1. Predation Study Using qPCR & Metabarcoding
2. FALCON Adult Trapping

Ralph Lampman, Yakama Nation Fisheries

(some slides from Andy Lara, Cramer Fish Sciences)

AFEP Review, December 3, 2024

Predation Study Outline

Project Overview	2023 Hatchery Trial and Field Study	2024 Year Two Field Study
• Background	• Methods and results	• Methods and initial results

Predation Study Background

Lamprey in Lower Columbia Basin

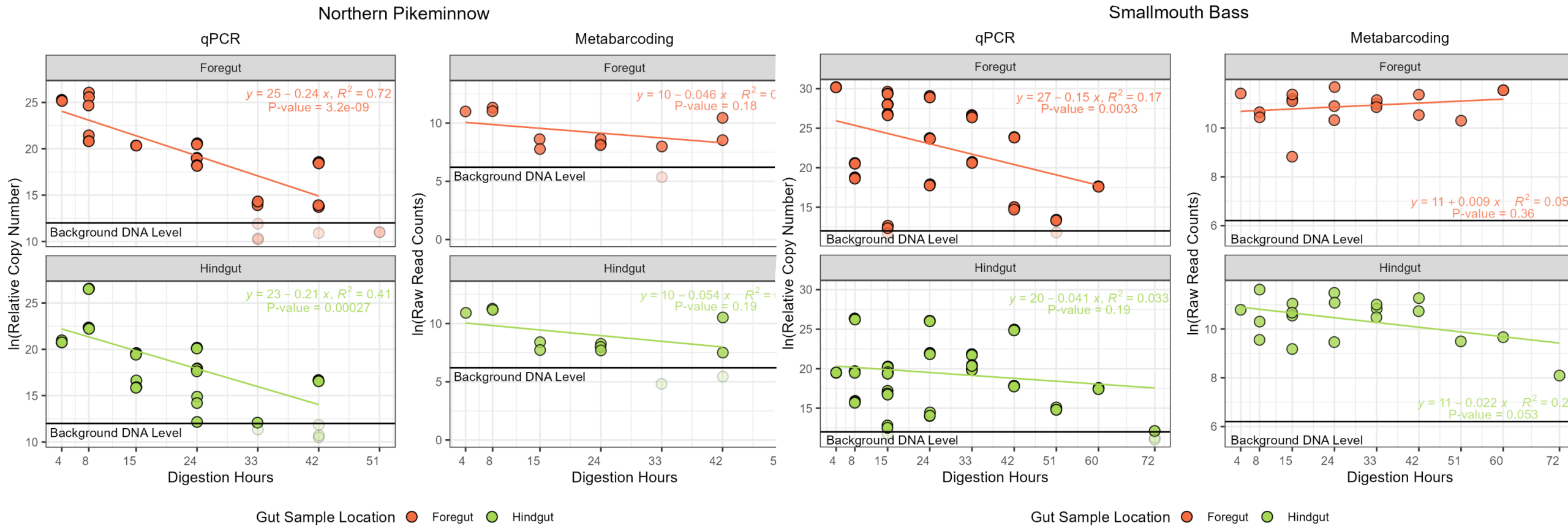
Environmental factors

- What Invasives eat Lamprey and ESA salmonids the most?
- Where does heavy predation occur?
- What are the temporal patterns of predation?

Hatchery Experiment

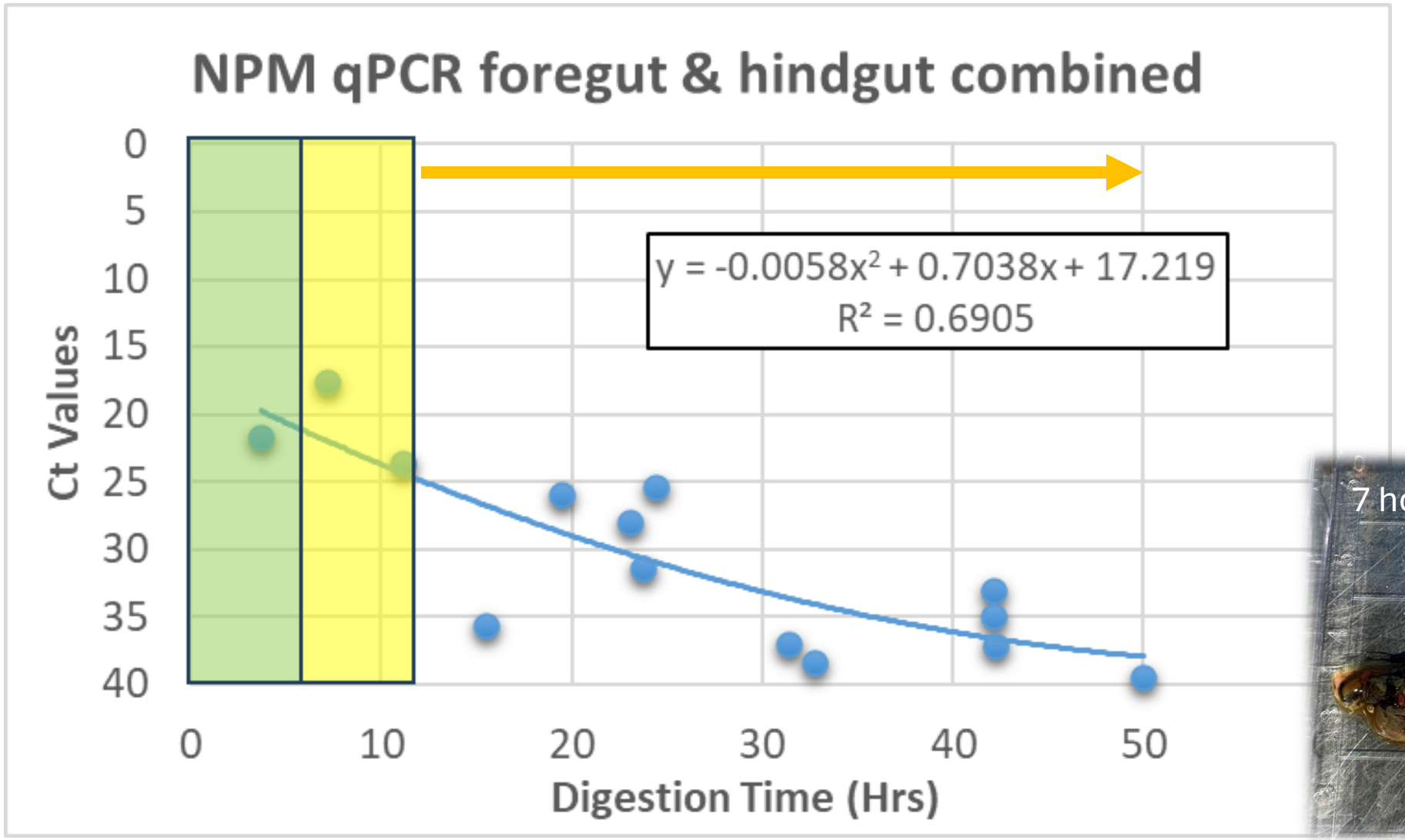
The Need for eDNA

- Through Visual analysis, lamprey remnants are present between a few to several hours before no longer visually identifiable
- Every predator that was fed a lamprey had a positive detection.
- eDNA qPCR was able to detect lamprey DNA after about 52 hours



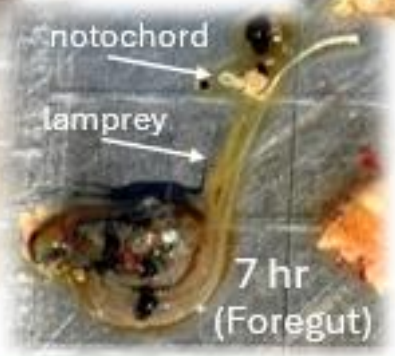
0-6 Hours = Lamprey visually identifiable

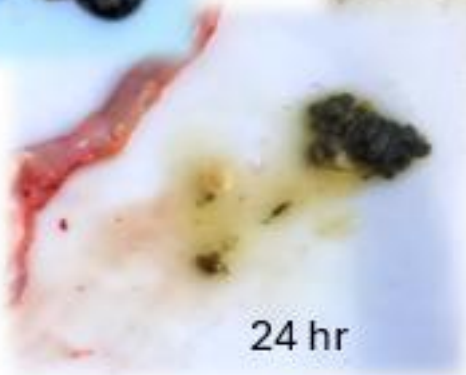
6-12 Hours = Difficult to identify lamprey (Need to ID key features)

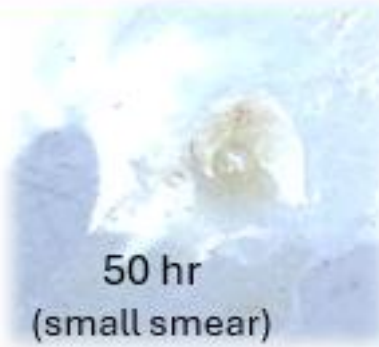


Pacific Lamprey Decomposition Over Time in Three Predator Fishes' Digestive Tracts (@ 14.5°C)

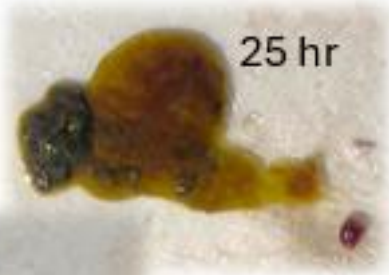
Northern Pike Minnow



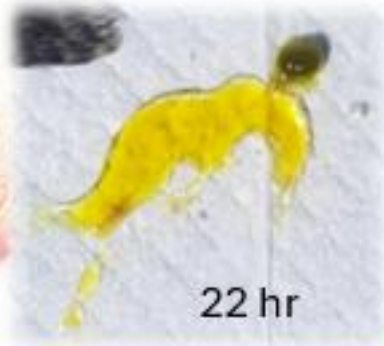




Smallmouth Bass

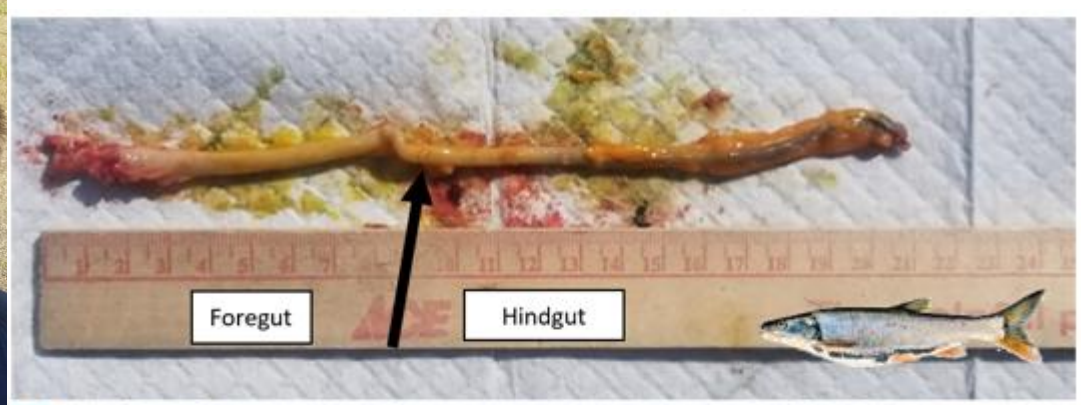


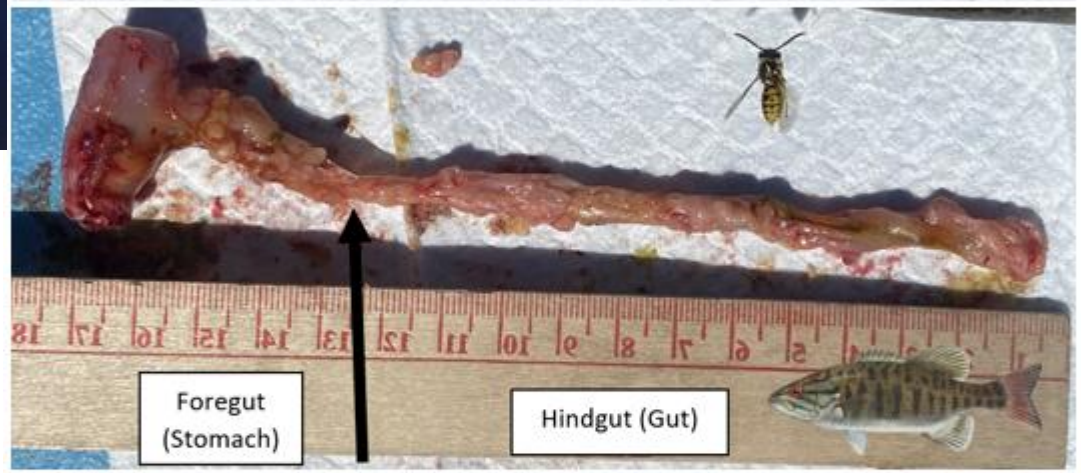
Walleye

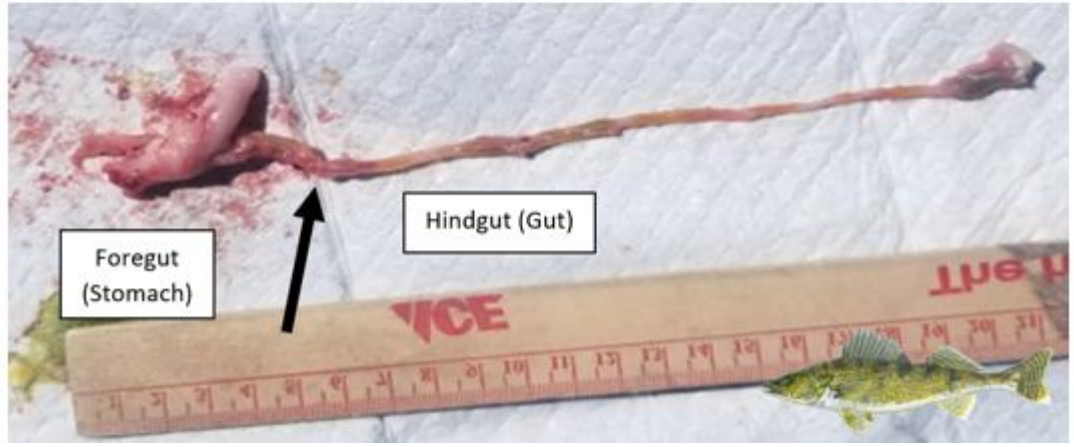


Methods

- Fish collection (e-fishing, hook & line, juvenile traps)
- Ethanol inserted through mouth (stops further digestion & preserves the samples)
- Predator fishes killed by physical injury to the head (blunt object)
- Freeze or move onto dissection
- Cut open to remove just the digestive tract (esophagus to posterior end of gut) [*could end here & freeze]
- Remove the digestive tract content (<10 g) & place into buffer solution

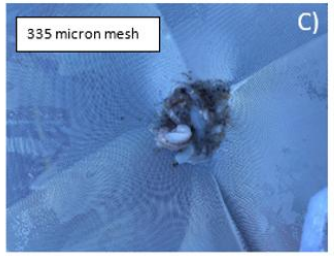

Foregut
Hindgut


Foregut
(Stomach)
Hindgut (Gut)


Hindgut (Gut)
Foregut
(Stomach)


A)
335 micron mesh
goes between
the two funnels


B)
water gun set up to conduct the lavage


C)
335 micron mesh


D)
content cut-out in Whirl-Pak bag (in ethanol)

2023 Field Collection

Sampling occurred between April and June.

