Pacific Lamprey

2020 Regional Implementation Plan

for the

Mid-Columbia

Regional Management Unit

Submitted to the Conservation Team August 12th, 2020

Primary Authors		Primary Editors
J Poirier	U.S. Fish and Wildlife Service	

This page left intentionally blank

I. Status and Distribution of Pacific Lamprey in the RMU

General Description of the RMU

The Mid-Columbia River Regional Management Unit (RMU) includes watersheds that drain into the Columbia River mainstem from the Walla Walla River at Rkm 507, west to Bonneville Dam at Rkm 235 (Figure 10-1). It is comprised of sixteen 4th field HUCs ranging in size from 1,793−8,158 km^2 (Table 1). Watersheds within in the Mid-Columbia RMU include the Walla Walla, Umatilla, Willow, Middle Columbia-Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Upper Deschutes, Little Deschutes, Beaver-South Fork, Upper Crooked, Lower Crooked and Trout watersheds (Figure 1).

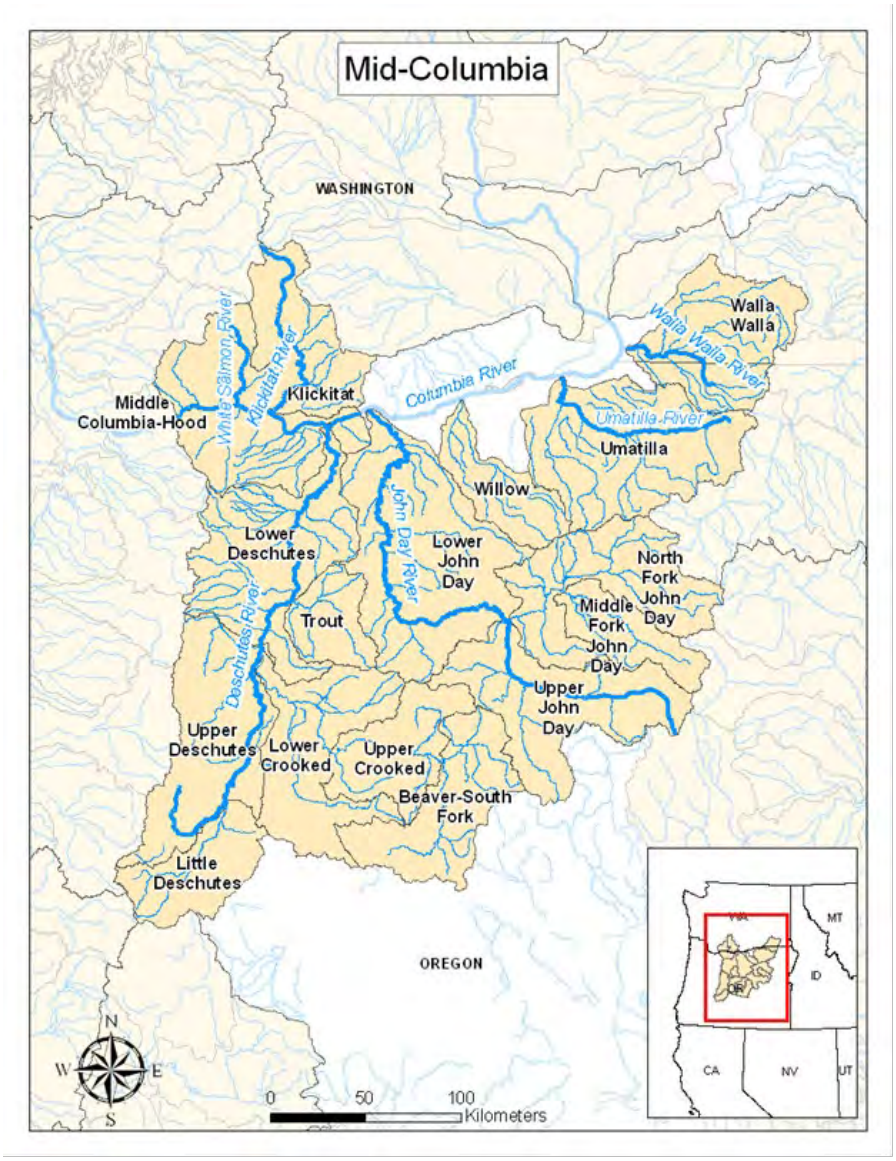

Figure 1. Map of watersheds within the Mid-Columbia Regional Management Unit.

Table 1. Drainage size and Level III Ecoregions of the 4th Field Hydrologic Unit Code (HUC) watersheds located within the Mid-Columbia Region.

Watershed	HUC Number	Drainage Size (km^2)	Level III Ecoregion(s)
Walla Walla	17060102	4,612	Columbia Plateau, Blue Mountains
Umatilla	17060103	6,553	Columbia Plateau, Blue Mountains
Willow	17060104	2,248	Columbia Plateau, Blue Mountains
Mid-Columbia – Hood	17060105	5,587	Cascades, Eastern Cascade Slopes, Columbia Plateau
Klickitat	17060106	3,501	Cascades, Eastern Cascade Slopes, Columbia Plateau
Upper John Day	17070201	5,548	Blue Mountains
North Fork John Day	17070202	4,795	Blue Mountains
Middle Fork John Day	17070203	2,056	Blue Mountains
Lower John Day	17070204	8,158	Columbia Plateau, Blue Mountains
Upper Deschutes	17070301	5,578	Cascades, Eastern Cascade Slopes, Blue Mountains
Little Deschutes	17070302	2,726	Cascades, Eastern Cascade Slopes
Beaver-South Fork	17070303	3,968	Blue Mountains, Northern Basin
Upper Crooked	17070304	2,995	Blue Mountains, Northern Basin
Lower Crooked	17070305	4,787	Cascades, Eastern Cascade Slopes, Blue Mountains, Northern Basin
Lower Deschutes	17070306	5,944	Cascades, Eastern Cascade Slopes, Columbia Plateau, Blue Mountains
Trout	17070307	1,793	Columbia Plateau, Blue Mountains

Status of Species

Conservation Assessment and New Updates

Current Pacific Lamprey distribution in the Mid-Columbia RMU is still greatly reduced from historical range. Distribution of lamprey has remained the same in most watersheds since the completion of the 2011 Assessment (Table 2). A compilation of all known larval and adult Pacific Lamprey occurrences in the Mid-Columbia RMU are displayed in Figure 2, which is a product of the USFWS data Clearinghouse .

