

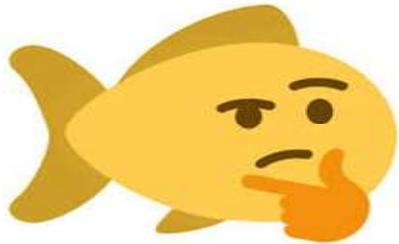
Investigating the Utility of Using Lamprey as a Surrogate of Ecosystem Health: Is a Prehistoric Fish the Canary of the Anthropocene?



Drs. Cynthia M. Le Doux-Bloom, Collin A. Eagles-Smith, and Michelle L. Hladik, and the Hoopa Valley Tribe







What are juveniles telling us about the water quality conditions that they and juvenile salmonids encounter during their FW residency on a histopath level?

Do juveniles bioaccumulate pesticides? Herbicides?

What could juveniles be trying to tell us across their distribution about the health of their natal watersheds?

Could this study link the Klamath Basin Tribes?

Could this study link all of the Tribes living within the Pacific Lamprey distribution?

Could this concept be used to braid Indigenous and Western Sciences to develop an evolved understanding for restoration and Tribal Trust Fish species recovery?





Dr. Collin Eagles-Smith, USGS



Dr. Michelle Hladik, USGS

Questions

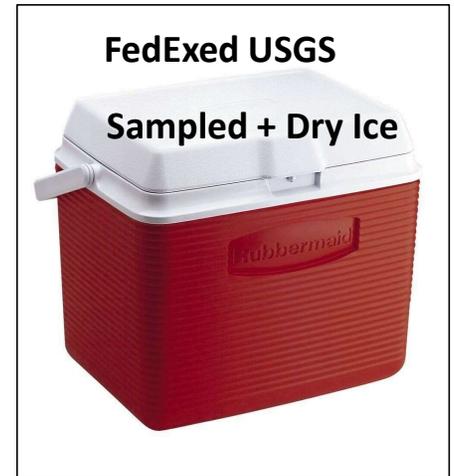
- Can juveniles indicate and monitor chemical stressors (e.g., pesticides)?
- Assess pre-dam removal chemical stressors (e.g., pesticides and Mercury [Hg])? conditions?
- Explore the use of juvenile tissues to evaluate larger aquatic ecosystem health relationships.
- Ditto with adult tissues...
- Investigate relationships between sample results, water and silt samples.



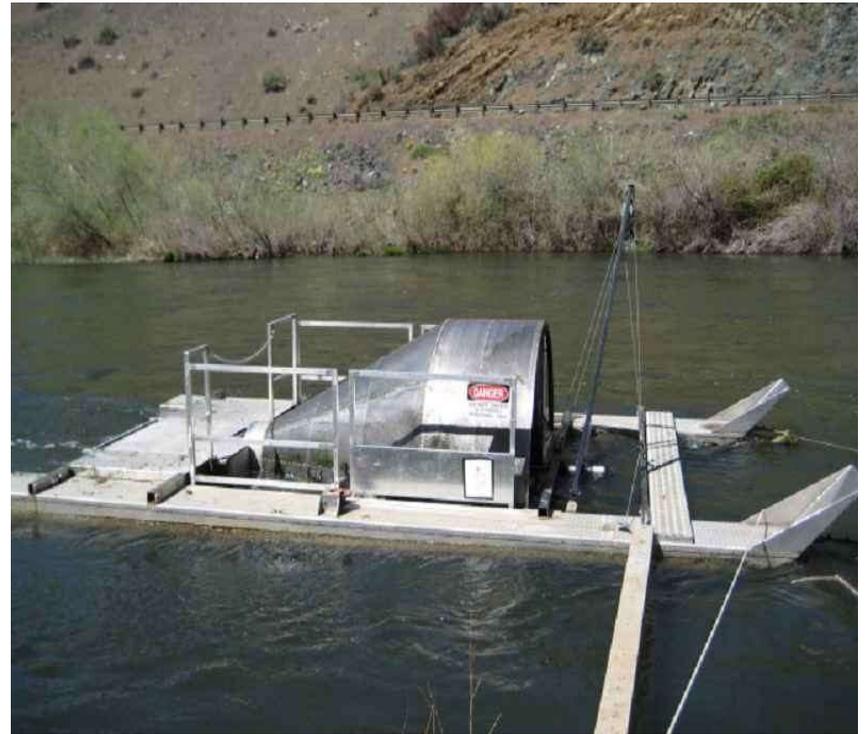
Sample Collection

125V, 3:1 Burst Rate
Slow Pulse (tickle charge) 4.0,
Duty Cycle 26.5%

Fast Pulse (Stun Charge) 30,
Duty Cycle 24.9%



Sample Collection



Pesticide Analyses (Dr. Michelle Hladik, USGS)

- Approximately 0.2 g of tissue was dried and homogenized with sodium sulfate.
- The samples were extracted with dichloromethane and acetone using an accelerated solvent extractor at 1500 psi and 100°C.
- Matrix removal was achieved with a solid phase extraction (Z-sep+ for tissue; carbon/alumina for sediment).
- Quantitation was done using both gas and liquid chromatography-tandem mass spectrometry.

