Interagency Ecological Program San Francisco Estuary 20-mm Survey (20-mm) **(FISH)** Metadata

Contents

Study Management

IEP Study Name: 20-mm Survey

Program Element: 033

Agency: Department of Fish and Wildlife, Bay Delta Region (R3)

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Study Overview

Purpose/Objective: The 20-mm Survey monitors and provides information on abundance, distribution, and timing of larval and juvenile Delta Smelt(*Hypomesus transpacificus*) and their food supply throughout their historical spring range in the San Francisco Bay-Delta Estuary.It is also used to help estimate larval and juvenile Delta Smelt and Longfin Smelt(*Spirinchus thaleichthys*) entrainment at the State Water Project (SWP) and Central Valley Project (CVP). This document contains metadata for **only the fish data** of the 20-mm survey.

Data Collected: Surface water temperature (°C), surface and bottom electro-conductivity (EC, μS/cm, normalized at 25 °C), Secchi depth (cm), surface water turbidity (NTU, FNU), water volume (m^3), tidal stage, start and end tow coordinates (DMS). Fish are identified to the lowest possible taxonomic level, enumerated, and measured (mm) to fork length when possible or total length when the fork in the caudal fin is not present.

Geographic Range of Work: The 20-mm Survey currently samples 61 stations every other week from March to July. These stations are spatially distributed in the San Francisco Bay-Delta Estuary with; 22 stations in the Far West region, 9 in Suisun Bay and Marsh, 12 in the Confluence, 8 in the North Delta, and 10 in the South Delta.

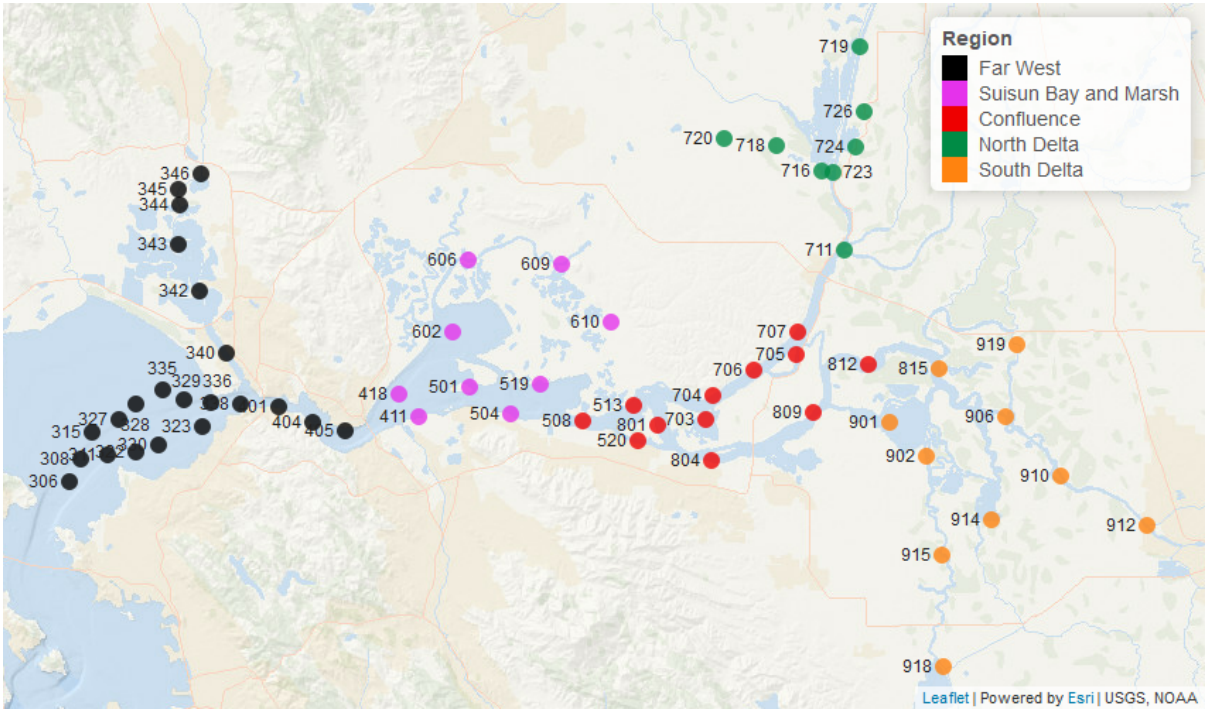

Figure 1: The geographic range of work for the 20-mm Survey. Each point represents the location of a sampling station, totaling to 61 stations of primary interest. Stations are colored according to their relationship with their sampling region, where black represents stations that are in the Far West, Purple represents stations in Suisun Bay and Marsh, red represents stations in the Confluence, Green stations are in the North Delta, and Orange stations are in the South Delta.

