WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Washington Invasive Species Council

Revised Meeting Agenda
Washington Invasive Species Council

December 9, 2021
Online Web Meeting

ATTENTION:
Protecting the public, our partners, and our staff are of the utmost importance. Due to health concerns with the novel coronavirus this meeting will be held online. The public is encouraged to participate online and will be given opportunities to comment, as noted below.

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.

Registration Link: https://zoom.us/webinar/register/WN_KFOO6oz9Sx2AmvJgs7S0eA

Phone Option: You may also access the webinar using a phone only. This can be completed by calling (646) 568-7788 at or shortly before the start of meeting. You will then be prompted for a meeting ID. The meeting ID is 986 8431 0256.

Location: RCO will also have a public meeting location for members of the public to listen via phone as required by the Open Public Meeting Act, unless this requirement is waived by gubernatorial executive order. In order to enter the building, the public must not exhibit symptoms of the COVID-19 and will be required to comply with current state law around personal protective equipment.

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.

Special Accommodations:
People with disabilities needing an accommodation to participate in RCO public meetings are invited to contact Leslie Frank by phone (360) 789-7889 or e-mail Leslie.Frank@rco.wa.gov. Accommodation requests should be received by November 25, 2021 to ensure availability.

Thursday, December 9

OPENING AND WELCOME

9:00 a.m. **Welcome and Call to Order** *Chair Joe Maroney*
- Web Meeting Ground Rules
- Roll Call and Determination of Quorum

- Review and Approval of Agenda (***Decision***)
- Approval of September 2021 Minutes (***Decision***)

HOT TOPIC AND STAFF REPORTS

9:10 a.m.	**1. Executive Coordinator's Report**	*Justin Bush*
9:40 a.m.	**2. Southern Resident Killer Whale 101: Diet, Distribution, and Recovery**	*Megan Wallen*
10:10 a.m.	**3. Introduced African Clawed Frogs and their Management in Washington**	*Max Lambert*

DISCUSSIONS, DECISIONS, AND UPDATES

10:40 a.m.	**Break**	
10:50 a.m.	**4. Washington Department of Fish and Wildlife Northern Pike Suppression Update**	*Charles Lee*
11:10 a.m.	**5. Data-Informed Decision Making for Agricultural Pests and Invasive Species**	*David Crowder*
11:30 p.m.	**6. Invasive Species Impacts to Culturally Significant Foods and Resources**	*Todd Murray*
11:40 p.m.	**7. Invasive Species Impacts to Culturally Significant Foods and Resources Discussion**	*Shaun Seaman*
12:00 p.m.	**Lunch**	
12:30 p.m.	**8. Recognition of Councilmember Shaun Seaman**	*Chair Joe Maroney*
12:50 p.m.	**9. U.S. Fish and Wildlife Service Update**	*Theresa Thom*
1:10 p.m.	**10. Washington Department of Fish and Wildlife Watercraft Inspection Update**	*Eric Anderson*
1:30 p.m.	**Ten Minute Break**	
1:40 p.m.	**11. European Green Crab Response Update**	*Allen Pleus*
2:20 p.m.	**12. Future Meeting Planning Roundtable Discussion** • March 2022 Meeting Logistics • March 2022 Meeting Topic Suggestions	*Chair Joe Maroney, Justin Bush*

2:40 p.m. **General Public Comment**

3:00 p.m. **ADJOURN**

Next regular meeting: March 10, 2022, Natural Resources Building, 1111 Washington St SE, Olympia, WA 98105 – Subject to change considering COVID-19

WASHINGTON INVASIVE SPECIES COUNCIL MEETING MINUTES

September 16, 2021

Online--Zoom

Invasive Species Council Members Present:

Joe Maroney, Chair	Kalispel Tribe of Indians
Shaun Seaman	Chelan County Public Utility District
Stacy Horton	Northwest Power and Conservation Council
Steve Burke	King County
Jason Anderson	Stillaguamish Tribe of Indians
Adam Fyall	Benton County
Todd Hass	Puget Sound Partnership
Clinton Campbell	U.S. Department of Agriculture (arrived late)
Carrie Cook-Tabor	U.S. Fish and Wildlife Service
Cindy Cooper	Washington State Department of Agriculture
Allen Pleus	Washington Department of Fish and Wildlife
Ray Willard, Acting Vice Chair	Washington Department of Transportation
Mary Fee	Washington State Noxious Weed Control Board
Andrea Thorpe	Washington State Parks and Recreation Commission
Todd Murray	Washington State University
Karen Ripley	U.S. Forest Service
Ian Sinks	Columbia Land Trust
Chris Richards	U.S. Customs and Border Protection
Heidi McMaster	U.S. Bureau of Reclamation
Alexandra Mostrom	U.S. Coast Guard

Guests:

Josh Milnes	Washington Department of Agriculture
Stephen Phillips	Pacific States Marine Fisheries Commission
Sasha Shaw	King County Noxious Weed Control Program

Recreation and Conservation Office Staff:

Justin Bush	Executive Coordinator
Wyatt Lundquist	Board Liaison
Alexis Haifley	Community Outreach & Environmental Education Specialist

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Welcome and Call to Order

Chair Joe Maroney welcomed attendees, members, and staff to the Washington Invasive Species Council (WISC/council) meeting promptly at 9:00 a.m. Following, Board Liaison, **Wyatt Lundquist**, reviewed ground rules and called attendance determining quorum.

Motion:	Approval of September agenda
Moved:	Member Willard
Seconded:	Member Thorpe
Decision:	Approved

Motion:	Approval of June meeting minutes
Moved:	Member Cooper
Seconded:	Member Fyall
Decision:	Approved

Chair Maroney noted that **Vice Chair Reeves** was excused from the meeting and **Member Willard** would be acting in his place. **Member Seebacher** would also be excused from this meeting.

Item 1: Executive Coordinator's Report

Justin Bush, WISC Executive Coordinator, provided a summary of the events, meetings, and relevant news, that have taken place since the June 2021 meeting. He highlighted the July 22nd Leavenworth Don't Let is Loose Event and the June 14th Washington State's Emergency Declaration Authorities Discussion.

Next, Mr. Bush reported social media growth and campaigns, invasive species sighting reports, and reviewed a new slide template that more directly draws a connection between WISC meeting topics and the council's strategic plan. Concerning campaigns and greatest social media reach, he highlighted the August Tree Month Check news release, which was written in partnership with Washington Department of Agriculture (WSDA), Washington Department of Natural Resources (DNR), and the US Department of Agriculture (USDA).

To close his summary, Mr. Bush suggested that a work group made of council members come together to develop and evaluate messaging and materials for people moving into the Pacific Northwest Region, including California, Oregon, and Washington, for the purpose of preventing introduction of invasive species. Thus far, this group would

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include **Member(s) Cooper, Burke, Murray, and Willard.** Mr. Bush will summarize the purpose of the work group in email and solicit more work group members.

Item 2: Flowering Rush Cost-Share Program, and Recreation and Conservation Office Supplemental Budget Request

Stephen Phillips, Pacific States Marine Fisheries Commission, and **Justin Bush**, WISC Executive Coordinator briefed the council on the history and background of the Flowering Rush Cost Share Program which was originally authorized by Congress in 2014 and has evolved into the program being considered today. Mr. Bush noted that the cost-share program is related to previous council work that went into creating the Columbia Basin Flowering Rush Management Plan.

Following, Mr. Phillips gave a high-level overview of the timeline and funding source that lead to this project in its current form. In his opinion the Recreation and Conservation Office (RCO), and by extension WISC is a great place to house this program due to the collaboration among agencies that take place within the council.

Mr. Bush then closed the presentation by reviewing the reasoning behind asking the legislature for 2022 supplemental budget funding. This state funding would be used to administer the Washington portion of a U.S. Army Corps of Engineers and Pacific State Marine Fisheries Commission cost-share program covering the entire Columbia River basin including Idaho, Oregon, and Montana. It would cover staff time required to manage this new program.

Mr. Bush requested a decision from the council to continue work on this program.

Motion:	WISC supports RCO's request for supplemental funding of $28,000 [to administer a Flowering Rush cost share program].
Moved:	Member Ripley
Seconded:	Member Fee
Decision:	Approved

Item 3: Spotted Lanternfly Risk to Agriculture and Connection to Tree-of-Heaven

Josh Milnes, Washington State Department of Agriculture, reviewed the history, biology, potential pathways, and risks associated with Spotted Lanternfly, a species native to Asia, becoming established in Washington.

He stated that while this pest has not yet been trapped or reported in this state, it may only be a matter of time. He noted that preliminary research modeling shows that the Pacific Northwest (PNW) could provide ideal habitat for this invasive species. Part of this

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ideal habitat is associated with the Washington invasive "Tree of Heaven", which the Spotted Lanternfly prefers.

Mr. Milnes closed his presentation by giving a high-level overview of the economic damages this pest could cause to the agricultural trade in Washington State underlining the importance of early detection and rapid response.

Council members discussed the various methods in which this pest could be transported to Washington and the importance of increasing public awareness.

Item 4: Spotted Lanternfly Action Plan Proposal and Discussion

Josh Milnes, Washington State Department of Agriculture, and **Justin Bush**, WISC Executive Coordinator, reviewed the council Spotted Lanternfly Action Plan suggestion for the council. The state action plan is proposed to include the following sections:

- Economic and Environmental Risk Assessment
- Preventative Measures
- Detection Protocols, Validation, and Notification
- Communications
- Initial Response Actions
- Long Term Response Actions
- Restoration and Recovery

Mr. Milnes noted that the Washington Department of Agriculture (WSDA) and council may not put begin planning until 2022—however he stressed the importance of getting this plan ready *before* 2022 would be ideal. Mr. Bush voiced his support for the plan and noted that facilitating collaboration between agencies is a specialty of the Council and they may be able to assist with this proposal.

Council members asked clarifying questions about scope of work and timelines. Several council members stressed the importance of ensuring this plan is based in actions that will drive actual work, rather than just a data gathering mission.

Mr. Milnes, and Mr. Bush closed the presentation by emphasizing the need for a plan of this scope, as well as the urgency in which it needs to be completed before it can by truly useful in guiding management actions and planning.

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Break: 11:10-11:20

Item 5: Invasive Species and Nexus to Environmental Justice

Shaun Seaman, Chelan Public Utilities District, provided background information on the Invasive Species and Environmental Justice working group. Member Seaman noted that in the 2020 Statewide Strategy, the council agreed to form a working group to examine the relationship between invasive species and diversity, equity, inclusion, and social and environmental justice. He acknowledged that this is a much bigger issue than can be covered in today's meeting but provided updates on what the working group has been focusing on. Within their discussion, Member Seaman had focused on invasive species impacts towards cultural resources, the harvesting of traditional foods, and habitat damage, which was highlighted in SB 5141. From the group discussions, they intent on bringing forth recommendations and an overall action to move forward with.

He closed his presentation by reviewing the three main questions he would like to gather feedback on from the council members, as this discussion will be imperative to guiding the work of the group until the next meeting.

Item 6: Invasive Species and Nexus to Environmental Justice Discussion

To streamline and facilitate effective discussion, **Wyatt Lundquist**, Board Liaison, and **Justin Bush**, WISC Executive Coordinator, called on each member allowing for 2 minutes of discussion for the following questions:

1. **What is your agency's approach to achieving environmental justice?**
2. **Do you see a nexus between environmental justice and the council's strategic plan and objectives?**
3. **The council work group is considering how environmental justice and cultural significance could be integrated into the invasive species assessment and prioritization tool. Do you have any initial thoughts for the work group to consider?**

Council members discussed what their respective agencies are doing to address environmental justice as it relates to invasive species. Several members noted that the council differs from their agencies both in how the council operates by bringing people together, and how the scope of the council is a statewide one.

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Lunch 12:10 PM-12:30 PM

Item 7: Connecting with all Communities- Invasive Species and Language

Justin Bush, Executive Coordinator, reviewed information from the Office of Financial Management and Washington Emergency Management Division that the top languages spoken in Washington, with the most used language other than English being Spanish. Mr. Bush noted that one of the topics related to the council's strategic plan and mission is to engage all communities within Washington to prevent and stop invasive species and one way that could be achieved is by translating the council's materials into different languages.

Council members asked clarifying questions about Mr. Bush's presentation and discussed the challenges, but necessity, of prioritizing tasks for an undertaking of this magnitude.

Item 8: King County Noxious Weed Control Program Spanish Language Poisonous Plants Outreach

Sasha Shaw, King County Noxious Weed Control Board, presented a case study of how her agency has been integrating multiple languages into their outreach and education materials. She prefaced her presentation by noting how King County has been engaging in this work for several years, but they are far from finished. Thus far, their primary focus has been translating material into Spanish.

Ms. Shaw reviewed the various demographics of the residents of King County, noting that there are over 30 different languages spoken there. The top spoken languages in Washington after English are Spanish, Vietnamese, Tagalong, Korean, Russian and Chinese.

Ms. Shaw continued by highlighting the importance of prioritizing translating materials that have the biggest human health impacts first. For example, giant hogweed grows prevalently in King County, and can cause severe burns and rashes to those who may touch it. This human health risk made translating educational and warning materials of giant hogweed into several languages a top priority.

After examining several more case studies, Ms. Shaw closed her presentation by summarizing that translating materials is time consuming, important, and expensive—therefore prioritization is key. She recommended prioritizing public health and safety issues first, as well as any plants or species that are toxic and the most risk to the populations you're trying to communicate with.

Council members thanked Ms. Shaw for her presentation and asked clarifying questions about the materials presented.

Item 9: Discussion on Invasive Species and Language

To streamline and facilitate effective discussion, **Wyatt Lundquist**, Board Liaison, and **Justin Bush**, WISC Executive Coordinator, called on each member allowing for 2 minutes of discussion for the following questions:

- **Is your organization doing multilingual outreach about invasive species?**
- **What languages are you using to communicated about invasive species, and what communities (demographics and geographic locations) are you engaging?**
- **Would it be helpful for the council to create tools or other guidance resources to determine which languages to use?**
- **Are there organizational gaps or barriers that the council could help overcome?**

Several members voiced concern that if materials were translated into other languages, but none of the staff spoke those languages and there is a communication gap for the public reaching out with questions. Council members discussed options on how to overcome the multilingual barrier. Lastly, several members inquired if there is a manual, or best practices, that can assist WISC in figuring out what their role is. In addition to spoken language, the topic of Americans with Disabilities Act accessibility was brought up for those who may not be sighted or may have reading disabilities.

Break 1:26PM-1:40PM

Item 10: Improving Response Preparedness for Aquatic Invasive Species- Survey Results and Next Steps

Justin Bush, WISC Executive Coordinator, reviewed the importance and history of improving response preparedness for aquatic invasive species. He noted that rapid response and early detection are key elements in the council's statewide strategy. Mr. Bush reviewed the key findings of a survey sent out to aquatic invasive species managers and workers.

This survey included a list of formal trainings and informal workshops that would assist in improving rapid response. Based upon the survey results, there will be four informal workshops that WISC will host. The trainings include the following:

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1. Zebra/Quagga Mussel Self-Contained Underwater Breathing Apparatus (SCUBA) Operations Rapid Response Workshop
2. Hazard Analysis and Critical Control (HACCP) Planning to Prevent the Spread of Invasive Species
3. Aquatic Invasive Species Monitoring Workshop
4. Watercraft Inspections and Operations Workshop

Mr. Bush closed his presentation out by reminding the council that this is an ongoing project and there will be additional opportunities to be involved in the future.

Item 11: Future Meeting Planning Roundtable Discussion

Wyatt Lundquist, Board Liaison, reviewed the findings of the survey he sent out to the council. While council members generally provided positive answers, council members found that more sufficient background material could be provided towards member reports and guest speakers when a decision is required. **Chair Maroney** also requested that WISC staff provide motion language to council members.

Using the online tool Mentimeter, **Mr. Bush** and Mr. Lundquist asked several clarifying follow-up questions in response to the survey.

Council members continued the discussion on how to improve council meetings and topics they would like to see brought up in future meetings.

Mr. Lundquist reviewed the dates proposed for the 2022 meeting calendar and reminded the council members to contact him if they had conflicts with any of the dates.

Motion: Approve the 2022 meeting calendar
Moved: Member Fee
Seconded: Member Burke

Decision: Approved

Following the decision, **Chair Maroney** moved the discussion to the proposed agenda for the December 2021 council meeting. Council discussed possible ideas and topics they would like to see during the winter meeting, including climate change and the nexus to invasive species management.

Several council members voiced their support of reviewing the results of the recent climate change panel—specifically asking **Chris Harley**, University of British Columbia,

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to talk more about the mortality event that took place in the intertidal zone due to the heat dome effect from earlier this summer. Additionally, **Theresa Thom**, U.S. Fish and Wildlife Service, volunteered to provide an update on Moss Balls.

Chair Maroney closed out the discussion by thanking the speakers of today's meeting and reminded council members to submit any suggestions for December's meeting topics to Mr. Bush.

General Public Comment: no public comment at this time.

ADJOURN

The meeting adjourned at 2:50 PM.

