

Integrating Lamprey Passage into Restoration



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US Fish and Wildlife Service

April 25, 2023



Objectives

1. Raise Awareness
2. Review Behavior
3. Address Barriers



Freshwater

Larva - Filter feeder
~3-10 years

Prolarva
~2 weeks

Egg
~2 weeks

Pacific Lamprey Life Cycle

Juvenile - Transformation
starts in Summer-Fall
~6-9 months

Adult - Upstream migration and holding
Spring-Summer spawning
~1 year
Adults die after spawning

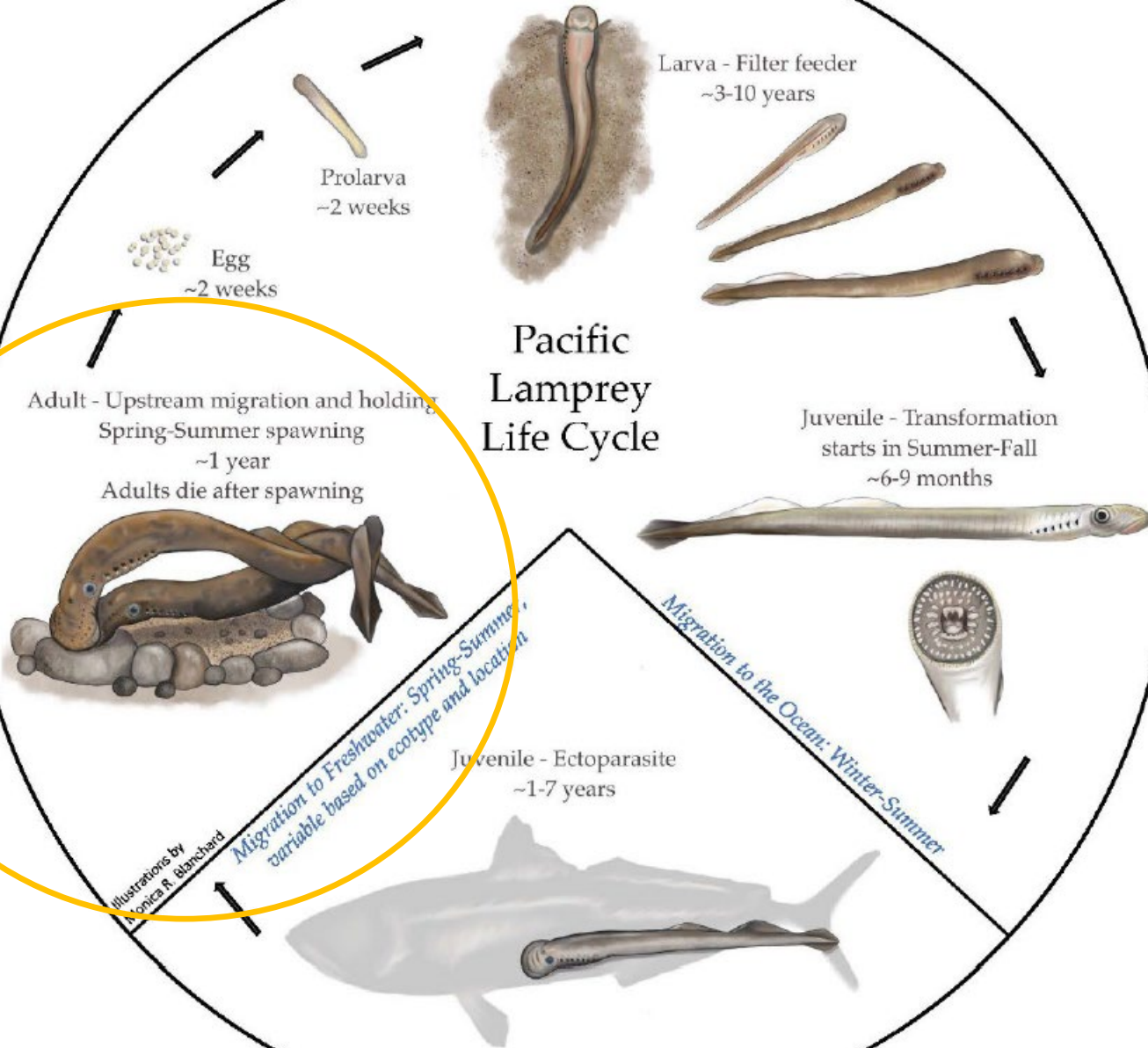
Juvenile - Ectoparasite
~1-7 years

Migration to the Ocean: Winter-Summer

Illustrations by
Monica R. Blanchard

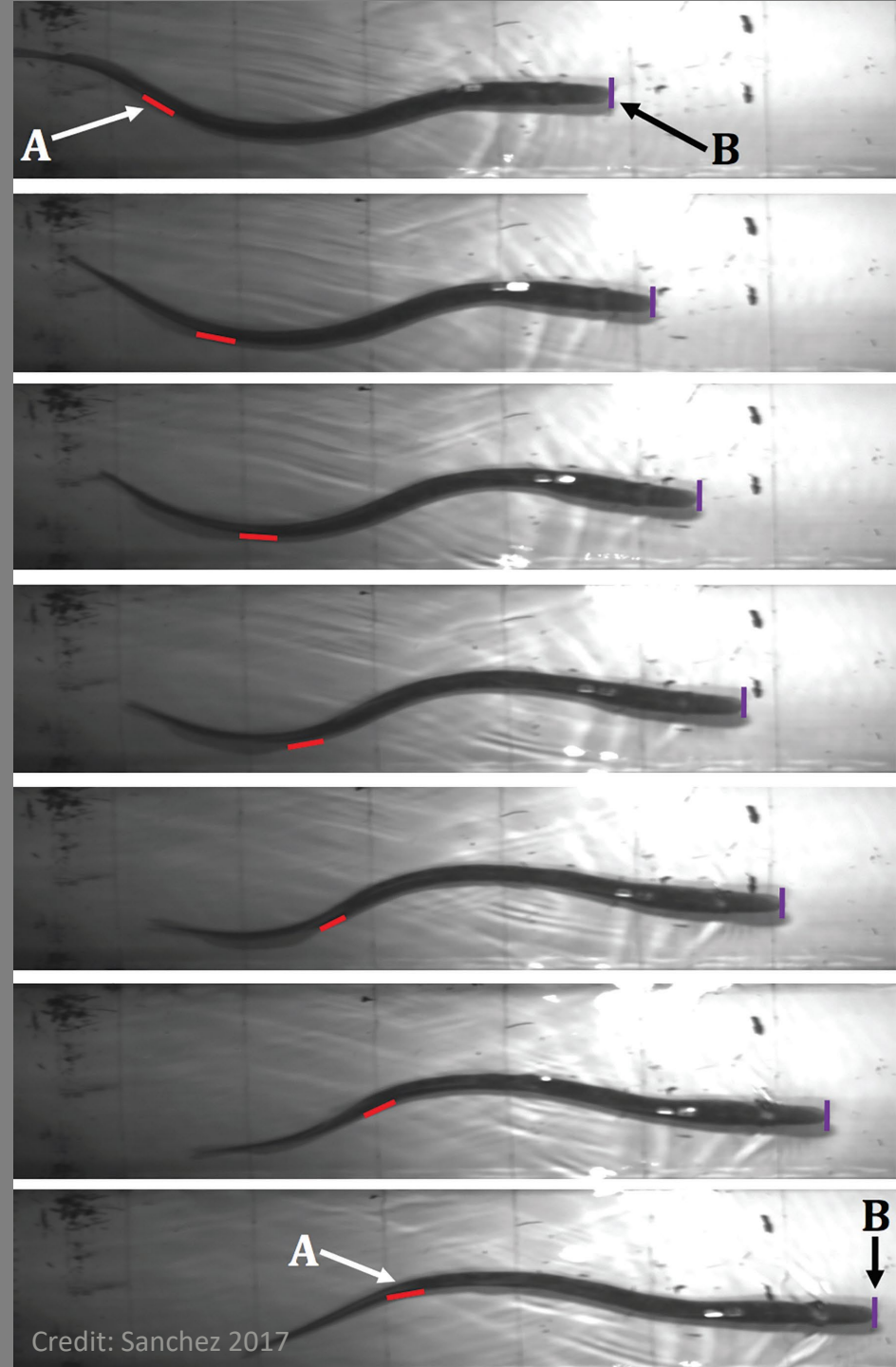
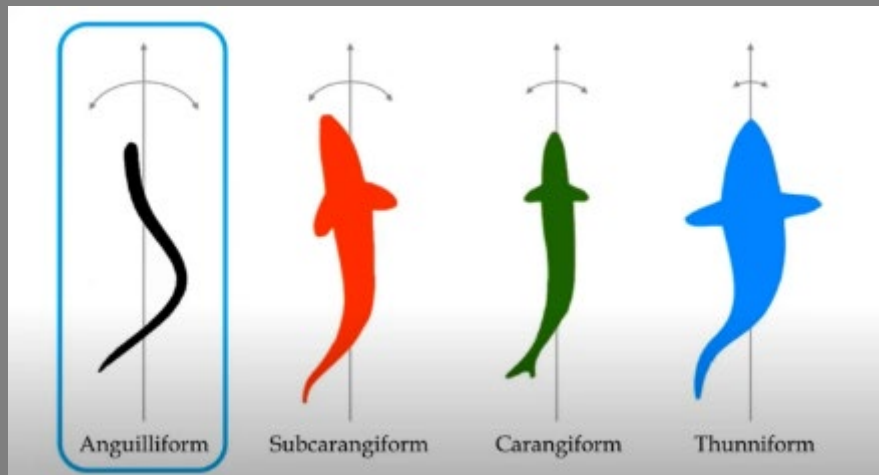
Migration to Freshwater: Spring-Summer,
variable based on ecotype and location

