

## **Semi-Annual Report (Quarter 2, 2011)**

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### **Grant Number 2009-0215**

**Project Name:** Monitoring the Response of Fish Assemblages to Restoration in the South Bay Salt Ponds

#### **Project Goals:**

- (1) Document fish species and communities associated with newly restored salt marsh habitat.
- (2) Document fish species and communities associated with adjacent habitats (i.e. sloughs and creeks) within the South Bay Salt Pond (SBSP) complex
- (3) Develop indicators of sentinel species population health to assess the effects of the restoration.

#### **Project Activities during Quarter 1 2011**

This report covers the second quarter of 2011 (April-June 2011). Sampling took place May 6-9, 13<sup>th</sup> and the 20-21<sup>st</sup>. We were unable to sample during the month of April due to the American Fisheries Society meeting occurring during optimal tide conditions and illness. Due to wind conditions sampling occurred on several dates in May. We conducted additional minnow trapping efforts to locate appropriate mark-recapture study sites for goal 3. On Saturday May 8<sup>th</sup> we had Judy X aboard the RV Triakis at Bair Island for a day of photographing fish. We conducted angling studies at Eden Landing inside and outside Pond E9 and caught 3 leopard sharks inside pond E9 and released them into the ditch outside the pond. We began tagging studies on the sentinel species the longjaw mudsucker, marking a total of 112 individuals (56 at Alviso Slough, 9 at Outer Bair Island, 18 in Coyote Creek and 29 at SF2).

#### **Project Goals 1 and 2**

##### **Otter Trawls**

Replicate otter trawls were conducted in Alviso Slough, Coyote Creek, the Island Ponds (A19, A20, A21), Mt. Eden Creek, Old Alameda Creek, Steinburger Slough, outer Bair Island and Redwood Creek and SF2 (Figure 1).

Thus far we have collected 5087 fishes of 31 different species by otter trawl, a majority of which were native to the San Francisco Estuary. The Northern anchovy and three-spine stickleback

were the most common species found in each of the sites sampled with the otter trawl, however young of year Pacific herring abundance increase significantly in May becoming the most common fish in that sampling period (Figure 2, Table 2). Overall fish abundance was greater during the summer surveys (July and Aug), decreased in October, when water temperatures dropped below 20 °C, and reached a low in February and was low in May. Northern anchovy and three-spine stickleback were the most abundant species found throughout the South Bay during the fall-winter period with the recruitment of Pacific herring in May becoming the most abundant species. (Figure 2). In December the catches of many of the abundance fish species during summer declined and a suite of new species arrived, including Pacific herring, longfin smelt and two species of shad (Figure 3) In February, the winter clade of pelagic fish decreased in abundance and remained low into May suggesting these species have a very short seasonal use of the South Bay, likely utilizing the shallow sloughs for spawning.

Fish abundance continued to be greatest in Alviso Slough (Pacific herring, three-spine stickleback), while catches of Northern Anchovy were similar between Alviso and Bair Island sloughs. Eden Landing had the lowest catch of all species examined (Figure 4). Fish community composition within the Island Ponds (A19-21) was similar to adjacent sites in Coyote Creek, and did exhibit greater catches for several species, including pelagic seasonal species (e.g. Northern anchovy, Pacific herring) and pelagic resident species (e.g. three-spine stickleback and top smelt), and benthic resident fishes (staghorn sculpin, arrow goby and yellowfin goby).

## **Water Quality**

Water quality parameters varied across the survey months, with the lows in temperature, occurring in the Dec-Feb period, and highs occurring during the summer months (July-Aug) (Figure 6). Dissolved oxygen was lowest in the summer-fall months (July –October) and was lower for the Alviso site. (Figure 7). Salinity was overall highest in October and lowest in May, but significant differences were observed at the different restoration sites, with Alviso exhibiting the lowest salinities and Bair Island exhibiting the highest (Figure 8).

**Project Goal 3:** Develop indicators of sentinel species population health to assess the effects of the restoration.

Thus far we have collected 871 fishes from 8 different species via minnow and clover traps in the intertidal creeklets of the saltmarsh habitats. The longjaw mudsucker was the most common fish found in minnow and clover traps (Table 3). Longjaw mudsucker were most abundant at the Alviso Slough fringing marsh along pond A6, with the highest recorded in July (Figure 9). The abundance of longjaw mudsuckers declined in October along with declining water temperatures and the onset of breeding season. Catch declined to a low in February but in May we observed the recruitment of a new cohort (spring 2011) of mudsuckers to the minnow traps at all sites and the re-emergence of adults post spawning. This seasonal trend is similar to patterns found in marsh sites in Central and North San Francisco Bay and Tomales Bay.

During the May survey we increased our minnow trapping efforts at sites that had previously not been productive for longjaw mudsucker catch to determine if catch effort was necessary to

document the occurrence of mudsuckers and identify sites to conduct mark-recapture studies to estimate mortality. At outer Bair Island we sampled the north and south edges of the inner marsh along the burrow and at the two inner channels using a total of 47 traps. At Eden Landing we sampled the north-west corner of E9 along the tide gate channel and adjacent creeklets using a total of 68 traps. We also sampled the island ponds A19-21 along the borrow ditches and on the marsh surface in A21 using a total of 45 traps. Lastly the two sites that have consistently produced mudsuckers Alviso Slough at A6 and the otter pickleweed marsh of SF2 were sampled using the standard 15 traps. Catch was highest at the Alviso Slough site averaging ~3.5 fish per trap, while SF2 was the second highest just shy of 2 fish per trap. At outer Bair Island we captured a total of 9 fish for 47 traps all but two being new recruits and at Eden Landing we captured only 1 juvenile mudsucker (Figure 10). During the May survey we marked a total of 112 longjaw mudsuckers, the smallest being 44-mm SL (Table 4).

