
TECHNICAL MEMORANDUM

TO: Chris Berry
City of Santa Cruz Water Department

FROM: Jeff Hagar
Hagar Environmental Science

DATE: December 11, 2012

PROJECT: City of Santa Cruz Habitat Conservation Plan, Lagoon Fish Population Sampling 2011

Fish population and steelhead rearing were assessed in Laguna Creek lagoon and the San Lorenzo River lagoon during the summer of 2011 by the City of Santa Cruz Water Department and Hagar Environmental Science (HES). Surveys were conducted in the early summer and again in the fall using large seines. Mark-recapture abundance estimates for *O. mykiss* were completed in both lagoons during both the June and October sampling periods. Marking was accomplished by clipping the lower tip of the caudal fin. Fish were marked one day and recaptured the next day in Laguna Creek. In the larger San Lorenzo River lagoon, fish were captured and marked on two consecutive days and recaptured during a subsequent two-day period (in the San Lorenzo lagoon there were two days between the mark and the recapture period). In Laguna Creek a 100 foot long by 6 foot deep seine with a bag and ¼ inch mesh was used. In the San Lorenzo River lagoon we used both the 100 foot seine and a 150 foot long by 8 foot deep seine with ¼ inch mesh. The larger seine was used in deeper water and at higher lagoon stages. A summary of the results of the survey follows.

Laguna Creek

Summary

Laguna Creek typically closes by mid-May and remains closed into the fall but in 2011 the lagoon did not fully close until July 29 and reopened in early October (2nd Nature 2012). In early June, when seining was conducted, the beach berm had built up and the lagoon was relatively full and filling. The lagoon spilled and drained on June 16. The lagoon was tidal with stage fluctuating to low levels through the end of July. Although juvenile steelhead of multiple age-classes were abundant in the lagoon in early June, they were absent after the breach in early October. The June 16 breach and subsequent fluctuating low lagoon stage may have caused rearing juveniles to leave the lagoon. Whether any juveniles reared through the closed lagoon period in August and September is not known nor is it clear whether any juvenile steelhead

would have been present at the time of October 6 breach event.

Spring (June 7-8)

- Site Conditions
 - Mouth open, lagoon full (Figure 1), long section of lagoon extending north along fore-beach area (Figure 2). Heavy rain June 3 with flows at the Laguna anadromous gage to about 68 cfs on the 4th. The anadromous gage reported about 7.5 cfs on the 7th and 6.5 cfs on the 8th.
 - Depth to maximum of 4-5+ feet.
 - Little tidal action apparent on sampling dates.
 - Salinity stratification with surface at 0.2 ppt. Deeper water (3.5-4 feet) at 16-20 ppt near mouth and 2.3-2.8 near station 1.5.
 - Temperature stratification with surface at 12.3°C to 12.9°C near mouth and 14.6° to 15.3° near station 1.5. Bottom temperature 17.6° to 18.4° near mouth and 16.2° to 17.0° near station 1.5.
 - Oxygen stratification with surface at 10.4 to 11.2 mg/l and deeper water (3.5-4 feet) at 1.9 to 5.7mg/l.
 - The water column was relatively clear.
 - The overwash pond was full



Figure 1 Laguna Lagoon, June 7, 2011.



Figure 2 Mouth of Laguna lagoon, June 7, 2011 with extension north along forebeach.

- Survey results
 - *O. mykiss* were captured and marked on June 7. On June 8 the lagoon was re-sampled and the proportion of re-captured fish was recorded.
 - 15 hauls between beach and water quality monitoring location (LA-3) (Table 1).
 - Highest abundance of *O. mykiss* in spring since 2005 based on catch per unit effort (CPUE) (Table 6).
 - Three length class modes: 20-69 mm FL, 80-189 mm, and greater than 200mm comprising 21%, 77%, and 2% of the total catch respectively (Figure 3). Presence of the 20-69mm length class in the spring in the lagoon was unusual based on past years sampling.
 - Most *O. mykiss* captured in June were age 1+ at lengths from ~90mm to ~180mm (Table 3 and Figure 3). The largest (200-240mm) were likely primarily age 2+ and 3+ stream-reared fish (Table 2).
 - Majority of fish less than 70mm were at parr stage; most in the 70 to 190mm size class were silvery parr; only 5 fish (2% of the catch) were at smolt stage and they were all 160 mm or larger (Figure 4).
 - Lots of very small yoy *O. mykiss* (25-30mm) at channel margins near LA-1.5, possibly as a result of recent high flows.
 - A single adult tidewater goby (TWG) was also captured. The gear used is not effective for goby (mesh-size too large).
 - The overwash pond was not sampled.

Table 1. Fish catch in Laguna Creek lagoon, June 2011.

Species	LA-1	LA-1.5	LA-2	LA-3	Grand Total
	June 7 and 8				
<i># Hauls</i>	9	3	3		15
Steelhead	117	132	48		297
Staghorn sculpin	59	8	7		74
Stickleback	14	8	118		140
Sculpin	7				7
Tidewater goby	1				1
<i>Steelhead CPUE</i>	13	44	16		19.8

Note: See Figures at end of document for sample station locations.

