TECHNICAL MEMORANDUM

TO: Chris Berry
City of Santa Cruz Water Department

FROM: Jeff Hagar
Hagar Environmental Science

DATE: June 25, 2015

PROJECT: City of Santa Cruz Habitat Conservation Plan, Lagoon Fish Population Sampling 2014

Steelhead (*Oncorhynchus mykiss*) population abundance and life-history characteristics were assessed in Laguna Creek Lagoon and the San Lorenzo River Lagoon during the summer of 2014 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 a large seine (150 feet long by 8 feet deep). An additional one-day survey was conducted in the San Lorenzo River Lagoon during July. Mark-recapture abundance estimates for *O. mykiss* were completed in both lagoons during both the June and September sampling periods using PIT tags. Fish were tagged one day and recaptured the next day in Laguna Creek Lagoon. In the larger San Lorenzo River Lagoon, fish were captured and tagged on two consecutive days and recaptured during a subsequent two-day period (in the San Lorenzo River Lagoon there were three days between the mark and the recapture period). During July only catch per unit effort (CPUE) was assessed. Fish were checked for tags but no new tags were implanted and no population estimate was made. A summary of the results of the survey follows.

Laguna Creek Lagoon and the San Lorenzo River Lagoon provided very different conditions and were used in very different ways by steelhead. Laguna Creek Lagoon held large numbers of large steelhead through the summer. Laguna Creek Lagoon also recruited rearing steelhead over the summer with the fall population estimate tripling the June estimate and exceeding all previous estimates since 2008. The San Lorenzo River Lagoon was closed from mid-July through the fall and was very warm. The San Lorenzo River Lagoon supported only low numbers of juveniles in June and by September the main lagoon appeared empty of steelhead, with a few individuals occupying the area just below Water Street in very warm temperatures.

Laguna Creek Lagoon

<u>Summary</u>

The winter of 2013-2014 was critically dry with flow in Laguna Creek at less than 1 cfs for much of the winter. Storm flows occurred only for brief intervals during the second week of February (peak 33 cfs), the first two weeks of March (peaking at about 40 cfs), and the first week in April (peak at about 8 cfs). The lagoon closed shortly after the monitoring equipment was installed on May 1 (Figure 1). The extent of open conditions before May 1 is unknown. The lagoon opened briefly in mid-May and remained closed through the fall, at least until November 27. Wave overwash resulted in increasing lagoon stage beginning in early September, with higher salinity, lower dissolved oxygen, and relatively warm temperature.

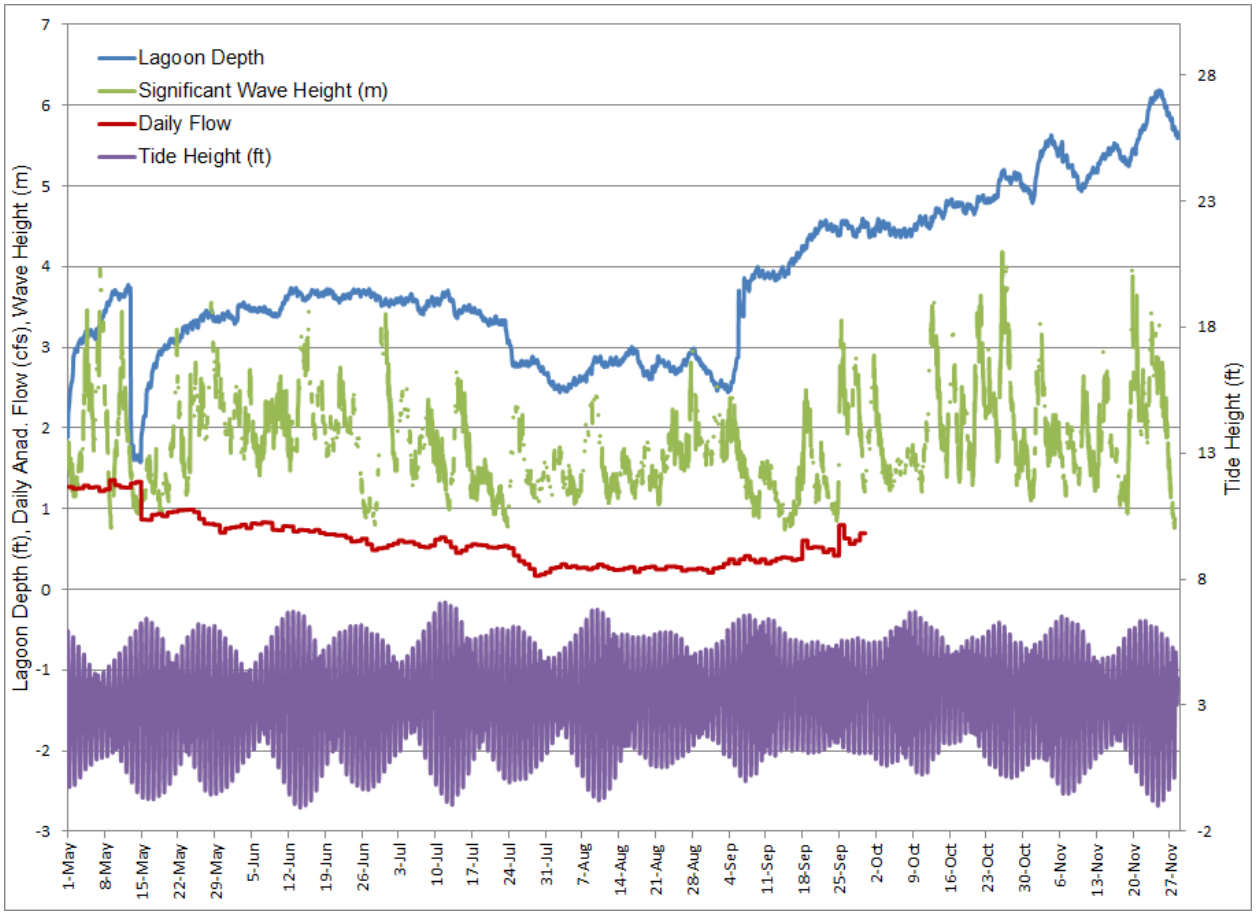

Figure 1. Laguna Creek Lagoon stage, streamflow, wave height, and tides 2014 (Source: lagoon stage from 2ND Nature, streamflow from Balance Hydrologics, wave and tide data from NOAA).

In June, the lagoon contained relatively large numbers of *O. mykiss* in the 120mm to 190mm fork length (FL) size class (probably 1+), including a few holdovers from 2013, but no young-of-year. In September the population estimate of *O. mykiss* in the lagoon was more than triple what it had been in June and the highest population estimate observed for Laguna Creek Lagoon. There is some indication that fish were moving into the lagoon between the mark period and recapture period in September. Larger *O. mykiss* in September (160mm to 240mm FL with a few outliers over 280mm FL) were likely the age 1+ fish that were 120mm to 190mm in June. Average growth of PIT-tagged fish in the 120mm to 190mm size class was 46mm between June and September based on recoveries of tagged fish in September. Smaller fish in September (80mm to 140mm FL) were likely age 0+ fish that had moved into the lagoon after the June survey.

