D.W. ALLEY & Associates aquatic biology

SOQUEL CREEK LAGOON MONITORING REPORT, 2001

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Project #106-11

Prepared for

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ACKNOWLEDGMENTS

We appreciate the efforts of the Capitola Public Works Department and Bill Casalegno (supervising) and his, Grandson, Matt Kotila, heavy equipment operators, in forming and maintaining the lagoon. The Begonia Festival organizers and other volunteers effectively removed flowers after the Begonia Festival in September. We thank Nels and Susan Westman for the loan of their boat for fish censusing in October.

We are grateful to the volunteers who do the annual fish censusing at the lagoon. They come mainly from Friends of Soquel Creek and Earth Links, with other interested volunteers and innocent bystanders who join in to lend a hand. This was the tenth year of sampling, providing a valuable index of steelhead abundance in the lagoon. Volunteers are very welcome to help on the first two Sunday mornings in October. The fun usually ends by 1:00 pm.

REPORT SUMMARY

When the estuary periphery and lateral channel across the beach were sampled before sandbar construction on 11 June 2001, the fish captured in the lateral channel included yellowfin goby (*Acanthogobius flavimanus*), staghorn sculpin (*Leptocottus armatus*), starry flounder (*Platichthys stellatus*) and threespine stickleback (*Gasterosteus aculeatus*). Many male sticklebacks were in spawning coloration. The diversity of fish species in the lateral channel across the beach was similar to past years. The fish density in the lateral channel was greater than previous years. No tidewater gobies (*Eucyclogobius newberryi*), prickly sculpins (*Cottus asper*) or juvenile Sacramento suckers (*Catostomus occidentalis*) were detected in the estuarine lateral channel. A school of 30+ steelhead smolts (*Oncorhynchus mykiss*) was observed near the flume during the sandbar construction. Common mergansers (*Mergus merganser*) were hunting them at the time.

Passage for steelhead smolts was provided during the out-migration season in 2001. The 2001 steelhead population estimate in fall was about half the previous year's estimate at 454 juveniles +/- 27. Other species captured in October were staghorn sculpin, prickly sculpin, starry flounder, Sacramento sucker and threespine stickleback. No tidewater gobies were detected in 2001, with the last detection occurring in 1997 before the El Niño storms of 1997-98. The lagoon sandbar was manually breached on 12 November to prevent flooding.

Habitat conditions in the 2001 lagoon followed a drier winter than 2000, with summer baseflow approximately half the previous year. However, inflow remained between 1 and 2 cubic feet per second at the least, which is much higher than drought conditions. Water temperature was much warmer than usual due to two episodes of tidal overwash in July. As a result, there were two weeks in which water temperature near the bottom ranged between approximately 23 and 26°C (73 and 79°F). This elevated water temperature likely forced steelhead higher in the water column or further upstream where depth was shallow. This made them more vulnerable to predation. The elevated water temperature also increased fish metabolic rate and may have reduced growth rate. The median size for young-of-the-year steelhead was less in 2001 than in 2000. The flume shrouds were used much of the summer in 2001 to draw heavier saltwater off the lagoon bottom and remove it. This lessened the negative effect of tidal overwash. Lagoon water temperature was cooler than usual in September, though lagoon water temperatures were warmer than that of stream inflow in 2001. The reverse was true in 2000.

During the summer monitoring beginning 23 June 2001 in the lagoon, 22 days had temperatures greater than 70° F (21.1° C) (only 1 day in 2000) (**Figures 4a-d**). A total of 45 days had temperatures above 68° F in the 2001 lagoon (27 days in 2000; 31 days in 1999 (**Figure 6a**)). At the 2001 creek site, 11 days had temperatures greater than 70° F in 2001 (41 days in 2000 (**Figure 5d**); 26 days in 1999 (**Figure 6b**)), which was half as many as in the lagoon in 2001 (**Figure 5b**). At the stream site, 25 days had temperatures above 68°F in 2001 (45 days in 2000). With a water temperature goal of 16.7° C (62° F) for coho salmon, it has become obvious that considerably more stream shading will be required to make lower Soquel Creek habitable for this species.

As is typical in Soquel Lagoon, algae and pondweed became dense in August and continued to be through September, although the pondweed developed earlier than the previous year about a month after sandbar closure. Very little algae reached the surface and less than in 2000. With the development of plant life in the lagoon comes the threat of low oxygen levels at dawn after nights of high cell respiration that uses oxygen. However, oxygen levels remained good throughout the summer. Water quality from Noble Gulch may have improved, as no gray water was detected during monitoring.

The lagoon near the beach was closed to human contact due to bacterial levels above the maximum acceptable level. The beach was closed at times. The gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe in the lagoon. They roost on the buildings surrounding the lagoon. . Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution The use of gull sweeps has been observed to be successful in other locales to prevent gull roosting. A better method of refuge disposal is needed. The refuge cans situated on the beach have no lids. The gulls have excellent access to refuse that they drag onto the beach. Refuse containers with lids that are gull-proof and user-friendly may reduce gull numbers.

Another source of bird pollution is the rock dove (pigeon) population that circulates between the wharf and the railroad trestle over Soquel Creek Lagoon. As stated in the original Management Plan, the trestle could be screened so that roosting areas were eliminated. This would likely reduce bird pollution.

Regarding pollution from urban runoff, maintenance of existing silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. All new drainage systems from new development and parking lots should be installed with effective traps and percolation basins to encourage winter percolation of storm runoff. The City has obtained grant money to install silt and grease traps on 4 storm drains that empty into the lagoon.

Ideally, all storm drains leading to the lagoon would be re-directed away from the lagoon in summer, including the culvert draining Noble Gulch. By minimizing stream inflow from Noble Gulch, there would be reduced nutrients and bacteria entering the lagoon and reduced algal production. Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has been detected in recent years. This drain could be capped if summer runoff was re-directed into the sewer. It is our understanding that grant money has been obtained to put grease and silt traps on several of these storm drains.

There has been a pollution problem and high flashiness in streamflow increase in the past after the first small storms of the fall. At times, the lagoon required breaching prematurely because the flume could not accept all of the stormflow and flooding was imminent. Retrofitting of storm drainage systems with holding tanks or percolation basins could reduce the sudden increase in street runoff and pollution during early storms. Drains leading from Wharf Road (across the Rispin property), the Auto Plaza and 41st Avenue businesses north of Highway 1 are some of the culprits in this problem.

New Recommendations and Those Not Yet Implemented

1. Construct the sandbar berm sufficiently high to reduce the likelihood of tidal overwash during the summer. Creation of a temporary ponding area on the beach may be required.

2. Replace the open, lid-less refuse containers on the beach with gull-proof lids that are convenient to use. Use enough refuse containers to satisfy the demand for refuse disposal.

3. Look into installing gull sweeps on restaurant roofs.

4. Look into screening the railroad trestle to discourage roosting and nesting by rock doves.

5. Repair the cracked flume. Its integrity is jeopardized, and the beach craters created by flume underflow are a safety hazard. (Grant money has been secured to repair the flume.)

6. We continue to recommend that an insert be designed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume.

7. As stated in previous reports, if the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing surface flow, notify Tiedemann Nursery and the Fish and Game Department of the streamflow conditions so that direct water pumping from the stream may be reduced or discontinued until flow returns. Loss of surface flow should be prevented.

8. Regarding the Begonia Festival, recommend surfboard paddling for float propulsion rather than wading. If participants choose wading, recommend that the organizers set a limit of 3 waders per float. Allow passage of floats in one direction only, presumably downstream and then to the dismantling location near the Stockton Avenue Bridge. In the past, floats were taken down the lagoon and then back up through the lagoon before dismantling back at the lower end near the bridge.

9. Continue to retain large woody material in the lagoon for fish cover.

LAGOON AND ESTUARY FORMATION

Results of Fish Sampling Prior to Sandbar Construction Activities

On 11 June 2001, Ed Garcia of the City of Capitola Public Works Department assisted Don Alley in making 5 seine hauls in the lower lateral channel leading southeast from the main estuary across the beach. The seine was 30 feet x 4 feet x 1/8-inch mesh. We decided again this year to have the lateral channel blocked off from the main estuary with a sand berm prior to fish rescue because streamflow was too great to allow effective seining. The lateral channel was allowed to partially dewater before seining began. In the upper lateral channel, the accumulation of sea grass and kelp was too thick to allow seining. In this section, Alley waded through for approximately 1 hour, capturing fish with a dip net and transporting them to the estuary via a

water-filled bucket. The fish captured in the lateral channel included one yellowfin goby (*Acanthogobius flavimanus*), between 50 and 100 juvenile staghorn sculpin (*Leptocottus armatus*), 1 juvenile starry flounder (*Platichthys stellatus*) and 50-100 threespine stickleback (*Gasterosteus aculeatus*). Many male sticklebacks were in spawning coloration. There were obvious signs of poor water quality in the sea grass as sticklebacks swam near the surface and staghorn sculpins swam into the shallow margin of the channel where they could be easily captured. Three staghorn sculpin mortalities were observed. The Venetian Court margin of the estuary did not require seining because the narrow estuary did not require disturbance this year. The diversity of fish species in the lateral channel was similar to past years. The fish density in the lateral channel was greater than previous years. No tidewater gobies (*Eucyclogobius newberryi*), prickly sculpins (*Cottus asper*) or juvenile Sacramento suckers (*Catostomus occidentalis*) were detected in the estuarine lateral channel. If tidewater goby had been found, they would have been transported even further upstream where cover existed. No tidewater gobies had been captured in the lower lagoon since fall, 1997.

Fishes were placed in a bucket of water after each seine haul. Fishes captured in the lateral channel were relocated in the main estuary. The lateral channel was checked several times as it became dewatered. No more fish were seen.

As required in the permit, the fisheries biologist, Don Alley, was present during activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was the eleventh year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Reports for the first 10 years are available at the City (**Alley 1991-2001**). As stated in the Soquel Lagoon Management and Enhancement Plan (**1990**), all instream removal of kelp, sea grass and other organic debris was to be accomplished without the use of heavy equipment in the stream channel except within 25 feet of the flume. The bulldozer could traverse the area adjacent to the flume.

Monitoring of Sandbar Construction

11 June 2001. The first activity accomplished on Monday, 11 June, was the construction of channel along the east side of the flume. This was done before 0700 hr. Then a berm was constructed across the upstream end of the lateral channel. The estuary then began to drain and fill with the tides along the new channel. It drained partially after the new channel was constructed. The estuary was quite deep near the restaurants. Puddles and the base of the bulkhead were searched as the estuary drained. No fish were observed. After the lateral channel was seined and dewatered, the equipment operator moved the plant material away from the berm toward the rock jetty to the east. The sand that had filled the concrete flume during the winter was partially flushed out to make it passable to out-migrating steelhead at a point on the seaward side of the dam constructed in the outlet channel at 1800 hr. However, the lagoon did not fill sufficiently to move water out through the flume overnight because of the low inflow to the lagoon after a relatively dry winter.

12 June 2001. By 0730 hr the sandbar was already re-opened along the flume. Kelp had moved up past the trestle during the winter. Four City Public Works personnel and Alley raked most of the kelp and sea grass out of the lagoon. The Venetian side of the lagoon was deepened and

contoured behind a sand berm that had been constructed along the margin of the estuary. There was considerable sand on the beach after a mild winter. The flume was flushed of sand. Part of the lateral channel was covered over. Three juvenile steelhead were observed just downstream of Noble Gulch. The downed cottonwood was still in place across the lagoon from Noble Gulch. The outlet channel was closed at 1420 hr to prevent saltwater and plant material from entering the lagoon in early morning.

13 June 2001. Alley and the Public Works crew continued to rake plant material from the lagoon after the outlet channel was open. The flume outlet had plugged with sand overnight and was re-opened at 0700 hr. The raking was completed this day and the crew was ready to prepare a pad around the flume inlet for final sandbar closure. However, the caterpillar broke a track guide and 3 hours of operator time were lost. By the time the tractor was repaired, it was time to close the sandbar at 1430 hr before the tide could enter the lagoon.

14 June 2001. The channel next to the flume was re-opened at 0800 hr. The flume had again been plugged with sand overnight because insufficient flow was exiting to keep it open. It was unplugged immediately. The pad around the flume inlet was prepared with visquine and filter fabric. Sandbags were placed around the base of the flume to prevent water leakage along the flume. The visquine and filter fabric were covered with a layer of sand and the sandbar was closed for the season by 1400 hr. Then the remainder of the lateral channel was buried. A school of 30+ juvenile steelhead smolts were seen near the flume at 1000 hr. A common merganser female and 7 chicks were hunting them.

15 June 2001. Boards were placed in the flume inlet the following day to promote filling of the lagoon to a maximum level.

18 June 2001. Saltwater remained in the lagoon under the Stockton Bridge. Public Works was instructed to install a shroud on the flume inlet with a notched board at the top to allow steelhead smolt passage.

23 June 2001. No saltwater was detected in the lagoon under the Stockton Bridge.

Effects of Sandbar Construction on Tidewater Gobies in 2001

It did not appear that tidewater gobies used the lower estuary in mid-June. If they were present in the estuary, it was likely that they used habitat upstream of the construction area, where there was less tidal fluctuation and salinity. No mortality of tidewater goby was observed during the construction activities. However, artificial water level fluctuations were created during sandbar construction activities. The estuary receded after the lateral channel was blocked and the new channel was constructed along the flume. This would require tidewater gobies to retreat to deeper water as water surface receded in the upper estuary. There were likely few, if any tidewater gobies left in Soquel Creek after the past torrential El Niño stormflows of the 1997-98 winter. The channel lacked sheltered backwaters for fish to escape high water velocity during high stormflows. However, tidewater gobies have been detected recently in Aptos Lagoon after years of no detection, and they may repopulate Soquel Lagoon in the future from adjacent populations.

The seasonal effect of removing organic material and constructing the sandbar is to create cooler, freshwater conditions with reduced potential for eutrophication and biological oxygen demand. Kelp and sea grass removal and sandbar closure create better fish habitat for tidewater goby and steelhead than if the sandbar was allowed to close naturally. Natural closure would allow considerable kelp and sea grass to become trapped in the lagoon to decompose. Saltwater would also be trapped to create an unmixed, anoxic lagoon bottom, which would collect heat and raise lagoon temperature. The naturally formed sandbar would be lower in stature, allowing more tidal overwash of saltwater during especially high tides. Increased tidal overwash would further elevate water temperature, making the lagoon less hospitable for steelhead. With the sandbar constructed, the lagoon still suffered from 2 tidal overwashes in 2001. The flume shrouds were used to suck the saltwater out of the lagoon.

Recommendations for Lagoon Preparation and Sandbar Construction

1. In low-flow years such as 2001, closing the sandbar in late May is better than mid-June because streamflow is greater then. In 2001, there was insufficient outflow to keep the flume open throughout the night.

2. The management solution for minimizing the time required for sandbar construction is for the City to remain flexible on timing of the work. If rain is in the forecast within two days after the intended starting date for sandbar construction, Public Works should postpone construction until clear weather is forecasted.

3. Continue to rake as much kelp and sea grass out of the lagoon as possible before final closure, including plant material trapped under the restaurants, in depressions around the bridge and at the mouth of Noble Gulch. It is best to minimize time required to stockpile sand, rake out the decomposing organic material and prepare the flume inlet for fish passage. This will minimize the number of instances of artificial fluctuation of lagoon water level. Sufficient City staff should be assigned to quickly rake out decomposing kelp and clear the sand-filled flume.

4. Dispose of kelp in the Bay rather than bury it in the sandbar. Disperse it up and down the beach. Continue to include this in the Fish and Game permit for sandbar construction. County Environmental Health approved this method so long as kelp is spread over a wide area (**J. Ricker, personal comm.**).

5. Annually evaluate the structural integrity of the flume and its supports. Repair cracks and supports as necessary. (A grant has been secured for flume repair.)

6. During sandbar construction, continue to close the lagoon each day before the incoming tide can wash salt water and kelp into the lagoon. Re-open the sandbar and unplug the flume, if necessary, each morning to drain out more kelp.

7. Search under the bridge and in Reaches 2 and 3 for stranded fish to rescue as the lagoon drains each day. It is best to minimize the number of days required to construct the

drains each day. It is best to minimize the number of days required to construct the sandbar and rake out the decomposing organic material. This will minimize the artificial fluctuation of lagoon water level. Having a maximum number of personnel to rake decomposing organic material into the bay and to clear the flume of sand will minimize the days needed to prepare the lagoon for the summer.

8. Maintain the underwater portal in the flume intake for adult steelhead until June 15, while maintaining a notched top plank for out-migration of smolts until 1 July.

9. Maintain the 1-foot high baffle inside the flume until July 1 for safe entrance of out-migration of smolts into the flume inlet as they enter the Monterey Bay.

10. Construct the sandbar berm sufficiently high to reduce the likelihood of tidal overwash during the summer. Creation of a temporary ponding area on the beach may be required.

11. Continue to retain large woody material in the lagoon for fish cover.

Procedure for Emergency Sandbar Breaching at Soquel Lagoon by The City of Capitola

In 1990, a bolt was set into a wooden piling adjacent to the restaurants at the lagoon. The bolt's elevation was surveyed to coincide with the water surface elevation at which flooding was imminent. The bolt is 1.77 feet above the elevation of the top of the flume inlet. The management goal is to pass stormflow through the flume from the first small storm events in the fall. This is done by the City removing boards from the flume inlet prior to and during increased stormflow. The wooden cover of the first flume portal may also be removed.

A tractor is used in the fall to cut a notch in the sandbar adjacent to the flume. The intent is to prepare the sandbar so that it will breach at the proper time to prevent flooding. The City cuts the sandbar notch at the elevation of the piling bolt. However, the notch fills in from foot-traffic on the beach as time goes on. If, despite efforts to pass the stormflow through the flume, the water surface reaches the elevation of the piling bolt, then the City facilitates sandbar breaching. A tractor is used to re-cut the sandbar notch so that the sandbar breaches prior to flooding.

If the flume is able to receive the stormflow and flooding does not become a threat, boards are replaced in the flume inlet after the stormflow has passed.

Sandbar Breaching During the 2001-2002 Rainy Season.

12 November 2001. The sandbar was manually breached at approximately 1100 hr after it had rained through the night. Half screens had been placed in the flume on 11 November. At 1202 hr the lagoon level was still at its maximum of 3 inches below the piling bolt. The flume was flowing at full capacity during the breach. By 1220 hr, the lagoon level had dropped three inches. It continued to rain through the day. The emergency breach was a good decision.

Recommendations Regarding Sandbar Breaching

1. As stated in the Management Plan (**1990**), make sure that parking lots and streets draining into the lagoon are cleaned before the rainy season. This will reduce the pollutants entering the lagoon during the first storm of the season that are lethal to fish. Street sweepers with water and suction may be necessary. In addition, roadwork such as repaving and application of fresh petrochemicals should be done in the early summer to allow sufficient time for penetration and drying before the rainy season.

2. The notch in the sandbar should be cut slightly lower than the piling bolt. The City may have to periodically re-establish the notch if it does not rain or high tides obliterate it. If a storm is predicted, the sandbar needs a notch as preparation.

