Thiamine Availability in the Weber River and its Implications for Native Fish Conservation and Sportfish Management

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Thiamine (Vitamin B1)

- Thiamine Deficiency Complex (TDC)
- High mortality in early life stages.
- Increasing frequency of TDC worldwide.
- Can be caused by thiamine deficiency or thiaminase excess.



Figure 1. A Green Sucker from Logan Hatchery with fin deformities
https://wildlife.utah.gov/index.php?option=com_content&view=article&id=1981&catid=37

Harder at al. 2018

Historical causes of Thiamine Deficiency Complex



- Honeyfield et al. 2005- A lake trout diet consisting of invasive alewife high in thiaminase
- Fitzsimons et al. 2013- American Eel in Lake Ontario with diet of high thiaminase crayfish.
- Karlsson et al. 1999- Baltic Salmon with diets high in native thiaminase rich Sprat exhibited TDC.

Green Sucker (*Pantosteus virescens*)

- Feeds on invertebrates, periphyton, and detritus.
- Native to Utah's Weber River, Raft River, Goose Creek, and other small creeks.
- Declining numbers is Utah

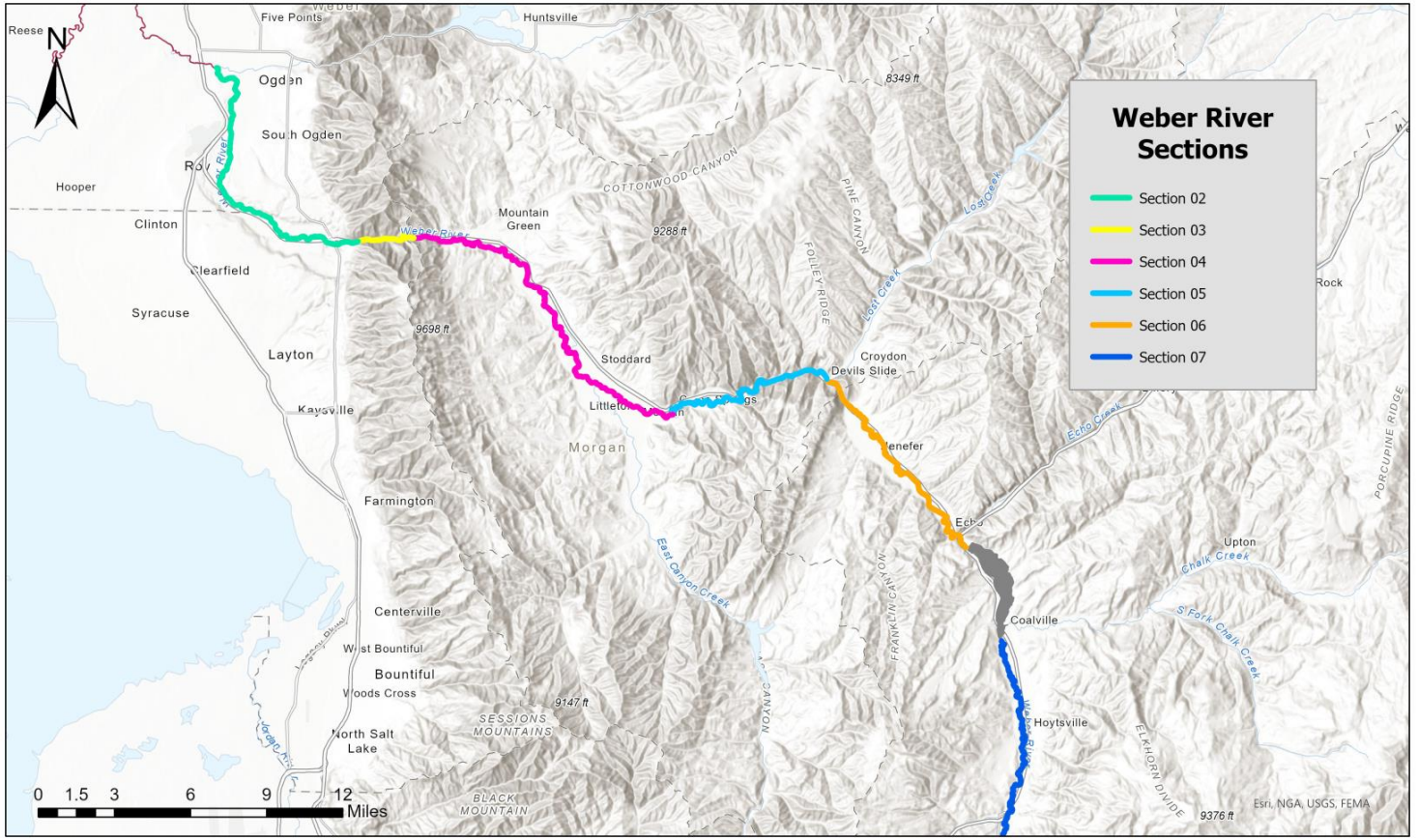


Figure 2. Photo taken by Caleb Campbell, Fish Culturist at Logan Hatchery

Bangs et al. 2020

Weber River

- 7 sections
- From Echo Reservoir Dam downstream
- Approximately 60 miles (97 km) of river



Map created by Utah Department of Wildlife Resources

Weber River Historical Context





1869

Photos by: Andrew J. Russell & William Henry Jackson

Weber River Historical Context





1869

1902
Brown Trout Introduction

Weber River Historical Context









1869

1902
Brown Trout Introduction

1931
Dam Completion

Weber River Historical Context

Influence of Introgression and Geological Processes on Phylogenetic Relationships of Western North American Mountain Suckers (*Pantosteus*, Catostomidae)

