Enhanced Delta Smelt Monitoring

Preliminary Abundance Analysis

DRAFT

U.S. Fish and Wildlife Service

March 3, 2017

This analysis is preliminary and the results are subject to correction and revision. 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. Abundance estimates labeled **Total** exclude any strata that were not sampled in a given week.
3. The **Week** designations used here were defined out of convenience and are subject to change.

Update Log

January 14, 2017

- Different abundance estimation methods were applied to Weeks 1 – 3 and Week 4 because of model convergence issues.

January 20, 2017

- A new optimization method was used to estimate abundance estimates and overcome the issues in the last report. The updated method was applied to Weeks 1 - 5 and resulted in changes to past abundance estimates, particularly in Week 4. The updated method will be used in future reports unless otherwise noted.

January 27, 2017

- The method used to calculate confidence intervals in Table 2 was updated.
- Maps of average delta smelt catch densities by site were added.
- An abundance time series figure was added.
- An update log was added to reflect major changes made to this report between weeks.

February 3, 2017

- Sampling was cut short by fog and high winds, resulting in fewer sites in the "High Risk, Low Density" stratum than originally scheduled.

February 10, 2017 (End of Week 8)

- Previous reports incorrectly indicated that a total of 6 sites were visited in the "High Risk, Low Density" stratum during Week 4. The correct total is 7.
- Corrections to sample volumes have resulted in minor changes to abundance estimates from previous weeks.

February 17, 2017 (End of Week 9)

- Tables 3 and 4 were added.

- A minor correction was made to the confidence interval calculations for proportions.
- Sampling in the eastern portion of the "Low Risk, Low Density" stratum was limited due to flooding.

February 24, 2017 (End of Week 10)

- There is a discrepancy in the Week 8 abudandance estimates relative to previous reports. The cause is unknown.

March 3, 2017 (End of Week 11)

- The Week 8 issue from the last report was resolved. An incorrect number of maximum possible tows was being used in the low density strata calculations (10 was being used when it should have been 8). The reports from Weeks 8 and 9 used the incorrect value.

Table 1: Abundance estimates by week. *No delta smelt were caught.

				Estimate and 95% CI		
Week	**Dates**	**Stratum**	**Num of Sites**	**Abundance**	**Lower Bound**	**Upper Bound**
1	Dec 15 - Dec 22	High Risk, High Density	12	3,446	1,200	7,861
		High Risk, Low Density	0	NA	NA	NA
		Low Risk, High Density	11	91,923	44,348	169,498
		Low Risk, Low Density	0	NA	NA	NA
		Total	23	95,369	47,213	172,672
2	Dec 27 - Dec 29	High Risk, High Density	10	11,243	5,403	20,786
		High Risk, Low Density	0	NA	NA	NA
		Low Risk, High Density	6	471,226	182,731	1,005,649
		Low Risk, Low Density	0	NA	NA	NA
		Total	16	482,468	191,249	1,015,259
3	Dec 30 - Jan 5	High Risk, High Density	15	24,350	13,618	40,326
		High Risk, Low Density	0	NA	NA	NA
		Low Risk, High Density	9	137,290	47,331	315,165
		Low Risk, Low Density	0	NA	NA	NA
		Total	24	161,640	65,125	336,588
4	Jan 6 - Jan 12	High Risk, High Density	11	2,495	884	5,633
		High Risk, Low Density	7	3,877	1,173	9,606
		Low Risk, High Density	3	253,743	83,929	597,118
		Low Risk, Low Density	0	NA	NA	NA
		Total	21	260,115	88,351	602,494
5	Jan 17 - Jan 19	High Risk, High Density	8	3,705	901	10,339
		High Risk, Low Density	0	NA	NA	NA
		Low Risk, High Density	8	70,983	26,418	155,463
		Low Risk, Low Density	0	NA	NA	NA
		Total	16	74,688	29,116	158,855
6	Jan 23 - Jan 26	High Risk, High Density	11	1,909	578	4,729
		High Risk, Low Density	0	NA	NA	NA
		Low Risk, High Density	12	115,339	48,069	234,929
		Low Risk, Low Density	0	NA	NA	NA
		Total	23	117,248	49,561	236,597

Table 1: Abundance estimates by week. *No delta smelt were caught.

				Estimate and 95% CI		
Week	**Dates**	**Stratum**	**Num of Sites**	**Abundance**	**Lower Bound**	**Upper Bound**
7	Jan 30 - Feb 2	High Risk, High Density	6	1,066	148	3,854
		High Risk, Low Density	2	0*	NA	NA
		Low Risk, High Density	6	26,242	2,207	113,564
		Low Risk, Low Density	8	2,452	339	8,865
		Total	22	29,760	3,137	119,291
8	Feb 6 - Feb 9	High Risk, High Density	6	3,353	786	9,536
		High Risk, Low Density	7	0*	NA	NA
		Low Risk, High Density	7	63,500	17,316	166,766
		Low Risk, Low Density	6	19,038	6,958	42,172
		Total	26	85,891	31,819	188,657
9	Feb 10 - Feb 16	High Risk, High Density	10	680	94	2,458
		High Risk, Low Density	7	0*	NA	NA
		Low Risk, High Density	8	0*	NA	NA
		Low Risk, Low Density	10	9,556	3,386	21,572
		Total	35	10,236	3,847	22,278
10	Feb 21 - Feb 23	High Risk, High Density	7	0*	NA	NA
		High Risk, Low Density	3	0*	NA	NA
		Low Risk, High Density	4	17,552	2,432	63,414
		Low Risk, Low Density	8	20,129	7,354	44,596
		Total	22	37,681	12,488	88,569
11	Feb 24 - Mar 2	High Risk, High Density	6	0*	NA	NA
		High Risk, Low Density	14	865	89	3,493
		Low Risk, High Density	12	14,568	2,440	48,582
		Low Risk, Low Density	17	9,765	4,188	19,515
		Total	49	25,197	8,239	59,698

Tables 2 - 4 show various proportion estimates. In the captions HH, HL, LH, and LL are used to represent the "High Risk, High Density", "High Risk, Low Density", "Low Risk, High Density", and "Low Risk, Low Density" strata respectively, and $\hat{n}_{HH}$, $\hat{n}_{HL}$, $\hat{n}_{LH}$, and $\hat{n}_{LL}$ are used to represent abundance estimates in the indicated strata.

Table 2: Proportion of delta smelt in high density areas that are also in high risk areas, $\hat{p} = \frac{\hat{n}_{HH}}{\hat{n}_{HH}+\hat{n}_{LH}}$.

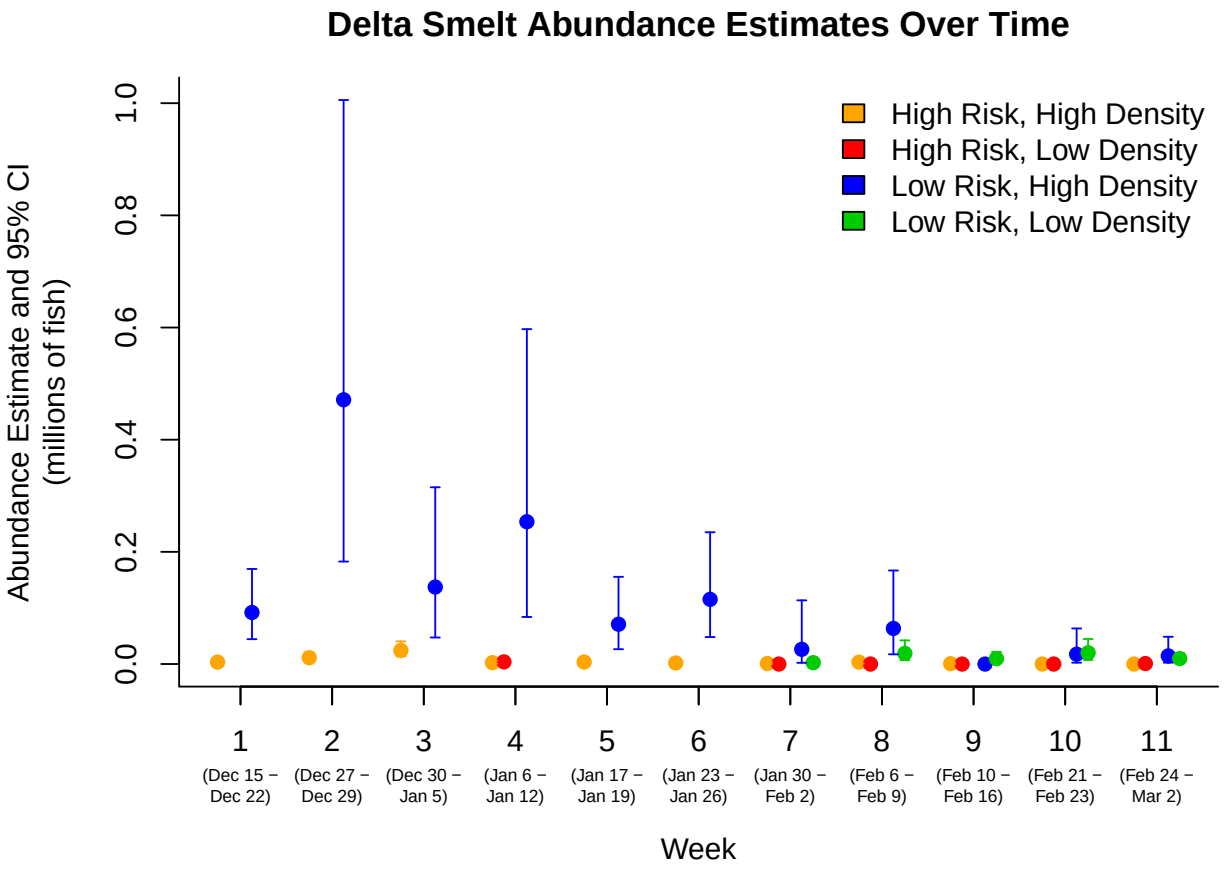
		Estimate and 95% CI		
Week	**Dates**	**Proportion**	**Lower Bound**	**Upper Bound**
1	Dec 15 - Dec 22	0.036	0.011	0.101
2	Dec 27 - Dec 29	0.023	0.008	0.068
3	Dec 30 - Jan 5	0.151	0.06	0.364
4	Jan 6 - Jan 12	0.010	0.003	0.037
5	Jan 17 - Jan 19	0.050	0.01	0.177
6	Jan 23 - Jan 26	0.016	0.004	0.055
7	Jan 30 - Feb 2	0.039	0.004	0.381
8	Feb 6 - Feb 9	0.050	0.009	0.215
9	Feb 10 - Feb 16	1.000	NA	NA
10	Feb 21 - Feb 23	0.000	NA	NA
11	Feb 24 - Mar 2	0.000	NA	NA

