

Annual Progress Report to USFWS from the Xerces Society for Invertebrate Conservation

Assessment of Freshwater Mussel Distribution, Status, and Health in the Chehalis River Mainstem and Priority Tributaries

Award Number F19AC00507

October 1, 2023 - September 30, 2024

Information regarding the distribution and status of freshwater mussels, as well as threats to their persistence in the Chehalis watershed, is limited. Yet, this information is critical to understanding the scope of declines now occurring within the area of a mussel bed die-off. By improving baseline knowledge of mussel distribution, status, health, and threats, this project supports future conservation efforts to restore mussel habitat and maintain healthy, abundant mussel populations over their maximum possible extent in the Chehalis watershed.

This project will result in 1) an increase in the total number of known freshwater mussel beds and occupied reaches in the Chehalis watershed, 2) an assessment of mussel condition, habitat, and water quality at six sites in the watershed, and 3) completion of a mapping project and report documenting the work. Additionally, in 2023 and 2024, this project was expanded to include monitoring to identify gravid western ridged mussels to support conservation propagation efforts, including a training session and monitoring and collection efforts intended to occur before 3/31/2025. Our progress to-date for each of our project objectives is described below. Full data and reporting will be provided in the final report.

Accomplishments and Deliverables

Objective 1: Expand and refine understanding of the occurrence and status of mussels

Task 1.1: Use eDNA samples to inform visual surveys and document previously undocumented water bodies with mussel populations

In the 2019 field season, Washington Department of Fish and Wildlife (WDFW) staff (project member: Marie Winkowski) sampled 32 sites using eDNA metabarcoding, and mussel presence was documented at eight sites (Figure 1 and Appendix Table). In the 2020 and 2021 field seasons, an additional 67 and 97 sites were sampled, respectively. Mussel presence was documented at 31 sites. Of those 31 sites, 25 were new sites and six were sites repeated from 2019 or 2020. Three of those repeated sites (#133, #159, and #20207) had detections in the year sampled and three (#132, #259, and #418) had detections in 2020 but did not have detections in 2019. There was one site (#136) where mussels were detected in 2019 but were not detected again in 2020. All detections were of western pearlshell (*Margaritifera falcata*), except one detection of Oregon floater (*Anodonta oregonensis*) in 2020. There were no detections of western ridged mussel (*Gonidea angulata*); however, much of the survey frame for the eDNA efforts did not encompass their currently-documented range. Several waterbodies (n=14) now have freshwater mussel detections that were previously not reported in the Western Freshwater Mussel Database (Xerces/CTUIR 2021). Two additional sites were also sampled in 2023 by WDFW staff (project member: Marie Winkowski), and in the 2024 field season, WDFW staff (project member: Julie Tyson) collected 53 samples to test for freshwater mussel eDNA from sites in the Chehalis River (n=49), Bunker Creek (n=1), Cedar Creek (n=1), Garrard Creek

(n=1), and the South Fork Chehalis River (n=1). These samples are pending analysis. All samples that have been analyzed to date are indicated in the Appendix Table.

Task 1.2: Conduct visual snorkel and wading surveys to identify the extent, distribution, and condition of mussel beds in target reaches

From 2020 to 2024, WDFW staff (project members: Julie Tyson, Keith Douville), Chehalis Tribe staff (previous project member: Hope Rieden; current project member: Tara Livingood-Schott) and Xerces Society staff (project members: Emilie Blevins, Jack Fetters), with assistance from other organization staff and US Fish and Wildlife Service (USFWS) biologists, have conducted visual snorkel or wading surveys in more than 13 reaches and over 220 miles (Figures 2 and 3). These included reaches on the main stem Chehalis River (~45 miles); the Chehalis River near the towns of Chehalis, Centralia, and Oakville; Newaukum River (~23 miles); Skookumchuck River (~1 mile); Black River (~39 miles); Lincoln Creek (~29 miles); Scatter Creek (~11 miles); Satsop River (~9 miles); Bunker Creek (~11 miles); Garrard Creek (~9 miles); Independence Creek (~10 miles); Stillman Creek (~4 miles); and 23 sites with previous eDNA detection of mussels, covering an additional ~29 miles in the basin (see Appendix Table). Some of these sites were visited twice during this study. Within these reaches, mussel species (generally *Margaritifera falcata*, but also several *Gonidea angulata*) were documented, and general bed sizes were noted. The presence of hundreds of apparently sick, fresh dead, or empty shells was also noted at sites in the Newaukum and Chehalis Rivers over multiple years. Table 1 indicates several creeks whose confluences with the Chehalis River were surveyed specifically for western ridged mussel by WDFW and Xerces, and the results of those surveys. Note that in 2024, just one site had a live western ridged mussel detection. Additionally, each year, Xerces Society staff have returned to survey each of the six sites established in Task 2.2.

Table 1. Confluence sites surveyed to better understand the distribution of western ridged mussel in the Chehalis River. Blank cells are sites that were not revisited by Xerces.

Creek Confluence with the Chehalis River	WDFW: Shells/Live	Xerces 2024: Shells/Live
Rock Creek	0/0	
Cedar Creek	2/0	
Elk Creek	0/0	
Salzar Creek	0/0	
Garrard Creek	2-3/1	0/0
Lincoln Creek	~10/2	0/0
South Fork Chehalis	0/2	0/0
Scatter Creek	~5/1	0/1
Satsop River	0/0	
Bunker Creek	0/0	1/2
Black River	0/0	

Seven of the nine historically known western ridged sites were surveyed in 2021 and 2022 by WDFW staff, who found evidence of recent occupancy at seven sites, but it was in low counts: two sites with live mussels (one to three mussels total) and five with shells only. A subset of these sites was also revisited by Xerces Society staff in 2024 (Table 2).

Table 2. Historic western ridged mussel site surveys. Blank cells are sites that were not revisited by Xerces.

Site	WDFW: Shells/Live	Xerces 2024: Shell/Live
Wakefield Bridge (Chehalis River)	~10/0	
Workman Creek Confluence (Chehalis River)	~12/3	
Skookumchuck (found on Chehalis downstream of confluence)	2/0	0/0
Stan Hedwall Park on Newaukum River	0/0	0/0
Alexander Park (Chehalis River)	2/0	0/0
Porter Bridge (Chehalis River)	5/0	
Galvin Rd Bridge(Chehalis River)	3/0	
Vance Creek Confluence (Chehalis River)	0/	0/0
Oakville Rd Bridge (Chehalis River)	0/0	0/0

Objective 2: Understand the extent and impact of the die-off

Task 2.1: Conduct targeted surveys to evaluate the geographic extent of the die-off, including within the mainstem river and priority tributaries

All surveys contribute to understanding the extent of the die-off, but these surveys specifically targeted upper portions of the mainstem Chehalis River to determine the current extent of the die-off and the health of mussels upstream of the die-off area. This task was updated with Phase 3 funds to support two years (2023 and 2024) of additional monitoring at project sites (UCM, MCM, LCM1, LCM2, NEW, and SKO) sampled in Task 2.2. The six project sites were all monitored in 2023 and 2024.