Next regular meeting: December 9, 2021, Natural Resource Building,1111 Washington St SE, Olympia, WA 98501- Subject to change considering COVID-19

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Pacific NorthWest Economic Region

2021 - 2022
PNWER Executive Committee*

Richard Gotfried, MLA
Alberta
President

Sen. Chuck Winder
Idaho
Vice President

Rick Glumac, MLA
British Columbia
Vice President

Sen. Mia Costello
Alaska
Vice President

Hon. Caroline Wawzonek
Northwest Territories

Rep. Cindy Ryu
Washington

Hon. Ranj Pillai
Yukon

Ken Francis, MLA
Saskatchewan

Sen. Lew Frederick
Oregon

David Bennett
FortisBC
Private Sector Co-Chair

Dan Kirschner
Northwest Gas Assoc.
Private Sector Co-Chair

Sen. Mike Cuffe
Montana
Imm. Past President

*Partial listing

October 21, 2021

Frédéric Bissonnette
Director General – Chief Registrar
Health Canada
Submitted by email to Dr. James Tansey
Saskatchewan Ministry of Agriculture

To Whom it May Concern:

I am writing to express grave concern for the emerging threat of feral swine in Canada and to recommend strong and decisive action by the Canadian Government, Pesticide Management Regulatory Agency, and other federal ministries such as Environment and Climate Change Canada and Agriculture and Agri-Food Canada.

Feral swine are a threat to our economy, health, and environment. Feral swine damage property, agriculture, and natural resources. In the United States alone, economic losses resulting from feral swine damage is estimated at greater than $1 billion per year. Feral swine are highly mobile disease reservoirs and can carry at least 30 important viral and bacterial diseases, and a minimum of 37 parasites that affect people, pets, livestock, or wildlife. Some of the more important diseases affecting people include leptospirosis, salmonellosis, toxoplasmosis, trichinosis, bovine tuberculosis, brucellosis, and balantidiasis. The potential for disease transmission from feral to commercial swine such as African swine fever has serious implications to the Canadian and U.S. economies.

While the distribution and spread of feral swine in Canada is not fully understood, research suggests that numbers are growing and that populations are moving into new areas. We are on the precipice of an emergency, which importantly can be avoided by decisive and preventative action.

Protecting our region against the significant environmental and economic risk of invasive species has long been recognized by PNWER and our Executive Committee as one of the key issues for our region. Every year we advocate and inform policy makers at the state, provincial, territorial, and federal levels on the issue of invasive species. PNWER recognizes the damaging impact that feral swine can have on our regional economy and ecosystem and are particularly concerned with the potential devastating impacts of disease such as African swine fever to the regional and global economy.

PNWER recognizes the need for, and sees significant value added in the development of new management tools and increasing support for rapid response

Pacific NorthWest Economic Region (PNWER) 2200 Alaskan Way, Suite 460, Seattle, WA 98121
Phone: (206) 443-7723 Fax: (206) 443-7703 Online: info@pnwer.org www.pnwer.org

activities. We recommend that the Canadian federal government, including the Pesticide Regulatory Management Agency, recognize the potential threat that feral swine and foreign animal diseases pose as an economic and environmental emergency and fully investigate and contribute to the prevention and management of feral swine.

Sincerely,

Richard S. Gotfried   Matt Morrison

MLA Richard Gotfried
PNWER President 2021-2022
Alberta Legislative Assembly

Matt Morrison
Executive Director
PNWER

Discussion Questions for
PNWER's Economic Leadership Forum Strategic Planning Session
Friday, November 19, 2021

Round 1

1. What common challenges can PNWER, as an organization and public/private network, best address in the upcoming year?
    a. How do we prioritize these common challenges and build solutions?
    b. What is the best way to utilize the platform of the PNWER community to achieve these solutions? (engagement of private sector, executive branch (US), public sector at all levels)
2. What are the most important activities or programs (projects, webinars, COVID calls, etc.) from the past 18 months that should be continued because they are providing value?

Report Out!

Round 2

3. How can we recruit and involve the best leaders for the future? This includes legislative, executive, and business and community leaders.
4. How can PNWER continue to expand state and provincial participation from various agencies and departments?
5. How can working groups better collaborate and share information about activities and challenges they are addressing on behalf of the region?

Report Out!

Designate someone in your group to report out on your group's answers!

Pacific NorthWest Economic Region

<u>PNWER's Mission Statement:</u>

To increase the economic well-being and quality of life for all citizens of the region, while maintaining and enhancing our natural environment.

<u>Goals:</u>

- Identify and promote "models of success"
- Serve as a conduit to exchange information.
- Promote greater regional collaboration
- Enhance the competitiveness of the region in both domestic and international markets
- Leverage regional influence in Ottawa and Washington D.C.
- Achieve continued economic growth while maintaining the region's natural environment
- Communicate provincial and state policies throughout the region

<u>4 Buckets of PNWER Work:</u>

- Sustainable Economic Development and Resilience
- Promoting Regional Priorities in Ottawa and DC
- Cross Border Collaboration and Relationship Building
- Crafting Regional Solutions to Common Challenges

Designate someone in your group to report out on your group's answers!

PACIFIC NORTHWEST CITIZEN SCIENCE SUMMIT

Virtual Event | October 26th & 27th 2021 | 9:00 a.m. to 12:30 p.m. PST

October 26th | 9:00 a.m. to 12:30 p.m. PST

8:30 a.m. – 9:00 a.m.	Informal networking in lobby	All participants and speakers
9:00 a.m. – 9:10 a.m.	Housekeeping, run of show, and introduction of Miro board	Justin Bush
9:10 a.m. – 9:20 a.m.	Opening statements	Troy Abercrombie
9:20 a.m. – 9:50 a.m.	**Keynote: Citizen Science as Science: Realities, Perceptions, Opportunities and Barriers**	***Dr. Julia Parrish***
9:50 a.m. – 10:10 a.m.	Citizen Science as a tool for local government land use planning, lessons from one of B.C.'s fastest growing cities	Pamela Zevit | City of Surrey B.C.
10:10 a.m. – 10:30 a.m.	IDAH2O Master Water Stewards	Dr. Jim Ekins | University of Idaho
10:30 a.m. – 11:30 a.m.	**BREAKOUT ROOMS: Two 20-minute talks with 10 minutes of Q&A**	**Concurrent sessions**
Breakout Group 1:	Snowy Plover patrol: a multi-partner collaboration to monitor a listed species	Allison Anholt | Portland Audubon
	Seattle-Tacoma City Nature Challenge – Engaging broader audiences	Katie Remine | Woodland Park Zoo
Breakout Group 2:	Reducing phosphorus, algae, and plants in a septic polluted lake	Sandy Williamson | Friends of Spanaway Lake
	Coordinated litter assessments across WA State, using EPA's protocol	Heather Trim & Xenia Dolovova | Zero Waste Washington
Breakout Group 3:	Community Science Informs Habitat Management on Public Lands: Twenty Years of Amphibian Surveys in Regional Wetlands.	Katy Weil | Metro Parks and Nature & Megan Garvey | The Wetlands Conservancy
	Urban Wetland Beaver Surveys	Shea Fuller & Megan Garvey | The Wetlands Conservancy

Breakout Group 4:	Whale Sighting Network: Community Science and so much more	Susan Berta | The ORCA Network
	Response to detection of *Vespa mandarinia* in the PNW	Cassie Cichorz | Washington State Department of Agriculture
Breakout Group 5:	MeadoWatch: a long-term community science database of wildflower phenology in Mount Rainier alpine meadows	Berry Brosi | University of Washington
	Engaging volunteers in monitoring the status and distribution of American pikas in the Pacific Northwest during a pandemic	Johanna Varner | Colorado Mesa University
11:30 a.m. – 12:00 p.m.	Improving and making use of iNaturalist data	Lindsey Wise | Portland State University
12:00 p.m. – 12:20 p.m.	Strategies for retaining citizen science volunteers	Jennifer Marquis | Washington State University
12:20 p.m. – 12:30 p.m.	Recap of Day 1 and future of the PNW CitSci Board	Dr. Joey Hulbert | Washington State University

Additional information:

These presentations will not be recorded, so you've gotta be there!

ZOOM LINK:
https://us06web.zoom.us/j/89160182251?pwd=S0tKa3MvR3l0WStRTmRjYXhvV1c2UT09

Miro Board: https://miro.com/app/board/o9J_lpKKk8A=/?invite_link_id=623970615397
*Password for Miro board provided at meeting

PACIFIC NORTHWEST CITIZEN SCIENCE SUMMIT

Virtual Event | October 26th & 27th 2021 | 9:00 a.m. to 12:30 p.m. PST

October 27th | 9:00 a.m. to 12:30 p.m. PST

8:30 a.m. – 9:00 a.m.	Informal networking in lobby	All participants and speakers
9:00 a.m. – 9:10 a.m.	Housekeeping, run of show, and introduction of Miro board	Troy Abercrombie
9:10 a.m. – 9:20 a.m.	Opening statements	Justin Bush
9:20 a.m. – 9:50 a.m.	**Keynote: Connecting over coffee, connecting over Zoom: Building relationships at many scales**	***Dr. Jennifer Shirk***
9:50 a.m. – 10:10 a.m.	Citizen Science: A tool for aquatic invasive species monitoring	Lisa Scott & Sierra Collins | Okanagan and Similkameen Invasive Species Society (OASISS)
10:10 a.m. – 10:30 a.m.	So, you want to start a citizen science project?	Dr. Joey Hulbert | Washington State University
10:30 a.m. – 11:30 a.m.	**BREAKOUT ROOMS: Two 20-minute talks with 10 minutes of Q&A**	**Concurrent sessions**
Breakout Group 1:	Establishing and sustaining a community-based water monitoring program	Gary Olson | Thornton Creek Alliance
	Engaging Washingtonians in water quality monitoring through Surfrider Foundation's Blue Water Task Force	Liz Schotman | Surfrider Foundation
Breakout Group 2:	Afoot and afloat: citizen science in the Protection Island Aquatic Reserve	Betsy Carlson | Port Townsend Marine Science Center
	Monitoring aquatic ecosystems through citizen science at Mount Rainier National Park	Katie Ewen | Western Washington University
Breakout Group 3:	Tracking climate change: Oregon season tracker a collaborative partnership	Jody Einerson | Oregon State University

	The great (digital) outdoors: how community science can engage youth in the outdoors even while inside	Rachel Van Schoik | California Academy of Sciences
Breakout Group 4:	The Pacific Northwest Bumble Bee Atlas	Xerces Society
	Engaging community scientists in urban carnivore research	Katie Remine | Woodland Park Zoo
Breakout Group 5:	There's an app for that! Implementing EDDMapS with citizen scientists for early detection and rapid response	Pacific Northwest Invasive Plant Council
	Machine learning for plant health monitoring and diagnosis	Peter Loyd | Seattle University
Breakout Group 6:	City nature challenge: a springboard for biodiversity and conservation in the Pacific Northwest and Northern Rockies	Dr. Preston Andrews | Native Plant Society
	The Arbutus ARME: building community around the sacred, emergent and adaptive Pacific madrone	Michael Yadrick | Seattle Parks & Recreation
11:30 a.m. – 11:50 a.m.	The River Mile Network Crayfish Study: Lessons Learned	Janice Elvidge | National Park Service & Rick Reynolds | Engaging Every Student
11:50 a.m. – 12:10 p.m.	15 years of citizen science in the Carpenter Creek Estuary restoration and monitoring program	Dr. Melissa Fleming | Stillwaters Environmental Center
12:10 p.m. – 12:25 p.m.	Miro board wrap up	Dr. Joey Hulbert | Washington State University
12:25 p.m. – 12:30 p.m.	Closing statements	Event organizers

Additional information:

ZOOM LINK:
https://us06web.zoom.us/j/89160182251?pwd=S0tKa3MvR3l0WStRTmRjYXhvV1c2UT09

Miro Board: https://miro.com/app/board/o9J_lpKKk8A=/?invite_link_id=623970615397
*Password for miro board provided at meeting

Natural Resources Building
P.O. Box 40917
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STATE OF WASHINGTON

RECREATION AND CONSERVATION OFFICE

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TTY: (800) 833-6388

E-mail: Info@rco.wa.gov
Web site: www.rco.wa.gov

November 30, 2021

Matt Bauer, Acting Director
Western Integrated Pest Management Center
2801 Second Street
Davis, CA 95618-7774

Re: Implementing New Prophylaxis For Invasive Fungal Bat Disease White Nose Syndrome in Washington

Mr. Bauer,

On behalf of the Washington Invasive Species Council, I am writing to express strong support for the Washington Department of Fish and Wildlife's Western Integrated Pest Management (IPM) Center Annual Grants application to protect Washington bats, economy, and environment through implementation of a new prophylaxis for white-nose syndrome.

The State Legislature established the Washington Invasive Species Council in 2006 to develop and implement a strategic approach to prevent and control invasive species that threaten Washington's environment and economy. Preventing invasive species from spreading into new areas in Washington and beyond is the most efficient and cost-effective approach to protecting the resources of our state and region. As such, the preventative approach of implementing a new prophylaxis is the best approach. When prevention fails, invasive species are often unable to be eradicated or contained. Nationally, invasive species cost hundreds of millions in damages and losses annually.

The Washington Department of Fish and Wildlife has a proven track record of protecting Washington's wildlife and resources through surveillance, regulatory enforcement, suppression, and other management actions. In this instance, this work has a direct benefit to agriculture and forestry in Washington. Bats are major predators of forest and agricultural insect pests and serve as indicators of environmental health. Agriculture is a cornerstone for Washington, being valued at $51 billion annually –or 13% of Washington's yearly economic activity. Investing in prevention of white-nose syndrome will protect our bats and agriculture with a substantial return on the relatively low investment when compared with high costs for pesticide use against agricultural insects.

In summary, the Washington Invasive Species Council strongly supports your funding of this suggestion. Please contact me at justin.bush@rco.wa.gov or 360-902-3088 with any questions you may have regarding our support of this project.

Sincerely,

Justin Bush
Executive Coordinator-Washington Invasive Species Council

Natural Resources Building
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STATE OF WASHINGTON

RECREATION AND CONSERVATION OFFICE

December 1, 2021

Matt Bauer
Associate Director
Western Integrated Pest Management Center
2801 Second Street
Davis, CA 95618-7774
Submitted by e-mail to Jill Silver

Re: Analysis of distribution, expansion and management of invasive knotweed over two decades on an unregulated river

Mr. Bauer,

On behalf of the State of Washington Invasive Species Council, I am writing to express strong support for the 10,000 Years Institute's Western Integrated Pest Management (IPM) Center Annual Grants application to synthesize, analyze and communicate lessons learned from a 20-year effort to monitor and eradicate invasive knotweed along the Hoh River on the Olympic Peninsula, in western Washington. Invasive knotweed is detrimental to the riparian and instream habitats and ecosystem services required by Pacific salmon, which are a mainstay of Pacific Northwest tribal and rural communities that rely on salmon and rivers for their culture, subsistence, recreation, and economies.

The council has collaborated with the 10,000 Years Institute for nearly 10 years and is deeply familiar with the institute's abilities and commitment to not only conduct invasive management and research, but communicate results based on the principles and practices of integrated pest management. The project leaders have long-term, practical experience in partnerships with diverse stakeholders to maintain momentum to control invasive species and are also committed to communicating results and best practices to improve and build expertise among the broader communities that work on invasive species and habitat restoration. This experience and expertise will benefit weed and habitat managers both in Washington and across the Western United States including the Province of British Columbia.

The Washington Invasive Species Council has been asked to serve as a collaborator on this project by reviewing the proposed analyses and interim products as they are created. This collaboration will ensure that the end products are of greatest utility to the diverse stakeholders that we and other organizations like ours require. We also commit to helping to publicize and distribute the results at a western scale. The council is proud to serve in this capacity and looks forward to supporting the project if funded.

Please contact me at justin.bush@rco.wa.gov or 360-902-3088 with any questions you may have regarding our support of this project.

Sincerely,

Justin Bush
Executive Coordinator--Washington Invasive Species Council

Stop The Invasion

Photographs courtesy of Peter Eimon and Brian Gratwicke

African Clawed Frog

Xenopus laevis

What are they?

African clawed frogs are predatory aquatic frogs that are highly adaptable to diverse environmental conditions including freezing and droughts. They reproduce so rapidly that they can double their population and range within 10 years.

Are they here yet?

Yes. African clawed frogs currently infest two separate watersheds in Washington State. They have entered the state through the aquarium and pet trades, and possibly via release after being used in science classes.

Why should I care?

African clawed frogs harm native ecosystems by competing with native species. They also have the potential to introduce harmful pathogens that hurt native amphibian and fish populations, including salmon. This decreases recreational fishing potential, in addition to the need to quarantine infested water bodies and close them off to public use.

What should I do if I find one?

Report a sighting online at www.invasivespecies.wa.gov/report.shtml.

How can we stop them?

Do not purchase or keep African clawed frogs as a pet—they are a prohibited species. Above all, do not release an unwanted pet or scientific specimen into the wild.

