Integrating Lampreys into Habitat Restoration

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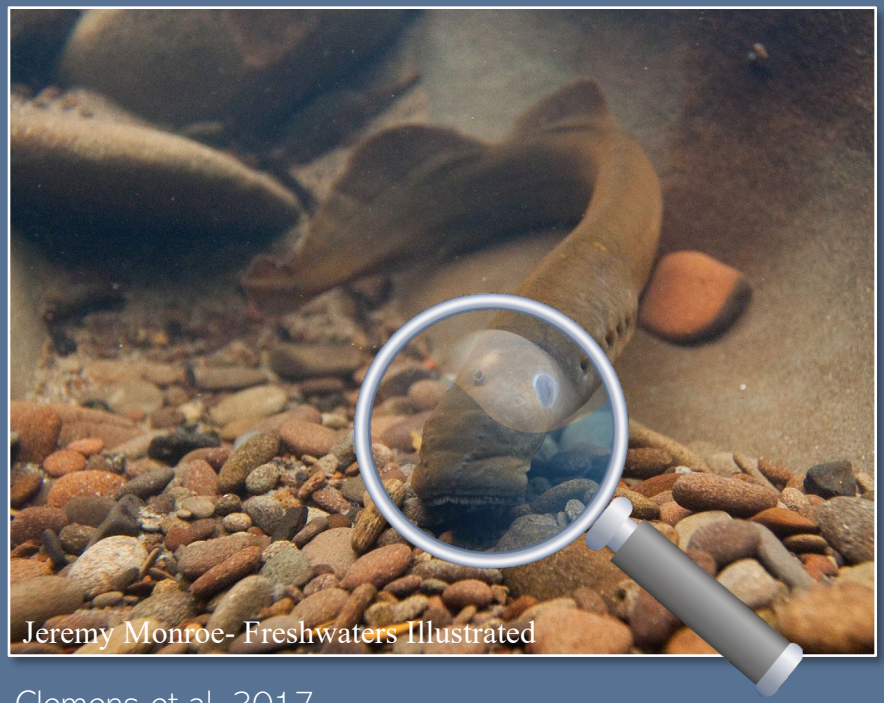


Clemens et al. 2017

Basic Data Gaps

- Distribution
- Abundance
- Limiting Factors
- Population Structure

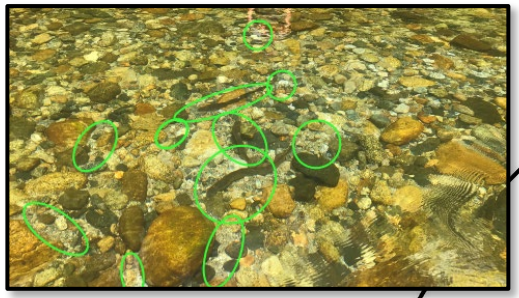
- Restoration Benefits?
- Understand Habitat Use
- Understand Local Threats
- Integrate into Projects - Lamprey Lens

