Pacific Lamprey
2022 Regional Implementation Plan
for the
Oregon Coast
Regional Management Unit
North Coast Sub-Region

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Status and Distribution of Pacific lamprey in the RMU

A. General Description of the RMU

North 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 North Oregon Coast sub-region includes all rivers that drain into the Pacific Ocean from the Columbia River Basin boundary in the north to the Umpqua River boundary in the south. It is comprised of seven 4th field HUCs ranging in size from 338 to 2,498 km^{2}. Watersheds within the sub-region include the Necanicum, Nehalem, Wilson-Trask-Nestucca, Siletz-Yaquina, Alsea, Siuslaw and Siltcoos Rivers (Figure 1; Table 1).

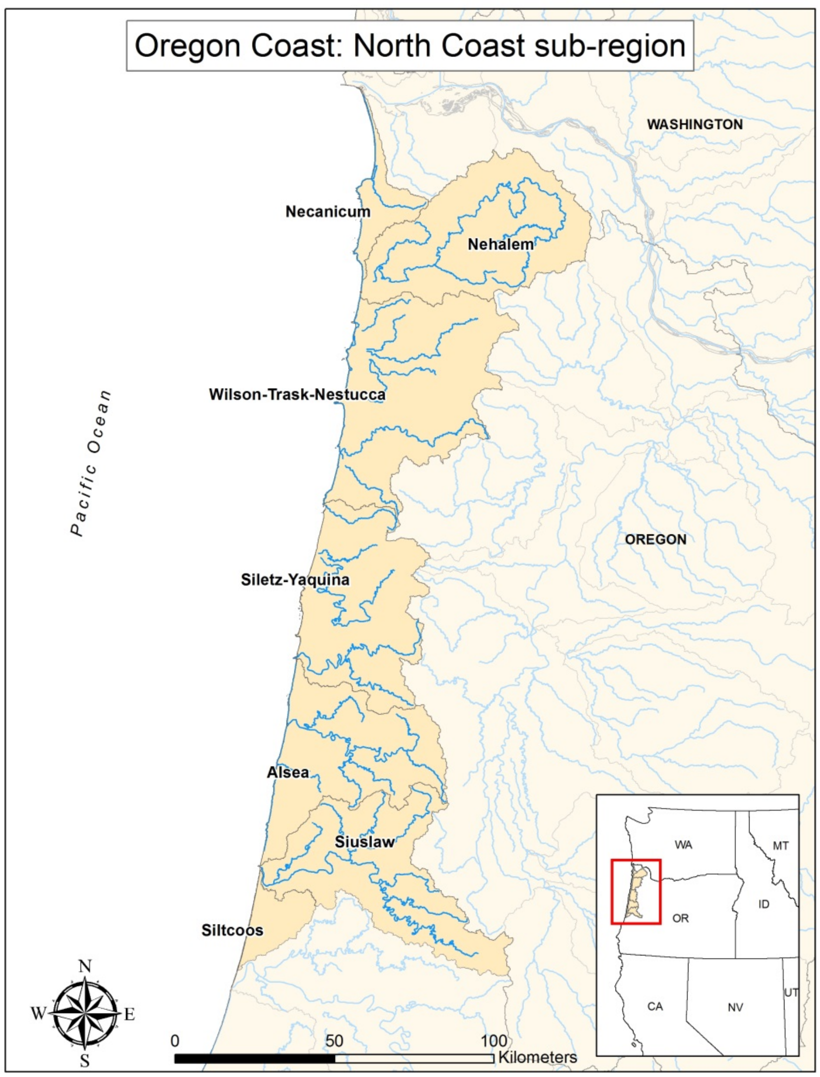

Figure 1. Map of watersheds within the Oregon Coast RMU, North Coast sub-region.

