

eDNA for Pacific Lamprey Conservation



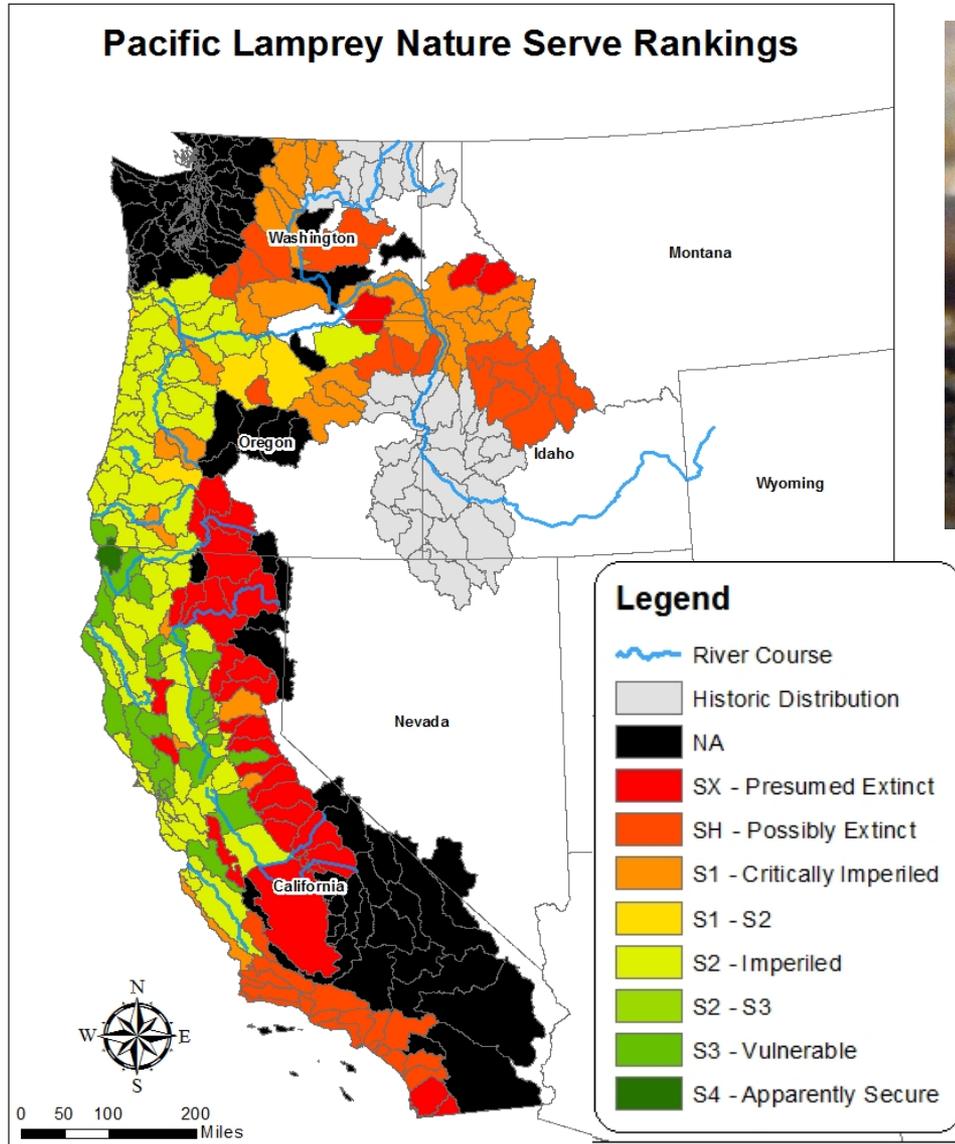
Kellie Carim, Mike Young, Dan Isaak, Dave Nagel,
Kevin McKelvey, Mike Schwartz, and Brett Roper



National Genomics Center
— FOR WILDLIFE AND FISH CONSERVATION —



Lack of information is a primary challenge for Pacific lamprey conservation



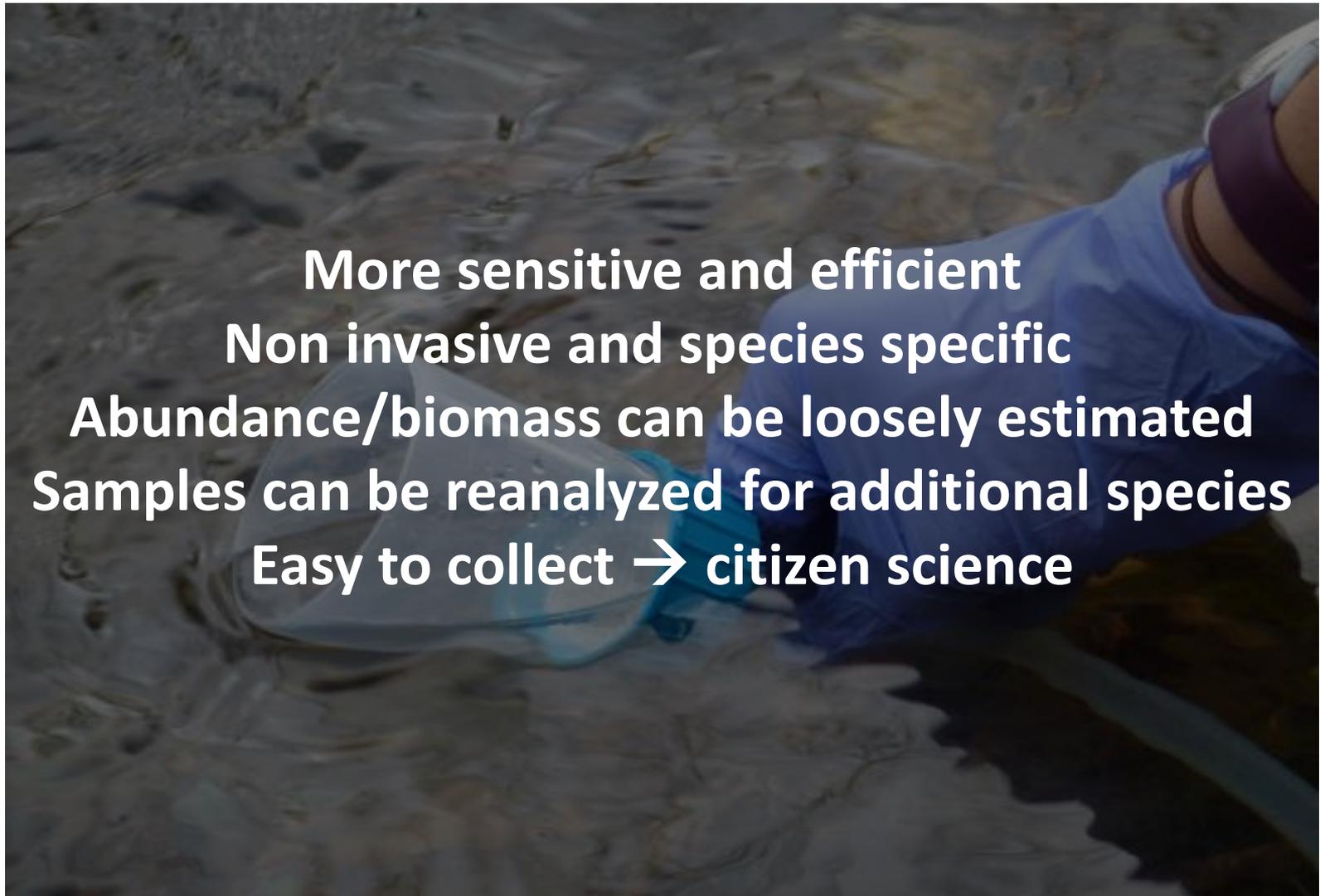
**-Presence
-Distribution
-Abundance**

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:



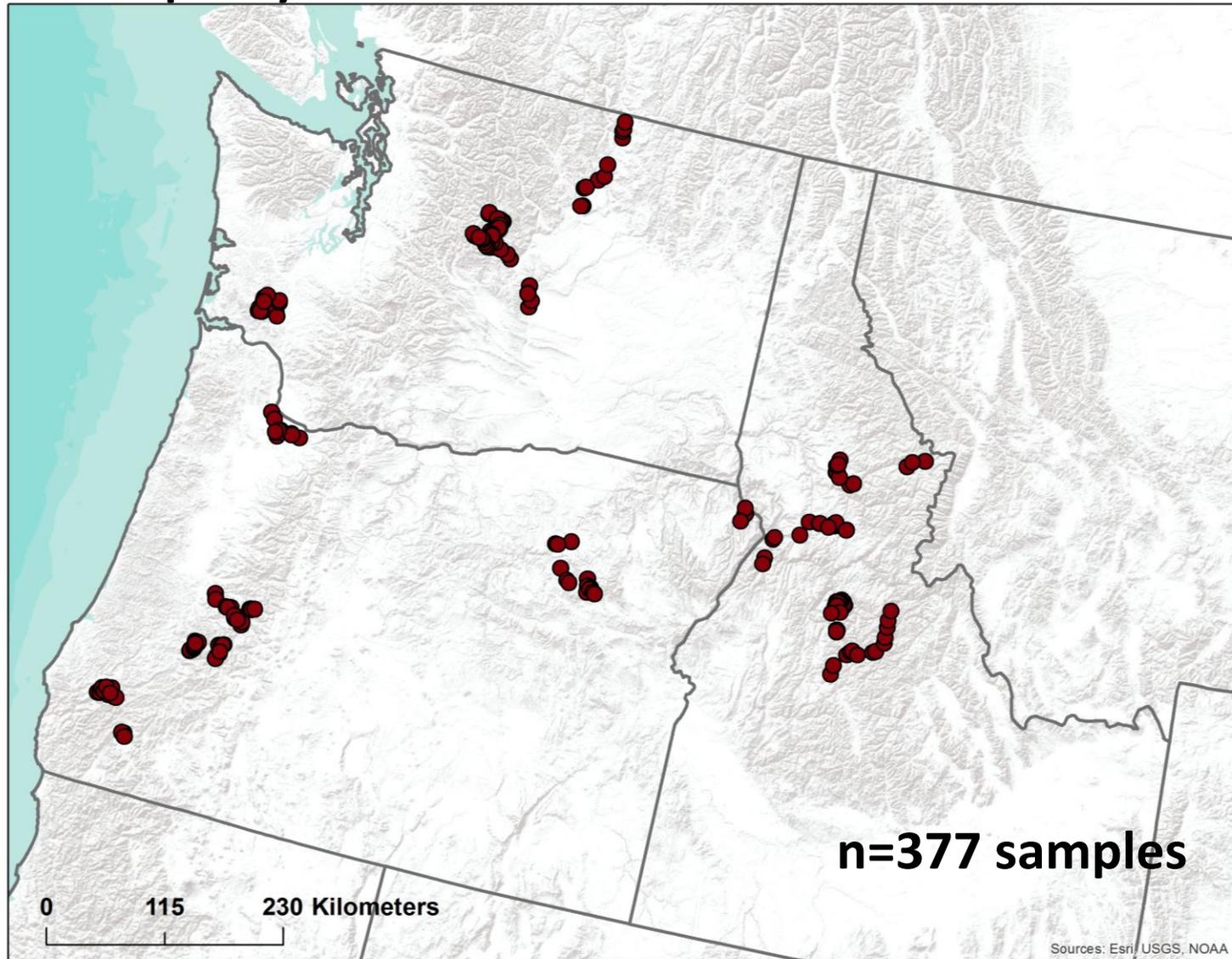
RESEARCH ARTICLE

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

Kellie J. Carim*[☉], J. Caleb Dysthe[☉], Michael K. Young, Kevin S. McKelvey, Michael K. Schwartz

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



eDNA Monitoring of Translocation Efforts

U.S. Fish and Wildlife Service

Using eDNA Sampling to Detect Pacific
Lamprey in a Large River:
2016 Wenatchee River Pilot Study