Table 3: Proportion of delta smelt in each stratum. For stratum i this is given by $\hat{p}_i = \frac{\hat{n}_i}{\hat{n}_{HH}+\hat{n}_{HL}+\hat{n}_{LH}+\hat{n}_{LL}}$. Weeks with one or more missing strata are omitted.

			Estimate and 95% CI		
Week	**Dates**	**Stratum**	**Proportion**	**Lower Bound**	**Upper Bound**
7	Jan 30 - Feb 2	High Risk, High Density	0.036	0.003	0.329
		High Risk, Low Density	0	NA	NA
		Low Risk, High Density	0.882	0.345	0.984
		Low Risk, Low Density	0.082	0.008	0.561
8	Feb 6 - Feb 9	High Risk, High Density	0.039	0.008	0.149
		High Risk, Low Density	0	NA	NA
		Low Risk, High Density	0.739	0.395	0.913
		Low Risk, Low Density	0.222	0.068	0.55
9	Feb 10 - Feb 16	High Risk, High Density	0.066	0.009	0.269
		High Risk, Low Density	0	NA	NA
		Low Risk, High Density	0	NA	NA
		Low Risk, Low Density	0.934	0.731	0.991
10	Feb 21 - Feb 23	High Risk, High Density	0	NA	NA
		High Risk, Low Density	0	NA	NA
		Low Risk, High Density	0.466	0.096	0.815
		Low Risk, Low Density	0.534	0.185	0.904
11	Feb 24 - Mar 2	High Risk, High Density	0	NA	NA
		High Risk, Low Density	0.034	0.003	0.176
		Low Risk, High Density	0.578	0.172	0.853
		Low Risk, Low Density	0.388	0.131	0.796

Table 4: Proportion of delta smelt in high risk strata, $\hat{p} = \frac{\hat{n}_{HH}+\hat{n}_{HL}}{\hat{n}_{HH}+\hat{n}_{HL}+\hat{n}_{LH}+\hat{n}_{LL}}$. Weeks with one or more missing strata are omitted.

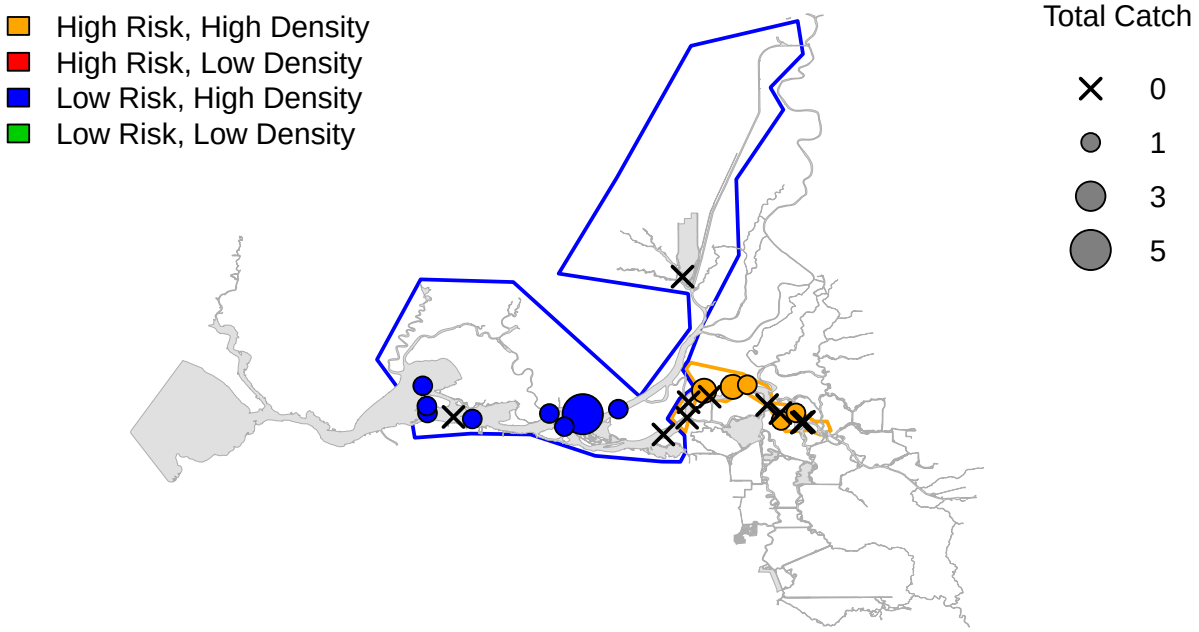
		Estimate and 95% CI		
Week	**Dates**	**Proportion**	**Lower Bound**	**Upper Bound**
7	Jan 30 - Feb 2	0.036	0.003	0.329
8	Feb 6 - Feb 9	0.039	0.008	0.149
9	Feb 10 - Feb 16	0.066	0.009	0.269
10	Feb 21 - Feb 23	0	NA	NA
11	Feb 24 - Mar 2	0.034	0.003	0.176


Delta Smelt Abundance Estimates Over Time
High Risk, High Density
High Risk, Low Density
Low Risk, High Density
Low Risk, Low Density
Abundance Estimate and 95% CI
(millions of fish)
0.0
0.2
0.4
0.6
0.8
1.0
1
(Dec 15 – Dec 22)
2
(Dec 27 – Dec 29)
3
(Dec 30 – Jan 5)
4
(Jan 6 – Jan 12)
5
(Jan 17 – Jan 19)
6
(Jan 23 – Jan 26)
7
(Jan 30 – Feb 2)
8
(Feb 6 – Feb 9)
9
(Feb 10 – Feb 16)
10
(Feb 21 – Feb 23)
11
(Feb 24 – Mar 2)
Week

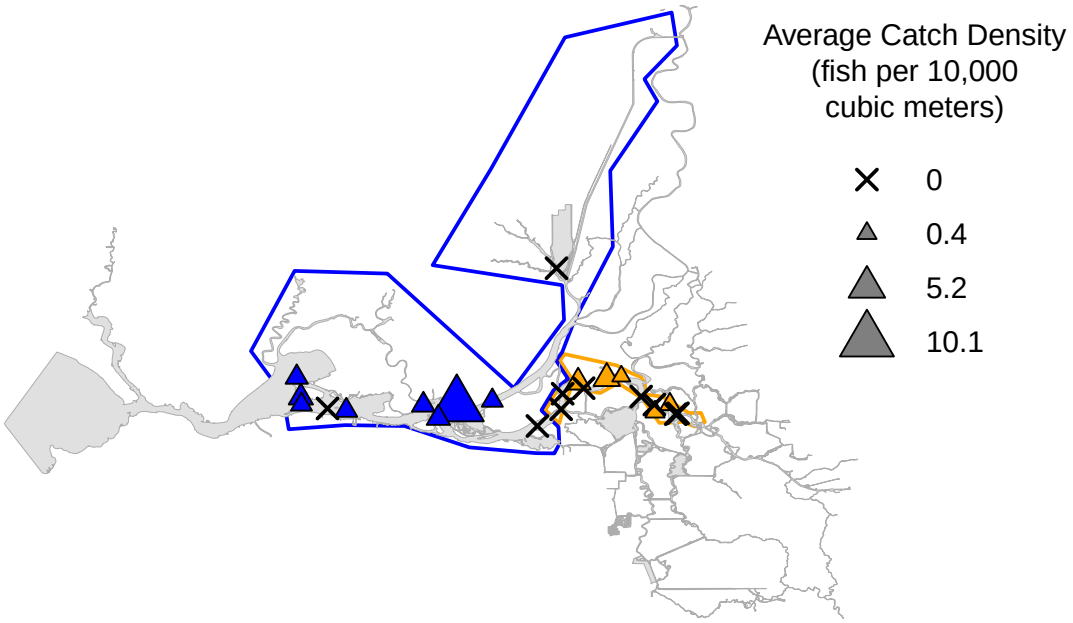
Week 1 (12/15/16 – 12/22/16)