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Abstract

Intense geological activity caused major topographic changes in Western North America over the past 15 million years. Major rivers here are composites of different ancient rivers, resulting in isolation and mixing episodes between river basins over time. This history influenced the diversification of most of the aquatic fauna. The genus *Pantosteus* is one of several clades centered in this tectonically active region. The eight recognized *Pantosteus* species are widespread and common across southwestern Canada, western USA and into northern Mexico. They are typically found in medium gradient, middle-elevation reaches of rivers over rocky substrates. This study (1) compares molecular data with morphological and paleontological data for proposed species of *Pantosteus*, (2) tests hypotheses of their monophyly, (3) uses these data for phylogenetic inferences of sister-group relationships, and (4) estimates timing of divergence events of identified lineages. Using 8055 base pairs from mitochondrial DNA protein coding genes, *Pantosteus* and *Catostomus* are reciprocally monophyletic, in contrast with morphological data. The only exception to a monophyletic *Pantosteus* is *P. columbianus* whose mtDNA is closely aligned with *C. tahoensis* because of introgression. Within *Pantosteus*, several species have deep genetic divergences among allopatric sister lineages, several of which are diagnosed and elevated to species, bringing the total diversity in the group to 11 species. Conflicting molecular and morphological data may be resolved when patterns of divergence are shown to be correlated with sympatry and evidence of introgression.

Citation: Unmack PJ, Dowling TE, Laitinen NJ, Secor CL, Mayden RL, et al. (2014) Influence of Introgression and Geological Processes on Phylogenetic Relationships of Western North American Mountain Suckers (*Pantosteus*, Catostomidae). PLoS ONE 9(3): e90061. doi:10.1371/journal.pone.0090061

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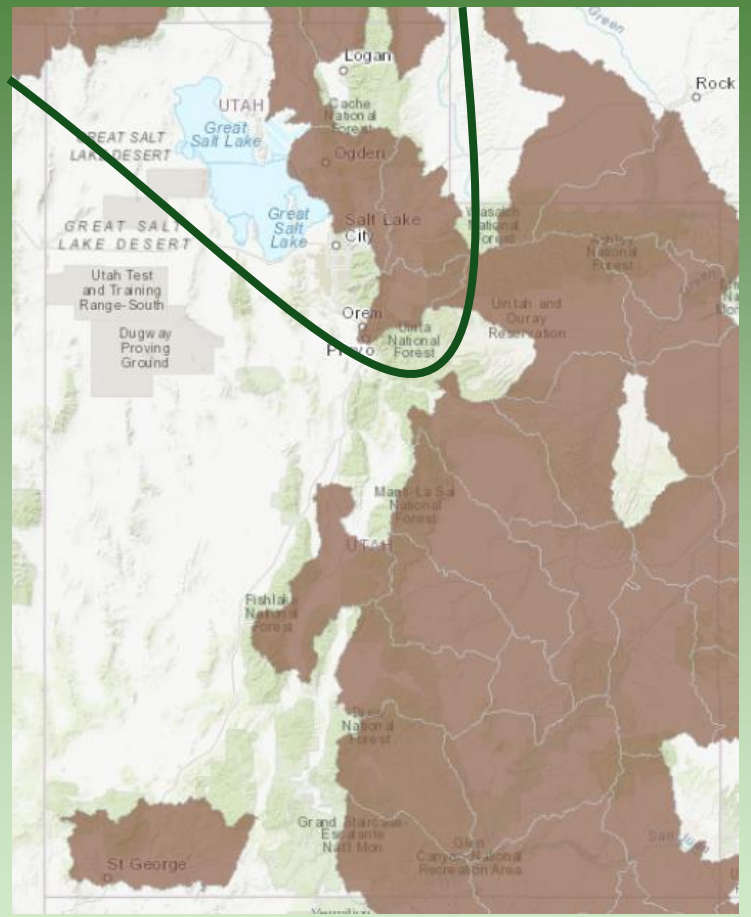
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1869

1902
Brown Trout Introduction

1931
Dam Completion

2014
First Genetic Work

Weber River Historical Context

- Weber River population declines
- Green Sucker Hatchery program starts





Fish need their vitamins too!



Weber Green Sucker might be vitamin B1 deficient

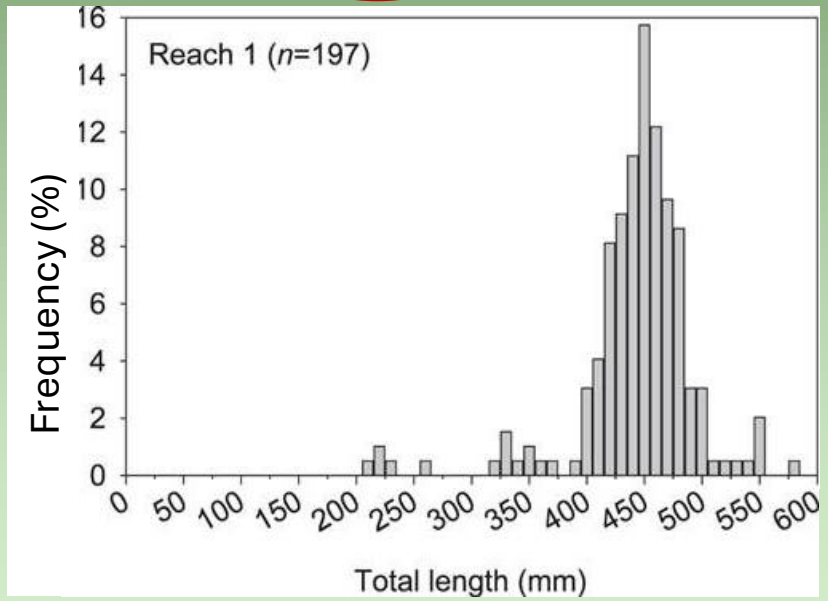






Young fish do not develop

=



Only adults in a declining population

Is vitamin B1 deficiency preventing the population from being restored?

