Pacific Lamprey
2019 Regional Implementation Plan
for the
Mid-Columbia
Regional Management Unit

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I. Status and Distribution of Pacific Lamprey in the RMU

A. 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).

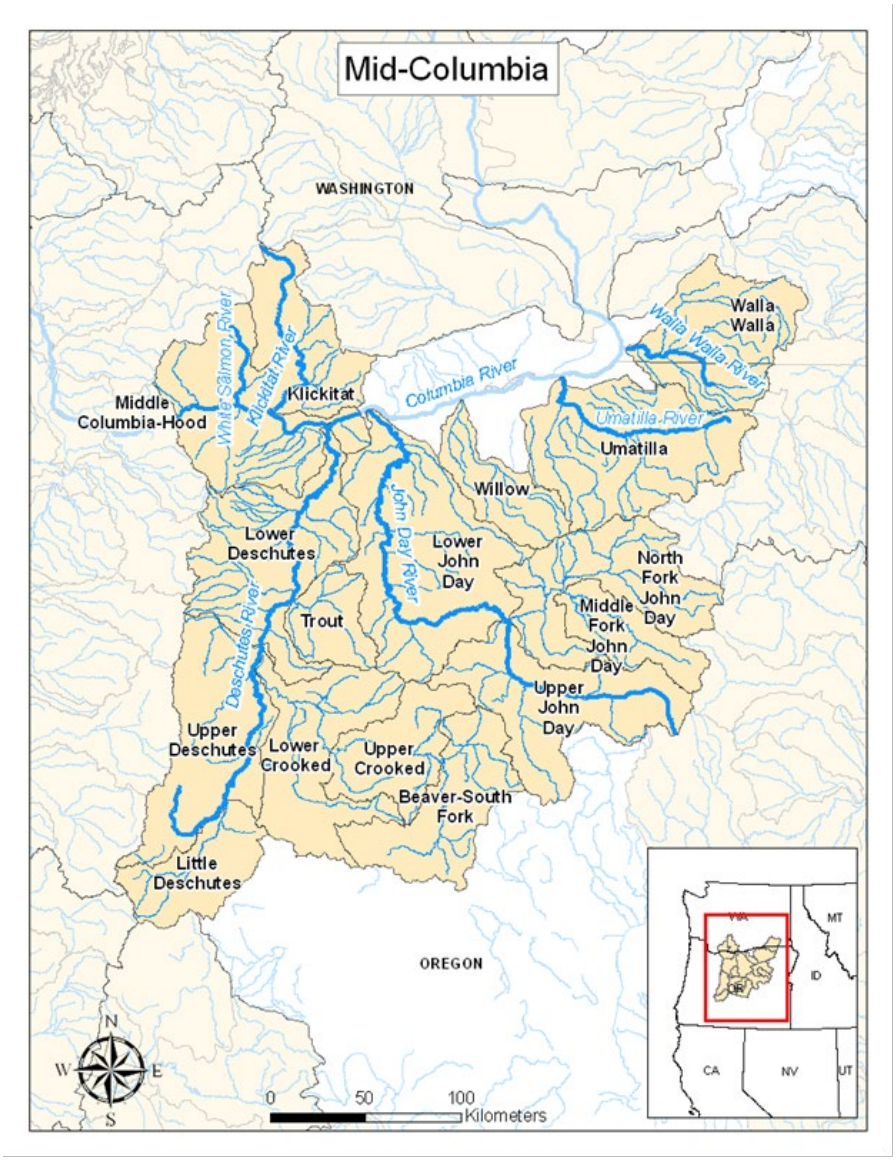

Figure 1. Map of watersheds within the Mid-Columbia Regional Management Unit.

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

B. 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 ammocoetes 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 2018). 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 Klickitat was the only subbasin to observe a further decline of Pacific Lamprey populations (from 10-30% to 50-70%) in the last five years. Numbers of larval/juvenile lamprey captured in a rotary screw trap near Lyle Falls (RM 2.2) have declined from 2,000-4,000 fish annually (2003-2006), to around 50 fish annually (Ralph Lampman, Yakima Nation Fisheries (YNF), personal communication)

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. Pacific Lamprey are also 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

