Pacific Lamprey

2022 Regional Implementation Plan

for the

Oregon Coast

Regional Management Unit

South Coast Sub-Region

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Status and Distribution of Pacific Lamprey in the RMU

General Description of the RMU

South Oregon Coast Sub-Region

The Oregon Coast Regional Management Unit is separated into two sub-regions equivalent to the USGS hydrologic unit accounting units 171002 (Northern Oregon Coastal) and 171003 (Southern Oregon Coastal). The South Oregon Coast sub-region includes all rivers that drain into the Pacific Ocean from the Umpqua River basin south to the Smith River boundary in California. It is comprised of twelve 4th field HUCs ranging in size from 1,216 to 4,662 km^2 (Table 1). Watersheds within the South Oregon Coast sub-region include the North and South Umpqua, Umpqua, Coos, Coquille, Sixes, Upper, Middle and Lower Rogue, Applegate, Illinois and Chetco (Figure 1).

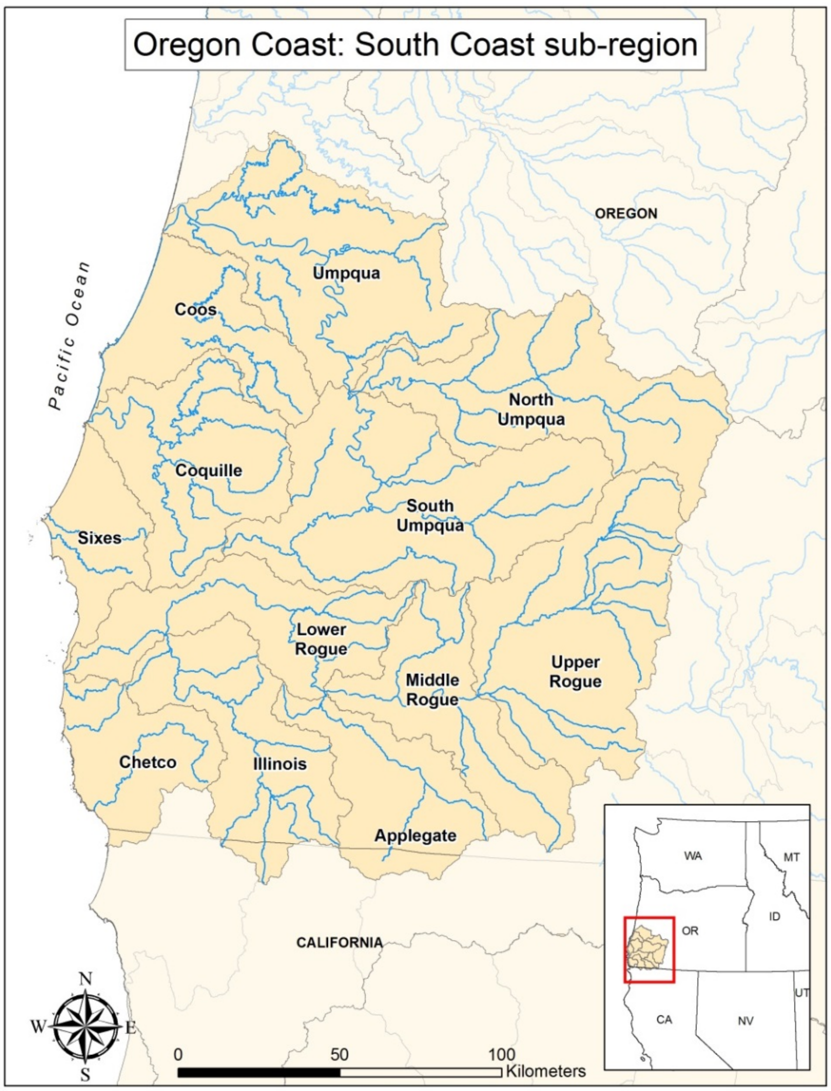

Figure 1. Map of watersheds within the Oregon Coast RMU, South Coast sub-region.

