

**Post-Construction Eelgrass Survey Report
Year 3 – 2016**

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Table of Contents	2
1) INTRODUCTION	4
2) METHODS	4
2.1) Eelgrass Extent	4
2.2) Percent Cover	5
2.3) Shoot Density	5
2.4) Non-Native Eelgrass	5
2.5) Photo Documentation	5
2.6) Control Site	5
Figure 1: Salt River Ecosystem Restoration Project, pre-construction. <i>Z. marina</i> survey area and Morgan Slough reference site.	6
Figure 2: 2015 <i>Z. marina</i> extent cover, transect marker locations and channel elevations for Salt River.	7
Table 1: 2015 locations of Salt River transect markers, including 7 additional transects.	8
Table 2: 2015 locations of Morgan Slough transect markers.	9
3) RESULTS	
3.1) Eelgrass Extent	10
3.2) Percent Cover	10
Table 3.1: 2016 <i>Z. marina</i> percent cover within the Salt River project area.	11
Table 3.2: 2015 <i>Z. marina</i> percent cover within the Salt River project area.	11
Table 3.3: 2014 <i>Z. marina</i> percent cover within the Salt River project area.	11
Table 3.4: 2013 <i>Z. marina</i> percent cover within the Salt River project area.	11
Table 4.1: 2016 <i>Z. marina</i> percent cover by zone within the Morgan Slough project area.	12
Table 4.2: 2015 <i>Z. marina</i> percent cover by zone within the Morgan Slough project area.	12
Table 4.3: 2014 <i>Z. marina</i> percent cover by zone within the Morgan Slough project area.	12
Table 4.4: 2013 <i>Z. marina</i> percent cover by zone within the Morgan Slough project area.	12
3.3) Shoot Density	13
Table 5.1: 2016 <i>Z. marina</i> shoot density within the Salt River project area.	14
Table 5.2: 2015 <i>Z. marina</i> shoot density within the Salt River project area.	14
Table 5.3: 2014 <i>Z. marina</i> shoot density within the Salt River project area.	14
Table 5.4: 2013 <i>Z. marina</i> shoot density within the Salt River project area.	14
Table 6.1: 2016 <i>Z. marina</i> shoot density within the Morgan Slough control area.	15
Table 6.2: 2015 <i>Z. marina</i> shoot density within the Morgan Slough control area.	15
Table 6.3: 2014 <i>Z. marina</i> shoot density within the Morgan Slough control area.	15
Table 6.4: 2013 <i>Z. marina</i> shoot density within the Morgan Slough control area.	15
4) COMPARISONS BETWEEN YEARS	16
4.1) Eelgrass Extent	16
4.2) Percent Cover	16
4.3) Density	16
4.4) Non-Native Eelgrass	16
4.5) Photo Documentation	16
5) DISCUSSION	
5.1) Eelgrass Extent	18
5.2) Salt River Percent Cover	18

5.3) Salt River Density	18
5.4) Morgan Slough Percent Cover	19
5.5) Morgan Slough Density	19
5.6) Eel River Delta	19

1) INTRODUCTION

In 2013, the Salt River Ecosystem Restoration Project converted 330 acres of dairy ranch into a salt marsh estuary. 4.02 km of the Salt River channel was excavated, expanded, and deepened. Over 4.8 km of new slough channels were excavated and enhanced. Restoration goals include increased habitat value, long-term sediment management and improved drainage/floodplain functioning.

Rare plant surveys were conducted throughout the project area in 2010. *Zostera marina*, a native species of eelgrass, was found in the Salt River for 2,286 meters, beginning upstream from the confluence with Cutoff Slough. The California Coastal Commission special conditions for CDP 1-10-32 states that within three years of completion of the project, the entire pre-construction eelgrass impact area plus the restored areas suitable for eelgrass recruitment shall have an extent of vegetative cover equal to at least 1.2 times the impacted area and have an average density equal to the pre-construction average density.

Pre-construction *Z. marina* surveys were conducted in 2013 to create a baseline for comparison to three yearly post-construction surveys. This document is the third of the three yearly post-construction *Z. marina* surveys and will be utilized in determining if the California Coastal Commission success criteria have been met.

2) METHODS

The 2016 post-construction *Z. marina* surveys were conducted during lower low water levels on the following dates and tidal heights in 2016:

June 21 / - 1.0 ft; June 22 / - 1.03ft; June 23 / - 0.94.ft; June 24 / - 0.72 ft; June 26 / 0.07 ft
July 3 / - 1.56 ft; July 4 / - 1.72 ft

The field methods utilized at the Salt River project area were duplicated at Morgan Slough, a nearby control site similar to, but not affected by, restoration activities (See Figure 1). Monitoring of the control site will aid in identifying environmental factors not associated with the project activities that potentially influence *Z. marina* recruitment in the Salt River.