23 sites; 19 Delta Smelt total

Delta Smelt Total Catch by Site



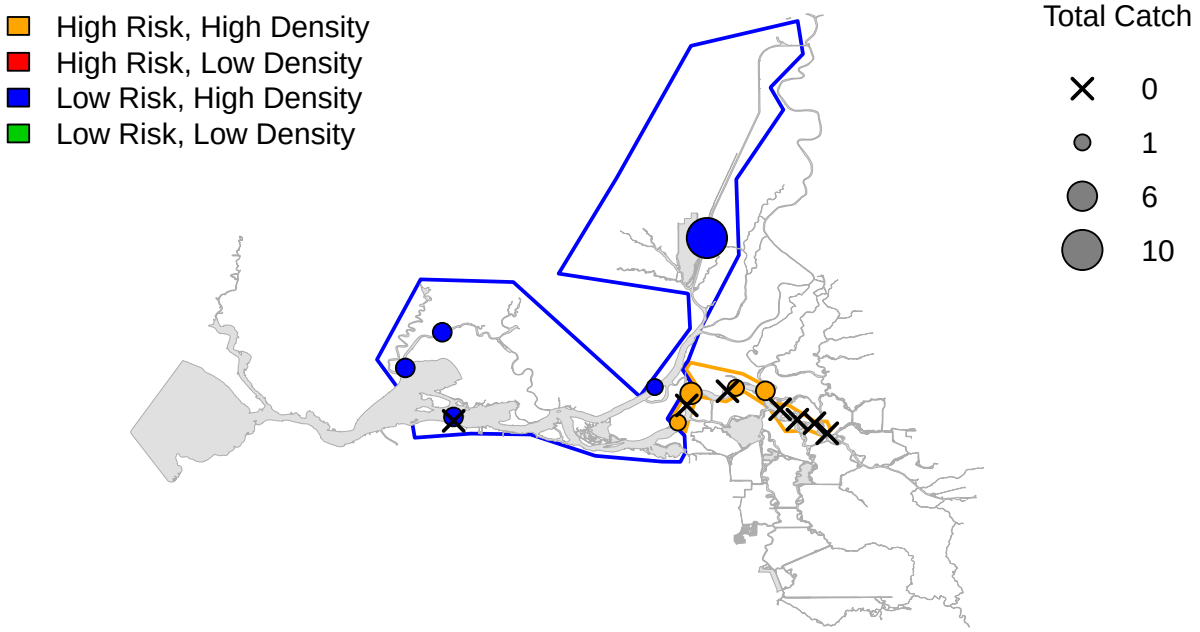
Delta Smelt Average Catch Density by Site



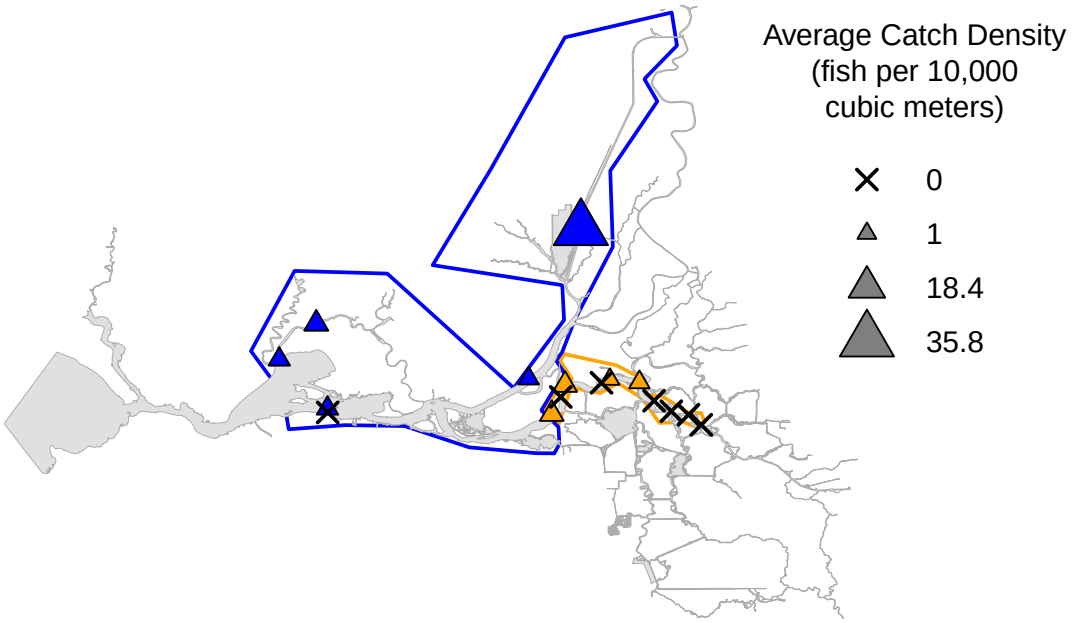
Week 2 (12/27/16 – 12/29/16)

16 sites; 24 Delta Smelt total

Delta Smelt Total Catch by Site



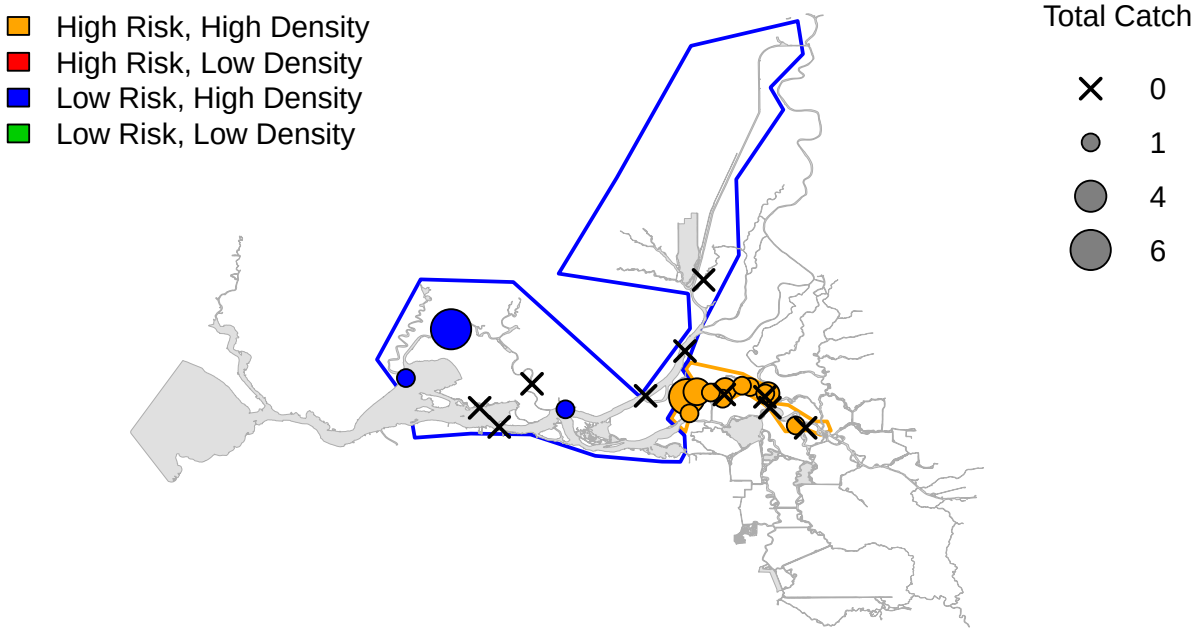
Delta Smelt Average Catch Density by Site



