Enhanced Delta Smelt Monitoring

2024 Phase 3 Preliminary Analysis

U.S. Fish and Wildlife Service

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DRAFT

# Overview

The Enhanced Delta Smelt Monitoring (EDSM) program started its 2024 Phase 3 sampling program for juvenile and sub-adult Delta Smelt on July 1, 2024. In order to improve our ability to make inferences about the population, sampling effort is being focused on geographic areas where Delta Smelt are likely to be caught based on historical data. Sampling locations are generated using a generalized random-tessellation stratified (GRTS) design (Stevens 2004) 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 (<https://www.wildlife.ca.gov/Conservation/Delta/Spring-Kodiak-Trawl>) is used to conduct multiple tows per site.

Everything presented here is preliminary and subject to correction, revision, and improvement. The following points should be taken into consideration when interpreting the results:

1. Abundance indices incorporate Delta Smelt regardless of origin, i.e.  wild or hatchery.
2. Delta Smelt captured outside of the live box or cod end of the net could not be assigned to a specific tow and were excluded from this analysis (see exception in Note section below). These fish are included in the daily catch summary and are indicated by a Gear Condition Code of 9. Delta Smelt captured in highly impaired samples, e.g., samples with large net blockages of debris or vegetation, were also excluded from this analysis. These fish are included in the daily catch summary and are indicated by a Gear Condition Code of 3.
3. The ‘Week’ designations used here were defined out of convenience and are subject to change.
4. Current sampling is limited to areas of the Bay-Delta that can be safely navigated by EDSM vessels, which means areas with a minimum depth of approximately 8 feet. The abundance estimation method used here assumes that the density of fish in unsampled areas (i.e., those with depth less than 8 feet) is the same as in sampled areas (i.e., those with depth greater than or equal to 8 feet).
5. The methods of analysis used here remain in development.

# Methods

Delta Smelt abundance indices were derived from a negative binomial generalized linear mixed model with tow-level resolution containing (1) fixed effects for each week-stratum combination, (2) first and second order polynomial terms for the environmental variables Secchi depth, specific conductance, and water temperature, (3) site random effect, and (4) volume of water sampled in a tow as an offset. The model was fit with EDSM Kodiak trawl data collected between December 2016 and the present. Results presented here are limited to the current phase.

# Results

Table 1: Delta Smelt catch summary and abundance indices by week. Lower Bound and Upper Bound represent a 95% confidence interval on the point estimate. An asterisk (\*) is used to emphasize weeks when no Delta Smelt were caught and NA is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters. See Table 2 for the dates corresponding to each week number.