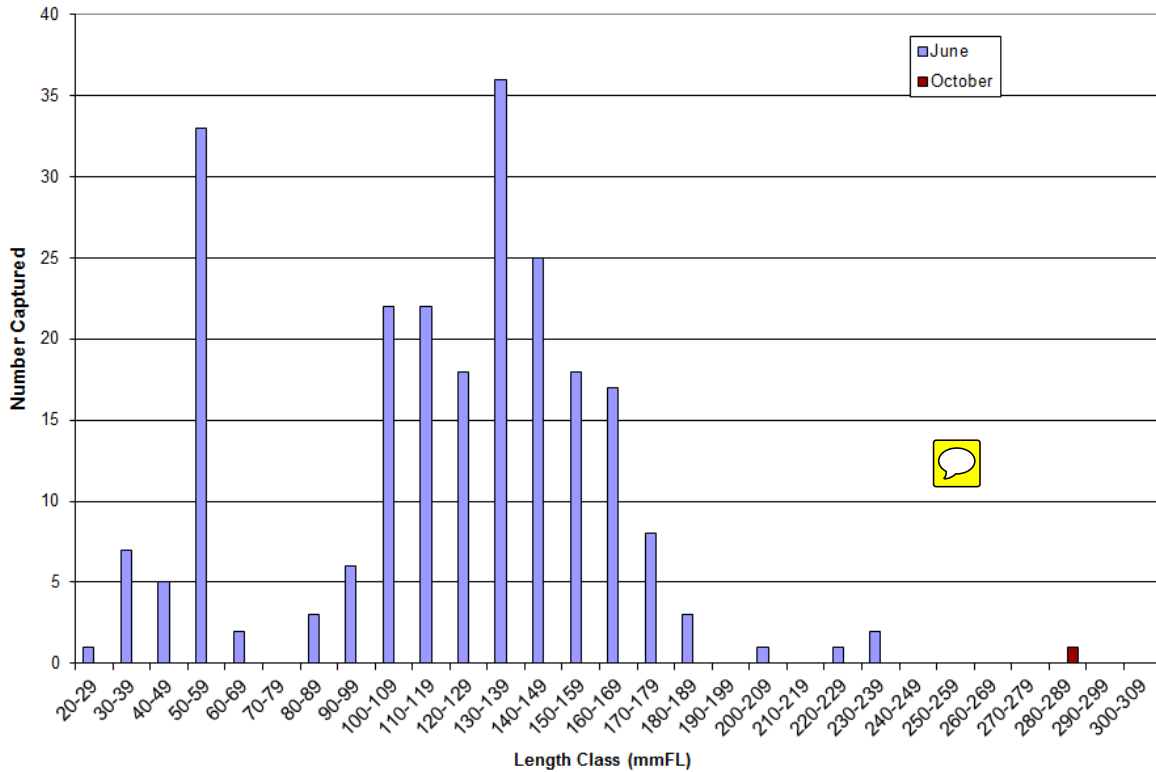


Figure 3 Steelhead length classes in Laguna Creek Lagoon.

Table 2. Results of Age Determination of Juvenile Steelhead in Laguna Creek Lagoon, 2011
(courtesy of Michelle Leicester, CDFG).

Date	Length (mm FL)	Age	Length at Annulus 1	Length at Annulus 2	Length at Annulus 3
7-Jun	96	1+	82		
7-Jun	101	1+	74		
7-Jun	104	1+	82		
7-Jun	120	1+	96		
7-Jun	128	1+	100		
7-Jun	134	1+	105		
7-Jun	141	1+	102		
7-Jun	143	1+	111		
7-Jun	148	1+	103		
7-Jun	161	1+	117		
7-Jun	223	3+	70	138	195
8-Jun	234	2+	97	177	
12-Oct	283	1+	104		

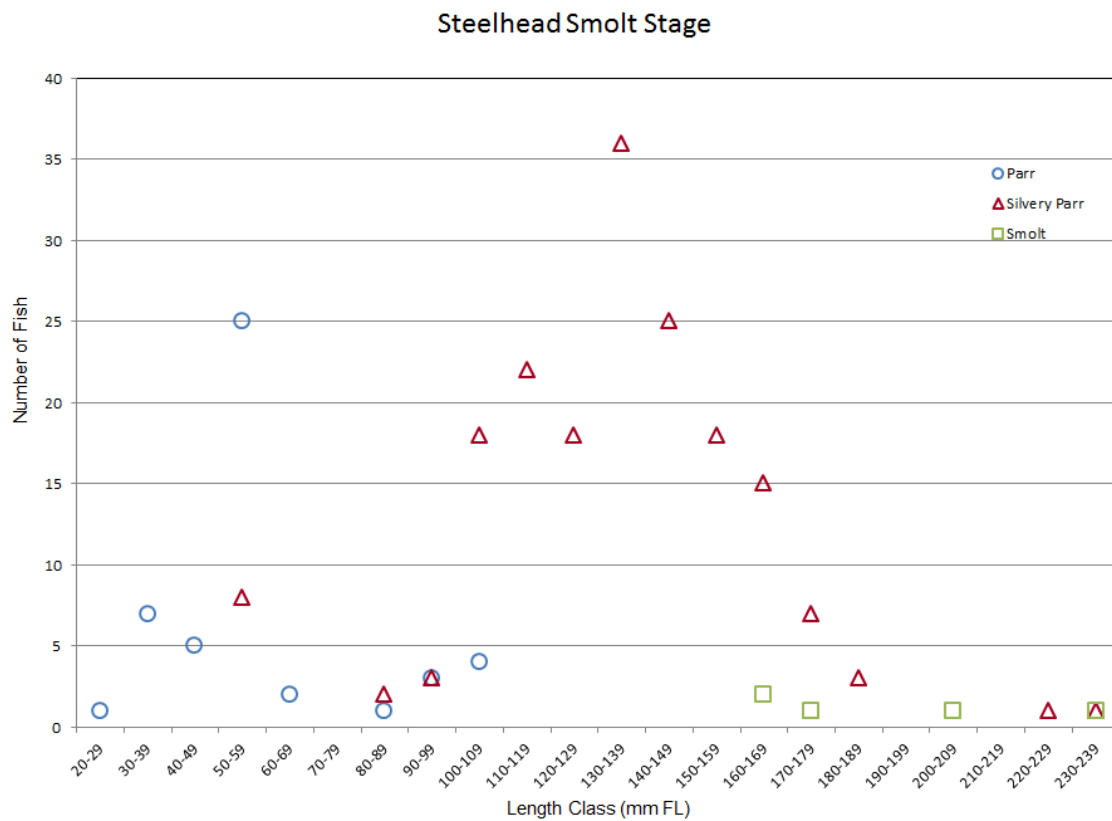


Figure 4 Steelhead smolt stage by length class, Laguna Creek Lagoon, June 2011.

- *O. mykiss* population estimate
 - All *O. mykiss* 50 mm FL or larger were marked on June 7 by clipping a small piece of the lower lobe of the caudal fin.
 - A total of 138 *O. mykiss* were marked including 14 between 50 and 74 mm FL and 124 75mmFL or larger. A total of 3 *O. mykiss* were less than 50mmFL and were not marked.
 - On June 8, a total of 146 *O. mykiss* 50mmFL or larger were captured of which 67 had been marked on June 7. Ten *O. mykiss* less than 50mmFL were also captured.
 - Population estimate using the Petersen method (Ricker 1975) is 300 *O. mykiss* larger than 50mm in the lagoon. The 95% confidence limits for this estimate are 237 and 380.
 - Support for assumption of mixed population for mark/recovery estimate: majority of steelhead were captured at LA-1.5 on June 7 but most recoveries on June 8 were at LA-1 (Table 2).

