Factors affecting Northern Pike (*Esox lucius*) leaping ability: implications for selective barrier design in invaded systems

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This research has been conducted on the ceded and unceded lands of the Lower Tanana Dene', Dena'ina, and Ahtna People of Alaska, and the Blackfeet and Crow People of Montana.

I am grateful for their past, present, and future stewardship of these habitats and aquatic resources I will share with you today.
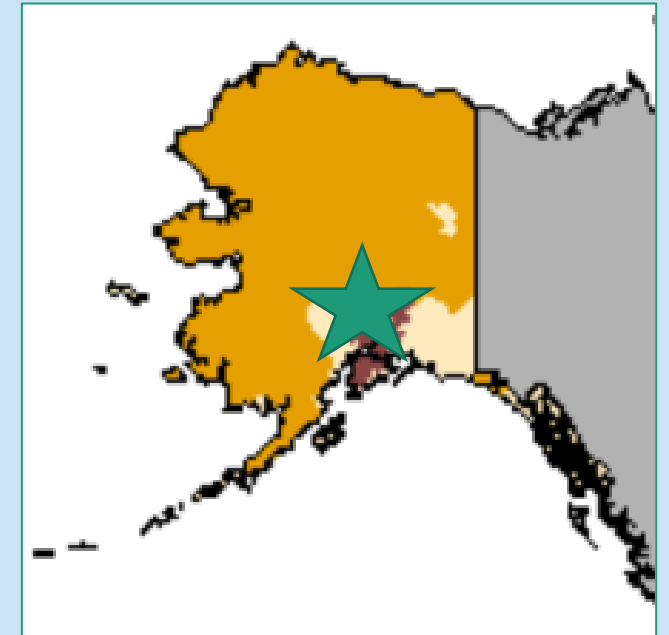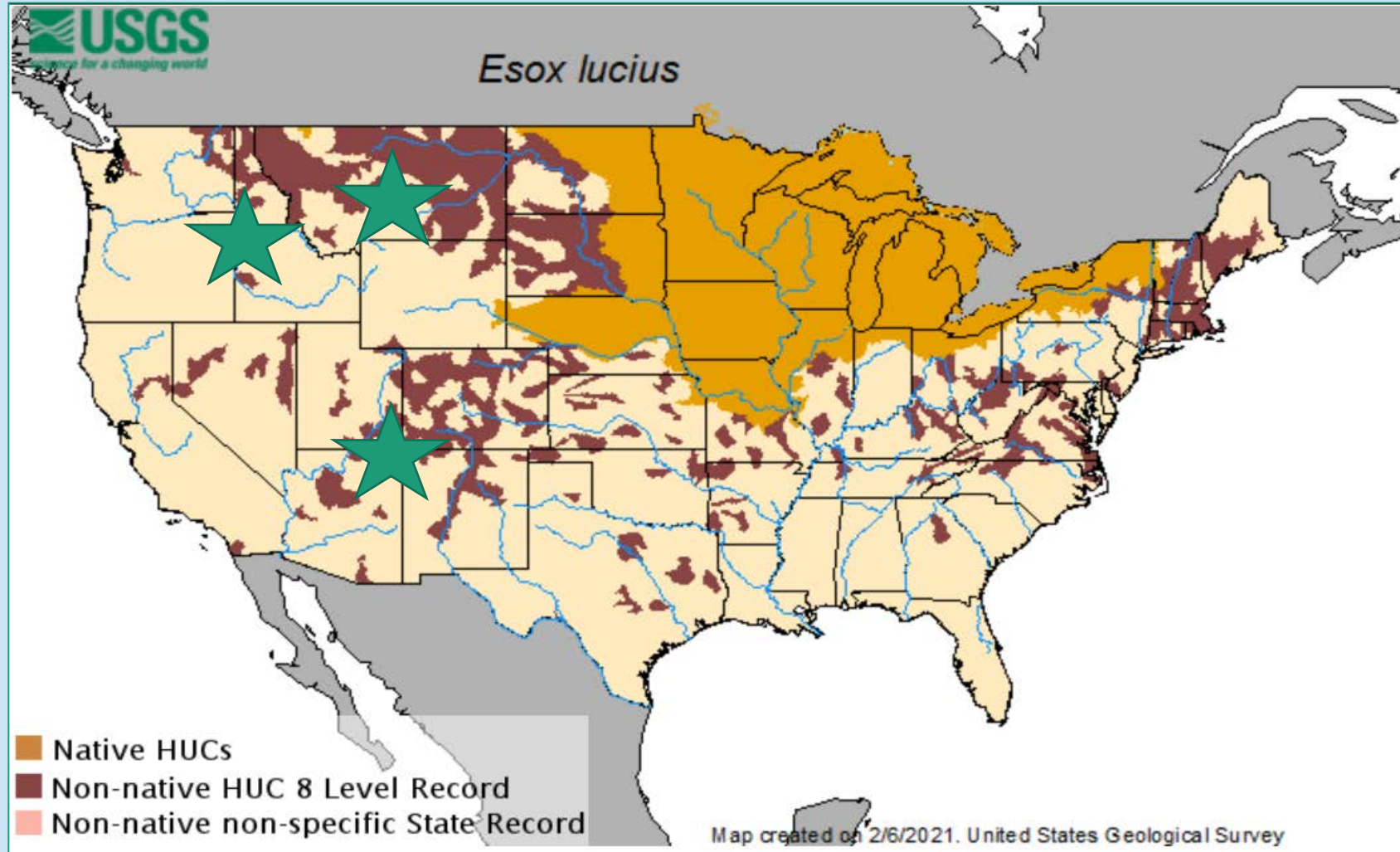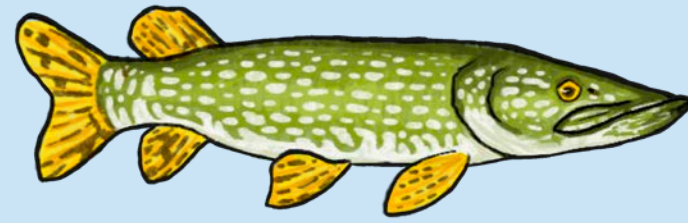
Biological invasions – learning opportunities

SMALLMOUTH BASS FOUND NORTH OF YELLOWSTONE

Image from: https://troutsflyfishing.com/

Longer-legged toads hop further faster

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Invasion example – Northern Pike