Report Sightings

@

InvasivesSpecies.wa.gov

July 2017

Photograph courtesy of Gregory Moine

What are their characteristics?

- Up to about 5 inches long, not including their legs.
- Smooth-skinned and plump.
- Range in color from mottled grey to brown, with a pale underbelly.
- Hind feet are particularly large, with clawed toes.

How do I distinguish them from native species?

- Native frogs tend to only inhabit water to breed, otherwise living on land, but near water.
- Native frogs are smaller, rougher-textured and less plump-looking.
- Look up native species (Pacific treefrogs, red-legged frogs, Columbia spotted frogs, Oregon spotted frogs, Cascade frogs) for individual distinguishing details.

Where do I get more information?

- Washington Department of Fish and Wildlife: http://wdfw.wa.gov/ais/xenopus_laevis/
- AmphibianWeb: www.amphibiaweb.org/cgi/amphib_query?where-genus=Xenopus&where-species=laevis

Report Sightings

@

invasivespecies.wa.gov

Washington State Recreation and Conservation Office
Washington Invasive Species Council

African Clawed Frog (*Xenopus laevis*) Risk Assessment, Strategic Plan, and Past Management for Washington State Department of Fish and Wildlife.

2021

Reed Ojala-Barbour[1], Richard Visser[2], Timothy Quinn[1], and Max Lambert[1]

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Contents

EXECUTIVE SUMMARY

African Clawed Frog (*Xenopus laevis*; ACF) occur in at least three disparate locations across the Puget Sound region. Repeated introductions by people, rather than dispersal among these locations, is the most likely explanation for these occurrences. Such repeated introductions may also be more widespread than is currently understood and, as such, future introductions are likely. ACF are voracious predators and vectors of novel pathogens and so pose a risk to native species through direct predation, competition, and disease. Here, we compile information about known ACF introductions, attempted control methods, and potential risks from ACF. We also outline knowledge gaps that are essential for research to address for risk assessment and mitigation. Unsuccessful prior management efforts and a lack of resources underscore the challenges of managing ACF in Washington State and the need for continued research. Without continued commitment from the agency, long-standing partnerships, particularly with local jurisdictions, that support ACF containment in Lacey are tenuous.

Purposeful management of ACF can only happen with an informed risk assessment. Such a risk assessment would ideally happen early in a species' invasion which ACF in Washington presumably are, although data on the extent and timing of their introduction and spread are sparse. To inform a risk assessment, we propose prioritized ideal next steps in ACF management that vary in effort and investment. These include support to maintain and build partnerships that are essential to ACF management and validation of environmental DNA (eDNA) as an important tool to rapidly and affordably monitor ACF spread. This proposal also includes multiple research efforts that would provide the necessary data to inform a risk assessment and ACF management plan. These efforts include surveying to document the true extent of current ACF populations and associated spread and the studies necessary to assess the efficacy of various control methods. Depauperate data on ACF in Washington preclude informed risk assessment and management. When we better define elements of risk, we will collectively understand tradeoffs between future management scenarios, their chance of success, and their costs.

ACKNOWLEDGEMENTS

We acknowledge the City of Lacey for their collaborative efforts controlling and containing ACF, as well as providing information for this document. Tony Capps and Ken Warheit with the WDFW Fish Health Lab performed Ranavirus screening. John Measey, Allen Pleus, Andy Gygli, Katherine Haman, Lisa Hallock, Chris Anderson and Taylor Cotton provided helpful suggestions on drafts. Thank you to the WDFW Executive Management Team, Habitat Program, and Diversity Division for supporting the cross-program development of this report.

1. INTRODUCTION

Invasive species pose a substantial threat to biodiversity and the Washington State Department of Fish and Wildlife's (WDFW) ability to preserve the state's native fish and wildlife and their habitats. The African clawed frog (*Xenopus laevis*; hereafter ACF) is an aquatic frog native to sub-Saharan Africa and a voracious predator that readily acclimates to a wide range of habitats (ACF biology is reviewed in **Appendix 1**; Measey *et al.* 2012). ACF was first identified in Washington state at two locations in western Washington in 2015. A third location was identified in 2020 in Issaquah. The species likely poses a substantial risk by preying on native species and potentially transmitting disease (Robert *et al.* 2007; Tinsley *et al.* 2015a). ACF's ability to rapidly reproduce and spread makes it a significant conservation concern (Vimercati *et al.* 2020). Listed as a prohibited level 3 species in Washington State, ACF are illegal to possess, introduce on or into a water body, or traffic without a permit (RCW 77.135.030(1)(c)). In 2017, WDFW and the City of Lacey were unsuccessful at eradicating the species from a stormwater pond at one of the two known introduced locations. Here, we assess the risk of ACF to Washington ecosystems based on the current status in the state, management history, and relevant literature on life history and other ACF invasions. We identify knowledge gaps and propose a research agenda that will be important for establishing management plans to address this invasive species.

1.1. INVASIVE SPECIES CLASSIFICATION

In 2002, the legislature classified ACF as prohibited, forbidding the purchase or sale of the species in Washington. Currently, ACF are classified as "Prohibited level 3" species under RCW 77.135.030(1)(c) and WAC 220-640-050(1)(c) because they are non-native aquatic animal species that are considered to pose a "moderate to high invasive risk" and which may require management by the Department or other affected landowners. Prohibited level 3 species, under RCW 77.135.040(1), "may not be possessed, introduced on or into a water body or property, or trafficked without department authorization, a permit, or as otherwise provided by rule". WDFW's 2015 Statewide Wildlife Action Plan (Chapters 2 & 3) highlights invasive plant and animal species and pathogens and diseases as a major statewide conservation issue which "constitute a severe and growing threat to Washington's native wildlife, habitat and biodiversity."

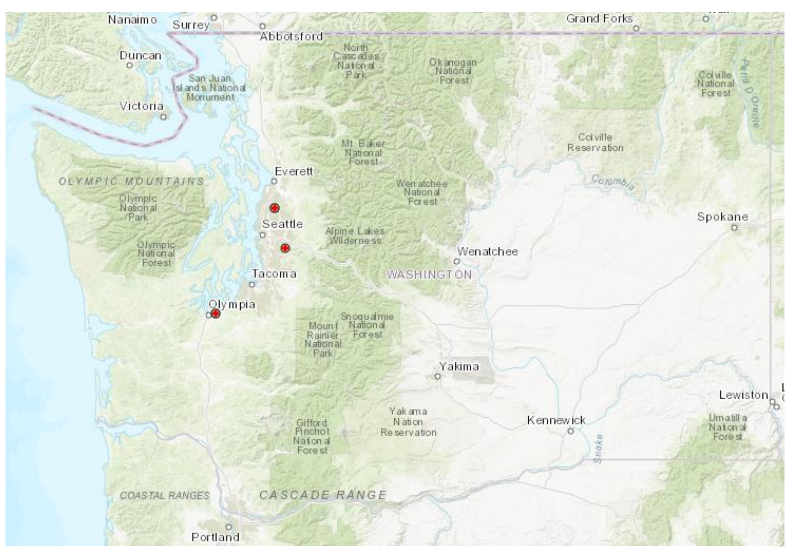

Figure 1. Active ACF introductions in Washington State in Lacey, Issaquah, and Bothell (Basemap ESRI).

2. STATUS IN WASHINGTON STATE

WDFW confirmed ACF present at two locations in 2015 and one location in 2020 (**Error! Reference source not found.**; **Table 1**). In all instances, ACF were discovered by non-agency personal and reported voluntarily. We know of no other ACF locations in the state, however no broad-scale systematic survey to identify additional populations has been conducted in the state. Though there is no direct evidence on how ACF have been introduced in Washington, the department believes the frog populations were initially established as the result of individuals discarding aquarium pets, which is a common practice with other invasive aquatic species (e.g., red-eared slider turtles (*Trachemys scripta elegans*). Importantly, the distribution of the three known ACF populations across the Puget Sound area suggests introductions were done by different individuals and that the possibility that introductions may be more widespread than currently understood.

Table 1. ACF introduction summary information by location.

	Lacey	**Bothell**	**Issaquah**
Site Description:	3 connected stormwater ponds and associated 171-hectare storm sewer network	3 ponds along North Creek including unconfined wetlands	Sediment pond with strong connection to Tibbets Creek
ACF Status:	Active	Presumed active	Presumed Active
First Detection:	July 2015	July 2015	July 2020
Reporting Party:	Department of Ecology staff	Children fishing	Fish removal contractor
Most Recent WDFW Effort:	December 2020	May 2019	None
Most Recent WDFW Detection	December 2020	May 2019	None
Containment provision	Perimeter fences and pipe screens. Annual coordination with City of Lacey during stormwater sewer maintenance.	None	None
***Ranavirus*:**	Undetected in 2020 using qPCR assays	Unknown	Unknown
Batrachochytrium dendrobatidis	Confirmed July 2018	Unknown	Unknown
ACF Removed	> 6,900	75	0 (no effort yet)
Partners	City of Lacey	Business park owners have allowed WDFW access in the past.	None

2.1. LACEY

2.1.1. Location Profile

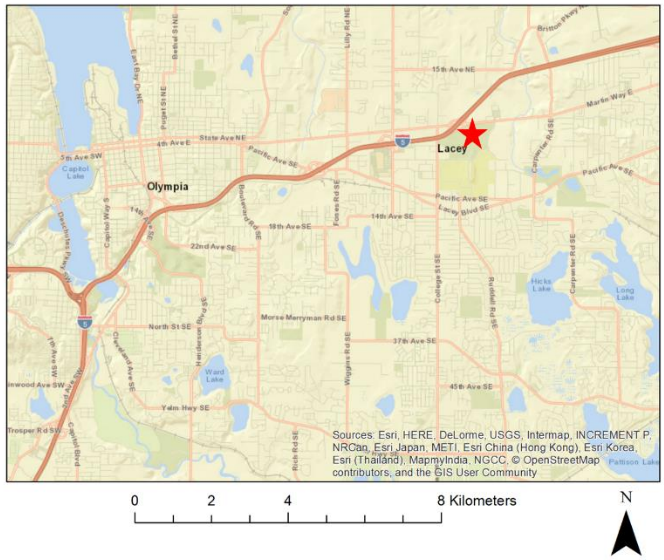

Figure 2. Vicinity map of Lacey Stormwater Ponds (College Regional Stormwater Facility) in relation to Cities of Lacey and Olympia. The ponds are denoted by the red star.

The Lacey Stormwater Ponds site, called the "College Regional Stormwater Facility", is located near Martin Way and I-5 in Lacey, WA (**Error! Reference source not found.**). The Lacey Stormwater Ponds consists of three constructed stormwater catchment ponds measuring approximately 0.42, 1.46 and 0.46 hectares respectively for Pond 1, 2, and 3 (**Error! Reference source not found.**). Pond 1 is connected to Pond 2 by a valved pipe. There is an overflow that connects Ponds 2 and 3 at high water (e.g., during a storm event). Ponds 2 and 3 drain northward under I-5 and eventually to a forested wetland and Woodland Creek. Pond 3 is longer and shallower than Pond 1 and 2, and has a firmer substrate than Pond 1, which has silty substrate covering a liner. Overland movements of ACF have been observed on the gravel paths adjacent to the ponds and crossing Abbey Way SE ~ 50 m south of the stormwater ponds personal communication, F. Waterstrat, USFWS). A silt fence is maintained around the perimeter of each pond.

Figure 3. Lacey stormwater ponds with introduced ACF. The star indicates the pond where the first ACF was detected.

The ponds are fed by a mostly urbanized 171-hectare watershed through a network of stormwater drainage pipes (**Error! Reference source not found.**). In October 2018, ACF were first detected in the drainage network beyond the ponds by the City of Lacey's vacuum trucks that are used to clean sediment catch basins within the stormwater drainage system. Since then, ACF have been detected throughout much of the drainage system but their full extent is unknown. Groundwater infiltration prevents the stormwater drainage system from drying out entirely despite limited overland flow during drier summer months and a liner in Pond 1 maintains water levels. This hydrology suggests that the sewer drainage system may provide suitable habitat for ACF year-round.

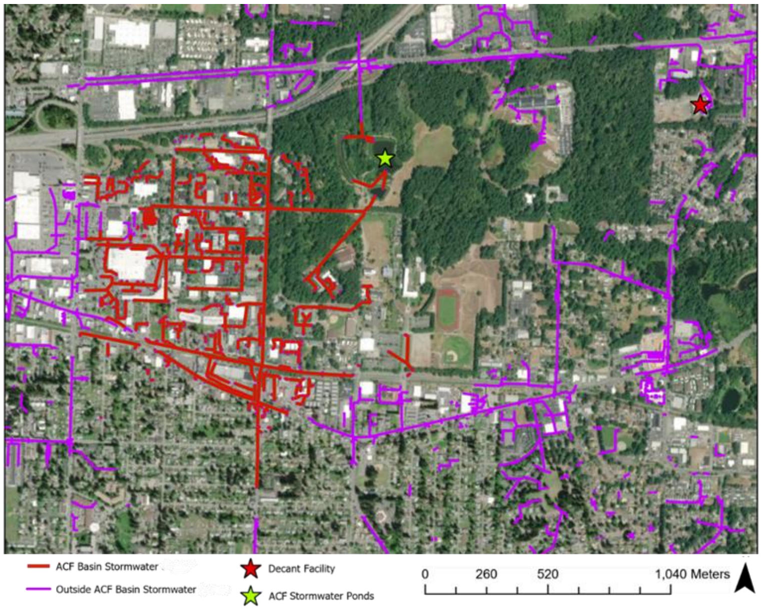

Figure 4. Map of stormwater drainage network that drains to Lacey Stormwater Ponds. Red drainage lines directly drain into stormwater ponds with ACF. Purple lines drain into other stormwater ponds in Lacey

2.1.2. 2020 Lacey Spread Assessment

During the summer of 2020, we evaluated 35 sites near the known focal ACF population to explore the spatial extent of ACF in Lacey. These sites are located within approximately a 1-km radius of the Storm water ponds and were selected based on past survey efforts, GIS aerial imagery, and communication with landowners about potential habitat (Error! Reference source not found.). We set traps at 23 of the 35 sites that had enough water to deploy minnow traps. This effort consisted of setting 10 baited minnow traps at each site for two to three nights for a total of 680 trap nights across the 23 sites. Five of the 680 trap nights used the Mega-trap (large custom designed frog trap; see below 5.1.2. Past Management Actions) instead of minnow traps. During this effort, we removed 13 ACF from the Lacey Stormwater Ponds but found no ACF at any of the other surveyed sites.

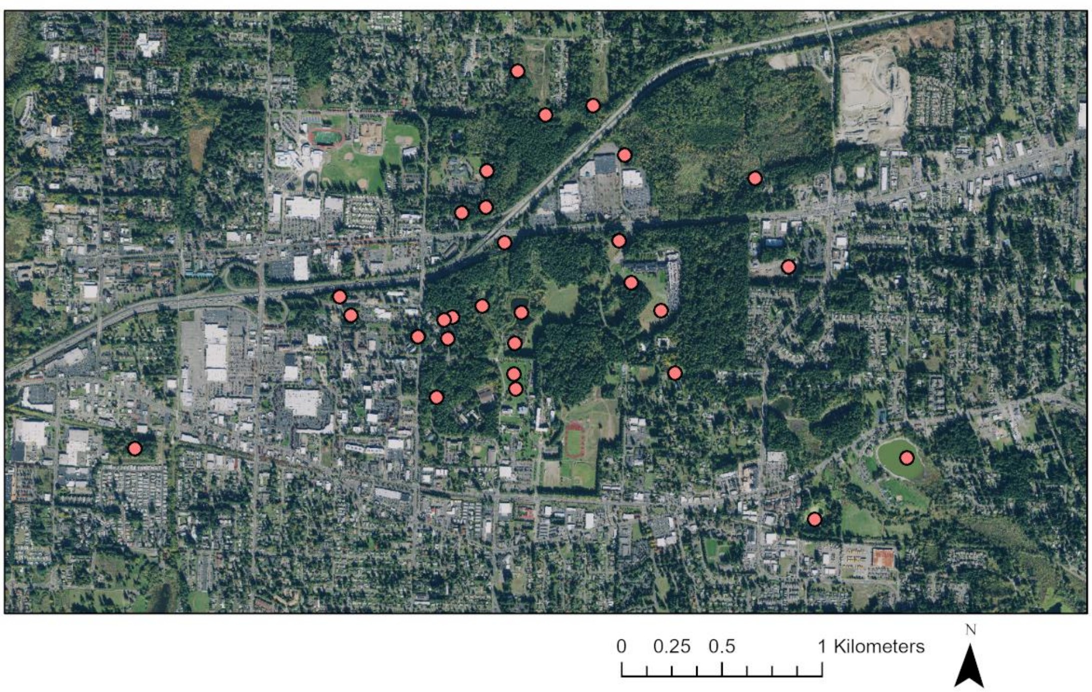

Figure 5. Spread assessment conducted in Lacey in 2020. Circles indicate sites that were evaluated for ACF.