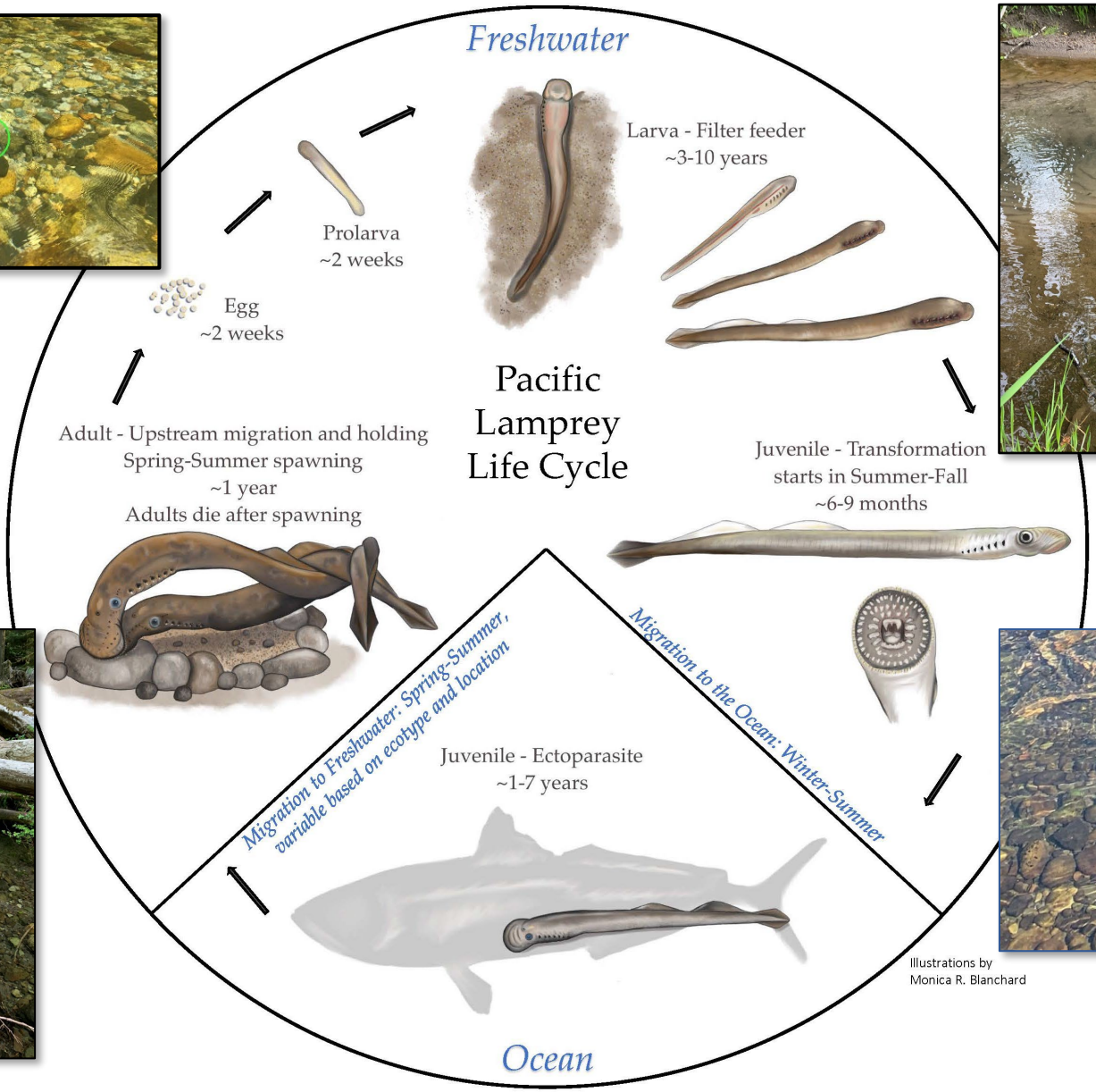
Integration in the Restoration Process

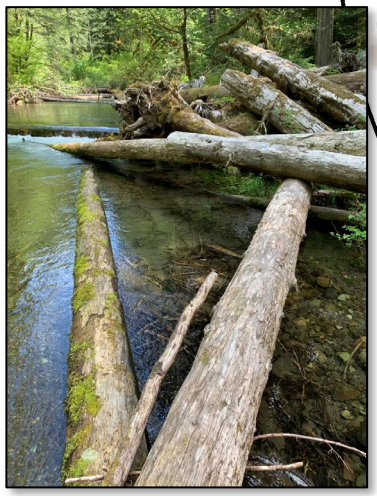
Including Lampreys at Every Step

- Pre-project assessment
- Incorporate design elements
- Implementation

Pre-Project: Pacific Lamprey Life Cycle - 12-year average lifespan



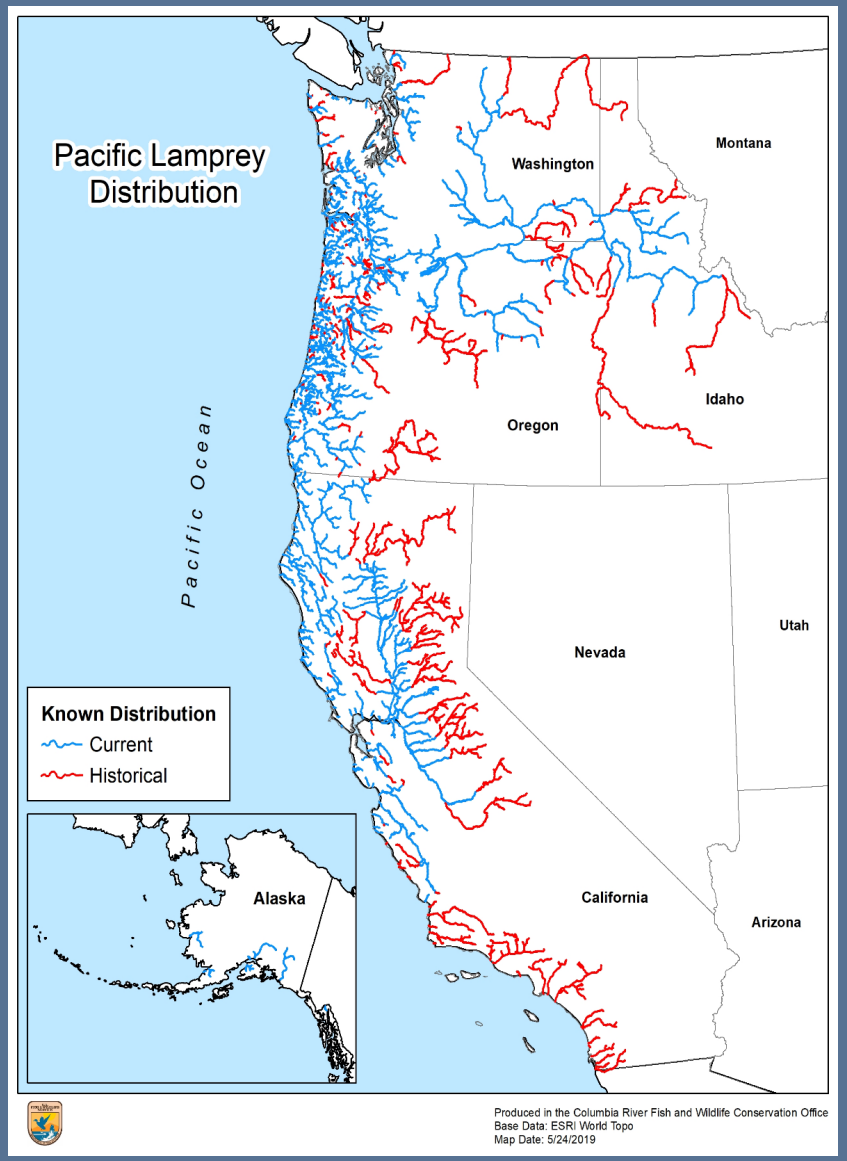




Illustrations by
Monica R. Blanchard

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

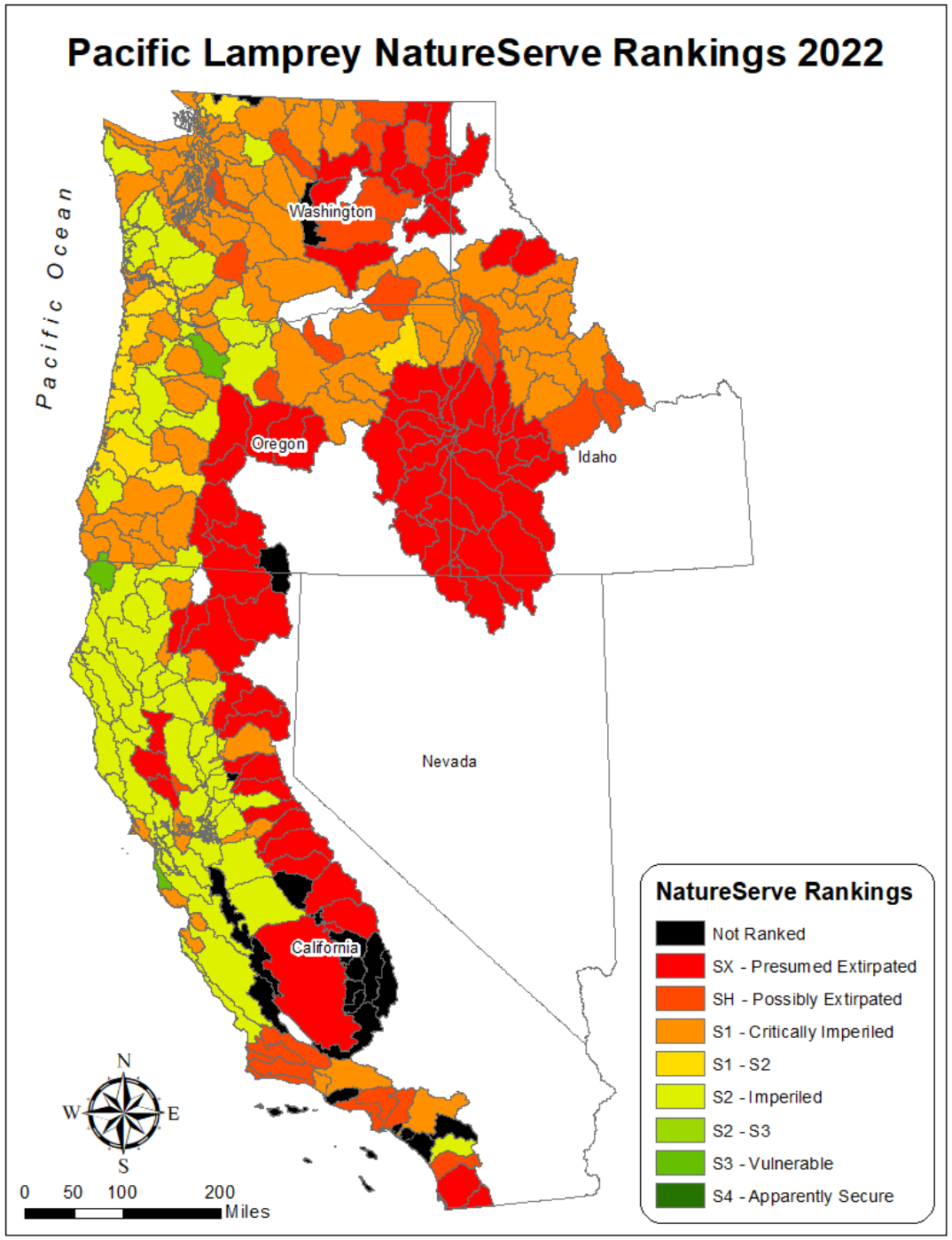


Pacific Lamprey Assessment 2022

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

Watershed	Climate Change		Lack of Awareness		Dewatering and Flow Management		Stream and Floodplain Degradation		Water Quality		Passage	
	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity	Scope	Severity
Sandy	4	4	4	3	3	2	2.5	3	3	4	2.5	3
Lewis	4	4	4	3	4	4	3	3	3	3	3	3
Upper Cowlitz	4	4	4	3	4	4	3	3	1	1	4	4
Lower Cowlitz	4	4	4	3	3	4	3.5	3.5	2.5	4	3	3
Clatskanie	4	4	4	3	3	3	4	3	3.5	4	3	3
Lower Columbia	4	4	4	3	2.5	2	3.5	3	3.5	4	2.5	2
Mean Scope & Severity	4.00		3.50		3.21		3.17		3.04		3.04	
Drainage Rank	H		H		M		M		M		M	