Population abundance of Pacific Lamprey in the Mid-Columbia RMU is largely unchanged since the 2011 Pacific Lamprey Assessment, with estimates ranging from zero to over 2,500 fish (Table 2). The Umatilla is the only watershed that has seen an increase in adult populations over the last 5-10 years. The Confederated Tribes of the Umatilla Indian Reservation has an active Pacific Lamprey translocation program, ongoing for the last 20 years. This program has contributed to increases in rearing larval lamprey and number of returning adults (Jackson et al. 1997, Close et al. 2003, Howard et al. 2004).

Mainstem dam counts provide one of the only long term records of adult Pacific Lamprey numbers in the Columbia River basin. Despite data gaps and monitoring inconsistencies, counts

of adult Pacific Lamprey at Bonneville Dam indicate a significant downward trend in abundance over time. Counts of adult Pacific Lamprey prior to 1970 averaged over 100,000 fish (1939-1969), while the recent 10-year average is just over 34,000 fish (FPC 2019). Although no long term count of Pacific Lamprey exists in Mid-Columbia tributaries, populations are believed to be declined by 10-70% (Table 2).

The status of Pacific Lamprey in Willow Creek is unknown. Surveys conducted in 2010 and 2011 found only Western Brook Lamprey at a single location out of the 11 sites surveyed in Willow and Rhea Creek (Reid et al. 2011). Willow Creek dam (RM 52.4) provides no fish passage and targeted sampling has not occurred in the basin. Pacific Lamprey are still believed to be extirpated from the Walla Walla River. Although Western Brook Lamprey are present in the basin, Pacific Lamprey have not been observed during ongoing electrofishing, screw trap and spawning survey efforts. The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) will be conducting environmental DNA (eDNA) sampling in smaller lateral tributaries of the John Day River as well as the Walla Walla River and Willow Creek in summer 2020. Results will provide information about Pacific Lamprey distribution on CTUIR ceded lands and will also inform the Pacific Lamprey Conservation Initiative Pacific Lamprey distribution database (see Databasin.org). The Umatilla tribe will also be conducting releases of artificially propagated Pacific Lamprey into the Walla Walla River as part of the Lamprey Master Supplementation Plan (CRITFC 2018). Pacific Lamprey are believed to be extirpated in Trout Creek as well as the Deschutes River basin upstream from Pelton Dam.

Table 2. Population demographic and conservation status ranks (see Appendix 1) of the 4th Field Hydrologic Unit Code (HUC) watersheds located in the Mid-Columbia RMU. Note – steelhead intrinsic potential 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)
Walla Walla	17060102	SX	1000-5000	Extinct	Zero to 1-50	>70%
Umatilla	17060103	S1↓	1000-5000	100-500	1000-2500	10-30%
Willow	17060104	SU	Not ranked	Not ranked	Not ranked	Not ranked
Mid-Columbia – Hood	17060105	S1↓	1000-5000	100-500	250-1000	Unknown
Klickitat	17060106	S1	1000-5000	20-100	50-250	50-70%
Upper John Day	17070201	S1	1000-5000	100-500	50-1000	50-70%
North Fork John Day	17070202	S1	1000-5000	100-500	50-1000	50-70%
Middle Fork John Day	17070203	S1	1000-5000	100-500	250-1000	50-70%
Lower John Day	17070204	S1↓	5000-20,000	100-500	50-1000	50-70%
Upper Deschutes	17070301	SX	1000-5000	Extinct	Extinct	Not ranked
Little Deschutes	17070302	SX	Not ranked	Extinct	Extinct	Not ranked
Beaver-South Fork	17070303	SX	1000-5000	Extinct	Extinct	Not ranked
Upper Crooked	17070304	SX	1000-5000	Extinct	Extinct	Not ranked
Lower Crooked	17070305	SX	1000-5000	Extinct	Extinct	Not ranked
Lower Deschutes	17070306	S1S2	1000-5000	100-500	2500-10,000	10-50%
Trout	17070307	SH	1000-5000	Zero	Zero	Unknown

