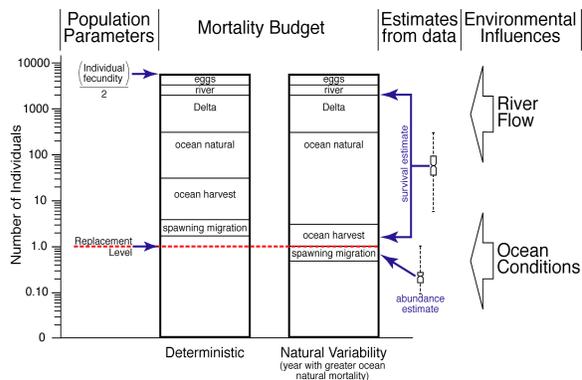




# Statistical Model of Central Valley Chinook Incorporating Uncertainty

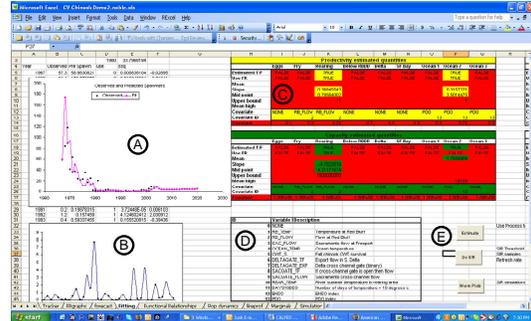
## San Francisco Bay-Sacramento River Delta, California

Over the past several decades, substantial resources have been devoted to the management of water, fisheries, and habitat in the San Francisco Bay-Sacramento River Delta (Bay-Delta) for resident Chinook salmon runs. There has been increasing concern for species in decline, with the listing of winter and spring-run Central Valley (CV) Chinook under both federal (Endangered Species Act, ESA) and state laws. Persistence of salmon populations depends on total mortality from egg to spawning, as well as how the various sources of mortality vary. When total mortality reduces the abundance of eggs produced by an individual spawner to less than one spawner returning, the population will decline.



### Project Elements:

- Decision Analysis
- Population Modeling
- Fisheries
- Bayesian Statistics
- ESA Species



The project developed a statistical modeling approach to the two CV Chinook salmon species-at-risk (winter-run and spring-run) that incorporated mortality in all phases of salmon life history, and includes the effects of uncertainty in assessing population status, guiding future research, and making management decisions. The model uses stages to characterize the salmon life history and estimates the stage-specific vital rates (e.g., survival) from abundance indices. Environmental factors are incorporated into the modeling framework and the vital rates are estimated with uncertainty using probability models (Bayesian estimation).

The outputs from the models are probability distributions that quantify the uncertainty in the population dynamics. Such probability distributions are used to define the probability the population could go extinct in the next 20 years as well as the population growth rate, observed abundance indices, and period of data collection needed to ensure the population has reached recovery goals. Furthermore, the model evaluates the role of water exports on mortality rates in relation to sources of mortality in other life history stages, such as pre-spawn mortality, egg incubation, and ocean survival.