### **Population Health**

One metric of population health is the balance between males and females in the population. Many of the emerging contaminants in estuarine systems act as hormone analogs and have been shown to cause intersex in fishes. The longjaw mudsucker is sexually dimorphic, with males have much longer upper maxilla, extended well past the operculum, and females have a shorter jaw and the anal pore is V-shaped as opposed to U-shaped in males. Sex ratios of females to males was slanted towards females with a 2:1 ratio at Alviso Slough and at the island ponds during the May survey. In this species males tend to guard nests and thus this behavior may explain the skewed sex ratio (Figure 11A). The number of juveniles relative to adults in a population can also be used as an index of population health. A ratio of 1 would indicate that there exists enough juveniles in a population to replace the adult population. Ratios for three of the four sites monitored in May were near or above 1, with Bair Island having a recruitment index much greater than 1. However we did only collect 9 individuals. The island ponds had the second highest index of 1.1 and then SF2 with an index of 0.93. Alviso slough had the lowest recruitment index (0.75), but were also the most abundant overall. The longjaw mudsucker has two spawning periods (Feb-March and August-September), thus an index above 0.5 may still indicate adequate recruitment if a second cohort of fish is successfully spawned.

### **Hook and Line Sampling**

Hook and line angling surveys were conducted at intermittently during the May survey. Surveys took place in Coyote Creek at Ponds A19-21 outlets and in Corkscrew Slough adjacent to the recently breached outer Bair Island outlet, however no fish were caught. At Eden Landing angling was conducted outside pond E9 along Old Alameda Creek, and within pond E9. Outside E9 we collected 4 bat rays (54-76cm TL) for two anglers and three angling hours. Inside we captured 3 leopard sharks (44-56 cmTL) for two anglers and one hour effort. All leopard sharks were released on the bay side of the tide gate at the corner of E9.

## **Progress Toward Milestones**

Thus far we have completed the first 6 surveys. The monitoring of A8 began in May and a baseline of fish abundance was collected using a new scaled down version of the otter trawl and gill nets. We have successfully provided another quarterly report to the Resource Legacy Fund and the South Bay Salt Pond Restoration Program and have given presentations at the Calfed-Delta Science Program Conference in Oct 2010; South Bay Salt Pond Restoration annual meeting in February of 2011 and the California-Nevada Chapter of the American Fisheries Society in Folsom Ca. March 31-April 2, where our student intern won best student poster and took 3<sup>rd</sup> place in the oral presentations.

## **Environmental Outcomes.**

May salinities were very low throughout the restoration sites, likely due to the extremely wet spring. Low salinity may have been the likely cause for the observations of dead leopard sharks in the area. We did not encounter any dead or moribund leopard sharks during our survey. We also collected a striped bass poaching rig in Coyote Creek and reported the finding to Fish and Game and the Park Ranger.

## **Problems encountered and resolutions.**

Due to scheduling conflicts with the AFS meeting and then subsequent illnesses of the crew we were not able to sample in April during our normally scheduled trip. We captured two voles in our minnow traps at SF2. Both were dead. We will need to modify our schedule to prevent traps being exposed, allowing terrestrial organisms to become trapped and then drowned by the incoming tide. If this problem persists we may terminate minnow trapping at SF2. Finding a site outside of Alviso Slough for the mark-recapture study has thus far not produced results.

## **Activities planned for next quarter.**

Next sampling period will be June 16-19th. We will spend a whole day at Eden Landings E9 sampling for leopard sharks. Any sharks captured will be tagged with a floy style plastic T-bar tag and released outside the pond.

## **Conclusion:**

Fish abundance overall remains low with the unseasonal weather. We anticipate this will change with the next survey. Recruitment of Pacific herring was prevalent throughout the restoration sites during the May survey. Longjaw mudsuckers continue to be in very low abundance at outer Bair Island, however we did capture 9 in May. Eden landing also was very low in abundance. We plan to continue monitoring these sites in June.

## Figures



Figure 1: Satellite imagery showing the location of otter trawl stations in the South Bay.

