Pacific Lamprey

2020 Regional Implementation Plan

for the

Washington Coast/Puget Sound

Regional Management Units

Submitted to the Conservation Team August 12, 2020

Primary Authors		Primary Editors
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I. Status and Distribution of Pacific lamprey in the RMUs

A. General Description of the RMUs

The Puget Sound/Strait of Juan de Fuca Region is bordered by the Strait of Juan de Fuca to the west, the Cascade Range to the east, Puget Sound systems to the south, and the U.S.–Canada border to the north (Figure 1). The Puget Sound/Strait of Juan de Fuca Region includes all Washington river basins flowing into the Puget Sound, Hood Canal, and Strait of Juan de Fuca. The major river basins in the Puget Sound initiate from the Cascade Range and flow west, discharging into Puget Sound, with the exception of the Fraser River system, which flows northwest into British Columbia. All of the major river basins in Hood Canal and the Strait of Juan de Fuca originate in the Olympic Mountains. This region is comprised of 20 4th field HUCs ranging in size from 435-6,604 km^2 (Table 1).

The Washington Coast Region is bordered by the Pacific Ocean to the West, Cape Flattery to the North, Olympic Mountain Range and Willapa Hills to the East, and the Columbia River to the South (Figure 2). This region includes all Washington river basins flowing directly into the Pacific Ocean. The Washington Coast Region includes the Hoh-Quillayute, Queets-Quinault, Upper and Lower Chehalis, Grays Harbor, and Willapa Bay sub-regions, or 4th field HUCs, ranging in size from 1,471-3,393 km^2 (Table 2).

Figure 1. Map of watersheds within the Puget Sound/Strait of Juan de Fuca RMU.

Table 1. Drainage Size and Level III Ecoregions of the 4th Field Hydrologic Unit Code (HUC) Watersheds located within the Puget Sound/Strait of Juan de Fuca Region.

Watershed	HUC Number	Drainage Size (km^2)	Level III Ecoregion(s)
Fraser	17110001	645	Puget Lowland, North Cascades
Strait of Georgia	17110002	2,473	Puget Lowland, North Cascades
San Juan Islands	17110003	1,621	Puget Lowland
Nooksack	17110004	1,282	Puget Lowland, North Cascades
Upper Skagit	17110005	4,222	North Cascades
Sauk	17110006	1,919	North Cascades
Lower Skagit	17110007	1,158	Puget Lowland, North Cascades
Stillaguamish	17110008	1,823	Puget Lowland, North Cascades
Skykomish	17110009	2,209	Puget Lowland, North Cascades
Snoqualmie	17110010	1,795	Puget Lowland, Cascades, North Cascades
Snohomish	17110011	720	Puget Lowland, North Cascades
Lake Washington	17110012	1,603	Puget Lowland, Cascades, North Cascades
Duwamish	17110013	1,261	Puget Lowland, Cascades, North Cascades
Puyallup	17110014	2,580	Puget Lowland, Cascades
Nisqually	17110015	1,880	Puget Lowland, Cascades
Deschutes	17110016	435	Puget Lowland, Cascades
Skokomish	17110017	642	Coast Range, Puget Lowland, North Cascades
Hood Canal	17110018	2,479	Coast Range, Puget Lowland, North Cascades
Puget Sound	17110019	6,604	Coast Range, Puget Lowland
Dungeness-Elwha	17110020	3,289	Coast Range, Puget Lowland, North Cascades
Crescent-Hoko	17110021	2,005	Coast Range, Puget Lowland

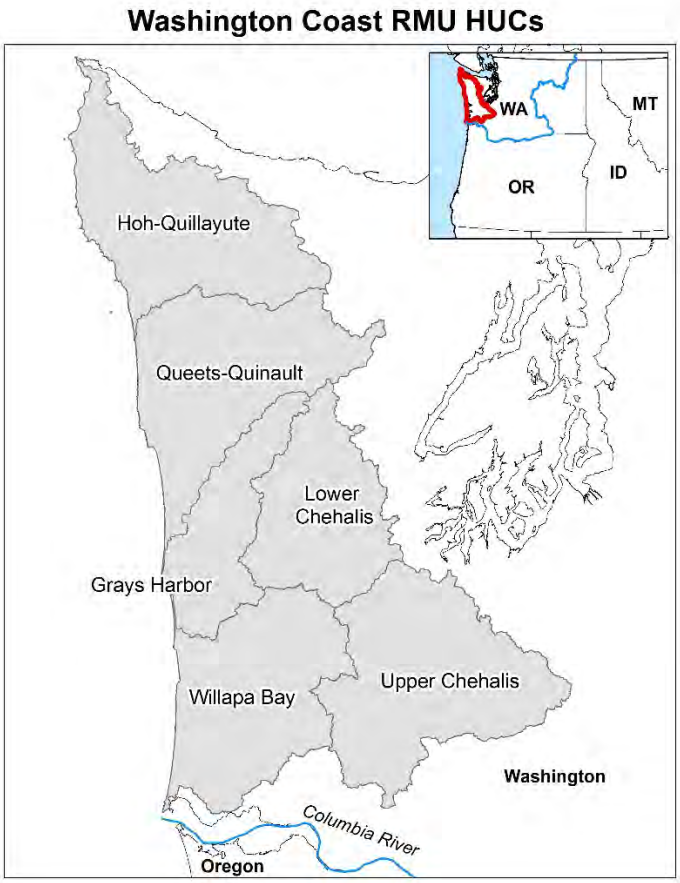

Figure 2. Map of watersheds within the Washington Coast RMU.

Table 2. Drainage Size and Level III Ecoregions of the 4th Field Hydrologic Unit Code (HUC) Watersheds located within the Washington Coast Region.

Watershed	HUC Number	Drainage Size (km^2)	Level III Ecoregion(s)
Hoh-Quillayute	17100101	3,186	Coast Range, North Cascades
Queets-Quinault	17100102	3,082	Coast Range, North Cascades
Upper Chehalis	17100103	3,393	Coast Range, Puget Lowland, Cascades
Lower Chehalis	17100104	2,170	Coast Range, Puget Lowland
Grays Harbor	17100105	1,471	Coast Range
Willapa Bay	17100106	2,849	Coast Range

B. Status of Species

Conservation Assessment and New Updates

Pacific lamprey has not been a management priority for federal or state agencies on the Washington Coast or Puget Sound. Lamprey distribution information is currently being gathered (e.g. environmental DNA sampling, occupancy sampling and networking with partner agencies to fill data gaps) in western Washington tributaries. In 2019, water samples were collected in four HUCs to help determine presence of Pacific lamprey using environmental DNA techniques. Existing lamprey distribution and occupancy information is largely based upon anecdotal observations, or has been collected incidentally while monitoring salmonid species. Results of the 2019 sampling season will inform and guide future project planning and fill distribution data gaps.