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

Watershed	HUC Number	Drainage Size (km^2)	Level III Ecoregion(s)
Necanicum	17100201	355	Coast Range
Nehalem	17100202	2,212	Coast Range
Wilson-Trask-Nestucca	17100203	2,498	Coast Range
Siletz-Yaquina	17100204	1,964	Coast Range
Alsea	17100205	1,786	Coast Range
Siuslaw	17100206	2,006	Coast Range, Willamette Valley
Siltcoos	17100207	338	Coast Range

B. Status of Species

Conservation Assessment and New Updates

Every five years the Pacific Lamprey Conservation Initiative (PLCI), through the RMUs, revise the Pacific Lamprey Assessment (USFWS 2019). 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 North Coast sub-region through an online Assessment questionnaire and virtual meeting held on February 23rd 2022. The following is a brief summary of key findings from the 2022 Pacific Lamprey Assessment.

NatureServe conservation status ranks changed in five of seven HUCs in 2022 (Table 2). Status ranks fell from Imperiled (S2) to Critically Imperiled (S1) in the Necanicum and from S2 to S1S2 in the Nehalem, Wilson-Trask-Nestucca, Siletz-Yaquina, and Alsea. The decline in ranks was generally due to an increase in the scope or severity of threats facing Pacific Lamprey in these watersheds (see Threats below).

Distribution

Although information on Pacific Lamprey distribution continues to improve through targeted redd surveys, presence/absence or occupancy sampling, fish salvage events, and eDNA sampling, Pacific Lamprey currently occupy a small proportion (21% to 29%) of their historical range (Table 2). A compilation of all known larval and adult Pacific Lamprey occurrences in the North Coast sub-region are displayed in Figure 2, which is a product of the USFWS data Clearinghouse.

Abundance

Pacific Lamprey population abundance was estimated 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 2009. 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 population abundance in the North Coast sub-region has ranged from ≈ 323 – 20,051 lamprey per year between 2007 and 2021 (Table 3). Clemens et al. (2021) indicates Pacific Lamprey abundance indices have both increased and decreased over time with periodic peaks in abundance every few years (Table 3). 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).

Short-term Population Trend

There is consensus that lamprey populations have declined significantly compared to past returns approximately 50-60 years ago (Downey et al.1993; Close et al. 2004; CRITFC 2011; 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 all North Coast watersheds in 2022 because there is a lack of continuous long-term population trend data in the region. The only ongoing long-term record of lamprey counts on the Oregon Coast is at Winchester Dam on the North Umpqua. The population has been monitored since 1965 and counts indicate a significant downward trend over time. 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).

Table 2. Population demographic and conservation status ranks (see Appendix 1) of the 4th Field HUC watersheds located within the North 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 (km²)	Current Occupancy (km²)	Population Size (adults)	Short-Term Trend (% decline)
Necanicum	17100201	S1↓	250-1000	20-100	250-1000	Unknown
Nehalem	17100202	S1S2↓	1000-5000	100-500	1000-10,000	Unknown
Wilson-Trask-Nestucca	17100203	S1S2↓	1000-5000	100-500	1000-10,000	Unknown
Siletz-Yaquina	17100204	S1S2↓	1000-5000	100-500	1000-10,000	Unknown
Alsea	17100205	S1S2↓	1000-5000	100-500	1000-10,000	Unknown
Siuslaw	17100206	S2	1000-5000	500-2000	1000-10,000	Unknown
Siltcoos	17100207	S1	250-1000	20-100	50-250	Unknown

Table 3. Minimum, mean, and maximum abundance indices for adult Pacific Lamprey in the North Coast sub-region (Clemens et al. 2021). Estimates are considered conservative.