Spring (June 3-4, 2014)

Spring Site Conditions

- Mouth closed, lagoon stage moderately high (~3.5 feet). The surface area at the ocean end was extensive, extending somewhat to the northwest at the beach. There was a large pocket of deep water along the rock bluff and the sand beach at the back of the mouth (Figures 2, 3).
- Inflow from Laguna Creek at about 0.8 cfs.
- Maximum depth to about 6 feet, becoming shallower upstream of the connection to the backwater pond.
- Lagoon fresh throughout, salinity 0.5 ppt or less, temperature ranging from 16.8°C to 18.6°C at surface and 16.2°C to 17.5°C at the bottom; dissolved oxygen 7.3 mg/l or more (saturation 74% to over 100%).
- The water column was clear with substrate visible at all locations (to 6 feet).

Figure 2. Laguna Creek Lagoon, deep pocket opposite mouth, June 4, 2014

Figure 3. Laguna Creek Lagoon, June 3, 2014

Spring 2014 Survey Results

- *O. mykiss* were captured and tagged on June 3. On June 4 the lagoon was re-sampled and the proportion of re-captured fish was recorded.
- Eleven seine hauls were completed between the beach and just downstream of the water quality monitoring station (LA-3) (Table 1).
- CPUE for *O. mykiss* was relatively high at about 20.1 per haul (Table 2).
- The majority of the catch included *O. mykiss* from about 120mm to 190mm FL (likely age 1+ fish), with a few larger individuals. Fish smaller than 80mm FL were absent from the catch, and presumably, the lagoon. The size distribution was slightly larger than the period average (Figure 4). The presence of larger *O. mykiss* in the lagoon was also observed in June 2013.
- Five *O. mykiss* tagged in 2013 were recaptured in spring 2014; four were tagged in June and one in September. Growth rates over the intervening period were relatively low at 0.21mm/day to 0.30mm/day for fish captured in June 2013 and 0.35mm/day for the fish captured in September (Table 3). It is interesting that the fish previously captured in September 2013 experienced a higher growth rate than the four previously captured in June 2013.
- The catch consisted of 32% parr, 57% silvery parr or advanced silvery parr, 3% smolts, and 9% with adult coloration.

- Approximately 6% of *O. mykiss* captured had black spot disease (BSD). *Salmonicola* were observed on about 1% of the catch.
- All *O. mykiss* had an adipose fin intact.
- Numerous small tidewater goby were observed at Station LA-1.5 along the back of beach.
- The overwash pond was not sampled.

Table 1. Fish catch in Laguna Creek Lagoon, June 2014

Species	LA-1	LA-1.5	LA-2	Grand Total
	June 3 and 4			
# Hauls	*6*	*2*	*3*	*11*
O. mykiss	117	21	83	221
Threespine stickleback	1301	385	35	1721
Staghorn sculpin	5	1	1	7
O. mykiss CPUE	*19.5*	*10.5*	*27.7*	*20.1*

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

Table 2. *O. mykiss* and coho salmon catch per seine haul in Laguna Creek Lagoon at consistently sampled stations (data from HES 2005, HES 2009, HES 2010, HES 2011, HES 2012, HES 2013, and HES 2014)

	O. mykiss Catch per Haul				Coho Catch per Haul			
	Jun	Jul	Sep	Oct	Jun	Jul	Sep	Oct
2004		*2.4*	*0*			*0*	*0*	
2008	*11*		*6*		*0*		*0*	
2009	*7*		*19*		*0*		*0*	
2010	*13*			*1.7*	*0*			*0*
2011	*19.8*			*0.1*	*0*			*0*
2012	*11.3*		*10.3*		*0*		*0*	
2013	*28*		*8.6*		*0*		*0*	
2014	*20*		*33*		*0*		*0*	

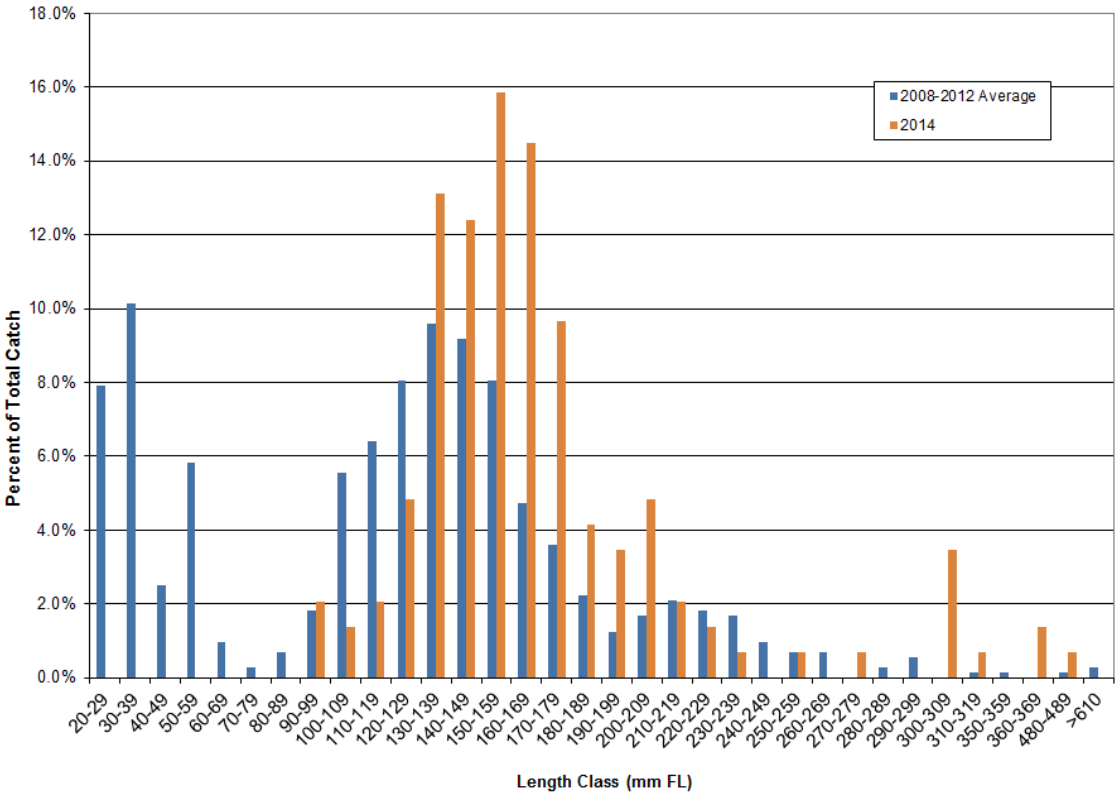

Figure 4. June *O. mykiss* length classes in Laguna Creek Lagoon in 2014 compared to 2008-2013 average

Table 3. Laguna Creek Lagoon *O. mykiss* tagged previously and recaptured in June 2014.