For the Washington Coast, conservation status ranks were calculated for two of six HUCs in 2017. An increase in available data from the Pacific Lamprey Distribution database and updates to the calculated range extent were used to rank current occupancy and calculate ratio ranks for all six HUCs, however the minimum required parameters to calculate a conservation status rank were not met in four HUCs, these HUCs do not have a conservation status rank (Table 3). The historical and current occupancy for the four HUCs without a conservation status rank still need to be finalized by the RMU work group. The Upper Chehalis and Lower Chehalis HUCs now have enough information from partners to be assigned a conservation status rank. Information provided allowed population size, short term trend, and threats to be ranked for these two HUCs. A compilation of all known larval and adult Pacific Lamprey occurrences in the Washington Coast RMU (as of 2017) are displayed in Figure 3, which is a product of the USFWS Data Clearinghouse.

Table 3. Population demographics of the 4th Field Hydrologic Unit Code (HUC) watersheds located within the Washington Coast Region, 2017. S1 = Critically Imperiled. S2 = Imperiled.

Watershed	HUC Number	Conservation Status Rank	Occupancy (km^2)		Current Population Size (Adults)	Short Term Trend
			Historical	Current		
Hoh-Quillayute	17100101		1,000−5,000	100-500	No rank	No rank
Queets-Quinault	17100102		1,000−5,000	100-500	No rank	No rank
Upper Chehalis	17100103	S2?	1,000−5,000	100-500	250−2,500	Stable
Lower Chehalis	17100104	S3	1,000−5,000	100-500	1,000−2,500	Stable
Grays Harbor	17100105		1,000−5,000	Zero	No rank	No rank
Willapa Bay	17100106		1,000−5,000	100-500	No rank	No rank

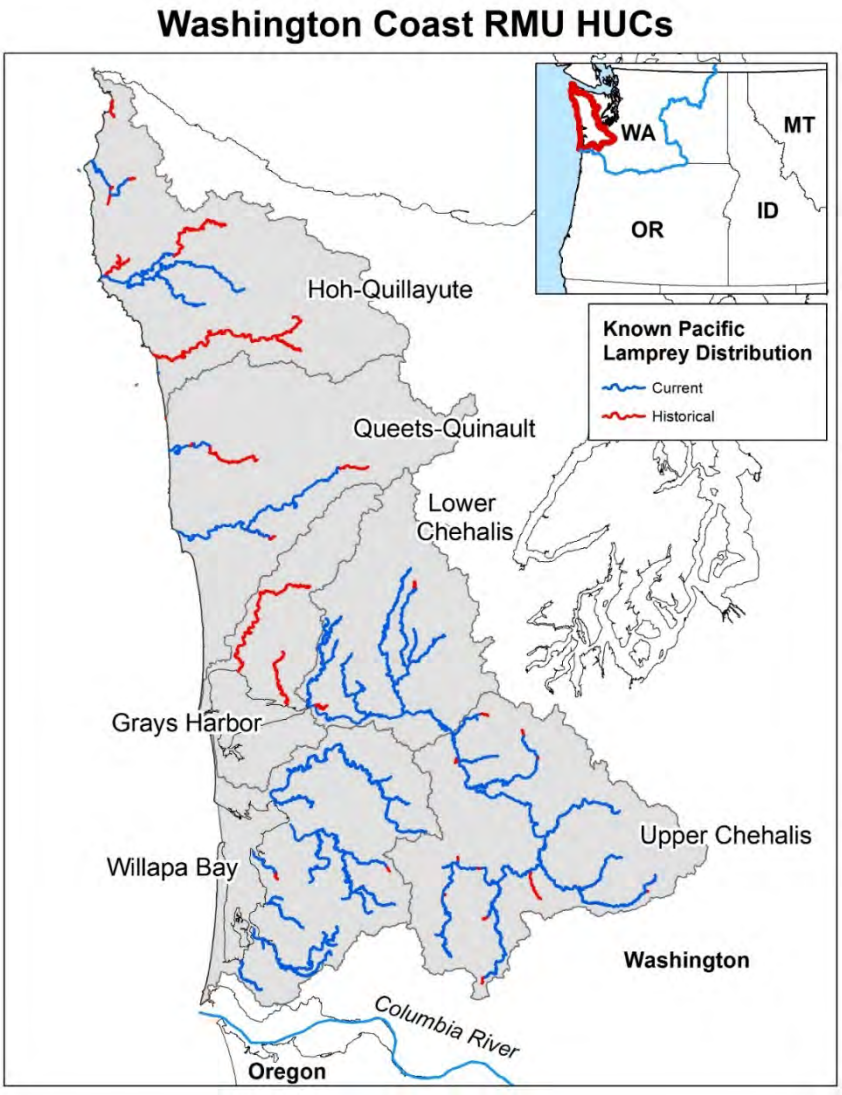

Figure 3. Current Pacific Lamprey distribution and location of 6 4th Field HUCs in the Washington Coast RMU (USFWS Data Clearinghouse 2017).

For the Puget Sound/Strait of Juan de Fuca, conservation status ranks were calculated in four of twenty HUCs in 2017 (Table 4). With limited data, all status ranks were S1 (Critically Imperiled) in the Nooksack, Puyallup, Dungeness-Elwha, and Crescent-Hoko. Much is still unknown about the watersheds in this region. Final Conservation Status Ranks changed in three HUCs. All three HUCs with Pacific Lamprey occupancy were categorized as Critically Imperiled (S1). Information availability and data quality were highest in the Elwha. The status of Pacific Lamprey in Sumas River, Strait of Georgia, San Juan Islands, Upper Skagit, Sauk, Lower Skagit, Stillaguamish, Skykomish, Snoqualmie, Snohomish, Lake Washington, Duwamish, Nisqually, Deschutes, Skokomish, Hood Canal, Puyallup and Puget Sound HUCs are still unknown, however with increased distribution data historical and current occupancy were calculated for these HUCs. These calculations should be considered preliminary until final approval from the RMU work group.

Table 4. Population demographic and Conservation Status Ranks of the 4th Field HUC watersheds in the Puget Sound/Strait of Juan de Fuca Region. S1 = Critically Imperiled. Ranks highlighted in yellow indicate a change in 2017 when all HUCs were unranked.