2.1) Eelgrass Extent

The 2016 eelgrass survey was initiated at the confluence of the Salt River and Cutoff Slough at the western end of the project area. Extent is defined as the area where *Z. marina* was observed. Discrete patches are separated from adjacent eelgrass patches by at least a meter, whereas, continuous eelgrass beds are less than one meter apart. GPS coordinates were recorded in the center of each discrete patch and assigned a number as indicated on the map (see Figure 2). Length and location of continuous *Z. marina* beds were also recorded and mapped.

2.2) Percent Cover

The percent cover was visually estimated by measuring how much of the substrate was covered by eelgrass within a 0.25-m² quadrat. Percent bottom cover is defined as total plant coverage per total bed area. Cover categories are given as the percentage of substrate covered by eelgrass. For example, if 90% of the substrate is exposed, that represents 10% coverage. If 50% of the substrate is exposed, that represents 50% coverage. See

<http://www.seagrassnet.org/sites/default/files/SeagrassNetManual2006Worldwide.pdf> page 71 for a percent cover photo guide. Percent cover measurements were taken within the same quadrat as the density measurements described below.

2.3) Shoot Density

Shoot density is defined as number of shoots per square meter. *Z. marina* percent cover and shoot density are a function of channel depth; therefore, percent cover and density measurements were spaced evenly across the channel. The entire length of the restored Salt River channel where eelgrass occurred was divided evenly into four cross-sectional zones: 1) north right bank to north mid slope, 2) north mid slope to north low slope, 3) south low slope to south mid slope, 4) south mid slope to south bank. Power analysis recommended a sample size of 10 density measurements for the entire length of the study area yielding 40 total replicates; however, a total of 30 density measurements for the entire length of the study area gave a total of 120 replicates, increasing the accuracy of estimated density. The total length of channel containing *Z. marina* in 2013 was 2,345 m. The total length of channels containing *Z. marina* in 2014 increased by 2,989 m, for a total range of 5,334 meters. Seven additional measurement transects (cross-section of four measurements) were added in the Salt River channel in 2014 due to increased *Z. marina* range (see Table 1). A hand-held GPS unit was used to measure distance along the channel. The first measurement transect was placed at the confluence of Cutoff Slough and Salt River and subsequent measurement occurred every 78 meters throughout the project area.

2.4) Non-Native Eelgrass

Zostera japonica, an invasive species of eelgrass, has been reported in the project area. Location and number of shoots found in the project area was recorded in the 2013 pre-construction survey, and a visual search was completed yearly between 2014 and 2016.

2.5) Photo Documentation

Photographs, location and compass bearings were recorded at each measurement transect to compare with future surveys.

2.6) Control Site

A nearby control site was selected in 2013, with the assistance of staff from CDFW and NOAA Fisheries, which best matches environmental conditions in the project area. Morgan Slough is located about 1 km north east of the project area, experiences a similar amount of freshwater and sediment inundation, and is on easily accessed, public land. The same survey procedures were used at the Morgan Slough control site on July 4, 2016.

The Morgan Slough channel was surveyed 1,640 meters upstream from the confluence with Cutoff Slough to the Morgan Slough Road Bridge. In 2013, a total of 21 transects, 78 meters apart, revealed continuous eelgrass present 1,600 m upstream (see Table 2). A comparison of eelgrass percent cover and shoot density was made between the Salt River and Morgan Slough between pre and post-construction years.

