# Enhanced Delta Smelt Monitoring
## Preliminary Abundance Analysis
## Phase 3 Sampling

**DRAFT**

U.S. Fish and Wildlife Service

July 28, 2017

## Overview

Beginning July 2017, the Enhanced Delta Smelt Monitoring (EDSM) program started its Phase 3 sampling program. The Bay-Delta has been divided into eight geographic strata:

- Western Delta
- Suisun Bay Marsh (Suisun Bay and Marsh)
- Lower Sacramento
- Cache Slough LI (Cache Slough and Liberty Island)
- Sac DW Ship Channel (Sacramento Deep Water Shipping Channel)
- Upper Sacramento
- Lower San Joaquin
- Southern Delta

Sampling locations are generated using a generalized random-tessellation stratified (GRTS) design [1] 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.

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. Delta smelt caught in the wings of the net (as opposed to the live box or cod end) were excluded from this analysis. Fish caught in the wings are indicated by a Gear Condition Code of 9.
2. The **Week** designations used here were defined out of convenience and are subject to change.
3. Current sampling is limited to areas of the Bay-Delta with a depth of at least 8 feet at mean tide. 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).
4. The methods of analysis used here remain in development.

# Change Log

Report date July 10, 2017:

- No changes.

Report date July 14, 2017:

- Sample volume corrections were made for tows in Suisun Bay Marsh during Week 1. This resulted in an increase in the abundance estimate for that week.

Report date July 21, 2017:

- Total sample volume has been added to Table 1. Sample volumes are subject to correction.
- In some strata, a single tow was conducted at one of the sites in contrast to the standard two tow minimum. This change in procedure necessitates changes to the statistical model. While these changes are in development, simple stratified ratio-expanded estimates will be shown in Table 1.

Report date July 28, 2017:

- No changes since last report.