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

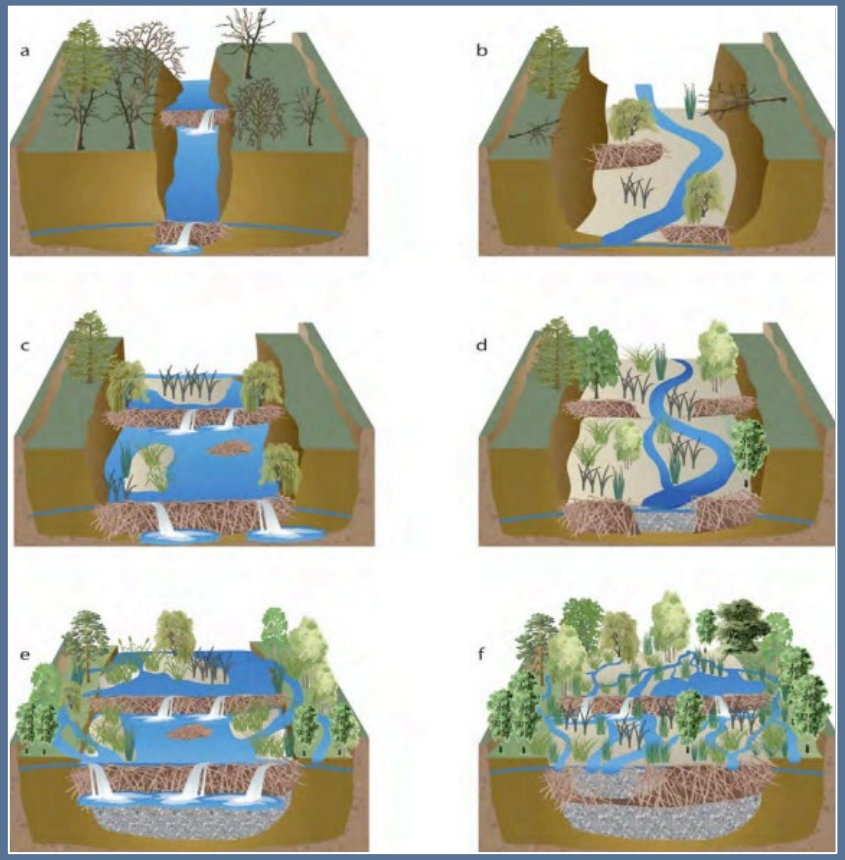
- Multiple flow paths
- Lateral connectivity
- Hyporheic connection
- Large wood
- Beavers
- Riparian trees
- High flows
- Longitudinal connectivity

