WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Washington Invasive Species Council

Meeting Agenda
Washington Invasive Species Council

September 25, 2025
Hybrid Meeting

This meeting is being held in-person and virtually.

Physical Location: Room 172, Natural Resources Building, 1111 Washington Street SE, WA 98501. Facility information and visitor parking.

Online Participation: If you wish to participate online, please click the link below to register and follow the instructions in advance of the meeting. You will be emailed specific instructions upon registering. Technical support for the meeting will be provided by the Recreation and Conservation Office (RCO) board liaison, Julia McNamara, who can be reached at Julia.McNamara@rco.wa.gov.

Online Registration: https://us06web.zoom.us/webinar/register/WN_AL-HWtQxS8WlWYu6aNOH9g

Phone Option: You may also access the webinar using a phone only. This can be completed by calling (669) 900-6833 at or shortly before the start of meeting. You will then be prompted for a meeting ID. The meeting ID is 871 0187 5392.

Time: Opening session will begin as shown; all other times are approximate.

Public Comment: General public comment is encouraged to be submitted in advance to the meeting in written form. If you wish to comment, you may e-mail your request or written comments to Julia.McNamara@rco.wa.gov.

Health Precautions: Masks and hand sanitizer will be made available.

Open Meeting Agreement: This open public meeting is webcasted on TVW and recorded. By attending the meeting, you agree that your image, anything you say, and any materials you submit may be posted indefinitely on RCO's and TVW's websites.

Special Accommodations: People with disabilities needing an accommodation to participate in RCO public meetings are invited to contact Megan Montgomery by phone (360) 970-3079 or e-mail megan.montgomery@rco.wa.gov.

Thursday, September 25

OPENING AND WELCOME

9:00 a.m. **Welcome and Call to Order** — *Chair Todd Murray, Julia McNamara*

- Hybrid Meeting Ground Rules
- Roll Call and Determination of Quorum
- Review and Approval of Agenda (***Decision***)
- Approval of July 2025 Minutes (***Decision***)

HOT TOPIC AND STAFF REPORTS

9:10 a.m. **1. Council Staff Report** — *Stephanie Helms & Council Staff*

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9:30 a.m.	**2. Using Ballast Water Reports to Assess Introduction Risk of Invasive Species**	*Dr. Amanda Newsom and Dr. Ben Rubinoff*
10:00 a.m.	**3. Invasive Freshwater Mussel Prevention and Readiness Update**	*Member Justin Bush*
10:40 a.m.	**Break**	
10:55 a.m.	**4. Council Project Updates**	*Stephanie Helms & Council Staff*
11:10 a.m.	**5. Overview of Washington Department of Natural Resources Natural Heritage Program's Invasives Ranking System**	*Tynan Ramm-Granberg and Molly Wiebush*
11:50 a.m.	**6. Moment of Silence in Honor of Karen Ripley**	*All*
12:00 p.m.	**Lunch**	

DISCUSSIONS, DECISIONS, AND UPDATES

1:00 p.m.	**7. 2025-2030 Strategic Plan Adoption (Decision)**	*Stephanie Helms, All*
1:10 p.m.	**8. The Addition of English Holly to the Noxious Weed List and other State Weed Board Updates**	*Vice-Chair Mary Fee*
1:40 p.m.	**9. Farewell from the Executive Coordinator**	*Stephanie Helms*
1:50 p.m.	**Break**	
2:00 p.m.	**10. General Update Roundtable (5 min each)**	*All*
2:40 p.m.	**11. Future Meeting Planning Roundtable Discussion** • December 4th, 2025, Meeting Topics	*All*
2:50 p.m.	**General Public Comment** *Please limit comment to three minutes*	
3:00 p.m.	**ADJOURN**	

Next regular meeting: December 4th, 2025, Room 172, Natural Resources Building, 1111 Washington St SE, Olympia, WA 98501.

WASHINGTON INVASIVE SPECIES COUNCIL SUMMARY MINUTES

Date: July 17, 2025

Place: Hybrid and Tour – Allmendinger Conference Center, Washington State University, Puyallup Research Center and Extension Center, 2606 West Pioneer, Puyallup WA 98371.

Invasive Species Council Members Present:

☒ Todd Murray	Washington State University
☒ Mary Fee	Washington State Noxious Weed Control Board
☒ Blain Reeves	Washington State Department of Natural Resources
☒ Joe Maroney	Kalispel Tribe of Indians
☒ Ray Willard	Washington State Department of Transportation
☒ Sven-Erik Spichiger	Washington State Department of Agriculture
☒ Marcie Clement	Avista
☒ Adam Fyall	Benton County
☐ Steve Burke	King County
☒ Stacy Horton	Northwest Power and Conservation Council
☒ Todd Hass	Puget Sound Partnership
☒ Jason Anderson	Stillaguamish Tribe of Indians
☒ Alexei Calambokidis	Trout Unlimited
☒ Cory Sandow	United States Bureau of Reclamation
☐ Vacant	United States Coast Guard
☐ Luca Furnare	United States Customs and Border Protection
☐ Yolanda Inguanzo	United States Department of Agriculture
☒ Regan McNatt	United States Fish and Wildlife Service
☐ Karen Ripley	United States Forest Service
☒ Wes Glisson	Washington Department of Ecology
☒ Justin Bush	Washington State Department of Fish and Wildlife
☒ Andrea Thorpe	Washington State Parks and Recreation Commission

Recreation and Conservation Office Staff:

☒ Stephanie Helms	Executive Coordinator
☒ Julia McNamara	Board Liaison
☒ Jessica La Belle	Invasive Species Program Specialist
☒ Maria Marlin	Outreach and Education Specialist
☒ Megan Montgomery	Board and Policy Administrative Assistant

Guests & Alternates:

Sara Mounts	Northwest Power and Conservation Council

The Recreation and Conservation Office (RCO) retains a recording as the formal record of the meeting.

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Welcome and Call to Order

Chair Todd Murray called the Washington Invasive Species Council meeting to order at 9:00 a.m. **Julia McNamara**, Recreation and Conservation Office (RCO) board liaison performed roll call and determined quorum. Members Steve Burke, Luca Furnare, Yolanda Inguanzo, and Karen Ripley were absent.

Motion:	Approval of **July 17, 2025, Agenda**
Moved by:	Member **Ray Willard**
Seconded by:	Member **Mary Fee**
Decision:	Approved

Motion:	Approval of **March 20, 2024, Meeting Minutes**
Moved by:	Member **Blain Reeves**
Seconded by:	Member **Ray Willard**
Decision:	Approved as amended.

Member Andrea Thorpe noted an emailed amendment, which was included in the updated minutes.

During the meeting, **Past Chair Blain Reeves** noted the March minutes are written with "Chair Blain Reeves" calling the meeting to order, which should be "Chair Todd Murray." The correction was noted.

Item 1: Strategic Plan Update Activity

Stephanie Helms, council executive coordinator, provided an overview of the council, the strategic plan's purpose, and the work the council completed on the 2026-2030 Strategic Plan update in March.

Member Wes Glisson arrived at 9:07 a.m.

In March, the council categorized topics in the six key strategic areas (Leadership and Coordination, Innovation and Research; Education and Outreach; Prevention Early Detection and Rapid Response; and Control, Eradication, and Containment) into Keep with Discussion, Retire – Achieved, Retire – Not Relevant, and Keep with Discussion.

During this meeting, the council deliberated on the "Keep with Discussion" topics.

Member Regan McNatt asked if there was time to discuss topics that might not be included in the six key strategic areas. Ms. Helms answered yes.

Members' comments were captured in the Whiteboard exercise to be collated after the meeting and incorporated into the strategic plan.

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Leadership and Coordination:

The key priority topics were Sovereign Nations and municipalities with the proposed achievement of collaboratively developing a coordination model, information sharing structures, and processes for Tribes, municipal governments, and others.

Members discussed creating a better process to inform procedure for reporting invasive species and getting information; the difference between the municipalities in western and eastern Washington; tribal engagement and recognized Tribes may have different capacities than municipalities and should be treated differently; and developing a memorandum of understanding with the help of state and federal agencies through the National Plant Board to better include Tribes.

Innovation and Research:

The key priority topics were diversity, equity, inclusion, and social justice. It was suggested to be modified to vibrant communities and human health. The key objective was to understand the issues and nexus between invasive species and diversity, equity, inclusion, and social justice. This was suggested to refocus on ensuring access to information, outreach, and resources to all communities and Tribes within Washington State and/or understanding the issues and the nexus between invasive species, human wellbeing, and healthy communities.

Member Thorpe discussed defining what diversity, equity, and inclusion means in the invasive species landscape and what the council can meaningfully make changes on; Member Bush mentioned engaging in other, broader efforts including One Health Washington; providing equity training to apply tangible actions; making existing materials available in multiple languages; engaging in other, broad efforts like creating a human health working group within the council and invite One Health Washington, Washington State Department of Health, and Washington State Office of Equity; consider who outreach is reaching, who is trying to be reached, and identify where gaps exist; develop messaging from the council that considers the nexus between human and environmental health and include process-based restoration; and develop an advisory group to provide guidance for federal funding that may be impacted by federal regulations.

While discussing Industry Advisory Panel engagement, members highlighted the difficulty engaging with the panel and industries, considering a new model to expand engagement, and having council staff provide assistance to the panel; engaging additional industries like rail lines, tourism, online retailers to broaden representation; creating a story map illustrating the relationship between industries and invasive

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species; and providing a pathway for contacting industries. Members agreed the advisory panel should engage annually.

Education and Outreach

The key priorities are professional development and cross training and developing messaging and campaigns to address emerging problems. The key objective is to improve statewide first detector capabilities by cross-training professionals.

Members discussed developing a webpage on the council's website that lists ongoing trainings at agencies with contacts; offering an advocate certificate for businesses that attend council workshops; creating a similar program to Clean Marinas for recreational vehicle parks and campgrounds; endorsing online certifications and offering an award; creating incentives for businesses to engage in invasive species trainings; conducting a global review of what exists, including available trainings, and make them more applicable to Washington; developing a framework for contracting restoration work; using existing templates available through council agencies; considering cross training opportunities; creating a logo and email signatures to include on resumes. Notably, contractors do not always know where to have equipment certified free of aquatic invasive species, which highlights an outreach opportunity.

BREAK: 10:40 A.M. – 10:50 A.M.

Item 2: Strategic Plan Update Activity (Continued)

Education and Outreach (Continued)

Members discussed ways to amplify accurate messaging of information relevant nationally and statewide; clarifying messaging for general education versus emergencies; council staff developing relationships with communication staff at key agencies to support different roles and ensure agency messaging aligns with council goals; hosting meetings with communication staff to improve communication between the council and agencies; have a designated agency lead and a list of people for better cooperation in emergencies; and creating a blue print for information.

Primarily, members discussed the importance of coordinating messaging and creating a framework for where information should go.

Prevention

The key objective is to better understand the risks of expanding invasive species and potential impacts.

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Members discussed potential cost of upgrading the Impact of Invasive Species Report; identifying experts to provide a better understanding of what the cost would be; updating a few species rather than all and considering new species since the last upgrade in 2017; acknowledging economic impacts to land use types (e.g.: roads, railroads, and utilities); collaborating with universities; tying economic impact to funding requests; adding a "lessons learned" section to the report; including cultural impacts and other non-economic impacts; conducting a literature and/or academic review of what exists; preface report with Washington's values to reiterate why natural and agricultural resources are important and highlight what is at risk; creating a frequently asked question sheet.; highlighting the value of the council to the state and country; and partnering with the Pacific NorthWest Economic Region to avoid duplicating existing efforts.

Members agreed that the Economic Impact of Invasive Species report needs to be updated with a different approach towards coordination, cost consideration, and information sharing between states.

Early Detection and Rapid Response

The key priority is emergency funding and the key objective is to ensure that emergency funding is available for rapid response.

Members discussed how the council should provide support when emergency funding is requested; clarifying verbiage to support lead agencies; defining roles better and reiterating that the council provides support, advocacy, and amplification of need; and ensuring that council staff and/or the chair are available to testify to Legislature when needed at state and federal levels.

Members also discussed the current Incident Command System and whether it is the council's role to mandate. Members agreed to keep the item but change the verbiage to include both Incident Command System and different frameworks being implemented by other agencies rather than a one-size-fits-all approach. **Member Bush** offered to present on the Snake River interagency response plan for quagga and zebra mussels at a future meeting as it relates to the Incident Command System.

BREAK: 12:08 P.M. – 12:25 P.M.

Item 3: Working Lunch and Strategic Plan Update Wrap Up

Eradication, Control, and Containment

The key priority is data collection, sharing, and mobilization. The key objective is to promote and assist with data collection, sharing, and mobilization among organizations

at the local, state, and regional and national levels to establish common situational awareness.

The Washington State Department of Agriculture has three verification processes when a potential invasive is reported and experiences frustration with iNaturalist, which provides crowd sourced identification versus EDDMaps. EDD Maps are verified by the Washington State Department of Agriculture. Other agencies, like Washington State Parks, value iNaturalist as a starting point for field crews. The Washington Department of Fish and Wildlife is developing a public-facing database, and the council could act as a hub for databases. Members discussed the technology and data collecting tools that their agencies use and agreed that it is important to know how agencies are collecting and using geospatial data to know who to contact and where to direct people to assist with invasive species management. A list of how members are tracking data should be created and updated annually.

The discussion outcomes will be worked into the updated strategic plan.

BREAK 1:01 p.m. – 1:10 P.M.

Item 4: Staff Report

Stephanie Helms shared the events staff attended, hosted, or presented at since March, highlighting the Invasive Species Workshops for Tribal Audiences on April 1 and 3 funded by the United States Department of Agriculture Animal and Plant Health Inspection Service's Plant Protection Act 7721; the Urban Forest Pest Readiness Workship on April 29 in the Tri-Cities, and council staff touring boot brush stations installed around the state in a "Tour de Boot Brush."

Over the next quarter, staff will participate in the upcoming Urban Forest Pest Summit on July 29 at the Washington State University Research Extension Center and apply the Fiscal Year 25 Plant Protection Act 7721 funding under Goal 5 to one Tribal government invasive species virtual summit and one national stink bug surveillance and identification virtual workshop. Staff will also assist in managing multiple federal and state interagency agreements.

Staff are pursuing new Fiscal Year 2026 Plant Protection Act 7721 funding under Goal 5 and are undecided on the topic. Staff are also working to submit a proposal with Washington State University to host habitat distribution modeling on the council's website.

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Maria Marlin, education and outreach specialist, provided an update on council social media statistics. Likes and followers on the council's Facebook and Instagram are up compared to last quarter. Reach is down on Facebook, but up on Instagram. Ms. Marlin requested council members send ideas to highlight on social media. "Find a Priority Species" was the most visited webpage on the council's website this quarter. Ms. Marlin gave a brief overview of the WA Invasive application, that was improved by council intern, Marissa Delaire. Lastly, the council was reminded to submit nominations for invasive species before the September 15 deadline.

Member Justin Bush noted the opportunity to invite Oregon Department of Fish and Wildlife to present on Prussian carp in an Oregon reservoir that feeds into the Snake River.

Ms. Marlin's quarterly highlight was the first ever Puget Sound Invasive Species and Exotic Pest Workshop that had fifty-seven attendees with several council agencies represented and a presentation by Member Jason Anderson.

Jessica La Belle, program specialist, highlighted the North American Invasive Species Management Association's monthly webinar on Spotted Lanternfly in North America: Insights, Impacts, and Preparing for the Future. She presented on the potential cultural impacts of spotted lanternfly in Washington State.

In the future, Ms. La Belle would like to highlight a breakdown of invasive species reports during the staff report. Unfortunately, a recent report to the Washington State Department Agriculture of a northern giant hornet was created by artificial intelligence. The report was caught due to the diligence of Washington State Department of Agriculture's entomologists. Future artificial intelligence reports could be more difficult to detect; however, the department started a person of interest list for false reports. **Member Sven-Erik Spichiger** noted there is an artificial intelligence application that can detect photos generated by artificial intelligence.

Item 5: Priority Aquatic Invasive Species Update and Golden Mussel Prohibition Consultation

Member Justin Bush, Washington State Department of Agriculture Aquatic Invasive Species division manager, provided background information on how the Revised Code of Washington 77.135.030 defines prohibited and regulated invasive species for the department and council. The department must consult with the council to classify or reclassify aquatic invasive species. Of interest, if a species is not specifically named in Washington Administrative Code, it may automatically be placed into the Regulated

Type B (not listed previously; used in aquarium and live food markets) or C (all non-native aquatic animals failing previous criteria) categories.

Member Bush noted the department is concerned over the recent detection of a Chinese mitten crab at Tongue Point on the Oregon side of the Columbia River. This non-native freshwater crab is classified as a Prohibited Level One species in Washington. The department conducted a risk assessment as outlined in the meeting materials. It is suspected the crabs arrive at the Columbia River through ballast water and potential transport and release by humans smuggling these crabs into Washington, despite state and federal prohibitions. The department would like to convene a meeting with council staff and interested council members to discuss messaging ahead of the upcoming salmon fishing season.

The golden mussel, first detected in the United States and North America in California last fall, is classified as a Regulated Type B species in Washington. The situation in California is becoming more complex as the golden mussel spreads throughout the California aqueduct system. Washington is concerned about the connection between the Port of Stockton and Washington via Marine Highways 5 and 84. The golden mussel behaves similarly to quagga and zebra mussels; however, has a much lower calcium limit tolerance. The department conducted a risk assessment outlined in the meeting materials. Several locations in Washington are considered suitable for golden mussel survival and reproduction, primarily in western Washington.

Member Bush noted the department was seeking consultation with the council to classify golden mussels as a Prohibited Level 1 Invasive Species statewide in Washington.

Member Joe Maroney supported the department's direction on golden mussels and asked if the department plans to review the classification of other aquatic species in Washington. Member Bush answered that the department is working to establish a process to determine invasive species risk level and criteria to inform how classification and reclassification will occur long-term. The department wishes to establish a process that can be replicated for evaluating species upon request or upon a determined frequency.

Member Bush noted the United States Fish and Wildlife Service proposed adding invasive mussels in the Injurious Wildlife Listing under the Lacey Act. **Member Regan McNatt** noted the United States Fish and Wildlife Service supports changing the status from regulated to prohibited in the United States. The public comment period has ended on the service's proposal to add invasive mussels to the Injurious Wildlife list.

Member Blain Reeves asked if there were currently any use for golden mussels in the United States that would oppose the decision. Member Bush answered there are no known positives of golden mussels.

Member Bush abstained from voting.

Motion:	Move that we, as a council, make a recommendation to Fish and Wildlife [Washington Department of Fish and Wildlife] to formally move forward in the rule process and classify golden mussels as Prohibited Level 1 invasive species statewide.
Moved by:	Member **Blain Reeves**
Seconded by:	Member **Alexei Calambokidis**
Decision:	Approved

Member Jason Anderson asked if golden mussels are prey for any freshwater fish. **Member Bush** answered because golden mussels did not co-evolve with any native species predation may not happen immediately, if at all.

The Washington Department of Fish and Wildlife will document the process of classifying golden mussels as a Prohibited Level 1 invasive species and work with council staff.

Item 6: Roundtable for State Agency Session Updates

Washington State Department of Natural Resources

Member Blain Reeves shared that the Department of Natural Resources should have a spending plan by November. The department received $2.5 million in the European green crab package, with guaranteed funding in the first biennium.

The department recently participated in regional spartina planning meetings and moved coastal operations into a facility in Montesano. The department's decision package for the Washington Conservation Corps support was successful in the aquatic resource division with fifteen weeks of crew time through October.

Member Reeves noted revenues from the wild stock fishery are down significantly due to tariffs, which will result in less funding for the Aquatic Lands Enhancement Account.

Washington State Department of Fish and Wildlife

Member Justin Bush requested time at a future meeting for a presentation about ballast water management and ballast water as a vector for transmitting aquatic invasive species and a presentation on containment systems and mitigating impacts of biofouling.

The Governor's emergency order for European green crab is still in place and the department appreciates the council's support of the six-year management plan for European green crab, which included specific federal and state requests. The National Oceanic and Atmospheric Administration is investing $1.5 million to implement the management plan and the State Legislature reaffirmed its commitment with an additional $12 million investment in the 2025-207 biennium.

In response to the detection of quagga mussels in Idaho's Snake River, the Washington Department of Fish and Wildlife received a Legislative proviso in 2025, which includes $1.8 million with the ability to leverage $1.8 million in federal funds for quagga and zebra mussel monitoring and will execute a first of its kind, site-specific zebra and quagga mussel rapid response plan following a State Environmental Policy Act review. The department expects a contract to leverage federal funds soon.

Member Marcie Clement asked if Oregon is working on a site-specific zebra and quagga mussel plan. Member Bush answered that Oregon is structured differently but is working to update their statewide response plan.

Washington State Department of Agriculture

Member Sven Spichiger shared that starting July 1 the Washington State Department of Agriculture will begin recruitment for a noxious weed coordinator. The department experienced budget reductions to the Japanese beetle and spongy moth programs. Federal Plant Protection Act 7721 funding was paused for a federal review, which could have significant impacts on implementing pest management during the desired treatment window.

Oregon's Japanese beetle program did not receive funding, which will have significant impacts in Washington. Treatments for Japanese beetle in Washington were applied in Grandview, Wapato, and Pasco. Foliar treatments were applied for the first time in Washington and are widely effective. Japanese beetles have also been trapped near Angle Lake to the southeast of the Seattle-Tacoma International Airport.

Multiple detections with live egg masses of Asian spongy moth were found on cargo ships and the department is preparing to trap near the ports later this year. There are currently over 16,000 traps out with no detections; however, it is before peak flight season.

In May, a picture of an immature spotted lantern fly was taken in an Oregon park, near the Washington border. The Oregon Department of Agriculture is taking the possible detection seriously. The Washington Department of Agriculture is planning to assist in

August. Samples of sagebrush, scotch broom, and other species were sent to Penn State for testing as alternate plant hosts for spotted lantern fly.

Washington State Noxious Weed Control Board

Vice Chair Mary Fee shared the Washington State Noxious Weed Control Board received draft allotment numbers. The board is having a difficult time paying for publications. Printing for Garden Wise, which will include pollinator sections, and the Noxious Weed booklets were recently completed for eastern and western Washington. The board is seeking funding and partnerships for printing toxic plant booklets.

The board had twelve applications for$50,000 in funding for county noxious weed boards to treat Class A and Class B noxious weeds. The applications are currently under review.

The Noxious Weed Committee is reviewing applications to add species to the Noxious Weed List. The process ends in November following a hearing and vote. The main plants under consideration are maiden grass, Norway maple, water hemp, and delta arrowhead.

Washington State Department of Transportation

Member Ray Willard noted that since March, the Washington State Department of Transportation has completed training crews across all twenty-four maintenance areas.

At the end of the recent biennium, regions stopped spending money on herbicides in anticipation of running out of funding, resulting in fewer treatments in late winter and early spring. The Legislature provided some backfill funding needing spending before the end of the biennium and was put toward urgent-need work. In the 2027-2029, the Legislature will try to fund preservation, which has been unavailable in recent biennia, and some of that money will go towards restoration of sites requiring more vegetation management.

Funding through the Washington Department of Natural Resources and United States Bureau of Land Management for annual grass control in eastern Washington for fire prevention. Treatment that targets annual grasses and preserves perennial grasses and sagebrush is underway near Ellensburg. As funding is available, the department will continue treating roadsides with the same approach, which should last three to five years. The department successfully flew an herbicide spray drone near Mossyrock on Highway Twelve last week.

Member Adam Fyall and **Member Andrea Thorpe** planned to discuss herbicides for treating cheat grass with Member Willard after the meeting.

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Washington State Parks

Member Andrea Thorpe noted Washington State Parks received three major restoration grants from RCO, including ongoing restoration at Ginko Petrified Forest State Park from damage caused by wildfires; sand verbena restoration on the coast; and sand dune restoration near Copalis Beach.

State Parks experienced significant reductions in Forest Health funding, including all the capital Forest Health funding and some operating funds. The loss of funding means Forest Health projects in eastern Washington will need to be prioritized, which will result in less funds for western Washington forest needs. Additionally, there is less funding available for weed control, resulting in less help for county weed control boards. Member Thorpe requested that staff report all citations to help prove need for future funding.

The bill to increase the Discover Pass fee from thirty to forty-five dollars goes into effect on October 1 and increases the cap for distributing the revenue of the Discover Pass between landowning agencies. Unfortunately, the budget reductions will not balance with the increase of the Discover Pass fee.

Member Thorpe requested that other agencies share what State Parks is not doing to meet policy to build a case for future funding.

Washington State Department of Ecology

Member Wes Glisson shared that Washington State Department of Ecology receives funding from boat trailer registration fees and redistributes some of that funding through the Freshwater Invasive Plant Management program. A final list of twelve applications, totaling $626,000, was released the previous week and will provide funding statewide. The projects will address all classes of noxious weeds, including flowering rush and milfoil. This grant will reopen in November for funding next year.

Recreation and Conservation Office

On behalf of Brock Milliern, legislative and policy director at RCO, **Stephanie Helms** requested that any questions regarding RCO be directed to Mr. Milliern or Ms. Helms. Ms. Helms is moving out of state and will step down as the executive coordinator after the September meeting. Mr. Milliern will begin the process of filling the position in late July. Ms. Helms plans to be present at the September meeting and encouraged the council to consider strong candidates and share with her or Mr. Milliern.

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Item 7: Future Meeting Planning Roundtable Discussion

Stephanie Helms welcomed ideas for the September meeting, noting the council can anticipate adopting the strategic plan following a third review between now and then. Ms. Helms suggested a drone update from the Washington Department of Transportation, an overview of whirling disease, an overview of Caulerpa, a deeper briefing on the achievements of the 10,000 Years Institute, a presentation from Trout Unlimited on invasive fish management in Lake Sammamish, and an overview of the Washington Invasive Ranking System from the Department of Natural Resources Natural Heritage Program.

Member Justin Bush noted English ivy, and other plants were added to the prohibited plant list and suggested an update from Washington State Department of Agriculture and the Washington Noxious Weed Control Board.

Vice Chair Mary Fee suggested an update on invasive crawfish that are moving up the Columbia River. Member Bush noted the University of Washington could provide an update. Additionally, the Washington Department of Fish and Wildlife is considering prohibiting self-replicating marbled crawfish.

Ms. Helms suggested keeping the state agency roundtable item for budget updates. **Member Andrea Thorpe** suggested using that time as a lightning round for members to provide a high-level briefing on what everyone is working on as an opportunity to identify areas for collaboration.

General Public Comment

None.

Item 7: Field Trip – Puyallup Research and Extension Center Invasive Tour

There was no quorum for the tour and the meeting was adjourned.

ADJOURNED: 3:02 P.M.

The next council meeting will be held on September 25, 2025. Room 172, Natural Resources Building, 1111 Washington Street SE, Olympia, Washington 98501.

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WASHINGTON NATURAL HERITAGE PROGRAM

Standardizing the Assessment of Invasive Species:

An Application of the Washington Invasive Ranking System

Prepared for

U.S. Environmental Protection Agency
Region 10

Prepared by

Tynan Ramm-Granberg

& Molly S. Wiebush

Natural Heritage
Report 2024-13

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Standardizing the Assessment of Invasive Species:

An Application of the Washington Invasive Ranking System

Washington Natural Heritage Program Report Number: 2024-13

December 31, 2024

Prepared by:
Tynan Ramm-Granberg
& Molly S. Wiebush

Washington Natural Heritage Program
Washington Department of Natural Resources
Olympia, Washington 98504-7014

ON THE COVER: *Ilex aquifolium* (English Holly) has an Ecological Impact Rank of High. Photo by V. Lohr (https://www.inaturalist.org/observations/254679415) https://creativecommons.org/licenses/by-nc/4.0/ .

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Introduction

The presence and abundance of invasive plant species are some of the most commonly used measures in wetland function and condition assessment tools (Hruby et al., 1999, 2000; Hruby & Stanley, 2000; Rocchio & Crawford, 2013; Hruby, 2014a, 2014b; Magee et al., 2019b, 2019a; Rocchio et al., 2020a). Existing state lists of noxious weeds (Washington State Noxious Weed Control Board, 2020) and invasive species (Washington Invasive Species Council, 2020) incorporate economic impacts and other values—they do not represent comprehensive lists of the plant species that are most impactful to the ecology of natural ecosystems. Consequently, wetland practitioners have often relied on "best professional judgment" to determine the invasiveness of nonnative species when using wetland assessment tools. Some wetland assessment tools attempt to address this by providing *a priori* lists of invasive species, but these generally identify only a small subset of invasive plants that might occur in a wetland (Hruby, 2014c, 2014d; USEPA, 2016a, 2016b). For example, only 12 species are listed as "aggressive" in the Washington Wetland Rating System (Hruby, 2014a, 2014b). A standardized list of invasive plant species has long been needed to minimize the inconsistent and subjective use of invasives as indicators of ecological condition.

As a first step in assembling a comprehensive list of invasive plant species, ecologists from the Washington Natural Heritage Program (WNHP) reviewed existing invasive species ranking methods to determine if any met our goals here in Washington. These methods included NatureServe's Invasive Species Assessment Protocol (Morse et al., 2004), the Invasiveness Ranking System for Nonnative Plants of Alaska (Carlson et al., 2008), the Plant Risk Evaluation tool (Conser et al., 2015), and many others (Hiebert & Stubbendieck, 1993; Morse et al., 2004; Cal-IPC, 2006; Carlson et al., 2008; Jordan et al., 2008; Virtue et al., 2008; Magee et al., 2010; Auld & Johnson, 2014; D'hondt et al., 2015; Vanderhoeven et al., 2015; Lieurance & Flory, 2016; Roy et al., 2018; Bartz & Kowarik, 2019a; González-Moreno et al., 2019; PPQ, 2019; Verbrugge et al., 2019; Vilà et al., 2019; Ries et al., 2020; Sohrabi et al., 2020; Clarke et al., 2021; Dorjee et al., 2021; Downey et al., 2022; Egawa & Matsuhashi, 2022). Following this review, we decided to develop a new protocol that borrows elements largely from Morse et al. (2004) and Carlson et al. (2008).

This new protocol, the Washington Invasive Ranking System (WIRS), focuses on the ecological impact of nonnative plant species in natural ecosystems (Ramm-Granberg et al., 2024). With the help of a pool of experts, WNHP staff then tested the protocol on a selection of nonnative plant species. This report summarizes the initial application, results, and future direction of the Washington Invasive Ranking System.

Methods

We took the following steps to develop and deploy an invasive ranking system for Washington State focused on ecological impacts. 1) We formed a scientific advisory panel, 2) evaluated

existing protocols, 3) developed a new protocol without reinventing the wheel, 4) revised that protocol with the help of the scientific advisory panel, 5) assembled a larger panel of experts to conduct assessments, 6) trained the assessors, 7) prioritized taxa for assessment, 8) carried out assessments, and then 9) analyzed, compiled, and shared results.

Scientific Advisory Panel

A scientific advisory panel was assembled to provide input on protocol development. The advisory panel also assisted in the prioritization of taxa for ranking, as well as synthesis of the assessment results into finalized ranks.

The following individuals agreed to participate in that capacity for all or part of the project:

- David Giblin (Collections Manager for the University of Washington Burke Herbarium)
- Walter Fertig (Collections Manager for the Washington State University Marion Ownbey Herbarium)
- David Wilderman (Natural Areas Program Ecologist, Washington Department of Natural Resources)
- Joe Rocchio (Natural Heritage Program Manager, Washington Department of Natural Resources)
- Justin Bush (Executive Coordinator, Washington Invasive Species Council)
    - Later replaced by Stephanie Helms when she succeeded the coordinator position.
- Lizbeth Seebacher (Wetland & Aquatic Ecologist, Washington Department of Ecology)

Existing Protocols

There have been many efforts to quantify the invasiveness/risk posed by nonnative species around the world (Hiebert & Stubbendieck, 1993; Morse et al., 2004; Cal-IPC, 2006; Carlson et al., 2008; Jordan et al., 2008; Virtue et al., 2008; Magee et al., 2010; Auld & Johnson, 2014; D'hondt et al., 2015; Vanderhoeven et al., 2015; Lieurance & Flory, 2016; Roy et al., 2018; Bartz & Kowarik, 2019a; González-Moreno et al., 2019; PPQ, 2019; Verbrugge et al., 2019; Vilà et al., 2019; Ries et al., 2020; Sohrabi et al., 2020; Clarke et al., 2021; Dorjee et al., 2021; Downey et al., 2022; Egawa & Matsuhashi, 2022). These tools primarily fall into three categories (Bartz & Kowarik, 2019b):

1. Prediction Tools: Determine which species might become invasive if introduced.
2. Prioritization Tools: Support decisions about managing existing introduced species.

3. Information Tools: Document impacts, invasiveness etc. of nonnative species without explicit ranking.

We distilled a few consensus takeaways from preexisting examples of such tools:

1) The need for a transparent scoring system.
    a) The scoring system should be easy to understand.
    b) Terms must be clearly defined so that users know what is meant by "small" versus "moderate" impacts, etc.
2) All protocols have considerable variation between assessors.
    a) "Final" scores are best reached through either consensus building or a final-review panel.
    b) Uncertainty scores are useful in communicating results.
3) The paucity of published data for many species (and their impacts) is a major issue
    a) This can be ameliorated via the expertise of qualified assessors, but it remains important to be transparent when published data is lacking.

We found the protocols developed by NatureServe (Morse et al., 2004) and Alaska (Carlson et al., 2008) to most closely align with our focus on the ecological impact of nonnative plants in native ecosystems. In consultation with the scientific advisory panel, however, we decided to combine and modify the two protocols for use in Washington, rather than simply adopt either method.

New Protocol Development

In reviewing the method from Alaska (Carlson et al., 2008), we appreciated the robust, repeatable framework and the assessment of physical attributes of each plant (allelopathy, reproductive strategy, dispersal mechanisms, etc.). However, we found it beneficial to more explicitly separate ecological impacts and management issues. Alaska also has less invasion pressure than the contiguous lower 48 states, which may be why that method is more forward-looking than focused on existing, established taxa. In that way, the method lies somewhere in between a prediction and prioritization tool. The protocol from NatureServe (Morse et al., 2004) focuses more heavily on spatial distribution and highly quantifiable data, with minimal evaluation of specific biological characteristics. It is less tailored to a specific geography than Carlson et al. (2008) and heavily emphasizes impacts to biodiversity.

Ultimately, we settled on a blend of NatureServe/Morse et al. (2004) and Alaska/Carlson et al. (2008), with additional biological trait and management feasibility metrics from other tools (Hiebert & Stubbendieck, 1993; Pheloung et al., 1999; Conser et al., 2015; D'hondt et al., 2015).

Protocol Revision

Over the course of two meetings, draft methods were reviewed and modified in coordination with the scientific advisory panel.

Ranking Panel

The scientific advisory panel also helped identify a list of prospective assessors with broad botanical and ecological expertise and experience working in conservation areas or other areas managed for natural vegetation. Ranking is best performed by individuals with relevant professional expertise, particularly when assessing plant taxa for which there is often little formal, quantitative data. For this project we attempted to integrate the ranks of *multiple* experts ("expert crowd-sourcing"), an approach similar to the process for assigning Floristic Quality Assessment (FQA) Coefficient of Conservatism (CoC) values (Rocchio & Crawford, 2013). We invited 147 individuals and 71 agreed to participate. Ten people submitted assessments (in addition to one WNHP ecologist). These individuals are here on referred to as the ranking panel (Table 1).

Table 1. Complete roster of individuals who completed WIRS assessments as of December 31, 2024

Name	Affiliation	Assessments	
		Partial	Complete
Carlo Abbruzzese	Natural Areas Manager, Washington Dept. of Natural Resources	1	7
Clayton Antieau	Botanist and Senior Watershed Planner, Seattle Public Utilities	0	1
David Wilderman	Natural Areas Program Ecologist, Washington Dept. of Natural Resources	0	1
Emily Stevenson	Program Coordinator, Skamania County Noxious Weed Control Program	10	1
Ethan Coggins	Natural Areas Steward, Washington Dept. of Natural Resources	0	3
Helen Lau	Botanist, US Forest Service	1	0
Kimberly Quayle	Natural Areas Steward, Washington Dept. of Natural Resources	0	2
Molly S. Wiebush	Natural Heritage Ecologist, Washington Natural Heritage Program, Dept. of Natural Resources	0	20
Regina Johnson	Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources	0	36
Walter Fertig	Collections Manager, Marion Ownbey Herbarium, Washington State University	3	1
Wesley Glisson	Aquatic Plant Specialist, Washington Dept. of Ecology	3	1

Protocol Trainings

WNHP hosted an online webinar training for the ranking panel on November 7th, 2023. The training was also recorded for those who could not attend. Additional one-on-one trainings were also conducted ad hoc as new experts were recruited.

Prioritizing Taxa to Rank

There are ~1,200 documented introduced species in Washington State (Weinmann et al., 2002), so it was necessary to focus this project on a subset of taxa. We created a priority list (Appendix A) through the following process:

1) We began with the State Noxious Weed List (https://www.nwcb.wa.gov/printable-noxious-weed-list) and synonymized these taxa with the Washington Flora Checklist (https://burkeherbarium.org/waflora/checklist.php).
2) The list was trimmed down to species with FAC, FACW, or OBL wetland indicator status in either the Arid West or Western Mountains, Valleys, and Coast wetland regions (https://wetland-plants.sec.usace.army.mil/).
3) The list was further trimmed by eliminating plants that have not yet established in Washington.
4) The scientific advisory panel was polled for their species of interest within and in addition to the working list.
5) WNHP then supplemented the list to make sure there were a variety of genera, physiognomic types (tree, shrub, herbaceous), and life history strategies (perennial/biennial, annual)
6) Using "best professional judgment", we also supplemented the list with species that seemingly represented a range of invasiveness. This helped test whether the method could reliably distinguish species with known or presumed differences in their invasive traits.
7) The list was subdivided into "high", "medium", and "low" priority sections. We asked that assessors start with plants in the "high" section so that we would receive multiple assessments for some plants, allowing us to test a crowd-sourced approach to ranking. The high/medium/low sections did *not* reflect our level of concern or any sort of estimated impact.

Members of the ranking panel were asked to rank plants for which they had first-hand knowledge, quantitative data, or documentation from the literature—beginning with the high priority section and then moving on to the medium and low priority sections. If an assessor exhausted the full list, they were asked to continue with any remaining species from the Washington State Noxious Weed Control Board (2020) and Invasive Species Council (2020) lists that have established in the state. If those lists were in turn exhausted, assessors were asked to continue with other nonnative plants at their leisure, with a preference for wetland taxa already established in Washington.

Assessment

The ranking panel was originally given three months in which to complete assessments (until February 9th, 2024). This deadline was later pushed back to June 1st, 2024 and assessments continued to trickle in until December 2024. Assessments were completed using a web-based Survey123 form. One minor protocol revision was pushed to the ranking panel during the assessment period (see the Release Notes in Ramm-Granberg et al. (2024)).

Data Compilation, Analysis, and Sharing

At the conclusion of the assessment period, we compiled submissions from the ranking panel along with assessments completed by WNHP staff and cleaned the data. Basic, descriptive summary statistics were calculated (see Results section below). Further revisions to the protocol—primarily to the roll-up procedure—were decided upon in coordination with the scientific advisory panel. We then finalized the Ecological Impact ranks and supplementary information for each plant, produced species assessment summaries, and began the process of hosting these data on our website (https://dnr.wa.gov/natural-heritage-program).

Results

The Washington Invasive Ranking System (WIRS) Protocol

The Washington Invasive Ranking System (WIRS) assesses nonnative plants relative to their impact on biodiversity and ecosystem condition. The complete protocol (version 1.5) is published in Ramm-Granberg et al. (2024).The primary output of WIRS is an Ecological Impact rank, which indicates the degree of ecological degradation caused by a given plant in the ecosystems in which it is found. WIRS also produces supplementary information related to each plant's management difficulty, biological characteristics, and distribution and abundance. The assessment includes:

- Screening questions (Is WIRS is the appropriate tool for assessing this plant?)
- Ecological Impact Assessment
- Supplementary Information Sections:
    - Management Difficulty
    - Biological Characteristics
    - Distribution and Abundance
- Data integration workflow for instances when multiple assessments have been completed for a single plant
- Roll-up procedure

Screening Questions

Each WIRS assessment begins with two simple screening questions: "Is the nonnative plant established in Washington?" and "Does it occur in natural ecosystems?". If the answer to both questions is "Yes", then WIRS is an appropriate tool for assessing the plant. WIRS is not designed as a predictive tool for plants that do not yet occur in the state, or are restricted to non-natural systems like agricultural fields.

Ecological Impact Assessment

The Ecological Impact Assessment focuses on the observed impact of nonnative species on biodiversity and ecosystem condition (Table 2). In this section, the assessor evaluates impacts of the plant on ecosystem structure, composition, abiotic processes, and individual species, as well as the observed ability of the plant to invade natural ecosystems. These characteristics are assessed through numerous metrics. In cases where we have Low confidence in the overall Ecological Impact Assessment (e.g., due to incomplete information or sparse, anecdotal observations), metrics

associated with Biological Characteristics are folded in as 50% of the overall Ecological Impact score.

Table 2. Washington Invasive Ranking System, Ecological Impact Assessment. [1]When confidence is Low, Ecological Impact calculation also incorporates Biological Characteristics supplementary information

Q18: Impact on Ecosystem Abiotic Processes (9 pts)
Q19: Impact on Ecosystem Structure (12 pts)
Q20: Impact on Ecosystem Composition (9 pts)
Q21: Impact on Particular Native Species (3 pts)
Q22: Observed Ability to Invade Undisturbed Ecosystems (15 pts)
Q23: Observed Ability to Invade Naturally Disturbed Ecosystems (3 pts)
Ecological Impact = Sum of Metrics Q18:Q:23 / Maximum Score of Metrics Rated [1]

Supplementary Information

Additional information about each species is also compiled in the WIRS protocol through numerous metrics. These metrics are grouped into three sections: Management Difficulty, Biological Characteristics, and Distribution and Abundance. Most of this information is not used to calculate the overall Ecological Impact rank, but provides additional context and information that may help guide management priorities and actions. The only exception is that Biological Characteristics metrics are used when confidence in the Ecological Impact rank is low.

Management Difficulty

The Management Difficulty section provides an overall indication of the management challenges posed by a given plant (Table 3). Some invasive plants may be relatively easy to manage, while there may be less invasive plants that are difficult to remove (or for which there is societal pressure to leave unmanaged).

Table 3. Washington Invasive Ranking System, Supplementary Information: Management Difficulty

Q24: General Management Difficulty (18 pts)
Q25: Minimum Time Commitment (15 pts)
Q26: Impacts of Management on Native Species (15 pts)
Q27: Accessibility of Invaded Areas (3 pts)
Q28: Sociopolitical Implications of Management (6 pts)
Management Difficulty Rank = Sum of Metrics Q24:Q:28 / Maximum Score of Metrics Rated

Biological Characteristics of Invasiveness

The Biological Characteristics section evaluates traits commonly associated with "invasiveness" (Carlson et al., 2008) that may allow the plant to disperse into, establish, and spread in natural ecosystems (Table 4). As noted above, this section only contributes to the overall Ecological Impact rank when the confidence rank for that section is Low. In such cases, the biological characteristics of the plant help supplement the determination of likely ecological impact. Otherwise, this section does not contribute to the overall Ecological Impact rank and should be used as a supplementary data source.

Table 4. Washington Invasive Ranking System, Supplementary Information: Biological Characteristics of Invasiveness

Q6: Aggressive Mode of Reproduction (3 pts)
Q7: Innate Potential for Long-Distance Dispersal (3 pts)
Q8: Potential to be Spread by Human Activities (3 pts)
Q9: Allelopathy (1 pt)
Q10: Competitive for Limiting Abiotic Factors (3 pts)
Q11: Growth Form (2 pts)
Q12: Germination Requirements (3 pts)
Q13: Invasiveness of Other Plants in Genus (2 pts)
Q14: Shade Tolerance (2 pts)
Q15: Disturbance Tolerance (2 pts)
Q16: Propagule Persistence (3 pts)
Q17: Palatability (1 pt)
Biological Characteristics of Invasiveness = Sum of Metrics Q6:Q17 / Maximum Score of Metrics Rated

Concern Related to Distribution and Abundance

The Distribution and Abundance section evaluates the current distribution, range trends, and potential for spread of the nonnative plant within Washington (Table 5). This section addresses questions such as, "How common is this plant? Is it spreading or infilling? Is there any suitable habitat left where it does not occur? Does it occur in many different types of ecosystems?". This section does not contribute to the overall Ecological Impact rank and should be used only as a supplementary data source.

Table 5. Washington Invasive Ranking System, Supplementary Information: Concern Related to Distribution and Abundance

Q1: Current Range Size in Washington
Q2: Current Trend in Total Range
Q3: Proportion of Potential Range Currently Unoccupied
Q4: Local Range Expansion or Change in Abundance
Q5: Diversity of Ecosystems Invaded
Concern Related to Distribution and Abundance = Sum of Metrics Q1:Q5 / Maximum Score of Metrics Rated

Participation and Data Integration

71 individuals initially agreed to participate, but only 10 (14%) ultimately completed even a partial assessment. In total, the ranking panel submitted 91 assessments, 73 of which (80%) were filled out completely. 40% (36) of those were submitted by a single individual. Another 20 assessments were completed by WNHP staff. We were able to assign an Ecological Impact rank to all taxa assessed. Five plants (*Schoenoplectus mucronatus*, *Chondrilla juncea*, *Myriophyllum heterophyllum*, *Potamogeton crispus*, and *Fallopia* × *bohemica*) had insufficient data submitted to assess Biological Characteristics. Two plants (*Cirsium vulgare* and *Potamogeton crispus*) did not have enough information with which to assign a Management Difficulty rank. All plants received Distribution and Abundance ranks.

Experienced scientists, land managers, and restoration personnel contributed their expertise to WIRS assessments, often leaving detailed notes along with their metric ratings. These notes have been preserved and included in the WIRS Database (Appendix B) and species assessment summaries (Appendix C, also available on the WNHP website). They provide additional useful context for the ranks.

Calculating the Ecological Impact Rank

Each metric has a maximum possible score (1 to 18), with each potential rating a proportionate amount of that maximum. For example, the potential ratings for a hypothetical metric worth 15 points may be High (15 points), Moderate (10 points), Low (5 points), and Insignificant (0 points). Points for each metric rating are summed and divided by the points possible in that section (Unknown and Not Rated metrics are excluded) to determine the overall score.

Assessors also assign a confidence rating to each metric (Unknown or Not Rated = 0 pts, Low = 0 pts, Moderate = 1 pt, High = 2 pts). Points for each confidence rating are summed and divided by the points possible for that section. Unknown and Not Rated metrics are included for the calculation of confidence because they represent uncertainty about the plant. Additionally, if Q22 is Unknown or Not Rated or if Q18, Q19, AND Q20 are Unknown or Not Rated, then the Ecological Impact confidence rank is automatically set to Low.

Calculation of the Ecological Impact score/rank depends on the confidence in the Ecological Impact metric ratings. If the overall confidence in the Ecological Impact metric ratings is Moderate to High, then the calculation is simply the total points from rated metrics divided by the total points possible (Unknown and Not Rated metrics are excluded) (Table 6, Figure 1). If the confidence rating for the Ecological Impact metric ratings is Low, we average that calculation with the overall score from the Biological Characteristics section.

Table 6. Overview of Ecological Impact Score Calculation. Calculation varies depending on confidence ratings and the number of unrated metrics in the Ecological Impact Assessment. Scores are then converted to ranks: ≤ 30% = Insignificant Impact, 31-50% = Low Impact, 51-70% = Moderate Impact, >70% = High Impact.

Calculating the Ecological Impact Rank	
Ecological Impact Metric	**Points Possible**
Q18: Impact on Ecosystem Abiotic Processes	9
Q19: Impact on Ecosystem Structure	12
Q20: Impact on Ecosystem Composition	9
Q21: Impact on Particular Native Species	3
Q22: Observed Ability to Invade Undisturbed Ecosystems	15
Q23: Observed Ability to Invade Naturally Disturbed Ecosystems	3
Ecological Impact Calculation (Option 1)	
Is Q18, Q19, OR Q20 rated? **Is Q22 rated?** **Is overall confidence for Q18:23 Medium or High?**	
Yes to all of the above	**No to one or all of the above**
Sum of Q18:Q23 Ratings / Sum of Q18:23 Points Possible [Rated Metrics Only]	Complete Biological Characteristics section and recalculate below
Biological Characteristics Metric	**Points Possible**
Q6: Aggressive Mode of Reproduction	3
Q7: Innate Potential for Long-Distance Dispersal	3
Q8: Potential to be Spread by Human Activities	3
Q9: Allelopathy	1
Q10: Competitive for Limiting Abiotic Factors	3
Q11: Growth Form	2
Q12: Germination Requirements	3
Q13: Invasiveness of Other Plants in Genus	3
Q14: Shade Tolerance	2
Q15: Disturbance Tolerance	2
Q16: Propagule Persistence	3
Q17: Palatability	1
Ecological Impact Calculation (Option 2)	

Q18, Q19, and Q20 NOT rated Q22 NOT rated Overall confidence for Q18:23 is Low
Sum of Q18:Q23 Ratings / Sum of Q18:23 Points Possible [Rated Metrics Only] * 0.5 + Sum of Q6:Q17 Ratings / Sum of Q6:17 Points Possible [Rated Metrics Only] * 0.5

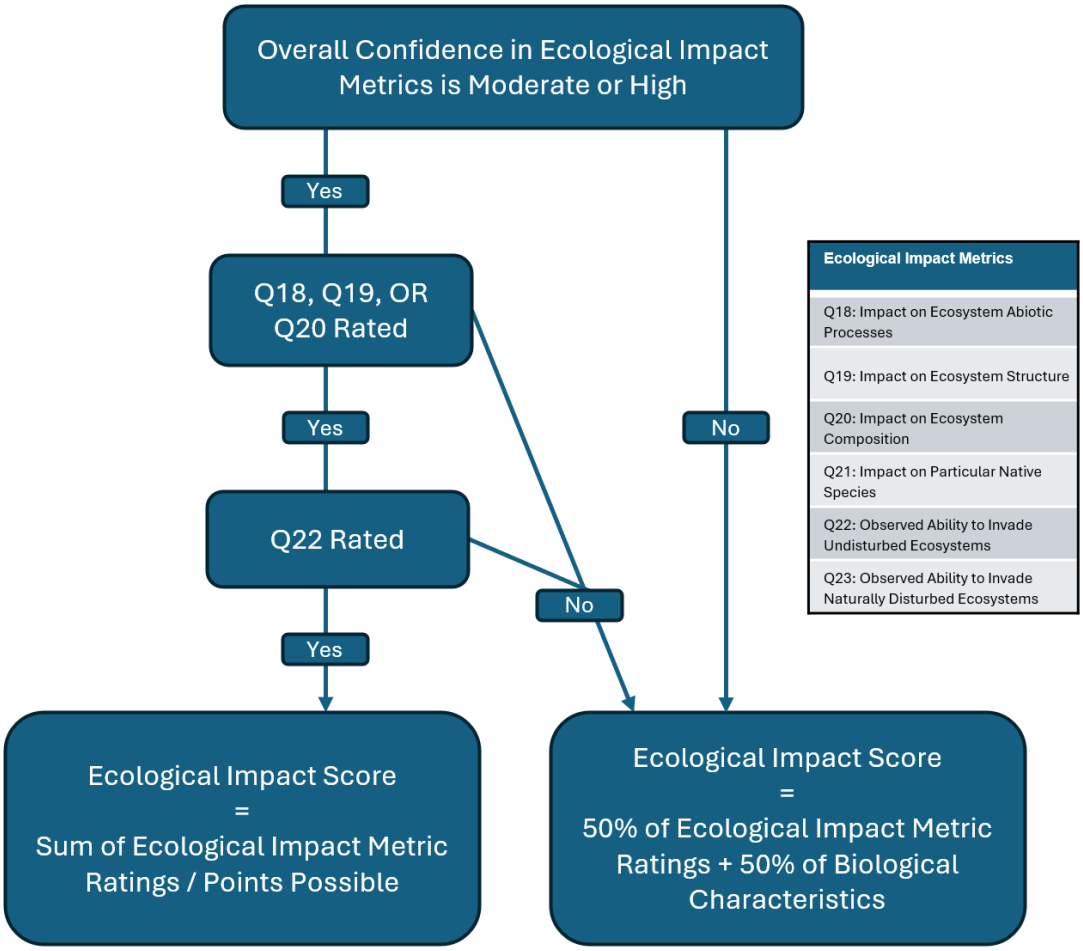

Figure 1. Flow chart demonstrating calculation of Ecological Impact rank. Scores are then converted to ranks: ≤ 30% = Insignificant Impact, 31-50% = Low Impact, 51-70% = Moderate Impact, >70% = High Impact.

Scores are converted to the following Ecological Impact ranks (rounded to the nearest whole percentage point):

- ≤ 30 = Insignificant Impact
- 31-50 = Low Impact
- 51-70 = Moderate Impact
- >70 = High Impact

Confidence scores are converted to the following confidence ranks (rounded to the nearest .01%):

- 0-33.33 = Low
- 33.34-66.66 = Moderate
- >66.66 = High

Note that the divisions between these ranks (modified slightly from Morse et al. (2004)) are largely arbitrary. The conversion to ranks, however, may help ameliorate the false sense of precision provided by numerical scores derived from largely qualitative data.

Plants Assessed

A total of 62 taxa received at least one complete assessment—another nine had partial assessments (Table 7). Species assessment summaries for all 71 plants are found in Appendix C (and at https://dnr.wa.gov/natural-heritage-program). Forty-three taxa received only rapid assessments; these were based primarily on the assessor's professional expertise and did not involve a review of available literature. For the remaining 28 taxa, at least one assessment included a literature review to supplement the assessors' professional expertise. Thirteen species were assessed by multiple individuals, enabling some degree of "crowd-sourcing".

All 71 taxa assessed occur in Washington. *Cirsium arvense*, *Cirsium vulgare*, and *Phalaris arundinacea*, *Solanum dulcamara* have been documented in all Washington counties, while *Schoenoplectus mucronatus* and *Solidago altissima* have been found in only two counties (5%). Of the 71 taxa assessed, 43 were from the species list provided in the initial protocol, and 28 taxa were not included in the initial species list provided to assessors.

One goal was to test the Washington Invasive Ranking System over a wide variety of life histories, growth forms, and habitat requirements. Of the plants assessed, 79% were perennial, though annual (17%) and biennial (4%) taxa were also represented (Table 8). Assessments were completed for forbs (61%), trees (9%), shrubs (11%), graminoids (18%), and one (1%) liana/vine (*Clematis vitalba*) (Table 9). Thirty-two (45%) of the taxa assessed had a wetland indicator status of FAC, FACW, or OBL in the US Army Corps of Engineers Arid West Wetland Delineation Region (Table 10), and 34 (48%) had a wetland indicator status of FAC, FACW, or OBL in the Western Mountains, Valleys, and Coast (Table 10). These lists have significant overlap, with only six species represented on one list but not the other.

Table 7. Plants Assessed.

Scientific Name	Common Name	Partial Assessments	Complete Assessments
Acer negundo	Box elder	1	2
Ailanthus altissima	Tree of Heaven	2	1
Alliaria petiolata	Garlic mustard	0	1
Alopecurus pratensis	Field meadow-foxtail	0	1

Scientific Name	Common Name	Partial Assessments	Complete Assessments
Amorpha fruticosa	Indigobush	1	1
Anthoxanthum odoratum	Sweet vernalgrass	0	2
Arrhenatherum elatius	Tall oatgrass	0	1
Arum italicum ssp. italicum	Italian arum	0	1
Arundo donax	Giant reed (except variegated cultivars)	0	1
Bellardia viscosa	Yellow glandweed	0	1
Bellis perennis	English daisy, lawn daisy	0	1
Betula pendula	European white birch	0	1
Butomus umbellatus	Flowering rush	1	0
Centaurea solstitialis	Yellow star-thistle	0	1
Chondrilla juncea	Rush skeletonweed	1	0
Cirsium arvense	Canada thistle	1	3
Cirsium vulgare	Bull thistle	1	0
Clematis vitalba	Old man’s beard	0	1
Cotoneaster spp.	Cotoneaster	0	1
Crataegus monogyna	English hawthorn	0	1
Cynoglossum officinale	Houndstongue	1	1
Dianthus armeria	Deptford pink	1	1
Dipsacus fullonum	Common teasel	0	3
Erechtites minimus	Toothed coast fireweed	1	1
Fallopia × *bohemica*	Bohemian knotweed	1	0
Hieracium pilosella	mouse-ear hawkweed	0	1
Holcus lanatus	Common velvetgrass	0	1
Ilex aquifolium	English holly	0	2
Impatiens capensis	Spotted jewelweed	0	1
Iris pseudacorus	Yellow flag iris	1	0
Jacobaea vulgaris	Stinking willie	0	1
Juglans regia	English walnut	0	1
Juncus effusus subsp. effusus	Common rush	0	1
Lamium galeobdolon	Yellow archangel	0	1

Scientific Name	Common Name	Partial Assessments	Complete Assessments
Lathyrus latifolius	Everlasting-pea	0	1
Lathyrus sylvestris	Narrow-leaf pea	0	1
Leucanthemum vulgare	Oxeye daisy	0	1
Lysimachia nummularia	Garden loosestrife	1	0
Lythrum salicaria	Purple loosestrife	0	2
Marrubium vulgare	White horehound	0	1
Mycelis muralis	Wall lettuce	0	1
Myosotis discolor	Yellow and blue scorpiongrass, yellow scorpiongrass	0	1
Myriophyllum heterophyllum	Variable-leaf milfoil	1	0
Myriophyllum spicatum	Eurasian watermilfoil	0	1
Nasturtium officinale	Watercress	0	1
Phalaris arundinacea	Reed canarygrass	1	2
Phleum pratense	Timothy	0	1
Plantago lanceolata	English plantain	0	1
Poa annua	Annual bluegrass	0	1
Potamogeton crispus	Curlyleaf pondweed	1	0
Quercus robur	British oak, English oak	0	1
Rosa canina	Dog rose	0	1
Rosa multiflora	Multiflora rose, rambler rose	0	1
Rosa rugosa	Rugosa rose	0	1
Rubus bifrons	Himalayan blackberry	1	2
Rubus laciniatus	Cut-leaf blackberry, evergreen blackberry	0	1
Rumex crispus	Curly dock	0	1
Sasa palmata	Broadleaf bamboo	0	1
Schedonorus arundinaceus	Tall fescue	0	1
Schoenoplectus mucronatus	Ricefield bullrush	1	0
Senecio sylvaticus	Woodland groundsel, wood groundsel, woodland ragwort	0	1

Scientific Name	Common Name	Partial Assessments	Complete Assessments
Solanum dulcamara	Bittersweet nightshade	0	1
Solidago altissima	Late goldenrod	0	1
Spartina alterniflora	Smooth or saltwater cordgrass	0	1
Tamarix ramosissima	Saltcedar	0	1
Trifolium pratense	Red clover	0	1
Trifolium subterraneum	Burrowing clover	0	1
Utricularia inflata	Swollen bladderwort	0	1
Verbascum blattaria	Moth mullein	0	1
Veronica anagallis-aquatica	Water speedwell	0	1
Veronica arvensis	Wall speedwell, corn speedwell	0	1

Table 8. Life history of plants assessed. Plants with more than one potential life history are lumped with their shortest lifespan (e.g., *Cynoglossum officinale*, which can be a biennial or a short-lived perennial is counted as a biennial).

Life History	Number of Taxa
Annual	12
Biennial	3
Perennial	56

Table 9. Growth habit of plants assessed.

Growth Habit	Number of Taxa
Forb	43
Graminoid	13
Shrub	8
Tree	6
Vine/Liana	1

Table 10. Wetland Indicator Status of plants assessed for the Arid West. Plants that were not listed in the National Wetland Plants list (https://cwbi-app.sec.usace.army.mil/nwpl_static/v34/home/home.html) are considered UPL, per standard wetland delineation guidance.

Arid West Wetland Indicator Status	Number of taxa	Western Mountains, Valleys, and Coast Wetland Indicator Status	Number of Taxa
FAC	13	FAC	17
FACU	18	FACU	19
FACW	8	FACW	6
OBL	11	OBL	11
UPL	21	UPL	18

Ecological Impact Rankings

The results presented here represent our initial application of the Washington Invasive Ranking System (version 1.5). Ranking will continue after publication of this report, with up-to-date results (and individual species assessment summaries) available on our website beginning in early 2025: https://www.dnr.wa.gov/natural-heritage-program.

Ecological Impact scores ranged from 0 (*Bellis perennis*) to 91.67 (*Fallopia* × *bohemica*) out of 100. Data were skewed slightly to the right (Figure 2, Figure 3), though a normal distribution was not necessarily to be expected. The mean Ecological Impact score was 52.31 (Moderate; SD = 23.28).

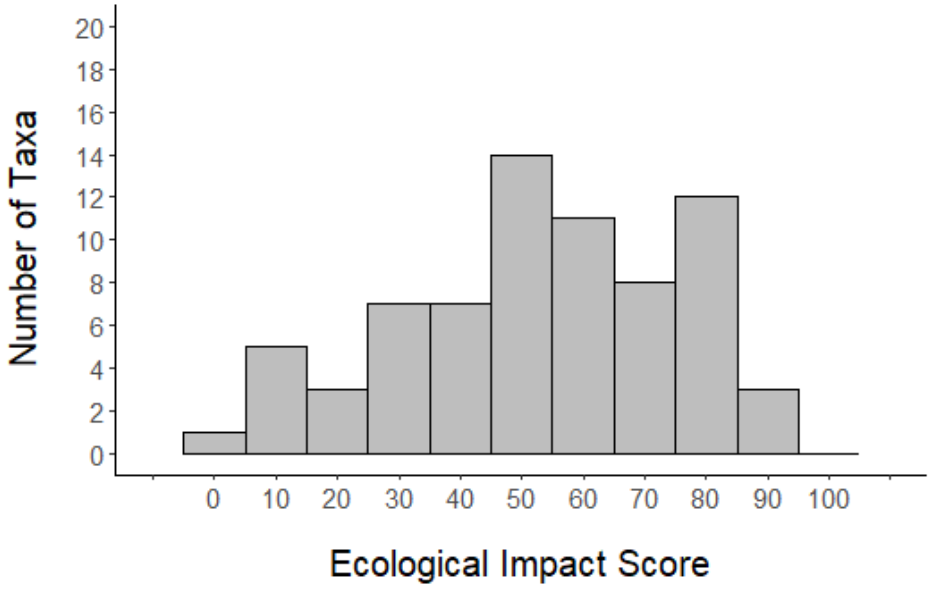

Figure 2. Histogram of Ecological Impact Score for all 71 taxa assessed. 100-70 points = High Ecological Impact, 70-50 = Moderate Ecological Impact, 50-30 = Low Ecological Impact, and < 30 = Insignificant Ecological Impact.

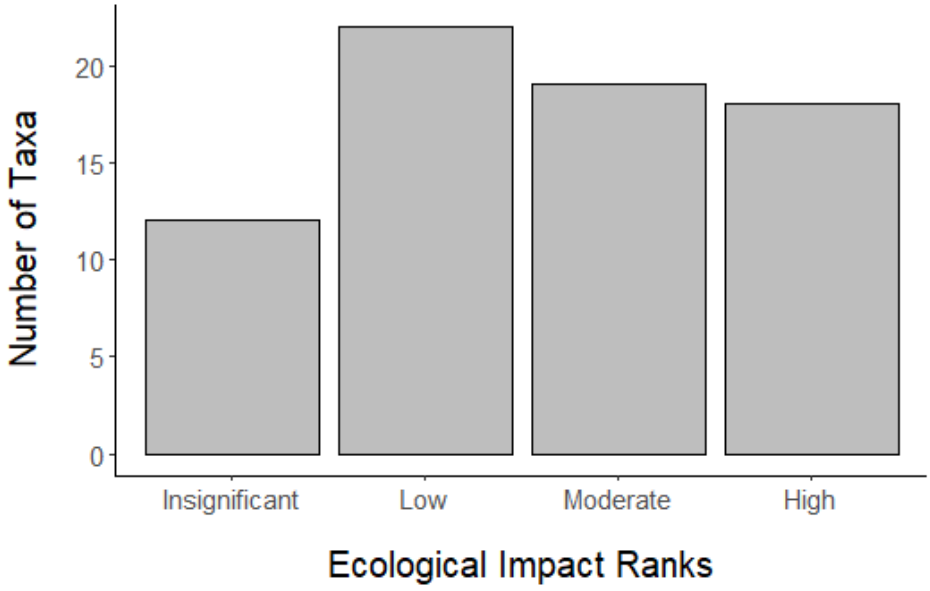

Figure 3. Bar graph showing Ecological Impact ranks for all 71 taxa assessed. 100-70 points = High Ecological Impact, 70-50 = Moderate Ecological Impact, 50-30 = Low Ecological Impact, and < 30 = Insignificant Ecological Impact.

Assessors also rated their confidence in each metric ("Not Rated" or "Unknown" responses were capped at Low confidence). Rolled-up Ecological Impact confidence scores (see "Calculating the

Ecological Impact Rank", above) ranged from 8.33 (*Schoenoplectus mucronatus*) to 100 (*Poa annua* and *Senecio sylvaticus*). The mean confidence score was 56.57 (Moderate; SD = 19.37). These data had a nearly normal distribution (Figure 4, Figure 5). Most assessments were rated as High 35%) or Moderate (51%) confidence (Table 11). For plants with Low Ecological Impact confidence ranks, Ecological Impact scores were supplemented with Biological Characteristics metric ratings when available (see "Calculating the Ecological Impact Rank" above and in Ramm-Granberg et al. (2024)). However, assessors of two low confidence taxa (*Chondrilla juncea* and *Schoenoplectus mucronatus*) did not rate metrics in the Biological Characteristics section.

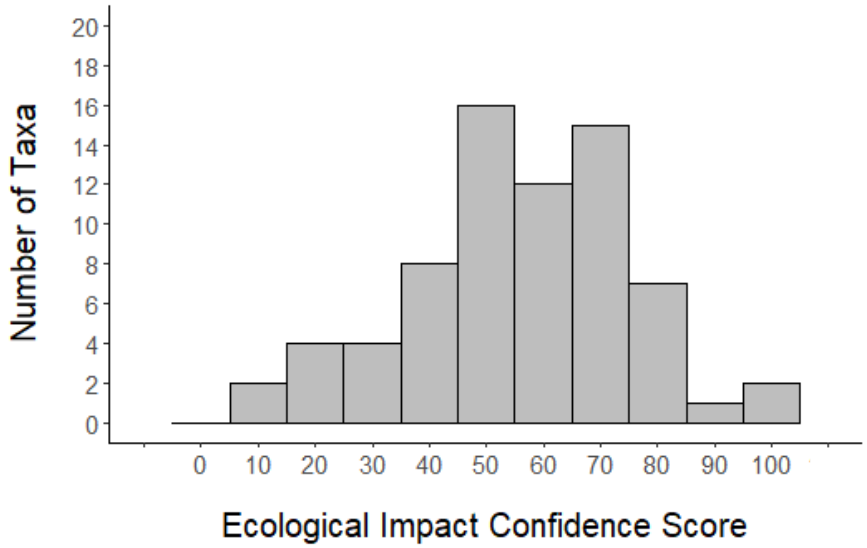

Figure 4. Histogram of confidence scores for Ecological Impact for all 71 taxa. Ecological Impact ranks with Low confidence ranks were supplemented using Biological Characteristics scores when possible (see "Calculating the Ecological Impact Rank"). 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

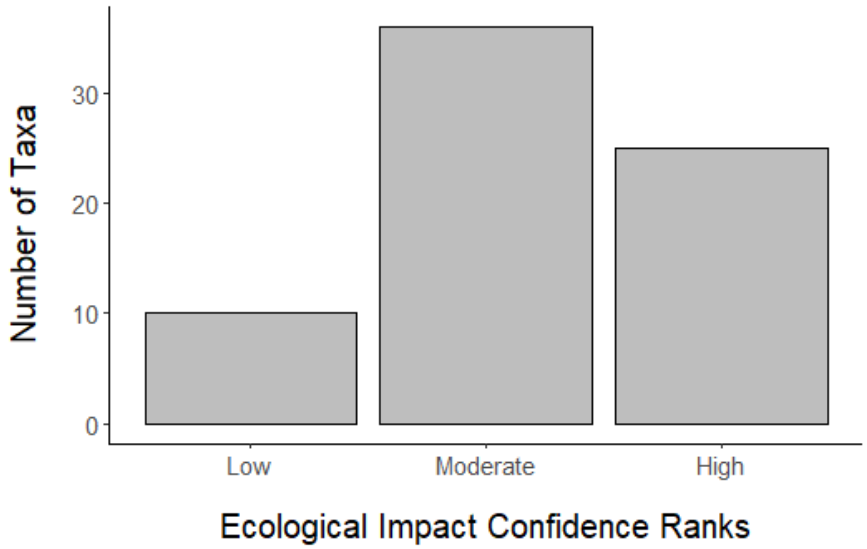

Figure 5. Bar graph of Ecological Impact confidence ranks for all 71 taxa. Ecological Impact ranks with Low confidence ranks were supplemented using Biological Characteristics scores when possible (see "Calculating the Ecological Impact Rank" in protocol). 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

Table 11.Ecological Impact Ranks, Confidence Ranks, and Supplementary Information for all 71 taxa assessed. See Appendix B for numeric scores and full results.

	Ecological Impact		Supplementary Information					
Taxon	**Ecological Impact Rank**	**Ecological Impact Confidence Rank**	**Management Difficulty Rank**	**Management Difficulty Confidence Rank**	**Biological Characteristics of Invasiveness**	**Biological Characteristics Confidence Rank**	**Concern Related to Distribution and Abundance Rank**	**Distribution and Abundance Confidence Rank**
Acer negundo	Low	Moderate	Moderate	Moderate	High	High	Moderate	Moderate
Ailanthus altissima	Moderate	Moderate	Low	Moderate	Moderate	High	High	Moderate
Alliaria petiolata	High	Low	High	Moderate	High	Moderate	High	Low
Alopecurus pratensis	Moderate	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate
Amorpha fruticosa	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	High
Anthoxanthum odoratum	Moderate	Moderate	Moderate	Moderate	Moderate	High	High	High
Arrhenatherum elatius	Moderate	High	High	High	Moderate	High	High	High
Arum italicum ssp. italicum	Low	Moderate	High	High	Moderate	High	Moderate	Moderate
Arundo donax	High	High	High	High	Moderate	High	Moderate	Moderate
Bellardia viscosa	Low	Moderate	Insignificant	Moderate	High	Moderate	Moderate	High
Bellis perennis	Insignificant	High	Insignificant	High	Insignificant	Moderate	High	Low
Betula pendula	Low	Moderate	Insignificant	High	Moderate	Moderate	High	High

	Ecological Impact		Supplementary Information					
Taxon	**Ecological Impact Rank**	**Ecological Impact Confidence Rank**	**Management Difficulty Rank**	**Management Difficulty Confidence Rank**	**Biological Characteristics of Invasiveness**	**Biological Characteristics Confidence Rank**	**Concern Related to Distribution and Abundance Rank**	**Distribution and Abundance Confidence Rank**
Butomus umbellatus	High	Moderate	High	High	High	Low	Moderate	Low
Centaurea solstitialis	High	High	Moderate	Moderate	High	High	Moderate	High
Chondrilla juncea	High	Low	Moderate	Moderate	Not Rated	Not Rated	High	Low
Cirsium arvense	High	Moderate	Moderate	High	High	High	Low	High
Cirsium vulgare	Low	Moderate	Not Rated	Not Rated	High	Moderate	Moderate	Moderate
Clematis vitalba	Moderate	High	High	Moderate	High	Moderate	High	Moderate
Cotoneaster spp.	Low	High	Insignificant	High	Moderate	Moderate	High	Moderate
Crataegus monogyna var. monogyna	High	High	High	High	High	High	High	High
Cynoglossum officinale	Moderate	Moderate	Moderate	Moderate	High	High	High	High
Dianthus armeria	Insignificant	Moderate	Insignificant	High	Insignificant	Moderate	Moderate	Moderate
Dipsacus fullonum	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	High
Erechtites minimus	Low	Moderate	Insignificant	Low	Moderate	Moderate	High	High

	Ecological Impact		Supplementary Information					
Taxon	**Ecological Impact Rank**	**Ecological Impact Confidence Rank**	**Management Difficulty Rank**	**Management Difficulty Confidence Rank**	**Biological Characteristics of Invasiveness**	**Biological Characteristics Confidence Rank**	**Concern Related to Distribution and Abundance Rank**	**Distribution and Abundance Confidence Rank**
Fallopia × bohemica	High	High	High	High	Not Rated	Not Rated	High	Low
Hieracium pilosella	Low	High	High	High	High	High	Low	High
Holcus lanatus	Moderate	Moderate	High	Moderate	Moderate	High	High	High
Ilex aquifolium	High	High	High	Moderate	High	High	High	High
Impatiens capensis	Low	Moderate	Low	High	High	Moderate	High	Moderate
Iris pseudacorus	High	Moderate	Moderate	High	High	High	High	Low
Jacobaea vulgaris	Moderate	Low	Moderate	Moderate	High	High	High	High
Juglans regia	Low	Moderate	Insignificant	Moderate	Low	Moderate	High	Low
Juncus effusus subsp. effusus	Low	Moderate	Low	Low	High	High	High	High
Lamium galeobdolon	Low	Moderate	High	High	High	Moderate	Moderate	Moderate
Lathyrus latifolius	Low	High	Moderate	High	High	High	High	High
Lathyrus sylvestris	Low	High	Moderate	High	High	High	High	High
Leucanthemum vulgare	Moderate	Moderate	High	High	Low	High	Moderate	High

	Ecological Impact		Supplementary Information					
Taxon	**Ecological Impact Rank**	**Ecological Impact Confidence Rank**	**Management Difficulty Rank**	**Management Difficulty Confidence Rank**	**Biological Characteristics of Invasiveness**	**Biological Characteristics Confidence Rank**	**Concern Related to Distribution and Abundance Rank**	**Distribution and Abundance Confidence Rank**
Lysimachia nummularia	Low	Moderate	Low	Low	High	Moderate	Moderate	Moderate
Lythrum salicaria	Moderate	Low	High	Moderate	Moderate	Moderate	Moderate	Moderate
Marrubium vulgare	Insignificant	Low	Insignificant	High	Low	High	High	Moderate
Mycelis muralis	Insignificant	High	Insignificant	High	Moderate	Moderate	Moderate	High
Myosotis discolor	Insignificant	Moderate	Insignificant	Moderate	Low	Moderate	High	High
Myriophyllum heterophyllum	High	Moderate	Moderate	Moderate	Not Rated	Not Rated	Low	High
Myriophyllum spicatum	High	High	Moderate	High	High	High	High	High
Nasturtium officinale	Moderate	High	Moderate	Moderate	High	High	High	Moderate
Phalaris arundinacea	High	Moderate	High	High	High	High	High	High
Phleum pratense	Low	Low	High	Low	Low	Moderate	High	High
Plantago lanceolata	Insignificant	High	Insignificant	High	Low	High	Moderate	High
Poa annua	Insignificant	High	Insignificant	High	High	High	Moderate	High

	Ecological Impact		Supplementary Information					
Taxon	**Ecological Impact Rank**	**Ecological Impact Confidence Rank**	**Management Difficulty Rank**	**Management Difficulty Confidence Rank**	**Biological Characteristics of Invasiveness**	**Biological Characteristics Confidence Rank**	**Concern Related to Distribution and Abundance Rank**	**Distribution and Abundance Confidence Rank**
Potamogeton crispus	High	Moderate	Not Rated	Not Rated	Not Rated	Not Rated	High	Moderate
Quercus robur	Low	High	Insignificant	High	Low	High	Moderate	High
Rosa canina	Moderate	Moderate	Moderate	Moderate	High	High	High	Moderate
Rosa multiflora	Moderate	High	Low	Moderate	Moderate	High	Moderate	Moderate
Rosa rugosa	Low	Moderate	Insignificant	High	High	High	Moderate	Moderate
Rubus bifrons	High	High	High	High	High	High	High	High
Rubus laciniatus	Moderate	Low	Low	Moderate	Moderate	Moderate	Moderate	Moderate
Rumex crispus	Insignificant	Moderate	Insignificant	High	Moderate	High	Moderate	Moderate
Sasa palmata	Moderate	High	Moderate	High	Moderate	High	Moderate	High
Schedonorus arundinaceus	Moderate	High	Moderate	High	High	Moderate	High	Moderate
Schoenoplectus mucronatus	Low	Low	High	Low	Not Rated	Not Rated	Low	Moderate
Senecio sylvaticus	Insignificant	High	Insignificant	High	High	High	Moderate	High
Solanum dulcamara	Low	High	Moderate	Moderate	Moderate	High	High	High
Solidago altissima	Moderate	Low	Low	Low	High	High	Moderate	Moderate

	Ecological Impact		Supplementary Information					
Taxon	**Ecological Impact Rank**	**Ecological Impact Confidence Rank**	**Management Difficulty Rank**	**Management Difficulty Confidence Rank**	**Biological Characteristics of Invasiveness**	**Biological Characteristics Confidence Rank**	**Concern Related to Distribution and Abundance Rank**	**Distribution and Abundance Confidence Rank**
Spartina alterniflora	High	Moderate	High	High	Moderate	High	Insignificant	High
Tamarix ramosissima	High	Moderate	High	Moderate	Moderate	High	High	High
Trifolium pratense	Low	Moderate	Insignificant	High	Low	High	Moderate	High
Trifolium subterraneum	Low	Moderate	Moderate	High	Low	High	High	High
Utricularia inflata	High	Low	Moderate	Low	High	Moderate	Moderate	Moderate
Verbascum blattaria	Insignificant	Moderate	Insignificant	High	Insignificant	Moderate	Moderate	Low
Veronica anagallis-aquatica	Insignificant	Moderate	Insignificant	Low	High	Moderate	Moderate	High
Veronica arvensis	Insignificant	High	Insignificant	High	Low	Moderate	Moderate	High

Supplementary Information

Management Difficulty Rank

Management Difficulty scores ranged from 0 (eight taxa: *Bellis perennis*, *Dianthus armeria*, *Marrubium vulgare*, *Mycelis muralis*, *Plantago lanceolata*, *Poa annua*, *Senecio sylvaticus*, and *Veronica arvensis*) to 92.98 for *Alliaria petiolata* and *Phalaris arundinacea* (Management Difficulty was not assessed for *Potamogeton crispus* or *Cirsium vulgare*). The mean Management Difficulty Score was 50.66 (Moderate; SD = 30.21). Management Difficulty data showed a bimodal distribution, with 20 species falling into the Insignificant (< 30%) range. However, taxa with non-zero Management Difficult scores skewed toward Moderate and High ratings (Figure 6, Figure 7).

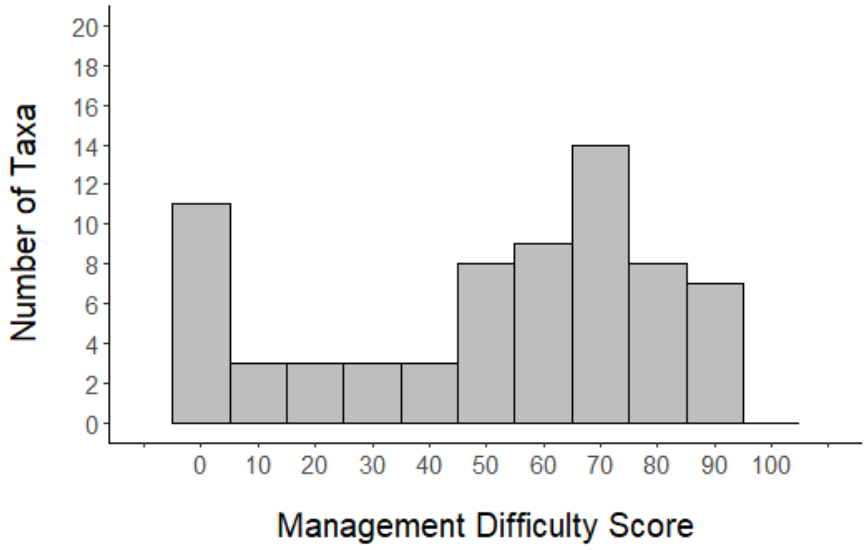

Figure 6. Histogram of Management Difficulty scores for 69 of 71 species assessed. *Potamogeton crispus* and *Cirsium vulgare* did not have data for Management Difficulty. 100-70 points = High Management Difficulty, 70-50 = Moderate Management Difficulty, 50-30 = Low Management Difficulty, and < 30 = Insignificant Management Difficulty.

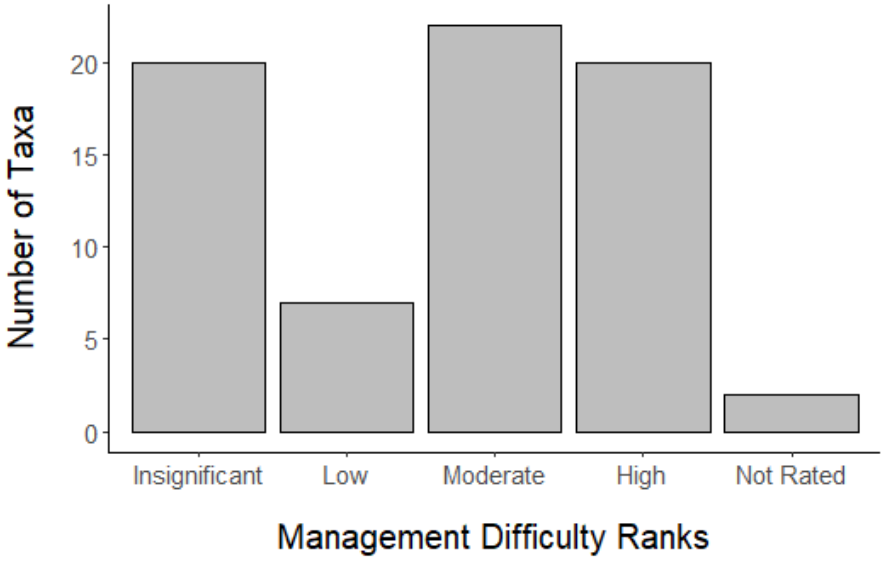

Figure 7. Bar graph of Management Difficulty ranks for 69 of 71 species assessed. *Potamogeton crispus* and *Cirsium vulgare* did not have data for Management Difficulty. 100-70 points = High Management Difficulty, 70-50 = Moderate Management Difficulty, 50-30 = Low Management Difficulty, and < 30 = Insignificant Management Difficulty.

Management Difficulty confidence scores ranged from 10 (*Veronica anagallis-aquatica*, *Juncus effusus* subsp. *effusus*, and *Utricularia inflata*) to 100 (*Bellis perennis*, *Crataegus monogyna* var. *monogyna*, *Dianthus armeria*, *Mycelis muralis*, *Plantago lanceolata*, *Poa annua*, *Quercus robur*, and *Veronica arvensis*). The mean Management Difficulty confidence score was 65.94 (Moderate; SD = 23.85). Management Difficulty confidence skewed toward Moderate and High ranks, with 52% of assessments ranked as High confidence and 36% of assessments ranked as Moderate confidence (Figure 8, Figure 9). Eight taxa received Low confidence ranks (12%). One of the Low confidence assessments, *Lysimachia nummularia*, only received ratings for Q27 (Accessibility of Invaded Areas) and Q28 (Sociopolitical Implications of Management).

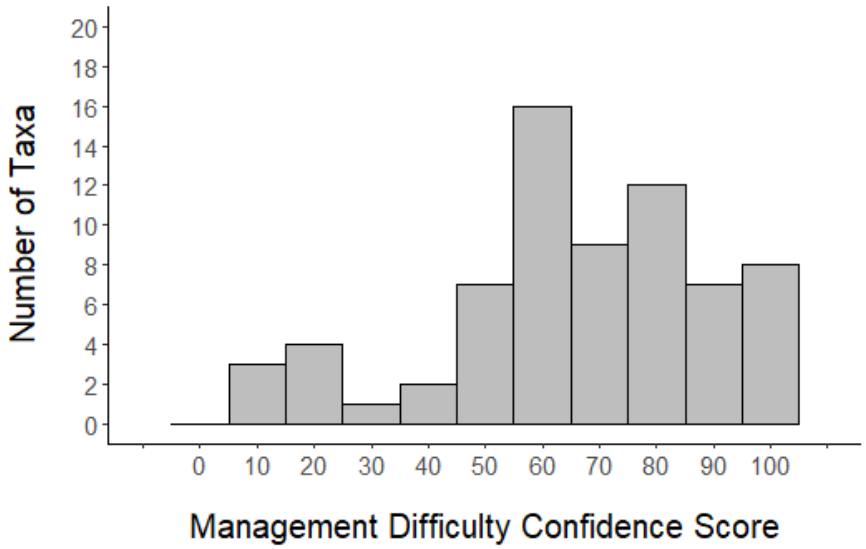

Figure 8. Histogram of Management Difficulty confidence scores for 69 of 71 taxa. Two plants (*Potamogeton crispus* and *Cirsium vulgare*) did not receive a Management Difficulty rank. 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

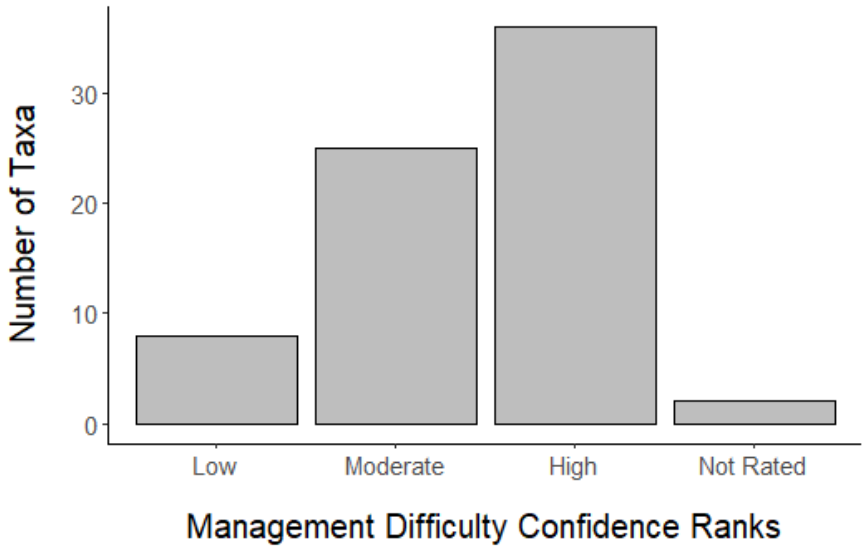

Figure 9. Bar graph of Management Difficulty confidence ranks for 69 of 71 taxa. Two plants (*Potamogeton crispus* and *Cirsium vulgare*) did not receive a Management Difficulty rank. 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

Biological Characteristics of Invasiveness

Biological Characteristics scores ranged from 23.08 (*Verbascum blattaria*) to 100 (*Butomus umbellatus*). *Butomus umbellatus* had only one metric assessed in this section. *Alliaria petiolata* had the high score (96.15) among species where most/all of the Biological Characteristics metrics were assessed. The mean score was 67.75 (Moderate; SD = 18.71). Five taxa (*Schoenoplectus mucronatus, Chondrilla juncea, Myriophyllum heterophyllum*, *Potamogeton crispus*, and *Fallopia* × *bohemica*) did not have their Biological Characteristics assessed. The majority (53%) of assessments resulted in High ranks. This section had a somewhat bimodal distribution of scores, with a small peak in Low scores and a large peak in High scores (Figure 10, Figure 11).

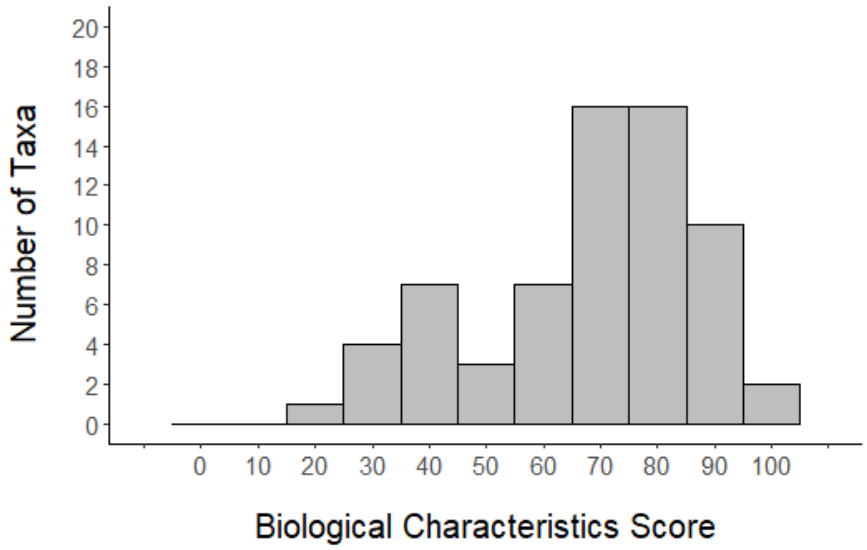

Figure 10. Histogram of Biological Characteristics scores for the 66 plants that received ratings in that section. Higher scores indicate that a species has more traits associated with invasiveness. 100-70 points = High Biological Characteristics of invasiveness, 70-50 = Moderate Biological Characteristics of invasiveness, 50-30 = Low Biological Characteristics of invasiveness, and < 30 = Insignificant Biological Characteristics of invasiveness.

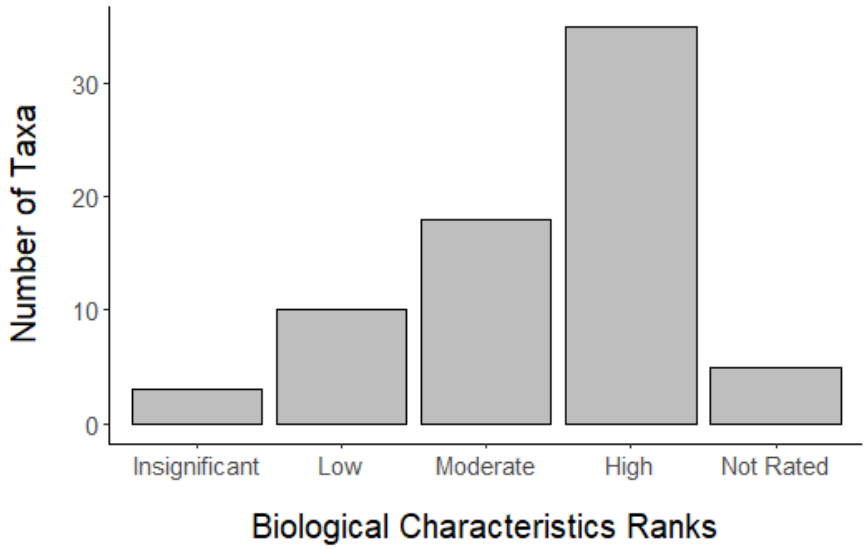

Figure 11. Bar graph of Biological Characteristics ranks for the 66 taxa that received ratings in that section. 100-70 points = High Biological Characteristics of invasiveness, 70-50 = Moderate Biological Characteristics of invasiveness, 50-30 = Low Biological Characteristics of invasiveness, and < 30 = Insignificant Biological Characteristics of invasiveness.

Confidence scores ranged from 4.16 (*Butomus umbellatus*, which had only one metric rated) to 91.67 (*Arundo donax*), with a mean of 64.66 (Moderate; SD = 15.56). Nearly all confidence ranks were High (62%) or Moderate (36%) (Figure 12, Figure 13). Only *Butomus umbellatus* received a Low confidence rank in Biological Characteristics.

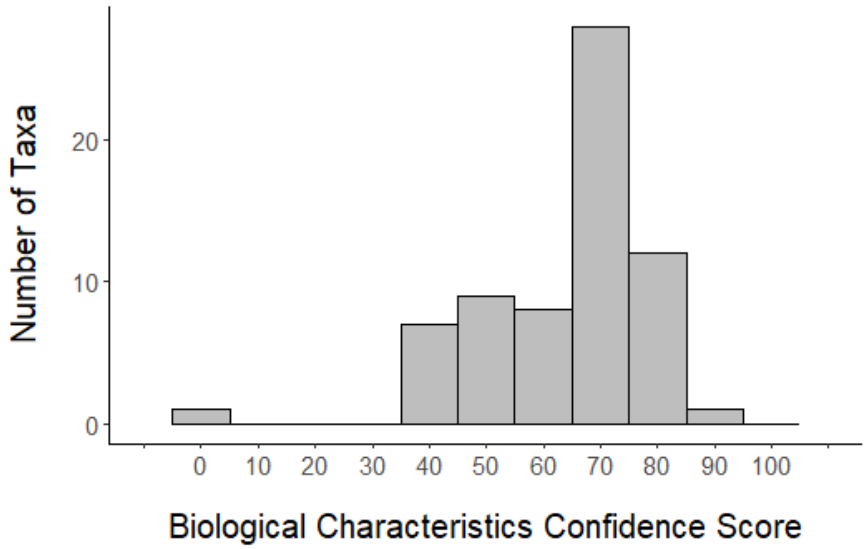

Figure 12. Histogram of Biological Characteristics confidence scores for the 66 taxa that received ratings in that section. 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

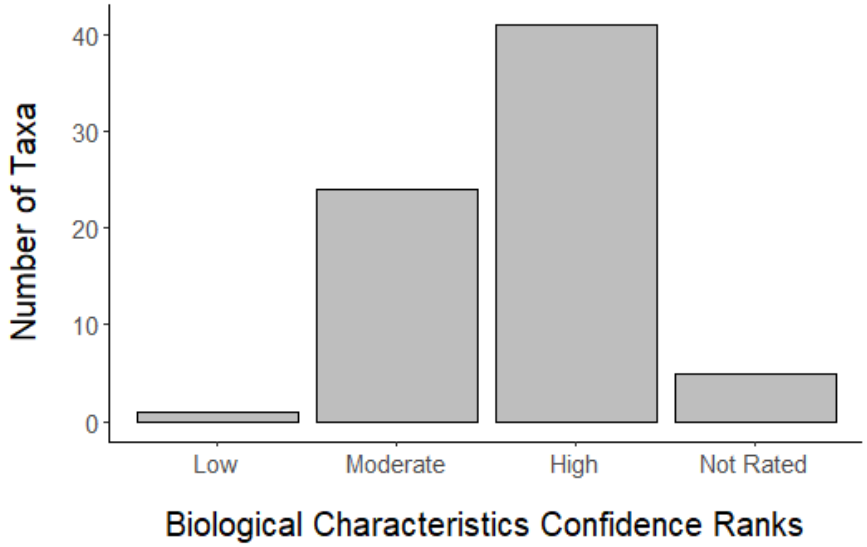

Figure 13. Bar graph of Biological Characteristics confidence ranks for the 66 taxa that received ratings in that section. 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

Concern Related to Distribution and Abundance

Distribution and Abundance scores ranged from 20 (*Spartina alterniflora*) to 93.94 (*Potamogeton crispus*). The mean score was 69.42 (Moderate; SD = 14.79). Again, the distribution of ranks for this section skewed towards Moderate and High ranks (Figure 14, Figure 15).

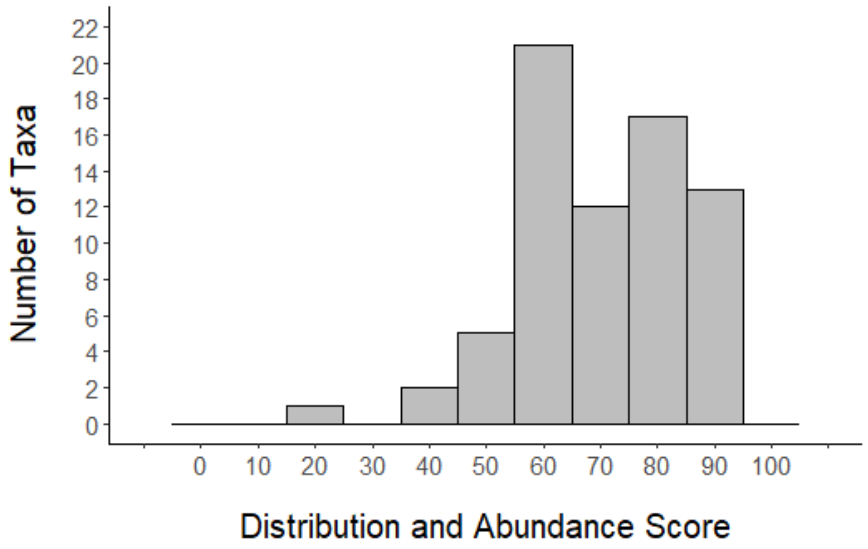

Figure 14. Histogram of Distribution and Abundance scores for all 71 taxa assessed. 100-70 points = High Distribution and Abundance, 70-50 = Moderate Distribution and Abundance, 50-30 = Low Distribution and Abundance, and less than 30 = Insignificant Distribution and Abundance.

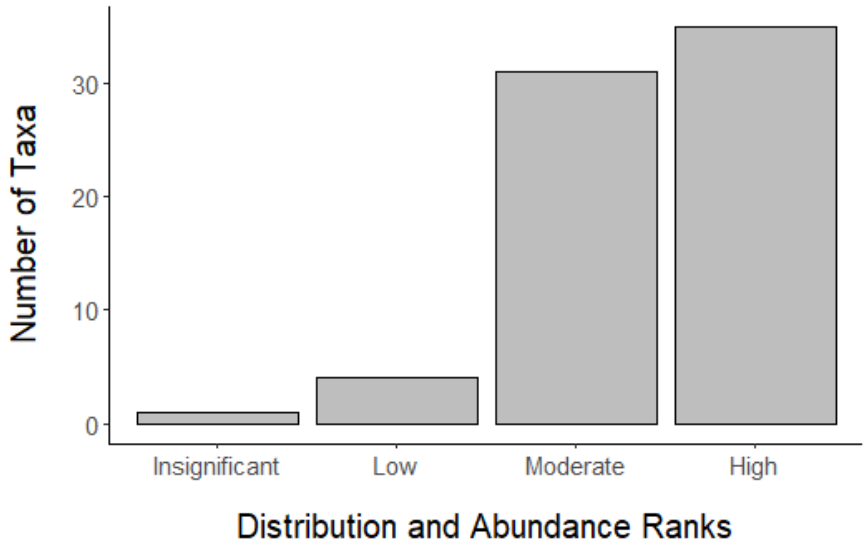

Figure 15. Bar graph of Distribution and Abundance ranks for all 71 taxa assessed. The final rank for species with multiple forms is rolled up from individually submitted ranks. 100-70 points = High Distribution and Abundance, 70-50 = Moderate Distribution and Abundance, 50-30 = Low Distribution and Abundance, and < 30 = Insignificant Distribution and Abundance.

Confidence scores ranged from 20 (*Chondrilla juncea* and *Fallopia* × *bohemica,* which both had only two metrics rated) to 100 (*Holcus lanatus, Lathyrus latifolius, Lathyrus sylvestris,* and *Sasa*

palmata). The mean was 65.35 (Moderate; SD = 20.90). The distribution of scores for this section was bimodal and skewed towards Moderate (35%) and High (54%) scores (Figure 16, Figure 17).

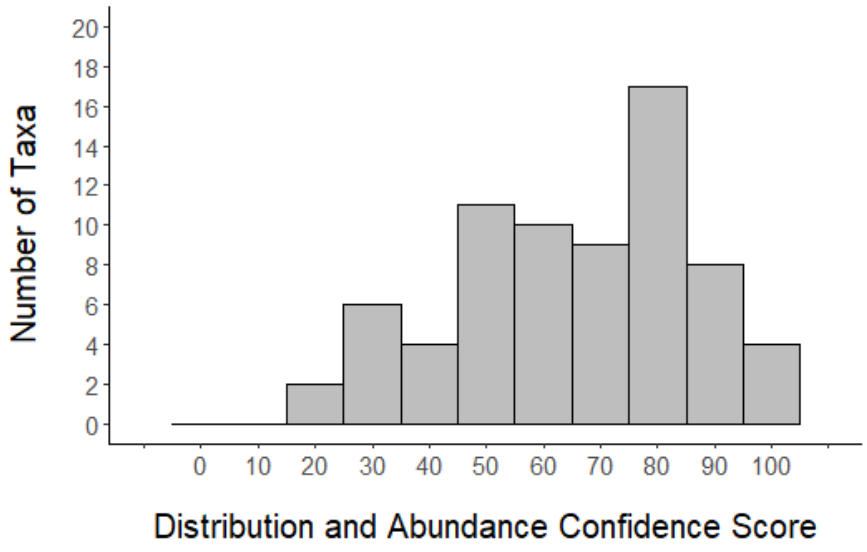

Figure 16. Histogram of Distribution and Abundance confidence scores for all 71 taxa. 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

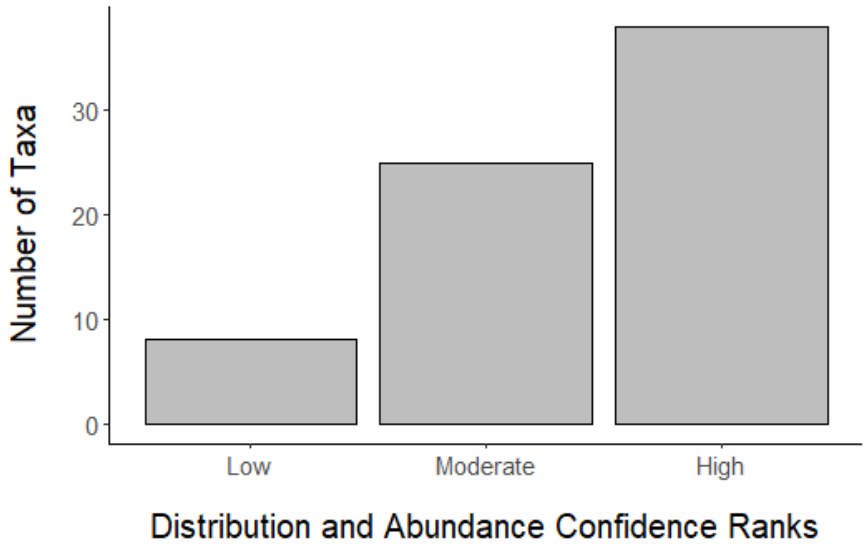

Figure 17. Bar graph of Distribution and Abundance confidence ranks for all 71 taxa. 100-66.67 points = High confidence, 66.67-33.33 = Moderate confidence, and < 33.33 = Low confidence.

Discussion

As environmental professionals, it is imperative that we share a consistent, defensible list of invasive plant species when carrying out assessment, conservation, and restoration objectives. In this project, we drew from the broad corpus of invasive species ranking tools to develop a customized protocol for evaluating the impacts nonnative plants on natural ecosystems of Washington State. The resulting Washington Invasive Ranking System (WIRS) is a standardized tool that can be used to help develop a comprehensive list of invasive plant species. Initial steps towards such a list have been made via our assessments of 71 plant taxa, with contributions from 10 professionals from across Washington. Ranking will continue—we plan on adding to the number of assessments and existing species assessment summaries will be revised as new data becomes available. Updated data will be available on the WNHP website (https://www.dnr.wa.gov/natural-heritage-program).

This initial deployment of the WIRS method included species with a wide range of life histories, growth habits, and habitat requirements. For all sections, assessments skewed toward Moderate and High ranks. There may be multiple drivers of that distribution. For one, we have simply not assessed the entirety of Washington's nonnative flora. Crowd-sourced professionals are also likely to be more familiar with highly invasive, broadly distributed plants and thus more likely to voluntarily assess those. Published information on nonnative species also tends to be skewed towards taxa that are known to be invasive and already managed as threats. Information for less invasive or less abundant nonnatives can be limited, especially information on their effects within a specific geography (i.e., Washington). Assessments of more recent arrivals and less invasive taxa leaned heavily on subjective "best professional judgment" and received lower confidence ranks—such assessments also benefited the most from the varied perspectives provided by multiple assessors. Lastly, this protocol is designed for assessment of nonnative plants that already occur in Washington, which may also select for plants that are naturally more impactful. There may be minimum biological and ecological traits required for initial establishment of nonnative species, meaning the least invasive/impactful plants may be less likely to establish here in the first place.

Applications

Ecological Assessments

The Washington Natural Heritage Program will maintain a database of WIRS results that will be made available on our website (also provided here as Appendix B). Managers of wetland function and condition assessment tools may choose to incorporate these ranks into their protocols as they see fit, or consult with WNHP. WNHP will use Ecological Impact ranks to inform which plants are considered "invasive" in Ecological Integrity Assessments (Rocchio et al., 2020b). WIRS results could also be used to further test and refine national-scale wetland condition assessment tools such as the Nonnative Plant Indicator (Magee et al., 2019b).

Prioritization of Risk and or Management Actions

Many management decisions involve triage. The Ecological Impact ranks and Management Difficulty information produced by WIRS assessments provide a valuable framework for choosing how to deploy limited land management resources. For example, managers may choose to target plant species with a High Ecological Impact but Low Management Difficulty, to get the most "bang for their buck". On the other hand, managers may choose to target plant species with High Management Difficulty while populations are small, to avoid costly and/or impractical interventions down the line. WIRS data may also be helpful in coordinating management and treatment of exotic species by providing a set of shared standards to work from.

The WIRS tool is currently designed to prioritize nonnative plants that are already established in natural ecosystems in Washington. However, the Biological Characteristics portion of the assessment could potentially be useful in flagging taxa that could be of concern in the future, with plants that rank higher in this section being of more concern.

Future Ecological Impact Ranking

This initial application of WIRS assessed 71 taxa from a list of ~1200 nonnative plants present in Washington—roughly 6% of the exotic flora in Washington. Users may reach out to WNHP if they are interested in a WIRS assessment of a specific unranked plant. Depending on staffing capacity, WNHP may be able to work with the interested party to complete an assessment and add the results to our database (Appendix B). Additionally, WNHP will continue to use the protocol as a component of future assessment projects (e.g., to assess unranked nonnative plants encountered while conducting Ecological Integrity Assessments), gradually expanding the number of plants ranked.

Challenges of the Assessment

Our attempt at crowd-sourced assessments was not as successful as we had hoped. Only a limited number of the individuals who initially expressed interest in this project completed assessments. Some assessors felt intimidated by the perceived time commitment and there were misunderstandings about the amount of literature review expected of our volunteers. Washington has diverse ecoregions and nonnative plants may behave differently across those regions. When recruiting the ranking panel, we targeted individuals with statewide experience where possible, but the limited number of assessors made drawing from a statewide perspective more challenging. If we were to attempt crowd-sourcing again, we would likely to try to arrange in-person or online group meetings to encourage engagement and foster discussion.

In response, we revised the data collection portion of our protocol. Instead of crowd-sourcing the entire method, WNHP staff will assess the relatively objective Distribution and Abundance and Biological Characteristics sections. Rating information for these sections can be drawn (mostly) from location records, published literature, and white papers. Staff will also complete draft assessments of the Ecological Impact and Management Difficulty sections before conducting targeted expert interviews to finalize scores for those two sections. Ecological Impact and

Management Difficulty metrics rely most strongly on professional expertise and the relevant information for these sections is less likely to be documented in published literature or white papers. Draft assessments will be sent out to the scientific advisory panel for a final peer review before being finalized and included on our website. In the future, WNHP may also send out abbreviated questionnaires to county weed boards or other bodies, or present at meetings to supplement assessments.

Moving Forward

The Washington Invasive Ranking System represents a standardized tool for assessing the ecological impact of nonnative plants in natural ecosystems. Initial results demonstrate application of the method to with a wide range of plants, providing actionable information for evaluating ecological impacts and prioritization of management resources and treatment. Continued development of the method—especially using our revised data collection procedure to grow our list of ranked species—will advance us closer to the ultimate goal of a standardized list of invasive plant species for function and condition assessments in Washington.

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Appendix A. Initial Prioritized List of Plants for Assessment

Members of the ranking panel were asked to rank plants for which they had first-hand knowledge, quantitative data, or documentation from the literature—beginning with the high priority list and then moving on to the medium and low priority lists. The goal of this prioritization was to make it more likely that we would receive multiple assessments of some taxa, allowing us to test the usefulness of a "crowd-sourced" approach to ranking. If an assessor exhausted the priority list, they were asked to continue with any remaining species from the Washington State Noxious Weed Control Board (https://www.nwcb.wa.gov/printable-noxious-weed-list) and Invasive Species Council (https://invasivespecies.wa.gov/find-a-priority-species/?_sft_priority-specie-type=noxious-weeds) lists. If those were in turn exhausted, assessors were asked to continue with other nonnative plants at their leisure, with a preference for wetland taxa already established in Washington.

Table A-1. Prioritized List of Plants for Assessment. Includes % of Washington counties in which each species has been observed (EDDMapS, 2023; iNaturalist Contributors, 2023) and/or collected (CPNWH, 2023).

Priority	Scientific Name	Common Name(s)	% of WA Counties Occupied	USDA PLANTS Code	Synonym(s)
High	Acer negundo	Box elder	51%	ACNE2	
High	Ailanthus altissima	Tree of Heaven	69%	AIAL	
High	Amorpha fruticosa	Indigobush	38%	AMFR	
High	Arundo donax	Giant reed (except variegated cultivars)	8%	ARDO4	
High	Carex pendula	Hanging sedge	18%	CAPE45	
High	Centaurea melitensis	Malta starthistle	21%	CEME2	
High	Cirsium arvense	Canada thistle	100%	CIAR4	
High	Dipsacus fullonum	Common teasel	92%	DIFU2	
High	Erechtites minimus	Toothed coast fireweed	31%	ERMI8	
High	Fallopia × bohemica	Bohemian knotweed	56%	POBO10	Polygonum × bohemicum, Reynoutria bohemica
High	Heracleum mantegazzianum	Giant hogweed	26%	HEMA17	
High	Impatiens capensis	Spotted jewelweed	62%	IMCA	
High	Lysimachia vulgaris	Garden loosestrife	21%	LYVU	

Priority	Scientific Name	Common Name(s)	% of WA Counties Occupied	USDA PLANTS Code	Synonym(s)
High	Lythrum portula	Spatula-leaf loosestrife	54%	LYPO4	
High	Lythrum salicaria	Purple loosestrife	95%	LYSA2	
High	Marrubium vulgare	White horehound	59%	MAVU	
High	Morus alba	White mulberry	38%	MOAL	
High	Myriophyllum spicatum	Eurasian watermilfoil	87%	MYSP2	
High	Phalaris arundinacea	Reed canarygrass	100%	PHAR3	
High	Polypogon monspeliensis	Annual rabbitsfoot grass	82%	POMO5	
High	Rubus bifrons	Himalayan blackberry	79%	RUBI	Rubus armeniacus
High	Tamarix ramosissima	Saltcedar	33%	TARA	
High	Thinopyrum ponticum	Tall wheatgrass	23%	THPO7	
High	Utricularia inflata	Swollen Bladderwort	13%	UTIN	
Med	Alhagi maurorum	Camelthorn	15%	ALMA12	
Med	Alopecurus pratensis	Meadow foxtail	59%	ALPR3	
Med	Artemisia absinthium	Absinth wormwood	54%	ARAB3	
Med	Bassia scoparia	Kochia, summer-cypress, burning-bush, fireball, Mexican fireweed	51%	BASC5	Kochia scoparia
Med	Betula pendula	European white birch	49%	BEPE3	
Med	Brachypodium sylvaticum	False brome	18%	BRSY	
Med	Bromus inermis	Smooth brome	44%	BRIN2	
Med	Butomus umbellatus	Flowering rush	26%	BUUM	
Med	Carduus acanthoides ssp. acanthoides	Plumeless thistle	21%	CAAC	
Med	Centaurea solstitialis	Yellow star-thistle	49%	CESO3	
Med	Chenopodium album	Lambsquarters	85%	CHAL7	
Med	Chondrilla juncea	Rush skeletonweed	59%	CHJU	
Med	Clematis vitalba	Old man's beard	36%	CLVI6	
Med	Conium maculatum	Poison hemlock	74%	COMA2	
Med	Cyperus esculentus	Yellow nutsedge	23%	CYES	

Priority	Scientific Name	Common Name(s)	% of WA Counties Occupied	USDA PLANTS Code	Synonym(s)
Med	Echinochloa crus-galli	Barnyardgrass	69%	ECCR	
Med	Elaeagnus angustifolia	Russian olive	44%	ELAN	
Med	Epilobium hirsutum	Hairy willowherb	28%	EPHI	
Med	Euphorbia virgata	Leafy spurge	18%	EUES	Euphorbia esula
Med	Fallopia japonica	Japanese knotweed	69%	POCU6	Polygonum cuspidatum
Med	Fallopia sachalinensis	Giant knotweed	41%	POSA4	Polygonum sachalinense
Med	Foeniculum vulgare	Common fennel (except bulbing fennel and F. vulgare var. azoricum)	38%	FOVU	
Med	Fraxinus pennsylvanica	Green ash	33%	FRPE	
Med	Holcus lanatus	Common velvetgrass	59%	HOLA	
Med	Iris pseudacorus	Yellow flag iris	97%	IRPS	
Med	Jacobaea vulgaris	Stinking willie	69%	SEJA	Senecio jacobaea
Med	Juglans regia	English walnut	67%	JURE80	
Med	Juncus bulbosus	Bulbous rush	15%	JUBU2	
Med	Juncus effusus ssp. effusus	Common rush	69%	JUEFE2	Juncus effusus var. effusus
Med	Lamium galeobdolon	Yellow archangel	46%	LAGA2	Lamiastrum galeobdolon
Med	Lepidium latifolium	Perennial pepperweed	59%	LELA2	
Med	Lysimachia nummularia	Creeping Jenny	41%	LYNU	
Med	Nanozostera japonica	Japanese eelgrass	28%	NAJA5	Zostera japonica
Med	Nymphaea odorata	Fragrant waterlily	51%	NYODO	
Med	Onopordum acanthium ssp. acanthium	Scotch thistle	49%	ONAC	
Med	Persicaria wallichii	Himalayan knotweed	15%	POPO5	Polygonum polystachyum
Med	Phragmites australis	Common reed (nonnative genotypes only)	72%	PHAU7	
Med	Platanus occidentalis	Sycamore	38%	PLOC	
Med	Potamogeton crispus	Curlyleaf pondweed	79%	POCR3	
Med	Rhaponticum repens	Russian knapweed	31%	ACRE3	
Med	Sagittaria platyphylla	Delta arrowhead	8%	SAPL	

Priority	Scientific Name	Common Name(s)	% of WA Counties Occupied	USDA PLANTS Code	Synonym(s)
Med	Scirpus cyperinus	Woolgrass	41%	SCCY	
Med	Sorbus aucuparia	European mountain ash	69%	SOAU	
Med	Spartina alterniflora	Smooth cordgrass	8%	SPAL	
Med	Spartina anglica	Common cordgrass	23%	SPAN5	
Med	Typha ×glauca	Common cat-tail, narrow-leaf cat-tail hybrid	21%	TYGL	Typha species
Med	Typha angustifolia	Narrowleaf cattail	49%	TYAN	
Med	Veronica serpyllifolia var. serpyllifolia	Thyme-leaved speedwell	51%	VESES	
Low	Acer saccharinum	Silver maple	54%	ACSA2	
Low	Aegilops cylindrica	Jointed goat grass	33%	AECY	
Low	Agropyron cristatum	Crested wheatgrass	46%	AGCR	
Low	Alopecurus myosuroides	Blackgrass	13%	ALMY	
Low	Ambrosia tomentosa	Skeletonleaf bursage	3%	AMTO3	
Low	Arum italicum ssp. italicum	Italian arum	10%	ARIT	
Low	Bacopa rotundifolia	Disk water hyssop	8%	BARO	
Low	Bassia hyssopifolia	Fivehorn smotherweed	28%	BAHY	
Low	Bromus briziformis	Rattlesnake brome	33%	BRBR5	
Low	Bryonia alba	White bryony	18%	BRAL4	
Low	Cabomba caroliniana	Fanwort	3%	CACA	
Low	Campanula rapunculoides	Creeping bellflower	49%	CARA	
Low	Centaurea ×gerstlaueri	Meadow knapweed	46%	CEDE5	Centaurea jacea x nigra, Centaurea x moncktonii
Low	Centaurea diffusa	Diffuse knapweed	85%	CEDI3	
Low	Centaurea nigrescens	Vochin knapweed	21%	CENI3	
Low	Chaerophyllum temulum	Rough chervil	15%	CHTE5	
Low	Clematis orientalis	Oriental clematis	3%	CLOR	
Low	Crataegus monogyna var. monogyna	English hawthorn	51%	CRMO3	
Low	Cynoglossum officinale	Houndstongue	56%	CYOF	

Priority	Scientific Name	Common Name(s)	% of WA Counties Occupied	USDA PLANTS Code	Synonym(s)
Low	Cyperus eragrostis	Tall Flatsedge	15%	CYER	
Low	Egeria densa	Brazilian elodea	33%	EGDE	
Low	Eichhornia crassipes	Water Hyacinth	8%	EICR	
Low	Epilobium leptophyllum	Bog willowherb	8%	EPLE2	
Low	Euphorbia cyparissias	Cypress spurge	41%	EUCY2	
Low	Euphorbia oblongata	Eggleaf spurge	23%	EUOB4	
Low	Ficaria verna	Lesser celandine	28%	RAFI	
Low	Galega officinalis	Goatsrue	13%	GAOF	
Low	Glyceria maxima	Reed sweetgrass, tall manna grass	8%	n/a	
Low	Hydrilla verticillata	Hydrilla	3%	HYVE3	
Low	Hydrocharis morsus-ranae	European frog-bit	3%	HYMO6	
Low	Impatiens glandulifera	Policeman's helmet	41%	IMGL	
Low	Impatiens parviflora	Small-flowered jewelweed	5%	IMPA2	
Low	Inula helenium	Inula	8%	INHE	
Low	Juncus compressus	Round-fruited rush	8%	JUCO	
Low	Lamium maculatum	Spotted hen-nettle, spotted henbit	31%	LAMA	
Low	Lepidium chalepense	Asian white-top, chalapa, lens-podded hoarycress	23%	CACH42	
Low	Lepidium draba	Hoary cress	51%	LEDR	
Low	Leucanthemum vulgare	Oxeye daisy	85%	LEVU	
Low	Limnobium laevigatum	South American spongeplant	3%	LILA7	
Low	Ludwigia hexapetala	Water primrose	8%	LUGR9	
Low	Ludwigia peploides	Floating primrose-willow	3%	LUPE5	
Low	Marsilea mutica	Australian water clover	5%	MAMU2	
Low	Miscanthus sinensis	Maiden grass	8%	MISI	
Low	Murdannia keisak	Marsh dew flower, Asian spiderwort	3%	MUKE	
Low	Myriophyllum aquaticum	Parrotfeather	44%	MYAQ2	

Priority	Scientific Name	Common Name(s)	% of WA Counties Occupied	USDA PLANTS Code	Synonym(s)
Low	Myriophyllum heterophyllum	Variable-leaf milfoil	8%	MYHE2	
Low	Myriophyllum spicatum × Myriophyllum sibiricum	Eurasian watermilfoil hybrid	13%	n/a	Myriophyllum sibiricum × Myriophyllum spicatum
Low	Nasturtium microphyllum	Onerow watercress	5%	NAMI2	
Low	Nasturtium officinale	Watercress	74%	NAOF	
Low	Oenothera curtiflora	Velvetweed	18%	GAMO5	
Low	Oxybasis rubra var. rubra	Red goosefoot	15%	CHRU	
Low	Petasites japonicus	Japanese coltsfoot	21%	PEJA3	
Low	Phleum pratense	Timothy	72%	PHPR3	
Low	Picris hieracioides	Hawkweed oxtongue	5%	PIHI	
Low	Poa palustris	Fowl bluegrass	74%	POPA2	
Low	Poa pratensis ssp. pratensis	Kentucky bluegrass	41%	POPRP2	
Low	Polygonum aviculare ssp. depressum	Oval-leaf knotweed	23%	POAR11	
Low	Populus alba	White poplar	59%	POAL7	
Low	Populus nigra	Lombardy poplar	36%	PONI	
Low	Prunus mahaleb	Perfumed cherry, mahaleb cherry	33%	PRMA	
Low	Puccinellia distans	weeping alkaligrass	36%	PUDI	
Low	Pyrus calleryana	Callery pear	13%	PYCA80	
Low	Rorippa austriaca	Austrian fieldcress	10%	ROAU	
Low	Rorippa sylvestris	Creeping fieldcress	21%	ROSY	
Low	Rosa multiflora	Multiflora rose, rambler rose	49%	ROMU	
Low	Rumex crispus	Curly dock	97%	RUCR	
Low	Rumex patientia	Patience dock	18%	RUPA5	
Low	Sagittaria graminea	Grass-leaved arrowhead	8%	SAGR	
Low	Salix ×fragilis	Crack Willow	21%	SAAL2	Salix alba, Salix x rubens
Low	Schoenoplectus mucronatus	Ricefield bulrush	5%	SCMU15	
Low	Sisymbrium loeselii	False london rocket, Loesel's tumblemustard	36%	SILO3	

Priority	Scientific Name	Common Name(s)	% of WA Counties Occupied	USDA PLANTS Code	Synonym(s)
Low	Solidago altissima	Late goldenrod	5%	SOAL6	
Low	Soliva sessilis	Lawnweed	33%	SOSE2	
Low	Spartina densiflora	Dense-flowered cordgrass	5%	SPDE2	
Low	Spartina patens	Saltmeadow cordgrass	5%	SPPA	
Low	Tanacetum parthenium	Feverfew	56%	TAPA6	
Low	Tripidium ravennae	Ravenna grass	15%	SARA3	Saccharum ravennae
Low	Typha domingensis	Southern cat-tail	8%	TYDO	
Low	Ulmus pumila	Siberian elm	49%	ULPU	
Low	Verbena bonariensis	Tall Verbena	21%	VEBO	
Low	Vicia villosa	Hairy vetch	92%	VIVI	

Appendix B. WIRS Database

See accompanying Excel Workbook. Results will also be posted online in early 2025 at: https://www.dnr.wa.gov/natural-heritage-program.

Appendix C. Initial Species Assessment Summaries

These and all additional species assessment summaries will be made available on the WNHP website in early 2025: https://www.dnr.wa.gov/natural-heritage-program

Washington Invasive Ranking System

Washington Natural Heritage Program

Acer negundo (Box Elder)

Assessed by
Walter Fertig (Collections Manager, Marion Ownbey Herbarium, Washington State University)
Clayton Antieau (Botanist and Senior Watershed Planner, Seattle Public Utilities)
David Wilderman (Natural Areas Program Ecologist, Washington Dept. of Natural Resources)
17 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (50) Confidence: **Moderate** (54)

Management Difficulty Rank: Moderate (54)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (87)	Confidence: High (84)
Concern Related to Distribution and Abundance: Moderate (58)	Confidence: Moderate (60)

Photo Credit: Jean Pawek 2017, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Acer negundo was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

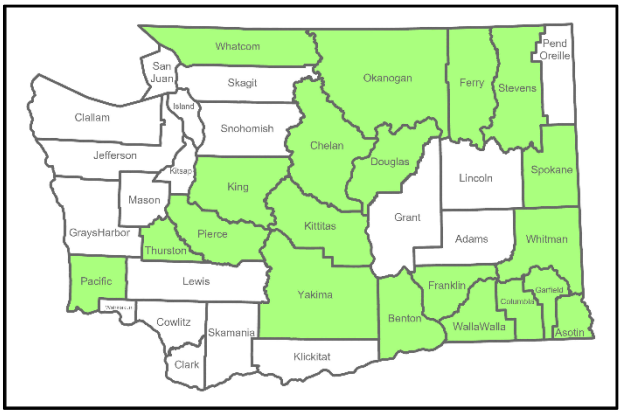

Figure 1. Distribution of counties where *Acer negundo* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Acer negundo is found in 23 of 39 counties in Washington and 7 of 9 ecoregions, though records in the Northwest Coast ecoregion are historical (not documented in the last 40 years). This species is newly documented in Cowlitz and Klickitat counties

(CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

Most populations appear to have spread short distances from cultivation. Numerous historical occurrences along the Snake River near Wawawai and Almota do not appear to have spread significantly after their initial documentation in the 1890s. Many collections bear notes that they are from cultivated street trees or from public spaces in towns or college campuses.

Source: Professional expertise, Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate (range Low - Moderate)

Confidence: Moderate

Acer negundo has the potential to occur over much of lowland Washington, including many counties on the west side of the state and in central Washington. It seems to be more dependent on humans spreading plants by seed or outplanting than by natural means of dispersal.

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Notable expansion has not been observed by assessors. Local range and abundance appears relatively stable or is at least constrained by surprisingly poor natural dispersal (without human assistance).

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Emergent Open Wetland

Rating: Low

Confidence: Moderate

Acer negundo is primarily seen in riparian zones along watercourses in eastern Washington.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Acer negundo suckers at the root collar (George, 1953) and has prolific seed production (Rosario, 1988).

Source: Published research, Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Produces samaras (winged seeds) that are wind-dispersed (Rosario, 1988).

Source: Published research, Informal publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Due to its hardiness and tolerance of difficult growing conditions (cold and drought), humans may use *Acer negundo* for revegetation, soil stabilization, shelter-belts, etc.

Source: Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: High

Evidence suggests this species is allelopathic (Eremenko, 2014; Nikolaeva et al., 2021).

Source: Published research, Informal publication, Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes (range Yes - No)

Confidence: Moderate

In eastern Washington, *Acer negundo* is startling in its ability to tolerate drought and poor soils and in its persistence beyond cultivation (C. Antieau, pers. comm., 2024).

Source: Informal publication, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: High

Evidence suggests that this species can germinate without disturbance (Rosario, 1988; Nikolaeva et al., 2021).

Source: Published research

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

In certain areas of the Pacific Northwest, *Acer pseudoplatanus* and *Acer platanoides* are especially problematic as invasive species.

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

This species has moderate shade tolerance (Rosario, 1988).

Source: Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: High

Evidence suggests that propagules persist for less than five years (Hildebrand, 2006; CNPS, 2024).

Source: Informal publication, Thesis

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Evidence suggests that this species is unpalatable (Rosario, 1988).

Source: Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Hydrology, Nutrient dynamics, Light availability, Chemistry

Rating: Moderate (range Low - Moderate)

Confidence: Moderate (range Moderate - High)

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low (range Low - Moderate)

Confidence: Moderate (range Moderate - High)

Acer negundo usually occurs with other riparian trees (D. Wilderman, pers. comm. 2024), suggesting that it is not converting previously open areas to tree canopy.

Source: Published research, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate (range Moderate - High)

Confidence: Moderate (range Moderate - High)

Source: Published research, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low (range Low - High)

Confidence: Moderate (range Moderate - High)

Acer negundo is mainly seen in areas of human or natural disturbance (e.g. old homesteads, riparian areas) and does not appear to spread very far from those areas (D. Wilderman, pers. comm. 2024).

Source: Published research, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate (range Moderate - High)

Acer negundo can invade naturally disturbed riparian habitats (Rosario, 1988).

Source: Published research, Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

Acer negundo is relatively easily managed using herbicides.

Source: Published research, Informal publication, Professional expertise, Other (not specified)

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

Source: Published research, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Low

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Access to private properties may be an important obstacle to management.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

Acer negundo is sometimes an indicator of former Euroamerican homesteads or other habitations and may be of interest from cultural resource or anthropological perspectives.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Ailanthus altissima (Tree-of-Heaven)

Assessed by
Emily Stevenson (Coordinator, Skamania County Noxious Weed Control Program)
Walter Fertig (Collections Manager, Marion Ownbey Herbarium, Washington State University)
Ethan Coggins (Natural Areas Steward, Washington Dept. of Natural Resources)
18 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (69) Confidence: **Moderate** (50)

Management Difficulty Rank: Low (46)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Moderate (63)	Confidence: High (70)
Concern Related to Distribution and Abundance: High (76)	Confidence: Moderate (50)

Photo Credit: Thomas Belfield 2023 (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Ailanthus altissima was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

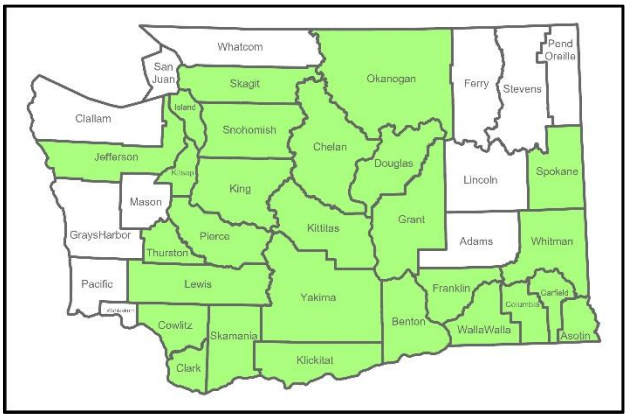

Figure 1. Distribution of counties where *Ailanthus altissima* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Ailanthus altissima is found in 27 of 39 counties in Washington. Most populations are found in cities and towns (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023). Escaped populations are frequently associated with the Columbia and Snake Rivers.

Source: Informal publication, Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Ailanthus altissima is mostly spreading in urban and suburban settings, especially in the greater Seattle area and eastern cities (Yakima, Tri-Cities, Spokane). Some in-filling or spread along the Columbia and Snake Rivers has also been observed. The rate of spread seems low, given potential for fruits to disperse downriver. This species has been in the state for almost 100 years (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low (range Low - Moderate)

Confidence: Moderate

There is potential for expansion of *Ailanthus altissima* in urban and suburban settings, though largely through assistance by humans (plants escaping from plantings). Some potential for spread also exists on the Columbia and Snake Rivers and major tributaries in eastern Washington. This species is likely able to occur in all counties in the state, at least in riparian systems (CPNWH, 2023).

Source: Professional expertise, Herbarium records

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate (range Low - High)

Confidence: Low (range Low - Moderate)

Recent evidence of expansion comes mostly from iNaturalist records that may be cultivated landscape trees in urban areas. Spread by natural means appears low compared to other introduced riparian trees and shrubs.

This species begins to rapidly infill areas shortly after establishment. Some experts suggest it is likely to increase by greater than 25% in density and range in many of the areas it occupies and will continue to do so until it dominates all suitable habitat in any invaded area.

Source: Professional expertise, iNaturalist observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Forested Wetland, Open Rock

Rating: Moderate

Confidence: Moderate

In Washington this species can be found in riparian systems in shrub-steppe and grassland landscapes. It can also be found in forested areas in Klickitat County (sometimes forming its own closed canopy forests in what was initially oak woodland) as well as numerous environments in western Washington. While this species can be found in dry environments it typically only occurs in low competition areas (such as rocky scree) or in areas with at least seasonal moisture, such as lakeshores, riparian areas, and drainages (CPNWH, 2023).

This species is found throughout the U.S., and the ecosystems in which it occurs are likely underreported. In the eastern and midwestern U.S., *A. altissima* is frequently found in early successional deciduous forests, and in the south it is often found in early successional pine forests and along roadsides and logged areas. In the southwest, this species is invasive in riparian areas. In California it is also found in valley and foothill plant communities in addition to riparian areas. Less information is available regarding where this species is found in the Pacific Northwest (Fryer, 2010).

Source: Informal publication, Professional expertise, Herbarium records.

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

This species is extremely fecund (producing up to 325,000 seeds per year) and can sprout from even small root fragments (NWCB, 2011; Knüsel, 2019).

Source: Informal publication, Professional expertise, Thesis

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

This species has samaras that are well-adapted to wind-dispersal. Seeds can also be transported by water, as can viable root fragments (NWCB, 2011; Knüsel, 2019).

Source: Informal publication, Professional expertise, Thesis

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

This species was introduced to many areas intentionally. It has potential to be used ornamentally, in bioremediation, and for silkworm cultivation, among other uses (NWCB, 2011; Knüsel, 2019).

Source: Informal publication, Professional expertise, Thesis

Q9: Allelopathy

Rating: Yes

Confidence: High

There are many studies demonstrating allelopathy in *Ailanthus altissima* (Heisey, 1990; Lawrence et al., 1991; Gómez-Aparicio & Canham, 2008; NWCB, 2011).

Source: Published research, Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

While *Ailanthus altissima* has an extensive root system, is fast growing, and can spread quickly (all traits that can aid it in outcompeting other species), its phenology and the depth of its root system are not unusual for at least some of the systems it has been observed in. This suggests that *A. altissima* may not be especially competitive for limiting abiotic factors.

Source: Published research, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Ailanthus altissima suckers and forms dense thickets that crowd out other species and can form a closed canopy (NWCB, 2011).

Source: Informal publication, Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Low

Ailanthus altissima's ability to germinate without disturbance is context dependent. This species has shown the ability to germinate through litter and in relatively undisturbed forests. However, it is also considered a "gap obligate species" that does not do well in areas with a closed canopy and restricted access to light. Studies have also shown that open spaces and rocky areas in a forest can provide suitable habitat for *A. altissima* to germinate. Many areas in Eastern Washington have forests without closed canopies, where light access would not be a limiting factor for this species (e.g. oak woodlands and open ponderosa pine forests). Once this species successfully establishes through generative reproduction it can then begin reproducing vegetatively. These vegetative sprouts have increased resiliency due to provisioning by the mother plant, and thus the impact of germination without disturbance is compounded by the effects of vegetative reproduction after germination and establishment (Knüsel, 2019).

Source: Professional expertise, Thesis

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

Ailanthus is a small genus with only 6 members. No evidence was found that any of the other species in the genus are invasive outside of their native range. There are no other species of *Ailanthus* recorded from Washington State (CPNWH, 2023).

Source: Professional expertise, Herbarium records

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

The research indicates this species is somewhat tolerant of slight shade but does not tolerate the low light levels one would expect in a closed canopy forest (Knüsel, 2019). Assessors have not found *Ailanthus altissima* persisting under a closed canopy except when the canopy is at least partially comprised of adults of this species, which are likely assisting their suckering offspring via the connected root system.

Source: Professional expertise, Thesis

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Ailanthus altissima germinates best in areas with high nutrient availability, good access to light, and low litter cover. This is the environment one would expect to see after a fire, and studies have shown this species to increase or establish in post-fire scenarios. *A. altissima* has been observed to reproduce by root suckers following a fire, so not only will it more readily establish following a fire, but its ability to sprout from surviving roots would give it a competitive advantage over some species in Washington State, like Douglas-fir and ponderosa pine, which do not resprout (Knüsel, 2019).

Source: Professional expertise, Thesis

Q16: Propagule Persistence

Rating: >5 years

Confidence: Moderate

While some older sources indicate that persistent seed banks are unlikely (Fryer, 2010; DiTomaso et al., 2013), more recent research indicates that seeds may remain viable for at least six years (Rebbeck & Jolliff, 2018).

Source: Published research, Informal publication, Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Low

While some sources indicate *Ailanthus altissima* can be controlled with grazing, others indicate that it is relatively unpalatable to ungulates. Several studies show that it is browsed less frequently than associated species in natural settings (Fryer, 2010; Knüsel, 2019).

Source: Informal publication, Professional expertise, Thesis

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Low

Confidence: Moderate

Ailanthus altissima forms a closed canopy forest when conditions are suitable and it is allowed to spread. Some areas of closed canopy *A. altissima* have sufficient moisture that the native canopy would likely have been significant before its arrival. However, this species frequently increases the amount of shade relative to the semi-open canopies of oak or big-leaf maple woodlands.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

Ailanthus altissima primarily invades disturbed sites. This species prefers forested sites such as oak

woodlands and riparian areas and will increase canopy density. This reduction in light availability, combined with the allelopathic effects of *A. altissima*, is likely to result in major changes to the understory of invaded areas. Eventually, changes in the overstory may follow.

Ailanthus altissima is the preferred host of the spotted lanternfly (*Lycorma delicatula*), an invasive insect that may also have a major impact on ecosystem structure (Washington Invasive Species Council, 2024).

Source: Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Ailanthus altissima is known to reduce native species abundance and diversity and can increase shade, which may in turn reduce certain diagnostic understory species. In addition, allelopathy may further reduce native species abundance and diversity (Knüsel, 2019; Demeter et al., 2021).

Source: Published research, Professional expertise, Thesis

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

The allelopathic nature of this species could potentially have outsized effects on particularly sensitive native species (Demeter et al., 2021; Knüsel, 2019).

Source: Published research, Professional expertise, Thesis

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Ailanthus altissima is mostly thought of as a disturbance-dependent species, however, studies have shown that it can germinate and establish in certain portions of undisturbed (or only mildly disturbed) ecosystems. It can establish in rocky areas (such as talus fields) and once established quickly spread by vegetative reproduction into denser vegetation (Knüsel, 2019).

Source: Professional expertise, Thesis

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

Ailanthus altissima can establish and increase in abundance following fires, provided appropriate habitat and a nearby seed source. In addition, this species is known to root from branches when soil is moist and is likely to benefit from open soil caused by flooding (Knüsel, 2019).

Source: Professional expertise, Thesis

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate (range Low-High)

Control of *Ailanthus altissima* requires the use of herbicide over several years to kill the existing root system and requires follow-up work for several years to exhaust the existing seedbank.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

Attempts to control *Ailanthus altissima* are relatively recent in Washington. Initial treatment and subsequent removal of dead trees is relatively expensive and the precise time commitment needed to control seedlings and eradicate the species from a site is not known. It is likely that *A. altissima* requires a moderate amount of time investment over many

years to reduce to acceptable levels. Control requires the use of herbicide over several years to kill the existing root system and requires follow-up work for several years to exhaust the existing seedbank. In some areas, constant reintroduction may be an issue, and vigilant site managers may be needed to keep this species at bay.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant (range Insignificant - Low)

Confidence: Moderate (range Moderate - High)

Collateral damage from *Ailanthus altissima* management is minimal and does far less damage to native species than uncontrolled spread. Typically, this species is controlled with herbicide. *Ailanthus altissima* control projects typically use hack and squirt, basal bark, or EZ-Ject lance systems to administer herbicide. These application methods are targeted, though they may result in occasional off-target damage (depending on which herbicides are chosen; herbicide type plays an important role in off-target damage). Managers have been known to use less targeted methods that may result in long term reductions in certain species. However, following best management practices, it is not difficult to limit off-target damage.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Ailanthus altissima appears to be mainly urban and along travel corridors. This species was largely introduced by human activity in the past 200 years, and most populations are still near areas frequented by humans. Perhaps 5% of the populations one assessor observed are on rocky slopes or thick riparian vegetation, but with enough effort these are also accessible.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate (range Moderate - High)

Ailanthus altissima is a conspicuous species that requires herbicide to control and typically occurs in areas frequented by humans. While this species frequently functions as a shade tree for landowners, most are happy to get rid of it because of its odor and its production of many seedlings and suckers. Some in the public oppose the removal of any tree on general principle unless the reasons behind removal are made clear. In areas that are highly visible to the public, treatment of *A. altissima* should be paired with concise and clear communication.

Source: Professional expertise

Additional Comments

Ailanthus altissima is the preferred host plant for the spotted lanternfly (*Lycorma delicatula*), which is a serious pest on tree fruit crops in the eastern U.S. (Washington Invasive Species Council, 2024).

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Washington Invasive Ranking System

Washington Natural Heritage Program

Alliaria petiolata (Garlic Mustard)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
3 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (77) Confidence: **Low** (8)

Management Difficulty Rank: Insignificant (93)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (96)	Confidence: Moderate (59)
Concern Related to Distribution and Abundance: High (73)	Confidence: Low (30)

Photo Credit: Dr. Amadej Trnkoczy 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Class A, Washington State quarantine list.

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

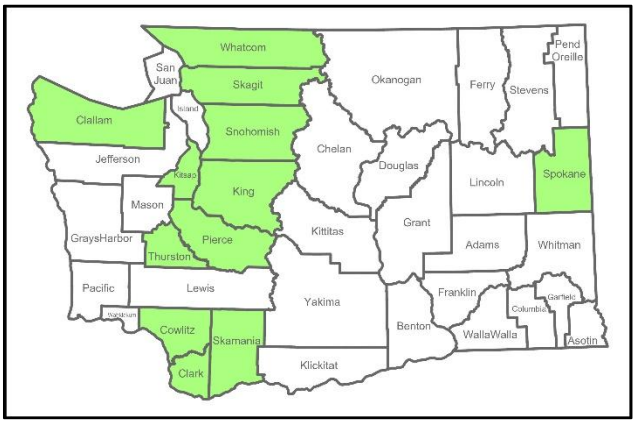

Figure 1. Distribution of counties where Alliaria petiolata has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Alliaria petiolata is found in 28% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). Most documentation is from iNaturalist.

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Low

Most of the occurrences documented are from iNaturalist, suggesting recent expansion for this species (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Unknown

Confidence: Not Rated

Alliaria petiolata is a class A species that is required by law to be eradicated. So far, control efforts appear to be successful at preventing local expansion.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Semi-Desert (includes Shrub-steppe), Marine Coastal Shore, Open Rock, Emergent Open Wetland, Forested Wetland

Rating: High

Confidence: Low

Based on the assessor's experience, this plant may grow in many different habitats.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: High

The assessor asserts that this species is allelopathic.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Low

This species maintains photosynthetic foliage for most of the year.

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

This species often forms dense stands.

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Unknown

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: High

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: >10 years

Confidence: Moderate

Further research is needed.

Source: Professional expertise

Q17: Palatability

Rating: Unknown

Confidence: Not Rated

Browsing has occasionally been observed in the wild, but not frequently. While some people do forage this species, there is likely not enough foraging activity to impact population growth.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability, Chemistry

Rating: Moderate

Confidence: Low

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Low

Source: Professional expertise, Thesis

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

This species has potential for high impacts on ecosystem composition if left unchecked.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Unknown

Confidence: Not Rated

This species might have the potential to invade intact systems if left unchecked.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes, plant is unpalatable

Confidence: Low

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Propagule persistence for *Alliaria petiolata* still needs research, which makes management more difficult. Plants vary widely in height, from 1 inch to 5 feet tall. This makes *A. petiolata* difficult to eradicate in westside forests, where small plants can be easily hidden beneath other vegetation.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: High

Confidence: Moderate

This species frequently occurs in dense westside forest settings with a lot of vegetation that may become collateral damage. However, the effects of *Alliaria petiolata* infestations may be more damaging than the effects of treatment to native plant communities.

Source: Professional expertise

Q27: Accessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Low

This plant is edible to humans, and foraging activities could potentially result in some resistance to management.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Alopecurus pratensis (Meadow Foxtail)

Assessed by
Carlo Abbruzzese, (Natural Areas Manager, Washington Dept. of Natural Resources)
18 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (63)	Confidence: **Moderate** (50)
Management Difficulty Rank: Moderate (68)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (70)	Confidence: Moderate (42)
Concern Related to Distribution and Abundance: Moderate (67)	Confidence: Moderate (40)

Photo Credit: Steve Matson 2005, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

None

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

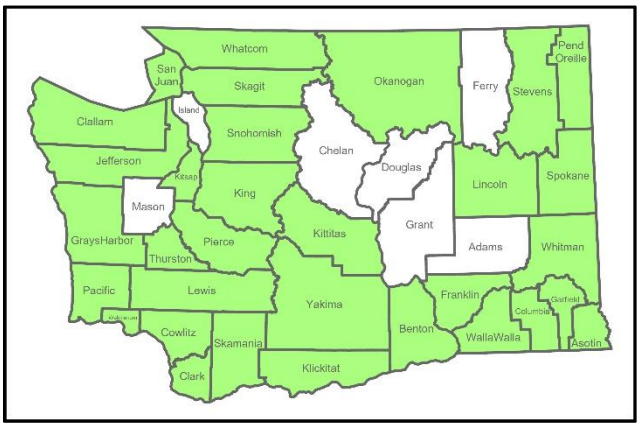

Figure 1. Distribution of counties where *Alopecurus pratensis* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

According to herbarium data and other records, this species occurs in 59% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Low

Potential available habitat suggests that the current trend in range for this species is stable (CPNWH, 2023).

Source: Herbarium records

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

This species could potentially spread to other counties with wetland habitats (CPNWH, 2023).

Source: Herbarium records

Q4: Local Range Expansion or Change in Abundance

Rating: Unknown

Confidence: Not Rated

Alopecurus pratensis is expanding locally at Lacamas Prairie in areas where it was less common, but the assessor cannot speak to changes in local abundance elsewhere in Washington.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland, Emergent Open Wetland, Forested Wetland

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Alopecurus pratensis is an aggressive invader due to its seed production, potential seedbank, rhizomes, and difficulty of eradication.

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

This species' seeds float and have the potential to be dispersed long distances by water.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Unknown

Confidence: Not Rated

This species could potentially be spread by humans in clothing.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

There is no evidence that this species is allelopathic (AKNHP 2010).

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Alopecurus pratensis competes for space, light, and nutrients. This species can outcompete native species, especially annuals.

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: Moderate

May form dense sods & mats (Rutledge & McLendon, 1996; Dzyubenko & Dzyubenko, 2009).

Source: Published research

Q12: Germination Requirements

Rating: Yes

Confidence: High

This species is very adaptable and does not require disturbance to germinate.

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Alopecurus geniculatus (native in Washington) is somewhat invasive in Alaska (AKNHP 2010). *Alopecurus myosuroides* is a listed noxious weed in Washington (NWCB, 2025).

Source: Informal publication, Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

This species has been observed growing in medium shade in ash forests.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Unknown

Confidence: Not Rated

This species might respond to high nitrogen input, but response to increased disturbance is unknown.

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

Grasses tend not to have long seed persistence, but the exact persistence of this species under field conditions is unknown.

Source: Professional expertise

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

Cattle are known to graze this species. *Alopecurus pratensis* was introduced as a pasture grass.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability, Nutrient dynamics

Rating: Low

Confidence: Moderate

Alopecurus pratensis likely has minimal impact on abiotic processes, though it may be more competitive for soil nitrogen than some native species (Rutledge & McLendon, 1996; Venterink & Güsewell, 2010).

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

This species can convert bunchgrass communities with scattered annuals to rhizomatous grasslands.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Occurances of *Alopecurus pratensis* can lead to loss of native bunchgrasses and forbs. It is capable of displacing native species, especially annuals.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Alopecurus pratensis may shade out some species, particularly annuals.

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Low

While the assessor has not observed *Alopecurus pratensis* establishing in undisturbed ecosystems, at Lacamas Prairie this species does appear to be spreading to areas where it was previously uncommon.

However, in Oregon this species has been observed establishing in native-dominated meadows that are maintained by hydrological conditions rather than frequent disturbance (Neugarten & Elseroad, 2006).

Source: Informal publication, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

This species persists after flooding and fire.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: Moderate

Glyphosate can be an effective control, but generally control of this species is difficult due to the volume of seeds produced. Additional mowing/cutting may be necessary to prevent seeding (OSU Rangeland Ecology and Management, 2005).

Source: Informal publication, professional Expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: Moderate

This species may require ongoing management.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Impacts on native species depend on control methods used. If one uses spot spraying, non-target kill is relatively low. Boom spraying would result in moderate to high non-target kill.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Public objections to herbicide use may present obstacles to management in some areas.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Amorpha fruticosa (Indigobush)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
Walter Fertig (Collections Manager, Marion Ownbey Herbarium, Washington State University)
29 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (67) Confidence: **Moderate** (58)

Management Difficulty Rank: Moderate (54)	Confidence: Moderate (50)
Biological Characteristics of Invasiveness: High (76)	Confidence: High (71)
Concern Related to Distribution and Abundance: Moderate (64)	Confidence: High (70)

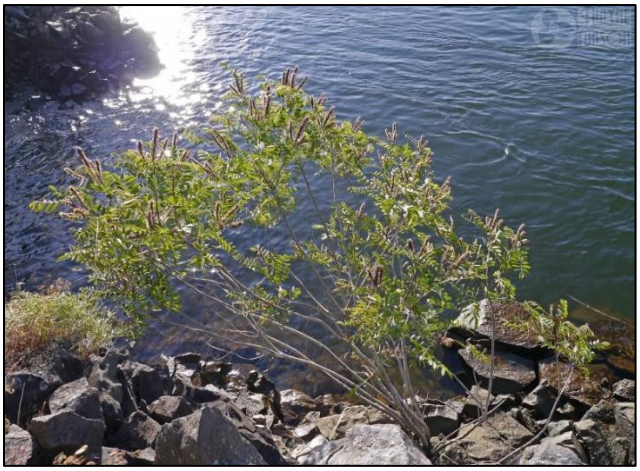

Photo Credit: Thayne Tuason 2013, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Amorpha fruticosa was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: Class B, Washington State quarantine list

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

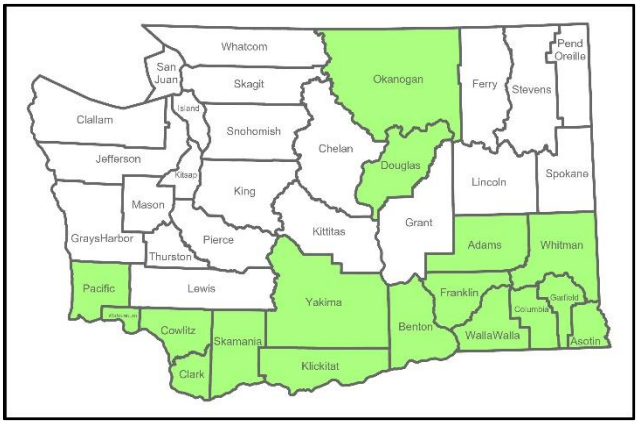

Figure 1. Distribution of counties where *Amorpha fruticosa* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Amorpha fruticosa is known from 16 of 39 counties and 4 of 9 ecoregions. Most populations are currently along the Snake River and the Columbia River (downstream of the Snake River confluence). Two recent discoveries (since 2019) in Douglas and Okanogan counties greatly expand its potential range

(CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: High

New populations have become established in riparian habitats along the Columbia River and its tributaries. There is high potential for this species to spread to similar habitats along the Yakima, Spokane, and Grand Ronde rivers. The 2019 Okanogan County site is troubling because it is not a direct tributary of the Columbia River, suggesting the species could spread into other bodies of water (and might also spread into Canada) (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

Establishment of *Amorpha fruticosa* in Grant, Kittitas, Lincoln, and/or Spokane counties seems likely, though it may occur only along major rivers or low-elevation riparian habitats.

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

This species seems to be under-collected, so the growth in collections in herbaria over the past decade may not be a good proxy. There are over 50 observations on iNaturalist in the past three years, mostly in-filling the known distribution based on herbarium vouchers. Casual observers avoid wetland species and access issues on the Columbia suggest that current observation data may be under-reporting its distribution and spread (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland

Rating: Low

Confidence: Moderate

Ecosystem information can be found in herbarium and citizen science observation records (CPNWH, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

DiTomaso et al. (2013) and NWCB (2015) suggest that this species has an aggressive mode of reproduction.

Source: Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Amorpha fruticosa's seed pods can float long distances. To date, spread in Washington has been mostly downriver on the Columbia from initial points of entry along the Snake and Walla Walla rivers. Establishment of new populations upriver in Douglas County and non-riverine sites in Okanogan County may be stepping stones for establishment elsewhere in central Washington. Recent (2022-2023) discoveries of populations in the Idaho panhandle (see iNaturalist) suggest a potential downstream invasion pathway in Northeastern Washington (Grabić et al., 2022).

Source: Published research, iNaturalist observations

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Though on the noxious weed list in the Pacific Northwest, *Amorpha fruticosa* is sold and endorsed for ornamental use elsewhere in the United States. Water sports enthusiasts (boaters, fishers) could transport seed or fruit between bodies of water (NWCB, 2015).

Source: Informal publication, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Evidence of allelopathy is mixed—*Amorpha fruticosa* is toxic to some plants and potentially stimulates others (Grabić et al., 2022). The greater impact from this species is probably from crowding out other species in competition for space and resources.

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Information on competitive abilities can be found in Grabić et al. (2022). This species is a known nitrogen-fixer (Plants for a Future, 2012).

Source: Published research, Informal publication

Q11: Growth Form

Rating: Yes

Confidence: High

Information on growth form is available in the NWCB (2015) report.

Source: Informal publication, Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: High

Amorpha fruticosa is pre-adapted to exploit natural or human disturbances to become established and spread (NWCB, 2015).

Source: Informal publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: High

Amorpha fruticosa is the only *Amorpha* species known from Washington state (Hitchcock & Cronquist, 2018). No documentation was found regarding the invasiveness of other *Amorpha* species in other locales.

Source: Species treatment

Q14: Shade Tolerance

Rating: Not Rated

Confidence: Not Rated

This species may have some degree of shade tolerance.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: Low

Other shrub species along the Columbia are also adapted to flooding disturbance. *Amorpha fruticosa*'s competitive advantage over other species is likely not due to relative disturbance tolerance. Perhaps this species lacks a significant herbivore at the sapling stage, is more fecund, or is just more aggressive once established.

Source: Professional Expertise

Q16: Propagule Persistence

Rating: Not Rated

Confidence: Not Rated

Source:

Q17: Palatability

Rating: No, plant is palatable

Confidence: High

This plant is palatable (NWCB, 2015).

Source: Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Nutrient dynamics, Light availability

Rating: Moderate

Confidence: High

Amorpha fruticosa produces dense thickets that can alter ecosystem processes by stabilizing soil (reducing erosion), adding more nitrogen to the system (as a nitrogen fixer), and shading out competing native vegetation (Grabić et al., 2022).

Source: Published research

Q19: Impact on Ecosystem Structure

Rating: Low (range Low - Moderate)

Confidence: Moderate (range Low - Moderate)

Amorpha fruticosa is the dominant shoreline shrub along stretches of the Columbia and Snake Rivers. It seems likely that this species is replacing native plants in these systems. These systems have been majorly altered with the presence of dams. The main change in ecosystem structure is that stands of brush become denser and more shaded than they might otherwise be, with impacts on light-sensitive species. Secondary effects also occur from increases in litter, increase in available nitrogen, and bank stabilization (NWCB, 2015).

Source: Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: Moderate (range Low - High)

Amorpha fruticosa likely reduces species richness where it occurs. However, arguably, regulation of the natural flow of the Columbia and competition from other invasive plant species (such as reed canarygrass) has had a more significant impact than *A. fruticosa* (NWCB, 2015).

Source: Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Several rare plant species of the Columbia River drainage may be negatively impacted from loss of riverine habitat due to competition from *Amorpha fruticosa*. A partial list includes *Rorippa columbiae*, *Artemisia campestris* var. *wormskioldii*, *Astragalus riparius*, *Ammannia robusta*, *Astragalus kentrophyta* var. *douglasii* (TX/SX), *Bergia texana* (SX), *Eleocharis coloradoensis*, *Schizachyrium scoparium*, and *Spiranthes diluvialis* (WNHP, 2023). However, no information was provided on whether the impact is specific to these species, or part of the larger effect of *A. fruticosa* on the co-occurring plant community.

Source: Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Information on ability to invade naturally disturbed ecosystems can be found in the NWCB (2015) report for this species.

Source: Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate

The Columbia Land Trust had success containing an population of *Amorpha fruticosa* at Pierce Island through a 2–3-year project of digging, cutting, and targeted application of herbicide. Ongoing vigilance is necessary to keep new plants from becoming established, and there is no lack of seed source from upstream, making real control a regional endeavor by multiple partners (NWCB, 2015).

Source: Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

The Columbia Land Trust had success containing an population of *Amorpha fruticosa* at Pierce Island through a 2–3-year project of digging, cutting, and targeted application of herbicide (NWCB, 2015). A reasonable estimate of minimum time commitment is likely 2–5 years. Seed viability could affect this estimate, however.

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: High

Impacts on co-occurring native species depend on the population and treatment history. Initial treatments typically occur in monocultures that are 100% *Amorpha fruticosa*. Follow up would be spot treatments in a more diverse vegetation community.

Source: Professional expertise

Q27: Accessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Physically reaching populations of *Amorpha fruticosa* on the Columbia and Snake Rivers involves several logistical challenges. Gaining permission for access, especially across private lands, is likely also an obstacle for access of populations for this species.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Low

Amorpha fruticosa occurs along a waterway. This species is also full of bees when in bloom. However, it is also crowding out willows, which are an important early food source for native bees. Objections to treatment could include objections to herbicide use, particularly near water, and the perceived importance of this species for pollinators.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Anthoxanthum odoratum (Sweet Vernalgrass)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
24 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (51) Confidence: **Moderate** (63)

Management Difficulty Rank: Moderate (58)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Moderate (57)	Confidence: High (67)
Concern Related to Distribution and Abundance: High (78)	Confidence: High (90)

Photo Credit: Ryan Batten 2011, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Anthoxanthum odoratum was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

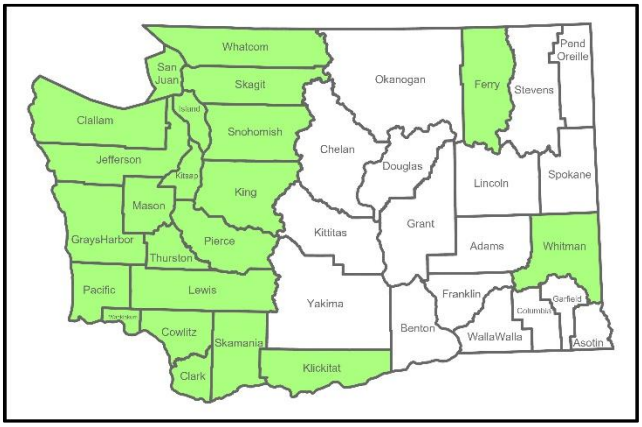

Figure 1. Distribution of counties where *Anthoxanthum odoratum* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Anthoxanthum odoratum is found in 24 of 39 (62%) of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: High

iNaturalist records suggest that *Anthoxanthum odoratum* has expanded into the northern Olympic Peninsula over the last 12 years (iNaturalist Community, 2024). This species has not apparently expanded its range in the rest of the state over the last 20 years (CPNWH, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Anthoxanthum odoratum is found in 62% of the counties in Washington, but is predicted to be able to grow in all counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate (range Moderate - High)

Herbarium records and iNaturalist records suggest that local abundance and range are increasing moderately for *Anthoxanthum odoratum* west of the Cascades. New observations of this species east of the Cascades have not apparently been documented (CPNWH, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland

Rating: High

Confidence: Moderate

Anthoxanthum odoratum occurs in open grasslands, savannas and woodlands, and disturbed areas. This species grows in both mesic and xeric conditions but exhibits greater survival in mesic habitats (Platenkamp, 1990). In the Pacific Northwest and northern California, this species is most common in coastal prairies and wet Willamette Prairie habitats, but it is also found in pastures, roadsides and other disturbed places (Platenkamp, 1990; Clark, 2002; Thorpe, 2011; Pitcher & Russo, 2012). It frequently grows in poor soils (Pitcher & Russo, 2012).

Source: Published research, Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Anthoxanthum odoratum only spreads by seed (Pitcher & Russo, 2012). Plants are self-incompatible (Roach, 1987). A study in North Carolina found individual plants produce 58–1257 seeds (Brusati & Warner, 2004; Pitcher & Russo, 2012). One study in New York found over 100 *A. odoratum* seeds per square meter at an old field site, making this species one of the 10 most abundant species in the seed bank (Morris et al., 1986). However, observations in northern California suggest spread of this species is slow (Brusati & Warner, 2004), and other research suggests that *A. odoratum* experiences high juvenile mortality (Roach, 1987). While this species is sometimes capable of producing more than 1000 seeds per plant, it appears to be less aggressive than other introduced species in the Pacific Northwest.

Source: Published research, Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Moderate

Anthoxanthum odoratum usually spreads only short distances (Brusati & Warner, 2004) with 90% of seeds found within 1.2 meters of their parent plants (Platenkamp, 1990). Awns can help move seeds short distances across the soil (Pitcher & Russo, 2012), but otherwise this species has no adaptations for long distance seed dispersal. A post-wildfire study in a *Quercus garryana* savanna in British Columbia found that *A. odoratum* was able to disperse from the neighboring community into areas where the original vegetation and seed bank had been removed by combinations of intense fire and firefighting techniques that washed top soil away (Lysgaard, 2022), suggesting at least some effective natural dispersal abilities. However, other studies have assumed that pollen and seed from this species could not disperse more than 50 m (Roach, 1987), suggesting, that in general, this species has very little innate potential for long distance dispersal.

Source: Published research, Informal publication, Thesis

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Anthoxanthum odoratum is dispersed mostly through human activities, including transportation along roadsides, and by mowing or other equipment, or on shoes (Brusati & Warner, 2004). This species was introduced to North America in the 1700s (Pitcher & Russo, 2012).

Source: Informal publication

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Live *Anthoxanthum odoratum* plants are allelopathic, and this species has been shown to suppress germination in other grass species. Chemicals from *A. odoratum* (and closely related species) can encourage growth in other *A. odoratum* plants. Decaying *A. odoratum* plants encourage the growth of other grass species, possibly due to the high level of phosphorus in the roots providing a fertilizing effect as they decay (Brusati & Warner, 2004; Pitcher & Russo, 2012). This species also stimulates legume germination.

Source: Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate (range Moderate - High)

Anthoxanthum odoratum is competitive for water, light, nitrogen, phosphorus, and potassium. This species can outcompete other grass species, including nonnative *Lolium perenne*, *Holcus lanatus*, and *Dactylis glomerata*, though it is generally more competitive against annual than perennial grasses. *Anthoxanthum odoratum* is also competitive against forbs, such as *Plantago lanceolata* (Platenkamp, 1990; Dennehy et al., 2011; Pitcher & Russo, 2012). This species is better able to coexist with *Cytisus scoparius* than most other introduced or native species, allowing it to rapidly increase when *C. scoparius* is removed (Lysgaard, 2022).

However, some studies have also demonstrated negative effects of competition on this species, including studies in coastal prairie habitats in northern California that shows *A. odoratum* has higher mortality and lower seed production when it is grown with neighboring plants (either *A. odoratum* or *H. lanatus*). *Anthoxanthum odoratum* also appears to be more competitive in mesic habitats than xeric ones (Platenkamp & Foin, 1990).

Source: Published research, Informal publication, Thesis

Q11: Growth Form

Rating: No

Confidence: Low

Anthoxanthum odoratum doesn't generally form smothering or tall monocultural stands, but it can still be competitive for light (Dennehy et al., 2011). Observations from northern California coastal prairies suggest that this species doesn't entirely exclude other species or form particularly dense populations. However, it can form thick root mats that exclude other species from establishing (Brusati &

Warner, 2004). In Willamette Prairie, *A. odoratum* occurs intermixed in a community of introduced perennial grasses and is usually shorter than most other introduced perennial grasses it co-occurs with.

Source: Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Germination of *Anthoxanthum odoratum* relies on local disturbances in most cases (Platenkamp & Foin, 1990; Brusati & Warner, 2004).

Source: Published research, Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Anthoxanthum aristatum is also invasive in the Pacific Northwest (Anzinger & Radosevich, 2008), and is considered undesirable in Taylor's Checkerspot Butterfly restoration sites at Joint Base Lewis McCord (R. Johnson pers. comm. 2025).

Source: Informal publication

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Anthoxanthum odoratum is generally found in open or disturbed areas. High light availability may result in earlier reproduction (Platenkamp, 1990). However, one study found that *A. odoratum* was one of a number of grass species that grew more biomass in partial shade than full sun in its native range (Pang et al., 2019). Another study found *A. odoratum* produced fewer but taller tillers, and did not have a reduction of biomass in reduced light (Edelkraut & Güsewell, 2006). While experiments suggest that shade doesn't affect growth in this species, it still appears to be mostly a plant of open areas, suggesting that *A. odoratum* does not thrive in shaded conditions.

Source: Published research, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Anthoxanthum odoratum thrives on disturbance. In most cases disturbance is required for establishment of this species, and it is more likely to invade disturbed areas (Brusati & Warner, 2004). A study in British Columbia found that *A. odoratum* showed the greatest increase in abundance post removal of *Cytisus scoparius*, and also readily colonized areas disturbed by wildfire and wildfire suppression techniques (Lysgaard, 2022). In western Washington, this species is known to move into areas where tall oatgrass has been removed (R. Johnson, pers. comm. 2025).

Source: Informal publication, Professional expertise, Thesis

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

Anthoxanthum odoratum seeds generally germinate between 4 and 8 weeks of dispersal. One study found that most seeds in the soil germinated within three months, and by 10 months all remaining seed were not viable. However, another study found that seeds in storage for four years were still 85% viable. Variation in temperature and conditions may reduce seed viability (Pitcher & Russo, 2012).

Source: Informal publication

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Anthoxanthum odoratum was introduced and is planted as a forage plant and grazing animals will eat this species (Brusati & Warner, 2004; Pitcher & Russo, 2012; Lysgaard, 2022). However, most grazers tend to prefer native grasses to *A. odoratum*, resulting in increases of this species where grazing occurs, at least in the Pacific Northwest (Dennehy et al., 2011).

Source: Informal publication, Thesis

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability

Rating: Moderate

Confidence: Moderate

Anthoxanthum odoratum stimulates legume germination, (Brusati & Warner, 2004), potentially increasing nitrogen fixation. Decaying *A. odoratum* plants increase nitrogen and phosphorus, which may benefit other grass species over forbs (Dennehy et al., 2011) and though *A. odoratum* doesn't grow in classic smothering monocultural stands, it is frequently abundant enough that it can reduce light availability for co-occurring species.

