MEMBER UNITS EXHIBIT NUMBER 27

Compilation Report
for
1996-97 Santa Ynez River Memorandum of Understanding

This report has been prepared by Scott Engblom, Project Biologist, in compliance with the 1995 MOU.

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1.0 Introduction

The State Water Resources Control Board (SWRCB) has scheduled hearings for the year 2000 to address issues related to the U.S. Bureau of Reclamation's (USBR) use of the Santa Ynez River (SYR) water for the Cachuma Project. The SWRCB has requested recommendations for maintenance of Public Trust Resources in the river below Bradbury Dam (lower river).

Since 1993, several parties (Signatory Parties) with interests in the water resources of Lake Cachuma and the lower river have participated in cooperative studies of stream habitat and fisheries resources. The parties signed a Memorandum of Understanding (MOU) for Cooperation in Research and Fish Maintenance on the SYR downstream of Bradbury Dam. Parties which entered into the agreement include the USBR, U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), Cachuma Conservation Release Board, Santa Ynez Water Conservation District Improvement District #1, Santa Ynez River Water Conservation District, Santa Barbara County Water Agency, and the City of Lompoc. The MOU established a Consensus Committee to oversee direction of the MOU and a Technical Advisory Committee (SYRTAC) to conduct cooperative studies of fisheries and hydrology.

The ultimate goal of the SYRTAC studies is to develop the information necessary for the SRYTAC to identify and evaluate potential management actions that will benefit fisheries resources in the lower river. The management priority in the lower SYR includes improving conditions for native fish in general and steelhead/rainbow trout in particular, while avoiding adverse impacts to other species of special concern or habitat values. The MOU participants anticipate presenting a consensus-based Fishery Management Plan to the SWRCB hearings in the year 2000.

The objectives of the SYRTAC studies, as outlined in the Long Term Study Plan (Updated 1997) are to develop technical information concerning:

1. The diversity, abundance, and condition of existing public trust fishery resources of the lower river.

2. Conditions – habitat quantity and quality, including water quantity and quality which may limit the diversity, abundance, or condition of public trust fishery resources of the lower river.

3. Non-flow measures which could be undertaken to change existing conditions that act to limit the diversity, abundance, or condition of public trust fishery resources of the lower river.

4. Alternative flow regimes for the Cachuma Project which could be expected to change the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river.

Since April 1994, the SYRTAC Project Biologist, Scott Engblom, has conducted the field investigation program and coordinated data collection in the lower river and its tributaries under the Long Term Study Plan. The duties of the Project Biologist include:

1. Monitoring water quality (temperature and dissolved oxygen) conditions in Lake Cachuma, the mainstem lower river, and its tributaries.

2. Performing habitat mapping of selected mainstem reaches and tributaries to characterize potential fish habitat.

3. Conducting fisheries surveys of various age classes of steelhead/rainbow trout and other fish species which inhabit the lower river and tributaries.

4. Producing reports that compile the data collected in the SYRTAC studies, minutes from TAC meetings, and correspondence between the Project Biologist and members of the SYRTAC.

This report presents a compilation summary of data collected in 1996 and 1997, SYRTAC minutes, and correspondence with members of the SYRTAC. Also appended is the Long Term Study Plan that was updated and approved in 1997.

2.0 Hydrology

2.1 Precipitation and Lake Cachuma Inflow

Inflow into Lake Cachuma and the Lower Santa Ynez Watershed (downstream of Bradbury Dam) is determined primarily from surface runoff following storm events. The soils, geology, and topography of the watershed create rapid runoff conditions, particurarly after the first storms of the year have saturated the watershed. As a result, the watershed is characterized as a "flashy" system during the winter and spring (December through May), with intermittant surface flow conditions in the summer and fall (June through November). Storm water runoff is reflected in the seasonal pattern and inter-annual variability of inflow to Cachuma Reservoir **(Figure 2.1-1 and Figure 2.1-2).** Typically, February and March are the months with the greatest rainfall.

2.2 Lake Cachuma Elevation

In 1995, the BOR was required to decrease storage in Lake Cachuma 25% to elevation 733.0 due to seismic saftey concerns **(Figure 2.2-1)**. In the winter of 1996, the BOR approved increasing the lake elevation resulting from storm runoff. From February 19 through February 22, 3.4 inches of rain fell in the watershed creating 17,772 acre feet of additional storage (elevation 733.60). Additional storms through April 1996 increased the lake elevation to 736.23 (maximum elevation for 1996).

In 1997, reservoir elevation reached a maximum of 739.63 during mid-March. Various water releases throughout the year such as WR 89-18 decreased the lake elevation to 722.18 (minimum for the year).

2.3 Fish Reserve Account and WR 89-18 Water Releases

The winter of both 1996 and 1997 was typical of an average rainfall year. Runoff after storm events in the tributaries did not generate sufficient runoff to justify ceasing Fish Account Releases during the Winter of 1996. Fish Account releases of approximately 3 cfs (6 acre feet/day) ran from January through July 18, 1996 (initiation of WR 89-18). Beginning again in November of 1996, Fish Account releases were initiated at 3 cfs. Historically, the Biological Subcommittee has authorized releases of approximately 3-5 cfs for maintenance of fish habitat in the SYR below Bradbury Dam. This was the case in January through March 1997.

As part of the Safety of Dams modifications to Bradbury Dam in late March 1997, it was necessary to drain the spill basin. As a result, water releases could not be made from the outlet works which discharges into the spill basin.. At that time, a temporary watering system was installed to supply 3-4 cfs into Hilton Creek. The BOR, CDFG, USFWS, and the SYRTAC undertook the subsequent capture and removal of fish in the spill basin prior to its de-watering. All captured rainbow trout/steelhead were administered PIT tags, and were relocated into Hilton Creek. Reclamation considered the discharge of flow into Hilton Creek to be a change in release

Figure 2.1-1 1996-1997 Daily Rainfall Data at Bradbury Dam

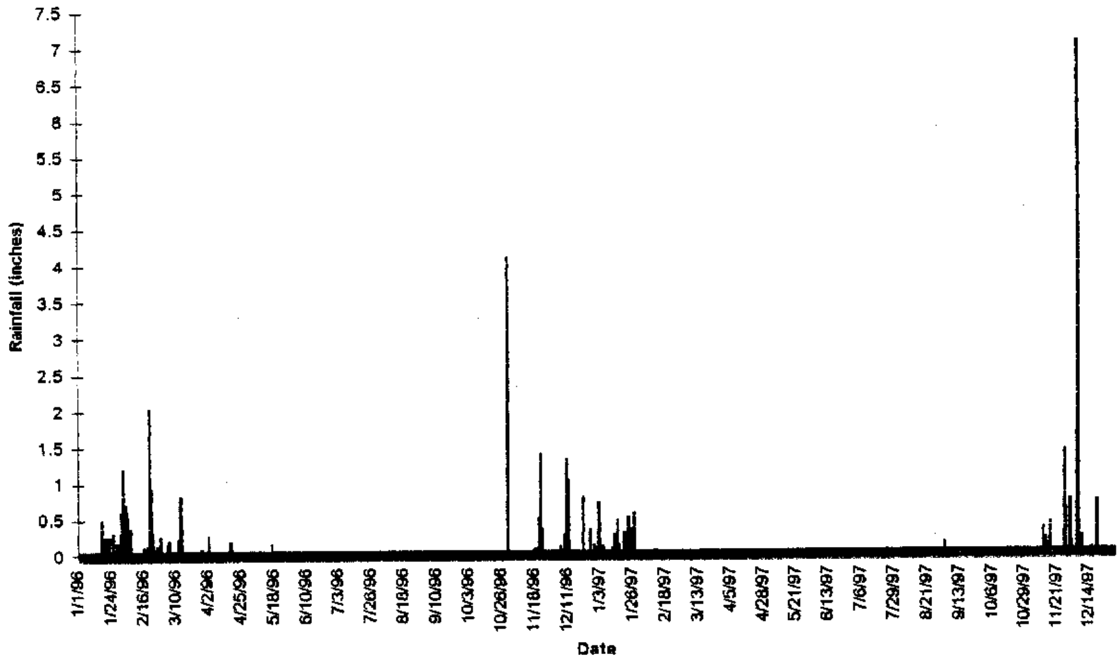
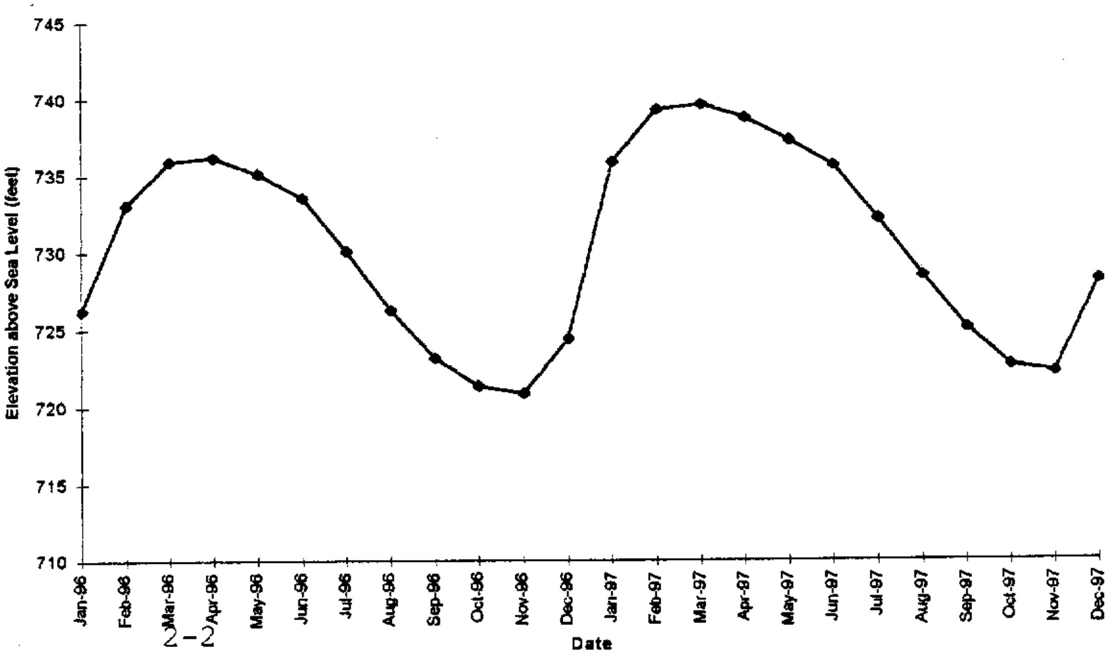


Figure 2.2-1 1996-1997 End of the Month Lake Elevations at Bradbury Dam



point for the releases that would normally be made through the outlet works, and therefore the releases made into Hilton Creek were deducted from the Fish Reserve Account. During periods when water was being released for water rights purposes, the water released into Hilton Creek was deducted from the water rights accounts (Bureau of Reclamation presentation, Technical Advisory Committee Meeting December 11, 1997). Total Fish Account usage for both years are tabulated in **Table 2.3-1.**

Table 2.3-1. Fish Account Usage (acre feet) 1996-97

Month 1996	Acre Feet Used 1996	Month 1997	Acre Feet Used 1997
January	184	January	181
February	172	February	170
March	163	March	188
April	160	April	233
May	179	May	224
June	171	June	289
July	96	July	84
August	0	August	0
September	0	September	0
October	0	October	16
November	173	November	226
December	176	December	278
Total	**1,474 acre feet released**	**Total**	**1,889 acre feet released**

1996 WR 89-18 releases began July 18 and continued through the end of October 1996 **(Figure 2.3-1)**. Releases were initiated to recharge the groundwater basins in both the above narrows and below narrows accounts. A total of 10,788 acre-feet of water was released from Lake Cachuma. Monthly acre-feet totals are provided in **Table 2.3-2.** In 1997, WR 89-18 releases began July 12 and continued through the end of October 1997. A total of 12,606 acre-feet of water was released from Lake Cachuma between April and October.

Figure 2.3-1 1996-1997 Controled Releases from Bradbury Dam

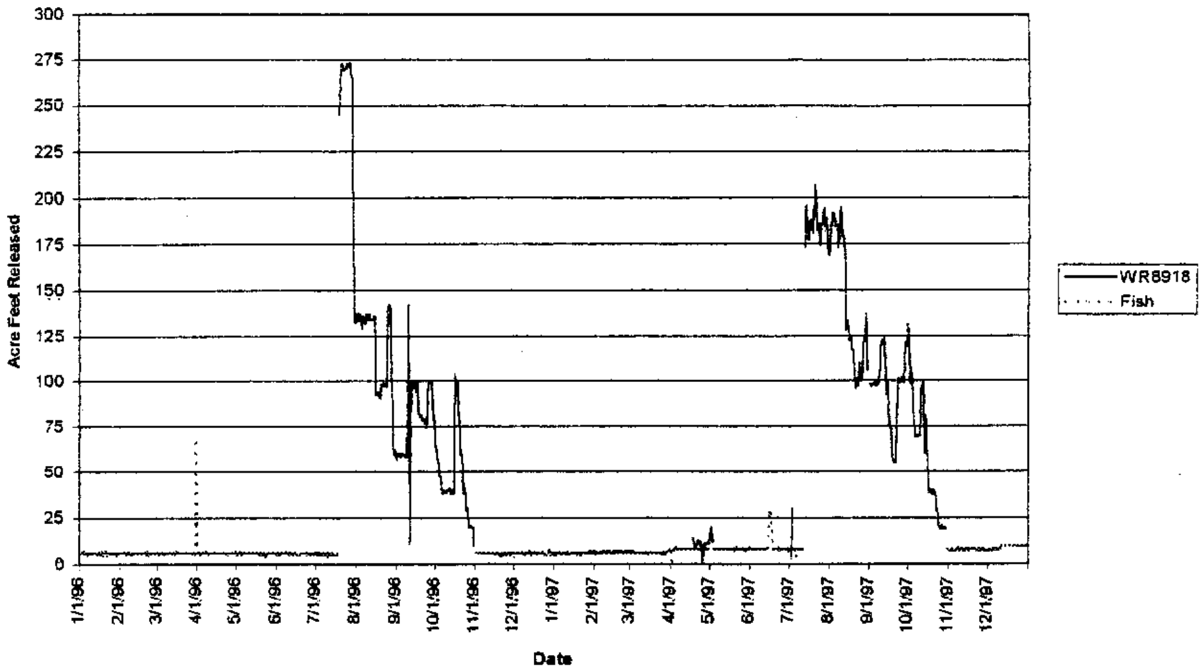


Table 2.3-2 1996 and 1997 Monthly WR 89-18 Release Totals (Acre Feet)

Month 1996	Acre Feet	Month	Acre Feet
April	0	April	134
May	0	May	50
July	3222	July	3753
August	3608	August	4078
September	2483	September	2907
October	1465	October	1684
Total	**10,788**	**Total**	**12,606**

2.4 Mainstem Longitudinal Temperature Response to WR 89-18 Water Releases

2.4.1 Methods

During the 1996 WR 89-18 releases, water flow was measured directly upstream of thermograph locations during the warmest portion of the day to determine what effect large volume releases may have on summer water temperatures at various locations downstream of Bradbury Dam. Flow was measured using a Marsh-McBirney Model 2000 FlowMate. Flows were measured during the warmest portion of the day (1400-1600 hours) at miles 3.4, 7.8, 9.5, 13.6, and 24.0 when releases from Bradbury Dam were 135 cfs, 70 cfs, 50 cfs, and 40 cfs. Thermograph data was downloaded, and instantaneous water temperatures were plotted according to when flow measurements were taken.

2.4.2 Results

As the groundwater basin is recharged, a substantial reduction in surface water flow occurs during WR 89-18 releases at downstream locations. For example, at 135 cfs release from the dam, only about 75 cfs may reach mile 24. At 70 cfs, only about 35 cfs reaches mile 24.

Water temperatures increased approximately 8-10 C between mile 0.5 and mile 24 at the 135 cfs release **(Figure 2.4-1)**. At the 70 cfs release in the beginning of August, water temperature increased between 8-9 C from mile 0.5 to mile 24 **(Figure 2.4-2)**. When releases were 50 cfs, and 40 cfs, water temperature warmed approximately 8 C from mile 0.5 to mile 13.6 **(Figure 2.4-3 and Figure 2.4-4)**.

Figure 2.4-1 July 25, 1996 Flow vs. Temperature at Mainstem Thermograph Locations - 135 cfs - 1400-1600 Hours

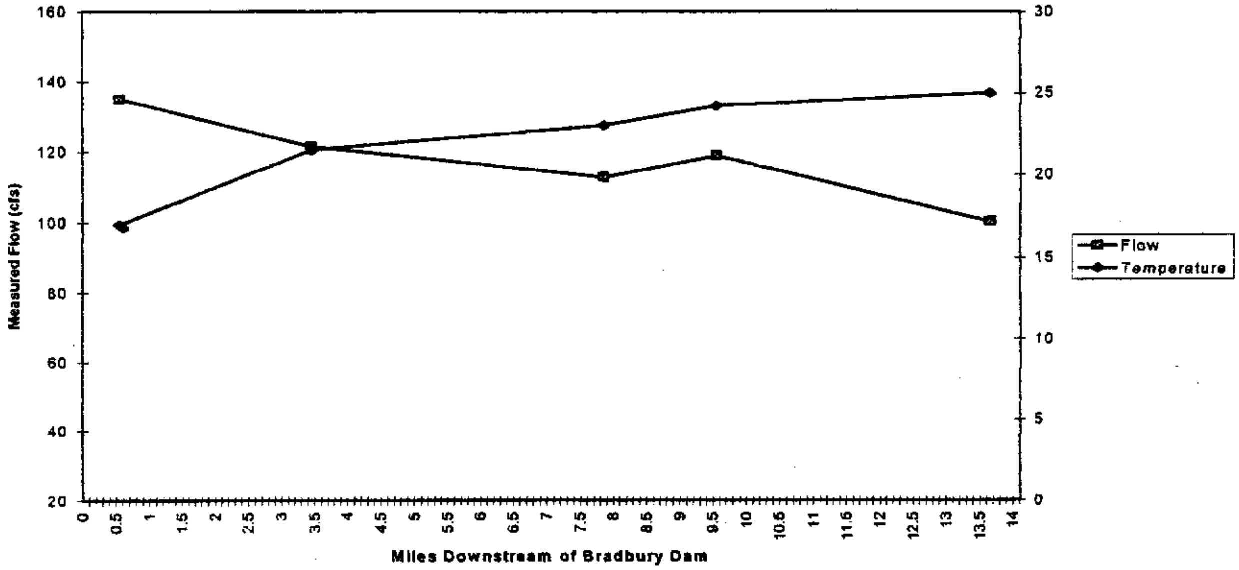


Figure 2.4-2 August 9, 1996 Flow vs. Temperature at Mainstem Thermograph Locations - 70 cfs Release from Bradbury - 1400-1630 Hours

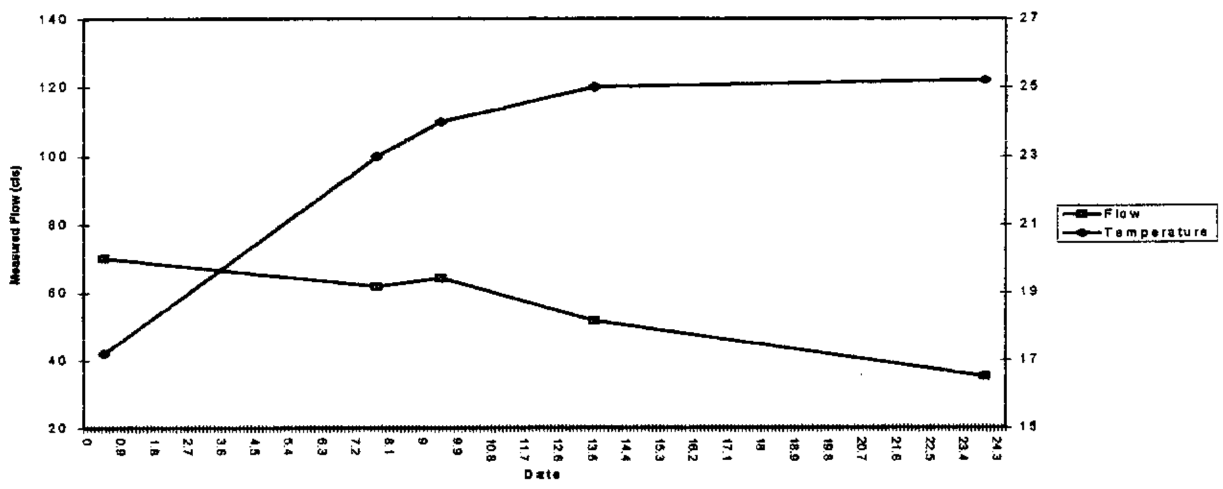


Figure 2.4-3 August 24, 1996 Flow vs. Temperature at Mainstem Thermograph Locations - 50 cfs from Bradbury - 1430-1700 Hours

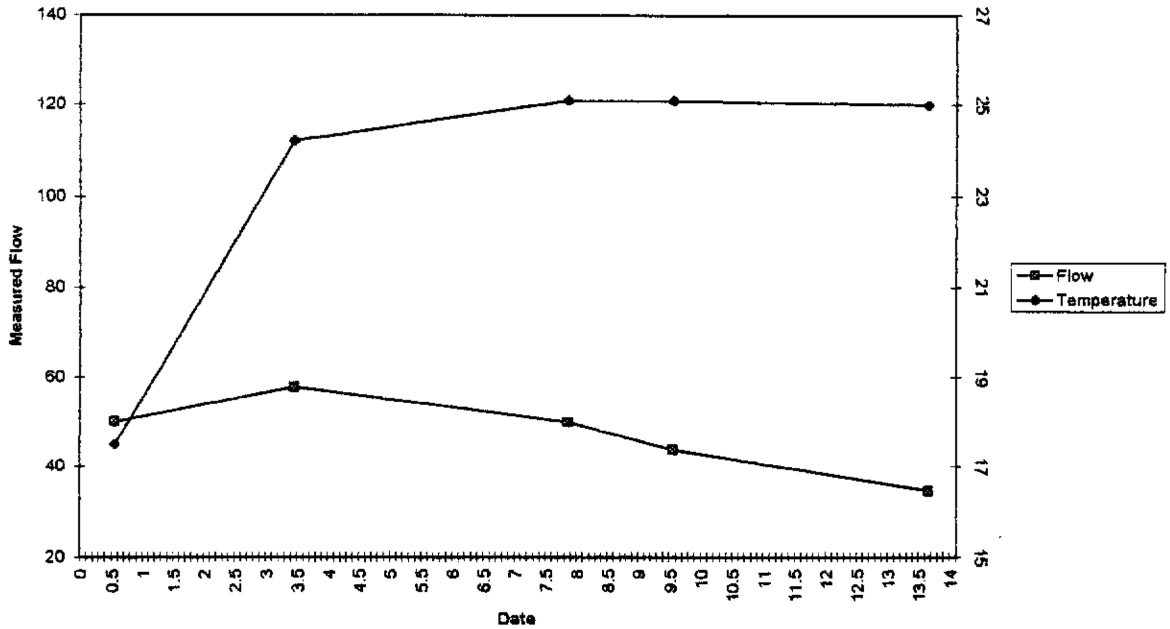
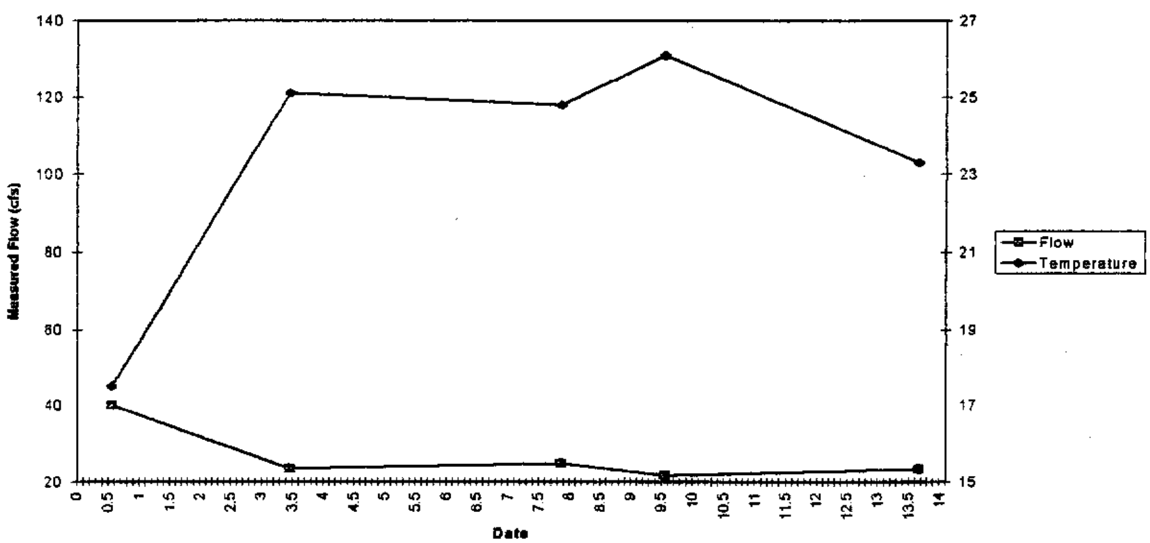


Figure 2.4-4 September 4, 1996 Flow vs. Temperature at Mainstem Thermograph Locations - 40 cfs from Bradbury



Surface water temperatures in the spill basin, and both surface and bottom temperatures in the long pool declined sharply after water releases reached the monitoring locations. The decrease in water temperature immediately below Bradbury Dam reflects the cool hyplominetic waters in the reservoir having a lower temperature than normal seasonal water temperature in the spill basin and long pool. Surface and bottom temperatures downstream of long pool did not show a corresponding reduction in temperature, but rather at many monitoring locations, water temperature increased coincident with the arrival of waters from the WR 89-18 releases. Increases in water temperature at monitoring locations reflects warming of waters along the longitudinal gradient within the SYR mainstem resulting from high ambient air temperatures, relatively broad channel width, shallow water depth, and lack of riparian canopy which would help reduce solar heating of surface waters. Release flows disrupted the thermal stratification that occurred within deeper pools habitats downstream and may have masked the effects of cold groundwater upwelling at several of the monitoring locations. These high flows however did contribute to improve dissolved oxygen concentrations by aerating the water and by removing large quantities of floating algae from pool surfaces.

At all flow releases (135-40 cfs), water temperatures increased quickly between the lower end of long pool (mile 0.5) and Refugio X site (mile 3.4). The river reach between Bradbury Dam and Refugio reach has sporadic, well developed riparian vegetation along the upper and lower portions of the stream corridor up to the Highway 154 Bridge. Despite the low to moderate shading, and relatively high instream flow during WR 89-18 releases, water temperatures increased rapidly within the first three to five miles downstream of Bradbury Dam. Water temperatures at all monitoring locations downstream of mile 3.4 remained at relatively high levels compared to spill basin and long pool monitoring locations.

3.0 Water Quality

Water quality parameters, mainly temperature and dissolved oxygen, were monitored in Lake Cachuma, the lower mainstem SYR, Lagoon, and five tributaries below Bradbury Dam. The studies examined seasonal patterns as well as longitudinal gradients along the mainstem. Air temperature, which affects water temperatures, was also monitored in the towns of Santa Ynez and Lompoc.

3.1 Water Quality Requirements for Steelhead

3.1.1 Water Temperature

Water temperature affects all metabolic and reproductive activities of fish, including such critical functions as growth, swimming, and the ability to capture and assimilate food. High summer water temperatures have been a concern for cool water fish species, which inhabit and/or over summer in the mainstem and/or tributaries of the SYR. Unfortunately, nearly all of the literature with respect to temperature tolerances for steelhead/rainbow trout are from studies conducted on fish in Northern California, Oregon, Washington and Idaho where water temperatures are significantly cooler compared to Southern California. No studies have been initiated to determine if southern steelhead/rainbow trout are more tolerant to higher water temperatures that are commonly associated with Southern California waters, particularly during summer. Rainbow trout/steelhead in the SYR have been observed in water temperatures which are the same or greater than the upper tolerances stated below. The likelihood that the southern range of steelhead has evolved to tolerate these higher water temperatures cannot be ruled out.

Temperatures preferred by RBT/STL have been identified at 10-13°C (Bjornn and Reiser 1991), 10-15°C (Barnhardt 1986, Piper et al 1986), and 16-18°C (Hokanson 1977). Although some salmonids can survive at relatively high temperatures, most are placed in stressful or life threatening conditions when temperatures exceed 23-25°C. High temperatures that can be tolerated by fishes have been defined and determined in two ways: slow heating of fish (to reveal the critical thermal maximum, CMT), and abrupt transfer of fish between waters of different temperature (to show incipient lethal temperature, ILT)(Bjornn and Reiser 1991). The CMT and ILT of rainbow trout have been identified at 29.4°C and 25.0°C respectively (Lee and Rinne 1980; Bjornn and Reiser 1991; Piper et al 1986). Upper tolerances for steelhead have been identified at 23.9°C (Bjornn and Reiser 1991, Barnhardt 1986) and 25.6°C (Hokanson 1977). In the 1977 Hokanson study, at temperatures in excess of the growth optimum, mortality rates were significantly higher during the first 20 days of the experiment than the last 30 days. This suggests that some percentage of rainbow trout/steelhead could be expected to survive up to two months when subjected to greater than preferred water temperatures.

In small streams where daily maximum water temperatures approach upper incipient lethal values, salmonids can thrive if the temperature is high for only a short period of time and then declines well into the optimum range (Bjornn and Reiser 1991). Bjornn and Reiser added that in an Idaho stream where summer maximum temperatures were 24-

26 C, but the minimums were relatively low (15-16 C), most young salmonids and trout moved upstream or into tributaries where temperatures were lower. Hokanson (1977) stated that the maximum temperature at which a rainbow trout population can be expected to maintain its weight for 40 days was a constant temperature of 23 C and a fluctuating mean temperature (+ - 3.8 C) of 21 C. It should be stated again that these temperature data are from studies of fish in northern regions, not Southern California. Southern California rainbow trout/steelhead may have developed greater tolerances to warm summer water temperatures.

Warmwater fish species inhabiting the SYR (largemouth and smallmouth bass, sunfish, catfish) can tolerate a warmer range of temperatures than salmonids. Preferred water temperatures for largemouth bass and sunfish have been identified at 13-27°C. Smallmouth bass prefer temperatures between 10-21°C, while catfish prefer temperature between 21-29°C (Piper et al 1986).

3.1.2 Dissolved Oxygen

During late spring and extending into early fall, the SYR exhibits tremendous algae production in most of its surface waters. During the day when photosynthesis is taking place, algae production can saturate the water with dissolved oxygen (DO). Conversely, during the dark hours, algae metabolism, bacterial decomposition, and invertebrate respiration can remove significant amounts of DO from the overlaying water causing oxygen depletion. Consequently, this abundant algae growth can have adverse effects on most fish species, particularly during summer in the hours before dawn.