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

Watershed	HUC Number	Drainage Size (km^2)	Level III Ecoregion(s)
North Umpqua	17100301	3,544	Cascades, Klamath Mountains
South Umpqua	17100302	4,662	Coast Range, Cascades, Klamath Mountains
Umpqua	17100303	3,918	Coast Range, Cascades, Willamette Valley, Klamath Mountains
Coos	17100304	1,909	Coast Range
Coquille	17100305	2,736	Coast Range, Klamath Mountains
Sixes	17100306	1,216	Coast Range
Upper Rogue	17100307	4,180	Cascades, Klamath Mountains, Eastern Cascades Slopes and Foothills
Middle Rogue	17100308	2,283	Cascades, Klamath Mountains
Applegate	17100309	2,005	Klamath Mountains
Lower Rogue	17100310	2,347	Coast Range, Klamath Mountains
Illinois	17100311	2,580	Klamath Mountains
Chetco	17100312	1,654	Coast Range, Klamath Mountains

Status of Species

Conservation Assessment and New Updates

Every five years the Pacific Lamprey Conservation Initiative (PLCI), through the Regional Management Units (RMU), revise the Pacific Lamprey Assessment (USFWS 2018). The Assessment utilizes local stakeholder knowledge and expertise to evaluate Pacific Lamprey distribution, population demographics and threats at the 4th field HUC watershed level. This information is used to inform NatureServe, a diagnostic tool that characterizes the conservation risk of Pacific Lamprey across their historical range. Information about current Pacific lamprey distribution, population size, trends, and watershed threats were collected from stakeholders in the South Coast sub-region through an online Assessment questionnaire and virtual meeting held on March 31st 2022. The following is a brief summary of key findings from the 2022 Pacific Lamprey Assessment.

NatureServe conservation status ranks changed in five of twelve HUCs in 2022 (Table 2). Status ranks fell from Imperiled (S2) to Critically Imperiled (S1) in the Middle Rogue, Applegate, Lower Rogue, and Chetco and from Imperiled (S2) to Imperiled/Critically Imperiled (S1S2) in the North Umpqua. The decline in status ranks was generally due to an increase in the scope or severity of threats facing Pacific Lamprey in these watersheds (see Threats below).

Distribution

Current Pacific Lamprey distribution in the South Coast sub-region is still greatly reduced from historical range (Table 2). The ratio of current to historical distribution was estimated to be small in the majority of watersheds, ranging from 1% (Applegate) to 29% (Coos) in areas with known Pacific Lamprey occupancy. Although current distribution of lamprey has remained the same in many watersheds since the completion of the 2018 Assessment, distribution expanded modestly in the Coos (+96 km^2), Illinois (+66 km^2) and Chetco (+75 km^2) watersheds due to increased sampling effort (i.e., occupancy sampling, smolt trapping, redd surveys, etc.). Distribution information is still limited in the Upper Rogue and Applegate watersheds. A compilation of all known larval and adult Pacific Lamprey occurrences in the South Coast sub-region are displayed in Figure 2, which is a product of the USFWS data Clearinghouse.

Abundance

Pacific Lamprey population abundance was revised in the North Umpqua, South Umpqua, Umpqua, Coos and Coquille watersheds using consolidated data from redd surveys conducted in coastal watersheds by Oregon Department of Fish and Wildlife (ODFW) personnel. As part of the annual monitoring for winter steelhead spawning populations, the Oregon Adult Salmonid Inventory and Sampling (OASIS) field crews have recorded counts of lamprey spawners and redds since 2007. ODFW has estimated the range of Pacific Lamprey abundance using extrapolations of published information on the average number of Pacific Lamprey per redd, average peak redd counts per kilometer, multiplied by the total length of potential habitat (see Clemens et al. 2021). Pacific Lamprey abundance indices are considered conservative abundance indices, as the surveys are focused on winter steelhead, and end before the completion of Pacific lamprey spawning. Estimated adult Pacific Lamprey abundance between 2007 and 2021 has ranged from 33 – 23,241 fish in the Mid-South Coast geographic management area (includes Coos and Coquille Rivers), 81 – 11,933 fish in the Umpqua geographic management area (includes lower, middle and South Fork Umpqua), and 31 – 1,278 fish at Winchester Dam on the North Umpqua (ODFW 2022; Clemens et al. 2021; Ben Clemens, ODFW, personal communication). Pacific Lamprey abundance indices have increased and decreased over time with periodic peaks in abundance every few years (Clemens et al. 2021). Variation in abundance from year to year and from one watershed to another may be due to natural population cycles, ocean or freshwater conditions, prey abundance/availability, or other environmental factors (Clemens et al. 2019).

Adult Pacific Lamprey abundance is currently unknown in the Sixes, Upper Rogue, Middle Rogue, Applegate, Lower Rogue, Illinois, and Chetco Rivers (Table 2).