Source: Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Given evidence that this species might not have strong effects on community composition, it likely has low effects on ecosystem structure.

Source: Published research, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate (range Low - High)

Confidence: Moderate (range Moderate - High)

Anthoxanthum odoratum is part of a suite of introduced perennial grasses that occur in Willamette Prairie and similar habitats. Introduced perennial grasses contribute reduction of plant community diversity and native plant diversity where they occur. In particular, *Phalaris arundinacea* is more productive when *A. odoratum* is present (Molofsky et al., 1999). *Anthoxanthum odoratum* can also prevent reestablishment of native plant species. However, at least in coastal prairie northern California, this plant does not appear to entirely exclude native plants, or significantly change species composition on its own (Brusati & Warner, 2004).

Source: Published research, Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Moderate

Confidence: Moderate

At Rocky Prairie, *Anthoxanthum odoratum* is implicated in population declines of *Castilleja levisecta*, potentially by crowding out more suitable host plants. At this site, *A. odoratum* is being specifically targeted for removal and replaced with native *Festuca roemeri* to improve *C. levisecta* habitat (R. Johnson, pers. comm. 2025). Not all host plants provide equal benefit for *Castilleja* species, and the loss of appropriate host taxa can reduce or prevent reproduction in at least some *Castilleja* (Adler, 2003). Reduction in host plant quality combined with direct competition for space and other resources could make hemiparasitic taxa like *Castilleja* more vulnerable than co-occurring native taxa to invasion by introduced species.

At a Willamette Prairie restoration site near Eugene, Oregon, *A. odoratum* has also been documented as a "significant threat" (in community with other invasive grasses) to *L. bradshawii*. Managers singled out *A. odoratum* in particular as a management target at that site. *Lomatium bradshawii* occurs in wet prairies in Clark County and is considered rare in both Oregon and Washington (Thorpe, 2011), suggesting potential concern for impact more broadly. However, few details on the specific impact *A. odoratum* might have on *L. bradshawii* were provided.

Source: Published research, Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

Anthoxanthum odoratum can occasionally germinate in or invade undisturbed sites, and adult plants can survive without disturbance. However, germination in these conditions likely relies on limited competition from co-occurring species (Brusati & Warner, 2004).

Source: Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Anthoxanthum odoratum is found in both restored and remnant Willamette Prairie habitats. This species may rely on human activities for dispersal, but if a seed source is nearby, *A. odoratum* can likely establish in areas of natural disturbance.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate (range Moderate - High)

Herbicide applications or tilling and reseeding with desirable species may be the most effective treatments for managing *Anthoxanthum odoratum*. Hand removal is effective for removing small patches of this species (Pitcher & Russo, 2012). Mowing and prescribed fire are being researched as control techniques; in at least some cases, these methods have been shown to increase flowering or abundance of this species (Clark, 2002; Dennehy et al., 2011; Lysgaard, 2022). Biocontrols are currently impractical for this species, and grazing also increases its abundance (Pitcher & Russo, 2012). "Intensive, long term restoration" may be necessary to control introduced species in oak woodland and prairie habitats, including *A. odoratum* (Lysgaard, 2022).

Source: Informal publication, Thesis

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Land managers have only recently started to treat *Anthoxanthum odoratum*, so not much is currently known, but it will likely require constant management (R. Johnson, pers. comm., 2024. Monitoring and treatment of the species minimally should continue until the seed bank is exhausted (2–5 years) (Pitcher & Russo, 2012). Restoration with desirable native plants is also important in preventing recolonization.

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low (range Low - High)

Confidence: Moderate

Treatments of *Anthoxanthum odoratum* that involve broadcast spraying or tilling will likely have long-term negative effects on native plant abundance and diversity. Using a grass-specific herbicide reduces impact to co-occurring native species. Native upland prairie grass species like *Festuca roemeri* may be resilient to grass specific herbicides that kill *A. odoratum*. However, in wet prairies, several native grass species are also susceptible to the herbicides that are effective against *A. odoratum* (Dennehy et al., 2011). Because *A. odoratum* occurs in wet prairies and with native endangered species, control techniques for this grass are constrained by the need to protect rare native species and use wetland-safe herbicides (Thorpe, 2011). The most effective treatments for this species are likely to have significant and potentially long-lasting effect on co-occurring native species.

Source: Informal publication, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Anthoxanthum odoratum is mainly spread by human activity (Brusati & Warner, 2004), so populations are likely to be in relatively accessible areas.

Source: Informal publication, Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant (range Insignificant - Moderate/Low)

Confidence: Moderate

Anthoxanthum odoratum is not considered beneficial for agriculture and it is considered a threat in rare ecosystems that support several federally protected plant and insect species. Therefor objections to treatment for this species likely focus on herbicide use.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Arrhenatherum elatius (Tall Oatgrass)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
26 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (65)	Confidence: **High** (75)
Management Difficulty Rank: High (72)	Confidence: High (80)
Biological Characteristics of Invasiveness: Moderate (59)	Confidence: High (75)
Concern Related to Distribution and Abundance: High (73)	Confidence: High (70)

Photo Credit: Fred Weinmann 1993 (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

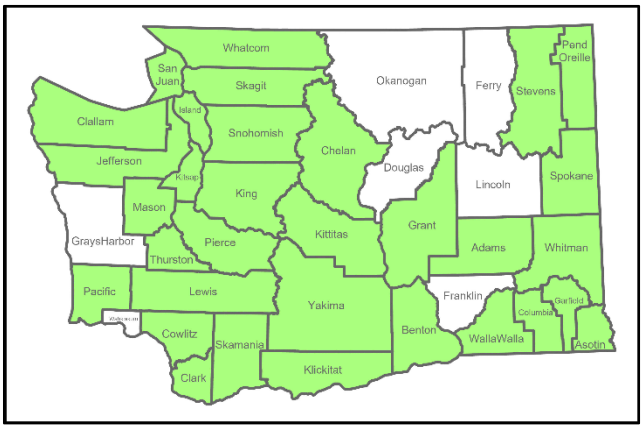

Figure 1. Distribution of counties where *Arrhenatherum elatius* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Arrhenatherum elatius has been documented in 82% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Moderate

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Arrhenatherum elatius is a sod forming grass and grows up to 5 feet tall.

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: High

Arrhenatherum elatius is the only species in this genus established in North America.

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Arrhenatherum elatius likes to grow along tree lines where it gets partial shade and hydrologic uplift.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Arrhenatherum elatius resprouts quickly after burning or grazing.

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Arrhenatherum elatius was introduced as a pasture grass. This species has a bitter taste to cattle and wildlife does not graze it enough to provide control (Afonin et al., 2016).

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Fire, Light availability

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

Arrhenatherum elatius transforms bunchgrass to tallgrass sod.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Moderate

Confidence: Moderate

Arrhenatherum elatius can crowd out the native host plants that *Castilleja* species prefer. Not all host plants provide equal benefit for *Castilleja* species, and the loss of appropriate host taxa can reduce or prevent reproduction in at least some *Castilleja* (Adler, 2003). Reduction in host plant quality combined with direct competition for space and other resources could make hemiparasitic taxa like *Castilleja* more vulnerable than co-occurring native taxa to invasion by introduced species.

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Arrhenatherum elatius impacts native ecosystems and conservation areas that depend on disturbance. This species has a high impact on Puget prairies, which depend on disturbance; but elsewhere it is a relatively manageable nonnative pasture grass.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Arrhenatherum elatius is extremely difficult to manage in grasslands and is not likely to be eradicated completely where it occurs. Annual spraying is required to keep populations under control. Even in

previously managed populations, this species increases in density and range quickly without treatment. Individual plants are fairly resistant to herbicide.

This species also takes advantage of nitrogen fixing plants, particularly Scotch broom (*Cytisus scoparius*). Where these two species co-occur, successful treatment of *Arrhenatherum elatius* requires treatment of the Scotch broom first.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Grass-specific herbicides minimize impacts on desirable vegetation, except for a couple of native grass species.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

The sheer volume of herbicide required to manage this species could be cause for public concern. People may not understand why this grass is a target for management on a prairie.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Arum italicum ssp. *italicum* (Italian Arum)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
14 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (33) Confidence: **Moderate** (50)

Management Difficulty Rank: High (74)	Confidence: High (80)
Biological Characteristics of Invasiveness: Moderate (65)	Confidence: High (68)
Concern Related to Distribution and Abundance: Moderate (62)	Confidence: Moderate (60)

Photo Credit: David Giblin 2022, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

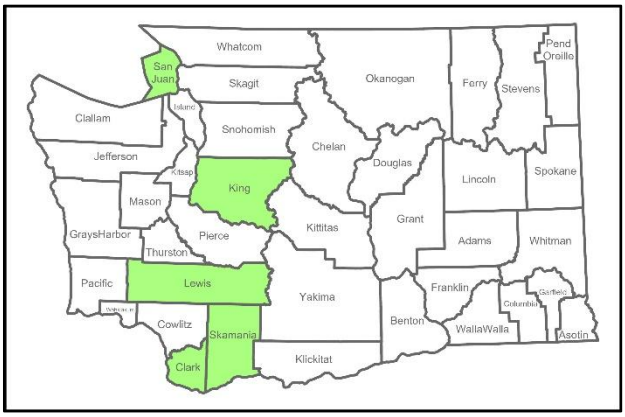

Figure 1. Distribution of counties where *Acer negundo* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Low

Confidence: Moderate

Arum italicum ssp. *italicum* is present in 10% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: High

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland

Rating: Low

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: High

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes

Confidence: High

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Arundo donax (Giant Reed)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
30 September 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (79)	Confidence: **High** (67)
Management Difficulty Rank: High (89)	Confidence: High (90)
Biological Characteristics of Invasiveness: Moderate (67)	Confidence: High (92)
Concern Related to Distribution and Abundance: Moderate (52)	Confidence: Moderate (50)

Photo Credit: Chris Wagner SBNF 2006, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Arundo donax can be difficult to distinguish from *Phragmites australis*, which includes a native subspecies found in Washington (McWilliams, 2004). There is limited information on the behavior and impact of *A. donax* in Washington. Most of the information presented here comes from California.

Legal Listings

Washington State Weed Board: Monitor list, Washington State quarantine list (except for variegated cultivars)

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

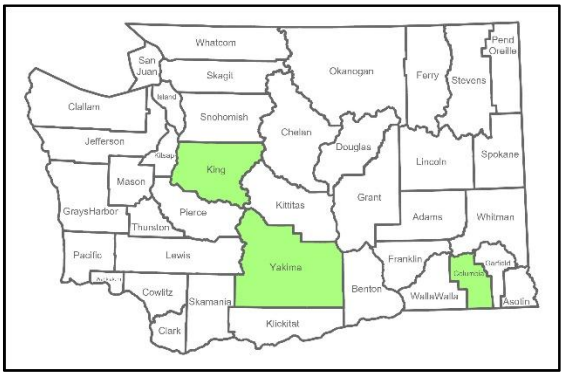

Figure 1. Distribution of counties where *Arundo donax* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: Low

Confidence: High

Arundo donax is documented in 8% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: iNaturalist records and other observations

Q2: Current Trend in Total Range

Rating: Unknown

Confidence: Not Rated

Not enough information is available to determine current trends and range for this species. The earliest reports of escaped *Arundo donax* in Washington appear to be from 2012 (EDDMapS, 2023; iNaturalist Contributors, 2023), suggesting it has only recently arrived in the state.

Experimental plantings of *A. donax* were done in Prosser, WA in 2003 and 2006, but failed to establish. In 2013, ornamental cultivation was reported from Yakima, Tacoma, and a community garden in Seattle. Only the community garden had populations that were potential escapes (NWCB, 2013).

Source: Informal publication, iNaturalist records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

Most models predict that *A. donax* has the potential to spread throughout most of Washington (NWCB, 2013; EDDMapS, 2023), but at least one model suggested that only the Puget Sound area and parts of the Columbia Plateau with active irrigation may be suitable for persistence of this species in Washington (Goolsby et al., 2023).

Source: Published research, Informal publication, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: Unknown

Confidence: Not Rated

There are very few documented naturalized populations of *Arundo donax* in Washington, so not enough data is available to determine changes in local range or abundance.

Source: iNaturalist records

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Coastal Brackish Tidal Wetland, Bogs & Fens, Forested Wetland

Rating: High

Confidence: High

Arundo donax invades riparian areas and wetlands, particularly in arid, Mediterranean and temperate oceanic environments (McWilliams, 2004; Goolsby et al., 2023). This species grows best where the water table is at or near soil surface but is drought resistant once established. In California, where most research has been done, *A. donax* grows near lakes, streams, ditches, and other wet areas, but can expand past riparian zones and into upland habitats once it is established. This species can grow in brackish water, and greenhouse experiments suggest it can establish in salt marshes. It has also been observed in bog and fen habitats (McWilliams, 2004). Freezing temperatures reduce *A. donax's* survival, and in cold areas, this species requires human support to maintain persistent populations (Goolsby et al., 2023).

Source: Published research, Informal publication

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Arundo donax does not produce viable seed anywhere in its invasive range (Goolsby et al., 2023). Instead, this species reproduces vegetatively via rhizomes,

stem nodes, layering, and plant fragments (most commonly rhizome fragments) (McWilliams, 2004; NWCB, 2013). Clonal reproduction can produce stands of several acres. This species grows rapidly after establishment, up to four inches a day, and readily resprouts from roots. It may be able to sprout even from deeply buried rhizomes (between 3–10 feet) (McWilliams, 2004).

Source: Published research, Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Vegetative propagules of *Arundo donax* can be dispersed over long distances within watersheds by flooding (Goolsby et al., 2023). Fragments have also been known to disperse to marine islands and establish populations despite exposure to sea water (NWCB, 2013).

Source: Published Research, Informal Publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Arundo donax has been widely cultivated for thousands of years and for a multitude of uses, including woodwind instrument reeds, construction materials, and high-quality paper. In ancient Egypt, it was even used to wrap mummies. This species was introduced to the U.S. as an ornamental plant and for erosion control (McWilliams, 2004). Many cultivars of this species are still used as ornamentals, and it has also been proposed for use as a biofuel and in phytoremediation (NWCB, 2013). Distribution of this species follows human disturbance, including construction, agriculture, livestock grazing, and manipulation of rivers and streams. Human dispersal is the main source of invasive propagules for this species (Goolsby et al., 2023).

As of 2013, this species was being tested for commercial growth in both Oregon and Washington for use in biofuels and making paper. Experimental plantings of this species in Washington had apparently failed by 2008 (NWCB, 2013) and it was added to the Washington's quarantine list in 2012.

Source: Published research, Informal publication

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Leachate from *Arundo donax* has been shown to inhibit growth of some species of algae (Mary et al., 2024). This species produces a number of secondary chemicals (McWilliams, 2004), suggesting that it could potentially be allelopathic to plants as well.

Source: Published research, Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Arundo donax is highly competitive for water. This species has relatively efficient photosynthesis, and can transfer water several meters along rhizomes from wet parts of a stand to culms in drier parts (NWCB, 2013; Goolsby et al., 2023). *Arundo donax* is considered a national threat in South Africa, because of its heavy water use. This species is also efficient at nutrient uptake (Goolsby et al., 2023).

In California, *Arundo donax* can remain green year-round, but it can also exhibit winter dormancy. (McWilliams, 2004). Washington is at the northern edge of this species range, suggesting that *A. donax* will exhibit winter dormancy here.

Source: Published research, Informal publication

Q11: Growth Form

Rating: Yes

Confidence: High

Arundo donax forms large monotypic, clonal stands that can be several acres in size, and physically exclude other species. The rhizomes can form mats up to three feet thick (McWilliams, 2004).

Source: Informal publication

Q12: Germination Requirements

Rating: No

Confidence: High

Vegetative propagules of *Arundo donax* generally require bare ground to establish, such as might be found after flooding, fire, or other disturbances (Goolsby et al., 2023). In at least some circumstances, established native plant communities can prevent re-invasion by *A. donax* (NWCB, 2013).

Source: Published research, Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

A literature search found no other species currently included in the genus *Arundo* documented as invasive.

Source:

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Arundo donax grows in full sun to partial shade, but can survive low light conditions (up to 90% reduction in sunlight), but may not establish or spread in full shade. (NWCB, 2013).

Source: Informal publication

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Arundo donax is well-adapted to disturbance, and is especially invasive in disturbed areas (McWilliams, 2004; NWCB, 2013). Changes in hydrology, disturbed riparian vegetation, and fire can all spread and increase abundance of *A. donax*. In particular, this species recovers much more quickly after fire than native riparian vegetation (McWilliams, 2004; NWCB, 2013; Goolsby et al., 2023). Eutrophication of rivers and other water sources also benefits *A. donax* (Goolsby et al., 2023).

Source: Published research, Informal publication

Q16: Propagule Persistence

Rating: <5 years

Confidence: High

Arundo donax rhizomes live for 3–4 years (Goolsby et al., 2023).

Source: Published research

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Arundo donax is not grazed by wildlife, and livestock do not preferentially graze this species, though cattle and goats will eat it if no other options are available (McWilliams, 2004).

Source: Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Fire, Hydrology, Light availability, Chemistry, Water quality

Rating: High

Confidence: Moderate

In California, *Arundo donax* has very high water transpiration rates, with an estimated 56,000 acre feet/year (compared to native vegetation transpiring an estimated 18,700 acre feet/year) (McWilliams, 2004). It can increase water loss from underground aquifers (NWCB, 2013). In South Africa, this species is considered a major threat because of its water use (Goolsby et al., 2023).

In southern California, *A. donax* can change the defining disturbance in desert riparian communities from flood to fire. This species can produce up to 20 tons of above ground biomass per hectare, and its height allows it to function as ladder fuel, carrying fire into tree canopies. Riparian areas with intact native vegetation can serve as fire barriers, but *A.*

donax turns riparian corridors into conduits of fire (McWilliams, 2004).

Arundo donax reduces the canopy directly over streams because it does not overhang channels. This increase in sunlight can then lead to increased water temperatures. This species can change water quality and pH, including changing ammonium to toxic ammonia (McWilliams, 2004).

This species is difficult to remove, so changes in abiotic processes may be irreversible.

Source: Published research, Informal publication

Q19: Impact on Ecosystem Structure

Rating: High

Confidence: High

Arundo donax can displace native vegetation such as cottonwood, willow, and other native riparian dominants, replacing them with a community that has no native analogs and does not support wildlife, with the exception of providing shelter for feral pigs (McWilliams, 2004). This species narrows waterways in the southwestern U.S., and can increase erosion of river banks during floods (Goolsby et al., 2023).

Source: Published research, Informal publication

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

In California, *Arundo donax* is known to reduce insect, bird, and reptile diversity, and habitats dominated by this species are avoided by predators such as coyotes and bobcats (Goolsby et al., 2023). In parts of southern California, loss of riparian canopy due to *A. donax* can be linked to declines of several fish species. *Arundo donax* supports less than 50% of the invertebrate diversity found in native habitats (McWilliams, 2004). Native species diversity increases when *A. donax* is removed (NWCB, 2013).

Source: Published research, Informal publication

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

While *Arundo donax* currently does not affect any particular native species in Washington, it has potential to do so. In California, *A. donax* invasions reduces suitable native habitat for two species of endangered birds, the Southwestern Willow Flycatcher and the Least Bell's Vireo. In Monterrey, Mexico, *A. donax* may have led to the local extinction of a rare fish species (NWCB, 2013; Goolsby et al., 2023). No information was available on whether the impact on these species were greater than the impact on co-occurring species with similar habitat requirements.

Source: Published research, Informal publication

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Arundo donax can be an early colonizer or a late successional species (McWilliams, 2004), but appears to rely on disturbance to facilitate invasion (Goolsby et al., 2023).

Source: Published research, Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Arundo donax is dispersed and establishes new populations after floods (McWilliams, 2004; NWCB, 2013; Goolsby et al., 2023).

Source: Published research, Informal publication

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Arundo donax management is costly, time-consuming, and can require cooperation between

multiple organizations and governments to be successful. Its dispersal ability means that successful management requires cooperation of all stakeholders within a watershed. Treatment requires multiple approaches, including herbicides (McWilliams, 2004). By 2013, *A. donax* control costs in coastal California averaged $25,000 per acre (NWCB, 2013). Biocontrol agents are in development and have been shown to reduce *A. donax* biomass in Texas (Goolsby et al., 2023).

Source: Published research, Informal publication

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Two projects in California were able to reduce *Arundo donax* cover to almost zero after 20 years. However, existing methods are generally regarded as inadequate and control efforts generally fail due to lack of follow up (Goolsby et al., 2023). Successful management of *A. donax* must include removing or killing rhizomes. All parts of the plant need to be burned, chipped, or otherwise disposed of to prevent re-establishment from vegetative propagules (McWilliams, 2004), and equipment used needs to be cleaned to prevent movement of plant fragments to new habitats (NWCB, 2013). Successful control of *A. donax* also requires careful planning of restoration plantings to establish native plant communities resistant to re-invasion (NWCB, 2013).

Source: Published research, Informal publication

Q26: Impacts of Management on Native Species

Rating: High

Confidence: High

Manual treatment of small populations of *Arundo donax* is least impactful to native vegetation (McWilliams, 2004). Treating large populations of this species may require mowing and backhoes to remove rhizomes (NWCB, 2013). This is likely to have large negative impacts on any co-occurring native plants. Grazing by goats, sheep, and cows is a possible treatment for *A. donax*, but may also have effects on co-occurring native plants through grazing pressure and soil compaction. *Arundo donax* is not generally a preferred food for grazers (NWCB, 2013), so effectiveness of grazing may be limited for other reasons as well.

Source: Informal publication

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

In Washington, all documented occurances of *Arundo donax* are in easily accessible areas (iNaturalist Contributors, 2023). Evidence from California suggests that this species tends not to expand up steep, narrow canyons into montane areas. This is likely due to this species' mode of dispersal, as fragments are generally broken off by flooding to take root downstream of source populations (McWilliams, 2004), or are dispersed by human activities (Goolsby et al., 2023).

Source: Published research, Informal publication, iNaturalist observations

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Arundo donax is regarded as invasive worldwide (Goolsby et al., 2023), but management will likely involve some sociopolitical difficulties. This species' dispersal capabilities requires cooperation of all stakeholders within a watershed for successful management (McWilliams, 2004). This species has been considered for use in biofuels and phytoremediation, including a proposal in 2013 to grow it for use by Portland General Electric as a replacement for coal at their Boardman, Oregon plant (NPSO, 2013).

More recently, tests using *A. donax* as biofuel or in phytoremediation have not been regarded as successful. In South Africa, harvesting invasive populations has proven to be inefficient (more costly than the energy produced) (Goolsby et al., 2023).

Source: Published research, Informal publication

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Bellardia viscosa (Yellow Glandweed)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
29 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (35)	Confidence: **Moderate** (58)
Management Difficulty Rank: Insignificant (30)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (75)	Confidence: Moderate (54)
Concern Related to Distribution and Abundance: Moderate (64)	Confidence: High (80)

Photo Credit: Gabriel Campbell 2024, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Some sources still use the name *Parentucellia viscosa* for this species.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

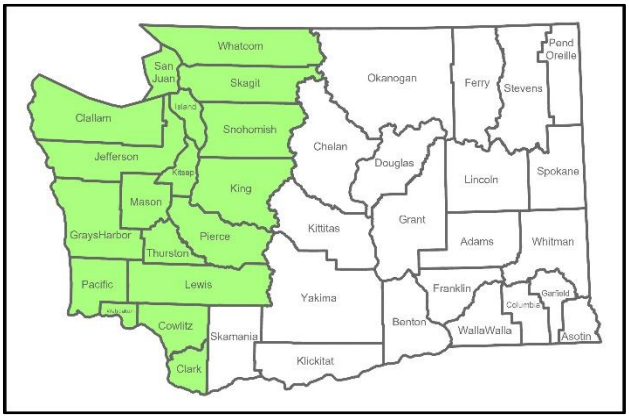

Figure 1. Distribution of counties where *Bellardia viscosa* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Bellardia viscosa is found in 18 of 39 (46%) of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Bellardia viscosa has expanded into the northern Olympic Peninsula within the last 20 years. This species has not apparently expanded its range in the rest of the state in the last 20 years (CPNWH, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Bellardia viscosa is currently occupies 46% of counties in Washington, all on the western side of the state (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024) However, this species has potential to spread to the rest of the state (EDDMapS, 2024).

Source: Herbarium records and other observations, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

iNaturalist records suggest a rapid increase in local abundance and local range for *Bellardia viscosa* over the last 20 years (iNaturalist Community, 2024). However, herbarium records from the same timespan suggest a more moderate expansion mostly limited to southwestern Washington (CPNWH, 2024). The abundance of iNaturalist observations could partially be an artifact of an increase in the number of observers in the last 20 years as well as an increase in abundance of this species.

Source: Professional expertise, Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland

Rating: Moderate

Confidence: High

Bellardia viscosa is found in naturally and anthropogenically disturbed areas. This species appears to prefer moist, open habitats and is frequently found in wet prairies, swales and other areas of low ground, wet meadows, low wet areas near dunes and beaches, disturbed wetlands and marshes, lake edges, and roadside ditches. It can also be found in old fields, upland prairies, clearcuts and other logged areas, under powerlines, along roadsides and in parking lots and other disturbed areas. *Bellardia viscosa* tolerates a wide variety of soils, including sand, loam, clay, and glacial outwash. While this species usually occurs in open places, it is also found along edges and roadsides in forested areas, and in tall grass or shrubs. It occurs with both introduced and native species (CPNWH, 2024).

Source: Professional expertise, Herbarium records

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Bellardia viscosa is a self-compatible annual and only reproduces by seed. A study at a dune site in northern California estimated seed production by plant size, with an average plant estimated to produce approximately 12,000 seeds. Plants parasitizing *Acmispon americanus* resulted in larger inflorescences than plants that parasitized other species or had no host (Pickart & Wear, 1999)

However, *B. viscosa* can flower and reproduce without a host plant (Pate & Bell, 2000).

Source: Published research, Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Sticky heads allow *Bellardia viscosa* fruits to attach to animals or clothing. Seeds are also wind-dispersed (Brusati & Corelli, 2005).

Source: Informal Publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

The presence of *Bellardia viscosa* in Washington appears to follow roads and areas of human activity (CPNWH, 2024; iNaturalist Community, 2024). A study from northern California also suggested a grazed pasture as the source population for invasion of *B. viscosa* in a dune wetland in Humboldt County (Pickart & Wear, 1999).

Source: Informal publication, Professional expertise, Herbarium records and other observations

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Information on allelopathy was not available for this species. However, *Bellaridia viscosa* produces defensive chemicals that deter *Spodoptera* larvae from feeding on them (Azab, 2021). The related species *Bellardia trixago* is known to produce secondary chemicals and has demonstrated allelopathic effects on some species (Soriano et al., 2022).

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Like many species in the Orobanchaceae family, *Bellardia viscosa* is a generalist hemiparasite. A study in interdunal wetlands in northern California found no effects of *Bellardia viscosa* on co-occurring species, suggesting that this species generally does not outcompete or otherwise harm native plants. Ecosystem changes over the course of the experiment tracked expected successional changes in these habitats (Pickart & Wear, 1999). However, more recent research in Japan did find an effect of parasitism by *B. viscosa* on infected plants, with plants infected by *B. viscosa* producing less biomass than plants that were not infected. Some plant species are better able to defend themselves against parasitic plants than others (Suetsugu et al., 2012). Studies in Australia suggest *B. viscosa* is less competitive for water than other plant species. However, this species is very competitive for nitrogen uptake via host plants (Pate & Bell, 2000).

Source: Published research, Informal publication, Professional expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

While *Bellardia viscosa* can be abundant where found, it does not form smothering or tall monocultural stands. It usually grows in mixed communities of other plants (Brusati & Corelli, 2005).

Source: Informal publication, Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Low

Bellardia viscosa is hemiparastic, but it can germinate and grow without available hosts (Brusati & Corelli, 2005). This species usually germinates in moist conditions and requires rainfall to germinate (Pickart & Wear, 1999). This species is mostly found in areas of natural or anthropogenic disturbance, and likely

requires bare ground or disturbance to establish, but information was limited.

Source: Informal publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Bellardia trixago is known from California and Texas and is tracked by the University of Georgia's Center for Invasive Species and Ecosystem Health (EDDMapS, 2024). *Bellardia viscosa* is currently not regarded as invasive in North America, but its potential for invasiveness is of concern in Japan (Suetsugu et al., 2012).

Source: Published research, Informal publication

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

In the Pacific Northwest, *Bellardia viscosa* is usually found in open areas, meadows and disturbed areas. However this species also occurs in edge habitats, disturbed forests, brush, and tall grass (CPNWH, 2024). Studies in northern California and New Zealand both suggest that *B. viscosa* will eventually be shaded out during succession (Gibb, 1994; Pickart & Wear, 1999).

Source: Published research, Informal publication, Professional expertise, Herbarium records

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Bellardia viscosa is usually found in disturbed areas and habitats maintained by natural disturbance. This species has been observed to increase after fire, including in wet prairies (Brusati & Corelli, 2005; Anzinger & Radosevich, 2008).

Source: Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: High

Bellardia viscosa does not appear to have long-lived seeds. Experiments in seed storage at the Royal Botanical Gardens, Kew, found that seeds dried and frozen for storage had only 26% viability after 2.8 years (SID, 2024).

Source: Seed Information Database

Q17: Palatability

Rating: Unknown

Confidence: Not Rated

This species produces defensive chemicals that deter *Spodoptera* larvae from feeding on them (Azab, 2021). No information was found on whether it was palatable to grazers.

Source: Published research

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Nutrient dynamics, Light availability

Rating: Low

Confidence: Moderate

Studies in Japan suggest that *Bellardia viscosa* can reduce the growth of their host plants (Suetsugu et al., 2012). In Japan and California, this species has been shown to prefer plants in the Fabaceae and Poaceae families (Pickart & Wear, 1999; Suetsugu et al., 2012). Coupled with its ability to be competitive for nitrogen (Pate & Bell, 2000), this suggests that *B. viscosa* could reduce nitrogen availability where it is found. Significant decreases in the biomass of plants in the Fabaceae and Poaceae families could also potentially increase light availability and possibly bare ground where this species is found, although this was not discussed in the available literature.

One reason invasive plants are of concern in coastal dunes is the potential for stabilizing dune habitats and converting them from open sand to grasslands or forests. However, *B. viscosa*'s annual habit and

apparently relatively localized invasions mean that it is unlikely to contribute significantly to dune stabilization.

Sources from California suggest this species has very little effect on the ecosystems in which it occurs (Pickart & Wear, 1999; Brusati & Corelli, 2005).

Source: Published research, Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Bellardia viscosa can reduce biomass production in its host plants (Suetsugu et al., 2012).

Source: Published research

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Hemiparasitic plants, in general, may be able to change vegetation community composition or change the distribution of species in a community. A study in Japan found that *B. viscosa* was most likely to parasitize plants from the Fabaceae and Poaceae families (Suetsugu et al., 2012). In a study in Australia, *B. viscosa* preferred to parasitize annual species (Pate & Bell, 2000). *Bellarida viscosa*'s preferred host in northern California, *Acmispon americanus*, is also an annual (Pickart & Wear, 1999).

A study in Japan found that removing *B. viscosa* from the community increased aboveground biomass, particularly for grass and legume species, suggesting that *B. viscosa* can have a significant effect on the growth of their host plants. Compositional impacts were also attributed to the presence of *B. viscosa* (Suetsugu et al., 2012). However, in northern Californian dunes, this species occurred in low numbers and had only minor effects on co-occurring species (on par with natural succession) (Brusati & Corelli, 2005). The related species *Parentucellia latifolia* does not apparently cause obvious harm to its host plants (Pickart & Wear, 1999)

This species is likely able to change the composition of vegetation communities at least somewhat, given the potential for negative effects on host plants. However, there is little evidence that this species has a significant effect on community diversity or composition in North America.

Source: Published research, Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

This species does not appear capable of outcompeting co-occurring native species on its own. However, increases in the abundance of annual species can degrade habitat for perennial hemiparasites like *Castilleja levisecta*, by reducing the number of suitable host species available in a community.

Invasive plant species on dunes can potentially be a threat to plant species that require open, shifting sand for habitat. However, *Bellardia viscosa* does not contribute to dune stabilization.

Parasitic plant species have been implicated in declines of plant species in some cases (Pickart & Wear, 1999), but there is no evidence suggesting that *B. viscosa* has caused declines of other plant species in North America.

Source: Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Research suggests that *Bellardia viscosa* has been able to invade relatively undisturbed habitats in Australia (Pate & Bell, 2000), but the type of disturbance discussed in this study was unclear (anthropogenic or all types of disturbance). In the Pacific Northwest, this species is primarily found in areas receiving natural or human disturbance.

Source: Published research, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Bellardia viscosa occurs in naturally disturbed habitats like prairies and interdunal wetlands, and does not require human disturbance to establish (Brusati & Corelli, 2005). This species may be somewhat sensitive to habitat conditions (Pickart & Wear, 1999).

Source: Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: Moderate

Control of *Bellardia viscosa* likely requires both seed bank exhaustion and removing recolonization sources. However, this species is not very aggressive and invasions may be short-lived—treatment may not be required (Pickart & Wear, 1999). Radiant heat treatments were extremely effective in killing *B. viscosa* in experimental plots on dunes in northern California (Emerzian, 2007), but otherwise little research has been done on weed management of *B. viscosa*. As an annual species, preventing reproduction by mowing or other techniques may be more effective than with many perennial species.

Source: Informal publication, Professional expertise, Thesis

Q25: Minimum Time Commitment

Score: Low

Confidence: Moderate

Monitoring and treatment of *Bellardia viscosa* should likely continue until seed bank is exhausted. Given the relatively short span of seed viability for this species, populations without an outside seed source could be treated in less than five years. As with other species, restoration of native community is likely important along with removal of *B. viscosa*.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Targeted manual treatments are suggested for managing *Bellardia viscosa* populations. These treatments are more likely to be low impact on co-occurring native species (Pickart & Wear, 1999). Another set of experiments in northern California suggest that radiant heat treatments are effective against *B. viscosa* and can be focused on target species, reducing damage to neighboring native plants. Treatments are most effective coupled with restoration of native plant communities or other techniques to prevent other invasive species from moving in to the open space (Emerzian, 2007).

Source: Informal publication, Professional expertise, Thesis

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: High

In Washington, populations of *Bellardia viscosa* usually occur along roadsides or other relatively accessible places (CPNWH, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Bellardia viscosa is not used in agriculture or as an ornamental species, and it seems unlikely that public comments would extend beyond general objections to herbicide use.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Bellis perennis (English Daisy, Lawn Daisy)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
26 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (0)

Confidence: **High** (67)

Management Difficulty Rank: Insignificant (0)	Confidence: High (100)
Biological Characteristics of Invasiveness: Insignificant (29)	Confidence: Moderate (54)
Concern Related to Distribution and Abundance: High (89)	Confidence: Low (30)

Photo Credit: Keir Morse 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

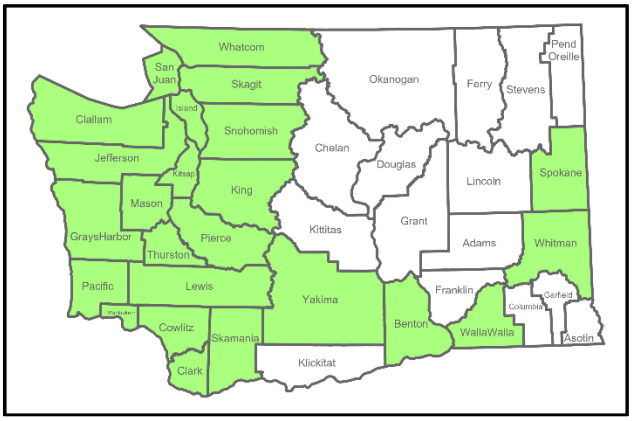

Figure 1. Distribution of counties where *Bellis perennis* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Bellis perennis is documented in 62% of Washington counties (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Not Rated

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Not Rated

Confidence: Not Rated

Source:

Q4: Local Range Expansion or Change in Abundance

Rating: Not Rated

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: No

Confidence: Moderate

This appears to be a weed of foot traffic primarily, and is usually found on trail sides, vista points, picnic areas, play areas, lawns.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

People may control this species in lawns, but otherwise it is not usually managed.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Betula pendula (European White Birch)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
14 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (38) Confidence: **Moderate** (50)

Management Difficulty Rank: Insignificant (26)	Confidence: High (70)
Biological Characteristics of Invasiveness: Moderate (62)	Confidence: Moderate (58)
Concern Related to Distribution and Abundance: High (76)	Confidence: High (80)

Photo Credit: Jean Pawek 2020, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

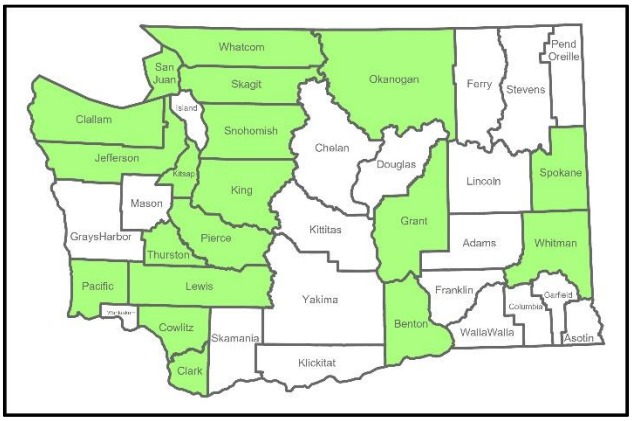

Figure 1. Distribution of counties where *Betula pendula* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Betula pendula is found in 49% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Forested Wetland, Bog & Fen, Emergent Open Wetland

Rating: High

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Seeds are very numerous, and a mature birch can produce over a million seeds per year (Vedel & Lange, 1960).

Source: Book

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Seeds are wind dispersed.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Hydrology, Light availability

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Source: Professional expertise

Additional Comments

Betula pendula is mostly an issue in disturbed areas, but populations appear to be growing rapidly.

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Washington Invasive Ranking System

Washington Natural Heritage Program

Butomus umbellatus (Flowering Rush)

Assessed by
Wesley Glisson (Aquatic Plant Specialist, Washington Dept. of Ecology)
2 February 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (78) Confidence: **Moderate** (50)

Management Difficulty Rank: High (74)	Confidence: High (80)
Biological Characteristics of Invasiveness: High (100)	Confidence: Low (4)
Concern Related to Distribution and Abundance: Moderate (62)	Confidence: Low (30)

Photo Credit: Zoya Akulova 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Biological Characteristics rank based on one assessed metric.

Legal Listings

Washington State Weed Board: Class A, Washington State quarantine list.

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

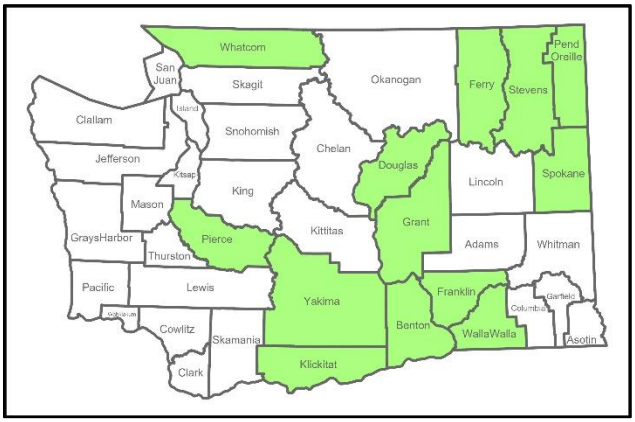

Figure 1. Distribution of counties where *Butomus umbellatus* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Butomus umbellatus is found in 26% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Not Rated

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Low

Butomus umbellatus is found in 26% of counties in Washington and distribution suggests that not all suitable habitat available to this species is occupied (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Rating: Not Rated

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Shallow Water Wetland (Aquatic)

Rating: Low

Confidence: Moderate

This is a species of freshwater aquatic and emergent marsh ecosystems (Knoke & Giblin, 2025).

Source: Burke Herbarium description

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Not Rated

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Not Rated

Confidence: Not Rated

Source:

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Not Rated

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: Yes

Confidence: Moderate

This plant can grow in dense, monotypic stands.

Source: Professional expertise

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Not Rated

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q15: Disturbance Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q16: Propagule Persistence

Rating: Not Rated

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Hydrology, Light availability, Increased sedimentation

Rating: Moderate

Confidence: Moderate

As with many other invasive species, the impacts for flowering rush have been observed qualitatively, but rarely quantified (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019). This plant can clearly grow in dense, monotypic stands, and grows in areas where other aquatic plants cannot, thereby acting as an ecosystem engineer. Its ability to invade both deep water and moist soil is also alarming and allows it to impact a variety of habitats, even in the same location.

It is unknown how irreversible these impacts may be, but if better solutions for its control are not found, then its persistent presence could indeed cause irreversible damage to invaded ecosystems (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).

Source: Published research, Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: High

Confidence: Moderate

This species likely has a high impact on lakes, and a more moderate impact in rivers (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).

Source: Published research, Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Low

There is not enough research to support strong conclusions about ecological impacts on ecosystem composition. However, this species' ability to colonize new habitat and potentially create suitable substrate for other aquatic plants is concerning. This attribute may facilitate other opportunistic invasive species (Gunderson et al., 2016).

Source: Published research, Professional expertise

Q21: Impact on Particular Native Species

Rating: Low

Confidence: Low

There is not enough evidence to suggest high impacts to specific native plant species, but it's likely that species with similar growth forms (like hard stem bulrush) and habitats will be impacted (Marko et al., 2015; Gunderson et al., 2016).

Source: Published research, Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: High

Confidence: High

While it can act as a pioneer species, it clearly also establishes in existing native plant communities (Gunderson et al., 2016; Madsen et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).

Source: Published research, Informal publication, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Naturally (and anthropogenic) fluctuating water levels appear to facilitate the growth of flowering rush (Parkinson et al., 2010; Columbia Basin Cooperative Weed Management Area, 2019).

Source: Published research, Informal publication

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

This plant has persisted for decades in waterbodies despite continued control efforts (Parkinson et al., 2010; Madsen et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019; Parsons et al., 2019).

Source: Published research, Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

This plant has persisted for decades in waterbodies despite continued control efforts.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

From the few published studies available, the impacts of some management techniques (namely diquat application) on native aquatic plants appears to be minimal. For some species, increases in abundance and frequency were observed following treatment.

However, the impacts of different management methods on native plants still needs to be evaluated (Madsen et al., 2016; Parsons et al., 2019).

Source: Published research

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Deep water areas, especially in rivers, are difficult to survey properly (as well as manage). Flowering rush likely occurs in some of these areas.

Also, wetlands and shallow water areas connected to rivers where this species occurs are very difficult to access via boat or from the shore (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).

Source: Published research, Informal publication, Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

Treatment of at least one major source location has been met with resistance from landowners over concerns regarding their ability to graze cattle near treated streams. This is a major impediment to controlling populations that contribute to spread throughout the Spokane and Columbia Rivers.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Centaurea solstitialis (Yellow Starthistle)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
2 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (82)	Confidence: **High** (75)
Management Difficulty Rank: Moderate (63)	Confidence: Moderate (50)
Biological Characteristics of Invasiveness: High (77)	Confidence: High (79)
Concern Related to Distribution and Abundance: Moderate (62)	Confidence: High (70)

Photo Credit: Keir Morse 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

None

Legal Listings

Washington State Weed Board: Class B

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

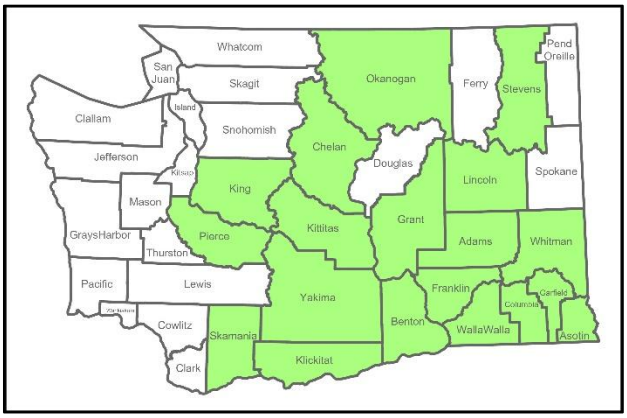

Figure 1. Distribution of counties where *Centaurea solstitialis* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Centaurea solstitialis is found in 49% counties in Washington State (CPNWH, 2023; EDDMapS, 2023;

iNaturalist Contributors, 2023). Washington, Oregon, California, and Idaho have the largest populations of *Centaurea solstitialis* in the United States (Innes & Zouhar, 2021).

Source: Informal publication, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: High

Based on herbarium records and iNaturalist observations, *Centaurea solstitialis* appears to be increasing its range primarily along the Columbia River east of the Cascades in Washington State (CPNHW, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Models predict that *Centaurea solstitialis* will spread throughout Washington, but will remain most abundant in the eastern half of the state (EDDMapS, 2023).

Climate change is expected to increase abundance and range of *C. solstitialis* (Dukes et al., 2011).

Source: Published research, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Low

Based on herbarium records and iNaturalist observations from the last 20 years, *Centaurea solstitialis* abundance and local range appears to be increasing south of the Snake River and in the vicinity of The Dalles on the Columbia River, but it does not appear to be increasing local range or abundance significantly in the rest of the state (CPNWH, 2023; iNaturalist Contributors, 2023).

However, in some other parts of the Northwest, *C. solstitialis* populations have been decreasing over the last 20 years. For example, biocontrol introductions have visibly decreased population density of this species in north-central Idaho, the center of *C. solstitialis* abundance for that state (EDDMapS, 2023).

Source: Professional expertise, Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland, Semi-Desert (includes Shrub-steppe)

Rating: Low

Confidence: Moderate

Centaurea solstitialis prefers open, disturbed upland habitats, and is often found in annual and perennial grasslands, shrub steppes, oak savannas, open woodlands, and openings in forests. In the Pacific Northwest, this species invades perennial grasslands and sagebrush steppe. In Washington, it can appear in many communities from below lower treeline to montane elevations, though it is most likely to occur in south-facing grasslands in the southeastern portion of the state. *Centaurea solstitialis* may establish in some riparian areas, but this is not common. This species grows best in deep, well-drained silt-loam or loam soils but can also grow in shallow, rocky soils. In Washington, abundance appears to be related to the soil's ability to hold moisture, with populations producing more seeds in moist soils (Innes & Zouhar, 2021).

Centaurea solstitialis' highest impacts are in areas with Mediterranean-type climates, though it can also establish in semi-arid climates like the Great Basin, and sometimes occurs in deserts, coastal regions, and at high elevations in California and Nevada. This species prefers cool, wet winters, which allow seeds to germinate and develop deep taproots before spring (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

Centaurea solstitialis is a winter annual or occasionally biennial species that reproduces from seed. This species produces two types of seeds. A study in Washington found that the average *C. solstitialis* plant produced 180 seeds. Data from Washington also found *C. solstitialis* populations could produce 1,940 seed per square foot in a wet year, and 470 seeds per foot in a dry year. However, in nursery conditions, this species can produce up to 100,000 seeds per plant. *Centaurea solstitialis* can produce flowers and seeds for several months to year-round if it does not experience drought or frost conditions. Propagule pressure is usually the most important factor in this species invasion of undisturbed or otherwise less than ideal habitats. Seeds are eaten by birds and insects—including biocontrol species—but *C. solstitialis* produces abundant seed; in some cases, populations may persist even when biocontrol species are present (Innes & Zouhar, 2021).

Centaurea solstitialis plants are self-incompatible and rely on pollinators (most importantly introduced honeybees) to reproduce. Floral visitors are abundant and diverse (Innes & Zouhar, 2021).

Source: Published research, Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Seeds spread short distances by wind and gravity but can also be transported longer distances by animals and water. The majority of achenes have barbed plumes that readily attach to humans and animals (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Centaurea solstitialis was likely introduced to North America in the 1800s through contaminated alfalfa shipments. Long distance dispersal of this species is enabled through movement of animals, including livestock, as well as vehicles and other equipment. Populations of *C. solstitialis* frequently spread along travel corridors (e.g., roads and trails). Use of contaminated mulch in restoration and other activities has also resulted in introductions of *C. solstitialis* (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: High

Centaurea solstitialis is generally considered to be allelopathic and allelopathy likely contributes to this species' invasiveness. Not all studies have confirmed allelopathy in *C. solstitialis*, so allelopathy may vary by population (or some plant species may be more resistant to its effects). The allelopathic chemical produced by this species is also toxic to horses (Innes & Zouhar, 2021) and herbivory can increase allelopathy in this species (Becerra et al., 2020). It releases a bitter tasting chemical when damaged.

Source: Published research, Informal publication, Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Centaurea solstitialis is highly competitive for water and can deplete soil moisture where it occurs—sometimes so much that it reduces its own germination success in the next year. This species can grow deep roots (longer than 6 feet) and exploit fissures in rock to obtain water in dry areas. These deep roots make *C. solstitialis* more drought tolerant than some annual grasses it co-occurs with (e.g.,

Taeniatherum caput-medusae), and roots can be deeper than the roots of co-occurring perennial grass species as well (Innes & Zouhar, 2021). Basal rosettes overwinter in Washington, and can have roots up to 2 feet deep by spring, giving this species an advantage over plants that are dormant in the winter (Innes & Zouhar, 2021).

Centaurea solstitialis is more competitive for abiotic factors in its introduced range than in its native range. Multiple introductions have resulted in novel genotypes, which can increase competitive ability and adaptability to a wider range of conditions. Competitive release from perennial grasses that have evolved with *C. solstitialis,* and escape from disease-causing agents are also important factors in the success of this species in its introduced range. Replacement of native perennial grass communities with introduced annual grass communities throughout the western U.S. may also have left an unexploited niche for *C. solstitialis* to exploit. This species is more competitive against early season, shallow rooted annuals, and less competitive against species that share the same niche (e.g., late-flowering, deep taproots) (Innes & Zouhar, 2021).

However, *C. solstitialis* is less competitive against diverse plant communities, with deep-rooted perennials being most able to outcompete this species for water and light. Restoring vegetation communities is a recommended management tool to resist invasions or re-invasions by this species (Innes & Zouhar, 2021).

Source: Informal publication

Q11: Growth Form

Rating: Yes

Confidence: High

Centaurea solstitialis frequently grows as monocultural stands that exclude other species (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Centaurea solstitialis germinates best in moist, disturbed soils, but this species can germinate under a wide range of conditions and disturbance is not required for establishment. Propagule pressure is usually the most important factor in invasion of undisturbed or otherwise less than ideal habitats. Increases in spring moisture can also increase the likelihood of *C. solstitialis* germinating in undisturbed areas in Washington. However, the conditions where this species can establish in undisturbed areas are relatively limited, and seedlings are more likely to be unhealthy and experience mortality in undisturbed habitats (Innes & Zouhar, 2021).

Source: Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Several other species in this genus are invasive in Washington and other states in the Pacific Northwest, including several species of knapweed and at least one other species of star-thistle.

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/insignificant

Confidence: High

Centaurea solstitialis usually occurs in areas with little or no overstory canopy, does not tolerate shade, and usually does not occur in areas with tall shrubs, forbs, grasses or late season annuals that can shade it out. This species roots grow more slowly in shaded conditions, and shading may reduce its ability to flower and produce viable seed (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Centaurea solstitialis is most invasive and productive in disturbed areas. This particularly includes areas of human disturbance such as hayfields, orchards, vineyards, old fields, roadsides and railroad tracks. Rangelands and pastures, particularly ones allowed to be overgrazed, also provide opportunities for introduction or increases of this species. In the Blue Mountains in Washington and Oregon, areas grazed by cattle and elk are readily invaded by *C. solstitialis*. While fire kills adult plants, it provides excellent habitat for establishing new populations (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: >5 years

Confidence: High

Centaurea solstitialis forms both a transient and a long-term seedbank, and seeds can remain viable for up to 10 years in Washington. However, most of this species' seeds germinate readily and do not appear to be innately dormant. Dormancy may instead develop when dispersed seeds do not find conditions conducive to germination—only a small number of total seed production will become dormant. Germination in *C. solstitialis* is related to light, moisture, and temperature (Innes & Zouhar, 2021).

Source: Informal publication

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Low

Centaurea solstitialis is toxic to horses, causing neurological damage when consumed, but sometimes horses will seek it out anyway. Other grazers, including mules and burros, can eat *C. solstitialis* without danger. Cows, sheep, and goats will graze this species when it is young, but avoid it once spines develop. Grasshoppers are also known to eat *C. solstitialis* (Innes & Zouhar, 2021).

Some sources describe *C. solstitialis* as palatable and nutritious to livestock, at least when young (Innes & Zouhar, 2021). Researchers studying the effects of *C. solstitialis* on plant communities have found this species vulnerable to herbivory and sometimes use exclosures to protect experimental plots from herbivory (e.g., Dukes et al., 2011; Becerra et al., 2020). Other resources—and the general public perception—regard this species as poor forage (NWCB, 2024).

Source: Published research, Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Fire, Hydrology, Nutrient dynamics

Rating: Moderate

Confidence: Moderate

Centaurea solstitialis is highly competitive for water and depletes soil moisture more and later in the season than annual and perennial grasses. This can temporarily disrupt soil moisture dynamics and reduce water availability for co-occurring species, sometimes even across seasons. *Centaurea solstitialis* changes soil nutrient availability and adult plants may increase inorganic nitrogen in the soil (Innes & Zouhar, 2021). A study found that increased nitrogen generally benefits *C. solstitialis* above co-occurring species (Dukes et al., 2011).

Source: Published research, Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

Centaurea solstitialis has competitive effects on both native and introduced species. This species can outcompete native, dominant bunchgrasses and convert ecosystems to ruderal ecosystems dominated by annuals. Some observations have found that this species can alternate dominance with *Bromus tectorum* when they co-occur (Innes & Zouhar, 2021).

Source: Published research, Informal publication

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Centaurea solstitialis can reduce native species abundance and diversity across trophic levels by displacing native plant species, reducing habitat and food for native animal species, and changing the composition of microbial communities (Innes & Zouhar, 2021). This species can also reduce biomass and diversity of co-occurring forbs, reducing both species richness and percent cover, likely due to allelopathy and water competition (Becerra et al., 2020).

Source: Informal publication

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Centaurea solstitialis is described as a threat to some rare native plants, including the federally endangered *Silene spaldingii*, which is present in southeastern Washington (Innes & Zouhar, 2021; WNHP, 2024). However, absent further details and given *C. solsitialis'* high impact on community composition, it is difficult to say if any particular species is more strongly affected by *C. solstitialis* than the co-occurring plant community.

Source: Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Centaurea solstitialis can invade undisturbed habitats if neighboring populations provide high propagule pressure, but they are more successful in disturbed habitats (Innes & Zouhar, 2021).

Source: Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Centaurea solstitialis is most successful in disturbed areas, especially where litter has been removed and bare soil is exposed. However, it is less competitive against intact native plant communities, even in naturally disturbed habitats, and most successful in areas where human disturbance or management have already damaged native plant communities (e.g. conversion of native perennial grasslands to invasive annual grasslands) (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Low

The best management for *Centaurea solstitialis* is prevention, particularly by minimizing soil disturbance and maintenance of native plant communities. This includes managing for perennial species and diverse communities that are competitive against *C. solstitialis*, reducing propagule pressure by treating patches of *C. solstitialis* before they flower and fruit, preventing transportation of seeds by equipment, feed, and livestock, and monitoring and immediately addressing small populations when found (Innes & Zouhar, 2021).

Small populations of *C. solstitialis* can be managed or eradicated by hand-pulling (taking care to remove and properly dispose of all the above-ground parts of the plant) and herbicides. Large populations usually require a combination of long-term management techniques. Effective treatments include fire or mowing combined with grazing, herbicides, and biocontrol agents. Restoration of native vegetation communities, and ongoing monitoring and treatment of new populations is important for preventing reinvasion. The goals of long-term management of this species are to deplete the seed bank and establish desirable vegetation that can outcompete *C. solstitialis* (Innes & Zouhar, 2021).

Several biocontrol agents are available for managing *C. solstitialis*, including six insect species that attack flowers and seeds and one pathogen that attacks the vegetative portions of the plant. Most research suggests that biocontrol agents alone can reduce spread, but do not eliminate *C. solstitialis* populations (Innes & Zouhar, 2021). However, in Idaho County, Idaho, a release of *C. solstitialis* seed predators significantly reduced the abundance of this species, even on the overgrazed hillsides it had previously dominated—suggesting that biocontrols can be a successful management tool. Idaho and Nez Perce Counties are at the epicenter of *C. solstitialis* in Idaho (EDDMapS, 2023).

Source: Informal publication, Professional expertise, Reported observations

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

Preventing seed rain can reduce *Centaurea solstitialis* seed banks significantly in 3–4 years, but continued monitoring is still required to keep populations from reestablishing. Small populations can be removed by hand-pulling or herbicide in the amount of time it takes to significantly reduce the seedbank, but large populations likely require multiple management techniques and ongoing management to control (Innes & Zouhar, 2021). The assessor has observed in north-central Idaho that successful releases of biocontrol agents have greatly reduced management efforts for local landowners.

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Moderate

The use of broadscale herbicide treatment to knock back *Centaurea solstitialis* occurances can have a significant and permanent effect on native plant communities. At one site in Idaho, several native species that were present before broadcast herbicide treatment in 1995 (e.g. *Lomatium*, *Primula*, and *Veronica* species), have not been observed in the years since (M.F. Wiebush, pers. comm. 2024). Active restoration may be required to recover the native plant community after initial treatments for *C. solstitialis*. While broadcast herbicide treatments may have lasting effects on co-occurring native plants, available biocontrols for *C. solstitialis* have been relatively effective, at least in parts of Idaho, without spillover effects on native species.

Reduction of *C. solstitialis* can also increase abundance of invasive annual grasses like *Bromus tectorum* and *Taeniatherum caput-medusae*. Use of fire may have fewer negative effects on native species; *C. solstitialis* flowers and sets seed later than most associated native species, and prescribed fire to control this species is most effective after grasses have gone to seed. However, maintenance and restoration of native grassland and prairie communities is a necessary part of reducing and preventing *C. solstitialis* invasion, so most effective long-term management of this species may benefit co-occurring native species (Innes & Zouhar, 2021).

Source: Informal publication, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Long-distance dispersal of *Centaurea solstitialis* is most frequently from human activity and it frequently expands along roads and trails (Innes & Zouhar, 2021), suggesting it usually occurs in relatively accessible locations.

Source: Informal Publication

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

In southwestern Oregon, land managers may be restricted in pulling *Centaurea solstitialis* and related species once they start flowering because they are a floral resource for the federally endangered Franklin's bumblebee (*Bombus franklini*). *Centaurea solstitialis* is also used by honeybees, and beekeepers

could potentially have concerns about treating this species.

However, *C. solstitialis* has significant negative effects on rangeland quality and is poisonous to horses, suggesting that agricultural communities, at least, will have fewer objections to controlling this species. For example, in north-central Idaho, private landowners have initiated successful releases of biocontrol agents to reduce populations of *C. solstitialis* on their property and neighboring lands.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Chondrilla juncea (Rush Skeletonweed)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
18 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **High** (77) Confidence: **Low** (25)

Management Difficulty Rank: Moderate (68)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Not Rated	Confidence: Not Rated
Concern Related to Distribution and Abundance: High (89)	Confidence: Low (20)

Photo Credit: Luigi Rignanese 2006, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Class B

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

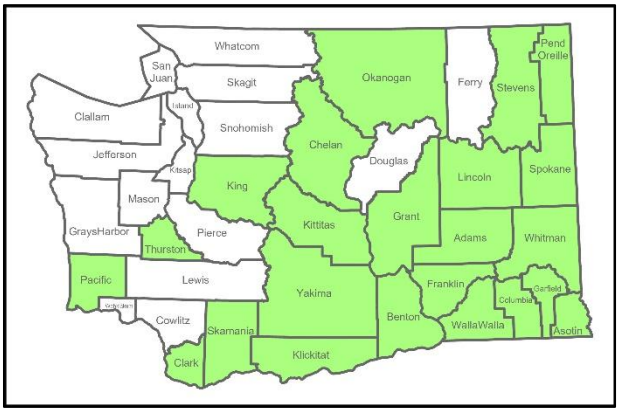

Figure 1. Distribution of counties where *Chondrilla juncea* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Chondrilla juncea is found in 59% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Not Rated

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Low

This species already occurs in more than 50% of the state (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations.

Q4: Local Range Expansion or Change in Abundance

Rating: Not Rated

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Not Rated

Rating: Not Rated

Confidence: Not Rated

Source:

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Not Rated

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Not Rated

Confidence: Not Rated

Source:

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Not Rated

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: Not Rated

Confidence: Not Rated

Source:

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Source:

Q13: Invasivity of Other Plants in Genus

Rating: Not Rated

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q15: Disturbance Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q16: Propagule Persistence

Rating: Not Rated

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Unknown

Rating: Unknown

Confidence: Not Rated

Source:

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Low

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Low

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

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iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.

Washington Invasive Ranking System

Washington Natural Heritage Program

Cirsium arvense (Canada Thistle)

Assessed by
Emily Stevenson, (Program Coordinator, Skamania County Noxious Weed Control Program)
Ethan Coggins, (Natural Areas Steward, Washington Dept. of Natural Resources)
Regina Johnson, (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
Molly S. Wiebush (Washington Natural Heritage Program)
17 June 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (75) Confidence: **Moderate** (58)

Management Difficulty Rank: Moderate (58)	Confidence: High (80)
Biological Characteristics of Invasiveness: High (80)	Confidence: High (83)
Concern Related to Distribution and Abundance: Low (49)	Confidence: High (90)

Photo Credit: David Giblin 2024, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Cirsium arvense was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

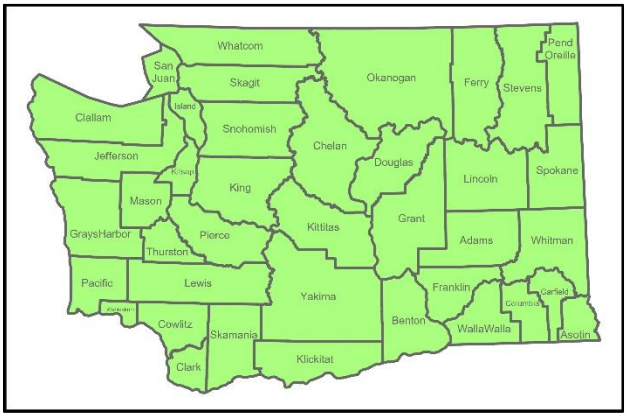

Figure 1. Distribution of counties where *Cirsium arvense* has been documented in Washington State (WSDA, 2018; CPNWH 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Cirsium arvense has been documented in all 39 counties in Washington State (WSDA, 2018; CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Score: Low

Confidence: High

Cirsium arvense is reported from all counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023). This species appears to occur in almost all of the suitable generalized habitat available in Washington (Jarnevich et al., 2023).

Source: Professional expertise, Herbarium records and other observations, U.S.G.S. data set

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Insignificant (range Insignificant - Low)

Confidence: High

Cirsium arvense is reported from all counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023) and it is likely already present in most suitable ecoregions, counties, and watersheds.

Source: Professional expertise, Herbarium records and other observations, Model predictions.

Q4: Local Range Expansion or Change in Abundance

Rating: Insignificant (range Insignificant - Moderate)

Confidence: Moderate (range Low - Moderate)

Areas of disturbance like roadsides, recently logged areas, or construction sites are readily colonized, and once established, populations can grow rapidly if not controlled. As of 2000, *Cirsium arvense* populations were increasing by 10% annually in the northwest (Zouhar, 2001). Based on herbarium records, populations of this species are remaining stable in Washington, and models predicted they will remain stable in the future (CPNWH, 2023; EDDMapS, 2023).

Source: Informal Publication, Professional Expertise, Herbarium records, model predictions

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Semi-Desert (includes Shrub-steppe), Marine Coastal Shore, Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland

Rating: High (range Moderate - High)

Confidence: High

Cirsium arvense can be found in almost every upland ecosystem within its range, though it is most likely to be found in prairie or riparian habitats, vernal pools and wet meadows in shrub-steppe systems, or in areas of recent disturbance. In the Pacific Northwest, *C. arvense* is rarely found in undisturbed forests, but readily colonizes forests and woodlands after human or natural disturbances (Zouhar, 2001; CABI, 2024; GISD, 2024; NatureServe, 2024).

Source: Informal publication, Professional expertise, Herbarium records and species treatment.

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Cirsium arvense primarily reproduces via vegetative propagation and can rapidly produce dense clonal stands. This species does not produce rhizomes but can produce adventitious root buds at any time of year. Plants can grow from small (6mm long) root fragments (Zouhar, 2001).

Cirsium arvense is the only dioecious species of *Cirsium*. Female plants can produce more than 1000 seeds/plant (Zouhar, 2001). One study in California found 280 (+/- 110) viable *C. arvense* seeds per m^2 in the top 2 cm of soil (Hobbs & Mooney, 1986). However, a study in New Zealand did not find any seedlings over three years of survey efforts, despite viable *C. arvense* seeds being present in the seed bank (Leathwick & Bourdôt, 2012), suggesting that high seed production doesn't necessarily lead to significant population growth in this species.

Cirsium arvense requires 15 hours of daylight to induce flowering, are "imperfectly dioecious" (male plants sometimes produce seeds), and require insect pollination. The major pollinators for this species appear to be honeybees. Extreme heat or cold can inhibit pollination, and seeds are subject to seed predation, which can lead to variable seed set between years (Zouhar, 2001). Since *C. arvense* is an obligate outcrosser, seed production may be more important for maintaining genetic diversity and adaptability in populations than for contributing to population growth or colonization. Even if seed production does not contribute significantly to population growth, *C. arvense* reproduces aggressively via vegetative propagules.

Source: Published research, Informal publications, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Cirsium arvense produces lightweight seeds with a feathery pappus for wind dispersal. Evidence from Washington shows *C. arvense* seeds are capable of dispersing more than 1 km. However, the seeds frequently break off from the pappus, so wind may not be the main dispersal mechanism for seeds (Zouhar, 2001). The majority of seeds are deposited near the parent plants (Leathwick & Bourdôt, 2012), suggesting this species may only have moderate ability for natural long-distance dispersal. Seeds are not particularly adapted for attachment to animals, though they may stick to some degree (as can many other types of seeds), facilitating longer distance dispersal. Some publications indicate at least some seeds can survive passing through the digestive tracts of some birds, which can also facilitate long-distance dispersal (DiTomaso et al., 2013; CABI, 2024).

Source: Published research, Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Score: Yes

Confidence: High

Cirsium arvense seeds and plant fragments are very likely to be spread by human activities, particularly by movements of livestock, hay, contaminated crop seeds, soil, and machinery (Zouhar, 2001; CABI, 2024).

Source: Informal publication, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Low

Allelopathy is suspected, but has not been reliably demonstrated in *Cirsium arvense* (Zouhar, 2001). Published research is contradictory, with some studies finding allelopathic effects (Stachon & Zimdahl, 1980). A literature search found a few recent small-scale studies of allelopathy in *C. arvense* since 2001, but data on allelopathy, particularly under natural conditions and outside of agricultural systems, appears to be limited, and one recent study suggested that *C. arvense* might not have allelopathic effects. Researchers have also found that several plant species grown in media inoculated with soil from sites invaded by *C. arvense* showed better growth than when the same species were raised in soil from areas not invaded by *C. arvense* (Verbeek & Kotanen, 2019).

Source: Published research, Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Cirsium arvense can reduce crop yields, outcompeting its neighbors for moisture, light, and nutrients (Moore, 1975). This species can metabolize fructans, allowing it to grow at cooler temperatures than other plants (Zouhar, 2001). A common garden experiment done in the Czech Republic comparing the growth and fitness of *C. arvense* from Europe to North American populations found that the populations from North America were more competitive for resources than native populations (Abela-Hofbauerová & Münzbergová, 2011).

However, *C. arvense* establishment can be prevented by seeding aggressive perennial grasses (e.g., introduced species such as crested wheatgrass, orchard grass, or smooth brome) (Zouhar, 2001). This and other reports of *C. arvense* being vulnerable to competition may hinge on the species shade intolerance, particularly as seedlings, though herbivory may also reduce competitive advantages for this species (Leathwick & Bourdôt, 2012).

Cirsium arvense's above-ground mass generally dies off after frost. However, *C. arvense* can use its roots as storage organs, enabling it to better survive disturbances such as fire and mowing, and to survive cold temperatures. These roots are generally short lived (a year or so), and likely influence the abundance and success of the next year's growth (Leathwick & Bourdôt, 2012).

Source: Published research, Informal publication, Professional expertise

Q11: Growth Form

Score: Yes

Confidence: High

Cirsium arvense's vegetative mode of reproduction frequently results in dense clonal stands (Zouhar, 2001). Seedlings may not be competitive for sunlight, however (Leathwick & Bourdôt, 2012), and this species can allow significant sunlight through its canopy.

Source: Published research, Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Cirsium arvense has low-to-moderate ability to propagate in undisturbed systems and does not compete well for light when establishing. Thus, bare ground is relatively important for establishment from seed. This species is occasionally found in undisturbed areas, but this is likely because *C. arvense* is able to take advantage of small disturbance such as rodent burrows or frost heave to establish from seed. Its seeds can germinate under a wide variety of conditions, but seedlings do not survive shading (Moore, 1975; Zouhar, 2001). However, vegetative reproduction is much more important to this species, and seeds probably have limited contribution to the spread of *C. arvense* (Moore, 1975; Zouhar, 2001).

Source: Published research, Informal publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Other species in this genus (e.g., *Cirsium vulgare*) are invasive in Washington (NWCB, 2024a). *Cirsium palustre* (marsh thistle) is invasive throughout the Midwest and Canada, including in BC (Gucker, 2009). In addition, other closely related genera in the Cardueae tribe (such as *Onopordum*, *Carduus*, *Centaurea*) contain well-known invasive species.

Source: Informal publications, Professional expertise

Q14: Shade Tolerance

Score: Low/Insignificant

Confidence: High

Cirsium arvense seedlings are poor competitors due to their low shade tolerance; in general, the species is most successful in sunny sites. Once established it can persist for a time under shade and can exist in a partially shaded condition seemingly indefinitely. Plants will grow to an unusual size when shaded and have been observed to grow to over 7 feet tall when shaded by thick snowberry and other shrubs. This species can also be found under closed deciduous canopies (e.g., quaking aspen) which likely receive more sunlight than closed conifer canopies. Post-fire studies have documented reductions in cover of *C. arvense* as tree cover increases (Zouhar, 2001). Mature plants produce fewer flowers in shaded areas (Moore, 1975).

Source: Published research, Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Cirsium arvense is an early successional species and appears in communities shortly after disturbances such as logging, fire, volcanic eruptions (e.g., debris deposits and landslides), grazing, and road building. This was one of the first species to recolonize disturbed areas after Mt. St. Helens erupted. This species uses its roots as storage organs, which is a common trait in plant species adapted to above-ground disturbances such as fire, and in fact *C. arvense* roots are known to survive even severe fires. *Cirsium arvense* can also re-establish after discing and herbicide treatment (Zouhar, 2001).

Source: Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: >10 years

Confidence: Moderate

While deeply buried seeds have occasionally been documented to survive longer than 20 years, most studies have found that *C. arvense* seeds do not have a dormancy period. On average, *C. arvense* seeds last for less than 5 years in the seed bank. Most seeds germinate in the first year (Zouhar, 2001; DiTomaso et al., 2013). Storage roots are generally short-lived (a year or so) (Leathwick & Bourdôt, 2012), but it can take 5-10 years of eradication efforts to exhaust vegetative propagules in a treatment area (Zouhar, 2001).

Source: Published research, Informal publication, Professional expertise

Q17: Palatability

Score: Yes, plant is unpalatable

Confidence: High

While some species may eat *Cirsium arvense*, it is generally thought of as a grazing increaser and is not considered palatable to livestock (Zouhar, 2001; DiTomaso et al., 2013; CABI, 2024). This plant requires thick gloves to pull because of its spines, so animals are likely to find less well-defended plants to eat.

Source: Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability, Hydrology, Fire, Nutrient dynamics

Rating: Moderate (range Insignificant - Moderate)

Confidence: Moderate

Cirsium arvense's thick root system may stabilize some banks when growing in riparian areas. This plant typically grows in relatively mesic areas. In Canada, *C. arvense* has been shown to increase fire frequency when it occurs in boreal wet meadows (Hogenbirk, 1995 as cited by Zouhar, 2001).

Research also suggests that *C. arvense* can alter soil microbial community composition (Verbeek & Kotanen, 2019), which can alter nutrient cycling.

Source: Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate (range Low - Moderate)

Confidence: Low (range Low - Moderate)

Research of severe soil disturbance in northern Idaho found *Cirsium arvense* was a component in a forb-rich vegetation community that prevented the re-establishment of trees (Green & Jensen, 1991; Jensen, 1991). This species can change vegetation density in grasslands, shrublands, and mixed shrub and forb ecosystems.

Source: Published research, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High (range Moderate - High)

Confidence: Moderate (range Moderate - High)

Cirsium arvense frequently occurs in monospecific stands and is potentially allelopathic (Stachon & Zimdahl, 1980). Native species diversity and

abundance is frequently reduced in areas where it occurs. Research suggests that *C. arvense* can alter soil microbial community composition. Changes in soil microbial community can benefit some plant species while inhibiting others, contributing to changes in vegetation community composition (Verbeek & Kotanen, 2019). Recent evidence suggests that *C. arvense* competes for pollinators and alters the structure of native plant-pollinator relationships. A study in Appalachian plant communities found pollinator visitation rates were reduced for all neighboring plants, and pollinator visitation for plants with radial symmetry was reduced community-wide in areas invaded by *C. arvense* (Daniels & Arceo-Gómez, 2020).

Source: Published research, Professional expertise

Q21: Impact on Particular Native Species

Rating: Moderate

Confidence: High

Cirsium arvense serves as the host plant for weevil species that will attack native thistles (Louda & O'Brien, 2002) and can potentially hybridize with another native thistle (*C. hookerianum*) (NWCB, 2024b).

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate (range Low - High)

Cirsium arvense rarely spreads into undisturbed forests or mature, intact native ecosystems, and maintaining natural communities is recommended as the best defense against this species. However, in Yellowstone National Park, *C. arvense* was found across all disturbance regimes, though abundance increased as disturbance did. This species can also establish in wet meadows from nearby populations, as well as establishing in disturbed patches within old-growth forests (Zouhar, 2001). In Washington, populations of this species have been observed growing densely amid competitive species such as snowberry under a mature aspen stand and in reed canarygrass fields. This indicates that this species can, at least occasionally, establish in competitive and mature vegetation (or requires only a small natural disturbance to establish).

Source: Informal publication, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Cirsium arvense can take advantage of natural as well as human disturbance, and has been found after fires, landslides, volcanic eruptions (e.g., Mt. St. Helens), grazing, and other disturbance by native animals (e.g., bison, pocket gophers) (Zouhar, 2001). *Cirsium arvense* is also known to invade intact vernal pool ecosystems in Eastern Washington, such as the populations at Marcellus Shrub Steppe Natural Area Preserve. The disturbance caused by frost heaving and the natural recession of water create openings for this species to germinate. It then thrives and severely impacts native species.

Source: Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate (range Moderate - High)

Confidence: High (range Moderate - High)

Control of *Cirsium arvense* is not impossible, but it is quite difficult, in part due to its ubiquitous nature. Effective control methods vary by context (e.g., tilling works in agricultural fields, but increases invasion in natural areas). Pulling and mowing are time-consuming but can be effective if efforts are carried out multiple times a year and persist over multiple years. However, mowing can increase *Cirsium arvense* populations instead of decreasing them, particularly in humid areas. Biocontrol is not effective, even within this species' native range. Herbicide effectiveness may also vary by conditions, though herbicides like aminopyralid and clopyralid can be very effective when used for multiple years,

albeit with high off-target damage. The bare ground left behind when controlling this species allows new seedlings to germinate—and the problem can begin again (Zouhar, 2001; DiTomaso et al., 2013).

Source: Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

Multiple broadcast treatments with clopyralid or aminopyralid can eliminate occurances of *Cirsium arvense* in 2 to 3 years. There is a 6-month (clopyralid) or one year (aminopyralid) re-seed interval after the last herbicide treatment. By year four, reseeding or replanting forbs into the treated area can begin, with follow-up in year five, with occasional follow-up and spot treatments afterward (Zouhar, 2001; DiTomaso et al., 2013). An isolated patch of *C. arvense* can be controlled in 2-5 years, but the ubiquity of this plant on the landscape makes it more difficult to manage. High rates of reintroduction and the potential for propagules to last 5-10 years suggest that the minimum time commitment for managing an established occurances of this species is also 5-10 years.

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate (range Low - High)

Confidence: High (range Moderate - High)

Depending on the method of control, off-target damage can vary. Spot treatment of patches with aminopyralid or clopyralid restricts damage to a small radius around treated plants. However, broadcast treatments are often deployed to save time. Broadscale herbicide treatments can cause significant and persistent reduction of native species. Mowing and tilling can also cause significant off-target damage (Zouhar, 2001; DiTomaso et al., 2013).

Source: Informal publication, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Cirsium arvense is mainly spread by human activities and human disturbance. This species usually grows in disturbed, relatively mesic areas that are generally not difficult to access. The main impediment to access is simply the extent of its range.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant (range Insignificant - Moderate/Low)

Confidence: High (range Moderate - High)

Cirsium arvense is one of the most widespread invasive plants in the world. This species is a major crop pest, has little palatability to livestock or wildlife, and is generally considered undesirable in recreational areas. This species also has little documented benefit to native pollinators (Zouhar, 2001; Daniels & Arceo-Gómez, 2020), though apiarists have been known to oppose the control of species like *C. arvense* that are used by honeybees. Public objections to herbicide use may present obstacles to management in some communities, but no more so than for management of any other invasive species.

Source: Professional expertise

Additional Comments

None

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Cirsium arvense is found in all counties in WA

Washington Invasive Ranking System

Washington Natural Heritage Program

Cirsium vulgare (Bull Thistle)

Assessed by
Carlo Abbruzzese (Natural Areas Manager, Washington Dept. of Natural Resources)
Ethan Coggins (Natural Areas Steward, Washington Dept. of Natural Resources)
6 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (33)

Confidence: **Moderate** (50)

Management Difficulty: Not Rated	Confidence: Not Rated
Biological Characteristics of Invasiveness: High (85)	Confidence: Moderate (54)
Concern Related to Distribution and Abundance: Moderate (64)	Confidence: Moderate (50)

Photo Credit: David Gilblin 2020, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

This summary includes information about *Cirsium vulgare* that was originally included as part of the assessment of *Cirsium arvense*.

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

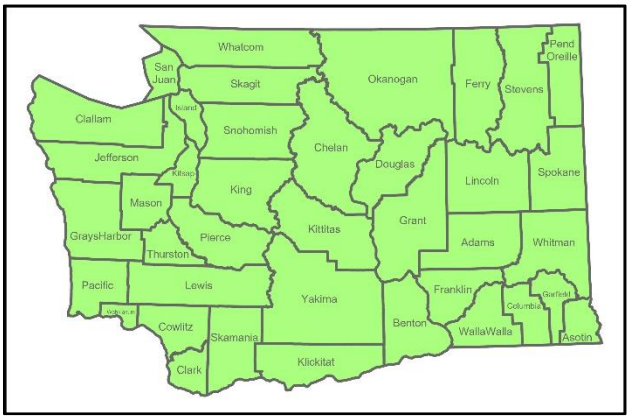

Figure 1. Distribution of counties where *Cirsium vulgare* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Cirsium vulgare has been documented in all 39 counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Insignificant

Confidence: Moderate

Cirsium vulgare has been documented in all 39 counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Rating: Unknown

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

This species usually produces 100–300 seeds per inflorescence and a single plant can produce up to 400 flowerheads. Seed production varies per plant and population, and is influenced by climate conditions (Zouhar, 2002).

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Seeds are wind-dispersed.

Source: Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Cirsium vulgare may be spread in hay and via many other human activities.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Low

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Cirsium vulgare often remains evergreen throughout the winter.

Source: Professional expertise (information from *Cirsium arvense* Assessment Summary)

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Cirsium vulgare germinates in mature prairie and saltmarsh.

Source: Professional Expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Other species in this genus (e.g., *Cirsium arvense*) are invasive in Washington (Noxious Weed Control Board (NWCB), 2024). *Cirsium palustre* (marsh thistle) is invasive throughout the Midwest and Canada, including in British Columbia (Gucker, 2009). In addition, other closely related genera in the Cardueae tribe (such as *Onopordum*, *Carduus*, *Centaurea*) contain well-known invasive species.

Source: Informal Publication, Professional Expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Cirsium vulgare is generally not found in areas of deep shade.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Low

Cirsium vulgare is an early successional species commonly found in open, disturbed ecosystems. However, low severity fires can kill seeds for this species (Clark & Wilson, 1994).

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

This species is very spiny—assessors have observed cattle attempting to eat it, but then being deterred.

Source: Professional expertise (information from *Cirsium arvense* Assessment Summary)

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: Moderate

This species likely has minor impact on ecosystem structure.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

This plant rarely grows with sufficient density to have a large impact on species composition.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Not Rated

Confidence: Not Rated

Source:

Q25: Minimum Time Commitment

Rating: Not Rated

Confidence: Not Rated

Source:

Q26: Impacts of Management on Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q27: Inaccessibility of Invaded Areas

Rating: Not Rated

Confidence: Not Rated

Source:

Q28: Sociopolitical Implications of Management

Rating: Not Rated

Confidence: Not Rated

Source:

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Clematis vitalba (Old Man's Beard)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
3 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (55)	Confidence: **High** (67)
Management Difficulty Rank: High (75)	Confidence: Moderate (50)
Biological Characteristics of Invasiveness: High (83)	Confidence: Moderate (64)
Concern Related to Distribution and Abundance: High (82)	Confidence: Moderate (50)

Photo Credit: David Giblin 2020, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: List C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

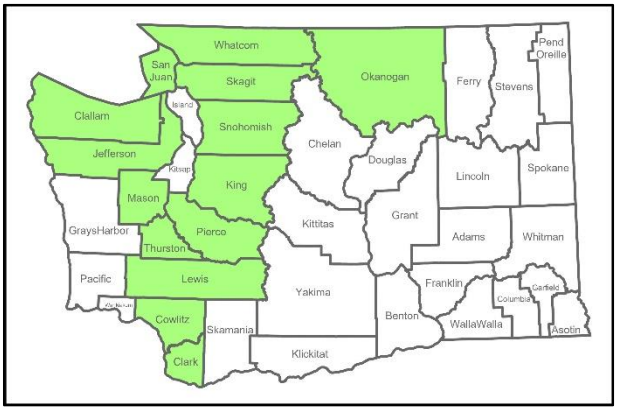

Figure 1. Distribution of counties where *Clematis vitalba* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: Moderate

This species is found in 36% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland

Rating: Low

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Unknown

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: High

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Moderate

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Low

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: High

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

Source: Professional expertise

Additional Comments

None

References

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iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.

Washington Invasive Ranking System

Washington Natural Heritage Program

Cotoneaster species (Cotoneaster)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
25 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (49)

Confidence: **High** (83)

Management Difficulty Rank: Insignificant (12)	Confidence: High (80)
Biological Characteristics of Invasiveness: High (70)	Confidence: Moderate (43)
Concern Related to Distribution and Abundance: High (82)	Confidence: Moderate (60)

Photo Credit: Erin Burke 2024, WNHP.

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Cotoneaster was assessed at the genus level because the species that occur in Washington all have similar traits, habitats, and ecological effects. All species of *Cotoneaster* in Washington are introduced.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

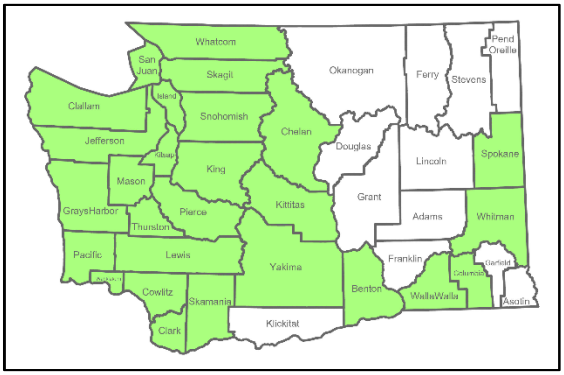

Figure 1. Distribution of counties where *Cotoneaster* species have been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Cotoneaster species are found in 69% of the Washington counties (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Cotoneaster berries are dispersed by birds.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

This genus is widely planted in landscaping.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Low

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: Low

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Multiple species in this genus have established in natural and semi-natural ecosystems in Washington. A literature search turned up several sources suggesting that many species in the *Cotoneaster* genus are invasive or potentially invasive in Europe.

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Cotoneaster species are somewhat less shade tolerant than other exotic forest shrubs/trees such as *Ilex aquifolium*. These species are generally observed on forest edges and roadsides, but not under closed forest canopies.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

The berries are palatable, but foliage browsing appears to be limited.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Low

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Cotoneaster species appear to be weeds of disturbed edges, and occasionally abandoned roadsides, but they are generally not found in undisturbed ecosystems.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Cotoneaster species have been observed on slides in forested areas when seed sources are nearby.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: High

To date, *Cotoneaster* are generally found as individual plants, which makes the genus relatively easy to treat.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

References

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.

EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024.

iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.

Washington Invasive Ranking System

Washington Natural Heritage Program

Crataegus monogyna var. *monogyna* (English Hawthorn)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
3 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (78)	Confidence: **High** (67)
Management Difficulty Rank: High (84)	Confidence: High (100)
Biological Characteristics of Invasiveness: High (76)	Confidence: High (67)
Concern Related to Distribution and Abundance: High (87)	Confidence: High (80)

Photo Credit: Dr. Amadej Trnkoczy 2007, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

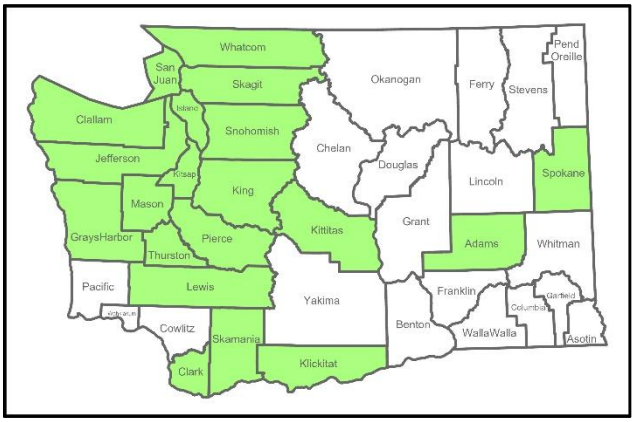

Figure 1. Distribution of counties where *Crataegus monogyna* var. *monogyna* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

This taxa is found in 51% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland

Rating: High

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: High

Crataegus phaenopyrum and *C. laevigata* occasionally naturalize in Washington, but are generally not considered invasive (University of Washington Herbarium, 2018).

Source: Professional Expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: >10 years

Confidence: Moderate

Source: Professional expertise

Q17: Palatability

Rating: No

Confidence: Low

Prominent thorns are likely to deter herbivory to some extent, but coppiced plants have been observed, indicating some degree of palatability.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Hydrology, Light availability

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: High

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Low

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Cynoglossum officinale (Houndstongue)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
Helen Lau (Botanist, US Forest Service)
4 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (60)	Confidence: **Moderate** (42)
Management Difficulty Rank: Moderate (58)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (77)	Confidence: High (79)
Concern Related to Distribution and Abundance: High (78)	Confidence: High (90)

Photo Credit: David Giblin 2023, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Cynoglossum officinale was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

This plant is considered rare in parts of its native range (Williams & Fishman, 2014). Much of the biological and ecological information available for this species is from its native range (Europe and western Asia). Data and observations from native versus introduced ranges are distinguished, where possible.

Legal Listings

Washington State Weed Board: Class B

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

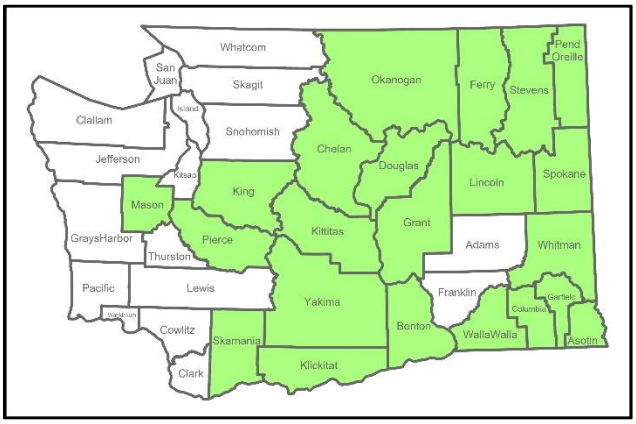

Figure 1. Distribution of counties where *Cynoglossum officinale* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Cynoglossum officinale is found in 56% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: High

Based on herbarium records and iNaturalist observations, *Cynoglossum officinale* is increasing its range in the ecoregions surrounding the Columbia Plateau, particularly in the East Cascades and Blue Mountains. This species' range is also expanding to a lesser extent in the Puget Trough (CPNWH, 2023; iNaturalist Contributors, 2023). Models predict that at least some areas of Washington State do not have suitable habitat for this species (EDDMapS, 2023).

Source: Herbarium records and other observations.

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate (range Moderate - High)

Models predict that while available range for *Cynoglossum officinale* will expand to the northwest portion of the state (Snohomish, Skagit and Whatcom Counties), overall *C. officinale* will experience a range contraction in Washington, particularly in the southwest and southeast. Future abundance of *C. officinale* is expected to be concentrated in northeastern Washington (EDDMapS, 2023).

Source: Model predictions.

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate (range High - Moderate)

Confidence: High (range Moderate - High)

Over the last 20 years, *Cynoglossum officinale* abundance and local range appears to have increased east of the Cascades, and increased rapidly in the eastern half of the Columbia Plateau and Okanogan Highlands (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Semi-Desert (includes Shrub-steppe), Forested Wetland, Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland

Rating: High

Confidence: Moderate

Little published information was available on the diversity of ecosystems invaded by Cynoglossum officinale in Washington. In its native range (Europe and western Asia), this species is found in open woodlands, meadows, dunes, and in marginal places near agricultural fields and other human disturbances. In North America, *C. officinale* is found in dry rangeland, grasslands, open woodlands and shrublands, and riparian areas, and is most abundant in highly disturbed areas such as clearcuts and grazed areas. This species is frequently associated with disturbed and ruderal habitats throughout its native and introduced ranges. Habitats and range may be limited by summer temperatures rather than winter cold (de Jong et al., 1990; Jacobs & Sing, 2007; Williams & Fishman, 2014; Momayyezi & Upadhyaya, 2017). One of the assessors reports encountering this species in upland shrub-steppe habitats as well as riparian areas.

In its native range, *C. officinale* prefers calcium rich basic soils and is frequently found on limestone and chalk substrates. Acidic soils may limit growth, even where calcium is abundant (de Jong et al., 1990). In its introduced range, this species can be found in rocky, sandy, loamy, or calcareous soils (Jacobs & Sing, 2007). In some areas *C. officinale* can be an indicator of drought or high soil nitrogen, and while this species is known to occur in riparian areas in both its native and introduced ranges, it does not survive in

waterlogged soil (de Jong et al., 1990; Jacobs & Sing, 2007; Williams & Fishman, 2014).

In its native range, *C. officinale* frequently co-occurs with other species that are exotic or invasive in the northwestern U. S., including *Ammophila arenaria*, *Cirsium arvense*, *C. vulgare*, *Jacobaea vulgaris*, *Rumex crispus*, *Solanum dulcamara*, *Arrhenatherum elatius*, *Sonchus arvensis*, *Carduus nutans*, *Myosotis arvensis*, *Geranium molle*, *Mycelis muralis, Brachypodium sylvaticum*, and *Verbascum thapsus* (de Jong et al., 1990).

Source: Professional expertise, Herbarium records and species treatment

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Low

Cynoglossum officinale is a biennial or short-lived perennial. In its native range, this species is usually monocarpic, but up to 20% of plants in its introduced range will flower in multiple years (Williams & Fishman, 2014). This may be due to release from specialist herbivores (Duncan & Williams, 2020). *Cynoglossum officinale* can delay flowering until conditions are favorable for reproduction (de Jong et al., 1990). This effectively creates a “bud bank” that helps plant populations survive years that are poor for seed production or seed germination (de Jong & Klinkhamer, 1988).

In its native range, one study found this species produced between 174–1823 seeds, with an average of 944 seeds per plant. Other studies report 306–1500 seeds per plant (de Jong et al., 1990). Larger plants produce more seeds per flower, and individual plants can produce up to 4000 seeds (Klinkhamer & de Jong, 1987). *Cynoglossum officinale* produced few seeds in pollinator exclusion experiments, and likely requires buzz pollination, suggesting that bumblebees are the most efficient pollinators for this species. Seed production can be limited by both pollinators and resource availability (de Jong et al., 1990). Fresh seeds have an estimated viability of 90%, and seedlings also have a high rate of establishment, in part because of the maternal provisions provided by large seeds (Jacobs & Sing, 2007).

Iteroparity (reproducing in multiple years) appears more common in Idaho and Montana then in Washington. High winter precipitation can increase flowering and seed set. *Mogulones cruciger*—a weevil approved for use as a biocontrol of *C. officinale* in Canada—reduces flowering and seed set (Duncan & Williams, 2020).

Source: Published research, Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Cynoglossum officinale seeds are covered in barbs that attach to animals or humans and can be transported for long distances. However, seeds are large and heavy, and are usually found within 2 meters of the parent plant (de Jong et al., 1990).

Source: Published research, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Cynoglossum officinale was likely transported to North America as a crop contaminant (Jacobs & Sing, 2007). This species also has an attractive flower and could potentially be spread as an ornamental. Seeds are very likely to be spread in clothes and the fur of domestic animals. In British Columbia one study found that 65% of seeds were dispersed by cattle (Jacobs & Sing, 2007). *Cynoglossum officinale* is frequently associated with human disturbances such as logging and heavy grazing (Andreas et al., 2008).

Source: Published research, Informal publication, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: High

One study found that leachate from *Cynoglossum officinale* seeds inhibited root growth in seedlings of other species (native and invasive), but not in *C. officinale*. Heat-killed seeds also exhibited allelopathic effects on neighboring seedlings (Rashid et al., 2005). Leachate from the leaves can also have an allelopathic effect on neighboring plants (Momayyezi & Upadhyaya, 2017).

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes (range Yes - No)

Confidence: High (range Low - High)

Cynoglossum officinale grows a long, thick taproot and develops mycorrhizal relationships that likely increase its ability to compete with other species for water and nutrients. The taproot also functions as a storage organ for the plant when it dies back to the roots in the winter (de Jong et al., 1990). A study in British Columbia found that *C. officinale* is competitive for water against co-occurring grassland species during drought (Momayyezi & Upadhyaya, 2017). Large seeds provision seedlings so they can establish strong roots after germination (de Jong et al., 1990) providing an edge over co-occurring species, though *C. officinale*'s relatively slow growth may reduce competitive advantages (Jacobs & Sing, 2007).

Genetic studies suggest that *C. officinale* populations in North America come from plants that grew on the edge of agricultural fields in this species' native range. The traits for surviving at the edge of agricultural fields might also make *C. officinale* more competitive in its introduced range (Williams & Fishman, 2014). Comparisons of populations in northwestern North America to native populations also suggest that introduced plants benefit from specialist insect release and less aggressive competition at the seedling stage (Williams et al., 2010; Duncan & Williams, 2020).

Source: Published research, Informal publication, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: Moderate

Cynoglossum officinale can form monocultural stands that exclude other vegetation (Jacobs & Sing, 2007). Seedlings tend to cluster around their parent plants (de Jong et al., 1990). A study comparing *C. officinale* populations between Montana and Germany found that populations in the introduced range were more dense than populations in the native range (Williams et al., 2010).

Source: Published research, Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Studies from Dutch sand dunes found that experimental small-scale disturbances resulted in an increase of *Cynoglossum officinale* seedlings the next spring (Klinkhamer & de Jong, 1988). In disturbance experiments done in Montana, seedlings were much less likely to survive in undisturbed plots than disturbed plots (Williams et al., 2010).

Source: Published research

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Cynoglossum creticum is on the non-native species Alert List in Australia (Weber & Panetta, 2006). *Cynoglossum lanceolatum* is considered invasive in parts of India (Sheikh & Dixit, 2017).

Source: Published research

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Cynoglossum officinale can grow in moderate shade, particularly in riparian areas disturbed by cattle. However, it grows best in full sunlight, and prefers

open habitats (de Jong et al., 1990; Jacobs & Sing, 2007).

Source: Published research, Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Cynoglossum officinale is frequently associated with disturbed and ruderal areas in both its native and introduced range. Disturbance increases establishment, growth, and recruitment in this species. For example, in its native range, *C. officinale* is known to increase in abundance after sheep grazing. In its introduced range, this species is usually found in clearcuts, pastures, grazed rangelands, and other heavily disturbed sites. (Klinkhamer & de Jong, 1988; Jacobs & Sing, 2007; Andreas et al., 2008; Williams & Fishman, 2014).

Cynoglossum officinale has a large taproot that can function as a storage organ. This species also has growing points that are at or just below the soil surface (Jacobs & Sing, 2007), suggesting that established plants may survive low or moderate severity fires. However, severe annual soil disturbance would not benefit this species, since it needs at least two years to reach reproductive age.

Source: Published research, Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: High

Cynoglossum officinale seeds generally persist only 2-3 years. Seeds are initially dormant, and stratification is required for germination. The presence of soil nitrate improves germination, and seeds are much more likely to germinate below ground than on the surface (de Jong et al., 1990). Seeds can remain attached to the parent plant for a relatively long time, creating a temporary above-ground seed bank (de Jong & Klinkhamer, 1988).

Source: Published research

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Cynoglossum has a number of physical and chemical defenses against herbivory. This species accumulates silicon in leaves, roots, and nutlets, which can make it more difficult for herbivores to chew and digest. It also produces alkaloids which can intoxicate or poison horses and cows when consumed, and in general, horses and cows won't eat *C. officinale*. It produces other defensive compounds to prevent herbivory as well. Rabbits also do not eat this species. Sheep will occasionally eat *C. officinale*, but may also be poisoned by it (de Jong et al., 1990; Cortinovis & Caloni, 2015).

Cynoglossum officinale may experience less insect herbivory in North America than in its native range (Eigenbrode et al., 2008). Some European butterfly species are able to repurpose *C. officinale*'s defensive chemicals for their own defense (de Jong et al., 1990). In the Pacific Northwest, at least some species of woolly bear caterpillars (Subfamily *Arctiinii*) will eat *C. officinale*.

Source: Published research, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics

Rating: Moderate

Confidence: Low

Very little information was found regarding *Cynoglossum officinale*'s effects on abiotic processes. One study that compared populations of *C. officinale* in Montana to populations in similar habitats in Germany found that experimentally disturbed areas in Montana had greater nitrogen content and lower colonization rates from species in the surrounding community than did experimentally disturbed habitats in Germany (Williams et al., 2010). It is

unclear whether *C. officinale* was the cause of these conditions, or merely taking advantage of them.

Source: Published Research

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Cynoglossum officinale is toxic to mammals and can prevent the establishment of desired forage species in its introduced range (Andreas et al., 2008). Disturbed sites with *C. officinale* have slower recruitment of other species (Williams et al., 2010). However, *C. officinale* populations tend not to persist over time. In its native range, this species exhibits metapopulation dynamics (that is, individual populations will go extinct while other habitat patches are recolonized). Combined with ongoing management in its introduced range, individual populations of this species may be unstable and not produce lasting structural impacts (Duncan & Williams, 2020).

Source: Published research

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Cynoglossum officinale can outcompete native species and reduces rangeland quality for both livestock and wildlife (Jacobs & Sing, 2007).

Plant species with significant chemical defenses against herbivory, like *C. officinale*, may have associational effects on their neighbors, and can either increase or decrease herbivory pressure on native species.

Source: Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

No information was found about disproportionate direct effects of *Cynoglossum officinale* on particular native species in Washington. However, biocontrol agents are not currently approved for use on this species in the U.S. because of concerns about spillover effects on co-occurring native *Boraginaceae* species in the U.S. (Duncan & Williams, 2020). One of the assessors has observed what are likely illegally introduced populations of one of these biocontrol agents (a weevil) growing in abundance near Cle Elum.

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Cynoglossum officinale establishes in areas that experience localized disturbance, and likely needs bare ground for seeds to germinate on (de Jong et al., 1990). This species is not likely to establish in undisturbed areas, but could take advantage of small-scale disturbances in mid or late successional habitats with appropriate light and moisture conditions.

Source: Published research, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Cynoglossum officinale often establishes in small-scale disturbed areas, like the entrances of rabbit warrens, in its native habitat (de Jong et al., 1990). In its introduced range, ground squirrels, gophers, and other burrowers can provide similar natural disturbances. This species also appears to be more responsive to disturbance in its introduced range than its native range (Williams et al., 2010). *C. officinale* is also common on riparian terraces, particularly where occasional flood disturbance is combined with heavy grazing.

Source: Published research, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate (range Moderate - High)

Both manual and chemical management techniques are effective in treating this species, though population mapping and treatment timing are important. Management should target seed production to prevent spread and recruitment. Herbicides, mowing, tilling, and prescribed fire can all be effective at reducing seed set. Herbicide application can make this species more palatable to livestock, increasing risks of poisonings. Manual removal should include removing root crowns to prevent resprouting, and care should be taken to prevent seed fall when pulling senesced plants. Management techniques that result in disturbance, such as burning or tilling, could also provide improved habitat for *C. officinale* colonization (Jacobs & Sing, 2007). Restoration of native vegetation communities (particularly perennial grasses) can prevent this species from colonizing or recolonizing areas.

A root-boring weevil, *Mogulones cruciger*, was approved for release as a biocontrol agent in Canada in 1997 and has significantly reduced *C. officinale* populations in British Columbia. These weevils reduce seed production by depleting stored food and limiting the ability to uptake water and nutrients from the soil (Duncan & Williams, 2020). *Mogulones cruciger* is not approved for release in the U.S. due to potential spillover effects on rare native species in the same family as *C. officinale* (Jacobs & Sing, 2007). However, populations of this weevil have migrated into the U.S., and low population numbers that result from natural migration could potentially select for weevil-resistant *C. officinale*, ultimately reducing the effectiveness of this particular biocontrol in the U.S. (Duncan & Williams, 2020).

This weevil may also have been illegally released in parts of Washington—where it is found, it appears to have reduced the population of *C. officinale*. However, even where this weevil is present and effective, dormant *C. officinale* seeds may lead to reappearance of the species.

Source: Published research, Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

None of the sources reviewed mentioned a minimum time commitment for treating *Cynoglossum officinale*. However, it seems likely that active treatment efforts need to extend long enough to exhaust the seed bank for this species, a minimum of two to three years (de Jong et al., 1990). Dormant seeds are known to re-establish populations in treated areas in Washington. Given this, ongoing monitoring coupled with restoration of native plant communities that can outcompete this species are likely necessary to prevent recolonization.

Source: Published research, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate (range Low - Moderate)

Confidence: Moderate (range Low - High)

Ongoing concerns about spillover effects of biocontrols on co-occurring native plants in the *Boraginaceae* family has prevented their approval in the U.S. (Duncan & Williams, 2020).

Several other techniques, particularly soil-tilling and broadcast herbicide spraying, can also have outsized effects on native communities, and soil disturbance without associated restoration may increase *C. officinale* abundance. Spot-spraying and dicot specific herbicides can reduce the impacts of herbicide treatments.

Source: Published research, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Cynoglossum officinale is most abundant in areas of human disturbance, particularly logging and heavy grazing (Andreas et al., 2008), suggesting populations are frequently in areas that are accessible for treatment.

Source: Published research, Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Cynoglossum officinale reduces the value of pasture and rangelands, and is poisonous to livestock, as well as reducing value of agricultural products like wool (Jacobs & Sing, 2007). Sociopolitical implications of management of this species are generally low, beyond general objections to herbicide use.

Source: Informal Publication, Professional Expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Dianthus armeria (Deptford Pink)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
Carlo Abbruzzese (Natural Areas Manager, Washington Dept. of Natural Resources)
6 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (16)	Confidence: **Moderate** (58)
Management Difficulty Rank: Insignificant (0)	Confidence: High (100)
Biological Characteristics of Invasiveness: Insignificant (27)	Confidence: Moderate (63)
Concern Related to Distribution and Abundance: Moderate (56)	Confidence: Moderate (60)

Photo Credit: Keir Morse 2016, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Dianthus armeria was assessed by multiple individuals, though both assessors conducted rapid assessments based largely on professional expertise and with minimal literature review. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

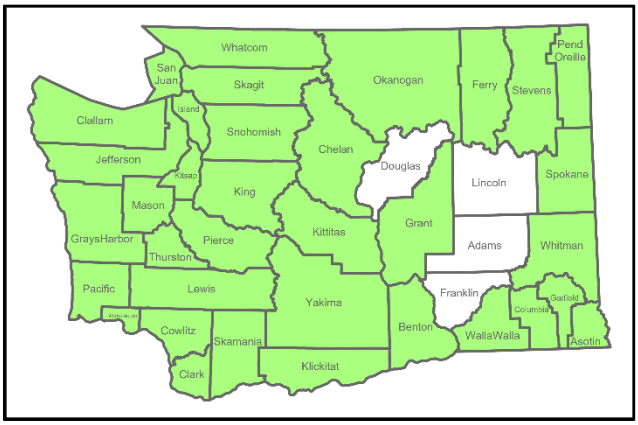

Figure 1. Distribution of counties where *Dianthus armeria* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

This species has been documented in 90% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

Dianthus armeria produces approximately 400 seeds per plant (Wells, 1967) and does not otherwise have an aggressive mode of reproduction.

Source: Published research, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Low

Seeds don’t appear to have adaptations for wind or animal dispersal.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

This species does not appear to be allelopathic and doesn't exclude other plants.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

Dianthus armeria requires soil disturbance and high light levels to germinate (Baskin & Baskin, 2001).

Source: Published research

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

There are at least two other introduced *Dianthus* species in the state (Burke Herbarium, University of Washington, 2024), but neither are commonly considered to be invasive.

Source: Professional expertise, Herbarium records

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Dianthus armeria is adapted to ecosystems with abundant direct sunlight (Wilson, 1999). One study demonstrated reduced seed production and seed mass in shaded conditions (Nightingale, 2007).

Source: Published research, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

This species is well-adapted to disturbed areas (Wilson, 1999; Stroh, 2014).

Source: Published research, Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: Yes

Confidence: High

Seeds may remain dormant for at least 40 years within the native range of this species (Wells, 1967).

Source: Published research, Professional expertise

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

Grazing is considered a threat within its native range, where *Dianthus armeria* is commonly considered Endangered or Vulnerable, so it is likely to be palatable (Wilson, 1999).

Source: Published research, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: Moderate (range Moderate - High)

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: Moderate (range Moderate - High)

This species might use nutrients that native species also use, but the impact appears minor.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low (range Low - Moderate)

Confidence: High (range Moderate - High)

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High (range Moderate - High)

This species is frequently observed in disturbed, ruderal ecosystems such as powerline corridors.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

This species is rarely a target for control as it is not considered invasive by most practitioners.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Dipsacus fullonum (Common Teasel)

Assessed by
Kimberly Quayle (Natural Areas Steward, Washington Dept. of Natural Resources)
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
Molly S. Wiebush (Washington Natural Heritage Program)
21 June 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (69) Confidence: **Moderate** (50)

Management Difficulty Rank: Moderate (67)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (76)	Confidence: High (83)
Concern Related to Distribution and Abundance: Moderate (67)	Confidence: High (80)

Photo Credit: David Giblin 2023, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Dipsacus fullonum was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Recent genetic evidence suggests *Dipsacus sativus* is a distinct species, not a subspecies or variety of *Dipsacus fullonum* (Gaskin et al., 2024), but it is considered a synonym of *D. fullonum* in the Washington Flora (University of Washington Herbarium, 2018). *Dipsacus sylvestris* is a synonym for *Dipsacus fullonum*.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

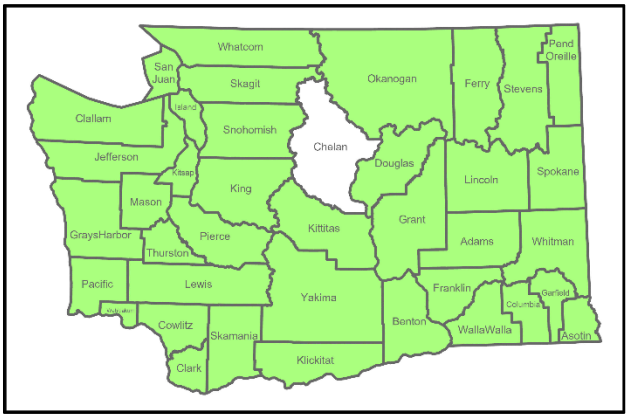

Figure 1. Distribution of counties where *Dipsacus fullonum* has been documented in Washington State (WSDA, 2018; CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Dipsacus fullonum has been documented in 97% of Washington counties (WSDA, 2018; CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium data and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: High

Dipsacus fullonum appears in most counties in Washington, with only Chelan County reporting no occurances of this species. This species appears to occur in almost all the suitable habitat available in Washington (WSDA, 2018; iNaturalist Contributors, 2023; Jarnevich et al., 2023). This species has expanded to six or seven new counties in Washington since 2012 (NWCB, 2012), with most expansions in the last 20 years limited to the northwestern part of the Columbia Plateau (CPNWH, 2023). Expansion for this species may be limited in desert habitats (Gucker, 2009).

Source: Informal publication, Professional expertise, Citizen science observations, USGS and WSDA datasets

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low (range Low - Moderate)

Confidence: High

Dipsacus fullonum appears in most counties in Washington, with only Chelan County reporting no occurances of this species. This species appears to occur, at least occasionally, in almost all suitable habitat in Washington (WSDA, 2018; iNaturalist Contributors, 2023; Jarnevich et al., 2023).

Source: Professional expertise, Citizen science observations, USGS and WSDA datasets

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate (range Low - Moderate)

Confidence: Low (range Low - Moderate)

In 2009, *Dipsacus fullonum* was described as "occasional, locally common, scattered, or infrequent" throughout its range in North America (Gucker, 2009). *Dipsacus* species have been recently described as rapidly expanding in the western U.S., especially in the Pacific Northwest (DiTomaso et al., 2013), and it appears to be occupying more riparian areas in steppe and grasslands and persisting longer (perhaps indefinitely) in Eastern Washington. Herbarium records from Washington State suggest that while this species is expanding locally, expansion appears to be relatively slow (CPNWH, 2023). The Early Detection and Distribution Mapping System predicts populations of *Dipsacus fullonum* may expand in some counties in Washington, but remain steady in most Washington counties (EDDMapS, 2023).

Source: Informal publication, Professional expertise, Herbarium records

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland

Rating: Moderate

Confidence: High

Dipsacus fullonum is usually found in disturbed areas, and prefers moist, open, sunny habitat with limited canopy cover, but can occur in both upland and wetland ecosystems. This species occurs in woodlands, forest openings, savannas, grasslands and meadows, and riparian areas. *Dipsacus fullonum* is also reported from sagebrush and juniper habitats in eastern Oregon and from inland salt marshes in Ohio, though saline conditions appear to prevent reproduction in this species (Gucker, 2009; DiTomaso et al., 2013).

Source: Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Dipsacus fullonum is biennial or a short-lived monocarpic perennial. This species only reproduces through seed and does not reproduce vegetatively.

Dipsacus fullonum plants can produce more than 3000 seeds, which have a 28%–86% germination rate. In old fields in Michigan, seed production four years post-introduction reached roughly 4500 seeds/m^2 (Gucker, 2009). *Dipsacus fullonum* produces perfect flowers but is mostly an outcrosser, though it can self-pollinate in rare circumstances (Gaskin et al., 2024). This species requires insect pollination, but has a generalist relationship with pollinators, with Hymenoptera, Diptera, and Lepidoptera all common visitors when *Dipsacus fullonum* is in flower (Werner, 1976; Gucker, 2009).

While individual plants do not produce seeds annually, many plants within a population are likely to produce a large number of seeds in any given year.

Source: Published Research, Informal Publication, Professional Expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Dipsacus fullonum is occasionally capable of natural long-distance dispersal by water, but most seeds fall within 1.5 meters of their parent plant. This species produces relatively large achenes (up to 8 mm long). These achenes float and seeds remain viable for at least 22 days in the water (Werner, 1975; Gucker, 2009). In eastern Washington, *Dipsacus fullonum* seeds are a measurable part of the diet in California quail, northern bobwhite, and pheasants. Several other birds and small rodents have been observed to eat this species' seeds (Gucker, 2009), suggesting that animal dispersal is also likely for this species.

Source: Published research, Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Dipsacus fullonum dispersal usually follows highways, roads, and other human disturbance. Mowing, particularly on highway right-of-ways, is likely a major dispersal mechanism for this species. The use of dried inflorescences in floral arrangements is also a mechanism for spread and is potentially the reason this species can be common in cemeteries. *Dipsacus* seeds are sometimes included in birdseed mixes (Gucker, 2009; Gaskin et al., 2024).

Source: Published research, Informal publication, Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not rated

Little information was found on allelopathy in *Dipsacus fullonum*. Some evidence suggests that *D. fullonum* plants can reduce germination and growth in neighboring *D. fullonum* plants (Gucker, 2009), but a literature search turned up no information on the effects of *D. fullonum* on other species, or on potential allelochemicals found in *D. fullonum* tissues.

Source: Informal publication, Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate (range Low - High)

Dipsacus fullonum is an aggressive competitor following disturbance; it is capable of excluding almost all other species once established. *Dipsacus fullonum* may even reduce *Cirsium arvense* occurances. This species has deep taproots (up to 2 feet long and an inch in diameter at the root crown) that give it access to resources that vegetation with shallower roots can't reach. Large taproots may also allow plants to store resources to survive damage or poor climate conditions, and potentially provides a growth advantage early in the growing season. *Dipsacus fullonum* also overwinters as a rosette in its first winter, providing a competitive advantage early in the spring when other species are dormant. However, this species will eventually be outcompeted by other species in the absence of periodic disturbance (Gucker, 2009).

Source: Informal publication, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Dipsacus fullonum's limited seed dispersal distance results in dense stands that can exclude all other species (Gucker, 2009). Large rosettes reduce the amount of sunlight available for other species, effectively outcompeting them for sunlight (Huarte et al., 2016) Competition for sunlight may be more important than competition for other abiotic resources in maintaining *D. fullonum* populations (Gucker, 2009).

Source: Published research, Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Soil disturbance and warm temperatures promote germination in *Dipsacus fullonum* (Huarte et al., 2016). Cover (both litter and standing) reduces germination and seedling survival rate but does not eliminate it. While capable of invading perennial grasslands in moist areas, this species generally relies on small openings created by disturbance (or the death of its parent plants) for germination (Gucker, 2009). Seedlings germinate best on open ground, but have improved survival with light ground cover that prevents desiccation (Gucker, 2009).

Source: Published research, Informal publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Dipsacus laciniatus and *Dipsacus sativus* are also invasive in North America, but *Dipsacus fullonum* is more widespread than both. *Dipsacus sativus* is common throughout the west. *Dipsacus laciniatus* spreads much more slowly than *D. fullonum* and is not widespread in the west (Gucker, 2009; DiTomaso et al., 2013; Gaskin et al., 2024). Some sources, including the Washington Flora Checklist, consider *D. sativus* and *D. fullonum* to be the same species (University of Washington Herbarium, 2018; Gaskin et al., 2024).

Source: Published research, Informal publication, Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Dipsacus fullonum grows in full sun to partial shade. Light shading from litter or established vegetation may aid in *D. fullonum* seedling establishment by preventing desiccation. However, after establishment, shading can significantly reduce seedling growth rates. Seedlings are generally found in canopy openings created by disturbance (Gucker, 2009).

Source: Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Dipsacus fullonum is an early successional species and requires periodic disturbance to maintain suitable habitat for seed germination. However, severe annual disturbance does not benefit this species because it needs at least two years of growth to reproduce. Activities like plowing, dredging, and grazing can increase this species' abundance. In Washington, grazing in *Crataegus douglasii* habitats has been observed to increase *Dipsacus fullonum* populations (Gucker, 2009).

Fire can increase *D. fullonum* populations. Large rosettes may be capable of surviving low or moderate severity fire in the same way that they survive mowing. Plants with below-ground meristematic tissue, such as *D. fullonum* (Gucker, 2009), are insulated from the heat of low and moderate severity fires by the soil (Wiggers et al., 2013, M. Wiebush, unpublished data). This could provide a competitive advantage in communities that are not adapted to fire or grazing disturbances but may not provide much

advantage in fire-dependent ecosystems (e.g., Willamette Prairie).

Source: Published research, Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: High

Dipsacus fullonum has a short-lived seed bank and produces seeds with very little dormancy—very few viable seed remain in the soil after five years. This species' seeds *can* survive longer when stored indoors (Gucker, 2009).

Dipsacus fullonum seeds germinate readily, even when immature or when inflorescences have been cut from the stem. Soil disturbance and warm temperatures promote germination. Alternating periods of light and dark and alternating temperatures may improve germination (Huarte et al., 2016), but in some cases *Dipsacus* seeds have germinated within 3 days of sowing without treatment. Maternal provisioning also affects germination, with larger seeds having higher germination rates. Freezing temperatures can induce dormancy and the presence of thick litter and established vegetation can prevent germination in *Dipsacus fullonum* (Gucker, 2009).

Source: Published research, Informal publication, Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Spines, tough stems, and bitter flavor generally make *Dipsacus fullonum* unpalatable to grazers (Gucker, 2009; DiTomaso et al., 2013), though livestock will occasionally eat *Dipsacus* flowers.

Source: Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Hydrology, Light availability, Fire

Rating: Moderate

Confidence: Moderate

Dipsacus fullonum usually occurs in moist areas where fire is less likely to spread, and dense stands of this species can further reduce the spread of fire (Gucker, 2009). The horizonal growth form of the rosettes can also reduce light availability for seeds and seedlings of co-occurring species (Werner, 1976; Huarte et al., 2016). In some systems, the deep taproot can alter water table levels if a high number of plants are present. If this species replaces natives with fibrous roots (e.g., perennial grasses), the switch to tap-rooted plants can lead to increased erosion.

Source: Published research, Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate (range Low - Moderate)

Dipsacus fullonum frequently occurs in monospecific stands, changing both density and cover of associated native species in ecosystems where it occurs. The tall biennial forb-dominated community this species creates is a departure from historical communities.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate (range Moderate - High)

Confidence: Moderate (range Moderate - High)

Dipsacus fullonum reduces the diversity and abundance of native species in the ecosystems in which it occurs. This species may also indicate reduced biotic integrity in riparian habitats, particularly related to changes in vertebrate and invertebrate composition (Ringold et al., 2008). However, it is unclear how much the loss in biotic integrity is due to the presence of invasive plants like

D. fullonum, and how much is due to co-occurring factors, such as anthropogenic disturbance (Gucker, 2009). Abundance and density of *D. fullonum* is site-dependent. Monocultural stands of this species are more likely to develop in mesic areas. In drier areas, it seems to remain persistently low in cover and is only mildly competitive with natives, likely because these areas are at the edge of suitable habitat for *D. fullonum*.

Source: Published research, Informal publications, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

No information was found on species-specific effects of *Dipsacus fullonum* on native species in Washington State.

Sources did note this species as a threat to rare plants, but effects were mostly community-wide (Gucker, 2009), such as light competition or potentially pollinator competition (based on observations during bumblebee surveys in eastern Washington.)

Seeds from this species can make up a meaningful percentage of the late season diet for a number of wildlife species (upland game birds and small mammals) (Gucker, 2009).

Source: Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate (range Moderate - High)

Confidence: Moderate (range Moderate - High)

Dipsacus fullonum is most common in disturbed areas, but it is occasionally capable of invading established native communities by taking advantage of small disturbances (e.g., frost heaves, rodent burrows) (Gucker, 2009). This species can establish, but will not persist in forest openings, usually disappearing as the canopy closes. *Dipsacus fullonum* will establish and persist in open riparian areas regardless of successional stage.

Source: Informal publication, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High (range Low - High)

Dipsacus fullonum can take advantage of natural disturbances to establish in suitable habitat (Gucker, 2009).

Source: Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate (range Moderate - High)

For short lived species like *Dipsacus fullonum*, effective management focuses on preventing reproduction. Immature seeds from cut stems can still be viable, and care needs to be taken not to spread seed during management efforts. The most consistent recommendation for managing this species is to use both mechanical and chemical control methods over multiple years. Timing of treatment is also important. Herbicide application alone may encourage seed germination by opening areas for seedlings to establish, so application efforts should include plans to prevent seedling germination or target emerging seedlings after initial herbicide application. Hand-pulling can be effective for small occurances if care is taken to remove as much of the root as possible. Reestablishing healthy native plant communities can also help in control efforts, since *D. fullonum* is less likely to establish in existing vegetation. There are currently no biocontrol options available for this species and burning or mowing alone are likely to increase its abundance (Gucker, 2009; DiTomaso et al., 2013; Gaskin et al., 2024).

Source: Published research, Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

In theory, *Dipsacus* species require 4–6 years of treatment to reduce viable seed in the seed bank (DiTomaso et al., 2013). In practice, 17 years of management efforts in Western Washington indicate that populations of *D. fullonum* may be reduced, but rarely fully controlled. Reinvasion of treated areas is quick if management is not continuous (R. Johnson, pers. comm., 2024).

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate (range Moderate - High)

Confidence: Low (range Low - High)

Discing or herbicide may cause reduction in co-occurring native species. However, the benefits of treatment could outweigh the costs in some cases, given *D. fullonum*'s dense, monospecific habit and relatively transient propagule bank. Spot treatments using herbicides can also reduce risk to native plant species.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Dipsacus fullonum is mainly spread by human activities and human disturbance (Gucker, 2009), so it is likely that the largest populations of this species are in areas that are easily accessible for management.

Source: Informal publication, Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant (range Insignificant - Moderate/Low)

Confidence: High (range Moderate - High)

Dipsacus fullonum is sold as a garden plant in the United States where it is advertised for attracting birds and pollinators, and used in floral arrangements (Gucker, 2009). However, it seems most likely that public opposition to treatment of this species would center around general objections to herbicide use or other treatment options, and not management of the species itself.

Source: Informal publication, Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Erechtites minimus (Toothed Coast Fireweed)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
Walter Fertig (Collections Manager, Marion Ownbey Herbarium, Washington State University)
31 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (38)	Confidence: **Moderate** (50)
Management Difficulty Rank: Insignificant (2)	Confidence: Low (20)
Biological Characteristics of Invasiveness: High (64)	Confidence: Moderate (46)I
Concern Related to Distribution and Abundance: High (87)	Confidence: High (80)

Photo Credit: David Giblin 2023, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Erechtites minimus was assessed by multiple individuals, though both assessors conducted rapid assessments based largely on professional expertise and with minimal literature review. Range of assessor ratings is provided in parentheses following the final assigned rating.

Some sources refer to this species as *Erechtites minima* or *Senecio minimus* (EDDMapS, 2024; iNaturalist Community, 2024).

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

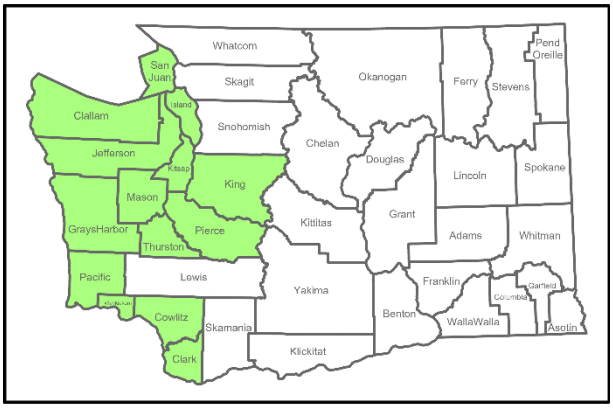

Figure 1. Distribution of counties where *Erechtites minimus* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: Moderate

Erechtites minimus is found in 14 of 39 counties and 3 of 9 ecoregions in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). A report from Spokane County (SEINet Portal Network, 2023) is a misidentified specimen.

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

At least 18 new occurrences have been documented with herbarium collections since 2020. The number of iNaturalist reports has also increased significantly (though some of those observations need to be verified) (SEINet Portal Network, 2023; CPNWH, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations.

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High (range Moderate - High)

Confidence: High

Erechtites minimus was documented at Mt. Rainier National Park in 2013, suggesting the species may be able to spread outside of its primary distribution center west of the Cascade crest. This species is probably under-reported from private lands in the southern Pacific Coast Range (where it is spreading rapidly along logging roads and trails). It is also likely to spread along the coast in Whatcom, Snohomish, and Skagit counties. So far, reports from eastern Washington are erroneous, but it has potential to spread to the East Cascades and potentially along the upper Columbia and Snake Rivers (SEINet Portal Network, 2023; CPNWH, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

The assessors have documented over 10 new sites where *Erechtites minimus* is present in natural areas in western Washington since 2020 (this is likely an undercount). This species is still under-the-radar for many biologists and can be easily overlooked when not in flower (vegetatively, it is easy to dismiss as *Solidago serra* or *Senecio* spp.).

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore

Rating: Moderate

Confidence: Moderate

This species is occasionally observed in wetlands, but generally only on elevated microsites.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Unknown

Confidence: Not Rated

Martin and Popenoe (1984) found that buried *Erechtites* spp. seeds were more abundant than any other species in an old-growth redwood forest.

Source: Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

This plant produces wind-dispersed seeds.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

This plant has primarily been observed along roadways and other areas of anthropogenic disturbance.

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Erechtites species are considered by some to be weak competitors with high nutrient demands (Muldavin et al., 1981). However, at least one species (*E. hieraciifolius*) may be facultatively mycorrhizal, which might explain its rapid spread in arid grasslands of coastal California (L. Allen, pers. comm. as cited in Cal-IPC, 2024).

Source: Informal publication, Professional expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

This species can be very common following disturbance, but is usually replaced within 5-10 years (Muldavin et al., 1981).

Source: Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Closely related *Erechtites hieraciifolius* requires disturbance for germination (Baskin & Baskin, 1996; Elliott et al., 1997). However, in some ecosystems, *Erectites* species may not always require disturbance to become established (Halvorson, 1992).

Source: Published research, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

There are no other *Erechtites* species in the Washington Flora, but *E. hieraciifolius* is considered invasive or a potential weed in Hong Kong, Hawaii, the Galapagos Islands, French Polynesia, Palau, US Minor Outlying Islands, New Zealand, Australia, and Hungary (Rojas-Sandoval, 2017).

Source: Informal publication, Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

All *Erechtites* species are considered shade-intolerant (Elliott et al., 1997).

Source: Published research, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

This species spreads rapidly following disturbance, particularly fire (Muldavin et al., 1981).

Source: Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: >5 years

Confidence: Low

Baskin and Baskin (1996) found that 89 percent of seeds from closely related *E. hieraciifolius* were viable after eight years of burial.

Source: Published research, Professional expertise

Q17: Palatability

Rating: Unknown

Confidence: Not rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: Low

Treatment efforts are not known from Washington. Reports from similar ecosystems in California indicate that *Erechtites minimus* is an ephemeral plant that does not require active management (Muldavin et al., 1981).

Source: Informal publication

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: Low

See Q24

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

This plant has primarily been observed along roadways and other accessible locales.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Public objections to treatment of this species are unlikely to rise above general concern regarding herbicide use.

Source: Professional expertise

Additional Comments

The Invasive Plants of California's Wildlands provides an excellent synthesis of information regarding this and related species in California (Cal-IPC, 2024).

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Muldavin E.H., J.M. Lenihan, W.S. Lennox, and S.D.Jr. Veirs. 1981. Vegetation succession in the first ten years following logging of coast redwood forests. National Park Service, Redwood National Park, Arcata, California. Technical Report #6.

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Washington Invasive Ranking System

Washington Natural Heritage Program

Fallopia × *bohemica* (Bohemian Knotweed)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
14 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **High** (92) Confidence: **High** (75)

Management Difficulty Rank: High (93)	Confidence: High (80)
Biological Characteristics of Invasiveness: Not Rated	Confidence: Not Rated
Concern Related to Distribution and Abundance: High (89)	Confidence: Low (20)

Photo Credit: Scot Loring 2018, used under Creative Commons license (CalFlora, 2024).

Ranking Notes

Rapid assessments only, based primarily on professional expertise.

Many closely related knotweeds (*Fallopia*) also have high ecological impacts.

Legal Listings

Washington State Weed Board: Class B, Washington State quarantine list

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

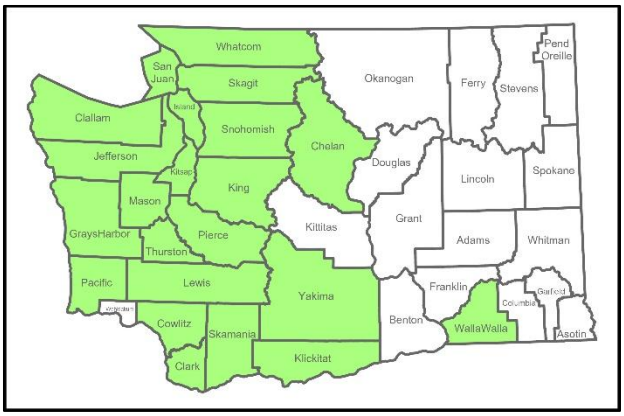

Figure 1. Distribution of counties where *Fallopia x bohemica* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

This taxa is found in 56% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Not Rated

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Low

This taxa is already present in 56% of counties of Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Rating: Not Rated

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Not Rated

Rating: Not Rated

Confidence: Not Rated

Source:

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Not Rated

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Not Rated

Confidence: Not Rated

Source:

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Not Rated

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: Not Rated

Confidence: Not Rated

Source:

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Not Rated

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q15: Disturbance Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q16: Propagule Persistence

Rating: Not Rated

Confidence: Not Rated

Source: Not Rated

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Hydrology

Rating: High

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

This plant readily invades sparsely vegetated cobble bars before native willows may establish. It may also convert herbaceous marshes into monocultural shrublands.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: High

Confidence: High

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional Expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q27: Inaccessibility of Invaded Areas

Rating: High

Confidence: High

Plants readily spread along river drainages and frequently occur on cobble bars and other sites that are difficult to access.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

This plant is often seen as an attractive ornamental and may serve as forage for honeybees. Perhaps more significantly, because of the way it spreads along major river drainages, management generally requires coordinated efforts across multiple jurisdictions and between public and private parties.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Hieracium pilosella (Mouse-ear Hawkweed)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
25 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (50)	Confidence: **High** (67)
Management Difficulty Rank: High (75)	Confidence: High (90)
Biological Characteristics of Invasiveness: High (73)	Confidence: High (83)
Concern Related to Distribution and Abundance: Low (38)	Confidence: High (70)

Photo Credit: David Giblin 2021, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessments only, based primarily on professional expertise.

The Washington State Weed Board tracks *Hieracium* subgenus *Pilosella*, which includes the species assessed in this document. Legal listings are tracked at the level of subgenus. Otherwise, the information in this document is provided at the level of species.

Legal Listings

Washington State Weed Board: *Hieracium* subgenus *Pilosella* is Class B, and all non-native *Hieracium* species and their hybrids are on the Washington State quarantine list.

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

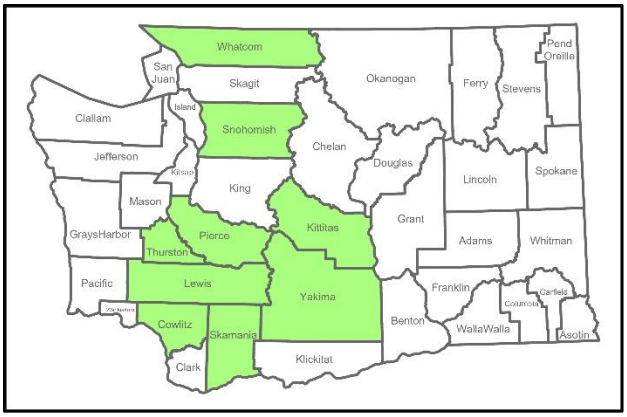

Figure 1. Distribution of counties where *Hieracium pilosella* has been documented in Washington State (CPNWH, 2024; iNaturalist Community, 2024).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: Low

Confidence: High

Hieracium pilosella is present in 23% of counties in Washington (CPNWH, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland

Rating: Low

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

This quick-growing species is stoloniferous.

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional Expertise

Q9: Allelopathy

Rating: Yes

Confidence: Low

At least one source describes exotic hawkweeds as potentially allelopathic (Czarapata, 2005).

Source: Professional Expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

This species forms contiguous mats.

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

Hieracium pilosella is a weed of both human and natural disturbance.

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

Source: Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Hieracium pilosella has been observed to exclude native prairie species.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

Hieracium pilosella establishes in disturbed ecosystems.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

This plant establishes in high-disturbance native ecosystems like prairies.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

This plant requires continual patrolling. It is cryptic due to its small size and coexistence with many other yellow asters (e.g., *Hypochaeris*). Reinvasion is frequent.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: High

Source: Professional expertise

Q27: Accessibility of Invaded Areas

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Objections to management are unlikely.

Source: Professional expertise

Additional Comments

None

References

Burke Herbarium, University of Washington. 2024. Burke Herbarium Image Collection. https://burkeherbarium.org/imagecollection. Accessed: December 17, 2024.

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iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.

Washington Invasive Ranking System

Washington Natural Heritage Program

Holcus lanatus (Common Velvet-grass)

Assessed by
Molly S. Wiebush, Washington Natural Heritage Program
30 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (59)	Confidence: **Moderate** (42)
Management Difficulty Rank: High (75)	Confidence: Moderate (50)
Biological Characteristics of Invasiveness: High (70)	Confidence: High (71)
Concern Related to Distribution and Abundance: High (87)	Confidence: High (100)

Photo Credit: David Giblin 2023, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

None

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

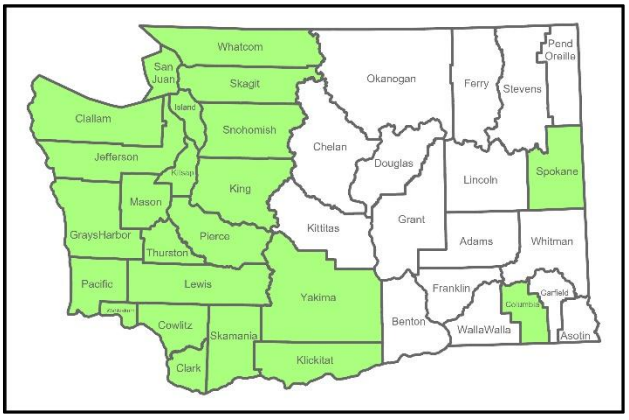

Figure 1. Distribution of counties where *Holcus lanatus* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Holcus lanatus is found in 59% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: High

Based on herbarium records and iNaturalist observations, *Holcus lanatus* is increasing in abundance and range west of the Cascades, but total range has not expanded east of the Cascades in the last 20 years (CPNWH, 2023; iNaturalist Contributors, 2023). Models predict that suitable habitat for this species is available in all counties in Washington State (EDDMapS, 2023).

Source: Herbarium records and other observations.

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Models predict that *Holcus lanatus* will expand into all counties in Washington, though it will remain most abundant west of the Cascades (EDDMapS, 2023).

Source: Model predictions.

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

Over the last 20 years, *Holcus lanatus* abundance and local range appears to have increased rapidly west of the Cascades, particularly around Puget Sound (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland

Rating: High

Confidence: High

Holcus lanatus is found in pastures, grasslands, wet and mesic meadows, and open forests and woodlands of all successional stages. In Washington, this species is also known from coastal scrub communities. This species is abundant in Willamette Prairie and oak woodland communities. This species is most competitive moist conditions but can grow well in wet conditions and survive moderate drought. In the Pacific Northwest, this species is generally known from areas with cool, wet, and relatively snow-free winters and warm, dry summers. It can be killed by heavy frosts. Throughout its introduced range, *H. lanatus* is frequently found in poor, shallow and/or acidic soils. *Holcus lanatus* commonly occurs with other introduced species such as *Daucus carota*, *Anthoxanthum odoratum*, and *Agrostis gigantea* (Gucker, 2009; Conner et al., 2013).

Source: Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Holcus lanatus is a perennial that can live for several decades in moist habitats. It is comparatively short-lived (2–4 years) in dry habitats and can even grow as an annual on the east coast of North America.

Holcus lanatus usually reproduces from seed but can also reproduce vegetatively by tillering or rooting from stem nodes. This species may need to experience cold temperatures to set flowers. Seed production requires cross-pollination. In coastal California, *H. lanatus* was found to produce 6000–19,000 seeds per square meter (depending on the density of the adult population) (Gucker, 2009). Seed

production in *H. lanatus* can be up to four times greater than that of native species in these habitats (Bennett et al., 2011). Seeds have high germination rates (frequently 90% or greater) (Gucker, 2009). *Holcus lanatus* can also produce seeds in its first year (Thomsen & D'Antonio, 2014).

Source: Published research, Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Low

Holcus lanatus seeds can be dispersed short distances by wind. A study in California found that most seeds fell within 17 feet of the parent plant. Animals may also disperse seeds, though they do not survive traveling through the digestive tract in all species. Seeds float easily and may be dispersed by water, though it is unknown how floating in water might affect seed viability (Gucker, 2009).

Source: Informal publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Holcus lanatus was likely introduced to North America multiple times, both as a crop contaminant and as a forage species. Seeds can be moved by equipment, with mowing equipment particularly noted (Gucker, 2009; Conner et al., 2013).

Source: Informal publication

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Holcus lanatus is likely mildly allelopathic. Extracts from this species have been shown to reduce growth in both *H. lanatus* seedlings and the seedlings of other species (Gucker, 2009; Bennett et al., 2011).

Source: Published research, Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Studies in California and the Pacific Northwest have found *Holcus lanatus* to be highly competitive. This species can crowd out both native and other introduced species where it occurs. Rapid growth of seedlings allows *H. lanatus* to quickly exclude other species when it colonizes new sites. It also creates thick litter which can prevent other species from establishing. This species can grow a higher proportion of roots to above ground biomass than many neighboring grass species, which also increases its competitive ability. In the winter, *H. lanatus* stores nutrients in its thick mat of roots (Gucker, 2009; Bennett et al., 2011; Conner et al., 2013).

Experimental studies in coastal prairies in California found that *H. lanatus* biomass was less affected by competition from neighboring plants. In contrast, other species in the study showed the greatest biomass reduction when planted with *H. lanatus* (Gucker, 2009). In another experimental study in California, direct competitive effects of *H. lanatus* had the greatest impact on co-occurring native forb *Erigeron glaucus* (Bennett et al., 2011).

Source: Published research, Informal publication

Q11: Growth Form

Rating: Yes

Confidence: High

Holcus lanatus is reported to form dense stands that exclude native species from several parts of its invasive range, including Hawaii, coastal California, and Willamette Prairie habitats in the Pacific Northwest (Gucker, 2009; Bennett et al., 2011) In California, concerns about this species center on its ability to form monocultural stands and reduce species diversity where it occurs (Ender et al., 2017). Restoration professionals in the Willamette Valley are also concerned about this species' ability to crowd out desirable species and reduce diversity in Willamette Prairie habitats.

Source: Published research, Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Seeds germinate best in full light on the top of the soil, and a study in coastal prairie in California found much greater germination success for this species in areas without litter. However, the same study also found that *H. lanatus* had higher germination rates than co-occurring native grass species when all were buried under litter. Still, soil disturbance is frequently an important contributing factor in *H. lanatus* invasion, particularly in shaded or forested areas, and this species generally appears to require openings to induce germination (Gucker, 2009; Conner et al., 2013).

Source: Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Holcus mollis also occurs in the Pacific Northwest and is predicted to expand throughout Washington, but this species is much less abundant at this time than *H. lanatus* (EDDMapS, 2023). The Washington Natural Heritage Program considers both species to be invasive for the purposes of Ecological Integrity Assessments (Rocchio et al., 2024).

Source: Reported observations and model predictions

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

In western Oregon, *Holcus lanatus* is most abundant in open areas. At least one study in Oregon found that *Holcus lanatus* seedlings did not grow as well when shaded (Gucker, 2009). However, this species can still be found in shaded areas and will grow in forests if disturbances occur to promote colonization. For example, this species has been found in *Alnus rubra* stands along the Hoh River in Olympic National Park. In Oregon and Washington, this species can frequently occur with *A. rubra* in areas with a history of disturbance (Gucker, 2009).

One study in California coastal prairie found that shade structures or shading by nearby plants could improve survival of *H. lanatus* seedlings in disturbed areas where it co-occurred with native *Bromus carinatus*. Shade may increase soil moisture available to seedlings in prairies. In contrast, shade reduced survival of *H. lanatus* in disturbed areas where it co-occurred with native *Festuca* or *Calamagrostis* species. Perhaps light is a more important resource in competitive interactions with those species. The study authors suggest that treatments that increase light availability (e.g., mowing, grazing, burning) may increase *H. lanatus* abundance in some circumstances. Propagule pressure may increase the likelihood of this species expanding into shaded areas (Thomsen & D'Antonio, 2014).

Source: Published research, Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Holcus lanatus is associated with disturbance throughout its range. Soil disturbance increases germination of this species and disturbance (or previous history of disturbance) may result in invasion by this species even in shaded forest conditions (Thomsen & D'Antonio, 2014). Soil disturbance from logging promotes establishment and/or increased cover of *H. lanatus. Holcus lanatus* was documented colonizing debris flows following the Mount St. Helens eruption (Gucker, 2009). A study in California suggests that large-scale disturbance is more likely to promote this species than small-scale disturbance (Thomsen & D'Antonio, 2014).

Grazing and trampling may reduce abundance of this species, but older plants can develop a tolerance for grazing. This species is likely killed by fire and establishes post-fire from the seed bank. In Washington this species has persisted in areas with

frequent (yearly) fire for over 50 years (Gucker, 2009).

Source: Published research, Informal publication

Q16: Propagule Persistence

Rating: >10 years

Confidence: Moderate

Seed banks may be important for *Holcus lanatus'* ability to colonize disturbed areas. Seeds are not innately dormant, but dormancy can be induced. At least one source reported that many seeds can remain viable in the soil for up to 12 years. Other sources report seed viability of only 1–4 years. *Holcus lanatus* produces abundant seeds, with one study reporting 16,900 seeds per meter square in samples from the top two inches of soil in a natural habitat (Gucker, 2009). Seeds are eaten by vertebrates and earthworms in this species' native range (Gucker, 2009; Conner et al., 2013).

Source: Informal publication

Q17: Palatability

Score: No, plant is palatable

Confidence: Moderate

Some sources regard *Holcus lanatus* as unpalatable or not preferred by grazers, but most literature suggests some degree of palatability. Grazing by both cattle and elk are known to reduce the abundance of this species. *H. lanatus* can provide up to 40% of a Tule elk's diet at Tomales Point, in California (Gucker, 2009). One study found that elk grazing at Tomales Point reduced *H. lanatus* abundance, cover, biomass, and seedling establishment in open grasslands (Ender et al., 2017). This species is also an important food source for elk near Mount St. Helens (Gucker, 2009). In addition, *H. lanatus* is eaten by birds and has become an important food source for California Quail (Gucker, 2009). Plants are at their most nutritious when vegetative (Gucker, 2009).

Source: Published research, Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Fire, Nutrient dynamics

Rating: Low

Confidence: Low

Increased litter from *Holcus lanatus* could potentially change fuel loads and fire behavior. Litter accumulation also reduces germination of native grasses (Gucker, 2009). This species can also increase nitrogen content in the soil. (Bennett et al., 2011). *Holcus lanatus* changes soil communities, increasing bacteria, decreasing mycorrhizal fungi, and reducing detritivores. These effects on the soil community (particularly reduction of mycorrhizal fungi) continue, and can have larger effects on the plant community, even after removal of *H. lanatus* populations (Bennett et al., 2011).

Source: Published research, Informal publication

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

In a study from Europe, *Holcus lanatus* was able to limit the growth of seedling birch trees, but it is unknown if this species can outcompete tree seedlings in the Pacific Northwest. Production of abundant litter can reduce available habitat for co-occurring species to germinate in (Gucker, 2009).

Source: Informal publication

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: Moderate

When left untreated, *Holcus lanatus* populations can outcompete neighboring vegetation and will significantly reduce community biodiversity (Conner et al., 2013). This species changes soil communities, increasing bacteria, decreasing mycorrhizal fungi, and reducing detritivores. These effects on the soil community (particularly reduction of mycorrhizal fungi) continue, and can have larger effects on the

plant community, even after removal of *H. lanatus* populations. For example, a study in California coastal prairie found *Erigeron glaucas*, a native forb, still experienced lower growth rates in areas where *H. lanatus* had been removed, likely because of the changes to the microbial community (Bennett et al., 2011).

Holcus lanatus is part of a suite of introduced perennial grasses that reduce diversity of native plants in Willamette Prairie communities.

Source: Published research, Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Low

Confidence: Low

Holcus lanatus is part of a suite of introduced perennial grasses that threaten rare butterflies such as the Taylor's Checkerspot and Mardon Skipper that depend on open prairie-oak grasslands and savannas for habitat. *Holcus lanatus* can crowd out or hide host species important for butterfly larvae (Schultz et al., 2011).

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Holcus lanatus can invade at least some grasslands without disturbance to aid establishment (e.g., *Bromus carinatus* dominated areas in California's coastal prairies) (Thomsen & D'Antonio, 2014). Seed banks for this species can be extensive in both disturbed and undisturbed sites throughout its range, and increase in propagule pressure can increase likelihood of establishment in undisturbed areas (Gucker, 2009; Thomsen & D'Antonio, 2014).

Source: Published research, Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Holcus lanatus establishes in naturally disturbed areas in California's coastal prairies (Thomsen & D'Antonio, 2014) and is a common invader in Garry oak woodlands, Willamette Prairie, and other grasslands in the Pacific Northwest (Gucker, 2009). Grasslands and woodlands in wet climates like western Washington, are maintained by disturbances like fire and grazing.

Source: Published Research, Informal Publication, Professional Expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate

Management suggestions for *Holcus lanatus* focus on removal and monitoring to prevent re-establishment from the seed bank. The large amount of seed produced may make this species difficult to control. Hand-pulling or hoeing plants is highly effective (Conner et al., 2013). Tilling larger populations may have a similar effects, though at least one source recommended turning the soil to a 14 inch depth to prevent recolonization from the seedbank (Gucker, 2009)—such intense soil disturbance is not practical in ecosystems that retain native plants. Removal of above ground biomass through fire, mowing, or grazing can be successful, but must be timed to prevent reproduction. If mechanical treatments like mowing or tilling are used, equipment needs to be cleaned to prevent moving seed. Correctly timed herbicide applications can also be effective, and *H. lanatus* is vulnerable to several herbicides. Some of these herbicides have wide-ranging effects on a broad suite of species, but this species' distinctive appearance may make it relatively easy to target (Gucker, 2009; Conner et al., 2013).

In California, *H. lanatus* is regarded as a severe threat to coastal prairies (Bennett et al., 2011), but generally, this species is a larger problem in western Oregon and

Washington grasslands than it is in California (Conner et al., 2013).

Source: Published research, Informal publication

Q25: Minimum Time Commitment

Rating: High

Confidence: Low

Minimum time commitments for treating *Holcus lanatus* invasions were not reported in available literature, but seed longevity suggests that it could take at least 10 years to exhaust the seed bank. Ongoing monitoring coupled with restoration of native plant communities are needed to prevent recolonization (Gucker, 2009; Conner et al., 2013).

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: High

Confidence: High

At least some of effective treatments for *Holcus lanatus* may be highly disruptive to co-occurring native species. For example, deep soil-tilling can result in loss of seed banks and propagules for native species. At least some of the effective herbicides for *Holcus lanatus* also affect a broad range of other plant species (Conner et al., 2013), which can also result in long-term changes to native plant communities.

Source: Informal Publication, Professional Expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Holcus lanatus is likely to be spread to new locations by human activity and most of the records for this species are from populated areas in western Washington, suggesting that most invaded areas are relatively accessible (Gucker, 2009; CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Informal publication, Professional expertise, herbarium records and other observations

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Public objection to treatment is unlikely, beyond broad concerns about herbicide application.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Ilex aquifolium (English Holly)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
21 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (88)	Confidence: **High** (75)
Management Difficulty Rank: High (75)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (90)	Confidence: High (75)
Concern Related to Distribution and Abundance: High (93)	Confidence: High (80)

Photo Credit: David Giblin 2022, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Ilex aquifolium was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Ilex aquifolium escapes in the U.S. are domesticated cultivars, so information on species biology and ecology were taken from research done in the U.S., when possible. Studies from *I. aquifolium's* native range frequently target wildtype plants that are less competitive than cultivars bread by horticulturalists, meaning comparisons between the two populations may not be relevant (Valladares et al., 2005).

Legal Listings

Washington State Weed Board: Monitor list. However, many counties in Washington actively control this species.

Washington Invasive Species Council: No

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Section 1: Distribution and Abundance

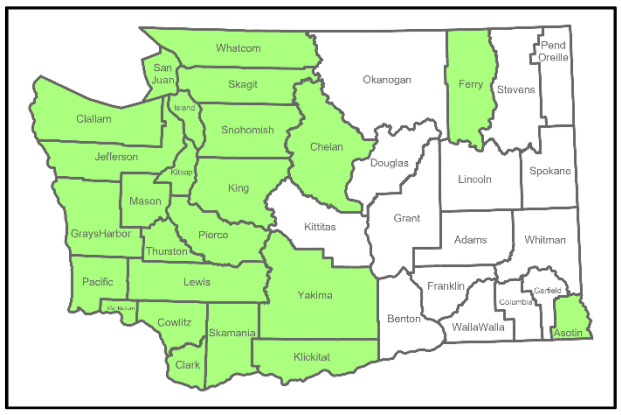

Figure 1. Distribution of counties where *Ilex aquifolium* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Ilex aquifolium is reported from 24 out of 39 counties (62%) in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

Ilex aquifolium populations are mostly limited to the west side of the Cascades in Washington, though this species has been reported twice from Ferry County and once from Asotin County in eastern Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). However, models predict that this species is capable of spreading to all counties in Washington (EDDMapS, 2024).

Source: Professional expertise, Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Ilex aquifolium has been reported from 59% of the counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). However, this species' potential range encompasses the entire state (EDDMapS, 2024), suggesting it is still capable of significant expansion.

Source: Professional expertise, Herbarium records and other observations, Model predictions.

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: Moderate (range Moderate - High)

Research supports rapid local expansion of *I. aquifolium* populations in western Washington (Church, 2016). The earliest recorded escaped *I. aquifolium* observations are from the 1960s, the first herbarium collection was made in 1987, and by 2010, naturalized populations had been documented in all urban areas west of the Cascades (Zika, 2010).

A study at St. Edward's Park in Seattle found that *I. aquifolium* had an average density of 55 stems per hectare in 2012. Data found the population established in 1966, showed little mortality and exhibited exponential growth with no sign of slowing (Stokes et al., 2014). This also indicates that *I. aquifolium* is increasing locally at the same time as expanding its range in Washington.

iNaturalist observations also indicate that *Ilex aquifolium* may be rapidly infilling habitat in western Washington (iNaturalist Community, 2024), though such trends may be tied to an increasing user base.

Source: Published research, Professional expertise, iNaturalist observations, Thesis

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Forested Wetland

Rating: Moderate

Confidence: Moderate

Ilex aquifolium invades mesic forests, woodlands, and riparian areas, as well as disturbed sites such as roadsides and edge habitats (Zika, 2010). This species' ability to invade undisturbed forests has the

potential to significantly alter forest understory and structure in Washington (Stokes et al., 2014). *Ilex aquifolium* may not be particularly cold or drought tolerant (Valladares et al., 2005; Pachura et al., 2021) and appears most successful in western Washington.

Source: Published research, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Ilex aquifolium is dioecious and reaches reproductive age at approximately 15 years. This species reproduces readily both vegetatively and from seed, grows rapidly, and sprouts readily from both living and cut stems. Vegetative reproduction occurs via suckers, layering, and roots. Thickets expand from a founder tree by means of root suckers and adventitious roots, and can also root from limbs or trunks where they touch the ground (Zika, 2010; Stokes et al., 2014; NWCB, 2022). While *Ilex aquifolium* can experience relatively rapid growth for a tree, invasions by tree species move slowly and can go unnoticed until populations are well-established and difficult to control (Church, 2016).

A study in western Washington found that consumption and regurgitation by American Robins (the most common seed dispersal mechanism for *I. aquifolium*) did not affect germination. The same study found that seed predation by rodents is rare in urban areas, but that rodents consume up to 39% of dispersed *I. aquifolium* seeds outside of urban areas. In forested areas, up to 76% of seeds were either damaged or non-viable. Differences in seed predation may explain why *I. aquifolium* is generally more abundant in urban and residential areas than in natural areas (Zika, 2010).

Source: Published research, Informal publication, Thesis

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Ilex aquifolium is dispersed by many frugivorous birds, which may prefer holly berries to native fruits (NWCB, 2022). These birds aid dispersal to remote places (e.g., seldom visited islands in the San Juan Islands) (NWCB, 2022). American Robins are by far the most common consumer of *Ilex* fruits in western Washington (Zika, 2010). Robins account for 96% of *I. aquifolium* fruit consumption and observations suggest that they are excellent and prolific long-distance dispersal agents for *I. aquifolium* seeds (Zika, 2010).

Source: Published research, Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Ilex aquifolium is a popular ornamental, planted both for appearance and for backyard habitat. This species also grows well in disturbed areas and edge habitats created by human activities (Zika, 2010). Timber harvest may also increase growth and abundance in *I. aquifolium* populations (Church, 2016).

Source: Published research, Thesis

Q9: Allelopathy

Rating: Yes

Confidence: Low

A literature search did not find information regarding allelopathy in *Ilex aquifolium*. However, other species of *Ilex*, such as *Ilex paraguariensis* (yerba mate) and *Ilex vomitoria* (yaupon), are known for their caffeine content, which can function as an allelopathic chemical in plants. Other *Ilex* species produce saponins, which may also be allelopathic (Coelho et al., 2010). *Ilex aquifolium* does not produce caffeine. However, it does produces a suite of other secondary compounds (Pachura et al., 2021), including known defensive chemicals (Valladares et al., 2005). At least some of these chemicals may be allelopathic.

Source: Published research, Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Studies have found reduced native vegetation cover beneath *I. aquifolium* canopies, with the densest thickets completely excluding native plants (Stokes et al., 2014). *I. aquifolium* can grow deep roots (NWCB, 2022)—in its native range, it frequently grows in nitrogen deficient soil (Valladares et al., 2005). Studies from its native range also suggest that *Ilex aquifolium* is less competitive at cooler temperatures (Valladares et al., 2005).

Source: Published research, Informal publication, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Ilex aquifolium is capable of developing dense monocultural stands that exclude all other species (Stokes et al., 2014). This species may form dense evergreen foliage all the way to the ground, and it suckers and layers readily. It creates a thick skirt of fallen leaves at its base, which allows the lower branches (now buried) to root. When knocked down by falling limbs and trees, it roots wherever it touches the ground, so individual plants can have many rooted stems.

Source: Published research, Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Research from Spain, within *Ilex aquifolium*'s native range, found that this species germinated best at forest edges, but was also capable of germinating within forests and grasslands. No information was found indicating that this species requires open ground to germinate, but given its ability to invade undisturbed areas and its habit as a late successional species in its native range (Arrieta & Suárez, 2004), it seems likely that this species does not require bare soil for germination.

Source: Published research, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

As of 2010, *Ilex opaca* and *Ilex crenata* have very occasionally been documented as escapes in Washington (one individual of *I. opaca* in King County and two individuals of *I. crenata* in Snohomish County) (Zika, 2010). Neither of these species are regarded as invasive in Washington, but *Ilex crenata* is considered invasive on the east coast of the U.S. (EDDMapS, 2024). Another introduced species, *Ilex cornuta*, is invasive in the southeastern U.S. (EDDMapS, 2024). *Ilex vomitoria* can also be invasive in parts of the U.S. outside of its native range (Schnelle, 2019).

Source: Published research, Professional expertise, Informal publications, reported observations

Q14: Shade Tolerance

Rating: High

Confidence: High

In Washington, this species has established in the understory throughout westside forests, in both disturbed and undisturbed areas, and can also be found in clearcuts, oak woodlands, or other areas with full or partial sun.

In its native habitat, *Ilex aquifolium* is a late-successional species (Arrieta & Suárez, 2004). Research from Spain suggests that in cool and wet climates, *I. aquifolium* can survive in sunny areas, but in hot, dry climates, *I. aquifolium* is constrained to shaded areas. Seedlings have greatest survival in 12% sunlight and minimal survival in both full shade and full sun. In areas with deep shade, *I. aquifolium* reproduces vegetatively and not via seed (Valladares et al., 2005).

Source: Published research, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Ilex aquifolium is described as a late-successional species in its native range (Arrieta & Suárez, 2004). However, in Washington this species is also found in disturbed areas (NWCB, 2022) and is common in urban and residential areas, along roadways and in other anthropogenically disturbed sites (Zika, 2010). *Ilex aquifolium* resprouts readily after cutting, and layers from branches and trunks if plants are knocked down.

Source: Published Research, Informal Publication, Professional Expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

A study from Spain, within the native range of *Ilex aquifolium*, found that the seedbank was 80%–90% depleted after three years. This species has seeds with woody outer shells and underdeveloped embryos, requiring a year of dormancy before seeds can germinate. Seeds break dormancy in grasslands and edges sooner than in woodlands. Estimated seed bank persistence is three to five years (Arrieta & Suárez, 2004).

Source: Published Research

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Herbivory results in increased spine development in *Ilex aquifolium* leaves and the bark produces defensive chemicals (e.g., methanol) that deter herbivory (NWCB, 2022). This species also produces a suite of other secondary compounds, several of which are herbivory defensive mechanisms (Valladares et al., 2005).

Cows and horses will browse *I. aquifolium* in the winter in this species' native range (Arrieta & Suárez, 2004). However, this does not suggest that *I. aquifolium* is preferred over other species.

Source: Published Research, Informal Publication, Professional Expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Fire, Nutrient dynamics, Light availability, Chemistry

Rating: High (range Moderate - High)

Confidence: High

Ilex aquifolium can reduce light availability to understory communities by establishing a new sub-canopy tree or shrub layer in both logged and unlogged forests (Stokes et al., 2014). *Ilex* thickets may increase fire risk in invaded forests because it is highly flammable and potentially creates a new sub-canopy layer (Stokes et al., 2014; NWCB, 2022). On the other hand, when ignitions occur, stand-replacing fires are already the historical norm in the western Washington ecosystems where *Ilex aquifolium* is most prevalent.

Ilex aquifolium also affects nutrient cycles and soil chemistry, increasing sulfur content and lowering soil pH (NWCB, 2022). It grows in thickets that can shade out other understory species (Stokes et al., 2014). In western Washington, this species is also drought-tolerant relative to many native species. Because *I. aquifolium* is difficult to manage, changes to ecosystem processes may effectively be irreversible.

Source: Published research, Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate (range Moderate - High)

Ilex aquifolium is capable of creating a new sub-canopy layer in invaded forests and woodlands in Washington (Stokes et al., 2014). This species is most competitive in shaded conditions (Valladares et al., 2005), making conversion of grasslands to shrublands

or woodlands unlikely. However, in cool, wet climates, *I. aquifolium* can survive in full sun (Valladares et al., 2005), suggesting that this species may also be able to invade grasslands in western Washington, at least occasionally.

Source: Published research, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

In Washington, native plant cover may be reduced or absent beneath dense *Ilex aquifolium* canopies (Stokes et al., 2014) and this species can all but eliminate native tree and shrub recruitment. In oak woodlands, *I. aquifolium* can occur with a suite of other invasives, including *Cytisus scoparius* and *Rubus bifrons*.

Source: Published Research, Professional Experience

Q21: Impact on Particular Native Species

Rating: Low

Confidence: Moderate

Ilex aquifolium can be a host for the invasive plant pathogen sudden oak death (*Phytophthora ramorum*) (NWCB, 2022; USDA APHIS, 2024). No data was available on how this changed disease burden in oaks. However, at least one study found this disease to be common in the Pack Research Forest in western Washington (Church, 2016).

Source: Informal publication, Professional expertise, Thesis

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: High

Confidence: High

Ilex aquifolium is described as a late successional species in its native range (Arrieta & Suárez, 2004) and has been documented as naturalized in old-growth forests west of the Cascades (Zika, 2010).

Source: Published research, Professional experience

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Ilex aquifolium can invade oak woodlands, which rely on disturbance to maintain their structure and composition. This species is also known from edges habitats and other disturbed areas.

Source: Professional experience

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Ilex aquifolium is expensive and time-consuming to manage. Mechanical removal (pulling and cutting) can be effective, if monitoring continues after removal. Removal is most effective when combined with chemical treatments to prevent or reduce suckering from cut stumps. The leaves are resistant to foliar herbicide due to their thick, waxy cuticles. Injecting trees with herbicide is the most effective—and expensive—option (NWCB, 2022).

Ilex aquifolium's ability to root from its lower branches or anywhere a limb or trunk touches the ground means that basal herbicide injections are difficult. Each plant can have many rooted stems, and each one must be treated individually; herbicide transfer between stems appears minimal.

Source: Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: Moderate

Control of *Ilex aquifolium* requires multiple years of effort. This species sprouts readily from its roots when cut and its seeds are dispersed over long distances by birds (NWCB, 2022), making re-invasion possible even without nearby source populations.

Source: Informal Publication, Professional Expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Low (range Low - Moderate)

Effective treatments for *Ilex aquifolium* generally target this species directly, either by hand removal or by direct application of pesticides to the tree (NWCB, 2022). While this treatment method could potentially also affect surrounding plants, generally few native plants are present under *I. aquifolium* canopies and negative effects of treatment on co-occurring native species has not yet been observed. Collateral damage to native species is probably minor and likely outweighed by the benefits of removing an invasive competitor.

Source: Informal publication, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Ilex aquifolium is most abundant in urban and residential areas (Stokes et al., 2014). However, seed dispersal by birds and other animals allows for this species to reach and establish in quite remote and inaccessible areas, as well (Zika, 2010).

Source: Published Research, Professional Expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low (range Insignificant - Moderate/Low)

Confidence: High (range Moderate - High)

Growers in the Pacific Northwest supply up to 90% of the holly vegetation used as holiday greenery in the U.S. (NWCB, 2022). This species is also popular as an ornamental, in part because its berries also attract many birds to people's yards (Zika, 2010). These could potentially result in objections to treatments for this species in Washinton State. However, given the potential for *I. aquifolium* to have negative impacts on growing merchantable timber for harvest and to increase fire danger (Church, 2016; NWCB, 2022), and treating this species may not be sociopolitically difficult.

While objections to *I. aquifolium* control are uncommon, the sources of new populations are unlikely to be removed from the state.

Source: Published research, Informal publication, Professional expertise, Thesis

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Impatiens capensis (Spotted Jewelweed)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
24 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (39)	Confidence: **Moderate** (58)
Management Difficulty Rank: Low (47)	Confidence: High (70)
Biological Characteristics of Invasiveness: High (74)	Confidence: Moderate (50)
Concern Related to Distribution and Abundance: High (76)	Confidence: Moderate (50)

Photo Credit: Keir Morse 2016, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

This species is native to the U.S. east of the Rocky Mountains.

Legal Listings

Washington State Weed Board: List C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

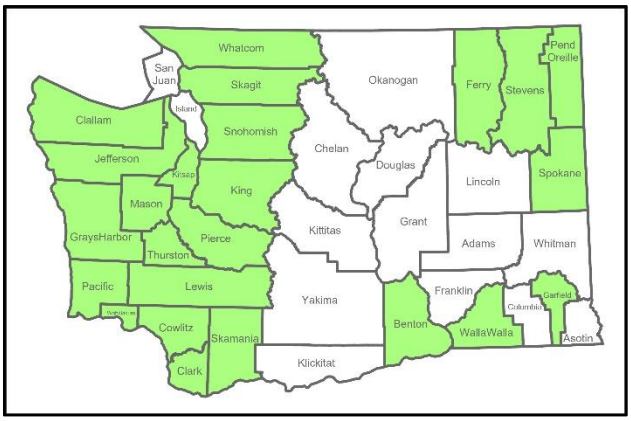

Figure 1. Distribution of counties where *Impatiens capensis* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

This species is found in 62% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Emergent Open Wetland, Forested Wetland

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Moderate

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Impatiens capensis is a strong competitor and has even been shown to successfully compete with introduced *Alliaria petiolata* (Garlic Mustard) in its native range (Karriker, 2025).

Source: Informal publication, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: High

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not rated

Source: Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

This plant contains numerous harmful chemicals, such as selenium and calcium oxalate crystals; while deer and rabbit herbivory have been observed in its native range, *Impatiens capensis* can be toxic to livestock (Mitchell, 2025).