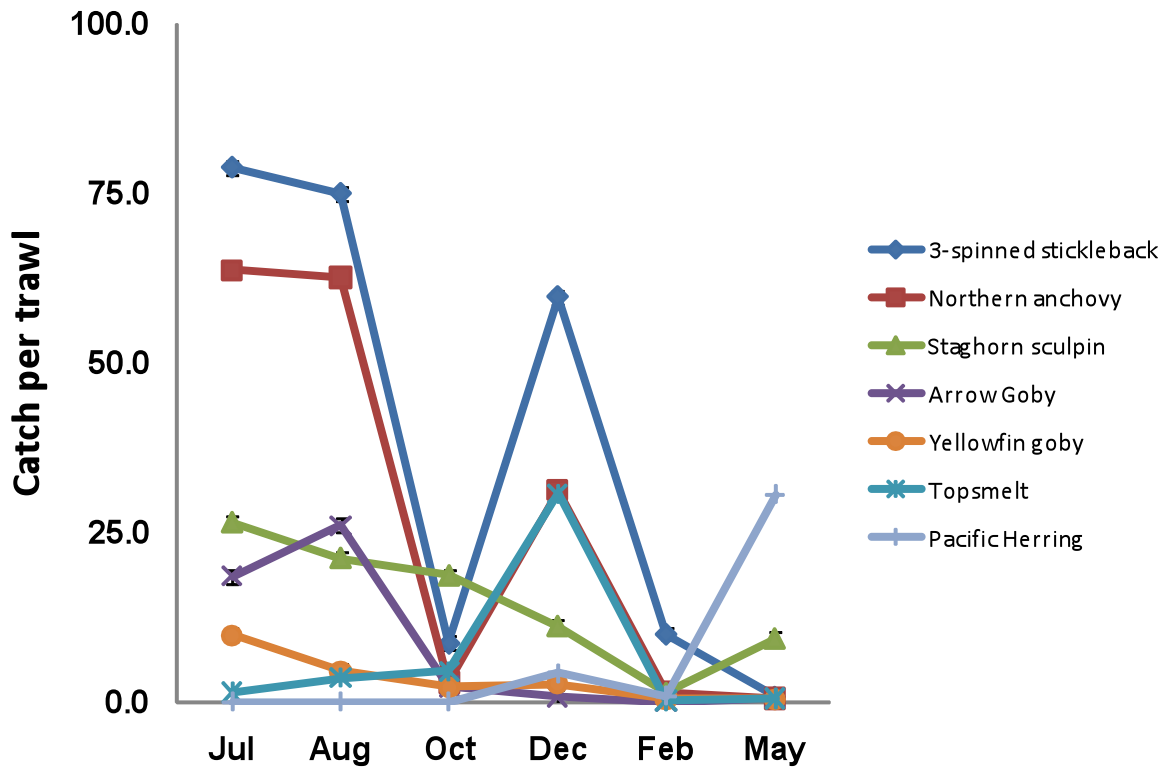


Figure 2: Mean Catch per trawl for the most abundant fish species from all sites across the 8 months of the year 1 survey.

