Task 1: Particle-tracking modeling:

The particle tracking model will be applied by Monismith, Fong, and Hench, with advice from Kimmerer, Bennett, and Rose. Since both the particle tracking and hydrodynamics codes exist, initial efforts will focus on familiarization of the project investigators with the codes, and assembly of appropriate data sets for model development and testing. This includes adapting (if necessary) the PTM to handle the transition of yolk-sac larvae to feeding larvae that have directed movement. We will also develop the appropriate software to map particle positions to exchanges among the spatial boxes represented in the IBM. The Matlab shell proposed to facilitate viewing of PTM results will not be developed because of budget cuts. We will examine the differences in transport of larvae across the Delta under various combinations of the six different hydrological year-types, on or off barrier operations, on or off VAMP activities, different export pumping levels, and alternative larval behaviors. PTM predictions will be viewed in terms of entrainment losses and transition probabilities of movement for use in the IBM and matrix projection models. The development and analysis of the PTM will be done in close collaboration with Rose, Bennett, and Kimmerer to ensure easy integration of the PTM results with the IBM and matrix projection models.

Task 2: Individual-based modeling:

The IBM will be developed and evaluated by Kimmerer, a post-doctoral student, and Rose, with advice from Bennett and Monismith. The modeling will extend the preliminary IBM presented at the 2003 EWA delta smelt workshop. The data leads and suggestions from the 2003 workshop will be pursued. Depending on the skills of the post-doctoral student, computer coding of the IBM will be done in C, C++, Fortran, or Visual-Basic. Initially, Kimmerer, the post-doctoral student, and Rose will meet to specify a work plan for keeping track of data acquisitions, data analyses, model process formulations and parameter values, and model coding. This work plan will be adapted to changing conditions (e.g., new data, results from other components) as the modeling process proceeds. Model development will be an iterative process that involves repeatedly revisiting the model and continually challenging the assumptions and data interpretations underlying its process formulations.

Task 3: Matrix projection modeling:

The majority of the matrix projection modeling will be done by Bennett and a graduate student, with advice from Rose, Kimmerer, and Monismith. Modeling will extend the preliminary three-season model developed by Bennett (2005). Parameter estimates and model structure will be reexamined using newly available data and information. Particular emphasis will be given to refining the mortality rates assigned to each life stage by careful analysis of available field data. Alternative model structures will be developed by incorporating additional life-history attributes such as a two-year life cycle, density dependent mortality, and environmental stochasticity. Modeled abundances will be projected forward in time to examine long-term dynamics and to compare model sensitivities among life stages and among alternative model structures. A subset of these models will then be further expanded to include explicit spatial regions in order to better accommodate the sources of mortality that are restricted to different areas of the delta smelt habitat (e.g. export pumping by the south Delta facilities). Once these models and their sensitivities have been evaluated, we will develop scenarios reflecting recruitment from past years to understand the potential influences of entrainment mortality and use of EWA water on the delta smelt population. Our overall modeling approach will also be iterative, incorporating refinements to model parameters as new information becomes available, and incorporating information from the PTM (transition probabilities, losses to entrainment) and the IBM (model results, vital rates).