2.2. BOTHELL (NORTH CREEK WETLANDS)

The first ACF in the North Creek drainage was observed by children fishing in the "Ground Zero" stormwater pond (**Figure 6**). Ground Zero pond is 0.6 hectares in surface area and is connected to the main channel of North Creek via 3 outlet pipes. North Creek flows through a large portion of Bothell's commercial zone and residential areas. Both commercial and residential areas have numerous other stormwater ponds that collect runoff that ultimately empty into North Creek. Two other locations were found to have ACF in a 2016 reconnaissance survey conducted by WDFW. "Richards Pond Large" is 0.03 hectares in size and connected to "Ground Zero" by a culvert. "Twin Ponds" are 44 and 28 m^2 in size, respectively, are 1.5 km downstream from the "Ground Zero" pond and are on the opposite side of North Creek from "Ground Zero" and "Richards Pond Large".

Figure 6. Map of 2016 Trap Results from North Creek, Bothell.

2.3. ISSAQUAH (TIBBETS CREEK SEDIMENT POND)

A single adult individual was incidentally captured from a sediment pond in July 2020 by a contractor electrofishing during fish capture and relocation efforts prior to removing accumulated sediment. The pond is well-connected to Tibbets Creek near Tibbets Valley Park in

Issaquah (**Figure 7**). Little is known about the status of ACF beyond this single individual at the site due to WDFW's limited capacity to follow up on the report.

Figure 7. Vicinity map (top) and aerial imagery (bottom) of Tibbets Creek ACF observation reported in July 2020. The pond is denoted by the red star in both maps.

3. INSIGHTS FROM OTHER INVASIONS

ACF can spread rapidly and establish under a wide range of habitat conditions.

Case studies from around the world illustrate the ability of ACF to rapidly expand beyond their point of introduction. For example, in France, ACF are believed to have been introduced in the 1980's (Fouquet and Measey 2006) and now occupy at least 2,055 km^2 area in an agricultural landscape (Courant *et al.* 2019; Vimercati *et al.* 2020). A population in Chile that is believed to have established from one or more releases in 1973 has expanded to an estimated 21,200 km^2 (Lobos et al. 2013). ACF can occupy a range of habitat freshwater aquatic habitats including both flowing and nonflowing waters as well as seasonal and permanent waterbodies (Moreira *et al.* 2017).

ACF can harm native amphibians and other species locally.

ACF can impact native amphibians populations through a combination of predation, competition, and disease (Lillo *et al.* 2011; Courant *et al.* 2018). Introduced ACF have been documented preying on native amphibian species (Measey *et al.* 2015; Vogt *et al.* 2017) and Wilson (2018) suggests that native species may leave an area to escape predation pressure (predator avoidance). ACF have toothed jaws, robust hindlimbs, and claws that allow them to consume larger prey items than other similar sized frog species. ACF was found to prey upon both larval and adult

Pacific chorus frog (*Pseudacris regilla*) (Wilson *et al.* 2018b), a common species native to Washington State. ACF have also been shown to reduce populations of invertebrates and zooplankton, which are important food sources for Washington's native aquatic fauna such as fish and amphibians (Courant *et al.* 2017; Courant *et al.* 2018). The extent to which ACF may impact salmonids is unknown.

ACF are cryptic and can spread without detection.

ACF behaviors including, nocturnal activity patterns, traveling along the bottom of waterbodies, and their lack of surface vocalizations makes them difficult to observe (Ringeis et al. 2017). In some cases, long extant populations may have gone undetected for 2-25 years (Measey *et al.* 2012). The Lacey Stormwater Ponds were constructed in 2008 and so the ACF population in these ponds may be over a decade old. To our knowledge, differences in detection probability has not been assessed as a function of survey method or environmental conditions.

ACF may carry diseases, including *Ranavirus* and chytrid fungus.

ACF, like other amphibian species, can act as a vector for *Ranavirus* (Robert *et al.* 2007) and the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*; *Bd)*. The earliest confirmed evidence of *Bd* is from a 1938 museum specimen of ACF, indicating that *Bd* may be long-associated with this species (Weldon *et al.* 2004). Both pathogens are believed to have caused declines in amphibian populations (Skerratt *et al.* 2007, Lesbarreres *et al.* 2012). The greatest concern is that introduced ACF could spread new more virulent strains (i.e., lineages) of *Bd* (Byrne et al. 2020).

The pet trade is a likely source of new introductions.

Globally, many introduced ACF populations are believed by the research community to have originated from medical laboratories in the early 20th century (Tinsley and McCoid 1996, Measey *et al.* 2012). ACF are still used in laboratory research but are often bred domestically for the pet trade and more recent introductions are thought to originate from discarded pets (Tinsley and McCoid 1996, Measey *et al*. 2012). For example, an albino population of ACF in China almost certainly originated from pet trade given albino ACF are common pets (Wang *et al.* 2019). Additionally, ACF introductions in California and Chile among others locations suggest multiple populations are the result of multiple releases (Measey *et al.* 2012). Over 99% of international trade of ACF to the USA has been for the pet trade rather than for laboratory purposes (Measey 2017), and the lack of regulation on pet ACF breeding highlights the risk of importing novel pathogens.

Eradication is possible but requires large and sustained efforts.

In at least one case, eradication of ACF was achieved through intensive management in a small isolated wetland site at Golden Gate Park, San Francisco, CA over years of chemical treatment using calcium carbonate (lime) solution (personal communication, E. Larson). In Great Britain, ACF were naturally extirpated by climate and/or fish at one pond (Measey 2012). In Spain, larval ACF were extirpated from a small garden pond by treating it with an anti-algae copper sulfate (Pascual *et al.* 2007). There are on-going eradication efforts for certain populations of frogs in Chile and Portugal but neither have yet achieved full eradication in occupied watersheds (personal communication, R. Rebelo).

4. RISKS TO WASHINGTON STATE RESOURCES

4.1. DISEASE

ACF can be a host for a variety of pathogens, including *Ranavirus* and *Bd* (Robert *et al.* 2007), and can asymptomatically carry these pathogens in the wild and in captivity and then transmit them to native species. ACF may also carry pathogens or pathogen strains which have yet to be discovered and which may harm native aquatic species. To date, *Ranavirus* has not been confirmed at any Washington site, although the presence of *Ranavirus* has not been evaluated at the Bothell or Issaquah sites using reliable sequencing techniques.

4.1.1. Ranavirus

Ranaviruses, or “RAN”, an Iridovirus, are on the World Organization for Animal Health (OIE) list of notifiable terrestrial and aquatic animal diseases. They are a risk to the entire suite of the state’s native amphibians as they represent one of two globally known and lethal amphibian pathogen groups. ACF have been documented carriers of *Ranaviruses* (Robert *et al.* 2007; Soto-Azat *et al.* 2016). Mortality levels associated with *Ranavirus* epidemics in sensitive (or naïve) species often exceed 95%. Once introduced into an area, *Ranaviruses* can be further spread by fish and turtles, which may act as reservoirs and which also may be susceptible to these pathogens (Brenes *et al.* 2014). In laboratory experiments, *Ranaviruses* can grow in Chinook salmon (*Oncorhynchus tshawytscha*) embryos (Ariel *et al.* 2009). Other Iridoviruses such as the White Sturgeon Iridovirus pose a significant threat to fish and can cause death in up to 95% of juvenile fish (LaPatra *et al.* 1994).

WDFW testing to date of ACF for *Ranavirus* shows no confirmed positive cases. In 2020, 174 samples were analyzed and yielded no positive samples. The WDFW Fish Health Lab used quantitative PCR (qPCR) to detect the presence of *Ranavirus* (using QuantStudio™ 6 Flex Real-time PCR System (ThermoFisher)) by amplifying an 83-base pair region of the *Ranavirus* major capsid protein. This test is a general *Ranavirus* assay that detects many forms of *Ranavirus* (Stilwell *et al.* 2018). For each qPCR run, each sample was run in triplicate (qPCR methods are detailed in Capps and Warheit 2021). Of the 174 samples from Lacey ponds, no samples (0%) were scored as positives and 5 samples (3%) were scored as Below the Limit of Detection (BLD). The remainder of the samples, 171, (97%) were scored as negative. All five BLD samples were sequenced for further *Ranavirus* determination. Two different sequencing reactions were used (Capps and Warheit 2021) including a 359-base pair region that includes the 89-base pair qPCR product (Stilwell *et al.* 2018) and a ~300-base pair region from Mao et al. (1997). None of the BLD samples produced *Ranavirus* sequence from either of the sequencing reactions. In summary, no detectable *Ranavirus* was found in the 2020 sample set submitted from Lacey ponds.

4.1.2. Amphibian chytrid fungus (Batrachochytrium dendrobatidis; Bd)

ACF can be asymptomatic carriers of *Bd*, an introduced fungus that can cause disease known as chytridiomycosis (Solís *et al.* 2010; Wilson *et al.* 2018a) and which is associated with some amphibians declines (Olson *et al.* 2013; Byrne *et al.* 2019). In 2018, USFWS and USGS conducted an analysis of 30 African Clawed Frogs collected from the Lacey Stormwater Ponds. The results showed that 23/30 (76.67%) of swabs were positive for *Bd.* All swabs were negative for *B. salamandrivorans* (*Bsal*), a closely related chytrid fungus that also affects amphibians.

The finding of *Bd* presence is only mildly informative and, on its own, may not be a concern depending on environmental conditions and the lineage or strain of *Bd* present. Many species have been shown to be positive for the pathogen despite showing no clinical signs. However, USGS recommended that the animals at the Lacey Stormwater Ponds should be closely monitored to ensure that no clinical signs of *Bd* develop. Particularly problematic are the diversity of lineages of *Bd* from around the world that vary in their degree of virulence and that can hybridize and create more lethal disease when spread by invasive pets (Byrne *et al.* 2019). Previous *Bd* testing in Washington was not designed to distinguish different *Bd* lineages, thus it remains unclear whether introduced frogs are spreading new, perhaps more lethal, pathogen strains or are simply carrying strains that are native to Washington. Future genomic analyses of *Bd* lineages in Washington are needed, particularly with respect to introduced amphibians like ACF.

Bd assessments Oregon and Washington suggest that *Bd* is relatively widespread in the environment with 16 of 37 (43%) surveyed sites reporting *Bd*-positive amphibians (Pearl *et al.* 2007). *Bd* may decrease survival over longer time scales, even in the absence of mass die-offs, as is suggested for the Washington state- and federally-protected Oregon Spotted Frog (*Rana pretiosa*; Russell et al. 2019). In Washington, we have uncertainty about potential impacts of *Bd* on amphibian populations due to a lack of data on comprehensive morbidity and transmissibility of the pathogen, how *Bd* interacts with other stressors, and knowledge gaps regarding diversity in *Bd* lineages (Pearl *et al*. 2007, Byrne *et al.* 2019). Introduced species have the potential to import new more lethal lineages of *Bd*, highlighting the importance of mitigating the introduction and spread of invasive aquatic species and for genomic monitoring of new *Bd* strains.

4.2. PREDATION AND COMPETITON

ACF can affect community structure through predation and competition (Measey 1998; Lillo *et al.* 2011; Courant *et al.* 2017). Post-metamorphic ACF are generalist predators capable of shredding large prey items with their hind claws. Laboratory predation trials suggest that larval and adult life stages of Pacific Tree Frog (*Pseudacris regilla*), a native species to Washington, avoid ACF which could reduce the direct impacts of predation. However, this behavior may also result in emigration of native amphibians from ACF occupied sites (Wilson *et al.* 2018b). Larval ACF are not considered a predatory threat to native amphibians because they are obligatory filter feeders (Seale 1982), but they may also be capable of modifying food webs. Although adult ACF likely consume native amphibians and invertebrates, diet studies are needed in Washington to understand the extent of this impact, particularly because stormwater ponds can act as critical habitat for a diversity of native amphibian species (Ostergaard *et al*. 2008).

4.3. SPREAD

ACF are cryptic due to their principally aquatic life history, predominantly nocturnal activity, underwater rather than surface vocalizations, and subsurface dwelling behaviors. In France, extensive spread has occurred throughout natural waterbodies (Vimercati *et al.* 2020). In Chile, ACF were more often found in artificial rather than natural waterbodies (Lobos et al. 2013), suggesting that urban areas may be particularly vulnerable to ACF introductions due to the prevalence of artificial waterbodies and the proximity to humans which can facilitate pet releases. All known ACF populations in Washington are stormwater ponds and are in proximity to other artificial and natural waterbodies. The hydrology of stormwater ponds can vary dramatically and include a diversity of seasonal habitats that dry each year and waterbodies that permanently hold water. Dispersal through water and over land are both possible and Gamble (2007) suggest that ACF do not exhibit strong site fidelity, potentially increasing the risk of dispersal and colonization of additional waterbodies.

The possibility of cryptic spread makes it difficult to assess the true extent of invasion in Washington State and to identify the original introduction timing(s) into the state. ACF have been observed on paths and roads near the Lacey Stormwater Ponds (personal communication, F. Waterstrat, USFWS) but, to date, have not been detected in any additional nearby waterbodies since their initial discovery in 2015. The stormwater drainage network also represents a potential pathway for spread that is hard to survey because it is largely subsurface. Large precipitation events that lead to increased surface water connectivity could facilitate escape from the storm sewers. Moreover, the risk of additional releases by the public remains high. For example, in 2016, WDFW Enforcement Officers confiscated four ACF from a pet store. Additionally, without control measures, outreach, and targeted communication, community members may encounter, obtain, and spread ACF

4.3.1. Expansion under Climate Change

Recent process-based species distribution modeling efforts suggest that ACF can tolerate a broader temperature spectrum and geographic extent than previously assumed (Ginal *et al.* 2021). This finding contrasts with prior work by Ihlow et al (2016) that suggested the global range of ACF would likely contract under commonly accepted climate change projections. Regardless, ACF thrive in Mediterranean climates, which are characterized by dry summers and cool, wet winters, conditions like those found along the North America’s west coast. Western Washington’s winters are projected to become wetter and warmer overall (Mote and Salathé 2010), and so will likely favor ACF. Conditions associated with climate change could improve physiological performance, fecundity, breeding success, and increase rates of larval development. It remains unclear how ACF and associated pathogens could expand under climate change.

5. SUMMARY OF WASHINGTON STATE CONTROL ATTEMPTS

There are a large variety of control and extermination options available for invasive amphibians, each with advantages and disadvantages (**Table 2**). As amphibians often have complex life histories corresponding to different habitats (e.g., aquatic habitats for breeding and larvae, terrestrial habitats for juveniles and adults), it is unlikely that a single control method will be effective in controlling the spread or eliminating an ACF population. It is important to consider each method and how they interact with each other for any given situation. Regardless of the methods chosen, adequate time, resources, and labor must be allocated to allow for success.

Table 2. Summary of control techniques.

Technique		Advantages	Disadvantages
Seining / Dip Net		• Native bycatch minimized • Effectively targets deeper habitats	• Requires multiple personnel • Labor intensive • Cannot access all habitat • Ineffective in deep sediments where ACF bury or where extensive debris clogs nets
Trapping	Minnow	• Successfully removed hundreds of ACF • Effectively targets shallower habitats	• Unknown trap efficiency and detection probability • Unknown efficacy at low densities • Native species bycatch • Trap lines require maintenance
	Mega-trap (described in section 5.1.2)	• Can be checked less often and capture more animals than minnow traps • Effectively targets deeper habitats	• Unknown trap efficiency and detection probability • Unknown efficacy at low densities • Native species bycatch • Trap lines must be maintained • Not suitable for highly vegetated areas or low water levels
Chemical	Salt	• Effective in lentic accessible water body • Other non-native species bycatch	• Expensive • Requires multiple personnel and is labor intensive • Connection to sewer facilitated recolonization • Less effective in flowing water • Native species bycatch
	Other: • Rotenone • CO2 • Calcium Oxide • Copper Sulfate • Clove oil		• Pesticides treatments were initially explored as an option but never implemented due to water quality concerns and the proximity of ESA-listed species • Variable efficacy across life stages • May cause adults to emigrate
Electroshocking (never implemented)		• Can be attenuated to target species	• Requires multiple personnel daily for several weeks • Most effective with specialized “electrofrogger” • Initial testing apparently ineffective for ACF
Water-Level Manipulation	Desiccation and or exposure to freezing temperatures	• Highly effective where applicable	• Refuge areas where water cannot be fully drained or reach freezing temps • Not always applicable • May cause adults to emigrate
Biological Control (never implemented)	Bass and/or Tiger Muskies	• Passive, low maintenance	• Concern of proximity of ESA listed species to the pond.

5.1. LACEY – A HISTORY OF CONTROL EFFORTS

Management actions in Lacey have received major contributions from the City of Lacey. Containment and eradication attempts have been supported by their staff time, expert knowledge of infrastructure, and equipment. Future management should prioritize maintaining this vital partnership between the City of Lacey and WDFW.