Ocean



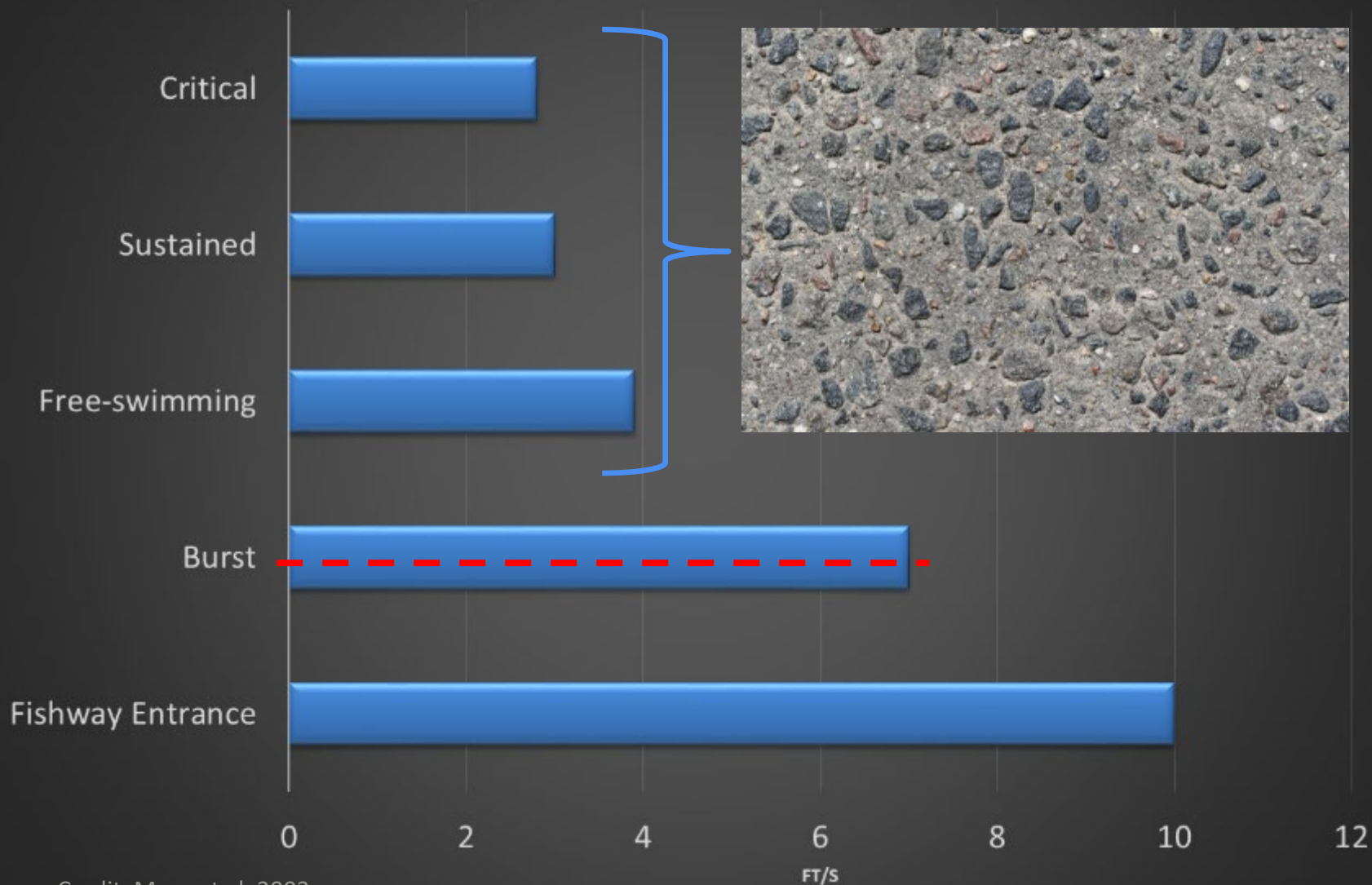
Anguilliform Swimming Mode

- Characterized by left-right body wave undulations that increase in amplitude as they approach the caudal fin
- Less efficient than salmonid mode
- Not incorporated into fish passage design



Credit: Sanchez 2017

Adult Pacific Lamprey Swimming Abilities



Credit: Mesa et al. 2003

Video: Lamprey climbing



1 Division 412
2 FISH PASSAGE

→ » ODFW Home » Fish Division » Fish Passage

3 **635-412-0001**
4 **Purpose of the Fish Passage Policy**

5 (1) The purpose of these rules is to further clarify and implement the State's fish passage statutes (ORS
6 509.580 through 509.910) and the Department's Climate and Ocean Change Policy (OAR 635-900-0001
7 through 635-900-0020) through the application of consistent standards.