Project Objectives

1. Investigate if thiamine supplementation improves early rearing mortality of hatched Green Sucker fry.
2. Develop a thiamine LC50 curve for Green Sucker.
3. Investigate the relationship between muscle thiamine and egg thiamine levels in green sucker.
4. Compare Weber River Brown Trout muscle thiamine levels to a known population of non thiamine deficient brown trout
5. Characterizing thiamine availability across different trophic levels along the Weber River and investigate their relationships among habitat parameters.

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Fish Collection

- 44 total river miles raft electrofished
- Sections 2, 5, and 6 each shocked twice
- Low water levels
- 8 females with eggs collected from Weber
- 1 female with eggs from hatchery

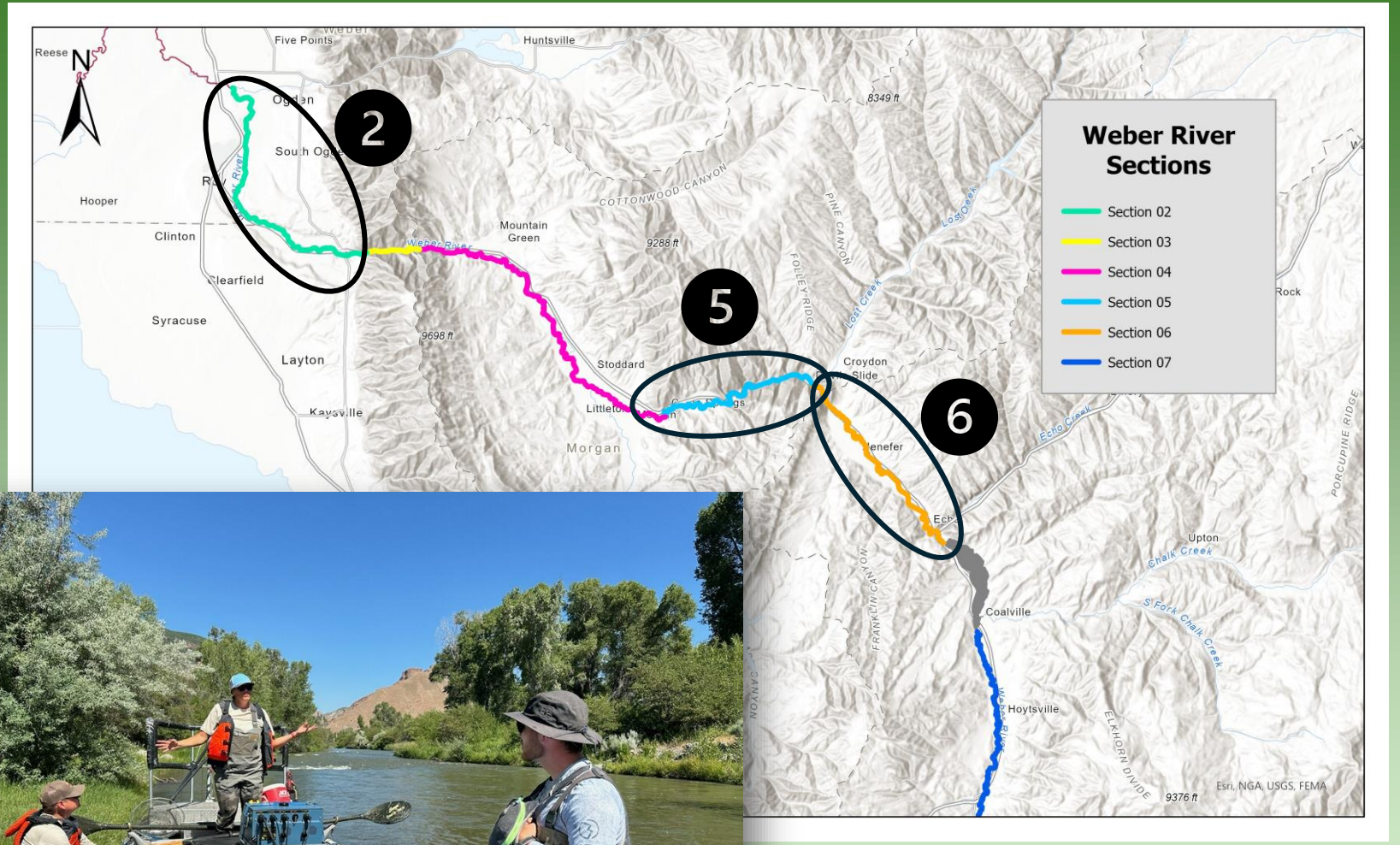
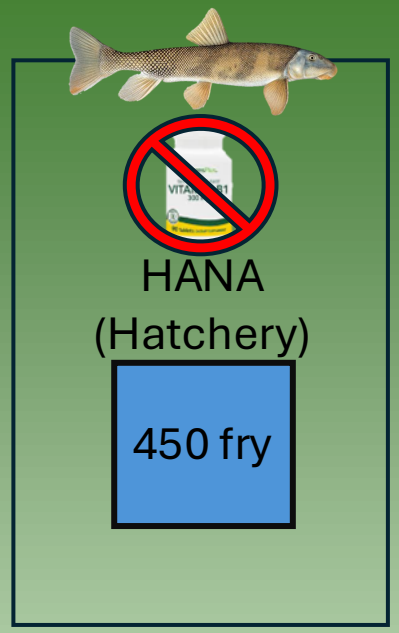


