

**Mike Milburn**  
Chair  
Montana

**Doug Grob**  
Montana

**Jeffery C. Allen**  
Idaho

**Ed Schriever**  
Idaho



# Northwest Power and Conservation Council

**Thomas L (Les) Purce**  
Vice Chair  
Washington

**KC Golden**  
Washington

**Margaret Hoffmann**  
Oregon

**Charles F. Sams III**  
Oregon

February 3, 2026

## MEMORANDUM

**TO:** Council Members

**FROM:** Stacy Horton, Washington Policy Analyst, Biologist

**SUBJECT:** Preparing for Invasive Freshwater Mussels, Assessing Hydropower and Hatchery Infrastructure

## BACKGROUND:

**Presenters:** James Littlely, Chief Operating Officer, Okanagan Basin Water Board  
Michael Stephenson, Resource Professional Leader, Idaho Power Company  
Justin Bush, Aquatic Invasive Species Division Manager, Washington Department of Fish and Wildlife

**Summary:** Implications of a widespread establishment of zebra, quagga, or golden mussel (mussel) in the Basin includes significant risks to raw water infrastructure, resources, ecosystems and species that are closely related to the Columbia River Basin Fish and Wildlife Program (FWP) and the Federal Columbia River Power System (FCRPS). Once established at scale mussels could impact hydropower generation and fish passage facilities at dams, affect hatcheries, habitat and valuable or endangered species, and disrupt navigational locks water diversion and pumping infrastructure (including agricultural irrigation systems and associated fish screens). The Council has had numerous presentations describing anticipated economic and ecological consequences of invasive mussels. Today's presentation builds on that foundation by specifically focusing on assessing impacts to vulnerable raw water infrastructure important to the Fish and Wildlife Program and the FCRPS.

**James Littley**, Okanagan Basin Water Board, will present information from their mussel vulnerability guide titled '[Preparing for Invasive Mussels: Vulnerability Assessment Guide for Raw Water Infrastructure](#).' First released in 2024, the Guide has been updated to include the most up-to-date information on golden mussels, with a focus on how to assess source water risk. The guide is useful for facility managers to understand risk, specific facility vulnerabilities, and treatment options.

**Michael Stephenson**, Idaho Power Company, will present information on the company's experience with the recent chemical treatments of the Snake River to eradicate invasive quagga mussels from the Snake River near Twin Falls. This presentation will discuss our preparations for an infestation; communication plans; challenges with access to, and staffing of facilities; and what we are doing moving forward.

**Justin Bush**, Washington Department of Fish and Wildlife, will present an overview of the State of Washington's comprehensive approach to invasive mussel readiness. This presentation will highlight efforts to assess fish hatchery vulnerabilities; procedures to ensure fish transport and movement do not introduce or spread invasive species; development and testing of novel containment systems to prevent mussel establishment and protect species at risk; and plans for upcoming exercises designed to enhance readiness and evaluate containment technologies.

Relevance: The Council's 2014 Columbia River Fish and Wildlife Program includes a strategy for non-native and invasive species that calls for regional coordination, preventative actions, and monitoring and management of pathways in order to preclude or limit invasive species introductions. (P. 47-48 2014 FWP)

Background: In 2010, the Councils Independent Economic Analysis Board drafted the report [Economic Risk Associated with the Potential Establishment of Zebra and Quagga Mussels in the Columbia River Basin](#), an early look at invasive mussels in the Columbia River Basin, and considered mussel infestation scenarios and impacts on facilities, resources, ecosystems and species and (at the time) laid out the current state of knowledge about the risk of mussel introduction, establishment, growth and densities, and estimates some potential costs of infestation, avoidance, and control. The 2010 report was updated in 2013 with the report [Invasive Mussels Update, Economic Risk of Zebra and Quagga Mussels in the Columbia River Basin](#) which provided information suggesting that recent efforts to augment ongoing regional prevention efforts were justified economically and should be continued if not expanded.

In the Councils 2014 Columbia River Fish and Wildlife Program the Council included a strategy to 'Prevent the introduction of non-native and invasive species in the Columbia River Basin, and suppress or eradicate non-native and invasive

species', finding in the rationale that "...aquatic non-native species can invade and significantly threaten infrastructure at hydroelectric dams and fish passage facilities in the Columbia River Basin. Currently, the greatest known threat in the Columbia River Basin from aquatic invasive species is introduction into the basin of zebra or quagga mussels."

The Council continues to work with the region to maintain the efforts described in the Fish and Wildlife Program, including to evaluate potential adverse impacts, prevent establishment, monitor and control non-native species introduction and dispersal, remove and eradicate non-native species, reduce competition from non-native fish, and continue regional coordination with partners and regional stakeholders.

Given the threat of invasive mussel introductions and their impact to hydropower and hatchery infrastructure in the Columbia River Basin, the presentation today is both timely and important.

More info:

[\*Preparing for Invasive Mussels: Vulnerability Assessment Guide for Raw Water Infrastructure\*](#)

[\*Oregon and Washington Invasive Mussel Near-Term Action Working Group Findings and Near-Term Action Recommendations\*](#)

[\*U.S. Geological Survey Zebra and Quagga Mussel Sightings Distribution Map\*](#)

[\*California Department of Fish and Wildlife Golden Mussel Survey Results in California Map\*](#)

[\*Economic Risk Associated with the Potential Establishment of Zebra and Quagga Mussels in the Columbia River Basin\*](#) (IEAB 2010-1)

[\*Invasive Mussels Update, Economic Risk of Zebra and Quagga Mussels in the Columbia River Basin\*](#) (IEAB 2013-2)

[\*2014 Columbia River Fish and Wildlife Program\*](#) (Document# 2014-12)

# Protect our **WA**ters:

## State of Washington Approach to Invasive Freshwater Mussel Readiness

Justin Bush (He/Him)