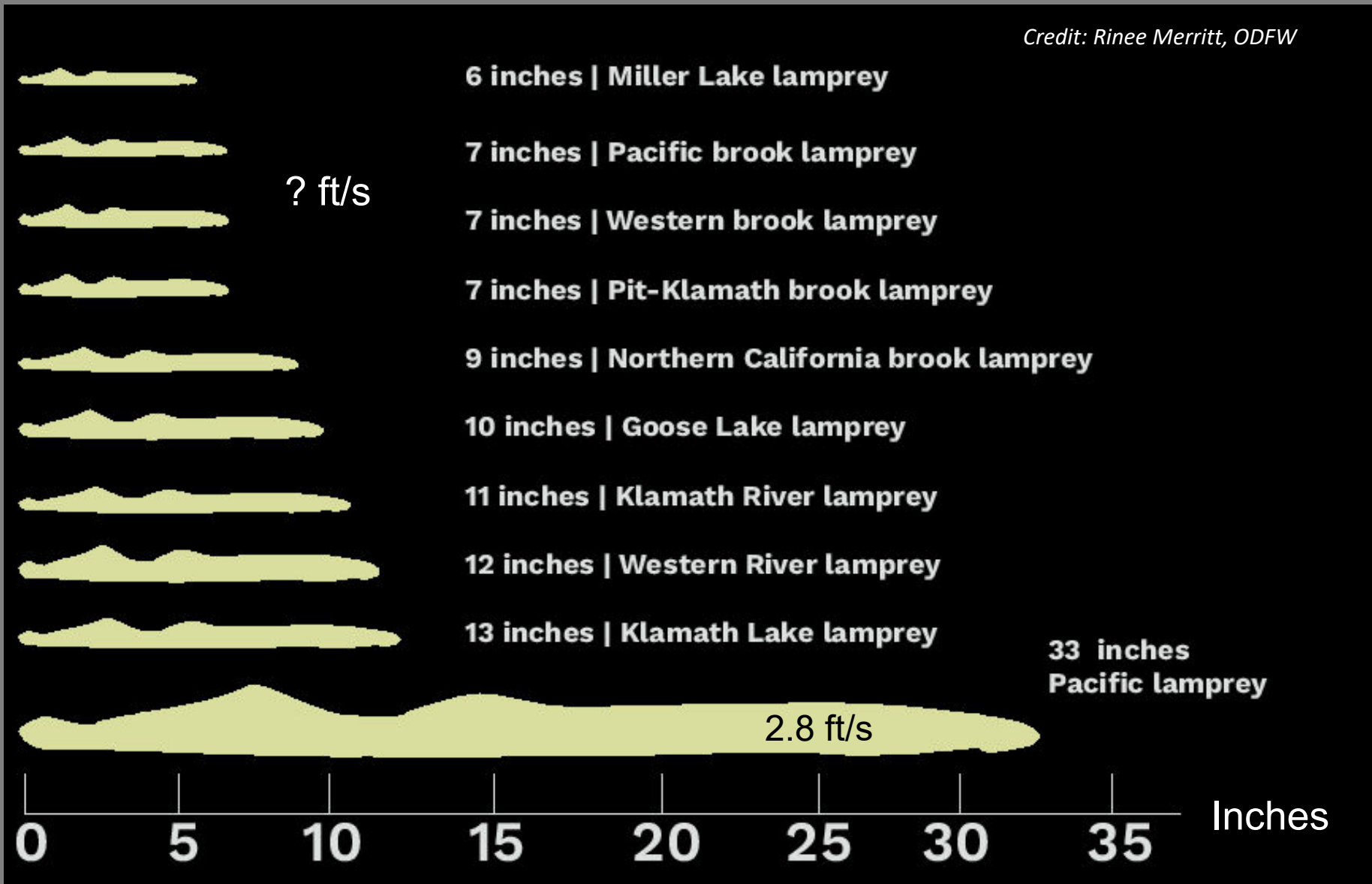
(20) "Fish passage" means the ability, by the weakest native migratory fish and life history stages determined by the Department to require passage at the site, to move either volitionally or by trap collection and transport if consistent with requirements of OAR 635-412-0035(6), with minimal stress, minimal delay, and without physical or physiological injury upstream and downstream of an artificial obstruction.

167 (33) "Native migratory fish" means naturally or hatchery produced native fish (as defined under OAR 635-
168 007-0501) indigenous (i.e., not introduced) to Oregon that migrate for their life cycle needs. These fish
169 include all sub-species and life history patterns of the following species listed by scientific name in use as
170 of 2022. Common names are provided for reference but are not intended to be a complete listing of
171 common names, sub-species, or life history patterns for each species.