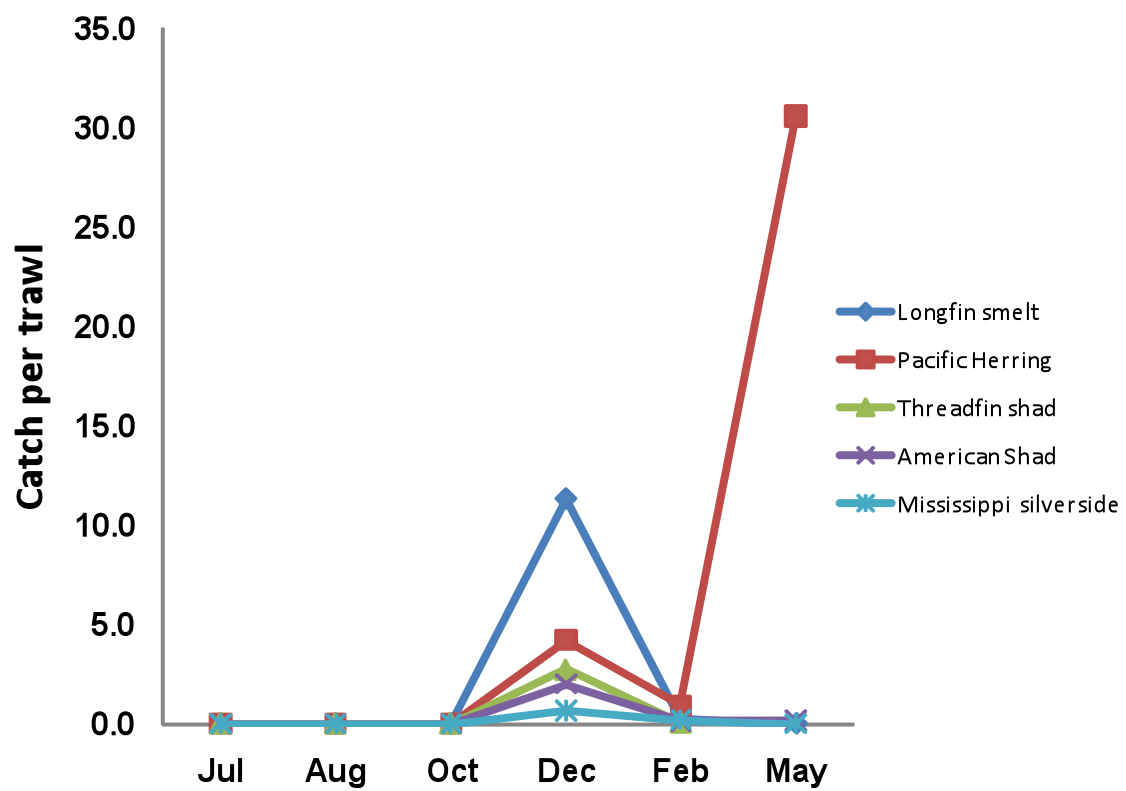


Figure 3: Mean catch per trawl of the winter fish assemblage from all sites

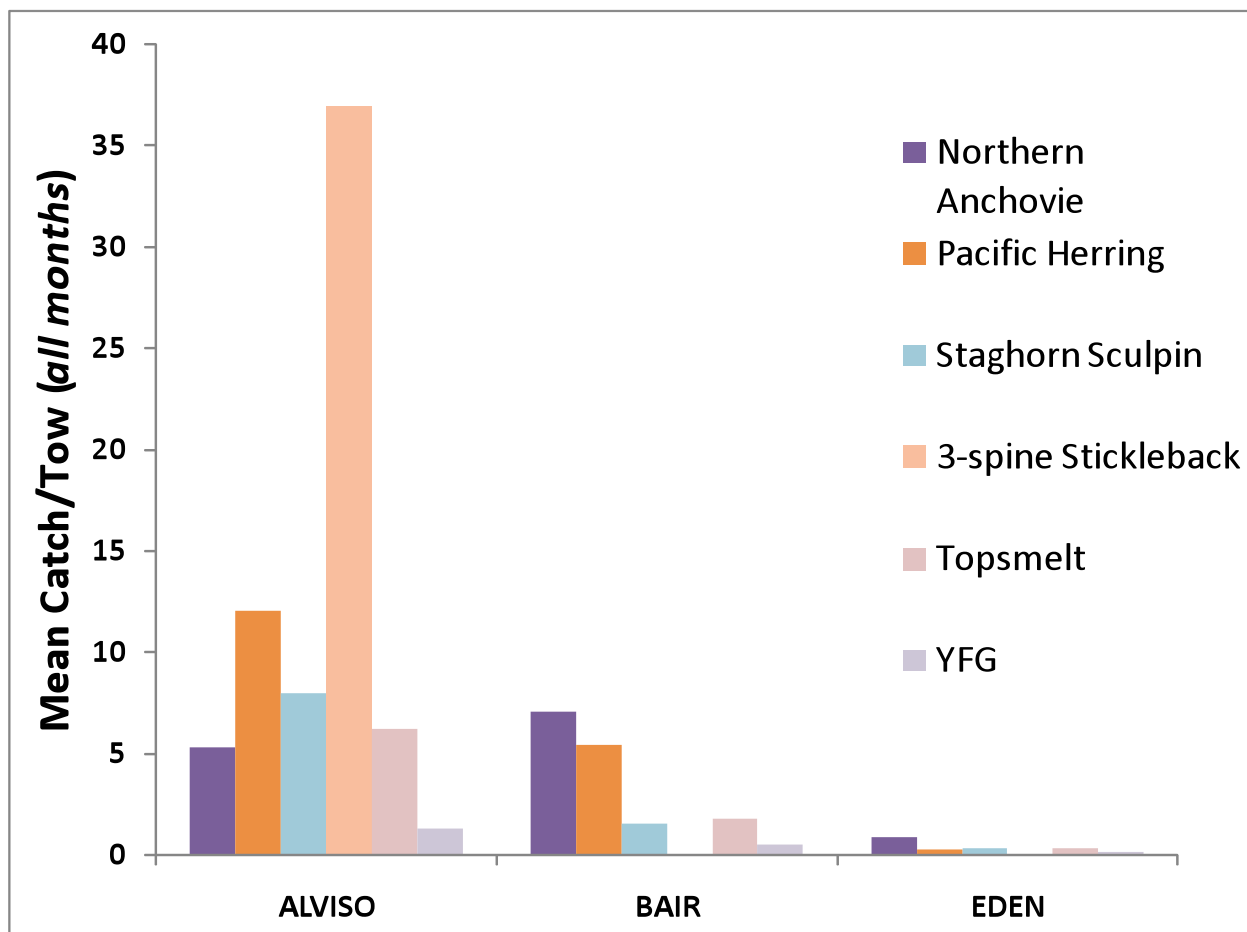


Figure 4: Mean catch per trawl (all months) of the six most abundant fish species at the three South Bay Salt Pond Restoration Program sites.