| **Week** | **Stratum** | **Number of Sites** | **Number of Tows** | **Total Number Caught** | **Total Sample Volume** | **Abundance Index** | **Lower Bound** | **Upper Bound** | **Number Marked** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | Suisun Bay | 4 | 16 | 0 | 71,686 | 0\* | NA | NA | 0 |
| 1 | Suisun Marsh | 6 | 24 | 0 | 125,125 | 0\* | NA | NA | 0 |
| 1 | Lower Sacramento | 5 | 20 | 0 | 72,922 | 0\* | NA | NA | 0 |
| 1 | Cache Slough LI | 5 | 20 | 0 | 66,334 | 0\* | NA | NA | 0 |
| 1 | Sac DW Ship Channel | 3 | 12 | 0 | 44,550 | 0\* | NA | NA | 0 |
| 1 | Lower San Joaquin | 5 | 20 | 0 | 74,563 | 0\* | NA | NA | 0 |
| 1 | All Strata | 28 | 112 | 0 | 455,181 | 0\* | NA | NA | 0 |
| 2 | Suisun Bay | 6 | 24 | 0 | 103,509 | 0\* | NA | NA | 0 |
| 2 | Suisun Marsh | 6 | 24 | 0 | 105,102 | 0\* | NA | NA | 0 |
| 2 | Lower Sacramento | 6 | 22 | 0 | 92,131 | 0\* | NA | NA | 0 |
| 2 | Cache Slough LI | 5 | 20 | 0 | 71,912 | 0\* | NA | NA | 0 |
| 2 | Sac DW Ship Channel | 6 | 24 | 0 | 92,008 | 0\* | NA | NA | 0 |
| 2 | Lower San Joaquin | 6 | 24 | 0 | 87,715 | 0\* | NA | NA | 0 |
| 2 | All Strata | 35 | 138 | 0 | 552,375 | 0\* | NA | NA | 0 |
| 3 | Suisun Bay | 6 | 24 | 0 | 101,082 | 0\* | NA | NA | 0 |
| 3 | Suisun Marsh | 6 | 24 | 0 | 98,894 | 0\* | NA | NA | 0 |
| 3 | Lower Sacramento | 6 | 22 | 0 | 78,777 | 0\* | NA | NA | 0 |
| 3 | Cache Slough LI | 5 | 20 | 0 | 61,449 | 0\* | NA | NA | 0 |
| 3 | Sac DW Ship Channel | 3 | 12 | 0 | 43,499 | 0\* | NA | NA | 0 |
| 3 | Lower San Joaquin | 6 | 24 | 0 | 89,875 | 0\* | NA | NA | 0 |
| 3 | All Strata | 32 | 126 | 0 | 473,576 | 0\* | NA | NA | 0 |
| 4 | Suisun Bay | 3 | 12 | 0 | 47,852 | 0\* | NA | NA | 0 |
| 4 | Suisun Marsh | 6 | 24 | 0 | 97,590 | 0\* | NA | NA | 0 |
| 4 | Lower Sacramento | 6 | 20 | 0 | 82,039 | 0\* | NA | NA | 0 |
| 4 | Cache Slough LI | 6 | 21 | 0 | 75,074 | 0\* | NA | NA | 0 |
| 4 | Sac DW Ship Channel | 5 | 18 | 0 | 70,428 | 0\* | NA | NA | 0 |
| 4 | Lower San Joaquin | 6 | 24 | 0 | 97,691 | 0\* | NA | NA | 0 |
| 4 | All Strata | 32 | 119 | 0 | 470,672 | 0\* | NA | NA | 0 |
| 5 | Suisun Bay | 2 | 7 | 0 | 31,827 | 0\* | NA | NA | 0 |
| 5 | Suisun Marsh | 5 | 18 | 0 | 78,156 | 0\* | NA | NA | 0 |
| 5 | Lower Sacramento | 6 | 24 | 0 | 90,327 | 0\* | NA | NA | 0 |
| 5 | Cache Slough LI | 6 | 24 | 0 | 85,083 | 0\* | NA | NA | 0 |
| 5 | Sac DW Ship Channel | 6 | 24 | 0 | 94,049 | 0\* | NA | NA | 0 |
| 5 | Lower San Joaquin | 6 | 24 | 0 | 88,533 | 0\* | NA | NA | 0 |
| 5 | All Strata | 31 | 121 | 0 | 467,976 | 0\* | NA | NA | 0 |
| 6 | Suisun Bay | 3 | 12 | 1 | 52,708 | 6,659 | 562 | 28,795 | 0 |
| 6 | Suisun Marsh | 6 | 24 | 0 | 96,757 | 0\* | NA | NA | 0 |
| 6 | Lower Sacramento | 6 | 24 | 0 | 102,740 | 0\* | NA | NA | 0 |
| 6 | Cache Slough LI | 6 | 24 | 0 | 88,101 | 0\* | NA | NA | 0 |
| 6 | Sac DW Ship Channel | 4 | 16 | 0 | 59,954 | 0\* | NA | NA | 0 |
| 6 | Lower San Joaquin | 6 | 21 | 0 | 81,692 | 0\* | NA | NA | 0 |
| 6 | All Strata | 31 | 121 | 1 | 481,952 | 6,659 | 562 | 28,795 | 0 |
| 7 | Suisun Bay | 6 | 24 | 0 | 95,817 | 0\* | NA | NA | 0 |
| 7 | Suisun Marsh | 5 | 19 | 0 | 73,915 | 0\* | NA | NA | 0 |
| 7 | Lower Sacramento | 6 | 24 | 0 | 90,852 | 0\* | NA | NA | 0 |
| 7 | Cache Slough LI | 6 | 22 | 0 | 87,677 | 0\* | NA | NA | 0 |
| 7 | Sac DW Ship Channel | 6 | 24 | 0 | 88,968 | 0\* | NA | NA | 0 |
| 7 | Lower San Joaquin | 6 | 24 | 0 | 92,376 | 0\* | NA | NA | 0 |
| 7 | All Strata | 35 | 137 | 0 | 529,606 | 0\* | NA | NA | 0 |
| 8 | Suisun Bay | 4 | 13 | 0 | 65,061 | 0\* | NA | NA | 0 |
| 8 | Suisun Marsh | 5 | 20 | 0 | 81,346 | 0\* | NA | NA | 0 |
| 8 | Lower Sacramento | 6 | 24 | 0 | 93,040 | 0\* | NA | NA | 0 |
| 8 | Cache Slough LI | 6 | 24 | 0 | 77,604 | 0\* | NA | NA | 0 |
| 8 | Sac DW Ship Channel | 6 | 24 | 0 | 91,368 | 0\* | NA | NA | 0 |
| 8 | Lower San Joaquin | 6 | 24 | 0 | 88,926 | 0\* | NA | NA | 0 |
| 8 | All Strata | 33 | 129 | 0 | 497,344 | 0\* | NA | NA | 0 |