- Surveys at one project site (UCM) has revealed that a mussel bed located in the river just upstream of Rainbow Falls had reduced in size following a reworking of the river substrate during an early summer spate in 2021. During a site visit in August 2021, only 78 western pearlshell mussels remained of the ~1,000 western pearlshell mussels counted there in September of 2020. In August 2022, only 17 remained. By August 2023 and again in 2024, we had documented just 2 remaining western pearlshell mussels. However, there is no evidence to suggest this was the result of the continuing die-off observed downstream.
- The massive western pearlshell bed documented in 2020 downstream of Rainbow Falls State Park (MCM) was revisited twice each summer in 2021, 2022, and 2023, and once in 2024. Estimates of bed size based on quadrats sampled within the bed and measurement of the bed area in 2022 suggest a population size of approximately 21,000 mussels (or about 169 mussels/m²). During the August site visit in 2023, observers noted the development of a large mat of aquatic macrophytes that was contributing to exceptionally warm water. Several dead fish and mussels were observed. Surveyors hand-pulled aquatic vegetation in an effort to restore the area to its previous character. Monitoring was again conducted in 2024 by Xerces and Chehalis Tribe staff, and while some macrophytes had regrown, the density was much lower than in 2023. Additionally, just downstream of the project site, Chehalis tribe staff observed a dewatered portion of the shore, where a number of western pearlshell had dried up and perished.
- At the next downstream project site, which is adjacent to Alexander Park (LCM1), where the die-off has been previously observed, conditions continue to appear similar as in years past, with many empty shells and sick or dying mussels present. Transect surveys in 2022 revealed that just 10.5% of mussels previously present at the site remained alive (average of 14 live and 119 dead [shells] per square meter). Repeat surveys in 2023 documented that just 6.7% remained alive.

However, a single live western ridged mussel (and 4 shells) was detected during the 2023 transect and plot surveys performed by Xerces and USFWS staff. Analysis of 2024 data is pending.

- Site LCM2 was resurveyed in collaboration with staff of the Chehalis Tribe in 2023 and 2024.
- The two tributary sites, NEW and SKO, were also resurveyed in 2023 and 2024. Final analysis of all monitoring data will be provided in the final report.
- As part of this objective, additional surveys at the mouths of tributaries were conducted by WDFW staff (see Table 2), both upstream of LCM1 and elsewhere in the basin. WDFW focused surveys in 2023 on the mainstem Newaukum River to further document the extent of the only mussel die-offs occurring in a tributary known to date. Figure 4 shows the results of those surveys which confirmed evidence of past die-offs (large amounts of shells) occurring upstream of Jackson Highway. Recent or currently dying mussels seemed less common at the time of survey in 2023, compared to 2022. However, the extent of the previous die-offs was relatively large indicative of the large amounts of shells found.

Based on mainstem Chehalis River surveys conducted by Xerces Society staff in 2024, spanning more than 10 miles of the river upstream of the Newaukum, the current known extent of the mussel die-off appears to fall just downstream of the South Fork Chehalis River. However, surveys should be conducted upstream of the South Fork confluence to determine if this is indeed the most upstream extent.

Task 2.2: Evaluate the condition of mussels at beds occurring within the die-off and outside the affected area in the mainstem river and priority tributaries

In 2020, USFWS staff (project members: Ann Gannam, James Barron), Chehalis Tribe staff (project member: Hope Rieden), and Xerces Society staff (project member: Emilie Blevins) collected whole mussels for condition analysis at one upstream Chehalis River mainstem site (upstream of the die-off impacts), two downstream Chehalis River mainstem sites (within the zone of impact), a site on the Skookumchuck River (an unimpacted site), and a site on the Newaukum River (a site that may now be within the zone of impact). In total, we sampled 103 western pearlshell for condition analysis (Table 3). The final results of these analyses will be provided in detail in the final report.

Table 3. Project site codes and locations

Basin	Site Code	Reach	Latitude	Longitude
Chehalis Mainstem	UCM	Upper Chehalis (near Rainbow Falls)	46.630	-123.235
Skookumchuck	SKO	Skookumchuck (near Centralia)	46.733	-122.951
Chehalis Mainstem	MCM	Middle Chehalis (near Rainbow Falls)	46.635	-123.182
Newaukum	NEW	Newaukum (near Chehalis)	46.637	-122.964
Chehalis Mainstem	LCM1	Lower Middle Chehalis (near Chehalis)	46.652	-122.986
Chehalis Mainstem	LCM2	Lower Chehalis (near Oakville)	46.829	-123.258

In addition, in coordination with researchers at the USFWS LaCrosse Fish Health Lab and University of Wisconsin – Madison, project members have also collected hemolymph from mussels at sites both within and outside of the die-off for disease analysis. In 2020, we sampled 211 freshwater mussels (including four western ridged mussels within the zone of the die-off). In 2022, 2023, and 2024, using Phase 3 funds, an additional set of hemolymph samples from the project study sites were collected. Results from some of the samples collected during this work have now been published in peer-reviewed journals (see attached):

Goldberg, T. L., Blevins, E., Leis, E. M., Standish, I. F., Richard, J. C., Lueder, M. R., Cer, R. Z., & Bishop-Lilly, K. A. (2023). Plasticity, Paralogy, and Pseudogenization: Rhabdoviruses of Freshwater Mussels Elucidate Mechanisms of Viral Genome Diversification and the Evolution of the Finfish-Infecting Rhabdoviral Genera. *Journal of Virology*, e0019623.

Richard, J. C., Blevins, E., Dunn, C. D., Leis, E. M., & Goldberg, T. L. (2023). Viruses of Freshwater Mussels during Mass Mortality Events in Oregon and Washington, USA. *Viruses*, 15. <https://doi.org/10.1038/s41467-018-06659-3>

Task 2.3: Assess habitat and monitor water quality at selected sites over two seasons

Water quality sampling was completed twice each during 2021 and 2022, in late spring - early summer and again in late summer - early fall. Water samples were collected for analysis, and results will be described in the final report. Habitat has been described for each sample site and changes have been observed and documented for each site during annual monitoring.

Objective 3: Understand and document potential factors contributing to mussel distribution and the die-off

Task 3.1: Overlay mussel occurrence data, relevant environmental (e.g., temperature, geologic, land cover) and sociocultural data (e.g., point source outfalls, spills, fish barriers)

WDFW staff (project members: Keith Douville, Julie Tyson, Marie Winkowski) and Xerces Society staff (project members: Emilie Blevins, Jack Fetters), as well as other collaborators, have created a comprehensive datasheet of mussel occurrence in the basin. Mussel occurrence data collected during the project will be added to the existing map and database associated with this project. In the final report, we will interpret trends in mussel occurrence, condition, and relevant data. Several relevant data layers have already been compiled and added to the growing map.

Task 3.2: Evaluate the extent over which warming water temperatures may impact mussel beds using the Chehalis Thermalscape model

As with task 3.1, we will provide this information in the final report.

Task 3.3: Complete a summary report to describe project activities and outcomes for use to support conservation efforts

We anticipate completion of a project summary report on schedule, following the conclusion of Phase 3 in March 2025.