Number of Stations: 61 stations that are sampled yearly. See the metadata section for additional details of each station.

Data Range: 1995-04-24 to 2024-07-11 (YYYY-mm-dd)

Sampling Frequency: Sampling begins in early spring (mid-March), is conducted *every other week* and concludes mid-summer (July) when catch efficiency decreases or Delta Smelt are not in danger of being entrained at the CVP and SWP. Standard sampling surveys are numbered 1-9, while supplemental sampling surveys are identified as ≥ 10.

Field Sampling Methods

Net: The 20-mm Survey collects both fish and zooplankton samples across multiple tows per station. A 20-mm net targets larval and juvenile fish with a conical plankton net that is 5.5 meters (m) in length, has a mouth area of 1.51 m^2, and features a 1600 μm (1/16 in.) knotless nylon Delta mesh (35 lb. test). Fish

are collected into a removable 2.2 L screened (474 μm stainless steel wire bolting cloth) cod-end jar attached to the deepest part of the net. General Oceanics flowmeters are mounted in the mouth of the 20-mm and CB nets to estimate the volume (m^3) of water sampled by each net. After each tow, the entire sample is transferred into a labeled jar containing 37% full-strength formaldehyde buffered with sodium borate and dyed with Rose Bengal. The dye is used to aid laboratory in sample processing. Bucketed water is then sieved into the sample jar to dilute the full-strength formaldehyde to 10% formalin.

Tow: Up to three replicate 10-minute stepped oblique tows with the boat moving at 1 m/s is conducted at each station. Specifically, fish are sampled across all tows, while zooplankton are typically sampled only once during the first tow. The amount of cable released is dependent on the water depth at the station. A gradual oblique tow is achieved following the tow schedule specific to the amount of cable released and the duration of the tow. Although most tows are 10 minutes in length, tow time can be reduced during periods of heavy samples. If the net is clogged during algal blooms, jellyfish blooms, or heavy debris events and the cod-end jar is overfilling with materials, the tow time can be reduced to 5 or 2.5 minutes and follow an alternate tow schedule. The duration time of the tow is recorded on the datasheet. If materials are still overflowing from the cod-end jar in a 2.5 minute tow, the tow or entire station is dropped. Re-tows do occur if a sample is compromised, or the flowmeter of the fish net reads less than 10000 revolutions or greater than 30000 revolutions in a 10 minute tow. All abnormal events are to be recorded in the "comments" section of the datasheet.

Flowmeter Calibration: General Oceanics flowmeters are used to estimate the volume of water sampled by each net. This calculation relies on a calibration factor specific to the flowmeter model that equates the rotor constant with the number of counts. Prior to 2015, the calibration factor for every flowmeter was calibrated at UC Davis before the start of the season. Beginning in 2015, the calibration flume at UC Davis became inoperable, and the meters were sent to General Oceanics for refurbishing before each field season to justify using the factory calibration factor. Since 2019, meters are inspected at the end of every field season and are replaced with new units if refurbishing is required. This ensures that the factory calibration factor can continue to be used to estimate tow volume.

Environmental and Water Quality Data: Immediately prior to each tow, benthic and surface water quality measurements are independently collected. Water quality measurements inlcude: 1) surface water temperature (°C) 2) surface and benthic electro-conductivity (μS/cm, normalized at 25 °C) 3) surface turbidity (FNU) 4) Secchi depth (cm) is measured using Secchi discs mounted to rigid meter sticks to a maximum depth of 200 centimeters; values are measured by the same person off the side of the boat, in the shade, and without sunglasses on for the entire day to maximize consistency 5) Water bottom depth (ft) is recorded using a depth finder on the boat 6) Tide data is recorded as the visually observed tidal stage by the crew during the tow as high slack, ebb, low slack, or flood.

