

# Enhanced Delta Smelt Monitoring

## 2022 Phase 1 Sampling

### Preliminary Analysis

**DRAFT**

U.S. Fish and Wildlife Service

January 14, 2022

## Overview

The Enhanced Delta Smelt Monitoring (EDSM) program started its 2022 Phase 1 sampling program for adult Delta Smelt on November 29, 2021. In order to improve our ability to make inferences about the population, sampling effort is being focused on eight 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 and Olsen, 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](#) 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 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. 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.
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 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).
4. The methods of analysis used here remain in development.

## Change Log

Report date December 20, 2021:

- The Western Delta stratum has been removed from the sampling frame as of December 13, 2021.
- On December 15th, 2021, 12,800 captively produced Delta Smelt were released in the Lower Sacramento River. These fish have been marked with either an adipose fin clip or a visible tag. Catches of marked Delta Smelt are briefly summarized here, but these individuals are not incorporated into the abundance estimates.

Report date December 27, 2021:

- Abundance estimates now incorporate unmarked and marked Delta Smelt.

## Results

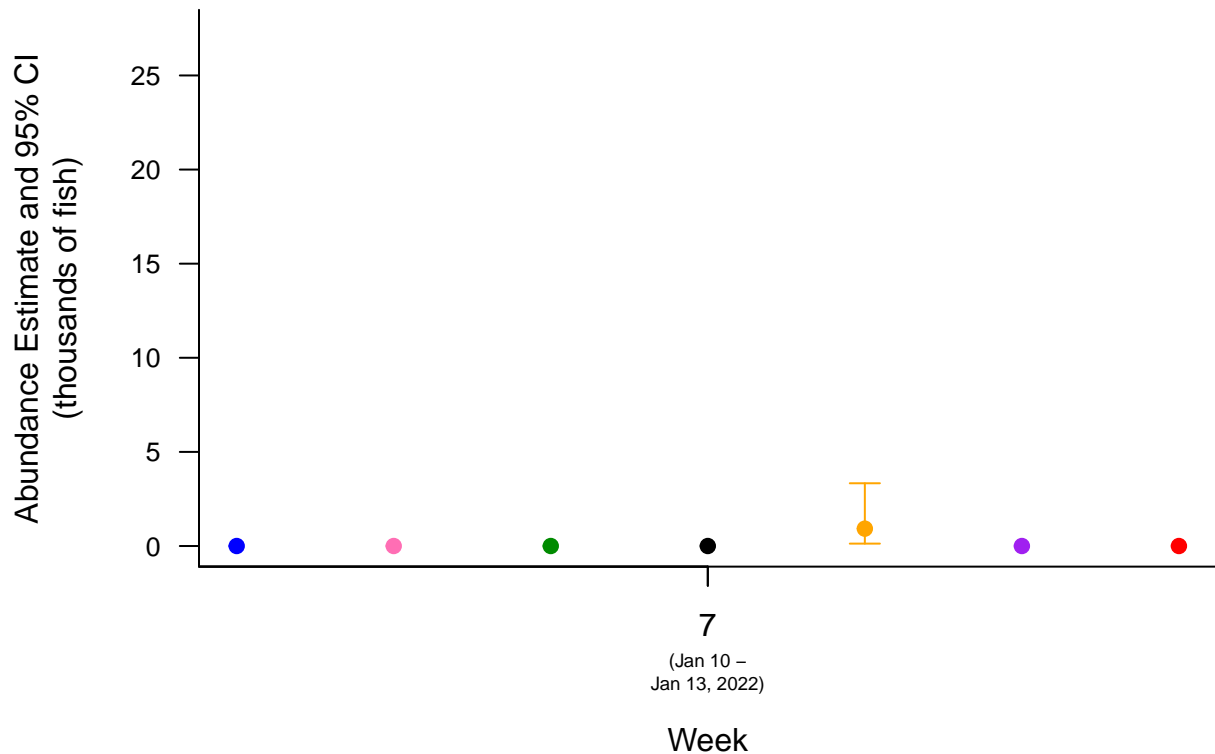
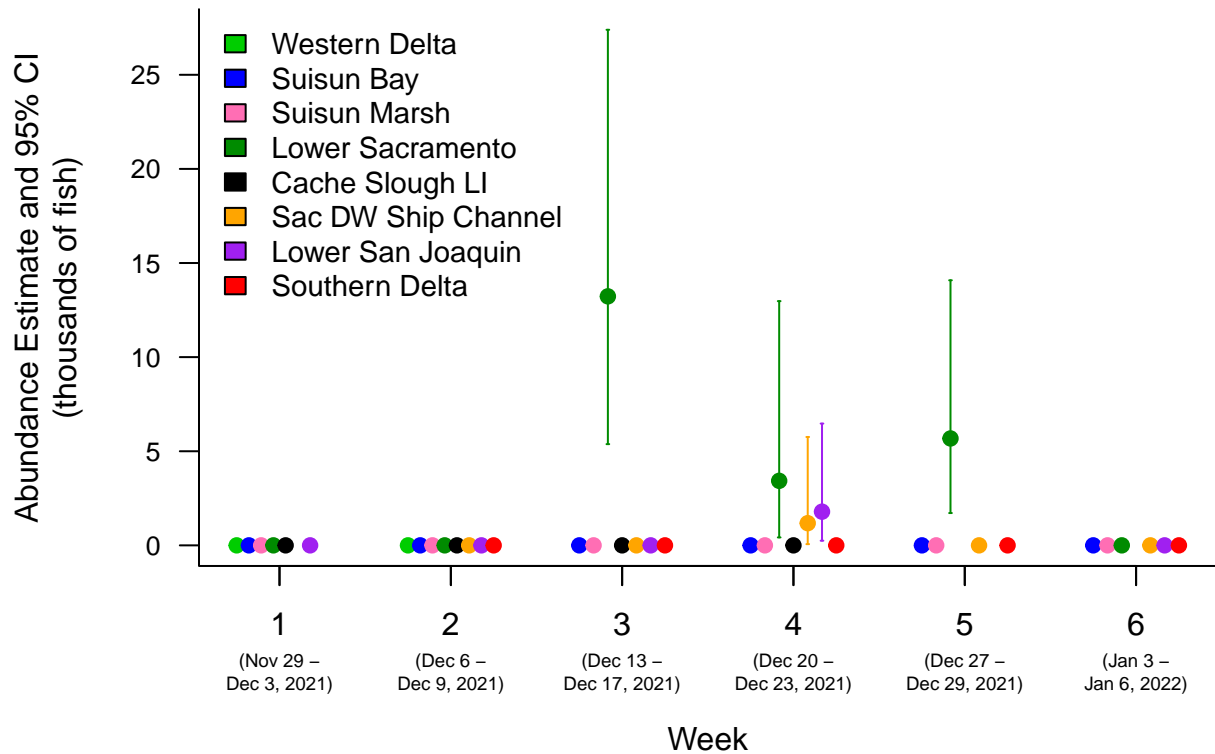
Table 1: Delta Smelt catch summary and abundance estimates by week. An asterisk (\*) is used to emphasize weeks when no Delta Smelt were caught and a dash (-) is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters. Abundance estimates include unmarked and marked Delta Smelt. The number of marked Delta Smelt caught is indicated in the last column. The number of unmarked Delta Smelt is given by the total number ('Total Number Caught' field) minus the number of marked fish ('Number Marked' field).