Mercury Analyses (Dr. Collin Eagles-Smith, USGS)

- Each sample was freeze-dried and homogenized to a fine powder using a porcelain mortar and pestle.
- Total Hg was determined via cold-vapor atomic absorption following EPA method 7473 (U.S. Environmental Protection Agency, 2000) on a Nippon MA-3000 mercury analyzer.
- For MeHg, 2-10 mg of dried homogenate was digested in 3-4ml 30% nitric acid at 60°C overnight (~15 hours), ethylated with 1% sodium tetraethylborate, then analyzed via cold-vapor atomic fluorescence spectrometry on a MERX-M (Brooks Rand Instruments, Seattle, Washington, USA) automated methylmercury analyzer.

Pilot Study Draft Results - Pesticides

Adults are being exposed to pesticides including historically used insecticides such as DDT and its degradates, and two currently used pesticides, bifenthrin and pendimethalin.

Larvae are being exposed to the insecticide bifenthrin. Both bifenthrin and pendimethalin have a variety of uses, at the time their source is unknown.

Bifenthrin could be of concern for salmonid health and the uptake of bifenthrin into Larvae is evidence of this insecticide in the watershed.

Table 1. Ranges of Bifenthrin, Pendimethalin, DDD, DDE, and DDT in $\mu\text{g}/\text{kg}$ of adult and juvenile tissue samples by location in the Klamath Basin in 2018.

Site/ Sites Sampled	Mo/Yr	Method	Bifenthrin	Pendimethalin	DDD	DDE	DDT
Trinity R (12) ADULTS	Mar 18	DMT					
Trinity R (6)	Apr 18	E-Fish					
Mill Cr (6)	Apr 18	E-Fish					
Supply Cr (2)	Apr 18	E-Fish					

Pilot Study Results – Hg and MeHg

Nearly half of all tissue samples exceeded the 0.3 µg/g (micrograms per gram) wet-weight mercury (Hg) concentration set for human health by the U.S. EPA.

Nearly all exceeded the suggested benchmark criteria of 0.2 µg/g wet weight for the protection of fish-eating birds and wildlife.

Immobilization of Hg in silt could be of concern for aquatic and nearshore organism health downstream during dam removal flushing and subsequent silt resettling events.

Hg et al. 2012 – linking adolescent MeHg consumption with diabetes.

Table 2. Ranges of Total Hg and Methyl Hg $\mu\text{g/g}$ of adult and larvae tissue samples by location in the Klamath Basin in 2018.

Site/n	Mo/Yr	Method	THg	MeHg
Klamath (3)	Jan 18	Creel		
Trinity R (10)	Mar 18	DMT		
Trinity R (22)	Apr 18	E-Fish		
Mill Cr (11)	Apr 18	E-Fish		

Summary

Juvenile lamprey have utility as pesticide presence indicators and can help identify chemical stressors effecting ecosystem health.

Juvenile lamprey can be used to identify Hg levels (Bettaso and Goodman 2008), and become a useful monitoring tool.

Adult tissues provide valuable insight into larger aquatic ecosystem-wide (Riverine-Estuarine-Marine) health and impacts on human health.

Next Steps

- Repeated 2019
- US BOR Funded for 2020-2021 track pesticides in Hoopa Valley Tribe Reservation water sources (Trinity River and three tributaries)
- Discussions on Inter-Tribal Science coordination of implementing larval Pacific Lamprey across Tribes in CA –AK to assess watershed health. Initiated this year with CRITFC.

Thank you, Hoopa Valley Tribe & USGS

HVT Fisheries Department provided field staff, equipment, and paid Le Doux-Bloom for sample collection, processing and shipping while an employee. USGS processed and analyzed samples. HVT TEPA provided GIS and on-going graphic expertise. HVT Fisheries collected samples.

This pilot study was conducted under CDFW Scientific Collecting Permit #11733, Le Doux-Bloom and Hoopa Valley Tribe

Dr. Cynthia Le Doux-Bloom
Humboldt State – Fisheries
CML136@Humboldt.edu

