Pacific Lamprey

2018 Regional Implementation Plan

for the

Oregon Coast

Regional Management Unit

North Coast Sub-Region

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I. Status and Distribution of Pacific lamprey in the RMU

A. General Description of the RMU

North Oregon Coast Sub-Region

The Oregon Coast Regional Management Unit is separated into two sub-regions equivalent to the USGS hydrologic unit accounting units 171002 (Northern Oregon Coastal) and 171003 (Southern Oregon Coastal). The North Oregon Coast sub-region includes all rivers that drain into the Pacific Ocean from the Columbia River Basin boundary in the north to the Umpqua River boundary in the south. It is comprised of seven 4th field HUCs ranging in size from 338 to 2,498 km^2. Watersheds within the sub-region include the Necanicum, Nehalem, Wilson-Trask-Nestucca, Siletz-Yaquina, Alsea, Siuslaw and Siltcoos Rivers (Figure 1; Table 1).

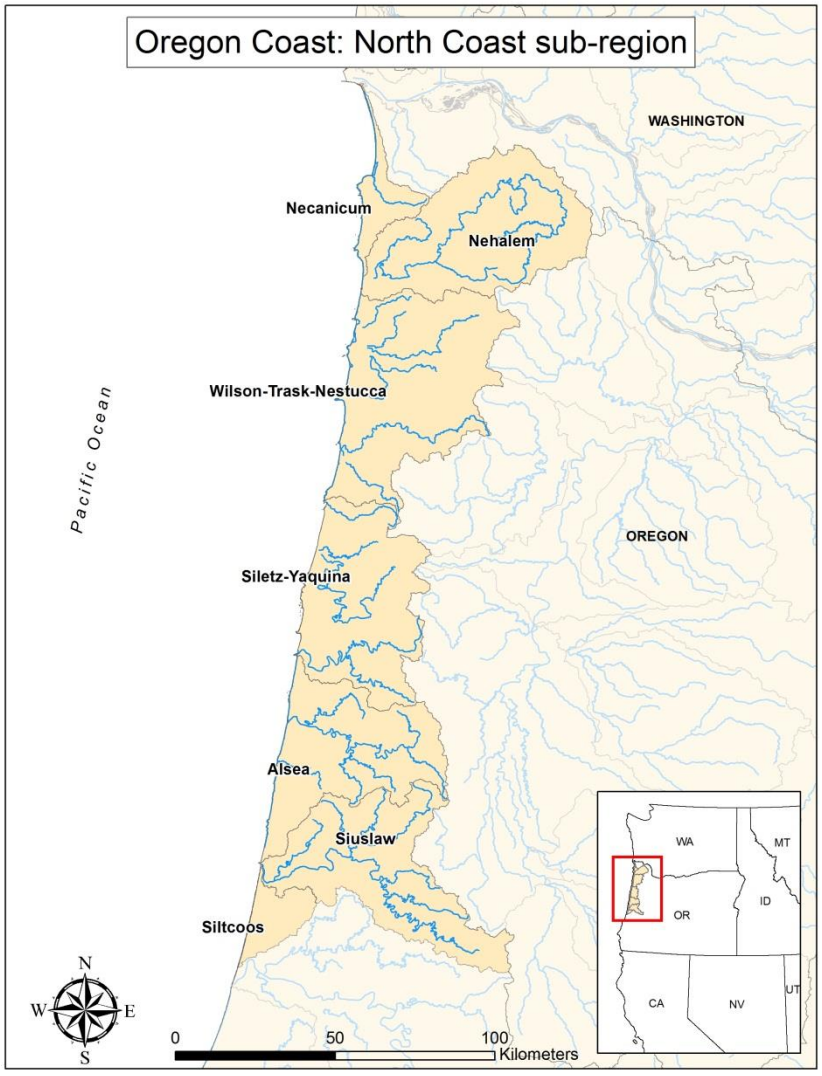


Figure 1. Map of watersheds within the Oregon Coast RMU, North Coast sub-region.

Table 1. Drainage Size and Level III Ecoregions of the 4th Field Hydrologic Unit Code (HUC) Watersheds located within the North Oregon Coast sub-region.

Watershed	HUC Number	Drainage Size (km^2)	Level III Ecoregion(s)
Necanicum	17100201	355	Coast Range
Nehalem	17100202	2,212	Coast Range
Wilson-Trask-Nestucca	17100203	2,498	Coast Range
Siletz-Yaquina	17100204	1,964	Coast Range
Alsea	17100205	1,786	Coast Range
Siuslaw	17100206	2,006	Coast Range, Willamette Valley
Siltcoos	17100207	338	Coast Range

B. Status of Species

Conservation Assessment and New Updates

Increased attention on Pacific lamprey has improved our understanding of this species in the North Coast sub-region. Monitoring efforts, in which lamprey are either the target species or information is collected during other species' monitoring, have expanded the amount of information available and the quality of this information in most watersheds.

Current Pacific Lamprey distribution in the North Coast sub-region is greatly reduced from historical range (Table 2; Figure 2). The 2017 Assessment ranking of current distribution was reduced from 2011 rankings in all HUCs except the Necanicum. The decline in these areas is a result of more accurately calculating the numeric area of occupancy (versus using a visual estimate), rather than a decline in Pacific Lamprey range (cite 2017 Assessment when complete).

Population abundance was estimated within all HUCs using information provided by Oregon Department of Fish and Wildlife (ODFW). ODFW estimated a range of Pacific Lamprey population abundance using extrapolations of published information on the number of Pacific Lamprey per redd, average peak redd counts per mile, multiplied by the number of miles surveyed for Pacific Lamprey (Table 3; Table 4). As part of the monitoring for winter steelhead spawning populations, the Oregon Adult Salmonid Inventory and Sampling (OASIS) field crews have recorded counts of lamprey spawners and redds since 2009. These estimates are considered conservative abundance indices, as the surveys are focused on steelhead, and end before the completion of Pacific lamprey spawning (Jacobsen et al. 2014; Jacobsen et al. 2015; Brown et al. 2017, ODFW 2017).

There was consensus that lamprey populations have declined significantly from historical numbers approximately 50-60 years ago (i.e. Downey 1993). However, short-term population trend which is defined as the degree of change in population size over 3 lamprey generations, was not ranked (determined "unknown") because there is insufficient data available over the past 27 years. Abundance indices have generally increased over the 3 to 5 years (Table 3), but without a longer term data set it is unknown whether this apparent increase is simply an upswing in a larger cyclical trend.

Based on the ODFW data, and noting this information is limited, the Wilson-Trask-Nestucca, Siuslaw and Nehalem HUCs appear to support greater numbers of lamprey than the other HUCs in the North Coast (ODFW 2017).