Source: Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

This species is highly competitive and may significantly reduce the diversity and cover of native forbs and graminoids in wetlands where it occurs.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Moderate

Confidence: Moderate

Impatiens capensis is known to hybridize with native *I. ecornuta* (Zika, 2020).

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Impatiens capensis is common in freshwater intertidal wetlands that can be very difficult to enter due to dense vegetation and irregular boat access.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

This plant has a very attractive flower and a number of reported medicinal uses (Mitchell, 2025).

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Iris pseudacorus (Yellow Flag Iris)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
19 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **High** (82)	Confidence: **Moderate** (42)
Management Difficulty Rank: Moderate (58)	Confidence: High (70)
Biological Characteristics of Invasiveness: High (78)	Confidence: High (75)
Concern Related to Distribution and Abundance: High (81)	Confidence: Low (30)

Photo Credit: David Giblin 2024, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessments only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

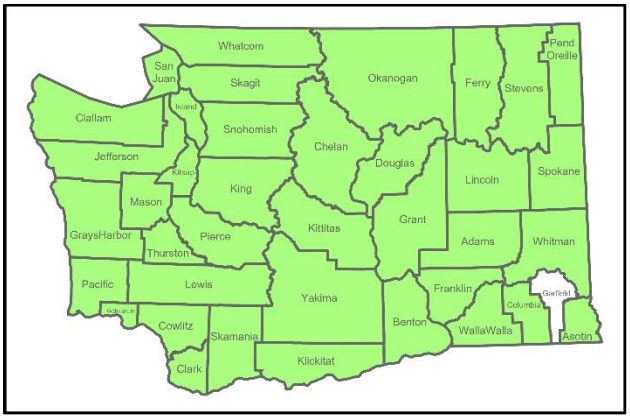

Figure 1. Distribution of counties where *Iris pseudacorus* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Iris pseudacorus is documented in 97% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Not Rated

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Insignificant

Confidence: Low

Iris pseudacorus is documented in 97% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Rating: Not Rated

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Shallow Water Wetland, Coastal Brackish Tidal Wetland

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Iris pseudacorus reproduces both vegetatively and by seed—the proportion may vary by local site conditions (Preece, 1964; Sutherland, 1990).

Source: Published research

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Iris pseudacorus seeds are dispersed by water and remain buoyant for extremely long periods (Whitehead, 1971; Weber, 2003; King County Noxious Weed Control Program, 2007).

Source: Published research, Informal publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

This plant is an attractive ornamental.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Low

This plant is not known to produce allelopathic chemicals, but the assessor was not aware of any published studies to this effect.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Low

This plant is most competitive in high nutrient environments (Tu, 2004). However, seedling *Iris pseudacorus* invest heavily in extensive root systems that allow them to persist through large water level fluctuations (Whitehead, 1971).

Source: Published research, Informal publication

Q11: Growth Form

Rating: Yes

Confidence: High

Rhizome growth may compact wetland soils into hardpans that exclude the establishment of other species (Thomas, 1980; Stone, 2009).

Source: Informal publication

Q12: Germination Requirements

Rating: Yes

Confidence: High

Iris pseudacorus does not require bare soil for germination—seedlings have been observed growing from trash, on top of tree roots, etc. (Thomas, 1980).

Source: Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: Not Rated

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: Yes

Confidence: High

Low light may inhibit seedling establishment, but likely does not slow growth or vegetative reproduction by mature plants (Thomas, 1980).

Source: Informal publication

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Disturbance benefits *Iris pseudacorus* by spreading rhizome fragments and seeds.

Source:

Q16: Propagule Persistence

Rating: >10 years

Confidence: High

Rhizome fragments have been shown to remain viable for at least 10 years (Sutherland & Walton, 1990).

Source: Published research

Q17: Palatability

Rating: Yes, not palatable

Confidence: High

This species is considered poisonous (Diggs et al., 1999).

Source: Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Hydrology

Rating: Moderate

Confidence: Moderate

This species can change the hydrology and sedimentation rates (King County Noxious Weed Control Program, 2007) of the ecosystems in which it occurs.

Source: Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: High

Confidence: Low

One study from the eastern US reports that *Iris pseudacorus* suppresses willow establishment and provides a raised surface upon which wetland trees may establish, thus speeding the successional trajectory from marsh to swamp (Thomas, 1980).

Source: Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: Moderate

This species grows as large vegetative clones that crowd out co-occurring native species, even competitive native species such *Typha latifolia* (Preece, 1964; Morgan, 2008).

Source: Published research, Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: Moderate

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

This species may occur in areas of deep water that are difficult to access.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

This species is an attractive ornamental.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Jacobaea vulgaris (Tansy Ragwort)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
14 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (60)	Confidence: **Low** (25)
Management Difficulty Rank: Moderate (67)	Confidence: Moderate (40)
Biological Characteristics of Invasiveness: High (77)	Confidence: High (71)
Concern Related to Distribution and Abundance: High (87)	Confidence: High (90)

Photo Credit: Photo by iNaturalist observer thirty_legs, 2024, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

None

Legal Listings

Washington State Weed Board: Class B, Washington State quarantine list.

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

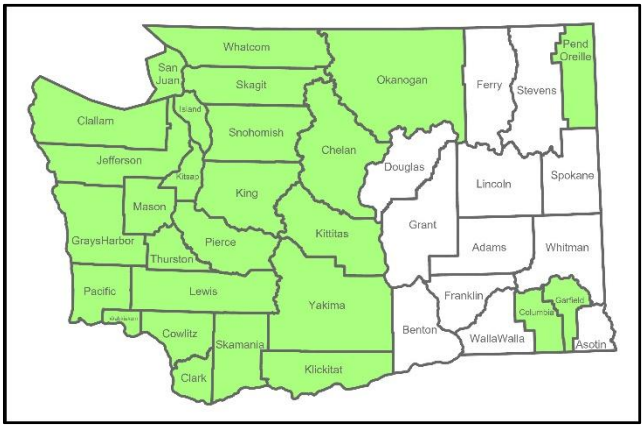

Figure 1. Distribution of counties where *Jacobaea vulgaris* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Jacobaea vulgaris is found in 69% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: High

In Washington, *Jacobaea vulgaris* is most abundant west of the Cascades, but has been documented in most counties outside of the Columbia Plateau (EDDMapS, 2023). In the past 20 years, this species appears to have expanded into the Olympic Peninsula and the western Cascades, but does not appear to be expanding east of the Cascades (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations, Model predictions.

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

According to model predictions, *Jacobaea vulgaris* may expand somewhat further in eastern Washington, but may not gain a foothold in the Columbia Plateau (EDDMapS, 2023). However, the vast majority of herbarium records are from west of the Cascades, as are all herbarium and iNaturalist records documented in the past 20 years (CPNWH, 2023; iNaturalist Contributors, 2023). This species survives best in cool, wet climates; hot, dry summers reduce seedling survival and establishment (Richardson, 2004), likely limiting its range in eastern Washington.

Source: Informal publication, Herbarium records and other observations, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

Over the last 20 years, *Jacobaea vulgaris* abundance and local range appears to have increased rapidly west of the Cascades, particularly in the Puget Trough ecoregion (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland

Rating: High

Confidence: Moderate

In its introduced range, *Jacobaea vulgaris* is mainly known from disturbed mesic sites in cool and wet climates. In the Pacific Northwest, it is abundant in prairie and oak habitats, and frequently found in old fields, pastures, roadsides, forest clearings, the edges of riparian areas and wetlands, and other open disturbed areas. This species prefers well-drained loamy or sandy soils and frequently occurs with *Cirsium arvense*, *Hypericum perforatum* and *Linaria vulgaris* (Richardson, 2004; Jacobs, 2009).

Source: Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Jacobaea vulgaris is a winter annual to short-lived perennial. Many plants are monocarpic, but this species can also grow as a true perennial, flowering and producing seed in multiple years. While *J. vulgaris* can reproduce from root fragments, it is most likely to reproduce from seed. One plant can produce between 5,000–200,000 seeds in four to six weeks, with an average viability of 80%. Populations can spread rapidly in disturbed areas without control efforts. One population in Montana grew to cover 150 square miles between 1993 and 1997 (Richardson, 2004; Jacobs, 2009).

Source: Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Jacobaea vulgaris' ray flowers shed their pappus, but disc flowers maintain the pappus, allowing for wind dispersal. Seeds are usually dispersed only a few meters from the parent plant but can be dispersed up to several kilometers by wind under the right conditions. Seeds are also occasionally dispersed by animals and water (Richardson, 2004; Jacobs, 2009).

Source: Informal publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

In its introduced range, *Jacobaea vulgaris* is usually found in areas of human disturbance such as roadsides, old fields, and developments. Mowing can disperse this species' seeds more than double the distance of natural dispersal. Seeds can also be spread via other agricultural equipment, tires and clothes, livestock manure, contaminated weed and straw, and by firefighting activities (Richardson, 2004; Jacobs, 2009).

Source: Informal publication, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Jacobaea vulgaris produces alkaloids that may be allelopathic and some studies have shown that this species can inhibit seed germination in several other plant species (Richardson, 2004; Jacobs, 2009). However, other studies found a positive effect of *J. vulgaris* presence on growth and survival of heterospecific plant species (at least in *J. vulgaris'* native range) (Van De Voorde et al., 2012).

Source: Published research, Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Jacobaea vulgaris can crowd out other species in disturbed areas, but this species generally does not invade intact plant communities (Richardson, 2004). Several studies have compared the competitive ability of plants from introduced populations of *J. vulgaris* to plants from *J. vulgaris'* native range. These studies have found that plants from the introduced range are more competitive than their counterparts from their native range. This is likely due to release from specialist predators, allowing plants to allocate more resources (such as nitrogen) to growth and reproduction instead of defense (Lin et al., 2019). Adult plants are strongly competitive against other plant species, but seedlings are not (Wardle, 1987).

Jacobaea vulgaris is a winter annual, biennial, or short-lived perennial. This species is generally monocarpic and overwinters as a seed or rosette (Jacobs, 2009).

Source: Published research, Informal publication

Q11: Growth Form

Rating: No

Confidence: Moderate

In restored Willamette Prairie habitats, *Jacobaea vulgaris* can occur as scattered individuals or small clumps. This species can form large, dense stands in unrestored old fields in the same habitat. This species' rosettes have large leaves that lay flat to the ground, shading out neighboring plants. The death of adult plants provides openings for new *J. vulgaris* seedlings to establish (Richardson, 2004; Jacobs, 2009). However, *J. vulgaris* does not appear to exclude other species long term.

Source: Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

Jacobaea vulgaris seeds require light to germinate. Cover from other plants may prevent germination. Seedling survival is greatly reduced in areas with tall vegetation or dense turf and increases in grazed or cleared areas. Seedling establishment increases with available open ground (Jacobs, 2009; Van De Voorde et al., 2012).

Source: Published research, Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Jacobaea aquatica is an increaser species in its native habitat in Central Europe (Krieger et al., 2023).

Source: Published research

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Jacobaea vulgaris is generally found in open, disturbed areas, and requires light to germinate seeds and establish seedlings (Richardson, 2004; Jacobs, 2009). However, at least in its native range, open habitat can also increase vulnerability to drought and the chances of discovery by specialist herbivores like *Tyria jacobaeae*. In these instances, partially shaded areas can become refugia from drought and herbivory for some populations of this species (Van Der Meijden et al., 1992), at least in Europe.

Source: Published Research, Informal Publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

In the Pacific Northwest, *Jacobaea vulgaris* is usually found in open, disturbed areas such as old fields, roadsides or the edges of disturbed wetlands. Fire can kill seeds and encourage plant species that are competitive with *J. vulgaris* in grasslands but creates habitat conducive to *J. vulgaris* invasion in forests (Jacobs, 2009). This species has a persistent seed bank and can reproduce from root fragments, enabling populations to increase after disturbances like grazing, mowing, and tilling (Richardson, 2004; Jacobs, 2009). In its native and invasive range, *J. vulgaris* colonizes disturbed areas and disappears from stable communities, suggesting that it relies on disturbance to maintain populations (Van Der Meijden et al., 1992; Jacobs, 2009; Van De Voorde et al., 2012).

Source: Published research, Informal publication, Professional Expertise

Q16: Propagule Persistence

Rating: >10 years

Confidence: Moderate

Jacobaea vulgaris seeds are not innately dormant. However, frost, drought, and burial can all induce dormancy, and seeds can remain viable for 6–20 years (Richardson, 2004; Jacobs, 2009).

Source: Informal Publication

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Due to high alkaloid contents, *Jacobaea vulgaris* is toxic to most mammals (sheep are an exception) (Richardson, 2004; Jacobs, 2009). This species has caused serious poisonings of livestock in the Pacific Northwest and may also be poisonous to deer (Richardson, 2004; Jacobs, 2009). The alkaloids present in the nectar and pollen of this plant also make bitter, off-color honey (Jacobs, 2009). The presence of *J. vulgaris* reduces forage values in the pastures where it occurs (Jacobs, 2009). *Jacobaea vulgaris* plants in the introduced range can produce up to 90% more alkaloids than plants in the native range (Lin et al., 2019). While these alkaloids are effective in discouraging generalist herbivores, plants from the invasive range have less defense against specialist herbivores than plants growing in their native range, even after the introduction of those specialists as biocontrols (Lin et al., 2019).

Source: Published research, Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Light availability

Rating: Low

Confidence: Low

Jacobaea vulgaris rosettes have large leaves that lay flat to the ground, excluding other species by blocking light. When adult plants die, they leave bare openings in the vegetation. In Oregon, studies found that *J. vulgaris* seedlings established best in the openings left by senesced adult plants, allowing populations to persist in plant communities after initial establishment (Wardle, 1987).

In California, has been shown to increase erosion rates (Richardson, 2004).

Source: Published research

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Low

Jacobaea vulgaris can reduce biomass of microbes in the soil (Richardson, 2004). Given the ability of rosettes to shade out neighboring plants, the presence of this species may reduce overall vegetation cover where it occurs.

Source: Informal publication

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Jacobaea vulgaris is capable of displacing native plant species, reducing plant community diversity and the abundance and cover of beneficial plant species within a vegetation community (Jacobs, 2009). It can also displace herbivore pressure to more palatable species (Wardle, 1987). In grasslands and oak woodlands west of the Cascades, this species frequently occurs with other introduced and invasive species such as *Cirsium vulgare*, and a multitude of introduced perennial grasses.

Source: Published research, Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Low

Confidence: Low

In Oregon, the rare plant *Sidalcea hirtipes* (which is also present in southwestern Washington (WNHP, 2024) showed a 40% increase in seed production after *J. vulgaris* biocontrols were released (Richardson, 2004). However, no information was found on whether this apparent effect on reproduction was a result of direct interaction between the two species, or part of a community wide response to reduction in *J. vulgaris* populations.

Jacobaea vulgaris may also have the potential to interfere with pollination of *Senecio* or *Packera* species, but little evidence is available to confirm this. (Richardson, 2004). One of the successful biocontrol agents for *J. vulgaris*, *Tyria jacobaeae* (cinnabar moth), reportedly feeds on native *Senecio* and *Packera* species after exhausting local *J. vulgaris* populations (Jacobs, 2009).

Jacobaea vulgaris may have a positive effect as a nectar source for the federally threatened butterfly *Speyeria zerene hippolyt*a (Oregon silverspot) (Richardson, 2004), though there was no information on the quality or importance of this species as a nectar plant.

Source: Informal publication

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

Intact plant communities are resistant to invasion by *Jacobaea vulgaris*, but this species can establish in small disturbances (e.g., gopher burrows) and then serve as a vector for increased abundance (Richardson, 2004).

Source: Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Low

At a site in Corvallis, Oregon, *Jacobaea vulgaris* was common in restored old fields, but was not frequent in remnant prairie that had not been previously farmed. This species appears to require soil disturbances to establish (Van De Voorde et al., 2012), but grasslands with intact native communities and fire regimes may be resistant to invasion by *J. vulgaris* (Jacobs, 2009). However, this species may be able to invade naturally disturbed communities when the recurring disturbance results in bare soil (e.g., flooding, landslides, high-severity fire).

Source: Published research, Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate

Herbicide application before flowering may be the most effective management technique for *Jacobaea vulgaris*. Care is required when using herbicide because application can temporarily make the plant more palatable to livestock. Mowing is not recommended because it does not remove the vegetative portion of the plant and *J. vulgaris* may flower more vigorously after mowing. Tilling is also not recommended unless combined with herbicide use and revegetation with another competitive plant species, because plants can regrow from root fragments and soil disturbance stimulates germination of seeds from the seed bank. Hand pulling can be effective if all of the caudex and roots are removed, but gloves should be used when pulling this species. Several biocontrol agents have been developed for *J. vulgaris*, and in California and Oregon *Tyria jacobaeae* and the fleabeetle *Longitarsus jacobaeae* have both been effective in reducing *J. vulgaris* populations (Richardson, 2004; Jacobs, 2009). *Jacobaea vulgaris* populations in North America are less well defended against specialist herbivores like *T. jacobaeae* or *L. jacobaeae* than plants from this species' native range (Lin et al., 2019).

Source: Published research, Informal publication

Q25: Minimum Time Commitment

Rating: High

Confidence: Low

Literature review did not reveal a minimum time commitment for treating *Jacobaea vulgaris*. However, it seems likely that active treatment efforts need to extend long enough to exhaust the seed bank for this species (6-20 years) (Richardson, 2004). To prevent recolonization, ongoing monitoring coupled with native plant community restoration is likely needed.

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Low

Broadcast herbicide use could have negative effects on co-occurring forbs and grasses. Biocontrol agents may also spill over on related *Senecio* and *Packera* species (Jacobs, 2009).

Source: Informal publication, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Jacobaea vulgaris appears to rely primarily on human disturbance to invade plant communities (Jacobs, 2009), suggesting populations are frequently in areas that are accessible for treatment.

Source: Informal publication, Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Jacobaea vulgaris reduces the value of pasture and rangelands, and is poisonous to livestock

(Richardson, 2004; Jacobs, 2009). Given these effects, objections are likely to be minimal, beyond general objections to herbicide use.

Source: Informal publication, Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Juglans regia (English Walnut)

Assessed by
Carlo Abbruzzese (Natural Areas Manager, Washington Dept. of Natural Resources)
18 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (31)

Confidence: **Moderate** (42)

Management Difficulty Rank: Insignificant (11)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Low (44)	Confidence: Moderate (38)
Concern Related to Distribution and Abundance: High (73)	Confidence: Low (30)

Photo Credit: Luigi Rignanese 2005, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessments only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

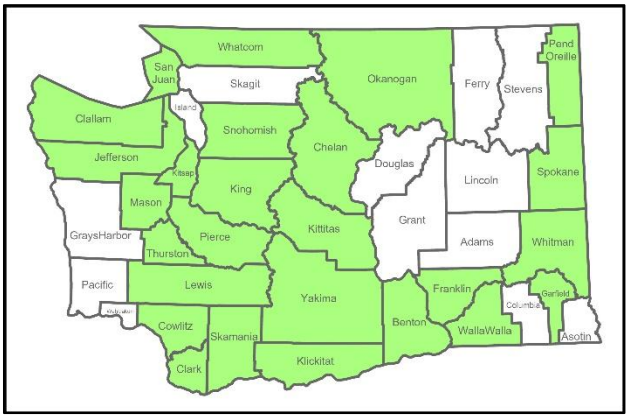

Figure 1. Distribution of counties where *Juglans regia* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Juglans regia is found in 67% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Unknown

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Low

Most likely only a small percentage of potential range is currently occupied.

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Local range expansion is limited, with a few new plants found every few years, but populations are generally not spreading.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Forested Wetland

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

This species has relatively low fruit production.

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Moderate

This species is probably spread by squirrels and possibly jays.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Trees are planted by landowners and grown for their nuts.

Source: Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Walnuts are likely allelopathic.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Not Rated

Confidence: Not Rated

Source:

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional Expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Low

Black walnut can also become established, but neither is very invasive.

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

This species is generally shade intolerant but can be found at forest edges.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

This species tends to be most competitive in openings and grassy fields.

Source: Professional Expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Seeds likely only persist 2-3 years, but more information is needed.

Source: Professional Expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

The seed is palatable, but animals don't appear to browse this species often.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability, Chemistry

Rating: Low

Confidence: Moderate

Juglans regia likely shades out native trees and shrubs and may be allelopathic.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Not Rated

Confidence: Not Rated

Source:

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Juncus effusus ssp. *effusus* (Common Rush)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
30 September 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (50) Confidence: **Moderate** (42)

Management Difficulty Rank: Low (49)	Confidence: Low (10)
Biological Characteristics of Invasiveness: High (87)	Confidence: High (76)
Concern Related to Distribution and Abundance: High (76)	Confidence: High (70)

Photo Credit: *Juncus effusus* ssp *effusus*. Barbara L. Wilson 2016, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

Some taxonomists do not distinguish subspecies in the *Juncus effusus* aggregate (e.g., Brooks & Clemants, 2019), but experts in the Pacific Northwest find that characteristics of *Juncus effusus* ssp. *effusus* are reliably different from native subspecies of *J. effusus* (Zika, 2003).

Subspecies-level information about *J. effusus* ssp. *effusus* was generally not available, though information from Europe likely addresses this subtaxon. Information from the eastern U.S. likely addresses *Juncus effusus* ssp. *solutus*, which is also introduced in the western U.S., but found in wetter habitats than *J. effusus* ssp. *effusus* (Zika, 2003).

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

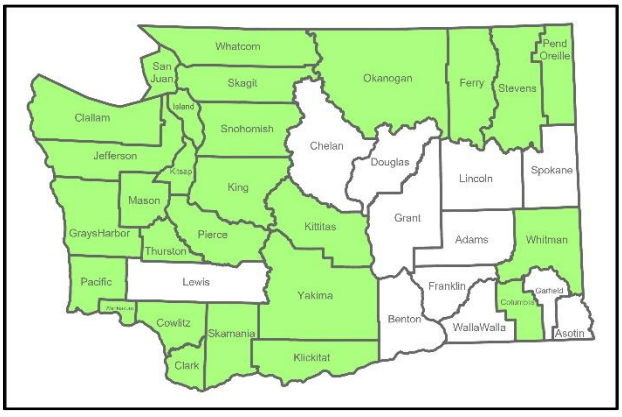

Figure 1. Distribution of counties where *Juncus effusus* ssp. *effusus* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Juncus effusus ssp. *effusus* is known from 27 of 39 (69%) counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: High

Juncus effusus ssp. *effusus* does not appear to be as abundant in the Columbia Plateau or Okanogan ecoregions as it is elsewhere in Washington (CPNWH, 2023; iNaturalist Contributors, 2023), suggesting potential ecological constraints to expansion in those ecoregions. Based on herbarium records and other observations, much of the expansion into the Cascades and east side of the Olympic Peninsula appears to have occurred in the last 20 years (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Juncus effusus ssp. *effusus* is known from 27 of 39 (69%) counties in Washington State (CPNWH, 2023; iNaturalist Contributors, 2023). Based on habitat needs and potential adaptability (Arslan et al., 2019), it seems likely that this species could still expand to new counties in Washington, but that expansion in drier areas like the Columbia Plateau may be constrained by availability of appropriate habitat.

Source: Published research, Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

In the last 10 years, local range and abundance of *Juncus effusus* ssp. *effusus* is expanding mainly west of the Cascades. Some increase in local abundance and range has also occurred in northeastern Washington in the Canadian Rockies ecoregion in the last 20 years (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Bogs & Fens, Forested Wetland

Rating: Moderate

Confidence: Moderate

Juncus effusus is found in a wide range of wetlands, including wet meadows and pastures, marshes, seeps, lakeshores, wet woodlands and riparian areas, disturbed fens and bogs, and other disturbed wet areas (McCorry & Renou, 2003; Zika, 2015; Arslan et al., 2019; Brooks & Clemants, 2019). *Juncus effusus* is most successful in acidic and somewhat nutrient-rich soils. This taxon is not found in permanently submerged areas and likely relies on fluctuating water tables (McCorry & Renou, 2003). This taxon is found in shallow peat and on the edges of healthy bogs and fens, but generally only invades disturbed (e.g., drained, mined, and/or grazed) bogs and fens (McCorry & Renou, 2003).

Source: Published research, Informal publication, Flora of North America and Jepson eFlora treatments

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Juncus effusus reproduces by seed and short rhizomes and grows rapidly above and below ground (Ervin & Wetzel, 2000; Arslan et al., 2019). Seeds are abundant and disperse readily (Arslan et al., 2019). One source found that *J. effusus* could produce up to 8 million

seeds per yard (Lazenby, 1955), while other sources suggest 8,500 seeds per fertile stem, or 4 million seeds per square meter (McCorry & Renou, 2003). Seeds are the primary source for colonization by this taxon and germination rates are typically relatively high (Lazenby, 1955; McCorry & Renou, 2003). Established populations can maintain and expand themselves through rhizomes (McCorry & Renou, 2003).

Source: Published research, Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Juncus effusus produces abundant small seeds that are dispersed readily by wind, animals, and water (Lazenby, 1955; Neff & Baldwin, 2005). Seeds are dispersed by wind relatively short distances, but likely travel further by water and animal dispersal. Seeds have been found in areas where adult plants are not present, suggesting at least some capability for long-distance dispersal (McCorry & Renou, 2003).

Source: Published research, Informal publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Juncus effusus seeds can be dispersed by machinery and other human activities (McCorry & Renou, 2003). This taxon has also been studied for use in phytoremediation and is used in constructed wetlands built to treat wastewater (Arslan et al., 2019). Non-native subspecies are often mistakenly introduced to restoration sites (T. Ramm-Granberg, pers. comm. 2025).

Source: Published research, Informal publication, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Low

Juncus effusus produces several secondary compounds that are potentially allelopathic (Ervin & Wetzel, 2000). Senesced culms are slow to decay, also indicating potential for allelopathic effects. In a greenhouse study from Alabama, researchers found that *J. effusus* leachate could reduce germination of *J. effusus* seeds and survival of *J. effusus* seedlings but had no effect on germination or survival of other species tested. Researchers did find a slight reduction in chlorophyll production in one of the other species tested, but evidence was not strong enough to support or rule out allelopathy in this species (Ervin & Wetzel, 2000).

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Once established, *Juncus effusus* is an effective competitor. European populations of *J. effusus* have high genetic diversity in the portions of the genome associated with stress responses, likely helping this taxon tolerate a wide range of conditions (Arslan et al., 2019). Rapid growth, particularly underground, suggest *J. effusus* is highly competitive for soil resources (Ervin & Wetzel, 2000). Physiological adaptations also allow this taxon to obtain oxygen from saturated soils (Arslan et al., 2019). *Juncus effusus* remains green and photosynthetically active throughout the winter, at least at its base, even at latitudes further north than Washington (Ervin & Wetzel, 2002; McCorry & Renou, 2003).

Juncus effusus seedlings are much less tolerant of competition than mature plants. A 1955 study from Wales found that competition with other species reduced both the number of seeds that germinated and seedling survival, likely due to reduced light availability (Lazenby, 1955). Competition may have also reduced flowering in *J. effusus* in this study.

Source: Published research, Informal publication

Q11: Growth Form

Rating: Yes

Confidence: High

Juncus effusus frequently grows as dense tussocks. The natural growth form of this taxon (arched culms) can greatly reduce light availability below its canopy (Ervin & Wetzel, 2002). A study in Alabama on the effects of shading by *J. effusus* found that when culms were held upright to allow more light through their canopy, the diversity and biomass of other species increased compared to areas where *J. effusus* was unmanipulated (Ervin & Wetzel, 2002). Grasses were not significantly affected by shading from this species, but forbs were. Vegetation surveys found almost no other species growing in *J. effusus* tussocks (Ervin & Wetzel, 2002). However, *Juncus effusus* is only an effective competitor for light after it has established. Seedlings are poor competitors for light (Lazenby, 1955).

Source: Published research

Q12: Germination Requirements

Rating: No

Confidence: High

Juncus effusus establishment likely relies on a high number of seeds germinating in bare soil patches (Lazenby, 1955).

Source: Published research

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

No *Juncus* species occur on formal invasive lists in Washington (NWCB, 2024; Washington Invasive Species Council, 2024) and the Washington Natural Heritage Program has not previously considered any species or subtaxa to be invasive for the purposes of Ecological Integrity Assessments (Rocchio & Ramm-Granberg, 2022; Rocchio et al., 2024). A literature search found research on several species of *Juncus* considered invasive outside their native range (e.g., Ellery Mayence et al., 2010; Moe et al., 2013). *Juncus effusus* ssp. *effusus* is considered a weed (or native increaser) in at least part of its native range (Ireland and Great Britain), as well as in New Zealand (McCorry & Renou, 2003).

Source: Published research, Informal publications

Q14: Shade Tolerance

Rating: Moderate

Confidence: Low

Juncus effusus usually grows in full sun, but established plants grows well in partial shade and tolerate full shade (McCorry & Renou, 2003). Shading can prevent germination of *J. effusus* seed (as can desiccation) (Ervin & Wetzel, 2000).

Source: Published research, Informal publication

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Experiments have found the *Juncus effusus* is an early colonizer of disturbed wetlands. Research in Europe found that while seedlings may not tolerate disturbance, competition, or drought (Lazenby, 1955), disturbance can allow buried *J. effusus* seeds to germinate (Ervin & Wetzel, 2000). Observations from Ireland are common in trampled areas in wetlands (e.g., trails or places where animals gather). Soil disturbance from grazing promotes establishment of *J. effusus* in wet pastures. Established plants are resilient to trampling, grazing, and mowing (McCorry & Renou, 2003).

Source: Published research, Informal publication

Q16: Propagule Persistence

Rating: >20 years

Confidence: High

Juncus effusus seed sink in water, allowing them to establish persistent seed banks. *Juncus effusus* seeds are long-lived in the seed bank, and populations have resurfaced after old beaver dams have failed (Ervin & Wetzel, 2000). One source reported *J. effusus* seeds could remain viable for more than 60 years (Lazenby, 1955).

Source: Published research

Q17: Palatability

Rating: Yes

Confidence: High

When found in pastures, *Juncus effusus* tussocks are obviously ungrazed (Brooks & Clemants, 2019). This taxon is regarded as a weed in Ireland, Great Britain, and New Zealand in part because it is unpalatable and has low nutritional value (McCorry & Renou, 2003).

Source: Informal publication, Flora of North America treatment

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability, Chemistry

Rating: Moderate

Confidence: Low

A competition study in Alabama found that established *Juncus effusus* plants could reduce species richness and biomass by shading (Ervin & Wetzel, 2002). In Ireland, this species can also shade out young plantation trees in disturbed peatlands (McCorry & Renou, 2003).

Juncus effusus can affect biogeochemical cycles, and is capable of either increasing or decreasing methane production from wetlands, depending on conditions (Arslan et al., 2019). This taxon has also been tested for use in restoration, and a literature search found many studies on potential phytoremediation uses for *J. effusus*, (e.g., Syranidou et al., 2017; Peng et al., 2018; Zhang et al., 2019). These impacts could potentially be beneficial to the ecosystems in which this plant occurs in Washington.

Source: Published research, Informal publication

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Low

Juncus effusus can occasionally outcompete tree seedlings, though this may only occur where the conditions for tree establishment are marginal (McCorry & Renou, 2003).

Source: Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: High

Juncus effusus can reduce community composition and diversity through competition for light (Ervin & Wetzel, 2002).

Source: Published research, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

No information was found regarding potential effects of *Juncus effusus* ssp. *effusus* on individual native species. Future research on impacts to native *Juncus effusus* subspecies would be valuable.

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Juncus effusus relies on disturbance to create suitable substrate for establishment. Field staff have only observed high cover of *Juncus effusus* ssp. *effusus* in highly disturbed ecosystems (T. Ramm-Granberg, pers. comm. 2025). However, this taxon's long-lived seedbank may allow it to take advantage of one time disturbances to establish in mid- and late-successional habitats (Lazenby, 1955; Ervin & Wetzel, 2000; McCorry & Renou, 2003).

Source: Published research, Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Juncus effusus requires bare substrate for seeds to germinate. This taxon has multiple dispersal methods, maintains a persistent seedbank, and regularly establishes in disturbed areas (Lazenby, 1955; Ervin & Wetzel, 2000; McCorry & Renou, 2003).

Source: Published research, Informal publication

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Low

Since the non-native subspecies of *Juncus effusus* was only recently recognized, there is little information regarding its management in the Pacific Northwest. In Ireland, *Juncus effusus* treatment frequently involves mowing, herbicide, and draining wetlands, with the goal of promoting agriculture (including tree plantations and grazing). Restoration of degraded wetlands may also help control *Juncus effusus*. In particular, restoring the hydrology of wetlands with historically long hydroperiods will help exclude this taxon (McCorry & Renou, 2003).

Source: Informal publication

Q25: Minimum Time Commitment

Rating: High

Confidence: Moderate

In Ireland, herbicide treatments have temporarily removed *Juncus effusus* populations within a year, but don't resolve the ecological conditions that allow this taxon to establish (McCorry & Renou, 2003). Other management techniques (e.g., manipulating wetlands or changing pasture management) can take several years (McCorry & Renou, 2003). Propagule persistance suggests that this taxon likely requires ongoing management due to the long life of the seed bank.

Source: Informal publication

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Low

Herbicide treatments can be relatively targeted for *Juncus effusus* (McCorry & Renou, 2003), allowing some reduction to impacts on co-occurring native species. Other techniques (e.g., hydrological restorations) could have higher negative impacts on native species in the short term, though restoration efforts are likely beneficial to most native species in the long term.

Source: Informal publication

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Low

Juncus effusus ssp. *effusus* is fairly widespread in Washington, but many of the observations appear to be in accessible areas (CPNWH, 2023; iNaturalist Contributors, 2023). However, given that seeds can be dispersed by animals as well as wind and water, it is possible that some populations are in areas that are difficult to access.

Source: Herbarium records and other observations

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Low

Objections to treatment of this species seem unlikely, beyond potential questions about using herbicide in wetlands.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Lamium galeobdolon (Yellow Archangel)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
14 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (50) Confidence: **Moderate** (50)

Management Difficulty Rank: High (93)	Confidence: High (80)
Biological Characteristics of Invasiveness: High (91)	Confidence: Moderate (64)
Concern Related to Distribution and Abundance: Moderate (67)	Confidence: Moderate (60)

Photo Credit: Erin Burke 2024, WNHP.

Ranking Notes

Rapid assessments only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

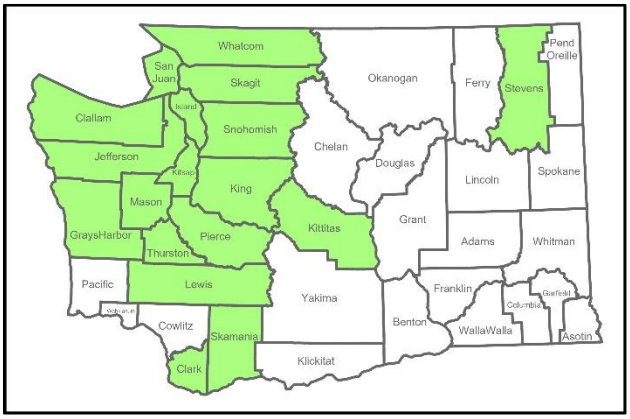

Figure 1. Distribution of counties where *Lamium galeobdolon* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: Moderate

Lamium galeobdolan is present in 46% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

Source: Professional Expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

Source: Professional Expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Forested Wetland

Rating: Moderate

Confidence: Moderate

Source: Professional Expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

Source: Professional expertise

Q12: Germination Requirements

Rating: Unknown

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: High

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology

Rating: Low

Confidence: Moderate

When growing along streambanks, this species may be washed away in flooding events and contribute minor amounts of debris to log jams, gravel bars, etc.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: High

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Low/Moderate

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Lathyrus latifolius (Everlasting-pea)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
26 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (47)	Confidence: **High** (83)
Management Difficulty Rank: High (70)	Confidence: High (70)
Biological Characteristics of Invasiveness: High (92)	Confidence: High (75)
Concern Related to Distribution and Abundance: High (91)	Confidence: High (100)

Photo Credit: David Giblin 2022, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise. This species was assessed concurrently with *Lathyrus sylvestris* and much of the information is the same. *Lathyrus latifolius* and *L. sylvestris* have similar appearance, ecological impacts and management techniques, though *L. latifolius* is more common in Washington (R. Johnson, pers. comm. 2024).

Legal Listings

Washington State Weed Board: Monitor List

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

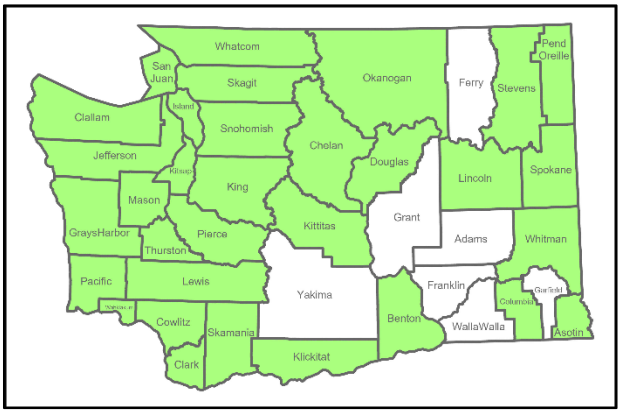

Figure 1. Distribution of counties where *Lathyrus latifolius* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Lathyrus latifolius is found in 82% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

This plant is toxic to wildlife and primarily spreads via violent dehiscion and vegetative reproduction (Burnham, 2013; Sweet, 2020).

Source: Published research, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

This species establishes best with some level of disturbance.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

Constant reintroduction extends the time commitment for treating this species.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Moderate

This species can't be manually treated (digging or pulling). Spraying will result in collateral damage of

co-occurring species because this plant grows over and through neighboring plants.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: High

This species is commonly found on beach bluffs, road cuts, and slides.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: High

Confidence: Moderate

Some people may mistake this species for a sweet pea and object to management based on that misconception.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Lathyrus sylvestris (Narrow-Leaf Peavine)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
26 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (47) Confidence: **High** (83)

Management Difficulty Rank: High (70)	Confidence: High (70)
Biological Characteristics of Invasiveness: High (92)	Confidence: High (75)
Concern Related to Distribution and Abundance: High (91)	Confidence: High (100)

Photo Credit: Peter Zika 2025, used under Creative Commons license (iNaturalist Community, 2025).

Ranking Notes

Rapid assessment only, based primarily on professional expertise. This species was assessed concurrently with *Lathyrus latifolius* and much of the information is the same. *Lathyrus latifolius* and *L. sylvestris* have similar appearance, ecological impacts and management techniques, though *L. latifolius* is more common in Washington (R. Johnson, pers. comm. 2024).

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

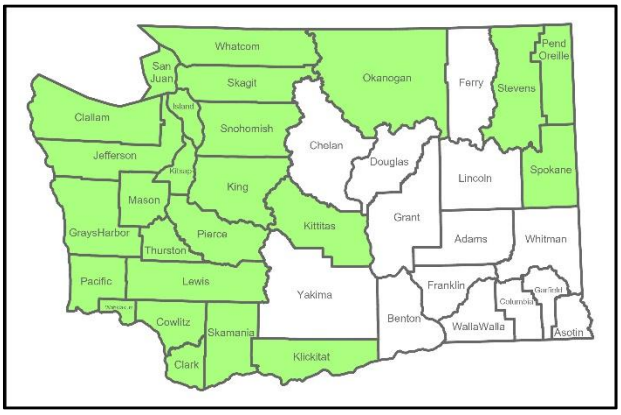

Figure 1. Distribution of counties where *Lathyrus sylvestris* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

This species is found in 64% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Source: Professional expertise, Herbarium records

Q2: Current Trend in Total Range

Rating: High

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

This plant is toxic to wildlife and primarily spreads via violent dehiscion and vegetative reproduction (Burnham, 2013; Sweet, 2020).

Source: Published research, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

This species establishes best with some level of disturbance present.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

Constant reintroduction extends the time commitment for treating this species.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Moderate

This species can't be manually treated (digging or pulling). Spraying will result in collateral damage of co-occurring species because this plant grows over and through neighboring plants.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: High

This species is commonly found on beach bluffs, road cuts, and slides.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: High

Confidence: Moderate

Some people may mistake this species for a sweet pea and object to management based on that misconception.

Source: Professional expertise

Additional Comments

None

References

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Washington Invasive Ranking System

Washington Natural Heritage Program

Leucanthemum vulgare (Oxeye Daisy)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
22 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (56) Confidence: **Moderate** (50)

Management Difficulty Rank: High (91)	Confidence: High (80)
Biological Characteristics of Invasiveness: Low (37)	Confidence: High (67)
Concern Related to Distribution and Abundance: Moderate (62)	Confidence: High (80)

Photo Credit: David Giblin 2024, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

It is possible that *Leucanthemum vulgare* may actually be a species complex (Clements et al., 2004).

Legal Listings

Washington State Weed Board: List C, Washington State quarantine list

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

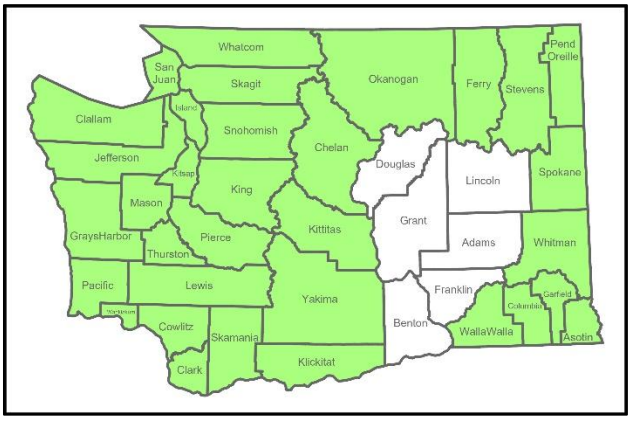

Figure 1. Distribution of counties where Leucanthemum vulgare has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Leucanthemum vulgare is found in 85% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: High

Leucanthemum vulgare was introduced to Washington in the 1800s (NWCB, 2000). It was already present in most of Washington 20 years ago and its range has not expanded significantly since (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Insignificant

Confidence: High

Models predict that *Leucanthemum vulgare* already occupies all counties in Washington where it is capable of persisting and that its range will likely contract on the Columbia Plateau (EDDMapS, 2023). Herbarium and iNaturalist records from the Columbia Plateau are already limited (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Low

Herbarium records over the last 20 years indicate very little change in abundance or local range for *Leucanthemum vulgare* (CPNWH, 2023), though the assessor has observed at least moderate infill for this species. Both iNaturalist and herbarium records are most abundant west of the Cascades, and least abundant on the Columbia Plateau. Other sources report greatest density of this species in the eastern Cascades and the northeastern portion of the state (EDDMapS, 2023) and in 2000, this species was reported as most abundant in southwestern and northeastern Washington (NWCB, 2000). Most sources agree that the Columbia Plateau has the least abundance of this species (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Informal publication, Professional expertise, Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland

Rating: Low

Confidence: High

Leucanthemum vulgare is a ruderal species that establishes in open, disturbed upland areas. This species can be found in grasslands and prairies, pastures (especially when overgrazed) and old fields, clearcuts, roadsides and other disturbed corridors, and disturbed forest openings and edges. A few sources also document this species occurring in forests in North America (e.g. (Brusati, 2005; Stutz et al., 2018)), but the assessor has not commonly observed this species under closed canopies. If it is found in forests, it is likely still associated with edges, clearings or other open disturbed areas.

This plant prefers moist climates, but tolerates drought and frost (Clements et al., 2004). *Leucanthemum vulgare* is most abundant in nutrient-poor soils and thrives in moist clay soils (Clements et al., 2004; Brusati, 2005; DiTomaso et al., 2013; NWCB, 2024). This species can grow at high latitudes (up to 70 degrees north in Europe) (Clements et al., 2004) and at relatively high altitudes (Khan et al., 2021). Its ability to invade in subalpine regions is of serious concern outside of North America, particularly in the Himalayas (Ahmad et al., 2019).

Source: Published research, Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Leucanthemum vulgare primarily reproduces by seed, but can also reproduce from root crowns, creeping

rhizomes, and root or rhizome fragments. This species usually does not flower in the first year, but once it starts flowering it can produce between 1300–4000 seeds per year—under ideal conditions a single plant can produce 26,000 seeds in a year. Seed production is most abundant in wet years. Creeping roots and abundant seed make *L. vulgare* an aggressive invader (Clements et al., 2004; Brusati, 2005; DiTomaso et al., 2013; EDDMapS, 2023). *Leucanthemum vulgare* plants from North America produce more flowers than plants from their native range (Stutz et al., 2018).

Source: Published research, Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Moderate

Leucanthemum vulgare achenes have no obvious adaptations for dispersal. Seeds are generally assumed to be spread by wind, water, or in animal manure. Studies have found that this species' seeds are unlikely to be transported in fur or wool (Clements et al., 2004). In a study from Great Britain—within *L. vulgare*'s native range—seeds did not travel far from parent plants, rarely moving further than 0.6 meters from seed sources. Grazing treatments also did not affect seed dispersal, as most seeds were dispersed by wind before grazing treatments occurred (Coulson et al., 2001). No seeds were found in manure after grazing. Though some *L. vulgare* seeds can survive an animal's digestive tract, no seeds were found in manure during additional experiments (Coulson et al., 2001; Clements et al., 2004). Natural long-distance dispersal is unlikely in this species.

Source: Published research, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Human activity is the main dispersal agent for *Leucanthemum vulgare*. This species was introduced into the Pacific Northwest in the 1800s and is spread by contaminated livestock feed, seed crops, and machinery. *Leucanthemum vulgare* is also frequently raised and planted as an ornamental. Sale, purchase, and transport of this species is banned in Washington State, but *L. vulgare* is still a frequent component of commercial wildflower mixes, including wildflower mixes sold in Washington (NWCB, 2000; Clements et al., 2004; DiTomaso et al., 2013).

Source: Published research, Informal publication

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Leucanthemum vulgare produces many secondary compounds, some of which have been shown to have allelopathic properties in other species. Oil extracted from *L. vulgare* flowers has been shown to reduce germination and growth in some plant species (Magharri et al., 2015; Khan et al., 2021). Allelopathy likely contributes to this species ability to dominate grasslands in its invasive range (Khan et al., 2021).

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Low

Leucanthemum vulgare is an early colonist of disturbed areas and is more common on low-nutrient soils (Clements et al., 2004). While it may outcompete other early colonists of ruderal areas, without ongoing disturbance, *L. vulgare* is likely to be outcompeted by perennial grasses (Clements et al., 2004). *Leucanthemum vulgare* may be a better competitor in its invasive range than in its native range. Plants in the Pacific Northwest are generally larger, produce more flowers, and experience less herbivore damage than plants in Europe. Release from herbivores may allow plants to allocate more energy to growth and reproduction. However, studies in the Pacific Northwest still found that competition (specifically increased vegetation cover) reduced number of flower heads and density of *L. vulgare* plants compared to plants in areas with reduced vegetation cover (Stutz et al., 2016). Instead of competing directly with other plant species, *L.*

vulgare appears to rely on avoiding competition through a long-lived seed bank that germinates readily after disturbance and an ability to grow in low nutrient areas that do not support aggressive competitors (Clements et al., 2004).

Leucanthemum vulgare senesces in the fall, but basal rosettes may persist until spring in mild climates (Clements et al., 2004).

Source: Published research, Professional expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

While *Leucanthemum vulgare* doesn't produce stands as dense and as large as some other invasive species in the Pacific Northwest, it is visibly dominant where it occurs, turning old fields and pastures white with flowers in the summer in the Pacific Northwest. This species frequently occurs as part of a community of introduced species in grasslands, particularly *Daucus carota* and introduced perennial grasses. Leucanthemum vulgare grows in clonal clumps, and populations are generally dense enough to reduce native diversity and cover in plant communities where this species occurs (Clements et al., 2004; Brusati, 2005; NWCB, 2024).

Source: Published research, Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Leucanthemum vulgare germinates readily in bare soil and is more likely to germinate in disturbed areas than undisturbed areas. This species may require grazing or other disturbances to establish. Thick leaf litter can impede germination (NWCB, 2000; Clements et al., 2004).

Source: Published Research, Informal Publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

The ornamental Shasta daisy (a hybrid of multiple *Leucanthemum* species) and closely related *Lecuanthemum ircutianum* (part of the *L. vulgare* complex) are present but not considered invasive in North America (Clements et al., 2004; Stutz et al., 2016).

A small patch of *Leucanthemum maximum* is reported from Lake Crescent, but this species does not appear to be widespread in North America (EDDMapS, 2023). A literature review did not reveal any information indicating this species is considered invasive.

Source: Published research, Informal publication, Google Scholar search results

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Leucanthemum vulgare is usually found in open disturbed areas such as old fields, clearcuts, and grasslands, and is not usually found under closed canopies (Clements et al., 2004). Seeds germinate at relatively cool temperatures, perhaps to escape competition for light as seedlings. Light reduction from competing plant species can reduce abundance of *L. vulgare*. This species may also be less able to benefit from nutrients in shaded conditions (Clements et al., 2004).

Source: Published research, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Leucanthemum vulgare is frequently found in disturbed areas such as old fields, clearcuts, roadsides, pastures and abandoned places. This species is an early colonizer of disturbed areas and may require grazing or other disturbances to establish (Clements et al., 2004; DiTomaso et al., 2013). Mowing can increase vegetative abundance for this species, as can a single round of tilling. However,

annual tilling can deplete seedbanks and prevent establishment (Clements et al., 2004; DiTomaso et al., 2013; EDDMapS, 2023), though such treatment would of course be devastating to the native plant community.

Source: Published research, Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: >10 years

Confidence: High

Leucanthemum vulgare seeds are not innately dormant and most seeds will germinate in the fall, after dispersal, or the following spring (Clements et al., 2004). However, dormancy can be induced and seed longevity trials have found that most buried *L. vulgare* seeds remain viable for at least 10 years in the soil, with some seeds persisting in the seed bank for up to 20 years. Approximately 1% of seeds remain viable for more than 20 years (Clements et al., 2004).

Source: Published research

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

Cattle generally avoid grazing *Leucanthemum vulgare*, but horses, sheep, and goats will eat this species. However, livestock generally prefer grasses to *L. vulgare* (Clements et al., 2004; Brusati, 2005). Grazing can help deplete the seed bank via trampling, but at the same time disperses seeds through livestock digestive tracts (EDDMapS, 2023).

Leucanthemum vulgare produces several secondary compounds that function as defenses against insect herbivory (NWCB, 2000). *Leucanthemum vulgare* plants in the Pacific Northwest experience less herbivory than they would in their native range, because very few insects are adapted to feed on *L. vulgare* in North America (Stutz et al., 2016).

Source: Published Research, Informal Publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Nutrient dynamics, Light availability

Rating: Moderate

Confidence: Moderate

Though *Leucanthemum vulgare* doesn't always grow in classic smothering monocultural stands, it is frequently abundant enough that it can reduce light availability for co-occurring species. Bare soil is common in areas heavily invaded by *L. vulgare*, and this species' shallow roots do not hold soil in place well. Areas with large populations of *L. vulgare* experience increased erosion and reduced soil nutrients and organic matter (NWCB, 2000; Clements et al., 2004).

Source: Published research, Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Presence of *Leucanthemum vulgare* can increase bare soil in ecosystems (Clements et al., 2004).

Source: Published research

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: Moderate

In its native range, *Leucanthemum vulgare* is frequently used in restoration projects to promote biodiversity. However, outside its native range, this species significantly reduces community diversity where it occurs (Coulson et al., 2001; Clements et al., 2004; Khan et al., 2021). A study in Kashmir also found that removal of *L. vulgare* from invaded meadows lead to increased species diversity (Khan et al., 2021).

Source: Published Research, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Leucanthemum vulgare is one of the most abundant introduced forbs in Willamette Prairies restored for and managed for threatened and endangered plant species such as *Lupinus oreganus*, *Sidalcea nelsoniana*, and *Castilleja levisecta*. The height and abundance of this species may obscure host plants from rare butterfly species (e.g., Taylor's checkerspot). In Washington, federal and state endangered species list candidate *Lathyrus holochlorus* occurs with *Leucanthemum vulgare*, and competition with introduced species is a significant threat to this species (Fertig, 2020). However, it seems likely that *L. vulgare*'s documented effects on native species in Washington are due to community-wide impacts and not direct interactions between species.

Source: Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Leucanthemum vulgare is an early colonizer of disturbed sites. It may occasionally invade undisturbed sites, but usually needs disturbance to establish (Clements et al., 2004; Brusati, 2005).

Source: Published research, Informal publication, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Leucanthemum vulgare is present in remnant Willamette Prairie habitats and can take advantage of small soil disturbances by burrowing animals or other causes to establish in naturally disturbed areas when there is a nearby seed source. This species is described as "common in native grasslands" (NWCB, 2000; Clements et al., 2004).

Source: Published research, Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Control of *Leucanthemum vulgare* is difficult or infeasible in many cases. Successful treatment involves both removal of the introduced species and restoration or revegetation with desirable species that are more competitive than *L. vulgare* (Stutz et al., 2024).

Mowing *L. vulgare* can reduce seed production for the year of mowing but will increase vegetative growth and potentially even the following year's seed set (Clements et al., 2004; DiTomaso et al., 2013). Tilling needs to occur over multiple years to reduce population sizes, with significant impacts to native plants. A single round of tilling may also increase populations of this species. Hand pulling may be effective against small populations, if care is taken to remove root fragments as well. Broadscale herbicides can be effective, but *L. vulgare* is known to develop herbicide resistance (Clements et al., 2004; DiTomaso et al., 2013). At least one study in Washington found that applying nitrogen fertilizer, which provides a competitive advantage for other species in the community, can be as effective as herbicide in reducing *L. vulgare* populations (NWCB, 2000).

While *Leucanthemum vulgare* is not closely related to any native species in North America (biocontrol spillover is not of concern), biocontrol agents have been difficult to develop (Clements et al., 2004). A specialist herbivore moth species (*Dichrorampha aeratana)* showed biocontrol potential as of 2021. Feeding activity of this moth is specific enough that it has limited effect on the closely related ornamental (non-invasive) Shasta daisy, while still having significant impact in *L. vulgare* (Stutz et al., 2021).

Source: Published research, Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Leucanthemum vulgare has a persistent seed bank and a significant proportion can maintain viability up to 20 years. This suggests that monitoring and treatment to prevent reestablishment from this seedbank needs to last at least 20 years. Herbicide treatments need to be reapplied every 3–5 years to treat plants from the seed bank (Clements et al., 2004). Mechanical treatments such as tilling also need to be repeated to be effective (DiTomaso et al., 2013), thought tilling is not recommended in areas with significant native plant cover. Given the prevalence of this species in the Pacific Northwest, ongoing monitoring to prevent reinvasion may be needed well after local seed banks have been exhausted.

Application of nitrogen fertilizer over seven years was effective in reducing *L. vulgare* populations in Washington (NWCB, 2000), but this treatment could leave behind viable propagules and may promote invasion by other introduced species. For example, the introduced perennial grass *Arrhenatherum elatius* is known to increase with the presence of nitrogen fixing species (R. Johnson, pers. comm. 2024).

Source: Published research, Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: High

Confidence: High

All effective herbicide treatments for *Leucanthemum vulgare* affect legumes and other broad-leaved plants (Clements et al., 2004; Stutz et al., 2024). Treatments that involve broadcast spraying or tilling will likely have long-term negative effects on native plant abundance and diversity.

Source: Published research, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Leucanthemum vulgare does not have much innate potential for long distance dispersal and is spread mainly by human activities. Invasion of this species in North America likely followed roadsides and other travel corridors (Clements et al., 2004).

Source: Published research, Informal publication

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Leucanthemum vulgare's agricultural impacts—particularly in reducing the value of pasture forage and hay—and its function as a reservoir for yellow dwarf potato virus and potentially other diseases (Clements et al., 2004; Brusati, 2005) mean that support for management of this species is likely . However, *L. vulgare* is also an attractive species with a long history of use as an ornamental. As of 2004 in Canada, task forces were set up to educate people about the invasiveness of *L. vulgare* and suggest less problematic alternatives for ornamentals (Clements et al., 2004) and this may also be a useful part of management plans for this species in the Northwest. Development of biocontrols has been slowed because of potential spillover effects to ornamental Shasta daisies (DiTomaso et al., 2013; Stutz et al., 2020).

Source: Published research, Informal publication, Professional expertise

Additional Comments

Aedes aegypti (an introduced mosquito that spreads yellow fever among other diseases) is attracted to *Leucanthemum vulgare* and may nectar on it (Clements et al., 2004). Male mosquitoes are nectar feeding pollinators.

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Washington Invasive Ranking System

Washington Natural Heritage Program

Lysimachia nummularia (Creeping Jenny)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
3 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (48) Confidence: **Moderate** (42)

Management Difficulty Rank: Low (44)	Confidence: Low (20)
Biological Characteristics of Invasiveness: High (71)	Confidence: Moderate (38)
Concern Related to Distribution and Abundance: Moderate (67)	Confidence: Moderate (40)

Photo Credit: Gabriel Campbell 2024, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Monitor list

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

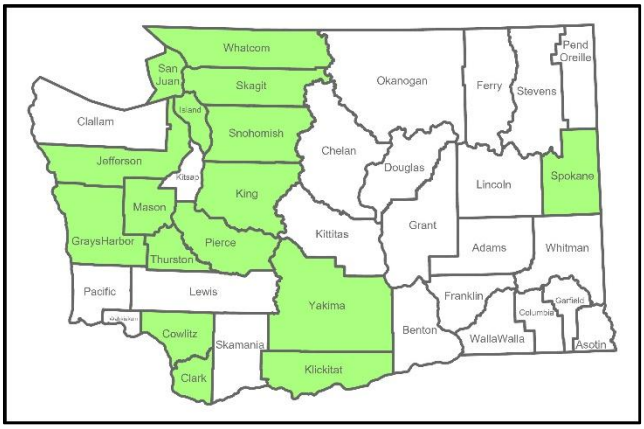

Figure 1. Distribution of counties where *Lysimachia nummularia* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Lysimachia nummularia is present in 41% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Not Rated

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Low

Lysimachia nummularia is present in 41% of counties in Washington, and unoccupied available habitat likely still exists in the state (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Rating: Not Rated

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Bog & Fen, Forested Wetland

Rating: Moderate

Confidence: High

This species is primarily found in wetlands (including fens) and is often abundant on freshwater mudflats. It may establish in mesic upland ecosystems but is typically more incidental in those settings.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Lysimachia nummularia plants in North America are not known to produce seed (Cao & Berent, 2025), instead reproducing vegetatively via plant fragments (MISIN, 2024). Horizontal stems typically root at the nodes.

Source: Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Unknown

Confidence: Not Rated

Plant fragments may be dispersed by water, but the degree to which this occurs is not known.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Deliberate release of plants grown as ornamentals is thought to be common.

Source: Professional expertise

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Not Rated

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: No

Confidence: Low

Forms dense low mats that are capable of excluding native species, but this may be restricted to mudflats and other early successional ecosystems.

Source: Professional expertise

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Lysimachia vulgaris and *L. terrestris* are frequently considered invasive.

Source: Professional expertise

Q14: Shade Tolerance

Rating: High

Confidence: Moderate

Lysimachia nummularia reportedly grows in a range of light conditions from full shade to full sun (Innes, 2011).

Source: Informal publication

Q15: Disturbance Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

This plant rarely, if ever, seeds in North America (MISIN, 2024), but the longevity of vegetative fragments is not known.

Source: Informal publication

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Secondary compounds produced by *Lysimachia nummularia* make it unpalatable to many herbivorous mammals (Hilty, John, 2019).

Source: Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Low

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

This species forms a trailing mat that likely excludes many other plants, but rarely impacts ecosystems over large areas (NPSO Emerald Chapter, 2008).

Source: Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

This plant can establish and survive in late-successional ecosystems of a variety of disturbance regimes (Innes, 2011), but likely requires at least minor, one-time soil disturbance to become established.

Source: Informal publication, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Not Rated

Confidence: Not Rated

Source:

Q25: Minimum Time Commitment

Rating: Not Rated

Confidence: Not Rated

Source:

Q26: Impacts of Management on Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Low

Populations on freshwater mudflats may be difficult to access.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

This species is widely sold as an ornamental, but any objections to control are likely to be limited to highly visible populations.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Lythrum salicaria (Purple Loosestrife)

Assessed by
Kimberly Quayle (Natural Areas Steward, Washington Dept. of Natural Resources)
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
11 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (63)	Confidence: **Low** (33)
Management Difficulty Rank: High (84)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Moderate (60)	Confidence: Moderate (58)
Concern Related to Distribution and Abundance: Moderate (64)	Confidence: Moderate (50)

Photo Credit: David Giblin 2024, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Lythrum salicaria was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: List B, Washington State quarantine list

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

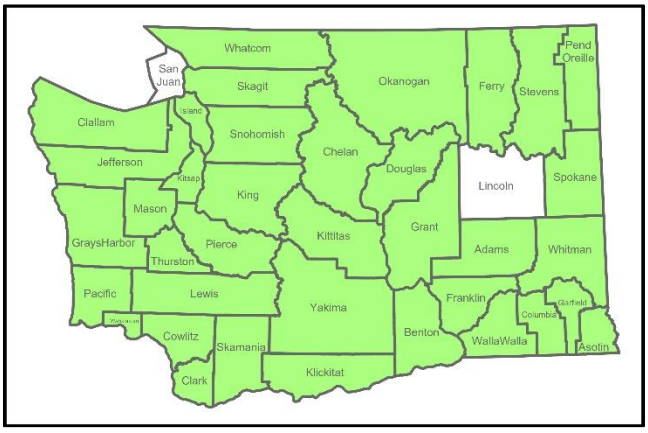

Figure 1. Distribution of counties where *Lythrum salicaria* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Lythrum salicaria is found in 95% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

This species is already found in almost all counties in Washington (Munger, 2002).

Source: Informal publication, Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low (range Insignificant - Low)

Confidence: Moderate (range Moderate - High)

Temperature limits germination in *Lythrum salicaria*. Increasing temperatures may allow this species to germinate more abundantly where it is currently found and allow it to establish in additional locales (Shamsi & Whitehead, 1974).

Source: Published research, Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Low (range Low - Moderate)

Source: Professional Expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Shallow Water Wetland (Aquatic)

Rating: Low

Confidence: Moderate

Lythrum salicaria may sometimes establish in disturbed peatlands.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Mature *Lythrum salicaria* can produce 2.5 million seeds per established plant in good conditions; even young plants can produce 100,000 seeds (Thompson et al., 1987).

Source: Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Seedlings are buoyant and can be dispersed along waterways and tiny seeds can be transported by waterfowl and aquatic mammals (Thompson et al., 1987).

Source: Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Lythrum salicaria can be spread by watercraft, irrigation development (Thompson et al., 1987), and horticultural introductions.

Source: Professional expertise, Published research

Q9: Allelopathy

Rating: No

Confidence: Moderate

No evidence was found suggesting this species is allelopathic.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Lythrum salicara is a fast-growing, competitive perennial that can reproduce its first year and quickly regenerate from root stock but otherwise does not appear particularly aggressive in competing for limiting abiotic factors.

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: Low

Lythrum salicaria forms dense thickets, but the primary native plants it often competes with (e.g., *Typha, Schoenoplectus*) are just as tall and unlikely to be shaded out. A study from the east coast showed no difference in species richness between areas with and without purple loosestrife (Treberg & Husband, 1999).

Source: Published research, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

Germination requires some amount of sunlight to occur and experimental plantings in wetland plots with no disturbance showed no germination (Rachich & Reader, 1999). Seeds can, however, germinate underwater.

Source: Published research, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Lythrum virgatum is also a Class B weed in Washington (NWCB, 2025) and other exotic *Lythrum* species may also be considered invasive.

Source: Informal publication, Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Source: Professional Expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Low

One study found 91% of clipped seedlings resprouted within 42 days. Mature plants can resprout from rootstock (Gabor & Murkin, 1990). However, the degree to which this provides a competitive advantage to *Lythrum salicaria* is unclear, as it typically establishes in native communities characterized by highly disturbance-tolerant genera (*Typha*, *Schoenoplectus*, etc.).

Source: Published Research, Professional Expertise

Q16: Propagule Persistence

Rating: >5 years

Confidence: Moderate

One source from Canada suggests seed longevity up to 20 years (Regional District Okanagan-Similkameen, 2006). More conservative assessments have confirmed viability of at least 80% beyond 2-3 years (Shamsi & Whitehead, 1974; Rawinski, 1982). The sheer volume of seeds often leads to seed bank dominance (Welling & Becker, 1993).

Source: Published research, Informal publication, Professional expertise, Thesis

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Lythrum salicaria primarily grows in areas with little herbivory pressure from livestock, but studies have shown that muskrats prefer other species such as cattails (*Typha* spp.) (Thompson et al., 1987).

Source: Published research, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Hydrology, Light availability, Nutrient dynamics

Rating: Moderate (range Low - Moderate)

Confidence: Low

Lythrum salicaria may impact detrital food chains (Grout et al., 1997). A report from the Snake River warns that *Lythrum salicaria* may speed aggradation of gravel bars through increased sedimentation trapping (Dixon & Johnson, 1999).

Source: Published research, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate (range Low - Moderate)

Confidence: Moderate (range Low - Moderate)

Lythrum salicaria populations can substantially reduce the amount of open water in marshes, or speed the development of aquatic vegetation towards marsh. *Lythrum salicaria* may shift communities from graminoid dominance to forb dominance, but rarely completely replaces characteristic marsh genera like *Typha* and *Schoenoplectus*.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Low (range Low - High)

Information regarding impacts to native plant species composition is contradictory and often based on untested hypotheses (Anderson, 1995; Hager & McCoy, 1998). Research has generally failed to demonstrate *Lythrum salicaria* impacts on native plant diversity and apparent monocultures may have had low species richness to start (Anderson, 1995; Treberg & Husband, 1999). While diversity impacts have not been proven, reductions in cover of dominant native species are readily apparent.

Source: Published research, Professional expertise

Q21: Impact on Particular Native Species

Rating: Low

Confidence: Low

Lythrum salicaria hybridizes with *Lythrum alatum* (native in central and eastern North America) (Houghton-Thompson et al., 2005), but there are no native *Lythrum* species in Washington. There are many hypotheses regarding *Lythrum salicaria* impacts on various native animal and plant species (e.g., Bury, 1979), but the assessors found no strong evidence for disproportionate impacts on individual species.

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate (range Low - High)

Confidence: Moderate

This plant is most pervasive in ecosystems that experience regular disturbance. However, it may establish in relatively low-disturbance ecosystems following one-off events and then persist for very long periods with low-level recruitment (Thompson et al., 1987; Anderson, 1991).

Source: Published research, Professional expertise, Thesis

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High (range Moderate - High)

Confidence: High

Once strongly established, control of *Lythrum salicaria* is “expensive, intrusive, and difficult” (Thompson et al., 1987; Munger, 2002). Reintroduction is very likely along waterways that are not comprehensively treated.

Source: Published research, Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

This species resprouts readily and the seed bank is difficult to exhaust (Welling & Becker, 1993).

Source: Published research, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Moderate

In very small populations mechanical (hand pulling) may be the most effective removal strategy, though care must be taken to leave behind any vegetative fragments that can resprout. In larger, established populations herbicide is often recommended. This poses little threat to monocots but is damaging to dicots. Most of dominant, diagnostic native species are monocots in the ecosystems where *Lythrum salicaria* poses a threat.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

A substantial proportion of populations are in wetland riparian areas that are difficult to access.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low (range Insignificant - Moderate/Low)

Confidence: Moderate

Lythrum salicaria can be a food source for honeybees. It is no longer commonly promoted as an ornamental plant (Thompson et al., 1987).

Source: Published research, Professional expertise

Additional Comments

The Fire Effects Information System provides an excellent review of the state of knowledge regarding *Lythrum salicaria*, although information is only current as of 2002 (Munger, 2002).

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Washington Invasive Ranking System

Washington Natural Heritage Program

Marrubium vulgare (White Horehound)

Assessed by
Ethan Coggins (Natural Areas Steward, Washington Dept. of Natural Resources)
28 November 2023 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (28)	Confidence: **Low** (33)
Management Difficulty Rank: Insignificant (0)	Confidence: High (80)
Biological Characteristics of Invasiveness: Low (33)	Confidence: High (67)
Concern Related to Distribution and Abundance: High (76)	Confidence: Moderate (40)

Photo Credit: Luigi Rignanese 2007, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

None

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

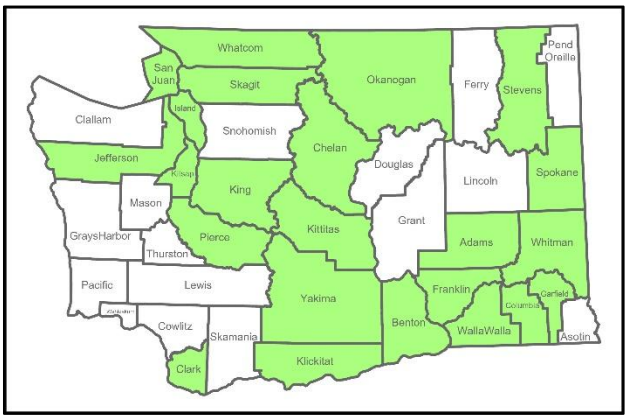

Figure 1. Distribution of counties where *Marrubium vulgare* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Marrubium vulgare is document in 59% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Reliable data regarding trends are not available. Herbarium records suggest that this species has been present in Washington for over 100 years, with the most recent introduction into a county documented in Walla Walla County in 1979 (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations.

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Based on spread in other regions that are climatically similar to the Columbia Basin (Weiss et al., 2000; Lucidcentral.org, 2016) *Marrubium vulgare* has potential to spread into some counties for which there are no herbarium records, particularly Grant, Adams, Lincoln, and Douglas Counties.

Source: Informal Publication, Herbarium records and other observations,

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Low

The assessor has observed significant infill within at least one natural area in eastern Washington.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Semi-Desert (includes Shrub-steppe)

Rating: Moderate

Confidence: Moderate

This species is known to invade temperate to arid grasslands in other parts of the world (Weiss & Sagliocco, 1994). In Washington, *Marrubium vulgare* also establishes and persists in relatively dry woodlands.

Source: Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Large mature plants are known to produce up to 20,000 seeds in wet years in Tasmania, with high germination rates (Lippai et al., 1996; Weiss et al., 2000).

Source: Published research, Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

This species produces burs which facilitate long range spread by animals (Weiss & Sagliocco, 1994; Weiss et al., 2000).

Source: Informal Publication

Q8: Potential to be Spread by Human Activities

Rating: No

Confidence: Moderate

This species has been introduced in other areas for medicinal uses (Lodhi et al., 2017), but this appears to be uncommon in the US (Baker, 1986; Cal-IPC, 2004). In Australia, this species has also been used for dune stabilization (Weiss & Sagliocco, 1994).

Source: Published research, Informal publication

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

At least one study has indicated that *Marrubium vulgare* leaf extracts have allelopathic properties (Dallali et al., 2017).

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

This species is most competitive in areas with heavy grazing. While some sources state this species is deciduous, others report the species remaining green into the winter (Weiss et al., 2000). *Marrubium vulgare* may continue to photosynthesize in relatively mild parts of western Washington, but the assessor is not confident.

Source: Informal publication, Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

This species is a clumping perennial and rarely forms dense monocultures.

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

This species likely requires disturbance, such as livestock soil disturbance, to establish (Weiss et al., 2000).

Source: Informal publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Moderate

Marrubium vulgare is the only species from this genus in the Washington Flora (Weinmann et al., 2002) and no other taxa from this genus are known to occur in North America.

Source: Professional expertise, Herbarium and other records

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

This plant prefers full sun and typically invades grasslands where there is little shade (Weiss et al., 2000; Barton & Drost, 2020). In Washington, it only grows in open woodlands without canopy closure.

Source: Informal Publication, Professional Expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: Moderate

This species appears not to resprout after fire, but it is a grazing increaser (Weiss & Wills, 2000).

Source: Published research, Professional expertise

Q16: Propagule Persistence

Rating: >10 years

Confidence: Low

Anecdotally, propagules can persist for more than 10 years, but viability has only been confirmed for three or more years (Weiss et al., 2000; Cal-IPC, 2004).

Source: Informal publication

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Reviews of weed control and impact documents strongly suggests horehound is unpalatable to livestock and taints meat (Greonteman, 2018). Horehound is a grazing increaser, further supporting this idea.

Source: Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology

Rating: Low

Confidence: Low

There is little indication that this species alters abiotic processes significantly, though there are reports that it has been used for dune stabilization (Weiss & Sagliocco, 1994). This plant is a small subshrub or forb that is unlikely to compete for sunlight, except with smaller forbs, grasses, and nonvascular species. This species is noted to prefer calcareous soils (Weiss & Sagliocco, 1994).

Source: Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: Low

In Washington, this species does not appear to significantly alter vegetation structure.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: Low

Marrubium vulgare appears to have little impact on the composition, diversity, and cover of native plants in Washington. It may be more impactful in other parts of the world, such as Australia and Catalina Island, California (Weiss et al., 2000; Cal-IPC 2004).

Source: Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

This species requires disturbance to establish and has only been observed to reach significant foliar cover in naturally disturbed ecosystems, or in localized areas of soil disturbance (foot traffic, turkey scratches, invasive treatment areas, etc.).

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: Moderate

In Australia, multiple herbicide treatments, extensive manual control, prescribed burning, and establishment of competitive native species is necessary to eliminate large occurances (Weiss et al., 2000). In Washington hand pulling is effective in controlling small populations. In general, this species has not been a target of control, but there are informational resources available (DiTomaso et al., 2013).

Source: Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Seed viability in the soil may reach 10 years (Weiss et al., 2000), but generally active management of this species has not been deemed necessary in Washington.

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Populations in Washington are usually small enough that hand-pulling is a sufficient treatment method. In other parts of the world, prescribed fire and herbicides are effective but result in greater off-target damage (Weiss et al., 2000).

Source: Informal publication, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: Moderate

This plant generally grows in easily accessible, disturbed environments.

Source: Professional Expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Medicinal uses for this plant are reported, but actual foraging appears to be quite uncommon (Cal-IPC, 2004). Objections to management are unlikely, aside from generalized objection to herbicide use (which is not required for most populations in Washington).

Source: Informal publication, Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Mycelis muralis (Wall Lettuce)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
21 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (16) Confidence: **High** (83)

Management Difficulty Rank: Insignificant (0)	Confidence: High (100)
Biological Characteristics of Invasiveness: Moderate (55)	Confidence: Moderate (37)
Concern Related to Distribution and Abundance: Moderate (56)	Confidence: High (80)

Photo Credit: David Giblin 2024, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

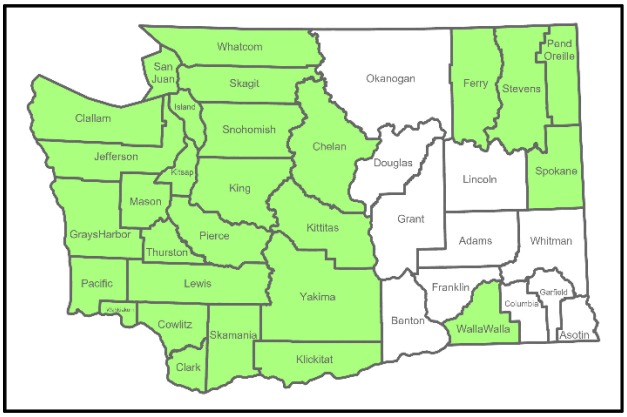

Figure 1. Distribution of counties where *Mycelis muralis* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Mycelis muralis is found in 72% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional Expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland

Rating: Low

Confidence: High

May occur incidentally in more open ecosystems, but this species is primarily restricted to forests.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Not Rated

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional Expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Source: Professional Expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

Source: Professional Expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional Expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: High

Mycelis muralis is the only species documented in this genus for North America (Strother, 2022). This plant was formerly in the *Lactuca* genus, which is represented by a number of widespread introduced species in North America.

Source: Professional expertise, Flora of North America treatment

Q14: Shade Tolerance

Rating: High

Confidence: High

Source: Professional Expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Unknown

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Myosotis discolor (Yellow and Blue Forget-me-not)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
30 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (16)	Confidence: **Moderate** (58)
Management Difficulty Rank: Insignificant (2)	Confidence: Moderate (40)
Biological Characteristics of Invasiveness: Low (33)	Confidence: Moderate (54)
Concern Related to Distribution and Abundance: High (78)	Confidence: High (80)

Photo Credit: Keir Morse 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Relatively little information is available for *Myosotis discolor* outside of its native range.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

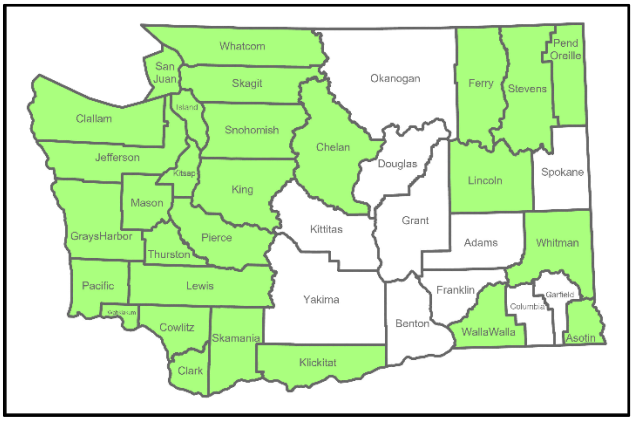

Figure 1. Distribution of counties and provinces where *Myosotis* discolor has been documented in the United States and Canada (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Myosotis discolor is found in 28 of 39 (72%) of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

This species may have expanded to the northern Olympic Peninsula over the last 20 years and may also be slightly expanding in eastern Washington (CPNWH, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Myosotis discolor is currently most abundant west of the Cascades in Washington State (CPNWH, 2024; iNaturalist Community, 2024) However, this species is predicted to be able to expand to the rest of the state (EDDMapS, 2024)

Source: Herbarium records and other observations, Model predictions.

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

iNaturalist records suggest a rapid increase in local abundance and local range for *Myosotis discolor* over the last 20 years (iNaturalist Community, 2024). However, herbarium records from the same timespan suggest very little expansion of local range and abundance in Washington (CPNWH, 2024). The majority of iNaturalist records are concentrated in areas of the state with the highest human populations, so some increase in records may be due to an increase in observers. However, because this species is small and easily overlooked, it appears likely that there has been at least some increase in local abundance over the last 20 years.

Source: Professional expertise, Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland; Grassland & Shrubland; Marine Coastal Shore; Emergent Open Wetland; Forested Wetland

Rating: High

Confidence: High

Myosotis discolor is found in a wide range of naturally and anthropogenically disturbed areas and can grow in both wetland and uplands. It is found in both Willamette and coastal prairies, balds, and other grasslands; savannas, woodlands, and open forests; a wide variety of open, shrubby, or forested wetlands; dunes and beaches; and cliffs and rockfaces. It may also be able to grow in salt marshes. This species is frequently associated with anthropogenic disturbances, including roadsides and other travel corridors, powerline easements, trails, and agricultural fields. *Myosotis discolor* grows in a range of sandy, loamy, or clay soils, as well as gravelly or rocky substrates (CPNWH, 2024; Feuillet, 2024; Knoke & Giblin, 2024)

Source: Professional expertise, Herbarium records and species treatment

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

Myosotis discolor is a self-compatible annual or occasionally biennial species (Parachnowitsch & Elle, 2005; Kelley & Joyal, 2012). This species likely reproduces only by seed. Reproductive information was only available from this species' native range, and seed production rates could be different in its

introduced range. Two studies from England documented reproductive output for *M. discolor* and both found low seed production. One study harvested 132 seeds in approximately 10 square meters (Smith et al., 1996). The other study found that this species produced on average 55 seeds per plant and exhibited relatively poor colonization (Asefa, 2011).

Source: Published research, Professional expertise, Thesis, Jepson eFlora treatment

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

A study in England found that *Myosotis discolor* was more likely to disperse into areas with rabbit pellets, compared to areas where rabbit pellets were removed, suggesting that this species can be dispersed in the manure of small mammals. This species has also been suggested to disperse in the fur of animals (Pakeman et al., 1998). Dispersal by wind or gravity occurs over relatively short distances. Another study from England found a mean dispersal distance of 9.6 cm and a maximum distance of 47 cm from the parent plant for *M. discolor* seeds (Asefa, 2011).

Source: Published research, Thesis

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

No direct evidence for human dispersal was found in the literature but given that *Myosotis discolor* has spread to many parts of the world, this species has at least some potential to be dispersed by human activities.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Low

No information on secondary chemicals in *Myosotis discolor* was found. However, the species habit does not suggest that it is allelopathic.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

While some research suggests *Myosotis discolor* can be competitive with selected annual species in its native range (Asefa, 2011), in the Pacific Northwest this species appears to be found either in ruderal places or in trace amounts underneath dominant plant species (CPNWH, 2024), suggesting it is not a strong competitor.

Myosotis discolor is a winter annual, in England it germinates in the fall and overwinters as a rosette before growing in the spring (Asefa, 2011).

Source: Professional expertise, Thesis, Herbarium records

Q11: Growth Form

Rating: No

Confidence: High

While *Myosotis discolor* can be locally abundant where found, it does not form smothering or tall monocultural stands. This species usually grows under mixed communities of other plants and does not appear to be competitive for light.

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Low

Given that *Myosotis discolor* is mostly found in areas of natural or anthropogenic disturbance, it may require bare ground or disturbance to establish, but no information was found about germination requirements.

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Several other *Myosotis* species are tracked by the University of Georgia's Center for Invasive Species and Ecosystem Health (EDDMapS, 2024).

Source: Professional Expertise, EDDMaps database

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Myosotis discolor can be found growing in partial shade to full sun (CPNWH, 2024). This species frequently grows beneath other plant species when it occurs in meadows or prairies.

Source: Professional expertise, Herbarium records

Q15: Disturbance Tolerance

Rating: No

Confidence: High

Myosotis discolor is found in a wide variety of ruderal ecosystems and other areas that experience regular disturbance (CPNWH, 2024). A study in southwestern Oregon found presence of this species indicated burned areas (Sikes, 2005). However, disturbance responses likely do not provide *M. discolor* an advantage over co-occurring native species.

Source: Professional expertise, Thesis, Herbarium records

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

A study in England documented *Myosotis discolor* seeds persisting up to four years in the seed bank, but no longer (Asefa, 2011).

Source: Thesis

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

In England, rabbits eat *Myosotis discolor* frequently enough to be a significant source of seed dispersal (Pakeman et al., 1998).

Source: Published Research

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Little information was available on the abiotic effects of *Myosotis discolor*. While it can compete with other small annual species in its native range (Asefa, 2011), it does not have easily observable impacts on ecosystem processes in the Pacific Northwest. This species is usually present only as a trace component in prairies and grasslands, suggesting its effects on abiotic processes are insignificant.

Source: Professional Expertise, Thesis

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: Moderate

The assessor has observed that this plant has trace cover in relevé surveys of Willamette prairie in Oregon and does not appear to change community structure. Little information on structural impacts were available in the literature, though it may be competitive against some annual grasses in its native range (Asefa, 2011).

Source: Professional expertise, Thesis

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: Moderate

The assessor has observed that this plant has trace cover in relevé surveys of Willamette prairie in Oregon, suggesting an insignificant change in community composition.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

The abundance of annual plants is a concern in *Castilleja levisecta* habitat, as annuals are poor hosts. An overabundance of annuals can reduce *C. levisecta* habitat quality and individual survival. However, *Myosotis discolor* is usually only a trace component of these communities, and its effects on species like *C. levisecta* are more likely as a minor component of a larger community shift, not because of *Myosotis discolor*'s presence alone.

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Based on habitat preferences, *Myosotis discolor* likely needs either natural or anthropogenic disturbance to establish.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Myosotis discolor is found in remnant prairie and other naturally disturbed ecosystems in Washington (CPNWH, 2024).

Source: Professional expertise, Herbarium records

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: Moderate

Carbon addition can reduce abundance of *Myosotis discolor* in Pacific Northwest prairies (Mitchell & Bakker, 2011), but otherwise little research has been done on weed management of this species. Control of *M. discolor* would likely require exhausting the seed bank and removing populations that can recolonize areas. *Myosotis discolor* likely is a low priority for treatment, especially given its limited ecological impact, and is therefore rated as insignificant.

Source: Published Research, Professional Expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: Moderate

Given the relatively short span of seed viability, *Myosotis discolor* populations without an outside seed source could be treated in less than five years. This species may not need treatment at all, given its limited ecological impacts.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Unknown

Confidence: Not Rated

Management techniques are not well-developed for *Myosotis discolor*, likely because it has limited ecological impact compared to other nonnative species in the Pacific Northwest. Effects of management techniques for *M. discolor* on co-occurring native species are therefore not known. However, costs of treatment to native plants should be carefully weighed against the likely limited benefits gained by treating *M. discolor*.

Source: Professional Expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Known populations of *Myosotis discolor* are most abundant near areas of anthropogenic disturbance. It seems likely that the majority of populations of this

species are relatively accessible (CPNWH, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Myosotis discolor is not used in agriculture or as an ornamental species, and it seems unlikely that objections would extend beyond general objections to herbicide use.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Myriophyllum heterophyllum (Variable-leaf Milfoil)

Assessed by
Wesley Glisson (Aquatic Plant Specialist, Washington Dept. of Ecology)
24 May 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (85) Confidence: **Moderate** (42)

Management Difficulty Rank: Moderate (68)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Not Rated	Confidence: Not Rated
Concern Related to Distribution and Abundance: Low (38)	Confidence: High (80)

Photo Credit: Rich Miller 2017, used under Creative Commons license (iNaturalist Community, 2025).

Ranking Notes

Biological characteristics section was not rated for this species.

Legal Listings

Washington State Weed Board: Class A, Washington State quarantine list

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

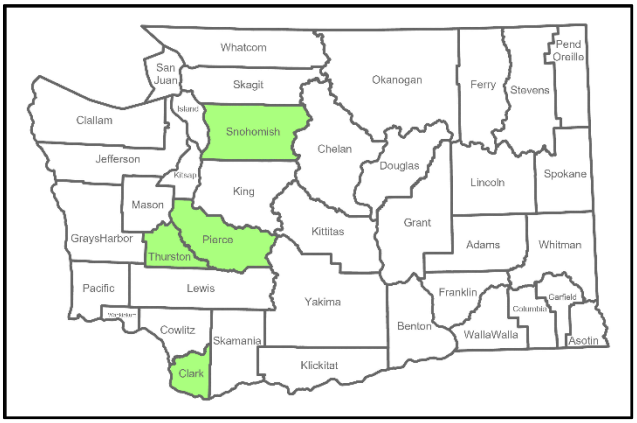

Figure 1. Distribution of counties where *Myriophyllum heterophyllum* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Low

Confidence: High

Myriophyllum heterophyllum is found in 10% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023; Washington State Department of Ecology, 2023).

Source: Professional expertise, Herbarium records and other observations, Unpublished Washington State Department of Ecology data

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

Many populations of this species were found in Clark County in 2022, but they have likely existed for a long time and are primarily on private property. All discovered populations have been robust and in isolated locations (Washington State Department of Ecology, 2023).

Source: Professional expertise, Unpublished Washington State Department of Ecology data

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

This species has been spreading in the northeastern US and in lakes in Europe where it is also introduced. It could likely thrive in many Washington lakes (Les & Mehrhoff, 1999; Thum & Lennon, 2010; Gross et al., 2020; Washington State Department of Ecology, 2023).

Source: Published research, Professional expertise, Unpublished Washington State Department of Ecology data

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: High

Populations in several lakes have diminished or been eradicated through intensive yearly management, but populations in less managed lakes have remained stable or even increased (Washington State Department of Ecology, 2023).

Source: Professional expertise, Unpublished Washington State Department of Ecology data

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Shallow Water Wetland (Aquatic)

Rating: Low

Confidence: High

This is a submersed freshwater aquatic plant. It can survive along muddy shorelines in a terrestrial form, but primarily occurs fully submersed.

Source: Professional expertise, Unpublished Washington State Department of Ecology data

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Not Rated

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Not Rated

Confidence: Not Rated

Source:

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Not Rated

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: Not Rated

Confidence: Not Rated

Source:

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Not Rated

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q15: Disturbance Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q16: Propagule Persistence

Rating: Not Rated

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Hydrology, Nutrient dynamics, Light availability

Rating: High

Confidence: Moderate

There is a lack of research in this area, but the biomass and structure of the plants suggests that these impacts are at least moderate (Gross et al., 2020).

Source: Published research, Professional expertise, Unpublished Washington State Department of Ecology data

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

There is a lack of research in this area, but the biomass and structure of the plants suggests that these impacts are at least moderate. These plants fill the water column in a manner not seen with other native and invasive submersed aquatic plants (Gross et al., 2020).

Source: Published research, Professional expertise, Unpublished Washington State Department of Ecology data

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Low

As with the topics above, there is just not enough research on this topic. However, the information we do have suggests that this species can outcompete others native species (Dülger & Hussner, 2017; Gross et al., 2020).

Source: Published Research, Professional Expertise, Unpublished Washington State Department of Ecology data

Q21: Impact on Particular Native Species

Rating: High

Confidence: Moderate

This plant hybridizes with the native *Myriophyllum hippuroides*, an uncommon species in Washington and a Pacific Northwest endemic. Hybridization could lead to the reduction of native gene pools. Many new hybrid populations have been found in Clark County, Washington and ongoing research will help shed light on these taxa (Thum et al., 2011).

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: High

Confidence: High

Based on the data from Ecology and a handful of other sources, these plants seem to be able to establish in lakes with intact and healthy native plant populations (Gross et al., 2020; Washington State Department of Ecology, 2023).

Source: Published research, Professional expertise, Unpublished Washington State Department of Ecology data

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Unknown

Confidence: Not Rated

The handful of lakes where this species is found in Washington do not appear to undergo substantial natural disturbance.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

Based on personal experience and knowledge, established populations have been very difficult to control (Bailey, 2007; Glomski & Netherland, 2008; Haug & Bellaud, 2013; Gross et al., 2020).

Source: Published research, Professional expertise, Thesis

Q25: Minimum Time Commitment

Rating: High

Confidence: High

This plant has only been eradicated in one lake with a very small population (i.e., a few plants) and that took yearly hand pulls for ~ 5 years. Larger established populations have been managed for more than 10 years to achieve control and in one lake, the population remains largely unchanged after nearly 15 years of ongoing management.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Low

There is a lack of quantitative research on non-target impacts of management. There is a current research project examining this, so we should have more information on this soon (Washington State Department of Ecology, 2023).

Source: Professional expertise, Unpublished Washington State Department of Ecology data

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

It is relatively easy to access known occurances.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

In general, the public has been supportive of treatment efforts for this species.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Myriophyllum spicatum (Eurasian Watermilfoil)

Assessed by
Wesley Glisson (Aquatic Plant Specialist, Washington Dept. of Ecology)
12 December 2023 (WIRS Version 1.5)

Ecological Impact Rank: **High** (80)	Confidence: **High** (92)
Management Difficulty Rank: Moderate (58)	Confidence: High (70)
Biological Characteristics of Invasiveness: High (92)	Confidence: High (67)
Concern Related to Distribution and Abundance: High (73)	Confidence: High (90)

Photo Credit: Thayne Tuason 2010, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

None.

Legal Listings

Washington State Weed Board: Class B, Washington State quarantine list

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

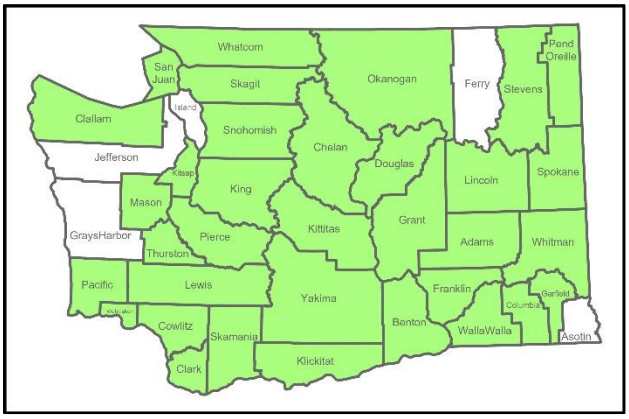

Figure 1. Distribution of counties where *Myriophyllum spicatum* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Myriophyllum spicatum is documented from 87% of counties in Washington State. We have good data on Eurasian watermilfoil locations in waterbodies throughout the state. The species often tops out on the water's surface, so it is easily recognized by surveyors and the public. Spatial data is copious (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors,

2023; WSDA, 2023; Washington State Department of Ecology, 2023a).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

While the rate of spread seems to have slowed recently, a 20-year view still shows a steady increase in the number of lakes (and counties) colonized by Eurasian watermilfoil, with new lakes being discovered each year. Populations have been eradicated from some individual lakes, but the general range size has continued to grow steadily over the time span. Data collected by the Washington State Department of Ecology supports this range expansion (Washington State Department of Ecology, 2023a, 2023b).

Source: Professional expertise, Washington State Department of Ecology data

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

In terms of counties, only a few have not reported any Eurasian watermilfoil. However, many lakes still remain free of Eurasian watermilfoil and could be easily colonized. This species can tolerate most water conditions and readily invades a variety of aquatic ecosystems (WSDA, 2023; Washington State Department of Ecology, 2023b, 2023a).

Source: Professional Expertise, Department of Ecology data

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

While the Department of Ecology collects rough abundance data during lake surveys, these data are not fine-scale enough or collected frequently enough to determine accurate trends in abundance (Washington State Department of Agriculture (WSDA), 2023; Washington State Department of Ecology, 2023a, 2023b). Across the state, familiarity with this species has led to quick management action where it is found. In some locations, populations have declined due to management, while other populations have expanded. The assessor estimates that there has been a net range expansion and abundance increase, but that it is overall low when examined across the state. However, we lack good state-wide data to support any strong conclusions.

Source: Professional expertise, Washington State Department of Ecology data

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Shallow Water Wetland (Aquatic)

Rating: Low

Confidence: High

This plant grows rooted to the bottom of freshwater lakes, rivers, and streams. It can tolerate a wide range of salinity and pH, but is not typically found in shallow marshes, salt marshes, bogs, or fens (Aiken et al., 1979; Smith & Barko, 1990).

Source: Published Research, Professional Expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Reproduces readily by fragments and seeds, both supported by many studies (Aiken et al., 1979; Madsen & Boylen, 1989, 1989; Smith & Barko, 1990; Hartleb et al., 1993; Madsen & Smith, 1997; Standifer & Madsen, 1997; Evans et al., 2011; Li et al., 2013; Wani & Arshid, 2013).

Source: Published research, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Plant fragments are easily moved via water movement. Waterbirds can also disperse propagules

(Madsen et al., 1991; Madsen & Smith, 1997). See also studies cited for Q6.

Source: Published research, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

There is clear evidence that boats move aquatic invasive species such as Eurasian watermilfoil and that Eurasian watermilfoil fragments moved by boaters can survive for several hours before dying (Evans et al., 2011; Jerde et al., 2012; Mcalarnen et al., 2012; Kao et al., 2021; Pfingsten et al., 2024).

Source: Published research, Informal publication, Professional expertise

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Eurasian watermilfoil can occur at deeper depths than other macrophytes, can grow quickly in the spring to reach the surface, and can photosynthesize at lower water temperatures than most native species, providing it with a competitive advantage (Smith & Barko, 1990; Glisson & Larkin, 2021). While most of the plant dies back, some green stems persist throughout the winter in the climates of both western and eastern Washington. The rate of photosynthesis slows substantially, but still occurs during winter months (Adams & McCracken, 1974).

Source: Published research, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

As a canopy-forming species, it reduces light for other species below (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999).

Source: Published research, Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Most research has been in a lab setting and Eurasian watermilfoil seeds do have constraints to germination (Hartleb et al., 1993; Wani & Arshid, 2013). Hence, the ability of seeds to germinate under a range of different environmental conditions *in situ* is still not fully understood.

Source: Published research, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

There are several *Myriophyllum* species that are known invasives both in North American and across the world. *Myriophyllum heterophyllum* is a Class A listed noxious weed (NWCB, 2023a) and *Myriophyllum aquaticum* is a Class B listed noxious weed in Washington State (NWCB, 2023b).

Source: Informal publication, Professional expertise

Q14: Shade Tolerance

Rating: High

Confidence: Moderate

This species thrives in lower light conditions and quickly becomes the canopy-forming species in aquatic environments.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

The species can occur in low light conditions and on substrates where other species are unable to survive. It often invades following disturbance (Smith & Barko, 1990).

Source: Published Research, Professional Expertise

Q16: Propagule Persistence

Rating: >5 years

Confidence: Low

The assessor is not aware of research on the long-term longevity of propagule viability for Eurasian watermilfoil. Stem fragments likely do not persist for more than several months to a year. Studies suggest that seeds can remain viable for 3-7 years, but they may actually be viable for longer (Guppy, 1897; Patten, 1955; Aiken et al., 1979; Standifer & Madsen, 1997).

Source: Published research, Professional expertise

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Hydrology, Light availability

Rating: Moderate

Confidence: High

There is a lot of evidence of Eurasian watermilfoil impacts to abiotic processes, but importantly, these are often reversible with milfoil management (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999).

Source: Published research, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

This species creates a new aquatic plant canopy structure that is different than most native vegetation (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999).

Source: Published research, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Eurasian watermilfoil invasion has been associated with declines in native species richness in several lakes where it has been studied intensively. However, when examining more colonized lakes across the landscape this relationship is not supported (Mikulyuk et al., 2020). Hence, the plant community response to Eurasian watermilfoil invasions varies by lake and is not always negative. Moreover, native macrophyte species declines can be associated with other environmental changes such as reductions in water quality and disturbance that promote concurrent Eurasian watermilfoil invasion (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999; Verhoeven, 2022).

Source: Published research, Professional expertise, Thesis

Q21: Impact on Particular Native Species

Rating: High

Confidence: High

Eurasian watermilfoil hybridizes readily with native northern watermilfoil (*Myriophyllum sibirium*) (Moody & Les, 2002; Eltawely et al., 2020; Thum et al., 2020). Many hybrid genotypes have been found, indicating routine hybridization events. Hybridization occurs in Washington and is likely more widespread than currently known. Continued spread of Eurasian watermilfoil and hybridization may deplete the pure gene pool of northern watermilfoil and ultimately cause local or regional extinction.

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: High

Confidence: High

While Eurasian watermilfoil establishes most readily in recently disturbed areas, it can establish in mature plant beds (Aiken et al., 1979; Smith & Barko, 1990).

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Eurasian watermilfoil readily invades disturbed habitat and ecosystems (Aiken et al., 1979; Smith & Barko, 1990).

Source: Published research, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

There has been a lot of research on the control of Eurasian watermilfoil and new compounds and methods have been developed that are much more effective than those used in the past (Hussner et al., 2017; Kujawa et al., 2017; Mikulyuk et al., 2020). Controlling the species to a reasonable level is relatively simple using current tools, but it still takes a long time and can be expensive. Complete eradication is still very difficult and rarely achieved.

Source: Published research, Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

This species will likely continue to spread in a waterbody unless eradication is achieved, which requires multiple years of management (Smith & Barko, 1990; Kujawa et al., 2017; Mikulyuk et al., 2020). At a minimum, a low level of management is needed at most locations, but some populations may require greater than 10 years of treatment. On average, for a population of 2.5 acres, approximately 5 years of repeated management and surveys could result in an eradicated population, or control to the level that the population is low and follow-up treatments could only be needed every few years.

Source: Published research, Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Moderate

Recent research highlights that native plant richness and some individual species decline in response to Eurasian watermilfoil management with herbicides (Parsons et al., 2009; Kujawa et al., 2017; Mikulyuk et al., 2020). Several herbicides used for Eurasian watermilfoil management are not highly selective and can harm non-target native species. Recently developed herbicides such as florpyrauxifen-benzyl are much better at targeting milfoil species but will likely negatively impact our native milfoils if they are found in the same waterbody.

Source: Published research, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

This is difficult to assess for a species that can occur at 30 ft of water depth. The Department of Ecology uses tools such as sonar and plant rakes to determine where Eurasian watermilfoil occurs in a deep or turbid waterbody, but these tools are imperfect. Most areas on colonized waterbodies are easy to access by boat, but the actual plants beneath the water may not be easy to target with management.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

For the most part, folks want to manage Eurasian watermilfoil where it occurs. However, there are different opinions of how best to manage the species and where and when herbicides should be used. Sometimes there is opposition to the most effective management approach.

Source: Professional Expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Nasturtium officinale (Watercress)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
4 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (63) Confidence: **High** (67)

Management Difficulty Rank: Moderate (53)	Confidence: Moderate (50)
Biological Characteristics of Invasiveness: High (89)	Confidence: High (71)
Concern Related to Distribution and Abundance: High (78)	Confidence: Moderate (60)

Photo Credit: Keir Morse 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Monitor list

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

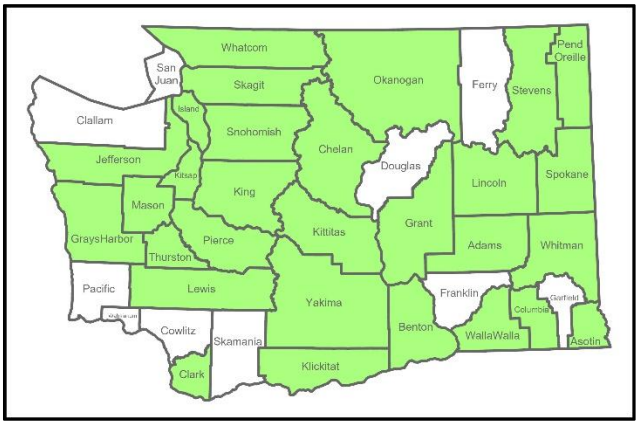

Figure 1. Distribution of counties where *Nasturtium officinale* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Nasturtium officinale is found in 74% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Shallow Water Wetland (Aquatic), Emergent Open Wetland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

The assessor has observed rapid spread via highway ditches. Spread may be aided by roadside mowing and ditching equipment.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: No, plant is palatable

Confidence: High

Watercress species produce compounds that deter aquatic invertebrate herbivores, but do not appear to deter mammalian herbivores.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Hydrology, Geomorphology, Light availability

Rating: High

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Source: Professional Expertise

Q28: Sociopolitical Implications of Management

Rating: Low/Moderate

Confidence: Low

There may be some objections to management from those who forage this palatable species.

Source: Professional expertise

Additional Comments

Nasturtium officinale is considered noxious and/or invasive in 46 states (Moore, 2025).

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Washington Invasive Ranking System

Washington Natural Heritage Program

Phalaris arundinacea (Reed Canarygrass)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
Molly S. Wiebush (Washington Natural Heritage Program)
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
11 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (81)

Confidence: **Moderate** (58)

Management Difficulty Rank: High (93)	Confidence: High (80)
Biological Characteristics of Invasiveness: High (83)	Confidence: High (79)
Concern Related to Distribution and Abundance: High (76)	Confidence: High (90)

Photo Credit: Thayne Tuason 2011, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

There are at least 11 cultivars of *Phalaris arundinacea*. This species has a circumboreal distribution. While native to North America, it is likely that all populations present have experienced at least some gene flow from introduced European genotypes (Magee et al., 1999). If any native genotypes of *Phalaris arundinacea* remain in the Pacific Northwest, it is likely safe to assume that populations exhibiting invasiveness likely represent introduced genotypes (Magee et al., 1999; Lavergne & Molofsky, 2004; Waggy, 2010).

Phalaris arundinacea was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: List C

Washington Invasive Species Council: No

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Section 1: Distribution and Abundance

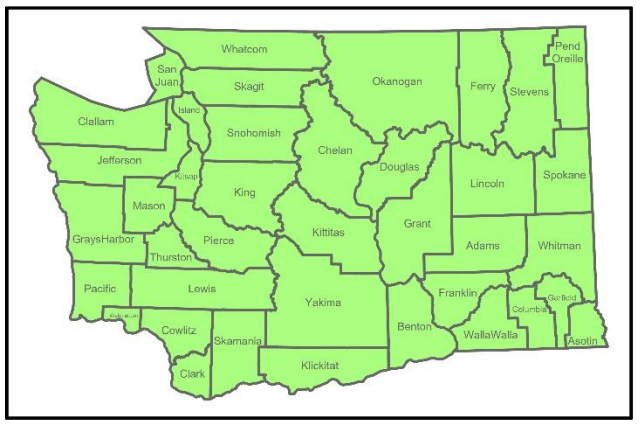

Figure 1. Distribution of counties where *Phalaris arundinacea* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Phalaris arundinacea has been documented in all 39 counties in Washington State (100%) (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: High

Phalaris arundinacea has already expanded to all 39 counties in Washington State (100%) (CPNWH. 2023; iNaturalist Contributors, 2023; Jarnevich et al., 2023). Based on herbarium records, it is possible that this species spread to the Olympic Peninsula in the last 20 years (CPNWH, 2023).

Source: Professional Expertise, Herbarium records and other observations, USGS dataset

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Insignificant (range Insignificant - Low)

Confidence: Moderate (range Moderate - High)

Phalaris arundinacea is especially common in the Pacific Northwest (Waggy, 2010). This species has been documented in all 39 counties in Washington state (100%), and appears to occur throughout the suitable habitat available in Washington (CPNWH, 2023; iNaturalist Contributors, 2023; Jarnevich et al., 2023).

Source: Informal publication, Professional expertise, Herbarium records and other observations, USGS dataset

Q4: Local Range Expansion or Change in Abundance

Rating: High (range Low - High)

Confidence: High (range Moderate - High)

Based on herbarium records *Phalaris arundinacea* may already occupy a large portion of its available habitat in Washington. The largest increases in local abundance appear to be in the northwestern portion of the state, including the Olympic Peninsula, but increases in abundance and range appear to be somewhat constrained in the last 20 years (CPNWH, 2023).

Source: Professional expertise, Herbarium records

Q5: Diversity of Ecosystems Invaded

Ecosystem Types: Forest & Woodland, Emergent Open Wetland, Bogs & Fens, Forested Wetland

Rating: High

Confidence: High

Phalaris arundinacea is usually found in wetlands, including wet meadows, marshes, peatlands, and riparian areas, where it frequently makes up 50–100% of the vegetation cover. This species is more occasionally found in uplands (Lavergne & Molofsky, 2004; Waggy, 2010).

Source: Published research, Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Phalaris arundinacea is a long-lived rhizomatous perennial. This species increases in established populations via rhizomes and tillers and colonizes new areas via seed. Plants can produce rhizomes in less than two months. Individual rhizomes can grow up to four inches long in wet soils and form dense mats. One experimental garden study found 383 feet of rhizomes growing in one square meter of loam. Plants are also capable of rooting from their stem nodes (Mueller, 1941). Rhizomes can account for up to 74% of new tillers in a *P. arundinacea* population, with the rest of the tillers coming from buds in aboveground leaf axils. *Phalaris arundinacea* can also sprout via fragments and recovers quickly after mowing and other damage (Waggy, 2010).

Phalaris arundinacea is wind-pollinated and is an obligate outcrosser. Seed production can reach 1000 seeds per square meter, with individual inflorescences documented producing up to 600 seeds in the Pacific Northwest (Lavergne & Molofsky, 2004; Waggy, 2010).

Repeated introductions of *P. arundinacea* cultivars from Eurasia have resulted in high genetic diversity in North American populations. High genetic diversity and novel genotypes makes *P. arundinacea* especially adaptable to new conditions. Differences in invasive potential between populations is likely due to this genetic diversity (Lavergne & Molofsky, 2004; Waggy, 2010).

Source: Published research, Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Phalaris arundinacea seeds naturally disperse via gravity, water, animals, and potentially wind (Waggy, 2010). Seeds can remain buoyant in water for a few days(Waggy, 2010). Seeds are also capable of adhering to animals and have been found in the feet and feathers of waterfowl, suggesting that this species has good potential for long distance dispersal (Waggy, 2010).

Source: Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Phalaris arundinacea seeds are capable of adhering to humans and machinery, allowing for long distance dispersal (Waggy, 2010). This species is also purposely spread for revegetation, soil stabilization, phytoremediation, and waste water management, as well as for livestock forage (Lavergne & Molofsky, 2004).

Phalaris arundinacea is occasionally recommended for erosion control and revegetation, including in dozer lines and burned sites, and it is being grown as a biofuel crop, particularly in Europe (Waggy, 2010). However, its ability to dominate makes it a poor choice for revegetation, cultivation, or other projects (Waggy, 2010).

Source: Published research, Informal publication, Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Phalaris arundinacea shows little allelopathic effects on *Medicago sativa*, *Trifolium pratense*, and *Festuca arundinacea,* suggesting this species is not allelopathic, but more research is needed (Lavergne & Molofsky, 2004).

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Phalaris arundinacea exhibits a suite of traits that make it a highly effective competitor (Lavergne & Molofsky, 2004). Phenotypic plasticity allows *P. arundinacea* to adapt to changing biotic and abiotic conditions and tolerate a wide variety of environmental conditions (Lavergne & Molofsky, 2004). This species stores carbohydrates in its roots, allowing it to start growing earlier in the spring than co-occurring native species (Lavergne & Molofsky,

2004). The extensive root system is effective at nutrient uptake and is water efficient, Relationships with mycorrhizal fungi are also likely to increase its competitiveness for resources, including water (when it occurs in drier habitats) (Lavergne & Molofsky, 2004). Native vegetation communities have demonstrated reduced root growth in mesocosm experiments when grown with *P. arundinacea* (Lavergne & Molofsky, 2004).

Source: Published research, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Phalaris arundinacea grows rapidly and forms dense monotypic stands and swards that can make up 50–100% of the vegetation cover where found(Lavergne & Molofsky, 2004; Waggy, 2010). The height and growth form of this species allow it to effectively shade out neighboring plants (Lavergne & Molofsky, 2004). Experiments in prairie pothole communities suggest that *P. arundinacea* is more competitive for light than even *Typha latifolia* and other species with similar growth forms (Lavergne & Molofsky, 2004; Waggy, 2010).

Source: Published research, Informal publication, Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

While *Phalaris arundinacea* takes advantage of disturbance to establish, it is not required. Seedlings are most likely to grow in open areas like mudflats or flood plains, and rapidly develop rhizomes and tillers (Waggy, 2010). Saturated soil and exposure to light increases germination, and at least some research suggests that this species requires light to germinate (Kim et al., 2006).

Source: Published research, Informal publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

The genus *Phalaris* consists of 20 species, from narrow endemics to cosmopolitan invasives. *Phalaris arundinacea* appears to be the most invasive of these species, occurring many places outside its native range, but *Phalaris aquatica* and *Phalaris minor* are also invasive in some places (Kim et al., 2006; Voshell et al., 2015; Xu et al., 2019). *Phalaris canariensis* is occasionally documented in Washington State (Weinmann et al., 2002).

Source: Published research, Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Phalaris arundinacea prefers full sun but can occur in partially shaded and shaded areas. This species commonly dominates the understory of riparian forests and woodlands. Seedlings can also establish in shade, though not as easily or as successfully as they do in full sun. Some research suggests that *P. arundinacea* needs light to germinate, and development of dense canopies can reduce the number of sites available for seedling germination. *Phalaris arundinacea* also usually has much reduced biomass and rhizome survival in shaded areas (Kim et al., 2006; Waggy, 2010).

In an experiment planting willow stakes to try to shade out *P. arundinacea* at a site on Lake Washington, dense plantings of willow cuttings taken from nearby willow trees were able to significantly reduce *P. arundinacea* biomass. This result was likely due to the willow outcompeting the *P. arundinacea* for light, though other mechanisms of competition cannot be ruled out (Kim et al., 2006).

Source: Published research, Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Phalaris arundinacea occurs across successional communities, though it appears to be most common in early to mid-succession communities. Disturbance likely benefits this species. *Phalaris arundinacea* frequently invades after human or natural disturbances in both its native and invasive ranges. This includes moving into areas after the removal of other invasive species (e.g., *Lythrum salicaria*, purple loosestrife). Addition of nitrogen to wetlands due to human activities also likely increases the invasive capacity of this species (Lavergne & Molofsky, 2004; Waggy, 2010).

Source: Published research, Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: >10 Years

Confidence: High

Phalaris arundinacea likely does form a significant seed bank, with densities between 100–5000 seeds per meter. Studies have found that seeds can survive up to 20 years. Seeds in inundated soil stay viable for longer than seeds floating in water (Waggy, 2010). This species can also apparently survive decades of mowing without exhausting its root resources (NRCS, 2003)

P. arundinacea germination is highly variable, with rates ranging from 3–93% (Kim et al., 2006). The drivers of this variability are unclear but may include genetic variability or poor curing/storage of seed (Kim et al., 2006). Saturated soil and exposure to light increases germination, and at least some research suggests that this species requires light to germinate (Kim et al., 2006). The seeds can germinate immediately after ripening, but they are also capable of dormancy (Lavergne & Molofsky, 2004) and whether seeds germinate immediately in natural conditions is unknown (Waggy, 2010).

Source: Informal publication, Professional expertise

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

Phalaris arundinacea has been cultivated as forage for both livestock and wildlife (Lavergne & Molofsky, 2004; Waggy, 2010). In some studies, *P. arundinacea* has been preferred over other pasture grasses by horses and geese, but palatability and nutritional value may depend on age and variety (Waggy, 2010). Some varieties of this species may contain enough alkaloids to render them potentially toxic, but because *P. arundinacea* was introduced to North America as a forage species, it may have fewer alkaloids than in its Eurasian range(Lavergne & Molofsky, 2004; Waggy, 2010). Wildlife has been observed to occasionally forage on this species, but its importance to any of the animals seen to consume it is unknown (Lavergne & Molofsky, 2004; Waggy, 2010).

Insect diversity is frequently lower in wetlands dominated by *P. arundinacea* and fewer insects feed on this species than on native species (Lavergne & Molofsky, 2004). Plants frequently produce secondary compounds like alkaloids as a defense against herbivory, so *P. arundinacea* may be better defended against insect damage and disease than its native competitors.

Source: Published research, Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Fire, Geomorphology, Hydrology, Light availability, Nutrient dynamics

Rating: High (range Moderate - High)

Confidence: Moderate (range Low - High)

Several sources note that *Phalaris arundinacea* is capable of changing stream channels, narrowing and slowing flows by capturing silt and debris with its roots and stems (Lavergne & Molofsky, 2004; Waggy, 2010). These changes may impede or halt abiotic processes like scouring that are important for maintaining salmon habitat (Lavergne & Molofsky, 2004; Waggy, 2010). *Phalaris arundinacea* can also

alter soil structure and organic content, which can in turn change the species composition of the vegetation community (Lavergne & Molofsky, 2004). Its dense, tall growth habit also alters the light regime for neighboring plant species (Lavergne & Molofsky, 2004; Waggy, 2010). No specific information was found regarding the length or irreversibility of these impacts but given the difficulty of treating occurances of this species, it seems reasonable to rate it as causing major potentially irreversible changes to the abiotic system.

Source: Published research, Informal publication, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate (range Moderate - High)

Confidence: Moderate (range Moderate - High)

Phalaris arundinacea readily converts bunchgrass-dominant wet meadows and prairies to rhizomatous meadows/marshes. *Phalaris arundinacea* may change ecosystem successional patterns and prevent establishment of woody species. These structural changes may have a negative effect on salmon, particularly by reducing riparian insect abundance and therefore available food for immature salmon (Waggy, 2010).

Source: Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Studies from Oregon and Wisconsin found that *Phalaris arundinacea* reduced community diversity and changed vegetation composition in wetlands (Waggy, 2010). This species reduces community diversity over time by displacing native species, with reportedly greater negative effects on graminoids than on forbs (Lavergne & Molofsky, 2004). *Phalaris arundinacea* also displaces even historically dominant native species (Lavergne & Molofsky, 2004).

While *Phalaris arundinacea* may provide cover for a number of animal species, including wild ungulates, birds, fish and amphibians, only northern leopard frogs appear to prefer it over native vegetation (Waggy, 2010).

Source: Published research, Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Phalaris arundinacea may have greater impact on co-occurring graminoids than forbs (Lavergne & Molofsky, 2004). This species also potentially displaces rare native plants in the Pacific Northwest, including *Sidalcea nelsoniana* and *Howellia aquatilis*, which both occur in Washington (Lavergne & Molofsky, 2004; Waggy, 2010). However, it seems likely that these rare taxa are being displaced as part of a community as opposed to being more vulnerable than co-occurring species to *P. arundinacea* encroachment.

Source: Published research, Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate (range Moderate - High)

Confidence: Moderate

Phalaris arundinacea is described as an aggressive invader by multiple sources and does not require disturbance to establish (Magee et al., 1999; Waggy, 2010).

Source: Published Research, Informal Publication, Professional Expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Phalaris arundinacea can invade after flooding and other disturbances (Lavergne & Molofsky, 2004; Waggy, 2010).

Source: Published Research, Informal Publication, Professional Expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High (range Moderate - High)

Confidence: High (range Moderate - High)

Management of this species is difficult. No single treatment appears to be effective in controlling *Phalaris arundinacea* long-term. Effective treatment needs to have a long-term ecosystem wide approach and ongoing treatments may be needed to manage resprouting, re-invasion, or encroachment by other invasive plant species. The best management for *P. arundinacea* is to prevent its establishment by avoiding disturbance and preserving the integrity of wetlands. Planting woody or long-lived perennial species may be the most effective way to out-compete *P. arundinacea* where it is already established. An integrated approach incorporating multiple treatment options is needed to manage *Phalaris arundinacea* populations (Lavergne & Molofsky, 2004; Kim et al., 2006; Waggy, 2010).

Source: Published research, Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Phalaris arundinacea occurances are likely to require long term management, unless they are caught early in their invasion (Lavergne & Molofsky, 2004; Waggy, 2010). This species has a persistent seed bank and reinvasion by propagules from other populations is highly likely.

Source: Published Research, Informal Publication, Professional Expertise

Q26: Impacts of Management on Native Species

Rating: High (range Low - High)

Confidence: Moderate (range Moderate - High)

Most available herbicides are too broad for effective use in wildlands, and broadcast spraying would have negative impacts on native species (Waggy, 2010). Use of willow stakes cut from nearby sources may have a net positive effect on native species, but more research is needed (Kim et al., 2006). Many treatment suggestions start with treatments that potentially eliminate all existing vegetation on a site (Lavergne & Molofsky, 2004; Kim et al., 2006). However, mechanical removal of *P. arundinacea* has been observed to have positive effects on some areas, for example, one assessor observed an area of *P. arundinacea* that was bulldozed had native salt marsh plants return on their own, suggesting that communities with long-lived native seedbanks may be able to return (R. Johnson, pers. comm. 2024).

Source: Published Research, Informal Publication, Professional Expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Phalaris arundinacea occurs in both accessible and remote, inaccessible locations.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low (range Insignificant - High)

Confidence: High

Treatment efforts in populated areas may require additional public education.

Source: Informal Publication, Professional Expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Phleum pratense (Timothy)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
15 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (46) Confidence: **Low** (25)

Management Difficulty Rank: High (81)	Confidence: Low (20)
Biological Characteristics of Invasiveness: Low (43)	Confidence: Moderate (42)
Concern Related to Distribution and Abundance: High (78)	Confidence: High (80)

Photo Credit: Steve Matson 2002, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Phleum pratense may be confused with native *Phleum alpinum* (alpine timothy) where their range and habitat overlap (Ogle et al., 2011).

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

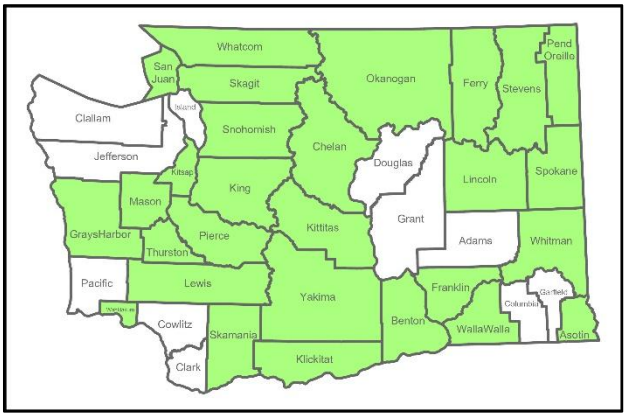

Figure 1. Distribution of counties where *Phleum pratense* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Phleum pratense is found in 72% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Phleum pratense occurs throughout Washington. In the last 20 years this species may have expanded in the southwestern portion of the state and in the Columbia Plateau (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

According to model predictions, *Phleum pratense* is expected to expand to the remaining counties in Washington, but also experience a range contraction on the Columbia Plateau (EDDMapS, 2023).

Source: Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

In the last 20 years, *Phleum pratense* abundance and local range appears to have increased the most west of the Cascades and in northeastern Washington (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland

Rating: High

Confidence: High

Phleum pratense grows in a wide range of ecosystems and can be found in both forests and grasslands. It grows in upland and wetland habitats and frequently colonizes waterways. This species prefers deep, neutral pH, clay to loam soils, but can survive in rocky and shallow soils. It exhibits better survival in cold than warm environments and does not tolerate drought (Esser, 1993; Ogle et al., 2011). *Phleum pratense* may occasionally be found in alpine areas, but establishment above upper tree line appears to be more common elsewhere in the Rocky Mountains (T. Ramm-Granberg, pers. comm. 2025).

Source: Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

Phleum pratense is a short lived (4–7 years) fast-growing perennial bunchgrass. This species mainly reproduces via seed and does not reproduce by rhizomes, but can reproduce vegetatively via tillers, rooting from nodes, or root fragments (Esser, 1993). Seed yields per plant were not found in the literature search, but one pound of *P. pratense* seed is approximately 1,230,000 seeds (Ogle et al., 2011). One study found seeds to consistently have germination rates of 90% or higher (Williams, 1954). Seedling germination peaked in the fall in a study from New York (Morris et al., 1986), potentially giving seedlings a head start on the spring growing season. Seedlings also grow rapidly (Esser, 1993).

Source: Published research, Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Low

Phleum pratense seeds don't have any specific adaptations for long distance dispersal, but they can still be dispersed by wind (Esser, 1993). Wind dispersal is likely an average of 1–2 meters, but seeds may be dispersed further by large mammals (Mouissie et al., 2005).

Source: Published research, Informal publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Phleum pratense is grown as pasture grass and hay, particularly for horses. This species is also used in revegetation of clearcuts, rangelands, and sites disturbed by human development (e.g., roads or construction projects). *Phleum pratense* has also been used for mine rehabilitation and erosion control. Seeds can also be dispersed by livestock (Esser, 1993; Mouissie et al., 2005).

Source: Published research, Informal publication, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Phleum pratense exhibits potential allelopathy both via pollen and extracts of leaves and stems. *Phleum pratense* pollen is known to inhibit pollination and seed development in at least one grass species, *Agropyron repens* (quackgrass), and perhaps other grass species as well. Some studies have also shown that leaf and stem extracts inhibit several other plant species from germination. (Wardle, 1987; Murphy & Aarssen, 1995; Rivernider et al., 2017). Allelopathic abilities may aid *P. pratense* in outcompeting tree seedlings (Esser, 1993).

Source: Published research, Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Low

Phleum pratense is an intermediate competitor. It can be competitive against other grasses under the right circumstances (e.g., favorable moisture and soil) but will eventually be replaced by slower growing and more long-lived species (Esser, 1993). This species is frequently grown with alfalfa and other legumes for hay because it is less competitive against legumes than other grass species (Ogle et al., 2011).

The bunchgrass growth form may be an adaptation for co-existing in a highly competitive environment, allowing the plant to better exploit immediate resources (Cheplick & Chui, 2001). *Phleum pratense* senesces in the fall. This species can store food in corms for winter (Esser, 1993).

Source: Published research, Informal publication, Professional expertise

Q11: Growth Form

Rating: No

Confidence: Low

Phleum pratense can form monocultures on favorable sites and its height allows this species to be competitive for light. However *P. pratense* usually co-exists with native species instead of forming thickets or dense monocultural stands (Isselin-Nondedeu & Bédécarrats, 2009; Ogle et al., 2011).

Source: Published research, Informal publication, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Low

Phleum pratense seeds can germinate both at and below the soil surface. Which seeds are most successful in germinating depends on soil moisture (Williams, 1954). No other information was found regarding germination needs. However, at least one source noted that this species only establishes in intact ecosystems under favorable circumstances (Ogle et al., 2011), which suggests that it may not germinate in other vegetation except under narrow circumstances.

Source: Published research, Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Low

Phleum phleoides was noted as an increaser and potentially invasive in a study done in Poland (Ciosek et al., 2003). No other information on invasiveness in

this genus was found. The only other *Phleum* in Washington is the native *Phleum alpinum*. *Phleum pratense* is a listed noxious weed in Virginia and New Jersey (Kasulyte & Praciak, 2022).

Source: Published research, Informal publication

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Phleum pratense is usually found in open areas such as grasslands and open woodlands, but this species does tolerate partial shade. Shading reduces nutritional value and delays flowering by one or two weeks (Esser, 1993; Ogle et al., 2011).

Source: Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Phleum pratense is common in pastures, grasslands, and disturbed areas, and increases cover after disturbance. However, heavy grazing and mowing can both decrease populations, likely by damaging the corms at the base of plants that store carbohydrates. However, corms and belowground growing points also allow this plant to resprout after by fire, and tillering and seed production increases after fire (Esser, 1993; Ogle et al., 2011).

Source: Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: High

Phleum pratense seeds can remain viable for up to five years (Esser, 1993). One study found most seeds germinate in the year they disperse. Some seeds also go dormant for the winter, allowing this species to take advantage of warm winters without risking entire generations (Morris et al., 1986).

Source: Published research, Informal publication

Q17: Palatability

Rating: No, plant is palatable

Confidence: High

Phleum pratense is cultivated as a pasture grass and hay for livestock (especially horses) and big game animals. This species can also be a significant part of elk, deer, and wild bird diets (Esser, 1993).

Source: Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Light Availability

Rating: Low

Confidence: Low

Phleum pratense is sometimes used in combination with other species for erosion control, though its shallow roots mean that it is not an ideal erosion control agent when planted alone (Esser, 1993). This species also grows tall enough to outcompete at least some plant species for light (Isselin-Nondedeu & Bédécarrats, 2009).

Source: Published research, Informal publication

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Phleum pratense is most commonly found in graminoid-dominant ecosystems in Washington and is unlikely greatly alter the structure of communities. In other circumstances, *Phleum pratense* can either hinder or aid establishment of conifer seedlings. This species may sometimes prevent conifer seedlings from establishing through a combination of outcompeting seedlings for light and potentially allelopathy. However, if seedlings are already established, *P. pratense* may be able to exclude other plant species, reducing the overall competition that tree seedlings face. In some ecosystems, *P. pratense*

can tip the balance from forest to grassland (Esser, 1993).

Source: Informal publication

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Low

In some cases, *Phleum pratense* can reduce community diversity and prevent establishment of native species. In Glacier National Park, this species is known to prevent establishment of native grasses and cryptograms (Tyser, 1992; Esser, 1993). An experiment in the French Alps found that a cultivar of *P. pratense* prevented a subset of co-occurring species from colonizing disturbed areas and reduced community diversity (Isselin-Nondedeu & Bédécarrats, 2009).

Source: Published research, Informal publication

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Phleum pratense provides cover for small animals, particularly game birds and waterfowl, throughout its range. It can also provide significant forage for big game animals (Esser, 1993). Bees, including native bumblebees, and syrphids have been documented feeding on *P. pratense* in North America. In Maine, *Bombus* species were observed actively collecting *P. pratense* pollen, and on average greater than 70% of the pollen they carried was from this species. The value and nutrition of *P. pratense* pollen for bees is not known, but this species is also frequently included in pollinator mixes (Rivernider et al., 2017).

Source: Published research, Informal publication

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Low

At least some sources suggest that *Phleum pratense* can invade undisturbed forest, grassland, and tundra habitats (Esser, 1993; Ogle et al., 2011). However, invasion of neighboring vegetation communities may only occur in a limited number of circumstances (Esser, 1993; Ogle et al., 2011).

Source: Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Phleum pratense is commonly found in grassland and woodland habitats that experience significant natural disturbance (Esser, 1993).

Source: Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: Low

As of 2011, *Phleum pratense* is still recommended for revegetation projects (AKNHP, 2011) and commonly grown for hay and silage. This species appears to be widely regarded as non-aggressive, so very little literature focuses on managing it as a weed. Where management is needed and possible, removal coupled with planting of desirable competitive species is recommended. There are some areas (e.g., Glacier National Park) where this species has proven troublesome and not practical to remove. In those cases, avoiding spread or introduction to new areas is recommended (Tyser, 1992; Esser, 1993).

Source: Published research, Informal publication

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: Moderate

Phleum pratense reproduces mainly by seed, so the minimum time commitment for treatment is likely the same as seed bank longevity (4–7 years) (Esser, 1993). Ongoing monitoring is likely necessary to

prevent recolonization, since source populations are quite common.

Source: Informal Publication, Professional Expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Low

Herbicide use to remove *Phleum pratense* populations will likely have negative effects on co-occurring native species, particularly grasses. Native grasses are typically the dominant plants in the ecosystems where *Phleum pratense* most commonly occurs. In some cases, the management impacts may outweigh the benefits of trying to eliminate this species.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Low

Phleum pratense is widespread in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023) and many populations are likely to be inaccessible.

Source: Professional expertise, herbarium records and other observations

Q28: Sociopolitical Implications of Management

Rating: High

Confidence: Moderate

Phleum pratense is grown as a high-value hay and pasture grass, particularly for horses. It seems likely that large-scale efforts to manage this species as an invasive would receive objections.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Plantago lanceolata (English Plantain)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
26 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (29) Confidence: **High** (83)

Management Difficulty Rank: Insignificant (0)	Confidence: High (100)
Biological Characteristics of Invasiveness: Low (46)	Confidence: High (67)
Concern Related to Distribution and Abundance: Moderate (56)	Confidence: High (80)

Photo Credit: Therese Philips 2024, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

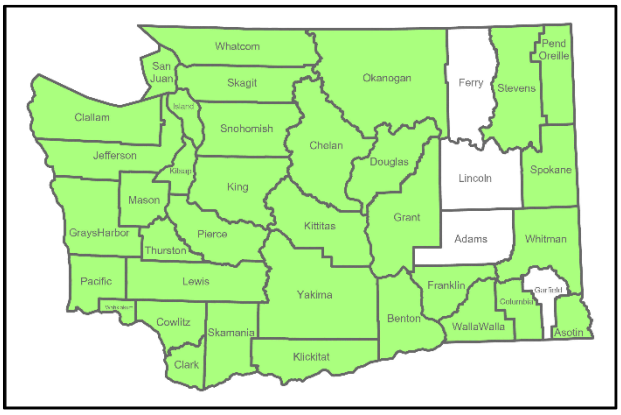

Figure 1. Distribution of counties where *Plantago lanceolata* has been documented in Washington State (CPNWH 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Plantago lanceolata is found in 90% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Restoration professionals are considering planting this species as a host plant for the Taylor's checkerspot butterfly.

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: High

Plantago lanceolata has a positive effect on some native species—it is currently the main larval host for the federally listed Taylor's Checkerspot butterfly. Some land managers plant this species just for the butterfly, as its host range is extremely limited.

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

This species is fairly disturbance dependent, and it seems to persist best in compacted soil along trails and roadsides.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

This plant is not usually managed.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Source: Professional expertise

Additional Comments

None

References

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Washington Invasive Ranking System

Washington Natural Heritage Program

Poa annua (Annual Bluegrass)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
21 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (6) Confidence: **High** (100)

Management Difficulty Rank: Insignificant (0)	Confidence: High (100)
Biological Characteristics of Invasiveness: High (71)	Confidence: High (71)
Concern Related to Distribution and Abundance: Moderate (56)	Confidence: High (70)

Photo Credit: Julie Kierstead Nelson 2002, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

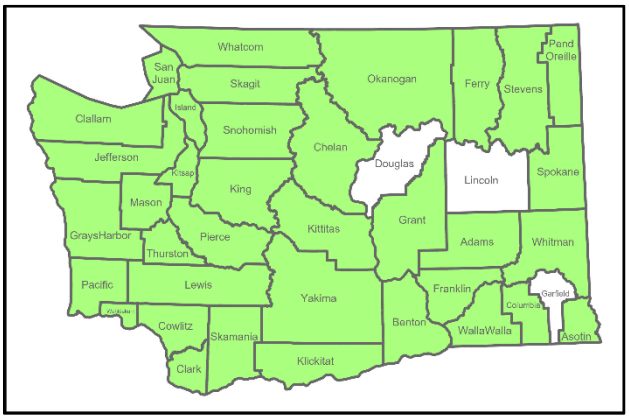

Figure 1. Distribution of counties where *Poa annua* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Poa annua is found in 92% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Low

Confidence: High

Source: Professional Expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Unknown

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: High

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

This species is a winter annual.

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: Moderate

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

This plant thrives on disturbance.

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: No, plant is palatable

Confidence: High

This plant is highly palatable to livestock (Cornell CALS, 2025).

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: High

This species tends to grow in trampled areas where few other plants will grow—structural impacts are insignificant.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: High

This species requires disturbance.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Public opposition is unlikely, aside from generalized herbicide skepticism.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Potamogeton crispus (Curly-leaf Pondweed)

Assessed by
Wesley Glisson (Aquatic Plant Specialist, Washington Dept. of Ecology)
31 May 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (73) Confidence: **Moderate** (42)

Management Difficulty Rank: Not Rated	Confidence: Not Rated
Biological Characteristics of Invasiveness: Not Rated	Confidence: Not Rated
Concern Related to Distribution and Abundance: High (94)	Confidence: Moderate (60)

Photo Credit: Christopher J. Earle 2023, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

Rapid assessment, only Distribution and Abundance and Ecological Impacts are rated.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

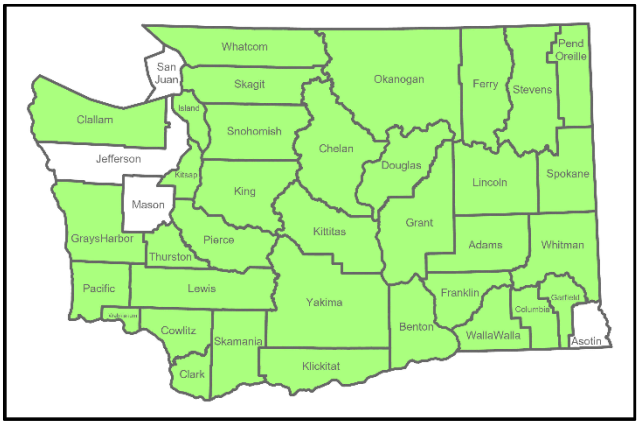

Figure 1. Distribution of counties where *Potamogeton crispus* has been documented in Washington State (WSDA, 2018; CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Potamogeton crispus is documented in 90% of Washington Counties (WSDA 2018; CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023; Washington State Department of Ecology, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: Moderate

New discoveries may be of populations that have already been established for some time (Washington State Department of Ecology, 2023).

Source: Professional expertise, Washington State Department of Ecology unpublished data

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

There are likely many suitable water bodies where this plant has yet to establish (Tamayo & Olden, 2014).

Source: Published research, Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Unknown

Confidence: Not Rated

There has not been extensive study or reporting on this species in Washington to estimate this with certainty.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Shallow Water Wetland (Aquatic)

Rating: Low

Confidence: High

This species is a submersed aquatic plant and thus limited in its ability to colonize many different habitats (Bolduan et al., 1994).

Source: Published Research, Professional Expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Not Rated

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Not Rated

Confidence: Not Rated

Source:

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Not Rated

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: Not Rated

Confidence: Not Rated

Source:

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Not Rated

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: Not Rated

Confidence: Not Rated

Source

Q15: Disturbance Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q16: Propagule Persistence

Rating: Not Rated

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability

Rating: Moderate

Confidence: Low

This species has been documented as having a high impact in other regions of North America (Nichols & Shaw, 1986; Bolduan et al., 1994; Woolf & Madsen, 2003), but these impacts have not yet been thoroughly evaluated in Washington. At least in the warmer regions of western and southern Washington, its impacts do not seem as severe as other areas of North America.

In cooler climates, curly-leaf pondweed grows rapidly in the winter, under the ice, and rapidly dies off as the water warms. This rapid die-off can cause substantial reductions in water clarity and fuel algae growth (Nichols & Shaw, 1986; Bolduan et al., 1994; Woolf & Madsen, 2003). The extent to which this occurs in Washington lakes, however, is unknown.

Source: Published research, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

The species can grow very densely and top out at the water's surface, creating a canopy where one did not exist before. In cooler climates where its growth occurs before other species, it creates a new early-season layer of plants within the water column that would not have occurred with the native flora (Nichols & Shaw, 1986; Bolduan et al., 1994; Woolf & Madsen, 2003).

Source: Published research, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Low

Because of its early-season phenology in cooler climates, it doesn't directly compete with native species for very long. Occurances here in Washington and the Pacific Northwest do not appear to cause reductions in native species richness, but this has not been tested. Based on its ability to grow densely and rapidly, it is likely at least impacting the abundance of native species in colonized waterbodies (Bolduan et al., 1994; Verhoeven et al., 2020).

Source: Published Research, Professional Expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

The assessor was not aware of impacts to particular native species.

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: High

Confidence: High

This plant readily spreads to waterbodies that are otherwise undisturbed (Washington State Department of Ecology, 2023).

Source: Professional expertise, Washington State Department of Ecology data

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

This plant demonstrates an ability to invade naturally disturbed ecosystems (Bolduan et al., 1994).

Source: Published research, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Not Rated

Confidence: Not Rated

Source:

Q25: Minimum Time Commitment

Rating: Not Rated

Confidence: Not Rated

Source:

Q26: Impacts of Management on Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q27: Inaccessibility of Invaded Areas

Rating: Not Rated

Confidence: Not Rated

Source:

Q28: Sociopolitical Implications of Management

Rating: Not Rated

Confidence: Not Rated

Source: Not Rated

Additional Comments

None

References

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Washington Invasive Ranking System

Washington Natural Heritage Program

Quercus robur (English Oak)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
25 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (50) Confidence: **High** (83)

Management Difficulty Rank: Insignificant (16)	Confidence: High (100)
Biological Characteristics of Invasiveness: Low (37)	Confidence: Moderate (67)
Concern Related to Distribution and Abundance: Moderate (56)	Confidence: High (70)

Photo Credit: Nancy Janz 2024, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

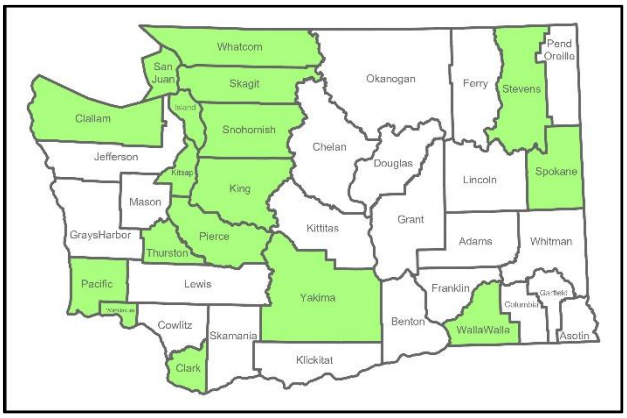

Figure 1. Distribution of counties where *Quercus robur* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: High

Quercus robur is documented in 44% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Birds and squirrels can disperse the acorns.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Some people may mistake this species for a native oak (*Quercus garryana*) and plant it thinking it is native.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: High

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: Moderate

Trees can grow quite large.

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: No

Confidence: Low

Quercus rubra is also established in Washington, but generally not considered invasive. *Quercus acutissima* (native to Asia) is common in the southeast, but there appears to be little consensus regarding its invasiveness (Center for Invasive Species and Ecosystem Health, 2018; Kling, 2024). Non-native oaks are most likely to be invasive in areas where native oak woodlands or oak-prominent forests are more common.

Source: Professional expertise, Informal publication

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: Low

Quercus robur is a fast-growing pioneer species, but plants in Washington have not demonstrated a competitive advantage gained from any potential disturbance tolerance.

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: High

Source: Professional expertise

Q17: Palatability

Rating: No, plant is palatable

Confidence: High

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: High

Confidence: High

In some cases, this species could have significant effects on ecosystem structure.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

Generally spreads into undisturbed ecosystems via birds and squirrels.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

The general public may not be able to distinguish native from introduced oaks.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Rosa canina (Dog Rose)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
4 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (60) Confidence: **Moderate** (58)

Management Difficulty Rank: Moderate (63)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: High (71)	Confidence: High (72)
Concern Related to Distribution and Abundance: High (78)	Confidence: Moderate (50)

Photo Credit: David Giblin 2024, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

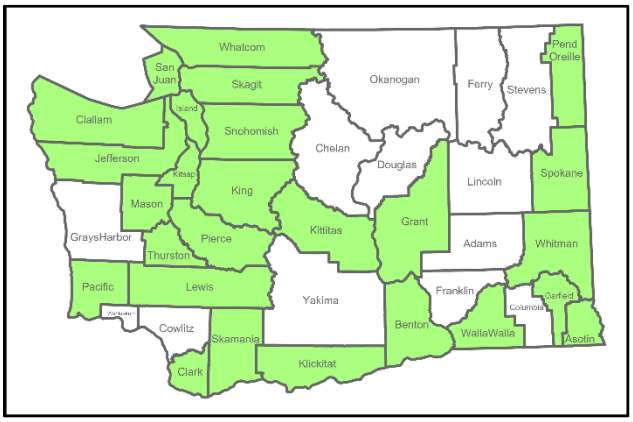

Figure 1. Distribution of counties where *Rosa canina* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Rosa canina is documented from 67% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland

Rating: High

Confidence: Moderate

Source: Professional Expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: High

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: No

Confidence: Moderate

Deer and elk prefer many rose species, including *Rosa canina*, in spite of the thorns. However, browsing pressure does not appear to be enough to control this species.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: High

Confidence: Moderate

This species can produce large shrubby thickets in grasslands.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

References

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iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.

Washington Invasive Ranking System

Washington Natural Heritage Program

Rosa multiflora (Multiflora Rose)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
3 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (69) Confidence: **High** (67)

Management Difficulty Rank: Low (35)	Confidence: Moderate (50)
Biological Characteristics of Invasiveness: Moderate (70)	Confidence: High (83)
Concern Related to Distribution and Abundance: High (64)	Confidence: Moderate (50)

Photo Credit: David Giblin 2020, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Monitor list

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

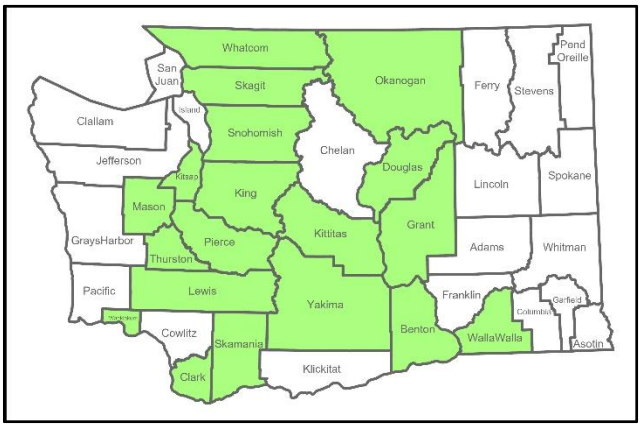

Figure 1. Distribution of counties where *Rosa multiflora* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: Moderate

Rosa multiflora is documented from 49% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

A single plant can produce up to 500,000 seeds in a single year (Hoffman & Kearns, 1997).

Source: Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: High

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: High

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: No

Confidence: High

Deer and elk prefer many rose species, including *Rosa multiflora*, in spite of the thorns. However, browsing pressure does not appear to be enough to control this species.

Source: Professional Expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Moderate

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Source: Professional expertise

Additional Comments

The Fire Effects Information System provides an excellent synthesis of the state of knowledge for *Rosa multiflora*, although only as of 2002 (Munger, 2002).

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Washington Invasive Ranking System

Washington Natural Heritage Program

Rosa rugosa (Rugosa Rose)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
4 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (48) Confidence: **Moderate** (50)

Management Difficulty Rank: Insignificant (28)	Confidence: High (90)
Biological Characteristics of Invasiveness: High (78)	Confidence: High (75)
Concern Related to Distribution and Abundance: Moderate (69)	Confidence: Moderate (60)

Photo Credit: David Giblin 2023, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

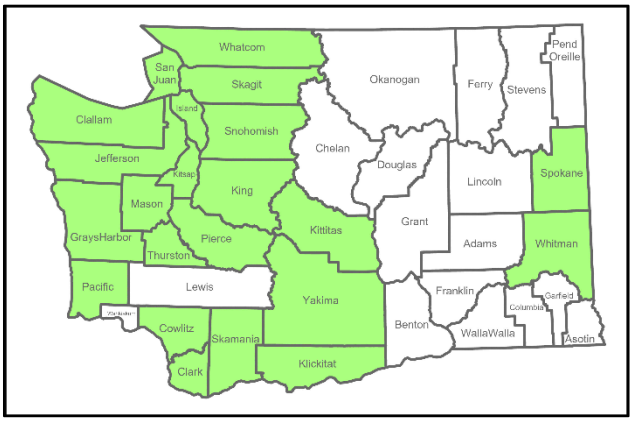

Figure 1. Distribution of counties where *Rosa rugosa* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Rosa rugosa is documented in 56% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Coastal Brackish Tidal Wetland

Rating: Low

Confidence: Moderate

This species is mainly found in drift log piles on sand spits and similar habitats, that typically don't have any woody vegetation.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Fruits appear to disperse by floating on salt water, in addition to bird dispersal.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

This plant is a popular low-maintenance landscaping shrub.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

This species is recommended in landscaping as a reliably deer proof rose.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology

Rating: Moderate

Confidence: Moderate

This species grows in drift log piles and may provide additional stabilization.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

Often grows where there is typically little native vegetation.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Low

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Rubus bifrons (Himalayan Blackberry)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
Molly S. Wiebush (Washington Natural Heritage Program)
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
27 June 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (80)	Confidence: **High** (75)
Management Difficulty Rank: High (74)	Confidence: High (70)
Biological Characteristics of Invasiveness: High (77)	Confidence: High (79)
Concern Related to Distribution and Abundance: High (78)	Confidence: High (80)

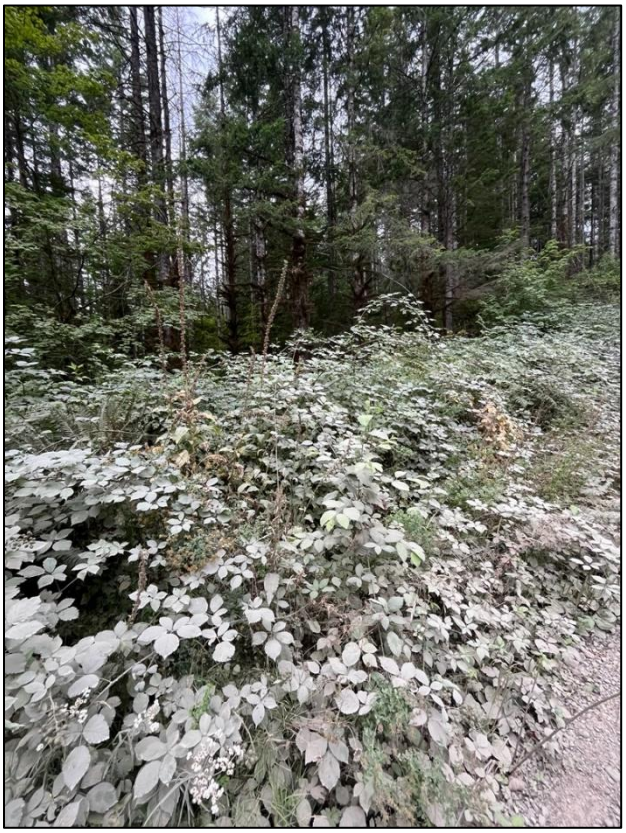

Photo Credit: Erin Burke, 2024. WNHP.

Ranking Notes

Rubus armeniacus is a synonym for *Rubus bifrons* in the Washington Flora Checklist and Flora of North America (Weinmann et al., 2002; Alice et al., 2020). The Fire Effects Information System (Fryer, 2021) and USDA Plants database treat *R. bifrons* and *R. armeniacus* as different species. Washington Flora Checklist nomenclature is followed here and information documented for both *R. armeniacus* and *R. bifrons* in North America are used to inform this ranking document.

Rubus bifrons can hybridize with other species of *Rubus*, and hybrid swarms related to this species exist in the Pacific Northwest (Fryer, 2021).

Rubus bifrons was assessed by multiple individuals. Range of assessor ratings is provided in parentheses following the final assigned rating.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Section 1: Distribution and Abundance

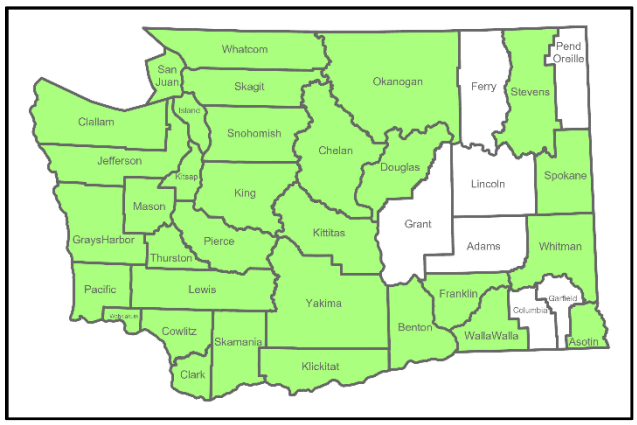

Figure 1. Distribution of counties where *Rubus bifrons* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Rubus bifrons has herbarium records from 32 of 39 counties in Washington state (82%) (CPNWH, 2023; iNaturalist Contributors, 2023). This species is also reported from Okanogan and Pend Oreille Counties (EDDMapS, 2023).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Low

Rubus bifrons is reported most frequently in western Washington but is documented throughout the state. This species is least abundant in northeastern Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023). However, *R. bifrons* is increasing along the Snake River.

Source: Professional expertise, Herbarium records and other observations, Model predictions

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: High (range Low - High)

Rubus bifrons is regarded as the most invasive shrub on the west coast (Fryer, 2021). This species is predicted to increase in abundance and expand its range to all counties in Washington (EDDMapS, 2023), but it is currently documented in only 82% of Washington counties (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Informal publication, Professional expertise, Herbarium records and other observations, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: High

Rubus bifons observations have increased locally in the northern part of Puget Sound and are also reported to be increasing in the Snake River Canyon.

Source: Profession expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem Types: Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland, Forested Wetland

Rating: High

Confidence: High

Rubus bifrons is considered a facultative wetland species, capable of growing in both wetland and upland environments. While it prefers rich, loamy soils, The FEIS review for this species documented reports from a wide diversity of soil types and is capable of colonizing bare gravel (Fryer, 2021). *Rubus bifrons* is usually found in woodlands, forests, and riparian areas with moist, well-drained soils, in Mediterranean climates. It occurs in Willamette Prairies, where it can form extensive stands of encroaching shrubs along with *Rosa* spp. and *Toxicodendron diversilobum*. Other sources also note this species occurring in estuaries and coastal scrub (Cal-IPC, 2004; Stannard, 2014).

Source: Informal publication, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Rubus bifrons is a rhizomatous perennial shrub, with short-lived canes and long-lived roots and rhizomes. This species primarily reproduces vegetatively from rhizomes, root crown sprouts, and layering. This includes resprouting from cut stems after mechanical removal attempts. Rhizomes can grow at a depth of 0.5-2 meters and reach 10 meters long. This species grows more rapidly than co-occurring woody vegetation (Fryer, 2021).

Rubus bifrons has bisexual flowers and can seed through pollination and apomixis. This species has a mixed mating system, cross-pollination results in larger fruits and more seeds. Seeds are more commonly produced by apomixis and *Rubus bifrons* has relatively low genetic diversity. Pollination syndrome is generalist, but bees, particularly honeybees, are the most common floral visitors to this species. *Rubus bifrons* can produce between 7000 and 13,000 seeds per square meter (Fryer, 2021).

Source: Informal publication, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Rubus bifrons seeds are distributed by animals, mammals and birds being the primary dispersal agents, though other animals, including slugs, are also capable of seed dispersal. Both seeds and plant fragments, which can also root and form new populations, are spread long distances by water (Fryer, 2021).

Source: Informal publication, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Rubus bifrons is native to Eurasia but has established populations on all continents except Antarctica. This species was introduced to North America for cultivation in the late 1800s; it is a major fruit crop in the Pacific Northwest and continued cultivation contributes to the spread of this species (Fryer, 2021). This species also readily invades areas after anthropogenic disturbances.

Source: Informal Publication, Professional Expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

A literature search revealed no information about allelopathy in *Rubus bifrons*.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Rubus bifrons is especially competitive for water and nitrogen due to its extensive root system (Fryer, 2021). This species can also store water in its roots (Fryer, 2021). *Rubus bifrons* exhibits phenotypic plasticity: it can adapt leaf size to drought conditions, allowing it to be more water efficient than co-occurring species (Fryer, 2021).

The Fire Effects Information System account describes *R. bifrons* as "semievergreen" because leaves can stay green well into fall, with some green leaves remaining throughout the winter (Fryer, 2021). Cal-IPC refers to this species as "essentially evergreen" (Cal-IPC, 2024). Persistence of leaves is more likely in mild climates (Stannard, 2014), so this species may not be functionally evergreen throughout Washington.

Source: Informal publication, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Rubus bifrons forms dense stands or thickets, with up to 252 canes per square meter. These thickets crowd

out native vegetation and hinder wildlife movement (Fryer, 2021).

Source: Informal Publication, Professional Expertise

Q12: Germination Requirements

Rating: No

Confidence: Low

Rubus bifrons seedlings establish best in open habitats and this species appears to prefer disturbed areas. Sources say it can establish in areas without disturbance, but did not specify what conditions promoted germination of this species in undisturbed habitats (Cal-IPC, 2004; Fryer, 2021).

Source: Informal publication, Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Rubus bifrons is part of the *Rubus fruticosus* complex of species. All species in this complex are classified as noxious weeds in the U.S. (Fryer, 2021).

Source: Informal Publication, Professional Expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Rubus bifrons is frequently described as shade intolerant (Caplan & Yeakley, 2006). However, in the Pacific Northwest, *R. bifrons* is capable of growing and reproducing in woodland and forest understories.

Research does suggest that this species' growth can be limited in shaded conditions (Caplan & Yeakley, 2006). Seedlings establish best in open habitat, and plants grow more quickly and are better able to produce fruits in sun than in shade. A study in Australia found that this species required at least 45% sunlight for survival (Fryer, 2021).

Source: Published research, Informal publication, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Rubus bifrons occurs across successional stages but is most successful in early seral communities and is frequently found on disturbed sites. Fire does not have a negative effect on this species—it may even break seed dormancy and eliminates cover of competing plants, allowing for seedling growth. Roots and rhizomes can be very deep in the soil, potentially insulating this species from even severe fires (Wiggers et al., 2013). *Rubus bifrons* frequently increases in both density and reproduction after fire and other disturbances (Fryer, 2021).

Source: Published Research, Informal Publication, Professional Expertise

Q16: Propagule Persistence

Rating: >5 years

Confidence: Moderate

Rubus bifrons seeds exhibit both mechanical and chemical dormancy and usually take two to three years to germinate. Both fire and digestion can break seed dormancy. Freeze-thaw cycles, wet-dry cycles, or scarification by insect or fungi damage can also break dormancy and induce germination for *Rubus bifrons* seeds. This species develops a seed bank, but information on seed longevity in the seed bank is currently lacking (Fryer, 2021).

Source: Informal Publication

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Ungulates sometimes browse *Rubus bifrons* leaves, but they do not prefer them, likely due to the large spines. Insects and other invertebrates, including several leafhopper species, do eat the leaves. *Rubus bifrons* is the preferred host for *Dikrella californica* (blackberry leafhopper), which is also an agricultural pest on grapes and roses. (Fryer, 2021). Young shoots of *Rubus bifrons* apparently contain a chemical that

deters *Ariolimax columbianus* from feeding (Wood, 2012).

Source: Published research, Informal publication, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability, Hydrology, Fire, Nutrient dynamics

Rating: Moderate (range Moderate - High)

Confidence: Moderate (range Moderate - High)

Dense thickets and tall canes limit light availability for co-occurring species (Fryer, 2021). Large amounts of leaf litter are found under *Rubus bifrons* thickets, affecting how much bare soil is available for seeds to germinate in, and potentially also changing nutrient dynamics in invaded systems (Caplan & Yeakley, 2006). *Rubus bifrons* litter and plants may not burn well in moist sites, but it is flammable where fuels are sufficient (Fryer, 2021), and it seems likely that high densities of this species could change fire dynamics and post-fire recovery in grasslands, woodlands, and forests. No specific information was found on how long-term or reversable these impacts might be.

Source: Published research, Informal publications, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: High (range Moderate - High)

Confidence: High

This species can prevent species like *Pinus ponderosa* or *Quercus garryana* from establishing, potentially preventing succession to woodland or forested ecosystems. Replacement of native species leads to permanent monocultural thickets of *R. bifrons* that can prevent animal movement and reduce the habitat value of meadows and forest openings (Fryer, 2021). In Willamette Prairie habitats, *R. bifrons* is part of a suite of species that convert existing grasslands into shrublands.

Source: Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Rubus bifrons can alter community structure by replacing native riparian shrubs and thickets, including native *Rubus* species. *Rubus bifrons* forms thick, monotypic stands of impenetrable brush that can reduce species diversity and significantly change the community composition of ecosystems it occurs in (Fryer, 2021). In Willamette Prairie habitats it reduces native species diversity and frequently occurs with other introduced species (including *Jacobaea vulgaris*, *Cytisus scoparius*, and numerous pasture grasses). Where forest understories have been disturbed, monocultural stands of *R. bifrons* can also outcompete diagnostic understory species like *Polystichum munitum*.

Source: Informal publication, Professional expertise

Q21: Impact on Particular Native Species

Rating: Low

Confidence: Moderate

Rubus bifrons is part of a suite of invasive species that threaten rare butterflies such as the Taylor's Checkerspot that depend on open prairie-oak grasslands and savannas for habitat. *Rubus bifrons* converts grasslands to shrublands and can smother host species important for butterfly larvae (Schultz et al., 2011).

Rubus bifrons has many flowers and can flower for several months, potentially competing with native species for pollinators (Shelby & Peterson, 2015). In a study from Ferndale, Washington, *R. bifrons* pollen was the most common heterospecific pollen found on *Sidalcea hendersonii* stigma. Receiving *R. bifrons* pollen did not apparently limit seed set in this species, but this may not be the case for other species (Shelby & Peterson, 2015). *Rubus bifrons* was most commonly visited by honeybees, potentially disrupting or displacing native pollinators, which could also have additional adverse effects on native plant communities (Shelby & Peterson, 2015). On the

other hand, *Rubus bifrons*' showy flowers, generalist pollinator syndrome, and persistence in disturbed areas could potentially be beneficial to native pollinators and increase pollinator visits to neighboring native plants.

Information from California suggests that *R. bifrons* can provide cover for many native animal species, but was also found to be preferred shelter for the invasive black rat, which can have a significant impact on native bird populations (Cal-IPC, 2004; Fryer, 2021).

Source: Published research, Informal publication, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate (range Moderate - High)

Confidence: Moderate

Rubus bifrons is an aggressive invader, and can establish in late successional habitats, though usually by taking advantage of natural disturbances within those habitats.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Rubus bifrons is a common invader in naturally disturbed ecosystems like riparian areas, Willamette Prairie, and oak woodlands. This species is also resilient to fire and is capable of increasing in abundance post-fire (Fryer, 2021).

Source: Informal publication, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate (range Moderate - High)

Confidence: High

The major difficulty in managing *Rubus bifrons* is maintaining control efforts through a long enough cycle. Management requires a long-term, ecosystem-wide control effort using integrated management techniques. Herbicide and other treatments need to be on a long enough cycle to address the lifespan of the seedbank and other propagules in the soil (R. Johnson, pers. comm. 2024). The most effective control method in non-forested ecosystems is mowing (Fryer, 2021). Rhizomes and root crowns can continue sprouting after several years of treatment, but repeated mowing can eventually exhaust root reserves (Fryer, 2021). Grazing by goats or other animals following mowing may also be helpful (Fryer, 2021). Prescribed fire, alone or accompanied with mowing, does not reduce *Rubus bifrons* abundance, and may increase this species (Fryer, 2021). Mechanical treatment alone may also increase abundance of this species if efforts are not maintained long-term (Fryer, 2021). Herbicides are only effective when combined with other techniques and require multiple follow up treatments (Fryer, 2021). Seed dispersal can result in new populations in treated areas, increasing management difficulty (Fryer, 2021). Climate change is likely to have a positive effect on *Rubus bifrons*, increasing management difficulty.

Source: Informal publication, Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: High

Rubus bifrons occurances are likely to require long term management, unless they are caught early in their invasion (Fryer, 2021).

Source: Informal publication, Professional expertise

Q26: Impacts of Management on Native Species

Rating: High (range Low - High)

Confidence: Moderate (range Moderate - High)

Timing of management efforts could potentially affect birds using *Rubus bifrons* as nesting habitat (Astley, 2011). Initial treatments for this species can include mowing, tilling, broadscale herbicide applications or other techniques that have significant collateral damage to co-occurring native species.

Rubus bifrons can overtop trees and other plants, and there are no treatments that won't also negatively affect the co-occurring species (R. Johnson, pers. comm. 2024).

Source: Professional expertise, Thesis

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Rubus bifrons can be found in steep or otherwise difficult to access areas, particularly east of the Cascades.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low (range Insignificant-Moderate/Low)

Confidence: Moderate (range Moderate - High)

Rubus bifrons is a major crop in the Pacific Northwest and feral fruits are widely used. There may be public objection to herbicide application in some locations. However, this species is also an alternative host for pests and diseases that affect grapevines, and is a significant weed in grass production fields in Oregon (Fryer, 2021).

Source: Informal publication, Professional expertise

Additional Comments

For a more detailed overview of *Rubus bifrons* characteristics, ecology, and management, see the Fire Effects Information System report on *Rubus armeniacus* and *R. bifrons* (Fryer, 2021).

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Washington Invasive Ranking System

Washington Natural Heritage Program

Rubus laciniatus (Cut-Leaf Blackberry)

Assessed by
Carlo Abbruzzese (Natural Areas Manager, Washington Dept. of Natural Resources)
5 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (59) Confidence: **Low** (33)

Management Difficulty Rank: Low (47)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Moderate (70)	Confidence: Moderate (58)
Concern Related to Distribution and Abundance: Moderate (60)	Confidence: Moderate (40)

Photo Credit: Barry Breckling 2019, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: Class C

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

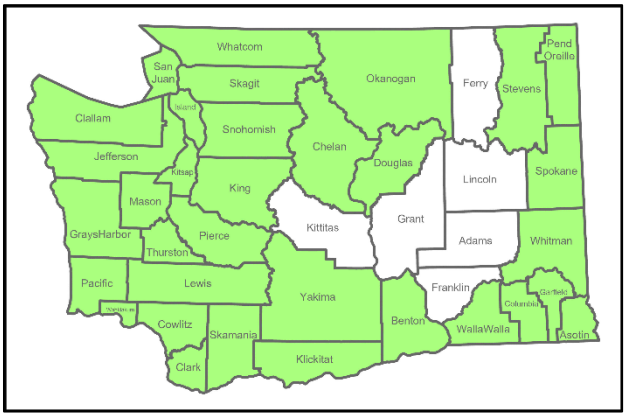

Figure 1. Distribution of counties where *Rubus laciniatus* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Rubus laciniatus is documented from 85% of counties in Washington State (CPNWH 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

This species doesn't seem to be spreading much in southwest Washington. However, it may be of more concern in other parts of the state.

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Low

This species is fairly widespread already, may not have much remaining suitable habitat.

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Does not appear to be spreading as aggressively as *Rubus bifrons*.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland

Rating: High

Confidence: Low

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

This species produces large amounts of seed and can reproduce vegetatively.

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Moderate

Fruits are eaten by birds and mammals.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

This plant is cultivated for its fruits in some areas.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: High

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Low

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

This species forms thickets and can shade other plants.

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: High

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

There are several other invasive *Rubus* species.

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

May be found in partial shade.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Disturbance appears to give this species a competitive advantage.

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: Low

Propagule persistence is estimated here based on the time needed to treat seedlings after control.

Source: Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

The fruit is palatable, but most animals don't eat the leaves and canes.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Light availability

Rating: Low

Confidence: Not Rated

This species competes with natives for light and potentially nutrients, but thickets usually don't grow particularly large.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

May cause loss of native plants beneath the thicket, but overall structural impact is generally restricted.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Likely minor impacts to native plant composition.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

This species may impact *Trillium parviflorum*, but impacts are not likely to be disproportionate.

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

Seems more common in disturbed areas.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Low

Confidence: Moderate

This species requires 2-3 years of treatment of mature plants and seedlings.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: High

Treatment is usually conducted in the fall when most natives have senesced for the year.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Some people may oppose herbicide control because berries are edible.

Source: Professional expertise

Additional Comments

None

References

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Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.

EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024.

iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.