5.1.1. Containment

Pond containment

A double-layer perimeter silt fence was constructed around the three stormwater ponds to contain ACF and prevent overland dispersal in 2015. Because these stormwater ponds have outflow pipes that exit the facility into uncontained waterways, WDFW and the City of Lacey used seine netting to cover the outflows pipes of Ponds Two and Three. This outflow netting is an attempt to minimize aquatic dispersal of ACF into other waterbodies during high water levels. This netting has been sporadically maintained and repaired as needed. The silt fence was replaced in 2019 by City of Lacey. During winter months, WDFW has periodically checked the condition of the fence and pipe screens due to the risk of damage from heavy precipitation events.

Sewer containment

The City of Lacey detected ACF in the stormwater drainage network within the stormwater pond drainage basin (see **Figures 3** and **4**). This pipe network flows directly into the stormwater ponds. ACF were found when cleaning out the sewer catch basins with vacuum trucks (**Figure 8**). WDFW worked with City of Lacey to determine that all ACF specimens were likely from the stormwater pond basin only. The spoils from the sewer catch basins were manually sifted (**Figure 8**) through when emptying the vacuum truck at the Decant Facility. All ACF specimens were removed and humanely euthanized. To ensure containment, this collaborative work must continue to occur annually when City of Lacey cleans this section of sewers.

Figure 8. City of Lacey storm sewer vacuum truck transports ACF along with debris during annual maintenance.

5.1.2. Past Management Actions

Substantially greater effort has been put into ACF management in Lacey than in Bothell or Issaquah. Since 2015, WDFW personnel have conducted various management actions in attempts to eradicate and minimize the spread of ACF in Lacey, with most effort occurring from 2015-2017. At least 6,911 ACF have been removed from the Lacey sites. This includes 744 adults, 5,320 juveniles, 859 tadpoles, and no eggs. Eggs are laid individually, so the lack of egg observations is not surprising. Control efforts also removed at least 4,074 American bull frogs (*Rana catesbeiana*; another harmful invasive species) and 10,838 invasive goldfish. During these efforts, 748 native amphibians including Pacific Tree Frogs (*Pseudacris regilla*), Newts (*Taricha granulosa*), Northwestern Salamanders (*Ambystoma gracile*) were also encountered.

To date, the WDFW's Aquatic Invasive Species (AIS) unit and Habitat and Wildlife Programs have contributed a total of 2,375 personnel hours into management actions since 2015. Partners such as City of Lacey contributed over 619 personnel hours. Other stakeholders, agencies, and volunteers contributed over 365 personnel hours.

Water levels

Manipulating water levels in ponds can be a critical tool in controlling invasive amphibians. When lowered, ponds can completely freeze or dry out, resulting in eradication of tadpoles. Reducing the volume of water can also help reduce the quantity of chemicals inputs needed to achieve target concentrations needed to lethally remove ACF. However, effective containment nets or fencing must be in place to prevent mass emigration of adults to new areas.

Water levels of the ponds can be manipulated to some extent. Pond 1 has a control valve that can be opened to drain some water into Pond 2. The City of Lacey also used a water pump on Pond 1 and Pond 3 to lower water levels. During the winter of 2015, water levels were lowered to reduce the amount of favorable ACF habitat, enhance control efforts, and increase the ponds' ability to freeze. These ponds are difficult to drain completely due to inputs from groundwater and stormwater runoff. In January 2017 water levels were lowered during a period of cold weather in the hopes that freezing temperatures would kill ACF, but there was no evidence of mortality even though the ponds' surfaces froze. If animals died in the mud, it is possible that they went undetected. In August 2017, water levels were lowered to facilitate salt treatments as detailed below.

Managers have considered discharging water onto the grass fields adjacent to the stormwater ponds to reduce water volumes and desiccate portions of the ponds. However, this could impact a small but persistent Mazama pocket gopher population on site and so this activity would be considered take of a listed species and has not been pursued further (Schmidt et al 2015). Given these limitations, complete drainage of the ponds is not an option, but partial drainage could continue to be used in conjunction with other future efforts.

Seine Net/Dip Net

In August 2015 there was an eradication attempt at Pond 3 using seine and dip nets (**Figure 9**). This effort was implemented in conjunction with lowering the water levels. Seine nets were then dragged along the bottom to herd ACF and dip nets were then used to scoop specimens out. The effort yielded 20 juvenile ACF, 471 bullfrogs, 59 newts, and one unidentified amphibian. The effort required about 283 person-hours.

Figure 9. Seine netting removal effort conducted at Pond 3 in Lacey in the summer of 2015.

Trapping with Minnow Traps

From 2015 to 2020 managers and researchers have used minnow traps to catch ACF, with more efforts in earlier years. Traps are baited with sardines or cat food and placed in shallow waters. The traps are set so that they are not fully submerged allowing native amphibian bycatch to come up for air. Setting traps in this manner limits effort to a depth of no more than 10 inches, the height of the trap. Minnow traps have consistently caught ACF at sites with relatively high density. It has also been used to evaluate spread in nearby waterbodies. It is unknown how successful minnow trapping is at sites with low ACF density.

Mega-trap

A "Mega-trap" (**Figure 10**) was developed by WDFW in 2015 using the minnow trap concept of funneling animals into a holding area from which they cannot escape. This larger trap was designed to be placed in deeper water, hold more specimens, and require less frequent checking than minnow traps. The traps, constructed from PVC and fyke net, have gone through multiple design iterations. Mega-traps can be deployed with minnow traps to trap at multiple depths. It can be baited or deployed without bait. Bycatch of native amphibians has occurred. Mega-traps are responsible for 21% of adult and 8% of juvenile ACF captures at Pond 1 and 42% of adults and 48% of juveniles from Pond 2 from 2015-2020. These traps are also responsible for >99% of the larvae captured.

Figure 10. A mega-trap is a large custom-built trap that can be deployed for multiple days and capture many animals.

Salt treatment

Laboratory research indicates increased sodium chloride (NaCl; i.e., table salt) concentrations are lethal to ACF (Personal communication, J. Gross). Jackson Gross, Smith Root, experimentally determined that 16 parts per thousand (ppt) NaCl results in 100% mortality of both larval and adult ACF (**Error! Reference source not found.**). In August 2017, in partnership with the City of Lacey, WDFW added NaCl to Pond 1. After lowering the water levels in the pond, the City of Lacey applied two treatments using 23.3% NaCl solution two weeks apart. The solution was initially pumped into the stormwater pipe leading to the pond to flush out any ACF residing the pipes. After several flushes with no ACF, the inflow to the pond was blocked using seine nets. Once secured, the brine solution was dispersed uniformly until the salinity was verified to have reached 16 ppt following the pesticide label. Specimens were collected up to eight days after the second treatment. The treated water with elevated levels of salinity was contained until natural rainfall and stormwater runoff filled the stormwater pond and salinity dropped below than 2 ppt.

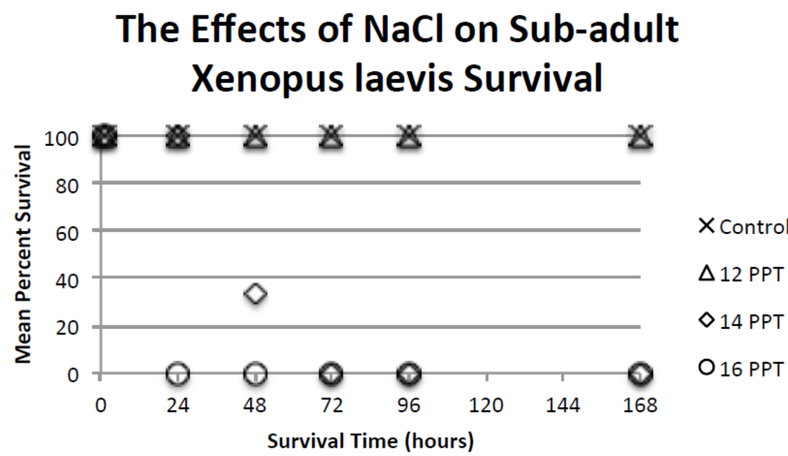

Figure 11. ACF survival under variable sodium chloride (NaCl) concentrations (personal communication, J. Gross).

After the treatment, the pond was visually searched for animals and agitated with rakes over multiple days. In total, 513 ACF, 3 bullfrogs, 2 native red-legged frogs, 258 native newts, and 9,671 introduced goldfish were recovered during the salt treatment. These animals were dead or dying. In February 2018 a large, gravid female was caught in the treated pond. In July 2018, an additional 28 juveniles and 2 metamorphs were captured indicating continued and recent recruitment. In October 2018, stormwater sewer maintenance activities revealed that ACF were more extensively distributed throughout the stormwater network than previously thought and were likely the source of ACF that recolonized the treated pond. The extent of their spread in the stormwater drainage network is still unknown to WDFW and future collaborative work with the City of Lacey is necessary to determine any continued ACF spread in the drainage network.

Other chemical options including copper sulfate, rotenone, and lime were explored but not deemed feasible due to the proximity of ESA-listed salmon.

Electroshocking

Smith Root Inc evaluated the use of electrical fields as a containment barrier and for herding to facilitate ACF capture and eradication. They noted that the frogs would dive to the bottom as soon as they felt the initial electricity. Once the frog came up for air and were immobilized via the second shock, they would either: 1) stay afloat because of air retained in their lungs or 2) release the air and sink. Because of this second scenario there is a limited period for netting frogs and so ultimately electroshocking was not pursued further.

Biological Control

Biological Controls are a possible measure for reducing the impacts of introduced species and were briefly considered for ACF with different predatory fish species (see **Table 2**). However, biological controls have complex positive and negative attributes in their implementation that are challenging to balance. For instance, while biological controls may directly harm the introduced species, they likely also harm native species. Bass have been successfully used in South Africa (personal communication, J. Measey), but ACF may evacuate the waterbody to escape predation. Containment and capture of fleeing ACF would be a necessary component of biological control to mitigate further spread, this approach cannot be effective on its own.

5.2. BOTHELL

5.2.1. Containment

Containment fences at waterbodies with introduced ACF has not been attempted because it is viewed as unfeasible due to the presence of ACF in unconfined wetlands with strong connectivity to North Creek.

5.2.2. Past Management Actions

In September 2015, 40 ACF were removed from “Ground Zero”. In August 2016, two of seven additional locations revealed ACF. During Winter 2016, an additional 29 ACF were removed from “Ground Zero”. In July 2017, six minnow traps were set overnight at “Ground Zero” yielding 2 additional animals. In May 2019, USGS researchers trapped an additional 4 animals. No work has been conducted at the North Creek sites since 2019. Reconnaissance surveys to revisit ACF occupied and other nearby waterbodies was proposed for 2020 but, due to COVID-19 impacts to fieldwork, these surveys were not conducted.

6. NEXT STEPS TO INFORM A MANAGEMENT PLAN

Future management recommendations for ACF will rely on building and maintaining partnerships in addition to insights gained from targeted research. Because ACF pose a risk to native species through predation, competition, and disease there is an urgent need to study the extent to which invasive ACF can be managed. Based on our current limited understanding of ACF in Washington State, we cannot assess the risks ACF pose to the state’s native species relative to other invasive species. These limitations severely hinder our ability to determine if invasive ACF are contained to several urban stormwater ponds in disparate regions of Puget Sound, if ACF has the potential to significantly spread throughout the region and negatively impact a broader suite of aquatic habitats and species, and the extent to which management options – including eradication – are feasible. We emphasize that existing data gaps preclude developing a robust management plan for ACF.

A top priority for WDFW is continuing partnering with City of Lacey and cultivating additional partnerships to monitor and control ACF. Containment at the Lacey Stormwater Ponds relies on a partnership with the City of Lacey and cross-program ad-hoc efforts. Funding has come from different agency programs to fill this critical need. Without ACF designated funds, a cross-program commitment may be necessary to maintain current containment measures. Such a commitment could support a sustained partnership with the City of Lacey and build new partnerships to evaluate the threat of and management potential for ACF beyond Lacey.

Aquatic invasive species that pose threats to non-game species and terrestrial and semi-aquatic invasive species are not currently addressed by WDFW. Given ACF have multiple similar attributes to another serious invasive amphibian – the American bullfrog (*Rana catesbeiana*) – there is an urgent need to reconsider how the state manages species like these amphibians which are not strictly aquatic. Doing so may require a more comprehensive management strategy that includes but is not restricted to the Aquatic Invasive Species Unit (AIS). Beyond having sufficient knowledge to manage ACF, AIS currently does not have the financial capacity to effectively manage aquatic invasive species and "implement the findings and broad authorities provided by the state Legislature under Chapter 77.135 RCW"[1]. These limitations extend to the study and management of ACF. ACF management has largely relied on ad-hoc cross-program support to maintain the vital partnerships with City of Lacey. However, no control work has taken place since 2017. A 2021 legislative budget request of $2.8 million for AIS did not include support for ACF. Although AIS was ultimately allocated $6 million, it is unclear whether some of that funding may be allocated towards ACF given European green crabs and Zebra and Quagga Mussels remain top management priorities by Fish Program. Because of this and with diverse expertise across the agency, there may be opportunities for a broader wildlife invasive species coordinator to support management of ACF, strengthen cross-program collaboration, and build the partnerships that are necessary to manage introduced species.

Our literature review suggests that released aquarium pets are a major cause of ACF invasions. Based on the limited known occurrence of ACF in the state we suggest that there may be value in enhancing education and outreach. For example, education campaigns like "Don't let it loose" by RCO's Invasive Species Council could help reduce new introductions. In addition to maintaining partnerships, policies and outreach that prevent introductions should be a top priority for WDFW. Furthermore, because it is unknown if eradication of the three currently identified populations is feasible, early detection of new populations will be essential to a rapid response and mitigation efforts. The AIS reporting system[2], which is managed by the Washington Invasive Species Council, relies on voluntary reporting and does not provide a comprehensive status of the species' extent. The AIS unit maintains a rapid response program as part of the Agency's Policy 5310 Managing Invasive Species. Even so, currently AIS does not have enough capacity to respond to new or existing ACF reports. Further investment into

[1] 2021 Legislative Session: Budget Information, Funding for emerging issues in 2021-2023 (https://wdfw.wa.gov/about/administration/budget/update#)
[2] https://invasivespecies.wa.gov/report-a-sighting/invasive-animals/

community engagement that helps report new populations will be an essential component of future management efforts.

6.1. KNOWLEDGE GAPS AND RESEARCH NEEDS

The largest data gaps with respect to invasive ACF ecology in Washington are 1) not knowing the full extent of ACF's distribution, 2) uncertainty about the novel pathogens ACF may carry, and 3) whether ACF cause local extirpation of native amphibians or fish and whether coexistence between invasive ACF and native species is possible. Although ACF represent likely risks to aquatic ecosystems in Washington, addressing these three unknowns is essential to addressing the extent of ACF's threat and developing a management plan. Targeted surveys adjacent to areas with known ACF introductions would inform the extent of spread and the means by which ACF spread (i.e., via stormwater drainages and/or by natural means like creeks). Additionally, a broader series of surveys across habitat throughout the Puget Sound region will be essential in understanding whether ACF have been introduced or have spread to other habitats beyond what is currently known. Identifying the strains of *Bd* and *Ranaviruses* will be critical in determining the disease risks ACF poses to Washington's native aquatic species.

Beyond knowledge gaps pertaining to the ecology of ACF in Washington, we are limited in our understanding of the efficacy of various management tools for ACF. In particular, we do not know which methods are most suitable for detecting and managing ACF, how effective trapping is for determining occupancy of ACF especially at sites with low densities, or how detection probability is related to environmental variation such as water temperature, depth, and seasonality. Additionally, non-permanent waterbodies may facilitate movement or continue to host ACF that burrow into muddy substrate where they can survive during extended periods of drought. Understanding how these factors influence detection probability could inform when and how to trap ACF for detection and control efforts. A variety of detection and removal methods are suitable for experimental testing and should be rigorously evaluated before being deployed at scale. Furthermore, it is likely that multiple control measures will be needed to manage ACF, although this needs to be experimentally determined.

Addressing the efficacy of management tools and of eradication is important because incomplete eradication of invasive species can have unintended consequences. For instance, in some invasive species scenarios, attempts to remove the invader without complete eradication can result in a compensatory response (known as the "hydra effect") where the invasive species' population quickly recovers (Grosholz *et al.* 2021). WDFW should assess the extent to which control and eradication attempt may exacerbate the threats ACF pose or be a costly problem to address but never solve.

WDFW also needs resolved our data management and information sharing approach within and outside the agency. We lack a consistent data management structure that documents our efforts. Having an information sharing approach would facilitate a more efficient analysis of attempted efforts and success. For instance, a Microsoft Access database that enforces data structure would help facilitate summarization and cross-program utilization of data. Additionally, the occurrence of ACF in Washington State is not documented in peer-reviewed scientific literature and therefore is underreported in international research. The substantial effort put into salt treatments and trapping could be published in the peer-reviewed literature to help inform

ACF management issues. Importantly, publishing this work would make this issue better understood by the broader research and management community which could help foster new collaborative partners. Currently, the financial support to publish this work is missing.

