Adding Lampreys into the Mix:

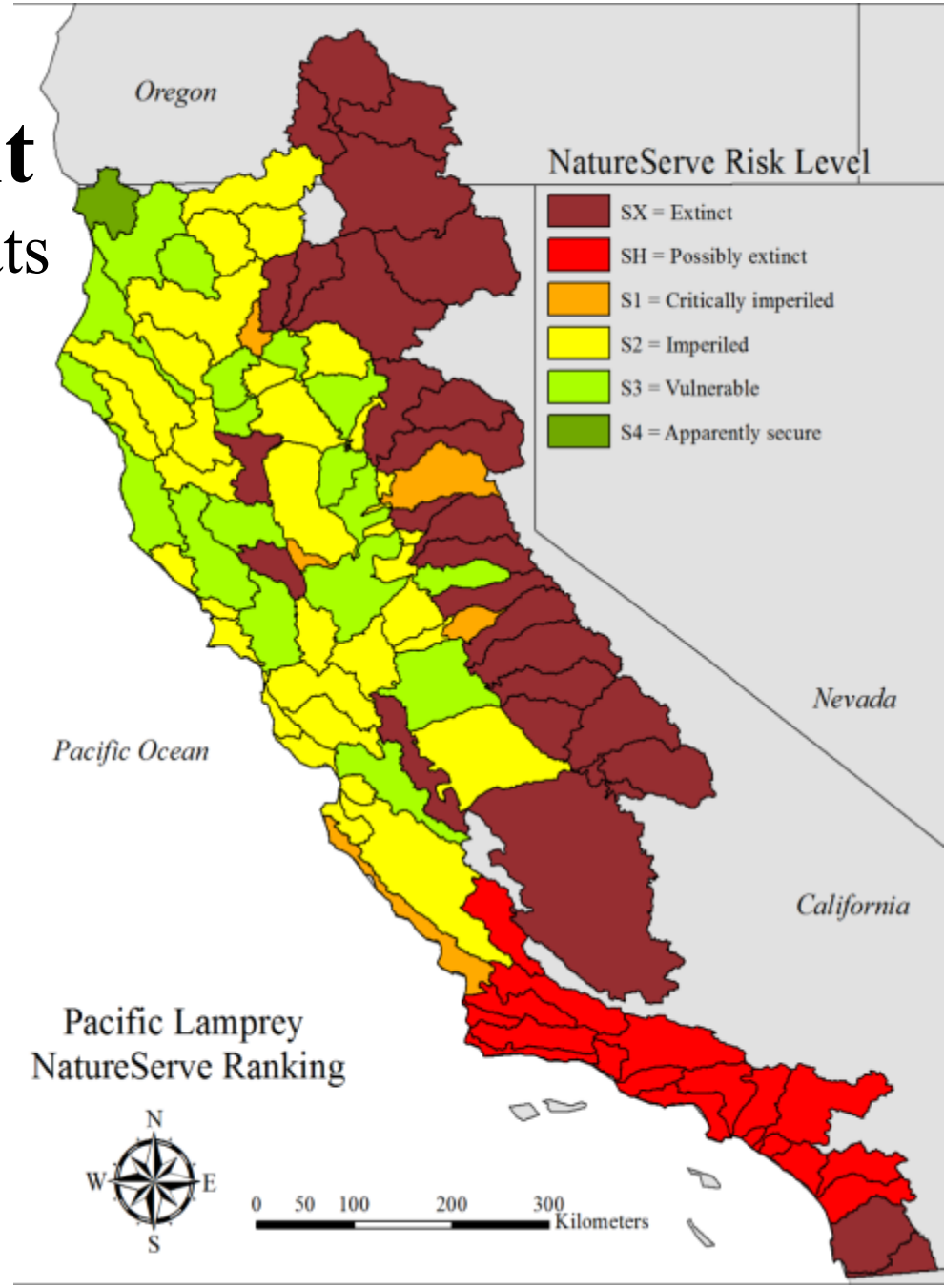
Approaches for Considering Lampreys in Passage Assessments

Damon H. Goodman - USFWS
Stewart B. Reid – Western Fishes
Javier Linares - USFWS

CA Threat Assessment

Moderate or Substantial Threats

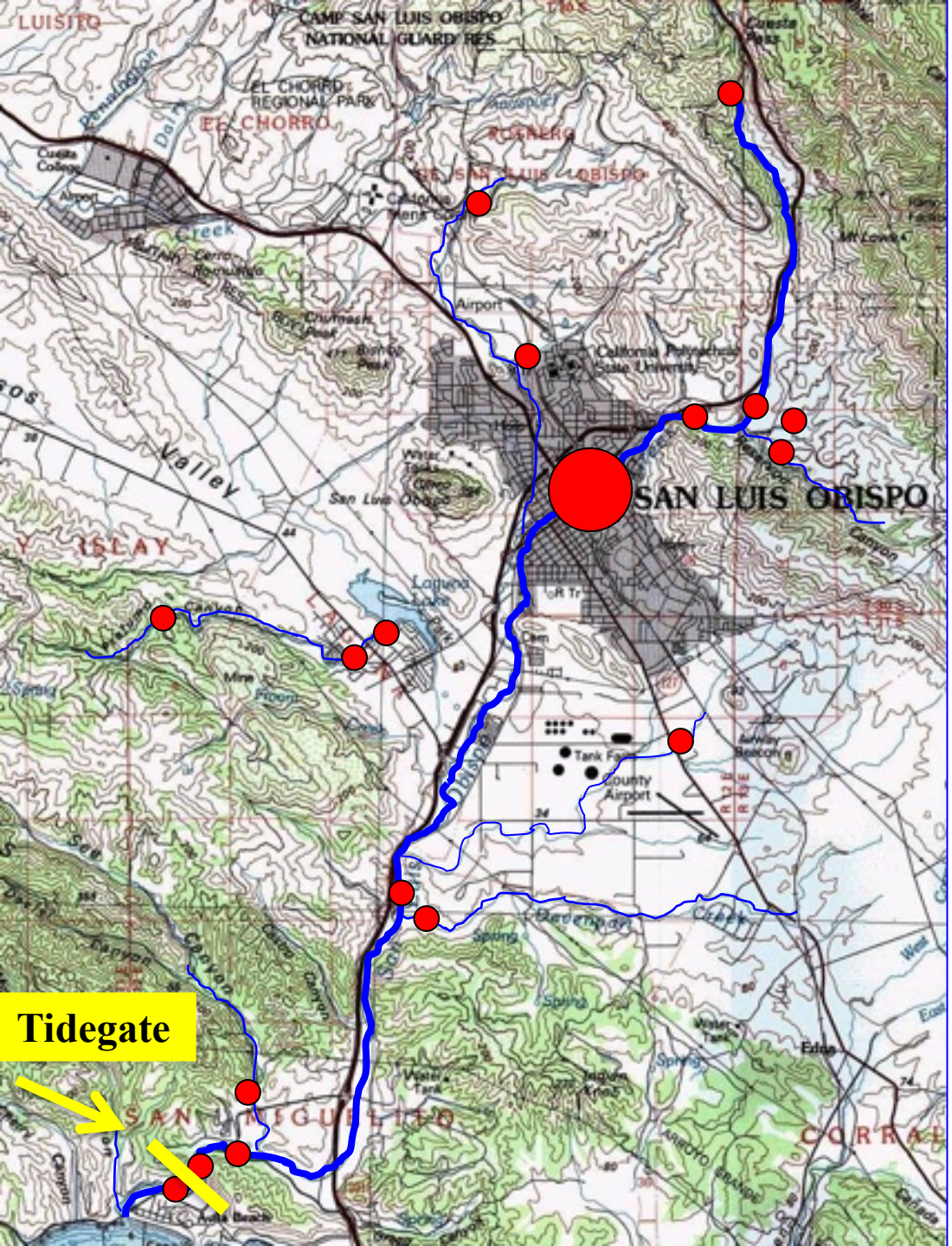
- **Passage (63% of HUCs)**
  - CA-FPF*****
- Dewatering and Streamflow Management (36%)
- Stream and Floodplain Degradation (18%)
- Water Quality (10%)
- No moderate or substantial threats (18%)