Objective 4: Engagement with key partners in mussel conservation, including the Chehalis Tribe and Washington Department of Fish and Wildlife

Task 4.1: Continue engagement with key partners throughout project

Phase 3 funding specifically provides opportunities for engagement between Xerces Society staff and collaborators in the basin, including outreach, shared surveys, trainings, presentations, and other opportunities to contribute to shared objectives. In 2022, 2023, and 2024, Xerces Society staff met with Chehalis Tribe staff members to discuss freshwater mussel conservation in the basin and opportunities to

work together. In August 2022, Xerces Society staff provided a one-day training to tribal staff, including a presentation and field survey at two sites in the river. In 2023, Xerces Society staff and Chehalis Tribe staff met for two days to conduct surveys in the river on the reservation. Additionally, data from surveys were submitted into a map to include in a handout at a Chehalis Lead Entity booth at the Onalaska Apple Festival for citizen engagement (see attached flyer). In 2024, Chehalis Tribe staff and Xerces Society staff again met to conduct surveys together at two project sites.

Objective 5: Collect western ridged mussel broodstock from the Chehalis River Basin for propagation

The goal of this collaborative effort is to collect western ridged mussel broodstock from the Chehalis River Basin for propagation, which will enable investigative research about the species and maintain current levels of species-wide genetic diversity given the imminent extirpation of the Chehalis population.

Task 5.1: Identify and assess sites inhabited by western ridged mussels in the Chehalis River Basin, monitor these sites for gravid mussels during the spawning season, and collect broodstock for propagation if possible

This 2023 addition to the project provided funding for surveys to identify the locations of remaining western ridged mussels and to monitor these sites for gravidity. It also provided funding to participate in a gravidity monitoring training with partners. In 2023, Xerces Society staff participated in gravidity training and conducted seven days of surveying in the Chehalis basin over the course of three months, resulting in the detection by USFWS and Xerces staff of just a single live western ridged mussel that did not appear to be gravid (Figure 5). Due to the later-than-anticipated award of funding, surveys were continued during the breeding season in 2024, during which only a single live (non-gravid) western ridged mussel was observed (see Table 1; Figure 6). The surveys funded by this addition to the project are described in greater detail in the above sections, as the funds ultimately supported multiple objectives.

Figure 1. Survey frame and environmental DNA (eDNA) mussel detections in the Chehalis River Basin for the 2019, 2020, and 2021 field seasons as well as the four macro ecosystem diversity regions.

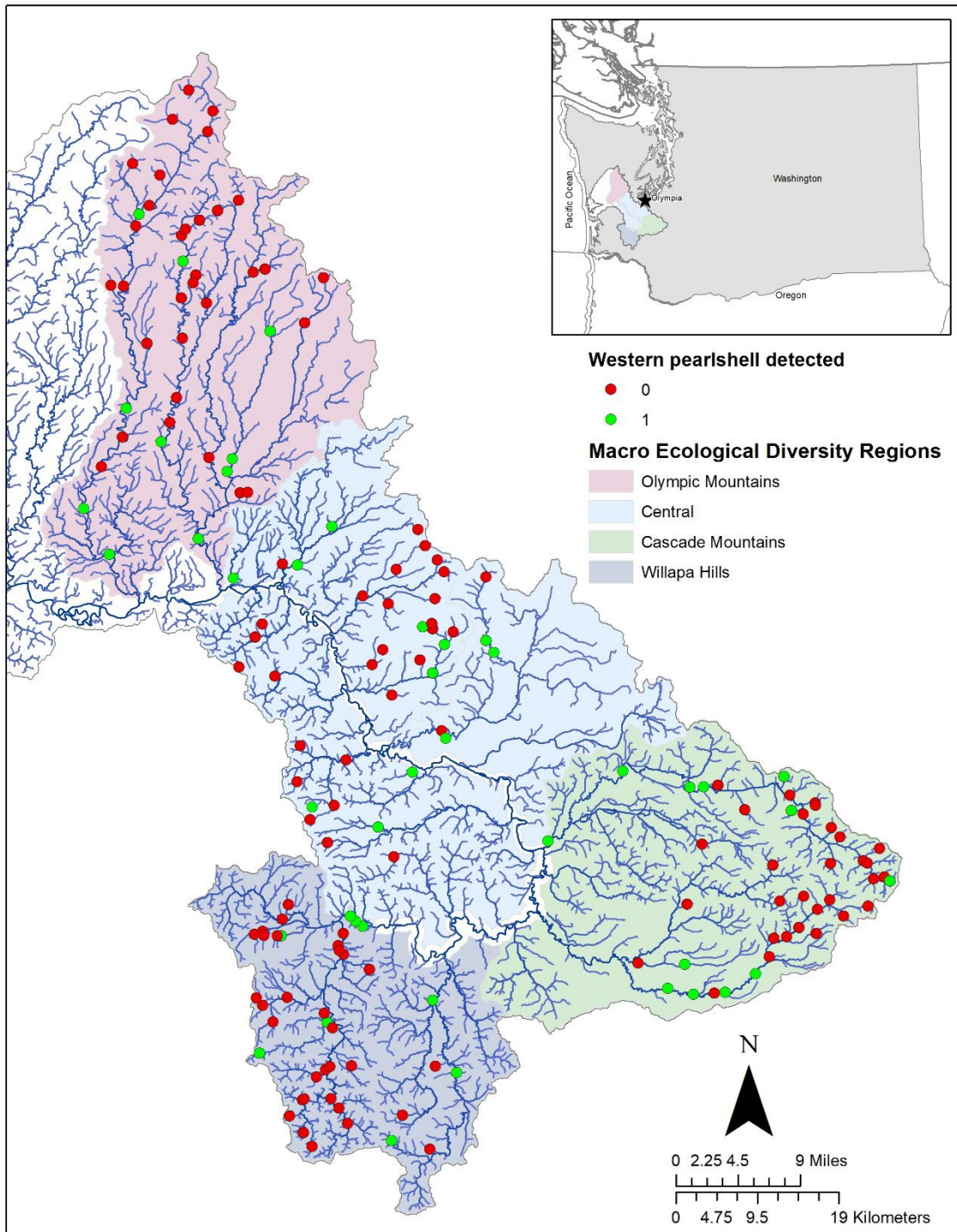


Figure 2. WDFW visual mussel surveys for the 2020 to 2023 field seasons within Chehalis basin streams.