Year	**MIN**	**MEAN**	**MAX**
2007	988	3,793	6,956
2008	1,324	5,085	9,322
2009	885	3,400	6,234
2010	323	11,85	2,268
2011	749	2,876	5,272
2012	1,068	4,103	7,523
2013	2,727	10,468	19,192
2014	1,065	4,089	7,496
2015	2,510	9,635	17,665
2016	2,733	10,493	19,237
2017	1,273	4,887	8,961
2018	2,849	10,937	20,051
2019	1,532	5,880	10,781
2020	1,341	5,149	9,439
2021	2,144	8,236	15,098
MEAN	**1,567**	**6,014**	**11,033**

Figure 2. Current and historical known distribution for Pacific Lamprey: Oregon Coast Regional Management Unit, North 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 (Passage)

The NatureServe Assessment ranking of fish passage increased from a low to a moderate threat in 2022. Though passage scope and severity scores rose slightly in three HUCs (Nehalem, Wilson-Trask-Nestucca, and Siltcoos), these increases were the result of new information gained from recent barrier assessments and/or a better understanding of lamprey passage needs, rather than a true increase in the number of barriers within these watersheds. Culverts at stream road crossings have been identified as an important passage concern throughout the North Coast sub-region. Many of the perched, undersized and/or aging culverts, which are known to restrict salmonid distribution and abundance, have been removed or are prioritized for removal. However, there are still thousands of culvert barriers in the region and their cumulative impact to Pacific Lamprey are unknown. Recent barrier assessments in the Lower Nehalem, Tillamook Bay, Nestucca Neskowin and Sand Lake watersheds identified a rather large number of barriers at stream-road crossings (for juvenile salmonids). It is likely many more structures could be passage barriers for lamprey given their unique swimming capabilities (i.e. inability to jump, difficulty navigating past sharp angles or through areas with high water velocity, etc.) (see LTW 2020a). In addition to culvert barriers, instream structures such as tide gates and water diversions are also prevalent throughout the North Coast sub-region and may restrict or impede lamprey passage to an unknown extent. A notable barrier identified within the Siltcoos watershed includes dams on Siltcoos and Tahkenitch Lakes. Both structures have ladders intended to provide passage for migratory coho, but it's unclear whether the ladders provide suitable passage conditions for adult Pacific Lamprey.

Overall, fish passage in these basins is slowly improving, but there are still a large number of impassable or partially impassable barriers that need to be addressed. An extensive effort is currently underway in portions of the North Coast sub-region to identify and prioritize barrier structures for repair (retrofit), replacement, or removal. Though the focus of these efforts is primarily salmonids, many projects are beginning to consider the passage needs of Pacific Lamprey. Improving passage through the complete removal of barrier structures (e.g., dams, culverts, tide gates, diversions, etc.), replacing culverts with bridges, or using open-bottom culverts with a stream simulation design will have the greatest benefit to Pacific Lamprey and other native aquatic organisms. For more information about how to provide or improve passage for adult Pacific Lamprey at barriers and road crossings, please refer to LTW (2020a).

C. Threats

Summary of Major Treats

The following table summarizes the key threats (Mean Scope/Severity ≥ 2.5) within the North Coast sub-region as identified by RMU participants during the Pacific Lamprey Assessment revision meeting in February 2022. Climate change and stream and floodplain degradation were ranked a high threat in the North Coast sub-region, while passage, water quality and lack of awareness were ranked a moderate threat in 2022.

Table 4. Summary of the Assessment results for the key threats of the North Oregon Coast sub-region.

	Climate Change		Stream and Floodplain Degradation		Water Quality		Passage		Lack of Awareness	
Watershed	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity
Necanicum	4	4	3	3	2	2	2	2	3	2
Nehalem	4	4	3	3	3.5	3.5	3	3	3	2
Wilson-Trask-Nestucca	4	4	3	3	2.5	2.5	3.5	3	3	2
Siletz-Yaquina	4	4	4	4	3	4	2	2	3	2
Alsea	4	4	4	4	3	3	2	2	3	2
Siuslaw	4	4	4	4	3	3	2	2	3	2
Siltcoos	4	4	3.5	4	3	3	4	3	3	2
Mean Scope & Severity	4.00		3.53		2.93		2.54		2.50	
Drainage Rank	H		H		M		M		M	

Current Threats

The highest ranked threats in the North Coast sub-region are described below. Mean Scope/Severity scores for climate change, stream and floodplain degradation, water quality and passage rose (i.e., worsened) in 2022; while the Mean Scope/Severity score for lack of awareness fell in 2022.

