Longfin Smelt

The section presents BDCP species-level Biological Goals & Objectives (BGOs) for Longfin smelt, and the rationale behind these BGOs. A brief summary of Longfin smelt biology and factors influencing their growth, reproduction, survival, and migration is provided followed by the proposed goals and objectives.

The longfin smelt in California is a small, pelagic, anadromous and estuarine species that can tolerate salinities ranging from freshwater to nearly pure seawater. Most longfin smelt occupy the middle or bottom of a water column and tend to favor temperatures in the range of 16-18°C and salinities ranging from 15-30 ppt. Their spatial distribution within the estuary is seasonally variable. Generally speaking longfin smelt are found closer to the ocean during summer whereas they move upstream in cool seasons. They can survive summer temperatures up to 20°C. Longfin smelt may also make daily migrations; remaining deep during the day and rising to the surface at night.. In addition longfin smelt may follow food sources which include opossum shrimp, copepods, and crustaceans. Longfin smelt reach 6-7 cm SL in the first 9-10 months of life. Growth is minimal during their first winter, but the growth rate increases again in their second summer and fall when they may reach 9-11 cm SL. The largest longfin smelt are female fish that reach standard lengths up to 15 cm in their third year. Longfin smelt move into freshwater to spawn, with the peak breeding season occurring between February and April. Older and larger fish tend to spawn in the later stages of the spawning season. Little is known about spawning in the Estuary. In other smelt populations, males are first to move into areas with gravel or sandy substrate where rocks and aquatic plants are present. Spawning occurs at night, when female smelt release an average of 5,000-24,000 adhesive eggs. Smelt typically die after spawning though a few females may survive another year. After a protracted incubation, eggs hatch into buoyant larvae that are transported by freshwater outflows to the mixing zone. In the San Francisco estuary, high spring flows are associated with higher resulting populations of smelt. Larvae are mobile and move according to salinity preferences. In 30-60 days the larvae morph into juvenile fish. Larvae feed extensively (both day and night) on copepods, particularly *Eurytemora affinis* and later *Pseudodiaptomus forbesi* (Hobbs et al. 2006, Slater unpublished). Juveniles include mysids, and later amphipods, in their diet as soon as they can accommodate the larger size (Feyrer et al. 2003, Slater unpublished). Recruitment of juvenile longfin smelt has, and continues to be, positively associated with winter-spring Delta outflow. However over time, longfin smelt abundance has declined relative to X2. That is, the same value of X2 is now associated with a lower abundance of longfin smelt (Kimmerer 2002, Rosenfield and Baxter 2007, Baxter et al. 2010). Stimulation of the Delta and Suisun Bay food webs is a goal of BDCP, and if successful will improve feeding opportunities for longfin smelt.

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Species-Specific Goals and Objectives

Following the Logic Chain approach, the table below lists BDCP species-level BGOs for Longfin smelt in the context of global goals and objectives developed by the agencies to support recovery planning and key stressors that BDCP will address. The global goals and objectives at the top of the table do not reflect BDCP goals and objectives, but rather represent broader goals and objectives developed by state and federal resource agencies relative to full species recovery. BDCP will contribute to meeting these goals and objectives, but will not in-and-of-itself achieve them.

The goal of the BDCP is enhanced environmental conditions in the Delta that support increased abundance and distribution of Longfin smelt in the Study Area. Four specific, measureable species-level objectives are provided to support achieving this goal that focus on juvenile growth; prey availability (food supply), entrainment; and the availability of spawning habitat. These objectives will be achieved primarily through Conservation Measures to relocate and operate the primary point of diversion to the North Delta (thereby reducing the spatial overlap of diversion intakes and longfin smelt and substantially reducing entrainment), and to restore tidal wetlands that can support greater primary and secondary production and provide increased food resources. Specific numeric goals will be better informed following the development of a longfin smelt life cycle model; multiple models are being developed at this time.

Species:	**Longfin smelt**	
Global Goals / Objectives: *Note: These are not BDCP goals and objectives. BDCP will contribute to meeting these, but will not in-and-of-itself achieve them.*	**GG1:** Improved food web productivity for pelagic fishes in general and for longfin smelt in particular. **GG2:** Longfin smelt will be considered restored when its population dynamics (measured as magnitude of winter spring abundance are similar to those that existed in the 1967-1987 period.	**GO1:** (a*bundance criteria*): Productivity (abundance indices) must be equal to or greater than predicted for 5 of 10 years based upon a regression of 1967-1987 abundance on December through May mean outflow (or X_2). **GO2** *(distributional criteria)***:** (1) longfin smelt must be captured in at least 40 percent of Carquinez Strait and Suisun Bay Fall Midwater Trawl stations in at least 80 percent of years sampled, and (2) during each sampling year for the Fall Midwater Trawl individual trawl catches of 13 longfin smelt or more must be made at least once (this reflects a return to historical schooling behavior). **GO3:** Implement actions to benefit longfin smelt abundance (winter-spring outflow enhancements), to minimize threats (reduce exports) and to improve the scientific understanding of their ecology to benefit future management.

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Stressors addressed by BDCP:	Increased food limitation Entrainment Physical Spawning Habitat Loss and Modification
BDCP Species Goal:	Enhanced environmental conditions in the Delta that support increased distribution and abundance of Longfin smelt in the Study Area.
BDCP Growth Objective:	Increase fall mean body length of juvenile longfin smelt by ___percent by increasing summer growth rates within 14 years of implementation. ADDITIONAL ANALYSES IS NEEDED TO DEVELOP AN APPROPRIATE PERCENT INCREASE IN GROWTH. Increase summer-time growth rates by increasing the density of zooplankton in the lower Sacramento, lower San Joaquin, and confluence areas in low outflow years, and confluence and below in high flow years. The average daily spring and summer zooplankton production should increase in quantities and quality such that longfin smelt growth rates become similar to their growth rates in 1970's and 1980's. Increase density of longfin smelt preferred prey by ____ percent. ADDITIONAL ANALYSES IS NEEDED TO DEVELOP AN APPROPRIATE PERCENT INCREASE IN PREY DENSITY.
BDCP Entrainment Objective:	From December through February, entrainment of juveniles and reproductive adults in combined SWP and CVP delta pumping facilities shall not exceed ____percent of population as estimated using the Fall Midwater Trawl longfin smelt index from the previous September through December. ADDITIONAL ANALYSES IS NEEDED TO DEVELOP AN APPROPRIATE PERCENTAGE OF THE POPULATION. Percentage would be based on historical longfin smelt lost to entrainment at the project diversions relative to the FMWT—values estimated for years with historically low entrainment and relatively high fish index or some other indicator.
BDCP Physical Spawning Habitat Objective:	Increase extent and availability of quality longfin smelt physical spawning habitat. Based on available information, quality spawning habitat is identified as rocks, sandy or gravelly substrates, aquatic plants, or some other firm substrate, located in freshwater. Until more is known, *"Promote the expansion and availability of freshwater spawning habitat for longfin smelt within the Delta upstream of X2 where water temperatures are maintained at an average 10-12 deg C during mid-December to April."*

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