Population Trend

There is consensus that lamprey populations have declined significantly in coastal areas compared to past returns approximately 50-60 years ago (Downey et al.1993; Sheoships 2014). However, short-term population trend which is defined as the degree of change in population size over three lamprey generations (≈36 years), was ranked as ‘Unknown’ in the majority of South Coast watersheds in 2022 because there is a lack of continuous long-term population trend data in the region. One exception is Winchester Dam on the North Umpqua River. Winchester

Dam has maintained a continuous count of adult Pacific Lamprey since 1965. Overall, counts of Pacific Lamprey at Winchester Dam have declined precipitously since the early 1970s. The 10-year average count of adult Pacific Lamprey from 1965-1974 was over 22,000 fish, while the recent 10-year average is just over 800 fish (ODFW 2022). More recently however, the number of adults passing Winchester Dam has shown a slight increase following the installation of a lamprey passage structure in 2013. It is unclear whether the increase is due to the installation of the lamprey ramp and more efficient counting methods, actual increases in the number of adults migrating upstream past the dam, or both. Oregon Department of Fish and Wildlife abundance indices in the Mid-South Coast and Umpqua geographic management areas also indicate a possible increase in adult abundance over the last several years (Clemens et al. 2021), but this dataset is not long enough to infer population trend.

Table 2. Population demographic and conservation status ranks (see Appendix 1) of the 4th Field Hydrologic Unit Code (HUC) watersheds located within the South Oregon Coast Sub-region. Note – coho salmon distribution was used as a surrogate estimate of historical lamprey range extent in areas where historical occupancy information was not available. Ranks highlighted in Yellow indicate a change from the 2018 Assessment.

Watershed	HUC Number	Conservation Status Rank	Historical Occupancy (km^2)	Current Occupancy (km^2)	Population Size (adults)	Short-Term Trend (% decline)
North Umpqua	17100301	S1 S2↓	1000-5000	100-500	250-2500	Stable
South Umpqua	17100302	S1	1000-5000	100-500	250-2500	Unknown
Umpqua	17100303	S2	1000-5000	500-2000	1000-10,000	Unknown
Coos	17100304	S2	1000-5000	100-500	250-2500	Unknown
Coquille	17100305	S2	1000-5000	500-2000	2500-10,000	Unknown
Sixes	17100306	S2	1000-5000	100-500	Unknown	Unknown
Upper Rogue	17100307	S1	1000-5000	100-500	Unknown	Unknown
Middle Rogue	17100308	S1↓	1000-5000	100-500	Unknown	Unknown
Applegate	17100309	S1↓	1000-5000	100-500	Unknown	Unknown
Lower Rogue	17100310	S1↓	1000-5000	100-500	Unknown	Unknown
Illinois	17100311	S1	1000-5000	100-500	Unknown	Unknown
Chetco	17100312	S1↓	250-1000	100-500	Unknown	Unknown

