Topic: Smelt Monitoring

Region: Delta

Type of Idea: Study

Timeframe: Study periods, or indefinite

Species and Lifestage: Delta Smelt – all life stages, primarily adult

Current Requirement / Action

The USFWS 2008 BO bases OMR action triggers on, in part, the Fall Mid-water Trawl, Spring Kodiak Trawl, and delta smelt salvage at the Jones and Banks pumping plants. Recent enhanced Delta Smelt Monitoring (EDSM) also provides information to inform entrainment risk. As indicated in the USFWS BO, "abundances near the detection threshold of the sampling techniques makes it very difficult to draw reliable inferences about how many delta smelt there are, and where they are located". The BO also allows the Smelt Working Group to use "available physical and biological real-time monitoring data" to decide whether a large fraction of the Delta smelt population is at a high entrainment risk.

Idea

All of the current sampling efforts require physical handling of Delta Smelt, which requires take. Non-invasive methods of determining smelt presence could greatly expand our knowledge of Delta smelt presence and locations, while avoiding the need for physical handling or capture of the smelt. These include environmental DNA as well as scent dogs.

Past Implementation

As stated in the 2008 USFWS BO, "the Fall Midwater Trawl Survey (FMWT) and the Summer Townet Survey (TNS) are the two longest running IEP fish monitoring programs that are used to index delta smelt abundance. They work well because they were originally designed to target age-0 striped bass, which have similar habitat requirements to delta smelt. Two more recent programs, the 20-mm Survey and the Spring Kodiak Trawl Survey (SKT), were designed specifically to sample delta smelt and are also commonly used to evaluate relative abundance and distribution. Each of these four sampling programs targets different life stages and encompasses the entire distribution of delta smelt for the given life stage and time of year. The efficiency of sampling gears used for delta smelt is unknown. However, they were all designed to target open-water pelagic fishes and data from these programs have been used extensively in prior studies of delta smelt abundance and distribution (e.g., Stevens and Miller 1983; Moyle et al. 1992; Jassby et al. 1995; Dege and Brown 2004; Bennett 2005; Feyrer et al. 2007).

Data from the FMWT are used to calculate indices of relative abundance for delta smelt. The program has been conducted each year since 1967, except that no sampling was done in 1974 or 1979. Samples (10-minute tows) are collected at 116 sites each month from September to December throughout the Bay-Delta. Detailed descriptions of the sampling program are available from Stevens and Miller (1983) and Feyrer et al. (2007). The delta smelt recovery index includes distribution and abundance components and is calculated from a subset of the September and October FMWT sampling (http://www.delta.dfg.ca.gov/). The details on the calculation of the recovery index can be found in the Delta Native Fishes Recovery Plan (Service 1995).

Data from the TNS are used to calculate indices of abundance for young-of-year delta smelt during the summer. The TNS has been conducted annually since 1959 (Turner and Chadwick 1972). It involves sampling at up to 32 stations with three replicate tows to complete a survey. A minimum of two surveys is conducted each year. The delta smelt index is generated from the first two TNS surveys (Moyle et al. 1992). The TNS sampling has had an average survey starting date of July 13, but surveys have been conducted as early as June 4 and as late as August 28 in some years (Nobriga et al. 2008).

Data from the 20-mm survey are used to examine the abundance and distribution of young post-larval/early juvenile delta smelt during the spring (Dege and Brown 2004). The survey has been conducted each year since 1995, and involves the collection of three replicate samples at up to 48 sites; additional sites have been added in recent years. A complete set of samples from each site is termed a survey and 5-9 surveys are completed 144 each year from approximately March though June. This survey also simultaneously samples zooplankton with a Clarke-Bumpus net during one of the three sampling tows at each site.

Data from the SKT are used to monitor and provide information on the pre-spawning and spawning distributions of delta smelt. The survey also quantifies the reproductive maturity status of all adult delta smelt collected. SKT sampling has been done since 2002 at approximately 39 stations. Sampling at each station is completed five or more times per year from January to May. Supplemental surveys are often completed when additional information is requested by managers to assist with decisions relating to water project operations."

The Enhanced Delta Smelt Monitoring (EDSM) program, which began in November 2016, is a year-round weekly sampling program administered by the US Fish and Wildlife Service (USFWS) that samples nearly all life stages of Delta Smelt and produces weekly estimates of abundance for several spatially-defined, and temporally dynamic, strata. The original motivation for the survey was to acquire finer temporal resolution information than existing surveys provided about the spatial distribution and abundance of adult Delta Smelt during the December through March period when State Water Project (SWP) and the federal Central Valley Project (CVP) are exporting water that leads to the entrainment of Delta Smelt and other fish species. Beginning December 2017, the Enhanced Delta Smelt Monitoring (EDSM) program started its Phase 1 sampling program for adult delta smelt. The Bay-Delta has been divided into ten geographic strata. Sampling locations are generated using a generalized random-tessellation stratified (GRTS) design with stratification and equal probability sampling. Trawling gear similar to that used in the California Department of Fish and Wildlife's Spring Kodiak Trawl Survey is used to conduct multiple tows per location.

The sampling locations of the EDSM change from week to week and are randomly selected using a probabilistic procedure aimed at providing a spatially dispersed sample. This is in contrast to existing long-term fish monitoring programs, such as the USFWS's Beach Seine Survey and the California Department of Fish and Wildlife's 20mm Survey (20mm), Summer Townet Survey (STN), Fall Midwater Trawl Survey (FMWT), and Spring Kodiak Trawl Survey (SKT), that sample the same non-randomly selected locations over and over. Another key difference from existing surveys is the use of a stopping rule for sampling of life stages that can be readily identified at the time of capture, which includes all life stages but small larvae that require a microscope to identify. Tows are repeated until a fish is caught or an upper limit on the number of tows is reached. The motivation behind the stopping rule is to lower the probability of a "False Zero", i.e., failing to catch fish when fish are present, while aiming to minimize the "take" of a threatened species.

Current Science

Science is ongoing related to environmental DNA and scent dogs, see below.

Environmental DNA

Identification of aqueous environmental DNA (eDNA) allows determination of presence without direct observation of organisms. Environmental DNA decomposes quickly, and degrades with UV radiation exposure. Thus, identifying Delta Smelt eDNA in water samples may provide a way to determine smelt presence in a specific location at a time within several days. DNA detectability decreases with time after the removal of the species source of DNA. DNA fragments may persist up to one week at 18 degrees C in lake water (Matsui, 2001). In another study, DNA was detectable for less than one month in the lab and field conditions (Dejean, 2011). The density of individuals also influences the dynamics of DNA detectability in water samples, but methods exist to obtain eDNA information even at low densities (Ficetola, 2008).

Samples persist longer in sediments than in the water column, so for overall Delta smelt presence geographically, sediment sampling could be done instead of water sampling (Turner 2014). Water sampling would instead provide more real-time information.

Scent Dogs

Scent dogs are currently being used and developed in several applications to identify rare aquatic species, including Giant Garter Snake in California (unpublished data referred to in Hansen, 2017), and quagga mussels in Lake Mead (DeShon, 2016).

Modeling Assumptions

Not applicable.

Sources

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