Watershed	HUC Number	Conservation Status Rank	Historical Occupancy (km2)	Current Occupancy (km2)	Current Population Size (adults)	Short-term Trend (% decline)
Sumas River	17110001		250-1,000	Zero		
Strait of Georgia	17110002		250-1,000	Zero		
San Juan Islands	17110003					
Nooksack	17110004	S1	1,000-5,000	20-100	1,000-10,000	-Stable
Upper Skagit	17110005		1,000-5,000	Zero		
Sauk	17110006		1,000-5,000	Zero		
Lower Skagit	17110007		250-1,000	20-100		
Stillaguamish	17110008		1,000-5,000	100-500		
Skykomish	17110009		1,000-5,000	20-100		
Snoqualmie	17110010		1,000-5,000	20-100		
Snohomish	17110011		250-1,000	20-100		
Lake Washington	17110012		250-1,000	Zero		
Duwamish	17110013		250-1,000	20-100		
Puyallup	17110014	S1	1,000-5,000	20-100	Unknown	
Nisqually	17110015		1,000-5,000	20-100		
Deschutes	17110016		250-1,000	Zero		
Skokomish	17110017		250-1,000	4-20		
Hood Canal	17110018		1,000-5,000	20-100		
Puget Sound	17110019		1,000-5,000	20-100		
Dungeness-Elwha	17110020	S1	1,000-5,000	20-100	Unknown	Increasing
Crescent-Hoko	17110021	S1	250-1,000	20-100	Unknown	

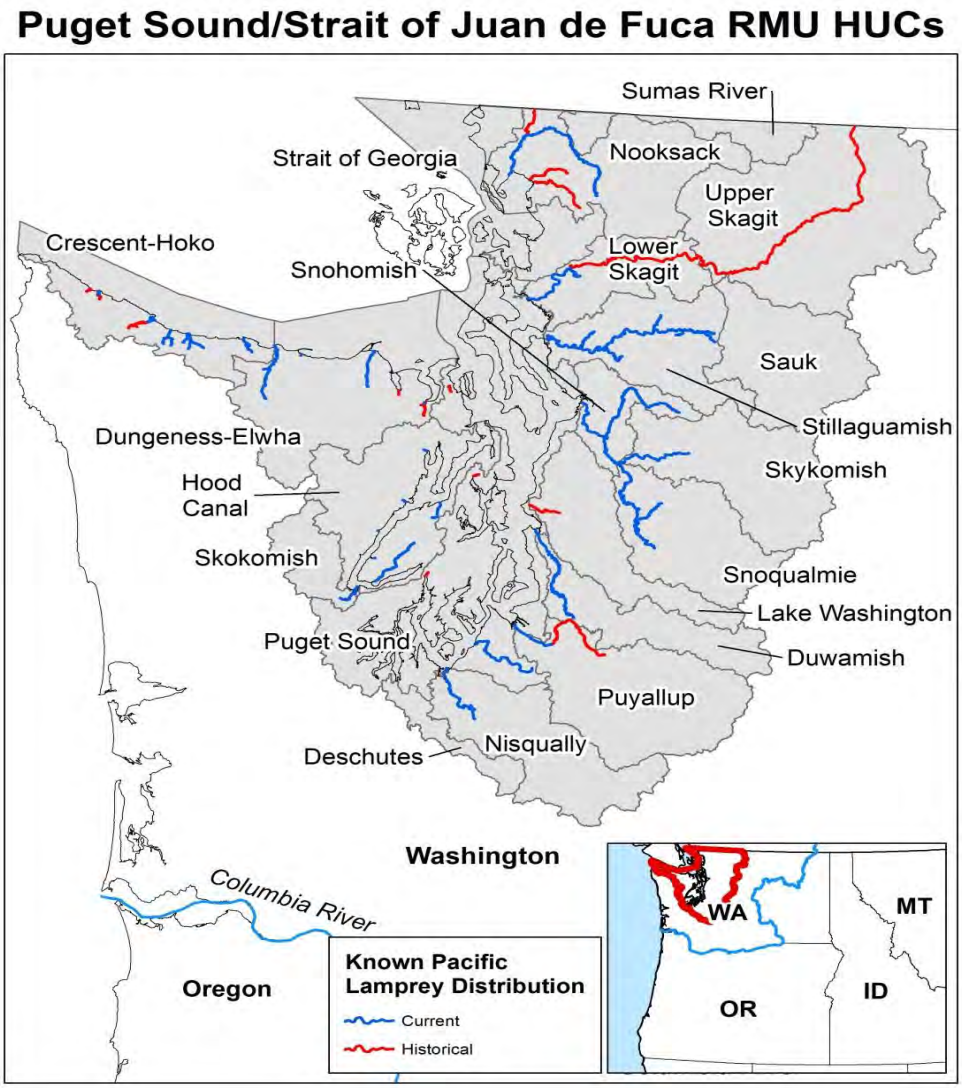

Figure 4. Current Pacific Lamprey distribution and location of 20 4th Field HUCs in the Puget Sound/Strait of Juan de Fuca RMU (USFWS Data Clearinghouse 2017).

Distribution, Connectivity, and Threats

Lack of awareness, stream and floodplain degradation, dewatering and flow management, and climate change were identified as threats to Pacific Lamprey in the four HUCs ranked in the Puget Sound/Strait of Juan de Fuca RMU in 2017. These most likely account for Washington Coast threats as well. Lack of awareness ranked as the greatest threat with moderate scope and severity. Stream and floodplain degradation were moderate threats with moderate scope and severity. Dewatering and flow management were moderate threats with low scope and moderate severity. Finally, climate change was identified as a low threat in the Dungeness-Elwha HUC with low scope and low severity. Passage was identified as a threat in the Puyallup River but was not ranked in severity or scope. More information from all HUCs need to be collected and analyzed before threats are ranked and prioritized.

Road crossing culverts are prevalent in the Washington Coast RMU. Poorly designed or installed culverts may fragment aquatic habitat and impede the migration of fish. Culverts with excessive water velocity (>0.86 m/s), inadequate attachment points, perched outlets, or added features with abrupt 90 degree angles (e.g., baffles, fish ladder steps, outlet aprons), may obstruct passage of adult lamprey (Moser et al. 2002; Mesa et al. 2003; Stillwater Sciences 2014; Crandall and Wittenbach 2015). Many impassable culverts occur low in watersheds (near tributary outlets), preventing access to miles of potential habitat. An extensive effort is underway to inventory and prioritize problem culverts for removal, replacement or repair.

Restoration and Research Actions

To date, the primary lamprey restoration activities that have occurred or are occurring within these RMUs are being performed by organizations focused on salmon and steelhead recovery in both western Washington RMUs. Many instream and floodplain habitat restoration activities have been identified in watershed management plans (e.g., Puget Sound Salmon Recovery Plan (2007)). The vast majority of these actions have been funded and designed for salmon recovery, but work may improve habitat conditions for lamprey as well. The following lamprey research and restoration actions were initiated by RMU partners in the Washington Coast and Puget Sound/Strait of Juan de Fuca RMUs.