Esox lucius

Native HUCs
Non-native HUC 8 Level Record
Non-native non-specific State Record

Map created on 2/6/2021. United States Geological Survey

Northern Pike in Alaska

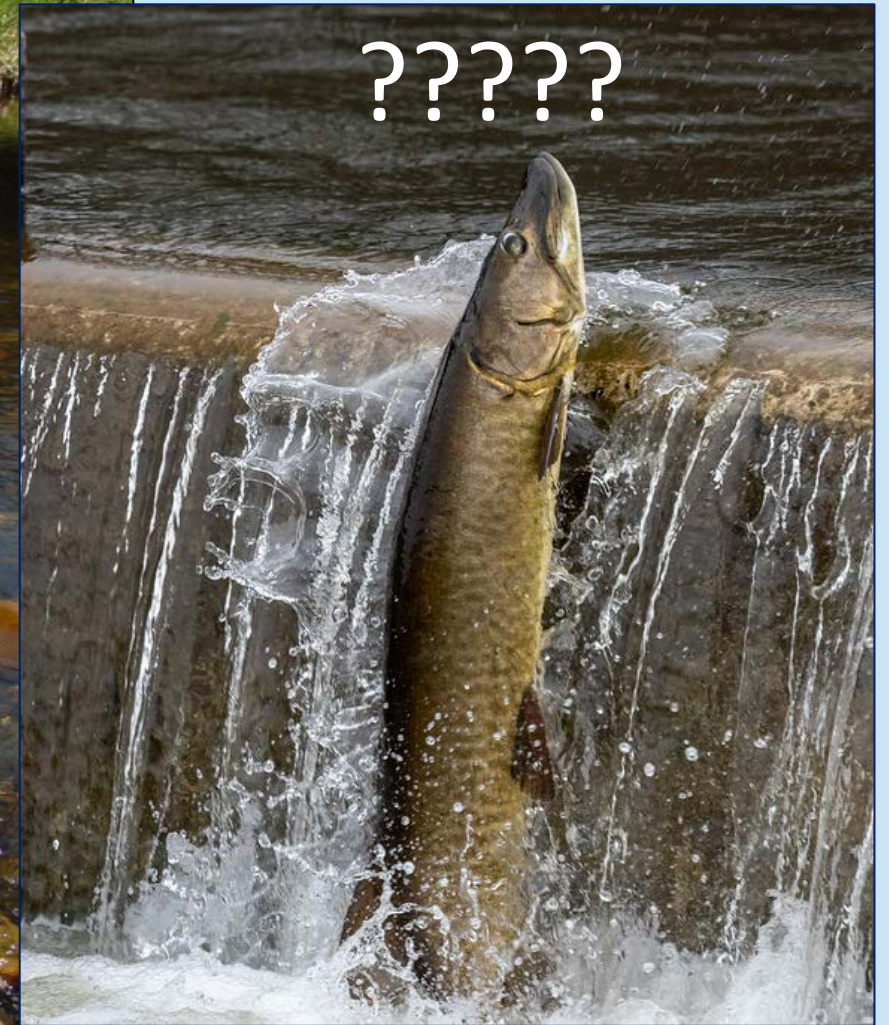Image from Dunker et al. 2020
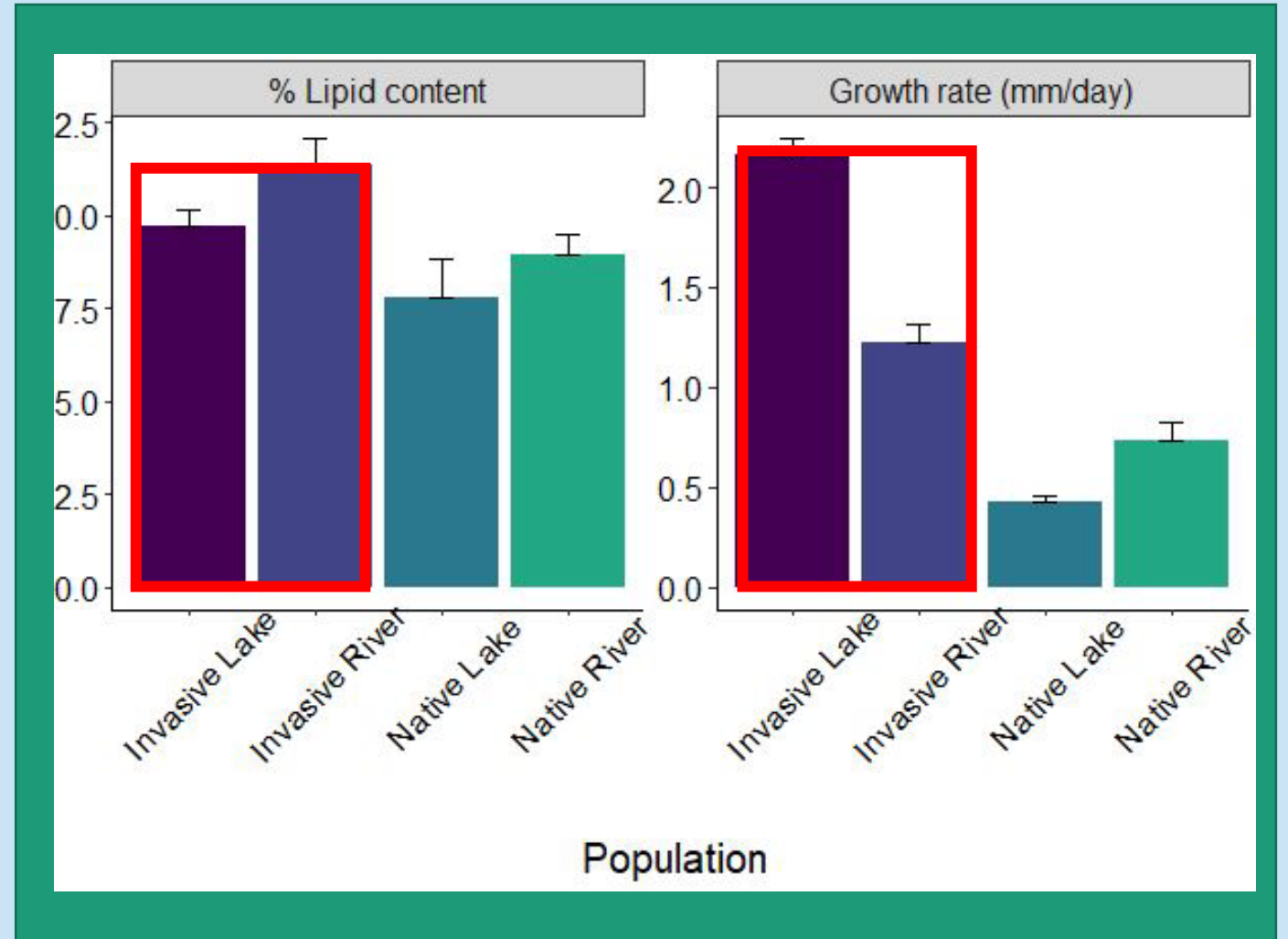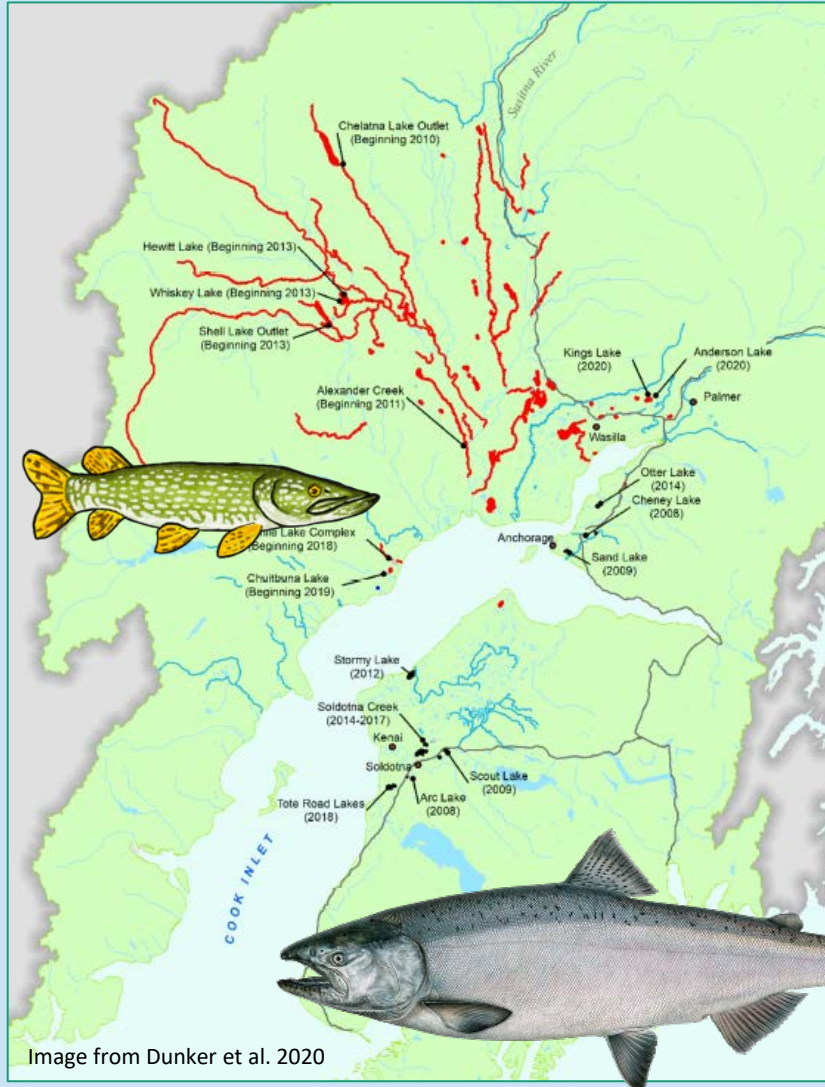
Selective fragmentation