Salmonids function normally at DO concentrations of 7.75 mg/L; exhibit various distress symptoms at 5.00-6.00 mg/L; and are often negatively affected at 4.25 mg/L (Barnhardt 1986). Rainbow trout have also survived laboratory tests at DO concentrations of less than 2.0 mg/L. Warm water species, such as largemouth bass, and cool water species like salmonids may be able to survive when DO concentrations are relatively low, but growth, food conversion efficiency, and swimming performance will be adversely affected (Bjornn and Reiser 1991, Piper et al 1986). High water temperatures, which reduce oxygen solubility, can compound the stress on fish caused by marginal DO concentrations (Bjornn and Reiser 1991).

3.2 Air Temperature

Air temperatures were recorded at both the towns of Santa Ynez (river mile 6.0), and Lompoc (river mile 38.0). Air temperatures recorded in Lompoc were significantly cooler than those recorded in Santa Ynez due to the marine influence. Maximum air temperatures in Santa Ynez were up to 10 C warmer during the summer and early fall. Temperatures measured in 1996 were noticeable warmer than those recorded in 1997. Ambient air temperatures for both towns are presented in **Table 3.2-1 and Table 3.2-2.**

Table 3.2-1. 1996-1997 Maximum and Average Air Temperatures at Santa Ynez Airport

	Santa Ynez Airport 1996		Santa Ynez Airport 1997	
Month	**Maximum (C)**	**Average (C)**	**Maximum (C)**	**Average (C)**
January	18.0	10.6	17.5	10.8
February	17.6	12.1	19.7	10.6
March	19.1	11.9	23.9	13.0
April	23.4	15.0	22.9	13.8
May	24.4	15.7	27.6	17.8
June	26.5	17.3	24.7	16.7
July	31.2	20.1	26.9	17.9
August	31.3	19.8	28.7	19.7
September	28.4	17.8	30.4	20.2
October	26.4	15.7	25.7	16.2
November	21.1	12.8	25.7	16.2
December	18.5	10.9	17.0	9.4

Table 3.2-2. 1996-97 Maximum and Average Air Temperatures at Lompoc

	Lompoc 1996		Lompoc 1997	
Month	**Maximum (C)**	**Average (C)**	**Maximum (C)**	**Average (C)**
January	17.5	11.9	16.6	12.2
February	17.8	13.4	17.5	11.8
March	18.2	12.9	19.4	13.0
April	21.6	15.3	18.4	13.5
May	20.5	15.3	22.1	16.8
June	19.5	15.0	19.8	16.0
July	21.2	16.0	20.7	16.6
August	21.1	16.0	23.1	19.0
September	21.3	15.9	25.0	19.3
October	21.0	14.9	23.7	17.0
November	19.6	13.8	23.7	17.0
December	17.8	12.8	16.9	11.0

3.3 Lake Cachuma Temperature and Dissolved Oxygen Profiles

3.3.1 Methods

Lake Cachuma, a Bureau of Reclamation water supply reservoir in Southern California, has routinely experienced severe hypolimnetic oxygen depletion during summer stratification (Sartoris and Boehmke 1984). Dissolved oxygen and temperature profiles were measured at three locations in Lake Cachuma by USBR personnel in an aeration study between 1980-1984 (**Figure 3.3-1 Map not yet inserted**). The USBR originally chose these sites to document oxygen depletion at the head, middle, and lower portions of the reservoir. The purpose of the current studies is to gather information on:

- water quality at the three locations within the lake.
- anoxic conditions within the region where water is released for downstream uses.
- depth of water quality conditions preferable for RBT/STL in relation to the proposed Hilton Creek pump/siphon.
- a historical data base documenting the stratification and turnover of the lake.

Station #1 is located upstream of Bradbury Dam at the deepest portion of the lake (40-45 meters) roughly 50 meters from where water is released for downstream uses.

Station #2 is located within the deep river channel off Tequepis Point (middle lake).

Station #3 is located within the deep river channel off Tecolote Tunnel (lower lake)

Vertical profiles of dissolved oxygen and temperature were performed during four surveys conducted in May, July, August, and October of 1996, and in May, August, and November of 1997. The profiles were measured using a Yellow Springs Instrument (YSI) Model 57 Oxygen Meter. Measurements were taken by boat at one meter intervals from the surface of the lake to the bottom.

3.3.2 Results

Temperature

Thermal stratification shows a remarkably similar development from the upper to the lower portion of the lake. For ease of illustration, discussion regarding both temperature and DO will center on data collected at Bradbury Dam. Water quality profiles were measured in May, July, and August of 1996 (**Figure 3.3.2-1**), and in May, August, and October 1997 (**Figure 3.3.2-2**). Thermal stratification was observed developing in May and becoming firmly established by August of both years. In May 1996 and 1997, epilimnion temperatures were approximately 18 C. By July and August, epilimnion temperatures had increased to 23-24 C. Hypolimnion temperatures remained around 14-16 C during both years.

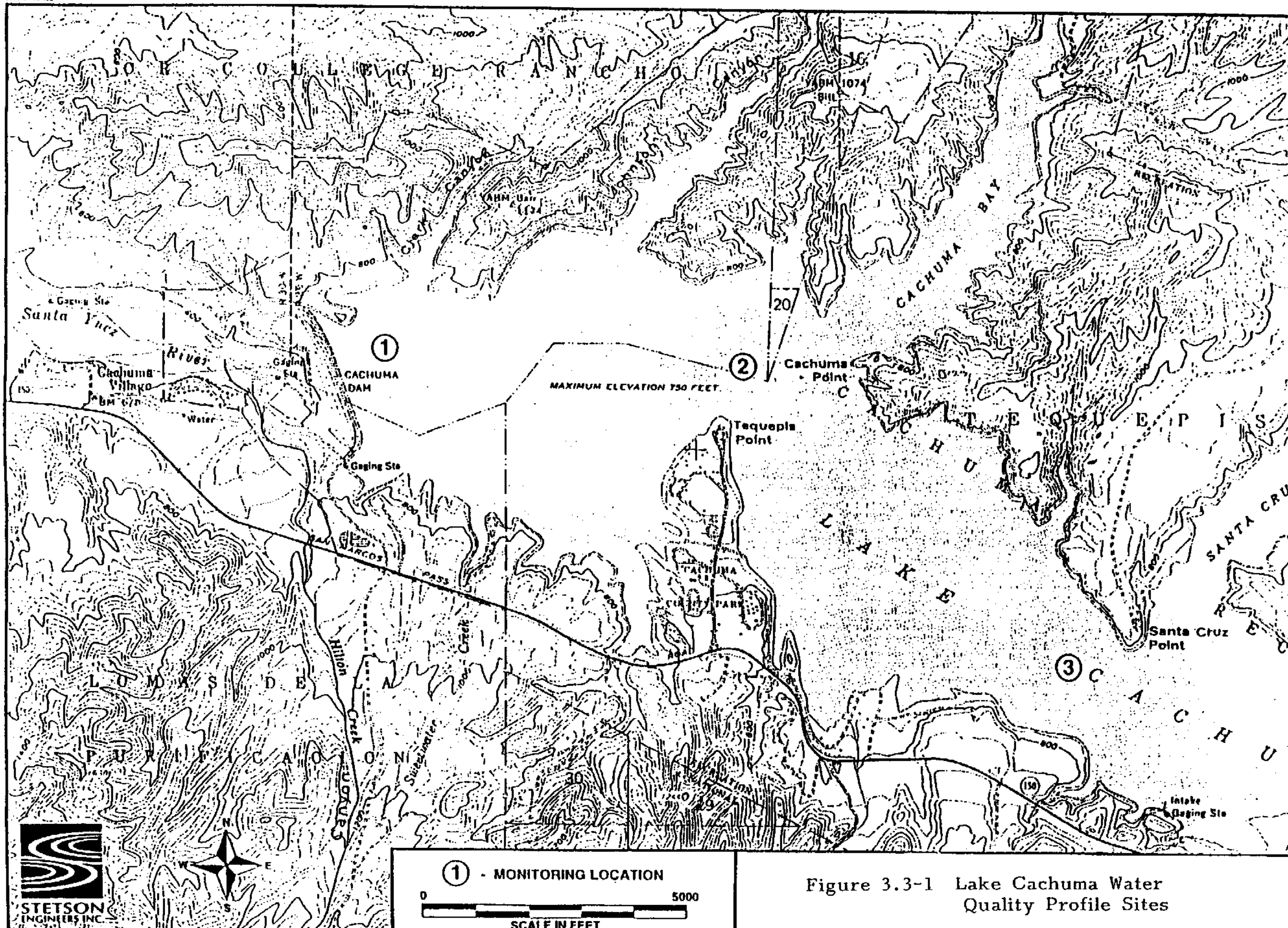


Figure 3.3-1 Lake Cachuma Water Quality Profile Sites

Figure 3.3.2-1. 1996 Combined Temperature Profiles at Bradbury Dam

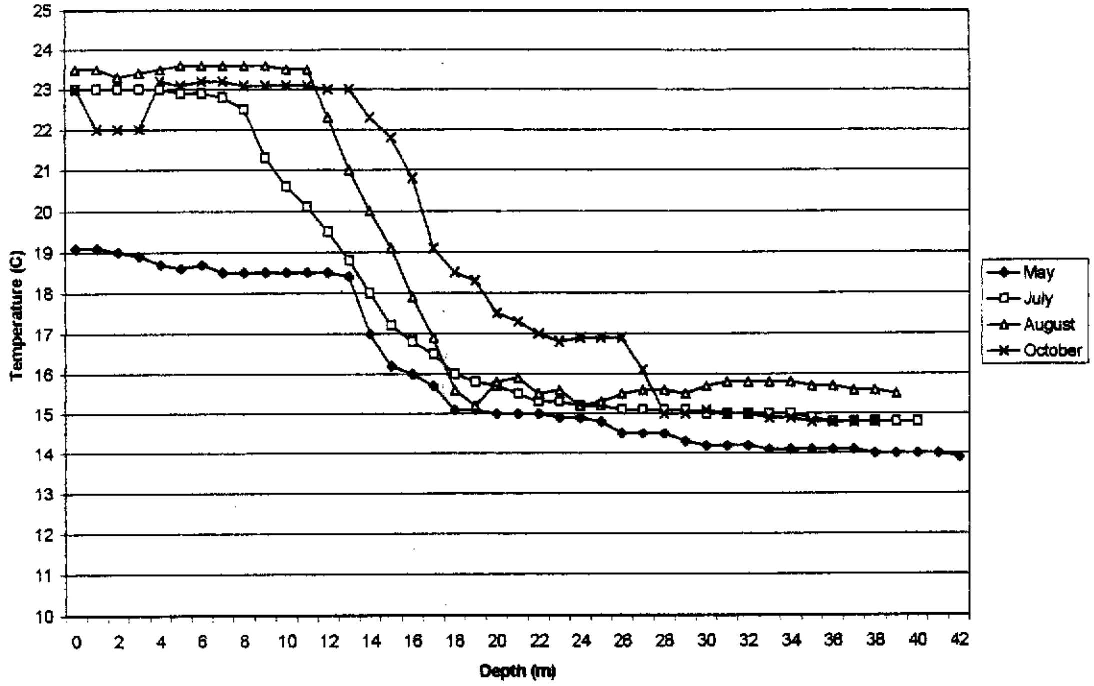
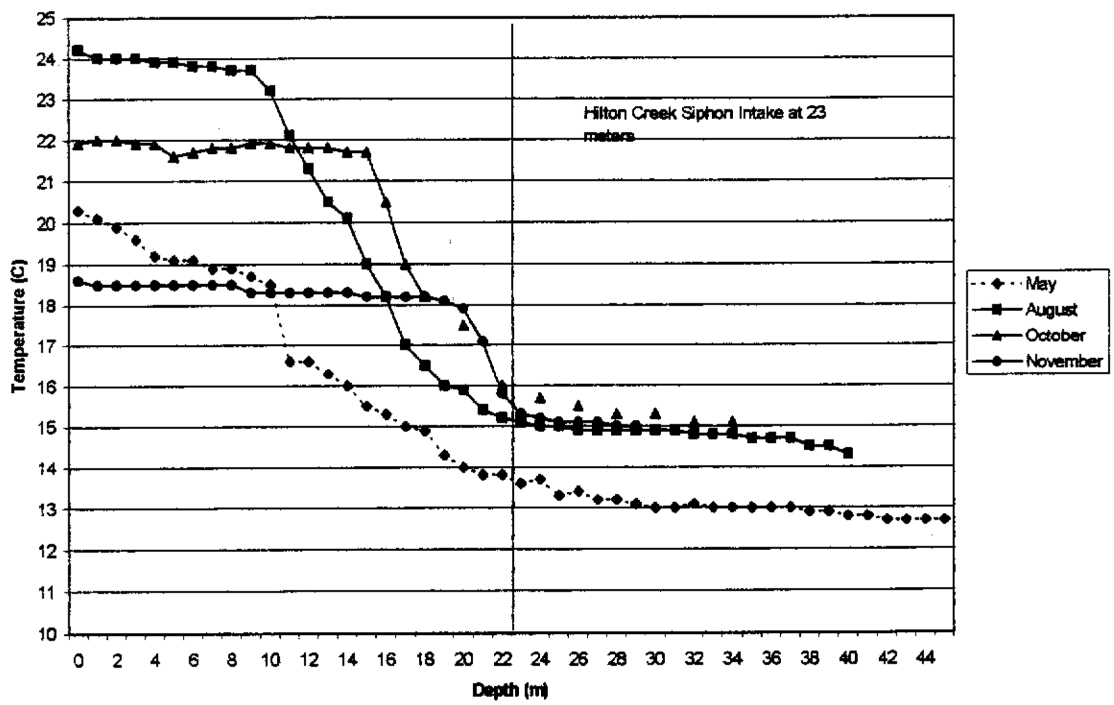


Figure 3.3.2-2. 1997 Combined Temperature Profiles at Bradbury Dam



Temperature data gathered from profiles will also be used to determine the appropriate depth to remove water for the Hilton Creek Pump/Siphon. A criterion of 18 C was determined by the Biological Subcommittee to be the maximum temperature for any water released into Hilton Creek. These cool water temperatures have been observed to develop in the hypolimnion of the lake. The minimum depth at which water temperature was at least 18 C was 20 meters. The pump/siphon will have the ability to intake water from various depths to obtain cool water as needed.

Dissolved Oxygen

Lake Cachuma experiences severe hypolimnetic dissolved oxygen depletion during the summer and fall after the reservoir becomes stratified. In 1996, dissolved oxygen in the epilimnion ranged between 6-8 mg/l, while in the hypolinmion dissolved oxygen ranged from 3-6 mg/l **(Figure 3.3.2-3)**. In 1997, dissolved oxygen in the eplimnion ranged between 7-11 mg.l, while hypolimnion oxygen ranged from 0-4 mg/l **(Figure 3.3.2-4)**. Once the reservoir became stratified (summer through fall), a marked decrease in hypolimetic dissolved oxygen concentrations below 2 mg/l was observed. Dissolved oxygen concentrations in the epilimnion remained greater than 7 mg/l for both years.

The Biological Subcommittee has determined a criterion of 5 mg/L for any water released into Hilton Creek. It is likely that DO concentrations of released water will be less than 5 mg/L, particularly during summer, due to hypolimnetic oxygen depletion. Any water released into Hilton Creek will flow through a series of energy dissipaters at the release point to insure that the water is well oxygenated.

3.4 Mainstem Water Temperatures

3.4.1 Methods

The principle objectives of water temperature monitoring include evaluation of:

- Seasonal patterns of water temperature downstream of Bradbury Dam.
- Diel variations in water temperature.
- Longitudinal gradient in water temperature conditions downstream of Bradbury Dam.
- Vertical stratification and evidence of cool water upwelling in selected refuge pools.
- Habitat quality and suitability for various fish species including steelhead trout.
- Information sufficient to calibrate a stream temperature model for the SYR under different flow releases.

Figure 3.3.2-3. 1996 Combined Dissolved Oxygen Profiles at Bradbury Dam

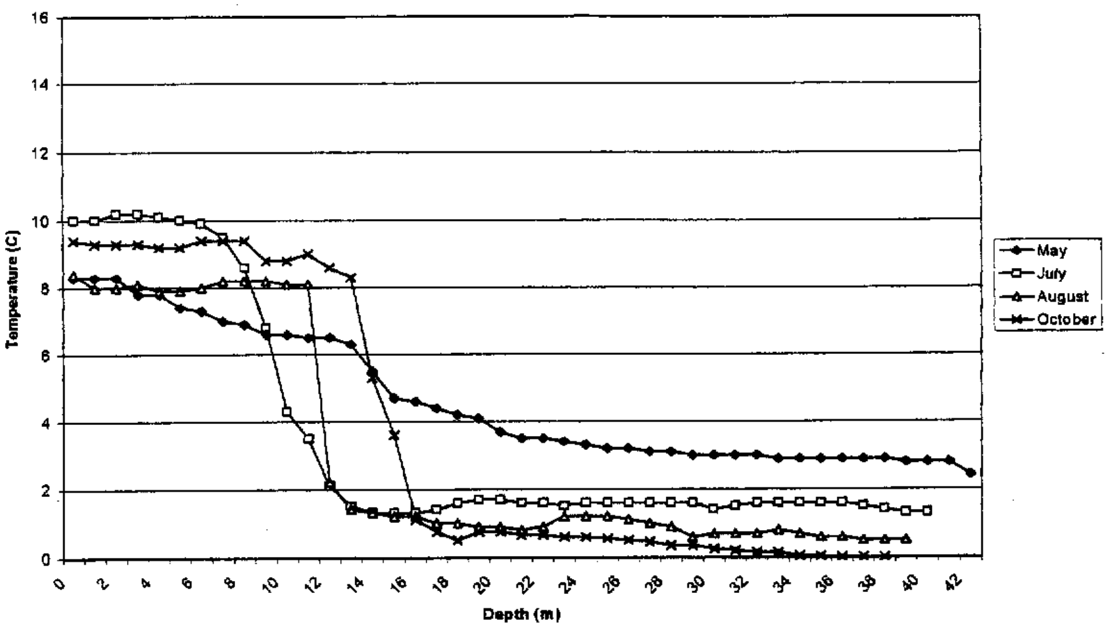
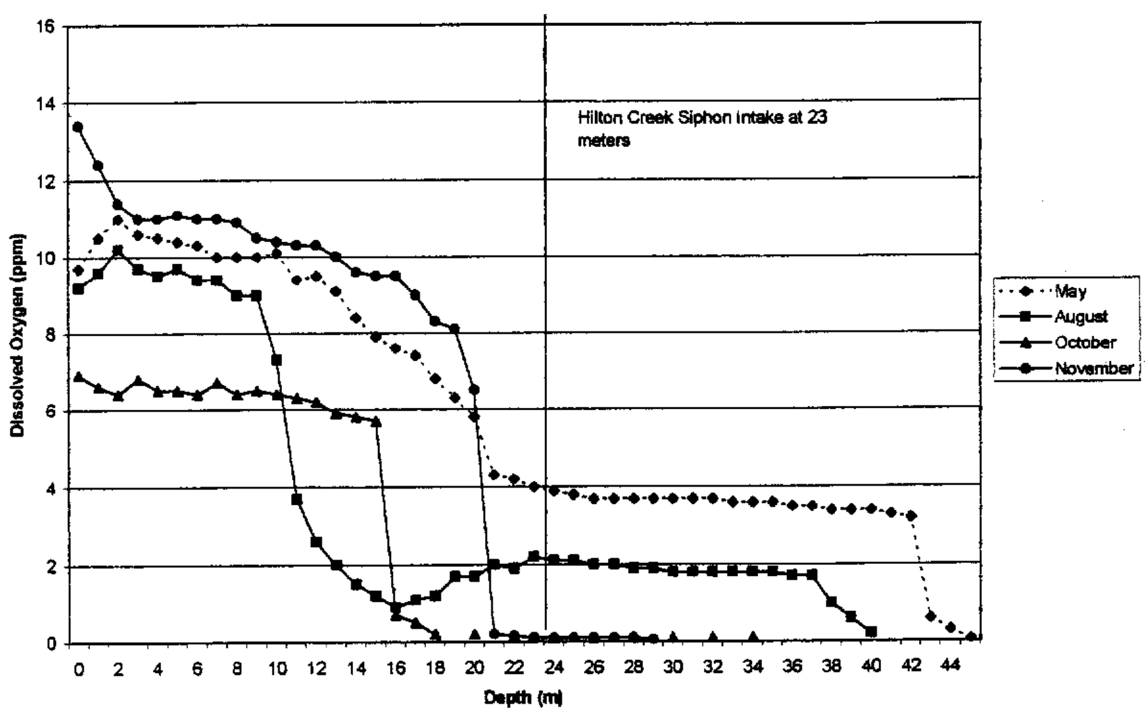


Figure 3.3.2-4. 1997 Combined Dissolved Profiles at Bradbury Dam



In 1996, 24 remote thermographs were deployed throughout the lower SYR, and tributaries, from the spill basin at Bradbury Dam to the lagoon at Vandenburg Air Force Base **(Figure 3.4-1).**

The Project used Optic Stowaway thermographs set to record hourly temperatures 24-hours a day (i.e., 24 instantaneous recordings per day). Both the daily average and daily maximum temperatures for each thermograph were calculated using Excel macros, and presented in graphical form. Project thermographs were deployed between January and April 1996. Thermographs were placed in small metal pipe enclosures that allowed free flow of water and protection from debris during high flows. The pipe enclosures were attached to 1/4-inch steel cable, which in turn were attached to nearby trees. Floats were attached to those units that were suspended in the water column.

Inherent technical difficulties or thermograph damage from vandals resulted in loss of data at various locations. The following is a list of locations of the temperature monitors throughout the SYR. **Table 3.4-1** provides a habitat description where thermographs were deployed.

Table 3.4-1. Habitat Description of Thermograph Locations.

Unit location (Refer to Figure 3.5-1)	**Habitat unit width (ft)**	**Total habitat length (ft)**	**Average depth (ft)**	**Maximum depth (ft)**
S.basin-At outlet works #5 (1)	N/A	N/A	N/A	N/A
Long pool mile 0.5 #6 (2)	129	1273	3.8	10.1
Refugio X mile 3.4 #11 (2)	38	60	1.9	3.4
Alisal Unit 45 mile 7.8 #15 (2)	44	85	2.4	4.0
Alisal Unit 20 mile 8.7 #14(2)	40	147	2.8	9.1
Alisal Unit 9 mile 9.5 #13(2)	44	116	2.4	4.0
Buellton mile 13.9 #18 (1)	35	95	2.0	3.5
Weister Ranch #19 (1)				
Cargasachi mile 24 #20 (1)	3	35	2.0	3.0
Lagoon #1 mile 46.5 #23 (2)	85	N/A	varied	varied
Lagoon #2 mile 47.1 #24 (2)	170	N/A	varied	varied

* (1) Single unit
* (2) Vertical monitoring array

3.4.1.1 Highway 154 Reach

Spill Basin

The thermograph in the spill basin (#5) was located adjacent to the outlet works where water releases are made. The unit was attached to a cable and suspended in approximately five feet of water. The unit was in operation from March 1996 through March 1997. The unit was removed from the spill basin prior to the dewatering for seismic retrofit and the BOR fish removal.

Long Pool

A vertical array (#6) was deployed approximately 1000 feet downstream from the spill basin. The surface unit was deployed from January 17, 1996 through December 1997. A malfunction in the unit resulted in a loss of data between early May through early July 1996, and between mid-November through mid-January 1997.

The bottom unit has a continuous data log from early July 1996 through early December 1997. Thermograph malfunction resulted in a gap in the data set between mid-July and mid-August 1997. The purpose of the long pool array is to confirm observations of cool water upwelling and/or stratification in the long pool. The units are located in the middle portion of the pool in the area of maximum depth (10.1 feet) with the bottom unit laying on the substrate and the surface unit approximately two feet below the surface.

3.4.1.2 Refugio Reach

Refugio Habitat Unit X

Habitat unit X is located approximately one mile below Highway 154 Bridge and approximately 3.4 miles downstream from Bradbury Dam. The Project has had a bottom unit deployed at this location from January 1, 1996 through December 31, 1997. The unit was removed from service early May through mid July 1996-97 due to absence of water. A surface unit was added (#11) in mid July 1996 just after WR 89-18 releases began. The units were held in the protective enclosures and attached to cable with a float at the surface. The top unit was suspended approximately one foot below the surface, with the bottom unit laying directly on the substrate in the area of maximum depth (3.4 feet).

Refugio Habitat Unit 17

Refugio unit 17 is located approximately six miles downstream of Bradbury Dam (#12). A vertical array was deployed at this location from late May through early July 1996. Unfortunately, beavers in the habitat unit removed the branch the thermograph array was attached to and the units were lost. Two additional units were deployed immediately after, however, the units were removed by vandals. No additional thermographs were deployed at this location after the second incident.

3.4.1.3 Alisal Reach

Alisal Habitat Unit 45

Alisal Habitat Unit 45 is a pool habitat (#15) and is located 200 yards downstream from Refugio Road Bridge and approximately 7.9 miles downstream from Bradbury Dam. The Project has had the array deployed at this location from early May 1996 through December 1997. The surface unit experienced a malfunction and data was lost between mid July through early August 1996, and again between early May and mid-June 1997.

The bottom unit was deployed during the same time frame as the surface unit. Thermograph malfunction occurred between late January through mid-March 1997. The array is located in the area of maximum depth (6.0 feet) with the bottom unit laying on the substrate and the other unit suspended approximately one foot below the surface.

Alisal Habitat Unit 9

Alisal Habitat Unit 9 is located 0.5 miles upstream from Alisal Road Bridge in Solvang and approximately 9.5 miles downstream from Bradbury dam (#13). The vertical array is deployed in a refuge pool suspected of providing cool water upwelling. The surface unit was deployed from early May through December 31, 1996. The bottom unit was deployed from January 1 through early October 1996. Malfunction of the bottom unit occurred after October, and the rest of the years data was lost. The array is located in the area of maximum depth (4.0 feet) with the bottom unit laying on the substrate and the surface unit suspended approximately 1 foot below the surface.

Alisal Bridge

The Alisal Bridge is located approximately 10.5 miles downstream of Bradbury Dam (#16). Temperature monitoring of the pool unit below the Alisal Bridge began in late March 1997 and continued through December 1997. A vertical array was deployed at the location. The surface unit experienced a brief malfunction between late May and early June 1997. The bottom unit also experienced a malfunction, resulting in a data gap between mid-June and mid-July.

3.4.1.4 Avenue of the Flags, Buellton

A single bottom thermograph was deployed approximately 150 feet downstream from the Avenue of the Flags Bridge in Buellton (#18), and approximately 13.6 miles downstream of Bradbury Dam. The thermograph was deployed from May 6, 1996 through December 31, 1997. The unit was deployed in a run habitat in the area of maximum depth (3.0 ft).

3.4.1.5 Weister Reach

The Weister Ranch is located near town of Buellton, and approximately 16.0 miles downstream of Bradbury Dam (#19). A vertical array was deployed at this location from late July through December 31, 1997. The thermographs were deployed in a pool habitat in the area of maximum depth (4.5 feet).

3.4.1.6 Cargasachi Reach

A single bottom thermograph is deployed in a beaver pool area, approximately one-quarter mile upstream from the area known as 'Coopers Reef' (#20), and approximately 24.0 miles downstream from Bradbury Dam. The unit was deployed from May 1996 through August 1996, before beavers removed the branch from which the thermograph was attached. A replacement thermograph was deployed in early July 1997 in a run habitat (3.0 feet), approximately one-half mile downstream from the above described location.

3.4.1.7 Santa Ynez Lagoon

These sites provide information as to water temperature conditions within the lagoon. This data will be used to help determine if water quality conditions favor rearing of juvenile steelhead trout within the lagoon. However, frequent thermograph malfunctions have occurred to all of the units deployed at this location resulting in a highly fragmented picture of the seasonal temperature changes within the lagoon.

Site # 1 is located in the main river channel in the lagoon approximately 200 yards downstream from the river mouth and approximately 46.5 miles downstream from Bradbury Dam (#23). A vertical array is deployed at this location. Each unit is encased within a protective enclosure and cabled off to a tree. The bottom unit is laying directly on the substrate with the top unit deployed approximately one foot below the surface. Water depth at the deployment all sites vary depending on whether the lagoon is open or closed.

Site # 2 is located in the main river channel in the lagoon approximately 300 yards upstream from the river-ocean interface and approximately 47.1 miles downstream from Bradbury dam (#24). Both the surface and bottom unit were placed in protective enclosures and cabled off to the railroad bridge at the first railroad abutment. The bottom unit is laying directly on the substrate, while the top unit is suspended approximately one foot below the surface.

3.4.2 Results

3.4.2.1 Seasonal Patterns and Diel Variation

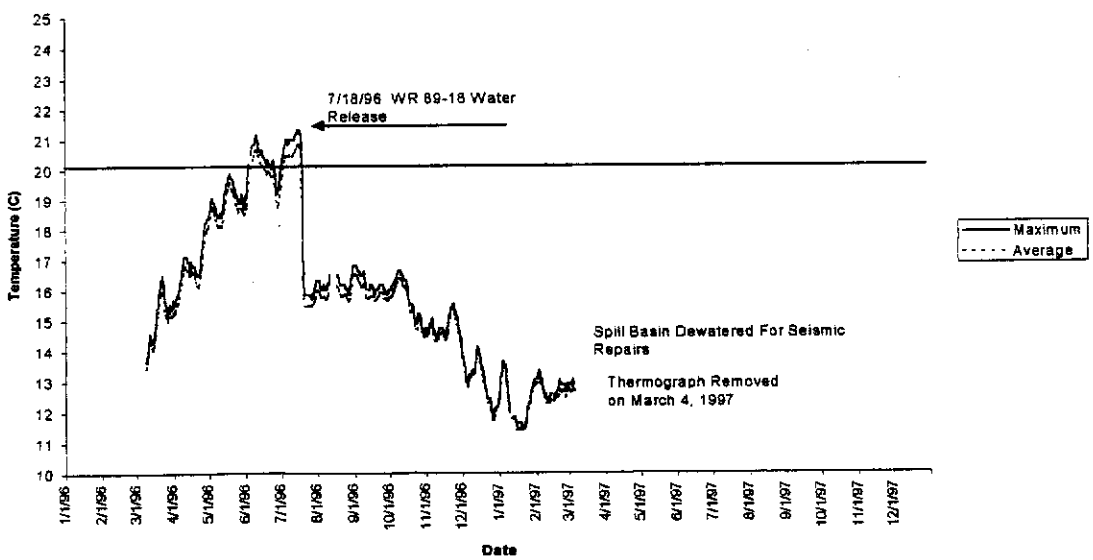
Highway 154 Reach

Spill Basin

Results of the surface thermograph are shown in **Figure 3.4.2-1**. In 1996, average and maximum water temperatures ranged from 13.5 C to 18.0 C in the spring and from 18.0

C to 22.2 C in the summer. Beginning on July 18, 1996, WR 89-18 releases were initiated at a flow rate of 150 cubic feet per second (cfs). Water temperatures in the spill basin show a dramatic decrease coincident with the water releases. Water temperatures dropped from approximately 21.0 C to around 15.5 C. The cool water temperatures recorded at the onset of WR 89-18 releases are consistent with hypolimnetic water quality measurements in Lake Cachuma during July 1996. Very slight water temperature variation (< 1.0 C) was recorded during WR 89-18 releases (July 18 through October 10, 1996. The thermograph was removed from service on March 4, 1997 during the seismic retrofit of Bradbury Dam.