- 193 (v) *Lampetra ayresii* — Western river lamprey;
- 194 (w) *Lampretra pacifica* -- Pacific brook lamprey;
- 195 (x) *Lampetra richardsoni* -- Western brook lamprey;

Critical Swimming Performance – Lampreys

Credit: Rinee Merritt, ODFW



Adult Lamprey Behavior Relative to Passage

- Nocturnal
 - Passage often peaks 10 pm to 2 am
 - Daytime observations indicate a passage issue
 - To avoid predation
- Demersal
 - Travel near the bed, unless velocities high
- Negatively phototactic
 - Avoid excessive lighting

Passage guideline Papers:

- Practical Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways - 2022
- Design Guidelines for Pacific Lamprey Passage Structures: Zobott et al. 2015 (UI, NMFS, USACE)
 - LPS system design, incl. “digital parts library”
- Barriers to Adult Pacific Lamprey at Road Crossings: Guidelines for evaluating and proving passage - 2020



Fishway Considerations for Lamprey

- Type of ladder - different hydraulics
- False attraction flows – Entrance & AWS
- Limited or no continuous attachment surfaces
- Picket spacing
 - $<0.7''$ precludes and $>1.0''$ enables
- Counting stations & lighting
- Transition areas/ confusing flow patterns
- Limited resting area/refuges



Lamprey Technical Workgroup

ADULT PASSAGE & ENGINEERING

Develops guidance and shares information across parties and regions to improve upstream adult lamprey passage. Contact the subgroup lead – Ann Gray (USFWS) for more information.

[LEARN MORE](#)

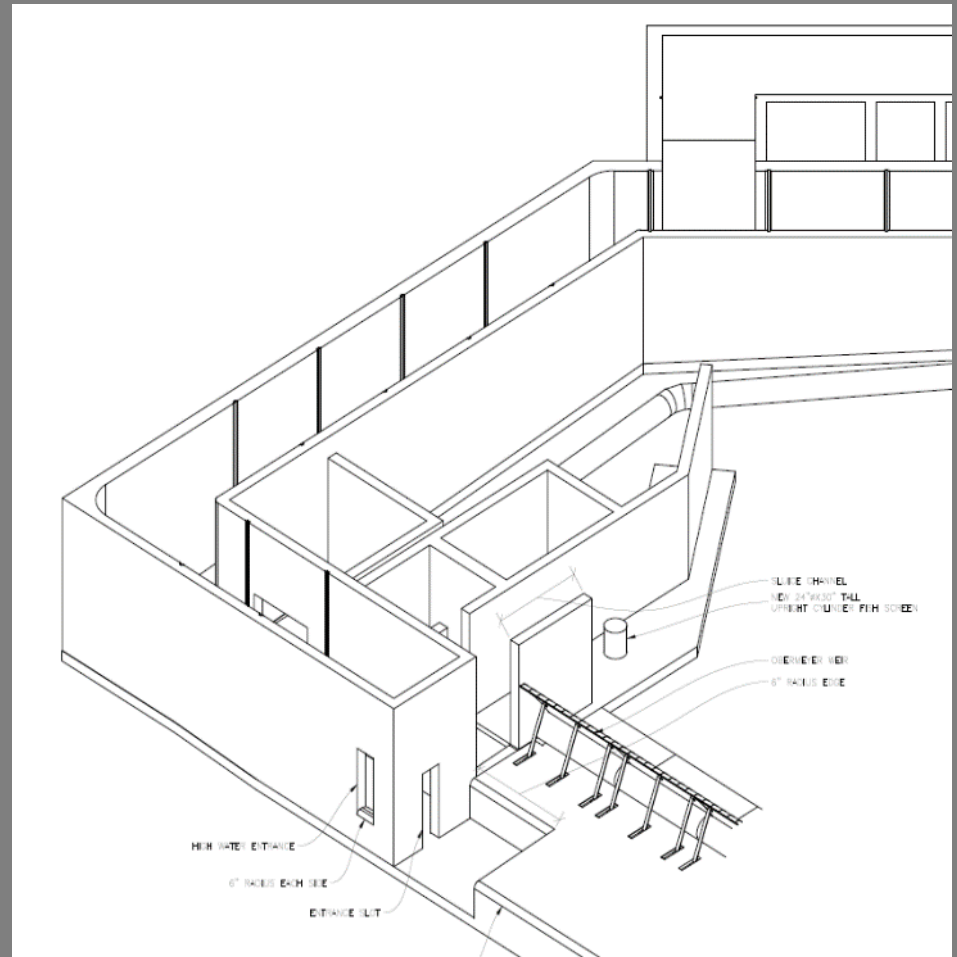
RESTORATION

Develops guidance and shares information across parties and regions to consider and integrate lampreys into restoration. Contact the subgroup lead – Christina Wang (USFWS) for more information.