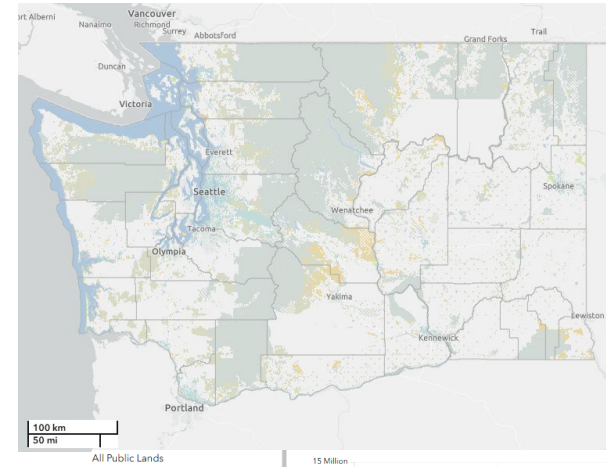
Aquatic Invasive Species (AIS)  
Division Manager



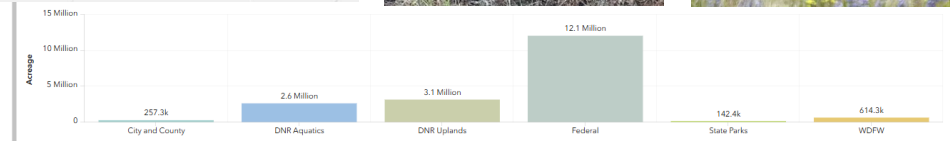
Washington  
Department of  
**FISH &  
WILDLIFE**

# State of Washington

- 8.12 million residents
- 21 treaty tribes, 8 executive order tribes
- 39 counties, 281 cities and towns
- 42.6 million acres of land: 44% public
- > 8,000 lakes, 74,000 miles of streams and rivers
- > 3,000 square miles of marine estuary
- 47 species listed as endangered, threatened, or sensitive
- 75 ports, including 11 deep-draft
  - Marine Highway (M)-5 along Pacific Coast
  - M-84 pm the Columbia/Snake River system (365 miles)
  - Puget Sound and Salish Sea
- 145 federally regulated or owned dams
- Home to significant Indo-Pacific military readiness and strategic defense capabilities and logistics infrastructure



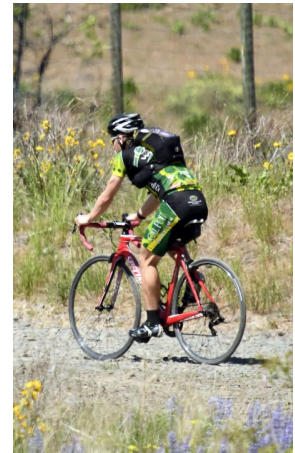
Total Acreage  
18.81 Million



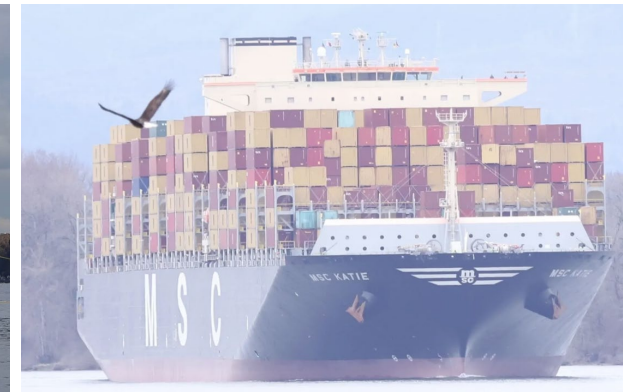
Washington Recreation and Conservation Office



WDFW



WDFW



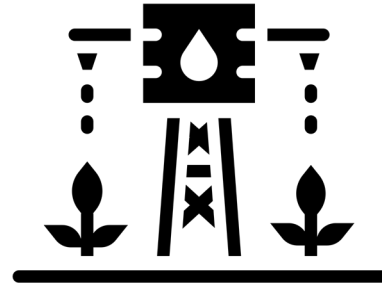
Grace Thornton, WDFW

# State of Washington



## **\$31.2 billion Columbia River and \$80 billion Puget Sound shipping**

- Commodities and products
- Key U.S. trade gateway
  - **Leading** wheat export pathway
  - **Second** soy and corn export pathway



## **\$14 billion Agricultural production \$9.6 billion**

### **Irrigated agriculture**


- 75% of Washington's agriculture crops irrigated
- Top 10 commodities: Apples, Cattle and Calves, Milk, Potatoes, Hay, Wheat, Eggs, Hops, Onions, Grapes



## **\$20.5 billion Outdoor recreation and fisheries**

- \$5 billion in outdoor recreation involving public waters
- \$1.5 billion in recreational fisheries
- \$14 billion in commercial salmon fisheries



 : Pacific Northwest Waterways Association, Puget Sound Pilots

 : Washington State Department of Agriculture

 : Washington Recreation and Conservation Office (2020)



# Invasive Freshwater Mussel Economic Risk

- \$100 million annual hydroelectric mitigation and maintenance.
- Anticipated similar mitigation and maintenance costs for:
  - Fish Hatcheries
  - Fish Passage Infrastructure
  - Agricultural Irrigation Systems
  - Drinking and Wastewater Systems
  - Legacy Data Centers
  - Navigational Locks