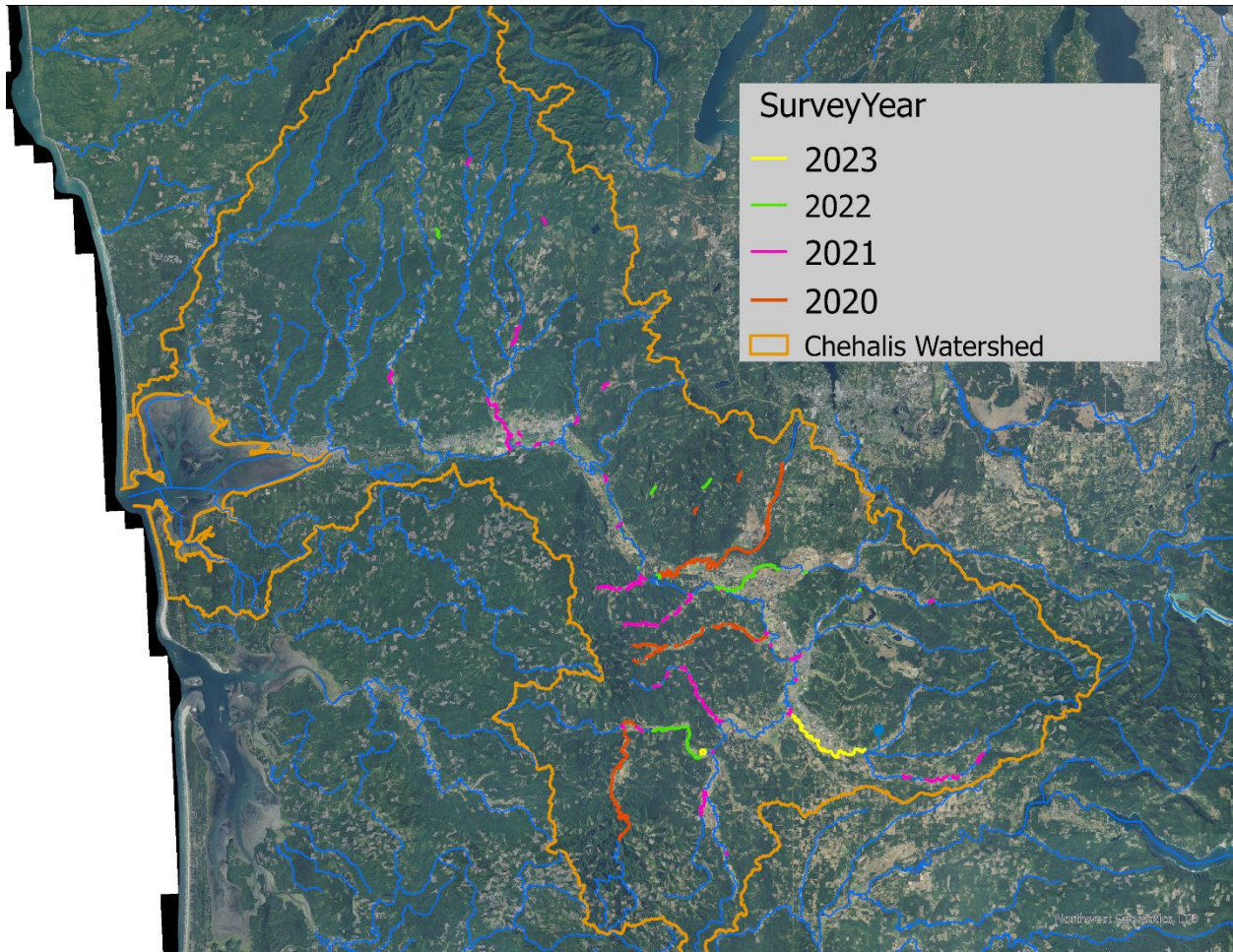
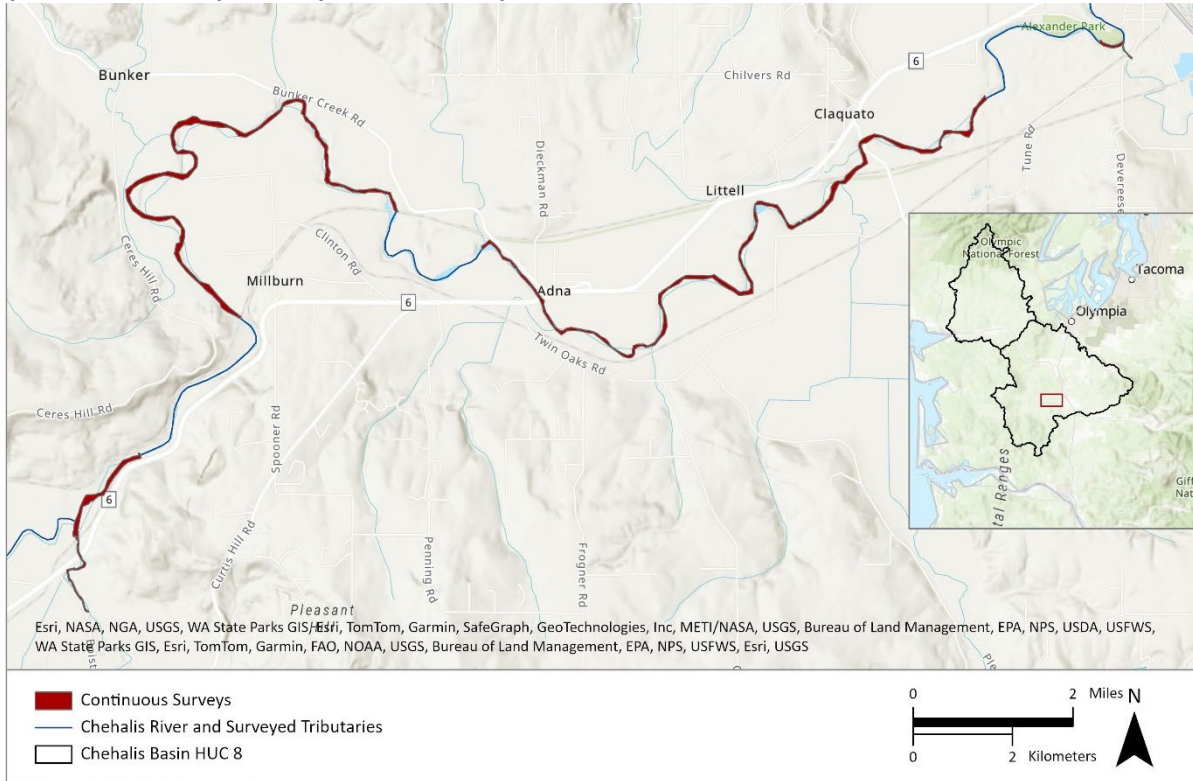
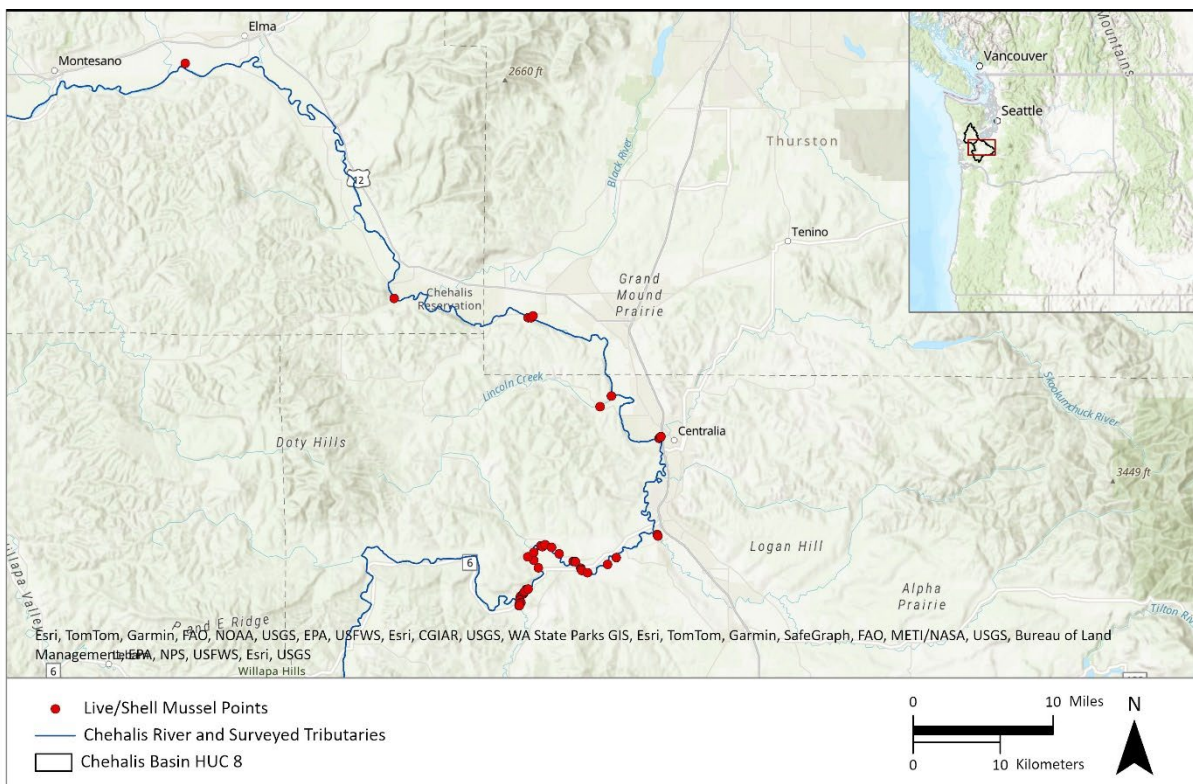