4th Level HUCs

San Luis Obispo Creek

In 2006 a low-jump notch was designed for the tidegate, dewatering the old fish ladder and providing easy passage for steelhead



San Luis Obispo Creek

Lamprey Sampling Sites

Abundant in 2004

Absent in 2011 – 2016

Over 100 adult Steelhead in 2012

San Luis Obispo Lamprey Working Group

PASSAGE ISSUE RESOLVED!

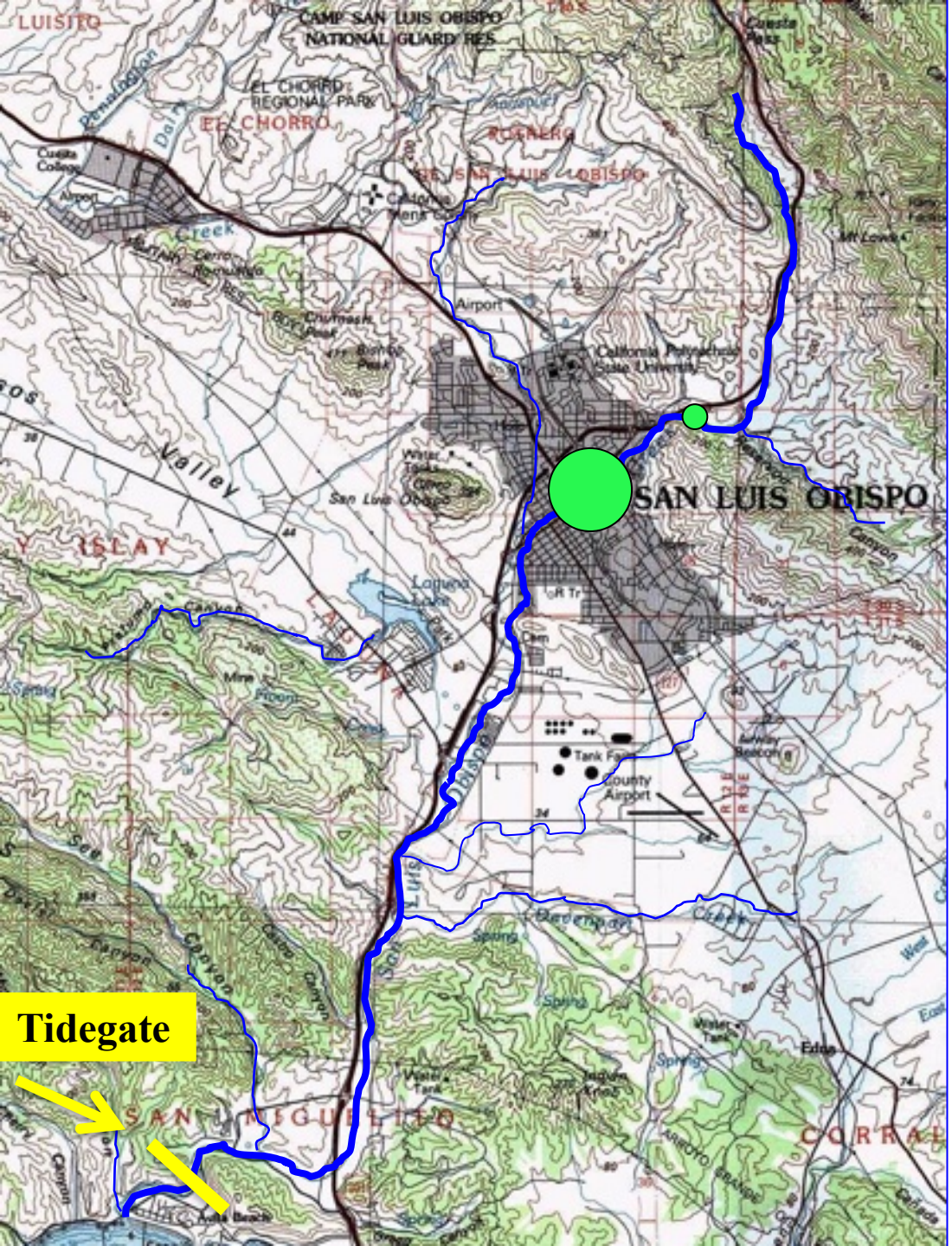
-"Lamp Ramp" installed 2013

-Total project cost = $312
(primarily recycled materials)

-Habitat now accessible= 19.5 mi

-$16 per mile

San Luis Obispo – Mission Plaza 2017!



