Native Freshwater Mussels in the Pacific Northwest

Stewardship & Environmental Education for Community-based Organizations

A Xerces Society Guide

The Xerces Society
FOR INVERTEBRATE CONSERVATION

Protecting the life that sustains us

In cooperation with

Acknowledgements

Written by Celeste Searles Mazzacano and Michele Blackburn.
Layout by Michele Blackburn; editing by Margo Conner.

Financial support to the Xerces Society for the development of this guide was provided by Endangered Species Chocolate and Xerces Society members.

Our thanks go to the photographers for allowing us to use their photos. Copyright of all photos remains with the photographers.

Front Cover Photograph:
Western pearlshell mussels (Roger Tabor, U.S. Fish and Wildlife Service Pacific Region).

Introduction

Freshwater mussels are a vital but often unrecognized component of many aquatic ecosystems. Mussels improve water quality and clarity, provide nutrients and living space for the aquatic invertebrates at the core of the food web, and are food for other wildlife. They are also culturally important to many Native Americans in the Pacific Northwest. But freshwater mussels are the most imperiled wildlife in the world, and over 75% of North America's species are listed as endangered, threatened, or of special concern. Like our native salmonids, freshwater mussels are declining due to habitat degradation and fragmentation caused by dams, water pollution, and reduced streamflow.

Unlike the southeastern United States, where there are dozens of species of freshwater mussels, only a few species occur in the Pacific Northwest: western pearlshell (*Margaritifera falcata*), western ridged mussel (*Gonidea angulata*), and floaters (*Anodonta spp.*). Pearlshells and ridged mussels prefer flowing waters, while floaters are more tolerant of warmer temperatures and sediment and can be found in slow streams, lakes, and reservoirs.

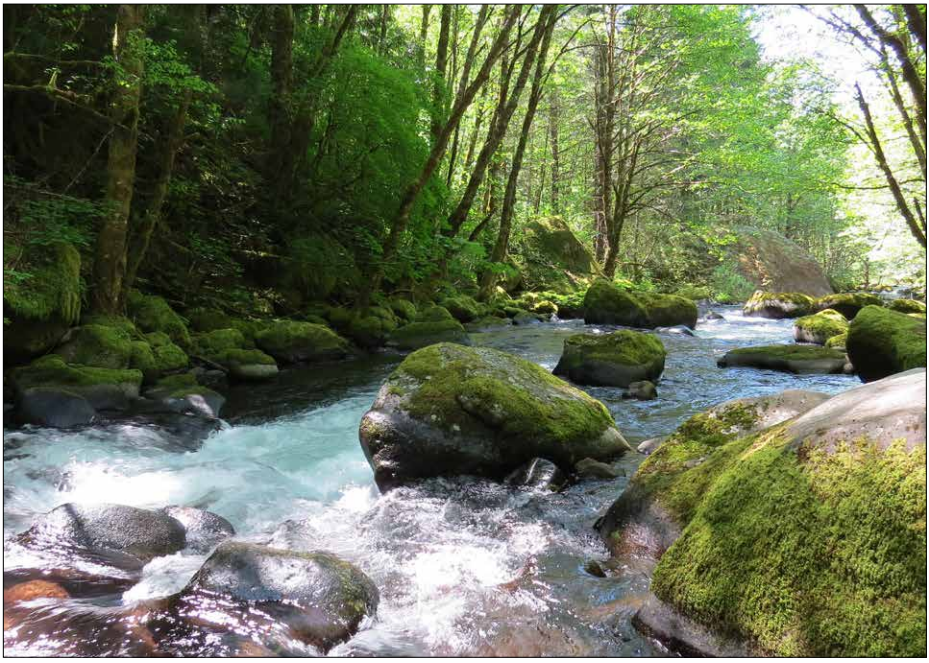
Most people are unaware of the presence and importance of mussels in local waters, and staff of natural resource organizations often lack the resources to survey mussels, salvage them from restoration sites, or develop management plans. Conducting research with trained volunteers (citizen scientists) is an increasingly popular and successful model for gathering data while increasing public science education and connecting people with nature where they live and play. Xerces has used this model to develop effective protocols for volunteer-based mussel surveys. Our work has helped address existing gaps in capacity and education, but there are many opportunities to work with new partners in additional watersheds and across cultures.