Figure 3.4.2-1. 1996-1997 Spill Basin Thermograph Data



Long Pool - Surface Unit

Average surface water temperatures show a steady increase from 13.0 C in January to approximately 20 C in April 1996 (**Figure 3.4.2-2**). Maximum temperatures were slightly greater, particularly closer to the summer months. Daily variation in maximum water temperatures was between 0-2.5 C greater than average temperatures. Several peaks and valleys were observed in the graph, probably a result of ambient air temperatures warming and cooling the surface waters. Just prior to WR 89-18 water releases of both years, surface water temperatures were recorded between 21-25C. A sharp decrease of approximately 6.0 C was recorded after initiation of WR 89-18 water releases in both 1996 and 1997. Following the releases, both average and maximum water temperatures in the long pool were generally less than 19.0 C.

Long Pool - Bottom Unit

Due to thermograph malfunction, no data was recorded before June 30, 1996. Prior to the 1996 WR 89-18 releases, average and maximum temperatures for the 19-day period remained between 18.5-19.5 with essentially no variation between average and maximum

was recorded until June 18 (Initiation of WR 89-18). Following water releases, water temperature decreased to approximately 16.5 C **(Figure 3.4.2-3)**.

Prior to WR 89-18 releases in both 1996-97, significant temperature stratification occurred in long pool, resulting in a 3-7 C difference between surface and bottom temperatures. Temperature differences between the surface and bottom within the long pool varied between 1.0-5.0 C following initiation of 1996 WR 89-18 releases. Bottom water temperatures never exceeded 19.5 C in 1996, and never exceeded 17.8 C in 1997. Overall, water temperatures were slightly cooler in 1997.

Refugio Reach

Refugio Unit X - Mile 3.4

Average and maximum bottom water temperatures at Refugio Habitat Unit X, located 3.4 miles downstream from Bradbury Dam, were recorded for all of 1996-97. A gap in the data is shown to occur between early May and mid June of both years because of the habitat unit being dry **(Figure 3.4.2-4 and Figure 3.4.2-5)**. Both a surface and bottom thermograph were redeployed to monitor water temperatures from the WR 89-18 releases. Continuous monitoring of surface temperatures began in mid-July 1996

Both surface and bottom thermographs recorded nearly identical plots in 1996-97 indicating an absence of stratification and/or cool water upwelling. Overall, temperatures were cooler in 1997 compared to 1996. For both years, daily variations in the winter typically ranged between 0.5-4.0 C, while variations in the spring ranged 0.5-6.0 C. Average bottom temperatures usually remained below 20 C, and were never greater than 22 C. Maximum bottom water temperatures were commonly between 20-24 C in the

Figure 3.4.2-2. 1996-97 Long Pool Surface Thermograph Data

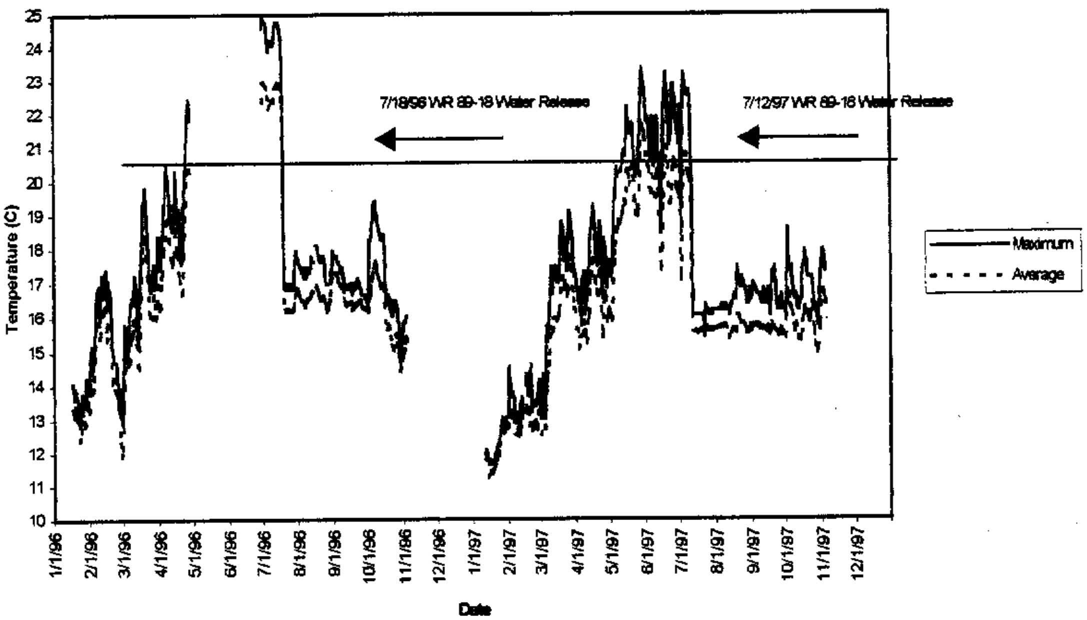
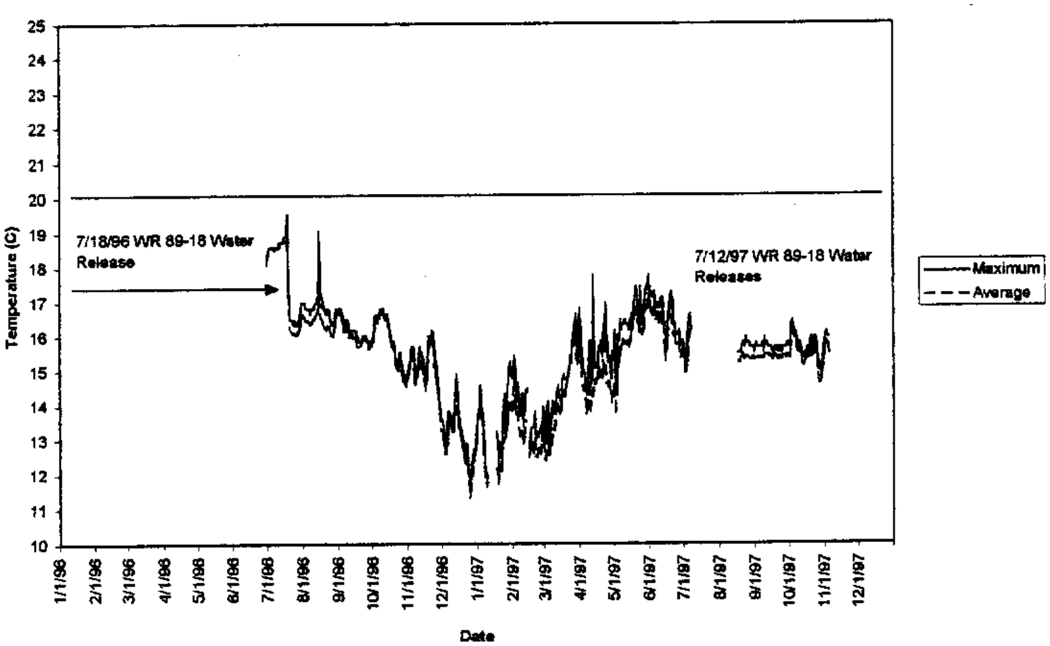


Figure 3.4.2-3. 1996-97 Long Pool Bottom Thermograph Data



spring with peaks of nearly 26 C occurring briefly on one occasion. Summer and fall average water temperatures show a similar pattern compared to the spring, but maximum water temperatures were generally between 21.5-25 C with a peak of nearly 27 C occurring briefly no one occasion.

After initiation of WR 89-18 releases, both average and maximum increased between 1-3 C. However, essentially no differences in temperature were noted between the surface and bottom thermograph for both 1996 and 1997 at Unit X.

Figure 3.4.2-4. 1996-97 Refugio X - Pool Habitat - Surface Thermograph - Mile 3.4

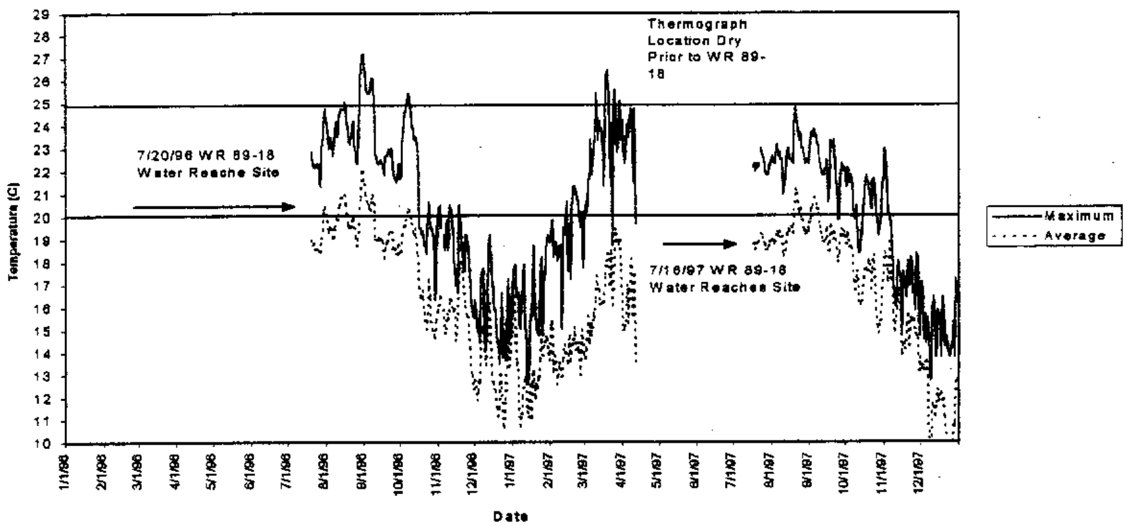
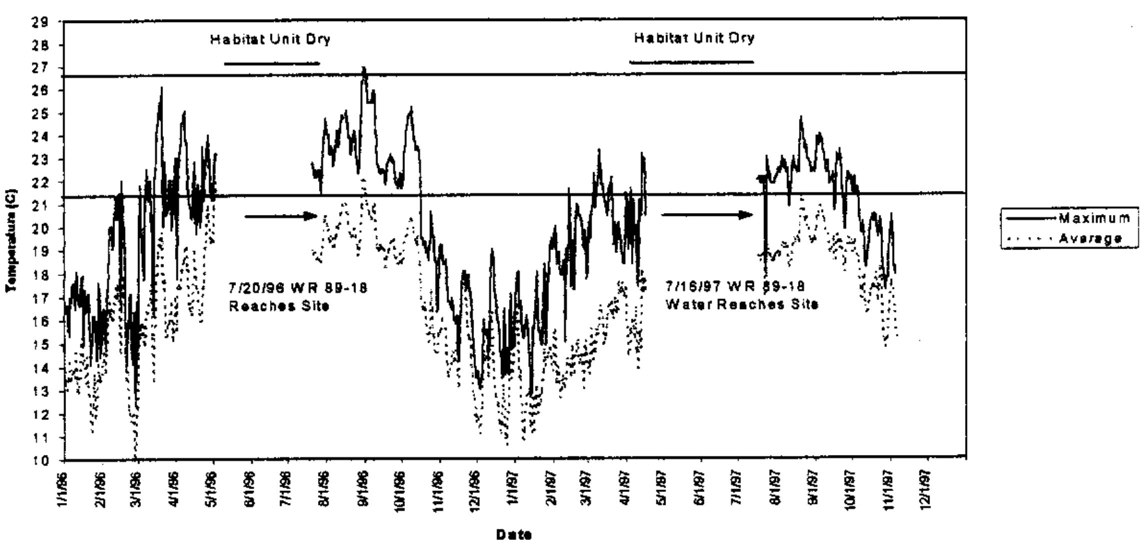


Figure 3.4.2-5. 1996-97 Refugio X - Bottom Thermograph Data



Refugio Unit # 17 - Mile 6.0

Surface and bottom thermographs were deployed at Refugio Habitat Unit 17 (**Figure 3.4.2-6 and Figure 3.4.2-7**) from late May through early July 1996, prior to WR 89-18 releases. Monitoring at this location was insufficient in duration to characterize seasonal trends in water temperature. Variations between average daily and maximum daily water temperatures differed at the surface when compared to the bottom. Maximum surface temperatures typically ranged between 21-23 C, while average temperatures remained at or below 20 C. The bottom thermograph showed essentially no variation between average and maximum water temperature during the deployment time. Both average and maximum water temperatures ranged between 18.5-20.3 C.

Figure 3.4.2-6. 1996 Refugio Habitat Unit #17 - Pool habitat - Surface Thermograph - Mile 6.0

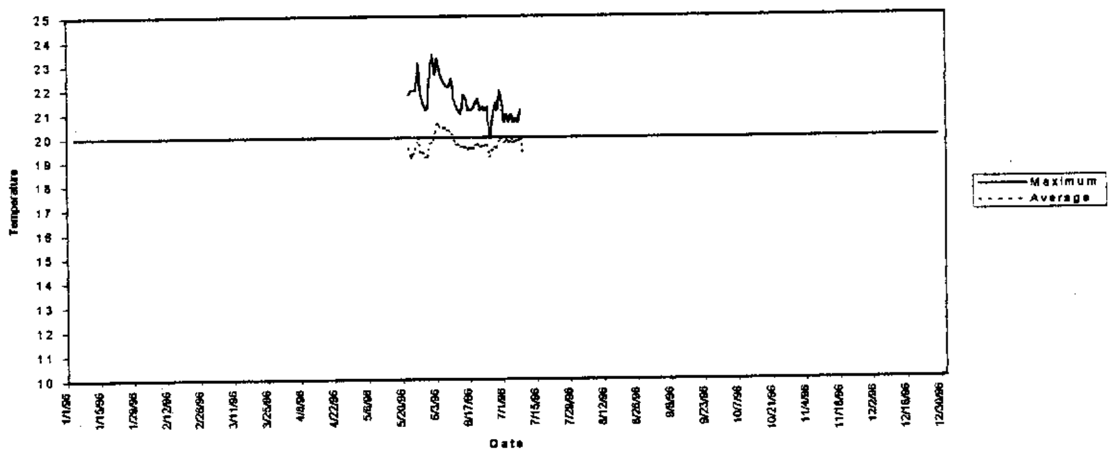
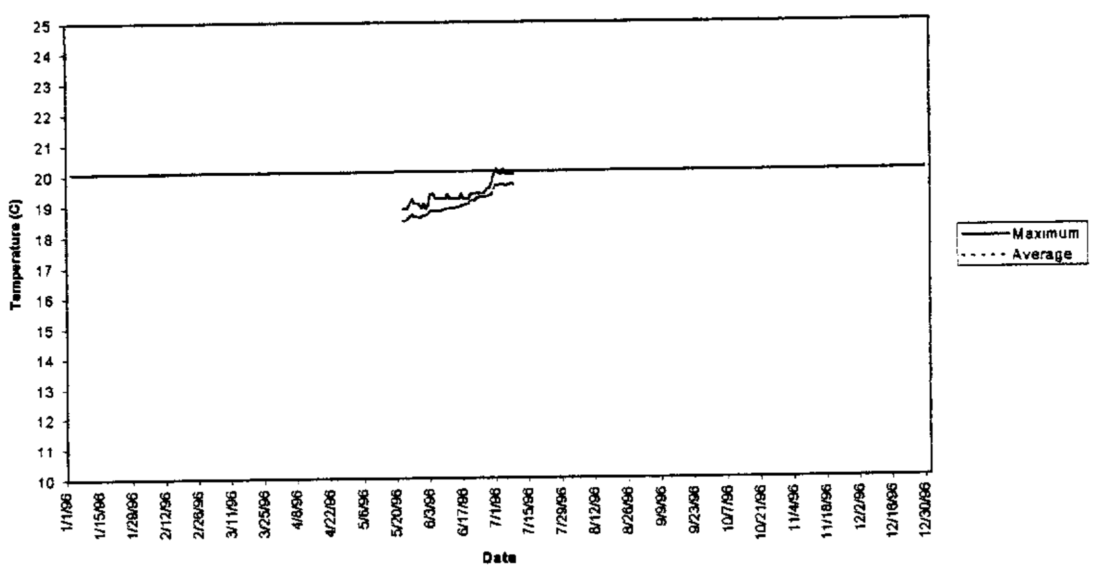


Figure 3.4.2-7. 1996 Refugio Habitat #17 - Pool habitat - Bottom Thermograph - Mile 6.0



Alisal Reach

Alisal Unit # 45 - Mile 7.9

Water temperatures measured at the surface and bottom of Alisal Habitat Unit 45 located 7.9 miles downstream of Bradbury Dam are shown for the period of January through December 1996-97 **(Figure 3.4.2-8 and Figure 3.4.2-9)**. No data surface data was collected between early July and August 1996 and between May and June 1997 due to thermograph malfunction. From May through early July 1996, surface temperatures were relatively cool, with average temperatures ranging between 17.0-19.5 C. Variations from 0-2.0 C were recorded during May, but decreased to less than 0.5 C in June and early July. 1997 temperatures were identical or slightly cooler compared to 1996.

Both average and maximum bottom water temperatures were less than 20 C from May through mid-July (WR 89-18). Variation between daily average and daily maximum water temperatures prior to WR 89-18 was essentially zero. Following WR 89-18 and extending through the fall of 1996, average temperatures were between 20-22.5 C, while maximum temperatures were generally between 22-25 C with one peak of nearly 27 C.

After initiation of WR 89-18 releases for both 1996 and 1997, both the average and maximum water temperatures at the surface and bottom increased too greater than 20 C. However, bottom temperatures were generally cooler in 1997, and recorded less variation when compared to the surface unit for both years. Average temperatures at the surface and bottom generally ranged between 20-22.5 C until early October when they decreased rapidly to between 16-17 C. Maximum temperatures peeked in mid-August at nearly 27 C for both surface and bottom thermographs. Daily variations at the surface increased after the WR 89-18 releases during both years. Bottom maximum water temperatures typically cooled faster than surface temperatures. Surface temperatures did not cool below 25 C until near the middle of September 1996 and 1997.

Alisal Unit # 9 - Mile 9.5

Water temperature was measured in Alisal Habitat Unit 9 at the surface unit from May 4 through December 31, 1996 **(Figure 3.4.2-10)**, and at the bottom unit from January 1 through early October 1996 **(Figure 3.4.2-11)**. Monitoring was conducted at the bottom during 1997, however, thermograph malfunction resulted in a loss of that data. Alisal Habitat Unit 9 is located 9.5 miles downstream of Bradbury Dam. Comparison of daily variation of surface and bottom water temperatures provide evidence that water temperatures within the habitat unit were either vertically stratified, or that cool groundwater upwelling occurred in the habitat unit. Either reason would explain the lower, more stable water temperatures observed near the bottom. Average bottom water temperatures remained below 20 C from January to the beginning of July 1996. Maximum bottom water temperatures generally remained below 20 C from January through early March 1996. During March through April, average and maximum bottom water temperatures varied within a day by up to 5 C, followed by a substantial reduction in the daily temperature variation observed during May and June. Following the arrival

Figure 3.4.2-8. 1996-97 Alisal Reach - Pool Habitat #45- Surface Thermograph - Mile 7.8

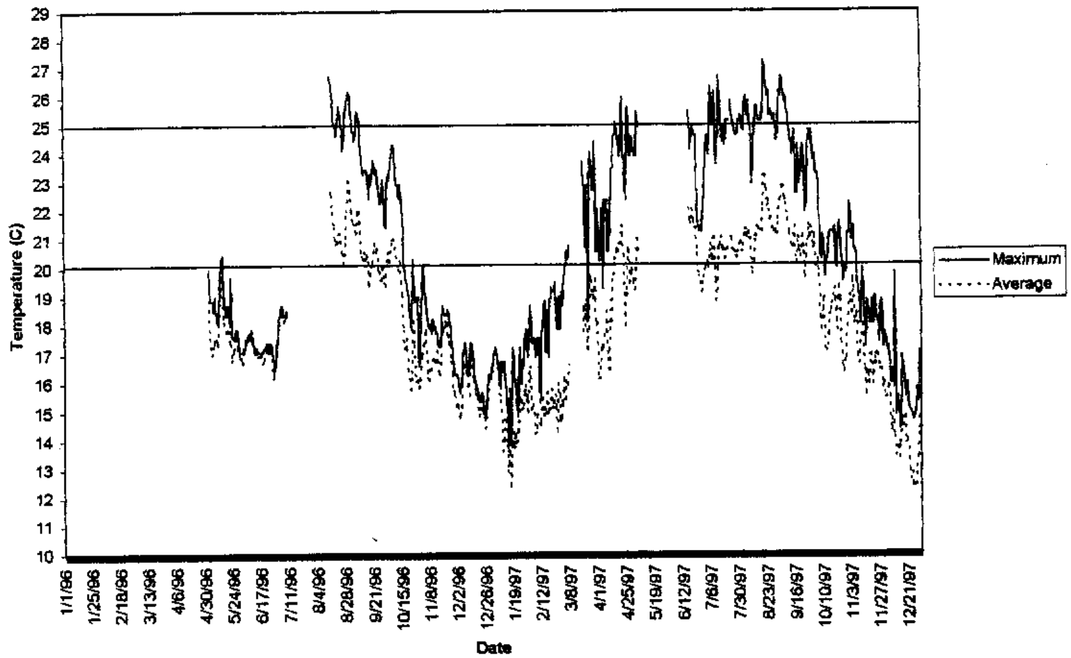


Figure 3.4.2-9. 1996-97 Alisal Reach - Pool Habitat #45- Bottom Thermograph - Mile 7.8

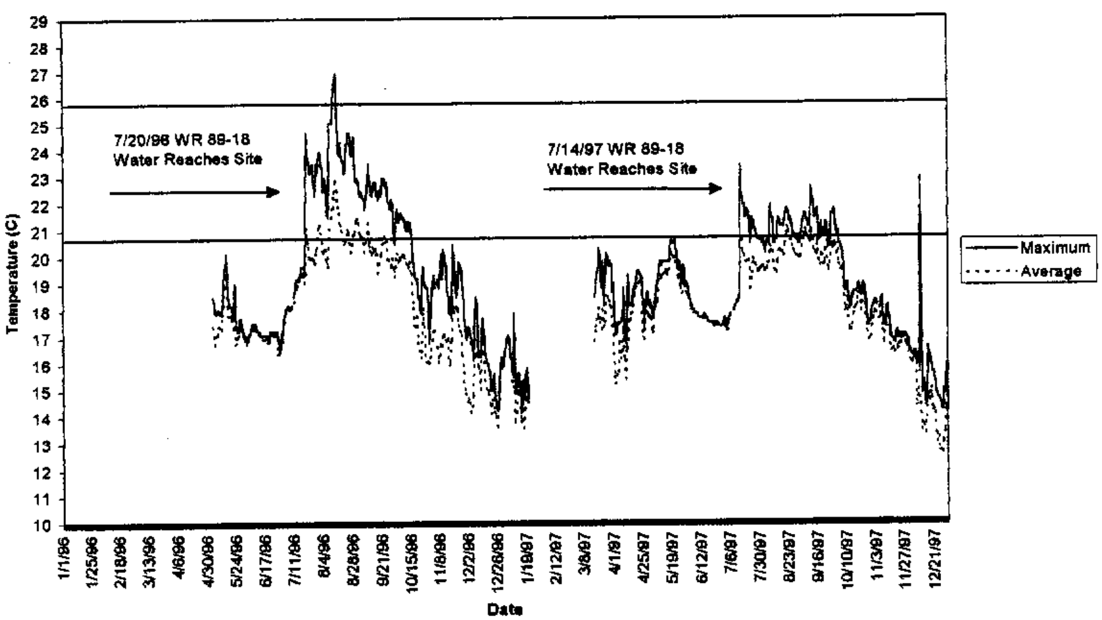


Figure 3.4.2-10. 1996-97 Alisal Habitat #9 Surface Unit - Pool Habitat - Mile 9.5

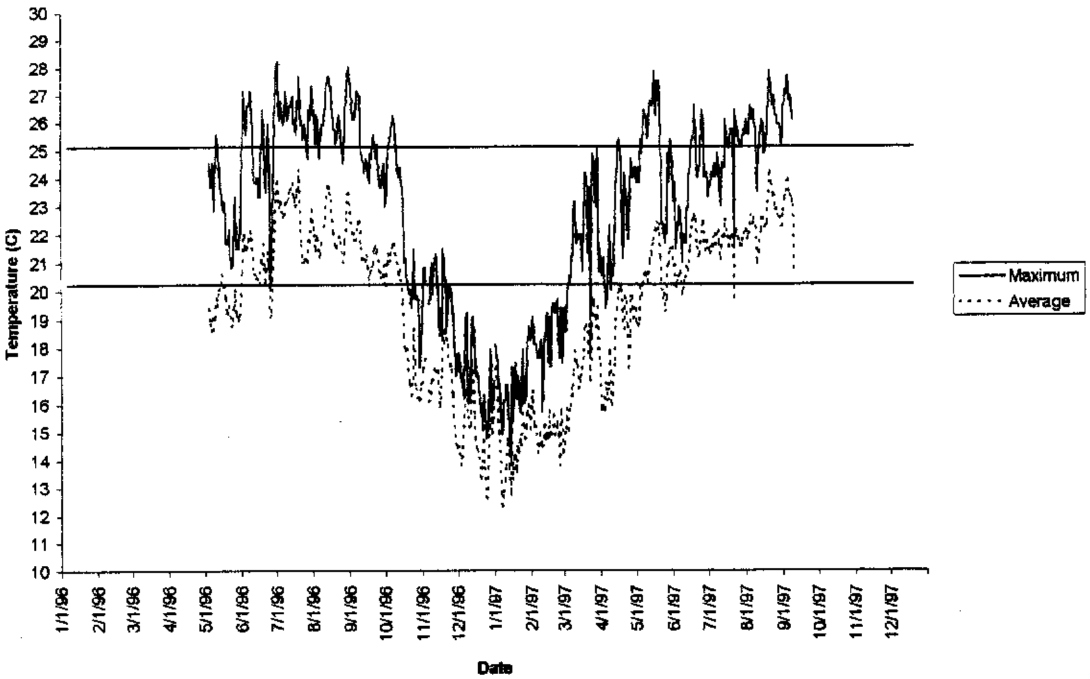
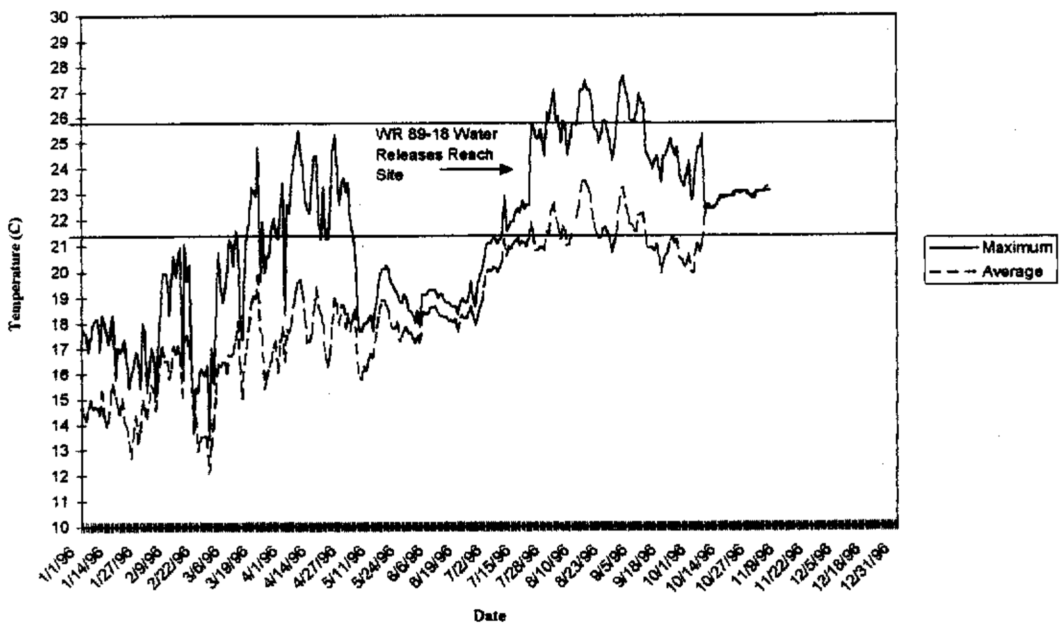


Figure 3.4.2-11. Alisal 9 Bottom Unit - 1996 Daily Maximum and Average Water Temperatures - MILE 9.5



of WR 89-18 releases, average water temperatures ranged between 20-23 C from July 21 through early October. Maximum water temperatures generally varied between 24.5-27.5 C from mid-July through the first week in September.

Average and maximum water temperatures at the surface varied between 2-5 C before WR 89-18 releases, and between 1-5.5 C after WR 89-18 releases reached the monitoring site. Unlike the bottom plot, no clear increase in water temperature was observed with the arrival of WR 89-18 releases. Average water temperatures remained above 20 C between the first week of June, and the middle of October. Average temperatures at this time typically ranged between 20-24 C. Maximum temperatures generally fluctuated between 20-27 C from May through early June. From June through early September, maximum water temperatures remained greater than 25 C.

Alisal Bridge – Mile 10.5

Monitoring of the Alisal Bridge site began in mid-March 1997. From late April until the WR 89-18 releases in mid July, water temperatures were generally warmer at the surface compared to the bottom, indicating thermal stratification, and/or cool water upwelling. Daily variation generally ranged between 1-4 C **(Figure 3.4.2-12 and Figure 3.4.2-13)**. After releases reached the monitoring site, both the surface and bottom graphs were nearly identical suggesting that the releases disrupted thermal stratification. Daily variation at both the surface and bottom increased to a nearly constant 4 C after 89-18 water reached the site. Maximum temperatures at both the surface and bottom ranged between 23-27.5 C after 89-18 water releases.

Avenue of the Flags Reach – Mile 13.9

Water temperatures were recorded at the Avenue of the Flags Bridge in Buellton from March 1996 through December 1997 (**Figure 3.4.2-14).** Average water temperatures in 1997 are nearly identical to those in 1996. Maximum water temperatures in 1997 are slightly cooler compared to 1996. Unlike 1996, it could not be determined when water from 1997 WR 89-18 releases reached the thermograph location. 1996-97 average water temperatures generally ranged between 20-24 C during the late spring and extending through fall. Maximum water temperatures remained between 20-24 C until releases from WR 89-18 (1996) arrived when water temperatures increased to between 22-28 C. Daily variations between average and maximum water temperatures prior to 1996 WR 89-18 releases typically ranged between 1-3.5 C. After the releases reached the thermograph, maximum temperatures increased 4 C and average temperatures increased 2 C. Variations between average and maximum temperatures remained fairly constant at approximately 4-5 C until the onset of fall when the temperatures began to steadily decrease.