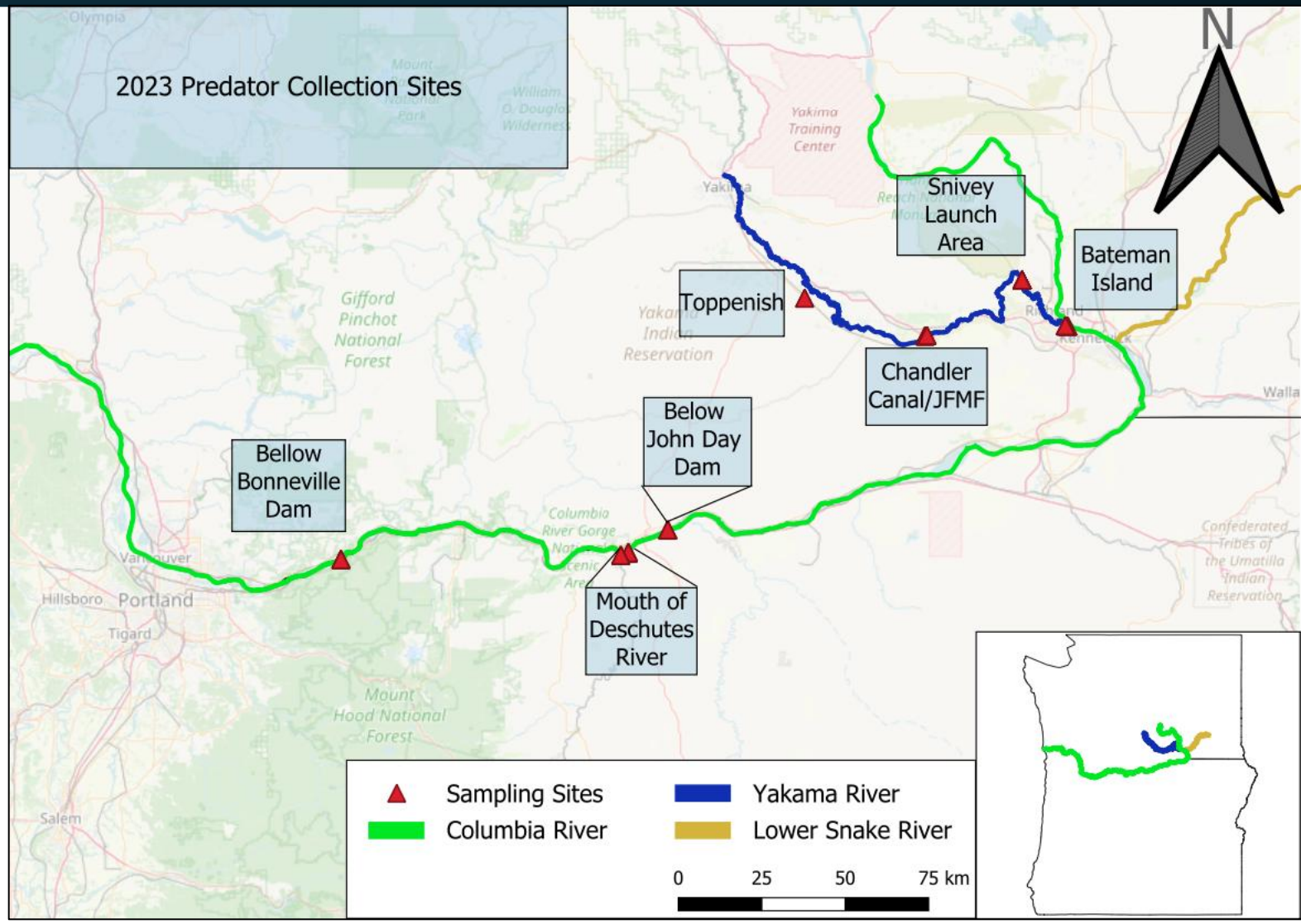
Hook-and-Line Fishing

Boat Electrofishing

Juvenile Fish Monitoring Facility

Target Species:

Smallmouth Bass (SMB)
Northern Pikeminnow (NPM)
Walleye (WAL)
Largemouth Bass(LMB)
Channel Catfish
Yellow Perch (YEP)
American Shad(AMS)



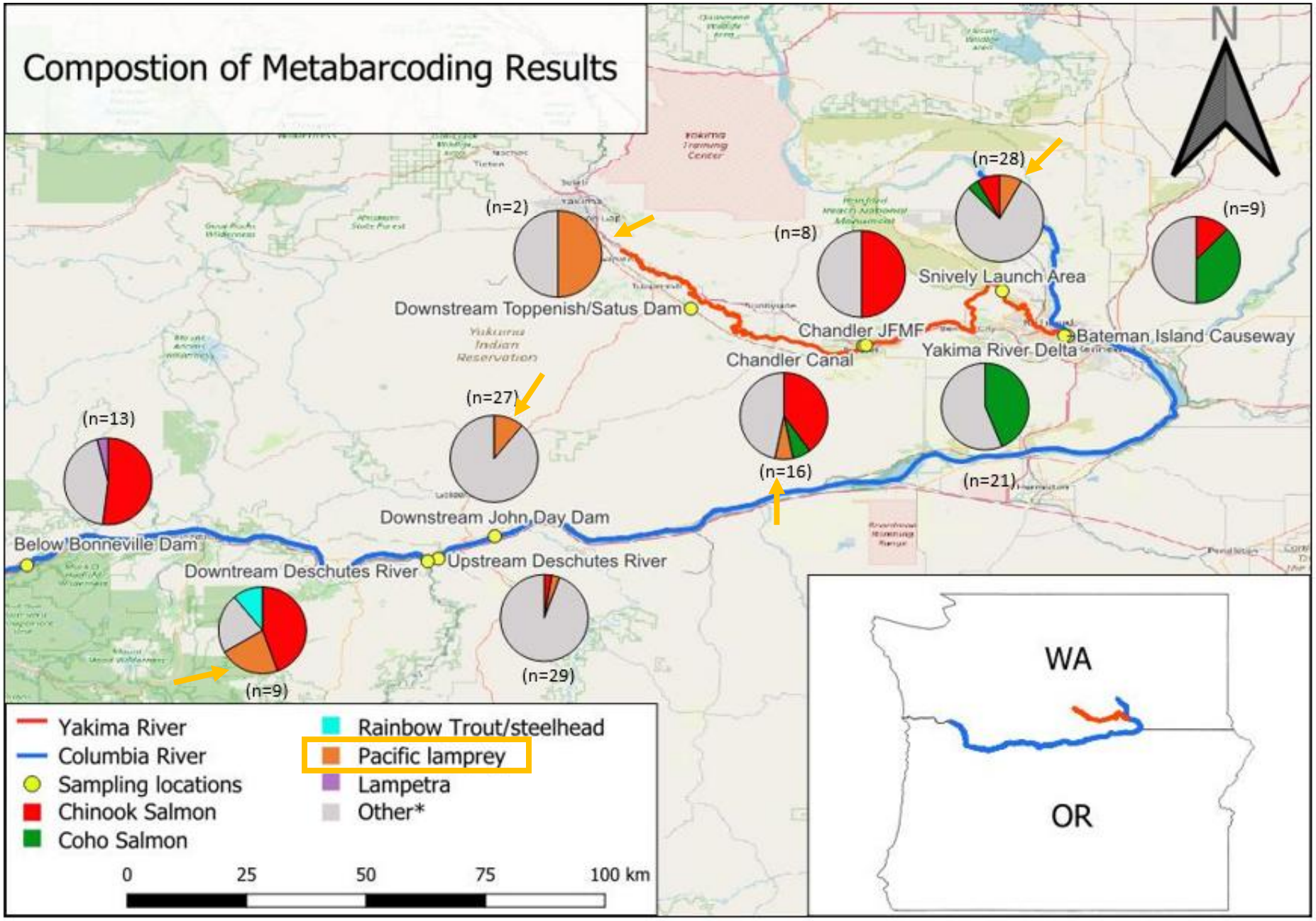
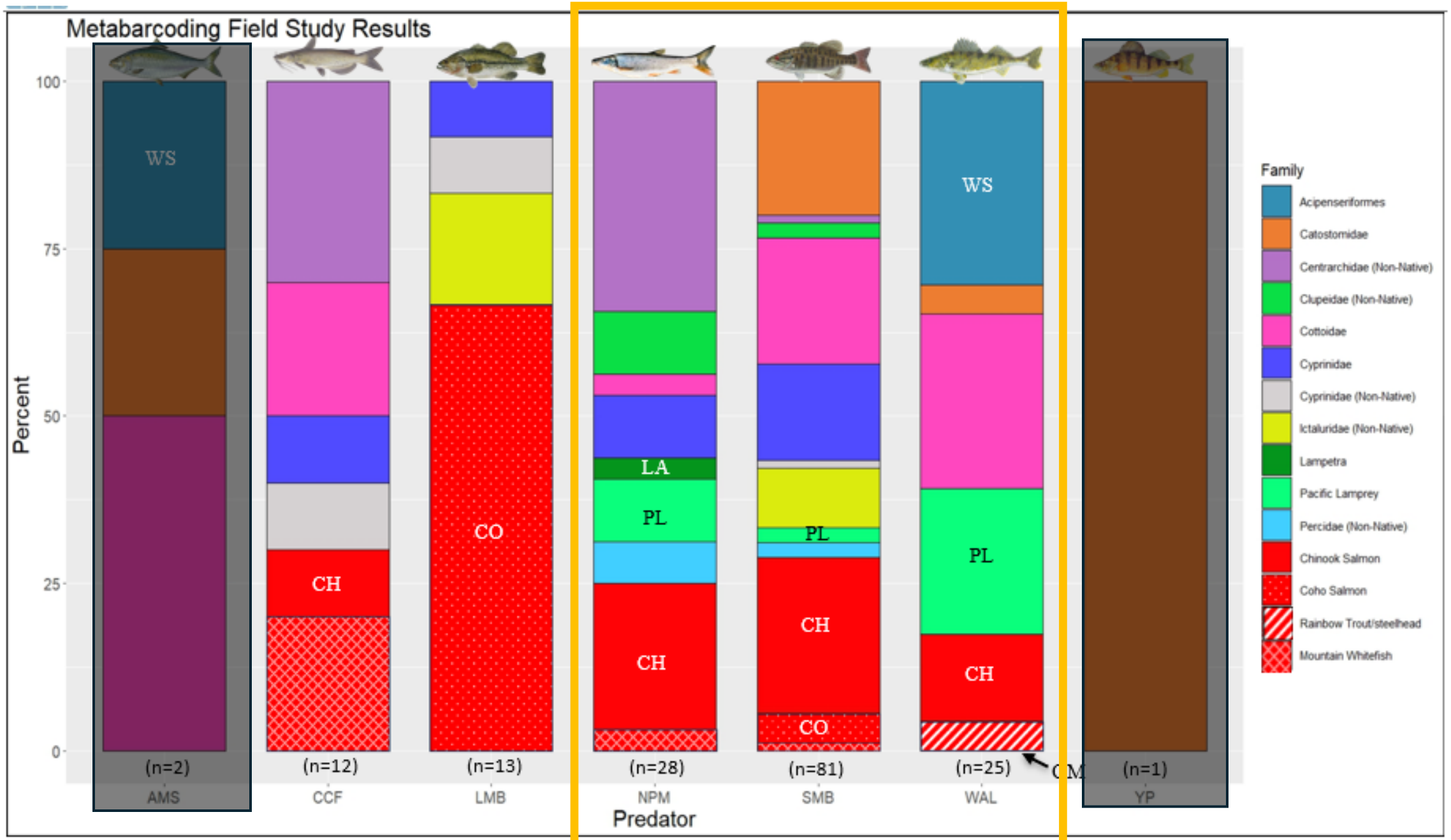


Figure 2. Map of target prey species detections across all 162 predators analyzed using metabarcoding. Overall sample sizes are also displayed in parentheses. See Appendix B for a summary of detections for all species including "*Other**" categories.



American Shad

Channel Catfish

Largemouth Bass

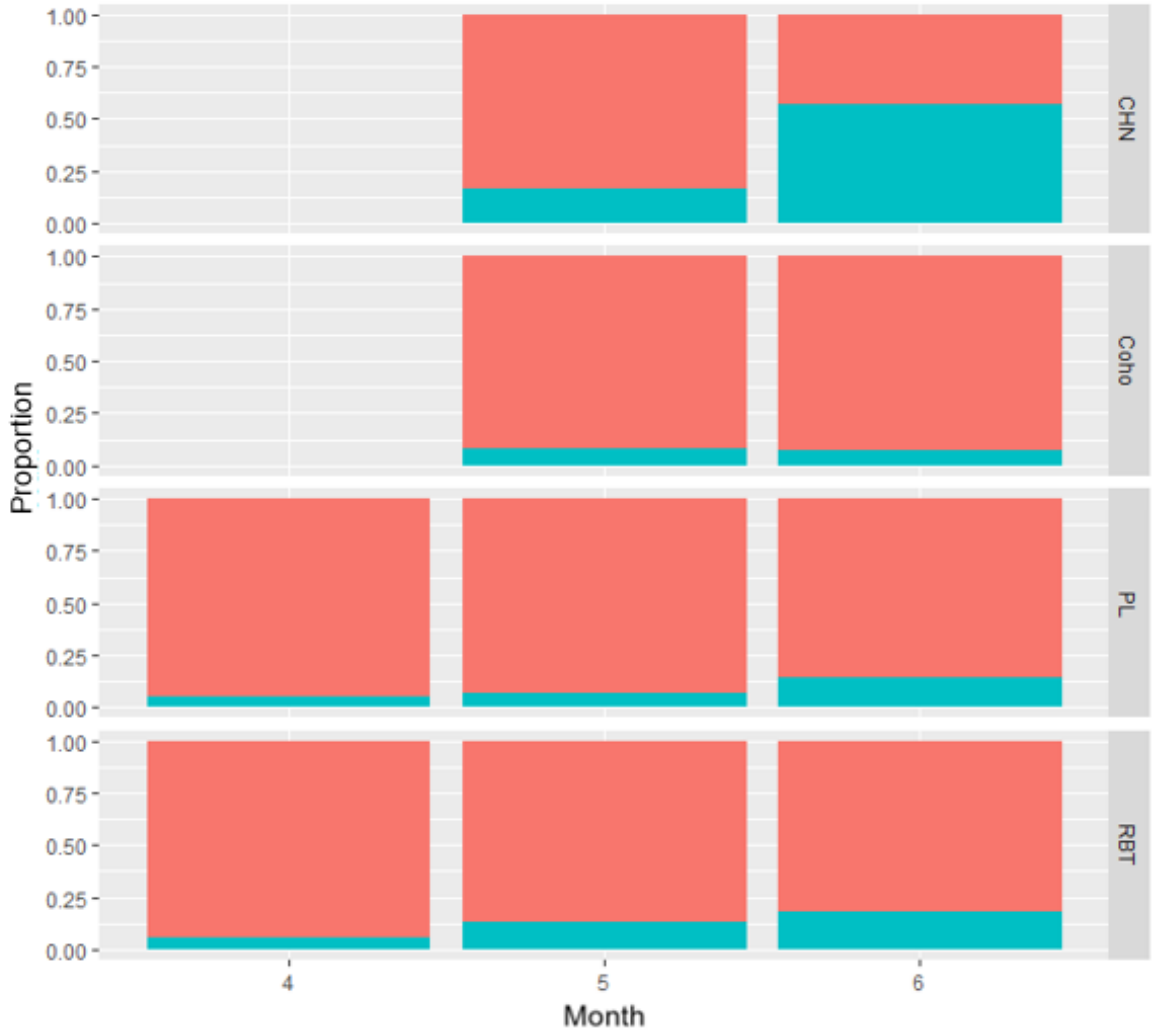
Northern Pikeminnow

Smallmouth Bass

Walleye

Yellow Perch

qPCR Results - % Detection by Month (x-axis) & Prey Species (y-axis)



Chinook Salmon

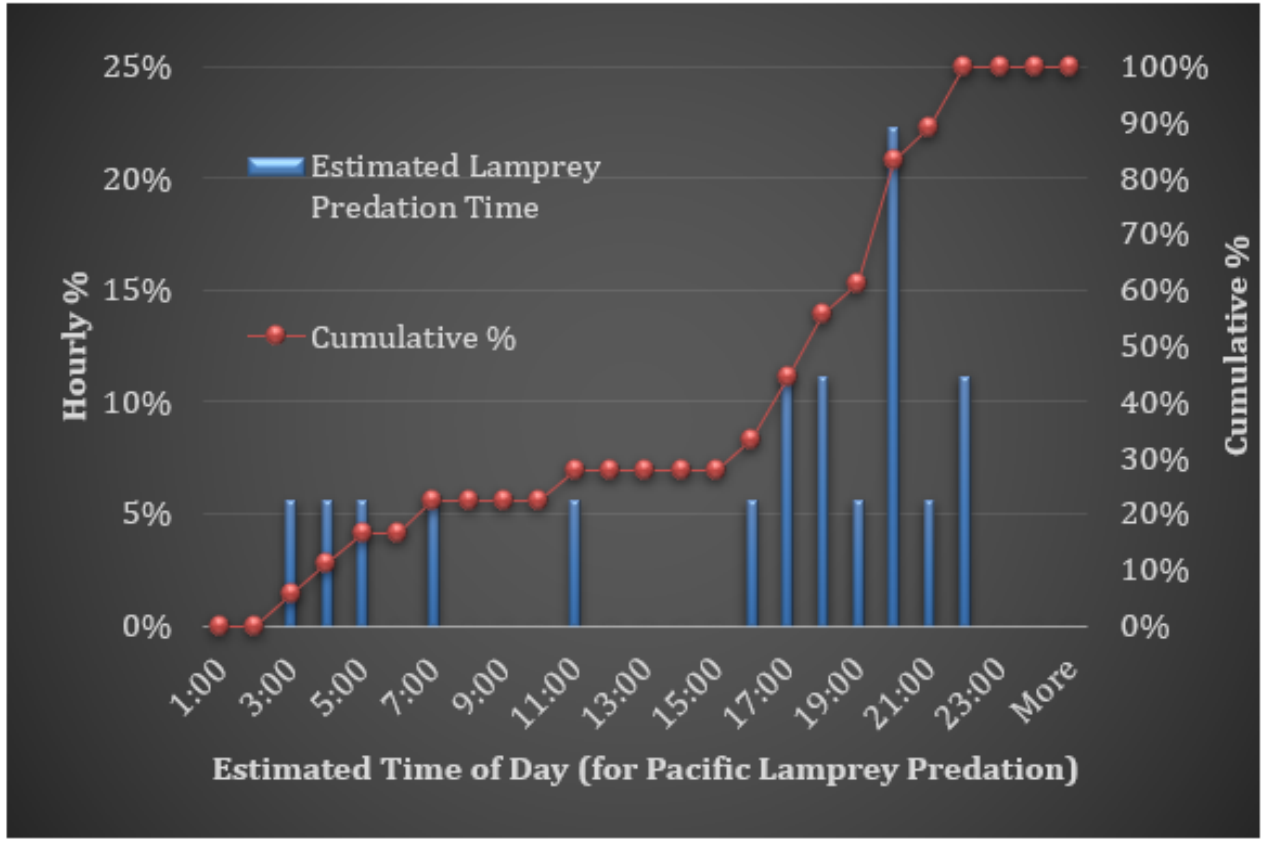
Coho Salmon

Pacific Lamprey

Steelhead / Rainbow Trout

Figure 10. Stacked bar chart of positive and negative qPCR detections for Chinook Salmon (*CHIN*), Coho Salmon (*Coho*), Pacific Lamprey (*PL*), and *O. mykiss* (*RBT*) by month. Predator sample sizes were n=162 for *PL* and *RBT* and n=26 for *CHIN* and *Coho*.