3. Just as the first storm of the fall season begins, remove one board from each side of the flume if a small storm is anticipated. Remove two boards from either side if a large storm is anticipated. Clear the exit to the flume by removing the plate from one side of the exit. Clear the sand away from the top of the flume back to the first portal cover. As stated in the 1993 monitoring report, management options to delay sandbar breaching include installation of a perimeter fence around the flume inlet to collect algae and the opening of the first flume portal behind the flume inlet. The portal must be screened and isolated from human access to prevent a hazard to public safety. Replace the boards after the stormflow subsides, removing them for each succeeding storm until the sandbar is eventually breached during later, larger storms usually occurring after Thanksgiving. Remove the first flume portal cover and screen it if the entrance of the flume cannot handle the volume of the stormflow in October and early November. After the stormflow subsides, replace the cover until the next storm.

4. If the sandbar breaches early in the rainy season, followed by a period of 2-4 weeks of a reformed sandbar that prevents water exchange with the ocean, attempt to pull the decomposing kelp out of the stagnating lagoon. Open the flume and encourage streamflow out with the shroud installed.

5. If a stagnant, kelp-filled lagoon forms in fall after an early breach and a dry period, do not empty the lagoon by breaching the sandbar. Instead, use the flume to pull salt water out. Breaching of the lagoon will increase the opportunity for more kelp to enter and probably will not empty the entire lagoon anyway. Fish passage need not be maintained through the flume because it should be discouraged until sufficient stormflows develop to provide passage up the Creek. If adult salmonids enter too early, they will become stranded and unable to migrate upstream because of insufficient streamflow.

6. We continue to recommend, as we did in the 1996 and 1997 reports, that an insert be designed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. Another proposal to create a grated hole in the top of the flume inlet may also work. The other side of the flume entrance may have secured wooden flashboards, as is presently the case. Flashboards may be removed to remove

sand from the flume at the beginning of the summer season or at the end to maximize flume capacity during small, fall storms. With an improved insert and/or the grated hole in place, flooding may be more easily prevented before the sandbar breaches. Also, early, small stormflows would be less likely to breach the sandbar prematurely with this louver design. During the summer, operation of the insert with the top hole would make it easy to maximize the lagoon height as the streamflow declined through the summer. As the streamflow drops, lagoon depth must be maximized. The present effort of removing screens and replacing them with smaller screens and boards as the streamflow declines could be much reduced, while doing a better job of maximizing lagoon water depth. However, fish must be prevented from becoming impinged on any grated hole.

WATER QUALITY MONITORING, 2001

Rating Criteria

Water quality parameters were rated according to the tolerances of steelhead. This was because they are least tolerant of low oxygen, higher salinity and higher temperatures. Stress to freshwater acclimatized steelhead would probably not occur until conductivity levels reach 12,000 to 15,000 umhos, associated with sudden increases in salinity to 10- 12 parts per thousand. Water temperatures above 22° C (72° F) (**Table 1**) and oxygen levels below 5 parts per million (mg/L) are thought to stress steelhead. However, steelhead have been found surviving in pools in the Carmel River at 1-2 mg/L for 1-2 hours at dawn. Based on 1988 monitoring, steelhead appear to survive in Soquel Lagoon at water temperatures of 23-25°C for 1-2 hours toward the end of the day (**Habitat Restoration Group 1990**). Water temperature may rise as much as 3-5°C during a sunny day from a minimum at dawn.

Oxygen levels critical to steelhead were classified as those measured in the lower 0.25 meters from the bottom, where steelhead would inhabit. Early Morning oxygen levels below 2 mg/L were rated "critical" (**Table 2**). Those levels between 2 and 5 mg/L were rated "poor." Early morning oxygen levels of 5 to 7 mg/L were rated "fair" with above 7 mg/L rated as "good." Early morning water temperatures in the lower 0.25 meters of the water column of less than 20° C were rated "good" while those 20-21.5° C were rated "fair." Temperatures between 21.5 and 23° C were rated "poor," while those greater than 23° C at dawn were rated "critical." High levels of dissolved carbon dioxide in water will inhibit absorption of oxygen by fish. However, in the alkaline conditions of Soquel Creek Lagoon, carbon dioxide is poorly dissolved and is not a problem (**J. Smith, personal comm.**). Therefore, its monitoring was unnecessary.

Lagoon water level was monitored with the staff gage on the eastern bulkhead, upstream of the Stockton Avenue Bridge (**Figure 1.**) Readings below 1.5 feet were rated "critical" while readings between 1.5 and 1.85 were rated poor (**Table 2**). Readings between 1.85 and 2.2 were rated "fair." Readings above 2.2 were rated "good." These criteria were somewhat arbitrary, being based on an as yet poorly defined relationship between lagoon depth and associated fish cover, water temperature and algal growth. If the upper lagoon becomes too shallow, steelhead habitat is eliminated and algae growth may be stimulated. An important factor not directly under control by the City is change in streambed elevation resulting from winter scour or fill.

Table 1. Temperature Conversions From Degrees Celsius to Degrees Farenheit.

Degrees Celsius	Degrees Farenheit
10	50.0
11	51.8
12	53.6
13	55.4
14	57.2
15	59.0
16	60.8
17	62.6
18	64.4
19	66.2
20	68.0
21	69.8
22	71.6
23	73.4
24	75.2
25	77.0
26	78.8
27	80.6
28	82.4
29	84.2
30	86.0

Table 2. Water Quality Criteria for Measurements Within 0.25 Meters Off the Bottom at Dawn and Gage Height Readings.

MORNING RATING	MORNING TEMPERATURE (Celsius)	OXYGEN (mg/L)	GAGE HEIGHT (ft)
Good	< 20	> 7	> 2.20
Fair	20-21.5	5-7	1.85-2.20
Poor	21.5-23	2-5	1.50-1.85
Critical	> 23	< 2	< 1.50

Locations of Water Quality Monitoring

Water quality was monitored in early morning near first light at four stations. The first station was at the flume inlet (**Figure 1**). The second station was reached off the downstream side of the Stockton Avenue Bridge in the deepest thalweg area. The third was just downstream of the railroad trestle on the east side. The fourth station was at the mouth of Noble Gulch.

In 2001 as in 2000 and 1999, two temperature data loggers were installed. One was placed in Soquel Creek above the lagoon near the bottom, and one was placed in the lagoon near the bottom in lower Reach 3 from 23 June to 10 October. Temperature was recorded in 30-minute intervals.

Results of Water Quality Monitoring After Sandbar Closure

Lagoon Level. The lagoon level was monitored 10 times within no more than 2-week intervals from 18 June to 10 October, 2001. For 2001, the measurements of lagoon level as measured on the staff gage were rated "good" on 8 occasions (80%) and "fair" on 2 occasions (20%) (**Table 3; Figure 2**). Back pressure through the flume may dislodge boards and allow leakage through the flume, resulting in reduced water surface elevation. On 22 July, the boards were removed from the flume to let water out as a result of a tidal overwash occurring on 21 July, which had raised the lagoon 6 inches under the trestle. By 28 July, plywood was installed to prevent boards from being dislodged and to reduce leakage between the boards. Installation of an improved insert at the flume inlet should prevent negative effects of tidal back pressure and vandalism.

No vandalism was detected in 2001. The plywood protected against both back pressure and vandalism. Wedges were used to secure the top boards, as well. One or both shrouds were in place most of the summer due to tidal overwash that required saltwater suction from the bottom. Vandalism had been a problem in 1995-1998. A method is still needed to secure the flashboards against vandalism, on the one hand, while allowing convenient adjustment or removal of boards by city staff when necessary. While the wedges discourage all but the most determined vandals, they do not allow easy, temporary removal of boards when surface algae and debris near the flume needs to be drained out or when sandbar breaching is to be prevented by increasing the volume through the flume.

Flume Passability. According to the Management Plan (**1990**), fish passage is to be maintained until July 1. A flume depth of 12 inches or deeper was desired at the entrance until that time. The baffle remained in place in June 2001 to insure water depth inside the flume entrance. The flume was partially cleared of sand before the sandbar was closed the first day of construction activity and cleared completely before final sandbar closure, to insure steelhead smolt passage during and after sandbar construction. Sufficient baseflow in 2001 resulted in excellent passage for steelhead smolts. The sandbar was artificially breached on 12 November 2001 to prevent flooding during a sizeable storm event. The sandbar remained open afterwards.

Water Temperature. Lagoon water temperature was "good" more than half the time throughout the summer within 0.25 meters of the bottom, but there had been some of the lowest ratings in the lagoon in the past 4 years. The poorer water temperatures resulted from tidal overwash on 2 July and again on 21 July. Of the 11 monitorings, Station 2 at the Stockton Avenue Bridge had a "poor" or "critical" rating during 4 monitorings (36%) (**Table 3; Figure 3; Appendix A**). On 28 July, all but the flume station had critical ratings. Lagoon depth had fluctuated more in the latter portion of the summer than in 2000 (**Figure 2**), and there was less streamflow to flush out the saltwater than the previous year.

Lagoon water temperatures in July after 2 tidal overwashes were probably stressful for juvenile steelhead in 2001, unlike the 4 previous years. For 14 days, daily temperatures near the bottom fluctuated between approximately 23 and 26°C. It would have been even more stressful for coho salmon when water temperatures above 20° C (68° F) are considered limiting to juvenile coho salmon in the presence of steelhead (depending on food abundance), and temperatures below 16° C (60.8° F) are preferred (**J. Smith, personal communication**).

Appendix A provides detailed data on water quality. **Table 3** rates habitat conditions.

Table 3. Water Quality Ratings in Soquel Creek Lagoon, 2001, Within 0.25 Meters Of the Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow Visual est. (cfs)
18June01	open	2.78 good	- poor - -	- poor - -	- poor - -	
23June01 (afternoon)	open	2.58 good	- fair - -	- - - -	- good - -	
29June01	open	2.59 good	fair	good	good	
2 July01	*Tidal Overwash*					
14July01	open	2.58 good	fair poor good good	good	good	2.5-3 cfs
20July01	open	-	good good - -	- - - -	good good - -	
21July01	*Tidal Overwash*					
28July01	open	2.52 good	good critical critical critical	good	good poor poor poor	2.5-3 cfs
10Aug01	open	2.50 good	fair critical fair good	good	good	2 cfs
25Aug01	open	2.00 fair	good fair good good	good	good	1.5-1.75 cfs
9Sept01	Begonia Festival	2.21 good	good	good	good	2.25 cfs
22Sept01	open	2.10 fair	good	good	good	
8Oct01	closed	2.98 good	good	good		
12Nov01	Sandbar breached.					

* Four ratings refer to Reaches 1-3 and at Noble Gulch. One rating refers to all stations.

Daily minima in the lagoon were consistently warmer than the stream above in 1999-2001. However, the daily stream temperature fluctuated more in the stream than the lagoon. The diurnal water temperature in the stream fluctuated approximately 1.5-9° F (0.8°-5° C) each day compared to 1.5°-7.5° F (0.8°-4.2° C) in the 2001 lagoon (**Figures 4a-d**). As a result of the tidal overwashes in 2001, the lagoon was considerably warmer than the creek inflow. The lagoon was considerably warmer in 2001 than 2000 and stream inflow was, as well, until the relatively cool September in 2001. The maximum recorded temperature in the stream was 71.8°F (71.2° F in 2000) (**Figures 5a-d**)) compared to 79.4°F (70.4° F in 2000) in the lagoon. The 79.4° F (26.3° C) was recorded at 6:00 p.m. on 5 July, after a minimum morning temperature of 73.8° F (23.2° C) at 5:30 a.m.

The effects of the first tidal overwash began on 2 July in the afternoon and evening when regular daily maxima increased from the 69-70 F range to between 74.5 and 79.4 F from the afternoon of 3 July to the morning of 7 July, about 3.5 days. By 9 July, temperatures were back to normal, 8 days after the warming began.

The effects of the second tidal overwash began on 22 July when afternoon water temperature increased steadily from 70.4 F to 72.5 F on afternoon on 23 July to 73.8 F in evening of 24 July to 74.5 F in afternoon of 25 July. Water temperature was in the 74.5-78 F range from afternoon of 26 July to morning of 2 August, about 6.5 days. By 3 August, water temperatures were back to normal, 11 days after warming began.

During the summer monitoring beginning 23 June 2001 in the lagoon, 22 days had temperatures greater than 70° F (21.1° C) (only 1 day in 2000). A total of 45 days had temperatures above 68° F in the 2001 lagoon (27 days in 2000; 31 days in 1999 (**Figure 6a**)). At the 2001 creek site, 11 days had temperatures greater than 70° F in 2001 (41 days in 2000; 26 days in 1999 (**Figure 6b**)), which was half as many as in the lagoon in 2001. At the stream site, only 25 days had temperatures above 68°F in 2001 (45 days in 2000) due to a cooler September. Thus, the inflow to the 2000 lagoon was at times warmer than in 2001 and 1999. With a water temperature goal of 16.7° C (62° F) for coho salmon, it has become obvious that considerably more stream shading will be required to make lower Soquel Creek habitable for this species.

Stream conditions in 1999-2001 had been much cooler than in 1998, despite the much higher baseflow in 1998. In 1998, there was a 20-day period in which water temperature rose above 21° C (69.8° F) for several hours each day in the stream above the lagoon, with a maximum of approximately 23.5° C (74.3° F) on 3 August 1998 (**Figure 6c**). Daily maxima were still approaching 21° C on 4 September 1998.

Dissolved Oxygen. Critical oxygen levels are lowest in the early morning after oxygen has been depleted by cell respiration and before plant photosynthesis can produce much oxygen. This was the time that oxygen levels were measured and rated. Algae and pondweed was first noted in mid-July, a month after sandbar closure. As in 2000, algae and pondweed became dense in August, 2001, and remained so until early October. Pondweed was not noticed until 14 August in 2000 and not until 20 August in 1999. Surface algae never really developed in 2001, with only 1-2% coverage appearing in September after the Begonia Festival. In 2000 the most coverage was

15% in Reach 3 in mid-August. In 1999, surface algae had reached a maximum during the two July monitorings, with as much as 25% of certain reaches being covered.

Water quality for aquatic life in the lagoon was rated "good" near the bottom on all monitorings in 2001 (**Table 3; Appendix A**), with it staying above 5 mg/l (**Figure 7**).

Salinity. Salinity was not an issue in summer, except after tidal overwash on 21 July. The warm water effects were seen until 25 August.

Conductivity. Conductivity was registered as stressful at 3 of the 4 monitoring sites on 28 July, a week after the second tidal overwash. Conductivity near the bottom was approximately 15,000 umhos at all three sites. The smaller tidal overwash on 2 July was mostly flushed out by 14 July. (**Appendix A**).

Stream In-Flow to the Lagoon. Inflow to the lagoon ranged from 2.5-3 cfs (visually estimated) in mid-July down to 1.5-1.75 cfs in late August. Then it rebounded to a visually estimated 2.25 cfs on 9 September. Streamflow was measured at 1.58 cfs on 21 October 2001 near the Grange in Soquel Village. Flow in 2001 was less than in 2000 when 8 cubic feet per second (cfs) was visually estimated in late June and 3.5 cfs was estimated in early October (**Table 3**). On 23 October 2000, we measured 2.32 cfs at the Grange. Streamflow was somewhat higher in 1999, when a visually estimated 8-10 cfs was recorded in mid-June and a measured 3.7 cfs was recorded on 24 October 1999 (**Alley 2000**). By comparison, on 17 June and 29 June 1998, streamflow was measured at Nob Hill to be 31.2 and 22.6 cfs, respectively. On 19 September 1998, the Coastal Watershed Council measured streamflow with a flowmeter at Nob Hill to be 6.91 cfs (**Alley 1999**). Water quality worsens at the end of the dry season in most years, when stream inflow is at a minimum. The lowest visually estimated summer baseflows in 1995, 1996 and 1997 had been 2.5 cfs, 2.25 cfs and 1 cfs, respectively. In 1994, lagoon in-flow declined below 1 cfs by late July and to an estimated 0.05 cfs by late September.

The lagoon water quality is generally best when more summer baseflow occurs. When tidal overwash occurs or saltwater back-flushes into the lagoon, with more summer baseflow the saltwater is flushed out of the lagoon more quickly to reduce lagoon heating (**Figure 3; 1997 was the driest year and 1998 was the wettest**). The year 2001 was most affected by tidal overwash in the last 4 years. With proper flume management, it should be easier to maintain lagoon depth and prevent fluctuations with more baseflow. However, this potential has not been fully realized (**Figure 2**). To maximize summer baseflow, water percolation into the aquifer must be maximized and surface runoff must be minimized during the rainy season. Summer water diversion and pumping from the underflow of the creek reduce summer baseflow and should be curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek.

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon. The restaurants contiguous with the Soquel Creek Lagoon that had accessible plumbing systems were tested for leaks and repaired as necessary. Confirmation is contained in **Appendix B**.

Discussion of Options to Improve Water Quality

All storm drains leading to the lagoon should ideally be re-directed away from the lagoon in summer. Included in these is culvert draining Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch until 2001 (**Alley 1995; 1996b; 1997-2000**). In 2001, no gray water was observed during monitorings. In 2000, gray water plumes were observed on 5 of the 7 monitorings. Stimulation of algal growth has annually occurred at the mouth of Noble Gulch, with consistently greater growth there compared to elsewhere in the lagoon until 2001. Increased algal growth indicates elevated nutrient inputs probably associated with bacteria. Although oxygen depletion has been consistently registered at the mouth of Noble Gulch in past years, this was not the case in 2001. Usually when cloudy water enters the lagoon from Noble Gulch, the water is clear upstream in Noble Gulch at the park beyond Bay Street. This indicates that pollutants enter Noble Gulch from the lower village near Soquel Creek. There are ducks living at the mobile home park up that drainage that could be removed to reduce nutrient influxes and coliform bacterial inputs. A flashboard dam could be constructed in Noble Gulch at Bay Street to impound water to be pumped out for irrigation purposes, provided that lagoon depth is being adequately maintained.

By minimizing the stream inflow from Noble Gulch, nutrients and bacteria entering the lagoon would be reduced. Algae production may be reduced. Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has been detected in recent years. This drain could be capped if summer runoff was re-directed into the sewer.

The gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe in the lagoon. They roost on the buildings surrounding the lagoon. Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution. It is likely that the gull population is artificially high because of the artificial food source and artificial roosting areas. If these were be reduced, then the gull population would probably decline and pollution would be reduced at Soquel Lagoon. Better refuge disposal is needed. The refuge cans currently on the beach have no lids. The gulls have excellent access and commonly drag refuge out of the cans. Refuse containers with lids that were gull-proof and user-friendly to beach-goers may reduce gull numbers. Regarding roosting, there are methods available to make buildings' roofs inhospitable to gulls.

Another source of bird pollution is the rock dove (pigeon) population that circulates between the wharf and the railroad trestle over Soquel Creek Lagoon. As stated in the original management plan, the trestle could be screened so that roosting areas were eliminated. This may also reduce bird pollution.

Regarding urban runoff, maintenance of existing silt and grease traps on storm drains is critical to reducing pollution by petrochemicals. All new drainage systems from new development and parking lots should include installation of effective traps and percolation basins to increase percolation of storm runoff.