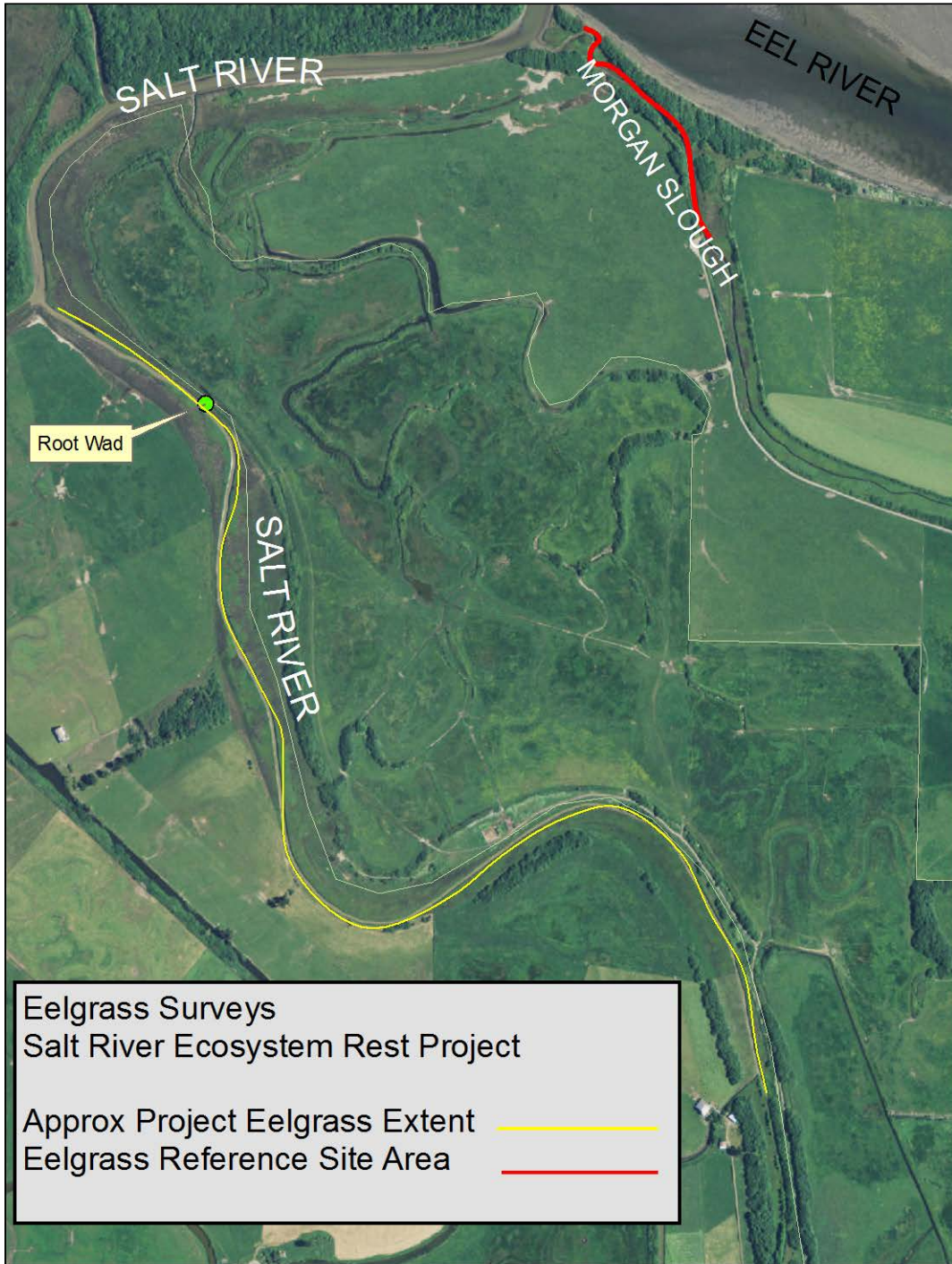


Figure 1: Salt River Ecosystem Restoration Project, pre-construction. *Z. marina* survey area and Morgan Slough reference site.