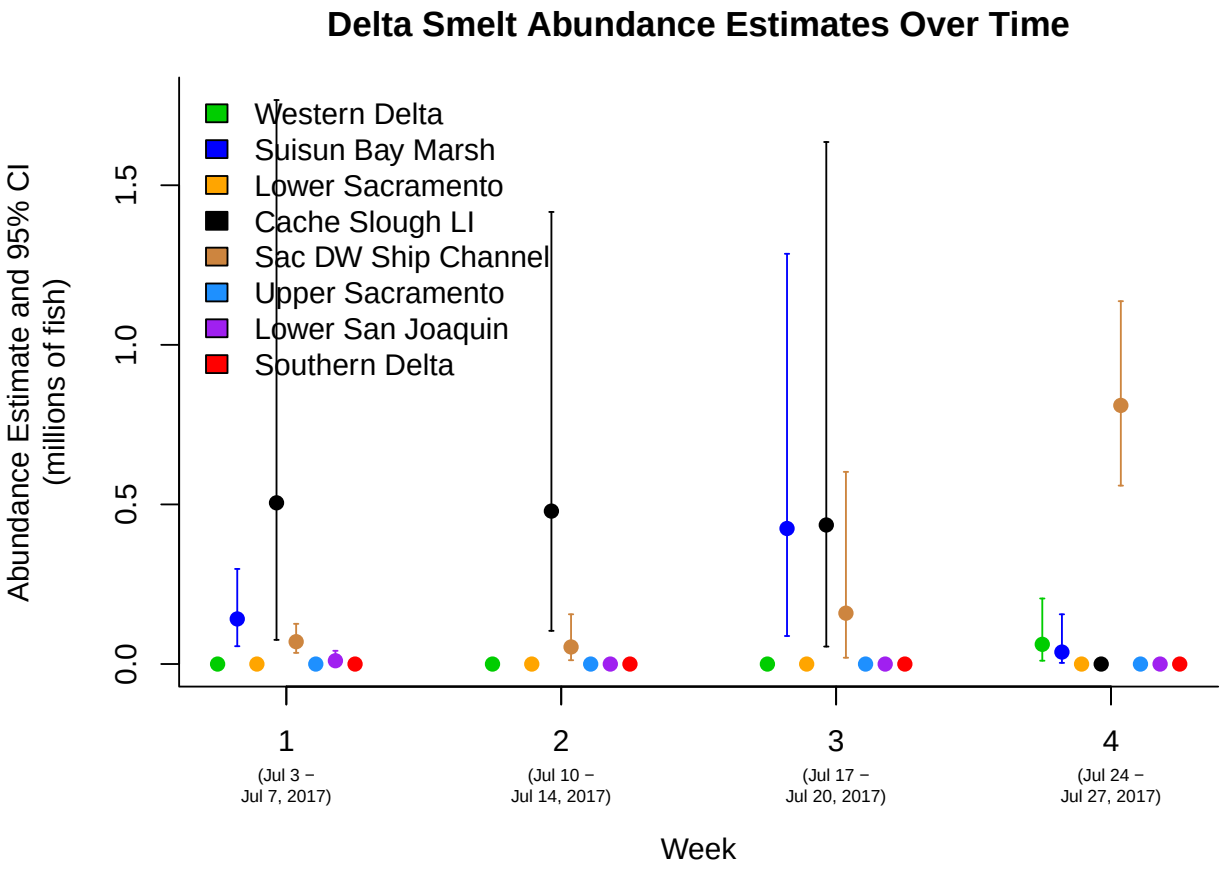
## Results

Table 1: Delta smelt catch summary and abundance estimates by week. An asterisk (*) is used to emphasize weeks when no delta smelt were caught and a dash (-) 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 currently only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters. Values in blue use a stratified ratio-expanded estimation method that does not account for EDSM's stopping rules.

| | | | | | Estimate and 95% CI | | |
|---|---|---|---|---|---|---|---|
| **Stratum** | **Number of Sites** | **Number of Tows** | **Number Caught** | **Total Sample Volume** | **Abundance** | **Lower Bound** | **Upper Bound** |
| **Week 1: July 3 - July 7, 2017** | | | | | | | |
| Western Delta | 4 | 32 | 0 | 130,560 | 0* | - | - |
| Suisun Bay Marsh | 2 | 5 | 5 | 12,373 | 141,293 | 55,832 | 297,925 |
| Lower Sacramento | 2 | 10 | 0 | 21,249 | 0* | - | - |
| Cache Slough LI | 2 | 3 | 37 | 6,047 | 505,151 | 75,706 | 1,766,992 |
| Sac DW Ship Channel | 2 | 4 | 9 | 4,462 | 70,077 | 35,057 | 125,938 |
| Upper Sacramento | 2 | 13 | 0 | 44,296 | 0* | - | - |
| Lower San Joaquin | 4 | 20 | 1 | 32,098 | 10,376 | 1,107 | 41,414 |
| Southern Delta | 6 | 48 | 0 | 179,539 | 0* | - | - |
| Total | 24 | 135 | 52 | 430,624 | 726,897 | 183,533 | 1,989,343 |
| **Week 2: July 10 - July 14, 2017** | | | | | | | |
| Western Delta | 2 | 12 | 0 | 62,818 | 0* | - | - |
| Suisun Bay Marsh | 0 | - | - | - | - | - | - |
| Lower Sacramento | 2 | 10 | 0 | 20,226 | 0* | - | - |
| Cache Slough LI | 2 | 7 | 25 | 10,323 | 479,200 | 104,033 | 1,416,325 |
| Sac DW Ship Channel | 2 | 7 | 7 | 10,194 | 53,507 | 11,959 | 155,885 |
| Upper Sacramento | 2 | 16 | 0 | 57,880 | 0* | - | - |
| Lower San Joaquin | 4 | 20 | 0 | 37,240 | 0* | - | - |
| Southern Delta | 6 | 48 | 0 | 191,973 | 0* | - | - |
| Total | 20 | 120 | 32 | 390,654 | - | - | - |
| **Week 3: July 17 - July 20, 2017** | | | | | | | |
| Western Delta | 4 | 32 | 0 | 120,388 | 0* | - | - |
| Suisun Bay Marsh | 2 | 7 | 10 | 13,558 | 424,672 | 87,828 | 1,285,210 |
| Lower Sacramento | 2 | 10 | 0 | 15,534 | 0* | - | - |
| Cache Slough LI | 2 | 4 | 27 | 5,117 | 435,653 | 54,781 | 1,635,421 |
| Sac DW Ship Channel | 2 | 6 | 40 | 8,721 | 159,427 | 19,743 | 602,025 |
| Upper Sacramento | 2 | 16 | 0 | 53,937 | 0* | - | - |
| Lower San Joaquin | 4 | 20 | 0 | 40,021 | 0* | - | - |
| Southern Delta | 6 | 48 | 0 | 199,987 | 0* | - | - |
| Total | 24 | 143 | 77 | 457,263 | 1,019,752 | 307,430 | 2,532,564 |
| **Week 4: July 24 - July 27, 2017** | | | | | | | |
| Western Delta | 4 | 26 | 2 | 116,912 | 61,789 | 10,442 | 205,263 |
| Suisun Bay Marsh | 2 | 10 | 2 | 18,635 | 37,562 | 3,594 | 155,752 |
| Lower Sacramento | 2 | 11 | 0 | 23,195 | 0* | - | - |
| Cache Slough LI | 2 | 10 | 0 | 18,250 | 0* | - | - |
| Sac DW Ship Channel | 2 | 2 | 62 | 2,660 | 810,345 | 558,999 | 1,136,809 |
| Upper Sacramento | 2 | 16 | 0 | 62,159 | 0* | - | - |
| Lower San Joaquin | 4 | 20 | 0 | 49,625 | 0* | - | - |