Prediction of Feeding Time



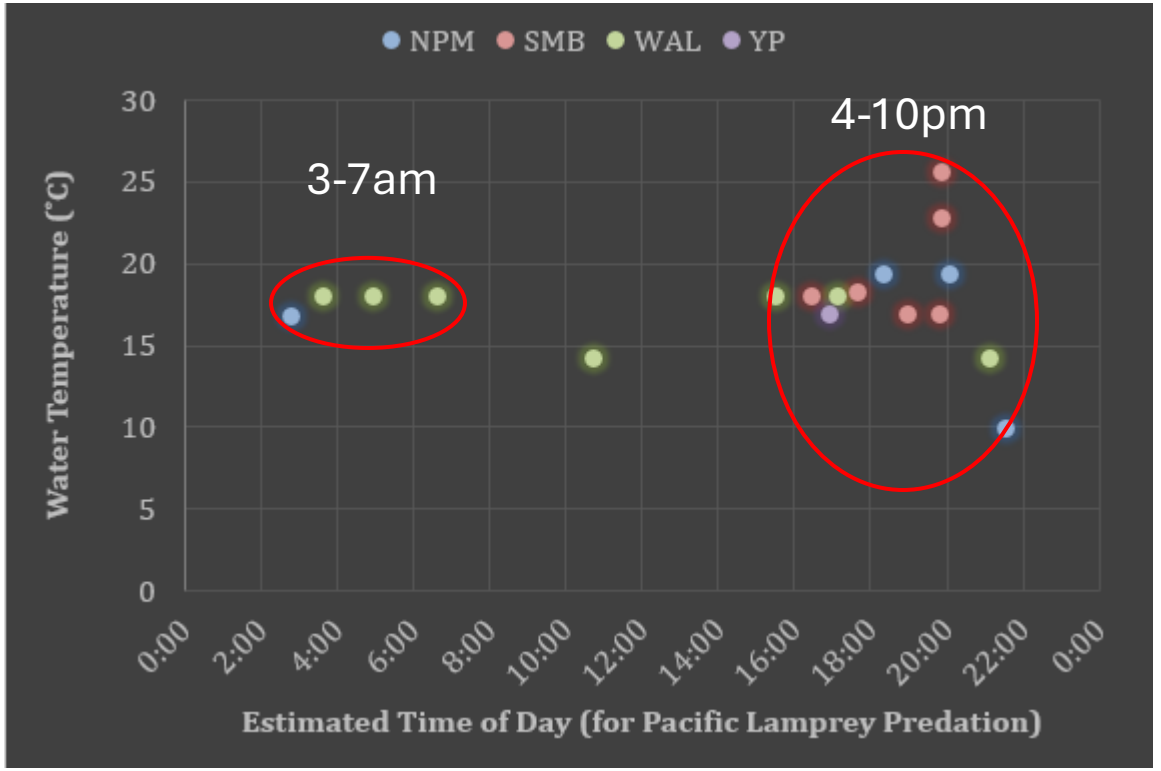
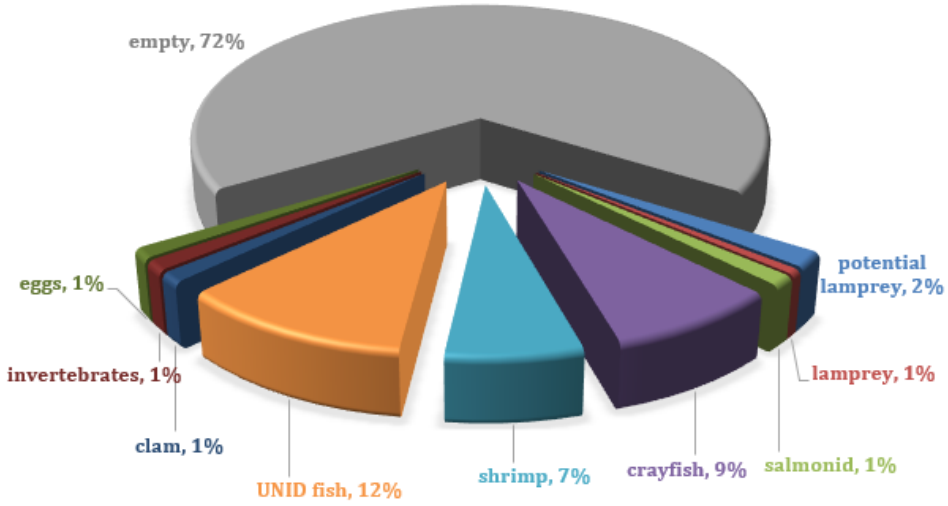
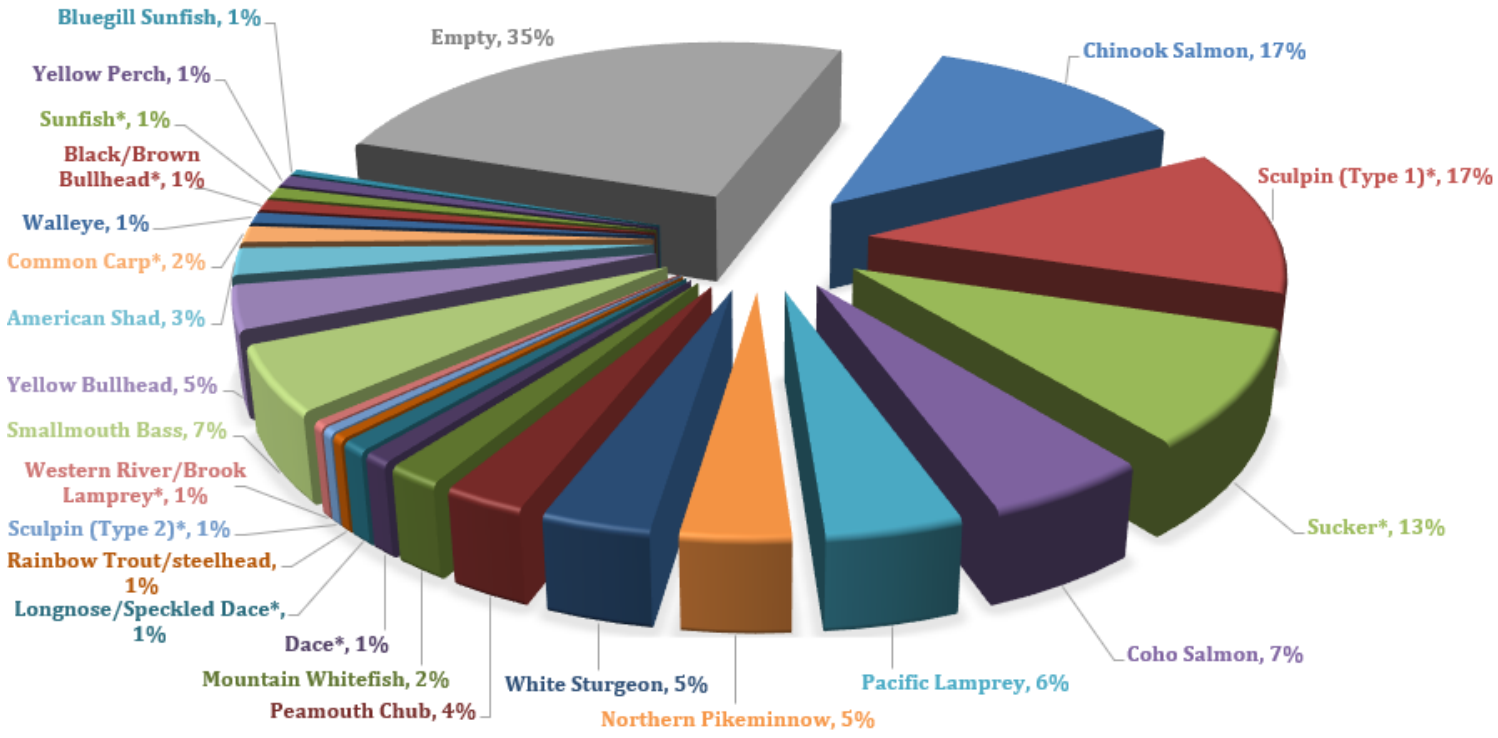


Figure 18. Estimated time of day for Pacific Lamprey Predation based on the regression analysis from the laboratory feeding study.

Visual ID vs Metabarcoding



Visual ID



Metabarcoding

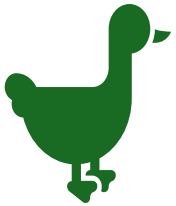
2024 Field Collection

Type \ Month	4	5	6	7	8	9	10	11	12	Subtotal
Fish	74	116	135	153	6	0	0	0	0	484
Bird	32	71	71	147	2	0	0	0	0	323
Bird Excreta	0	0	0	9	21	0	12	17	0	59
Sea Lion	47		0	0	0	0	0	0	0	47
Subtotal	153	187	206	309	29	0	12	17	0	913

Fish Collection

Collections occurred in the Columbia river, Yakima River, and Snake River

- **ODFW**- Boat Electrofishing (Daytime and Nightime)
- **WDFW**- Boat Electrofishing and Hook and line Dam Angling Program
- **Volunteer anglers-** Hook and line sampling



Avian Collection

Collection occurred along the Columbia River from The Dalles Dam to the Yakima River.

- **Yakima Nation-** near Yakima river
- **USDA**- The Dalles Dam through John Day Dam
- **USACE**- Fecal collection near The Dalles Dam through John Day Dam

Sea Lion

Collection occurred below Bonneville Dam

CRITFC/ODFW/WDFW

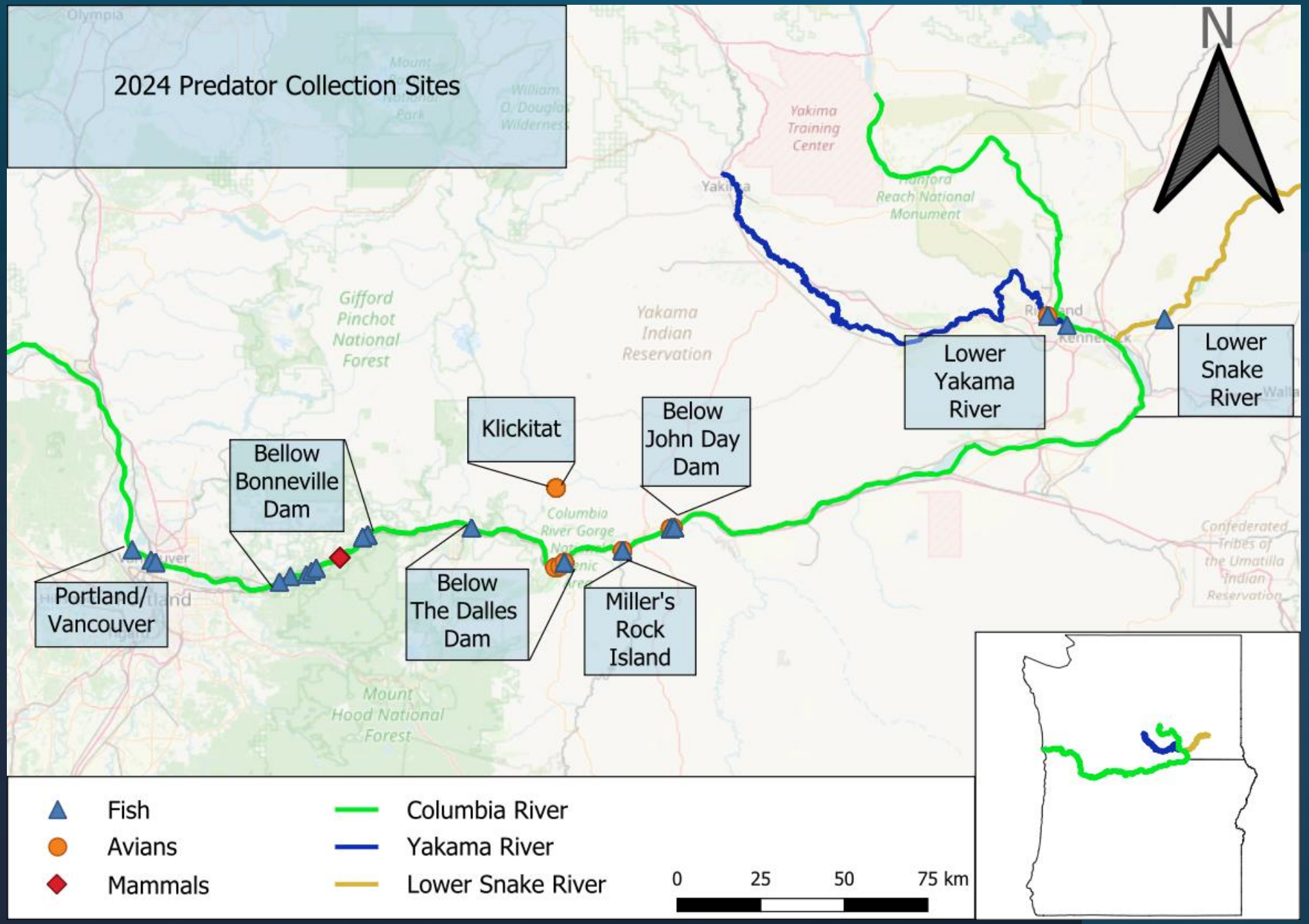
Gastric Fluids were collected through syringes from euthanized Stellar and California Sea lions

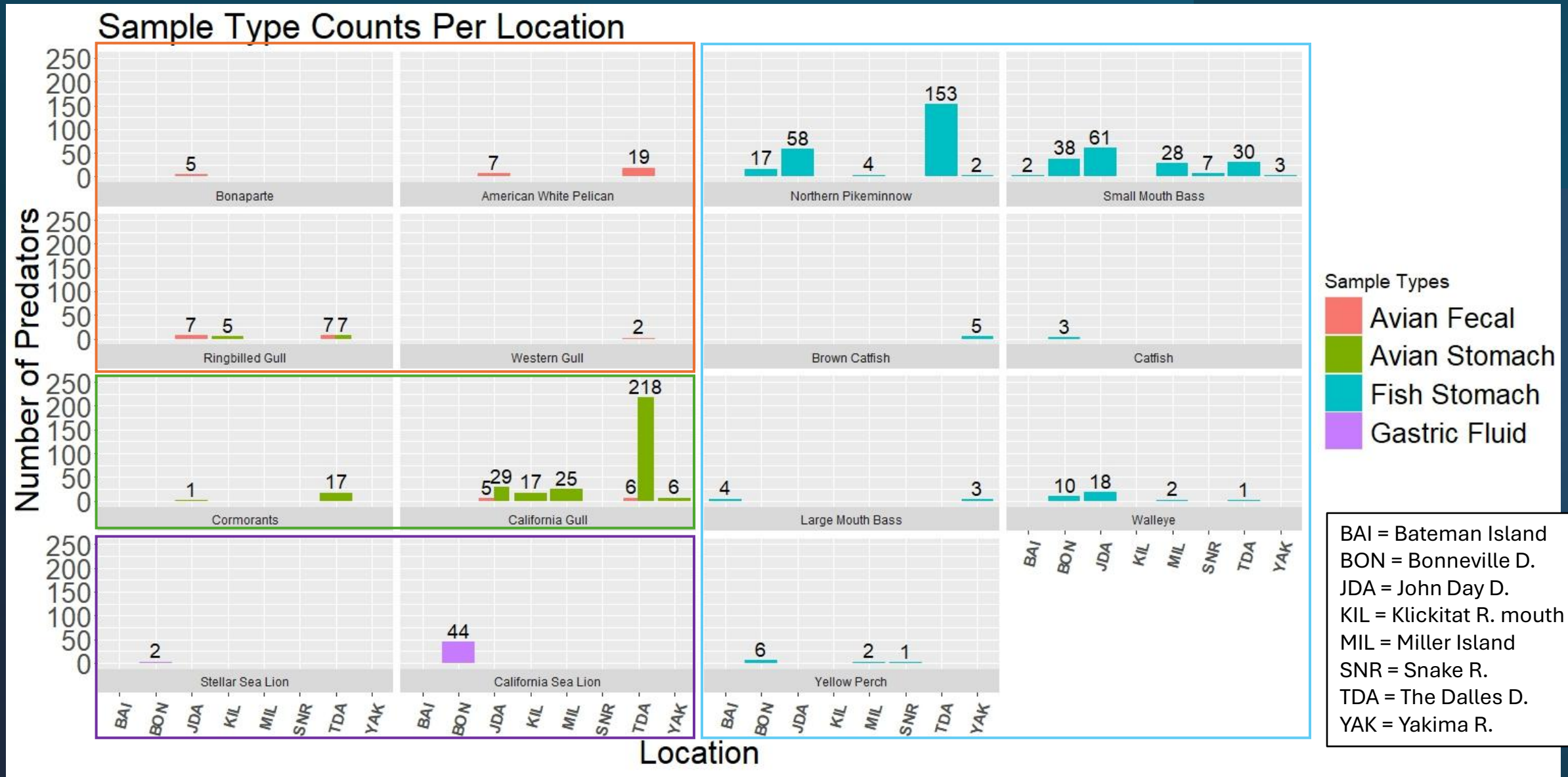
Round 1 of Metabarcoding (Experimental questions)

How viable are prey detections from avian samples that did not receiving the ETOH stomach injection, BUT were frozen within a 2-hour window?

