Reconstructing life history and thermal resilience of a small endangered fish in California from strontium and oxygen isotope ratios

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The Delta Smelt (*Hypomesus transpacificus*) is a small pelagic fish and rapidly approaching extinction. It is endemic to the Sacramento-San Joaquin Bay-Delta which is an important link in California's water supply. This estuary is managed for human use as well as for several species of threatened and endangered fish and the Delta Smelt is at the center of conflict between human and environmental uses of the limited water resources. Extensive monitoring surveys have shown that Delta Smelt exhibit a diverse life history with both resident and migratory phenotypes within a genetically homogenous population, however the details of this life history remain unclear.

Here we used strontium ($^{87}Sr/^{86}Sr$) and oxygen ($\delta^{18}O$) isotope tracers from archived Delta Smelt otoliths to reconstruct life history and thermal resilience at fine temporal scales (<1 week). $^{87}Sr/^{86}Sr$ ratios from otoliths can be used to reconstruct salinity habitats, while $\delta^{18}O$ reflects the water temperature a fish has experienced. $\delta^{18}O$ is also influenced by the ambient water conditions and species dependent isotope fractionation. As a first step, we calibrated the $\delta^{18}O$ temperature-dependent fractionation and validate the reconstruction of ambient water temperature from otolith $\delta^{18}O$ using Delta Smelt from lab experiments at UC Davis. This new method will then be applied to wild-caught Delta Smelt for which detailed salinity habitat reconstructions based on $^{87}Sr/^{86}Sr$ have already been established.

The combination of these two isotopic tracers will allow us to investigate the relationship between Delta Smelt abundance, freshwater outflow and water temperature. Understanding this relationship can give new insights into resilience and habitat utilization of Delta Smelt in the face of warming water temperatures during prolonged drought periods and long-term climate change.