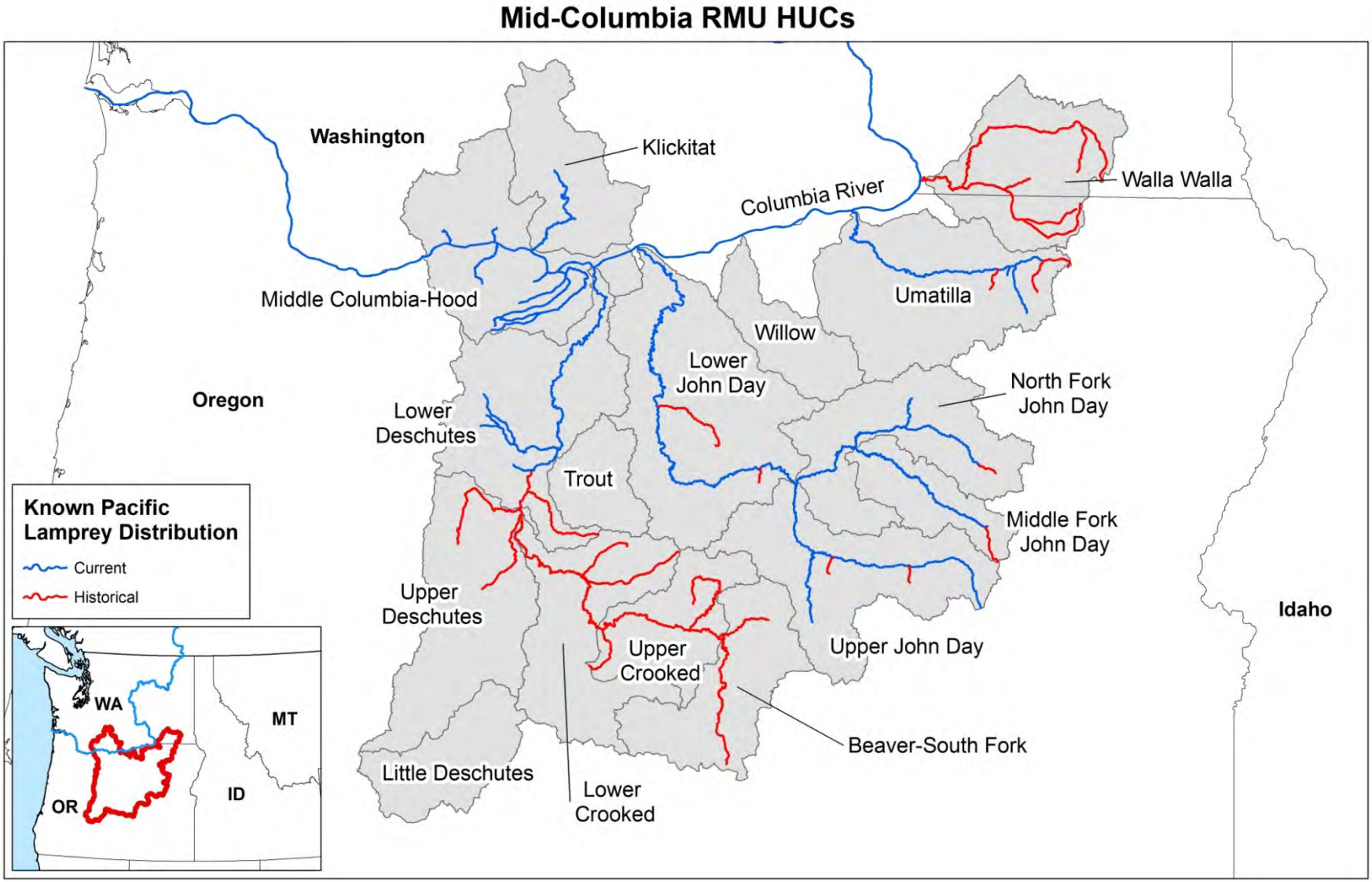

Figure 2. Current and historical known distribution for Pacific Lamprey: Mid-Columbia RMU (USFWS Data Clearinghouse 2019). Historical Pacific Lamprey distribution depicted in map was obtained from published literature, tribal accounts and state and federal agency records.

Distribution and Connectivity

Passage for both adults and juveniles in the Mid-Columbia RMU is impeded by four Federal Columbia River Power System (FCRPS) dams (Bonneville, The Dalles, John Day, and McNary). A multi-agency effort to assess and reduce the impact of mainstem passage is ongoing (CRITFC 2011; USACE 2009). Threats to passage within tributaries were considered moderate in the Mid-Columbia RMU. Four dams that previously blocked fish passage have been removed from the region including Hemlock Dam on the Wind River (2009), Powerdale Dam and Odell Dam on the Hood River (2010 and 2016), and Condit Dam on the White Salmon River (2011). In the Umatilla River basin, adult lamprey passage structures (i.e. Lamprey Passage System or flat plates) have been installed at Three Mile Falls diversion, Maxwell diversion dam, and Feed Diversion Dam to enhance passage. Additionally, three large diversion dams (Boyd's, Dillon and Brownell diversion dams) were recently removed on the lower Umatilla River. In the John Day basin, over 100 push-up diversion dams have been removed to restore fish passage (Brent Smith, Oregon Department of Fish and Wildlife, personal communication).

While many passage barriers have been removed or structurally modified to improve passage, the region is still affected by a number of dams (e.g., Willow Creek Dam, McKay Dam (Umatilla River), Pelton Round Butte Hydroelectric Project), and low elevation water diversions. Irrigation diversions for crops and/or livestock are numerous, particularly in the Mid-Columbia/Hood, Walla Walla, Umatilla and John Day basins. Contemporary structures are required to operate and maintain screening or by-pass devices to protect fish from impingement or entrainment. Unfortunately there are still a large number of diversions with no screens or inadequate screening that may entrap or impinge migrating juveniles. The structural design of diversion dams may also delay or inhibit the passage of adult lamprey that are unable to navigate past sharp edges (e.g. 90° angles), especially in areas of high velocity (e.g., dam crest; Pacific Lamprey Technical Workgroup 2017).

Fish hatcheries in the lower Columbia River basin often utilize barrier dams/weirs and fish ladders to divert returning adult salmon into the hatchery during brood collection. Many of these structures are major barriers to adult Pacific Lamprey. In the Klickitat River, very few Pacific Lamprey larvae are observed upstream from the Klickitat Hatchery where a low head weir likely hinders adult passage. In addition, the surface water intake pump inadvertently diverts larval lamprey into hatchery ponds where they later become stranded when ponds are dewatered (Ralph Lampman, YNF, personal communication).

The cumulative impacts from this series of passage impediments likely impose a significant impact on distribution and connectivity for Pacific lamprey in most of the watersheds (Clemens et al. 2017).

Threats

Summary of Major Threats

The following table summarizes the key threats within the Mid-Columbia RMU tributaries as identified by RMU participants during the Risk Assessment revision meeting in April 2017 (High = 4; Moderate/High = 3.5; Moderate = 3; Low/Moderate = 2.5; Low = 2; Unknown = no value).

Table 3. Summary of the Assessment results for the key threats of the Mid-Columbia RMU

	Tributary Passage		Dewatering and Flow Management		Stream and Floodplain Degradation		Water Quality		Small Population Size		Lack of Awareness		Climate Change		Mainstem Passage	
Watershed	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity
Walla Walla	4	4	4	4	4	4	3.5	3.5	4	4	3	3	3.5	3.5	4	4
Umatilla	4	3	3	3.5	4	4	3.5	3	3.5	3.5	3	3	3.5	3.5	4	4
Willow	4	4	4	4	4	4	3.5	3.5			4	4	4	4	4	4
Mid-Columbia/Hood	2	2	3	4	3	3	3.5	3.5	2.5	2.5	2.5	2.5	4	4	4	4
Klickitat	3	3	2	2	2	2	4	3.5	3.5	3.5	3.5	3	3	3	4	4
Upper John Day	3.5	3.5	3.5	3.5	3.5	4	4	4	3	3	3	3	3.5	3.5	4	4
North Fork John Day	2	2	2.5	2.5	2.5	2.5	3	3	3	3	3	3	3.5	3.5	4	4
Middle Fork John Day	2	2	2.5	2.5	3.5	3.5	3	3	3	3	3	3	3.5	3.5	4	4
Lower John Day	3	3	4	4	3.5	3.5	4	4	2	2	3	3	3.5	3.5	4	4
Lower Deschutes	2	2.5	1.5	1.5	2.5	2.5	2	2	2	2	2	2	3.5	3.5	4	4
Mean	3.30	3.27	3.00	3.15	3.21	3.25	3.36	3.27	3.32	3.32	3.33	3.30	3.55	3.55	4.00	4.00
Rank	M	M	M	M	M	M	M	M	M	M	M	M	H	H	H	H
Mean Scope & Severity	3.28		3.08		3.23		3.32		3.32		3.32		3.55		4.00	
Drainage Rank	**M**		**M**		**M**		**M**		**M**		**M**		**H**		**H**	

Current Threats

Among the many threats identified in the Mid-Columbia RMU, some showed a pervasive impact in the entire region, such as *Mainstem Passage*, *Climate Change*, and *Lack of Awareness*. Other threats were more location specific, but nevertheless showed significant impacts at the local scale, such as *Tributary Passage*, *Dewatering and Flow Management*, *Stream and Floodplain Degradation*, and *Water Quality* (Clemens et al. 2017).

