Pacific Lamprey

2019 Regional Implementation Plan

for the

Upper Columbia

Regional Management Unit

Submitted to the Conservation Team August 20, 2019

Author: Ann Grote – USFWS	Marty Liedtke – USGS
RMU Participants: RD Nelle – USFWS	Patrick Verhey – WDFW
Steve Lewis – USFWS	John Crandall – Methow Salmon Recovery Foundation
Ralph Lampman – Yakama Nation	Mariah Mayfield – USFS
Paul Wagner – Colville Confederated Tribes	McKenzie Baxter – Interfluve
Steve Hemstrom – Chelan County PUD	Ann Gray – USFWS

Projects proposed and discussed within this Regional Implementation Plan are in accordance with direction provided within the *Conservation Agreement for Pacific Lamprey in the States of Alaska, Washington, Idaho, Oregon and California, 2012.* Cooperative efforts through the Agreement intend to: a) develop regional implementation plans derived from existing information and plans; b) implement conservation actions; c) promote scientific research; and d) monitor and evaluate the effectiveness of those actions.

Projects identified in this Regional Implementation Plan do not imply or intend a funding obligation or any related activity from any of the government agencies, tribes or non-governmental entities discussed within this document.

I. Status and Distribution of Pacific Lamprey in the RMU

General Description of the RMU

The Upper Columbia Regional Management Unit (UCRMU) is defined as the tributaries to Columbia River from the Snake River to Chief Joseph Dam in which there are 15 4th Field Hydrologic Unit Codes (HUCs) (Figure 1). This Regional Implementation Plan (RIP) focuses on six subbasins of the Columbia River: Yakima, Wenatchee, Entiat, Methow, Okanogan, and Similkameen rivers. The priority 4th Field HUCs from these major tributaries include: Lower Yakima (#17030003), Naches (#17030002), Upper Yakima (#17030001), Wenatchee (#17020011), Entiat (#17020010), Methow (#17020008), Okanogan (#17020006), and Similkameen (#17020007). Crab Creek (#'s 17020013,17020015), the Chelan River (#17020009) and various smaller tributaries (Colockum-area streams and Foster Creek) are also included, but little information is available on lamprey presence in these subbasins (Table 1). Although historic Pacific Lamprey distribution likely extended into Sanpoil (#17020004), Colville (#17020003), and Kettle (#17020002) HUCs, these areas were excluded from consideration at this time due to existing anadromous passage barriers at Chief Joseph and Grand Coulee dams.

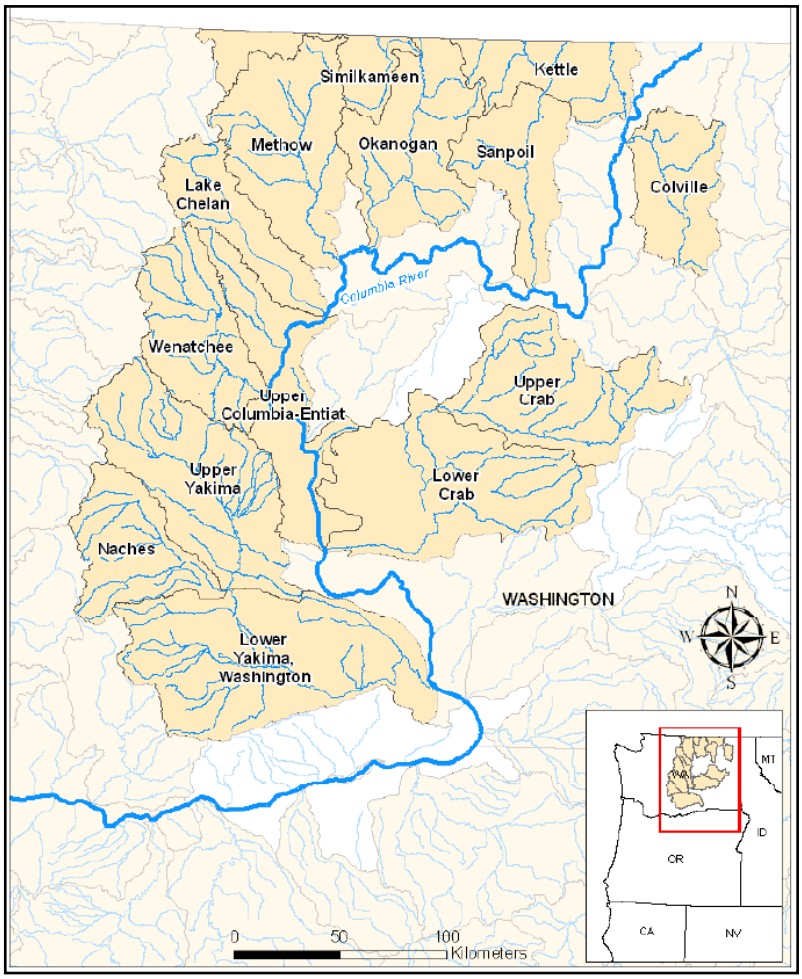


Figure 1: Map of the watersheds within the UCRMU.

Table 1: Drainage Size and Level III Ecoregions of the 4th Field HUC Watersheds located within the UCRMU.

Watershed	HUC Number	Drainage Size (km^2)	Level III Ecoregion(s)
Similkameen	17020007	1,735	Columbia Plateau, North Cascades
Okanogan	17020006	4,248	Columbia Plateau
Methow	17020008	4,714	Columbia Plateau, North Cascades
Chelan	17020009	2,473	Columbia Plateau
Entiat	17020010	3,937	Columbia Plateau, North Cascades
Wenatchee	17020011	3,648	Columbia Plateau, North Cascades
Crab Creek	17020013,17020015	11,318	Columbia Plateau
Upper Yakima	17030001	5,517	Columbia Plateau, Eastern Cascade Slopes and Foothills
Lower Yakima	17030003	7,640	Columbia Plateau, Eastern Cascade Slopes and Foothills
Naches	17030002	2,927	Columbia Plateau, Eastern Cascade Slopes and Foothills
Smaller Tributaries	--	2,512	Columbia Plateau

Status of Species

2017 Conservation Assessment and 2019 Updates

Pacific Lamprey *Entosphenus tridentatus* conservation status, distribution, and population information in the UCRMU were updated in the 2017 Pacific Lamprey Assessment (Table 2). Compared with the 2011 Assessment (Luzier at al. 2011), Conservation Status Ranks changed in five HUCs in 2017: two improved and three declined (Table 2). Pacific Lamprey are still believed to be either Critically Imperiled (S1) or Possibly Extinct (SH), in all UCRMU HUCs. Changes in status rankings from the 2011 to 2017 largely resulted from declines in some subbasins, adult translocations in others, and implementation of an improved and more accurate approach to calculating historical and current range extent using steelhead intrinsic potential as a surrogate for absent lamprey distribution data.

Table 2: Population, demographic, and Conservation Status Ranks of the 4th Field Hydrologic Unit Code (HUC) watersheds located within the UCRMU as of *April, 2017*. Steelhead intrinsic potential was used as a surrogate estimate of historical lamprey range extent in areas where historical occupancy information was not available. S1 = Critically Imperiled. SH = Possibly Extinct. Conservation Status rankings highlighted in yellow indicate a change (↑ improved, ↓ worsened) in 2017 relative to the 2011 Assessment

Watershed	HUC Number	Conservation Status Rank	Historic Occupancy (km^2)	2017 Occupancy (km^2)	2017 Population Size (adults)	Short-Term Trend (% change)
Similkameen	17020007	SH↓	<100	Zero*	Zero*	>70%
Okanogan	17020006	SH↓	1000-5000	20-100*	1-50*	>70%
Methow	17020008	S1	1000-5000	100-500	50-250	30-50%
Chelan	17020009	SH↓	Unknown	Zero	Zero	Unknown
Entiat	17020010	S1	1000-5000	100-500	250-1000	Stable
Wenatchee	17020011	S1	1000-5000	20-100	250-1000	Stable
Crab Creek	17020013, 17020015	SH	1000-5000	Zero	Zero	Unknown
Upper Yakima	17030001	S1↑	1000-5000	20-100	1-50	Increasing (+ >10%)
Lower Yakima	17030003	S1	1000-5000	100-500	250-1000	Increasing (+ >10%)
Naches	17030002	S1↑	1000-5000	20-100	1-50	Stable
Smaller Tributaries	--	--	Unknown	Zero	Zero	Unknown

* The information and rankings listed above were current as of April 2017 and do not reflect adult translocations that have occurred since the Assessment was completed

Since the completion of the 2017 Assessment, information on Pacific Lamprey distribution continues to improve due to additional sampling. Current Pacific Lamprey distribution in the UCRMU is displayed in Figure 2. For the purposes of this document, distribution of Pacific Lamprey is defined as the areas occupied by both adult and larval/juvenile lampreys. The UCRMU includes several subbasins (Upper Yakima, Okanogan, and Similkameen) where translocated adult lamprey have been released, but larvae/juveniles have not yet been detected. Radio tracking also located tagged translocated adults in reaches of the Naches and Tieton rivers where larvae were not detected (Grote et al. 2016). Adult translocation and larval monitoring are ongoing throughout the RMU, and translocation is resulting in expanded adult distribution and increased adult abundance in the Upper Yakima, Methow, Wenatchee, Okanogan, and Similkameen Rivers in 2019 (Table 3). The distribution map is expected to continue changing as new surveys and translocations are completed in the future.