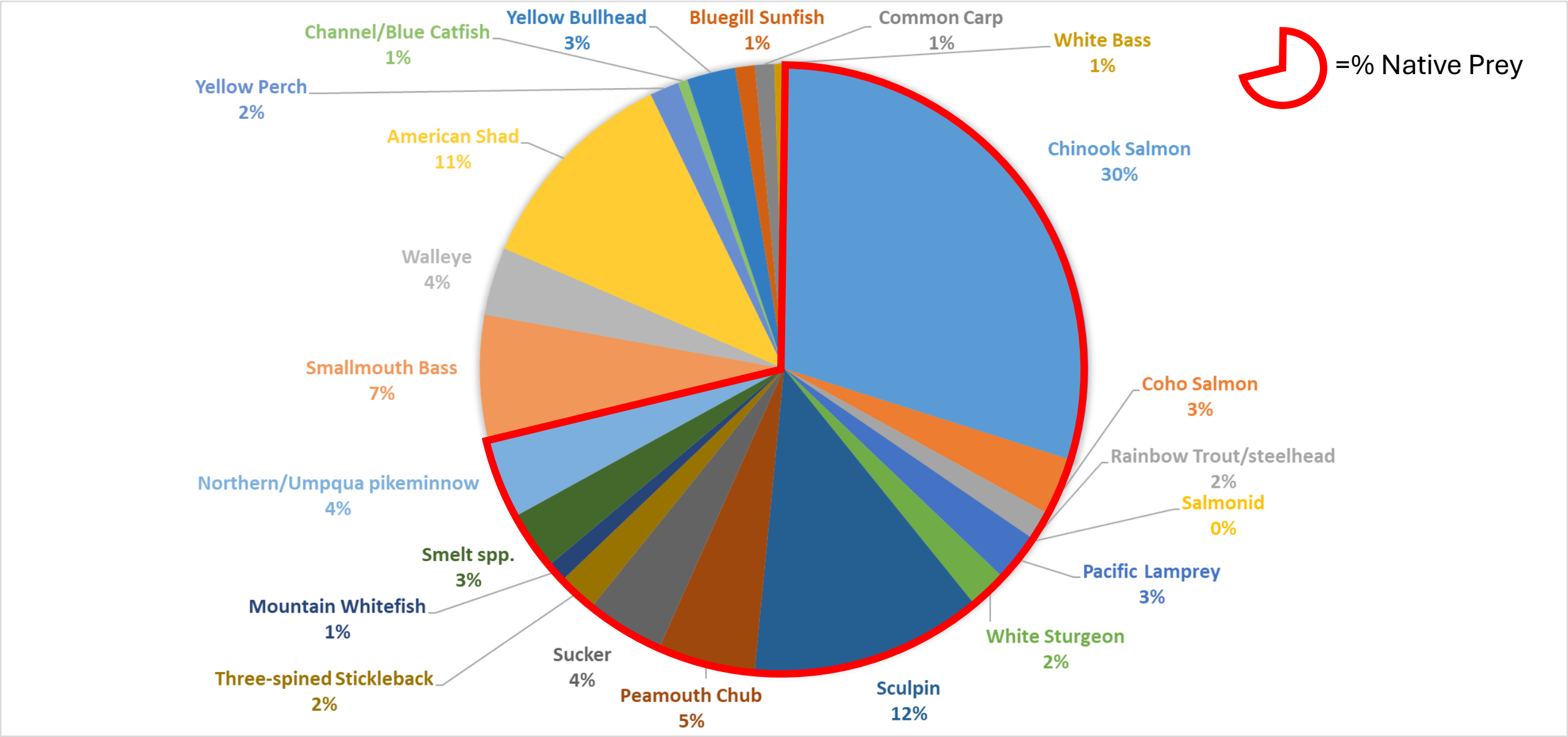
Can fecal samples provide informative insights into the consumption of fish by avians that are not available for lethal take and diet analysis?

How effectively will a subsample of sea lion gastric fluid provide insights into the composition of prey consumed?

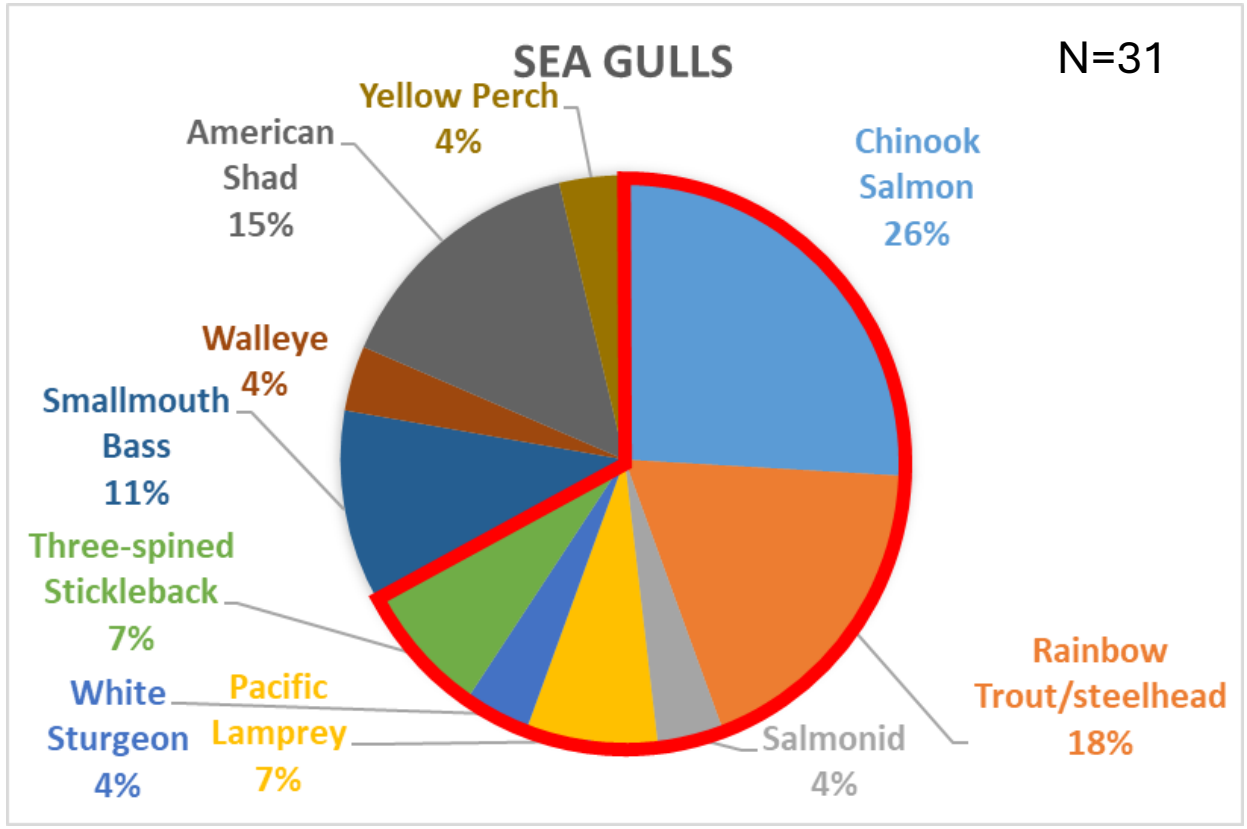

2024 Predator Collection Sites
N
Lower Yakama River
Lower Snake River
Klickitat
Below John Day Dam
Bellow Bonneville Dam
Below The Dalles Dam
Miller's Rock Island
Portland/ Vancouver
Yakima Training Center
Hanford Reach National Monument
Gifford Pinchot National Forest
Yakama Indian Reservation
Columbia River Gorge
Confederated Tribes of the Umatilla Indian Reservation
Mount Hood National Forest
Fish
Avians
Mammals
Columbia River
Yakama River
Lower Snake River
0
25
50
75 km

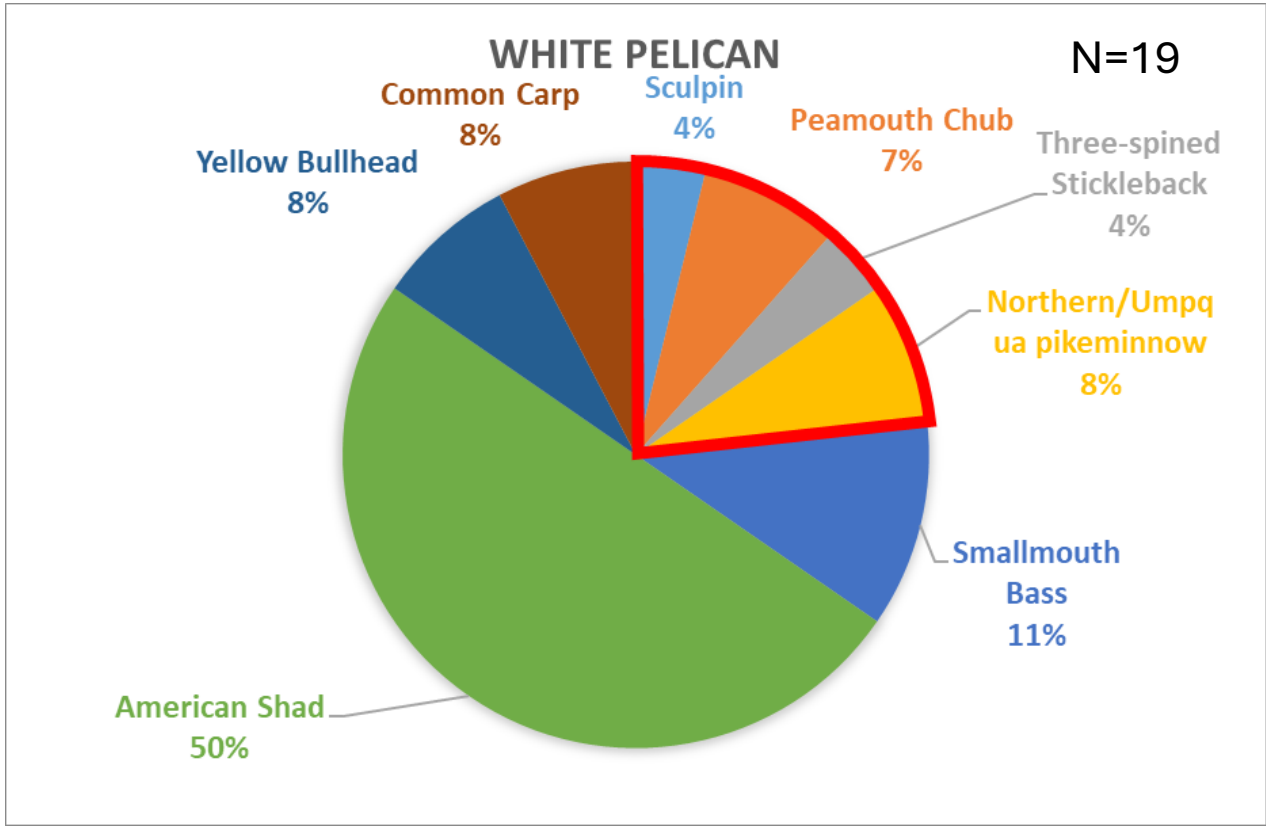

Sample Type Counts Per Location
Number of Predators
Location
Bonaparte
American White Pelican
Northern Pikeminnow
Small Mouth Bass
Ringbilled Gull
Western Gull
Brown Catfish
Catfish
Cormorants
California Gull
Large Mouth Bass
Walleye
Stellar Sea Lion
California Sea Lion
Yellow Perch
BAI
BON
JDA
KIL
MIL
SNR
TDA
YAK
Sample Types
Avian Fecal
Avian Stomach
Fish Stomach
Gastric Fluid
BAI = Bateman Island
BON = Bonneville D.
JDA = John Day D.
KIL = Klickitat R. mouth
MIL = Miller Island
SNR = Snake R.
TDA = The Dalles D.
YAK = Yakima R.