Previous Capture Date	Recapture Date	Initial Length	Length at Recapture	Growth Rate (mm/day)
6/04/2013	6/3/2014	168	278	0.30[1]
6/05/2013	6/3/2014	212	289	0.21
6/05/2013	6/3/2014	216	296	0.22
6/05/2013	6/3/2014	222	311	0.24[1]
9/10/2013	6/3/2014	204	297	0.35[1]

[1]Scale sample collected

Spring 2014 *O. mykiss* Population Estimate

- A total of 117 *O. mykiss* were captured on June 3. One was 480mm FL and was released untagged (fish larger than 370mm FL are not tagged). Fourteen *O. mykiss* captured on June 3 had also been tagged on June 3. One *O. mykiss* died. Therefore, a total of 101 *O. mykiss* were uniquely marked by insertion of a PIT tag in the abdominal cavity during the mark period.
- On June 4, a total of 104 *O. mykiss* were captured with 102 of them between 65mm FL and 370mm FL. Of these, 40 were marked on June 3.
- Population estimate using the Petersen method (Ricker 1975) is 256 *O. mykiss* between 65 and 370mm FL in the lagoon on June 4. The 95% confidence limits for this estimate are 189 and 346.

Fall 2014 (September 9-10)

Fall Site Conditions

- Mouth was closed; stage was relatively high at about 4 feet (2nd Nature data). (Figure 5).
- The lagoon had remained closed since the June survey. Water quality monitoring data indicates periods of slightly elevated bottom salinity in May following closure, and in mid-July and early September (2nd Nature preliminary data). The September increase is associated with rising lagoon elevation indicating significant wave overwash (Figure 1).
- Inflow from Laguna Creek at about 0.4 cfs.
- Maximum depth to about 6 feet, becoming shallower upstream of the connection to the backwater pond.
- Lagoon salinity increasing with depth from about 6 ppt surface to 25 ppt on bottom. Temperature from 14°C to 20°C at the surface to 21°C to 23°C at the bottom; dissolved oxygen 8-11 mg/l at the surface but declining in the saline layer to 4 mg/l.
- The water column was relatively clear with secchi depth of 3.8 to 4.6 feet.

Figure 5. Laguna Creek Lagoon, September 10, 2014.Fall 2014 Survey Results

- *O. mykiss* were captured and marked on September 9. On September 10 the lagoon was re-sampled and the proportion of re-captured fish was recorded.
- Seven seine hauls were completed on September 9 and five hauls on September 10 between beach (LA-1) and just downstream of the water quality monitoring station (Table 4).
- Overall abundance of *O. mykiss* based on number caught per seine haul (catch per unit effort or CPUE) at 33 per haul was the highest recorded for Laguna Creek of all previous years surveys (Table 2).
- The majority of *O. mykiss* were captured near the mouth at Station 1.
- There were two modes in the length distribution: 80mm to 140mm and 160mm to 240mm with a few outliers over 280mm (Figure 6). The 160mm to 240mm size class were likely the age 1+ fish that were 120mm to 190mm in June (average growth of the 120mm to 190mm size class was 46mm between June and September). The smaller size group was likely comprised of fish that had moved into the lagoon after the June survey.
- A total of 94 of the *O. mykiss* captured in September had previously been captured in June. Seventy-two of these were measured in both June and September. Growth rates ranged from 0.12mm/day to 0.80mm/day and averaged 0.43mm/day (standard deviation 0.15) (Figure 7). Three *O. mykiss* captured in September 2014 had also been captured in September 2013. Growth of these individuals ranged from 0.33mm/day to 0.45mm/day and averaged 0.37mm per day. This was not significantly different from average growth rates from June to September and indicates that winter growth rates may have been comparable to summer growth rates. Ten *O. mykiss* captured in September 2014 had also been captured in June 2013. Growth rates of these individuals ranged from 0.14 mm/day to 0.37mm/day (average 0.25mm/day). The lower average growth rate of this group may be accounted for by the fact that many of these were larger individuals which tend to have lower growth rates. It is unclear whether the individuals marked in 2013 had been in the lagoon the entire period or whether they may have spent some time in the sea or upstream of the lagoon.
- CPUE for the 160mm to 240mm size class in September was comparable to the CPUE for the 120mm-190mm size class in June (11.2 vs 9.8 per haul) indicating good survival over the summer (see also Figure 6).
- Twenty-three percent of the catch was characterized as parr, 58% were silvery parr or advanced silvery parr, and 18% had the external coloration and appearance of adult stream fish (no parr marks, not particularly silvery, not thin, no blackened caudal margin, and “rainbow” coloration).
- About 5 percent of *O. mykiss* examined had light to moderate black-spot disease.
- All *O. mykiss* examined had an adipose fin intact.
- The overwash pond was not sampled.

Table 4. Fish catch in Laguna Creek Lagoon, September 2014

Species	LA-1	LA-1.5	LA-2	Grand Total
	September 9 and 10			
# Hauls	*7*	*3*	*2*	*12*
O. mykiss	375	23		398
Threespine stickleback	37	6	15	58
Staghorn sculpin	6	2	1	9
O. mykiss CPUE	53.6	7.7	0.0	33.2