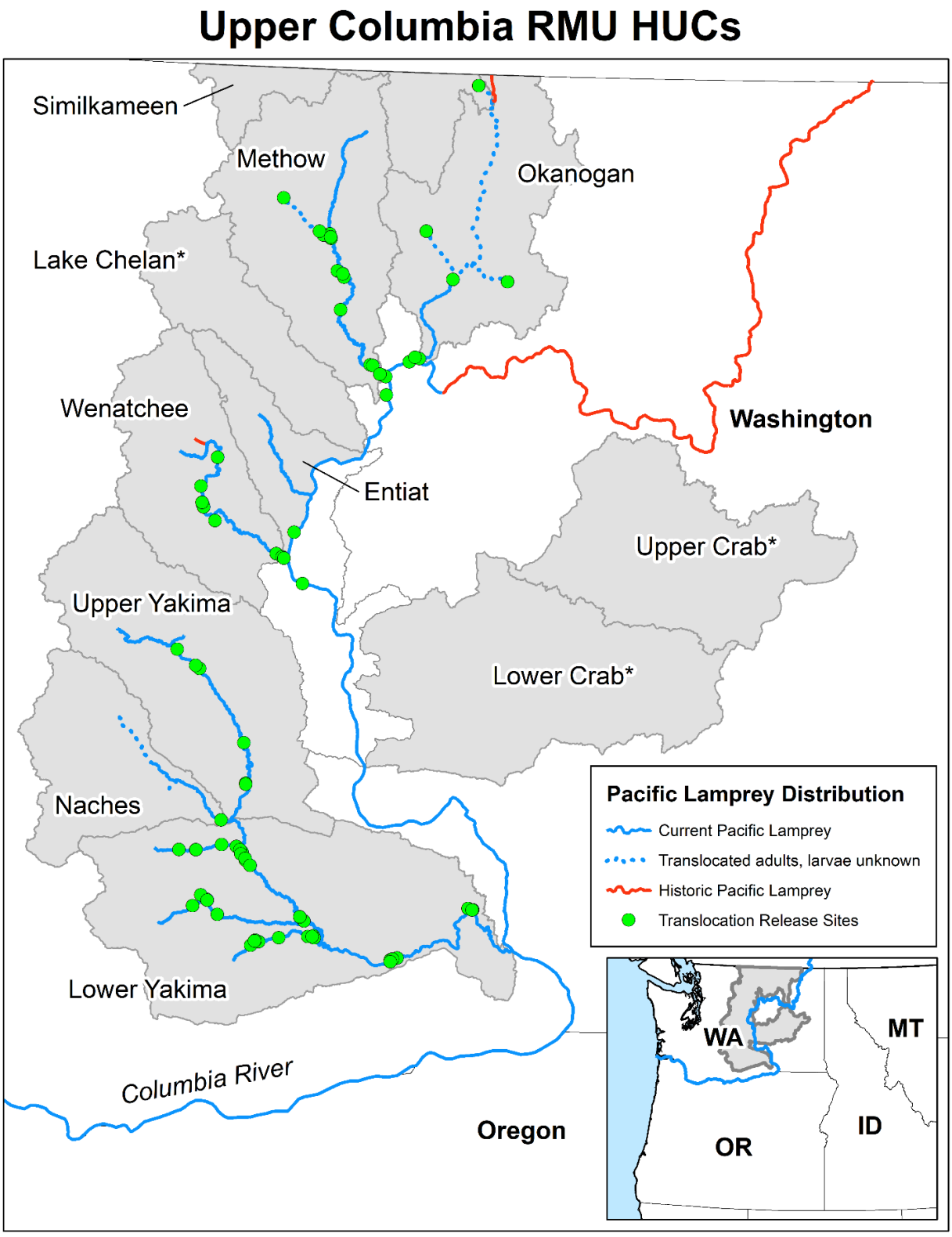


Figure 2: UCRMU Pacific Lamprey distribution and translocation release sites as of July 31, 2019. HUCs where historic distribution is uncertain are identified with an (*).

The current distribution map is informed by a variety of sources, including electrofishing, Environmental DNA (eDNA), and nesting surveys, and smolt trap, adult ladder, and translocation counts. Specific sources of information include: annual electrofishing surveys conducted by the Yakama Nation (YN) in the Lower Yakima (Beals and Lampman 2016a), Upper Yakima (Beals and Lampman 2016b), Naches (Beals and Lampman 2016c), Wenatchee (Beals and Lampman 2016d), Entiat (Beals and Lampman 2016e) and Methow (Beals and Lampman 2016f, Beals and Lampman 2018a), USFWS electrofishing data from the Wenatchee, Entiat, Chelan, Methow and Okanogan Rivers and smaller tributaries (USFWS, unpublished data), USFWS eDNA surveys (Grote and Carim 2017), and YN translocation reports (Lampman 2019a, 2019b, 2019c). Looking forward to 2020, new distribution information is expected as eDNA survey results from the USFS National Genomics Center Basin-Wide Lamprey Inventory and Monitoring Project (BLIMP) become available. BLIMP survey HUCs in the UCRMU include Upper and Lower Crab Creek, which are of special interest given the dearth of both historic and current lamprey information in this system.

Table 3: Summary of adult Pacific Lamprey Translocations to HUCs within the UCRMU as of July, 2019.

Watershed	Translocation Years	YN Translocated Adults	USFWS Translocated Adults	CCT Translocated Adults	Translocation Totals
Wenatchee	2016 - 2019	1204	0	0	1204
Methow	2015 - 2019	854	0	0	854
Upper Yakima	2013 - 2019	273	45	0	273
Naches	2013 - 2014	0	44	0	44
Lower Yakima	2011 - 2019	2981	164	0	3145
Columbia River	2017	0	0	359	359
Okanogan	2018 – 2019	?	?	200	200
Similkameen	2017 – 2019	0	0	97	97

Distribution and Connectivity

There are five hydroelectric dams on the Columbia River within the UCRMU downstream of Chief Joseph Dam: Priest Rapids, Wanapum, Rock Island, Rocky Reach, and Wells dams. Although the mainstem dams are outside of the purview of this RIP, it is important to note that the combined impacts from Columbia River dams have greatly reduced the number of adults that can contribute to the tributary adult escapement. Within the subbasins, there are also many irrigation dams and diversions used for a variety of purposes including hydropower, irrigation, water storage and fisheries management. The impacts to connectivity of these smaller tributary dams vary by structure and subbasin.

The Yakima River has multiple diversion dams on the mainstem and many more on its tributary streams. Based on radio telemetry studies, mainstem Yakima River diversion dams impeded Pacific Lamprey upstream migration with passage rates ranging between 0% and 82% depending on time of year (Johnsen et al. 2013, Grote et al. 2014, Grote et al. 2016). Cumulative passage through successive dams was very low, as less than 5% of adult lamprey successfully passed three or more of the

lowermost diversion dams. No lamprey are known to have voluntarily passed Roza Dam (rkm 210.5). Prior to translocations, Pacific Lamprey were assumed to be functionally extirpated from the Upper Yakima HUC upstream of Roza Dam.

In 2019, YN and the Bureau of Reclamation (BOR) implemented additional lamprey-specific passage improvements at Prosser Dam. Two additional Lamprey Passage System (LPS) units were installed at the center island of Prosser dam, and two of the existing Prosser LPS units were modified to allow for volitional passage. These modified units can now be operated in trapping mode (to collect adults for tagging, genetic sampling etc.) or in volitional passage mode whereby lampreys exit the LPS directly into the forebay without being trapped and handled. The YN continues to refine an automated infrared video system to monitor and count lampreys using the LPS. The YN, BOR, USFWS, and Natural Resources Conservation Service (NRCS) are in the process of designing and installing new LPS units at Sunnyside, Wapato, and Wanawish dams on the Lower Yakima. These new passage structures are will likely be installed in 2020.

In the Wenatchee River, Pacific Lamprey were historically documented upstream of Tumwater Dam (49.6) in Lake Wenatchee and the upper mainstem, and likely occupied four large upper basin tributaries (Chiwawa, White, and Little Wenatchee rivers, and Nason Creek). Extensive electrofishing surveys conducted from 2011-2016 identified Tumwater Dam as the upper limit of lamprey distribution in the Wenatchee River (Johnsen and Nelson 2012, Beals and Lampman 2016d, Kelly-Ringel 2016, USFWS unpublished data). Adult lamprey passage at Tumwater Dam has not been formally evaluated, and incidental PIT detection data from the fishladder and upstream antennas indicate passage is rare. In 2017, for the first time in several decades, adult Pacific Lamprey were observed at the Tumwater Dam fish counting window (n =10). In response to low lamprey passage, Chelan County Public Utility District (PUD) modified trapping operations at Tumwater Dam beginning in 2018. For several weeks in August and September the fishladder exit is left open at night allowing fish to bypass the fish trapping system. These night operating conditions are intended to facilitate passage for nocturnal lampreys.

Following the 2016 adult translocations, electrofishing surveys detected larvae for the first time upstream of Tumwater Dam from both the mainstem Wenatchee River and Nason Creek (Beals and Lampman 2017a). Recolonization of Nason Creek continues, as larval lamprey are encountered further upstream in Nason Creek each survey year. Genetic parentage analysis of these larvae is ongoing, and they are assumed to be the progeny of translocated fish. Dryden Dam (rkm 28.3) on the Wenatchee River is passable by Pacific Lamprey, but has not been evaluated.

Distribution in the Entiat River is not limited by dams. Entiat River rotary screw trap counts of larval and juvenile lamprey have varied from close to 1,200 to just over 5,500 over the past 10 years (USFWS unpublished data). Larval lamprey are distributed widely from river mouth to rkm 46.4 (Beals and Lampman 2016e). USFWS lamprey spawning surveys conducted in 2018 detected nests near, but not upstream of the larval distribution limit. Spawning survey results from both 2018 and 2019 indicated that the majority of lamprey spawning occurs in the lower 10 rkm of the Entiat River.

Migratory connectivity in the Methow HUC is generally better, although several structures have not been evaluated. Prior to adult translocation in the Methow subbasin, lamprey distribution was severely reduced and larval recruitment was absent or severely limited (Beals and Lampman 2016f, Crandall 2010). Since translocation began in 2016, larval lamprey have been detected at most mainstem survey

sites from mouth to Chewuch River confluence, and up the Chewuch River to rkm 23.9 (Beals and Lampman 2016f). In spring 2018, larval lamprey were captured for the first time in the Twisp River screw trap, and recent electrofishing surveys are detecting increased numbers of larval lamprey at index sites (John Crandall, personal communication).

In the Okanogan River, no lamprey were found during distribution work in 2015 (electrofishing) and 2017 (electrofishing and eDNA sampling) (USFWS unpublished data). Juvenile Pacific Lamprey were last observed at the Colville Confederated Tribes (CCT) Okanogan screw trap in in 2010 (Wagner et al. 2018). In the Similkameen River, the Enloe Dam (rkm 8) has blocked all fish passage in since 1919/1920. In August 2017, CCT in collaboration with YN released adult Pacific Lamprey near the confluence of the Columbia and Okanogan rivers, and into the Similkameen River. Translocations continued with additional adult releases in the mainstem Okanogan and tributary streams in September 2018 and April 2019. The Okanogan and Similkameen translocation lampreys originate from two sources: fish are captured at the Lower Columbia River Dams (Bonneville, the Dalles, and John Day dams) and held at that YN Prosser Hatchery, or they are trapped in the Mid-Columbia at Priest Rapids Dam and hauled in partnership with Grant County PUD and Douglas County PUD. The USFWS continues to conduct yearly comparative electrofishing and eDNA surveys in the mainstem Okanogan River. Despite the release of translocated adult lampreys, electrofishing surveys have yet to detect larvae in this system, and the eDNA results cannot differentiate between lamprey life history stages.