191 Samples (*Subset of All Samples - Preliminary)

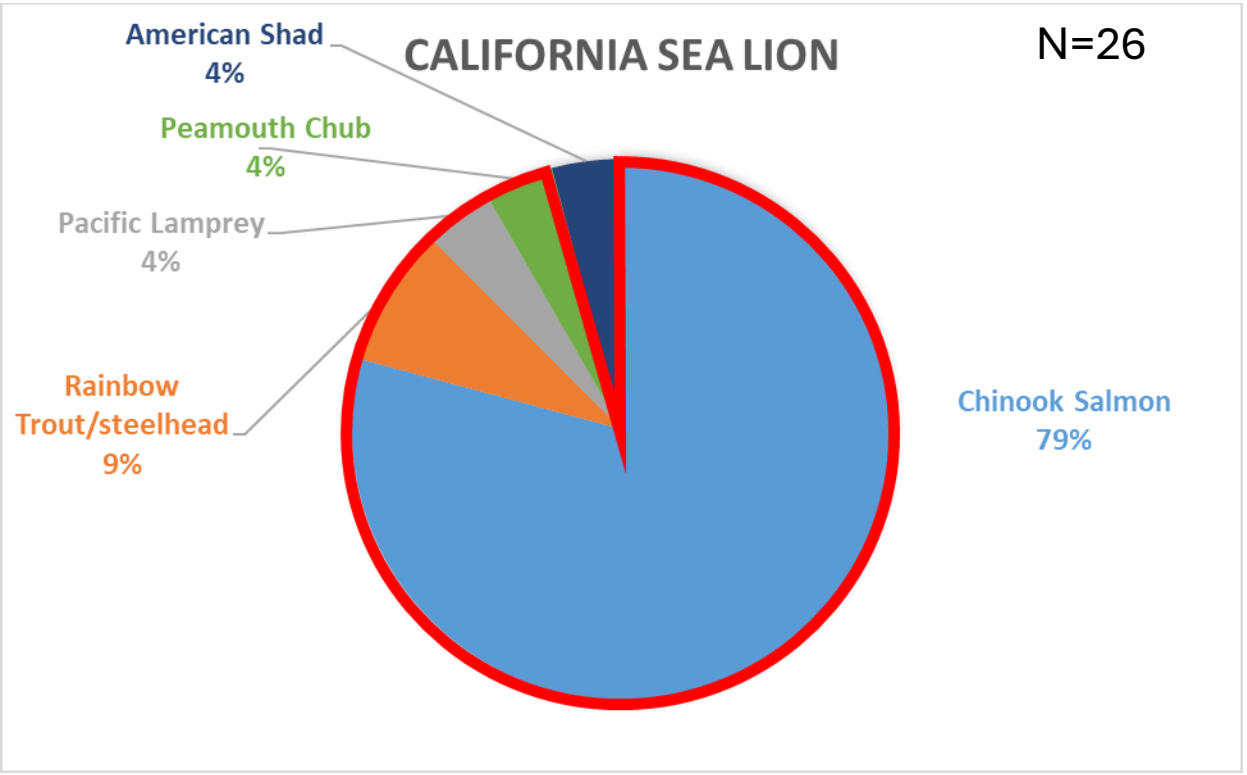


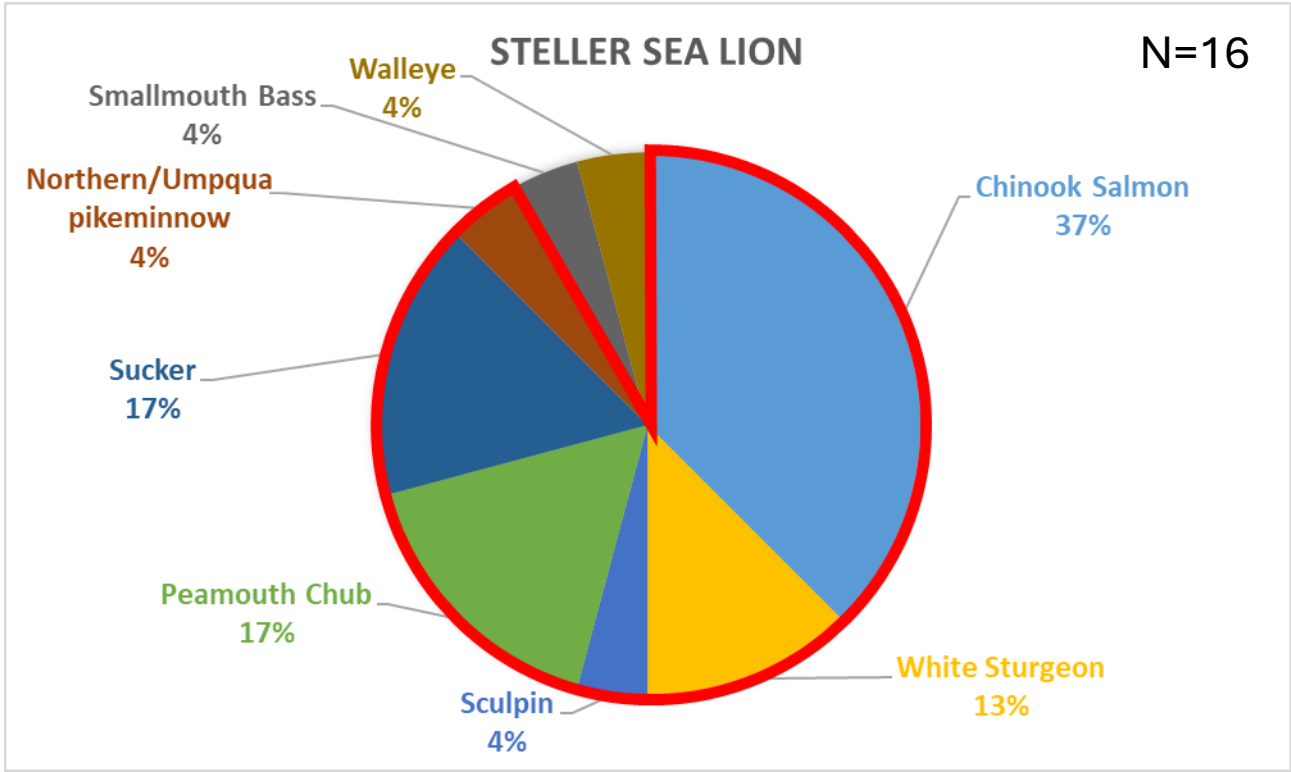
Avian Species
(*combination of gut & excreta & seasons)



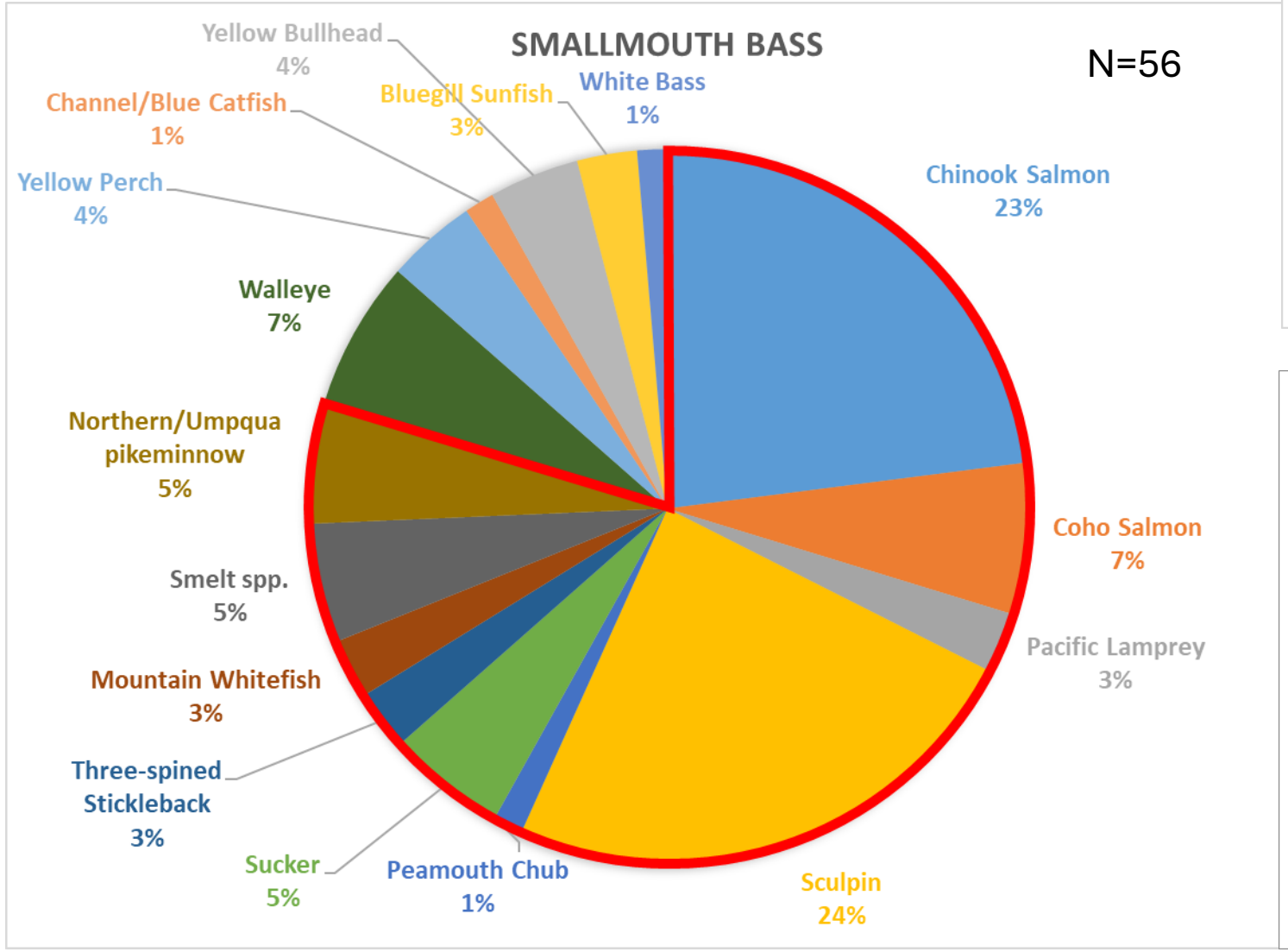


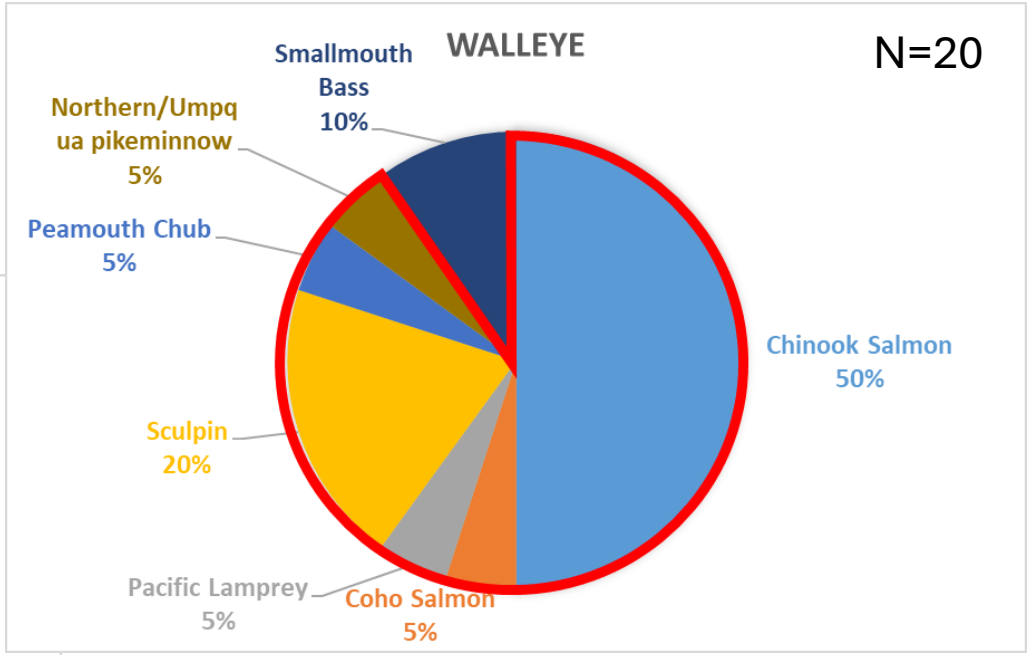
Sea Lions

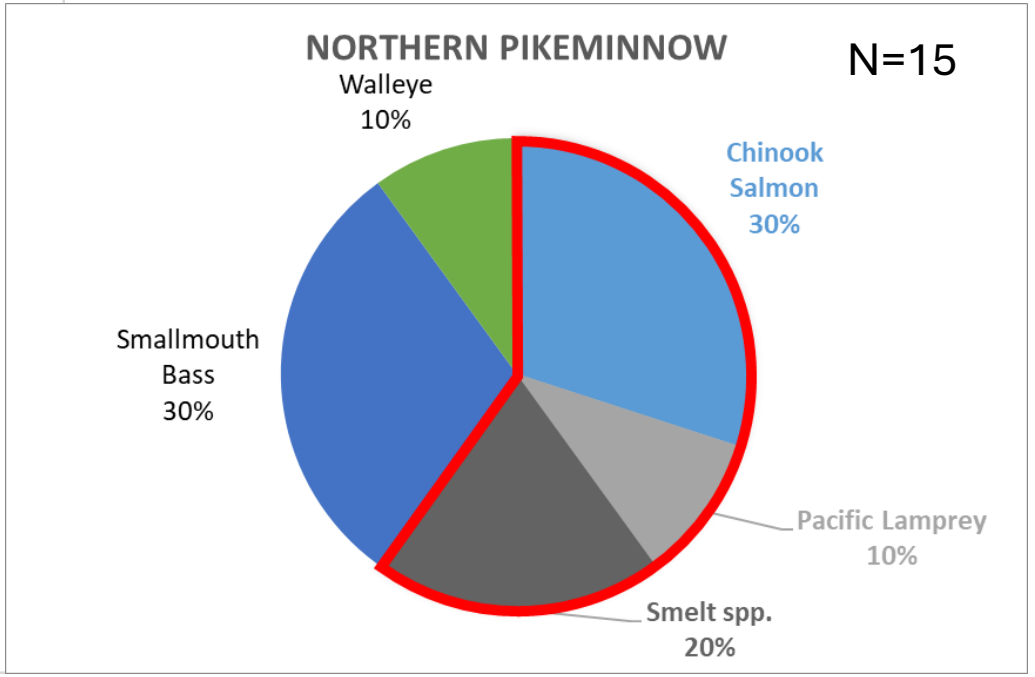

CALIFORNIA SEA LION
N=26
American Shad
4%
Peamouth Chub
4%
Pacific Lamprey
4%
Rainbow
Trout/steelhead
9%
Chinook Salmon
79%


STELLER SEA LION
N=16
Walleye
4%
Smallmouth Bass
4%
Northern/Umpqua
pikeminnow
4%
Chinook Salmon
37%
Sucker
17%
Peamouth Chub
17%
White Sturgeon
13%
Sculpin
4%

Fish Species







Creative Solution for Passage

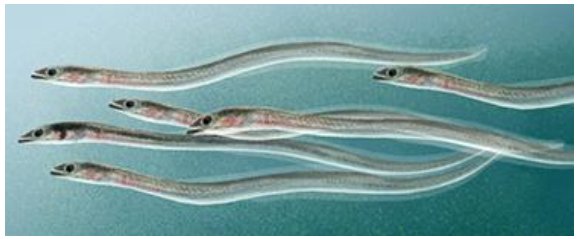
- **Watz et al. 2017** -> Trap from Sweden (Karlstad Uni)

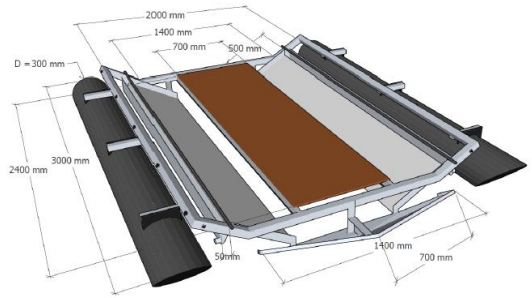
MANAGEMENT AND ECOLOGICAL NOTE

WILEY Fisheries Management and Ecology

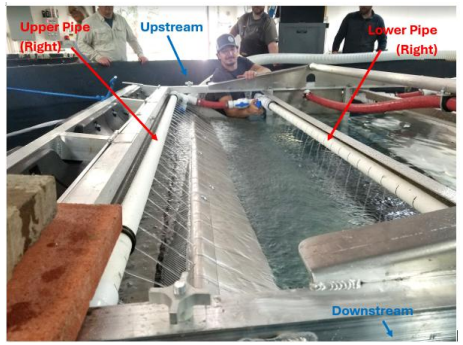
Evaluation of a novel mobile floating trap for collecting migrating juvenile eels, *Anguilla anguilla*, in rivers

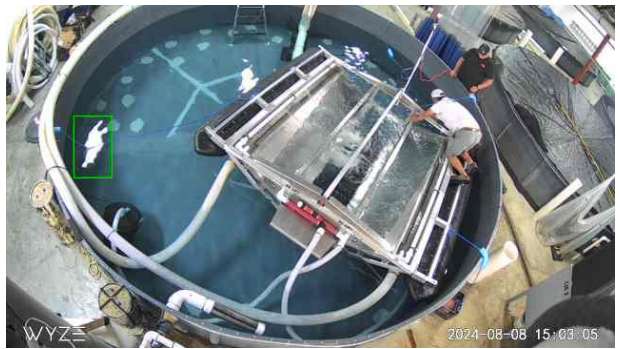
J. Watz[1] | J. Elghagen[2] | P. A. Nilsson[1,3] | O. Calles[1]