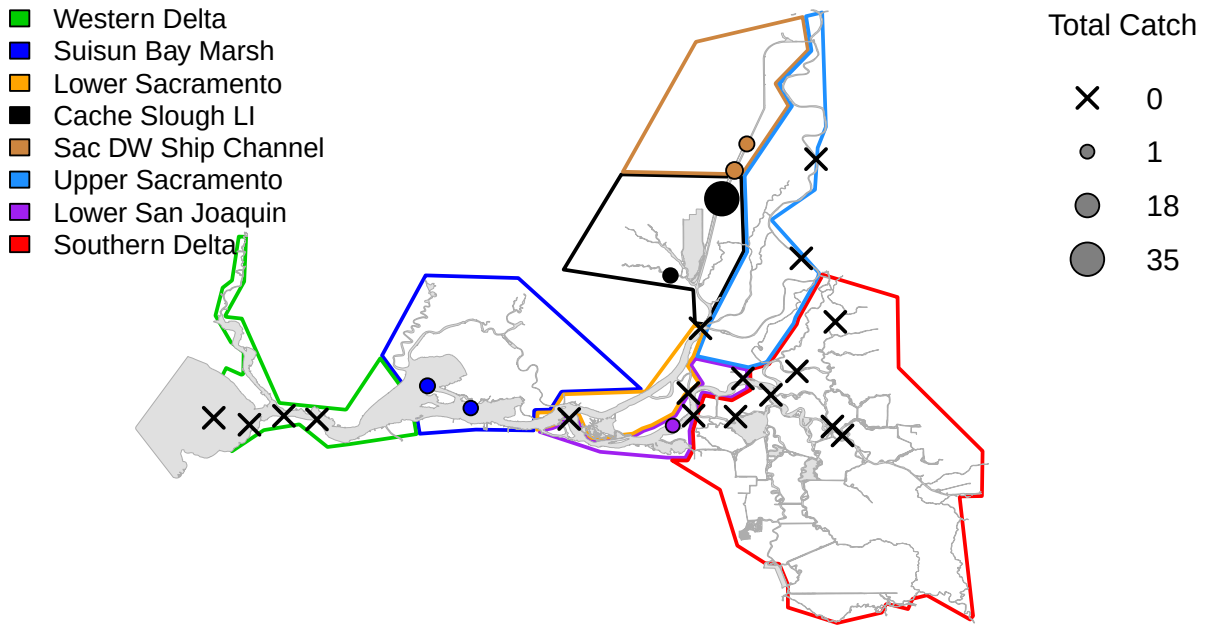
Table 1: Delta smelt catch summary and abundance estimates by week. An asterisk (*) is used to emphasize weeks when no delta smelt were caught and a dash (-) is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are currently only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters. Values in blue use a stratified ratio-expanded estimation method that does not account for EDSM's stopping rules.

| | | | | | Estimate and 95% CI | | |
|---|---|---|---|---|---|---|---|
| **Stratum** | **Number of Sites** | **Number of Tows** | **Number Caught** | **Total Sample Volume** | **Abundance** | **Lower Bound** | **Upper Bound** |
| Southern Delta | 6 | 49 | 0 | 201,306 | 0* | - | - |
| Total | 24 | 144 | 66 | 492,741 | 909,696 | 630,017 | 1,272,003 |