Rahel and McLaughlin 2018. Selective fragmentation and the management of fish movement across anthropogenic barriers
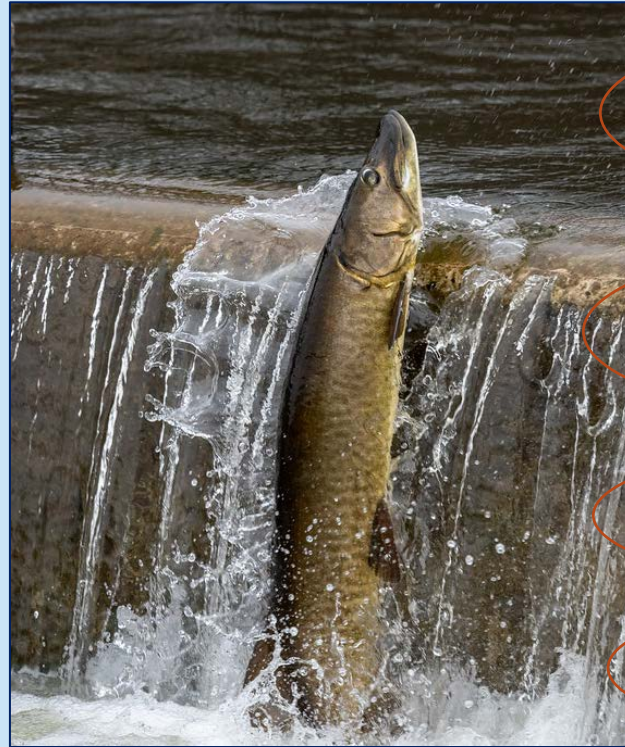
What affects leaping ability?