Table 3. Comparison of locations of capture for marked fish and location of recovery.

	LA-1	LA-1.5	LA-2
Marked (June 7)	7	112	19
Recoveries or marked fish (June 8)	62	3	2

Fall (October 11-12)

- Site Conditions
 - Mouth open, stage low on morning of October 11(Figures 5-8). Stage higher with waves washing in to lagoon on October 12 (Figure 9). The mouth had migrated further south than observed in June. An early storm on October 4th and 5th resulted in increased flows and a rise in lagoon elevation that breached the lagoon (2nd Nature 2012, Figure 10). Periods of larger waves leading up to the breach may have also contributed by eroding the sandbar (Figure 10). Stage data at the Laguna anadromous stream gage and the lagoon stage recorder indicate that the breach occurred between 3:00 am and 3:30 am on October 6 (the lagoon was so high before the breach that it was influencing the anadromous gage upstream of Highway 1).
 - Following the spring sample on June 7 and 8, the lagoon mouth closed around June 9th or 10th and stage increased gradually until the lagoon breached on June 16. It remained open and tidal until July 29 and then was closed with increasing water level through the October 6 breach. Large swells around August 31 coincided with increased lagoon stage indicating increased elevation of the sandbar (Figure 10).

- Greatest depth in center of channel at Station 1 and along east bank at Station 1.5, 3 to 3.5 feet on October 11, stage 1-2 feet higher on October 12 with waves washing in to lagoon during morning high tide.
- Salinity stratification with surface at 4-5 ppt and deeper water (3-3.5- feet) at 29-30 ppt near station 1. On October 12, surface salinity was 28 ppt near mouth in morning and 14 ppt near Station 2 late morning.
- Slight temperature stratification with surface at 14.9°C to 15.6 °C and bottom temperature 16.2° to 15.8° near mouth on October 11. More mixed on October 12 with 14.2° to 14.4° near mouth in early morning and 15.0° to 15.5 at Station 2 around noon.
- Well oxygenated through the water column on both dates at 7.3 mg/l to 8.4 mg/l.



Figure 5 Mouth of Laguna Creek, October 11.



Figure 6 Laguna Lagoon, October 11, looking from LA-1 to LA-1.5.



Figure 7 Laguna Lagoon, October 11, looking from LA-1.5 to LA-3.



Figure 8 Laguna Lagoon, October 11, looking from LA-2 to LA-3.



Figure 9 Laguna Lagoon mouth, October 12.

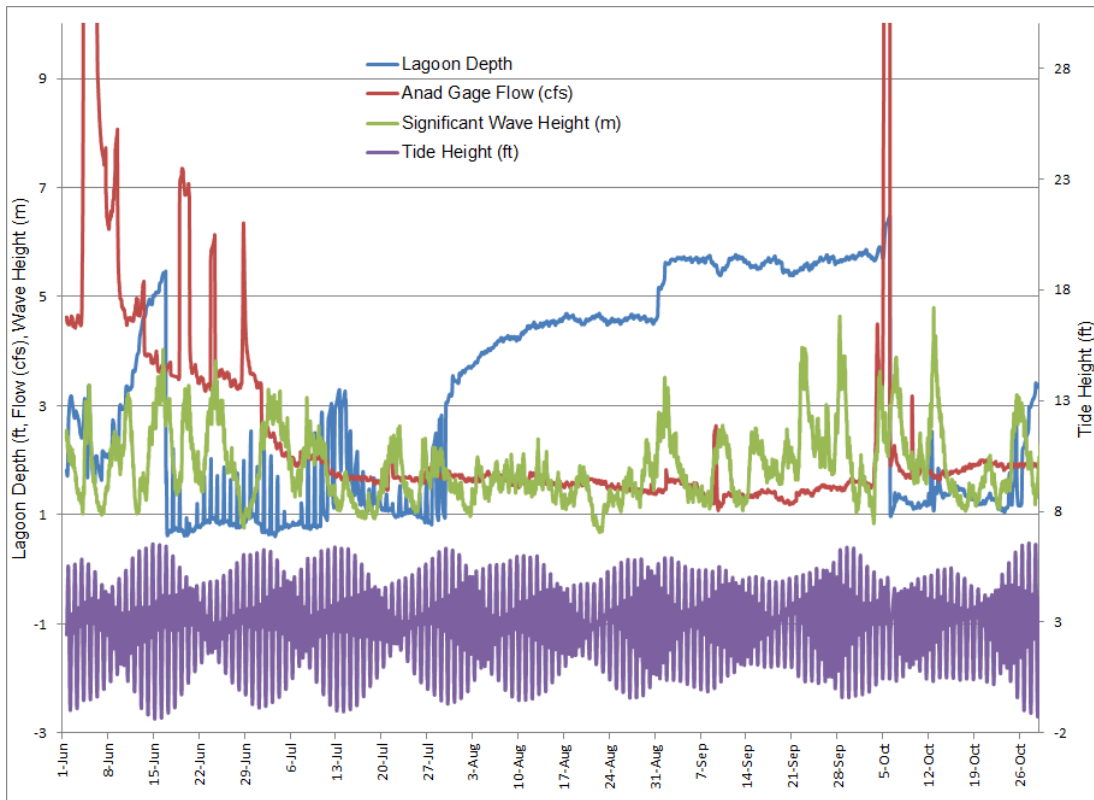


Figure 10 Laguna Lagoon stage, streamflow, wave height, and tides (Source: lagoon stage from 2ND Nature, streamflow from Balance Hydrologics, wave and tide data from NOAA).

- Survey results
 - 6 seine hauls completed on October 11 and 8 hauls on October 12 between beach (LA-1) and water quality monitoring location (LA-3) (Table 4).
 - A single steelhead was captured on October 12 at LA-1. It was in smolt condition and was 283 mm FL. It had a compound fracture of the lower jaw (possible angling injury) but appeared in good condition otherwise. Scale analysis indicated that it was in its second year of growth (age 1+) with annulus formation at 104mm (Table 3).
 - The fate of the *O. mykiss* present in the lagoon in June is unknown. The most likely scenarios are that they returned upstream or went to sea after the lagoon breached on October 6.
 - Stickleback were captured in most hauls, with abundance ranging from dozens to thousands per haul. Tidewater goby were also captured though not more than several per haul. The seine used has mesh size that is too large to be effective for goby. A couple of prickly sculpin were captured as was one pied-billed grebe.
 - A number of seine hauls were completed with a small mesh net to survey for tidewater goby. TWG were most abundant on the gently sloping, shallow sandy beach opposite the mouth (Table 5).
 - The over-wash pond was not sampled.

