

# **Demise of the Delta's Smelts: Impact of Drought and Climate Change on the Unlikely Survival of Endangered Smelt in a Highly-Altered Ecosystem**

J. Hobbs, L. Lewis, M. Willmes,  
UC Davis, Wildlife, Fish and Conservation Biology

Local and global anthropogenic impacts have caused extinction of plants and wildlife world-wide. Rapid changes in climate, in particular, are likely to claim many more species in the near future. Two, once-abundant native osmerid smelts, Delta Smelt and Longfin Smelt have declined precipitously in the Sacramento-San Joaquin River Delta. While many factors likely impact the environment and survival of these semi-anadromous species, recent extreme changes in the physical conditions in which these organisms are found have likely contributed significantly to recent population declines. Here we examine temporal trends in the environmental drivers (e.g., outflow, cumulative thermal stress) and population biology (e.g, abundance, hatch dates, growth rates, and variation in life-history strategies) of these two threatened/endangered native fishes. We demonstrate that recent temporal trends in freshwater outflow and thermal stress in the Delta are extreme and unprecedented, and that abundances of both smelt species reached record lows over this warming period. Furthermore, phenology, growth rates, and life-history strategies have all varied as a function of regional climate. While the ocean-going Longfin Smelt responds positively to outflow, no such relationship has been observed for Delta Smelt, which appears to respond strongest to variation in water temperature. The positive response of Delta Smelt to two sequential cool years in 2010-2011 suggest some population resilience remains; however, the ongoing drought has resulted in extreme low abundance and further erosion of resilience. Observed and predicted trends toward warmer, drier summers in California indicate that thermal stress is likely to intensify and further impact Sacramento Delta's smelts. We recommend that conservation and habitat restoration efforts focus directly on providing summertime thermal refuges for Delta Smelt in freshwater rearing habitats and increased outflows to enhance recruitment of Longfin Smelt.