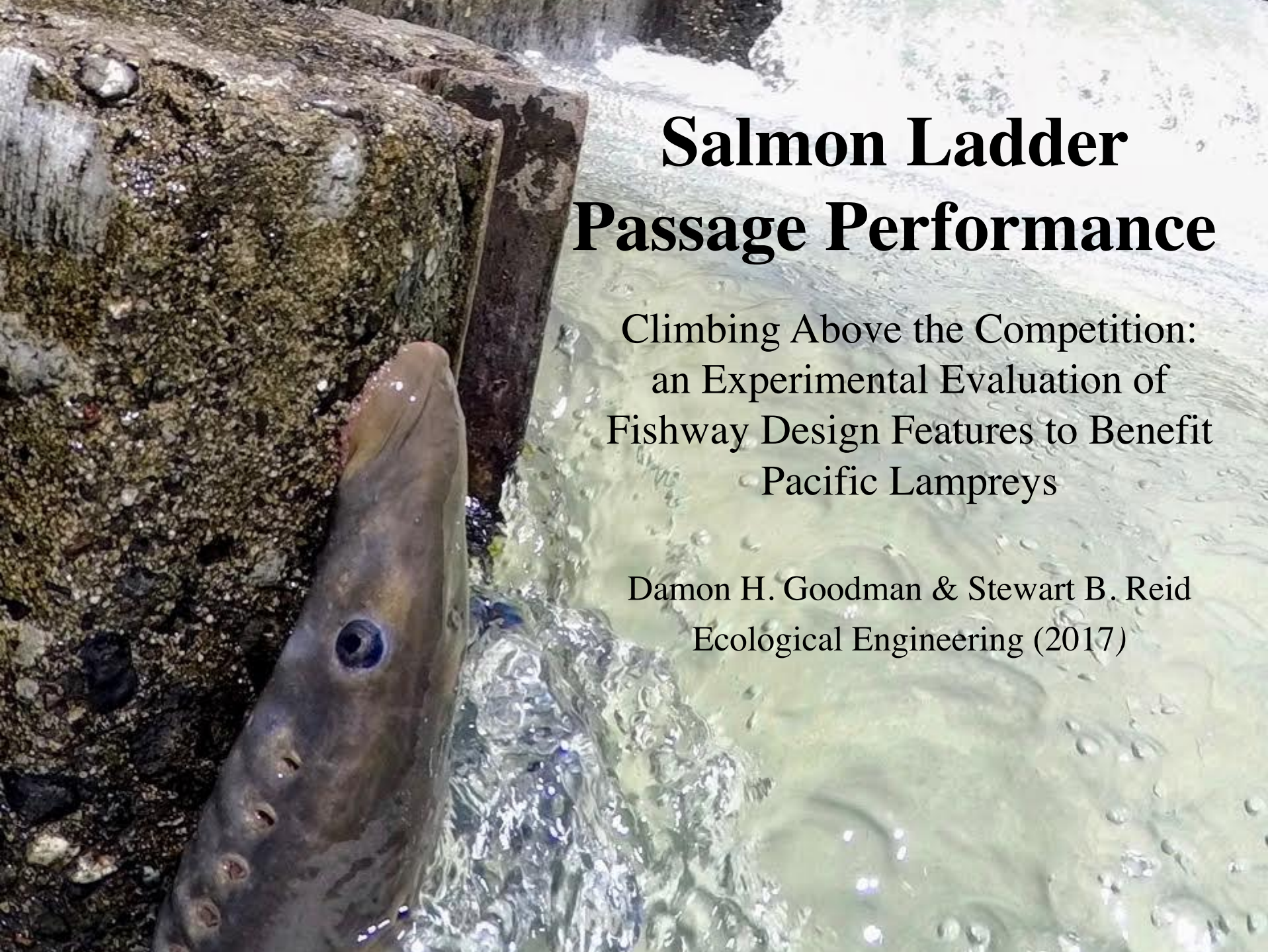
San Luis Obispo Creek

Celebrating the return of the Lampreys!

Spawning Observed in 2017

Extended distribution south by 100 mi

First example of natural recolonization



Salmon Ladder Passage Performance

Climbing Above the Competition: an Experimental Evaluation of Fishway Design Features to Benefit Pacific Lampreys

Damon H. Goodman & Stewart B. Reid

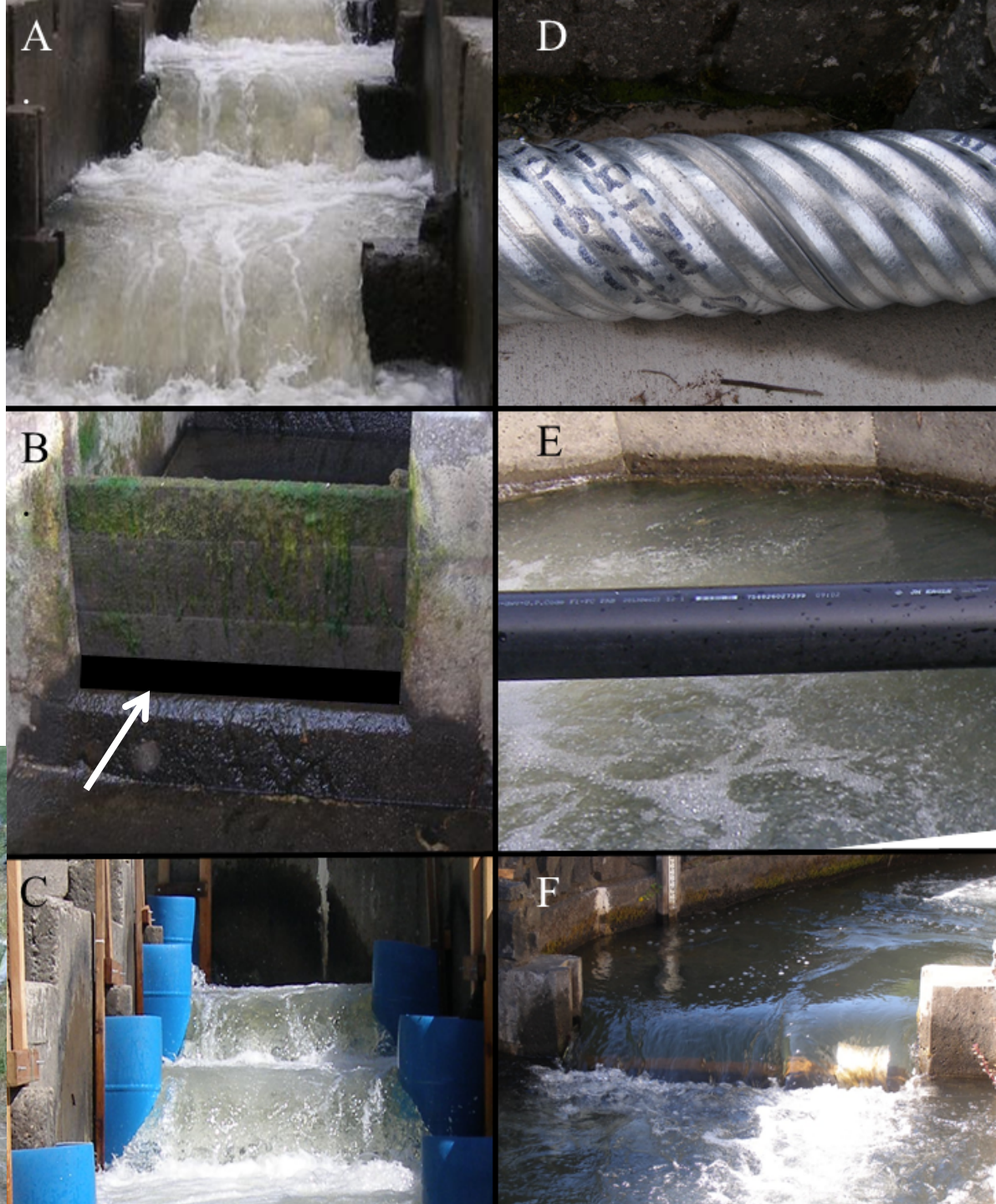
Ecological Engineering (2017)