HUC	Threat	Action Description	Type	Status
RMU	Population	Environmental DNA sampling to better understand lamprey distribution.	Survey	Underway
RMU	Lack of Awareness	Consideration of lamprey when planning and implementing instream habitat restoration work	Coordination	Ongoing
Washington Coast	Passage	Initial planning, assessment, sampling for potential lamprey passage at fish hatchery.	Coordination, Survey, Analysis	Underway

II. Selection of Priority Actions

High Priority Proposed Project Information

The following projects were submitted by RMU partners for the Puget Sound/Strait of Juan de Fuca and Washington Coast RMUs in 2020:

Project Title: Lamprey Distribution and Abundance in Urban Streams, Olympic Peninsula, WA

Project Applicant/Organization: Lower Elwha Klallam Tribe
Contact Person: Rebecca Paradis, Project Biologist
Email: Rebecca.paradis@elwha.org
Phone: 360-457-4012 ext. 7498

Project type: lamprey habitat assessment
Lamprey RMU populations: Puget Sound/Strait of Juan de Fuca RMU
Watershed (5th HUC Field): 1711002004 Morse Creek-Frontal Port Angeles Harbor
NPCC Subbasin (4th HUC Field) name: 17110020 Dungeness-Elwha
Project location: Port Angeles, WA
Project Coordinates: approximate coordinates: Tumwater Creek 48.123482, -123.446356; Peabody Creek 48.117336, -123.431713; Valley Creek 48.121957, -123.439135; Morse Creek 48.115344, -123.351551; Ennis Creek 48.1159241, -123.4049073

Total Requested funds: $71,057

1. Short Project Summary:

Lampreys historically represented a critical niche in watershed ecology throughout the Northwest. Their decline has tracked that of Pacific salmonids throughout much of their range. The large scale restoration of the Elwha River has shown that lamprey can return and contribute to a recovering ecosystem relatively quickly when conditions are favorable (Lower Elwha Klallam Tribe (LEKT), unpublished data). Urban streams, such as those in Port Angeles have additional constraints on lamprey survival beyond habitat loss and site access. Stormwater runoff, pesticides, and septage releases are additional factors that can adversely affect both salmonids and lamprey. Lamprey contribute vital marine-derived nutrients to areas where they spawn, filter water and provide food for native fish and wildlife, and potentially buffer predation during critical salmonid migration periods. However, the degree to which lamprey occupy the Port Angeles's urban streams is relatively unknown. We propose to document the species and population of lamprey in Tumwater, Valley, Peabody, Ennis and Morse creeks (Figure 1).

The Lower Elwha Klallam Tribe has restored many miles of riparian habitat in stream systems across the North Olympic Peninsula, including some of these urban streams, and has restored over 2100 meters of shoreline in the receiving waters of Port Angeles Harbor. Anadromous

lamprey restoration will occur parallel with recovery of salmon resources, and the wildlife and people that rely on them. The project involves partners from the Lower Elwha Klallam Tribe, Clallam County and Clallam County Marine Resource Committee (MRC).

2. Detailed Project Description:

The conservation status of the Pacific Lamprey has become a concern to Native American tribes, management agencies, conservation groups and other stakeholders because the population has declined in the last few decades, and its range has contracted (Close et al. 2002; USFWS 2004; Moyle et al. 2009; Renaud et al. 2009; Luzier et al. 2011; Goodman and Reid 2012). Unlike anadromous salmonids, lampreys have not been widely surveyed and have frequently been overlooked or not recorded in fish surveys focused on other species. As a result, we find ourselves in the position of trying to conserve what is probably one of the most broadly distributed freshwater fishes in western North America, yet we know little about its actual distribution within specific drainages (Reid and Goodman 2015).

The goal of this project is to gain information on lamprey distribution and behavior in order to inform management decisions which will increase resilience of ecosystem restoration. Project objectives are to obtain a representative sample of larval lamprey distribution in urban streams in the north coast of the Olympic Peninsula to aid in refining distribution maps in the Puget Sound/Strait of Juan de Fuca RMU.

Larval lamprey (ammocoete) electrofishing surveys in above named urban streams will be conducted in the Spring and Summer. Sample sites for electrofishing will be focused in optimal habitats of both side channels and tributaries according to preferred lamprey depth and the substrate (Dunham et al. 2013). Preferably, sites will be wadeable reaches less than a meter in depth. Each site will be approximately 100 meters in length and we will conduct 2-4 electrofishing passes each to ensure presence. Larval lamprey sampling often involves a two-stage method, such as that detailed by Weisser and Klar (1990) and reviewed in Moser et al. (2007). Larval lamprey > 75 mm will be identified using physical characteristics (Hayes et al. 2013). Larval Lampetra species are not distinguishable from each other, but larval Entosphenus can be distinguished from larval Lampetra. Samples from lamprey smaller than 75 mm will be saved for genetic analysis along with tissue samples from larger lamprey. These lamprey will be PIT tagged for tracking future movements.

Passive integrated transponder (PIT) tags identify individuals and show promise for elucidation of ammocoete behavior and biology. Ammocoetes will be electrofished from the above named watersheds in suitable habitat. They will be induced to emerge from the sediment by delivering a 125 V, 4–20 amp, direct current using a 25% duty cycle, AbP-2 backpack electrofisher (Department of Engineering Technical Services, University of Wisconsin, Madison, WI) at a pulse rate of 3/s to stun ammocoetes for dipnet capture. The smallest PIT tag currently available (8.4 mm) will be used to tag larval Pacific lamprey with high fish survival and tag retention (Moser et. al.2017).

