Synthesis of data and studies relating to Delta Smelt biology in the San Francisco Estuary, emphasizing water year 2017 (FLOAT-MAST IEP Technical Report 95)

Interagency Ecological Program Flow Alteration Management Analysis and Synthesis Team

Main finding: **High fall outflow is necessary, but not sufficient to provide favorable conditions for Delta Smelt**. High flows in 2017 resulted in many good habitat characteristics for Delta Smelt but smelt did not have the expected high survival or abundance. **High temperatures in 2017 may have stopped Delta Smelt from thriving**.

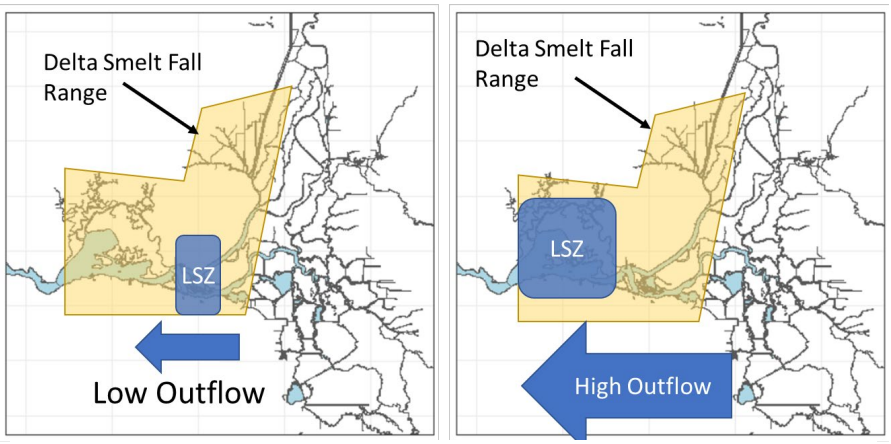

Figure 1. Location of the fall low salinity zone (LSZ) where most Delta Smelt are found in the fall under low outflow and high outflow conditions.

Background and motivation: The USFWS Biological Opinions for the State Water Project and Central Valley Project require adaptive management of Delta outflows during years with above normal precipitation. This is motivated by the theory that when the Low Salinity Zone (LSZ, between 1-6 PSU) is located further seaward, habitat conditions for smelt are improved (Figure 1). However, adaptive management of fall flows requires a better understanding of how habitat conditions in the LSZ change with high outflow.

Approach: **Evaluate the response of Delta Smelt and habitat to the high flows in 2017**

- IEP formed the Flow Alteration Management Analysis and Synthesis Team.
- Used previous studies and conceptual models to predict the response of physical habitat, biological habitat (including food supply), and smelt responses.
- Compared 2017 to the most recent high-flow years (2011 and 2006) to see whether there were consistent trends between water year type and ecological responses.
- Used data from a variety of long-term monitoring programs and short-term special studies to determine whether the data supported the predictions.

Findings: Some habitat predictions were supported by the available data (Table 1). The area of the LSZ was higher in wet years, clam biomass and grazing rate was lower, and water hyacinth was lower. Other predictions held true for 2017 but did not show consistent trends with water year type, such as increased phytoplankton and zooplankton biomass. Most of the Delta Smelt response metrics did not respond as predicted; populations in 2017 were at a record low, despite relatively good health metrics. The unusually high temperatures in summer of 2017 may have prevented smelt from responding as predicted to high flows.

Table 1 - Results of analyses of each response variable assessed as part of the FLOAT-MAST report for the most recent high flow-years (2006, 2011, and 2017), low flow years, and specifically for 2017. Arrows represent direction of trend. Solid green symbols signify the variable responded as predicted. Red checked symbols signify the variable did not respond as predicted. Grey circles indicate insufficient data to evaluate the variable.

Physical Habitat	Low Flows	High Flows	2017
Fall X2 location	Sac-San J. Confluence	Suisun Region	Suisun Region
Area of LSZ			
Turbidity			
Water Temperature			

Biotic Habitat	Low Flows	High Flows	2017
Phytoplankton			
Harmful algal blooms			
Zooplankton			
Clams			
Water Hyacinth			

Delta Smelt	Low Flows	High Flows	2017
Distribution			
Growth and survival			
Health metrics			
Feeding success			
Life history diversity			

Suggestions for future directions:

1. Establish a group of scientists and managers dedicated to the development and implementation of a science plan for Delta Smelt.
2. The Delta Smelt Science Plan should consider all aspects of Delta Smelt science from monitoring to modeling and should consider all factors potentially affecting the species.
3. We suggest an initial effort to better understand how water temperature varies across the Delta in different water year types.
4. Conduct large mesocosm studies or field experiments using caged hatchery fish to better understand responses of Delta Smelt to ambient conditions.