Table 2: Week numbers and corresponding dates used in Table 1.

| **Week** | **Dates** |
| --- | --- |
| 1 | July 1–5, 2024 |
| 2 | July 8–12, 2024 |
| 3 | July 15–19, 2024 |
| 4 | July 22–26, 2024 |
| 5 | July 29–August 2, 2024 |
| 6 | August 5–9, 2024 |
| 7 | August 12–16, 2024 |
| 8 | August 19–23, 2024 |

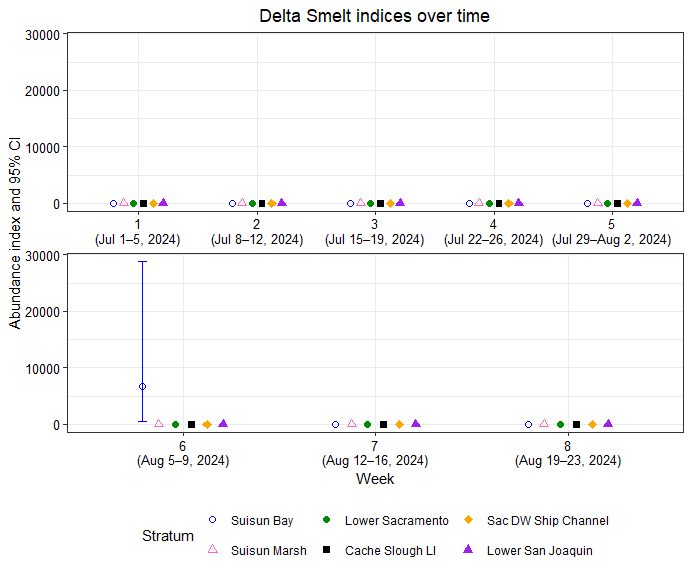


Figure 1: Delta Smelt abundance indices and 95% confidence intervals by week and stratum.

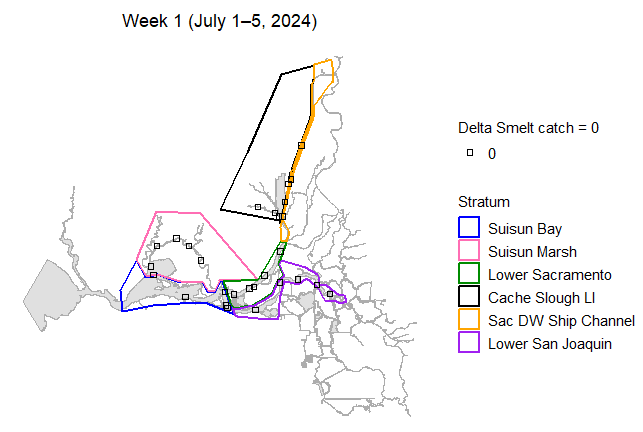


Figure 2: Map of total Delta Smelt catch by site in week 1.