A sculpin rests near a pair of western pearlshell mussels in a Washington stream (Roger Tabor, U.S. Fish and Wildlife Service Pacific Region).

Why are Mussels Important?

Mussels are ecological powerhouses that improve habitat function and structure. They help oxygenate the substrate and increase nutrient availability. Their filter-feeding improves water quality and clarity, reduces large algal blooms, and removes excess nutrients and bacteria, resulting in greater light penetration that makes it easier for fish to find prey. Filtering capacity can be significant within large mussel beds; a study found dense mussel beds within a large river were capable of filtering 35% of total daily downstream discharge. In this capacity, long-lived mussel populations provide important long-term storage of large amounts of nutrients.

Mussel beds create living space and habitat for the aquatic invertebrates that are eaten by juvenile salmon and other fish. Empty mussel shells are a refuge for crayfish, snails, and fish, and decaying shells are a slow-release source of calcium, phosphorus, and nitrogen. Mussel fecal pellets provide nutrients for aquatic invertebrates, thereby increasing the prey base for fish, and mussels are energy-rich prey for birds, otters, muskrats, raccoons, invertebrates, and fish. Mussel beds help stabilize streambed sediments during periods of high flow. Mussels can be excellent biological indicators of stream condition, as they are long-lived (10–100 years, depending on species), relatively stationary, and sensitive to changes in water quality. Long-term changes in resident mussel populations reflect changes in streams and watersheds, providing an indicator of stream health and informing management decisions.



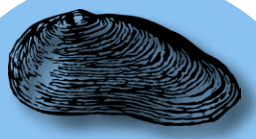
The cooler, faster-flowing water in many Pacific Northwest streams creates conditions preferred by western pearlshell mussels (*Margaritifera falcata*). In contrast, floater mussels (*Anodonta* spp.) can tolerate still water with reduced oxygen.

Despite their Ecological Importance as...

A BENEFIT TO FISH
Improve habitat conditions for fish

SUSTENANCE
Energy-rich prey for a suite of important predators

REFUGIA
Beds create habitat for invertebrates that are prey for juvenile salmon



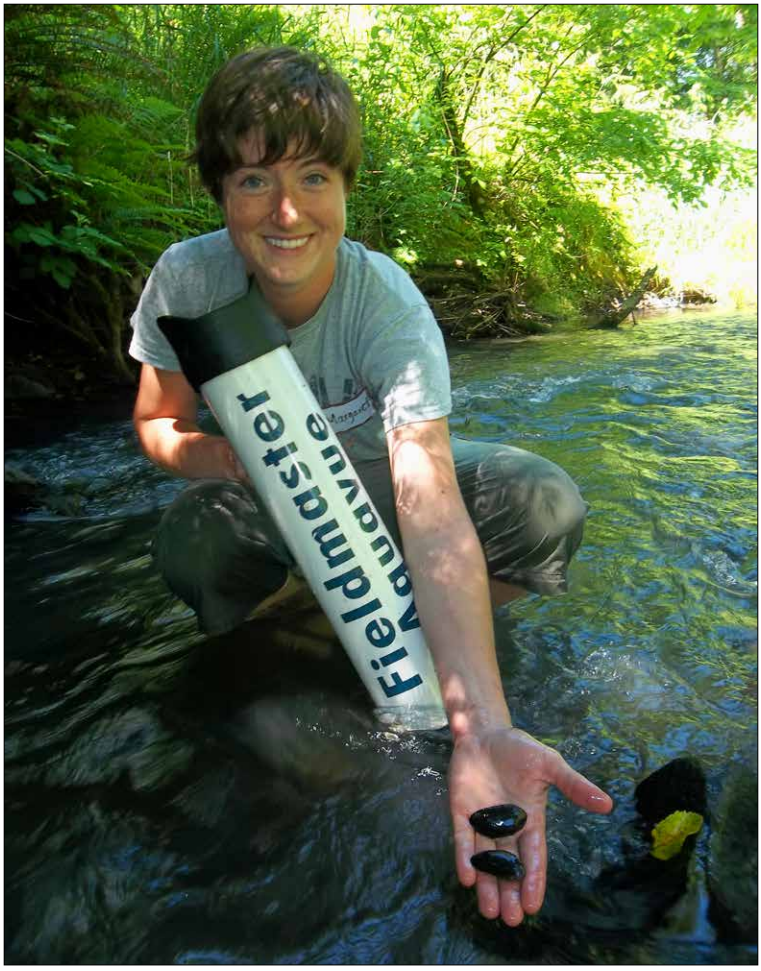
BIOINDICATORS
Long-lived, sedentary benthic inhabitants that reflect changes in streams