Figure 3.4.2-12 1997 Alisal Bridge - Pool Habitat - Surface Thermograph - Mile 10.5

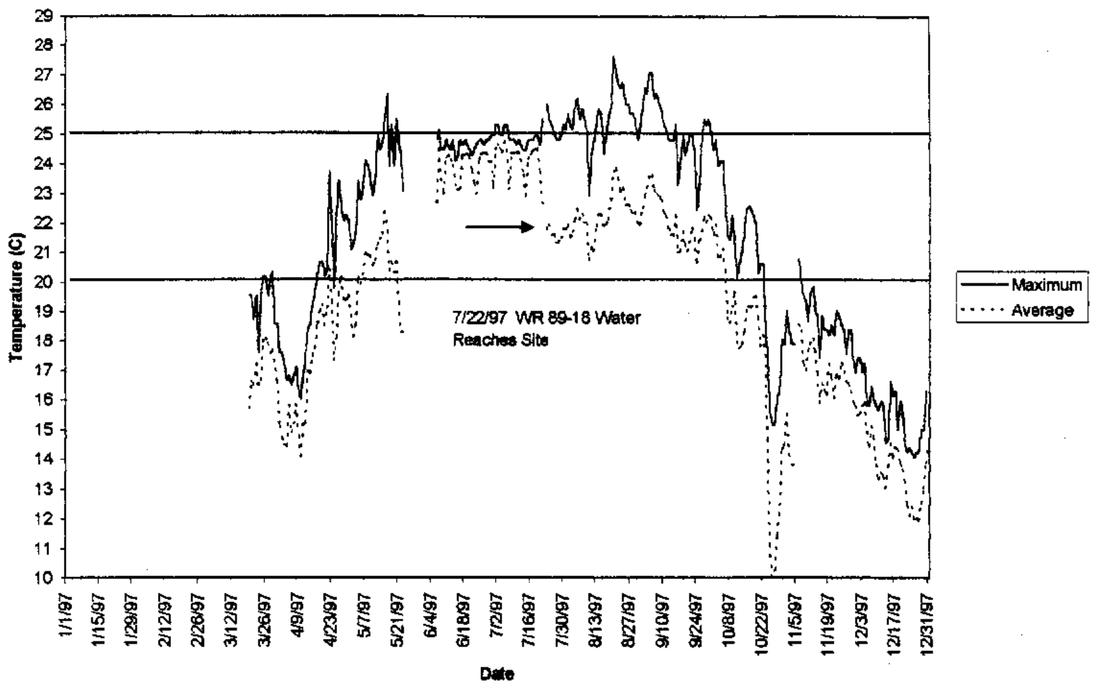


Figure 3.4.2-13. 1997 Alisal Bridge - Pool Habitat - Bottom Thermograph - Mile 10.5

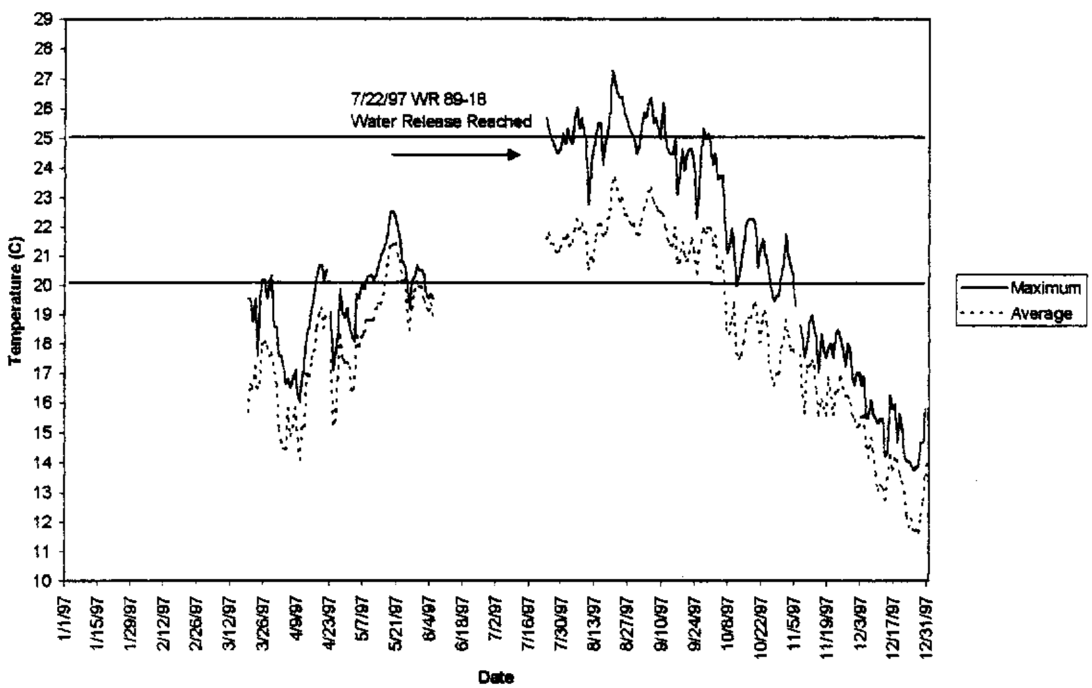
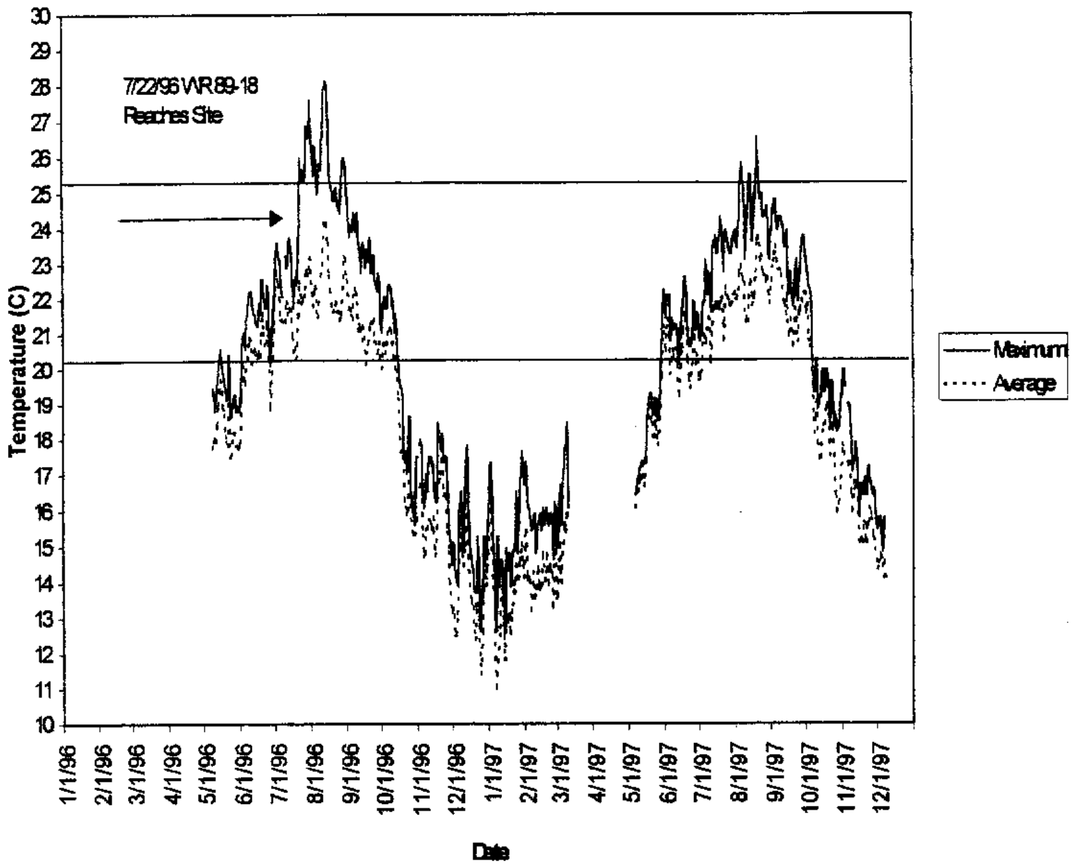


Figure 3.4.2-14. 1996-97 Avenue of the Flags Bridge - Buellton - Mile 13.6 - Run Habitat - Bottom Thermograph



Weister Ranch Reach

Surface and bottom water temperature monitoring was conducted at the Weister Ranch (16.0 miles downstream of Bradbury Dam) during the period from July 30 through December 31, 1996 **(Figure 3.4.2-15 and Figure 3.4.2-16)**. The thermographs were deployed after WR 89-18 releases reached the location. Comparison of surface and bottom thermographs shows virtually no difference between each plot indicating no stratification or influences of cool water upwelling during the releases. Average water temperatures at both the surface and bottom unit typically fluctuated between 20-24 C from late July through early October. Maximum temperatures at both the surface and bottom typically fluctuated between 24.5-27 C during the summer. In September, water temperatures generally remained between 22-24 C before decreasing to less than 20 C in early October.

Figure 3.4.2-15. 1996-97 Weister Ranch - Surface Thermograph - Pool Habitat - Mile 16.0

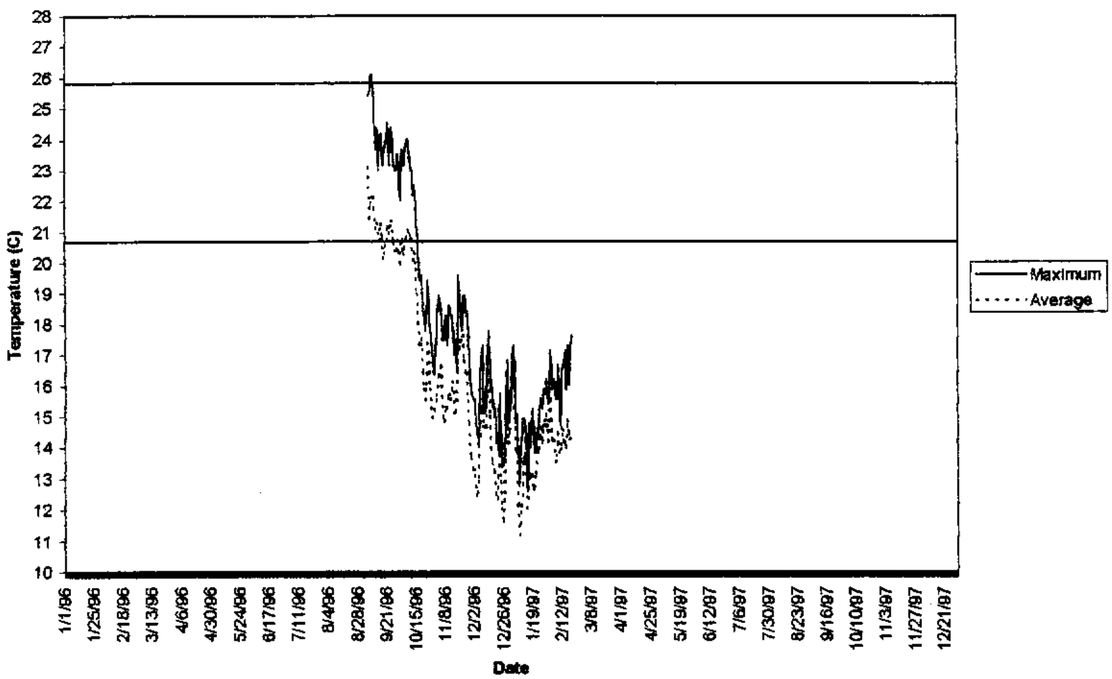


Figure 34.2-16. 1996-97 Weister Ranch - Bottom Thermograph - Pool Habitat - Mile 16.0

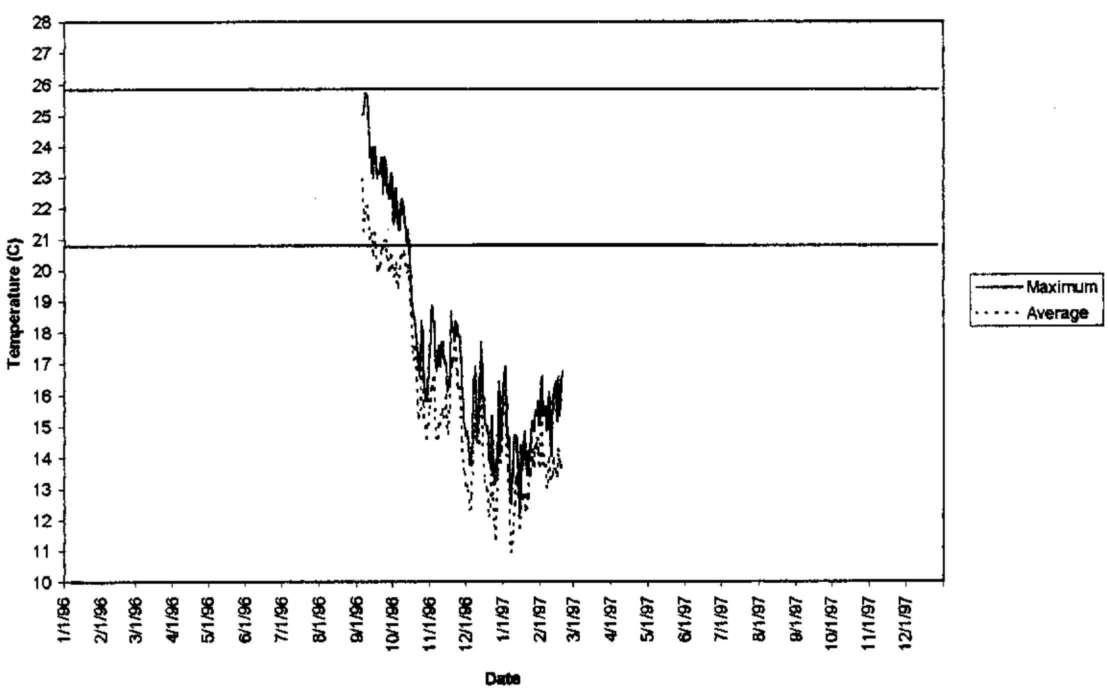
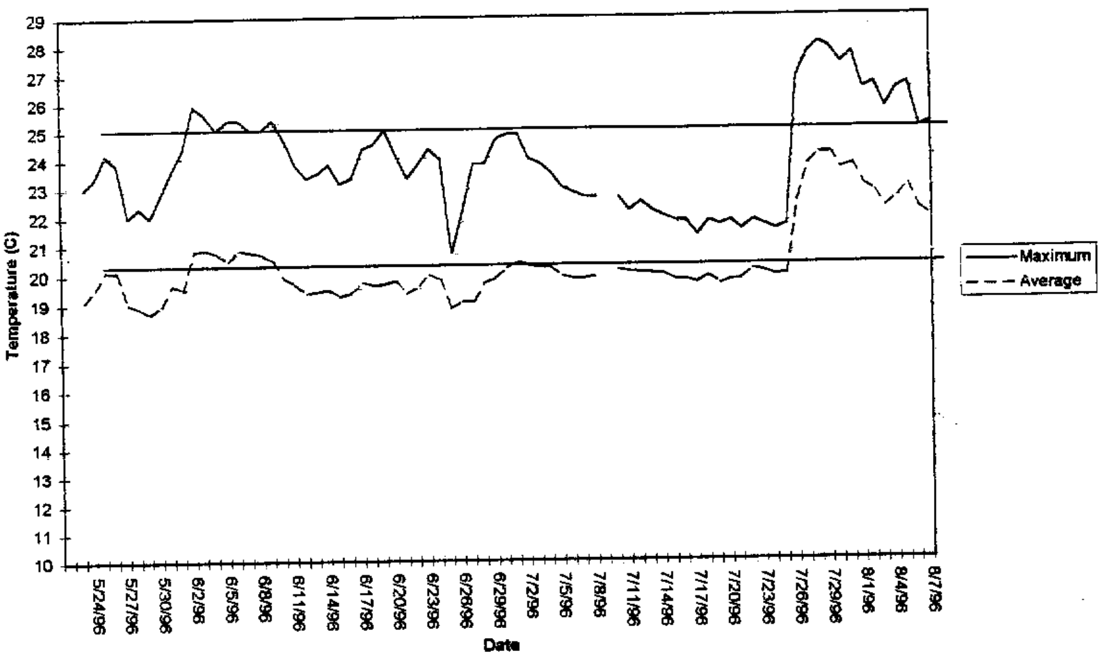


Figure 3.4.2-17. Cargasachi Ranch - 1996 Daily Maximum and Average Water Temperatures (*Graph Incomplete)



Cargasachi Ranch Reach

Water temperature monitoring at the Cargasachi reach, located 24 miles downstream of Bradbury Dam, was conducted from May 24 through August 1996 (**Figure 3.4.2-17**). Water temperature during May and June 1996 showed a general declining pattern, followed by a pronounced increase in both the average daily and maximum daily water temperature, coincident with the arrival of 1996 WR 89-18 releases. Average water temperatures generally hovered around 20 C until WR 89-18 water reached the thermograph location and average temperatures increased approximately 4 C. Maximum water temperatures generally fluctuated between 21-26 C prior to WR 89-18 releases. Once releases reached the location, an immediate 6 C increase in the maximum water temperature was observed. After August, a beaver moved into the habitat unit and removed the branch the thermograph was attached to and the data was lost. Average temperatures recorded in 1997 were greater than 20 C until the onset of fall. Maximum water temperatures ranged between 23-27 C during the summer before decreasing rapidly in the fall.

Santa Ynez Lagoon

Ocean Park

Both the average and maximum daily temperatures at the surface show little variation between each during the deployment time. The 1997 water temperatures, unlike the upper SYR, were slightly warmer than 1996 water temperatures **(Figure 3.4.2-18)**. In July through August of both years, average and maximum temperatures ranged between 20-24

Figure 3.4.2-18. 1996-97 Santa Ynez Lagoon at Ocean Park - Surface Thermograph - Mile 47.0

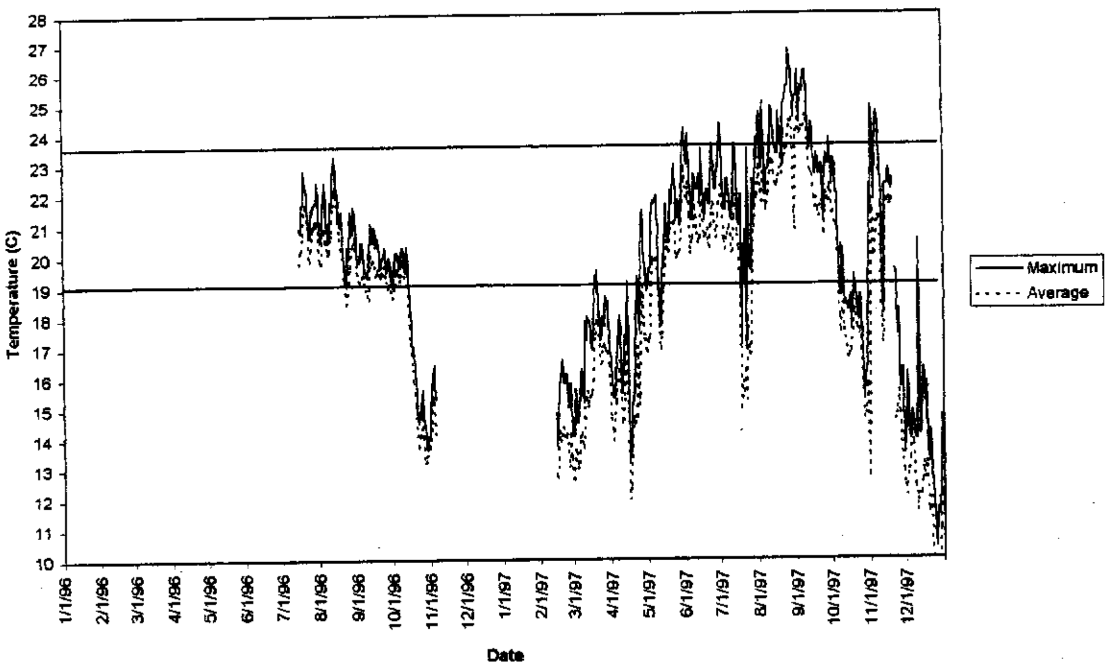
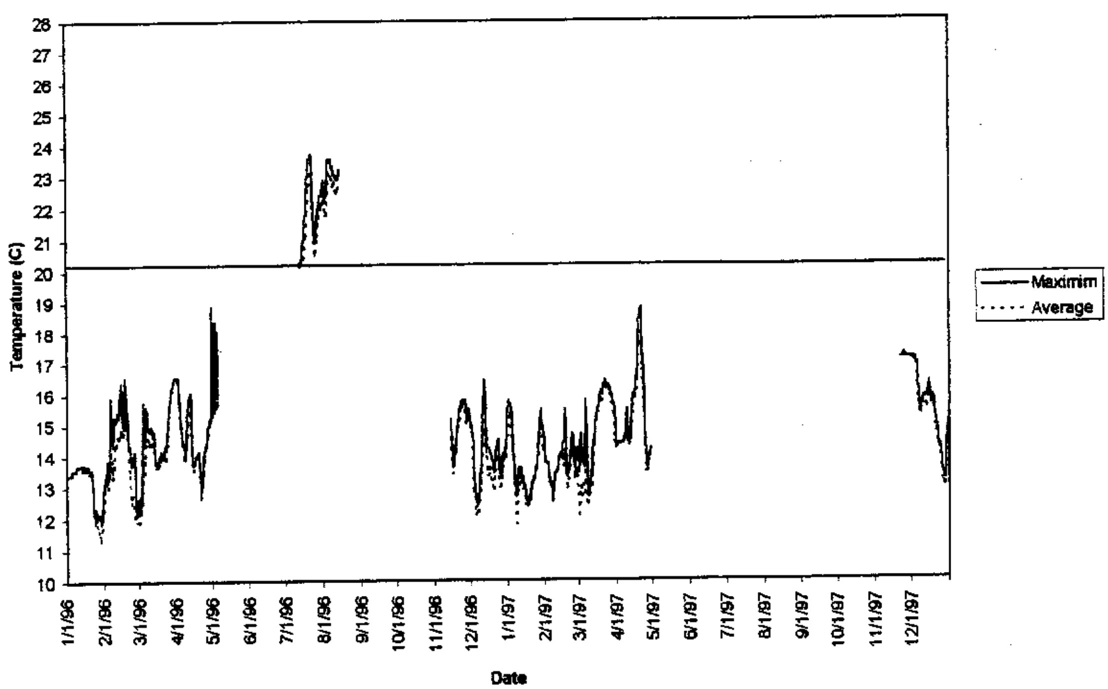


Figure 3.4.2-19. 1996-97 Santa Ynez Lagoon at Ocean Park - Bottom Thermograph - Mile 47.0



C. Water temperatures decreased slightly from mid August through early October 1996, but were somewhat warmer in 1997. An approximate 5-6 C decrease in water temperature was recorded in early October 1996, probably the result of lagoon breaching and influx of cool ocean water.

The bottom thermograph data at Ocean Park is fragmented due to vandals, and thermograph malfunction **(Figure 3.4.2-19)**. Very little variation between maximum and average water temperatures was recorded during both years.

Upper Lagoon

The surface thermographs deployed in the upper lagoon in both 1996-97 recorded substantially greater average and maximum temperatures compared to Ocean Park **(Figure 3.4.2-20)**. Additionally, water temperatures were slightly warmer in 1997 compared to 1996. Maximum temperatures during the spring of both years typically ranged between 20-24 C, while average temperatures generally remained less than 20 C. Both average and maximum water temperatures during the summer and early fall remained between 20-25 C, with maximum peaks reaching 26 C and 27 C for the respective years. An approximate 5-6 C decrease in water temperature was recorded in early October 1996, probably the result of lagoon breaching.

The bottom unit at the upper lagoon is also very fragmented because of thermograph malfunction **(Figure 3.4.2-21)**. Bottom temperatures showed less variation and were typically cooler compared to the surface thermograph in both years, particularly during the spring and early summer. Overall, bottom temperatures were cooler compared to the surface indicating stratification and/or coolwater upwelling.

3.4.2.1 Diel Variations

Diel variation in surface and bottom water temperatures in the mainstem varied between locations during both summer and fall of 1996-97, particularly after WR 89-18 releases reached thermograph locations. During the winter and spring, prior to WR 89-18 releases, 24-hour temperature fluctuations differed significantly between locations. For surface units, small 24 hour temperature fluctuations between 0.5-3 C were recorded at the spill basin (mile 0.0), long pool (mile 0.25), and Alisal Habitat Unit 45 (mile 7.9). Moderate fluctuations between 3-5 C and 4-6 C were noted at Alisal Habitat Unit 9 (mile 9.5) Weister (mile 16.0, 1996) and Cargasachi Ranch (mile 24, 1996). Large fluctuations between 5-9 C were recorded at Buellton (mile 14).

Bottom thermographs at the long pool (mile 0.25), Alisal Habitat Unit 45 (mile 7.9), and Alisal Bridge (mile 10.5) recorded 24 hour temperature fluctuations of 0-2.5 C during the winter and spring of 1996 and 1997. Greater fluctuations of generally 5-9 C were recorded at Refugio X (mile 3.4), and Alisal 9 (mile 9.5, 1996).

Water temperatures began to decrease in September and October, coincident with a decrease in 24 hour temperature fluctuations of 2-6 C at all thermograph locations.

Figure 3.4.2-20. 1996-97 Upper Santa Ynez River Lagoon at 35th Street Bridge - Surface Thermograph - Mile 46.0

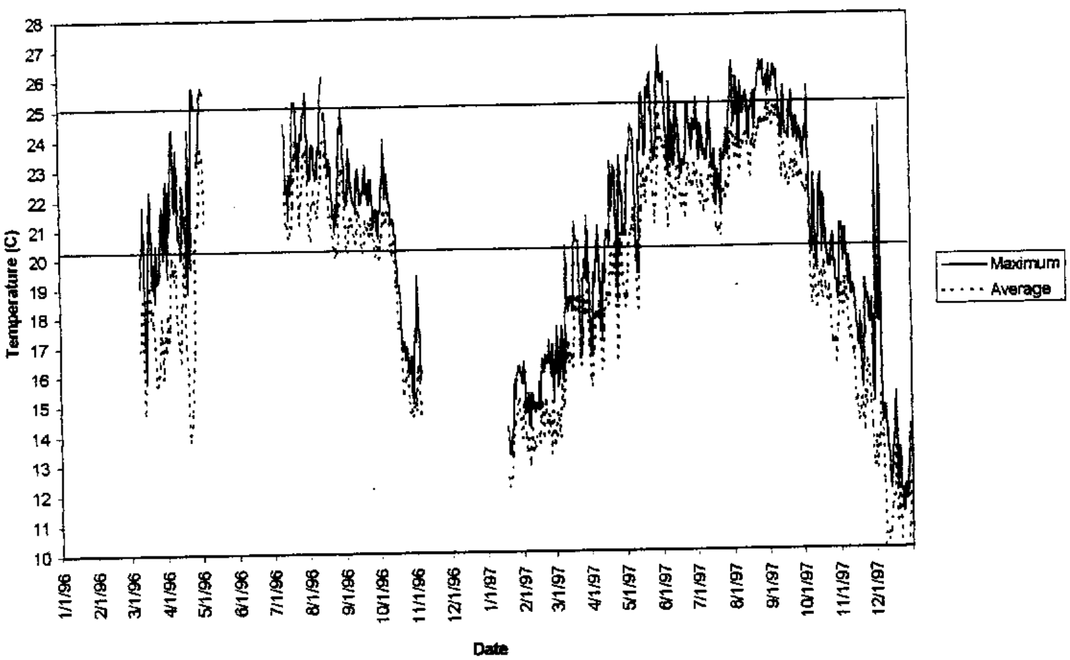
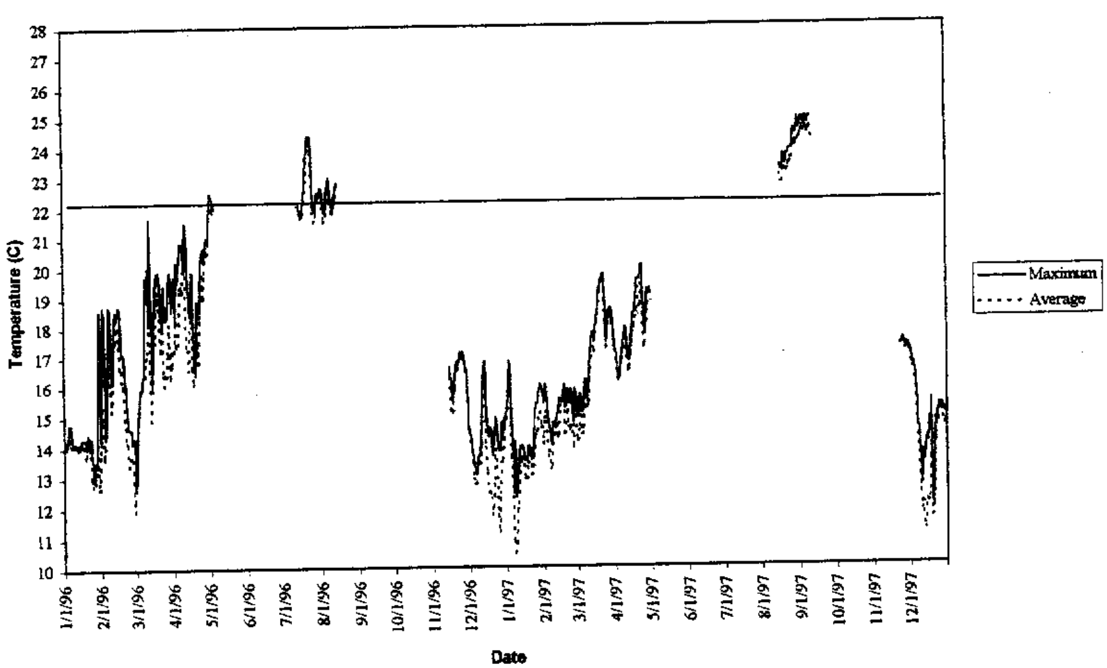


Figure 3.4.2-21. 1996-97 Santa Ynez River Lagoon at 35th Street Bridge - Bottom Thermograph - Mile 46.0



After 1996-97 water released for WR 89-18 reached thermograph locations, 24-hour fluctuations increased to 6-8 C at most sites. Smaller fluctuations of 4-6 C were recorded at Refugio X, Alisal 9 (surface), and Buellton. Additionally, 1997 water temperatures were generally cooler at all thermograph locations.

2.4.2.2 **Vertical Stratification and Cool water Upwelling**

1996-97 temperature data collected from the thermograph network suggests that either vertical stratification or cool water upwelling may be influencing water temperatures in deeper pool habitats resulting in cooler temperatures near the bottom.

