2025 Technical Memo

IEP 096 Smelt Larva Survey

Introduction

The Smelt Larva Survey (SLS) was initiated in 2009 to monitor the distribution and abundance of newly hatched Longfin Smelt (*Spirinchus thaleichthys*) in the upper San Francisco Estuary (SFE). SLS is referenced in the Incidental Take Permit No. 2081-2023-054-00 from the California Department of Fish and Wildlife (CDFW) to manage the Longfin Smelt take at the State Water Project (SWP) and the Central Valley Project (CVP) export facilities. Near real-time catch data is provided to resource managers. The survey also collects data on other larval fishes in the upper SFE, including Delta Smelt (*Hypomesus transpacificus*).

Objectives

1. Provide near real-time catch data to resource managers to assess the risk of entrainment of Longfin Smelt at water export facilities.
2. To determine and improve our understanding of the temporal and spatial distribution and abundance of larval and post-larval Longfin Smelt.

Methods

Study Area: SLS currently samples 59 fixed stations distributed throughout the upper San Francisco Estuary. See Appendix A for map of stations.

Sampling Methods: Eight surveys are conducted every other week, from early December through mid-March, when larval Longfin Smelt are most likely to be present in the sampling range. A single 10-minute oblique tow is conducted at each of the 59 stations. Immediately after each tow, easy to identify juvenile and adult fish are identified, measured, and released back into the water. The remaining contents of the cod-end jar are preserved in 10% formalin for later identification at the CDFW Lab in Stockton. The first 50 randomly selected individuals of each species are measured to the nearest millimeter. After the required measurements, any fish of that species is simply enumerated. However, up to 100 Longfin Smelt are measured and noted for the presence or absence of a yolk-sac or oil globule from each station.

The 500 µm Nitex mesh plankton (505 µm pre-2014) netting is comprised of two sections: a cylindrical front section that includes a durable canvas mouth and a funnel-shaped back section with a canvas throat that attaches to a 1-liter cod-end jar, which collects the sample. This net is lashed onto a D-frame with skis that prevent it from digging into substrate. A flowmeter is mounted across the center of the net's mouth to estimate the volume of water sampled. See Appendix B for net dimensions.

Data Collection: Surface temperature, surface water clarity (FNU), and surface and benthic electro-conductivity (normalized @ 25ºC) are collected using a handheld YSI ProDSS. A Secchi disk reading (cm), Microcystis rank, tidal stage, and water depth (ft) are also recorded.

Data Analysis: Fish catch and length data are released in near-real time in summary tables and shared with other agencies via email and conference calls. Catch per unit effort (CPUE) is calculated and released to the public on a weekly basis as fish distribution maps on the CDFW Smelt Larva Survey's webpage. At the end of each sampling season, data is validated and released to the public on the FTP and EDI websites.

Design-based abundance (DBA) calculations were implemented to standardize catch abundance estimates across studies and species based on a regional estimate of volume. This population estimation was adapted from Polansky et al., 2019.

Results

The 2025 SLS season conducted 470 tows between December 2, 2024, and March 13, 2025. A total of 64,673 individual fish, representing 30 taxa, were collected (Appendix C). Pacific Herring, Longfin Smelt, Prickly Sculpin, and Yellowfin Goby comprised about 99% of the overall catch in 2025 (Appendix D).

The SLS caught 20,712 Longfin Smelt with a fork length range of 5-75 mm. This represents the second-highest catch in the history of SLS, surpassed only by the 2013 sampling season (Appendix E). It is also the highest catch in the last 10 years—at minimum, three times greater than any other year.

The Napa River continues to lead in Longfin smelt CPUE when compared to the other strata in recent years (Appendix F). The DBA for Longfin Smelt sharply increased in 2025 (Appendix I).

The highest concentrations of Longfin Smelt larvae with yolk sacs were found in the Confluence, followed closely by San Pablo Bay & Carquinez Strait and Suisun & Honker Bay (Appendix G). The highest ratio of yolk-sac larvae occurred in December and January. As the sampling season progressed, larvae were generally larger and had mostly absorbed their yolk sacs (Appendix H). Despite a peak in January, newly hatched larvae were still observed into March.

No Delta Smelt were caught or observed by SLS in 2025. There was no noticeable change to DBA for Delta Smelt (Appendix J). It is important to note that the SLS specifically targets Longfin Smelt.

Discussion

Interpretation of the Results: Longfin Smelt are facultatively anadromous fish whose life history in the San Francisco Estuary is shaped by seasonal environmental conditions (Moyle 2002). Adults spawn in low salinity to freshwater zones from late fall through spring, with the timing and duration of spawning influenced by temperature and flow conditions (U.S. Fish and Wildlife Service 2022). In wetter years, extended freshwater input helps maintain favorable temperatures and expands low salinity habitat, supporting prolonged spawning and larval development (U.S. Fish and Wildlife Service 2022). In drier years, Longfin Smelt tend to concentrate inland closer to the water export facilities.

A few considerations should be noted before making direct comparisons with past data and across strata:

1. The Napa River is not an area that has been sampled regularly. The SLS sampled the 9 stations from 2014 to 2018 and then restarted in 2022.
2. Prior to the 2023 sampling season, San Pablo Bay & Carquinez Strait strata consisted of only one station (405).
3. Some strata contain more stations than others.