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

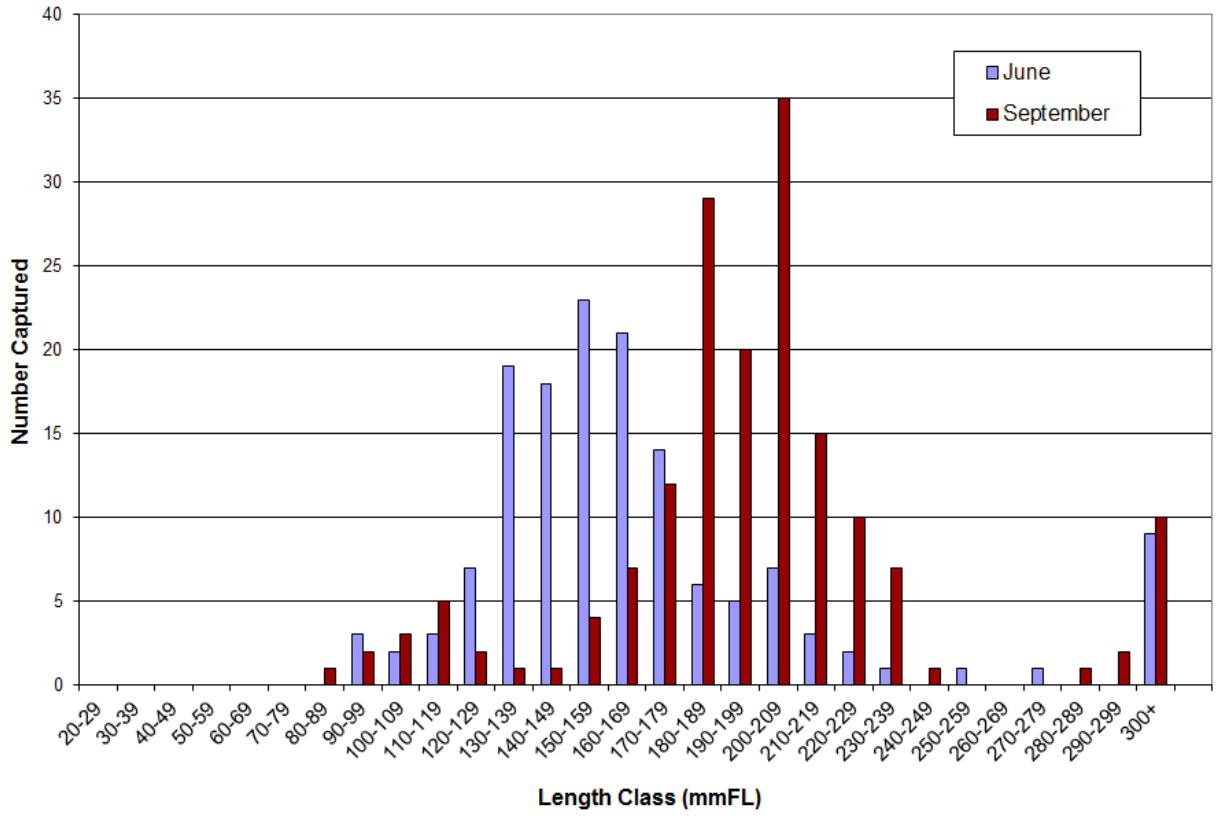

Figure 6. *O. mykiss* length classes in Laguna Creek Lagoon, 2014

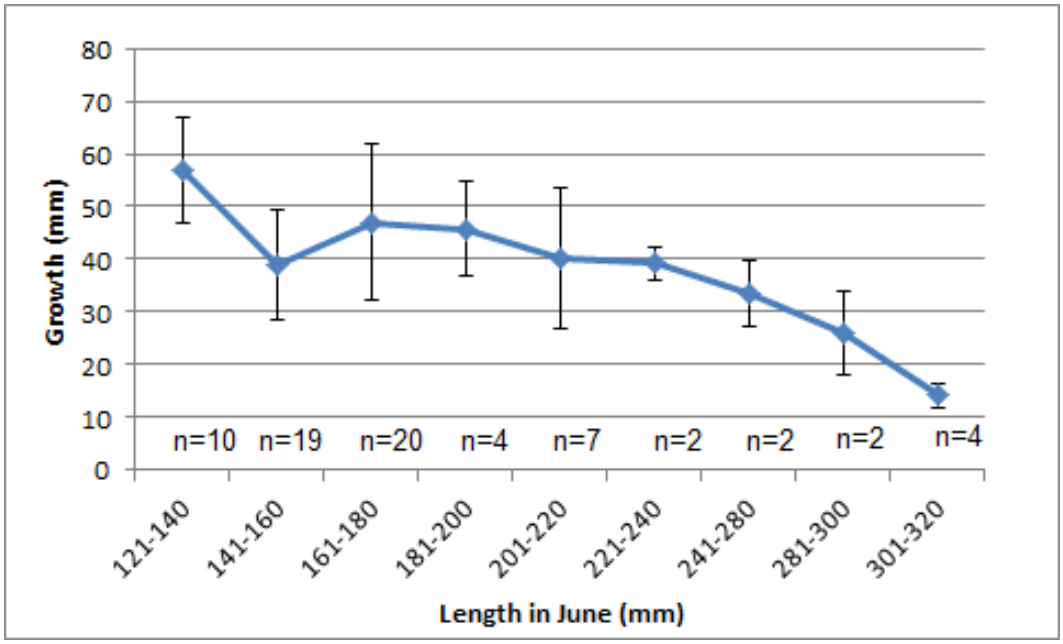

Figure 7. Growth of *O. mykiss* captured in June and recaptured in September in Laguna Creek Lagoon, 2014

Fall 2014 *O. mykiss* Population Estimate

- All *O. mykiss* captured on September 9 were larger than 50mm FL. Five *O. mykiss* were over 320 mm and were not included in the population estimate. A total of 48 *O. mykiss* were marked by insertion of a PIT tag in the abdominal cavity. An additional 26 *O. mykiss* were recaptured fish that had been tagged previously. These were also included as marked fish for a total of 74 marked fish.
- On September 10, a total of 308 *O. mykiss* between 50 and 320mm were captured. Seven fish over 320 mm were also captured but excluded from the analysis since fish over 320mm were not marked. Of the 308 *O. mykiss* captured, 27 were marked on September 10.
- Population estimate using the Petersen method (Ricker 1975) is 828 *O. mykiss* larger than 50mm and smaller than 320 mm in the lagoon on September 10. The 95% confidence limits for this estimate are 575 and 1186. The fall population estimate was over three times the population estimate in the spring. This would indicate that numerous *O. mykiss* entered the lagoon after June. Since the lagoon was closed throughout the period, these fish could only have come from areas upstream of the sample area. Based on the length frequency distribution (Figure 6), this would have included fish in the 80mm to 150mm size class (likely young-of-year or 1+) as well as older fish. It is possible that the lagoon provided better rearing than upstream areas in this low-flow year.
- Some of the fish present may have moved into the lagoon during the recapture period. CPUE increased from 12 fish per haul on September 9 to 63 fish per haul on September 10. On the 9th, 30 out of 78 fish or 38% were recaptures; most of these had been tagged in June or 2013. On September 10th, after marking 74 fish, 127 out of 315 fish captured (40%) were recaptures. We would have expected the recapture rate to increase with more tagged fish in the lagoon.
- Recapture rate for *O. mykiss* tagged on September 9 and recaptured on September 10 was 27 out of 74 tagged or about 36%.
- A total of 77 *O. mykiss* tagged in June were captured on September 10. If capture efficiency was the same for these fish as for the fish tagged September 9, they would represent 77/0.36 or 214 *O. mykiss* in the lagoon on September 10 that were tagged in June. However, only 146 *O. mykiss* were tagged in June. Although there is undoubtedly some error in these estimates, the indication is that survival of *O. mykiss* present in June was good.

San Lorenzo River Lagoon

Summary

City of Santa Cruz monitoring data shows that the lagoon was closed for much of the time between May 1 (when the monitor was installed) and the end of October. It was open briefly from May 17 to May 24, and breached on May 31 and June 4 but closed right away on both dates. Another breach on July 9 was followed by open conditions through July 15. A controlled limited breach was conducted by the City on September 26 and 27 with the lagoon open and flowing out during the day with mechanical closure afterward. Lagoon stage was reduced from about 7 feet on September 26 to about 5 feet at the end of the day on the 27th.

The lagoon had just closed after a brief (one day) opening the day prior to the survey. Although there was some cooler water near the mouth initially due to the recent breach, most of the lagoon was very warm by the end of the survey period with mid-water temperatures of 22°C to 25°C near the mouth and 25°C to 32°C upstream of the Riverside Bridge. Catch rates for steelhead were relatively low with CPUE of 1.2 fish per haul in June. Steelhead were most abundant in the cooler water near the mouth although some were captured upstream of Riverside even though most of the water column (except for the surface 1 foot to 1.5 feet) was hot.