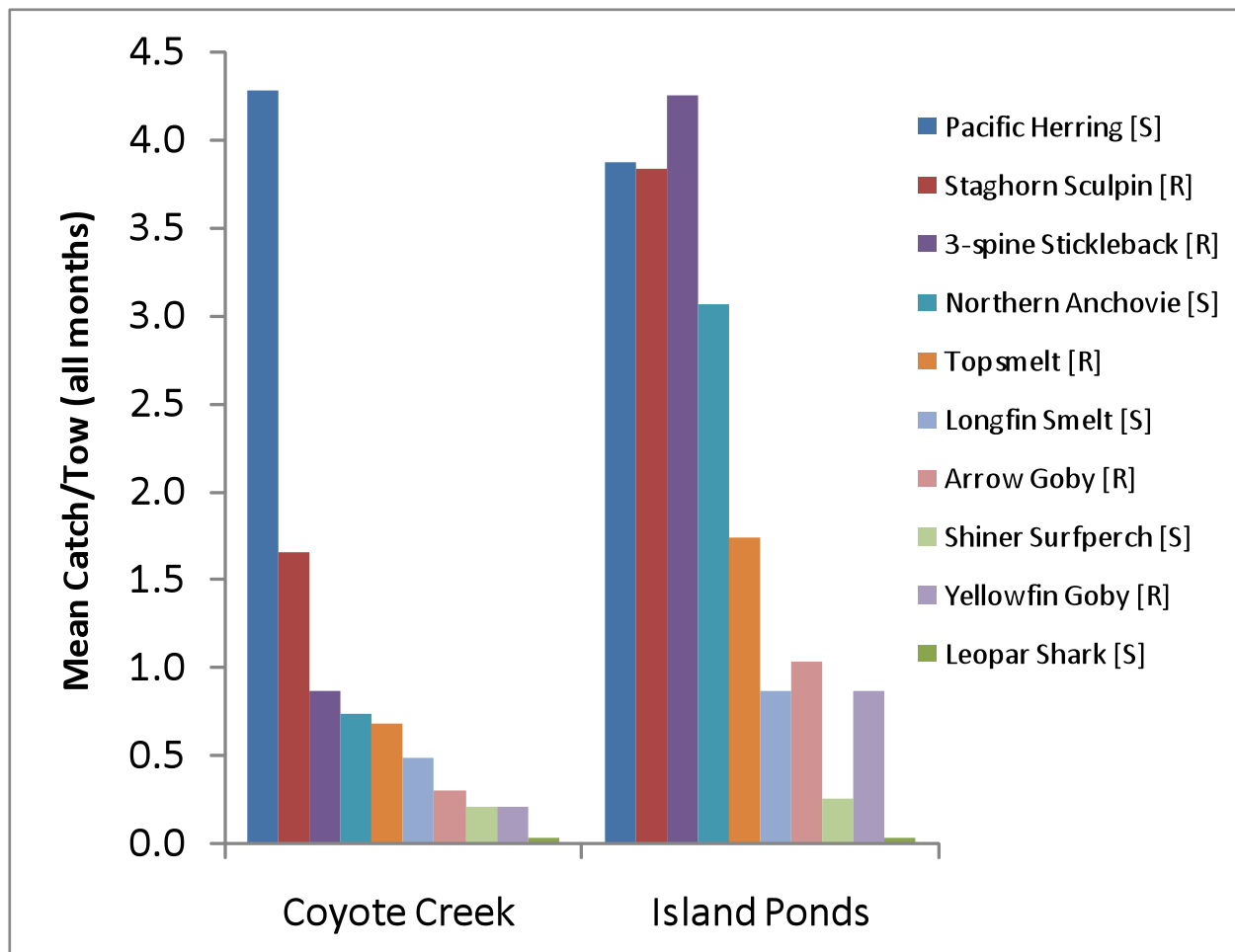


Figure 5: Mean catch per trawl of the top 5 species captured within the island ponds (A19-A21) and in adjacent trawls within Coyote Creek.

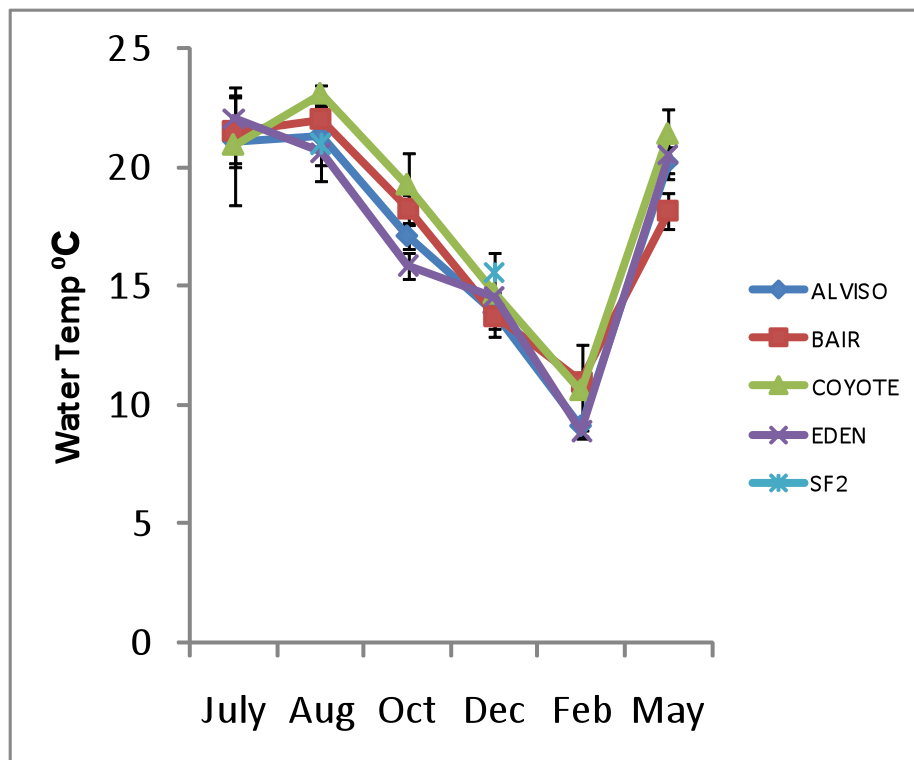


Figure 6: Mean monthly water temperature from slough sites. Error bars are 1 standard deviation.