Mainstem and Tributary Passage

A summary of passage issues in Mid-Columbia tributaries were described in the previous section (Distribution and Connectivity). Threats associated with adult and juvenile passage at mainstem FCRPS dams are described in the 2020 Regional Implementation Plan for the Mainstem Columbia River Regional Management Unit (see https://www.fws.gov/pacificlamprey/PLCI_RIPs.cfm).

Climate change

Climate changes is expected to produce changes in ambient temperature, precipitation, and streamflow patterns. In a region heavily dominated by agricultural crop production, rising ambient temperatures will likely increase demand for water for irrigation that will in turn reduce streamflows and elevate water temperatures. These conditions may restrict lamprey habitat availability, hamper adult migration, reduce reproductive capability, or contribute to increased mortality if incubating eggs, burrowing larvae or migrating juveniles are exposed to relatively warm temperatures (>20°C) for an extended duration (Clemens et al. 2016). The impacts of climate change will vary across watersheds with some areas more resilient to impacts of climate change (e.g., Klickitat), and some areas at greater risk from potential change based upon the underlying geology, impoundments, land use, or other factors. Climate change is identified as a critical subject for the Mid-Columbia RMU, but the feasibility of making tangible changes will be challenging and require large scale institutional changes. Within the Walla Walla basin, one of the strategies to combat climate change is the acquisition and subsequent protection of habitat. In the John Day basin, stream restoration (e.g., increasing channel complexity, channel deepening, riparian planting, riparian fencing) is being used as a tool to mitigate the effects of climate change.

Lack of Awareness

General knowledge of Pacific Lamprey has improved considerably within conservation and fisheries management communities, however, many stream restoration and passage improvement projects are still funded and designed to benefit salmonids with little understanding of how these actions may impact lamprey. In addition, the general public is still relatively unfamiliar with lamprey, their ecological and cultural importance, and how to avoid impacts to them.

Dewatering & flow management

Natural conditions (e.g., climate, geology, vegetation, topography) and extensive water withdrawals for irrigation leave many watersheds in the Mid-Columbia RMU dewatered or with inadequate flow during summer and fall months. These conditions are most severe in the Walla

Walla, Umatilla, and John Day basins where demand often exceeds available water supply. Streamflow is an important determinant of water quality and aquatic habitat conditions (Clemens et al. 2017). Reduced flows may increase water temperatures to critical levels, lower dissolved oxygen levels, reduce spawning and rearing habitat availability, prevent access to backwater or side channel habitats, and create low water barriers. Actions to restore and protect diminished instream flows will require large scale institutional changes involving water rights and salmonid management and will likely require a long-term effort. Current measures to improve flows include buying or leasing water rights, cooperative exchange of Columbia River water for instream flows (Umatilla Basin Project Act), diversion improvements (e.g., flow measuring devices, fish screens, conversion from flood to sprinkler systems), and irrigation efficiency projects (e.g., replacing open ditches/canals with pipe). These water efficiency improvements may help conserve water for instream flows, but with predicted trends in population growth, increased demand, and the anticipated effects of climate change, water supply issues will likely be an ongoing problem in the Mid-Columbia RMU.

Stream & floodplain degradation

Aquatic habitat conditions within the Klickitat and Lower Deschutes HUCs are relatively intact with only moderate impacts to riparian vegetation. In the majority of the Mid-Columbia RMU however, land use activities and human settlement have greatly altered the physical habitat and hydrology of the region. In upland areas, historical and ongoing timber practices have completely deforested or altered the function and diversity of riparian vegetation. Many watersheds in the RMU are lacking mature trees that play a pivotal role in bank stability, water quality protection, thermal cover, and input of wood into channels. Large wood can benefit streams by influencing the structural complexity of the channel (i.e., creating pools or undercut banks), increasing the deposition of fine substrate and organic matter, thereby providing important rearing habitat for juvenile salmonids and larval lamprey (Gonzalez et al. 2017). Within lowlands, agriculture and grazing practices have contributed to the loss of aquatic and riparian habitat. Efforts to prevent flooding and provide irrigation for crops and livestock have straightened and scoured streambeds, eliminated side channels and cut off floodplains. Cultivation, riparian clearing and conversion of land for infrastructure (e.g., railroad and roads), crops, pastures and residential development have filled and/or drained wetlands, increased soil erosion and sedimentation, and promoted the establishment and spread of invasive plant species.

Water quality

Elevated water temperature is the primary water quality concern in the Mid-Columbia RMU. Increased temperatures may be associated with excessive solar radiation, removal of riparian vegetation, reduction of instream flow, and flood irrigation water returns. Other water quality concerns include low dissolved oxygen, pH extremes, sedimentation, and the presence of bacteria, heavy metals, and toxic pollutants (e.g., insecticides, PCBs; Clemens et al. 2017). These issues are likely attributable to land use practices or other natural causes. Toxins and heavy metals may be a particular concern for Pacific Lamprey. Direct exposure to toxins in water or sediment during larval and adult life stages can result in high concentrations of contaminants accumulating in fatty tissues that may compromise fish health and development (Nilsen et al. 2015; Clemens et al. 2017). Monitoring and restoration efforts to improve and protect water quality for fish, wildlife, and human health are ongoing in the Mid-Columbia RMU.

Restoration Actions

Within the mainstem Columbia River, improvements to Bonneville, The Dalles, John Day and McNary hydroelectric dam fishways have occurred to increase adult passage success. Instream and floodplain habitat restoration activities have been implemented in the Mid-Columbia subbasins, although these actions have been designed / funded primarily for salmonid recovery. The following conservation actions were initiated or recently completed by RMU partners in the Mid-Columbia Regional Management Unit from 2012-2019.