Table 4. Fish catch in Laguna Creek lagoon, October 2011.

Species	LA-1	LA-1.5	LA-2	LA-3	Grand Total
<i># Hauls</i>	8	2	3	2	15
Steelhead	1				1
Prickly sculpin			2		2
Stickleback	43	0	25	0	68
Tidewater goby	2				2
Steelhead CPUE	0.1	0	0	0	0.1

Table 5. Results of seining for tidewater goby in Laguna Lagoon.

Location	Haul Distance (ft.)	Substrate	Number of TWG	Notes
Outlet		Course sand	0	Seine held in outflow
Bank just above outlet	30	Sand	0	
Around point of sandbar above outlet	30	Sand	0	
Over bar near outlet	40	Sand	2	
Over bar	45	Sand	2	
Back of beach	30	Sand/silt	0	
Back of beach	30	Sand/silt	3	
Beach opposite mouth	50	Sand/silt	86	Gently sloping shallow sand
Beach opposite mouth		Sand/silt	45	Parallel shore, ~1.5 ft. depth
Beach opposite mouth	30	Sand/silt	55	Parallel shore, ~2 ft. depth
Back of beach between LA-1 and LA-1.5	40	Sand/silt	13	
Along marsh bench at LA-1.5	30	Sand/silt	24	
Through submerged veg. on marsh bench at LA-1.5	30	Sand/silt/veg	2	
Shallow area at LA-2	30	Sand/Gravel/silt	11	
Mid-channel gravel bar LA-2	30	Gravel/sand/silt	17	

Table 6. Steelhead and coho salmon catch per seine haul in Laguna Creek lagoon at consistently sampled stations (data from 2NDNATURE 2006b, Ellen Freund (NOAA Fisheries), HES 2005, HES 2009, HES 2010, and HES 2011).

	Location	Steelhead Catch per Haul						Coho Catch per Haul		
		May	Jun	Jul	Sep	Oct	Nov	May	Jul	Sep
2004										
	LA-1			0					0	
	LA-1.5			0	0				0	0
	LA-2									
	LA-3			0	0				0	0
	LA-4.5									
	LA-5			7	0				0	0
	LA-6			5	0				0	0
2005										
	LA-1	0		9.3	33		46	5.5	0	0
	LA-1.5									
	LA-2	0		16	50		5	14	6	0
	LA-3	7		40	51		15	30	6	0.5
	LA-4.5									
	LA-5	26		25	8		0	24	6	0
	LA-6	11		10	0		0	32	7	0
2008								Jun		Sep
	LA-1		1		0.5			0		0
	LA-1.5		18		10.5			0		0
	LA-2		22		15			0		0
	LA-3		0		0			0		0
	LA-4.5				0					0
	LA-5				0					0
	LA-6				3					0
	Overall		11		6			0		0
2009								Jun		Sep
	LA-1		8		34			0		0
	LA-1.5		8		21			0		0
	LA-2		10		10			0		0
	LA-3		0		0			0		0
	Overall		7		19			0		0
2010								Jun		Oct
	LA-1					2				0
	LA-1.5					0.3				0
	LA-2		13			5		0		0
	Overall		13			1.7		0		0
2011								Jun		Oct
	LA-1		13			0.1		0		0
	LA-1.5		44			0		0		0
	LA-2		16			0		0		0
	LA-3					0				0
	Overall		19.8			0.1		0		0

San Lorenzo River

Summary

In 2011 San Lorenzo Lagoon was only closed for a total of 11 days and never closed for more than 5 days at a time, which is the lowest seasonal closure duration observed since 2003. Microtidal conditions (partial sandbar closure and reduced circulation) occurred for 19 consecutive days during 2011, whereas the average for previous years is over 40 consecutive days. The combined higher freshwater inputs and reduced closure duration in San Lorenzo Lagoon prevented prolonged vertical density stratification that is common during drier hotter summers (2nd Nature 2012). In 2011, we started with abundant, large, 1+ age steelhead (120-200mm) with declining abundance but apparently good growth over the summer. Juvenile steelhead were present in the lagoon in June at the highest abundance (CPUE) since 2005. The population estimate for *O. mykiss* larger than 50 mm FL was 501 in June. In October the catch rate (CPUE) was 19% of the June value and the population estimate for fish greater than 50mm FL was 138 (28% of the June value). Changes in abundance could reflect movement in and out of the lagoon as well as mortality (Hayes et al. 2011). Growth rates of *O. mykiss* in the lagoon appeared good based on change in the length distribution between June and October.

Spring (June 9-10, 13-14)

- Site Conditions
 - Lagoon open, tidal (Figure 10); flow at Santa Cruz gage 101 cfs June 9 declining to 79 cfs by June 14.
 - Salinity 0.3-2.2 ppt at surface and 0.3-29.2 at the bottom depending on tidal stage;
 - Surface temperature 15-17.1°C, bottom temperature 14.9-17.1;
 - Surface DO ranged from 7.2 to 12.3 mg/l and DO at 3.5 to 4 feet depth was from 4.5 to 9.7 mg/l.



Figure 11 San Lorenzo lagoon, June 9, 2011.

- Survey results
 - *O. mykiss* were captured and marked on June 9 and 10 and the lagoon was resampled on June 13 and 14.
 - 27 hauls between beach and bend upstream of Riverside Bridge.
 - Steelhead were captured at all sites but most abundant between the railroad bridge and the water quality monitoring site and along the bank protection project upstream of Riverside Bridge (Table 7).
 - Highest abundance of *O. mykiss* in June surveys since 2005 based on catch per unit effort (CPUE) (Table 11).
 - Three length class modes: 60-90 mm FL, 100-210 mm, and 220 mm and larger comprising 9%, 90%, and 2% of the total catch respectively (Figure 11).
 - Most *O. mykiss* captured in June were likely age 1+ at lengths from ~100mm to ~210mm (Table 8 and Figure 11).
 - All of the fish less than 90 mm were parr stage; the larger size classes were a mixture of parr and smolt (Figure 12). Smolts made up 25% of the steelhead catch in June.
 - There was no apparent correlation of steelhead catch with any of the water quality parameters. Nearly as many steelhead were captured at sites with bottom salinity greater than 20 ppt (156 fish) as at sites with bottom salinity less than 3 ppt (199).