6.1. RECOMMENDED NEXT STEPS

We propose prioritized next steps in ACF management that vary in effort and investment (**Table 3**). These include support to maintain and build partnerships that are essential to ACF management (Priorities 1 & 2) and validation of environmental DNA (eDNA) as a tool to rapidly and affordably monitor ACF spread (Priority 3). This proposal also includes multiple research efforts that would provide the necessary data to inform a risk assessment and ACF management plan (Priorities 4-7). These efforts include surveying to document the true extent of current ACF populations and associated spread and the studies necessary to assess the efficacy of various control methods. Purposeful management of ACF can only happen with an informed risk assessment. Such a risk assessment would ideally happen early in a species' invasion which ACF in Washington presumably are, although data on the extent and timing of their introduction and spread are sparse. Depauperate data on ACF in Washington preclude informed risk assessment and purposeful management and the outlined priorities would help meet these data needs.

Table 3. Critical Research Needs and Proposed Next Steps.

Priority	Action	Estimated Cost
1	**Maintain Partnership with City of Lacey** Funds for WDFW to participate in routine maintenance of stormwater sewers to make sure that ACF are not transported away from the occupied site within the debris.	$10,000 annually
2	**Build and Maintain New Partnerships** Pursue new partnerships with faculty at Pacific Lutheran, St. Martin's, and other universities. Invest in better understanding the management of stormwater ponds in Bothell and Issaquah and seek willing partners in the control of ACF in those areas. Bolster public outreach efforts to minimize further ACF releases and increase reporting of ACF observations.	$10,000 annually
3	**eDNA Pilot Study** Evaluate the utility of eDNA as a tool for rapid assessment of ACF populations in Washington.	$45,000 total; one-time expense
4	**Assessment of ACF extent** Includes eDNA and conventional trapping methods to determine the likely extent of ACF at three known ACF locations.	$100,000 total; repeat at 3-5 year interval
5	**Testing Various Eradication Measures** Experimental tests of different approaches to eradicate ACF and whether eradication is feasible.	$100,000 total; one-time expense
6	**Pathogen (Ranavirus and Chytrid fungus) Assessment** Surveys at all three known ACF locations.	$40,000 total may be repeated at 5-year intervals
7	**Spread Assessment at New Localities** Random sampling of stormwater ponds with eDNA and conventional methods to evaluate cryptic spread of ACF and other AIS.	$100,000 total may be repeated at 3-5 year intervals

6.1.1. Maintain Partnerships

The agency's current partnership with City of Lacey is at risk under the current ad-hoc approach. There is a consistent need each Fall to sift the debris removed from storm sewer catch basins which is a labor-intensive task but one which provides essential data on ACF presence, abundance, and location. Maintaining partnerships will require sustained commitment from WDFW. Estimated annual cost: $10,000.

6.1.2. Build New Partnerships

A commitment to ACF management may be required to leverage participation by external organizations. We recommend pursuing new partnerships with faculty and staff at nearby academic institutions including St. Martin's as well as other universities. Given ACF's association with stormwater facilities, a better understanding of the design and management of stormwater ponds in Bothell and Issaquah (and other possible future sites) would inform the ecology of ACF in Washington and what mechanisms may facilitate ACF management. Seeking willing partners like regional water resources engineers and stormwater managers will be pivotal in developing this cross-disciplinary insight. Additionally, bolstering public outreach efforts to minimize further ACF releases and increase reporting of ACF observations is key to the agency's management of ACF and identifying partners that can facilitate public engagement will be valuable (Section 7). Additional potential partnerships are outlined below in the Partnership section. Estimated annual cost: $10,000.

6.1.3. Environmental DNA Pilot

Environmental DNA (eDNA) is a cutting-edge monitoring tool that involves sampling for DNA shed from target organisms into their environment. It has been used to assess spread of ACF (Secondi *et al.* 2016; Vimercati *et al.* 2020) and *Ranavirus* (Miaud *et al.* 2019). ACF have been detected using eDNA at a density as low as 1 individual/100 m^2 (Secondi *et al.* 2016). An eDNA approach could be scaled for different objectives and budgets that range from sampling in waterbodies adjacent to invades sites to broader efforts to identify additional ACF invasions. eDNA of an additional three species (including an array of native and exotic fishes, amphibians, and other aquatic species) could be assayed simultaneously with ACF to identify co-occurrence. We propose a pilot project in **Appendix 2** that includes a sampling design and cost estimate for materials. Estimated total cost: $45,000.

6.1.4. Assessment of ACF extent

Key to informing future management recommendation is understanding whether ACF are currently restricted to three known localities or whether ACF has spread to or been subsequently introduced to other locations. We recommend surveys that join eDNA and conventional trapping methods to determine the likely extent of ACF at three known ACF locations. The status of ACF spread in the North Creek and Tibbets creek areas are entirely unknown. The 2020 spread assessment activities in Bothell were postponed due to COVID-19 delays and prior efforts in

Bothell in 2017 and 2019 were conducted only at the known site and simply confirmed continued occupancy. Adjacent waterbodies in Bothell have not been trapped to assess spread since 2016. No effort has been made by WDFW in Issaquah. Estimated total cost: $100,000.

6.1.5. Testing Various Eradication Measures

The current state of knowledge on various control measures (e.g., chemical or trapping) prohibits adequately developing an ACF management plan. Targeted, controlled experiments of various control measures are essential to understanding the extent to which ACF can be contained and the feasibility of eradication. Estimated total cost: $100,000.

6.1.6. Pathogen (Ranavirus and Chytrid fungus) Assessment

Given pathogens are a concern for aquatic invasive species generally, including ACF, an investigation of the pathogens known to harm amphibians would inform how much of a risk ACF pose to native amphibians with respect to disease. Currently, the status of *Ranavirus* and *Bd* in Bothell and Issaquah is entirely unexplored and data from Lacey is limited. Estimated total cost: $40,000.

6.1.7. Spread Assessment at New Localities

Beyond exploring the spread of ACF near known localities, assessing spread more broadly in the region would inform the extent of risk and management needs associated with ACF. A random sampling of stormwater ponds using eDNA and conventional methods is recommended to evaluate cryptic spread of ACF and other aquatic invasive species. To date, all known ACF populations are in urban stormwater ponds and prior work around the Puget lowlands suggests that stormwater ponds may help propagate another aquatic invasive amphibian, the American bullfrog (Ostergaard et al. 2008). Given the close affinity of ACF and invasive bullfrogs with urban stormwater ponds, there is an important need to invest further research in understanding the roles these engineered waterways play in the spread of these and other aquatic invasive species and what design plans may be most helpful in minimizing their use by aquatic invaders. Estimated total cost: $100,000

6.2. LONG-TERM MANAGEMENT: LACEY STORMWATER PONDS

<u>*Containment*</u>- Maintaining containment barriers around each pond and screening overflow outlets is the least expensive management options and requires relatively low staff hours except for during and after storm events. However, containment requires long-term extensive coordination and cooperation by landowners. Regularly conducted stormwater maintenance activities (e.g., vacuuming catch basins) also has a high risk of moving ACF among locations. Even, so, such activities can help monitor for ACF as the species has been detected in the sediment spoils deposited from the trucks.

Control – These activities require a high cost of long-term capture and disposal activities with uncertainty surrounding how much effort is needed to diminish a target population and prevent spread to new sites.

Eradication – The complexity of stormwater drainage networks imposes a high cost and high uncertainty of success for ACF eradication. More thorough and extension survey and monitoring data as to ACF presence and abundances throughout the drainage system would help inform how extensively they are distributed and where to target eradication efforts. The addition of molecular or capture-mark-recapture data may also help inform whether there are ACF "hubs" in the network which produce a high number of individuals that disperse. Identifying these hubs would be critical for targeting management efforts. Rigorous data on the efficacy of various control measures are also essential to confirming eradication success in Lacey.

6.3. LONG-TERM MANAGEMENT: BOTHELL

Containment – Thorough containment requires developing a strategic plan. The "Ground Zero" pond is unlikely to be containable due to its urban setting and direct outlets to North Creek. "Richards Pond Large" and "Twin Ponds" may be suitable for containment but doing so requires research into the suitability of these sites for these activities.

Control – Adequate controlling in Bothell means a high cost of long-term capture and disposal activities with uncertainty as to the effects on the target population preventing spread to new sites.

Eradication –The strong surface water connection to North Creek means that eradication has a high uncertainty of success.

6.4. LONG-TERM MANAGEMENT: ISSAQUAH

Containment, Control, and Eradication cannot be evaluated at this point. WDFW has not had capacity to verify the extent of ACF at the site.

7. PARTNERS

To date, ACF management has been achieved through partnerships with other entities. Partner roles range from active management to helping reduce introductions of additional populations through outreach and education.

7.1. PRIMARY PARTNERS

City of Lacey, Public Works has been an active cooperative partner in supporting eradication and containment efforts but has significant resource limitations to address the ACF issue. Their specific contributions are outlined in the section Summary of Control Methods in Washington

State. Maintaining this partnership is vital for containing ACF at the Lacey Stormwater Ponds and for informing detection, monitoring, and management elsewhere in Washington.

Washington State Recreation and Conservation Office, Washington Invasive Species Council (WISC)

The WISC can help WDFW disseminate messaging surrounding the presence, spread, and possible impacts of ACF. Doing so could help prevent their release and would inform the public of how to report sightings. Additionally, WISC manages the "Report a Sighting" reporting system that includes an Invasive Animals webform, mobile app, and associated field guide. The system routes citizen reports of ACF to WISC staff, which then push the notification through to the appropriate staff in WDFW's AIS unit. It also publishes confirmed reports to the Early Detection and Distribution Mapping system managed by University of Georgia. The mapping system shares data through publicly available distribution maps contributing to a nationwide citizen science network.

WISC also develops regional messaging campaigns to raise public awareness about invasive species. ACF management can benefit from the "Don't Let It Loose" campaign to help prevent new releases of ACF into waterbodies in Washington State (Ex. **Error! Reference source not found.**). This outreach campaign is primarily disseminated through social media platforms. WISC also has an educational curriculum targeted at middle schoolers that raises awareness about invasive species including the impacts of released aquarium pets such as crayfish and goldfish that could be expanded to include ACF.

Figure 12. Washington Invasive Species Council's "Don't Let it Loose" Campaign includes messaging about African Clawed Frog in Washington State.

City of Olympia, Stream Team, Michelle Stevie coordinates an annual amphibian egg-mass identification workshop and surveys (January-March). They routinely provide data to WDFW and could be encouraged to train volunteers about ACF identification and reporting. Experienced volunteers could be trained to conduct ACF surveillance at a subset of high-risk sites in Lacey using minnow trapping techniques

St. Martins University, Biology Department and/or Facilities

St. Martins University did not grant access to conduct surveys in 2020. They requested assurances that they will not be held financially liable if ACF are found on their property.

7.2. SECONDARY PARTNERS

7.2.1. Natural Resource Agencies

Natural resource agencies with offices near the Lacey Stormwater Ponds have shown an interest in being kept appraised of ACF activities. They have knowledgeable staff that can help share information about ACF and management activities. Suggested contacts include:

Department of Ecology, Senior Wetland Ecologist, Amy Yahnke

U.S. Fish and Wildlife Service, Teal Waterstrat

United States Geological Survey, the Nonindigenous Aquatic Species (NAS) information resource.

7.2.2. Other Potential Opportunities

Citizen science groups that have active amphibian egg mass monitoring groups present an opportunity for outreach and education. For example, the iNaturalist and Woodland Park Zoo's Amphibians of Washington project (https://www.inaturalist.org/projects/amphibians-of-washington). Additionally, natural history museums like the University of Washington's Burke Museum can play an active role in facilitating research on this issue and educating the public.

7.3. KNOWLEDGE SHARING PARTNERS

Domestic- California, Colorado, Florida, Massachusetts, North Carolina, Virginia, and Wisconsin have all reported ACF invasions. These states have a range of local and state agencies cooperatively managing ACF.

International – John Measey, Stellenbosch University, South Africa is the hub of an international research group with partners in multiple countries. This network may be an avenue to share knowledge about ACF invasions and management.

7.4 CHALLENGES

Efforts in 2020 to assess if there had been a spread of ACF from the Lacey stormwater ponds or drainage system were impacted by a denial of access by one landowner. The landowner was averse to the potential economic risk (management costs) of WDFW detecting AIS on their property. Recent policy advances outline protocols for entry when access is denied (POL-5310 Invasive Species Management and RCW 77.135.170), but more collaborative approaches could be explored. Uncertainty about commitment to ACF management also makes it more difficult to cultivate collaborative partnerships.

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8. APPENDIX 1 – SPECIES DESCRIPTION

ACF (also called the Platanna) are an aquatic frog and intrepid predator in the family Pipidae. They are highly divergent from native amphibians in morphology and behavior. They have been used extensively in research and widely traded as pets. Their extensive uses, in combination with the ability to easily adapt to diverse aquatic habitats, has led to their establishment in numerous aquatic ecosystems around the globe.

8.1. IDENTIFICATION

Post-metamorphic adults (frogs) – ACF have olive to brown skin, often with blotches or spots in a variegated pattern (**Error! Reference source not found.**). These frogs lack eye lids, tongues, and vocal sacs. Their front feet have relatively long unwebbed fingers that lack claws whereas their back ones are fully webbed and the outer three digits have sharp, black claws. Dimorphism exists in body size. Females average larger and reach larger maximum sizes than males, growing to larger than an adult human fist. ACF adult body size and mass range from 50 to over 140 mm (Vogt *et al.* 2017). In their native range, only females attain body size >100 mm SVL, but long-established invasive populations in California produce even larger females >140 mm SVL (Crayon 2005). We have size information for one of the two infested locations in Washington. At the Lacey location, ACF averaged 60 mm SVL (range: 41-90 mm) and all ACF >65 mm SVL were females.

Figure 13. African Clawed Frog. A. Dorsal View. B. Front foot. C. Hind foot with webbing and claws (adapted from: CaliforniaHerp).

Larvae (tadpoles) – Larvae superficially look like a small catfish. The most prominent feature of all but the youngest tadpoles are a pair of long thin barbels that extend from each side of their chin (Error! Reference source not found.).

Figure 14. ACF tadpole with distinctive whiskers (adapted from: CaliforniaHerp).

Eggs – Eggs are deposited singly or in small clusters and are attached to hard structure in fresh waterbodies (**Figure 15**) (Ringeis *et al.* 2017). Clutch sizes are believed to be large based on ovarian egg counts that range in the thousands of eggs, but field observations are scarce, which may reflect their highly scattered presumably concealed nature. Developmental stages have been photographed and characterized in laboratory settings (see Nieuwkoop and Faber 1994).

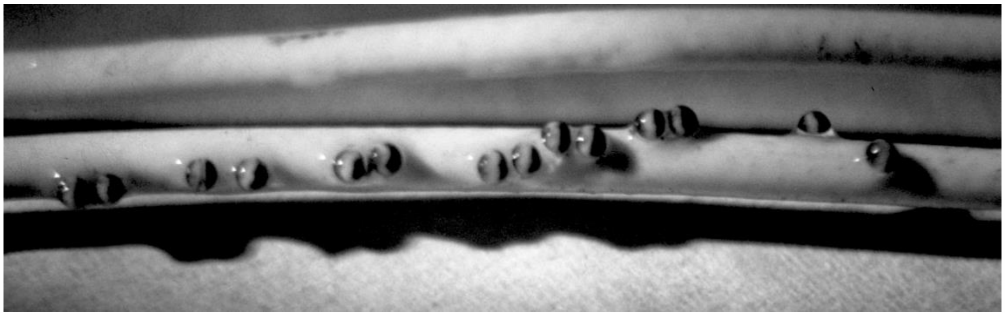


Figure 15. Small clusters of ACF eggs laid on an underwater cable in a pond (Photo: Ringeis *et al.* 2017).

8.2. NATURAL HISTORY

Reproduction – ACF has a short generation time, long life span, an extended breeding season, and prolific reproduction (Measey and Tinsley 1998; Green 2002). Females deposit many small eggs in freshwater. At about the body size when ACF first produce eggs, a 67-mm SVL female had ~2,700 eggs (McCoid and Fritts 1989). However, egg production increases exponentially with size, for example, a 104-mm SVL female contained ~17,000 eggs (McCoid and Fritts 1989). Eggs are scattered in the aquatic habitat because they are laid singly or a few at a time on varied substrates (aquatic plants, rocks and other structures)(Crayon 2005). Introduced ACF in California have been recorded reproducing nearly year-round (January-November), but reproduction typically occurs in spring (March to June)(Crayon 2005). Year-round reproduction is likely in introduced environments in western North America. Like other frogs in the family Pipidae, both their vocalizations and hearing are adapted to underwater conditions. Courtship calls are made by contracting the intrinsic laryngeal muscles and are composed of a series of clicks that differ in repetition rate and frequency (Tobias *et al.* 1998; Ringeis *et al.* 2017).