Figure 3. Xerces Society visual mussel surveys for the 2024 field season within Chehalis basin streams. Top: Continuous exploratory mussel surveys. Bottom: Locations of mussel observations from surveys.



Produced by The Xerces Society on 12/04/2024



Produced by The Xerces Society on 12/4/2024

Figure 4. Locations surveyed in the Newaukum River in 2023 to assess mussel population health status.

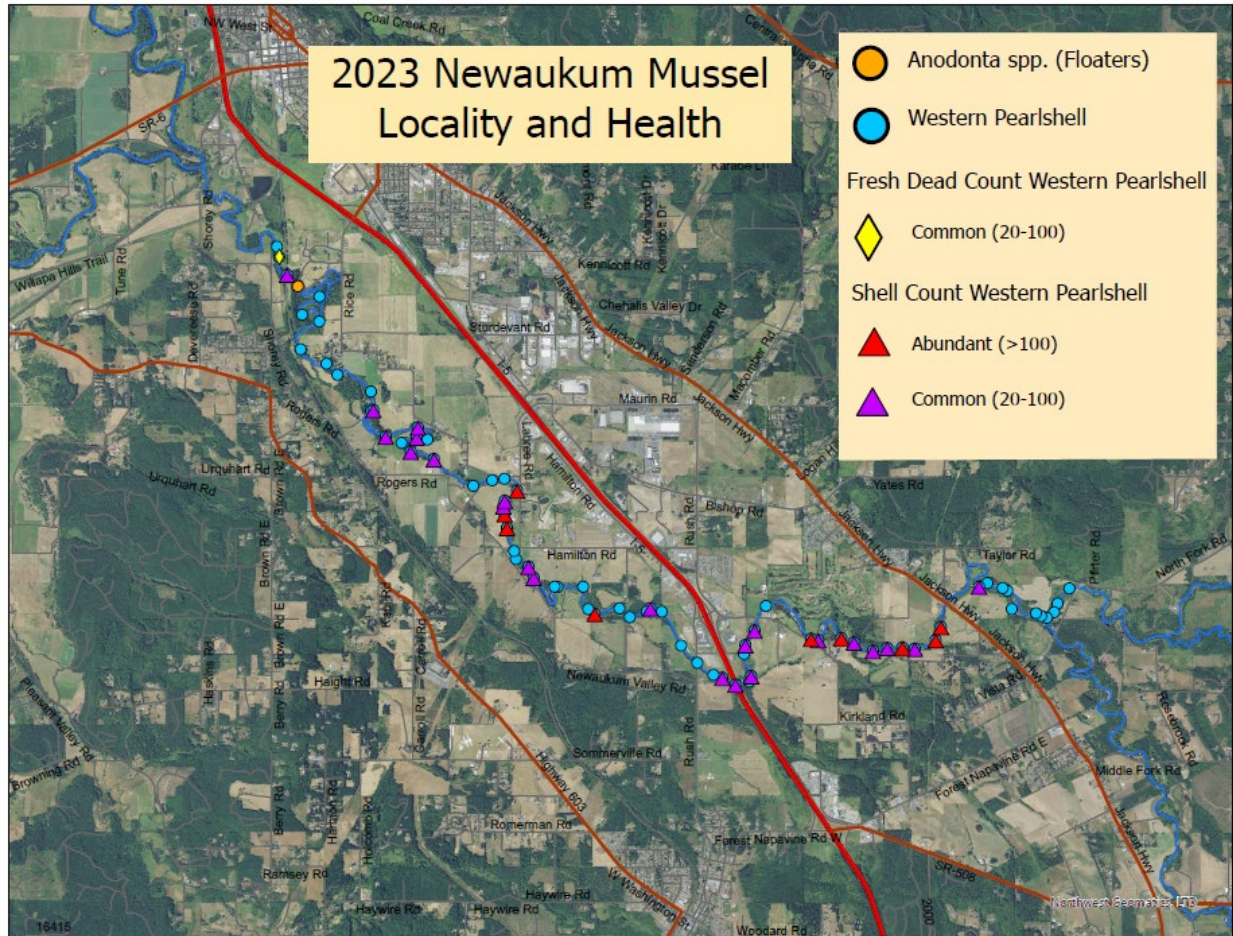


Figure 5. USFWS staff assisting with mussel surveys in the Chehalis River basin in 2023. A single live western ridged mussel was detected during these surveys.



Figure 6. A single live western ridged mussel detected during the 2024 season was located at Bunker Creek.



Appendix Table. Mussel detections from environmental DNA (eDNA) for *Margaritifera falcata* (Ma. fa.) and *Anodonta oregonensis* (An. or.) in the area surveyed within the Chehalis Basin (see Figure 1). Site Type indicates if a site was novel that year or repeated (R) from the previous year. Confirmed with traditional (trad.) sampling indicates that mussel presence was confirmed using a combination of snorkeling and tactile surveys by Tyson et al. Mussel presence was cross-referenced with the Western Freshwater Mussel Database (Xerces/CTUIR 2022). Previously documented (Prev. doc.) and novel detection (Novel det.) indicates that mussel presence was or was not reported in the database, respectively.