	Stratum	Number of Sites	Number of Tows	Total Number Caught	Total Sample Volume	Estimate and 95% CI			Number Marked
						Abund	Lower Bound	Upper Bound	
Week 1: November 29 - December 3, 2021									
	Western Delta	3	12	0	54,130	0*	-	-	-
	Suisun Bay	6	22	0	86,385	0*	-	-	-
	Suisun Marsh	3	11	0	46,914	0*	-	-	-
	Lower Sacramento	3	12	0	48,796	0*	-	-	-
	Cache Slough LI	3	10	0	37,071	0*	-	-	-
	Sac DW Ship Channel	0	-	-	-	-	-	-	-
	Lower San Joaquin	1	4	0	15,599	0*	-	-	-
	Southern Delta	0	-	-	-	-	-	-	-
	Total	19	71	0	288,896	-	-	-	-
Week 2: December 6 - 9, 2021									
	Western Delta	3	12	0	55,927	0*	-	-	-
	Suisun Bay	6	23	0	99,747	0*	-	-	-
	Suisun Marsh	3	12	0	51,347	0*	-	-	-
	Lower Sacramento	6	22	0	83,390	0*	-	-	-
	Cache Slough LI	3	12	0	43,254	0*	-	-	-
	Sac DW Ship Channel	3	6	0	21,420	0*	-	-	-
	Lower San Joaquin	6	24	0	99,642	0*	-	-	-
	Southern Delta	6	23	0	89,699	0*	-	-	-
	Total	36	134	0	544,427	0*	-	-	-
Week 3: December 13 - 17, 2021									
	Suisun Bay	9	35	0	139,963	0*	-	-	0
	Suisun Marsh	3	12	0	46,150	0*	-	-	0
	Lower Sacramento	6	22	8	77,392	13,229	5,377	27,391	6
	Cache Slough LI	3	10	0	33,212	0*	-	-	0
	Sac DW Ship Channel	3	12	0	44,129	0*	-	-	0
	Lower San Joaquin	6	24	0	100,989	0*	-	-	0
	Southern Delta	5	20	0	80,210	0*	-	-	0
	Total	35	135	8	522,045	13,229	5,377	27,391	6
Week 4: December 20 - 23, 2021									
	Suisun Bay	9	36	0	157,822	0*	-	-	0
	Suisun Marsh	3	12	0	54,009	0*	-	-	0
	Lower Sacramento	6	20	2	75,100	3,428	422	12,975	2
	Cache Slough LI	3	12	0	44,049	0*	-	-	0
	Sac DW Ship Channel	3	12	1	46,174	1,179	65	5,758	1
	Lower San Joaquin	6	24	1	94,504	1,789	247	6,470	1

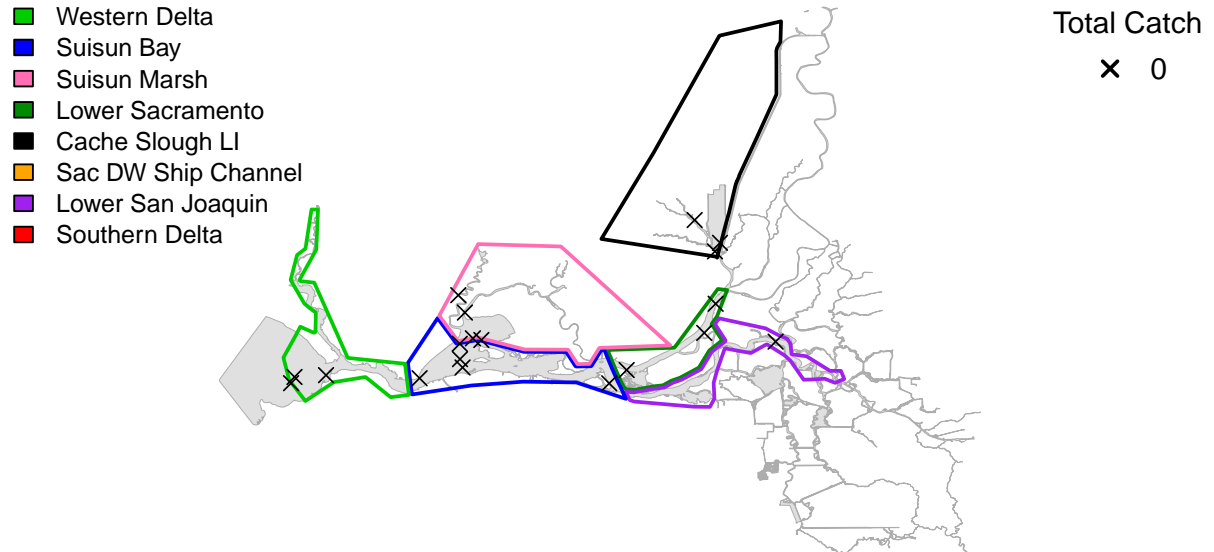
Table 1: Delta Smelt catch summary and abundance estimates by week. An asterisk (\*) is used to emphasize weeks when no Delta Smelt were caught and a dash (-) is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters. Abundance estimates include unmarked and marked Delta Smelt. The number of marked Delta Smelt caught is indicated in the last column. The number of unmarked Delta Smelt is given by the total number ('Total Number Caught' field) minus the number of marked fish ('Number Marked' field).