Physical factors

Waterfall height

Plunge pool depth

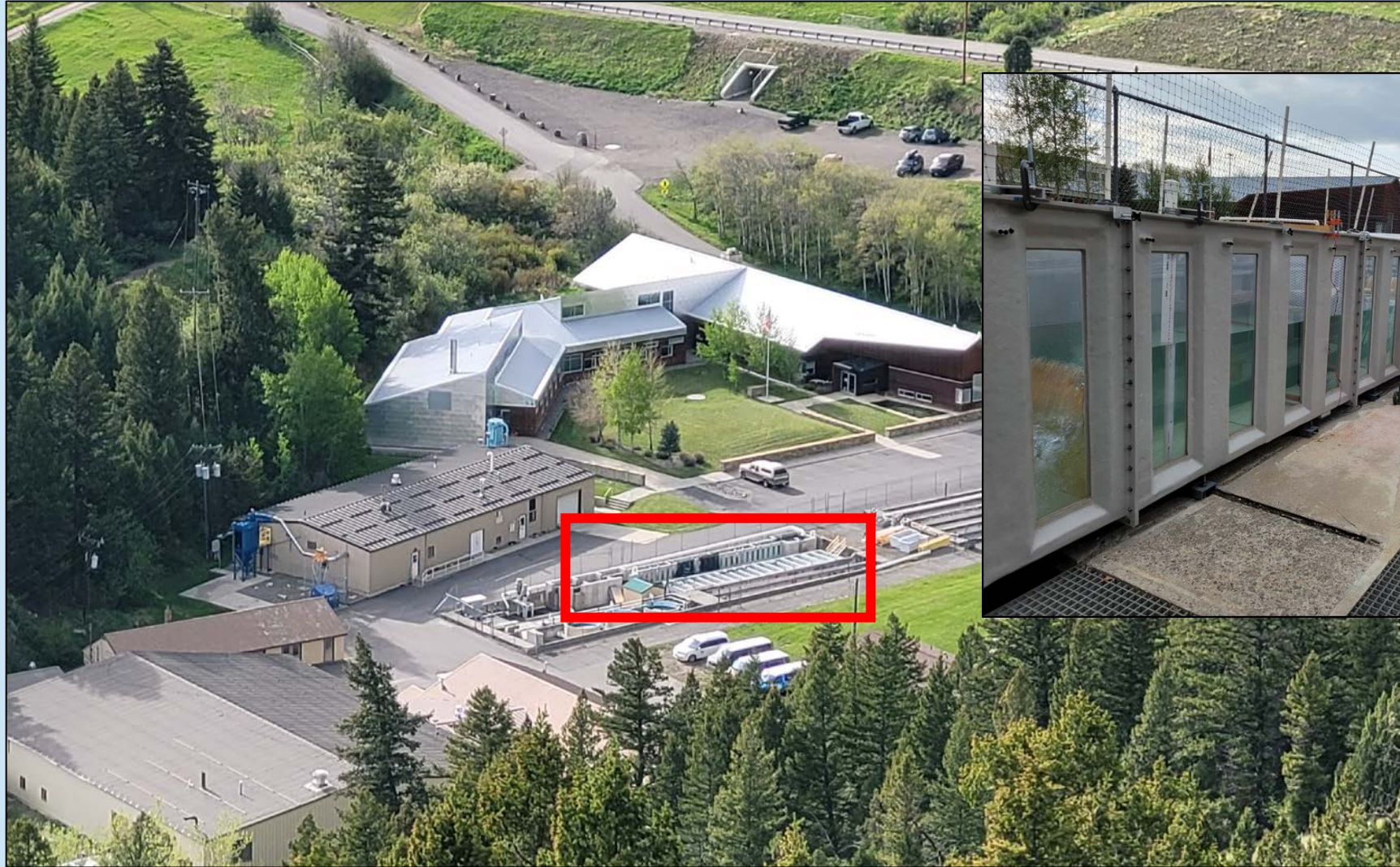Water temperature

Flow rate

Biological factors
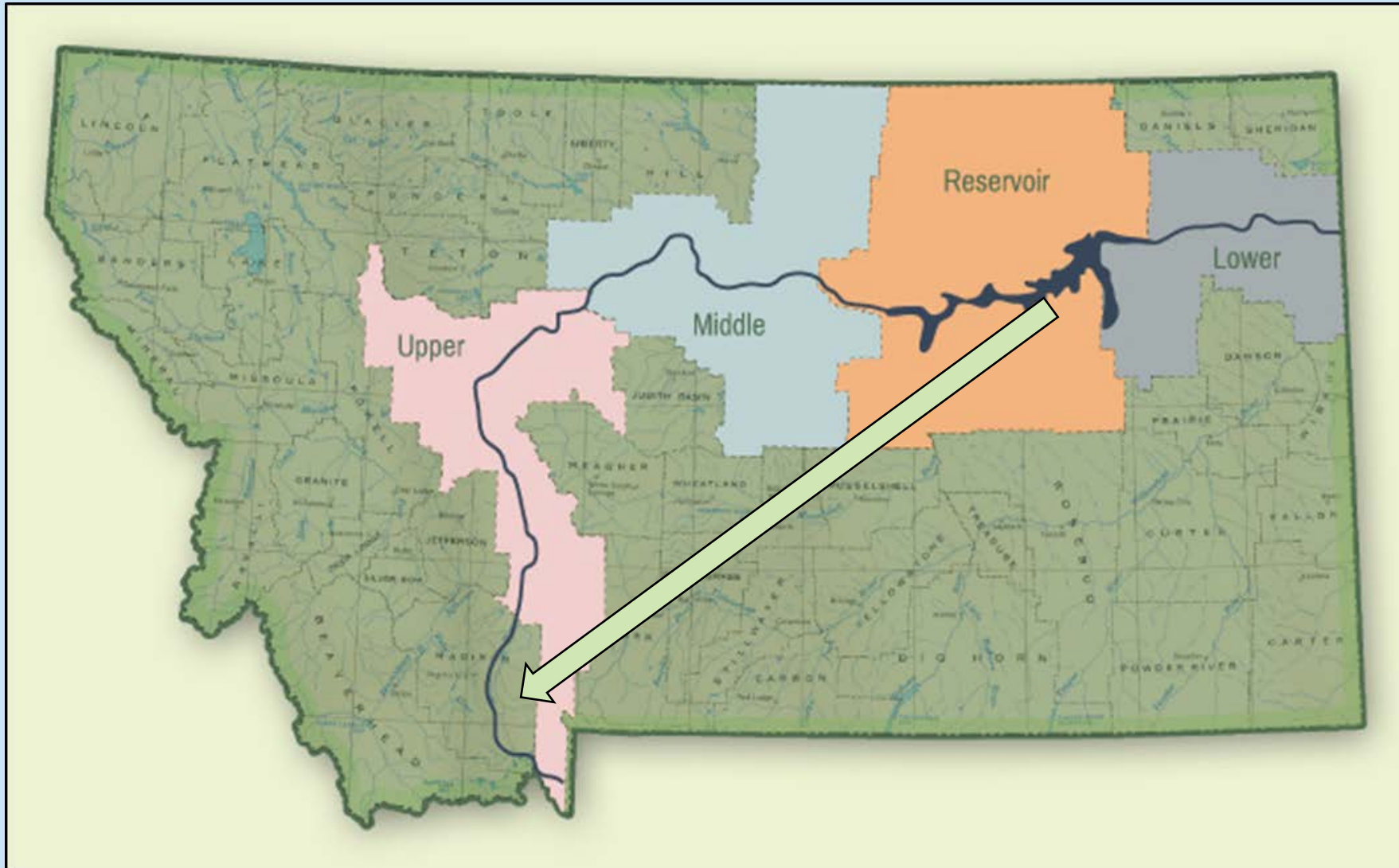
Fish size