Objectives

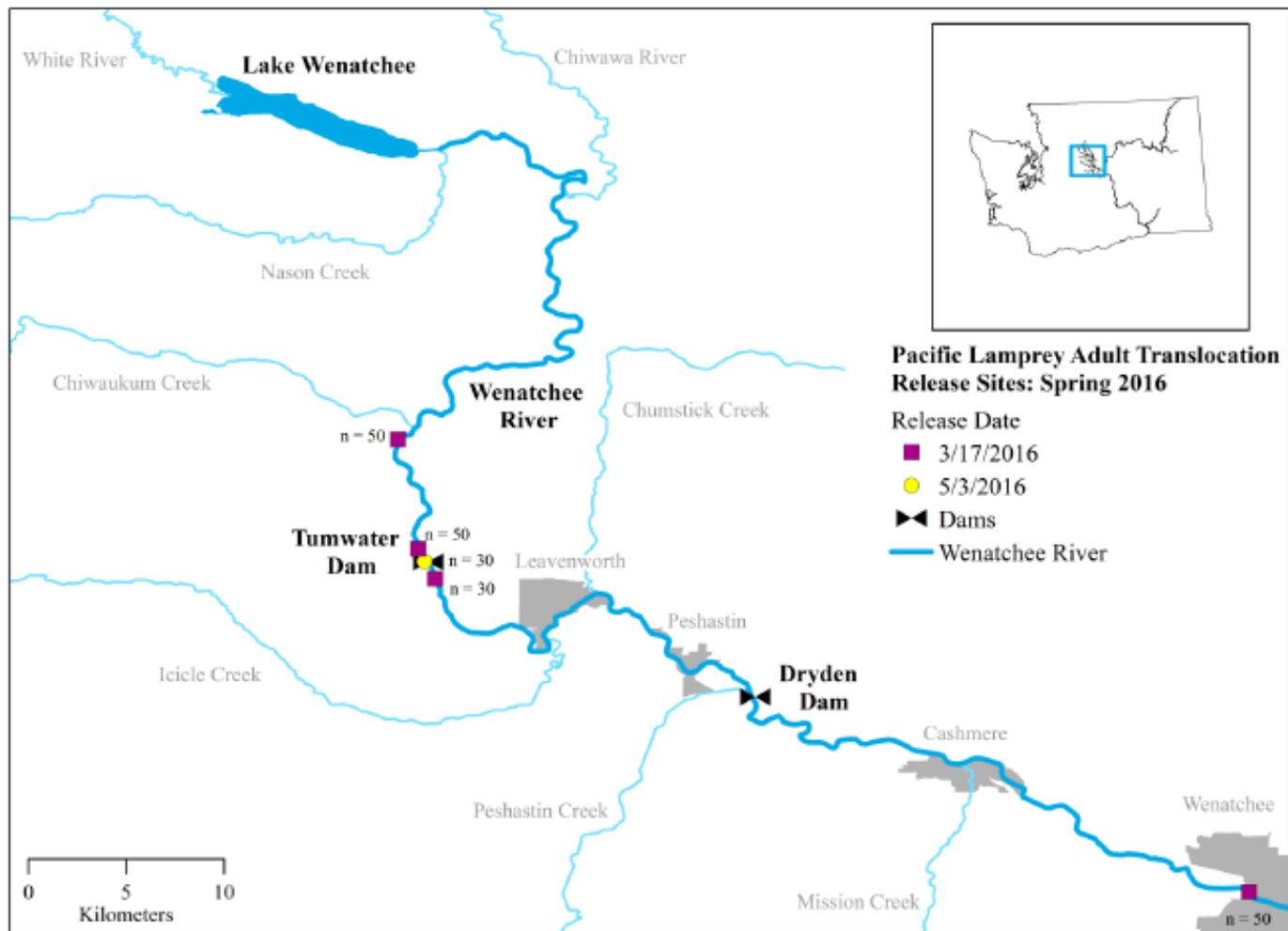
- 1) Monitor Pacific lamprey after translocation
- 2) Improve understanding of eDNA detections in a larger river system



Ann B. Grote
U.S. Fish and Wildlife Service
Mid-Columbia Fish and Wildlife Conservation Office
Leavenworth, WA 98826

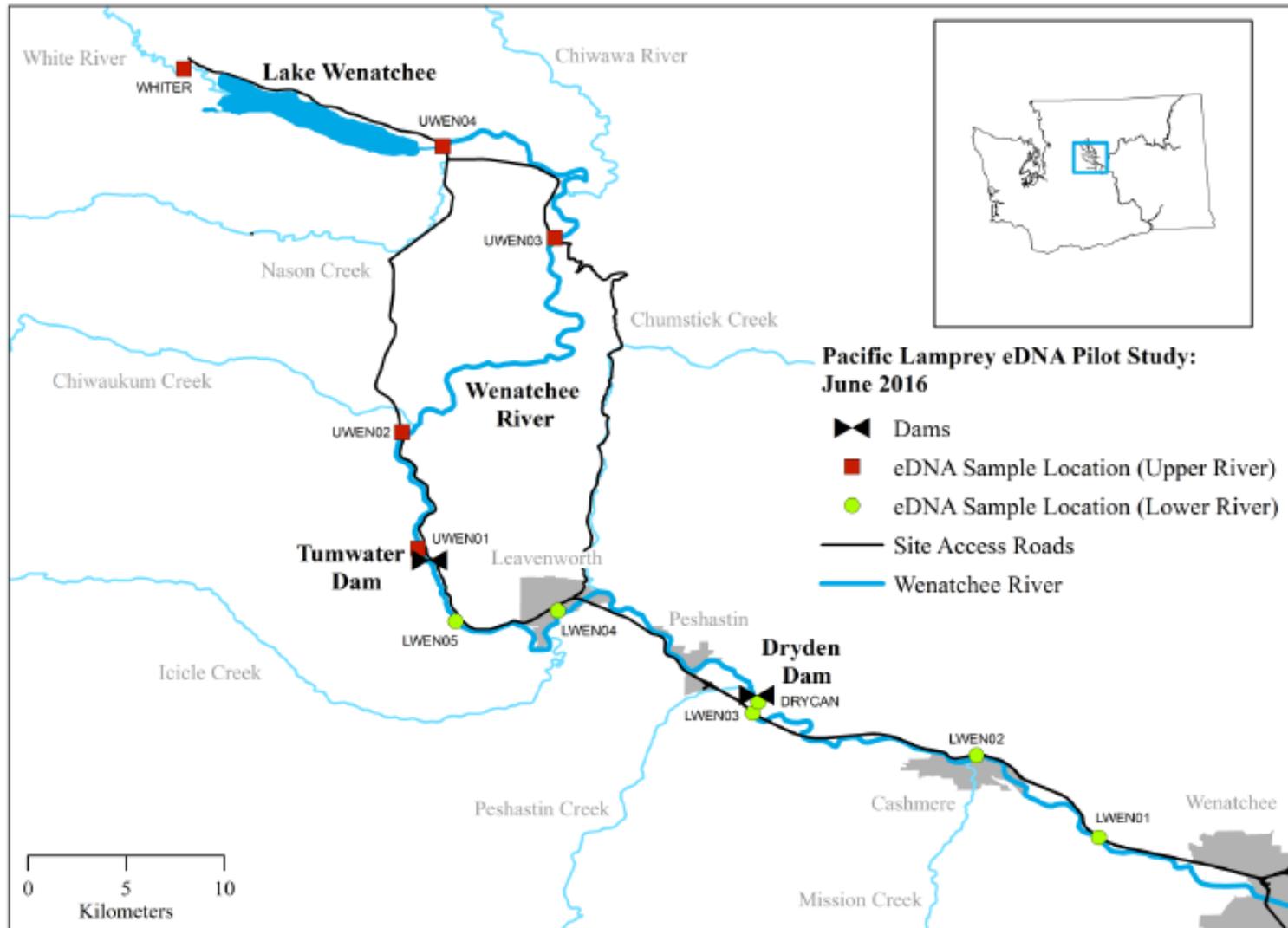
Kellie J. Carim
U.S.D.A. Forest Service
National Genomics Center for Wildlife and Fish Conservation
Missoula, MT 59801

Pacific lamprey reintroductions in the Wenatchee River basin by the Yakama Nation Fisheries Program

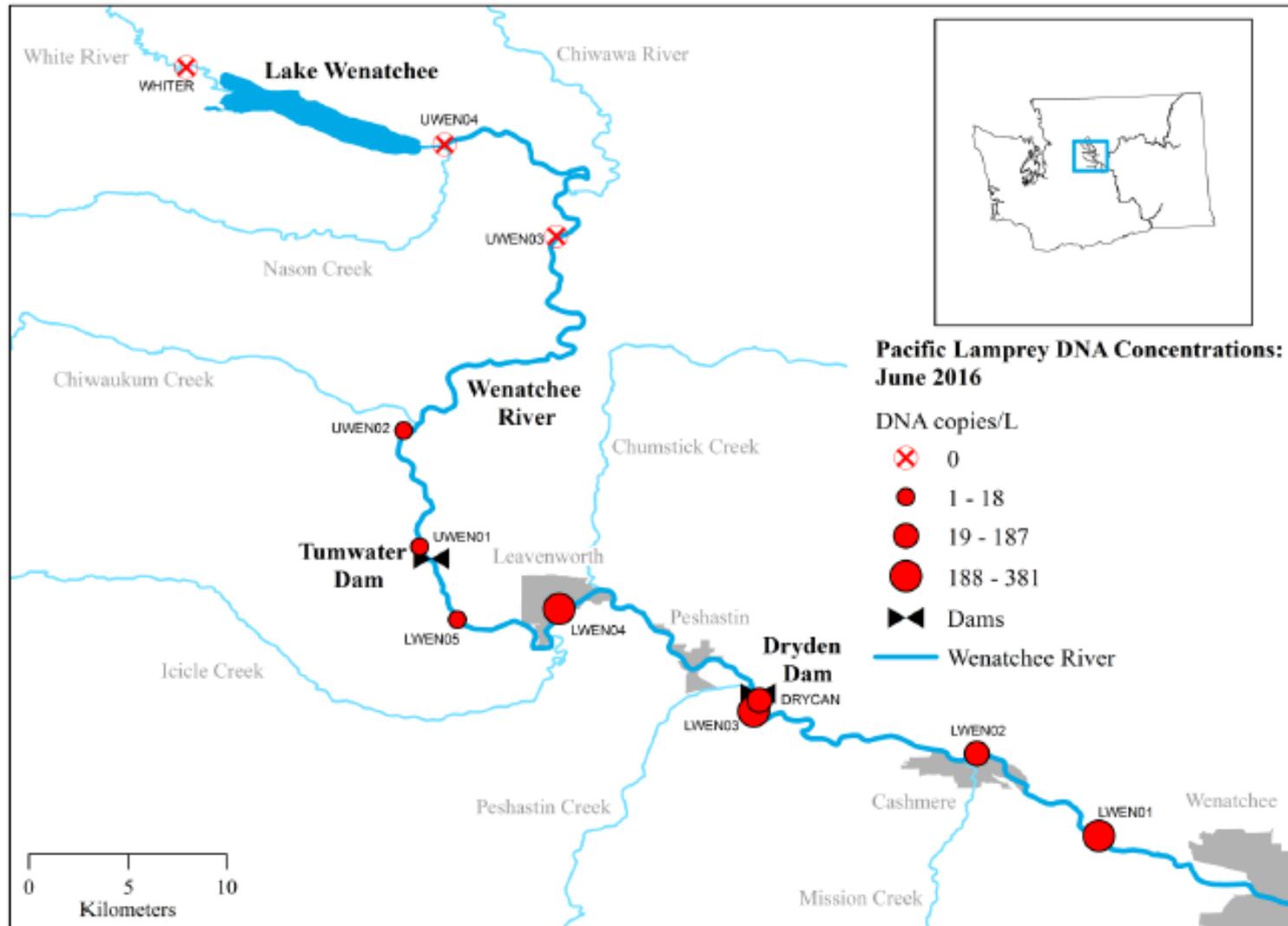


Adults released in March and May 2016

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

Stream Reach	Site ID	Collection Date	Latitude	Longitude	DNA copies/L
Wenatchee River downstream of Tumwater Dam	LWEN01LB	6/13/2016	47.48745	-120.41376	132
	LWEN01RB	6/13/2016	47.48715	-120.41444	134
	LWEN02LB	6/14/2016	47.52584	-120.46994	68
	LWEN02RB	6/14/2016	47.52504	-120.47003	119
	LWEN03LB	6/14/2016	47.54554	-120.57269	62
	LWEN03RB	6/14/2016	47.45612	-120.57324	210
	LWEN04LB	6/14/2016	47.59326	-120.66212	41
	LWEN04RB	6/14/2016	47.59319	-120.66229	340
	LWEN05LB	6/15/2016	47.58827	-120.70908	5
	LWEN05RB	6/15/2016	47.58802	-120.70930	9
Wenatchee River upstream of Tumwater Dam	UWEN01LB	6/15/2016	47.62299	-120.72577	7
	UWEN01RB	6/15/2016	47.62223	-120.72639	11
	UWEN02LB	6/15/2016	47.67585	-120.77381	2
	UWEN02RB	6/15/2016	47.67646	-120.73376	14
	UWEN03LB	6/17/2016	47.76669	-120.66264	0
	UWEN03RB	6/17/2016	47.76696	-120.66344	0
	UWEN04LB	6/17/2016	47.81015	-120.71546	0
	UWEN04RB	6/17/2016	47.80973	-120.71503	0
Dryden Canal	WHITER01	6/17/2016	47.84580	-120.83384	0
White River	DRYCAN	6/21/2016	47.55069	-120.57010	106