Vertical thermograph arrays were deployed in 6 pool habitats at river miles 0.5, 3.4, 6.0 (1996), 7.9, 9.5, 10.5 (1997) and 16.0 (1996). Thermographs were deployed at Refugio X (mile 3.4) and Weister Ranch (mile 16.0) after water from WR 89-18 reached each location due to absence of water and access issues at each location. The high volume of water released for WR 89-18 caused various degrees of disruption to the stratification of monitored pool habitats. At the long pool (mile 0.5), thermograph failure of both surface and bottom units prevent evaluation of surface and bottom water temperatures during the winter, spring, and early summer of 1996. Both units were replaced in late June 1996, 19 days prior to WR 89-18 releases. Average and maximum water temperatures at the bottom of the long pool were 4.5 C and 6.0 C cooler respectively compared to the surface during the 19 days prior to WR 89-18 water releases. This temperature difference indicates the presence of stratification and/or coolwater upwelling. Fish Account releases were 3.0 cfs prior to 89-18. Following 89-18 releases for both 1996 and 1997, the surface thermograph recorded an immediate drop in temperature from around 24 C to about 17 C. Data from the bottom thermograph shows a less dramatic drop in temperature (19 C to 17 C). In the weeks following 89-18 releases, both the surface and bottom temperatures generally remained less than 19 C, with the bottom being 1-2 C cooler.

Thermograph data at Refugio X during both 1996-97 recorded essentially identical data at both the surface and bottom indicating an absence of stratification and/or cool water upwelling both before and after WR 89-18 releases of both years. Both of these units were dry prior to the water releases.

Thermograph data at Refugio Habitat 17 (mile 6.0) shows cooler temperatures at the bottom compared with the surface. The thermographs were deployed from May 23 through July 9, 1996. Average temperatures were 0.5-1.5 C cooler at the bottom compared to the surface. Maximum temperatures were 1-4 C cooler at the bottom compared to the surface. Little or no water was flowing into this unit prior to WR 89-18 releases. Beaver activity and vandals removed four thermographs from this habitat unit after July 9. No additional thermographs were deployed at this location.

Thermographs deployed at Alisal Habitat 45 (mile 7.9) in 1996 recorded virtually no difference in temperature between the surface and bottom. Both the average and maximum water temperatures were significantly cooler compared to other vertical array locations. Water temperatures at the surface and bottom ranged between 17-20 C between May 3 through July 17, 1996. Once 89-18 water reached this location, both the average and maximum temperatures at the surface and bottom increased to greater than 20 C during the summer months. On several occasions maximum water temperatures approached or exceeded 25 C during summer along the vertical array. However, in 1997, water temperatures were significantly cooler at the bottom compared to the surface, both before and after WR 89-18 releases. The probability of cool water upwelling cannot be ruled out at this site since stratification was not disrupted by 1997 WR 89-18 releases.

Comparison of thermograph data at Alisal Habitat 9 in 1996 can only be made between May 4 through mid July due to failure of the surface unit prior to May 4. Average and maximum water temperatures were 1-4 C and 3.5-6.5 C cooler at the bottom compared to the surface indicating the presence of stratification and/or cool water upwelling.

Virtually no differences were recorded between surface and bottom water temperatures at the Weister Ranch monitoring site in 1996.

3.5 Frequency Analysis of Potentially Stressful Temperatures

The potential influence of average daily and maximum daily water temperatures in the mainstem SYR with respect to habitat suitability for steelhead/rainbow trout was evaluated for the 1995-96 monitoring period. The frequency of average daily water temperatures greater than or equal to 20 C(68 F), and maximum daily water temperatures greater than 24 C(75 F), was compiled for each study reach. Maximum daily water temperatures greater than 25 C(77 F) were used to indicate potentially lethal conditions. Results of this temperature analysis should, however, be used only as a general index and guideline of habitat suitability for steelhead/rainbow trout within the various reaches of the mainstem SYR. Variation in the effects of acclimation temperature and thermal tolerances of steelhead/rainbow trout inhabiting the SYR, when compared to more northerly stocks, compound the selection of specific temperature criteria for use in this analysis.

Analysis of 1995-96 water temperature monitoring results are consistent in demonstrating that water temperatures would be suitable for steelhead/rainbow trout at all locations where monitoring occurred during late fall, winter, and early spring. However, during summer (typically June-August) potentially adverse water temperatures (those exceeding either the average or daily maximum temperature criteria used in these analysis) were observed in surface thermographs at all mainstem monitoring locations. The maximum daily temperature criteria (24 C) was not exceeded in the bottom thermographs (except Alisal Habitat Unit 48) during the 1995-96 surveys. In addition, the frequency and magnitude of potentially adverse water temperature conditions increased as a function of distance downstream from Bradbury Dam, with the exception of temperature conditions within the lagoon. **Table 3.5-1** summarizes results of the frequency analysis of seasonal water temperatures exceeding criteria related to conditions that are potentially stressful to steelhead/rainbow trout. Results are briefly discussed below for various mainstem monitoring locations.

Table 3.5-1. Results of a frequency analysis of water temperature measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead.

Location		Month	Number Days Monitored	Frequency (Days)			
				Average Daily >20 C[1]	Maximum Daily >24 C[1]	Maximum Daily	Maximum Monthly (C)
Spill Basin (0.0 miles) Surface							
	1996	March	24	0	0	0	16.5
		April	30	0	0	0	18.4
		May	31	0	0	0	19.9
		June	30	14	1	1	26.3
		July	31	15	0	0	21.3
		August	10	0	0	0	16.5
		September	30	0	0	0	16.5
		October	31	0	0	0	16.7
		November	30	0	0	0	15.5
		December	31	0	0	0	14.1
	1997	January	31	0	0	0	13.7
		February	28	0	0	0	13.4
		March	5	0	0	0	13.1
Long Pool (0.5 miles) Surface							
	1996	January	19	0	0	0	14.2
		February	29	0	0	0	17.4
		March	31	0	0	0	19.8
		April	28	4	0	0	22.5
		May	-	-	-	-	-
		June	-	-	-	-	-
		July	31	18	17	1	25.1
		August	30	0	0	0	18.1
		September	30	0	0	0	17.6
		October	31	0	0	0	19.4
		November	4	0	0	0	
		December		0	0	0	
	1997	January	21	0	0	0	13
		February	28	0	0	0	14.6
		March	31	0	0	0	19.1
		April	30	0	0	0	19.3
		May	31	10	0	0	23.4
		June	30	13	0	0	23.2
		July	21	10	0	0	23.2
		August	31	0	0	0	17.5
		September	30	0	0	0	17.5
		October	31	0	0	0	18

Table 3.5-1. Results of a frequency analysis of water temperature measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead.

Location		Month	Number Days Monitored	Frequency (Days)			
				Average Daily >20 C[1]	Maximum Daily >24 C[1]	Maximum Daily	Maximum Monthly (C)
Long Pool (0.5 miles) Bottom							
	1996	January	4	0	0	0	17.0
		February	-	-	-	-	-
		March	-	-	-	-	-
		April	-	-	-	-	-
		May	-	-	-	-	-
		June	-	-	-	-	-
		July	31	0	0	0	19.6
		August	14	0	0	0	17.1
		September	30	-	-	-	16.8
		October	31	-	-	-	16.8
		November	30	-	-	-	16.2
		December	31	-	-	-	14.9
	1997	January	21	0	0	0	15.3
		February	28	0	0	0	15.4
		March	31	0	0	0	16.8
		April	30	0	0	0	17.8
		May	31	0	0	0	17.8
		June	30	0	0	0	17.3
		July	10	0	0	0	16.7
		August	15	0	0	0	15.8
		September	30	0	0	0	16.0
		October	31	0	0	0	16.5
		November		0	0	0	
		December		0	0	0	
Refugio X (3.4 miles) Surface	*1996*	July	12	2	3	1	24.7
		August	30	23	21	8	27.2
		September	30	9	9	9	26.6
		October	31	8	10	6	25.4
		November	30	0	0	0	20.5
		December	31	0	0	0	19.2

Location		Month	Number Days Monitored	Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Monthly (C)
Refugio X (3.4 miles) Surface	*1997*	January	31	0	0	0	19.2
		February	28	0	0	0	21.3
		March	31	0	0	0	25.6
		April	30	0	0	0	?
		May	0	0	0	0	Dry
		June	0	0	0	0	Dry
		July	14	0	0	0	23.0
		August	15	6	3	0	24.9
		September	30	7	0	0	23.8
		October	31	0	0	0	22.2
		November					
		December					
Refugio X (3.4 miles) Bottom	*1996*	January	31	0	0	0	18.1
		February	29	0	0	0	22.0
		March	31	0	5	2	26.1
		April	30	2	4	1	25.1
		May	3	3	0	0	23.2
		June	0	0	0	0	0.0
		July	12	2	2	1	24.7
		August	30	24	19	8	27.0
		September	30	9	9	9	26.6
		October	31	9	9	5	25.2
		November	30	0	0	0	19.2
		December	31	0	0	0	19.0
	1997	January	31	0	0	0	19.5
		February	28	0	0	0	21.7
		March	31	0	0	0	23.3
		April	30	0	0	0	21.2
		May	0	0	0	0	Dry
		June	0	0	0	0	Dry
		July	14	0	0	0	23
		August	30	6	3	0	24.7
		September	30	7	1	0	24.1
		October	31	0	0	0	22.5
		November					
		December					

Location	Month	Number Days Monitored	Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Monthly (C)
Refugio Unit 17 (6.0 miles)						
Surface *1996*						
	May	8	1	0	0	23.1
	June	30	8	0	0	23.5
	July	9	2	0	0	21.9
Refugio Unit 17 (6.0 miles)						
Bottom *1996*	May	9	0	0	0	19.2
	June	30	0	0	0	19.7
	July	9	0	0	0	20.2
Alisal Unit 45 (7.9 miles)						
Surface						
1996	May	29	0	0	0	20.4
	June	30	0	0	0	17.9
	July	9	0	0	0	18.7
	August	16	16	16	15	26.7
	September	30	28	12	8	25.8
	October	31	12	5	0	24.3
	November	30	0	0	0	20.1
	December	31	0	0	0	17.4
1997	January	31	0	0	0	17.8
	February	28	0	0	0	19.5
	March	31	0	2	0	24.4
	April	30	10	13	3	26
	May	5	2	4	1	25.4
	June	13	8	7	2	25.5
	July	31	25	27	16	26.7
	August	30	31	31	30	27.3
	September	30	30	20	9	26.7
	October	31	4	0	0	23.9
	November					
	December					
Alisal Unit 45 (7.9 miles)						
Bottom *1996*	January	31	0	0	0	17.9
	February	29	0	0	0	18.3
	March	31	0	0	0	20.3
	April	30	0	0	0	22.6
	May	31	0	0	0	20.3
	June	30	0	0	0	17.5
	July	31	6	2	0	24.7
	August	30	30	18	8	26.9
	September	30	28	0	0	23.5
	October	31	12	0	0	21.8
	November	29	0	0	0	20.4

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Monthly Maximum (C)
		December	31	0	0	0	18.5
Alisal Unit 45 (7.9 miles)							
Bottom	1997	January	31	0	0	0	17.9
		February	0				N/A
		March	15	0	0	0	20.3
		April	30	0	0	0	19.4
		May	31	3	0	0	20.6
		June	30	0	0	0	18.6
		July	31	4	0	0	23.4
		August	30	18	0	0	21.9
		September	30	21	0	0	22.6
		October	31	2	0	0	20.9
		November	29				
		December	31				
Alisal Unit 9 (9.5 miles)							
Surface	1996	January	-	-	-	-	-
		February	-	-	-	-	-
		March	-	-	-	-	-
		April	-	-	-	-	-
		May	28	7	7	2	25.6
		June	30	28	21	17	28.0
		July	31	31	31	30	28.2
		August	30	30	30	30	28.0
		September	30	30	29	22	27.5
		October	31	15	13	9	26.3
		November	30	0	0	0	21.5
		December	31	0	0	0	19.1
	1997	January	31	0	0	0	18.7
		February	28	0	0	0	19.7
		March	30	0	0	0	25.1
		April	30	3	11	2	25.4
		May	6	2	11	2	25.8
		June	18	19	16	8	26.6
		July	31	30	25	16	26.5
		August	30	31	28	27	27.9
		September	30	30	25	15	27.7
		October	31	6	6	2	25.8
		November	29				
		December	31				

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Monthly Maximum (C)
Alisal Unit 9 (9.5 miles)							
Bottom	*1996*	January	31	0	0	0	18.3
		February	29	0	0	0	21.1
		March	31	0	1	0	24.8
		April	30	0	10	2	25.5
		May	31	0	0	0	21.4
		June	30	0	0	0	20.4
		July	31	31	11	10	27.1
		August	30	30	30	29	27.1
		September	-	-	-	-	-
		October	-	-	-	-	-
		November	-	-	-	-	-
		December	-	-	-	-	-
Alisal Bridge (mile 10.5)							
Surface	*1997*	January	N/A				N/A
		February	N/A				N/A
		March	11	0	0	0	20.3
		April	30	2	0	0	20.3
		May	23	20	10	5	26.4
		June	24	24	24	3	25.2
		July	31	30	30	17	25.5
		August	30	31	31	27	27.6
		September	30	30	27	18	27.1
		October	31	6	6	0	24.8
		November	30				
		December					
Alisal Bridge (mile 10.5)							
Bottom	*1997*	January	N/A				
		February	N/A				
		March	11	0	0	0	20.3
		April	30	0	0	0	20.7
		May	23	10	0	0	22.5
		June	24	0	0	0	20.3
		July	31	9	9	4	25.7
		August	30	31	31	24	27.3
		September	30	30	25	14	26.2
		October	31	6	2	0	24.5
		November	30				
		December					

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >26 C	Maximum Daily (C)
Buellton (13.6 miles)							
Bottom	*1996*	January	-	-	-	-	-
		February	-	-	-	-	-
		March	24	0	0	0	23.4
		April	30	5	2	0	24.8
		May	27	0	0	0	20.6
		June	30	23	0	0	22.6
		July	30	30	10	10	27.6
		August	30	30	30	29	28.1
		September	30	30	13	2	25.0
		October	31	14	0	0	22.4
		November	0	0	0	0	18.1
		December	0	0	0	0	17.8
	1997	January	31	0	0	0	17.7
		February	28	0	0	0	17.3
		March	24	0	0	0	18.5
		April	0				N/A
		May	24	0	0	0	22.3
		June	30	24	0	0	22.6
		July	30	28	3	0	24.3
		August	30	31	23	12	26.6
		September	30	30	13	0	24.8
		October	31	6	0	0	22.9
		November	0				
		December	0				
Weister Ranch (16.0 miles)							
Surface	*1996*	July	2	2	2	2	26.5
		August	31	31	31	24	27.3
		September	29	29	22	9	26.1
		October	31	14	6	0	24.0
		November	30	0	0	0	19.6
		December	31	0	0	0	17.8
	1997	January	31	0	0	0	13.7
		Febuary	16	0	0	0	14.3
Weister Ranch (16.0 miles)							
Bottom	*1996*	July	2	2	2	2	26.4
		August	31	31	31	21	27.1
		September	29	29	16	7	25.9
		October	31	13	0	0	22.6
		November	30	0	0	0	18.9
		December	31	0	0	0	16.9
	1997	January	31	0	0	0	13.4

	February	16	0	0	0	13.8

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Cargasachi Ranch (24.0 miles)						
Surface						
1996	January	4	0	0	0	15.9
	February	-	-	-	-	-
	March	-	-	-	-	-
	April	-	-	-	-	-
	May	10	2	1	0	24.2
	June	30	10	18	9	25.9
	July	31	18	8	6	28.1
	August	7	7	7	7	26.6
	September	N/A				
	October	N/A				
	November	N/A				
	December	N/A				
1997	January	N/A				
	February	N/A				
	March	N/A				
	April	N/A				
	May	N/A				
	June	N/A				
	July	23	19	13	7	26.8
	August	9	9	9	9	27.3
	September	19	20	17	14	24.9
	October	31	6	5	0	24.9
	November	6	0	0	0	21.0
	December					

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Lagoon (35th Avenue Bridge) Surface							
	1996	March	22	0	0	0	22.3
		April	29	6	7	3	25.7
		May	4	4	4	4	25.7
		June	-	-	-	-	-
		July	20	20	12	4	25.6
		August	30	30	13	5	26.1
		September	30	30	1	0	23.7
		October	31	14	1	0	24
		November	5	0	0	0	19.4
		December	-	-	-	-	-
	1997	January	31	0	0	0	16.3
		February	28	0	0	0	16.6
		March	31	0	0	0	21.3
		April	30	4	0	0	23.3
		May	30	25	14	10	27
		June	30	30	18	7	25.9
		July	31	31	11	3	25.2
		August	31				
		September	30				
		October	31				
		November	30				
		December	31				
Lagoon (35th Avenue Bridge) Bottom							
	1996	January					
		February					
		March					
		April					
		May					
		June					
		July	20	20	4	0	24.4
		August	14	14	0	0	23.0
		September					
		October					
		November					
		December					

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Lagoon (35th Street Bridge)							
Bottom	*1997*	January	31	0	0	0	16.8
		February	28	0	0	0	16.0
		March	31	0	0	0	19.7
		April	30	0	0	0	20.0
		May	31	N/A			
		June	30	N/A			
		July	31	N/A			
		August	16	16	16	0	24.9
		September	11	11	11	0	
		October	31				
		November	30				
		December	31				
Ocean Park (47.1 miles)							
Surface	*1996*	July	17	15	1	0	24.5
		August	31	26	0	0	23.3
		September	30	9	0	0	21.1
		October	31	3	0	0	20.3
		November	5	0	0	0	16.4
		December	-	-	-	-	-
	1997	January	N/A				
		February	14	0	0	0	16.6
		March	31	0	0	0	19.5
		April	30	0	0	0	21.5
		May	31	14	1	0	24.0
		June	30	30	2	0	24.2
		July	31	20	2	0	24.3
		August	31	31	16	10	26.8
		September	11	11	11	11	26.1
		October	31				
		November	30				
		December	31				

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Ocean Park (47.1 miles)							
Bottom	1996	January	31	0	0	0	13.7
		February	29	0	0	0	16.4
		March	31	0	0	0	16.5
		April	30	0	0	0	16.5
		May	5	0	0	0	15.9
		June	N/A				
		July	20	20	0	0	23.7
		August	14	14	0	0	23.6
		September	N/A				
		October	N/A				
		November	17	0	0	0	15.8
		December	31	0	0	0	16.4
	1997	January	31	0	0	0	15.8
		February	0	0	0	0	15.5
		March	0	0	0	0	16.4
		April	0	0	0	0	18.8
		May	6	0	0	0	21.8
		June	4	0	0	0	23.5
		July					
		August					
		September					
		October					
		November					
		December					

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Monthly Maximum (C)
Hilton Creek - Spawn Pool							
	1996	March	25	0	0	0	23.2
		April	30	0	0	0	15.6
		May	31	0	0	0	15.9
		June	13	0	0	0	24.8
Upper Hilton Creek							
	1997	January	N/A				
		February	N/A				
		March	N/A				
		April	24	0	0	0	14.7
		May	31	0	0	0	16.1
		June	30	0	0	0	15.8
		July	31	0	0	0	16.6
		August	31	0	0	0	17.1
		September	30	0	0	0	16.1
		October	31	0	0	0	16.0
		November	30	0	0	0	
		December	31	0	0	0	
Lower Hilton Creek at SYR Confluence	1997	January	N/A				
		February	N/A				
		March	N/A				
		April	24	0	0	0	15.8
		May	31	0	0	0	18.0
		June	30	0	0	0	17.2
		July	31	0	0	0	17.2
		August	31	0	0	0	17.9
		September	30	0	0	0	17.2
		October	31	0	0	0	16.9
		November	30	0	0	0	
		December	31	0	0	0	
Nojoqui Creek - Upper Unit							
	1996	May	29	0	0	0	23.3
		June	28	1	5	5	30.2
		July	20	0	0	0	18.8
		August	8	0	0	0	18.7

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Monthly Maximum (C)
Nojoqui Creek						
1997	January	28	0	0	0	16.3
	February	13	0	0	0	15.6
	March	31	0	0	0	18.5
	April	30	0	0	0	17.5
	May	31	0	0	0	17.0
	June	30	0	0	0	17.2
	July	31	0	0	0	17.8
	August	31	0	0	0	18.9
	September	30	0	0	0	18.6
	October	31	0	0	0	
	November	30	0	0	0	
	December	31	0	0	0	
Salsipuedes Creek - Upstream of El Jaro Creek *1996*	May	28	0	0	0	20.7
	June	25	0	0	0	21.2
	July	-	-	-	-	-
	August	-	-	-	-	-
	September	-	-	-	-	-
	October	-	-	-	-	-
	November	22	0	0	0	15.8
	December	31	0	0	0	14.8
1997	January	31	0	0	0	15.5
	February	28	0	0	0	13.8
	March	31	0	0	0	18.4
	April	30	0	0	0	19.9
	May	31	0	0	0	22.8
	June	30	0	0	0	21.7
	July	31	0	0	0	21.7
	August	31	0	0	0	22.4
	September	30	0	0	0	22.7
	October	31	0	0	0	19.3
	November	30	0	0	0	
	December	31	0	0	0	
Lower Salsipuedes Creek - At Santa Rosa Road Bridge						
1996	May	24	6	8	2	26.3
	June	30	14	18	10	27.0
	July	31	31	30	26	27.6
	August	31	30	30	21	27.2
	September	30	5	7	1	24.8
	October	30	0	0	0	21.7
	November	-	-	-	-	-
	December	-	-	-	-	-

Location		Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Lower Salsipudes Creek At Santa Rosa Road Bridge							
	1997	January	31	0	0	0	14.5
		February	28	0	0	0	16.8
		March	31	0	0	0	21.9
		April	30	0	0	0	23.9
		May	31	15	18	12	27.4
		June	30	25	22	8	25.6
		July	7	7	7	1	25.6
		August	15	16	10	1	25.6
		September	30	24	7	0	24.9
		October	31	2	0	0	22.8
		November	30				
		December	31				
El Jaro Creek							
	1996	May	23	7	10	4	26.5
		June	30	9	10	8	26.9
		July	31	2	0	0	23.7
		August	29	21	21	20	26.0
		September	30	30	13	2	25.0
		October	31	14	0	0	22.4
		November	-	-	-	-	-
		December	-	-	-	-	-
	1997	January	31	0	0	0	15.6
		February	28	0	0	0	14.8
		March	31	0	0	0	20.6
		April	30	0	1	0	24.1
		May	31	15	13	12	26.5
		June	30	15	4	0	24.8
		July	7	9	2	0	24.5
		August	15	6	0	0	21.1
		September	30	4	0	0	21.4
		October	31	0	0	0	18.3
		November	30				
		December	31				
San Miguelito Creek							
	1997	January	N/A				
		February	N/A				
		March	16	0	0	0	18.7
		April	30	0	0	0	20.2
		May	31	0	0	0	23.4
		June	31	30	30	3	25.2
		July					

Spill Basin and Long Pool

Within the Spill basin, average daily temperature conditions equal to or greater than 20 C occurred during the summer of 1996. Monitoring within the spill basin during 1996 showed that average daily water temperatures exceeded the criterion on 14 days in June, and 15 days in July. The maximum daily temperature exceeded the 24 C criterion during 1 day in June, 1996. Temperatures recorded from March to early August 196 exceeded the incipient lethal temperature (25 C) on one day in June.

Surface water temperatures within the Long Pool exceeded the average daily criterion during April (4 days), and July (18 days), however, temperature records are incomplete for a portion of the summer monitoring period. Maximum daily water temperatures exceeded the 24 C criterion during 17 days in July, and exceeded 25 C on one day in July.

The frequency of exceedence was lower within the Long Pool at the bottom monitoring location. No temperatures were recorded that exceeded 20 C at the bottom unit during the hot summer months, however, monitoring was interrupted during the spring and early fall 1996.

Refugio Reach

Water temperatures were not recorded at the surface of Refugio X until after releases from WR 89-18 reached the monitoring location (due to habitat being dry). Average daily temperature criterion was exceeded in July (2 days), August (23 days), September (9 days), and October (10 days). Maximum daily temperatures exceeded the 25 criterion during the same months described above, but for eight days or less each month.

Prior to WR 89-18 releases, average criterion was exceeded Refugio X bottom thermograph for only two days in April and three days in May. Maximum daily temperatures (24 and 25 C) were exceeded briefly in March, April, and May. The bottom thermograph recorded nearly identical water temperatures as described above for the surface thermograph.

Alisal Reach

Results of temperature monitoring at Alisal Habitat Unit 45 (beaver pool) indicate that the average and maximum daily was exceeded at various times for each month from August through October. The surface thermograph recorded all three temperature criterion exceeded during August and September. Waters began cooling by October, and only the 20 C and 24 C criterion was exceeded (less than half the month). Surface water temperatures during 1997 recorded low to moderate frequency of exceedence from April through June, and moderate to high frequency from July through September. The warmest surface water temperatures were recorded during August and September. The bottom thermographs at Alisal 45 recorded much lower frequency of exceedence compared to the surface thermograph. Average criterion was exceeded for less than half the months of July and October 1997, and for the majority of August and September. The maximum criterion (24 C and 25 C) was exceeded briefly in July 1996, and for about half the month of August 1996. In 1997, only the average criterion was exceeded at the bottom for the majority of August and September.

Results of surface monitoring at Alisal Habitat Unit 9 (oak pool) indicate that both average (20 C) and maximum (24 C and 25 C) temperatures was exceeded from June through September for 1996 and 1997. All three temperature criterion were exceeded for the majority of July and September (maximum criterion exceeded for half the month). The bottom unit only has data available from January through August 1996. August was the warmest month with all three criterions exceeded for the majority of August, and for part of July.

Alisal Bridge

Thermograph data for the Alisal Bridge location is available for 1997 only. The warmest months were recorded at both the surface and bottom during August and September when all three temperature criterion was exceeded for the majority of each month. Surface measurements in July were similar in exceedence to August and September, however, the bottom thermograph exceeded the temperature criterion for less than half the month.

Buellton

During the 1996-97 monitoring period, the average criterion was exceeded for the majority of June through September, and for less than half of October. The maximum criterion was exceeded for most of August, and for less than half of July and September. 1996 was noticeably warmer compared to 1997 as evident by less frequency of the maximum criterions.

Weister Ranch

Water temperature monitoring at both the surface and bottom locations demonstrates that all three temperature criterions were exceeded during most of August and September. The potentially lethal maximum (25 C) was exceeded for less than half of September at both the surface and bottom. Overall, exceedence of the 25 C criterion was slightly lower for the bottom monitoring location.

Cargasachi Ranch

Water temperature data is only available from January through August 1996, and from July through November 1997. All three temperature criterion were exceeded for about half of each month from June through August 1996, and for July through October 1997. June was the warmest month in 1996, and September was the warmest month in 1997.

Lagoon

Water temperatures monitored at the upper lagoon showed that water temperature was higher at both the surface and bottom locations when compared to the downstream most location at Ocean Park. During the period of March through October 1996, and May through July 1997, surface temperatures at the upper lagoon location showed a pattern of increasing frequency in summer, with the greatest frequency in exceedence occurring during August and September. All three temperature criterion had a greater frequency of exceedence in 1997 compared to 1996. At the Ocean Park monitoring location in 1996, the average criterion was exceeded for half of the month during August and September. The average temperature criterion was exceeded for the majority of June through August, and for half the months of May and September. Both of the maximum temperature criterions were exceeded for about half of August and September.

Tributaries

Thermograph monitoring locations for 1996-97 in Upper and Lower Hilton Creek, Nojoqui Creek (June 1996 exception), and Upper Salsipuedes Creek did not exceed any of the specified temperature criterions. However, Lower Salsipuedes Creek, El Jaro Creek, and San Miguelito Creek did exceed specified temperature criteria. Lower Salsipuedes Creek experienced exceedence of all temperature criterions for the majority of July and August 1996, half of June 1996, and for a small portion of May and September 1996. Similar conditions developed for Lower Salsipuedes during 1997. Unfortunately, thermograph malfunction during July and August resulted in a loss of data and a comparison with 1996 cannot be made.

Very warm water conditions were recorded in El Jaro Creek, particularly in 1996. August was the warmest month with all temperature criterions being exceeded for over half the month. Average criterion was exceeded for most of September, half of October, and less than half of May, June, July, and October. The 24 C criterion was exceeded for less than half of May, June and September. Aside from August, the 25 C criterion was exceeded for roughly one week or less during May, June, and September. Temperature conditions were significantly cooler in 1997 compared to 1996. May was the warmest month with all three temperature criterions exceeded for less than half the month. In fact, May was the only month when the 25 C temperature criterion was exceeded. The average criterion was exceeded for half the month or less during June through September. The 24 C criterion was exceeded for less than one week from April through July (May being the exception.

Monitoring was conducted in San Miguelito Creek from March through June 1997. June was the only month when criterions were exceeded. Both the 20 C and 24 C criterions were exceeded for all of June. The 25 C criterion was exceeded for only three days. It should be mentioned, however, that the thermograph location in the lower creek was completely de-watered by the first part of July, which could account for the high recorded temperatures in June. Upper portions of San Miguelito Creek are perennial with good quality water.

3.6 Mainstem Diurnal and Temperature Monitoring

3.6.1 Methods

In 1996, dissolved oxygen and temperature were measured on April 15, July 16, August 2 and 17, and September 17 during the early morning and late afternoon **(Figures 3.6-1 Foldout Map from Synthesis Report)**. Measurements were made a one foot intervals throughout the water column. The locations were as follows: Refugio Unit X (pool habitat, river mile 3.4), Alisal units # 45 & 48, (pool habitats, river mile 7.8 and 7.9), Avenue of the Flags, (run habitat, river mile 16.0), and Cargasachi Ranch (run habitat, river mile 24). In 1997, diurnal measurements were conducted between June 12-14, one month prior to WR 89-18 releases. Two pool habitats were measured in the Highway 154 reach, one in the long pool, and the other in a pool habitat under the Highway 154 Bridge. Three habitats were measured in the Refugio Reach (river mile 3.4): one pool, riffle, and run. Seven habitats were measured in the Alisal Reach (river mile 7.9 and 8.7 respectively): 4 pools, 2 runs, and 1 riffle.

Measurements at each site were taken twice daily using a Yellow Springs Instrument Model 57 Dissolved Oxygen Meter. Measurements were made in the deepest portion of the habitat unit, at one-foot intervals. Morning measurements were taken before or at first light to insure measurements of the lowest dissolved oxygen during the 24-hour period. Evening measurements were recorded during the hours of 4:00-6:00 p.m. to insure levels of highest dissolved oxygen for the 24 hour period. Measurements at all sites were completed on the same day.

3.6.2 Results

1996

Prior to the 1996 WR 89-18 water releases, much of the mainstem river began to dry beginning in May. Some small pool habitats remained where monitoring was performed. **(Table 3.6.2-1)**. All surveys with the exception of the July 16 survey measured DO concentrations in the morning hours in excess of 6.0 mg/L. Evening DO concentrations were generally in excess of 8.0 mg/L in all surveys except on July 16. The July 16 survey measured morning DO concentrations <1.0 mg/L at the bottom of pool habitats at mile 6 (new site), mile 7.8, and mile 13.6 (new site). Evening DO levels at these locations were 6.62 mg/L, 0.23 mg/L, and 13.83 mg/L respectively.