Washington Invasive Ranking System

Washington Natural Heritage Program

Rumex crispus (Curly Dock)

Assessed by
Carlo Abbruzzese (Natural Areas Manager, Washington Dept. of Natural Resources)
4 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (6) Confidence: **Moderate** (58)

Management Difficulty Rank: Insignificant (2)	Confidence: High (90)
Biological Characteristics of Invasiveness: Moderate (53)	Confidence: High (75)
Concern Related to Distribution and Abundance: Moderate (53)	Confidence: Moderate (50)

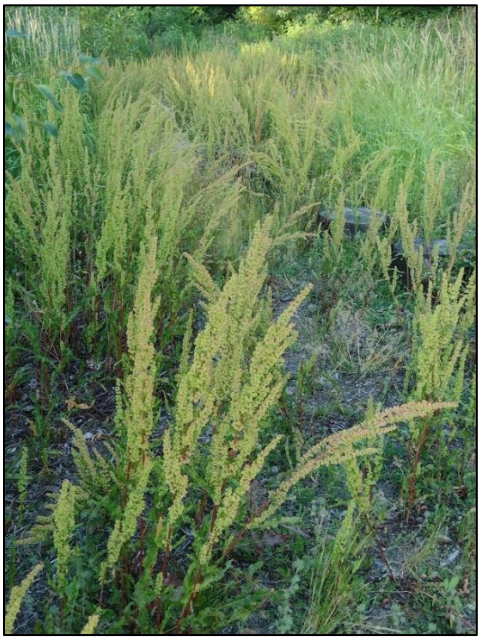

Photo Credit: David Giblin 2023, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

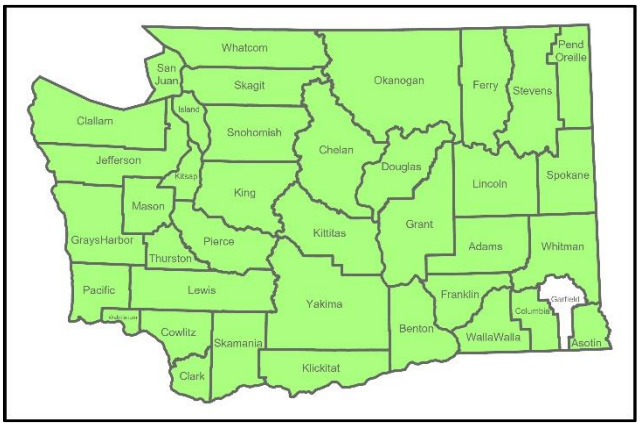

Figure 1. Distribution of counties where *Rumex crispus* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

This species is found in 97% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Unknown

Confidence: Not Rated

Source:

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Unknown

Confidence: Not Rated

Source:

Q4: Local Range Expansion or Change in Abundance

Rating: Insignificant

Confidence: Moderate

This species doesn't seem to be expanding locally in areas with which the assessor is familiar.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland, Emergent Open Wetland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

As noted in Cavers & Harper (1964), this species flowers multiple times per year, produces copious seed, and can resprout from vegetative fragments.

Source: Published research

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: Low

Viable seeds of the related *R. obtusifolius* have been found in cattle dung (Salisbury, 1961).

Source: Published research, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: No

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Low

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: High

This plant does have a long tap root but is not competitive outside of highly disturbed areas.

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

This plant requires bare soil to germinate and establish (Cavers & Harper, 1964).

Source: Published research

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

This species resprouts readily after fire or cutting (Cal-IPC, 2004).

Source: Informal publication, Professional expertise

Q16: Propagule Persistence

Rating: >20 years

Confidence: High

All published research reviewed in Cavers and Harper (1964) demonstrated buried seed viability of greater than 20 years.

Source: Published research

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

This species is not palatable to most domestic grazers, but may be browsed by deer (Cavers & Harper, 1964).

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability

Rating: Insignificant

Confidence: Low

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: High

Often establishes in disturbed portions of native plant communities, but rarely persists without ongoing disturbance or severe soil compaction.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Readily establishes in ecosystems with frequent flooding or fire.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

This species is rarely deemed to be a management priority but is likely easily managed with herbicide.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

While seeds may remain viable in the soil for some time, this species is rarely a management target.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Since this species is not managed, collateral damage is nonexistent.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Source: Professional expertise

Additional Comments

None

References

Burke Herbarium, University of Washington. 2024. Burke Herbarium Image Collection. https://burkeherbarium.org/imagecollection. Accessed: December 17, 2024.

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EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.

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Washington Invasive Ranking System

Washington Natural Heritage Program

Sasa palmata (Broadleaf Bamboo)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
16 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (65) Confidence: **High** (75)

Management Difficulty Rank: Moderate (58)	Confidence: High (80)
Biological Characteristics of Invasiveness: Moderate (59)	Confidence: High (84)
Concern Related to Distribution and Abundance: Moderate (56)	Confidence: High (100)

Photo Credit: Regina Johnson 2014, used with permission (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

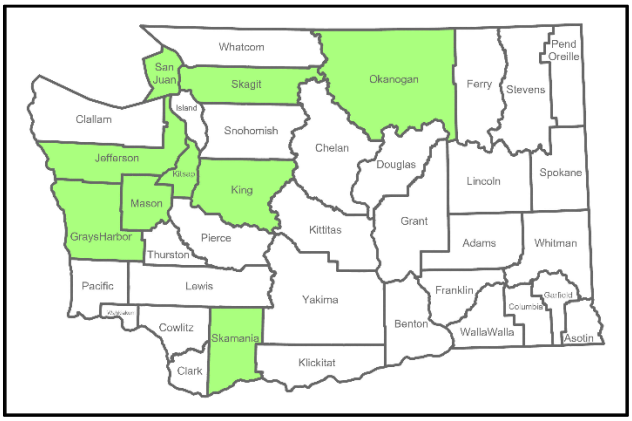

Figure 1. Distribution of counties where Sasa palmata has been documented in Washington State (CPNWH, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: Low

Confidence: High

Sasa palmata is present in 23% of Washington counties (CPNWH, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: High

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: High

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Emergent Open Wetland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: High

This species may be spread by flooding or erosion in riparian systems or on slopes subject to erosion—anything that breaks off and carries bits of the crown. However, natural spread appears to be rare.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

This species spreads by human disturbance, either by planting or disposing of yard debris. Once established the plants persist long-term.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

Does not spread by seed in Washington.

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Hydrology, Light availability

Rating: Moderate

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

This plant may establish and persist in undisturbed natural ecosystems, but only when spreading from adjacent cultivation or dumped vegetative fragments.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

This plant will establish and spread in naturally disturbed ecosystems when introduced.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: High

Some occurances have been controlled in less than 5 years, while others are ongoing more than 5 years later.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

This species only occurs where it has been planted or dumped.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

References

Burke Herbarium, University of Washington. 2024. Burke Herbarium Image Collection. https://burkeherbarium.org/imagecollection. Accessed: December 17, 2024.

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.

iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.

Washington Invasive Ranking System

Washington Natural Heritage Program

Schedonorus arundinaceus (Tall Fescue)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
21 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (51) Confidence: **High** (83)

Management Difficulty Rank: Moderate (54)	Confidence: High (80)
Biological Characteristics of Invasiveness: High (90)	Confidence: Moderate (58)
Concern Related to Distribution and Abundance: High (73)	Confidence: Moderate (60)

Photo Credit: David Giblin 2023, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

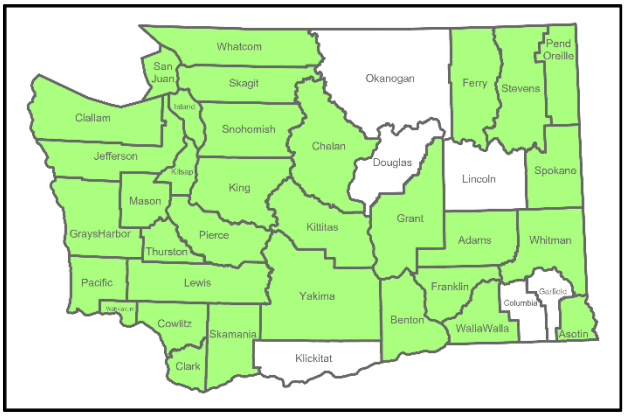

Figure 1. Distribution of counties where *Schedonorus arundinaceus* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Schedonorus arundinaceus is documented in 85% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland

Rating: Low

Confidence: Moderate

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Unknown

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Research indicates that *Schedonorus arundinaceus* is allelopathic (Hughes, 1987). Closely related *S. pratensis* also produces allelopathic chemicals (Hughes, 1987).

Source: Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q12: Germination Requirements

Rating: Unknown

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Schedonorus pratensis is introduced in the Pacific Northwest and *S. giganteus* is found in northeastern North America (Darbyshire, 2021). Both exhibit invasive traits, though neither are commonly listed as invasive species, perhaps because of their value as pasture grasses.

Source: Professional expertise, Flora of North America treatment

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source: Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Some populations are palatable, while others are not, depending on endophytes. It's commonly planted as a pasture grass but with endophyte-free seed. Feral populations may be endophyte free or not.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Nutrient dynamics, Light availability

Rating: Moderate

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: High

Schedonorus arundinaceus does not just cause changes in structure of grasslands—where it was planted for pasture, it is very difficult to re-establish trees and shrubs, and it excludes woody plant recruitment unless there is a major investment in physical removal.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: High

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: High

In order to reforest a tall fescue pasture, one must control the tall fescue until trees grow above it, which can take a few years.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Impacts of management on native species are generally low, though this may be because there is often little native community remaining in areas with tall fescue.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: High

Source: Professional expertise

Additional Comments

None

References

Burke Herbarium, University of Washington. 2024. Burke Herbarium Image Collection. https://burkeherbarium.org/imagecollection. Accessed: December 17, 2024.

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EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024.

Hughes H.G. 1987. Use of native shrubs on strip-mined lands in the humid East. n: Wallace, Arthur; McArthur, E. Durant; Haferkamp, Marshall R., compilers. Proceedings--symposium on shrub ecophysiology and biotechnology. June 30 - July 2; Logan, UT. US Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. Gen. Tech. Rep. INT-256.

iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.

Washington Invasive Ranking System

Washington Natural Heritage Program

Schoenoplectus mucronatus (Ricefield Bulrush)

Assessed by
Emily Stevenson (Program Coordinator, Skamania County Noxious Weed Control Program)
3 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: Low (41) — Confidence: **Low** (8)

Management Difficulty Rank: High (72)	Confidence: Low (20)
Biological Characteristics of Invasiveness: Not Rated	Confidence: Not Rated
Concern Related to Distribution and Abundance: Low (47)	Confidence: Moderate (50)

Photo Credit: Peter Zika 2021, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: List A, Washington State quarantine List

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

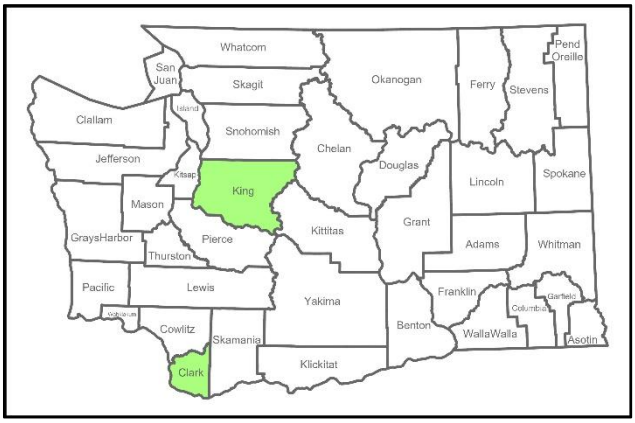

Figure 1. Distribution of counties where *Schoenoplectus mucronatus* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Low

Confidence: High

The Flora of North America notes that *Schoenoplectus mucronatus* is cultivated for wildlife in Clark County, Washington, but has yet to establish elsewhere in that area (NWCB, 2007; Smith, 2020). This species is currently documented from 5% of the counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023)

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Spread to King County may have occurred within the past 5 years (iNaturalist Contributors, 2023).

Source: iNaturalist observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Not Rated

Confidence: Not Rated

Source:

Q4: Local Range Expansion or Change in Abundance

Rating: Not Rated

Confidence: Not Rated

Source:

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Not Rated

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Not Rated

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Not Rated

Confidence: Not Rated

Source:

Q9: Allelopathy

Rating: Not Rated

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Not Rated

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: Not Rated

Confidence: Not Rated

Source:

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Source:

Q13: Invasiveness of Other Plants in Genus

Rating: Not Rated

Confidence: Not Rated

Source:

Q14: Shade Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q15: Disturbance Tolerance

Rating: Not Rated

Confidence: Not Rated

Source:

Q16: Propagule Persistence

Rating: Not Rated

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Unknown

Confidence: Not Rated

Source:

Q19: Impact on Ecosystem Structure

Rating: Unknown

Confidence: Not Rated

Source:

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Low

Washington populations are actively managed. If left unchecked, impacts may be higher.

Source: Professional Expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

At this time, this plant is primarily a weed in agricultural settings and highly disturbed wetlands (Center for Invasive Species and Ecosystem Health, 2010).

Source: Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: No

Confidence: Low

Currently only documented from anthropogenically disturbed wetlands in Washington.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: Moderate

Initial control efforts in Washington have been difficult.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Unknown

Confidence: Not Rated

Source:

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Low

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: High

Confidence: Moderate

In at least one Washington site, this species either grows in areas relatively deep water or in mucky soils that are difficult to maneuver through.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Unknown

Confidence: Not Rated

Source:

Additional Comments

None

References

Center for Invasive Species and Ecosystem Health. 2010. Bog Bulrush. Invasive and Exotic Species of North America. https://www.invasive.org/alien/pubs/midatlantic/scmu.htm. Accessed: February 3, 2025.

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Washington Invasive Ranking System

Washington Natural Heritage Program

Senecio sylvaticus (Wood Groundsel)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
5 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (6) Confidence: **High** (100)

Management Difficulty Rank: Insignificant (0)	Confidence: High (90)
Biological Characteristics of Invasiveness: High (72)	Confidence: High (75)
Concern Related to Distribution and Abundance: Moderate (58)	Confidence: High (80)

Photo Credit: Keir Morse 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

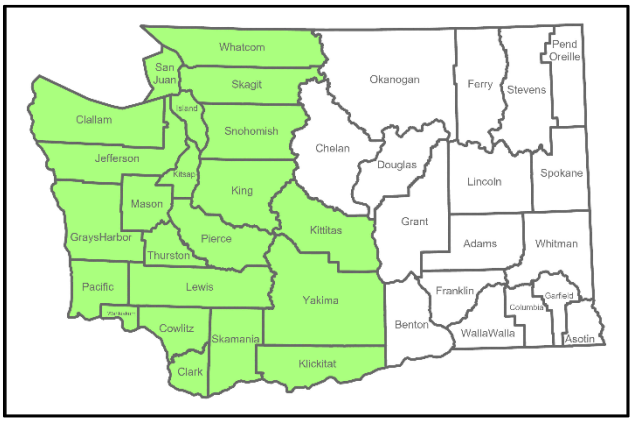

Figure 1. Distribution of counties where *Senecio sylvaticus* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Senecio sylvaticus is documented in 56% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Low

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: Unknown

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: No

Confidence: Moderate

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: High

This is a weed of clearcuts and wildfires.

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

This species seems to require major disturbance, particularly clearcutting and wildfires. The assessor has seldom seen it in other settings and it typically

only remains on site for a couple of years following disturbance.

Source: Professional expertise

Q16: Propagule Persistence

Rating: >20 years

Confidence: Moderate

It is likely that the seed bank lasts from one major disturbance to the next.

Source: Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: High

This species has only short-lived impacts. Plants are present for only a couple years in recently disturbed areas, potentially reducing recruitment of longer-lived species during that time.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Insignificant

Confidence: High

This species might reduce recruitment for a year or two following major disturbance.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

This species can follow fire, but it's more common in forested landscapes than grasslands.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

People do confuse this species with tansy ragwort, which is mandated for control in most places. However, there is no need for control, and this species will disappear on its own after a couple of years.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Solanum dulcamara (Bittersweet Nightshade)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
24 January 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (31)	Confidence: **High** (67)
Management Difficulty Rank: High (70)	Confidence: Moderate (60)
Biological Characteristics of Invasiveness: Moderate (69)	Confidence: High (67)
Concern Related to Distribution and Abundance: High (93)	Confidence: High (90)

Photo Credit: Dr. Amadej Trnkoczy 2005, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

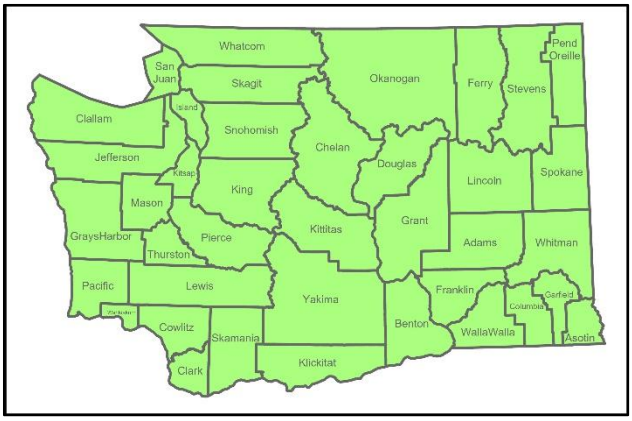

Figure 1. Distribution of counties where *Solanum dulcamara* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Solanum dulcamara is documented from all counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: High

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Forested Wetland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

Source: Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Moderate

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

A literature review found no documented impacts to abiotic ecosystem processes (Waggy, 2009).

Source: Informal publication

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: High

This plant may compete with native shrubs along small creeks, but rarely occurs with enough cover to have significant impact.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

Solanum dulcamara will establish in disturbed areas, but generally does not spread or persist without ongoing disturbance.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: Moderate

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

This species can grow in active channels of riparian areas such as gravel bars and log jams.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

This plant is poisonous and objections to management are unlikely, aside from generalized concern about herbicide use.

Source: Professional expertise

Additional Comments

None

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CalPhotos. 2024. Berkeley Natural History Museums, University of California, Berkeley. https://calphotos.berkeley.edu/. Accessed: December 17, 2024.

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Washington Invasive Ranking System

Washington Natural Heritage Program

Solidago altissima (Tall Goldenrod)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
17 October 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Moderate** (66) Confidence: **Low** (33)

Management Difficulty Rank: Low (40)	Confidence: Low (30)
Biological Characteristics of Invasiveness: High (78)	Confidence: High (71)
Concern Related to Distribution and Abundance: Moderate (52)	Confidence: High (50)

Photo Credit: Keir Morse 2016, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Solidago altissima is native to the eastern and central portions of North America and as far west as Montana (Walck et al., 2001). Sometimes this species is included as part of the *Solidago canadensis* complex (Kato-Noguchi & Kato, 2022).

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

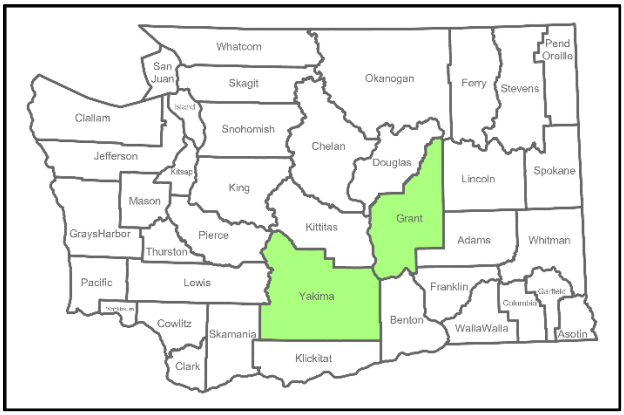

Figure 1. Distribution of counties where *Solidago altissima* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: Low

Confidence: High

Solidago altissima is found in 5% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Solidago altissima is currently only known from six confirmed locations on the Columbia Plateau in Washington. The first observation of this species is from 1948 and four of these observations are from the last 20 years. None of the recent observations appear to be from new watersheds (CPNWH, 2023; iNaturalist Contributors, 2023). Cold, dry climate may limit the spread of this species (Park et al., 2020).

Source: Published research, Herbarium records and other observations.

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: Moderate

In its native range, *Solidago altissima* occurs in grasslands and open woodlands and in moist to dry habitats and is broadly adaptable. It occurs over a wide range of latitudes (25–45 degrees) (Etterson et al., 2008). This suggests *S. altissima* could potentially establish in open, disturbed habitats throughout most of Washington State, but to date it is mainly restricted to the fringes of herbaceous (often alkaline) wetlands.

Source: Published research, Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Unknown

Confidence: Not Rated

In the last 10 years, documented populations of *S. altissima* have grown from three to six. All of these records are currently from the Columbia Plateau (CPNWH, 2023; iNaturalist Contributors, 2023). The actual increase in cover (if any) of this species is unknown.

Source: Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland; Grassland & Shrubland

Rating: Low

Confidence: Moderate

In Washington, *Solidago altissima* is primarily documented from open riparian areas and wetland fringes (often alkaline) (T. Ramm-Granberg, pers. comm. 2025). This species is generally found in open habitats and in other parts of its range, it is also found in open habitats, including grasslands, open woodlands, old fields and pastures, and other open disturbed areas. It can also be found on roadsides and stream or riverbanks and can survive occasional flooding. While this species is found on forest edges, it is usually not found in forests in either its native or invasive range (Etterson et al., 2008; Park et al., 2020). This species occurs from moist to dry sites, and in its native range, it occurs from latitudes of 25–43 degrees (Etterson et al., 2008; Park et al., 2020). *Solidago altissima* is most successful on deep, nutrient rich soil and less competitive on shallow, rocky soils (Walck et al., 2001). The broad range of climate and geography that this species occurs on in its native range may increase adaptive ability and make *S. altissima* more successful outside of its native range. (Walck et al., 2001; Etterson et al., 2008; Park et al., 2020).

Source: Published research, Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Solidago altissima reproduces sexually and vegetatively and can flower and reproduce by rhizomes in its first year. Local reproduction and population growth is usually clonal, but sources estimate that single plants produce 1000-200,000 seeds annually (Meyer & Schmid, 1999; Etterson et al., 2008; Kato-Noguchi & Kato, 2022), with one study estimating 30-75% germination(Kato-Noguchi & Kato, 2022). High germination rates in the lab do not necessarily indicate high germination in the field; at least one study found that most seeds failed to germinate in the field (frequently due to fungal infection or other disease) or vanished from field sites (Walck et al., 2001). Even with low germination rates in the field, high seed production makes this species an excellent colonizer. Aggressive colonization abilities combined with other competitive traits likely contribute to this species success as an invasive species in Europe and Asia (Meyer & Schmid, 1999; Etterson et al., 2008; Kato-Noguchi & Kato, 2022). However, in *S. altissima*'s native range, herbivory pressure can prevent sexual reproduction (Meyer & Schmid, 1999; Walck et al., 2001; Etterson et al., 2008).

Source: Published Research, Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Seeds are small and lightweight and have a feathery pappus that aids in wind distribution. They may also be dispersed by water (Kato-Noguchi & Kato, 2022). One study found only a small number of seeds remained in the study area after seed dispersal, suggesting a higher rate of dispersal than expected for this species (Meyer & Schmid, 1999).

Source: Published research, Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

While in Washington *Solidago altissima* doesn't currently occur in places were mowing or vehicle access is common, this species seeds could easily be spread by mowing and other equipment given the opportunity. Soil disturbance could also spread this species via rhizome fragments. In Europe and Asia, this species was introduced as an ornamental and for pollinators (Walck et al., 2001; Etterson et al., 2008).

Source: Published research, Professional expertise

Q9: Allelopathy

Rating: Yes

Confidence: Moderate

Allelopathy in *Solidago altissima* is relatively well-researched (Uesugi et al., 2019; Kato-Noguchi & Kato, 2022). This species produces several chemicals that are known to be allelopathic in closely related plant species, and allelopathy has been demonstrated in *S. altissima* in both the lab and the field(Uesugi et al., 2019). Common garden experiments suggest that *S. altissima* is allelopathic (at least against *Poa pratensis*) and that populations from this species' introduced range (Japan and Australia in this case) are more likely to be allelopathic than populations from the native range. Increase of allelopathic ability in introduced populations is likely related to herbivore release. Production of allelopathic chemicals also increased in *S. altissima* populations when herbivores were experimentally removed (Uesugi et al., 2019).

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Solidago altissima is considered strongly competitive, particularly in its invasive range (Uesugi et al., 2019; Kato-Noguchi & Kato, 2022) and is capable of displacing other species and resisting colonization (Walck et al., 2001). A study in Florida found that soil moisture was reduced in plant communities dominated by *S. altissima* in comparison to communities without *S. altissima* present (Kim, 2017), suggesting that this species is competitive for water. However, most sources attribute competitive success to light competition and allelopathy. The assessor has observed that dense stands of *Solidago altissima* reduce the size of co-

occurring *Solanum carolinense* (Carolina horsenettle) plants, though the etiolated growth of *S. carolinense* suggests this may be due to light competition.

Solidago altissima can also have reduced vigor when experiencing vegetative competition (Walck et al., 2001). Insect herbivory in this species' native range can reduce growth and change the outcome of competitive relationships in the vegetation community (Etterson et al., 2008). Competitive abilities in this species introduced range could be in part because of reduced herbivory pressure.

Solidago altissima senesces in late fall, even in southeastern North America. While this species may produce overwintering rosettes, this is not usual (Walck et al., 2001).

Source: Published research, Professional expertise

Q11: Growth Form

Rating: Yes

Confidence: High

Throughout most of its native and introduced range *Solidago altissima* grows in dense, monocultural stands, and outcompeting other species for light is likely how it gains dominance in a vegetation community. Height, leaf area, and ability for clonal growth make *S. altissima* an excellent competitor for light (Walck et al., 2001; Kato-Noguchi & Kato, 2022). Growth of other plants is limited underneath dense stands of *S. altissima*, and plants that are present are small and may exhibit signs of stress due to reduced light availability.

However, in Washington, this species currently usually occurs with species such as *Typha latifolia* and *Schoenoplectus acutus* which it may not be able to outcompete (T. Ramm-Granberg, pers. comm. 2024).

Source: Published research, Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Solidago altissima germinates and survives best in bare ground. Seed germination is poor under litter and vegetation canopy, and likely requires light to initiate (Walck et al., 2001). Though lab germination tests report high seed viability rates, at least one study in Europe suggested germination in established vegetation is very rare (Meyer & Schmid, 1999). Mowing did not increase light availability at the soil level enough to encourage germination in this species (Meyer & Schmid, 1999). Germination, growth, and survival of *S. altissima* seedlings was much higher in bare ground (Meyer & Schmid, 1999).

Source: Published Research

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Many *Solidago* species are of concern for their effects on plant communities throughout Asia and Europe. *Solidago altissima* and its close relative *Solidago canadensis* are considered either naturalized or invasive in Europe, Asia, Australia, and New Zealand (Park et al., 2020; Kato-Noguchi & Kato, 2022).

Source: Published research, Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Solidago altissima is generally a species of open, sunny areas, and does not invade areas with closed canopies. Vegetative plants can tolerate shade, but are much less likely to flower or may not reproduce at all in shade (Walck et al., 2001; Park et al., 2020). Seeds of this species may also require light to germinate (Meyer & Schmid, 1999).

Source: Published research, Professional expertise

Q15: Disturbance Tolerance

Rating: Yes

Confidence: High

Solidago altissima likely requires disturbance to establish populations and disturbance is important to

maintaining the open habitats that this species prefers. However, *S. altissima* is generally a later colonizer in old field habitats, and yearly disturbances may limit this species' ability to persist (Collins et al., 2001; Walck et al., 2001). Frequent mowing, fire, and other disturbances can reduce food reserves stored in rhizomes, prevent reproduction and colonization of new sites, and reduce population size in this species (Meyer & Schmid, 1999; Collins et al., 2001; Walck et al., 2001).

Source: Published research, Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

No quantitative data for propagule persistence in *Solidago altissima* was found in the literature search. Rhizomes can be maintained in refrigerated storage for at least a year. This species is described as forming a "large and long-lived" seedbank in its native range (Walck et al., 2001). One study from Europe found *S. altissima* to make between approximately 2–30% of the persistent seed bank where it was found (Meyer & Schmid, 1999). Seeds from this species are initially dormant and may require stratification to break dormancy and light to stimulate germination (Walck et al., 2001).

Source: Published research, Professional expertise

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

Though *Solidago altissima* is reported to decrease under grazing pressure, it is rarely eaten by mammals and may be toxic to mice (Walck et al., 2001). On the other hand, this species is host to a diversity of invertebrate herbivores in its native range, ranging from generalists like grasshoppers, to a wide variety of specialist gall-forming insects. Insect herbivory can reduce growth and other competitive advantages for this species, preventing it from developing a closed canopy that excludes other plants (Walck et al., 2001).

Source: Published research, Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Hydrology, Light availability

Rating: Low

Confidence: Moderate

Solidago altissima grows in dense stands that reduce light availability for neighboring plants. At least one study also found that *S. altissima* reduced soil water availability (Kim, 2017).

Source: Published research, Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

In Washington, this plant primarily occurs in open riparian and wetland ecosystems dominated by other tall, rhizomatous herbs (e.g., *Typha latifolia, Schoenoplectus acutus*). Structural impacts are likely minor, aside from potential delayed establishment of native shrubs (T. Ramm-Granberg, pers. comm. 2025).

In other areas where this species has naturalized, *Solidago altissima* can grow five to six feet tall, and where this species is invasive it can create a tall layer of perennial vegetation over existing earlier-colonizing species (Collins et al., 2001).

Source: Published research, Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Low

In Washington, *Solidago altissima* usually occurs with other highly competitive species, and in habitats that may naturally be low diversity (T. Ramm-Granberg, pers. comm. 2025).

However, in Europe and Asia, this species reduces plant community diversity where it occurs (Uesugi et

al., 2019). This species can also drive an increase in generalist pollinators and herbivores that may spill over to other species. Studies done in Florida, in *S. altissima*'s native range, have found that spillover from generalist herbivores can increase herbivory on neighboring plant species. Dense *S. altissima* stands can also hide neighboring species from their specialist pollinators or herbivores (Kim, 2017).

Source: Published research, Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

No information on *S. altissima* impacts to particular native species in Washington is available. However, this species is a model organism for testing associational effects on co-occurring plant species (e.g., Kim, 2017). These studies tend to focus on how *S. altissima* affects herbivory damage or pollination success in co-occurring plant species, and spillover effects have been demonstrated on *Solanum carolinense*, which overlaps *S. altissima*'s native range.

Solidago altissima likely has a reduced insect community outside of its native range (Etterson et al., 2008), so there may be less impact on abundance and behavior of insect herbivores and pollinators where it occurs in its invasive range.

Source: Published research, Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

This species does not persist under closed canopies and likely needs disturbance to establish (Meyer & Schmid, 1999; Park et al., 2020). All locations where it has been observed in Washington are anthropogenically disturbed.

Source: Published research, Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Moderate

Solidago altissima is known from disturbed areas in its native and non-native range (Park et al., 2020), including naturally disturbed areas like prairies and riverbanks. While the Washington sites where it has been documented all have varying degrees of anthropogenic disturbance, *S. altissima* is likely also able to invade naturally disturbed ecosystems that lack significant human impacts.

Source: Published research, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: Low

Mowing at flowering time is considered an effective treatment against *Solidago altissima*, and reduces rhizome growth, size, and survival (Stoll et al., 1998). One study in Europe found mowing at flowering reduced also reduced seed abundance on the soil surface from 49,000 seeds per meter to 1800 seeds per meter. Mowing reduced seed production in mowed areas to zero, and all seeds in mowed plots were from neighboring unmowed populations. Mowing also did not open the canopy enough to allow *S. altissima* seeds to germinate. Mowing prevents seed production which may be key in preventing spread of new populations of *S. altissima* where it is invasive (Meyer & Schmid, 1999).

However, mowing may not be a practical treatment in riparian areas or wetland sites. Information on other management techniques for this species were not found.

Source: Published research

Q25: Minimum Time Commitment

Rating: Unknown

Confidence: Not Rated

No sources mentioned a minimum time commitment for treating *S. altissima* invasions. Given the presence of a seed bank and the abundant rhizomes this species produces, treatments need to persist for at least the amount of time it takes to exhaust propagules.

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Low

In mowing experiments from *Solidago altissima'*s native range, mowing increased species diversity (Collins et al., 2001), though this may not be beneficial for naturally low diversity ecosystems. This species occurs in naturally disturbed ecosystems, so management by mowing may not be as impactful to native species as other treatment options (e.g., herbicide or tilling).

Source: Published research, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

There are only six documented populations of *Solidago altissima* in Washington, and they are all near highways and populated areas (CPNWH, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and other observations

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Solidago altissima is attractive to many pollinators and has been introduced in Asia in part because of its attractiveness to pollinators (Park et al., 2020). This may be the most likely friction point for management of this species.

Source: Published research, Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Spartina alterniflora (Smooth Cordgrass)

Assessed by
Carlo Abbruzzese (Natural Areas Manager, Washington Dept. of Natural Resources)
27 November 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (83) Confidence: **Moderate** (58)

Management Difficulty Rank: High (84)	Confidence: High (70)
Biological Characteristics of Invasiveness: Moderate (69)	Confidence: High (67)
Concern Related to Distribution and Abundance: Insignificant (20)	Confidence: High (80)

Photo Credit: Zoya Akulova 2009, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: List A, Washington State quarantine list

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

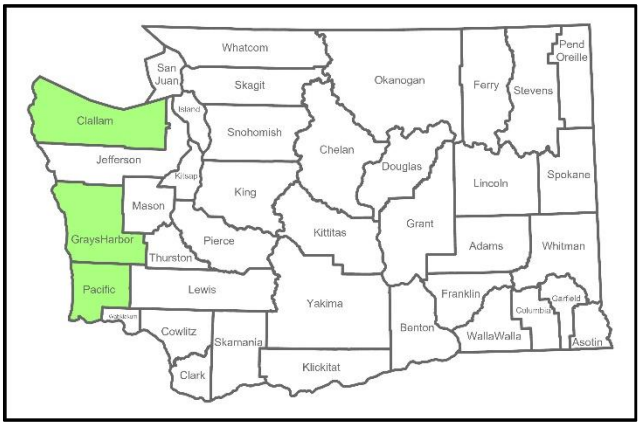

Figure 1. Distribution of counties where *Spartina alterniflora* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Q1: Current Range Size in Washington

Rating: Low

Confidence: High

Spartina alterniflora is documented from 8% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Insignificant

Confidence: High

A long term (30+ years) eradication program has been successful in mostly eradicating this species. There are still a few spots in Willapa Bay where it is found (CPNWH, 2023).

Source: Professional expertise, Herbarium records

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: High

Spartina eradication efforts have reduced its acreage in Washington from >9,000 acres (in 2003) to approximately 4 acres (in 2023). While successful, this means that at least 99% of its potential range is currently unoccupied.

Source: Professional expertise, Herbarium records

Q4: Local Range Expansion or Change in Abundance

Rating: Insignificant

Confidence: High

Millions of dollars have been spent to eradicate this plant over the past 30 years.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Coastal Brackish Tidal Wetland, Marine Seagrass & Kelp Bed

Rating: Low

Confidence: Not Rated

This species mostly occupies mudflats and saltmarshes. It competes with eelgrass, but mostly *Nanozostera japonica* (Japanese eelgrass).

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

This species produces abundant seed and can reproduce from floating rhizomes.

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Seed and rhizomes travel throughout water bodies with currents and tides.

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Seed can travel via mud on boots or clothing. Plants were likely spread to the west coast via oyster packing material.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Unknown

Confidence: Not Rated

Source:

Q11: Growth Form

Rating: Yes

Confidence: High

This species grows in dense swards.

Source: Professional expertise

Q12: Germination Requirements

Rating: Yes

Confidence: High

This species germinates in open mudflat and openings in saltmarsh.

Source: Professional Expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Spartina anglica (introduced from Europe) and *S. densiflora* (introduced from Chile) are present in Washington (Weinmann et al., 2002) and considered invasive (NWCB, 2025).

Source: Professional Expertise, Herbarium records

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Low

This species likely does not tolerate shade.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: Moderate

All salt marsh plants are typically disturbance tolerant and this species does not appear to gain a competitive advantage from disturbance.

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: Low

The assessor estimates seed persistence of 4–5 years and 1–2 years for rhizomes.

Source: Professional expertise

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Elk will eat this species rarely, when accessible, but herbivory is not a practical control for this species.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Geomorphology, Hydrology, Light availability

Rating: Moderate

Confidence: Moderate

This species has significant impacts on wave energy and sedimentation rates in intertidal ecosystems.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: High

Confidence: High

The impact this species has on ecosystem structure is high on mudflats and moderate in salt marshes. It takes over mudflats, displacing shorebirds and invertebrate foraging habitat.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: Moderate

This species shades diatoms, micro algae and eelgrasses and changes mudflats to high marsh through accumulation of silt. It also displaces salt marsh species.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Moderate

Confidence: Moderate

This species is not as competitive in established saltmarsh vegetation as it is in more frequently flooded sites, such as mudflats.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

It took over thirty years and millions of dollars to control this plant. Siltation on plants interferes with herbicide efficacy.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: High

Confidence: High

See comments in Q24

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Moderate

Herbicides used to treat this species are non-selective and also kill native saltmarsh vegetation.

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Moderate

Confidence: Moderate

Tides, mud, and channels make treating this plant very time-consuming and difficult. Airboats and other watercraft are nearly prerequisites for treatment.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Oyster growers and others from the public have objected to herbicide use in Willapa Bay and elsewhere.

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Tamarix ramosissima (Salt Cedar)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
18 September 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (71) Confidence: **Moderate** (50)

Management Difficulty Rank: High (88)	Confidence: Moderate (50)
Biological Characteristics of Invasiveness: High (70)	Confidence: High (80)
Concern Related to Distribution and Abundance: High (76)	Confidence: High (70)

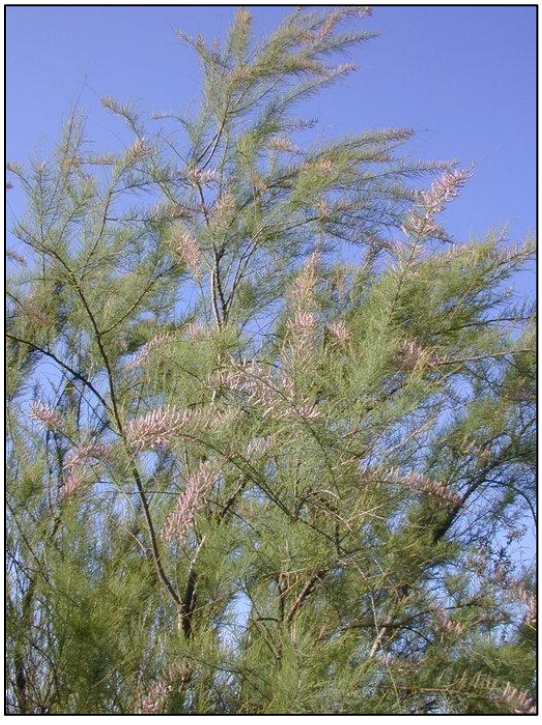

Photo Credit: Steven Thorsted 2010, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Tamarix is taxonomically difficult and there is some debate about whether the common species of *Tamarix* in the western U.S. is *T. ramosissima* or *T. chinensis* (Young et al., 2004). These two species also hybridize in their invasive range (Zouhar, 2003). Most of the information on *Tamarix* is provided by genus. Most data is from the southwest, but *Tamarix* invasions may behave differently elsewhere (Stromberg et al., 2007).

Legal Listings

Washington State Weed Board: Class B, Washington State quarantine list

Washington Invasive Species Council: Yes

Section 1: Distribution and Abundance

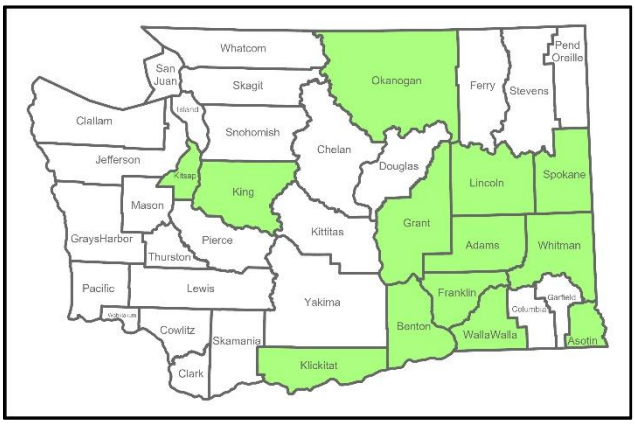

Figure 1. Distribution of counties where *Tamarix ramosissima* has been documented in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: Moderate

Tamarix ramosissima is documented in 33% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Source: Herbarium records and reported observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Tamarix ramosissima is currently most abundant in southeastern Washington, particularly on the Columbia Plateau, but it appears to be expanding into the rest of the state (EDDMapS, 2023). No information on the rate of spread was found. However, ecological factors likely constrain *T. ramosissima* and its hybrids mostly to riparian areas in arid parts of Washington, where it is better able to outcompete native vegetation for resources (Stromberg et al., 2007; Kerns et al., 2009; Lehnhoff et al., 2011).

Source: Published research, Model predictions

Q3: Proportion of Potential Range Currently Unoccupied

Rating: High

Confidence: High

In 2009, less than 1% of suitable habitat for *Tamarix* in the northwest was occupied (Kerns et al., 2009). Models predict that *T. ramosissima* is likely expand to all counties in Washington (EDDMapS, 2023), though it is most likely to be dominant east of the Cascades (Kerns et al., 2009). A 2009 study also predicts a 2-10x expansion of suitable habitat for *Tamarix* in central Washington and Oregon by 2099, due to climate change (Kerns et al., 2009).

Tamarix species have generally been regarded as poorly adapted to cold climates. However, *T. ramosissima* and *T. chinensis* both originate from cold desert environments that can experience severe winters. Hybridization between these two species has likely increased genetic and phenotypic diversity of invasive *Tamarix* in the U. S., allowing expansion into colder environments (Kerns et al., 2009; Lehnhoff et al., 2011).

Source: Published research, Model predictions

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: Moderate

The earliest record of *Tamarix* from Washington in the Consortium of Pacific Northwest Herbaria (CPNWH) is from 2005. iNaturalist observations suggest increased abundance in the last 20 years. Model scenarios predict *Tamarix* to gain and maintain at least 5% cover east of the Cascades, particularly in the Columbia Plateau ecoregion (EDDMapS, 2023), and as of 2009, less than 1% of suitable habitat for *Tamarix* was occupied (Kerns et al., 2009), suggesting that local range and abundance could increase rapidly for this genus.

Source: Published research, Model predictions

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Forested Wetland

Rating: Low

Confidence: High

Tamarix is restricted by availability of suitable habitat, preferring riparian areas in relatively warm and dry ecosystems (Kerns et al., 2009). *Tamarix* is also found in playas, alkali sinks, lowland woody communities, saline marshes and meadows, and prairies. Associated species are generally species of arid and semi-arid habitats or found in riparian areas or wetlands in areas that are otherwise arid or semi-arid. In these areas, *Tamarix* species are usually found in habitats that are seasonally submerged (Zouhar, 2003).

Source: Published research, Informal publication

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Tamarix ramosissima, *T. chinensis*, and their hybrids are self-compatible and usually reproduce by seed. One tree can produce hundreds of thousands of seeds in a growing season. Stress, including fire, drought, or damage, can induce further flowering and seed production. Seeds are very small, with short hairs that aid in wind and water dispersal (Zouhar, 2003). One study documented 4,600 seeds in one square meter under a *Tamarix* stand, with 2,400 seeds per square meter at a distance of 0.1 kilometers from the stand, and 51 seed per square meter 8 kilometers from the stand (Young et al., 2004). *Tamarix* can produce seeds up to 5.5 months of the year, peaking in late spring and early summer. While seeds are the most common way for *Tamarix* to disperse, they can also resprout from the roots and grow from root and stem fragments. Sources differ on how likely vegetative reproduction through lateral roots is in *Tamarix* species (Zouhar, 2003; Young et al., 2004; Kerns et al., 2009).

Reliable information on pollination in *Tamarix* is not available, but experimental exclusion of insect pollinators suggests that wind pollination is unlikely (Stevens, 1989).

Source: Published research, Informal publication

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Tamarix seeds have small hairs that aid in wind dispersal and can also be dispersed by water (Zouhar, 2003; Young et al., 2004). Seeds have been documented traveling at least 8 km from their source, allowing *Tamarix* species to invade adjacent stream reaches (Zouhar, 2003; Young et al., 2004). At least one source also suggested that birds aid in seed dispersal for this genus (Lehnhoff et al., 2011).

Source: Published research, Informal publication

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Tamarix was introduced in the U.S. to stabilize soil and is also used as a windbreak and an ornamental (Zouhar, 2003; Stromberg et al., 2007). *Tamarix* is usually found in areas of anthropogenic disturbance. Human activity appears to be the main driver of habitat suitability for *Tamarix* species in the southwest. Changes in stream flow patterns, reduced water tables, and increased soil and water salinity all favor *Tamarix* over native cottonwood and willow species in the southwest. Livestock grazing also favors *Tamarix*, since livestock preferentially graze native riparian vegetation (Stromberg et al., 2007).

Source: Published research, Informal publication

Q9: Allelopathy

Rating: No

Confidence: Moderate

Soil leachate from *Tamarix* was not found to impede germination of *Tamarix* seeds. However, plants in this genus excrete salt from their leaves, which can increase soil salinity, especially in habitats where flooding is regulated by dams or other human activities. Increased soil salinity can give *Tamarix* a competitive advantage over native riparian plant species (Zouhar, 2003).

Source: Informal publication

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Tamarix's slow growth and shade intolerance ultimately make species in this genus poor competitors with non-stressed native riparian vegetation (Zouhar, 2003; Stromberg et al., 2007). However, deep taproots, high water use efficiency, and salt tolerance mean that *Tamarix* is generally less sensitive to water stress than the native species it occurs with (Zouhar, 2003; Stromberg et al., 2007). *Tamarix* species also produce lateral roots that can behave like rhizomes and are capable of extracting water from unsaturated soil (Zouhar, 2003; Stromberg et al., 2007). These traits allow *Tamarix* species to outcompete native riparian vegetation in areas where human activities or climate change have reduced

waterflow, lowered the water table, or changed the timing of flood events (Zouhar, 2003; Stromberg et al., 2007).

Tamarix ramosissima is deciduous. However, *Tamarix* species have physiological traits that allow them to continue to photosynthesize in dryer conditions than native riparian vegetation, giving them an advantage during droughts and where human disturbance and climate change have reduced water availability (Zouhar, 2003; Gafke et al., 2022). This provides a similar advantage in climates where growth and survival are affected by drought more than cold.

Source: Published research, Informal publication

Q11: Growth Form

Rating: Yes

Confidence: Moderate

Under favorable conditions, *Tamarix* species form monospecific stands (or nearly so). However, *Tamarix* is often unable to outcompete native riparian vegetation for sunlight in ecosystems that are not experiencing water stress (Zouhar, 2003; Stromberg et al., 2007).

Source: Published research, Informal publication

Q12: Germination Requirements

Rating: No

Confidence: High

Tamarix seeds generally germinate post-flood and prefer bare fine silt soils. Evidence suggests seedlings don't establish well in leaf litter or under shaded conditions (Zouhar, 2003; Lehnhoff et al., 2011).

Source: Published research, Informal publication

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Up to 12 species of *Tamarix* are present in the U.S., but only four of those species are highly invasive. *Tamarix ramosissima* and *T. chinensis* are the most aggressive *Tamarix* species that occur in North America. High genetic diversity, phenotypic plasticity, and hybridization contribute to the success of invasive *Tamarix* species (Zouhar, 2003; Kerns et al., 2009).

Source: Published research, Informal publication

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Tamarix species prefer open disturbed sites and are not shade tolerant. A study in Montana found populations of *Tamarix* that hadn't recruited new individuals in up to 27 years, likely due to the combination of thick litter under the canopy and adults outcompeting seedlings for light (Lehnhoff et al., 2011). Under the right conditions, native riparian vegetation can also shade out *Tamarix* seedlings, even if *Tamarix* establishes first. Adult *Tamarix* may also be susceptible to shading (Zouhar, 2003).

Source: Published research, Informal publication

Q15: Disturbance Tolerance

Rating: Yes

Confidence: Moderate

Tamarix can grow in highly disturbed areas, including mine tailings, and survives in saline and alkali environments. Wind-borne seeds and high seed production make *Tamarix* an excellent pioneer species. Anthropogenic changes to stream and groundwater hydrology enable the spread of *Tamarix* species in the western U.S. (Zouhar, 2003; Kerns et al., 2009). *Tamarix* is also more likely than native riparian vegetation to survive and increase post-fire (Gafke et al., 2022).

However, *Tamarix* may be less resilient to natural disturbance regimes, and may not be able to outcompete native vegetation in areas with frequent, severe flooding (Zouhar, 2003). On free-flowing perennial waterways, *Tamarix* may struggle to establish seedlings. A study comparing river reaches with altered flows against free-flowing reaches found *Tamarix* less common where natural river dynamics

were intact (Stromberg et al., 2007). *Tamarix* may also be less competitive after flooding disturbances in areas where biocontrols have been successfully established (Gafke et al., 2022).

Source: Published research, Informal publication

Q16: Propagule Persistence

Rating: < 5 years

Confidence: High

Tamarix seeds are short-lived, loosing viability in as few as 24 days when exposed to direct sunlight. In ideal conditions they can persist for up to 130 days. Seeds do not exhibit dormancy and *Tamarix* species do not have a persistent seed bank (Zouhar, 2003; Young et al., 2004).

Seeds require only moisture to germinate and generally do so within 24 hours of receiving moisture. They can have up to 98–100% germination rates under the right conditions. Seeds are capable of germination and establishment over a wide range of temperature regimes (Zouhar, 2003; Young et al., 2004).

Source: Published research, Informal publication

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: High

Grazers and browsers, including livestock, prefer native trees and shrubs to *Tamarix*. Grazing practices are implicated in the spread and abundance of *Tamarix* in the southwest (Zouhar, 2003; Stromberg et al., 2007).

Source: Published research, Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes Impacted: Fire, Hydrology, Nutrient dynamics, Light availability, Soil salinity

Rating: High

Confidence: Moderate

Tamarix can lower water tables through high evapotranspiration rates (Zouhar, 2003; Gafke et al., 2022). Accumulation of *Tamarix* leaves can also alter soil salinity, particularly in areas where dams have halted annual flooding, impairing germination and growth of native species (Zouhar, 2003; Gafke et al., 2022). *Tamarix* also burns readily, changing fire frequency and extent where it occurs (Zouhar, 2003; Gafke et al., 2022). Riparian corridors invaded by *Tamarix* spread fire instead of functioning as a barrier to fire (Zouhar, 2003; Gafke et al., 2022). Monospecific stands of *Tamarix* also reduce light availability for other species (Zouhar, 2003; Gafke et al., 2022). Effects on nutrient cycling and mycorrhizal associations need more study, but it seems likely that *Tamarix* dominance also affects these, with interactions making soil conditions less hospitable to native plants (Zouhar, 2003; Gafke et al., 2022).

However, dominance of *Tamarix* species is likely a response to anthropogenic changes in hydrology and river flow, not a cause of those changes (Zouhar, 2003; Gafke et al., 2022). Effects on abiotic processes caused by *Tamarix* might be reversible when coupled with efforts to restore more natural hydrological regimes, but political and economic impediments to restoring historical river conditions coupled with climate change may make this process difficult.

Source: Informal publication

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

Tamarix invasions in the western U.S. simplify riparian ecosystem structure, affecting habitat quality for many species (Gafke et al., 2022). Some sources also document *Tamarix* replacing grassland community types (Zouhar, 2003), but this genus appears to most commonly simplify the structure of existing riparian woodland communities.

Source: Informal publication

Q20: Impact on Ecosystem Composition

Rating: High

Confidence: Moderate

Tamarix reduces native species diversity where hydrologic conditions allow it to establish dominance. Invasive species such as *Cirsium arvense* and *Rhaponticum repens* are more common in association with *Tamarix* species than with native communities (Zouhar, 2003; Gafke et al., 2022).

Source: Informal publication

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

No information was available for the impact of *Tamarix* invasions on particular Washington species. However, where *Tamarix* is abundant in the southwest, it can provide habitat for the federally endangered Southwest Willow Flycatcher, complicating efforts to treat *Tamarix* invasions (Stromberg et al., 2007; Gafke et al., 2022).

Source: Published research, Informal publication

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Tamarix is shade intolerant and depends on floods or human disturbance to create suitable germination conditions (Zouhar, 2003). Given these traits, *Tamarix* species' ability to invade intact undisturbed areas is likely limited.

Source: Informal publication

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Tamarix species are more likely to invade stream reaches with altered hydrological conditions but are still capable of establishing on perennial streams with unaltered hydrologic conditions (Zouhar, 2003; Stromberg et al., 2007; Lehnhoff et al., 2011). *Tamarix* species benefit from moderate flooding, which deposits substrate for seeds to germinate on and provides the moisture needed to induce germination. However, in areas where hydrologic conditions are unaltered, *Tamarix* appears to have difficulty establishing as a dominant and where present may remain subdominant to native riparian trees (Zouhar, 2003; Stromberg et al., 2007; Lehnhoff et al., 2011).

Source: Published research, Informal publication

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: High

In 2001, the cost of mitigating or treating *Tamarix* in the western U.S. was estimated to be $280–$450 per hectare of land (Kerns et al., 2009).

Tamarix dominance is frequently driven by altered hydrological conditions that prevent native riparian trees from reestablishing and thriving. Coupling removal with restoration of historical hydrological regimes and native riparian vegetation is suggested for successfully managing *Tamarix* invasions in the long-term. Post-restoration monitoring is also required, especially early on, to prevent *Tamarix* from reestablishing (Stromberg et al., 2007; Lehnhoff et al., 2011). Biocontrols have shown some success but have been difficult to establish in the northern part of *Tamarix's* U.S. range. Biocontrol effectiveness also varies by target species (Gafke et al., 2022).

Source: Published research; Informal publication

Q25: Minimum Time Commitment

Rating: High

Confidence: High

Coupling *Tamarix* removal with stream restoration efforts and post-restoration monitoring likely requires an ongoing time commitment for *Tamarix* removal projects (Lehnhoff et al., 2011), but none of the sources found in the literature search provided a specific time commitment.

Source: Published research

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Low

No information was available on the effect *Tamarix* management could have on native species that occur in Washington. Restoration of historical hydrological regimes and native riparian vegetation may be the most effective treatment for *Tamarix* invasions (Stromberg et al., 2007). While the heavy equipment required for initial removal and restoration activities may have a negative effect on remaining native species in areas colonized by Tamarix, it is expected that the native riparian vegetation will recover quickly once removal and restoration efforts are complete. However, in the southwest, *Tamarix* removal is complicated due to their importance as habitat for the federally endangered Southwest Willow Flycatcher. For example, use and transportation of biocontrol agents in the western U.S. were halted after Southwest Willow Flycatcher nests were lost when *Tamarix* trees were defoliated (Gafke et al., 2022).

Source: Published research, Informal publication, Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Low

Confidence: Low

As of 2009, most records of *Tamarix* presence and abundance in the Northwest were from relatively accessible areas (Kerns et al., 2009). However, further establishment in many of the canyons of eastern Washington would be difficult to access.

Source: Published Research

Q28: Sociopolitical Implications of Management

Rating: High

Confidence: Moderate

Successful *Tamarix* management is likely to rely on restoring natural water flows and hydrological regimes and potentially changing livestock grazing practices (Stromberg et al., 2007). Grazing and water issues are historically fraught in the western U.S., suggesting that an important part of any work with *Tamarix* removal needs to include building relationships and buy in from stakeholders.

Research on and use of biocontrol agents is restricted in a portion of *Tamarix*'s range in the western U.S. due to lawsuits to protect the Southwest Flycatcher. The result of these lawsuits restricts federal funding on research into *Tamarix* biocontrols as well as interstate transport of biocontrols (Gafke et al., 2022). While the Southwest Flycatcher does not occur in Washington, some of these restrictions may limit the tools available to manage *Tamarix* invasions in the state.

While *Tamarix* management may not be opposed by the general public, dealing with complex water issues and the current regulations on biocontrol agents that target *Tamarix* species could still make management sociopolitically difficult.

Source: Published research, Informal publication, Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Trifolium pratense (Red Clover)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
4 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (38)	Confidence: **Moderate** (50)
Management Difficulty Rank: Insignificant (16)	Confidence: High (90)
Biological Characteristics of Invasiveness: Low (37)	Confidence: High (75)
Concern Related to Distribution and Abundance: High (56)	Confidence: High (80)

Photo Credit: David Giblin 2020, used under Creative Commons license (Burke Herbarium, University of Washington, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

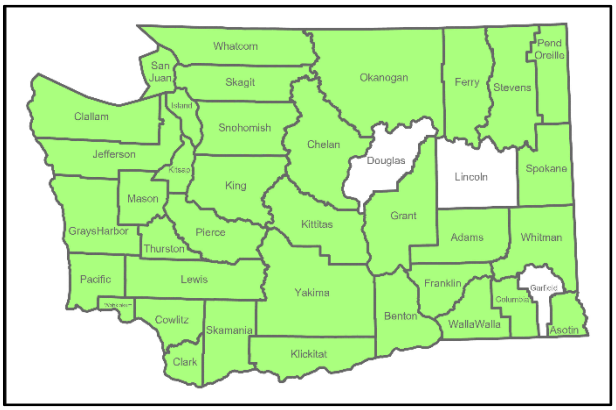

Figure 1. Distribution of counties where *Trifolium pratense* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Trifolium pratense is documented from 92% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Low

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

This species has likely occupied most of its available habitat.

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

Trifolium pratense generally does not reproduce vegetatively, although there are vegetatively reproductive cultivars (Hyslop et al., 1999).

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Moderate

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

This species is used for forage, for erosion control, and it's in livestock feed.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: High

This species is used as a forage plant for pasture mixes, where allelopathy would be a significant drawback.

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

Trifolium pratense is a nitrogen-fixer, like nearly all legumes.

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: High

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: Moderate

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

Source: Professional expertise

Q17: Palatability

Rating: No, plant is palatable

Confidence: High

This is a forage plant often included in pasture mixes.

Source: Published Research

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics

Rating: Low

Confidence: Moderate

Prairies are low-nitrogen systems so this species' nitrogen fixing abilities may benefit tall oatgrass, similarly to *Cytisus* species.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Low

Confidence: High

This species is usually not a priority for control in Washington, though the assessor believes control would be comparatively easy.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Trifolium subterraneum (Burrowing Clover)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
4 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Low** (35) Confidence: **Moderate** (58)

Management Difficulty Rank: Moderate (61)	Confidence: High (90)
Biological Characteristics of Invasiveness: Low (44)	Confidence: High (71)
Concern Related to Distribution and Abundance: High (91)	Confidence: High (80)

Photo Credit: Steve Matson 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

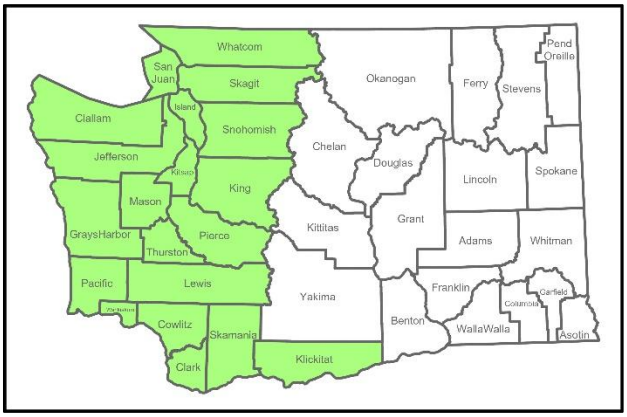

Figure 1. Distribution of counties where *Trifolium subterraneum* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

This species may be underreported, but is currently documented in 51% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: High

Confidence: High

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q4: Local Range Expansion or Change in Abundance

Rating: High

Confidence: High

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland, Marine Coastal Shore

Rating: Low

Confidence: High

Common on road shoulders, prairies, and deflation plains of coastal dunes.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

This plant spreads both vegetatively and by seed.

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: Unknown

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Aside from accidental transport, this plant is also used in pasture mixes.

Source: Professional expertise

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: High

This species is a winter annual and, like most legumes, a nitrogen fixer.

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

This species grows prostrate, but it can grow through and under everything else on prairies.

Source: Professional Expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: Moderate

This species resprouts readily but does not appear to gain a competitive advantage.

Source: Professional expertise

Q16: Propagule Persistence

Rating: <5 years

Confidence: Moderate

At best guess, the seeds persist for less than five years, but observations are confounded by the use of pre-emergent herbicides.

Source: Professional expertise

Q17: Palatability

Rating: Yes

Confidence: Moderate

This species is used in pasture mixes, primarily as a source of nitrogen for grasses.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics

Rating: Low

Confidence: Moderate

Prairies are low-nitrogen systems so this species' nitrogen fixing abilities may benefit tall oatgrass, similarly to *Cytisus* species.

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: Moderate

This species reduces bare ground, which is important in prairies for seedling recruitment. Structural impacts appear to be insignificant, however.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

May reduce seedling recruitment for native species.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Not Rated

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Low

Confidence: High

This species establishes and persists in disturbance-dependent ecosystems only.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Moderate

Confidence: High

This species' prostrate growth habit and small size suggests that it might take significant labor to treat if considered a management priority.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Moderate

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

While accessibility is likely not a problem with this species, its cryptic nature does make it difficult to find.

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Moderate/Low

Confidence: Moderate

Source: Professional expertise

Additional Comments

None

References

CalPhotos. 2024. Berkeley Natural History Museums, University of California, Berkeley. https://calphotos.berkeley.edu/. Accessed: December 17, 2024.

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Washington Invasive Ranking System

Washington Natural Heritage Program

Utricularia inflata (Swollen Bladderwort)

Assessed by
Molly S. Wiebush (Washington Natural Heritage Program)
30 September 2024 (WIRS Version 1.5)

Ecological Impact Rank: **High** (79)	Confidence: **Low** (25)
Management Difficulty Rank: Moderate (67)	Confidence: Low (10)
Biological Characteristics of Invasiveness: High (78)	Confidence: Moderate (54)
Concern Related to Distribution and Abundance: Moderate (64)	Confidence: Moderate (60)

Photo Credit: Milli Vedder 2023, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

Utricularia inflata's native range extends from Texas to the southeastern coastal plains and north to Delaware (Titus & Grisé, 2009). It is introduced in Washington and the Northeastern U.S. (Urban & Dwyer, 2016). Little information was found regarding *U. inflata* populations in Washington, so most information on this species' invasiveness is from studies from New York.

Legal Listings

Washington State Weed Board: Washington State monitor list, Washington State quarantine list.

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

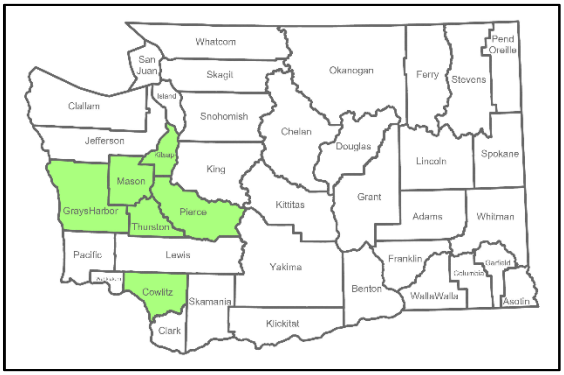

Figure 1. Distribution of counties where *Utricularia inflata* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: Moderate

Confidence: Moderate

Herbarium and iNaturalist records of *Utricularia inflata* have been collected in 6 out of 39 counties in Washington state (15%) as of 2024 (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Rating: Moderate

Confidence: Moderate

Utricularia inflata is expanding its range in Washington. The earliest record for this species in the Consortium for Pacific Northwest Herbaria is from Kitsap County in 1980. Records were reported from Cowlitz, Mason, and Thurston counties by 1995, and from Pierce County in 2018 (CPNWH, 2024). A record from a Gray's Harbor County was reported in 2024 (iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Moderate

Confidence: Moderate

The potential range for *Utricularia inflata* has not been modeled for Washington. Given habitat requirements, at minimum, this species can likely survive in all the counties west of the Cascades. Native *Utricularia* species are reported from all ecoregions in Washington, though they appear to be least abundant on the Columbia Plateau (CPNWH, 2024). This evidence suggests that a large portion of *Utricularia inflata*'s potential range is not yet invaded.

Source: Professional expertise, Herbarium records

Q4: Local Range Expansion or Change in Abundance

Rating: Moderate

Confidence: Moderate

Quantitative data was not available regarding the increase in *Utricularia inflata* cover where it currently occurs in Washington. However, based on reported observations, abundance of this species appears to be increasing within the Puget Basin (CPNWH 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem Types: Shallow Water Wetland (Aquatic)

Rating: Low

Confidence: High

Utricularia inflata is a suspended aquatic plant limited to impounded freshwater environments. It occurs in ponds, lakes, swamps, sloughs, ditches, and canals (Crow, 2022). As a carnivorous plant, this species may be further limited to sunny, wet, and nutrient poor environments (Wiebush, 2022). In New York, this species is described as particularly problematic in oligotrophic (that is, deep, cold and clear) lakes (Titus & Grisé, 2009). At least one study found that *U. inflata* was relatively robust to changes in pH, and is potentially capable of colonizing a wide variety of freshwater ecosystems (Titus & Urban, 2013).

Source: Published research, Informal publication, Flora of North America treatment

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Yes

Confidence: High

Even *Utricularia* species that do reproduce sexually (including *Utricularia inflata*) are more likely to reproduce vegetatively from plant fragments than from seed (Wiebush, 2022). *Utricularia inflata* fragments easily, and is capable of reproducing even from small fragments (Titus & Urban, 2013). A study of introduced populations of *Utricularia inflata* in New York (Urban & Dwyer, 2016) found that asexual reproduction in this species was more prolific than in the native *Utricularia vulgaris* (*U. vulgaris* is the most widespread native *Utricularia* in Washington (CPNWH, 2024)). Aggressive vegetative

reproduction contributes to the spread of this species in New York (Urban & Dwyer, 2016).

Source: Published research, Informal publication, herbarium records

Q7: Innate Potential for Long-Distance Dispersal

Rating: Yes

Confidence: High

Vegetative propagules are more effective dispersal agents than seeds in aquatic plants, traveling further and establishing more easily than do seeds (Urban & Dwyer, 2016). All *Utricularia* species disperse through plant fragments and turions (small storage organs that allow *Utricularia* species to overwinter in cold climates). *Utricularia* that reproduce sexually also disperse small buoyant seeds. Dispersal agents are wind, water, and animals, particularly waterfowl. Many species of *Utricularia* are widespread, suggesting the capability for long distance dispersal is somewhat common in this genus (Wiebush, 2022). *Utricularia inflata* is fairly buoyant, which, in combination with its unrooted habit increases the likelihood of long-distance dispersal (Urban & Dwyer, 2016). In New York, dispersal of *U. inflata* after initial introductions appear to be mostly via water, with populations spreading downstream (Titus & Urban, 2013).

Source: Published research, Informal publications

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: High

Fragments of *Utricularia inflata* can be transported from invaded waterways to new locations by boats and boat trailers (Urban & Dwyer, 2016). *Utricularia inflata* was likely introduced in western Washington as an ornamental or for mosquito control (Howard Morgan, 2011). Buying, selling, and transport of *U. inflata* is illegal in Washington (Washington State Legislature, 2021), but this species is for sale through several internet sources based outside of Washington.

Sources: Published research, Informal publication, Web search, Washington Administrative Code

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Utricularia inflata is included in a list of plant species that may be allelopathic to algae in one review (Emery-Butcher et al., 2020), but no primary sources discussed allelopathy in this species. Further research is needed.

Source: Published research

Q10: Competitive for Limiting Abiotic Factors

Rating: Yes

Confidence: Moderate

Utricularia species are adapted to sunny, low-nutrient habitats, gaining most of their nitrogen, phosphorus, and other nutrients via the small aquatic invertebrates they capture and digest in their underwater traps (Wiebush, 2022). Being able to supplement nutrients through carnivory is a competitive advantage in nutrient-poor habitats; increases in nutrient availability can reduce or erase the competitive advantages of carnivory in plants (Givnish et al., 1984).

Utricularia species overwinter in cold environments as storage organs called turions or winter buds (Silva et al., 2018).

Source: Published research, Informal publication

Q11: Growth Form

Rating: Yes

Confidence: High

Where it is found in Washington, *Utricularia inflata* is reported to form dense floating mats of vegetation (Smith, 2007). In New York, studies have shown that mats of *Utricularia inflata* can shade out native aquatic vegetation (Titus & Grisé, 2009; Urban & Dwyer, 2016). Outcompeting other aquatic species for light may be *Utricularia inflata*'s main mechanism for invasion (Fleming & Dibble, 2015).

Source: Published research, Informal publication

Q12: Germination Requirements

Rating: Not Rated

Confidence: Not Rated

Utricularia inflata is a floating, aquatic plant that does not root in the soil and is found in a limited number of ecosystem types.

Sources:

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Utricularia is a diverse and widespread genus, represented by over 240 species, and making up 30% of carnivorous plant diversity (Wiebush, 2022). However, it appears very few of those species have been documented as invasive. *Utricularia gibba* is considered invasive in New Zealand (Compton et al., 2012) and Croatia (Piria et al., 2022). Introduced populations previously thought to be *Utricularia inflata* in Japan have recently been identified as *Utricularia* cf. *platensis*. *Utricularia platensis* originates from South America (Kadono et al., 2019).

Source: Published research, Informal publication

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

No information was directly available on *Utricularia inflata*'s shade tolerance. However, carnivorous plants, including most *Utricularia* species, are generally found in sunny, wet, nutrient-poor environments (Givnish et al., 1984).

Source: Published research

Q15: Disturbance Tolerance

Rating: No

Confidence: Moderate

No information was found on *Utricularia inflata*'s disturbance tolerance relative to co-occurring species. Increases in water turbidity, eutrophication and changes to hydrogeology are generally regarded as a threat for aquatic *Utricularia* species (Wiebush, 2022). Studies done in New York, where *U. inflata* is also introduced, found that this species is most abundant in waters sheltered from waves and currents (Urban & Titus, 2010). This suggests that *U. inflata* may not have a markedly different disturbance tolerance than other co-occurring species.

Source: Published research, Informal publication

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Aquatic *Utricularia* species produce turions, or winter buds, which are storage organs that allow these species to overwinter. Turions can also resist desiccation (Silva et al., 2018). However, no details were available on how long turions or other propagules might remain viable.

Source: Published research

Q17: Palatability

Rating: No, plant is palatable

Confidence: Moderate

Utricularia species in Washington may be eaten by fish, muskrats, and waterfowl (Washington Department of Ecology, 2024). However, grazing is not a practical management technique for this aquatic plant.

Source: Informal publication

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability, Chemistry

Rating: Moderate

Confidence: Low

Information on *Utricularia inflata* impacts to abiotic processes in Washington was not available. In New York, invasions of *U. inflata* change sedimentary nutrient cycling processes by extirpating native plant

species, in turn changing the proportion of oxygen, metals, and other nutrients in the water column (Titus & Urban, 2013). These changes to nutrient cycles and water chemistry are an indirect effect of this species' ability to outcompete other aquatic species for light (Urban et al., 2009; Urban & Titus, 2010). However, the persistence of *U. inflata* invasions and their long-term impacts are unknown (Titus & Grisé, 2009).

Source: Published research

Q19: Impact on Ecosystem Structure

Rating: Moderate

Confidence: Moderate

Information on *Utricularia inflata*'s ecosystem affects in Washington are limited. Studies of *U. inflata* invasions in New York found this species capable of shading out aquatic vegetation rooted in the substrate, resulting in cascading effects on nutrient and oxygen availability (Urban et al., 2009; Urban & Titus, 2010). At minimum, presence of *U. inflata* in Washington could result in loss of some vegetation layers in aquatic ecosystems.

Source: Published research

Q20: Impact on Ecosystem Composition

Rating: Moderate

Confidence: Moderate

While no information was available from Washington, a study from New York comparing changes in aquatic vegetation from 1933–2000 found increases in *Utricularia inflata* corresponded with decreases in native aquatic vegetation. *Utricularia inflata* was the most abundant species found in the target systems by 2000. The authors attributed the majority of changes in community composition to *U. inflata*'s presence and abundance (Titus & Grisé, 2009). Given *U. inflata*'s ability to shade out native species in other ecoregions, it seems likely that this species could have similar effects in Washington.

Source: Published research

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

No impacts on particular native species in Washington were found in the literature search, but in the northeast, *Utricularia inflata* may be contributing to extirpation of some native aquatic plant species from lakes where it occurs (Urban & Dwyer, 2016). *Utricularia* species are also known to hybridize with each other (e.g. Wiebush, 2022) but no information was found on *U. inflata* hybridizing with native *Utricularia* species in Washington.

Source: Published research, Informal publication

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: High

Confidence: Moderate

Disturbance responses were not discussed in most of the literature available on *Utricularia inflata*. However, based on descriptions of *U. inflata* invasions in New York, it seems likely that this species is capable of invading undisturbed ecosystems when the habitat is suitable. Other ecological factors are likely more important for determining where this species is capable of invading an ecosystem (Titus & Grisé, 2009; Urban et al., 2009; Urban & Titus, 2010; Titus & Urban, 2013; Urban & Dwyer, 2016).

Source: Published research

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: Low

Research suggests that once *Utricularia inflata* establishes in a waterway, natural disturbance can help it spread (Titus & Urban, 2013). Related studies found that *U. inflata* abundance increased in areas where plants were sheltered from wave action and currents (Urban & Titus, 2010). Ecological factors other than disturbance may be more important for determining whether this species is capable of invading an ecosystem or not.

Source: Published research

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: High

Confidence: Low

Utricularia species can be difficult to identify without flowers (Wiebush, 2022), but *U. inflata* produces distinctive floating platforms from which flowers eventually emerge. Successful manual removal of this species requires capturing all vegetative fragments. Other suggested options include draining the waterbody in which the plant occurs, or using herbicides (NWCB, 2024). Practical and effective management methods for this species seem to be limited.

Source: Informal publication

Q25: Minimum Time Commitment

Rating: Unknown

Confidence: Not Rated

The persistence and long-term effects of *Utricularia inflata* invasions are not currently known, and at least some invasive populations observed in New York appeared to be short-lived (Titus & Grisé, 2009).

Source: Published Research

Q26: Impacts of Management on Native Species

Rating: Moderate

Confidence: Low

No information was available discussing the effects of *Utricularia inflata* management on co-occurring native species. However, suggested treatment options for *U. inflata* occurances, particularly draining lakes, seem likely to result in significant collateral damage to native species (NWCB, 2024).

Source: Informal publication

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: Moderate

Utricularia inflata was introduced by human activities (Howard Morgan, 2011) and is currently found in a limited area in Washington (CPNWH, 2024; iNaturalist Community, 2024), suggesting that most water ways where this species occurs are currently fairly accessible.

Source: Informal publication, Herbarium records and other observations

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: Moderate

Public objection to treating this species seems unlikely, particularly since it can contribute to degradation of recreation opportunities on the waterbodies where it occurs (Smith, 2007). Draining occupied areas to eliminate *U. inflata* populations could potentially be unpopular, but this suggestion is also less appealing for other reasons (see Q26). The most likely objection to management comes from generalized opposition to herbicide use, particularly in aquatic systems.

Source: Informal ublication, Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Verbascum blattaria (Moth Mullein)

Assessed by
Carlo Abbruzzese (Natural Areas Manager, Washington Dept. of Natural Resources)
4 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (13) Confidence: **Moderate** (50)

Management Difficulty Rank: Insignificant (9)	Confidence: High (70)
Biological Characteristics of Invasiveness: Insignificant (23)	Confidence: Moderate (46)
Concern Related to Distribution and Abundance: High (70)	Confidence: Low (30)

Photo Credit: Photo by iNaturalist observer sanderee2, 2024, used under Creative Commons license (iNaturalist Community, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

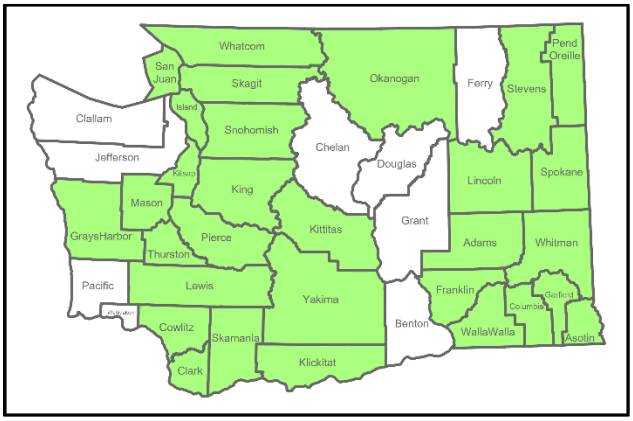

Figure 1. Distribution of counties where *Verbascum Blattaria* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: Moderate

Verbascum blattaria is documented in 77% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other records

Q2: Current Trend in Total Range

Rating: Unknown

Confidence: Not Rated

This species may be slowly spreading to new areas.

Source: Professional expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Not Rated

Confidence: Not Rated

Source:

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

The assessor has observed this species slowing increasing in Clark County.

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Grassland & Shrubland, Emergent Open Wetland

Rating: Moderate

Confidence: Moderate

May also infrequently occur in forested wetlands.

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: No

Confidence: Moderate

This species doesn't seem to produce high seed numbers.

Source: Professional expertise

Q7: Innate Potential for Long-Distance Dispersal

Rating: No

Confidence: Moderate

Source: Professional expertise

Q8: Potential to be Spread by Human Activities

Rating: Unknown

Confidence: Not Rated

Source:

Q9: Allelopathy

Rating: No

Confidence: Moderate

Source: Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Low

This species is likely not a strong competitor, relying more on disturbance.

Source: Professional expertise

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Low

This species likely requires bare soil for germination.

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: Moderate

Verbascum thapsus (Giant mullein) is listed as invasive by the Colorado Department of Agriculture (CDA, 2023), and is tracked by the Oklahoma Invasive Plant Council (OkIPC, 2024) and the Texas Invasive Species Institute (2024). Unofficial sources also treat this species as an invasive (e.g., Remaley, 2009).

Verbascum thapsus is also introduced in the Pacific Northwest but is usually not considered invasive and is not tracked by any states in the region. British Columbia lists this species a nuisance, but not in need of management (Center for Invasive Species and Ecosystem Health, 2025).

Source: Informal publication, Professional expertise

Q14: Shade Tolerance

Rating: Low/Insignificant

Confidence: Moderate

This plant is likely shade intolerant.

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: High

Verbascum blattaria requires disturbance such as fire to establish but does not appear to gain a significant competitive advantage over native species following disturbance.

Source: Professional expertise

Q16: Propagule Persistence

Rating: >20 years

Confidence: High

At least some *Verbascum blattaria* seeds have been shown to remain viable for at least 120 years in controlled conditions (Telewski & Zeevaart, 2002).

Source: Published research

Q17: Palatability

Rating: Not Rated

Confidence: Not Rated

Source:

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: Moderate

This species sometimes forms groups that can crowd out other plants, but impact is likely minor.

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

This species could compete with natives but the impact is likely low.

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Unknown

Confidence: Not Rated

Source:

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

This plant is primarily found in ecosystems with naturally frequent fire regimes, such as prairies.

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: Moderate

This plant is both relatively uncommon and not seen as a priority for control. This species is easily controlled with herbicide where it occurs.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Veronica anagallis-aquatica (Water Speedwell)

Assessed by
Molly S. Wiebush, Washington Natural Heritage Program
30 September 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (29) Confidence: **Moderate** (50)

Management Difficulty Rank: Insignificant (25)	Confidence: Low (10)
Biological Characteristics of Invasiveness: High (74)	Confidence: Moderate (38)
Concern Related to Distribution and Abundance: Moderate (69)	Confidence: High (80)

Photo Credit: Keir Morse 2008, used under Creative Commons license (CalPhotos, 2024).

Plant Information

Whether or not *Veronica anagallis-aquatica* is introduced to North America is debated. However, this species is known to be introduced in at least some parts of the continent and it is easily spread by human activity (Albach, 2020). Most sources, including the Washington Flora Checklist, treat this species as introduced in Washington. At least some states treat this species as native and even of conservation concern: Nevada ranks it as Vulnerable (S3), Arkansas ranks it as Imperiled (S2), and North Carolina ranks it as Critically Imperiled (S1) (NatureServe, 2024). *Veronica anagallis-aquatica* can be difficult to distinguish from related species (Ellmouni et al., 2018; Hosseinnejad Azad et al., 2021).

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Section 1: Distribution and Abundance

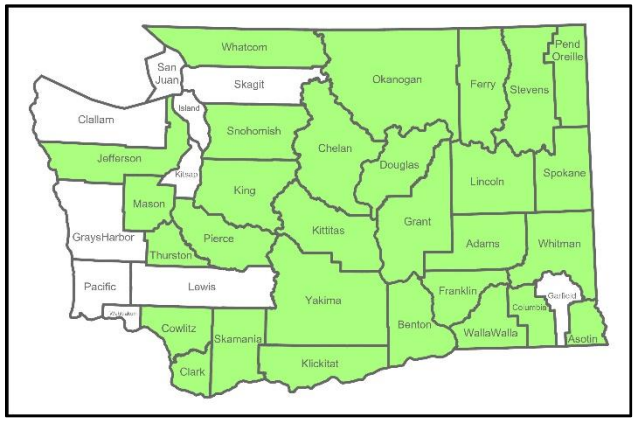

Figure 1. Distribution of counties where *Veronica anagallis-aquatica* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Score: High

Confidence: High

Veronica anagallis-aquatica is documented in 29 of 39 (74%) counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q2: Current Trend in Total Range

Score: Moderate

Confidence: High

Veronica anagallis-aquatica is most common east of the Cascades, however its range may have expanded in the Puget Basin in the last 20 years (CPNWH, 2024; iNaturalist Community, 2024).

Source: Herbarium records and other observations

Q3: Proportion of Potential Range Currently Unoccupied

Score: Low

Confidence: High

Veronica anagallis-aquatica is reported from 74% of counties in Washington. This species is a wetland obligate; in Washington it is found in ditches, canals, lake and river shores, wet meadows, and occasionally as mats of floating vegetation, suggesting it can establish under a variety of conditions (CPNWH, 2024). This species is likely capable of expanding into other counties in Washington.

Source: Herbarium records and other observations

Q4: Local Range Expansion or Change in Abundance

Score: Low

Confidence: Moderate

Based on observations and herbarium records, *Veronica anagallis-aquatica* may be increasing in abundance and expanding its range locally in Washington (CPNWH, 2024; iNaturalist Community, 2024). Records suggest this species is widespread, but only locally abundant in Washington.

Source: Herbarium records and other observations

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Emergent Open Wetland, Bogs & Fens, Forested Wetland, Shallow Water Wetland (Aquatic)

Score: High

Confidence: Moderate

Veronica anagallis-aquatica is an obligate wetland species. This species and its close relatives are phenotypically plastic, allowing it to grow under a wide range of conditions (Ellmouni et al., 2018). *Veronica anagallis-aquatica* frequently grows in water and has both emergent and submerged forms (Boeger & Poulson, 2003; Ellmouni et al., 2018). It is found in wet meadows and standing water, along streambanks and lakesides, and in slow streams, ditches, and irrigation channels (Wetherwax, 2012; Albach, 2020; CPNWH, 2024). This species has been found in a wide range of wetlands in Washington, including vernal pools and other seasonal wetlands, draw down areas of lakes, streams, and rivers, and floating vegetation mats, and on a wide range of substrates, including silt, muck, sand, and cobbles. *Veronica anagallis-aquatica* is frequently found in wetlands in sagebrush steppe and other arid areas, but is expanding into wetter west side habitats (CPNWH, 2024; iNaturalist Community, 2024). In its native

range, this species is also known from estuaries (Ribeiro et al., 2022), suggesting some salt tolerance.

Source: Published research, Professional expertise, Herbarium records and other observations, Flora of North America and Jepson treatments

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Score: Yes

Confidence: Low

Veronica anagallis-aquatica reproduces from seed, with reported germination rates between 50–100% (SID, 2023). This species can also reproduce vegetatively via rhizomes, stolons, and fragments (Riis et al., 2004; DiTomaso et al., 2013), but means of reproduction in this species are not very different from reproduction of co-occurring native species (Stromberg & Chew, 1997).

Sexual reproduction is usually by selfing, but *V. anagallis-aquatica* can also be pollinated by small insects. A study from Iran found an average of approximately 30–45 seeds per capsule in this species (Hosseinnejad Azad et al., 2021). Seed production information from invasive populations of *V. anagallis-aquatica* were not found. Plants have both emergent and submerged forms, but only emergent individuals can reproduce sexually (Boeger & Poulson, 2003).

A study from New Zealand found *V. anagallis-aquatica* to be a primary colonizer on bare sediment in streams, suggesting a high level of propagule production, strong dispersal abilities, and/or efficient establishment capabilities. This study also observed a high number of seedlings after *V. anagallis-aquatica* flowered, suggesting a high rate of germination (Riis et al., 2004).

Source: Published research, Informal publication, Seed Information Database

Q7: Innate Potential for Long-Distance Dispersal

Score: Yes

Confidence: Moderate

Veronica anagallis-aquatica propagules can be transported by water, and its seeds germinate readily (Boeger & Poulson, 2003; DiTomaso et al., 2013). A study from New Zealand found *V. anagallis-aquatica* to be a primary colonizer on bare sediment in streams, suggesting strong dispersal abilities, or efficient establishment capabilities (Riis et al., 2004).

Source: Published research, Informal publication

Q8: Potential to be Spread by Human Activities

Score: Yes

Confidence: High

Veronica anagallis-aquatica is easily transported by human activity, particularly in mud attached to shoes or equipment (Albach, 2020; Hosseinnejad Azad et al., 2021).

Source: Published research, Flora of North America treatment

Q9: Allelopathy

Score: Yes

Confidence: Low

Veronica anagallis-aquatica has a history of use as a medicinal plant and produces saponins, among many other secondary compounds, which may be allelopathic (Coelho et al., 2010; Shahzad et al., 2011). However, no sources directly addressed allelopathy or chemical defenses in this species.

Source: Published research, Professional expertise

Q10: Competitive for Limiting Abiotic Factors

Score: Yes

Confidence: Low

In a study from New Zealand, this species became dominant when establishing on bare substrate and prevented other species from establishing, suggesting that it is capable of outcompeting co-occurring species (Riis et al., 2004).

Source: Published research

Q11: Growth Form

Score: No

Confidence: Low

Veronica anagallis-aquatica is capable of growing in dense stands, and can impede stream flow (DiTomaso et al., 2013). While no information was available on *V. anagallis-aquatica*'s effects on light availability, emergent plants can shade out aquatic plants (Riis et al., 2004).

Source: Published research, Informal publication

Q12: Germination Requirements

Score: Unknown

Confidence: Not Rated

No information was found on *Veronica anagallis-aquatica*'s ability to germinate without disturbance providing an open substrate.

Source:

Q13: Invasiveness of Other Plants in Genus

Score: Yes

Confidence: Moderate

Veronica is a genus of over 400 species with a wide range of life histories. Many species of *Veronica* are described as weedy (Ellmouni et al., 2018). While *Veronica anagallis-aquatica* is not designated as an invasive species in North America, it is designated as invasive in Japan (Saito & Kadono, 2021), demonstrating the ability to become invasive under the right conditions. *Veronica beccabunga* has also been introduced to North America, but has not spread significantly; it may be unable to establish where the closely related native *Veronica americana* is present (Ellmouni et al., 2018).

Source: Published Research

Q14: Shade Tolerance

Score: Moderate

Confidence: High

Veronica anagallis-aquatica is frequently observed in full sun, but at least some observations in Washington are from partial shade or in areas shaded by other plants (CPNWH, 2024). A study from Idaho on the morphological differences between emerged and submerged *V. anagallis-aquatica* found that above water leaves were morphologically similar to terrestrial species adapted to full sun, and submerged leaves were morphologically similar to shade-adapted species (Boeger & Poulson, 2003). This suggests that *V. anagallis aquatica* is adaptable to both sunny and partially shaded conditions.

Source: Published research, Herbarium records

Q15: Disturbance Tolerance

Score: Yes

Confidence: High

In Washington, *Veronica anagallis-aquatica* occurs with increaser (e.g., *Typha latifolia*) or invasive species (particularly *Phalaris arundinacea*), and in draw down areas of lakes and streams, wet ditches, irrigation channels, disturbed soil, wet areas in degraded shrub steppe, and areas of heavy cattle grazing (CPNWH, 2024). It was also an early colonizer of disturbed areas in studies from New Zealand (Riis et al., 2004).

Source: Published research, Herbarium records

Q16: Propagule Persistence

Score: <5 years

Confidence: Low

Little information is available on seed longevity, but they are not expected to remain in the seed bank for more than a few years (DiTomaso et al., 2013).

Source: Informal publication

Q17: Palatability

Score: No, plant is palatable

Confidence: Moderate

This plant has historically been used as both food and medicine by humans (Shahzad et al., 2011). Grazer desirability is unknown.

Source: Published research

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: Nutrient dynamics, Light availability, Chemistry

Score: Low

Confidence: Moderate

Occasionally, dense stands of *Veronica anagallis-aquatica* may impede stream flow (DiTomaso et al., 2013). *Veronica anagallis-aquatica* is potentially an effective bioaccumulator, with studies showing that it can immobilize metals such as cadmium and lead (Ribeiro et al., 2022). This species is also capable of removing nitrates from eutrophic water sources (Bannister et al., 2021). It also potentially reduces light availability for aquatic species (Riis et al., 2004). *Veronica anagallis-aquatica*'s ability to uptake heavy metals and excessive nitrates could potentially have a positive effect on abiotic processes, and several studies have been done to test the potential of this species for phytoremediation (e.g., Ribeiro et al., 2022).

Source: Published research

Q19: Impact on Ecosystem Structure

Score: Insignificant

Confidence: High

Little information was available on how *Veronica anagallis-aquatica* might impact ecosystem structure. Dense stands of *V. anagallis-aquatica* may at least occasionally impede stream flow (DiTomaso et al., 2013) and emergent plants can shade out submerged or aquatic plants (Riis et al., 2004). However, any minor structural impacts from *V. anagallis-aquatica* are likely to be short-lived.

Source: Published research, Informal publication, Professional expertise

Q20: Impact on Ecosystem Composition

Score: Low

Confidence: High

Little information was available on *Veronica anagallis-aquatica*'s impact on ecosystem composition. It may shade out aquatic vegetation in some ecosystems (Riis et al., 2004), potentially reducing species diversity. However, *V. anagallis-aquatica* is often observed in naturally low-diversity ecosystem types (such as Columbia Plateau Basin Marshes).

Source: Published research, Professional expertise

Q21: Impact on Particular Native Species

Score: Unknown

Confidence: Not Rated

Veronica anagallis-aquatica has been studied as a bioaccumulator and can immobilize heavy metals such as cadmium. This could potentially have a negative effect on species that feed on *V. anagallis-aquatica* and concentrate heavy metals up the food chain (Ribeiro et al., 2022).

A study in Japan found potential pollinator competition between *V. anagallis-aquatica* and a co-occurring native *Veronica* species (Saito & Kadono, 2021), though more research is needed to conclusively show that pollinator competition was the factor resulting in decreased seed set in both species.

Source: Published research

Q22: Observed Ability to Invade Undisturbed Ecosystems

Score: Low

Confidence: Moderate

This plant is occasionally observed in laggs surrounding bogs, but generally only when hydrological conditions have been altered. It may establish in relatively undisturbed aquatic systems. However, this species is most frequent in naturally disturbed ecosystems such as riparian areas, or basin marshes that have large water-level fluctuations.

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Score: Yes

Confidence: High

This species is common in naturally and anthropogenically disturbed wetlands. A study testing colonization of stream channels in New Zealand found that *Veronica anagallis-aquatica* was one of the first colonizers and remained the dominant species for the first 60–80 weeks in artificial stream reaches (simulating reaches disturbed by floods). This study started with bare substrate, and all propagules arrived from upstream (Riis et al., 2004).

Source: Published research, Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Score: Unknown

Confidence: Not Rated

Very little information was available on the treatment of *Veroncia anagallis-aquatica* populations. Mechanical removal techniques such as pulling require care not to disperse plant fragments, which can start new populations. Herbicides have not been tested for this species, but herbicides that are effective against other *Veronica* species are likely to also work on *V. anagallis-aquatica* (DiTomaso et al., 2013).

Source: Informal publication

Q25: Minimum Time Commitment

Score: Unknown

Confidence: Not Rated

No information was available on the amount of time treatment of *Veronica anagallis-aquatica* populations might take. A general minimum time for treatment is the lifespan of the propagules, which is likely less than five years, but other factors, such as likelihood of reinvasion from other source populations, is also important to consider.

Source:

Q26: Impacts of Management on Native Species

Score: Unknown

Confidence: Not Rated

No information was available on the effects treatment of *Veronica anagallis-aquatica* might have on native species. Herbicides are likely the most effective treatment available for this species (DiTomaso et al., 2013). Effects of herbicide treatment on co-occurring species likely depend on if herbicide application can be targeted to just *V. anagallis-aquatica* or not. Reduction in *V. anagallis-aquatica* populations could have positive effects on neighboring native plants, potentially reducing pollinator interference (Saito & Kadono, 2021) and competition for light (Riis et al., 2004).

Source: Published research, Informal publication

Q27: Inaccessibility of Invaded Areas

Score: Low

Confidence: Low

This plant can spread easily in riparian systems, so at least some populations are likely difficult to access.

Source: Professional expertise

Q29: Sociopolitical Implications of Management

Score: Insignificant

Confidence: Moderate

Objections to potential management are unlikely, aside from generalized skepticism of herbicides (particularly in wetland and aquatic systems).

Source: Professional expertise

Additional Comments

None

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Washington Invasive Ranking System

Washington Natural Heritage Program

Veronica arvensis (Corn Speedwell)

Assessed by
Regina Johnson (Assistant Natural Areas Ecologist, Westside, Washington Dept. of Natural Resources)
4 December 2024 (WIRS Version 1.5)

Ecological Impact Rank: **Insignificant** (12) Confidence: **Moderate** (67)

Management Difficulty Rank: Insignificant (0)	Confidence: High (100)
Biological Characteristics of Invasiveness: Low (40)	Confidence: Moderate (38)
Concern Related to Distribution and Abundance: Moderate (56)	Confidence: High (70)

Photo Credit: Steve Matson 2008, used under Creative Commons license (CalPhotos, 2024).

Ranking Notes

Rapid assessment only, based primarily on professional expertise.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

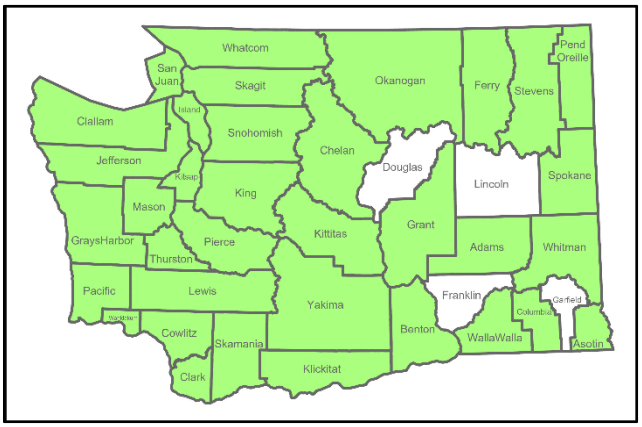

Figure 1. Distribution of counties where *Veronica arvensis* has been documented in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Q1: Current Range Size in Washington

Rating: High

Confidence: High

Veronica arvensis is documented in 90% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Source: Professional expertise, Herbarium records and other observations

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Q2: Current Trend in Total Range

Rating: Low

Confidence: Moderate

Source: Professional Expertise

Q3: Proportion of Potential Range Currently Unoccupied

Rating: Low

Confidence: Moderate

Source: Professional Expertise

Q4: Local Range Expansion or Change in Abundance

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q5: Diversity of Ecosystems Invaded

Ecosystem types: Forest & Woodland, Grassland & Shrubland

Rating: Low

Confidence: High

Source: Professional expertise

Section 2: Biological Characteristics

Q6: Aggressive Mode of Reproduction

Rating: Unknown

Confidence: Not Rated

Source:

Q7: Innate Potential for Long-Distance Dispersal

Rating: Unknown

Confidence: Not Rated

Source:

Q8: Potential to be Spread by Human Activities

Rating: Yes

Confidence: Moderate

Source: Professional expertise

Q9: Allelopathy

Rating: Unknown

Confidence: Not Rated

Source:

Q10: Competitive for Limiting Abiotic Factors

Rating: No

Confidence: Moderate

This species comes up pretty early in spring, but it is likely too small and low in cover to seriously deplete soil moisture.

Source: Professional Expertise

Q11: Growth Form

Rating: No

Confidence: High

Source: Professional expertise

Q12: Germination Requirements

Rating: No

Confidence: Moderate

Source: Professional expertise

Q13: Invasiveness of Other Plants in Genus

Rating: Yes

Confidence: High

Source: Professional expertise

Q14: Shade Tolerance

Rating: Moderate

Confidence: Moderate

Source: Professional expertise

Q15: Disturbance Tolerance

Rating: No

Confidence: Moderate

Commonly establishes following disturbance, but does not appear to gain a competitive advantage from it.

Source: Professional expertise

Q16: Propagule Persistence

Rating: Unknown

Confidence: Not Rated

Source:

Q17: Palatability

Rating: Yes, plant is unpalatable

Confidence: Low

Small size makes it unlikely to be grazed.

Source: Professional expertise

Section 3: Ecological Impact

Q18: Impact on Ecosystem Abiotic Processes

Abiotic Processes: None listed

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q19: Impact on Ecosystem Structure

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q20: Impact on Ecosystem Composition

Rating: Low

Confidence: Moderate

Source: Professional expertise

Q21: Impact on Particular Native Species

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q22: Observed Ability to Invade Undisturbed Ecosystems

Rating: Insignificant

Confidence: Moderate

Source: Professional expertise

Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Rating: Yes

Confidence: High

Source: Professional expertise

Section 4: Management Difficulty

Q24: General Management Difficulty

Rating: Insignificant

Confidence: High

This species is not targeted for management.

Source: Professional expertise

Q25: Minimum Time Commitment

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q26: Impacts of Management on Native Species

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q27: Inaccessibility of Invaded Areas

Rating: Insignificant

Confidence: High

Source: Professional expertise

Q28: Sociopolitical Implications of Management

Rating: Insignificant

Confidence: High

This species is not targeted for management.

Source: Professional expertise

Additional Comments

None

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WASHINGTON NATURAL HERITAGE PROGRAM

The Washington Invasive Ranking System (Version 1.5)

Prepared by
Tynan Ramm-Granberg,
Irene Weber, & Molly S. Wiebush

Natural Heritage
Report 2024-12

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

The Washington Invasive Ranking System

Version 1.5

Washington Natural Heritage Program Report Number: 2024-12

December 31, 2024

Prepared by:
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ON THE COVER: A selection of the ~1200 nonnative plant species established in Washington State: *Typha angustifolia* (Narrowleaf cattail, photo by Thurman Johnson, https://www.inaturalist.org/observations/171511373), *Prunus mahaleb* (Perfumed cherry, photo by Tynan Ramm-Granberg), Bromus tectorum (Cheatgrass, photo by Thurman Johnson, https://www.inaturalist.org/observations/186062175), Utricularia inflata (Swollen bladderwort, photo by Tynan Ramm-Granberg). iNaturalist photos used under creative commons license: https://creativecommons.org/licenses/by-nc/4.0/ .

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Dr. Matt Carlson (Director, Alaska Center for Conservation Science) gave excellent advice and the methods published here borrow heavily from the Invasiveness Ranking System for Non-native Plants of Alaska (Carlson et al., 2008).

We could not have completed this protocol without the contributions of our scientific advisory panel. In particular, Dr. David Giblin (Collections Manager for the University of Washington Burke Herbarium), Dr. Walter Fertig (Collections Manager for the Washington State University Marion Ownbey Herbarium), David Wilderman (Natural Areas Program Ecologist, Washington Department of Natural Resources), and Joe Rocchio (Natural Heritage Program Manager, Washington Department of Natural Resources) provided abundant feedback drawn from decades of experience.

Introduction

The need for a standardized list of invasive plant species for Washington State has long been recognized, particularly since the presence and abundance of invasive plants are some of the most frequently used measures in function and condition assessment tools (Hruby et al., 1999, 2000; Hruby & Stanley, 2000; Rocchio & Crawford, 2013; Hruby, 2014a, 2014b; Magee et al., 2019b, 2019a; Rocchio et al., 2020). Existing state lists of noxious weeds (Washington State Noxious Weed Control Board, 2020) and invasive species (Washington Invasive Species Council, 2020) serve valuable purposes, but incorporate economic impacts and other values that don't always identify the plant species that are most impactful to the ecology of natural ecosystems.

Beginning in 2021, The Washington Natural Heritage Program (WNHP) began work to assemble a consistent, defensible list of invasive plant species of Washington State for carrying out assessment, conservation, and restoration objectives. WNHP ecologists first reviewed existing invasive species ranking methods, including NatureServe's Invasive Species Assessment Protocol (Morse et al., 2004), the Invasiveness Ranking System for Nonnative Plants of Alaska (Carlson et al., 2008), the Plant Risk Evaluation tool (Conser et al., 2015), and many others (Hiebert & Stubbendieck, 1993a; Morse et al., 2004; Cal-IPC, 2006; Carlson et al., 2008; Jordan et al., 2008; Virtue et al., 2008; Magee et al., 2010; Auld & Johnson, 2014; D'hondt et al., 2015; Vanderhoeven et al., 2015; Lieurance & Flory, 2016; Roy et al., 2018; Bartz & Kowarik, 2019; González-Moreno et al., 2019; PPQ, 2019; Verbrugge et al., 2019; Vilà et al., 2019; Ries et al., 2020; Sohrabi et al., 2020; Clarke et al., 2021; Dorjee et al., 2021; Downey et al., 2022; Egawa & Matsuhashi, 2022). Following this review, we decided to adapt a new protocol that borrows largely from Morse et al. (2004) and Carlson et al. (2008).

The Washington Invasive Ranking System is a method for assessing the ecological impact of nonnative plant species in natural ecosystems of Washington State. The primary output of WIRS is an Ecological Impact rank, which indicates the degree of ecological degradation caused by a given plant in the ecosystems in which it is found. WIRS also produces supplementary information related to each plant's management difficulty, biological characteristics, and distribution and abundance.

Results from an initial application of the WIRS protocol to 71 plant taxa are presented in Ramm-Granberg & Wiebush (2024).

Methods

Overview

The Washington Invasive Ranking System produces an Ecological Impact rank and supplementary information through the following process:

- Two-question screening section (Is WIRS the appropriate tool for assessing this plant?)

- Ecological Impact Assessment
- Supplementary Information Sections:
    - Management Difficulty
    - Biological Characteristics
    - Distribution and Abundance
- Data integration workflow for instances when multiple assessments have been completed for a single plant
- Roll-up procedure

Appropriate Uses

The Washington Invasive Ranking System may be used to estimate the ecological impact of a given nonnative plant species in natural ecosystems of Washington State. It does not incorporate economic considerations such as agricultural impacts. Ranks should not be used in isolation to determine management actions. It may be necessary to combine Ecological Impact and with other tools that, for example, look more explicitly at the spatial distribution of infestations and defensible space (M. Carlson, pers comm).

Appropriate Assessors

Assessments are best performed by individuals with relevant professional expertise, particularly when assessing plant taxa for which there may be little formal, quantitative data. The most qualified assessors will have experience in diverse natural ecosystems across the state, though individuals with more localized experience may still contribute significant knowledge, particularly to the Management Difficulty section.

In trial runs of the protocol, WNHP used a crowd-sourced approach that resulted in few outside assessments. In a typical application, Washington Natural Heritage Program (WNHP) staff complete all sections of the assessment and then conduct targeted expert interviews to discuss the most subjective sections: Ecological Impact and Management Difficulty. If the WNHP staff do not have the first-hand expertise to provide initial scores for these sections, they instead walk the consulted expert through those sections and use the expert's ratings. Afterwards, WNHP sends the assessment (or batch of assessments) to a scientific advisory panel for peer-review.

Taxonomic Considerations

Hybrids should be assessed separately from parent species whenever feasible, as they may have different biological characteristics, ecological impacts, etc. In cases where taxonomy is uncertain, however, hybrids and their parent species may be assessed as a single unit. Cultivars should be treated similarly.

Subspecies, varieties, and forms should be assessed at the species level, with the exception of species that contain native and nonnative subtaxa or genotypes. For example, *Poa pratensis* contains both native and nonnative subspecies, so *Poa pratensis* ssp. *pratensis* (nonnative) should be assessed at the subspecies level.

Data Collection

WNHP staff use a custom Survey123 form to complete assessments. Readers interested in adapting these methods to their geography may reach out via Natural_Heritage_Program@dnr.wa.gov for form templates.

Screening Questions

These questions are used to determine if this protocol is appropriate for the nonnative plant under consideration.

1. Is the nonnative plant established in Washington?
    a. "Established" means that the plant has been confirmed to occur within Washington State.
    b. For nativity, refer to the Washington Flora Checklist: https://burkeherbarium.org/waflora/search.php (Weinmann et al., 2002)
    c. If **Yes**, go to question 2. If **No**, this is not the appropriate assessment method.
2. Does the plant occur in natural ecosystems.
    a. We use "natural ecosystems" in the same sense as the EcoVeg approach (Faber-Langendoen et al., 2014) and others (van der Maarel, 2005) to describe vegetation that forms spontaneously and/or is dominated by ecological processes, as opposed to cultural vegetation that is planted and/or dominated by human processes (agricultural fields, lawns, etc.). "Natural ecosystems" include any vegetation type in the natural vegetation hierarchy of the US National Vegetation Classification (Faber-Langendoen et al., 2016; USNVC, 2023), including ruderal (i.e. "semi-natural") vegetation such as abandoned fields that eventually develop the character of natural stands. See Metric 5 in the "Distribution and Abundance" section below for a list of coarse ecosystem examples to consider.
    b. If **Yes**, proceed with the assessment. If **No**, this is not the appropriate assessment method.

NOTE: This method may also be used to assess species that are invasive in adjacent states (or other regions with similar climates, etc.) and likely to occur in WA, but it has only been tested on plants that have already established in Washington. It is a prioritization tool and not a prediction tool.

Assessment Metrics

For each metric, users will select a rating (generally either High, Moderate, Low, or Insignificant), specify that there is not enough information to assess the metric (Unknown), OR indicate that they have skipped it (Not Rated). To clarify further, "Unknown" indicates that the user considered the metric, looked for information, and was unable to find sufficient data with which to make an estimate, while "Not Rated" means that the user did not consider the metric. Users will record the source of the information guiding their rating decision, how confident they are in their rating, and any additional notes. No confidence rating is assigned if the metric rating is "Unknown" or "Not Rated".

Each metric is worth a specified number of points (from 1 to 18). Point distributions generally match the NatureServe (Morse et al., 2004) and Alaska (Carlson et al., 2008) methods from which most of the metrics originate. Point distributions in the Ecological Impact Assessment and elsewhere were adjusted to emphasize specific metrics, in consultation with the scientific advisory panel (see Release Notes).

Section 1: Distribution and Abundance

The first portion of the assessment evaluates the current distribution, range trends, and potential for spread of the nonnative plant within Washington. It asks the questions, "How common is this plant? Is it spreading or infilling? Is there any suitable habitat left where it does not occur? Does it occur in many different types of ecosystems?". This section does not contribute to the Ecological Impact rank, but is completed first as an information gathering exercise that sets the stage for the Ecological Impact Assessment. The Distribution and Abundance section consists of five metrics (Table 1).

Table 1. Washington Invasive Ranking System, Section 1: Distribution and Abundance

Q1: Current Range Size in Washington
Q2: Current Trend in Total Range
Q3: Proportion of Potential Range Currently Unoccupied
Q4: Local Range Expansion or Change in Abundance
Q5: Diversity of Ecosystems Invaded

Data Sources for Distribution and Abundance

The Washington State Department of Agriculture (WSDA) is the state repository for invasive species mapping information: https://agr.wa.gov/washington-agriculture/maps/weed-distribution. However, WSDA may not compile data for every plant we wish to rank. Additional sources may be consulted, including:

- Consortium of Pacific Northwest Herbaria -- https://www.pnwherbaria.org/data.php
- Early Detection and Distribution Mapping System (EDDMapS) -- https://www.eddmaps.org/distribution
- iNaturalist – https://www.inaturalist.org
    - The most efficient way to access research grade iNaturalist data is via the Global Biodiversity Information Facility (GBIF) -- https://www.gbif.org
- Washington Department of Ecology Lakes – Environmental Data -- https://apps.ecology.wa.gov/lakes

- Perhaps the most comprehensive and up-to-date distribution data for fully aquatic plants. Observations are updated more frequently than WSDA.

Range data sources used should be cited in the assessment.

Q1. Current Range Size in Washington (15 pts)

The first metric addresses the current geographic distribution of the plant in Washington. This refers to the "generalized" range of the plant. Counties have been the standard geographic unit to date, but future assessors may choose to use ecoregions or other biogeographic systems. This metric is based on the "Current Range Size in Region" and "Proportion of Region's Biogeographic Units Invaded" metrics in the NatureServe method (Morse et al., 2004).

Rating:

- **High**: Widespread in Washington (> 50% of counties or biogeographic units).
- **Moderate**: Range covers a substantial part of Washington (26-50% counties or biogeographic units).
- **Low**: Spotty range in Washington (5-25% of counties or biogeographic units).
- **Insignificant**: Isolated occurrences in Washington (≤ 5% of counties or biogeographic units) or not yet found in the state.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: See Data Sources for Distribution and Abundance (above).

Q2. Current Trend in Total Range (12 pts)

Is the plant spreading only in some areas—which may indicate an ecological constraint—or is it spreading somewhat indiscriminately across the state? This metric evaluates the spread into new counties, watersheds, or ecoregions in the last ~10-20 years. Increases in local abundance (infilling) or spread into new ecosystem types is addressed in subsequent metrics. This metric is based on the "Current Trend in Total Range Within The Region" metric in the NatureServe method (Morse et al., 2004) and "Recent trend in total area infested within state" in the California Invasive Plant Council (Cal-IPC) method (Cal-IPC, 2006).

Rating:

- **High**: Range consistently expanding, and/or spreading in most or all areas.
- **Moderate**: Range increasing in some areas but not most or all.
- **Low**: Range stable, or areas of range contraction balancing areas of expansion.
- **Insignificant**: Range decreasing.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Data availability for range trends is inconsistent across taxa. If you are aware of quantitative data for the plant being assessed, use that information to choose the appropriate rating.

However, clear trends are difficult to derive from collections, citizen science efforts, etc. Otherwise, direct observations/experience/professional judgment may be used.

Q3. Proportion of Potential Range Currently Unoccupied (3 pts)

How much of the potential generalized range in Washington is currently unoccupied? In other words, are there counties in WA where this plant does not yet occur, but are likely to be habitable? This metric assumes current climate and disturbance regimes. This protocol is *not* built to directly assess impacts of projected *future* climates. However, if the plant has the potential to be more/less impactful in specific scenarios, please describe this potential in the metric notes. This metric is directly adapted from the NatureServe method (Morse et al., 2004).

Rating:

- **High**: Less than 10% of potential range currently occupied.
- **Moderate**: 10-30% of potential range currently occupied.
- **Low**: 30-90% of potential range currently occupied.
- **Insignificant**: Greater than 90% of potential range currently occupied.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Consult the mapping resources listed above and incorporate your direct observations/experience/professional judgment to generate an estimate. Some species may have published habitat suitability/potential range models to draw from (e.g., *Tamarix ramosissima*).

Q4. Local Range Expansion or Change in Abundance (12 pts)

Is the plant increasing in abundance (i.e., infilling as measured by cover, density, frequency, etc.) *within* its current range in Washington based on trends of the past 10-20 years? Users may report specific areas of rapid expansion/abundance increase in the notes field. This metric is directly adapted from the NatureServe method (Morse et al., 2004).

Rating:

- **High**: Local range and/or abundance is increasing rapidly (e.g., the area covered within occupied counties has doubled in the last 10 years) and/or abundance is increasing significantly (by >25%) in >75% of the area that it has invaded.
- **Moderate**: Local range and/or abundance is expanding at a moderate rate (e.g., the area covered within occupied counties has increased by >50% in the last 10 years) and/or abundance is increasing significantly (by >25% of current values) in 25%-75% of the area that it has already been invaded.
- **Low**: Local range within occupied counties is expanding slowly and/or abundance is increasing significantly (by >25% of current values) in only a small portion (<25%) of the areas that have already been invaded.
- **Insignificant**: Species abundance and local range is stable within occupied counties OR all potential habitat is already invaded.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Data availability for local abundance trends is inconsistent across taxa. If you are aware of quantitative data for the plant being assessed, use that information to choose the appropriate rating. Otherwise, direct observations/experience/professional judgment may be used.

Q5. Diversity of Ecosystems Invaded (3 pts)

How many of the ecosystem types listed below are known or likely to be invaded by this plant under normal circumstances? Plants that have previously invaded a diverse assortment of ecosystems are more likely to invade new types to which they spread. Ecosystems in which the plant is only sporadically present, or in which the plant is only found along trails/roadsides/etc. should not be counted. USNVC National Vegetation Classification Subbiomes are the standard classification unit. This metric is based on the "Diversity of Habitats or Ecological Systems Invaded in Region" metric in the NatureServe method (Morse et al., 2004) and "Ecological amplitude" in Cal-IPC (2006).

Ecosystems (USNVC Subbiomes):

Uplands

- Forest & Woodland
- Grassland & Shrubland
- Semi-desert (Shrub-steppe + Semi-desert grasslands)
- Alpine & Tundra
- Marine Coastal Shore (Shrublands & Grasslands)
- Open Rock

Wetlands

- Emergent Open Wetland (Freshwater Marsh, Wet Meadow & Shrub Wetlands + Inland Salt Marshes)
- Coastal Brackish Tidal Wetland (Salt Marsh)
- Bog & Fen
- Forested Wetland
- Marine Seagrass & Kelp Bed
- Shallow Water Wetland (Aquatic Vegetation)

Rating:

- **High**: Many (4+) distinct ecosystems invaded.
- **Moderate**: Moderate number (3) of distinct ecosystems invaded OR both wetland and upland ecosystems are invaded.
- **Low**: Small number (1-2) of ecosystems.
- **Insignificant**: Only ruderal/semi-natural ecosystems (e.g., old fields) are invaded.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Some plants may have detailed literature descriptions of the range of habitats in which they are found, but habitat descriptions are generally not comprehensive (e.g., descriptions of *Bromus tectorum* may mention invasion of shrub-steppe, but not dry grasslands and woodlands). Be sure to supplement any sources with your personal experience/observations/professional judgement. Collection records and other observations may also be consulted, although it may be difficult to determine whether the plant is only incidentally present and/or which USNVC Subbiome is represented.

Section 2: Biological Characteristics

This section evaluates traits that may allow the plant to disperse into, establish, and spread in natural areas. Such traits are commonly associated with "invasiveness" (Carlson et al., 2008). This section also contributes to the Ecological Impact rank when the confidence rank for that section is Low. In such cases, the biological characteristics of the plant help supplement the determination of likely ecological impact. See the "Calculating the Ecological Impact Rank" below. As with Distribution & Abundance, this section an information gathering exercise that sets the stage for the Ecological Impact Assessment. The Biological Characteristics section consists of 12 metrics (Table 2).

Table 2. Washington Invasive Ranking System, Section 2: Biological Characteristics.

Q6: Aggressive Mode of Reproduction
Q7: Innate Potential for Long-Distance Dispersal
Q8: Potential to be Spread by Human Activities
Q9: Allelopathy
Q10: Competitive for Limiting Abiotic Factors
Q11: Growth Form
Q12: Germination Requirements
Q13: Invasiveness of Other Plants in Genus
Q14: Shade Tolerance
Q15: Disturbance Tolerance
Q16: Propagule Persistence
Q17: Palatability

Data Sources for Biological Characteristics

There are many species abstract repositories that may be useful. A subset includes:

- The Fire Effects Information System -- https://www.feis-crs.org/feis/faces/index.xhtml
- The Alaska Center for Conservation Science (ACCS) Non-Native Plant Species List -- https://accs.uaa.alaska.edu/invasive-species/non-native-plant-species-list
- The Cal-IPC Inventory -- https://www.cal-ipc.org/plants/inventory/

Data sources used should be cited as part of each relevant metric in the assessment.

Q6. Aggressive Mode of Reproduction (3 pts)

Does the plant spread rapidly via vegetative reproduction, produce many seeds, or otherwise have any combination of traits listed below? This metric is based on the "Mode of reproduction" metric in the Alaska method (Carlson et al., 2008) and the Southwest Exotic Plants system (Hiebert & Stubbendieck, 1993b), "Reproductive Characteristics" from the NatureServe method (Morse et al., 2004), "Innate reproductive potential" from Cal-IPC (2006), and several propagule/reproduction-related metrics in the Australian Weed Risk Assessment model (WRA) (Pheloung et al., 1999a) and California's Plant Risk Evaluation tool (PRE) (Conser et al., 2015). Additional background from Pysek (1997). The following reproductive characteristics are typical of invasive plants:

- Produces over 1,000 seeds or spores per plant annually.
- Reproduces more than once per year.
- Grows more rapidly to reproductive maturity than most plants of its lifeform.
- Reproduces readily both vegetatively and by seed or spores.
- Has quickly spreading rhizomes or stolons that may root at nodes.
- Resprouts readily when broken, cut, grazed, or burned.
- Fragments easily, with fragments capable of dispersing and establishing.
- Has other comparable reproductive factors suggesting potential aggressiveness

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q7. Innate Potential for Long-Distance Dispersal (3 pts)

Does the plant have an innate potential for long-distance dispersal, regardless of human intervention? Examples of innate long-distance dispersal mechanisms include fleshy fruits that promote bird dispersal, barbs or other mechanisms that stick to animal hair, buoyant seeds that facilitate water dispersal, awns that facilitate wind dispersal, etc. This metric is based on the "Innate potential for long-distance dispersal" metric in the Alaska method (Carlson et al., 2008), "Long-Distance Dispersal Potential Within Region" from the NatureServe method (Morse et al., 2004), and several dispersal related metrics in WRA (Pheloung et al., 1999a). Additional background from Rejmánek & Richardson (1996).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q8. Potential to be Spread by Human Activities (3 pts)

Is the plant likely to be spread either directly or indirectly by human activities? Possible mechanisms include commercial sales, use as forage, revegetation projects, spread along highways, transport via agricultural activities or contaminated boats, etc. This metric is based on the "Potential to be spread by human activities" metric in the Alaska method (Carlson et al., 2008), "Potential for human-caused dispersal" from Cal-IPC (2006), and "Propagules dispersed intentionally by people" in WRA (Pheloung et al., 1999a). Additional background from: (Mack, 2000; Kolar & Lodge, 2001; Rejmánek, 2001; Mack & Erneberg, 2002).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q9. Allelopathy (1 pt)

Is the plant known to be allelopathic, providing a competitive advantage and making it more likely to cause long term ecosystem alterations? The term "allelopathic" is used here in a broad sense to refer to any plant that adds harmful chemical agents to the environment. If the plant produces compounds that are thought to be allelopathic, but allelopathy has yet to be demonstrated for this taxon, select "Yes" and "Low Confidence". This metric is adapted from the Alaska method (Carlson et al., 2008), WRA (Pheloung et al., 1999a), and PPQ (2019). It is also similar to "Excretes salts or toxins" in the US Environmental Protection Agency's Index of Alien Impact (Magee et al., 2010).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review (unlikely to be reliably determined by direct experience/observations).

Q10. Competitive for Limiting Abiotic Factors (4 pts)

Is the plant competitive for limited water or nutrients in its environment (abiotic factors). Competitive advantages may be gained through efficient use of limited abiotic factors, accessing water or nutrients that are inaccessible to other plants (e.g., deep tap root), timing (e.g., winter annuals or evergreens taking advantage of moist conditions when other species may remain dormant), or other means. If the plant is a nitrogen fixer, select "Yes". Competition for sunlight is addressed in the following metric. This metric is based on the "Competitive ability" metric in the

Alaska method (Carlson et al., 2008) and the Southwest Exotic Plants system (Hiebert & Stubbendieck, 1993b). Additional background from Pheloung et al. (1999b).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q11. Growth Form (2 pts)

Does the plant form dense thickets, have a climbing or smothering growth habit, or otherwise outcompete native vegetation for sunlight for extended periods of time? Some exotic plant populations establish as a dense flush, but are relatively quickly replaced by other species, such plants are not considered to have an invasive growth form in this assessment and should be rated as "No". This metric is based on the "Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation" metric in the Alaska method (Carlson et al., 2008), "Does this plant overtop and/or smother surrounding vegetation?" and "Does the plant produce impenetrable thickets, blocking or slowing movement?" in PRE (Conser et al., 2015), and "Climbing or smothering growth habit" in WRA (Pheloung et al., 1999a) and PPQ (2019). Additional background from: (Rejmanek & Richardson, 1996; Goodwin et al., 1999).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q12. Germination Requirements (3 pts)

Is this plant able to germinate without natural or anthropogenic disturbance providing open soil? Select "Yes" if this species may germinate in natural ecosystems in a variety of conditions. Select No if this species only germinates amid other vegetation in a narrow range of conditions. This metric is based on the "Germination requirements" metric in the Alaska method (Carlson et al., 2008) and the Southwest Exotic Plants system (Hiebert & Stubbendieck, 1993b) and "Ability to establish without anthropogenic or natural disturbance" in Cal-IPC (2006).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q13. Invasiveness of Other Plants in Genus (3 pts)

Are there other nonnative plants in this genus that are invasive in Washington or other non-native regions where they are found? You may also consider whether there are plants in this genus that are *native* to Washington, but invasive in other locales. Similarly, consider other plants in this genus that act as native increasers (i.e., "native invasives", aggressive natives, successful competitors) (Richardson et al., 2000). If other plants in this genus have been rated using this protocol, consider an Ecological Impact rank of Moderate or higher to be "invasive" for the purposes of this metric. If the plant is a monotypic species (i.e., the only species in the genus) select "Not Rated". This metric is based on the "Other species in the genus invasive in Alaska or elsewhere" metric in the Alaska method (Carlson et al., 2008) and "Are other species of the same genus invasive in other areas with a similar climate?" in PRE (Conser et al., 2015). Additional background from Rejmánek (1999).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement. Assessments of other species in the genus using this protocol.

Q14. Shade Tolerance (2 pts)

Is the plant able to persist under closed overstory canopies? This metric is based on the "Is a shade tolerant plant at some stage of its life cycle" metric in WRA (Pheloung et al., 1999a), "Wide light regime" in the EPA Index of Alien Impact (Magee et al., 2010), and "Shade tolerant at some stage of life cycle" in PPQ (2019).

Rating:

- **High**: Shade tolerant and persists under closed overstory canopies.
- **Moderate**: Tolerates partial shade.
- **Low/Insignificant**: Shade intolerant and does not persist under closed overstory canopies.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q15. Disturbance Tolerance (2 pts)

Is the plant's response to disturbance markedly different than other plants in the same ecosystem? Does that response provide a competitive advantage? For example, does this plant resprout readily following fires, while native plants in the ecosystem do not? This metric is based on the "Tolerates or benefits from mutilation, cultivation or fire" metric in WRA (Pheloung et al., 1999a) and "Is

the plant noted as being highly flammable and/or promotes fire and/or changes fire regimes?" in PRE (Conser et al., 2015).

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgement.

Q16. Propagule Persistence (3 pts)

How long do seeds (or other reproductive structures such as vegetative propagules) of this plant persist? This metric is based on the "Seed banks" and "Vegetative regeneration" metrics in the Alaska method (Carlson et al., 2008), "Evidence that a persistent ([1 year) propagule bank (seed bank) is formed" in PPQ (2019), "Dispersal over time" in the EPA Index of Alien Impact (Magee et al., 2010), and "Evidence that a persistent propagule bank is formed" in WRA (Pheloung et al., 1999a). Additional background from Auld & Johnson (2014).

Rating:

- **>20 years**
- **>10 years**
- **>5 years**
- **<5 years**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Most likely from a literature review, but potentially observable via direct experience.

Q17. Palatability (1 pt)

Is this plant unpalatable to most grazing/browsing animals for all or part of its lifespan? Plants with low palatability are likely to increase under grazing pressure. Unpalatability may be due to coarseness, poison, thorns, etc. Select "Yes" if the plant is only eaten under extreme circumstances, such as targeted invasive species treatments with goats. Management implications of palatability are considered in the Management Difficulty metrics below. This metric is based on the "Grazing tolerant or increaser" metric in the EPA Index of Alien Impact (Magee et al., 2010) and "Unpalatable to grazing animals" in WRA (Pheloung et al., 1999a).

Rating:

- **Yes, the plant is unpalatable.**
- **No, the plant is palatable.**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review (range management documents are often useful) and direct experience/observations/professional judgement.

Section 3: Ecological Impact Assessment

This section evaluates the impact of the plant on ecosystem structure, composition, abiotic processes, and individual species, as well as the observed ability of the plant to invade natural ecosystems. Because the Washington Invasive Ranking System focuses on the observed impact of nonnative species on biodiversity and ecosystem condition, this section is the core of the assessment. For plants that receive a Low confidence rank in Ecological Impact, the Biological Characteristics section is also factored in. See "Calculating the Ecological Impact Rank" (below) for more information. The Ecological Impact section consists of six metrics (Table 3).

Table 3. Washington Invasive Ranking System, Section 3: Ecological Impact.

Q18: Impact on Ecosystem Abiotic Processes
Q19: Impact on Ecosystem Structure
Q20: Impact on Ecosystem Composition
Q21: Impact on Particular Native Species
Q22: Observed Ability to Invade Undisturbed Ecosystems
Q23: Observed Ability to Invade Naturally Disturbed Ecosystems

Data Sources for Ecological Impact

This section relies heavily on the user's "best professional judgment", but journal articles, grey literature, and species abstracts like those found on the Fire Effects Information System (https://www.feis-crs.org/feis/faces/index.xhtml) may be useful for drawing ecological connections. Other sources noted in the Biological Characteristics section may also be useful.

Data sources used should be cited as part of each relevant metric in the assessment.

Q18. Impact on Ecosystem Abiotic Processes (9 pts)

What is the impact of the plant on abiotic processes and attributes in the ecosystem? Some nonnative plants can alter the natural range and variability of ecosystem processes and attributes in ways that impact the survival and reproduction of native species. This metric is based on the "Impact on Ecosystem Processes and System-Wide Parameters" metric from the NatureServe method (Morse et al., 2004), "Impact on abiotic ecosystem processes (e.g. hydrology, fire, nutrient cycling)" in Cal-IPC (2006), "Change ecosystem processes and parameters that affect other species" in PPQ (2019), "Effect on natural processes and character" in the Southwest Exotic Plants system (Hiebert & Stubbendieck, 1993b), and "Impact on Natural Ecosystem Processes" in the Alaska method (Carlson et al., 2008).

Examples of abiotic ecosystem processes and attributes include:

- Fire – Does the plant alter the occurrence, frequency, and/or intensity of fire?
- Geomorphology – Does the plant alter erosion or sedimentation rates, as in stabilization of mobile dunes by *Ammophila arenaria*?
- Hydrology – Does the plant impact the hydrologic regime/water table, e.g., lowering water levels in wetland systems through rapid transpiration.
- Nutrient Dynamics – Does the plant impact nutrient cycling in the ecosystem? For example, nonnative nitrogen-fixing plants that invade ecosystems with few native nitrogen fixers can increase soil nitrogen to the benefit of other nonnative invaders.
- Light Availability – Does invasion by this plant produce a stand-wide reduction in light availability? For example, some aquatic plants may cover entire bodies of water that may otherwise be open. Invasive trees may alter the light availability in the understory.
- Chemistry – Does invasion by the plant change soil or water pH or electroconductivity?

Rating:

- **High**: The plant causes major, potentially irreversible, alteration or disruption of abiotic ecosystem processes and attributes.
- **Moderate**: Moderate impacts to abiotic ecosystem processes and attributes.
- **Low**: Perceivable, but minor impacts to abiotic ecosystem processes and attributes.
- **Insignificant**: No measurable impact on abiotic ecosystem processes and attributes.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgment.

Q19. Impact on Ecosystem Structure (12 pts)

What is the impact of the plant on ecosystem structure? This metric is directly adapted from the NatureServe method (Morse et al., 2004). Additional background from: (Cal-IPC, 2006; Carlson et al., 2008; PPQ, 2019).

Examples of structural changes include:

- Conversion of grasslands to shrublands, shrublands to forests, aquatic vegetation to emergent marshes, etc. See the list of USNVC Subbiomes in Q5.
- Changes in canopy structure that alter or eliminate understory vegetation.
- Creation of a new vegetation layer or elimination of an existing layer.
- Changes in density or total cover.

Rating:

- **High**: The plant causes major alterations to ecosystem structure, such as conversion to a different USNVC Subbiome.
- **Moderate**: Moderate structural alterations, such as conversion from bunchgrass-dominated to rhizomatous grassland or development of an additional vegetation layer/subcanopy.
- **Low**: Minor structural impacts, such as changes in density or total cover with a given vegetation layer.
- **Insignificant**: No impact. The plant establishes within existing vegetation layers without altering structure.
- **Unknown**: Not enough information.

- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgment.

Q20. Impact on Ecosystem Composition (9 pts)

What is the impact of the plant on the species composition of the ecosystem? Some nonnative plants impact the relative abundance and diversity of native species or alter successional patterns. This metric is directly adapted from the NatureServe method (Morse et al., 2004). Additional background from: (Cal-IPC, 2006; Carlson et al., 2008; Conser et al., 2015).

Examples of compositional changes include:

- Reduction or extirpation of native plant, animal, fungal, or other species through increased shade, competition, allelopathy, or other means.
- Elimination or reduction in cover of diagnostic dominant plant species.
- Reduced native species diversity.
- Increased proportion of other nonnative plants in the ecosystem.
- Suppression of successional/climax species.

Rating:

- **High**: The plant has major impacts on ecosystem composition, such as elimination of diagnostic dominant plant species or significant reduction in native species diversity.
- **Moderate**: Moderate compositional impacts, such as reduction in the cover of diagnostic dominant species or moderate reduction in native species diversity.
- **Low**: Observable but minor compositional impacts, such as reduced recruitment of one or more diagnostic dominant species, likely resulting in reduction in long-term abundance of that species, or minor reduction in native species diversity.
- **Insignificant**: No impact. No known alterations to species composition, cover, diversity, etc.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgment.

Q21. Impact on Particular Native Species (3 pts)

Does the plant disproportionately negatively impact particular native plant, animal, fungal, or other species (at least at some sites)? Such impacts may occur even if alterations to broader ecosystem structure or composition are minimal. Note that this metric focuses on unusual, disproportionate impacts on individual native species, and should not be used to catalog long lists of species that are more generally impacted in rough proportion to the local abundance of the nonnative plant. For many plants, individual impacts will be "Unknown". This metric is based on the "Impact on Individual Native Plant or Animal Species" metric from the NatureServe method (Morse et al., 2004), and several separate metrics in the Harmonia+ method (D'hondt et al., 2015).

Examples of disproportionate individual impacts to one or more native species include:

- Strong competition with a particular native species.
- Hybridization with a particular native species.

- Parasitism upon a particular native species.
- Poisoning of a particular native species.
- Serving as a host for nonnative diseases that impact a particular native species.
- Distraction of pollinators that would otherwise interact with a particular native species.

Rating:
- **High**: The plant has major, disproportionate negative impacts on one or more particular native species.
- **Moderate**: Moderate negative impacts on one or more particular native species.
- **Low**: Occasional negative impacts on one or more particular native species. Some native species may experience positive impacts.
- **Insignificant**: Rare or no negative impacts on particular native species (or impacts are generally positive).
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Most likely from a literature review, but potentially observable via direct experience.

Q22. Observed Ability to Invade Undisturbed Ecosystems (15 pts)

Has the plant been observed to invade relatively undisturbed, mature natural vegetation with intact substrates? Plants rated highly in this metric typically have a "competitive" evolutionary strategy (Grime, 1977). This metric is related to other metrics such as "Germination Requirements", but is less theoretical—the focus here is on observed invasion of relatively intact ecosystems. This metric is based on the "Inherent Ability to Invade Conservation Areas and Other Native Species Habitats" metric from the NatureServe method (Morse et al., 2004) and "Invades in absence of human disturbance" from the EPA Index of Alien Impact (Magee et al., 2010).

Rating:
- **High**: The plant regularly establishes and persists in undisturbed, otherwise healthy, late-successional or mature native vegetation with intact substates.
- **Moderate**: Occasionally establishes and persists in mid-successional native vegetation, but may establish in late-successional or mature vegetation following minor one-time or recurrent disturbances such as tree fall, social trails, or streambank erosion. The plant rarely establishes in undisturbed portions of intact, mature native vegetation.
- **Low**: Occasionally establishes and persists in areas where major natural or human-caused disturbance has occurred in the previous 20 years (e.g., fires, clearcuts, major windthrow, landslides, utility corridors, heavy grazing), but seldom if ever in undisturbed areas or areas with only minor disturbance.
- **Insignificant**: Not known to spread to and persist in conservation areas or other native ecosystems on its own.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgment. Potentially supplemented by precise mapping data (see Section 1), collections, or citizen science observations.

Q23. Observed Ability to Invade Naturally Disturbed Ecosystems (3 pts)

Has the plant been observed to invade ecosystems that are naturally maintained by regular disturbance? Many ecosystems in Washington experience regular disturbance when operating within their natural range of variability. Natural disturbances may include fire (e.g., grasslands), flooding (e.g., riparian systems), landslides (e.g., cliff vegetation and landslide forests), avalanches (e.g., subalpine shrublands), shifting sand (e.g., coastal dune vegetation), and others. Nonnative plants that invade and persist under such disturbance regimes typically have a "ruderal" evolutionary strategy (Grime, 1977). Invasion of anthropogenically disturbed ecosystems is *not* considered here. This metric is very similar to the previous one, but the focus here is on observed invasion of ecosystems operating within naturally frequent disturbance regimes.

Rating:

- **Yes**
- **No**
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Literature review and direct experience/observations/professional judgment. Potentially supplemented by precise mapping data (see Section 1), collections, or citizen science observations.

Section 4: Management Difficulty

Unlike similar protocols, management difficulty is separated from ecological impact in this protocol and reported as a separate rank. The assessment of management difficulty consists of five metrics (Table 4).

Table 4. Washington Invasive Ranking System, Section 4: Management Difficulty

Q24: General Management Difficulty
Q25: Minimum Time Commitment
Q26: Impacts of Management on Native Species
Q27: Accessibility of Invaded Areas
Q28: Sociopolitical Implications of Management

Data Sources for Management Difficulty

As with the Ecological Impact section, the Management Difficulty section relies heavily on the user's "best professional judgment", but the Fire Effects Information System (https://www.feis-crs.org/feis/faces/index.xhtml) often has valuable information about control methods and difficulty. Other resources such as the Washington Noxious Weed Control Board's species abstracts (https://www.nwcb.wa.gov/) and the Pacific Northwest Weed Management Handbook (https://pnwhandbooks.org/weed) may also be useful.

Data sources used should be cited as part of each relevant metric in the assessment.

Q24. General Management Difficulty (18 pts)

How difficult is it to control an established stand of this plant with the management methods and tools that are currently available? Consider both the difficulty of control and the state of knowledge regarding the management of the plant. Potential unavailability of some methods/tools for social or other reasons is addressed in the "Sociopolitical Implications of Management" metric below. This metric is directly adapted from the NatureServe method (Morse et al., 2004). Additional background from: (Hiebert & Stubbendieck, 1993a; Pheloung et al., 1999a; Carlson et al., 2008).

Rating:

- **High**: Control of this plant typically requires a major, long-term investment of human and/or financial resources OR is not possible with available technology and knowledge.
- **Moderate**: Control requires a major, short-term investment of human and/or financial resources, or a moderate long-term investment.
- **Low**: Control is relatively easy and inexpensive, requiring only a minor investment of human and/or financial resources.
- **Insignificant**: Active management/control is unnecessary. For example, it does not persist in the absence of ongoing human disturbance.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Direct experience/observations/professional judgment and literature review.

Q25. Minimum Time Commitment (15 pts)

What is the minimum time commitment needed to control this plant? For this exercise, assume a 1-hectare (~2.5 acre) site in which it is abundant or well-established. Include time for the initial survey, follow-up treatments, focused monitoring, and ecosystem restoration. For this metric, "control" is defined as a reduction to acceptable levels that can be maintained with little effort beyond ambient monitoring (i.e., the native ecosystem is on a stable restoration trajectory). With some exceptions, the minimum time commitment typically cannot be shorter than the length of time that the plant's propagules remain viable (see Q16). This metric is directly adapted from the NatureServe method (Morse et al., 2004). Additional background from: (Pheloung et al., 1999a; Carlson et al., 2008).

Rating:

- **High**: Control of this plant requires at least 10 years OR is only possible with constant management (this may be due to persistence or near-constant reintroduction) OR is not possible with available technology and knowledge.
- **Moderate**: Control requires 5-10 years.
- **Low**: Control requires 2-5 years.
- **Insignificant**: Control can usually be accomplished within 2 years OR active management/control is unnecessary.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Direct experience/observations/professional judgment and literature review.

Q26. Impacts of Management on Native Species (15 pts)

What is the degree of collateral damage (i.e., non-target damage) to native species when implementing effective management of this plant? This metric is directly adapted from the NatureServe method (Morse et al., 2004).

Rating:

- **High**: Collateral damage from management is often severe. The only effective methods for controlling this plant cause significant and persistent reductions in the abundance of native species >75% of the time.
- **Moderate**: Collateral damage from management is usually moderate. Effective control causes significant and persistent reductions in the abundance of native species 25-75% of the time.
- **Low**: Collateral damage from management is usually minor. Effective control causes significant and persistent reductions in the abundance of native species <25% of the time.
- **Insignificant**: Collateral damage from effective management is insignificant and/or rare OR causes only ephemeral reductions in the abundance of native species (lasting <2 years).
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Direct experience/observations/professional judgment and literature review.

Q27. Inaccessibility of Invaded Areas (3 pts)

How difficult is it to access invaded areas? Inaccessibility may be due to terrain (e.g., coastal bluffs), remoteness (e.g., roadless areas), deep water, or any other factors that make it difficult to initiate management. This metric does *not* address access difficulty caused by private property or other jurisdictional issues. This metric is directly adapted from the NatureServe method (Morse et al., 2004). Additional background from: (Hiebert & Stubbendieck, 1993a; Pheloung et al., 1999a).

Rating:

- **High**: Accessibility problems are significant. Many invaded areas (hundreds of thousands of acres, or >30% of the infested area) are not accessible for treatment.
- **Moderate**: Accessibility problems are moderate. A substantial percentage of the area invaded by this plant is inaccessible (tens of thousands of acres, or 5-30% of the infested area).
- **Low**: Accessibility problems are minor. Only a small percentage of the area invaded by this plant is inaccessible (thousands of acres or <5% of the infested area).
- **Insignificant**: Accessibility is not a problem. Little or none of the infested area is inaccessible.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Direct experience/observations/professional judgment and literature review, supplemented by data sources from the Distribution and Abundance section.

Q28. Sociopolitical Implications of Management (6 pts)

Are there social, political, cultural, economic, or other non-ecological complications that impact one's ability to implement management of this plant? For example, land managers may receive pushback from the public when managing ornamental or fruit-bearing plants, or plants that are

useful for forage/grazing. Similarly, there may be public objection to intensive herbicide treatment of highly visible populations (more common with foliar application than with other methods such as cut-stump). This metric addresses public opposition to management—the human impact on spread and cultivation of the plant is considered in the "Potential to be Spread by Humans" metric.

Rating:

- **High**: Management is very difficult to initiate or maintain due to public opposition. Treatment is opposed in most areas and is not restricted to specific locales or highly visible populations.
- **Moderate/Low**: There is some public opposition to management, but it may be limited to specific locales (e.g., public lands with grazing leases) or highly visible populations (e.g., an escaped ornamental in a public park). Treatment may still be initiated with sufficient public engagement and remains possible in other areas without engagement.
- **Insignificant**: There is little or no public opposition to treatment.
- **Unknown**: Not enough information.
- **Not Rated**: Did not consider this metric.

Data Sources: Direct experience/observations/professional judgment and literature review.

Outputs

Ecological Impact Rank

The Washington Invasive Ranking System (WIRS) assesses nonnative plants relative to their impact on biodiversity and ecosystem condition. The primary output of WIRS is an Ecological Impact rank, which indicates the degree of ecological degradation caused by a given plant in the ecosystems in which it is found.

Calculating the Ecological Impact Rank

Each metric has a maximum possible score (1 to 18), with each potential rating a proportionate amount of that maximum. For example, the potential ratings for a hypothetical metric worth 15 points may be "high" (15 points), "moderate" (10 points), "low" (5 points), and "insignificant" (0 points). Points for each metric rating are summed and divided by the points possible in that section (Unknown and Not Rated metrics are excluded) to determine the overall score.

Assessors also assign a confidence rating to each metric (Metric Unknown or Not Rated = 0 pts, Low = 0 pts, Moderate = 1 pt, High = 2 pts). Points for each confidence rating are summed and divided by the points possible for that section. Unknown and Not Rated metrics are included for the calculation of confidence because they represent uncertainty about the plant. Additionally, if Q22 is "unknown" or "not rated" or if Q18, Q19, AND Q20 are Unknown or Not Rated, then the Ecological Impact confidence rank is automatically set to Low.

Calculation of the Ecological Impact score/rank depends on the confidence in the Ecological Impact metric ratings. If the overall confidence in the Ecological Impact metric ratings is Moderate to High, then the calculation is simply the total points from rated metrics divided by the total points possible (Unknown and Not Rated metrics are excluded) (Table 5, Figure 1). If the confidence

rating for the Ecological Impact metric ratings is Low, we average that calculation with the overall score from the Biological Characteristics section.

Table 5. Overview of Ecological Impact score calculation. Calculation varies depending on confidence ratings and the number of unrated metrics in the Ecological Impact Assessment. Scores are then converted to ranks: ≤ 30% = Insignificant Impact, 31-50% = Low Impact, 51-70% = Moderate Impact, >70% = High Impact.

Calculating the Ecological Impact Rank	
Ecological Impact Metric	**Points Possible**
Q18: Impact on Ecosystem Abiotic Processes	9
Q19: Impact on Ecosystem Structure	12
Q20: Impact on Ecosystem Composition	9
Q21: Impact on Particular Native Species	3
Q22: Observed Ability to Invade Undisturbed Ecosystems	15
Q23: Observed Ability to Invade Naturally Disturbed Ecosystems	3
Ecological Impact Calculation (Option 1)	
Is Q18, Q19, OR Q20 rated? **Is Q22 rated?** **Is overall confidence for Q18:23 Medium or High?**	
Yes to all of the above	**No to one or all of the above**
Sum of Q18:Q23 Ratings / Sum of Q18:23 Points Possible [Rated Metrics Only]	Complete Biological Characteristics section and recalculate below
Biological Characteristics Metric	**Points Possible**
Q6: Aggressive Mode of Reproduction	3
Q7: Innate Potential for Long-Distance Dispersal	3
Q8: Potential to be Spread by Human Activities	3
Q9: Allelopathy	1
Q10: Competitive for Limiting Abiotic Factors	3
Q11: Growth Form	2
Q12: Germination Requirements	3
Q13: Invasiveness of Other Plants in Genus	3
Q14: Shade Tolerance	2
Q15: Disturbance Tolerance	2
Q16: Propagule Persistence	3
Q17: Palatability	1
Ecological Impact Calculation (Option 2)	
Q18, Q19, and Q20 NOT rated **Q22 NOT rated** **Overall confidence for Q18:23 is Low**	
Sum of Q18:Q23 Ratings / Sum of Q18:23 Points Possible [Rated Metrics Only] * 0.5 + Sum of Q6:Q17 Ratings / Sum of Q6:17 Points Possible [Rated Metrics Only] * 0.5	

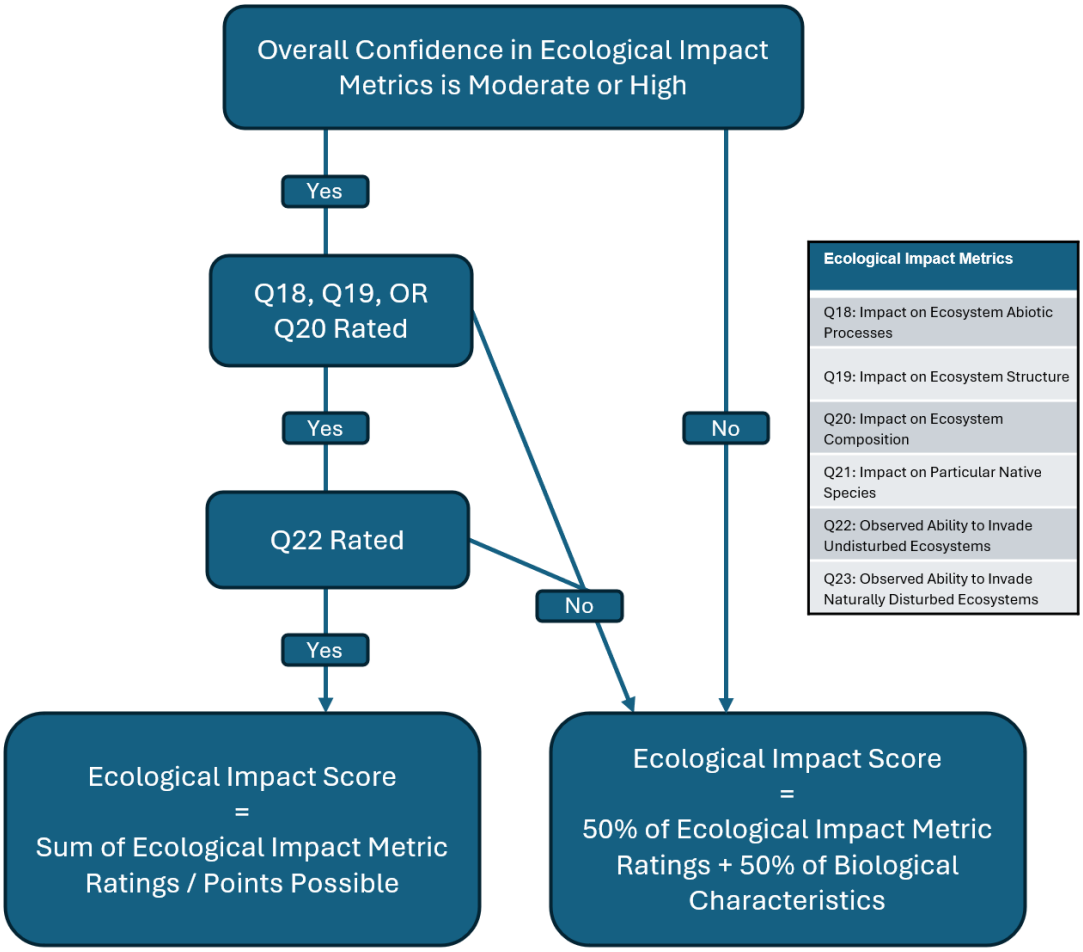


Figure 1. Flow chart demonstrating calculation of Ecological Impact rank. Scores are then converted to ranks: ≤ 30% = Insignificant Impact, 31-50% = Low Impact, 51-70% = Moderate Impact, >70% = High Impact.

Scores are converted to the following Ecological Impact ranks (rounded to the nearest whole percentage point):

- ≤ 30 = Insignificant Impact
- 31-50 = Low Impact
- 51-70 = Moderate Impact
- >70 = High Impact

Confidence scores are converted to the following confidence ranks (rounded to the nearest .01%):

- 0-33.33 = Low
- 33.34-66.66 = Moderate
- >66.66 = High

Note that the divisions between these ranks (modified slightly from Morse et al. (2004)) are largely arbitrary. The conversion to ranks, however, may help ameliorate the false sense of precision provided by numerical scores derived from largely qualitative data.

Supplementary Information

WIRS also produces supplementary information related to each plant's management difficulty, biological characteristics, and distribution and abundance.

Management Difficulty Rank

Some plants may cause significant ecological impacts if left unchecked, but are relatively easy to control, while others require major investments of time and resources to control—or may be impractical to control at all. The assessment of management difficulty provides another means of prioritizing action among exotic plants that may have the same ecological impact. For example, land managers with limited resources may choose to target a plant species with a high ecological impact but a low management difficulty. On the other hand, managers may choose to target plant species with high management difficulty while populations are small, to avoid costly and/or impractical interventions down the line.

Biological Characteristics of Invasiveness

This result synthesizes the number of traits a plant has that may allow it to disperse into, establish, and spread in natural ecosystems. It may be appropriate to maintain vigilance for plants that have high Biological Characteristics of Invasiveness but are not yet well-established in the region. This section contributes to the overall Ecological Impact rank only when the confidence in Ecological Impact is Low.

Concern Related to Distribution and Abundance

As noted above, this result basically synthesizes "How common is this plant? Is it spreading or infilling? Is there suitable habitat left where it does not occur? Does it occur in many different types of ecosystems?". While it does not contribute to the Ecological Impact rank, information provided here may prove useful in prioritizing between similarly impactful plants at a statewide level. For example, a land management agency may choose to focus management on a plant with a High Ecological Impact rank but for which there is Low Concern Related to Distribution and Abundance, as there will be comparatively few acres to treat.

Quality Control & Integration of Multiple Assessments

When submissions from outside parties are accepted, assessments are first screened to remove duplicate or repeat submissions from individual users. WNHP then reads through all submissions and removes those from users who appear to have misunderstood the protocol. This protocol provides flexibility to incorporate assessments from multiple individuals into a single aggregate assessment. When multiple assessments are integrated, there is an additional QA/QC step. If the spread in a section score for the different users is 20+ percentage points:

- Check that disagreement is due to diverging scores and not simply from a disproportionate number of "unknown" or "not rated" ratings on the part of one or more users.

- If disagreement remains, contact the assessors directly and discuss their scores to see if they still agree with their initial assessment.

- If disagreement remains, contact one or more additional experts—these can be from a scientific advisory panel, or other individuals—and walk them through that section of the protocol, essentially treating their ratings as an additional assessment/tie-breaker.

Following QA/QC, integration happens at the level of individual metrics, permitting the use of incomplete assessments. There is no change in the remainder of the roll-up procedure. Integration varies based on the type of metric:

Subjective Metrics

For metrics that involve substantial "professional judgement" or experience, we take the modal rating (when possible), unless one user clearly has more expertise. If there are fewer than three assessments, or if no rating has a majority, the median rating is used (again, unless one user clearly has more expertise). "Unknown" or "not rated" ratings are not included in these calculations (but do count against Confidence scores).

To calculate overall confidence for subjective metrics, we simply take the median confidence of the modal ratings. For example, consider a situation in which there are three ratings for a metric: "High" with High confidence, "High" with Low confidence, and "Insignificant" with High confidence. The modal rating is "High" and the confidence is then "Moderate" (median confidence of the modal ratings). When there is no modal rating, the median of all confidence values is used. Confidence scores calculated in this manner are rounded to the nearest whole number.

Relatively Objective Metrics

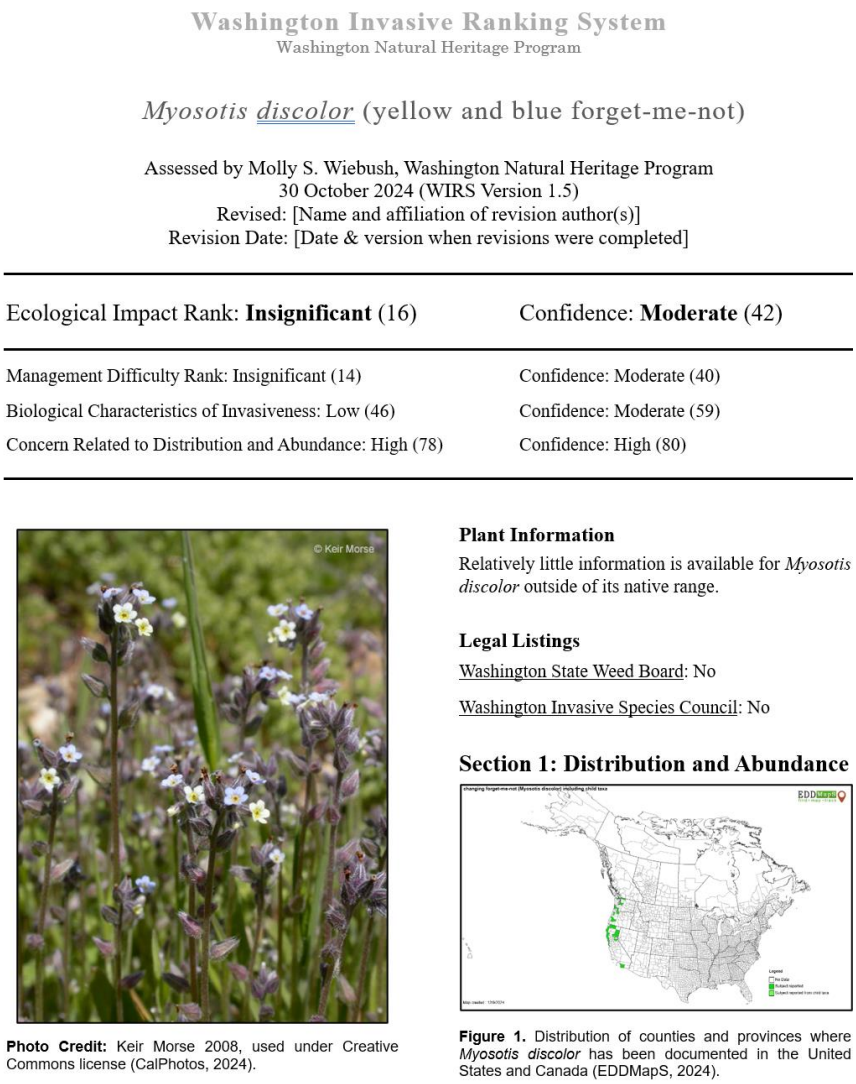
Some metrics—particularly in Section 2 (Biological Characteristics)—are relatively quantifiable and/or can be rated with a yes/no with some degree of certainty. For example, it's relatively straightforward to determine the longevity of plant propagules (Q16). When reviewing these metrics, we do not want to dilute the ratings of individuals who may have more information than the other assessors (e.g., they may be aware of recent research that shows greater longevity for the propagules of a given plant). We review all relatively objective metrics with disagreeing ratings and choose the one with the most supporting evidence. Overall confidence is calculated as the median of the confidence values associated with the chosen rating. Table 6 shows which metrics are considered subjective vs. objective in this context.

Table 6. Subjective v. Relatively Objective Metrics. This distinction impacts how ratings are integrated only when multiple users assess the same plant.

Metric	Type
Q1: Current Range Size in Washington	Relatively Objective
Q2: Current Trend in Total Range	Relatively Objective
Q3: Proportion of Potential Range Currently Unoccupied	Subjective
Q4: Local Range Expansion or Change in Abundance	Subjective
Q5: Diversity of Ecosystems Invaded	Relatively Objective
Q6: Aggressive Mode of Reproduction	Relatively Objective
Q7: Innate Potential for Long-Distance Dispersal	Relatively Objective
Q8: Potential to be Spread by Human Activities	Relatively Objective
Q9: Allelopathy	Relatively Objective
Q10: Competitive for Limiting Abiotic Factors	Subjective
Q11: Growth Form	Relatively Objective
Q12: Germination Requirements	Relatively Objective
Q13: Invasiveness of Other Plants in Genus	Relatively Objective
Q14: Shade Tolerance	Relatively Objective
Q15: Disturbance Tolerance	Relatively Objective
Q16: Propagule Persistence	Relatively Objective
Q17: Palatability	Relatively Objective
Q18: Impact on Ecosystem Abiotic Processes	Subjective
Q19: Impact on Ecosystem Structure	Subjective
Q20: Impact on Ecosystem Composition	Subjective
Q21: Impact on Particular Native Species	Relatively Objective
Q22: Observed Ability to Invade Undisturbed Ecosystems	Subjective
Q23: Observed Ability to Invade Naturally Disturbed Ecosystems	Subjective
Q24: General Management Difficulty	Subjective
Q25: Minimum Time Commitment	Relatively Objective
Q26: Impacts of Management on Native Species	Subjective
Q27: Accessibility of Invaded Areas	Relatively Objective
Q28: Sociopolitical Implications of Management	Subjective

Data Storage

The Washington Natural Heritage Program is responsible for maintaining a database of assessments that will be accessible online in early 2025 (https://www.dnr.wa.gov/natural-heritage-program). **Importantly, ranks are not static—they may change as new information is incorporated**. Each species will be labeled with its assessment date and date of any revisions. Revised species will be highlighted in the "What's New?" section of the WNHP website: https://www.dnr.wa.gov/natural-heritage-program. A page specific to the database will be live in early 2025. Besides the database, WNHP will also host Species Assessment Summaries for each plant assessed to date (Figure 2).



Washington Invasive Ranking System
Washington Natural Heritage Program

Myosotis discolor (yellow and blue forget-me-not)

Assessed by Molly S. Wiebush, Washington Natural Heritage Program
30 October 2024 (WIRS Version 1.5)
Revised: [Name and affiliation of revision author(s)]
Revision Date: [Date & version when revisions were completed]

Ecological Impact Rank: **Insignificant** (16)	Confidence: **Moderate** (42)
Management Difficulty Rank: Insignificant (14)	Confidence: Moderate (40)
Biological Characteristics of Invasiveness: Low (46)	Confidence: Moderate (59)
Concern Related to Distribution and Abundance: High (78)	Confidence: High (80)

Photo Credit: Keir Morse 2008, used under Creative Commons license (CalPhotos, 2024).

Plant Information

Relatively little information is available for *Myosotis discolor* outside of its native range.

Legal Listings

Washington State Weed Board: No

Washington Invasive Species Council: No

Section 1: Distribution and Abundance

Figure 1. Distribution of counties and provinces where *Myosotis discolor* has been documented in the United States and Canada (EDDMapS, 2024).

Figure 2. Species Assessment Summary screenshot.

Release Notes

Version 1.3.1 (November 27, 2023)

- Added Washington Department of Ecology's lakes environmental database as a potential resource for distribution data for aquatic plants
- Added Table of Contents and page numbers.

Version 1.4 (November 7, 2024)

- Minor citation corrections
- Following recent changes to the US National Vegetation Classification, this protocol now uses USNVC Subbiomes as the standard classification unit (See Q5).

Version 1.5 (December 31, 2024)

- Metric weighting changes [All reported Q #'s are current as of publication of Version 1.5]:
  - Q19 points possible increased from 9 to 12
  - Q21 points possible reduced from 9 to 3
  - Q22 points possible increased from 9 to 15
  - Q23 points possible reduced from 6 to 3
- Finalized integration methods for multiple assessments of the same plant
- Ecology section (Section 3) renamed "Ecological Impact". Ecological Impact rank no longer integrates Sections 1-3. Only integrates Section 2 when Section 3 confidence rank is Low.
- Ecology section (Section 3) confidence rank capped at Low if Q22 or Q18, Q19, AND Q20 are "unknown" or "not rated".
- Finalized QA/QC procedure for plants with large spread (20+ percentage points) in section ranks.
- "Unknown" and "not rated" metrics are now included in confidence calculations (both count as "low" confidence).
- Codified WNHP's roll in future assessments (WNHP staff will conduct majority of assessment and then conduct expert interviews, followed by a "gut check" style peer-review).
- Clarified that public objection to herbicide treatment may be considered in Q28.

- Former Q18 “Evergreen” merged into current Q10 “Competitive for Limiting Abiotic Factors”. Q10 points possible increased from 3 points to 4 points. All other Q#’s reduced by 1 relative to Version 1.4 and total number of metrics reduced from 29 to 28.

- Name of Q3 “Proportion of Potential Range Currently Occupied” changed to “Proportion of Potential Range Currently **Unoccupied**” to align with rating criteria and reduce user confusion.

- Name of Q27 “Accessibility of Invaded Areas” changed to “**Inaccessibility** of Invaded Areas” to align with rating criteria and reduce user confusion.

- Switched terminology from “Questions” to “Metrics”.

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Appendix A. WIRS Database

See accompanying Excel Workbook. Results (including individual Species Assessment Summaries) will also be posted online in early 2025 at: https://www.dnr.wa.gov/natural-heritage-program.