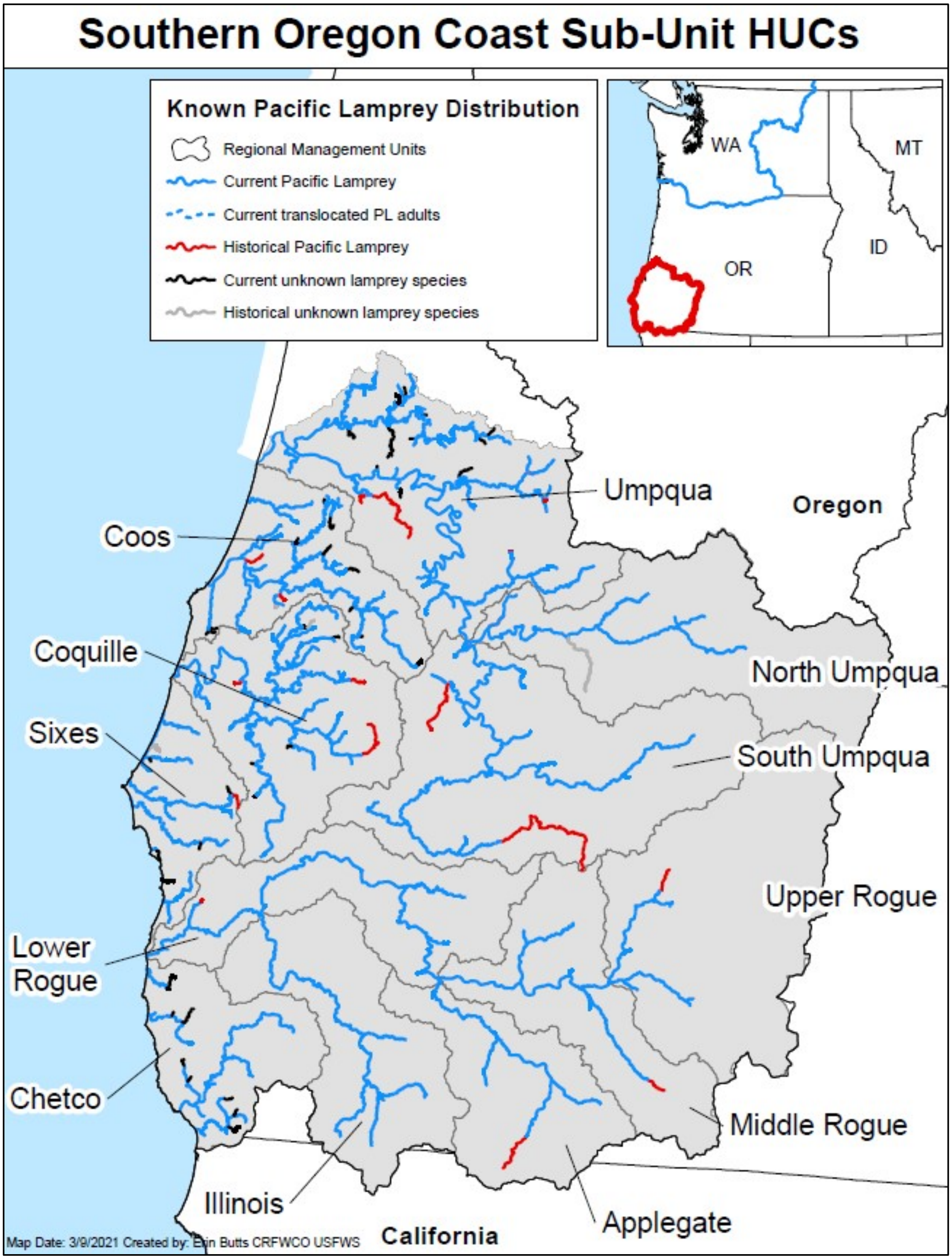

Figure 2. Current and historical known distribution for Pacific Lamprey: Oregon Coast Regional Management Unit, South Coast sub-region (USFWS Data Clearinghouse 2021). Historical Pacific Lamprey distribution depicted in map was obtained from published literature, tribal accounts and state and federal agency records.

Distribution and Connectivity

Fish Passage was ranked a high threat in the North Umpqua (mean Scope/Severity 3.75), a moderate threat in the South Umpqua, Upper Rogue, Middle Rogue, and Applegate (mean Scope/Severity 3.0) and a low threat in all other watersheds (mean Scope/Severity ≤ 2.0). A number of major passage issues have been addressed in the North Umpqua (e.g., Rock Creek Dam upstream of the hatchery, Soda Springs Dam) and an unprecedented four dams have been removed from the Middle Rogue since 2007 (i.e., Savage Rapids, Elk Creek, Gold Hill, and Gold Ray Dam). However, a number of existing structures continue to impede passage or alter the hydrograph to the detriment of fish and aquatic wildlife. Most notably, Applegate Dam and Murphy Dam on the Applegate River, Galesville Dam on Cow Creek (South Umpqua), Emigrant Dam on Bear Creek (Middle Rogue), and Lost Creek Dam on the Upper Rogue completely block upstream passage and access to historical spawning and rearing habitat. Passage at Winchester Dam is still a limiting factor for Pacific Lamprey in the North Umpqua watershed.

Smaller dams and water diversions for municipal, irrigation, livestock and other uses are abundant within the South Coast sub-region. Contemporary structures are required to provide passage for migratory fish and maintain screening or by-pass devices to protect fish from impingement or entrainment, though most screens are designed to protect/exclude salmonids and not larval or juvenile lamprey. Unfortunately, there are a large number of older structures that predate current screening and fish passage requirements. Additionally, active water rights associated with diversions make them difficult to upgrade or remove. Water diversion structures with inadequate screening or open irrigation canals can harm or entrap larval and juvenile lamprey while channel spanning concrete dams may delay or impede adult lamprey passage given their difficulty navigating over or around sharp edges (e.g., 90° angles), especially in areas with high velocity (LTWG 2017).