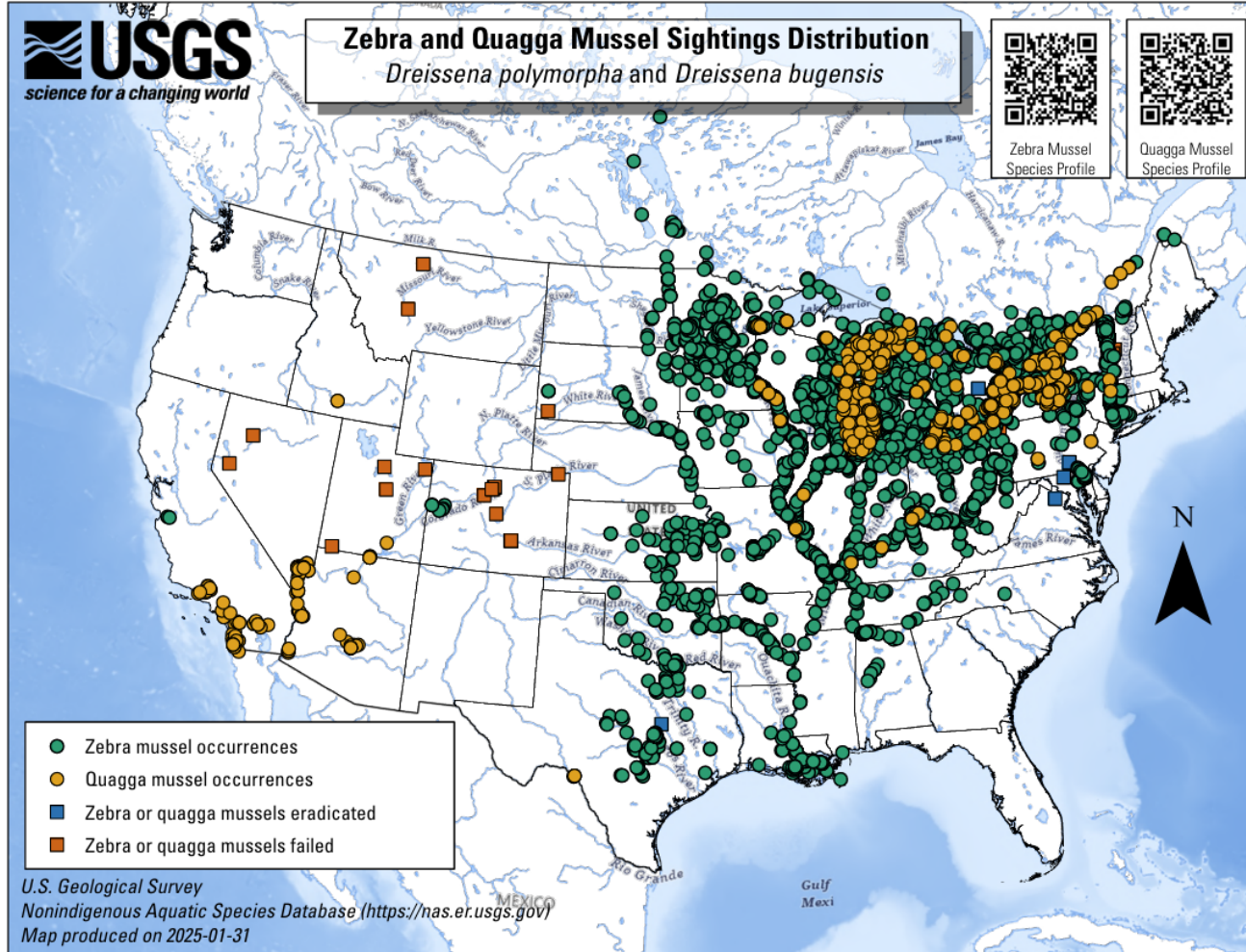
Invasive mussels fouling a penstock gate at Davis Dam.  
📷 : U.S. Bureau of Reclamation



Dense colonies of zebra mussels can clog intake pipes.  
📷 : Marrone Bio Innovations



# Quagga and Zebra Mussel Distribution



Twin Falls, Idaho is approximately 375 River Miles from Washington waters, and 175 miles from Oregon Waters.