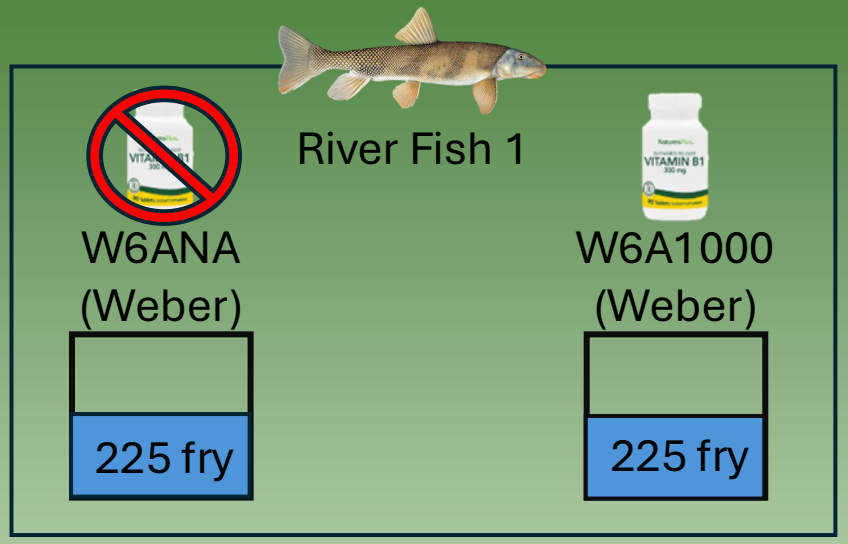
Photo by: Chad Teal

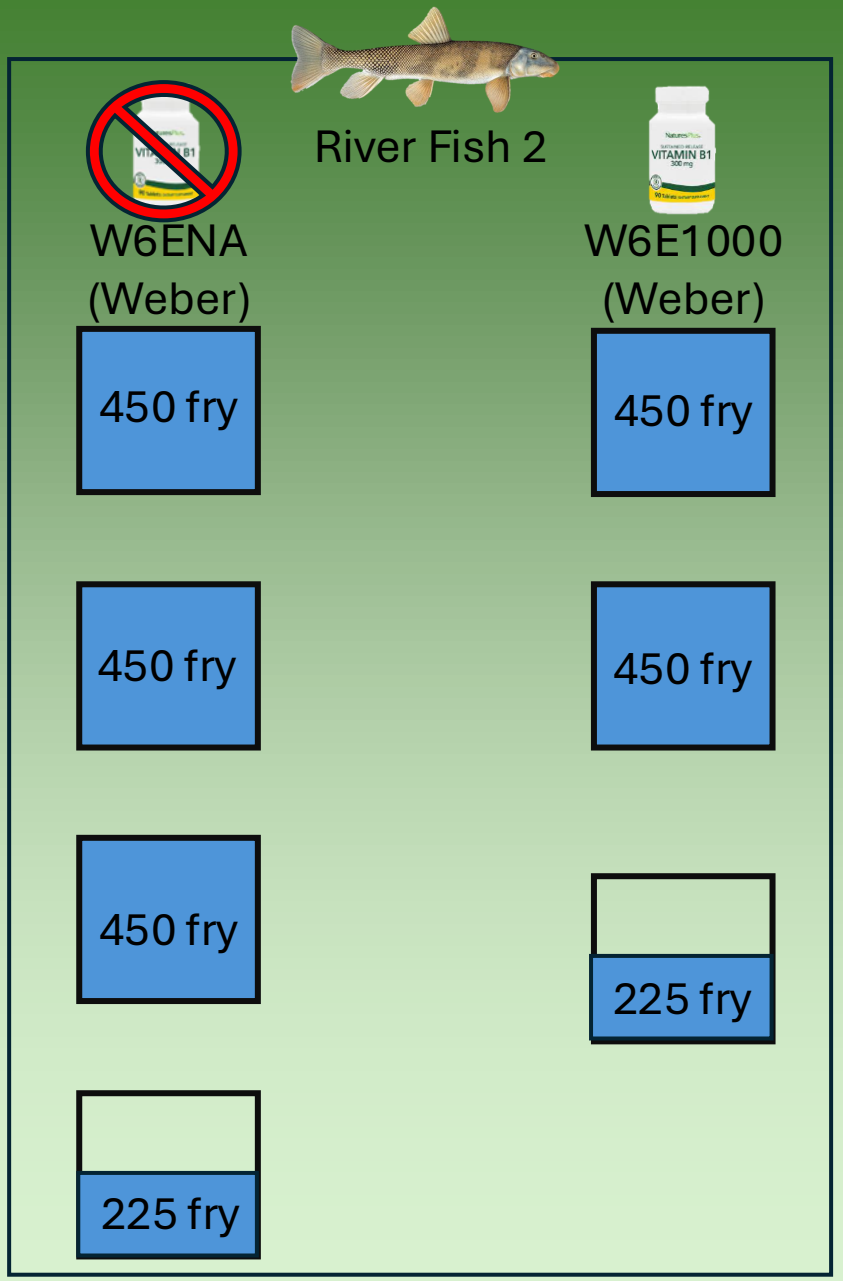



AAHRC Lab

Treatment set up