HUC	Threat	Action Description	Type	Status
RMU	Population	Environmental DNA, spawning ground surveys, smolt trapping and occupancy sampling to better understand lamprey distribution.	Survey	Ongoing
RMU	Stream Degradation	Implementation of instream and floodplain habitat restoration activities.	Instream	Ongoing
RMU	Passage	Evaluation of juvenile entrainment mechanisms and preventative measures.	Assessment	Underway
RMU	Population	Development of protocols and techniques for artificial propagation and larval rearing of Pacific Lamprey	Research	Underway
RMU	Dewatering/ flow	Water savings through Columbia Basin Water Transactions Program	Instream	Ongoing
RMU	Population	Conservation Plan for Lampreys in Oregon (ODFW) *https://www.dfw.state.or.us/fish/CRP/coastal_columbia_snake_lamprey_plan.asp*	Other	Complete
RMU	Population	Artificial propagation and larval rearing (YN, CTUIR, USFWS)	Supplementation	Ongoing
RMU	Population	Mesocosm experiment to investigate performance of artificially propagated larvae and juveniles vs wild fish	Research	Proposed
RMU	Population	eDNA sampling in tributaries of John Day River, Walla Walla River and Willow Creek	Survey	Underway
RMU	Dewatering/ flow	Study to evaluate fate of salvaged larval lamprey during dewatering events	Research	Underway

RMU	Disease	New lamprey pathogen publication (Jackson et al. 2019)	Research	Complete
Columbia River	Population	Seasonal abundance of larval lamprey at confluence of 3 tributaries in Bonneville Dam reservoir and 3 tributaries below Bonneville Dam (5 year study)	Survey	Underway
Columbia River	Population	eDNA sampling at Bonneville, McNary, Wells and Rocky Reach to determine number of PCL DNA copies/second.	Survey	Complete
Walla Walla–Umatilla–John Day	Population	Master Plan for Pacific Lamprey Artificial Propagation, Translocation, Restoration, and Research (CRITFC, YN, CTUIR, NPT)	Other	Complete
Walla Walla	Population	Release of artificially propagated lamprey as part of Master Supplementation Plan	Instream	Proposed
Umatilla	Population	Translocation/reintroduction of adult Pacific Lamprey.	Instream	Underway
Umatilla	Population	Monitoring larval density trends and adult passage success to spawning areas.	Instream	Underway
Umatilla	Population	Collection of genetic samples to contribute to ongoing work by John Hess (CRITFC)	Survey	Ongoing
Umatilla	Population/ Passage	Ongoing larval and juvenile lamprey PIT tagging study	Instream	Underway
Umatilla	Passage	Installation of Lamprey Passage Systems to enhance passage for Pacific Lamprey at three water diversion dams.	Instream	Complete
Umatilla	Passage	Telemetry to assess use of Lamprey Passage Systems at diversion dams.	Assessment	Complete
Umatilla	Passage	Sampling of Bureau of Reclamation canals to estimate extent of juvenile entrainment into diversions.	Survey	Ongoing
Umatilla	Passage	Removal of Boyd, Dillon and Brownell diversion dams.	Instream	Complete
Mid-Col. Hood	Passage	Monitoring natural recolonization above former site of Powerdale Dam on Hood River and Condit	Survey	Ongoing

		Dam on White Salmon River.		
Mid-Col Hood	Population	Larval occupancy/density surveys in principal tributaries.	Survey	Ongoing
Mid-Col Hood	Population	Electrofishing in White Salmon and Wind Rivers to assess distribution and abundance of larval lamprey	Survey	Underway
Mid-Col Hood	Population	Course scale eDNA sampling on White Salmon River and tributaries	Survey	Complete
Mid-Col Hood	Population	Survey to assess Pacific Lamprey recolonization of White Salmon River following Condit Dam removal	Survey	Proposed
Klickitat	Population	Distribution surveys of mainstems and principal tributaries.	Survey	Ongoing
Klickitat	Passage	Modification/improvements to Lamprey Passage Structure at Lyle Falls fish ladder.	Instream	Underway
Klickitat	Passage	Passage improvement for adult Pacific Lamprey at Klickitat Hatchery weir	Instream	Proposed
Klickitat	Population	Electrofishing in tributaries to assess distribution and abundance of larval lamprey	Survey	Underway
Klickitat	Population	Course scale eDNA sampling on mainstem and confluence of all tributaries	Survey	Complete
John Day Basins	Population	Collected genetic samples and PIT tagged ≈400 PCL (>100 mm) in NF John Day	Survey	Complete
John Day Basins	Stream Degradation	Large channel restoration project in core area for lamprey (Middle Fork John Day)	Instream	Underway
John Day Basins	Passage	Removal of over 100 push-up diversion dams	Instream	Ongoing
John Day Basins	Passage	Fish screening improvements	Instream	Ongoing
Lower Deschutes	Passage	Installation of LPS and video monitoring system at Warm Springs National Fish Hatchery fishway	Instream	Complete

II. Selection of Priority Actions

A. Prioritization Process

Members of the Mid-Columbia RMU had a virtual meeting on May 11th, 2020 to discuss completed and ongoing conservation actions and identify specific projects and research needed to address threats and uncertainties within the region. The following project proposal was submitted by RMU partners for the Mid-Columbia RMU in 2020:

- Quantifying Contaminants in Adult Lamprey from Tributaries of the Deschutes River on the Warm Springs Reservation

B. High Priority Proposed Project Information

Project Title: Quantifying Contaminants in Adult Lamprey from Tributaries of the Deschutes River on the Warm Springs Reservation

Project Applicant/Organization: U.S. Geological Survey (USGS)
Contact Person: Casie Smith
Email: cassandrasmith@usgs.gov
Phone: 541-383-5589 (telework phone: 864-316-5191)

Project Type: **Research**

Lamprey RMU population(s): Mid-Columbia
Multi-RMU project? Please list RMUs
Mid-Columbia and Lower Columbia

Watershed (5th HUC Field): The study area encompasses multiple 5th HUC fields:
1707030601
1707030603
1707030604
1707030605
1707030606
1707030611
NPCC Subbasin (4th HUC Field) name: Lower Deschutes (HUC 17070306)
Project Location: Warm Springs Reservation
Project Coordinates (latitude and longitude, decimal degrees, NAD 1983):
44.763718, -121.232550

Total Requested funds: $95,712.44

1. Short Project Summary (200 words or less):

Fisheries biologists with the Confederated Tribes of Warm Springs (CTWS) are concerned about water and habitat quality on Reservation lands, as related to the health of local people and wildlife. There are multiple suspected contaminant sources to three tributaries of the Deschutes River (Warm Springs River, Dry Creek, and Shitike Creek). However, these contaminant sources are poorly understood and have not been adequately studied. Before the CTWS can prioritize the issues and make management decisions, they need data identifying the contaminants and concentrations found in the aquatic environment and tissues of fish species of concern, including Pacific lamprey.

