Are Macrophytes Positively Contributing to Fish in the SJR? : Modeling Juvenile Chinook Salmon Prey Sources and Monitoring Macrophyte Habitat Use

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Background

The Blumenshine Aquatic Ecology Lab at CSU-Fresno has been working on a two phase conceptual model in order to accurately simulate juvenile Chinook salmon (*Oncorhynchus tshawytscha*) growth and survival over space and time in Reach 1A. The first phase consists of combining empirical approaches of habitat attributes relevant to juvenile Chinook production with simulations in phase two including drone images and spatial models, bioenergetics models, habitat simulations, hydrodynamic models, and stable isotope mixing models. As part of this funded research my MS Thesis project aims to explore juvenile Chinook salmon (JCS) use of macrophyte beds within Reach 1A of the San Joaquin River through patterns of stable isotope ratios & macrophyte habitat observations. Macrophytes have habitat attributes such as having lower water velocity, reducing maximum water temperatures, increasing habitat structure, supporting larger invertebrate taxa, and supporting more macroinvertebrates than the surrounding open water, making macrophytes an ideal microhabitat for supporting the bioenergetic needs of fish species including juvenile Chinook salmon.

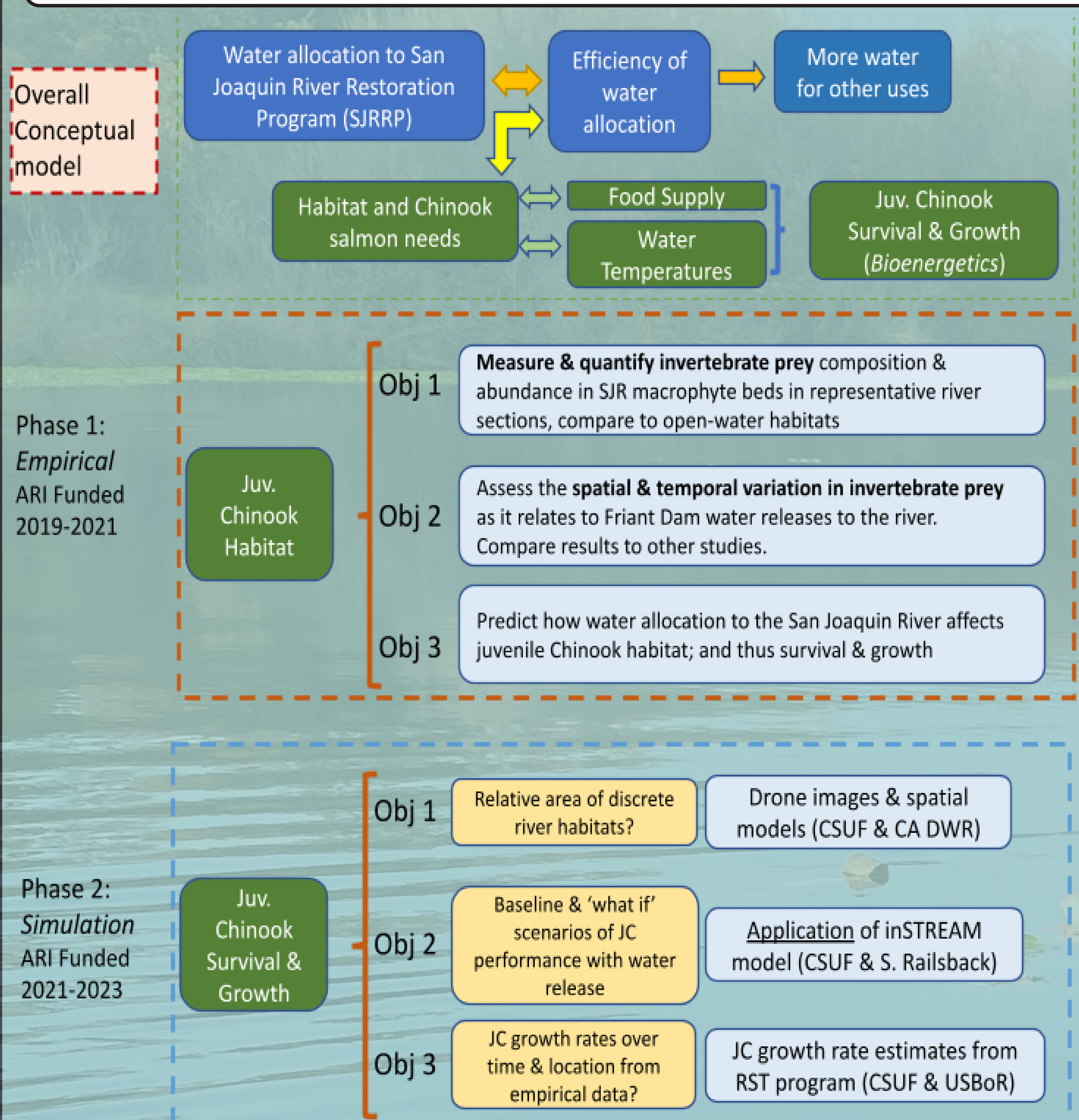

Figure 1: Conceptual Model Flowchart

Thesis Project Objectives

Objective 1: Estimate the dietary contributions of drift, macrophyte, and benthic macroinvertebrates to juvenile Chinook salmon from Reach 1A using stable isotope analysis.

Objective 2: Observe fish presence in macrophyte beds using underwater video footage throughout Reach 1A to evaluate for randomness in terms of species observed, number of individuals, macrophyte type, site location, camera position, and time of footage collection.