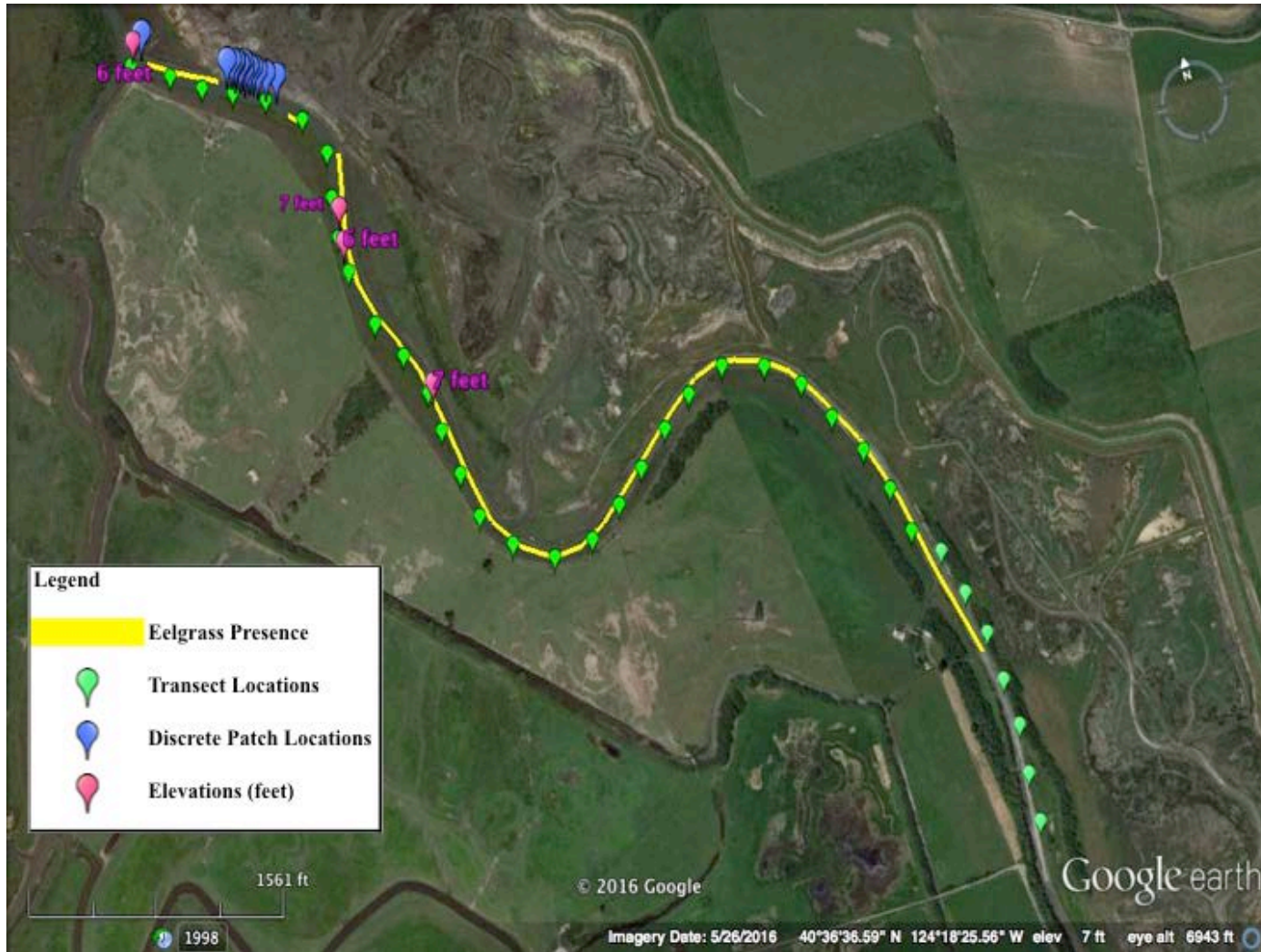


Figure 2: 2016 *Z. marina* extent cover, transect marker locations and channel elevations for Salt River.

Table 1: 2016 locations of Salt River transect markers, including the 7 additional transects.

Transect	Waypoint	Latitude	Longitude
1	139	40°37'8.04"	124° 18'57.96"
2	140	40°37'6.66"	124° 18'54.96"
3	141	40°37'5.40"	124° 18'52.62"
4	116	40°37'4.50"	124° 18'50.22"
5	117	40°37'3.48"	124° 18'47.70"
6	118	40°37'1.74"	124° 18'45.12"
7	119	40°36'59.46"	124° 18'43.80"
8	120	40°36'56.94"	124° 18'44.34"
9	121	40°36'54.66"	124° 18'44.64"
10	122	40°36'52.02"	124° 18'44.70"
11	123	40°36'49.38"	124° 18'43.44"
12	124	40°36'47.16"	124° 18'41.82"
13	125	40°36'44.76"	124° 18'40.62"
14	126	40°36'42.54"	124° 18'40.32"
15	127	40°36'39.96"	124° 18'39.72"
16	128	40°36'36.37"	124° 18'39.06"
17	129	40°36'36.35"	124° 18'37.02"
18	130	40°36'33.96"	124° 18'34.02"
19	131	40°36'34.14"	124° 18'30.72"
20	132	40°36'35.40"	124° 18'27.90"
21	133	40°36'36.84"	124° 18'25.38"
22	134	40°36'38.40"	124° 18'22.68"
23	135	40°36'39.72"	124° 18'20.04"
24	136	40°36'40.56"	124° 18'16.80"
25	137	40°36'39.72"	124° 18'13.44"
26	138	40°36'38.10"	124° 18'10.92"
27	142	40°36'35.82"	124° 18'9.24"
28	143	40°36'33.54"	124° 18'7.50"
29	144	40°36'31.08"	124° 18'6.30"
30	145	40°36'28.56"	124° 18'5.58"
31	27	40°36'26.4"	124° 18'04.0"
32	28	40°36'23.9"	124° 18'03.1"
33	29	40°36'21.5"	124° 18'02.3"
34	30	40°36'18.9"	124° 18'02.1"
35	31	40°36'16.4"	124° 18'01.9"
36	32	40°36'13.9"	124° 18'02.3"
37	33	40°36'11.4"	124° 18'02.5"

Table 2: 2016 locations of Morgan Slough transect markers. *Z. marina* shoot density and percent cover measurements were taken in each zone across the channel from each marker.