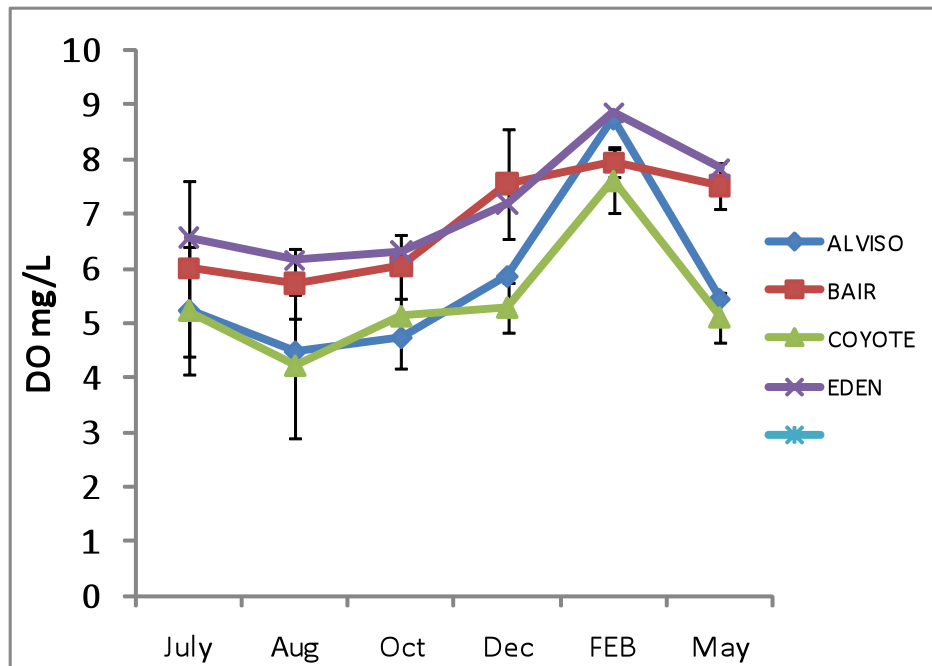


Figure 7: Mean monthly dissolved oxygen from slough sites. Error bars are 1 standard deviation.

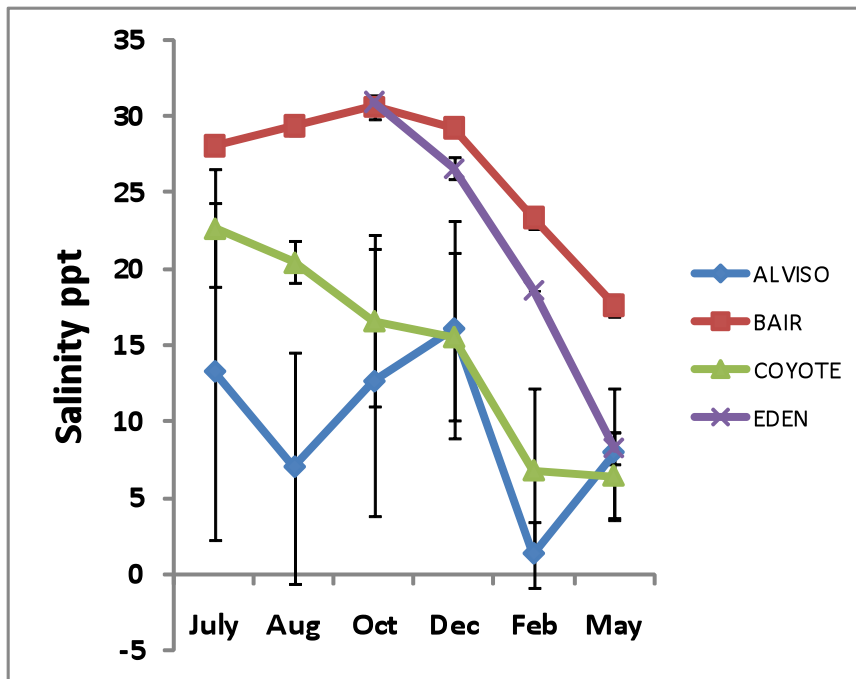


Figure 8: Mean monthly salinity from slough sites. Error bars are 1 standard deviation.

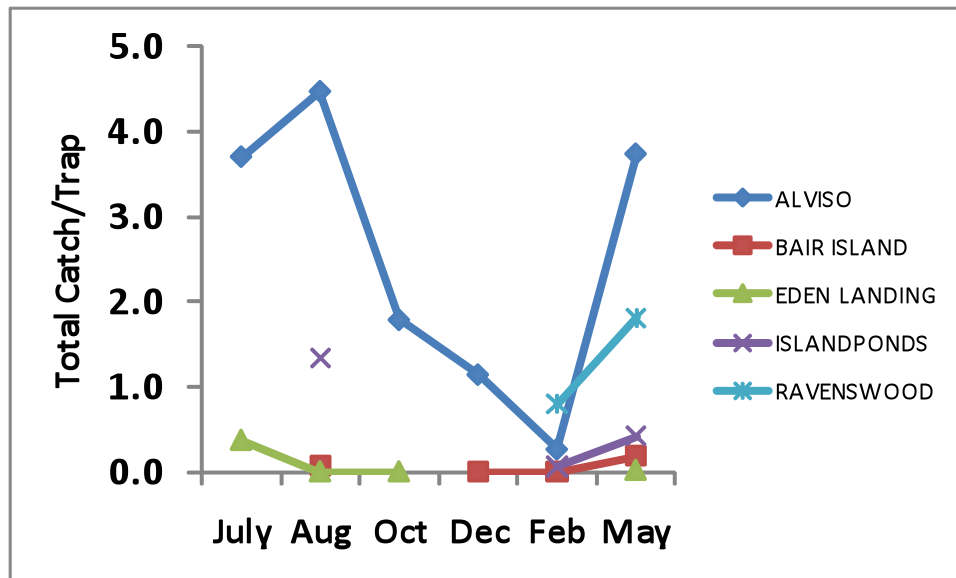


Figure 9: Total catch per minnow trap of the sentinel species longjaw mudsucker (*Gillichthys mirabilis*) in pickleweed marsh habitats adjacent to trawl sites.