Stratum	Number of Sites	Number of Tows	Total Number Caught	Total Sample Volume	Estimate and 95% CI			Number Marked
					Abund	Lower Bound	Upper Bound	
Southern Delta	6	24	0	81,461	0*	-	-	0
Total	36	140	4	553,119	6,395	1,501	18,176	4
<b>Week 5: December 27 - 29, 2021</b>								
Suisun Bay	6	24	0	104,027	0*	-	-	0
Suisun Marsh	3	12	0	47,638	0*	-	-	0
Lower Sacramento	6	18	3	64,497	5,680	1,717	14,082	3
Cache Slough LI	0	-	-	-	-	-	-	-
Sac DW Ship Channel	3	12	0	42,522	0*	-	-	0
Lower San Joaquin	0	-	-	-	-	-	-	-
Southern Delta	6	24	0	85,630	0*	-	-	0
Total	24	90	3	344,314	-	-	-	3
<b>Week 6: January 3 - 6, 2022</b>								
Suisun Bay	6	24	0	103,514	0*	-	-	0
Suisun Marsh	3	12	0	54,015	0*	-	-	0
Lower Sacramento	6	24	0	89,271	0*	-	-	0
Cache Slough LI	0	-	-	-	-	-	-	-
Sac DW Ship Channel	3	12	0	45,385	0*	-	-	0
Lower San Joaquin	6	24	0	90,217	0*	-	-	0
Southern Delta	6	24	0	91,239	0*	-	-	0
Total	30	120	0	473,641	-	-	-	0
<b>Week 7: January 10 - 13, 2022</b>								
Suisun Bay	9	36	0	145,278	0*	-	-	0
Suisun Marsh	3	12	0	48,677	0*	-	-	0
Lower Sacramento	6	24	0	89,079	0*	-	-	0
Cache Slough LI	3	12	0	43,871	0*	-	-	0
Sac DW Ship Channel	3	11	1	45,680	922	127	3,333	1
Lower San Joaquin	6	24	0	89,032	0*	-	-	0
Southern Delta	5	16	0	62,094	0*	-	-	0
Total	35	135	1	523,712	922	127	3,333	1

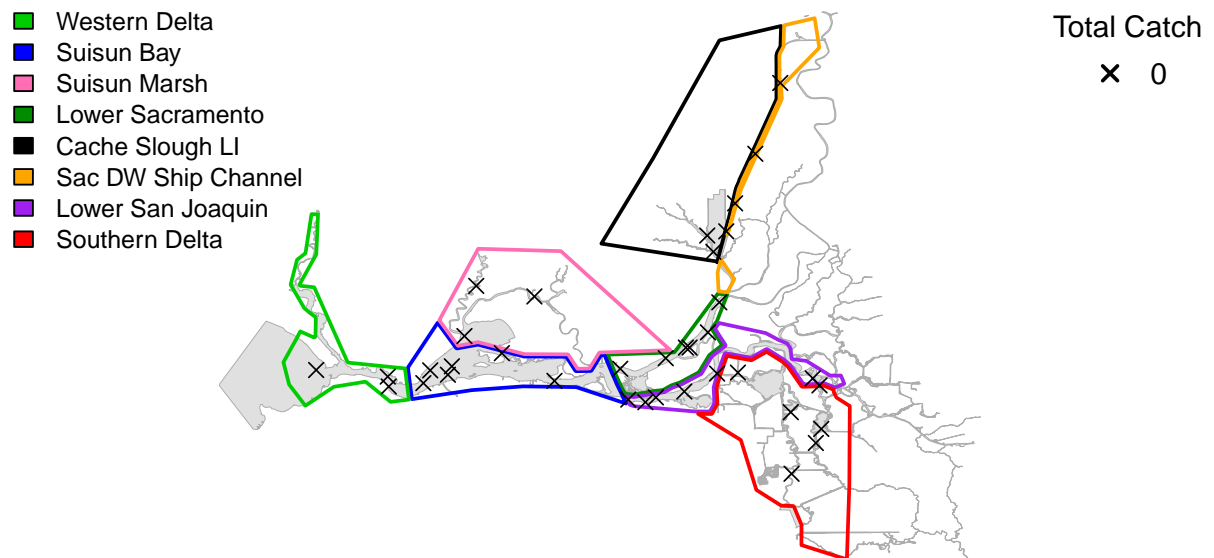
## Delta Smelt Abundance Estimates Over Time