Survey Date	MEDR	Site	Site Type	Ma. fa.	An. or.	Latitude	Longitude	Stream name	Confirmed trad. sampling	Novel det.	Prev. doc.
8/18/2021	Cascade	490	2021 eDNA	0	0	46.66529	-122.7575	Bear Creek			
9/23/2020	Cascade	341	2020	0	0	46.6382	-122.5593	Beaver Creek			
6/17/2021	Cascade	341	2021 Repeat	0	0	46.6382	-122.5593	Beaver Creek			
8/15/2019	Cascade	260	2019	0	0	46.79092	-122.7154	Bloody Run Creek			
9/2/2020	Cascade	260	2020 R	0	0	46.79092	-122.7154	Bloody Run Creek			
6/22/2021	Cascade	415	2021 eDNA	0	0	46.72907	-122.4665	Drop Creek			
9/28/2021	Cascade	450	2021 eDNA	0	0	46.76599	-122.6736	Fall Creek			
9/10/2020	Cascade	346	2020 eDNA	0	0	46.72864	-122.7371	Hanaford Creek			
8/28/2019	Cascade	291	2019	0	0	46.77502	-122.5664	Hospital Creek			
6/16/2021	Cascade	451	2021 eDNA	0	0	46.73993	-122.5274	Houser Creek			
9/22/2021	Cascade	487	2021 eDNA	0	0	46.78257	-122.6055	Laramie Creek			
9/14/2021	Cascade	492	2021 eDNA	0	0	46.60214	-122.8294	MF Newaukum R.			
9/10/2019	Cascade	294	2019	0	0	46.60211	-122.7586	MF Newaukum R.			
7/21/2021	Cascade	342	2021 Repeat	0	0	46.70868	-122.6287	NF Newaukum R.			
6/30/2020	Cascade	342	2020	0	0	46.70868	-122.6287	NF Newaukum R.			
8/20/2019	Cascade	259	2019	0	0	46.80166	-122.6152	Run Creek			
9/1/2020	Cascade	259	2020 R	1	0	46.80166	-122.6152	Run Creek		Y	
8/12/2021	Cascade	467	2021 eDNA	0	0	46.66806	-122.4815	SF Newaukum R.			
8/18/2021	Cascade	480	2021 eDNA	0	0	46.61257	-122.6298	SF Newaukum R.			
8/26/2021	Cascade	473	2021 eDNA	0	0	46.66351	-122.5584	SF Newaukum R.			
9/14/2021	Cascade	465	2021 eDNA	0	0	46.63433	-122.6043	SF Newaukum R.			
8/1/2019	Cascade	262	2019	1	0	46.57092	-122.7438	SF Newaukum R.	Y (2021)		Y

Survey Date	MEDR	Site	Site Type	Ma. fa.	An. or.	Latitude	Longitude	Stream name	Confirmed trad. sampling	Novel det.	Prev. doc.
8/13/2019	Cascade	317	2019	0	0	46.64398	-122.5863	SF Newaukum R.			
9/11/2019	Cascade	266	2019	1	0	46.57397	-122.696	SF Newaukum R.	Y (2021)		Y
7/1/2020	Cascade	340	2020 eDNA	1	0	46.57623	-122.7831	SF Newaukum R.	Y (2021)		Y
7/8/2020	Cascade	333	2020 eDNA	1	0	46.59436	-122.6507	SF Newaukum R.	N (2021)		Y
8/4/2020	Cascade	337	2020 eDNA	0	0	46.57283	-122.7119	SF Newaukum R.			
8/26/2020	Cascade	317	2020 R	0	0	46.64398	-122.5863	SF Newaukum R.			
7/7/2021	Cascade	435	2021 eDNA	0	0	46.71595	-122.4904	Skookumchuck R.			
8/4/2021	Cascade	351	2021 eDNA	1	0	46.78789	-122.7584	Skookumchuck R.			Y
8/4/2021	Cascade	399	2021 eDNA	0	0	46.69687	-122.4741	Skookumchuck R.			
8/17/2021	Cascade	458	2021 eDNA	1	0	46.72704	-122.9719	Skookumchuck R.			Y
8/26/2021	Cascade	495	2021 eDNA	0	0	46.76298	-122.5838	Skookumchuck R.			
7/7/2021	Cascade	475	2021 eDNA	0	0	46.71323	-122.4843	Skookumchuck R.			
8/12/2020	Cascade	332	2020	1	0	46.69523	-122.4493	Skookumchuck R.			Y
8/12/2020	Cascade	343	2020 eDNA	0	0	46.69919	-122.4579	Skookumchuck R.			
9/10/2020	Cascade	345	2020 eDNA	1	0	46.80296	-122.8614	Skookumchuck R.	Y (2022)		Y
9/22/2021	Cascade	359	2021 eDNA	0	0	46.7499	-122.541	Three Deer Creek			
9/18/2019	Cascade	295	2019	0	0	46.76635	-122.6024	Unnamed Tributary			
9/19/2020	Cascade	295	2020 R	0	0	46.76635	-122.6024	Unnamed Tributary			
6/16/2021	Cascade	411	2021 eDNA	0	0	46.77265	-122.5658	Unnamed Tributary			
7/26/2021	Cascade	483	2021 eDNA	0	0	46.67115	-122.6163	Unnamed Tributary			
7/26/2021	Cascade	511	2021 eDNA	0	0	46.6768	-122.58	Unnamed Tributary			
8/5/2021	Cascade	332	2021 Repeat	0	0	46.69523	-122.4493	Unnamed Tributary			
8/10/2021	Cascade	427	2021 eDNA	0	0	46.67382	-122.5404	Unnamed Tributary			
7/12/2021	Central	2021259	2021 eDNA	0	0	46.83152	-123.1333	Black R.			
8/13/2020	Central	232	2020 eDNA	0	0	46.83909	-123.14	Black R.			
7/28/2020	Central	171	2020 eDNA	0	0	46.81806	-123.3551	Bloomquist Creek			

Survey Date	MEDR	Site	Site Type	Ma. fa.	An. or.	Latitude	Longitude	Stream name	Confirmed trad. sampling	Novel det.	Prev. doc.
8/31/2020	Central	238	2020 eDNA	0	0	46.70524	-123.2062	Bunker Creek			
8/4/2020	Central	179	2020 eDNA	1	0	47.00742	-123.369	Cloquallum Creek	Y (2021)	Y	
7/30/2020	Central	175	2020	0	0	46.93042	-123.4299	Delezene Creek			
9/14/2021	Central	327	2021 eDNA	0	0	46.89826	-123.4531	Delezene Creek			
8/16/2021	Central	303	2021 eDNA	0	0	46.94304	-123.1274	Fall Creek			
8/27/2019	Central	160	2019	0	0	46.8049	-123.2842	Garrard Creek			
7/26/2021	Central	245	2021 eDNA	0	0	46.7802	-123.358	Garrard Creek			
9/24/2021	Central	246	2021 eDNA	0	0	46.90585	-123.2497	Gibson Creek			
9/16/2021	Central	252	2021 eDNA	0	0	46.9699	-123.228	Iron Creek			
7/12/2021	Central	328	2021 eDNA	0	0	47.00813	-123.3922	Mcdonald Creek			
8/21/2019	Central	134	2019	1	0	46.99125	-123.4668	Newman Creek	Y (2021)	Y	
8/7/2019	Central	133	2019	1	0	46.73593	-123.2319	NF Lincoln Creek	Y	Y	
8/18/2020	Central	133	2020 R	1	0	46.73593	-123.2319	NF Lincoln Creek		Y	
8/4/2020	Central	180	2020 eDNA	0	0	46.97711	-123.157	SF Porter Creek			
7/16/2019	Central	136	2019	1	0	46.89902	-123.1566	Sherman Creek	Y	Y	
7/15/2020	Central	136	2020 R	0	0	46.89902	-123.1566	Sherman Creek			
8/13/2020	Central	231	2020 eDNA	1	0	46.92957	-123.1403	Sherman Creek	N (2022)		Y
9/12/2019	Central	132	2019	0	0	46.9218	-123.2342	Thurston Creek	N		
9/29/2020	Central	132	2020 R	1	0	46.9218	-123.2342	Thurston Creek	N (2022)	Y	
8/23/2021	Central	132	2021 eDNA R	0	0	46.92181	-123.2342	Thurston Creek			
7/28/2020	Central	172	2020 eDNA	0	0	46.91257	-123.1764	Unnamed Tributary			
9/23/2019	Central	164	2019	0	0	46.95103	-123.1604	Unnamed Tributary			
6/17/2020	Central	182	2020 eDNA	0	0	47.01789	-123.155	Unnamed Tributary			
6/23/2020	Central	176	2020	0	0	46.94571	-123.1587	Unnamed Tributary			
8/31/2020	Central	239	2020 eDNA	0	0	47.00563	-123.1441	Unnamed tributary			
9/9/2020	Central	174	2020	0	0	46.71782	-123.308	Unnamed tributary			