Assessors	**Taxon**	**Arid West Wetland Indicator Status**	**Western Mountains, Valleys, and Coast Wetland Indicator Status**
Walter Fertig, Clayton Antieau, David Wilderman	Acer negundo	FACW	FAC
Emily Stevenson, Walter Fertig, Ethan Coggins	Ailanthus altissima	FACU	FACU
Emily Stevenson	Alliaria petiolata	FACU	FACU
Carlo Abbruzzese	Alopecurus pratensis	FACW	FAC
Emily Stevenson, Walter Fertig	Amorpha fruticosa	FACW	FACW
Regina Johnson, Molly S. Wiebush	Anthoxanthum odoratum	FAC	FACU
Regina Johnson	Arrhenatherum elatius	UPL	UPL
Regina Johnson	Arum italicum ssp. italicum	UPL	UPL
Molly S. Wiebush	Arundo donax	FACW	FACW
Molly S. Wiebush	Bellardia viscosa	FAC	FAC
Regina Johnson	Bellis perennis	UPL	UPL

Regina Johnson	Betula pendula	FACU	FACU
Wesley Glisson	Butomus umbellatus	OBL	OBL
Molly S. Wiebush	Centaurea solstitialis	UPL	UPL
Emily Stevenson	Chondrilla juncea	UPL	UPL
Emily Stevenson, Ethan Coggins, Regina Johnson, Molly S. Wiebush	Cirsium arvense	FACU	FAC
Carlo Abbruzzese	Cirsium vulgare	FACU	FAC
Regina Johnson	Clematis vitalba	FAC	FAC
Regina Johnson	Cotoneaster spp.	UPL	UPL
Regina Johnson	Crataegus monogyna var. monogyna	FAC	FAC
Helen Lau, Molly S. Wiebush	Cynoglossum officinale	FACU	FACU
Regina Johnson, Carlo Abbruzzese	Dianthus armeria	UPL	UPL

Kimberly Quayle, Regina Johnson, Molly S. Wiebush	Dipsacus fullonum	FAC	FAC
Regina Johnson, Walter Fertig	Erechtites minimus	FACU	FACU
Emily Stevenson	Fallopia xbohemica	FACU	FACU
Regina Johnson	Hieracium pilosella	UPL	UPL
Molly S. Wiebush	Holcus lanatus	FAC	FAC
Molly S. Wiebush, Regina Johnson	Ilex aquifolium	FACU	FACU
Regina Johnson	Impatiens capensis	FACW	FACW
Emily Stevenson	Iris pseudacorus	OBL	OBL

Molly S. Wiebush	Jacobaea vulgaris	FACU	FACU
Carlo Abbruzzese	Juglans regia	UPL	UPL
Molly S. Wiebush	Juncus effusus subsp. effusus	FACW	FACW
Regina Johnson	Lamium galeobdolon	UPL	UPL
Regina Johnson	Lathyrus latifolius	UPL	UPL
Regina Johnson	Lathyrus sylvestris	UPL	UPL

Molly S. Wiebush	Leucanthemum vulgare	UPL	UPL
Emily Stevenson	Lysimachia nummularia	FACW	FACW
Kimberly Quayle, Regina Johnson	Lythrum salicaria	OBL	OBL
Ethan Coggins	Marrubium vulgare	FACU	FACU
Regina Johnson	Mycelis muralis	UPL	UPL
Molly S. Wiebush	Myosotis discolor	FAC	FAC
Wesley Glisson	Myriophyllum heterophyllum	OBL	OBL
Wesley Glisson	Myriophyllum spicatum	OBL	OBL
Regina Johnson	Nasturtium officinale	OBL	OBL
Emily Stevenson, Molly S. Wiebush, Regina Johnson	Phalaris arundinacea	FACW	FACW

Molly S. Wiebush	Phleum pratense	FACU	FAC
Regina Johnson	Plantago lanceolata	FAC	FACU
Regina Johnson	Poa annua	FAC	FAC
Wesley Glisson	Potamogeton crispus	OBL	OBL
Regina Johnson	Quercus robur	UPL	UPL
Regina Johnson	Rosa canina	UPL	UPL
Regina Johnson	Rosa multiflora	FACU	FACU
Regina Johnson	Rosa rugosa	UPL	UPL
Emily Stevenson, Regina Johnson, Molly S. Wiebush	Rubus bifrons	FAC	FAC

Carlo Abbruzzese	Rubus laciniatus	FACU	FACU
Carlo Abbruzzese	Rumex crispus	FAC	FAC
Regina Johnson	Sasa palmata	UPL	UPL
Regina Johnson	Schedonorus arundinaceus	FACU	FAC
Emily Stevenson	Schoenoplectus mucronatus	OBL	OBL
Regina Johnson	Senecio sylvaticus	UPL	UPL
Regina Johnson	Solanum dulcamara	FAC	FAC
Molly S. Wiebush	Solidago altissima	FACU	FACU
Carlo Abbruzzese	Spartina alterniflora	OBL	OBL
Molly. S. Wiebush	Tamarix ramosissima	FAC	FAC
Regina Johnson	Trifolium pratense	FACU	FACU
Regina Johnson	Trifolium subterraneum	UPL	UPL

Molly. S. Wiebush	Utricularia inflata	OBL	OBL
Carlo Abbruzzese	Verbascum blattaria	UPL	UPL
Molly S. Wiebush	Veronica anagallis-aquatica	OBL	OBL
Regina Johnson	Veronica arvensis	FACU	FACU

		Ecolo	
Life History	**Growth Habit**	**Ecological Impact Score**	**Ecological Impact Rank**
Perennial	Tree	50.00	Low
Perennial	Tree	68.75	Moderate
Annual	Forb	76.86	High
Perennial	Graminoid	62.50	Moderate
Perennial	Shrub	66.67	Moderate
Perennial	Graminoid	50.98	Moderate
Perennial	Graminoid	64.71	Moderate
Perennial	Forb	33.33	Low
Perennial	Graminoid	79.17	High
Annual	Forb	35.29	Low
Perennial	Forb	0.00	Insignificant

Perennial	Tree	37.50	Low
Perennial	Forb	78.43	High
Annual	Forb	82.35	High
Perennial	Forb	76.92	High
Perennial	Forb	74.51	High
Perennial	Forb	33.33	Low
Perennial	Vine	54.90	Moderate
Perennial	Shrub	49.02	Low
Perennial	Shrub	78.43	High
Biennial	Forb	60.42	Moderate
Annual	Forb	15.69	Insignificant

Biennial	Forb	68.75	Moderate
Annual	Forb	37.50	Low
Perennial	Forb	91.67	High
Perennial	Forb	50.00	Low
Perennial	Graminoid	58.82	Moderate
Perennial	Tree	88.24	High
Annual	Forb	39.22	Low
Perennial	Forb	82.35	High

Perennial	Forb	59.91	Moderate
Perennial	Tree	31.25	Low
Perennial	Graminoid	50.00	Low
Perennial	Forb	50.45	Low
Perennial	Forb	47.06	Low
Perennial	Forb	47.06	Low

Perennial	Forb	56.25	Moderate
Perennial	Forb	47.79	Low
Perennial	Forb	63.34	Moderate
Perennial	Forb	28.13	Insignificant
Annual	Forb	15.69	Insignificant
Annual	Forb	15.69	Insignificant
Perennial	Forb	85.42	High
Perennial	Forb	80.39	High
Perennial	Forb	62.50	Moderate
Perennial	Graminoid	81.25	High

Perennial	Graminoid	45.63	Low
Perennial	Forb	29.41	Insignificant
Annual	Graminoid	5.88	Insignificant
Perennial	Forb	72.92	High
Perennial	Tree	50.10	Low
Perennial	Shrub	60.42	Moderate
Perennial	Shrub	68.75	Moderate
Perennial	Shrub	47.92	Low
Perennial	Shrub	80.39	High

Perennial	Forb	58.96	Moderate
Perennial	Forb	5.88	Insignificant
Perennial	Graminoid	64.58	Moderate
Perennial	Graminoid	50.98	Moderate
Perennial	Graminoid	40.74	Low
Annual	Forb	5.88	Insignificant
Perennial	Forb	31.25	Low
Perennial	Forb	66.32	Moderate
Perennial	Graminoid	83.33	High
Perennial	Shrub	70.83	High
Perennial	Forb	37.50	Low
Annual	Forb	35.42	Low

Perennial	Forb	78.71	High
Perennial	Forb	12.50	Insignificant
Biennial	Forb	29.17	Insignificant
Annual	Forb	11.76	Insignificant

gical Impact Rank			Supplementary Information -->
Ecological Impact Score Calculation (Biological Characteristics are rolled in when Ecological Impact Confidence is Low)	**Ecological Impact Confidence Score**	**Ecological Impact Confidence Rank**	
Sum (Question 18 : Question 23)	54.17	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	8.33	Low	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	62.50	Moderate	
Sum (Question 18 : Question 23)	75.00	High	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	66.67	High	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	66.67	High	

Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	75.00	High	
Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	25.00	Low	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	66.67	High	
Sum (Question 18 : Question 23)	83.33	High	
Sum (Question 18 : Question 23)	66.67	High	
Sum (Question 18 : Question 23)	41.67	Moderate	
Sum (Question 18 : Question 23)	58.33	Moderate	

Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	75.00	High	
Sum (Question 18 : Question 23)	66.67	High	
Sum (Question 18 : Question 23)	41.67	Moderate	
Sum (Question 18 : Question 23)	75.00	High	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	41.67	Moderate	

Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	25.00	Low	
Sum (Question 18 : Question 23)	41.67	Moderate	
Sum (Question 18 : Question 23)	41.67	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	83.33	High	
Sum (Question 18 : Question 23)	83.33	High	

Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	41.67	Moderate	
Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	33.33	Low	
Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	33.33	Low	
Sum (Question 18 : Question 23)	83.33	High	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	41.67	Moderate	
Sum (Question 18 : Question 23)	91.67	High	
Sum (Question 18 : Question 23)	66.67	High	
Sum (Question 18 : Question 23)	58.33	Moderate	

Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	25.00	Low	
Sum (Question 18 : Question 23)	83.33	High	
Sum (Question 18 : Question 23)	100.00	High	
Sum (Question 18 : Question 23)	41.67	Moderate	
Sum (Question 18 : Question 23)	83.33	High	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	66.67	High	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	75.00	High	

Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	33.33	Low	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	75.00	High	
Sum (Question 18 : Question 23)	83.33	High	
Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	8.33	Low	
Sum (Question 18 : Question 23)	100.00	High	
Sum (Question 18 : Question 23)	66.67	High	
Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	33.33	Low	
Sum (Question 18 : Question 23)	58.33	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	58.33	Moderate	

Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	25.00	Low	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	50.00	Moderate	
Sum (Question 18 : Question 23)	66.67	High	

Management Difficulty Rank			
Management Difficulty Score	**Management Difficulty Rank**	**Management Difficulty Confidence score**	**Management Difficulty confidence rank**
54.39	Moderate	60.00	Moderate
45.61	Low	60.00	Moderate
92.98	High	60.00	Moderate
68.42	Moderate	60.00	Moderate
54.39	Moderate	50.00	Moderate
57.89	Moderate	60.00	Moderate
71.93	High	80.00	High
73.68	High	80.00	High
89.47	High	90.00	High
29.82	Insignificant	60.00	Moderate
0.00	Insignificant	100.00	High

26.32	Insignificant	70.00	High
73.68	High	80.00	High
63.16	Moderate	50.00	Moderate
68.42	Moderate	60.00	Moderate
57.89	Moderate	80.00	High
NA	NA	NA	NA
75.44	High	50.00	Moderate
12.28	Insignificant	80.00	High
84.21	High	100.00	High
57.89	Moderate	60.00	Moderate
0.00	Insignificant	100.00	High

66.67	Moderate	60.00	Moderate
2.38	Insignificant	20.00	Low
92.86	High	80.00	High
75.44	High	90.00	High
75.44	High	50.00	Moderate
75.44	High	60.00	Moderate
47.37	Low	70.00	High
57.89	Moderate	70.00	High

66.67	Moderate	40.00	Moderate
10.53	Insignificant	60.00	Moderate
49.12	Low	10.00	Low
92.98	High	80.00	High
70.18	Moderate	70.00	High
70.18	Moderate	70.00	High

91.23	High	80.00	High
44.44	Low	20.00	Low
84.21	High	60.00	Moderate
0.00	Insignificant	80.00	High
0.00	Insignificant	100.00	High
2.38	Insignificant	40.00	Moderate
68.42	Moderate	60.00	Moderate
57.89	Moderate	70.00	High
52.63	Moderate	50.00	Moderate
92.98	High	80.00	High

80.70	High	20.00	Low
0.00	Insignificant	100.00	High
0.00	Insignificant	100.00	High
NA	NA	NA	NA
15.79	Insignificant	100.00	High
63.16	Moderate	60.00	Moderate
35.09	Low	50.00	Moderate
28.07	Insignificant	90.00	High
73.68	High	70.00	High

47.37	Low	60.00	Moderate
1.75	Insignificant	90.00	High
57.89	Moderate	80.00	High
54.39	Moderate	80.00	High
72.22	High	20.00	Low
0.00	Insignificant	90.00	High
70.18	Moderate	60.00	Moderate
40.48	Low	30.00	Low
84.21	High	70.00	High
87.72	High	50.00	Moderate
15.79	Insignificant	90.00	High
61.40	Moderate	90.00	High

66.67	Moderate	10.00	Low
8.77	Insignificant	70.00	High
25.00	Insignificant	10.00	Low
0.00	Insignificant	100.00	High

Biological Characteristics of Invasiveness			
Biological Characteristics Score	**Biological Characteristics Rank**	**Biological Characteristics confidence score**	**Biological Characteristics confidence rank**
86.67	High	84.38	High
63.33	Moderate	69.79	High
96.15	High	59.38	Moderate
76.00	High	50.00	Moderate
76.00	High	70.83	High
56.67	Moderate	66.67	High
59.26	Moderate	75.00	High
65.38	Moderate	67.71	High
66.67	Moderate	91.67	High
78.57	High	54.17	Moderate
29.17	Insignificant	54.17	Moderate

61.54	Moderate	58.33	Moderate
100.00	High	4.16	Low
76.67	High	79.17	High
NA	NA	NA	NA
80.00	High	83.33	High
85.19	High	54.17	Moderate
82.61	High	63.54	Moderate
70.37	Moderate	43.33	Moderate
75.86	High	66.67	High
76.67	High	79.17	High
26.67	Insignificant	62.50	Moderate

75.86	High	83.33	High
64.00	Moderate	45.83	Moderate
NA	NA	NA	NA
73.33	High	83.33	High
70.00	Moderate	70.83	High
90.00	High	75.00	High
74.07	High	50.00	Moderate
77.78	High	75.00	High

76.67	High	70.83	High
44.00	Low	37.50	Moderate
86.67	High	76.04	High
91.30	High	63.54	Moderate
92.31	High	75.00	High
92.31	High	75.00	High

36.67	Low	66.67	High
70.59	High	37.50	Moderate
60.00	Moderate	58.33	Moderate
33.33	Low	66.67	High
55.00	Moderate	36.67	Moderate
33.33	Low	54.17	Moderate
NA	NA	NA	NA
92.29	High	66.67	High
88.89	High	70.83	High
83.33	High	79.17	High

43.33	Low	41.67	Moderate
46.15	Low	66.67	High
70.83	High	70.83	High
NA	NA	NA	NA
36.67	Low	66.67	High
70.83	High	71.88	High
70.37	Moderate	83.33	High
77.78	High	75.00	High
76.67	High	79.17	High

70.00	Moderate	58.33	Moderate
53.33	Moderate	75.00	High
59.26	Moderate	84.38	High
90.48	High	58.33	Moderate
NA	NA	NA	NA
72.00	High	75.00	High
69.23	Moderate	66.67	High
77.78	High	70.83	High
69.23	Moderate	66.67	High
70.00	Moderate	80.21	High
36.67	Low	75.00	High
44.44	Low	70.83	High

78.26	High	54.17	Moderate
23.08	Insignificant	45.83	Moderate
74.07	High	37.50	Moderate
40.00	Low	37.50	Moderate

Concern Related to Distribution and Abundance			
Distribution and Abundance Score	**Distribution and Abundance Rank**	**Distribution and Abundance confidence score**	**Distribution and Abundance confidence rank**
57.78	Moderate	60.00	Moderate
75.56	High	50.00	Moderate
72.73	High	30.00	Low
66.67	Moderate	40.00	Moderate
64.44	Moderate	70.00	High
77.78	High	90.00	High
73.33	High	70.00	High
62.22	Moderate	60.00	Moderate
52.38	Moderate	50.00	Moderate
64.44	Moderate	90.00	High
88.89	High	30.00	Low

75.56	High	80.00	High
61.90	Moderate	30.00	Low
62.22	Moderate	70.00	High
88.89	High	20.00	Low
48.89	Low	90.00	High
63.63	Moderate	50.00	Moderate
82.22	High	50.00	Moderate
82.22	High	60.00	Moderate
86.67	High	80.00	High
77.78	High	90.00	High
55.56	Moderate	60.00	Moderate

66.67	Moderate	80.00	High
86.67	High	80.00	High
88.89	High	20.00	Low
37.78	Low	70.00	High
86.67	High	100.00	High
93.33	High	80.00	High
75.56	High	50.00	Moderate
80.95	High	30.00	Low

86.67	High	90.00	High
72.73	High	30.00	Low
75.56	High	70.00	High
66.67	Moderate	60.00	Moderate
91.11	High	100.00	High
91.11	High	100.00	High

62.22	Moderate	80.00	High
66.67	Moderate	40.00	Moderate
64.44	Moderate	50.00	Moderate
75.56	High	40.00	Moderate
55.56	Moderate	80.00	High
77.78	High	80.00	High
37.78	Low	80.00	High
73.33	High	90.00	High
77.78	High	60.00	Moderate
75.56	High	90.00	High

77.78	High	80.00	High
55.56	Moderate	80.00	High
55.56	Moderate	70.00	High
93.94	High	60.00	Moderate
55.56	Moderate	70.00	High
77.78	High	50.00	Moderate
64.44	Moderate	50.00	Moderate
68.89	Moderate	60.00	Moderate
77.78	High	80.00	High

60.00	Moderate	40.00	Moderate
53.33	Moderate	50.00	Moderate
55.56	Moderate	100.00	High
73.33	High	60.00	Moderate
46.67	Low	50.00	Moderate
57.78	Moderate	80.00	High
93.33	High	90.00	High
51.52	Moderate	50.00	Moderate
20.00	Insignificant	80.00	High
75.56	High	70.00	High
55.56	Moderate	80.00	High
91.11	High	80.00	High

64.44	Moderate	60.00	Moderate
70.00	Moderate	30.00	Low
68.89	Moderate	80.00	High
55.56	Moderate	70.00	High

Notes and comments
Ranking Information and Additional Comments
Ailanthus altissima is the preferred host plant for the spotted lanternfly (Lycorma delicatula), which is a serious pest on tree fruit crops in the eastern U.S. (Washington Invasive Species Council, 2024).
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Arundo donax can be difficult to distinguish from Phragmites australis, which includes a native sub-species found in Washington (McWilliams, 2004). There is limited information on the behavior and impact of A. donax in Washington. Most of the information presented here comes from California.
Some sources still use the name Parentucellia viscosa for this species.
Rapid assessment only, based primarily on professional expertise.

Rapid assessment only, based primarily on professional expertise. Betula pendula is mostly an issue in disturbed areas, but the population is growing rapidly.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
This summary includes information about Cirsium vulgare that was originally included as part of the assessment of Cirsium arvense. Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise. Cotoneaster was assessed at the genus level because the species that occur in Washington all have similar traits, habitats, and ecological effects. All species of Cotoneaster in Washington are introduced.
Rapid assessment only, based primarily on professional expertise.
This plant is considered rare in parts of its native range (Williams & Fishman, 2014). Much of the biological and ecological information available for this species is from its native range (Europe and western Asia). Data and observations from native versus introduced ranges are distinguished, where possible.
Rapid assessments only, based primarily on professional expertise.

Recent genetic evidence suggests Dipsacus sativus is a distinct species, not a subspecies or variety of Dipsacus fullonum (Gaskin et al., 2024), but it is considered a synonym of D. fullonum in the Washington Flora (University of Washington Herbarium, 2018). Dipsacus sylvestris is a synonym for Dipsacus fullonum.
Rapid assessments only, based primarily on professional expertise. Some sources refer to this species as Erechtites minima or Senecio minimus (EDDMapS, 2024; iNaturalist Community, 2024).The Invasive Plants of California's Wildlands provides an excellent synthesis of information regarding this and related species in California (Cal-IPC, 2024).
Rapid assessments only, based primarily on professional expertise. Many closely related knotweeds (Fallopia) also have high ecological impacts.
Rapid assessments only, based primarily on professional expertise. The Washington State Weed Board tracks Hieracium subgenus Pilosella, which includes the species assessed in this document. Legal listings are tracked at the level of subgenus. Otherwise, the information in this document is provided at the level of species.
Ilex aquifolium escapes in the U.S. are domesticated cultivars, so information on species biology and ecology were taken from research done in the U.S., when possible. Studies from I. aquifolium's native range frequently target wildtype plants that are less competitive than cultivars bread by horticulturalists, meaning comparisons between the two populations may not be relevant (Valladares et al., 2005).
Rapid assessment only, based primarily on professional expertise. This species is native to the U.S. east of the Rocky Mountains.
Rapid assessments only, based primarily on professional expertise.

Rapid assessments only, based primarily on professional expertise.
Some taxonomists do not distinguish subspecies in the Juncus effusus aggregate (e.g., Brooks & Clemants, 2019), but experts in the Pacific Northwest find that characteristics of Juncus effusus ssp. effusus are reliably different from native subspecies of J. effusus (Zika, 2003). Subspecies-level information about J. effusus ssp. effusus was generally not available, though information from Europe likely addresses this subtaxon. Information from the eastern U.S. likely addresses Juncus effusus ssp. solutus, which is also introduced in the western U.S., but found in wetter habitats than J. effusus ssp. effusus (Zika, 2003).
Rapid assessments only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise. This species was assessed concurrently with Lathyrus sylvestris and much of the information is the same. Lathyrus latifolius and L. sylvestris have similar appearance, ecological impacts and management techniques, though L. latifolius is more common in Washington (R. Johnson, pers. comm. 2024).
Rapid assessment only, based primarily on professional expertise. This species was assessed concurrently with Lathyrus latifolius and much of the information is the same. Lathyrus latifolius and L. sylvestris have similar appearance, ecological impacts and management techniques, though L. latifolius is more common in Washington (R. Johnson, pers. comm. 2024).

It is possible that Leucanthemum vulgare may actually be a species complex (Clements et al., 2004). Aedes aegypti (an introduced mosquito that spreads yellow fever among other diseases) is attracted to Leucanthemum vulgare and may nectar on it (Clements et al., 2004). Male mosquitoes are nectar feeding pollinators.
Rapid assessment only, based primarily on professional expertise.
The Fire Effects Information System provides an excellent review of the state of knowledge regarding Lythrum salicaria, although information is only current as of 2002 (Munger, 2002).
Rapid assessment only, based primarily on professional expertise.
Relatively little information is available for Myosotis discolor outside of its native range
Biological characteristics section was not rated for this species.
Rapid assessment only, based primarily on professional expertise. Nasturtium officinale is considered noxious and/or invasive in 46 states (Moore, 2025).
There are at least 11 cultivars of Phalaris arundinacea. This species has a circumboreal distribution. While native to North America, it is likely that all populations present have experienced at least some gene flow from introduced European genotypes (Magee et al., 1999). If any native genotypes of Phalaris arundinacea remain in the Pacific Northwest, it is likely safe to assume that populations exhibiting invasiveness likely represent introduced genotypes (Magee et al., 1999; Lavergne & Molofsky, 2004; Waggy, 2010).

Phleum pratense may be confused with native Phleum alpinum (alpine timothy) where their range and habitat overlap (Ogle et al., 2011).
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment, only Distribution and Abundance and Ecological Impacts are rated.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise. The Fire Effects Information System provides an excellent synthesis of the state of knowledge for Rosa multiflora, although only as of 2002 (Munger, 2002).
Rapid assessment only, based primarily on professional expertise.
Rubus armeniacus is a synonym for Rubus bifrons in the Washington Flora Checklist and Flora of North America (Weinmann et al., 2002; Alice et al., 2020). The Fire Effects Information System (Fryer, 2021) and USDA Plants database treat R. bifrons and R. armeniacus as different species. Washington Flora Checklist nomenclature is followed here and information documented for both R. armeniacus and R. bifrons in North America are used to inform this ranking document.For a more detailed overview of Rubus bifrons characteristics, ecology, and management, see the Fire Effects Information System report on Rubus armeniacus and R. bifrons (Fryer, 2021). Rubus bifrons can hybridize with other species of Rubus, and hybrid swarms related to this species exist in the Pacific Northwest (Fryer, 2021).

Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.
Solidago altissima is native to the eastern and central portions of North America and as far west as Montana (Walck et al., 2001). Sometimes this species is included as part of the Solidago canadensis complex (Kato-Noguchi & Kato, 2022).
Rapid assessment only, based primarily on professional expertise.
Tamarix is taxonomically difficult and there is some debate about whether the common species of Tamarix in the western U.S. is T. ramosissima or T. chinensis (Young et al., 2004). These two species also hybridize in their invasive range (Zouhar, 2003). Most of the information on Tamarix is provided by genus. Most data is from the southwest, but Tamarix invasions may behave differently elsewhere (Stromberg et al., 2007).
Rapid assessment only, based primarily on professional expertise.
Rapid assessment only, based primarily on professional expertise.

Utricularia inflata's native range extends from Texas to the southeastern coastal plains and north to Delaware (Titus & Grisé, 2009). It is introduced in Washington and the Northeastern U.S. (Urban & Dwyer, 2016). Little information was found regarding U. inflata populations in Washington, so most information on this species' invasiveness is from studies from New York.
Rapid assessment only, based primarily on professional expertise.
Whether or not Veronica anagallis-aquatica is introduced to North America is debated. However, this species is known to be introduced in at least some parts of the continent and it is easily spread by human activity (Albach, 2020). Most sources, including the Washington Flora Checklist, treat this species as introduced in Washington. At least some states treat this species as native and even of conservation concern: Nevada ranks it as Vulnerable (S3), Arkansas ranks it as Imperiled (S2), and North Carolina ranks it as Critically Imperiled (S1) (NatureServe, 2024). Veronica anagallis-aquatica can be difficult to distinguish from related species (Ellmouni et al., 2018; Hosseinnejad Azad et al., 2021).
Rapid assessment only, based primarily on professional expertise.

Assessor(s)	**Taxon**	**Q18 rank**	**Q18 confidence rank**
Walter Fertig, Clayton Antieau, David Wilderman	Acer negundo	Moderate (range Low - Moderate)	Moderate (range Moderate - High)
Emily Stevenson, Walter Fertig, Ethan Coggins	Ailanthus altissima	Low	Moderate
Emily Stevenson	Alliaria petiolata	Moderate	Low
Carlo Abbruzzese	Alopecurus pratensis	Low	Moderate
Emily Stevenson, Walter Fertig	Amorpha fruticosa	Moderate	High

Regina Johnson, Molly S. Wiebush	Anthoxanthum odoratum	Moderate	Moderate
Regina Johnson	Arrhenatherum elatius	Moderate	Moderate
Regina Johnson	Arum italicum ssp. italicum	Low	Moderate

Molly S. Wiebush	Arundo donax	High	Moderate
Molly S. Wiebush	Bellardia viscosa	Low	Moderate

Regina Johnson	Bellis perennis	Insignificant	Moderate
Regina Johnson	Betula pendula	Low	Moderate
Wesley Glisson	Butomus umbellatus	Moderate	Moderate
Molly S. Wiebush	Centaurea solstitialis	Moderate	Moderate
Emily Stevenson	Chondrilla juncea	Unknown	Not Rated

Emily Stevenson, Ethan Coggins, Regina Johnson, Molly S. Wiebush	Cirsium arvense	Moderate (range Insignificant - Moderate)	Moderate
Carlo Abbruzzese	Cirsium vulgare	Insignificant	Moderate
Regina Johnson	Clematis vitalba	Moderate	High
Regina Johnson	Cotoneaster spp.	Low	High
Regina Johnson	Crataegus monogyna var. monogyna	Moderate	Moderate
Helen Lau, Molly S. Wiebush	Cynoglossum officinale	Moderate	Low
Regina Johnson, Carlo Abbruzzese	Dianthus armeria	Insignificant	Moderate

Kimberly Quayle, Regina Johnson, Molly S. Wiebush	Dipsacus fullonum	Moderate	Moderate
Regina Johnson, Walter Fertig	Erechtites minimus	Low	Moderate
Emily Stevenson	Fallopia xbohemica	High	Moderate
Regina Johnson	Hieracium pilosella	Low	Moderate
Molly S. Wiebush	Holcus lanatus	Low	Low

Molly S. Wiebush, Regina Johnson	Ilex aquifolium	High (range Moderate - High)	High
Regina Johnson	Impatiens capensis	Insignificant	Moderate
Emily Stevenson	Iris pseudacorus	Moderate	Moderate

Molly S. Wiebush	Jacobaea vulgaris	Low	Low
Carlo Abbruzzese	Juglans regia	Low	Moderate

Molly S. Wiebush	Juncus effusus subsp. effusus	Moderate	Low
Regina Johnson	Lamium galeobdolon	Low	Moderate
Regina Johnson	Lathyrus latifolius	Moderate	Moderate
Regina Johnson	Lathyrus sylvestris	Moderate	Moderate
Molly S. Wiebush	Leucanthemum vulgare	Moderate	Moderate

Emily Stevenson	Lysimachia nummularia	Insignificant	Low
Kimberly Quayle, Regina Johnson	Lythrum salicaria	Moderate (range Low - Moderate)	Low
Ethan Coggins	Marrubium vulgare	Low	Low
Regina Johnson	Mycelis muralis	Insignificant	Moderate
Molly S. Wiebush	Myosotis discolor	Insignificant	Moderate

Wesley Glisson	Myriophyllum heterophyllum	High	Moderate
Wesley Glisson	Myriophyllum spicatum	Moderate	High
Regina Johnson	Nasturtium officinale	High	High

Emily Stevenson, Molly S. Wiebush, Regina Johnson	Phalaris arundinacea	High (range Moderate - High)	Moderate (range Low - High)
Molly S. Wiebush	Phleum pratense	Low	Low
Regina Johnson	Plantago lanceolata	Insignificant	Moderate
Regina Johnson	Poa annua	Insignificant	High

Wesley Glisson	Potamogeton crispus	Moderate	Low
Regina Johnson	Quercus robur	Low	Moderate
Regina Johnson	Rosa canina	Low	Moderate
Regina Johnson	Rosa multiflora	Moderate	High
Regina Johnson	Rosa rugosa	Moderate	Moderate
Emily Stevenson, Regina Johnson, Molly S. Wiebush	Rubus bifrons	Moderate (range Moderate - High)	Moderate (range Moderate - High)
Carlo Abbruzzese	Rubus laciniatus	Low	Not Rated

Carlo Abbruzzese	Rumex crispus	Insignificant	Low
Regina Johnson	Sasa palmata	Moderate	High
Regina Johnson	Schedonorus arundinaceus	Moderate	High
Emily Stevenson	Schoenoplectus mucronatus	Unknown	Not Rated
Regina Johnson	Senecio sylvaticus	Insignificant	High
Regina Johnson	Solanum dulcamara	Insignificant	Moderate
Molly S. Wiebush	Solidago altissima	Low	Moderate
Carlo Abbruzzese	Spartina alterniflora	Moderate	Moderate

Molly. S. Wiebush	Tamarix ramosissima	High	Moderate
Regina Johnson	Trifolium pratense	Low	Moderate
Regina Johnson	Trifolium subterraneum	Low	Moderate

Molly. S. Wiebush	Utricularia inflata	Moderate	Low
Carlo Abbruzzese	Verbascum blattaria	Insignificant	Moderate
Molly S. Wiebush	Veronica anagallis-aquatica	Low	Moderate
Regina Johnson	Veronica arvensis	Insignificant	Moderate

Question 18. Impact on Ecosystem Abiotic Processes (9 p

Abiotic Processes	Q18 notes
Hydrology, Nutrient dynamics, Light availability, Chemistry	
Light availability	Ailanthus altissima forms a closed canopy forest when conditions are suitable and it is allowed to spread. Some areas of closed canopy A. altissima have sufficient moisture that the native canopy would likely have been significant before its arrival. However, this species frequently increases the amount of shade relative to the semi-open canopies of oak or big-leaf maple woodlands.
Nutrient dynamics, Light availability, Chemistry	
Light availability, Nutrient dynamics	Alopecurus pratensis likely has minimal impact on abiotic processes, though it may be more competitive for soil nitrogen than some native species (Rutledge & McLendon, 1996; Venterink & Güsewell, 2010).
Geomorphology, Nutrient dynamics, Light availability	Amorpha fruticosa produces dense thickets that can alter ecosystem processes by stabilizing soil (reducing erosion), adding more nitrogen to the system (as a nitrogen fixer), and shading out competing native vegetation (Grabić et al., 2022).

Light availability, Nutrient dynamics	Anthoxanthum odoratum stimulates legume germination, (Brusati & Warner, 2004), potentially increasing nitrogen fixation. Decaying A. odoratum plants increase nitrogen and phosphorus, which may benefit other grass species over forbs (Dennehy et al., 2011) and though A. odoratum doesn't grow in classic smothering monocultural stands, it is frequently abundant enough that it can reduce light availability for co-occurring species.
Fire, Light availability	
None Listed	

Fire, Hydrology, Light availability, Chemistry, Water Quality	In California, Arundo donax has very high water transpiration rates, with an estimated 56,000 acre feet/year (compared to native vegetation transpiring an estimated 18,700 acre feet/year) (McWilliams, 2004). It can increase water loss from underground aquifers (NWCB, 2013). In South Africa, this species is considered a major threat because of its water use (Goolsby et al., 2023). In southern California, A. donax can change the defining disturbance in desert riparian communities from flood to fire. This species can produce up to 20 tons of above ground biomass per hectare, and its height allows it to function as ladder fuel, carrying fire into tree canopies. Riparian areas with intact native vegetation can serve as fire barriers, but A. donax turns riparian corridors into conduits of fire (McWilliams, 2004). Arundo donax reduces the canopy directly over streams because it does not overhang channels. This increase in sunlight can then lead to increased water temperatures. This species can change water quality and pH, including changing ammonium to toxic ammonia (McWilliams, 2004). This species is difficult to remove, so changes in abiotic processes may be irreversible.
Geomorphology, Nutrient dynamics, Light availability	Studies in Japan suggest that Bellardia viscosa can reduce the growth of their host plants (Suetsugu et al., 2012). In Japan and California, this species has been shown to prefer plants in the Fabaceae and Poaceae families (Pickart & Wear, 1999; Suetsugu et al., 2012). Coupled with its ability to be competitive for nitrogen (Pate & Bell, 2000), this suggests that B. viscosa could reduce nitrogen availability where it is found. Significant decreases in the biomass of plants in the Fabaceae and Poaceae families could also potentially increase light availability and possibly bare ground where this species is found, although this was not discussed in the available literature. One reason invasive plants are of concern in coastal dunes is the potential for stabilizing dune habitats and converting them from open sand to grasslands or forests. However, B. viscosa's annual habit and apparently relatively localized invasions mean that it is unlikely to contribute significantly to dune stabilization. Sources from California suggest this species has very little effect on the ecosystems in which it occurs (Pickart & Wear, 1999; Brusati & Corelli, 2005).

None Listed	
Hydrology, Light availability	
Hydrology, Light availability, Increased sedimentation	As with many other invasive species, the impacts for flowering rush have been observed qualitatively, but rarely quantified (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019). This plant can clearly grow in dense, monotypic stands, and grows in areas where other aquatic plants cannot, thereby acting as an ecosystem engineer. Its ability to invade both deep water and moist soil is also alarming and allows it to impact a variety of habitats, even in the same location. It is unknown how irreversible these impacts may be, but if better solutions for its control are not found, then its persistent presence could indeed cause irreversible damage to invaded ecosystems (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).
Fire, Hydrology, Nutrient dynamics	Centaurea solstitialis is highly competitive for water and depletes soil moisture more and later in the season than annual and perennial grasses. This can temporarily disrupt soil moisture dynamics and reduce water availability for co-occurring species, sometimes even across seasons. Centaurea solstitialis changes soil nutrient availability and adult plants may increase inorganic nitrogen in the soil (Innes & Zouhar, 2021). A study found that increased nitrogen generally benefits C. solstitialis above co-occurring species (Dukes et al., 2011).
Unknown	

Light Availability, Hydrology, Fire, Nutrient Dynamics	Cirsium arvense's thick root system may stabilize some banks when growing in riparian areas. This plant typically grows in relatively mesic areas. In Canada, C. arvense has been shown to increase fire frequency when it occurs in boreal wet meadows (Hogenbirk, 1995 as cited by Zouhar, 2001). Research also suggests that C. arvense can alter soil microbial community composition (Verbeek & Kotanen, 2019), which can alter nutrient cycling.
None Listed	
Light availability	
Light availability	
Geomorphology, Hydrology, Light availability	
Nutrient dynamics	Very little information was found regarding Cynoglossum officinale's effects on abiotic processes. One study that compared populations of C. officinale in Montana to populations in similar habitats in Germany found that experimentally disturbed areas in Montana had greater nitrogen content and lower colonization rates from species in the surrounding community than did experimentally disturbed habitats in Germany (Williams et al., 2010). It is unclear whether C. officinale was the cause of these conditions, or merely taking advantage of them.
None Listed	

Geomorphology, Hydrology , Light availability, Fire	Dipsacus fullonum usually occurs in moist areas where fire is less likely to spread, and dense stands of this species can further reduce the spread of fire (Gucker, 2009). The horizonal growth form of the rosettes can also reduce light availability for seeds and seedlings of co-occurring species (Werner, 1976; Huarte et al., 2016). In some systems, the deep taproot can alter water table levels if a high number of plants are present. If this species replaces natives with fibrous roots (e.g., perennial grasses), the switch to tap-rooted plants can lead to increased erosion.
Light availability	
Geomorphology, Hydrology	
None Listed	
Fire, Nutrient dynamics	Increased litter from Holcus lanatus could potentially change fuel loads and fire behavior. Litter accumulation also reduces germination of native grasses (Gucker, 2009). This species can also increase nitrogen content in the soil. (Bennett et al., 2011). Holcus lanatus changes soil communities, increasing bacteria, decreasing mycorrhizal fungi, and reducing detritivores. These effects on the soil community (particularly reduction of mycorrhizal fungi) continue, and can have larger effects on the plant community, even after removal of H. lanatus populations (Bennett et al., 2011).

Fire, Nutrient dynamics, Light availability, Chemistry	Ilex aquifolium can reduce light availability to understory communities by establishing a new sub-canopy tree or shrub layer in both logged and unlogged forests (Stokes et al., 2014). Ilex thickets may increase fire risk in invaded forests because it is highly flammable and potentially creates a new sub-canopy layer (Stokes et al., 2014; NWCB, 2022). On the other hand, when ignitions occur, stand-replacing fires are already the historical norm in the western Washington ecosystems where Ilex aquifolium is most prevalent. Ilex aquifolium also affects nutrient cycles and soil chemistry, increasing sulfur content and lowering soil pH (NWCB, 2022). It grows in thickets that can shade out other understory species (Stokes et al., 2014). In western Washington, this species is also drought-tolerant relative to many native species. Because I. aquifolium is difficult to manage, changes to ecosystem processes may effectively be irreversible.
None Listed	
Geomorphology, Hydrology	This species can change the hydrology and sedimentation rates (King County Noxious Weed Control Program, 2007) of the ecosystems in which it occurs.

Geomorphology, Light availability,	Jacobaea vulgaris rosettes have large leaves that lay flat to the ground, excluding other species by blocking light. When adult plants die, they leave bare openings in the vegetation. In Oregon, studies found that J. vulgaris seedlings established best in the openings left by senesced adult plants, allowing populations to persist in plant communities after initial establishment (Wardle, 1987). In California, has been shown to increase erosion rates (Richardson, 2004).
Light availability, Chemistry	Juglans regia likely shades out native trees and shrubs and may be allelopathic.

Light availability, Chemistry	A competition study in Alabama found that established Juncus effusus plants could reduce species richness and biomass by shading (Ervin & Wetzel, 2002). In Ireland, this species can also shade out young plantation trees in disturbed peatlands (McCorry & Renou, 2003). Juncus effusus can affect biogeochemical cycles, and is capable of either increasing or decreasing methane production from wetlands, depending on conditions (Arslan et al., 2019). This taxon has also been tested for use in restoration, and a literature search found many studies on potential phytoremediation uses for J. effusus, (e.g., Syranidou et al., 2017; Peng et al., 2018; Zhang et al., 2019). These impacts could potentially be beneficial to the ecosystems in which this plant occurs in Washington.
Geomorphology	When growing along streambanks, this species may be washed away in flooding events and contribute minor amounts of debris to log jams, gravel bars, etc.
Nutrient dynamics, Light availability	
Nutrient dynamics, Light availability	
Geomorphology, Nutrient dynamics, Light availability	Though Leucanthemum vulgare doesn't always grow in classic smothering monocultural stands, it is frequently abundant enough that it can reduce light availability for co-occurring species. Bare soil is common in areas heavily invaded by L. vulgare, and this species' shallow roots do not hold soil in place well. Areas with large populations of L. vulgare experience increased erosion and reduced soil nutrients and organic matter (NWCB, 2000; Clements et al., 2004).

None Listed	
Geomorphology, Hydrology, Light availability, Nutrient dynamics	Lythrum salicaria may impact detrital food chains (Grout et al., 1997). A report from the Snake River warns that Lythrum salicaria may speed aggradation of gravel bars through increased sedimentation trapping (Dixon & Johnson, 1999).
Geomorphology	There is little indication that this species alters abiotic processes significantly, though there are reports that it has been used for dune stabilization (Weiss & Sagliocco, 1994). This plant is a small subshrub or forb that is unlikely to compete for sunlight, except with smaller forbs, grasses, and nonvascular species. This species is noted to prefer calcareous soils (Weiss & Sagliocco, 1994).
None Listed	
None Listed	Little information was available on the abiotic effects of Myosotis discolor. While it can compete with other small annual species in its native range (Asefa, 2011), it does not have easily observable impacts on ecosystem processes in the Pacific Northwest. This species is usually present only as a trace component in prairies and grasslands, suggesting its effects on abiotic processes are insignificant.

Hydrology, Nutrient dynamics, Light availability	There is a lack of research in this area, but the biomass and structure of the plants suggests that these impacts are at least moderate (Gross et al., 2020).
Hydrology, Light availability	There is a lot of evidence of Eurasian watermilfoil impacts to abiotic processes, but importantly, these are often reversible with milfoil management (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999).
Hydrology, Geomorphology, Light availability	

Fire, Geomorphology, Hydrology, Light availability, Nutrient dynamics	Several sources note that Phalaris arundinacea is capable of changing stream channels, narrowing and slowing flows by capturing silt and debris with its roots and stems (Lavergne & Molofsky, 2004; Waggy, 2010). These changes may impede or halt abiotic processes like scouring that are important for maintaining salmon habitat (Lavergne & Molofsky, 2004; Waggy, 2010). Phalaris arundinacea can also alter soil structure and organic content, which can in turn change the species composition of the vegetation community (Lavergne & Molofsky, 2004). Its dense, tall growth habit also alters the light regime for neighboring plant species (Lavergne & Molofsky, 2004; Waggy, 2010). No specific information was found regarding the length or irreversibility of these impacts but given the difficulty of treating infestations of this species, it seems reasonable to rate it as causing major potentially irreversible changes to the abiotic system.
Geomorphology, Light availability	Phleum pratense is sometimes used in combination with other species for erosion control, though its shallow roots mean that it is not an ideal erosion control agent when planted alone (Esser, 1993). This species also grows tall enough to outcompete at least some plant species for light (Isselin Nondedeu & Bédécarrats, 2009).
None Listed	
None Listed	Tends to grow in places that few plants will grow in, especially trampled areas.

Nutrient dynamics, Light availability	This species has been documented as having a high impact in other regions of North America (Nichols & Shaw, 1986; Bolduan et al., 1994; Woolf & Madsen, 2003), but these impacts have not yet been thoroughly evaluated in Washington. At least in the warmer regions of western and southern Washington, its impacts do not seem as severe as other areas of North America. In cooler climates, curly-leaf pondweed grows rapidly in the winter, under the ice, and rapidly dies off as the water warms. This rapid die-off can cause substantial reductions in water clarity and fuel algae growth (Nichols & Shaw, 1986; Bolduan et al., 1994; Woolf & Madsen, 2003). The extent to which this occurs in Washington lakes, however, is unknown.
Light availability	
Light availability	
Light availability	
Geomorphology	This species grows in drift log piles and may provide additional stabilization.
Light availability, Hydrology, Fire, Nutrient dynamics	Dense thickets and tall canes limit light availability for co-occurring species (Fryer, 2021). Large amounts of leaf litter are found under Rubus bifrons thickets, affecting how much bare soil is available for seeds to germinate in, and potentially also changing nutrient dynamics in invaded systems (Caplan & Yeakley, 2006). Rubus bifrons litter and plants may not burn well in moist sites, but it is flammable where fuels are sufficient (Fryer, 2021), and it seems likely that high densities of this species could change fire dynamics and post-fire recovery in grasslands, woodlands, and forests. No specific information was found on how long-term or reversable these impacts might be.
Light availability	This species competes with natives for light and potentially nutrients, but thickets usually don't grow particularly large.

Nutrient dynamics, Light availability	
Geomorphology, Hydrology, Light availability	
Geomorphology, Nutrient dynamics, Light availability	
None Listed	
None Listed	
None Listed	A literature review found no documented impacts to abiotic ecosystem processes (Waggy, 2009).
Hydrology, Light availability,	Solidago altissima grows in dense stands that reduce light availability for neighboring plants. At least one study also found that S. altissima reduced soil water availability (Kim, 2017).
Geomorphology, Hydrology, Light availability	This species has significant impacts on wave energy and sedimentation rates in intertidal ecosystems.

Fire, Hydrology, Nutrient dynamics, Light availability, soil salinity	Tamarix can lower water tables through high evapotranspiration rates (Zouhar, 2003; Gafke et al., 2022). Accumulation of Tamarix leaves can also alter soil salinity, particularly in areas where dams have halted annual flooding, impairing germination and growth of native species (Zouhar, 2003; Gafke et al., 2022). Tamarix also burns readily, changing fire frequency and extent where it occurs (Zouhar, 2003; Gafke et al., 2022). Riparian corridors invaded by Tamarix spread fire instead of functioning as a barrier to fire (Zouhar, 2003; Gafke et al., 2022). Monospecific stands of Tamarix also reduce light availability for other species (Zouhar, 2003; Gafke et al., 2022). Effects on nutrient cycling and mycorrhizal associations need more study, but it seems likely that Tamarix dominance also affects these, with interactions making soil conditions less hospitable to native plants (Zouhar, 2003; Gafke et al., 2022). However, dominance of Tamarix species is likely a response to anthropogenic changes in hydrology and river flow, not a cause of those changes (Zouhar, 2003; Gafke et al., 2022). Effects on abiotic processes caused by Tamarix might be reversible when coupled with efforts to restore more natural hydrological regimes, but political and economic impediments to restoring historical river conditions coupled with climate change may make this process difficult.
Nutrient dynamics	Prairies are low-nitrogen systems so this species' nitrogen fixing abilities may benefit tall oatgrass, similarly to Cytisus species.
Nutrient dynamics	Prairies are low-nitrogen systems so this species' nitrogen fixing abilities may benefit tall oatgrass, similarly to Cytisus species.

Nutrient dynamics, Light availability, Chemistry	Information on Utricularia inflata impacts to abiotic processes in Washington was not available. In New York, invasions of U. inflata change sedimentary nutrient cycling processes by extirpating native plant species, in turn changing the proportion of oxygen, metals, and other nutrients in the water column (Titus & Urban, 2013). These changes to nutrient cycles and water chemistry are an indirect effect of this species' ability to outcompete other aquatic species for light (Urban et al., 2009; Urban & Titus, 2010). However, the persistence of U. inflata invasions and their long-term impacts are unknown (Titus & Grisé, 2009).
Nutrient dynamics, Light availability	
Nutrient dynamics, Light availability, Chemistry	Occasionally, dense stands of Veronica anagallis-aquatica may impede stream flow (DiTomaso et al., 2013). Veronica anagallis-aquatica is potentially an effective bioaccumulator, with studies showing that it can immobilize metals such as cadmium and lead (Ribeiro et al., 2022). This species is also capable of removing nitrates from eutrophic water sources (Bannister et al., 2021). It also potentially reduces light availability for aquatic species (Riis et al., 2004). Veronica anagallis-aquatica's ability to uptake heavy metals and excessive nitrates could potentially have a positive effect on abiotic processes, and several studies have been done to test the potential of this species for phytoremediation (e.g. (Ribeiro et al., 2022)).
None Listed	

ɔts)	
Q18 citation	**Q19 rank**
	Low (range Low - Moderate)
	Moderate
	Low
Rutledge C. and T. McLendon. 1996. An assessment of exotic plant species in Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University, Fort Collins, CO. Venterink H. and S. Güsewell. 2010. Competitive interactions between two meadow grasses under nitrogen and phosphorous limitation. Functional Ecology 24(4):877–886.	Moderate
Grabić J., B. Ljevnaić-Mašić, A. Zhan, B. Benka, and H. Heilmeier. 2022. A review on invasive false indigo bush (Amorpha fruticosa L.): Nuisance plant with multiple benefits. Ecology and Evolution 12(9).	Low (range Low - Moderate)

Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Dennehy C., E.R. Alverson, H.E. Anderson, D.R. Clements, R. Gilbert, and T.N. Kaye. 2011. Management strategies for invasive plants in Pacific Northwest prairies, savannas, and oak woodlands. Northwest Science 85(2):329–351.	Low
	Moderate
	Low

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	High
Brusati E. and T. Corelli. 2005. Parentucellia viscosa. https://www.cal-ipc.org/plants/paf/parentucellia-viscosa-plant-assessment-form/. Accessed: October 29, 2024. Pate J. and Bell. 2000. Host associations of the introduced annual root hemiparasite Parentucellia viscosa in agricultural and bushland settings in western Australia. Annals of Botany 85(2):203–213. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70. Suetsugu K., Y. Takeuchi, K. Futai, and M. Kato. 2012. Host selectivity, haustorial anatomy and impact of the invasive parasite Parentucellia viscosa on floodplain vegetative communities in Japan. Botanical Journal of the Linnean Society 170(1):69–78.	Low

	Insignficant
	Low
Columbia Basin Cooperative Weed Management Area. 2019. Columbia Basin Flowering Rush Management Plan: A regional strategy to address Butomus umbellatus throughout the Columbia Basin. https://agr.mt.gov/_docs/weeds-docs/columbia-basin-flowering-rush.pdf. Accessed: January 14, 2025. Gunderson M.D., K.L. Kapuscinski, D.P. Crane, and J.M. Farrell. 2016. Habitats colonized by non-native flowering rush Butomus umbellatus (Linnaeus, 1753) in the Niagara River, USA. Aquatic Invasions 11(4):369–380.	High
Dukes J.S., N.R. Chiariello, S.R. Loarie, and C.B. Field. 2011. Strong response of an invasive plant species (Centaurea solstitialis L.) to global environmental changes. Ecological Applications 21(6):1887–1894. Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Moderate
	Moderate

Hogenbirk J.C. 1995. Fire in boreal wet-meadows: implications for climate change. In: Cerulean, Susan I.; Engstrom, R. Todd, eds. Fire in wetlands: a management perspective. 1993 November 3-6: 19th Tall Timbers Fire Ecology Conference. Tall Timbers Research Station, Tallahassee, FL. Verbeek J.D. and P.M. Kotanen. 2019. Soil-mediated impacts of an invasive thistle inhibit the recruitment of certain native plants. Oecologia 190(3):619–628. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Moderate (range Low - Moderate)
	Insignficant
	Moderate
	Moderate
	High
Williams J.L., H. Auge, and J.L. Maron. 2010. Testing hypotheses for exotic plant success: parallel experiments in the native and introduced ranges. Ecology 91(5):1355–1366.	Low
	Insignficant

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. Huarte H.R., M.D.R.P. Zorraquín, E.M. Bursztyn, and M.L. Zapiola. 2016. Effects of environmental factors on seed germination and seedling emergence of common teasel (Dipsacus fullonum). Weed Science 64(3):421–429. Werner P.A. 1976. Ecology of plant populations in successional environments. Systematic Botany 1(3):246.	Moderate
	Low
	Moderate
	Low
Bennett A.E., M. Thomsen, and S.Y. Strauss. 2011. Multiple mechanisms enable invasive species to suppress native species. American Journal of Botany 98(7):1086–1094. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	Low

NWCB. 2022. Draft written findings of the Washington State Noxious Weed Control Board: Ilex aquifolium. Washington State Noxious Weed Control Board.Online: https://www.nwcb.wa.gov/pdfs/English-holly-Ilex-aquifolium-written-findings-2022.pdf Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93.	Moderate
	Low
King County Noxious Weed Control Program. 2007. Best management practices: yellow-flag iris (Iris pseudacorus) Iridaceae, [Online]. In: Noxious weeds--weed control information. Seattle, WA: King County Department of Natural Resources and Parks, Water and Land Resources Division, Noxious Weed Control Program (Producer). http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/BMPs/yellow-flag-iris-control.pdf. Accessed: June 16, 2009.	High

Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024. Wardle D.A. 1987. The ecology of ragwort (Senecio jacobaea L.) - A review. New Zealand Journal of Ecology 10:67–76.	Low
	Low

Arslan M., U.K. Devisetty, M. Porsch, I. Große, J.A. Müller, and S.G. Michalski. 2019. RNA-Seq analysis of soft rush (Juncus effusus): transcriptome sequencing, de novo assembly, annotation, and polymorphism identification. BMC Genomics 20(1):489. Ervin G.N. and R.G. Wetzel. 2002. Influence of a dominant macrophyte, Juncus effusus, on wetland plant species richness, diversity, and community composition. Oecologia 130(4):626–636. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland. Peng Y., J. Chen, H. Wei, S. Li, T. Jin, and R. Yang. 2018. Distribution and transfer of potentially toxic metal (loid) s in Juncus effusus from the indigenous zinc smelting area, northwest region of Guizhou Province, China. Ecotoxicology and environmental safety 152:24–32. Syranidou E., S. Christofilopoulos, and N. Kalogerakis. 2017. Juncus spp.—The helophyte for all (phyto) remediation purposes? New Biotechnology 38:43–55.	Low
	Low
	Low
	Low
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA.	Low

	Low
Dixon M.D. and W.C. Johnson. 1999. Riparian vegetation along the middle Snake River, Idaho: zonation, geographical trends, and historical changes. Great Basin Naturalist 59(1):18–34. Grout J.A., C.D. Levings, and J.S. Richardson. 1997. Decomposition rates of purple loosestrife (Lythrum salicaria) and Lyngbyei's sedge (Carex lyngbyei) in the Fraser River estuary. Estuaries 20(1):96–102.	Moderate (range Low - Moderate)
Weiss J. and J.-L. Sagliocco. 1994. Horehound, Marrubium vulgare-A global perspective. In: Fourth Biennial Proclaimed Animal and Plant State Conference. Animal and Plant Control Commission. SA.	Insignficant
	Insignficant
Asefa G. 2011. The dynamics of coexistence in annual plants. PhD Dissertation. Imperial College London, London, United Kingdom.	Insignficant

Gross E.M., H. Groffier, C. Pestelard, and A. Hussner. 2020. Ecology and environmental impact of Myriophyllum heterophyllum, an aggressive invader in European waterways. Diversity 12(4):127.	Moderate
Aiken S.G., P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds: 34. Myriophyllum spicatum L. Canadian Journal of Plant Science 59(1):201–215. Boylen C.W., L.W. Eichler, and J.D. Madsen. 1999. Loss of native aquatic plant species in a community dominated by Eurasian watermilfoil. Hydrobiologia 415(0):207–211. Madsen J.D., J.A. Sutherland, J.A. Bloomfield, L.W. Eichler, and C.W. Boylen. 1991. The decline of native vegetation under dense Eurasian watermilfoil canopies. Journal of Aquatic Plant Management 29:94–99. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	Moderate
	Low

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Moderate (range Moderate - High)
Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Isselin Nondedeu F. and A. Bédécarrats. 2009. Assessing the dominance of Phleum pratense cv. climax, a species commonly used for ski trail restoration. Applied Vegetation Science 12(2):155–165.	Low
	Low
	Insignficant

Bolduan B.R., G.C. van Eeckhout, H.W. Quade, and J.E. Gannon. 1994. Potamogeton crispus–the other invader. Lake and Reservoir Management 10(2):113–125. Nichols S.A. and B.H. Shaw. 1986. Ecological life histories of the three aquatic nuisance plants, Myriophyllum spicatum, Potamogeton crispus and Elodea canadensis. Hydrobiologia 131(1):3–21. Woolf T.E. and J.D. Madsen. 2003. Seasonal biomass and carbohydrate allocations patterns in southern Minnesota curlyleaf pondweed populations. Aquat. Plant Manage 41:113–118.	Moderate
	High
	High
	Moderate
	Moderate
Caplan J.S. and J.A. Yeakley. 2006. Rubus armeniacus (Himalayan blackberry) occurrence and growth in relation to soil and light conditions in western Oregon. Northwest Science 80(1):10–17. Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	High (range Moderate - High)
	Low

	Insignficant
	Moderate
	Moderate
	Unknown
	Insignficant
Waggy M.A. 2009. Solanum dulcamara. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/soldul/all.html. Accessed: February 3, 2025.	Low
Kim T.N. 2017. How plant neighborhood composition influences herbivory: Testing four mechanisms of associational resistance and susceptibility. PLOS ONE 12(5):e0176499.	Low
	High

Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https:// bugwoodcloud.org/resource/files/23194.pdf Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Moderate
	Low
	Insignficant

Titus J.E. and D.J. Grisé. 2009. The invasive freshwater macrophyte Utricularia inflata (inflated bladderwort) dominates Adirondack Mountain lake sites. The Journal of the Torrey Botanical Society 136(4):479–486. Titus J.E. and R.A. Urban. 2013. Invasion in progress: Utricularia inflata in Adirondack submersed macrophyte communities. The Journal of the Torrey Botanical Society 140(4):506–516. Urban R.A. and J.E. Titus. 2010. Exposure provides refuge from a rootless invasive macrophyte. Aquatic Botany 92(4):265–272. Urban R.A., J.E. Titus, and W.-X. Zhu. 2009. Shading by an invasive macrophyte has cascading effects on sediment chemistry. Biological Invasions 11(2):265–273.	Moderate
	Insignficant
Bannister J.W., L.K. Clairmont, K.J. Stevens, and R.M. Slawson. 2021. Exposure to elevated nutrient load results in structural and functional changes to microbial communities associated with riparian wetland plants Phalaris arundinaceae and Veronica anagallis-aquatica. Rhizosphere 18. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Water speedwell. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Ribeiro C., A. Almeida, and C. Couto. 2022. Aquatic macrophytes as bioindicators of heavy metals contamination in estuarine ecosystems. Scientific Letters 1(5):1–10. Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	Insignficant
	Insignficant

Question 19. Impact on Ecosystem Structure

Q19 confidence rank	Q19 notes
Moderate (range Moderate - High)	Acer negundo usually occurs with other riparian trees (D. Wilderman, pers. comm. 2024), suggesting that it is not converting previously open areas to tree canopy.
Moderate	Ailanthus altissima primarily invades disturbed sites. This species prefers forested sites such as oak woodlands and riparian areas and will increase canopy density. This reduction in light availability, combined with the allelopathic effects of A. altissima, is likely to result in major changes to the understory of invaded areas. Eventually, changes in the overstory may follow. Ailanthus altissima is the preferred host of the spotted lanternfly (Lycorma delicatula), an invasive insect that may also have a major impact on ecosystem structure (Washington Invasive Species Council, 2024).
Low	
High	This species can convert bunchgrass communities with scattered annuals to rhizomatous grasslands.
Moderate (range Low - Moderate)	Amorpha fruticosa is the dominant shoreline shrub along stretches of the Columbia and Snake Rivers. It seems likely that this species is replacing native plants in these systems. These systems have been majorly altered with the presence of dams. The main change in ecosystem structure is that stands of brush become denser and more shaded than they might otherwise be, with impacts on light-sensitive species. Secondary effects also occur from increases in litter, increase in available nitrogen, and bank stabilization (NWCB, 2015).

Moderate	Given evidence that this species might not have strong effects on community composition, it likely has low effects on ecosystem structure.
High	Arrhenatherum elatius transforms bunchgrass to tallgrass sod.
Moderate	

High	Arundo donax can displace native vegetation such as cottonwood, willow, and other native riparian dominants, replacing them with a community that has no native analogs and does not support wildlife, with the exception of providing shelter for feral pigs (McWilliams, 2004). This species narrows waterways in the southwestern U.S., and can increase erosion of river banks during floods (Goolsby et al., 2023).
Moderate	Bellardia viscosa can reduce biomass production in its host plants (Suetsugu et al., 2012).

High	
Moderate	
Moderate	This species likely has a high impact on lakes, and a more moderate impact in rivers (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).
Moderate	Centaurea solstitialis has competitive effects on both native and introduced species. This species can outcompete native, dominant bunchgrasses and convert ecosystems to ruderal ecosystems dominated by annuals. Some observations have found that this species can alternate dominance with Bromus tectorum when they co-occur (Innes & Zouhar, 2021).
Low	

Low (range Low - Moderate)	Research of severe soil disturbance in northern Idaho found Cirsium arvense was a component in a forb-rich vegetation community that prevented the re-establishment of trees (Green & Jensen, 1991; Jensen, 1991). This species can change vegetation density in grasslands, shrublands, and mixed shrub and forb ecosystems.
Moderate	This species likely has minor impact on ecosystem structure.
High	
High	
High	
Moderate	Cynoglossum officinale is toxic to mammals and can prevent the establishment of desired forage species in its introduced range (Andreas et al., 2008). Disturbed sites with C. officinale have slower recruitment of other species (Williams et al., 2010). However, C. officinale populations tend not to persist over time. In its native range, this species exhibits metapopulation dynamics (that is, individual populations will go extinct while other habitat patches are recolonized). Combined with ongoing management in its introduced range, individual populations of this species may be unstable and not produce lasting structural impacts (Duncan & Williams, 2020).
Moderate (range Moderate - High)	

Moderate (range Low - Moderate)	Dipsacus fullonum frequently occurs in monospecific stands, changing both density and cover of associated native species in ecosystems where it occurs. The tall biennial forb-dominated community this species creates is a departure from historical communities.
Moderate	
High	This plant readily invades sparsely vegetated cobble bars before native willows may establish. It may also convert herbaceous marshes into monocultural shrublands.
Moderate	
Moderate	In a study from Europe, Holcus lanatus was able to limit the growth of seedling birch trees, but it is unknown if this species can outcompete tree seedlings in the Pacific Northwest. Production of abundant litter can reduce available habitat for co-occurring species to germinate in (Gucker, 2009).

Moderate (range Moderate - High)	Ilex aquifolium is capable of creating a new sub-canopy layer in invaded forests and woodlands in Washington (Stokes et al., 2014). This species is most competitive in shaded conditions (Valladares et al., 2005), making conversion of grasslands to shrublands or woodlands unlikely. However, in cool, wet climates, I. aquifolium can survive in full sun (Valladares et al., 2005), suggesting that this species may also be able to invade grasslands in western Washington, at least occasionally.
Moderate	
Low	One study from the eastern US reports that Iris pseudacorus suppresses willow establishment and provides a raised surface upon which wetland trees may establish, thus speeding the successional trajectory from marsh to swamp (Thomas, 1980).

Low	Jacobaea vulgaris can reduce biomass of microbes in the soil (Richardson, 2004). Given the ability of rosettes to shade out neighboring plants, the presence of this species may reduce overall vegetation cover where it occurs.
Moderate	

Low	Juncus effusus can occasionally outcompete tree seedlings, though this may only occur where the conditions for tree establishment are marginal (McCorry & Renou, 2003).
Moderate	
High	
High	
Moderate	Presence of Leucanthemum vulgare can increase bare soil in ecosystems (Clements et al., 2004).

Moderate	This species forms a trailing mat that likely excludes many other plants, but rarely impacts ecosystems over large areas (NPSO Emerald Chapter, 2008).
Moderate (range Low - Moderate)	Lythrum salicaria populations can substantially reduce the amount of open water in marshes, or speed the development of aquatic vegetation towards marsh. Lythrum salicaria may shift communities from graminoid dominance to forb dominance, but rarely completely replaces characteristic marsh genera like Typha and Schoenoplectus.
Low	In Washington, this species does not appear to significantly alter vegetation structure.
High	
Moderate	The assessor has observed that this plant has trace cover in relevé surveys of Willamette prairie in Oregon and does not appear to change community structure. Little information on structural impacts were available in the literature, though it may be competitive against some annual grasses in its native range (Asefa, 2011).

Moderate	There is a lack of research in this area, but the biomass and structure of the plants suggests that these impacts are at least moderate. These plants fill the water column in a manner not seen with other native and invasive submersed aquatic plants.
High	This species creates a new aquatic plant canopy structure that is different than most native vegetation (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999).
High	

Moderate (range Moderate - High)	Phalaris arundinacea readily converts bunchgrass-dominant wet meadows and prairies to rhizomatous meadows/marshes. Phalaris arundinacea may change ecosystem successional patterns and prevent establishment of woody species. These structural changes may have a negative effect on salmon, particularly by reducing riparian insect abundance and therefore available food for immature salmon (Waggy, 2010).
Moderate	Phleum pratense is most commonly found in graminoid-dominant ecosystems in Washington and is unlikely greatly alter the structure of communities. In other circumstances, Phleum pratense can either hinder or aid establishment of conifer seedlings. This species may sometimes prevent conifer seedlings from establishing through a combination of outcompeting seedlings for light and potentially allelopathy. However, if seedlings are already established, P. pratense may be able to exclude other plant species, reducing the overall competition that tree seedlings face. In some ecosystems, P. pratense can tip the balance from forest to grassland (Esser, 1993).
High	
High	

Moderate	The species can grow very densely and top out at the water's surface, creating a canopy where one did not exist before. In cooler climates where its growth occurs before other species, it creates a new early-season layer of plants within the water column that would not have occurred with the native flora (Nichols & Shaw, 1986; Bolduan et al., 1994; Woolf & Madsen, 2003).
High	In some cases, this species could have significant effects on ecosystem structure.
Moderate	This species can produce large shrubby thickets in grasslands.
High	
Moderate	
High	This species can prevent species like Pinus ponderosa or Quercus garryana from establishing, potentially preventing succession to woodland or forested ecosystems. Replacement of native species leads to permanent monocultural thickets of R. bifrons that can prevent animal movement and reduce the habitat value of meadows and forest openings (Fryer, 2021). In Willamette Prairie habitats, R. bifrons is part of a suite of species that convert existing grasslands into shrublands.
Moderate	May cause loss of native plants beneath the thicket, but overall structural impact is generally restricted.

Moderate	
Moderate	
High	Schedonorus arundinaceus does not just cause changes in structure of grasslands—where it was planted for pasture, it is very difficult to re-establish trees and shrubs, and it excludes woody plant recruitment unless there is a major investment in physical removal.
Not Rated	
High	This species has only short-lived impacts. Plants are present for only a couple years in recently disturbed areas, potentially reducing recruitment of longer-lived species during that time.
High	This plant may compete with native shrubs along small creeks, but rarely occurs with enough cover to have significant impact.
Moderate	In Washington, this plant primarily occurs in open riparian and wetland ecosystems dominated by other tall, rhizomatous herbs (e.g., Typha latifolia, Schoenoplectus acutus). Structural impacts are likely minor, aside from potential delayed establishment of native shrubs (T. Ramm-Granberg, pers. comm. 2025). In other areas where this species has naturalized, Solidago altissima can grow five to six feet tall, and where this species is invasive it can create a tall layer of perennial vegetation over existing earlier-colonizing species (Collins et al., 2001).
High	The impact this species has on ecosystem structure is high on mudflats and moderate in salt marshes. It takes over mudflats, displacing shorebirds and invertebrate foraging habitat.

Moderate	Tamarix invasions in the western U.S. simplify riparian ecosystem structure, affecting habitat quality for many species (Gafke et al., 2022). Some sources also document Tamarix replacing grassland community types (Zouhar, 2003), but this genus appears to most commonly simplify the structure of existing riparian woodland communities.
Moderate	
Moderate	This species reduces bare ground, which is important in prairies for seedling recruitment. Structural impacts appear to be insignificant, however.

Moderate	Information on Utricularia inflata's ecosystem affects in Washington are limited. Studies of U. inflata invasions in New York found this species capable of shading out aquatic vegetation rooted in the substrate, resulting in cascading effects on nutrient and oxygen availability (Urban et al., 2009; Urban & Titus, 2010). At minimum, presence of U. inflata in Washington could result in loss of some vegetation layers in aquatic ecosystems.
Moderate	This species sometimes forms groups that can crowd out other plants, but impact is likely minor.
High	Little information was available on how Veronica anagallis-aquatica might impact ecosystem structure. Dense stands of V. anagallis-aquatica may at least occasionally impede stream flow (DiTomaso et al., 2013) and emergent plants can shade out submerged or aquatic plants (Riis et al., 2004). However, any minor structural impacts from V. anagallis-aquatica are likely to be short-lived.
High	

e (12 pts)	
Q19 citation	**Q20 rank**
	Moderate (range Moderate - High)
Washington Invasive Species Council. 2024. Spotted Lanternfly. https://invasivespecies.wa.gov/priorityspecies/spotted-lanternfly/. Accessed: December 18, 2024.	High
	Moderate
	Moderate
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	High

	Moderate (range Low - High)
	High
	Moderate

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024.	High
Suetsugu K., Y. Takeuchi, K. Futai, and M. Kato. 2012. Host selectivity, haustorial anatomy and impact of the invasive parasite Parentucellia viscosa on floodplain vegetative communities in Japan. Botanical Journal of the Linnean Society 170(1):69–78.	Low

	Insignificant
	Low
Columbia Basin Cooperative Weed Management Area. 2019. Columbia Basin Flowering Rush Management Plan: A regional strategy to address Butomus umbellatus throughout the Columbia Basin. https://agr.mt.gov/_docs/weeds-docs/columbia-basin-flowering-rush.pdf. Accessed: January 14, 2025. Gunderson M.D., K.L. Kapuscinski, D.P. Crane, and J.M. Farrell. 2016. Habitats colonized by non-native flowering rush Butomus umbellatus (Linnaeus, 1753) in the Niagara River, USA. Aquatic Invasions 11(4):369–380.	Low
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	High
	High

Green P. and M. Jensen. 1991. Plant succession within managed grand fir forests of northern Idaho. In: Proceedings--Management and Productivity of Western-montane Forest Soils. United States Forest Service, Boise, ID. INT-280. Jensen M. 1991. Ecological classification and cumulative soil effects. In: Proceedings--Management and Productivity of Western-montane Forest Soils. United States Forest Service, Boise, ID. INT-280.	High (range Moderate - High)
	Low
	Moderate
	Moderate
	High
Andreas J.E., M. Schwarzländer, and R. De Clerck-Floate. 2008. The occurrence and potential relevance of post-release, nontarget attack by Mogulones cruciger, a biocontrol agent for Cynoglossum officinale in Canada. Biological Control 46(3):304–311. Duncan S.S. and J.L. Williams. 2020. Life history variation in an invasive plant is associated with climate and recent colonization of a specialist herbivore. American Journal of Botany 107(10):1366–1374. Williams J.L., H. Auge, and J.L. Maron. 2010. Testing hypotheses for exotic plant success: parallel experiments in the native and introduced ranges. Ecology 91(5):1355–1366.	Moderate
	Insignificant

	Moderate (range Moderate - High)
	Low
	High
	High
Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	High

Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93. Valladares F., S. Arrieta, I. Aranda, D. Lorenzo, D. Sanchez-Gomez, D. Tena, F. Suarez, and J.A. Pardos. 2005. Shade tolerance, photoinhibition sensitivity and phenotypic plasticity of Ilex aquifolium in continental Mediterranean sites. Tree Physiology 25(8):1041–1052.	High
	Moderate
Thomas L.K. Jr. 1980. The impact of three exotic plant species on a Potomac island. US Department of the Interior, National Park Service, Washington, DC. National Park Service Scientific Monograph Series No. 13.	High

Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Moderate
	Low

McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	Moderate
	Moderate
	Moderate
	Moderate
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363.	High

Native Plant Society of Oregon (NPSO), Emerald Chapter. 2008. Exotic gardening and landscaping plants invasive in native habitats of the southern Willamette Valley, [Online]. In: Invasive plants--Invasive exotic plants list 2008. http://www.emeraldnpso.org/PDFs/Invas_Orn.pdf. Accessed: June 24, 2009.	Moderate
	Moderate
	Insignificant
	Insignificant
Asefa G. 2011. The dynamics of coexistence in annual plants. PhD Dissertation. Imperial College London, London, United Kingdom.	Insignificant

Gross E.M., H. Groffier, C. Pestelard, and A. Hussner. 2020. Ecology and environmental impact of Myriophyllum heterophyllum, an aggressive invader in European waterways. Diversity 12(4):127.	Moderate
Aiken S.G., P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds: 34. Myriophyllum spicatum L. Canadian Journal of Plant Science 59(1):201–215. Boylen C.W., L.W. Eichler, and J.D. Madsen. 1999. Loss of native aquatic plant species in a community dominated by Eurasian watermilfoil. Hydrobiologia 415(0):207–211. Madsen J.D., J.A. Sutherland, J.A. Bloomfield, L.W. Eichler, and C.W. Boylen. 1991. The decline of native vegetation under dense Eurasian watermilfoil canopies. Journal of Aquatic Plant Management 29:94–99. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	Moderate
	High

Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	High
Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024.	Low
	Low
This species tends to grow in trampled areas where few other plants will grow—structural impacts are insignificant.	Insignificant

Bolduan B.R., G.C. van Eeckhout, H.W. Quade, and J.E. Gannon. 1994. Potamogeton crispus–the other invader. Lake and Reservoir Management 10(2):113–125. Nichols S.A. and B.H. Shaw. 1986. Ecological life histories of the three aquatic nuisance plants, Myriophyllum spicatum, Potamogeton crispus and Elodea canadensis. Hydrobiologia 131(1):3–21. Woolf T.E. and J.D. Madsen. 2003. Seasonal biomass and carbohydrate allocations patterns in southern Minnesota curlyleaf pondweed populations. Aquat. Plant Manage 41:113–118.	Low
	Low
	Moderate
	Moderate
	Moderate
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	High
	Low

	Insignificant
	High
	High
	Moderate
	Insignificant
	Low
Collins B., G. Wein, and T. Philippi. 2001. Effects of disturbance intensity and frequency on early old field succession. Journal of Vegetation Science 12(5):721–728.	Moderate
	High

Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https:// bugwoodcloud.org/resource/files/23194.pdf Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	High
	Low
	Moderate

Urban R.A. and J.E. Titus. 2010. Exposure provides refuge from a rootless invasive macrophyte. Aquatic Botany 92(4):265–272. Urban R.A., J.E. Titus, and W.-X. Zhu. 2009. Shading by an invasive macrophyte has cascading effects on sediment chemistry. Biological Invasions 11(2):265–273.	Moderate
	Low
DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Water speedwell. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	Low
	Low

Question 20. Impact on Ecosystem Compositi

Q20 confidence rank	Q20 notes
Moderate (range Moderate - High)	
High	Ailanthus altissima is known to reduce native species abundance and diversity and can increase shade, which may in turn reduce certain diagnostic understory species. In addition, allelopathy may further reduce native species abundance and diversity (Knüsel, 2019; Demeter et al., 2021).
Moderate	This species has potential for high impacts on ecosystem composition if left unchecked.
Moderate	Occurances of Alopecurus pratensis can lead to loss of native bunchgrasses and forbs. It is capable of displacing native species, especially annuals.
Moderate (range Low - High)	Amorpha fruticosa likely reduces species richness where it occurs. However, arguably, regulation of the natural flow of the Columbia and competition from other invasive plant species (such as reed canarygrass) has had a more significant impact than A. fruticosa (NWCB, 2015).

Moderate (range Moderate - High)	Anthoxanthum odoratum is part of a suite of introduced perennial grasses that occur in Willamette Prairie and similar habitats. Introduced perennial grasses contribute reduction of plant community diversity and native plant diversity where they occur. In particular, Phalaris arundinacea is more productive when A. odoratum is present (Molofsky et al., 1999). Anthoxanthum odoratum can also prevent reestablishment of native plant species. However, at least in coastal prairie northern California, this plant does not appear to entirely exclude native plants, or significantly change species composition on its own (Brusati & Warner, 2004).
High	
Moderate	

High	In California, Arundo donax is known to reduce insect, bird, and reptile diversity, and habitats dominated by this species are avoided by predators such as coyotes and bobcats (Goolsby et al., 2023). In parts of southern California, loss of riparian canopy due to A. donax can be linked to declines of several fish species. Arundo donax supports less than 50% of the invertebrate diversity found in native habitats (McWilliams, 2004). Native species diversity increases when A. donax is removed (NWCB, 2013).
Moderate	Hemiparasitic plants, in general, may be able to change vegetation community composition or change the distribution of species in a community. A study in Japan found that B. viscosa was most likely to parasitize plants from the Fabaceae and Poaceae families (Suetsugu et al., 2012). In a study in Australia, B. viscosa preferred to parasitize annual species (Pate & Bell, 2000). Bellarida viscosa's preferred host in northern California, Acmispon americanus, is also an annual (Pickart & Wear, 1999). A study in Japan found that removing B. viscosa from the community increased aboveground biomass, particularly for grass and legume species, suggesting that B. viscosa can have a significant effect on the growth of their host plants. Compositional impacts were also attributed to the presence of B. viscosa (Suetsugu et al., 2012). However, in northern Californian dunes, this species occurred in low numbers and had only minor effects on co-occurring species (on par with natural succession) (Brusati & Corelli, 2005). The related species Parentucellia latifolia does not apparently cause obvious harm to its host plants (Pickart & Wear, 1999) This species is likely able to change the composition of vegetation communities at least somewhat, given the potential for negative effects on host plants. However, there is little evidence that this species has a significant effect on community diversity or composition in North America.

Moderate	
Moderate	
Low	There is not enough research to support strong conclusions about ecological impacts on ecosystem composition. However, this species' ability to colonize new habitat and potentially create suitable substrate for other aquatic plants is concerning. This attribute may facilitate other opportunistic invasive species (Gunderson et al., 2016).
High	Centaurea solstitialis can reduce native species abundance and diversity across trophic levels by displacing native plant species, reducing habitat and food for native animal species, and changing the composition of microbial communities (Innes & Zouhar, 2021). This species can also reduce biomass and diversity of co-occurring forbs, reducing both species richness and percent cover, likely due to allelopathy and water competition (Becerra et al., 2020).
Moderate	

Moderate (range Moderate - High)	Cirsium arvense frequently occurs in monospecific stands and is potentially allelopathic (Stachon & Zimdahl, 1980). Native species diversity and abundance is frequently reduced in areas where it occurs. Research suggests that C. arvense can alter soil microbial community composition. Changes in soil microbial community can benefit some plant species while inhibiting others, contributing to changes in vegetation community composition (Verbeek & Kotanen, 2019). Recent evidence suggests that C. arvense competes for pollinators and alters the structure of native plant-pollinator relationships. A study in Appalachian plant communities found pollinator visitation rates were reduced for all neighboring plants, and pollinator visitation for plants with radial symmetry was reduced community-wide in areas invaded by C. arvense (Daniels & Arceo-Gómez, 2020).
Moderate	This plant rarely grows with sufficient density to have a large impact on species composition.
Moderate	
High	
High	
Moderate	Cynoglossum officinale can outcompete native species and reduces rangeland quality for both livestock and wildlife (Jacobs & Sing, 2007). Plant species with significant chemical defenses against herbivory, like C. officinale, may have associational effects on their neighbors, and can either increase or decrease herbivory pressure on native species.
Moderate (range Moderate - High)	This species might use nutrients that native species also use, but the impact appears minor.

Moderate (range Moderate - High)	Dipsacus fullonum reduces the diversity and abundance of native species in the ecosystems in which it occurs. This species may also indicate reduced biotic integrity in riparian habitats, particularly related to changes in vertebrate and invertebrate composition (Ringold et al., 2008). However, it is unclear how much the loss in biotic integrity is due to the presence of invasive plants like D. fullonum, and how much is due to co-occurring factors, such as anthropogenic disturbance (Gucker, 2009). Abundance and density of D. fullonum is site-dependent. Monocultural stands of this species are more likely to develop in mesic areas. In drier areas, it seems to remain persistently low in cover and is only mildly competitive with natives, likely because these areas are at the edge of suitable habitat for D. fullonum.
Moderate	
High	
High	Hieracium pilosella has been observed to exclude native prairie species.
Moderate	When left untreated, Holcus lanatus populations can outcompete neighboring vegetation and will significantly reduce community biodiversity (Conner et al., 2013). This species changes soil communities, increasing bacteria, decreasing mycorrhizal fungi, and reducing detritivores. These effects on the soil community (particularly reduction of mycorrhizal fungi) continue, and can have larger effects on the plant community, even after removal of H. lanatus populations. For example, a study in California coastal prairie found Erigeron glaucas, a native forb, still experienced lower growth rates in areas where H. lanatus had been removed, likely because of the changes to the microbial community (Bennett et al., 2011). Holcus lanatus is part of a suite of introduced perennial grasses that reduce diversity of native plants in Willamette Prairie communities.

High	In Washington, native plant cover may be reduced or absent beneath dense Ilex aquifolium canopies (Stokes et al., 2014) and this species can all but eliminate native tree and shrub recruitment. In oak woodlands, I. aquifolium can occur with a suite of other invasives, including Cytisus scoparius and Rubus bifrons.
Moderate	This species is highly competitive and may significantly reduce the diversity and cover of native forbs and graminoids in wetlands where it occurs.
Moderate	This species grows as large vegetative clones that crowd out co-occurring native species, even competitive native species such Typha latifolia (Preece, 1964; Morgan, 2008).

Moderate	Jacobaea vulgaris is capable of displacing native plant species, reducing plant community diversity and the abundance and cover of beneficial plant species within a vegetation community (Jacobs, 2009). It can also displace herbivore pressure to more palatable species (Wardle, 1987). In grasslands and oak woodlands west of the Cascades, this species frequently occurs with other introduced and invasive species such as Cirsium vulgare, and a multitude of introduced perennial grasses.
Moderate	

High	Juncus effusus can reduce community composition and diversity through competition for light (Ervin & Wetzel, 2002).
Moderate	
High	
High	
Moderate	In its native range, Leucanthemum vulgare is frequently used in restoration projects to promote biodiversity. However, outside its native range, this species significantly reduces community diversity where it occurs (Coulson et al., 2001; Clements et al., 2004; Khan et al., 2021). A study in Kashmir also found that removal of L. vulgare from invaded meadows lead to increased species diversity (Khan et al., 2021).

Moderate	
Low (range Low - High)	Information regarding impacts to native plant species composition is contradictory and often based on untested hypotheses (Anderson, 1995; Hager & McCoy, 1998). Research has generally failed to demonstrate Lythrum salicaria impacts on native plant diversity and apparent monocultures may have had low species richness to start (Anderson, 1995; Treberg & Husband, 1999). While diversity impacts have not been proven, reductions in cover of dominant native species are readily apparent.
Low	Marrubium vulgare appears to have little impact on the composition, diversity, and cover of native plants in Washington. It may be more impactful in other parts of the world, such as Australia and Catalina Island, California (Weiss et al., 2000; California Invasive Plant Council (Cal-IPC), 2004).
High	
Moderate	The assessor has observed that this plant has trace cover in relevé surveys of Willamette prairie in Oregon, suggesting an insignificant change in community composition.

Low	As with the topics above, there is just not enough research on this topic. However, the information we do have suggests that this species can outcompete others native species (Dülger & Hussner, 2017; Gross et al., 2020).
Moderate	Eurasian watermilfoil invasion has been associated with declines in native species richness in several lakes where it has been studied intensively. However, when examining more infested lakes across the landscape this relationship is not supported (Mikulyuk et al., 2020). Hence, the plant community response to Eurasian watermilfoil invasions varies by lake and is not always negative. Moreover, native macrophyte species declines can be associated with other environmental changes such as reductions in water quality and disturbance that promote concurrent Eurasian watermilfoil invasion (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999; Verhoeven, 2022)
High	

High	Studies from Oregon and Wisconsin found that Phalaris arundinacea reduced community diversity and changed vegetation composition in wetlands (Waggy, 2010). This species reduces community diversity over time by displacing native species, with reportedly greater negative effects on graminoids than on forbs (Lavergne & Molofsky, 2004). Phalaris arundinacea also displaces even historically dominant native species (Lavergne & Molofsky, 2004). While Phalaris arundinacea may provide cover for a number of animal species, including wild ungulates, birds, fish and amphibians, only northern leopard frogs appear to prefer it over native vegetation (Waggy, 2010).
Low	In some cases, Phleum pratense can reduce community diversity and prevent establishment of native species. In Glacier National Park, this species is known to prevent establishment of native grasses and cryptograms (Tyser, 1992; Esser, 1993). An experiment in the French Alps found that a cultivar of P. pratense prevented a subset of co-occurring species from colonizing disturbed areas and reduced community diversity (Isselin Nondedeu & Bédécarrats, 2009).
Moderate	
High	

Low	Because of its early-season phenology in cooler climates, it doesn't directly compete with native species for very long. Infestations here in Washington and the Pacific Northwest do not appear to cause reductions in native species richness, but this has not been tested. Based on its ability to grow densely and rapidly, it is likely at least impacting the abundance of native species in infested waterbodies (Bolduan et al., 1994; Verhoeven et al., 2020).
Moderate	
High	
High	
Moderate	Often grows where there is typically little native vegetation.
High	Rubus bifrons can alter community structure by replacing native riparian shrubs and thickets, including native Rubus species. Rubus bifrons forms thick, monotypic stands of impenetrable brush that can reduce species diversity and significantly change the community composition of ecosystems it occurs in (Fryer, 2021). In Willamette Prairie habitats it reduces native species diversity and frequently occurs with other introduced species (including Jacobaea vulgaris, Cytisus scoparius, and numerous pasture grasses). Where forest understories have been disturbed, monocultural stands of R. bifrons can also outcompete diagnostic understory species like Polystichum munitum.
Moderate	Likely minor impacts to native plant composition.

Moderate	
High	
High	
Low	Washington populations are actively managed. If left unchecked, impacts may be higher.
High	This species might reduce recruitment for a year or two following major disturbance.
Moderate	
Low	In Washington, Solidago altissima usually occurs with other highly competitive species, and in habitats that may naturally be low diversity (T. Ramm-Granberg, pers. comm. 2025). However, in Europe and Asia, this species reduces plant community diversity where it occurs (Uesugi et al., 2019). This species can also drive an increase in generalist pollinators and herbivores that may spill over to other species. Studies done in Florida, in S. altissima's native range, have found that spillover from generalist herbivores can increase herbivory on neighboring plant species. Dense S. altissima stands can also hide neighboring species from their specialist pollinators or herbivores (Kim, 2017).
Moderate	This species shades diatoms, micro algae and eelgrasses and changes mudflats to high marsh through accumulation of silt. It also displaces salt marsh species.

Moderate	Tamarix reduces native species diversity where hydrologic conditions allow it to establish dominance. Invasive species such as Cirsium arvense and Rhaponticum repens are more common in association with Tamarix species than with native communities (Zouhar, 2003; Gafke et al., 2022).
Moderate	
Moderate	May reduce seedling recruitment for native species.

Moderate	While no information was available from Washington, a study from New York comparing changes in aquatic vegetation from 1933–2000 found increases in Utricularia inflata corresponded with decreases in native aquatic vegetation. Utricularia inflata was the most abundant species found in the target systems by 2000. The authors attributed the majority of changes in community composition to U. inflata's presence and abundance (Titus & Grisé, 2009). Given U. inflata's ability to shade out native species in other ecoregions, it seems likely that this species could have similar effects in Washington.
Moderate	This species could compete with natives but the impact is likely low.
Low	Little information was available on Veronica anagallis-aquatica's impact on ecosystem composition. It may shade out aquatic vegetation in some ecosystems (Riis et al., 2004), potentially reducing species diversity. However, V. anagallis-aquatica is often observed in naturally low-diversity ecosystem types (such as Columbia Plateau Basin Marshes).
Moderate	

ion (9 pts)	
Q20 citation	**Q21 ranks**
See numerous published sources.	Unknown
Demeter A., D. Saláta, E. Tormáné Kovács, O. Szirmai, P. Trenyik, S. Meinhardt, K. Rusvai, K. Verbényiné Neumann, B. Schermann, Z. Szegleti, and S. Czóbel. 2021. Effects of the invasive tree species Ailanthus altissima on the floral diversity and soil properties in the Pannonian Region. Land 10(11):1155. Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland.	Unknown
	Unknown
	Unknown
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	Unknown

Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Molofsky J., S.L. Morrison, and C.J. Goodnight. 1999. Genetic and environmental controls on the establishment of the invasive grass, Phalaris arundinacea. Biological Invasions 1:181–188.	Moderate
	Moderate
	NA

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Unknown
Brusati E. and T. Corelli. 2005. Parentucellia viscosa. https://www.cal-ipc.org/plants/paf/parentucellia-viscosa-plant-assessment-form/. Accessed: October 29, 2024. Pate J. and Bell. 2000. Host associations of the introduced annual root hemiparasite Parentucellia viscosa in agricultural and bushland settings in western Australia. Annals of Botany 85(2):203–213. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70. Suetsugu K., Y. Takeuchi, K. Futai, and M. Kato. 2012. Host selectivity, haustorial anatomy and impact of the invasive parasite Parentucellia viscosa on floodplain vegetative communities in Japan. Botanical Journal of the Linnean Society 170(1):69–78.	Insignificant

	Insignificant
	Unknown
Gunderson M.D., K.L. Kapuscinski, D.P. Crane, and J.M. Farrell. 2016. Habitats colonized by non-native flowering rush Butomus umbellatus (Linnaeus, 1753) in the Niagara River, USA. Aquatic Invasions 11(4):369–380.	Low
Becerra P.I., L. Cavieres, and R.O. Bustamante. 2020. Effect of the invasive exotic herb Centaurea solstitialis on plant communities of a semiarid ecosystem. Plant Ecology & Diversity 13(3–4):267–275. Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Unknown
	Unknown

Daniels J.D. and G. Arceo-Gómez. 2020. Effects of invasive Cirsium arvense on pollination in a southern Appalachian floral community vary with spatial scale and floral symmetry. Biological Invasions 22:783–797. Stachon W.J. and R.L. Zimdahl. 1980. Allelopathic activity of Canada Thistle (Cirsium arvense) in Colorado. Weed Science 28(1):83–86. Verbeek J.D. and P.M. Kotanen. 2019. Soil-mediated impacts of an invasive thistle inhibit the recruitment of certain native plants. Oecologia 190(3):619–628.	Moderate
	Unknown
	Insignificant
	Insignificant
	Insignificant
Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8.	Unknown
	Insignificant

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. Ringold P.L., T.K. Magee, and D.V. Peck. 2008. Twelve invasive plant taxa in US western riparian ecosystems. Journal of the North American Benthological Society 27(4):949–966.	Unknown
	Unknown
	NA
	NA
Bennett A.E., M. Thomsen, and S.Y. Strauss. 2011. Multiple mechanisms enable invasive species to suppress native species. American Journal of Botany 98(7):1086–1094. Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024.	Low

Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93.	Low
	Moderate
Morgan V.H. 2008. Fact sheet: Iris pseudacorus, [Online]. In: Nonindigenous Aquatic Species (NAS) database. General taxa information--Plants. Gainsville, FL: U.S. Department of the Interior, U.S. Geological Survey, Center for Aquatic Resource Studies. http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=1115. Accessed: May 18, 2009. Preece S.J. 1964. Iris pseudacorus in Montana. Proceedings of the Montana Academy of Sciences 24:1–4.	Moderate

Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Wardle D.A. 1987. The ecology of ragwort (Senecio jacobaea L.) - A review. New Zealand Journal of Ecology 10:67–76.	Low
	Insignificant

Ervin G.N. and R.G. Wetzel. 2002. Influence of a dominant macrophyte, Juncus effusus, on wetland plant species richness, diversity, and community composition. Oecologia 130(4):626–636.	Unknown
	Not Rated
	Insignificant
	Insignificant
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Coulson S.J., J.M. Bullock, M.J. Stevenson, and R.F. Pywell. 2001. Colonization of grassland by sown species: dispersal versus microsite limitation in responses to management. Journal of Applied Ecology 38(1):204–216. Khan M.A., K. Hussain, and M.A. Shah. 2021. Ecological restoration of habitats invaded by Leucanthemum vulgare that alters key ecosystem functions. PLOS ONE 16(3).	Unknown

	Unknown
Anderson M.G. 1995. Interactions between Lythrum salicaria and native organisms: a critical review. Environmental Management 19(2):225–231. Hager H.A. and K.D. McCoy. 1998. The implications of accepting untested hypotheses: a review of the effects of purple loosestrife (Lythrum salicaria) in North America. Biodiversity and Conservation 7(8):1069–1079. Treberg M.A. and B.C. Husband. 1999. Relationship between the abundance of Lythrum salicaria (purple loosestrife) and plant species richness along the Bar River, Canada. Wetlands 19(1):118–125.	Low
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	Insignificant
	Insignificant

Dülger E. and A. Hussner. 2017. Differences in the growth and physiological response of eight Myriophyllum species to carbon dioxide depletion. Aquatic Botany 139:25–31. Gross E.M., H. Groffier, C. Pestelard, and A. Hussner. 2020. Ecology and environmental impact of Myriophyllum heterophyllum, an aggressive invader in European waterways. Diversity 12(4):127.	High
Aiken S.G., P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds: 34. Myriophyllum spicatum L. Canadian Journal of Plant Science 59(1):201–215. Boylen C.W., L.W. Eichler, and J.D. Madsen. 1999. Loss of native aquatic plant species in a community dominated by Eurasian watermilfoil. Hydrobiologia 415(0):207–211. Madsen J.D., J.A. Sutherland, J.A. Bloomfield, L.W. Eichler, and C.W. Boylen. 1991. The decline of native vegetation under dense Eurasian watermilfoil canopies. Journal of Aquatic Plant Management 29:94–99. Mikulyuk A., E. Kujawa, N.E. Nault, S. van Egeren, K.I. Wagner, M. Barton, J. Hauxwell, and M.J. vander Zanden. 2020. Is the cure worse than the disease? Comparing the ecological effects of an invasive aquatic plant and the herbicide treatments used to control it. Facets 5(1):353–366. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64. Verhoeven M.R. 2022. Community assembly, invasion, and management of aquatic plant communities. PhD Dissertation. University of Minnesota, St. Paul, MN.	High
	NA

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Unknown
Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Isselin Nondedeu F. and A. Bédécarrats. 2009. Assessing the dominance of Phleum pratense cv. climax, a species commonly used for ski trail restoration. Applied Vegetation Science 12(2):155–165. Tyser R.W. 1992. Vegetation associated with two alien plant species in a fescue grassland in Glacier National Park, Montana. The Great Basin Naturalist 52(2):189–193.	Unknown
	Insignificant
	Insignificant

Bolduan B.R., G.C. van Eeckhout, H.W. Quade, and J.E. Gannon. 1994. Potamogeton crispus–the other invader. Lake and Reservoir Management 10(2):113–125. Verhoeven M.R., W.J. Glisson, and D.J. Larkin. 2020. Niche models differentiate potential impacts of two aquatic invasive plant species on native macrophytes. Diversity 12(4):162.	Unknown
	Insignificant
	NA
	Not Rated
	Not Rated
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Low
	Unknown

	Insignificant
	Not Rated
	Insignificant
	Unknown
	Insignificant
	NA
Kim T.N. 2017. How plant neighborhood composition influences herbivory: Testing four mechanisms of associational resistance and susceptibility. PLOS ONE 12(5):e0176499. Uesugi A., R. Johnson, and A. Kessler. 2019. Context dependent induction of allelopathy in plants under competition. Oikos 128(10):1492–1502.	Unknown
	Not Rated

Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https:// bugwoodcloud.org/resource/files/23194.pdf Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Unknown
	Not Rated
	Not Rated

Titus J.E. and D.J. Grisé. 2009. The invasive freshwater macrophyte Utricularia inflata (inflated bladderwort) dominates Adirondack Mountain lake sites. The Journal of the Torrey Botanical Society 136(4):479–486.	Unknown
	Unknown
Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	Unknown
	Insignificant

Question 21. Impact on Particular Native Spec

Q21 confidence ranks	Q21 notes
Not Rated	
Not Rated	The allelopathic nature of this species could potentially have outsized effects on particularly sensitive native species (Demeter et al., 2021; Knüsel, 2019).
Not Rated	
Not Rated	Alopecurus pratensis may shade out some species, particularly annuals.
Not Rated	Several rare plant species of the Columbia River drainage may be negatively impacted from loss of riverine habitat due to competition from Amorpha fruticosa. A partial list includes Rorippa columbiae, Artemisia campestris var. wormskioldii, Astragalus riparius, Ammannia robusta, Astragalus kentrophyta var. douglasii (TX/SX), Bergia texana (SX), Eleocharis coloradoensis, Schizachyrium scoparium, and Spiranthes diluvialis (WNHP, 2023). However, no information was provided on whether the impact is specific to these species, or part of the larger effect of A. fruticosa on the co-occurring plant community.

Moderate	At Rocky Prairie, Anthoxanthum odoratum is implicated in population declines of Castilleja levisecta, potentially by crowding out more suitable host plants. At this site, A. odoratum is being specifically targeted for removal and replaced with native Festuca roemeri to improve C. levisecta habitat (R. Johnson, pers. comm. 2025). Not all host plants provide equal benefit for Castilleja species, and the loss of appropriate host taxa can reduce or prevent reproduction in at least some Castilleja (Adler, 2003). Reduction in host plant quality combined with direct competition for space and other resources could make hemiparasitic taxa like Castilleja more vulnerable than co-occurring native taxa to invasion by introduced species. At a Willamette Prairie restoration site near Eugene, Oregon, A. odoratum has also been documented as a “significant threat” (in community with other invasive grasses) to L. bradshawii. Managers singled out A. odoratum in particular as a management target at that site. Lomatium bradshawii occurs in wet prairies in Clark County and is considered rare in both Oregon and Washington (Thorpe, 2011), suggesting potential concern for impact more broadly. However, few details on the specific impact A. odoratum might have on L. bradshawii were provided.
Moderate	Arrhenatherum elatius can crowd out the native host plants that Castilleja species prefer. Not all host plants provide equal benefit for Castilleja species, and the loss of appropriate host taxa can reduce or prevent reproduction in at least some Castilleja (Adler, 2003). Reduction in host plant quality combined with direct competition for space and other resources could make hemiparasitic taxa like Castilleja more vulnerable than co-occurring native taxa to invasion by introduced species.
NA	

Not Rated	While Arundo donax currently does not affect any particular native species in Washington, it has potential to do so. In California, A. donax invasions reduces suitable native habitat for two species of endangered birds, the Southwestern Willow Flycatcher and the Least Bell's Vireo. In Monterrey, Mexico, A. donax may have led to the local extinction of a rare fish species (NWCB, 2013; Goolsby et al., 2023). No information was available on whether the impact on these species were greater than the impact on co-occurring species with similar habitat requirements.
Moderate	This species does not appear capable of outcompeting co-occurring native species on its own. However, increases in the abundance of annual species can degrade habitat for perennial hemiparasites like Castilleja levisecta, by reducing the number of suitable host species available in a community. Invasive plant species on dunes can potentially be a threat to plant species that require open, shifting sand for habitat. However, Bellardia viscosa does not contribute to dune stabilization. Parasitic plant species have been implicated in declines of plant species in some cases (Pickart & Wear, 1999), but there is no evidence suggesting that B. viscosa has caused declines of other plant species in North America.

High	
Not Rated	
Low	There is not enough evidence to suggest high impacts to specific native plant species, but it's likely that species with similar growth forms (like hard stem bulrush) and habitats will be impacted (Marko et al., 2015; Gunderson et al., 2016).
Not Rated	Centaurea solstitialis is described as a threat to some rare native plants, including the federally endangered Silene spaldingii, which is present in southeastern Washington (Innes & Zouhar, 2021; WNHP, 2024). However, absent further details and given C. solsitialis' high impact on community composition, it is difficult to say if any particular species is more strongly affected by C. solstitialis than the co-occurring plant community.
Not Rated	

High	Cirsium arvense serves as the host plant for weevil species that will attack native thistles (Louda & O'Brien, 2002) and can potentially hybridize with another native thistle (C. hookerianum) (NWCB, 2024b).
Not Rated	
Low	
Moderate	
Low	
Not Rated	No information was found about disproportionate direct effects of Cynoglossum officinale on particular native species in Washington. However, biocontrol agents are not currently approved for use on this species in the U.S. because of concerns about spillover effects on co-occurring native Boraginaceae species in the U.S. (Duncan & Williams, 2020). One of the assessors has observed what are likely illegally introduced populations of one of these biocontrol agents (a weevil) growing in abundance near Cle Elum.
High	

Not Rated	No information was found on species-specific effects of Dipsacus fullonum on native species in Washington State. Sources did note this species as a threat to rare plants, but effects were mostly community-wide (Gucker, 2009), such as light competition or potentially pollinator competition (based on observations during bumblebee surveys in eastern Washington.) Seeds from this species can make up a meaningful percentage of the late season diet for a number of wildlife species (upland game birds and small mammals) (Gucker, 2009).
Not Rated	
NA	
NA	
Low	Holcus lanatus is part of a suite of introduced perennial grasses that threaten rare butterflies such as the Taylor's Checkerspot and Mardon Skipper that depend on open prairie-oak grasslands and savannas for habitat. Holcus lanatus can crowd out or hide host species important for butterfly larvae (Schultz et al., 2011).

Moderate	Ilex aquifolium can be a host for the invasive plant pathogen sudden oak death (Phytophthora ramorum) (NWCB, 2022; USDA APHIS, 2024). No data was available on how this changed disease burden in oaks. However, at least one study found this disease to be common in the Pack Research Forest in western Washington (Church, 2016).
Moderate	Impatiens capensis is known to hybridize with native I. ecornuta (Zika, 2020).
Moderate	

Low	In Oregon, the rare plant Sidalcea hirtipes (which is also present in southwestern Washington (WNHP, 2024) showed a 40% increase in seed production after J. vulgaris biocontrols were released (Richardson, 2004). However, no information was found on whether this apparent effect on reproduction was a result of direct interaction between the two species, or part of a community wide response to reduction in J. vulgaris populations. In Oregon, the rare plant Sidalcea hirtipes (which is also present in southwestern Washington (WNHP, 2024) showed a 40% increase in seed production after J. vulgaris biocontrols were released (Richardson, 2004). However, no information was found on whether this apparent effect on reproduction was a result of direct interaction between the two species, or part of a community wide response to reduction in J. vulgaris populations. Jacobaea vulgaris may also have the potential to interfere with pollination of Senecio or Packera species, but little evidence is available to confirm this. (Richardson, 2004). One of the successful biocontrol agents for J. vulgaris, Tyria jacobaeae (cinnabar moth), reportedly feeds on native Senecio and Packera species after exhausting local J. vulgaris populations (Jacobs, 2009). Jacobaea vulgaris may have a positive effect as a nectar source for the federally threatened butterfly Speyeria zerene hippolyta (Oregon silverspot) (Richardson, 2004), though there was no information on the quality or importance of this species as a nectar plant.
Moderate	

Not Rated	No information was found regarding potential effects of Juncus effusus ssp. effusus on individual native species. Future research on impacts to native Juncus effusus subspecies would be valuable.
Not Rated	
Moderate	
Moderate	
Not Rated	Leucanthemum vulgare is one of the most abundant introduced forbs in Willamette Prairies restored for and managed for threatened and endangered plant species such as Lupinus oreganus, Sidalcea nelsoniana, and Castilleja levisecta. The height and abundance of this species may obscure host plants from rare butterfly species (e.g., Taylor's checkerspot). In Washington, federal and state endangered species list candidate Lathyrus holochlorus occurs with Leucanthemum vulgare, and competition with introduced species is a significant threat to this species (Fertig, 2020). However, it seems likely that L. vulgare's documented effects on native species in Washington are due to community-wide impacts and not direct interactions between species.

Not Rated	
Low	Lythrum salicaria hybridizes with Lythrum alatum (native in central and eastern North America) (Houghton-Thompson et al., 2005), but there are no native Lythrum species in Washington. There are many hypotheses regarding Lythrum salicaria impacts on various native animal and plant species (e.g., Bury, 1979), but the assessors found no strong evidence for disproportionate impacts on individual species.
Not Rated	
High	
Moderate	The abundance of annual plants is a concern in Castilleja levisecta habitat, as annuals are poor hosts. An overabundance of annuals can reduce C. levisecta habitat quality and individual survival. However, Myosotis discolor is usually only a trace component of these communities, and its effects on species like C. levisecta are more likely as a minor component of a larger community shift, not because of Myosotis discolor's presence alone.

Moderate	This plant hybridizes with the native Myriophyllum hippuroides, an uncommon species in Washington and a Pacific Northwest endemic. Hybridization could lead to the reduction of native gene pools. Many new hybrid populations have been found in Clark County, Washington and ongoing research will help shed light on these taxa (Thum et al., 2011).
High	Eurasian watermilfoil hybridizes readily with native northern watermilfoil (Myriophyllum sibirium) (Moody & Les, 2002; Eltawely et al., 2020; Thum et al., 2020). Many hybrid genotypes have been found, indicating routine hybridization events. Hybridization occurs in Washington and is likely more widespread than currently known. Continued spread of Eurasian watermilfoil and hybridization may deplete the pure gene pool of northern watermilfoil and ultimately cause local or regional extinction.
NA	

Not Rated	Phalaris arundinacea may have greater impact on co-occurring graminoids than forbs (Lavergne & Molofsky, 2004). This species also potentially displaces rare native plants in the Pacific Northwest, including Sidalcea nelsoniana and Howellia aquatilis, which both occur in Washington (Lavergne & Molofsky, 2004; Waggy, 2010). However, it seems likely that these rare taxa are being displaced as part of a community as opposed to being more vulnerable than co-occurring species to P. arundinacea encroachment.
Not Rated	Phleum pratense provides cover for small animals, particularly game birds and waterfowl, throughout its range. It can also provide significant forage for big game animals (Esser, 1993). Bees, including native bumblebees, and syrphids have been documented feeding on P. pratense in North America. In Maine, Bombus species were observed actively collecting P. pratense pollen, and on average greater than 70% of the pollen they carried was from this species. The value and nutrition of P. pratense pollen for bees is not known, but this species is also frequently included in pollinator mixes (Rivernider et al., 2017).
High	Plantago lanceolata has a positive effect on some native species—it is currently the main larval host for the federally listed Taylor's Checkerspot butterfly. Some land managers plant this species just for the butterfly, as its host range is extremely limited.
High	

Not Rated	The assessor was not aware of impacts to particular native species.
High	
NA	
Not Rated	
Not Rated	
Moderate	Rubus bifrons is part of a suite of invasive species that threaten rare butterflies such as the Taylor's Checkerspot that depend on open prairie-oak grasslands and savannas for habitat. Rubus bifrons converts grasslands to shrublands and can smother host species important for butterfly larvae (Schultz et al., 2011). Rubus bifrons has many flowers and can flower for several months, potentially competing with native species for pollinators (Shelby & Peterson, 2015). In a study from Ferndale, Washington, R. bifrons pollen was the most common heterospecific pollen found on Sidalcea hendersonii stigma. Receiving R. bifrons pollen did not apparently limit seed set in this species, but this may not be the case for other species (Shelby & Peterson, 2015). Rubus bifrons was most commonly visited by honeybees, potentially disrupting or displacing native pollinators, which could also have additional adverse effects on native plant communities (Shelby & Peterson, 2015). On the other hand, Rubus bifrons' showy flowers, generalist pollinator syndrome, and persistence in disturbed areas could potentially be beneficial to native pollinators and increase pollinator visits to neighboring native plants. Information from California suggests that R. bifrons can provide cover for many native animal species, but was also found to be preferred shelter for the invasive black rat, which can have a significant impact on native bird populations (Cal-IPC, 2004; Fryer, 2021).
Not Rated	This species may impact Trillium parviflorum, but impacts are not likely to be disproportionate.

Moderate	
Not Rated	
Moderate	
Not Rated	
High	
NA	
Not Rated	No information on S. altissima impacts to particular native species in Washington is available. However, this species is a model organism for testing associational effects on co-occurring plant species (e.g., Kim, 2017). These studies tend to focus on how S. altissima affects herbivory damage or pollination success in co-occurring plant species, and spillover effects have been demonstrated on Solanum carolinense, which overlaps S. altissima's native range. Solidago altissima likely has a reduced insect community outside of its native range (Etterson et al., 2008), so there may be less impact on abundance and behavior of insect herbivores and pollinators where it occurs in its invasive range.
Not Rated	

Not Rated	No information was available for the impact of Tamarix invasions on particular Washington species. However, where Tamarix is abundant in the southwest, it can provide habitat for the federally endangered Southwest Willow Flycatcher, complicating efforts to treat Tamarix invasions (Stromberg et al., 2007; Gafke et al., 2022).
Not Rated	
Not Rated	

Not Rated	No impacts on particular native species in Washington were found in the literature search, but in the northeast, Utricularia inflata may be contributing to extirpation of some native aquatic plant species from lakes where it occurs (Urban & Dwyer, 2016). Utricularia species are also known to hybridize with each other (e.g. Wiebush, 2022) but no information was found on U. inflata hybridizing with native Utricularia species in Washington.
Not Rated	
Not Rated	Veronica anagallis-aquatica has been studied as a bioaccumulator and can immobilize heavy metals such as cadmium. This could potentially have a negative effect on species that feed on V. anagallis-aquatica and concentrate heavy metals up the food chain (Ribeiro et al., 2022). A study in Japan found potential pollinator competition between V. anagallis-aquatica and a co-occurring native Veronica species (Saito & Kadono, 2021), though more research is needed to conclusively show that pollinator competition was the factor resulting in decreased seed set in both species.
Moderate	

ies (3 pts)	
Q21 citation	**Q22 ranks**
	Low (range Low - High)
Demeter A., D. Saláta, E. Tormáné Kovács, O. Szirmai, P. Trenyik, S. Meinhardt, K. Rusvai, K. Verbényiné Neumann, B. Schermann, Z. Szegleti, and S. Czóbel. 2021. Effects of the invasive tree species Ailanthus altissima on the floral diversity and soil properties in the Pannonian Region. Land 10(11):1155. Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland.	Moderate
	Unknown
	Moderate
Washington Natural Heritage Program (WNHP). 2023. Online Field Guide to the Rare Plants of Washington. https://fieldguide.mt.gov/wa/. Accessed: December 29, 2023.	Moderate

Adler L.S. 2003. Host species affects herbivory, pollination, and reproduction in experiments with parasitic Castilleja. Ecology 84(8):2083–2091. Thorpe A.S. 2011. Controlling exotic grasses while maintaining native plant communities in fire-maintained wet prairies. Prepared by Institute for Applied Ecology for U.S. Army Corps of Engineers, Willamette Valley Projects, Corvallis, OR.	Low
Adler L.S. 2003. Host species affects herbivory, pollination, and reproduction in experiments with parasitic Castilleja. Ecology 84(8):2083–2091.	Low
	Insignficant

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Low
Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70.	Low

	Insignficant
	Low
Gunderson M.D., K.L. Kapuscinski, D.P. Crane, and J.M. Farrell. 2016. Habitats colonized by non-native flowering rush Butomus umbellatus (Linnaeus, 1753) in the Niagara River, USA. Aquatic Invasions 11(4):369–380. Marko M.D., J.D. Madsen, R.A. Smith, B. Sartain, and C.L. Olson. 2015. Ecology and phenology of flowering rush in the Detroit Lakes Chain of Lakes, Minnesota. J Aquat Plant Manage 53:54–63.	High
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024. Washington Natural Heritage Program (WHNP). 2024. Spalding's catchfly - Silene spaldingii. Washington Field Gude. https://fieldguide.mt.gov/wa/?species=silene%20spaldingii. Accessed: October 2, 2024.	Moderate
	Moderate

Louda S.M. and C.W. O'Brien. 2002. Unexpected ecological effects of distributing the exotic weevil, Larinus planus (F.), for the biological control of Canada Thistle. Conservation Biology 16(3):717–727. Noxious Weed Control Board (NWCB). 2024b. Cirsium arvense, Canada thistle. https://www.nwcb.wa.gov/weeds/canada-thistle. Accessed: December 23, 2024.	Moderate
	Moderate
	Low
	Low
	Moderate
Duncan S.S. and J.L. Williams. 2020. Life history variation in an invasive plant is associated with climate and recent colonization of a specialist herbivore. American Journal of Botany 107(10):1366–1374.	Moderate
	Low (range Low - Moderate)

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	Moderate (range Low - Moderate)
	Low
	High
	Low
Schultz C.B., E. Henry, A. Carleton, T. Hicks, R. Thomas, A. Potter, M. Collins, M. Linders, C. Fimbel, S. Black, H.E. Anderson, G. Diehl, S. Hamman, R. Gilbert, J. Foster, D. Hays, D. Wilderman, R. Davenport, E. Steel, N. Page, P.L. Lilley, J. Heron, N. Kroeker, C. Webb, and B. Reader. 2011. Conservation of prairie-oak butterflies in Oregon, Washington, and British Columbia. Northwest Science 85(2):361–388.	Moderate

Church E.D. 2016. Invasive English holly (Ilex aquifolium L.) in clear-cut and forest units in a western Washington managed forest. MS Thesis. University of Washington, Seattle, WA. Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board. USDA APHIS. 2024. Phytophthora ramorum. https://www.aphis.usda.gov/plant-pests-diseases/pramorum. Accessed: October 9, 2024.	High
Zika P. 2020. Impatiens capensis Meerb., spotted jewelweed. https://oregonflora.org/taxa/index.php?tid=5723. Accessed: January 31, 2025.	Low
	Moderate

Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024. Washington Natural Heritage Program (WNHP). 2024. Bristly-stemmed checkermallow - Sidalcea hirtipes. Washington Field Guide. https://fieldguide.mt.gov/wa/?species=sidalcea%20hirtipes. Accessed: October 14, 2024.	Low
	Low

	Low
	Moderate
	Low
	Low
Fertig W. 2020. Potential federal candidate plant species of Washington: Lathyrus holochlorus (thin-leaved peavine). Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA. Report 2020-1.	Low

	Moderate
Bury B.R. 1979. Review of the ecology and conservation of the bog turtle, Clemmys muhlenbergii. US Department of the Interior, Fish and Wildlife Service, Washington, DC. Special Scientific Report--Wildlife No. 219. Houghton-Thompson J., H.H. Prince, J.J. Smith, and J.F. Hancock. 2005. Evidence of hybridization between Lythrum salicaria (purple loosestrife) and L. alatum (winged loosestrife) in North America. Annals of Botany 96(5):877–885.	Moderate (range Low - High)
	Low
	Low
	Low

Thum R.A. and J.T. Lennon. 2010. Comparative ecological niche models predict the invasive spread of variable-leaf milfoil (Myriophyllum heterophyllum) and its potential impact on closely related native species. Biological Invasions 12:133–143.	High
Eltawely J.A., R.M. Newman, and R.A. Thum. 2020. Factors influencing the distribution of invasive hybrid (Myriophyllum spicatum x M . sibiricum). Diversity 12(3):120. Moody M.L. and D.H. Les. 2002. Evidence of hybridity in invasive watermilfoil (Myriophyllum) populations. Proceedings of the National Academy of Sciences of the United States of America 99(23):14867–14871. Thum R.A., G.M. Chorak, R.M. Newman, J.A. Eltawely, J. Latimore, E. Elgin, and S. Parks. 2020. Genetic diversity and differentiation in populations of invasive Eurasian (Myriophyllum spicatum) and hybrid (Myriophyllum spicatum × Myriophyllum sibiricum) watermilfoil. Invasive Plant Science and Management 13(2):59–67.	High
	Low

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Moderate (range Moderate - High)
Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Rivernider R., E. Venturini, and F.A. Drummond. 2017. Phleum pratense (Poales: Poaceae), a pollen forage for native bumble bees Bombus Latrielle (Hymenoptera: Apidae). Journal of the Kansas Entomological Society 90(1):63–68.	Moderate
	Low
	Insignficant

	High
	Low
	Low
	Moderate
	Insignficant
Cal-IPC. 2004. Rubus armeniacus Plant Assessment Form. https://www.cal-ipc.org/plants/paf/rubus-armeniacus-plant-assessment-form/. Accessed: June 27, 2024. Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024. Schultz C.B., E. Henry, A. Carleton, T. Hicks, R. Thomas, A. Potter, M. Collins, M. Linders, C. Fimbel, S. Black, H.E. Anderson, G. Diehl, S. Hamman, R. Gilbert, J. Foster, D. Hays, D. Wilderman, R. Davenport, E. Steel, N. Page, P.L. Lilley, J. Heron, N. Kroeker, C. Webb, and B. Reader. 2011. Conservation of prairie-oak butterflies in Oregon, Washington, and British Columbia. Northwest Science 85(2):361–388. Shelby N. and M.A. Peterson. 2015. Despite extensive pollinator sharing, invasive blackberry has negligible impacts on reproductive success of a rare native wildflower. Northwest Science 89(1):47–57.	Moderate (range Moderate - High)
	Moderate

	Insignficant
	Low
	Insignficant
	Low
	Insignficant
	Low
Etterson J.R., D.E. Delf, T.P. Craig, Y. Ando, and T. Ohgushi. 2008. Parallel patterns of clinal variation in Solidago altissima in its native range in central USA and its invasive range in Japan. Botany 86(1):91–97. Kim T.N. 2017. How plant neighborhood composition influences herbivory: Testing four mechanisms of associational resistance and susceptibility. PLOS ONE 12(5):e0176499.	Low
	Moderate

Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https:// bugwoodcloud.org/resource/files/23194.pdf Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393.	Low
	Low
	Low

Urban R.A. and M.E. Dwyer. 2016. Asexual reproduction and its potential influence on the distribution of an invasive macrophyte. Northeastern Naturalist 23(3):408–419. Wiebush M. 2022. Utricularia intermedia Hayne, flat-leaved bladderwort. California Native Plant Society, Sacramento, CA. Online: https://rareplantfiles.cnps.org/scc/UtricularIaIntermediaSpAcctSCC20220408r.pdf	High
	Insignficant
Ribeiro C., A. Almeida, and C. Couto. 2022. Aquatic macrophytes as bioindicators of heavy metals contamination in estuarine ecosystems. Scientific Letters 1(5):1–10. Saito R. and Y. Kadono. 2021. Reproductive interference between an alien species, Veronica anagallis-aquatica L., and a native congener, Veronica undulata Wallich (Plantaginaceae): A field observation. Acta Phytotax. Geobot. 72(3):293–300.	Low
	Insignficant

Question 22. Observed Ability to Invade Undisturbed Ec	
Q22 confidence ranks	**Q22 notes**
Moderate (range Moderate - High)	Acer negundo is mainly seen in areas of human or natural disturbance (e.g. old homesteads, riparian areas) and does not appear to spread very far from those areas (D. Wilderman, pers. comm. 2024).
Moderate	Ailanthus altissima is mostly thought of as a disturbance-dependent species, however, studies have shown that it can germinate and establish in certain portions of undisturbed (or only mildly disturbed) ecosystems. It can establish in rocky areas (such as talus fields) and once established quickly spread by vegetative reproduction into denser vegetation (Knüsel, 2019).
Not Rated	This species might have the potential to invade intact systems if left unchecked.
Low	While the assessor has not observed Alopecurus pratensis establishing in undisturbed ecosystems, at Lacamas Prairie this species does appear to be spreading to areas where it was previously uncommon. However, in Oregon this species has been observed establishing in native-dominated meadows that are maintained by hydrological conditions rather than frequent disturbance (Neugarten & Elseroad, 2006).
Moderate	

High	Anthoxanthum odoratum can occasionally germinate in or invade undisturbed sites, and adult plants can survive without disturbance. However, germination in these conditions likely relies on limited competition from co-occurring species (Brusati & Warner, 2004).
Moderate	Arrhenatherum elatius impacts native ecosystems and conservation areas that depend on disturbance. This species has a high impact on Puget prairies, which depend on disturbance; but elsewhere it is a relatively manageable nonnative pasture grass.
Moderate	

Moderate	Arundo donax can be an early colonizer or a late successional species (McWilliams, 2004), but appears to rely on disturbance to facilitate invasion (Goolsby et al., 2023).
Moderate	Research suggests that Bellardia viscosa has been able to invade relatively undisturbed habitats in Australia (Pate & Bell, 2000), but the type of disturbance discussed in this study was unclear (anthropogenic or all types of disturbance). In the Pacific Northwest, this species is primarily found in areas receiving natural or human disturbance.

Moderate	
High	
High	While it can act as a pioneer species, it clearly also establishes in existing native plant communities (Gunderson et al., 2016; Madsen et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).
Moderate	Centaurea solstitialis can invade undisturbed habitats if neighboring populations provide high propagule pressure, but they are more successful in disturbed habitats (Innes & Zouhar, 2021).
Low	

Moderate (range Low - High)	Cirsium arvense rarely spreads into undisturbed forests or mature, intact native ecosystems, and maintaining natural communities is recommended as the best defense against this species. However, in Yellowstone National Park, C. arvense was found across all disturbance regimes, though abundance increased as disturbance did. This species can also establish in wet meadows from nearby populations, as well as establishing in disturbed patches within old-growth forests (Zouhar, 2001). In Washington, populations of this species have been observed growing densely amid competitive species such as snowberry under a mature aspen stand and in reed canarygrass fields. This indicates that this species can, at least occasionally, establish in competitive and mature vegetation (or requires only a small natural disturbance to establish).
Moderate	
Moderate	
Moderate	Cotoneaster species appear to be weeds of disturbed edges, and occasionally abandoned roadsides, but they are generally not found in undisturbed ecosystems.
Moderate	
Moderate	Cynoglossum officinale establishes in areas that experience localized disturbance, and likely needs bare ground for seeds to germinate on (de Jong et al., 1990). This species is not likely to establish in undisturbed areas, but could take advantage of small-scale disturbances in mid or late successional habitats with appropriate light and moisture conditions.
High (range Moderate - High)	

Moderate (range Moderate - High)	Dipsacus fullonum is most common in disturbed areas, but it is occasionally capable of invading established native communities by taking advantage of small disturbances (e.g., frost heaves, rodent burrows) (Gucker, 2009). This species can establish, but will not persist in forest openings, usually disappearing as the canopy closes. Dipsacus fullonum will establish and persist in open riparian areas regardless of successional stage.
Moderate	
High	
High	Hieracium pilosella establishes in disturbed ecosystems.
Moderate	Holcus lanatus can invade at least some grasslands without disturbance to aid establishment (e.g., Bromus carinatus dominated areas in California's coastal prairies) (Thomsen & D'Antonio, 2014). Seed banks for this species can be extensive in both disturbed and undisturbed sites throughout its range, and increase in propagule pressure can increase likelihood of establishment in undisturbed areas (Gucker, 2009; Thomsen & D'Antonio, 2014).

High	Ilex aquifolium is described as a late successional species in its native range (Arrieta & Suárez, 2004) and has been documented as naturalized in old-growth forests west of the Cascades (Zika, 2010).
Moderate	
Moderate	

High	Intact plant communities are resistant to invasion by Jacobaea vulgaris, but this species can establish in small disturbances (e.g., gopher burrows) and then serve as a vector for increased abundance (Richardson, 2004).
Moderate	

Moderate	Juncus effusus relies on disturbance to create suitable substrate for establishment. Field staff have only observed high cover of Juncus effusus ssp. effusus in highly disturbed ecosystems (T. Ramm-Granberg, pers. comm. 2025). However, this taxon's long-lived seedbank may allow it to take advantage of one time disturbances to establish in mid- and late-successional habitats (Lazenby, 1955; Ervin & Wetzel, 2000; McCorry & Renou, 2003).
Moderate	
High	This species establishes best with some level of disturbance.
High	This species establishes best with some level of disturbance.
Moderate	Leucanthemum vulgare is an early colonizer of disturbed sites. It may occasionally invade undisturbed sites, but usually needs disturbance to establish (Clements et al., 2004; Brusati, 2005).

Moderate	This plant can establish and survive in late-successional ecosystems of a variety of disturbance regimes (Innes, 2011), but likely requires at least minor, one-time soil disturbance to become established.
Moderate	This plant is most pervasive in ecosystems that experience regular disturbance. However, it may establish in relatively low-disturbance ecosystems following one-off events and then persist for very long periods with low-level recruitment (Thompson et al., 1987; Anderson, 1991).
High	This species requires disturbance to establish and has only been observed to reach significant foliar cover in naturally disturbed ecosystems, or in localized areas of soil disturbance (foot traffic, turkey scratches, invasive treatment areas, etc.).
Moderate	
Moderate	Based on habitat preferences, Myosotis discolor likely needs either natural or anthropogenic disturbance to establish.

High	Based on the data from Ecology and a handful of other sources, these plants seem to be able to establish in lakes with intact and healthy native plant populations (Gross et al., 2020; Washington State Department of Ecology, 2024).
High	While Eurasian watermilfoil establishes most readily in recently disturbed areas, it can establish in mature plant beds (Aiken et al., 1979; Smith & Barko, 1990).
Moderate	

Moderate	Phalaris arundinacea is described as an aggressive invader by multiple sources and does not require disturbance to establish (Magee et al., 1999; Waggy, 2010).
Low	At least some sources suggest that Phleum pratense can invade undisturbed forest, grassland, and tundra habitats (Esser, 1993; Ogle et al., 2011). However, invasion of neighboring vegetation communities may only occur in a limited number of circumstances (Esser, 1993; Ogle et al., 2011).
High	This species is fairly disturbance dependent, and it seems to persist best in compacted soil along trails and roadsides.
High	This species requires disturbance.

High	This plant readily spreads to waterbodies that are otherwise undisturbed (Washington State Department of Ecology, 2023).
High	Generally spreads into undisturbed ecosystems via birds and squirrels.
Moderate	
Moderate	
Moderate	
Moderate	Rubus bifrons is an aggressive invader, and can establish in late successional habitats, though usually by taking advantage of natural disturbances within those habitats.
Moderate	

High	Often establishes in disturbed portions of native plant communities, but rarely persists without ongoing disturbance or severe soil compaction.
High	This plant may establish and persist in undisturbed natural ecosystems, but only when spreading from adjacent cultivation or dumped vegetative fragments.
Moderate	
Moderate	At this time, this plant is primarily a weed in agricultural settings and highly disturbed wetlands (Center for Invasive Species and Ecosystem Health, 2010).
High	
High	Solanum dulcamara will establish in disturbed areas, but generally does not spread or persist without ongoing disturbance.
Moderate	This species does not persist under closed canopies and likely needs disturbance to establish (Meyer & Schmid, 1999; Park et al., 2020). All locations where it has been observed in Washington are anthropogenically disturbed.
Moderate	This species is not as competitive in established saltmarsh vegetation as it is in more frequently flooded sites, such as mudflats.

Moderate	Tamarix is shade intolerant and depends on floods or human disturbance to create suitable germination conditions (Zouhar, 2003). Given these traits, Tamarix species' ability to invade intact undisturbed areas is likely limited.
Moderate	
High	This species establishes and persists in disturbance-dependent ecosystems only.

Moderate	Disturbance responses were not discussed in most of the literature available on Utricularia inflata. However, based on descriptions of U. inflata invasions in New York, it seems likely that this species is capable of invading undisturbed ecosystems when the habitat is suitable. Other ecological factors are likely more important for determining where this species is capable of invading an ecosystem (Titus & Grisé, 2009; Urban et al., 2009; Urban & Titus, 2010; Titus & Urban, 2013; Urban & Dwyer, 2016).
Moderate	
Moderate	This plant is occasionally observed in laggs surrounding bogs, but generally only when hydrological conditions have been altered. It may establish in relatively undisturbed aquatic systems. However, this species is most frequent in naturally disturbed ecosystems such as riparian areas, or basin marshes that have large water-level fluctuations.
Moderate	

cosystems (15 pts)	
Q22 citation	**Q23 ranks**
	Yes
Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland.	Yes
	Yes
Neugarten R. and A. Elseroad. 2006. The response of meadow foxtail, Alopecurus pratensis, to a prescribed burn at Sycan Marsh: Pre-burn report. Unpublished Report. The Nature Conservancy.	Yes
	Yes

Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024.	Yes
	Yes
	Yes

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024.	Yes
Pate J. and Bell. 2000. Host associations of the introduced annual root hemiparasite Parentucellia viscosa in agricultural and bushland settings in western Australia. Annals of Botany 85(2):203–213.	Yes

	No
	Yes
Gunderson M.D., K.L. Kapuscinski, D.P. Crane, and J.M. Farrell. 2016. Habitats colonized by non-native flowering rush Butomus umbellatus (Linnaeus, 1753) in the Niagara River, USA. Aquatic Invasions 11(4):369–380. Madsen J.D., B. Sartain, G. Turnage, and M.D. Marko. 2016. Management of flowering rush in the Detroit Lakes, Minnesota. J. Aquat. Plant Manage 54:61–67. Marko M.D., J.D. Madsen, R.A. Smith, B. Sartain, and C.L. Olson. 2015. Ecology and phenology of flowering rush in the Detroit Lakes Chain of Lakes, Minnesota. J Aquat Plant Manage 53:54–63.	Yes
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes
	Yes

Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes
	Yes
	Yes
	Yes
	Yes
de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144.	Yes
	Yes

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	Yes
	Yes
	Yes
	Yes
Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024. Thomsen M.A. and C.M. D'Antonio. 2014. How does simulated gopher disturbance affect the establishment of Holcus lanatus L. (Poaceae) in California Coastal Prairie? Madroño 61(2):218–226.	Yes

Arrieta S. and F. Suárez. 2004. Germination and seed bank depletion of holly (Ilex aquifolium L.) in four microhabitat types. Seed Science Research 14(3):305–313. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	Yes
	Yes
	Yes

Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Yes
	NA

Ervin G.N. and R.G. Wetzel. 2000. Allelochemical autotoxicity in the emergent wetland macrophyte Juncus effusus (Juncaceae). American Journal of Botany 87(6):853–860. Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	Yes
	Yes
	Yes
	Yes
Brusati E. 2005. Plant assessment form: Leucanthemum vulgare. California Invasive Plant Council (CAL-IPC). https://www.cal-ipc.org/plants/paf/leucanthemum-vulgare-plant-assessment-form/. Accessed: October 22, 2024. Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363.	Yes

Innes R.J. 2011. Lysimachia nummularia. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/lysnum/all.html#113. Accessed: February 1, 2024.	Yes
Anderson M.G. 1991. Population structure of Lythrum salicaria in relation to wetland community structure. University of New Hampshire, Durham, NH. Thompson D.Q., R.L. Stuckey, and E.B. Thompson. 1987. Spread, impact, and control of purple loosestrife (Lythrum salicaria) in North American wetlands. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.	Yes
	Yes
	Yes
	Yes

Gross E.M., H. Groffier, C. Pestelard, and A. Hussner. 2020. Ecology and environmental impact of Myriophyllum heterophyllum, an aggressive invader in European waterways. Diversity 12(4):127. Washington State Department of Ecology. 2024. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	Unknown
Aiken S.G., P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds: 34. Myriophyllum spicatum L. Canadian Journal of Plant Science 59(1):201–215. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	Yes
	Yes

Magee T.K., T.L. Ernst, M.E. Kentula, and K.A. Dwire. 1999. Floristic comparison of freshwater wetlands in an urbanizing environment. Wetlands 19(3):517–534. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Yes
Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Ogle D.G., L. St. John, and D.J. Tilley. 2011. Plant guide for timothy (Phleum pratense). USDA-Natural Resources Conservation Service, Idaho State Office. Boise, ID. Online: https://plants.usda.gov/DocumentLibrary/plantguide/doc/pg_phpr3.docx	Yes
	Yes
	Yes

Washington State Department of Ecology. 2023. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes

	Yes
	Yes
	Yes
Center for Invasive Species and Ecosystem Health. 2010. Bog Bulrush. https://www.invasive.org/alien/pubs/midatlantic/scmu.htm. Accessed: February 3, 2025.	No
	Yes
	Yes
Meyer Andrea.H. and B. Schmid. 1999. Seed dynamics and seedling establishment in the invading perennial Solidago altissima under different experimental treatments. Journal of Ecology 87(1):28–41. Park J.S., D. Choi, and Y. Kim. 2020. Potential distribution of goldenrod (Solidago altissima L.) during climate change in South Korea. Sustainability 12(17):6710.	Yes
	Yes

Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Yes
	Yes
	Yes

Titus J.E. and D.J. Grisé. 2009. The invasive freshwater macrophyte Utricularia inflata (inflated bladderwort) dominates Adirondack Mountain lake sites. The Journal of the Torrey Botanical Society 136(4):479–486. Titus J.E. and R.A. Urban. 2013. Invasion in progress: Utricularia inflata in Adirondack submersed macrophyte communities. The Journal of the Torrey Botanical Society 140(4):506–516. Urban R.A. and M.E. Dwyer. 2016. Asexual reproduction and its potential influence on the distribution of an invasive macrophyte. Northeastern Naturalist 23(3):408–419. Urban R.A. and J.E. Titus. 2010. Exposure provides refuge from a rootless invasive macrophyte. Aquatic Botany 92(4):265–272. Urban R.A., J.E. Titus, and W.-X. Zhu. 2009. Shading by an invasive macrophyte has cascading effects on sediment chemistry. Biological Invasions 11(2):265–273.	Yes
	Yes
	Yes
	Yes

Q23: Observed Ability to Invade Naturally Disturbed E

Q23 confidence ranks	Q23 notes
Moderate (range Moderate - High)	Acer negundo can invade naturally disturbed riparian habitats (Rosario, 1988).
Moderate	Ailanthus altissima can establish and increase in abundance following fires, provided appropriate habitat and a nearby seed source. In addition, this species is known to root from branches when soil is moist and is likely to benefit from open soil caused by flooding (Knüsel, 2019).
Low	
Moderate	This species persists after flooding and fire.
High	Information on ability to invade naturally disturbed ecosystems can be found in the NWCB (2015) report for this species.

High	Anthoxanthum odoratum is found in both restored and remnant Willamette Prairie habitats. This species may rely on human activities for dispersal, but if a seed source is nearby, A. odoratum can likely establish in areas of natural disturbance.
High	
Moderate	

High	Arundo donax is dispersed and establishes new populations after floods (McWilliams, 2004; NWCB, 2013; Goolsby et al., 2023).
High	Bellardia viscosa occurs in naturally disturbed habitats like prairies and interdunal wetlands, and does not require human disturbance to establish (Brusati & Corelli, 2005). This species may be somewhat sensitive to habitat conditions (Pickart & Wear, 1999).

Moderate	This appears to be a weed of foot traffic primarily, and is usually found on trail sides, vista points, picnic areas, play areas, lawns.
High	
High	Naturally (and anthropogenic) fluctuating water levels appear to facilitate the growth of flowering rush (Parkinson et al., 2010; Columbia Basin Cooperative Weed Management Area, 2019).
High	Centaurea solstitialis is most successful in disturbed areas, especially where litter has been removed and bare soil is exposed. However, it is less competitive against intact native plant communities, even in naturally disturbed habitats, and most successful in areas where human disturbance or management have already damaged native plant communities (e.g. conversion of native perennial grasslands to invasive annual grasslands) (Innes & Zouhar, 2021).
High	

High	Cirsium arvense can take advantage of natural as well as human disturbance, and has been found after fires, landslides, volcanic eruptions (e.g., Mt. St. Helens), grazing, and other disturbance by native animals (e.g., bison, pocket gophers) (Zouhar, 2001). Cirsium arvense is also known to invade intact vernal pool ecosystems in Eastern Washington, such as the populations at Marcellus Shrub Steppe Natural Area Preserve. The disturbance caused by frost heaving and the natural recession of water create openings for this species to germinate. It then thrives and severely impacts native species.
High	
High	
High	Cotoneaster species have been observed on slides in forested areas when seed sources are nearby.
High	
High	Cynoglossum officinale often establishes in small-scale disturbed areas, like the entrances of rabbit warrens, in its native habitat (de Jong et al., 1990). In its introduced range, ground squirrels, gophers, and other burrowers can provide similar natural disturbances. This species also appears to be more responsive to disturbance in its introduced range than its native range (Williams et al., 2010). C. officinale is also common on riparian terraces, particularly where occasional flood disturbance is combined with heavy grazing.
High (range Moderate - High)	This species is frequently observed in disturbed, ruderal ecosystems such as powerline corridors.

High (range Low - High)	Dipsacus fullonum can take advantage of natural disturbances to establish in suitable habitat (Gucker, 2009).
High	
High	
High	This plant establishes in high-disturbance native ecosystems like prairies.
High	Holcus lanatus establishes in naturally disturbed areas in California's coastal prairies (Thomsen & D'Antonio, 2014) and is a common invader in Garry oak woodlands, Willamette Prairie, and other grasslands in the Pacific Northwest (Gucker, 2009). Grasslands and woodlands in wet climates like western Washington, are maintained by disturbances like fire and grazing.

High	Ilex aquifolium can invade oak woodlands, which rely on disturbance to maintain their structure and composition. This species is also known from edges habitats and other disturbed areas.
High	
Moderate	

Low	At a site in Corvallis, Oregon, Jacobaea vulgaris was common in restored old fields, but was not frequent in remnant prairie that had not been previously farmed. This species appears to require soil disturbances to establish (Van De Voorde et al., 2012), but grasslands with intact native communities and fire regimes may be resistant to invasion by J. vulgaris (Jacobs, 2009). However, this species may be able to invade naturally disturbed communities when the recurring disturbance results in bare soil (e.g., flooding, landslides, high-severity fire).
NA	

High	Juncus effusus requires bare substrate for seeds to germinate. This taxon has multiple dispersal methods, maintains a persistent seedbank, and regularly establishes in disturbed areas (Lazenby, 1955; Ervin & Wetzel, 2000; McCorry & Renou, 2003).
High	
High	
High	
High	Leucanthemum vulgare is present in remnant Willamette Prairie habitats and can take advantage of small soil disturbances by burrowing animals or other causes to establish in naturally disturbed areas when there is a nearby seed source. This species is described as “common in native grasslands” (NWCB, 2000; Clements et al., 2004).

High	
High	
High	
High	
High	Myosotis discolor is found in remnant prairie and other naturally disturbed ecosystems in Washington (CPNWH, 2024).

Not Rated	The handful of lakes where this species is found in Washington do not appear to undergo substantial natural disturbance.
High	Eurasian watermilfoil readily invades disturbed habitat and ecosystems (Aiken et al., 1979; Smith & Barko, 1990).
Moderate	

High	Phalaris arundinacea can invade after flooding and other disturbances (Lavergne & Molofsky, 2004; Waggy, 2010).
High	Phleum pratense is commonly found in grassland and woodland habitats that experience significant natural disturbance (Esser, 1993)
High	
High	

High	This plant demonstrates an ability to invade naturally disturbed ecosystems (Bolduan et al., 1994).
High	
High	
Moderate	
High	
High	Rubus bifrons is a common invader in naturally disturbed ecosystems like riparian areas, Willamette Prairie, and oak woodlands. This species is also resilient to fire and is capable of increasing in abundance post-fire (Fryer, 2021).
Moderate	Seems more common in disturbed areas.

High	Readily establishes in ecosystems with frequent flooding or fire.
High	This plant will establish and spread in naturally disturbed ecosystems when introduced.
High	
Low	Currently only documented from anthropogenically disturbed wetlands in Washington.
High	This species can follow fire, but it's more common in forested landscapes than grasslands.
High	
Moderate	Solidago altissima is known from disturbed areas in its native and non-native range (Park et al., 2020), including naturally disturbed areas like prairies and riverbanks. While the Washington sites where it has been documented all have varying degrees of anthropogenic disturbance, S. altissima is likely also able to invade naturally disturbed ecosystems that lack significant human impacts.
High	

High	Tamarix species are more likely to invade stream reaches with altered hydrological conditions but are still capable of establishing on perennial streams with unaltered hydrologic conditions (Zouhar, 2003; Stromberg et al., 2007; Lehnhoff et al., 2011). Tamarix species benefit from moderate flooding, which deposits substrate for seeds to germinate on and provides the moisture needed to induce germination. However, in areas where hydrologic conditions are unaltered, Tamarix appears to have difficulty establishing as a dominant and where present may remain subdominant to native riparian trees (Zouhar, 2003; Stromberg et al., 2007; Lehnhoff et al., 2011).
High	
High	

Low	Research suggests that once Utricularia inflata establishes in a waterway, natural disturbance can help it spread (Titus & Urban, 2013). Related studies found that U. inflata abundance increased in areas where plants were sheltered from wave action and currents (Urban & Titus, 2010). Ecological factors other than disturbance may be more important for determining whether this species is capable of invading an ecosystem or not.
High	This plant is primarily found in ecosystems with naturally frequent fire regimes, such as prairies.
High	This species is common in naturally and anthropogenically disturbed wetlands. A study testing colonization of stream channels in New Zealand found that Veronica anagallis-aquatica was one of the first colonizers and remained the dominant species for the first 60–80 weeks in artificial stream reaches (simulating reaches disturbed by floods). This study started with bare substrate, and all propagules arrived from upstream (Riis et al., 2004).
High	

cosystems (3 pts)		
Q23 citation	**Unadjusted Ecological Impact Score**	**Unadjusted Ecological Impact Rank**
Rosario L.C. 1988. Acer negundo. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/aceneg/all.html. Accessed: December 16, 2024.	50.00	Low
Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland.	68.75	Moderate
	57.58	Moderate
	62.50	Moderate
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	66.67	Moderate

	50.98	Moderate
	64.71	Moderate
	33.33	Low

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	79.17	High
Brusati E. and T. Corelli. 2005. Parentucellia viscosa. https://www.cal-ipc.org/plants/paf/parentucellia-viscosa-plant-assessment-form/. Accessed: October 29, 2024. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70.	35.29	Low

	0.00	Insignificant
	37.50	Low
Columbia Basin Cooperative Weed Management Area. 2019. Columbia Basin Flowering Rush Management Plan: A regional strategy to address Butomus umbellatus throughout the Columbia Basin. https://agr.mt.gov/_docs/weeds-docs/columbia-basin-flowering-rush.pdf. Accessed: January 14, 2025. Parkinson H., J. Mangold, V. Dupuis, and P. Rice. 2010. Biology, ecology, and management of flowering rush (Butomus umbellatus). Montana State University Extension.	78.43	High
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	82.35	High
	76.92	High

Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	74.51	High
	33.33	Low
	54.90	Moderate
	49.02	Low
	78.43	High
de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144. Williams J.L., H. Auge, and J.L. Maron. 2010. Testing hypotheses for exotic plant success: parallel experiments in the native and introduced ranges. Ecology 91(5):1355–1366.	60.42	Moderate
	15.69	Insignificant

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	68.75	Moderate
	37.50	Low
	91.67	High
	50.00	Low
Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024. Thomsen M.A. and C.M. D'Antonio. 2014. How does simulated gopher disturbance affect the establishment of Holcus lanatus L. (Poaceae) in California Coastal Prairie? Madroño 61(2):218–226.	58.82	Moderate

	88.24	High
	39.22	Low
	82.35	High

Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Van De Voorde T.F.J., W.H. Van Der Putten, and T.M. Bezemer. 2012. The importance of plant–soil interactions, soil nutrients, and plant life history traits for the temporal dynamics of Jacobaea vulgaris in a chronosequence of old fields. Oikos 121(8):1251–1262.	43.14	Low
	31.25	Low

Ervin G.N. and R.G. Wetzel. 2000. Allelochemical autotoxicity in the emergent wetland macrophyte Juncus effusus (Juncaceae). American Journal of Botany 87(6):853–860. Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	50.00	Low
	50.45	Low
	47.06	Low
	47.06	Low
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA.	56.25	Moderate

	47.79	Low
	66.67	Moderate
	22.92	Low
	15.69	Insignificant
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	15.69	Insignificant

	85.42	High
Aiken S.G., P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds: 34. Myriophyllum spicatum L. Canadian Journal of Plant Science 59(1):201–215. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	80.39	High
	62.50	Moderate

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	81.25	High
Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024.	47.92	Low
	29.41	Insignificant
	5.88	Insignificant

Bolduan B.R., G.C. van Eeckhout, H.W. Quade, and J.E. Gannon. 1994. Potamogeton crispus–the other invader. Lake and Reservoir Management 10(2):113–125.	72.92	High
	50.10	Low
	60.42	Moderate
	68.75	Moderate
	47.92	Low
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	80.39	High
	47.92	Low

	5.88	Insignificant
	64.58	Moderate
	50.98	Moderate
	40.74	Low
	5.88	Insignificant
	31.25	Low
Park J.S., D. Choi, and Y. Kim. 2020. Potential distribution of goldenrod (Solidago altissima L.) during climate change in South Korea. Sustainability 12(17):6710.	43.75	Low
	83.33	High

Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65. Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	70.83	High
	37.50	Low
	35.42	Low

Titus J.E. and R.A. Urban. 2013. Invasion in progress: Utricularia inflata in Adirondack submersed macrophyte communities. The Journal of the Torrey Botanical Society 140(4):506–516. Urban R.A. and J.E. Titus. 2010. Exposure provides refuge from a rootless invasive macrophyte. Aquatic Botany 92(4):265–272.	79.17	High
	12.50	Insignificant
Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	29.17	Insignificant
	11.76	Insignificant

Ecological Impact Confidence Score	**Ecological Impact Confidence Rank**	**Ecological Impact Calculation** (Biological Characteristics are rolled in when Ecological Impact Confidence is Low)	**Ecological Impact Score**
54.17	Moderate	Sum (Question 18 : Question 23)	50.00
50.00	Moderate	Sum (Question 18 : Question 23)	68.75
8.33	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	76.86
50.00	Moderate	Sum (Question 18 : Question 23)	62.50
58.33	Moderate	Sum (Question 18 : Question 23)	66.67

62.50	Moderate	Sum (Question 18 : Question 23)	50.98
75.00	High	Sum (Question 18 : Question 23)	64.71
50.00	Moderate	Sum (Question 18 : Question 23)	33.33

66.67	High	Sum (Question 18 : Question 23)	79.17
58.33	Moderate	Sum (Question 18 : Question 23)	35.29

66.67	High	Sum (Question 18 : Question 23)	0.00
50.00	Moderate	Sum (Question 18 : Question 23)	37.50
50.00	Moderate	Sum (Question 18 : Question 23)	78.43
75.00	High	Sum (Question 18 : Question 23)	82.35
25.00	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	76.92

58.33	Moderate	Sum (Question 18 : Question 23)	74.51
50.00	Moderate	Sum (Question 18 : Question 23)	33.33
66.67	High	Sum (Question 18 : Question 23)	54.90
83.33	High	Sum (Question 18 : Question 23)	49.02
66.67	High	Sum (Question 18 : Question 23)	84.31
41.67	Moderate	Sum (Question 18 : Question 23)	60.42
58.33	Moderate	Sum (Question 18 : Question 23)	15.69

50.00	Moderate	Sum (Question 18 : Question 23)	68.75
50.00	Moderate	Sum (Question 18 : Question 23)	37.50
75.00	High	Sum (Question 18 : Question 23)	91.67
66.67	High	Sum (Question 18 : Question 23)	50.00
41.67	Moderate	Sum (Question 18 : Question 23)	58.82

83.33	High	Sum (Question 18 : Question 23)	88.24
58.33	Moderate	Sum (Question 18 : Question 23)	39.22
41.67	Moderate	Sum (Question 18 : Question 23)	82.35

25.00	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	59.91
41.67	Moderate	Sum (Question 18 : Question 23)	31.25

41.67	Moderate	Sum (Question 18 : Question 23)	50.00
50.00	Moderate	Sum (Question 18 : Question 23)	50.45
83.33	High	Sum (Question 18 : Question 23)	47.06
83.33	High	Sum (Question 18 : Question 23)	47.06
50.00	Moderate	Sum (Question 18 : Question 23)	56.25

41.67	Moderate	Sum (Question 18 : Question 23)	47.79
33.33	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	63.34
33.33	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	28.13
83.33	High	Sum (Question 18 : Question 23)	15.69
58.33	Moderate	Sum (Question 18 : Question 23)	15.69

41.67	Moderate	Sum (Question 18 : Question 23)	85.42
91.67	High	Sum (Question 18 : Question 23)	80.39
66.67	High	Sum (Question 18 : Question 23)	62.50

58.33	Moderate	Sum (Question 18 : Question 23)	81.25
25.00	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	45.63
83.33	High	Sum (Question 18 : Question 23)	29.41
100.00	High	Sum (Question 18 : Question 23)	5.88

41.67	Moderate	Sum (Question 18 : Question 23)	72.92
83.33	High	Sum (Question 18 : Question 23)	50.10
58.33	Moderate	Sum (Question 18 : Question 23)	60.42
66.67	High	Sum (Question 18 : Question 23)	68.75
41.67	Moderate	Sum (Question 18 : Question 23)	47.92
75.00	High	Sum (Question 18 : Question 23)	80.39
33.33	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	58.96

58.33	Moderate	Sum (Question 18 : Question 23)	5.88
75.00	High	Sum (Question 18 : Question 23)	64.58
83.33	High	Sum (Question 18 : Question 23)	50.98
8.33	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	40.74
100.00	High	Sum (Question 18 : Question 23)	5.88
66.67	High	Sum (Question 18 : Question 23)	31.25
33.33	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	66.32
58.33	Moderate	Sum (Question 18 : Question 23)	83.33

50.00	Moderate	Sum (Question 18 : Question 23)	70.83
50.00	Moderate	Sum (Question 18 : Question 23)	37.50
58.33	Moderate	Sum (Question 18 : Question 23)	35.42

25.00	Low	Sum (Question 18 : Question 23) * 0.5 + Biological Characteristics of Invasivity * 0.5	78.71
50.00	Moderate	Sum (Question 18 : Question 23)	12.50
50.00	Moderate	Sum (Question 18 : Question 23)	29.17
66.67	High	Sum (Question 18 : Question 23)	11.76

Ecological Impact Rank	**Ecological Impact Confidence Score**	**Ecological Impact Confidence Rank**
Low	54.17	Moderate
Moderate	50.00	Moderate
High	8.33	Low
Moderate	50.00	Moderate
Moderate	58.33	Moderate

Moderate	62.50	Moderate
Moderate	75.00	High
Low	50.00	Moderate

High	66.67	High
Low	58.33	Moderate

Insignificant	66.67	High
Low	50.00	Moderate
High	50.00	Moderate
High	75.00	High
High	25.00	Low

High	58.33	Moderate
Low	50.00	Moderate
Moderate	66.67	High
Low	83.33	High
High	66.67	High
Moderate	41.67	Moderate
Insignificant	58.33	Moderate

Moderate	50.00	Moderate
Low	50.00	Moderate
High	75.00	High
Low	66.67	High
Moderate	41.67	Moderate

High	75.00	High
Low	58.33	Moderate
High	41.67	Moderate

Moderate	25.00	Low
Low	41.67	Moderate

Low	41.67	Moderate
Low	50.00	Moderate
Low	83.33	High
Low	83.33	High
Moderate	50.00	Moderate

Low	41.67	Moderate
Moderate	33.33	Low
Insignificant	33.33	Low
Insignificant	83.33	High
Insignificant	58.33	Moderate

High	41.67	Moderate
High	91.67	High
Moderate	66.67	High

High	58.33	Moderate
Low	25.00	Low
Low	83.33	High
Insignificant	100.00	High

High	41.67	Moderate
Low	83.33	High
Moderate	58.33	Moderate
Moderate	66.67	High
Low	50.00	Moderate
High	75.00	High
Moderate	33.33	Low

Insignificant	58.33	Moderate
Moderate	75.00	High
Moderate	83.33	High
Low	8.33	Low
Insignificant	100.00	High
Low	66.67	High
Moderate	33.33	Low
High	58.33	Moderate

High	50.00	Moderate
Low	50.00	Moderate
Low	58.33	Moderate

High	25.00	Low
Insignificant	50.00	Moderate
Insignificant	50.00	Moderate
Insignificant	66.67	High

Assessor(s)	**Taxon**	**Q24 rank**	**Q24 confidence rank**
Walter Fertig, Clayton Antieau. David Wilderman	Acer negundo	Moderate	High
Emily Stevenson, Walter Fertig. Ethan Coggins	Ailanthus altissima	Moderate	Moderate (range Low - High)
Emily Stevenson	Alliaria petiolata	High	High
Carlo Abbruzzese	Alopecurus pratensis	High	Moderate
Emily Stevenson. Walter Fertig	Amorpha fruticosa	Moderate	Moderate

Regina Johnson. Molly S. Wiebush	Anthoxanthum odoratum	Moderate	Moderate (range Moderate - High)
Regina Johnson	Arrhenatherum elatius	High	High
Regina Johnson	Arum italicum ssp. italicum	Moderate	High

Molly S. Wiebush	Arundo donax	High	High
Molly S. Wiebush	Bellardia viscosa	Low	Moderate
Regina Johnson	Bellis perennis	Insignificant	High
Regina Johnson	Betula pendula	Low	High

Wesley Glisson	Butomus umbellatus	High	High

Molly S. Wiebush	Centaurea solstitialis	Moderate	Low
Emily Stevenson	Chondrilla juncea	High	High

Emily Stevenson, Ethan Coggins, Regina Johnson. Molly S. Wiebush	Cirsium arvense	Moderate (range Moderate - High)	High (range Moderate - High)
Carlo Abbruzzese	Cirsium vulgare	NA	NA
Regina Johnson	Clematis vitalba	Moderate	Moderate
Regina Johnson	Cotoneaster spp.	Low	High
Regina Johnson	Crataegus monogyna var. monogyna	High	High

Helen Lau. Molly S. Wiebush	Cynoglossum officinale	Moderate	Moderate (range Moderate - High)
Regina Johnson, Carlo Abbruzzese	Dianthus armeria	Insignificant	High

Kimberly Quayle, Regina Johnson. Molly S. Wiebush	Dipsacus fullonum	Moderate	Moderate (range Moderate - High)
Regina Johnson. Walter Fertig	Erechtites minimus	Insignificant	Low
Emily Stevenson	Fallopia xbohemica	High	High
Regina Johnson	Hieracium pilosella	High	High

Molly S. Wiebush	Holcus lanatus	Moderate	Moderate
Molly S. Wiebush. Regina Johnson	Ilex aquifolium	High	High

Regina Johnson	Impatiens capensis	Moderate	High
Emily Stevenson	Iris pseudacorus	High	Moderate
Molly S. Wiebush	Jacobaea vulgaris	Moderate	Moderate
Carlo Abbruzzese	Juglans regia	Low	Moderate
Molly S. Wiebush	Juncus effusus subsp. effusus	Moderate	Low
Regina Johnson	Lamium galeobdolon	High	High
Regina Johnson	Lathyrus latifolius	Moderate	High

Regina Johnson	Lathyrus sylvestris	Moderate	High
Molly S. Wiebush	Leucanthemum vulgare	High	High
Emily Stevenson	Lysimachia nummularia	NA	NA

Kimberly Quayle. Regina Johnson	Lythrum salicaria	High (range Moderate - High)	High
Ethan Coggins	Marrubium vulgare	Insignificant	Moderate
Regina Johnson	Mycelis muralis	Insignificant	High
Molly S. Wiebush	Myosotis discolor	Insignificant	Moderate

Wesley Glisson	Myriophyllum heterophyllum	High	High
Wesley Glisson	Myriophyllum spicatum	Moderate	High
Regina Johnson	Nasturtium officinale	Low	High

Emily Stevenson, Molly S. Wiebush. Regina Johnson	Phalaris arundinacea	High (range Moderate - High)	High (range Moderate - High)
Molly S. Wiebush	Phleum pratense	High	Low
Regina Johnson	Plantago lanceolata	Insignificant	High
Regina Johnson	Poa annua	Insignificant	High
Wesley Glisson	Potamogeton crispus	NA	NA
Regina Johnson	Quercus robur	Low	High
Regina Johnson	Rosa canina	Moderate	Moderate
Regina Johnson	Rosa multiflora	Low	Moderate
Regina Johnson	Rosa rugosa	Low	High

Emily Stevenson, Regina Johnson. Molly S. Wiebush	Rubus bifrons	Moderate (range Moderate - High)	High
Carlo Abbruzzese	Rubus laciniatus	Moderate	Moderate
Carlo Abbruzzese	Rumex crispus	Insignificant	High
Regina Johnson	Sasa palmata	Moderate	High
Regina Johnson	Schedonorus arundinaceus	Moderate	High
Emily Stevenson	Schoenoplectus mucronatus	High	Moderate
Regina Johnson	Senecio sylvaticus	Insignificant	High
Regina Johnson	Solanum dulcamara	High	Moderate

Molly S. Wiebush	Solidago altissima	Moderate	Low
Carlo Abbruzzese	Spartina alterniflora	High	High
Molly. S. Wiebush	Tamarix ramosissima	High	High
Regina Johnson	Trifolium pratense	Low	High

Regina Johnson	Trifolium subterraneum	Moderate	High
Molly. S. Wiebush	Utricularia inflata	High	Low
Carlo Abbruzzese	Verbascum blattaria	Insignificant	Moderate
Molly S. Wiebush	Veronica anagallis-aquatica	Unknown	Not Rated
Regina Johnson	Veronica arvensis	Insignificant	High

Question 24. General Management Difficulty

Q24 notes
Acer negundo is relatively easily managed using herbicides.
Control of Ailanthus altissima requires the use of herbicide over several years to kill the existing root system and requires follow-up work for several years to exhaust the existing seedbank.
Propagule persistence for Alliaria petiolata still needs research, which makes management more difficult. Plants vary widely in height, from 1 inch to 5 feet tall. This makes A. petiolata difficult to eradicate in westside forests, where small plants can be easily hidden beneath other vegetation.
this species is difficult due to the volume of seeds produced. Additional mowing/cutting may be necessary to prevent seeding (OSU Rangeland Ecology and Management, 2005).
The Columbia Land Trust had success containing an infestation of Amorpha fruticosa at Pierce Island through a 2–3-year project of digging, cutting, and targeted application of herbicide. Ongoing vigilance is necessary to keep new plants from becoming established, and there is no lack of seed source from upstream, making real control a regional endeavor by multiple partners (NWCB, 2015).

Herbicide applications or tilling and reseeding with desirable species may be the most effective treatments for managing Anthoxanthum odoratum. Hand removal is effective for removing small patches of this species (Pitcher & Russo, 2012). Mowing and prescribed fire are being researched as control techniques; in at least some cases, these methods have been shown to increase flowering or abundance of this species (Clark, 2002; Dennehy et al., 2011; Lysgaard, 2022). Biocontrols are currently impractical for this species, and grazing also increases its abundance (Pitcher & Russo, 2012). “Intensive, long term restoration” may be necessary to control introduced species in oak woodland and prairie habitats, including A. odoratum (Lysgaard, 2022).
Arrhenatherum elatius is extremely difficult to manage in grasslands and is not likely to be eradicated completely where it occurs. Annual spraying is required to keep populations under control. Even in previously managed populations, this species increases in density and range quickly without treatment. Individual plants are fairly resistant to herbicide. This species also takes advantage of nitrogen fixing plants, particularly Scotch broom (Cytisus scoparius). Where these two species co-occur, successful treatment of Arrhenatherum elatius requires treatment of the Scotch broom first.

Arundo donax management is costly, time-consuming, and can require cooperation between multiple organizations and governments to be successful. Its dispersal ability means that successful management requires cooperation of all stakeholders within a watershed. Treatment requires multiple approaches, including herbicides (McWilliams, 2004). By 2013, A. donax control costs in coastal California averaged $25,000 per acre (NWCB, 2013). Biocontrol agents are in development and have been shown to reduce A. donax biomass in Texas (Goolsby et al., 2023).
Control of Bellardia viscosa likely requires both seed bank exhaustion and removing recolonization sources. However, this species is not very aggressive and invasions may be short-lived—treatment may not be required (Pickart & Wear, 1999). Radiant heat treatments were extremely effective in killing B. viscosa in experimental plots on dunes in northern California (Emerzian, 2007), but otherwise little research has been done on weed management of B. viscosa. As an annual species, preventing reproduction by mowing or other techniques may be more effective than with many perennial species.
People may control this species in lawns, but otherwise it is not usually managed.

This plant has persisted for decades in waterbodies despite continued control efforts (Parkinson et al., 2010; Madsen et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019; Parsons et al., 2019).

The best management for Centaurea solstitialis is prevention, particularly by minimizing soil disturbance and maintenance of native plant communities. This includes managing for perennial species and diverse communities that are competitive against C. solstitialis, reducing propagule pressure by treating patches of C. solstitialis before they flower and fruit, preventing transportation of seeds by equipment, feed, and livestock, and monitoring and immediately addressing small populations when found (Innes & Zouhar, 2021).

Small populations of C. solstitialis can be managed or eradicated by hand-pulling (taking care to remove and properly dispose of all the above-ground parts of the plant) and herbicides. Large infestations usually require a combination of long-term management techniques. Effective treatments include fire or mowing combined with grazing, herbicides, and biocontrol agents. Restoration of native vegetation communities, and ongoing monitoring and treatment of new populations is important for preventing reinvasion. The goals of long-term management of this species are to deplete the seed bank and establish desirable vegetation that can outcompete C. solstitialis (Innes & Zouhar, 2021).

Several biocontrol agents are available for managing C. solstitialis, including six insect species that attack flowers and seeds and one pathogen that attacks the vegetative portions of the plant. Most research suggests that biocontrol agents alone can reduce spread, but do not eliminate C. solstitialis populations (Innes & Zouhar, 2021). However, in Idaho County, Idaho, a release of C. solstitialis seed predators significantly reduced the abundance of this species, even on the overgrazed

Control of Cirsium arvense is not impossible, but it is quite difficult, in part due to its ubiquitous nature. Effective control methods vary by context (e.g., tilling works in agricultural fields, but increases invasion in natural areas). Pulling and mowing are time-consuming but can be effective if efforts are carried out multiple times a year and persist over multiple years. However, mowing can increase Cirsium arvense populations instead of decreasing them, particularly in humid areas. Biocontrol is not effective, even within this species' native range. Herbicide effectiveness may also vary by conditions, though herbicides like aminopyralid and clopyralid can be very effective when used for multiple years, albeit with high off-target damage. The bare ground left behind when controlling this species allows new seedlings to germinate—and the problem can begin again (Zouhar, 2001; DiTomaso et al., 2013).
To date, Cotoneaster are generally found as individual plants, which makes the genus relatively easy to treat.

Both manual and chemical management techniques are effective in treating this species, though population mapping and treatment timing are important. Management should target seed production to prevent spread and recruitment. Herbicides, mowing, tilling, and prescribed fire can all be effective at reducing seed set. Herbicide application can make this species more palatable to livestock, increasing risks of poisonings. Manual removal should include removing root crowns to prevent resprouting, and care should be taken to prevent seed fall when pulling senesced plants. Management techniques that result in disturbance, such as burning or tilling, could also provide improved habitat for C. officinale colonization (Jacobs & Sing, 2007). Restoration of native vegetation communities (particularly perennial grasses) can prevent this species from colonizing or recolonizing areas. A root-boring weevil, Mogulones cruciger, was approved for release as a biocontrol agent in Canada in 1997 and has significantly reduced C. officinale populations in British Columbia. These weevils reduce seed production by depleting stored food and limiting the ability to uptake water and nutrients from the soil (Duncan & Williams, 2020). Mogulones cruciger is not approved for release in the U.S. due to potential spillover effects on rare native species in the same family as C. officinale (Jacobs & Sing, 2007). However, populations of this weevil have migrated into the U.S., and low population numbers that result from natural migration could potentially select for weevil-resistant C. officinale, ultimately reducing the effectiveness of this particular biocontrol in the U.S. (Duncan & Williams, 2020). This weevil may also have been illegally released in parts of
This species is not usually controlled as it is viewed as not terribly invasive.

For short lived species like Dipsacus fullonum, effective management focuses on preventing reproduction. Immature seeds from cut stems can still be viable, and care needs to be taken not to spread seed during management efforts. The most consistent recommendation for managing this species is to use both mechanical and chemical control methods over multiple years. Timing of treatment is also important. Herbicide application alone may encourage seed germination by opening areas for seedlings to establish, so application efforts should include plans to prevent seedling germination or target emerging seedlings after initial herbicide application. Hand-pulling can be effective for small occurances if care is taken to remove as much of the root as possible. Reestablishing healthy native plant communities can also help in control efforts, since D. fullonum is less likely to establish in existing vegetation. There are currently no biocontrol options available for this species and burning or mowing alone are likely to increase its abundance (Gucker, 2009; DiTomaso et al., 2013; Gaskin et al., 2024).
Treatment efforts are not known from Washington. Reports from similar ecosystems in California indicate that Erechtites minimus is an ephemeral plant that does not require active management (Muldavin et al., 1981).
This plant requires continual patrolling. It is cryptic due to its small size and coexistence with many other yellow asters (e.g., Hypochaeris). Reinvasion is frequent.

Management suggestions for Holcus lanatus focus on removal and monitoring to prevent re-establishment from the seed bank. The large amount of seed produced may make this species difficult to control. Hand-pulling or hoeing plants is highly effective (Conner et al., 2013). Tilling larger populations may have a similar effects, though at least one source recommended turning the soil to a 14 inch depth to prevent recolonization from the seedbank (Gucker, 2009)—such intense soil disturbance is not practical in ecosystems that retain native plants. Removal of above ground biomass through fire, mowing, or grazing can be successful, but must be timed to prevent reproduction. If mechanical treatments like mowing or tilling are used, equipment needs to be cleaned to prevent moving seed. Correctly timed herbicide applications can also be effective, and H. lanatus is vulnerable to several herbicides. Some of these herbicides have wide-ranging effects on a broad suite of species, but this species' distinctive appearance may make it relatively easy to target (Gucker, 2009; Conner et al., 2013). In California, H. lanatus is regarded as a severe threat to coastal prairies (Bennett et al., 2011), but generally, this species is a larger problem in western Oregon and Washington grasslands than it is in California (Conner et al., 2013).
Ilex aquifolium is expensive and time-consuming to manage. Mechanical removal (pulling and cutting) can be effective, if monitoring continues after removal. Removal is most effective when combined with chemical treatments to prevent or reduce suckering from cut stumps. The leaves are resistant to foliar herbicide due to their thick, waxy cuticles. Injecting trees with herbicide is the most effective—and expensive—option (NWCB, 2022). Ilex aquifolium's ability to root from its lower branches or anywhere a limb or trunk touches the ground means that basal herbicide injections are difficult. Each plant can have many rooted stems, and each one must be treated individually; herbicide transfer between stems appears minimal.

Herbicide application before flowering may be the most effective management technique for Jacobaea vulgaris. Care is required when using herbicide because application can temporarily make the plant more palatable to livestock. Mowing is not recommended because it does not remove the vegetative portion of the plant and J. vulgaris may flower more vigorously after mowing. Tilling is also not recommended unless combined with herbicide use and revegetation with another competitive plant species, because plants can regrow from root fragments and soil disturbance stimulates germination of seeds from the seed bank. Hand pulling can be effective if all of the caudex and roots are removed, but gloves should be used when pulling this species. Several biocontrol agents have been developed for J. vulgaris, and in California and Oregon Tyria jacobaeae and the fleabeetle Longitarsus jacobaeae have both been effective in reducing J. vulgaris populations (Richardson, 2004; Jacobs, 2009). Jacobaea vulgaris populations in North America are less well defended against specialist herbivores like T. jacobaeae or L. jacobaeae than plants from this species' native range (Lin et al., 2019).
Since the non-native subspecies of Juncus effusus was only recently recognized, there is little information regarding its management in the Pacific Northwest. In Ireland, Juncus effusus treatment frequently involves mowing, herbicide, and draining wetlands, with the goal of promoting agriculture (including tree plantations and grazing). Restoration of degraded wetlands may also help control Juncus effusus. In particular, restoring the hydrology of wetlands with historically long hydroperiods will help exclude this taxon (McCorry & Renou, 2003).

Control of Leucanthemum vulgare is difficult or infeasible in many cases. Successful treatment involves both removal of the introduced species and restoration or revegetation with desirable species that are more competitive than L. vulgare (Stutz et al., 2024).

Mowing L. vulgare can reduce seed production for the year of mowing but will increase vegetative growth and potentially even the following year's seed set (Clements et al., 2004; DiTomaso et al., 2013). Tilling needs to occur over multiple years to reduce population sizes, with significant impacts to native plants. A single round of tilling may also increase populations of this species. Hand pulling may be effective against small populations, if care is taken to remove root fragments as well. Broadscale herbicides can be effective, but L. vulgare is known to develop herbicide resistance (Clements et al., 2004; DiTomaso et al., 2013). At least one study in Washington found that applying nitrogen fertilizer, which provides a competitive advantage for other species in the community, can be as effective as herbicide in reducing L. vulgare populations (NWCB, 2000).

While Leucanthemum vulgare is not closely related to any native species in North America (biocontrol spillover is not of concern), biocontrol agents have been difficult to develop (Clements et al., 2004). A specialist herbivore moth species (Dichrorampha aeratana) showed biocontrol potential as of 2021. Feeding activity of this moth is specific enough that it has limited effect on the closely related ornamental (non-invasive) Shasta daisy, while still having significant impact in L. vulgare (Stutz et al., 2021).