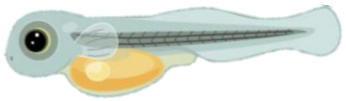


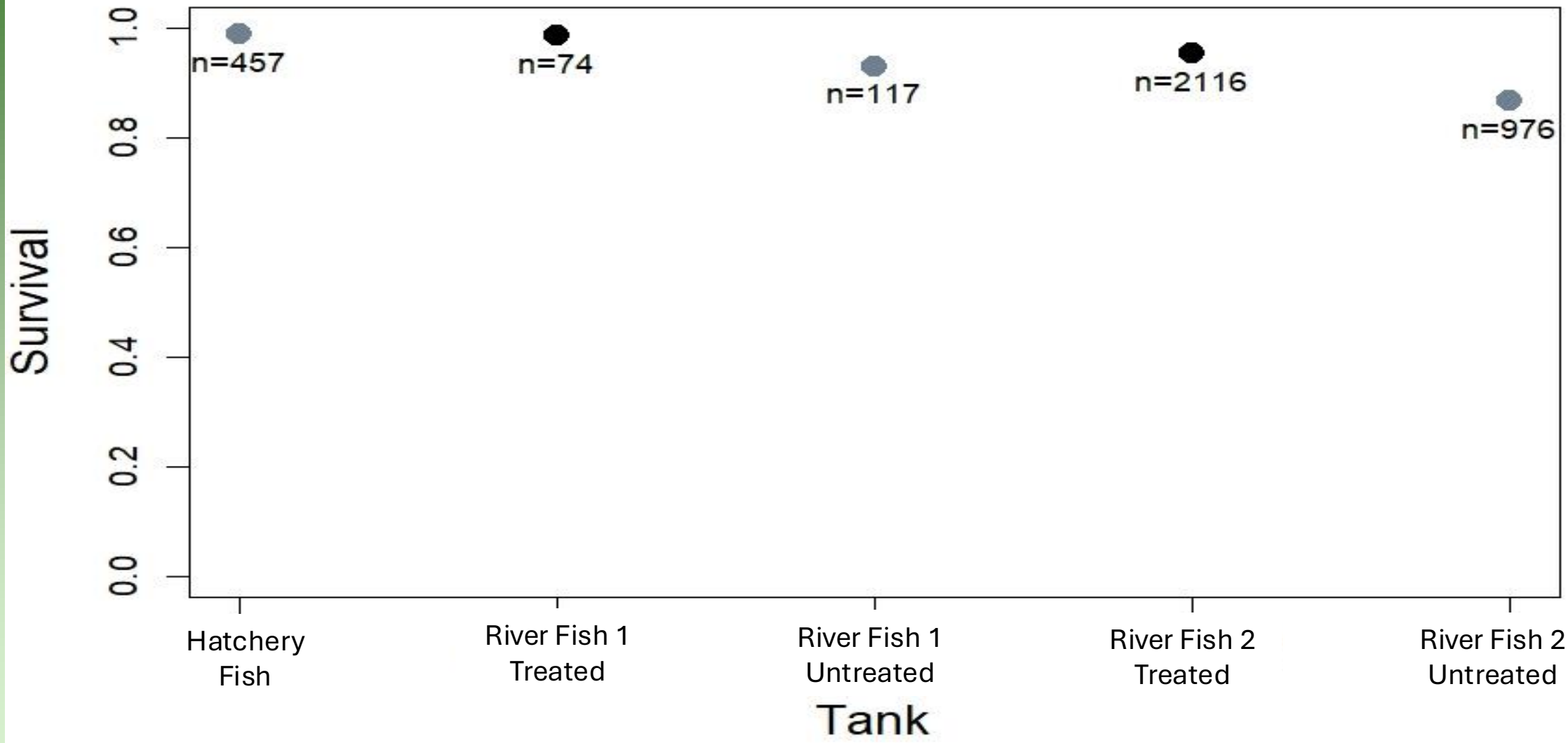




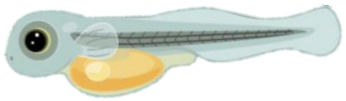
- Standardized stocking rate at ~ 6.25 fry/L