WATER PURIFIERS
Filter-feeding power-houses intricately tied to the health of our watersheds

...Freshwater Mussels Receive Little Protection in the West & are the Most At-Risk Fauna in the U.S.

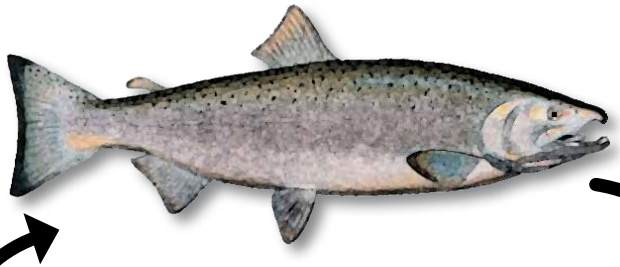
Freshwater Mussels & Salmon: Mutual Dependence

Mussel reproduction and dispersal is tied to native fish. Mussel larvae (glochidia) are released into the water and must attach to a host fish to survive and transform into a free-living juvenile; without host fish, glochidia soon die. The movement of fish hosts enables juveniles to colonize new and distant habitat. Decreases in native fish species are among the causes of freshwater mussel decline; streams where native species have declined or been extirpated may retain relict adult mussel populations, but no juveniles can enter the system. The restoration and protection of native salmon and freshwater mussels is interdependent, and the conservation of either can benefit both.



Volunteer Margaret Wagner helps locate western pearlshell mussels during a survey in the Johnson Creek Watershed (Amy Lodholz).

Freshwater Mussel Life Cycle



Transport

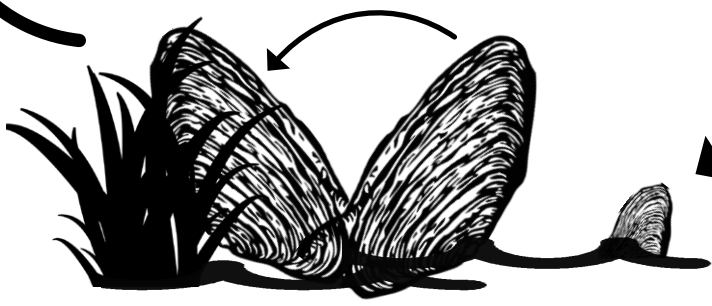
Glochidia lucky enough to find a suitable host will remain on the fish for days to weeks.

Settlement

Juvenile mussels release from fish and sink to the stream bottom. They burrow in sediment and remain buried until they mature.

Breeding

Males release sperm into the water. After being inhaled by females, sperm fertilize eggs.