The Longfin Smelt DBA showed a sharp increase in 2025, although it remains well below the peak levels observed in 2013 (Appendix I). This difference in DBA despite similar overall annual catch (Appendix E) is largely attributed to the specific regions sampled and the associated water volumes i.e. Napa River has limited historical sampling and a smaller water

volume estimate. Thus, although raw catches trend upward, the DBA provides a more accurate, volume adjusted measure of abundance. Consecutive favorable water years have likely supported a perhaps short-term population rebound, driven by more ideal spawning conditions, specifically lower temperatures and reduced salinity in strata such as the Napa River, San Pablo Bay & Carquinez Strait, and Suisun Bay & Marsh.

Limitations: Occasionally SLS cannot sample due to bridge access, vessel issues, gear loss, inclement weather, and excessive debris

Comparison with Previous Efforts: The SLS sampled the same number of tows as last year, 470 tows. Two stations were dropped during survey 4 due to windy conditions (Appendix K).

Conclusion

Despite persistently low or zero Delta Smelt catches, recent water years have fostered a relatively fruitful reproductive season for Longfin Smelt in 2025. Their distribution has shifted to more favorable westward strata. The unusually high concentration of Longfin Smelt in the Napa River stratum is particularly noteworthy and warrants further investigation. Detection rates climbed, but this uptick likely reflects both intensified sampling in the Napa River and San Pablo strata and sustained above normal outflow conditions. Regardless, the combination of current and historical monitoring data continues to deepen our understanding of Longfin Smelt population dynamics which remain fragile yet exhibit surprising resilience.

References

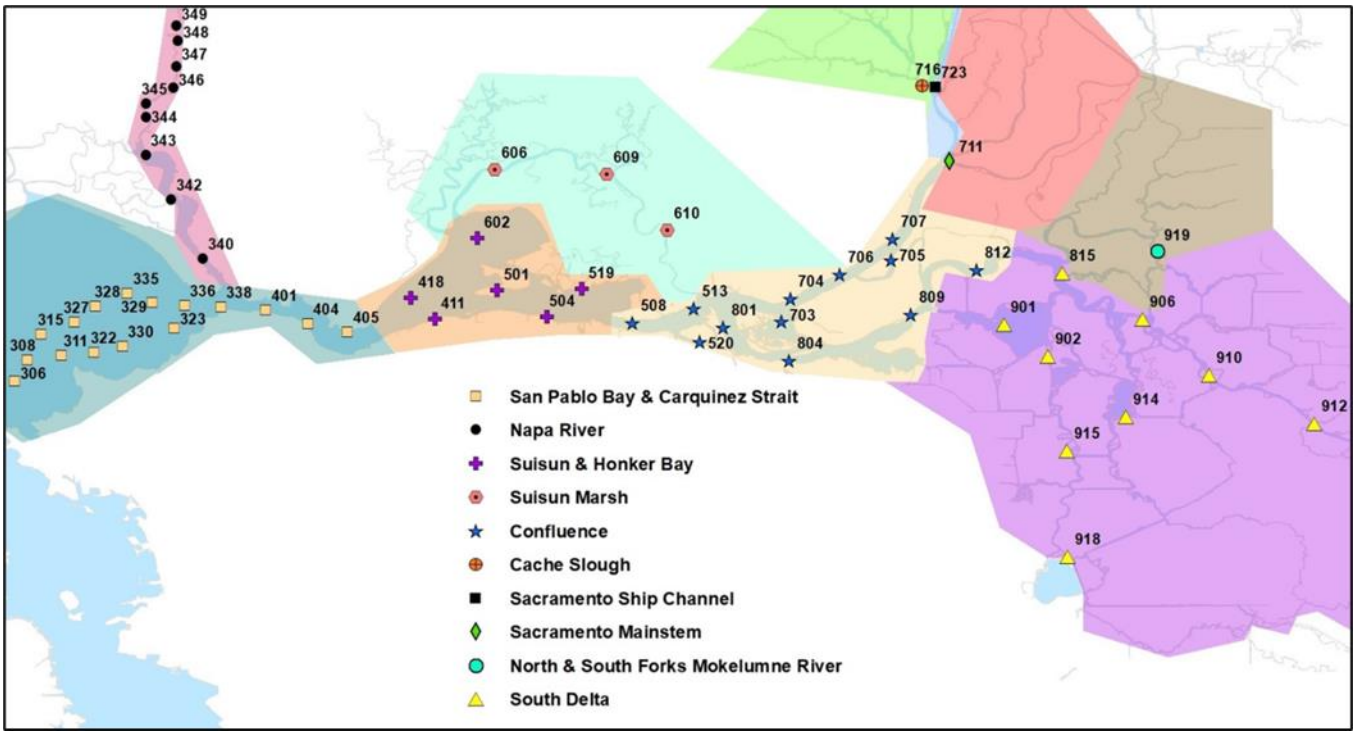
Moyle, P. B. (2002). *Inland fishes of California* (Rev. & expanded ed.). University of California Press.

Polansky, L., Mitchell, L., & Newman, K. B. (2019). Using multistage design-based methods to construct abundance indices and uncertainty measures for Delta Smelt. *Transactions of the American Fisheries Society, 148*(4), 710–724.