Table 2. Population demographic and conservation status ranks (see Appendix 1) of the 4th Field HUC watersheds located within the North Oregon Coast sub-region. Note – coho salmon distribution was used as a surrogate estimate of historical lamprey range extent in areas where historical occupancy information was not available. Ranks highlighted in Yellow indicate a change from the 2011 Assessment.

Watershed	HUC Number	Conservation Status Rank	Historical Occupancy (km^2)	Current Occupancy (km^2)	Population Size (adults)	Short-Term Trend (% decline)
Necanicum	17100201	S2↑	250-1000	20-100	250-1000	Unknown
Nehalem	17100202	S2	1000-5000	100-500	1000-2500	Unknown
Wilson-Trask-Nestucca	17100203	S2	1000-5000	100-500	1000-2500	Unknown
Siletz-Yaquina	17100204	S2	1000-5000	100-500	1000-2500	Unknown
Alsea	17100205	S2	1000-5000	100-500	1000-2500	Unknown
Siuslaw	17100206	S2	1000-5000	100-500	2500-10,000	Unknown
Siltcoos	17100207	S1↓	250-1000	20-100	50-250	Unknown

Table 3. Minimum, mean, and maximum abundance indices for adult Pacific Lamprey in the North Coast RMU (ODFW 2017). Estimates are considered conservative.

Year	**MIN**	**MEAN**	**MAX**
2009	1,113	4,271	7,831
2010	289	1,109	2,032
2011	736	2,828	5,184
2012	758	2,911	5,337
2013	2,335	8,968	16,441
2014	1,162	4,459	8,175
2015	2,456	9,429	17,287
2016	2,500	9,597	17,594
2009-2016 MEAN	**1,419**	**5,447**	**9,985**

Table 3. Mean abundance indices for adult Pacific lamprey by HUC from 2009 to 2016 in the North Coast RMU (ODFW 2017). Estimates are considered conservative.

HUC	Mean
Necanicum	177
Nehalem	923
Wilson-Trask-Nestucca	1,178
Siletz-Yaquina	885
Alsea	487
Siuslaw	1,157
Siltcoos	18

Figure 2. Current and historical known distribution for Pacific Lamprey: Oregon Coast Regional Management Unit, North Coast sub-region (USFWS Data Clearinghouse 2017). Historical Pacific Lamprey distribution depicted in map was obtained from published literature, tribal accounts and state and federal agency records.

Distribution and Connectivity

In the majority of watersheds that were assessed, the scope and severity of threats from passage are low. Culverts and tidegates in low-lying areas are widespread and may impact or impede lamprey passage to an unknown extent. An extensive effort is currently underway in portions of the North Coast sub-region to identify and prioritize barrier structures for repair (retrofit), replacement, or removal; however, the focus of these efforts is juvenile salmonids.

Several major passage issues have been addressed in the past several years:

- City of Seaside's Diversion Dam was removed and intake screens upgraded on the South Fork Necanicum.
- ODOT breached several dikes in the lower mainstem Necanicum near RM5.
- Several tide gates in the lower North Fork of the Nehalem were replaced.
- Multiple culverts have been replaced or removed in the Wilson-Trask-Nestuccca HUC over the past several years as part of the Salmon Super Highway Project (SSH). SSH project partners plan to continue efforts to replace barrier culverts in these basins in coming years.
- A substantial barrier dam on the East Fork South Fork Trask River was removed during summer 2016 and another dam removal at Skookum Lake (Tillamook River Basin) was completed during summer 2017.
- Several removals are planned for the Necanicum and Nehalem HUCs in 2017 and beyond.
- Upgrades at hatchery barriers and the Lord Creek Culvert in the Alsea watershed.
- Upgrade to Cedar Creek Hatchery barrier on Three Rivers in the Nestucca Basin.

The Siltcoos and Tahkenitch dams are not believed to be a complete barrier but there is interest in evaluating lamprey passage success at these structures. Culvert passage is thought to be the main concern in the Nehalem watershed, and low water levels in the Alsea and Nestucca may be seasonal barriers in some areas with water diversions. Private and municipal water diversions are present throughout the North Coast sub-region. Aging or obsolete diversions with inadequate screening may impinge or entrain juvenile lamprey.

C. Threats

Summary of Major Treats

The following table summarizes the key threats within the North Coast sub-region as identified by RMU participants during the Risk Assessment revision meeting in April 2017. Stream and floodplain degradation, water quality, and lack of awareness were all considered a moderate threat in the North Coast sub-region.

Table 3. Summary of the assessment results for the key threats of the North Oregon Coast sub-region.

	Stream and Floodplain Degradation		Water Quality		Lack of Awareness	
Watershed	Scope	Severity	Scope	Severity	Scope	Severity
North Oregon Coast						
Necanicum	3	3	2	2	4	2
Nehalem	3	3	3	3	4	2
Wilson-Trask-Nestucca	3	3	2	2	4	2
Siletz-Yaquina	3	3	3	3	4	2
Alsea	3	3	3	2	4	2
Siuslaw	3	3	3	3	4	2
Siltcoos	4	3	3	2.5	4	2
Mean	3.14	3.00	2.71	2.50	4.00	2.00
Rank	**M**	**M**	**M**	**M**	**H**	**M**
Mean Scope & Severity	3.07		2.61		3.00	
Drainage Rank	**M**		**M**		**M**	

Current Threats

The highest ranked threats in the sub-region are described below. Stream and Floodplain degradation and Water Quality were ranked slightly higher than in 2011; lack of awareness was determined to be a greater concern than 2011. Although not a key threat in 2017 (Mean Scope & Severity = 2.43), dewatering and Flow Management was also ranked higher than in 2011.

Stream and Floodplain Degradation

Stream and floodplain degradation was ranked moderate in scope and severity throughout all watersheds of the North Coast sub-region. Within lowlands, wetlands and side channels have been channelized, diked, diverted or drained to prevent flooding, create farmland or pastures, and provide land for commercial and residential development. In upland areas, historical and ongoing timber practices, agriculture, and urbanization have deforested or altered the function and diversity of riparian vegetation. Many watersheds in the RMU are lacking mature conifers that play a pivotal role in bank stability, water quality protection, thermal cover, and the provision of large woody debris.

Water Quality

Elevated water temperature is the primary water quality concern in the North Coast sub-region. Excessive temperatures generally occur during summer months and may be attributed to increased air temperature, lack of riparian cover, or reduced instream flows associated with water withdrawals for irrigation, municipal or residential use. The impacts of relatively warm water temperatures (e.g., ≥20°C) on Pacific Lamprey embryonic development, physiology, adult migrations, reproductive capability and evolutionary pressures can be multitudinous and substantial (Clemens et al. 2016). Other water quality concerns in tributaries include low dissolved oxygen and presence of bacteria (e.g., fecal coliform, e coli), that may be associated with elevated water temperatures and agricultural or urban runoff. Monitoring and restoration efforts to improve and protect water quality for fish, wildlife, and human health are ongoing in the North Coast sub-region.