Faulty tide gates are numerous in tidally-influenced areas of the Umpqua, Coos, and Coquille Rivers (see https://oregontidegates.org/tide-gate-inventory/). The Coquille Watershed Association completed a tide gate inventory in the Coquille watershed in 2015 and is working with The Nature Conservancy, ODFW, and landowners to prioritize the removal and/or replacement of failing structures. The Oregon Tide Gate Partnership also recently completed an inventory of existing tide gates throughout the Oregon Coast and is working with stakeholder groups to facilitate the removal, repair or replacement of failing structures and restore more natural conditions. Although physical and ecological effects of tide gates are well documented, more research is needed to better understand how tide gates may influence the migration and passage of Pacific Lamprey (PLCI 2021). Barrier culverts were also identified as a threat in the North Umpqua, South Umpqua, Coos and Coquille Rivers. Poorly designed or installed culverts may fragment aquatic habitat and prevent access to miles of potential habitat. Culverts with excessive water velocity (>0.86 m/s), inadequate attachment points, perched outlets, or abrupt 90 degree angles (e.g., baffles, fish ladder steps, outlet aprons) may obstruct passage of adult lamprey (Moser et al. 2002; Mesa et al. 2003; Keefer et al. 2003; Stillwater Sciences 2014; Crandall and Wittenbach 2015; LTWG 2020a). Stakeholder groups are working to systematically remove or replace problem culverts to improve passage conditions for Pacific Lamprey and other native fish in the South Coast sub-region.

Threats

Summary of Major Threats

The following table summarizes the known key threats (i.e., mean Scope & Severity ≥2.50) within the South Coast sub-region tributaries as identified by RMU participants during the Risk Assessment revision meeting in March 2022. The highest priority threat in South Coast watersheds is Climate Change followed by Water Quality, Lack of Awareness, Stream and Floodplain Degradation, and Dewatering and Flow Management.

Table 1. Key threats to Pacific Lamprey and their habitats within the South Coast sub-region, 2022.

	Climate Change		Water Quality		Lack of Awareness		Stream & Floodplain Degradation		Dewatering & Flow Management	
Watershed	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity
South Oregon Coast										
North Umpqua	4	4	4	3.5	3	2	2	3	4	3.5
South Umpqua	4	4	4	4	4	2	4	3.5	3	4
Umpqua	4	4	4	4	4	2	3	3	3	3
Coos	4	4	3	3	3	2	3	3	2	2
Coquille	4	4	4	3	3	2	3	3	2.5	2
Sixes	4	4	3	3	4	3	3	3	1	2
Upper Rogue	4	4	3	3	4	3	3	3	3	3
Middle Rogue	4	4	4	3	4	3	3	3	3	3
Applegate	4	4	3	3	4	4	3	3	3	3
Lower Rogue	4	4	3	2.5	4	3	1	1.5	1	1
Illinois	4	4	3	3	4	2	2.5	2.5	3	3
Chetco	4	4	2	2	4	3	1	2	1	2
Mean Scope & Severity	4.00		3.21		3.17		2.71		2.54	
Drainage Rank	**H**		**M**		**M**		**M**		**M**	