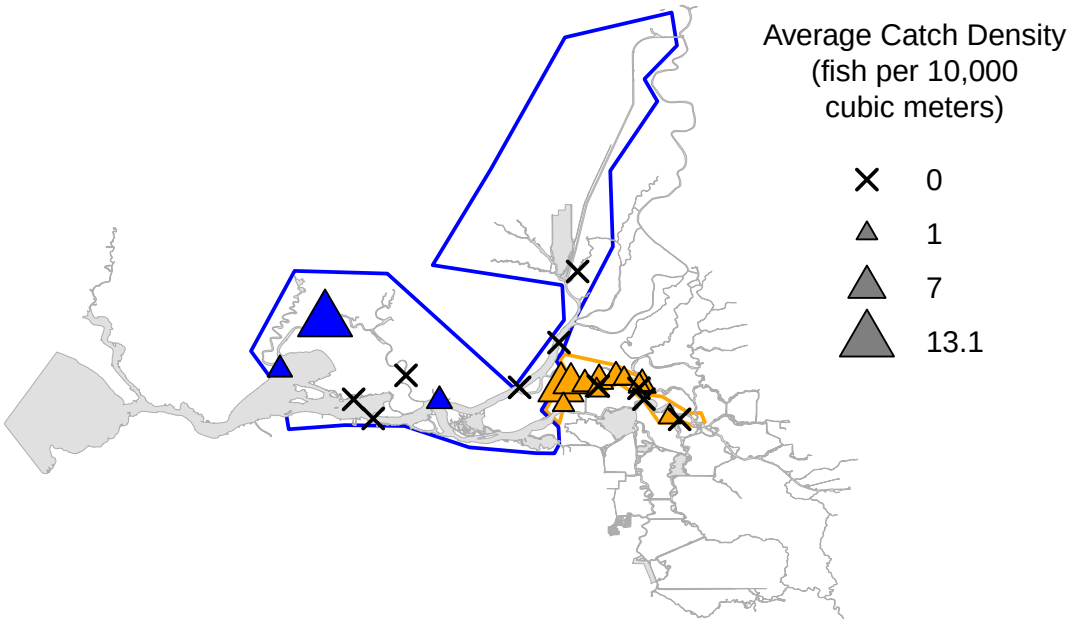
Week 3 (12/30/16 – 1/5/17)

24 sites; 27 Delta Smelt total

Delta Smelt Total Catch by Site



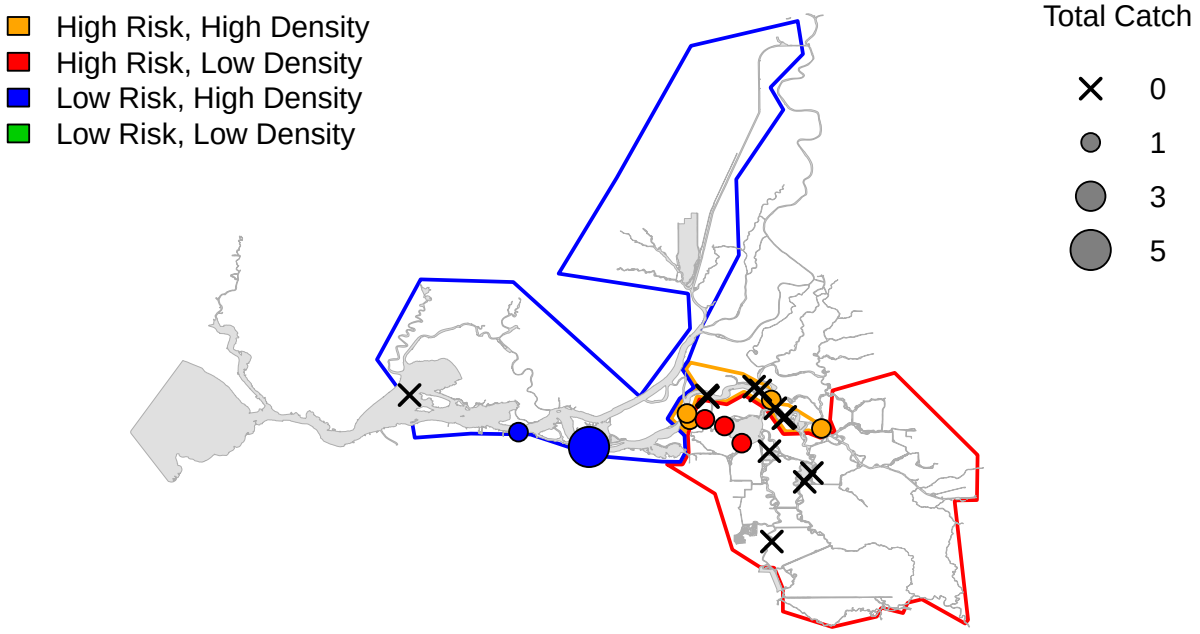
Delta Smelt Average Catch Density by Site



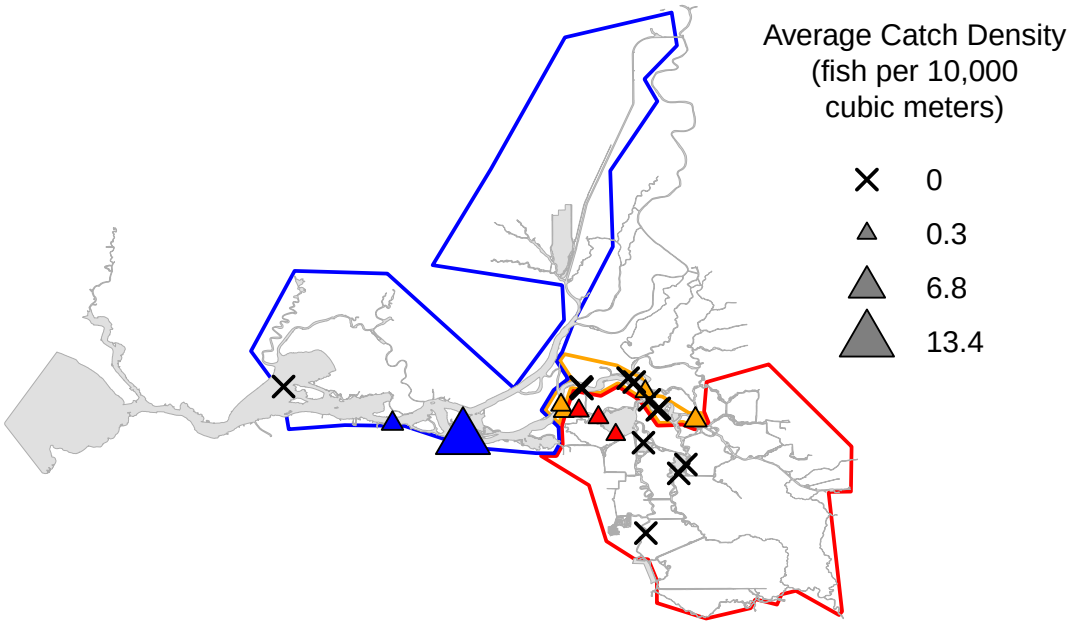
Week 4 (1/6/17 – 1/12/17)

21 sites; 13 Delta Smelt total

Delta Smelt Total Catch by Site



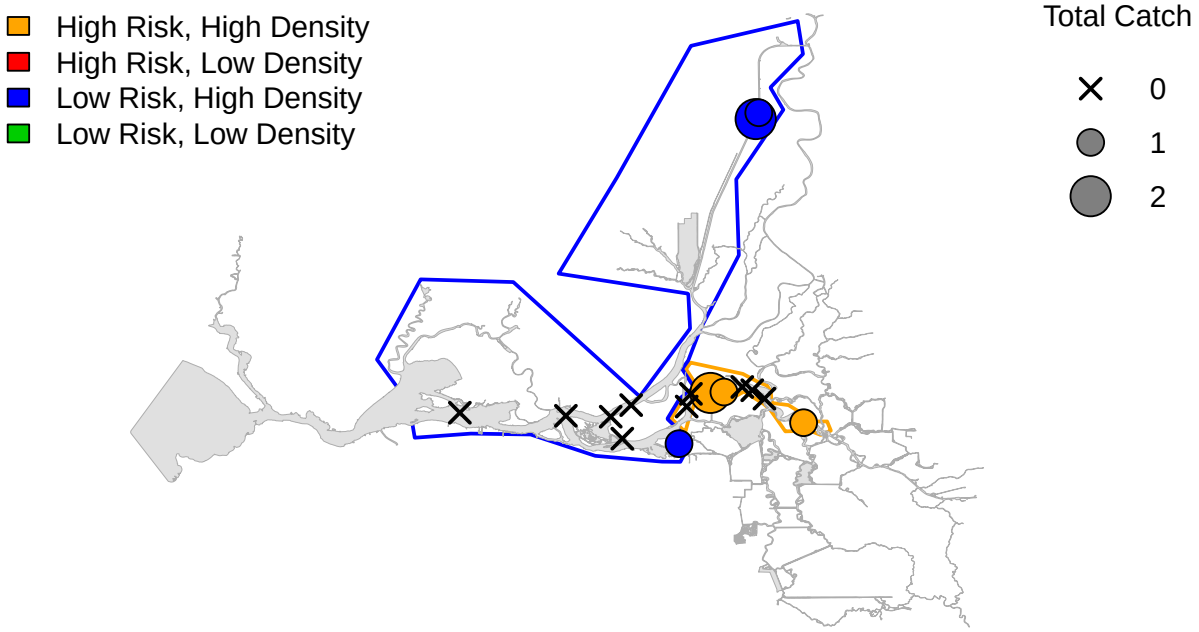
Delta Smelt Average Catch Density by Site