Climate Change

Climate Change was the highest ranking threat in the North Coast sub-region (Table 4). 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. More severe winter rainfall events may increase the frequency and intensity of flooding that can increase bank erosion and scouring of streambeds. Warmer summer temperatures and low summer flows may increase water temperatures to the detriment of Pacific Lamprey. Elevated summer water temperatures have become more commonplace in North Coast watersheds over the last five years. 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). Temperature increases could also shift or expand the range of nonnative predatory fish, putting further stress on larval and adult lamprey (Lawrence et al. 2014). In addition to temperature concerns, water withdrawals for irrigation, municipal, or residential uses further depress already low summer stream flows in many North Coast watersheds and these withdrawals may increase as climate warms. 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 (Justice et al. 2017).

Stream and Floodplain Degradation

Stream and floodplain degradation was ranked a high threat in the North Coast sub-region. Scope/Severity scores were increased in the Siletz-Yaquina, Alsea, Siuslaw, and Siltcoos. However, changes in these areas reflect an improved understanding of habitat conditions more so than changes on the ground for lamprey. Legacy impacts of splash damming, log drives, road construction, beaver eradication, stream cleaning, fires and other land use practices have contributed to large scale losses in stream habitat complexity throughout the North Coast sub-region. Within lowlands, many of the depositional valleys where larval lamprey once reared have been lost to stream channelization and construction of dikes/levees to prevent flooding and facilitate development (e.g., agriculture, livestock grazing, industrial, residential) within the floodplain. In upland areas, legacy and ongoing timber practices, 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). RMU partners continue to work hard to implement restoration projects aimed at addressing habitat degradation, water quality issues and impaired floodplain function throughout the North Coast sub-region.

Water Quality

Water quality was ranked a moderate threat in the North Coast sub-region. Assessment scope and/or severity scores increased in the Nehalem, Wilson-Trask-Nestucca, Siletz-Yaquina, Alsea, and Siltcoos. Elevated water temperature is still the primary water quality concern in the North Coast sub-region. Lower and mainstem reaches regularly experience prolonged warming often starting in late spring, extending into fall. Factors contributing to excessive water temperatures generally include increased air temperature, lack of riparian cover (in response to past logging, fires and land clearing activities), widening of stream channels, or reduced instream flows associated with water withdrawals. The Siuslaw Basin Strategic Action Plan recently used Netmap to model predicted temperature changes over the next few decades and found that water temperatures in many tributary streams where lamprey spawning is likely occurring will be increasing during the summer low flow period (Siuslaw SAP 2019). 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 water quality concerns in North Coast watersheds include low dissolved oxygen levels and presence of bacteria (e.g., fecal coliform, e. coli), that may be associated with elevated water temperatures, agricultural or urban runoff, poorly functioning septic systems, wastewater treatment plants, or high aquatic plant density. Siltcoos Lake experiences periodic toxic 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.

Passage

A summary of passage issues in the North Coast sub-region are described in the previous section (Distribution and Connectivity).

Lack of Awareness

Lack of Awareness was ranked a moderate threat, though the severity of this threat was reduced in all North Coast watersheds in 2022. Pacific Lamprey awareness is becoming more widespread among stakeholders and the public. Local watershed councils, the USFS and others in the North Coast sub-region have played a significant role in improving awareness through targeted outreach, youth education events and webinars. 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 public 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 LTW (2020b).