Development – Development is rapid. Field and laboratory populations reach metamorphosis in about two months, and development from egg to maturity in females requires only about eight months (Gasche 1943; McCoid and Fritts 1989). For a frog, ACF is relatively long-lived. It has been recorded to survive 15-16 years in captivity (Flower 1937; Wager 1965) and at least 23 years in feral populations in Wales, UK (Measey and Tinsley 1998; Tinsley *et al.* 2015b).

Diet –Larvae filter-feed largely on unicellular phytoplankton: alga, diatoms, protozoans and bacteria (Crayon 2005), and have even been known to filter virus-sized particles from water (Wassersug 1996). In contrast, while post-metamorphic ACF are omnivorous (Prinsloo *et al.* 1981), they are predators, with a diet similar to that of American bullfrogs (*Rana catesbeiana*) in that they will eat any live prey that they can successfully overpower that is not too distasteful (including other frogs, fish, birds and snails). Also, like bullfrogs, ACF are opportunistic, with a diet that varies with condition and location. However, ACF diet is more plastic than that of bullfrogs due to scavenging carrion. Benthic invertebrates and large zooplankters dominated the diet of ACF introduced in a South Wales pond (Measey 1998). The diet of introduced ACF in stream habitats in Portugal were also dominated by benthic prey (in this case water snails), but native fishes and amphibians were also consumed (Amaral and Rebelo 2012). In a focused feeding trials, ACF was found to readily prey upon both larval and adult Pacific chorus frog (*Pseudacris regilla*) (Wilson *et al.* 2018b) a common species native to Washington State. ACF have also been observed consuming species of true frogs (*Rana)* and toads (*Bufo = Anaxyrus)*. When present, tadpoles make up the majority of the diet of large adult ACF (Vogt *et al.* 2017). Among amphibians, Crayon (2005) reported the strongest evidence for a negative effect of predation on native amphibians is for Western toads, keeping in mind that the Western toad taxon in California may not be equivalent to that in Washington State. Lafferty and Page (1997) reported consumption of the small federally Endangered tidewater goby in California. ACF have the capacity to find and eat immobile fish eggs (Crayon 2005). ACF commonly cannibalize their eggs and larvae (Measey 1998; Vogt *et al*. 2017).

Habitat – In their native African range, ACF is known to utilize a variety of waterbodies including seasonal rain pools. Over their very broad introduced range, the species has been observed using a much broader array of habitats in both still- and flowing-water, including small streams (Amaral and Rebelo 2012; Moreira *et al.* 2017) and rivers (Crayon 2005; Torreilles and Green 2007). Larval ACF occur in habitats ranging from permanently flowing, air-saturated streams (Moreira *et al.* 2017), to temporary ponds with very low values of dissolved oxygen, and even stagnant pools in buffalo wallows (Hastings and Burggren 1995). Introduced populations have repeatedly shown plasticity in habitat characteristics such as food availability, vegetation, substrate, turbidity, salinity, water temperature, hydrology and food availability (Crayon 2005). The highest densities are reached in permanent, eutrophic, fish-free waters that have soft substrates and submerged vegetation, and do not freeze over but remain above 20°C for most of the year (Crayon 2005, Hill *et al*. 2017). Further, ACF introduced to stream and rivers systems in California have migrated both up- and downstream using human-created waterbodies as "stepping stones" to invade new habitats (Van Dijk 1977). The scavenging ability of ACF enables them to use a broader range of habitats, particularly those of lesser quality.

Thirty years after their introduction in California, Crayon (2005) made five key generalizations about patterns of ACF distribution:

1) Stream systems are vulnerable to complete colonization.
2) Some barriers (climatic and biological) seem to retard the spread of ACF.
3) Desert wetlands can sustain ACF populations.
4) Few freshwater aquatic habitats are not at risk of colonization.
5) Most populations are derived from independent introduction events

These generalizations are likely to apply to ACF in Washington State, though we would expect the first to be less absolute because of climate gradient differences. We underscore the fourth generalization as particularly important, especially in Western Washington due to the milder Mediterranean climate. We also note that the relatively short development time to metamorphosis, combined with their aestivation abilities, allow them to occupy non-permanent aquatic habitats. However, there are potentially limits to these abilities, though they remain poorly understood.

Surfacing activity is greatly diminished during colder months in California populations. Nevertheless, frogs in water bodies that ice up at the edges during the winter remain active enough to come to baited traps (Crayon 2005).

Movement – ACF are often referred to as "purely aquatic", but overwhelming evidence suggests extensive overland movement (Measey 2016; Courant *et al.* 2019). Reports of moves vary from 40 m to over 2 km (De Villiers and Measey 2017), and stream network corridors appear to be commonly used as migration corridors. In their native range, opportunistic migrations to other water sources have been observed when ponds dry up (Crayon 2005; Ringeis *et al.* 2017).

Similar behavior has been observed in their introduced range, but plasticity in behavior is indicated under different local conditions. For example, mass migration was observed during the draining of San Joaquin Reservoir in Newport Beach, California in 1984 (Crayon 2005). At a critical but unspecified low water level, the resident ACF population migrated in mass from the reservoir in one night and were seen traveling over nearby roads. This reservoir has a solid asphalt bottom that precludes frogs digging down to avoid desiccation. Overland movements do not appear confined to wet seasons or conditions, but midday is avoided in movement timing (Measey 2016). Overland dispersal had to be the mode of colonization of many ponds in France (Fouquet and Measey 2006; Courant *et al.* 2019). Movement rates reported some introduced populations appear larger that values reported for native populations (DeVilliers and Measey 2017), and greater dispersals have been observed at the edge of the range in at least one.

Predators - ACF produce a large amount of an extremely slippery mucus from skin glands when harassed (Crayon 2005). Dogs attempting to eat ACF foam at the mouth in response to these skin secretions (Hey 1949). Data are lacking on native North American non-fish predators that might prey on ACF. Larvae are weak swimmers and school in deep waters making them especially vulnerable to predation (Crayon 2005). A variety of birds, warmwater fish and garter snakes are known to prey on ACF (Crayon 2005). Largemouth bass (*Micropterus salmoides* have been used as a biological control in fish ponds in South Africa (Prinsloo et al. 1981).

Environmental Tolerance – ACF may be well suited to adapt to the stressors of increasing temperatures (as anticipated with climate change) and decreasing water depth during the warm season in different ways (Crayon 2005). Having evolved in a Mediterranean climate, they tolerate severe drought via cocoon-like aestivation in fine substrates (Wager 1965; Balinsky *et al.* 1967) and a wide range of water temperatures, ranging from <4C (<39.2F) under ice (Prinsloo *et al.* 1981) up to 28C (82.4F) (Brown 1970). They can survive at least 8 months of starvation in this state (Hewitt and Power 1913), but the actual limits of survivability in the cocooned condition are unknown. In southern California, ACF dug 30-40 cm deep pits in the mud of evaporating ponds where water remain 10°C below surface water temperatures (McCoid and Fritts 1980). ACF can also alter body fluid concentrations via retention of urea, and in this hypertonic state, minimize water loss to the surrounding substrate (Balinsky *et al.* 1967). This ability makes them one of the most saltwater tolerant frog species and facilitates their invasion of brackish water habitats (Munsey 1972, Romspert 1976).

8.3. USES

ACF are common in the pet trade and are used extensively in laboratory research. By 1970, ACF was the world's most widely distributed amphibian (Van Sittert and Measey 2016). The ability to obtain eggs in all seasons, a relatively short lifecycle and the ability to resist disease and survive in captivity helped their rapid proliferation in laboratory use (Gurdon and Hopwood 2000). The widespread global exportation of ACF date as far back as the early 1930s, when ACF were used for pregnancy testing (Shapiro and Zwarenstein 1934), but with the advent of a chemical pregnancy test in the 1960s that use rapidly declined. Simultaneously, after World War II, ACF were adopted as a "model organism" and used for a large range of research including the widely adopted toxicology methodology, frog embryo teratogenesis assay: Xenopus (FETAX) (Dumont *et al.* 1983). Interestingly, ACF were the first vertebrate to be cloned (Gurdon *et al.* 1958) and have been studied in space (Snetkova *et al.* 1995). ACF continue to have major importance in biomedical research. ACF have also been extensively used in teaching for a wide range of educational purposes from classroom pet to dissection (Gurdon and Hopwood 2000). The pet trade has emerged as a major potential source of ACF introductions into non-native range. In the early 2000's approximately 99% of imports were for the pet trade, the majority of these were declared to be captive bred (Measey 2017). Unwanted pets being released to the wild is a likely source of some invasive populations (Measey *et al.* 2012).

8.4. GEOGRAPHIC RANGE

African clawed frogs are native to sub-Saharan Africa and were originally imported to the United States for laboratory use and as pets (Measey *et al.* 2020). ACF are believed to be the most widespread invasive amphibian on the planet (Measey 2017) and can be found in at least 48 countries on four continents. Infestations of the species has been reported in at least nine states across the contiguous United States (**Figure 16**).

Figure 16. Cumulative locations of reported ACF in the Nonindigenous Aquatic Species Database managed by USGS (Basemap ESRI).

Outside of North America, invasive populations have also been reported in South America, Europe, and Asia (Measey et al 2012). Establishment of invasive populations has been most successful in areas with a Mediterranean climate resembling environmental conditions of the southwestern African Cape region of ACF origin (Ihlow *et al.* 2016), but the persistence of populations for decades in cooler environments suggests a capacity for long-term adaptation (Measey and Tinsley 1998). Moreover, recent research emphasizes that the global invasion potential of ACF has been severely underestimated, with vast areas being potentially vulnerable to invasion (Measey *et al.* 2012). It has also been suggested that climate change could enhance this species' invasion potential in regions where the climate is marginally suitable (Tinsley *et al.* 2015b). However, both recent disappearance of some populations in some areas regarded as marginally suitable climatically (Tinsley *et al.* 2015b) and recent modeling efforts contradict this conclusion (Ihlow *et al.* 2016).

9. APPENDIX 2 – EDNA PILOT PROPOSAL

Environmental DNA (eDNA) is an emerging tool that can facilitate surveying for aquatic species in a cost- and time-efficient manner, especially when species are at low density. We propose an eDNA pilot project to validate the efficacy of established protocols in known ACF populations in Washington and to use this tool in other locations to assess ACF spread. Contamination is a potential risk when sampling for low-quality DNA samples, such as eDNA (Goldberg *et al.* 2016). We propose to utilize the rigorous quality control protocol developed by the Asian Carp Monitoring program's Quality Assurance Project Plan, both in the field and laboratory to ensure samples are not contaminated (USFWS 2015). Before sampling begins at a site, all equipment (peristaltic pump, water bottles, etc.) will be either wiped down with or submerged in a 50% bleach solution (Kemp and Smith 2005; Champlot *et al.* 2010), and subsequently rinsed with DI water. Water sampling will be conducted with a peristaltic pump. At each site, we will collect 200 ml in 10 locations around a body of water and combine samples into two 2 L whirlpaks (**Figure 17**). Each 2 L water sample will be filtered through a 1.0 µm pore size filter. At the end of each sampling day, we will filter 500 ml of sterile water for an equipment control to monitor potential contamination from the filtering equipment. Filters (stored in 15mL of desiccant beads) will be stored at room temperature until DNA extraction.

All laboratory work will be performed in AirClean 600 Work Stations (ISC Bioexpress, Utah, USA), which are equipped with HEPA air filters and UV lights. All work surfaces will be wiped down with 50% bleach and exposed to UV light for at least one hour before work begins. We will test for the presence of ACF (Secondi *et al.* 2016) and at least two other aquatic species of interests (e.g., Chinook salmon ,*Oncorhynchus tshawytscha*; Coho ,*Oncorhynchus kisutch*; bullfrog, *Rana catesbeiana*) using species specific qPCR primers and probes (Ostberg, unpublished).

Filter samples will be cut in half, and one of the halves will be used per extraction. eDNA filter subsamples will be extracted with Qiagen DNeasy Blood & Tissue and Qiashredder kits (Qiagen, Inc.), as per Pilliod and colleagues (2013). DNA samples will be processed through OneStep PCR Inhibitor Removal kits (Zymo Research), to remove inhibitors that are typically abundant in Lake/Pond samples. Each filter sample will be qPCRed in triplicate. Each qPCR will include a 10-fold serial dilution of the species of interest (e.g. ACF, Chinook salmon, Coho) amplicons (gBlock from IDT). Additionally, qPCRs will include an extraction blank and a negative template control (water) to assess for laboratory contamination. We will consider samples positive for detection when two out of three qPCR triplicates result in a positive amplification (Cycling threshold, $C_T \leq 40$), as per Turner and colleagues (2014). In order to rule out field contamination leading to false positives in the lab, we will extract the equipment control associated with paired samples.

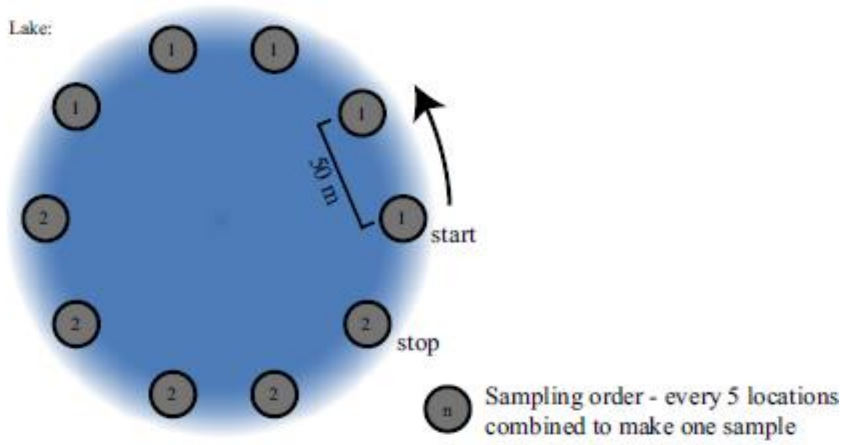


Figure 17. Schematic of pond/lake sampling. Adapted from Bedwell et al. 2020

In addition to utilizing environmental DNA to detect the presence of salmonids or amphibians of interest, eDNA has increasingly been used to detect aquatic pathogens (Chestnut et al. 2014; Miaud et al. 2019; Vilaça et al. 2020; Hall et al. 2016; Hall et al. 2018). Ranaviruses (family Iridoviridae) are double stranded DNA viruses that commonly infect amphibians, fish and reptiles (Gray and Chinchar 2015). Ranaviruses are especially lethal to amphibian tadpoles, in some cases causing 90% mortality. Environmental DNA monitoring for the detection of Ranaviruses allows for the rapid identification of a potential outbreak, in comparison to surveys for clinical signs or histological changes (which involve lethal sampling) (Miaud et al. 2019; Brunner et al. 2004; Hall et al. 2016). Recent studies utilizing eDNA samples to detect Ranavirus have shown that viral DNA titers increased in the environment prior mass mortality events (Miaud et al. 2019; Hall et al. 2016).

Water samples collected above will be analyzed additionally for Ranavirus eDNA detection. Samples will be amplified using primers and probes from Leung et al. (2017). Each qPCR will include a 10-fold serial dilution of the species of interest (e.g. African clawed frog, Chinook salmon, Coho) amplicons (gBlock from IDT). Additionally, qPCRs will include an extraction blank and a negative template control (water) to assess for laboratory contamination. We will consider samples positive for detection when two out of three qPCR triplicates result in a positive amplification (Cycling threshold, CT $\leq$ 40), as per Turner et al. (2014). In order to rule out field contamination leading to presumptive positives in the lab, we will extract the equipment control associated with paired samples.

We propose a pilot project that would sample 50 sites (ponds/lakes/streams) near known ACF occupied waterbodies.

Materials:

Option 1 Backpack Sampler Method

Smith-Root ANDe backpack= 79.43/filter = $7,943 (50 sites, two filters per site)

The estimates do not include cost of an ANDe backpack. Genetics lab has two, and the AIS team has one. Alternatively purchasing one would cost about $6,000.

Option 2 Peristaltic pump method

Peristaltic pump = 68.26/filter = $6,826 (50 sites, two filters per site)

$493 one-time purchases.

eDNA Sampling- One-time Purchases	Reactions per unit	Unit	Company	Catalog #	Price per case/ unit
Peristaltic pump head	1	Each	Cole-Parmer	EW-07518-12	$278.00
Tubing		1 each	Cole-Parmer	Ew-96410-24	$103.00
Cordless Drill		1 each	Target	LDX120C	$50.00
Rubber stopper (#8)	12	pack	Fisher Sci	14135M	$62.00

The remainder of the budget in Table 3 is for travel and staff time to collect samples, analyze data, and write up the results.