[LEARN MORE](#)

Integrating lamprey passage into fishway design

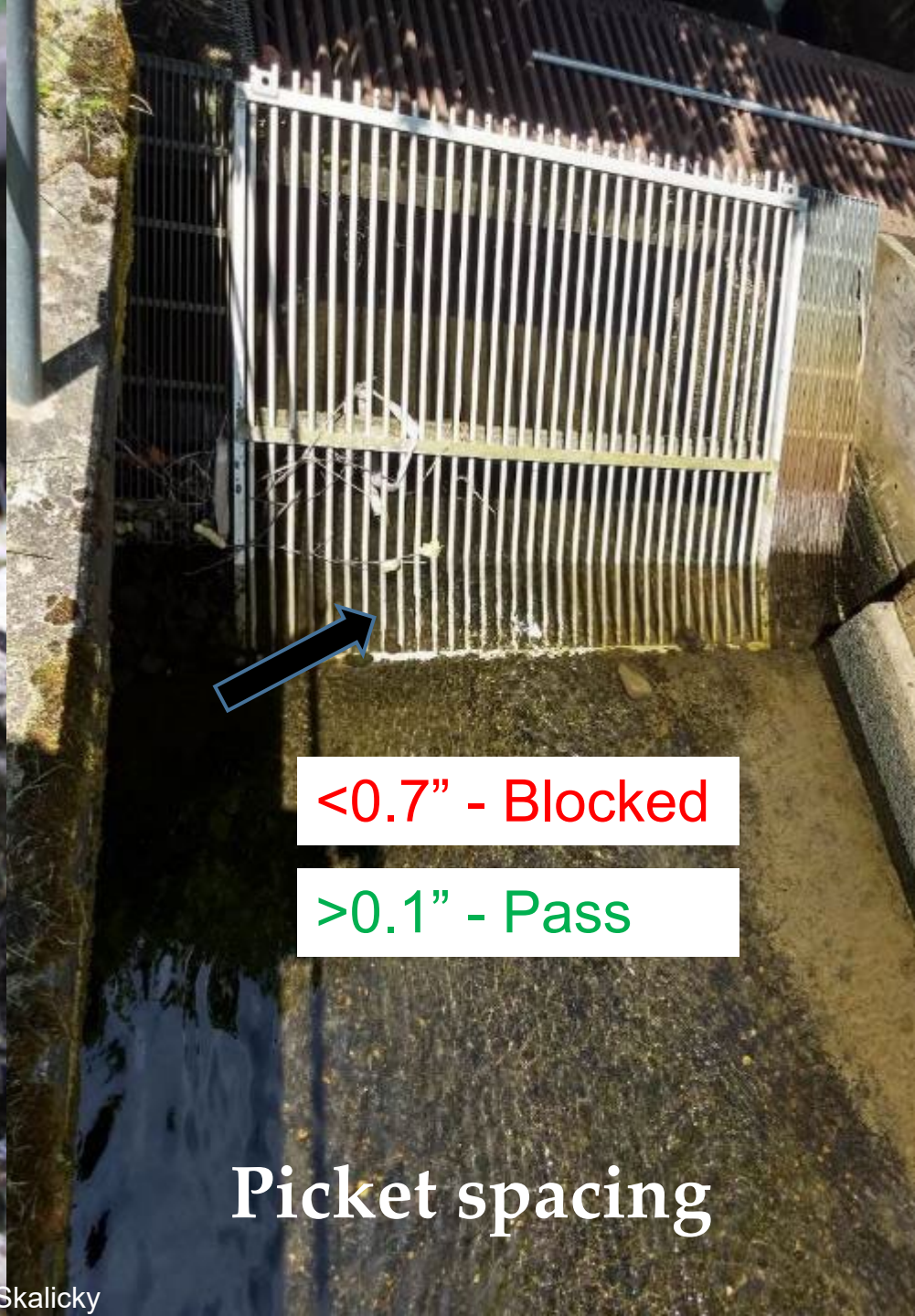
- Plan early
- No extra cost
- Orifices?
- 90° angles
- High velocities
- LTWG review





Attachment surfaces

Joe Skalicky



$<0.7''$ - Blocked

$>0.1''$ - Pass

Picket spacing

Fishway - Retrofits

- Round 90 corners to ~6 inch radius
- Cut orifices
- Add ramps
- Removal
- Removal with season weir
- Add resting boxes
- Smooth surfaces
- Add cover below



Credit: Eugene Water & Electric Board

Video – Why rounded corners matter!