The July survey was also conducted immediately following lagoon closure though the lagoon had been open a week this time. The lagoon was actually cooler than it had been in June, no doubt due to it having been open to tidal circulation for the previous week. Catch rate was similar to June with CPUE of 1.1 fish per haul. The steelhead population structure appeared to shift between June and July. Predominantly young-of-year and 1+ fish were present in June while larger fish with the appearance of having been in the ocean appeared in July. Appearance of ocean-type fish during or following open lagoon conditions in summer has been observed in previous years as well.

By the time of the fall survey, the lagoon had been closed for over two months with gradually increasing stage and the lagoon was warm, relatively saline, but well oxygenated except for the deepest areas. Surface temperature had peaked in late-July and early-August at 22°C to 25°C (2ndNature in prep.). Surface dissolved oxygen levels had also declined intermittently to levels below 2 mg/l during the late-July and early-August period (2ndNature in prep.). Near the bottom of the water column temperature reached over 30°C during this period and dissolved oxygen levels were often near 0.0 mg/l. No steelhead were captured in the initial two days of seining. Since no steelhead were marked the lagoon was not resurveyed for recaptures. Instead, since the lagoon stage was high, sampling was conducted further upstream than usual, between Water Street and the lower pedestrian bridge, to see if fish had moved out of the lower lagoon into this area. Temperature conditions were actually worse in this reach than in the lower lagoon with mid-water temperatures of 24°C to 27°C on September 15. In spite of high temperature, a few smolt-sized steelhead were captured in this section.

Spring 2014 (June 5-6, 9-10)

Spring Site Conditions

- The lagoon had just closed on the day prior to spring sampling, after having been open briefly for about one day (Figure 8). Daily average flow at Santa Cruz gage ranged between 2.6 cfs and 4.5 cfs during the surveys (USGS data).
- Lagoon stage was low on June 5 (about 1.7 ft. NGVD29) but increased to 3.3 feet on the last day of the recapture period.
- Near the mouth initially there was a reverse thermocline with warm (22°C to 23°C), fresher water in the upper 2.5 feet and cooler (18.5°C to 20°C), more saline water below. This was likely the result of brief seawater influx during the brief opening.
- Later in the survey period (June 9-10), the temperature was 18°C to 20°C at the surface and warmer with depth: 22°C to 25°C near the mouth and 25-32°C upstream of Riverside Bridge.
- The lagoon was more turbid during the mark period (June 5-6) with secchi depths of 2.8 feet to-3.8 feet. During the recapture period (June 9-10) clarity increased with secchi depth of 6.8 feet near the mouth and 4.4 feet near Riverside Bridge.

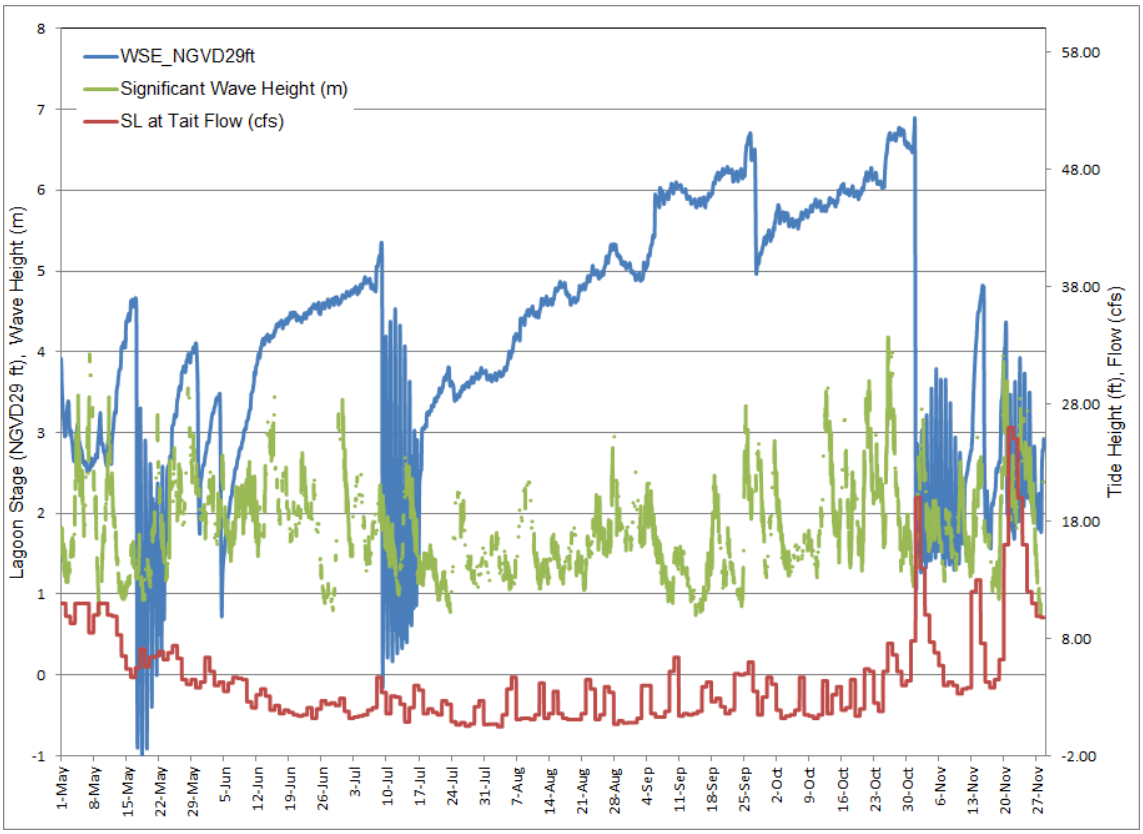

Figure 8. San Lorenzo River Lagoon stage, streamflow, wave height, and tides 2014, (Source: lagoon stage from 2ND Nature, streamflow from USGS, wave and tide data from NOAA)

Spring 2014 Survey Results

- *O. mykiss* were captured and marked on June 5 and 6 and the lagoon was resampled on June 9 and 10. Untagged *O. mykiss* captured on June 9 and 10 were also tagged for over-summer information.
- Completed 31 hauls between the beach and the bend upstream of Riverside Bridge.
- *O. mykiss* were present at low abundance (1.2 per haul) and were most abundant oceanward of the railroad trestle bridge (Table 5).
- O. mykiss were primarily 110mm to 180mm FL, probably age 1+, with a couple of smaller fish in the 60mm to 90 mm FL size class, probably age 0+ (Figure 9). Abundance (measured as CPUE) was somewhat lower during the recapture period (0.7 per haul) compared to the mark period (1.8 per haul). Although numbers are too low to make conclusive observations, the smaller size class appeared in the catch during the recapture period after the lagoon had been rising for a few days after closure. This pattern has been observed in previous years including 2013 (HES 2014).
- Thirty percent of *O. mykiss* captured were at the parr or advanced parr stage, 58% were silvery parr or advanced silvery parr, and 12% were smolts.
- All 33 *O. mykiss* examined had an adipose fin, indicating they were not of hatchery origin.