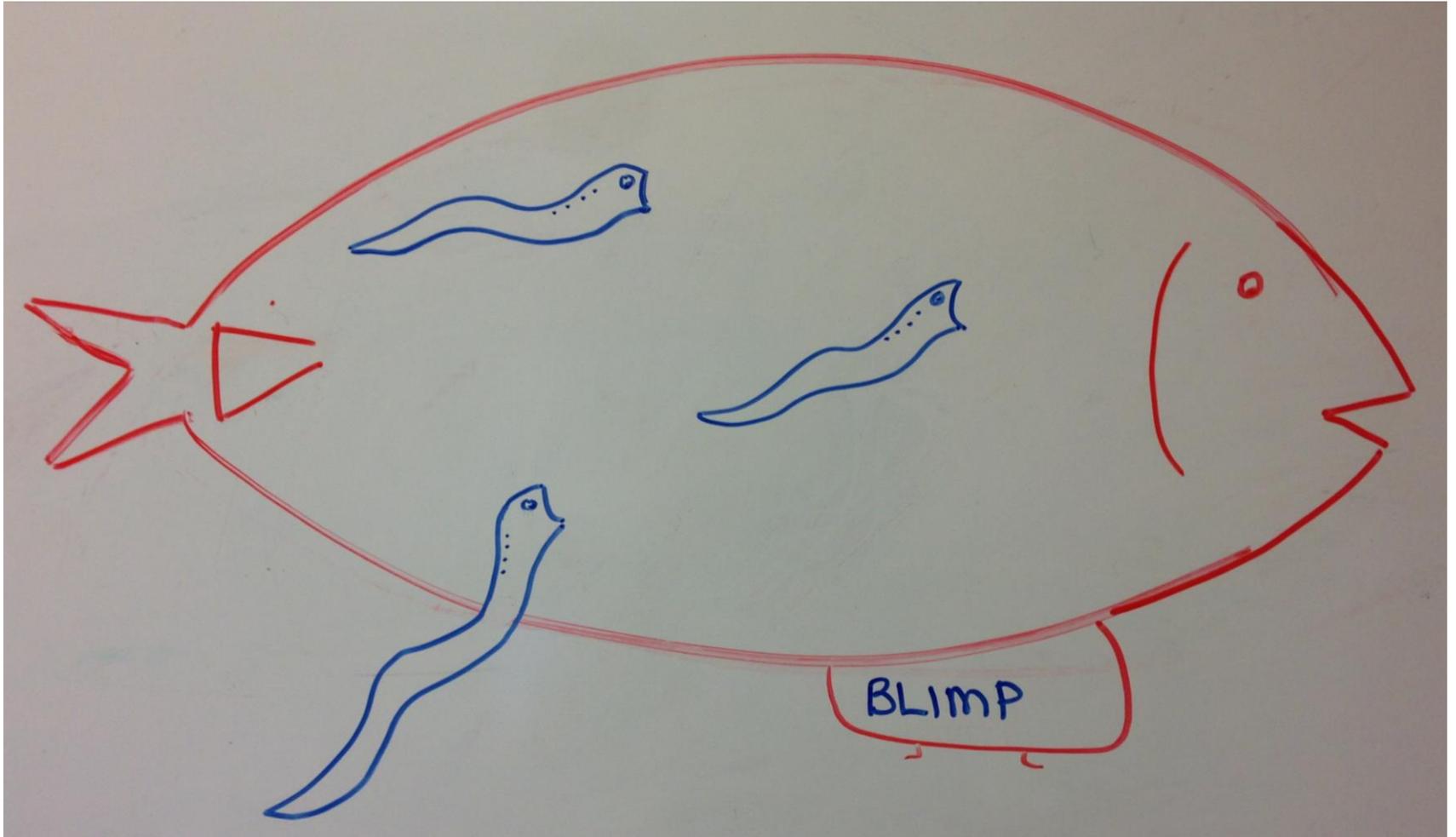
Data Needs and Next Steps

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



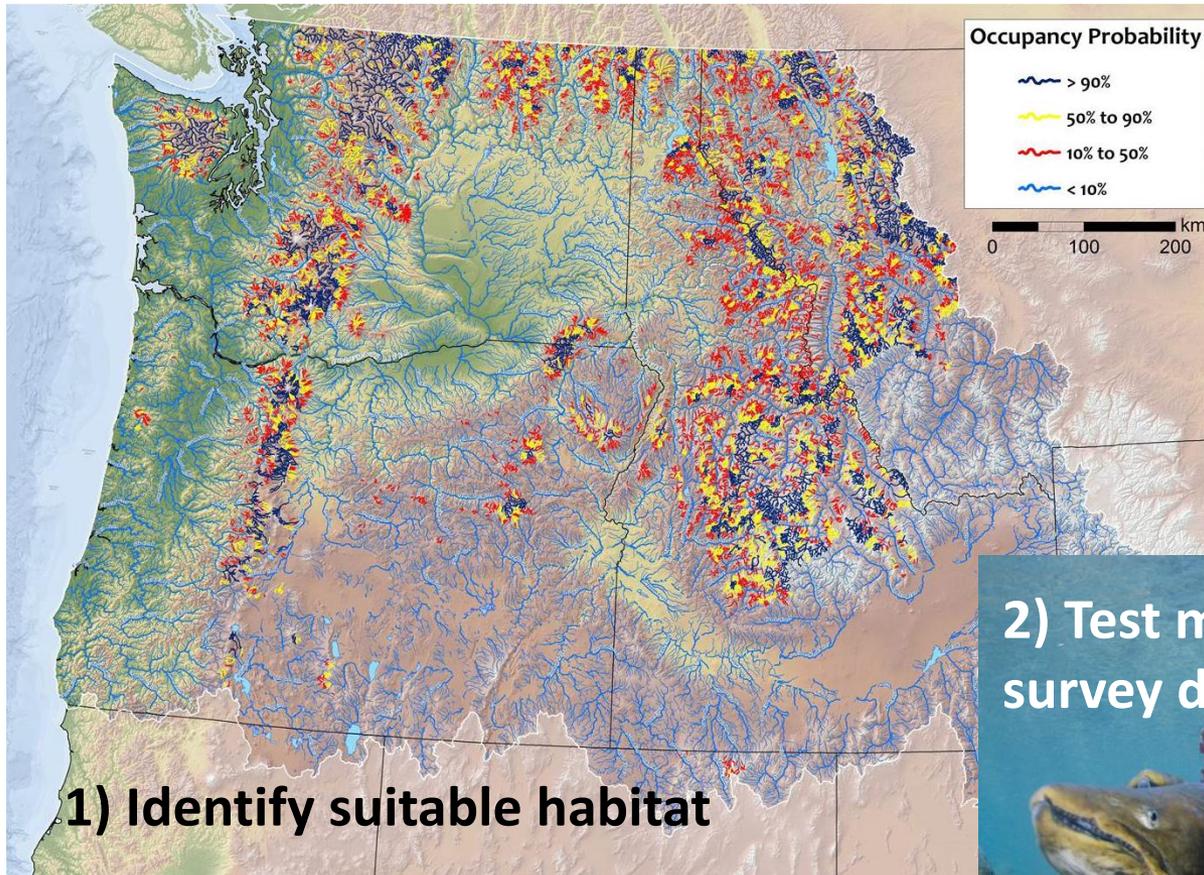
eDNA and Bull Trout Inventory

Collaborative effort with > 30 state, federal and tribal partners



eDNA and Bull Trout Inventory

Collaborative effort with > 30 state, federal and tribal partners

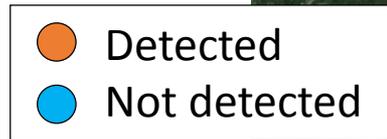
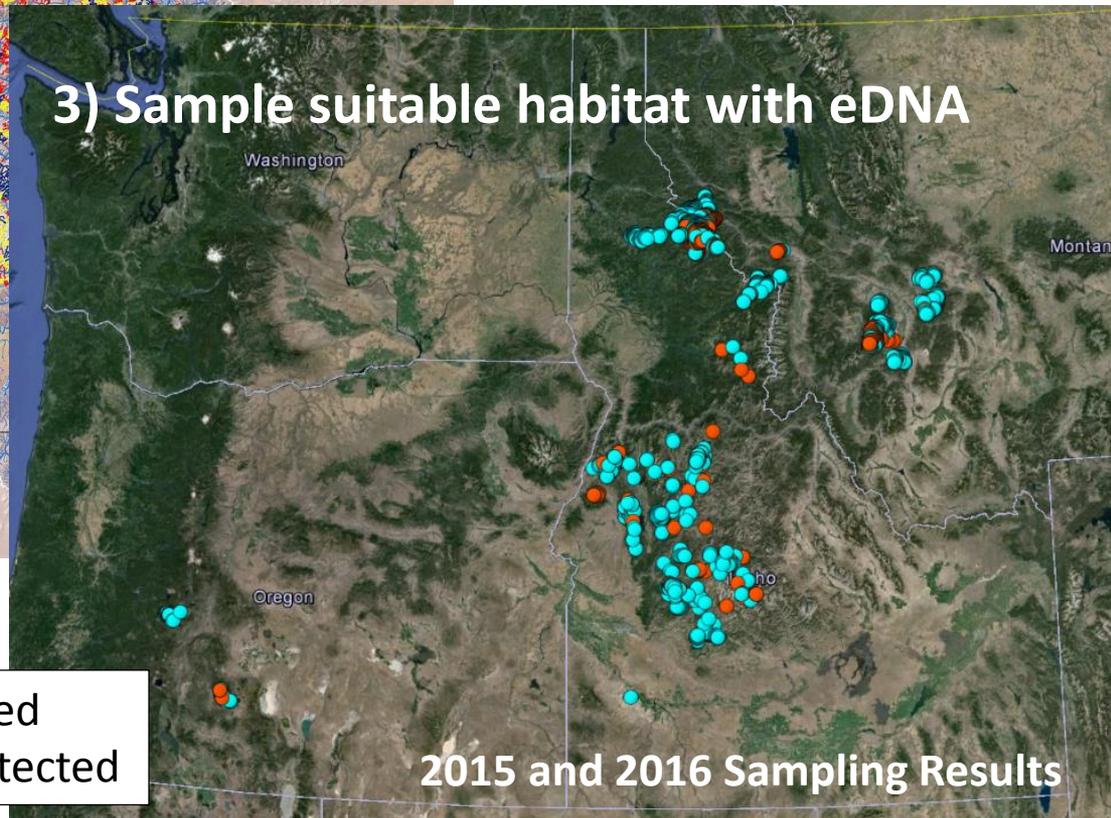
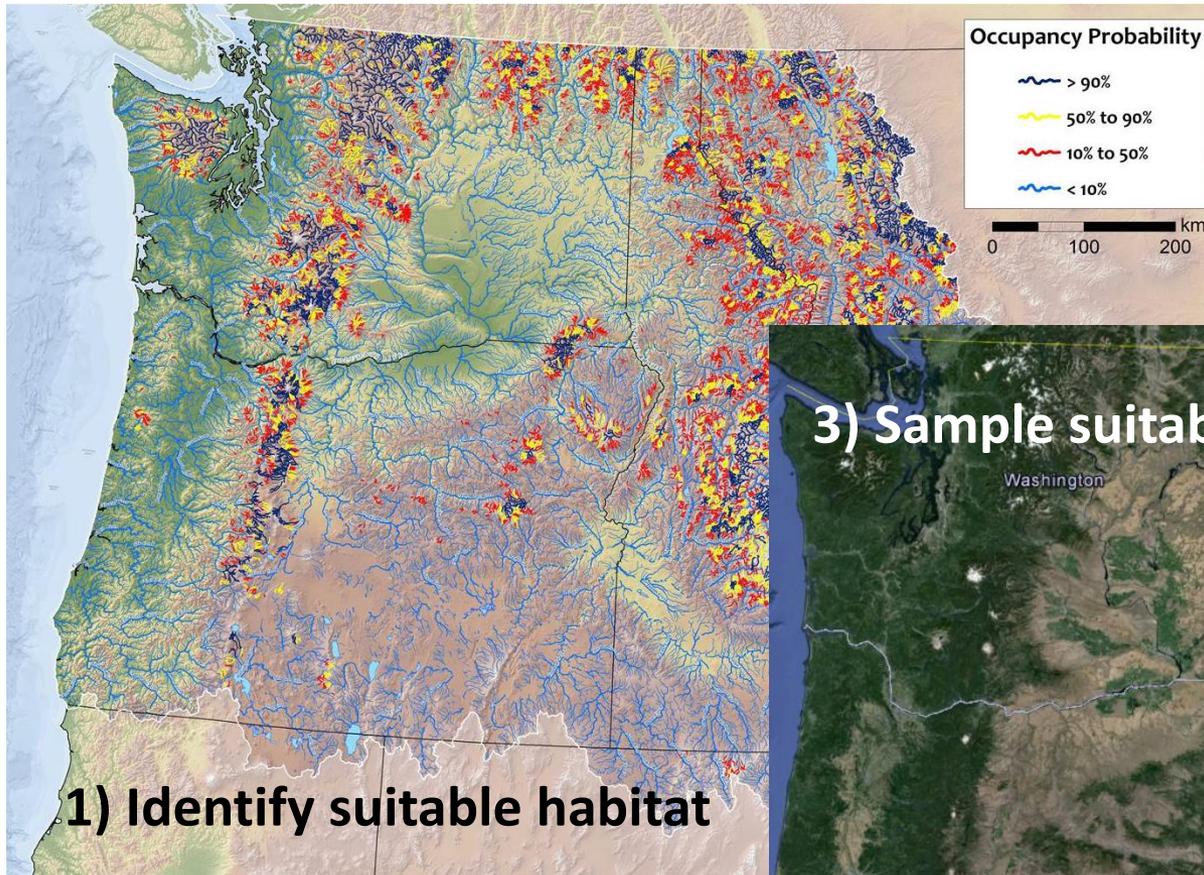