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6/9/2021	Central	269	2021 eDNA	0	0	46.88997	-123.3975	Unnamed Tributary			
7/6/2021	Central	164	2021 eDNA R	0	0	46.95103	-123.1604	Unnamed Tributary			
7/6/2021	Central	2021266	2021 eDNA	0	0	46.94734	-123.1743	Unnamed Tributary			
7/14/2021	Central	176	2021 Repeat	0	0	46.94571	-123.1587	Unnamed Tributary			
7/26/2021	Central	2021295	2021 eDNA	0	0	46.75441	-123.3334	Unnamed Tributary			
7/28/2021	Central	175	2021 Repeat	0	0	46.93042	-123.4299	Unnamed Tributary			
8/19/2021	Central	174	2021 Repeat	0	0	46.71782	-123.308	Unnamed Tributary			
8/24/2021	Central	189	2021 eDNA	0	0	46.75696	-123.3	Unnamed Tributary			
8/24/2021	Central	323	2021 eDNA	1	0	46.7945	-123.1821	Unnamed Tributary		Y	
8/30/2021	Central	265	2021 eDNA	0	0	46.74118	-123.3362	Unnamed Tributary			
9/14/2021	Central	281	2021 eDNA	0	0	46.94417	-123.4197	Unnamed Tributary			
9/16/2021	Central	285	2021 eDNA	0	0	46.87443	-123.2179	Unnamed Tributary			
9/28/2021	Central	241	2021 eDNA	0	0	47.04887	-123.1866	Unnamed Tributary			
8/22/2019	Central	159	2019	1	0	46.93496	-123.0766	Waddell Creek	Y		Y
9/8/2020	Central	159	2020 R	1	0	46.93496	-123.0766	Waddell Creek			Y
6/9/2021	Central	312	2021 eDNA	1	0	46.923	-123.0638	Waddell Creek			Y
9/24/2021	Central	263	2021 eDNA	0	0	47.00158	-123.0799	Waddell Creek			
6/17/2020	Central	183	2020 eDNA	0	0	47.00641	-123.2179	WF porter Creek			
8/16/2021	Central	329	2021 eDNA	0	0	46.97756	-123.2677	WF Porter Creek			
9/1/2021	Central	251	2021 eDNA	0	0	47.03211	-123.1744	WF Porter Creek			
7/17/2019	Central	137	2019	1	0	47.04906	-123.3188	WF Wildcat	Y (2021)		Y
7/2/2019	Olympic	6	2019	0	0	47.31605	-123.4358	Baker Creek			
7/11/2019	Olympic	34	2019	0	0	47.2616	-123.3721	Bingham Creek			
8/6/2020	Olympic	10	2020 eDNA	0	0	47.30941	-123.3452	Bingham Creek			
8/9/2021	Olympic	139	2021 eDNA	0	0	47.38707	-123.4808	Canyon R.			
8/17/2020	Olympic	62	2020 eDNA	0	0	47.27816	-123.5241	Canyon R.			

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8/17/2021	Olympic	107	2021 eDNA	0	0	47.50052	-123.5638	Chikamin Creek			
7/28/2020	Olympic	13	2020 eDNA	1	0	47.11615	-123.4754	Decker Creek	Y (2021)	Y	
9/30/2020	Olympic	61	2020 eDNA	1	0	47.10254	-123.4824	Decker Creek	N/Y (2021)	Y	
9/28/2020	Olympic	20207	2020 R	1	0	47.2513	-123.4242	Dry Creek	Y (2021)	Y	
9/29/2021	Olympic	20207	2021 Repeat	1	0	47.25132	-123.4242	Dry Creek	Y	Y	
8/25/2021	Olympic	169	2021 eDNA	0	0	47.29888	-123.5459	Little R.			
8/6/2019	Olympic	30	2019	0	0	47.30712	-123.5417	Little R.			
8/5/2020	Olympic	30	2020 R	0	0	47.30712	-123.5417	Little R.			
7/22/2020	Olympic	20206	2020 eDNA	0	0	47.1166	-123.5109	MF Satsop R.			
9/7/2021	Olympic	144	2021 eDNA	0	0	47.31232	-123.4537	MF Satsop R.			
7/19/2021	Olympic	81	2021 eDNA	1	0	47.03133	-123.5228	Satsop R.			Y
7/22/2021	Olympic	131	2021 eDNA	0	0	47.41065	-123.6037	Scatter Creek			
7/9/2019	Olympic	7	2019	0	0	47.23375	-123.6131	Schafer Creek	N		
6/25/2020	Olympic	7	2020	1	0	47.23375	-123.6131	Schafer Creek	N (2022)	Y	
7/15/2019	Olympic	4	2019	0	0	47.36506	-123.5398	Spoon Creek			
7/7/2020	Olympic	4	2020 R	0	0	47.36506	-123.5398	Spoon Creek			
9/16/2021	Olympic	156	2021 eDNA	0	0	47.35487	-123.5604	Spoon Creek			
7/24/2019	Olympic	5	2019	1	0	47.13095	-123.5855	Unnamed Tributary			Y
9/17/2019	Olympic	2	2019	0	0	47.08067	-123.4611	Unnamed Tributary			
7/21/2020	Olympic	20205	2020	0	0	47.3754	-123.5122	Unnamed Tributary			
7/28/2020	Olympic	20202	2020 eDNA	0	0	47.08163	-123.4498	Unnamed Tributary			
7/1/2021	Olympic	20205	2021 Repeat	0	0	47.3754	-123.5122	Unnamed Tributary			
8/17/2021	Olympic	105	2021 eDNA	0	0	47.29298	-123.6723	Unnamed Tributary			
9/16/2021	Olympic	2021160	2021 eDNA	0	0	47.42152	-123.6462	Unnamed Tributary			
6/24/2021	Olympic	155	2021 eDNA	0	0	47.46942	-123.5874	W Branch Wynoochee			
6/10/2021	Olympic	76	2021 eDNA	0	0	47.34802	-123.5662	WF Satsop R.			

