Integrating Lampreys into Habitat Restoration

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Basic Data Gaps

- Distribution
- Abundance
- Limiting Factors
- Population Structure

- Restoration Benefits?
- Understand Habitat Use
- Understand Local Threats
- Integrate into Projects - Lamprey Lens

NOAA

Jeremy Monroe- Freshwaters Illustrated

Clemens et al. 2017
Integration in the Restoration Process

Including Lampreys at Every Step

- Pre-project assessment
- Incorporate design elements
- Implementation
Pre-Project: Pacific Lamprey Life Cycle - 12-year average lifespan

Freshwater
- Egg ~2 weeks
- Prolarva ~2 weeks
- Larva - Filter feeder ~3-10 years

Pacific Lamprey Life Cycle
- Adult - Upstream migration and holding Spring-Summer spawning ~1 year Adults die after spawning
- Juvenile - Transformation starts in Summer-Fall ~6-9 months
- Migration to the Ocean: Winter-Summer
  - Juvenile - Ectoparasite ~1-7 years

Migration to Freshwater: Spring-Summer, variable based on ecotype and location

Illustrations by Monica R. Blanchard
Pre-Project: Lamprey Presence

- Data Basin Map: Pacific Lamprey Distribution Map
  - Salmonid distribution
- Current presence of habitat types?
  - Fine sediment
  - Spawning substrate
- Site survey - multiple species/life stages present:
  - Larvae
  - Juveniles
  - Adults
Pacific Lamprey Assessment 2022

Characterizes conservation risk of Pacific Lamprey across their range

Flexible for data poor species and included threat analysis

Prioritize restoration action
### Summary of Major Threats

**Lower Columbia River Sub-units**

Table 23. Key threats to Pacific Lamprey and their habitats within the Lower Columbia River sub-region, 2017. High = 4; Moderate/High = 3.5; Moderate = 3; Low/Moderate = 2.5; Low = 2; Unknown = no value

<table>
<thead>
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<th>Watershed</th>
<th>Climate Change</th>
<th>Lack of Awareness</th>
<th>Dewatering and Flow Management</th>
<th>Stream and Floodplain Degradation</th>
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[https://www.pacificlamprey.org/rmu/](https://www.pacificlamprey.org/rmu/)
History of Loss and Simplification

- Multiple flow paths
- Lateral connectivity
- Hyporheic connection
- Large wood
- Beavers
- Riparian trees
- High flows
- Longitudinal connectivity
Encourage Complexity

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Design: Promote Natural River Processes

Process-based restoration aims to reestablish normative rates and magnitudes of physical, chemical, and biological processes that sustain river and floodplain ecosystems – Beechie et al. 2010

Reset the pre-disturbance condition through river-floodplain reconnection

http://stagezeroriverrestoration.com/

The Beaver Restoration Guidebook, 2015: https://www.fws.gov/media/beaver-restoration-guidebook
Design: Enhance Lateral Connectivity

- Remove channel confining structures
  - Increase lateral and vertical connectivity
  - Increasing wetted area and hyporheic exchange
  - Flow path diversity
- Create diverse habitat supporting multiple life stages
  - Proximity to habitats

Figure from: Sarah Dyrdahl, Johan Hogervorst, Paul Burns, Kate Meyer, Matt Helstab, Lisa Kurian and Paul Powers, December 2016
Design: Large Wood Enhancement

Habitat Benefits for Adults and Larvae:

- Sediment Sorting - areas of depositions and erosions
  - Fine sediment patches
  - Spawning gravels/cobbles
- Floodplain Connection
- Flow Path Diversity
- Increased Cover

Not all projects are created equal:

*Beyond Salmon: Lamprey use of Salmonid-Focused Habitat Restoration Projects, Methow Salmon Recovery Foundation assessment*
Stage 0 Restoration

Valley Floor Reset

S.F. McKenzie River and Fivemile-Bell Creeks, OR Lamprey Occupancy Study

Using Lamprey Monitoring Methods!

Future: Quartz Creeks, OR Lamprey pre- and post-restoration study
Complexity and Scale
Design: Water Quality - Overlapping Benefits

- Clean and cold water
- Excessive sediment load detrimental
- 10+ years in freshwater
  - Bioaccumulation of contaminants
- Riparian plantings
- Fencing
- Stormwater treatment
Reduce impacts to lamprey where possible:

- In-water work periods are made to reduce impacts to SALMONIDS
  - Adults lampreys spawning or holding – interstitial spaces between rocks
  - Eggs in gravel
  - Transforming juveniles
  - Larvae in sediments – multi-year cohorts

- Alter extent of project impact or dewatering?
Implementation: Monitoring and Salvage

*Salmon e-fishing settings can trap larval lamprey*

https://www.smith-root.com/support/kb/setting-up-a-backpack-electrofisher-to-capture-larval-lamprey

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<th>Bursted Slow Pulse Primary Wave Form</th>
<th>Standard Fast Pulse Secondary Wave Form</th>
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Lamprey Salvage Plan

- Avoid dewatering nests/redds, areas of high larval density, mussel beds - if possibly

- Have appropriate tools:
  - Fine mesh nets
  - Extra bucket and aerator – leave on site

- Slower the draw down the better
  - Increases self-rescue rates
  - 1-2” per hour

- Depending on conditions – emergence timing variable - most lamprey that are going to emerge do so in the first ~30 min (Liedtke et al. 2020)
  - In some cases it take much longer
  - Keep bucket and net on site!

- Only about 50% emerge
  - Dry shocking increases %
“Dry” Electrofishing
**Implementation: Additional Dewatering Steps**

1. *Conduct pre-drawdown lamprey presence/absence surveys - Use Lamprey settings!*
   - Mussels – plan for relocation

2. Perform pre-drawdown lamprey salvage – **Use Lamprey settings!**
   - Collect mussels

3. Perform pre-drawdown salvage boney fishes

4. Perform all species salvage during drawdown - **Use Lamprey settings!**

5. Perform “dry” shocking on dewatered substrates with high density of lamprey. Continue until site is completely dewatered – **Use Lamprey settings!**
   - Look for lamprey and mussels that emerge after dewatering
Online Resources: PacificLamprey.org*

*New Website!
Pre-project assessment:
- Understand habitat use by life stage
- Presence year-round
- Current project use

Incorporate design elements:
- Enhance larval and adult habitat
- “Protect the best”
- Complexity and connectivity is important
  - Lateral and vertical – restoring natural process, increase wetted area, increase sediment sorting
  - Longitudinal – migration corridors

Implementation: be prepared!
- Lamprey specific monitoring and salvage techniques
- Reduce impacts to lamprey habitat
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Figure 1: Estuarine salinity slowly increases as one moves away from freshwater sources and toward the ocean.