Data collected by USGS in 2019 characterized contaminants in sediment and larval lamprey tissues on Reservation lands, and this proposed study will compliment and extend the understanding of contaminants in the tributaries on the Warm Springs Reservation. The goals of this study are to 1) characterize the contaminants present in water and adult lamprey tissues at selected sites on the CTWS Reservation, 2) compare contaminant concentrations to biologically relevant thresholds and human health consumption guidelines, and 3) prioritize areas of concern

for local decision-making.

2. Detailed Project Description (500 words or less):

USGS and CTWS will coordinate to select sampling locations near suspected point sources of contaminants, based on information from CTWS and the results of previous sampling. To characterize contaminant inputs from a point-source effluent, the team will collect depth- and width-integrated water samples downstream of the effluent, near a USGS stream gage. Water samples will be collected during both high streamflows (late spring) and low streamflows (summer) and will be representative of the cross section of the channel. Fisheries biologists with the CTWS will collect three adult lampreys from each tributary containing potential point sources, when possible; 13 total lampreys will be collected, which includes one quality assurance/quality control sample. To minimize lamprey mortality, adult lamprey that perish naturally on the Reservation (and are collected and frozen quickly) will also be included, if available, as opportunistic samples.

Target analytes for tissue samples will include more than 50 halogenated organic contaminants (including flame retardants, PCBs, DDT), organochlorines, current use pesticides, and several contaminants of emerging concern, including endocrine-disrupting compounds. Tissue samples will also be analyzed for four metals (mercury, arsenic, cadmium, and selenium) that are related to human health and consumption guidelines. Whole water samples will be analyzed for more than 50 halogenated organic contaminants, a suite of wastewater indicator compounds, and 17 metals.

The adult lamprey tissue results will be compared to regional studies and Oregon Health Authority results. Since adult lamprey are a culturally important food source, this analysis has human health implications. Comparing adult tissue contaminants to larval contaminants may indicate where (and at what life stage) the lampreys are exposed to the contaminants. The concentrations and presence of contaminants in one or more life stage may also indicate if the contaminants are likely to cause acute or chronic issues, based on aquatic organism benchmarks.

Results from this study will be documented in a published USGS report that will be available to the public, and data will reside in the USGS's online, publicly available database. Additionally, USGS scientists will present the information to the fisheries biologists and tribal council on the CTWS Reservation. The research questions answered by this study will inform management of key lamprey habitat on the CTWS Reservation. Managing contaminant point sources on the Reservation may have far-reaching implications by also positively affecting downstream water quality and organisms.

3. Descriptive Photographs-Illustrations-Maps (limit to three total):

Figure 1: Site map showing six probable sampling locations, two reference sampling locations, three tributaries, and the Deschutes River on the CTWS Reservation.

Figure 2: Larval lamprey collected in depositional areas downstream of potential point sources in 2019.

Figure 3: Fisheries biologists with the CTWS and USGS scientists collecting larval lamprey and sediment in depositional areas downstream of potential point sources in 2019.

4. ***Linkage of Actions to Identified Threats for Lampreys in RMU(s) (300 words or less):***
    - What threat(s) to lampreys does this project address? (See your RIP(s) for key threats) ***Water Quality Lack of Awareness*** Choose an item. Choose an item.
    - Does this project address threat(s) to lampreys specific to this RMU only, or does the project address the threat(s) prevalent in multiple RMUs?
      Single RMU ☐, Multiple RMUs ☒ list additional RMUs: Lower Columbia
    - Describe how this project addresses key threat(s) to lampreys within the HUC(s) where project is proposed.

Contaminants including flame retardants, pesticides, and metals have been identified as potential threats to Pacific lamprey (Nilsen and others, 2015). Through direct exposure of contaminants in sediment, water, and prey, some contaminants can bioaccumulate in lamprey tissue that could potentially harm the fish. Accumulated contaminants can also potentially pose a threat to consumers of these fish if levels are above human health criteria for consumption. Information provided from this study will inform decision makers where water-quality concerns are present within the study area and guide their decisions to remediate areas of concern, as well as inform development of consumption advisories, if needed. Furthermore, results from this study will assist managers in conservation efforts by providing valuable data in understanding where to target water-quality improvements which will ultimately increase Pacific lamprey survival.

Several contaminants have been identified in sediment, water, and fish tissues within the Lower and Mid-Columbia River, as well as its tributaries. However, little is known about what contaminants exist within the Warm Springs Reservation, which includes important tributaries to the Deschutes River. This study addresses two threats to lamprey, including water quality and lack of awareness. Contaminants comprise regional issues that can have far-reaching implications. While this study assesses water quality in the Mid-Columbia RMU, the potentially degraded water quality can affect downstream organisms (in the Lower Columbia RMU) and organisms migrating through the Mid-Columbia RMU. The study will address 1) water quality concerns by identifying contaminants in lamprey tissues and in the water column, and 2) lack of awareness by providing all data and analyses to the general public, fishery managers, and decision makers to improve awareness of water quality threats to lamprey detected within the study area.

5. ***Species/Habitat Benefits (200 words or less):***
    - Provide citation of literature, distribution maps, and/or surveys demonstrating lampreys are currently and/or were historically present in the project area.

Pacific lampreys are currently present in the tributaries on the CTWS Reservation (fig. 2) and at the hatchery on the Warm Springs River.
https://www.fws.gov/CRFWCO/publications/2017%20Annual%20Report_WarmSpringsLPS.pdf
https://www.fws.gov/CRFWCO/publications/Oregon%20AFS%202018_Warm%20Springs%20LPS.pdf

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

The proposed research project will identify the contaminants and concentrations currently found in lampreys and water in Reservation tributaries. These data will provide a baseline for comparison when monitoring contaminants in the future and following local action, such as remediation.

- What life stage or stages will benefit from action? How?

All Pacific lamprey life stages would benefit from action that reduces contamination in their aquatic environments. Larval lampreys have a close association with the sediment where they live for approximately 4-6 years, which makes them susceptible to localized contaminants and contaminants from upstream sources (Close and others, 2002). Lampreys and other benthic organisms may be exposed to contaminants through ingestion or absorption. Some contaminants may concentrate in organisms over time, which can affect adult lamprey. Lamprey may be ingested by other animals (Close and others, 2002), potentially passing contaminants through food chains.