Body condition

Metabolism

Growth

Location - BFTC
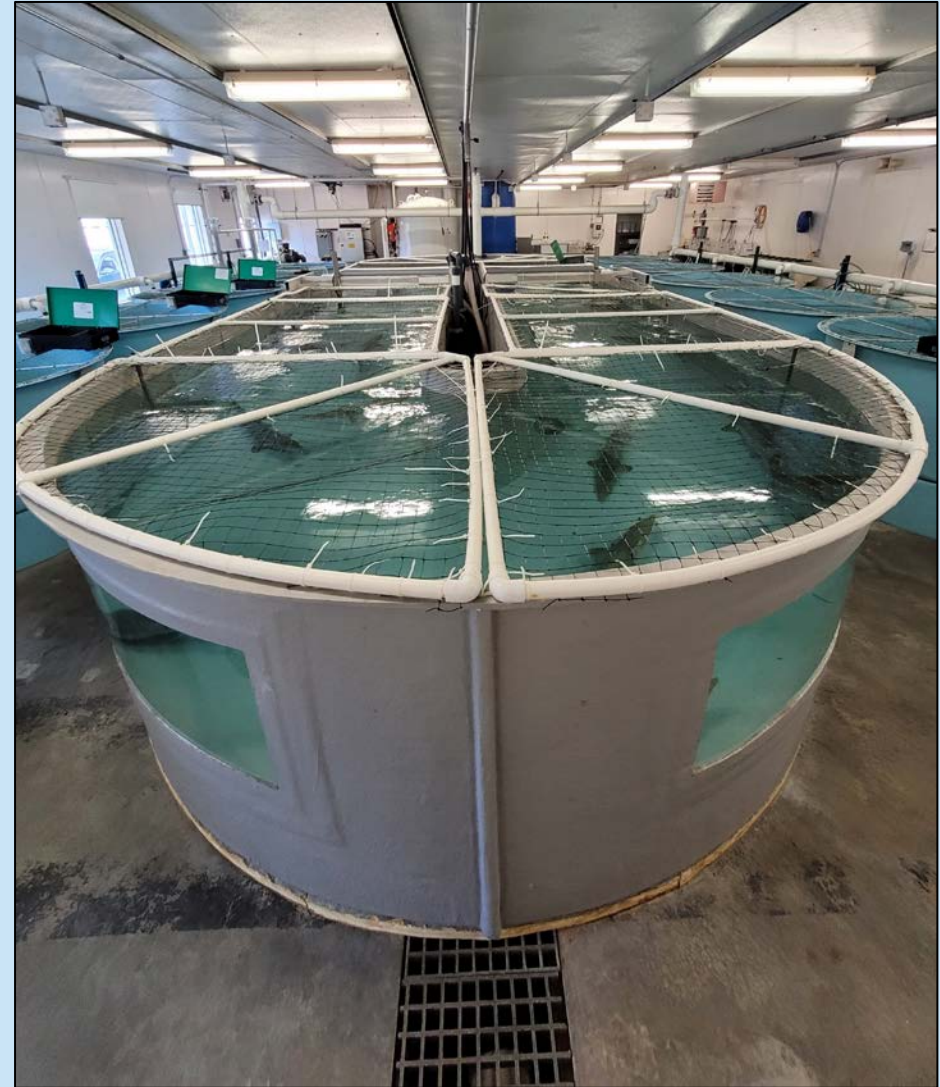

USFWS Bozeman Fish Technology Center
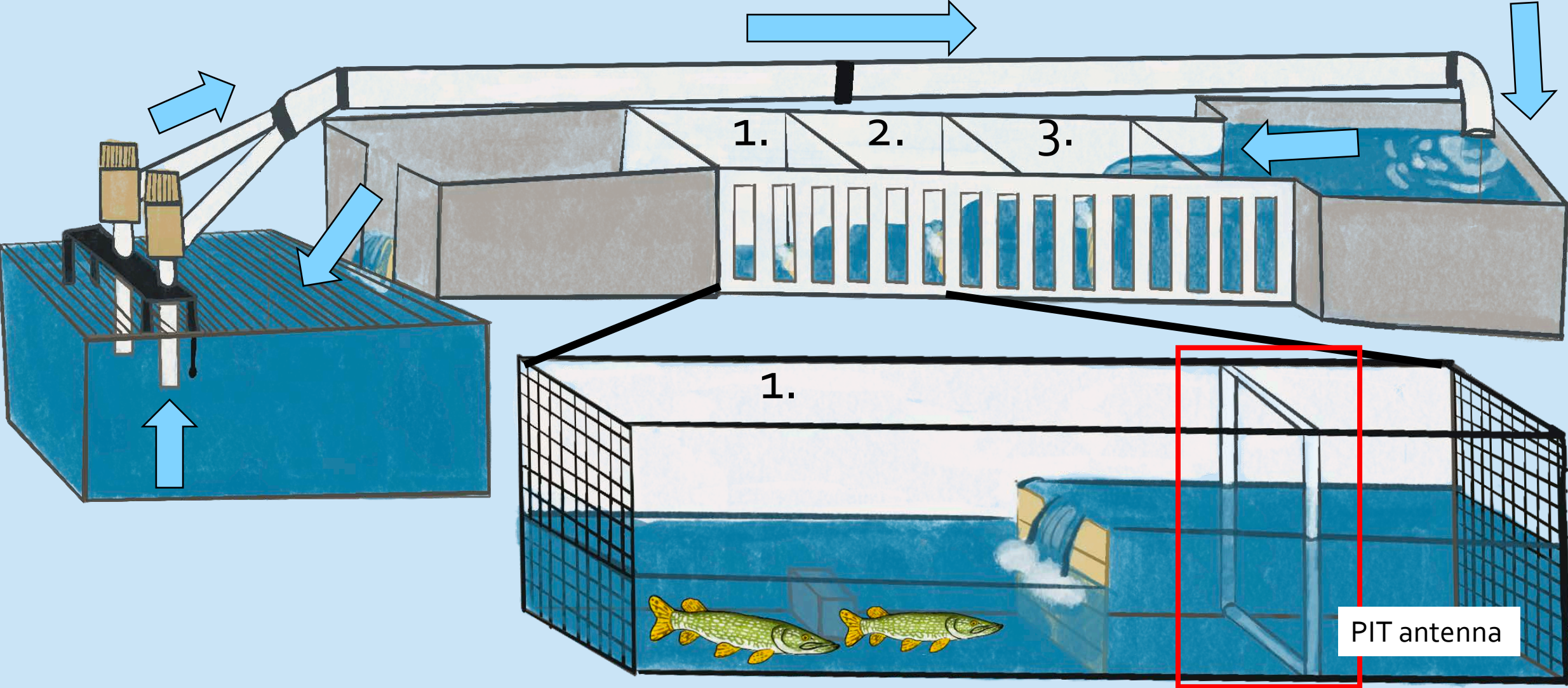
Pike collection