Lack of Awareness

Instream water work, whether for restoration activities or maintenance of diversions, can dewater areas or remove sediments in which juvenile lamprey are burrowed. Such actions without first salvaging lamprey may result in the death of hundreds of juveniles. Increasing public and agency awareness about the presence of juvenile lamprey in the sediments, adult lamprey spawning habitats and timing during inwater work, as well as the effect of water diversions, and education on actions to minimize these impacts, could greatly decrease localized mortality and injury to lamprey populations.

Dewatering and Flow Management

Stream flow conditions have generally improved in the Necanicum since the completion of the 2011 Assessment, however, the scope and/or severity of this threat has increased in the Alsea, Siuslaw, and Siltcoos basins. Water withdrawals for irrigation, municipal, or residential uses leave many watersheds in the North Coast sub-region dewatered or with inadequate flow during summer and fall months. Low flow levels can reduce habitat availability, prevent lamprey access to backwater or side channel habitats, and may contribute to mortality if incubating eggs or burrowing larvae are dewatered or exposed to a high temperature or low oxygen environment. The projected rise in human population and anticipated effects of climate change (i.e., elevated ambient temperatures, decreased surface water availability, altered flow regimes), may increase the frequency, duration and intensity of low flow conditions in the future.

Restoration Actions

Multiple projects are currently underway to restore floodplain connectivity, relocate or reconnect side channel habitat, enhance damaged riparian areas, and remove, replace or improve barriers to fish passage (e.g. culverts, tidegates, and diversion dams). Assessments that identify and prioritize future restoration work and passage problems are also ongoing in these areas. Although the majority of research and restoration projects are developed and implemented with adult and juvenile salmonids in mind, a growing number of projects are incorporating benefits for Pacific lamprey and some passage projects are targeting lamprey specifically. The following conservation actions were initiated or recently completed by RMU partners in the North Coast sub-region from 2012-2017.

HUC	Threat	Action Description	Type	Status
RMU	Stream Degradation	Implementation of instream and floodplain habitat restoration activities (e.g. large wood placement, side channel and floodplain reconnection, channel reconstruction, bank stabilization, etc.).	Instream	Ongoing
RMU	Population	Distribution surveys of mainstem and principal tributaries	Survey	Ongoing
RMU	Lack of Awareness	Consideration of lamprey when planning and implementing instream habitat restoration work	Coordination	Ongoing
RMU	Passage	Map, assess and prioritize passage barriers in tributaries and evaluate available lamprey habitat upstream	Assessment	Proposed
RMU	Population	Conduct spawning ground surveys in mainstem and principal tributaries to monitor Pacific Lamprey distribution, timing, and number of redds to develop relative abundance indexes.	Survey	Ongoing
Necanicum	Passage	South Fork Necanicum diversion dam removed and intake screens updated/improved.	Instream	Complete
Necanicum	Stream Degradation	Culvert removal or replacement projects to restore access to spawning and rearing habitat.	Instream	Ongoing
Nehalem & Siuslaw	Stream Degradation	Coho Strategic Action Plan – identifies high priority conservation areas for restoration and monitoring. Will likely benefit other native aquatic species.	Instream	Underway
Nehalem	Passage	Several tide gate replacement projects on lower North Fork	Instream	Ongoing
Wilson – Trask – Nestucca	Stream Degradation	Numerous culvert removal or replacement projects as part of Salmon SuperHwy Project.	Instream	Ongoing
Wilson – Trask – Nestucca	Passage	Removal of the East Fork South Fork Trask River Hatchery Dam.	Instream	Complete
Wilson – Trask – Nestucca	Passage	Skookum Reservoir Dam removal, Tillamook River Drainage	Instream	Underway
Siletz	Passage	Evaluation of passage constraints for lamprey at Siletz Gorge Falls fish	Instream	Proposed

		ladder/trap		
Alsea	Passage	Installation of Lamprey Passage Ramp at water diversion structure upstream from Alsea River Hatchery on North Fork Alsea River.	Instream	Underway
Alsea	Passage	Monitoring relative abundance of larval Pacific Lamprey upstream of water diversion structure pre and post lamprey ramp installation	Assessment	Underway
Siltcoos	Passage	Evaluation of passage constraints for lamprey at Siltcoos and Tahkenitch Dam fish ladders.	Assessment	Proposed
Siltcoos	Stream Degradation	Implementation of instream and floodplain habitat restoration activities (Fivemile-Bell, Grant Cr., Fiddle Cr.)	Instream	Ongoing

II. Selection of Priority Actions

A. Prioritization Process

Participating members of the North Coast sub-region had a conference call on May 23rd, 2018 to discuss completed and ongoing conservation actions and identify specific projects and research needed to address threats and uncertainties within the region. The following projects were submitted by RMU members for the North Coast sub-region in 2018:

- Understanding Pacific Lamprey Distribution and Habitat Use in Smaller Streams with No Passage Barriers
- Tweedle Creek Habitat Restoration

B. High Priority Proposed Project Information

Project Title: Understanding Pacific Lamprey distribution and habitat use in smaller streams with no passage barriers

Project Applicant/Organization: *Oregon Department of Fish and Wildlife*
Contact: *Steve Starcevich and Ben Clemens*
Email: *steve.starcevich@oregonstate.edu, Ben.Clemens@oregonstate.edu*
Phone: *541-231-1806*

Project Location: Oregon coastal watersheds
NPCC Subbasin (4th HUC Field) name: *Nehalem (17100202), Wilson-Trask-Nestucca (17100203), Coos (17100304), Coquille (17100305)*
Lamprey RMU population: *North and South Oregon Coast*
HUC4 Risk Level: *S2*

Requested funds: $50,000 per RMU

***Total Project cost*:** $81,500 per RMU

Short Project Description:

In coastal Oregon basins, there are thousands of potential fish passage barriers (Figure 1). These typically are culverts at road crossings, which disproportionately affect small streams (Figure 2). Pacific Lamprey distribution is typically associated with low elevations and large stream size (Pirtle et al. 2002, Gunckel et al. 2009); however, this species is also distributed in smaller stream channels (Torgersen and Close 2004, Dunham et al. 2013, Starcevich and Clements 2013). Given barrier numbers and uncertainty about their effect on Pacific Lamprey in these watersheds, understanding the importance of these channels to this species is a critical research need (Mesa and Copeland 2009).

The main goal is to bolster the information databases on distribution and habitat use of Pacific Lamprey. **The second goal is to create an occupancy model for Pacific Lamprey in streams with no barriers. The third goal is use this model to identify and prioritize barriers for removal based on their potential impact on Pacific Lamprey.** Occupancy electrofishing surveys will occur in selected coastal watersheds in streams with no passage barriers. Reach and site characteristics will be used to model occupancy and detection. This model will be used to refine sampling frames for monitoring, evaluate potential barrier effects, and prioritize barrier removal.