2) Test model with existing survey data



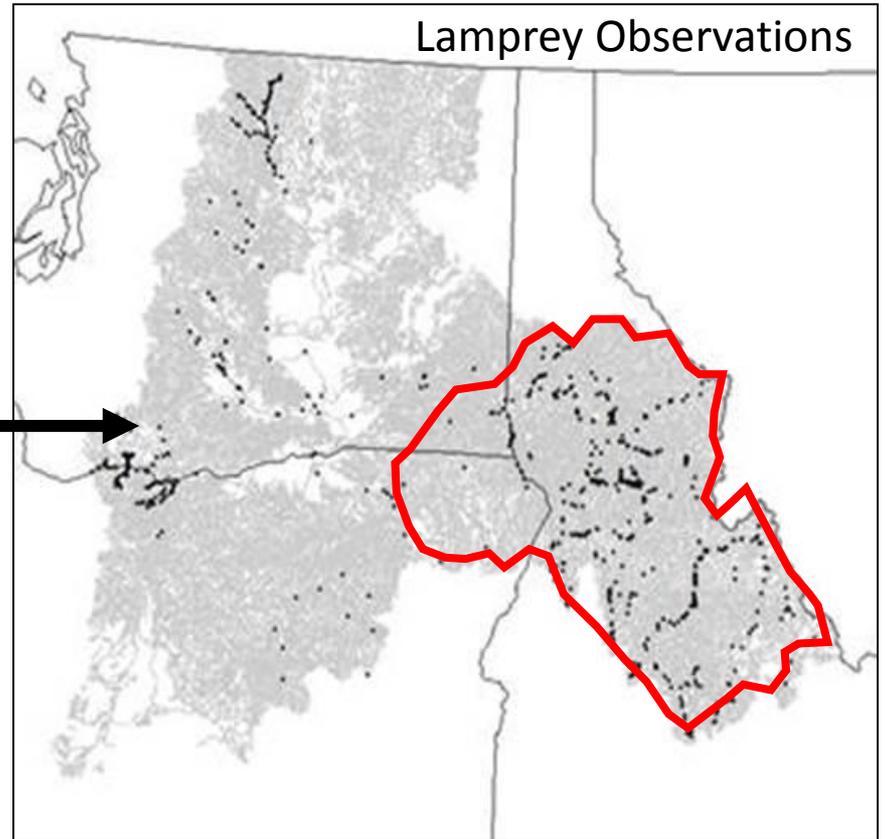
eDNA and Bull Trout Inventory

Collaborative effort with > 30 state, federal and tribal partners



Modeling Pacific Lamprey Occurrence

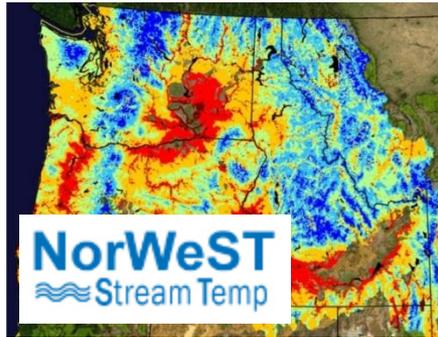
Queried the Pacific Lamprey Data Clearinghouse for Pacific lamprey survey data



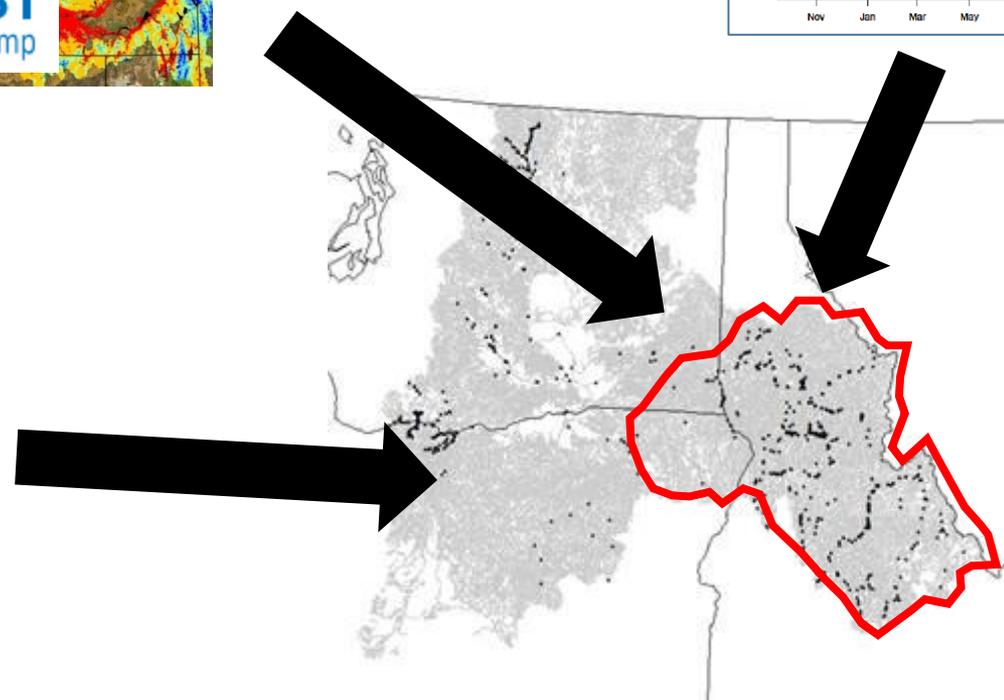
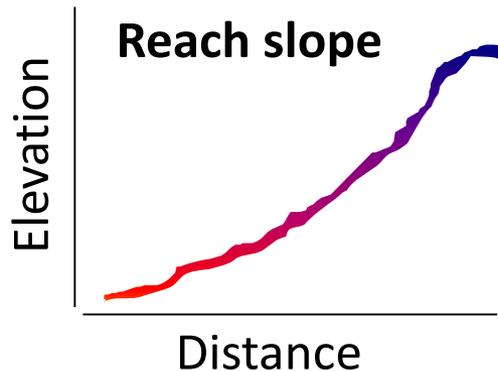
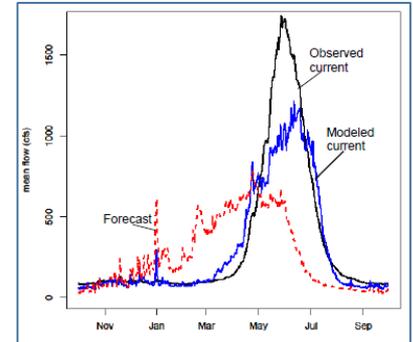
Modeling Pacific Lamprey Occurrence

Identified habitat variables that predict occurrence

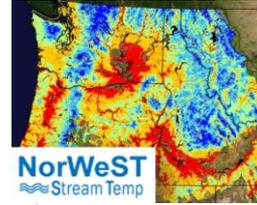
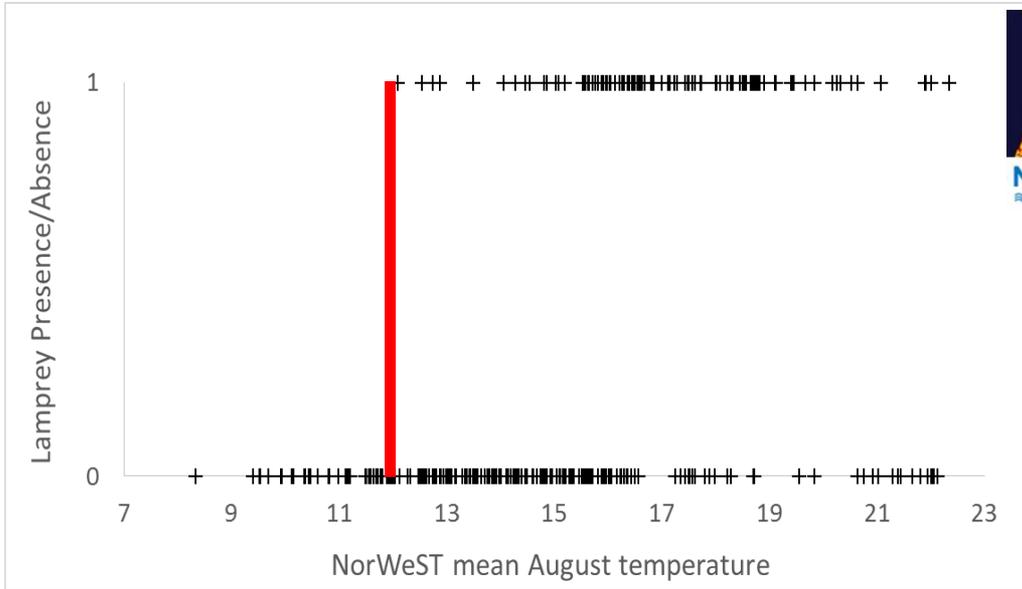
Mean August Temperature



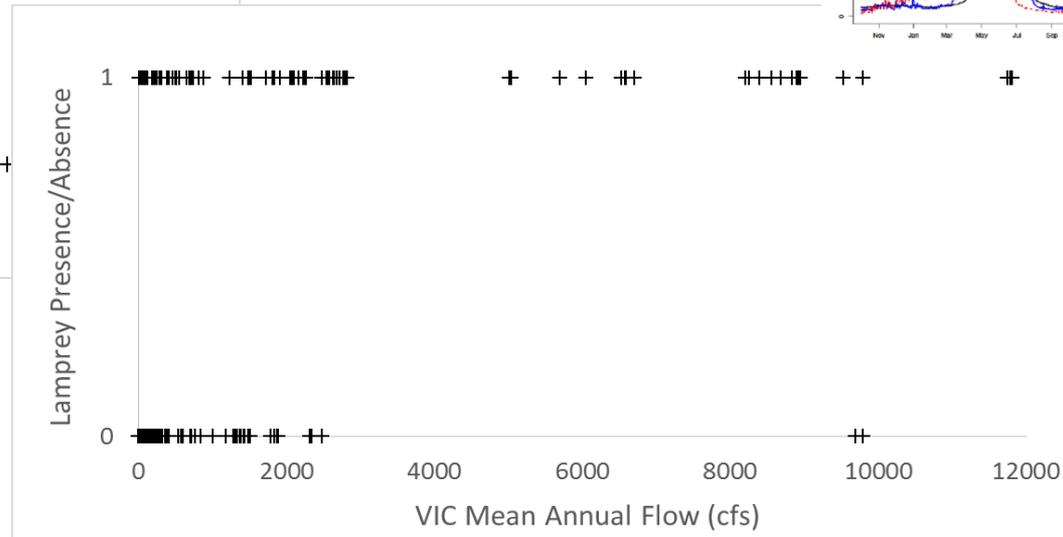
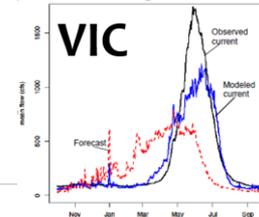
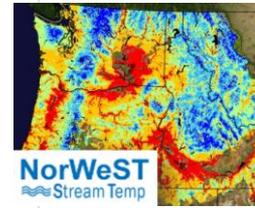
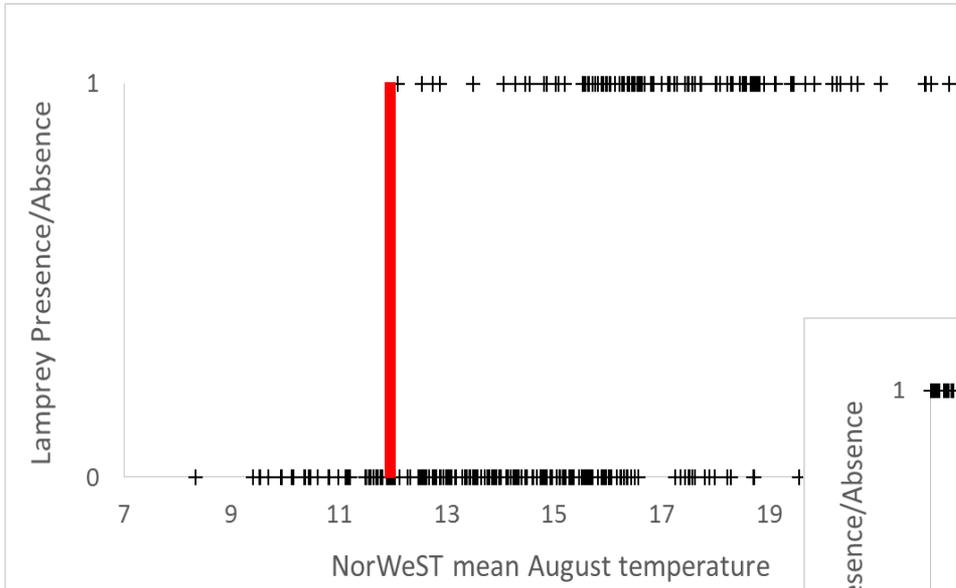
Mean annual flow