Pike husbandry

Flume configuration

PIT antenna

Experimental design – height and depth

Height	10	10	15	15	15	20	20	30	30	30	30	35	40	40	40	65
Depth	30	40	50	65	80	20	30	40	50	65	80	30	40	65	80	40

Each treatment x 3 at 27 L/s
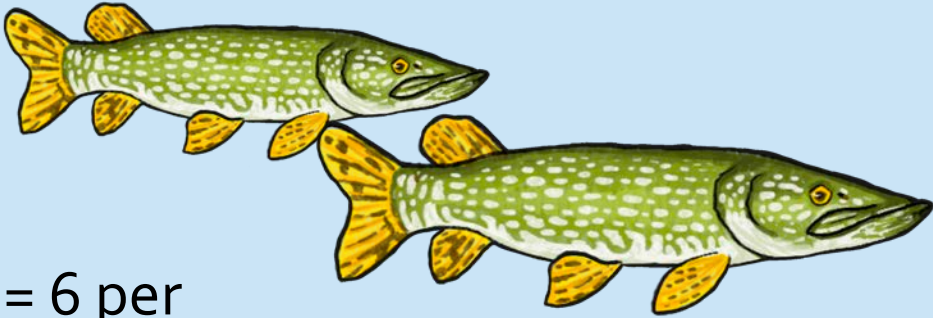
N = 6 per treatment

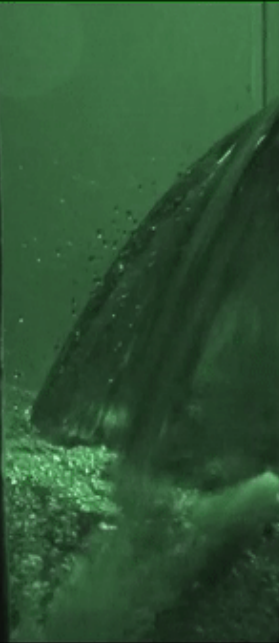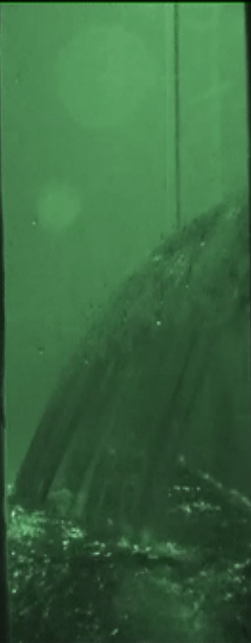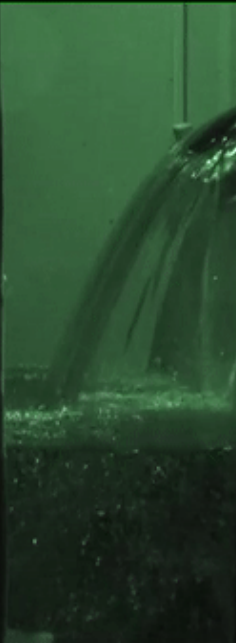| Variable type	Variable of interest
Response	Passage success
Explanatory	Height, Depth
Constant	Temperature, flow rate
Covariate	Pike size, age, growth rate, body condition, metabolism

Experimental design – height, depth, and flow

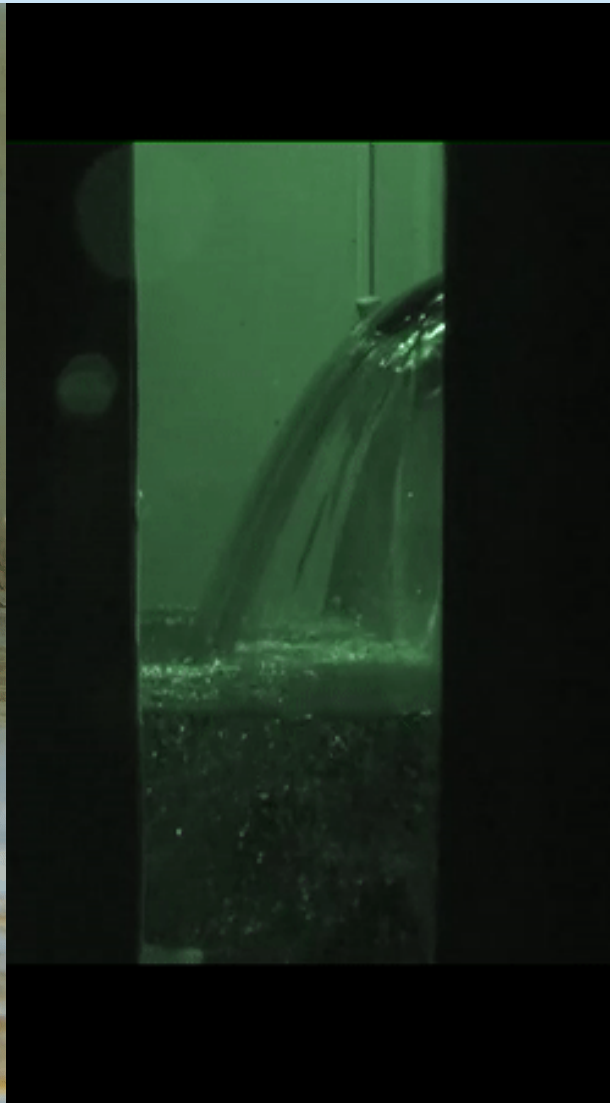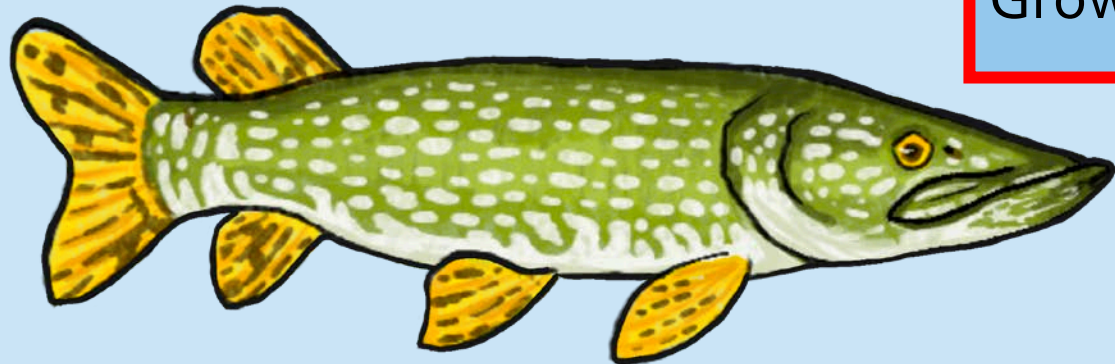| Height	10	10	15	15	15	20	20	30	30	30	30	35	40	40	40	65
Depth	30	40	50	65	80	20	30	40	50	65	80	30	40	65	80	40

