Monitoring Responses Of The Delta Smelt Population To Multiple Restoration Actions In The San Francisco Estuary

A project under consideration by the CALFED Ecosystem Restoration Program

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Restoring the threatened delta smelt (*Hypomesus transpacificus*) population has remained a primary goal of CALFED for a decade. Numerous restoration actions have been proposed or implemented to provide benefits for delta smelt, yet a coherent plan for investigating the population or its responses to concurrent restoration actions does not exist. Monitoring for delta smelt occurs at a few restoration sites, and throughout the species' range by the Interagency Ecological Program (IEP). However, there is no systematic effort to link across scales of biological organization to understand population-level responses. Environmental change including restoration affects individuals through growth rates, fecundity, or mortality risk; population responses then arise from the cumulative outcome of these individual responses. Therefore, to understand the efficacy of restoration we must quantify these vital parameters for individual fish, and interpret results in the context of the entire delta smelt population.

We request three years of support to implement a state-of-the-art monitoring program to link key vital parameters for individual delta smelt with survival to adulthood at the population level. Our plan is to measure five vital parameters for fish collected by the IEP, including growth and body condition, exposure to toxic chemicals, survival to the adult stage, spawning success, and feeding and food selectivity. We previously developed the methodology for measuring four of these parameters for delta smelt and the fifth is a standard technique.

Our approach is novel because it combines information from histopathology of fish tissues, gut contents, and analyses of fish growth from otoliths to distinguish among mechanisms influencing the state of the individual fish. In addition, we now have the technology to use the composition of chemical elements incorporated in otoliths to provide a chemical history of a fish's movements. This enables us to identify in which of four major regions each fish hatched, and where it has spent its time during rearing. By combining this information on surviving fish with region-specific information on the vital rates and risk of loss to the water export facilities, we can begin to discern what combinations of environmental conditions result in high or low survival and population abundance. The overall synthesis will provide the most novel and technologically advanced monitoring for understanding the spatiotemporal patterns by which various factors interact to influence population abundance. In other words, we will proceed from what we can reliably measure to what matters for the population (and the species) and therefore what is important to management. Our plan is also extremely cost-effective and environmentally friendly: we will extract the greatest possible amount of information from fish that will be collected and therefore killed in the course of monitoring.