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

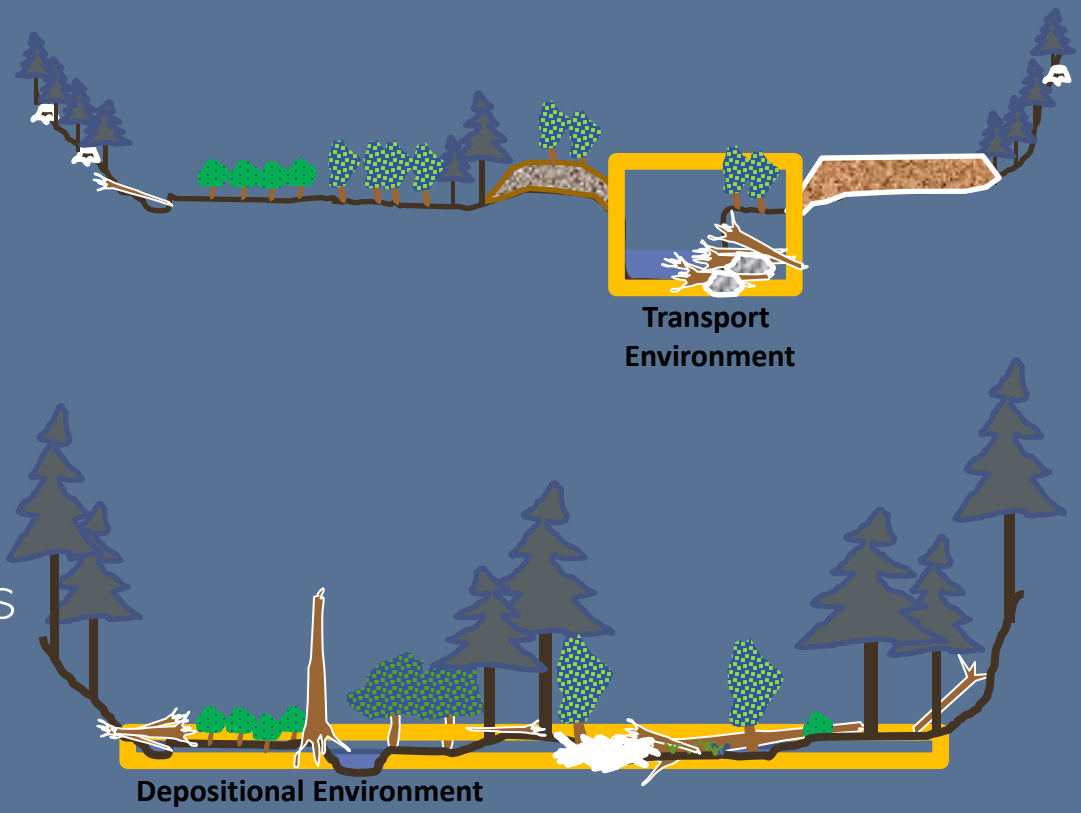


Figure from: Sarah Dyrdahl, Johan Hogervorst, Paul Burns, Kate Meyer, Matt Helstab, Lisa Kurian and Paul Powers, December 2016

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

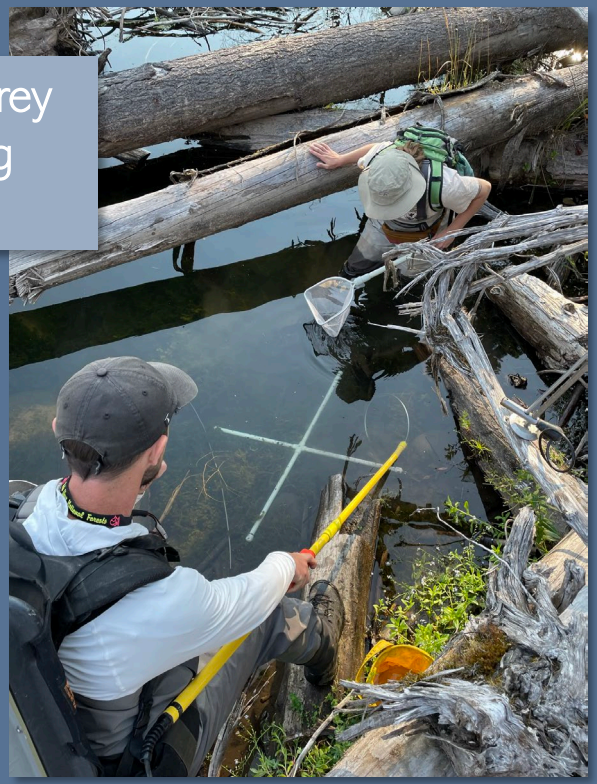
Lamprey Evaluation

Stage 0 Restoration

Valley Floor Reset

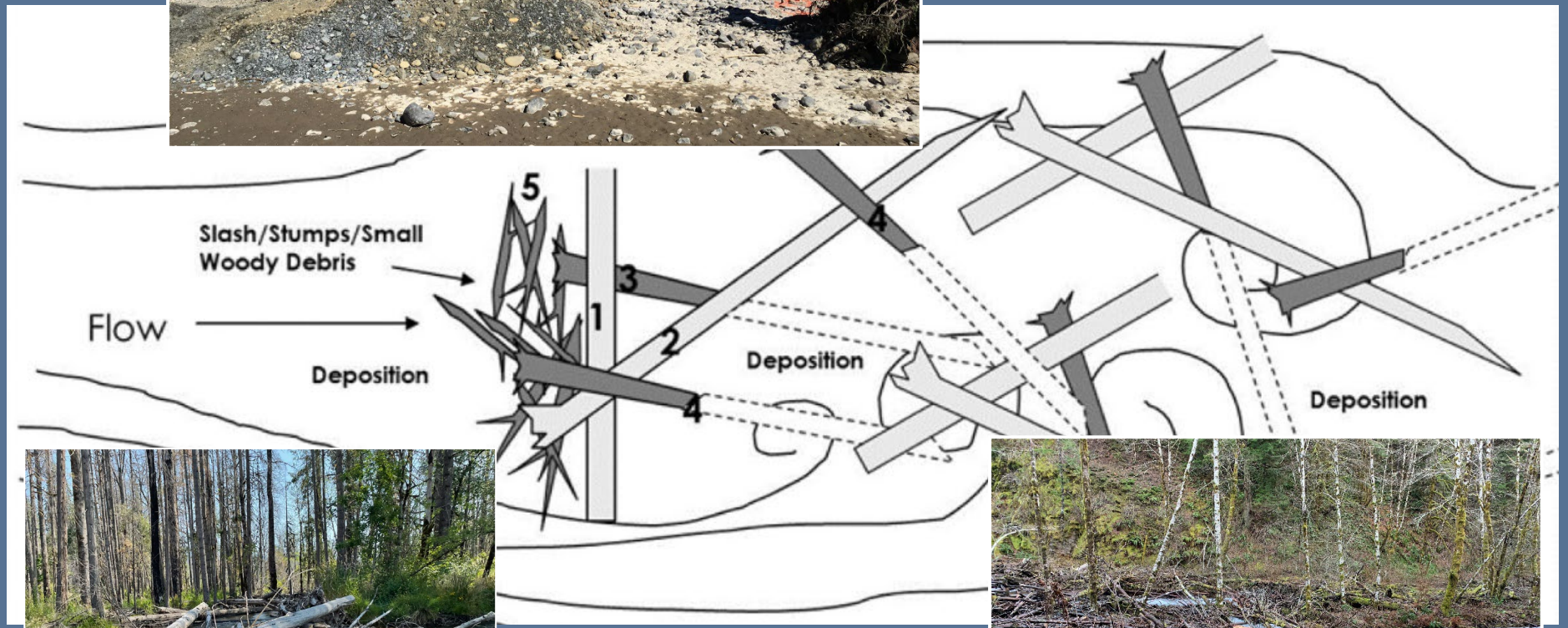
S.F. McKenzie River and **Fivemile-Bell Creeks**, OR Lamprey Occupancy Study