***Descriptive Photographs-illustrations-Maps*:**

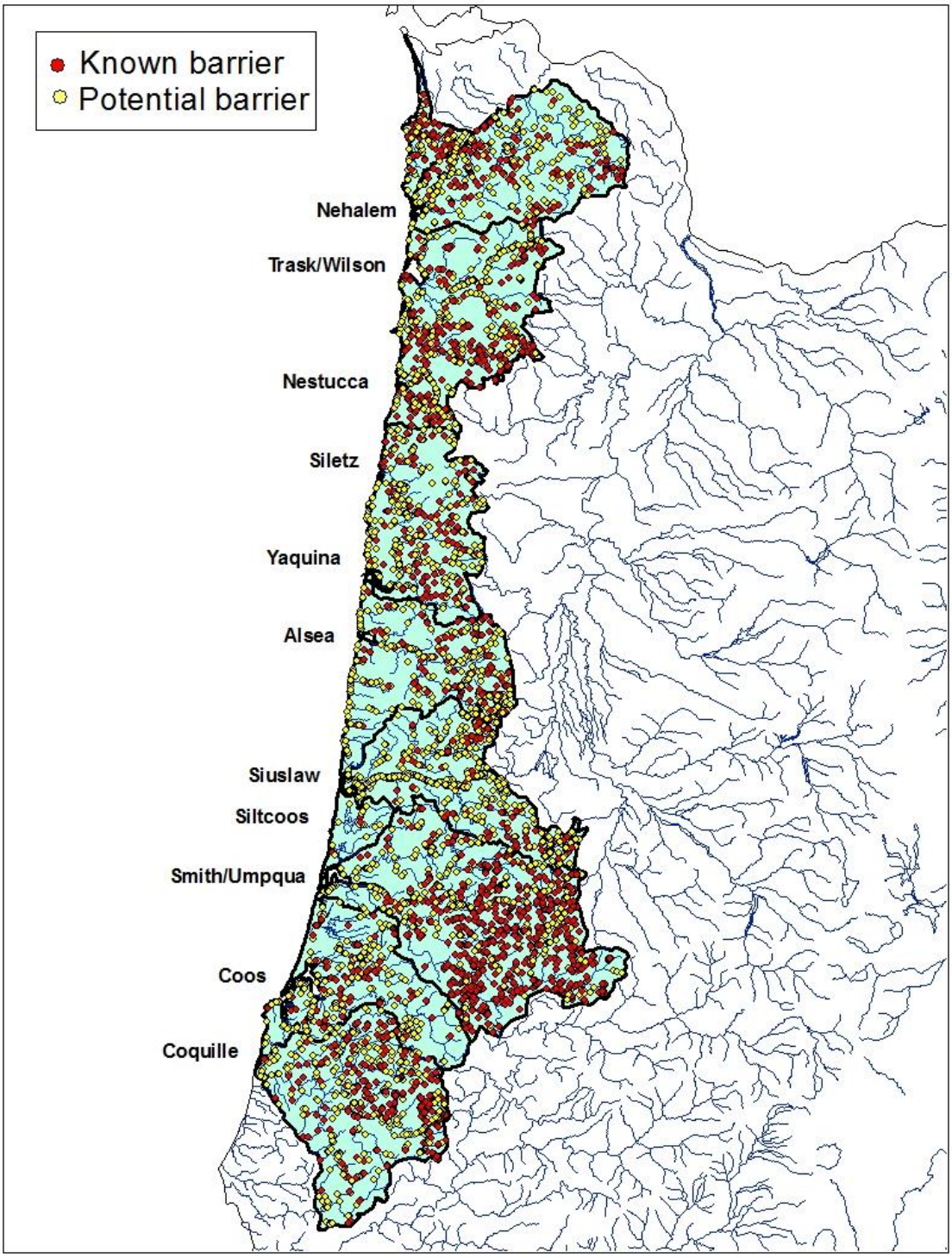


Figure 1. Map of 4,177 known and potential fish passage barriers in Oregon coastal basins. Point data are from the Oregon Fish Passage Barrier Data Standard dataset, ODFW. (Oregon Fish Passage Barrier Data Standard dataset; figure from Starcevich and Clements 2013)

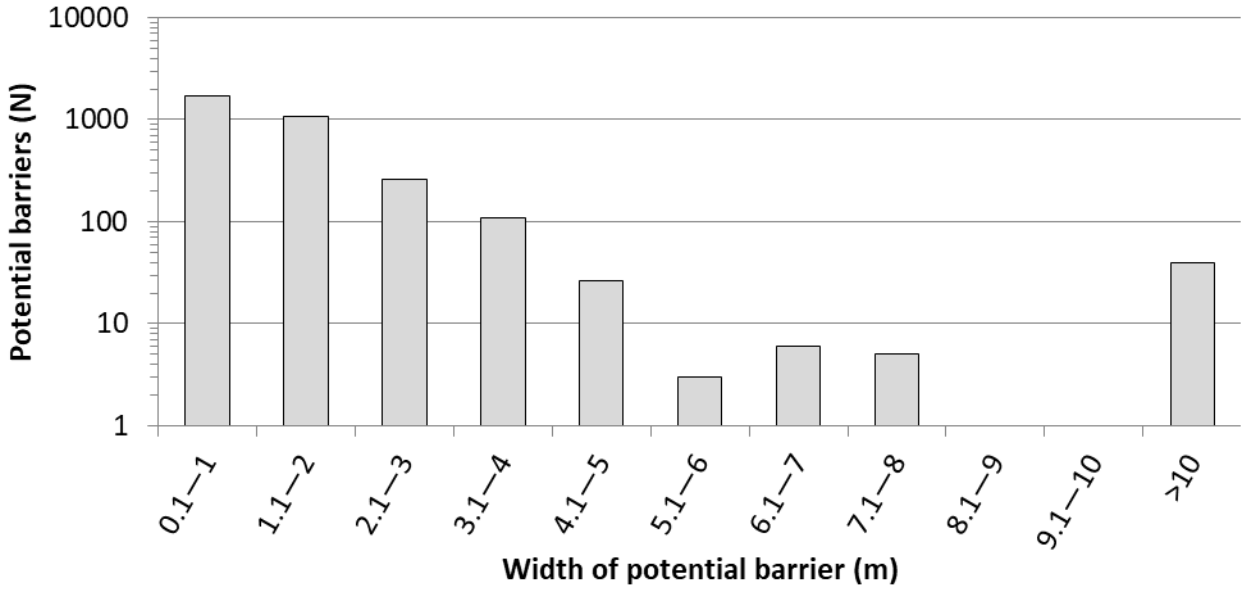


Figure 2. Frequency distribution of barrier width in the coastal Oregon watersheds; 96% of which are culverts (Oregon Fish Passage Barrier Data Standard dataset; figure from Starcevich and Clements 2013). One study in the Siuslaw National Forest provides data that suggest bankfull width of streams with older ("non-replaced") culverts are on average twice as wide as the potential barrier width (Chelgren and Dunham 2015)

