Executive Summary

We propose a program of collaborative research to determine the productivity base of the foodweb of the Low-Salinity Zone (LSZ) of the northern San Francisco Estuary. The proposed research would address two critical issues for CALFED: foodweb support for the threatened delta smelt, and the basis for the relationships between abundance of estuarine fish species and freshwater flow. Delta smelt spend their lives from late larval to early adult stages in and near the LSZ, feeding on copepods. There is evidence that they can be severely food limited, as are the copepods on which they feed. In addition, several other estuarine-dependent species that rear in the LSZ have abundance relationships to freshwater flow. One possible mechanism for these relationships is a positive response of the foodweb to freshwater flow.

Exogenous organic carbon likely provides important support to the LSZ foodweb. Primary productivity has been low since the estuary was invaded in 1987 by the introduced clam Potamocorbula amurensis. A summer-long phytoplankton bloom occurred in most years before 1987, but since then, phytoplankton biomass is high only during brief, unreliable spring blooms when clams are scarce. The roughly 5-fold decline in phytoplankton biomass and production since 1987 led to substantial changes in the LSZ foodweb, but declines in copepods and some fish were considerably smaller than might have been expected. This implies compensation by the microbial foodweb, supported by exogenous carbon, most likely from freshwater phytoplankton that release dissolved organic carbon upon entering brackish water. Mass balance suggests a substantial seaward flux of freshwater phytoplankton, yet freshwater species are not abundant in the LSZ.

Our proposed research will examine the base of the foodweb, from phytoplankton and bacteria to copepods, in the LSZ to address the following issues:

? Controls on phytoplankton production, survival, and species composition including benthic grazing, turbidity, salinity, and nutrients.

? The response of bacterial production to changes in organic inputs with freshwater flow

? The role of the microbial foodweb in supporting higher trophic levels

? The contributions of alternative energetic pathways in supporting copepods.

We propose a 3-year project in which field and laboratory work will occur in the first two years, leaving the third year for analysis and synthesis. Fieldwork will focus on two periods when larval, juvenile and adult delta smelt are present. During spring we will conduct weekly cruises to observe whatever spring bloom occurs. Research during this period will include phytoplankton experiments on the potential influence of ammonium concentration on nitrate uptake and therefore growth, and measurements of grazing, light limitation, and other losses. In the summer period of low chlorophyll we will measure bacterial abundance and production, microzooplankton abundance and feeding, copepod feeding on alternative food sources, and benthic grazing.

Synthesis of the results of our study will take advantage of the vast amount of historical data on some of the foodweb components, with which the lead PI has extensive experience. The outcome will be a foodweb model with quantitative functional relationships among components, and estimates of the likely response of the foodweb to flow.