Assessment Framework

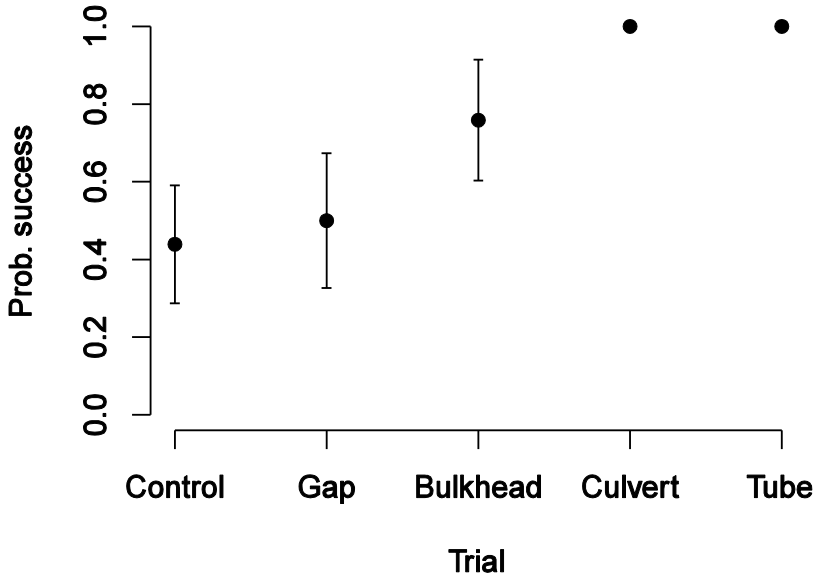
- Challenged lampreys with 5 modifications
  - 10 m section (4 weirs)
  - 10% gradient

- Nighttime observations
- Established PIT arrays

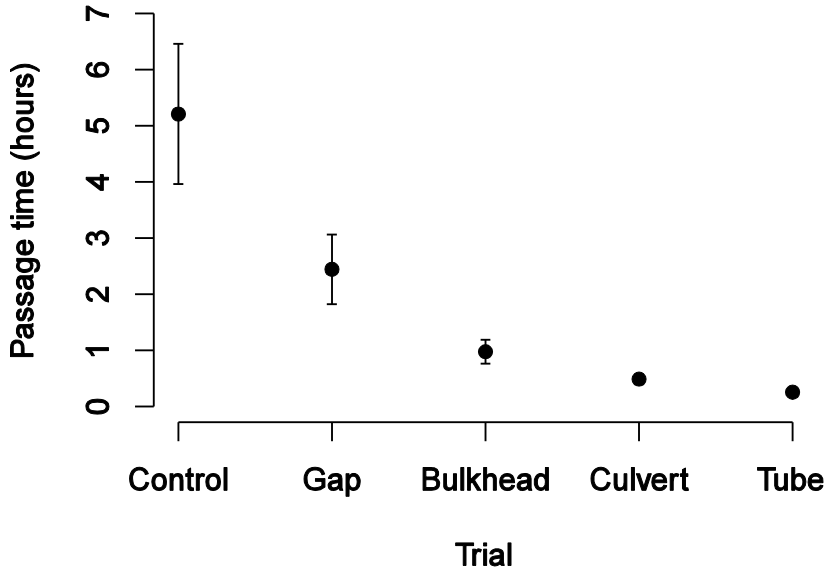
- Evaluated
  - Behavior
  - Passage success (overnight)
  - Passage time



Probability of Success

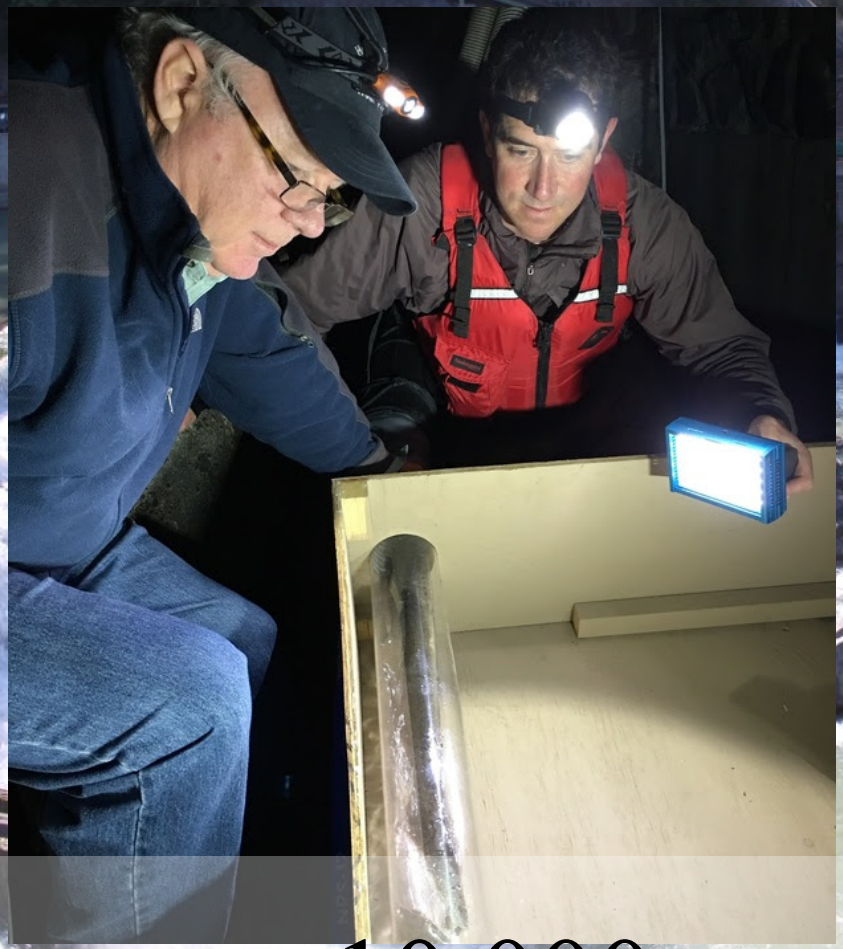


Passage Time



GLM
Error bars indicate 95% CI
No effect of lamprey length

So Now What????