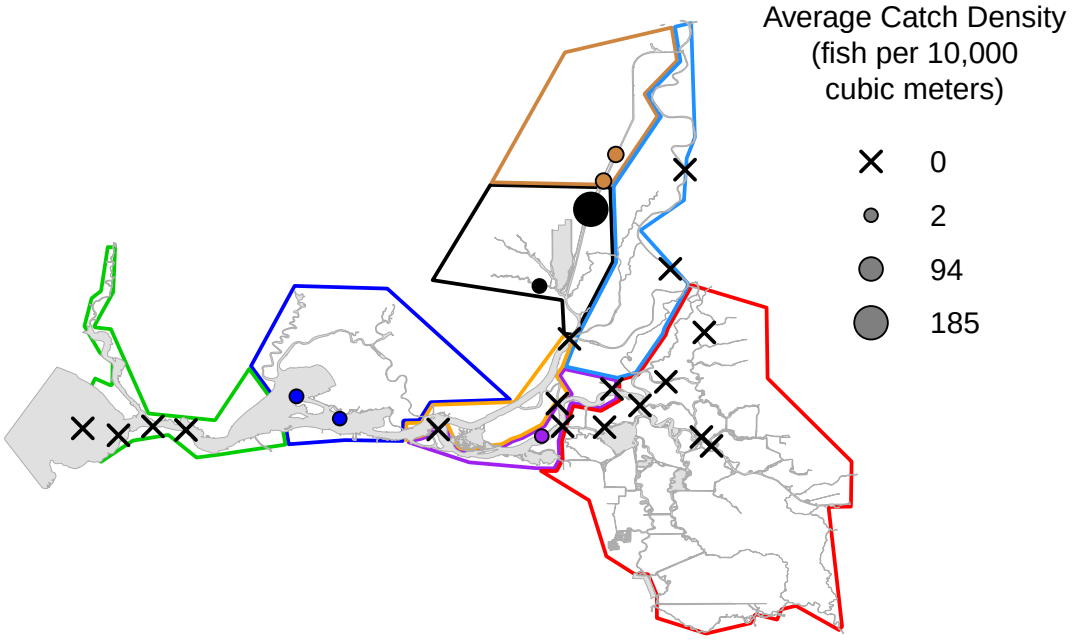

Delta Smelt Abundance Estimates Over Time
Western Delta
Suisun Bay Marsh
Lower Sacramento
Cache Slough LI
Sac DW Ship Channel
Upper Sacramento
Lower San Joaquin
Southern Delta
Abundance Estimate and 95% CI
(millions of fish)
0.0
0.5
1.0
1.5
1
(Jul 3 –
Jul 7, 2017)
2
(Jul 10 –
Jul 14, 2017)
3
(Jul 17 –
Jul 20, 2017)
4
(Jul 24 –
Jul 27, 2017)
Week