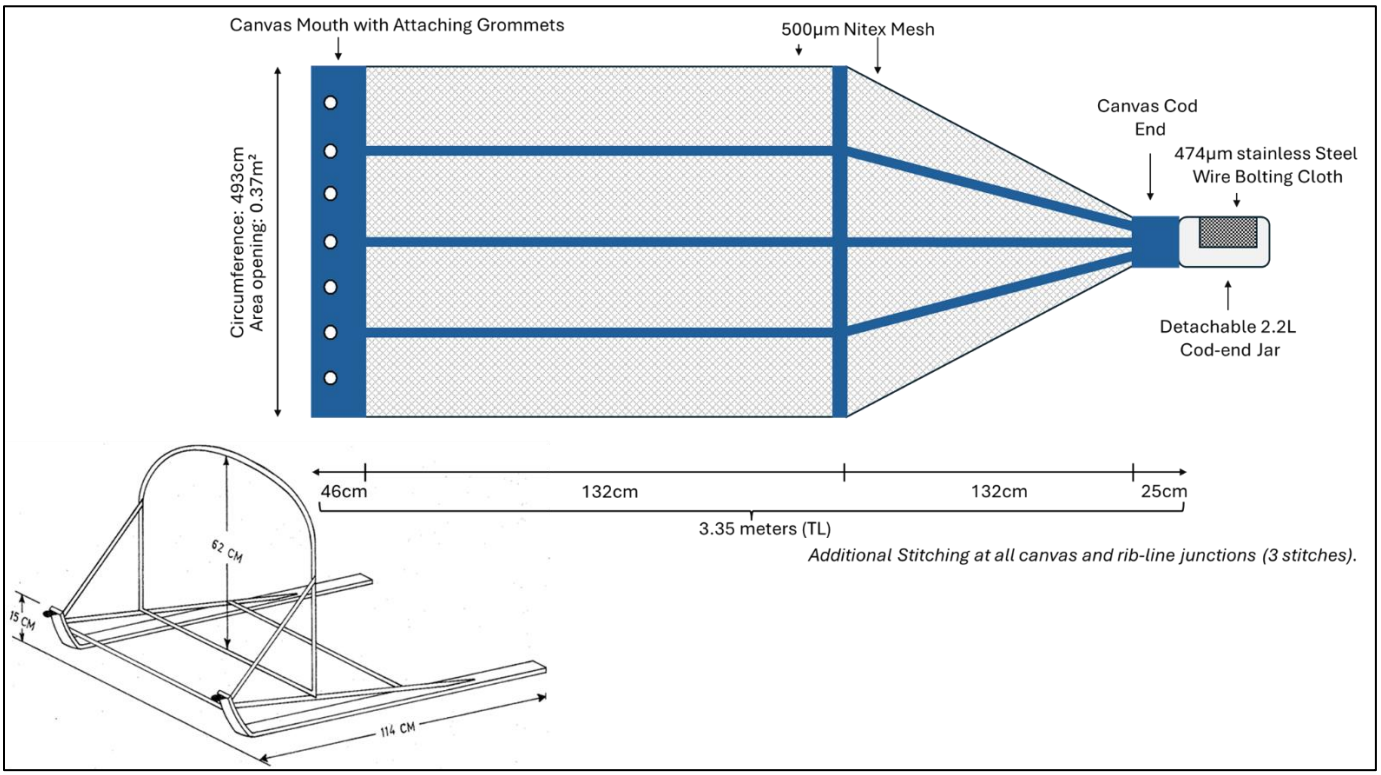
U.S. Fish and Wildlife Service. (2022). *Species status assessment for the San Francisco Bay Delta distinct population segment of the Longfin Smelt*. San Francisco Bay-Delta Fish and Wildlife Office.

Appendix

A. Map of the Smelt Larva Survey station locations in the upper San Francisco Estuary. Shaded areas represent different strata.