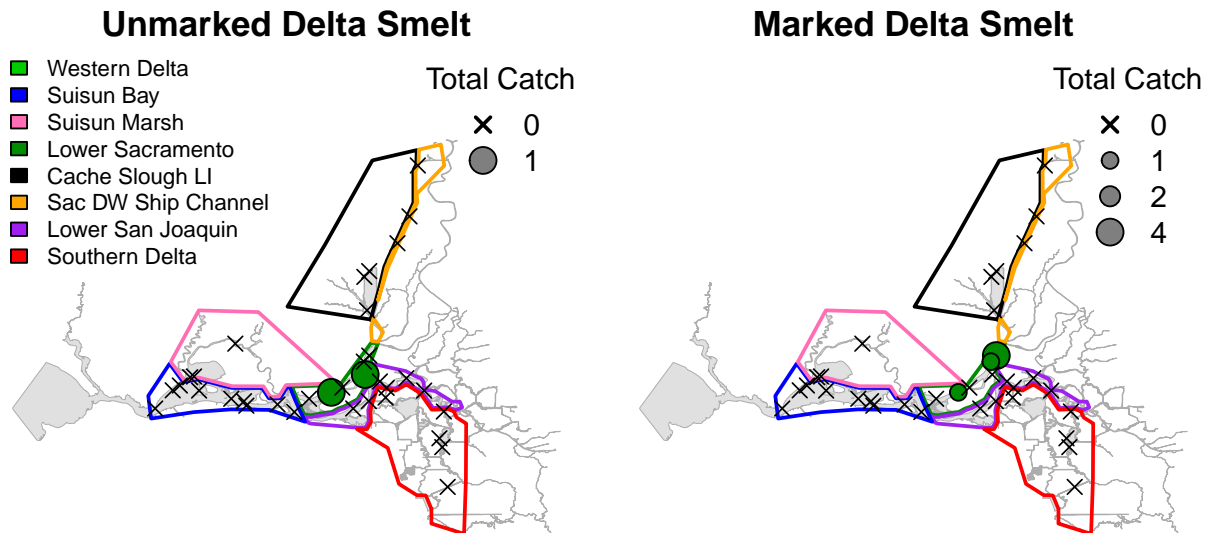
**Delta Smelt Catch by Site:  
Week 1 (November 29 – December 3, 2021)**