Methods

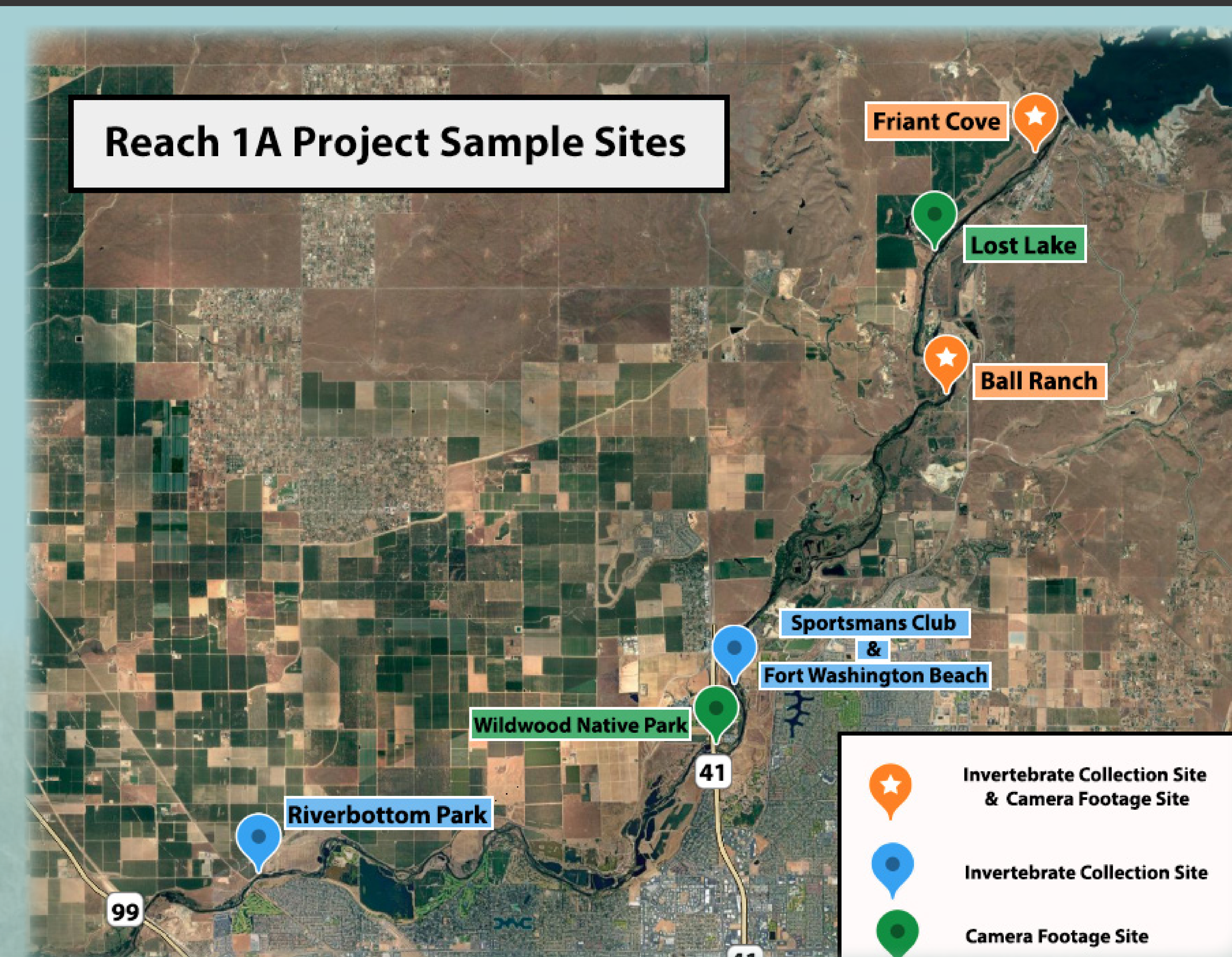

Figure 2:Study Site Map: Sample site locations along reach 1A of the SJR: invertebrate sampling and macrophyte camera footage collection (Orange), only invertebrate sampling (Blue), and only macrophyte camera footage collection (Green). Invertebrates were collected from benthic, drift, and macrophyte beds at sites along reach 1A of the SJR. Juvenile Chinook salmon were obtained from the rotary screw trap mortalities at Highway 99 and Owl Hollow in reach 1A of the SJR. Video footage was taken at several sites along reach 1A of the SJR where either Elodea or Parrot Feather macrophyte beds were present.