Transect	Waypoint	Latitude	Longitude
1	146	40°37'22.59"	124°18'22.36"
2	147	40°37'23.40"	124°18'19.13"
3	149	40°37'21.63"	124°18'17.53"
4	151	40°37'20.67"	124°18'14.63"
5	152	40°37'15.87"	124°18'10.54"
6	153	40°37'12.24"	124°18'9.49"
7	154	40°37'10.01"	124°18'7.59"
8	155	40°37'7.28"	124°18'7.44"
9	156	40°37'4.69"	124°18'6.63"
10	157	40°37'2.16"	124°18'5.63"
11	168	40°37'0.49"	124°18'3.01"
12	158	40°36'59.33"	124°17'59.88"
13	159	40°36'58.30"	124°17'56.20"
14	160	40°36'57.85"	124°17'52.86"
15	161	40°36'57.27"	124°17'49.63"
16	162	40°36'56.22"	124°17'46.27"
17	163	40°36'54.92"	124°17'42.95"
18	164	40°36'53.16"	124°17'39.91"
19	165	40°36'52.33"	124°17'38.28"
20	166	40°36'51.86"	124°17'35.83"
21	167	40°36'51.29"	124°17'32.40"

3) RESULTS

3.1) Eelgrass Extent

In 2016, 14 discrete patches of *Z. marina* were observed in the Salt River. Between 2013 and 2014, *Z. marina* extent increased in range by 2,900 meters in the main channel of the Salt River, and newly formed slough channels. There was no further increase in *Z. marina* range in 2015 or 2016. The eelgrass extent discussed below is defined as the length of channel where *Z. marina* was observed within the range of the project area including both continuous, and discrete patches.

3.2) Percent Cover

The 2016 average *Z. marina* percent cover of the Salt River sampled areas was: Zone 1 (Z1) = 8%; Zone 2 (Z2) = 11%; Zone 3 (Z3) = 20%; and Zone 4 (Z4) = 11%. 2016 *Z. marina* percent cover for each zone in the Salt River project area is summarized in Table 3.1. For comparison, 2015, 2014 and 2013 *Z. marina* percent cover for each zone in the Salt River are summarized in Tables 3.2 - 3.4. In 2016, *Z. marina* percent cover for the entire population within the project area was 12.5% +/- 2.36. The location of each of the 37 Salt River transect locations where *Z. marina* percent cover and density measurements were measured are shown in Table 1. The same transects were used from the pre-construction 2013 survey, along with the 7 transects added in 2014. Within the Salt River site the, average percent cover in zone 3 was significantly higher than zone 1 and zone 4 (ANOVA $F = 5.03$, $P < 0.05$).

The 2016 average *Z. marina* percent cover of eelgrass at the Morgan Slough control site was zero in all zones. 2016 *Z. marina* percent cover for each zone in the Morgan Slough project area is summarized in Table 4.1. For comparison, 2015, 2014 and 2013 *Z. marina* percent cover for each zone in Morgan Slough are summarized in Tables 4.2 - 4.4. Table 2 lists the locations of each of the 21 Morgan Slough transect locations where *Z. marina* percent cover and density measurements were recorded. These locations were the same as the 2013 pre-construction surveys. Due to the complete absence of eelgrass presence in Morgan Slough in 2016, statistical comparisons of eelgrass quantity were not made between the two sites.

Salt River *Z. marina* percent cover. Estimated percent cover/m² represents percent cover of the sampled area extrapolated over the total project area. The combined estimated percent cover is a mean of the four zones.

Table 3.1: 2016 *Z. marina* percent cover within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	30	1.88	15.7	23750	198444	315020	8.4
2	33	2.06	23.0	23750	265197	261048	11.2
3	32	2.0	39.7	23750	471289	393300	19.8
4	32	2.0	21.1	23750	250488	312313	10.5
Combined	127	8.25	99.5	95000	1185419	1275221	12.5

Table 3.2: 2015 *Z. marina* percent cover within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	34	2.13	10.7	23750	118997	138119	5.0
2	37	2.31	18.5	23750	190416	213842	8.0
3	37	2.31	23.1	23750	237326	260819	10.0
4	32	2	38.3	23750	454961	425574	19.2
Combined	140	8.25	90.6	95000	1001700	1038354	10.5

Table 3.3: 2014 *Z. marina* percent cover within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	34	2.13	1.9	23750	20709	28212	0.9
2	37	2.31	1.8	23750	18320	21534	0.8
3	37	2.31	3.5	23750	35530	51952	1.5
4	27	1.69	6.5	23750	91742	73065	3.9
Combined	135	8.44	13.6	95000	166301	174764	1.8

Table 3.4: 2013 *Z. marina* percent cover within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	24	1.50	4.7	4514	14044	26271	3.1
2	30	1.88	30.8	4514	74230	67096	16.4
3	30	1.88	27.4	4514	66045	69239	14.6
4	22	1.38	4.5	4514	14624	17958	3.2
Combined	106	6.63	67.4	18056	168942	180564	9.4

Morgan Slough *Z. marina* percent cover.