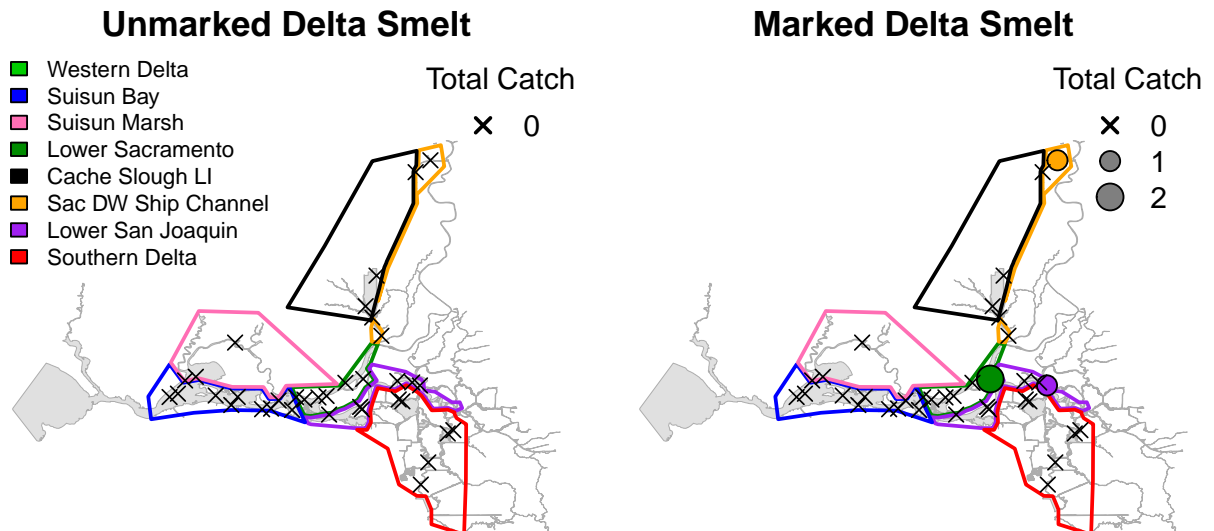
**Delta Smelt Catch by Site:  
Week 2 (December 6 – 9, 2021)**



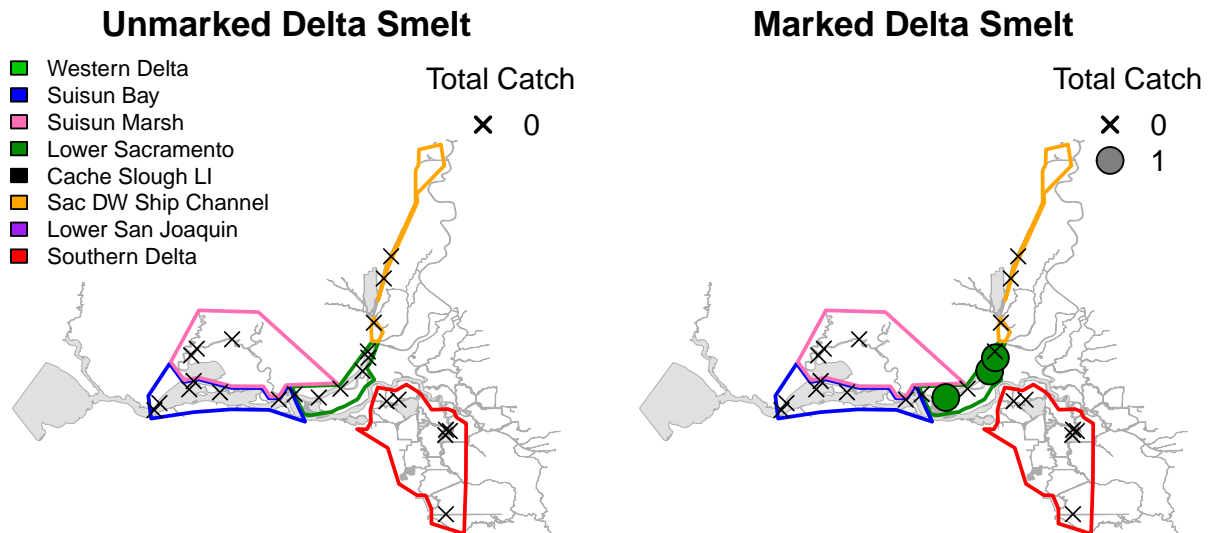
## Delta Smelt Catch by Site: Week 3 (December 13 – 17, 2021)