# Week 1 (Jul 3 – Jul 7, 2017)

## Delta Smelt Total Catch by Site

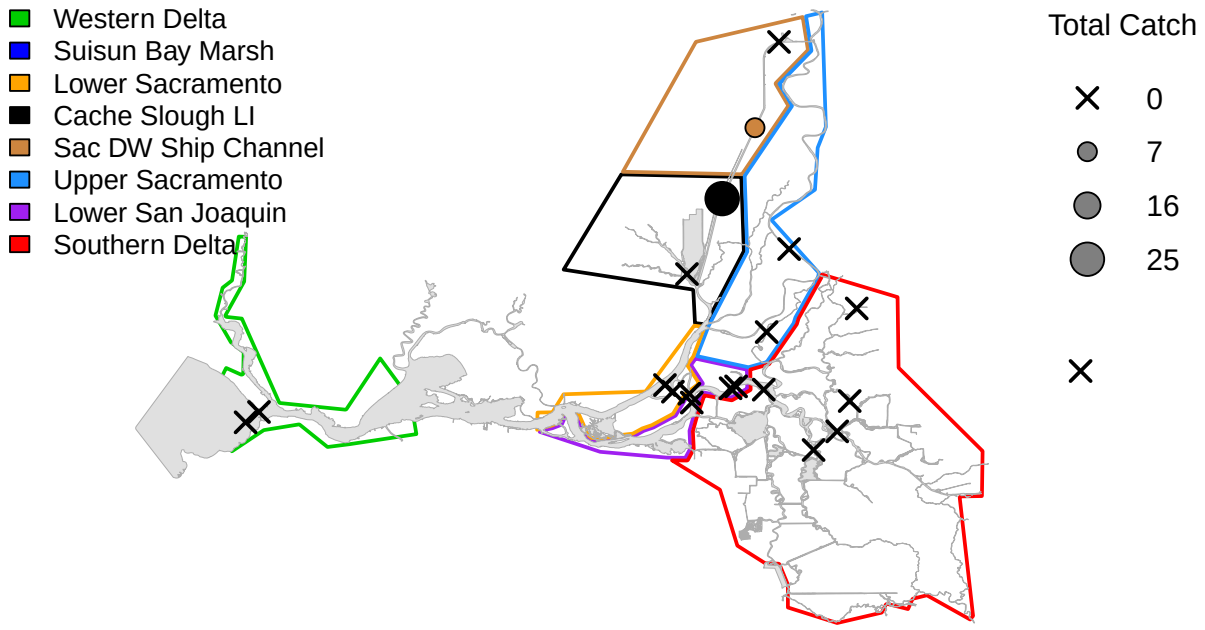



## Delta Smelt Catch Density by Site

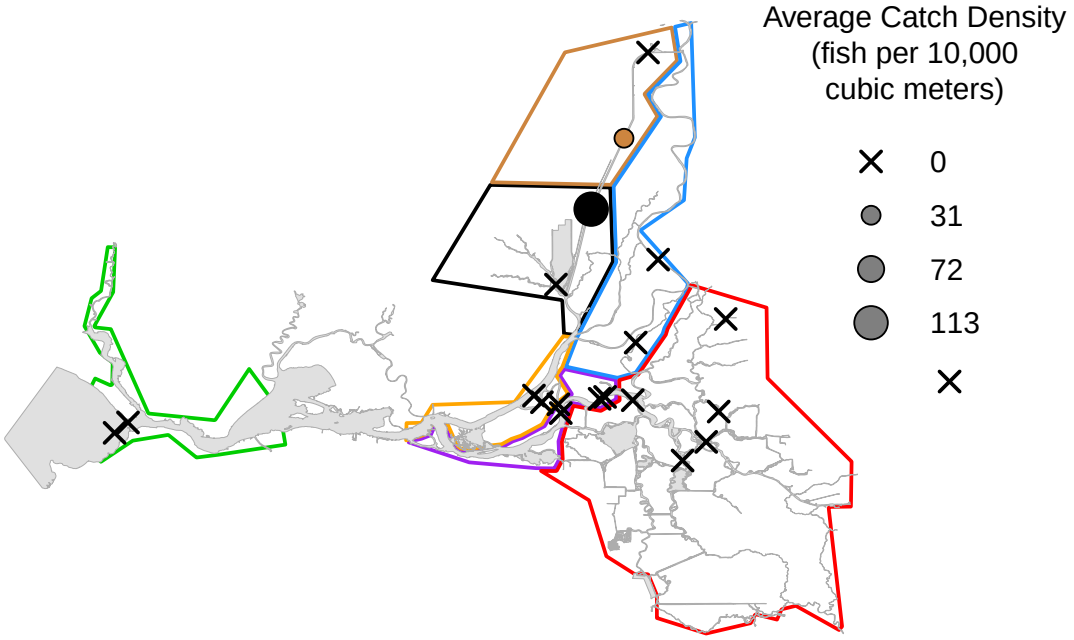


# Week 2 (Jul 10 – Jul 14, 2017)

