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WHY THIS RESEARCH MATTERS

Due to the rapid decline in Bay-Delta fish populations and projections for continued drought and climate change, the persistence of several fishes is considered to be extremely vulnerable. Rising temperatures and salinity may impact the physiology and behavior of some fishes, which in turn may impact their larger aquatic communities. Understanding these interactions is essential for conservation planning efforts for Bay-Delta fishes, especially the endangered Delta smelt, in a future of climate change.

California drought and Delta fishes: Impacts of multiple stressors on the physiological performance and predator/prey dynamics in native and non-native fishes



Brittany Davis studied three species responses to multiple stressors including native Delta smelt (imaged top prey) and non-natives Mississippi silversides (imaged bottom prey) and largemouth bass (predator).

PROJECT

The project characterized species-specific vulnerability to elevated temperature and salinity for three Bay-Delta species: native Delta smelt, and non-natives Mississippi silversides and largemouth bass. In laboratory studies, Davis investigated how multiple stressors of warming and altered salinity regimes associated with drought periods and future climate change in California may influence the physiological performance of Delta smelt, as well as competitors (Mississippi silversides) and predators (largemouth bass) that influence Delta smelt populations.

RESULTS

The initial results of the project showed that water temperature had a greater impact on Delta smelt physiology than salinity; subsequently, in the second study of the project, Davis focused solely on the impacts of warming. She examined the effects of constant and fluctuating higher temperatures on behavior, group structure, response to predation alarm cues, and predation rates by largemouth bass. The study showed that exposure to constant warm water led to changes in Delta smelt behavior and predator-prey dynamics that could prove detrimental to Delta smelt survival and population persistence in a warming climate. Both studies are being prepared for a peer-reviewed scientific publication.

MANAGEMENT APPLICATIONS

The study has contributed to a better understanding of fish responses to multiple environmental stressors associated with drought and climate change. By examining individual physiology, behavior, group structure, and community interactions, the study lays the groundwork for future work informing the complex challenge of restoring and protecting Bay-Delta species under the increased environmental pressures that climate change may bring.

The findings have been shared with conservation managers and the Interagency Ecology Program, and Davis has been hired at the California Department of Water Resources, where she will continue as a fisheries biologist.



Brittany Davis conducts experiments on Delta smelt behavior and predation susceptibility at the UC Davis Center for Aquatic Biology and Aquaculture.

PRESENTATIONS

Davis BE, Cocherell D, Baxter R, Sommer T, Todgham AE, Fangué NA, 2017. Species-specific vulnerability to multiple stressors. Oral presentation: *California-Nevada American Fisheries Society Annual Meeting*, Eureka CA.

Davis BE, Cocherell D, Sommer T, Baxter R, Todgham AE, Fangué NA, 2017. Oral presentation: Delta fishes and multiple stressors: Native and non-native vulnerability to elevated temperature and salinity. *State of the Estuary Conference*, Oakland, CA.

Davis BE, Hansen M, Cocherell DE, Nguyen TX, Sommer T, Baxter RD, Fangué NA, Todgham AE, 2018. Delta Smelt behavior: Warming effects on swimming, group structure and predation. Invited oral presentation. *Interagency Ecological Program Annual Workshop*, Folsom, CA.

RESEARCH MENTORS

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COMMUNITY MENTORS

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