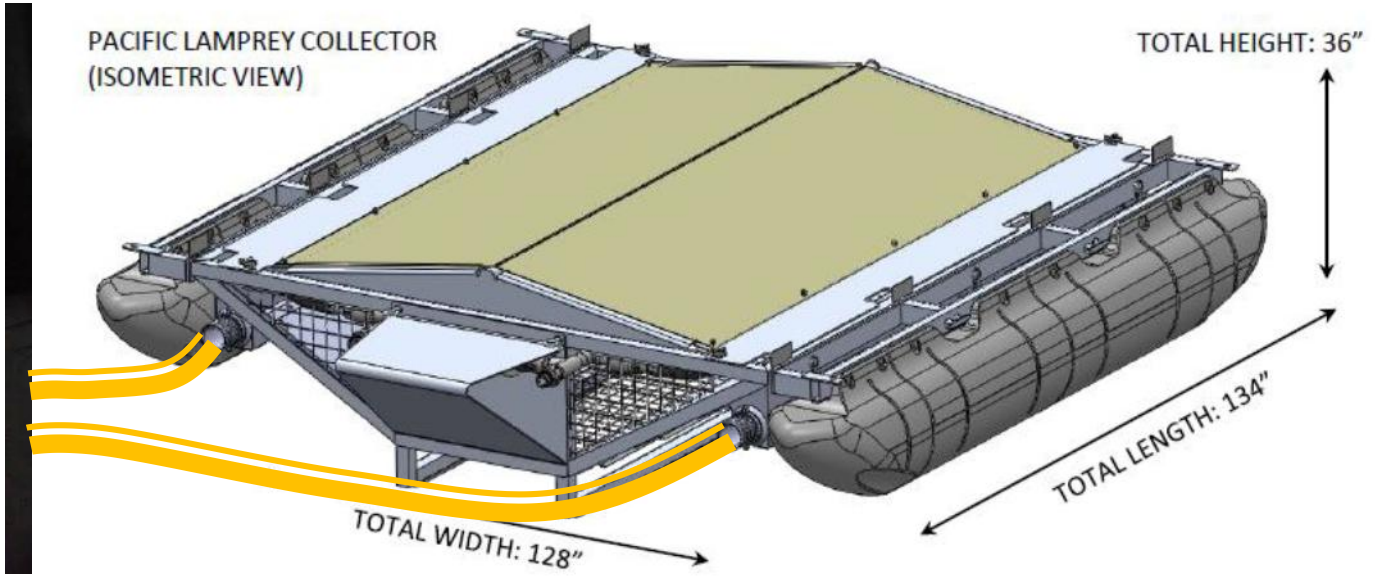


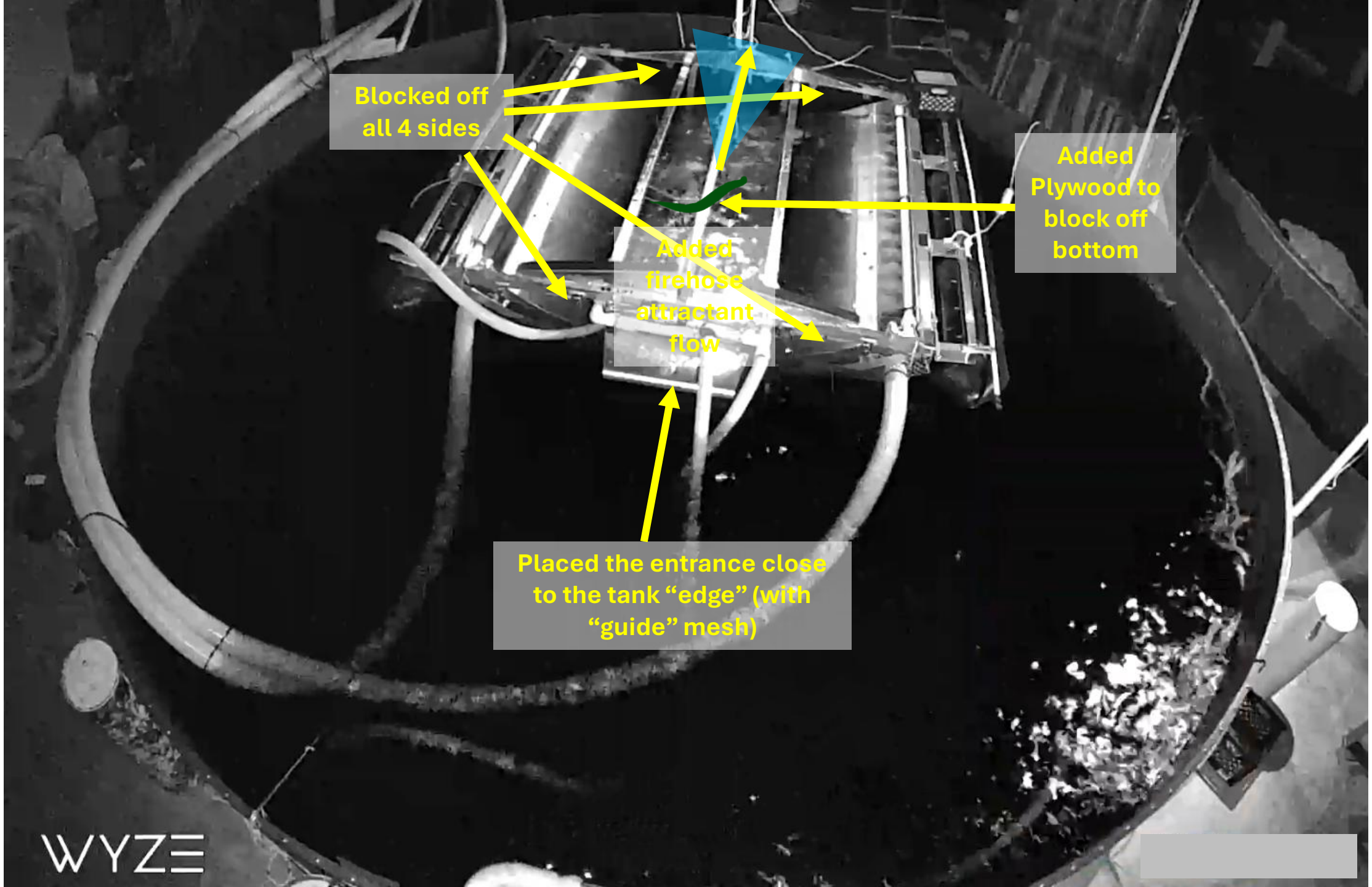


- Whooshh Innovations (patent)
  -> CRITFC Tribes input for lamprey
- **Floating Adult Lamprey Collector (Operation Nocturnal) [FALCON]**



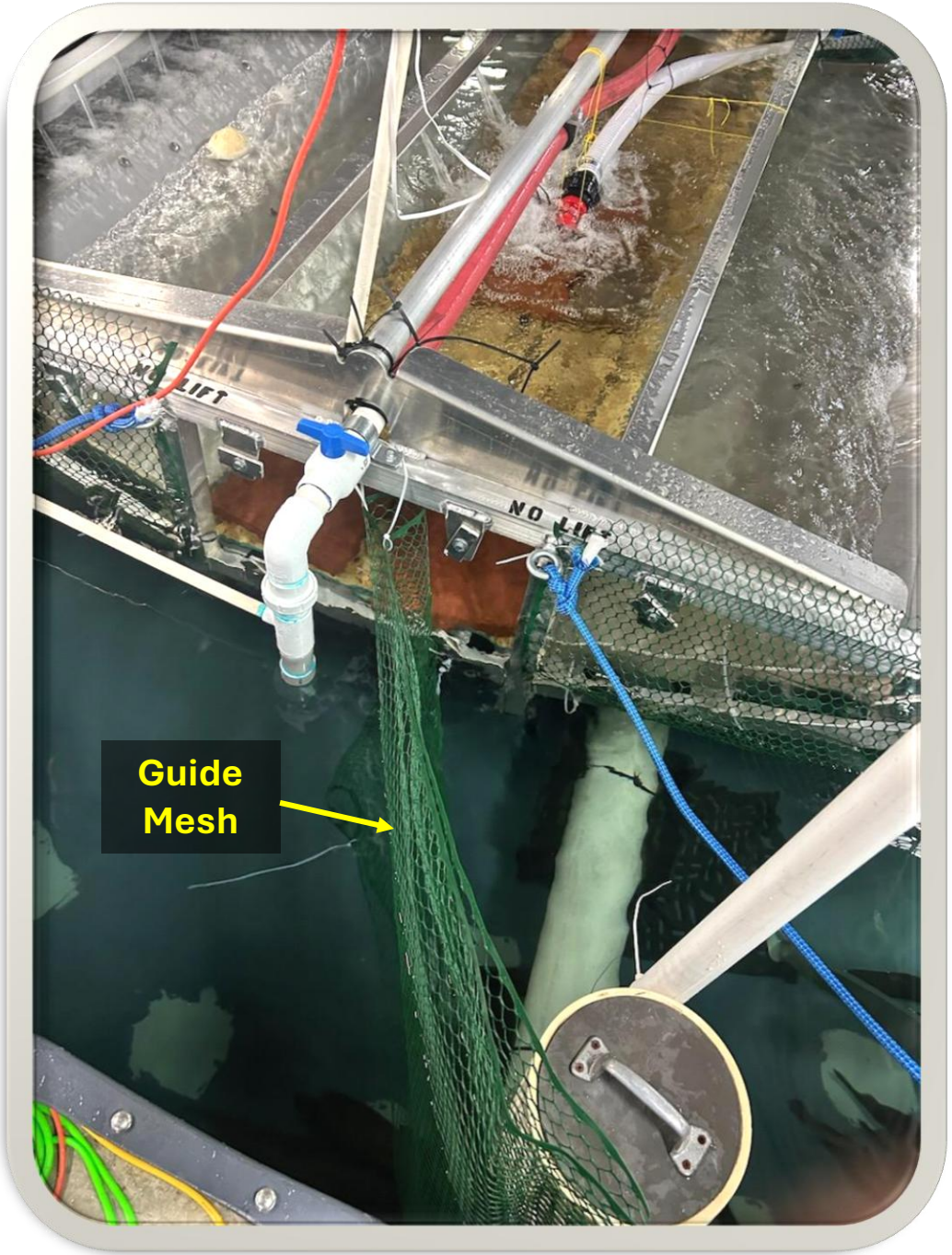


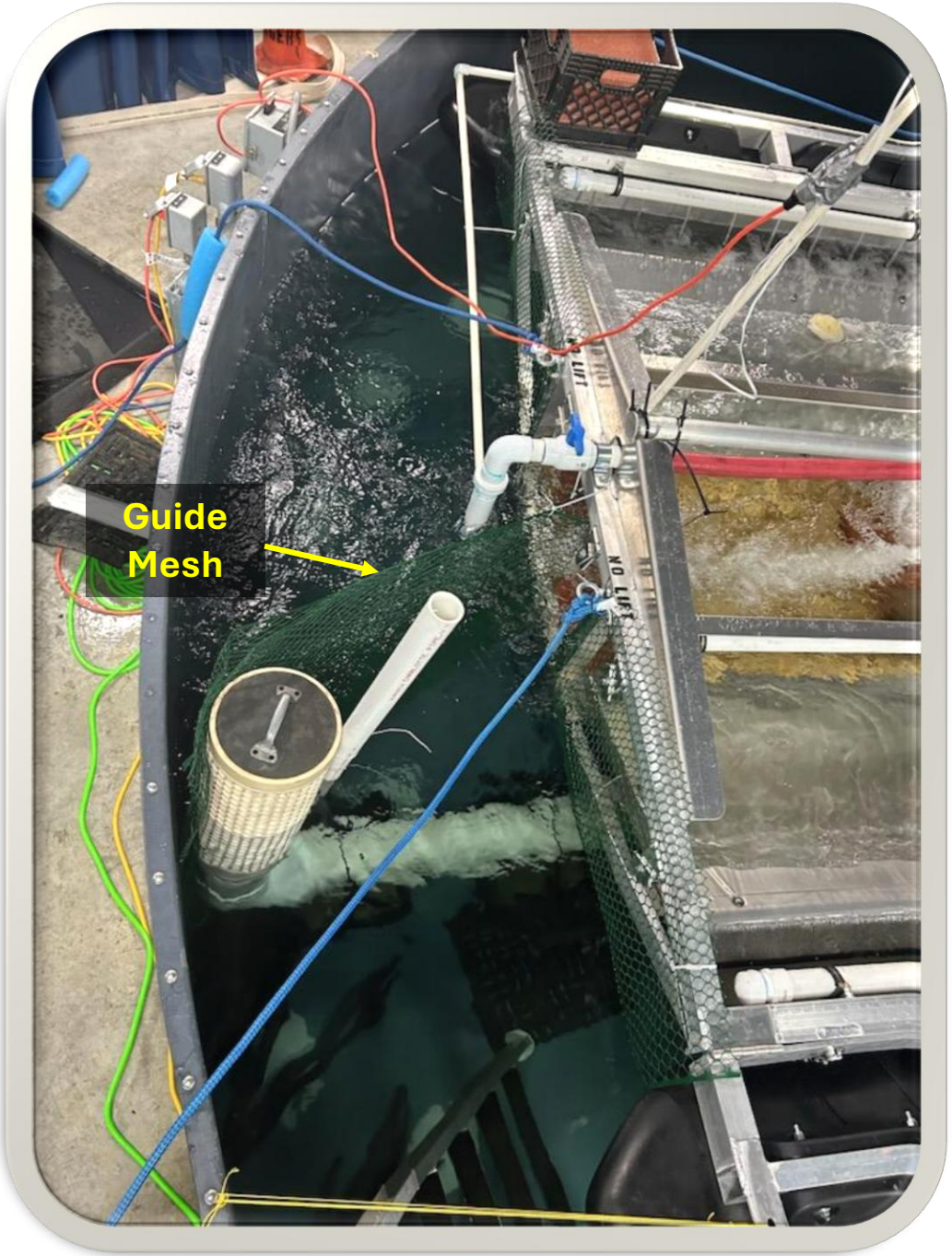



Blocked off all 4 sides
Added Plywood to block off bottom
Added firehose attractant flow
Placed the entrance close to the tank “edge” (with “guide” mesh)
WYZE