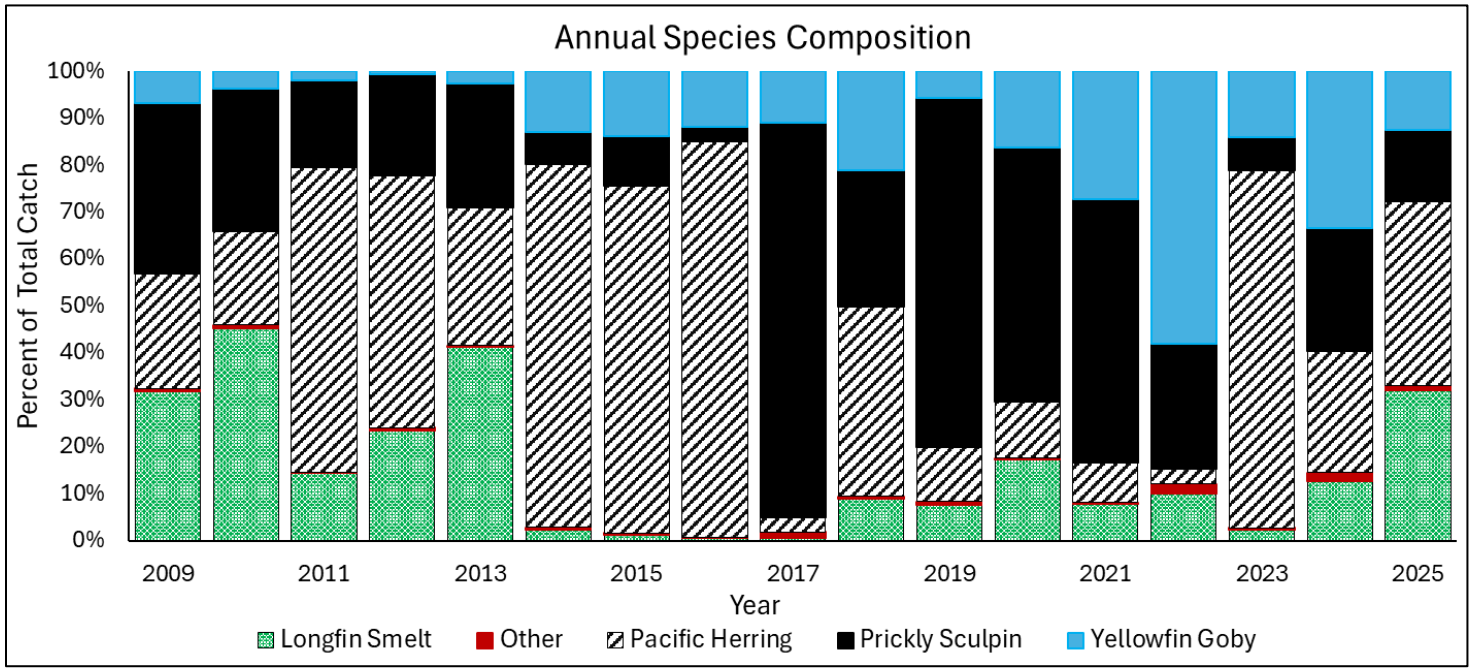
B. The Smelt Larva Survey sampling gear and dimensions.



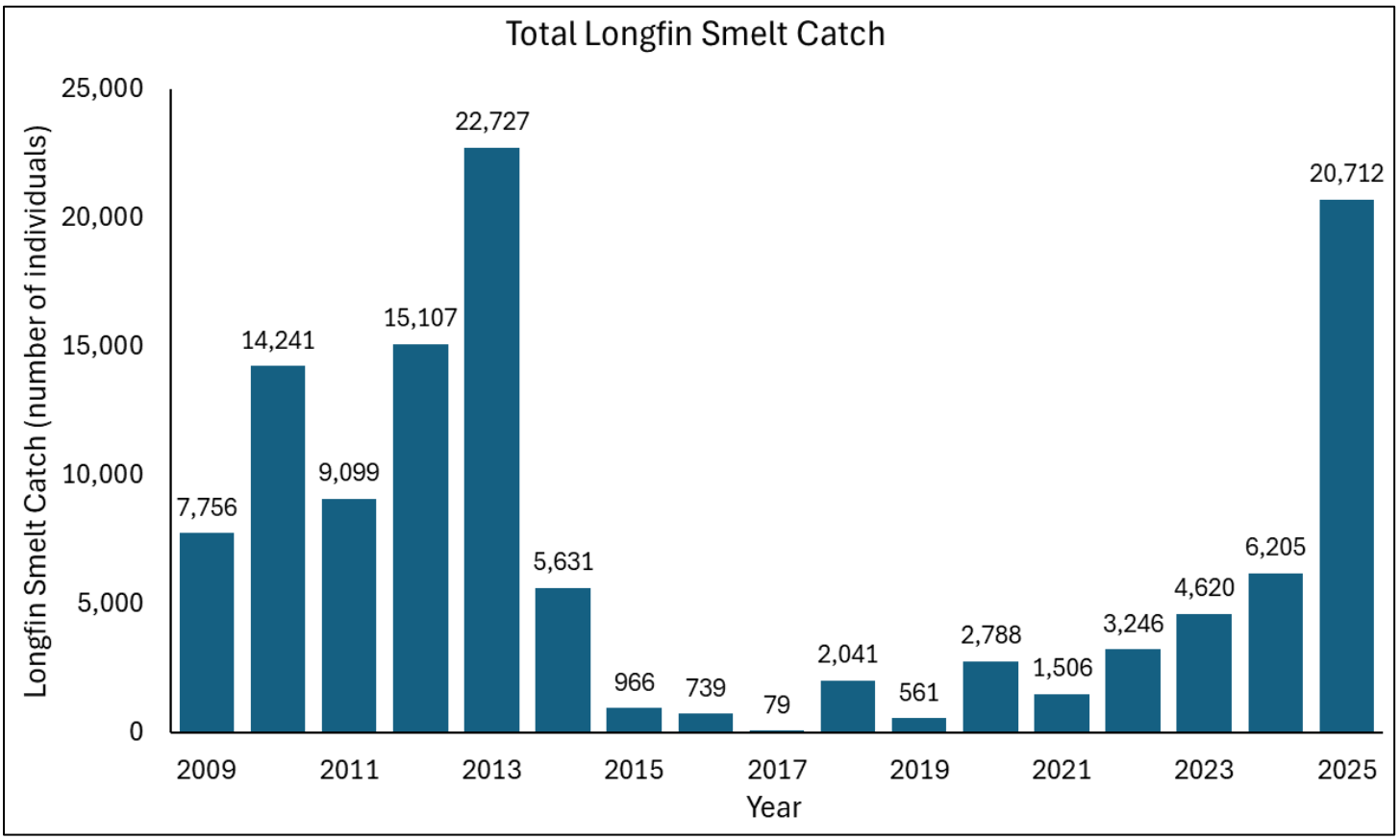
C. Total catch and percentage of species caught in the 2025 Smelt Larva Survey.