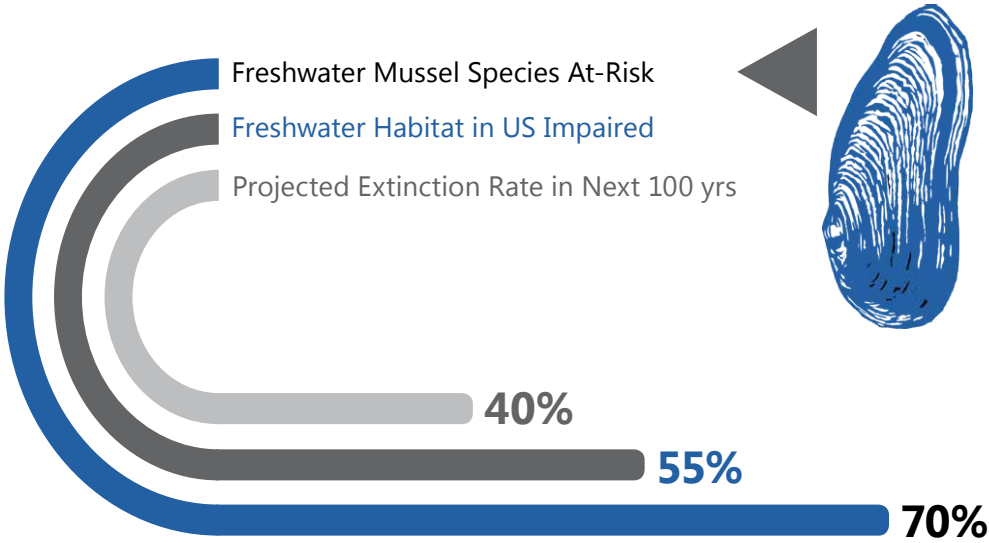


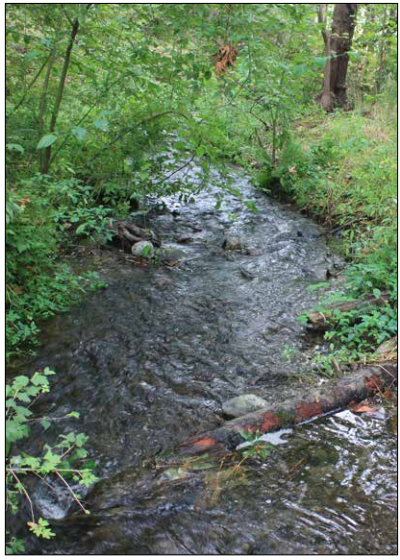
Spawning

Embryos develop into larvae called glochidia, which are released into the water and must find a host fish or die.

Freshwater mussels have a unique life cycle that is intricately tied to native fishes like salmonids. (Image Credits: Salmon, Wikimedia Commons; small mussel icon, Daniel Gamage, The Noun Project; mussel block print, Patrick Norton, Crystal Springs Partnership; grass, bryn mackenzie, The Noun Project).

Conservation Crisis





Urban rivers like Crystal Springs Creek in Portland, Oregon can serve as important refuge for native mussels in the Pacific Northwest.

Mussel Conservation

Reduced water quality, habitat loss, dams, dewatering, pollution, and impacts of invasive bivalves such as Asian clams (*Corbicula fluminea*) have eliminated northwestern mussels from portions of rivers and even entire watersheds. Mussels are more sensitive than fish to some water conditions; for example, the EPA recently revised allowable ammonia levels to reflect mussels' greater sensitivity. Despite these declines, northwestern freshwater mussels receive no federal protection, and there is much to be learned about their distribution, biology, and habitat requirements.

Effective long-term mussel conservation demands a better understanding of our native species, knowledge of their distribution and abundance, and protection of remaining populations.