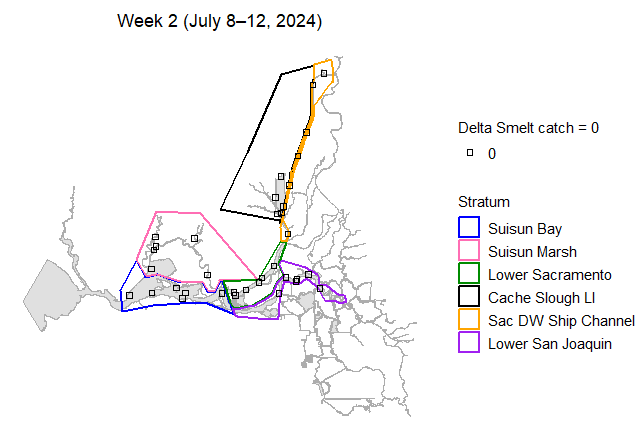


Figure 3: Map of total Delta Smelt catch by site in week 2.

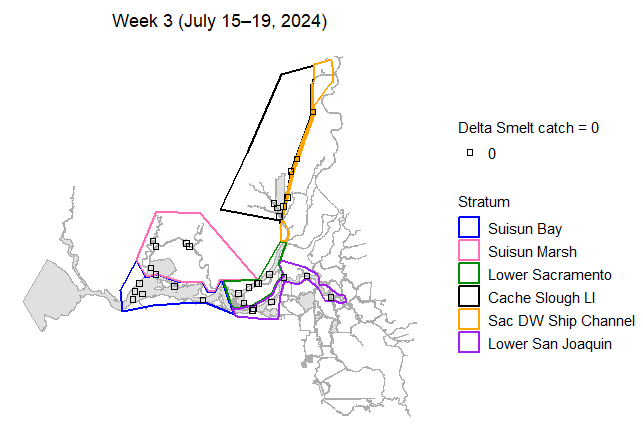


Figure 4: Map of total Delta Smelt catch by site in week 3.

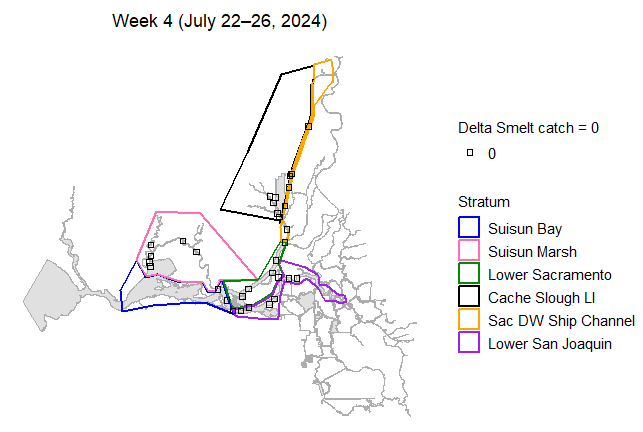


Figure 5: Map of total Delta Smelt catch by site in week 4.

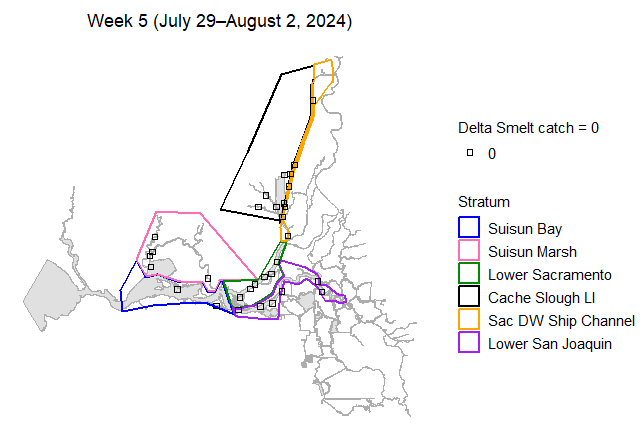


Figure 6: Map of total Delta Smelt catch by site in week 5.