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

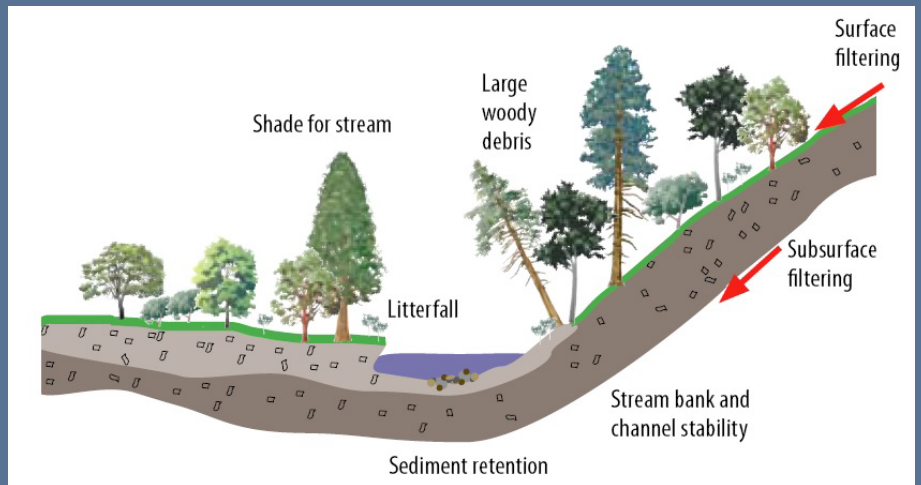


Figure 4.—Important functions of a riparian area include shade for the stream, stream bank stability, woody debris for the stream, sediment retention, litter for aquatic organisms in the stream, water filtering, aquatic habitat, and riparian wildlife habitat. (Adapted from Sacramento Area Flood Control Agency.)

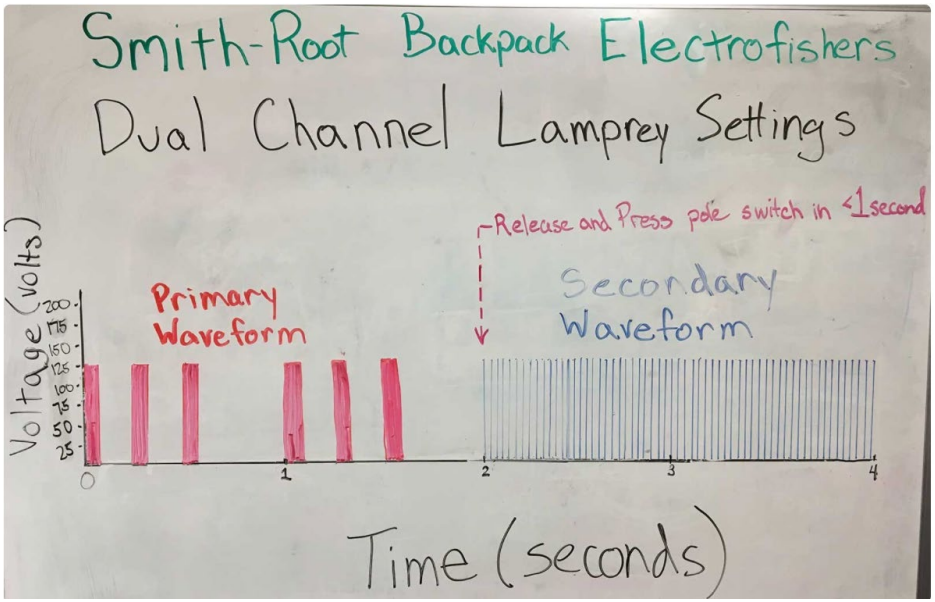
Project Implementation: Timing and Extent

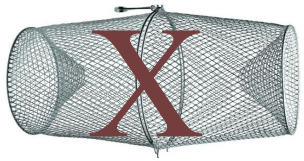
Reduce impacts to lamprey where possible:

- **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





	Bursted Slow Pulse Primary Wave Form	Standard Fast Pulse Secondary Wave Form
Voltage	125 v	125 v
Pulse Frequency	3 Hz	30 Hz
Duty Cycle	25%	25%
Burst Pulse Train	3:1	X