DAS “engine”

Key components

Comprehensive inputs

Environmental Data & Climate Change
- Weather data
- Temperature
- Rainfall
- Leaf wetness

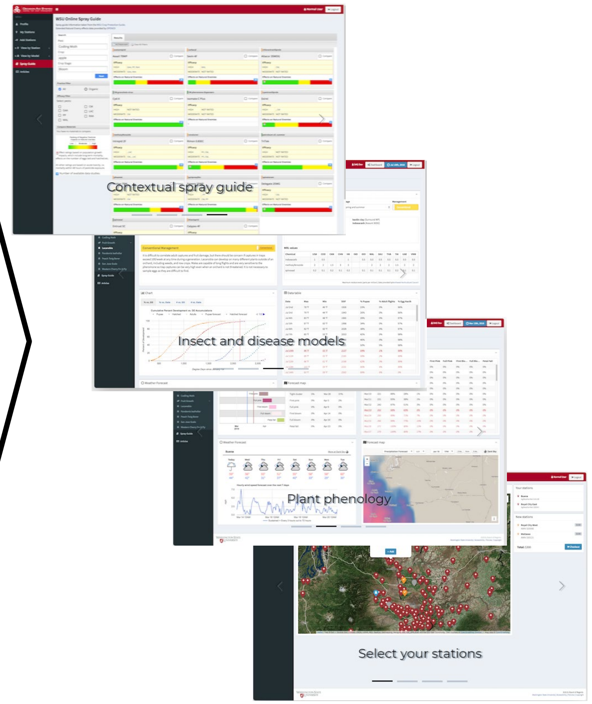
Horticulture
- Production models
- Bloom timing
- Crop development

Entomology
- Pest models
- Spray guides
- Evaluation
- Improve control

Plant pathology
- Pathogen models
- Assess risk
- Avoid disease

Northwest Horticultural Council

Advanced platform



Deep insights

- Business
- Policy
- Teaching

Impact and benefits

- Most comprehensive utilization of available data sources
- Decades of deep expertise in integrated pest management

- Depth: 43 pest and crop models
- User-friendly system
- Scalable platform: can be easily add other crops models, e.g., potatoes, and for invasive species

- Most sophisticated and well-rounded tool for conventional and organic farming
- Over 75 USD savings per acre per year in spraying
- Applicable for invasive species

DAS IPM impact – can we make a similar impact for invasive species?

User-friendly system with 43 pest and crop models to provide the most comprehensive pest management advice

One-of-a-kind insecticide spray evaluator to optimize spray programs and respective timing

Accomplishments so far

Verified impact; **over $75 savings per acre** for growers, while maintaining or increasing production ($15m annual value)

High coverage; over 90% of the acreage for tree fruit in the Washington State and British Columbia

User feedback (excerpts)

DAS is a world class tool. Thank you for developing a 'must use' program and website.

This is a very valuable, even essential service. Thank you for all your work making it accessible and easy to use.

I feel that DAS gives me an edge in bringing valuable information to growers each day.

Washington Invasive Species Council
Invasive Species Impact and Prevention/Early Action Assessment Tool|

Discussion Item – Addition of Cultural Resource Assessment Questions

Invasive species – plants, animals, insects, and pathogens – are a threat to Washington's environment and economy, exacting a high price for their presence. These biological invaders can produce serious, often irreversible effects on our natural and cultural resources and natural resource-based industries; they may also harm the health of humans and livestock. While not all non-native species have aggressive or harmful traits, the sheer number of these species coming through our gates increases the risk of significant adverse impacts. With limited resources available to manage this problem, agencies and stakeholders must be strategic in their approach.

In response to this increasing threat, the Washington Invasive Species Council has developed a ranking system to evaluate the impacts and potential invasiveness of ~~invasive~~ introduced, or non-native species to our natural areas, natural resource-based industries, cultural resources, and public health. This ranking system has been designed to be a robust and transparent procedure to aid the Council in (1) identifying the most problematic invasive species in or near to the state and (2) prioritizing Council actions. We created an impact assessment process by incorporating components from other assessment models (e.g., Invasiveness Ranking System for Non-native Plants in Alaska, California Invasive Plant Inventory), in which species are ranked by a series of questions in ~~five~~ six broad categories: ecological impacts, economic impacts, human health impacts, cultural impacts, invasive potential, and difficulty of control. In addition, in keeping with the Council's strategic focus on prevention and early detection and rapid response as identified in '*Invaders at the Gate*', we have included a separate assessment of how feasible it would be for Washington state agencies to take preventive measures or be effective with early action for a species.

The first ~~three~~ four sections of the impact assessment pertain to the severity of a species' potential or actual impact on the natural environment, cultural resources, natural-resource based industries, and human health. These impacts may have been observed occurring in Washington or, if not yet here, in another state or region. The Invasive Potential section focuses on a species' biological characteristics associated with its potential to disperse, spread, and flourish into and within a new area. The questions in this section provide a measure of a species' potential to be invasive. The fifth section, Difficulty of Control, measures the financial and human investment needed to control a species. A higher total impact score corresponds to a greater detrimental impact caused by a species.

Note of explanation on the next section

- The following scoring section (two subsesctions) would be added to the assessment tool to account for the impact of an invasive species on culturally or historically significant food and other traditional resources.
- These sections are added to ensure the Council accounts for damage or loss of foods and resources traditionally used by indigenous residents of Washington state. Scoring values are added for starting the discussion

(Proposed New Impact Section) Impact on culturally or historically significant resources

Impact on culturally or historically significant food resources

A. No impact on food resources. 0

B. Causes minor impact on food resources
(e.g., somewhat reduced production and crop yields, reduced foraging opportunities). 5

C. Causes significant impact on food resources
(e.g., major reduction in production and crop yields, loss of foraging opportunities). 7

D. Potential to eliminate foraging opportunities. 10

U. Unknown

Impact on other culturally or historically significant resources

A. No impact on resources. 0

B. Causes minor impact on resources
(e.g., somewhat reduced opportunities to gather resources for cultural uses). 5

C. Causes significant impact on resources
(e.g., major reduction in reduced opportunities to gather resources for cultural uses). 7

D. Potential to eliminate opportunities to have access to the resources for cultural uses. 10

U. Unknown

Invasive Species Impact and Prevention/Early Action Assessment Tool

Species/Guild Name:

Through the Gate? Here Near Far

Summary of Scores

		Potential Max.	Score
Ecological Impacts		*40*	______
Economic Impacts		*40*	______
Human Health Impacts		*10*	______
Invasive Potential		*33*	______
Difficulty of Control		*10*	______
	TOTAL IMPACT	*133*	______
Feasibility of Prevention/Early Action		*50*	

Number of 'Unknown' Scores Recorded:
Level of Certainty in Assessment: High Medium Low

Invasive species – plants, animals, insects, and pathogens – are a threat to Washington's environment and economy, exacting a high price for their presence. These biological invaders can produce serious, often irreversible effects on our natural resources and natural resource-based industries; they may also harm the health of humans and livestock. While not all non-native species have aggressive or harmful traits, the sheer number of these species coming through our gates increases the risk of significant adverse impacts. With limited resources available to manage this problem, agencies and stakeholders must be strategic in their approach.

In response to this increasing threat, the Washington Invasive Species Council has developed a ranking system to evaluate the impacts and potential invasiveness of invasive species to our natural areas, natural resource-based industries, and public health. This ranking system has been designed to be a robust and transparent procedure to aid the Council in (1) **identifying the most problematic invasive species in or near to the state** and (2) **prioritizing Council actions**. We created an impact assessment process by incorporating components from other assessment models (e.g., Invasiveness Ranking System for Non-native Plants in Alaska, California Invasive Plant Inventory), in which species are ranked by a series of questions in five broad categories: ecological impacts, economic impacts, human health impacts, invasive potential, and difficulty of control. In addition, in keeping with the Council's strategic focus on prevention and early detection and rapid response as identified in *Invaders at the Gate*, we have included a separate assessment of how feasible it would be for Washington state agencies to take preventive measures or be effective with early action for a species.

The first three sections of the impact assessment pertain to the severity of a species' potential or actual impact on the natural environment, natural-resource based industries, and human health. These impacts may have been observed occurring in Washington or, if not yet here, in another state or region. The Invasive Potential section focuses on a species' biological characteristics associated with its potential to disperse, spread, and flourish into and within a new area. The questions in this section provide a measure of a species' potential to be invasive. The fifth section, Difficulty of Control, measures the financial and human investment needed to control a species. **A higher total impact score corresponds to a greater detrimental impact caused by a species.**

The second part of the assessment, the Current Ability to Prevent/Take Early Action section, asks questions related to entry and transport pathways, current distribution, and policy and outreach measures already in place to facilitate efforts to conduct prevention measures or an effective rapid response. **A higher score for Current Ability to**

Prevent/Take Early Action corresponds to a greater likelihood of Washington state agencies being able to effectively implement prevention measures or conduct early action on a species.

For most questions, scores range from 0 to 10 points. This numeric spread was adapted from Alaska's ranking system and chosen to highlight relative differences among species. Any score of 'unknown' is given a numeric score of 1 and incorporated into the overall score. The number of unknown responses are recorded and used to determine the level of certainty in the assessment (i.e., high, medium, low).

WORKSHEET

IS IT THROUGH THE GATE?

Here	Species has established populations in Washington.
Near	Species has established populations in western U.S. region and similar habitat exists in Washington or species has been identified entering Washington through pathways but is not yet established.
Far	Species has established populations in areas outside of western U.S. region that have climate conditions similar to Washington.

IMPACTS

A score of 'unknown' will be given a numeric score of 1.

1. ____ ECOLOGICAL IMPACT

____ Impact on ecosystem processes

A. No impact on ecosystem processes.	0
B. Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability).	3
C. Causes significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coasts, reduces areas of open water important to waterfowl, alters water chemistry, alters rate of water retention, reduces ecosystem productivity).	7
D. Causes major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., alters geomorphology, hydrology, or fire frequency; fixes substantial levels of nitrogen in the soil which favors non-native species).	10
U. Unknown	

Comments: ____________________

____

____

____ Impact on community composition, structure, and interactions

A. No impact on community composition, structure, and interactions.	0
B. Influences community composition, structure, and interactions (e.g., reduces the number of individuals in one or more native species).	3
C. Causes significant alteration of community composition, structure, and interactions (e.g., produces a significant reduction in the population size of one or more native species).	7
D. Causes major alteration in community composition, structure, and interactions (e.g., forms a complete monotype, results in the extirpation of one or more native species reducing biodiversity or changing composition towards exotic species).	10
U. Unknown	

Comments: ____________________

____

____

____ Impact on genetic integrity of native species/potential for hybridization

A. No impact on genetic integrity of native species/no potential for hybridization.	0
B. Known to hybridize with one or more native species and produce sterile offspring that lower the reproductive output of native species.	5
C. Known to hybridize with one or more native species and produce fertile offspring that can outcompete native species.	10
U. Unknown	

Comments: ____

____

____

____ Impact on federal or state species of concern (SOC) or high-value/rare ecological communities as defined by the Washington Natural Heritage Program

A. No impact on SOC or high-value/rare ecological communities.	0
B. Causes detrimental impact on SOC species or high-value/rare communities.	5
C. Causes extirpation of one or more SOC species or eradication of a high-quality/ rare ecological community.	10
U. Unknown	

Comments: ____

____

____

2. ____ ECONOMIC IMPACT

____ Impact on agricultural/aquaculture industry

A. No impact on agriculture or aquaculture.	0
B. Causes minor impact on agriculture or aquaculture (e.g., somewhat reduced production and crop yields, reduced forage for livestock).	3
C. Causes significant impact on agriculture or aquaculture (e.g., major reduction in production and crop yields, loss of livestock, loss of markets by contaminants, genetic integrity of crop species, damage to water diversion system).	7
D. Potential to shut-down portions of the industry (could be due to regulatory measure).	10
U. Unknown	

Comments: ____

____

____

____ Impact on forest products industry

A. No impact to forest products industry.	0
B. Causes minor impact to forest products industry (e.g., somewhat reduced timber and other forest products yields, small increase in susceptibility to fire).	3
C. Causes significant impact to forest products industry (e.g., major reduction in timber and other forest product yields, significant increase in susceptibility to fire).	7
D. Potential to shut-down portions of the industry (could be due to quarantine or other regulatory measure).	10
U. Unknown	

Comments: ____

____

____

____ Impact on physical infrastructure

A. No impact on physical infrastructure.	0
B. Causes minor impact on physical infrastructure (e.g., minor damage and/or impediments to dams, roads, railways, fences, power lines, flood control ditches, aquaculture equipment).	3
C. Causes significant impact on physical infrastructure (e.g., major damage and/or impediments to dams, roads, railways, power lines, aquaculture equipment).	7
D. Potential to render parts of physical infrastructure unusable, replacement costs would be extreme.	10
U. Unknown	

Comments: ______________________________

____ Impact on recreational sector

A. No impact on recreational opportunities.	0
B. Causes detrimental impact on recreational opportunities (e.g., diminished opportunities for camping, biking, hiking, boating, fishing/shellfish gathering, birding, hunting).	5
C. Elimination of one or more recreational opportunities.	10
U. Unknown	

Comments: ______________________________

3. ____ HUMAN HEALTH IMPACT

A. No impact on human health.	0
B. Causes physical injury (e.g., thorns, shells of zebra mussel) or provides habitat for a disease vector or organism.	5
C. Is a human disease vector or is a disease organism. May also cause individual mortality (e.g., accidental ingestion of poison hemlock, West Nile Virus).	10
U. Unknown	

Comments: ______________________________

4. ____ INVASIVE POTENTIAL

____ Rate of spread with no management

A. Does not occur – species does not spread within suitable habitat.	0
B. Actual or potential slow rate of spread within suitable habitat.	3
C. Actual or potential moderate rate of spread within suitable habitat.	7
D. Actual or potential rapid rate of spread (doubling in < 10 years) within suitable habitat.	10
U. Unknown	

Comments: ______________________________

____ Natural ability for dispersal beyond parent population

A. Does not occur.	0
B. Infrequent or inefficient dispersal (occurs occasionally despite lack of adaptations).	3
C. Efficient dispersal occurs but population remains within a natural boundary (such as a waterbody or natural area surrounded by human development).	7
D. Numerous opportunities for dispersal (species has ability to move across natural barriers or has adaptations such as wings or hooked fruit-coats that facilitate dispersal).	10
U. Unknown	

Comments: ______________________________

____ Habitat specialization (How far-reaching can infestation become/potential distribution)

A. Highly specialized habitat requirements (species is found in only one ecotype or ecological niche).	0
B. Moderately specialized habitat requirements (species is found in 2-3 ecotypes or ecological niches).	5
C. General habitat requirements (species occupies a wide range of ecotypes or ecological niches).	10
U. Unknown	

Comments: ______________________________

____ Other species in the genus invasive

A. No.	0
B. Yes.	3
U. Unknown	

Comments: ______________________________

5. ____ DIFFICULTY OF CONTROL – LEVEL OF EFFORT REQUIRED

A. Management is not required (e.g., species does not persist).	0
B. Management is relatively easy and inexpensive; requires a minor investment in human and financial resources.	3
C. Management requires a major short-term investment of human and financial resources, or a moderate long-term investment.	7
D. Management requires a major, long-term investment of human and financial resources.	10
U. Unknown	

Comments: ______________________________

Total Impact Score ____

CURRENT ABILITY TO PREVENT/TAKE EARLY ACTION

____ Potential for entry into and transport within Washington via human activities (both directly and indirectly – possible mechanisms include commercial sales, use as forage/ revegetation, aquaculture, biological supply, horticulture, transport on boats, etc.)

A. High - numerous pathways for entry into and transport within Washington exist and species is routinely identified traveling on these pathways.	0
B. Moderate - some entry into and transport pathways within Washington exist and species is occasionally identified on these pathways.	3
C. Low - entry and transport pathways are infrequent and inefficient.	7
D. Does not occur.	10
U. Unknown	

Comments: ____________________

____ Regulatory barriers to prevent entry into and transport within Washington

A. No or minor regulatory restrictions on organisms/host and no surveillance.	0
B. No or minor regulatory restrictions on organisms/host with surveillance.	3
C. Regulatory oversight on organisms/host with restricted trade.	5
D. Trade and/or transport of organisms/hosts illegal.	7
E. Strict prohibition on organisms/host and some infrastructure for interception.	10
U. Unknown	

Comments: ____________________

____ Current distribution in Washington

A. Widely distributed throughout state.	0
B. Regionally distributed.	3
C. More than one infestation known spread within one or multiple watersheds.	5
D. Isolated infestation, 1-3 known locations encompassing fewer than 50 acres.	7
E. Not present.	10
U. Unknown	

Comments: ____________________

____ Degree to which control is mandated

A. No regulatory barriers, voluntary control may or may not be encouraged.	0
B. Mandatory control at local level.	3
C. Mandatory containment of species where regionally established and mandatory control of species where not yet established.	7
D. Mandatory eradication of species.	10
U. Unknown	

Comments: ____________________

____ Current efforts for education and outreach

A. No education and outreach efforts are undertaken for this species.	0
B. Some education materials exist and passive outreach occurs (e.g., signs posted at public access points, information cards made available at public events).	3
C. Education materials exist and outreach occurs sporadically and/or after a new species or infestation is discovered.	7
D. Education and outreach materials and programs exist and are actively provided to targeted audiences before the species or a new infestation is discovered.	10
U. Unknown	

Comments: ____

____ **Total Current Ability to Prevent/Take Early Action Score**