Table 7. Fish catch in San Lorenzo River lagoon, June 2011.

Species	Around Trestle (2)	Between Trestle and WQ site (3)	Marsh Outlet (4)	Upstream of Riverside Bridge (5)	Bend near Laurel Ave. (6)	Grand Total
<i># Hauls</i>	18	4	1	2	2	27
Pacific herring	1					1
Sacramento sucker	1					1
Steelhead	210	31	16	97	1	355
Topsmelt	391	1326		1		1718
Stickleback	3					3
Bay pipefish	5					5
Sculpin	193			1		194
Staghorn sculpin	277	9	40	1		327
Shiner surfperch	250					250
Starry flounder	53					53
Shrimp	2					2
<i>Steelhead CPUE</i>	12	8	16	48	0.5	13

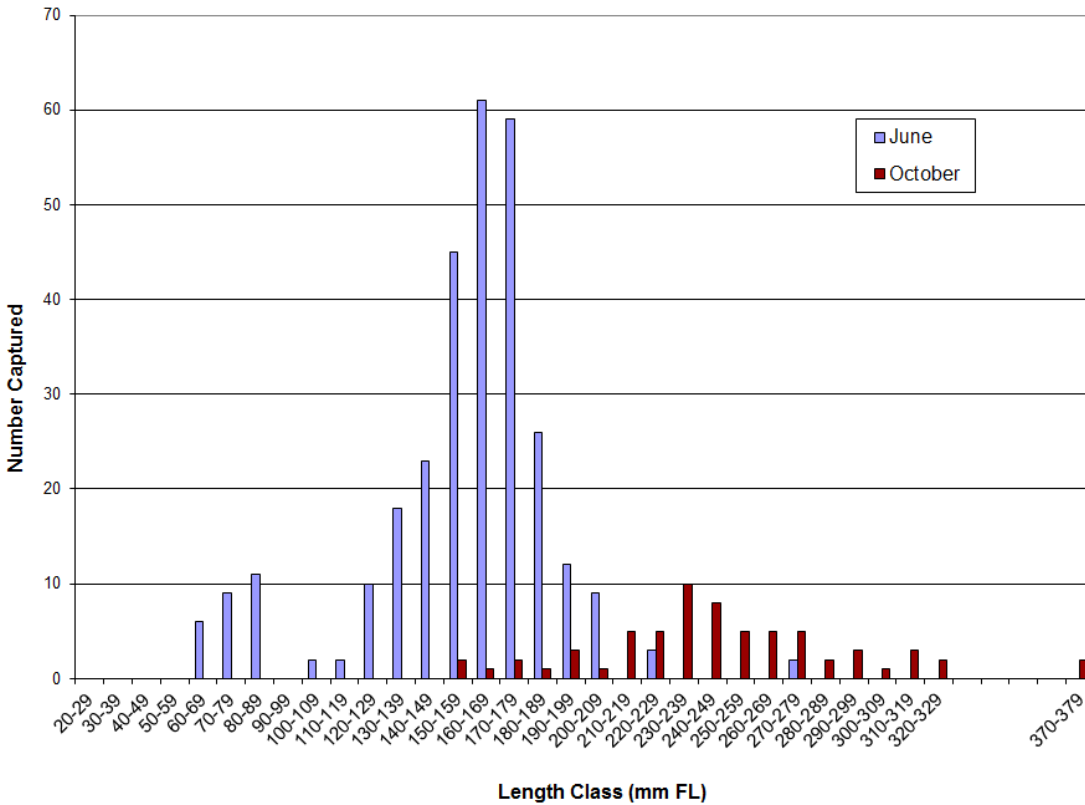


Figure 12 Steelhead length classes in San Lorenzo Lagoon, 2011.

Table 8. Results of Age Determination of Juvenile Steelhead in San Lorenzo Lagoon, June 2011
(courtesy of Michelle Leicester, CDFG).

Date	Length (mm FL)	Age	Length at Annulus 1
9-Jun-11	174	1+	129
9-Jun-11	174	1+	87
9-Jun-11	175	1+	114
9-Jun-11	178	1+	71
9-Jun-11	179	1+	92
9-Jun-11	179	1+	95
9-Jun-11	180	1+	102
9-Jun-11	202	1+	113