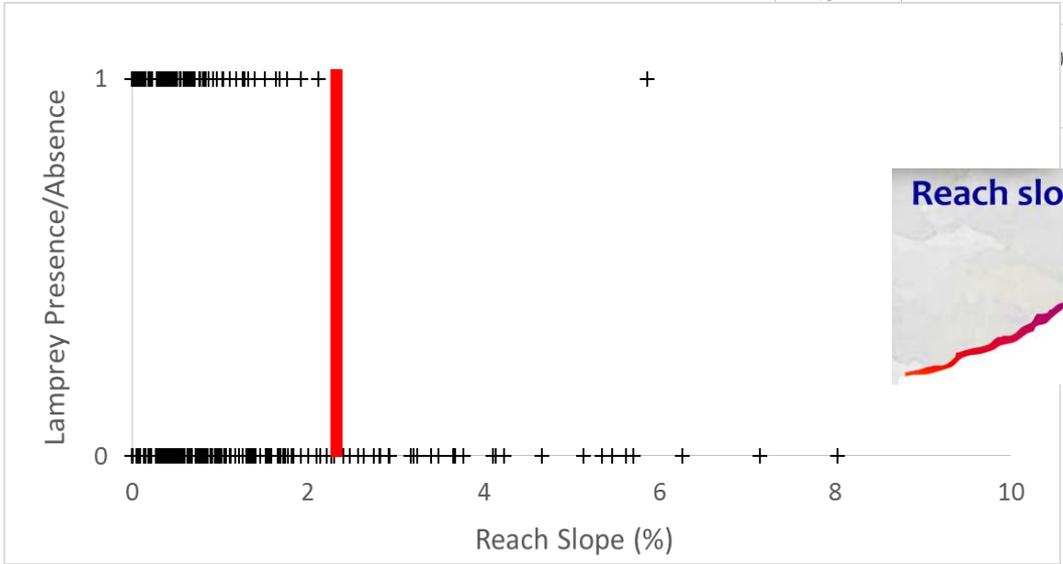
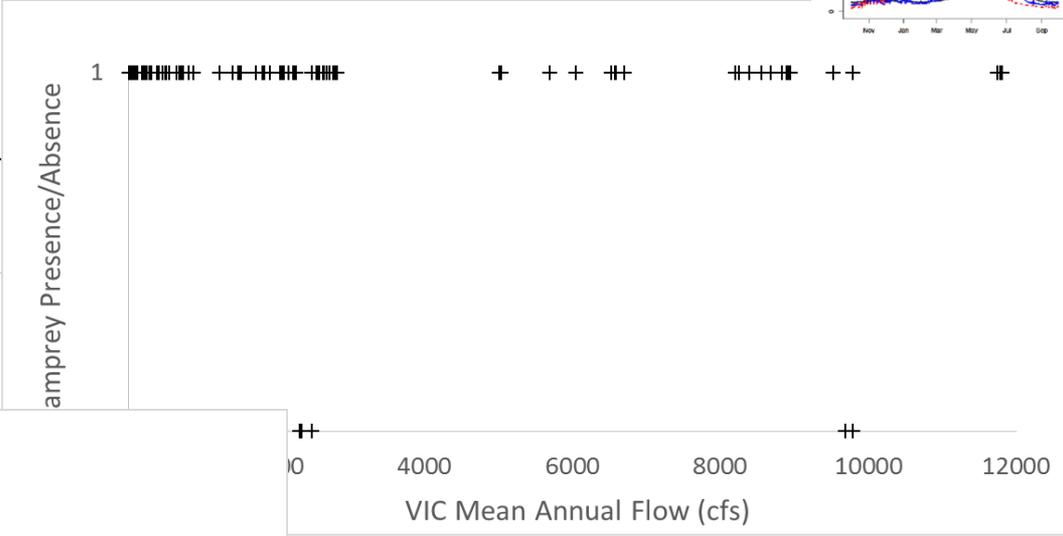
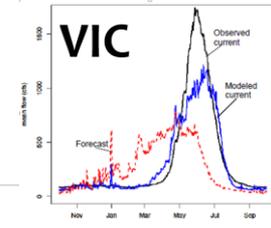
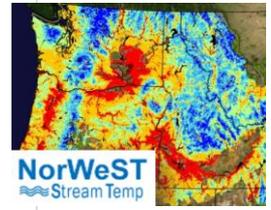
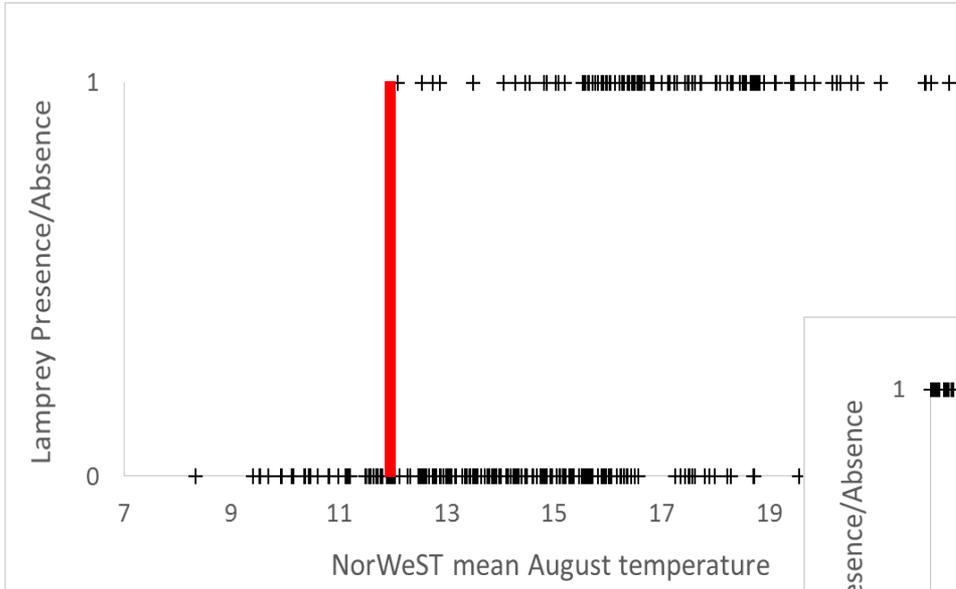
Lamprey Data Summaries:



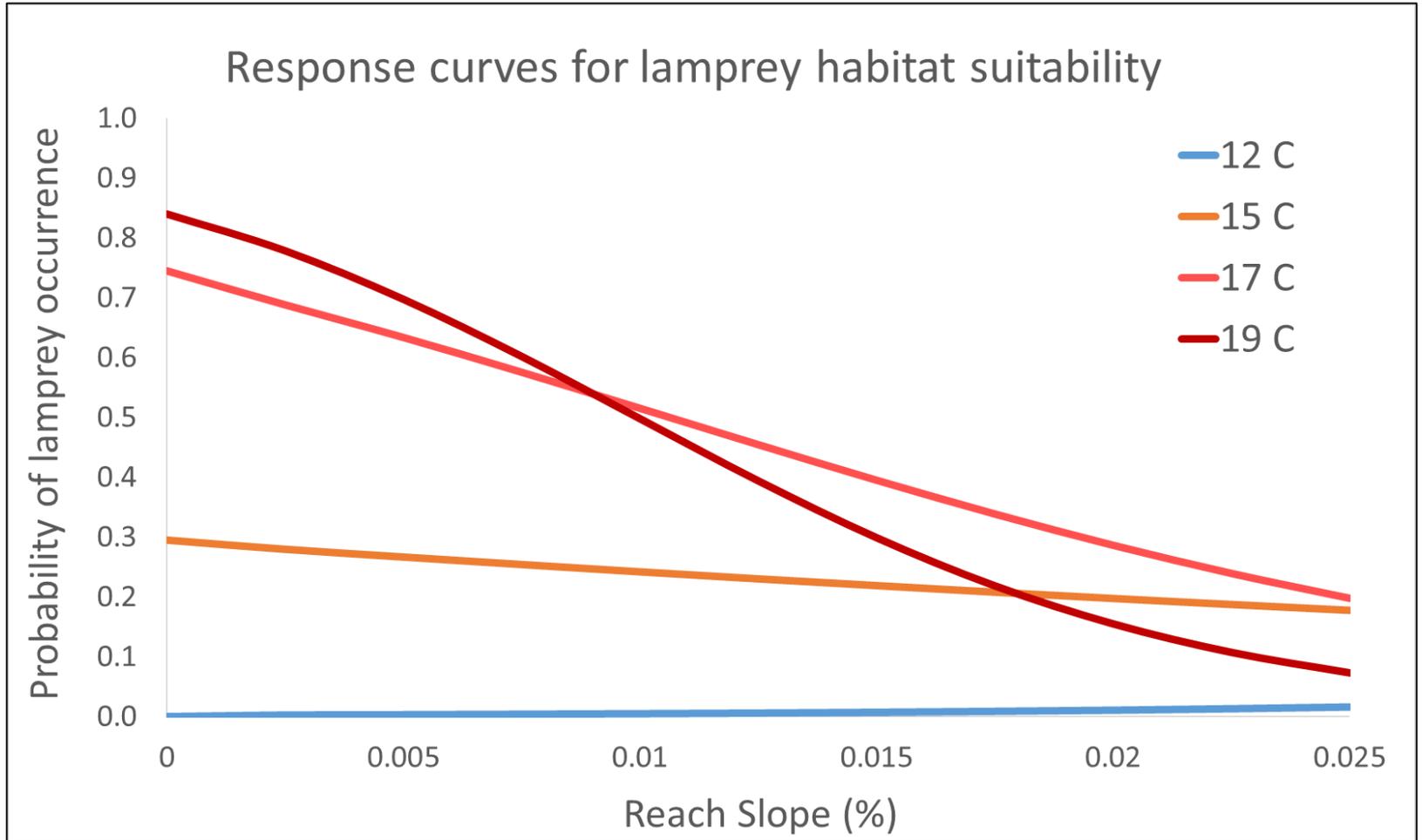
Lamprey Data Summaries:



Lamprey Data Summaries:



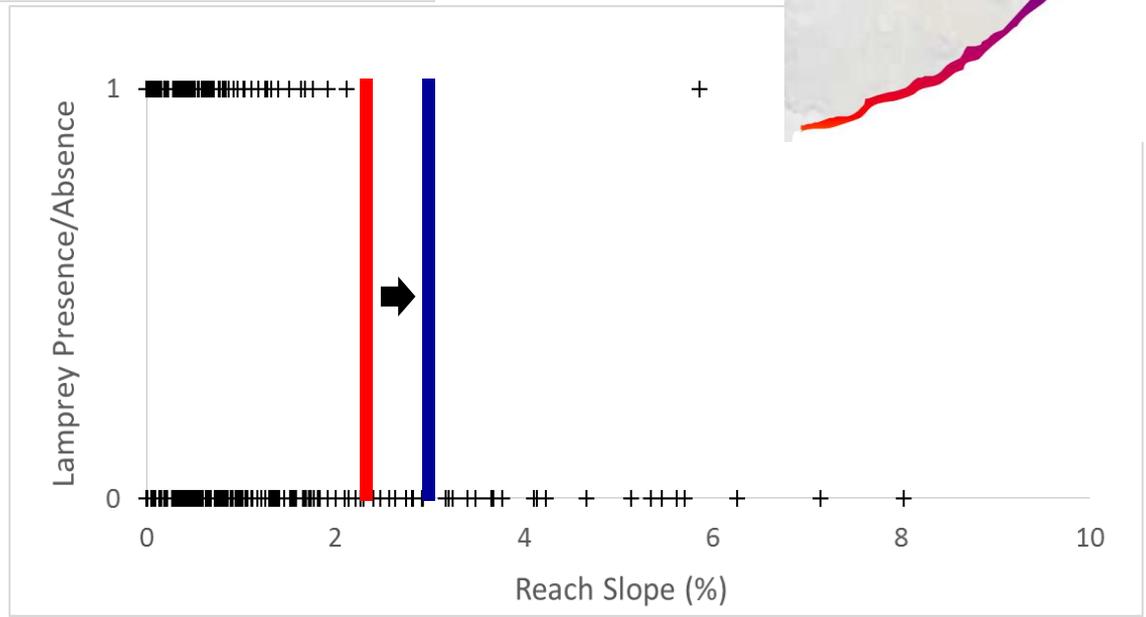
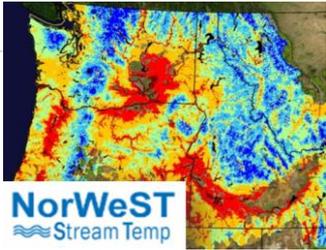
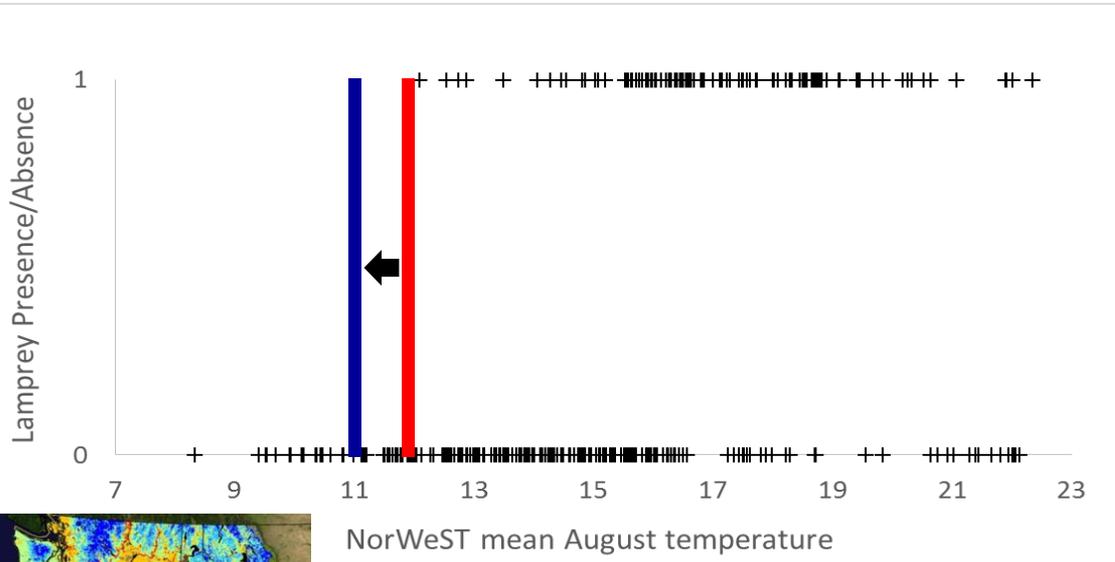
Modeling Pacific Lamprey Occurrence



Lamprey are unlikely to occur in cold, steep streams

Modeling Pacific Lamprey Occurrence

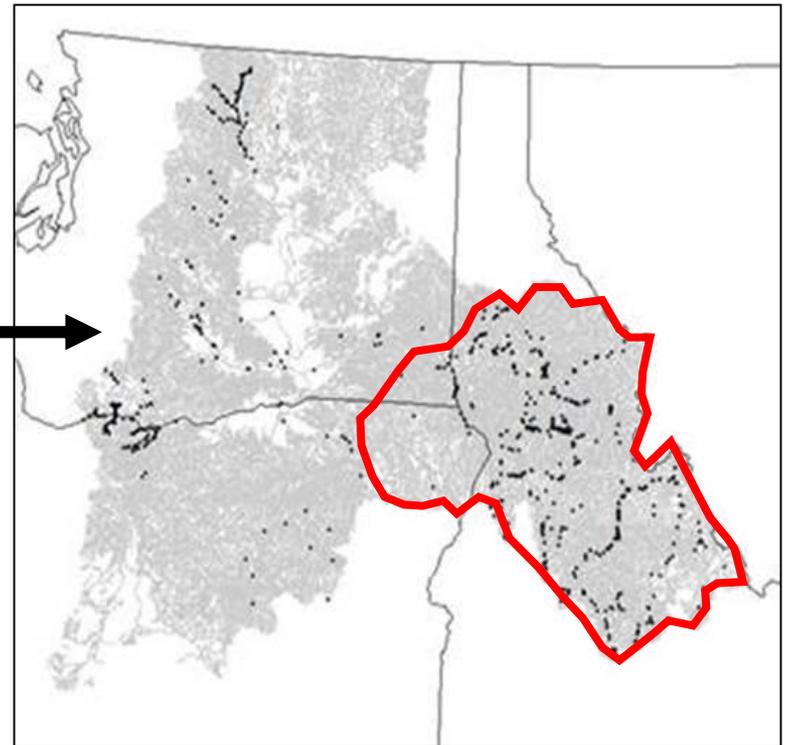
Buffer model to reduce underestimating suitable habitat



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:

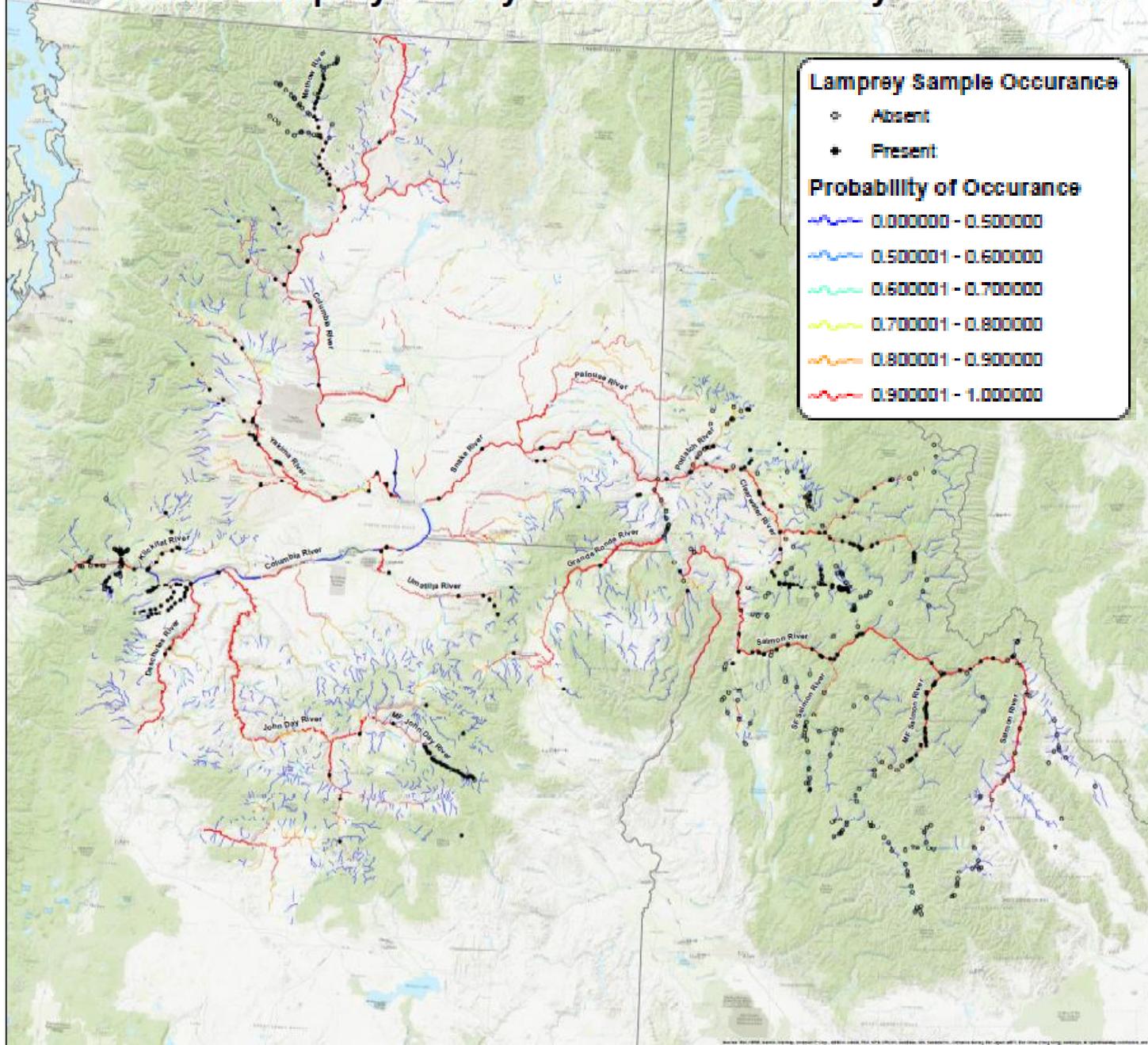
- Abundant data on Chinook occupancy
- Similar distribution to lamprey, less broad than steelhead



0 1,750 3,500 Kilometers

Created March 2010; Adapted from Lee et al. 1980 and Scott and Crossman 1973

Interior Columbia Basin Pacific Lamprey Survey Sites and Probability of Occurrence



Interior Columbia Basin Pacific Lamprey Survey Sites and Probability of Occurance

Sampling eDNA design:

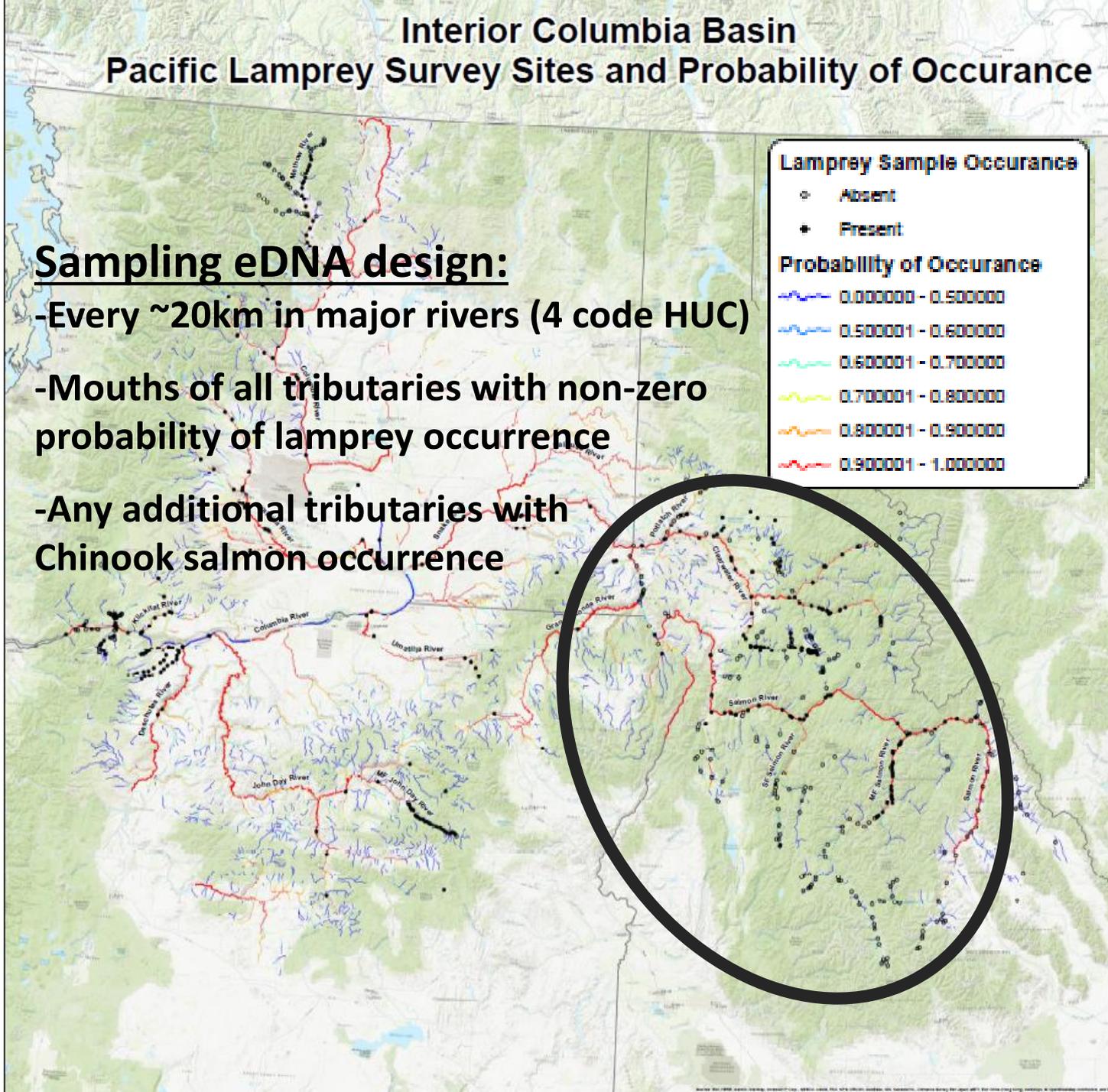
- Every ~20km in major rivers (4 code HUC)
- Mouths of all tributaries with non-zero probability of lamprey occurrence
- Any additional tributaries with Chinook salmon occurrence