Table 5. Fish catch in San Lorenzo River Lagoon, June 2014

Species	South of Trestle (1)	Around Trestle (2)	Between Trestle and WQ site (3)	Upstream of Riverside Bridge (5)	Bend near Laurel Ave. (6)	Grand Total
# Hauls	*5*	*11*	*3*	*6*	*6*	***31***
Northern anchovy		1				**1**
Pacific herring	5	11	4		1	**21**
Steelhead (*O. mykiss*)	16	10	3	3	5	**37**
Chinook salmon	2	1				**3**
Topsmelt	1160	7430	3370	3020	1403	**16383**
Threespine stickleback	1	1		6	5	**13**
Bay pipefish				2		**2**
Staghorn sculpin	66	191	32	25	2	**316**
Shiner surfperch	16	61	7			**84**
Dwarf surfperch	4					**4**
Bay goby		1				**1**
Starry flounder	1					**1**
Crab	133	934	147	42	27	**1283**
O. mykiss CPUE	*3.2*	*0.9*	*1.0*	*0.5*	*0.8*	***1.2***

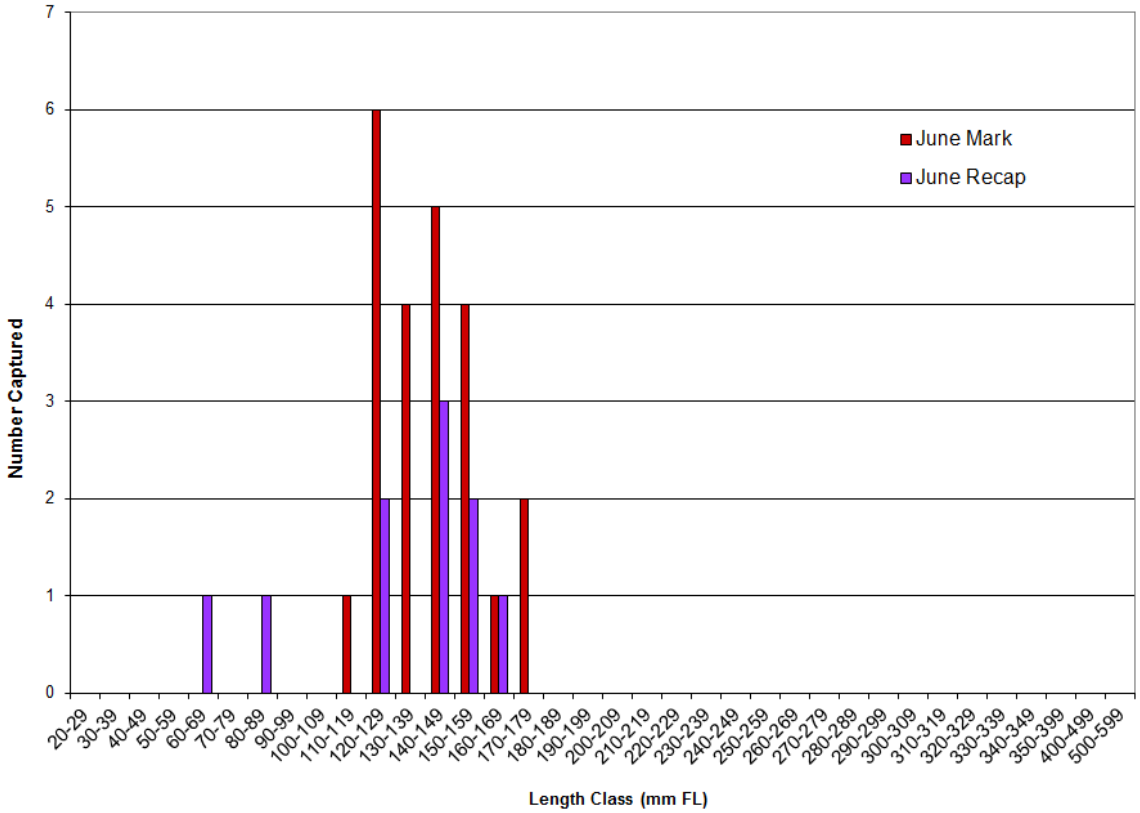

Figure 9. June 2014 *O. mykiss* length classes in San Lorenzo River Lagoon during mark and recapture periods

Spring 2014 *O. mykiss* Population Estimate

- A total of only 25 *O. mykiss* were captured during the marking period. All were larger than 50 mm and smaller than 320 mm. Two fish were captured twice. A total of 23 *O. mykiss* were marked with PIT tags on June 5 and 6.
- Twelve *O. mykiss* were captured during the recapture period. None of these had been tagged during the marking period.
- Population estimation was not possible due to lack of recaptures.
- All untagged fish captured during the recapture period were tagged in order to collect over-summer information. Two of these were recaptured during the recapture period.

Summer 2014 (July 17)

The July survey was a one-day relative abundance survey requested by the California Department of fish and Wildlife (CDFW). In order to minimize potential harmful effects during potentially stressful mid-summer conditions, captured fish were not tagged and no population estimation was conducted. Sampling was only conducted at Stations 2 and 3, around the railroad trestle bridge and up to the WQ (water quality) Station.

Summer Site Conditions

- The lagoon had just closed at the time of sampling, after having been open for about a week. USGS data show daily average flow at Santa Cruz gage of 3.6 cfs on the 17th.
- The lagoon stage was about 2.5 feet NGVD29 in the morning, increasing to about 3 feet at the end of the day. There was extensive sand beach south of the railroad trestle bridge and upstream of Riverside Bridge.
- The lagoon was quite saline, cool, and well-oxygenated reflecting recent open conditions.
- Water column salinity ranged from 25 ppt to 33 ppt with a thin layer of lower salinity water just at the surface (11 ppt to 23 ppt).
- Water column temperatures ranged from 15°C to 17°C near the mouth to 18°C to 20°C upstream of Riverside Bridge.
- Dissolved oxygen was 7-10 mg/l. The water column was very clear with the bottom visible at depths up to 8 feet.

Summer Survey Results

- The July survey was a one-day relative abundance survey requested by CDFW. In order to minimize potential harmful effects during potentially stressful mid-summer conditions, captured fish were not tagged and no population estimation was conducted. No scales were taken.
- Completed 9 hauls between the beach and the water quality buoy and upstream of Riverside Bridge (Table 6). The relatively cool water temperature following open lagoon conditions allowed seining to continue into the afternoon.
- Catch rates (CPUE) were comparable to June (Table 7).
- Two size classes of *O. mykiss* were present in July (Figure 10). The smaller mode of fish from 140-190 mm FL is consistent with fish present in June, possibly with a little growth. A larger mode of fish from 240 mm to 300 mm FL likely entered the lagoon after June. No fish this large were present in June and growth of the largest fish in June would not account for this group.
- Fish in the smaller mode were characterized as silvery parr. One fish (295 mm FL) was characterized as a smolt based on coloration and black margin of the caudal fin but was quite plump for a smolt (Figure 11). The larger fish all had the appearance of ocean fish (Figure 12).