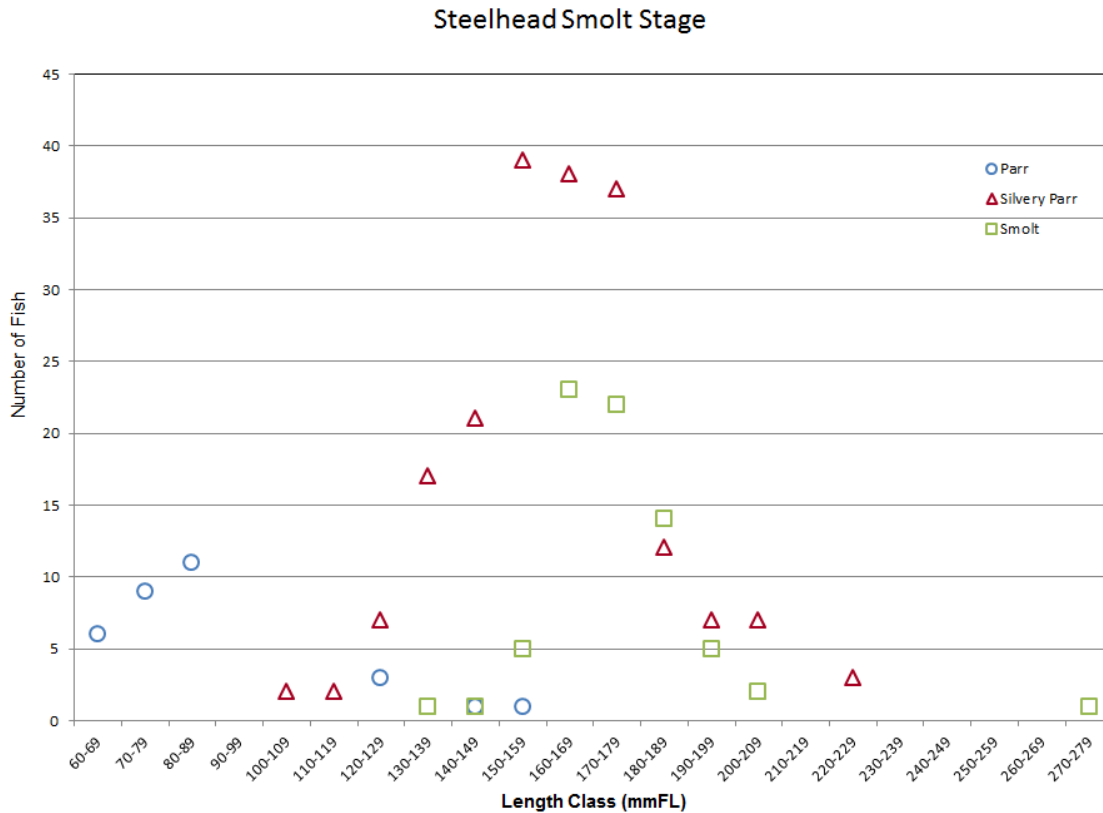


Figure 13 Steelhead smolt stage by length class, San Lorenzo Lagoon, June 2011.

- *O. mykiss* population estimate
 - All *O. mykiss* captured were marked on June 9 and 10 by clipping a small piece of the lower lobe of the caudal fin. No steelhead smaller than 50 mm were captured.
 - A total of 92 *O. mykiss* were marked including 6 between 50 and 74 mm FL and 86 75 mm FL or larger. A total of 11 marked fish were recaptured during the mark period.
 - On June 13 and 14, a total of 252 *O. mykiss* 50 mm FL or larger were captured of which 46 had been marked on June 9-10.
 - Population estimate using the Petersen method (Ricker 1975) is 501 *O. mykiss* larger than 50mm FL in the lagoon in June. The 95% confidence limits for this estimate are 377 and 663.
 - There was support for the assumption of a mixed population for mark/recovery estimates: No steelhead were captured at stations near Riverside Bridge or upstream on June 10 during the marking period so none were marked there. However, during the recovery period on June 14, 15% of steelhead captured at these locations were marked. The marked proportion at these locations was comparable with the marking proportion for the population as a whole (18%).

Fall (October 13-14 and 17-18)

- Site Conditions
 - Lagoon open, tidal (Figures 13 and 14). Water quality monitoring conducted by the City and 2NDNATURE indicated that the lagoon had been open until August 31, then closed for 5 days, then closed again September 19-23, with periods of muted tidal exchange in between.
 - Early storm beginning around October 3 resulted in flows into the lagoon of over 100 cfs on October 5. Inflow declining from 34 cfs on October 9 to about 20 cfs on October 18. The mouth closed briefly between October 15 and 17.
 - During the fish census period, no samples had bottom salinity less than 28 ppt, and surface salinity ranged from 1.5 to 4.5 ppt.
 - Surface temperature 15.3-18°C, bottom temperature 16.4-18.7°C.
 - Surface DO ranged from 5.8-8.4 mg/l and bottom DO measurements were 0.1-6.4 mg/l. Steelhead were captured at sites with bottom DO 2.2 mg/l or less (57% of total catch) and sites with DO of 5.7 or more (43% of total catch).
 - Visibility was fair to good.



Figure 14 San Lorenzo Lagoon mouth, October 13, 2011.



Figure 15 San Lorenzo Lagoon near Riverside Drive, low tide, October 13, 2011.

- Survey results
 - 33 hauls between beach and bend upstream of Riverside Bridge.
 - Catch included a total of 19 species including six fish species and two invertebrates not previously seen in this study: jack mackerel, chinook salmon, giant kelpfish, barred surfperch, redbtail surfperch, dwarf surfperch, Dungeness crab, and kelp crab (Table 9).
 - Catch dominated by very abundant topsmelt.
 - Steelhead were captured at all sites but most abundant near water quality monitoring site and along steep bank to railroad bridge, and along the bank protection project upstream of Riverside Bridge (Table 9).
 - CPUE for steelhead about 20% of June CPUE.
 - Steelhead ranged in size from 150 mm(FL) to 329 mm with one individual at 373 mm (Figure 11). 75% of steelhead were between 190 and 290 mm.
 - Analysis of scale samples revealed that these steelhead included age 0+, 1+, and 2+ fish (Table 10). This is in contrast to fall 2010 when large numbers of primarily 0+ steelhead were in the lagoon.
 - Only one of the steelhead was characterized as parr stage, all others were characterized as silvery parr (many advanced to close to smolt stage), and smolts based on external characteristics. Silvery parr were 80% of the catch and smolts were 19% (Figure 15).

- There were no obvious correlations of steelhead catch with any of the water quality parameters. All sites where steelhead were captured had bottom salinity over 28 ppt and steelhead were caught across the full range of surface salinity (1.5 ppt to 4.5 ppt). More steelhead captures occurred at sites with bottom DO of 2.2 mg/l or less (46 fish) than at sites with DO of 5.7 or more (35 fish). Most steelhead were captured at sites with surface DO between 7.1 and 7.6 mg/l but some were also captured at sites with surface DO of 5.8 (4 fish) and 8.4 (9 fish).
- Contrast to 2010: in 2010, steelhead abundance (CPUE) increased over the course of the summer with abundance of 0+ fish greater in October than in June or July. These 0+ fish were large, about 100 to 160 mm FL in October with some in the 200mm size class. This may indicate good upstream and lagoon rearing conditions in 2010 with y-o-y moving down into the lagoon through the summer. Conversely, steelhead in the 130-200 mm size class present in June 2010 were not present in the lagoon that October. With open lagoon conditions through the summer of 2010, some steelhead present early in the summer may have also gone to sea by October. In 2011, we started with abundant, large, 1+ age steelhead (120-200mm) with declining abundance but apparently good growth over the summer. The difference between the smallest size steelhead in June and October was 90mm and the difference in the peaks of the distributions was about 70mm, giving estimated growth rates of between 0.7 and 0.5 mm/day.
- Several steelhead were infected with *Salmincola*, this parasite has not been seen in the lagoon in previous surveys.
- Five chinook salmon were captured. All were between 232 and 235 mm FL and had clipped adipose fins.