The USFWS distribution surveys in the Chelan River, Colockum and L.T. Murray Wildlife Area creeks, and Foster Creek have not detected lamprey. Pacific Lamprey are believed to be absent in Crab Creek as recent electrofishing surveys detected no larvae (Timko et al. 2017).

Threats

Summary of Major Threats

Ranking of UCRMU threats was based on the 2017 Assessment and further developed through information and consensus of the participating UCRMU members during a conference call on May 20, 2019 (Table 4). No major changes to the threat rankings were suggested at the RMU meeting; so the overall rankings remain the same as they were in 2018. Recommendation of Priority Projects from the UCRMU is based upon and consistent with the highest-ranked threats indicated in the Table.

Among the threats identified in the UCRMU, some showed a pervasive impact in the entire region (Small Population Size, Stream and Floodplain Degradation). Other threats were more location specific, but nevertheless cause severe impacts to the local populations, such as Tributary Passage, Dewatering & Flow Management and Predation. Although Mainstem Passage is a key threat for this region, it was not included in the priority actions because the RIP is focused on the tributaries. As of 2019, there is a separate RIP for the Mainstem Columbia RMU, under which the ongoing mainstem passage impacts and improvements are addressed.

Small Population Size continues to be the highest-ranked threat in the UCRMU in 2019. Small Population Size is the cumulative effect from reduced mainstem dam passage and the other threats listed above. Small Population Size can result in a lack of pheromone attraction to migrating adults, inability of migrating adults to pass barriers en-masse, inability of spawning adults to find mates, the loss of functional ecological services provided by healthy larval populations, and potential for

Table 4: Threats to Pacific Lamprey within the UCRMU, as identified and ranked the at RIP conference call on May 20, 2019. High = 3.5-4.0, Medium = 2.5-3.4, Low = 1.5-2.4, Insignificant =≤ 1.4, Unknown = No value

2017	Tributary Passage		Dewatering and Flow Management		Stream and Floodplain Degradation		Water Quality		Predation		Small Population Size	
Watershed	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity
U. Columbia Drainages												
Crab Creek	-	-	(2)	(2)	(3)	(3)	(4)	(4)	(2)	(3)	-	-
Smaller Tributaries	(1)	(1)	(3)	(2)	(1)	(2)	(1)	(2)	(1)	(1)	-	-
Wenatchee	3	3	3	2	3	3	2	2	1	1	3	3.5
Entiat	1	1	2	2	3	3	2	2	1	1	2	2
Chelan	-	-	-	-	1	1	1	1	1	1	-	-
Methow	1	1	2.5	1	3	3	1	1	2	2	3.5	4
Okanogan	1	1	3	3	3	3	3	3	2.5	3	4	4
Similkameen	4	4	3	3	2	2	2	2	2.5	3	4	4
Yakima Drainages												
Upper Yakima	4	4	4	3	2	2	2	2	2	2	4	4
Naches	3	3	2	2	2	2	2	2	2	2	4	3
Lower Yakima	4	3	3	4	2	2	4	4	4	4	3	3
UCRMU												
Mean Score	2.63	2.5	2.81	2.50	2.33	2.33	2.11	2.11	2.00	2.11	3.44	3.44
Mean Scope & Severity	2.56		2.66		2.33		2.11		2.06		3.44	
Drainage Rank	**M**		**M**		**L**		**L**		**L**		**H**	

catastrophic loss of the local population from environmental perturbations. Current adult translocation programs throughout the UCRMU aim to combat this threat. However, conservation actions targeting the causal mechanisms behind diminished populations (poor adult passage, juvenile entrainment, etc.) will likely be needed to improve self-sustaining Upper Columbia Pacific Lamprey runs.

Tributary Passage is a key threat in the Yakima, and Wenatchee subbasins as evidenced by radio telemetry (Yakima) and juvenile distribution surveys (Yakima, Wenatchee). Adult passage issues in the lower subbasins severely limit distribution into the upper watersheds. Prior to translocation, larval lamprey distribution of Pacific Lamprey stopped immediately downstream of Tumwater Dam (Wenatchee River) and Roza Diversion Dam (Yakima River). Counts from both of these dams also support the hypothesis that few to no adult lamprey currently move past these structures; counts at Tumwater Dam viewing window in 2017 indicate that some (n = 10) Pacific Lamprey adults did pass the fishladder. How many attempts were made and the number of unsuccessful passage events is unknown, as lamprey passage efficiency at this facility has yet to be evaluated. The Okanogan River has several dams that have not been evaluated for Pacific Lamprey passage such as Zosel Dam and the Lake Osoyoos Control. The Enloe Dam on the Similkameen River has no fish passage structures and is impassable.

Dewatering & Flow Management was also identified as a key threat in the Yakima Basin but meaningful restoration actions will require large scale institutional changes involving water rights and salmonid management and is likely a long-term action. Many of these actions are being addressed within the Yakima Basin Integrated Water Resources Management Plan. Larval and juvenile entrainment is included in the Dewatering and Flow Management threat category. Larval entrainment has been examined extensively and intensively by the YN within the Yakima Basin and Wenatchee Subbasin (Beals and Lampman 2017b, 2017c, 2018b, Lampman 2018). Because of their small size, larval lamprey less than 80 mm in length were easily entrained past the existing fish screens which are designed exclusively for juvenile salmonids. Diversion waterways provide ample larval lamprey habitat during the irrigation season when these structures hold water. However, dewatering in the winter months severely impacts juvenile lamprey and their ability to survive or return back to the river. Annual fish salvage operations have been implemented at several UCRMU diversions each fall at the end of the irrigation season. These operations can be costly and extensive, and the efficacy of salvage techniques in reducing larval survival in largely unknown.

Stream and Floodplain Degradation is a low to moderate threat in most RMU subbasins as all of these systems have undergone extensive channel modifications. Wetlands and side channels have been channelized, diked, diverted or drained to prevent flooding, create farmland or pastures, and provide land for commercial and residential development. In upland areas, historical and ongoing mining and timber practices, agriculture, road construction, and urbanization have deforested or altered the function and diversity of riparian vegetation. Owing to their complex, multi-stage life history, Pacific Lamprey require varied freshwater habitats (spawning gravels, well oxygenated permeable fines, etc.) that are often absent or lacking in highly-modified rivers.

Water Quality is considered a threat in some watersheds within the RMU, particularly the Lower Yakima and Okanogan rivers, and Upper and Lower Crab Creek. Summer water temperatures are a concern in both these systems, where warm water "thermal barriers" may persist at the river mouths and prevent migratory adults from entering. Concentrations of a wide variety of contaminants in lamprey tissue as well as larval lamprey habitat (fine sediment) was found to be high in the Yakima Basin based according to collaborative research by the USGS, Columbia River Inter-Tribal Fish Commission (CRITFC), YN, and Pacific Northwest National Laboratory (PNNL) (Nilsen et al. 2015). Pesticide and herbicide loads from agricultural runoff and irrigation returns are a concern throughout the UCRMU.

Predation risk is likely higher than was initially estimated in the 2011, and was ranked higher in the 2017 Assessment. A 2017 experimental feeding study showed a that wide variety of native (Chinook Salmon *Oncorhynchus tshawytscha*, Coho Salmon *O. kisutch*, Rainbow Trout *O. Mykiss* Northern Pikeminnow *Ptychocheilus oregonensis*, White Sturgeon *Acipenser transmontanus*, Chiselmouth *Acrocheilus alutaceus*) and non-native (Smallmouth Bass *Micropterus dolomieu*, Common, Carp *Cyprinus carpio*, Yellow Bullhead *Ameiurus natalis*) fishes feed on larval lamprey under laboratory conditions (Arakawa and Lampman 2017). Northern Pikeminnow and Walleye *Sander vitreus* have been show to prey on larval and juvenile lamprey in the Lower Columbia (Carpenter et al. 2019) but the effects of these predators have not been investigated in the Upper Columbia. Predation is assumed to be especially problematic in areas where invasive species are more prevalent (as a result of stocking history, or altered hydrologic conditions) such as the Lower Yakima, Okanogan and Similkameen subbasins. Avian and mammalian are likewise yet to be investigated in the UCRMU.

Restoration Actions

Tributary restoration projects have been implemented by numerous stakeholders and cover a wide range of activities including: installation of lamprey-specific passage systems at Prosser Dam on the Yakima River, survival and outmigration monitoring of acoustic tagged macropthalmia, distribution and abundance surveys throughout the RMU, juvenile rescue and salvage operations, adult translocations, and artificial propagation. For a list of lamprey-focused restoration projects and the agencies involved, see Table 5. Within the mainstem Columbia River, restoration actions continue to be implemented by Grant, Chelan, and Douglas County PUDs at their respective hydroelectric dams. The majority of these efforts are focused on increasing adult fishway passage and improving detectability at counting stations. Owing to their location on the mainstem and not the tributaries, these actions fall outside of the RIP.

Table 5: Conservation actions specifically for or substantially benefitting lampreys that were initiated or completed in the UCRMU from 2012-2019.

HUC	Threat	Action Description (Agency)	Type	Status
Okanogan	Population	Distribution surveys to evaluate larval lamprey presence in the main stem Okanogan River (USFWS, CCT)	Survey	Ongoing
Methow	Population	Distribution surveys to evaluate the upper extent of larval lamprey presence in the main stem Methow, Chewuch, and Twisp rivers (YN, Methow Salmon Recovery Foundation (MSRF), USFWS)	Survey	Ongoing
Chelan	Population	Distribution surveys to evaluate larval lamprey presence in the lower Chelan River (USFWS)	Survey	Complete
Entiat	Population	Nest surveys to evaluate spawn timing and distribution (USFWS)	Survey	Ongoing
Entiat	Population	Distribution surveys to evaluate the upper extent of larval lamprey presence in the main stem Entiat River and Mad River (USFWS, YN)	Survey	Ongoing
Wenatchee	Population	Distribution surveys to evaluate larval lamprey presence in the main stem Wenatchee River and tributaries (Peshastin Creek, Icicle Creek)(USFWS, YN)	Survey	Ongoing
Smaller Tributaries	Population	Distribution surveys to evaluate larval lamprey presence in the Colockum Plateau Streams and Foster Creek (USFWS)	Survey	Complete

Table 5 Continued: Conservation actions specifically for or substantially benefitting lampreys that were initiated or completed in the UCRMU from 2012-2019.