1.0 Detailed Project Description

Study Areas

The Nehalem and Wilson-Trask-Nestucca watersheds in the North Coast Regional Management Unit (RMU), and the Coos and Coquille watersheds in the South Coast RMU are the proposed study areas for three reasons. First, the Oregon Coast Regional Implementation Plan (RIP) identifies the threat of culvert barriers to Pacific Lamprey as a main concern in all these basins, except for the Wilson-Trask-Nestucca. Second, the RIP reports relatively high adult Pacific Lamprey abundance in each basin, which suggests there will be relatively high larval seeding of available habitat. Third, these watersheds are adjacent in their respective RMUs and would be logistically easier for a crew to survey.

Sampling Frame

The sampling frame of streams in Oregon coastal watersheds for this project will be based on the one used by ODFW's Oregon Adult Salmonid Inventory and Sampling (OASIS) monitoring program for estimating salmon and Pacific lamprey status. A subset of candidate streams within the study areas will be identified by the main study criterion: no natural or artificial barriers to lamprey movement.

Survey Design

Each sample stream will be divided into 500 m reaches. Basin area for the downstream boundary of each reach will be estimated using GIS and linked to stream width and discharge through

hydrological equations and field reconnaissance. Stratified random sampling will be used to select sample reaches at the following stream width stratifications: 10-6 m, <6-3 m, and <3 m. In order to estimate occupancy and detection probability, a subsample of reaches will be surveyed using a spatial revisit occupancy design: Electrofishing surveys of all Type I and Type II rearing habitat will be taken from three different pools in this sample reach. Sampling will occur from July through September.

Field Protocol

The field crew will locate the downstream end of a sampling reach using a GPS, move upstream to the nearest pool channel unit and conduct the electrofishing survey. Pools are characterized by relatively high availability of Type I rearing habitat and relatively high densities of rearing larvae (Starcevich and Clemens 2013, Reid and Goodman 2015). A habitat survey will follow the electrofishing survey. Wetted and bankfull channel width and stream discharge will be measured for each reach. Surface area of Type I and Type II larval rearing substrate will be estimated for the sample pool. Pool dimensions will be measured. Reach slope will be estimated for each site using GIS.

Data analysis

Occupancy modeling will be used to evaluate the relationship of covariates to Pacific and Western Brook lamprey occupancy and detection. These covariates will include channel width, pool characteristics, substrate, survey date, and presence or absence of the other lamprey species.

2.0 Regional Priorities: Linkage of actions to Identified Threats

The threat of culvert barriers to Pacific Lamprey has been identified as an important concern in the Nehalem River basin (North Coast Sub-Region) and the South Umpqua River, Coos River, and Coquille River basins (South Coast Sub-Region) of the RIP. Many of the culvert barriers on larger stream channels, which are known to restrict Pacific salmon and lamprey distribution and abundance, have been removed or are prioritized for removal. However, there are thousands of culvert barriers in smaller streams (<10 m bankfull width) in the coastal Oregon RMUs and their impact on Pacific Lamprey is unknown. Pacific Lamprey have been shown to use smaller channels, which suggests that many more culverts than currently recognized may be limiting distribution and abundance of Pacific Lamprey in these RMUs. The extent of this threat is unknown because there is a lack of scientific understanding of how Pacific Lamprey use these stream reaches, which prevents regional managers from adequately evaluating these culvert barriers for their potential impact on distribution. This proposed project addresses this need for information on Pacific Lamprey distribution and habitat use in these stream reaches and will result in a model that can be used to inform culvert removal programs in regard to Pacific Lamprey in these RMUs.

Secondarily, this project focuses its sampling frame in the upper reaches of these watersheds, which may act as refugia from the threats identified in the Oregon Coast RIP of elevated water temperatures and climate warming. These upper reaches are colder than low elevation reaches and may provide thermally stable spawning and rearing habitat for Pacific Lamprey. This increases the motivation for understanding how Pacific Lamprey use these reaches.

Furthermore, the distribution and habitat use information of this project may be useful in delineating potential Pacific lamprey spawning habitat in other lamprey RMUs and refining the sampling frame of the OASIS monitoring program in the Oregon coastal RMUs to reflect the actual Pacific Lamprey distribution potential.

3.0 Project Goals/Objectives and Species/Habitat Benefits:

This project will improve our understanding of Pacific Lamprey and Western Brook Lamprey distribution and habitat use and provide an occupancy and detection model that can be used as a tool for determining suitable lamprey habitat in the upper reaches of watersheds and to inform future sampling designs and monitoring programs.

4.0 Project Design / Feasibility:

This project is highly feasible because we have allotted enough time for pre-project planning and preparation and possess the expertise to carry out this study (please see the Budget and Timeline section).

5.0 Partner Engagement and Support:

We have begun outreach to the coastal Oregon RMUs and will continue seeking support and active partners from state, federal, and tribal agencies and other interested local parties. ODFW will provide in-kind services in the form of study design development, field crew training and supervision, field gear, data analysis, and summarization of results.

6.0 Monitoring and Evaluation – Contribution to Knowledge Gaps:

This is not a monitoring and evaluation project. However, this project will contribute information to knowledge gaps. Mainly, it will provide distribution and habitat use information about Pacific Lamprey and Western Brook Lamprey in small streams, which are disproportionately affected by culvert barriers in these two RMUs. The effect of culvert barriers on Pacific Lamprey status has been identified as a critical uncertainty in need of research (Mesa and Copeland 2009).

7.0 Budget and Timeline

Budget estimate:

Items	Unit	Quantity	Unit Cost	ODFW	Requested Funds
Personnel Services					
NRS-3 (Project Leader)	Month	2.5	$9,000	$22,500	
ODFW Lamprey Coordinator		1	$9,000	$9,000	
EBA (Field Technician)	Month	7	$4,800		$33,600
Services and Supplies					
Employee allowances	Year	2	$250		$500
Employee per diem	Week	2	$200		$400
Vehicle lease	Month	3	$377		$1,131
Vehicle mileage	Mile	4000	$0.30		$1,200
Sampling gear & supplies					$1,929
Adminstrative Overhead					
Overhead			29%		$11,240.40
		Agency Share		$31,500	$50,000
		Agency Share (%)		39%	61%

Timeline:

Workflow	Date completed
Pre-project preparation	January-June 2019
Field surveys	July-September 2019
Analysis & summarization	May 2020

8.0 References

Chelgren, N. D, and J. B. Dunham. 2015. Connectivity and conditional models of access and abundance of species in stream networks. Ecological Applications 25:1357-1372.