- All 10 *O. mykiss* examined had an adipose fin, indicating they were not of hatchery origin.
- There were no recaptures of fish tagged in June.

Table 6. Fish catch in San Lorenzo River Lagoon, July 2014

Species	South of Trestle (1)	Around Trestle (2)	Between Trestle and WQ site (3)	Upstream of Riverside Bridge (5)	Bend near Laurel Ave. (6)	Grand Total
# Hauls	*1*	*2*	*2*	*2*	*2*	***9***
Pacific herring			53			**53**
Steelhead (*O.mykiss*)		7	1		2	**10**
Topsmelt	1	20	6	586	1419	**2032**
Threespine stickleback			1	2	3	**6**
Bay pipefish						
Staghorn sculpin				1	1	**2**
Shiner surfperch			1		1	**2**
Crab				1		**1**
O. mykiss CPUE	*0.0*	*3.5*	*0.5*	*0.0*	*1.0*	***1.1***

Table 7. *O.mykiss* catch per haul for the San Lorenzo River Lagoon during 2014

Station	Location	*O. mykiss* Catch per Haul					
2014		5-10 Jun	17 July		Sep 11-15		
SL-1	South of Trestle	3.2	0		0		
SL-2	RR Trestle	0.9	3.5		0		
SL-3	Near WQ Station	1.0	0.5		0		
SL-5	Riverside Drive	0.5	0		0		
SL-6	U/S Bank Restoration	0.8	1		0		
SL-8	Water Street				1.1		
	Overall	***1.2***	***1.1***		***0.0***[1]		

[1] Including regularly sampled sites only

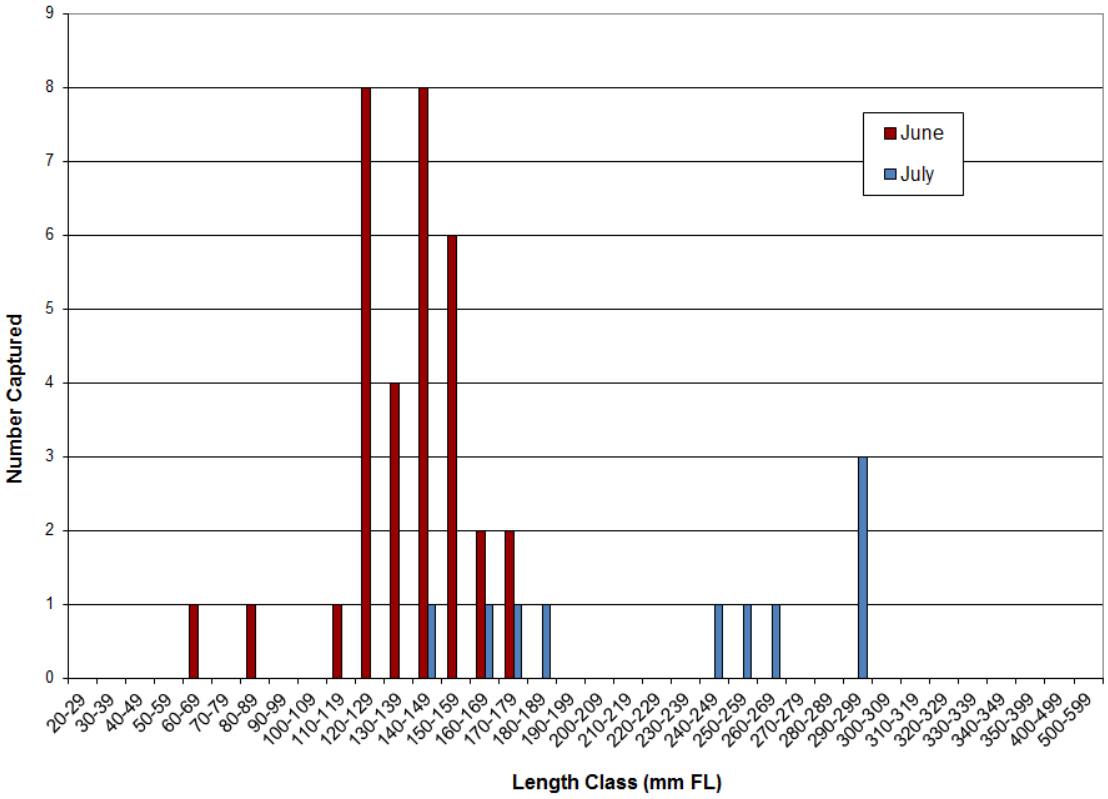

Figure 10. *O. mykiss* length classes in San Lorenzo River Lagoon, June and July 2014

Figure 11. *O. mykiss* smolt caught July 17, 2014 in the San Lorenzo River Lagoon

Figure 12. Large *O. mykiss* caught July 17, 2014 in the San Lorenzo River Lagoon

Fall 2014 (September 11-12 and 15)

Fall Site Conditions

- Lagoon was closed during the survey period. The stage was high at 5.9 feet to 6.0 feet NGVD29. It had been closed since mid-July. The water was relatively clear, with secchi disk readings of 4.7 feet to 5.4 feet.
- Salinity at the time of the survey was 5 ppt to 7 ppt at the surface with gradual increase to 10 ppt at a depth of 6 feet and increase to 18 ppt to 22 ppt below 8 feet.
- Temperature was 19°C to 20°C at the surface increasing to as much as 22°C at a depth of 1.5 feet and to as much as 23°C to 24°C in water over 2 feet deep.
- Dissolved oxygen was high through the upper water column at levels ranging from 10 mg/l to 18 mg/ l. Oxygen depletion at levels below 5 mg/l occurred only at depths of 9 feet or more.
- Between Water Street and the pedestrian bridge conditions were warm, well-oxygenated, and slightly fresher than the main lagoon downstream. Salinity was 0.1 ppt to 0.8 ppt at the surface and increasing from 6 ppt to 10 ppt at depth (up to 5 feet). Temperature was warmer than the lower lagoon with surface temperature of 18°C at Water Street increasing to 23.7°C at the pedestrian bridge. Mid-water temperatures ranged from 24°C to 27°C. Dissolved oxygen was lowest at the surface from 6.3 mg/l at Water Street to 11 mg/l at the pedestrian bridge. Below 1.5 feet of depth dissolved oxygen was super-saturated at over 20 mg/l.

Fall 2014 Survey Results

- Eleven seine hauls were completed at Stations 1, 2, 3, 5, and 6 on September 11 and 12. No *O. mykiss* were captured. Since no *O. mykiss* were tagged, no recaptures were possible and no additional seining was completed at these sites.
- Catch of all fish species was low in the lower lagoon (Table 8).
- Catch rates were higher for most species between Water Street and the pedestrian bridge than in the lower lagoon.
- The 8 steelhead captured were caught in a single haul just downstream of Water Street. They were somewhat thin and all but one had the appearance of stream fish (parr marks and coloration). The exception was characterized as a silvery parr. Lengths of these fish ranged from 122 mm to 180 mm FL. All had adipose fins. Thirty-eight percent had light to moderate black spot infestations. None of these fish were tagged.