Main Threats Facing Freshwater Mussels

Construction

Impoundments and in-stream construction can impact mussels

Barriers

Dams block the passage of native host fish required for mussel reproduction

Pollution

Pollution degrades freshwater habitat and water quality of rivers & streams

Invasive Species

Invasive species compete with native mussels for space & resources

Effective Partnerships in Mussel Conservation

Community-based partnerships are essential for mussel conservation. The Xerces Society has worked with multiple Portland-area watershed groups and natural resource agencies to better understand mussel distribution and abundance. These partnerships increased awareness and stewardship and fostered engagement among watershed professionals and hundreds of volunteers working together to conduct surveys and generate baseline data on local mussel populations, and to rescue and re-locate mussels from restoration project sites.

Freshwater mussels have declined in the Portland region as in other urban areas, but recent data is lacking in most watersheds. In the past 5 years, the Xerces Society has partnered with Johnson Creek Watershed Council, Friends of Crystal Springs, Friends of Tryon Creek, Clackamas River Basin Council, Metro, and Portland Bureau of Environmental Services to conduct environmental education and surveys centered on mussels. We have shared the information and resources needed for partners to educate volunteers, residents, and stakeholders about the ecology and conservation needs of freshwater mussels, enabled them to educate and train volunteers, and increased their capacity to conserve native mussels.

Identifying New Partnerships

The Xerces Society is working to create partnerships in more watersheds to expand awareness of the importance of native mussels through outreach and education, generate needed data on species distributions and age structures, and help partners build a framework to engage members of their community to monitor, manage, and conserve this essential component of western freshwater habitats into the future.

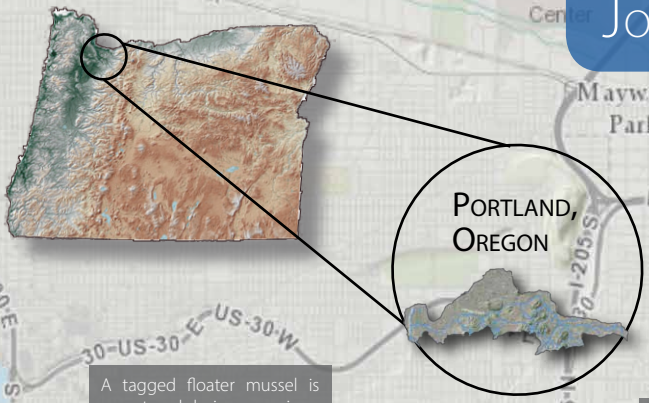
Volunteer Wesley Mahan helps locate and count mussels during a survivorship survey in Crystal Springs Creek in Portland, Oregon.

Partnership Case Study

The ongoing relationship between the Xerces Society and **Johnson Creek Watershed Council** illustrates the multiple benefits of mussel surveys to organizations and community members. Johnson Creek is on the state list of impaired waters, and prior to our partnership with JCWC, mussel presence and distribution in the watershed was unknown. This collaboration realized the following conservation and community benefits:

- Hundreds of adult and youth volunteers from within the community learned about a previously unknown component of their streams.
- Volunteers were empowered by gathering data for scientific studies while interacting directly and positively with other participants and the animals they were monitoring.
- Presence/absence of native mussels and invasive Asian clams was determined throughout the Johnson Creek mainstem and multiple tributaries, and the abundance and age structure of populations was assessed.
- Hundreds of mussels were rescued and relocated from restoration sites that would otherwise have died when the site was de-watered.
- JCWC grew their volunteer base via a novel citizen science activity, as many people participated in mussel surveys who had not volunteered previously.
- Survey data were integrated into ongoing JCWC science initiatives including State of the Watershed reports and the 1st annual JCWC Science Symposium.
- A presentation on mussels done as part of the JCWC "Science Talk" series for the public was highly popular; a PDF of the talk on the JCWC web site is one of their most frequently downloaded resources.
- JCWC staff can now monitor mussels independently, and project data are being used to support ongoing watershed-wide biodiversity assessments, conservation projects, and habitat management planning.
- Other natural resource agency partners of JCWC now have increased awareness of freshwater mussels and their needs.
- All participants gained new and unexpected insights into the important role that even impaired urban streams play in providing habitat connectivity and refugia for native mussel populations.