■ : Washington Department of Fish and Wildlife

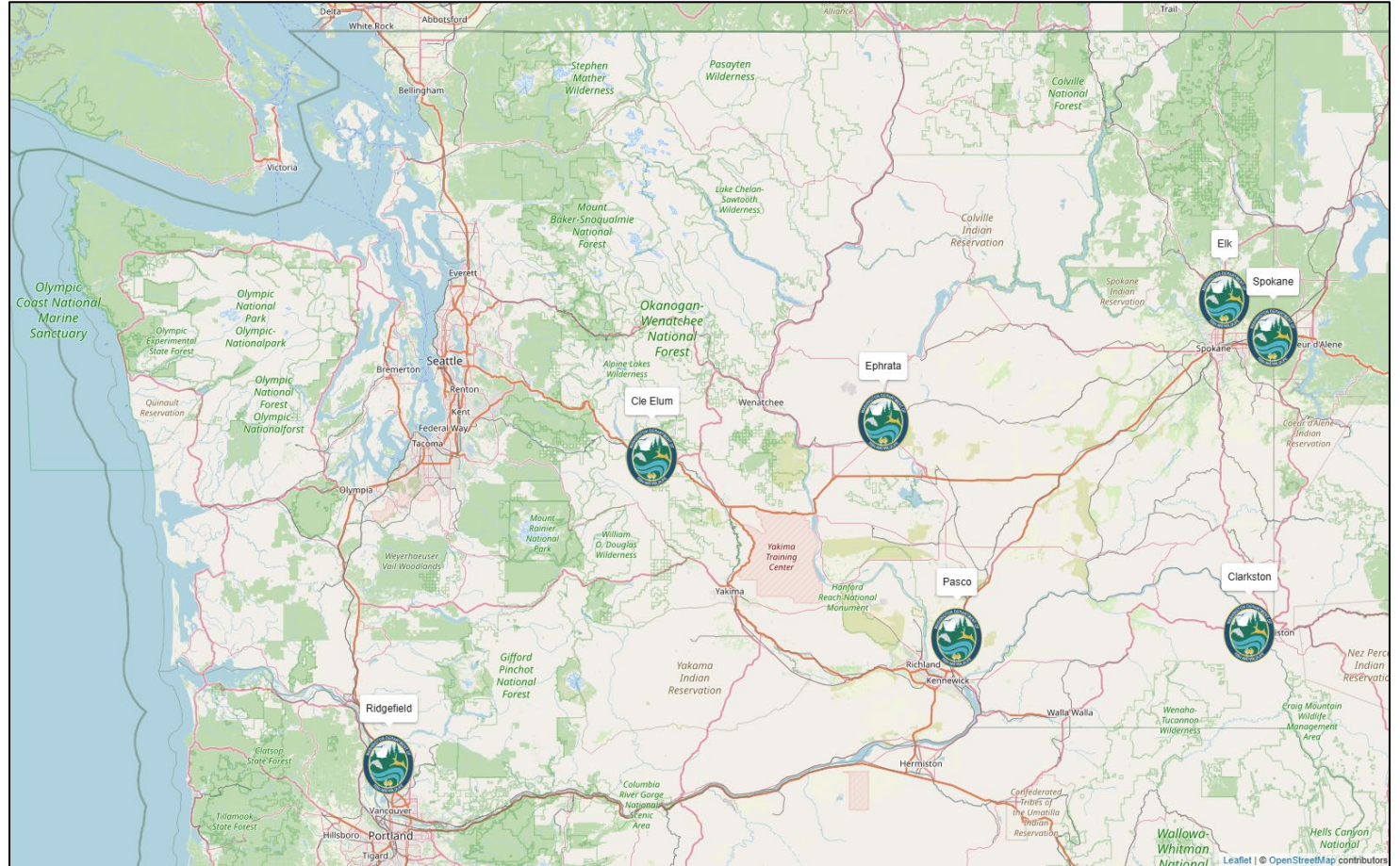




# Watercraft Inspection and Decontamination



	2023	2024	2025
Watercraft Inspected	55,810	56,388	61,137
Mussel Fouled Watercraft	23	18	21
Total Decontaminations	1,116	1,320	3,374



 &  Washington Department of Fish and Wildlife





# Jan. 2025 Largest Interception on Record: Increased Prevention and Readiness in Action

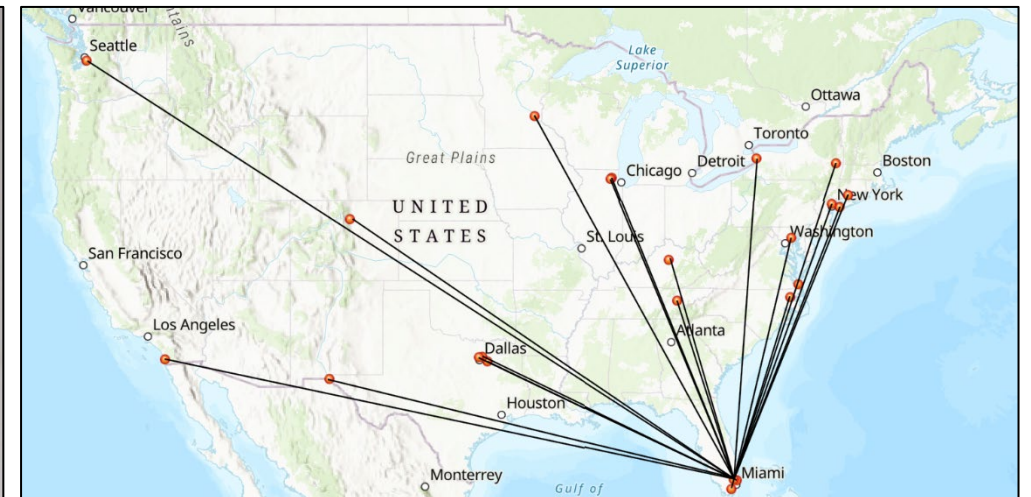
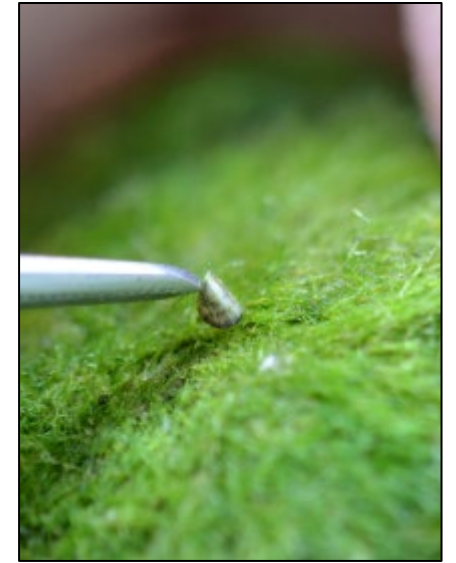
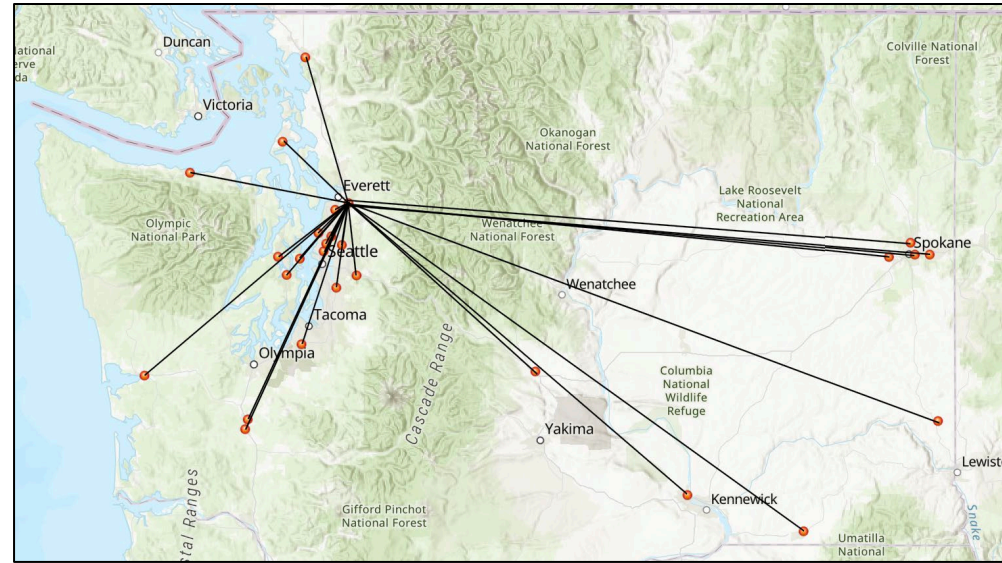


- Conveyance:
  - 2 Tugboats; 1 infested
  - 30 feet length
- Origin: Lake Michigan
- Interception Point: Spokane (Liberty Lake)
- Interception: 21 gallons of invasive mussels – analysis indicates some may have been **alive**
- Staff Time: 20 hours