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7/20/2021	Olympic	25	2021 eDNA	0	0	47.15172	-123.5735	WF Satsop R.			
8/31/2021	Olympic	125	2021 eDNA	0	0	47.24062	-123.559	WF Satsop R.			
9/7/2021	Olympic	111	2021 eDNA	0	0	47.17789	-123.5647	WF Satsop R.			
9/13/2021	Olympic	20203	2021 Repeat	0	0	47.32113	-123.5629	WF Satsop R.			
9/18/2020	Olympic	20203	2020	1	0	47.32113	-123.5629	WF Satsop R.	N (2021)		Y
9/4/2019	Olympic	3	2019	0	0	47.28259	-123.5629	WF Satsop R.			
9/22/2020	Olympic	3	2020 R	0	0	47.28259	-123.5629	WF Satsop R.			
7/7/2023	Olympic		2023 eDNA	1	0	47.12342	-123.7745	Wishkah R.	Shell on bank		
7/7/2023	Olympic		2023 eDNA	0	0	47.18354	-123.7233	Wishkah R.			
7/8/2020	Olympic	20204	2020 eDNA	0	0	47.35595	-123.6377	Wynoochee R.			
6/24/2021	Olympic	151	2021 eDNA	0	0	47.37808	-123.6182	Wynoochee R.			
7/22/2021	Olympic	2021137	2021 eDNA	0	0	47.36881	-123.6336	Wynoochee R.			
8/3/2021	Olympic	63	2021 eDNA	0	0	47.29251	-123.6527	Wynoochee R.			
8/9/2021	Olympic	127	2021 eDNA	0	0	47.45811	-123.5321	Wynoochee R.			
8/31/2021	Olympic	70	2021 eDNA	1	0	47.01099	-123.6582	Wynoochee R.			Y
9/23/2021	Olympic	90	2021 eDNA	1	0	47.16465	-123.641	Wynoochee R.			Y
9/23/2021	Olympic	98	2021 eDNA	0	0	47.13452	-123.645	Wynoochee R.			
7/8/2020	Olympic	1	2020 eDNA	0	0	47.47961	-123.5257	Wynoochee R.			
9/3/2020	Olympic	8	2020 eDNA	0	0	47.10259	-123.6756	Wynoochee R.			
9/3/2020	Olympic	12	2020 eDNA	1	0	47.05778	-123.7	Wynoochee R.	Y (2021)	Y	
7/23/2020	Willapa	526	2020 eDNA	1	0	46.63131	-123.2501	Chehalis R.	Y (2021)		Y
8/3/2020	Willapa	574	2020 eDNA	0	0	46.62314	-123.2789	Chehalis R.			
6/30/2021	Willapa	527	2021 eDNA	0	0	46.47941	-123.2988	Chehalis R.			
7/6/2021	Willapa	662	2021 eDNA	1	0	46.63628	-123.2609	Chehalis R.			Y
7/13/2021	Willapa	679	2021 eDNA	0	0	46.52355	-123.2903	Chehalis R.			
7/27/2021	Willapa	675	2021 eDNA	1	0	46.64151	-123.2691	Chehalis R.			Y

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8/2/2021	Willapa	630	2021 eDNA	0	0	46.48282	-123.2922	Chehalis R.			
9/21/2021	Willapa	626	2021 eDNA	0	0	46.60493	-123.2843	Chehalis R.			
9/5/2019	Willapa	390	2019	0	0	46.60115	-123.2774	Chehalis R.			
7/31/2020	Willapa	522	2020 eDNA	0	0	46.60996	-123.2862	Chehalis R.			
8/14/2019	Willapa	418	2019	0	0	46.52944	-123.2991	Crim Creek			
8/29/2019	Willapa	420	2019	0	0	46.49448	-123.3999	Crim Creek			
8/27/2020	Willapa	418	2020 R	1	0	46.52944	-123.2991	Crim Creek		Y	
9/21/2020	Willapa	420	2020 R	0	0	46.49448	-123.3999	Crim Creek			
7/15/2021	Willapa	602	2021 eDNA	0	0	46.53855	-123.3036	Crim Creek			
7/6/2021	Willapa	587	2021 eDNA	0	0	46.43973	-123.2765	EF Chehalis R.			
7/15/2021	Willapa	620	2021 eDNA	0	0	46.42396	-123.2622	EF Chehalis R.			
9/27/2021	Willapa	589	2021 eDNA	0	0	46.44934	-123.2889	EF Chehalis R.			
7/14/2020	Willapa	513	2020	0	0	46.62223	-123.4016	Eight Creek			
7/8/2021	Willapa	513	2021 Repeat	0	0	46.62223	-123.4016	Eight Creek			
9/3/2019	Willapa	417	2019	0	0	46.63589	-123.3726	Elk Creek			
7/13/2021	Willapa	654	2021 eDNA	0	0	46.4873	-123.1322	Foster Creek			
8/25/2020	Willapa	520	2020	1	0	46.40799	-123.1949	Hanlan Creek		Y	
8/11/2021	Willapa	520	2021 Repeat	0	0	46.40799	-123.1949	Hanlan Creek			
9/19/2019	Willapa	422	2019	0	0	46.5863	-123.2379	Kowalski Creek			
7/29/2020	Willapa	422	2020 R	0	0	46.5863	-123.2379	Kowalski Creek			
10/2/2020	Willapa	523	2020 eDNA	0	0	46.48479	-123.2596	Little Roger Creek			
10/1/2020	Willapa	578	2020 eDNA	0	0	46.55396	-123.3611	Rock Creek			
9/2/2021	Willapa	666	2021 eDNA	0	0	46.54465	-123.3977	Salmon Creek			
7/25/2019	Willapa	392	2019	0	0	46.61821	-123.3736	Seven Creek			
8/3/2020	Willapa	572	2020 eDNA	0	0	46.61818	-123.3796	Seven Creek			
7/16/2020	Willapa	525	2020 eDNA	1	1	46.55635	-123.1401	SF Chehalis R.	Y (2021)		Y

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8/6/2020	Willapa	518	2020 eDNA	1	0	46.48116	-123.0999	SF Chehalis R.	Y (2021)		Y
8/10/2020	Willapa	394	2020 eDNA	1	0	46.78858	-122.7373	Skookumchuck R.	Y (2021)		Y
7/13/2020	Willapa	395	2020 eDNA	0	0	46.71191	-122.5405	Twelve Creek			
7/30/2019	Willapa	388	2019	0	0	46.55249	-123.4079	Unnamed Tributary			
7/8/2020	Willapa	397	2020 eDNA	0	0	46.65745	-122.5185	Unnamed Tributary			
7/22/2020	Willapa	517	2020 eDNA	0	0	46.52753	-123.3814	Unnamed Tributary			
8/4/2020	Willapa	2020392	2020 eDNA	0	0	46.63207	-122.6236	Unnamed Tributary			
8/2/2021	Willapa	628	2021 eDNA	0	0	46.42968	-123.3507	Unnamed Tributary			
8/4/2021	Willapa	617	2021 eDNA	0	0	46.65139	-123.3644	Unnamed Tributary			
8/4/2021	Willapa	660	2021 eDNA	0	0	46.47162	-123.3123	Unnamed Tributary			
9/2/2021	Willapa	687	2021 eDNA	0	0	46.61785	-123.4001	Unnamed Tributary			
9/8/2021	Willapa	516	2021 Repeat	0	0	46.41298	-123.3293	Unnamed Tributary			
9/9/2021	Willapa	684	2021 eDNA	0	0	46.40004	-123.1365	Unnamed Tributary			
9/15/2021	Willapa	636	2021 eDNA	0	0	46.43485	-123.1795	Unnamed Tributary			
9/21/2021	Willapa	621	2021 eDNA	0	0	46.61875	-123.4141	Unnamed Tributary			
6/30/2021	Willapa	623	2021 eDNA	0	0	46.39874	-123.3149	WF Chehalis R.			
9/27/2021	Willapa	532	2021 eDNA	0	0	46.44805	-123.3295	WF Chehalis R.			
9/24/2020	Willapa	516	2020	0	0	46.41298	-123.3293	WF Chehalis R.			
8/8/2019	Willapa	419	2019	0	0	46.4471	-123.3319	WF Chehalis R.			
8/11/2020	Willapa	419	2020 R	0	0	46.4471	-123.3319	WF Chehalis R.			