Recommendations to Maintain Good Water Quality and Fish Habitat in the Summer Lagoon

1. Replace the open, lid-less refuse cans on the beach with those with gull-proof lids and convenience in use. Use enough refuse cans to satisfy the demand for refuse disposal.

2. Look into screening the railroad trestle in order to discourage roosting and nesting by rock doves.

3. Re-install the 12-inch high wooden baffle inside the flume prior to directing water through the flume, if it was destroyed during the previous winter.

4. Do not allow the pedal boat operator to dictate lagoon level.

5. Maximize lagoon depth throughout the dry season, while maintaining passage through the flume for adult steelhead until June 1 and steelhead smolts until July 1. If the lagoon level begins to drop below the notch for steelhead smolts on one side of the flume because of the hole for adult steelhead on the other side after June 1, close the hole for adults. Close the adult hole by July 1 in any event. If adult steelhead are seen in the lagoon after June 1 and the adult hole has been closed, then open the hole for a week, allowing them to out-migrate.

6. After July 1, leave the flume exit closed once it closes, unless flooding is eminent. Install visquine on the outside of the flashboards to prevent leakage into the flume. Maximize the number of boards in the flume entrance to maximize lagoon depth.

7. Secure the flume boards to prevent their lifting by vandals to drain the lagoon.

8. If the lagoon bottom becomes invisible due to turbidity for more than one day after the rains that do not breach the sandbar, immediately lower the lagoon level to the point where the bottom is visible. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen and prevent anoxic conditions. A previous recommendation in the Management Plan (**1990**) should be emphasized to prevent fish mortality; parking lots and streets draining into the lagoon should be cleaned thoroughly before the first fall rains.

9. Road repaving and application of petrochemicals should be done early in the summer. This will allow penetration and drying before fall rains.

10. Do not reduce the lagoon level for the Begonia Festival

11. Check the gage height at the lagoon once a week (preferably the same day each week) and keep a log of measurements so that the biologist may contact the City to obtain a weekly update.

12. We continue to recommend that an insert be designed for at least one side of the flume

entrance that will allow easy manipulation of water volume through the flume. A design with louvers that may be actuated independently would allow quick and easy opening of the flume entrance. The other side of the flume entrance may be filled with flashboards as before, if secured against vandals. In this way, vandalism would be prevented, and flooding may be more easily prevented before the sandbar breaches. Also, with this louver system the early, small stormflows of fall would be less likely require premature sandbar breaching to prevent flooding. With the louver design, the lagoon level may be easily maintained in summer, thus preventing the lagoon level from fluctuating into the "poor" range as occurs with the old flashboard system when boards are not been added quickly as streamflow declines in summer.

13. We recommend that "Gull Sweeps" sold by West Marine Products ($32.00 each and 6 feet across) be installed on Esplanade roofs to test their effectiveness in deterring gulls. According to the catalogue, "Powered by the slightest breeze, the Gull Sweep's motion will deter the most determined bird." These have been used successfully on restaurants in San Diego (**Y. Sherman, personal communication**).

14. Regarding the Begonia Festival, we recommend that float propulsion by surfboard paddling be encouraged rather than pulling and pushing by waders. If wading is allowed, set a limit of 3 waders per float. Allow float passage in one direction only, presumably downstream, before dismantling near the Stockton Avenue Bridge. In the past, floats were take down the lagoon and then back up before dismantling back at the bridge.

15. We recommend that the City encourage and influence planners, architects and property owners through the permit review process to maximize water percolation and to filter out and collect surface runoff pollutants from new and existing land development within the City limits and upstream.

16. We recommend that the City request from the responsible flood control district that sediment and grease traps leading into lower Soquel Creek be annually inspected and cleaned.

FISH CENSUSING

Steelhead Plantings in Soquel Creek

No steelhead were planted in 2001.

Results of Fish Sampling in Soquel Creek Lagoon

Even with a freshwater lagoon created by the City of Capitola, the water temperature sometimes reaches to near the upper tolerance limit of steelhead for 1-2 hours per day when morning fog is absent. If sufficient saltwater was present in the lagoon, water temperatures could become lethal for steelhead. Due to 2 tidal overwashes in July 2001, daily water temperature fluctuated between approximately 23 and 26°C for 14 days near the bottom in Reaches 1-3. This likely

forced juveniles higher in the water column or further upstream where water depth was less. This would increase vulnerability to predation. Also, the increased temperature increased the metabolic rate of fishes, possibly reducing growth rate.

Fall sampling for steelhead was undertaken on 7 and 14 October 2001, from just upstream of the Stockton Avenue Bridge and downstream. The bag-seine with dimensions 106-foot long by 6-feet high by 5/16-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and just upstream of the Bridge. Juvenile steelhead congregate in the shade under the Bridge. The seine was pulled into the beach in front of Venetian Court. With this larger, coarser-meshed seine, no tidewater gobies were captured. On 7 and 14 October, a total of 310 unclipped juvenile steelhead ranging from 75 to 262 mm Standard Length (SL) were measured, having marked 186 juveniles from four good seine hauls on 7 October (**Figure 8**). The 5 mm increment with the most young-of-the-year steelhead was and 125-129 mm SL in 2001. In 2000, the most popular young-of-the-year steelhead size increment was 135-139 mm SL (**Figure 9**). In 1999 it had been 120-125 mm SL (**Figure 10**). In 1998, the most popular size increment was 115-119 mm SL (**Figure 10b**). There were no steelhead mortalities on 1 October 2000. On 7 October there was one steelhead mortality. On 14 October, 210 juvenile steelhead (86 previously clipped), were captured from 4 seine hauls. There was one steelhead mortality on 14 October.

Our steelhead population estimate for fall 2001 was 454 juveniles +/-27. Other species captured with the 106-foot seine were 7 staghorn sculpin, 3 starry flounders, 1juvenile Sacramento suckers. Refer to **Table 4 and Figure 10** for a summary of juvenile steelhead estimates for the last 8 years.

Somewhat more than half as many steelhead were produced in the lagoon in 2001 compared to 2000. Slightly fewer juvenile steelhead reared in the lagoon from the lower Creek in 2000 compared to 1999, though higher numbers were estimated in the 1993 and 1994 lagoons. Probably, limited spawning occurred in lower Soquel Creek in 2000 and 2001 because of adequate spawning access to the upper watershed and a preponderance of sand and poor spawning conditions in the lower Creek. Our sampling of lower Soquel Creek in fall, 1997-2001, indicated very low densities of juvenile steelhead in the lower 2 miles of stream habitat above the lagoon. Past calculations indicated that lagoon production represented nearly 1/3 of the smolt-sized steelhead production in the lower 7.2 miles of mainstem Soquel Creek in both 1999 and 2000. In 1993, when lagoon production reached 2,800 fish, it likely represented as much as 10% of the smolt production in the entire 16.6 miles of steelhead habitat in the mainstem, East and West Branches. Thus, the lagoon provides valuable habitat through proper management.

Further, the reduction of juveniles in the 2001 lagoon may be due to increased predation resulting from saltwater entering from tidal overwash, causing warmer water near the bottom and forcing fish to shallower locations. The smaller median size of YOY steelhead compared to 2000 also indicated slower growth rates perhaps resulting from warmer water temperature and higher metabolic rate. The barges placed in the lagoon had no apparent benefit in increasing juvenile numbers.

On 7 October 2001, five seine hauls were made for tidewater gobies with a 30-foot x 4-foot x

1/8-inch mesh beach seine in lower Soquel Lagoon near the beach. This was adjacent to Venetian Court, around to the flume and between the flume and the restaurants. This is the only location where a seine could be adequately beached to capture tidewater gobies. Only threespine sticklebacks were captured and no tidewater gobies. The last capture of tidewater gobies was one in fall, 1997. The low number captured in 1992-2001 probably indicated a lack of backwater areas to be used as refuges during high winter stormflows. This species was plentiful during the last drought of the late 1980's and early 1990's.

Table 4. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2000.

Year	Steelhead Population Estimate for Soquel Creek Lagoon
1988-	Rough estimate of a few hundred. No mark/recapture activity done. 157 juveniles captured in 5 seine hauls.
1992-	Rough estimate of a few hundred. No mark/recapture activity was done. 60 juveniles captured in 4 seine hauls.
1993-	2,787 +/- 306 (95% confidence interval.) 1,046 fish marked from two seine hauls.
1994-	1,140 +/- 368 (95% confidence interval.) 76 fish were marked from two seine hauls.
1995-	360 +/- 60 (95% confidence interval.) 59 fish were marked from 4 seine hauls.
1996-	255 +/- 20 (95% confidence interval). 105 fish were marked from 3 seine hauls.
1997-	560 +/- 182 (95% confidence interval). 53 fish were marked from 3 effective seine hauls.
1998-	671 +/- 74 (95% confidence interval). 164 fish were marked from 3 effective and one snagged seine haul.
1999-	928 +/- 55 (95% confidence interval). 397 fish were marked from 4 effective seine hauls.
2000-	875 +/- 156 (95% confidence interval). 185 fish were marked from 4 effective seine hauls.
2001-	454 +/- 27 (95% confidence interval). 186 fish were marked from 4 effective seine hauls.

In order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced, and the City must maintain the water level as high as possible throughout the summer until sandbar breaching, without large fluctuations. It is potentially easier to maintain good water quality and water depth with higher streamflow into the lagoon in summer (known as summer baseflow). However, Public Works has an easier time of maximizing water depth in years with intermediate streamflows, such as 1999-2001 rather than 1998. If the lagoon becomes too shallow, steelhead habitat in the upper lagoon is lost. This is another reason to keep the lagoon as deep as possible during summer. The flume's flashboards must be secured against vandals intent on draining the lagoon and against tidal back-pressure that may dislodge the boards. Maintenance of the lagoon in the fall after the first small storms is important. Minimizing pollutant input from early fall storms is also important to avoid fish kills.

Recommendations Regarding Fish Management

1. If the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing surface flow, notify nurseries with surface diversions upstream and the Fish and Game Department of the streamflow conditions so that direct water pumping from the stream may be reduced or discontinued until flow returns. Complete loss of surface flow should be avoided.

2. Maximize lagoon depth by adding boards to the flume as streamflow declines and by sealing the boards with visquine and/or plywood, as was done in the past.

3. Secure the flume boards so that vandals cannot pry them up and drain the lagoon. This will prevent tidal surges through the flume from doing the same thing. Installation of a louver system on one side of the flume inlet would eliminate the need to deal with boards all summer. The design and installation of a louver system is recommended.

4. Do not unplug the flume exit after 1 July unless flooding is eminent.

5. Do not remove flume boards for the Begonia Festival or prior to taking fall vacation time.

6. Remove flume boards as the first small storms begin in fall and replace the boards after the stormflow has subsided. The effort should be to minimize lagoon fluctuation until the sandbar actually breaches. Many forecasts for rain and storm intensities are incorrect in the early fall. It is harmful to steelhead to drop the lagoon level in anticipation of a storm that fails to develop and then fail re-install the flume board afterwards.

7. Maintain the lagoon in fall until streamflow has increased enough (20-25 cfs) to prevent stranding of spawning adult steelhead or coho salmon and to prevent osmotic stress to lagoon- inhabiting steelhead. If necessary, install a perimeter

fence with 2"x 4" mesh with 6-foot panels around the flume entrance by October to prevent plugging of the flume's screen with aquatic vegetation during the first minor storms. The goal should be to maintain the lagoon until approximately Thanksgiving in late November, before allowing stormflow to breach the sandbar.

8. As recommended in the 1997-2000 reports, we again recommend that an insert be designed and installed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. This will prevent the lagoon level from declining into the poor range because sufficient boards have not been added to the flume inlet as streamflow declines. A design with louvers that may be actuated independently would allow quick and easy closing of the flume entrance. The other side of the flume entrance may have boards, as is presently the case. In this way, the lagoon level may be easily maintained and vandalism may be prevented. Furthermore, sustaining lagoon habitat until later in fall when storm frequency and streamflows increase, will maximize the lagoon's benefit to juvenile steelhead. The City has obtained grant money to design and construct a new insert for the flume entrance, as well as for repair of the cracked flume.

LITERATURE CITED

Alley, D.W. 1992. Soquel Creek Lagoon Monitoring Report, 1990- 91. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1993. Soquel Creek Lagoon Monitoring Report, 1991- 92. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1994. Soquel Creek Lagoon Monitoring Report, 1992- 93. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1995. Soquel Creek Lagoon Monitoring Report, 1993- 94. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1996a. Summary Report Regarding Development, Implementation and Monitoring of the Soquel Creek Lagoon Management and Enhancement Plan, 1996. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1996b. Soquel Creek Lagoon Monitoring Report, 1994- 95. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1997. Soquel Creek Lagoon Monitoring Report, 1995- 96. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 1998. Soquel Creek Lagoon Monitoring Report, 1996- 97. Prepared by D.W. ALLEY & Associates for the City of Capitola.

LITERATURE CITED (continued)

Alley, D.W. 1999. Soquel Creek Lagoon Monitoring Report, 1997- 98. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2000. Soquel Creek Lagoon Monitoring Report, 1998-1999. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2000. Soquel Creek Lagoon Monitoring Report, 1999-2000. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2001. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 2000 Estimate of Juvenile Production and Index of Expected Adult Returns. Prepared by D.W. ALLEY & Associates for the Soquel Creek Water District.

Sherman, Y. 2002. Personal Communication. Editorial Services. San Diego, California.

Smith, J.J. 1999. Personal Communication. San Jose State University.

Soquel Creek Lagoon Management and Enhancement Plan. 1990. Donald Alley, Project Manager. Prepared by the Habitat Restoration Group for the City of Capitola and the Coastal Conservancy.

FIGURES

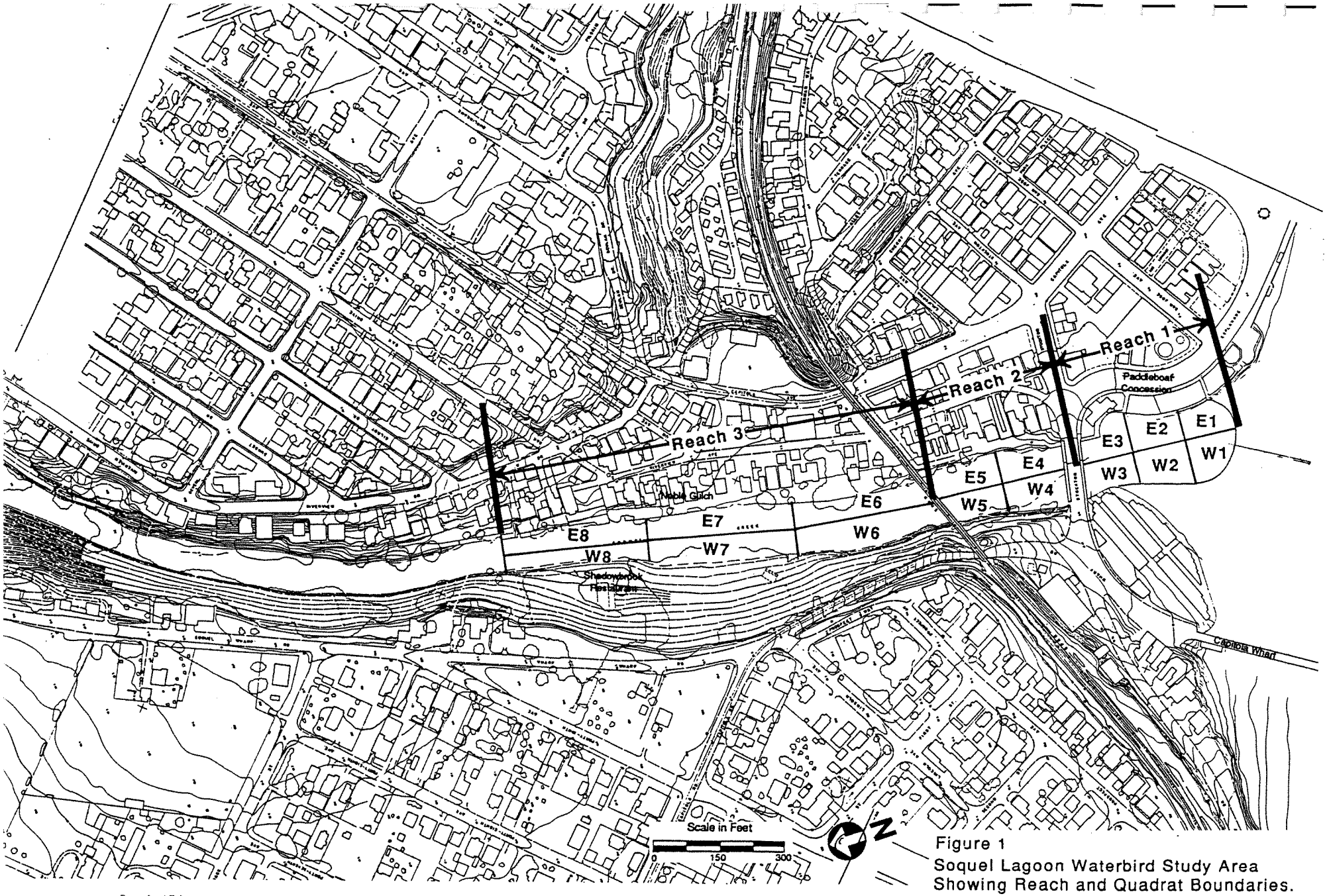


Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Boundaries.