Dunham, J. B., N. D. Chelgren, M. P. Heck, and S. M. Clark. 2013. Comparison of electrofishing techniques to detect larval lampreys in wadeable streams in the Pacific Northwest. North American Journal of Fisheries Management 33:1149–1155.

Gunckel, S. L., K. K. Jones, and S. E. Jacobs. 2009. Spawning distribution and habitat use of adult Pacific and western brook lampreys in Smith River, Oregon. Pages 173–190 *in* L. R. Brown, S. D. Chase, M. G. Mesa, R. J. Beamish, and P. B. Moyle, editors. Biology, management, and conservation of lampreys in North America Symposium. American Fisheries Society, Bethesda, Maryland.

Mesa, M. G., and E. S. Copeland. 2009. Critical uncertainties and research needs for the restoration and conservation of native lampreys in North America. Page 311321 *in* L. R. Brown, S. D. Chase, M. G. Mesa, R. J. Beamish, and P. B. Moyle, editors. Biology, management, and

conservation of lampreys in North America Symposium. American Fisheries Society, Bethesda, Maryland.
Pirtle, J., J. Stone, and S. Barndt. 2002. Evaluate habitat use and population dynamics of lampreys in Cedar Creek, Annual Report 2000. Portland, Oregon.
Reid, S. B., and D. H. Goodman. 2015. Detectability of Pacific Lamprey occupancy in western drainages : implications for distribution surveys. Transactions of the American Fisheries Society 144:315–322.
Starcevich, S. J., and S. Clements. 2013. Larval lamprey distribution and habitat use in small stream channels on the Oregon coast. ODFW Progress Report. Corvallis, Oregon.
Torgersen, C. E., and D. A. Close. 2004. Influence of habitat heterogeneity on the distribution of larval Pacific lamprey (*Lampetra tridentata*) at two spatial scales. Freshwater Biology 49:614–630.

Project Title: Tweedle Creek Habitat Restoration – meander realignment/off channel refuge/beaver analog project

Project Applicant/Organization: *Upper Nehalem Watershed Council*
Contact: *Maggie Peyton – UNWC Executive Director*
Email: *Maggie@nehalem.org*
Phone: *503-396-2046*

Landowner: *Wayne & Laurie Carmichael*
Contact: *Wayne Carmichael*
Phone/email: *wayne.carmichael@wright.edu*

Technical Advisor(s): *Oregon Department of Fish and Wildlife (ODFW)*
Contact: *Troy Laws – Restoration Biologist*
Phone: *503-842-2741*

Contact: *Bio-Surveys LLC-Steve Trask Consulting*
Phone: *541-487-4338*

Project Location: *Tweedle Creek*
NPCC Subbasin (4th HUC Field) name: *Nehalem (17100202)*
Lamprey RMU population: *North Oregon Coast sub-region*
HUC4 Risk Level: *S2 (Imperiled)*
Threats Addressed: *habitat modification, water quality (elevated temperature & elevated turbidity – fine sediment) and water quantity (low flows/high flows)*

Requested funds: $50,000

Total Project cost: *$184,000*

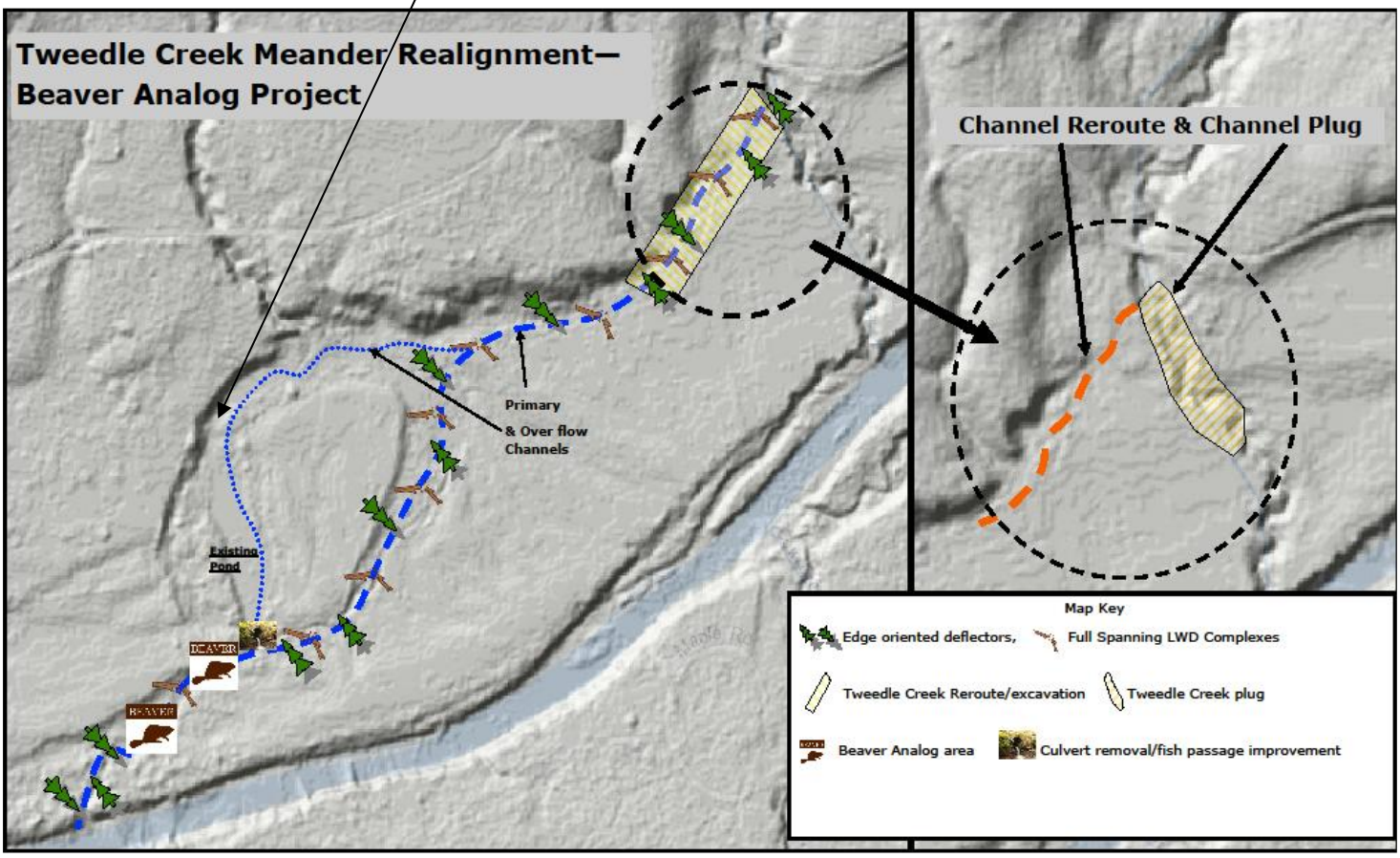
Short Project Description:

Aquatic habitat degradation, stream/floodplain disconnect, and hindered access into Off-Channel refuge has contributed to the decline of native lamprey and salmonid production throughout Oregon, including the ESA listed Coho and lamprey populations of the Nehalem River basin. This project seeks $50,000 in cost share funding to restore the historic relic channel alignment of Tweedle Creek and implement the proposed associated habitat restoration actions to significantly increase the availability of both low velocity off channel rearing during winter high flows and cooler summer refuge away from the hotter main stem Nehalem for these species by addressing these habitat limiting factors.
This project was selected because it exists in one of the NSAP's high priority 6th fields for restoration (main stem Nehalem) and addresses the needs of native lamprey and a unique salmonid life history strategy for coho also identified in the NSAP planning process (Nomadic spring fry dropping out of headwater reaches into the Mid / Lower Nehalem main stem).

This project will realign/abandon 1,280 feet of lower Tweedle Creek from its present location into its historic relic toe slope channel to restore 4,800 feet of low gradient stream channel and associated floodplain habitat. This action will increase Mid-Nehalem River off-channel salmonid/lamprey stream rearing nearly fourfold and will feed/enhance the existing Carmichael wetland complex, increasing its overall size by another 15+ acres. Grantee will begin by excavating the relic stream channel across a 1,250-foot section of floodplain to reconnect to the existing historic channel and wetland matrix and then plugging the existing Tweedle Creek channel to restore the "new" relic channel with the stream flow. The Grantee will establish grade controls throughout the length of the newly restored relic stream channel using LWD structures and a minimum of two beaver dam analogues. Grantee will also replant a variety of native plant species along 15 acres of riparian/wetland habitat directly associated with the stream channel.

This project will 1) restore Tweedle Creek into a historic channel and oxbow/wetland area of the Middle Nehalem River and increase the overall stream length by approximately 4,800 feet, 2) improve hyporheic connectivity on the associated floodplain and into the wetland complex, 3) create habitat conditions conducive to long-term beaver colonization and provide additional backwater habitat during high winter main stem flows, 4) improve riparian conditions, and 5) address the habitat needs of salmonids and lamprey spawning and rearing in this area of the Nehalem River Basin Watershed.

Descriptive Photographs-illustrations-Maps:



1.0 Detailed Project Description (please see map above)

The Tweedle Creek - Carmichael Habitat Restoration project is a comprehensive effort to return and restore Lower Tweedle Creek (approximately 4800 ft.) into a historic relic channel and reconnect it with the associated floodplain, wetlands, and an off channel pond. In total the project comprises

about 40 acres and will enhance critical habitat for Pacific & Western Brook lamprey, Coho & Chinook salmon, winter steelhead, cutthroat trout, and a host of other aquatic and terrestrial species. The Upper Nehalem watershed council will co-manage the project with the landowners and associated partners. Planning, survey/design, permit acquisition, budget development, etc. are all underway with implementation set for the 2019 summer instream work period.

Funding through the Pacific Lamprey Conservation Initiative (Regional Implementation Plan) will address instream, off-channel, and wetland enhancements specific to lamprey habitat benefits that support adult spawning and juvenile rearing deficiencies in this part of the Nehalem River Basin. The project will enhance stream/floodplain connectivity, habitat complexity, and recreate several acres of historical habitat lost to floodplain developments (agricultural) around the turn of the 19th century.

Brook and Pacific lamprey currently utilize Tweedle Creek albeit in its present state the habitat is highly limited. We estimate the available habitat for this specie to increase several fold once the project is constructed.

Miles/acres of stream/wetland habitat accessed by lamprey and anadromous fish after channel relocation and wetland enhancement = approx. **3 miles/90+ acres**

Miles of stream treated with LWD/BDA = **0.9 miles**

- A 0.9 mile stream reach in the vicinity of the wetland complex will be enhanced with BDA and LWD structures for fish habitat improvements.

2.0 Regional Priorities: Linkage of actions to identified limiting factors

- What threat(s) does this project address?
  Vegetation and habitat modification (winter/summer rearing, refuge and spawning habitat), water quality (excessive solar loading to stream temperature/excessive sediment release/turbidity), water quantity (extreme low summer/high winter flows)

- How does this project address this key threat/limiting factors(s)?
  - **Habitat modification:** this project re-lengthens Tweedle creek by diverting the stream back into its relic toe-slope channel installs the foundation wood and beaver dam analogues to improve the stream conditions now.
  - **Water quality:** natural stream flow dynamics interact with the LWD/BDA structures that filter and capture sediments, and capture winter high flows that are stored in hyporheic zone and released during summer low flows. Ground water released is cooler than the instream water and improves the aquatic conditions for freshwater species.
  - **Water quantity:** the strategic placement of complex large woody debris structures and the formation of active beaver dams' with-in the stream channel expands the area of ground water infiltration/recharge during peak stream flows/heavy rain. The hyporheic zone is expanded by the increased area of surface water infiltration. This stored water released naturally in the summer time augments instream flows improving the aquatic conditions for freshwater species.

3.0 Project Goals/Objectives and Species/Habitat Benefits:

- What life stage or stages will benefit from action?

Fresh water life stages of juvenile and adult lamprey, salmon, trout and steelhead.

- How?

Improved and expanded spawning, rearing and refugia habitat created by stream dynamics interacting with the restored relic stream channel, associated floodplain/wetlands, off channel pond, and LWD/BDA structures.

- What other species may benefit from action?

Brook and Pacific Lamprey and other native aquatic organisms.

- How will the project provide meaningful measureable results to improve anadromous populations and/or their habitat conditions?

LWD and BDA structures are known to improve habitat conditions for anadromous fish during their freshwater life cycle by providing improved spawning, rearing and refuge habitat which increases the over-all survival rate and the health and vitality of juveniles. Healthy juveniles (ammocoetes in the case of lamprey) mature into smolts/adults in preparation for the ocean portion of their life cycle and survival on into adulthood.

4.0 Project Design / Feasibility:

- Have the designs for the project been completed already or will they be completed before planned project implementation?

Grummel Engineering and associates will complete the engineering for the stream meander expansion design by the fall of 2018. ODFW and Bio-Surveys have conducted their field reconnaissance, completed their preferred lay-out of site locations, and will develop site specific specifications for beaver dam analogs and large woody debris structures in consultation with the project engineers.

- Are the appropriate permits (ESA and environmental compliance) in place already or will they be in place before planned project implementation?