Common Name	Total Catch (# of Individuals)	Percent of Catch
Pacific Herring	25,495	39.4%
Longfin Smelt	20,712	32.0%
Prickly Sculpin	9,711	15.0%
Yellowfin Goby	8,145	12.6%
Longjaw Mudsucker	170	0.3%
White Croaker	134	0.2%
Arrow Goby	107	0.2%
Northern Anchovy	86	0.1%
Bay Goby	16	<0.1%
Pacific Staghorn Sculpin	15	<0.1%
Rockfish (Unid)	15	<0.1%
Speckled Sanddab	13	<0.1%
Cheekspot Goby	11	<0.1%
English Sole	4	<0.1%
Smelt (Unid)	4	<0.1%
Bay Pipefish	3	<0.1%
Chinook Salmon	3	<0.1%
Jacksmelt	3	<0.1%
Rainwater Killifish	3	<0.1%
Unknown	3	<0.1%
Wakasagi	3	<0.1%
Bigscale Logperch	2	<0.1%
California Halibut	2	<0.1%
Pacific Sanddab	2	<0.1%
Sculpins (Unid)	2	<0.1%
Shimofuri Goby	2	<0.1%
Shokihaze Goby	2	<0.1%
Threespine Stickleback	2	<0.1%
Monkeyface Prickleback	1	<0.1%
Ronquil (Unid)	1	<0.1%
Striped Bass	1	<0.1%

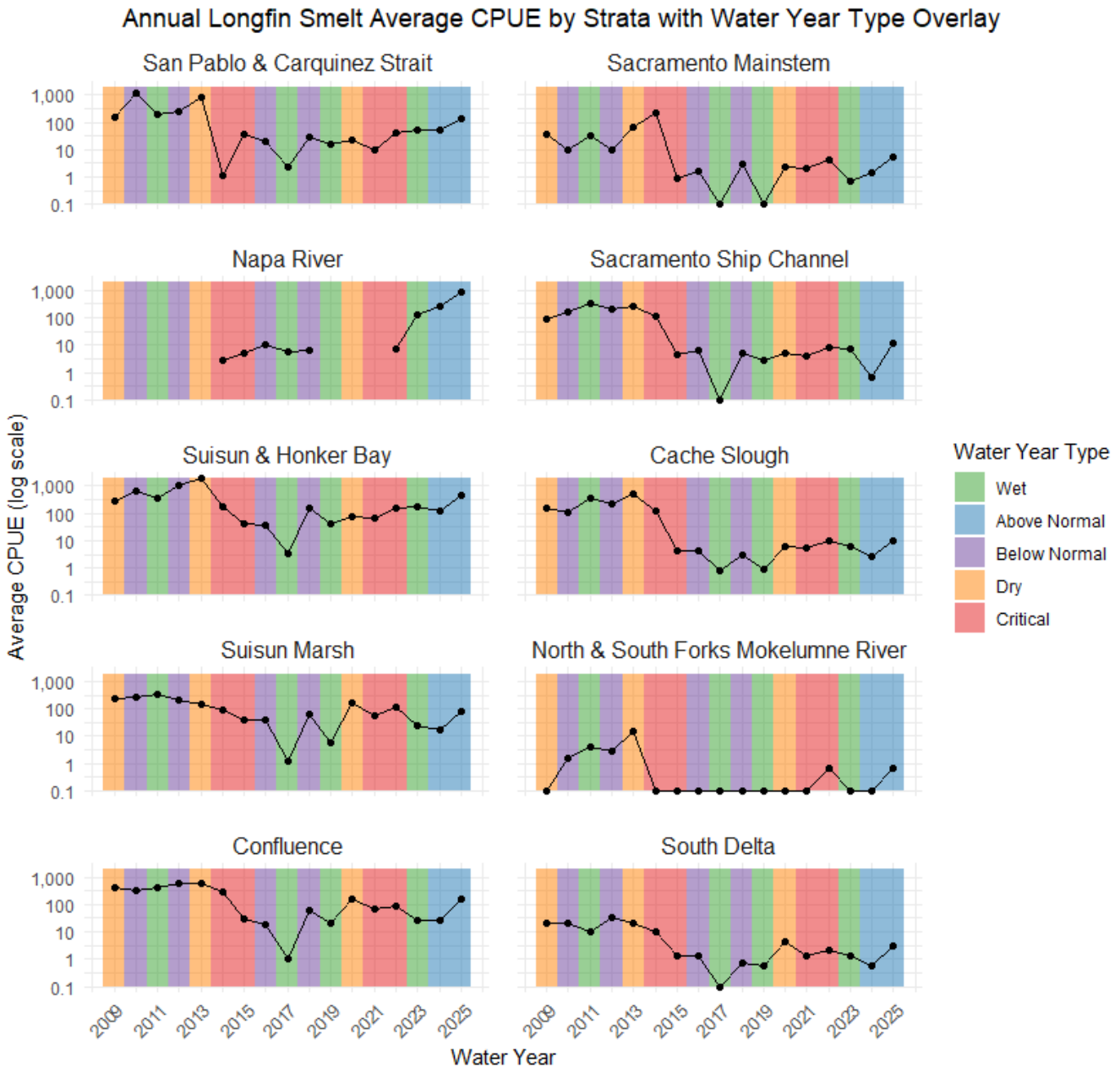
D. Annual percent species composition from the Smelt Larva Survey from 2009 to 2025. Data includes the December surveys from 2021 to 2025.