Figure 1	SOQUEL LAGOON Management & Enhancement Plan	May 1990

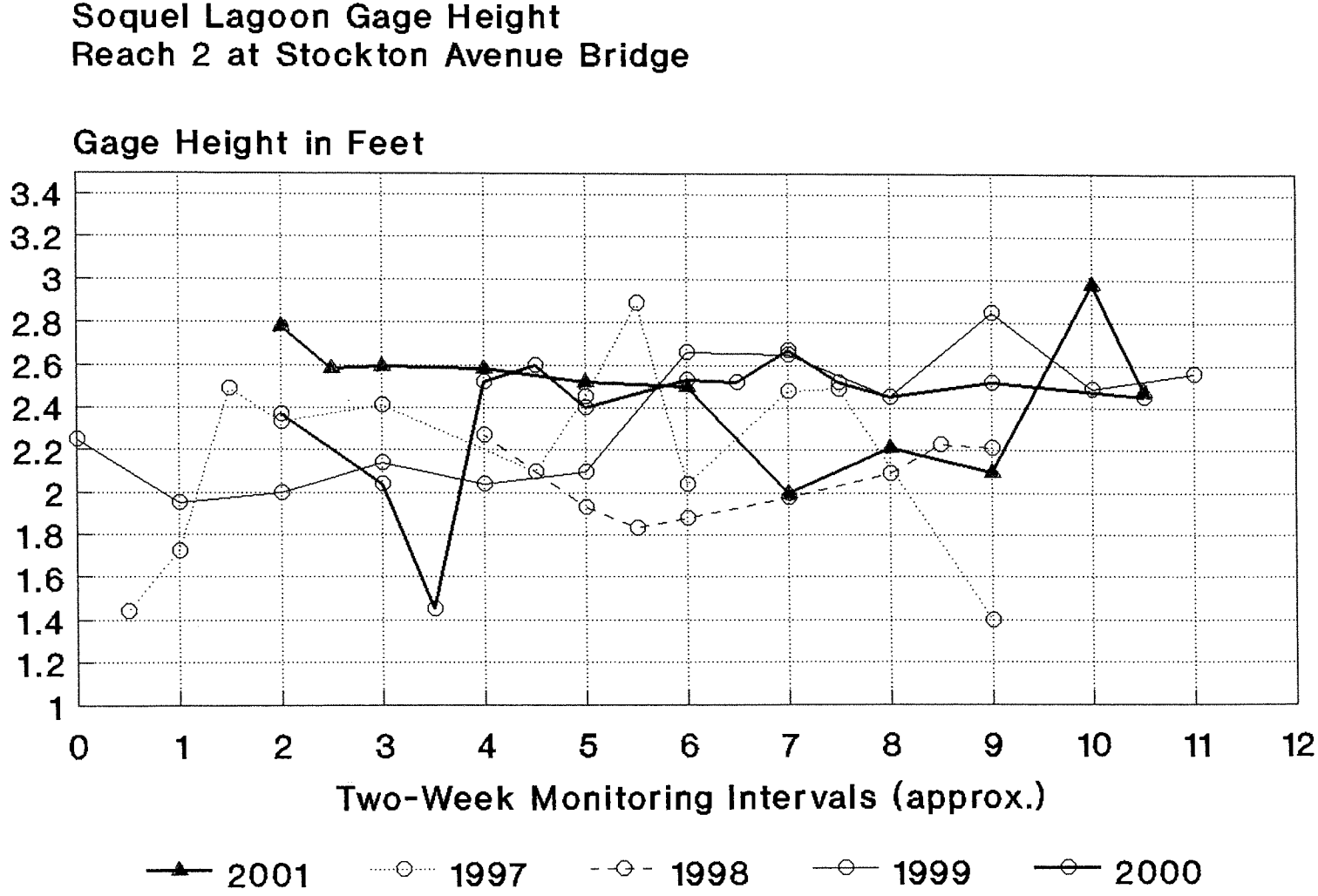


Figure 2. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Mid-May to Late October, 1997-2001.

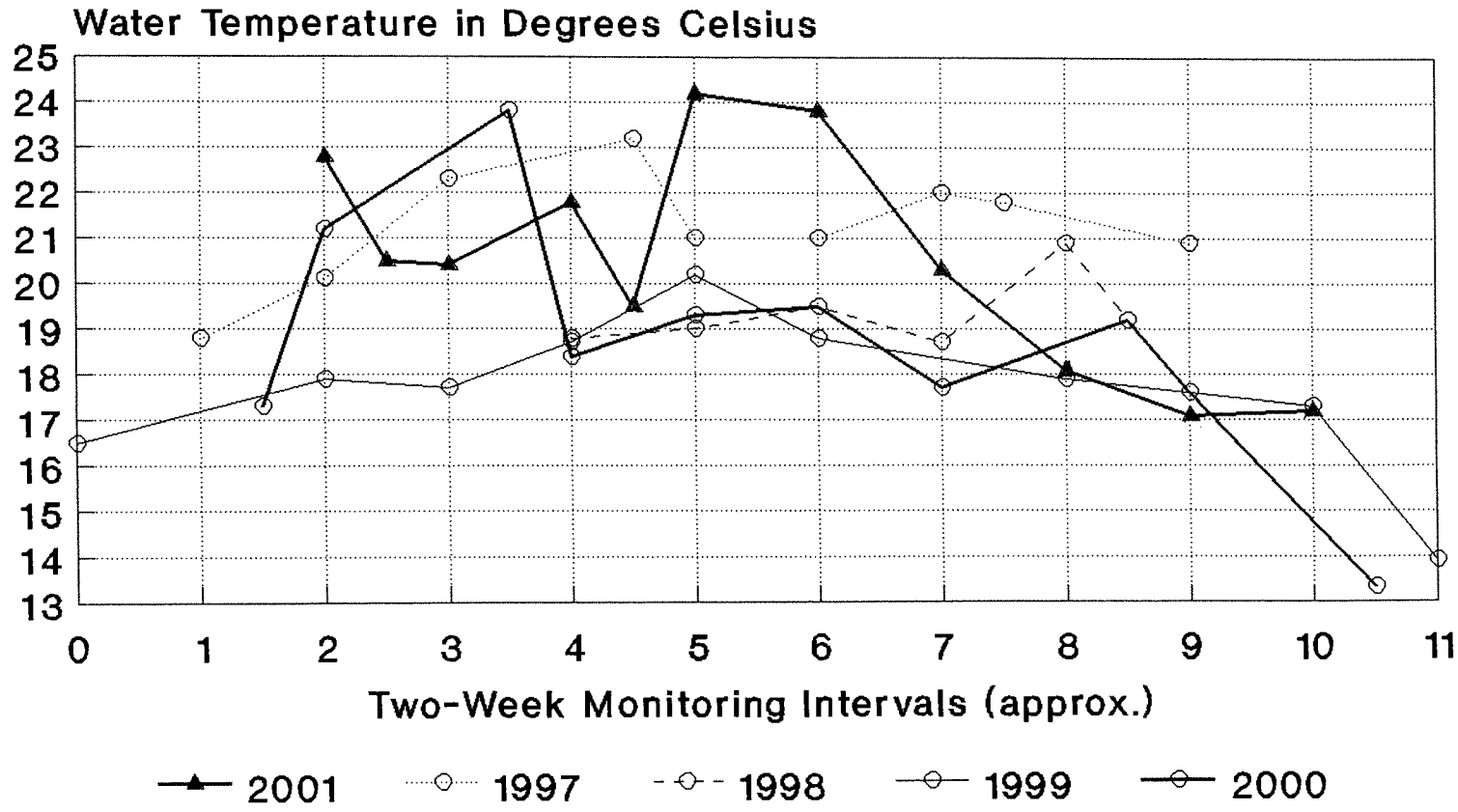


Figure 3. Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Mid-May to Late October 1997-2001.

Figure 4a. Water Temperature (Degrees Celsius) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 23 June to 10 October 2001.

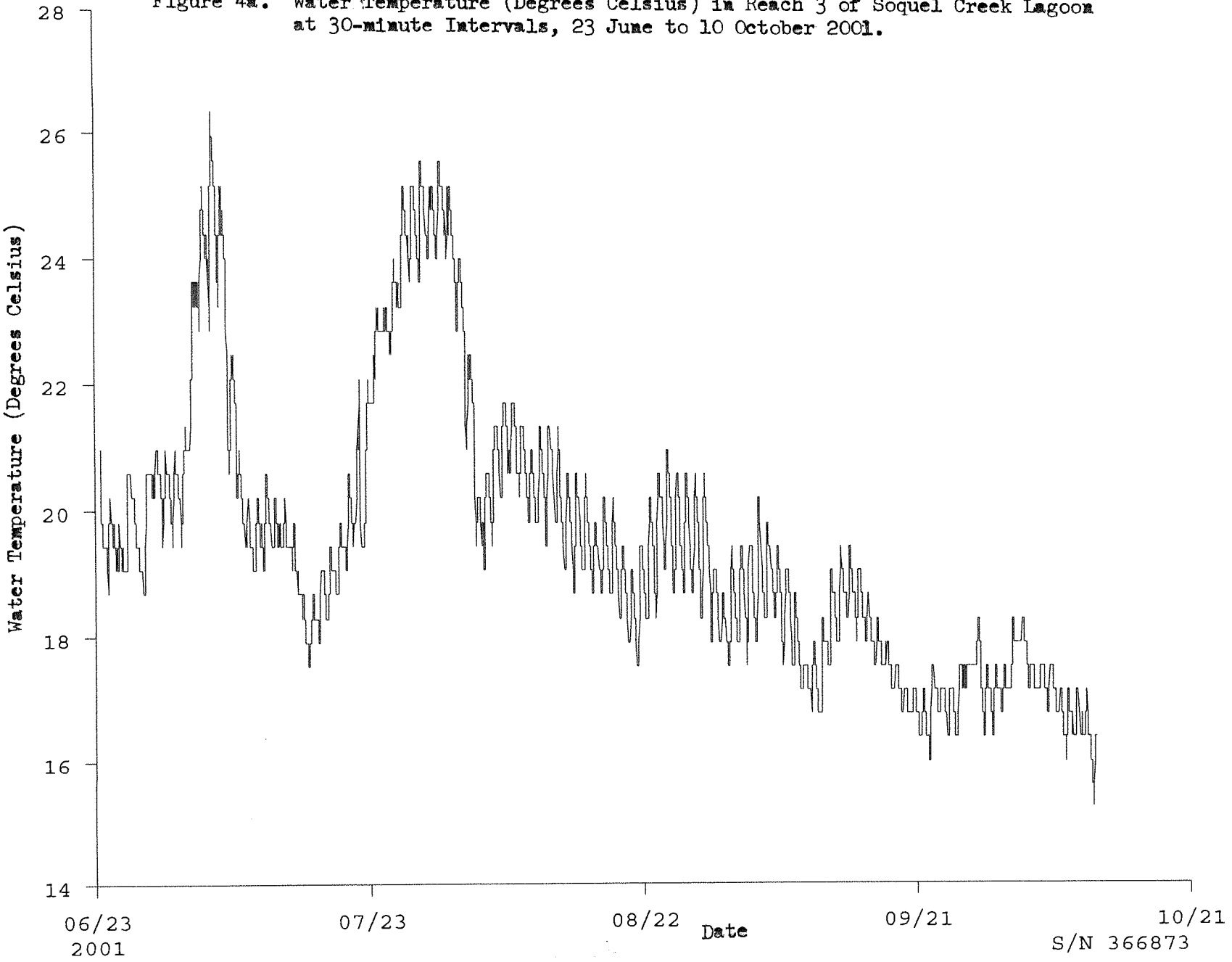


Figure 4b. Water Temperature (Degrees Faremheit) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 23 June to 10 October, 2001.

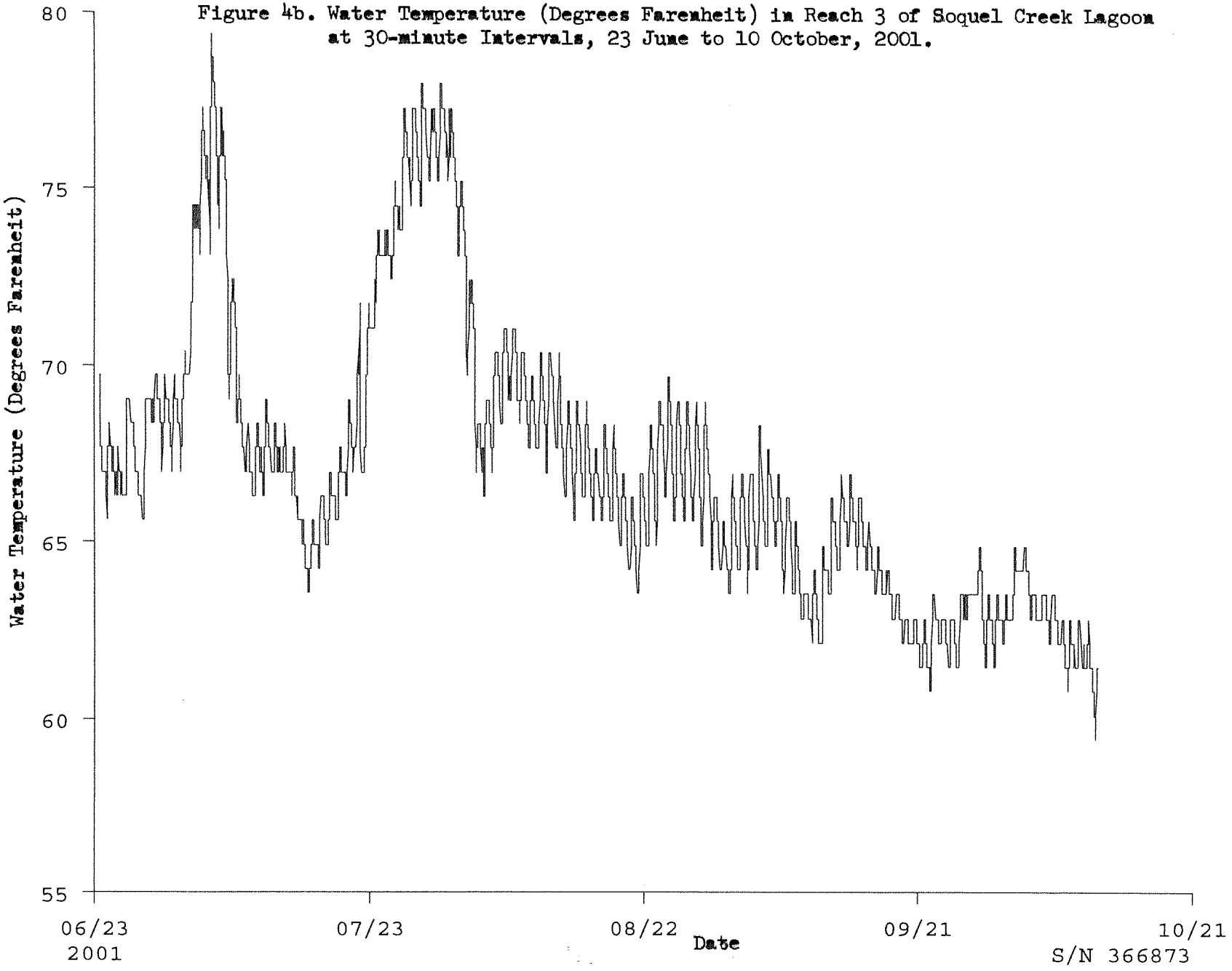


Figure 4c. Water Temperature (Degrees Celsius) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 26 June to September 2000.

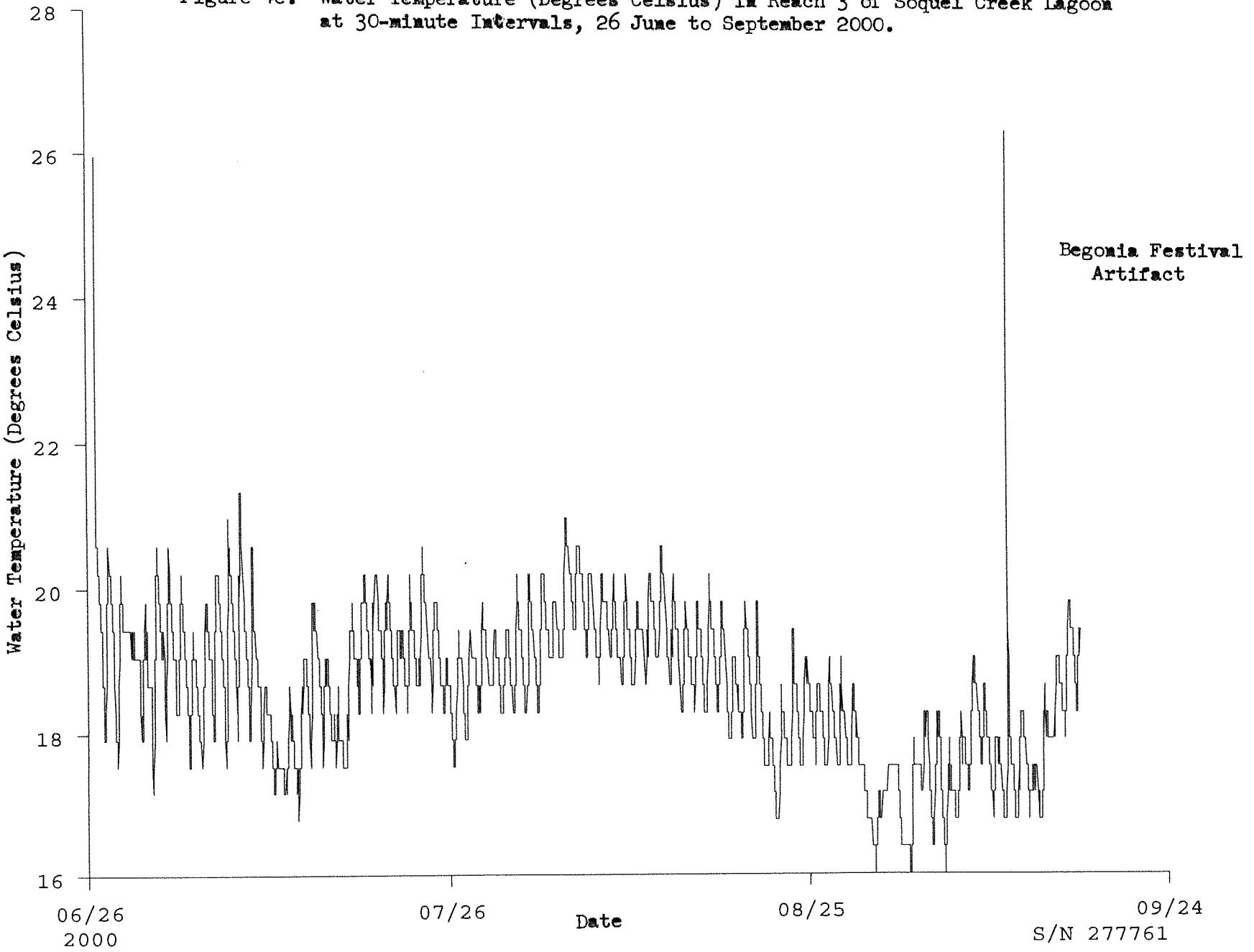


Figure 4d. Water Temperature (Degrees Farenheit) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 26 June to 16 September, 2000.