3. Descriptive Maps:

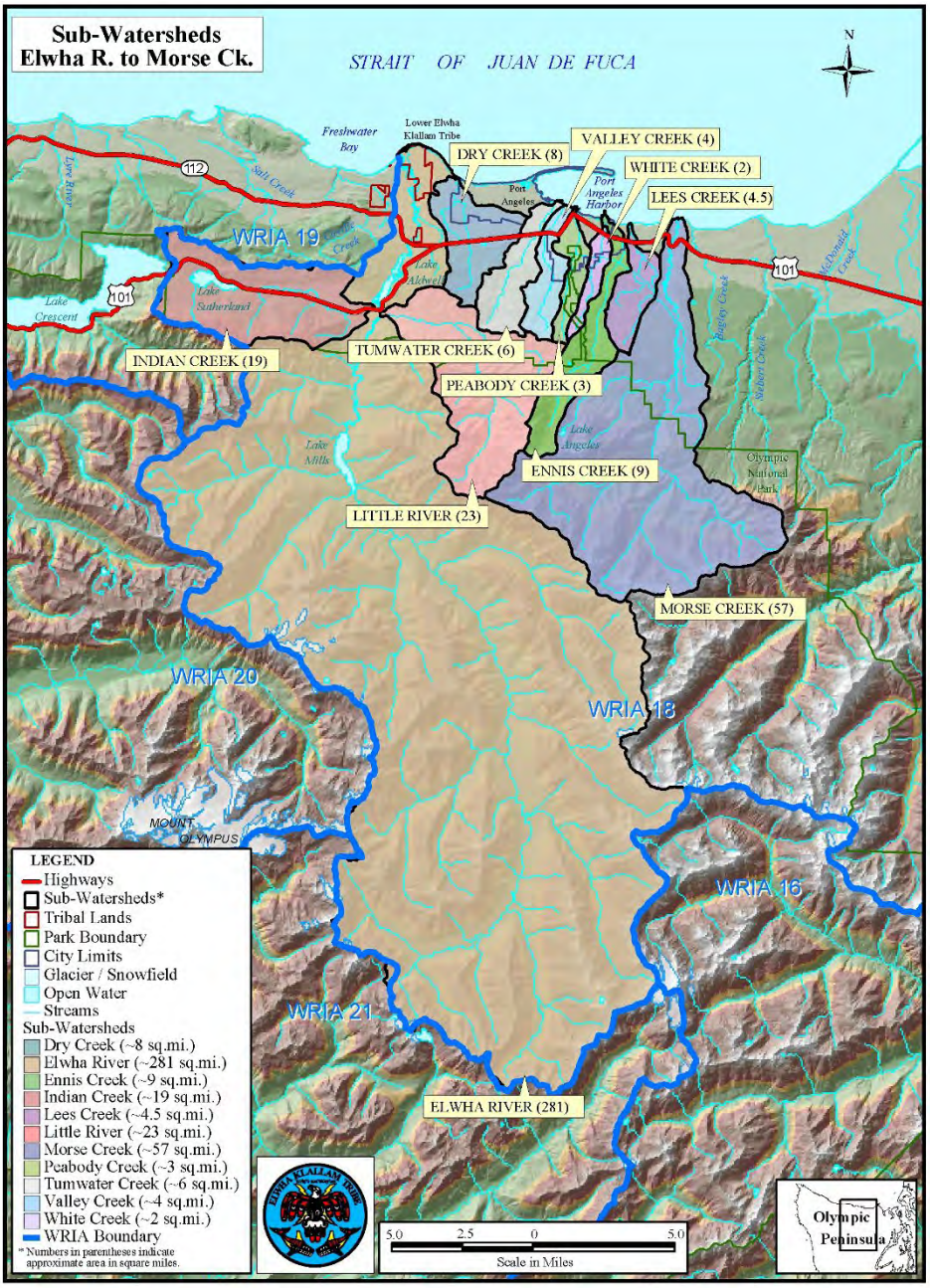

Figure 1. Port Angeles Urban Streams (From: WRIA 18 Watershed Management Plan (2005).

4. Linkage of Actions to Identified Threats for Lampreys in RMU(s):

Lack of awareness, stream and floodplain degradation, dewatering and flow management, and climate change were identified as threats to Pacific Lamprey in the HUCs ranked in the Puget Sound/Strait of Juan de Fuca RMU. This lamprey distribution and movement project will address all of those and most specifically address lack of awareness. This project will gain needed information on lamprey distribution and will be shared with partner agencies and the public. The data collected will be added to the PLCI data clearinghouse. Once the project results are analyzed and shared with partner agencies the threat of flow management may also be addressed by informing stakeholders on lamprey best management practices, habitat, and flow requirements for survival.

5. Species/Habitat Benefits:

This project will improve our understanding of Pacific and river lamprey in urban streams on the Olympic Peninsula. Restoration of lampreys is important to general restoration of ecosystem health. In addition, the larvae could provide a ready food source for salmonids and other freshwater residents. Returning adults are a food source for marine mammals, birds, and terrestrial predators and their tissue contains large amounts of energetic fats. For this reason, abundant and natural lamprey resources could replace salmon in the diets of these predators, thereby increasing salmon abundance.

Tumwater Creek is the only stream in this proposal known to currently have lamprey. The Lower Elwha Klallam Tribe installs a smolt trap from April to June. It is monitored by Clallam County Marine Resources Committee board members and interns/Port Angeles High School students.

Tumwater Creek smolt totals by year. Unpublished data from Helle Anderson.

Species	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Coho smolt	2	2	8	105	555	30
O.mykiss smolt	21	15	38	25	38	41
Cutthroat smolt	59	38	35	72	162	242
Pacific lamprey adults	3	5	9	1	4	4
Total	82	55	81	202	755	313

6. Priority Objectives and Goals:

The Puget Sound/Strait of Juan de Fuca Regional Implementation Plan and the PLCI Pacific Lamprey Assessment (February 2019) both clearly state the need for more information to fill data gaps and to refine lamprey distribution information in the western Washington RMUs. This project will address the needs outlined in the RIP. Once more data is gathered for the currently unknown areas on the Olympic Peninsula the RIP will be more robust and lead toward identifying and implementing priority conservation actions for lamprey.

This project will address Objective Three of the National Fish Habitat Partnership National Fish Habitat Action Plan 2nd Edition (2012). Objective Three addresses raising public awareness of the role healthy fish habitats play related to the well-being of local communities. The proposed project will increase public awareness of lamprey existing in their local streams and provide information for them to understand the connection lamprey have to the popular salmon fisheries in the area. The project will also address Objective Four which highlights the need to fill data gaps. In order to make science-based management decisions we need to have fewer data gaps in lamprey and other fisheries information.

This project addresses multiple goals in the Strategic Plan for the USFWS Fish and Aquatic Conservation Program FY2016-2020. Refining lamprey distribution information and learning more about movement and behavior clearly addresses the Goals to Conserve Aquatic Species (Objective 3: Prevent declines of other priority species by addressing recognized threats as soon as possible); Conserve, Restore and Enhance Aquatic Habitats, and Fulfill Tribal Trust Responsibilities (Objective 2: Develop and maintain effective relationships between the Service

and federally recognized tribes).

7. Project Design / Feasibility:

The project sponsor is experienced in this type of project implementation. They are a primary investigator on the lamprey recolonization project in the Elwha River. The designs for this project will be completed before planned project implementation. Any required permits will be in place before planned project implementation. The project will be implemented within the defined timeframe (see Budget and Timeline). The project timeframe for completion meets all the dates specified by the NFHP.

8. Partner Engagement and Support:

The project involves partners from Clallam County and Marine Resource Committee (MRC). The Clallam County MRC provided a letter of support (inserted below). The project sponsor, Lower Elwha Klallam Tribe, has a field technician to lead the project and works with the Tribe's Youth Program to provide education and opportunities to tribal youth interns which will be in-kind support from the project sponsor. The MRC will provide in-kind support by providing smolt trap access and scanning for PIT tagged lamprey.