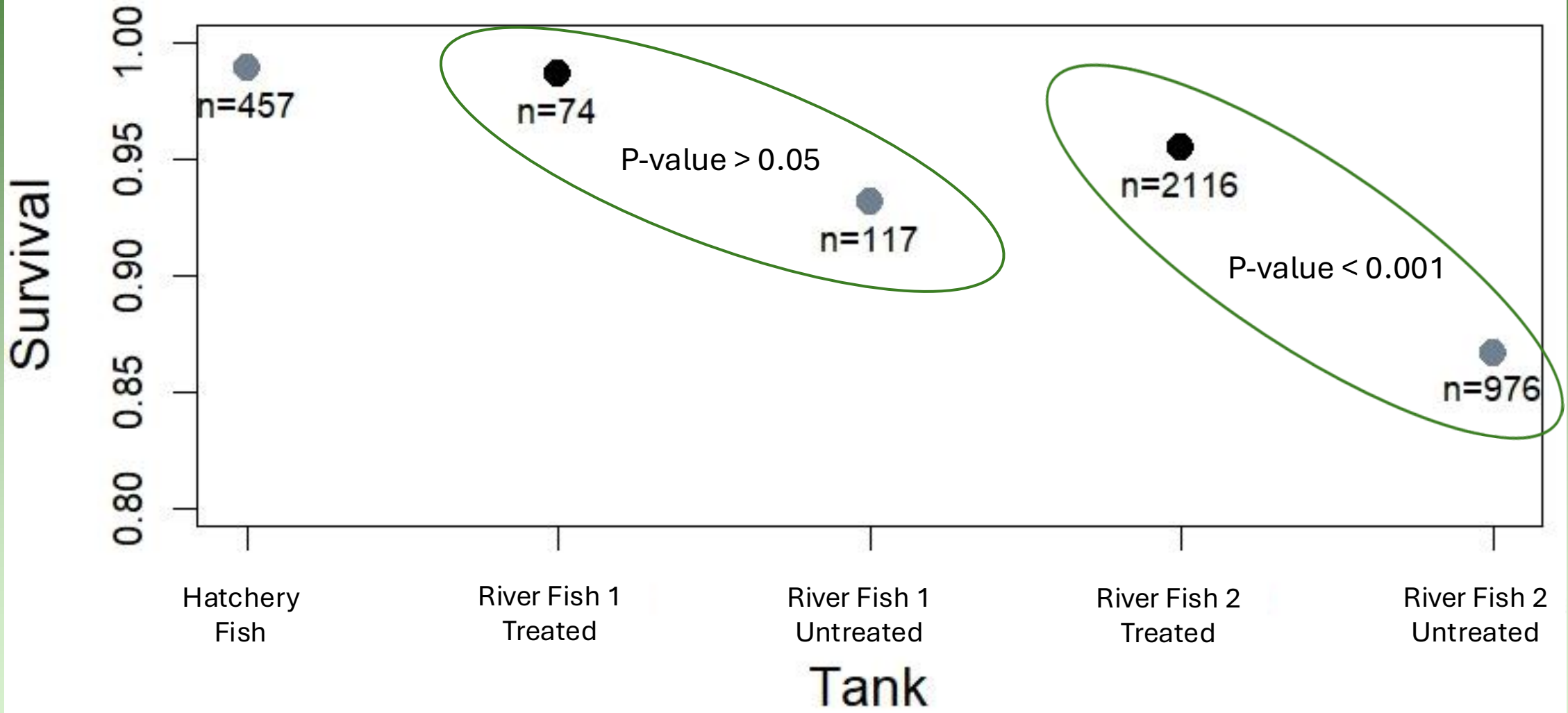
Fry Survival



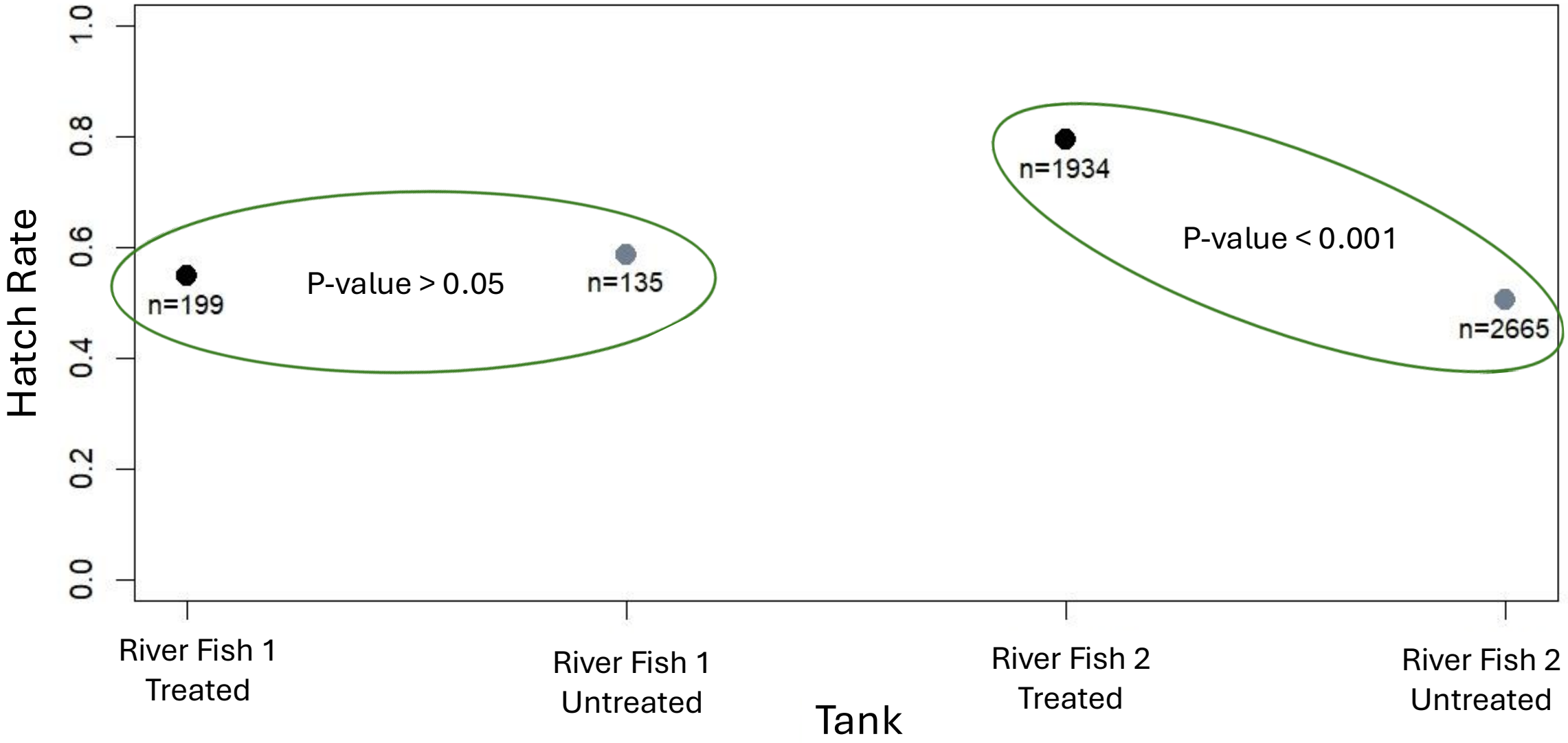


Fry Survival





Egg Hatch Rates



Project Objectives

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2. ~~Develop a thiamine LC50 curve for Green Sucker.~~
3. Investigate the relationship between muscle thiamine and egg thiamine levels in green sucker.
4. Compare Weber River Brown Trout muscle thiamine levels to a known population of non thiamine deficient brown trout
5. Characterizing thiamine availability across different trophic levels along the Weber River and investigate their relationships among habitat parameters.

Muscle Biopsy

- Samples taken from each female with eggs
- Nonlethal
- Minimally invasive
- Goal: Correlate muscle thiamine level with egg thiamine level
- 11 samples collected

Objective addressed: Investigate the relationship between muscle thiamine and egg thiamine levels in green sucker.