11.5 L/s   27 L/s   43 L/s

Experimental procedure

Results – pike metrics

- 55 pike
- 44 males
- 11 females
- 98% mature

Metric	Minimum	Maximum
Fork length (mm)	520	840
Metabolic capacity (µmol/g/min)	300	600
% Dry lipid	11	20.5
Age (years)	2	10
Growth rate (mm/day)	0.06	0.96

Results – height and depth
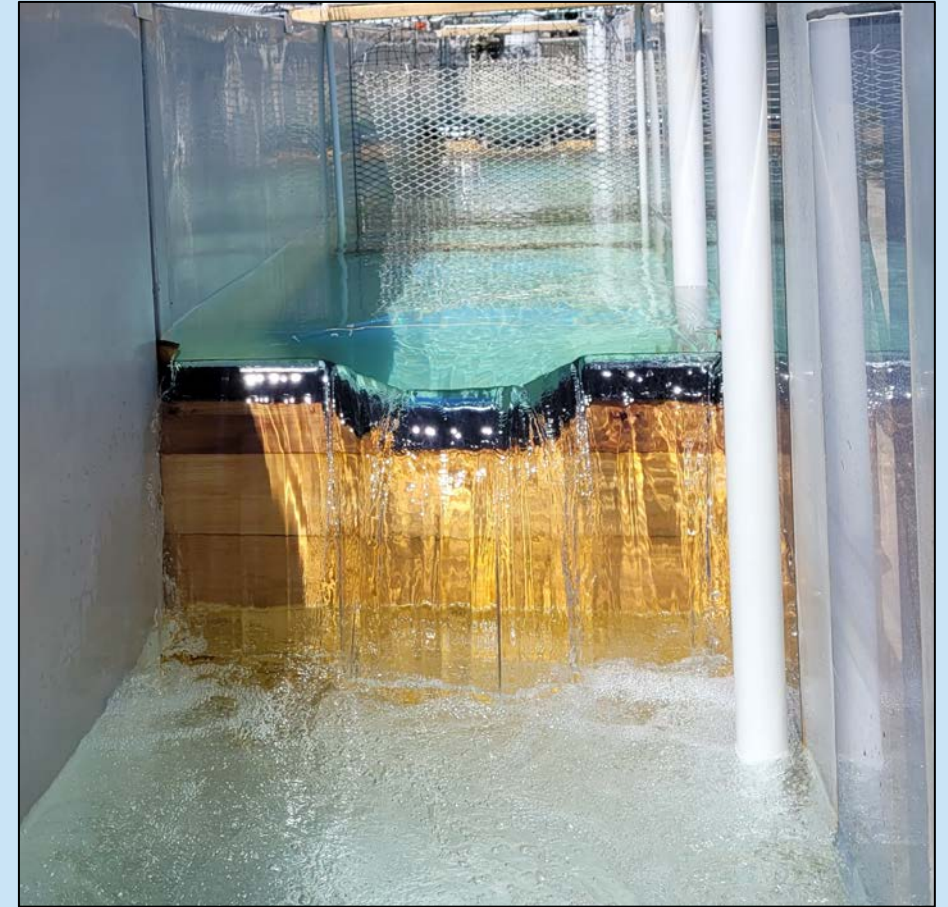

10 X 30
84%

40 x 65
17%

40 x 40
0%

65 x 40
0%

Results – height, depth, and flow

10 x 30 x 27 L/s
84%

40 x 40 x all flows
0%

Results – model selection

Passage success ~
Barrier height
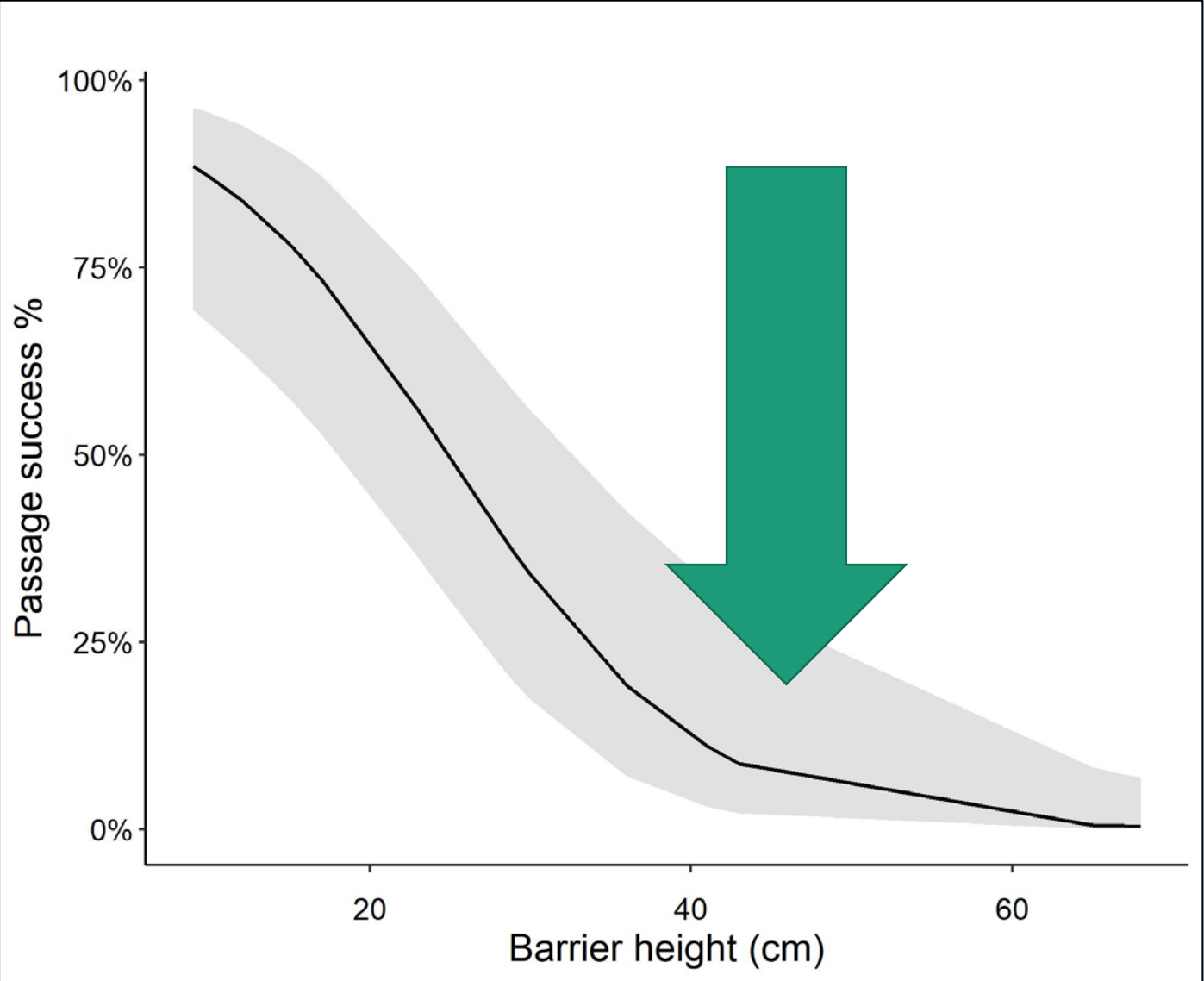Pool depth^2
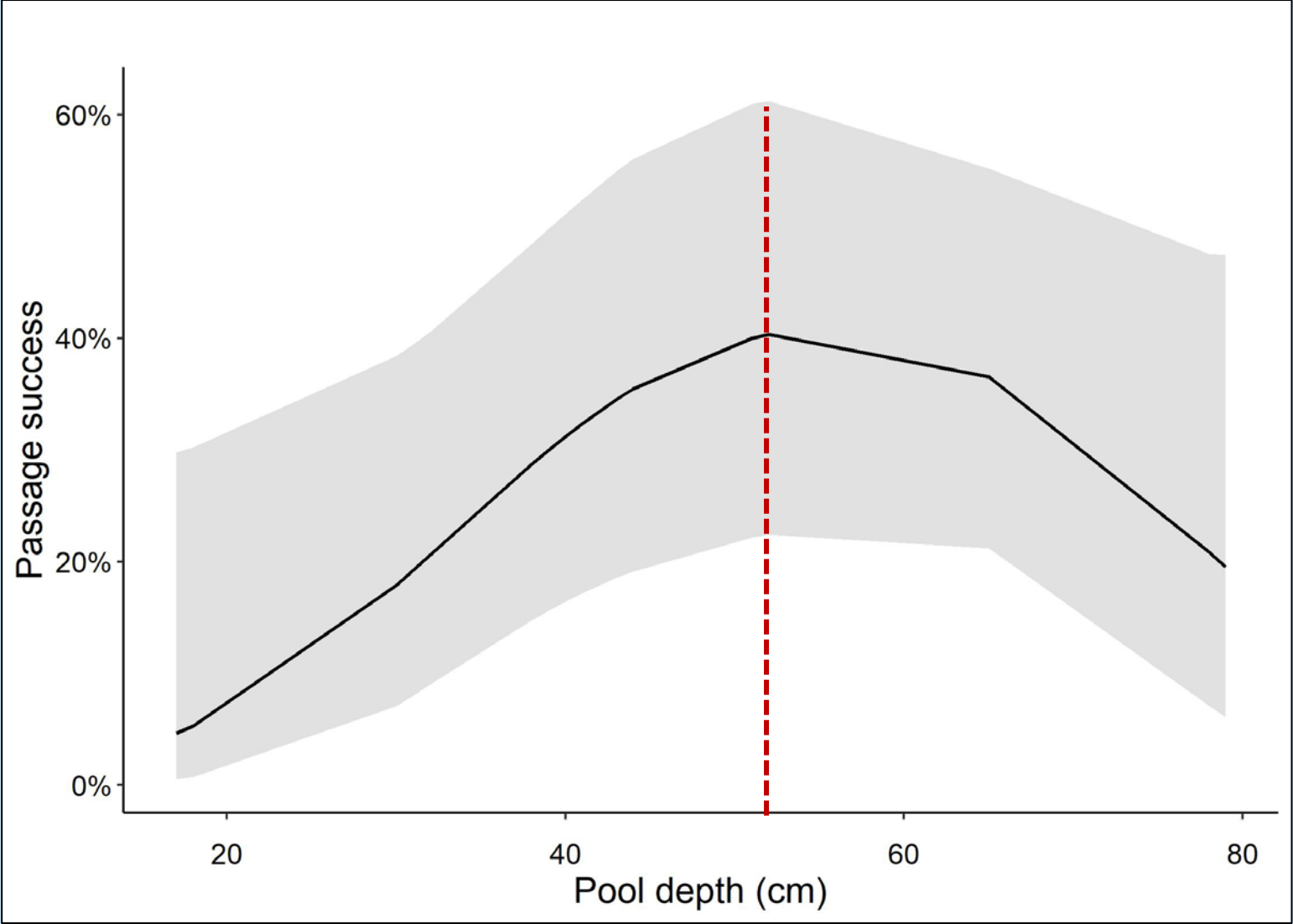Fork length * pool depth
Growth rate