After WR 89-18 water releases were initiated, monitoring was performed when water releases from Bradbury Dam were 135, 70, and 50 cfs. At no time did DO concentrations decline below 7 mg/L during either the morning or evening surveys. River flow provided by the WR 89-18 releases was sufficient to remove much of the algae from the remaining pool habitats and create sufficient turbulence and mixing to sustain higher DO concentrations throughout the day and night.

1997

Dissolved oxygen concentrations within the long pool show a slight 2 mg/l decrease in concentration from the surface to the bottom **(Table 3.6.2-2)**. Overall, DO concentrations remained greater than 7.7 mg/l. Measurements at the Highway 154 Bridge indicate potentially stressful low morning DO levels between 2.5-3.0 mg/l in the lower two feet of the water column. Evening DO concentrations were greater than 7.5 mg/l.

Measurements taken in the Refugio Reach recorded evening DO concentrations greater than 14.0 mg/l in both riffle and run habitats. Morning DO concentrations were significantly lower, between 0.82-3.25 in the same habitats. The pool habitat had potentially stressful conditions in both the evening and morning. Evening concentrations ranged between 7.02-11.88 mg/l from the surface to two feet. From three to five feet, concentrations decreased sharply to between 3.25-0.63 mg/l. Morning concentrations were significantly reduced with readings of 2.72-0.08 mg/l from the surface to the bottom.

Measurements taken in the Alisal Reach show a similar pattern as seen in the Refugio Reach for both the morning and evening in one of the two runs, and the riffle habitat. Evening measurements in one run ranged between 9.98-13.78 mg/l, while morning measurements decreased sharply to between 3.03-3.19 mg/l. The remaining run habitat

Table 3.6.2-1 Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1997.

Site 1, Long Pool, River Mile o.5, 20% algal cover
12-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	345	1730	345	1730
0	17.76	20.5	11.8	12
1	17.76	20.4	11.68	11.95
2	17.76	20.4	11.64	11.95
3	17.76	20.3	11.58	12.02
4	17.7	18.09	11.15	16.2
5	17.1	18.3	7.7	16.11
6	16.9	17.2	8.5	13.69
7	16.8	16.8	9.6	12.62
8	16.8	16.8	9.5	12.99

Site 2, Highway 154 Bridge, Mile 3.0, 5% algal cover
12-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	420	1615	420	1615
0	19.2	21.2	8.1	9.8
1	19.2	21.2	8	9.9
2	18.5	20.6	6.5	8.9
3	18.2	20	3	7.5
4	18.2	20	2.5	7.5

Site 3 Refugio Habitat Unit 21, pool, Mile 6.0
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	524	1724	524	1724
0	18.3	23.2	2.72	11.88
1	18.5	22.9	2.18	10.27
2	18.7	20.9	1.77	7.02
3	19.4	20.2	0.18	3.82
4	19.4	19.9	0.1	1.29
5	19.3	19.8	0.08	0.63

Table 3.6.2-1 Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1997.

Site 4, Refugio Habitat 20, run, Mile 6.0
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	534	1733	534	1733
0-1	17.1	23.6	0.82	16.34

Site 5, Refugio Habitat 22, riffle, Mile 6.0
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	519	1736	519	1736
0-1	16.9	25.5	3.25	14.08

Site 6, Alisal Habitat Unit 45, pool, Mile 7.9
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	445	1645	445	1645
0	18.4	24.3	1.82	11.18
1	18.4	23.4	1.54	9.05
2	18.3	19.7	1.34	3.44
3	18.1	18.6	0.83	1.65
4	17.9	18	0.49	0.48
4.5	17.9	17.9	0.2	0.3

Site 7, Alisal Habitat Unit 46, run, Mile 7.9
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	456	1657	456	1657
0-1	18.6	24.4	3.03	9.98

Site 8, Alisal Habitat Unit 47, riffle, Mile 7.9
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	459	1659	459	1659
0-1	17.8	25.6	3.19	13.78

Table 3.6.2-1 Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1997.

Site 9, Alisal Habitat Unit 20, pool, Mile 8.7, 70% algal cover
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	Evening	Morning	Evening
Depth (ft)	405	1730	405	1730
0	19.14	22.9	0.56	3.02
1	19.14	21.86	0.43	1.22
2	19.14	20.37	0.33	0.33
3	19.15	19.53	0.26	0.19

Site 10, Alisal Habitat Unit 9, pool, Mile 9.5, 60% algal cover
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	Evening	Morning	Evening
Depth (ft)	421	1705	421	1705
0	18.41	22.06	7.87	15.3
1	18.41	21.64	7.43	14.05
2	18.41	20.55	7.22	12.13
3	18.25	19.45	6.11	8.59

Site 11, Alisal Habitat Unit 8, run, Mile 9.5, 30% algal cover
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	Evening	Morning	Evening
Depth (ft)	430	1700	430	1700
0	19.29	24.9	8.63	> 20
1.5	19.42	24.6	8.49	> 20

Site 12, Alisal Habitat Unit 6, pool, Mile 9.6, 25% algal cover
13-Jun

	Temperature (C)		Dissolved Oxygen (mg/l)	
	Morning	Evening	Morning	Evening
Depth (ft)	440	1645	440	1645
0	19.3	23.57	4.62	> 20
1	19.28	23.59	4.98	> 20
2	19.27	23.5	5.01	> 20
3	19.1	21.2	3.64	17.1
4	19.04	19.59	2.22	16.13

recorded readings greater than 8.49 mg/l for both the morning and evening. Three of the four pool habitats recorded stressful DO concentrations during both morning and evening surveys. The one exception was Alisal Habitat Unit 9. Pool unit 9 and unit 6 had concentrations greater than 8.0 mg/l in the evening hours, and greater than 6.0 mg/l (unit 9) in the morning hours. Habitat unit 6 had stressful DO levels (5.0-2.2 mg/l) throughout the water column in the morning hours. Both habitat unit 45 (beaver pool downstream of Refugio Bridge) and 20 (directly upstream of mainstem trap site) had the lowest DO levels in the reach. Evening concentrations at unit 45 show concentrations in excess of 9.0 mg/l within one foot of the surface. However, from 2.0-4.5 feet, DO levels decrease sharply to 3.44-0.3 mg/l. Morning concentrations at unit 45 recorded readings of 1.8-0.2 mg/l. Unit 20 recorded the lowest DO concentrations of all the sites measured. Evening measurements ranged from 3.0-0.2 mg/l, while morning measurements ranged from 0.6-0.3 mg/l.

Prior to WR 89-18 releases in mid July, an alga flushing study was conducted from April 18 through May 3, 1997 to determine if low level water releases from Lake Cachuma could increase dissolved concentrations by removing accumulated algae on pool surfaces. Mainstem flow had already begun to attenuate prior to the study, and portions of the shallower habitats had started to dry. A total of 184 acre-feet of water were released with flows of up to 15 cfs. Water from these releases never reached past the Highway 154 Bridge (river mile 3.0), and no water quality benefit to downstream habitats was realized

3.7 Lagoon Water Quality

Estuaries and lagoons are the most complex bodies of water commonly encountered by limnologists, and they are the most productive. Estuaries have fewer plants and animal species than fresh or seawater, but instead have very large numbers of individual animal species present. The dominant features of an estuary are variable salinity, a salt wedge or interface between salt and fresh water, and large areas of shallow, turbid water overlaying mud flats and salt marshes. A workable definition of an estuary is a partially enclosed body of water of variable salinity, with a freshwater inflow at one end and seawater introduced by tidal action at the other (Goldman and Horne 1983).

Water quality in the lagoon was monitored for seasonal, vertical, and longitudinal patterns. The main purpose of the monitoring was to assess the habitat suitability for various age classes of steelhead/rainbow trout that rear and/or oversummer prior to out/up migration.

3.7.1 Methods

Lagoon water quality was monitored at three sites, nine times in 1996, and three times in 1997. Site #1 was located directly across from Ocean Park. Site #2 was located at the approximate midpoint of the lagoon near the washed out 35th Street Bridge. Site #3 was located approximately 200 yards downstream from the river entrance. The monitoring crew used an inflatable raft to reach each site. The crew entered the lagoon at the Ocean Park parking area and proceeded upstream. At each site, a visual transect was established across the lagoon channel and measurements were taken at the approximate center, right one-third, and left one-third along each transect. Measurements were made and recorded at one-foot intervals using a HYDROLAB DATASONDE 3 Water Quality Meter. The following water quality parameters were measured: temperature (C), dissolved oxygen (ppm), specific conductance (unhos), pH, salinity (ppt), and redox potential (mv).

3.7.2 Results

No differences were noted in water quality measurements across transects throughout both years. However, when the lagoon was both open and closed, water quality differences were recorded between the upstream and downstream monitoring locations (**Table 3.7.2-1**). Lagoon water depth fluctuated several feet between months at each location depending if the lagoon was open or closed. Water temperature fluctuated seasonally at all sites, staying cool in winter, warming in the spring and summer, and cooling again in the fall. Since salinity induced density effects dominate over those of temperature in estuaries and the ocean, the following discussion centers around measurements made in the deepest portion of the channel for each transect.

Temperature - Site #1: Water temperatures were never greater than 21.1 C, with the majority ranging between 16-19 C in the spring, summer, and fall. Winter temperatures ranged between 12-16 C. Very slight stratification was observed in February, August, October, and November of 1996, and in all three 1997 surveys, differing less than 2.5 C throughout the water column.

Table 3.7.2-1. Site # 1 Ocean Park Lagoon Water Quality- Deepest channel measurements only						
January 10, 1996 at 1150 Hours						
Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
0	13.49	9.09	19600	11.6	8.39	364
1	13.52	9.11	19600	11.6	8.40	365
2	13.20	9.08	19600	11.6	8.38	366
3	12.86	8.92	20100	11.8	8.41	368
4	12.02	9.33	20600	12.2	8.46	368
5	11.96	9.13	20600	12.3	8.44	369
6	11.98	8.61	20700	12.3	8.40	370
7	12.03	7.41	20900	12.4	8.35	309
8	12.70	3.79	24000	12.4	8.00	326
9	12.95	3.09	24300	14.4	7.99	329
10	13.05	3.26	25100	14.9	7.96	333
February 6, 1996 at 1032 hours						
0	15.99	6.77	16800	9.9	8.30	430
1	14.69	6.93	31300	21.2	8.26	435
2	14.65	7.01	39100	23.6	8.30	435
3	13.59	7.20	49500	32.0	8.39	435
4	13.59	7.44	50200	33.3	8.40	434
5	13.51	7.50	52000	34.3	8.41	434
6	13.50	7.56	52000	34.3	8.42	433
March 11, 1996 at 1206 hours						
0	18.97	7.88	4040	2.2	8.92	323
1	18.63	12.10	4430	2.4	8.89	325
2	18.82	13.18	36900	22.6	8.87	346
3	16.39	9.09	42500	27.7	8.66	356
April 29, 1996 at 1050 hours						
0	18.96	10.80	14070	8.1	10.24	284
1	18.68	11.02	14100	8.1	10.26	289
2	18.44	11.27	14110	8.2	10.26	292
3	18.22	11.14	14160	8.2	10.26	294
4	17.54	9.63	14420	8.5	10.23	296
5	18.13	3.69	34700	21.6	9.47	321
June 4, 1996 at 1240 hours						
0	19.32	20.00	17912	10.6	9.71	268
1	19.48	16.91	20103	12.3	9.63	273
2	19.31	13.76	23482	14.1	9.59	275
3	19.88	8.68	25969	15.6	9.40	280
4	20.51	3.65	32101	19.9	9.00	293
5	20.16	0.94	35213	22.0	8.79	298

Table 3.7.2-1. Site # 1 Ocean Park Lagoon Water Quality- Deepest channel measurements only						
July 9, 1996 at 1216						
Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
0	20.02	5.48	17439	10.2	9.44	307
1	20.01	5.48	17522	10.3	9.46	310
2	19.98	5.46	17575	10.3	9.46	311
3	19.44	3.77	18306	10.8	9.50	311
4	19.04	3.54	18730	11.1	9.53	311
5	18.84	2.27	18992	11.2	9.50	311
6	19.07	0.35	19523	11.7	9.44	146
7	19.50	0.08	26634	15.7	8.87	-22
August 27, 1996 at 1133						
0	19.89	5.59	12125	6.9	9.03	288
1	19.80	5.38	12164	6.9	9.04	289
2	19.80	5.45	12252	7.0	9.04	291
3	18.94	4.22	12733	7.3	9.02	292
4	18.74	3.86	12838	7.4	9.01	293
5	18.68	3.65	12851	7.4	9.01	294
6	18.60	3.08	12927	7.4	9.00	295
7	18.58	1.71	13031	7.5	8.98	295
8	18.53	0.21	13283	7.6	8.96	294
9	18.51	0.06	14109	8.0	8.96	66
October 4, 1996 at 1030						
0	19.36	11.99	9271	5.2	9.39	288
1	19.36	11.98	9269	5.2	9.41	290
2	19.36	11.97	9263	5.2	9.41	291
3	19.22	11.73	9232	5.2	9.42	292
4	19.13	11.37	9308	5.3	9.4	294
5	19.04	10.82	9407	5.3	9.38	295
6	19.02	10.45	9474	5.3	9.37	296
7	18.86	7.52	9781	5.4	9.29	295
November 5, 1996 at 1426						
0	15.45	10.76	11070	6.3	8.79	331
1	15.48	10.63	11088	6.3	8.8	330
2	15.27	9.69	11421	6.4	8.8	330
3	14.28	7.4	25930	16.2	8.47	342
3.5	13.99	6.46	29621	18.5	8.42	344

Table 3.7.2-1. Site # 1 Ocean Park Lagoon Water Quality-
Deepest channel measurements only

Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
April 13, 1997 at 0930 Hours						
0	17.6	13.4	11597	6.6	11.2	214
1	17.6	13.6	11639	6.6	11.3	219
2	17.6	13.6	11728	6.7	11.3	221
3	16.5	12	12684	7.3	11.3	223
4	16.4	9.8	13614	7.5	11.3	224
5	16.7	7.9	16590	9.7	11.2	225
6	16.9	5.9	16990	9.9	11.2	198
7	17	0.14	30125	18.9	10.1	-140
8	16.4	0.1	38290	24	9.7	-172
9	15.7	0.1	42803	27.6	9.1	-209
July 23, 1997 at 1142 Hours						
0	21.1	16.6	11774	6.7	9.5	320
1	21	16.6	11792	6.7	9.6	314
2	20.9	16.6	11900	6.8	9.6	312
3	20	10	12591	7.1	9.5	309
4	19.3	8.4	12865	7.4	9.4	308
5	19.3	7.9	12890	7.4	9.4	308
6	19.1	8.1	12923	7.4	9.4	308
7	19.2	1.6	13099	7.5	9.3	300
7.8	19.3	0.14	13281	7.6	9.3	134
November 13, 1997 at 1310 Hours						
0	16.1	10.4	15445	9	8.8	255
1	16.1	10.5	15476	9	8.8	254
2	16.1	10.3	15461	9	8.8	253
3	16	10	15463	9	8.8	253
4	16	10.2	15494	9	8.8	253
5	16	10	15517	9	8.8	252
6	15.8	9.3	15581	9.1	8.8	253
7	15.8	8.2	15908	9.3	8.8	252

Table 3.7.2-1. Site # 2 Mid Lagoon Water Quality Measurements

Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
Deep Channel Measurements for January 10, 1996 at 1314 Hours						
0	14.84	11.88	17200	10.1	8.40	366
1	14.44	11.55	18000	10.4	8.61	368
2	13.29	9.62	19600	11.7	8.47	373
3	12.95	9.08	20700	12.5	8.40	376
4	12.90	8.26	21600	13.0	8.34	377
5	12.80	7.00	22400	13.5	8.24	380
6	12.92	5.31	23000	13.9	8.19	381
7	12.96	4.52	23400	14.1	8.15	381
8	13.36	3.24	24400	14.7	8.09	383
9	13.58	2.55	24600	15.1	8.04	384
10	13.67	2.12	25200	15.3	8.03	369
February 6, 1996 at 1201 hours						
0	17.05	6.93	5150	2.8	8.37	387
1	17.04	6.90	4780	2.5	8.38	389
2	16.26	6.56	8010	5.2	8.24	397
3	15.40	6.18	14250	8.3	8.14	400
4	14.89	5.58	33400	21.3	8.12	406
5	14.57	5.20	40400	25.8	8.13	403
6	14.53	5.14	41000	26.3	8.13	402
March 11, 1996 at 1357 hours						
0	18.81	9.83	2240	1.2	9.10	330
1	18.81	9.86	2240	1.2	9.10	332
2	18.83	10.60	2480	1.2	9.09	335
3	19.33	14.71	37400	21.5	8.98	352
4	18.61	13.41	40600	25.4	8.75	357
4.5	18.49	13.50	41200	26.2	8.80	356
April 29, 1996 at 1238 hours						
0	22.15	13.83	9470	5.3	10.16	306
1	22.01	13.58	9600	5.4	10.15	310
2	19.80	14.00	16200	9.3	10.25	314
3	19.95	12.12	22600	13.5	10.17	318
4	19.93	10.51	24700	15.0	10.07	318
5	19.95	8.01	26700	16.2	9.89	324
6	19.52	2.30	32100	20.0	9.41	339
June 4, 1996 at 1124 hours						
0	20.39	20.00	10601	6.0	9.62	291
1	20.68	20.00	14509	8.2	9.64	294
2	21.65	15.03	19696	12.3	9.53	294
3	21.44	8.15	25364	15.2	9.30	302
4	21.24	4.71	30177	18.7	9.04	309
5	20.87	1.71	33569	21.0	8.85	312

Table 3.7.2-1. Site # 2 Mid Lagoon Water Quality Measurements						
July 9, 1996 at 1305 hours						
Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
0	20.95	7.81	9352	5.3	9.25	306
1	20.67	5.35	10010	5.5	9.28	306
2	21.08	3.49	17238	6.4	9.48	302
3	21.14	3.17	17572	10.6	9.52	300
4	19.98	1.33	19190	10.8	9.52	296
5	20.02	0.86	19650	11.7	9.50	293
6	20.03	0.23	19926	11.7	9.49	219
7	20.05	0.17	21075	12.8	9.36	33
8	20.18	0.12	28777	15.5	8.81	-0.56
August 27, 1996 at 1311						
0	21.53	10.61	10625	6.1	9.28	305
1	21.44	9.06	10871	6.1	9.25	306
2	20.84	7.89	11159	6.4	9.21	306
3	20.55	5.77	11543	6.5	9.17	308
4	20.18	4.58	11882	6.7	9.12	309
5	20.14	2.8	12203	7	9.06	309
6	20.08	2.67	12254	7	9.05	308
7	20.01	2.68	12267	7	9.05	306
8	19.54	2.7	12426	7.1	9.04	214
October 4, 1996 at 1138						
0	20.46	16.64	7792	4.4	9.61	279
1	20.33	16.71	7945	4.4	9.61	282
2	19.92	12.16	8434	4.5	9.43	287
3	19.54	10.12	9560	5.4	9.32	292
4	19.38	7.94	9848	5.5	9.27	293
5	19.36	6.13	9890	5.6	9.26	293
6	19.26	5.68	9976	5.6	9.22	294
7	19.21	5.47	9993	5.7	9.21	294
8	19.2	5.34	2000	5.7	9.21	294
November 5, 1996 at 1315						
0	15.23	10.12	4385	2.4	8.7	368
1	15.19	9.66	4418	2.4	8.69	367
2	15.1	9.26	4513	2.4	8.69	366
3	15.23	8.7	5459	3	8.66	366
4	15.12	7.9	6398	3.6	8.61	359
5	15.18	3.75	7258	4.7	8.38	236

Table 3.7.2-1. Site # 2 Mid Lagoon Water Quality Measurements

Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
April 13, 1997 at 1100 Hours						
0	20.2	13	6911	3.8	11	175
1	20.2	14.1	9644	5.4	11.2	174
2	19	11.2	15562	8.9	11.3	173
3	17.8	11	16039	9.4	11.3	173
4	17.5	6.1	16356	9.5	11.2	174
5	17.3	5.9	16574	9.7	11.2	172
6	17.3	4.8	16665	9.7	11.2	97
7	17.3	4.8	16680	9.8	11.2	38
July 23, 1997 at 1315 Hours						
0	22.8	N/A	10195	5.8	9.6	244
1	22.7	16.5	10196	5.8	9.6	245
2	22.1	15.5	10512	6	9.6	246
3	21.1	8.1	12094	6.9	9.5	249
4	20.5	4.9	12757	7.3	9.4	250
5	20.4	0.57	12907	7.4	9.3	245
6	20.3	0.55	12990	7.5	9.3	214
7	20.3	0.75	12986	9.3	9.3	223
November 13, 1997 at 1355 Hours						
0	17	15.9	13619	7.9	8.9	277
1	17	13.4	13617	7.9	8.9	276
2	16.7	10.1	13703	7.9	8.9	275
3	16.3	8.4	14372	8.3	8.8	276
4	16.1	7.7	14872	8.6	8.8	275
5	16	7.6	15237	8.9	8.8	275
6	16	6.3	15486	9	8.8	9
7	16.2	5.6	15837	9.3	8.7	9.3
8	16.2	3.2	15971	9.3	8.7	9.3

Table 3.7.2-1 Site # 3 Upper Lagoon Water Quality Measurements						
Deep Channel Measurements for January 10, 1996 at 1314 Hours						
Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
0	15.99	12.10	17600	10.3	8.74	396
1	15.96	12.36	17600	10.3	8.74	396
2	15.50	12.44	17700	10.6	8.73	396
3	14.36	11.84	19200	12.3	8.68	399
4	13.38	10.46	21600	13.1	8.54	402
5	13.18	8.64	22300	13.6	8.37	406
6	13.27	6.69	23100	13.8	8.26	409
7	13.64	5.34	23800	14.3	8.17	410
8	14.02	2.71	24600	14.8	8.07	412
February 6, 1996 at 1311 hours						
0	17.75	7.45	1690	0.9	8.54	381
1	17.72	7.47	1690	0.9	8.55	383
2	17.50	7.50	1690	0.9	8.56	385
3	17.43	7.51	1700	0.9	8.56	386
4	17.45	7.51	1700	0.9	8.57	387
March 11, 1996 at 1425 hours						
0	21.44	9.73	1940	1	9.12	370
1	21.46	9.95	1940	1	9.13	370
2	21.47	10.22	1940	1	9.14	369
April 29, 1996 at 1356 hours						
0	23.14	15.06	11800	6.8	10.13	324
1	23.14	15.52	11810	6.8	10.13	326
2	23.08	16.83	16100	7.8	10.17	327
3	22.16	17.13	20700	12.4	10.24	320
4	21.49	12.01	23000	13.7	10.08	325
June 6, 1996 at 1232 hours						
0	21.90	20.00	9501	5.4	9.65	285
1	22.13	20.00	10468	6.3	9.61	294
2	22.71	11.90	18544	10.7	9.26	307
3	22.45	4.70	21653	13.1	8.98	299
4	21.14	1.72	29361	18.2	8.75	184
July 9, 1996 at 1401 hours						
0	21.49	7.71	6023	3.3	9.16	293
1	21.56	7.62	7016	4.0	9.19	294
2	21.52	5.59	10247	4.2	9.32	292
3	22.18	3.09	15680	9.3	9.42	287
4	21.41	1.21	18355	9.9	9.51	278
5	21.35	0.89	19541	11.6	9.47	40

Table 3.7.2-1 Site # 3 Upper Lagoon Water Quality Measurements

Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
August 27, 1996 at 1355						
0	22.27	16.55	8474	4.7	9.53	321
1	21.17	16.74	8715	5	9.54	320
2	21.75	16.71	9034	5.1	9.54	319
3	21.53	16.23	9163	5.2	9.51	319
4	21.24	15.82	9229	5.2	9.49	320
5	21.15	8.25	10762	5.8	9.3	325
6	20.9	6.79	11207	6.4	9.19	327
7	20.52	2.23	11590	6.5	9.12	311
October 4, 1996 at 1256						
0	22.05	16.15	6499	3.6	9.65	298
1	22.01	16.67	6513	3.6	9.66	298
2	21.75	17.09	6541	3.6	9.67	299
3	20.77	> 20	8461	4	9.64	305
4	20.44	8.81	9299	5.3	9.43	310
5	20.25	8.13	9491	5.4	9.36	313
6	20.14	7.39	9552	5.4	9.34	311
November 5, 1996 at 1225						
0	14.51	9.9	3442	1.9	8.57	356
1	14.51	9.77	3451	1.9	8.58	355
2	14.51	9.73	3461	1.9	8.58	355
April 13, 1997 at 1300 Hours						
0	22	15.1	7327	4.2	11.2	N/A
1	22.1	15.7	7735	4.3	11.2	27.1
2	21.6	17	9551	4.7	11.3	31.6
3	19.9	13.8	12790	7.7	11.4	45.1
4	18.7	7.5	14745	8.6	11.3	54.1
July 23, 1997 at 1407 Hours						
0	23.2	16.5	8206	4.6	9.6	225
1	23.2	N/A	8568	4.8	9.6	226
2	23	N/A	9878	5	9.7	228
3	22.7	N/A	9540	5.4	9.7	230
4	21.8	5.87	11480	6.6	9.4	220
5	21.2	0.33	12337	7.1	9.3	232

Table 3.7.2-1 Site # 3 Upper Lagoon Water Quality Measurements						
November 13, 1997 at 1505 Hours						
Depth (ft.)	Temp. (C)	DO (ppm)	Cond. (umhos)	Salinity (ppt)	pH	Redox (mV)
0	17.5	14.3	13045	7.5	8.9	281
1	17.5	14	13030	7.5	8.9	281
2	17.5	14	13045	7.5	8.9	281
3	17.3	12.4	13261	7.6	8.9	281
4	16.5	7.7	14673	8.5	8.8	283
5	16.7	5.1	15290	8.9	8.8	283
6	16.6	4.2	15322	8.9	8.8	280

Site #2 - mid lagoon: Water temperatures at site #2 were slightly warmer compared to site #1. Temperatures were never greater than 22.15 C (surface measurement in April). Temperatures generally ranged between 18.5-21.5 C during spring, summer, and fall. Winter temperatures ranged between 12.8-17.1 C. Very slight stratification was observed in February, April, August, and October, typically differing less than 2.5 C throughout the water column.

Site #3 - upper lagoon: Water temperature at site #3 was consistently warmer than at sites 1 and 2. Temperatures remained greater than 20 C beginning in March and continuing through October. The warmest temperatures were recorded in April (23.14 C). Very slight stratification was recorded in August and October, typically differing less than 2.0 C throughout the water column.

Dissolved Oxygen - Site #1: 1996 DO concentrations fluctuated greatly between months at site 1. During the surveys, water depth varied between 3-10 feet. Stratification was recorded in January, June, July, August, October, and November 1996. Anoxic conditions (0.06-1.71 mg/L) developed in the bottom 1-3 feet in June, July, and August 1996. In July and August 1996, DO concentrations were 5.6 mg/L or less throughout the water column. During 1997, water depth ranged between 7-9 feet. Stratification was recorded during each survey. Anoxic conditions developed in the bottom 1-3 feet in both April and July 1997. Generally, DO concentrations were greater than 5 mg/L in the upper three-quarters of the water column during months when stratification developed.

Site #2 - mid lagoon: As seen in site #1, DO fluctuated greatly from month to month. Water depth varied between 4.5 and 10 feet during surveys. Varying degrees of stratification was recorded every month except March 1996. Anoxic or near anoxic conditions were recorded in the bottom 2 feet in June (0.23-1.71 mg/L), and the bottom 5 feet in July (0.12-1.33 mg/L) 1996. DO concentrations less than 5 mg/L were recorded from 7-10 feet in January (2.12-4.52 mg/L), from 5-8 feet in August (2.7-2.8 mg/L), and at the 5 foot mark in November (3.75 mg/L). Generally, DO concentrations were greater than 5 mg/L in the upper half to three-quarters of the water column. During 1997, stratification was observed to develop for each of the three months monitored. Low to anoxic conditions were recorded in the lower one to three feet of the water column, with July 1997 having the lowest DO.

Site #3 - Upper lagoon: DO concentrations fluctuated greatly from month to month in 1996, but were consistently greater compared to sites 1 and 2. Water depth varied between 2 and 8 feet during surveys. Stratification was recorded in January, June, July, and August. Anoxic or near anoxic conditions developed in bottom foot in June (1.72 mg/L), and the bottom 2 feet in July (0.89-1.21 mg/L). DO concentrations generally remained greater than 5 mg/L except in the lower few feet of the water column during months when stratification developed. During 1997, low to anoxic conditions were recorded on the lower one foot of the water column during July and November.

Conductivity: Specific conductance is a measure of water's capacity to conduct an electrical current, and is used to estimate the total concentration of dissolved ionic matter in the water. Conductivity measurements essentially mimic salinity measurements at all three sample sites during both years. Salinity increases the amount of dissolved ionic matter in the water thus giving increased conductivity measurements as salinity increases. Conductivity was greatest at Ocean Park during all surveys for both 1996 and 1997. Lower concentrations were recorded at site #2 and #3 due to influence of freshwater inflow.

Salinity: Salinity, the dissolved solids present in seawater, is reported in parts per thousand (ppt). Full-strength seawater has a salinity of 33-35 ppt. Salinity decreases gradually from the sea to the upstream limit of an estuary, which is considered fresh at about 0.5 ppt (Lind 1985). The presence of dissolved salts increases the density of water.

In January 1996, salinity at all three sample sites varied between 10.3-15.3 ppt with slightly higher levels recorded at the bottom of site #2. February measurements at site #1 had the greatest salinity concentrations of any month, ranging between 21.3-34.3 ppt in the bottom three feet. The greatest vertical variations in salinity within the water column were recorded at sites #1 and #2 in March, which had levels of 1.2-2.2 ppt at the surface and 26.2 and 27.7 at the bottom. Salinity concentrations at site #3 were generally between 3.3-13.7 ppt from January through July, and between 1.9-6.5 ppt from August through November.

In 1997, site #1 recorded the highest levels of salinity during each of the three surveys, while site #3 recorded the lowest. Salinity measurements in July and November were very similar at all three sites ranging between 4.2-9.3 mg/l.

pH: The acidity or alkalinity of solutions is measured in units called pH, an exponential scale from 1-14. Acidity is denoted from 0-7 and alkalinity from 7-14 (Goldman and Horne 1983). It is important to remember that a change of one pH unit represents a tenfold change in the hydrogen ion concentration. The pH of most natural waters falls in the range of 4.0-9.0, and much more offer in the range of 6.0-8.0 (Lind 1985). The combination of decompositional processes in the hymolimnion or at the mud surface interface, results in a pH decrease. As the intensity of decomposition increases in the tropholytic zone (mud-water interface), the pH decreases markedly (Wetzel 1975).