# Marimo Moss Ball Zebra Mussel Incident (Aug. 2024)



Washington Department of Fish and Wildlife



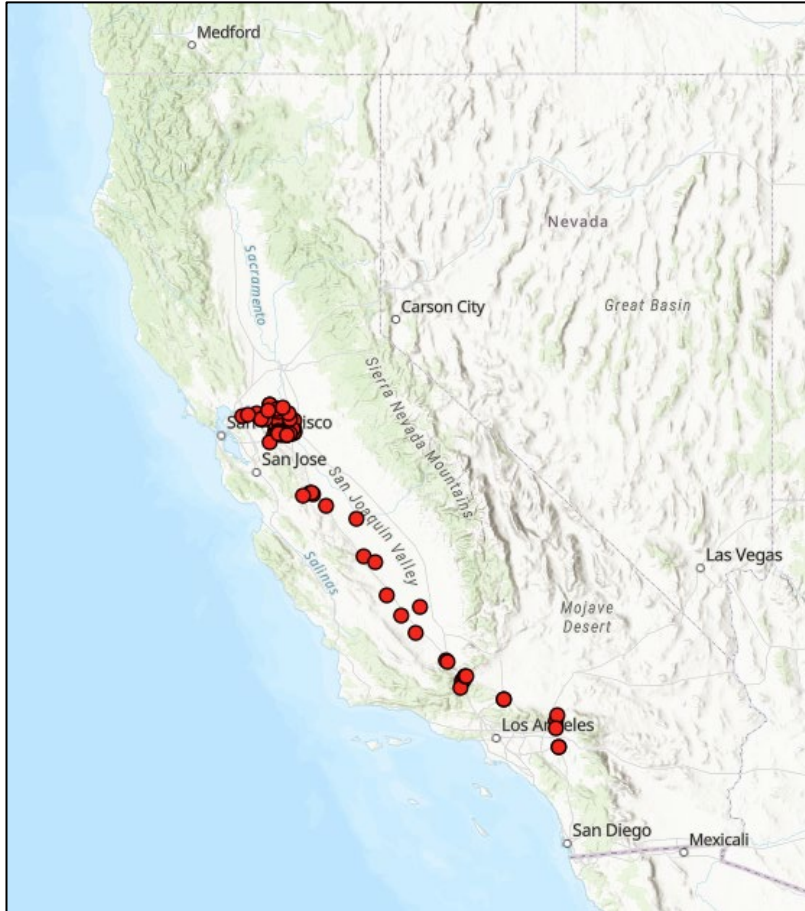
# U.S. Marine Highway System






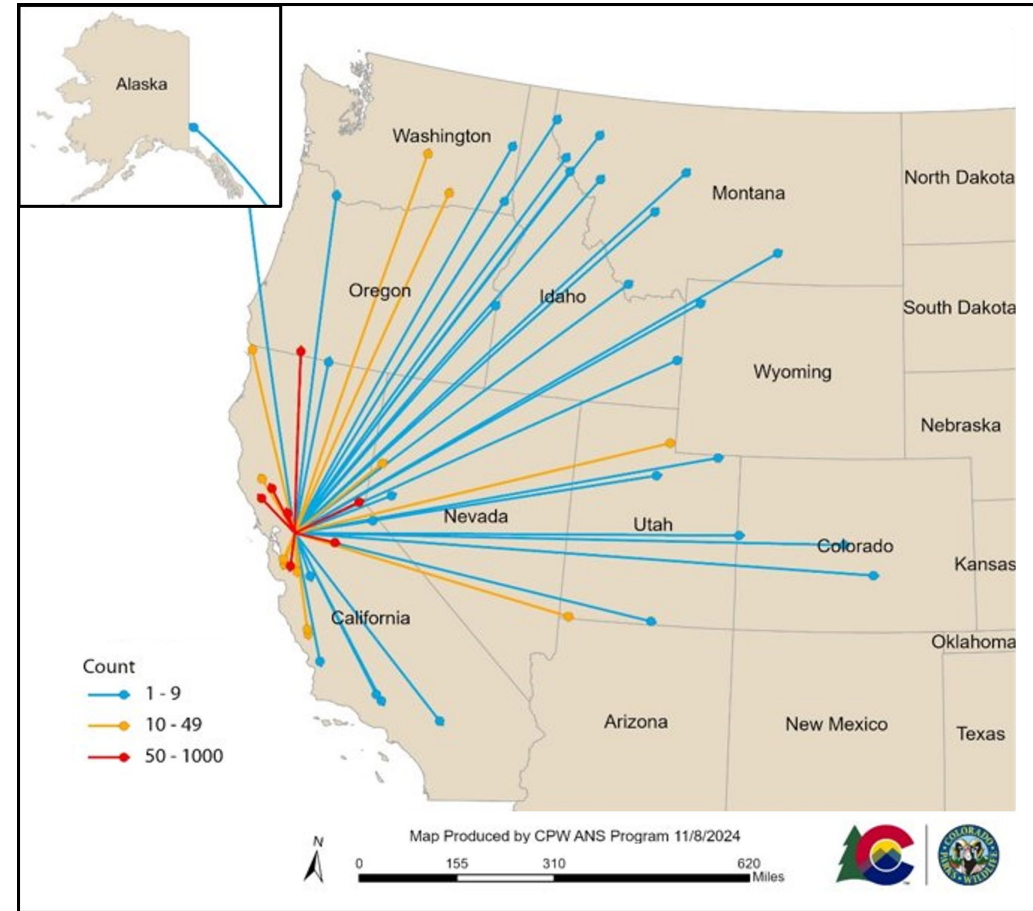
# Golden Mussels in Sacramento Delta


Golden Mussel  
Survey Results in California



 : California Department of Fish and Wildlife

2024 Watercraft Inspections Where  
“California Delta” was Last Water Visited