- What other species may benefit from action?

Many aquatic organisms would benefit from actions that reduce contamination. On the CTWS Reservation, spring Chinook salmon returns to Reservation streams have declined (Galbreath et al., 2018), with causes unknown. Reducing contaminants in streams on the Reservation would positively affect resident organisms, migrating salmonids, and aquatic organisms residing downstream of the sources.

6. ***Priority Objectives and Goals:***
    - Indicate the strategies, and/or restoration/management plans are addressed by this project (when available relevant documents/websites are hyperlinked below for reference):
        - PLCI Conservation Agreement ☒
        - National Fish Habitat Partnership National Conservation Strategies ☐
        - USFWS Climate Change Strategies ☐
        - Bonneville Power Administration Northwest Power and Conservation Council Columbia River Basin Fish and Wildlife Program ☒
        - CRITFC Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin ☒
        - US Army Corps of Engineers Pacific Lamprey Passage Improvement Implementation Plan ☐
        - PUD Management Plan (please name below) ☐
        - Other (please name below) ☐
    - Clearly describe how the project addresses the goals and objectives in the strategies, restoration/management plans indicated above (200 words or less).

The Columbia River and its tributaries have several water-quality concerns that can potentially pose adverse effects on aquatic species, including Pacific lamprey. Anthropogenic-derived contaminants have contributed to poor water-quality conditions. Of particular concern is the presence of contaminants in traditional foods held sacred by tribal populations, and the potential human health impacts if contaminated fish are consumed (CRITFC objective 4). This

study will help inform the public about whether contaminants are detected in lamprey sampled from the study area (CRITFC objective 5; PLCI objectives 2, 3, 4). The results from this study can assist decision makers in determining if remediation plans are needed and where to focus their restoration efforts (PLCI objectives 4, 6). The data collected could help raise awareness to the public and assist local fishery managers in educating target audiences by informing them of the potential threats impacting lamprey survival from local contaminant sources (CRITFC objective 5; PLCI objectives 3, 4). Furthermore, the results from this study would provide the necessary data to help guide conservation efforts and assist managers in improving water quality that will ultimately advance Pacific lamprey survival (CRITFC objective 4; PLCI objectives 2, 4, 6).

7. Project Design / Feasibility:

- Have the designs for the project been completed already or will they be completed before planned project implementation? **Yes ☒ No☐**
- Are the appropriate permits (e.g., ESA consultation, Scientific Collection, fish health/transport, etc.) in place already or will they be in place before planned project implementation? **Yes ☒ No☐**
- Can the project be implemented within the defined timeframe? (*See BPA & NFHP requirements in the accompanying PLCI RIP Priority Project Guidance document).* **Yes ☒ No☐**
- Please provide a brief description (200 words or less):

USGS has been in close communication with the CTWS fisheries biologists regarding the study design. The CTWS personnel and USGS scientists are selecting the sampling locations, and both groups will work together in the field for the collection of samples.

The CTWS fisheries biologists will be collecting the lampreys for the study. The Tribe follows established protocols that include yearly reporting of the number of individuals collected.

The study will occur during the defined timeframe. Sample collection is dependent on the adult lamprey spawning up-migration period and on streamflows. Adult lamprey and low-flow water samples will be collected in summer 2021, likely in July or August. Additional water samples will be collected during periods of high streamflows which occur in winter and spring, according to past hydrographs. The report will be completed by the final written report due date (December 30, 2022).

8. Partner Engagement and Support (200 words or less):

- What partners are supporting the project?
- What partners are active in implementing the project?
- What partners are providing matching funds or in-kind services that directly contribute to the project?

This proposed study is a collaboration between the USGS and CTWS. To better understand the threats to the fisheries on the Reservation, the CTWS fisheries biologists initiated the 2019 USGS contaminant study that focused on contaminants in sediment and larval lamprey. The CTWS fisheries biologists are very supportive of this proposed study (which focuses on water and adult lamprey), since it will provide the additional information for a thorough and current

understanding of contaminants in tributaries on the Reservation. Results from this study will inform the CTWS regarding the relative importance of contaminants and allow CTWS fisheries biologists to allocate resources accordingly in their efforts to restore fisheries on the Reservation.

Both USGS and the CTWS fisheries biologists are active in the study by collaborating on site selection and study design. CTWS fisheries biologists will collect the adult lamprey, and USGS scientists will collect the water samples and will analyze data.

Matching funds are not available for this study. However, the CTWS are providing multiple in-kind services, including their time, expertise, and equipment (examples: vehicles and lamprey trapping equipment).

9. Monitoring and Reporting (200 words or less):

- How is completion of the project going to be documented? (*See BPA and NFHP requirements in the accompanying PLCI RIP Project Proposal Guidance document*.)
- How will the project's benefits to lampreys be monitored over time?

Results and conclusions from this study will be published in a USGS report that will be available to the public. USGS reports provide high-quality, objective scientific data, and reports and conclusions are subject to multiple rounds of peer reviews. Upon completion of the analyses, USGS scientists will present the information to the fisheries biologists and tribal council on the CTWS Reservation. In addition, USGS scientists will report the findings at the next Lamprey Information Exchange through an oral presentation or poster.

This proposed study will document the current status of contaminants in adult lamprey and water from tributaries on the Warm Springs Reservation. The published results will provide the groundwork for best management practices and future monitoring regarding contaminants. Future monitoring results can be compared to these results to gain a better understanding of how lamprey respond to the threat of contamination.

10. Project Budget (including overhead):

- See example on last page.

11. Timeline of major tasks and milestones:

Task	***Start Date***	***End Date***	***Responsible Party***
Environmental compliance/permits	***Recurring***	***Recurring***	***CTWS***
Pre-project preparation	***May 2020***	***June 2021***	***USGS***
Sample collection	***July 2021***	***March 2022***	***USGS & CTWS***
Data analysis	***January 2022***	***September 2022***	***USGS***
Reporting	***January 2022***	***December 2022***	***USGS***

12. References:

Close, D.A., Fitzpatrick, M.S., Li, H.W., 2002, The Ecological and Cultural Importance of a Species at Risk of Extinction, Pacific lamprey, Fisheries, v. 27, p. 19-25.

Galbreath, P. F., I. Janowitz-Koch, G. Boostrom, and C. Baker, 2018, Estimation of the effective number of breeders of Warm Springs River spring Chinook Salmon - Broodyears 2015 and 2016, Columbia River Inter-Tribal Fish Commission Technical Report 18-04, Portland, Oregon.

