

Identification and Conservation of Larval Pacific Lamprey Habitat in the Columbia River Estuary

Executive Summary

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Client: Columbia River Inter-Tribal Fish Commission



Pacific lamprey (*Entosphenus tridentata*) are native fish to the Columbia River Basin. Over the past 60 years, anthropogenic disturbances have contributed to a 95% decline of historical population numbers.^{1,2,3} Member-tribes of the Columbia River Inter-Tribal Fish Commission have acknowledged the importance of Pacific lamprey to the Columbia River ecosystem and expressed concern about the loss of an essential tribal cultural resource. As a result, the Columbia River Inter-Tribal Fish Commission created the Tribal Pacific Lamprey Restoration Plan to halt their decline, re-establish the species, and restore the population to sustainable, harvestable levels throughout their historical range.¹

Limited knowledge about the movement and preferred habitat of larval Pacific lamprey, such as optimal habitat conditions, demographic information, and species resilience, results in challenges to monitor and protect the species. Pacific lamprey are known to use the mainstem Columbia River to migrate between their spawning grounds and the Pacific Ocean. However, dams, levees, and culverts within the Columbia River Estuary and adjacent tributaries have restricted the lamprey's access to spawning grounds and other upstream habitats.^{1,4} These restrictions have prompted conservation and restoration efforts to better understand how Pacific lamprey utilize the Columbia River Estuary.



Figure 1. Life cycle of Pacific lamprey in the Columbia River Estuary.

Here, we address these knowledge gaps in an effort to aid restoration initiatives by completing a Habitat Suitability Analysis to determine where optimal larval Pacific lamprey habitat may exist in the Columbia River Estuary. The project identified the spatial and temporal distribution of suitable habitat for larval Pacific lamprey, and generated recommendations to address habitat-related knowledge gaps and further evaluate anthropogenic threats to their recovery. The results of the Habitat Suitability Analysis suggest that habitat conditions in the Columbia River itself are unable to support larval lamprey year-round, but may provide suitable habitat on a seasonal basis due to spatial and temporal limitations. However, we stress that our analyses were necessarily limited to aquatic conditions, and that the temperature of the water column used in our analyses may differ from the temperature within fine sediments, where larval lamprey burrow. Our results imply that suitable lamprey habitat is present at times throughout the year in the Columbia River Estuary, and these locations can be used to support habitat restoration and conservation strategies for improving the species' recovery.

Anthropogenic threats to the Columbia River continue to alter habitat conditions, including average water temperature, salinity, and sedimentation. Laboratory experiments have provided insight into the potential impacts of changing temperature and salinity on larval Pacific lamprey, where elevated water temperatures can affect their development and elevated salinity levels can result in larval mortality.^{5,6} In addition, anthropogenic disturbances such as dams, levees, and culverts have cut off the Columbia River Estuary's floodplain habitats from the mainstem Columbia River, decreased sedimentation rates, and separated adult lamprey from the floodplains and tributaries that they use to spawn.⁴

The presence of these barriers in the region can inhibit the distribution of fine sediments in the river, limiting where larval lamprey burrow and develop. The burrowing behavior of larval lamprey has yet to fully be investigated in the Columbia River Estuary.⁴ Limited research may be due to the lack of resources for studying Pacific lamprey's life cycle, habitat, and population dynamics since they are not federally designated as an endangered species, like resident salmonid species. This has further added to the challenge of understanding the species and restoring its population to sustainable numbers.

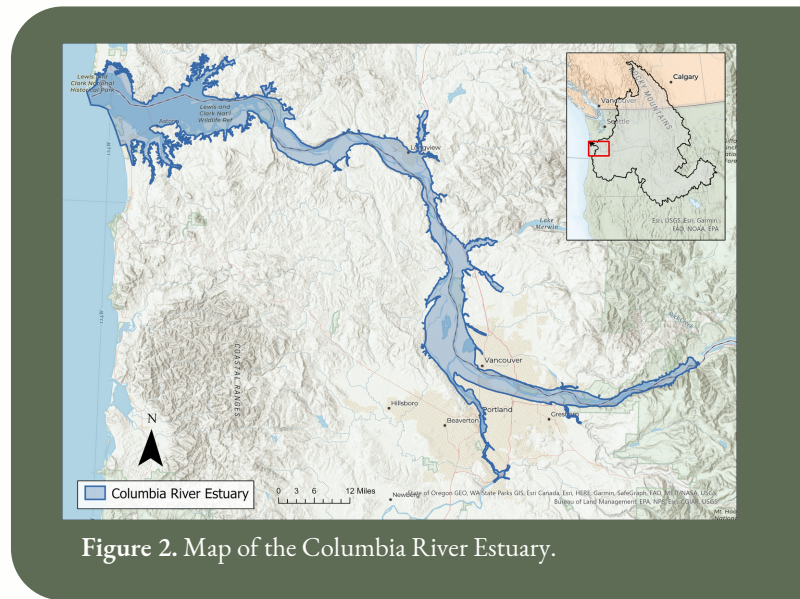


Figure 2. Map of the Columbia River Estuary.

To the best of our knowledge, this project is the first to explore spatial and temporal trends of suitable larval Pacific lamprey habitat conditions in the Columbia River Estuary. The Habitat Suitability Analysis provides technical information about the presence and distribution of suitable conditions to address habitat-related uncertainties. The member-tribes of the Columbia River Inter-Tribal Fish Commission and their collaborators can incorporate this information into current and future Pacific lamprey restoration, conservation, and education programs to enhance general understanding of lamprey populations throughout the Columbia River Basin. Key recommendations are provided to address additional knowledge gaps and prioritize future restoration projects in the Columbia River Basin including the refinement of the Habitat Suitability Analysis, evaluation of barrier effects on Pacific lamprey passage, and assessment of climate change scenarios on larval lamprey habitat.

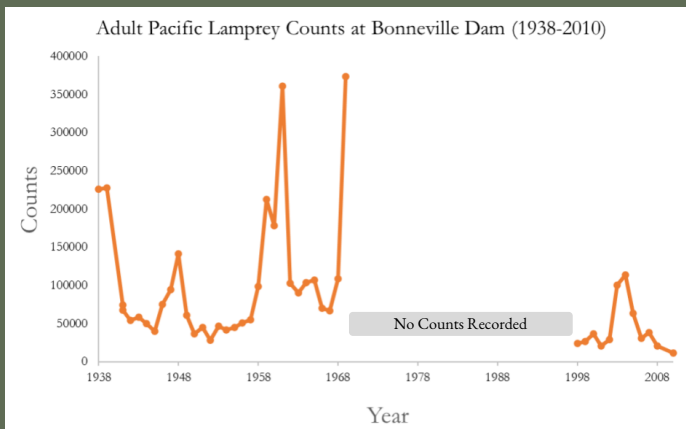


Figure 3. Adult Pacific lamprey counted crossing Bonneville Dam from 1938 to 1969, and from 1998 to 2010. [Data Source: Columbia River Inter-Tribal Fish Commission, 2011.]

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