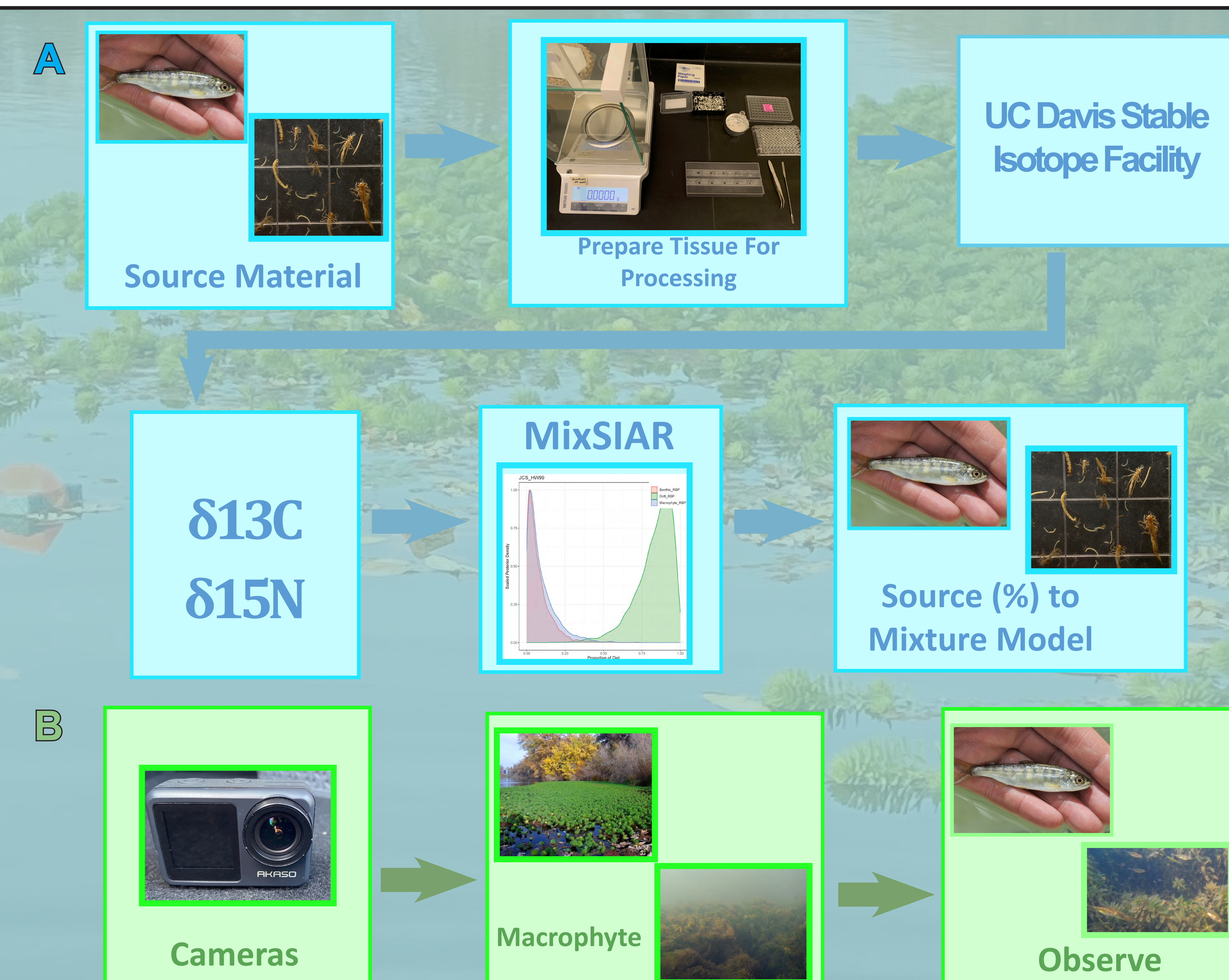

Figure 3: Method Flowchart: (3A) Samples were identified and prepared for SIA at CSU Fresno and shipped to UC Davis Stable Isotope Facility for C and N analysis. After the raw stable isotope data is obtained we ran it through the mixing model MixSIAR to determine the contribution of each invertebrate source modeled to the juvenile Chinook salmon"mixture". (3B) Four underwater action cameras were set out at the edge of macrophyte beds at 5 sites along reach 1A of the SJR. Cameras were positioned upstream and downstream of the macrophyte bed and left to record undisturbed for a minimum of 30 minutes per site. Footage was is being reviewed to identify and quantify any fish observed. Footage is being evaluated for randomness in terms of species observed, number of individuals, macrophyte type, site location, camera position, and time of footage collection.

Results (In Progress)