Restoration Actions

Multiple projects are currently underway to restore floodplain connectivity, relocate or reconnect side channel habitat, enhance damaged riparian areas, and remove, replace or improve barriers to fish passage (e.g. culverts, tide gates, and diversion dams). Assessments that identify and prioritize future restoration work and passage problems are also ongoing in these areas. Although the majority of research and restoration projects are developed and implemented with adult and juvenile salmonids in mind, a growing number of projects are incorporating benefits for Pacific lamprey and some passage projects are targeting lamprey specifically. The following conservation actions were initiated or recently completed by RMU partners in the North 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/or boulder placement, side channel and floodplain reconnection, channel reconstruction, bank stabilization, etc.).	Ongoing
RMU	Population	Distribution surveys of mainstem and principal tributaries	Ongoing
RMU	Lack of Awareness	Consideration of lamprey when planning and implementing instream habitat restoration work	Ongoing
RMU	Passage	Map, assess and prioritize passage barriers in tributaries and evaluate available lamprey habitat upstream	Proposed
RMU	Population	Conduct spawning ground surveys in mainstem and principal tributaries to	Ongoing

		monitor Pacific Lamprey distribution, timing, and number of redds to develop relative abundance indexes.	
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
Multi-RMU	Stream Degradation	Assessment looking at effectiveness of restoring/reconnecting the floodplain (Stage 0 restoration) and lamprey recolonization of these areas (i.e., SF McKenzie & Fivemile Bell)	Ongoing
Necanicum	Passage	South Fork Necanicum diversion dam removed, and intake screens updated/improved.	Complete
Necanicum	Stream Degradation	Culvert removal or replacement projects to restore access to spawning and rearing habitat.	Ongoing
Nehalem & Siuslaw	Stream Degradation	Coho Strategic Action Plan – identifies high priority conservation areas for restoration and monitoring. Will likely benefit other native aquatic species.	Ongoing
Nehalem	Stream Degradation	Evaluation of lamprey and salmonid response to Beaver Dam Analog stream channel restoration	Ongoing
Wilson – Trask – Nestucca	Stream Degradation	Numerous culvert removal or replacement projects as part of Salmon SuperHwy Project.	Ongoing
Wilson – Trask – Nestucca	Passage	Removal of the East Fork South Fork Trask River Hatchery Dam.	Complete
Wilson – Trask – Nestucca	Passage	Skookum Reservoir Dam removal, Tillamook River Drainage	Complete
Wilson – Trask – Nestucca	Passage	Upgrade to Cedar Creek Hatchery weir and fish ladder on Three Rivers. Ladder will meet lamprey passage criteria	Complete
Siletz	Passage	Evaluation of passage constraints for lamprey at Siletz Gorge Falls fish ladder/trap	Proposed
Siletz	Population	Environmental DNA to assess Pacific Lamprey distribution above Lake Creek Falls & Lobster Creek Wild and Scenic	Ongoing

		River	
Siletz	Stream Degradation	Habitat improvements on mainstem Siletz River to increase habitat complexity and substrate sorting along margins of river	Ongoing
Alsea	Passage	Installation of Lamprey Passage Ramp at water diversion structure upstream from Alsea River Hatchery on North Fork Alsea River.	Complete
Alsea	Passage	Monitoring relative abundance of larval Pacific Lamprey upstream of water diversion structure pre and post lamprey ramp installation	Ongoing
Alsea	Population	Environmental DNA pilot project to assess Pacific Lamprey distribution	Ongoing
Siuslaw	Population	Environmental DNA to assess Pacific Lamprey distribution	Ongoing
Siuslaw	Population	Environmental DNA to evaluate passage of Denil fishway and determine presence/absence of Pacific Lamprey above Lake Creek Falls	Proposed
Siuslaw	Passage	Improve passage conditions for Pacific Lamprey at Lake Creek Falls fishway	Proposed
Siuslaw – Siltcoos	Stream Degradation	Environmental DNA to monitor lamprey occupancy pre/post floodplain reconnection projects	Ongoing
Siltcoos	Passage	Evaluation of passage constraints for lamprey at Siltcoos and Tahkenitch Dam fish ladders.	Proposed
Siltcoos	Stream Degradation	Implementation of several large floodplain reconnection projects (Stage 0; Fivemile Bell)	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.