9. Monitoring and Reporting:

The completion of the project will be documented in a final report and may include an annual report, depending on the source of funding and the timeframe of completion.
This project will benefit Pacific Lamprey within this RMU and region-wide by contributing information needed to fill data gaps and inform adaptive management decisions.
Although PIT tag reader arrays are lacking on these urban streams we can monitor the tagged individuals by scanning for tags at Tumwater Creek and all the other screw/smolt traps the Tribe operates. The tag numbers will be put in a database jointly monitored by LEKT and NOAA.

10. Project Budget (including overhead):

Line item and description	Total Cost	Requested	Non-Federal Match	Federal Contributions/Leveraged Funds
LEKT Salaries/Wages				
Natural Resource Biologist				
3 mo/yr for 2 years provided by other grants	6 months @ $14,580	$14,580		
Natural Resource Technician				
3 mo/yr for 2 years	6 months @ $9,700	$9,700		
Natural Resource Technician 3mo/yr	6 months @ $10,800			$10,800
LEKT Fringe Benefits Approx. 35% of staff salaries/wages.		$18,436		$9,031
Salaries and Fringe Benefits Total		$42,716		$19,831
Supplies				
Backpack shocker	LEKT property		$8,000	
PIT tag reader	LEKT property		$4,000	
GPS unit	LEKT property		$200	
Misc. office supplies (DNA paper, rite in rain), fish handling supplies, waders and boots, maint. & service etc.		$3,200		
PIT tags	400 @ $2.75/tag	$ 1,100		
Supplies Total		$4,300	$12,200	$19,831
Other				
DNA analysis (CRITFC)	400 @ $30/sample	$12,000		
Vehicle costs				$6,000 (Tribally owned vehicle)
Other Total		$12,000	$12,200	$6,000
Indirect	28.19%	$12,041		
Subtotal		59,016		
		Requested	**Match**	**Other**
Totals		**$71,057**	**$12,200**	**$25,831**

11. Timeline of major tasks and milestones:

DATE	PROJECT GOALS/ACTIVITIES
May 2021	• Apply secure permits • Create field datasheets and databases. • Order equipment.
Spring/ Summer 2021	• Secure genetic contract with CRITFC • Create data sheets and spreadsheets • Conduct nest/larval lamprey surveys. • Collect DNA samples. • Enter data
Fall 2021- Spring/Summer 2022 Fall 2022	• Conduct nest/ larval lamprey surveys. • Collect/organize DNA samples. • GIS mapping/manage databases. • Analyze data • Ship DNA samples • Report writing • Final report: October 31, 2022

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13. Letters of Support:

CLALLAM COUNTY
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MARY ELLEN WINBORN, DIRECTOR

August 3, 2020

Hello,

I am writing to support the Lower Elwha Klallam Tribe's Pacific Lamprey tagging and tracking project, which seeks to understand the presence/absence and genetics in the urban streams located east of the Elwha River in the city of Port Angeles. The project may also yield migration data.

A lamprey shocker will be used on 4 urban streams to determine presence/absence of Pacific Lamprey. Where found, genetic samples will be taken. If large enough, the Lamprey will be implanted with a PIT tag.

Furthering our understanding of Pacific Lamprey is key to recovering the population and restoring ecosystems of the Salish Sea.

Thank you
Cathy Lear
Habitat Biologist

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MARY ELLEN WINBORN, DIRECTOR

August 5, 2020

To Whom It May Concern,

I am writing to express full support for the Lower Elwha Klallam Tribe's Pacific Lamprey tagging and tracking project. The project seeks to understand the presence/absence and genetics in four urban streams located in the City of Port Angeles. In addition, the project may also provide information on lamprey migration.

The presence/absence of Pacific Lamprey will be determined in the following urban streams; Tumwater, Peabody, Ennis and Morse creeks, using a lamprey shocker. Where found, genetic samples will be taken and a PIT tag will be implanted if the lamprey is large enough.

Pacific Lamprey has been identified as a species of concern by USFWS. Available information on the abundance of Pacific lamprey in western Washington is limited and largely anecdotal. It is therefore important to further our understanding of the distribution of Pacific Lamprey in order to recover the population and restore ecosystems of the Salish Sea.

Sincerely,

Project Coordinator
Clallam Marine Resources Committee

Project Title: Lamprey Distribution and Abundance in Urban Streams, Olympic Peninsula, WA

Project Applicant/Organization: Miranda Plumb, Jeffery Johnson, Pat DeHaan
USFWS Western Washington Fish & Wildlife Conservation Office
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Project type: assessment
Lamprey RMU populations: Washington Coast and Puget Sound/Strait of Juan de Fuca RMUs
NPCC Subbasin (4th HUC Field) name: Sampling will be conducted in all HUC 8 identified for the Washington Coast and Puget Sound/Strait of Juan de Fuca RMUs
Project location: Olympic Peninsula and Puget Sound area, WA
Project Coordinates: multiple coordinates in RMUs

Total Requested funds: $40,059

1. Short Project Summary:

Pacific lamprey (*Entosphenus tridentatus*) are an anadromous species important to freshwater ecosystems along the Pacific Rim (Close et al. 2002). A decline in Pacific lamprey populations was noted and an effort to improve the status of Pacific lamprey throughout their range in the United States was developed. In 2012, several tribes and the U.S. Fish and Wildlife Service along with other state, local, and federal agencies committed to the Pacific Lamprey Conservation Initiative. This project focuses on the lamprey assessment component of the Initiative. The assessment tracks the known information on Pacific lamprey habitat requirements, abundance, historic and current distribution, threats, and other information.

Currently, limited information exists regarding the distribution of Pacific lamprey in many western Washington watersheds outside of the Columbia River Basin. Although they are likely present in many streams year round, juvenile Pacific Lamprey are often not detected in routine surveys for other species (e.g., electrofishing surveys for Pacific salmon, snorkel surveys; Reid and Goodman 2015). Targeted surveys using alternative, lamprey-specific methods have been successful and have helped to obtain accurate information on the species presence and distribution (Moser et al. 2007; Dunham et al. 2013). Information on the distribution and abundance of Pacific Lamprey is important for refining assessment data (especially in Puget Sound and coastal Washington watersheds) and prioritizing habitat protection and restoration efforts.

2. Detailed Project Description:

Recently, occupancy models have emerged as a useful tool for estimating the distribution of fish species that are patchily distributed and may be difficult to sample; including Pacific Lamprey (Reid and Goodman 2015). These models utilize multiple sampling events and information on habitat attributes to estimate the probability of species occurrence in a given area (MacKenzie et al. 2006). Environmental DNA (eDNA) represents another useful tool for determining the distribution of species that are difficult to sample using traditional methods (Goldberg et al.