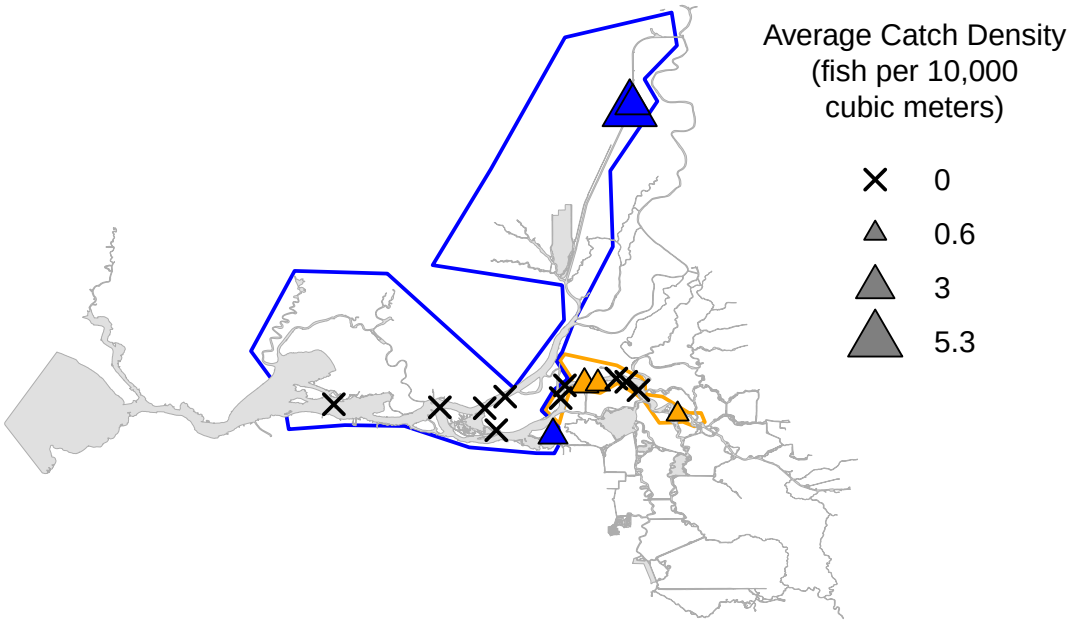
Week 5 (1/17/17 − 1/19/17)

16 sites; 8 Delta Smelt total

Delta Smelt Total Catch by Site



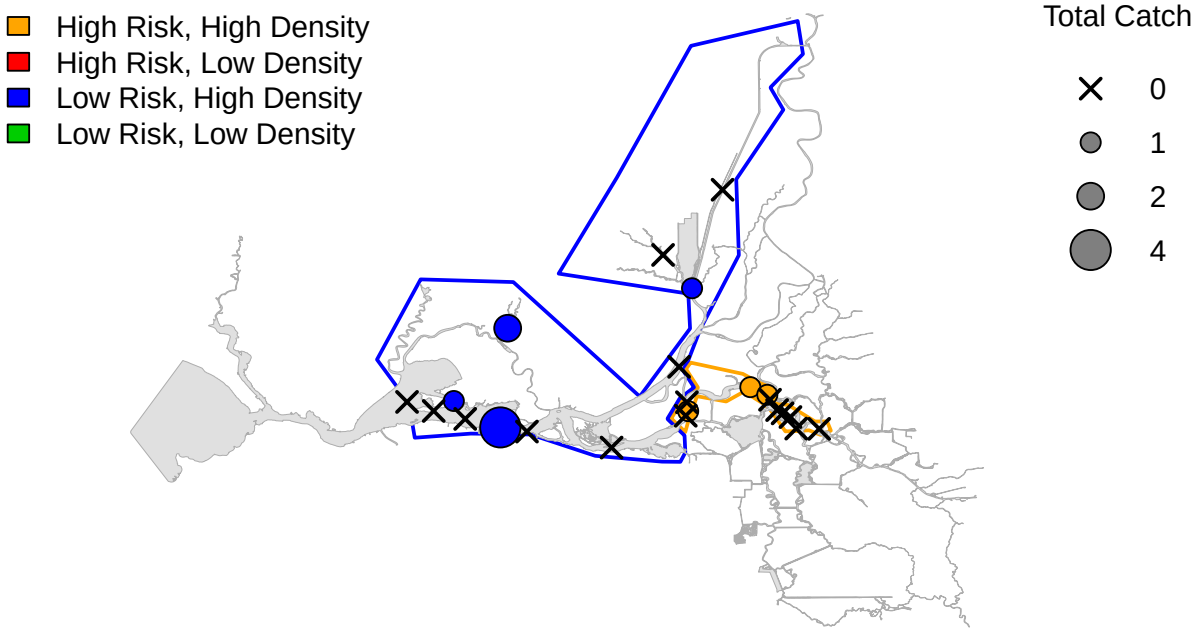
Delta Smelt Average Catch Density by Site



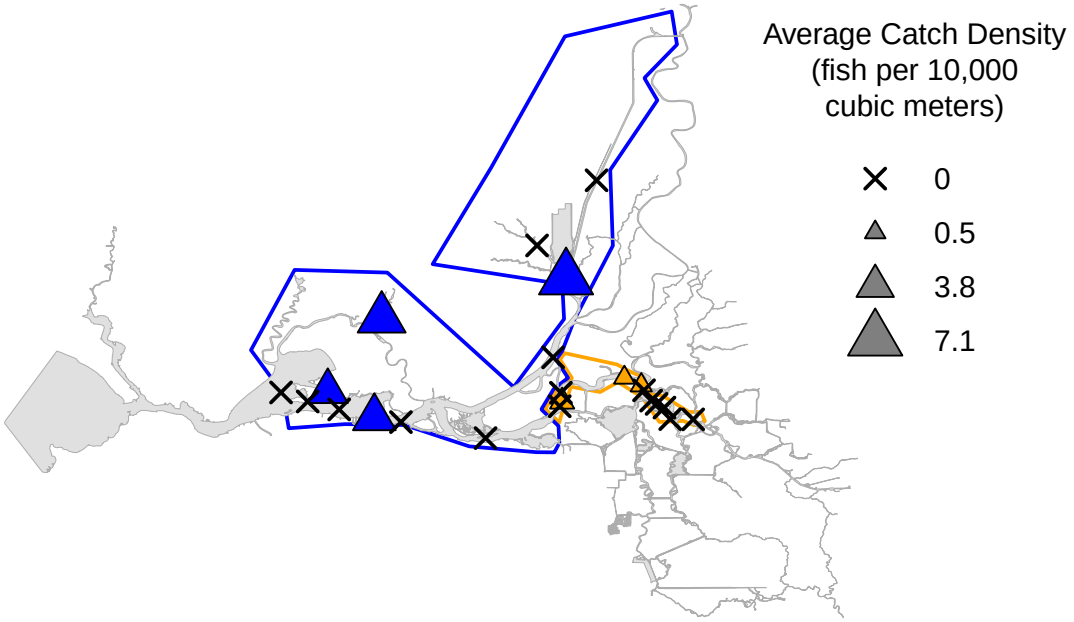
Week 6 (1/23/17 − 1/26/17)

23 sites; 11 Delta Smelt total

Delta Smelt Total Catch by Site



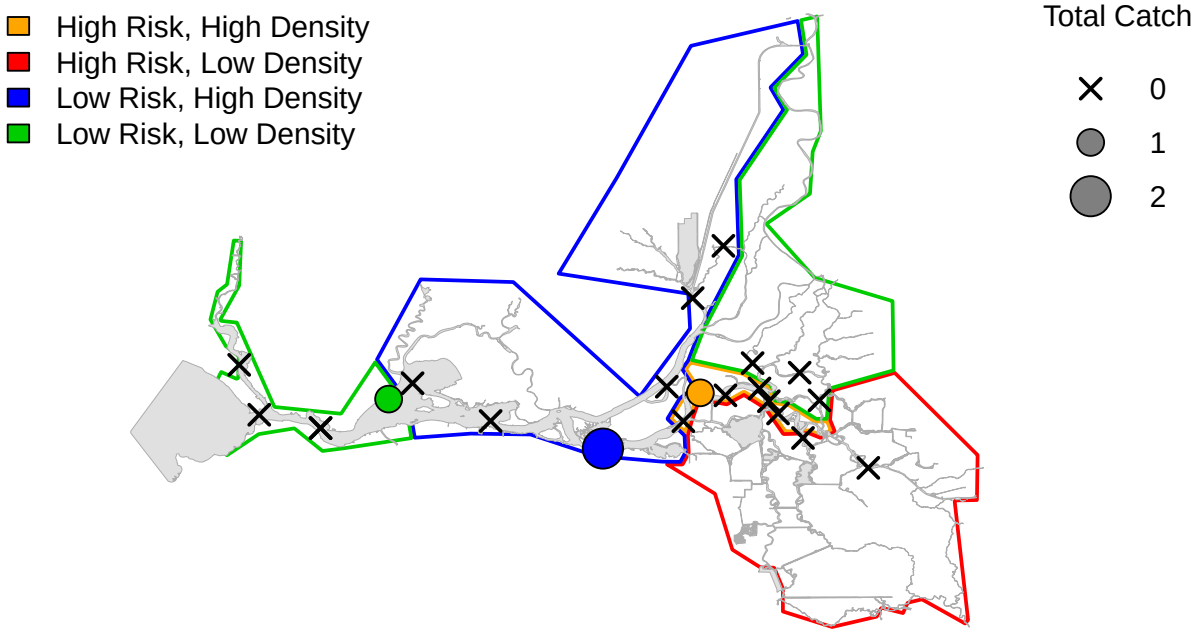
Delta Smelt Average Catch Density by Site