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

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 %

Photo Credit: Ralph Lampman

"Dry" Electrofishing

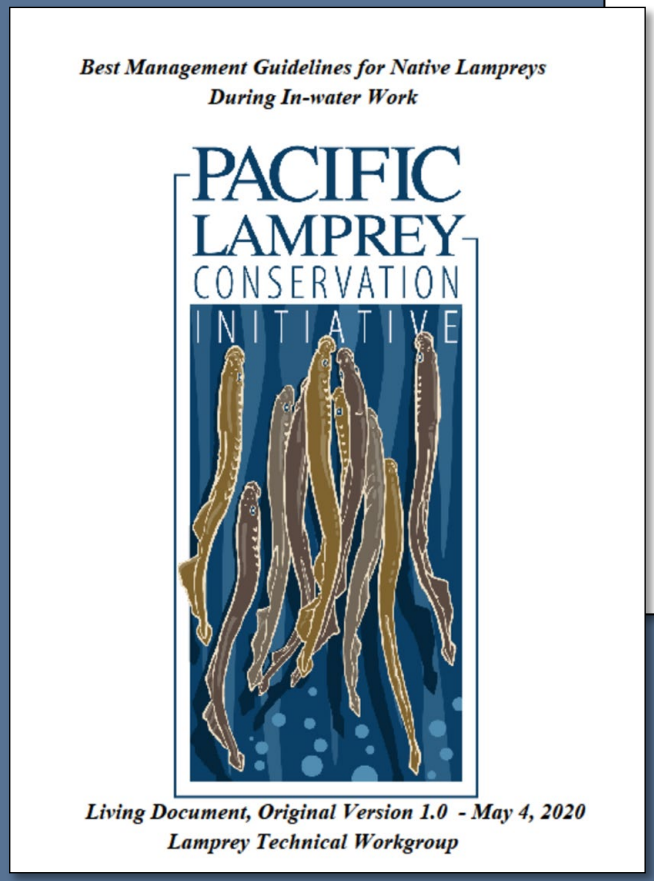
Implementation: Additional Dewatering Steps

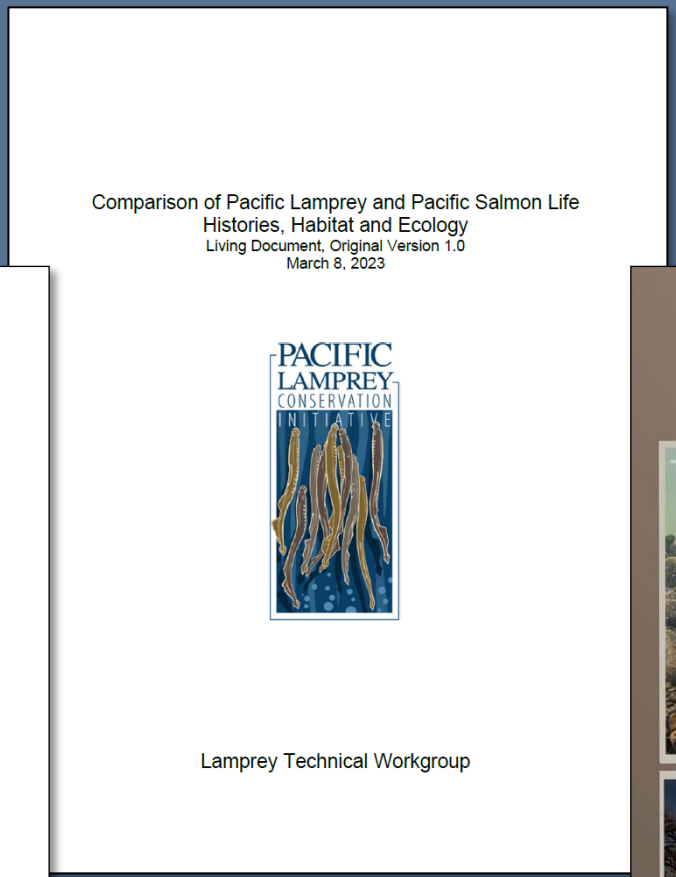
1. *Conduct pre-drawdown lamprey presence/absence surveys - Use Lamprey settings!
   - Mussels – plan for relocation
2. Perform pre-drawdown lamprey salvage – Use Lamprey settings!
   - Collect mussels
3. Perform pre-drawdown salvage boney fishes
4. Perform all species salvage during drawdown - Use Lamprey 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

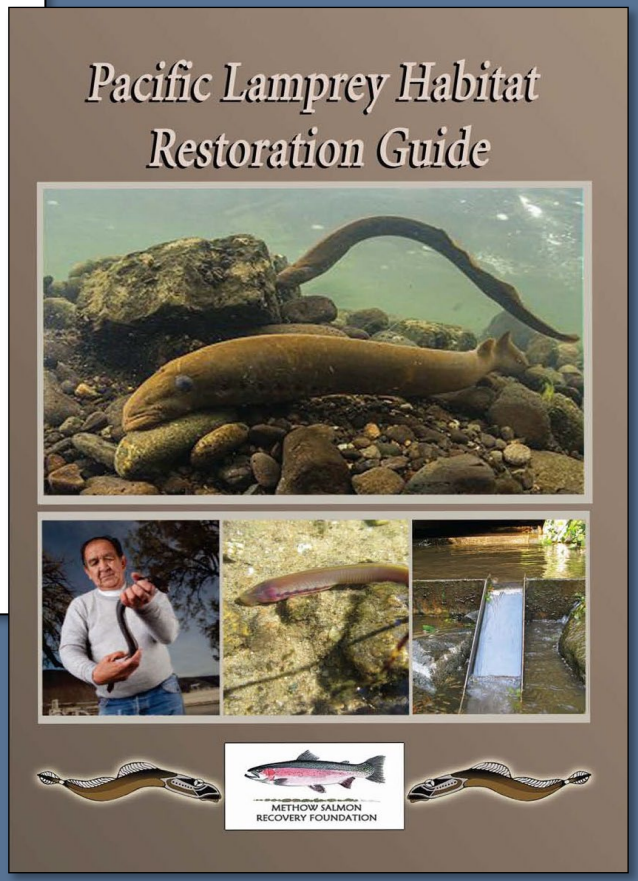
Plan ahead – extra time, equipment, and people needed!!