## Delta Smelt Total Catch by Site

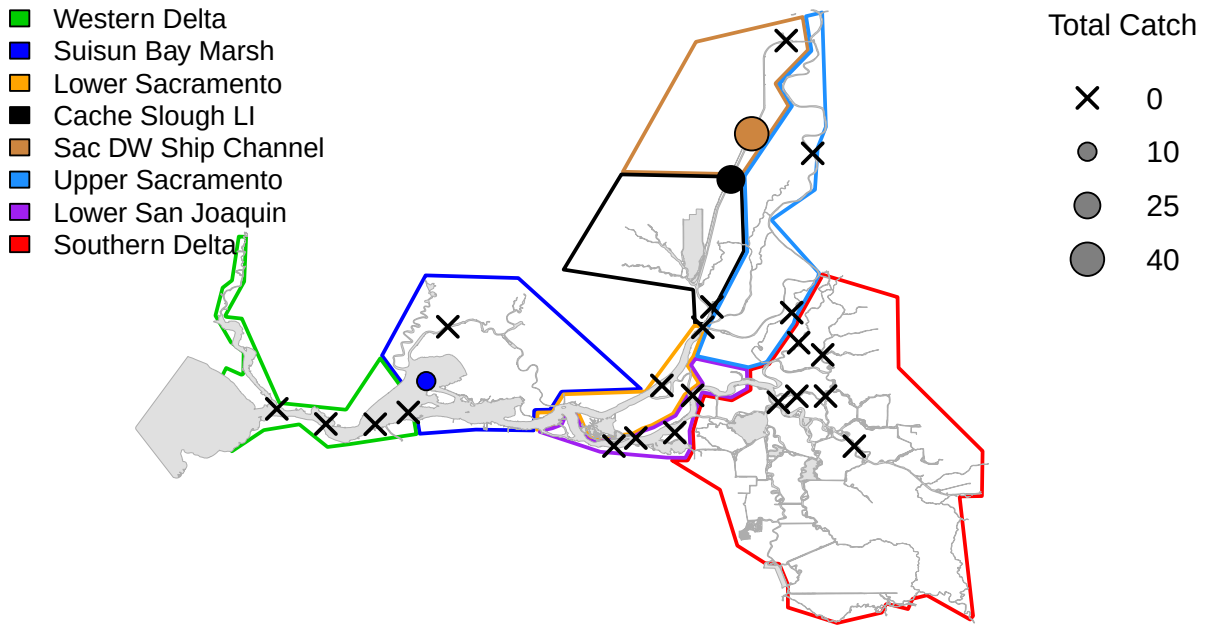



## Delta Smelt Catch Density by Site

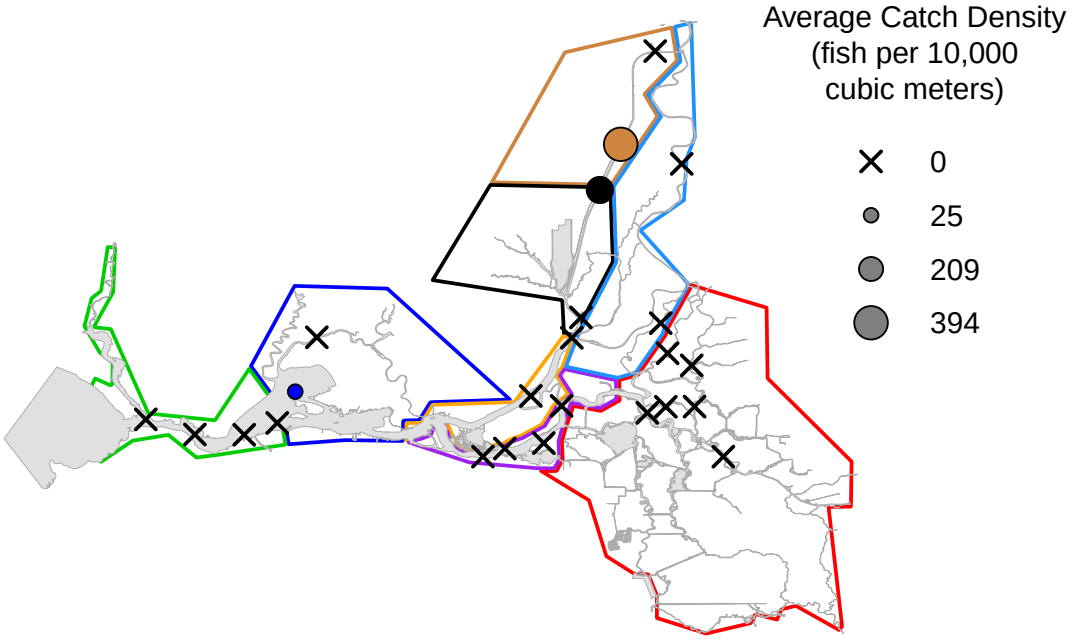


# Week 3 (Jul 17 – Jul 20, 2017)

## Delta Smelt Total Catch by Site