HUC	Threat	Action Description (Agency)	Type	Status
Lower Yakima	Population	Distribution surveys to evaluate larval lamprey presence in the main stem Yakima River and tributaries (YN)	Survey	Ongoing
Upper Yakima	Population	Distribution surveys to evaluate larval lamprey presence in the main stem Upper Yakima River and tributaries (Wenas Creek, Teanaway River) (YN)	Survey	Ongoing
Naches	Population	Distribution surveys to evaluate larval lamprey presence in the main stem Naches River (YN)	Survey	Ongoing
Methow	Population	Translocate & release adult lamprey (YN)	Supplementation	Ongoing
Wenatchee	Population	Translocate & release adult lamprey (YN)	Supplementation	Ongoing
Lower Yakima	Population	Translocate & release adult lamprey (YN)	Supplementation	Ongoing
Upper Yakima	Population	Translocate & release adult lamprey (YN)	Supplementation	Ongoing
Naches	Population	Translocate & release adult lamprey (USFWS)	Supplementation	Ongoing
Upper RMU	Population	Trap adults at Priest Rapids Dam for translocation (GCPUD, DCPUD)	Supplementation	Ongoing
Wenatchee	Population	Truck and release adult lamprey (GCPUD)	Supplementation	Ongoing
Methow	Population	Truck and release adult lamprey (YN, DCPUD)	Supplementation	Ongoing
Okanogan	Population	Truck and release adult lamprey (CCT, YN, DCPUD)	Supplementation	Ongoing
Similkameen	Population	Truck & release adult lamprey CCT, YN, DCPUD)	Supplementation	Ongoing

Table 5 Continued: Conservation actions specifically for or substantially benefitting lampreys that were initiated or completed in the UCRMU from 2012-2019.

HUC	Threat	Action Description (Agency)	Type	Status
RMU	Population	BLIMP eDNA sampling and distribution model verification (USFS, YN, USFWS)	Assessment	Ongoing
RMU	Population	Artificial propagation and larval rearing (YN, Confederated Tribes of the Umatilla Indian Reservation (CTUIR) , CCPUD, BPA, USFWS)	Supplementation	Ongoing (in lab)
RMU	Population	Genetic evaluation of translocation success - (YN, USFWS, CRITFC, USFS)	Assessment	Ongoing
Wenatchee	Passage	Fish trap/forebay bypass operations at Tumwater Dam (CCPUD, WDFW)	Instream	Ongoing
Wenatchee	Passage	Fishway, count window, hopper modifications at Tumwater Dam (CCPUD)	Instream	Underway
Lower Yakima	Passage	Construction, operation, and evaluation of LPS units at Prosser Dam (USBOR, YN, USFWS)	Assessment	Ongoing
Lower Yakima	Passage	Radio telemetry assessment of adult lamprey passage at Wanawish, Prosser, Sunnyside, and Wapato Dams (USFWS)	Assessment	Complete
Upper Yakima	Passage	Radio telemetry assessment of adult lamprey passage Roza Dam (USFWS)	Assessment	Complete
Naches	Passage	Radio telemetry assessment of adult lamprey passage Cowiche Dam (USFWS)	Assessment	Complete

Table 5 Continued: Conservation actions specifically for or substantially benefitting lampreys that were initiated or completed in the UCRMU from 2012-2019.

HUC	Threat	Action Description (Agency)	Type	Status
Lower Yakima	Passage	Coordinate funding and design of LPS passage structures at Sunnyside and Wapato dams (YN, BOR, NRCS)	Coordination	Underway
Lower Yakima	Passage	Coordinate funding and design of LPS passage structure at Wanawish Dam dams (USFWS, BOR, YN)	Coordination	Underway
Wenatchee	Passage	Investigate Tumwater Dam lamprey passage constraints (CCPUD)	Assessment	Complete
Wenatchee	Dewatering/Flow Management	Monitor, salvage, and reduce larval/juvenile entrainment at the Dryden irrigation diversion (CCPUD, USFWS, YN, WDFW)	Instream	Ongoing
Lower Yakima	Dewatering/Flow Management	Monitor, salvage, and reduce larval/juvenile entrainment at irrigation diversions/canals (YN, BOR, WDFW, irrigation districts)	Instream	Ongoing
Lower Yakima	Dewatering /Flow Management	Acoustic telemetry assessment of juvenile lamprey downstream passage (YN, BOR, USGS, PNNL)	Assessment	Ongoing
Upper Yakima	Dewatering/Flow Management	Monitor, salvage, and reduce larval/juvenile entrainment at irrigation diversions/canals (YN, BOR, WDFW, irrigation districts)	Instream	Ongoing
Upper Yakima	Dewatering/Flow Management	Monitoring the impacts of “Flip-Flop” flow management in Yakima Basin	Assessment	Complete

Table 5 Continued: Conservation actions specifically for or substantially benefitting lampreys that were initiated or completed in the UCRMU from 2012-2019.

HUC	Threat	Action Description (Agency)	Type	Status
Naches	Dewatering/Flow Management	Monitor, salvage, and reduce larval/juvenile entrainment at irrigation diversions/canals (YN, BOR, WDFW, irrigation district)	Instream	Ongoing
Methow	Stream & Floodplain Degradation	Habitat restoration effectiveness monitoring for larval lamprey (MSRF, YN)		
RMU	Water Quality	Toxicology/ Contaminant levels of larval, juvenile, and adult lamprey (CRITFC, USGS, PNNL, YN)	Assessment	Complete
Lower Yakima	Lack of Awareness	Role of lamprey carcasses in Lower Yakima River tributaries (University of Idaho, Heritage University, YN, CTUIR, CRITFC)	Assessment	Complete
RMU	Lack of Awareness	Elder interviews on Pacific Lamprey - Traditional Ecological Knowledge (YN, Heritage University)	Assessment	Ongoing
RMU	Lack of Awareness	Conduct outreach and provide educational opportunities (USFWS, YN)	Education	Ongoing
RMU	Lack of Awareness	Conduct lamprey identification training (YN, USFWS)	Education	Complete
RMU	Lack of Awareness	Developing lamprey tagging methods (USFWS, YN, USGS, PNNL)	Lack of Awareness	Complete
Lower Yakima	Predation	Lab study of larval lamprey susceptibility to fish predators (YN)	Research	Complete

Long-Term Priority Projects:

In addition to the Priority Projects detailed above, RMU participants developed a list of long-term projects that would ideally be funded and implemented by 2025 (Table 6). Like the Priority Projects, these long-term projects address the major threats identified through the RIP process. However, these projects are currently not "shovel-ready" and need to be further developed in the near term.

Table 6: Long-term (2020-2025) priority Pacific Lamprey conservation projects for the UCRMU.

HUC	Threat	Action Description	Agencies	Approach
Lower Yakima	Adult Passage	Passage improvements at Wanawish, Prosser, Sunnyside, Wapato dams	YN, BOR, USFWS	LPS, ladder modification
Upper Yakima	Adult Passage	Adult passage improvements Roza, Town Canal dams	YN, BOR, USFWS	LPS, ladder modification
Wenatchee	Adult Passage	Passage evaluation & improvement Tumwater, Dryden dams	CCPUD, USFWS, WDFW	LPS, ladder modification, telemetry
Okanogan	Adult Passage	Passage evaluation Zosel Dam	CCT	Telemetry
Similkameen	Adult Passage	Passage evaluation & Enloe Dam	CCT	Telemetry, LPS
Upper RMU	Adult Passage	Evaluate adult passage through Rocky Reach Reservoir and Wells Dam	CCPUD, DCPUD	Research
RMU	Adult Passage	Standardize passage metrics used by U.S. Army Corps of Engineers and PUDs	GCPUD, CCPUD, DCPUD, ACOE	Research
Lower Yakima	Juvenile Passage	Acoustic Telemetry of juvenile lamprey passage	YN, BOR, USGS	Telemetry
Upper Yakima	Dewatering/Flow Management	Juvenile entrainment improvements at irrigation diversions & "Flip-Flop"	YN, BOR, irrigation districts	Operational, FVES, large sifter
Naches	Dewatering/Flow Management	Juvenile entrainment improvements at irrigation diversions	YN, BOR, irrigation districts	Operational, FVES, large sifter

Table 6 Continued: Long-term (2020-2025) priority Pacific Lamprey conservation projects for the UCRMU.

HUC	Threat	Action Description	Agencies	Approach
Lower Yakima	Dewatering/Flow Management	Juvenile entrainment improvements at irrigation diversions	YN, BOR, irrigation districts	Operational, FVES, large sifter
Wenatchee	Dewatering/Flow Management	Juvenile entrainment improvement at Dryden Irrigation Canal	CCPUD, WDFW, USFWS, YN	Operational and sluice gates
Lower Yakima	Water Quality	Yakima Delta Restoration	YN, ACOE, DNR, MCRFEG	Bateman Island Causeway Modification
RMU	Water Quality	Toxicological Evaluations	YN, BOR, USGS.	Research

II. Selection of Priority Actions

A. 2017 Funded Projects

In 2017, Bonneville Power Agency funded a priority lamprey conservation project from the Upper Columbia RMU. Under this project, the dam owner (USBOR) collaborated with YN and USFWS to install two additional LPS units at Prosser Dam in the center island fishway. These units were installed in March 2019. Operational modifications are ongoing, and reporting on the installation and first year operations are expected in by the end of 2019.

B. 2018 Funded Projects

In 2018, Bonneville Power Agency funded two priority lamprey conservation projects from the UCRMU. The first is a joint USGS/YN/PNNL acoustic telemetry project evaluating entrainment and survival of outmigrating juvenile lamprey in the Lower Yakima River. The second is an assessment of a flow barrier (Flow Velocity Enhancement System) to reduce larval entrainment at the Bachelor Hatten Diversion on Ahtanum Creek. Contracting for these projects is expected to be complete in August 2019 with field activities scheduled for spring 2020.

C. Prioritization Process

Participating members of the UCRMU met in met in May 2019 to discuss completed and ongoing conservation actions and identify specific projects and research needed to address threats and uncertainties within the region. Prioritization of projects is based on consensus by all participating members of the UCRMU. Criteria used in prioritization include: (1) action will provide significant and persistent benefit to the subbasin population, (2) action is supported by

all affected parties, and (3) action can and will be implemented contingent upon securing funding.