No Effect
Body condition
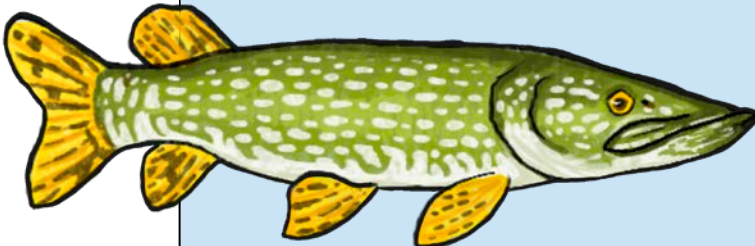Metabolism
Age
Flow rate
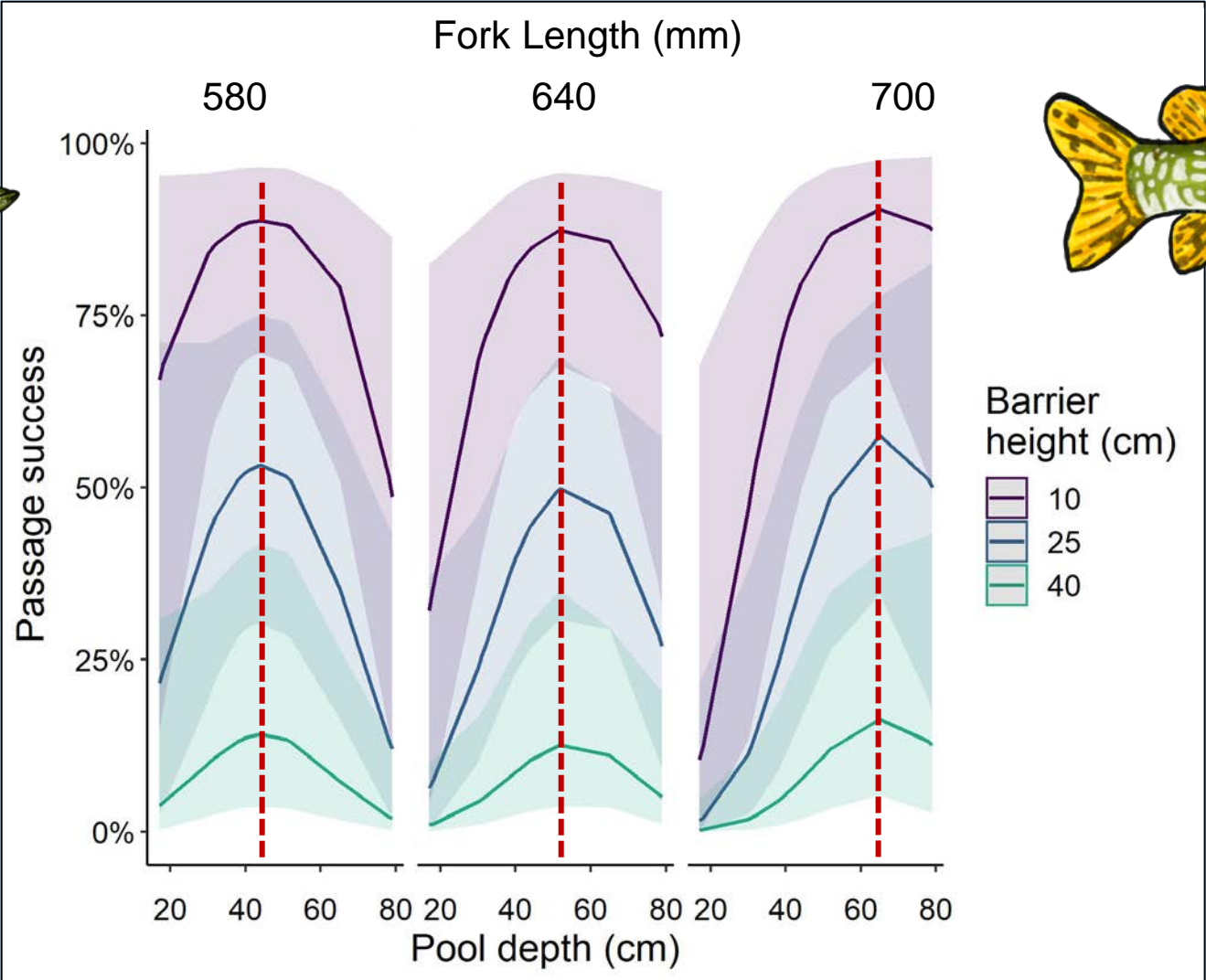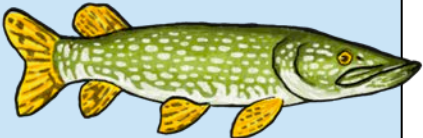
Results – Barrier height
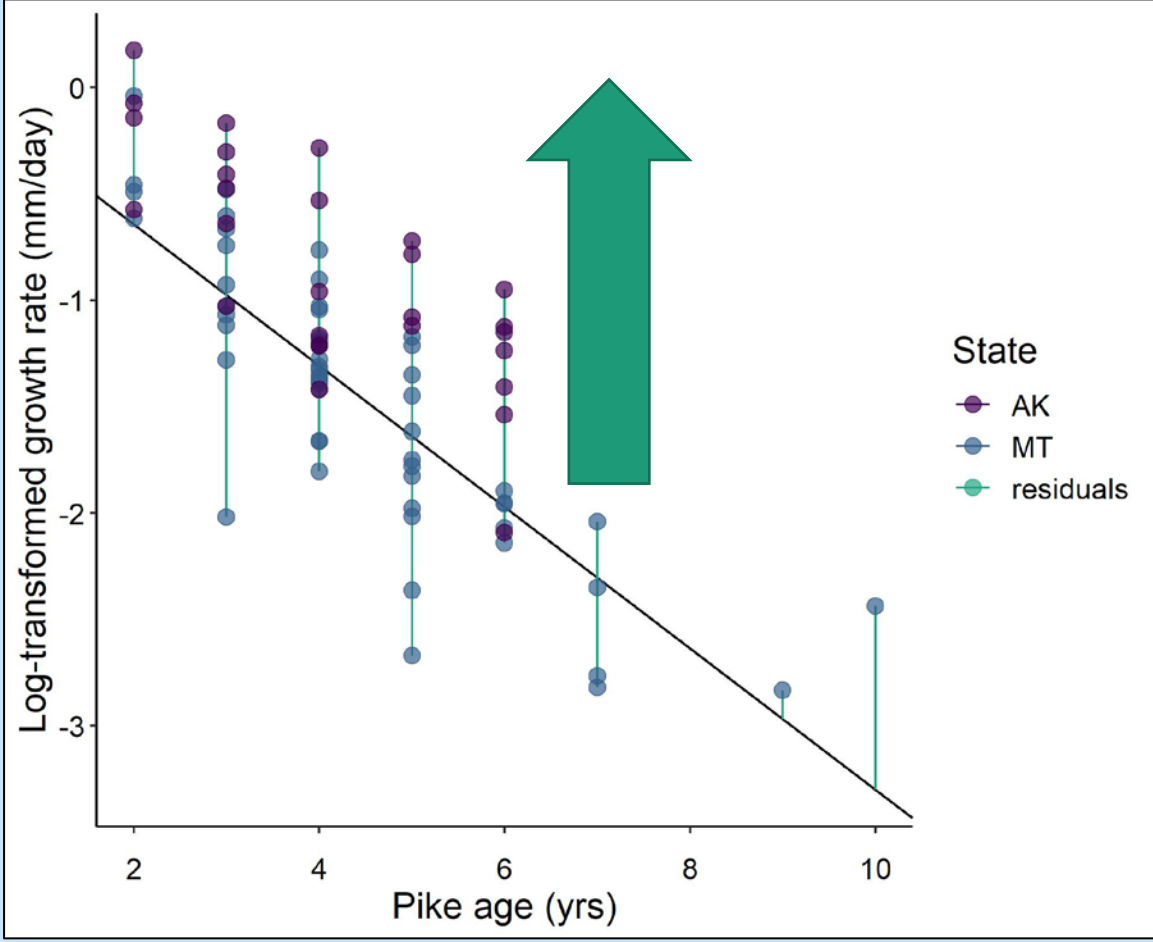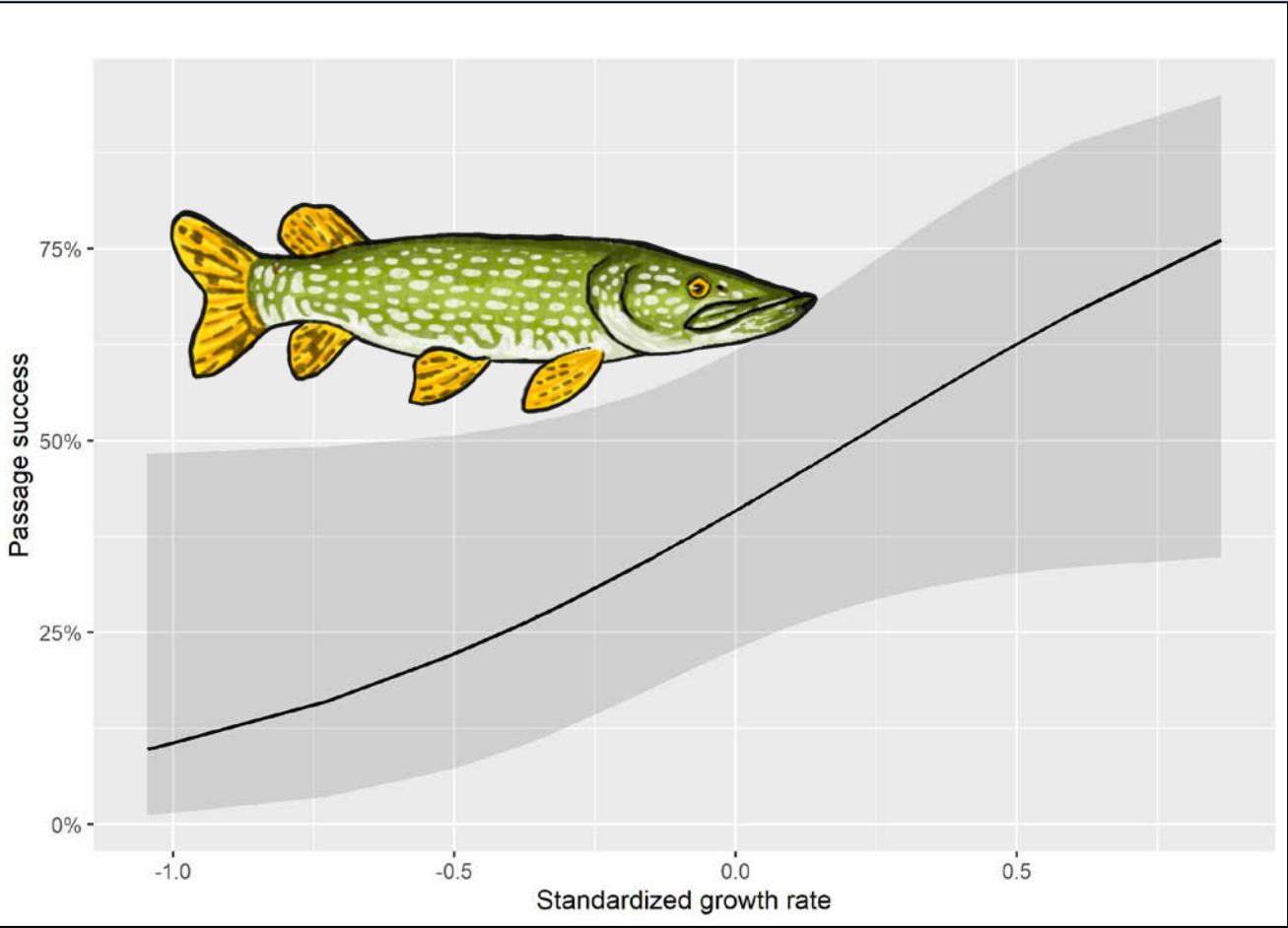
Results – pool depth

Results – Pool depth and FL interaction

Results - growth rate

2 x faster growth
4% increase in leap success

Conclusions

- Captured range of pike leaping ability (0%-84%)

- 40 cm x 40 cm impassable

- Physical > Biological factors

- Effects of water temperature, higher flows, seasonal motivation

- In-situ testing

40 cm < 70+ cm

Acknowledgements

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Alaska Cooperative Fish & Wildlife Research Unit

UAF
UNIVERSITY OF ALASKA FAIRBANKS

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