 : Colorado Parks and Wildlife Department



# Zebra Mussel Spread 1986 - 2006


U.S. Marine Highway System



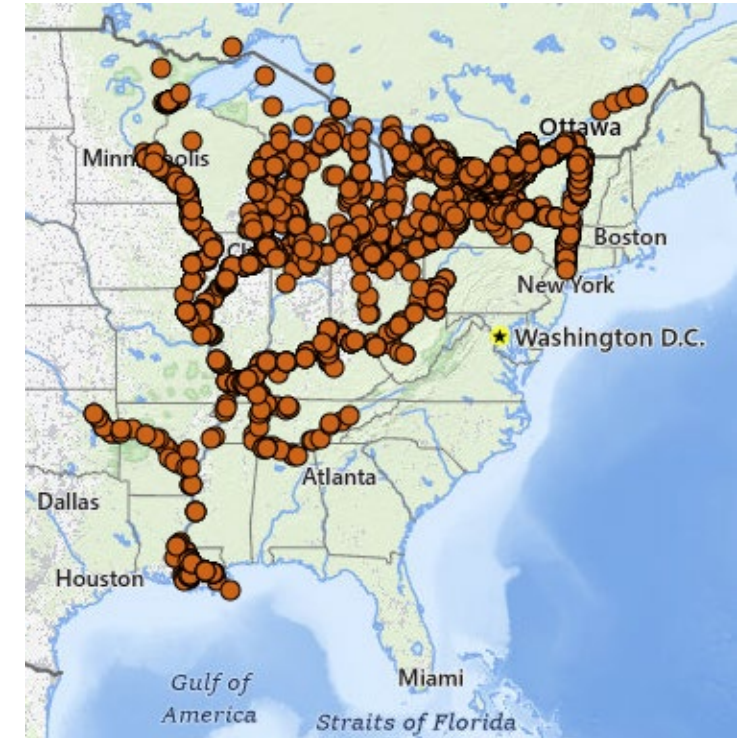
 : U.S. Department of Transportation Maritime Administration


1986



 : U.S. Geological Survey

1996



 : U.S. Geological Survey

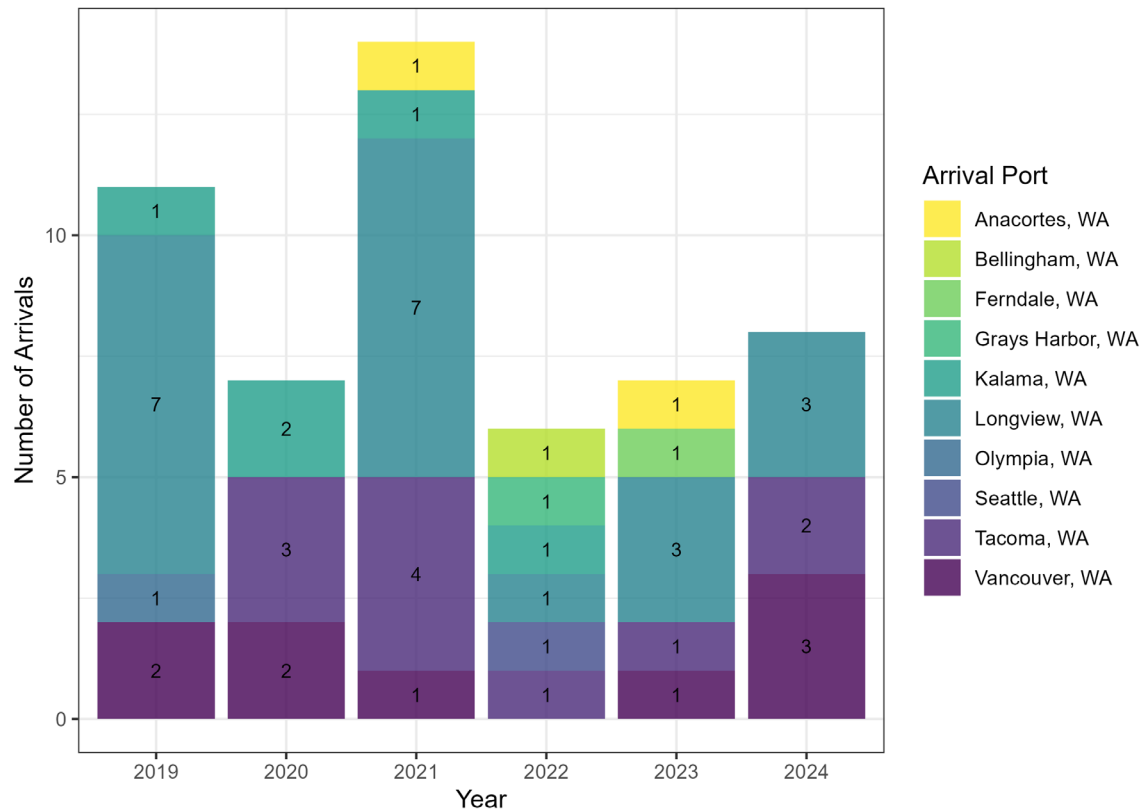
U.S. Geological Survey Non-Indigenous Aquatic Species Zebra Mussel Animated Map