Once strongly established, control of Lythrum salicaria is “expensive, intrusive, and difficult” (Thompson et al., 1987; Munger, 2002). Reintroduction is very likely along waterways that are not comprehensively treated.
In Australia, multiple herbicide treatments, extensive manual control, prescribed burning, and establishment of competitive native species is necessary to eliminate large occurances (Weiss et al., 2000). In Washington hand pulling is effective in controlling small populations. In general, this species has not been a target of control, but there are informational resources available (DiTomaso et al., 2013).
Carbon addition can reduce abundance of Myosotis discolor in Pacific Northwest prairies (Mitchell & Bakker, 2011), but otherwise little research has been done on weed management of this species. Control of M. discolor would likely require exhausting the seed bank and removing populations that can recolonize areas. Myosotis discolor likely is a low priority for treatment, especially given its limited ecological impact, and is therefore rated as insignificant.

Based on personal experience and knowledge, established populations have been very difficult to control (Bailey, 2007; Glomski & Netherland, 2008; Haug & Bellaud, 2013; Gross et al., 2020).
There has been a lot of research on the control of Eurasian watermilfoil and new compounds and methods have been developed that are much more effective than those used in the past (Hussner et al., 2017; Kujawa et al., 2017; Mikulyuk et al., 2020). Controlling the species to a reasonable level is relatively simple using current tools, but it still takes a long time and can be expensive. Complete eradication is still very difficult and rarely achieved.

Management of this species is difficult. No single treatment appears to be effective in controlling Phalaris arundinacea long-term. Effective treatment needs to have a long-term ecosystem wide approach and ongoing treatments may be needed to manage resprouting, re-invasion, or encroachment by other invasive plant species. The best management for P. arundinacea is to prevent its establishment by avoiding disturbance and preserving the integrity of wetlands. Planting woody or long-lived perennial species may be the most effective way to out-compete P. arundinacea where it is already established. An integrated approach incorporating multiple treatment options is needed to manage Phalaris arundinacea infestations (Lavergne & Molofsky, 2004; Kim et al., 2006; Waggy, 2010).
As of 2011, Phleum pratense is still recommended for revegetation projects (AKNHP, 2011) and commonly grown for hay and silage. This species appears to be widely regarded as non-aggressive, so very little literature focuses on managing it as a weed. Where management is needed and possible, removal coupled with planting of desirable competitive species is recommended. There are some areas (e.g., Glacier National Park) where this species has proven troublesome and not practical to remove. In those cases, avoiding spread or introduction to new areas is recommended (Tyser, 1992; Esser, 1993).
This plant is not usually managed.

The major difficulty in managing Rubus bifrons is maintaining control efforts through a long enough cycle. Management requires a long-term, ecosystem-wide control effort using integrated management techniques. Herbicide and other treatments need to be on a long enough cycle to address the lifespan of the seedbank and other propagules in the soil (R. Johnson, pers. comm. 2024). The most effective control method in non-forested ecosystems is mowing (Fryer, 2021). Rhizomes and root crowns can continue sprouting after several years of treatment, but repeated mowing can eventually exhaust root reserves (Fryer, 2021). Grazing by goats or other animals following mowing may also be helpful (Fryer, 2021). Prescribed fire, alone or accompanied with mowing, does not reduce Rubus bifrons abundance, and may increase this species (Fryer, 2021). Mechanical treatment alone may also increase abundance of this species if efforts are not maintained long-term (Fryer, 2021). Herbicides are only effective when combined with other techniques and require multiple follow up treatments (Fryer, 2021). Seed dispersal can result in new infestations in treated areas, increasing management difficulty (Fryer, 2021). Climate change is likely to have a positive effect on Rubus bifrons, increasing management difficulty.
This species is rarely deemed to be a management priority but is likely easily managed with herbicide.
Some infestations have been controlled in less than 5 years, while others are ongoing more than 5 years later.
Initial control efforts in Washington have been difficult.
People do confuse this species with tansy ragwort, which is mandated for control in most places. However, there is no need for control, and this species will disappear on its own after a couple of years.

Mowing at flowering time is considered an effective treatment against Solidago altissima, and reduces rhizome growth, size, and survival (Stoll et al., 1998). One study in Europe found mowing at flowering reduced also reduced seed abundance on the soil surface from 49,000 seeds per meter to 1800 seeds per meter. Mowing reduced seed production in mowed areas to zero, and all seeds in mowed plots were from neighboring unmowed populations. Mowing also did not open the canopy enough to allow S. altissima seeds to germinate. Mowing prevents seed production which may be key in preventing spread of new populations of S. altissima where it is invasive (Meyer & Schmid, 1999). However, mowing may not be a practical treatment in riparian areas or wetland sites. Information on other management techniques for this species were not found.
It took over thirty years and millions of dollars to control this plant. Siltation on plants interferes with herbicide efficacy.
In 2001, the cost of mitigating or treating Tamarix in the western U.S. was estimated to be $280–$450 per hectare of land (Kerns et al., 2009). Tamarix dominance is frequently driven by altered hydrological conditions that prevent native riparian trees from reestablishing and thriving. Coupling removal with restoration of historical hydrological regimes and native riparian vegetation is suggested for successfully managing Tamarix invasions in the long-term. Post-restoration monitoring is also required, especially early on, to prevent Tamarix from reestablishing (Stromberg et al., 2007; Lehnhoff et al., 2011). Biocontrols have shown some success but have been difficult to establish in the northern part of Tamarix's U.S. range. Biocontrol effectiveness also varies by target species (Gafke et al., 2022).
This species is usually not a priority for control in Washington, though the assessor believes control would be comparatively easy.

This species' prostrate growth habit and small size suggests that it might take significant labor to treat if considered a management priority.
Utricularia species can be difficult to identify without flowers (Wiebush, 2022), but U. inflata produces distinctive floating platforms from which flowers eventually emerge. Successful manual removal of this species requires capturing all vegetative fragments. Other suggested options include draining the waterbody in which the plant occurs, or using herbicides (NWCB, 2024). Practical and effective management methods for this species seem to be limited.
This plant is both relatively uncommon and not seen as a priority for control. This species is easily controlled with herbicide where it occurs.
Very little information was available on the treatment of Veroncia anagallis-aquatica populations. Mechanical removal techniques such as pulling require care not to disperse plant fragments, which can start new populations. Herbicides have not been tested for this species, but herbicides that are effective against other Veronica species are likely to also work on V. anagallis-aquatica (DiTomaso et al., 2013).
This species is not targeted for management

(18 pts)		
Q24 citation	**Q25 ranks**	**Q25 confidence ranks**
	Moderate	Moderate
	Moderate	Moderate
	High	High
pratensis L. Department of Rangeland Ecology and Management, College of Agricultural Sciences, Oregon State University, Corvallis, OR.	High	Moderate
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	Moderate	Moderate

Clark D.L. 2002. Controlling woody vegetation in wetland prairies 1994-2001. Coast Range Resource Area Bureau of Land Management, Eugene, OR. HE-R01-0378. Dennehy C., E.R. Alverson, H.E. Anderson, D.R. Clements, R. Gilbert, and T.N. Kaye. 2011. Management strategies for invasive plants in Pacific Northwest prairies, savannas, and oak woodlands. Northwest Science 85(2):329–351. Lysgaard C. 2022. Invasive species removal and changing Fire Regimes in a ləkʷ wəŋən Garry Oak Ecosystem. MS Thesis. University of Victoria, Victoria, BC. Pitcher D. and M.J. Russo. 2012. Anthoxanthum odoratum, Global Invasive Species Team, The Nature Conservancy. https://wiki.bugwood.org/Archive:TNC/Anthoxanthum_odoratum. Accessed: October 25, 2024.	High	High
	High	High
	High	High

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	High	High
Emerzian V.K. 2007. Radiant heater effects on Leontodon taraxacoides, Hypochaeris glabra, and Parentucellia viscosa in dunes and seasonal swales at Humboldt Bay National Wildlife Refuge. MS Thesis. Humboldt State University, Arcata, CA. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70.	Low	Moderate
	Insignificant	High
	Low	Moderate

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EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Moderate	Moderate
	High	Moderate

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Canada thistle. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Moderate	Moderate
	NA	NA
	High	Moderate
	Insignificant	Moderate
	High	High

Duncan S.S. and J.L. Williams. 2020. Life history variation in an invasive plant is associated with climate and recent colonization of a specialist herbivore. American Journal of Botany 107(10):1366–1374. Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8.	Moderate	Moderate
	Insignificant	High

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Common, Cutleaf, and Fuller's Teasel. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Gaskin J.F., N. West, and B.G. Rector. 2024. Population structure of three invasive congeneric teasel (Dipsacus) species. Invasive Plant Science and Management 17(1):37–45. Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	High	High
Muldavin E.H., J.M. Lenihan, W.S. Lennox, and S.D.Jr. Veirs. 1981. Vegetation succession in the first ten years following logging of coast redwood forests. National Park Service, Redwood National Park, Arcata, California. Technical Report #6.	Insignificant	Low
	High	High
	High	High

Bennett A.E., M. Thomsen, and S.Y. Strauss. 2011. Multiple mechanisms enable invasive species to suppress native species. American Journal of Botany 98(7):1086–1094. Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	High	Low
Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board.	High	Moderate

	Low	Moderate
	Moderate	High
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Lin T., P.G.L. Klinkhamer, T.L. Pons, P.P.J. Mulder, and K. Vrieling. 2019. Evolution of increased photosynthetic capacity and its underlying traits in invasive Jacobaea vulgaris. Frontiers in Plant Science 10:1016. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	High	Low
	Insignificant	Moderate
McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	High	Moderate
	High	High
	Moderate	Moderate

	Moderate	Moderate
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Leucanthemum vulgare Lam., oxeye daisy. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA. Stutz S., R. De Clerck-Floate, H.L. Hinz, A. McClay, A.J. McConnachie, and U. Schaffner. 2021. Host range and impact of Dichrorampha aeratana, the first potential biological control agent for Leucanthemum vulgare in North America and Australia. Insects 12(5):438. Stutz S., A.S. McClay, and R.A. De Clerck-Floate. 2024. Leucanthemum vulgare Lamarck, Oxeye Daisy/Marguerite blanche (Asteraceae). Biological Control Programmes in Canada, 2013-2023 (ed. by M.A. Vankosky and V. Martel), pp. 498–504. CABI, GB.	High	High
	NA	NA

Munger G.T. 2002. Lythrum salicaria. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/lytsal/all.html. Accessed: January 4, 2024. Thompson D.Q., R.L. Stuckey, and E.B. Thompson. 1987. Spread, impact, and control of purple loosestrife (Lythrum salicaria) in North American wetlands. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.	Moderate	Moderate
DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: White Horehound. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	Insignificant	High
	Insignificant	High
Mitchell R.M. and J.D. Bakker. 2011. Carbon addition as a technique for controlling exotic species in Pacific Northwest prairies. Northwest Science 85(2):247–254.	Insignificant	Moderate

Bailey J.E. 2007. Myriophyllum heterophyllum Michx. (Haloragaceae): Control and vegetative reproduction in southwestern Maine. MS Thesis. University of Maine, Orono, ME. Glomski L.M. and M.D. Netherland. 2008. ffect of water temperature on 2,4-D ester and carfentrazone-ethyl applications for control of variable-leaf milfoil. Journal of Aquatic Plant Management 46:119–121. Gross E.M., H. Groffier, C. Pestelard, and A. Hussner. 2020. Ecology and environmental impact of Myriophyllum heterophyllum, an aggressive invader in European waterways. Diversity 12(4):127. Haug E.J. and M.D. Bellaud. 2013. Efficacy of 2,4-D ester on variable-leaf milfoil control for partial lake treatments in New Hampshire waterbodies. Journal of Aquatic Plant Management 51:49–52.	High	High
Hussner A., I. Stiers, M.J.J.M. Verhofstad, E.S. Bakker, B.M.C. Grutters, J. Haury, J.L.C.H. van Valkenburg, G. Brundu, J. Newman, J.S. Clayton, L.W.J. Anderson, and D. Hofstra. 2017. Management and control methods of invasive alien freshwater aquatic plants: A review. Aquatic Botany 136:112–137. Kujawa E.R., P. Frater, A. Mikulyuk, M. Barton, M.E. Nault, S. van Egeren, and J. Hauxwell. 2017. Lessons from a decade of lake management: Effects of herbicides on Eurasian watermilfoil and native plant communities. Ecosphere 8(4). Mikulyuk A., E. Kujawa, N.E. Nault, S. van Egeren, K.I. Wagner, M. Barton, J. Hauxwell, and M.J. vander Zanden. 2020. Is the cure worse than the disease? Comparing the ecological effects of an invasive aquatic plant and the herbicide treatments used to control it. Facets 5(1):353–366.	Moderate	Moderate
	High	Moderate

Kim K.D., K. Ewing, and D.E. Giblin. 2006. Controlling Phalaris arundinacea (reed canarygrass) with live willow stakes: A density-dependent response. Ecological Engineering 27(3):219–227. Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	High	High
Alaska Natural Heritage Program (AKNHP). 2011. Timothy, Phleum pratense L. Alaska Natural Heritage Program, University of Alaska, Anchorage. Online: https://accs.uaa.alaska.edu/wp-content/uploads/Phleum_pratense_BIO_PHPR3.pdf Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Tyser R.W. 1992. Vegetation associated with two alien plant species in a fescue grassland in Glacier National Park, Montana. The Great Basin Naturalist 52(2):189–193.	Moderate	Moderate
	Insignificant	High
	Insignificant	High
	NA	NA
	Insignificant	High
	High	High
	Low	Moderate
	Low	High

Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Moderate	High
	Low	Moderate
	Insignificant	High
	Moderate	High
	Moderate	High
	Unknown	Not Rated
	Insignificant	High
	High	Moderate

Meyer Andrea.H. and B. Schmid. 1999. Seed dynamics and seedling establishment in the invading perennial Solidago altissima under different experimental treatments. Journal of Ecology 87(1):28–41. Stoll P., P. Egli, and B. Schmid. 1998. Plant foraging and rhizome growth patterns of Solidago altissima in response to mowing and fertilizer application. Journal of Ecology 86(2):341–354.	Unknown	Not Rated
	High	High
Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215. Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65. Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	High	High
	Insignificant	High

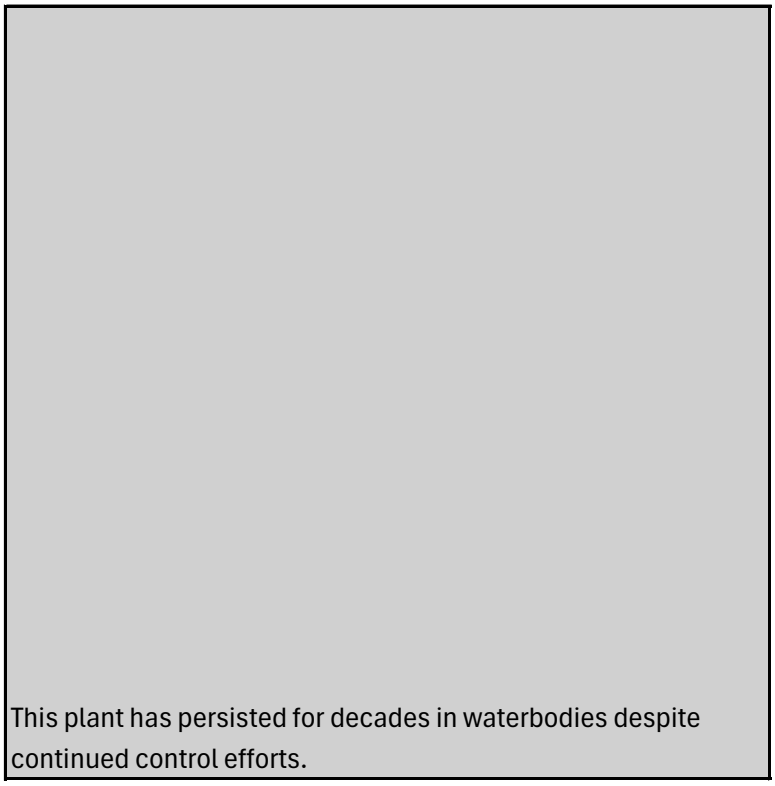
	Moderate	High
Noxious Weed Control Board (NWCB). 2024. Swollen bladderwort, Utricularia inflata. https://www.nwcb.wa.gov/weeds/swollen-bladderwort. Accessed: September 19, 2024. Wiebush M. 2022. Utricularia intermedia Hayne, flat-leaved bladderwort. California Native Plant Society, Sacramento, CA. Online: https://rareplantfiles.cnps.org/scc/UtricilariaIntermediaSpAcctSCC20220408r.pdf	Unknown	Not Rated
	Insignificant	Moderate
DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Water speedwell. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA.	Unknown	Not Rated
	Insignificant	High

Question 25. Minimum Time Commitment (

Q25 notes
Attempts to control Ailanthus altissima are relatively recent in Washington. Initial treatment and subsequent removal of dead trees is relatively expensive and the precise time commitment needed to control seedlings and eradicate the species from a site is not known. It is likely that A. altissima requires a moderate amount of time investment over many years to reduce to acceptable levels. Control requires the use of herbicide over several years to kill the existing root system and requires follow-up work for several years to exhaust the existing seedbank. In some areas, constant reintroduction may be an issue, and vigilant site managers may be needed to keep this species at bay.
This species may require ongoing management.
The Columbia Land Trust had success containing an infestation of Amorpha fruticosa at Pierce Island through a 2–3-year project of digging, cutting, and targeted application of herbicide (NWCB, 2015). A reasonable estimate of minimum time commitment is likely 2–5 years. Seed viability could affect this estimate, however.

Land managers have only recently started to treat Anthoxanthum odoratum, so not much is currently known, but it will likely require constant management (R. Johnson, pers. comm., 2024. Monitoring and treatment of the species minimally should continue until the seed bank is exhausted (2–5 years) (Pitcher & Russo, 2012). Restoration with desirable native plants is also important in preventing recolonization.

Two projects in California were able to reduce Arundo donax cover to almost zero after 20 years. However, existing methods are generally regarded as inadequate and control efforts generally fail due to lack of follow up (Goolsby et al., 2023). Successful management of A. donax must include removing or killing rhizomes. All parts of the plant need to be burned, chipped, or otherwise disposed of to prevent re-establishment from vegetative propagules (McWilliams, 2004), and equipment used needs to be cleaned to prevent movement of plant fragments to new habitats (NWCB, 2013). Successful control of A. donax also requires careful planning of restoration plantings to establish native plant communities resistant to re-invasion (NWCB, 2013).
Monitoring and treatment of Bellardia viscosa should likely continue until seed bank is exhausted. Given the relatively short span of seed viability for this species, populations without an outside seed source could be treated in less than five years. As with other species, restoration of native community is likely important along with removal of B. viscosa.



This plant has persisted for decades in waterbodies despite continued control efforts.

Preventing seed rain can reduce Centaurea solstitialis seed banks significantly in 3–4 years, but continued monitoring is still required to keep populations from reestablishing. Small infestations can be removed by hand-pulling or herbicide in the amount of time it takes to significantly reduce the seedbank, but large infestations likely require multiple management techniques and ongoing management to control (Innes & Zouhar, 2021). The assessor has observed in north-central Idaho that successful releases of biocontrol agents have greatly reduced management efforts for local landowners.

Multiple broadcast treatments with clopyralid or aminopyralid can eliminate occurances of Cirsium arvense in 2 to 3 years. There is a 6-month (clopyralid) or one year (aminopyralid) re-seed interval after the last herbicide treatment. By year four, reseeding or replanting forbs into the treated area can begin, with follow-up in year five, with occasional follow-up and spot treatments afterward (Zouhar, 2001; DiTomaso et al., 2013). An isolated patch of C. arvense can be controlled in 2-5 years, but the ubiquity of this plant on the landscape makes it more difficult to manage. High rates of reintroduction and the potential for propagules to last 5-10 years suggest that the minimum time commitment for managing an established occurances of this species is also 5-10 years.

None of the sources reviewed mentioned a minimum time commitment for treating Cynoglossum officinale. However, it seems likely that active treatment efforts need to extend long enough to exhaust the seed bank for this species, a minimum of two to three years (de Jong et al., 1990). Dormant seeds are known to re-establish populations in treated areas in Washington. Given this, ongoing monitoring coupled with restoration of native plant communities that can outcompete this species are likely necessary to prevent recolonization.

In theory, Dipsacus species require 4–6 years of treatment to reduce viable seed in the seed bank (DiTomaso et al., 2013). In practice, 17 years of management efforts in Western Washington indicate that populations of D. fullonum may be reduced, but rarely fully controlled. Reinvasion of treated areas is quick if management is not continuous (R. Johnson, pers. comm., 2024).
See Q24

Minimum time commitments for treating Holcus lanatus invasions were not reported in available literature, but seed longevity suggests that it could take at least 10 years to exhaust the seed bank. Ongoing monitoring coupled with restoration of native plant communities are needed to prevent recolonization (Gucker, 2009; Conner et al., 2013).
Control of Ilex aquifolium requires multiple years of effort. This species sprouts readily from its roots when cut and its seeds are dispersed over long distances by birds (NWCB, 2022), making re-invasion possible even without nearby source populations.

Literature review did not reveal a minimum time commitment for treating Jacobaea vulgaris. However, it seems likely that active treatment efforts need to extend long enough to exhaust the seed bank for this species (6-20 years) (Richardson, 2004). To prevent recolonization, ongoing monitoring coupled with native plant community restoration is likely needed.
In Ireland, herbicide treatments have temporarily removed Juncus effusus populations within a year, but don't resolve the ecological conditions that allow this taxon to establish (McCorry & Renou, 2003). Other management techniques (e.g., manipulating wetlands or changing pasture management) can take several years (McCorry & Renou, 2003). Propagule persistance suggests that this taxon likely requires ongoing management due to the long life of the seed bank.
Constant reintroduction extends the time commitment for treating this species.

Constant reintroduction extends the time commitment for treating this species.

Leucanthemum vulgare has a persistent seed bank and a significant proportion can maintain viability up to 20 years. This suggests that monitoring and treatment to prevent reestablishment from this seedbank needs to last at least 20 years. Herbicide treatments need to be reapplied every 3–5 years to treat plants from the seed bank (Clements et al., 2004). Mechanical treatments such as tilling also need to be repeated to be effective (DiTomaso et al., 2013), thought tilling is not recommended in areas with significant native plant cover. Given the prevalence of this species in the Pacific Northwest, ongoing monitoring to prevent reinvasion may be needed well after local seed banks have been exhausted.

Application of nitrogen fertilizer over seven years was effective in reducing L. vulgare populations in Washington (NWCB, 2000), but this treatment could leave behind viable propagules and may promote invasion by other introduced species. For example, the introduced perennial grass Arrhenatherum elatius is known to increase with the presence of nitrogen fixing species (R. Johnson, pers. comm. 2024).

This species resprouts readily and the seed bank is difficult to exhaust (Welling & Becker, 1993).

Seed viability in the soil may reach 10 years (Weiss et al., 2000), but generally active management of this species has not been deemed necessary in Washington.

The assessor has observed that this plant has trace cover in relevé surveys of Willamette prairie in Oregon, suggesting an insignificant change in community composition.

This plant has only been eradicated in one lake with a very small population (i.e., a few plants) and that took yearly hand pulls for ~ 5 years. Larger established populations have been managed for more than 10 years to achieve control and in one lake, the population remains largely unchanged after nearly 15 years of ongoing management.

This species will likely continue to spread in a waterbody unless eradication is achieved, which requires multiple years of management (Smith & Barko, 1990; Kujawa et al., 2017; Mikulyuk et al., 2020). At a minimum, a low level of management is needed at most locations, but some populations may require greater than 10 years of treatment. On average, for a population of 2.5 acres, approximately 5 years of repeated management and surveys could result in an eradicated population, or control to the level that the population is low and follow-up treatments could only be needed every few years.

Phalaris arundinacea infestations are likely to require long term management, unless they are caught early in their invasion (Lavergne & Molofsky, 2004; Waggy, 2010). This species has a persistent seed bank and reinvasion by propagules from other populations is highly likely.
Phleum pratense reproduces mainly by seed, so the minimum time commitment for treatment is likely the same as seed bank longevity (4–7 years) (Esser, 1993). Ongoing monitoring is likely necessary to prevent recolonization, since source populations are quite common.

Rubus bifrons infestations are likely to require long term management, unless they are caught early in their invasion (Fryer, 2021).
This species requires 2-3 years of treatment of mature plants and seedlings.
While seeds may remain viable in the soil for some time, this species is rarely a management target.
Some infestations have been controlled in less than 5 years, others are still going 5+ years on.
In order to reforest a tall fescue pasture, one must control the tall fescue until trees grow above it, which can take a few years.

No sources mentioned a minimum time commitment for treating S. altissima invasions. Given the presence of a seed bank and the abundant rhizomes this species produces, treatments need to persist for at least the amount of time it takes to exhaust propagules.

See comments in Q24

Coupling Tamarix removal with stream restoration efforts and post-restoration monitoring likely requires an ongoing time commitment for Tamarix removal projects (Lehnhoff et al., 2011), but none of the sources found in the literature search provided a specific time commitment.

The persistence and long-term effects of Utricularia inflata invasions are not currently known, and at least some invasive populations observed in New York appeared to be short-lived (Titus & Grisé, 2009).
This species does seem to respond to herbicide.
No information was available on the amount of time treatment of Veronica anagallis-aquatica populations might take. A general minimum time for treatment is the lifespan of the propagules, which is likely less than five years, but other factors, such as likelihood of reinvasion from other source populations, is also important to consider.

15 pts)		
Q25 citation	**Q26 ranks**	**Q26 confidence ranks**
	Low	Low
	Insignificant (range Insignificant - Low)	Moderate (range Moderate - High)
	High	Moderate
	Low	Moderate
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	Low	High

Pitcher D. and M.J. Russo. 2012. Anthoxanthum odoratum, Global Invasive Species Team, The Nature Conservancy. https://wiki.bugwood.org/Archive:TNC/Anthoxanthum_odoratum. Accessed: October 25, 2024.	Low (range Low -High)	Moderate
	Low	Moderate
	Moderate	High

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	High	High
	Low	Moderate
	Insignificant	High
	Insignificant	High

	Low	Moderate

Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Moderate	Moderate
	Low	Moderate

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Canada thistle. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Moderate (range Low - High)	High (range Moderate - High)
	NA	NA
	Moderate	Moderate
	Insignificant	High
	Moderate	High

de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144.	Moderate (range Low - Moderate)	Moderate (range Low - High)
	Insignificant	High

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Common, Cutleaf, and Fuller's Teasel. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA.	Moderate (range Moderate - High)	Low (range Low - High)
	Unknown	Not Rated
	NA	NA
	Moderate	High

Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	High	High
Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board.	Low	Low (range Low - Moderate)

	Low	High
	Insignificant	High
Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Moderate	Low
	Insignificant	Moderate
McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	Low	Low
	High	High
	Moderate	Moderate

	Moderate	Moderate
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Leucanthemum vulgare Lam., oxeye daisy. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA.	High	High
	Unknown	Not Rated

Welling C.H. and R.L. Becker. 1993. Reduction of purple loosestrife establishment in Minnesota wetlands. Wildlife Society Bulletin 21(1):56–64.	Moderate	Moderate
Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	Insignificant	High
	Insignificant	High
	Unknown	Not Rated

	Low	Low
Kujawa E.R., P. Frater, A. Mikulyuk, M. Barton, M.E. Nault, S. van Egeren, and J. Hauxwell. 2017. Lessons from a decade of lake management: Effects of herbicides on Eurasian watermilfoil and native plant communities. Ecosphere 8(4). Mikulyuk A., E. Kujawa, N.E. Nault, S. van Egeren, K.I. Wagner, M. Barton, J. Hauxwell, and M.J. vander Zanden. 2020. Is the cure worse than the disease? Comparing the ecological effects of an invasive aquatic plant and the herbicide treatments used to control it. Facets 5(1):353–366. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	Moderate	Moderate
	Low	Moderate

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	High (range Low - High)	Moderate (range Moderate - High)
Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024.	Moderate	Low
	Insignificant	High
	Insignificant	High
	NA	NA
	Insignificant	High
	Low	Moderate
	Low	Moderate
	Insignificant	High

Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	High (range Low - High)	Moderate (range Moderate - High)
	Low	High
	Insignificant	High
	Moderate	High
	Low	Moderate
	Low	Low
	Insignificant	High
	Low	Moderate

	Low	Low
	Moderate	Moderate
Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65.	Moderate	Low
	Insignificant	High

	Moderate	High
Titus J.E. and D.J. Grisé. 2009. The invasive freshwater macrophyte Utricularia inflata (inflated bladderwort) dominates Adirondack Mountain lake sites. The Journal of the Torrey Botanical Society 136(4):479–486.	Moderate	Low
	Low	Moderate
	Low	Low
	Insignificant	High

Q26: Impacts of Management on Native Spec

Q26 notes
Collateral damage from Ailanthus altissima management is minimal and does far less damage to native species than uncontrolled spread. Typically, this species is controlled with herbicide. Ailanthus altissima control projects typically use hack and squirt, basal bark, or EZ-Ject lance systems to administer herbicide. These application methods are targeted, though they may result in occasional off-target damage (depending on which herbicides are chosen; herbicide type plays an important role in off-target damage). Managers have been known to use less targeted methods that may result in long term reductions in certain species. However, following best management practices, it is not difficult to limit off-target damage.
This species frequently occurs in dense westside forest settings with a lot of vegetation that may become collateral damage. However, the effects of Alliaria petiolata infestations may be more damaging than the effects of treatment to native plant communities.
Impacts on native species depend on control methods used. If one uses spot spraying, non-target kill is relatively low. Boom spraying would result in moderate to high non-target kill.
Impacts on co-occurring native species depend on the infestation and treatment history. Initial treatments typically occur in monocultures that are 100% Amorpha fruticosa. Follow up would be spot treatments in a more diverse vegetation community.

Treatments of Anthoxanthum odoratum that involve broadcast spraying or tilling will likely have long-term negative effects on native plant abundance and diversity. Using a grass-specific herbicide reduces impact to co-occurring native species. Native upland prairie grass species like Festuca roemeri may be resilient to grass specific herbicides that kill A. odoratum. However, in wet prairies, several native grass species are also susceptible to the herbicides that are effective against A. odoratum (Dennehy et al., 2011). Because A. odoratum occurs in wet prairies and with native endangered species, control techniques for this grass are constrained by the need to protect rare native species and use wetland-safe herbicides (Thorpe, 2011). The most effective treatments for this species are likely to have significant and potentially long-lasting effect on co-occurring native species.
Grass-specific herbicides minimize impacts on desirable vegetation, except for a couple of native grass species.

Manual treatment of small populations of Arundo donax is least impactful to native vegetation (McWilliams, 2004). Treating large infestations of this species may require mowing and backhoes to remove rhizomes (NWCB, 2013). This is likely to have large negative impacts on any co-occurring native plants. Grazing by goats, sheep, and cows is a possible treatment for A. donax, but may also have effects on co-occurring native plants through grazing pressure and soil compaction. Arundo donax is not generally a preferred food for grazers (NWCB, 2013), so effectiveness of grazing may be limited for other reasons as well.
Targeted manual treatments are suggested for managing Bellardia viscosa populations. These treatments are more likely to be low impact on co-occurring native species (Pickart & Wear, 1999). Another set of experiments in northern California suggest that radiant heat treatments are effective against B. viscosa and can be focused on target species, reducing damage to neighboring native plants. Treatments are most effective coupled with restoration of native plant communities or other techniques to prevent other invasive species from moving in to the open space (Emerzian, 2007).

From the few published studies available, the impacts of some management techniques (namely diquat application) on native aquatic plants appears to be minimal. For some species, increases in abundance and frequency were observed following treatment.

However, the impacts of different management methods on native plants still needs to be evaluated (Madsen et al., 2016; Parsons et al., 2019).

The use of broadscale herbicide treatment to knock back Centaurea solstitialis infestations can have a significant and permanent effect on native plant communities. At one site in Idaho, several native species that were present before broadcast herbicide treatment in 1995 (e.g. Lomatium, Primula, and Veronica species), have not been observed in the years since (M.F. Wiebush, pers. comm. 2024). Active restoration may be required to recover the native plant community after initial treatments for C. solstitialis. While broadcast herbicide treatments may have lasting effects on co-occurring native plants, available biocontrols for C. solstitialis have been relatively effective, at least in parts of Idaho, without spillover effects on native species.

Reduction of C. solstitialis can also increase abundance of invasive annual grasses like Bromus tectorum and Taeniatherum caput-medusae. Use of fire may have fewer negative effects on native species; C. solstitialis flowers and sets seed later than most associated native species, and prescribed fire to control this species is most effective after grasses have gone to seed. However, maintenance and restoration of native grassland and prairie communities is a necessary part of reducing and preventing C. solstitialis invasion, so most effective long-term management of this species may benefit co-occurring native species (Innes & Zouhar, 2021).

Depending on the method of control, off-target damage can vary. Spot treatment of patches with aminopyralid or clopyralid restricts damage to a small radius around treated plants. However, broadcast treatments are often deployed to save time. Broadscale herbicide treatments can cause significant and persistent reduction of native species. Mowing and tilling can also cause significant off-target damage (Zouhar, 2001; DiTomaso et al., 2013).

Ongoing concerns about spillover effects of biocontrols on co-occurring native plants in the Boraginaceae family has prevented their approval in the U.S. (Duncan & Williams, 2020). Several other techniques, particularly soil-tilling and broadcast herbicide spraying, can also have outsized effects on native communities, and soil disturbance without associated restoration may increase C. officinale abundance. Spot-spraying and dicot specific herbicides can reduce the impacts of herbicide treatments.

Discing or herbicide may cause reduction in co-occurring native species. However, the benefits of treatment could outweigh the costs in some cases, given D. fullonum's dense, monospecific habit and relatively transient propagule bank. Spot treatments using herbicides can also reduce risk to native plant species.

At least some of effective treatments for Holcus lanatus may be highly disruptive to co-occurring native species. For example, deep soil-tilling can result in loss of seed banks and propagules for native species. At least some of the effective herbicides for Holcus lanatus also affect a broad range of other plant species (Conner et al., 2013), which can also result in long-term changes to native plant communities.
Effective treatments for Ilex aquifolium generally target this species directly, either by hand removal or by direct application of pesticides to the tree (NWCB, 2022). While this treatment method could potentially also affect surrounding plants, generally few native plants are present under I. aquifolium canopies and negative effects of treatment on co-occurring native species has not yet been observed. Collateral damage to native species is probably minor and likely outweighed by the benefits of removing an invasive competitor.

Broadcast herbicide use could have negative effects on co-occurring forbs and grasses. Biocontrol agents may also spill over on related Senecio and Packera species (Jacobs, 2009).
Herbicide treatments can be relatively targeted for Juncus effusus (McCorry & Renou, 2003), allowing some reduction to impacts on co-occurring native species. Other techniques (e.g., hydrological restorations) could have higher negative impacts on native species in the short term, though restoration efforts are likely beneficial to most native species in the long term.
This species can't be manually treated (digging or pulling). Spraying will result in collateral damage of co-occurring species because this plant grows over and through neighboring plants.

This species can’t be manually treated (digging or pulling). Spraying will result in collateral damage of co-occurring species because this plant grows over and through neighboring plants.
All effective herbicide treatments for Leucanthemum vulgare affect legumes and other broad-leaved plants (Clements et al., 2004; Stutz et al., 2024). Treatments that involve broadcast spraying or tilling will likely have long-term negative effects on native plant abundance and diversity.

In very small populations mechanical (hand pulling) may be the most effective removal strategy, though care must be taken to leave behind any vegetative fragments that can resprout. In larger, established populations herbicide is often recommended. This poses little threat to monocots but is damaging to dicots. Most of dominant, diagnostic native species are monocots in the ecosystems where Lythrum salicaria poses a threat.
Populations in Washington are usually small enough that hand-pulling is a sufficient treatment method. In other parts of the world, prescribed fire and herbicides are effective but result in greater off-target damage (Weiss et al., 2000).
Management techniques are not well-developed for Myosotis discolor, likely because it has limited ecological impact compared to other nonnative species in the Pacific Northwest. Effects of management techniques for M. discolor on co-occurring native species are therefore not known. However, costs of treatment to native plants should be carefully weighed against the likely limited benefits gained by treating M. discolor.

There is a lack of quantitative research on non-target impacts of management. There is a current research project examining this, so we should have more information on this soon (Washington State Department of Ecology, 2024).

Recent research highlights that native plant richness and some individual species decline in response to Eurasian watermilfoil management with herbicides (Parsons et al., 2009; Kujawa et al., 2017; Mikulyuk et al., 2020). Several herbicides used for Eurasian watermilfoil management are not highly selective and can harm non-target native species. Recently developed herbicides such as florpyrauxifen-benzyl are much better at targeting milfoil species but will likely negatively impact our native milfoils if they are found in the same waterbody.

Most available herbicides are too broad for effective use in wildlands, and broadcast spraying would have negative impacts on native species (Waggy, 2010). Use of willow stakes cut from nearby sources may have a net positive effect on native species, but more research is needed (Kim et al., 2006). Many treatment suggestions start with treatments that potentially eliminate all existing vegetation on a site (Lavergne & Molofsky, 2004; Kim et al., 2006). However, mechanical removal of P. arundinacea has been observed to have positive effects on some areas, for example, one assessor observed an area of P. arundinacea that was bulldozed had native salt marsh plants return on their own, suggesting that communities with long-lived native seedbanks may be able to return (R. Johnson, pers. comm. 2024).
Herbicide use to remove Phleum pratense populations will likely have negative effects on co-occurring native species, particularly grasses. Native grasses are typically the dominant plants in the ecosystems where Phleum pratense most commonly occurs. In some cases, the management impacts may outweigh the benefits of trying to eliminate this species.

Timing of management efforts could potentially affect birds using Rubus bifrons as nesting habitat (Astley, 2011). Initial treatments for this species can include mowing, tilling, broadscale herbicide applications or other techniques that have significant collateral damage to co-occurring native species. Rubus bifrons can overtop trees and other plants, and there are no treatments that won't also negatively affect the co-occurring species (R. Johnson, pers. comm. 2024).
Treatment is usually conducted in the fall when most natives have senesced for the year.
Since this species is not managed, collateral damage is nonexistent.
Impacts of management on native species are generally low, though this may be because there is often little native community remaining in areas with tall fescue.

In mowing experiments from Solidago altissima's native range, mowing increased species diversity (Collins et al., 2001), though this may not be beneficial for naturally low diversity ecosystems. This species occurs in naturally disturbed ecosystems, so management by mowing may not be as impactful to native species as other treatment options (e.g., herbicide or tilling).
Herbicides used to treat this species are non-selective and also kill native saltmarsh vegetation.
No information was available on the effect Tamarix management could have on native species that occur in Washington. Restoration of historical hydrological regimes and native riparian vegetation may be the most effective treatment for Tamarix invasions (Stromberg et al., 2007). While the heavy equipment required for initial removal and restoration activities may have a negative effect on remaining native species in areas colonized by Tamarix, it is expected that the native riparian vegetation will recover quickly once removal and restoration efforts are complete. However, in the southwest, Tamarix removal is complicated due to their importance as habitat for the federally endangered Southwest Willow Flycatcher. For example, use and transportation of biocontrol agents in the western U.S. were halted after Southwest Willow Flycatcher nests were lost when Tamarix trees were defoliated (Gafke et al., 2022).

No information was available discussing the effects of Utricularia inflata management on co-occurring native species. However, suggested treatment options for U. inflata infestations, particularly draining lakes, seem likely to result in significant collateral damage to native species (NWCB, 2024).
This plant usually does not occur close to other plants.
No information was available on the effects treatment of Veronica anagallis-aquatica might have on native species. Herbicides are likely the most effective treatment available for this species (DiTomaso et al., 2013). Effects of herbicide treatment on co-occurring species likely depend on if herbicide application can be targeted to just V. anagallis-aquatica or not. Reduction in V. anagallis-aquatica populations could have positive effects on neighboring native plants, potentially reducing pollinator interference (Saito & Kadono, 2021) and competition for light (Riis et al., 2004).

cies (15)		
Q26 citation	**Q27 rank**	**Q27 confidence rank**
	Low	Moderate
	Low	Moderate
	Moderate	Moderate
	Low	High
	Moderate	Moderate

Dennehy C., E.R. Alverson, H.E. Anderson, D.R. Clements, R. Gilbert, and T.N. Kaye. 2011. Management strategies for invasive plants in Pacific Northwest prairies, savannas, and oak woodlands. Northwest Science 85(2):329–351. Thorpe A.S. 2011. Controlling exotic grasses while maintaining native plant communities in fire-maintained wet prairies. Prepared by Institute for Applied Ecology for U.S. Army Corps of Engineers, Willamette Valley Projects, Corvallis, OR.	Low	Moderate
	Insignificant	High
	Moderate	Moderate

McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Insignificant	High
Emerzian V.K. 2007. Radiant heater effects on Leontodon taraxacoides, Hypochaeris glabra, and Parentucellia viscosa in dunes and seasonal swales at Humboldt Bay National Wildlife Refuge. MS Thesis. Humboldt State University, Arcata, CA. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70.	Low	High
	Insignificant	High
	Low	Moderate

Madsen J.D., B. Sartain, G. Turnage, and M.D. Marko. 2016. Management of flowering rush in the Detroit Lakes, Minnesota. J. Aquat. Plant Manage 54:61–67. Parsons J.K., L. Baldwin, and N. Lubliner. 2019. An operational study of repeated diquat treatments to control submersed flowering rush. Journal of Aquatic Plant Management:28–32.	Moderate	Moderate

Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Low	Moderate
	Low	Moderate

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Canada thistle. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Low	Moderate
	NA	NA
	High	Moderate
	Low	High
	Moderate	High

Duncan S.S. and J.L. Williams. 2020. Life history variation in an invasive plant is associated with climate and recent colonization of a specialist herbivore. American Journal of Botany 107(10):1366–1374.	Low	Moderate
	Insignificant	High

	Low	Moderate
	Low	Moderate
	High	High
	Insignificant	Moderate

Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024.	Low	Moderate
Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board.	Moderate	Moderate

	Moderate	Moderate
	Moderate	Moderate
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715.	Low	Moderate
	Insignificant	High
McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	Low	Low
	Moderate	Moderate
	Moderate	High

	Moderate	High
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Stutz S., A.S. McClay, and R.A. De Clerck-Floate. 2024. Leucanthemum vulgare Lamarck, Oxeye Daisy/Marguerite blanche (Asteraceae). Biological Control Programmes in Canada, 2013-2023 (ed. by M.A. Vankosky and V. Martel), pp. 498–504. CABI, GB.	Low	Moderate
	Low	Low

	Moderate	Moderate
Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	Insignificant	Moderate
	Insignificant	High
	Low	Moderate

Washington State Department of Ecology. 2024. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023	Low	Moderate
Kujawa E.R., P. Frater, A. Mikulyuk, M. Barton, M.E. Nault, S. van Egeren, and J. Hauxwell. 2017. Lessons from a decade of lake management: Effects of herbicides on Eurasian watermilfoil and native plant communities. Ecosphere 8(4). Mikulyuk A., E. Kujawa, N.E. Nault, S. van Egeren, K.I. Wagner, M. Barton, J. Hauxwell, and M.J. vander Zanden. 2020. Is the cure worse than the disease? Comparing the ecological effects of an invasive aquatic plant and the herbicide treatments used to control it. Facets 5(1):353–366. Parsons J.K., A. Couto, K.S. Hamel, and G.E. Marx. 2009. Effect of fluridone on macrophytes and fish in a coastal Washington Lake. Journal of Aquatic Plant Management 47(1):31–40.	Low	Moderate
	Low	Moderate

Kim K.D., K. Ewing, and D.E. Giblin. 2006. Controlling Phalaris arundinacea (reed canarygrass) with live willow stakes: A density-dependent response. Ecological Engineering 27(3):219–227. Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Moderate	Moderate
	Moderate	Low
	Insignificant	High
	Insignificant	High
	NA	NA
	Insignificant	High
	Low	Moderate
	Low	Moderate
	Moderate	Moderate

Astley C. 2011. How does Himalayan blackberry (Rubus armeniacus) impact breeding bird diversity?: a case study of the lower mainland of British Columbia. MS Thesis. Library and Archives Canada = Bibliothèque et Archives Canada, Ottawa.	Moderate	Moderate
	Moderate	Moderate
	Low	Moderate
	Low	Moderate
	Low	Moderate
	High	Moderate
	Insignificant	High
	Moderate	Moderate

Collins B., G. Wein, and T. Philippi. 2001. Effects of disturbance intensity and frequency on early old field succession. Journal of Vegetation Science 12(5):721–728.	Insignificant	High
	Moderate	Moderate
Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https:// bugwoodcloud.org/resource/files/23194.pdf Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393.	Low	Low
	Insignificant	High

	Insignificant	High
Noxious Weed Control Board (NWCB). 2024. Swollen bladderwort, Utricularia inflata. https://www.nwcb.wa.gov/weeds/swollen-bladderwort. Accessed: September 19, 2024.	Insignificant	Moderate
	Insignificant	High
DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Water speedwell. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95. Saito R. and Y. Kadono. 2021. Reproductive interference between an alien species, Veronica anagallis-aquatica L., and a native congener, Veronica undulata Wallich (Plantaginaceae): A field observation. Acta Phytotax. Geobot. 72(3):293–300.	Low	Low
	Insignificant	High

Question 27. Inccessibility of Invaded Areas

Q27 notes
Access to private properties may be an important obstacle to management.
Ailanthus altissima appears to be mainly urban and along travel corridors. This species was largely introduced by human activity in the past 200 years, and most populations are still near areas frequented by humans. Perhaps 5% of the infestations one assessor observed are on rocky slopes or thick riparian vegetation, but with enough effort these are also accessible.
Physically reaching populations of Amorpha fruticosa on the Columbia and Snake Rivers involves several logistical challenges. Gaining permission for access, especially across private lands, is likely also an obstacle for access of populations for this species.

Anthoxanthum odoratum is mainly spread by human activity (Brusati & Warner, 2004), so populations are likely to be in relatively accessible areas.

In Washington, all documented occurances of Arundo donax are in easily accessible areas (iNaturalist Contributors, 2023). Evidence from California suggests that this species tends not to expand up steep, narrow canyons into montane areas. This is likely due to this species' mode of dispersal, as fragments are generally broken off by flooding to take root downstream of source populations (McWilliams, 2004), or are dispersed by human activities (Goolsby et al., 2023).
In Washington, populations of Bellardia viscosa usually occur along roadsides or other relatively accessible places (CPNWH, 2024; iNaturalist Community, 2024).

Deep water areas, especially in rivers, are difficult to survey properly (as well as manage). Flowering rush likely occurs in some of these areas.
Also, wetlands and shallow water areas connected to rivers where this species occurs are very difficult to access via boat or from the shore (Gunderson et al., 2016; Columbia Basin Cooperative Weed Management Area, 2019).

Long-distance dispersal of Centaurea solstitialis is most frequently from human activity and it frequently expands along roads and trails (Innes & Zouhar, 2021), suggesting it usually occurs in relatively accessible locations.

Cirsium arvense is mainly spread by human activities and human disturbance. This species usually grows in disturbed, relatively mesic areas that are generally not difficult to access. The main impediment to access is simply the extent of its range.

Cynoglossum officinale is most abundant in areas of human disturbance, particularly logging and heavy grazing (Andreas et al., 2008), suggesting populations are frequently in areas that are accessible for treatment.

Dipsacus fullonum is mainly spread by human activities and human disturbance (Gucker, 2009), so it is likely that the largest populations of this species are in areas that are easily accessible for management.

Holcus lanatus is likely to be spread to new locations by human activity and most of the records for this species are from populated areas in western Washington, suggesting that most invaded areas are relatively accessible (Gucker, 2009; CPNWH, 2023; iNaturalist Contributors, 2023).
Ilex aquifolium is most abundant in urban and residential areas (Stokes et al., 2014). However, seed dispersal by birds and other animals allows for this species to reach and establish in quite remote and inaccessible areas, as well (Zika, 2010).

Impatiens capensis is common in freshwater intertidal wetlands that can be very difficult to enter due to dense vegetation and irregular boat access.
Jacobaea vulgaris appears to rely primarily on human disturbance to invade plant communities (Jacobs, 2009), suggesting populations are frequently in areas that are accessible for treatment.
Juncus effusus ssp. effusus is fairly widespread in Washington, but many of the observations appear to be in accessible areas (CPNWH, 2023; iNaturalist Contributors, 2023). However, given that seeds can be dispersed by animals as well as wind and water, it is possible that some populations are in areas that are difficult to access.
This species is commonly found on beach bluffs, road cuts, and slides.

This species is commonly found on beach bluffs, road cuts, and slides.
Leucanthemum vulgare does not have much innate potential for long distance dispersal and is spread mainly by human activities. Invasion of this species in North America likely followed roadsides and other travel corridors (Clements et al., 2004).
Populations on freshwater mudflats may be difficult to access.

A substantial proportion of populations are in wetland riparian areas that are difficult to access.
This plant generally grows in easily accessible, disturbed environments.
Known populations of Myosotis discolor are most abundant near areas of anthropogenic disturbance. It seems likely that the majority of populations of this species are relatively accessible (CPNWH, 2024; iNaturalist Community, 2024).

It is relatively easy to access known occurances.
This is difficult to assess for a species that can occur at 30 ft of water depth. The Department of Ecology uses tools such as sonar and plant rakes to determine where Eurasian watermilfoil occurs in a deep or turbid waterbody, but these tools are imperfect. Most areas on infested waterbodies are easy to access by boat, but the actual plants beneath the water may not be easy to target with management.

Phalaris arundinacea occurs in both accessible and remote, inaccessible locations.
Phleum pratense is widespread in Washington (CPNWH, 2023; iNaturalist Contributors, 2023) and many populations are likely to be inaccessible.

Rubus bifrons can be found in steep or otherwise difficult to access areas, particularly east of the Cascades.
This species only occurs where it has been planted or dumped.
In at least one Washington site, this species either grows in areas relatively deep water or in mucky soils that are difficult to maneuver through.
This species can grow in active channels of riparian areas such as gravel bars and log jams.

There are only six documented populations of Solidago altissima in Washington, and they are all near highways and populated areas (CPNWH, 2023; iNaturalist Contributors, 2023).
Tides, mud, and channels make treating this plant very time-consuming and difficult. Airboats and other watercraft are nearly prerequisites for treatment.
As of 2009, most records of Tamarix presence and abundance in the Northwest were from relatively accessible areas (Kerns et al., 2009). However, further establishment in many of the canyons of eastern Washington would be difficult to access.

While accessibility is likely not a problem with this species, its cryptic nature does make it difficult to find.
Utricularia inflata was introduced by human activities (Howard Morgan, 2011) and is currently found in a limited area in Washington (CPNWH, 2024; iNaturalist Community, 2024), suggesting that most water ways where this species occurs are currently fairly accessible.
This plant can spread easily in riparian systems, so at least some populations are likely difficult to access.

s (3 pts)		
Q27 citation	**Q28 rank**	**Q28 confidence rank**
	Moderate/Low	High
	Moderate/Low	Moderate (range Moderate - High)
	Moderate/Low	Low
	Insignificant	Moderate
	Moderate/Low	Low

Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024.	Insignificant (range Insignificant - Moderate/Low)	Moderate
	Moderate/Low	Moderate
	Moderate/Low	Moderate

iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024.	Moderate/Low	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations of Bellardia viscosa from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=537967. Accessed: October 29, 2024.	Insignificant	Moderate
	Insignificant	High
	Moderate/Low	Moderate

Columbia Basin Cooperative Weed Management Area. 2019. Columbia Basin Flowering Rush Management Plan: A regional strategy to address Butomus umbellatus throughout the Columbia Basin. https://agr.mt.gov/_docs/weeds-docs/columbia-basin-flowering-rush.pdf. Accessed: January 14, 2025. Gunderson M.D., K.L. Kapuscinski, D.P. Crane, and J.M. Farrell. 2016. Habitats colonized by non-native flowering rush Butomus umbellatus (Linnaeus, 1753) in the Niagara River, USA. Aquatic Invasions 11(4):369–380.	Moderate/Low	High

Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Moderate/Low	High
	Insignificant	Moderate

	Insignificant (range Insignificant - Moderate/Low)	High (range Moderate - High)
	NA	NA
	Moderate/Low	High
	Insignificant	Moderate
	Moderate/Low	High

Andreas J.E., M. Schwarzländer, and R. De Clerck-Floate. 2008. The occurrence and potential relevance of post-release, nontarget attack by Mogulones cruciger, a biocontrol agent for Cynoglossum officinale in Canada. Biological Control 46(3):304–311.	Insignificant	High
	Insignificant	High

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	Insignificant (range Insignificant - Moderate/Low)	High (range Moderate - High)
	Insignificant	Moderate
	Moderate/Low	High
	Insignificant	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Insignificant	Moderate
Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	Moderate/Low (range Insignificant - Moderate/Low)	High (range Moderate - High)

	Moderate/Low	Moderate
	Moderate/Low	Moderate
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715.	Insignificant	High
	Insignificant	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Insignificant	Low
	Low/Moderate	Moderate
	High	Moderate

	High	Moderate
Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363.	Moderate/Low	Moderate
	Moderate/Low	High

	Moderate/Low (range Insignificant - Moderate/Low)	Moderate
	Insignificant	High
	Insignificant	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Insignificant	Moderate

It is relatively easy to access areas of infestation.	Insignificant	Moderate
	Insignificant	High
	Low/Moderate	Low

	Moderate/Low (range Insignificant - High)	High
Consortium of Pacific Northwest Herbaria (CPNWH). (2023). Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php EDDMapS. (2023). Early Detection & Distribution Mapping System. The University of Georgia—Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org iNaturalist Contributors. (2023). iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x	High	Moderate
	Insignificant	High
	Insignificant	High
	NA	NA
	Moderate/Low	High
	Moderate/Low	Moderate
	Moderate/Low	Moderate
	Moderate/Low	High

	Moderate/Low (range Insignificant - Moderate/Low)	Moderate (range Moderate - High)
	Moderate/Low	Moderate
	Insignificant	High
	Insignificant	Moderate
	Moderate/Low	High
	Unknown	Not Rated
	Insignificant	Moderate
	Insignificant	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Insignificant	Moderate
	Moderate/Low	Moderate
Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215.	High	Moderate
	Moderate/Low	Moderate

	Moderate/Low	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. Howard Morgan V. 2011. Utricularia inflata Walter. U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI. https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?Species_ID=238. Accessed: September 19, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Insignificant	Low
	Insignificant	High
	Insignificant	Moderate
	Insignificant	High

Question 28. Sociopolitical Implications of Manag

Q28 notes
Acer negundo is sometimes an indicator of former Euroamerican homesteads or other habitations and may be of interest from cultural resource or anthropological perspectives.
Ailanthus altissima is a conspicuous species that requires herbicide to control and typically occurs in areas frequented by humans. While this species frequently functions as a shade tree for landowners, most are happy to get rid of it because of its odor and its production of many seedlings and suckers. Some in the public oppose the removal of any tree on general principle unless the reasons behind removal are made clear. In areas that are highly visible to the public, treatment of A. altissima should be paired with concise and clear communication.
This plant is edible to humans, and foraging activities could potentially result in some resistance to management.
Public objections to herbicide use may present obstacles to management in some areas.
Amorpha fruticosa occurs along a waterway. This species is also full of bees when in bloom, although it replaces a very important early food source for native bees. Objections to treatment could include objections to herbicide use, particularly near water, and the perceived importance of this species for pollinators.

Anthoxanthum odoratum is not considered beneficial for agriculture and it is considered a threat in rare ecosystems that support several federally protected plant and insect species. Therefor objections to treatment for this species likely focus on herbicide use.
The sheer volume of herbicide required to manage this species could be cause for public concern. People may not understand why this grass is a target for management on a prairie.

Arundo donax is regarded as invasive worldwide (Goolsby et al., 2023), but management will likely involve some sociopolitical difficulties. This species' dispersal capabilities requires cooperation of all stakeholders within a watershed for successful management (McWilliams, 2004). This species has been considered for use in biofuels and phytoremediation, including a proposal in 2013 to grow it for use by Portland General Electric as a replacement for coal at their Boardman, Oregon plant (NPSO, 2013). More recently, tests using A. donax as biofuel or in phytoremediation have not been regarded as successful. In South Africa, harvesting invasive populations has proven to be inefficient (more costly than the energy produced) (Goolsby et al., 2023).
Bellardia viscosa is not used in agriculture or as an ornamental species, and it seems unlikely that public comments would extend beyond general objections to herbicide use.

Treatment of at least one major source location has been met with resistance from landowners over concerns regarding their ability to graze cattle near treated streams. This is a major impediment to controlling populations that contribute to spread throughout the Spokane and Columbia Rivers.

In southwestern Oregon, land managers may be restricted in pulling Centaurea solstitialis and related species once they start flowering because they are a floral resource for the federally endangered Franklin's bumblebee (Bombus frankilini). Centaurea solsititialis is also used by honeybees, and beekeepers could potentially have concerns about treating this species.

However, C. solstitialis has significant negative effects on rangeland quality and is poisonous to horses, suggesting that agricultural communities, at least, will have fewer objections to controlling this species. For example, in north-central Idaho, private landowners have initiated successful releases of biocontrol agents to reduce infestations of C. solstitialis on their property and neighboring lands.

Cirsium arvense is one of the most widespread invasive plants in the world. This species is a major crop pest, has little palatability to livestock or wildlife, and is generally considered undesirable in recreational areas. This species also has little documented benefit to native pollinators (Zouhar, 2001; Daniels & Arceo-Gómez, 2020), though apiarists have been known to oppose the control of species like C. arvense that are used by honeybees. Public objections to herbicide use may present obstacles to management in some communities, but no more so than for management of any other invasive species.

Cynoglossum officinale reduces the value of pasture and rangelands, and is poisonous to livestock, as well as reducing value of agricultural products like wool (Jacobs & Sing, 2007). Sociopolitical implications of management of this species are generally low, beyond general objections to herbicide use.

Dipsacus fullonum is sold as a garden plant in the United States where it is advertised for attracting birds and pollinators, and used in floral arrangements (Gucker, 2009). However, it seems most likely that public opposition to treatment of this species would center around general objections to herbicide use or other treatment options, and not management of the species itself.
Public objections to treatment of this species are unlikely to rise above general concern regarding herbicide use.
This plant is often seen as an attractive ornamental and may serve as forage for honeybees. Perhaps more significantly, because of the way it spreads along major river drainages, management generally requires coordinated efforts across multiple jurisdictions and between public and private parties.
Objections to management are unlikely.

Public objection to treatment is unlikely, beyond broad concerns about herbicide application.

Growers in the Pacific Northwest supply up to 90% of the holly vegetation used as holiday greenery in the U.S. (NWCB, 2022). This species is also popular as an ornamental, in part because its berries also attract many birds to people's yards (Zika, 2010). These could potentially result in objections to treatments for this species in Washinton State. However, given the potential for I. aquifolium to have negative impacts on growing merchantable timber for harvest and to increase fire danger (Church, 2016; NWCB, 2022), and treating this species may not be sociopolitically difficult.

While objections to I. aquifolium control are uncommon, the sources of new populations are unlikely to be removed from the state.

This plant has a very attractive flower and a number of reported medicinal uses (Mitchell, 2025).
This species is an attractive ornamental.
Jacobaea vulgaris reduces the value of pasture and rangelands, and is poisonous to livestock (Richardson, 2004; Jacobs, 2009). Given these effects, objections are likely to be minimal, beyond general objections to herbicide use.
Objections to treatment of this species seem unlikely, beyond potential questions about using herbicide in wetlands.
Some people may mistake this species for a sweet pea and object to management based on that misconception.

Some people may mistake this species for a sweet pea and object to management based on that misconception.
Leucanthemum vulgare's agricultural impacts—particularly in reducing the value of pasture forage and hay—and its function as a reservoir for yellow dwarf potato virus and potentially other diseases (Clements et al., 2004; Brusati, 2005) mean that support for management of this species is likely . However, L. vulgare is also an attractive species with a long history of use as an ornamental. As of 2004 in Canada, task forces were set up to educate people about the invasiveness of L. vulgare and suggest less problematic alternatives for ornamentals (Clements et al., 2004) and this may also be a useful part of management plans for this species in the Northwest. Development of biocontrols has been slowed because of potential spillover effects to ornamental Shasta daisies (DiTomaso et al., 2013; Stutz et al., 2020).
This species is widely sold as an ornamental, but any objections to control are likely to be limited to highly visible populations.

Lythrum salicaria can be a food source for honeybees. It is no longer commonly promoted as an ornamental plant (Thompson et al., 1987).
Medicinal uses for this plant are reported, but actual foraging appears to be quite uncommon (Cal-IPC, 2004). Objections to management are unlikely, aside from generalized objection to herbicide use (which is not required for most populations in Washington).
Myosotis discolor is not used in agriculture or as an ornamental species, and it seems unlikely that objections would extend beyond general objections to herbicide use.

In general, the public has been supportive of treatment efforts for this species.
For the most part, folks want to manage Eurasian watermilfoil where it occurs. However, there are different opinions of how best to manage the species and where and when herbicides should be used. Sometimes there is opposition to the most effective management approach.
There may be some objections to management from those who forage this palatable species.

Treatment efforts in populated areas may require additional public education.
Phleum pratense is grown as a high-value hay and pasture grass, particularly for horses. It seems likely that large-scale efforts to manage this species as an invasive would receive objections.
Public opposition is unlikely, aside from generalized herbicide skepticism.
The general public may not be able to distinguish native from introduced oaks.

Rubus bifrons is a major crop in the Pacific Northwest and feral fruits are widely used. There may be public objection to herbicide application in some locations. However, this species is also an alternative host for pests and diseases that affect grapevines, and is a significant weed in grass production fields in Oregon (Fryer, 2021).
Some people may oppose herbicide control because berries are edible.
This plant is poisonous and objections to management are unlikely, aside from generalized concern about herbicide use.

Solidago altissima is attractive to many pollinators and has been introduced in Asia in part because of its attractiveness to pollinators (Park et al., 2020). This may be the most likely friction point for management of this species.
Oyster growers and others from the public have objected to herbicide use in Willapa Bay and elsewhere.
Successful Tamarix management is likely to rely on restoring natural water flows and hydrological regimes and potentially changing livestock grazing practices (Stromberg et al., 2007). Grazing and water issues are historically fraught in the western U.S., suggesting that an important part of any work with Tamarix removal needs to include building relationships and buy in from stakeholders. Research on and use of biocontrol agents is restricted in a portion of Tamarix's range in the western U.S. due to lawsuits to protect the Southwest Flycatcher. The result of these lawsuits restricts federal funding on research into Tamarix biocontrols as well as interstate transport of biocontrols (Gafke et al., 2022). While the Southwest Flycatcher does not occur in Washington, some of these restrictions may limit the tools available to manage Tamarix invasions in the state. While Tamarix management may not be opposed by the general public, dealing with complex water issues and the current regulations on biocontrol agents that target Tamarix species could still make management sociopolitically difficult.

Public objection to treating this species seems unlikely, particularly since it can contribute to degradation of recreation opportunities on the waterbodies where it occurs (Smith, 2007). Draining infested areas to eliminate U. inflata populations could potentially be unpopular, but this suggestion is also less appealing for other reasons (see Q26). The most likely objection to management comes from generalized opposition to herbicide use, particularly in aquatic systems.
Objections to potential management are unlikely, aside from generalized skepticism of herbicides (particularly in wetland and aquatic systems).
This species is not targeted for management.

gement (6 pts)	
Q28 citation	Management Difficulty Score
	54.39
	45.61
	92.98
	68.42
	54.39

	57.89
	71.93
	73.68

Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Native Plant Society of Oregon (NPSO). 2013. State of Oregon control area established for Arundo donax. Bulletin of the Native Plant Society of Oregon 46(1).	89.47
	29.82
	0.00
	26.32

73.68

	63.16
	68.42

Daniels J.D. and G. Arceo-Gómez. 2020. Effects of invasive Cirsium arvense on pollination in a southern Appalachian floral community vary with spatial scale and floral symmetry. Biological Invasions 22:783–797. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	57.89
	NA
	75.44
	12.28
	84.21

Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8.	57.89
	0.00

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	66.67
	2.38
	92.86
	75.44

	75.44
Church E.D. 2016. Invasive English holly (Ilex aquifolium L.) in clear-cut and forest units in a western Washington managed forest. MS Thesis. University of Washington, Seattle, WA. NWCB. 2022. Draft written findings of the Washington State Noxious Weed Control Board: Ilex aquifolium. Washington State Noxious Weed Control Board.Online: https://www.nwcb.wa.gov/pdfs/English-holly-Ilex-aquifolium-written-findings-2022.pdf Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	75.44

Mitchell G. 2025. Jewelweed. https://indiananativeplants.org/images/resources/Gordon%20Mitchell%20Articles/GM_jewelweed.pdf. Accessed: January 31, 2025.	47.37
	57.89
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	66.67
	10.53
	49.12
	92.98
	70.18

	70.18
Brusati E. 2005. Plant assessment form: Leucanthemum vulgare. California Invasive Plant Council (CAL-IPC). https://www.cal-ipc.org/plants/paf/leucanthemum-vulgare-plant-assessment-form/. Accessed: October 22, 2024. Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Leucanthemum vulgare Lam., oxeye daisy. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Stutz S., H.L. Hinz, and U. Schaffner. 2020. Evaluation of Cyphocleonus trisulcatus (Coleoptera: Curculionidae) as a potential biological control agent for Leucanthemum vulgare in North America. Journal of Applied Entomology 144(1–2):81–93.	91.23
	44.44

Thompson D.Q., R.L. Stuckey, and E.B. Thompson. 1987. Spread, impact, and control of purple loosestrife (Lythrum salicaria) in North American wetlands. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.	84.21
California Invasive Plant Council (Cal-IPC). 2004. Plant Assessment Form: Marrubium vulgare. https://www.cal-ipc.org/plants/paf/marrubium-vulgare-plant-assessment-form/. Accessed: February 5, 2025.	0.00
	0.00
	2.38

	68.42
	57.89
	52.63

	92.98
	80.70
	0.00
	0.00
	NA
	15.79
	63.16
	35.09
	28.07

Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	73.68
	47.37
	1.75
	57.89
	54.39
	72.22
	0.00
	70.18

Park J.S., D. Choi, and Y. Kim. 2020. Potential distribution of goldenrod (Solidago altissima L.) during climate change in South Korea. Sustainability 12(17):6710.	40.48
	84.21
Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https:// bugwoodcloud.org/resource/files/23194.pdf Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393.	87.72
	15.79

NA	61.40
Smith D. 2007. Integrated aquatic vegetation monitoring plan. Barnes Lake Management District, City of Tumwater. Online: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=a118bdc30aea782f71a7abc230f1eb01bd9a907e	66.67
	8.77
	25.00
	0.00

Management Difficulty Rank	**Management Difficulty Confidence score**	**Management Difficulty confidence rank**
Moderate	60.00	Moderate
Low	60.00	Moderate
High	60.00	Moderate
Moderate	60.00	Moderate
Moderate	50.00	Moderate

Moderate	60.00	Moderate
High	80.00	High
High	80.00	High

High	90.00	High
Insignificant	60.00	Moderate
Insignificant	100.00	High
Insignificant	70.00	High

High	80.00	High

Moderate	50.00	Moderate
Moderate	60.00	Moderate

Moderate	80.00	High
NA	NA	NA
High	50.00	Moderate
Insignificant	80.00	High
High	100.00	High

Moderate	60.00	Moderate
Insignificant	100.00	High

Moderate	60.00	Moderate
Insignificant	20.00	Low
High	80.00	High
High	90.00	High

High	50.00	Moderate
High	60.00	Moderate

Low	70.00	High
Moderate	70.00	High
Moderate	40.00	Moderate
Insignificant	60.00	Moderate
Low	10.00	Low
High	80.00	High
Moderate	70.00	High

Moderate	70.00	High
High	80.00	High
Low	20.00	Low

High	60.00	Moderate
Insignificant	80.00	High
Insignificant	100.00	High
Insignificant	40.00	Moderate

Moderate	60.00	Moderate
Moderate	70.00	High
Moderate	50.00	Moderate

High	80.00	High
High	20.00	Low
Insignificant	100.00	High
Insignificant	100.00	High
NA	NA	NA
Insignificant	100.00	High
Moderate	60.00	Moderate
Low	50.00	Moderate
Insignificant	90.00	High

High	70.00	High
Low	60.00	Moderate
Insignificant	90.00	High
Moderate	80.00	High
Moderate	80.00	High
High	20.00	Low
Insignificant	90.00	High
Moderate	60.00	Moderate

Low	30.00	Low
High	70.00	High
High	50.00	Moderate
Insignificant	90.00	High

Moderate	90.00	High
Moderate	10.00	Low
Insignificant	70.00	High
Insignificant	10.00	Low
Insignificant	100.00	High

Assessor(s)	**Taxon**	**Q6 rank**	**Q6 confidence rank**
Walter Fertig, Clayton Antieau, David Wilderman	Acer negundo	Yes	High
Emily Stevenson, Walter Fertig, Ethan Coggins	Ailanthus altissima	Yes	High
Emily Stevenson	Alliaria petiolata	Yes	High

Carlo Abbruzzese	Alopecurus pratensis	Yes	High
Emily Stevenson, Walter Fertig	Amorpha fruticosa	Yes	High
Regina Johnson, Molly S. Wiebush	Anthoxanthum odoratum	Yes	High

Regina Johnson	Arrhenatherum elatius	Yes	High
Regina Johnson	Arum italicum ssp. italicum	Yes	High
Molly S. Wiebush	Arundo donax	Yes	High
Molly S. Wiebush	Bellardia viscosa	Yes	High
Regina Johnson	Bellis perennis	No	Moderate

Regina Johnson	Betula pendula	Yes	High
Wesley Glisson	Butomus umbellatus	NA	NA
Molly S. Wiebush	Centaurea solstitialis	Yes	Moderate
Emily Stevenson	Chondrilla juncea	NA	NA

Emily Stevenson, Ethan Coggins, Regina Johnson, Molly S. Wiebush	Cirsium arvense	Yes	High
Carlo Abbruzzese	Cirsium vulgare	Yes	High
Regina Johnson	Clematis vitalba	Yes	Moderate

Regina Johnson	Cotoneaster spp.	No	Moderate
Regina Johnson	Crataegus monogyna var. monogyna	Yes	Moderate
Helen Lau, Molly S. Wiebush	Cynoglossum officinale	Yes	Low
Regina Johnson, Carlo Abbruzzese	Dianthus armeria	No	Moderate

Kimberly Quayle, Regina Johnson, Molly S. Wiebush	Dipsacus fullonum	Yes	High
Regina Johnson, Walter Fertig	Erechtites minimus	Unknown	Not Rated
Emily Stevenson	Fallopia xbohemica	NA	NA
Regina Johnson	Hieracium pilosella	Yes	High

Molly S. Wiebush	Holcus lanatus	Yes	High

Molly S. Wiebush, Regina Johnson	Ilex aquifolium	Yes	High
Regina Johnson	Impatiens capensis	Yes	High

Emily Stevenson	Iris pseudacorus	Yes	High
Molly S. Wiebush	Jacobaea vulgaris	Yes	High
Carlo Abbruzzese	Juglans regia	No	Moderate

Molly S. Wiebush	Juncus effusus subsp. effusus	Yes	High
Regina Johnson	Lamium galeobdolon	Yes	High
Regina Johnson	Lathyrus latifolius	Yes	High
Regina Johnson	Lathyrus sylvestris	Yes	High

Molly S. Wiebush	Leucanthemum vulgare	Yes	High
Emily Stevenson	Lysimachia nummularia	Yes	High

Kimberly Quayle, Regina Johnson	Lythrum salicaria	Yes	High
Ethan Coggins	Marrubium vulgare	Yes	High
Regina Johnson	Mycelis muralis	NA	NA

Molly S. Wiebush	Myosotis discolor	No	Moderate
Wesley Glisson	Myriophyllum heterophyllum	NA	NA

Wesley Glisson	Myriophyllum spicatum	Yes	High
Regina Johnson	Nasturtium officinale	Yes	High

Emily Stevenson, Molly S. Wiebush, Regina Johnson	Phalaris arundinacea	Yes	High

Molly S. Wiebush	Phleum pratense	Yes	Moderate
Regina Johnson	Plantago lanceolata	No	Moderate
Regina Johnson	Poa annua	Yes	High
Wesley Glisson	Potamogeton crispus	NA	NA
Regina Johnson	Quercus robur	No	Moderate
Regina Johnson	Rosa canina	Yes	Moderate

Regina Johnson	Rosa multiflora	Yes	Moderate
Regina Johnson	Rosa rugosa	Yes	Moderate
Emily Stevenson, Regina Johnson, Molly S. Wiebush	Rubus bifrons	Yes	High
Carlo Abbruzzese	Rubus laciniatus	Yes	Moderate
Carlo Abbruzzese	Rumex crispus	Yes	High
Regina Johnson	Sasa palmata	No	High
Regina Johnson	Schedonorus arundinaceus	Yes	Moderate
Emily Stevenson	Schoenoplectus mucronatus	NA	NA

Regina Johnson	Senecio sylvaticus	Yes	High
Regina Johnson	Solanum dulcamara	Yes	High
Molly S. Wiebush	Solidago altissima	Yes	High
Carlo Abbruzzese	Spartina alterniflora	Yes	High

Molly. S. Wiebush	Tamarix ramosissima	Yes	High
Regina Johnson	Trifolium pratense	No	Moderate
Regina Johnson	Trifolium subterraneum	Yes	High

Molly. S. Wiebush	Utricularia inflata	Yes	High
Carlo Abbruzzese	Verbascum blattaria	No	Moderate

Molly S. Wiebush	Veronica anagallis-aquatica	Yes	Low
Regina Johnson	Veronica arvensis	Unknown	Not Rated

Question 6. Aggressive Mode of Reproductio

Q6 notes

Acer negundo suckers at the root collar (George, 1953) and has prolific seed production (Rosario, 1988).

This species is extremely fecund (producing up to 325,000 seeds per year) and can sprout from even small root fragments (NWCB, 2011; Knüsel, 2019).

Alopecurus pratensis is an aggressive invader due to its seed production, potential seedbank, rhizomes, and difficulty of eradication.
DiTomaso et al. (2013) and NWCB (2015) suggest that this species has an aggressive mode of reproduction.
Anthoxanthum odoratum only spreads by seed (Pitcher & Russo, 2012). Plants are self-incompatible (Roach, 1987). A study in North Carolina found individual plants produce 58–1257 seeds (Brusati & Warner, 2004; Pitcher & Russo, 2012). One study in New York found over 100 A. odoratum seeds per square meter at an old field site, making this species one of the 10 most abundant species in the seed bank (Morris et al., 1986). However, observations in northern California suggest spread of this species is slow (Brusati & Warner, 2004), and other research suggests that A. odoratum experiences high juvenile mortality (Roach, 1987). While this species is sometimes capable of producing more than 1000 seeds per plant, it appears to be less aggressive than other introduced species in the Pacific Northwest.

Arundo donax does not produce viable seed anywhere in its invasive range (Goolsby et al., 2023). Instead, this species reproduces vegetatively via rhizomes, stem nodes, layering, and plant fragments (most commonly rhizome fragments) (McWilliams, 2004; NWCB, 2013). Clonal reproduction can produce stands of several acres. This species grows rapidly after establishment, up to four inches a day, and readily resprouts from roots. It may be able to sprout even from deeply buried rhizomes (between 3–10 feet) (McWilliams, 2004).
Bellardia viscosa is a self-compatible annual and only reproduces by seed. A study at a dune site in northern California estimated seed production by plant size, with an average plant estimated to produce approximately 12,000 seeds. Plants parasitizing Acmispon americanus resulted in larger inflorescences than plants that parasitized other species or had no host (Pickart & Wear, 1999) However, B. viscosa can flower and reproduce without a host plant (Pate & Bell, 2000).

Seeds are very numerous, and a mature birch can produce over a million seeds per year (Vedel & Lange, 1960).

Centaurea solstitialis is a winter annual or occasionally biennial species that reproduces from seed. This species produces two types of seeds. A study in Washington found that the average C. solstitialis plant produced 180 seeds. Data from Washington also found C. solstitialis populations could produce 1,940 seed per square foot in a wet year, and 470 seeds per foot in a dry year. However, in nursery conditions, this species can produce up to 100,000 seeds per plant. Centaurea solstitialis can produce flowers and seeds for several months to year-round if it does not experience drought or frost conditions. Propagule pressure is usually the most important factor in this species invasion of undisturbed or otherwise less than ideal habitats. Seeds are eaten by birds and insects—including biocontrol species—but C. solstitialis produces abundant seed; in some cases, populations may persist even when biocontrol species are present (Innes & Zouhar, 2021).

Centaurea solstitialis plants are self-incompatible and rely on pollinators (most importantly introduced honeybees) to reproduce. Floral visitors are abundant and diverse (Innes & Zouhar, 2021).

Cirsium arvense primarily reproduces via vegetative propagation and can rapidly produce dense clonal stands. This species does not produce rhizomes but can produce adventitious root buds at any time of year. Plants can grow from small (6mm long) root fragments (Zouhar, 2001).
Cirsium arvense is the only dioecious species of Cirsium. Female plants can produce more than 1000 seeds/plant (Zouhar, 2001). One study in California found 280 (+/- 110) viable C. arvense seeds per m2 in the top 2 cm of soil (Hobbs & Mooney, 1986). However, a study in New Zealand did not find any seedlings over three years of survey efforts, despite viable C. arvense seeds being present in the seed bank (Leathwick & Bourdôt, 2012), suggesting that high seed production doesn't necessarily lead to significant population growth in this species.
Cirsium arvense requires 15 hours of daylight to induce flowering, are "imperfectly dioecious" (male plants sometimes produce seeds), and require insect pollination. The major pollinators for this species appear to be honeybees. Extreme heat or cold can inhibit pollination, and seeds are subject to seed predation, which can lead to variable seed set between years (Zouhar, 2001). Since C. arvense is an obligate outcrosser, seed production may be more important for maintaining genetic diversity and adaptability in populations than for contributing to population growth or colonization. Even if seed production does not contribute significantly to population growth, C. arvense reproduces aggressively via vegetative propagules.

This species usually produces 100–300 seeds per inflorescence and a single plant can produce up to 400 flowerheads. Seed production varies per plant and population, and is influenced by climate conditions (Zouhar, 2002).

Cynoglossum officinale is a biennial or short-lived perennial. In its native range, this species is usually monocarpic, but up to 20% of plants in its introduced range will flower in multiple years (Williams & Fishman, 2014). This may be due to release from specialist herbivores (Duncan & Williams, 2020). Cynoglossum officinale can delay flowering until conditions are favorable for reproduction (de Jong et al., 1990). This effectively creates a “bud bank” that helps plant populations survive years that are poor for seed production or seed germination (de Jong & Klinkhamer, 1988). In its native range, one study found this species produced between 174–1823 seeds, with an average of 944 seeds per plant. Other studies report 306–1500 seeds per plant (de Jong et al., 1990). Larger plants produce more seeds per flower, and individual plants can produce up to 4000 seeds (Klinkhamer & de Jong, 1987). Cynoglossum officinale produced few seeds in pollinator exclusion experiments, and likely requires buzz pollination, suggesting that bumblebees are the most efficient pollinators for this species. Seed production can be limited by both pollinators and resource availability (de Jong et al., 1990). Fresh seeds have an estimated viability of 90%, and seedlings also have a high rate of establishment, in part because of the maternal provisions provided by large seeds (Jacobs & Sing, 2007). Iteroparity (reproducing in multiple years) appears more common in Idaho and Montana then in Washington. High winter precipitation can increase flowering and seed set. Mogulones cruciger—a weevil approved for use as a biocontrol of C. officinale in Canada—reduces flowering and seed set (Duncan
Dianthus armeria produces approximately 400 seeds per plant (Wells, 1967) and does not otherwise have an aggressive mode of reproduction.

Dipsacus fullonum is biennial or a short-lived monocarpic perennial. This species only reproduces through seed and does not reproduce vegetatively.
Dipsacus fullonum plants can produce more than 3000 seeds, which have a 28%–86% germination rate. In old fields in Michigan, seed production four years post-introduction reached roughly 4500 seeds/m2 (Gucker, 2009). Dipsacus fullonum produces perfect flowers but is mostly an outcrosser, though it can self-pollinate in rare circumstances (Gaskin et al., 2024). This species requires insect pollination, but has a generalist relationship with pollinators, with Hymenoptera, Diptera, and Lepidoptera all common visitors when Dipsacus fullonum is in flower (Werner, 1976; Gucker, 2009).
While individual plants do not produce seeds annually, many plants within a population are likely to produce a large number of seeds in any given year.

Martin and Popenoe (1984) found that buried Erechtites spp. seeds were more abundant than any other species in an old-growth redwood forest.

This quick-growing species is stoloniferous.

Holcus lanatus is a perennial that can live for several decades in moist habitats. It is comparatively short-lived (2–4 years) in dry habitats and can even grow as an annual on the east coast of North America.

Holcus lanatus usually reproduces from seed but can also reproduce vegetatively by tillering or rooting from stem nodes. This species may need to experience cold temperatures to set flowers. Seed production requires cross-pollination. In coastal California, H. lanatus was found to produce 6000–19,000 seeds per square meter (depending on the density of the adult population) (Gucker, 2009). Seed production in H. lanatus can be up to four times greater than that of native species in these habitats (Bennett et al., 2011). Seeds have high germination rates (frequently 90% or greater) (Gucker, 2009). Holcus lanatus can also produce seeds in its first year (Thomsen & D'Antonio, 2014).

Ilex aquifolium is dioecious and reaches reproductive age at approximately 15 years. This species reproduces readily both vegetatively and from seed, grows rapidly, and sprouts readily from both living trees and cut stems. Ilex aquifolium is dioecious and reaches reproductive age at approximately 15 years. This species reproduces readily both vegetatively and from seed, grows rapidly, and sprouts readily from both living and cut stems. Vegetative reproduction occurs via suckers, layering, and roots. Thickets expand from a founder tree by means of root suckers and adventitious roots, and can also root from limbs or trunks where they touch the ground (Zika, 2010; Stokes et al., 2014; NWCB, 2022). While Ilex aquifolium can experience relatively rapid growth for a tree, invasions by tree species move slowly and can go unnoticed until populations are well-established and difficult to control (Church, 2016).

A study in western Washington found that consumption and regurgitation by American Robins (the most common seed dispersal mechanism for I. aquifolium) did not affect germination. The same study found that seed predation by rodents is rare in urban areas, but that rodents consume up to 39% of dispersed I. aquifolium seeds outside of urban areas. In forested areas, up to 76% of seeds were either damaged or non-viable. Differences in seed predation may explain why I. aquifolium is generally more abundant in urban and residential areas than in natural areas (Zika, 2010).

Iris pseudacorus reproduces both vegetatively and by seed—the proportion may vary by local site conditions (Preece, 1964; Sutherland, 1990).
Jacobaea vulgaris is a winter annual to short-lived perennial. Many plants are monocarpic, but this species can also grow as a true perennial, flowering and producing seed in multiple years. While J. vulgaris can reproduce from root fragments, it is most likely to reproduce from seed. One plant can produce between 5,000–200,000 seeds in four to six weeks, with an average viability of 80%. Populations can spread rapidly in disturbed areas without control efforts. One population in Montana grew to cover 150 square miles between 1993 and 1997 (Richardson, 2004; Jacobs, 2009).
This species has relatively low fruit production.

Juncus effusus reproduces by seed and short rhizomes and grows rapidly above and below ground (Ervin & Wetzel, 2000; Arslan et al., 2019). Seeds are abundant and disperse readily (Arslan et al., 2019). One source found that J. effusus could produce up to 8 million seeds per yard (Lazenby, 1955), while other sources suggest 8,500 seeds per fertile stem, or 4 million seeds per square meter (McCorry & Renou, 2003). Seeds are the primary source for colonization by this taxon and germination rates are typically relatively high (Lazenby, 1955; McCorry & Renou, 2003). Established populations can maintain and expand themselves through rhizomes (McCorry & Renou, 2003).

Leucanthemum vulgare primarily reproduces by seed, but can also reproduce from root crowns, creeping rhizomes, and root or rhizome fragments. This species usually does not flower in the first year, but once it starts flowering it can produce between 1300–4000 seeds per year—under ideal conditions a single plant can produce 26,000 seeds in a year. Seed production is most abundant in wet years. Creeping roots and abundant seed make L. vulgare an aggressive invader (Clements et al., 2004; Brusati, 2005; DiTomaso et al., 2013; EDDMapS, 2023). Leucanthemum vulgare plants from North America produce more flowers than plants from their native range (Stutz et al., 2018).
Lysimachia nummularia plants in North America are not known to produce seed (Cao & Berent, 2025), instead reproducing vegetatively via plant fragments (MISIN, 2024). Horizontal stems typically root at the nodes.

Mature Lythrum salicaria can produce 2.5 million seeds per established plant in good conditions; even young plants can produce 100,000 seeds (Thompson et al., 1987).

Large mature plants are known to produce up to 20,000 seeds in wet years in Tasmania, with high germination rates (Lippai et al., 1996; Weiss et al., 2000).

Myosotis discolor is a self-compatible annual or occasionally biennial species (Parachnowitsch & Elle, 2005; Kelley & Joyal, 2012). This species likely reproduces only by seed. Reproductive information was only available from this species' native range, and seed production rates could be different in its introduced range. Two studies from England documented reproductive output for M. discolor and both found low seed production. One study harvested 132 seeds in approximately 10 square meters (Smith et al., 1996). The other study found that this species produced on average 55 seeds per plant and exhibited relatively poor colonization (Asefa, 2011).

Reproduces readily by fragments and seeds, both supported by many studies (Aiken et al., 1979; Madsen & Boylen, 1989, 1989; Smith & Barko, 1990; Hartleb et al., 1993; Madsen & Smith, 1997; Standifer & Madsen, 1997; Evans et al., 2011; Li et al., 2013; Wani & Arshid, 2013).

Phalaris arundinacea is a long-lived rhizomatous perennial. This species increases in established populations via rhizomes and tillers and colonizes new areas via seed. Plants can produce rhizomes in less than two months. Individual rhizomes can grow up to four inches long in wet soils and form dense mats. One experimental garden study found 383 feet of rhizomes growing in one square meter of loam. Plants are also capable of rooting from their stem nodes (Mueller, 1941). Rhizomes can account for up to 74% of new tillers in a P. arundinacea population, with the rest of the tillers coming from buds in aboveground leaf axils. Phalaris arundinacea can also sprout via fragments and recovers quickly after mowing and other damage (Waggy, 2010).
Phalaris arundinacea is wind-pollinated and is an obligate outcrosser. Seed production can reach 1000 seeds per square meter, with individual inflorescences documented producing up to 600 seeds in the Pacific Northwest (Lavergne & Molofsky, 2004; Waggy, 2010).
Repeated introductions of P. arundinacea cultivars from Eurasia have resulted in high genetic diversity in North American populations. High genetic diversity and novel genotypes makes P. arundinacea especially adaptable to new conditions. Differences in invasive potential between populations is likely due to this genetic diversity (Lavergne & Molofsky, 2004; Waggy, 2010).

Phleum pratense is a short lived (4–7 years) fast-growing perennial bunchgrass. This species mainly reproduces via seed and does not reproduce by rhizomes, but can reproduce vegetatively via tillers, rooting from nodes, or root fragments (Esser, 1993). Seed yields per plant were not found in the literature search, but one pound of P. pratense seed is approximately 1,230,000 seeds (Ogle et al., 2011). One study found seeds to consistently have germination rates of 90% or higher (Williams, 1954). Seedling germination peaked in the fall in a study from New York (Morris et al., 1986), potentially giving seedlings a head start on the spring growing season. Seedlings also grow rapidly (Esser, 1993).

A single plant can produce up to 500,000 seeds in a single year (Hoffman & Kearns, 1997).
Rubus bifrons is a rhizomatous perennial shrub, with short-lived canes and long-lived roots and rhizomes. This species primarily reproduces vegetatively from rhizomes, root crown sprouts, and layering. This includes resprouting from cut stems after mechanical removal attempts. Rhizomes can grow at a depth of 0.5-2 meters and reach 10 meters long. This species grows more rapidly than co-occurring woody vegetation (Fryer, 2021). Rubus bifrons has bisexual flowers and can seed through pollination and apomixis. This species has a mixed mating system, cross-pollination results in larger fruits and more seeds. Seeds are more commonly produced by apomixis and Rubus bifrons has relatively low genetic diversity. Pollination syndrome is generalist, but bees, particularly honeybees, are the most common floral visitors to this species. Rubus bifrons can produce between 7000 and 13,000 seeds per square meter (Fryer, 2021).
This species produces large amounts of seed and can reproduce vegetatively.
As noted in Cavers & Harper (1964), this species flowers multiple times per year, produces copious seed, and can resprout from vegetative fragments.

Solidago altissima reproduces sexually and vegetatively and can flower and reproduce by rhizomes in its first year. Local reproduction and population growth is usually clonal, but sources estimate that single plants produce 1000-200,000 seeds annually (Meyer & Schmid, 1999; Etterson et al., 2008; Kato-Noguchi & Kato, 2022), with one study estimating 30-75% germination(Kato-Noguchi & Kato, 2022). High germination rates in the lab do not necessarily indicate high germination in the field; at least one study found that most seeds failed to germinate in the field (frequently due to fungal infection or other disease) or vanished from field sites (Walck et al., 2001). Even with low germination rates in the field, high seed production makes this species an excellent colonizer. Aggressive colonization abilities combined with other competitive traits likely contribute to this species success as an invasive species in Europe and Asia (Meyer & Schmid, 1999; Etterson et al., 2008; Kato-Noguchi & Kato, 2022). However, in S. altissima's native range, herbivory pressure can prevent sexual reproduction (Walck et al., 2001).
This species produces abundant seed and can reproduce from floating rhizomes.

Tamarix ramosissima, T. chinensis, and their hybrids are self-compatible and usually reproduce by seed. One tree can produce hundreds of thousands of seeds in a growing season. Stress, including fire, drought, or damage, can induce further flowering and seed production. Seeds are very small, with short hairs that aid in wind and water dispersal (Zouhar, 2003). One study documented 4,600 seeds in one square meter under a Tamarix stand, with 2,400 seeds per square meter at a distance of 0.1 kilometers from the stand, and 51 seed per square meter 8 kilometers from the stand (Young et al., 2004). Tamarix can produce seeds up to 5.5 months of the year, peaking in late spring and early summer. While seeds are the most common way for Tamarix to disperse, they can also resprout from the roots and grow from root and stem fragments. Sources differ on how likely vegetative reproduction through lateral roots is in Tamarix species (Zouhar, 2003; Young et al., 2004; Kerns et al., 2009).
Reliable information on pollination in Tamarix is not available, but experimental exclusion of insect pollinators suggests that wind pollination is unlikely (Stevens, 1989).

Trifolium pratense generally does not reproduce vegetatively, although there are vegetatively reproductive cultivars (Hyslop et al., 1999).

This plant spreads both vegetatively and by seed.

Even Utricularia species that do reproduce sexually (including Utricularia inflata) are more likely to reproduce vegetatively from plant fragments than from seed (Wiebush, 2022). Utricularia inflata fragments easily, and is capable of reproducing even from small fragments (Titus & Urban, 2013). A study of introduced populations of Utricularia inflata in New York (Urban & Dwyer, 2016) found that asexual reproduction in this species was more prolific than in the native Utricularia vulgaris (U. vulgaris is the most widespread native Utricularia in Washington (CPNWH, 2024)). Aggressive vegetative reproduction contributes to the spread of this species in New York (Urban & Dwyer, 2016).

This species doesn't seem to produce high seed numbers.

Veronica anagallis-aquatica reproduces from seed, with reported germination rates between 50–100% (SID, 2023). This species can also reproduce vegetatively via rhizomes, stolons, and fragments (Riis et al., 2004; DiTomaso et al., 2013), but means of reproduction in this species are not very different from reproduction of co-occurring native species (Stromberg & Chew, 1997).

Sexual reproduction is usually by selfing, but V. anagallis-aquatica can also be pollinated by small insects. A study from Iran found an average of approximately 30–45 seeds per capsule in this species (Hosseinnejad Azad et al., 2021). Seed production information from invasive populations of V. anagallis-aquatica were not found. Plants have both emergent and submerged forms, but only emergent individuals can reproduce sexually (Boeger & Poulson, 2003).

A study from New Zealand found V. anagallis-aquatica to be a primary colonizer on bare sediment in streams, suggesting a high level of propagule production, strong dispersal abilities, and/or efficient establishment capabilities. This study also observed a high number of seedlings after V. anagallis-aquatica flowered, suggesting a high rate of germination (Riis et al., 2004).

n (3 pts)		
Q6 citation	**Q7 rank**	**Q7 confidence rank**
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	Yes	Moderate

	Yes	Moderate
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	No	Moderate
	Yes	High
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	NA	NA

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	NA	NA

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	Yes	Moderate

	Yes	High
	Yes	High
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	Yes	Moderate
	NA	NA
	Yes	High

Bennett A.E., M. Thomsen, and S.Y. Strauss. 2011. Multiple mechanisms enable invasive species to suppress native species. American Journal of Botany 98(7):1086–1094. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024. Thomsen M.A. and C.M. D'Antonio. 2014. How does simulated gopher disturbance affect the establishment of Holcus lanatus L. (Poaceae) in California Coastal Prairie? Madroño 61(2):218–226.	No	Low

Church E.D. 2016. Invasive English holly (Ilex aquifolium L.) in clear-cut and forest units in a western Washington managed forest. MS Thesis. University of Washington, Seattle, WA. Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board. Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	Yes	High
	No	Moderate

Preece S.J. 1964. Iris pseudacorus in Montana. Proceedings of the Montana Academy of Sciences 24:1–4. Sutherland W.J. 1990. Biological flora of the British Isles: Iris pseudacorus L. Journal of Ecology 78(3):833–848.	Yes	High
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Yes	Moderate
	No	Moderate

Arslan M., U.K. Devisetty, M. Porsch, I. Große, J.A. Müller, and S.G. Michalski. 2019. RNA-Seq analysis of soft rush (Juncus effusus): transcriptome sequencing, de novo assembly, annotation, and polymorphism identification. BMC Genomics 20(1):489. Ervin G.N. and R.G. Wetzel. 2000. Allelochemical autotoxicity in the emergent wetland macrophyte Juncus effusus (Juncaceae). American Journal of Botany 87(6):853–860. Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	Yes	Moderate
	Yes	High
	Yes	High
	Yes	High

Brusati E. 2005. Plant assessment form: Leucanthemum vulgare. California Invasive Plant Council (CAL-IPC). https://www.cal-ipc.org/plants/paf/leucanthemum-vulgare-plant-assessment-form/. Accessed: October 22, 2024. Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Leucanthemum vulgare Lam., oxeye daisy. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Stutz S., P. Mráz, H.L. Hinz, H. Müller-Schärer, and U. Schaffner. 2018. Biological invasion of oxeye daisy (Leucanthemum vulgare) in North America: Pre-adaptation, post-introduction evolution, or both? PLOS ONE 13(1).	No	Moderate
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Lippai A., P. Smith, T. Price, J. Weiss, and C. Lloyd. 1996. Effects of temperature and water potential on germination of horehound (Marrubium vulgare) seeds from two Australian localities. Weed Science 44:91–99. Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	Yes	High
	NA	NA

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	NA	NA

Aiken S.G., P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds: 34. Myriophyllum spicatum L. Canadian Journal of Plant Science 59(1):201–215. Evans C.A., D.L. Kelting, K.M. Forrest, and L.E. Steblen. 2011. Fragment viability and rootlet formation in Eurasian watermilfoil after desiccation. Journal of Aquatic Plant Management 48:57–62. Hartleb C.F., J.D. Madsen, and C.W. Boylen. 1993. Environmental factors affecting seed germination in Myriophyllum spicatum L. Aquatic Botany 45(1):15–25. Madsen J.D. and C.W. Boylen. 1989. Eurasian watermilfoil seed ecology from an oligotrophic and eutrophic lakes. Journal of Aquatic Plant Management 27:119–121. Madsen J.D. and D.H. Smith. 1997. Vegetative spread of Eurasian watermilfoil colonies. Journal of Aquatic Plant Management 35(2):63–68. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64. Standifer N.E. and J.D. Madsen. 1997. The effect of drying period on the germination of Eurasian watermilfoil seeds. Journal of Aquatic Plant Management 35:35–36. Li F., L. Zhu, Y. Xie, L. Jiang, X. Chen, Z. Deng, and B. Pan. 2013.	Yes	High
	Yes	High

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Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Morris W.F., P.L. Marks, C.L. Mohler, N.R. Rappaport, F.R. Wesley, and M.A. Moran. 1986. Seed dispersal and seedling emergence in an old field community in central New York (USA). Oecologia 70(1):92–99. Ogle D.G., L. St. John, and D.J. Tilley. 2011. Plant guide for timothy (Phleum pratense). USDA-Natural Resources Conservation Service, Idaho State Office. Boise, ID. Online: https://plants.usda.gov/DocumentLibrary/plantguide/doc/pg_phpr3.docx Williams S.S. 1954. The effect of depth of sowing and moisture on the germination and seedling development of Phleum pratense L. The Journal of Ecology 42(2):445	No	Low
	Yes	Moderate
	Unknown	Not Rated
	NA	NA
	Yes	High
	Yes	High

Hoffman R. and K. Kearns. 1997. Multiflora rose (Rosa multiflora) In: Wisconsin manual of control recommendations for ecologically invasive plants [Online]. Wisconsin Department of Natural Resources, Bureau of Endangered Resources, Madison, WI. Online: http://www.dnr.state.wi.us/org/land/er/invasive/manuallist.htm	Yes	High
	Yes	High
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Yes	High
	Yes	Moderate
Cavers P.B. and J.L. Harper. 1964. Rumex obtusifolius L. and R. crispus L. Journal of Ecology 52(3):737–766.	Yes	Low
	No	High
	Unknown	Not Rated
	NA	NA

	Yes	High
	Yes	High
Kato-Noguchi H. and M. Kato. 2022. Allelopathy and allelochemicals of Solidago canadensis L. and S. altissima L. for their naturalization. Plants 11(23):3235. Etterson J.R., D.E. Delf, T.P. Craig, Y. Ando, and T. Ohgushi. 2008. Parallel patterns of clinal variation in Solidago altissima in its native range in central USA and its invasive range in Japan. Botany 86(1):91–97. Meyer Andrea.H. and B. Schmid. 1999. Seed dynamics and seedling establishment in the invading perennial Solidago altissima under different experimental treatments. Journal of Ecology 87(1):28–41. Walck J.L., J.M. Baskin, and C.C. Baskin. 2001. Why is Solidago shortii narrowly endemic and S. altissima geographically widespread? A comprehensive comparative study of biological traits. Journal of Biogeography 28(10):1221–1237.	Yes	High
	Yes	High

Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215. Stevens L.E. 1989. The status of ecological research on tamarisk (Tamaricaceae: Tamarix ramosissima) in Arizona. In: Kunzmann, Michael R.; Johnson, R. Roy; Bennett, Peter, technical coordinators. Tamarisk control in southwestern United States: Proceedings; 1987 September 2-3; Tucson, AZ. National Park Service, Cooperative National Park Resources Studies Unit, School of Renewable Natural Resources, Tucson, AZ. Special Report No. 9. Young J.A., C.D. Clements, and D. Harmon. 2004. Germination of seeds of Tamarix ramosissima. Rangeland Ecology & Management 57(5):475–481. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Yes	High
Hyslop M.G., P.D. Kemp, and J. Hodgson. 1999. Vegetatively reproductive red clovers (Trifolium pratense L.): An overview. Proceedings of the New Zealand Grassland Association:121–126.	No	Moderate
	Unknown	Not Rated

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. Titus J.E. and R.A. Urban. 2013. Invasion in progress: Utricularia inflata in Adirondack submersed macrophyte communities. The Journal of the Torrey Botanical Society 140(4):506–516. Urban R.A. and M.E. Dwyer. 2016. Asexual reproduction and its potential influence on the distribution of an invasive macrophyte. Northeastern Naturalist 23(3):408–419. Wiebush M. 2022. Utricularia intermedia Hayne, flat-leaved bladderwort. California Native Plant Society, Sacramento, CA. Online: https://rareplantfiles.cnps.org/scc/UtriculariaIntermediaSpAcctSCC20220408r.pdf	Yes	High
	No	Moderate

Boegel M.R.T. and M.E. Poulson. 2005. Morphological adaptations and photosynthetic rates of amphibious Veronica anagallis-aquatica L. (Scrophulariaceae) under different flow regimes. Aquatic Botany 75(2):123–135. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Water speedwell. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Hosseinnejad Azad G., I. Mehregan, and D.C. Albach. 2021. Morphometric analysis for the evaluation of diversity within and among Veronica anagallis-aquatica L. populations in Iran. Iranian Journal of Botany 27(2). Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95. Seed Information Database (SID). 2023. Seed Information Database. Society for Ecological Restoration, International Network for Seed Based Restoration, and Royal Botanic Gardens Kew. https://ser-sid.org/. Accessed: September 26, 2024. Stromberg J.C. and M.K. Chew. 1997. Herbaceous exotics in	Yes	Moderate
	Unknown	Not Rated

Question 7. Innate Potential for Long-Distance Dis

Q7 notes
Produces samaras (winged seeds) that are wind-dispersed (Rosario, 1988).
This species has samaras that are well-adapted to wind-dispersal. Seeds can also be transported by water, as can viable root fragments (NWCB, 2011; Knüsel, 2019).

This species' seeds float and have the potential to be dispersed long distances by water.
Amorpha fruticosa's seed pods can float long distances. To date, spread in Washington has been mostly downriver on the Columbia from initial points of entry along the Snake and Walla Walla rivers. Establishment of new populations upriver in Douglas County and non-riverine sites in Okanogan County may be stepping stones for establishment elsewhere in central Washington. Recent (2022-2023) discoveries of populations in the Idaho panhandle (see iNaturalist) suggest a potential downstream invasion pathway in Northeastern Washington (Grabić et al., 2022).
Anthoxanthum odoratum usually spreads only short distances (Brusati & Warner, 2004) with 90% of seeds found within 1.2 meters of their parent plants (Platenkamp, 1990). Awns can help move seeds short distances across the soil (Pitcher & Russo, 2012), but otherwise this species has no adaptations for long distance seed dispersal. A post-wildfire study in a Quercus garryana savanna in British Columbia found that A. odoratum was able to disperse from the neighboring community into areas where the original vegetation and seed bank had been removed by combinations of intense fire and firefighting techniques that washed top soil away (Lysgaard, 2022), suggesting at least some effective natural dispersal abilities. However, other studies have assumed that pollen and seed from this species could not disperse more than 50 m (Roach, 1987), suggesting, that in general, this species has very little innate potential for long distance dispersal.

Vegetative propagules of Arundo donax can be dispersed over long distances within watersheds by flooding (Goolsby et al., 2023). Fragments have also been known to disperse to marine islands and establish populations despite exposure to sea water (NWCB, 2013).
Sticky heads allow Bellardia viscosa fruits to attach to animals or clothing. Seeds are also wind-dispersed (Brusati & Corelli, 2005).

Seeds are wind dispersed.
Seeds spread short distances by wind and gravity but can also be transported longer distances by animals and water. The majority of achenes have barbed plumes that readily attach to humans and animals (Innes & Zouhar, 2021).

Cirsium arvense produces lightweight seeds with a feathery pappus for wind dispersal. Evidence from Washington shows C. arvense seeds are capable of dispersing more than 1 km. However, the seeds frequently break off from the pappus, so wind may not be the main dispersal mechanism for seeds (Zouhar, 2001). The majority of seeds are deposited near the parent plants (Leathwick & Bourdôt, 2012), suggesting this species may only have moderate ability for natural long-distance dispersal. Seeds are not particularly adapted for attachment to animals, though they may stick to some degree (as can many other types of seeds), facilitating longer distance dispersal. Some publications indicate at least some seeds can survive passing through the digestive tracts of some birds, which can also facilitate long-distance dispersal (DiTomaso et al., 2013; CABI, 2024).
Seeds are wind-dispersed.

Cotoneaster berries are dispersed by birds.
Cynoglossum officinale seeds are covered in barbs that attach to animals or humans and can be transported for long distances. However, seeds are large and heavy, and are usually found within 2 meters of the parent plant (de Jong et al., 1990).
Seeds don’t appear to have adaptations for wind or animal dispersal.

Dipsacus fullonum is occasionally capable of natural long-distance dispersal by water, but most seeds fall within 1.5 meters of their parent plant. This species produces relatively large achenes (up to 8 mm long). These achenes float and seeds remain viable for at least 22 days in the water (Werner, 1975; Gucker, 2009). In eastern Washington, Dipsacus fullonum seeds are a measurable part of the diet in California quail, northern bobwhite, and pheasants. Several other birds and small rodents have been observed to eat this species' seeds (Gucker, 2009), suggesting that animal dispersal is also likely for this species.
This plant produces wind-dispersed seeds.

Holcus lanatus seeds can be dispersed short distances by wind. A study in California found that most seeds fell within 17 feet of the parent plant. Animals may also disperse seeds, though they do not survive traveling through the digestive tract in all species. Seeds float easily and may be dispersed by water, though it is unknown how floating in water might affect seed viability (Gucker, 2009).

Ilex aquifolium is dispersed by many frugivorous birds, which may prefer holly berries to native fruits (NWCB, 2022). These birds aid dispersal to remote places (e.g., seldom visited islands in the San Juan Islands) (NWCB, 2022). American Robins are by far the most common consumer of Ilex fruits in western Washington (Zika, 2010). Robins account for 96% of I. aquifolium fruit consumption and observations suggest that they are excellent and prolific long-distance dispersal agents for I. aquifolium seeds (Zika, 2010).

Iris pseudacorus seeds are dispersed by water and remain buoyant for extremely long periods (Whitehead, 1971; Weber, 2003; King County Noxious Weed Control Program, 2007).
Jacobaea vulgaris' ray flowers shed their pappus, but disc flowers maintain the pappus, allowing for wind dispersal. Seeds are usually dispersed only a few meters from the parent plant but can be dispersed up to several kilometers by wind under the right conditions. Seeds are also occasionally dispersed by animals and water (Richardson, 2004; Jacobs, 2009).
This species is probably spread by squirrels and possibly jays.

Juncus effusus produces abundant small seeds that are dispersed readily by wind, animals, and water (Lazenby, 1955; Neff & Baldwin, 2005). Seeds are dispersed by wind relatively short distances, but likely travel further by water and animal dispersal. Seeds have been found in areas where adult plants are not present, suggesting at least some capability for long-distance dispersal (McCorry & Renou, 2003).
This plant is toxic to wildlife and primarily spreads via violent dehiscion and vegetative reproduction (Burnham, 2013; Sweet, 2020).
This plant is toxic to wildlife and primarily spreads via violent dehiscion and vegetative reproduction (Burnham, 2013; Sweet, 2020).

Leucanthemum vulgare achenes have no obvious adaptations for dispersal. Seeds are generally assumed to be spread by wind, water, or in animal manure. Studies have found that this species' seeds are unlikely to be transported in fur or wool (Clements et al., 2004). In a study from Great Britain—within L. vulgare's native range—seeds did not travel far from parent plants, rarely moving further than 0.6 meters from seed sources. Grazing treatments also did not affect seed dispersal, as most seeds were dispersed by wind before grazing treatments occurred (Coulson et al., 2001). No seeds were found in manure after grazing. Though some L. vulgare seeds can survive an animal's digestive tract, no seeds were found in manure during additional experiments (Coulson et al., 2001; Clements et al., 2004). Natural long-distance dispersal is unlikely in this species.

Plant fragments may be dispersed by water, but the degree to which this occurs is not known.

Seedlings are buoyant and can be dispersed along waterways and tiny seeds can be transported by waterfowl and aquatic mammals (Thompson et al., 1987).
This species produces burs which facilitate long range spread by animals (Weiss & Sagliocco, 1994; Weiss et al., 2000).

A study in England found that Myosotis discolor was more likely to disperse into areas with rabbit pellets, compared to areas where rabbit pellets were removed, suggesting that this species can be dispersed in the manure of small mammals. This species has also been suggested to disperse in the fur of animals (Pakeman et al., 1998). Dispersal by wind or gravity occurs over relatively short distances. Another study from England found a mean dispersal distance of 9.6 cm and a maximum distance of 47 cm from the parent plant for M. discolor seeds (Asefa, 2011).

Plant fragments are easily moved via water movement. Waterbirds can also disperse propagules (Madsen et al., 1991; Madsen & Smith, 1997). See also studies cited for Q6.

Phalaris arundinacea seeds naturally disperse via gravity, water, animals, and potentially wind (Waggy, 2010). Seeds can remain buoyant in water for a few days (Waggy, 2010). Seeds are also capable of adhering to animals and have been found in the feet and feathers of waterfowl, suggesting that this species has good potential for long distance dispersal (Waggy, 2010).

Phleum pratense seeds don’t have any specific adaptations for long distance dispersal, but they can still be dispersed by wind (Esser, 1993). Wind dispersal is likely an average of 1–2 meters, but seeds may be dispersed further by large mammals (Mouissie et al., 2005).
Birds and squirrels can disperse the acorns.

Fruits appear to disperse by floating on salt water, in addition to bird dispersal.
Rubus bifrons seeds are distributed by animals, mammals and birds being the primary dispersal agents, though other animals, including slugs, are also capable of seed dispersal. Both seeds and plant fragments, which can also root and form new populations, are spread long distances by water (Fryer, 2021).
Fruits are eaten by birds and mammals.
Viable seeds of the related R. obtusifolius have been found in cattle dung (Salisbury, 1961).
This species may be spread by flooding or erosion in riparian systems or on slopes subject to erosion—anything that breaks off and carries bits of the crown. However, natural spread appears to be rare.

Seeds are small and lightweight and have a feathery pappus that aids in wind distribution. They may also be dispersed by water (Kato-Noguchi & Kato, 2022). One study found only a small number of seeds remained in the study area after seed dispersal, suggesting a higher rate of dispersal than expected for this species (Meyer & Schmid, 1999).
Seed and rhizomes travel throughout water bodies with currents and tides.

Tamarix seeds have small hairs that aid in wind dispersal and can also be dispersed by water (Zouhar, 2003; Young et al., 2004). Seeds have been documented traveling at least 8 km from their source, allowing Tamarix species to invade adjacent stream reaches (Zouhar, 2003; Young et al., 2004). At least one source also suggested that birds aid in seed dispersal for this genus (Lehnhoff et al., 2011).

Vegetative propagules are more effective dispersal agents than seeds in aquatic plants, traveling further and establishing more easily than do seeds (Urban & Dwyer, 2016). All Utricularia species disperse through plant fragments and turions (small storage organs that allow Utricularia species to overwinter in cold climates). Utricularia that reproduce sexually also disperse small buoyant seeds. Dispersal agents are wind, water, and animals, particularly waterfowl. Many species of Utricularia are widespread, suggesting the capability for long distance dispersal is somewhat common in this genus (Wiebush, 2022). Utricularia inflata is fairly buoyant, which, in combination with its unrooted habit increases the likelihood of long-distance dispersal (Urban & Dwyer, 2016). In New York, dispersal of U. inflata after initial introductions appear to be mostly via water, with populations spreading downstream (Titus & Urban, 2013).

Veronica anagallis-aquatica propagules can be transported by water, and its seeds germinate readily (Boeger & Poulson, 2003; DiTomaso et al., 2013). A study from New Zealand found V. anagallis-aquatica to be a primary colonizer on bare sediment in streams, suggesting strong dispersal abilities, or efficient establishment capabilities (Riis et al., 2004).

spersal (3 pts)		
Q7 citation	**Q8 rank**	**Q8 confidence rank**
Rosario L.C. 1988. Acer negundo. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/aceneg/all.html. Accessed: December 16, 2024.	Yes	Moderate
Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland. Noxious Weed Control Board (NWCB). 2011. Written findings of the Washington State Noxious Weed Control Board: Ailanthus altissima (Mill.) Swingle. https://www.nwcb.wa.gov/pdfs/Ailanthus-altissima-Written-Findings-2011.pdf. Accessed: December 18, 2024.	Yes	High
	Yes	High

	Unknown	Not Rated
Grabić J., B. Ljevnaić-Mašić, A. Zhan, B. Benka, and H. Heilmeier. 2022. A review on invasive false indigo bush (Amorpha fruticosa L.): Nuisance plant with multiple benefits. Ecology and Evolution 12(9).	Yes	High
Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Lysgaard C. 2022. Invasive species removal and changing Fire Regimes in a ləkʷ wəŋən Garry Oak Ecosystem. MS Thesis. University of Victoria, Victoria, BC. Roach D.A. 1987. Variation in seed and seedling size in Anthoxanthum odoratum. American Midland Naturalist 117(2):258. Platenkamp G.A.J. 1990. Phenotypic plasticity and genetic differentiation in the demography of the grass Anthoxanthum odoratum. The Journal of Ecology 78(3):772.	Yes	High

	Yes	High
	Yes	High
Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Yes	High
Brusati E. and T. Corelli. 2005. Parentucellia viscosa. https://www.cal-ipc.org/plants/paf/parentucellia-viscosa-plant-assessment-form/. Accessed: October 29, 2024.	Yes	Moderate
	Yes	High

	Yes	High
	NA	NA
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes	High
	NA	NA

CABI. 2024. Cirsium arvense (creeping thistle). https://www.cabidigitallibrary.org/doi/full/10.1079/cabicompendium.13628. Accessed: December 20, 2024. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Canada thistle. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Leathwick D.M. and G.W. Bourdôt. 2012. A conceptual model for the population dynamics of Cirsium arvense in a New Zealand pasture. New Zealand Journal of Agricultural Research 55(4):371–384. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes	High
	Yes	Moderate
	Yes	High

	Yes	High
	Yes	High
de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144.	Yes	High
	Yes	Moderate

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. Werner P.A. 1976. Ecology of plant populations in successional environments. Systematic Botany 1(3):246.	Yes	High
	Yes	High
	NA	NA
	Yes	High

Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	Yes	High

Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	Yes	High
	Yes	Moderate

King County Noxious Weed Control Program. 2007. Best management practices: yellow-flag iris (Iris pseudacorus) Iridaceae, [Online]. In: Noxious weeds--weed control information. Seattle, WA: King County Department of Natural Resources and Parks, Water and Land Resources Division, Noxious Weed Control Program (Producer). http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/BMPs/yellow-flag-iris-control.pdf. Accessed: June 16, 2009. Weber E. 2003. Invasive plant species of the world: a reference guide to environmental weeds. CABI Publishing, Cambridge, MA. Whitehead F.H. 1971. Comparative autecology as a guide to plant distribution. The scientific management of animal and plant communities for conservation: Proceedings of the 11th symposium of the British Ecological Society; 1970 July 7-9 (ed. by E.O. Duffey and A.S. Watt), pp. 167–176. Oxford: Blackwell Scientific Publications, Norwich, UK.	Yes	High
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Yes	Moderate
	Yes	Moderate

Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland. Neff K.P. and A.H. Baldwin. 2005. Seed dispersal into wetlands: Techniques and results for a restored tidal freshwater marsh. Wetlands 25(2):392–404.	Yes	High
	Yes	High
Burnham R.J. 2013. Censusing lianas in mesic biomes of eastern regions: Lathyrus latifolius. University of Michigan. Sweet L. 2020. Lathyrus latifolius Risk Assessment. California Invasive Plant Council (Cal-IPC).	Yes	High
Burnham R.J. 2013. Censusing lianas in mesic biomes of eastern regions: Lathyrus latifolius. University of Michigan. Sweet L. 2020. Lathyrus latifolius Risk Assessment. California Invasive Plant Council (Cal-IPC).	Yes	High

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Coulson S.J., J.M. Bullock, M.J. Stevenson, and R.F. Pywell. 2001. Colonization of grassland by sown species: dispersal versus microsite limitation in responses to management. Journal of Applied Ecology 38(1):204–216.	Yes	High
	Yes	High

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Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023. Weiss J. and J.-L. Sagliocco. 1994. Horehound, Marrubium vulgare-A global perspective. In: Fourth Biennial Proclaimed Animal and Plant State Conference. Animal and Plant Control Commission. SA.	No	Moderate
	Yes	Moderate

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	NA	NA

Madsen J.D. and D.H. Smith. 1997. Vegetative spread of Eurasian watermilfoil colonies. Journal of Aquatic Plant Management 35(2):63–68. Madsen J.D., J.A. Sutherland, J.A. Bloomfield, L.W. Eichler, and C.W. Boylen. 1991. The decline of native vegetation under dense Eurasian watermilfoil canopies. Journal of Aquatic Plant Management 29:94–99.	Yes	High
	Yes	High

Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Yes	High

Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Mouissie A.M., W. Lengkeek, and R. Van Diggelen. 2005. Estimating adhesive seed dispersal distances: field experiments and correlated random walks. Functional Ecology 19(3):478–486.	Yes	High
	Yes	High
	Yes	High
	NA	NA
	Yes	High
	Yes	High

	Yes	High
	Yes	High
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Yes	High
	Yes	High
Salisbury E.J. 1961. Weeds and aliens. Collins, London, UK	No	High
	Yes	High
	Yes	High
	NA	NA

	Yes	High
	Yes	High
Kato-Noguchi H. and M. Kato. 2022. Allelopathy and allelochemicals of Solidago canadensis L. and S. altissima L. for their naturalization. Plants 11(23):3235. Meyer Andrea.H. and B. Schmid. 1999. Seed dynamics and seedling establishment in the invading perennial Solidago altissima under different experimental treatments. Journal of Ecology 87(1):28–41.	Yes	High
	Yes	High

Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65. Young J.A., C.D. Clements, and D. Harmon. 2004. Germination of seeds of Tamarix ramosissima. Rangeland Ecology & Management 57(5):475–481. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Yes	High
	Yes	Moderate
	Yes	High

Titus J.E. and R.A. Urban. 2013. Invasion in progress: Utricularia inflata in Adirondack submersed macrophyte communities. The Journal of the Torrey Botanical Society 140(4):506–516. Urban R.A. and M.E. Dwyer. 2016. Asexual reproduction and its potential influence on the distribution of an invasive macrophyte. Northeastern Naturalist 23(3):408–419. Wiebush M. 2022. Utricularia intermedia Hayne, flat-leaved bladderwort. California Native Plant Society, Sacramento, CA. Online: https://rareplantfiles.cnps.org/scc/UtricularIaIntermediaSpAcctSCC20220408r.pdf	Yes	High
	Unknown	Not Rated

Boeger M.R.T. and M.E. Poulson. 2003. Morphological adaptations and photosynthetic rates of amphibious Veronica anagallis-aquatica L. (Scrophulariaceae) under different flow regimes. Aquatic Botany 75(2):123–135. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Water speedwell. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	Yes	High
	Yes	Moderate

Question 8. Potential to be Spread by Human Act

Q8 notes

Due to its hardiness and tolerance of difficult growing conditions (cold and drought), humans may use Acer negundo for revegetation, soil stabilization, shelter-belts, etc.

This species was introduced to many areas intentionally. It has potential to be used ornamentally, in bioremediation, and for silkworm cultivation, among other uses (NWCB, 2011; Knüsel, 2019).

This species could potentially be spread by humans in clothing.
Though on the noxious weed list in the Pacific Northwest, Amorpha fruticosa is sold and endorsed for ornamental use elsewhere in the United States. Water sports enthusiasts (boaters, fishers) could transport seed or fruit between bodies of water (NWCB, 2015).
Anthoxanthum odoratum is dispersed mostly through human activities, including transportation along roadsides, and by mowing or other equipment, or on shoes (Brusati & Warner, 2004). This species was introduced to North America in the 1700s (Pitcher & Russo, 2012).

Arundo donax has been widely cultivated for thousands of years and for a multitude of uses, including woodwind instrument reeds, construction materials, and high-quality paper. In ancient Egypt, it was even used to wrap mummies. This species was introduced to the U.S. as an ornamental plant and for erosion control (McWilliams, 2004). Many cultivars of this species are still used as ornamentals, and it has also been proposed for use as a biofuel and in phytoremediation (NWCB, 2013).
Distribution of this species follows human disturbance, including construction, agriculture, livestock grazing, and manipulation of rivers and streams. Human dispersal is the main source of invasive propagules for this species (Goolsby et al., 2023).
As of 2013, this species was being tested for commercial growth in both Oregon and Washington for use in biofuels and making paper. Experimental plantings of this species in Washington had apparently failed by 2008 (NWCB, 2013) and it was added to the Washington's quarantine list in 2012.

The presence of Bellardia viscosa in Washington appears to follow roads and areas of human activity (CPNWH, 2024; iNaturalist Community, 2024). A study from northern California also suggested a grazed pasture as the source population for invasion of B. viscosa in a dune wetland in Humboldt County (Pickart & Wear, 1999).

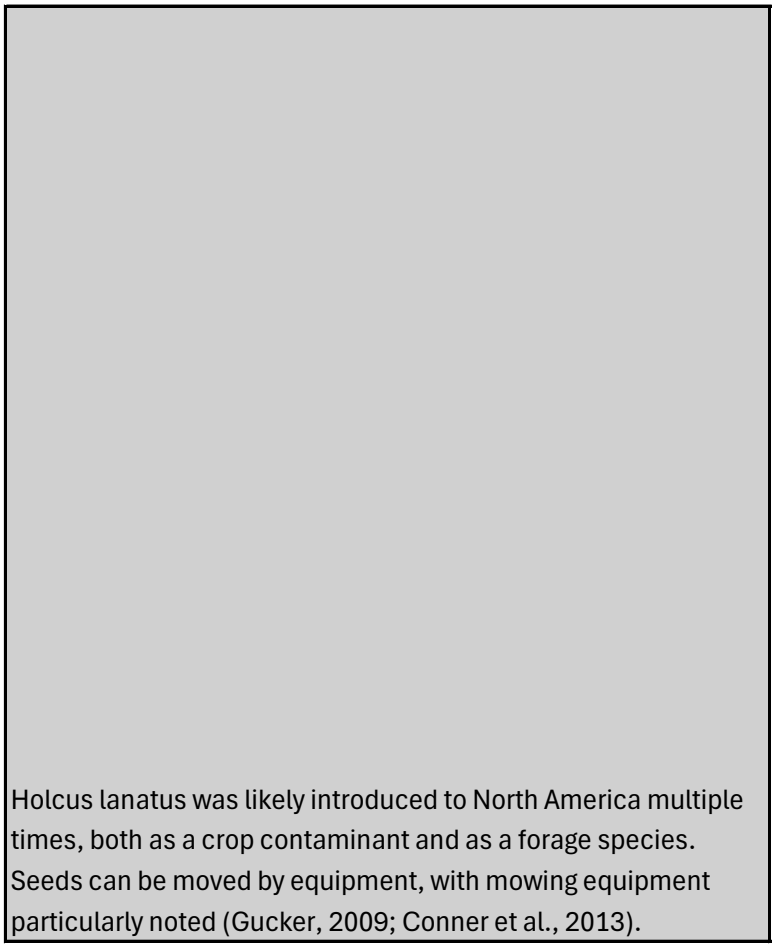
Centaurea solstitialis was likely introduced to North America in the 1800s through contaminated alfalfa shipments. Long distance dispersal of this species is enabled through movement of animals, including livestock, as well as vehicles and other equipment. Populations of C. solstitialis frequently spread along travel corridors (e.g., roads and trails). Use of contaminated mulch in restoration and other activities has also resulted in introductions of C. solstitialis (Innes & Zouhar, 2021).

Cirsium arvense seeds and plant fragments are very likely to be spread by human activities, particularly by movements of livestock, hay, contaminated crop seeds, soil, and machinery (Zouhar, 2001; CABI, 2024).
Cirsium vulgare may be spread in hay and via many other human activities.

This genus is widely planted in landscaping.

Cynoglossum officinale was likely transported to North America as a crop contaminant (Jacobs & Sing, 2007). This species also has an attractive flower and could potentially be spread as an ornamental. Seeds are very likely to be spread in clothes and the fur of domestic animals. In British Columbia one study found that 65% of seeds were dispersed by cattle (Jacobs & Sing, 2007). Cynoglossum officinale is frequently associated with human disturbances such as logging and heavy grazing (Andreas et al., 2008).

Dipsacus fullonum dispersal usually follows highways, roads, and other human disturbance. Mowing, particularly on highway right-of-ways, is likely a major dispersal mechanism for this species. The use of dried inflorescences in floral arrangements is also a mechanism for spread and is potentially the reason this species can be common in cemeteries. Dipsacus seeds are sometimes included in birdseed mixes (Gucker, 2009; Gaskin et al., 2024).
This plant has primarily been observed along roadways and other areas of anthropogenic disturbance.



Holcus lanatus was likely introduced to North America multiple times, both as a crop contaminant and as a forage species. Seeds can be moved by equipment, with mowing equipment particularly noted (Gucker, 2009; Conner et al., 2013).

Ilex aquifolium is a popular ornamental, planted both for appearance and for backyard habitat. This species also grows well in disturbed areas and edge habitats created by human activities (Zika, 2010). Timber harvest may also increase growth and abundance in I. aquifolium populations (Church, 2016).

This plant is an attractive ornamental.

In its introduced range, Jacobaea vulgaris is usually found in areas of human disturbance such as roadsides, old fields, and developments. Mowing can disperse this species' seeds more than double the distance of natural dispersal. Seeds can also be spread via other agricultural equipment, tires and clothes, livestock manure, contaminated weed and straw, and by firefighting activities (Richardson, 2004; Jacobs, 2009).

Trees are planted by landowners and grown for their nuts.

Juncus effusus seeds can be dispersed by machinery and other human activities (McCorry & Renou, 2003). This taxon has also been studied for use in phytoremediation and is used in constructed wetlands built to treat wastewater (Arslan et al., 2019). Non-native subspecies are often mistakenly introduced to restoration sites (T. Ramm-Granberg, pers. comm. 2025).

Human activity is the main dispersal agent for Leucanthemum vulgare. This species was introduced into the Pacific Northwest in the 1800s and is spread by contaminated livestock feed, seed crops, and machinery. Leucanthemum vulgare is also frequently raised and planted as an ornamental. Sale, purchase, and transport of this species is banned in Washington State, but L. vulgare is still a frequent component of commercial wildflower mixes, including wildflower mixes sold in Washington (NWCB, 2000; Clements et al., 2004; DiTomaso et al., 2013).

Deliberate release of plants grown as ornamentals is thought to be common.

Lythrum salicaria can be spread by watercraft, irrigation development (Thompson et al., 1987), and horticultural introductions.

This species has been introduced in other areas for medicinal uses (Lodhi et al., 2017), but this appears to be uncommon in the US (Baker, 1986; Cal-IPC, 2004). In Australia, this species has also been used for dune stabilization (Weiss & Sagliocco, 1994).

No direct evidence for human dispersal was found in the literature but given that Myosotis discolor has spread to many parts of the world, this species has at least some potential to be dispersed by human activities.

There is clear evidence that boats move aquatic invasive species such as Eurasian watermilfoil and that Eurasian watermilfoil fragments moved by boaters can survive for several hours before dying (Evans et al., 2011; Jerde et al., 2012; Mcalarnen et al., 2012; Kao et al., 2021; Pfingsten et al., 2024).

The assessor has observed rapid spread via highway ditches. Spread may be aided by roadside mowing and ditching equipment.

Phalaris arundinacea seeds are capable of adhering to humans and machinery, allowing for long distance dispersal (Waggy, 2010). This species is also purposely spread for revegetation, soil stabilization, phytoremediation, and waste water management, as well as for livestock forage (Lavergne & Molofsky, 2004).

Phalaris arundinacea is occasionally recommended for erosion control and revegetation, including in dozer lines and burned sites, and it is being grown as a biofuel crop, particularly in Europe (Waggy, 2010). However, its ability to dominate makes it a poor choice for revegetation, cultivation, or other projects (Waggy, 2010).

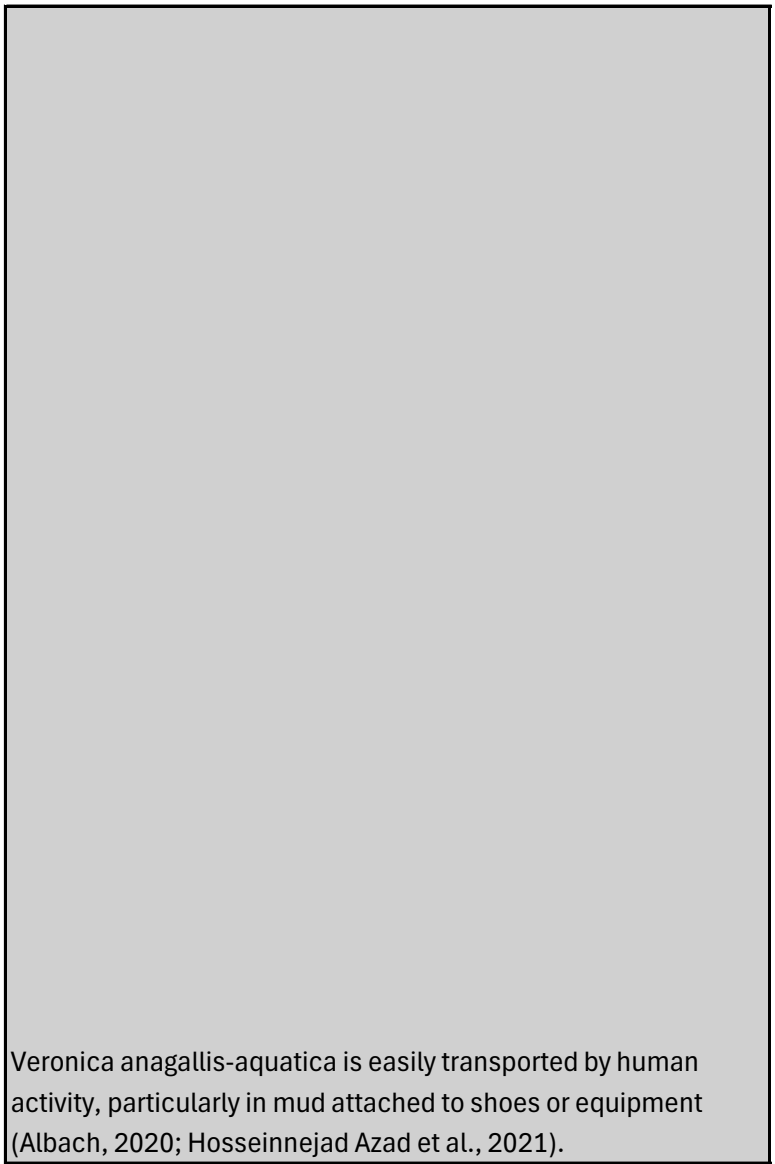
Phleum pratense is grown as pasture grass and hay, particularly for horses. This species is also used in revegetation of clearcuts, rangelands, and sites disturbed by human development (e.g., roads or construction projects). Phleum pratense has also been used for mine rehabilitation and erosion control. Seeds can also be dispersed by livestock (Esser, 1993; Mouissie et al., 2005).
Restoration professionals are considering planting this species as a host plant for the Taylor's checkerspot butterfly.
Some people may mistake this species for a native oak (Quercus garryana) and plant it thinking it is native.

This plant is a popular low-maintenance landscaping shrub.
Rubus bifrons is native to Eurasia but has established populations on all continents except Antarctica. This species was introduced to North America for cultivation in the late 1800s; it is a major fruit crop in the Pacific Northwest and continued cultivation contributes to the spread of this species (Fryer, 2021). This species also readily invades areas after anthropogenic disturbances.
This plant is cultivated for its fruits in some areas.
This species spreads by human disturbance, either by planting or disposing of yard debris. Once established the plants persist long-term.

While in Washington Solidago altissima doesn't currently occur in places were mowing or vehicle access is common, this species seeds could easily be spread by mowing and other equipment given the opportunity. Soil disturbance could also spread this species via rhizome fragments. In Europe and Asia, this species was introduced as an ornamental and for pollinators (Walck et al., 2001; Etterson et al., 2008).
Seed can travel via mud on boots or clothing. Plants were likely spread to the west coast via oyster packing material.

Tamarix was introduced in the U.S. to stabilize soil and is also used as a windbreak and an ornamental (Zouhar, 2003; Stromberg et al., 2007). Tamarix is usually found in areas of anthropogenic disturbance. Human activity appears to be the main driver of habitat suitability for Tamarix species in the southwest. Changes in stream flow patterns, reduced water tables, and increased soil and water salinity all favor Tamarix over native cottonwood and willow species in the southwest. Livestock grazing also favors Tamarix, since livestock preferentially graze native riparian vegetation (Stromberg et al., 2007).
This species is used for forage, for erosion control, and it's in livestock feed.
Aside from accidental transport, this plant is also used in pasture mixes.

Fragments of Utricularia inflata can be transported from invaded waterways to new locations by boats and boat trailers (Urban & Dwyer, 2016). Utricularia inflata was likely introduced in western Washington as an ornamental or for mosquito control (Howard Morgan, 2011). Buying, selling, and transport of U. inflata is illegal in Washington (Washington State Legislature, 2021), but this species is for sale through several internet sources based outside of Washington.



Veronica anagallis-aquatica is easily transported by human activity, particularly in mud attached to shoes or equipment (Albach, 2020; Hosseinnejad Azad et al., 2021).

ivities (3 pts)		
Q8 citation	**Q9 rank**	**Q9 confidence rank**
	Yes	High
Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland. Noxious Weed Control Board (NWCB). 2011. Written findings of the Washington State Noxious Weed Control Board: Ailanthus altissima (Mill.) Swingle. https://www.nwcb.wa.gov/pdfs/Ailanthus-altissima-Written-Findings-2011.pdf. Accessed: December 18, 2024.	Yes	High
	Yes	High

	No	Moderate
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	Yes	Moderate
Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Pitcher D. and M.J. Russo. 2012. Anthoxanthum odoratum, Global Invasive Species Team, The Nature Conservancy. https://wiki.bugwood.org/Archive:TNC/Anthoxanthum_odoratum. Accessed: October 25, 2024.	Yes	Moderate

	No	Moderate
	Unknown	Not Rated
Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Yes	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations of Bellardia viscosa from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=537967. Accessed: October 29, 2024. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70.	Unknown	Not Rated
	No	Moderate

	Unknown	Not Rated
	NA	NA
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes	High
	NA	NA

CABI. 2024. Cirsium arvense (creeping thistle). https://www.cabidigitallibrary.org/doi/full/10.1079/cabicompendium.13628. Accessed: December 20, 2024. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes	Low
	No	Low
	Unknown	Not Rated

	No	Moderate
	Unknown	Not Rated
Andreas J.E., M. Schwarzländer, and R. De Clerck-Floate. 2008. The occurrence and potential relevance of post-release, nontarget attack by Mogulones cruciger, a biocontrol agent for Cynoglossum officinale in Canada. Biological Control 46(3):304–311. Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8.	Yes	High
	No	Moderate

Gaskin J.F., N. West, and B.G. Rector. 2024. Population structure of three invasive congeneric teasel (Dipsacus) species. Invasive Plant Science and Management 17(1):37–45. Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	Unknown	Not Rated
	Unknown	Not Rated
	NA	NA
	Yes	Low

Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	Yes	Moderate

Church E.D. 2016. Invasive English holly (Ilex aquifolium L.) in clear-cut and forest units in a western Washington managed forest. MS Thesis. University of Washington, Seattle, WA. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	Yes	Low
	No	Moderate

	No	Low
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Yes	Moderate
	Yes	Moderate

Arslan M., U.K. Devisetty, M. Porsch, I. Große, J.A. Müller, and S.G. Michalski. 2019. RNA-Seq analysis of soft rush (Juncus effusus): transcriptome sequencing, de novo assembly, annotation, and polymorphism identification. BMC Genomics 20(1):489. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	Yes	Low
	Unknown	Not Rated
	Unknown	Not Rated
	Unknown	Not Rated

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Leucanthemum vulgare Lam., oxeye daisy. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA.	Yes	Moderate
	NA	NA

Thompson D.Q., R.L. Stuckey, and E.B. Thompson. 1987. Spread, impact, and control of purple loosestrife (Lythrum salicaria) in North American wetlands. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.	No	Moderate
Baker H.G. 1986. Patterns of plant invasion in North America. Ecology of biological invasions of North America and Hawaii. Ecological Studies (ed. by H.A. Mooney and J.A. Drake), pp. 44–57. Springer-Verlag, New York, NY. California Invasive Plant Council (Cal-IPC). 2004. Plant Assessment Form: Marrubium vulgare. https://www.cal-ipc.org/plants/paf/marrubium-vulgare-plant-assessment-form/. Accessed: February 5, 2025. Lodhi S., G. Vadnere, V. Sharma, and M. Usman. 2017. Marrubium vulgare L.: A review on phytochemical and pharmacological aspects. Journal of Intercultural Ethnopharmacology 6(4):429. Weiss J. and J.-L. Sagliocco. 1994. Horehound, Marrubium vulgare-A global perspective. In: Fourth Biennial Proclaimed Animal and Plant State Conference. Animal and Plant Control Commission. SA.	Yes	Moderate
	No	Moderate

	No	Low
	NA	NA

Evans C.A., D.L. Kelting, K.M. Forrest, and L.E. Steblen. 2011. Fragment viability and rootlet formation in Eurasian watermilfoil after desiccation. Journal of Aquatic Plant Management 48:57–62. Jerde C.L., M.A. Barnes, E.K. DeBuysser, A. Noveroske, W.L. Chadderton, and D.M. Lodge. 2012. Eurasian watermilfoil fitness loss and invasion potential following desiccation during simulated overland transport. Aquatic Invasions 7(1):135–142. Kao S.-Y.Z., E.A. Enns, M. Tomamichel, A. Doll, L.E. Escobar, H. Qiao, M.E. Craft, and N.B.D. Phelps. 2021. Network connectivity of Minnesota waterbodies and implications for aquatic invasive species prevention. Biological Invasions 23(10):3231–3242. Mcalarnen L.A., M.A. Barnes, C.L. Jerde, and D.M. Lodge. 2012. Simulated overland transport of Eurasian watermilfoil: survival of desiccated plant fragments. Journal of Aquatic Plant Management 50:147–149. Pfingsten I.A., L. Berent, C.C. Jacono, and M.M. Richerson. 2024. Myriophyllum spicatum L.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL. https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=237. Accessed: December 30, 2024.	NA	NA
	No	Moderate

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	No	Moderate

Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Mouissie A.M., W. Lengkeek, and R. Van Diggelen. 2005. Estimating adhesive seed dispersal distances: field experiments and correlated random walks. Functional Ecology 19(3):478–486.	Yes	Moderate
	Unknown	Not Rated
	No	High
	NA	NA
	No	High
	No	High

	No	High
	No	Moderate
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	No	Moderate
	No	High
	No	Low
	No	Moderate
	Yes	Moderate
	NA	NA

	Unknown	Not Rated
	Unknown	Not Rated
Etterson J.R., D.E. Delf, T.P. Craig, Y. Ando, and T. Ohgushi. 2008. Parallel patterns of clinal variation in Solidago altissima in its native range in central USA and its invasive range in Japan. Botany 86(1):91–97. Walck J.L., J.M. Baskin, and C.C. Baskin. 2001. Why is Solidago shortii narrowly endemic and S. altissima geographically widespread? A comprehensive comparative study of biological traits. Journal of Biogeography 28(10):1221–1237.	Yes	Moderate
	No	Moderate

Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	No	Moderate
	No	High
	No	Moderate

Howard Morgan V. 2011. Utricularia inflata Walter. U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI. https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?Species_ID=238. Accessed: September 19, 2024. Urban R.A. and M.E. Dwyer. 2016. Asexual reproduction and its potential influence on the distribution of an invasive macrophyte. Northeastern Naturalist 23(3):408–419. Washington State Legislature. 2021. WAC 16-752-610. https://apps.leg.wa.gov/WAC/default.aspx?cite=16-752-610. Accessed: September 19, 2024.	Unknown	Not Rated
	No	Moderate

Albach D. 2020. Veronica anagallis-aquatica Linnaeus. In: Flora of North America [Online]. http://floranorthamerica.org/Veronica_anagallis-aquatica. Accessed: September 25, 2024. Hosseinnejad Azad G., I. Mehregan, and D.C. Albach. 2021. Morphometric analysis for the evaluation of diversity within and among Veronica anagallis-aquatica L. populations in Iran. Iranian Journal of Botany 27(2).	Yes	Low
	Unknown	Not Rated

Question 9. Allelopathy (1 pt)

Q9 notes
Evidence suggests this species is allelopathic (Eremenko, 2014; Nikolaeva et al., 2021).
There are many studies demonstrating allelopathy in Ailanthus altissima (Heisey, 1990; Lawrence et al., 1991; Gómez-Aparicio & Canham, 2008; NWCB, 2011).
The assessor asserts that this species is allelopathic.

There is no evidence that this species is allelopathic (AKNHP 2010).
Evidence of allelopathy is mixed—Amorpha fruticosa is toxic to some plants and potentially stimulates others (Grabić et al., 2022). The greater impact from this species is probably from crowding out other species in competition for space and resources.
Live Anthoxanthum odoratum plants are allelopathic, and this species has been shown to suppress germination in other grass species. Chemicals from A. odoratum (and closely related species) can encourage growth in other A. odoratum plants. Decaying A. odoratum plants encourage the growth of other grass species, possibly due to the high level of phosphorus in the roots providing a fertilizing effect as they decay (Brusati & Warner, 2004; Pitcher & Russo, 2012). This species also stimulates legume germination.

Leachate from Arundo donax has been shown to inhibit growth of some species of algae (Mary et al., 2024). This species produces a number of secondary chemicals (McWilliams, 2004), suggesting that it could potentially be allelopathic to plants as well.
Information on allelopathy was not available for this species. However, Bellaridia viscosa produces defensive chemicals that deter Spodoptera larvae from feeding on them (Azab, 2021). The related species Bellardia trixago is known to produce secondary chemicals and has demonstrated allelopathic effects on some species (Soriano et al., 2022).

Centaurea solstitialis is generally considered to be allelopathic and allelopathy likely contributes to this species' invasiveness. Not all studies have confirmed allelopathy in C. solstitialis, so allelopathy may vary by population (or some plant species may be more resistant to its effects). The allelopathic chemical produced by this species is also toxic to horses (Innes & Zouhar, 2021) and herbivory can increase allelopathy in this species (Becerra et al., 2020). It releases a bitter tasting chemical when damaged.

Allelopathy is suspected, but has not been reliably demonstrated in Cirsium arvense (Zouhar, 2001). Published research is contradictory, with some studies finding allelopathic effects (Stachon & Zimdahl, 1980). A literature search found a few recent small-scale studies of allelopathy in C. arvense since 2001, but data on allelopathy, particularly under natural conditions and outside of agricultural systems, appears to be limited, and one recent study suggested that C. arvense might not have allelopathic effects. Researchers have also found that several plant species grown in media inoculated with soil from sites invaded by C. arvense showed better growth than when the same species were raised in soil from areas not invaded by C. arvense (Verbeek & Kotanen, 2019).

One study found that leachate from Cynoglossum officinale seeds inhibited root growth in seedlings of other species (native and invasive), but not in C. officinale. Heat-killed seeds also exhibited allelopathic effects on neighboring seedlings (Rashid et al., 2005). Leachate from the leaves can also have an allelopathic effect on neighboring plants (Momayyezi & Upadhyaya, 2017).
This species does not appear to be allelopathic and doesn't exclude other plants.

Little information was found on allelopathy in Dipsacus fullonum. Some evidence suggests that D. fullonum plants can reduce germination and growth in neighboring D. fullonum plants (Gucker, 2009), but a literature search turned up no information on the effects of D. fullonum on other species, or on potential allelochemicals found in D. fullonum tissues.
At least one source describes exotic hawkweeds as potentially allelopathic (Czarapata, 2005).

Holcus lanatus is likely mildly allelopathic. Extracts from this species have been shown to reduce growth in both H. lanatus seedlings and the seedlings of other species (Gucker, 2009; Bennett et al., 2011).

A literature search did not find information regarding allelopathy in Ilex aquifolium. However, other species of Ilex, such as Ilex paraguariensis (yerba mate) and Ilex vomitoria (yaupon), are known for their caffeine content, which can function as an allelopathic chemical in plants. Other Ilex species produce saponins, which may also be allelopathic (Coelho et al., 2010). Ilex aquifolium does not produce caffeine. However, it does produces a suite of other secondary compounds (Pachura et al., 2021), including known defensive chemicals (Valladares et al., 2005). At least some of these chemicals may be allelopathic.

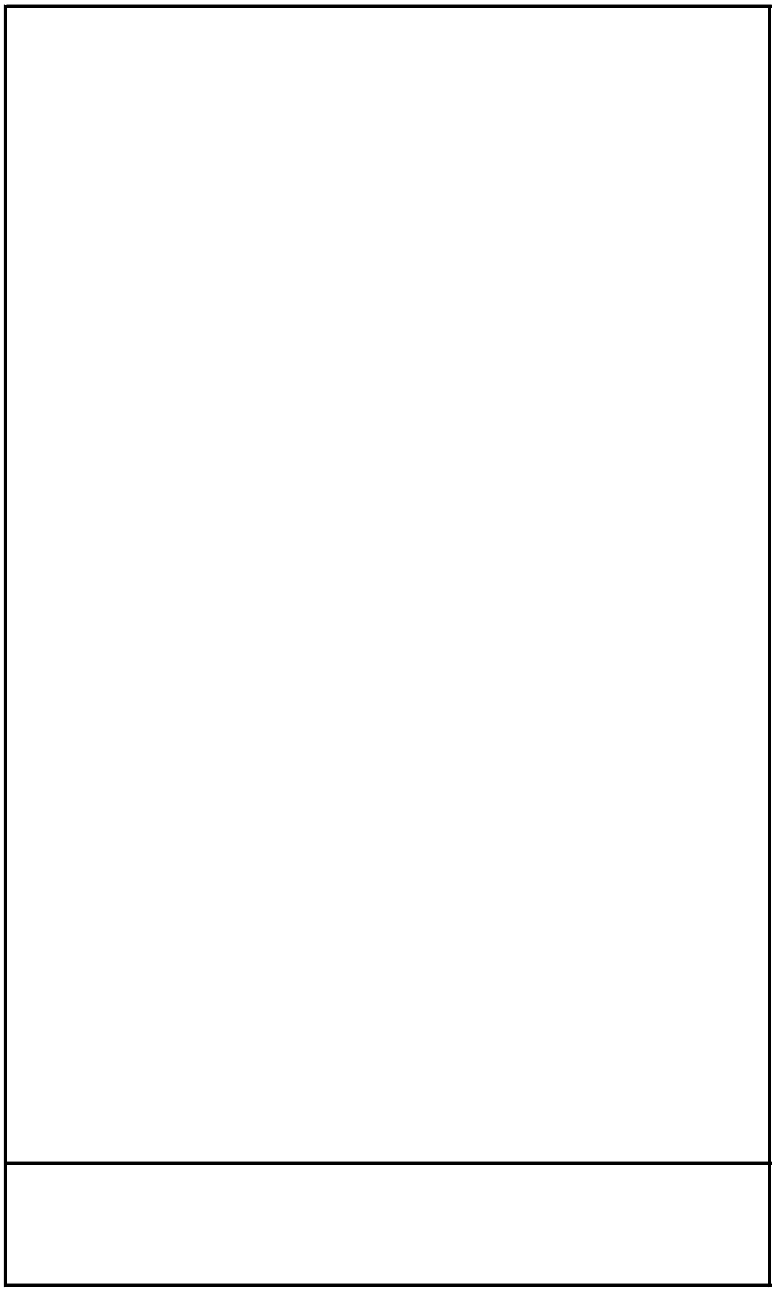
This plant is not known to produce allelopathic chemicals, but the assessor was not aware of any published studies to this effect.
Jacobaea vulgaris produces alkaloids that may be allelopathic and some studies have shown that this species can inhibit seed germination in several other plant species (Richardson, 2004; Jacobs, 2009). However, other studies found a positive effect of J. vulgaris presence on growth and survival of heterospecific plant species (at least in J. vulgaris' native range) (Van De Voorde et al., 2012).
Walnuts are likely allelopathic.

Juncus effusus produces several secondary compounds that are potentially allelopathic (Ervin & Wetzel, 2000). Senesced culms are slow to decay, also indicating potential for allelopathic effects. In a greenhouse study from Alabama, researchers found that J. effusus leachate could reduce germination of J. effusus seeds and survival of J. effusus seedlings but had no effect on germination or survival of other species tested. Researchers did find a slight reduction in chlorophyll production in one of the other species tested, but evidence was not strong enough to support or rule out allelopathy in this species (Ervin & Wetzel, 2000).

Leucanthemum vulgare produces many secondary compounds, some of which have been shown to have allelopathic properties in other species. Oil extracted from L. vulgare flowers has been shown to reduce germination and growth in some plant species (Magharri et al., 2015; Khan et al., 2021). Allelopathy likely contributes to this species ability to dominate grasslands in its invasive range (Khan et al., 2021).

No evidence was found suggesting this species is allelopathic.
At least one study has indicated that Marrubium vulgare leaf extracts have allelopathic properties (Dallali et al., 2017).

No information on secondary chemicals in Myosotis discolor was found. However, the species habit does not suggest that it is allelopathic.



Phalaris arundinacea shows little allelopathic effects on Medicago sativa, Trifolium pratense, and Festuca arundinacea, suggesting this species is not allelopathic, but more research is needed (Lavergne & Molofsky, 2004).

Phleum pratense exhibits potential allelopathy both via pollen and extracts of leaves and stems. Phleum pratense pollen is known to inhibit pollination and seed development in at least one grass species, Agropyron repens (quackgrass), and perhaps other grass species as well. Some studies have also shown that leaf and stem extracts inhibit several other plant species from germination. (Wardle, 1987; Murphy & Aarssen, 1995; Rivernider et al., 2017). Allelopathic abilities may aid P. pratense in outcompeting tree seedlings (Esser, 1993).

A literature search revealed no information about allelopathy in Rubus bifrons.
Research indicates that Schedonorus arundinaceus is allelopathic (Hughes, 1987). Closely related S. pratensis also produces allelopathic chemicals (Hughes, 1987).

Allelopathy in Solidago altissima is relatively well-researched (Uesugi et al., 2019; Kato-Noguchi & Kato, 2022). This species produces several chemicals that are known to be allelopathic in closely related plant species, and allelopathy has been demonstrated in S. altissima in both the lab and the field(Uesugi et al., 2019). Common garden experiments suggest that S. altissima is allelopathic (at least against Poa pratensis) and that populations from this species' introduced range (Japan and Australia in this case) are more likely to be allelopathic than populations from the native range. Increase of allelopathic ability in introduced populations is likely related to herbivore release. Production of allelopathic chemicals also increased in S. altissima populations when herbivores were experimentally removed (Uesugi et al., 2019).

Soil leachate from Tamarix was not found to impede germination of Tamarix seeds. However, plants in this genus excrete salt from their leaves, which can increase soil salinity, especially in habitats where flooding is regulated by dams or other human activities. Increased soil salinity can give Tamarix a competitive advantage over native riparian plant species (Zouhar, 2003).
This species is used as a forage plant for pasture mixes, where allelopathy would be a significant drawback.

Utricularia inflata is included in a list of plant species that may be allelopathic to algae in one review (Emery Butcher et al., 2020), but no primary sources discussed allelopathy in this species. Further research is needed.

Veronica anagallis-aquatica has a history of use as a medicinal plant and produces saponins, among many other secondary compounds, which may be allelopathic (Coelho et al., 2010; Shahzad et al., 2011). However, no sources directly addressed allelopathy or chemical defenses in this species.

Q9 citation	**Q10 Rank**	**Q10 confidence rank**
Eremenko Y.A. 2014. Allelopathic activity of invasive tree species. Russian Journal of Biological Invasions 2:33–39. Nikolaeva A.A., E.V. Golosova, and O.V. Shelepova. 2021. Allelopathic activity of Acer negundo L. leaf litter as a vector of invasion species into plant communities. BIO Web of Conferences, Northern Asia Plant Diversity.	Yes (range Yes - No)	Moderate
Gómez-Aparicio L. and C.D. Canham. 2008. Neighbourhood analyses of the allelopathic effects of the invasive tree Ailanthus altissima in temperate forests. Journal of Ecology 96:447–458. Heisey R.M. 1990. Evidence for allelopathy by tree-of-heaven (Ailanthus altissima). J Chem Ecol. 16(6):2039–55. Lawrence J.G., A. Colwell, and O.J. Sexton. 1991. The ecological impact of allelopathy in Ailanthus altissima (Simaroubaceae). American Journal of Botany 78(8):948–958. Noxious Weed Control Board (NWCB). 2011. Written findings of the Washington State Noxious Weed Control Board: Ailanthus altissima (Mill.) Swingle. https://www.nwcb.wa.gov/pdfs/Ailanthus-altissima-Written-Findings-2011.pdf. Accessed: December 18, 2024.	No	Moderate
	Yes	Low

Alaska Natural Heritage Program (AKNHP). 2010. Alopecurus pratensis L. Alaska Natural Heritage Program, University of Alaska, Anchorage. Online: https://accs.uaa.alaska.edu/wp-content/uploads/Alopecurus_pratensis_RANK_ALPR3.pdf	Yes	Moderate
Grabić J., B. Ljevnaić-Mašić, A. Zhan, B. Benka, and H. Heilmeier. 2022. A review on invasive false indigo bush (Amorpha fruticosa L.): Nuisance plant with multiple benefits. Ecology and Evolution 12(9).	Yes	High
Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Pitcher D. and M.J. Russo. 2012. Anthoxanthum odoratum, Global Invasive Species Team, The Nature Conservancy. https://wiki.bugwood.org/Archive:TNC/Anthoxanthum_odoratum. Accessed: October 25, 2024.	Yes	Moderate (range Moderate - High)

	Yes	High
	No	Moderate
Mary M.A., S. Tábora-Sarmiento, S. Nash, G.D. Mayer, J. Crago, and R. Patiño. 2024. Plant-derived products selectively suppress growth of the harmful alga Prymnesium parvum. Water 16(7):930. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024.	Yes	High
Azab A. 2021. Orobanchaceae plants of Israel and Palestine. Chemical and medicinal treasures. European Chemical Bulletin 10(1):1. Soriano G., A. Siciliano, M. Fernández-Aparicio, A. Cala Peralta, M. Masi, A. Moreno-Robles, M. Guida, and A. Cimmino. 2022. Iridoid glycosides isolated from Bellardia trixago identified as inhibitors of Orobanche cumana radicle growth. Toxins 14(8):559.	Yes	Moderate
	No	Moderate

	Yes	Moderate
	NA	NA
Becerra P.I., L. Cavieres, and R.O. Bustamante. 2020. Effect of the invasive exotic herb Centaurea solstitialis on plant communities of a semiarid ecosystem. Plant Ecology & Diversity 13(3–4):267–275. Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes	Moderate
	NA	NA

Stachon W.J. and R.L. Zimdahl. 1980. Allelopathic activity of Canada Thistle (Cirsium arvense) in Colorado. Weed Science 28(1):83–86. Verbeek J.D. and P.M. Kotanen. 2019. Soil-mediated impacts of an invasive thistle inhibit the recruitment of certain native plants. Oecologia 190(3):619–628. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes	High
	Yes	Moderate
	No	Moderate

	Yes	Low
	No	Moderate
Momayyezi M. and M.K. Upadhyaya. 2017. Influence of soil moisture stress on vegetative growth and mycorrhizal colonization in hound's-tongue (Cynoglossum officinale). Weed Science 65(1):107–114. Rashid A., N.H. Furness, B.E. Ellis, and M.K. Upadhyaya. 2005. Inhibition of seed germination and seedling growth by hound's tongue (Cynoglossum officinale L.) seed leachate. Weed Biology and Management 5(3):143–149.	Yes (range Yes - No)	High (range Low - High)
	No	Moderate

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	Yes	Moderate (range Low - High)
	Yes	Moderate
	NA	NA
Czarapata E.J. 2005. Invasive plants of the Upper Midwest: An illustrated guide to their identification and control. The University of Wisconsin Press, Madison, WI.	Yes	High

Bennett A.E., M. Thomsen, and S.Y. Strauss. 2011. Multiple mechanisms enable invasive species to suppress native species. American Journal of Botany 98(7):1086–1094. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	Yes	High

Coelho G.C., S.B. Gnoatto, V.L. Bassani, and E.P. Schenkel. 2010. Quantification of saponins in extractive solution of mate leaves (Ilex paraguariensis A. St. Hil.). Journal of Medicinal Food 13(2):439–443. Pachura N., R. Kupczyński, J. Sycz, A. Kuklińska, A. Zwyrzykowska-Wodzińska, K. Wińska, A. Owczarek, P. Kuropka, R. Nowaczyk, P. Bąbelewski, and A. Szumny. 2021. Biological potential and chemical profile of European varieties of Ilex. Foods 11(1):47. Valladares F., S. Arrieta, I. Aranda, D. Lorenzo, D. Sanchez-Gomez, D. Tena, F. Suarez, and J.A. Pardos. 2005. Shade tolerance, photoinhibition sensitivity and phenotypic plasticity of Ilex aquifolium in continental Mediterranean sites. Tree Physiology 25(8):1041–1052.	Yes	Moderate
	Yes	Moderate

	No	Low
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024. Van De Voorde T.F.J., W.H. Van Der Putten, and T.M. Bezemer. 2012. The importance of plant–soil interactions, soil nutrients, and plant life history traits for the temporal dynamics of Jacobaea vulgaris in a chronosequence of old fields. Oikos 121(8):1251–1262.	Yes	Moderate
	No	Moderate

Ervin G.N. and R.G. Wetzel. 2000. Allelochemical autotoxicity in the emergent wetland macrophyte Juncus effusus (Juncaceae). American Journal of Botany 87(6):853–860.	Yes	Moderate
	Yes	Moderate
	Yes	High
	Yes	High

Khan M.A., K. Hussain, and M.A. Shah. 2021. Ecological restoration of habitats invaded by Leucanthemum vulgare that alters key ecosystem functions. PLOS ONE 16(3). Magharri E., S.M. Razavi, E. Ghorbani, L. Nahar, and S.D. Sarker. 2015. Chemical composition, some allelopathic aspects, free-radical- scavenging property and antifungal activity of the volatile oil of the flowering tops of Leucanthemum vulgare Lam. Records of Natural Products 9(4):538–545.	No	Low
	NA	NA

	No	Moderate
Dallali S., S. Rouz, H. Aichi, and H.B. Hassine. 2017. Phenolic content and allelopathic potential of leaves and rhizosphere soilaqueous extracts of white horehound (Marrubium vulgare L.). Journal of New Sciences 39(3):2106–2120.	No	Moderate
	Yes	Moderate

	No	Moderate
	NA	NA

	Yes	High
	Yes	Moderate

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429.	Yes	High

Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Murphy S.D. and L.W. Aarssen. 1995. Allelopathic pollen extract from Phleum pratense L. (Poaceae) reduces seed set in sympatric species. International Journal of Plant Sciences 156(4):435–444. Rivernider R., E. Venturini, and F.A. Drummond. 2017. Phleum pratense (Poales: Poaceae), a pollen forage for native bumble bees Bombus Latrielle (Hymenoptera: Apidae). Journal of the Kansas Entomological Society 90(1):63–68. Wardle D.A. 1987. Allelopathy in the New Zealand grassland/pasture ecosystem. New Zealand Journal of Experimental Agriculture 15(2):243–255.	No	Low
	No	Moderate
	Yes	Moderate
	NA	NA
	No	Moderate
	Yes	Moderate

	No	High
	Yes	Moderate
	Yes	High
	No	Low
	No	High
	Yes	Moderate
Hughes H.G. 1987. Use of native shrubs on strip-mined lands in the humid East. n: Wallace, Arthur; McArthur, E. Durant; Haferkamp, Marshall R., compilers. Proceedings--symposium on shrub ecophysiology and biotechnology. June 30 - July 2; Logan, UT. US Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. Gen. Tech. Rep. INT-256.	Yes	High
	NA	NA

	Unknown	Not Rated
	No	Moderate
Kato-Noguchi H. and M. Kato. 2022. Allelopathy and allelochemicals of Solidago canadensis L. and S. altissima L. for their naturalization. Plants 11(23):3235. Uesugi A., R. Johnson, and A. Kessler. 2019. Context dependent induction of allelopathy in plants under competition. Oikos 128(10):1492–1502.	Yes	Moderate
	Unknown	Not Rated

Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Yes	Moderate
	Yes	High
	Yes	High

- Emery Butcher H.E., S.J. Beatty, and B.J. Robson. 2020. The impacts of invasive ecosystem engineers in freshwaters: A review. Freshwater Biology 65(5):999–1015.	Yes	Moderate
	No	Low

Coelho G.C., S.B. Gnoatto, V.L. Bassani, and E.P. Schenkel. 2010. Quantification of saponins in extractive solution of mate leaves (Ilex paraguariensis A. St. Hil.). Journal of Medicinal Food 13(2):439–443. Shahzad A., S. Parveen, and M. Fatema. 2011. Development of a regeneration system via nodal segment culture in Veronica anagallis-aquatica L. – an amphibious medicinal plant. Journal of Plant Interactions 6(1):61–68.	Yes	Low
	No	Moderate

Question 10. Competitive for Limiting Abiotic Fa

Q10 notes

In eastern Washington, Acer negundo is startling in its ability to tolerate drought and poor soils and in its persistence beyond cultivation (C. Antieau, pers. comm., 2024).

While Ailanthus altissima has an extensive root system, is fast growing, and can spread quickly (all traits that can aid it in outcompeting other species), its phenology and the depth of its root system are not unusual for at least some of the systems it has been observed in. This suggests that A. altissima may not be especially competitive for limiting abiotic factors.

This species maintains photosynthetic foliage for most of the year.

Alopecurus pratensis competes for space, light, and nutrients. This species can outcompete native species, especially annuals.
Information on competitive abilities can be found in Grabić et al. (2022). This species is a known nitrogen-fixer (Plants for a Future, 2012).
Anthoxanthum odoratum is competitive for water, light, nitrogen, phosphorus, and potassium. This species can outcompete other grass species, including nonnative Lolium perenne, Holcus lanatus, and Dactylis glomerata, though it is generally more competitive against annual than perennial grasses. Anthoxanthum odoratum is also competitive against forbs, such as Plantago lanceolata (Platenkamp, 1990; Dennehy et al., 2011; Pitcher & Russo, 2012). This species is better able to coexist with Cytisus scoparius than most other introduced or native species, allowing it to rapidly increase when C. scoparius is removed (Lysgaard, 2022). However, some studies have also demonstrated negative effects of competition on this species, including studies in coastal prairie habitats in northern California that shows A. odoratum has higher mortality and lower seed production when it is grown with neighboring plants (either A. odoratum or H. lanatus). Anthoxanthum odoratum also appears to be more competitive in mesic habitats than xeric ones (Platenkamp & Foin, 1990).

Arundo donax is highly competitive for water. This species has relatively efficient photosynthesis, and can transfer water several meters along rhizomes from wet parts of a stand to culms in drier parts (NWCB, 2013; Goolsby et al., 2023). Arundo donax is considered a national threat in South Africa, because of its heavy water use. This species is also efficient at nutrient uptake (Goolsby et al., 2023). In California, Arundo donax can remain green year-round, but it can also exhibit winter dormancy. (McWilliams, 2004). Washington is at the northern edge of this species range, suggesting that A. donax will exhibit winter dormancy here.
Like many species in the Orobanchaceae family, Bellardia viscosa is a generalist hemiparasite. A study in interdunal wetlands in northern California found no effects of Bellardia viscosa on co-occurring species, suggesting that this species generally does not outcompete or otherwise harm native plants. Ecosystem changes over the course of the experiment tracked expected successional changes in these habitats (Pickart & Wear, 1999). However, more recent research in Japan did find an effect of parasitism by B. viscosa on infected plants, with plants infected by B. viscosa producing less biomass than plants that were not infected. Some plant species are better able to defend themselves against parasitic plants than others (Suetsugu et al., 2012). Studies in Australia suggest B. viscosa is less competitive for water than other plant species. However, this species is very competitive for nitrogen uptake via host plants (Pate & Bell, 2000).

Centaurea solstitialis is highly competitive for water and can deplete soil moisture where it occurs—sometimes so much that it reduces its own germination success in the next year. This species can grow deep roots (longer than 6 feet) and exploit fissures in rock to obtain water in dry areas. These deep roots make C. solstitialis more drought tolerant than some annual grasses it co-occurs with (e.g., Taeniatherum caput-medusae), and roots can be deeper than the roots of co-occurring perennial grass species as well (Innes & Zouhar, 2021). Basal rosettes overwinter in Washington, and can have roots up to 2 feet deep by spring, giving this species an advantage over plants that are dormant in the winter (Innes & Zouhar, 2021).

Centaurea solstitialis is more competitive for abiotic factors in its introduced range than in its native range. Multiple introductions have resulted in novel genotypes, which can increase competitive ability and adaptability to a wider range of conditions. Competitive release from perennial grasses that have evolved with C. solstitialis, and escape from disease-causing agents are also important factors in the success of this species in its introduced range. Replacement of native perennial grass communities with introduced annual grass communities throughout the western U.S. may also have left an unexploited niche for C. solstitialis to exploit. This species is more competitive against early season, shallow rooted annuals, and less competitive against species that share the same niche (e.g., late-flowering, deep taproots) (Innes & Zouhar, 2021). However, C. solstitialis is less competitive against diverse plant communities, with deep-rooted perennials being most able to outcompete this species for water and light. Restoring

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Cirsium arvense can reduce crop yields, outcompeting its neighbors for moisture, light, and nutrients (Moore, 1975). This species can metabolize fructans, allowing it to grow at cooler temperatures than other plants (Zouhar, 2001). A common garden experiment done in the Czech Republic comparing the growth and fitness of C. arvense from Europe to North American populations found that the populations from North America were more competitive for resources than native populations (Abela-Hofbauerová & Münzbergová, 2011).