Catch Data: At the end of every tow, the net is washed down so that all visible vegetation, fish, sand, and debris are collected into the cod-end jar. Large debris and fish ($\geq$ 50 mm) can be removed if positively identified. When salmonids are caught, a fork length is recorded, presence of the adipose fin is noted, and the fish are immediately released. All other larval and juvenile fishes are kept in distinctively labeled sampling jars and preserved in 10% buffered and dyed formalin for later processing in the laboratory.

Lab Analysis, Fish Identification, and Quality-Control

Prior to the next survey, fish are identified and enumerated under a microscope by trained lab staff to the lowest possible taxon. First, fish are separated from debris and other organisms during a process referred to as "sorting". The entire sample then undergoes a quality control (QC) check to ensure that fish were not missed during the initial sorting process. Finally, fish undergo identification and enumeration by a CDFW taxonomist, which can be followed by a QC from a larval fish ID specialist to confirm all species identifications and counts. This ID QC process is dependent on the experience of the identifier doing the first ID. Fish identifiers will begin with all their identifications QC'ed and transition to having fewer and fewer samples QC'ed with experience, until the identifier is considered a larval fish ID specialist. Samples are randomly selected to undergo this QC process. Across all samples (QC required or not), all CESA and

ESA fishes and any questionable fish IDs must undergo a second ID. All fish are identified to species or the lowest possible taxon. Only the first 50 randomly selected individuals of each species from each tow are measured for lengths to the nearest millimeter, and the rest of the sample is enumerated. However, all Delta Smelt are measured for lengths regardless of catch size. All Longfin Smelt are measured unless there is an excessive amount (>200) then only 100 are measured per tow and the rest are enumerated.

Calculating Catch Per Unit Effort (CPUE)

Fish

The total number of fish per volume water sampled (standardized to 10000 m^3) across all replicate tows is calculated using the following equations:

$$V_t = A * K * D_t$$

Where:

V_t = volume of water (m^3) filtered through the net per tow t

A = mouth opening of the net (1.51 m^2)

K = calibration factor of the flowmeter, 0.026873027 since 2015

D_t = difference in flowmeter counts from start to finish of tow t

$$n_t = F_t/V_t * 10000m^3$$

Where:

n_t = number of fish per 10000 m^3 per tow t

F_t = fish caught per tow t

V_t = volume of water filtered through the net m^3 per tow t

$$N = \frac{\sum n_t}{3}$$

Where:

N = mean number of fish per 10000 m^3 per station

Data Management

All field data are entered into a digital Access database using electronic forms between survey events during the season. Immediately after entry, data undergoes two rounds of 'line-by-line' checks, wherein all data fields are checked against the original datasheets for fidelity. At the end of the 20-mm Survey field season once all fish samples have been processed in the laboratory and data entry is complete, all data is 'finalized' to be as accurate as possible for public use. The first step in this finalization process is to conduct two additional line-by-line checks. Next, a project lead will run a series of coded queries to analyze the underlying data distributions to detect potential outliers in the environmental data. Not all data is changed if it is flagged as an outlier (generally beyond 2 standard deviations of the mean). In most cases, outliers are real data. These queries simply alert the project lead of potential erroneous data, and care is taken to edit only data that truly needs to be edited, e.g., data that was entered incorrectly or caused by equipment failures. All resulting data edits are documented in a separate log file.

Project History

The table below is a timeline of critical changes to the survey methods since its inception. The years listed below are water years, which begins three months before the new calendar year on October 1.

Table 1: History of substantial changes to the 20-mm Survey since its inception. Rows are highlighted per unique water year.