Low-head barrier dams



Warm Spring National Fish Hatcher, Fishway, Barrier Dam, and Lamprey Passage System

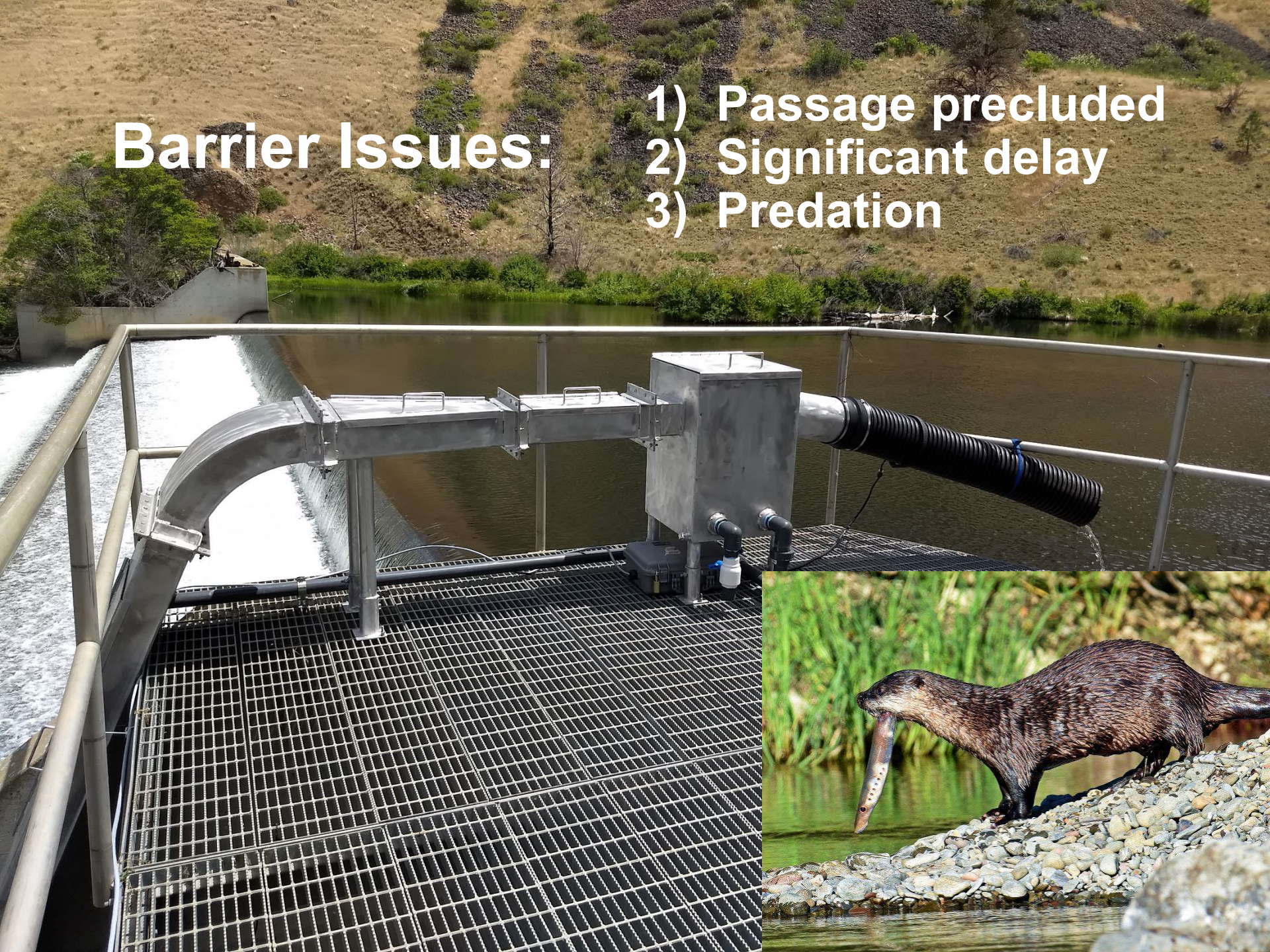


Burst and attach locomotion – Video

Warm Springs NFH

Barrier Issues:

- 1) Passage precluded
- 2) Significant delay
- 3) Predation



Passage Delay – Prespawn Mortality?



Karie Wiltshire

Issues and Perspectives

Warmwater Temperatures ($\geq 20^{\circ}\text{C}$) as a Threat to Pacific Lamprey: Implications of Climate Change

Benjamin J. Clemens*

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Abstract

Interest in the effects of warmwater temperatures ($\geq 20^{\circ}\text{C}$) on fishes has grown as biologists attempt to understand the impacts of climate change on native species. Previous research hypothesized that rivers displaying warmwater temperatures and low river flows, such as may become more common with climate change in North America, may select against Pacific Lamprey *Entosphenus tridentatus* migrating and spawning in the upper reaches of some watersheds. I provide new information from different locations that supports this hypothesis, including observations of prespawn mortalities of Pacific Lamprey during a recent heat wave, when daily water temperatures averaged 26.6°C (range: $20.8\text{--}30.6^{\circ}\text{C}$), and additional data from the literature. These observations and data suggest that the continued warming and slowing of rivers pose a threat to Pacific Lamprey in some Oregon (USA) rivers, which appears to agree with other research that suggests that lampreys will lose habitats in lower latitudes as climate change progresses.