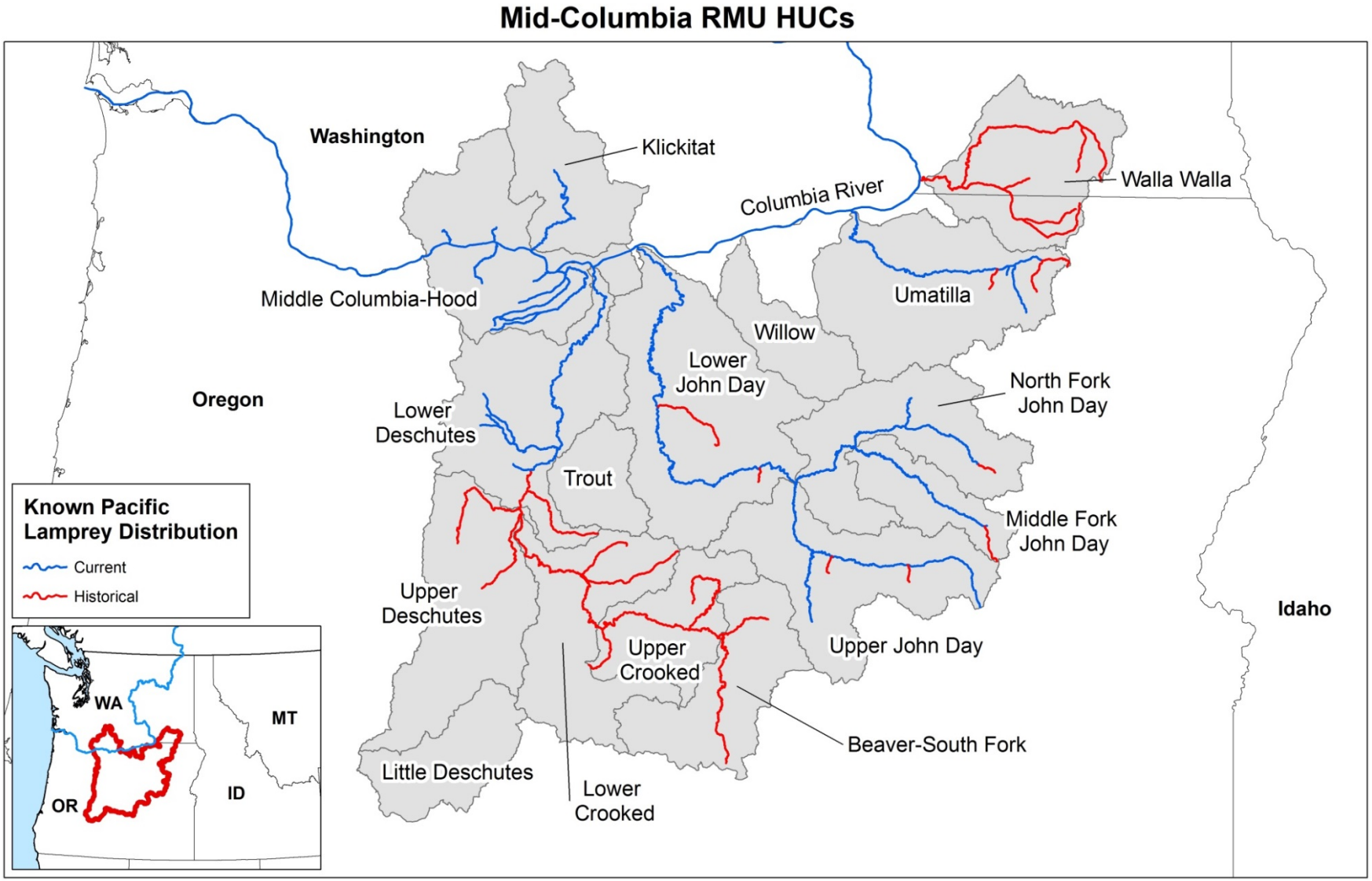

Figure 2. Current and historical known distribution for Pacific Lamprey: Mid-Columbia RMU (USFWS Data Clearinghouse 2017). Historical Pacific Lamprey distribution depicted in map was obtained from published literature, tribal accounts and state and federal agency records.

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, Pacific Lamprey are distributed upstream to the Klickitat Hatchery where a low head weir currently impedes 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).

C. 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 Pacific Lamprey 2017 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 ammocoetes 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 2012-2018.

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)	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
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
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	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 Dam on White Salmon River.	Survey	Ongoing
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	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 conference call June 11th, 2019 to discuss completed and ongoing conservation actions and identify specific projects and research needed to address threats and uncertainties within the region. There were no lamprey project proposals submitted to the Mid-Columbia Regional Implementation Plan in 2019.

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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.