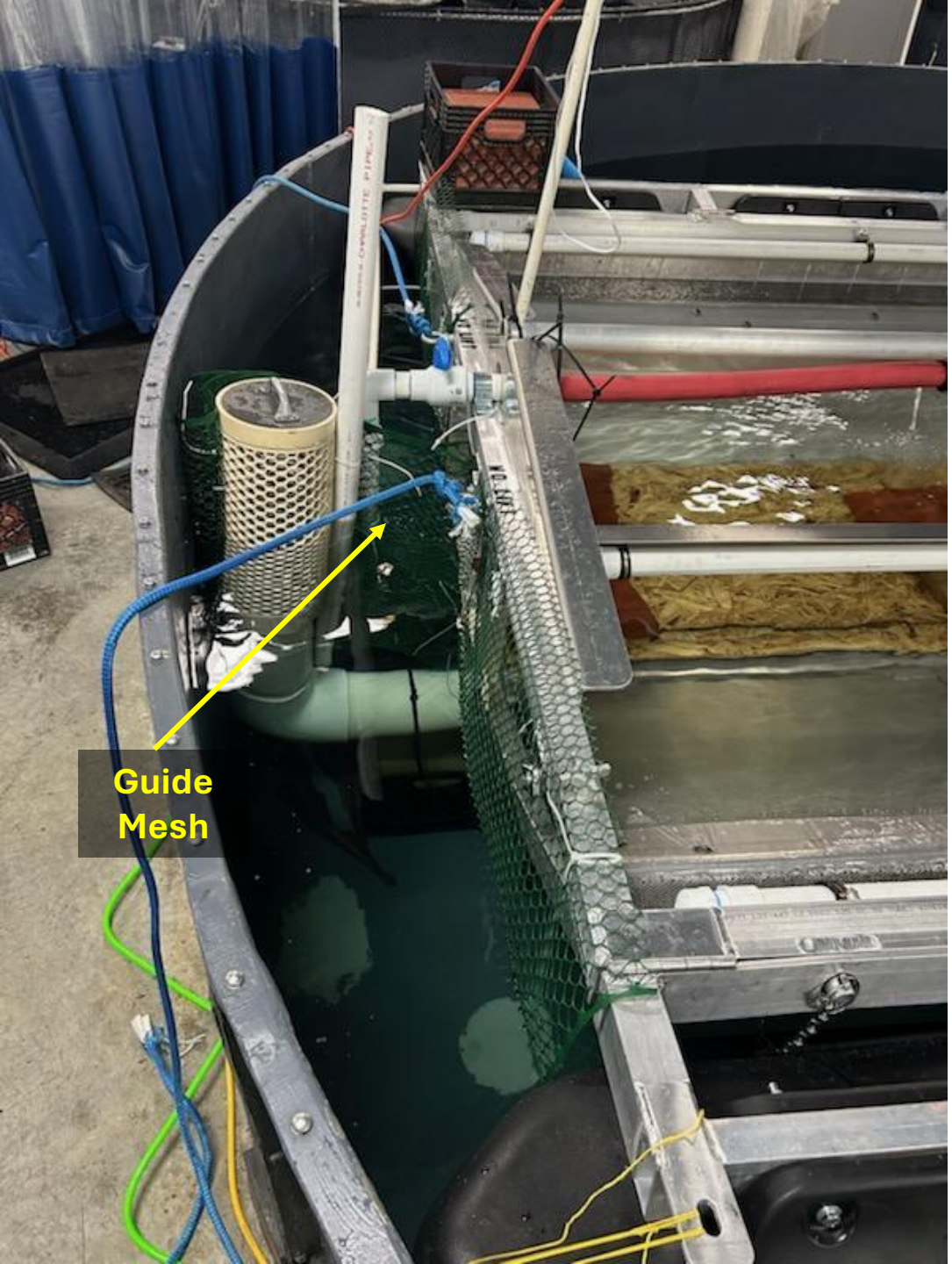

WYZE
2024-08-14 18:19:01

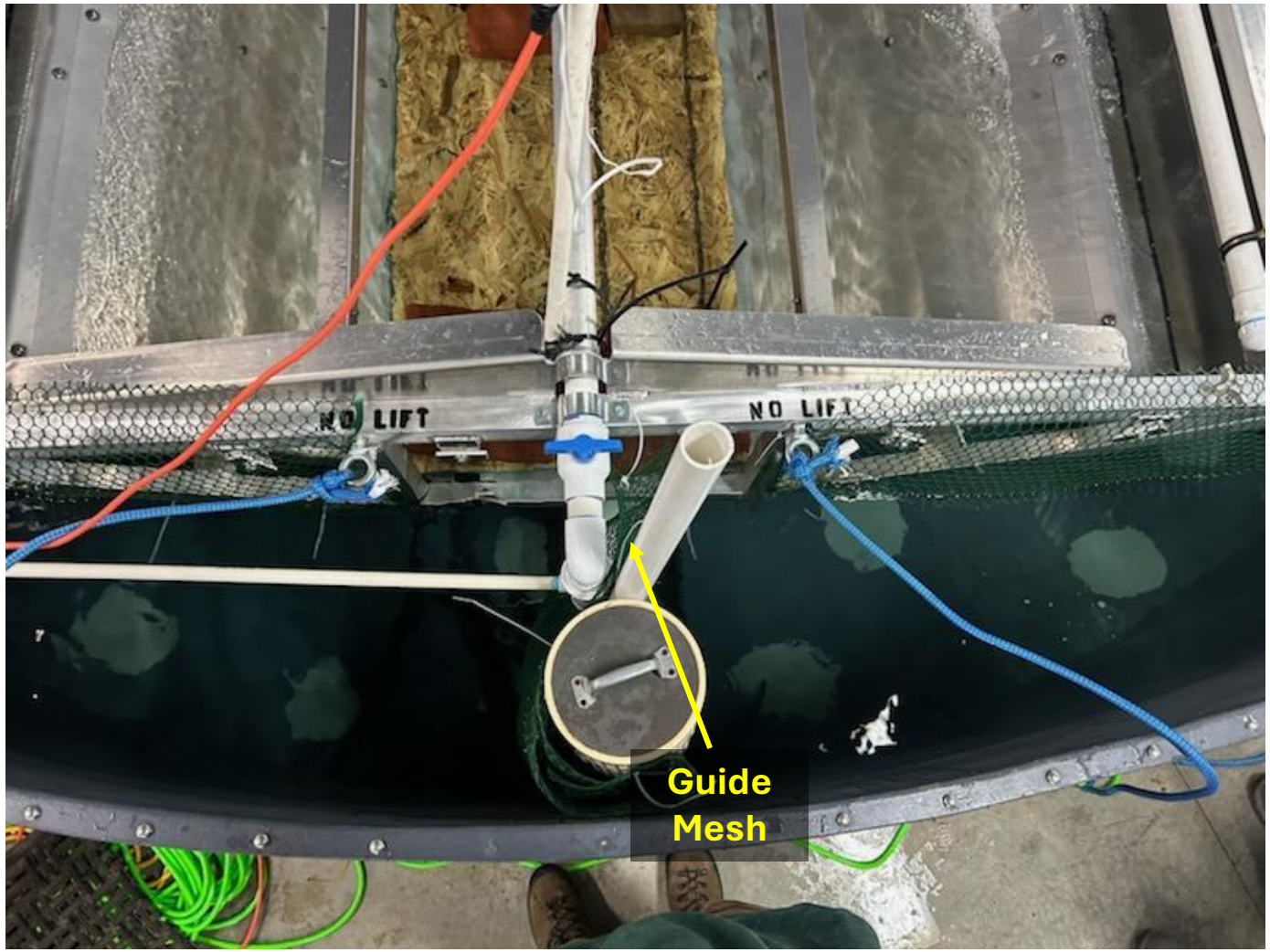
8/20/24 – Structure Entrance "Closer" with a Guide Mesh



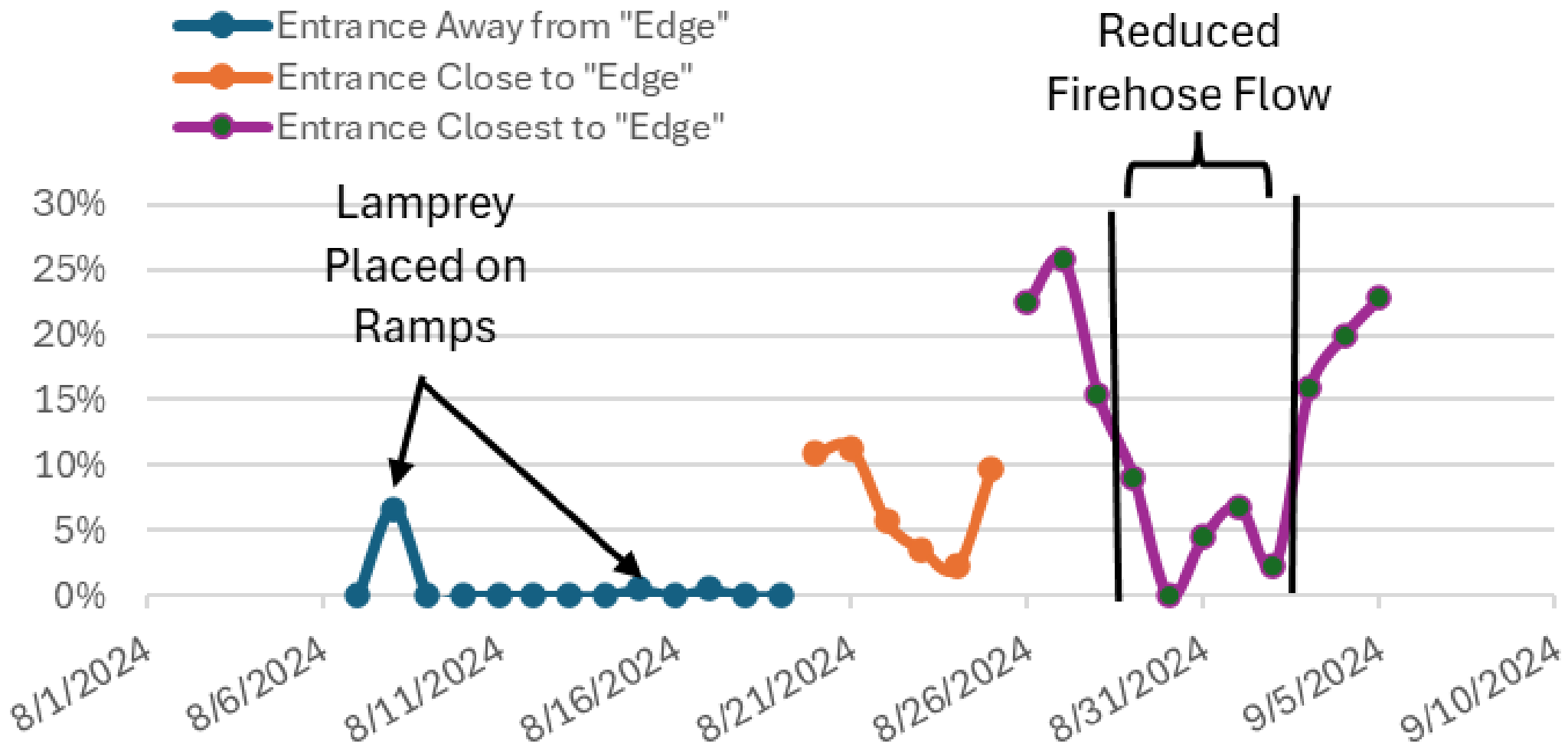


8/26/24 – Structure Entrance “Closer” with a Guide Mesh





Floating Adult Lamprey Collector Operational Nocturnal Capture Efficiency

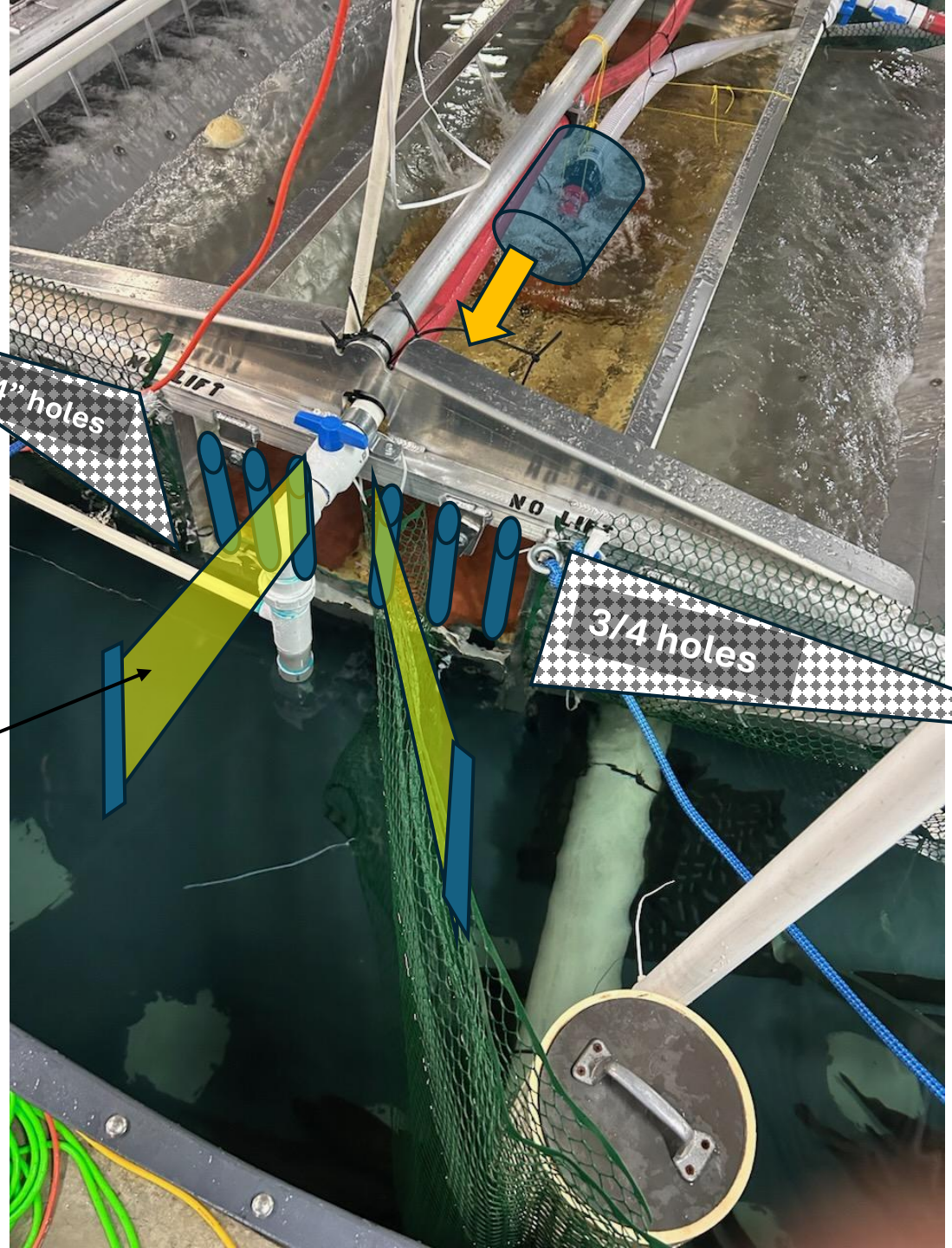



Spray bar added
to test lamprey
response
WYZE
2024-08-14 23:17:00


One Hypothesis:
Lamprey Pheromone /
Scent on Edge
Environment!
WYZE

2. Close off the 4 sides (3/4 inch perforated plates)

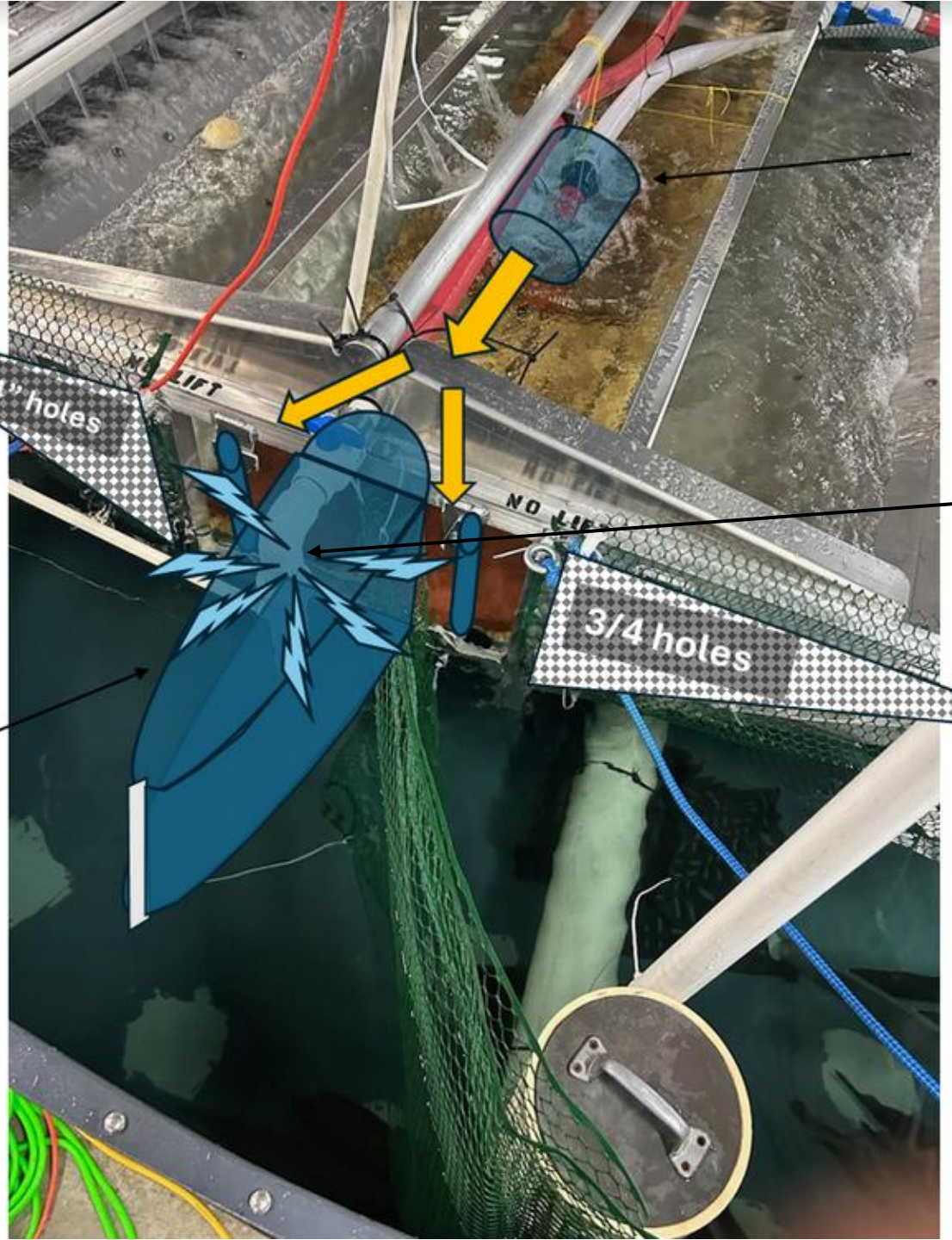
5. Add a media that connects the entrance to the wall that the structure is facing (I envision two short triangle plates with rubber at the end, so it touches the wall).



Alternative Design

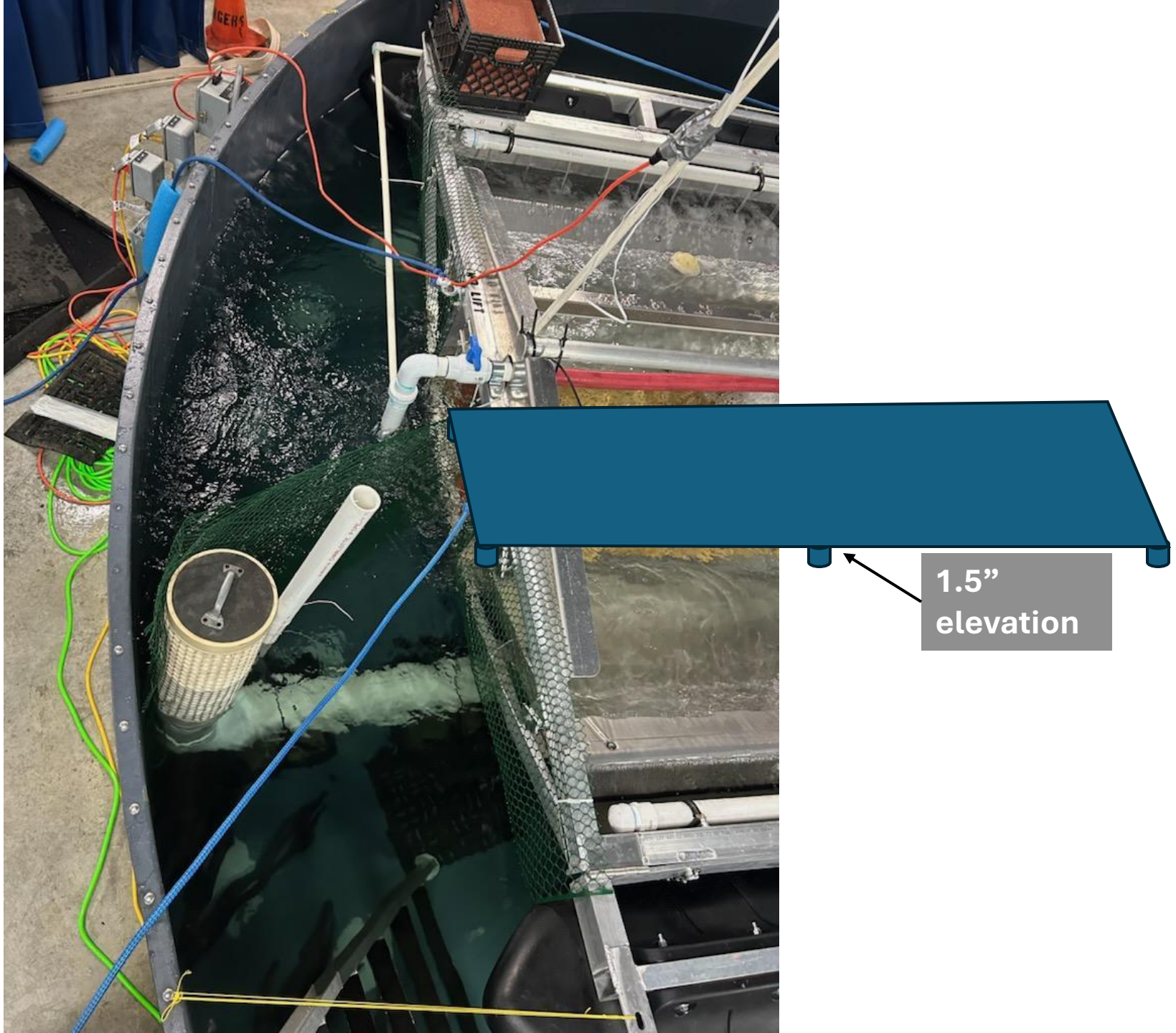
2. Close off the 4 sides (3/4 inch perforated plates)

5. Add a media that connects the entrance to the wall that the structure is facing (I envision two short triangle plates with rubber at the end, so it touches the wall).