Measurements of pH during 1996 generally remained between 8.0-9.6 at all three sample sites. During April however, pH at all three sites was in excess of 10 except at the very bottom indicating a higher level of eutrophication. The pH generally decreased from the surface to the bottom, particularly during months when DO stratification developed. When compared to surface measurements, decreases of nearly one pH unit were recorded at the mud surface interface when DO concentrations were approaching anoxic conditions. In addition, low redox measurements were associated with lower pH and anoxic conditions indicating decompositional processes at work.

Measurements made in 1997 show very similar readings between each site within any given month. Generally, pH decreased between April and November at all three sites. The greatest variation in pH occurred in April at site #1 with a 2.1 decrease in pH from the surface to the bottom. Negative redox measurements were associated with the bottom 3 feet in April indicating decompositional processes at work.

Redox Potential: Oxygen combines with other elements to form oxides. The change in oxidation state of many metal ions and some nutrient compounds (predominately carbon, oxygen, nitrogen, sulfur, iron, and manganese) is defined by the redox, or oxidation-reduction potential. For most purposes, the measure of dissolved oxygen is sufficient since oxidation controls redox (Lind 1986). Therefore, even though a distinctly clinograde oxygen curve (higher oxygen near the surface compared to the bottom) may be found, as long as the water is not near anoxia, the redox will remain fairly high (300-500 mv) (Wetzel 1975). As oxygen concentrations approach zero and anoxia conditions appear, the redox decreases rapidly. As the decomposition in the hypolimnion continues throughout the period of stratification, the redox potential of the hypolimnetic waters can be further reduced well below 100 mv (Wetzel 1975).

In general, the redox potential in 1996 and 1997 at all three sites remained between 200-400 mv, with the majority of the readings between 250-300 mv. Low redox measurements (-22 to 40 mv, and –140 to -209) were associated with the anoxic bottom two feet of the lagoon during July 1996, and April 1997. Low DO measurements were associated with negative redox measurements.

3.8 Tributary Water Temperature Monitoring

3.8.1 Methods

In 1996, five Optic Stowaway thermographs were deployed in four tributaries to the SYR: Hilton, Nojoqui, Salsipuedes, and El Jaro. In 1997, seven thermographs were deployed in the same above tributaries, with the addition of one tributary, San Miguelito Creek (**Figures 3.4-1**). The principle objectives of water temperature monitoring in the tributaries include the evaluation of:

- Seasonal patterns of water temperature in each tributary.
- Diel variations in water temperature.
- Habitat quality and suitability for various fish species including steelhead trout.

All thermographs were deployed in run habitats, with the exception of the chute pool in Hilton Creek.

Hilton Creek

In 1996, Hilton Creek reached the SYR for only 6 days immediately after a storm event in February. In 1996, one thermograph was deployed in a deep pool located approximately 200 feet downstream of a passage impediment. No thermograph was deployed in the lower creek due to lack of water. However, the upper chute pool had water flowing into it well after continuity with the SYR was lost. The thermograph was deployed in this habitat to determine if the area provides enough protection from the sun to keep water temperatures cooler during the summer. The unit was deployed on March 8, and removed at the end of May 1996 due to lack of water. The thermograph was situated approximately 1150 feet upstream of the confluence with the SYR in a narrow bedrock chute area that is heavily shaded by scrub oak and sheer walls. This habitat provided temporary cool water refuge to adult, juvenile, and young of the year steelhead/rainbow trout over summering in the creek (1995 Compilation Report). The unit was attached to a 3 pound weight and placed on the substrate in four feet of water.

Two thermographs were deployed in the creek in early April 1997 to monitor the water temperatures for the recently installed Hilton Creek Pump/Siphon. The upper thermograph was located approximately 250 ft. downstream from the release point. The unit was placed in a protective enclosure and attached to a tree with ¼ inch cable. The lower thermograph was located approximately 50 ft. upstream from the Santa Ynez River channel. This unit was also placed in a protective enclosure and attached to a tree with ¼ inch cable.

Nojoqui Creek

The thermograph in Nojoqui Creek was deployed from early May 1996 through December 1997, and was located 200 feet downstream from Highway 101 Bridge # 51-74R (2.5 miles upstream from the SYR confluence). The temperature unit was placed in a protective enclosure in the first pool/run habitat approximately two feet deep roughly 200 feet downstream from the bridge. The thermograph was exposed to air twice in the summer of 1996 due to the creek drying. On each occasion, the thermograph was relocated a short distance downstream (quarter to half -mile) where water flow persisted. The thermograph was lost during a storm event in December 1996 resulting in a loss of data until early January 1997.

Salsipuedes Creek

Two temperature units were deployed in Salsipuedes Creek, one directly upstream of the confluence with El Jaro Creek, and the other upstream Santa Rosa Road Bridge. The upper unit was in operation from early May 1996 through December 1997, and was located 100 yards upstream from the confluence with El Jaro Creek and 3.7 miles upstream from the SYR confluence. The thermograph was located in a shady run in approximately 2 feet of water. The unit was placed in a protective enclosure on the bottom of the habitat unit and cabled off to a tree.

The Lower Salsipuedes Creek thermograph was in operation from mid May 1996 through December 1997, and was located approximately 200 yards upstream from Santa Rosa Road Bridge (2 miles downstream from the confluence with El Jaro Creek) and 1/2 of a mile upstream from the SYR confluence. A thermograph malfunction occurred between November 1996 and January 1997, probably a result of storm damage. The unit was placed in a metal enclosure in a run habitat 2.5 feet deep and cabled off to a tree.

El Jaro Creek

The El Jaro Creek thermograph was deployed from early May 1996 through early December 1997 and was located 50 feet upstream from the confluence with Salsipuedes Creek and 3.7 miles upstream from the confluence with the SYR. The unit was placed in a protective enclosure in a run/pool habitat, and cabled off to a nearby tree. Data was lost due to instrument malfunction in November 1996, and January 1997. The unit was placed in a protective enclosure and cabled off to a tree.

San Miguelito Creek

The San Miguelito Creek thermograph was deployed from mid-March through mid-July 1997 and again from the beginning of December through the remainder of the year. The unit was placed in a run habitat approximately one mile upstream from the San Miguelito settling basin and roughly four miles upstream from the confluence with the SYR.

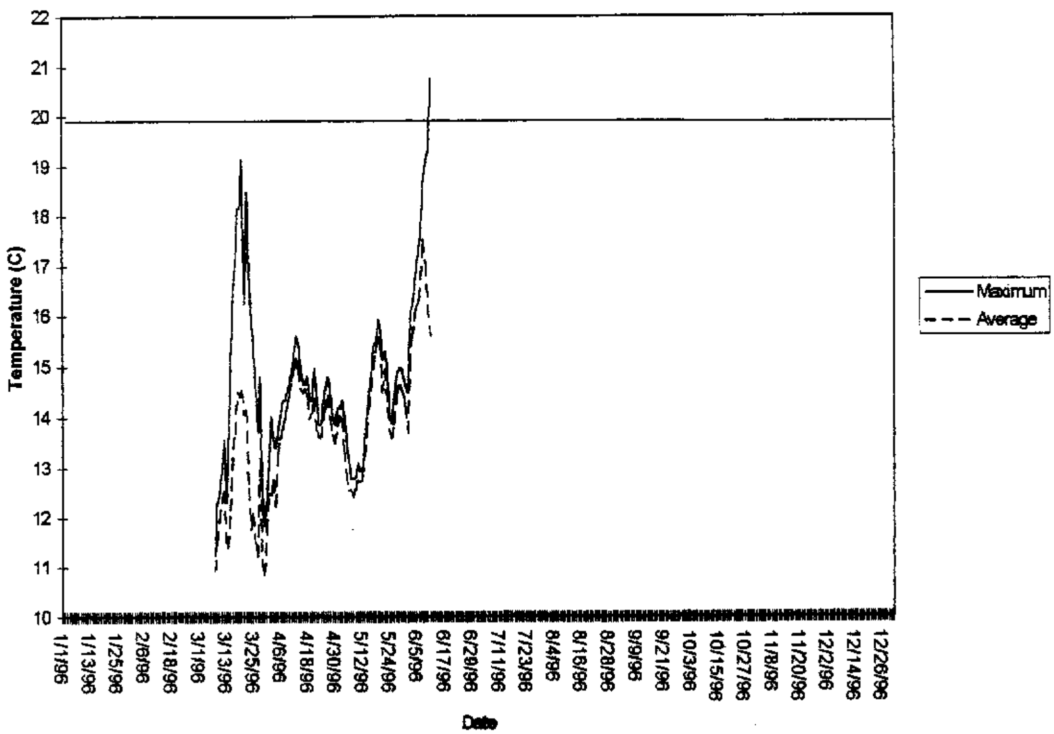
3.8.2 Results

Hilton Creek

Hilton Creek began to flow into the mainstem river on February 20, 1996 following a storm event. By February 26, flow was no longer contiguous with the SYR and the lower 40 feet of creek was dry. Hilton Creek did not re-establish surface flow with the SYR in 1996.

Seasonal patterns and diel variation **(Figure 3.8.2-1)**: Maximum water temperatures remained less than 20 C during the deployment time. Seasonal patterns show a slow warming pattern from March through the end of May. Daily variation remained less than

Figure 3.8.2-1. Upper Hilton Creek - 1996 Daily Maximum and Average Water Temperatures



1 C from March 8 through March 12. From March 18 through March 24, 1996, a 6-7 C spike in daily variation was recorded. After March 24, daily variation decreased to between 1-3 C. Maximum average air temperatures at the SYR airport were 18.2 C in March. In April and May 1996, maximum daily air temperatures were 21.6 and 20.5 C respectively, while maximum water temperatures in the chute pool remained between 13-16 C.

Upper Hilton

Both average and maximum water temperatures between April through December 1997 generally remained between 15-16 C during the summer monitoring **(Figure 3.8.2-2)**. A few peaks and valleys were recorded in the graph; probably a result of de-watering caused from pump malfunctions at the intake barge in Lake Cachuma. The low temperatures are consistent with hypolimnetic temperatures measured during Lake Cachuma profiles. Little daily variation was observed between average and maximum temperatures.

Lower Hilton

Both average and maximum water temperatures were slightly warmer compared to surface temperatures during the 1997 monitoring **(Figure 3.8.2-3)**. Generally, average and maximum temperatures in the lower creek ranged between 15.5-17.0 C. There was a slightly greater 24 hour variation recorded in the lower thermograph compared to the

Figure 3.8.2-1. 1997 Upper Hilton Creek Thermograph Data - 1500 Feet Upstream of Santa Ynez River Confluence

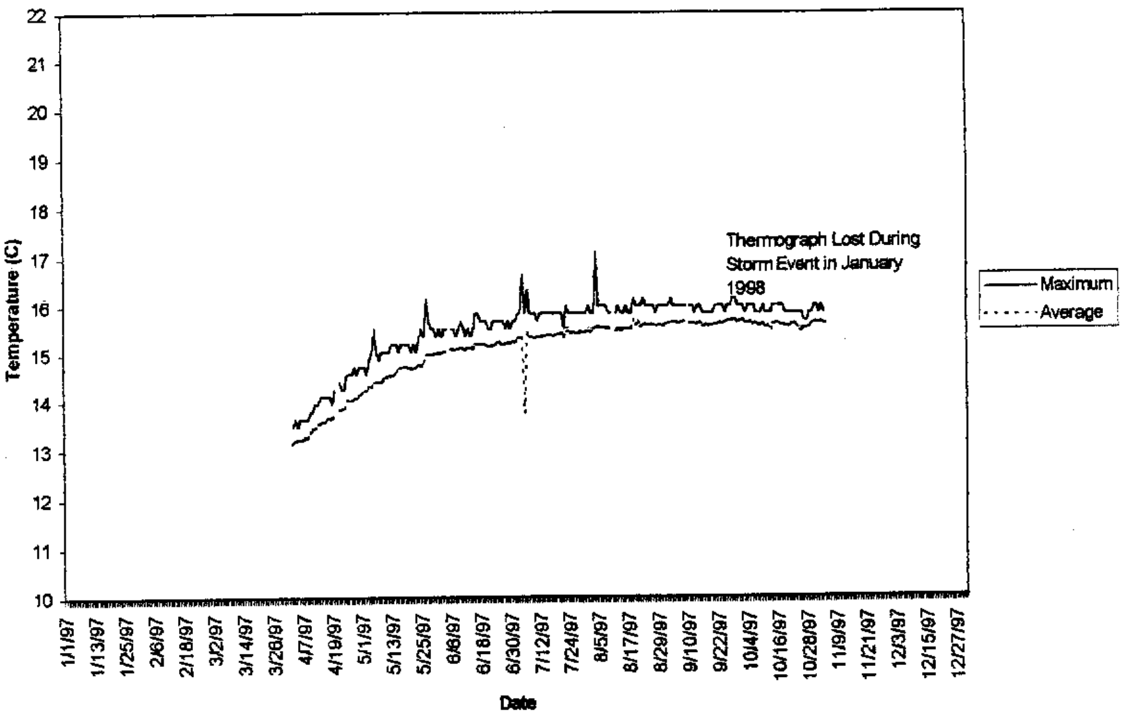
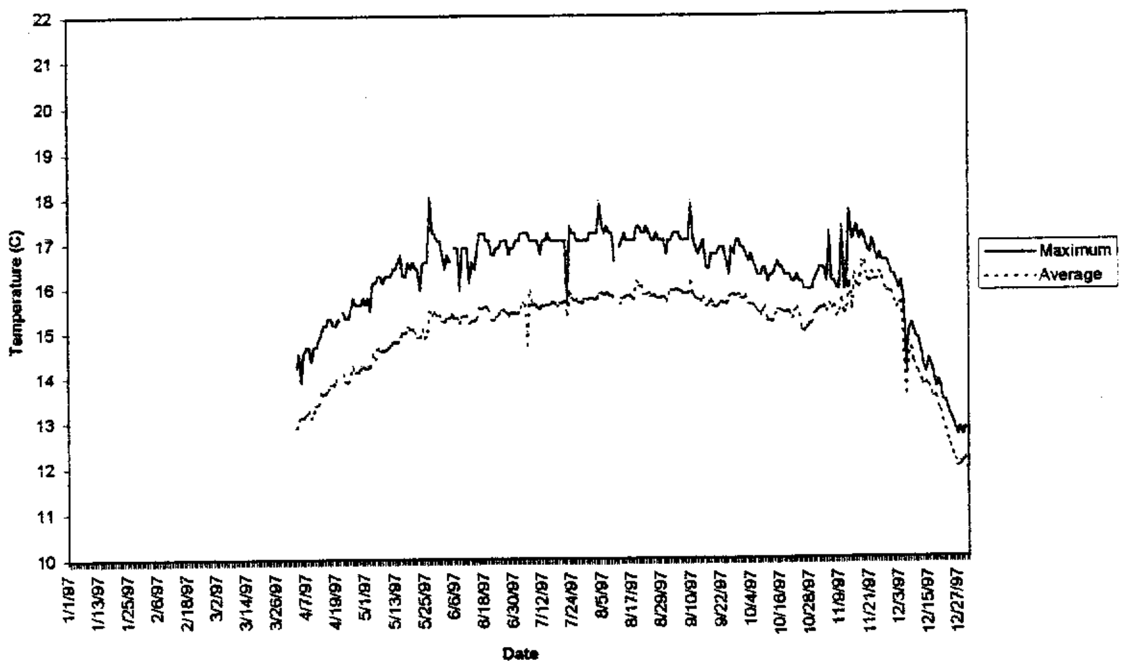


Figure 3.8.2-3. 1997 Lower Hilton Creek Thermograph Data - 20 Feet Upstream of Santa Ynez River Confluence



upper thermograph resulting from warming of waters between the upper and lower thermograph location.

Nojoqui Creek

Seasonal patterns and diel variations 1996: Maximum water temperatures remained less than 25 C during thermograph deployment (**Figure 3.8.2-4 Cannot access disk with graph**). In the late spring, and again in the early summer, two spikes in water temperature occurred when the section of the creek dried and the thermograph was exposed to air. The unit was relocated downstream approximately 0.5 miles where minimal water flowed through for the remainder of the year. After the unit was relocated to the downstream position, both the maximum and average water temperatures remained less than 19 C from early July through the remainder of the year.

Seasonal patterns and diel variations 1997: Both maximum and average water temperatures remained less than 19 C during the deployment time. Water temperatures were significantly cooler in 1997 compared to 1996.

Lower Salsipuedes Creek - 2 Miles Downstream of Confluence with El Jaro Creek

Seasonal patterns and daily variation: Daily maximum and average water temperatures were greater than 25 and 20 C respectively for short periods in May and June, and for the majority of July and August in both 1996 and 1997 (**Figure 3.8.2-5**). Overall, water temperatures were generally cooler in 1997. Water temperatures began to cool in September of both years as evident by a rapid decrease in both the maximum and average water temperatures

Diel variations: 24-hour temperature variations were generally between 3-7 C in the late spring and early fall in both 1996-97. June and July recorded daily variations of between 5.5-9 C before cooling marginally to between 5-7 C in August. Slightly less variation was recorded in 1997, probably a result of the cooler ambient air temperatures. By the winter, variations had decreased to less than 2 C.

Salsipuedes Creek - 100 Feet Upstream of El Jaro Creek Confluence

Seasonal patterns: Maximum temperatures were between 20-21 C for short periods in mid May and early June 1996 (**Figure 3.8.2-6**). Maximum water temperatures were less than 22 C for the majority of June 1996. Average water temperatures in 1997 remained less than 20 C during the entire monitoring period. Maximum water temperatures varied between 19-22.9 C during the 1997 monitoring period.

Diel variation: 24-hour variations were between 3-6 C for the late spring and early summer of 1996-97. Variations in November and December were less than 1 C.

Figure 3.8.2-5. 1996-97 Lower Salsipuedes Creek Thermograph Data - Run Habitat - Santa Rosa Road Bridge - 1200 Feet Upstream of Santa Ynez River Confluence

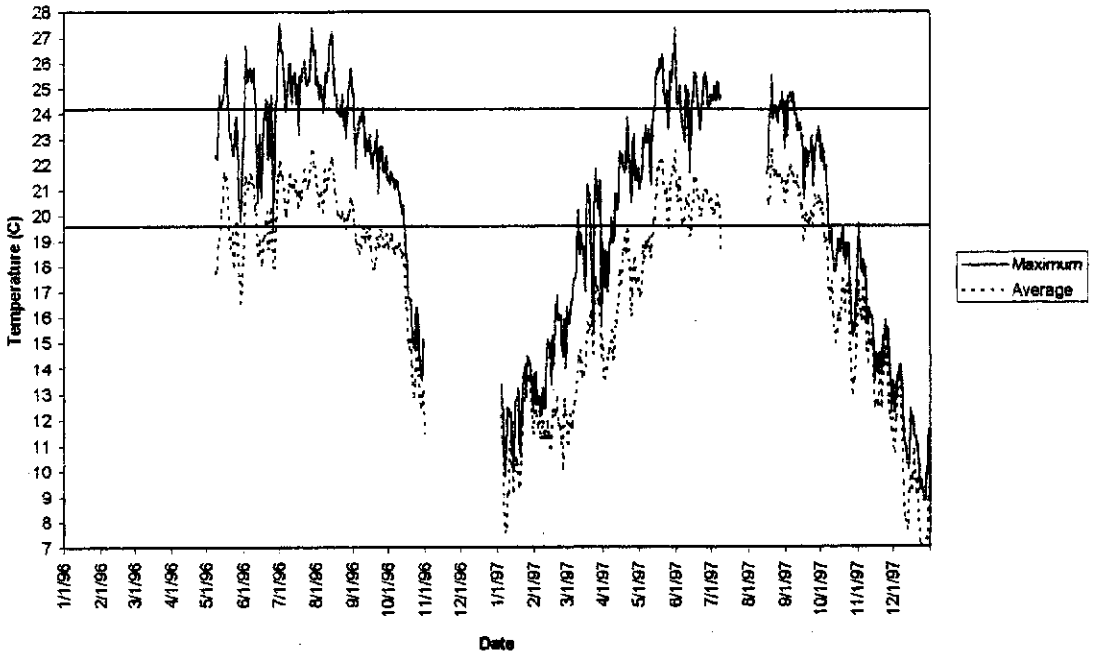
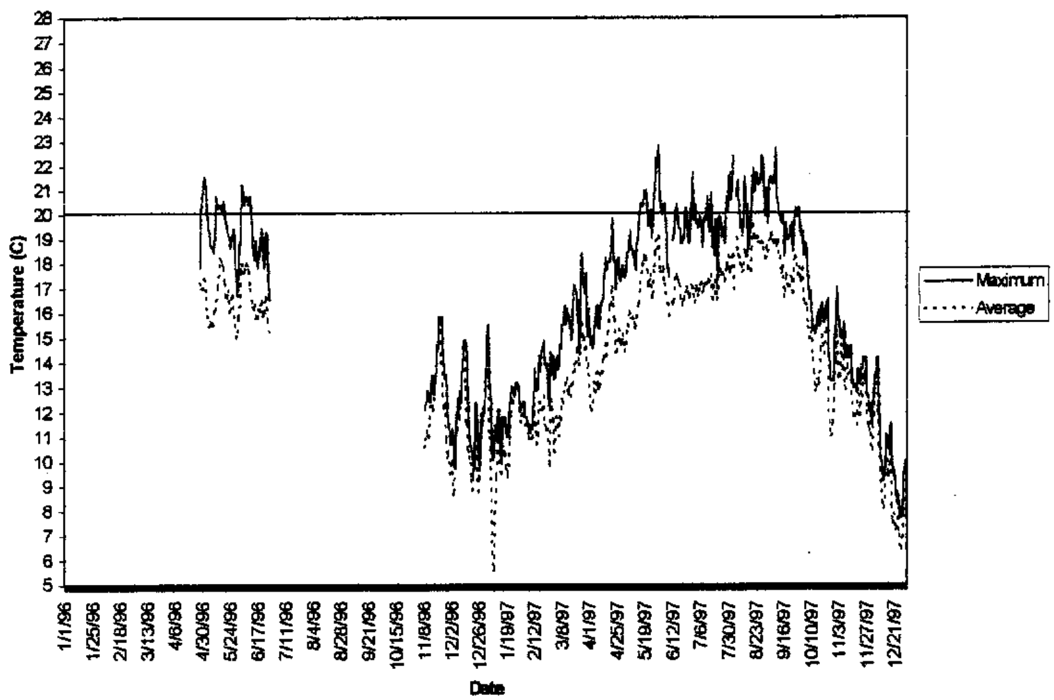


Figure 3.8.2-6. 1996-97 Upper Salsipuedes Creek Thermograph Data - 100 Feet Upstream of El Jaro Creek Confluence

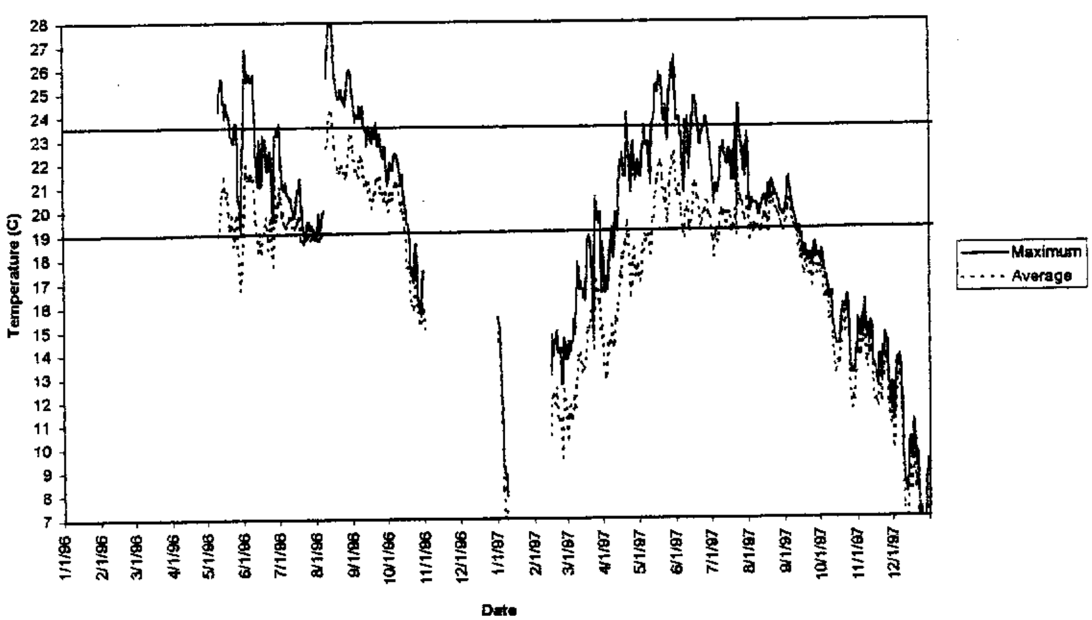


El Jaro Creek - 50 Feet Upstream of Salsipuedes Creek Confluence

Seasonal pattern: Water temperature fluctuated greatly in El Jaro Creek. Maximum water temperatures for the majority of May, June, and July were less than 25 C except for two brief periods in early May and June 1996 **(Figure 3.8.2-7)**. It was noted during the August 1996 thermograph downloading that the unit was buried in approximately 2 inches of substrate, which may account for the lower temperatures plotted for the first portion of 1996. In early August, when the thermograph was positioned above the substrate, maximum and average water temperatures increased greater than 25 and 20 C respectively for the remainder of August before slowly decreasing to less than 20 C by mid October. In 1997, average temperatures were generally less than 20 C except for approximately one month between May and June when average temperatures increased to 22 C. Maximum temperatures generally ranged between 21-26.5 C and, overall, were slightly cooler compared to 1996 temperatures.

Daily variation: 24 hour variations were between 1-7 C for the period of early March through August 1996-97. Variation decreased to between 1-3 C by the end of September and into October.

Figure 3.8.2-7. 1996-97 El Jaro Creek Thermograph Data - 50 Feet Upstream of Salsipuedes Creek Confluence

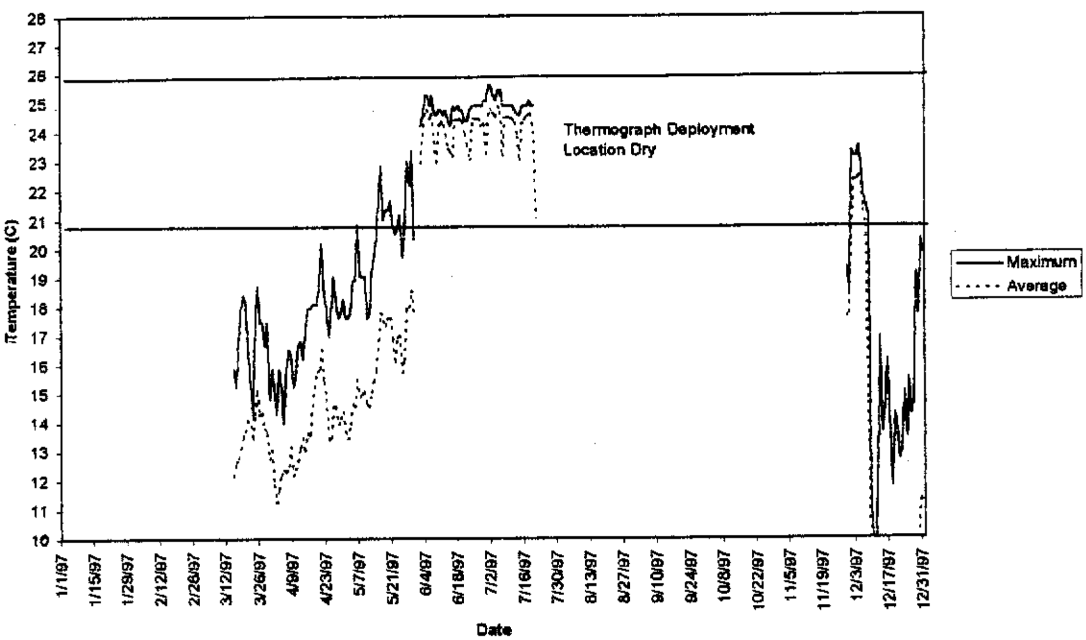


San Miguelito Creek

Seasonal pattern: The thermograph recorded large fluctuations between both average and maximum temperatures during the monitoring period **(Figure 3.8.2-8)**. Average temperatures did not exceed 20 C. Maximum temperatures of 23 C were recorded near the end of the monitoring period (early June). By mid-July, water was no longer flowing at the thermograph site.

Daily variation: 24-hour variations were between 0.5-5.5 for the entire monitoring period.

Figure 3.8.2-8. 1997 San Migueito Creek Thermograph Data - Lompoc



4. Habitat Characterization

Aquatic habitat measurements play an integral role in fisheries management. Their use is critical in predicting such things as the impacts of habitat alterations, potential fish production, and probable limiting factors. Habitat measurements also make it possible to classify aquatic habitats into similar groups so that research and management results may be generalized (Nielsen and Johnson 1983). The number and types of species and their relative abundance is largely determined by the habitat. Habitat measurements can be used in conjunction with knowledge of a species' habitat preference to determine if habitat parameters are limiting and which type of habitat improvements may be beneficial. The quantity and quality of aquatic habitat available within the SYR and its tributaries play an important role in determining the potential of the river to support fish populations. Aquatic habitat includes all living (biotic) and nonliving (abiotic) aspects of the aquatic ecosystem. Physical habitat parameters include the amount of space available, water depth, current velocity, substrate, availability of cover, water temperature, and water chemistry characteristics. Habitat mapping surveys have been conducted in parts of the SYR and its tributaries to assess the quantity and quality of physical habitat available.

The mapping surveys measured the areal extent of distinct habitat types (riffles, pools, runs) that have different characteristics of water velocity and depth. Riffles are high gradient areas with shallow depth and relatively fast water velocities. Runs have a lower gradient than riffles and are generally deeper, with uniform water velocities and without surface turbulence. Pools are characterized by low surface gradient and low water velocity, and are generally deeper than riffles and runs. Other important features such as substrate, cover, instream vegetation, and riparian canopy were also measured.

4.1 Methods

Monthly habitat mapping of the mainstem was conducted for the purpose of:

- gathering baseline information on habitat conditions.
- identifying survey sites for monthly snorkel surveys.

Two separate habitat surveys were conducted in 1996 and 1997 in the SYR, using two different methodologies, each of which are employed by the CDFG.

Approximately eleven miles in six separate reaches of the SYR was habitat mapped in September 1996 **(Figure 4.1-1)**. Flow measurements during the mapping ranged between 25-35 cfs in each reach. The reaches are as follows:

Reach #1 (Highway 154) was located a quarter of a mile downstream from Bradbury Dam and extended upstream to the tail-out of the spill basin.

Reach #2 (Refugio) was located between Refugio Road and approximately one mile downstream of the Highway 154 Bridge. This 2.5-mile stretch of river was habitat mapped and 15 sites chosen for monthly surveys.

Reach #3 (Alisal) was located between Alisal Road in Solvang and Refugio Road in the town of Santa Ynez, and stretches for a distance of nearly three miles.

Reach #4 (Avenue of the Flags) was located between Alisial Bridge and the Highway 101 Bridge in Buellton. Twelve sites were selected in the three-mile stretch of river.