<https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=95>

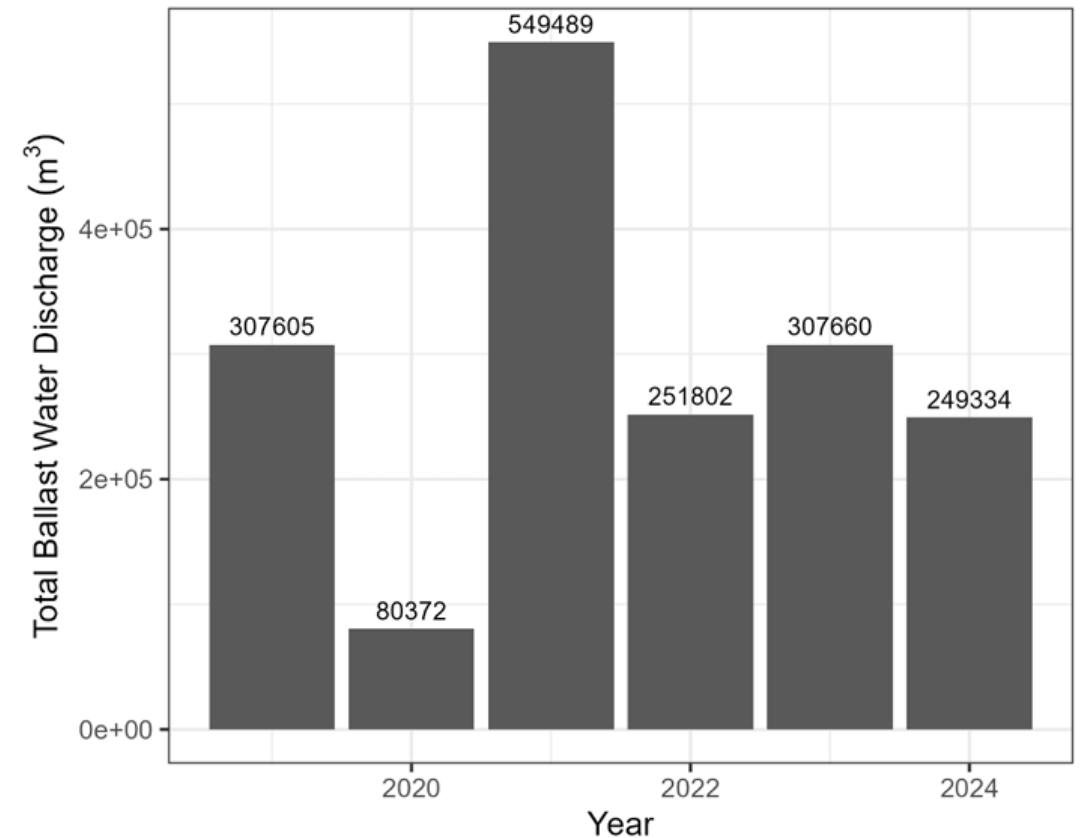


# Golden Mussels Ballast Water Introduction Risk

Regulated transoceanic vessel arrivals from Stockton area, California to Washington ports 2019-2024.



Ballast water discharged to Washington from 2019-2024 that contained water sourced in Stockton area.



2020 (low) = 21,232,036 gallons versus 2-8 gallons of water is retained in a wake boat





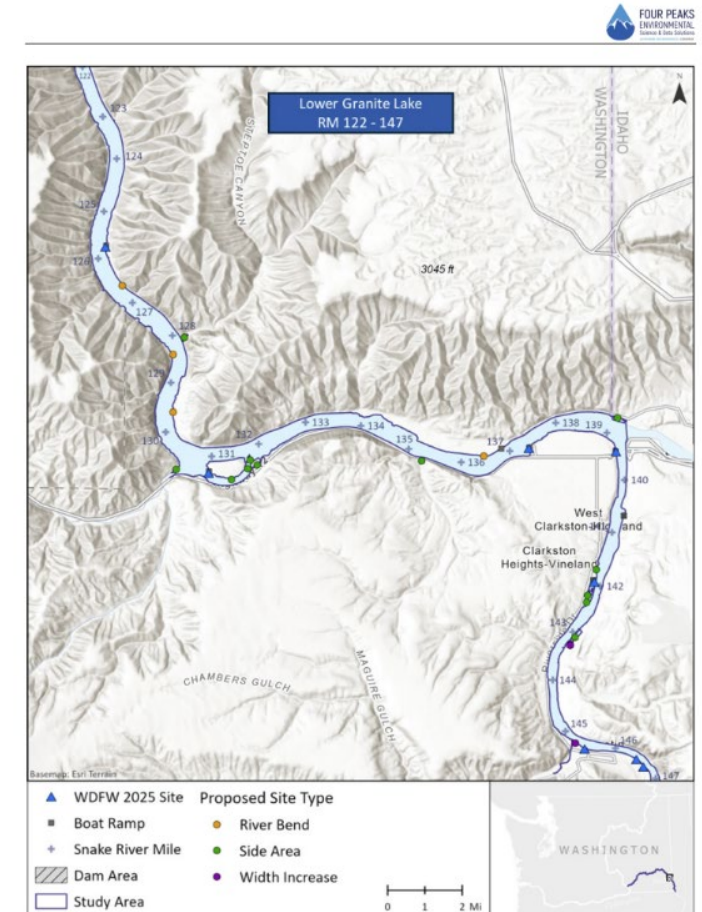
# Assessing and Mitigating Infrastructure Risks





# 1. Understanding Downstream Spread

- Historic early detection monitoring focused on 26 criterion focused on human-mediated introduction.
  - Waterbody open to public, motorized watercraft allowed, fishing tournament, stocked with fish, etc.
- Phase 1: Spatial assessment modeling where sediments likely settle out:
  - Back and side channels.
  - Insides of river bends.
  - Locations where the cross-sectional width of the river increased.
- Identified new 74 new monitoring sites between River Mile 176 and 108.
- Phase 2: Hydraulic model using simulated veligers.




Attachment Figure A-3. Proposed and existing study sites, Lower Granite Lake between river mile 122 and river mile 147

Four Peaks Environmental Science and Data Solutions on behalf of the Washington Department of Fish and Wildlife


## 2. Developing Containment Systems and Testing

- Building on 2019 field operations response exercise in November 2026 at Central Ferry Habitat Management Unit .
- Deploying and testing specifically designed containment systems.
- Bulk water exchange testing using a dye and taking readings for up to 48hours.