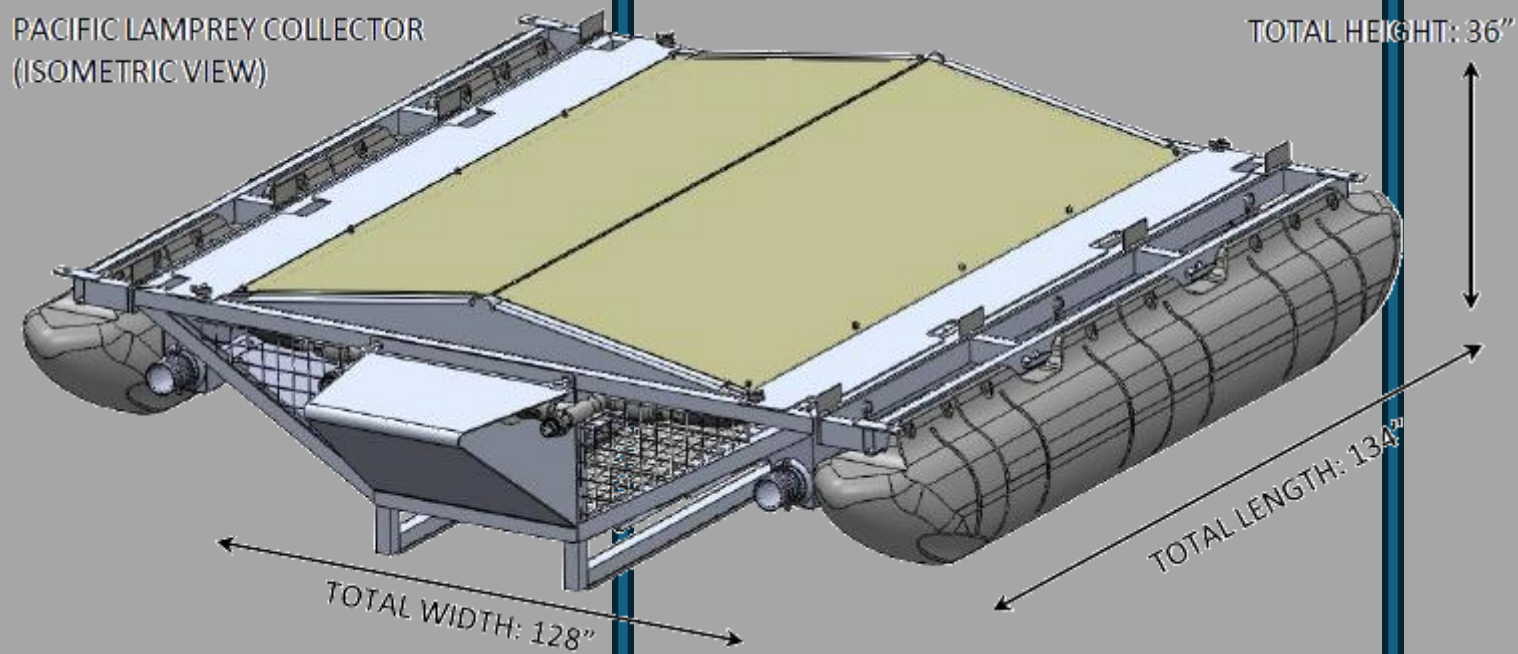


8. Modify this to splash water on the triangle plates (which will attract more lamprey to move this direction)

3. Close off the bottom (or elevate it slightly so there is 1.5 inch opening)



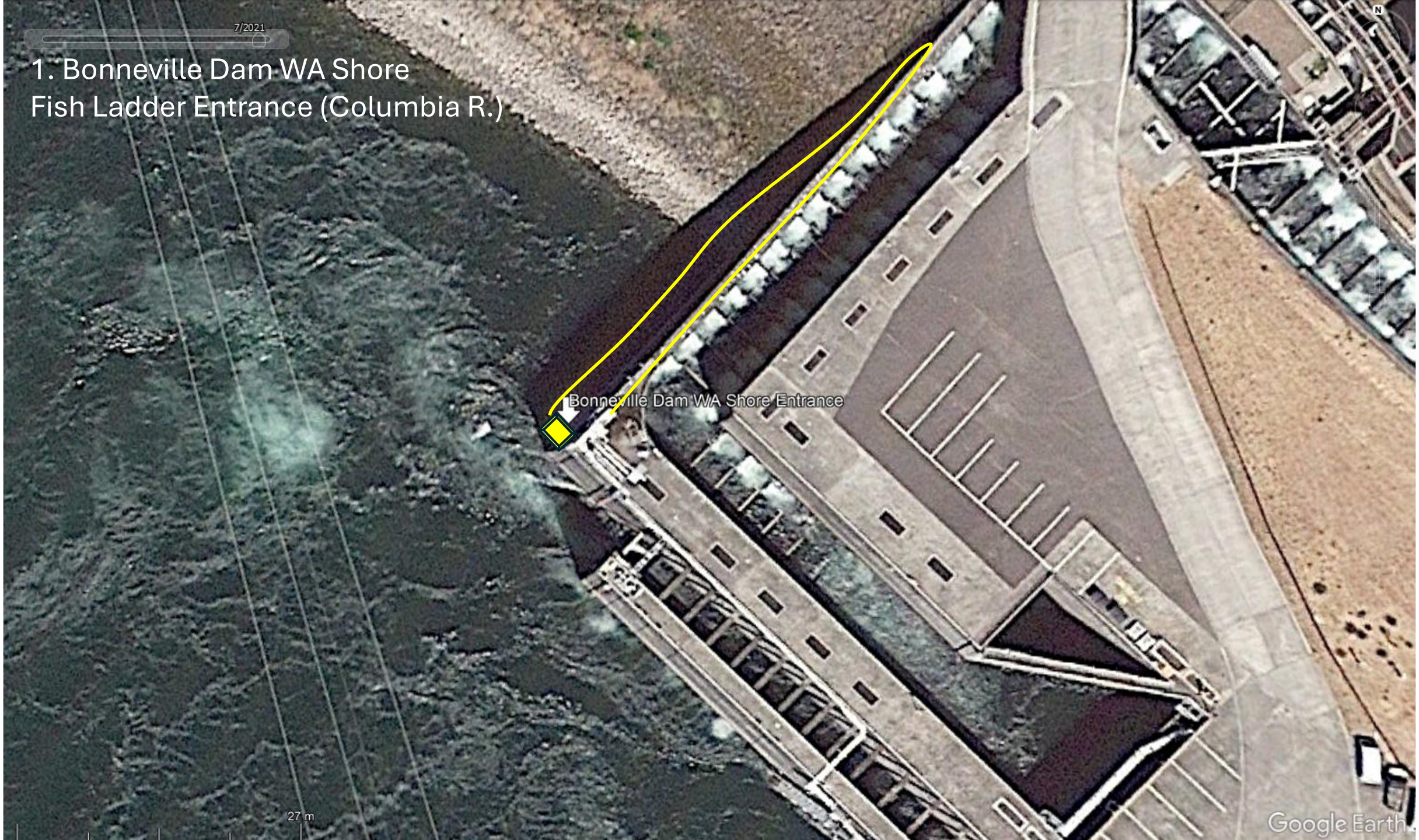
Dual Rail System



Entrance Flow

Key Needs for an Ideal Test Site

1. A high abundance of adult lamprey moving through
2. A pinch point that forces lamprey to search the wall/bank for alternative passage
3. A wall/bank that the structure can adhere to as close as possible
4. Some type of protection from high flow and debris moving through

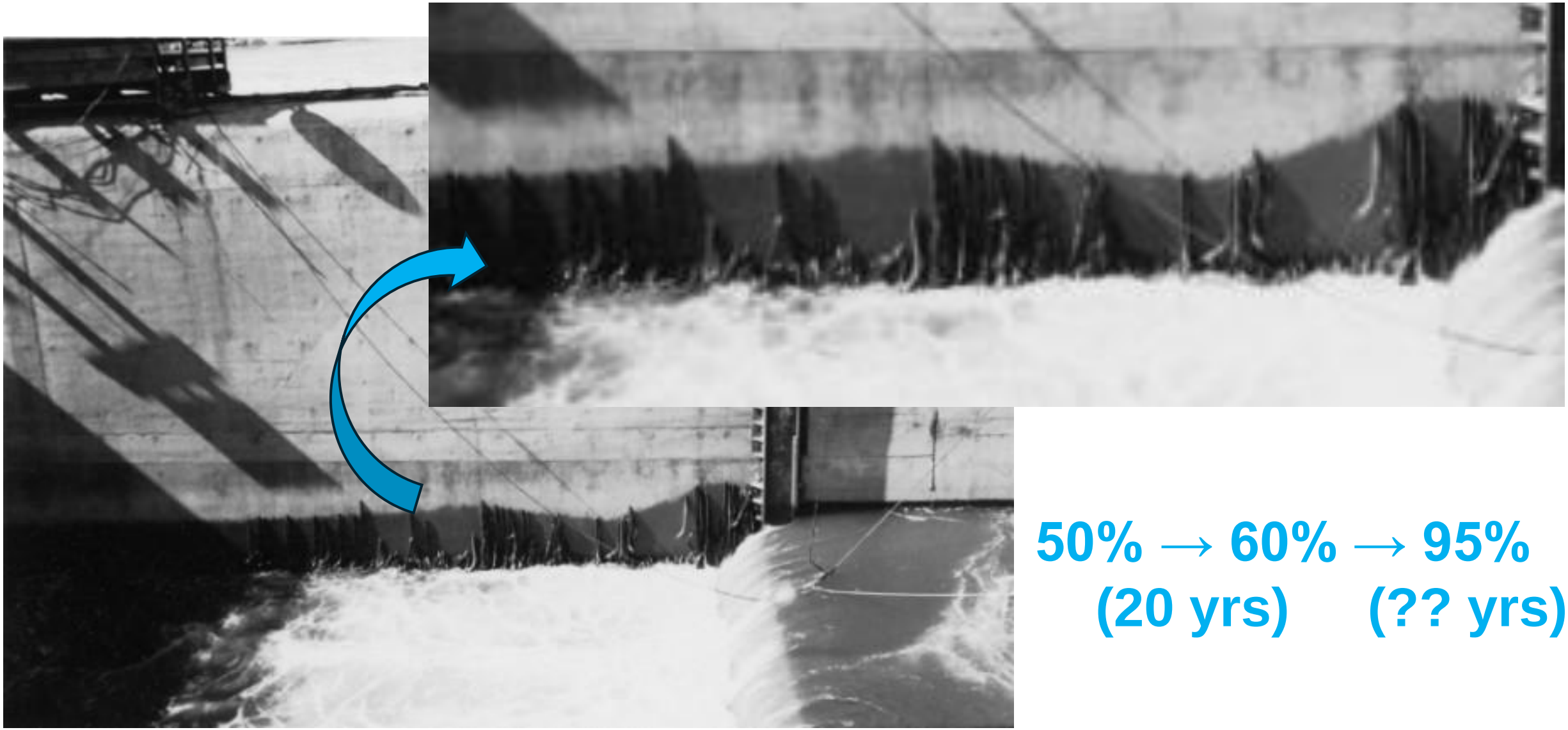

7/2021
1. Bonneville Dam WA Shore
Fish Ladder Entrance (Columbia R.)
Bonneville Dam WA Shore Entrance
27 m
Google Earth

2. The Dalles Dam (East Fish Ladder Entrance)

2. The Dalles Dam (East Fish Ladder Entrance)

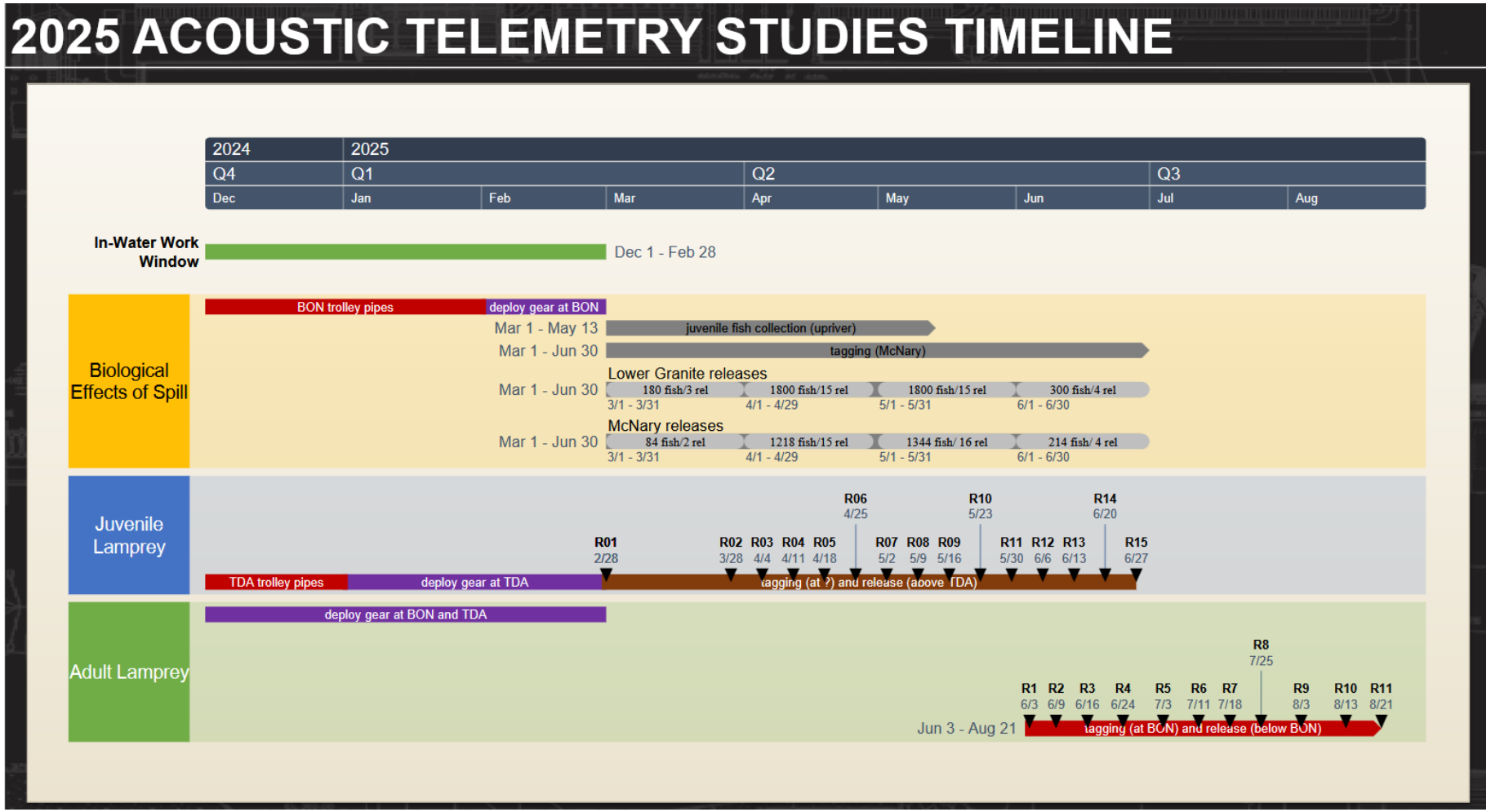
3. The Dalles Dam (East Fish Ladder Entrance)

Bonneville Dam Temp. Fish Ladder (7/2/1937)



50% → 60% → 95%
(20 yrs) (?? yrs)

2025 Lamprey Acoustic Telemetry Study



All adult Lamprey will be tagged with HDX tags

Asking all tributary instream / facility operators to turn on dual mode for FDX/HDX detections