Year	Changes
1995	NA
1996	Napa River Stations (341, 342, 343, 344, 345, 346, & 347) added to sampling program.
1997	Napa River stations (341 & 347) and Big Break station (802) discontinued from sampling program.
1998	Zooplankton taxa stages (Eurytermora copepodid–& Pseudodiaptomus copepodid) added to database.
1999	Number of fish measured reduced from 300 to 100 (all Delta Smelt are measured regardless of catch size).
2000	NA
2001	Number of fish measured reduced from 100 to 50 (all Delta Smelt are measured regardless of catch size).
2002	Napa River stations 347, 348, & 349 added to sampling program when higher outflow conditions persist in Napa River.
2003	Zooplankton taxon Pseudodiaptomus spp. speciated to include Pseudodiaptomus–euryhalinus, Pseudodiaptomus forbesi, and Pseudodiaptomus marinus.
2004	Zooplankton processing changed from identifying the first 200 organisms to 6% of the sub-sample.
2005	Zooplankton processing continued to process 6% of the sub-sample, but would not exceed 20 slides from a sample.
2006	Zooplankton processing will continue to process 6% of the sub-sample, but will process a minimum of 5 cells and a maximum of 20 cells from a sample. Zooplankton taxa stages (Acartia copepodid, Acartiella copepodid, and Tortanus copepodid) added to database. Cumaceans and Chironomid larvae were dropped from the list of organisms to be identified.
2007	NA
2008	Cache Slough complex stations (718, 720, 726, 724, 723, 719) added to regular sampling program.
2009	Supplemental sampling in Sacramento Deepwater Channel stations (794, 795, 796, 797, 798, 799) occurred over surveys 7 and 8.
2010	Implementation of the use of a Hach Model # 2100P Turbidimeter as Standard Operating Procedure to record turbidity in NTU's. Recorded latitude and longitude on datasheets, but not entered into database.
2011	Begin recording latitude and longitude coordinates of each sampling station in the field, and this data was entered into the database.
2012	NA
2013	NA
2014	NA
2015	Review of project documents indicated a discrepancy between documented 20-mm net dimensions and actual 20-mm net dimensions. In 1995 staff worked with Lodi Tent and Awning to accommodate for shrinkage of the canvas-collar mouth of the nets. The problem was resolved by increasing the circumference of the mouth from 455 cm to 493 cm. It appears that all subsequent 20-mm net purchases incorporated this change; however, these changes were not incorporated into documentation of net dimensions. The updated net dimensions are now available in the protocol.

2015	A total of 6 additional tows were performed during surveys 6-9 at stations 706, 707, and 719 as part of a pilot study on Delta Smelt genetics at UC Davis. Samples were preserved in 95% EtOH and sent to Mandi Finger, with Bernie May's lab. Stations sampled each survey was based on the likelihood of Delta Smelt occurrence, as indicated by results of prior surveys.
2015	The vendor that historically supplied the net mesh to construct 20-mm nets went out of business. A new vendor was found, Christensen Net Works. New nets were constructed and used in 2015.
2015	Factory k-value (0.026873027) used in the 'MeterCorrections' table. Flowmeters were not calibrated at UC Davis due to machinery malfunction. The facility is awaiting repairs.
2016	Like 2015, no flowmeter calibration occurred in 2016. The factory value was used for all meters, and 9 meters were sent for refurbishing prior to the survey season.
2017	Continued using factory k-value for 'MeterCorrections.' Malfunctioning and inaccurate flowmeters were sent to General Oceanics for refurbishing prior to field season.
2018	Continued using factory k-value for 'MeterCorrections.' Malfunctioning and inaccurate flowmeters were sent to General Oceanics for refurbishing prior to field season.
2019	Continued using factory k-value for MeterCorrections. Flowmeters were sent to General Oceanics for refurbishing prior to field season or replaced with new meters if readings are inaccurate (assessed at the end of a season). Factory K-values will continue to be used until we can test the flowmeters independently.
2020	Surveys 2 and 3 only sampled the high priority stations in the south and central Delta due to concerns related to the COVID-19 pandemic.
2021	NA
2022	Number of Longfin Smelt measured reduced from all to 300 per tow due to excessive amounts.
2022	All Osmerids preserved in 95% ethanol and brought back to laboratory for verification.
2022	Beginning in the 2022 season, the 20-mm index features several modifications to its calculatoins. Please see memo from Trinh Nguyen outlining the changes made to the revised index.
2022	Station 712 (Spring Kodiak Trawl Survey) in Steamboat Slough was sampled from surveys 5-8
2022	Zooplankton QC protocol has been implemented.
2023	End latitude and longitude now added to database.
2023	Changed from YSI model 30 to YSI ProDSS which can now measure turbidity (FNU). Instead of collecting bottom water sample with a Van Dorn the ProDSS probe is deployed to the bottom to measure bottom electro-conductivity.
2023	14 Fall Midwater Trawl stations have been added in the San Pablo Bay region to improve spatial balance .
2023	Number of Longfin Smelt measured reduced from all to 100 per tow due to excessive amounts.
2024	Added Hypomesus spp. and Lepomis spp. to FishCodes

Station Metadata

Station theoretical latitudes and longitudes and start and end dates are provided in Table 2.