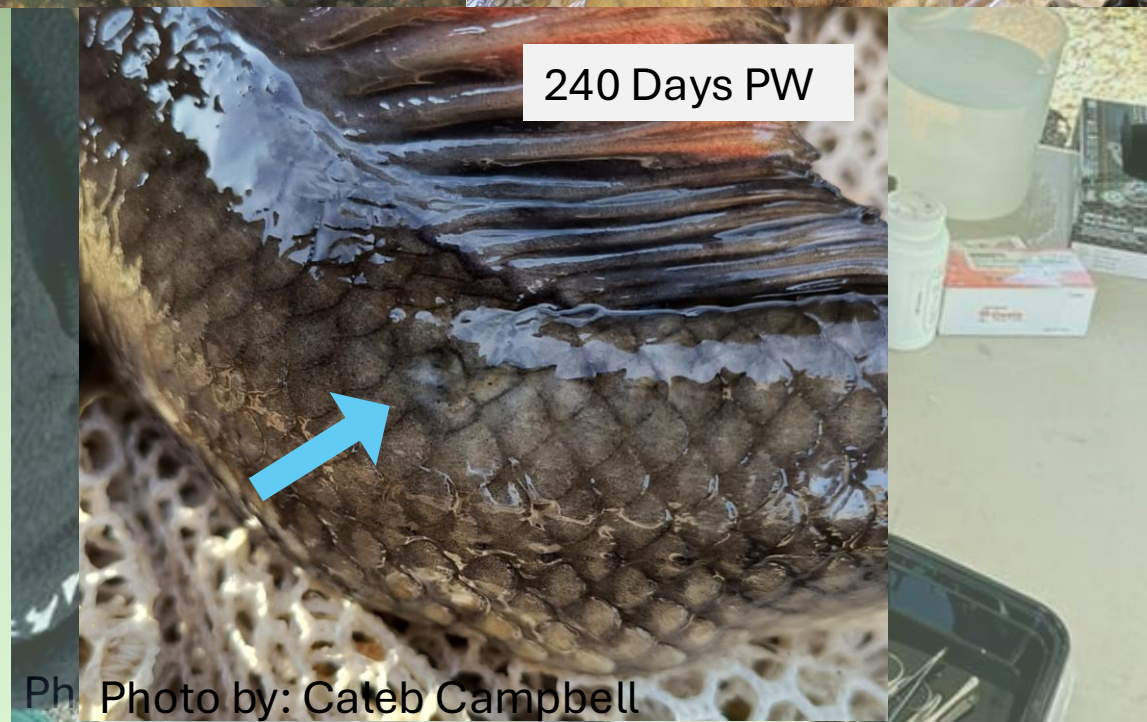


Photo by: Caleb Campbell

Weber River Food Web



Brown Trout



Cutthroat & Rainbow Trout



Green Suckers



Periphyton/Algae



Aquatic Invertebrates

Other Species Present

- Mountain Whitefish
- Utah Sucker
- Common Carp
- Other small bodied fishes

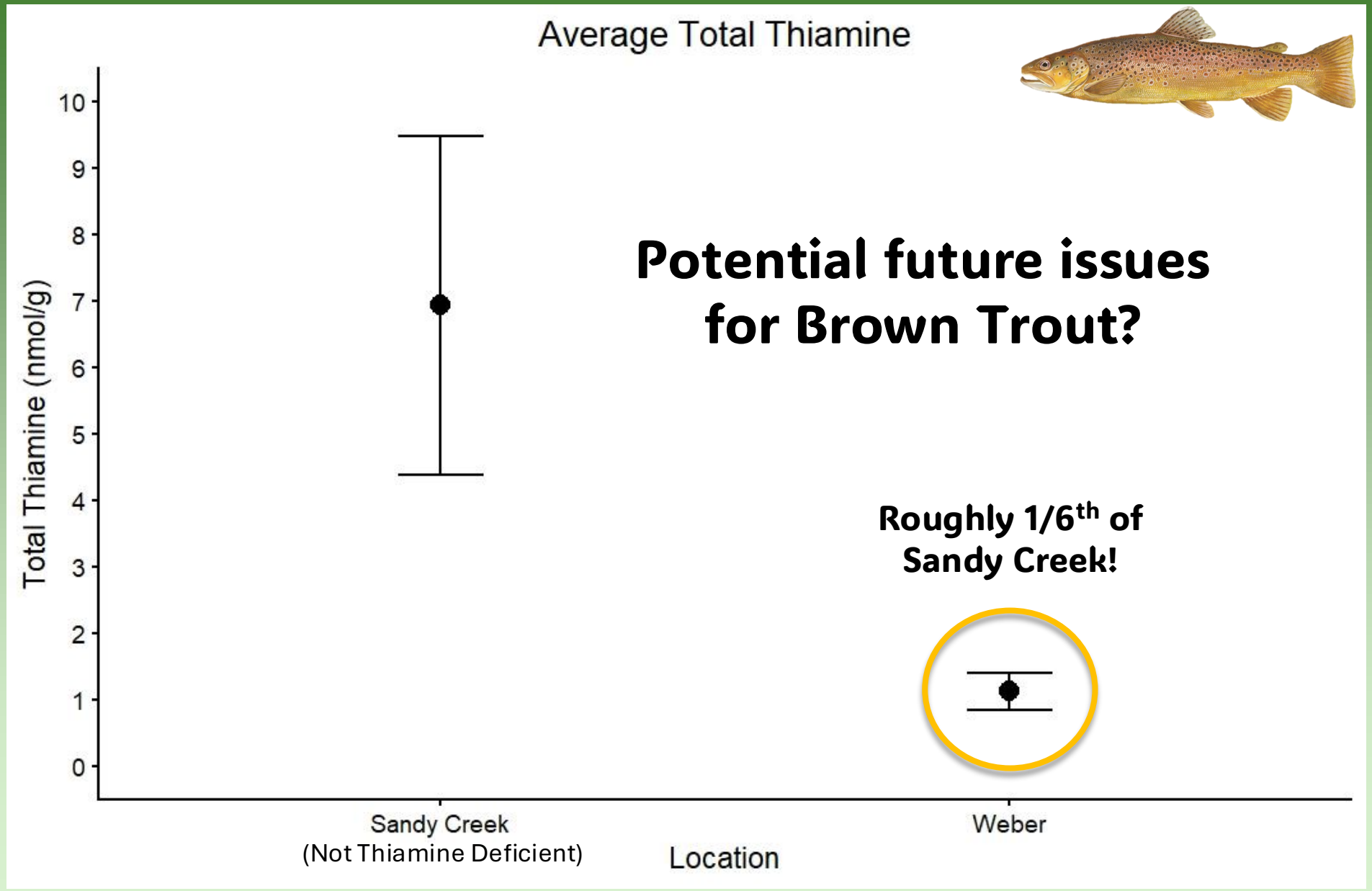
Brown Trout Sampling

- 21 females collected
- 7 from each section
- Data collected: Muscle tissue sample, stomach contents, egg sample
- Goal: Compare brown trout thiamine levels to non thiamine deficient population

Objective addressed: Compare Weber River Brown Trout muscle thiamine levels to a known population of non thiamine deficient brown trout.