Two Priority Project projects were submitted by RMU members for the Upper Columbia Regional Implementation Plan in 2019. The complete applications for these projects attached as appendices:

Appendix A: Okanogan River Basin Pacific Lamprey *(Entosphenus tridentatus*) Translocation and Monitoring, and

Appendix B: Evaluation of Historic Presence of Pacific Lamprey *(Entosphenus tridentatus*) in the Okanogan River Basin

III. Literature Cited

Arakawa, H. and R. Lampman. 2017. Assessment on the predation potential of various native and non-native fish species to Pacific Lamprey (*Entosphenus tridentatus*) and Western Brook Lamprey (*Lampetra richardsoni*) ammocoetes. Annual Report, BPA Project No. 2008-470-00. 30 pp.

Beals, T., and R. Lampman. 2016a. Lower Yakima Subbasin larval lamprey monitoring report, 2016. Annual Report, BPA Project No. 2008-470-00. 70 pp.

Beals, T., and R. Lampman. 2016b. Upper Yakima larval lamprey monitoring report, 2016. Annual Report, BPA Project No. 2008-470-00. 66 pp.

Beals, T. and Lampman, R. 2016c. Naches larval lamprey monitoring report, 2016. Annual Report, BPA Project No. 2008-470-00. 29 pp.

Beals, T., and R. Lampman. 2016d. Wenatchee Subbasin larval lamprey monitoring report, 2016. Annual Report, BPA Project No. 2008-470-00. 43 pp.

Beals, T., and R. Lampman. 2016e. Entiat Subbasin larval lamprey monitoring report, 2016. Annual Report, BPA Project No. 2008-470-00. 27 pp.

Beals, T., and R. Lampman. 2016f. Methow Subbasin larval lamprey monitoring report, 2016. Annual Report, BPA Project No. 2008-470-00. 37 pp.

Beals, T., and R. Lampman. 2017a. Wenatchee Subbasin larval lamprey monitoring report, 2017. Annual Report, BPA Project No. 2008-470-00. 35 pp.

Beals, T., and R. Lampman. 2017b. Intensive monitoring of larval/juvenile lamprey entrainment within the Yakima Subbasin, 2016. Annual Report, BPA Project No. 2008-470-00. 18 pp.

Beals, T., and R. Lampman. 2017c. Intensive monitoring of larval/juvenile lamprey entrainment within Dryden Diversion, Wenatchee River, 2016. Annual Report, BPA Project No. 2008-470-00. 7 pp.

Beals, T., and R. Lampman. 2018a. Distribution and occupancy of Pacific Lamprey in six major Columbia River subbasins within the Yakima Nation Ceded Lands: Summary from 2009-2017 surveys. Annual Report, BPA Project No. 2008-470-00. 27 pp.

Beals, T., and R. Lampman. 2018b. Summary assessment of larval/juvenile lamprey entrainment in irrigation diversions within the Yakima Subbasin, 2017. Annual Report, BPA Project No. 2008-470-00. 7 pp.

Carpenter, A. L., C. M. Barr, E. S. Anderson, and E. Tinus. 2019. Report C: System-wide Predator Control Program: Fisheries and Biological Evaluation. BPA Project No. Project No. 1990-077-00, 112 pp.

Crandall, J. 2010. Methow Lamprey Inventory and Restoration Assessment: Draft Report. Wild Fish Conservancy. 44 pp.

Grote, A.B. and K.J Carim. 2017. Using eDNA sampling to detect Pacific Lamprey in a large river: 2016 Wenatchee River Pilot Study. U.S. Fish and Wildlife Service, Leavenworth, WA. 23 pp.

Grote, A.B., M. C. Nelson, C. Yonce, A. Johnsen, D. J. Sulak, and R. D. Nelle. 2014. Passage of radio-tagged adult Pacific lamprey at Yakima River diversion dams. 2013 Annual Report Phase : Sunnyside and Wapato Dams. U.S. Fish and Wildlife Service, Leavenworth, WA. 59 pp.

Grote, A.B., M. C. Nelson, C. Yonce, K. Poczekaj, RD Nelle. 2016. Passage of radio-tagged adult Pacific lamprey at Yakima River diversion dams. 2014 Annual Report Phase 3: Roza and Cowiche Dams. U.S. Fish and Wildlife Service, Leavenworth, Washington. 59 pp.

Johnsen, A., and M.C. Nelson. 2012. Surveys of Pacific Lamprey Distribution in the Wenatchee River Watershed 2010 – 2011. U.S. Fish and Wildlife Service, Leavenworth, WA. 15 pp.

Johnsen, A., M. C. Nelson, C. Yonce, D. J. Sulak, and R. D. Nelle. 2013. Passage of radio-tagged adult Pacific lamprey at Yakima River diversion dams. 2012 Annual Report. U.S. Fish and Wildlife Service, Leavenworth, WA. 89 pp.

Kelly-Ringel, B. 2016. Opportunistic surveys of Pacific Lamprey in the Wenatchee River. USFWS Memorandum, February 2, 2016. Leavenworth, WA. 6 pp.

Lampman, R. 2018. Intensive monitoring of larval/juvenile lamprey entrainment within Dryden Diversion, Wenatchee River, 2017. Annual Report, BPA Project No. 2008-470-00. 21 pp.

Lampman, R. 2019a. Translocation of Adult Pacific Lamprey within the Yakima Subbasin, 2017-2018 Broodstock. Annual Report, BPA Project No. 2008-470-00. 39 pp.

Lampman, R. 2019b. Translocation of Adult Pacific Lamprey within the Wenatchee Subbasin, 2017-2018 Broodstock. Annual Report, BPA Project No. 2008-470-00. 34 pp.

Lampman, R. 2019c. Translocation of Adult Pacific Lamprey within the Upper Columbia, 2017-2018 Broodstock. Annual Report, BPA Project No. 2008-470-00. 47 pp.

Luzier, C.W, H.A. Schaller, J.K. Brostrom, C. Cook-Taber, D.H. Goodman, R.D. Nelle, K. Ostrand, and B. Streif. 2011. Pacific Lamprey (Entosphenus tridentatus) Assessment and Template for Conservation Measures. U.S. Fish and Wildlife Service, Portland, OR. 282 pp.

Nilsen, E. B., Hapke, W. B., McIlraith, B., 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.

Timko, M., Le, B., and Nass, B. 2017. Assessment of Juvenile Lamprey Presence/Absence, Habitat Use, and Relative Abundance in the Priest Rapids Project Area. 19 pp.

Wagner, P., M. Young, J. Rohrback, and C. Fisher. 2018 Fall Okanogan Sub-basin Adult Pacific Lamprey Translocation Plan. Colville Tribes Fish and Wildlife Program. August 20, 2018. 5 pp.

Appendix A: Priority Project Information for Okanogan River Basin Pacific Lamprey *(Entosphenus tridentatus*) Translocation and Monitoring

Project Title: **Okanogan River Basin Pacific Lamprey *(Entosphenus tridentatus*) Translocation and Monitoring**

Project Applicant/Organization: Colville Tribes Fish and Wildlife (CCT F&W)
Contact Person: John Rohrback
Email: john.rohrback@colvilletribes.com
Phone: (509) 634-1068

Project Type: Other

Lamprey RMU population: Upper-Columbia
Watershed (5th HUC Field): 1702000622 – Loup Loup Creek – Okanogan River; 1702000620 – Salmon Creek; 1702000619 – Omak Creek; 1702000615 – Antoine Creek – Okanogan River; 1702000720 – Snehumption Creek-Similkameen River
NPCC Subbasin (4th HUC Field) name: 17020006 – Okanogan; 17020007 – Similkameen
Project Location: **Various lamprey release and eDNA sampling sites within the Okanogan river basin in the aforementioned HUCs**

Total Requested funds: $11,180.60

Short Project Summary (200 words or less):

- Provide a brief overview of your project including goals
- This information will be used to describe your project to potential funding entities

Prior to the initiation of reintroduction efforts in 2017, Pacific lamprey (*Entosphenus tridentatus*) were last documented in the Okanogan river subbasin in 2010 (Wagner et al. 2018). This project proposal calls for the continuation of lamprey translocation efforts into the Okanogan river subbasin from mainstem Columbia collection sites, and solicits funding to create a monitoring framework, utilizing environmental DNA (eDNA) sampling, to evaluate and improve translocation efforts. Project goals include:

1. Employ eDNA sampling (n = 8 sites, two sampling occasions) in the Okanogan River and select tributaries to establish a baseline understanding current lamprey stream occupancy prior to 2020 translocation efforts to inform future release strategy and document lamprey stream presence/nondetection
2. Translocate lamprey sourced from a downstream Columbia river collection site to the Okanogan river basin in the spring and late summer/early fall of 2020
3. Monitor post-release lamprey movement using existing PIT tag infrastructure
4. Repeat eDNA sampling in March, 2021 for continued presence/nondetection monitoring prior to lamprey translocation efforts later that same year

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

After construction of Chief Joseph Dam began in the early 1950s, the Okanogan became the terminal watershed to support Pacific lamprey production in the Columbia Basin. However, since juveniles were collected in a main-stem Okanogan rotary screw trap in 2010, there had been no observations of lamprey in the Okanogan basin until adult translocation efforts began in 2017. Furthermore, in the decade prior translocation of adult lamprey in the Upper Columbia (2007-2016), only 92 lamprey were observed passing Wells Dam.

Lamprey translocation and supplementation allows for occupation of presumably underutilized habitat within the Okanogan basin. These efforts may help establish a lamprey pheromone signal in the Okanogan basin to naturally attract re-colonizing adults. The Pacific Lamprey Regional Implementation Plan for the Upper Columbia Regional Management Unit identifies both mainstem passage and small population sizes in the Okanogan and Similkameen watersheds as key threats to Pacific lamprey. Translocation and supplementation mitigate these threats, and appropriate monitoring enhances the effectiveness of these efforts.

Objective 1: Pre-release eDNA monitoring at all four previous lamprey release locations

In 2017, 2018, and 2019 Pacific lamprey were released into the Okanogan and Similkameen watersheds. However, apart from PTAGIS queries to monitor movement of PIT-tagged adults, no lamprey monitoring efforts have been implemented by CCT F&W. eDNA sampling and analysis will provide current lamprey presence/nondetection data in the Okanogan River and selected tributaries. These data can be used to inform release strategies for translocation efforts based on presence/nondetection results (e.g. lamprey presence in a select tributary may indicate suitable habitat, and result in higher numbers of adults released at that area). Samples (each of which consists of three field replicates and one negative control) will be collected at eight sites – one at each release location, and one at a location downstream.

