Executive Summary

Pelagic organisms are in serious decline in the San Francisco Estuary (SFE). A potentially important, yet understudied, factor in this decline is the invasion of four predatory hydrozoan species (Maeotias marginata, Moerisia sp., Blackfordia virginica, and Cordylophora caspia). Our current level of knowledge regarding the basic biology and ecology of these organisms is alarmingly poor in light of both their possibly negative effect on the SFE ecosystem and the increasing trends in jellyfish blooms around the globe. Our proposed research seeks to investigate the potential effects of these species on the SFE ecosystem, to determine the key factors allowing successful establishment and spread of these species, and to predict future effects and spread of the invasions. This multi-tiered research project involves three independent tasks utilizing genetic analyses, field surveys, and controlled laboratory investigations. First, through the use of genetic analyses, we will identify the species present in all life history forms via the development of molecular tools. In the second portion of this task, we will use molecular techniques to evaluate clonal diversity and mode of reproduction. Hydrozoans are novel predators in that they can reproduce both asexually and sexually. The capacity to reproduce asexually may confer a strong advantage on these rapidly expanding invasives, therefore it is important to gain a clear understanding of both the nature of clonal diversity and how they are reproducing and spreading. The second task is two-fold and will be accomplished via directed field surveys focused in Suisun Marsh. In the first portion, we will establish a reliable estimation of the current distributions and abundances of invasive hydrozoans and relate these trends to water quality and habitat data. The remainder of this task will involve detailed gut contents analysis to determine patterns of prey selectivity (including predation on larval fishes), temporal feeding behavior, and dietary overlap with planktivorous fishes. The third task will involve a suite of laboratory studies, designed to determine ecophysiological characteristics of these species. We will quantify feeding rates upon zooplankton and larval fish prey for both the medusae and polyp life history stages, as well as evaluate salinity and temperature tolerances and their effect on survival and reproduction. We will integrate the understanding gained from our studies, the available data for the zooplankton and ichthyofaunal communities, as well as the historical and contemporary data on hydrozoan presence and abundance into a predictive model. This tool will evaluate the potential ecological effects of these invasives on the SFE and how the invasions may change under different scenarios of climate change and water management. The expected outcome of this work will be a clearer understanding of the effects of several abundant and novel hydrozoan predators in the system, as well as predicting trends and patterns of the populations in response to a changing SFE environment. We will understand what makes these invasives successful and predict how the invasion may spread and adapt in the years to come. The proposed body of work will address the CALFED Priority Research Topics of aquatic invasive species, trends and patterns of populations and system response to a changing environment, and habitat availability and response to change. It also is an important research component in elucidating the cause of pelagic organism decline in SFE. In addition to providing a predictive model, the information produced will be disseminated to the management and scientific communities through quarterly reports, poster and oral presentations at local and national meetings, as well as submissions to the IEP Newsletter and multiple publications in peer reviewed journals