2011). One particularly useful attribute of aquatic eDNA surveys is that this technique allows large areas to be surveyed in a fraction of the time required by traditional methods. Several studies have suggested increased detection ability with eDNA surveys, although limitations of this method do exist and data must be interpreted correctly (Goldberg et al. 2016). Environmental DNA detection methods have been developed for Pacific Lamprey and used to fill critical data gaps in their distribution (Carim et al. 2017; Ostberg et al. 2019). Recently, several studies have utilized a combination of traditional field sampling and eDNA surveys to inform occupancy models for species of conservation concern where data on distribution is limited (Schmelzle and Kinziger 2016; Sutter and Kinziger 2019; Smith and Goldberg 2020).

Our primary objective is to fill data gaps in the distribution of Pacific Lamprey in watersheds in coastal Washington and Puget Sound. We aim to do this using both lamprey-specific electrofishing surveys and eDNA surveys to develop occupancy models for the species. We will conduct eDNA surveys at regular spatial intervals in all HUC 8s within the Coastal Washington and Puget Sound Regional Management Units (RMUs) identified in the PLCI. At each site we plan to filter 5 liters of water following protocols developed by the USFWS Alaska Conservation Genetics Lab. Filters will be preserved at -20 C until laboratory analysis. Laboratory staff will use existing eDNA assays for Pacific Lamprey (Carim et al. 2017) to determine Pacific Lamprey presence or absence for each site. In order to decrease the probability of type II error (failure to detect lamprey when they occupy a site) we will collect three eDNA samples (i.e., water filters) at each site. We also plan to return to a subset of our eDNA sites to conduct Lamprey specific electrofishing surveys. Briefly, surveys will use Lamprey specific electrofisher settings (Lamprey Technical Workgroup 2020) and focus on the stream margins along a 50 m transect at each site. Lamprey > 60 mm that we capture will be identified to species. If any Pacific Lamprey are captured, we will classify a site as occupied.

At each sampling location, we will collect data on habitat characteristics (i.e. site-level covariates; flow, depth, substrate type, canopy cover, slope, river kilometer), to model occupancy probability. Additionally, we will collect information describing the conditions at the time of sampling (observation-level covariates; temperature, turbidity), to model detection probability for each sampling method under heterogeneous conditions. First, we will apply a multi-scale occupancy modeling approach to investigate differences in detection probability among the two sampling methods. Second, the top model of detection will be incorporated into a suite of occupancy models to determine habitat characteristics that influence Pacific Lamprey probability of occupancy (Nichols et al. 2008). The top model of occupancy will be used to back-transform probabilities of occupancy to site-level covariate data to generate a distribution map (Kery et al. 2013). Additionally, site-level covariates that are able to be remotely gathered (slope, river kilometer) will be used to construct a subset of occupancy models. We will then estimate Pacific Lamprey probability of occupancy at a much larger spatial scale than we are able to physically sample.

3. Descriptive Maps:

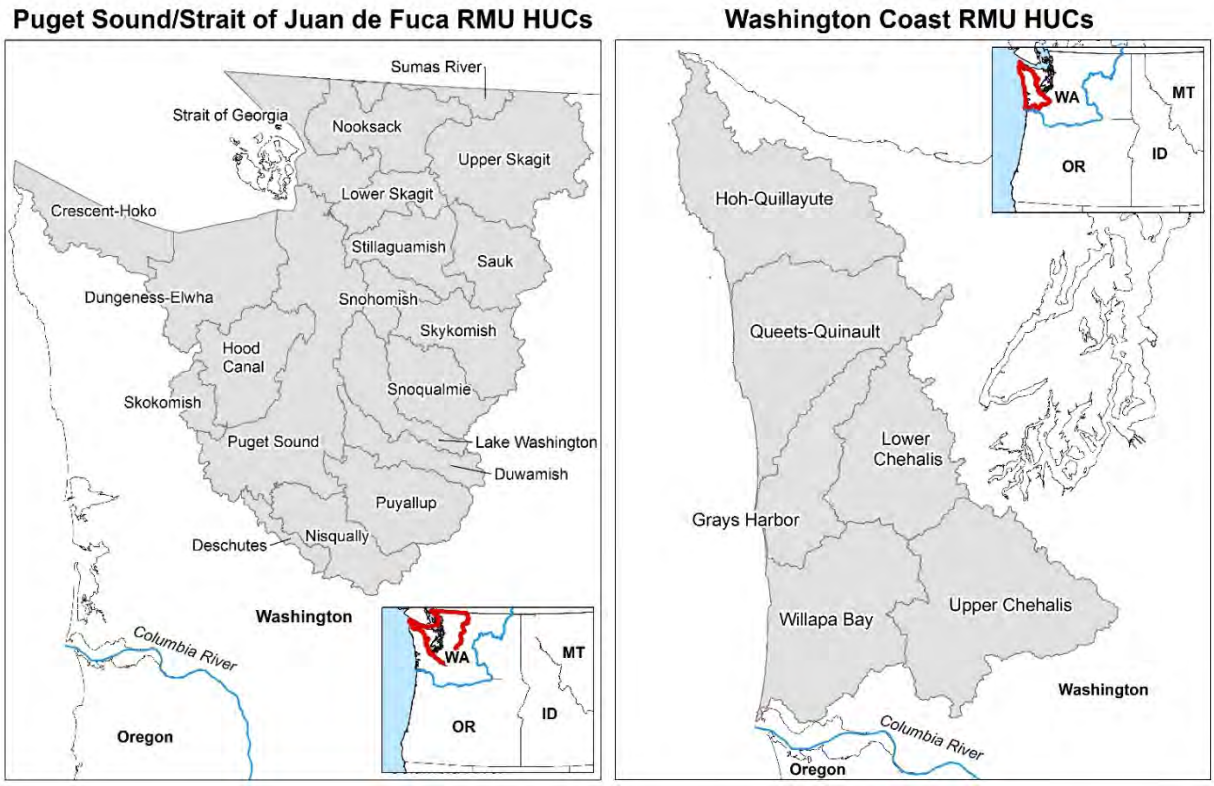

Figure 1. HUC 8 eDNA surveys at regular spatial intervals within the Coastal Washington and Puget Sound Regional Management Units.

4. Linkage of Actions to Identified Threats for Lampreys in RMU(s):

Lack of awareness, stream and floodplain degradation, dewatering and flow management, and climate change were identified as threats to Pacific Lamprey in the HUCs ranked in the Puget Sound/Strait of Juan de Fuca and Washington Coast RMUs. This project will address all of those and most specifically address lack of awareness. There is still a large portion of the human population that is not aware of lamprey, its importance to freshwater ecosystems, and how to avoid impacts to them. This project will gain needed information on lamprey distribution and will be shared with partner agencies and the public. The data collected will be added to the PLCI data clearinghouse. Our distribution and habitat information will be used to inform management agencies and stakeholders which variables best predict lamprey distribution.