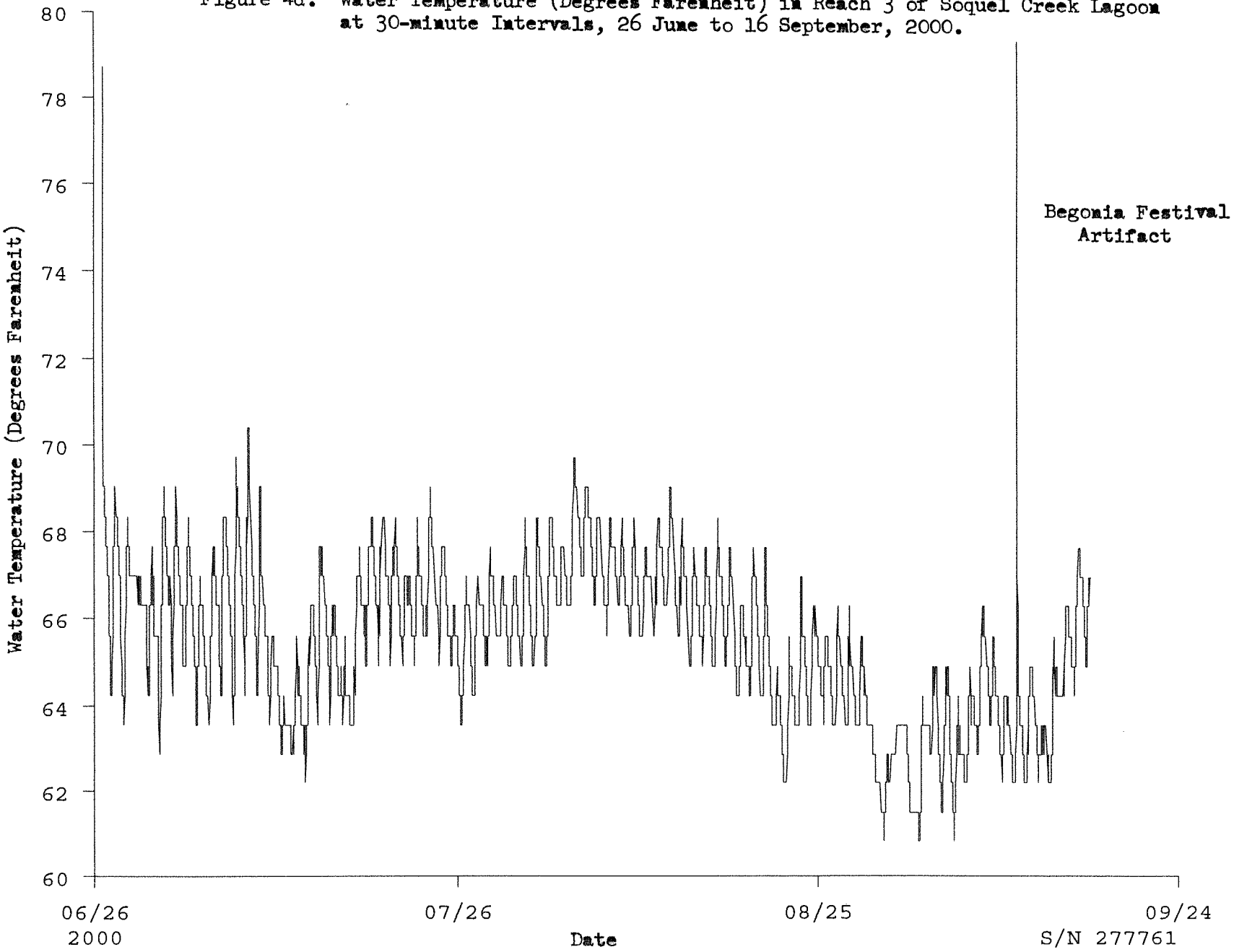


Figure 5a. Water Temperature (Degrees Celsius) in Soquel Creek at Nob Hill, 23 June to 10 October 2001 at 30-minute Intervals.

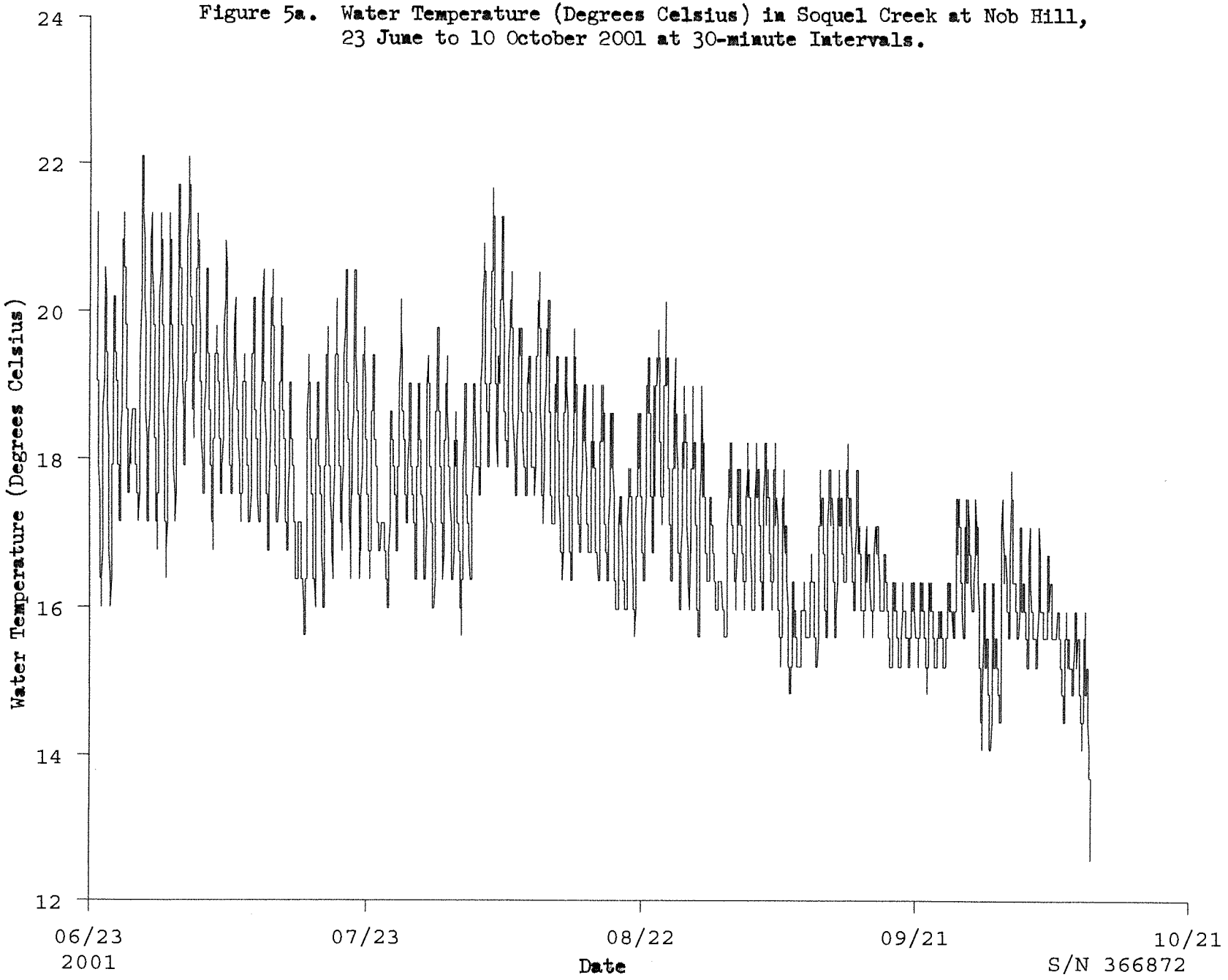


Figure 5b. Water Temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 23 June to 10 October 2001 at 30-minute Intervals.

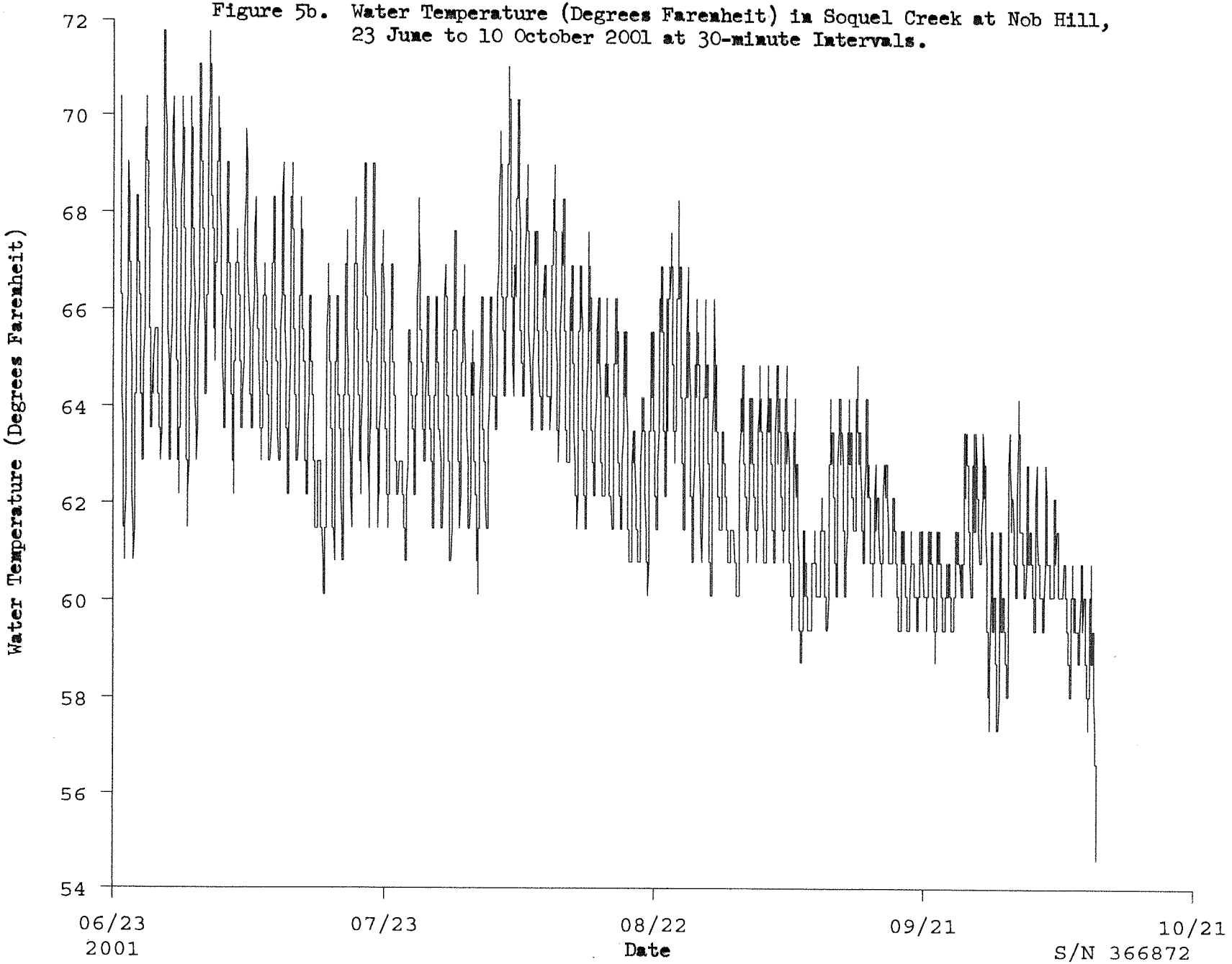


Figure 5c. Water Temperature (Degrees Celsius) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30-minute Intervals.

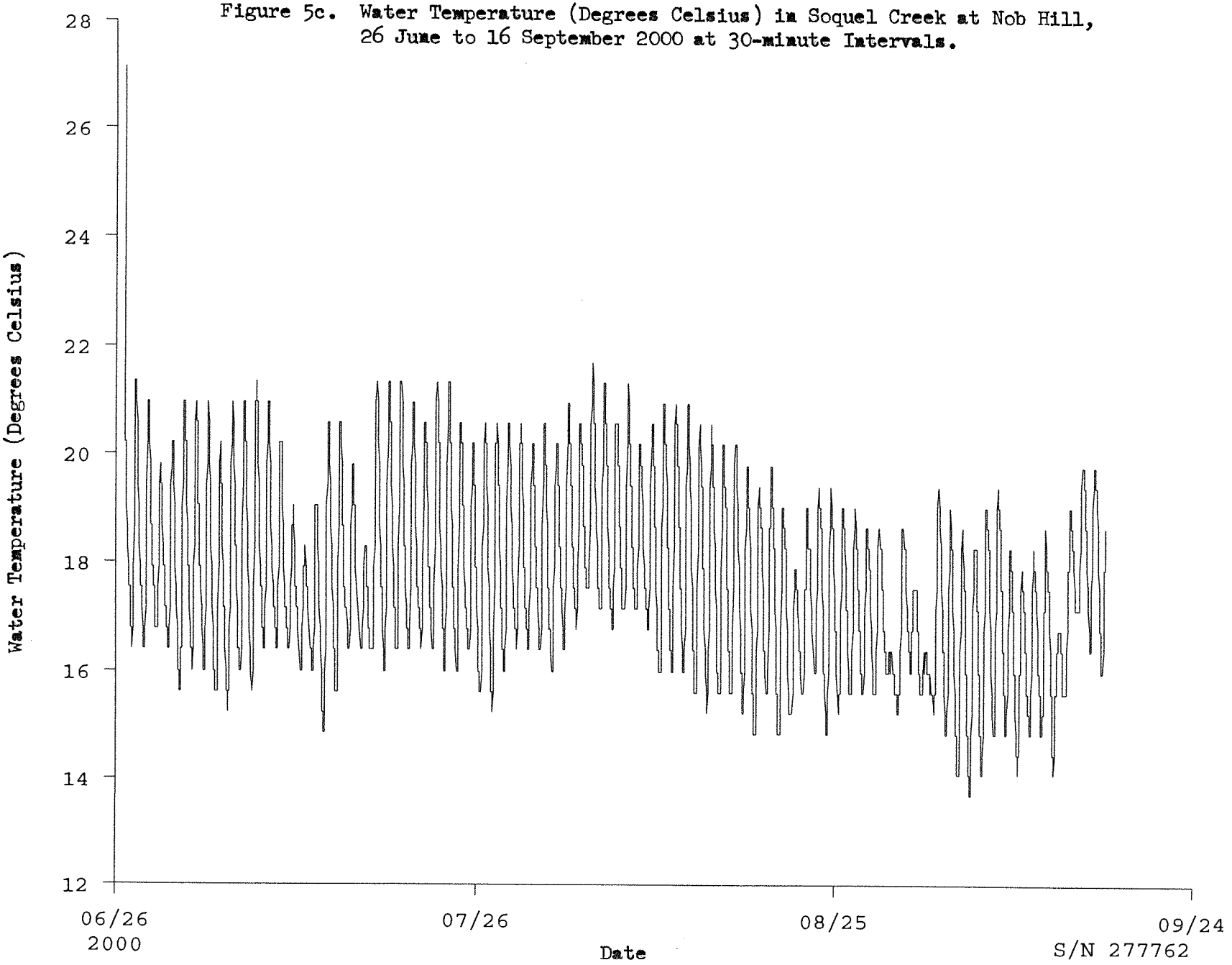


Figure 5d. Water Temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30-minute Intervals.

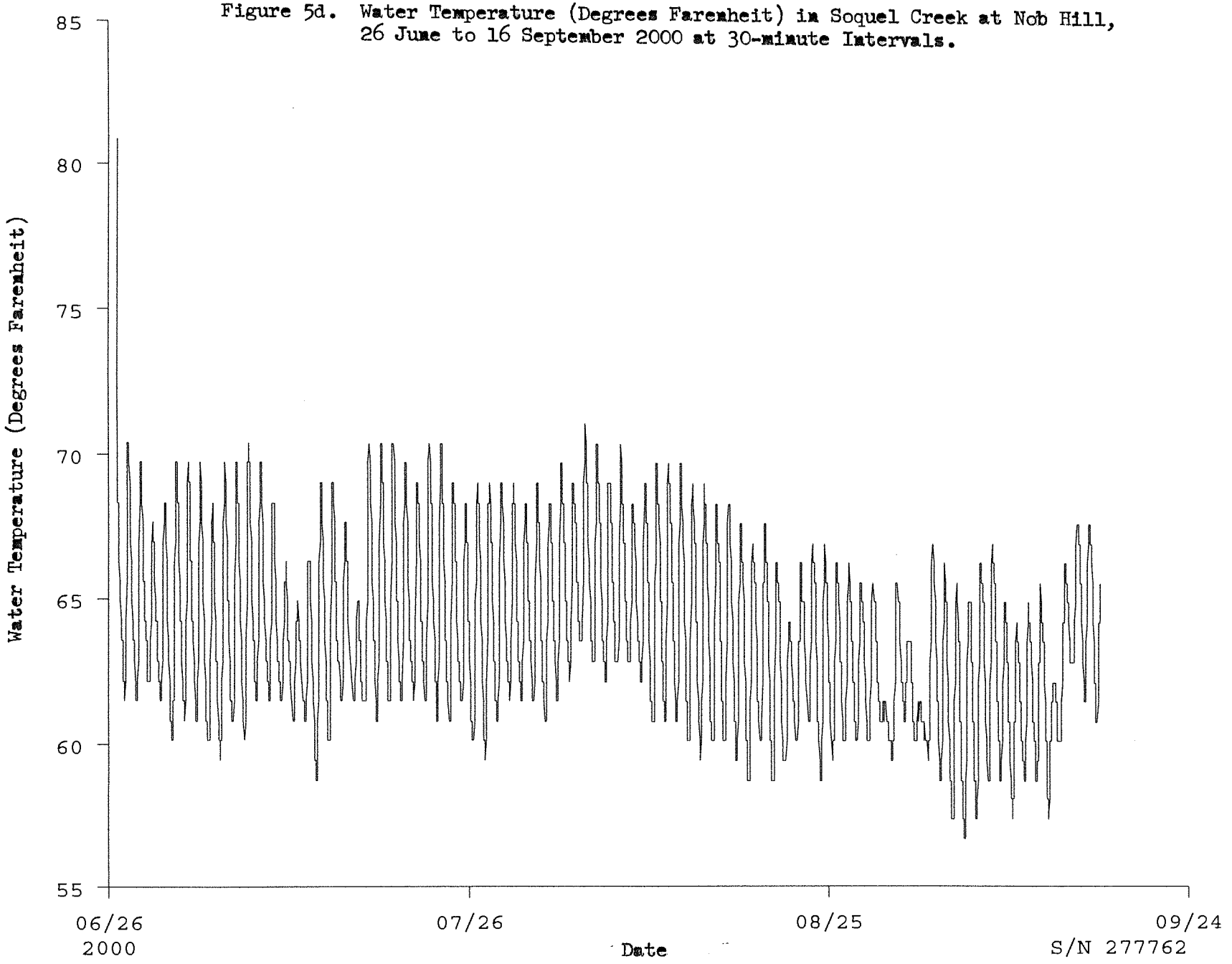


Figure 6a. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek Lagoon, 16 July to 18 September 1999.