However, C. arvense establishment can be prevented by seeding aggressive perennial grasses (e.g., introduced species such as crested wheatgrass, orchard grass, or smooth brome) (Zouhar, 2001). This and other reports of C. arvense being vulnerable to competition may hinge on the species shade intolerance, particularly as seedlings, though herbivory may also reduce competitive advantages for this species (Leathwick & Bourdôt, 2012).

Cirsium arvense's above-ground mass generally dies off after frost. However, C. arvense can use its roots as storage organs, enabling it to better survive disturbances such as fire and mowing, and to survive cold temperatures. These roots are generally short lived (a year or so), and likely influence the abundance and success of the next year's growth (Leathwick & Bourdôt, 2012).

Cirsium vulgare often remains evergreen throughout the winter.

Cynoglossum officinale grows a long, thick taproot and develops mycorrhizal relationships that likely increase its ability to compete with other species for water and nutrients. The taproot also functions as a storage organ for the plant when it dies back to the roots in the winter (de Jong et al., 1990). A study in British Columbia found that C. officinale is competitive for water against co-occurring grassland species during drought (Momayyezi & Upadhyaya, 2017). Large seeds provision seedlings so they can establish strong roots after germination (de Jong et al., 1990) providing an edge over co-occurring species, though C. officinale's relatively slow growth may reduce competitive advantages (Jacobs & Sing, 2007).
Genetic studies suggest that C. officinale populations in North America come from plants that grew on the edge of agricultural fields in this species' native range. The traits for surviving at the edge of agricultural fields might also make C. officinale more competitive in its introduced range (Williams & Fishman, 2014). Comparisons of populations in northwestern North America to native populations also suggest that introduced plants benefit from specialist insect release and less aggressive competition at the seedling stage (Williams et al., 2010; Duncan & Williams, 2020).

Dipsacus fullonum is an aggressive competitor following disturbance; it is capable of excluding almost all other species once established. Dipsacus fullonum may even reduce Cirsium arvense occurances. This species has deep taproots (up to 2 feet long and an inch in diameter at the root crown) that give it access to resources that vegetation with shallower roots can't reach. Large taproots may also allow plants to store resources to survive damage or poor climate conditions, and potentially provides a growth advantage early in the growing season. Dipsacus fullonum also overwinters as a rosette in its first winter, providing a competitive advantage early in the spring when other species are dormant. However, this species will eventually be outcompeted by other species in the absence of periodic disturbance (Gucker, 2009).
Erechtites species are considered by some to be weak competitors with high nutrient demands (Muldavin et al., 1981). However, at least one species (E. hieraciifolius) may be facultatively mycorrhizal, which might explain its rapid spread in arid grasslands of coastal California (L. Allen, pers. comm. as cited in Cal-IPC, 2024).

Studies in California and the Pacific Northwest have found Holcus lanatus to be highly competitive. This species can crowd out both native and other introduced species where it occurs. Rapid growth of seedlings allows H. lanatus to quickly exclude other species when it colonizes new sites. It also creates thick litter which can prevent other species from establishing. This species can grow a higher proportion of roots to above ground biomass than many neighboring grass species, which also increases its competitive ability. In the winter, H. lanatus stores nutrients in its thick mat of roots (Gucker, 2009; Bennett et al., 2011; Conner et al., 2013).

Experimental studies in coastal prairies in California found that H. lanatus biomass was less affected by competition from neighboring plants. In contrast, other species in the study showed the greatest biomass reduction when planted with H. lanatus (Gucker, 2009). In another experimental study in California, direct competitive effects of H. lanatus had the greatest impact on co-occurring native forb Erigeron glaucus (Bennett et al., 2011).

Studies have found reduced native vegetation cover beneath I. aquifolium canopies, with the densest thickets completely excluding native plants (Stokes et al., 2014). I. aquifolium can grow deep roots (NWCB, 2022)—in its native range, it frequently grows in nitrogen deficient soil (Valladares et al., 2005). Studies from its native range also suggest that Ilex aquifolium is less competitive at cooler temperatures (Valladares et al., 2005).
Impatiens capensis is a strong competitor and has even been shown to successfully compete with introduced Alliaria petiolata (Garlic Mustard) in its native range (Karriker, 2025).

This plant is most competitive in high nutrient environments (Tu, 2004). However, seedling Iris pseudacorus invest heavily in extensive root systems that allow them to persist through large water level fluctuations (Whitehead, 1971).

Jacobaea vulgaris can crowd out other species in disturbed areas, but this species generally does not invade intact plant communities (Richardson, 2004). Several studies have compared the competitive ability of plants from introduced populations of J. vulgaris to plants from J. vulgaris' native range. These studies have found that plants from the introduced range are more competitive than their counterparts from their native range. This is likely due to release from specialist predators, allowing plants to allocate more resources (such as nitrogen) to growth and reproduction instead of defense (Lin et al., 2019). Adult plants are strongly competitive against other plant species, but seedlings are not (Wardle, 1987).
Jacobaea vulgaris is a winter annual, biennial, or short-lived perennial. This species is generally monocarpic and overwinters as a seed or rosette (Jacobs, 2009).

Once established, Juncus effusus is an effective competitor. European populations of J. effusus have high genetic diversity in the portions of the genome associated with stress responses, likely helping this taxon tolerate a wide range of conditions (Arslan et al., 2019). Rapid growth, particularly underground, suggest J. effusus is highly competitive for soil resources (Ervin & Wetzel, 2000). Physiological adaptations also allow this taxon to obtain oxygen from saturated soils (Arslan et al., 2019).
Juncus effusus remains green and photosynthetically active throughout the winter, at least at its base, even at latitudes further north than Washington (Ervin & Wetzel, 2002; McCorry & Renou, 2003).
Juncus effusus seedlings are much less tolerant of competition than mature plants. A 1955 study from Wales found that competition with other species reduced both the number of seeds that germinated and seedling survival, likely due to reduced light availability (Lazenby, 1955). Competition may have also reduced flowering in J. effusus in this study.

Leucanthemum vulgare is an early colonist of disturbed areas and is more common on low-nutrient soils (Clements et al., 2004). While it may outcompete other early colonists of ruderal areas, without ongoing disturbance, L. vulgare is likely to be outcompeted by perennial grasses (Clements et al., 2004).
Leucanthemum vulgare may be a better competitor in its invasive range than in its native range. Plants in the Pacific Northwest are generally larger, produce more flowers, and experience less herbivore damage than plants in Europe. Release from herbivores may allow plants to allocate more energy to growth and reproduction. However, studies in the Pacific Northwest still found that competition (specifically increased vegetation cover) reduced number of flower heads and density of L. vulgare plants compared to plants in areas with reduced vegetation cover (Stutz et al., 2016). Instead of competing directly with other plant species, L. vulgare appears to rely on avoiding competition through a long-lived seed bank that germinates readily after disturbance and an ability to grow in low nutrient areas that do not support aggressive competitors (Clements et al., 2004).
Leucanthemum vulgare senesces in the fall, but basal rosettes may persist until spring in mild climates (Clements et al., 2004).

Lythrum salicara is a fast-growing, competitive perennial that can reproduce its first year and quickly regenerate from root stock but otherwise does not appear particularly aggressive in competing for limiting abiotic factors.

This species is most competitive in areas with heavy grazing. While some sources state this species is deciduous, others report the species remaining green into the winter (Weiss et al., 2000). Marrubium vulgare may continue to photosynthesize in relatively mild parts of western Washington, but the assessor is not confident.

While some research suggests Myosotis discolor can be competitive with selected annual species in its native range (Asefa, 2011), in the Pacific Northwest this species appears to be found either in ruderal places or in trace amounts underneath dominant plant species (CPNWH, 2024), suggesting it is not a strong competitor.

Myosotis discolor is a winter annual, in England it germinates in the fall and overwinters as a rosette before growing in the spring (Asefa, 2011).

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Eurasian watermilfoil can occur at deeper depths than other macrophytes, can grow quickly in the spring to reach the surface, and can photosynthesize at lower water temperatures than most native species, providing it with a competitive advantage (Smith & Barko, 1990; Glisson & Larkin, 2021). While most of the plant dies back, some green stems persist throughout the winter in the climates of both western and eastern Washington. The rate of photosynthesis slows substantially, but still occurs during winter months (Adams & McCracken, 1974).

Phalaris arundinacea exhibits a suite of traits that make it a highly effective competitor (Lavergne & Molofsky, 2004). Phenotypic plasticity allows P. arundinacea to adapt to changing biotic and abiotic conditions and tolerate a wide variety of environmental conditions (Lavergne & Molofsky, 2004). This species stores carbohydrates in its roots, allowing it to start growing earlier in the spring than co-occurring native species (Lavergne & Molofsky, 2004). The extensive root system is effective at nutrient uptake and is water efficient, Relationships with mycorrhizal fungi are also likely to increase its competitiveness for resources, including water (when it occurs in drier habitats) (Lavergne & Molofsky, 2004). Native vegetation communities have demonstrated reduced root growth in mesocosm experiments when grown with P. arundinacea (Lavergne & Molofsky, 2004).

Phleum pratense is an intermediate competitor. It can be competitive against other grasses under the right circumstances (e.g., favorable moisture and soil) but will eventually be replaced by slower growing and more long-lived species (Esser, 1993). This species is frequently grown with alfalfa and other legumes for hay because it is less competitive against legumes than other grass species (Ogle et al., 2011).
The bunchgrass growth form may be an adaptation for co-existing in a highly competitive environment, allowing the plant to better exploit immediate resources (Cheplick & Chui, 2001).
Phleum pratense senesces in the fall. This species can store food in corms for winter (Esser, 1993).

This species is a winter annual.

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Rubus bifrons is especially competitive for water and nitrogen due to its extensive root system (Fryer, 2021). This species can also store water in its roots (Fryer, 2021). Rubus bifrons exhibits phenotypic plasticity: it can adapt leaf size to drought conditions, allowing it to be more water efficient than co-occurring species (Fryer, 2021). The Fire Effects Information System account describes R. bifrons as “semievergreen” because leaves can stay green well into fall, with some green leaves remaining throughout the winter (Fryer, 2021). Cal-IPC refers to this species as “essentially evergreen” (Cal-IPC, 2024). Persistence of leaves is more likely in mild climates (Stannard, 2014), so this species may not be functionally evergreen throughout Washington.
This plant does have a long tap root but is not competitive outside of highly disturbed areas.
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Solidago altissima is considered strongly competitive, particularly in its invasive range (Uesugi et al., 2019; Kato-Noguchi & Kato, 2022) and is capable of displacing other species and resisting colonization (Walck et al., 2001). A study in Florida found that soil moisture was reduced in plant communities dominated by S. altissima in comparison to communities without S. altissima present (Kim, 2017), suggesting that this species is competitive for water. However, most sources attribute competitive success to light competition and allelopathy. The assessor has observed that dense stands of Solidago altissima reduce the size of co-occurring Solanum carolinense (Carolina horsenettle) plants, though the etiolated growth of S. carolinense suggests this may be due to light competition.

Solidago altissima can also have reduced vigor when experiencing vegetative competition (Walck et al., 2001). Insect herbivory in this species' native range can reduce growth and change the outcome of competitive relationships in the vegetation community (Etterson et al., 2008). Competitive abilities in this species introduced range could be in part because of reduced herbivory pressure.

Solidago altissima senesces in late fall, even in southeastern North America. While this species may produce overwintering rosettes, this is not usual (Walck et al., 2001).

Tamarix's slow growth and shade intolerance ultimately make species in this genus poor competitors with non-stressed native riparian vegetation (Zouhar, 2003; Stromberg et al., 2007). However, deep taproots, high water use efficiency, and salt tolerance mean that Tamarix is generally less sensitive to water stress than the native species it occurs with (Zouhar, 2003; Stromberg et al., 2007). Tamarix species also produce lateral roots that can behave like rhizomes and are capable of extracting water from unsaturated soil (Zouhar, 2003; Stromberg et al., 2007). These traits allow Tamarix species to outcompete native riparian vegetation in areas where human activities or climate change have reduced waterflow, lowered the water table, or changed the timing of flood events (Zouhar, 2003; Stromberg et al., 2007). Tamarix ramosissima is deciduous. However, Tamarix species have physiological traits that allow them to continue to photosynthesize in dryer conditions than native riparian vegetation, giving them an advantage during droughts and where human disturbance and climate change have reduced water availability (Zouhar, 2003; Gafke et al., 2022). This provides a similar advantage in climates where growth and survival are affected by drought more than cold.
Trifolium pratense is a nitrogen-fixer, like nearly all legumes.
This species is a winter annual and, like most legumes, a nitrogen fixer.

Utricularia species are adapted to sunny, low-nutrient habitats, gaining most of their nitrogen, phosphorus, and other nutrients via the small aquatic invertebrates they capture and digest in their underwater traps (Wiebush, 2022). Being able to supplement nutrients through carnivory is a competitive advantage in nutrient-poor habitats; increases in nutrient availability can reduce or erase the competitive advantages of carnivory in plants (Givnish et al., 1984).
Utricularia species overwinter in cold environments as storage organs called turions or winter buds (Silva et al., 2018).

This species is likely not a strong competitor, relying more on disturbance.

In a study from New Zealand, this species became dominant when establishing on bare substrate and prevented other species from establishing, suggesting that it is capable of outcompeting co-occurring species (Riis et al., 2004).

This species comes up pretty early in spring, but it is likely too small and low in cover to seriously deplete soil moisture.

ctors (4pts)		
Q10 citation	**Q11 rank**	**Q11 confidence rank**
Rosario L.C. 1988. Acer negundo. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/aceneg/all.html. Accessed: December 16, 2024.	Yes	High
	Yes	High
	Yes	High

	Yes	Moderate
Grabić J., B. Ljevnaić-Mašić, A. Zhan, B. Benka, and H. Heilmeier. 2022. A review on invasive false indigo bush (Amorpha fruticosa L.): Nuisance plant with multiple benefits. Ecology and Evolution 12(9). Plants for a Future. 2012. Amorpha fruticosa - L. https://pfaf.org/USER/Plant.aspx?LatinName=Amorpha+fruticosa. Accessed: January 10, 2025.	Yes	High
Dennehy C., E.R. Alverson, H.E. Anderson, D.R. Clements, R. Gilbert, and T.N. Kaye. 2011. Management strategies for invasive plants in Pacific Northwest prairies, savannas, and oak woodlands. Northwest Science 85(2):329–351. Lysgaard C. 2022. Invasive species removal and changing Fire Regimes in a ləkʷ wəŋən Garry Oak Ecosystem. MS Thesis. University of Victoria, Victoria, BC. Pitcher D. and M.J. Russo. 2012. Anthoxanthum odoratum, Global Invasive Species Team, The Nature Conservancy. https://wiki.bugwood.org/Archive:TNC/Anthoxanthum_odoratum. Accessed: October 25, 2024. Platenkamp G.A.J. 1990. Phenotypic plasticity and genetic differentiation in the demography of the grass Anthoxanthum odoratum. The Journal of Ecology 78(3):772. Platenkamp G.A.J. and T.C. Foin. 1990. Ecological and evolutionary importance of neighbors in the grass Anthoxanthum odoratum. Oecologia 83(2):201–208.	No	Low

	Yes	High
	No	Moderate
Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Yes	High
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	No	High

	No	Moderate
	Yes	Moderate
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes	High
.	NA	NA

Abela-Hofbauerová I. and Z. Münzbergová. 2011. Increased performance of Cirsium arvense from the invasive range. Flora 206(12):1012–1019. Leathwick D.M. and G.W. Bourdôt. 2012. A conceptual model for the population dynamics of Cirsium arvense in a New Zealand pasture. New Zealand Journal of Agricultural Research 55(4):371–384. Moore R.J. 1975. The biology of Canadian weeds.: 13. Cirsium arvense (L.) Scop. Canadian Journal of Plant Science 55(4):1033–1048. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes	High
Information from Ethan Coggins' Assessment of Cirsium arvense	No	High
	Yes	High

	Yes	Low
	Yes	High
Duncan S.S. and J.L. Williams. 2020. Life history variation in an invasive plant is associated with climate and recent colonization of a specialist herbivore. American Journal of Botany 107(10):1366–1374. Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8. de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144. Momayyezi M. and M.K. Upadhyaya. 2017. Influence of soil moisture stress on vegetative growth and mycorrhizal colonization in hound's-tongue (Cynoglossum officinale). Weed Science 65(1):107–114. Williams J.L. and L. Fishman. 2014. Genetic evidence for founder effects in the introduced range of houndstongue (Cynoglossum officinale). Biological Invasions 16(1):205–216.0	Yes	Moderate
	No	High

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	NA	NA
	Yes	High

Bennett A.E., M. Thomsen, and S.Y. Strauss. 2011. Multiple mechanisms enable invasive species to suppress native species. American Journal of Botany 98(7):1086–1094. Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	Yes	High

Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board. Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93. Valladares F., S. Arrieta, I. Aranda, D. Lorenzo, D. Sanchez-Gomez, D. Tena, F. Suarez, and J.A. Pardos. 2005. Shade tolerance, photoinhibition sensitivity and phenotypic plasticity of Ilex aquifolium in continental Mediterranean sites. Tree Physiology 25(8):1041–1052.	Yes	High
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	NA	NA

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	No	Moderate
	Yes	High
	Yes	High

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Stutz S., K. Štajerová, H.L. Hinz, H. Müller-Schärer, and U. Schaffner. 2016. Can enemy release explain the invasion success of the diploid Leucanthemum vulgare in North America? Biological Invasions 18(7):2077–2091.	No	Moderate
	No	Low

	Yes	Low
Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	No	High
	No	Moderate

Asefa G. 2011. The dynamics of coexistence in annual plants. PhD Dissertation. Imperial College London, London, United Kingdom. Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	No	High
.	NA	NA

Adams M.S. and M.D. McCracken. 1974. Seasonal production of the Myriophyllum component of the littoral of Lake Wingra, Wisconsin. Journal of Ecology 62(2):457–465. Glisson W.J. and D.J. Larkin. 2021. Hybrid watermilfoil (Myriophyllum spicatum × Myriophyllum sibiricum) exhibits traits associated with greater invasiveness than its introduced and native parental taxa. Biological Invasions 23(8):2417–2433. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	Yes	High
	Yes	High

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429.	Yes	High

Cheplick G.P. and T. Chui. 2001. Effects of competitive stress on vegetative growth, storage, and regrowth after defoliation in Phleum pratense. Oikos 95(2):291–299. Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Ogle D.G., L. St. John, and D.J. Tilley. 2011. Plant guide for timothy (Phleum pratense). USDA-Natural Resources Conservation Service, Idaho State Office. Boise, ID. Online: https://plants.usda.gov/DocumentLibrary/plantguide/doc/pg_phpr3.docx	No	Low
	No	High
	No	Moderate
.	NA	NA
	Yes	Moderate
	Yes	High

	Yes	High
	Yes	High
Cal-IPC. 2004. Rubus armeniacus Plant Assessment Form. https://www.cal-ipc.org/plants/paf/rubus-armeniacus-plant-assessment-form/. Accessed: June 27, 2024. Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024. Stannard M.E. 2014. Plant guide for Himalayan blackberry (Rubus armeniacus). USDA-Natural Resources Conservation Service, Plant Materials Center, Pullman, WA. Online: https://plants.usda.gov/DocumentLibrary/plantguide/pdf/pg_rubar9.pdf	Yes	High
	Yes	High
	No	High
	Yes	High
	Yes	Moderate
.	NA	NA

	No	Moderate
	Yes	High
Etterson J.R., D.E. Delf, T.P. Craig, Y. Ando, and T. Ohgushi. 2008. Parallel patterns of clinal variation in Solidago altissima in its native range in central USA and its invasive range in Japan. Botany 86(1):91–97. Kato-Noguchi H. and M. Kato. 2022. Allelopathy and allelochemicals of Solidago canadensis L. and S. altissima L. for their naturalization. Plants 11(23):3235. Kim T.N. 2017. How plant neighborhood composition influences herbivory: Testing four mechanisms of associational resistance and susceptibility. PLOS ONE 12(5):e0176499. Uesugi A., R. Johnson, and A. Kessler. 2019. Context dependent induction of allelopathy in plants under competition. Oikos 128(10):1492–1502. Walck J.L., J.M. Baskin, and C.C. Baskin. 2001. Why is Solidago shortii narrowly endemic and S. altissima geographically widespread? A comprehensive comparative study of biological traits. Journal of Biogeography 28(10):1221–1237.	Yes	High
	Yes	High

Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https://bugwoodcloud.org/resource/files/23194.pdf Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Yes	Moderate
	No	High
	No	High

Givnish T.J., E.L. Burkhardt, R.E. Happel, and J.D. Weintraub. 1984. Carnivory in the bromeliad Brocchinia reducta, with a cost/benefit model for the general restriction of carnivorous plants to sunny, moist, nutrient-poor habitats. The American Naturalist 124(4):479–497. Silva S.R., R. Gibson, L. Adamec, Y. Domínguez, and V.F.O. Miranda. 2018. Molecular phylogeny of bladderworts: A wide approach of Utricularia (Lentibulariaceae) species relationships based on six plastidial and nuclear DNA sequences. Molecular Phylogenetics and Evolution 118:244–264. Wiebush M. 2022. Utricularia intermedia Hayne, flat-leaved bladderwort. California Native Plant Society, Sacramento, CA. Online: https://rareplantfiles.cnps.org/scc/UtriculariaIntermediaSpAcctSCC20220408r.pdf	Yes	High
	No	High

Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	No	Low
	No	High

Question 11. Growth Form (2 pts)

Q11 notes
Ailanthus altissima suckers and forms dense thickets that crowd out other species and can form a closed canopy (NWCB, 2011).
This species often forms dense stands.

May form dense sods & mats (Rutledge & McLendon, 1996; Dzyubenko & Dzyubenko, 2009).
Information on growth form is available in the NWCB (2015) report.
Anthoxanthum odoratum doesn't generally form smothering or tall monocultural stands, but it can still be competitive for light (Dennehy et al., 2011). Observations from northern California coastal prairies suggest that this species doesn't entirely exclude other species or form particularly heavy infestations. However, it can form thick root mats that exclude other species from establishing (Brusati & Warner, 2004). In Willamette Prairie, A. odoratum occurs intermixed in a community of introduced perennial grasses and is usually shorter than most other introduced perennial grasses it co-occurs with.

Arrhenatherum elatius is a sod forming grass and grows up to 5 feet tall.
Arundo donax forms large monotypic, clonal stands that can be several acres in size, and physically exclude other species. The rhizomes can form mats up to three feet thick (McWilliams, 2004).
While Bellardia viscosa can be abundant where found, it does not form smothering or tall monocultural stands. It usually grows in mixed communities of other plants (Brusati & Corelli, 2005).

This plant can grow in dense, monotypic stands.

Centaurea solstitialis frequently grows as monocultural stands that exclude other species (Innes & Zouhar, 2021).

Cirsium arvense's vegetative mode of reproduction frequently results in dense clonal stands (Zouhar, 2001). Seedlings may not be competitive for sunlight, however (Leathwick & Bourdôt, 2012), and this species can allow significant sunlight through its canopy.

Cynoglossum officinale can form monocultural stands that exclude other vegetation (Jacobs & Sing, 2007). Seedlings tend to cluster around their parent plants (de Jong et al., 1990). A study comparing C. officinale populations between Montana and Germany found that populations in the introduced range were more dense than populations in the native range (Williams et al., 2010).

Dipsacus fullonum's limited seed dispersal distance results in dense stands that can exclude all other species (Gucker, 2009). Large rosettes reduce the amount of sunlight available for other species, effectively outcompeting them for sunlight (Huarte et al., 2016) Competition for sunlight may be more important than competition for other abiotic resources in maintaining D. fullonum populations (Gucker, 2009).
This species can be very common following disturbance, but is usually replaced within 5-10 years (Muldavin et al., 1981).
This species forms contiguous mats.

Holcus lanatus is reported to form dense stands that exclude native species from several parts of its invasive range, including Hawaii, coastal California, and Willamette Prairie habitats in the Pacific Northwest (Gucker, 2009; Bennett et al., 2011) In California, concerns about this species center on its ability to form monocultural stands and reduce species diversity where it occurs (Ender et al., 2017). Restoration professionals in the Willamette Valley are also concerned about this species' ability to crowd out desirable species and reduce diversity in Willamette Prairie habitats.

Ilex aquifolium is capable of developing dense monocultural stands that exclude all other species (Stokes et al., 2014). This species may form dense evergreen foliage all the way to the ground, and it suckers and layers readily. It creates a thick skirt of fallen leaves at its base, which allows the lower branches (now buried) to root. When knocked down by falling limbs and trees, it roots wherever it touches the ground, so individual plants can have many rooted stems.

Rhizome growth may compact wetland soils into hardpans that exclude the establishment of other species (Thomas, 1980; Stone, 2009).
In restored Willamette Prairie habitats, Jacobaea vulgaris can occur as scattered individuals or small clumps. This species can form large, dense stands in unrestored old fields in the same habitat. This species' rosettes have large leaves that lay flat to the ground, shading out neighboring plants. The death of adult plants provides openings for new J. vulgaris seedlings to establish (Richardson, 2004; Jacobs, 2009). However, J. vulgaris does not appear to exclude other species long term.

Juncus effusus frequently grows as dense tussocks. The natural growth form of this taxon (arched culms) can greatly reduce light availability below its canopy (Ervin & Wetzel, 2002). A study in Alabama on the effects of shading by J. effusus found that when culms were held upright to allow more light through their canopy, the diversity and biomass of other species increased compared to areas where J. effusus was unmanipulated (Ervin & Wetzel, 2002). Grasses were not significantly affected by shading from this species, but forbs were. Vegetation surveys found almost no other species growing in J. effusus tussocks (Ervin & Wetzel, 2002). However, Juncus effusus is only an effective competitor for light after it has established. Seedlings are poor competitors for light (Lazenby, 1955).

While Leucanthemum vulgare doesn't produce stands as dense and as large as some other invasive species in the Pacific Northwest, it is visibly dominant where it occurs, turning old fields and pastures white with flowers in the summer in the Pacific Northwest. This species frequently occurs as part of a community of introduced species in grasslands, particularly Daucus carota and introduced perennial grasses. Leucanthemum vulgare grows in clonal clumps, and populations are generally dense enough to reduce native diversity and cover in plant communities where this species occurs (Clements et al., 2004; Brusati, 2005; NWCB, 2024).
Forms dense low mats that are capable of excluding native species, but this may be restricted to mudflats and other early successional ecosystems.

Lythrum salicaria forms dense thickets, but the primary native plants it often competes with (e.g., Typha, Schoenoplectus) are just as tall and unlikely to be shaded out. A study from the east coast showed no difference in species richness between areas with and without purple loosestrife (Treberg & Husband, 1999).
This species is a clumping perennial and rarely forms dense monocultures.

While Myosotis discolor can be locally abundant where found, it does not form smothering or tall monocultural stands. This species usually grows under mixed communities of other plants and does not appear to be competitive for light.

As a canopy-forming species, it reduces light for other species below (Aiken et al., 1979; Smith & Barko, 1990; Madsen et al., 1991; Boylen et al., 1999).

Phalaris arundinacea grows rapidly and forms dense monotypic stands and swards that can make up 50–100% of the vegetation cover where found(Lavergne & Molofsky, 2004; Waggy, 2010). The height and growth form of this species allow it to effectively shade out neighboring plants (Lavergne & Molofsky, 2004). Experiments in prairie pothole communities suggest that P. arundinacea is more competitive for light than even Typha latifolia and other species with similar growth forms (Lavergne & Molofsky, 2004; Waggy, 2010).

Phleum pratense can form monocultures on favorable sites and its height allows this species to be competitive for light. However P. pratense usually co-exists with native species instead of forming thickets or dense monocultural stands (Isselin Nondedeu & Bédécarrats, 2009; Ogle et al., 2011).
Trees can grow quite large.

Rubus bifrons forms dense stands or thickets, with up to 252 canes per square meter. These thickets crowd out native vegetation and hinder wildlife movement (Fryer, 2021).
This species forms thickets and can shade other plants.

Throughout most of its native and introduced range Solidago altissima grows in dense, monocultural stands, and outcompeting other species for light is likely how it gains dominance in a vegetation community. Height, leaf area, and ability for clonal growth make S. altissima an excellent competitor for light (Walck et al., 2001; Kato-Noguchi & Kato, 2022). Growth of other plants is limited underneath dense stands of S. altissima, and plants that are present are small and may exhibit signs of stress due to reduced light availability. However, in Washington, this species currently usually occurs with species such as Typha latifolia and Schoenoplectus acutus which it may not be able to outcompete (T. Ramm-Granberg, pers. comm. 2024).
This species grows in dense swards.

Under favorable conditions, Tamarix species form monospecific stands (or nearly so). However, Tamarix is often unable to outcompete native riparian vegetation for sunlight in ecosystems that are not experiencing water stress (Zouhar, 2003; Stromberg et al., 2007).
This species grows prostrate, but it can grow through and under everything else on prairies.

Where it is found in Washington, Utricularia inflata is reported to form dense floating mats of vegetation (Smith, 2007). In New York, studies have shown that mats of Utricularia inflata can shade out native aquatic vegetation (Titus & Grisé, 2009; Urban & Dwyer, 2016). Outcompeting other aquatic species for light may be Utricularia inflata's main mechanism for invasion (Fleming & Dibble, 2015).

Veronica anagallis-aquatica is capable of growing in dense stands, and can impede stream flow (DiTomaso et al., 2013). While no information was available on V. anagallis-aquatica's effects on light availability, emergent plants can shade out aquatic plants (Riis et al., 2004).

Q11 citation	**Q12 rank**	**Q12 confidence rank**
	Yes	High
Noxious Weed Control Board (NWCB). 2011. Written findings of the Washington State Noxious Weed Control Board: Ailanthus altissima (Mill.) Swingle. https://www.nwcb.wa.gov/pdfs/Ailanthus-altissima-Written-Findings-2011.pdf. Accessed: December 18, 2024.	Yes	Low
	Yes	Moderate

Dzyubenko N.I. and E.A. Dzyubenko. 2009. Crops: Alopecurus pratensis L. - Meadow foxtail. https://agroatlas.ru/en/content/cultural/Alopecurus_pratensis_K/index.html. Accessed: January 14, 2024. Rutledge C. and T. McLendon. 1996. An assessment of exotic plant species in Rocky Mountain National Park. Department of Rangeland Ecosystem Science, Colorado State University, Fort Collins, CO.	Yes	High
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	Yes	High
Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Dennehy C., E.R. Alverson, H.E. Anderson, D.R. Clements, R. Gilbert, and T.N. Kaye. 2011. Management strategies for invasive plants in Pacific Northwest prairies, savannas, and oak woodlands. Northwest Science 85(2):329–351.	No	Moderate

	No	Moderate
	Yes	Moderate
McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024.	No	High
Brusati E. and T. Corelli. 2005. Parentucellia viscosa. https://www.cal-ipc.org/plants/paf/parentucellia-viscosa-plant-assessment-form/. Accessed: October 29, 2024.	Yes	Low
	No	Moderate

	No	Moderate
	NA	NA
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	No	Moderate
	NA	NA

Leathwick D.M. and G.W. Bourdôt. 2012. A conceptual model for the population dynamics of Cirsium arvense in a New Zealand pasture. New Zealand Journal of Agricultural Research 55(4):371–384. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	No	Moderate
	Yes	Moderate
	Unknown	Not Rated

	No	Moderate
	Yes	Moderate
Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8. de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144. Williams J.L. and L. Fishman. 2014. Genetic evidence for founder effects in the introduced range of houndstongue (Cynoglossum officinale). Biological Invasions 16(1):205–216.	No	Moderate
	No	High

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. Huarte H.R., M.D.R.P. Zorraquín, E.M. Bursztyn, and M.L. Zapiola. 2016. Effects of environmental factors on seed germination and seedling emergence of common teasel (Dipsacus fullonum). Weed Science 64(3):421–429.	No	Moderate
Muldavin E.H., J.M. Lenihan, W.S. Lennox, and S.D.Jr. Veirs. 1981. Vegetation succession in the first ten years following logging of coast redwood forests. National Park Service, Redwood National Park, Arcata, California. Technical Report #6.	No	Moderate
	NA	NA
	No	High

Bennett A.E., M. Thomsen, and S.Y. Strauss. 2011. Multiple mechanisms enable invasive species to suppress native species. American Journal of Botany 98(7):1086–1094. Ender C.L., C.E. Christian, and J.H. Cushman. 2017. Native herbivores and environmental heterogeneity as mediators of an exotic grass invasion. Ecology and Evolution 7(5):1561–1571. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	No	Moderate

Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93.	Yes	Moderate
	No	Moderate

Stone K.R. 2009. Iris pseudacorus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/iripse/all.html. Accessed: January 28, 2025. Thomas L.K. Jr. 1980. The impact of three exotic plant species on a Potomac island. US Department of the Interior, National Park Service, Washington, DC. National Park Service Scientific Monograph Series No. 13.	Yes	High
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	No	High
	Yes	Moderate

Ervin G.N. and R.G. Wetzel. 2002. Influence of a dominant macrophyte, Juncus effusus, on wetland plant species richness, diversity, and community composition. Oecologia 130(4):626–636. Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103.	No	High
	Unknown	Not Rated
	Yes	Moderate
	Yes	Moderate

Brusati E. 2005. Plant assessment form: Leucanthemum vulgare. California Invasive Plant Council (CAL-IPC). https://www.cal-ipc.org/plants/paf/leucanthemum-vulgare-plant-assessment-form/. Accessed: October 22, 2024. Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Noxious Weed Control Board (NWCB). 2024. Oxeye daisy, Leucanthemum vulgare. https://www.nwcb.wa.gov/weeds/oxeye-daisy. Accessed: October 21, 2024.	No	Moderate
	NA	NA

Treberg M.A. and B.C. Husband. 1999. Relationship between the abundance of Lythrum salicaria (purple loosestrife) and plant species richness along the Bar River, Canada. Wetlands 19(1):118–125	No	High
	No	Moderate
	No	Moderate

	No	Low
	NA	NA

Aiken S.G., P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds: 34. Myriophyllum spicatum L. Canadian Journal of Plant Science 59(1):201–215. Madsen J.D., J.A. Sutherland, J.A. Bloomfield, L.W. Eichler, and C.W. Boylen. 1991. The decline of native vegetation under dense Eurasian watermilfoil canopies. Journal of Aquatic Plant Management 29:94–99. Boylen C.W., L.W. Eichler, and J.D. Madsen. 1999. Loss of native aquatic plant species in a community dominated by Eurasian watermilfoil. Hydrobiologia 415(0):207–211. Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	Yes	Moderate
	Yes	Moderate

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Yes	Moderate

- Isselin Nondedeu F. and A. Bédécarrats. 2009. Assessing the dominance of Phleum pratense cv. climax, a species commonly used for ski trail restoration. Applied Vegetation Science 12(2):155–165. Ogle D.G., L. St. John, and D.J. Tilley. 2011. Plant guide for timothy (Phleum pratense). USDA-Natural Resources Conservation Service, Idaho State Office. Boise, ID. Online: https://plants.usda.gov/DocumentLibrary/plantguide/doc/pg_phpr3.docx	No	Low
	No	High
	No	Moderate
	NA	NA
	Yes	Moderate
	No	Moderate

	Yes	Moderate
	No	Moderate
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	No	Low
	Yes	High
	No	High
	No	High
	Unknown	Not Rated
	NA	NA

	No	High
	No	Moderate
Kato-Noguchi H. and M. Kato. 2022. Allelopathy and allelochemicals of Solidago canadensis L. and S. altissima L. for their naturalization. Plants 11(23):3235. Walck J.L., J.M. Baskin, and C.C. Baskin. 2001. Why is Solidago shortii narrowly endemic and S. altissima geographically widespread? A comprehensive comparative study of biological traits. Journal of Biogeography 28(10):1221–1237.	No	Moderate
	Yes	High

Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	No	High
	No	Moderate
	No	Moderate

Fleming J.P. and E.D. Dibble. 2015. Ecological mechanisms of invasion success in aquatic macrophytes. Hydrobiologia 746(1):23–37. Smith D. 2007. Integrated aquatic vegetation monitoring plan. Barnes Lake Management District, City of Tumwater. Online: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=a118bdc30aea782f71a7abc230f1eb01bd9a907e Titus J.E. and D.J. Grisé. 2009. The invasive freshwater macrophyte Utricularia inflata (inflated bladderwort) dominates Adirondack Mountain lake sites. The Journal of the Torrey Botanical Society 136(4):479–486. Urban R.A. and M.E. Dwyer. 2016. Asexual reproduction and its potential influence on the distribution of an invasive macrophyte. Northeastern Naturalist 23(3):408–419.	NA	NA
	No	Low

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Water speedwell. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	Unknown	Not Rated
	No	Moderate

Question 12. Germination Requirements (

Q12 notes

Evidence suggests that this species can germinate without disturbance (Rosario, 1988; Nikolaeva et al., 2021).

Ailanthus altissima's ability to germinate without disturbance is context dependent. This species has shown the ability to germinate through litter and in relatively undisturbed forests. However, it is also considered a "gap obligate species" that does not do well in areas with a closed canopy and restricted access to light. Studies have also shown that open spaces and rocky areas in a forest can provide suitable habitat for A. altissima to germinate. Many areas in Eastern Washington have forests without closed canopies, where light access would not be a limiting factor for this species (e.g. oak woodlands and open ponderosa pine forests). Once this species successfully establishes through generative reproduction it can then begin reproducing vegetatively. These vegetative sprouts have increased resiliency due to provisioning by the mother plant, and thus the impact of germination without disturbance is compounded by the effects of vegetative reproduction after germination and establishment (Knüsel, 2019).

This species is very adaptable and does not require disturbance to germinate.
Amorpha fruticosa is pre-adapted to exploit natural or human disturbances to become established and spread (NWCB, 2015).
Germination of Anthoxanthum odoratum relies on local disturbances in most cases (Platenkamp & Foin, 1990; Brusati & Warner, 2004).

Vegetative propagules of Arundo donax generally require bare ground to establish, such as might be found after flooding, fire, or other disturbances (Goolsby et al., 2023). In at least some circumstances, established native plant communities can prevent re-invasion by A. donax (NWCB, 2013).
Bellardia viscosa is hemiparastic, but it can germinate and grow without available hosts (Brusati & Corelli, 2005). This species usually germinates in moist conditions and requires rainfall to germinate (Pickart & Wear, 1999). This species is mostly found in areas of natural or anthropogenic disturbance, and likely requires bare ground or disturbance to establish, but information was limited.

Centaurea solstitialis germinates best in moist, disturbed soils, but this species can germinate under a wide range of conditions and disturbance is not required for establishment. Propagule pressure is usually the most important factor in invasion of undisturbed or otherwise less than ideal habitats. Increases in spring moisture can also increase the likelihood of C. solstitialis germinating in undisturbed areas in Washington. However, the conditions where this species can establish in undisturbed areas are relatively limited, and seedlings are more likely to be unhealthy and experience mortality in undisturbed habitats (Innes & Zouhar, 2021).

Cirsium arvense has low-to-moderate ability to propagate in undisturbed systems and does not compete well for light when establishing. Thus, bare ground is relatively important for establishment from seed. This species is occasionally found in undisturbed areas, but this is likely because C. arvense is able to take advantage of small disturbance such as rodent burrows or frost heave to establish from seed. Its seeds can germinate under a wide variety of conditions, but seedlings do not survive shading (Moore, 1975; Zouhar, 2001). However, vegetative reproduction is much more important to this species, and seeds probably have limited contribution to the spread of C. arvense (Moore, 1975; Zouhar, 2001).

Cirsium vulgare germinates in mature prairie and saltmarsh.

Studies from Dutch sand dunes found that experimental small-scale disturbances resulted in an increase of Cynoglossum officinale seedlings the next spring (Klinkhamer & de Jong, 1988). In disturbance experiments done in Montana, seedlings were much less likely to survive in undisturbed plots than disturbed plots (Williams et al., 2010).
Dianthus armeria requires soil disturbance and high light levels to germinate (Baskin & Baskin, 2001).

Soil disturbance and warm temperatures promote germination in Dipsacus fullonum (Huarte et al., 2016). Cover (both litter and standing) reduces germination and seedling survival rate but does not eliminate it. While capable of invading perennial grasslands in moist areas, this species generally relies on small openings created by disturbance (or the death of its parent plants) for germination (Gucker, 2009). Seedlings germinate best on open ground, but have improved survival with light ground cover that prevents desiccation (Gucker, 2009).
Closely related Erechtites hieraciifolius requires disturbance for germination (Baskin & Baskin, 1996; Elliott et al., 1997). However, in some ecosystems, Erectites species may not always require disturbance to become established (Halvorson, 1992).
Hieracium pilosella is a weed of both human and natural disturbance.

Seeds germinate best in full light on the top of the soil, and a study in coastal prairie in California found much greater germination success for this species in areas without litter. However, the same study also found that H. lanatus had higher germination rates than co-occurring native grass species when all were buried under litter. Still, soil disturbance is frequently an important contributing factor in H. lanatus invasion, particularly in shaded or forested areas, and this species generally appears to require openings to induce germination (Gucker, 2009; Conner et al., 2013).

Research from Spain, within Ilex aquifolium's native range, found that this species germinated best at forest edges, but was also capable of germinating within forests and grasslands. No information was found indicating that this species requires open ground to germinate, but given its ability to invade undisturbed areas and its habit as a late successional species in its native range (Arrieta & Suárez, 2004), it seems likely that this species does not require bare soil for germination.

Iris pseudacorus does not require bare soil for germination—seedlings have been observed growing from trash, on top of tree roots, etc. (Thomas, 1980).
Jacobaea vulgaris seeds require light to germinate. Cover from other plants may prevent germination. Seedling survival is greatly reduced in areas with tall vegetation or dense turf and increases in grazed or cleared areas. Seedling establishment increases with available open ground (Jacobs, 2009; Van De Voorde et al., 2012).

Juncus effusus establishment likely relies on a high number of seeds germinating in bare soil patches (Lazenby, 1955).

Leucanthemum vulgare germinates readily in bare soil and is more likely to germinate in disturbed areas than undisturbed areas. This species may require grazing or other disturbances to establish. Thick leaf litter can impede germination (NWCB, 2000; Clements et al., 2004).

Germination requires some amount of sunlight to occur and experimental plantings in wetland plots with no disturbance showed no germination (Rachich & Reader, 1999). Seeds can, however, germinate underwater.

This species likely requires disturbance, such as livestock soil disturbance, to establish (Weiss et al., 2000).

Given that Myosotis discolor is mostly found in areas of natural or anthropogenic disturbance, it may require bare ground or disturbance to establish, but no information was found about germination requirements.

Most research has been in a lab setting and Eurasian watermilfoil seeds do have constraints to germination (Hartleb et al., 1993; Wani & Arshid, 2013). Hence, the ability of seeds to germinate under a range of different environmental conditions in situ is still not fully understood.

While Phalaris arundinacea takes advantage of disturbance to establish, it is not required. Seedlings are most likely to grow in open areas like mudflats or flood plains, and rapidly develop rhizomes and tillers (Waggy, 2010). Saturated soil and exposure to light increases germination, and at least some research suggests that this species requires light to germinate (Kim et al., 2006).

Phleum pratense seeds can germinate both at and below the soil surface. Which seeds are most successful in germinating depends on soil moisture (Williams, 1954). No other information was found regarding germination needs. However, at least one source noted that this species only establishes in intact ecosystems under favorable circumstances (Ogle et al., 2011), which suggests that it may not germinate in other vegetation except under narrow circumstances.

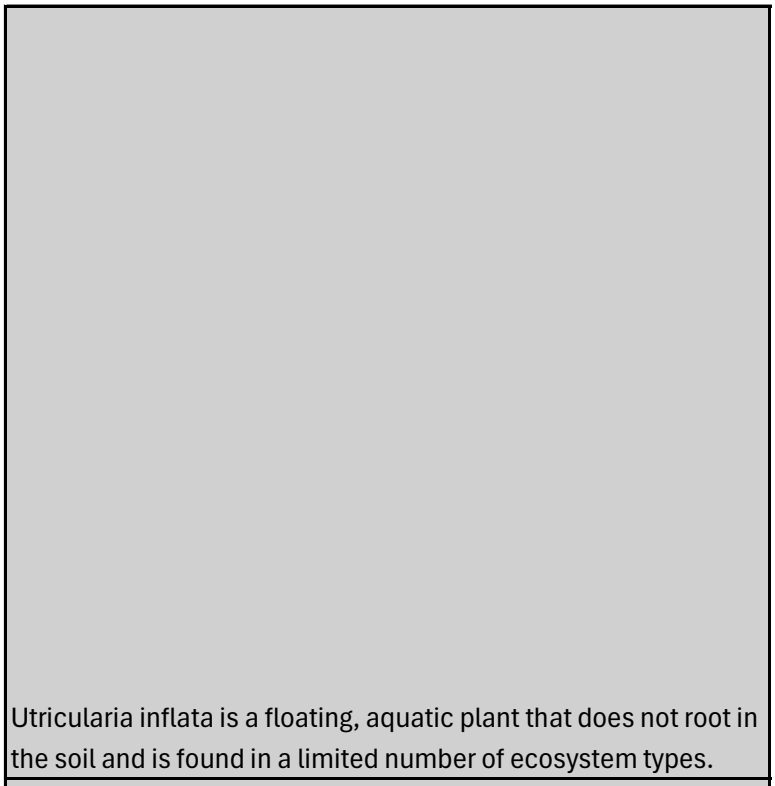
Rubus bifrons seedlings establish best in open habitats and this species appears to prefer disturbed areas. Sources say it can establish in areas without disturbance, but did not specify what conditions promoted germination of this species in undisturbed habitats (Cal-IPC, 2004; Fryer, 2021).
This plant requires bare soil to germinate and establish (Cavers & Harper, 1964).
Does not spread by seed in Washington.

This is a weed of clearcuts and wildfires.

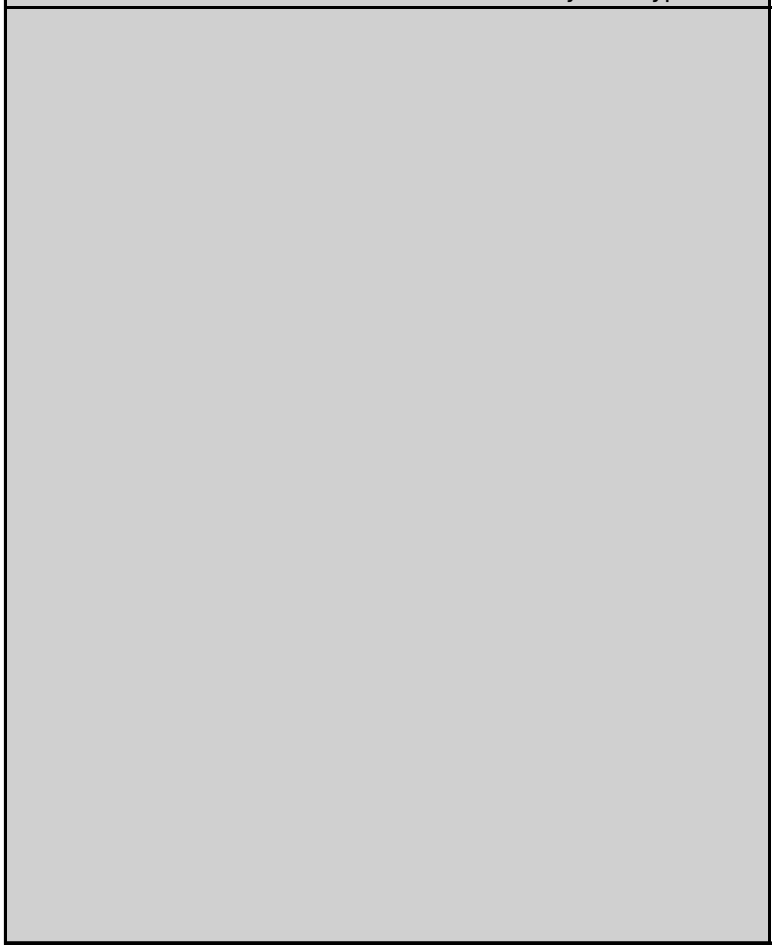
Solidago altissima germinates and survives best in bare ground. Seed germination is poor under litter and vegetation canopy, and likely requires light to intiate (Walck et al., 2001). Though germination tests in the lab find high viability rates in S. altissima seeds, at least one study in Europe suggested germination in established vegetation is very rare. Mowing did not increase light availability at the soil level enough to encourage germination in this species. Germination, growth, and survival of S. altissima seedlings was much higher in bare ground (Meyer & Schmid, 1999).

This species germinates in open mudflat and openings in saltmarsh.

Tamarix seeds generally germinate post-flood and prefer bare fine silt soils. Evidence suggests seedlings don't establish well in leaf litter or under shaded conditions (Zouhar, 2003; Lehnhoff et al., 2011).



Utricularia inflata is a floating, aquatic plant that does not root in the soil and is found in a limited number of ecosystem types.



No information was found on Veronica anagallis-aquatica's ability to germinate without disturbance providing an open substrate.

3 pts)		
Q12 citation	**Q13 ranks**	**Q13 confidence ranks**
Nikolaeva A.A., E.V. Golosova, and O.V. Shelepova. 2021. Allelopathic activity of Acer negundo L. leaf litter as a vector of invasion species into plant communities. BIO Web of Conferences, Northern Asia Plant Diversity. Rosario L.C. 1988. Acer negundo. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/aceneg/all.html. Accessed: December 16, 2024.	Yes	High
Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland.	No	Moderate
	Unknown	Not Rated

	Yes	Moderate
Noxious Weed Control Board (NWCB). 2015. Written findings of the Washington State Noxious Weed Control Board: Amorpha fruticosa. https://www.nwcb.wa.gov/images/weeds/Indigo_bush.pdf. Accessed: December 18, 2024.	No	High
Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Platenkamp G.A.J. and T.C. Foin. 1990. Ecological and evolutionary importance of neighbors in the grass Anthoxanthum odoratum. Oecologia 83(2):201–208.	Yes	High

	No	High
	No	Moderate
Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	No	Moderate
Brusati E. and T. Corelli. 2005. Parentucellia viscosa. https://www.cal-ipc.org/plants/paf/parentucellia-viscosa-plant-assessment-form/. Accessed: October 29, 2024. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70.	Yes	High
	No	Moderate

	No	Moderate
	NA	NA
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes	High
	NA	NA

Moore R.J. 1975. The biology of Canadian weeds.: 13. Cirsium arvense (L.) Scop. Canadian Journal of Plant Science 55(4):1033–1048. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes	High
	Yes	High
	Yes	High

	Yes	High
	No	High
Klinkhamer P.G.L. and T.J. de Jong. 1988. The importance of small-scale disturbance for seedling establishment in Cirsium vulgare and Cynoglossum officinale. The Journal of Ecology 76(2):383. Williams J.L., H. Auge, and J.L. Maron. 2010. Testing hypotheses for exotic plant success: parallel experiments in the native and introduced ranges. Ecology 91(5):1355–1366.	Yes	High
Baskin C.C. and J.M. Baskin. 2001. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Academic Press, San Diego, California.	No	Moderate

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. Huarte H.R., M.D.R.P. Zorraquín, E.M. Bursztyn, and M.L. Zapiola. 2016. Effects of environmental factors on seed germination and seedling emergence of common teasel (Dipsacus fullonum). Weed Science 64(3):421–429.	Yes	High
Baskin C.C. and J.M. Baskin. 1996. Role of temperature and light in the germination ecology of buried seeds of weedy species of disturbed forests. II. Erechtites hieracifolia. Canadian J. of Botany 74(12):2002–2005. Elliott K.J., L.R. Boring, W.T. Swank, and B.R. Haines. 1997. Successional changes in plant species diversity and composition after clearcutting a southern Appalachian watershed. Forest Ecology and Management 92(1):67–85. Halvorson W.L. 1992. Alien plants at Channel Islands National Park. Alien Plant Invasions in Native Ecosystems of Hawaii : Management and Research (ed. by C.P. Stone, C.W. Smith, and J.T. Tunison), pp. 64–96. University of Hawaii Cooperative National Park Studies Unit, Honolulu, HI.	Yes	Moderate
	NA	NA
	Yes	High

Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	Yes	Moderate

Arrieta S. and F. Suárez. 2004. Germination and seed bank depletion of holly (Ilex aquifolium L.) in four microhabitat types. Seed Science Research 14(3):305–313.	Yes	High
	Yes	Moderate

Thomas L.K. Jr. 1980. The impact of three exotic plant species on a Potomac island. US Department of the Interior, National Park Service, Washington, DC. National Park Service Scientific Monograph Series No. 13.	NA	NA
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Van De Voorde T.F.J., W.H. Van Der Putten, and T.M. Bezemer. 2012. The importance of plant–soil interactions, soil nutrients, and plant life history traits for the temporal dynamics of Jacobaea vulgaris in a chronosequence of old fields. Oikos 121(8):1251–1262.	Yes	High
	No	Low

Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103.	Yes	High
	Yes	Moderate
	Yes	High
	Yes	High

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA.	No	Moderate
	Yes	High

Rachich J. and R.J. Reader. 1999. An experimental study of wetland invasibility by purple loosestrife (Lythrum salicaria). Canadian Journal of Botany 77(10):1499–1503.	Yes	High
Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	No	Moderate
	No	High

	Yes	High
	NA	NA

Hartleb C.F., J.D. Madsen, and C.W. Boylen. 1993. Environmental factors affecting seed germination in Myriophyllum spicatum L. Aquatic Botany 45(1):15–25. Wani A.A. and S. Arshid. 2013. Assessment of seed quality parameters and effect of physical and chemical treatments on seed germination of Myriophyllum spicatum L. Comunicata Scientiae 4(1):1–11.	Yes	High
	Yes	Moderate

Kim K.D., K. Ewing, and D.E. Giblin. 2006. Controlling Phalaris arundinacea (reed canarygrass) with live willow stakes: A density-dependent response. Ecological Engineering 27(3):219–227. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Yes	High

Ogle D.G., L. St. John, and D.J. Tilley. 2011. Plant guide for timothy (Phleum pratense). USDA-Natural Resources Conservation Service, Idaho State Office. Boise, ID. Online: https://plants.usda.gov/DocumentLibrary/plantguide/doc/pg_phpr3.docx Williams S.S. 1954. The effect of depth of sowing and moisture on the germination and seedling development of Phleum pratense L. The Journal of Ecology 42(2):445	Yes	Low
	Yes	High
	Yes	High
	NA	NA
	No	Low
	Yes	High

	Yes	High
	Yes	High
Cal-IPC. 2004. Rubus armeniacus Plant Assessment Form. https://www.cal-ipc.org/plants/paf/rubus-armeniacus-plant-assessment-form/. Accessed: June 27, 2024. Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Yes	High
	Yes	High
Cavers P.B. and J.L. Harper. 1964. Rumex obtusifolius L. and R. crispus L. Journal of Ecology 52(3):737–766.	Yes	Moderate
	Yes	High
	Yes	High
	NA	NA

	Yes	High
	Yes	Moderate
Meyer Andrea.H. and B. Schmid. 1999. Seed dynamics and seedling establishment in the invading perennial Solidago altissima under different experimental treatments. Journal of Ecology 87(1):28–41. Walck J.L., J.M. Baskin, and C.C. Baskin. 2001. Why is Solidago shortii narrowly endemic and S. altissima geographically widespread? A comprehensive comparative study of biological traits. Journal of Biogeography 28(10):1221–1237.	Yes	High
	Yes	High

Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Yes	High
	Yes	High
	Yes	High

	Yes	Moderate
This species likely requires bare soil for germination.	Yes	Moderate

	Yes	Moderate
	Yes	High

Question 13. Invasiveness of Other Plants in Ge

Q13 notes
In certain areas of the Pacific Northwest, Acer pseudoplatanus and Acer platanoides are especially problematic as invasive species.
Ailanthus is a small genus with only 6 members. No evidence was found that any of the other species in the genus are invasive outside of their native range. There are no other species of Ailanthus recorded from Washington State (CPNWH, 2023).

Alopecurus geniculatus (native in Washington) is somewhat invasive in Alaska (AKNHP 2010). Alopecurus myosuroides is a listed noxious weed in Washington (NWCB, 2025).
Amorpha fruticosa is the only Amorpha species known from Washington state (Hitchcock & Cronquist, 2018). No documentation was found regarding the invasiveness of other Amorpha species in other locales.
Anthoxanthum aristatum is also invasive in the Pacific Northwest (Anzinger & Radosevich, 2008), and is considered undesirable in Taylor's Checkerspot Butterfly restoration sites at Joint Base Lewis McCord (R. Johnson pers. comm. 2025).

Arrhenatherum elatius is the only species in this genus established in North America.
A literature search found no other species currently included in the genus Arundo documented as invasive.
Bellardia trixago is known from California and Texas and is tracked by the University of Georgia's Center for Invasive Species and Ecosystem Health (EDDMapS, 2024). Bellardia viscosa is currently not regarded as invasive in North America, but its potential for invasiveness is of concern in Japan (Suetsugu et al., 2012).

Several other species in this genus are invasive in Washington and other states in the Pacific Northwest, including several species of knapweed and at least one other species of star-thistle.

Other species in this genus (e.g., Cirsium vulgare) are invasive in Washington (NWCB, 2024a). Cirsium palustre (marsh thistle) is invasive throughout the Midwest and Canada, including in BC (Gucker, 2009). In addition, other closely related genera in the Cardueae tribe (such as Onopordum, Carduus, Centaurea) contain well-known invasive species.
Other species in this genus (e.g., Cirsium arvense) are invasive in Washington (Noxious Weed Control Board (NWCB), 2024). Cirsium palustre (marsh thistle) is invasive throughout the Midwest and Canada, including in British Columbia (Gucker, 2009). In addition, other closely related genera in the Cardueae tribe (such as Onopordum, Carduus, Centaurea) contain well-known invasive species.

Multiple species in this genus have established in natural and semi-natural ecosystems in Washington. A literature search turned up several sources suggesting that many species in the Cotoneaster genus are invasive or potentially invasive in Europe.
Crataegus phaenopyrum and C. laevigata occasionally naturalize in Washington, but are generally not considered invasive (University of Washington Herbarium, 2018).
Cynoglossum creticum is on the non-native species Alert List in Australia (Weber & Panetta, 2006). Cynoglossum lanceolatum is considered invasive in parts of India (Sheikh & Dixit, 2017).
There are at least two other introduced Dianthus species in the state (Burke Herbarium, University of Washington, 2024), but neither are commonly considered to be invasive.

Dipsacus laciniatus and Dipsacus sativus are also invasive in North America, but Dipsacus fullonum is more widespread than both. Dipsacus sativus is common throughout the west. Dipsacus laciniatus spreads much more slowly than D. fullonum and is not widespread in the west (Gucker, 2009; DiTomaso et al., 2013; Gaskin et al., 2024). Some sources, including the Washington Flora Checklist, consider D. sativus and D. fullonum to be the same species (University of Washington Herbarium, 2018; Gaskin et al., 2024).
There are no other Erechtites species in the Washington Flora, but E. hieraciifolius is considered invasive or a potential weed in Hong Kong, Hawaii, the Galapagos Islands, French Polynesia, Palau, US Minor Outlying Islands, New Zealand, Australia, and Hungary (Rojas-Sandoval, 2017).

Holcus mollis also occurs in the Pacific Northwest and is predicted to expand throughout Washington, but this species is much less abundant at this time than H. lanatus (EDDMapS, 2023). The Washington Natural Heritage Program considers both species to be invasive for the purposes of Ecological Integrity Assessments (Rocchio et al., 2024).

As of 2010, Ilex opaca and Ilex crenata have very occasionally been documented as escapes in Washington (one individual of I. opaca in King County and two individuals of I. crenata in Snohomish County) (Zika, 2010). Neither of these species are regarded as invasive in Washington, but Ilex crenata is considered invasive on the east coast of the U.S. (EDDMapS, 2024). Another introduced species, Ilex cornuta, is invasive in the southeastern U.S. (EDDMapS, 2024). Ilex vomitoria can also be invasive in parts of the U.S. outside of its native range (Schnelle, 2019).

Jacobaea aquatica is an increaser species in its native habitat in Central Europe (Krieger et al., 2023).
Black walnut can also become established, but neither is very invasive.

No Juncus species occur on formal invasive lists in Washington (NWCB, 2024; Washington Invasive Species Council, 2024) and the Washington Natural Heritage Program has not previously considered any species or subtaxa to be invasive for the purposes of Ecological Integrity Assessments (Rocchio & Ramm-Granberg, 2022; Rocchio et al., 2024). A literature search found research on several species of Juncus considered invasive outside their native range (e.g., Ellery Mayence et al., 2010; Moe et al., 2013). Juncus effusus ssp. effusus is considered a weed (or native increaser) in at least part of its native range (Ireland and Great Britain), as well as in New Zealand (McCorry & Renou, 2003).

The ornamental Shasta daisy (a hybrid of multiple Leucanthemum species) and closely related Lecuanthemum ircutianum (part of the L. vulgare complex) are present but not considered invasive in North America (Clements et al., 2004; Stutz et al., 2016). A small patch of Leucanthemum maximum is reported from Lake Crescent, but this species does not appear to be widespread in North America (EDDMapS, 2023). A literature review did not reveal any information indicating this species is considered invasive.
Lysimachia vulgaris and L. terrestris are frequently considered invasive.

Lythrum virgatum is also a Class B weed in Washington (NWCB, 2025) and other exotic Lythrum species may also be considered invasive.
Marrubium vulgare is the only species from this genus in the Washington Flora (Weinmann et al., 2002) and no other taxa from this genus are known to occur in North America.
Mycelis muralis is the only species documented in this genus for North America (Strother, 2022). This plant was formerly in the Lactuca genus, which is represented by a number of widespread introduced species in North America.

Several other Myosotis species are tracked by the University of Georgia's Center for Invasive Species and Ecosystem Health (EDDMapS, 2024).

There are several Myriophyllum species that are known invasives both in North American and across the world. Myriophyllum heterophyllum is a Class A listed noxious weed (NWCB, 2023a) and Myriophyllum aquaticum is a Class B listed noxious weed in Washington State (NWCB, 2023b).

The genus Phalaris consists of 20 species, from narrow endemics to cosmopolitan invasives. Phalaris arundinacea appears to be the most invasive of these species, occurring many places outside its native range, but Phalaris aquatica and Phalaris minor are also invasive in some places (Kim et al., 2006; Voshell et al., 2015; Xu et al., 2019). Phalaris canariensis is occasionally documented in Washington State (Weinmann et al., 2002).

Phleum phleoides was noted as an increaser and potentially invasive in a study done in Poland (Ciosek et al., 2003). No other information on invasiveness in this genus was found. The only other Phleum in Washington is the native Phleum alpinum. Phleum pratense is a listed noxious weed in Virginia and New Jersey (Kasulyte & Praciak, 2022).
Quercus rubra is also established in Washington, but generally not considered invasive. Quercus acutissima (native to Asia) is common in the southeast, but there appears to be little consensus regarding its invasiveness(Center for Invasive Species and Ecosystem Health, 2018; Kling, 2024). Non-native oaks are most likely to be invasive in areas where native oak woodlands or oak-prominent forests are more common.

Rubus bifrons is part of the Rubus fruticosus complex of species. All species in this complex are classified as noxious weeds in the U.S. (Fryer, 2021).
There are several other invasive Rubus species.
Schedonorus pratensis is introduced in the Pacific Northwest and S. giganteus is found in northeastern North America (Darbyshire, 2021). Both exhibit invasive traits, though neither are commonly listed as invasive species, perhaps because of their value as pasture grasses.

Many Solidago species are of concern for their effects on plant communities throughout Asia and Europe. Solidago altissima and its close relative Solidago canadensis are considered either naturalized or invasive in Europe, Asia, Australia, and New Zealand (Park et al., 2020; Kato-Noguchi & Kato, 2022).
Spartina anglica (introduced from Europe) and S. densiflora (introduced from Chile) are present in Washington (Weinmann et al., 2002) and considered invasive (NWCB, 2025).

Up to 12 species of Tamarix are present in the U.S., but only four of those species are highly invasive. Tamarix ramosissima and T. chinensis are the most aggressive Tamarix species that occur in North America. High genetic diversity, phenotypic plasticity, and hybridization contribute to the success of invasive Tamarix species (Zouhar, 2003; Kerns et al., 2009).

Utricularia is a diverse and widespread genus, represented by over 240 species, and making up 30% of carnivorous plant diversity (Wiebush, 2022). However, it appears very few of those species have been documented as invasive. Utricularia gibba is considered invasive in New Zealand (Compton et al., 2012) and Croatia (Piria et al., 2022). Introduced populations previously thought to be Utricularia inflata in Japan have recently been identified as Utricularia cf. platensis. Utricularia platensis originates from South America (Kadono et al., 2019).
Verbascum thapsus (Giant mullein) is listed as invasive by the Colorado Department of Agriculture (CDA, 2023), and is tracked by the Oklahoma Invasive Plant Council (OkIPC, 2024) and the Texas Invasive Species Institute (2024). Unofficial sources also treat this species as an invasive (e.g., Remaley, 2009). Verbascum thapsus is also introduced in the Pacific Northwest but is usually not considered invasive and is not tracked by any states in the region. British Columbia lists this species a nuisance, but not in need of management (Center for Invasive Species and Ecosystem Health, 2025).

Veronica is a genus of over 400 species with a wide range of life histories. Many species of Veronica are described as weedy (Ellmouni et al., 2018). While Veronica anagallis-aquatica is not designated as an invasive species in North America, it is designated as invasive in Japan (Saito & Kadono, 2021), demonstrating the ability to become invasive under the right conditions. Veronica beccabunga has also been introduced to North America, but has not spread significantly; it may be unable to establish where the closely related native Veronica americana is present (Ellmouni et al., 2018).

ɛnus (3 pts)		
Q13 citation	**Q14 rank**	**Q14 confidence rank**
	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023.	Low/Insignificant	High
	High	High

Alaska Natural Heritage Program (AKNHP). 2010. Alopecurus pratensis L. Alaska Natural Heritage Program, University of Alaska, Anchorage. Online: https://accs.uaa.alaska.edu/wp-content/uploads/Alopecurus_pratensis_RANK_ALPR3.pdf Noxious Weed Control Board (NWCB). 2025. Blackgrass, Alopecurus myosuroides. https://www.nwcb.wa.gov/weeds/blackgrass. Accessed: January 10, 2025.	Moderate	High
Hitchcock C.L. and A. Cronquist. 2018. Flora of the Pacific Northwest: An Illustrated Manual. Edited by D.E. Giblin, B.S. Legler, P.F. Zika, and R.G. Olmstead. University of Washington Press, Seattle, WA.	Not Rated	Not Rated
Anzinger D. and S.R. Radosevich. 2008. Chapter 10: Fire and Nonnative Invasive Plants in the Northwest Coastal Bioregion. US Department of Agriculture, Forest Service. RMRS-GTR-42.	Low/Insignificant	Moderate

	Moderate	High
	High	High
	Moderate	High
EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. Suetsugu K., Y. Takeuchi, K. Futai, and M. Kato. 2012. Host selectivity, haustorial anatomy and impact of the invasive parasite Parentucellia viscosa on floodplain vegetative communities in Japan. Botanical Journal of the Linnean Society 170(1):69–78.	Moderate	Moderate
	Moderate	High

	Moderate	Moderate
	NA	NA
no sources	Low/Insignificant	High
	NA	NA

Gucker C.L. 2009. Cirsium palustre. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirpal/all.html. Accessed: June 20, 2024. Noxious Weed Control Board (NWCB). 2024a. Cirsium vulgare, bull thistle. https://www.nwcb.wa.gov/weeds/bull-thistle. Accessed: December 23, 2024.	Low/Insignificant	High
Gucker C.L. 2009. Cirsium palustre. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirpal/all.html. Accessed: June 20, 2024. Noxious Weed Control Board (NWCB). 2024. Cirsium arvense, Canada thistle. https://www.nwcb.wa.gov/weeds/canada-thistle. Accessed: December 23, 2024.	Moderate	Moderate
	High	High

	Moderate	High
University of Washington Herbarium. 2018. Washington Flora Checklist. http://biology.burke.washington.edu/herbarium/waflora/checklist.php. Accessed: November 20, 2018	Moderate	High
Sheikh D.K. and A.K. Dixit. 2017. Occurrence of invasive plant in three phytogeographical region of Bilaspur district of Chhattisgarh. Annals of Plant Sciences 6(12):1872. Weber J. and F.D. Panetta. 2006. Weed risk assessment of the DEH Alert List and other non-native plant species. Fifteenth Australian Weed Conference. pp. 739–742.	Moderate	Moderate
Burke Herbarium, University of Washington. 2024. Burke Herbarium Image Collection. https://burkeherbarium.org/imagecollection. Accessed: December 17, 2024.	Low/Insignificant	High

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Common, Cutleaf, and Fuller's Teasel. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Gaskin J.F., N. West, and B.G. Rector. 2024. Population structure of three invasive congeneric teasel (Dipsacus) species. Invasive Plant Science and Management 17(1):37–45. Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. University of Washington Herbarium. 2018. Washington Flora Checklist. http://biology.burke.washington.edu/herbarium/waflora/checklist.php. Accessed: November 20, 2018.	Moderate	High
Rojas-Sandoval J. 2017. Erechtites hieraciifolius (American burnweed). https://www.cabidigitallibrary.org/doi/full/10.1079/cabicompendium.114182. Accessed: January 30, 2025.	Low/Insignficant	High
	NA	NA
	Low/Insignificant	High

EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Rocchio F.J., Rex C. Crawford, and Tynan Ramm-Granberg. 2024. Field manual for applying rapid Ecological Integrity Assessments in upland plant communities of Washington State (Version 1.5). Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA. NHR-2024-04. Online: https://www.dnr.wa.gov/publications/amp_nh_eia_protocol_upland_ver1_5.pdf	Moderate	High

EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. Schnelle M.A. 2019. Native woody plants of the wouthern United States with weedy or invasive tendencies: A review of common offenders. HortTechnology 29(5):567–570. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	High	High
	High	Moderate

	Yes	High
Krieger M.-T., L.H. Teixeira, K. Grant, J. Kollmann, and H. Albrecht. 2023. Reconciling the control of the native invasive Jacobaea aquatica and ecosystem multifunctionality in wet grasslands. Basic and Applied Ecology 68:13–22.	Moderate	Moderate
	Moderate	Moderate

Ellery Hayenee G., D.J. Marshall, and R.G. Godfree. 2010. Hydrologic and mechanical control for an invasive wetland plant, Juncus ingens, and implications for rehabilitating and managing Murray River floodplain wetlands, Australia. Wetlands Ecology and Management 18:717–730. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland. Moe T.F., A.K. Brysting, T.O.M. Andersen, S.C. Schneider, Ø. Kaste, and D.O. Hessen. 2013. Nuisance growth of Juncus bulbosus: the roles of genetics and environmental drivers tested in a large scale survey. Freshwater Biology 58(1):114–127. Noxious Weed Control Board (NWCB). 2024. Printable Noxious Weed List. https://www.nwcb.wa.gov/printable-noxious-weed-list. Accessed: September 30, 2024. Rocchio F.J. and T. Ramm-Granberg. 2022. Wetland types of Washington State: a classification framework based on the U.S. National Vegetation Classification (2022 Draft). Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA. NHR-20XX-XX. Rocchio F.J., Rex C. Crawford, and Tynan Ramm-Granberg. 2024. Field manual for applying rapid Ecological Integrity	Moderate	Low
	High	High
	Low/Insignificant	High
	Low/Insignificant	High

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Stutz S., K. Štajerová, H.L. Hinz, H. Müller-Schärer, and U. Schaffner. 2016. Can enemy release explain the invasion success of the diploid Leucanthemum vulgare in North America? Biological Invasions 18(7):2077–2091.	Low/Insignificant	High
	High	Moderate

Noxious Weed Control Board (NWCB). 2025. Purple Loosestrife, Lythrum salicaria. https://www.nwcb.wa.gov/weeds/purple-loosestrife. Accessed: February 5, 2025.	Low/Insignificant	High
Weinmann F., P.F. Zika, D.E. Giblin, and B. Legler. 2002. Checklist of the Vascular Plants of Washington State. University of Washington Herbarium. http://biology.burke.washington.edu/herbarium/waflora/checklist.php. Accessed: January 3, 2022.	Low/Insignificant	High
Strother J.L. 2022. Mycelis Cassini. In: Flora of North America. http://floranorthamerica.org/Mycelis. Accessed: February 5, 2025.	High	High

EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024.	Moderate	Moderate
	NA	NA

Noxious Weed Control Board (NWCB). 2023a. Variable-Leaf Milfoil, and Hybrid variable-leaf milfoil; Myriophyllum heterophyllum, Myriophyllum heterophyllum x Myriophyllum hippuroides. https://www.nwcb.wa.gov/weeds/variable-leaf-milfoil. Accessed: December 12, 2023. Noxious Weed Control Board (NWCB). 2023b. Parrotfeather, Myriophyllum aquaticum. https://www.nwcb.wa.gov/weeds/parrotfeather. Accessed: December 12, 2023.	High	Moderate
	Moderate	High

Kim K.D., K. Ewing, and D.E. Giblin. 2006. Controlling Phalaris arundinacea (reed canarygrass) with live willow stakes: A density-dependent response. Ecological Engineering 27(3):219–227. Voshell S.M., R.M. Baldini, and K.W. Hilu. 2015. Infrageneric treatment of Phalaris (Canary grasses, Poaceae) based on molecular phylogenetics and floret structure. Australian Systematic Botany 28(6):355. Weinmann F., P.F. Zika, D.E. Giblin, and B. Legler. 2002. Checklist of the Vascular Plants of Washington State. University of Washington Herbarium. http://biology.burke.washington.edu/herbarium/waflora/checklist.php. Accessed: October 11, 2024. Xu G., S. Shen, Y. Zhang, D.R. Clements, S. Yang, J. Li, L. Dong, F. Zhang, G. Jin, and Y. Gao. 2019. Designing cropping systems to improve the management of the invasive weed Phalaris minor Retz. Agronomy 9(12):809.	Low/Insignificant	Moderate

Ciosek M.T., G. Bzdon, and J. Krechowski. 2003. Phleum phleoides (L.) Karst. - An invasive species? Electronic Journal of Polish Agricultural Universities 6(2). Kasulyte D. and A. Praciak. 2022. Phleum pratense (timothy grass). https://www.cabidigitallibrary.org/doi/full/10.1079/cabicompendium.40248. Accessed: February 6, 2025.	Moderate	Moderate
	Low/Insignificant	High
	Moderate	High
	NA	NA
Center for Invasive Species and Ecosystem Health. 2018. Sawtooth Oak, Quercus acutissima Carruthers. Invasive Plant Atlas of the United States. https://www.invasiveplantatlas.org/subject.cfm?sub=10086. Accessed: February 6, 2025. Kling A. 2024. Invasives in Your Woodland: Sawtooth Oak. Univeristy of Maryland Extension. https://extension.umd.edu/resource/invasives-your-woodland-sawtooth-oak/. Accessed: February 6, 2025.	Low/Insignificant	High
	Moderate	Moderate

	Low/Insignificant	High
	Low/Insignificant	High
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Moderate	Moderate
	Moderate	Moderate
	Moderate	Moderate
	Moderate	High
Darbyshire S.J. 2021. Schedonorus P. Beauv. In: Flora of North America. http://floranorthamerica.org/Schedonorus. Accessed: February 6, 2025.	Low/Insignificant	High
	NA	NA

	Low/Insignificant	High
	Moderate	High
Kato-Noguchi H. and M. Kato. 2022. Allelopathy and allelochemicals of Solidago canadensis L. and S. altissima L. for their naturalization. Plants 11(23):3235. Park J.S., D. Choi, and Y. Kim. 2020. Potential distribution of goldenrod (Solidago altissima L.) during climate change in South Korea. Sustainability 12(17):6710.	Low/Insignificant	Moderate
Noxious Weed Control Board (NWCB). 2025. Smooth Cordgrass, Spartina alterniflora. https://www.nwcb.wa.gov/weeds/smooth-cordgrass. Accessed: February 6, 2025. Weinmann F., P.F. Zika, D.E. Giblin, and B. Legler. 2002. Checklist of the Vascular Plants of Washington State. University of Washington Herbarium. http://biology.burke.washington.edu/herbarium/waflora/checklist.php. Accessed: January 3, 2022	Low/Insignificant	Low

Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Low/Insignificant	Moderate
	Moderate	High
	Low/Insignificant	Moderate

Compton T.J., M. De Winton, J.R. Leathwick, and S. Wadha. 2012. Predicting spread of invasive macrophytes in New Zealand lakes using indirect measures of human accessibility. Freshwater Biology 57(5):938–948. Kadono Y., T. Noda, K. Tsubota, K. Shutoh, and T. Shiga. 2019. The identity of an alien Utricularia Lentibulariaceae) naturalized in Japan. Acta Phytotax. Geobot. 70(2):129–134. Piria M., T. Radočaj, L. Vilizzi, and M. Britvec. 2022. Climate change may exacerbate the risk of invasiveness of non-native aquatic plants: the case of the Pannonian and Mediterranean regions of Croatia. NeoBiota 76:25–52. Wiebush M. 2022. Utricularia intermedia Hayne, flat-leaved bladderwort. California Native Plant Society, Sacramento, CA. Online: https://rareplantfiles.cnps.org/scc/UtricularIaIntermediaSpAcctSCC20220408r.pdf	Low/Insignificant	Moderate
Center for Invasive Species and Ecosystem Health. 2025. Common mullien, Verbascum thapsus L. Invasive Plant Atlas. https://www.invasiveplantatlas.org/subject.cfm?sub=3080. Accessed: February 10, 2025. Colorado Department of Agricutlure (CDA). 2023. Colorado Noxious Weeds (including Watch List), effective May, 2023. https://ag.colorado.gov/conservation/noxious-weeds/species-id. Accessed: February 10, 2024. Oklahoma Invasive Plant Council (OkIPC). 2024. Common Mullein. https://www.okinvasives.org/chinese-salt-cedar. Accessed: February 10, 2025. Remaley T. 2009. Common Mullein. In: Plant Conservation Alliance's Alien Plant Working Group. Least Wanted [Online]. https://www.invasive.org/alien/fact/veth1.htm. Accessed: February 10, 2025. Texas Invasive Species Insititute. 2024. Verbasucm thapsus: Texas Invasives Database. https://www.texasinvasives.org/plant_database/detail.php?symbol=VETH. Accessed: February 10, 2025.	Low/Insignificant	Moderate

Ellmouni F., M. Karam, R. Ali, and D. Albach. 2018. Systematic treatment of Veronica L. Section Beccabunga (Hill) Dumort (Plantaginaceae). Taeckholmia 38(1):168–183. Saito R. and Y. Kadono. 2021. Reproductive interference between an alien species, Veronica anagallis-aquatica L., and a native congener, Veronica undulata Wallich (Plantaginaceae): A field observation. Acta Phytotax. Geobot. 72(3):293–300.	Moderate	High
	Moderate	Moderate

Question 14. Shade Tolerance (2 pts)

Q14 notes

This species has moderate shade tolerance (Rosario, 1988).

The research indicates this species is somewhat tolerant of slight shade but does not tolerate the low light levels one would expect in a closed canopy forest (Knüsel, 2019). Assessors have not found Ailanthus altissima persisting under a closed canopy except when the canopy is at least partially comprised of adults of this species, which are likely assisting their suckering offspring via the connected root system.

This species has been observed growing in medium shade in ash forests.

This species may have some degree of shade tolerance.

Anthoxanthum odoratum is generally found in open or disturbed areas. High light availability may result in earlier reproduction (Platenkamp, 1990). However, one study found that A. odoratum was one of a number of grass species that grew more biomass in partial shade than full sun in its native range (Pang et al., 2019). Another study found A. odoratum produced fewer but taller tillers, and did not have a reduction of biomass in reduced light (Edelkraut & Güsewell, 2006). While experiments suggest that shade doesn't affect growth in this species, it still appears to be mostly a plant of open areas, suggesting that A. odoratum does not thrive in shaded conditions

Arrhenatherum elatius likes to grow along tree lines where it gets partial shade and hydrologic uplift.
Arundo donax grows in full sun to partial shade, but can survive low light conditions (up to 90% reduction in sunlight), but may not establish or spread in full shade. (NWCB, 2013).
In the Pacific Northwest, Bellardia viscosa is usually found in open areas, meadows and disturbed areas. However this species also occurs in edge habitats, disturbed forests, brush, and tall grass (CPNWH, 2024). Studies in northern California and New Zealand both suggest that B. viscosa will eventually be shaded out during succession (Gibb, 1994; Pickart & Wear, 1999).

Centaurea solstitialis usually occurs in areas with little or no overstory canopy, does not tolerate shade, and usually does not occur in areas with tall shrubs, forbs, grasses or late season annuals that can shade it out. This species roots grow more slowly in shaded conditions, and shading may reduce its ability to flower and produce viable seed (Innes & Zouhar, 2021).

Cirsium arvense seedlings are poor competitors due to their low shade tolerance; in general, the species is most successful in sunny sites. Once established it can persist for a time under shade and can exist in a partially shaded condition seemingly indefinitely. Plants will grow to an unusual size when shaded and have been observed to grow to over 7 feet tall when shaded by thick snowberry and other shrubs. This species can also be found under closed deciduous canopies (e.g., quaking aspen) which likely receive more sunlight than closed conifer canopies. Post-fire studies have documented reductions in cover of C. arvense as tree cover increases (Zouhar, 2001). Mature plants produce fewer flowers in shaded areas (Moore, 1975).
Cirsium vulgare is generally not found in areas of deep shade.

Cotoneaster species are somewhat less shade tolerant than other exotic forest shrubs/trees such as Ilex aquifolium. These species are generally observed on forest edges and roadsides, but not under closed forest canopies.
Cynoglossum officinale can grow in moderate shade, particularly in riparian areas disturbed by cattle. However, it grows best in full sunlight, and prefers open habitats (de Jong et al., 1990; Jacobs & Sing, 2007).
Dianthus armeria is adapted to ecosystems with abundant direct sunlight (Wilson, 1999). One study demonstrated reduced seed production and seed mass in shaded conditions (Nightingale, 2007).

Dipsacus fullonum grows in full sun to partial shade. Light shading from litter or established vegetation may aid in D. fullonum seedling establishment by preventing desiccation. However, after establishment, shading can significantly reduce seedling growth rates. Seedlings are generally found in canopy openings created by disturbance (Gucker, 2009).
All Erechtites species are considered shade-intolerant (Elliott et al., 1997).

In western Oregon, Holcus lanatus is most abundant in open areas. At least one study in Oregon found that Holcus lanatus seedlings did not grow as well when shaded (Gucker, 2009). However, this species can still be found in shaded areas and will grow in forests if disturbances occur to promote colonization. For example, this species has been found in Alnus rubra stands along the Hoh River in Olympic National Park. In Oregon and Washington, this species can frequently occur with A. rubra in areas with a history of disturbance (Gucker, 2009).

One study in California coastal prairie found that shade structures or shading by nearby plants could improve survival of H. lanatus seedlings in disturbed areas where it co-occurred with native Bromus carinatus. Shade may increase soil moisture available to seedlings in prairies. In contrast, shade reduced survival of H. lanatus in disturbed areas where it co-occurred with native Festuca or Calamagrostis species. Perhaps light is a more important resource in competitive interactions with those species. The study authors suggest that treatments that increase light availability (e.g., mowing, grazing, burning) may increase H. lanatus abundance in some circumstances. Propagule pressure may increase the likelihood of this species expanding into shaded areas (Thomsen & D'Antonio, 2014).

In Washington, this species has established in the understory throughout westside forests, in both disturbed and undisturbed areas, and can also be found in clearcuts, oak woodlands, or other areas with full or partial sun.

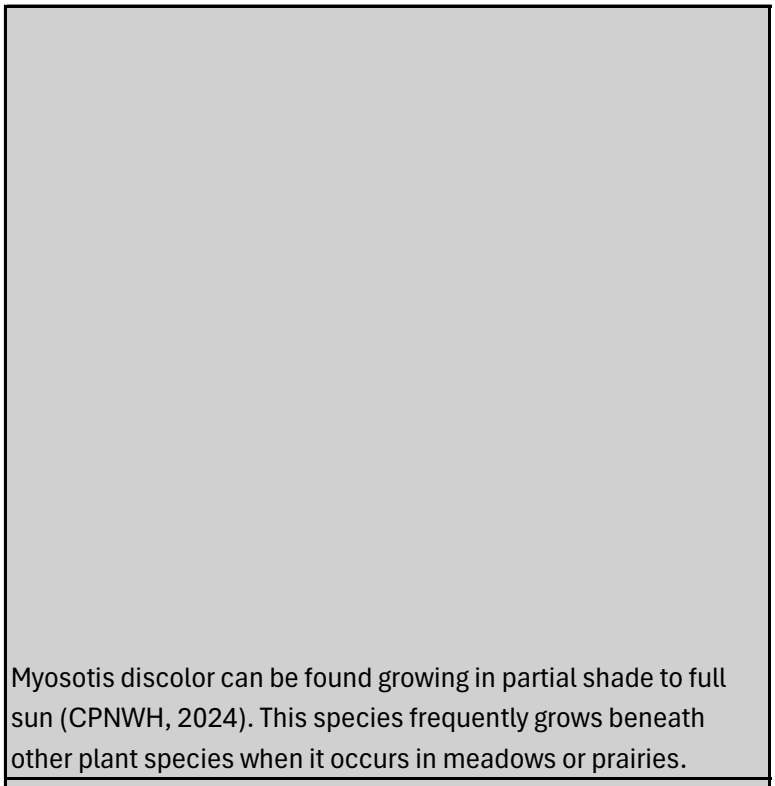
In its native habitat, Ilex aquifolium is a late-successional species (Arrieta & Suárez, 2004). Research from Spain suggests that in cool and wet climates, I. aquifolium can survive in sunny areas, but in hot, dry climates, I. aquifolium is constrained to shaded areas. Seedlings have greatest survival in 12% sunlight and minimal survival in both full shade and full sun. In areas with deep shade, I. aquifolium reproduces vegetatively and not via seed (Valladares et al., 2005).

Low light may inhibit seedling establishment, but likely does not slow growth or vegetative reproduction by mature plants (Thomas, 1980).
Jacobaea vulgaris is generally found in open, disturbed areas, and requires light to germinate seeds and establish seedlings (Richardson, 2004; Jacobs, 2009). However, at least in its native range, open habitat can also increase vulnerability to drought and the chances of discovery by specialist herbivores like Tyria jacobaeae. In these instances, partially shaded areas can become refugia from drought and herbivory for some populations of this species (Van Der Meijden et al., 1992), at least in Europe.
This species is generally shade intolerant but can be found at forest edges.

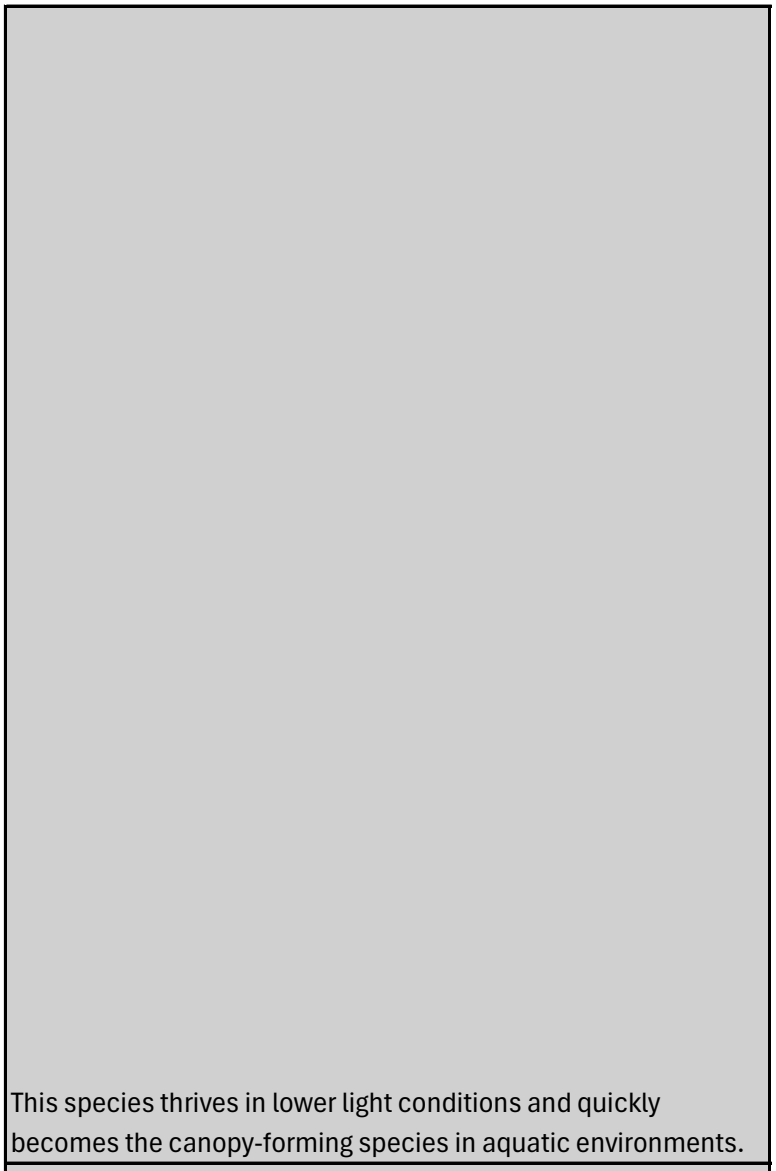
Juncus effusus usually grows in full sun, but established plants grows well in partial shade and tolerate full shade (McCorry & Renou, 2003). Shading can prevent germination of J. effusus seed (as can desiccation) (Ervin & Wetzel, 2000).

Leucanthemum vulgare is usually found in open disturbed areas such as old fields, clearcuts, and grasslands, and is not usually found under closed canopies (Clements et al., 2004). Seeds germinate at relatively cool temperatures, perhaps to escape competition for light as seedlings. Light reduction from competing plant species can reduce abundance of L. vulgare. This species may also be less able to benefit from nutrients in shaded conditions (Clements et al., 2004).
Lysimachia nummularia reportedly grows in a range of light conditions from full shade to full sun (Innes, 2011).

This plant prefers full sun and typically invades grasslands where there is little shade (Weiss et al., 2000; Barton & Drost, 2020). In Washington, it only grows in open woodlands without canopy closure.



Myosotis discolor can be found growing in partial shade to full sun (CPNWH, 2024). This species frequently grows beneath other plant species when it occurs in meadows or prairies.



This species thrives in lower light conditions and quickly becomes the canopy-forming species in aquatic environments.

Phalaris arundinacea prefers full sun but can occur in partially shaded and shaded areas. This species commonly dominates the understory of riparian forests and woodlands. Seedlings can also establish in shade, though not as easily or as successfully as they do in full sun. Some research suggests that P. arundinacea needs light to germinate, and development of dense canopies can reduce the number of sites available for seedling germination. Phalaris arundinacea also usually has much reduced biomass and rhizome survival in shaded areas (Kim et al., 2006; Waggy, 2010).

In an experiment planting willow stakes to try to shade out P. arundinacea at a site on Lake Washington, dense plantings of willow cuttings taken from nearby willow trees were able to significantly reduce P. arundinacea biomass. This result was likely due to the willow outcompeting the P. arundinacea for light, though other mechanisms of competition cannot be ruled out (Kim et al., 2006).

Phleum pratense is usually found in open areas such as grasslands and open woodlands, but this species does tolerate partial shade. Shading reduces nutritional value and delays flowering by one or two weeks (Esser, 1993; Ogle et al., 2011).

Rubus bifrons is frequently described as shade intolerant (Caplan & Yeakley, 2006). However, in the Pacific Northwest, R. bifrons is capable of growing and reproducing in woodland and forest understories. Research does suggest that this species' growth can be limited in shaded conditions (Caplan & Yeakley, 2006). Seedlings establish best in open habitat, and plants grow more quickly and are better able to produce fruits in sun than in shade. A study in Australia found that this species required at least 45% sunlight for survival (Fryer, 2021).
May be found in partial shade.

Solidago altissima is generally a species of open, sunny areas, and does not invade areas with closed canopies. Vegetative plants can tolerate shade, but are much less likely to flower or may not reproduce at all in shade (Walck et al., 2001; Park et al., 2020). Seeds of this species may also require light to germinate (Meyer & Schmid, 1999).
This species likely does not tolerate shade.

Tamarix species prefer open disturbed sites and are not shade tolerant. A study in Montana found populations of Tamarix that hadn't recruited new individuals in up to 27 years, likely due to the combination of thick litter under the canopy and adults outcompeting seedlings for light (Lehnhoff et al., 2011). Under the right conditions, native riparian vegetation can also shade out Tamarix seedlings, even if Tamarix establishes first. Adult Tamarix may also be susceptible to shading (Zouhar, 2003).

No information was directly available on Utricularia inflata's shade tolerance. However, carnivorous plants, including most Utricularia species, are generally found in sunny, wet, nutrient-poor environments (Givnish et al., 1984).

This plant is likely shade intolerant.

Veronica anagallis-aquatica is frequently observed in full sun, but at least some observations in Washington are from partial shade or in areas shaded by other plants (CPNWH, 2024). A study from Idaho on the morphological differences between emerged and submerged V. anagallis-aquatica found that above water leaves were morphologically similar to terrestrial species adapted to full sun, and submerged leaves were morphologically similar to shade-adapted species (Boeger & Poulson, 2003). This suggests that V. anagallis aquatica is adaptable to both sunny and partially shaded conditions.

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Q14 citation	**Q15 score**	**Q15 confidence rank**
Rosario L.C. 1988. Acer negundo. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/aceneg/all.html. Accessed: December 16, 2024.	Yes	Moderate
Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland.	Yes	Moderate
	Yes	Moderate

	Unknown	Not Rated
	No	Low
Edelkraut K.A. and S. Güsewell. 2006. Progressive effects of shading on experimental wetland communities over three years. Plant Ecology 183(2):315–327. Pang K., J.W. Van Sambeek, N.E. Navarrete-Tindall, C.-H. Lin, S. Jose, and H.E. Garrett. 2019. Responses of legumes and grasses to non-, moderate, and dense shade in Missouri, USA. I. Forage yield and its species-level plasticity. Agroforestry Systems 93(1):11–24. Platenkamp G.A.J. 1990. Phenotypic plasticity and genetic differentiation in the demography of the grass Anthoxanthum odoratum. The Journal of Ecology 78(3):772.	Yes	Moderate

	Yes	High
	Yes	High
Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Yes	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. Gibb J.A. 1994. Plant succession on the braided bed of the Orongorongo River, Wellington, New Zealand, 1973-1990. New Zealand Journal of Ecology 18(1):29–40. Pickart A.J. and K.S. Wear. 1999. The ecology of Parentucellia viscosa invasion in dune wetlands. In: California Exotic Pest Plant Council Symposium. California Exotic Pest Plant Council, Sacramento, CA. 5, pp. 57–70.	Yes	High
	Yes	Moderate

	Yes	Moderate
	NA	NA
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes	High
	NA	NA

Moore R.J. 1975. The biology of Canadian weeds.: 13. Cirsium arvense (L.) Scop. Canadian Journal of Plant Science 55(4):1033–1048. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes	High
	Yes	Low
	Yes	High

	Yes	Moderate
	Yes	High
Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8. de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144.	Yes	High
Nightingale J. 2007. The ecology and conservation of Dianthus armeria (L.) and Arabis glabra (L.) In the UK. PhD Dissertation. University of Sussex, Brighton, UK. Wilson P.J. 1999. The status and distribution of Dianthus armeria L. in Britain. Plantlife, London.	Yes	Moderate

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	Yes	High
Elliott K.J., L.R. Boring, W.T. Swank, and B.R. Haines. 1997. Successional changes in plant species diversity and composition after clearcutting a southern Appalachian watershed. Forest Ecology and Management 92(1):67–85.	Yes	High
	NA	NA
	Yes	High

Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024. Thomsen M.A. and C.M. D'Antonio. 2014. How does simulated gopher disturbance affect the establishment of Holcus lanatus L. (Poaceae) in California Coastal Prairie? Madroño 61(2):218–226.	Yes	High

Arrieta S. and F. Suárez. 2004. Germination and seed bank depletion of holly (Ilex aquifolium L.) in four microhabitat types. Seed Science Research 14(3):305–313. Valladares F., S. Arrieta, I. Aranda, D. Lorenzo, D. Sanchez-Gomez, D. Tena, F. Suarez, and J.A. Pardos. 2005. Shade tolerance, photoinhibition sensitivity and phenotypic plasticity of Ilex aquifolium in continental Mediterranean sites. Tree Physiology 25(8):1041–1052.	Yes	Moderate
	Yes	Moderate

Thomas L.K. Jr. 1980. The impact of three exotic plant species on a Potomac island. US Department of the Interior, National Park Service, Washington, DC. National Park Service Scientific Monograph Series No. 13.	Yes	High
Van De Voorde T.F.J., W.H. Van Der Putten, and T.M. Bezemer. 2012. The importance of plant–soil interactions, soil nutrients, and plant life history traits for the temporal dynamics of Jacobaea vulgaris in a chronosequence of old fields. Oikos 121(8):1251–1262. Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Yes	High
	Yes	Moderate

Ervin G.N. and R.G. Wetzel. 2000. Allelochemical autotoxicity in the emergent wetland macrophyte Juncus effusus (Juncaceae). American Journal of Botany 87(6):853–860. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	Yes	High
	Yes	High
	Yes	High
	Yes	High

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363.	Yes	High
Innes R.J. 2011. Lysimachia nummularia. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/lysnum/all.html#113. Accessed: February 1, 2024.	NA	NA

	Yes	Low
Barton B. and D. Drost. 2020. How to grow horehound in your garden. https://extension.usu.edu/yardandgarden/research/horehound-in-the-garden. Accessed: November 28, 2023. Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	No	Moderate
	Yes	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	No	High
	NA	NA

	Yes	High
	Yes	Moderate

Kim K.D., K. Ewing, and D.E. Giblin. 2006. Controlling Phalaris arundinacea (reed canarygrass) with live willow stakes: A density-dependent response. Ecological Engineering 27(3):219–227. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	Yes	High

Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Ogle D.G., L. St. John, and D.J. Tilley. 2011. Plant guide for timothy (Phleum pratense). USDA-Natural Resources Conservation Service, Idaho State Office. Boise, ID. Online: https://plants.usda.gov/DocumentLibrary/plantguide/doc/pg_phpr3.docx	Yes	Moderate
	Yes	Moderate
	Yes	High
	NA	NA
	No	Low
	Yes	High

	Yes	High
	Yes	High
Caplan J.S. and J.A. Yeakley. 2006. Rubus armeniacus (Himalayan blackberry) occurrence and growth in relation to soil and light conditions in western Oregon. Northwest Science 80(1):10–17. Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Yes	High
	Yes	Moderate
	Yes	High
	Yes	High
	Yes	High
	NA	NA

	Yes	High
	Yes	High
Park J.S., D. Choi, and Y. Kim. 2020. Potential distribution of goldenrod (Solidago altissima L.) during climate change in South Korea. Sustainability 12(17):6710. Meyer Andrea.H. and B. Schmid. 1999. Seed dynamics and seedling establishment in the invading perennial Solidago altissima under different experimental treatments. Journal of Ecology 87(1):28–41. Walck J.L., J.M. Baskin, and C.C. Baskin. 2001. Why is Solidago shortii narrowly endemic and S. altissima geographically widespread? A comprehensive comparative study of biological traits. Journal of Biogeography 28(10):1221–1237.	Yes	High
	No	Moderate

Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	Yes	Moderate
	No	Moderate
	No	Moderate

Givnish T.J., E.L. Burkhardt, R.E. Happel, and J.D. Weintraub. 1984. Carnivory in the bromeliad Brocchinia reducta, with a cost/benefit model for the general restriction of carnivorous plants to sunny, moist, nutrient-poor habitats. The American Naturalist 124(4):479–497.	No	Moderate
	No	High

Boeger M.R.T. and M.E. Poulson. 2003. Morphological adaptations and photosynthetic rates of amphibious Veronica anagallis-aquatica L. (Scrophulariaceae) under different flow regimes. Aquatic Botany 75(2):123–135. Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	Yes	High
	No	Moderate

Question 15. Disturbance Tolerance (2 p

Q15 notes

Ailanthus altissima germinates best in areas with high nutrient availability, good access to light, and low litter cover. This is the environment one would expect to see after a fire, and studies have shown this species to increase or establish in post-fire scenarios. A. altissima has been observed to reproduce by root suckers following a fire, so not only will it more readily establish following a fire, but its ability to sprout from surviving roots would give it a competitive advantage over some species in Washington State, like Douglas-fir and ponderosa pine, which do not resprout (Knüsel, 2019).

This species might respond to high nitrogen input, but response to increased disturbance is unknown.
Other shrub species along the Columbia are also adapted to flooding disturbance. Amorpha fruticosa's competitive advantage over other species is likely not due to relative disturbance tolerance. Perhaps this species lacks a significant herbivore at the sapling stage, is more fecund, or is just more aggressive once established.
Anthoxanthum odoratum thrives on disturbance. In most cases disturbance is required for establishment of this species, and it is more likely to invade disturbed areas (Brusati & Warner, 2004). A study in British Columbia found that A. odoratum showed the greatest increase in abundance post removal of Cytisus scoparius, and also readily colonized areas disturbed by wildfire and wildfire suppression techniques (Lysgaard, 2022). In western Washington, this species is known to move into areas where tall oatgrass has been removed (R. Johnson, pers. comm. 2025).

Arrhenatherum elatius resprouts quickly after burning or grazing.
Arundo donax is well-adapted to disturbance, and is especially invasive in disturbed areas (McWilliams, 2004; NWCB, 2013). Changes in hydrology, disturbed riparian vegetation, and fire can all spread and increase abundance of A. donax. In particular, this species recovers much more quickly after fire than native riparian vegetation (McWilliams, 2004; NWCB, 2013; Goolsby et al., 2023). Eutrophication of rivers and other water sources also benefits A. donax (Goolsby et al., 2023).
Bellardia viscosa is usually found in disturbed areas and habitats maintained by natural disturbance. This species has been observed to increase after fire, including in wet prairies (Brusati & Corelli, 2005; Anzinger & Radosevich, 2008).

Centaurea solstitialis is most invasive and productive in disturbed areas. This particularly includes areas of human disturbance such as hayfields, orchards, vineyards, old fields, roadsides and railroad tracks. Rangelands and pastures, particularly ones allowed to be overgrazed, also provide opportunities for introduction or increases of this species. In the Blue Mountains in Washington and Oregon, areas grazed by cattle and elk are readily invaded by C. solstitialis. While fire kills adult plants, it provides excellent habitat for establishing new populations (Innes & Zouhar, 2021).

Cirsium arvense is an early successional species and appears in communities shortly after disturbances such as logging, fire, volcanic eruptions (e.g., debris deposits and landslides), grazing, and road building. This was one of the first species to recolonize disturbed areas after Mt. St. Helens erupted. This species uses its roots as storage organs, which is a common trait in plant species adapted to above-ground disturbances such as fire, and in fact C. arvense roots are known to survive even severe fires. Cirsium arvense can also re-establish after discing and herbicide treatment (Zouhar, 2001).
Cirsium vulgare is an early successional species commonly found in open, disturbed ecosystems. However, low severity fires can kill seeds for this species (Clark & Wilson, 1994).

Cynoglossum officinale is frequently associated with disturbed and ruderal areas in both its native and introduced range. Disturbance increases establishment, growth, and recruitment in this species. For example, in its native range, C. officinale is known to increase in abundance after sheep grazing. In its introduced range, this species is usually found in clearcuts, pastures, grazed rangelands, and other heavily disturbed sites. (Klinkhamer & de Jong, 1988; Jacobs & Sing, 2007; Andreas et al., 2008; Williams & Fishman, 2014). Cynoglossum officinale has a large taproot that can function as a storage organ. This species also has growing points that are at or just below the soil surface (Jacobs & Sing, 2007), suggesting that established plants may survive low or moderate severity fires. However, severe annual soil disturbance would not benefit this species, since it needs at least two years to reach reproductive age.
This species is well-adapted to disturbed areas (Wilson, 1999; Stroh, 2014).

Dipsacus fullonum is an early successional species and requires periodic disturbance to maintain suitable habitat for seed germination. However, severe annual disturbance does not benefit this species because it needs at least two years of growth to reproduce. Activities like plowing, dredging, and grazing can increase this species' abundance. In Washington, grazing in Crataegus douglasii habitats has been observed to increase Dipsacus fullonum populations (Gucker, 2009). Fire can increase D. fullonum populations. Large rosettes may be capable of surviving low or moderate severity fire in the same way that they survive mowing. Plants with below-ground meristematic tissue, such as D. fullonum (Gucker, 2009), are insulated from the heat of low and moderate severity fires by the soil (Wiggers et al., 2013, M. Wiebush, unpublished data). This could provide a competitive advantage in communities that are not adapted to fire or grazing disturbances but may not provide much advantage in fire-dependent ecosystems (e.g., Willamette Prairie).
This species spreads rapidly following disturbance, particularly fire (Muldavin et al., 1981).

Holcus lanatus is associated with disturbance throughout its range. Soil disturbance increases germination of this species and disturbance (or previous history of disturbance) may result in invasion by this species even in shaded forest conditions (Thomsen & D'Antonio, 2014). Soil disturbance from logging promotes establishment and/or increased cover of H. lanatus. Holcus lanatus was documented colonizing debris flows following the Mount St. Helens eruption (Gucker, 2009). A study in California suggests that large-scale disturbance is more likely to promote this species than small-scale disturbance (Thomsen & D'Antonio, 2014).

Grazing and trampling may reduce abundance of this species, but older plants can develop a tolerance for grazing. This species is likely killed by fire and establishes post-fire from the seed bank. In Washington this species has persisted in areas with frequent (yearly) fire for over 50 years (Gucker, 2009).

Ilex aquifolium is described as a late-successional species in its native range (Arrieta & Suárez, 2004). However, in Washington this species is also found in disturbed areas (NWCB, 2022) and is common in urban and residential areas, along roadways and in other anthropogenically disturbed sites (Zika, 2010). Ilex aquifolium resprouts readily after cutting, and layers from branches and trunks if plants are knocked down.

Disturbance benefits Iris pseudacorus by spreading rhizome fragments and seeds.
In the Pacific Northwest, Jacobaea vulgaris is usually found in open, disturbed areas such as old fields, roadsides or the edges of disturbed wetlands. Fire can kill seeds and encourage plant species that are competitive with J. vulgaris in grasslands but creates habitat conducive to J. vulgaris invasion in forests (Jacobs, 2009). This species has a persistent seed bank and can reproduce from root fragments, enabling populations to increase after disturbances like grazing, mowing, and tilling (Richardson, 2004; Jacobs, 2009). In its native and invasive range, J. vulgaris colonizes disturbed areas and disappears from stable communities, suggesting that it relies on disturbance to maintain populations (Van Der Meijden et al., 1992; Jacobs, 2009; Van De Voorde et al., 2012).
This species tends to be most competitive in openings and grassy fields.

Experiments have found the Juncus effusus is an early colonizer of disturbed wetlands. Research in Europe found that while seedlings may not tolerate disturbance, competition, or drought (Lazenby, 1955), disturbance can allow buried J. effusus seeds to germinate (Ervin & Wetzel, 2000). Observations from Ireland are common in trampled areas in wetlands (e.g., trails or places where animals gather). Soil disturbance from grazing promotes establishment of J. effusus in wet pastures. Established plants are resilient to trampling, grazing, and mowing (McCorry & Renou, 2003).

Leucanthemum vulgare is frequently found in disturbed areas such as old fields, clearcuts, roadsides, pastures and abandoned places. This species is an early colonizer of disturbed areas and may require grazing or other disturbances to establish (Clements et al., 2004; DiTomaso et al., 2013). Mowing can increase vegetative abundance for this species, as can a single round of tilling. However, annual tilling can deplete seedbanks and prevent establishment (Clements et al., 2004; DiTomaso et al., 2013; EDDMapS, 2023), though such treatment would of course be devastating to the native plant community.

One study found 91% of clipped seedlings resprouted within 42 days. Mature plants can resprout from rootstock (Gabor & Murkin, 1990). However, the degree to which this provides a competitive advantage to Lythrum salicaria is unclear, as it typically establishes in native communities characterized by highly disturbance-tolerant genera (Typha, Schoenoplectus, etc.).
This species appears not to resprout after fire, but it is a grazing increaser (Weiss & Wills, 2000).

Myosotis discolor is found in a wide variety of ruderal ecosystems and other areas that experience regular disturbance (CPNWH, 2024). A study in southwestern Oregon found presence of this species indicated burned areas (Sikes, 2005). However, disturbance responses likely do not provide M. discolor an advantage over co-occurring native species.

The species can occur in low light conditions and on substrates where other species are unable to survive. It often invades following disturbance (Smith & Barko, 1990)

Phalaris arundinacea occurs across successional communities, though it appears to be most common in early to mid-succession communities. Disturbance likely benefits this species. Phalaris arundinacea frequently invades after human or natural disturbances in both its native and invasive ranges. This includes moving into areas after the removal of other invasive species (e.g., Lythrum salicaria, purple loosestrife). Addition of nitrogen to wetlands due to human activities also likely increases the invasive capacity of this species (Lavergne & Molofsky, 2004; Waggy, 2010).

Phleum pratense is common in pastures, grasslands, and disturbed areas, and increases cover after disturbance. However, heavy grazing and mowing can both decrease populations, likely by damaging the corms at the base of plants that store carbohydrates. However, corms and belowground growing points also allow this plant to resprout after by fire, and tillering and seed production increases after fire (Esser, 1993; Ogle et al., 2011).
This plant thrives on disturbance.
Quercus robur is a fast-growing pioneer species, but plants in Washington have not demonstrated a competitive advantage gained from any potential disturbance tolerance.

Rubus bifrons occurs across successional stages but is most successful in early seral communities and is frequently found on disturbed sites. Fire does not have a negative effect on this species—it may even break seed dormancy and eliminates cover of competing plants, allowing for seedling growth. Roots and rhizomes can be very deep in the soil, potentially insulating this species from even severe fires (Wiggers et al., 2013). Rubus bifrons frequently increases in both density and reproduction after fire and other disturbances (Fryer, 2021).
Disturbance appears to give this species a competitive advantage.
This species resprouts readily after fire or cutting (Cal-IPC, 2004).

This species seems to require major disturbance, particularly clearcutting and wildfires. The assessor has seldom seen it in other settings and it typically only remains on site for a couple of years following disturbance.
Solidago altissima likely requires disturbance to establish populations and disturbance is important to maintaining the open habitats that this species prefers. However, S. altissima is generally a later colonizer in old field habitats, and yearly disturbances may limit this species' ability to persist (Collins et al., 2001; Walck et al., 2001). Frequent mowing, fire, and other disturbances can reduce food reserves stored in rhizomes, prevent reproduction and colonization of new sites, and reduce population size in this species (Meyer & Schmid, 1999; Collins et al., 2001; Walck et al., 2001).
All salt marsh plants are typically disturbance tolerant and this species does not appear to gain a competitive advantage from disturbance.

Tamarix can grow in highly disturbed areas, including mine tailings, and survives in saline and alkali environments. Wind-borne seeds and high seed production make Tamarix an excellent pioneer species. Anthropogenic changes to stream and groundwater hydrology enable the spread of Tamarix species in the western U.S. (Zouhar, 2003; Kerns et al., 2009). Tamarix is also more likely than native riparian vegetation to survive and increase post-fire (Gafke et al., 2022). However, Tamarix may be less resilient to natural disturbance regimes, and may not be able to outcompete native vegetation in areas with frequent, severe flooding (Zouhar, 2003). On free-flowing perennial waterways, Tamarix may struggle to establish seedlings. A study comparing river reaches with altered flows against free-flowing reaches found Tamarix less common where natural river dynamics were intact (Stromberg et al., 2007). Tamarix may also be less competitive after flooding disturbances in areas where biocontrols have been successfully established (Gafke et al., 2022).
This species resprouts readily but does not appear to gain a competitive advantage.

No information was found on Utricularia inflata's disturbance tolerance relative to co-occurring species. Increases in water turbidity, eutrophication and changes to hydrogeology are generally regarded as a threat for aquatic Utricularia species (Wiebush, 2022). Studies done in New York, where U. inflata is also introduced, found that this species is most abundant in waters sheltered from waves and currents (Urban & Titus, 2010). This suggests that U. inflata may not have a markedly different disturbance tolerance than other co-occurring species.
Verbascum blattaria requires disturbance such as fire to establish but does not appear to gain a significant competitive advantage over native species following disturbance.

In Washington, Veronica anagallis-aquatica occurs with increaser (e.g., Typha latifolia) or invasive species (particularly Phalaris arundinacea), and in draw down areas of lakes and streams, wet ditches, irrigation channels, disturbed soil, wet areas in degraded shrub steppe, and areas of heavy cattle grazing (CPNWH, 2024). It was also an early colonizer of disturbed areas in studies from New Zealand (Riis et al., 2004).
Commonly establishes following disturbance, but does not appear to gain a competitive advantage from it.

ɒts)		
Q15 citation	**Q16 ranks**	**Q16 confidence ranks**
	<5 years	High
Knüsel S. 2019. Tree of heaven or hell? On the ecology of Ailanthus altissima (Mill.) Swingle. Doctoral Thesis. ETH Zurich, Zurich, Switzerland.	>5 years	Moderate
	>10 years	Moderate

	<5 years	Low
	NA	NA
Brusati E. and P.J. Warner. 2004. Plant assessment form: Anthoxanthum odoratum. https://www.cal-ipc.org/plants/paf/anthoxanthum-odoratum-plant-assessment-form/. Accessed: October 28, 2024. Lysgaard C. 2022. Invasive species removal and changing Fire Regimes in a ləkʷ wəŋən Garry Oak Ecosystem. MS Thesis. University of Victoria, Victoria, BC.	<5 years	Moderate

	Unknown	Not Rated
	Unknown	Not Rated
Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. McWilliams J. 2004. Arundo donax: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/arudon/all.html. Accessed: September 26, 2024. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	<5 years	High
Anzinger D. and S.R. Radosevich. 2008. Chapter 10: Fire and Nonnative Invasive Plants in the Northwest Coastal Bioregion. US Department of Agriculture, Forest Service. RMRS-GTR-42. Brusati E. and T. Corelli. 2005. Parentucellia viscosa. https://www.cal-ipc.org/plants/paf/parentucellia-viscosa-plant-assessment-form/. Accessed: October 29, 2024.	<5 years	High
	Unknown	Not Rated

	Unknown	Not Rated
	NA	NA
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	>5 years	High
	NA	NA

Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	>10 years	Moderate
Clark D.L. and M.V. Wilson. 1994. Heat-treatment effects on seed bank species of an old-growth Douglas-fir forest. Northwest Science 68(1):1–5.	Unknown	Not Rated
	Unknown	Not Rated

	Unknown	Not Rated
	>10 years	Moderate
Andreas J.E., M. Schwarzländer, and R. De Clerck-Floate. 2008. The occurrence and potential relevance of post-release, nontarget attack by Mogulones cruciger, a biocontrol agent for Cynoglossum officinale in Canada. Biological Control 46(3):304–311. Jacobs J. and S. Sing. 2007. Ecology and management of houndstongue (Cynoglossum officinale L.). USDA-Natural Resources Conservation Service, Bozeman, MT. MT-8. Klinkhamer P.G.L. and T.J. de Jong. 1988. The importance of small-scale disturbance for seedling establishment in Cirsium vulgare and Cynoglossum officinale. The Journal of Ecology 76(2):383. Williams J.L. and L. Fishman. 2014. Genetic evidence for founder effects in the introduced range of houndstongue (Cynoglossum officinale). Biological Invasions 16(1):205–216.	<5 years	High
Stroh P.A. 2014. Dianthus armeria L. Deptford Pink. Species Account. Botanical Society of Britain and Ireland. Wilson P.J. 1999. The status and distribution of Dianthus armeria L. in Britain. Plantlife, London.	>20 years	High

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. Wiggers M.S., L.K. Kirkman, R.S. Boyd, and J.K. Hiers. 2013. Fine-scale variation in surface fire environment and legume germination in the longleaf pine ecosystem. Forest Ecology and Management 310:54–63.	<5 years	High
Muldavin E.H., J.M. Lenihan, W.S. Lennox, and S.D.Jr. Veirs. 1981. Vegetation succession in the first ten years following logging of coast redwood forests. National Park Service, Redwood National Park, Arcata, California. Technical Report #6.	>5 years	Low
	NA	NA
	<5 years	Moderate

Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024. Thomsen M.A. and C.M. D'Antonio. 2014. How does simulated gopher disturbance affect the establishment of Holcus lanatus L. (Poaceae) in California Coastal Prairie? Madroño 61(2):218–226.	>10 years	Moderate

Arrieta S. and F. Suárez. 2004. Germination and seed bank depletion of holly (Ilex aquifolium L.) in four microhabitat types. Seed Science Research 14(3):305–313. Noxious Weed Control Board (NWCB). 2022. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Ilex aquifolium. Washington State Noxious Weed Control Board. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	<5 years	Moderate
	Unknown	Not Rated

	>10 years	High
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Van Der Meijden E., P.G.L. Klinkhamer, T.J. De Jong, and C.A.M. Van Wijk. 1992. Meta-population dynamics of biennial plants: how to exploit temporary habitats. Acta Botanica Neerlandica 41(3):249–270. Van De Voorde T.F.J., W.H. Van Der Putten, and T.M. Bezemer. 2012. The importance of plant–soil interactions, soil nutrients, and plant life history traits for the temporal dynamics of Jacobaea vulgaris in a chronosequence of old fields. Oikos 121(8):1251–1262. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	>10 years	Moderate
	Unknown	Not Rated

Ervin G.N. and R.G. Wetzel. 2000. Allelochemical autotoxicity in the emergent wetland macrophyte Juncus effusus (Juncaceae). American Journal of Botany 87(6):853–860. Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103. McCorry M.J. and F. Renou. 2003. Ecology and management of Juncus effusus (soft rush) on cutaway peatlands. Forest Ecosystem Research Group, Department of Environmental Resource Management, University College Dublin, Dublin, Ireland.	>20 Years	High
	Unknown	Not Rated
	Unknown	Not Rated
	Unknown	Not Rated

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Leucanthemum vulgare Lam., oxeye daisy. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.	>10 years	High
	<5 years	Moderate

Gabor T.S. and H.R. Murkin. 1990. Effects of clipping purple loosestrife seedlings during a simulated wetland drawdown. Journal of Aquatic Plant Management 28:98–100.	>5 years	Moderate
Weiss J. and E. Wills. 2000. Integrated management of horehound (Marrubium vulgare L.) in Wyperfeld National Park. Plant Protection Quarterly 15(1):40–42.	>10 years	Low
	Unknown	Not Rated

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. Sikes K.G. 2005. The effects of two fuel reduction treatments on chaparral communities in Southwest Oregon. Oregon State University, Corvallis, OR.	<5 years	Moderate
	NA	NA

Smith C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28(2):55–64.	>5 years	Low
	Unknown	Not Rated

Lavergne S. and J. Molofsky. 2004. Reed canary grass (Phalaris arundinacea) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23(5):415–429. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	>10 years	High

Esser L.L. 1993. Phleum pratense: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phlpra/all.html. Accessed: October 15, 2024. Ogle D.G., L. St. John, and D.J. Tilley. 2011. Plant guide for timothy (Phleum pratense). USDA-Natural Resources Conservation Service, Idaho State Office. Boise, ID. Online: https://plants.usda.gov/DocumentLibrary/plantguide/doc/pg_phpr3.docx	<5 years	High
	Unknown	Not Rated
	Unknown	Not Rated
	NA	NA
	<5 years	High
	Unknown	Not Rated

	Unknown	Not Rated
	Unknown	Not Rated
Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024. Wiggers M.S., L.K. Kirkman, R.S. Boyd, and J.K. Hiers. 2013. Fine-scale variation in surface fire environment and legume germination in the longleaf pine ecosystem. Forest Ecology and Management 310:54–63.	>5 years	Moderate
	<5 years	Low
California Invasive Plant Council (Cal-IPC). 2004. Plant Assessment Form: Rumex crispus. https://www.cal-ipc.org/plants/paf/rumex-crispus-plant-assessment-form/. Accessed: February 3, 2025.	>20 years	High
	Unknown	Not Rated
	Unknown	Not Rated
	NA	NA

	>20 years	Moderate
	Unknown	Not Rated
Collins B., G. Wein, and T. Philippi. 2001. Effects of disturbance intensity and frequency on early old field succession. Journal of Vegetation Science 12(5):721–728. Meyer Andrea.H. and B. Schmid. 1999. Seed dynamics and seedling establishment in the invading perennial Solidago altissima under different experimental treatments. Journal of Ecology 87(1):28–41. Walck J.L., J.M. Baskin, and C.C. Baskin. 2001. Why is Solidago shortii narrowly endemic and S. altissima geographically widespread? A comprehensive comparative study of biological traits. Journal of Biogeography 28(10):1221–1237.	Unknown	Not Rated
	<5 years	Low

Gafke A.M., T. Dudley, D. Bean, G.M. Drus, M.J. Johnson, A.E. Knutson, D.K. Weaver, S.E. Sing, B.K. Orr, and D.C. Thompson. 2022. Bring on the Beetles!. USDA Forest Service, Morgantown, West Virginia. FHAAST-2019-05. Online: https:// bugwoodcloud.org/resource/files/23194.pdf Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215. Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393. Zouhar K. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/tamspp/all.html. Accessed: June 28, 2024.	<5 years	High
	<5 years	Moderate
	<5 years	Moderate

Urban R.A. and J.E. Titus. 2010. Exposure provides refuge from a rootless invasive macrophyte. Aquatic Botany 92(4):265–272. Wiebush M. 2022. Utricularia intermedia Hayne, flat-leaved bladderwort. California Native Plant Society, Sacramento, CA. Online: https://rareplantfiles.cnps.org/scc/UtricularIaIntermediaSpAcctSCC20220408r.pdf	Unknown	Not Rated
	>20 years	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. Riis T., B.J.F.F. Biggs, and M. Flanagan. 2004. Colonisation and temporal dynamics of macrophytes in artificial stream channels with contrasting flow regimes. Archiv für Hydrobiologie 159(1):77–95.	<5 years	Low
	Unknown	Not Rated

Question 16. Propagule Persistence (3 p

Q16 notes
Evidence suggests that propagules persist for less than five years (Hildebrand, 2006; CNPS, 2024).
Some sources suggest seeds remain viable for at least six years, while other sources indicate the formation of a persistent seed bank is unlikely. The research indicating persistence is more recent than many sources suggesting a shorter lived seedbank (DiTomaso et al., 2013; Rebbeck & Jolliff, 2018).
Further research is needed.

Grasses tend not to have long seed persistence, but the exact persistence of this species under field conditions is unknown.

Anthoxanthum odoratum seeds generally germinate between 4 and 8 weeks of dispersal. One study found that most seeds in the soil germinated within three months, and by 10 months all remaining seed were not viable. However, another study found that seeds in storage for four years were still 85% viable. Variation in temperature and conditions may reduce seed viability (Pitcher & Russo, 2012).

Arundo donax rhizomes live for 3–4 years (Goolsby et al., 2023).
Bellardia viscosa does not appear to have long-lived seeds. Experiments in seed storage at the Royal Botanical Gardens, Kew, found that seeds dried and frozen for storage had only 26% viability after 2.8 years (SID, 2024).

Centaurea solstitialis forms both a transient and a long-term seedbank, and seeds can remain viable for up to 10 years in Washington. However, most of this species' seeds germinate readily and do not appear to be innately dormant. Dormancy may instead develop when dispersed seeds do not find conditions conducive to germination—only a small number of total seed production will become dormant. Germination in C. solstitialis is related to light, moisture, and temperature (Innes & Zouhar, 2021).

While deeply buried seeds have occasionally been documented to survive longer than 20 years, most studies have found that C. arvense seeds do not have a dormancy period. On average, C. arvense seeds last for less than 5 years in the seed bank. Most seeds germinate in the first year (Zouhar, 2001; DiTomaso et al., 2013). Storage roots are generally short-lived (a year or so) (Leathwick & Bourdôt, 2012), but it can take 5-10 years of eradication efforts to exhaust vegetative propagules in a treatment area (Zouhar, 2001).

Cirsium vulgare does not appear to have a long-lived seed bank.

Cynoglossum officinale seeds generally persist only 2-3 years. Seeds are initially dormant, and stratification is required for germination. The presence of soil nitrate improves germination, and seeds are much more likely to germinate below ground than on the surface (de Jong et al., 1990). Seeds can remain attached to the parent plant for a relatively long time, creating a temporary above-ground seed bank (de Jong & Klinkhamer, 1988).
Seeds may remain dormant for at least 40 years within the native range of this species (Wells, 1967).

Dipsacus fullonum has a short-lived seed bank and produces seeds with very little dormancy—very few viable seed remain in the soil after five years. This species' seeds can survive longer when stored indoors (Gucker, 2009).
Dipsacus fullonum seeds germinate readily, even when immature or when inflorescences have been cut from the stem. Soil disturbance and warm temperatures promote germination. Alternating periods of light and dark and alternating temperatures may improve germination (Huarte et al., 2016), but in some cases Dipsacus seeds have germinated within 3 days of sowing without treatment. Maternal provisioning also affects germination, with larger seeds having higher germination rates. Freezing temperatures can induce dormancy and the presence of thick litter and established vegetation can prevent germination in Dipsacus fullonum (Gucker, 2009).

Baskin and Baskin (1996) found that 89 percent of seeds from closely related E. hieraciifolius were viable after eight years of burial.

Seed banks may be important for Holcus lanatus' ability to colonize disturbed areas. Seeds are not innately dormant, but dormancy can be induced. At least one source reported that many seeds can remain viable in the soil for up to 12 years. Other sources report seed viability of only 1–4 years. Holcus lanatus produces abundant seeds, with one study reporting 16,900 seeds per meter square in samples from the top two inches of soil in a natural habitat (Gucker, 2009). Seeds are eaten by vertebrates and earthworms in this species' native range (Gucker, 2009; Conner et al., 2013).

A study from Spain, within the native range of Ilex aquifolium, found that the seedbank was 80%–90% depleted after three years. This species has seeds with woody outer shells and underdeveloped embryos, requiring a year of dormancy before seeds can germinate. Seeds break dormancy in grasslands and edges sooner than in woodlands. Estimated seed bank persistence is three to five years (Arrieta & Suárez, 2004).

Rhizome fragments have been shown to remain viable for at least 10 years (Sutherland & Walton, 1990).
Jacobaea vulgaris seeds are not innately dormant. However, frost, drought, and burial can all induce dormancy, and seeds can remain viable for 6–20 years (Richardson, 2004; Jacobs, 2009).
Seeds likely only persist 2-3 years, but more information is needed.

Juncus effusus seed sink in water, allowing them to establish persistent seed banks. Juncus effusus seeds are long-lived in the seed bank, and populations have resurfaced after old beaver dams have failed (Ervin & Wetzel, 2000). One source reported J. effusus seeds could remain viable for more than 60 years (Lazenby, 1955).

Leucanthemum vulgare seeds are not innately dormant and most seeds will germinate in the fall, after dispersal, or the following spring (Clements et al., 2004). However, dormancy can be induced and seed longevity trials have found that most buried L. vulgare seeds remain viable for at least 10 years in the soil, with some seeds persisting in the seed bank for up to 20 years. Approximately 1% of seeds remain viable for more than 20 years (Clements et al., 2004).
This plant rarely, if ever, seeds in North America (MISIN, 2024), but the longevity of vegetative fragments is not known.

One source from Canada suggests seed longevity up to 20 years (Regional District Okanagan-Similkameen, 2006). More conservative assessments have confirmed viability of at least 80% beyond 2-3 years (Shamsi & Whitehead, 1974; Rawinski, 1982). The sheer volume of seeds often leads to seed bank dominance (Welling & Becker, 1993).
Anecdotally, propagules can persist for more than 10 years, but viability has only been confirmed for three or more years (Weiss et al., 2000; California Invasive Plant Council (Cal-IPC), 2004).

A study in England documented Myosotis discolor seeds persisting up to four years in the seed bank, but no longer (Asefa, 2011).

The assessor is not aware of research on the long-term longevity of propagule viability for Eurasian watermilfoil. Stem fragments likely do not persist for more than several months to a year. Studies suggest that seeds can remain viable for 3-7 years, but they may actually be viable for longer (Guppy, 1897; Patten, 1955; Aiken et al., 1979; Standifer & Madsen, 1997).

Phalaris arundinacea likely does form a significant seed bank, with densities between 100–5000 seeds per meter. Studies have found that seeds can survive up to 20 years. Seeds in inundated soil stay viable for longer than seeds floating in water (Waggy, 2010). This species can also apparently survive decades of mowing without exhausting its root resources (NRCS, 2003)
P. arundinacea germination is highly variable, with rates ranging from 3-93% (Kim et al., 2006). The drivers of this variability are unclear but may include genetic variability or poor curing/storage of seed (Kim et al., 2006). Saturated soil and exposure to light increases germination, and at least some research suggests that this species requires light to germinate (Kim et al., 2006). The seeds can germinate immediately after ripening, but they are also capable of dormancy (Lavergne & Molofsky, 2004) and whether seeds germinate immediately in natural conditions is unknown (Waggy, 2010).

Phleum pratense seeds can remain viable for up to five years (Esser, 1993). One study found most seeds germinate in the year they disperse. Some seeds also go dormant for the winter, allowing this species to take advantage of warm winters without risking entire generations (Morris et al., 1986).

Rubus bifrons seeds exhibit both mechanical and chemical dormancy and usually take two to three years to germinate. Both fire and digestion can break seed dormancy. Freeze-thaw cycles, wet-dry cycles, or scarification by insect or fungi damage can also break dormancy and induce germination for Rubus bifrons seeds. This species develops a seed bank, but information on seed longevity in the seed bank is currently lacking (Fryer, 2021).
Propagule persistence is estimated here based on the time needed to treat seedlings after control.
All published research reviewed in Cavers and Harper (1964) demonstrated buried seed viability of greater than 20 years.

It is likely that the seed bank lasts from one major disturbance to the next.

No quantitative data for propagule persistence in Solidago altissima was found in the literature search. Rhizomes can be maintained in refrigerated storage for at least a year. This species is described as forming a “large and long-lived” seedbank in its native range (Walck et al., 2001). One study from Europe found S. altissima to make between approximately 2–30% of the persistent seed bank where it was found (Meyer & Schmid, 1999). Seeds from this species are initially dormant and may require stratification to break dormancy and light to stimulate germination (Walck et al., 2001).

The assessor estimates seed persistence of 4–5 years and 1–2 years for rhizomes.

Tamarix seeds are short-lived, loosing viability in as few as 24 days when exposed to direct sunlight. In ideal conditions they can persist for up to 130 days. Seeds do not exhibit dormancy and Tamarix species do not have a persistent seed bank (Zouhar, 2003; Young et al., 2004).
Seeds require only moisture to germinate and generally do so within 24 hours of receiving moisture. They can have up to 98–100% germination rates under the right conditions. Seeds are capable of germination and establishment over a wide range of temperature regimes (Zouhar, 2003; Young et al., 2004).

At best guess, the seeds persist for less than five years, but observations are confounded by the use of pre-emergent herbicides.

Aquatic Utricularia species produce turions, or winter buds, which are storage organs that allow these species to overwinter. Turions can also resist desiccation (Silva et al., 2018). However, no details were available on how long turions or other propagules might remain viable.
At least some Verbascum blattaria seeds have been shown to remain viable for at least 120 years in controlled conditions (Telewski & Zeevaart, 2002).

Little information is available on seed longevity, but they are not expected to remain in the seed bank for more than a few years (DiTomaso et al., 2013).

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Q16 citation	**Q17 rank**	**Q17 confidence rank**
California Native Plant Society (CNPS). 2024. Acer negundo Forest & Woodland Alliance, Box-elder forest and woodland. https://vegetation.cnps.org/alliance/11. Accessed: December 16, 2024. Hildebrand N. 2006. Temperature and substrate effects on the juvenile establishment of the species Ailanthus altissima Mill. Swingle and Acer negundo L. M. Sc. University of Greenwich, London, UK.	Yes	Moderate
DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Tree-of-Heavan. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Fryer J.L. 2010. Ailanthus altissima. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/ailalt/all.html. Accessed: December 18, 2024. Rebbeck J. and J. Jolliff. 2018. How long do seeds of the invasive tree, Ailanthus altissima remain viable? Forest Ecology and Management 429:175–179.	Yes	Low
	Unknown	Not Rated

	No	Moderate
	No	High
Pitcher D. and M.J. Russo. 2012. Anthoxanthum odoratum, Global Invasive Species Team, The Nature Conservancy. https://wiki.bugwood.org/Archive:TNC/Anthoxanthum_odoratum. Accessed: October 25, 2024.	Yes	Moderate

	Yes	Moderate
	Yes	High
Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109.	Yes	High
Seed Information Database (SID). 2024. Seed Information Database. https://ser-sid.org/. Accessed: October 29, 2024.	Unknown	Not Rated
	Yes	Moderate

	No	Moderate
	NA	NA
Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Yes	Low
	NA	NA

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Canada thistle. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Leathwick D.M. and G.W. Bourdôt. 2012. A conceptual model for the population dynamics of Cirsium arvense in a New Zealand pasture. New Zealand Journal of Agricultural Research 55(4):371–384. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	Yes	High
	Yes	Moderate
	Yes	High

	Yes	Moderate
	No	Low
de Jong T.J. and P.G.L. Klinkhamer. 1988. Population ecology of the biennials Cirsium vulgare and Cynoglossum officinale in a coastal sand-dune area. The Journal of Ecology 76(2):366. de Jong T.J., P.G.L. Klinkhamer, and L.A. Boorman. 1990. Cynoglossum officinale L. Journal of Ecology 78(4):1123–1144.	Yes	High
Wells T.C.E. 1967. Dianthus armeria L. at Woodwalton Fen, Hunts. Proceedings of the Botanical Society of the British Isles 6:337–342.	No	Moderate

Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. Huarte H.R., M.D.R.P. Zorraquín, E.M. Bursztyn, and M.L. Zapiola. 2016. Effects of environmental factors on seed germination and seedling emergence of common teasel (Dipsacus fullonum). Weed Science 64(3):421–429.	Yes	High
Baskin C.C. and J.M. Baskin. 1996. Role of temperature and light in the germination ecology of buried seeds of weedy species of disturbed forests. II. Erechtites hieracifolia. Canadian J. of Botany 74(12):2002–2005.	Unknown	Not Rated
	NA	NA
	Yes	Moderate

Conner L., E. Carlson, and M. Harris. 2013. Holcus lanatus. https://wiki.bugwood.org/Holcus_lanatus. Accessed: October 11, 2024. Gucker C.L. 2009. Holcus lanatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/hollan/all.html. Accessed: October 10, 2024.	No	Moderate

Arrieta S. and F. Suárez. 2004. Germination and seed bank depletion of holly (Ilex aquifolium L.) in four microhabitat types. Seed Science Research 14(3):305–313.	Yes	High
	Yes	Moderate

Sutherland W.J. and D. Walton. 1990. The changes in morphology and demography of Iris pseudacorus L. at different heights on a saltmarsh. Functional Ecology 4(5):655–659.	Yes	High
Jacobs J.S. 2009. Plant guide for tansy ragwort, Senecio jacobaea L. USDA-Natural Resources Conservation Service, State Office, Bozeman, MT 49715. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	Yes	High
	Yes	Moderate

Ervin G.N. and R.G. Wetzel. 2000. Allelochemical autotoxicity in the emergent wetland macrophyte Juncus effusus (Juncaceae). American Journal of Botany 87(6):853–860. Lazenby A. 1955. Germination and establishment of Juncus effusus L.: The effect of different companion species and of variation in soil and fertility conditions. The Journal of Ecology 43(1):103.	Yes	High
	Yes	High
	Yes	Moderate
	Yes	Moderate

Clements D.R., D.E. Cole, J. King, and A. McClay. 2004. The biology of Canadian weeds. 128. Leucanthemum vulgare Lam. Canadian Journal of Plant Science 84(1):343–363.	No	Moderate
Midwest Invasive Species Information Network (MISIN). 2024. Moneywort (Lysimachia nummularia), Michigan State Unversity, East Lansing, MI. http://www.misin.msu.edu/facts/detail.php?id=178. Accessed: February 1, 2025.	Yes	Moderate

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	Unknown	Not Rated

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	No	High

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	Yes	High
	No	High
	NA	NA
	No	High
	No	Moderate

	No	High
	Yes	High
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	Yes	Moderate
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	Yes	High
	Yes	Moderate
	NA	NA

	Yes	High
	Yes	Moderate
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	Yes	High

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	No	High
	No	High

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Telewski F.W. and J.A.D. Zeevaart. 2002. The 120-yr period For Dr. Beal's seed viability experiment. American Journal of Botany 89(8):1285–1288.	NA	NA

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	Yes	Low

Q17: Palatability (1 pt)

Q17 notes
Evidence suggests that this species is unpalatable (Rosario, 1988).
While some sources indicate Ailanthus altissima can be controlled with grazing, others indicate that it is relatively unpalatable to ungulates. Several studies show that it is browsed less frequently than associated species in natural settings (Fryer, 2010; Knüsel, 2019).
frequently. While some people do forage this species, there is likely not enough foraging activity to impact population growth.

Cattle are known to graze this species. Alopecurus pratensis was introduced as a pasture grass.
This plant is palatable (NWCB, 2015).
Anthoxanthum odoratum was introduced and is planted as a forage plant and grazing animals will eat this species (Brusati & Warner, 2004; Pitcher & Russo, 2012; Lysgaard, 2022). However, most grazers tend to prefer native grasses to A. odoratum, resulting in increases of this species where grazing occurs, at least in the Pacific Northwest (Dennehy et al., 2011).

Arrhenatherum elatius was introduced as a pasture grass. This species has a bitter taste to cattle and wildlife does not graze it enough to provide control (Afonin et al., 2016).
Arundo donax is not grazed by wildlife, and livestock do not preferentially graze this species, though cattle and goats will eat it if no other options are available (McWilliams, 2004).
This species produces defensive chemicals that deter Spodoptera larvae from feeding on them (Azab, 2021). No information was found on whether it was palatable to grazers.

Centaurea solstitialis is toxic to horses, causing neurological damage when consumed, but sometimes horses will seek it out anyway. Other grazers, including mules and burros, can eat C. solstitialis without danger. Cows, sheep, and goats will graze this species when it is young, but avoid it once spines develop. Grasshoppers are also known to eat C. solstitialis (Innes & Zouhar, 2021).

Some sources describe C. solstitialis as palatable and nutritious to livestock, at least when young (Innes & Zouhar, 2021). Researchers studying the effects of C. solstitialis on plant communities have found this species vulnerable to herbivory and sometimes use exclosures to protect experimental plots from herbivory (e.g., Dukes et al., 2011; Becerra et al., 2020). Other resources—and the general public perception—regard this species as poor forage (NWCB, 2024).

While some species may eat Cirsium arvense, it is generally thought of as a grazing increaser and is not considered palatable to livestock (Zouhar, 2001; DiTomaso et al., 2013; CABI, 2024). This plant requires thick gloves to pull because of its spines, so animals are likely to find less well-defended plants to eat.
This species is very spiny—assessors have observed cattle attempting to eat it, but then being deterred.

The berries are palatable, but foliage browsing appears to be limited.
Prominent thorns are likely to deter herbivory to some extent, but coppiced plants have been observed, indicating some degree of palatability.
Cynoglossum has a number of physical and chemical defenses against herbivory. This species accumulates silicon in leaves, roots, and nutlets, which can make it more difficult for herbivores to chew and digest. It also produces alkaloids which can intoxicate or poison horses and cows when consumed, and in general, horses and cows won't eat C. officinale. It produces other defensive compounds to prevent herbivory as well. Rabbits also do not eat this species. Sheep will occasionally eat C. officinale, but may also be poisoned by it (de Jong et al., 1990; Cortinovis & Caloni, 2015). Cynoglossum officinale may experience less insect herbivory in North America than in its native range (Eigenbrode et al., 2008). Some European butterfly species are able to repurpose C. officinale's defensive chemicals for their own defense (de Jong et al., 1990). In the Pacific Northwest, at least some species of woolly bear caterpillars (Subfamily Arctiinii) will eat C. officinale.
Grazing is considered a threat within its native range, where Dianthus armeria is commonly considered Endangered or Vulnerable, so it is likely to be palatable (Wilson, 1999).

Spines, tough stems, and bitter flavor generally make Dipsacus fullonum unpalatable to grazers (Gucker, 2009; DiTomaso et al., 2013), though livestock will occasionally eat Dipsacus flowers.

Some sources regard Holcus lanatus as unpalatable or not preferred by grazers, but most literature suggests some degree of palatability. Grazing by both cattle and elk are known to reduce the abundance of this species. H. lanatus can provide up to 40% of a Tule elk's diet at Tomales Point, in California (Gucker, 2009). One study found that elk grazing at Tomales Point reduced H. lanatus abundance, cover, biomass, and seedling establishment in open grasslands (Ender et al., 2017). This species is also an important food source for elk near Mount St. Helens (Gucker, 2009). In addition, H. lanatus is eaten by birds and has become an important food source for California Quail (Gucker, 2009). Plants are at their most nutritious when vegetative (Gucker, 2009).

Herbivory results in increased spine development in Ilex aquifolium leaves and the bark produces defensive chemicals (e.g., methanol) that deter herbivory (NWCB, 2022). This species also produces a suite of other secondary compounds, several of which are herbivory defensive mechanisms (Valladares et al., 2005). Cows and horses will browse I. aquifolium in the winter in this species' native range (Arrieta & Suárez, 2004). However, this does not suggest that I. aquifolium is preferred over other species.
This plant contains numerous harmful chemicals, such as selenium and calcium oxalate crystals-; while deer and rabbit herbivory have been observed in its native range, Impatiens capensis can be toxic to livestock (Mitchell, 2025).

This species is considered poisonous (Diggs et al., 1999).

Due to high alkaloid contents, Jacobaea vulgaris is toxic to most mammals (sheep are an exception) (Richardson, 2004; Jacobs, 2009). This species has caused serious poisonings of livestock in the Pacific Northwest and may also be poisonous to deer (Richardson, 2004; Jacobs, 2009). The alkaloids present in the nectar and pollen of this plant also make bitter, off-color honey (Jacobs, 2009). The presence of J. vulgaris reduces forage values in the pastures where it occurs (Jacobs, 2009). Jacobaea vulgaris plants in the introduced range can produce up to 90% more alkaloids than plants in the native range (Lin et al., 2019). While these alkaloids are effective in discouraging generalist herbivores, plants from the invasive range have less defense against specialist herbivores than plants growing in their native range, even after the introduction of those specialists as biocontrols (Lin et al., 2019).

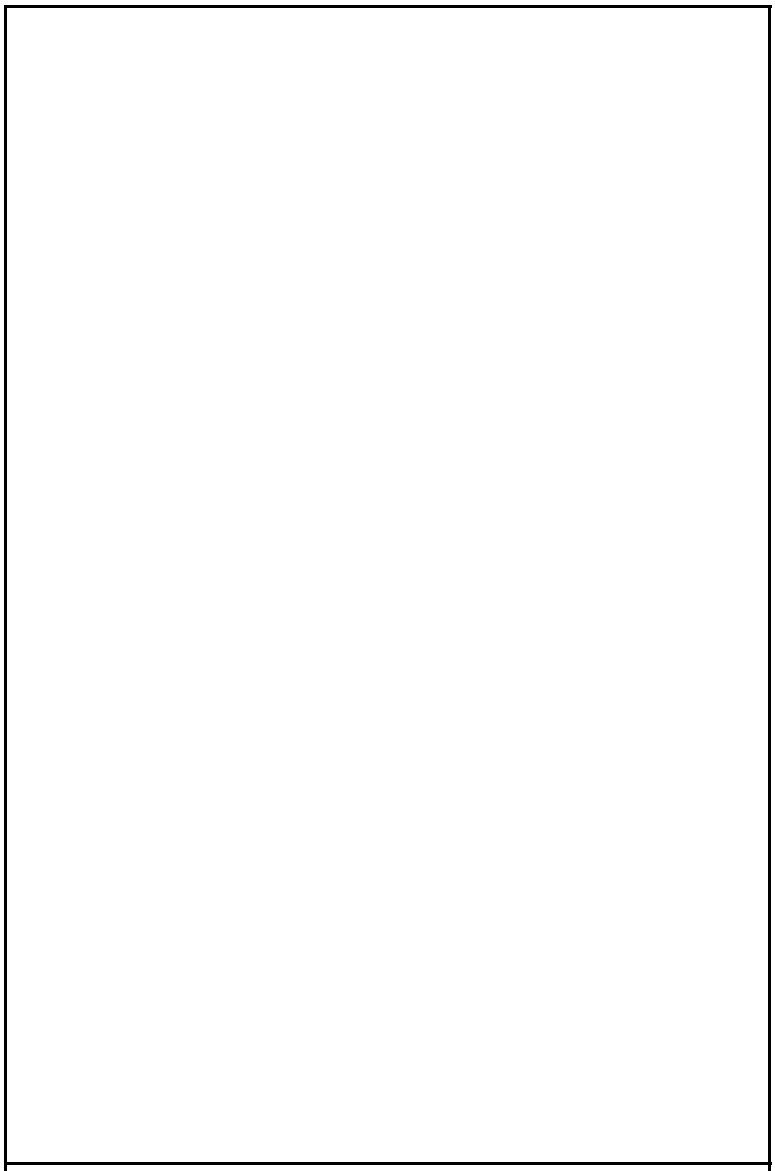
The seed is palatable, but animals don’t appear to browse this species often.

When found in pastures, Juncus effusus tussocks are obviously ungrazed (Brooks & Clemants, 2019). This taxon is regarded as a weed in Ireland, Great Britain, and New Zealand in part because it is unpalatable and has low nutritional value (McCorry & Renou, 2003).

Cattle generally avoid grazing Leucanthemum vulgare, but horses, sheep, and goats will eat this species. However, livestock generally prefer grasses to L. vulgare (Clements et al., 2004; Brusati, 2005). Grazing can help deplete the seed bank via trampling, but at the same time disperses seeds through livestock digestive tracts (EDDMapS, 2023). Leucanthemum vulgare produces several secondary compounds that function as defenses against insect herbivory (NWCB, 2000). Leucanthemum vulgare plants in the Pacific Northwest experience less herbivory than they would in their native range, because very few insects are adapted to feed on L. vulgare in North America (Stutz et al., 2016).
Secondary compounds produced by Lysimachia nummularia make it unpalatable to many herbivorous mammals (Hilty, John, 2019).

Lythrum salicaria primarily grows in areas with little herbivory pressure from livestock, but studies have shown that muskrats prefer other species such as cattails (Typha spp.) (Thompson et al., 1987).
Reviews of weed control and impact documents strongly suggests horehound is unpalatable to livestock and taints meat (Greonteman, 2018). Horehound is a grazing increaser, further supporting this idea.

In England, rabbits eat Myosotis discolor frequently enough to be a significant source of seed dispersal (Pakeman et al., 1998).



Watercress species produce compounds that deter aquatic invertebrate herbivores, but do not appear to deter mammalian herbivores.

Phalaris arundinacea has been cultivated as forage for both livestock and wildlife (Lavergne & Molofsky, 2004; Waggy, 2010). In some studies, P. arundinacea has been preferred over other pasture grasses by horses and geese, but palatability and nutritional value may depend on age and variety (Waggy, 2010). Some varieties of this species may contain enough alkaloids to render them potentially toxic, but because P. arundinacea was introduced to North America as a forage species, it may have fewer alkaloids than in its Eurasian range(Lavergne & Molofsky, 2004; Waggy, 2010). Wildlife has been observed to occasionally forage on this species, but its importance to any of the animals seen to consume it is unknown (Lavergne & Molofsky, 2004; Waggy, 2010).

Insect diversity is frequently lower in wetlands dominated by P. arundinacea and fewer insects feed on this species than on native species (Lavergne & Molofsky, 2004). Plants frequently produce secondary compounds like alkaloids as a defense against herbivory, so P. arundinacea may be better defended against insect damage and disease than its native competitors.

Phleum pratense is cultivated as a pasture grass and hay for livestock (especially horses) and big game animals. This species can also be a significant part of elk, deer, and wild bird diets (Esser, 1993).
This plant is highly palatable to livestock (Cornell CALS, 2025).
Deer and elk prefer many rose species, including Rosa canina, in spite of the thorns. However, browsing pressure does not appear to be enough to control this species.

Deer and elk prefer many rose species, including Rosa multiflora, in spite of the thorns. However, browsing pressure does not appear to be enough to control this species.
This species is recommended in landscaping as a reliably deer proof rose.
Ungulates sometimes browse Rubus bifrons leaves, but they do not prefer them, likely due to the large spines. Insects and other invertebrates, including several leafhopper species, do eat the leaves. Rubus bifrons is the preferred host for Dikrella californica (blackberry leafhopper), which is also an agricultural pest on grapes and roses. (Fryer, 2021). Young shoots of Rubus bifrons apparently contain a chemical that deters Ariolimax columbianus from feeding (Wood, 2012).
The fruit is palatable, but most animals don't eat the leaves and canes.
This species is not palatable to most domestic grazers, but may be browsed by deer (Cavers & Harper, 1964).
Some populations are palatable, while others are not, depending on endophytes. It's commonly planted as a pasture grass but with endophyte-free seed. Feral populations may be endophyte free or not.

Though Solidago altissima is reported to decrease under grazing pressure, it is rarely eaten by mammals and may be toxic to mice (Walck et al., 2001). On the other hand, this species is host to a diversity of invertebrate herbivores in its native range, ranging from generalists like grasshoppers, to a wide variety of specialist gall-forming insects. Insect herbivory can reduce growth and other competitive advantages for this species, preventing it from developing a closed canopy that excludes other plants (Walck et al., 2001).
Elk will eat this species rarely, when accessible, but herbivory is not a practical control for this species.

Grazers and browsers, including livestock, prefer native trees and shrubs to Tamarix. Grazing practices are implicated in the spread and abundance of Tamarix in the southwest (Zouhar, 2003; Stromberg et al., 2007).
This is a forage plant often included in pasture mixes.
This species is used in pasture mixes, primarily as a source of nitrogen for grasses.

Utricularia species in Washington may be eaten by fish, muskrats, and waterfowl (Washington Department of Ecology, 2024). However, grazing is not a practical management technique for this aquatic plant.

This plant has historically been used as both food and medicine by humans (Shahzad et al., 2011). Grazer desirability is unknown.

Small size makes it unlikely to be grazed.

Q17 citation	**Biological Characteristics Score**
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	70.83

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	40.00

Biological Characteristics Rank	**Biological Characteristics confidence score**	**Biological Characteristics confidence rank**
High	84.38	High
Moderate	69.79	High
High	59.38	Moderate

High	50.00	Moderate
High	70.83	High
Moderate	66.67	High

Moderate	75.00	High
Moderate	67.71	High
Moderate	91.67	High
High	54.17	Moderate
Insignificant	54.17	Moderate

Moderate	58.33	Moderate
High	4.16	Low
High	79.17	High
NA	NA	NA

High	83.33	High
High	54.17	Moderate
High	63.54	Moderate

Moderate	43.33	Moderate
High	66.67	High
High	79.17	High
Insignificant	62.50	Moderate

High	83.33	High
Moderate	45.83	Moderate
NA	NA	NA
High	83.33	High

Moderate	70.83	High

High	75.00	High
High	50.00	Moderate

High	75.00	High
High	70.83	High
Low	37.50	Moderate

High	76.04	High
High	63.54	Moderate
High	75.00	High
High	75.00	High

Low	66.67	High
High	37.50	Moderate

Moderate	58.33	Moderate
Low	66.67	High
Moderate	36.67	Moderate

Low	54.17	Moderate
NA	NA	NA

High	66.67	High
High	70.83	High

High	79.17	High

Low	41.67	Moderate
Low	66.67	High
High	70.83	High
NA	NA	NA
Low	66.67	High
High	71.88	High

Moderate	83.33	High
High	75.00	High
High	79.17	High
Moderate	58.33	Moderate
Moderate	75.00	High
Moderate	84.38	High
High	58.33	Moderate
NA	NA	NA

High	75.00	High
Moderate	66.67	High
High	70.83	High
Moderate	66.67	HIgh

Moderate	80.21	High
Low	75.00	High
Low	70.83	High

High	54.17	Moderate
Insignificant	45.83	Moderate

High	37.50	Moderate
Low	37.50	Moderate

Assessor(s)	**Taxon**	**Q1 rank**	**Q1 confidence rank**
Walter Fertig, Clayton Antieau, David Wilderman	Acer negundo	High	High
Emily Stevenson, Walter Fertig, Ethan Coggins	Ailanthus altissima	High	High

Emily Stevenson	Alliaria petiolata	Moderate	High
Carlo Abbruzzese	Alopecurus pratensis	High	Moderate
Emily Stevenson, Walter Fertig	Amorpha fruticosa	Moderate	High

Regina Johnson, Molly S. Wiebush	Anthoxanthum odoratum	High	High
Regina Johnson	Arrhenatherum elatius	High	Moderate

Regina Johnson	Arum italicum ssp. italicum	Low	Moderate
Molly S. Wiebush	Arundo donax	Low	High
Molly S. Wiebush	Bellardia viscosa	Moderate	High

Regina Johnson	Bellis perennis	High	Moderate
Regina Johnson	Betula pendula	Moderate	High
Wesley Glisson	Butomus umbellatus	Moderate	High

Molly S. Wiebush	Centaurea solstitialis	Moderate	High
Emily Stevenson	Chondrilla juncea	High	High

Emily Stevenson, Ethan Coggins, Regina Johnson, Molly S. Wiebush	Cirsium arvense	High	High
Carlo Abbruzzese	Cirsium vulgare	High	Moderate

Regina Johnson	Clematis vitalba	Moderate	Moderate
Regina Johnson	Cotoneaster spp.	High	Moderate
Regina Johnson	Crataegus monogyna var. monogyna	High	High

Helen Lau, Molly S. Wiebush	Cynoglossum officinale	High	High
Regina Johnson, Carlo Abbruzzese	Dianthus armeria	High	High

Kimberly Quayle, Regina Johnson, Molly S. Wiebush	Dipsacus fullonum	High	High

Regina Johnson, Walter Fertig	Erechtites minimus	Moderate	Moderate
Emily Stevenson	Fallopia xbohemica	High	High
Regina Johnson	Hieracium pilosella	Low	High

Molly S. Wiebush	Holcus lanatus	High	High
Molly S. Wiebush, Regina Johnson	Ilex aquifolium	High	High

Regina Johnson	Impatiens capensis	High	Moderate
Emily Stevenson	Iris pseudacorus	High	High

Molly S. Wiebush	Jacobaea vulgaris	High	High
Carlo Abbruzzese	Juglans regia	High	Moderate

Molly S. Wiebush	Juncus effusus subsp. effusus	High	High
Regina Johnson	Lamium galeobdolon	Moderate	Moderate

Regina Johnson	Lathyrus latifolius	High	High
Regina Johnson	Lathyrus sylvestris	High	High

Molly S. Wiebush	Leucanthemum vulgare	High	High
Emily Stevenson	Lysimachia nummularia	Moderate	High

Kimberly Quayle, Regina Johnson	Lythrum salicaria	High	High
Ethan Coggins	Marrubium vulgare	High	Moderate
Regina Johnson	Mycelis muralis	High	High

Molly S. Wiebush	Myosotis discolor	High	High
Wesley Glisson	Myriophyllum heterophyllum	Low	High

Wesley Glisson	Myriophyllum spicatum	High	High
Regina Johnson	Nasturtium officinale	High	Moderate

Emily Stevenson, Molly S. Wiebush, Regina Johnson	Phalaris arundinacea	High	High
Molly S. Wiebush	Phleum pratense	High	High

Regina Johnson	Plantago lanceolata	High	High
Regina Johnson	Poa annua	High	High

Wesley Glisson	Potamogeton crispus	High	High
Regina Johnson	Quercus robur	Moderate	High

Regina Johnson	Rosa canina	High	Moderate
Regina Johnson	Rosa multiflora	Moderate	Moderate
Regina Johnson	Rosa rugosa	High	High

Emily Stevenson, Regina Johnson, Molly S. Wiebush	Rubus bifrons	High	High
Carlo Abbruzzese	Rubus laciniatus	High	High

Carlo Abbruzzese	Rumex crispus	High	High
Regina Johnson	Sasa palmata	Low	High
Regina Johnson	Schedonorus arundinaceus	High	High

Emily Stevenson	Schoenoplectus mucronatus	Low	High
Regina Johnson	Senecio sylvaticus	High	High

Regina Johnson	Solanum dulcamara	High	High
Molly S. Wiebush	Solidago altissima	Low	High

Carlo Abbruzzese	Spartina alterniflora	Low	High
Molly. S. Wiebush	Tamarix ramosissima	Moderate	Moderate

Regina Johnson	Trifolium pratense	High	High
Regina Johnson	Trifolium subterraneum	High	Moderate

Molly. S. Wiebush	Utricularia inflata	Moderate	Moderate
Carlo Abbruzzese	Verbascum blattaria	High	Moderate

Molly S. Wiebush	Veronica anagallis-aquatica	High	High
Regina Johnson	Veronica arvensis	High	High

Question 1. Current Range Size in Washingto

Q1 notes
Acer negundo is found in 23 of 39 counties in Washington and 7 of 9 ecoregions, though records in the Northwest Coast ecoregion are historical (not documented in the last 40 years). This species is newly documented in Cowlitz and Klickitat counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).
Ailanthus altissima is found in 27 of 39 counties in Washington. Most populations are found in cities and towns (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023). Escaped populations are frequently associated with the Columbia and Snake Rivers.

Alliaria petiolata is found in 28% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). Most documentation is from iNaturalist.

According to herbarium data and other records, this species occurs in 59% of Washington counties (Consortium of Pacific Northwest Herbaria (CPNWH), 2023; iNaturalist Contributors, 2023).

Amorpha fruticosa is known from 16 of 39 counties and 4 of 9 ecoregions. Most populations are currently along the Snake River and the Columbia River (downstream of the Snake River confluence). Two recent discoveries (since 2019) in Douglas and Okanogan counties greatly expand its potential range (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Anthoxanthum odoratum is found in 24 of 39 (62%) of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Arrhenatherum elatius has been documented in 82% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Arum italicum ssp. italicum is present in 10% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Arundo donax is documented in 8% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Bellardia viscosa is found in 18 of 39 (46%) of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Bellis perennis is documented in 62% of Washington counties (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Betula pendula is found in 49% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Butomus umbellatus is found in 26% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Centaurea solstitialis is found in 49% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023). Washington, Oregon, California, and Idaho have the largest infestations of Centaurea solstitialis in the United States (Innes & Zouhar, 2021).

Chondrilla juncea is found in 59% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Cirsium arvense has been documented in all 39 counties in Washington State (WSDA, 2018; CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Cirsium vulgare has been documented in all 39 counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

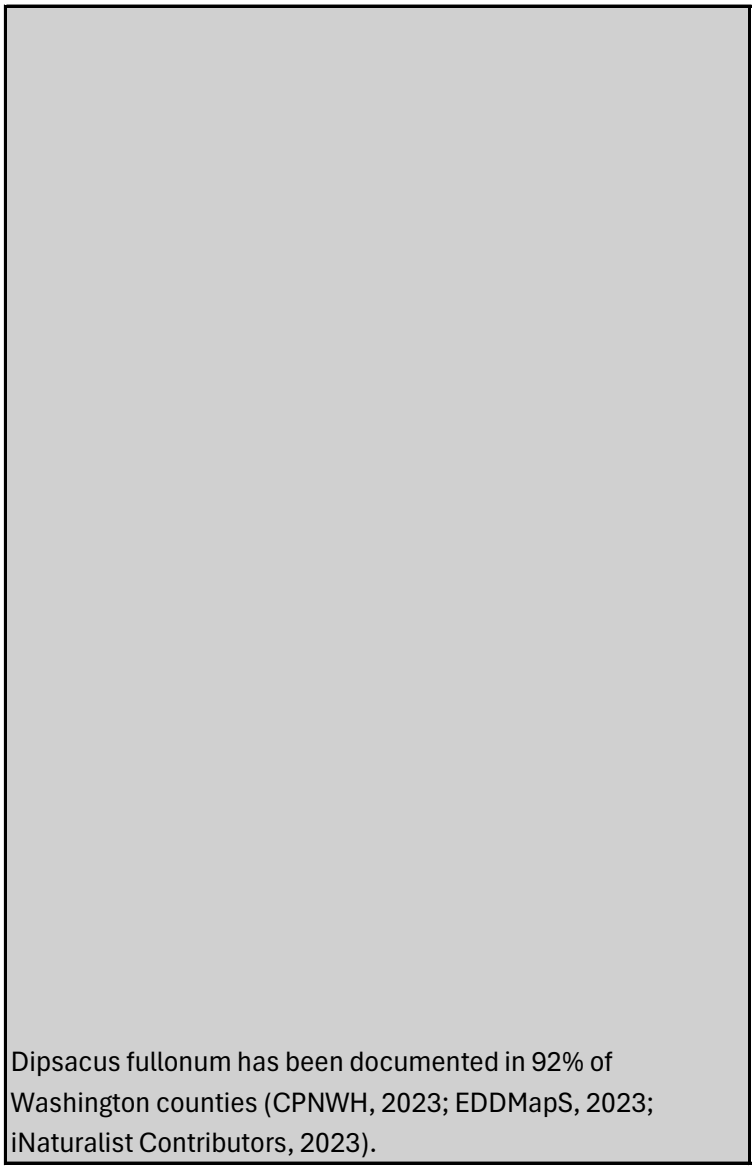
This species is found in 36% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Cotoneaster species are found in 69% of the Washington counties (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

This taxa is found in 51% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Cynoglossum officinale is found in 56% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

This species has been documented in 90% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).



Dipsacus fullonum has been documented in 92% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Erechtites minimus is found in 14 of 39 counties and 3 of 9 ecoregions in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). A report from Spokane County (SEINet Portal Network, 2023) is a misidentified specimen.

This taxa is found in 56% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Hieracium pilosella is present in 23% of counties in Washington (WSDA, 2018; CPNWH, 2024; iNaturalist Community, 2024).

Holcus lanatus is found in 59% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Ilex aquifolium is reported from 24 out of 39 counties (62%) in Washington (Consortium of Pacific Northwest Herbaria (CPNWH), 2024; EDDMapS, 2024; iNaturalist Community, 2024).

This species is found in 62% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Iris pseudacorus is documented in 97% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Jacobaea vulgaris is found in 69% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Juglans regia is found in 67% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Juncus effusus ssp. effusus is known from 27 of 39 (69%) counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Lamium galeobdolan is present in 46% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Lathyrus latifolius is found in 82% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

This species is found in 64% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Leucanthemum vulgare is found in 85% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Lysimachia nummularia is present in 41% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Lythrum salicaria is found in 95% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Marrubium vulgare is document in 59% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Mycelis muralis is found in 72% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Myosotis discolor is found in 28 of 39 (72%) of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Myriophyllum heterophyllum is found in 10% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023; Washington State Department of Ecology, 2024).

Myriophyllum spicatum is documented from 87% of counties in Washington State. We have good data on Eurasian watermilfoil locations in waterbodies throughout the state. The species often tops out on the water's surface, so it is easily recognized by surveyors and the public. Spatial data is copious (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023; WSDA, 2023; Washington State Department of Ecology, 2023a).
Nasturtium officinale is found in 74% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Phalaris arundinacea has been documented in all 39 counties in Washington state (100%) (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Phleum pratense is found in 72% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Plantago lanceolata is found in 90% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Potamogeton crispus is documented in 90% of Washington Counties (WSDA 2018; CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023; Washington State Department of Ecology, 2023).

Quercus robur is documented in 44% of counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Rosa canina is documented from 67% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Rosa multiflora is documented from 49% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Rosa rugosa is documented in 56% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Rubus bifrons has herbarium records from 32 of 39 counties in Washington state (82%) (CPNWH, 2023; iNaturalist Contributors, 2023). This species is also reported from Okanogan and Pend Oreille Counties (EDDMapS, 2023).

Rubus laciniatus is documented from 85% of counties in Washington State (CPNWH 2024; EDDMapS, 2024; iNaturalist Community, 2024).

This species is found in 97% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Sasa palmata is present in 23% of Washington counties (CPNWH, 2024; iNaturalist Community, 2024).