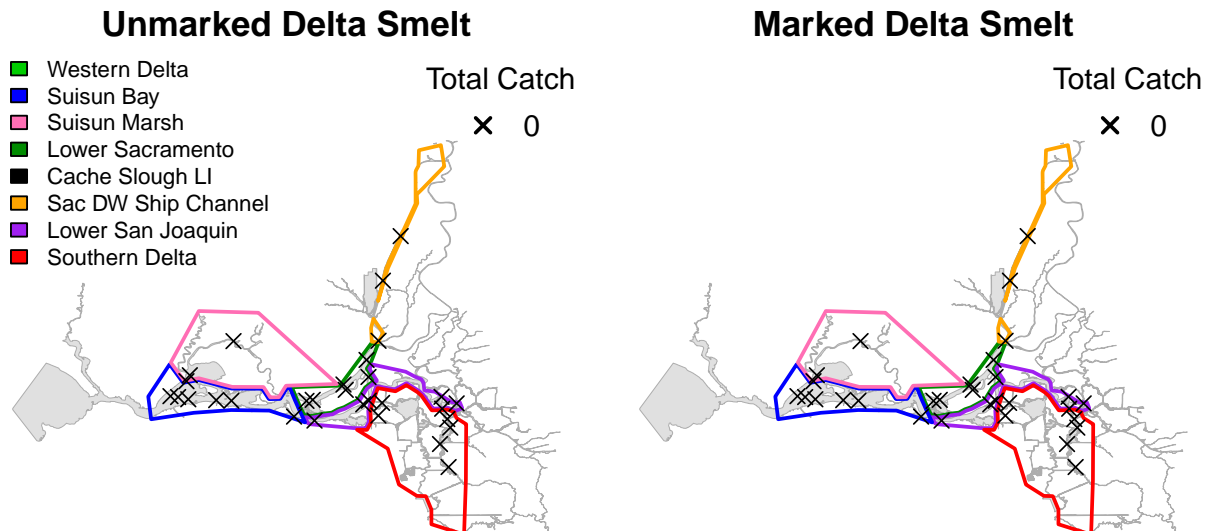
## Delta Smelt Catch by Site: Week 4 (December 20 – 23, 2021)



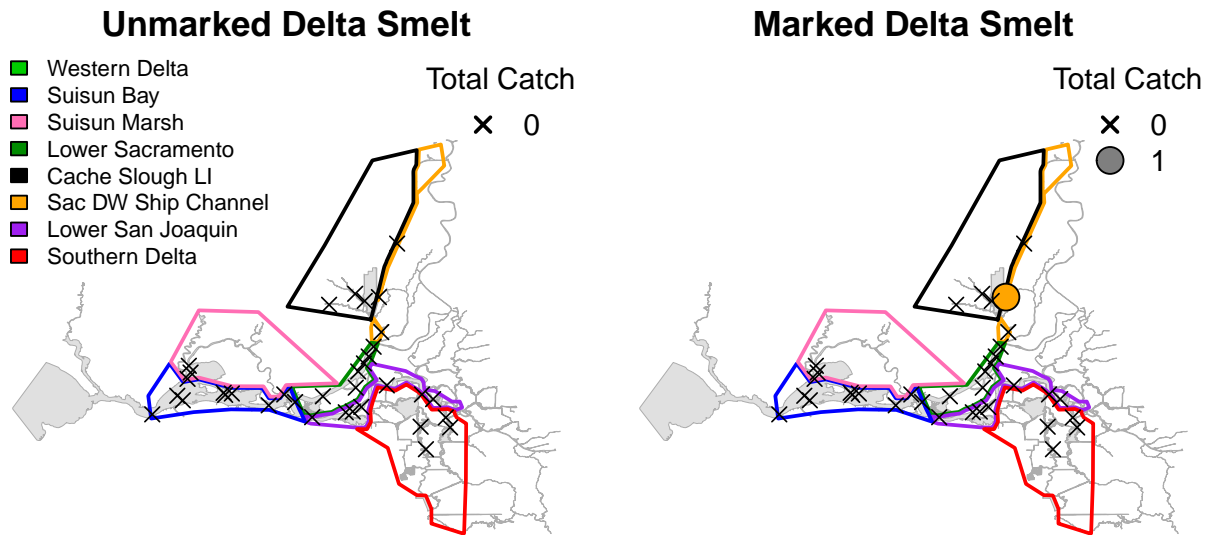
## Delta Smelt Catch by Site: Week 5 (December 27 – 29, 2021)