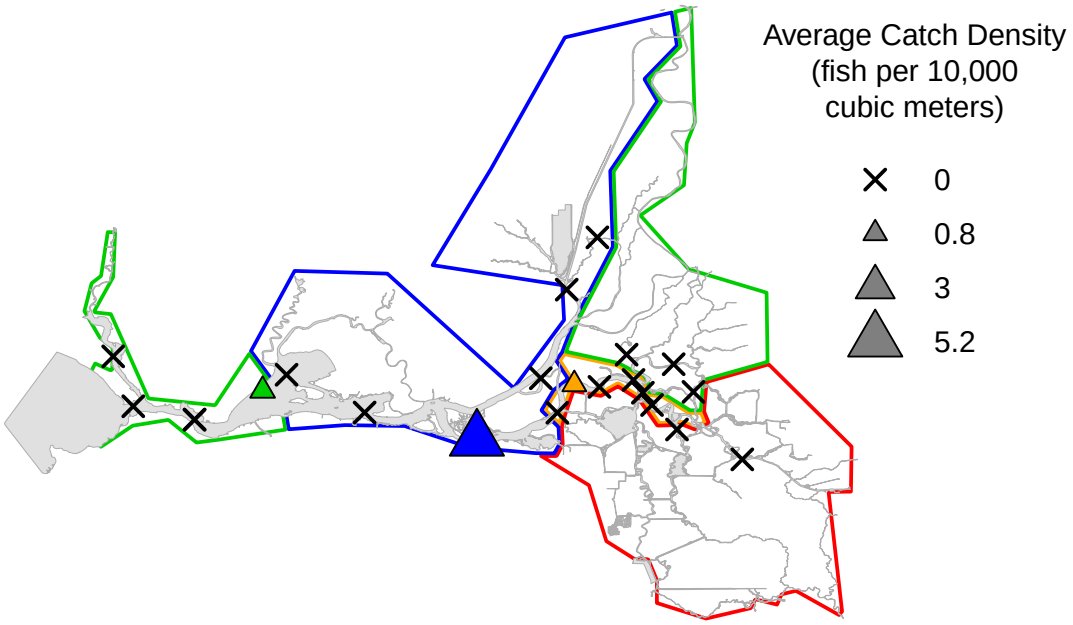
Week 7 (1/30/17 – 2/2/17)

22 sites; 4 Delta Smelt total

Delta Smelt Total Catch by Site



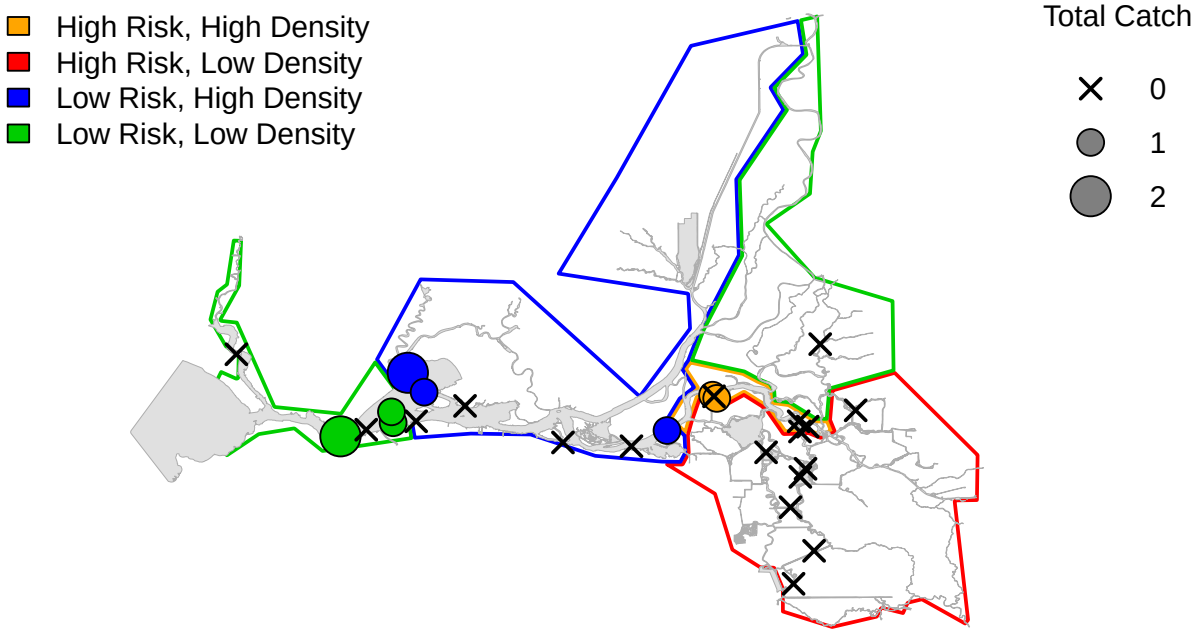
Delta Smelt Average Catch Density by Site



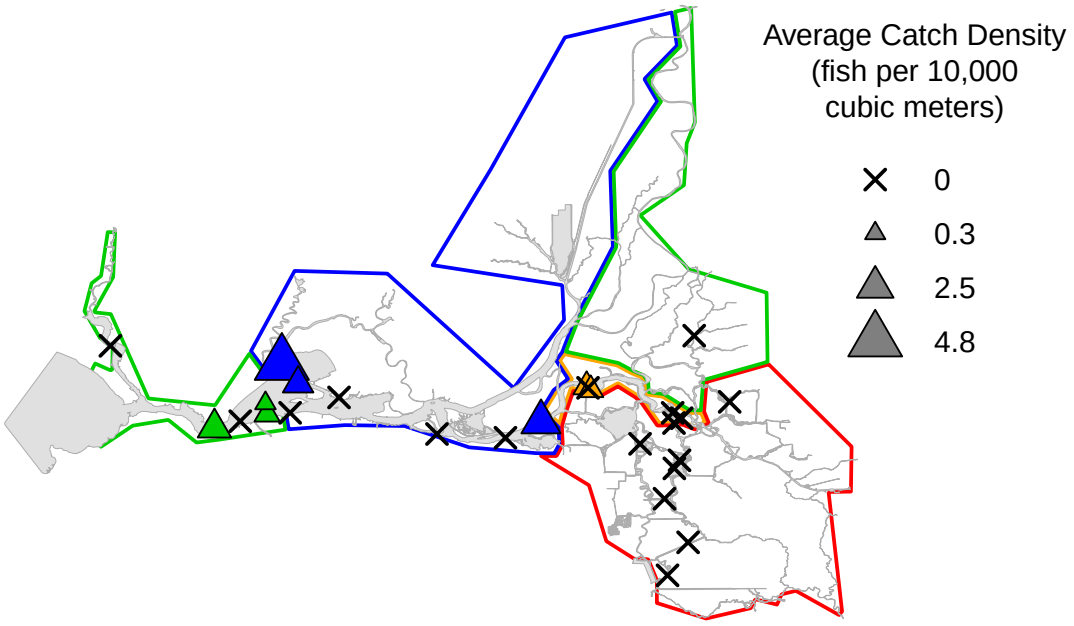
Week 8 (2/6/17 – 2/9/17)