Fall 2014 *O. mykiss* Population Estimate

- No *O. mykiss* captured during the mark period on September 11 and 12.
- No population estimate is possible though it is likely the population was at or close to zero.

Table 8. Fish catch in San Lorenzo River Lagoon, September 2014

Species	South of Trestle (1)	Around Trestle (2)	Between Trestle and WQ Station (3)	Upstream of Riverside Bridge (5)	Bend near Laurel Ave. (6)	Downstream of Water St. (8)	Grand Total
# Hauls	*1*	*5*	*1*	*2*	*2*	*7*	
Steelhead (*O.mykiss*)						8	**8**
Topsmelt	1	38	3		5	310	**357**
Threespine stickleback		3		11	2	6	**22**
Prickly sculpin					1	3	**4**
Staghorn sculpin				1			**1**
Shiner surfperch		1					**1**
Tidewater goby				1		4	**5**
Crab		7	1	2	3		**13**
Bullfrog tadpole						1	**1**
O. mykiss CPUE	*0*	*0*	*0*	*0*	*0*	*1.1*	

Table 9. *O.mykiss* 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, HES 2011, HES 2012, HES 2013 and HES 2014)

Station	Location	*O. mykiss* Catch per Haul					
2002						1 Oct	20 Nov
SL-2	RR Trestle						0.0
SL-3	Near WQ Station					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 WQ Station		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 WQ Station	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 WQ Station	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 WQ Station		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 WQ Station	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***	

Table 9 (continued)

Station	Location	*O. mykiss* Catch per Haul					
2012		7-12 Jun			Sep 13-18		
SL-2	RR Trestle	5.2			21.3		
SL-3	Near WQ Station	0.8			17.5		
SL-4	Near Marsh Outlet	0					
SL-5	Riverside Drive	0			3.5		
SL-6	U/S Bank Restoration	0.1			5.0		
	Overall	***1.7***			***14.4***		
2013		6-11 Jun	17 July		Sep 12-17		
SL-1	South of Trestle	0.6			13		
SL-2	RR Trestle	0.8	2.2		1.6		
SL-3	Near WQ Station	6	24		1		
SL-4	Near Marsh Outlet	3			2		
SL-5	Riverside Drive	3			5.8		
SL-6	U/S Bank Restoration	0.3			6		
	Overall	***2***	***8.4***		***4.7***		
2014		5-10 Jun	17 July		Sep 11-15		
SL-1	South of Trestle	3.2	0		0		
SL-2	RR Trestle	0.9	3.5		0		
SL-3	Near WQ Station	1.0	0.5		0		
SL-5	Riverside Drive	0.5	0		0		
SL-6	U/S Bank Restoration	0.8	1		0		
SL-8	Water Street				1.1		
	Overall[2]	***1.2***	***1.1***		***0.0***		

[2] Standard sites only (SL1-SL6)

Figure 13. Laguna Creek Lagoon sampling stations

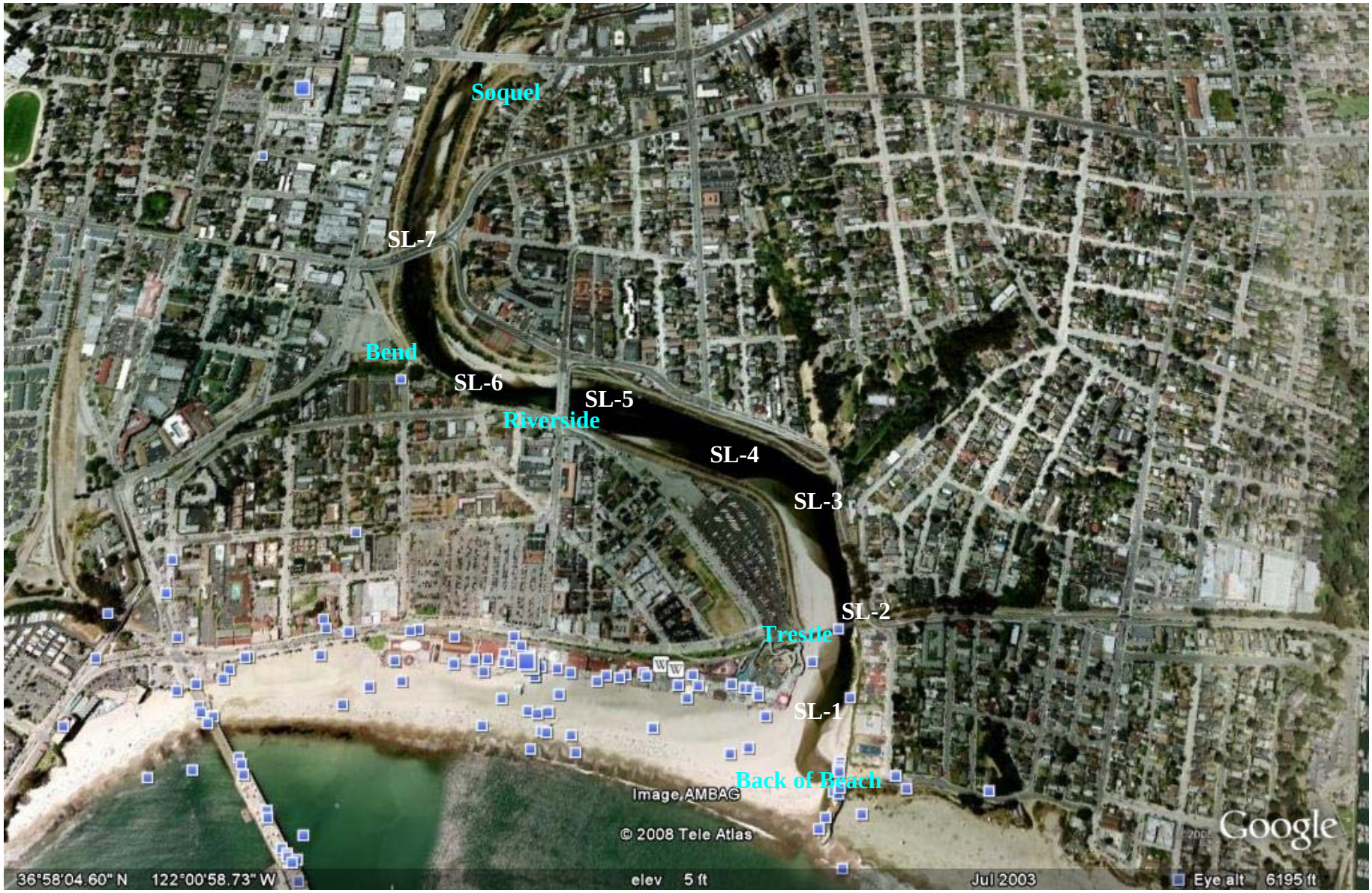

Figure 14. San Lorenzo River Lagoon sampling stations

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