Current Threats

Climate Change

Climate Change was the highest ranking threat in the South Coast sub-region (Table 3). NatureServe Scope and Severity ranks increased to high (4.0) in all watersheds in 2022. Climate change is happening faster and more intensely than anticipated and the combined effects of climate change (e.g., changes to ambient temperature, precipitation, and streamflow patterns) and predicted rise in human population will likely exacerbate other threats within the sub-region. Climate change is likely to alter the amount, timing, and type of precipitation with decreases in snowpack and more winter precipitation falling as rain in higher elevations. More severe winter rainfall events may increase the frequency and intensity of flooding that can increase bank erosion and scouring of streambeds. Earlier melting of snowpack and declining summer precipitation may increase the frequency and severity of wildfires and reduce summer baseflows. Warmer ambient temperatures and low summer flows may increase water temperatures to the detriment of Pacific Lamprey. These conditions may restrict lamprey habitat availability, hamper adult migration, reduce reproductive capability, or contribute to increased mortality if incubating eggs, burrowing larvae or migrating juveniles are exposed to warm temperatures (>20°C) for an extended duration (Clemens et al. 2016). Warm water temperatures can also increase vulnerability to pathogens and predation and may shift or expand the range of nonnative predatory fish, putting further stress on adult and larval lamprey (Lawrence et al. 2014). Additionally, water withdrawals for irrigation, municipal, or residential uses further depress already low summer stream flows in many South Coast watersheds. Low flow levels can reduce habitat availability, prevent lamprey access to backwater or side channel habitats, and may contribute to mortality if incubating eggs or burrowing larvae are dewatered or exposed to a high temperature or low oxygen environment. Climate change is identified as a critical threat across the range of Pacific Lamprey, but the feasibility of making tangible changes will be challenging and require large scale institutional changes. Focusing stream restoration efforts on actions that improve instream complexity and floodplain connectivity, restore tidal wetland habitats, remove unneeded impoundments, or revegetate riparian areas, can provide multiple benefits to the aquatic ecosystem (e.g., improve water quality, reduce flooding, increase channel stability, etc.) and can help make systems more resilient to climate change in the future (Wang et al. 2020; Justice et al. 2017).

Water Quality

Water quality ranked a moderate overall threat with Scope and/or Severity scores increasing in seven of twelve watersheds in 2022 (Table 3). Elevated water temperature is still the primary water quality concern in the South Coast sub-region. Most watersheds report excessively warm water temperatures well above 20°C during summer and early fall months. Factors contributing to high water temperatures generally include increased air temperature, reduced instream flows, and lack of riparian cover attributable to timber harvest, land clearing activities and wildfires. The impacts of warm water temperatures (e.g., ≥20°C) on Pacific Lamprey embryonic development, physiology, adult migrations, reproductive capability and evolutionary pressures can be multitudinous and substantial (Clemens et al. 2016). Other notable water quality concerns in South Coast watersheds include low dissolved oxygen levels, increased sedimentation and turbidity, and presence of bacteria (e.g., fecal coliform, E. coli) or toxic pollutants. Loss of forest and riparian vegetation during recent wildfires in the North Umpqua and Chetco watersheds have contributed to warmer stream temperatures, and increases in runoff and erosion that has elevated sediment loads and turbidity levels in downstream habitats. Sewage inputs from municipality discharge and chemical/herbicide inputs from agriculture and industrial forest practices were noted as problematic in the Coquille, Applegate and upper Illinois Rivers. The South Umpqua and mainstem Umpqua River also experience toxic blue green algae blooms (attributable to warm water temperatures and high nutrient concentrations) that can be harmful to people and wildlife, though impacts to lamprey are unknown.

Lack of Awareness

Lack of Awareness was ranked a moderate overall threat in the South Coast sub-region. NatureServe Scope ranks decreased (from High to Moderate) in the North Umpqua, Coos, and Coquille, while Severity ranks rose (from Low to Moderate or High) in the Sixes, Applegate, Chetco, and Rogue River basin (Table 3). Pacific Lamprey awareness is slowly becoming more widespread among stakeholders and the public. Tribes, state and federal agencies, watershed councils and others have played a significant role in improving awareness through targeted outreach, education events, and informational campaigns. Nevertheless, it’s unclear how improved awareness translates to on-the-ground actions that incorporate or benefit lamprey such as lamprey specific fish salvage, design of fish screens, passage improvements, habitat restoration, permitting (e.g., Section 404 permits), etc. For example, instream water work, whether for restoration activities or maintenance of diversions, can dewater areas or remove sediments in which larval lamprey are burrowed. Such actions without first salvaging lamprey may result in the death of hundreds to thousands of larvae. Increasing landowner and agency awareness about the presence of larval lamprey in the sediments, adult lamprey spawning habitats and timing during in-water work, and education on actions to minimize these impacts, could greatly decrease localized mortality and injury to lamprey populations. For more information about how to minimize impact to native lampreys during in-water work, please consult LTWG (2020b).