26 sites; 10 Delta Smelt total

Delta Smelt Total Catch by Site



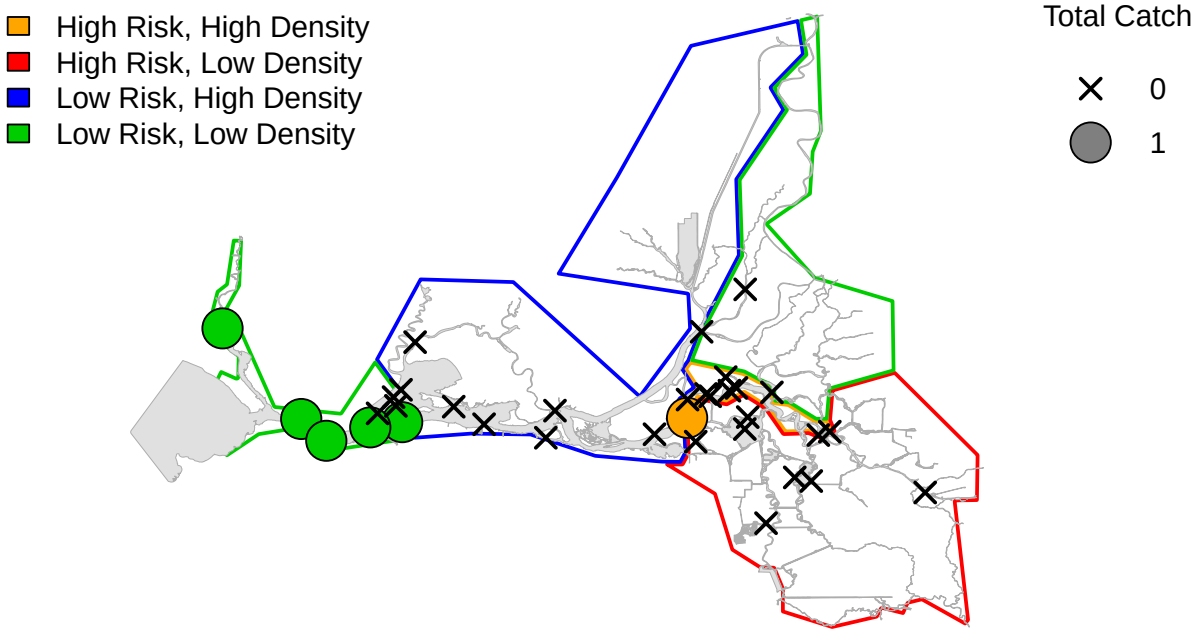
Delta Smelt Average Catch Density by Site



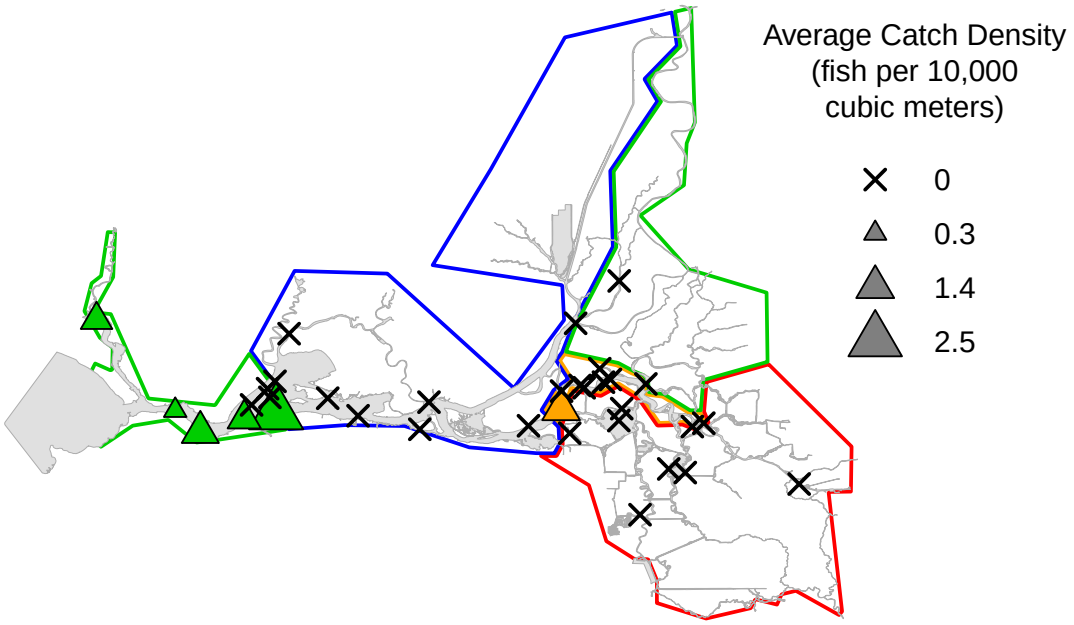
Week 9 (2/10/17 – 2/16/17)

34 sites; 6 Delta Smelt total

Delta Smelt Total Catch by Site



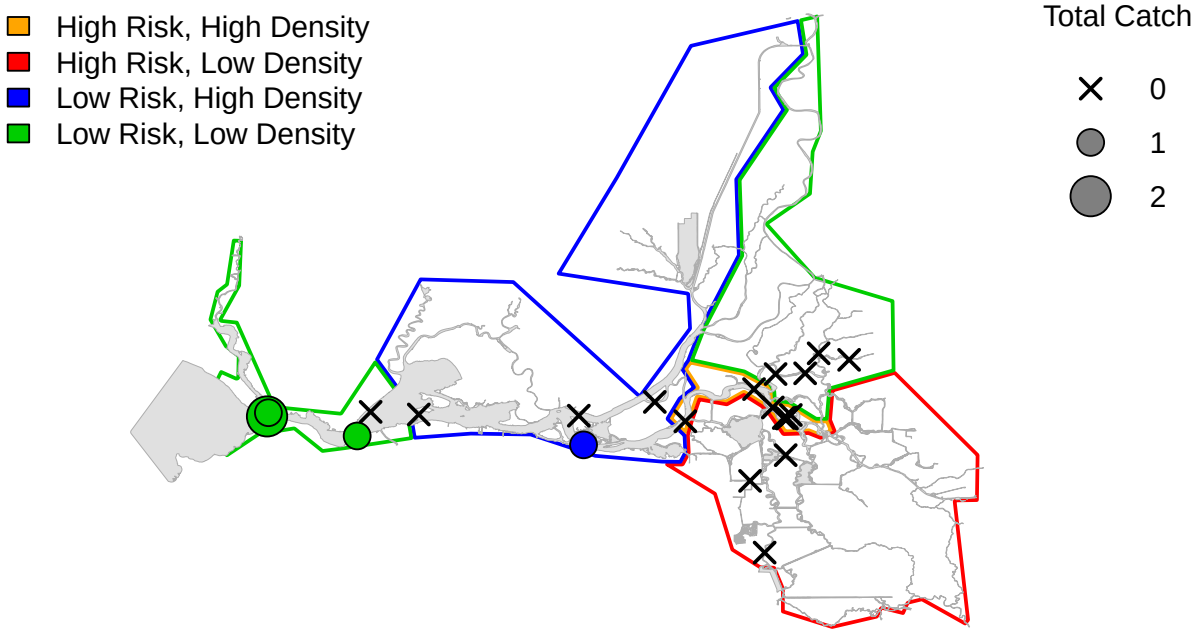
Delta Smelt Average Catch Density by Site



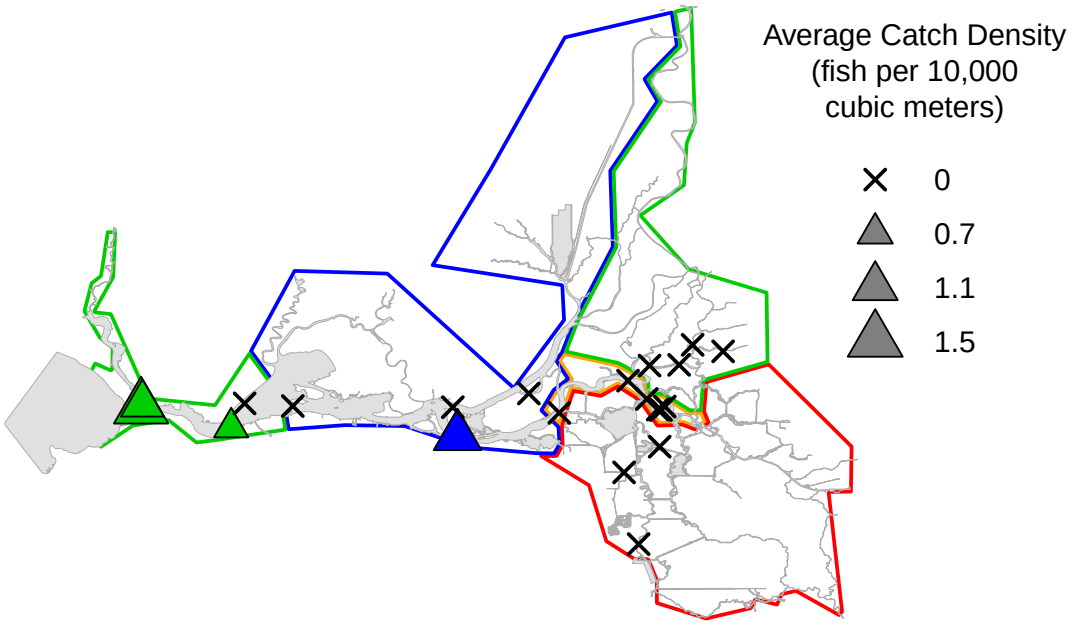
Week 10 (2/21/17 – 2/23/17)