Johnson Creek Water



A tagged floater mussel is recaptured during a survivorship survey

Volunteer Alicia Hirssig collects data at Leach Botanical Gardens

A volunteer holds a tagged mussel during a mussel salvage event

Volunteer Anne Phillips finds a western pearlshell mussel at Tideman Johnson Park

Western pearlshell mussels buried in the streambed

RSHED MUSSEL SURVEYS

PARTNERSHIPS IN MUSSEL CONSERVATION

The Xerces Society worked with community partners throughout the Johnson Creek Watershed to train volunteers and conduct outreach and education about freshwater mussels.

The partnerships provided a unique opportunity to educate local citizens, implement volunteer-mediated survey protocols for monitoring freshwater mussels developed by Xerces, and promote the stewardship of volunteers in placed-based watershed programs.

The Xerces Society's Aquatic Program Director, Celeste Searles Mazzacano holds a western pearlshell mussel found in Johnson Creek at Gresham Woods

Inspecting the gills of a cutthroat trout for the presence of glochidia

Volunteer Hilary Linch finds a western pearlshell mussel at Ambelside in Gresham, Oregon

Measuring the length of a western pearlshell mussel

Mussel Survey Sites

Creeks

Johnson Creek Watershed

0 Miles 2

N W E S

Young citizen scientists learn about and survey for freshwater mussels (Amy Lodholz).

Mussels Need Your Help

The future of North America's freshwater mussel populations is at risk, and these mollusks need your help!

As a land manager or outreach director, you can directly support mussels by including them in your restoration and outreach plans and projects. You can also assist in programs that are tracking the distribution of mussels throughout the U.S. To ensure the long-term conservation of mussels and the ecosystem services they provide, it is essential to both protect existing populations and increase the awareness of mussels and habitat through dedicated surveys and restoration activities.

Here's How You Can Help

Rescue Before Restoration!

- Survey prior to aquatic habitat restoration activities to determine mussel presence and distribution and be able to plan rescue and relocation.
- Contact the Xerces Society for help with surveying and rescuing mussels at project sites—or for information on how you can salvage mussels prior to de-watering and in-stream work.

Champion Mussels to Increase Awareness

- Include mussels in restoration and watershed action plans.
- Conduct watershed-wide or stream-wide surveys.
- Determine the distribution and abundance of native mussels and invasive clams in the watersheds, streams, and/or wetlands you manage.

Adopt Xerces' Simple, Cost-effective Monitoring Protocols

- Protocols are easy for natural resource professionals to adopt and are designed to establish the presence/absence of mussels in project areas and/or determine their distribution throughout a watershed.
- Protocols are amenable to citizen science projects for all ages.
- Contact us for training and/or survey methods.

Top: A western pearlshell mussel is seen on the streambed through a survey scope (Eric Griswold). Bottom, from left to right: A floater mussel is measured during a volunteer survey of Johnson Creek in the lower watershed (Amy Lodholz); Volunteer Patty Robards shows off a western pearlshell mussel (Amy Lodholz); Volunteers Emilie Blevins and Mary Meier help survey for mussels in the upper watershed along Johnson Creek (Amy Lodholz).

Contact Us

If you would like to work with the Xerces Society to help protect mussels in the Pacific Northwest, please contact us at aquatic@xerces.org to initiate discussions about mussel conservation. With more awareness and management tools, the conservation crisis of native freshwater mussels can be lessened, and engaged citizen-scientist volunteers will become better stewards of their environment.

Northwest Native Freshwater Mussels

Western Pearlshell (*Margaritifera falcata*)

- May live >100 years
- Live in areas with gravel & cobble substrates and higher water velocities

Floaters (*Anodonta* spp.)