## Delta Smelt Catch by Site: Week 6 (January 3 – 6, 2022)



## Delta Smelt Catch by Site: Week 7 (January 10 – 13, 2022)





## All Sampling Locations To Date

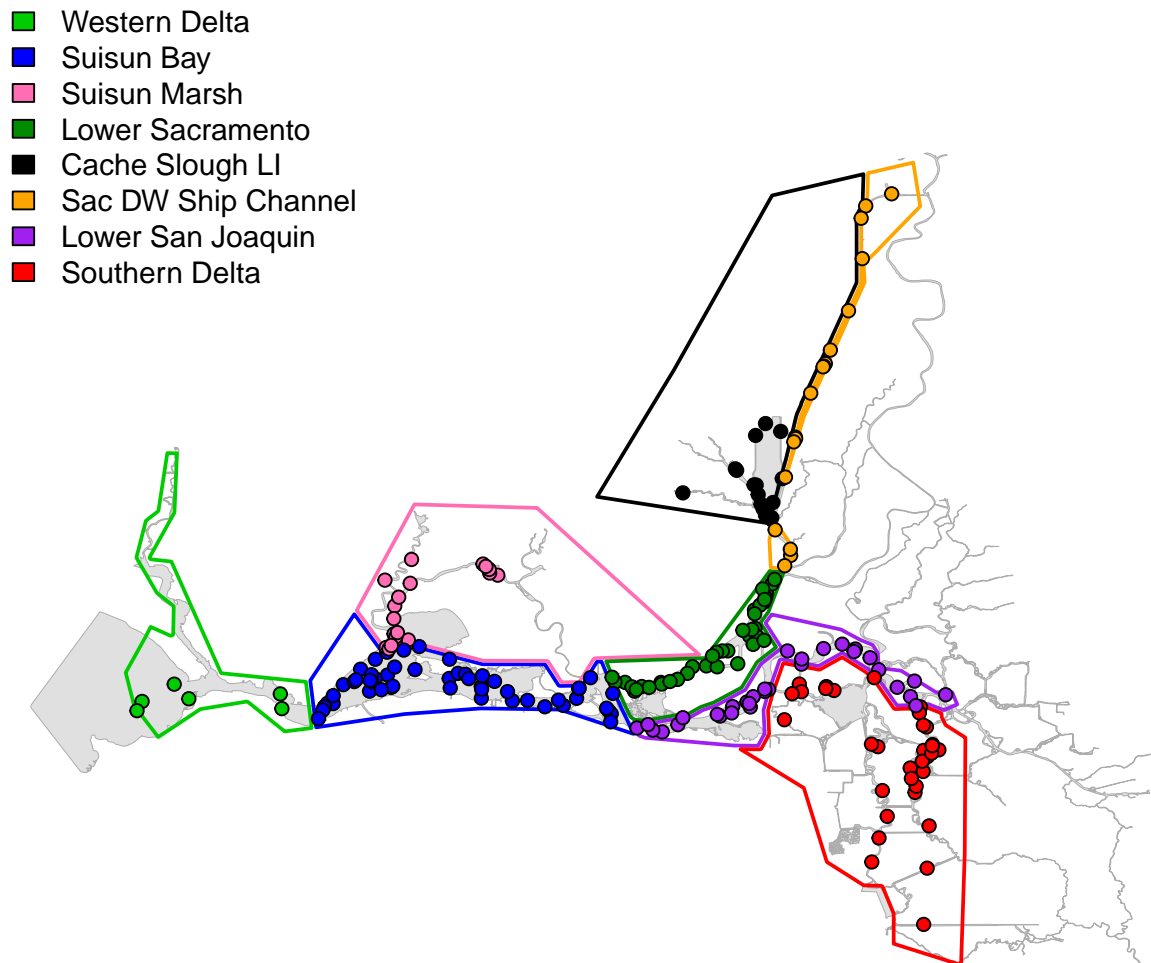


Table 2: Estimates of water volume (cubic meters) between 0.5-m and 4.5-m depth, by stratum.

Stratum	Volume
Cache Slough LI	33,420,492
Lower Sacramento	88,162,170
Lower San Joaquin	122,096,565
Sac DW Ship Channel	30,411,491
Southern Delta	136,731,814
Suisun Bay	285,840,678
Suisun Marsh	76,278,718
Western Delta	190,166,275

## References

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