23 sites; 5 Delta Smelt total

Delta Smelt Total Catch by Site



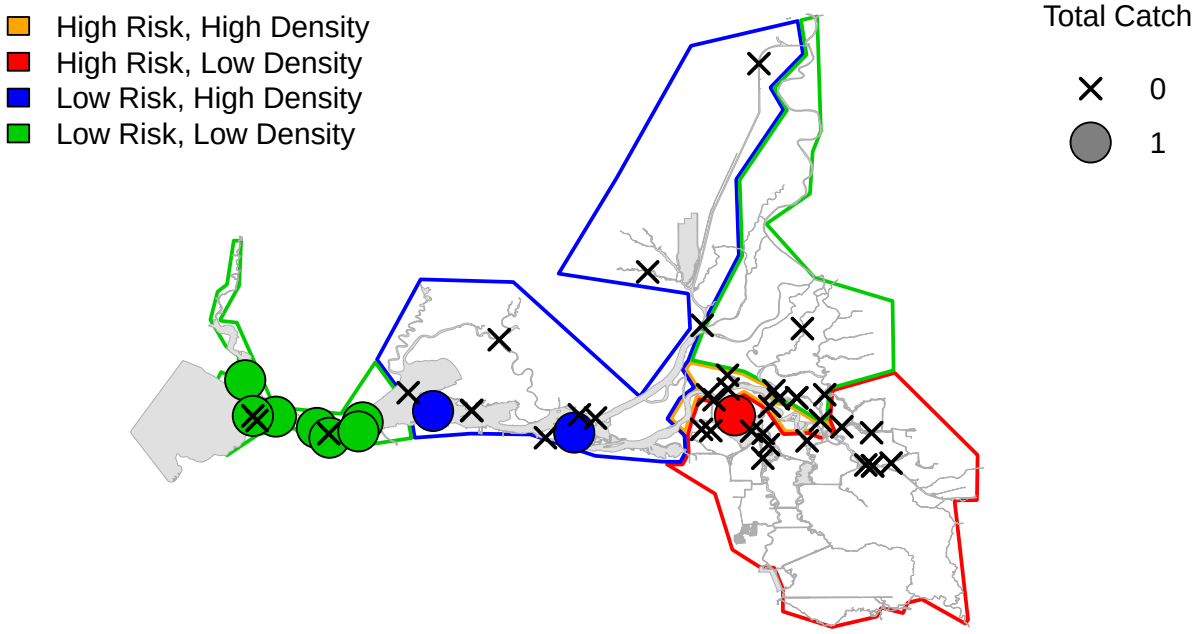
Delta Smelt Average Catch Density by Site



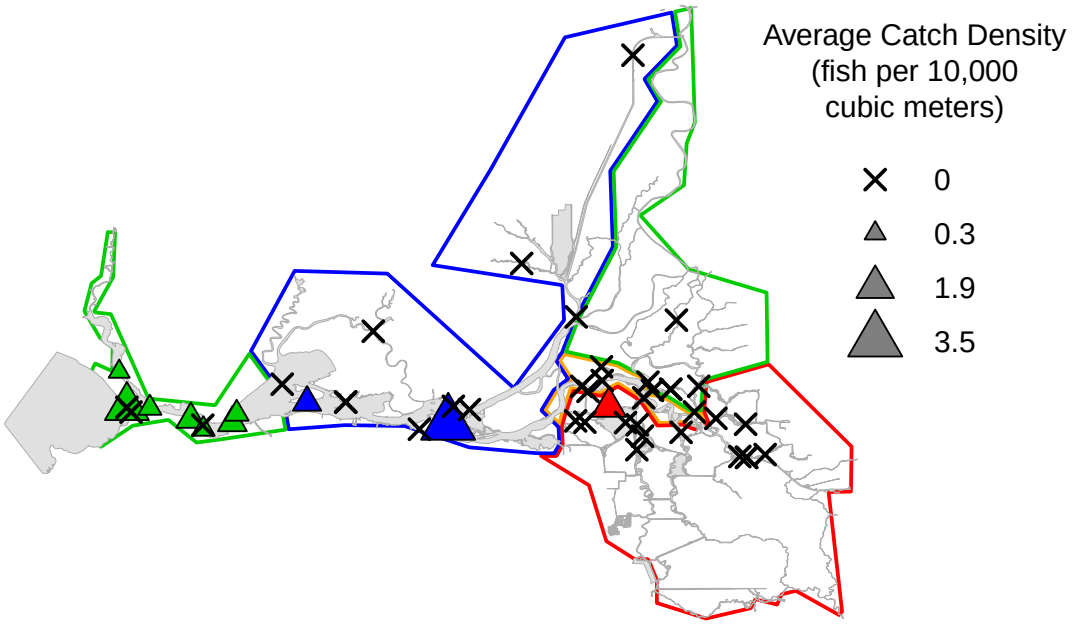
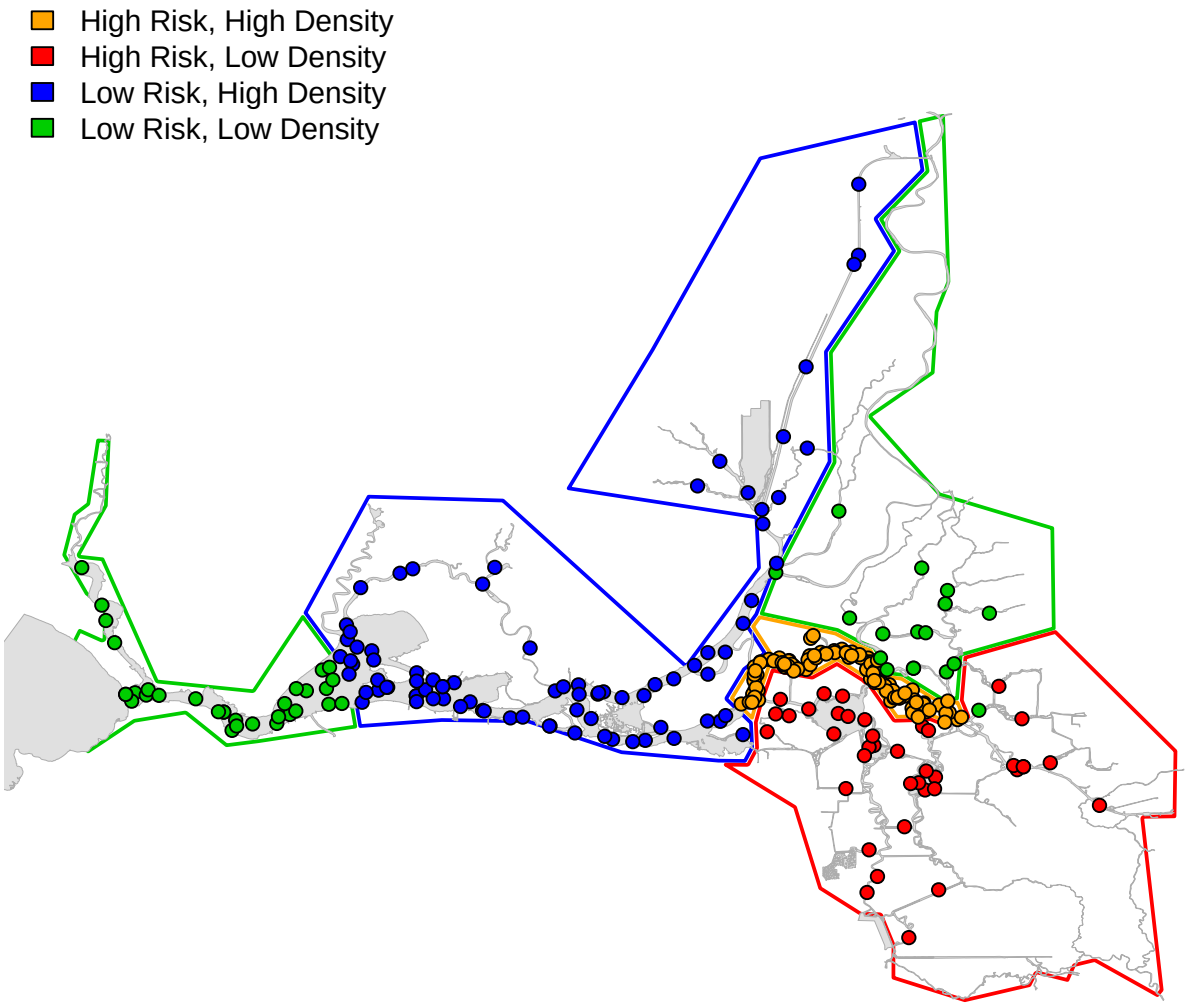
Week 11 (2/24/17 – 3/2/17)

48 sites; 10 Delta Smelt total

Delta Smelt Total Catch by Site



Delta Smelt Average Catch Density by Site



All Sampling Locations To Date