Objective 2: Lamprey translocation and release into the Okanogan river basin

Subject to the availability of adult lamprey at downstream collection sites (including Priest Rapids, John Day, The Dalles, and Bonneville dams), CCT F&W will receive adult lamprey at Wells Dam for translocation and release into the Okanogan basin. Translocation efforts should be similar to those conducted in past years – approximately five release occasions with a total number of released lamprey approximating 500 individuals, contingent on lamprey capture success, occurring in the spring and late summer/early fall.

Objective 3: Post-release PIT tag and eDNA monitoring

Following release, CCT F&W will periodically query the PTAGIS database to monitor the detected movements of released, PIT-tagged lamprey. After the overwintering period, eDNA samples will again be taken to monitor lamprey presence and distribution in the Okanogan river basin. qPCR analysis will be used to document presence/nondetection of lamprey and starting quantities of lamprey DNA. Results of these monitoring efforts – along with translocation results – will be compiled, summarized, and analyzed in a final report. In future years, after the collection of a sufficient time-series of eDNA presence/nondetection data for substantive analysis (see proposal "Evaluation of Historic Presence of Pacific Lamprey [*Entosphenus tridentatus*] in the Okanogan River Basin"), these results can be used to populate an Okanogan basin occupancy model that tracks the progress and evaluates the success of the translocation efforts.

2. Descriptive Photographs-illustrations-Maps (Limit to three total)**:**

Figures 1 and 2 are from the Okanogan Sub-basin adult Pacific lamprey translocation plan. They denote potential release locations for Pacific lamprey within the Okanogan river basin. Release locations will be chosen based on water temperature, habitat conditions and lamprey presence at the time of release. eDNA samples will be collected at release locations as well as sites located downstream. Historically, lamprey have been released in-basin in Salmon Creek, Omak Creek, the Similkameen River below Coyote Falls, and the Okanogan River near the mouth of Salmon Creek.

Figure 3: Upper Okanogan River Lamprey release and monitoring Sites

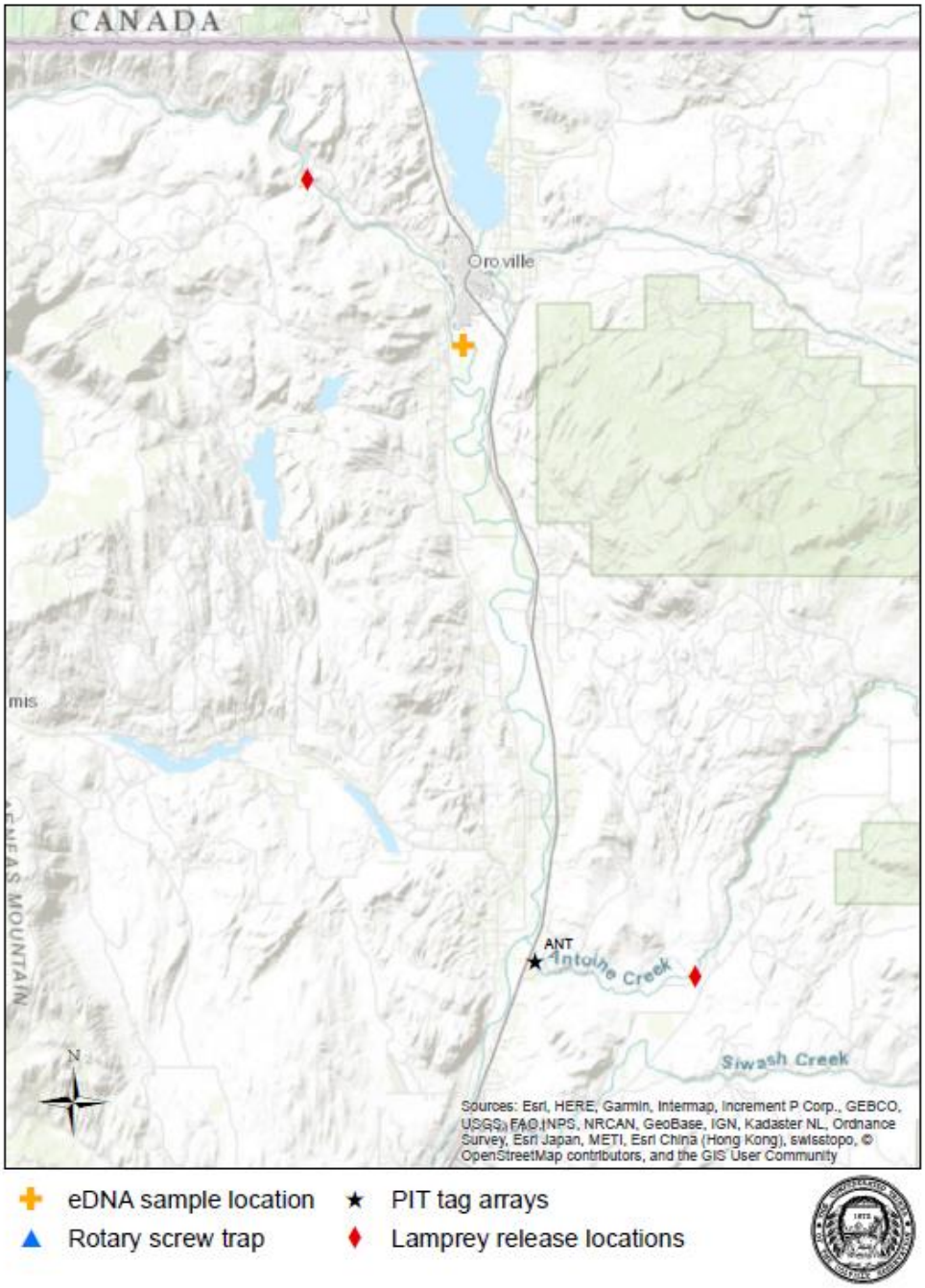
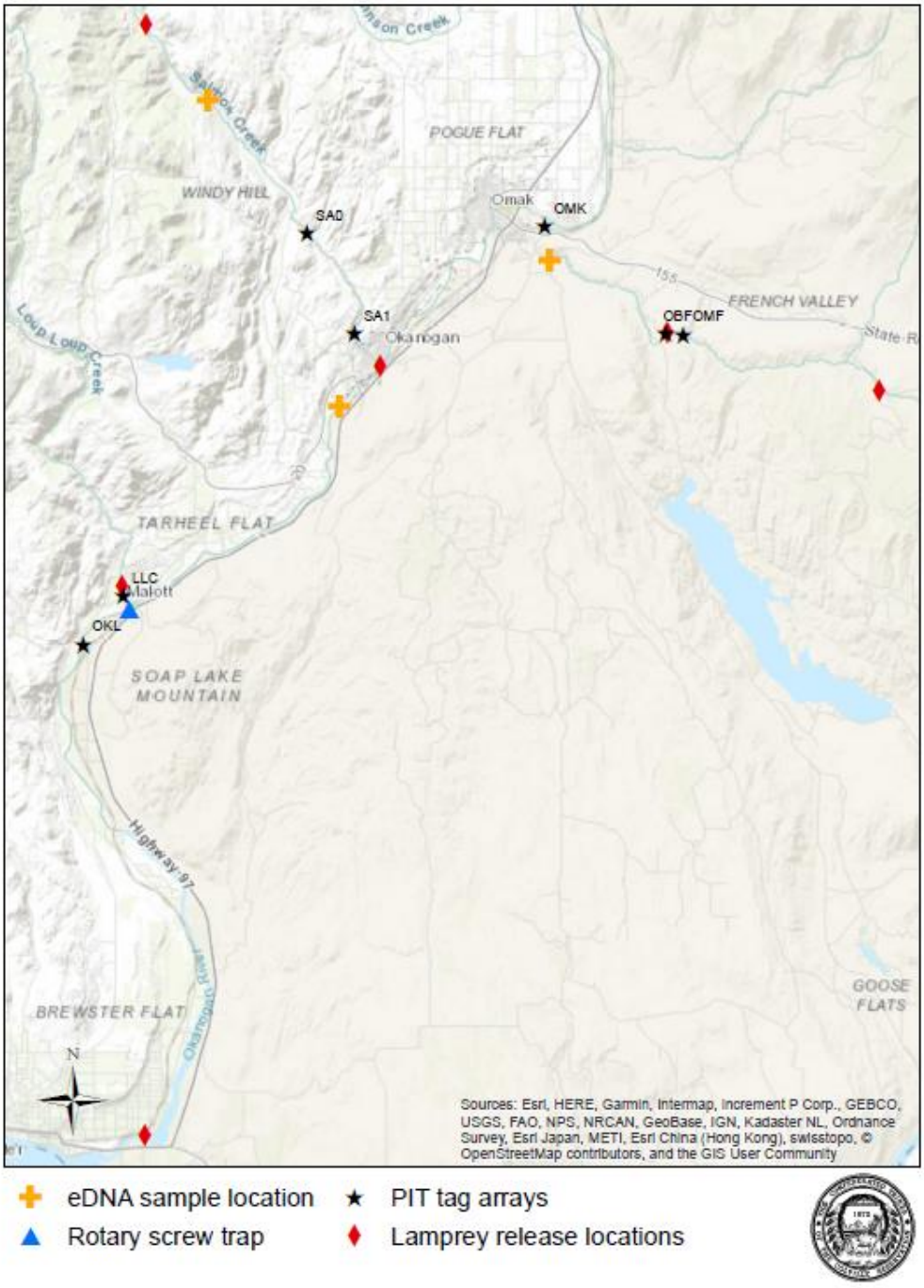


Figure 4: Lower Okanogan River Lamprey release and monitoring sites.



3. Linkage of actions to Identified Threats in RMU (300 words or less):

- What threat(s) does this project address? ***See your RIP for key threats: Small Effective Population Size*** AND ***Passage*** AND ***Lack of Awareness***
- Project scope: Does this project address threat(s) specific to this RMU only, or does the project address the threat(s) prevalent in multiple RMUs?
  Single RMU ☒, Multiple RMUs ☐ list additional RMUs:
- How does this project address key threat(s) within the HUC where project is proposed?
  - *Translocating lamprey from the mid-Columbia to the Okanogan river basin*

mitigates the upstream passage burden on adults returning to spawn. Releasing lamprey in the proposed HUCs addresses the key threat of small effective population size. eDNA monitoring helps to evaluate the success of the translocation efforts and reduce the lack of awareness and understanding about lamprey distribution in the Okanogan river basin.