>10,000 counted in 2017

Environ Biol Fish (2016) 99:969–974
DOI 10.1007/s10641-016-0537-2

Free-swimming speeds and behavior in adult Pacific Lamprey, *Entosphenus tridentatus*

Stewart B. Reid · Damon H. Goodman

Received: 22 May 2016 / Accepted: 19 October 2016 /Published online: 23 October 2016

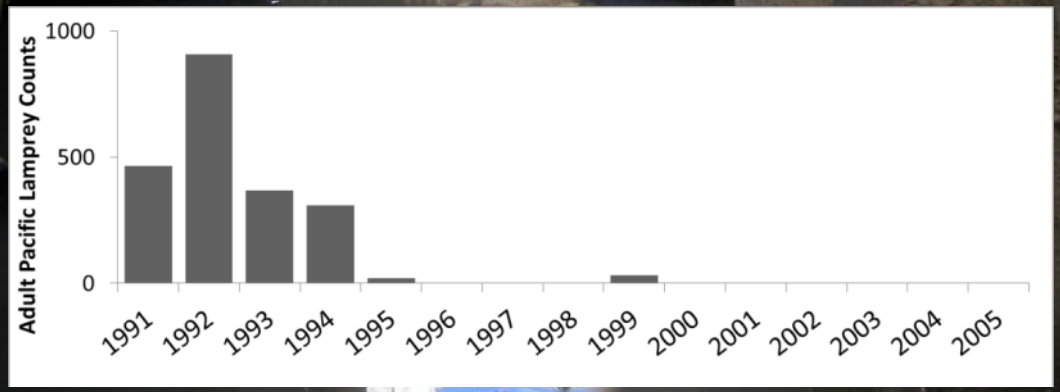
Upstream migration –

89% were swimming within **6 cm** of the bottom.

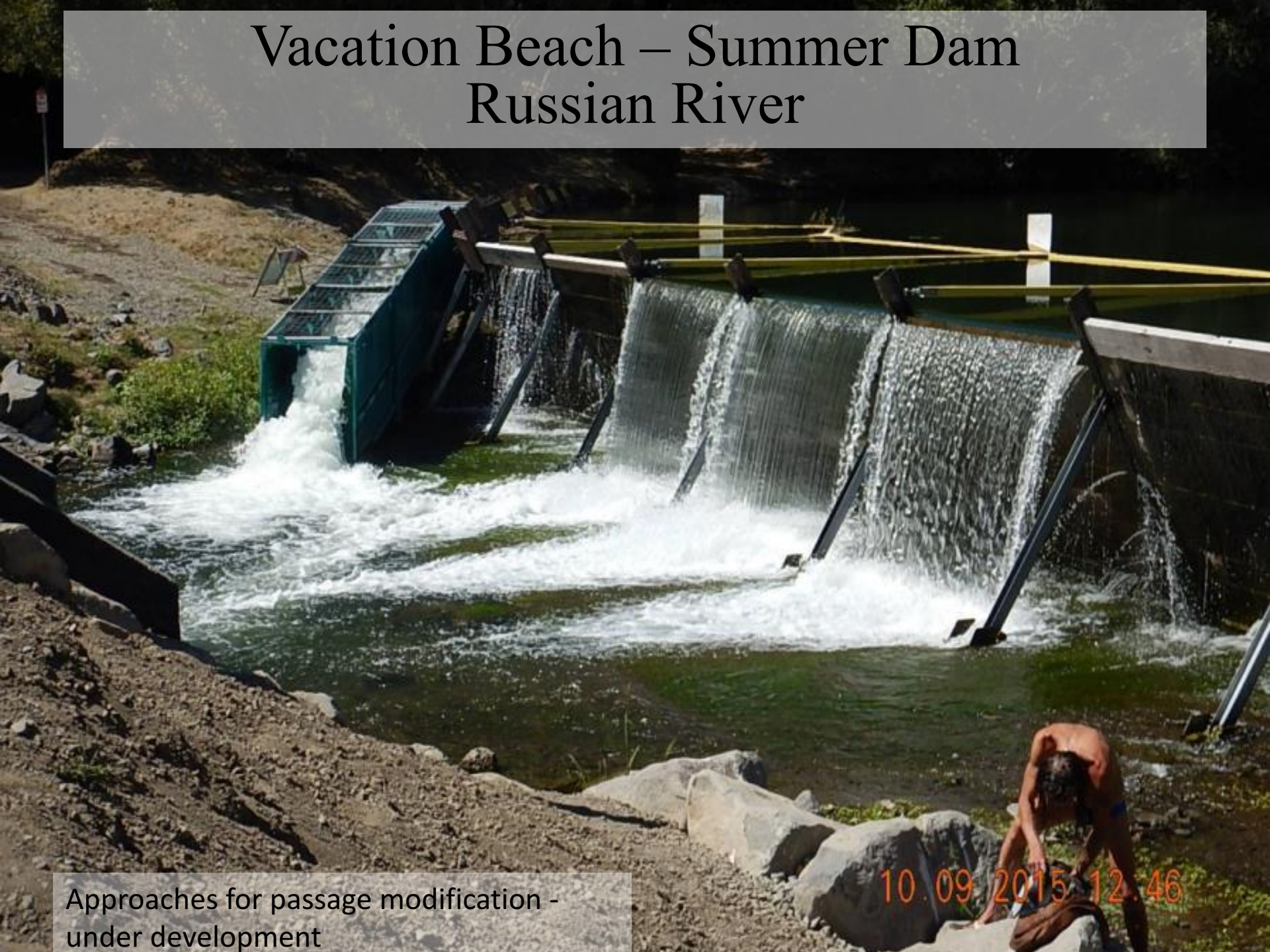
Velocity profiles decrease closer to the bottom