Schedonorus arundinaceus is documented in 85% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

The Flora of North America notes that Schoenoplectus mucronatus is cultivated for wildlife in Clark County, Washington, but has yet to establish elsewhere in that area (NWCB, 2007; Smith, 2020). This species is currently documented from 5% of the counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023)

Senecio sylvaticus is documented in 56% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Solanum dulcamara is documented from all counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Solidago altissima is found in 5% counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Spartina alterniflora is documented from 8% of counties in Washington State (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Tamarix ramosissima is documented in 33% of Washington counties (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023)

Trifolium pratense is documented from 92% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

This species is likely underreported.

Herbarium and iNaturalist records of Utricularia inflata have been collected in 6 out of 39 counties in Washington state (15%) as of 2024 (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Verbascum blattaria is documented in 77% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Veronica anagallis-aquatica is documented in 29 of 39 (74%) counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Veronica arvensis is documented in 90% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

n (15 pts)		
Q1 citation	**Q2 rank**	**Q2 confidence rank**
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate

CPNWH. 2024. Consortium of Pacific Northwest Herbaria. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Low
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Low
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations of Anthoxanthum odoratum from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=75475. Accessed: October 24, 2024.	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Unknown	Not Rated
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations of Bellardia viscosa from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=537967. Accessed: October 29, 2024.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations of Bellardia viscosa from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=537967. Accessed: October 29, 2024.	NA	NA
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Innes R.J. and K. Zouhar. 2021. Centaurea solstitialis: In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/censol/all.html. Accessed: September 26, 2024.	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Washington State Department of Agriculture (WSDA). 2018. Canada Thistle (Cirsium arvense) Distribution 2018. Washington State Department of Agriculture. https://cms.agr.wa.gov/WSDAKentico/Imported/ThistleCanada.pdf. Accessed: January 8, 2025.	Low	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024. SEINet Portal Network. 2023. SEINet Record Search. https://swbiodiversity.org/seinet/collections/search/index.php. Accessed: December 31, 2023.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Observations of Ilex aquifolium from Washington State, U.S.A. https://www.inaturalist.org/observations?place_id=46&subview=table&taxon_id=53856. Accessed: September 20, 2024.	High	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Unknown	Not Rated

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Washington State Department of Ecology. 2024. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	Low	Moderate

Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	Moderate
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.Bolduan B.R., G.C. van Eeckhout, H.W. Quade, and J.E. Gannon. 1994. Potamogeton crispus–the other invader. Lake and Reservoir Management 10(2):113–125. Washington State Department of Agriculture (WSDA). 2018. Curlyleaf Pondweed (Potamogeton crispus) Distribution 2018. https://cms.agr.wa.gov/WSDAKentico/Imported/CurlyLeafPondweed.pdf?/. Accessed: February 6, 2025. Washington State Department of Ecology. 2023. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	High	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.	Moderate	Low
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Unknown	Not Rated
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Noxious Weed Control Board (NWCB). 2007. Written Findings of the Washington State Noxious Weed Control Board: Schoenoplectus mucronatus. Olympia, WA. Smith S.G. 2020. Schoenoplectus mucronatus (Linnaeus) Palla. In: Flora of North America [Online]. http://floranorthamerica.org/Schoenoplectus_mucronatus. Accessed: February 3, 2025.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Insignificant	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	High
CPNWH. 2024. Consortium of Pacific Northwest Herbaria. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	High	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Unknown	Not Rated

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	Moderate

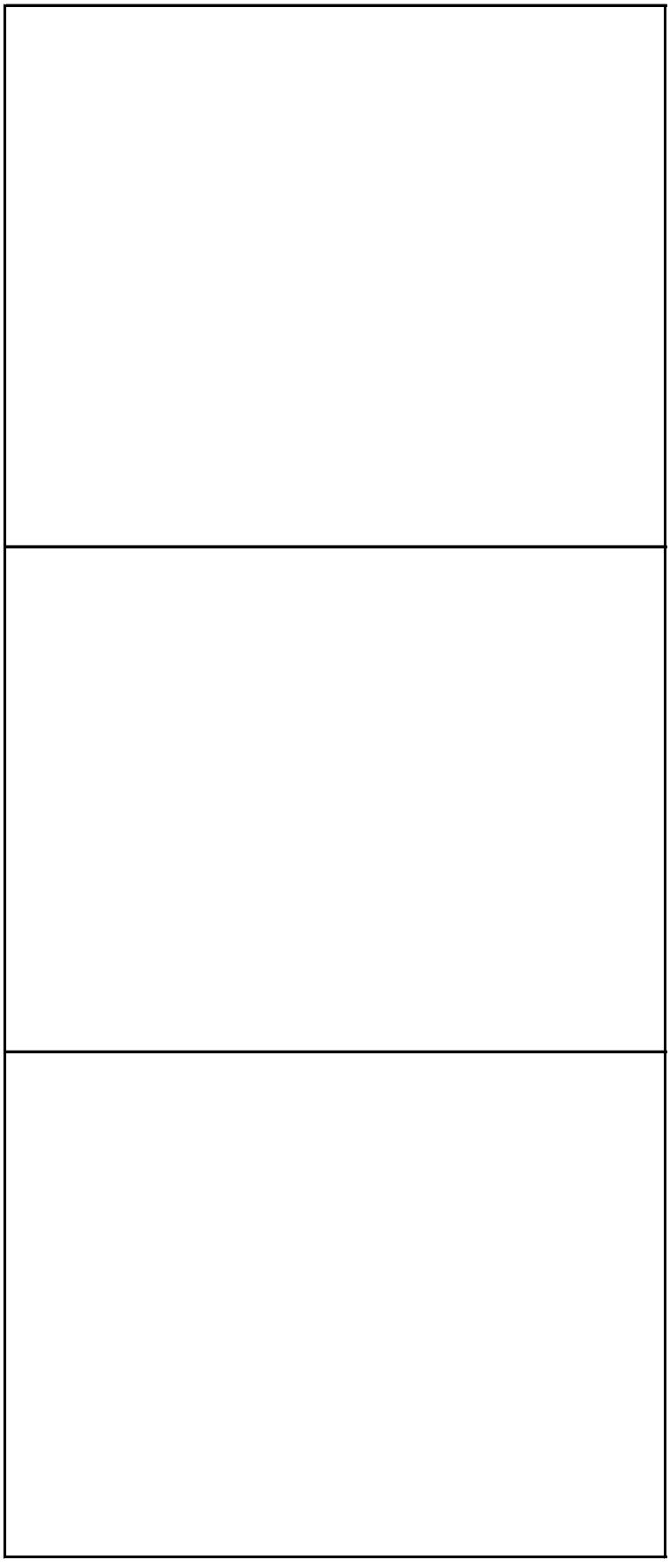
Question 2. Current Trend in Total Range (1

Q2 notes
Most populations appear to have spread short distances from cultivation. Numerous historical occurrences along the Snake River near Wawawai and Almota do not appear to have spread significantly after their initial documentation in the 1890s. Many collections bear notes that they are from cultivated street trees or from public spaces in towns or college campuses.
Ailanthus altissima is mostly spreading in urban and suburban settings, especially in the greater Seattle area and eastern cities (Yakima, Tri-Cities, Spokane). Some in-filling or spread along the Columbia and Snake Rivers has also been observed. The rate of spread seems low, given potential for fruits to disperse downriver. This species has been in the state for almost 100 years (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Most of the occurrences documented are from iNaturalist, suggesting recent expansion for this species (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).
Potential available habitat suggests that the current trend in range for this species is stable (Consortium of Pacific Northwest Herbaria (CPNWH), 2023).
New populations have become established in riparian habitats along the Columbia River and its tributaries. There is high potential for this species to spread to similar habitats along the Yakima, Spokane, and Grand Ronde rivers. The 2019 Okanogan County site is troubling because it is not a direct tributary of the Columbia River, suggesting the species could spread into other bodies of water (and might also spread into Canada) (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

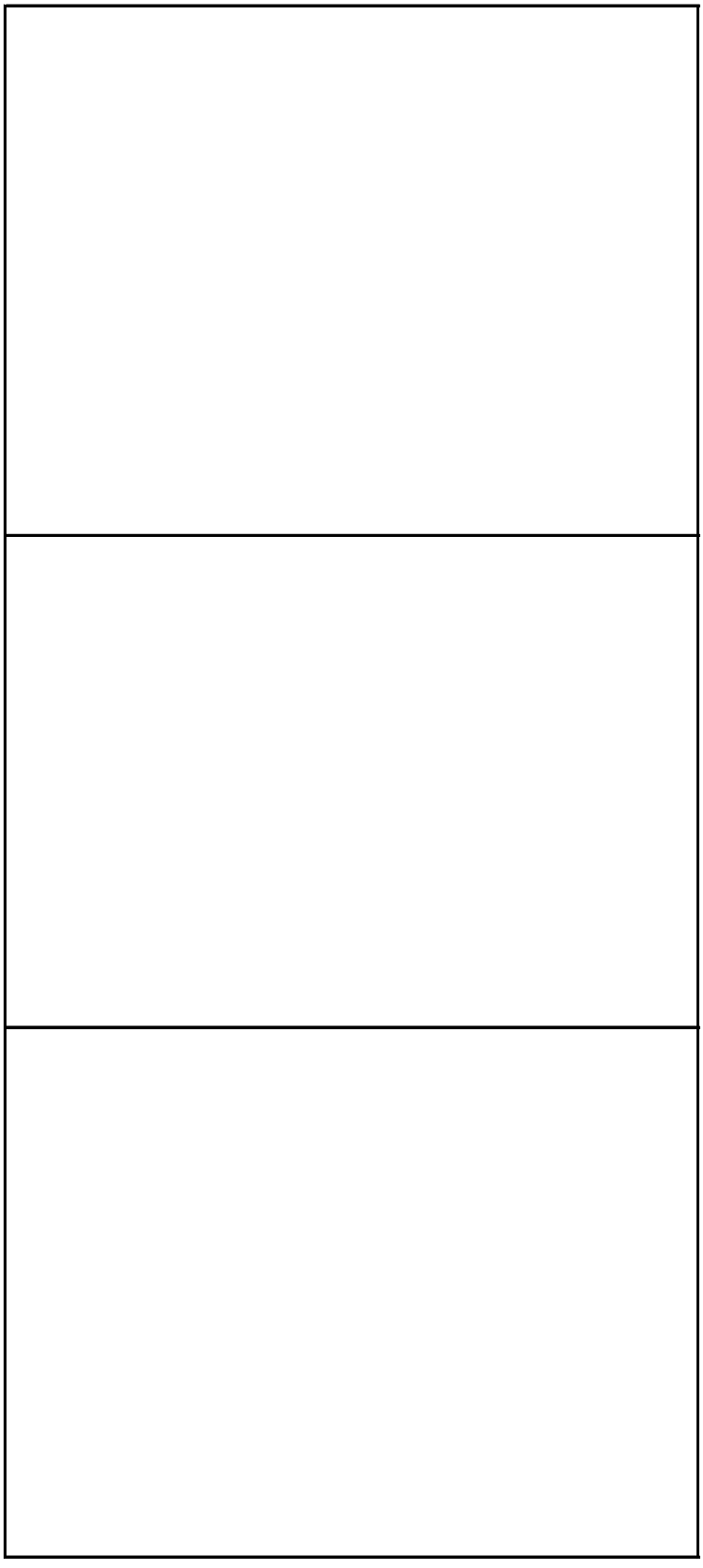
iNaturalist records suggest that Anthoxanthum odoratum has expanded into the northern Olympic Peninsula over the last 12 years (iNaturalist Community, 2024). This species has not apparently expanded its range in the rest of the state over the last 20 years (CPNWH, 2024; iNaturalist Community, 2024).

Not enough information is available to determine current trends and range for this species. The earliest reports of escaped Arundo donax in Washington appear to be from 2012 (EDDMapS, 2023; iNaturalist Contributors, 2023), suggesting it has only recently arrived in the state. Experimental plantings of A. donax were done in Prosser, WA in 2003 and 2006, but failed to establish. In 2013, ornamental cultivation was reported from Yakima, Tacoma, and a community garden in Seattle. Only the community garden had populations that were potential escapes (NWCB, 2013).
Bellardia viscosa has expanded into the northern Olympic Peninsula within the last 20 years. This species has not apparently expanded its range in the rest of the state in the last 20 years (CPNWH, 2024; iNaturalist Community, 2024).



Based on herbarium records and iNaturalist observations, Centaurea solstitialis appears to be increasing its range primarily along the Columbia River east of the Cascades in Washington State (CPNHW, 2023; iNaturalist Contributors, 2023).

Cirsium arvense is reported from all counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023). This species appears to occur in almost all of the suitable generalized habitat available in Washington (Jarnevich et al., 2023).

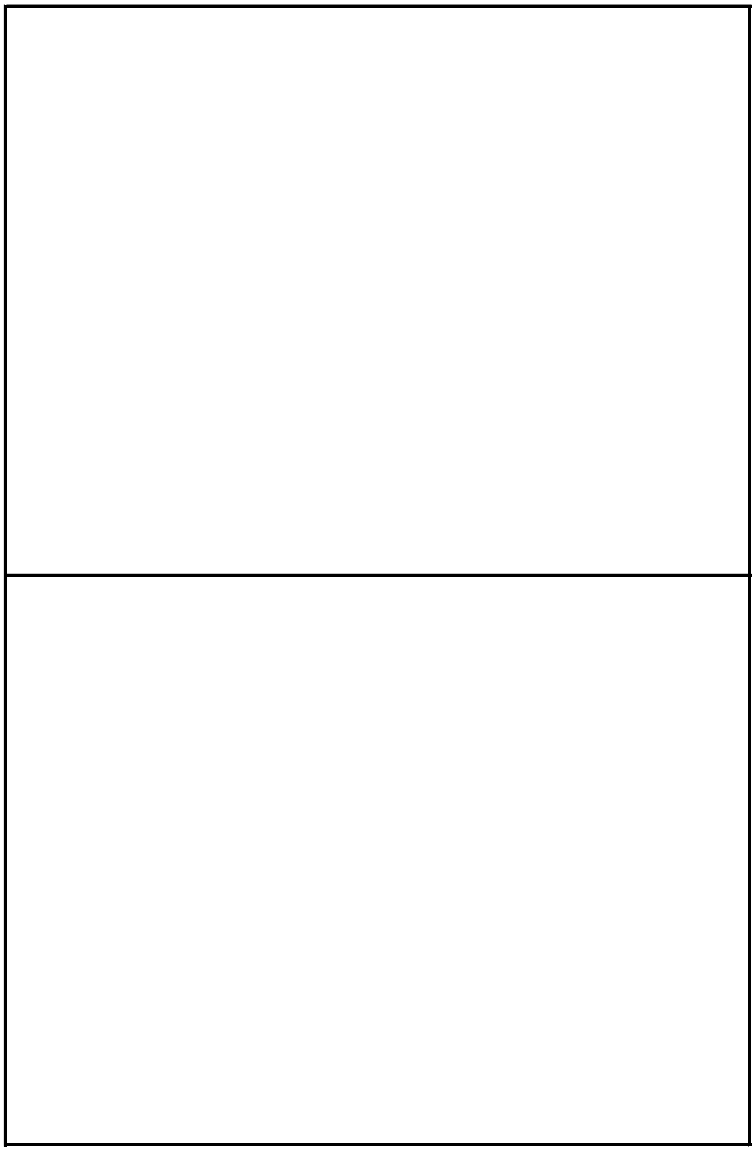


Based on herbarium records and iNaturalist observations, Cynoglossum officinale is increasing its range in the ecoregions surrounding the Columbia Plateau, particularly in the East Cascades and Blue Mountains. This species' range is also expanding to a lesser extent in the Puget Trough (CPNWH, 2023; iNaturalist Contributors, 2023). Models predict that at least some areas of Washington State do not have suitable habitat for this species (EDDMapS, 2023).

Dipsacus fullonum appears in most counties in Washington, with only Chelan County reporting no occurances of this species. This species appears to occur in almost all the suitable habitat available in Washington (WSDA, 2018; iNaturalist Contributors, 2023; Jarnevich et al., 2023). This species has expanded to six or seven new counties in Washington since 2012 (NWCB, 2012), with most expansions in the last 20 years limited to the northwestern part of the Columbia Plateau (CPNWH, 2023). Expansion for this species may be limited in desert habitats (Gucker, 2009).

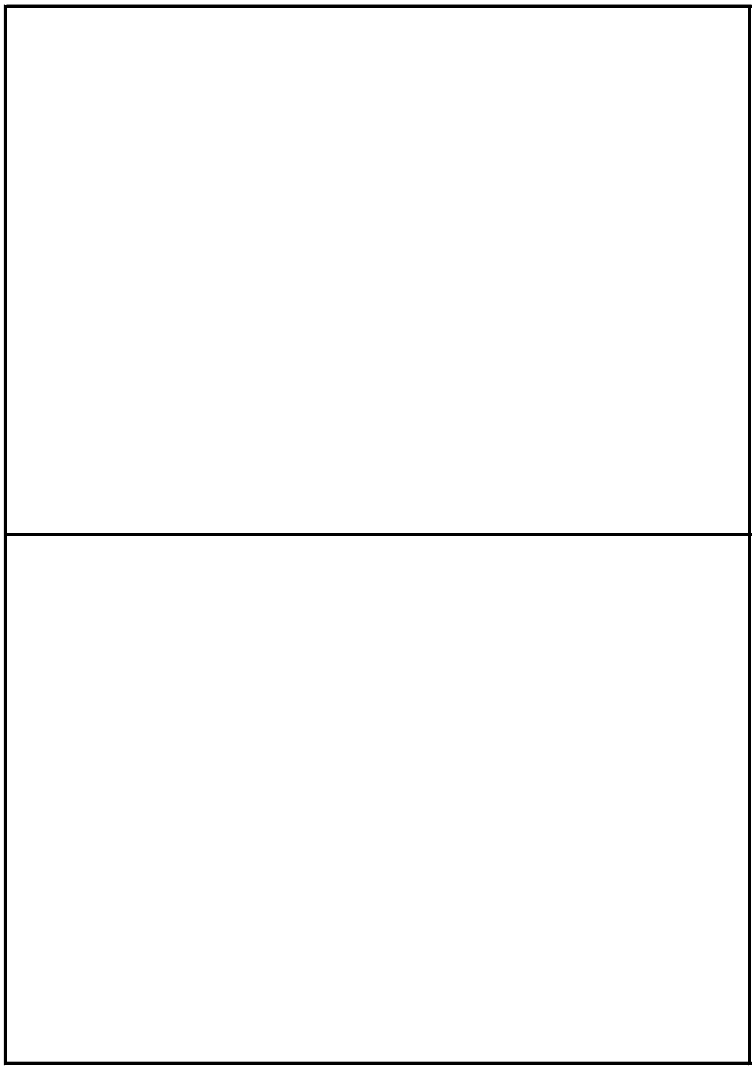
At least 18 new occurrences have been documented with herbarium collections since 2020. The number of iNaturalist reports has also increased significantly (though some of those observations need to be verified) (SEINet Portal Network, 2023; CPNWH, 2024; iNaturalist Community, 2024).

Based on herbarium records and iNaturalist observations, Holcus lanatus is increasing in abundance and range west of the Cascades, but total range has not expanded east of the Cascades in the last 20 years (CPNWH, 2023; iNaturalist Contributors, 2023). Models predict that suitable habitat for this species is available in all counties in Washington State (EDDMapS, 2023).
Ilex aquifolium populations are mostly limited to the west side of the Cascades in Washington, though this species has been reported twice from Ferry County and once from Asotin County in eastern Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). However, models predict that this species is capable of spreading to all counties in Washington (EDDMapS, 2024).



In Washington, Jacobaea vulgaris is most abundant west of the Cascades, but has been documented in most counties outside of the Columbia Plateau (EDDMapS, 2023). In the past 20 years, this species appears to have expanded into the Olympic Peninsula and the western Cascades, but does not appear to be expanding east of the Cascades (CPNWH, 2023; iNaturalist Contributors, 2023).

Juncus effusus ssp. effusus does not appear to be as abundant in the Columbia Plateau or Okanogan ecoregions as it is elsewhere in Washington (CPNWH, 2023; iNaturalist Contributors, 2023), suggesting potential ecological constraints to expansion in those ecoregions. Based on herbarium records and other observations, much of the expansion into the Cascades and east side of the Olympic Peninsula appears to have occurred in the last 20 years (CPNWH, 2023; iNaturalist Contributors, 2023).



Leucanthemum vulgare was introduced to Washington in the 1800s (NWCB, 2000). It was already present in most of Washington 20 years ago and its range has not expanded significantly since (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

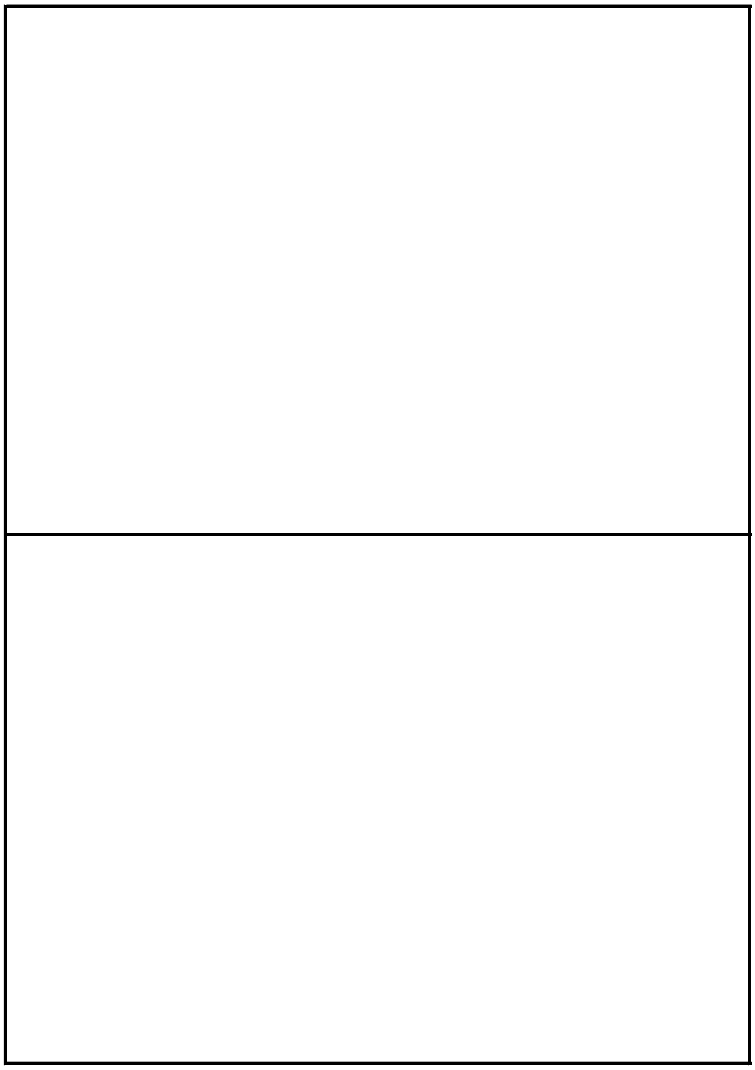
This species is already found in almost all counties in Washington (Munger, 2002).
Reliable data regarding trends are not available. Herbarium records suggest that this species has been present in Washington for over 100 years, with the most recent introduction into a county documented in Walla Walla County in 1979 (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

This species may have expanded to the northern Olympic Peninsula over the last 20 years and may also be slightly expanding in eastern Washington (CPNWH, 2024; iNaturalist Community, 2024).

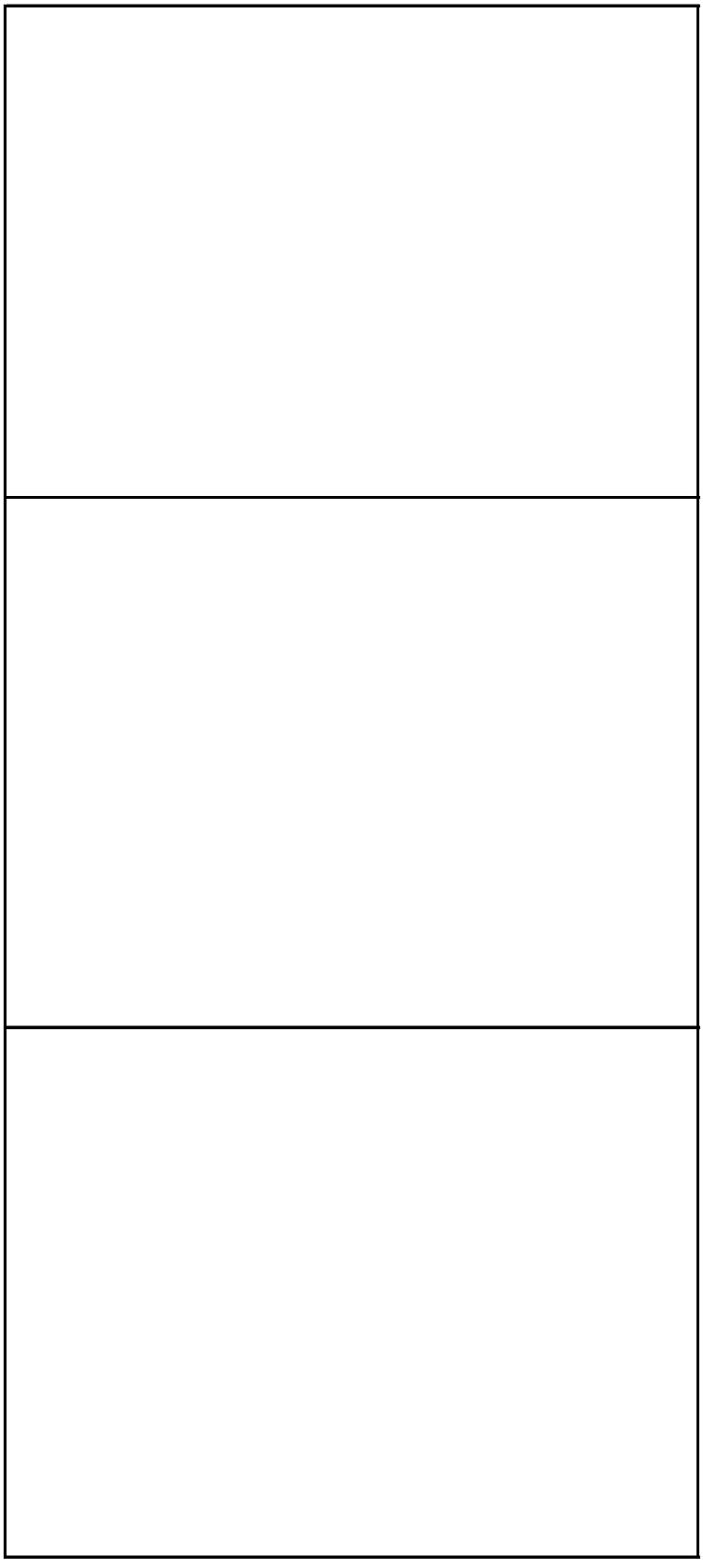
Many populations of this species were found in Clark County in 2022, but they have likely existed for a long time and are primarily on private property. All discovered populations have been robust and in isolated locations (Washington State Department of Ecology, 2024).

While the rate of spread seems to have slowed recently, a 20-year view still shows a steady increase in the number of lakes (and counties) infested with Eurasian watermilfoil, with new lakes being discovered each year. Populations have been eradicated from some individual lakes, but the general range size has continued to grow steadily over the time span. Data collected by the Washington State Department of Ecology supports this range expansion (Washington State Department of Ecology, 2023a, 2023b).

Phalaris arundinacea has already expanded to all 39 counties in Washington State (100%) (CPNWH. 2023; iNaturalist Contributors, 2023; Jarnevich et al., 2023). Based on herbarium records, it is possible that this species spread to the Olympic Peninsula in the last 20 years (CPNWH, 2023).
Phleum pratense occurs throughout Washington. In the last 20 years this species may have expanded in the southwestern portion of the state and in the Columbia Plateau (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

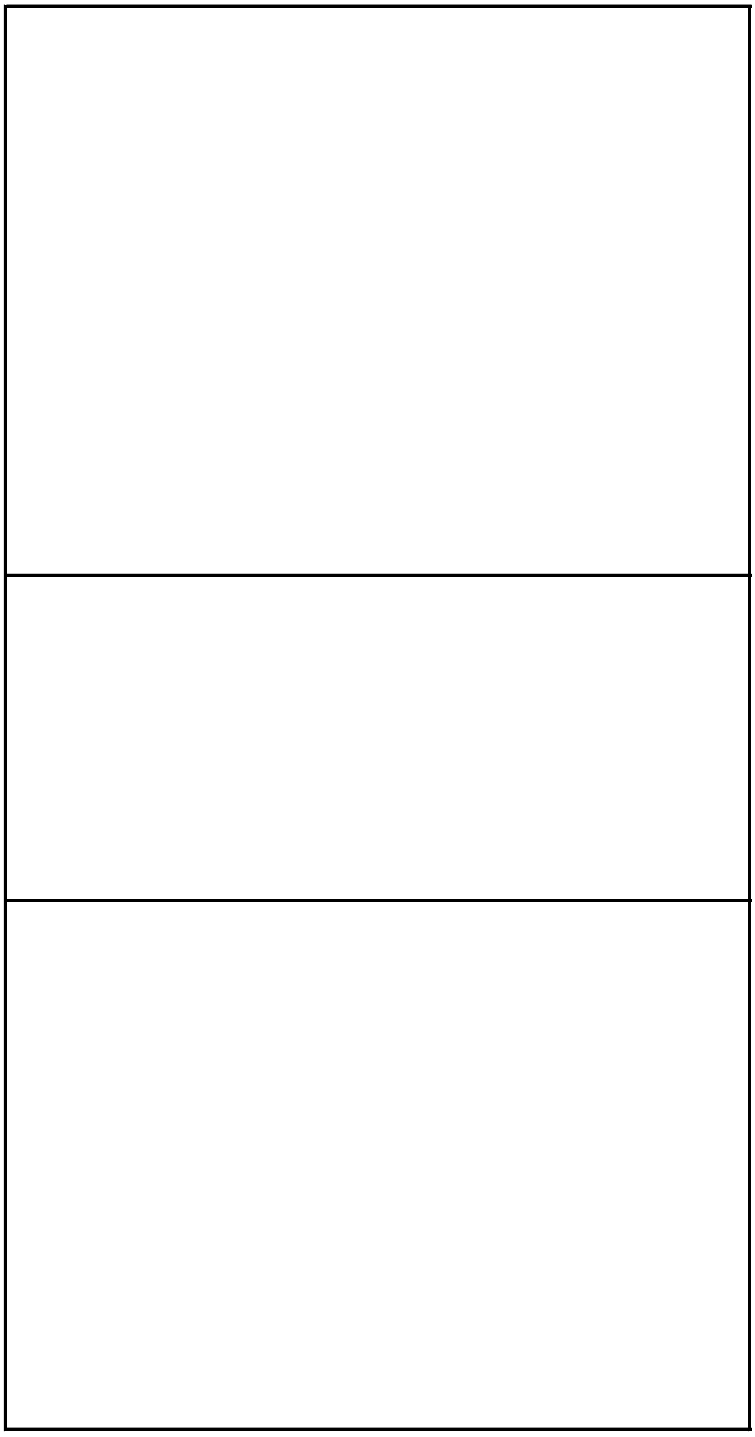


New discoveries may be of populations that have already been established for some time (Washington State Department of Ecology, 2023).



Rubus bifrons is reported most frequently in western Washington but is documented throughout the state. This species is least abundant in northeastern Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023). However, R. bifrons is increasing along the Snake River.

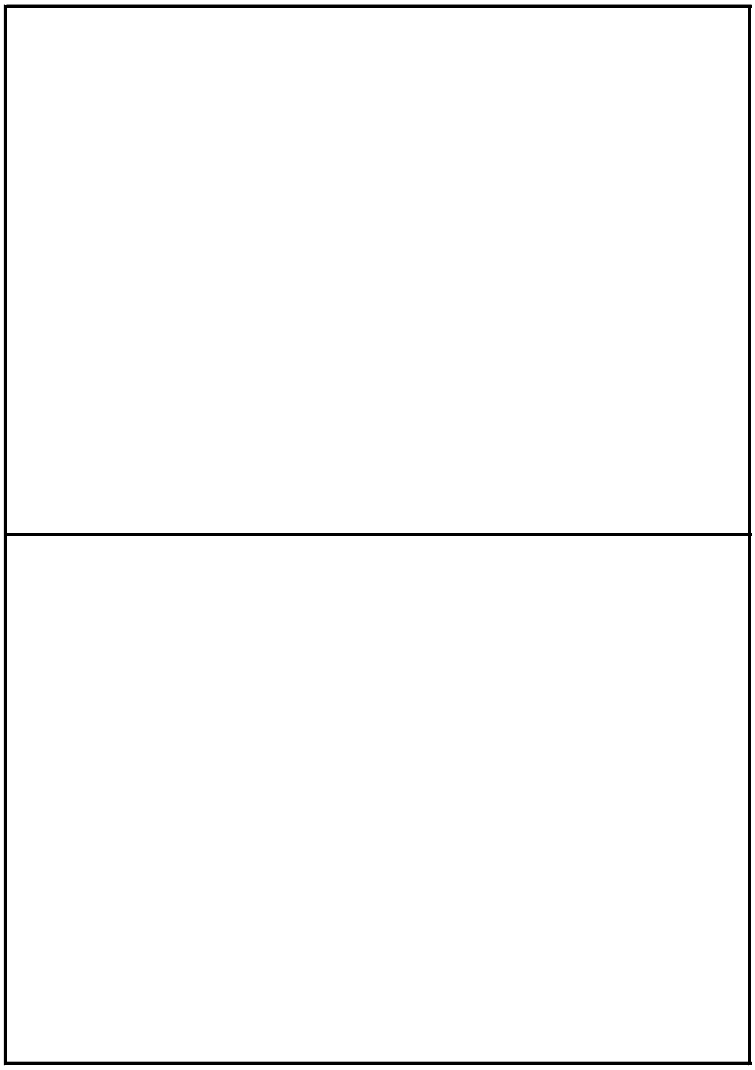
This species doesn't seem to be spreading much in southwest Washington. However, it may be of more concern in other parts of the state.



Spread to King County may have occurred within the past 5 years (iNaturalist Contributors, 2023).

Solidago altissima is currently only known from six confirmed locations on the Columbia Plateau in Washington. The first observation of this species is from 1948 and four of these observations are from the last 20 years. None of the recent observations appear to be from new watersheds (CPNWH, 2023; iNaturalist Contributors, 2023). Cold, dry climate may limit the spread of this species (Park et al., 2020).

A long term (30+ years) eradication program has been successful in mostly eradicating this species. There are still a few spots in Willapa Bay where it is found (CPNWH, 2023).
Tamarix ramosissima is currently most abundant in southeastern Washington, particularly on the Columbia Plateau, but it appears to be expanding into the rest of the state (EDDMapS, 2023). No information on the rate of spread was found. However, ecological factors likely constrain T. ramosissima and its hybrids mostly to riparian areas in arid parts of Washington, where it is better able to outcompete native vegetation for resources (Stromberg et al., 2007; Kerns et al., 2009; Lehnhoff et al., 2011)



Utricularia inflata is expanding its range in Washington. The earliest record for this species in the Consortium for Pacific Northwest Herbaria is from Kitsap County in 1980. Records were reported from Cowlitz, Mason, and Thurston counties by 1995, and from Pierce County in 2018 (CPNWH, 2024). A record from a Gray's Harbor County was reported in 2024 (iNaturalist Community, 2024).

This species may be slowly spreading to new areas.

Veronica anagallis-aquatica is most common east of the Cascades, however its range may have expanded in the Puget Basin in the last 20 years (CPNWH, 2024; iNaturalist Community, 2024).

L2 pts)	Ques	
Q2 citation	**Q3 rank**	**Q3 confidence rank**
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate (range Low - Moderate)	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low (range Low - Moderate)	Moderate

CPNWH. 2024. Consortium of Pacific Northwest Herbaria. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023.	Low	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations of Anthoxanthum odoratum from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=75475. Accessed: October 24, 2024.	Low	High
	Moderate	Moderate

	Moderate	High
EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	High	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations of Bellardia viscosa from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=537967. Accessed: October 29, 2024.	Low	High

	NA	NA
	Low	Moderate
	Moderate	Low

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	High
	Low	Low

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Jarnevich C.S., J. LaRoe, P. Engelstad, B. Hays, G. Henderson, D. Williams, K. Shadwell, I.S. Pearse, J.S. Prevey, and H.R. Sofaer. 2023. INHABIT species potential distribution across the contiguous United States (ver. 3.0, February 2023): U.S. Geological Survey data release. https://doi.org/10.5066/P9V54H5K. Accessed: June 17, 2024.	Insignificant (range Insignificant - Low)	High
	Insignificant	Moderate

	Moderate	Moderate
	Low	Moderate
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate (range Moderate - High)
	Low	Moderate

~~Consortium of Pacific Northwest Herbaria (CPNWH). 2023.~~ Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Jarnevich C.S., J. LaRoe, P. Engelstad, B. Hays, G. Henderson, D. Williams, K. Shadwell, I.S. Pearse, J.S. Prevey, and H.R. Sofaer. 2023. INHABIT species potential distribution across the contiguous United States (ver. 3.0, February 2023): US Geological Survey data release. https://doi.org/10.5066/P9V54H5K. Accessed: June 17, 2024. Noxious Weed Control Board (NWCB). 2012. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Dipsacus fullonum. Washington State Noxious Weed Control Board, Olympia, WA. Washington State Department of Agriculture (WSDA). 2018.	Low (range Low - Moderate)	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024. SEINet Portal Network. 2023. SEINet Record Search. https://swbiodiversity.org/seinet/collections/search/index.php. Accessed: December 31, 2023.	High (range Moderate - High)	High
	Low	Low
	High	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Observations of Ilex aquifolium from Washington State, U.S.A. https://www.inaturalist.org/observations?place_id=46&subview=table&taxon_id=53856. Accessed: September 20, 2024.	Low	High

	Low	Moderate
	Insignificant	Low

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	High
	High	Low

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate
	Moderate	Moderate

	Low	High
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA.	Insignificant	High
	Moderate	Low

Munger G.T. 2002. Lythrum salicaria. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/lytsal/all.html. Accessed: January 4, 2024.	Low (range Insignificant - Low)	Moderate (range Moderate - High)
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate
	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	High
Washington State Department of Ecology. 2024. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	High	Moderate

Washington State Department of Ecology. 2023a. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023. Washington State Department of Ecology. 2023b. Environmental Information Management System. https://apps.ecology.wa.gov/eim/search/Detail/Detail.aspx?DetailType=Study&SystemProjectId=99970394. Accessed: December 12, 2023. Note that these data are what feed the Washington Department of Ecology Lakes Database webpage found here: https://apps.ecology.wa.gov/lakes/	Low	High
	High	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Jarnevich C.S., J. LaRoe, P. Engelstad, B. Hays, G. Henderson, D. Williams, K. Shadwell, I.S. Pearse, J.S. Prevey, and H.R. Sofaer. 2023. INHABIT species potential distribution across the contiguous United States (ver. 3.0, February 2023): US Geological Survey data release.	Insignificant (range Insignificant - Low)	Moderate (range Moderate - High)
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	High

	Low	High
	Low	Moderate

Washington State Department of Ecology. 2023. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	High	Moderate
	Moderate	Moderate

	Low	Moderate
	Moderate	Moderate
	High	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.	Low	High (range Low - High)
	Low	Low

	Unknown	Not Rated
	High	High
	Low	Moderate

iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA
	Moderate	Moderate

	Moderate	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Park J.S., D. Choi, and Y. Kim. 2020. Potential distribution of goldenrod (Solidago altissima L.) during climate change in South Korea. Sustainability 12(17):6710.	High	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023.	High	High
EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215. Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65. Stromberg J.C., S.J. Lite, R. Marler, C. Paradzick, P.B. Shafroth, D. Shorrock, J.M. White, and M.S. White. 2007. Altered stream flow regimes and invasive plant species: the Tamarix case. Global Ecology and Biogeography 16(3):381–393.	High	High

	Low	Moderate
	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate
	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	High
	Low	Moderate

stion 3. Proportion of Potential Range Currently U
Q3 notes
Acer negundo has the potential to occur over much of lowland Washington, including many counties on the west side of the state and in central Washington. It seems to be more dependent on humans spreading plants by seed or outplanting than by natural means of dispersal.
There is potential for expansion of Ailanthus altissima in urban and suburban settings, though largely through assistance by humans (plants escaping from plantings). Some potential for spread also exists on the Columbia and Snake Rivers and major tributaries in eastern Washington. This species is likely able to occur in all counties in the state, at least in riparian systems (CPNWH, 2023).

This species could potentially spread to other counties with wetland habitats (Consortium of Pacific Northwest Herbaria (CPNWH), 2023).
Establishment of Amorpha fruticosa in Grant, Kittitas, Lincoln, and/or Spokane counties seems likely, though it may occur only along major rivers or low-elevation riparian habitats.

Anthoxanthum odoratum is found in 62% of the counties in Washington, but is predicted to be able to grow in all counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

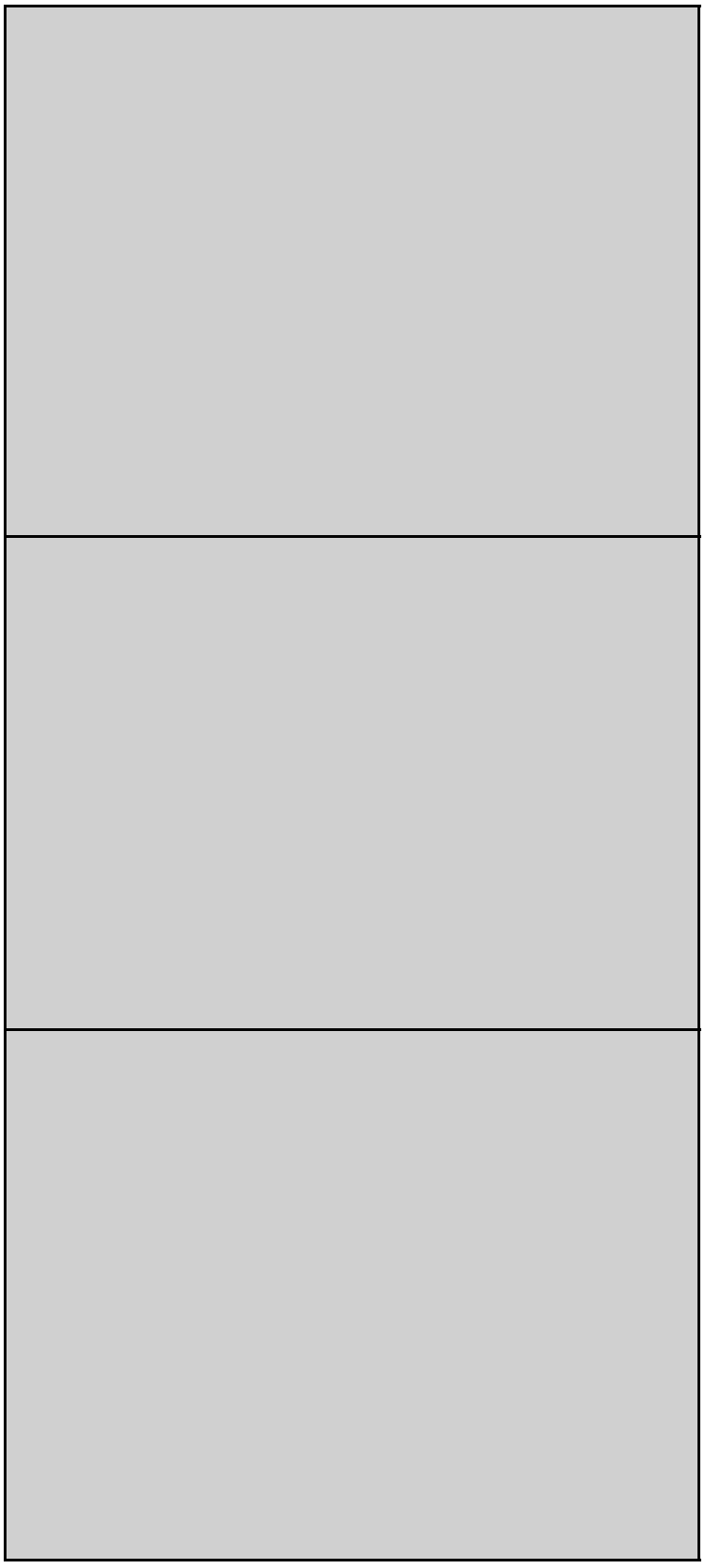
Most models predict that A. donax has the potential to spread throughout most of Washington (NWCB, 2013; EDDMapS, 2023), but at least one model suggested that only the Puget Sound area and parts of the Columbia Plateau with active irrigation may be suitable for persistence of this species in Washington (Goolsby et al., 2023).
Bellardia viscosa is currently occupies 46% of counties in Washington, all on the western side of the state (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024) However, this species has potential to spread to the rest of the state (EDDMapS, 2024).

Butomus umbellatus is found in 26% of counties in Washington and distribution suggests that not all suitable habitat available to this species is occupied (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

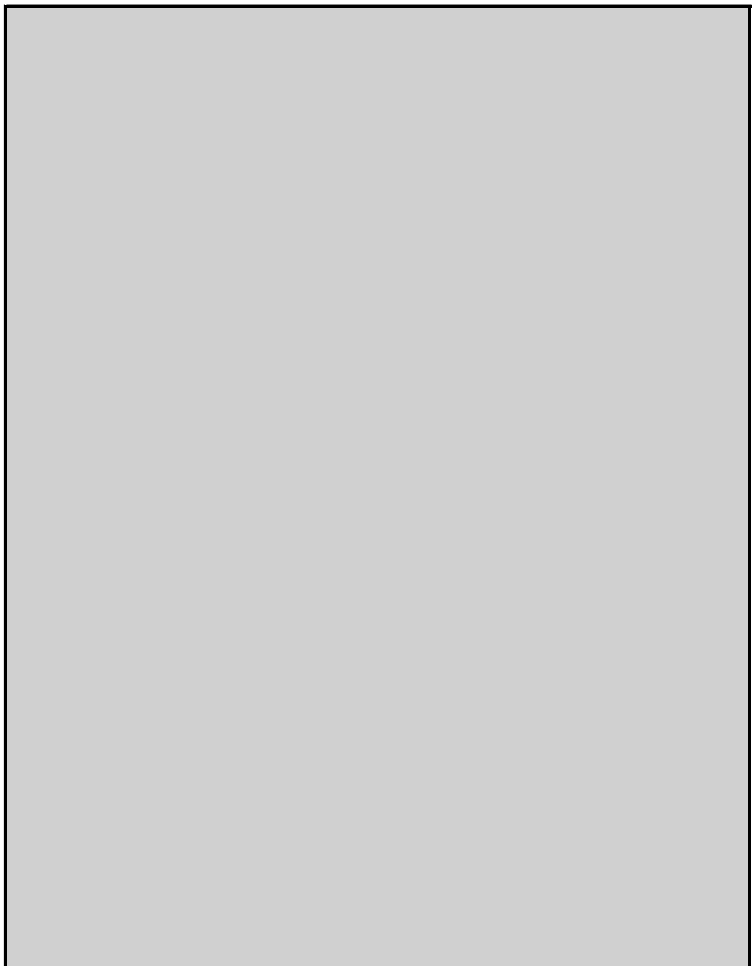
Models predict that Centaurea solstitialis will spread throughout Washington, but will remain most abundant in the eastern half of the state (EDDMapS, 2023). Climate change is expected to increase abundance and range of C. solstitialis (Dukes et al., 2011).
This species already occurs in more than 50% of the state (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Cirsium arvense is reported from all counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023) and it is likely already present in most suitable ecoregions, counties, and watersheds.

Cirsium vulgare has been documented in all 39 counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).



Models predict that while available range for Cynoglossum officinale will expand to the northwest portion of the state (Snohomish, Skagit and Whatcom Counties), overall C. officinale will experience a range contraction in Washington, particularly in the southwest and southeast. Future abundance of C. officinale is expected to be concentrated in northeastern Washington (EDDMapS, 2023).



Dipsacus fullonum appears in most counties in Washington, with only Chelan County reporting no occurances of this species. This species appears to occur, at least occasionally, in almost all suitable habitat in Washington (WSDA, 2018; iNaturalist Contributors, 2023; Jarnevich et al., 2023).

Erechtites minimus was documented at Mt. Rainier National Park in 2013, suggesting the species may be able to spread outside of its primary distribution center west of the Cascade crest. This species is probably under-reported from private lands in the southern Pacific Coast Range (where it is spreading rapidly along logging roads and trails). It is also likely to spread along the coast in Whatcom, Snohomish, and Skagit counties. So far, reports from eastern Washington are erroneous, but it has potential to spread to the East Cascades and potentially along the upper Columbia and Snake Rivers (SEINet Portal Network, 2023; CPNWH, 2024; iNaturalist Community, 2024).

This taxa is already present in 56% of counties of Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Models predict that Holcus lanatus will expand into all counties in Washington, though it will remain most abundant west of the Cascades (EDDMapS, 2023).

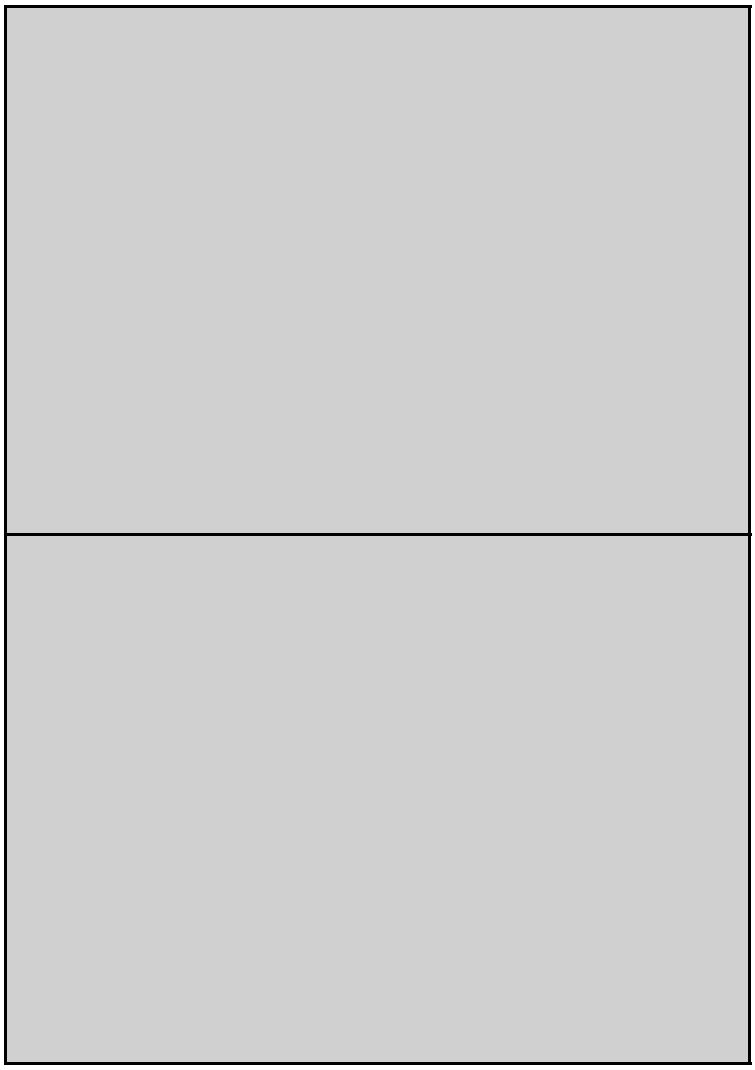
Ilex aquifolium has been reported from 59% of the counties in Washington (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024). However, this species' potential range encompasses the entire state (EDDMapS, 2024), suggesting it is still capable of significant expansion.

Iris pseudacorus is documented in 97% of counties in Washington (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

According to model predictions, Jacobaea vulgaris may expand somewhat further in eastern Washington, but may not gain a foothold in the Columbia Plateau (EDDMapS, 2023). However, the vast majority of herbarium records are from west of the Cascades, as are all herbarium and iNaturalist records documented in the past 20 years (CPNWH, 2023; iNaturalist Contributors, 2023). This species survives best in cool, wet climates; hot, dry summers reduce seedling survival and establishment (Richardson, 2004), likely limiting its range in eastern Washington.

Most likely only a small percentage of potential range is currently occupied.

Juncus effusus ssp. effusus is known from 27 of 39 (69%) counties in Washington State (CPNWH, 2023; iNaturalist Contributors, 2023). Based on habitat needs and potential adaptability (Arslan et al., 2019), it seems likely that this species could still expand to new counties in Washington, but that expansion in drier areas like the Columbia Plateau may be constrained by availability of appropriate habitat.



Models predict that Leucanthemum vulgare already occupies all counties in Washington where it is capable of persisting and that its range will likely contract on the Columbia Plateau (EDDMapS, 2023). Herbarium and iNaturalist records from the Columbia Plateau are already limited (CPNWH, 2023; iNaturalist Contributors, 2023).
Lysimachia nummularia is present in 41% of counties in Washington, and unoccupied available habitat likely still exists in the state (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

Temperature limits germination in Lythrum salicaria. Increasing temperatures may allow this species to germinate more abundantly where it is currently found and allow it to establish in additional locales (Shamsi & Whitehead, 1974).
Based on spread in other regions that are climatically similar to the Columbia Basin (Weiss et al., 2000; Lucidcentral.org, 2016) Marrubium vulgare has potential to spread into some counties for which there are no herbarium records, particularly Grant, Adams, Lincoln, and Douglas Counties.

Myosotis discolor is currently most abundant west of the Cascades in Washington State (CPNWH, 2024; iNaturalist Community, 2024) However, this species is predicted to be able to expand to the rest of the state (EDDMapS, 2024)

This species has been spreading in the northeastern US and in lakes in Europe where it is also introduced. It could likely thrive in many Washington lakes (Les & Mehrhoff, 1999; Thum & Lennon, 2010; Gross et al., 2020; Washington State Department of Ecology, 2024).

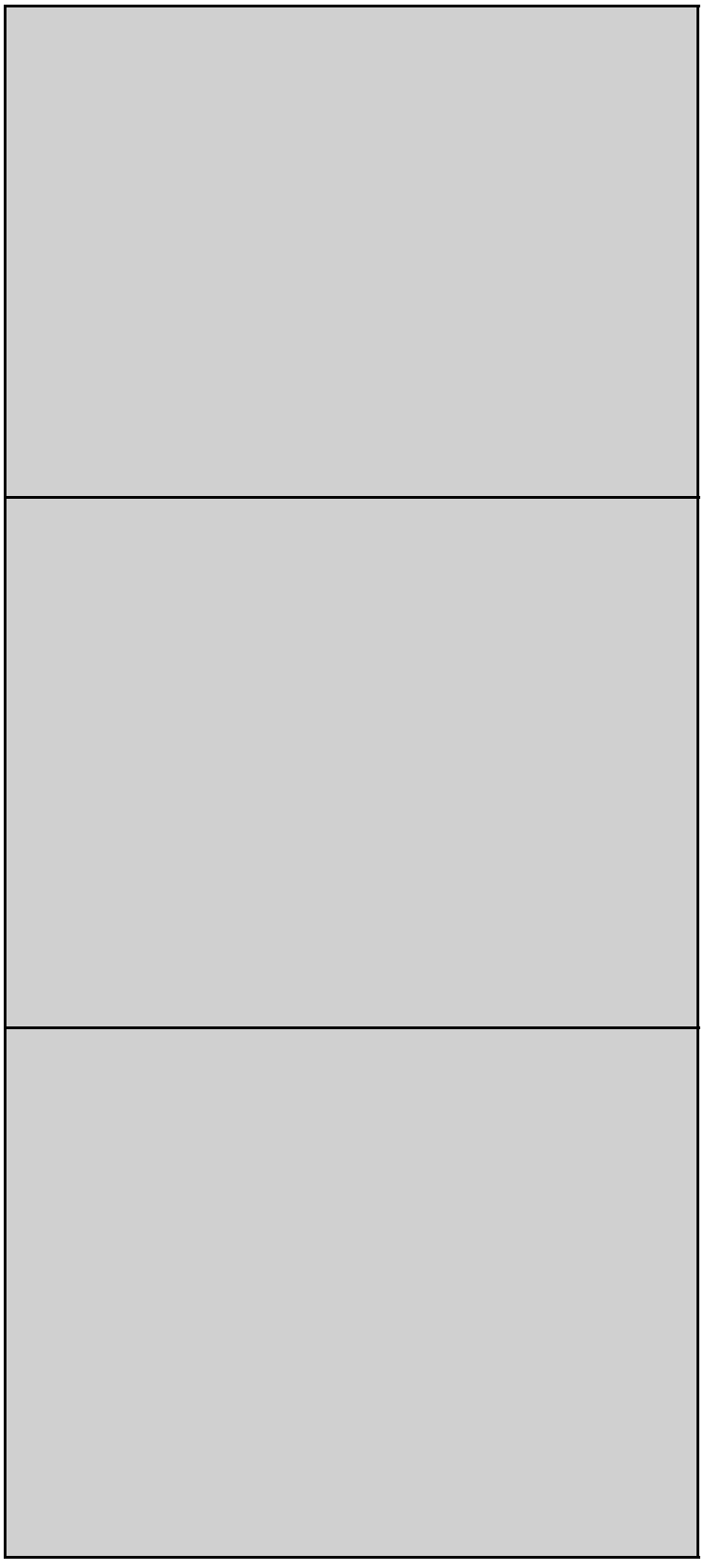
While the Department of Ecology collects rough abundance data during lake surveys, these data are not fine-scale enough or collected frequently enough to determine accurate trends in abundance (Washington State Department of Agriculture (WSDA), 2023; Washington State Department of Ecology, 2023a, 2023b). Across the state, familiarity with this species has led to quick management action where it is found. In some locations, populations have declined due to management, while other populations have expanded. The assessor estimates that there has been a net range expansion and abundance increase, but that it is overall low when examined across the state. However, we lack good state-wide data to support any strong conclusions.

Phalaris arundinacea is especially common in the Pacific Northwest (Waggy, 2010). This species has been documented in all 39 counties in Washington state (100%), and appears to occur throughout the suitable habitat available in Washington (CPNWH, 2023; iNaturalist Contributors, 2023; Jarnevich et al., 2023).

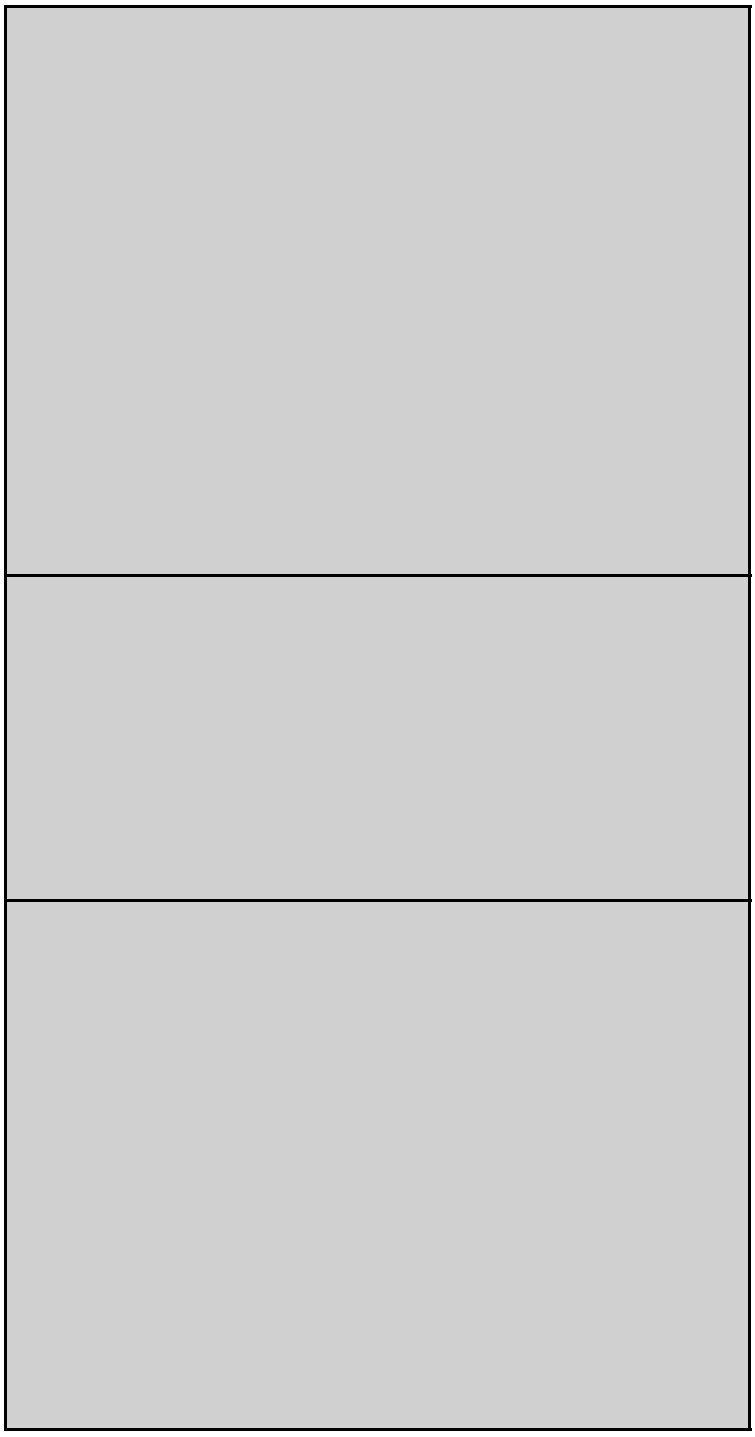
According to model predictions, Phleum pratense is expected to expand to the remaining counties in Washington, but also experience a range contraction on the Columbia Plateau (EDDMapS, 2023).

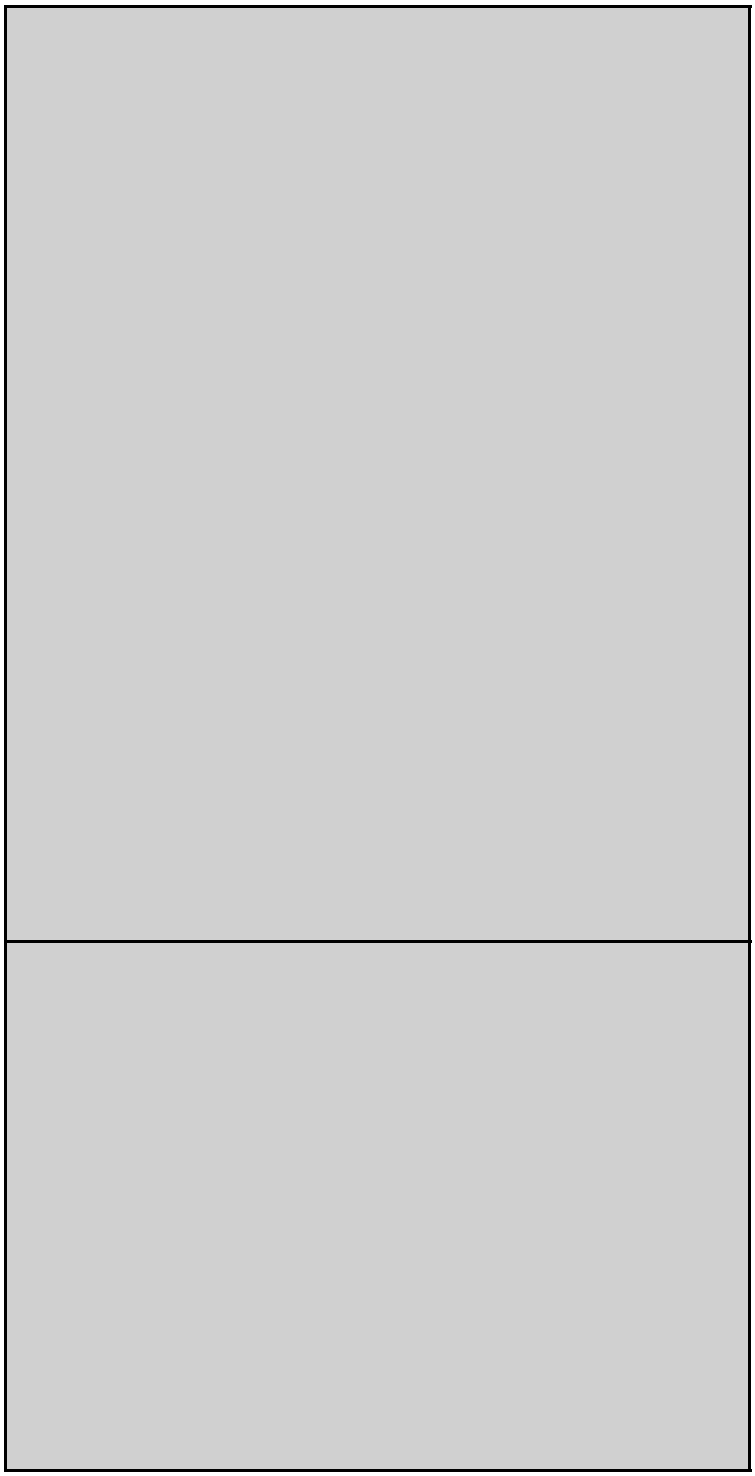
Poa annua is found in 92% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

There are likely many suitable water bodies where this plant has yet to establish (Tamayo & Olden, 2014).



Rubus bifrons is regarded as the most invasive shrub on the west coast (Fryer, 2021). This species is predicted to increase in abundance and expand its range to all counties in Washington (EDDMapS, 2023), but it is currently documented in only 82% of Washington counties (CPNWH, 2023; iNaturalist Contributors, 2023).
This species is fairly widespread already, may not have much remaining suitable habitat.





In its native range, Solidago altissima occurs in grasslands and open woodlands and in moist to dry habitats and is broadly adaptable. It occurs over a wide range of latitudes (25–45 degrees) (Etterson et al., 2008). This suggests S. altissima could potentially establish in open, disturbed habitats throughout most of Washington State, but to date it is mainly restricted to the fringes of herbaceous (often alkaline) wetlands.

Spartina eradication efforts have reduced its acreage in Washington from >9,000 acres (in 2003) to approximately 4 acres (in 2023). While successful, this means that at least 99% of its potential range is currently unoccupied.
In 2009, less than 1% of suitable habitat for Tamarix in the northwest was occupied (Kerns et al., 2009). Models predict that T. ramosissima is likely expand to all counties in Washington (EDDMapS, 2023), though it is most likely to be dominant east of the Cascades (Kerns et al., 2009). A 2009 study also predicts a 2-10x expansion of suitable habitat for Tamarix in central Washington and Oregon by 2099, due to climate change (Kerns et al., 2009). Tamarix species have generally been regarded as poorly adapted to cold climates. However, T. ramosissima and T. chinensis both originate from cold desert environments that can experience severe winters. Hybridization between these two species has likely increased genetic and phenotypic diversity of invasive Tamarix in the U. S., allowing expansion into colder environments (Kerns et al., 2009; Lehnhoff et al., 2011).

This species has likely occupied most of its available habitat.

This species may be underreported, but is currently documented in 51% of counties in Washington State (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024)

The potential range for Utricularia inflata has not been modeled for Washington. Given habitat requirements, at minimum, this species can likely survive in all the counties west of the Cascades. Native Utricularia species are reported from all ecoregions in Washington, though they appear to be least abundant on the Columbia Plateau (CPNWH, 2024). This evidence suggests that a large portion of Utricularia inflata's potential range is not yet invaded.

Veronica anagallis-aquatica is reported from 74% of counties in Washington. This species is a wetland obligate; in Washington it is found in ditches, canals, lake and river shores, wet meadows, and occasionally as mats of floating vegetation, suggesting it can establish under a variety of conditions (CPNWH, 2024). This species is likely capable of expanding into other counties in Washington.

noccupied (3 pts)	Que	
Q3 citation	**Q4 rank**	**Q4 confidence rank**
	Low	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023.	Moderate (range Low - High)	Low (range Low - Moderate)

	Unknown	Not Rated
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023.	Unknown	Not Rated
	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations of Anthoxanthum odoratum from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=75475. Accessed: October 24, 2024.	Moderate	Moderate (range Moderate - High)
	Moderate	High

	High	Moderate
EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Goolsby J.A., P.J. Moran, M. Martínez Jiménez, C. Yang, K. Canavan, Q. Paynter, N. Ota, and D.J. Kriticos. 2023. Biology of Invasive Plants 4. Arundo donax L. Invasive Plant Science and Management 16(2):81–109. Noxious Weed Control Board (NWCB). 2013. Draft Report: Written findings of the Washington State Noxious Weed Control Board, Arundo donax. Washington State Noxious Weed Control Board, Olympia, WA.	Unknown	Not Rated
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations of Bellardia viscosa from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=537967. Accessed: October 29, 2024.	Moderate	Moderate

	NA	NA
	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Dukes J.S., N.R. Chiariello, S.R. Loarie, and C.B. Field. 2011. Strong response of an invasive plant species (Centaurea solstitialis L.) to global environmental changes. Ecological Applications 21(6):1887–1894. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.	Moderate	Low
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Insignificant (range Insignificant - Moderate)	Moderate (range Low - Moderate)
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Unknown	Not Rated

	High	Moderate
	High	Moderate
	Moderate	Moderate

EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.	Moderate (range High - Moderate)	High (range Moderate - High)
	Low	Moderate

iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Jarnevich C.S., J. LaRoe, P. Engelstad, B. Hays, G. Henderson, D. Williams, K. Shadwell, I.S. Pearse, J.S. Prevey, and H.R. Sofaer. 2023. INHABIT species potential distribution across the contiguous United States (ver. 3.0, February 2023): US Geological Survey data release. https://doi.org/10.5066/P9V54H5K. Accessed: June 17, 2024. Washington State Department of Agriculture (WSDA). 2018. Common Teasel (Dipsacus fullonum) Distribution 2018. https://agr.wa.gov/washington-agriculture/maps/weed-distribution. Accessed: June 21, 2024.	Moderate (range Low - Moderate)	Low (range Low - Moderate)

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024. SEINet Portal Network. 2023. SEINet Record Search. https://swbiodiversity.org/seinet/collections/search/index.php. Accessed: December 31, 2023.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA
	Low	Moderate

EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Observations of Ilex aquifolium from Washington State, U.S.A. https://www.inaturalist.org/observations?place_id=46&subview=table&taxon_id=53856. Accessed: September 20, 2024.	High	Moderate (range Moderate - High)

	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Richardson B. 2004. Plant assessment form: Senecio jacobaea. https://www.cal-ipc.org/plants/paf/senecio-jacobaea-plant-assessment-form/. Accessed: October 14, 2024.	High	High
	Low	Moderate

Arslan M., U.K. Devisetty, M. Porsch, I. Große, J.A. Müller, and S.G. Michalski. 2019. RNA-Seq analysis of soft rush (Juncus effusus): transcriptome sequencing, de novo assembly, annotation, and polymorphism identification. BMC Genomics 20(1):489. Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate
	High	High

	High	High
	High	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Low
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	NA	NA

Shamsi S.R.A. and F.H. Whitehead. 1974. Comparative eco-physiology of Epilobium hirsutum L. and Lythrum salicaria L. I. General biology, distribution and germination. Journal of Ecology 62(79):272–290.	Moderate	Low (range Low - Moderate)
Lucidcentral.org. 2016. Marrubium vulgare. https://keyserver.lucidcentral.org/weeds/data/media/Html/marrubium_vulgare.htm. Accessed: November 28, 2023. Weiss J., Ainsworth, and I. Faithfull. 2000. Horehound, Marrubium vulgare. https://nre.tas.gov.au/Documents/Horehound_CRC_bpmg.pdf. Accessed: November 28, 2023.	Moderate	Low
	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Moderate	Moderate
Gross E.M., H. Groffier, C. Pestelard, and A. Hussner. 2020. Ecology and environmental impact of Myriophyllum heterophyllum, an aggressive invader in European waterways. Diversity 12(4):127. Les D.H. and L.J. Mehrhoff. 1999. Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions 1:281–300. Thum R.A. and J.T. Lennon. 2010. Comparative ecological niche models predict the invasive spread of variable-leaf milfoil (Myriophyllum heterophyllum) and its potential impact on closely related native species. Biological Invasions 12:133–143. Washington State Department of Ecology. 2024. Washington Department of Ecology Lakes Databasae. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	Low	High

Washington State Noxious Weed Data Viewer. https://www.arcgis.com/apps/webappviewer/index.html?id=cec83bd1b9fc4d7681afd219a9197654. Accessed: December 12, 2023. Washington State Department of Ecology. 2023a. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023. Washington State Department of Ecology. 2023b. Environmental Information Management System. https://apps.ecology.wa.gov/eim/search/Detail/Detail.aspx?D	Low	Moderate
	High	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Jarnevich C.S., J. LaRoe, P. Engelstad, B. Hays, G. Henderson, D. Williams, K. Shadwell, I.S. Pearse, J.S. Prevey, and H.R. Sofaer. 2023. INHABIT species potential distribution across the contiguous United States (ver. 3.0, February 2023): US Geological Survey data release. Waggy M.A. 2010. Phalaris arundinacea. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/graminoid/phaaru/all.html. Accessed: June 25, 2024.	High (range Low - High)	High (range Moderate - High)
EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023.	Moderate	Moderate

	Low	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	Moderate

Tamayo M. and J.D. Olden. 2014. Forecasting the vulnerability of lakes to aquatic plant invasions. Invasive Plant Science and Management 7(1):32–45.	Unknown	Not Rated
	Low	Moderate

	Moderate	Moderate
	Moderate	Moderate
	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Fryer J.L. 2021. Rubus armeniacus, R. bifrons. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/shrub/rubspp/all.html. Accessed: June 27, 2024.	Moderate	High
	Low	Moderate

	Insignificant	Moderate
	Low	High
	Moderate	Moderate

	NA	NA
	Low	Moderate

	High	Moderate
Etterson J.R., D.E. Delf, T.P. Craig, Y. Ando, and T. Ohgushi. 2008. Parallel patterns of clinal variation in Solidago altissima in its native range in central USA and its invasive range in Japan. Botany 86(1):91–97.	Unknown	Not Rated

	Insignificant	High
EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215. Lehnhoff E.A., F.D. Menalled, and L.J. Rew. 2011. Tamarisk (Tamarix spp.) establishment in its most northern range. Invasive Plant Science and Management 4(1):58–65.	High	Moderate

	Low	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	Moderate	Moderate
	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	Low	Moderate
	Low	Moderate

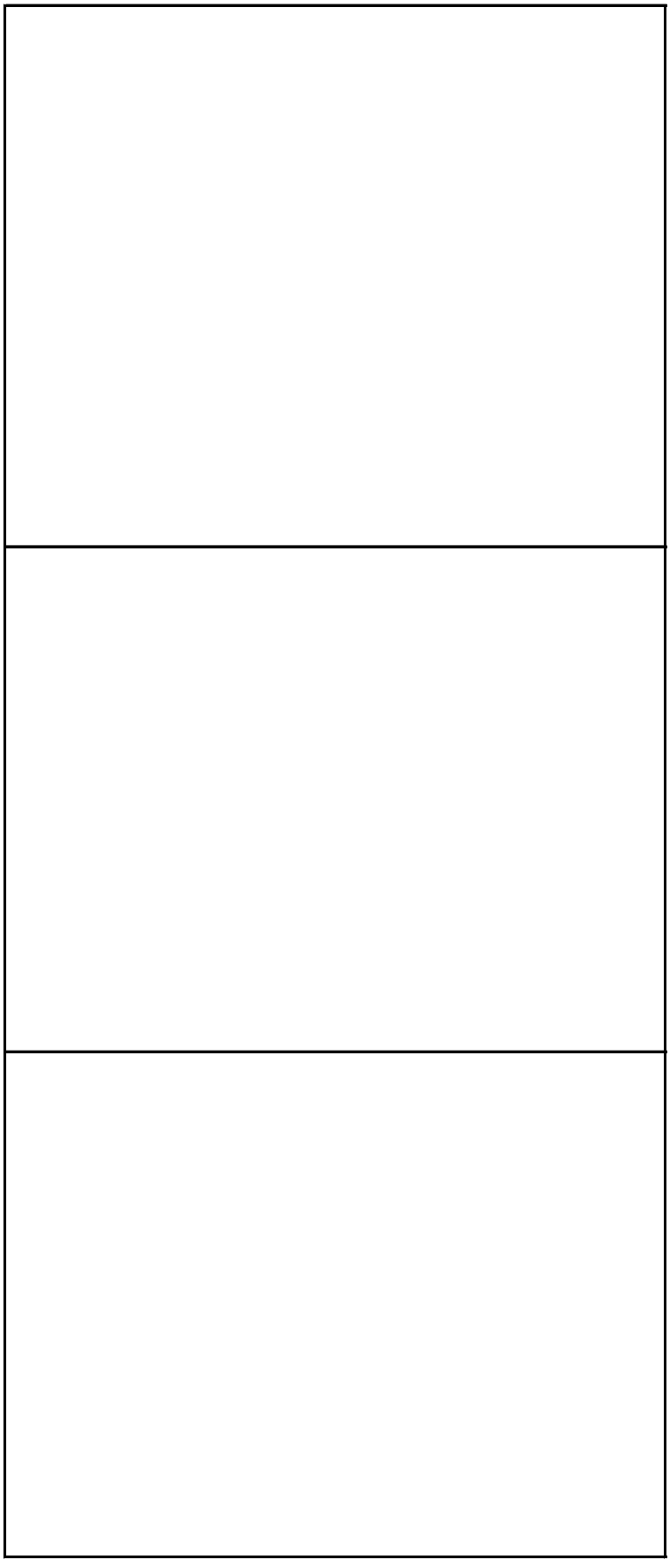
estion 4. Local Range Expansion or Change in Abu

Q4 notes
Notable expansion has not been observed by assessors. Local range and abundance appears relatively stable or is at least constrained by surprisingly poor natural dispersal (without human assistance).
Recent evidence of expansion comes mostly from iNaturalist records that may be cultivated landscape trees in urban areas. Spread by natural means appears low compared to other introduced riparian trees and shrubs. This species begins to rapidly infill areas shortly after establishment. Some experts suggest it is likely to increase by greater than 25% in density and range in many of the areas it occupies and will continue to do so until it dominates all suitable habitat in any invaded area.

Alliaria petiolata is a class A species that is required by law to be eradicated. So far, control efforts appear to be successful at preventing local expansion.
Alopecurus pratensis is expanding locally at Lacamas Prairie in areas where it was less common, but the assessor cannot speak to changes in local abundance elsewhere in Washington.
This species seems to be under-collected, so the growth in collections in herbaria over the past decade may not be a good proxy. There are over 50 observations on iNaturalist in the past three years, mostly in-filling the known distribution based on herbarium vouchers. Casual observers avoid wetland species and access issues on the Columbia suggest that current observation data may be under-reporting its distribution and spread (CPNWH, 2024; EDDMapS, 2024; iNaturalist Community, 2024).

Herbarium records and iNaturalist records suggest that local abundance and range are increasing moderately for Anthoxanthum odoratum west of the Cascades. New observations of this species east of the Cascades have not apparently been documented (CPNWH, 2024; iNaturalist Community, 2024).

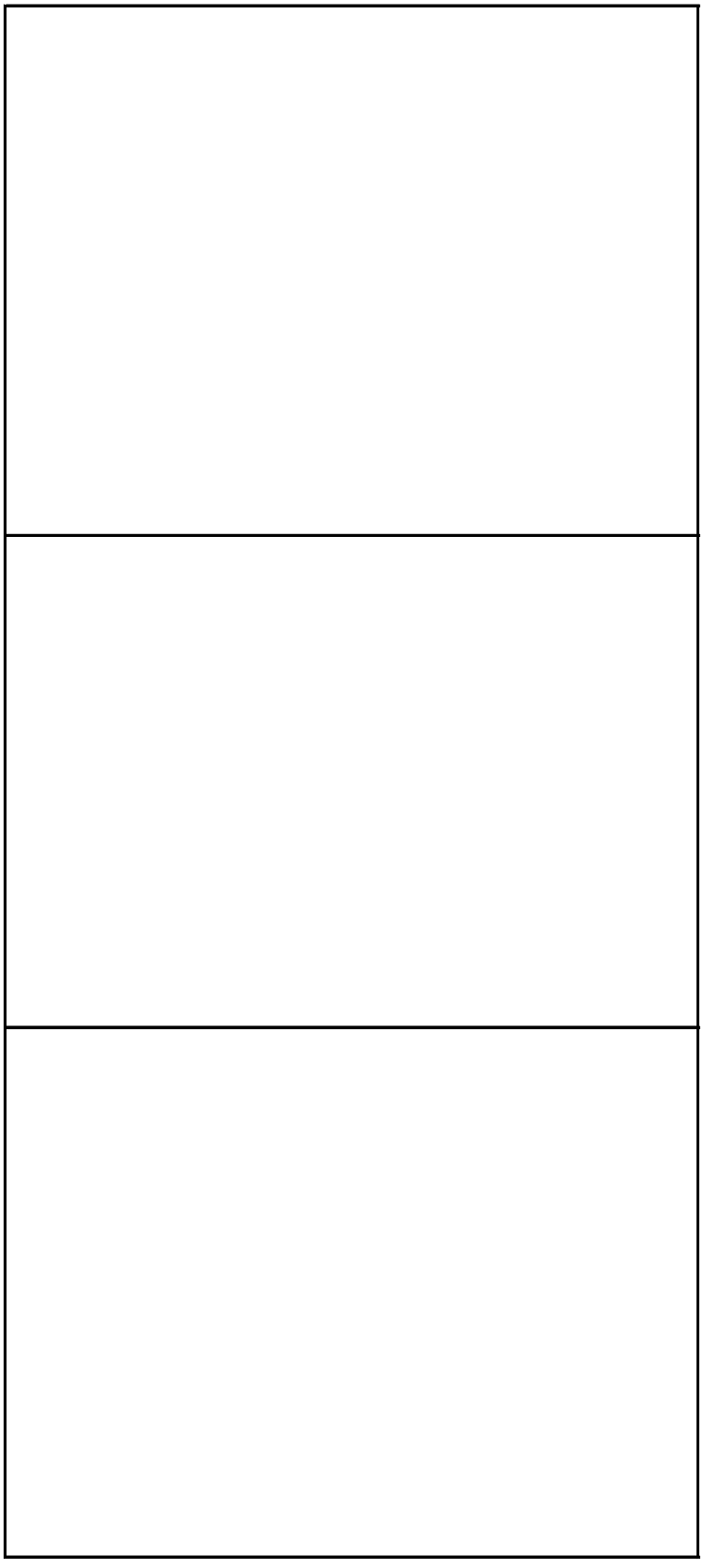
There are very few documented naturalized populations of Arundo donax in Washington, so not enough data is available to determine changes in local range or abundance.
iNaturalist records suggest a rapid increase in local abundance and local range for Bellardia viscosa over the last 20 years (iNaturalist Community, 2024). However, herbarium records from the same timespan suggest a more moderate expansion mostly limited to southwestern Washington (CPNWH, 2024). The abundance of iNaturalist observations could partially be an artifact of an increase in the number of observers in the last 20 years as well as an increase in abundance of this species.



Based on herbarium records and iNaturalist observations from the last 20 years, Centaurea solstitialis abundance and local range appears to be increasing south of the Snake River and in the vicinity of The Dalles on the Columbia River, but it does not appear to be increasing local range or abundance significantly in the rest of the state (CPNWH, 2023; iNaturalist Contributors, 2023).

However, in some other parts of the Northwest, C. solstitialis populations have been decreasing over the last 20 years. For example, biocontrol introductions have visibly decreased population density of this species in north-central Idaho, the center of C. solstitialis abundance for that state (EDDMapS, 2023).

Areas of disturbance like roadsides, recently logged areas, or construction sites are readily colonized, and once established, populations can grow rapidly if not controlled. As of 2000, Cirsium arvense populations were increasing by 10% annually in the northwest (Zouhar, 2001). Based on herbarium records, populations of this species are remaining stable in Washington, and models predicted they will remain stable in the future (CPNWH, 2023; EDDMapS, 2023).

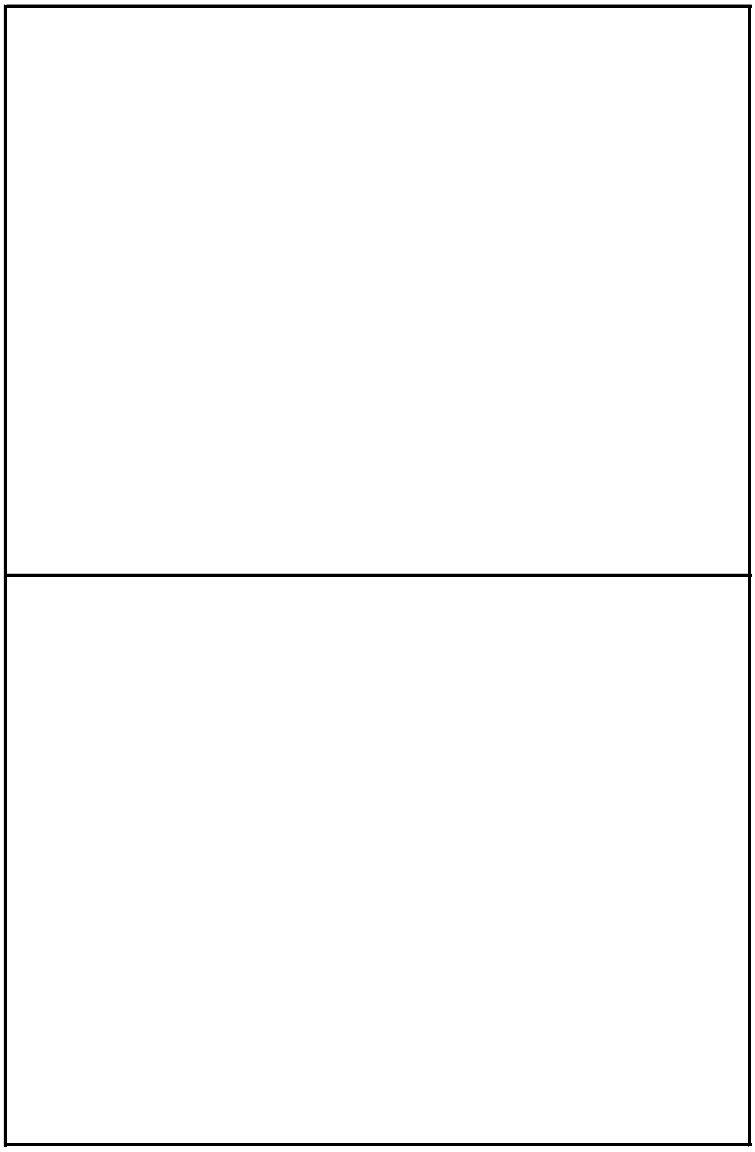


Over the last 20 years, Cynoglossum officinale abundance and local range appears to have increased east of the Cascades, and increased rapidly in the eastern half of the Columbia Plateau and Okanogan Highlands (CPNWH, 2023; iNaturalist Contributors, 2023).

In 2009, Dipsacus fullonum was described as “occasional, locally common, scattered, or infrequent” throughout its range in North America (Gucker, 2009). Dipsacus species have been recently described as rapidly expanding In 2009, Dipsacus fullonum was described as “occasional, locally common, scattered, or infrequent” throughout its range in North America (Gucker, 2009). Dipsacus species have been recently described as rapidly expanding in the western U.S., especially in the Pacific Northwest (DiTomaso et al., 2013), and it appears to be occupying more riparian areas in steppe and grasslands and persisting longer (perhaps indefinitely) in Eastern Washington. Herbarium records from Washington State suggest that while this species is expanding locally, expansion appears to be relatively slow (CPNWH, 2023). The Early Detection and Distribution Mapping System predicts populations of Dipsacus fullonum may expand in some counties in Washington, but remain steady in most Washington counties (EDDMapS, 2023).

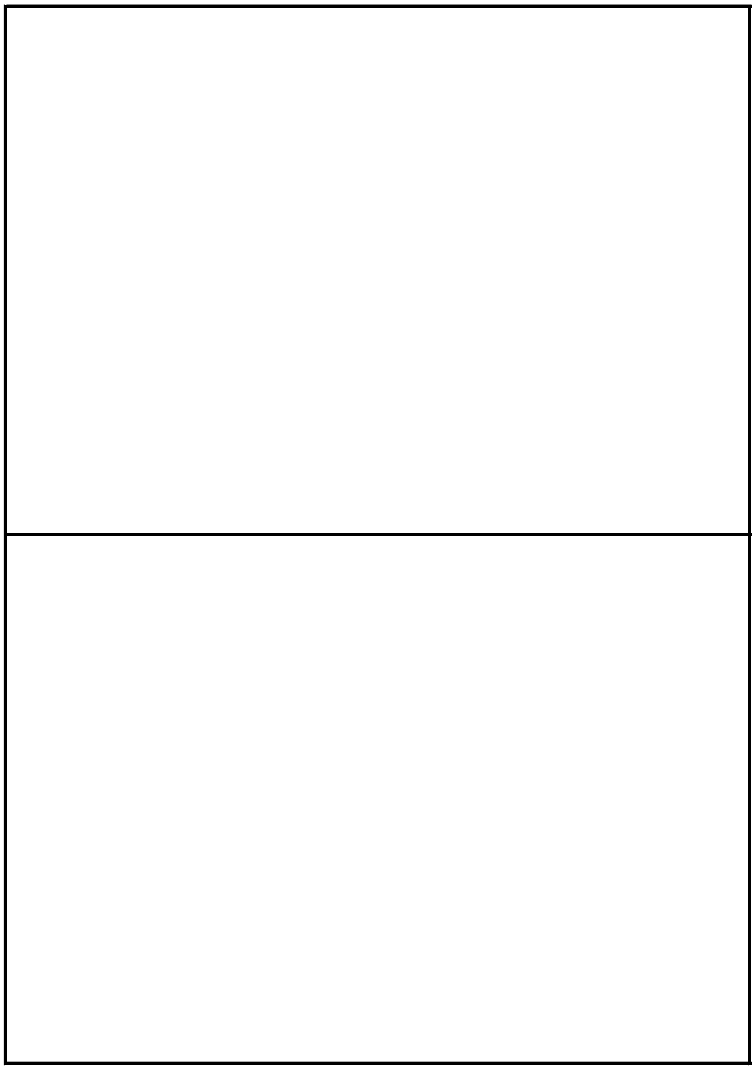
The assessors have documented over 10 new sites where Erechtites minimus is present in natural areas in western Washington since 2020 (this is likely an undercount). This species is still under-the-radar for many biologists and can be easily overlooked when not in flower (vegetatively, it is easy to dismiss as Solidago serra or Senecio spp.).

Over the last 20 years, Holcus lanatus abundance and local range appears to have increased rapidly west of the Cascades, particularly around Puget Sound (CPNWH, 2023; iNaturalist Contributors, 2023).
Research supports rapid local expansion of I. aquifolium populations in western Washington (Church, 2016). The earliest recorded escaped I. aquifolium observations are from the 1960s, the first herbarium collection was made in 1987, and by 2010, naturalized populations had been documented in all urban areas west of the Cascades (Zika, 2010). A study at St. Edward's Park in Seattle found that I. aquifolium had an average density of 55 stems per hectare in 2012. Data found the population established in 1966, showed little mortality and exhibited exponential growth with no sign of slowing (Stokes et al., 2014). This also indicates that I. aquifolium is increasing locally at the same time as expanding its range in Washington. iNaturalist observations also indicate that Ilex aquifolium may be rapidly infilling habitat in western Washington (iNaturalist Community, 2024), though such trends may be tied to an increasing user base.



Over the last 20 years, Jacobaea vulgaris abundance and local range appears to have increased rapidly west of the Cascades, particularly in the Puget Trough ecoregion (CPNWH, 2023; iNaturalist Contributors, 2023).
Local range expansion is limited, with a few new plants found every few years, but populations are generally not spreading.

In the last 10 years, local range and abundance of Juncus effusus ssp. effusus is expanding mainly west of the Cascades. Some increase in local abundance and range has also occurred in northeastern Washington in the Canadian Rockies ecoregion in the last 20 years (CPNWH, 2023; iNaturalist Contributors, 2023).



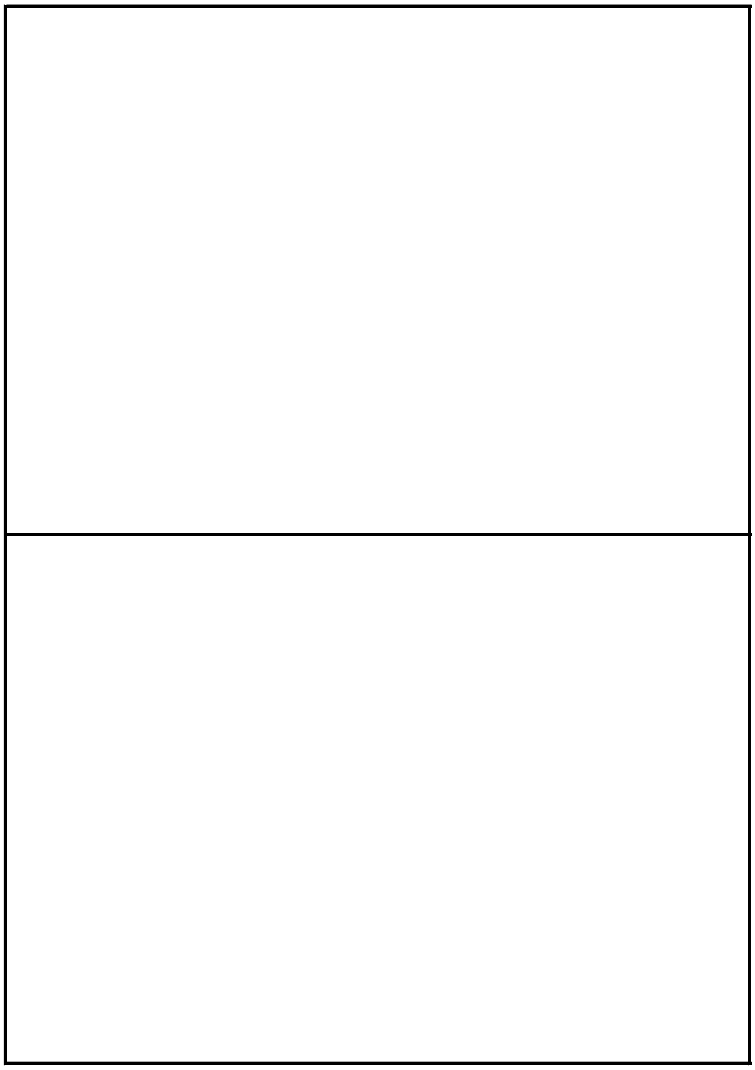
Herbarium records over the last 20 years indicate very little change in abundance or local range for Leucanthemum vulgare (CPNWH, 2023), though the assessor has observed at least moderate infill for this species. Both iNaturalist and herbarium records are most abundant west of the Cascades, and least abundant on the Columbia Plateau. Other sources report greatest density of this species in the eastern Cascades and the northeastern portion of the state (EDDMapS, 2023) and in 2000, this species was reported as most abundant in southwestern and northeastern Washington (NWCB, 2000). Most sources agree that the Columbia Plateau has the least abundance of this species (CPNWH, 2023; EDDMapS, 2023; iNaturalist Contributors, 2023).

The assessor has observed significant infill within at least one natural area in eastern Washington.

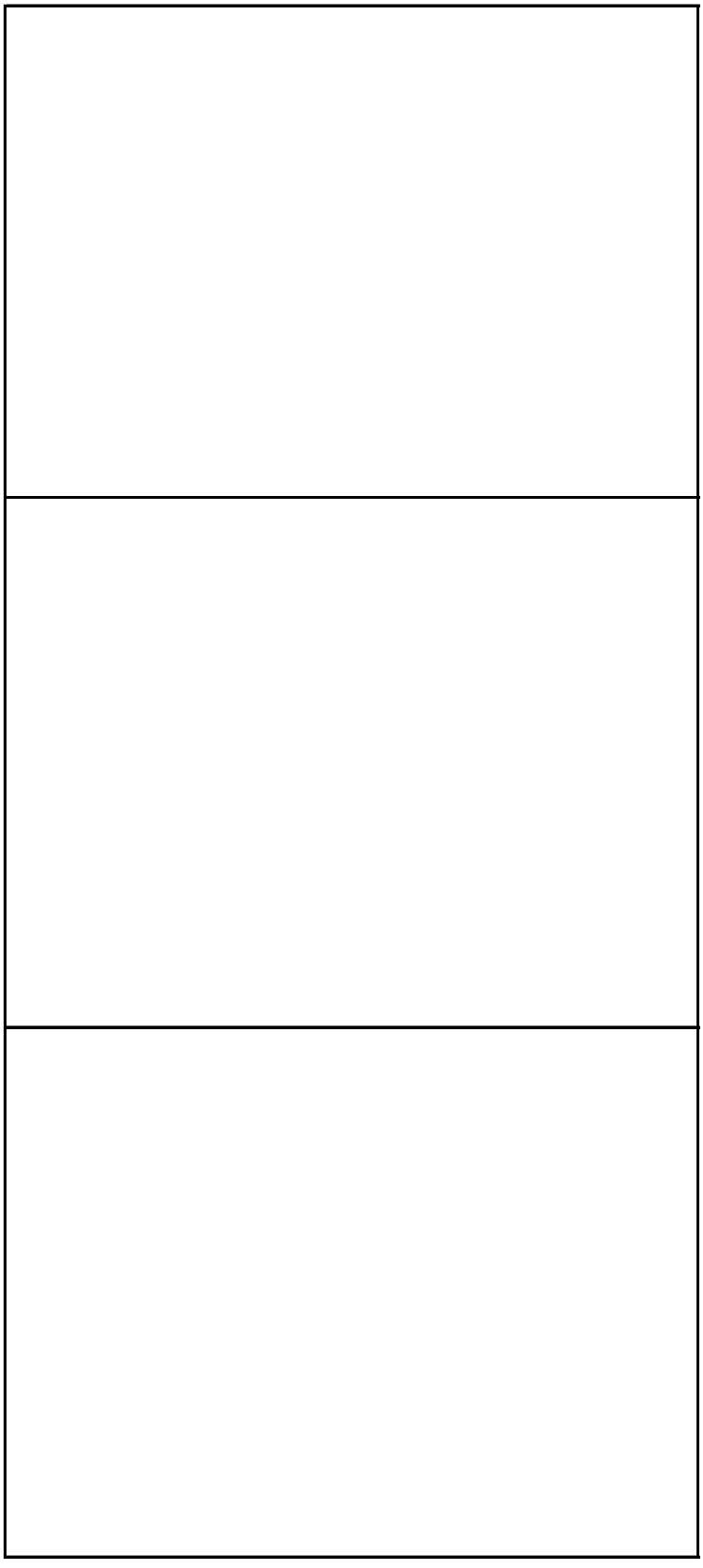
iNaturalist records suggest a rapid increase in local abundance and local range for Myosotis discolor over the last 20 years (iNaturalist Community, 2024). However, herbarium records from the same timespan suggest very little expansion of local range and abundance in Washington (CPNWH, 2024). The majority of iNaturalist records are concentrated in areas of the state with the highest human populations, so some increase in records may be due to an increase in observers. However, because this species is small and easily overlooked, it appears likely that there has been at least some increase in local abundance over the last 20 years.
Populations in several lakes have diminished or been eradicated through intensive yearly management, but populations in less managed lakes have remained stable or even increased (Washington State Department of Ecology, 2024).

The "low" rating is based on firsthand knowledge and scattered reports to the Department of Ecology. While we collect rough abundance data during lake surveys, these data are not fine-scale enough or collected frequently enough to determine accurate trends in abundance. Across the state, familiarity of this species has led to quick management action where it is found. In some locations, populations have declined due to management, while other populations have expanded. I estimate that there is a net range expansion/abundance increase, but that it is overall low when examined across that state. However, we don't have good state-wide data to support any strong conclusions.

Based on herbarium records Phalaris arundinacea may already occupy a large portion of its available habitat in Washington. The largest increases in local abundance appear to be in the northwestern portion of the state, including the Olympic Peninsula, but increases in abundance and range appear to be somewhat constrained in the last 20 years (CPNWH, 2023).
In the last 20 years, Phleum pratense abundance and local range appears to have increased the most west of the Cascades and in northeastern Washington (CPNWH, 2023; iNaturalist Contributors, 2023).

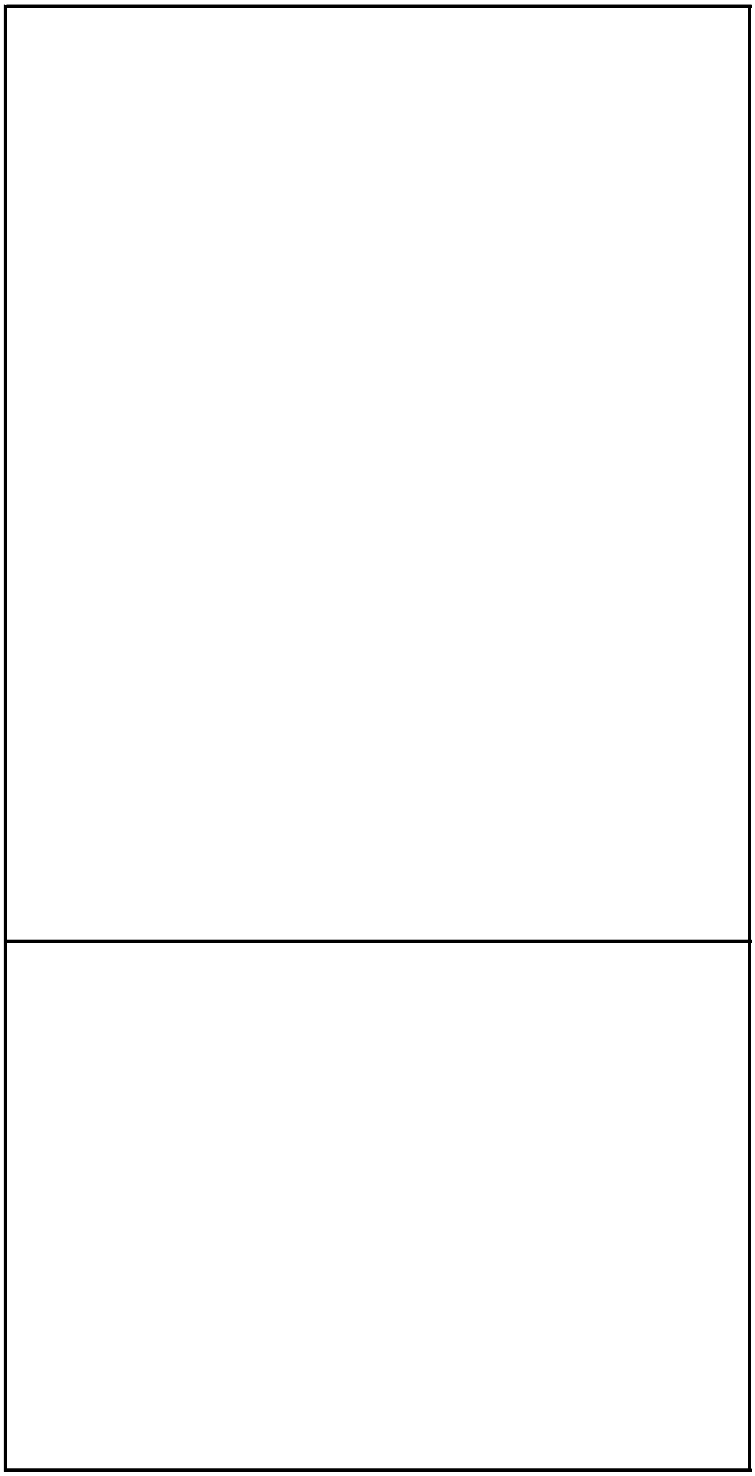


There has not been extensive study or reporting on this species in Washington to estimate this with certainty.



Rubus bifons observations have increased locally in the northern part of Puget Sound and are also reported to be increasing in the Snake River Canyon.
Does not appear to be spreading as aggressively as Rubus bifrons.

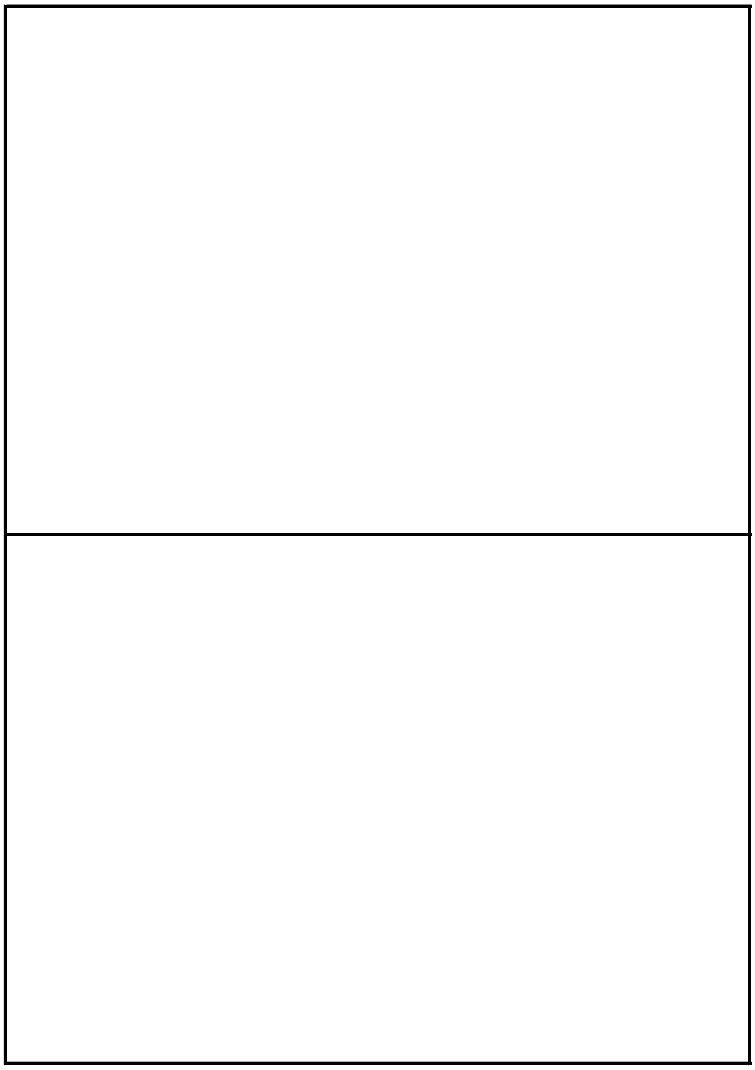
This species doesn’t seem to be expanding locally in areas with which the assessor is familiar.



In the last 10 years, documented populations of S. altissima have grown from three to six. All of these records are currently on the east side of the Columbia Plateau (Consortium of Pacific Northwest Herbaria (CPNWH), 2023; iNaturalist Contributors, 2023).

Millions of dollars have been spent to eradicate this plant over the past 30 years.

The earliest record of Tamarix from Washington in the Consortium of Pacific Northwest Herbaria (CPNWH) is from 2005. iNaturalist observations suggest increased abundance in the last 20 years. Model scenarios predict Tamarix to gain and maintain at least 5% cover east of the Cascades, particularly in the Columbia Plateau ecoregion (EDDMapS, 2023), and as of 2009, less than 1% of suitable habitat for Tamarix was occupied (Kerns et al., 2009), suggesting that local range and abundance could increase rapidly for this genus.



Quantitative data was not available regarding the increase in Utricularia inflata cover where it currently occurs in Washington. However, based on reported observations, abundance of this species appears to be increasing within the Puget Basin (CPNWH 2024; iNaturalist Community, 2024).
The assessor has observed this species slowing increasing in Clark County.

Based on observations and herbarium records, Veronica anagallis-aquatica may be increasing in abundance and expanding its range locally in Washington (CPNWH, 2024; iNaturalist Community, 2024). Records suggest this species is widespread, but only locally abundant in Washington.

ındance (12 pts)		
Q4 citation	**Q5 rank**	**Q5 confidence rank**
	Low	Moderate
iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate

	High	Low
	Moderate	Moderate
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations of Anthoxanthum odoratum from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=75475. Accessed: October 24, 2024.	High	Moderate
	Low	High

	Low	Moderate
iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations of Bellardia viscosa from Washington State. https://www.inaturalist.org/observations?place_id=46&quality_grade=research&subview=table&taxon_id=537967. Accessed: October 29, 2024.	Moderate	High

	Low	High
	High	High
	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate
	NA	NA

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	High	High
	Moderate	Moderate

	Low	Moderate
	Low	High
	High	Moderate

EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	Moderate
	Low	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Common, Cutleaf, and Fuller's Teasel. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	Moderate	High

	Moderate	Moderate
	NA	NA
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	High
Church E.D. 2016. Invasive English holly (Ilex aquifolium L.) in clear-cut and forest units in a western Washington managed forest. MS Thesis. University of Washington, Seattle, WA. iNaturalist Community. 2024. Observations of Ilex aquifolium from Washington State, U.S.A. https://www.inaturalist.org/observations?place_id=46&subview=table&taxon_id=53856. Accessed: September 20, 2024. Stokes D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an invasion: English holly (Ilex aquifolium) in a semi-natural Pacific Northwest Forest. Northwest Science 88(2):75–93. Zika P.F. 2010. Invasive hollies (Ilex, Aquifoliaceae) and their dispersers in the Pacific Northwest. Madroño 57(1):1–10.	Moderate	Moderate

	Moderate	Moderate
	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	Moderate
	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Moderate	Moderate
	Moderate	Moderate

	Low	High
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: October 15, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023. Noxious Weed Control Board (NWCB). 2000. Written findings of the Washington State Noxious Weed Control Board: Leucanthemum vulgare Lam. Washington State Noxious Weed Control Board, Kent, WA.	Low	High
	Moderate	High

	Low	Moderate
	Moderate	Moderate
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	High
Washington State Department of Ecology. 2024. Washington Department of Ecology Lakes Database. https://apps.ecology.wa.gov/lakes/. Accessed: December 12, 2023.	Low	High

	Low	High
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023.	High	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	High	High

	Low	High
	Low	Moderate

	Low	High
	Low	High

	High	Moderate
	Low	Moderate
	Low	Moderate

	High	High
	High	Low

	Low	High
	Low	High
	Low	Moderate

	Low	High
	Low	High

	Low	High
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. iNaturalist Contributors. 2023. iNaturalist Research-grade Observations, Accessed via GBIF.org. https://doi.org/10.15468/ab3s5x. Accessed: October 5, 2023.	Low	Moderate

	Low	Not Rated
Consortium of Pacific Northwest Herbaria (CPNWH). 2023. Consortium of Pacific Northwest Herbaria Specimen Database. http://www.pnwherbaria.org/index.php. Accessed: October 17, 2023. EDDMapS. 2023. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org. Accessed: June 17, 2024. Kerns B.K., B.J. Naylor, M. Buonopane, C.G. Parks, and B. Rogers. 2009. Modeling tamarisk (Tamarix spp.) habitat and climate change effects in the northwestern United States. Invasive Plant Science and Management 2(3):200–215.	Low	High

	Low	High
	Low	High

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	Low	High
	Moderate	Moderate

Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024. iNaturalist Community. 2024. Research grade observations from Washington State. https://www.inaturalist.org/. Accessed: December 24, 2024.	High	Moderate
	Low	High

Question 5. Diversity of Ecosystems Invaded (3 pts)

Ecosystem	Q5 notes
Forest & Woodland, Emergent Open Wetland	Acer negundo is primarily seen in riparian zones along watercourses in eastern Washington.
Forest & Woodland, Forested Wetland, Open Rock	In Washington this species can be found in riparian systems in shrub-steppe and grassland landscapes. It can also be found in forested areas in Klickitat County (sometimes forming its own closed canopy forests in what was initially oak woodland) as well as numerous environments in western Washington. While this species can be found in dry environments it typically only occurs in low competition areas (such as rocky scree) or in areas with at least seasonal moisture, such as lakeshores, riparian areas, and drainages (CPNWH, 2023). This species is found throughout the U.S., and the ecosystems in which it occurs are likely underreported. In the eastern and midwestern U.S., A. altissima is frequently found in early successional deciduous forests, and in the south it is often found in early successional pine forests and along roadsides and logged areas. In the southwest, this species is invasive in riparian areas. In California it is also found in valley and foothill plant communities in addition to riparian areas. Less information is available regarding where this species is found in the Pacific Northwest (Fryer, 2010).

Forest & Woodland, Grassland & Shrubland, Semi-Desert (includes Shrub-steppe), Marine Coastal Shore, Open Rock, Emergent Open Wetland, Forested Wetland	Based on the assessor's experience, this plant may grow in many different habitats.
Grassland & Shrubland, Emergent Open Wetland, Forested Wetland	
Emergent Open Wetland	Ecosystem information can be found in herbarium and citizen science observation records (CPNWH, 2024; iNaturalist Community, 2024).

Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland	Anthoxanthum odoratum occurs in open grasslands, savannas and woodlands, and disturbed areas. This species grows in both mesic and xeric conditions but exhibits greater survival in mesic habitats (Platenkamp, 1990). In the Pacific Northwest and northern California, this species is most common in coastal prairies and wet Willamette Prairie habitats, but it is also found in pastures, roadsides and other disturbed places (Platenkamp, 1990; Clark, 2002; Thorpe, 2011; Pitcher & Russo, 2012). It frequently grows in poor soils (Pitcher & Russo, 2012).
Grassland & Shrubland	

Forest & Woodland	
Emergent Open Wetland, Coastal Brackish Tidal Wetland, Bogs & Fens, Forested Wetland	Arundo donax invades riparian areas and wetlands, particularly in arid, Mediterranean and temperate oceanic environments (McWilliams, 2004; Goolsby et al., 2023). This species grows best where the water table is at or near soil surface but is drought resistant once established. In California, where most research has been done, A. donax grows near lakes, streams, ditches, and other wet areas, but can expand past riparian zones and into upland habitats once it is established. This species can grow in brackish water, and greenhouse experiments suggest it can establish in salt marshes. It has also been observed in bog and fen habitats (McWilliams, 2004). Freezing temperatures reduce A. donax's survival, and in cold areas, this species requires human support to maintain persistent populations (Goolsby et al., 2023).
Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland	Bellardia viscosa is found in naturally and anthropogenically disturbed areas. This species appears to prefer moist, open habitats and is frequently found in wet prairies, swales and other areas of low ground, wet meadows, low wet areas near dunes and beaches, disturbed wetlands and marshes, lake edges, and roadside ditches. It can also be found in old fields, upland prairies, clearcuts and other logged areas, under powerlines, along roadsides and in parking lots and other disturbed areas. Bellardia viscosa tolerates a wide variety of soils, including sand, loam, clay, and glacial outwash. While this species usually occurs in open places, it is also found along edges and roadsides in forested areas, and in tall grass or shrubs. It occurs with both introduced and native species (CPNWH, 2024).

Forest & Woodland, Grassland & Shrubland	
Forest & Woodland, Grassland & Shrubland, Forested Wetland, Bog & Fen, Emergent Open Wetland	
Emergent Open Wetland, Shallow Water Wetland (Aquatic)	This is a species of freshwater aquatic and emergent marsh ecosystems (Knoke & Giblin, 2025).

Grassland & Shrubland, Semi-Desert (includes Shrub-steppe)	Centaurea solstitialis prefers open, disturbed upland habitats, and is often found in annual and perennial grasslands, shrub steppes, oak savannas, open woodlands, and openings in forests. In the Pacific Northwest, this species invades perennial grasslands and sagebrush steppe. In Washington, it can appear in many communities from below lower treeline to montane elevations, though it is most likely to occur in south-facing grasslands in the southeastern portion of the state. Centaurea solstitialis may establish in some riparian areas, but this is not common. This species grows best in deep, well-drained silt-loam or loam soils but can also grow in shallow, rocky soils. In Washington, abundance appears to be related to the soil's ability to hold moisture, with populations producing more seeds in moist soils (Innes & Zouhar, 2021). Centaurea solstitialis' highest impacts are in areas with Mediterranean-type climates, though it can also establish in semi-arid climates like the Great Basin, and sometimes occurs in deserts, coastal regions, and at high elevations in California and Nevada. This species prefers cool, wet winters, which allow seeds to germinate and develop deep taproots before spring (Innes & Zouhar, 2021).
NA	

Semi-Desert (includes Shrub-steppe), Marine Coastal Shore, Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland	Cirsium arvense can be found in almost every upland ecosystem within its range, though it is most likely to be found in prairie or riparian habitats, vernal pools and wet meadows in shrub-steppe systems, or in areas of recent disturbance. In the Pacific Northwest, C. arvense is rarely found in undisturbed forests, but readily colonizes forests and woodlands after human or natural disturbances (Zouhar, 2001; CABI, 2024; GISD, 2024; NatureServe, 2024).
Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland	

Forest & Woodland	
Forest & Woodland	
Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland	

Semi-Desert (includes Shrub-steppe), Forested Wetland, Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland	Little published information was available on the diversity of ecosystems invaded by Cynoglossum officinale in Washington. In its native range (Europe and western Asia), this species is found in open woodlands, meadows, dunes, and in marginal places near agricultural fields and other human disturbances. In North America, C. officinale is found in dry rangeland, grasslands, open woodlands and shrublands, and riparian areas, and is most abundant in highly disturbed areas such as clearcuts and grazed areas. This species is frequently associated with disturbed and ruderal habitats throughout its native and introduced ranges. Habitats and range may be limited by summer temperatures rather than winter cold (de Jong et al., 1990; Jacobs & Sing, 2007; Williams & Fishman, 2014; Momayyezi & Upadhyaya, 2017). One of the assessers reports encountering this species in upland shrub-steppe habitats as well as riparian areas. In its native range, C. officinale prefers calcium rich basic soils and is frequently found on limestone and chalk substrates. Acidic soils may limit growth, even where calcium is abundant (de Jong et al., 1990). In its introduced range, this species can be found in rocky, sandy, loamy, or calcareous soils (Jacobs & Sing, 2007). In some areas C. officinale can be an indicator of drought or high soil nitrogen, and while this species is known to occur in riparian areas in both its native and introduced ranges, it does not survive in waterlogged soil (de Jong et al., 1990; Jacobs & Sing, 2007; Williams & Fishman, 2014). In its native range, C. officinale frequently co-occurs with other species that are exotic or invasive in the northwestern U. S., including Ammophila arenaria, Cirsium arvense, C. vulgare,
Forest & Woodland, Grassland & Shrubland	

Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland	Dipsacus fullonum is usually found in disturbed areas, and prefers moist, open, sunny habitat with limited canopy cover, but can occur in both upland and wetland ecosystems. This species occurs in woodlands, forest openings, savannas, grasslands and meadows, and riparian areas. Dipsacus fullonum is also reported from sagebrush and juniper habitats in eastern Oregon and from inland salt marshes in Ohio , though saline conditions appear to prevent reproduction in this species (Gucker, 2009; DiTomaso et al., 2013).

Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore	This species is occasionally observed in wetlands, but generally only on elevated microsites.
NA	
Grassland & Shrubland	

Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland	Holcus lanatus is found in pastures, grasslands, wet and mesic meadows, and open forests and woodlands of all successional stages. In Washington, this species is also known from coastal scrub communities. This species is abundant in Willamette Prairie and oak woodland communities. This species is most competitive moist conditions but can grow well in wet conditions and survive moderate drought. In the Pacific Northwest, this species is generally known from areas with cool, wet, and relatively snow-free winters and warm, dry summers. It can be killed by heavy frosts. Throughout its introduced range, H. lanatus is frequently found in poor, shallow and/or acidic soils. Holcus lanatus commonly occurs with other introduced species such as Daucus carota, Anthoxanthum odoratum, and Agrostis gigantea (Gucker, 2009; Conner et al., 2013).
Forest & Woodland, Grassland & Shrubland, Forested Wetland	Ilex aquifolium invades mesic forests, woodlands, and riparian areas, as well as disturbed sites such as roadsides and edge habitats (Zika, 2010). This species' ability to invade undisturbed forests has the potential to significantly alter forest understory and structure in Washington (Stokes et al., 2014). Ilex aquifolium may not be particularly cold or drought tolerant (Valladares et al., 2005; Pachura et al., 2021) and appears most successful in western Washington.

Forest & Woodland, Emergent Open Wetland, Forested Wetland	
Emergent Open Wetland, Shallow Water Wetland, Coastal Brackish Tidal Wetland	

Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland	In its introduced range, Jacobaea vulgaris is mainly known from disturbed mesic sites in cool and wet climates. In the Pacific Northwest, it is abundant in prairie and oak habitats, and frequently found in old fields, pastures, roadsides, forest clearings, the edges of riparian areas and wetlands, and other open disturbed areas. This species prefers well-drained loamy or sandy soils and frequently occurs with Cirsium arvense, Hypericum perforatum and Linaria vulgaris (Richardson, 2004; Jacobs, 2009).
Forest & Woodland, Grassland & Shrubland, Forested Wetland	

Emergent Open Wetland, Bogs & Fens, Forested Wetland	Juncus effusus is found in a wide range of wetlands, including wet meadows and pastures, marshes, seeps, lakeshores, wet woodlands and riparian areas, disturbed fens and bogs, and other disturbed wet areas (McCorry & Renou, 2003; Zika, 2015; Arslan et al., 2019; Brooks & Clemants, 2019). Juncus effusus is most successful in acidic and somewhat nutrient-rich soils. This taxon is not found in permanently submerged areas and likely relies on fluctuating water tables (McCorry & Renou, 2003). This taxon is found in shallow peat and on the edges of healthy bogs and fens, but generally only invades disturbed (e.g., drained, mined, and/or grazed) bogs and fens (McCorry & Renou, 2003).
Forest & Woodland, Grassland & Shrubland, Forested Wetland	

Forest & Woodland, Grassland & Shrubland	
Forest & Woodland, Grassland & Shrubland	

Grassland & Shrubland	Leucanthemum vulgare is a ruderal species that establishes in open, disturbed upland areas. This species can be found in grasslands and prairies, pastures (especially when overgrazed) and old fields, clearcuts, roadsides and other disturbed corridors, and disturbed forest openings and edges. A few sources also document this species occurring in forests in North America (e.g. (Brusati, 2005; Stutz et al., 2018)), but the assessor has not commonly observed this species under closed canopies. If it is found in forests, it is likely still associated with edges, clearings or other open disturbed areas. This plant prefers moist climates, but tolerates drought and frost (Clements et al., 2004). Leucanthemum vulgare is most abundant in nutrient-poor soils and thrives in moist clay soils (Clements et al., 2004; Brusati, 2005; DiTomaso et al., 2013; NWCB, 2024). This species can grow at high latitudes (up to 70 degrees north in Europe) (Clements et al., 2004) and at relatively high altitudes (Khan et al., 2021). Its ability to invade in subalpine regions is of serious concern outside of North America, particularly in the Himalayas (Ahmad et al., 2019).
Emergent Open Wetland, Bog & Fen, Forested Wetland	This species is primarily found in wetlands (including fens) and is often abundant on freshwater mudflats. It may establish in mesic upland ecosystems but is typically more incidental in those settings.

Emergent Open Wetland, Shallow Water Wetland (Aquatic)	Lythrum salicaria may sometimes establish in disturbed peatlands.
Forest & Woodland, Grassland & Shrubland, Semi-Desert (includes Shrub-steppe)	This species is known to invade temperate to arid grasslands in other parts of the world (Weiss & Sagliocco, 1994). In Washington, Marrubium vulgare also establishes and persists in relatively dry woodlands.
Forest & Woodland	May occur incidentally in more open ecosystems, but this species is primarily restricted to forests.

Forest & Woodland; Grassland & Shrubland; Marine Coastal Shore; Emergent Open Wetland; Forested Wetland	Myosotis discolor is found in a wide range of naturally and anthropogenically disturbed areas and can grow in both wetland and upland habitats. It is found in both Willamette and coastal prairies, balds, and other grasslands; savannas, woodlands, and open forests; a wide variety of open, shrubby, or forested wetlands; dunes and beaches; and cliffs and rockfaces. This species is frequently associated with anthropogenic disturbances, including roadsides and other travel corridors, powerline easements, trails, and agricultural fields. Myosotis discolor occurs and a range of sandy, loamy, or clay soils, as well as gravelly or rocky substrates (CPNWH, 2024; Feuillet, 2024; Knoke & Giblin, 2024)
Emergent Open Wetland, Shallow Water Wetland (Aquatic)	This is a submersed freshwater aquatic plant. It can survive along muddy shorelines in a terrestrial form, but primarily occurs fully submersed.

Shallow Water Wetland (Aquatic)	This plant grows rooted to the bottom of freshwater lakes, rivers, and streams. It can tolerate a wide range of salinity and pH, but is not typically found in shallow marshes, salt marshes, bogs, or fens (Aiken et al., 1979; Smith & Barko, 1990).
Water Wetland (Aquatic), Emergent Open Wetland	

Forest & Woodland, Emergent Open Wetland, Bogs & Fens, Forested Wetland	Phalaris arundinacea is usually found in wetlands, including wet meadows, marshes, peatlands, and riparian areas, where it frequently makes up 50–100% of the vegetation cover. This species is more occasionally found in uplands (Lavergne & Molofsky, 2004; Waggy, 2010).
Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland	Phleum pratense grows in a wide range of ecosystems, and can be found in forests and grasslands. It can grow in both upland and wetland habitats and frequently colonizes waterways. This species prefers deep, neutral pH, clay to loam soils, but can survive in rocky and shallow soils. It exhibits better survival in cold than warm environments and does not tolerate drought (Esser, 1993; Ogle et al., 2011). Phleum pratense may occasionally be found in alpine areas, but establishment above upper tree line appears to be more common elsewhere in the Rocky Mountains (T. Ramm-Granberg, pers. comm. 2025).

Forest & Woodland, Grassland & Shrubland	
Forest & Woodland, Grassland & Shrubland	

Emergent Open Wetland, Shallow Water Wetland (Aquatic)	This species is a submersed aquatic plant and thus limited in its ability to colonize many different habitats (Bolduan et al., 1994).
Forest & Woodland, Grassland & Shrubland	

Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland	
Forest & Woodland, Grassland & Shrubland	
Emergent Open Wetland, Coastal Brackish Tidal Wetland	This species is mainly found in drift log piles on sand spits and similar habitats, that typically don't have any woody vegetation.

Forest & Woodland, Grassland & Shrubland, Marine Coastal Shore, Emergent Open Wetland, Forested Wetland	Rubus bifrons is considered a facultative wetland species, capable of growing in both wetland and upland environments. While it prefers rich, loamy soils, The FEIS review for this species documented reports from a wide diversity of soil types and is capable of colonizing bare gravel (Fryer, 2021). Rubus bifrons is usually found in woodlands, forests, and riparian areas with moist, well-drained soils, in Mediterranean climates. It occurs in Willamette Prairies, where it can form extensive stands of encroaching shrubs along with Rosa spp. and Toxicodendron diversilobum. Other sources also note this species occurring in estuaries and coastal scrub (Cal-IPC, 2004; Stannard, 2014).
Forest & Woodland, Grassland & Shrubland, Emergent Open Wetland, Forested Wetland	This species may also be found in other ecosystems.

Grassland & Shrubland, Emergent Open Wetland	
Forest & Woodland, Emergent Open Wetland	
Grassland & Shrubland	

Emergent Open Wetland	
Forest & Woodland, Grassland & Shrubland	

Emergent Open Wetland, Forested Wetland	
Emergent Open Wetland; Grassland & Shrubland	In Washington, Solidago altissima is primarily documented from open riparian areas and wetland fringes (often alkaline) (T. Ramm-Granberg, pers. comm. 2025). This species is generally found in open habitats and in other parts of its range, it is also found in open habitats, including grasslands, open woodlands, old fields and pastures, and other open disturbed areas. It can also be found on roadsides and stream or riverbanks and can survive occasional flooding. While this species is found on forest edges, it is usually not found in forests in either its native or invasive range (Etterson et al., 2008; Park et al., 2020). This species occurs from moist to dry sites, and in its native range, it occurs from latitudes of 25–43 degrees (Etterson et al., 2008; Park et al., 2020). Solidago altissima is most successful on deep, nutrient rich soil and less competitive on shallow, rocky soils (Walck et al., 2001). The broad range of climate and geography that this species occurs on in its native range may increase adaptive ability and make S. altissima more successful outside of its native range. (Walck et al., 2001; Etterson et al., 2008; Park et al., 2020).

Coastal Brackish Tidal Wetland, Marine Seagrass & Kelp Bed	This species mostly occupies mudflats and saltmarshes. It competes with eelgrass, but mostly Nanozostera japonica (Japanese eelgrass).
Emergent Open Wetland, Forested Wetland	Tamarix is restricted by availability of suitable habitat, preferring riparian areas in relatively warm and dry ecosystems (Kerns et al., 2009). Tamarix is also found in playas, alkali sinks, lowland woody communities, saline marshes and meadows, and prairies. Associated species are generally species of arid and semi-arid habitats or found in riparian areas or wetlands in areas that are otherwise arid or semi-arid. In these areas, Tamarix species are usually found in habitats that are seasonally submerged (Zouhar, 2003).

Forest & Woodland, Grassland & Shrubland	
Grassland & Shrubland, Marine Coastal Shore	Common on road shoulders, prairies, and deflation plains of coastal dunes.

Shallow Water Wetland (Aquatic)	Utricularia inflata is a suspended aquatic plant limited to impounded freshwater environments. It occurs in ponds, lakes, swamps, sloughs, ditches, and canals (Crow, 2022). As a carnivorous plant, this species may be further limited to sunny, wet, and nutrient poor environments (Wiebush, 2022). In New York, this species is described as particularly problematic in oligotrophic (that is, deep, cold and clear) lakes (Titus & Grisé, 2009). At least one study found that U. inflata was relatively robust to changes in pH, and is potentially capable of colonizing a wide variety of freshwater ecosystems (Titus & Urban, 2013).
Grassland & Shrubland, Emergent Open Wetland	May also infrequently occur in forested wetlands.

Emergent Open Wetland, Bogs & Fens, Forested Wetland, Shallow Water Wetland (Aquatic)	Veronica anagallis-aquatica is an obligate wetland species. This species and its close relatives are phenotypically plastic, allowing it to grow under a wide range of conditions (Ellmouni et al., 2018). Veronica anagallis-aquatica frequently grows in water and has both emergent and submerged forms (Boeger & Poulson, 2003; Ellmouni et al., 2018). It is found in wet meadows and standing water, along streambanks and lakesides, and in slow streams, ditches, and irrigation channels (Wetherwax, 2012; Albach, 2020; CPNWH, 2024). This species has been found in a wide range of wetlands in Washington, including vernal pools and other seasonal wetlands, draw down areas of lakes, streams, and rivers, and floating vegetation mats, and on a wide range of substrates, including silt, muck, sand, and cobbles. Veronica anagallis-aquatica is frequently found in wetlands in sagebrush steppe and other arid areas, but is expanding into wetter west side habitats (CPNWH, 2024; iNaturalist Community, 2024). In its native range, this species is also known from estuaries (Ribeiro et al., 2022), suggesting some salt tolerance.
Forest & Woodland, Grassland & Shrubland	

Q5 citation	**Distribution and Abundance Score**
	57.78
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	72.73
	66.67
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	73.33

	62.22
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Consortium of Pacific Northwest Herbaria (CPNWH). 2024. Consortium of Pacific Northwest Herbaria Specimen Database. https://www.pnwherbaria.org/data/search.php. Accessed: December 20, 2024.	64.44

	88.89
	75.56
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	88.89

CABI. 2024. Cirsium arvense (creeping thistle). https://www.cabidigitallibrary.org/doi/full/10.1079/cabicompendium.13628. Accessed: December 20, 2024. GISD. 2024. Cirsium arvense. https://www.iucngisd.org/gisd/species.php?sc=413. Accessed: December 20, 2024. NatureServe. 2024. Cirsium arvense, creeping thistle. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.154063/Cirsium_arvense. Accessed: December 20, 2024. Zouhar K. 2001. Cirsium arvense. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/cirarv/all.html. Accessed: June 17, 2024.	48.89
	63.63

	82.22
NA	82.22
	86.67

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	55.56

DiTomaso J.M., G.B. Kyser, S.R. Oneto, R.G. Wilson, S.B. Orloff, L.W. Anderson, S.D. Wright, J.A. Roncoroni, T.L. Miller, T.S. Prather, C. Ransom, K.G. Beck, C. Duncan, K.A. Wilson, and J.J. Mann. 2013. Weed Report: Common, Cutleaf, and Fuller's Teasel. Weed Control in Natural Areas in the Western United States, pp. 544. Weed Research and Information Center, University of California, Davis, CA. Gucker C.L. 2009. Dipsacus fullonum, D. laciniatus. In: Fire Effects Information System, [Online]. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/forb/dipspp/all.html. Accessed: June 21, 2024.	66.67

	86.67
	88.89
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	91.11

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	55.56

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	64.44
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	60.00

	53.33
	55.56
	73.33

	46.67
	57.78

	93.33
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	20.00
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	55.56
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	55.56

Distribution and Abundance Rank	**Distribution and Abundance confidence score**	**Distribution and Abundance confidence rank**
Moderate	60.00	Moderate
High	50.00	Moderate

High	30.00	Low
Moderate	40.00	Moderate
Moderate	70.00	High

High	90.00	High
High	70.00	High

Moderate	60.00	Moderate
Moderate	50.00	Moderate
Moderate	80.00	High

High	30.00	Low
High	80.00	High
Moderate	30.00	Low

Moderate	70.00	High
High	20.00	Low

Low	90.00	High
Moderate	50.00	Moderate

High	50.00	Moderate
High	60.00	Moderate
High	80.00	High

High	90.00	High
Moderate	60.00	Moderate

Moderate	80.00	High

High	80.00	High
High	20.00	Low
Low	70.00	High

High	100.00	High
High	80.00	High

High	50.00	Moderate
High	30.00	Low

High	90.00	High
High	30.00	Low

High	70.00	High
Moderate	60.00	Moderate

High	100.00	High
High	100.00	High

Moderate	80.00	High
Moderate	40.00	Moderate

Moderate	50.00	Moderate
High	40.00	Moderate
Moderate	80.00	High

High	80.00	High
Low	80.00	High

High	90.00	High
High	60.00	Moderate

High	90.00	High
High	80.00	High

Moderate	80.00	High
Moderate	70.00	High

High	60.00	Moderate
Moderate	70.00	High

High	50.00	Moderate
Moderate	50.00	Moderate
Moderate	60.00	Moderate

High	80.00	High
Moderate	40.00	Moderate

Moderate	50.00	Moderate
Moderate	100.00	High
High	60.00	Moderate

Low	50.00	Moderate
Moderate	80.00	High

High	90.00	High
Moderate	50.00	Moderate

Insignificant	80.00	High
High	70.00	High

Moderate	80.00	High
High	80.00	High

Moderate	60.00	Moderate
Moderate	30.00	Low

Moderate	80.00	High
Moderate	70.00	High

Current Washington Invasive Rating System Version =
Database last updated =

Overview

Ecological Impact

Management Difficulty

Biological Characteristics

Distribution and Abundance

Ecological Impact data calculation
Metric
Q18

Q18 Abiotic effects
Q19

Q20

Q21

Q22

Q23

Unadjusted Ecological Impact Score

Unadjusted Ecological Impact Rank
Ecological Impact Confidence Score
Ecological Impact Confidence Rank
Ecological Impact Calculation (Biological Characteristics are rolled in when Ecological Impact Confidence is Low)
Ecological Impact Score
Ecological Impact Rank
Ecological Impact Confidence Score
Ecological Impact Confidence Rank

Management Difficulty data calculations
Metric
Q24

Q25

Q26

Q27

Q28

Management Difficulty Score
Management Difficulty Rank

Management Difficulty
Confidence score
Management Difficulty confidence rank

Biolgoical Characteristics Data
Calculations
Metric
Q6

Q7

Q8

Q9

Q10

Q11

Q12

Q13

Q14

Q15

Q16

Q17

Biological Characteristics Score
Biological Characteristics Rank
Biological Characteristics
confidence score
Biological Characteristics
confidence rank

Distribution and Abundance Data
Calculations
Metric
Q1

Q2

Q3

Q4

Q5 Score
Q5 named ecosystems

Distribution and Abundance Score
Distribution and Abundance Rank

Distribution and Abundance confidence score

Distribution and Abundance confidence rank

Version 1.5
2/7/2025

This page summarizes the final scores, ranks, and confidence ratings for the Ecological Impact , as well as the three supplementary information sections (Distribution and Abundance, Biological Characteristics, and Management Difficulty). Overall Ecological Impact Score is usually calculated from the Ecological Impact metrics alone, but assessments with low confindence are supplemented with Biological Characteristics metrics when available.
This page also includes wetland indicator status for each species for the Arid West and Western Mountains, Valleys, and Coast Army Corps of Engineers regions, as well as brief information on life history and growth habit.
Finally, this page also includes miscellaneous information, ranking method, and notes provided in assessment forms for that species.

This page contains the ratings for Metrics Q18 - Q23 and a list of abiotic processes potentially affected by the taxon. It also includes an unadjusted section score (see below for circumstances when the score may be adjusted), rank, confidence score and confidence rank, and the final assigned Ecological Impact scores and ranks.
There is a column that lists abiotic processes potentially affected by the plant.
Subjective metrics with multiple assessments also have the range of individual ratings and confidence ratings in parentheses following the assigned. Mertrics considered relatively objective do not display the range of ratings (instead, the assessor rating with the most evidence is used).
The metrics in this section make up the entirety of the Ecological Impact score, except when the section confidence rank is low. If that is the case, the Biological Characteristics section is incorporated as 50% of the score. Assessments that rated Q22 as unknown or rated all of Q18, Q19, AND Q20 as unknown were automatically assigned low confidence.
When section confidence is ranked as low, Ecological Impact Score = Ecological Impact Score *0. 5 + Biological Characteristics Score * 0.5. Confidence Score and Confidence Rank are not changed.
This sheet also includes notes and citations for all component metrics

This page contains the ratings for Metrics Q24 - Q28. It also includes the final section score, rank, confidence score and confidence rank.
Subjective metrics with multiple assessments also have the range of individual ratings and confidence ratings in parentheses following the assigned. Mertrics considered relatively objective do not display the range of ratings (instead, the assessor rating with the most evidence is used).
The metrics in this section make up the entirety of the Management Difficulty score.
This sheet also includes notes and citations for all component metrics

This page contains the ratings for Metrics Q6 - Q17. It also includes the final section score, rank, confidence score and confidence rank.
Subjective metrics with multiple assessments also have the range of individual ratings and confidence ratings in parentheses following the assigned. Mertrics considered relatively objective do not display the range of ratings (instead, the assessor rating with the most evidence is used).

When confidence in the Ecological Impact section was low, the Biological Characteristics score was averaged into the Ecological Impact (i.e., it was 50% of the Ecological Impact score). This was not done if the assessor did not rate any Biological Characteristics metrics.
This sheet also includes notes and citations for all component metrics

This page contains the ratings for Metrics Q1 - Q5, and a list of ecosystem types (USNVC Formations) each taxon is known to occupy. It also includes the final section score, rank, confidence score and confidence rank.
Subjective metrics with multiple assessments also have the range of individual ratings and confidence ratings in parentheses following the assigned. Mertrics considered relatively objective do not display the range of ratings (instead, the assessor rating with the most evidence is used).
This sheet also includes notes and citations for all component metrics

Roll up method (for taxa that received multiple assessments)
Score: Mode where possible, median when mode could not be calculated.

Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
Compiled all abiotic processes listed in individual assessment and removed duplicates.
Score: Mode where possible, median when mode could not be calculated.

Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
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Score: Mode where possible, median when mode could not be calculated.

Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are removed from the pool of points possible.

Rank assigned based on Ecological Impact Score
Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are included in the pool of points possible.
Rank assigned based on Ecological Impact Confidence Score. If Ecological Impact Confidence Rank is Low, Ecological Impact Score is adjusted by Biological Characteristics score.

Formula used to determine final Ecological Impact Score. Not all assessments had Biological Characteristics scores available.
The final Ecological Impact Score, with any required adjustments applied.
The final Ecological Impact Rank, after any required adjustments applied.

Ecological Impact Confidence Score is not adjusted.

Ecological Impact Confidence Rank is not adjusted.

Roll up method (for taxa that received multiple assessments)
Score: Mode where possible, median when mode could not be calculated.

Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
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Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are removed from the pool of points possible.
Rank assigned based on Management Difficulty Score.

Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are included in the pool of points possible.

Rank assigned based on Management Difficulty Confidence Score.

Roll up method (for taxa that received multiple assessments)
Score: Mode where possible, median when mode could not be calculated.

Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
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Score: Mode where possible, median when mode could not be calculated.

Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are removed from the pool of points possible.
Rank assigned based on Biological Characteristics Score.
Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are included in the pool of points possible.

Rank assigned based on Biological Characteristics Confidence Score.

Roll up method (for taxa that received multiple assessments)
Score: Mode where possible, median when mode could not be calculated.

Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
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Confidence Score: Mode of answers that were used to assign the score if possible, median of the answers that were used to assign the score otherwise.
compiled all ecosystems listed in individual assessment, and removed duplicates.
compiled all ecosystems listed in individual assessment, and removed duplicates.
Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are removed from the pool of points possible.
Rank assigned based on Distribution and Abundance Score.

Number of points received/Number of points possible * 100. Metrics ranked NA or Unknown are included in the pool of points possible.

Rank assigned based on Distribution and Abundance Confidence Score.

Metric Objectivity

Subjective
Subjective

Subjective

Subjective

Relatively Objective

Subjective

Subjective

Metric Objectivity

Subjective

Relatively Objective

Subjective

Relatively Objective

Subjective

Metric Objectivity

Relatively Objective

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Metric Objectivity

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Subjective

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Relatively Objective
Relatively Objective

Post-assessment revisions by WNHP

Post-assessment revisions by WNHP

Post-assessment revisions by WNHP

Post-assessment revisions by WNHP

Final rating for each species was checked against herbarium records, iNaturalist data, and EDDMaps and updated as necessary to reflect protocol. If assessors marked this metric as NA or Unknown, WNHP staff updated the rating with available data.

When Q1 and Q3 were both originally NA or Unknown, WNHP staff rated this metric

Item 7: 2025-2030 Strategic Plan Adoption (Decision)

Action Requested: Decision

Summary

This memo summarizes the update process for the 2025-2030 Strategic Plan Update.

Background

The first planning activity for the upcoming 2025-2030 Strategic Plan was March 20th, 2025, meeting of the Washington Invasive Species Council. A questionnaire was sent out beforehand, where council members were asked which elements of the current plan belonged to the following categories:

- Keep Without Discussion
- Keep but Discuss
- Retire (Achieved)
- Retire (No Longer Relevant)

Plan elements were arranged into a whiteboard for discussion during the March meeting. Items identified as "Keep Without Discussion" were either kept with their existing wording, combined with related items for conciseness, or reworded for clarity. Feedback for any of those verbiage changes or relocation of elements from one key strategic area to another were confirmed via an anonymous survey that was sent for review between April 30th and June 11th. Items deemed "Retire (Achieved)" or "Retire (No Longer Relevant)" were removed or highlighted as an achievement to be continued in future efforts. Items identified as "Keep but Discuss" were crafted into a worksheet that was sent out for preliminary review during the same period as the anonymous survey to prime council members prior to the July meeting.

Feedback from the anonymous survey was incorporated into the first draft of the 2025-2030 Strategic Plan, and the July discussion topics were incorporated into an official memo included in the meeting materials for the July 17th, 2025 meeting of the Washington Invasive Species Council. Items identified as "Keep but Discuss" were organized into nine major discussions per corresponding key strategic area and

deliberated at the July 17th, 2025 meeting. The council had roughly twenty minutes for each discussion. These discussions led to clarity around elements to be kept, as well as new initiatives for the council to pursue in the next five years. The results of these discussions were recorded in the meeting minutes and by council staff to include in the next iteration of the draft.

A second draft of the 2025-2030 Strategic Plan was sent out for review between September 2nd and September 17th to confirm that all feedback from the questionnaire, March meeting, anonymous survey, initial rounds of review, and the July meeting were captured. Any final edits were included in the final draft, which is included with this memo as part of the meeting materials for the September 25th meeting.

Staff Recommendation

Council staff will take any final comments to include in the final draft. Council staff recommend adopting the 2025-2030 Strategic Plan and the content within, with the understanding that formatting, photo replacement, and checking for spacing and spelling errors will be completed by Recreation and Conservation Office Communications staff prior to completion and submission to the legislature, as verbiage needs to be confirmed first to tailor the formatting and paneling around it. The decision purpose is to confirm the concepts contained within the draft and that all feedback was captured throughout the process.

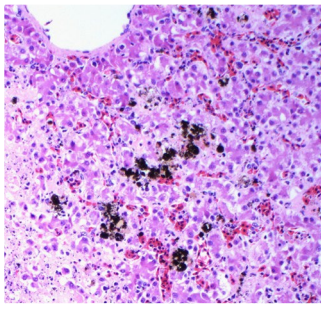
AFRICAN CLAWED FROG *(XENOPUS LAEVIS)*

RIGHT: OSHV-1 SHELLFISH VIRUS *(OSTREID HERPESVIRUS TYPE 1)*

ASIAN GIANT HORNET *(VESPA MANDARINIA)*

WHITE-NOSE SYNDROME DISEASE *(PSEUDOGYMNOASCUS DESTRUCTANS)*

GARLIC MUSTARD ***(ALLIARIA PETIOLATA)***



Washington Invasive Species Council 2025-2030 Strategic Plan

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE

Washington Invasive Species Council

Council Organizations

The council is comprised of members from state, federal, local, regional, and tribal government agencies; non-governmental organizations; and industry groups. The council meets quarterly and provides a venue for regular communication among its members, partners, and the public. This ongoing coordination results in consistent statewide priorities, efficient management approaches, and common messaging to prevent the introduction and spread of invasive species in Washington State.

Avista | Marcie Clement
Trout Unlimited | Alexei Calambokidis
Kalispel Tribe of Indians | Joe Maroney
King County | Steve Burke
Northwest Power and Conservation Council | Stacy Horton
Puget Sound Partnership | Todd Hass
Stillaguamish Tribe of Indians | Jason Anderson
U.S. Coast Guard | Vacant
U.S. Customs and Border Protection | Luca Furnare
U.S. Department of Agriculture | Yolanda Inguanzo
U.S. Department of the Interior | Cory Sandow
U.S. Fish and Wildlife Service | Regan McNatt
U.S. Forest Service | Vacant
Washington State Department of Agriculture | Sven-Erik Spichiger
Washington State Department of Ecology | Wesley Glisson
Washington State Department of Fish and Wildlife | Justin Bush
Washington State Department of Natural Resources | Blain Reeves, Past Chair
Washington State Department of Transportation | Ray Willard
Washington State Noxious Weed Control Board | Mary Fee
Washington State Parks and Recreation Commission | Andrea Thorpe
Washington State University | Todd Murray
Benton County | Adam Fyall

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facebook.com/WAInvasiveSpeciesCouncil/

YouTube
youtube.com/channel/UCXoDMajDN-kbUoqdbACV9jA

Twitter
twitter.com/WAinvasives

Instagram
instagram.com/wa_invasivespeciescouncil/

Administrative services are provided by the Recreation and Conservation Office (rco.wa.gov).

If you need this information in an alternative format, please call 360-902-3000 or TDD 800-833-6388.

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Washington Invasive Species Council

Washington Invasive Species Council 2025-2030 Strategic Plan

"Invasive species" include non-native organisms (terrestrial and aquatic plants, animals, wildlife diseases, and insects) that cause economic or environmental harm and are capable of spreading to new areas of the state. "Invasive species" does not include domestic livestock, intentionally planted agronomic crops, or non-harmful exotic organisms.

Mission

The council provides policy level direction, planning, and coordination that will:

- Empower those engaged in the prevention, detection, control, and eradication of invasive species.
- Include a strategic plan designed to build upon local, state, and regional efforts, while serving as a forum for invasive species education and communication.

Vision

Sustaining Washington's human, plant, and animal communities and our thriving economy by preventing the introduction and spread of harmful invasive species.

Purpose

Established by the Legislature in 2006, the council is tasked with providing policy level direction, planning, and coordination for combating harmful invasive species throughout the state and preventing the introduction of others that may be harmful. The council is tasked with improving coordination of state invasive species activities to ensure the investments made today are the right investments for the future.

Key Strategic Areas

- Leadership and Coordination
- Innovation and Research
- Education and Outreach
- Prevention
- Early Detection and Rapid Response
- Containment, Control, and Eradication

Leadership and Coordination

Key Priorities

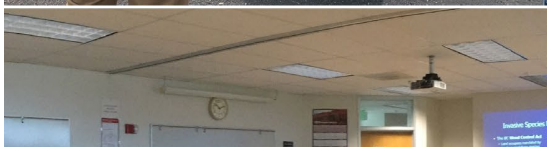
1. Statewide leadership and information sharing
2. Coordination and partnerships
3. Coordination and response structures and processes
4. State and federal policies and programming
5. Tribal and municipal collaboration
6. Unified industry, government, and research

▼ Key Objectives

- **Function as a statewide and regional hub** for leadership and information sharing across all jurisdictions.
- **Develop new and strengthen existing statewide, regional and local partnerships** and processes with industry, government, tribal, and non-governmental organizations to address key invasive species issues.
- **Collaboratively leverage federal funds for state, tribal, and local programs** where there is a cross-cutting need beyond the charge of one individual organization.
- **Build, reinforce, and systematize connections** among researchers, managers, industry and policy makers to address shared challenges.
- **Advocate for adequate and sustained resources, policies, and programs** at the federal, state, tribal, and local levels.

Before the Invasive Species Council, there was no statewide forum for addressing broad invasive species concerns. The council has helped bring the right people to the table to find balanced solutions to these important challenges.

- **Documenting impacts and building momentum** towards the council's reauthorization or permanent authorization in 2032.
- **Informed policy makers that understand the threats** of invasive species and the benefits of prevention, detection, response, and control, containment, or eradication.
- **Collaboratively developed communication frameworks and efficient processes** to support tribal and municipal governments and for enhanced information sharing.
- **Strengthened coordination among managers, researchers, and industry** in project development and planning, with the council leading cross-cutting projects on behalf of multiple organizations when appropriate.
- **Advocacy for adequate and sustainable invasive species resources, policies, and programs** at the federal, state, and local levels through collaboration with organizations such as the Pacific Northwest Economic Region, Western Governors' Association, Council of State Governments West, Western Regional Panel on Aquatic Nuisance Species, Western Plant Board, Pacific States Marine Fisheries Commission, and Northwest Power and Conservation Council.



Innovation and Research

▼

- Vulnerable species and resources, resilient landscapes, and sustainable development and infrastructure
- Vibrant communities and human health
- Industry partnerships in prevention

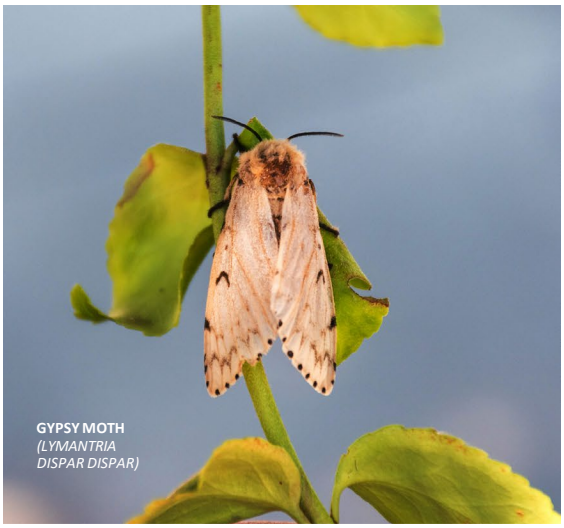
- **Advocate for prioritization and integration of invasive species prevention** and management into watershed and species recovery, forest health, wildlife, development, and climate adaptation, and other relevant plans.
- **Increase support and resource allocation for resilient native landscapes** that are more resistant to invasive or nuisance species establishment.
- **Identify and forge new connections and relationships** with industry and commerce, transportation, and human health that furthers prevention and management efforts.
- **Engage experts and researchers** to enhance horizon scanning and habitat suitability prediction.

- **Identifying and addressing the gap in understanding how invasive species affect** human wellbeing and healthy communities, and strengthen the nexus between ecological management, economic vitality, and resilient communities.

New threats are always looming. By strengthening our processes, procedures, and research, we can be better prepared for what lies on the horizon.

What We Will Achieve

- **Integration of invasive species prevention, management, and strategic actions** into federal, regional, and state plans, including watershed management, species recovery, forest health, wildlife, climate adaptation, and broader landscape resiliency efforts.
- **Expanded sharing of invasive species prevention and management best practices and lessons learned,** statewide and regionally, with emphasis on those that pose significant risks to Washington's economy and environment.
- **Continuation of the industry advisory panel, with expanded collaboration** and information sharing between panel members, the council, and key sectors such as commerce, transportation, and human health to advance prevention and management efforts.
- **Convening of a science advisory panel** to provide the council with timely, evidence-based recommendations on emerging or cross-cutting invasive species issues, ensuring decisions are informed by the best available science and expertise.
- **Convening of a work group to examine the connections between invasive species** and human health on both the individual and community levels. The group will provide recommendations to the council, which members will bring back to their own organizations to guide broader, equitable distribution of education, outreach, and resources across the state.



GYPSY MOTH
(LYMANTRIA DISPAR DISPAR)

Education and Outreach

Key Priorities

1. Public awareness and mobilization
2. Policy maker awareness
3. Youth and adult community science
4. Professional development and cross-training
5. Formal and informal education

Incentivizing new partnerships and proactive involvement

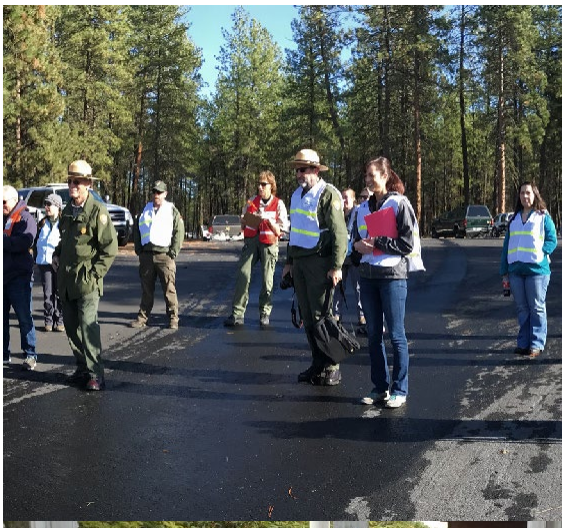
▼ Key Objectives

- **Raise awareness and mobilize the public** and whole community.
- **Collaboratively develop messaging and campaigns** to address emerging problems.
- **Harmonize messaging across organizations** to better address existing problems.
- **Improve statewide first detector capabilities** by cross-training professionals.
- **Engage both youth and adults** through formal and informal education.
- **Expand and enhance the council's online presence** to both new and existing audiences.
- **Strengthen and expand education for** key policy makers to increase their understanding of invasive species threats and the importance of prevention and management.
- **Incentivize and strengthen professional partnerships** through new certification opportunities.
- **Celebrate and highlight success stories** with stakeholders, partners, policy makers and the public to inspire positive action.

We must sustain and elevate awareness about invasive species challenges, while inspiring the next generation to take action and lead these efforts.

What We Will Achieve

- **Statewide leadership and promotion of Invasive Species Awareness Week** in Washington State in partnership with the Governor's Office and state agencies to raise public understanding and engagement.
- **Collaboration with agencies to promote statewide events** such as Tree Check Month and Clean Drain Dry Week, amplifying regional and national messages, while adapting the content to meet Washington's state and local needs.
- **Development and deployment of new campaigns** and messages with state, regional, and national partners.
- **Development and continuation of formal and informal education for all ages** through existing and new curriculum and programming.
- **Maintenance of the InvasiveSpecies.wa.gov Web site** as the central statewide information hub, with the council evaluating and guiding improvements to the Washington Invasives mobile app to ensure they both meet user and council needs.
- **Creation of invasive species prevention and management certifications** tailored to different professions, industries, and entities, in collaboration with regulatory agencies, to foster new partnerships, enhance professional development, and recognize the contributions of mindful private cooperators.
- **Continuation of the development and execution of an annual outreach plan** and year-end report, with council review and active participation to assess, improve and optimize outreach initiatives.
- **Enhance of our online presence and public awareness** by leveraging webinars, events, and workshops.
- **Continuation of the existing first** detector programming and investigation of opportunities to expand the network through partnerships with other existing networks to leverage these resources to achieve our objectives.



Prevention

Key Priorities

1. Address potential and existing impacts
2. Understand and evaluate risks and invasion pathways
3. Response readiness
4. Prevention protocols and public adoption

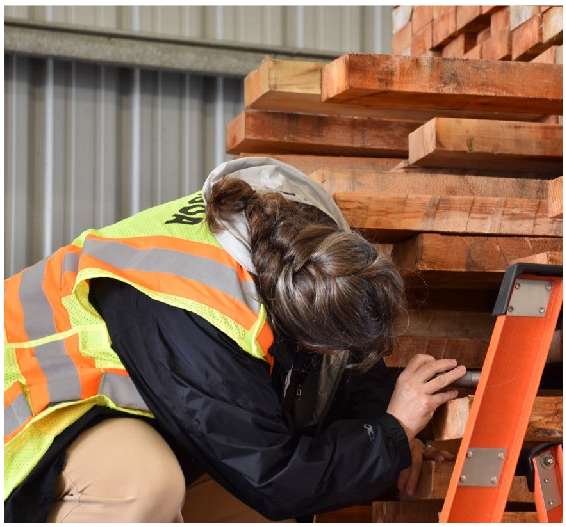
Key Objectives

- **Improve understanding of the risks posed by emerging and expanding** invasive species and their potential ecological, economic, and community impacts.
- **Effectively communicate the scope of economic impacts** to local, state, regional, national, and international stakeholders and decision makers.
- **Quickly analyze risks, pathways for introduction, and spread** of newly introduced invasive species and determine priority.
- **Work collaboratively with industry and organizations** to address risks and pathways and advocate for response preparedness and readiness.
- **Harmonize agency prevention protocols** and encourage public participation in prevention.
- **Advocate for and support national, regional, state, and local prevention programs** such as plant nursery, watercraft inspection, pet retailer, regulated shipping, and public and business awareness initiatives.

What We Will Achieve

- **Improved species assessment tools to evaluate both potential and existing risks and impacts, supporting council prioritization and strategic focus.** These tools will also be promoted to partners and local organizations to help prioritize actions and guide management at site-specific and local levels.
- **Convening of an economic impact technical committee to update and enhance the 2017 Economic Impact of Invasive Species Report,** providing stakeholders with clear actionable information on the importance of prevention and informed decision-making.
- **Advocacy for international and domestic pathway analyses** and response readiness activities.
- **Prevention protocols and best practices** actively implemented and adopted by government agencies and the public to reduce the spread and impact of invasive species.
- **Advocacy for and assistance to existing prevention programs** and explore opportunities for additional protection at the local level.
- **Outreach, trainings, tools, and equipment** that empower the public and recreators to implement prevention protocols.

Prevention is the most cost-effective tool in the toolbox. If we prevent the introduction of new invasive species, we avoid thousands, if not millions in management costs and economic losses.



Early Detection and Rapid Response

Key Priorities

1. Early detection capabilities
2. Emergency funding
3. Diagnosis and notification
4. Response plans and exercises
5. Optimizing and sharing response resources

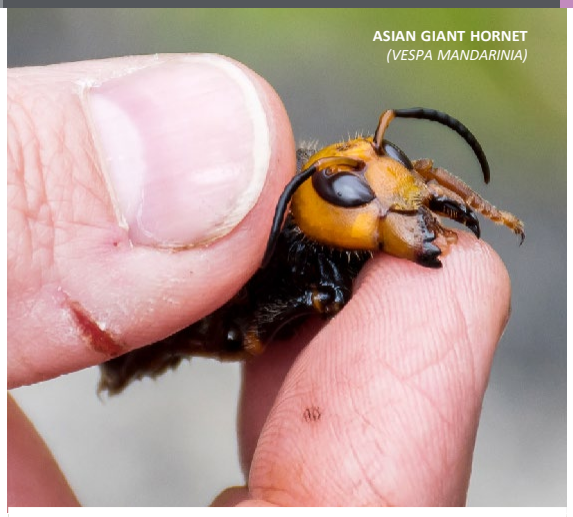
▼ Key Objectives

- **Support increasing the capacity and capabilities** of state, tribal, and local governments for early detection, leveraging resources and expertise across organization to maximize effectiveness.
- **Support the development, expansion, access, and use of diagnostic centers and pest detection technologies** for early detection and response readiness efforts.
- **Streamline and integrate incident notification systems** and processes to ensure timely and coordinated response actions across agencies, stakeholders, and the public.
- **Advocate for and support requests for state emergency funding** for rapid response actions, while assisting agencies in leveraging federal resources to address invasive species emergencies effectively.
- **Identify and refine processes and procedures** for early detection and rapid response, and promote resource sharing among agencies and stakeholders to enhance effectiveness.
- **Practice and enhance response plans** through workshops, drills, and exercises.
- **Facilitate the development and improvement of response plans, and provide input** informed by best practices, experience, industry perspective, site specific knowledge, or other expertise.

When prevention isn't possible, early detection and rapid response minimizes the ecological, economic, and community impacts of invasive species.

▼ What We Will Achieve

- **Expanded access and application of the Incident Command System (ICS)** and related resources, and encouragement of its adoption by council organizations and partners, where appropriate.
- **Early detection monitoring enhancements** to address gaps in monitoring and surveillance, improving coordination, data quality, and timely response across agencies and partners.
- **Advocacy for invasive species diagnostic centers** and adoption of new technologies and resource sharing to enhance early detection, accurate identification, and informed management decisions.
- **Streamlined notification systems** that enhance communication processes and initiation of response actions among agencies with jurisdiction, partners, and the public.
- **Improved response planning** through coordination and involvement of the council to ensure effective and timely response to invasive species incidents.
- **Strengthened response capabilities and action** through promotion and participation in workshops, drills, and exercises.
- **Consultation to agencies** with jurisdiction during invasive species emergencies and advocacy for federal support to enhance response efforts.
- **Participation in Multi-Agency Coordination (MAC) Groups** and aided incident command staff as requested.
- **Outreach to local organizations that can help** with early detection and response efforts.



ASIAN GIANT HORNET
(VESPA MANDARINIA)

Eradication, Control, and Containment

Key Priorities

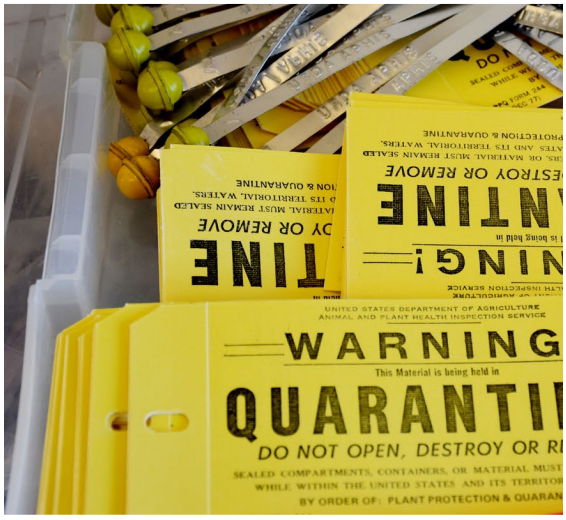
1. Adequate and sustainable funding
2. Data collection, sharing, and mobilization
3. Evaluation and optimization of response operations
4. Asset-based management for protection and natural or economic assets
5.

▼ Key Objectives

- **Advocacy for adequate and sustainable funding** to support the achievement of management goals for established invasive species.
- **Analyze and document current funding** and operational activities to identify gaps, unmet needs, and opportunities for improvement.
- **Advocate for achievable management goals and the evaluation of ongoing operations** using adaptive management principles informed by new science, best practices, changing population dynamics, and effectiveness of interventions.
- **Advocate for and support operational optimization** by promoting resource sharing, cross-training, and public engagement to enhance cross-agency and partner coordination.
- **Promote and facilitate data collection, sharing, and mobilization** among local, state, regional, and national organizations to establish a common situational awareness and support coordinated management efforts.
- **Analyze regulatory invasive species classifications,** management goals, operational practices, and propose reevaluation or adjustments as needed to ensure effectiveness and alignment with best practices.
- **Promote and support response strategies** that prioritize the protection of the most at-risk species and resources, mitigating both economic and environmental damages.

- **Adequate and sustainable funding that meets the management objectives** of lead organizations.
- **Cross-organizational work groups that analyze regulatory classifications** at the state and federal level, and advocate for updates and changes when appropriate to improve effectiveness.
- **Collection and sharing of data and execution of mobilization campaigns** to address data gaps.
- **Facilitation of sharing and cross-hosting of data sets** as appropriate to support research, analysis, and coordinated action across agencies and partners.
- **Workshops and symposia that share current research** and best practices supporting science-based strategies for managing both established and emerging invasive species.
- **Advocacy for adaptive management principles and support to lead agencies in setting and evaluating data-driven management goals** ensuring effective, science-based management of established invasive species.

Once we know an invasive species is detected, rapid and aggressive eradication, containment, and control provide a fighting chance to stop its spread and make sure we won't be spending millions of dollars to battle this species for decades to come.



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