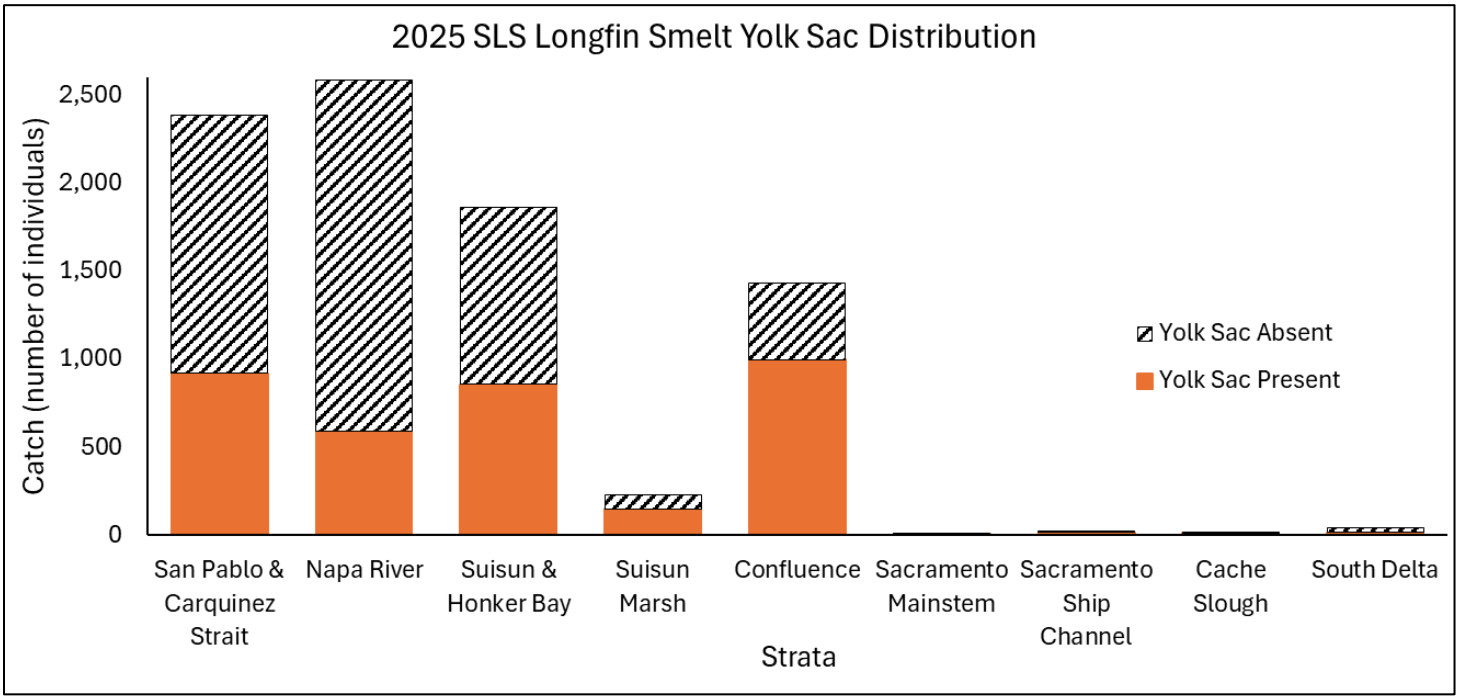
E. Annual Longfin Smelt catch from 2009 to 2025 sampled by the Smelt Larva Survey. Data includes the December surveys from 2021 to 2025. There was limited sampling in 2020 due to COVID-19.