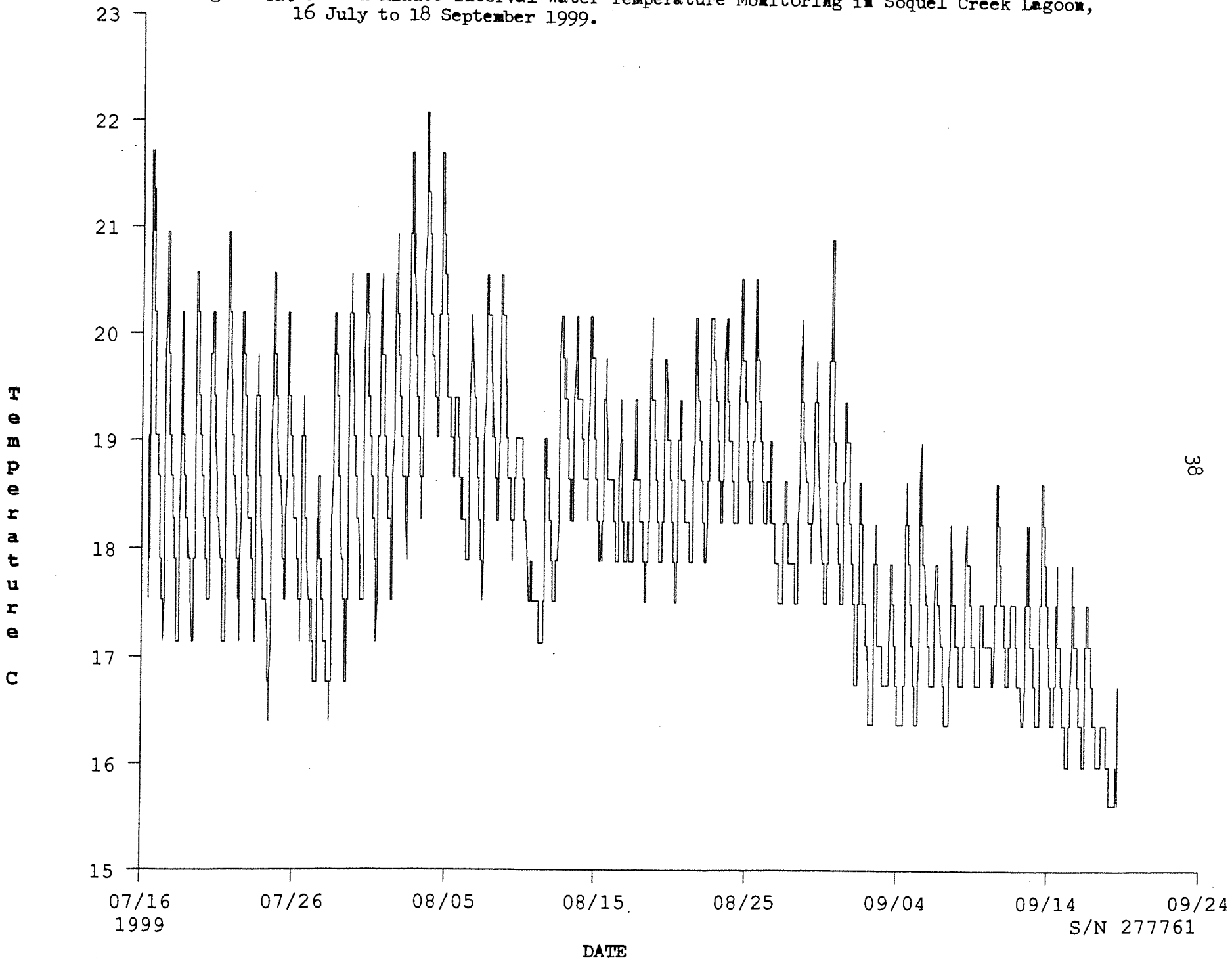


Figure 6b. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek at Nob Hill, 16 July to 18 September 1999.

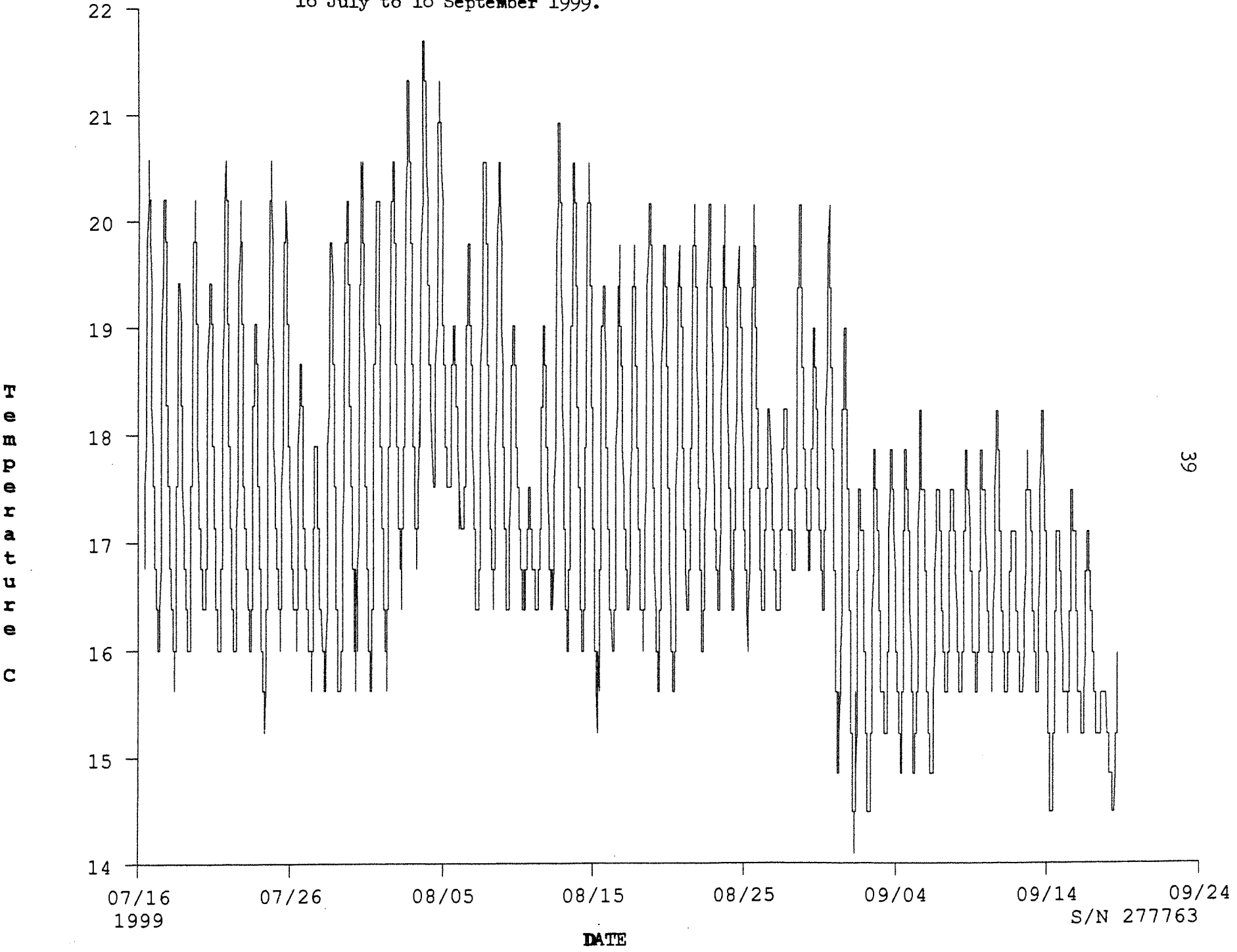


Figure 6c. Hourly Water Temperature Monitoring at Nob Hill on Soquel Creek, July 23 - September 4, 1998.

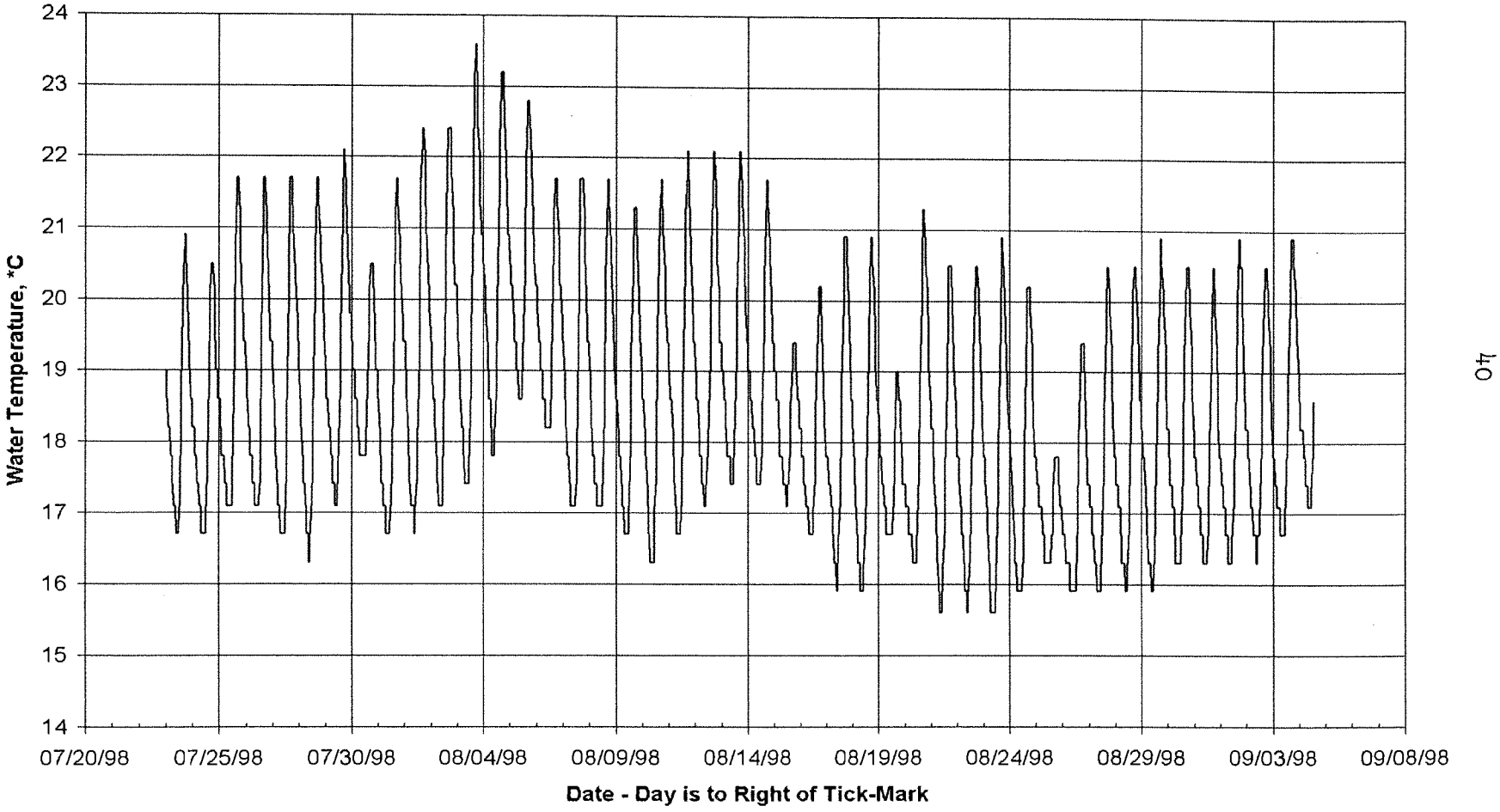


Figure 7. Soquel Lagoon Oxygen Concentration at Dawn, 29 June - 8 October 2001, Within 0.25 Meters of the Bottom at 4 Stations.

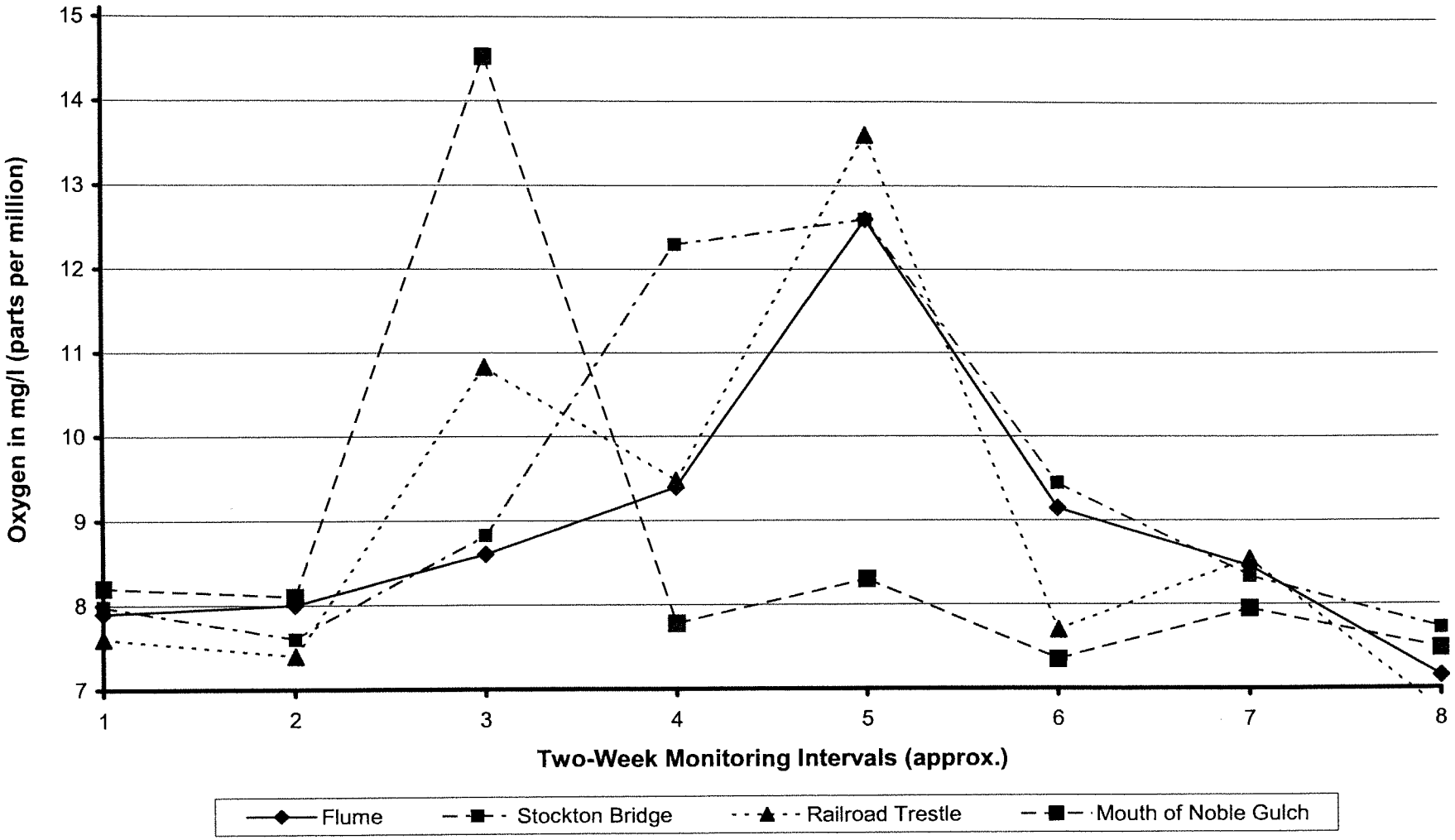


Figure 8. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001, in Soquel Lagoon.

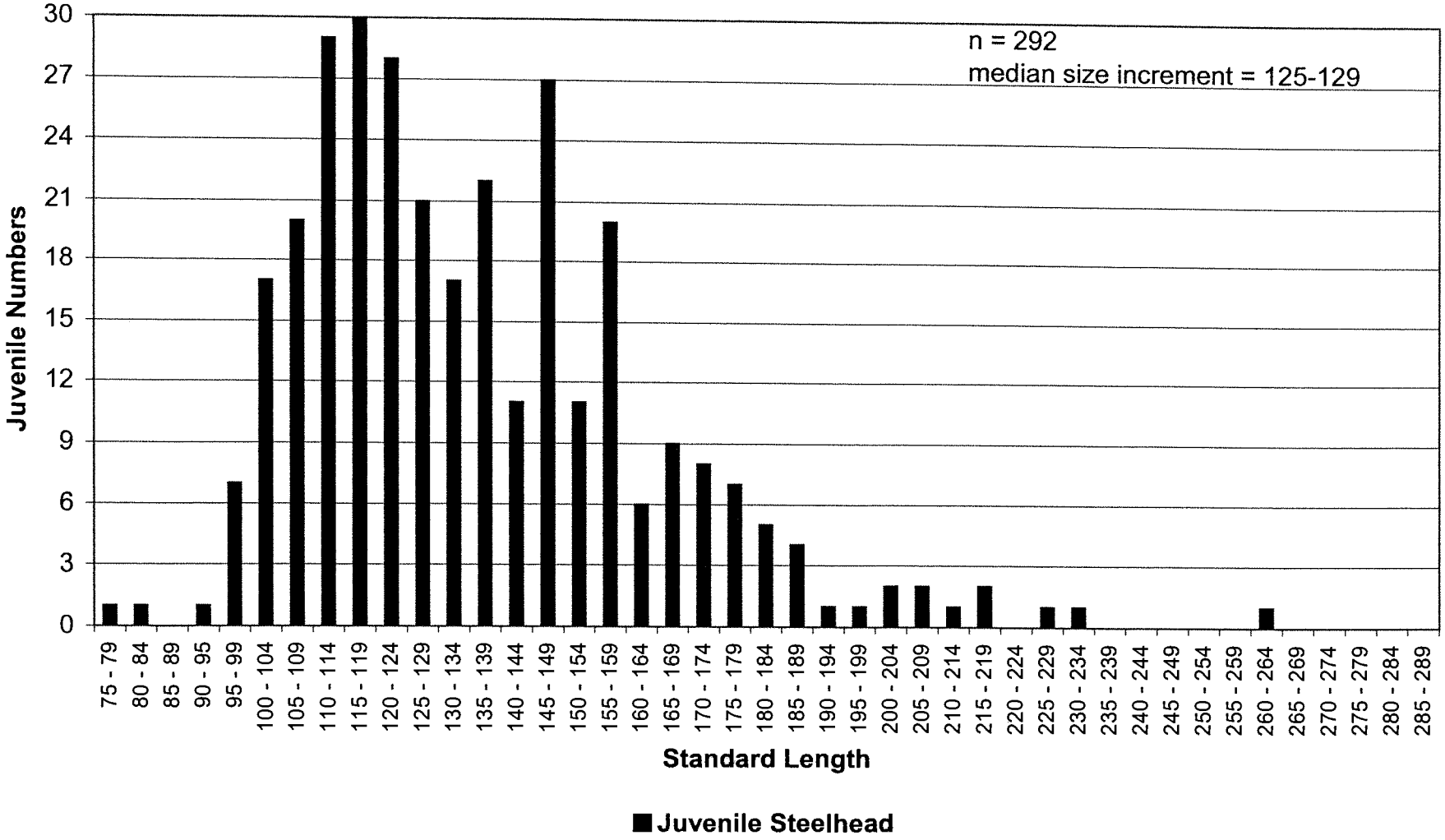


Figure 9. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000, in Soquel Lagoon.