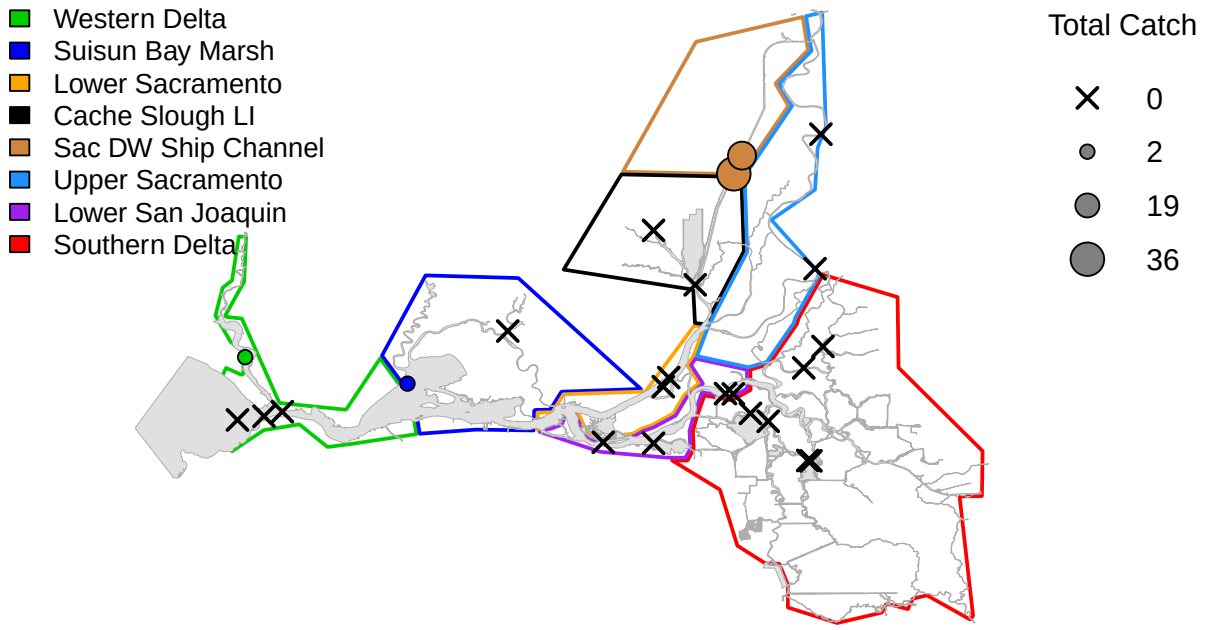



## Delta Smelt Catch Density by Site

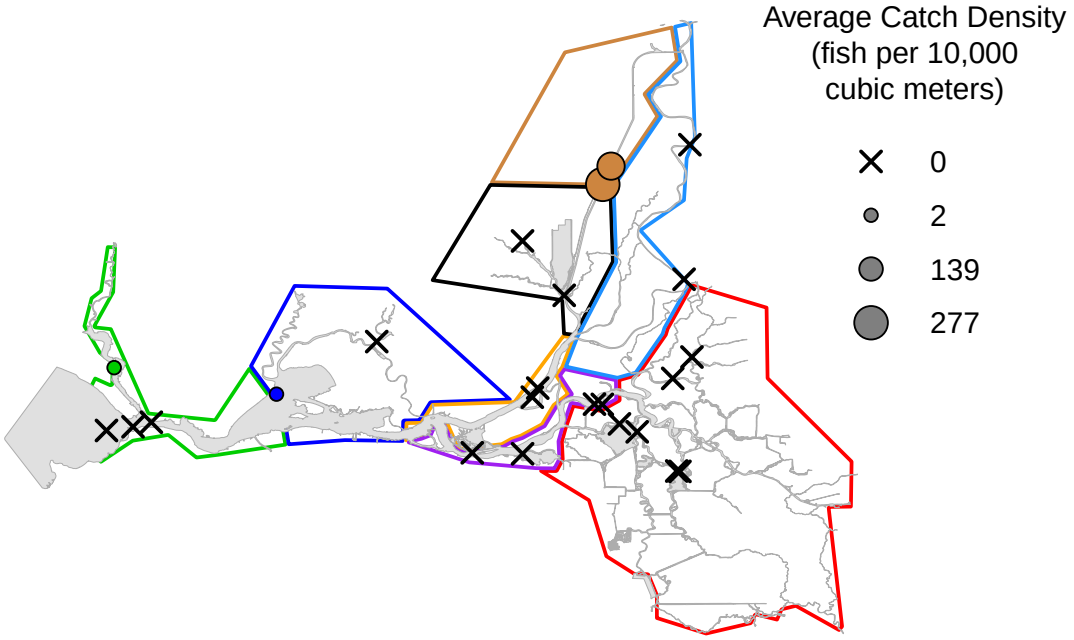


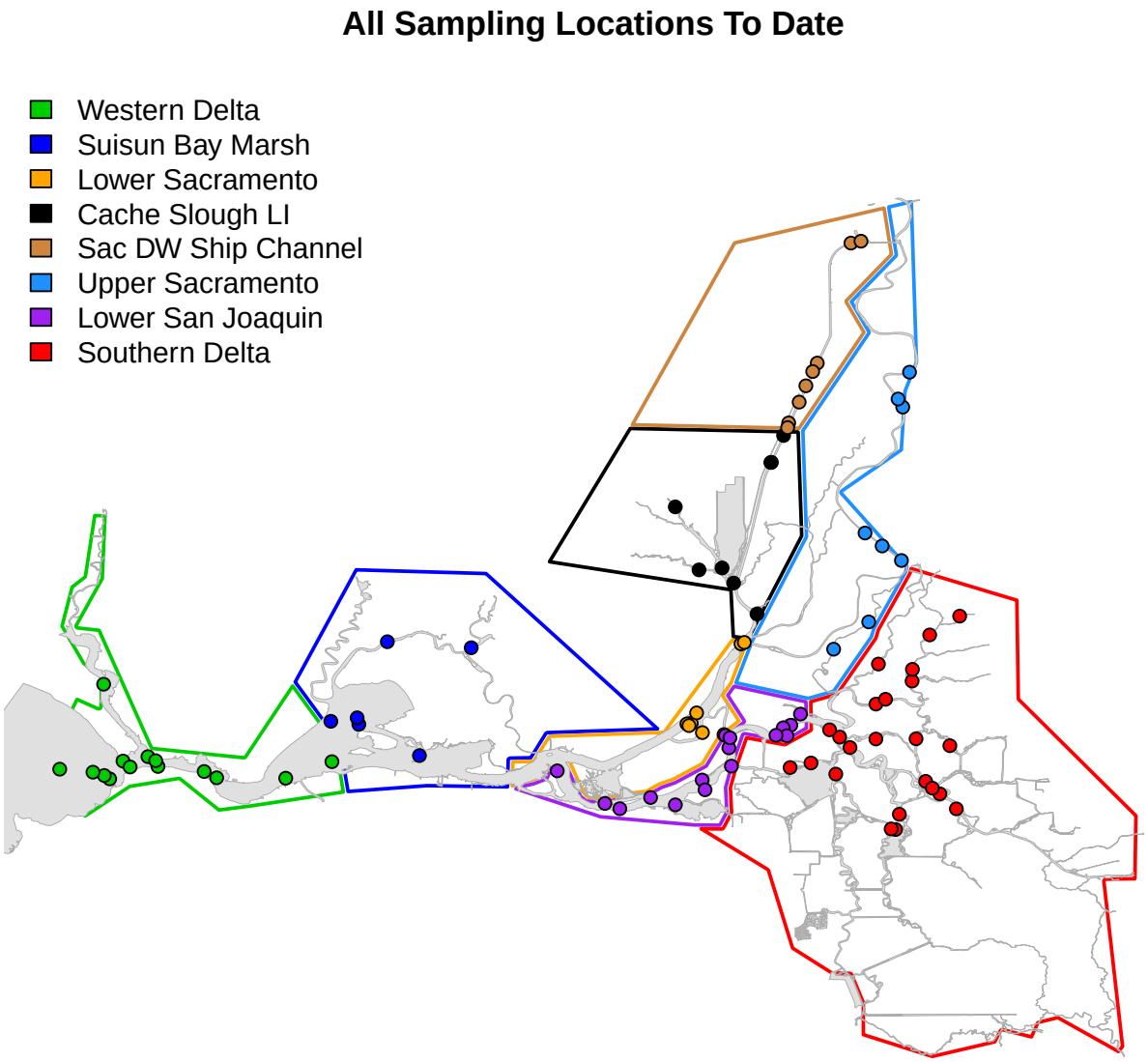
# Week 4 (Jul 24 – Jul 27, 2017)

## Delta Smelt Total Catch by Site




## Delta Smelt Catch Density by Site






## References

[1] Stevens, Don L., Olsen, Anthony R. 2004. Spatially balanced sampling of natural resources, *Journal of the American Statistical Association*, 99(465): 262 – 278.