eDNA for Pacific Lamprey Conservation

Kellie Carim, Mike Young, Dan Isaak, Dave Nagel, Kevin McKelvey, Mike Schwartz, and Brett Roper
Lack of information is a primary challenge for Pacific lamprey conservation.

- Presence
- Distribution
- Abundance
What is Environmental DNA?

DNA released from an organism into the surrounding environment
Benefits of eDNA Sampling Techniques

More sensitive and efficient
Non invasive and species specific
Abundance/biomass can be loosely estimated
Samples can be reanalyzed for additional species
Easy to collect ➔ citizen science
eDNA is already being used for Pacific lamprey detection:

RESEARCH ARTICLE

A Noninvasive Tool to Assess the Distribution of Pacific Lamprey (*Entosphenus tridentatus*) in the Columbia River Basin


United States Department of Agriculture, Forest Service, National Genomics Center for Wildlife and Fish Conservation, Rocky Mountain Research Station, Missoula, Montana, United States of America
> 350 eDNA samples analyzed for Pacific lamprey at the NGC since June 2016

n=377 samples
eDNA Monitoring of Translocation Efforts

Objectives

1) Monitor Pacific lamprey after translocation

2) Improve understanding of eDNA detections in a larger river system
Pacific lamprey reintroductions in the Wenatchee River basin by the Yakama Nation Fisheries Program

Adults released in March and May 2016

Grote & Carim 2017
eDNA samples collected along both banks in areas of known presence and at translocation sites
eDNA Results: Adult lamprey held near reintroduction sites; Had not begun spawning migration in June
## Results: Paired Bank Samples

Single bank sampling may be sufficient for detection of adults

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<th>Latitude</th>
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Data Needs and Next Steps

What is the best sampling protocol for detecting ammocoetes?

Where do Pacific lamprey currently exist on the landscape?
Basin-wide Lamprey Inventory and Monitoring Project

BLIMP
2018 BLIMP Objectives

What is the best sampling protocol for detecting ammocoetes?

Where do Pacific lamprey currently exist on the landscape?
2018 BLIMP Objectives

1) Where do Pacific lamprey currently exist on the landscape?

Model lamprey occurrence within the interior Columbia River basin and validate with eDNA
eDNA and Bull Trout Inventory
Collaborative effort with > 30 state, federal and tribal partners
eDNA and Bull Trout Inventory

Collaborative effort with > 30 state, federal and tribal partners

1) Identify suitable habitat

2) Test model with existing survey data
eDNA and Bull Trout Inventory
Collaborative effort with > 30 state, federal and tribal partners

1) Identify suitable habitat
2) Test model with existing survey data
3) Sample suitable habitat with eDNA

Detected
Not detected

2015 and 2016 Sampling Results
Modeling Pacific Lamprey Occurrence

Queried the Pacific Lamprey Data Clearinghouse for Pacific lamprey survey data
Modeling Pacific Lamprey Occurrence

Identified habitat variables that predict occurrence:

- Elevation
- Distance
- Mean August Temperature
- Mean annual flow
- Reach slope

![NorWeST Stream Temp](image)

![NHDPlus+](image)

![Mean annual flow graph](image)
Lamprey Data Summaries:

NorWeST mean August temperature vs. Lamprey Presence/Absence
Lamprey Data Summaries:

![Graphs showing relationship between NorWeST mean August temperature and Lamprey presence/absence, as well as VIC Mean Annual Flow (cfs) and Lamprey presence/absence.](image)
Lamprey Data Summaries:

NorWeST mean August temperature

VIC Mean Annual Flow (cfs)

Reach slope
Lamprey are unlikely to occur in cold, steep streams.
Modeling Pacific Lamprey Occurrence

Buffer model to reduce underestimating suitable habitat
Modeling Pacific Lamprey Occurrence

BLIMP Model correctly predicted lamprey occurrence at 82% of sites (n=345) in the interior Columbia River basin.

How can we account for the 18% error rate?
Modeling Pacific Lamprey Occurrence

Overlaid information on Chinook salmon:
- Abundant data on Chinook occupancy
- Similar distribution to lamprey, less broad than steelhead
Interior Columbia Basin
Pacific Lamprey Survey Sites and Probability of Occurrence
Sampling eDNA design:
- Every ~20km in major rivers (4 code HUC)
- Mouths of all tributaries with non-zero probability of lamprey occurrence
- Any additional tributaries with Chinook salmon occurrence
Pacific Lamprey Sampling Locations- 2018
→ 49 existing samples at NGC
Pacific Lamprey Sampling Locations- 2018
n=248 locations
2) What is the best sampling protocol for detecting ammocoetes?

Pair eDNA with density information to understand detection probabilities and fine scale sampling protocols.
Understanding eDNA Detection of Ammocoetes

Best information on presence of ammocoetes is in translocation areas

Nez Perce Tribe translocation and monitoring provides an ideal framework
Understanding eDNA Detection of Ammocoetes

Translocations in Asotin, Lolo and Newsome Creeks:
Focal streams with monitoring data and mapped Type I habitat
Methods:
- Intensive eDNA sampling at 1 km intervals in August (adults absent)
- Compare detections and DNA quantity with fine scale information on Type I habitat; ammocoete distribution and density
Understanding eDNA Detection of Ammocoetes

Outcome
An understanding of detection probabilities for larval lamprey
- Distance from fish
- Density of fish
- Type I habitat
2018 BLIMP Objectives

1) Model lamprey occurrence within the interior Columbia River basin and validate with eDNA

2) Pair eDNA with density information to understand detection probabilities and fine scale sampling protocols
A couple notes...

- eDNA samples can be archived and analyzed for additional species at a reduced cost.
- eDNA marker for *Lampetra* is in development
- Objectives 1 and 2 results will be ready this year
We need your help!

1) Help us prioritize where to sample next
   - Remaining funds for ~10 more 4 HUC basins

2) Collect samples at designated sampling locations

3) Help us spread these funds further
   - Cost matching on current sample analysis
   - Use BLIMP as a match on grants/proposals

QUESTIONS?