Vern Freeman Diversion, Santa Clara River

Passage fix in progress
in collaboration with United Water District



Vacation Beach – Summer Dam
Russian River



Approaches for passage modification - under development

Buckhorn Dam Spillway
Trinity River

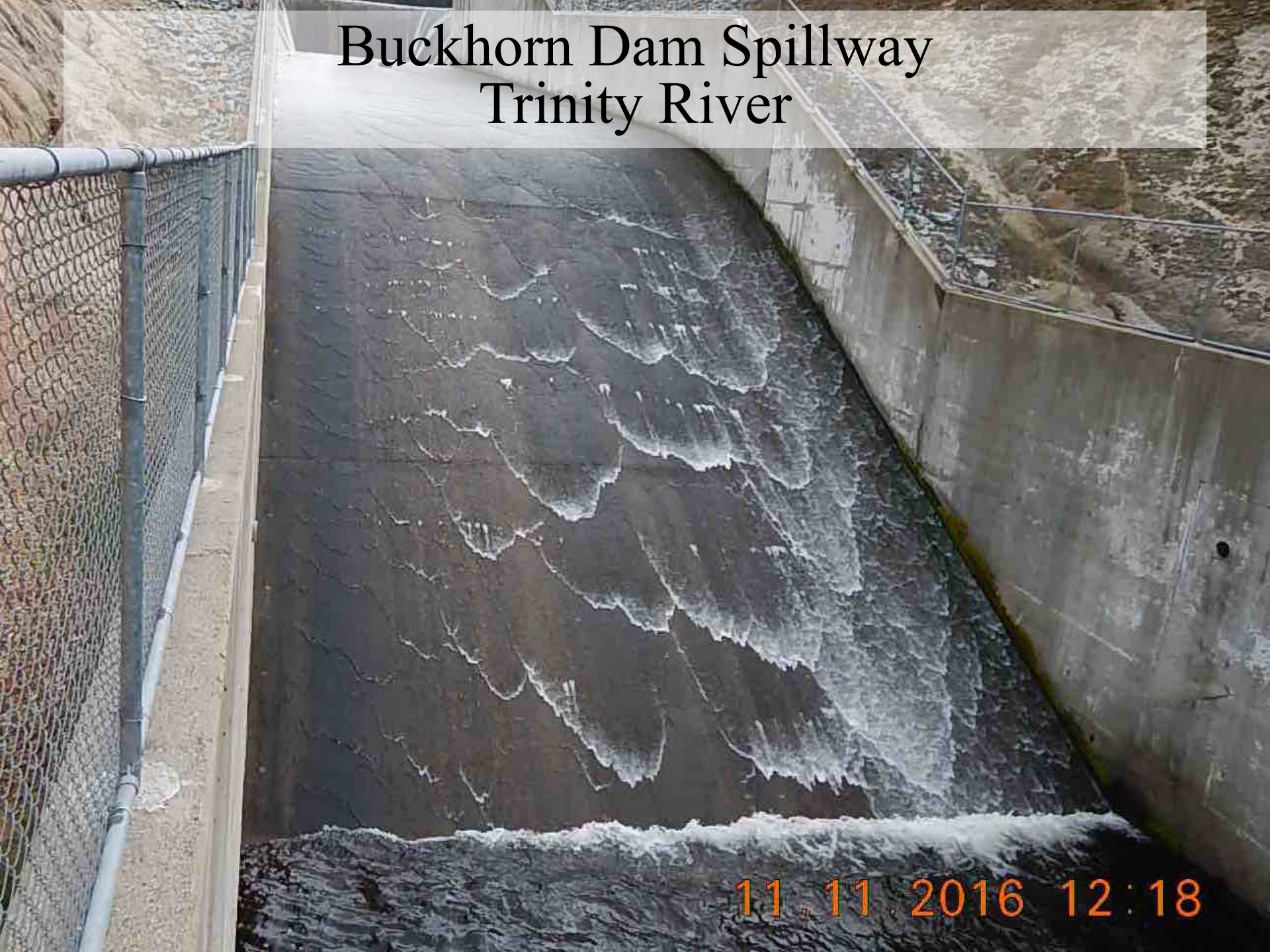


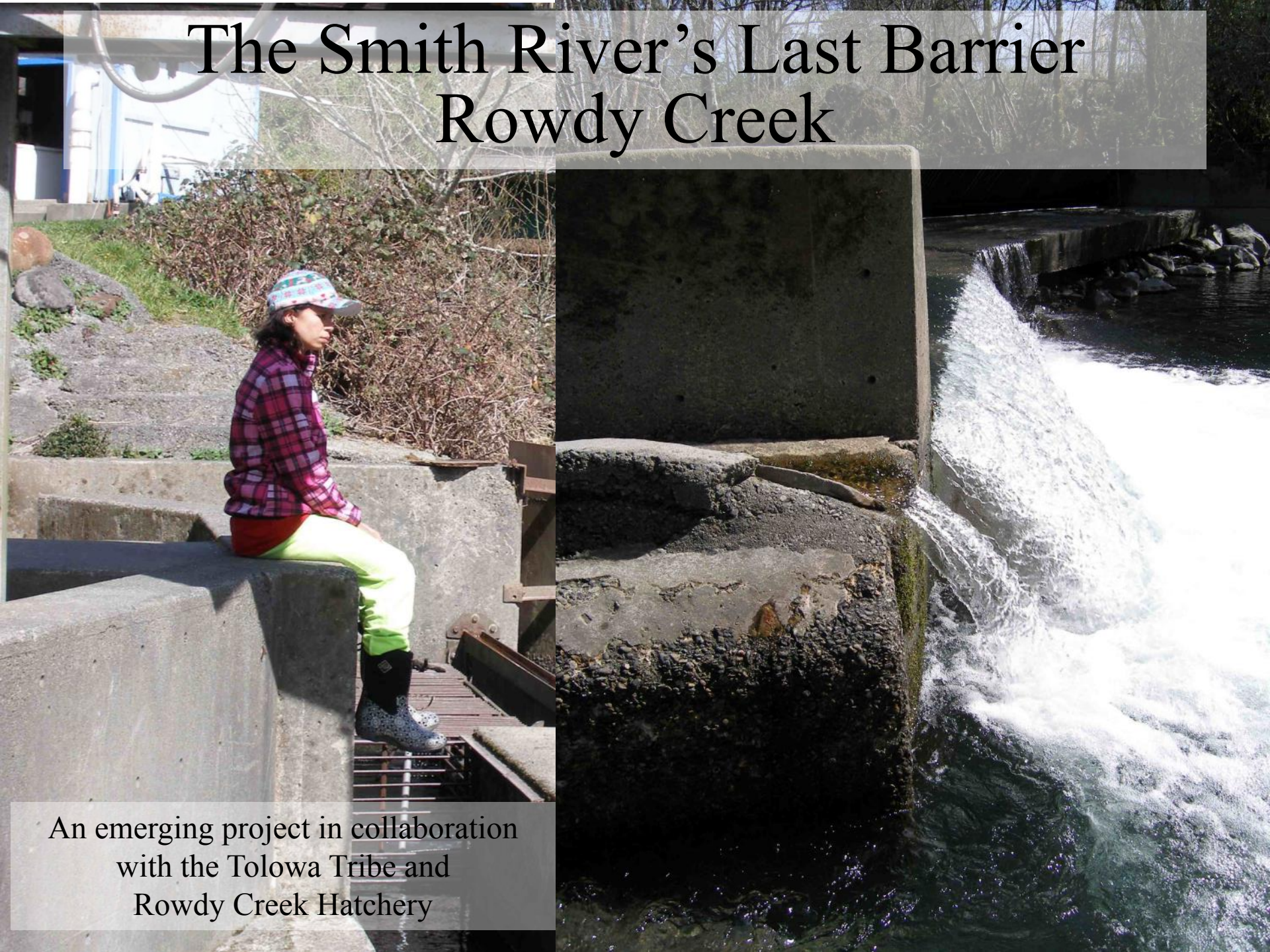
Photo credit - Roger Castillo (river watchdog)

Napa River

Before

After

The Smith River's Last Barrier
Rowdy Creek



An emerging project in collaboration
with the Tolowa Tribe and
Rowdy Creek Hatchery

Screen Efficiency and Implications for Losses of Lamprey Macrophthalmia at California's Largest Water Diversions.