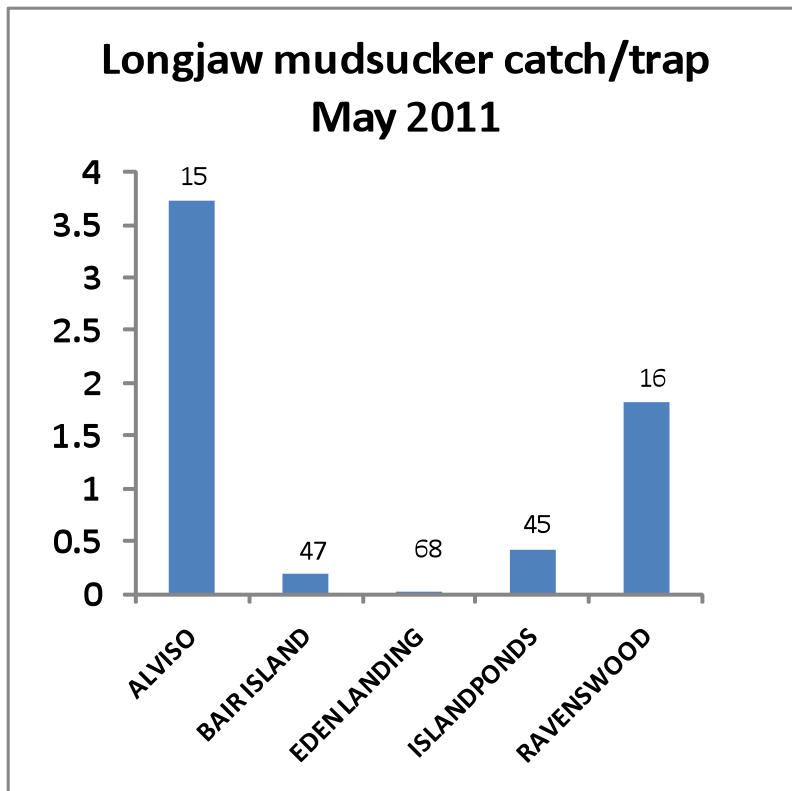


Figure 10: Catch per trap of sentinel species longjaw mudsucker (*Gillichthys mirabilis*) during the extended trapping efforts in May 2011. Note numbers above bars are the number of traps set at each location.

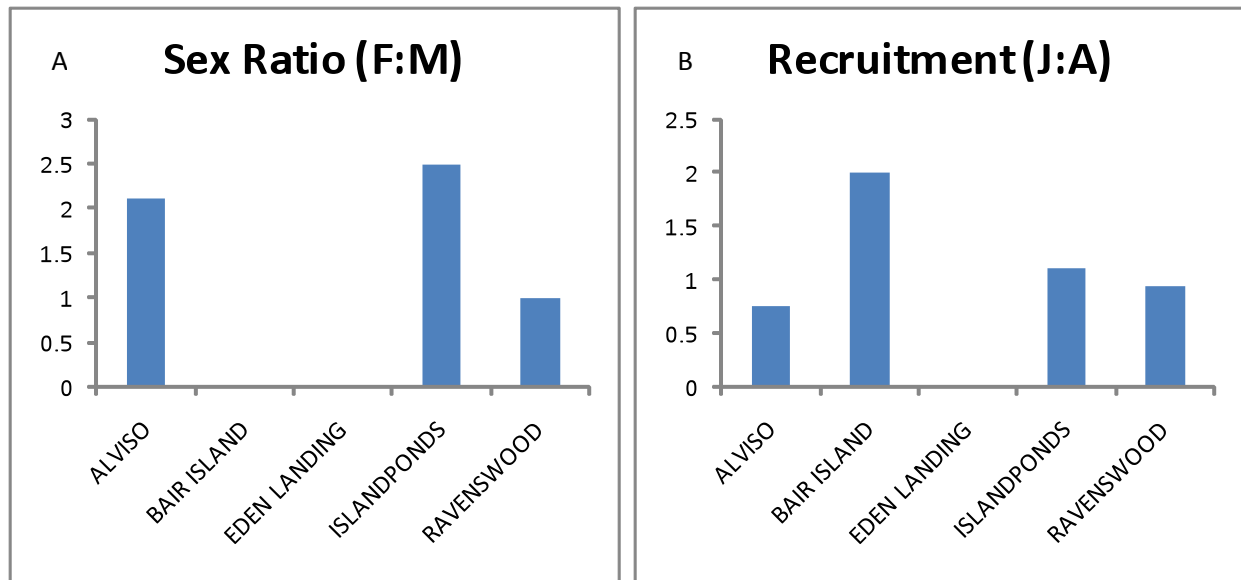


Figure 11. A. The ratio of male to female adult longjaw mudsucker at each location during the May survey. B. The ratio of juveniles (<80mm) to adults at each location in the May survey.