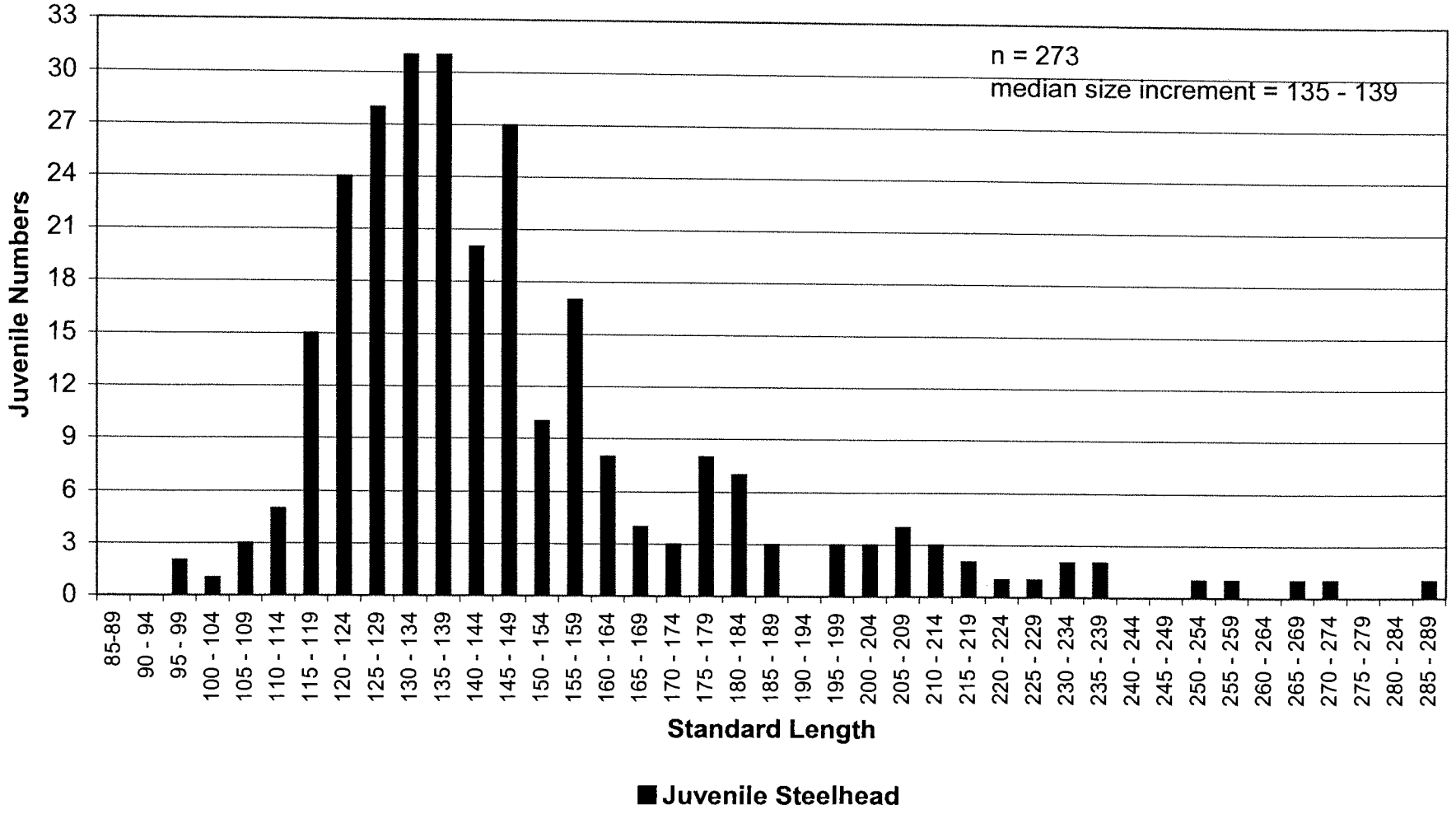
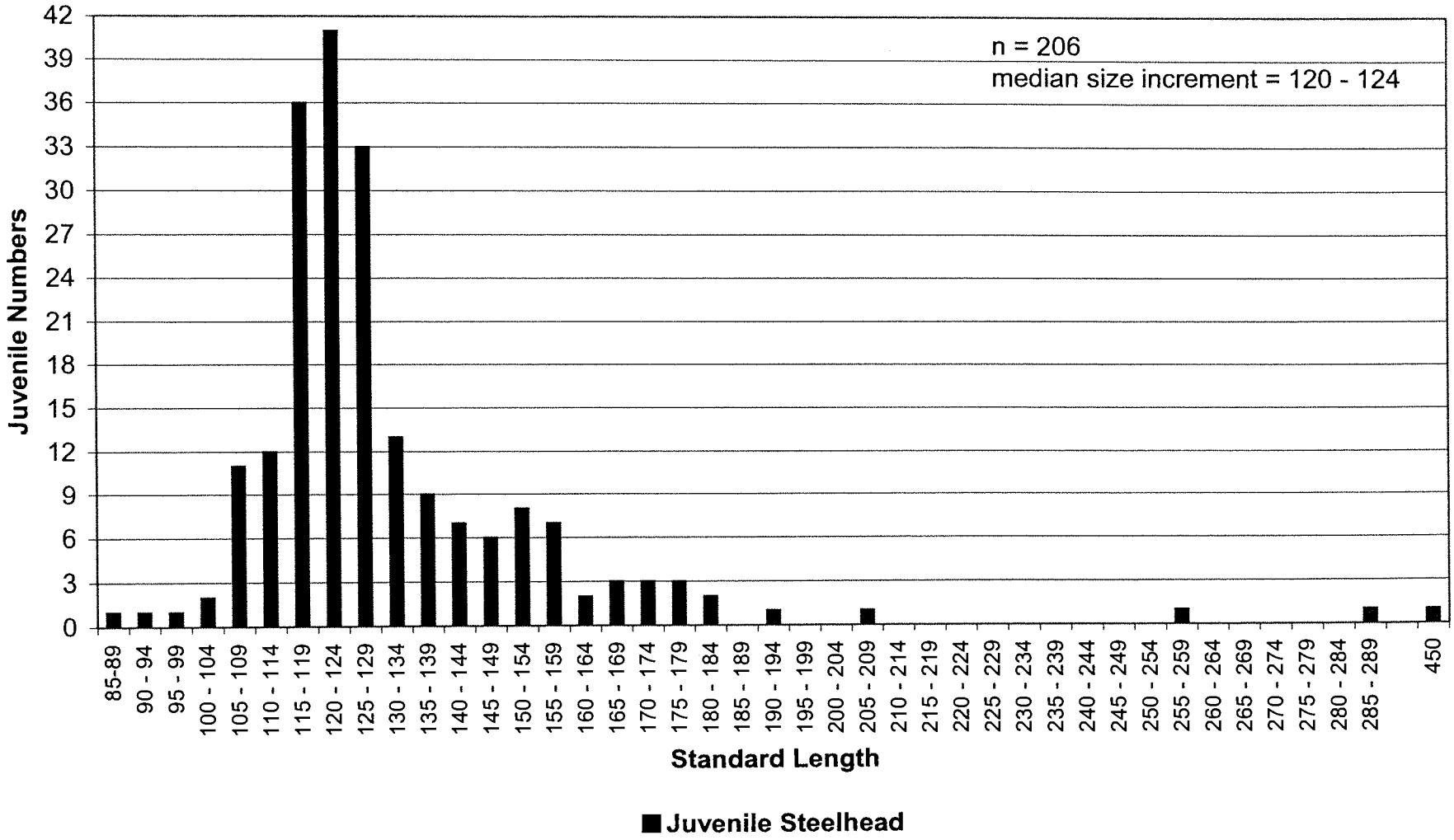


Figure 10. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 October 1999, in Soquel Lagoon.



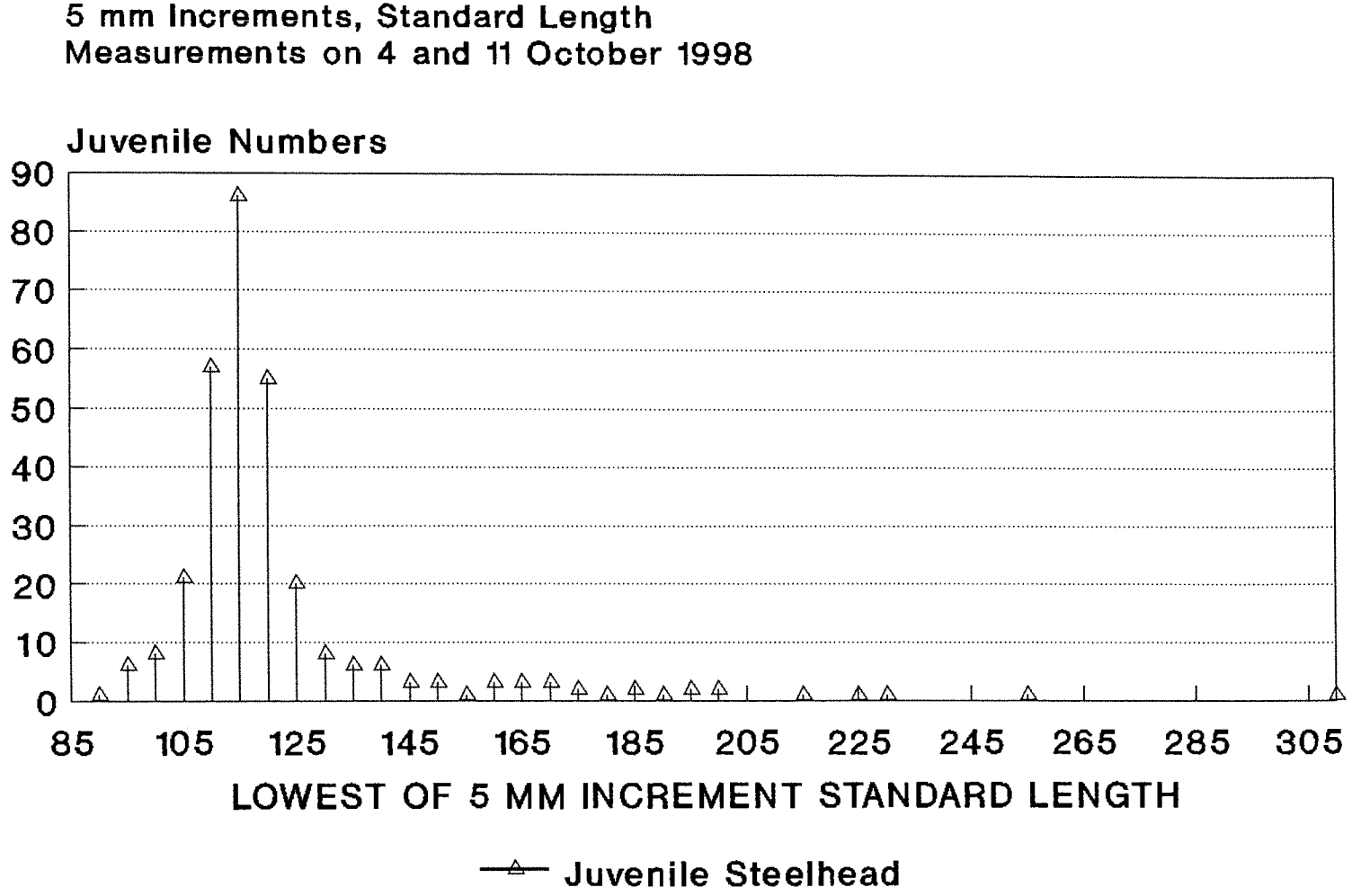
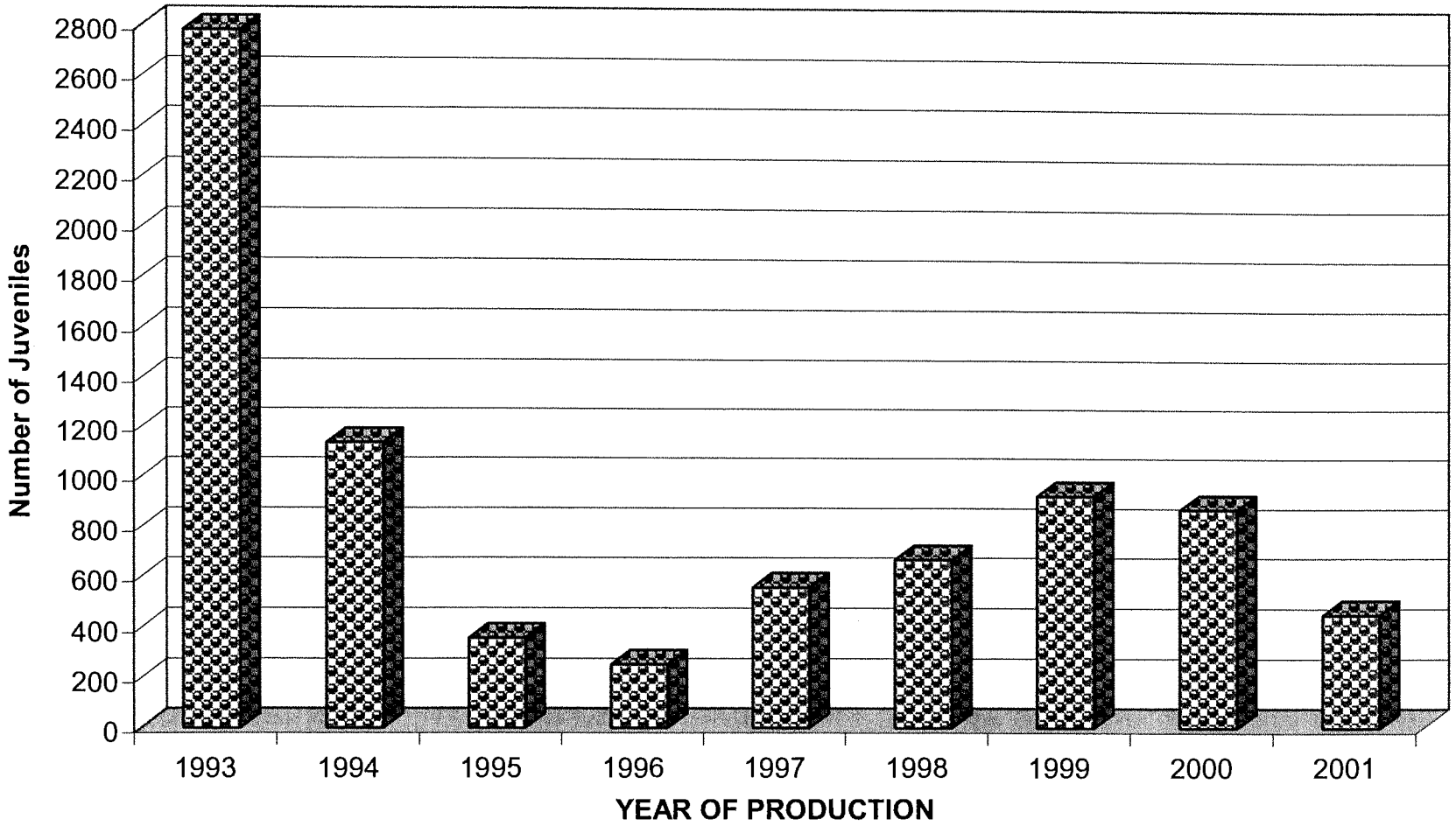


Figure 10b. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998, in Soquel Lagoon.

Figure 11. Juvenile Steelhead Production in Soquel Creek Lagoon, 1993-2001, Estimated by Mark and Recapture



APPENDIX A. WATER QUALITY DATA FOR 18 JUNE – 10 OCTOBER, 2001.

18 June 2001.

Station: Stockton Avenue Bridge at 1625 hr. Gage height of 2.78.

18-Jun-01									
		Flume				Stockton Avenue Bridge			4:25pm
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0					0	21.2	0	8.45	720
0.25					0.25	21.2	0	8.5	720
0.5					0.5	21.2	0	8.45	720
0.75					0.75	21.2	0	8.45	720
1					1	21.2	0	8.48	720
1.25					1.25	21.1	0	8.52	700
1.5					1.5	20.8	0	8.48	700
1.75					1.75	20.6	0	8.8	700
2					2	20.4	0	8.75	900
2.25					2.25	22.8	21-26.5	8.35	36K-39K
2.5					2.5	23.2	24.8-27	0.04	36K-39K

18-Jun-01									
		Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0					0				
0.25					0.25				
0.5					0.5				
0.75					0.75				
1					1				
1.25					1.25				
1.5					1.5				
1.75					1.75				
2					2				
2.25					2.25				
2.5					2.5				

23 June 2001. Stockton Avenue Bridge. Checking for maximum and minimum bottom and surface temperatures.

Station: Stockton Avenue Bridge at 1845 hr. Gage Height of 2.58. Surface temperature of 21.4°C and bottom temperature of 20.5°C with no increase in conductivity, indicating that saltwater had been flushed out.

23-Jun-01									
		Flume				Stockton Avenue Bridge			6:45pm
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0					0	21.4	0		650
0.25					0.25	21.3	0		650
0.5					0.5	21.2	0		650
0.75					0.75	21.2	0		650
1					1	21	0		650
1.25					1.25	21	0		650
1.5					1.5	21	0		650
1.75					1.75	20.8	0		650
2					2	20.5	0		650
2.25					2.25	20.5	0		650
2.5					2.5	20.5	0		650

23-Jun-01									
		Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0					0				
0.25					0.25				
0.5					0.5				
0.75					0.75				
1					1				
1.25					1.25				
1.5					1.5				
1.75					1.75				
2					2				
2.25					2.25				
2.5					2.5				

29 June 2001. Gage height of 2.59. Clear, sunny the previous day. Air temperature of 13.6 degrees Celsius. Flume inlet with shroud in place; outlet 1.7 feet deep.

Station: Flume at 0705 hr. Flume submerged 0.1 ft. Reach 1, no surface or bottom algae. Planktonic algae present

Station: Stockton Avenue Bridge, center span, ocean side at 0737 hr. Secchi depth=bottom. Reach 2, no surface algae. 25% of bottom covered in dark film on deep western side, remainder of bottom clear. 22 mallards cruising between Reaches 2 and 3.

Station: Railroad Trestle at 0807 hr. Reach 3, no surface algae. 5% of bottom covered in dark film on western side, deep above trestle; remainder of bottom clear.

Station: Mouth of Noble Gulch at 0825 hr. Fog rolling in. No surface or bottom algae. Planktonic algae present. 14 mallards roosting on downed cottonwood across the way.

Station: Nob Hill at 0949 hr. Water temperature 17.6 degrees Celsius. Air temperature 17.5 degrees Celsius. Conductivity 600 umhos, Oxygen 8.40 mg/l.

29-Jun-01									
7:05am		Flume				Stockton Avenue Bridge			7:37am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0	19.8	0	8.15	670	0	20.3	0	8.22	640
0.25	20	0	8.12	670	0.25	20.6	0	8	650
0.5	20.1	0	8.12	670	0.5	20.6	0	7.97	650
0.75	20.1	0	8.03	670	0.75	20.6	0	7.93	650
1	20.1	0	7.9	670	1	20.6	0	7.9	650
1.25	20.2	0	5.75	630	1.25	20.5	0	7.98	650
1.5					1.5	20.4	0	7.98	650
1.75					1.75	20.4	0	7.98	650
2					1.8	20.5	0	5.4	650
2.25					2.25				
2.5					2.5				

29-Jun-01									
8:07am		Railroad Trestle				Mouth of Noble Gulch			8:25am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	20.2	0	7.9	650	0	20.2	0	8.18	630
0.25	20.3	0	7.8	650	0.25	20.3	0	8.18	630
0.5	20.3	0	7.72	650	0.5	20.3	0	8.1	630
0.75	20.5	0	7.72	650	0.75	20.3	0	8.15	630
1	20.6	0	7.64	650	1	20.3	0	8.05	630
1.25	20.6	0	7.6	650	1.25	20.3	0	8.2	620
1.37	20.6	0	4.8	650	1.37	19.7	0	4.9	620

2 July 2001. Gage height of 2.57. Morrison observed mergansers above bridge. Tidal overwash on 2 and 3 July, with kelp in lagoon. Boards removed from Flume to let water out, shrouds left on.

14 July 2001. Gage height of 2.58. Overcast. Air temperature at 14 degrees Celsius at 0714 hr. Flume exit at 1.2 – 1.5 ft. Shroud still in place. Juvenile steelhead observed hitting the surface near Stockton Bridge at 0820 hr. Still feeding at 0915 hr. 17 mallards and 1 goose in Reach 1 at 0926hr.