Table 4.1: 2016 *Z. marina* percent cover by zone within the Morgan Slough project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	21	1.31	0	2988	0	0	0
2	21	1.31	0	2988	0	0	0
3	21	1.31	0	2988	0	0	0
4	21	1.31	0	2988	0	0	0
Combined	84	5.25	0	11952	0	0	0

Table 4.2: 2015 *Z. marina* percent cover by zone within the Morgan Slough project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	21	1.31	5	2988	11382	994	4
2	21	1.31	0	2988	0	0	0
3	21	1.31	0	2988	0	0	0
4	21	1.31	0	2988	0	0	0
Combined	84	5.25	5	11952	11382	994	1

Table 4.3: 2014 *Z. marina* percent cover by zone within the Morgan Slough project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	18	1.13	9.4	2988	25084	36236	8.4
2	21	1.31	22.0	2988	49976	38274	16.7
3	21	1.31	22.0	2988	49976	41823	16.7
4	18	1.13	13.6	2988	36151	39269	12.1
Combined	78	4.88	67.0	11952	161188	155601	13.5

Table 4.4: 2013 *Z. marina* percent cover by zone within the Morgan Slough project area.

Zone	# of Samples	Sampled Area (m ²)	% Cover	Total Area (m ²)	Estimated Total Cover	Std. Dev. of Total Cover	Est. % Cover/m ²
1	14	0.88	4.1	2988	13903	22094	4.7
2	21	1.31	41.8	2988	95074	69253	31.8
3	21	1.31	55.6	2988	126512	57984	42.3
4	11	0.69	9.8	2988	42672	80752	14.3
combined	67	4.19	111.2	11952	278161	230084	23.3

3.3) Shoot Density

The 2016 average *Z. marina* shoot density in the Salt River sampled area was: Z1 = 93; Z2 = 198; Z3 = 333; and Z4 = 187. 2016 *Z. marina* shoot density for each zone in the Salt River project area is summarized in Table 5.1. For comparison, 2015, 2014 and 2013 *Z. marina* shoot density for each zone in the Salt River are summarized in Tables 5.2 -5.4. In 2016, *Z. marina* shoot density for the entire population within the project area was 203 \pm 1.3 shoots/m². Within the Salt River site, average shoot density in zone 1 was significantly lower than average shoot density in zone 3 (ANOVA F = 4.4, P < 0.05).

The 2016 average *Z. marina* shoot density at the Morgan Slough control site was zero in all zones. *Z. marina* shoot density for each zone in the Morgan Slough control area is summarized in Table 6.1. For comparison, 2015, 2014 and 2013 *Z. marina* shoot density for each zone in Morgan Slough are summarized in Tables 6.2 - 6.4. Due to the complete absence of eelgrass presence in Morgan Slough in 2016, statistical comparisons of eelgrass quantity were not made between the two sites.

Salt River *Z. marina* Shoot Density

Table 5.1: 2016 *Z. marina* shoot density within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. of Total Shoots	Est. Density (Shoots/m ²)
1	30	1.88	174	23750	2204000	172900	92.8
2	33	2.06	409	23750	4709697	145552	198.3
3	32	2.0	665	23750	7896875	213750	332.5
4	32	2.0	374	23750	4441250	171950	187.0
Combined	127	7.94	1622	95000	19251822	704152	202.7

Table 5.2: 2015 *Z. marina* shoot density within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. of Total Shoots	Est. Density (Shoots/m ²)
1	34	2.13	150	23750	1676471	53503	71
2	37	2.31	280	23750	2875676	87131	121
3	37	2.31	324	23750	3327568	87126	140
4	32	2	459	23750	5450625	149163	230
Combined	140	8.25	1213	95000	14082247	397505	140

Table 5.3: 2014 *Z. marina* shoot density within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. Of Total Shoots	Est. Density (Shoots/m ²)
1	34	2.13	55	23750	614706	6490	26
2	37	2.31	54	23750	554595	5296	23
3	37	2.31	82	23750	842162	7610	35
4	27	1.69	147	23750	2068889	12123	87
Combined	135	8.44	338	95000	4080352	31520	43