Lamprey Sample Occurance

- Absent
- Present

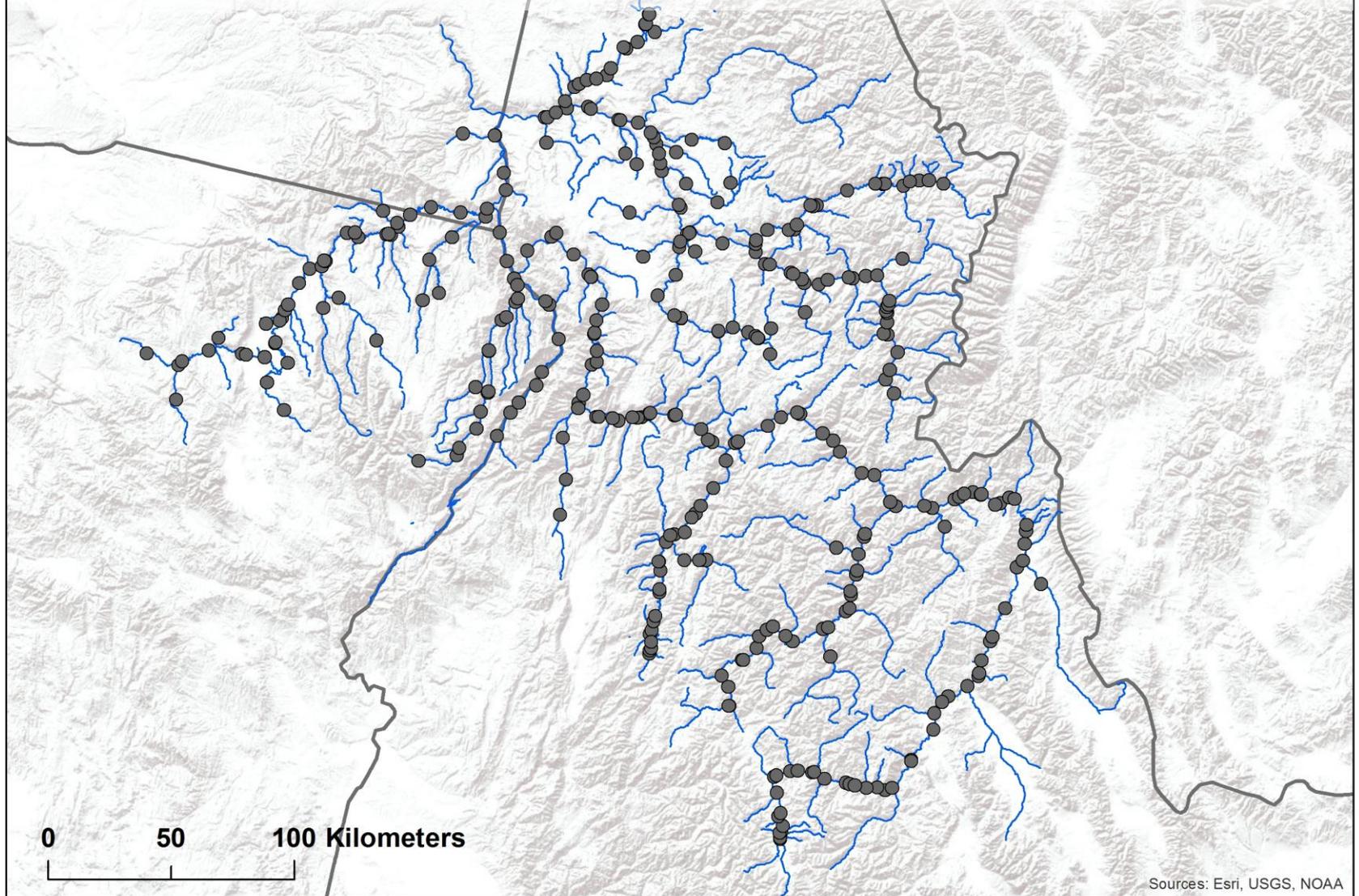
Probability of Occurance

- 0.000001 - 0.500000
- 0.500001 - 0.600000
- 0.600001 - 0.700000
- 0.700001 - 0.800000
- 0.800001 - 0.900000
- 0.900001 - 1.000000



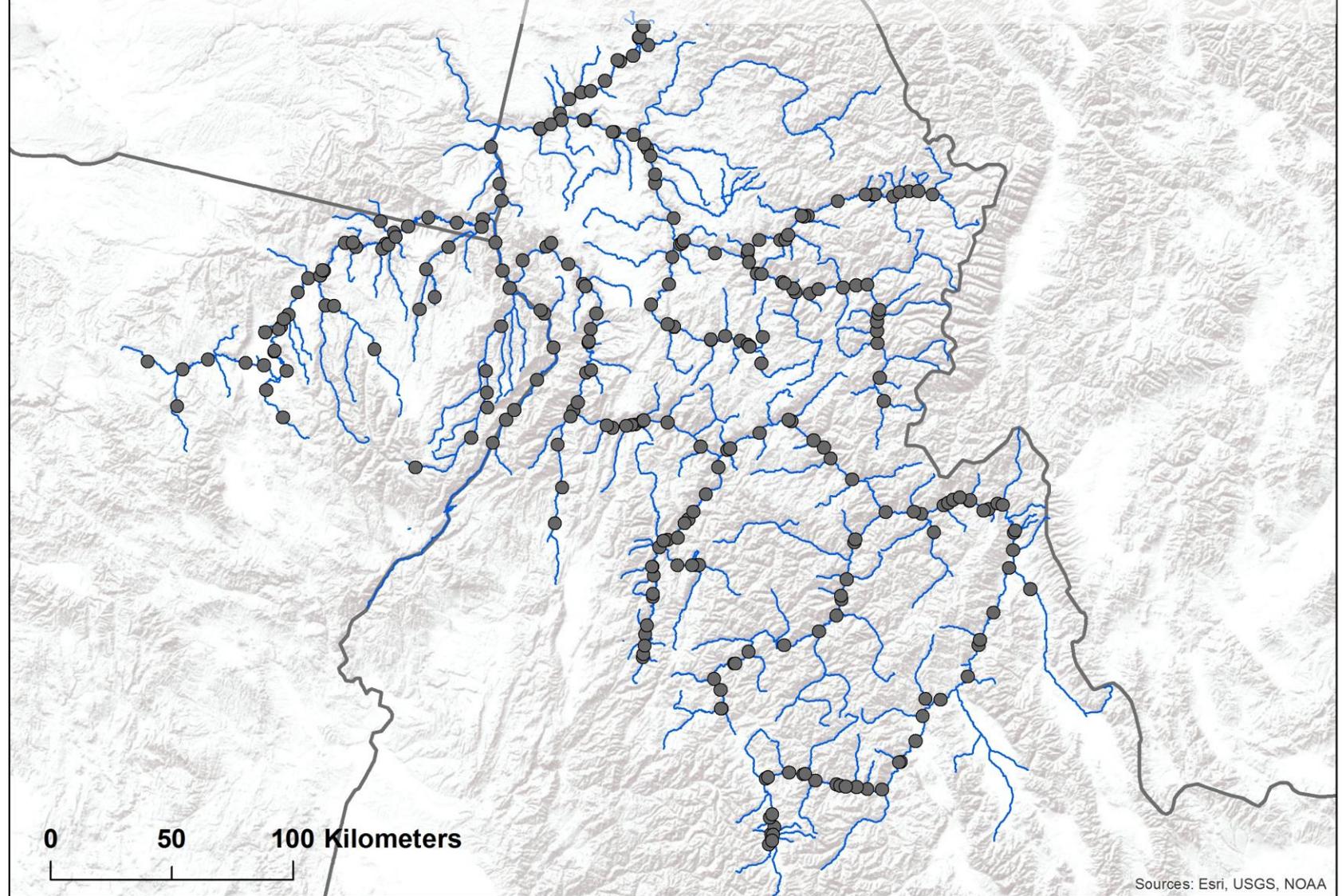
Pacific Lamprey Sampling Locations- 2018

→ 49 existing samples at NGC



Pacific Lamprey Sampling Locations- 2018

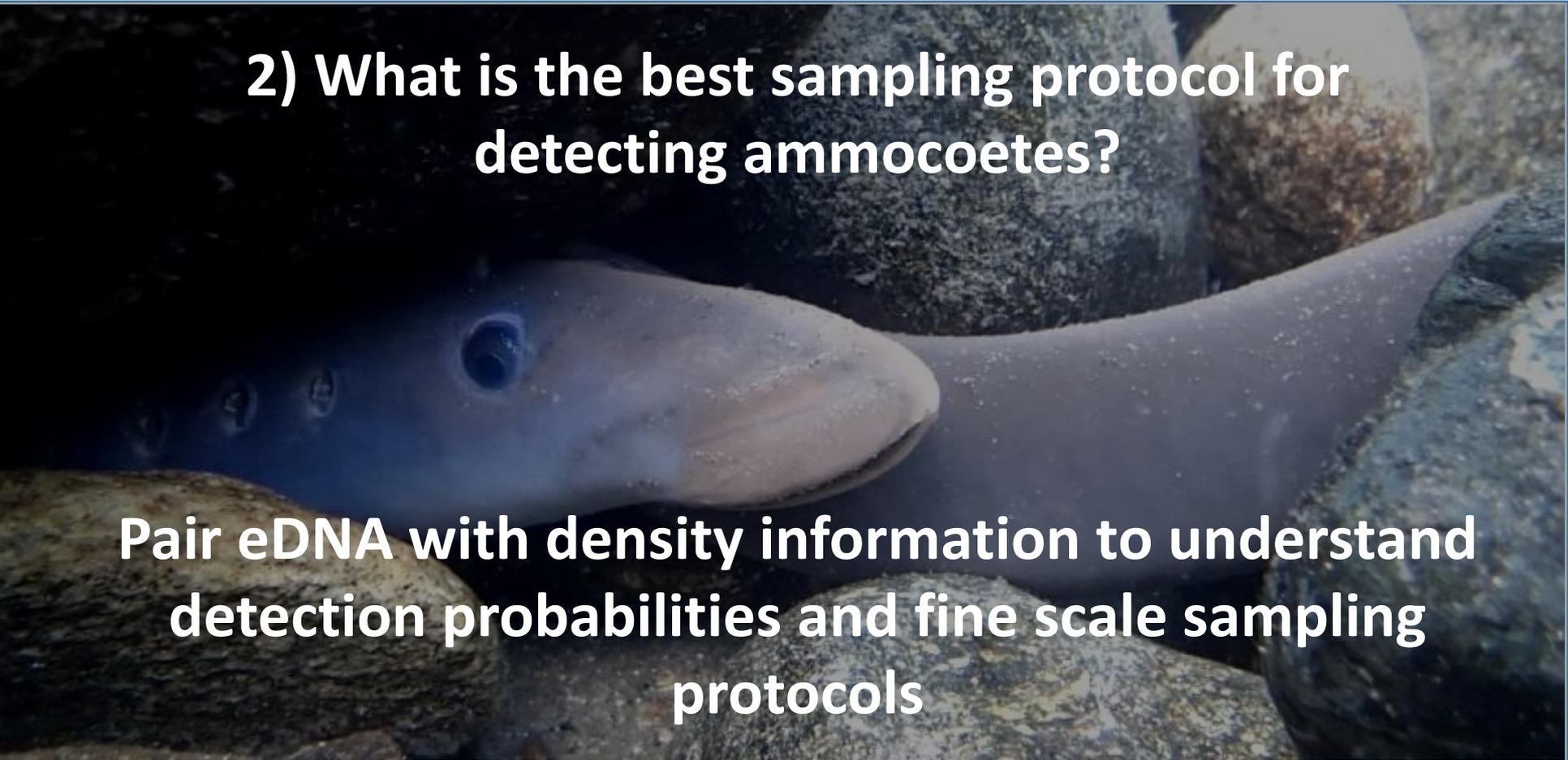
n=248 locations



2018 BLIMP Objectives

2) What is the best sampling protocol for detecting ammocoetes?