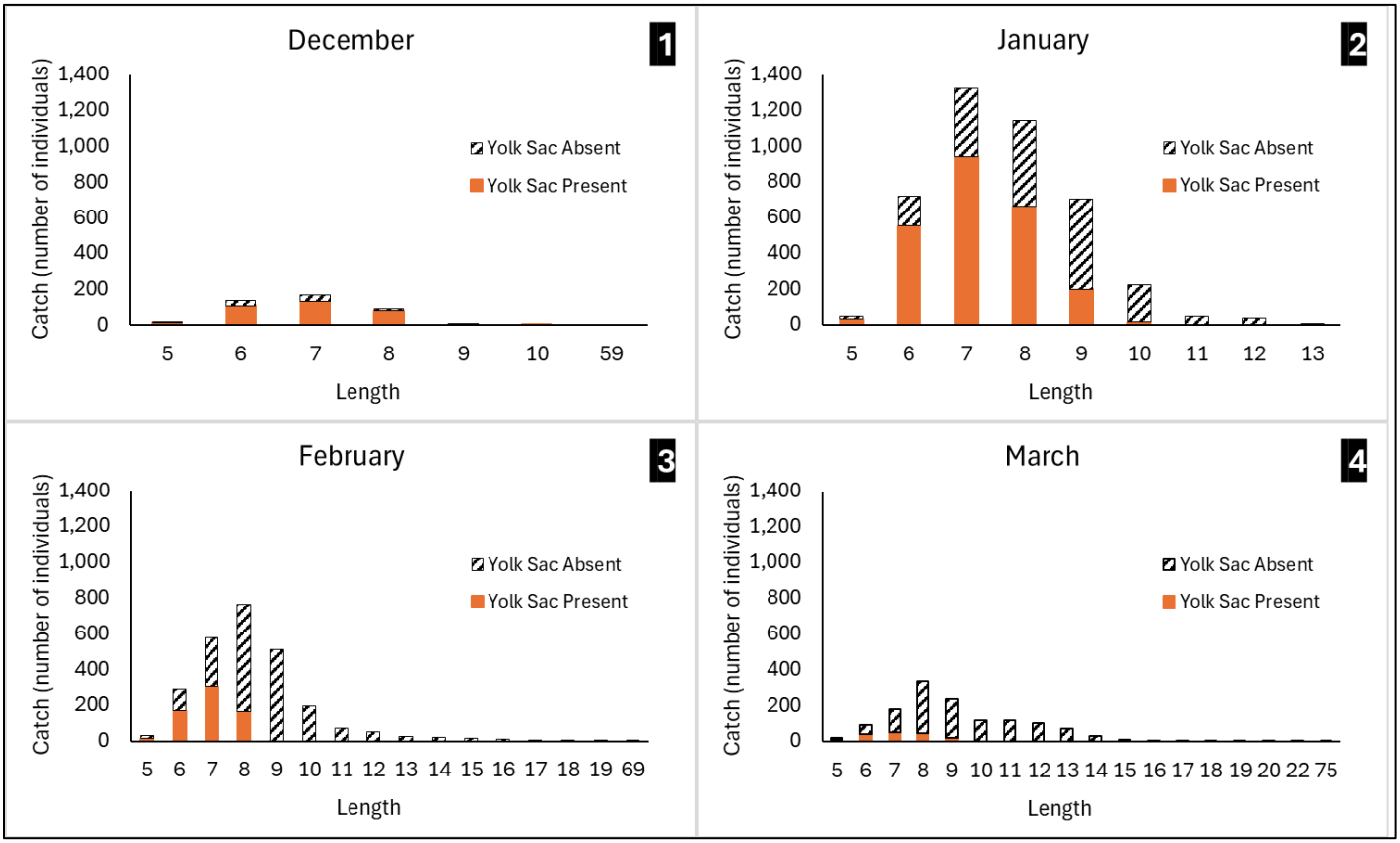
F. Annual Longfin Smelt Average CPUE by Smelt Larva Survey from 2009 to 2025. Data includes December surveys from 2021 to 2025. Napa River was only sampled 2014-2018 and 2022-2025. Each year is categorized by water year type, and the Y-axis is on a log scale to further highlight the differences in CPUE.



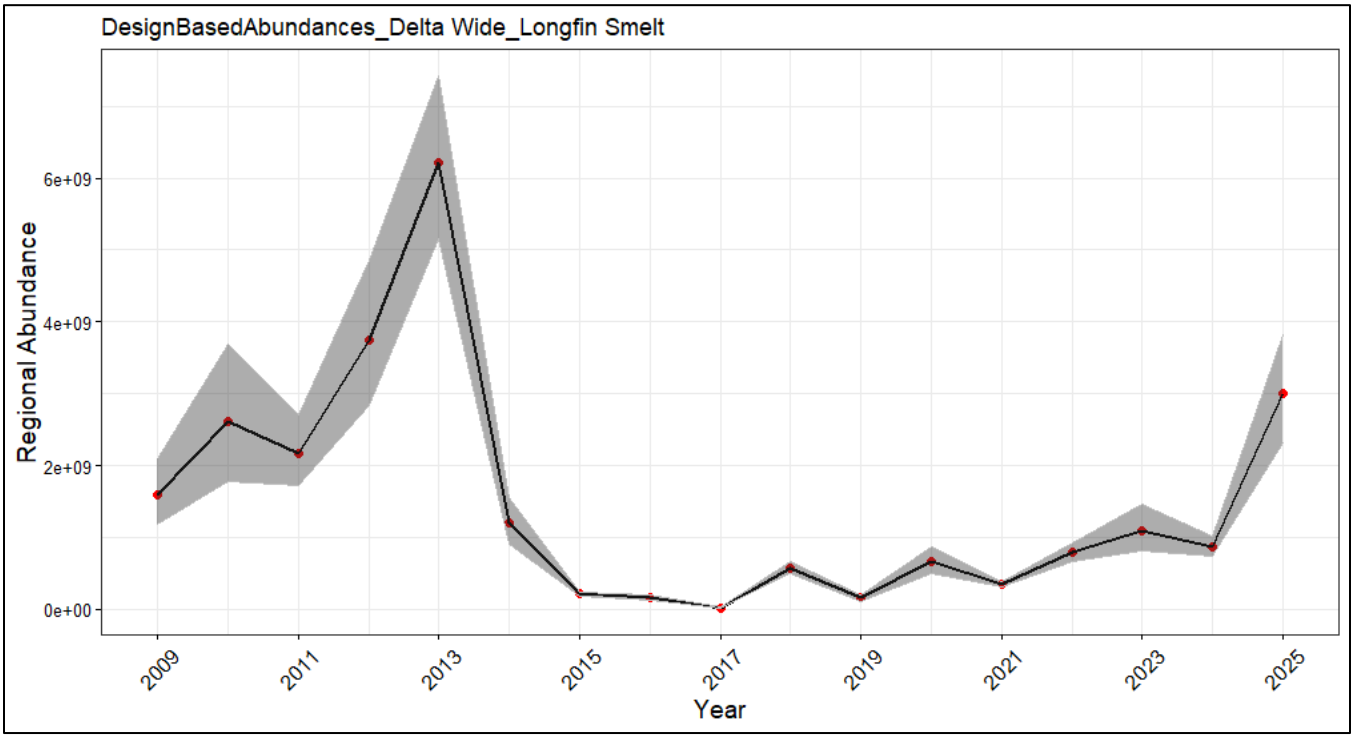
G. Number of larval Longfin Smelt, and proportion of yolk sac presence and absence caught in each stratum of the 2025 Smelt Larva Survey. Data includes the December 2024 surveys, but excludes North & South Forks Mokelumne River strata it only had 1 Longfin detection.