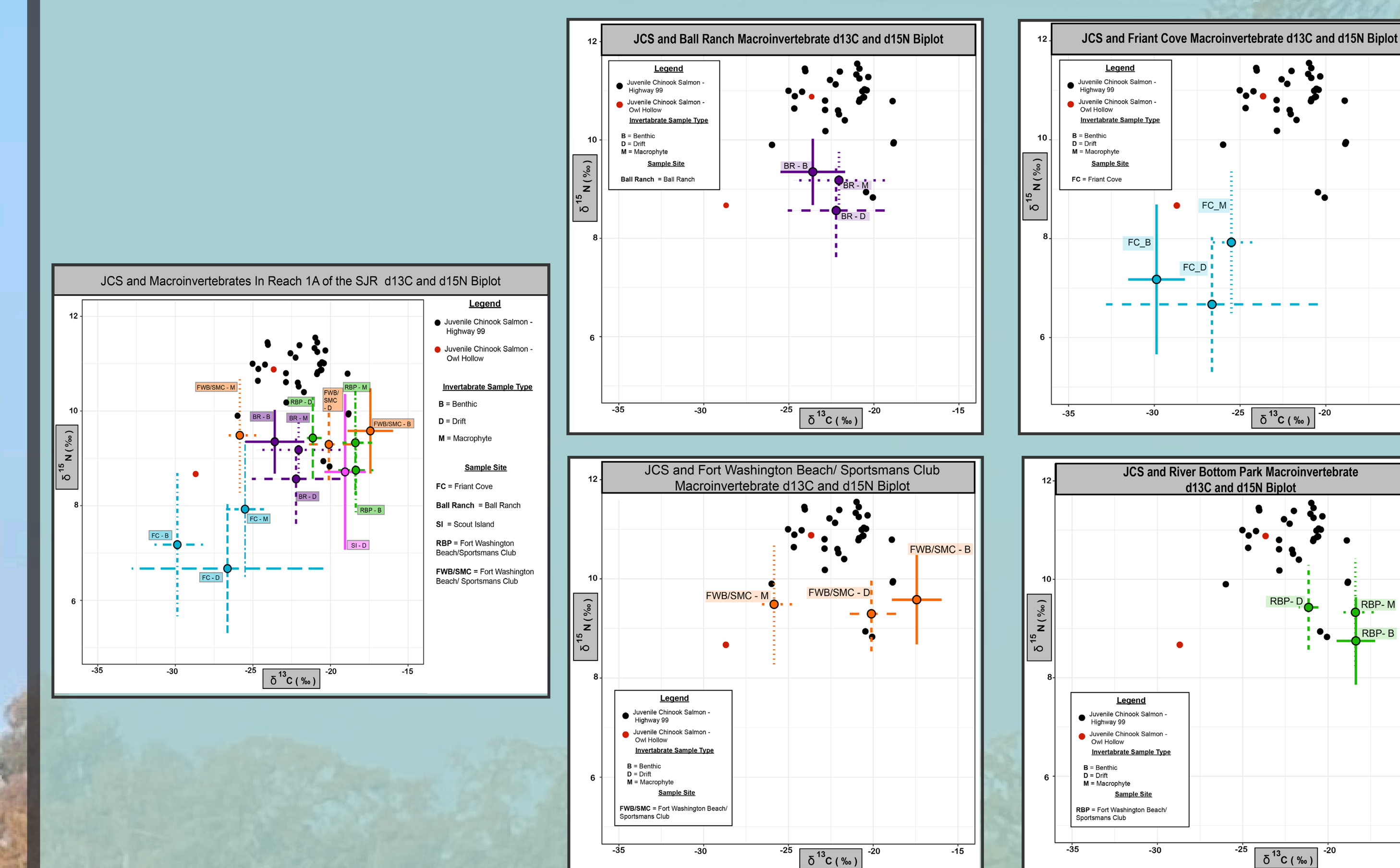

Figure 4: Source and Mixture Isospace Plot: Isospace plot generated by MixSIAR in R showing how corrected juvenile Chinook salmon (JCS) samples fit within different invertebrate sources (benthic, drift, and macrophyte) after applying a species specific trophic enrichment factor (Lerner et al. 2021). Figures show all invertebrate sources plotted with Owl Hollow and Highway 99 JCS (A) and invertebrate sources by individual study site along with Owl Hollow and Highway 99 JCS (B,C,D,E). Currently based on the assumptions of the *Lerner et al. 2021* TEF values this data does not explain this food web. Additional evaluation of a more appropriate TEF is needed.

Figure 5: Macrophyte Camera Observations: Three Spined Stickleback observed in Elodea beds at Lost Lake using underwater action cameras.

Future Directions

- Patterns of JCS Growth Over Time/Space
- Role of Maternal N in JCS SIA
- More Acurate Foraging Simulation
- Drone Imaging and Habitat Modeling

Acknowledgements

I would like to thank CDFW & U.S. Bureau of Reclamation for providing support for this project as well as thank the CSU Agricultural Research Institute & ICF for their support and funding. I would also like to thank everyone who helped collect and process samples especially Efrain Jimenez, Sierra Evans, and Yugjeet Grewal for their assistance on this project.