- May live 10–15 years
- More tolerant of still water, low dissolved oxygen, nutrient loads
- Found under vegetation or submerged logs

Western Ridged Mussel (*Gonidea angulata*)

- May live >20 years
- Inhabit areas where sand and silt abundant, may burrow deep with only siphons exposed

Fingernail and Pea Clams Family Sphaeriidae

- Occupy a wide range of habitats, including intermittent streams, vernal pools, and other wetlands
- Tolerant of low dissolved oxygen, warm water temperatures, and periodic drying

Invasive Mollusca

Asian Clam
(*Corbicula fluminea*)

- Compete with native mussels for space and resources
- Often most numerous bivalve in Pacific Northwest water bodies

Zebra & Quagga Mussels
(*Dreissena polymorpha; D. rostriformis*)

- Highly invasive and destructive to natives
- Not yet present in Oregon, but spreading throughout the west

New Zealand Mud Snail
(*Potamopyrgus antipodarum*)

- Widespread in Columbia Basin
- Can reach densities greater than 300,000/m^2

Chinese & Japanese Mystery Snails
(*Cipangopaludina chinensis; C. japonica*)

- Can reach high densities
- Compete with natives for food and habitat

More Information about Aquatic Invaders

Visit the Oregon Department of Fish & Wildlife Oregon Invasive Species site at http://www.dfw.state.or.us/conservationstrategy/invasive_species.asp

Thanks to a partnership with the Xerces Society, JCWC staff can now monitor mussels independently, and data are being used to support ongoing watershed-wide biodiversity assessments and habitat management planning (Eric Griswold).

Photographs

Front: Western pearlshell mussels in Stillwater Creek, Washington (Roger Tabor, U.S. Fish and Wildlife Service Pacific Region).

Inside: (Page 3) Salmon (Mallory Hawes, The Noun Project); heron (L. Shayamal, Wikimedia Commons); stonefly (Utah State University, Water Quality Extension); mussel (Patrick Norton); water drop (Nacho Janckowski, The Noun Project). (Page 6) Mussel block print (Patrick Norton). (Page 7) Construction (Markus Koltringer, The Noun Project); dam (iconsmind, The Noun Project); fish (Nathan Stag, The Noun Project); pollution (Luis Prado, The Noun Project). (Pages 10 and 11, clockwise from top left: A tagged floater mussel is recaptured during a Crystal Springs survivorship survey; Volunteer Alicia Hirssig collects data at Leach Botanical Gardens (Amy Lodholz); The Xerces Society's Aquatic Program Director, Celeste Searles Mazzacano holds a western pearlshell mussel found in Johnson Creek at Gresham Woods (Amy Lodholz); Inspecting the gills of a cutthroat trout for the presence of glochidia; A volunteer holds a tagged mussel during a mussel salvage event; Volunteer Anne Phillips at Tideman Johnson Park (Amy Lodholz); western pearlshell mussels buried in the streambed (Eric Griswold); Volunteer Hilary Linch finds a western pearlshell mussel at Ambelside in Gresham, Oregon (Amy Lodholz); Measuring the length of a western pearlshell mussel (Eric Griswold). (Page 15) Zebra mussel (Amy Benson, U.S. Geological Survey); New Zealand mud snail (Dan Gustafson, U.S. Fish and Wildlife Service Pacific Region); Chinese mystery snail (Doug Jensen; Wisconsin Dept. of Natural Resources; https://creativecommons.org/licenses/by-nd/2.0/).

All photographs taken by Xerces Society staff, except where indicated.

The Xerces Society

for invertebrate conservation

Protecting the life that sustains us

The Xerces Society for Invertebrate Conservation is a nonprofit organization that protects wildlife through the conservation of invertebrates and their habitat. Established in 1971, the Society is at the forefront of invertebrate protection, harnessing the knowledge of scientists and the enthusiasm of citizens to implement conservation programs worldwide. The Society uses advocacy, education, and applied research to promote invertebrate conservation.

628 NE Broadway, Suite 200, Portland, OR 97232
Tel (855) 232-6639 Fax (503) 233-6794
www.xerces.org