Table 5.4: 2013 *Z. marina* shoot density within the Salt River project area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. Of Total Shoots	Est. Density (Shoots/m ²)
1	24	1.50	94	4514	282877	14361	63
2	30	1.88	388	4514	934097	29268	207
3	30	1.88	375	4514	902800	28914	200
4	22	1.38	115	4514	377535	16145	84
Combined	106	6.63	972	18056	2497309	88687	138

Morgan Slough *Z. marina* Shoot Density

Table 6.1: 2016 *Z. marina* shoot density within the Morgan Slough control area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. of Total Shoots	Est. Density (Shoots/m ²)
1	21	1.31	0	2988	0	0	0
2	21	1.31	0	2988	0	0	0
3	21	1.31	0	2988	0	0	0
4	21	1.31	0	2988	0	0	0
Combined	84	5.25	0	11952	0	0	0

Table 6.2: 2015 *Z. marina* shoot density within the Morgan Slough control area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. of Total Shoots	Est. Density (Shoots/m ²)
1	21	1.31	2	2988	4553	994	2
2	21	1.31	0	2988	0	0	0
3	21	1.31	0	2988	0	0	0
4	21	1.31	0	2988	0	0	0
Combined	84	5.25	2	11952	4553	994	0.4

Table 6.3: 2014 *Z. marina* shoot density within the Morgan Slough control area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. Of Total Shoots	Est. Density (Shoots/m ²)
1	18	1.13	148	2988	393088	19700	132
2	21	1.31	317	2988	721673	17823	242
3	21	1.31	316	2988	719397	20596	241
4	18	1.13	187	2988	496672	27378	166
Combined	78	4.88	968	11952	2330830	85497	195

Table 6.4: 2013 *Z. marina* shoot density within the Morgan Slough control area.

Zone	# of Samples	Sampled Area (m ²)	Shoot #	Total Area (m ²)	Estimated Shoot #	Std. Dev. Of Total Shoots	Est. Density (Shoots/m ²)
1	14	0.88	62	2988	211721	23528	71
2	21	1.31	387	2988	881033	30483	295
3	21	1.31	485	2988	1104137	25657	370
4	11	0.69	78	2988	339002	54197	113
Combined	67	4.19	1012	11952	2535894	133866	212

4) COMPARISONS BETWEEN YEARS

4.1) Eelgrass Extent

In 2013, there were 35 discrete patches of *Z. marina* in the Salt River. Within these patches, there were an approximate total of 388 individual *Z. marina* shoots. In 2016, there were 14 discrete patches of *Z. marina* in the Salt River. Within these patches, there were an approximate total of 80 individual *Z. marina* shoots. In 2013, the total length of continuous *Z. marina* beds in the Salt River was 2,053 meters. In 2016, the total length of continuous *Z. marina* beds in the Salt River was 2,215 meters.

4.2) Percent Cover

Z. marina percent cover in the Salt River was significantly higher in zones 1 and 4 in 2016 than it was in 2013 ($p = 0.04, 0$; $t = 2.15, 1.56$, $df = 41, 35$). Salt River *Z. marina* percent cover in zones 2 and 3 did not differ significantly between 2016 and 2013 ($p = 0.23, 0.12$; $t = 1.21, 1.56$; $df = 56, 60$).

4.3) Density

Z. marina shoot density in Salt River was significantly higher in zones 3 and 4 in 2016 than it was in 2013 ($p = 0.04, 0.02$; $t = 2.14, 2.34$; $df = 54, 41$). Salt River *Z. marina* shoot density in zones 1 and 2 did not differ significantly between 2016 and 2013 ($p = 0.14, 0.86$; $t = 2.15, 1.21$; $df = 41, 61$).

4.4) Non-Native Eelgrass

In 2013, eight shoots of *Z. japonica*, the non-native eelgrass, were found in one patch in the Salt River. The GPS location of the patch was 40°37'7.20"N, 124°18'56.34"W. *Z. japonica* was not observed in the Morgan Slough control area. *Z. japonica* was not found in the Salt River or Morgan Slough in subsequent years.

4.5) Photo Documentation

Photographs and GPS waypoints were taken at each transect marker every 78 meters along the Salt River project and Morgan Slough control sites. The following sampling of photos was taken at the same locations in the Salt River in 2013 to 2016 and document *Z. marina* coverage pre and post-construction. Photos of each transect were taken in 2016 and have been submitted to Doreen Hansen at the Humboldt County Resource Conservation District. The following photos are taken at the beginning of the slough entrance and moving upstream. The captions for each photograph include the abbreviations as follows: Salt River (SR), transect number (T#), and compass bearing (#°).