Stream and Floodplain Degradation

Stream and Floodplain Degradation was ranked a moderate overall threat in the South Coast sub-region. Although most NatureServe ranks remained unchanged in 2022, Scope/Severity ranks increased moderately in the South Umpqua, Upper Rogue and Applegate and declined moderately in the Illinois (Table 3). Legacy impacts of splash damming, stream cleaning, road building, timber harvest, mining, and agricultural development have contributed to large scale losses in riparian and stream habitat complexity throughout the South Coast sub-region. Within lowlands, freshwater and tidal wetlands have been lost to stream channelization and construction of dikes/levees to prevent flooding and facilitate development (e.g., crop production, livestock grazing, urban development) within the floodplain. In upland areas, legacy and ongoing timber harvest, mining, agriculture, and urbanization have deforested or altered the function and diversity of riparian vegetation. Many watersheds in the sub-region lack mature conifers that play a pivotal role in bank stability, water quality protection, thermal cover, and recruitment of wood into channels. Large wood can benefit streams by influencing the structural complexity of the channel (i.e., creating pools or undercut banks), reducing flow velocities and facilitating the deposition of fine substrate and organic matter important for larval lamprey rearing and feeding (Gonzalez et al. 2017). The construction of roads within the active floodplain has further altered sediment, nutrient and large wood recruitment and transport, and cut-off side channels and other important off-channel habitats. RMU partners continue to work hard to implement restoration projects aimed at addressing habitat degradation, water quality issues and impaired floodplain function throughout the South Coast sub-region. However, as human populations and associated land use continues to rise, habitat degradation is outpacing restoration efforts in some areas.

Dewatering and Flow Management

Dewatering and Flow Management was ranked a moderate threat in the South Coast sub-region. NatureServe Scope and Severity ranks remained unchanged in the majority of watersheds in 2022. Water withdrawals for irrigation, livestock, and municipal uses leave many watersheds in the South Coast sub-region dewatered or with inadequate flow during summer and fall months. In recent years early cessation of rains, below average snowpack, and above average air temperature have further contributed to reduced stream flows in much of the region. Low flow conditions can impact fish by reducing spawning and rearing habitat availability, creating low water passage barriers, or impairing water quality. Water efficiency improvements and other actions to restore and protect diminishing instream flows will require large scale institutional changes involving water rights and will likely require a long-term effort. With predicted trends in population growth, increased water demand, and future effects of climate change, water supply issues will likely be an ongoing problem in the South Coast sub-region.

Predation

Although predation was not ranked a key threat during the 2022 Pacific Lamprey Assessment revision, predation of adult and larval lamprey by nonnative fish species was highlighted as a concern in the Umpqua, Coquille and Tenmile Basin (Coos HUC). Smallmouth bass predation on juvenile lamprey is well documented in the Umpqua Basin (Schultz et al. 2017) and a recent assessment conducted by ODFW and the Coquille Indian Tribe found smallmouth bass distributed throughout the mainstem Coquille and present in all main forks of the river. Low flows and warm water temperatures have created optimal conditions for smallmouth bass, striped bass and other nonnative fish, especially in main channels and lower sections of rivers. Dams and diversions can also increase habitat suitability for warm water fish species and may contribute to the decline of lamprey by delaying migration, potentially exposing fish to increased predation. As climate change continues to progress, future increases in stream temperature may facilitate the expansion of nonnative fish to the detriment of native lampreys (Lawrence and Olden 2013; Lawrence et al. 2014; Jones et al. 2020).

Restoration Actions

Pacific Lamprey conservation work in the South Coast sub-region is currently focused on adult passage improvements, expansion of occupancy surveys, environmental DNA sampling, habitat assessments, predation studies, and numerous projects to restore degraded habitat. The following conservation actions were initiated or recently completed by RMU partners in the South Coast sub-region from 2012-2021.

HUC	Threat	Action Description	Status
RMU	Stream Degradation	Implementation of instream and floodplain habitat restoration activities (e.g. large wood and boulder placement, side channel and floodplain reconnection, channel reconstruction, bank stabilization, gravel recruitment, etc.).	Ongoing
RMU	Population	Conduct spawning ground surveys in mainstem and principal tributaries to monitor Pacific Lamprey distribution, timing, and number of redds to develop relative abundance indexes.	Ongoing
RMU	Population	Environmental DNA sampling to fill distribution gaps on Rogue River Siskiyou National Forest Land.	Ongoing
RMU	Population	Oregon Department of Fish and Wildlife Conservation Plan for Lampreys in Oregon https://www.dfw.state.or.us/fish/CRP/coastal_columbia_snake_lamprey_plan.asp	Complete
RMU	Other	Formation of South Coast Lamprey Working Group	Ongoing
RMU	Stream Degradation	Science to Restoration Workshop and future whitepaper about restoration techniques for lampreys	Complete
RMU	Predation	Multi-RMU predation study to determine best methods for removal of nonnative fish	Proposed
RMU	Population	Study to look at use of lakes for lamprey	Proposed
RMU	Population	Study to look at estuary use by lamprey	Proposed
RMU	Lack of Awareness	Making meaningful connections between the life histories of Pacific Lamprey and Pacific salmon to improve awareness and support for lamprey conservation	Proposed
RMU	Passage	Evaluation of lamprey passage at culverts, small dams and fishways.	Proposed