Online Resources: PacificLamprey.org*

*New Website!







Integration in the Restoration Process

Including Lampreys at Every Step

- **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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Larval Saline Tolerances

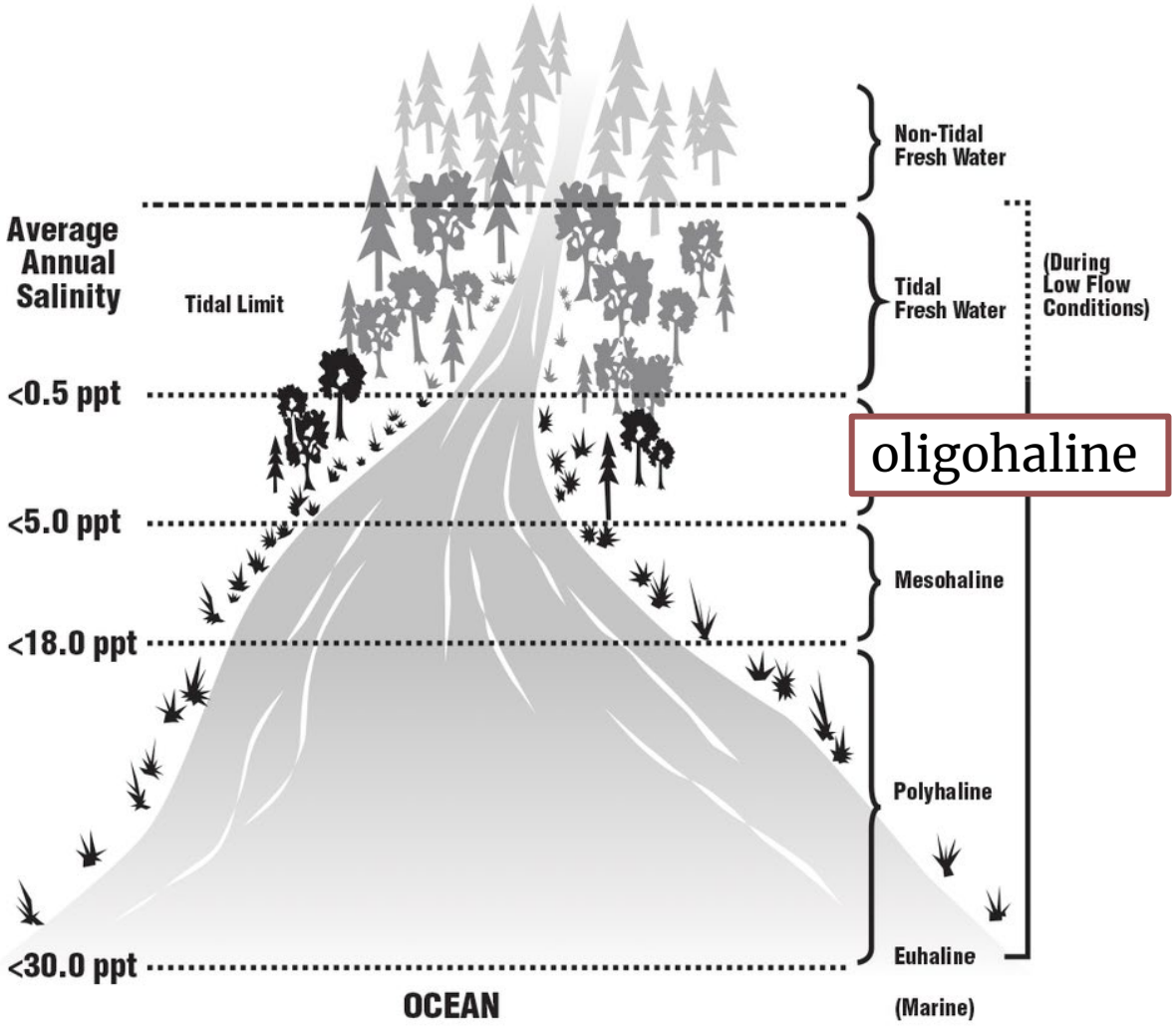

Figure 1: Estuarine salinity slowly increases as one moves away from freshwater sources and toward the ocean.
Source: Chapter 14 Salinity. Voluntary Estuary Monitoring Manual.