- Damon H. Goodman, *U.S. Fish and Wildlife Service*
- Stewart B. Reid, *Western Fishes*
- Rene C. Reyes, Brandon J. Wu, Brent B. Bridges, *BOR, Tracy Fish Collection Facility*

- *North American Journal of Fisheries Management* (2017)

Evaluating Screen Efficiency

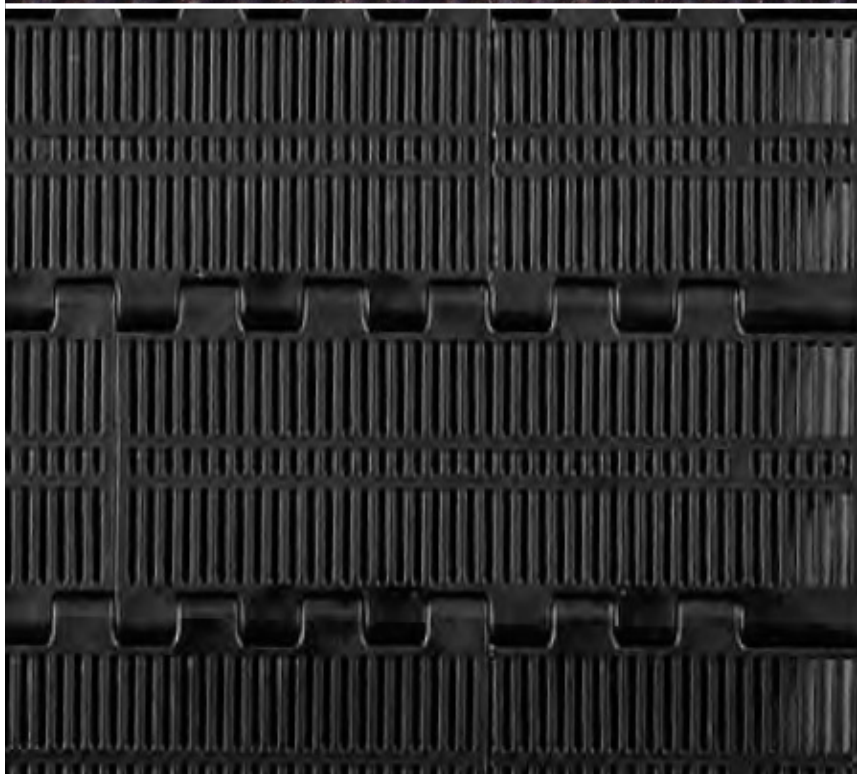
- Screen type (n = 2)
- Water velocity (n = 3)
- Day-time vs night-time
- Total of 60 trials
- 20 individuals per trial