 : U.S. Army Corps of Engineers  
Engineering Research and Development Center

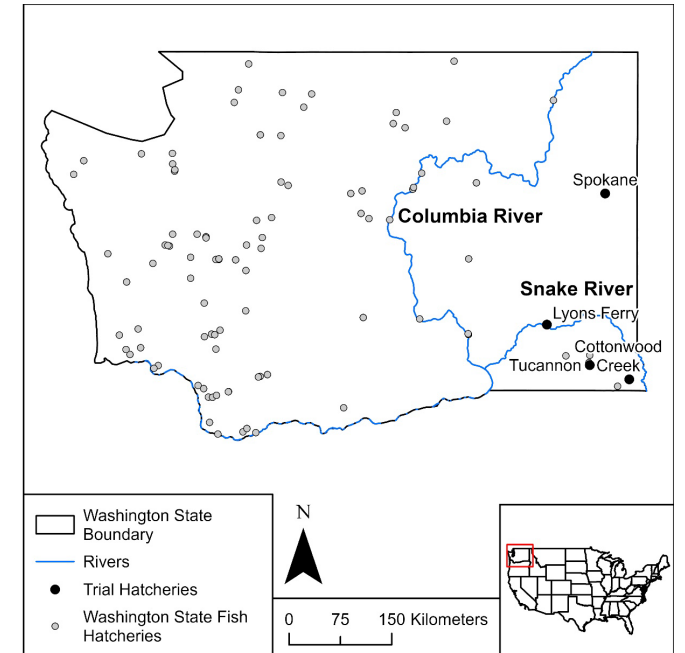
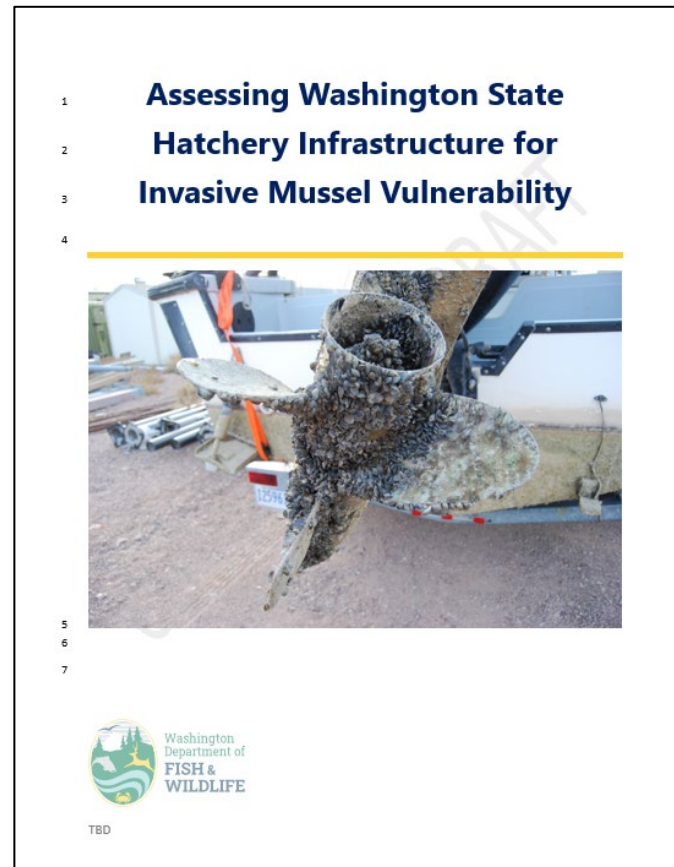


 : Washington Department of Fish and Wildlife

# 3. Understanding Fish Hatchery Vulnerabilities

Developed by U.S. Geological Survey (USGS) fish hatchery attributes such as:

- Facilities
  - Structures and materials
- Site Conditions
- Water flow and quality
- Maintenance
  - Dewatering, freezing
- Biosecurity Practices
  - Dedicated equipment and supplies (nets, waders)
- In final stages of federal approval and unpublished





# 5. Exploring Engineering Solutions

## Assessment of fish hatchery aquatic invasive species mitigating engineering solutions

- Proxy Species: New Zealand mud snails
- Location: Columbia Basin Fish Hatchery (Moses Lake)
- Evaluating and comparing engineering-based options to prevent the introduction, establishment, and persistence of invasive mussels and other aquatic invasive species within hatchery water systems.
- Identifies vulnerabilities within hatchery infrastructure and operations.
- Analyzes feasible technologies, and assesses their effectiveness, and operational constraints.
- Culminates in ranked recommendations and an implementation framework.



New Zealand Mud Snails

WDFW



Soos Creek Fish Hatchery

WDFW



## 6. Emergency Ballast Water Management Systems

- WDFW has convened a public/private working group to gather input on a port-based emergency ballast water treatment option for regulated vessels is desirable and feasible in Washington State.
- Working group meeting 2-3 times between February and April/May 2026.
- Potential applications within or supporting other raw water infrastructure or aquatic conveyances.





# Increasing Preparedness for Raw Water Infrastructure Managers

# Case Study – Skagit Hydroelectric Project (2025)

- Brought several large, portable, sectional barge platforms to the project to support in-water work
- Seattle City Light staff were trained in Watercraft Inspection and Decontamination (WID) and aware of invasive freshwater mussels and risk
- Seattle City Light staff followed protocols to inspect all equipment
- Seattle City Light staff found mussels on the portable barge platforms, alerting the state and decontaminated the equipment



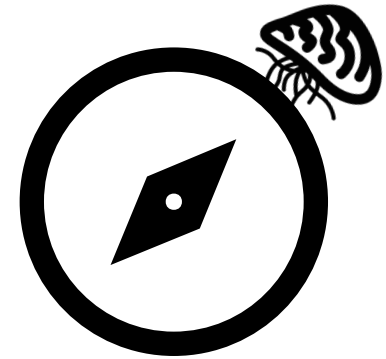
Seattle City Light



Seattle City Light

# Increasing Preparedness for Infrastructure Managers

1. Coordinate across jurisdictions and sectors; invasive mussels cross boundaries
2. Prioritize prevention; it is far less costly than long-term mitigation
3. Assess site-specific risk and vulnerabilities using standardized tools; adapt tools to identify risk and vulnerabilities of additional sectors
4. Institutionalize prevention through contracts, procurement, and operations
5. Implement monitoring, early detection, and detection notification capabilities
6. Document and promote both site and regional risks, pathways, and coordinated actions





# PROTECT OUR WATERS

## Clean, Drain, Dry



Washington  
Department of  
**FISH &  
WILDLIFE**

### Aquatic Invasive Species Division

[ais@dfw.wa.gov](mailto:ais@dfw.wa.gov)

1-888-WDFW-AIS

### Justin Bush

[Justin.Bush@dfw.wa.gov](mailto:Justin.Bush@dfw.wa.gov)

564-669-9486



Photo by:  
Gary Jackson



[dfw.wa.gov/clean-drain-dry](https://dfw.wa.gov/clean-drain-dry)



Washington Department of  
**FISH & WILDLIFE**