Station: Flume at 0714 hr. Reach 1, no surface algae. 30% of bottom with algae cover, 0.5 ft. thick. Poor visibility. Occasional pondweed.

Station: Stockton Avenue Bridge at 0739 hr. Secchi depth to bottom. No surface algae. 30% of bottom with algae cover 0.5 – 1.0 ft. thick. 5% algae and pondweed cover 1- 2 ft. high, average of 1.5 ft.

Station: Railroad Trestle at 0800 hr. No surface algae. 10% pondweed and algae cover on bottom .5 – 2 ft. high, average of 1 ft. Thick algae and ooze layer on remainder.

Station: Mouth of Noble Gulch at 0815 hr. No surface algae. 30% of bottom with algae cover 0.5 ft thick. 13 ducks associated with downed cottonwood.

Station: Nob Hill at 0932 hr. Water temperature 17 degrees Celsius. Conductivity 580. Estimated streamflow 2.5 – 3 cfs. Conductivity 580 umhos.

14-Jul-01

7:14am		Flume				Stockton Avenue Bridge			7:39am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0	19.7	0	8.3	770	0	19.8	0.1	8.16	740
0.25	19.8	0	8.2	770	0.25	20	0.1	8.12	740
0.5	19.8	0	8.15	770	0.5	20.2	0.1	8.05	740
0.75	19.8	0	8.1	770	0.75	20.2	0.1	8	740
1	19.8	0	8	770	1	20.2	0.1	7.95	760
1.12	20.5	0	6	780	1.25	20.2	0.25	7.97	850
					1.5	21.8	4.7	7.6	7000
					1.75	22.7	4.5	2.59	6700

14-Jul-01

		Railroad Trestle				Mouth of Noble Gulch			9:32am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	19.5	0	7.45	680	0	19.2	0	7.9	630
0.25	19.7	0	7.45	680	0.25	19.4	0	7.85	630
0.5	19.8	0	7.5	680	0.5	19.5	0	7.75	630
0.75	19.8	0	7.5	680	0.75	19.6	0	7.75	630
1	19.8	0	7.45	680	1	19.6	0	7.73	630
1.25	19.8	0	7.4	680	1.25	19	0	8.1	620
1.3	19.8	0	4.8	680	1.3	18.8	0	5.45	580

20 July 2001. Air temperature at 18.2 degrees Celsius.

Station: Above the Trestle, west side, at 1015 hr and Stockton Avenue afterwards. No salinity detected.

20-Jul-01

10:15am		Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0					0	19.6	0		
0.25					0.25	19.5	0		
0.5					0.5	19.5	0		
0.75					0.75	19.5	0		
1					1	19.5	0		
1.25					1.25	19.5	0		
					1.5	19.5	0		
					1.85	19.5	0		

20-Jul-01

		Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	19.4	0			0				
0.25	19.5	0			0.25				
0.5	19.6	0			0.5				
0.75	19.6	0			0.75				
1	19.4	0			1				
1.25	19.4	0			1.25				
1.5					1.5				

21 July 2001. Had large tidal overwash. Raised lagoon at least 6 inches under trestle.

28 July 2001. Gage height of 2.52. Overcast. Flume inlet at 1.6 ft., outlet at 1.0 ft. Found dead top smelt behind bulkhead at the trestle and threw it into the lagoon. Mergansers could not swallow it. Secondary berm constructed, west side near Venetian Courts. 2 dead smelt behind restaurant below bridge, 7 inches long. Left message with Eddie Ray to install another shroud. It was installed 7-30-2001. Gage height on 8-03-2001 at 2.58.

Station: Flume at 0720 hr. School of 20 steelhead; Pied billed grebe; 19 mallards; 5 mergansers feeding in lower lagoon; Steelhead in shallows; Great Blue Heron on log section. One shroud in place. Flume inlet beams attached to plywood raised 1 ft. out of the west inlet, no wedge. Reach 1, no surface algae. 25% of bottom with algae and pondweed clumps 1.5 – 2 ft. high.

Station: Stockton Avenue Bridge at 0749 hr. Secchi depth to bottom. Reach 2, no surface algae. 15% of bottom with algae and pondweed 1 – 2 ft. high, average height of 1.5 ft. Dark scum on bottom. 30% of bottom with algae 0.5 ft. thick. Thick ooze elsewhere. Cormorant in Reach 2.

Station: Railroad Trestle at 0820 hr. No surface algae. 20% of bottom with 1 – 2.5 ft. thick algae and pondweed. Thick film elsewhere. 30% of bottom with algae 0.5 ft. thick.

Station: Mouth of Noble Gulch at 0840 hr. No surface algae. 20% of bottom with clumps of algae and pondweed 1.5 – 2 ft. high. Thick film elsewhere.

Station: Nob Hill at 1000 hr. Water temperature at 16.7 degrees Celsius. 2.5 – 3 cfs. Conductivity at 500 umhos.

28-Jul-01									
7:20am		Flume				Stockton Avenue Bridge			7:49am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0	18.2	0.5	8.45	1190	0	18.2	0.3	8.5	1020
0.25	18.3	0.5	8.45	1280	0.25	18.4	0.3	8.45	1030
0.5	18.4	0.5	8.5	1320	0.5	18.6	0.3	8.4	1100
0.75	18.6	0.6	8.7	1520	0.75	18.8	1.2	8.35	1880
1	19	1.1	8.6	2600	1	21.2	6.8	9.86	10800
1.25	19.8	1.3	6.69	2920	1.25	23.8	9.6	1353	15700
					1.5	24.2	11.2	8.83	17300
					1.75	24.5		4.24	17000

28-Jul-01									
8:20am		Railroad Trestle				Mouth of Noble Gulch			8:40am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	18.3	0.2	8.3	925	0	18.2	0	8.2	760
0.25	18.5	0.2	8.3	940	0.25	18.3	0	8.05	770
0.5	18.7	0.2	8.3	940	0.5	18.3	0	8.12	780
0.75	18.7	0.3	8.2	1240	0.75	18.5	0.3	8.05	1270
1	21.6	6.25	11.06	8500	1	21.2	7.3	13.9	10600
1.25	24.2	10.3	10.53	15200	1.25	23.8	10.3	14.53	14800
1.33	24.2	10.6	5.28	15300	1.3	24	9.8	7.95	14300

10 August 2001. Gage height at 2.50. Overcast. Air temperature at 15.5 degrees Celsius. Flume outlet average of 1.1 ft.; 0.8 – 1.5 ft range. At 0800 hr 39/ minute steelhead hits above Stockton Bridge. Black crown night heron on trestle beam. Bullfrog heard in Reach 2. Great Blue Heron above trestle near floats. Shrouds were installed improperly. Informed Ed Morrison.

Station: Flume at 0700 hr. Pieded billed grebe; pelican in lagoon. No surface algae. 60% of bottom with pondweed and algae 2 – 3.5 ft. high.

Station: Stockton Avenue Bridge at 0728 hr. Secchi depth to bottom. Black crown night heron. Reach 2, no surface algae. 60% of bottom with pondweed and algae 1 – 2 ft. high. 20% of bottom with algae 0.5 ft. high with the remainder, sand.

Station: Railroad Trestle at 0813 hr. Reach 3, no surface algae. 20% of bottom with algae and pondweed 1 – 2.5 ft. thick. 70% of bottom with algae 0.5 – 1.0 ft. thick.

Station: Mouth of Noble Gulch. Hawk across on tree near log; 2 Great blue herons; Pieded billed grebe. No surface algae. 20% of bottom with algae and pondweed 2 – 3 ft. thick. Ooze on remainder.
Station: Nob Hill at 0934 hr. Water temperature at 17.8° C. Streamflow at 2 cfs. Conductivity 600 umhos.

10-Aug-01									
7:00am		Flume				Stockton Avenue Bridge			7:28am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0	20.8	0.02	9.24	1060	0	20.8	0.03	9.18	1050
0.25	21	0.02	9.25	1060	0.25	20.9	0.03	9.52	1050
0.5	21	0.02	9.26	1060	0.5	21	0.03	9.7	1050
0.75	21	0.02	9.35	1060	0.75	21.1	0.03	9.63	1050
1	21	0.02	9.4	1060	1	21.1	0.03	9.6	1080
1.13	20.8	0.02	6.85	1020	1.13	21.2	0.08	9.48	1080
					1.5	23.8	1.8	12.3	2700
					1.75	24.5	6.2	1.44	8000

10-Aug-01									
8:13am		Railroad Trestle				Mouth of Noble Gulch			9:34am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	20.5	0.01	9.5	780	0	19.3	0	7.65	720
0.25	20.6	0.01	9.48	780	0.25	19.8	0	7.85	720
0.5	20.6	0.01	9.55	780	0.5	19.8	0	7.87	720
0.75	20.6	0.01	9.55	780	0.75	19.8	0	7.85	720
1	20.6	0.01	9.48	780	1	19.7	0	7.65	700
1.05	20.8	0.01	6	780	1.25	18.9	0	7.78	680
					1.3	19	0	5.6	680

25 August 2001. Gage height of 2.00. Sunny. Air temperature 14 degrees Celsius. Flume inlet 1.1 ft., outlet 1 – 1.5 ft. Shrouds still in place.

Station: Flume at 0725 hr. Reach 1, nosurface algae. 70% of bottom with pondweed and algae 3 – 4.5 ft. thick.

Station: Stockton Avenue Bridge at 0750 hr. Secchi depth to bottom. Reach 2- 1% algae on surface. 25% of bottom with algae and pondweed 2 – 4 ft. thick. 75% of bottom with a 1 – 1.5 ft. thick carpet of algae.

Station: Railroad Trestle at 0815 hr. Fog rolling in. 3% surface algae. 5% of bottom with algae and pondweed 3 – 4 ft. thick. 70% of the bottom with algae, 0.5 – 3 ft thick. 25% of bottom with sand visible.
Station: Mouth of Noble Gulch at 0828 hr. 25% surface algae. 70% of bottom algae + pondweed 2.5-3.5 ft thick, 15% algae of bottom 0.2-4 ft thick. 15% of bottom sand.
Station: Nob Hill at 0945 hr. Water temp. 17.3°C, estimated flow 1.5-1.75 cfs, conductivity 580 umhos.

25-Aug-01									
7:25am		Flume				Stockton Avenue Bridge			7:50am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0	19.5	0	12.5	630	0	20.2	0	12.5	650
0.25	19.6	0	12.5	630	0.25	20.3	0	12.5	650
0.5	19.6	0	12.7	630	0.5	20.3	0	12.6	650
0.75	19.8	0	12.6	630	0.75	20.3	0	12.5	650
1	19.8	0	7.95	630	1	20.3	0	12.5	650
					1.13	20.3	0	12.6	650
					1.5	20.3	0	12.6	650
					1.75	20.3	0	7.2	660

25-Aug-01									
8:15am		Railroad Trestle				Mouth of Noble Gulch			8:28am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	19.6	0	13.3	650	0	18.5	0	8.3	650
0.25	19.8	0	13.5	650	0.25	18.5	0	8.3	650
0.5	19.8	0	13.4	650	0.5	18.6	0	8.35	650
0.75	19.8	0	13.6	650	0.75	18.6	0	8.33	650
1	19.8	0	13.6	650	1	17.9	0	8.3	600
1.13	20	0	8.3	630	1.25	17.7	0	5.16	620

9 September 2001. Begonia Festival Day. Gage height of 2.21. Overcast. Air temperature of 15.2 degrees Celsius. Flume inlet at 1.1 ft., outlet at .7 – 1.3 ft. Fish barges removed and used for Begonia floats.

Station: Flume at 0708 hr. 3 pelicans; a few coots; few steelhead hits. Reach 1, no surface algae. 30% of bottom with algae and pondweed 2.5 – 4 ft. thick, 3.5 ft. average.

Station: Stockton Avenue Bridge at 0715 hr. Secchi depth=bottom. Green back heron upstream of bridge on bulkhead. No ducks. Reach 2, no surface algae, 60% of bottom with algae and pondweed 1.5- 4 ft. thick, 3 ft. average. 40% of bottom with algae 1.5 ft. thick.

Station: Railroad Trestle at 0738 hr. Reach 3, no surface algae, 60% algae and pondweed on bottom; 1.0 – 3.5 ft. thick, averaging 2.0 ft. 40% of bottom with algae, average height of 1.0 ft., consistent mat.

Station: Mouth of Noble Gulch at 0755 hr. Kingfisher. No ducks on log. No surface algae. 50% of bottom with pondweed and algae 1.5 ft. thick, range of 1 to 2 ft. 50% of bottom algae is .5 – 1.5 ft. thick.

Station: Nob Hill at 0855 ft. Water temperature at 15.8 degrees Celsius. Estimated streamflow 2.25 cfs. Conductivity 570 umhos.

9-Sep-01									
7:08am		Flume				Stockton Avenue Bridge			7:15am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0	17.8	0	9.35	620	0	17.7	0	9.84	640
0.25	18.1	0	9.4	620	0.25	17.9	0	9.68	630
0.5	18.2	0	9.37	620	0.5	18	0	9.57	630
0.75	18.2	0	9.4	620	0.75	18.1	0	9.57	630
1	18.1	0	9.15	620	1	18.1	0	9.57	630
1.05	18.1	0	5.42	630	1.25	18.1	0	9.45	630
					1.5	18.2	0	5.6	630

9-Sep-01									
7:38am		Railroad Trestle				Mouth of Noble Gulch			7:55am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	17.6	0	7.36	630	0	17	620	9.55	0
0.25	17.8	0	7.46	630	0.25	17.2	620	9.17	0
0.5	17.9	0	7.61	630	0.5	17.2	620	9.1	0
0.75	17.9	0	7.61	630	0.75	17.2	620	7.7	0
1	17.8	0	7.7	630	1	16.8	630	7.35	0
1.2	17.8	0	4.73	650	1.25	16.8	640	1.65	0

9 September 2001. Gage height of 2.23 ft at 1755 hr after the Festival. No reduction in depth.

Station: Flume. Only 5 floats in the Festival this year. 1 merganser; only 3 ducks; 1 goose. Most ducks appeared to have left during the Festival.

Station: Stockton Avenue Bridge at 1755 hr. Secchi depth to bottom. Pied billed grebe.

9-Sep-01									
		Flume				Stockton Avenue Bridge			5:55pm
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0					0	19.2			650
0.25					0.25	19.2			650
0.5					0.5	19.2			650
0.75					0.75	19			650
1					1	19			650
1.25					1.5	18.9			650
1.5						18.8			660

22 September 2001. Gage height of 2.10. Foggy. Air temperature 11.2 degrees Celsius. Flume outlet 1.3 – 1.5 ft deep. Shroud removed after Begonia Festival.

Station: Flume at 0815 hr. Reach 1, coots present; 1 pied billed grebe, no surface algae. 50% of bottom with pondweed and algae 3-4 ft. thick. Could not see along bottom. Bare sand around margin.

Station: Stockton Avenue Bridge at 0835 hr. Secchi depth to bottom. Reach 2, no evidence of Begonia Festival effects. 2% surface algae. 40% pondweed and algae on bottom at 3-4 ft. thick. Algae carpet 1 ft. thick on remainder.

Station: Railroad Trestle at 0855 hr. Reach 3, no evidence of Begonia Festival effect. 1% surface algae. 30% pondweed and algae on bottom 2-4 ft. thick; 70% of bottom with algae 1 ft. thick.

Station: Mouth of Noble Gulch at 0915 hr. No surface algae. 15% of bottom pondweed and algae 2-3 ft. thick. 85% of bottom algae 1-2 ft. thick.

Station: Nob Hill at 1026 hr. Water temperature at 15.3 degrees Celsius. Conductivity 560 umhos.

22-Sep-01

8:15am		Flume				Stockton Avenue Bridge			8:35am
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (ppm)**	**Cond 1 umhos**	**Depth (m)**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (ppm)**	**Cond 2 umhos**
0	16.5	0	8.6	600	0	16.5	0	8.6	620
0.25	17	0	8.4	600	0.25	16.8	0	8.4	620
0.5	17	0	8.5	600	0.5	17	0	8.45	620
0.75	17	0	8.45	600	0.75	17	0	8.42	620
1	17	0	6.65	600	1	17	0	8.4	620
					1.25	17.1	0	8.4	620
					1.5	17.1	0	8.33	620
					1.63	17.2	0	5.03	630

22-Sep-01

8:55am		Railroad Trestle				Mouth of Noble Gulch			9:15am
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (ppm)**	**Cond 3 umhos**	**Depth (m)**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (ppm)**	**Cond 4 umhos**
0	16.3	0	8.06	620	0	16	0	7.96	580
0.25	16.3	0	8.43	620	0.25	16	0	7.9	580
0.5	16.8	0	8.55	620	0.5	16	0	7.95	580
0.75	16.8	0	8.54	620	0.75	16.2	0	7.95	580
1	16.8	0	8.54	620	1	16	0	7.95	580
1.25	16.9	0	5.23	620	1.25	16	0	4.15	560

8-Oct-01

7:25am		Flume				Stockton Avenue Bridge				7:50am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Depth (m)	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0	16.8	0	7.44	640	0	16.7	0	7.97	630	
0.25	17	0	7.4	640	0.25	17.2	0	7.86	630	
0.5	17	0	7.3	640	0.5	17.2	0	7.83	630	
0.75	17	0	7.3	630	0.75	17.2	0	7.76	630	
1	17.1	0	7.15	630	1	17.2	0	7.76	630	
1.25	17.2	0	5.32	620	1.25	17.2	0	7.75	630	
					1.5	17.2	0	7.73	630	
					1.75	17.2	0	7.72	630	
					2	17.2	0	4.18	640	

8-Oct-01

8:15am		Railroad Trestle				Mouth of Noble Gulch			8:30am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Depth (m)	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0	17.2	0	7.08	620	0	16.2	0	7.4	610
0.25	17.1	0	7.03	620	0.25	16.3	0	7.2	600
0.5	17.1	0	6.85	620	0.5	16.3	0	7.25	600
0.75	17.1	0	6.85	620	0.75	16.3	0	7.15	600
1	17.1	0	6.76	620	1	16.5	0	7.36	600
1.25	17.1	0	6.73	620	1.25	16.5	0	7.48	600
1.5	17.2	0	3.55	620	1.5	16.5	0	4.4	600

APPENDIX B

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON, 2001.

DRAIN LINE TEST FOR RESTAURANTS
CONTIGUOUS WITH SOQUEL CREEK

RESTAURANT	INITIAL CONTACT	TEST DATE	COMMENTS	SIGN OFF
BEACH HOUSE 207 ESPLANADE MAUREEN WILKS (831) 475-5846	5/18/01	5/23/01		
CALLOWAY'S 209 ESPLANADE LAURIE & MARCIE (831) 768-9220	5/18/01	5/23/01		
PIZZA MY HEART 209-A ESPLANDE CHUCK HAMMER (831) 426-2511	5/18/01	5/23/01		
FOG BANK 211 ESPLANDE LINDA BENNENT (831) 462-1881	5/18/01	6/12/01		
PARADISE BAR & GRILL 215 ESPLANADE STEVE YATES (831) 425-2625	5/18/01	6/12/01		