			CY 2010						Calendar Year CY2011											
			Qtr 3			Qtr 4			Qtr 1			Qtr 2			Qtr 3			Qtr 4		
I	Main Workplan Sites & Actions		J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
A	Alviso Complex																			
	Pond A6	To be Fully Tidal, Breaching complete late Fall 2010						X		X			X							
	Pond A8	Muted Tidal; Gates open 6/1-1/31 & closed 2/1-5/31.	X										X							
	Alviso Slough	Sampling before & after breaching of Ponds A6 & A8	X	X				X		X			X							
	Alviso Slough fringing marsh		X	X				X		X			X							
	Pond A19	Fully Tidal, Breached March 2006				X		X		X			X							
	Pond A20					X		X		X			X							
	Pond A21		X	X		X		X		X			X							
	Coyote Creek	Sampling associated with Ponds A19/A20/A21	X	X		X		X		X			X							
B	Eden Landing Complex																			
	E8A	Breaching & construction complete by Fall 2011	X	X		X		X												
	E9		X	X		X		X												
	E8X		X	X		X		X												
	Mt. Eden Creek	Sampling before & after breaching of Ponds E8A/E9/E8X						X		X			X							
	Old Alameda Creek							X		X			X							
II	Supplement #4 & Actions																			
	Pond SF2	Managed Pond, Construction complete Fall 2010						X		X			X							
III	Supplement #5 & Actions																			
	Outer Bair Island*	Fully Tidal, Breached in January 2009																		
	*specify site related to 2009 breaching		X	X				X		X			X							
						X		X		X			X							

Table 1. Sample schedule matrix. Green x's are sites and dates of successful sample collections. Red boxes depict sampling dates missed. Grey boxes are no sampling required. Yellow boxes are last sampling date prior to restoration actions.



Rank	Species	July	Aug	Oct	Dec	Feb	May	Total
1	3-spinned stickleback	236	223	827	392	261	19	1958
2	Pacific Herring				23	24	812	859
3	Northern anchovy	208	250	53	38	38	24	611
4	Staghorn sculpin	81	61	68	43	33	207	493
5	Topsmelt	5	21	50	316	6	10	408
6	Arrow Goby	55	74	8	5		9	151
7	Yellowfin goby	28	13	8	6	22	66	143
8	English sole				1	1	80	82
9	Speckled sand dab			1	5	70	5	81
10	Shiner surf perch	19	9	8	2	3	28	69
11	Longfin smelt				61	7		68
12	Prickly sculpin	9	1			3	9	22
13	Diamond Turbot				5	10	1	16
14	Starry flounder	1	2	10	1	2		16
15	Bat ray	7	7	1				15
16	American Shad				8	4	2	14
17	Rainwater killifish		1	5	1	5	1	13
18	Threadfin shad				12	1		13
19	Bay pipefish		7				3	10
20	Leopard Shark	3	3	2			2	10
21	Brown smoothound		5					5
22	Mississippi silverside			2	3			5
23	Striped bass		1				4	5
24	Chameleon goby						4	4
25	Pacific Lamprey					4		4
26	Barred surf perch	1	2					3
27	Longjaw mudsucker		1			1		2
28	Plainfin midshipmen		1				1	2
29	Shimofuri goby	1		1				2
30	Shokahaze goby				2			2
31	Sacramento sucker	1						1
				<b>Total Fish</b>				<b>5087</b>
				<b>Native</b>				<b>4886</b>
				<b>Non-Native</b>				<b>201</b>

Table 2. Rank order of abundance of the species and the total abundance among all sites and survey months.

Rank	Species	July	Aug	Oct	Dec	Feb	May	Total
1	Longjaw mudsucker	52	87	41	16	17	114	327
2	Yellowfin goby	44	63	10	10	9	76	212
3	Staghorn sculpin	4		2	4	3	138	151
4	3-spined stickleback	8	1				155	164
5	Rainwater killifish	3						3
6	Topsmelt	1			1	6	3	11
7	Shiner surf perch	1						1
8	Pacific Herring						2	2

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Table 3. Rank order of abundance of fish collected via minnow and clover trapping among all sites across the 5 survey months.

ALVISO	Marked	Total
Alviso-A	22	
Alviso-B	22	
Alviso-C	12	<b>56</b>
<b>BAIR ISLAND</b>		
B	1	
D	2	
E	2	
F	1	
G	3	<b>9</b>
<b>COYOTE</b>		
A19	5	
A20	3	
Mud Slough	10	<b>18</b>
<b>RAVENSWOOD</b>		
SF2-A	10	
SF2-B	4	
SF2-C	15	<b>29</b>
		<b>112</b>

Table 4. Summary of the numbers of longjaw mudsuckers marked with alpha numeric tags during the may Survey at each location.

<b>Summary of Expenditures through Quarter 1</b>		
Salaries + Benefits		\$15,248.89
Supplies		\$11,101.10
Travel		\$967.31
		<b>\$27,317.30</b>
<b>Labor</b>	<b>% Effort</b>	<b>Expenditures</b>
Task 1 – Alviso Complex Sampling	0.40	\$6,136.45
Task 2 – Eden Landing Complex Sampling	0.40	\$6,136.45
Task 3 – Pond SF2 Sampling	0.03	\$522.41
Task 4 – Bair Island Sampling	0.03	\$522.41
Task 5 – Data Analysis	0.04	\$653.14
Task 6a – Project Management	0.04	\$639.01
Task 6b – Reporting	0.04	\$639.01
		<b>\$15,248.89</b>
<b>Travel</b>		
February		\$967.31
		<b>\$967.31</b>
<b>Supplies</b>		
Boat Maintenance and Upgrade		\$3,538.75
Truck rentals		\$2,402.75
Field gear (nets, traps, sonar, wench etc.)		\$5,159.60
		<b>\$11,101.10</b>

Table 3. Budget breakdown for expenditures by task January to March 2011.