Pair eDNA with density information to understand detection probabilities and fine scale sampling protocols



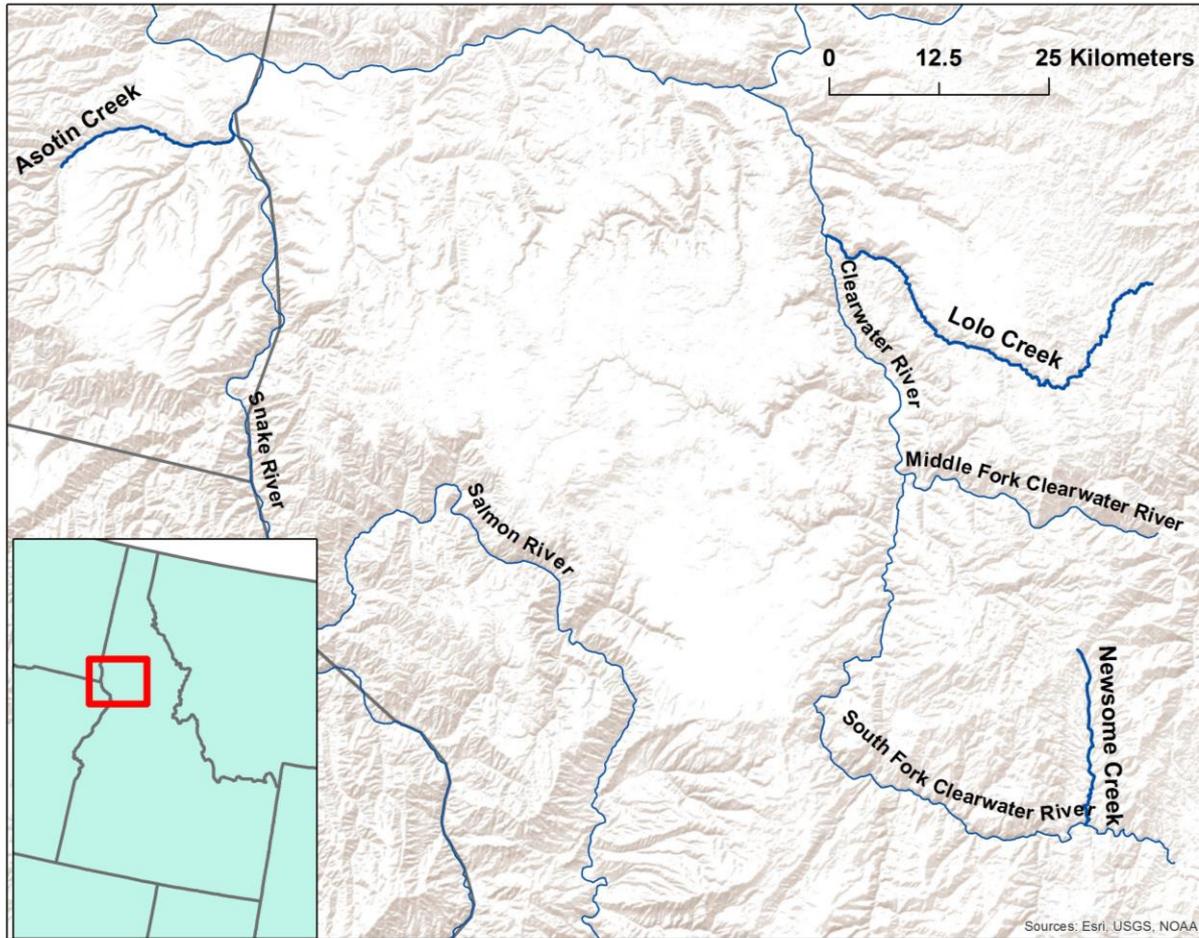
Understanding eDNA Detection of Ammocoetes

Best information on presence of ammocoetes is in translocation areas

Nez Perce Tribe translocation and monitoring provides an ideal framework

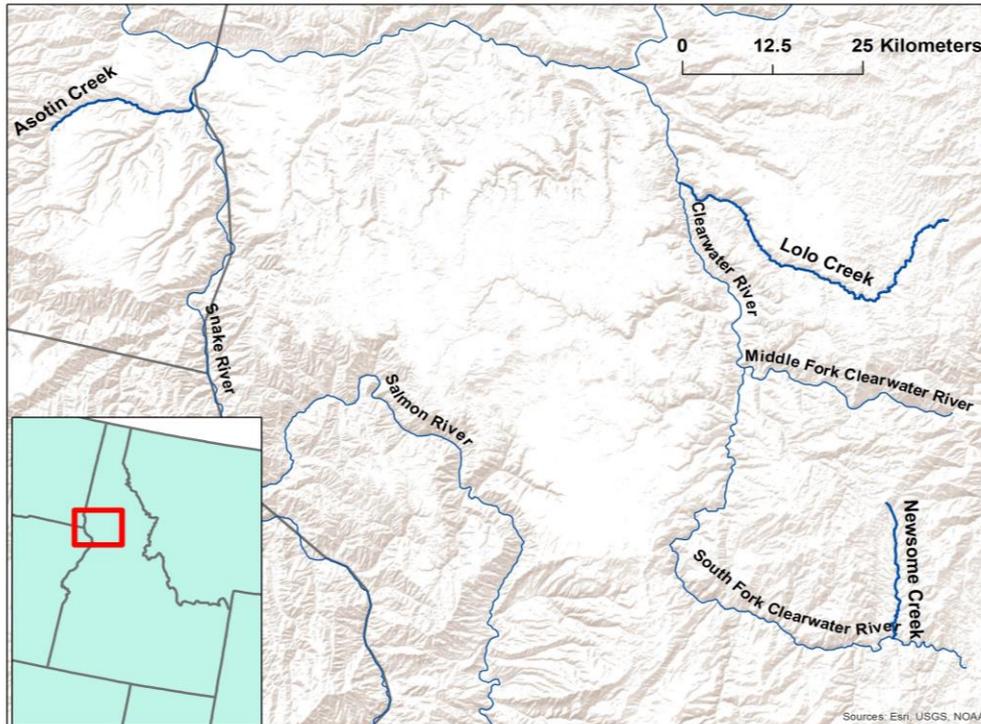


Understanding eDNA Detection of Ammocoetes



Translocations in Asotin, Lolo and Newsome Creeks:
Focal streams with monitoring data and mapped Type I habitat

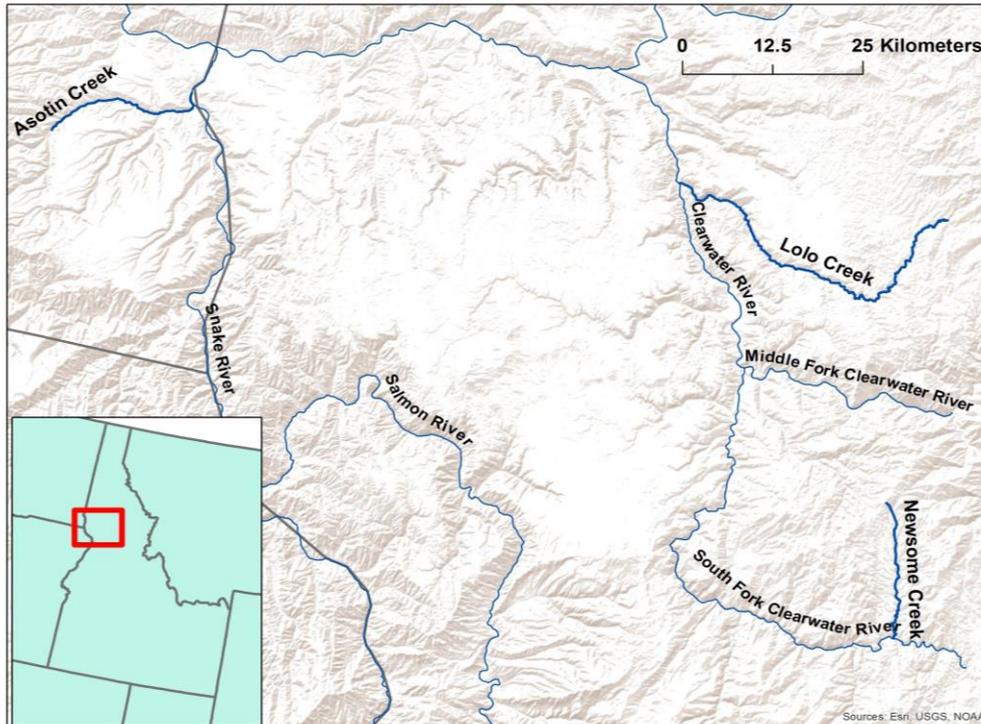
Understanding eDNA Detection of Ammocoetes



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

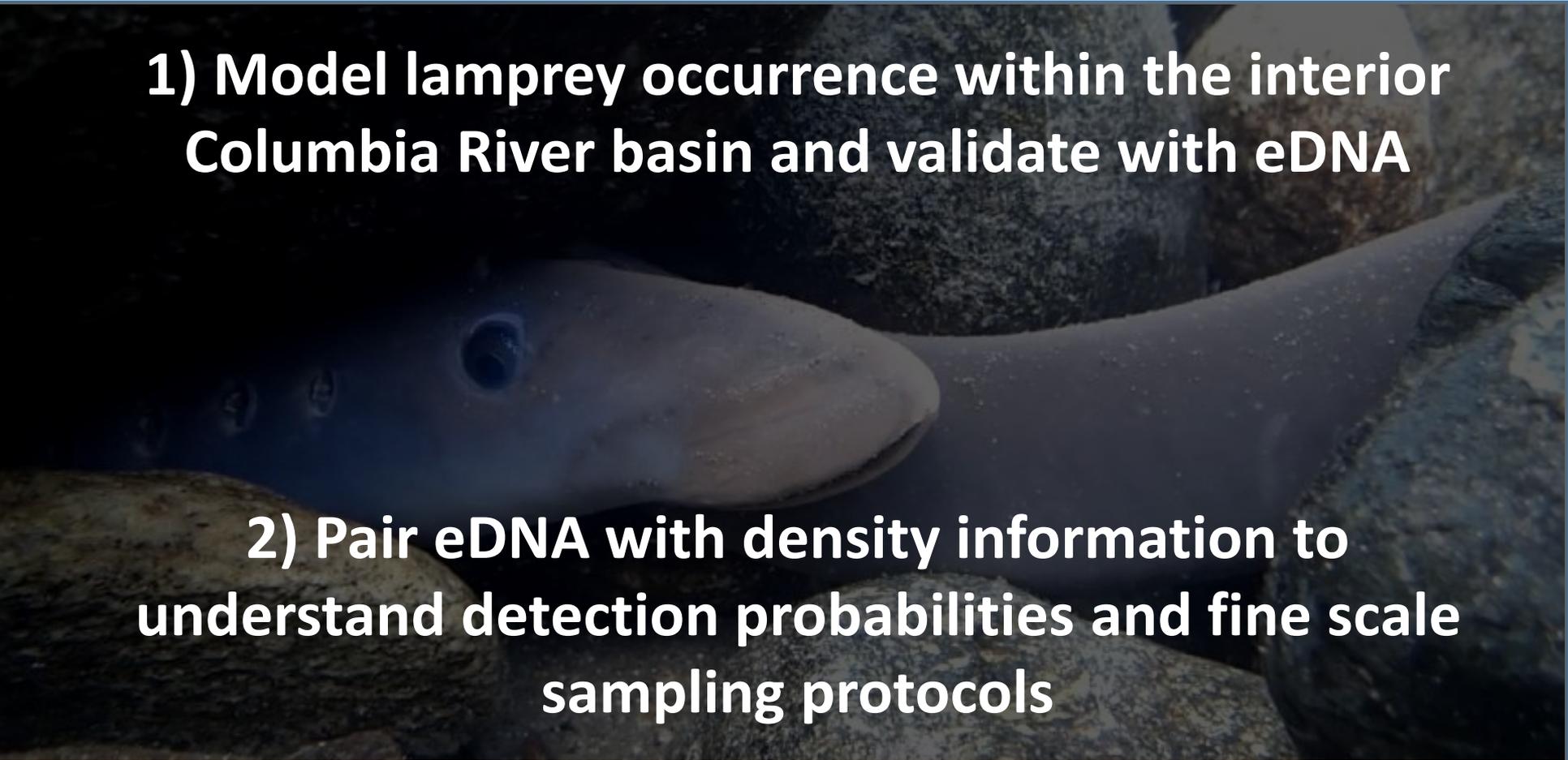
An understanding of detection probabilities for larval lamprey

- 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?