5. Species/Habitat Benefits:

Pacific Lamprey have been documented historically and recently in several watersheds within the Puget Sound and Washington Coast RMUs; however, much of the available data is based on anecdotal and/or opportunistic observations and few targeted surveys for the species exist. This lack of information has led to data gaps in the current Nature Serve model, uncertainty regarding the species current distribution, and in turn, lack of information to prioritize conservation actions in these RMUs. Our goal is to conduct Pacific Lamprey specific surveys to help refine the species distribution in the Puget Sound and Washington Coast RMUs, while also informing sampling strategies via modeling detection probability under variable conditions.

6. Measurable Results:

The current lack of information regarding the distribution and abundance of Pacific Lamprey in Puget Sound and Coastal Washington watersheds has limited the ability to prioritize recovery actions for the species in these two RMUs. Data generated from this study will allow the USFWS to work with partners to identify priority watersheds and prioritize conservation actions for Pacific Lamprey in the Washington Coast and Puget Sound RMUs. These actions will benefit life stages of Pacific Lamprey in freshwater habitats.

7. Priority Objectives and Goals:

The Washington Coast and Puget Sound/Strait of Juan de Fuca Regional Implementation Plan and the PLCI Pacific Lamprey Assessment (February 2019) both clearly state the need for more information to fill data gaps and to refine lamprey distribution information in the western Washington RMUs. This project will address the needs outlined in the RIP. Once more data is gathered for the currently unknown areas on the Olympic Peninsula and Puget Sound the RIP will be more robust and lead toward identifying and implementing priority conservation actions for lamprey.

This project will address Objective Three of the National Fish Habitat Partnership National Fish Habitat Action Plan 2nd Edition (2012). Objective Three addresses raising public awareness of the role healthy fish habitats play related to the well-being of local communities. The proposed project will increase public awareness of lamprey existing in their local streams and provide information for them to understand the connection lamprey have to the popular salmon fisheries in the area. The project will also address Objective Four which highlights the need to fill data gaps. In order to make science-based management decisions we need to have fewer data gaps in lamprey and other fisheries information.

This project addresses multiple goals in the Strategic Plan for the USFWS Fish and Aquatic Conservation Program FY2016-2020. Refining lamprey distribution information and learning more about movement and behavior clearly addresses the Goals to Conserve Aquatic Species (Objective 3: Prevent declines of other priority species by addressing recognized threats as soon as possible); and Conserve, Restore and Enhance Aquatic Habitats.

8. Project Design / Feasibility:

Permits required for this project will be a Washington Department of Fish and Wildlife Scientific Collection Permit and a NOAA Fisheries Section 10(a)(1)(A) permit authorizing take of listed species (required for scientific collection activities in Puget Sound). Our office has obtained these permits in the past for other projects and we anticipate no problems with acquiring them for this project ahead of the start of the 2021 field season. Bull Trout occur in many of the watersheds where we would be collecting Pacific Lamprey and our office has an existing Bull Trout recovery permit. We will add watersheds we plan to collect Pacific Lamprey to this permit for 2021.

We anticipate beginning this project in the summer of 2021. This proposal will cover funds for FY2021, although given the large geographic scope of this work, we anticipate it will take multiple years to complete our surveys and analyze the data.

8. Partner Engagement and Support:

This project will engage partners in two ways. First, we hope to coordinate with a number of Federal, State, Tribal, and NGO partners on our field collection efforts. USFWS staff will plan and lead collection efforts; however, we plan to reach out to partners for assistance during field work. Our hope is that this will help build awareness for Pacific Lamprey in the Coastal Washington and Puget Sound RMUs and get our partners who routinely survey these watersheds for other fish species (mainly Pacific salmonids) to start thinking about how they might expand routine monitoring efforts to include Pacific Lamprey surveys. By engaging partners in field survey efforts, we hope to increase the frequency that new distribution and abundance data is added to the existing Pacific Lamprey data clearinghouse and the NatureServe Occupancy and Relative Risk Ranking Maps.

The other way we hope to engage partners on this project is to raise the general awareness surrounding Pacific Lamprey conservation efforts in Western Washington. Thus far we have had limited partner engagement on our Pacific Lamprey Conservation planning initiatives. Our hope is that by engaging partners in this effort, they will gain an understanding and appreciation for Pacific Lamprey and their role in healthy aquatic ecosystems in Western Washington.

Partners we have been in contact with and hope to engage on this project include: Olympic National Park, Olympic National Forest, Several tribes (Chehalis, Quinault, others from Puget Sound), Washington Department of Fish and Wildlife, Washington Department of Natural Resources, Washington Coast Salmon Partnership.

9. Monitoring and Reporting:

This project covers a large geographic scope and will likely take multiple years to complete. Data on the species distribution and detection modeling resulting from this project represents baseline information that will inform future monitoring efforts for the species in these two RMUs. Upon completion of this project and dissemination of our results, we anticipate that USFWS and several partner agencies (US Forest Service, NOAA Fisheries, WDFW, WDNR, numerous tribal partners) will have baseline information that they can incorporate into existing monitoring efforts (e.g., juvenile salmonid surveys) and help to refine.

The completion of the project will be documented in a final report and may include an annual report, depending on the source of funding and the timeframe of completion.

10. Project Budget (including overhead):

Pacific Lamprey Occupancy Modelling Budget			
Salaries			
	# Weeks	Weekly Salary + Fringe	Total
GS09 Term Biologist	6	$1,345.80	$8,074.80
Technician	8	$392.26	$3,138.08
Technician	8	$392.26	$3,138.08
Total Salary Costs			**$14,350.96**
Field supplies (Lamprey electrofisher, waders, etc.)			$10,000.00
	# samples	Cost per sample	
Analysis of eDNA samples	200	$45.00	$9,000.00
Travel Costs			$4,800.00
Subtotal			**$38,150.96**
WWFWCO Admin Costs			$1,907.55
TOTAL RIP funds requested			**$40,058.51**

*This budget represents the initial year of sampling for this project including some field equipment purchases
*We would be able to implement the project with a reduced budget using cost-sharing from WWFWCO base funds

11. Timeline of major tasks and milestones:

DATE	PROJECT GOALS/ACTIVITIES
Fall 2020	• Apply for required permits • Create field datasheets and databases. • Order equipment.
Fall 2020-Fall 2021	• Create data sheets and spreadsheets • Conduct surveys • Collect DNA samples and send to lab • Enter data
Fall 2021- Spring/Summer 2021	• Conduct surveys • Collect DNA samples and send to lab • GIS mapping/manage databases. • Analyze data • Report writing

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