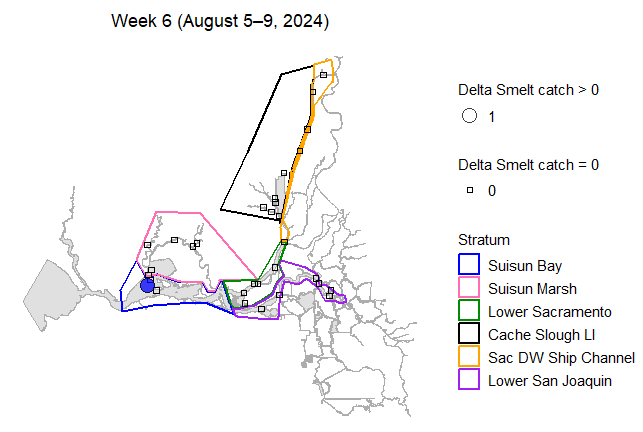


Figure 7: Map of total Delta Smelt catch by site in week 6.

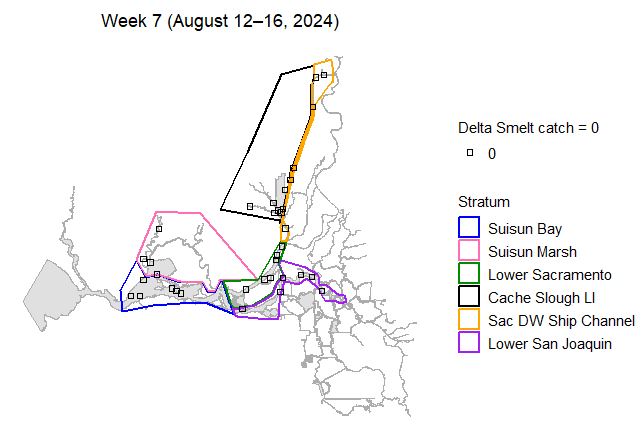


Figure 8: Map of total Delta Smelt catch by site in week 7.

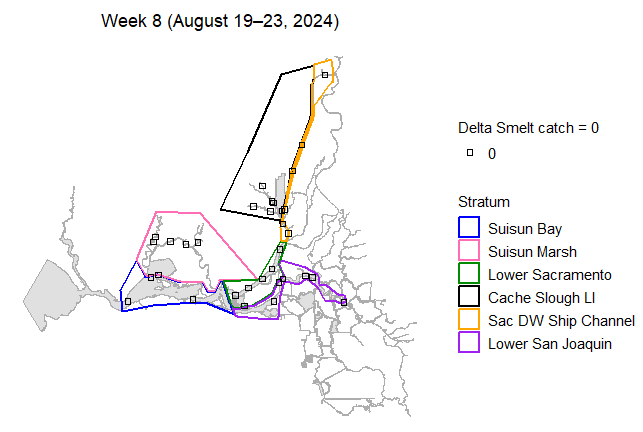


Figure 9: Map of total Delta Smelt catch by site in week 8.

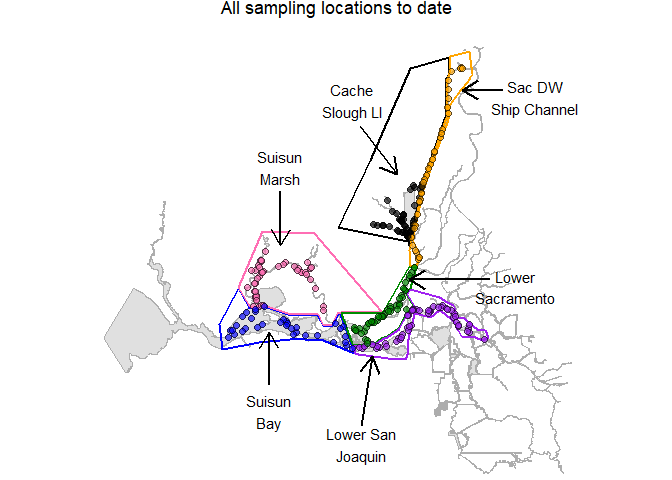


Figure 10: Map of all sampling sites in this phase.

# Habitat Volume Estimates

Table 3: Estimates of water volume (cubic meters) between 0.5-m and 4.5-m depth, by stratum.

| **Stratum** | **Volume** |
| --- | --- |
| Suisun Bay | 285,840,678 |
| Suisun Marsh | 76,278,718 |
| Lower Sacramento | 88,162,170 |
| Cache Slough LI | 33,420,492 |
| Sac DW Ship Channel | 30,411,491 |
| Lower San Joaquin | 122,096,565 |

# References

Stevens D.L. and Olsen A.R. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association, 99(465):262 – 278.