- Whole system screen efficiency
  - Primary + secondary

- Entrainment estimates

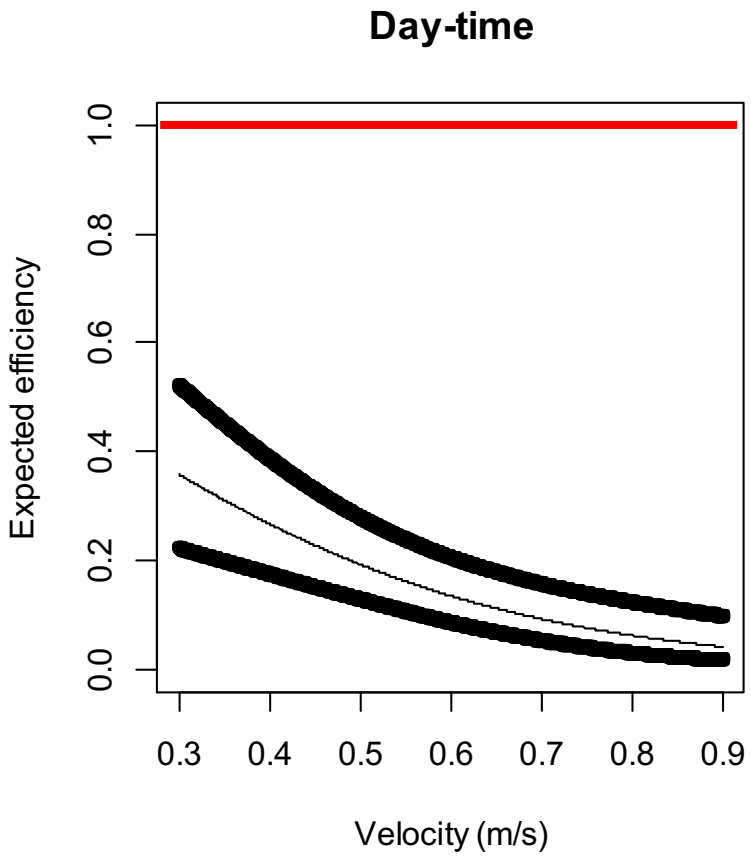
Louver

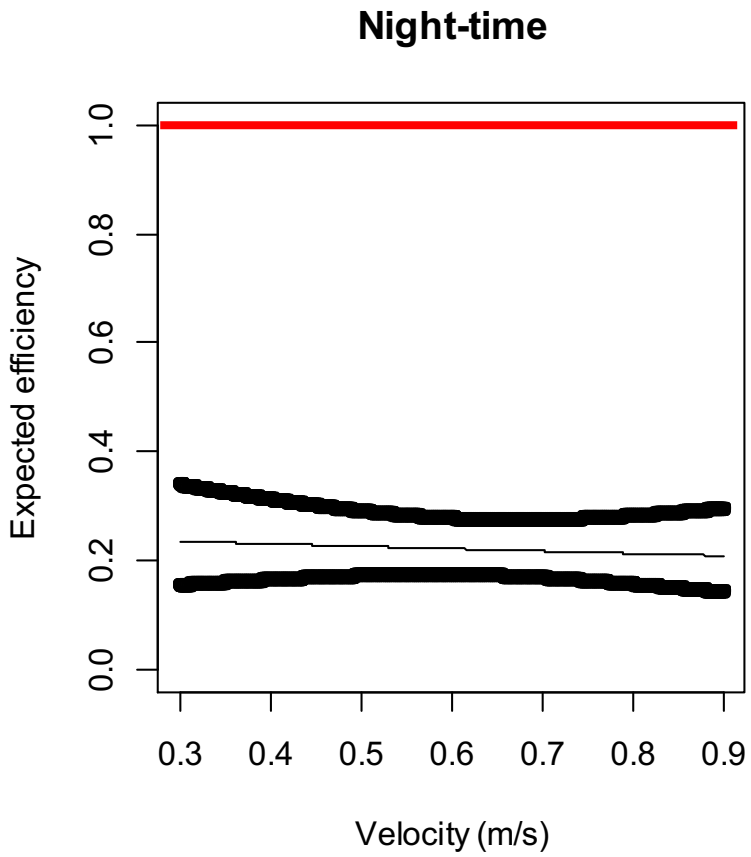
Vertical
Traveling
Screens



Efficiency

1. Louver
2. Interlock





Efficiency = 1 – Entrainment

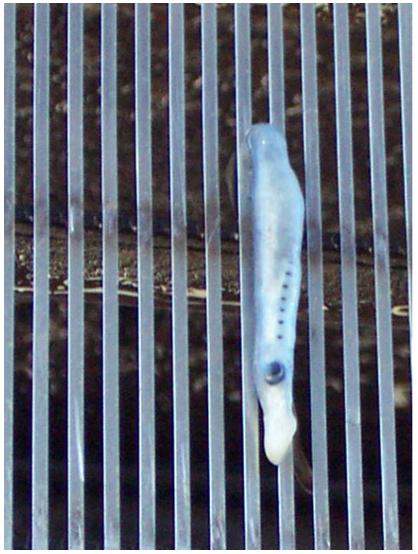
Binomial GLM

Providing Solutions
Emigration Cues and Diversion Management

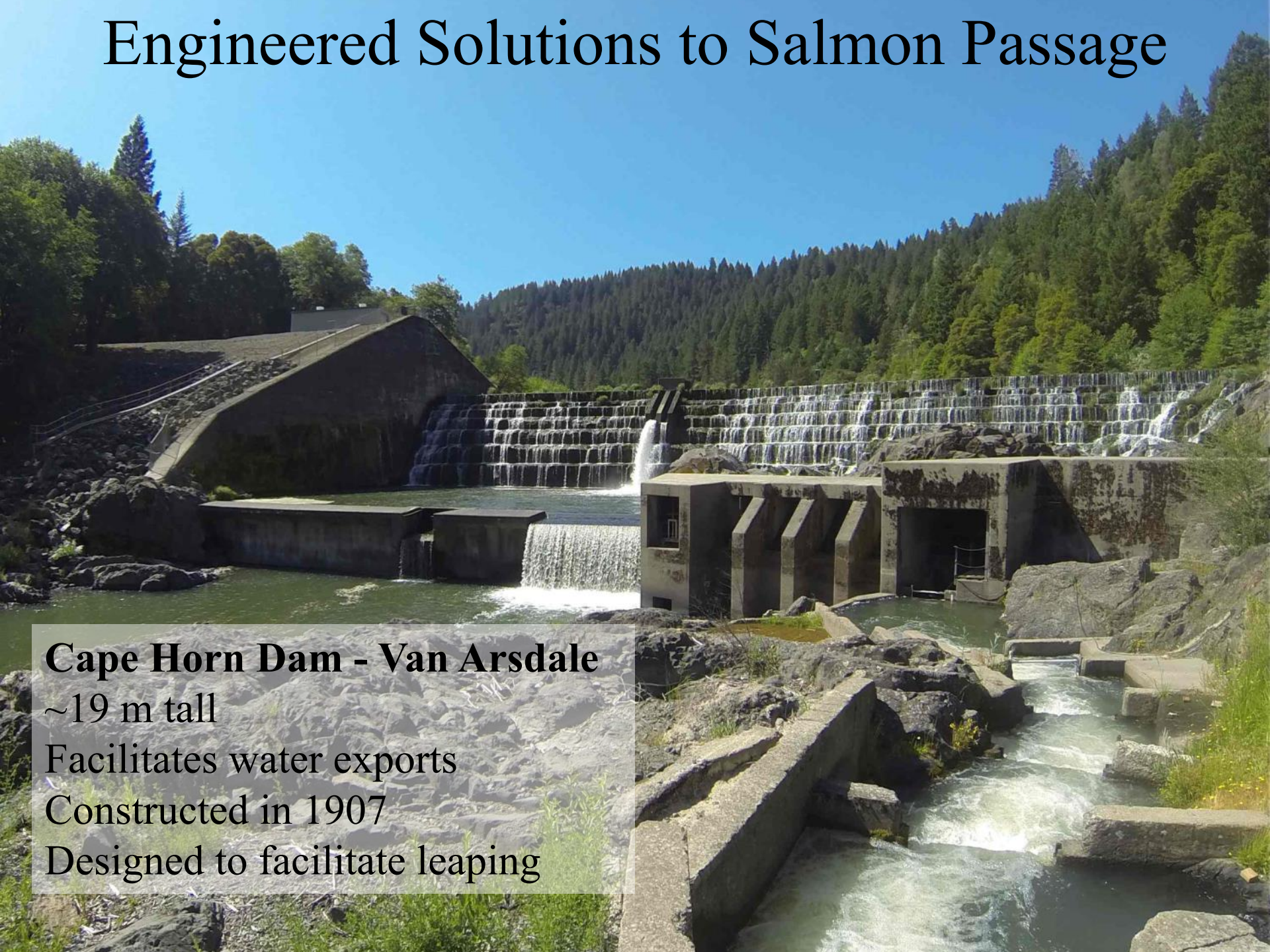
Curtail pumping during emigration events to avoid entrainment

The punctuated seaward migration of Pacific Lamprey (*Entosphenus tridentatus*): environmental cues and implications for streamflow management.
Damon H. Goodman, Stewart B. Reid, Nicholas A. Som, and Bill R. Poytress
Can. J. Fish. Aquat. Sci. (2015)

- Migrate based on rain or flow events
- Migrate in mass
- Migrate at night
- Lack swim bladder
- Follow the thalweg
- Hold in substrate cover



Engineered Solutions to Salmon Passage



Cape Horn Dam - Van Arsdale
~19 m tall
Facilitates water exports
Constructed in 1907
Designed to facilitate leaping

Salmonid monitoring since 1922