All work will be performed under a USACE removal fill permit, Clatsop County flood plain development permit, ODFW fish passage review and NOAA ESA programmatic review.

- Can the project be implemented within the defined time frame?

The time frame is defined by the funders who support the project. At this point UNWC has obtained $88,000 in coast share from NOAA toward design and to develop project to attract additional funders for summer 2019 implementation.

5.0 Partner Engagement and Support:

- What partners are supporting the project?

Landowners (Carmichaels), UNWC, ODFW, NOAA, and Wild Salmon Center/funders. Seeking to develop a partnership with Clatsop SWCD to pursue additional cost share for riparian fencing and reforestation thru the Oregon Watershed Enhancement Board supported/funded Oregon Department of Agriculture - Strategic Implementation Area

process to improve water quality on agricultural lands in the Cow Creek sub-basin which includes Tweedle Creek.

- What partners are active in implementing the project?

Landowner, UNWC, ODFW, Wild Salmon Center and NOAA.

- What partners are providing matching funds or in-kind services that directly contribute to the project? **Landowner, UNWC, ODFW, WSC and NOAA.**

6.0 Monitoring and Evaluation - Contribution to Knowledge Gaps:

- If this is a monitoring or evaluation project or an on the ground project with a monitoring or evaluation component:
  - Is there a monitoring framework in the proposal?

    All restoration actions are georeferenced. All sites will have set photo-point point documentation sites (downstream looking up/upstream looking down) to capture photos before, during and after structure installation - for multiple years of monitoring. Field observations will be recorded during monitoring survey. Lamprey presence/absence survey will be conducted by ODFW.

  - Does the monitoring framework provide clear objectives and measureable metrics that can be observed over time? **Yes**

  - Does the framework provide a clear description of the expected outcome? **Yes**

7.0 Budget (estimate)

Project Title:	Tweedle Creek - Meander - Anadromous Habitat Restoration - Carmichael				
	2018 Funds				
	NOAA Secured	**Other federal contributions (cash + in-kind)**	**State contributions (in-kind staff support for design and monitoring)**	**Other contributions (cash + in-kind) To Be Secured**	**Total cost**
DIRECT COSTS					
a) Personnel Salary: UNWC PM/Bookkeeper	3,000			3,000	6,000
b) Permitting / UNWC	2,500			2,500	5,000
c) Travel	300			300	600
d) Design, Drafting,	20,000		2,500		22,500

Layout					
e) Implementation Management	7,000		2,500	7,000	14,000
f) Planting Plan Management UNWC	3,000			3,000	6,000
g) Supplies Trees/Shrubs/Tubes	2,000		2,000	2,000	6,000
h) Crew Labor planting	6,000			NCL-RIP 6,000	12,000
i) Excavator	9,000			NCL-RIP 29,000	38,000
j) Dozer	4,000			NCL-RIP 4,000	8,000
k) Dump Truck	7,000			NCL-RIP 7,000	14,000
l) Equipment Mob	2,000			NCL-RIP 2,000	4,000
m) Log Trucking	2,000			NCL-RIP 2,000	4,000
n) Supplies (96 structure Logs)	9,600			9,600	19,200
o) Crew Labor Channel reconnect / LWD	6,300			6,300	12,600
p) Dewater supplies	2,000			2,000	4,000
TOTAL DIRECT (a-h)	85,700		7,000	85,700	178,400
INDIRECT COSTS (3%)	2,571			2,571	5,142
TOTAL	88,271		7,000	88,271	183,542

8.0 Timelines

Project planning and design phase is in progress. If cost share can be secured in a timely manner then the project can be implemented in the summer of 2019.

9.0 References

Available upon request.

III. Literature Cited

Clemens, B., C. Schreck, S. van de Wetering, & S. Sower. 2016. The potential roles of river environments in selecting for stream- and ocean-maturing Pacific Lamprey, *Entosphenus tridentatus* (Gairdner, 1836). pp. 299 – 322. *In*: A. Orlov, & R. J. Beamish (eds.) Jawless Fishes of the World. Cambridge Scholars.

Brown E, R Jacobsen, J. Nott, M. Weeber and M. Lewis. 2017. Assessment of Western Oregon Adult Winter Steelhead and Lamprey – Redd Surveys 2016. Monitoring Program Report Number OPSWODFW-2016-09. Oregon Department of Fish and Wildlife, Salem, Oregon.

Downey, T. D. Rilatos, A. Sondenaa, and B. Zybach. 1996. Skwakol: the Decline of the Siletz Lamprey Eel Population during the 20th Century. OSU Chapter, American Indians in Science and Engineering Society (AISES). Oregon State University, Corvallis, Oregon. 90 pp.

Jacobsen R., J. Nott, E. Brown, M. Weeber and M. Lewis. 2014. Assessment of Western Oregon Adult Winter Steelhead – Redd Surveys 2014. Monitoring Program Report Number OPSW ODFW-2014-09. Oregon Department of Fish and Wildlife, Salem, Oregon.

Jacobsen R., J. Nott, E. Brown, M. Weeber and M. Lewis. 2015. Assessment of Western Oregon Adult Winter Steelhead and Lamprey – Redd Surveys 2015. Monitoring Program Report Number OPSWODFW-2015-09. Oregon Department of Fish and Wildlife, Salem, Oregon.

ODFW (Oregon Department of Fish and Wildlife). 2017. Oregon Adult Salmonid Inventory and Sampling: Pacific lamprey Spawning Survey Data. Unpublished memo provided to the North Coast Pacific lamprey RMU for the April 5, 2017 meeting. ~12 pp.

State of Oregon. https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Approved-by-EPA.aspx

Appendix 1

The following are the definitions for interpreting the NatureServe conservation status ranks in Table 2.

SX Presumed Extirpated.—Species or ecosystem is believed to be extirpated from the jurisdiction (i.e., nation, or state/province). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered. (= "Regionally Extinct" in IUCN Red List terminology).

SH Possibly Extirpated.—Known from only historical records but still some hope of rediscovery. There is evidence that the species or ecosystem may no longer be present in the jurisdiction, but not enough to state this with certainty. Examples of such evidence include: (1) that a species has not been documented in approximately 20–40 years despite some searching or some evidence of significant habitat loss or degradation; or (2) that a species or ecosystem has been searched for unsuccessfully, but not thoroughly enough to presume that it is no longer present in the jurisdiction.

SU Unrankable. .—Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

S1 Critically Imperiled.—Critically imperiled in the jurisdiction because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the jurisdiction.

S2 Imperiled.—Imperiled in the jurisdiction because of rarity due to very restricted range, very few occurrences, steep declines, or other factors making it very vulnerable to extirpation from the jurisdiction.

S3 Vulnerable.—Vulnerable in the jurisdiction due to a restricted range, relatively few occurrences, recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure.—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure.—Common, widespread, and abundant in the jurisdiction.