Grade Control Structures



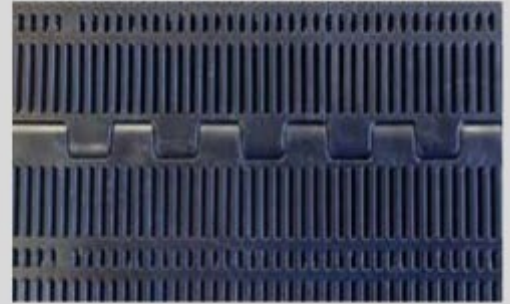
Passage Barrier?

Culverts – Lamprey cannot jump!



Stream simulation

Downstream Passage: Screening



NMFS criteria

- 1.75 mm maximum opening (slotted)
- 2.38 mm (round/perf plate)

Only good for large larvae (75+ mm)

Avoid woven wire screens for smaller larvae

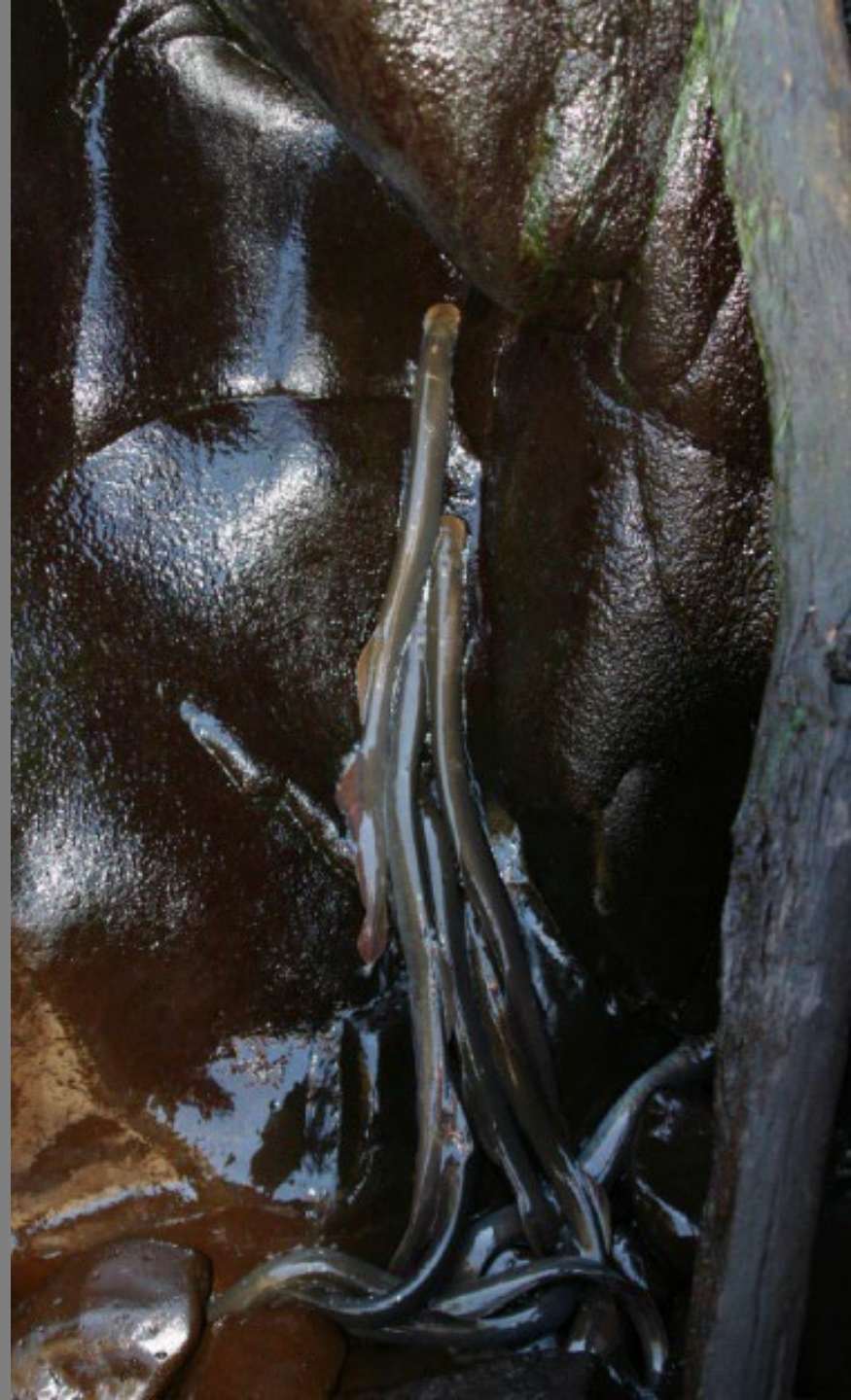
Orientation matters!

- Approach v Sweeping velocities



Summary

- Lamprey are poor swimmers compared to salmonids
- 90-degree corners alone can preclude passage
- Many options to provide passage at existing structures are available
- We are here to help



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