Table 2: List of stations sampled by 20-mm since its inception. "StartDate" indicates the date when sampling first began for a station; "EndDate" indicates the date when sampling last ended at a station, and "Ongoing" represents stations that are still actively sampled by the survey.

Station	StartDate	EndDate	Region
306	2023-03-13	Ongoing	Far West
308	2023-03-13	Ongoing	Far West
311	2023-03-13	Ongoing	Far West
315	2023-03-13	Ongoing	Far West
322	2023-03-13	Ongoing	Far West
323	1995-04-28	Ongoing	Far West
327	2023-03-13	Ongoing	Far West
328	1995-07-07	Ongoing	Far West
329	1995-08-04	Ongoing	Far West
330	2023-03-13	Ongoing	Far West
335	1995-08-04	Ongoing	Far West
336	1995-07-07	Ongoing	Far West
338	2023-03-15	Ongoing	Far West
340	1995-04-28	Ongoing	Far West
342	1996-04-29	Ongoing	Far West
343	1996-04-29	Ongoing	Far West
344	1996-04-29	Ongoing	Far West
345	1996-04-29	Ongoing	Far West
346	1996-04-29	Ongoing	Far West
401	2023-03-30	Ongoing	Far West
404	2023-03-15	Ongoing	Far West
405	1995-04-27	Ongoing	Far West
411	1995-04-28	Ongoing	Suisun Bay and Marsh
418	1995-04-27	Ongoing	Suisun Bay and Marsh
501	1995-04-28	Ongoing	Suisun Bay and Marsh
504	1995-04-28	Ongoing	Suisun Bay and Marsh
508	1995-04-28	Ongoing	Confluence
513	1995-04-26	Ongoing	Confluence
519	1995-04-28	Ongoing	Suisun Bay and Marsh
520	1995-04-27	Ongoing	Confluence
602	1995-04-27	Ongoing	Suisun Bay and Marsh
606	1995-04-27	Ongoing	Suisun Bay and Marsh
609	1995-04-27	Ongoing	Suisun Bay and Marsh
610	1995-04-27	Ongoing	Suisun Bay and Marsh
703	1995-04-26	Ongoing	Confluence
704	1995-04-26	Ongoing	Confluence
705	1995-04-25	Ongoing	Confluence
706	1995-04-26	Ongoing	Confluence
707	1995-04-25	Ongoing	Confluence

711	1995-04-25	Ongoing	North Delta
716	1995-04-25	Ongoing	North Delta
718	2008-03-17	Ongoing	North Delta
719	2008-03-17	Ongoing	North Delta
720	2008-03-17	Ongoing	North Delta
723	2008-03-17	Ongoing	North Delta
724	2008-03-17	Ongoing	North Delta
726	2008-03-17	Ongoing	North Delta
801	1995-04-26	Ongoing	Confluence
804	1995-04-26	Ongoing	Confluence
809	1995-04-24	Ongoing	Confluence
812	1995-04-25	Ongoing	Confluence
815	1995-04-25	Ongoing	South Delta
901	1995-04-24	Ongoing	South Delta
902	1995-04-24	Ongoing	South Delta
906	1995-04-25	Ongoing	South Delta
910	1995-04-24	Ongoing	South Delta
912	1995-04-24	Ongoing	South Delta
914	1995-04-24	Ongoing	South Delta
915	1995-04-24	Ongoing	South Delta
918	1995-04-24	Ongoing	South Delta
919	1995-04-25	Ongoing	South Delta
331	1995-05-26	1995-05-26	NA
341	1996-04-29	1996-05-13	NA
802	1995-04-26	1996-06-11	NA
997	1999-06-28	1999-06-28	NA
998	1999-06-28	1999-06-28	NA
999	1999-06-28	1999-06-28	NA
348	2001-03-24	2001-06-04	NA
349	2001-03-24	2001-06-04	NA
347	1996-07-26	2002-04-19	NA
798	2009-06-01	2009-06-01	NA
799	2009-06-01	2009-06-01	NA
794	2009-06-15	2009-06-15	NA
795	2009-06-15	2009-06-15	NA
796	2009-06-15	2009-06-15	NA
797	2009-06-15	2009-06-15	NA
334	1995-08-04	2019-05-09	NA
712	2022-05-16	2022-06-27	NA