RMU	Lack of Awareness	Larval/juvenile lamprey ID workshop (2019 S. Coast RIP project proposal)	Complete
North Umpqua	Passage	Passage improvement at Soda Springs Dam.	Complete
North Umpqua	Passage	Pacific Lamprey spawning and rearing habitat suitability above Soda Springs Dam	Complete
North Umpqua	Passage	Passage improvement at Rock Creek Hatchery diversion dam fish ladder.	Complete
North Umpqua	Passage	Installation of Lamprey Passage Structure at Winchester Dam.	Complete
North Umpqua	Passage	Installation of video monitoring camera on Winchester Dam lamprey ramp	Complete
North Umpqua	Population	Conduct native fish inventory to establish baseline lamprey distribution dataset	Complete
Umpqua	Predation	Smallmouth bass predation evaluation in lower Elk Creek and Umpqua R.	Complete
Umpqua & Rogue Basins	Population	Lamprey distribution mapping, occupancy and environmental DNA sampling.	Ongoing
Umpqua & Rogue Basins	Lack of Awareness	Provide education and outreach to stakeholders, resource managers and community members	Ongoing
Rogue Basin	Passage	Rogue Basinwide Priority Barrier Removal Analysis - project characterized and prioritized 38 passage barriers in basin.	Complete
Rogue Basin	Passage	Low cost passage retrofits at irrigation diversion dams.	Ongoing
Upper & Middle Rogue	Population	Distribution surveys in principal tributaries.	Complete
Middle Rogue	Passage	Removal of Fielder and Wimer dams on Evans Creek	Complete
Lower Rogue	Stream Degradation	Rogue River Estuary Strategic Plan and Lower Rogue Watershed Action Plan - to identify and prioritize conservation and restoration actions in lower Rogue and tributaries.	Complete
Applegate & Illinois	Population	Distribution surveys in principal tributaries	Complete
Applegate	Predation	Umpqua pikeminnow predation	Proposed

& Illinois		evaluation	
Applegate	Passage	Removal of large gravel push-up dam on Williams Cr. (RM 0.5) opening 31 miles of habitat for native fish	Ongoing
Coos	Passage & Population	Evaluation of passage constraints and baseline presence/absence of lamprey within the Eel Lake basin	Complete
Coos	Passage	Installation of lamprey passage ramp/trap at Eel Creek Dam.	Complete
Coos	Passage	Installation of new trap box and camera monitoring system in Eel Lake ladder	Complete
Coos	Population	Telemetry to monitor movement, distribution and spawning of Pacific Lamprey through Tenmile Lakes system.	Ongoing
Coos	Stream Degradation	Implementation of instream and floodplain habitat restoration activities (e.g. East Fork Millicoma Oxbow project, Ross Slough Project)	Complete
Coos	Population	Comparison of e-shocking and eDNA sampling (sediment & water samples) in the Coos Estuary (South Slough)	Ongoing
Coos	Population	Development of eDNA citizen science network in greater Coos targeting Pacific and western brook lamprey	Ongoing
Coos/ Coquille	Passage	Multiple culvert replacement or removal projects where lamprey salvage efforts occurred.	Ongoing
Coquille	Passage	Baker Creek culvert removal on SF Coquille – a regional stronghold for Pacific Lamprey	Complete
Coquille	Population	Lamprey spawning ground surveys in South Fork Coquille River.	Ongoing
Coquille	Population	Assessment to study entry timing of Pacific Lamprey into Coquille River	Proposed
Coquille	Predation	Assessment of the nonnative smallmouth bass population in Coquille to determine feasibility of eradication – will include week long fishing blitz and bass suppression efforts	Ongoing
Coquille	Climate Change	Water quality monitoring in lower Coquille River to identify cold water refuge.	Ongoing

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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.