4. ***Species/Habitat Benefits (200 words or less):***
   - How will the project provide meaningful measureable results to improve lamprey populations and/or their habitat conditions?
     - *eDNA monitoring will provide data to monitor lamprey presence and distribution throughout the Okanogan river basin. Translocation of adults will provide a minimum known number of adults that are available to spawn within basin.*
   - What life stage or stages will benefit from action? How?
     - *Adult lamprey will be the primary beneficiaries through the translocation process. Since passage over Wells has been extremely limited in recent years, assisting with their upstream migration will help to ensure lamprey have the opportunity to reproduce in the Okanogan watershed. Secondarily, Juvenile lamprey will benefit from expanded range in underutilized habitat.*
   - What other species may benefit from action?
     - *Transferal of marine derived nutrients into the Okanogan River Basin in the form of spawned out lamprey carcasses will help to offset the nutrient deficit from historic levels, providing benefit to the riverine ecosystem and all naturally occurring species.*
     - *Re-establishment of larval lamprey (from translocated parents) will provide a food source for both native and non-native (prey-buffering) fish species, and may contribute to improved nutrient cycling and water quality in streams with high larval densities.*

5. ***Project Design / Feasibility (200 words or less):***
   - Have the designs for the project been completed already or will they be completed before planned project implementation? Yes ☒, No☐
     - *Coordination with project partners is ongoing*
   - 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☐
     - *CCT F&W maintains a fish transport permit for lamprey. It expires on September 30, 2019, but will be renewed to allow for these efforts*
   - Can the project be implemented within the defined timeframe? ***See BPA and NFHP requirements above***. Yes ☒, No☐

6. ***Partner Engagement and Support (200 words or less):***
   - What partners are supporting the project?
     - *Yakama Nation, Grant PUD, Douglas PUD, and USGS*
   - What partners are active in implementing the project?
     - *Yakama Nations and Douglas PUD will both participate in the adult lamprey translocation efforts, moving fish from Priest Rapids Dam to Wells Hatchery, and conducting PIT-tagging and biosampling activities. Grant PUD will conduct lamprey trapping and transferal activities. USGS will conduct the eDNA extraction and analysis. CCT F&W will transport and release lamprey into the*

Okanogan River Basin, PIT tag and biosample lamprey, and collect eDNA samples.

- What partners are providing matching funds or in-kind services that directly contribute to the project?
    - *CCT F&W is providing vehicles, in-kind staff time that corresponds with planned eDNA sampling activities, and maintaining an extensive PIT array network in the Okanogan river basin that will allow for monitoring of released lamprey. Douglas PUD and Yakama Nations are providing staff time, lamprey transportation, and PIT tags to bring fish from Priest Rapids Dam to Wells, collect data, and PIT tag lamprey. USGS will provide use of nonconsumptive eDNA sampling supplies.*

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

- How is completion of the project going to be documented? ***See BPA and NFHP requirements above***.
    - *A written and photographed report of translocation events will be provided, which also includes post-release PIT tag monitoring through queries of the PTAGIS database, and the results of pre- and post-release eDNA sampling.*
- How will the projects' benefits to lamprey be monitored over time?
    - *The detection history of PIT-tagged lamprey will be monitored periodically through querying the publically available PTAGIS database. Collected and analyzed eDNA samples will provide additional insight into lamprey occupancy and habitat utilization in basin. Future activities to monitor the success of the lamprey translocation may include electroshocking and redd surveys, as funding allows.*

8. Project Budget (Including overhead):

- See example on last page.

9. Timeline of major tasks and milestones:

Workflow	***Start Date/Month***	***End Date/Month***	***Responsible Party***
Pre-release eDNA sample collection	***July 2020***	***Aug. 2020***	***CCT F&W***
Lamprey translocation	***Aug. 2020***	***Sept. 2020***	***CCT F&W***
Post-release eDNA sample collection	***Mar. 2021***	***Mar. 2021***	***CCT F&W***
qPCR analysis of eDNA samples	***Mar. 2021***	***Apr. 2021***	***USGS***
Reporting	***Mar. 2021***	***Apr. 2021***	***CCT F&W***

10. References

Wagner, P., Young, M., Rohrback, J., and Fisher, C. 2018 Fall Okanogan Sub-basin Adult Pacific Lamprey Translocation Plan. Colville Tribes Fish and Wildlife Program. August 20, 2018.

Project Budget:

Below is a budget for the funds requested for the proposed Pacific lamprey translocation and monitoring project

	Items	# Hours or Units	Cost per Unit ($)	RIP Funds Requested ($)	Cost Share ($)	Total Cost ($)
A	***Personnel:***	-	-	-	-	-
	a. CCT Biologist Salary	100	$30.01	$2400.80	$600.20	$3001.00
	b. CCT Biologist Fringe	1	$714.00	$714.00	$179.00	$893.00
	c. CCT Technician Salary	40	$22.19	$887.60		$887.60
	d. CCT Technician Fringe	1	$241.00	$241.00		$241.00
B	***Equipment & Supplies:***	-	-	-	-	-
	a. eDNA self-desiccating filters from Smith Root	64	$15.00	$960.00		$960.00
	b. eDNA filter shipping	1	$40.00	$40.00		$40.00
C	***Travel:***	-	-	-	-	-
	Translocation mileage from Omak to Wells, Similkameen release site, and back to Omak	748	$0.58/mile	$433.84		$433.84
D	***Other:***	-	-	-	-	-
	a. per sample qPCR Analysis for Pacific Lamprey	16	$265.56	$4248.96		$4248.96
	b. shipping filters to eDNA lab in Boise	2	$47.20	$94.40		$94.40
E	***Administrative:***	-	-	-	-	-
	Indirect Costs (35.29 %)	1	$1,160.00	$1,160.00		$1,160.00
	Total (Sum of A - E)	-	-	$11,180.60		$11,959.80

This page intentionally left blank for 2-sided printing

Appendix B: Priority Project Information for Evaluation of Historic Presence of Pacific Lamprey *(Entosphenus tridentatus*) in the Okanogan River Basin

Project Title: **Evaluation of Historic Presence of Pacific Lamprey *(Entosphenus tridentatus*) in the Okanogan River Basin**

Project Applicant/Organization: Colville Tribes Fish and Wildlife (CCT F&W)
Contact Person: John Rohrback
Email: john.rohrback@colvilletribes.com
Phone: (509) 634-1068

Project Type: Monitoring

Lamprey RMU population: Upper-Columbia
Watershed (5th HUC Field): 1702000622 – Loup Loup Creek – Okanogan River; 1702000620 – Salmon Creek; 1702000619 – Omak Creek; 1702000621 – Scotch Creek-Okanogan River; 1702000615 – Antoine Creek – Okanogan River; 1702000720 – Snehumption Creek-Similkameen River
NPCC Subbasin (4th HUC Field) name: 17020006 – Okanogan; 17020007 – Similkameen
Project Location: **Various lamprey release and eDNA sampling sites within the Okanogan river basin in the aforementioned HUCs**

Total Requested funds: $35,596.02

Short Project Summary (200 words or less):

- Provide a brief overview of your project including goals
- This information will be used to describe your project to potential funding entities

Prior to the initiation of reintroduction efforts in 2017, Pacific lamprey (*Entosphenus tridentatus*) were last documented in the Okanogan river subbasin in 2010 (Wagner et al. 2018). It appears as if lamprey had become extirpated in the Okanogan river basin some time shortly after that. However, until 2017, monitoring and management actions for lamprey were minimal in the Okanogan river basin. This lack of monitoring has resulted in a large gap in understanding of the recent historical status of lamprey in the Okanogan river basin. This project proposal requests the analysis of archived eDNA samples taken in the Okanogan river basin to evaluate the presence/nondetection of Pacific lamprey at various sites in the basin. Existing archived eDNA samples exist from 2012 to 2019. This spans the time prior to and post translocation efforts. Additional information regarding the presence and distribution of lamprey in the Okanogan river basin will inform recovery strategies, may help to refine knowledge of lamprey habitat requirements and preferences in the basin. Additionally, this monitoring data may increase the effectiveness of the translocation and reintroduction effort.

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

Outmigrating Pacific lamprey macrophthalmia were detected in the Okanogan River rotary screw trap (anchored to the Highway 20 bridge at the southern end of the town of Okanogan) were captured annually from initial installation in 2006 until 2010. The failure to detect Pacific lamprey in the Okanogan river basin post-2010, especially given the low numbers of adult lamprey counted passing over Wells Dam on the upstream migration to spawning grounds, indicates that lamprey may have been effectively extirpated from the Okanogan river basin after 2010.

Although dam passage for adult lamprey has been identified as a key threat to the Upper Columbia region's lamprey population, the hydroprojects had been in place for decades prior to the presumed extirpation of lamprey from the Okanogan. This implies that an additional contributing factor to the decline and fall of Okanogan lamprey may have been unfavorable in-basin changes to habitat. In order to re-establish a self-sustaining lamprey population in the Okanogan river basin, such changes must be identified and addressed.

Unfortunately, historic monitoring data for lamprey is limited to rudimentary counts of macrophthalmia in the rotary screw trap. The resulting data is insufficient to describe the recent historical presence, population, or distribution of lamprey in the Okanogan river basin. Specific and targeted monitoring, as requested in this proposal, is critical for increasing precision in estimating the date of presumed extirpation, and identifying tributaries or reaches where lamprey last persisted in the basin. This information can be synthesized with the extensive Okanogan EDT habitat monitoring protocol to identify priority habitat restoration actions to facilitate, expedite, and encourage lamprey recolonization of the Okanogan river basin.

Archived eDNA samples in the Okanogan river basin date back to 2012 (Figure 1), with the first samples taken approximately two years after the last instance of lamprey detection. The sampling regime has not been comprehensive in subsequent years (Figure 2). Samples were not taken to specifically target lamprey. Nevertheless, mining the archives for detection of lamprey eDNA is an important step to inform understanding of Pacific lamprey in the Okanogan river basin. Analysis of these samples will assist in:

1) Increasing the degree of confidence that lamprey actually did disappear from the Okanogan river basin, and refine estimates as to when that occurred;
2) Determining what factors may have contributed to the disappearance of lamprey within the Okanogan river basin;
3) Examining pre- and post-translocation occupancy of Okanogan basin streams by lamprey;
4) Correlate lamprey presence in the Okanogan basin with existing habitat data to identify local habitat characteristics preferred by lamprey to improve the success of relocation efforts.