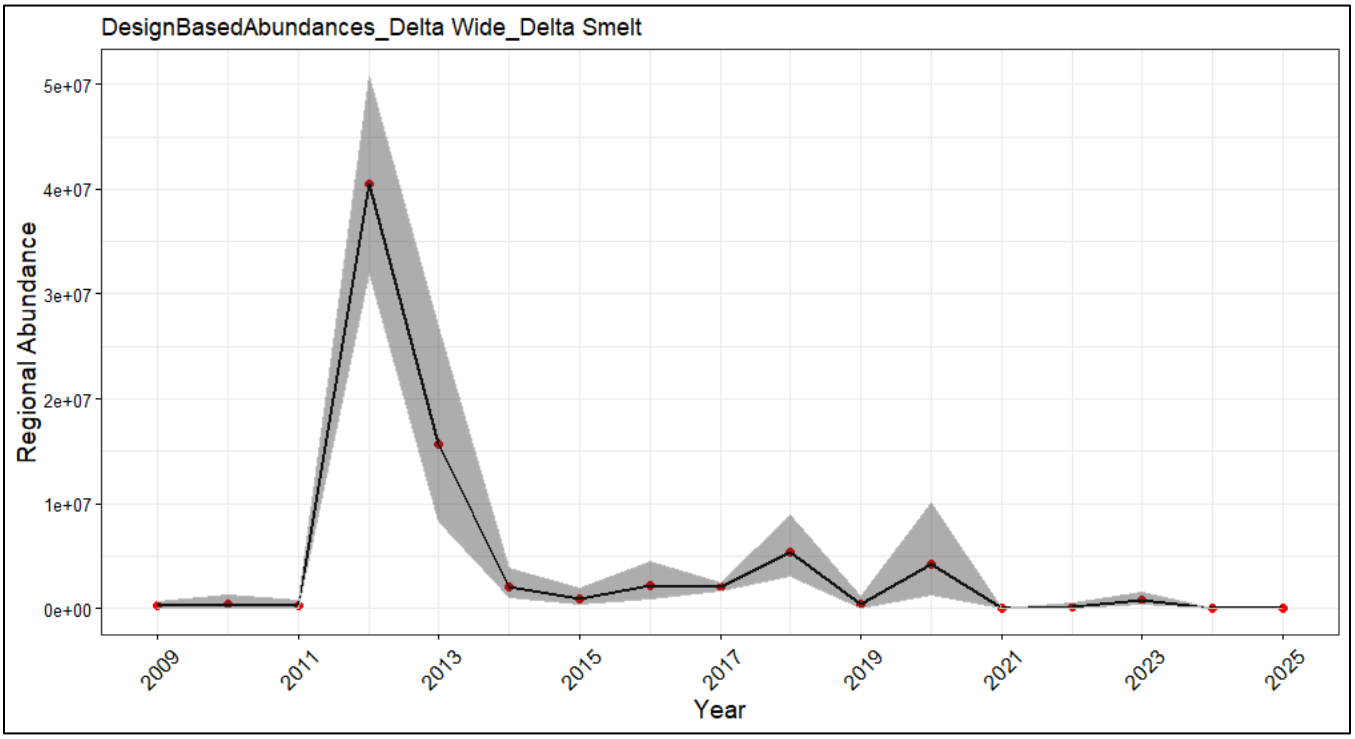
H. Length frequency with proportion of yolk sac presence and absence of larval Longfin Smelt caught during each month of the 2025 Smelt Larva Survey. (1) December 2024 (2) January 2025 (3) February 2025 (4) March 2025.



I. Annual Longfin Smelt CPUV from 2009 to 2025 sampled by the California Department of Fish and Wildlife's Smelt Larva Survey. Data includes the December surveys from 2021 to 2024.



J. Annual Delta Smelt CPUV from 2009 to 2025 sampled by the California Department of Fish and Wildlife's Smelt Larva Survey. Data includes the December surveys from 2021 to 2024.



K. Sampling effort for the California Department of Fish and Wildlife's 2025 Smelt Larva Survey.

Survey	Stations Sampled	Comments
12	59	All stations sampled.
13	59	All stations sampled.
1	59	All stations sampled.
2	59	All stations sampled.
3	59	All stations sampled.
4	57	Two stations dropped due to windy conditions.
5	59	All stations sampled.
6	59	All stations sampled.