Table 9. Fish catch in San Lorenzo River lagoon, October 2011.

Species	Around Trestle (2)	Between Trestle and WQ site (3)	Marsh Outlet (4)	Upstream of Riverside Bridge (5)	Bend near Laurel Ave. (6)	Grand Total
<i># Hauls</i>	15	7	1	6	4	33
Steelhead	26	40	1	13	1	81
Chinook salmon	5					5
Topsmelt	1238	426	32	1718	629	4043
Stickleback	2					2
Bay pipefish		2				2
Prickly sculpin	5	5		2		12
Sculpin	1					1
Staghorn sculpin	32	5	8	2		47
Jack mackerel	1					1
Shiner surfperch	3			5		8
Barred surfperch	1					1
Redtail surfperch	1					1
Dwarf surfperch	2	1				3
Giant kelpfish	1					1
Starry flounder	7	1	1	6		15
Dungeness crab	17	5				22
Kelp crab	1					1
Crab	8	3				11
Shrimp				1		1
<i>Steelhead CPUE</i>	<i>1.7</i>	<i>5.7</i>	<i>1</i>	<i>2.2</i>	<i>0.25</i>	<i>2.5</i>

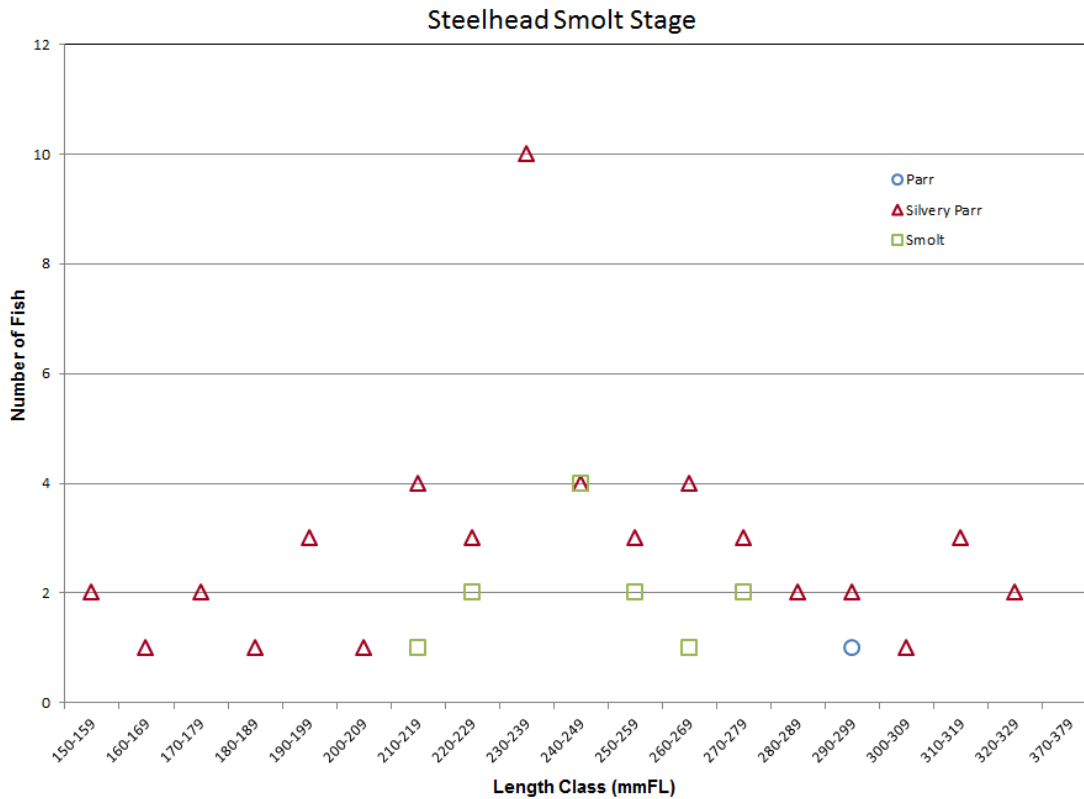


Figure 16 Steelhead smolt stage by length class, San Lorenzo Lagoon, October 2011.

Table 10. Results of Age Determination of Juvenile Steelhead in San Lorenzo Lagoon, October 2011 (courtesy of Michelle Leicester, CDFG).

Date	Length (mm FL)	Age	Length at Annulus 1	Length at Annulus 2
13-Oct-11	153	0+		
14-Oct-11	174	0+		
13-Oct-11	197	0+		
13-Oct-11	235	1+	93	
13-Oct-11	238	1+	86	
13-Oct-11	238	1+	99	
13-Oct-11	241	1+	88	
13-Oct-11	248	0+		
13-Oct-11	253	0+		
13-Oct-11	262	1+	138	
13-Oct-11	285	2+	86	120
13-Oct-11	293	2+	92	159
13-Oct-11	294	1+	88	
18-Oct-11	303	1+	126	
18-Oct-11	318	2+	87	144
13-Oct-11	328	1+	122	

Table 11. Steelhead catch per haul for the San Lorenzo River lagoon during recent sampling events (data from H.T. Harvey and Associates 2003, 2NDNATURE 2006, Ellen Freund (NOAA Fisheries), HES 2005, HES 2009, HES 2010, and HES 2011).