Colville Tribes Fish and Wildlife biologists will coordinate with USGS to select 108 archived eDNA samples to mine for lamprey DNA. After presence/nondetection of lamprey DNA in these samples has been determined, CCT and USGS will collaborate in the analysis of the results, looking at trends in historic habitat conditions for sampled streams. As a result of this analysis, the Okanogan Sub-basin Adult Pacific Lamprey Translocation Plan will be revised to improve its effectiveness and incorporate the best available science to identify habitat rehabilitation and remediation projects to benefit lamprey.

2. Descriptive Photographs-illustrations-Maps:

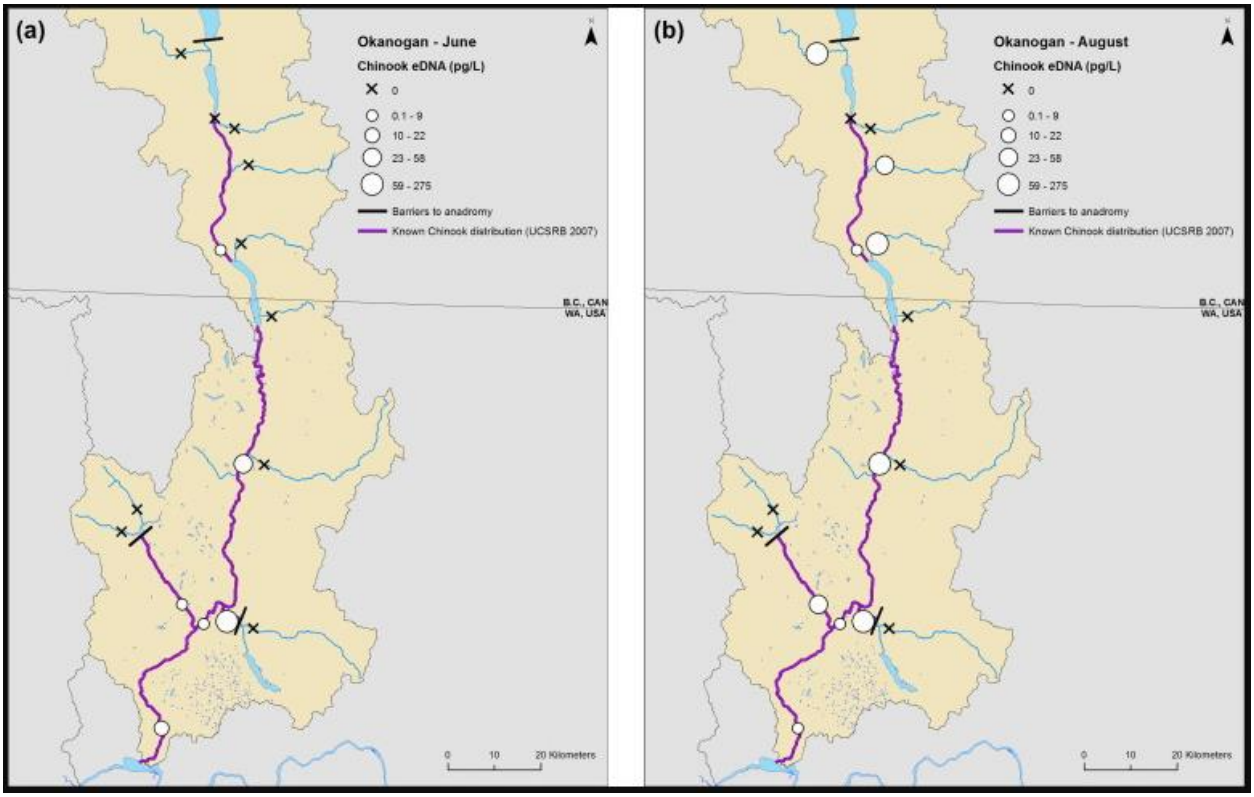


Figure 5. Initial collection sites for eDNA samples, from Laramie et al. (2015)

Site	2012	2013	2014	2015	2016	2017	2018	2019
Loup Loup Creek		+	+		+	+	+	+
Omak Creek (above falls)	+				+	+	+	+
Omak Creek (near mouth)	+		+		+	+	+	+
Salmon Creek	+		+		+	+	+	+
North Fork Salmon Creek	+		+			+		
West Fork Salmon Creek	+		+			+		
Wanacut Creek		+			+	+	+	+
Tunk Creek		+			+	+	+	+
Aeneas Creek		+	+		+	+	+	+
Bonaparte Creek	+		+		+	+	+	+
Siwash Creek		+					+	+
Tonasket Creek		+			+		+	+
Antoine Creek		+	+		+	+	+	+
Similkameen River		+	+			+		
Ninemile Creek	+		+		+		+	
Inkaneep Creek	+		+		+	+	+	
Vaseux Creek	+		+		+	+	+	
Shuttleworth Creek	+		+		+		+	
Shingle Creek	+		+		+	+	+	
Okanogan River (near mouth)	+		+			+	+	+
Okanogan River (above Salmon Cr.)	+		+			+	+	+
Okanogan River (above Siwash Cr.)	+		+					
Okanogan River (Inkaneep Cr.)	+		+			+	+	
Okanogan River (at Shuttleworth Cr.)	+		+					

+ Indicates Archived Sample

Figure 6. The record of locations from which archived eDNA samples are available for Pacific lamprey DNA extraction within the Okanogan river basin. Some sites have multiple (spring and fall) samples for certain years.

3. Linkage of actions to Identified Threats in RMU (300 words or less):

- What threat(s) does this project address? ***See your RIP for key threats: Small Effective Population Size*** AND ***Lack of Awareness***
- Project scope: Does this project address threat(s) specific to this RMU only, or does the project address the threat(s) prevalent in multiple RMUs?
  Single RMU ☒, Multiple RMUs ☐ list additional RMUs:
- How does this project address key threat(s) within the HUC where project is proposed?
  - *The additional knowledge about historical lamprey presence and distribution in the Okanogan river basin acquired through analysis of historic eDNA samples will increase understanding of lamprey status in the Okanogan. Analysis of these results will guide future translocation and habitat rehabilitation efforts, which will help to mitigate threats associated with the small effective population size in the Okanogan.*

4. Species/Habitat Benefits (200 words or less):

- How will the project provide meaningful measureable results to improve lamprey populations and/or their habitat conditions?
  - *Habitat project and translocation strategy recommendations that result from the analysis of historic eDNA samples will increase available rearing habitat which may result in larger lamprey populations in the Okanogan basin. Management activities such as translocation can be incredibly important steps in species recovery. However, absent appropriate monitoring, they can be misguided and, ultimately, deleterious. Analysis of historic eDNA samples for lamprey presence and distribution will inform an appropriate and effective recovery program.*

- What life stage or stages will benefit from action? How?
  - *All lamprey life stages will benefit from the eDNA analysis; the additional knowledge about presence and distribution will help to focus and refine future lamprey management and monitoring actions, which will benefit the species as a whole.*

- What other species may benefit from action?
  - *The entire aquatic ecosystem, including summer Chinook, and ESA listed summer steelhead and spring Chinook, will benefit as a historically naturally occurring species, Pacific lamprey, recolonizes part of its historic range.*

5. Project Design / Feasibility (200 words or less):

- Have the designs for the project been completed already or will they be completed before planned project implementation? Yes ☒, No☐
  - *Coordination with project partners is ongoing. USGS and CCT F&W have a valid collaborative agreement in place that enables coordination of eDNA analysis and extraction.*

- 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 and NFHP requirements above***. Yes ☒, No☐

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

- What partners are supporting the project?
    - *USGS, CCT F&W*

- What partners are active in implementing the project?
    - *USGS will conduct the eDNA extraction and analysis. CCT F&W and USGS have both participated in the collection of the archived eDNA samples. CCT F&W and USGS will collaborate on analysis of the results.*

- What partners are providing matching funds or in-kind services that directly contribute to the project?
    - *Sampling (including staff time and the cost of consumptive eDNA sampling materials) has already been carried out by CCT F&W and USGS. Samples have been stored by USGS since initial sample collection.*

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

- How is completion of the project going to be documented? ***See BPA and NFHP requirements above***.
    - *A written and report and analysis of the results, containing forward-looking recommendations for lamprey recovery and management actions will be provided at the completion of the project.*

- How will the projects' benefits to lamprey be monitored over time?
    - *Further monitoring of lamprey presence and distribution through PIT and additional eDNA analysis will help with tracking the benefits to lamprey.*

8. Project Budget (Including overhead):

- See example on last page.

9. Timeline of major tasks and milestones:

Workflow	***Start Date/Month***	***End Date/Month***	***Responsible Party***
qPCR analysis for Pacific lamprey from archived eDNA samples taken within the Okanogan river basin	***May 2020***	***Aug. 2020***	***USGS***
Data analysis and reporting	***Aug. 2020***	***Sept. 2020***	***CCT F&W and USGS***

10. References (If Applicable)

Laramie, M. B., Pilliod, D.S., and Goldberg, C.S. (2015). Characterizing the distribution of an endangered salmonids using environmental DNA analysis. Biological Conservation, 183:29-37.

Wagner, P., Young, M., Rohrback, J., and Fisher, C. 2018 Fall Okanogan Sub-basin Adult Pacific Lamprey Translocation Plan. Colville Tribes Fish and Wildlife Program. August 20, 2018

Project Budget:

Below is a budget for the funds requested for the proposed Pacific lamprey historic eDNA analysis project

	Items	# Hours or Units	Cost per Unit ($)	RIP Funds Requested ($)	Cost Share ($)	Total Cost ($)
A	***Personnel:***	-	-	-	-	-
	e. CCT F&W Biologist Salary	40	$30.01	$1200.40		$1200.40
	f. CCT F&W Biologist Fringe	1	$357.00	$357.00		$357.00
B	***Equipment & Supplies:***	-	-	-	-	-
C	***Travel:***	-	-	-	-	-
D	***Other:***	-	-	-	-	-
	c. per sample qPCR Analysis for Pacific Lamprey	108	265.56	28,680.42		28,680.42
	d. USGS Data Analysis & Reporting	1	4,934.58	4,934.58		4,934.58
E	***Administrative:***	-	-	-	-	-
	Indirect Costs (35.29 %)			$423.62		$423.62
	Total (Sum of A - E)	-	-	$35,596.02		$35,596.02