Brown Trout 2025 Results



Habitat Assessment

- Upper, Middle, and Lower collection sites for each reach
- 9 collection sites total
- Data collected
  - Temp
  - Turbidity
  - Dissolved Oxygen
  - Width
  - Overhead coverage
  - Sediment type/size
  - Flow
  - Periphyton
  - Invertebrates

Objective addressed: Characterize thiamine availability across different trophic levels along the Weber River and investigate their relationships among habitat parameters.



Thiamine Analysis

- Columbia Environmental Research Center (CERC)
- 5 days in-person training
- Decreased turn around time

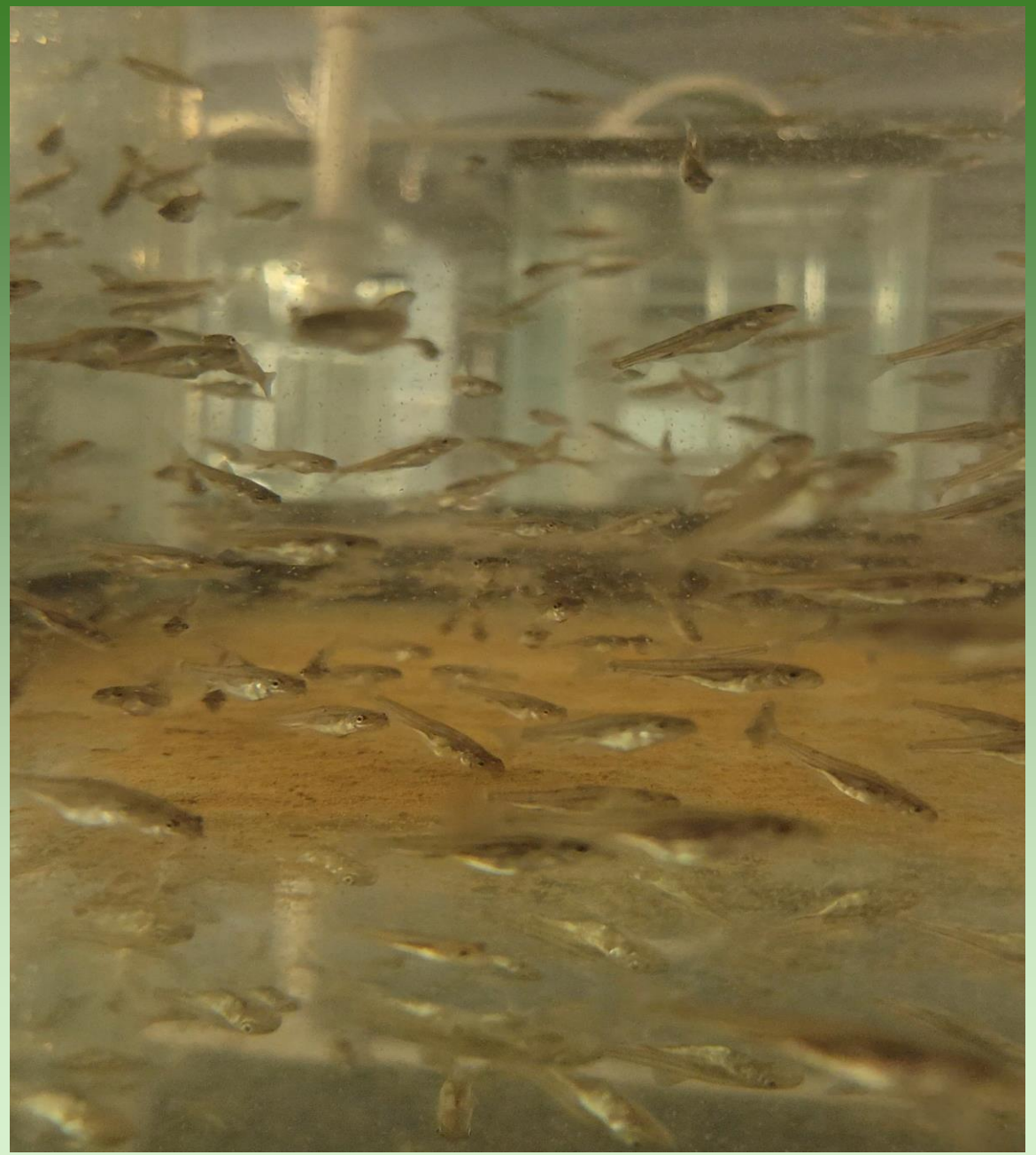





Thank You!

Questions?










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