2013 SR, T14, 70°



2016 SR, T14, 85°



2013 SR, T17, 30°



2016 SR, T17, 95°



2013 SR, T18, 6°



2016 SR, T18, 28°



5) DISCUSSION

5.1) Eelgrass Extent

The total combined area of *Z. marina* in both continuous beds, and discrete eelgrass patches in 2013 was 1.06535 acres. Of that total area, 0.53 acres of *Z. marina* were excavated in 2013. The success criterion states:

"within three years of completion of the project (both phases), the entire pre-construction eelgrass area plus the restored areas suitable for eelgrass recruitment shall have an extent of vegetative cover equal to at least 1.2 times the impacted area and have an average density equal to the pre-construction average density" (California Coastal Commission special conditions for CDP 1-10-32-Eelgrass).

The impacted area was 0.53 acres; 1.2 times 0.53 acres is 0.64 acres. The total combined *Z. marina* extent for 2014 was 1.06899 acres; the total acreage increased by 102% or a 2.02 times increase from the impacted area. Therefore, the success criterion of 1.2 times increase in *Z. marina* coverage was achieved in 2014. The total combined *Z. marina* extent for 2015 increased further to 1.08 acres, yielding a total acreage increase of 104% or a 2.04 times increase from the impacted area. The total combined *Z. marina* extent for 2016 increased further to 1.15 acres. Between 2013 and 2016, there was a total acreage increased by 117% or a 2.16 times increase from the impacted area. Acreage calculations are based on detailed surveys of previous and existing *Z. marina* continuous beds and discrete patches as described in detail in the methods section.

Percent Cover and Density

In 2016, average percent cover and density were both higher in the project area than in all previous years. When comparing *Z. marina* percent cover and shoot density between years, Zone 4 is the area least affected by excavation activity. All of Salt River eelgrass zones 1 through 4 in the 2013 pre-construction survey are contained within Zone 4 in the 2014 and 2015 surveys. In 2013, Zone 1 was not part of the channel and Zones 2 and 3 were heavily impacted by excavation activities. *Z. marina* occurring in zones 1-3 post-construction are novel recruitment.

5.2) Salt River Percent Cover

Comparing the Salt River *Z. marina* average percent cover between 2013 and 2014 indicates a decrease in percent cover of 81% following excavation activities. Between 2014 and 2015, *Z. marina* percent cover increased by 483%, indicating a substantial recovery in one year. Between 2013 and 2015, *Z. marina* percent cover in the Salt River increased by 11.7%. Therefore, the project has reached the percent cover criteria goal of being equal to pre-construction percent cover. Between 2013 and 2016, *Z. marina* percent cover in the Salt River increased by 33%.

5.3) Salt River Shoot Density

Comparing the Salt River *Z. marina* average density between 2013 and 2014 indicates a 69% decrease in shoots/m² following excavation activities. Between 2014 and 2015, *Z.*

marina density increased by 226%, indicating a substantial recovery in one year. Between 2013 and 2015, *Z. marina* average density in the Salt River increased by 1.45%. Therefore, the project has reached the shoot density criteria goal of being equal to pre-construction shoot density. Between 2013 and 2016, *Z. marina* average density in the Salt River increased by 47%.

5.4) Morgan Slough Percent Cover

Comparing the Morgan Slough *Z. marina* average percent cover between 2013 and 2014 indicates a decrease in percent cover of 42%. Between 2014 and 2015, *Z. marina* percent cover in Morgan Slough decreased by 93%. Between 2013 and 2016, *Z. marina* percent cover in Morgan Slough decreased by 100%, indicating a total collapse of the *Z. marina* population.

5.5) Morgan Slough Shoot Density

Comparing the Morgan Slough *Z. marina* average densities between 2013 and 2014 indicates 8% decrease in shoots/m². Between 2014 and 2015, *Z. marina* average density decreased by 99.8%. Between 2013 and 2016, *Z. marina* average density decreased by 100%, indicating a collapse of the *Z. marina* population in Morgan Slough.

5.6) Eel River Delta

The drastic decrease in the *Z. marina* population in Morgan Slough was witnessed in other areas of the Eel River Delta system, particularly in the interior marsh channels around Salt River and Cockrobin Island in 2015. Within the project area, there was initial *Z. marina* recruitment in the newly created slough channels in 2014, although those recruits were not present in 2015 or 2016. Abiotic factors such as increased water temperature and drought conditions may be affecting eelgrass in the Eel River Delta. Increase sediment suspension along with chemical loading due to heavy cattle use upstream of the Morgan Slough Bridge could also contribute to the *Z. marina* die-off in the control area. The fact that *Z. marina* is increasing in the project area despite the general decrease in surrounding areas is interesting and may warrant another season of surveys. We would recommend including water temperature/quality measurements in any future *Z. marina* survey work to establish baseline data that could be useful in understanding temporal changes in population size and health.