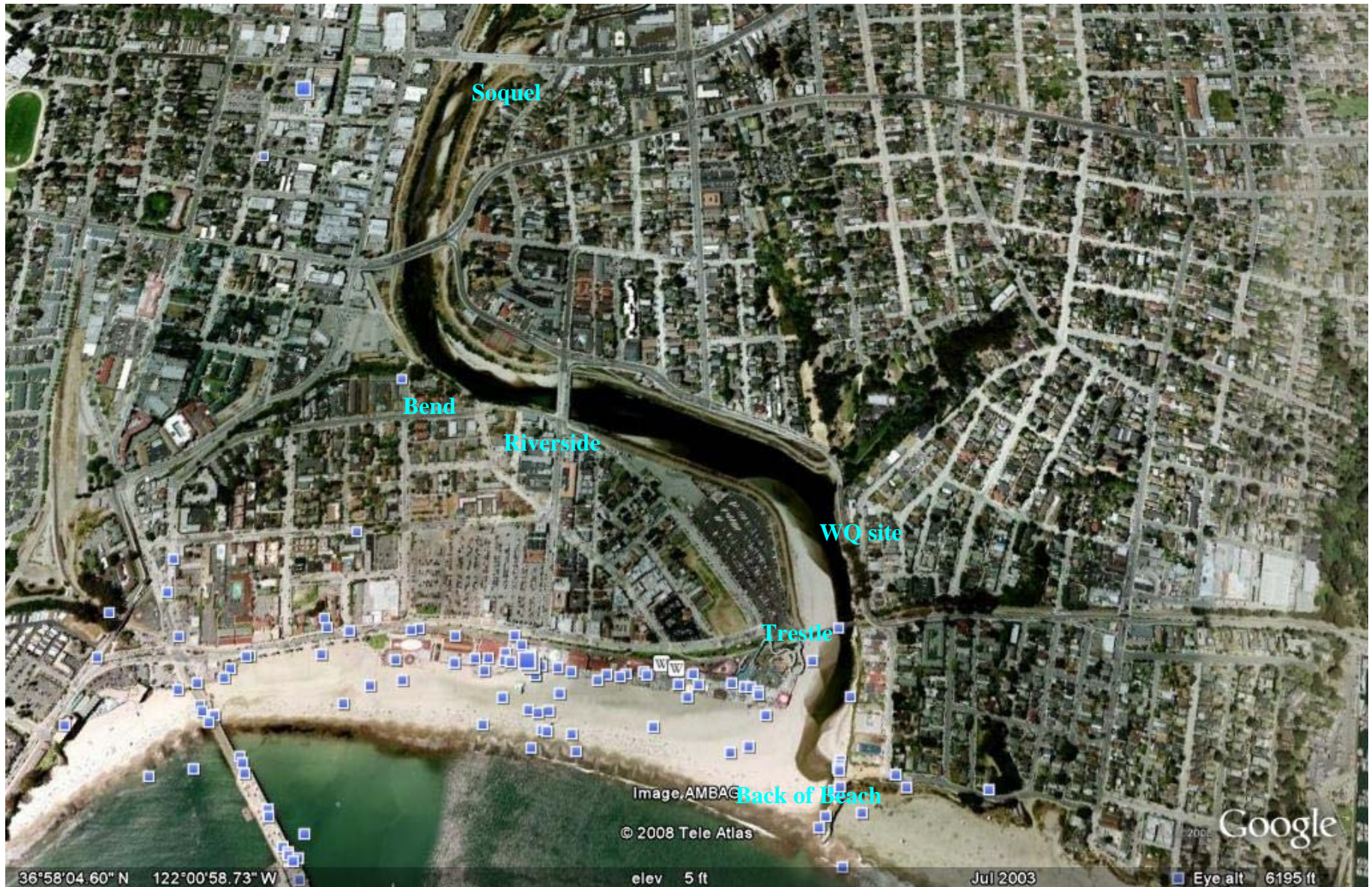
Station	Location	Steelhead Catch per Haul					
2002						1 Oct	20 Nov
SL-2	RR Trestle						0.0
SL-3	Near YSI Site					5.5	
SL-4	Below Riverside						
SL-5	Riverside Drive						9.0
SL-7	Laurel St.						1.0
SL-8	Soquel Ave.					20.0	0.3
2004			6 July		21 Sep	29 Sep	
SL-1	Near Mouth				0.0	0.0	
SL-2	RR Trestle		24.5			0.5	
SL-3	Near YSI Site		20.0				
SL-4	Below Riverside		0.0				
SL-5	Riverside Drive		62.0		0.0	0.0	
SL-6	U/S Bank Restoration		3.0			0.0	
SL-7	Laurel St.		3.0				
SL-8	Soquel Ave.				0.0	0.0	
2005		14 Jun	14 Jul	16 Aug		5 Oct	
SL-1	Near Mouth	0.0	0.0	1.7		0.0	
SL-2	RR Trestle	28.0	5.3	179.5		0.0	
SL-5	Riverside Drive	0.0	12.3	10.7		62.7	
SL-8	Soquel Ave.	7.7	1.0	0.0		0.0	
2008		8, 19 Jun				7-8 Oct	
SL-1	Near Mouth	0				0	
SL-2	RR Trestle	9				0.25	
SL-3	Near YSI Site	0				0	
SL-5	Riverside Drive	0				0	
SL-6	U/S Bank Restoration	0				0	
SL-8	Soquel Ave.	0				0	
	Overall	2.6				0.1	
2009		10-11 Jun			16 Sep	21 Oct	
SL-2	RR Trestle	0.75			1.0	0.25	
SL-3	Near YSI Site	0.25					
SL-5	Riverside Drive	0				0	
SL-6	U/S Bank Restoration	0				1.5	
	Overall	0.3			1.0	0.5	
2010		22-23 Jun	17 Jul			Oct	
SL-1	Near Mouth	0.0				0	
SL-2	RR Trestle	11.7	0.5			31.3	
SL-3	Near YSI Site		42.5			0	
SL-5	Riverside Drive	0.0				9.0	
SL-6	U/S Bank Restoration	9.0				80.0	
	Overall	8.3	21.5			28.25	
2011		9-14 Jun				Oct	
SL-2	RR Trestle	11.7				1.7	
SL-3	Near YSI Site	7.8				5.7	
SL-4	Near Marsh Outlet	16.0				1.0	
SL-5	Riverside Drive	48.5				2.2	
SL-6	U/S Bank Restoration	0.5				0.3	
	Overall	13				2.5	

O. mykiss population estimate

- All *O. mykiss* captured were marked on October 13 and 14 by clipping a small piece of the lower lobe of the caudal fin.
- A total of 39 *O. mykiss* were marked. All fish captured and marked were 75 mm FL or larger. A total of 5 marked fish were recaptured during the mark period.
- On October 17 and 18, a total of 37 *O. mykiss* were captured of which 10 had been marked on October 13-14.
- Population estimate using the Petersen method (Ricker 1975) is 138 *O. mykiss* larger than 50mm FL in the lagoon in October. The 95% confidence limits for this estimate are 78 and 237. This is 27% of the estimated number present in June.



Laguna Creek Lagoon sampling stations.



San Lorenzo River lagoon sampling stations.

Literature Citations

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