Nilsen, E.B., Hapke, W.B., McIlraith, B., Markovchick, D., 2015, Reconnaissance of contaminants in larval Pacific lamprey (*Entosphenus tridentatus*) tissues and habitats in the Columbia River Basin, Oregon and Washington, USA, Environmental Pollution, v. 201, p. 121-130.

Project Budget:

	Items	# Hours or Units	Cost per Unit ($)	RIP Funds Requested ($)	Cost Share ($)	Total Cost ($)
A	***Personnel:***	-	-	-	-	-
	a. GS-11 Ecologist	290	97.42	28,251.14		28,251.14
	b. GS-9 Hydrologist	206	93.00	19,159.00		19,159.00
	c. GS-12 Hydrologist	40	153.27	6,130.79		6,130.79
	d. GS-13 Research Chemist	20	182.58	3,651.55		3,651.55
	e. GS-11 Hydrologic Technician	10	109.54	1,095.42		1,095.42
B	***Equipment & Supplies:***	-	-	-	-	-
	a. Sample equipment		NA	928.64		928.64
C	***Travel:***	-	-	-	-	-
	a. Vehicle Costs	240	1.71	410.09		410.09
	b. Lodging	4	178.30	713.19		713.19
	c. M&IE	6	85.13	510.75		510.75
D	***Other:***	-	-	-	-	-
	a. Sample shipments	10	55.72	557.18		557.18
	b. Conference	2	557.18	1,114.36		1,114.36
E	***Analytical costs:***	-	-	-	-	-
	a. Halogenated compounds- tissue	13	1,029.39	13,382.03		13,382.03
	b. Metals- tissue	13	246.82	3,208.68		3,208.68
	c. Wastewater indicators- water	11	703.49	7,738.40		7,738.40
	d. Halogenated compounds- water	11	583.60	6,419.56		6,419.56
	e. Metals- water	11	221.97	2,441.66		2,441.66
	Total (Sum of A - E)	-	-	95,712.44		95,712.44

* Overhead costs vary based on the category. Overhead costs have been incorporated into each unit cost, and the Total Costs are the gross costs.

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.

Clemens, B. J., and 21 co-authors. 2017. Conservation challenges and research needs for Pacific Lamprey in the Columbia River Basin. Fisheries. 42: 268-280.

Close, D.A., K. Aronsuu, A. Jackson, T. Robinson, J. Bayer, J. Seelye, S. Yun, A. Scott, W. Li, and C. Torgerson. 2003. Pacific lamprey research and restoration project. Project No. 1994-02600, 115 electronic pages, (BPA Report DOE/BP-00005455-6.)

CRITFC (Columbia River Inter-Tribal Fish Commission), Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and Nez Perce Tribe. 2018. Master Plan: Pacific Lamprey artificial propagation, translocation, restoration, and research. Conceptual phase to address Step 1 – Master Plan review elements. March 23, 2018. 179 electronic pp. Available online at https://www.critfc.org/wp-content/uploads/2018/04/20180327-Master-Plan-Pac-Lamprey.pdf.

CRITFC (Columbia River Inter-Tribal Fish Commission). 2011. Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin. 194 pp.

FPC (Fish Passage Center). 2019. Fish Passage Center 201 Draft Annual Report. Fish Passage Center, Portland Oregon. Available online at https://www.fpc.org/documents/annual_FPC_report/2019DraftAnnualFPCReport.pdf.

Gonzalez, R., J. Dunham, S. Lightcap, and J. McEnroe. 2017. Large Wood and In-stream Habitat for Juvenile Coho Salmon and Larval Lampreys in a Pacific Northwest Stream. North American Journal of Fisheries Management 37:4, 683-699.

Hess, J.E., N.R. Campbell, M.F. Docker, C. Baker A. Jackson, R. Lampman, B. McIlraith, M.L. Moser, D.P. Statler, W.P. Young, A.J. Wildbill, and S.R. Narum. 2015. Use of genotyping by sequencing data to develop a high-throughput and multifunctional SNP panel for conservation applications in Pacific Lamprey. Molecular Ecology Resources 15, 187-202.

Howard, J.K., D. Close, and A. Jackson. 2004. Pacific Lamprey Research and Restoration Project, 2004 Annual Report, Project No. 199402600, 66 electronic pages, (BPA Report DOE/BP-00005455-8).

Jackson, A. D., M. L. Moser, S. T. Onjukka, S. LaPatra, K. Lujan, C. Samson, M. G. White, M. J. Blair, L. Rhodes, R. T. Lampman, A. N. Maine, and J. C. Jolley. 2019. Occurrence of pathogens in Pacific lamprey (Entosphenus tridentatus). Reviews in Fish Biology and Fisheries . https://doi.org/10.1007/s11160-019-09572-0

Jackson, A et al. 1997. Pacific Lamprey Research and Restoration. Project No. 1994-02600, 115 electronic pages, (BPA Report DOE/BP-00005455-6.)

Jolley, J.C., G.S. Silver, J.E. Harris, E.C. Butts, and C. Cook-Taber. 2016. Occupancy and Distribution of Larval Pacific Lamprey and *Lampetra* spp. In Wadeable Streams of the Pacific Northwest. U.S. Fish and Wildlife Service, Columbia River Fish and Wildlife Conservation Office, Vancouver, WA. 35 pp.

Nilsen, E.B., W.B. Hapke, B. McIlraith, and D. Markovchick. 2015. Reconnaissance of contaminants in larval Pacific lamprey (*Entosphenus tridentatus*) tissues and habitats in the Columbia River Basin, Oregon and Washington, USA. Environmental Pollution 201, 121-130.

Pacific Lamprey Technical Workgroup. 2017. Practical guidelines for incorporating adult Pacific Lamprey passage at fishways. White Paper. 47pp + Appendix. Available online: https://www.fws.gov/pacificlamprey/mainpage.cfm

Reid, S.B., D.A. Boguski, D.H. Goodman, and M.F. Docker. 2011. Validity of *Lampetra pacifica* (Petromyzontiformes: Petromyzontidae), a brook lamprey described from the lower Columbia River Basin. Zootaxa 3091, 42-50.

USACE (U.S. Army Corps of Engineers). 2009. Pacific Lamprey Passage Improvements Implementation Plan – 2008-2018. U.S. Army Corps of Engineers, Northwestern Division, Portland District. July 2009 Final Report. 88 pp.

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.