Reach #5 (Weister) was located approximately two miles downstream of the Avenue of the Flags in Buellton and extends approximately one mile further downstream.

Reach #6 (Cargasachi) was located in the lower portion of the river approximately 15 miles upstream from the lagoon. An approximate 1.5-mile section was habitat mapped.

Data is currently being analyzed for data collected during the 1997 habitat/flow studies. This data will be presented in a separate report sometime in 1998.

4.1.1 1996 Mainstem Habitat Typing

Habitat mapping in 1996 was conducted using California Department of Fish and Game habitat mapping method. The data collected at each survey location included: date, time, reach, habitat type, habitat number, total length, average width, average depth, maximum depth, percent cover and cover type, and average water velocity. Bank compositions and substrate composition were visually estimated during September only. With the exception of percent algae, percent cover and cover type were measured during August only since those types of cover were not expected to change during the surveys. First the total length of each habitat unit was measured. Then width measurements were taken at transects located at the upstream (1/4), middle (1/2), and downstream (3/4) of each habitat unit. At each width transect, depths and velocities were measured at left one-quarter, one-half, and right one-quarter across that transects. Lengths and widths were measured to the nearest foot using a 300 foot engineering tape. Depths were measured to the nearest 0.1 foot using a standard surveyors stadia rod. Average velocity was measured in the thalweg at five evenly spaced locations through the habitat unit using a Marsh-McBurney Model 2000 flow meter. In some habitat units, water depth through the middle transect was too deep for velocity measurements. In these cases, a float tube was used to reach the locations. Dissolved oxygen and temperature were measured in the middle of each habitat unit at the surface and bottom using a Yellow Springs Instrument Model 57 Dissolved Oxygen Meter.

4.1.2 1997 Mainstem Habitat Typing

The purpose of the 1997 stream habitat inventory was to produce a through description of the physical fish habitat in the SYR. The information provided by habitat typing combined with biological information will help identify habitat diversity and availability. Kris Vyverberg, California Department of Fish and Game Geomorphologist habitat typed the entire SYR using aerial photographs. Following this, the geomorphologist instructed the 3-4 person field crew in the ground truthing of the identified habitats. After ground truthing, 23 habitat units were selected for a habitat/flow study in the Refugio and Alisal Reaches. Between 5-10 transects were established within each habitat unit depending on the overall habitat unit length. Each transect was surveyed at the thalweg for water surface and channel bottom elevations. Depth and velocity measurements were also recorded from the thalweg in addition to the width of each transect. Each unit was surveyed at flow levels of 50 cfs, 35 cfs, 20 cfs, and 10 cfs. Two surveyor levels were used in conjunction with a 25 foot stadia rod to determine water surface and channel bottom elevations. Velocity measurements were made using a Marsh-McBirney Model 2000 Flow Meter. Depth measurements were made with a 25 foot stadia rod. Width measurements were made using a 150 foot engineering tape.

4.1.3 1996 Tributary Habitat Typing

Portions of El Jaro Creek (upstream of confluence with Salsipuedes Creek confluence), Upper Salsipuedes Creek (upstream of El Jaro confluence), and Lower Salsipuedes Creek (Santa Rosa Bridge upstream to the El Jaro Creek confluence) were habitat typed in June and July 1996. Methods employed were identical to those applied during the mainstem surveys in 1996. Pools, riffles, runs, deep runs, step runs, cascades, and bedrock chutes were among the habitats identified. No other tributaries were surveyed using this method in 1996 or 1997.

4.2 Results of Mainstem and Tributary Habitat Inventory

4.2.1 Mainstem Sites

4.2.1.1 Highway 154 Reach

Five habitats were consistently measured in the Highway 154 reach. One of these, the Long Pool, dominated the habitat volume in all surveys. Run and riffle habitat occurred at intervals in negligible amounts. The volume of the Long Pool had a persistent base level of 15-16 acre feet, with minimum volume occurring in May 1996. Volume peaked in January of 1996. No releases were made from Bradbury during the winter of 1995-96 so any changes in habitat volume would be related to inflow from Hilton Creek, stormwater runoff and changes in evaporation and transpirtation. In mid July 1996, releases from Bradbury Dam of 135 cfs were initiated under WR 89-18. There was a small increase in volume of the long pool as measured in July and August surveys. Habitat volume in runs was converted to riffles, but remained at negligible levels

A habitat inventory was conducted in the Highway 154 Reach in October 1996. There were 10 habitats identified that measured a total length of 2239 feet and accounts for the all river habitat on BOR property. Two pool habitats (mostly long pool) comprised the majority of the identified habitat by length. The two pools in the reach accounted for 64.7% of the total length. Runs (4) and riffles (3) consisted of 21.5% and 8.3% respectively.

4.2.1.2 Refugio Reach Main Channel

In the Refugio Reach, 10 habitat units were consistently measured between January and August 1996. Pools provided the majority of habitat volume throughout the monitoring period. As in the Highway 154 reach, there was some increase in habitat volume during the winter of 1995-96. Habitat volume gradually diminished during the spring and summer of 1996 with the reduction apparently accelerating into June. In a qualitative visual survey on July 16 (prior to WR 89-18), two of the habitat units were dry and a third was nearly dry. Other habitats were reduced to small isolated pools with turbid water. Reduction in habitat volume appeared to be greater in the summer of 1996 (following a winter with approximately average runoff) than during the summer of 1995 (following a winter with above average runoff pattern).

A habitat inventory was conducted for the entire Refugio reach in September 1996. Pool, riffle, and run habitats were identified and measured by length in order to stratify the habitats for random selection for future habitat typing and snorkel surveys. The total length of stream surveyed was 17687 feet in which 90 habitat units were identified. Run habitats were split into three categories depending on depth: run, deep run, and step run. Run and riffle habitats made up the vast majority or habitats identified **(Figure 4.2.1-1)**. Riffle, run and pool habitats comprised 25.6 %, 38.9%, and 13.8% by length respectively. Both deep runs and step runs comprised less than 3% in length. The main channel comprised 88 % of the total habitats identified.

Side channels were more abundant in the Refugio reach than in any other reach. Side channels comprised 12 % of the habitat units identified in the Refugio reach. There were one pool, eight riffles, and six runs identified with both riffles and runs comprising the majority of the habitat in total length. Total length of side channels was 2406 feet.

Seventeen mainstem habitat units evenly distributed throughout the reached were randomly selected for more detailed investigation in mid October. Revisited habitats consisted of 8 pools, 4 riffles, 4 runs, and one deep run **(Table 4.2.1-1)**. Flow was measured at 37.09 cfs. The single deep run (not included in below table) was 254 ft. in length, 51 ft. in width, was 2.4 ft. deep (max 3.6 ft.), and had 0.29 second ft. flowing through the unit.

Figure 4.2.1-1. 1996 Habitat Type Composition by Length - Santa Ynez River - Refugio Reach

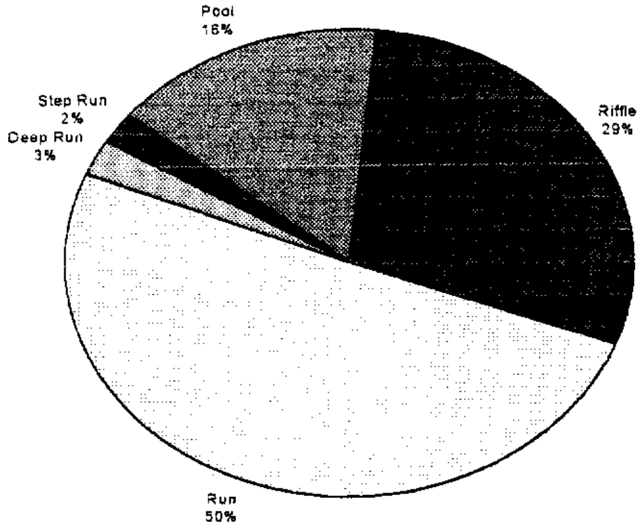


Table 4.2.1-1 Average Habitat Measurements of Revisited Units - Refugio Reach October 1996

Habitat Type	Number of Habitats	Average Length (ft)	Average Width (ft)	Average Depth (ft)	Average Flow (ft/sec)
Pool	8	201	43	2.8	0.87
Riffle	4	218	64	1.1	1.96
Run	4	185	70	2.0	1.02

Riparian Vegetation

Riparian vegetation in the Refugio reach is not well developed and does not provide significant shading for aquatic habitats. Pool habitats averaged 8% canopy coverage and ranged between 0-45% with two of the eight units having 40% and 45% coverage. Run habitats averaged only 2.3% coverage while riffle habitats had zero canopy.

Instream Vegetation

The overall development of instream vegetation in the Refugio Reach varied by habitat type. Percent unit coverage in pool habitats averaged 64% (range 35-80%) with the majority of coverage consisting of root masses, terrestrial and aquatic vegetation. Run habitats had considerably less coverage, averaging 38% (range 25-70%) and consisting primarily of aquatic vegetation. Riffle habitats averaged 29% coverage (range 15-70%) which consisted of aquatic vegetation, white water, and boulder cover.

Bank Composition

Bank composition (left and right side of habitat unit) around pool habitats included trees, grass, and brush. Run habitats included brush and cobble/gravel while riffle habitats included primarily cobble/gravel with a mixing of grass, brush, and trees.

Substrate

The dominant substrate in pool habitats was composed of silt, sand and clay, while the sub-dominant characteristics consisted of both large and small cobble. Run habitats had a general mix of all types of substrate for both dominant and sub-dominant types. Riffle habitats were dominated by large cobble and sub-dominated by small cobble

4.2.1.3 Alisal Reach

In the Alisal reach, evaluation of habitat volume was based on seven habitat units measured between January through August. Although data was generally recorded in 10 habitat units, data for at least one month was missing from three of them. Those three were omitted from the analysis. The pattern of change was similar to the Refugio reach except that reduction in habitat volume during the summer of 1996 was less severe. Habitat volume in the Alisal reach during the summer of 1996 also did not reach levels as low as it had during the summer of 1995. Although conditions worsened between the June 18 survey and initiation of the WR 89-18 releases almost a month later, qualitative observations on July 16 indicate that none of the seven habitats went dry. Many of the habitat units did become isolated and turbid as in the Refugio reach. In the lower pool unit it was noted that a large number of largemouth bass, sculpin, and stickleback had recently expired, probably a result of low DO concentrations.

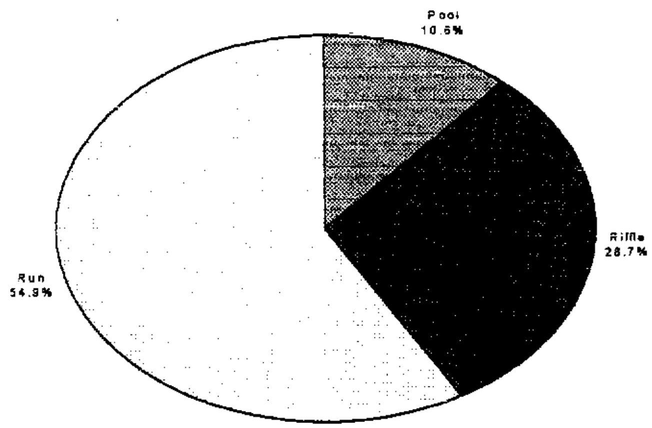
The Alisal reach was inventoried in September 1996. The total length of river surveyed was 15848 feet. As observed in the Refugio reach, riffles and runs comprised the majority of habitats identified **(Figure 4.2.1-2)**. Run, riffle and pool habitat comprised 54.9%, 28.4%, and10.6% by length respectively. The main channel constituted 94.2% of the habitats identified.

Fourteen habitat units evenly distributed throughout the reach were randomly selected in min-October for detailed evaluation **(Table 4.2.1-2)**. Revisited units consisted of 7 pools, 3 riffles, and 4 runs. Flow was measured at 27.15 cfs.

Table 4.2.1-2 Average Habitat Measurements of Revisited Units - Alisal Reach September 1996

Habitat Type	Number of Habitats	Average Length (ft)	Average Width (ft)	Average Depth (ft)	Average Flow
Pool	7	149	36	2.9	0.47
Riffle	3	84	26	0.5	1.54
Run	4	279	63	1.0	0.63

Figure 4.2.1-2. 1998 Habitat Type Composition by Length Santa Ynez River - Alisal Reach



Riparian Vegetation

Riparian vegetation in the Alisal Reach is not well developed and does not provide significant shading for aquatic habitats. The majority of pool habitats had zero canopy observed. One pool had 55% and another had 15% canopy. Both riffle and run habitats had zero canopy observed.

Instream Vegetation

Instream vegetation in the Alisal Reach differed between habitat types. Percent instream coverage in pool habitats averaged 75% (range 50-85%) with the majority of coverage consisting of aquatic vegetation. Run habitat instream coverage averaged 75% (range 55-80%) with the majority of coverage consisting of aquatic vegetation. Riffle habitats averaged 47% coverage (range 35-70%) with the majority consisting of aquatic vegetation and white water.

Bank Composition

Bank composition around pool, riffle, and run habitats in the Alisal Reach included primarily cobble/gravel with some brush and trees.

Substrate

The dominant and sub dominant substrate observed in pool habitats was split between gravels and silt, sand, clay. Run habitats consisted of small cobbles and gravels while riffles consisted of small and large cobbles.

Side Channels

The Alisal reach was the only other mainstem reach where side channels were identified. One side channel riffle was identified which constituted 5.8% of the habitat units identified.

4.2.1.4 Avenue of the Flags Reach

The Avenue of the Flags reach was inventoried in September 1996. The total length of river surveyed was 19799 feet. Run habitat made up the vast majority of the habitat identified with 70.1% by length. Riffles, pools, and deep runs 7.6%, 8.8%, and 13.2% respectively by length **(Figure 4.2.1-3)**. No side channels were identified.

Twelve habitat units evenly distributed throughout the reach were randomly selected for detailed evaluation in mid- October. Revisited units consisted of 5 pools, 3 runs, and 4 riffles. Flow was recorded at 9.08 cfs **(Table 4.2.1-3).**

Table 4.2.1-3 Average Habitat Measurements of Revisited Units - Avenue of the Flags Reach September 1996

Habitat Type	Number of Habitats	Average Length (ft)	Average Width (ft)	Average Depth (ft)	Average Flow
Pool	5	60	30	2.5	0.38
Riffle	3	136	38	0.3	1.41
Run	4	280	43	0.9	0.50

Riparian Vegetation

Riparian vegetation is lacking in the revisited units of the Avenue of the Flags reach. Essentially zero canopy exists in all monitored habitats.

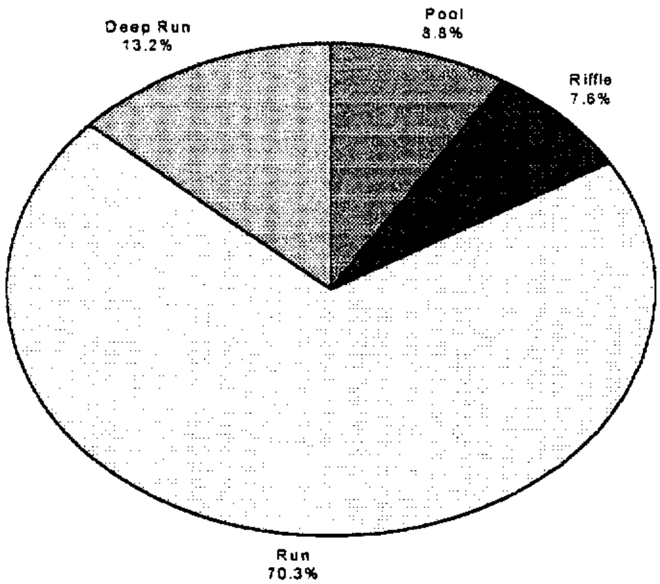
Instream Vegetation

Instream vegetation in the Avenue of the Flags reach is slightly more developed when compared to upstream reaches. Canopy covered an average of 38% (range 15-50%) of pool surfaces, with the majority of the cover consisting of terrestrial and aquatic vegetation. Run habitats averaged 28% (range 15-65%) coverage with aquatic vegetation. Riffle habitats were observed to have the greatest amount of coverage when compared to upstream reaches. Riffles habitats averaged 65% coverage (range 50-75%).

Bank Composition

Bank composition in the Avenue of the Flags reach included bare soil and cobble/gravel for all revisited habitats units.

Figure 4.2.1-3. 1996 Habitat Type Composition by Length - Santa Ynez River - Avenue of the Flags Reach



Substrate

Both the dominant and sub dominant substrate in pools alternated between gravel and silt-sand-clay. Run habitats had a greater majority of gravels compared to small cobbles and silt-sand-clay. Riffles were composed mainly of small cobbles and gravels.

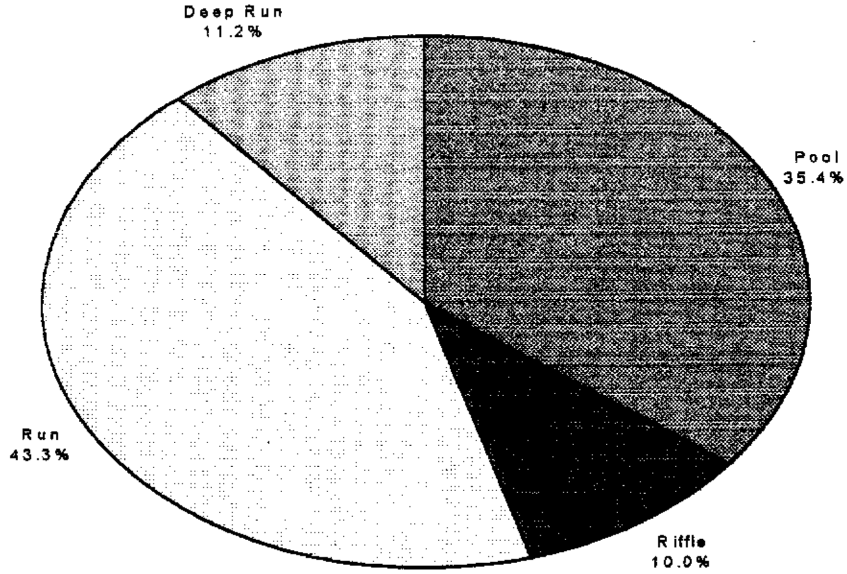
4.2.1.5 Weister Ranch Reach

The Weister Reach was inventoried in October 1996. Total length of river surveyed was 6370 feet. Runs made up the majority of habitat identified both in number (39.3%) and length (43.3%) **(Figure 4.2.1-4)**. Riffles were nearly as abundant in number compared to runs (35.7%), but their overall length comprised only 10.0% of the total reach. Pools comprised 35.4% by length. One deep run was also identified which made up 11.2% of the reaches length. No side channels were identified. Eleven units were revisited for more detailed evaluation: 4 pools, 3 riffles, and 4 runs **(Table 4.2.1-4)**.

Table 4.2.1-4 Average Habitat Measurements of Revisited Units - Weister Ranch October 1996

Habitat Type	Number of Habitats	Average Length (ft)	Average Width (ft)	Average Depth (ft)	Average Flow
Pool	4	425	48	2.7	0.29
Riffle	3	57	35	0.4	1.01
Run	4	341	41	1.1	0.62

Figure 4.2.1-4. 1996 Habitat Type Composition by Length - Santa Ynez River - Weister Ranch Reach



Riparian Vegetation

Riparian vegetation in the Weister Ranch Reach is not well developed and does not contribute significant shading for aquatic habitats. Observed canopy was essentially zero in all revisited habitat units.

Instream Vegetation

Instream vegetation coverage averaged nearly 50% or greater in each habitat type. Percent coverage in pools was 59% (range 55-70%), 42% in riffles (range 20-70%), and 59% in runs (range 45-70%). The coverage consisted mainly of aquatic vegetation with some terrestrial vegetation in all habitat types.

Bank Composition

Bank composition on both the left and right banks of the habitats units was dominated by brush, trees, and grass.

Substrate

Silt-sand-clay was the dominate substrate in pool habitats with large cobbles and gravels being sub-dominant. Riffles were composed mainly of both large and small cobbles with some gravels. Run habitats were dominated by silt-sand-clay with small cobbles being subdominant.

4.2.1.6 Cargasachi Ranch Reach

Habitat measurements from January through August in the Cargasachi reach changed in a similar pattern as in the upper reaches. Habitat volume peaked in January, and during WR 89-18 releases in July, 1996. Volume appeared to decline to lower levels in early summer, 1996, than they had by late summer in 1995

The Cargasachi Reach was inventoried in early October 1996. Total length of river surveyed was 7232 feet. Runs again made up the vast majority of surveyed habitat comprising 76.4% by length **(Figure 4.2.1-5)**. Pools and riffles comprised 18.8% and 0.7% by length. No side channels were identified. Eight units were revisited October 28: 4 pools, 3 runs, and 1 riffle. Flow was 10.27 cfs **(Table 4.2.1-5)**.

Table 4.2.1-5 Average Habitat Measurements of Revisited Units - Caragasachi Reach October 1996

Habitat Type	**Number of Habitats**	**Average Length (ft)**	**Average Width (ft)**	**Average Depth (ft)**	**Average Flow**	
Pool	4	327	55	1.9	0.53	
Riffle	1	44	33	0.5	2.67	
Run	3	230	63	1.1	0.93	

Riparian Vegetation

Riparian vegetation is not well developed in the Cargasachi Reach. All habitats had essentially zero canopy with the exception of one run with 20% canopy.

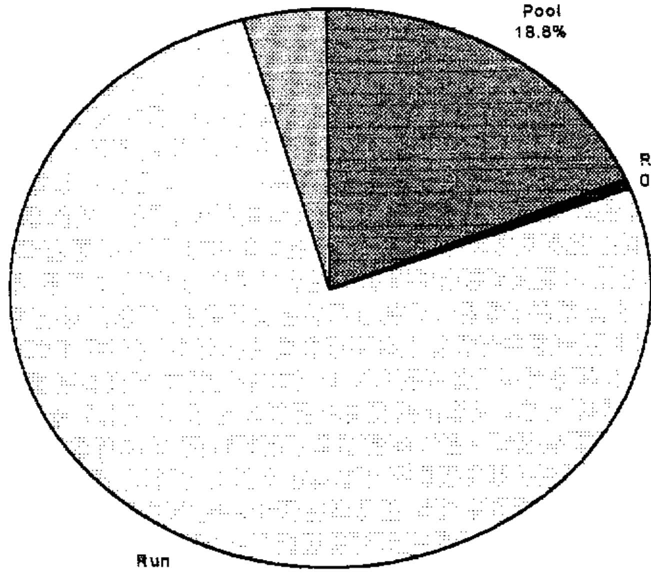
Instream Vegetation

Instream vegetation was observed to be less than 50% in all revisited habitat units. Pools averaged 43% coverage (range 10-60%), with the coverage consisting of aquatic and terrestrial vegetation with some bedrock ledges. The riffle had 7% coverage which was composed of terrestrial and aquatic vegetation along with some white water. Run habitats averaged 23% coverage (range 15-30%) and consisted of aquatic and terrestrial vegetation with some root masses.

Bank Composition/Substrate

Bank composition around all habitats consisted mainly of trees with some brush
The dominant substrate in all pool habitats was silt-sand-clay with the sub-dominant being gravels. The riffle consisted of small cobble and gravel. Runs were composed of silt-sand-clay and gravels.

Figure 4.2.1-5. 1996 Habitat Type Composition by Length - Santa Ynez River - Cargasachi Ranch Reach



4.2.2 Habitat Inventory of Tributaries for 1996

4.2.2.1 Lower Salsipuedes Creek

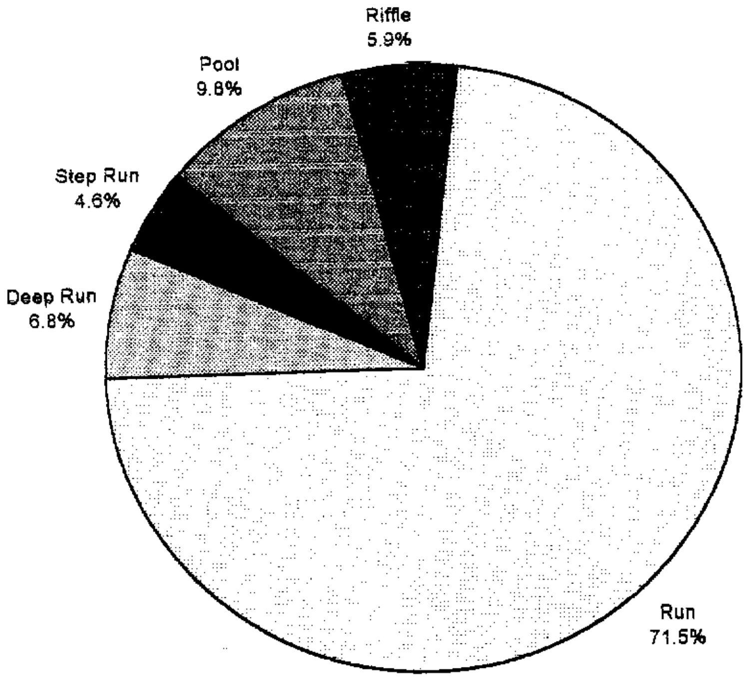
A total of 19317 feet of creek was surveyed in which 170 habitats were identified. Run habitat dominated this portion of the creek both in number identified (37.6%) and total length (71.5%) (**Figure 4.2.2-1**). All other habitat types independently comprised less than 10% by length. Pools, riffles, and deep runs comprised 9.8%, 5.8%, and 6.7% respectively by length. Step runs, cascades, and bedrock chutes individually comprised less than 5.0% of the total length.

Thirty-three habitat units evenly distributed throughout the lower creek were randomly selected for more detailed analysis. Each revisited habitat type comprised between 20-30% of all the habitats identified. Revisited habitat units were composed of 7 pools, 7 riffles, 15 runs, 3 deep runs, and 1 step run.

Percent Canopy

Percent average canopy was relatively low, however, some units did have significant canopy. Riffles had the highest average percent canopy (23.9 %, range 0-60%) followed by pools (15.9 %, range 0-45%). Runs, deep runs, and step runs each had less than 10% average canopy coverage.

Figure 4.2.2-1. 1996 Habitat Type Composition by Length - Lower Salsipuedes Creek



Percent Unit Coverage

Percent unit coverage consists of instream habitat such as undercut banks, small and large woody debris, root mass, terrestrial and aquatic vegetation, white water, boulders, and bedrock ledges which may offer shelter to all life stages of rainbow trout/steelhead. Unit coverage was consistently greater compared to percent canopy. Pools had the highest percent unit coverage with 33.7% (range 3-65%) most of which consisted of aquatic vegetation, bedrock ledges, and some small woody debris and rootwads. Deep runs average 28.3% (range 15-35%) coverage consisting mainly of terrestrial vegetation, bedrock and undercut banks. Run habitats averaged 16.7% (range 5-40%) and consisted of aquatic and terrestrial vegetation with some bedrock and undercut banks. Riffles averaged 12.9% coverage (range 5-30%) and consisted mainly of white water.

Substrate Composition

Substrate composition varied by habitat in lower Salsipuedes Creek. Pools were dominated silt-sand-clay and sub-dominated by bedrock and gravels. Riffles were dominated by small cobbles and sub-dominated by gravels and large cobbles. All run habitats were dominated by gravels and silt-sand-clay, and subdominated by small cobbles.

4.2.2.2 Upper Salsipuedes Creek

A total of 847 feet of creek was surveyed in which 16 habitats were identified. Again, runs dominated the reach comprising 37.5% by number, and 43.6% by length **(Figure 4.2.2-2)**. Pools, riffles, and runs made up 20.4%, 27.4%, and 8.6% by length respectively.

All 16 habitat units were revisited for more detailed habitat analysis. Identified habitat units consisted of 4 pools, 3 riffles, 6 runs, and 3 step runs.

Percent Canopy

Percent average canopy was relatively high in all habitat types when compared to both lower Salsipuedes and El Jaro Creeks. Average canopy was highest in riffles (46.7%, range 15-75%) and pools (28.8%, range 5-50%), and lower in runs (17.0% range 2-40%) and step runs (12.7% range 3-30%).

Percent Unit Coverage

Percent average unit shelter was consistently higher when compared to percent average canopy except in riffles which was slightly higher. Percent average unit coverage was similar in all habitat types ranging between 37.5-40.0%. Shelter in pools was dominated by aquatic vegetation, rootwads, and terrestrial vegetation. Riffle shelter was dominated by rootwads, aquatic vegetation, and small woody debris. Shelter in run habitats was similar to pools with aquatic vegetation and small woody debris being dominant. Step runs were dominated by aquatic and terrestrial vegetation.

Substrate Composition

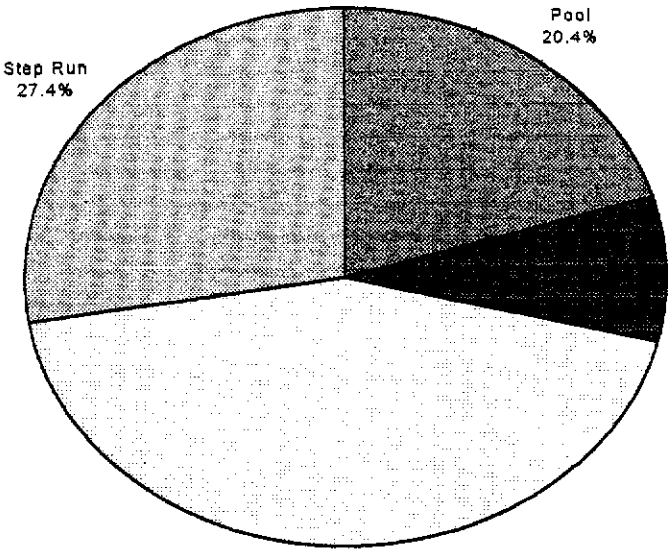
Substrate composition was similar in all habitat types. Pools and both run types was dominated by gravels and sub-dominated by silt-sand-clay. Riffles were dominated by gravels and sub-dominated by small gravels.

4.2.2.3 El Jaro Creek

A total of 4490 feet of creek was surveyed in which 63 habitats were identified. Runs, pools, and step runs comprised the majority of the identified. Runs comprised 38.1% by number and 60.3% by length **(Figure 4.2.2-3)**. Pools comprised 17.5% by number and 16.5% by length. Step runs comprised 14.3% by number and 13.2% by length. Riffles and deep runs individually comprised 5.6% and 2.7% respectively in total length.

Nineteen habitat units were revisited for more detailed analysis. Revisited units comprised between 30-40% of all identified habitat types. Revisited units consisted of 4 pools, 5 riffles, 6 runs, 3 deep runs, and 1 step run.

Figure 4.2.2-2. 1996 Habitat Type Composition by Length - Upper Salsipuedes Creek



Percent Canopy

Average percent canopy was higher in pools (26.3%, range 0-70%), riffles (27.6%, range 0-90%), and deep runs (23.3%, range 0-60%), and lower in runs (4.5%, range 0-15%) when compared to canopy in lower Salsipuedes Creek.

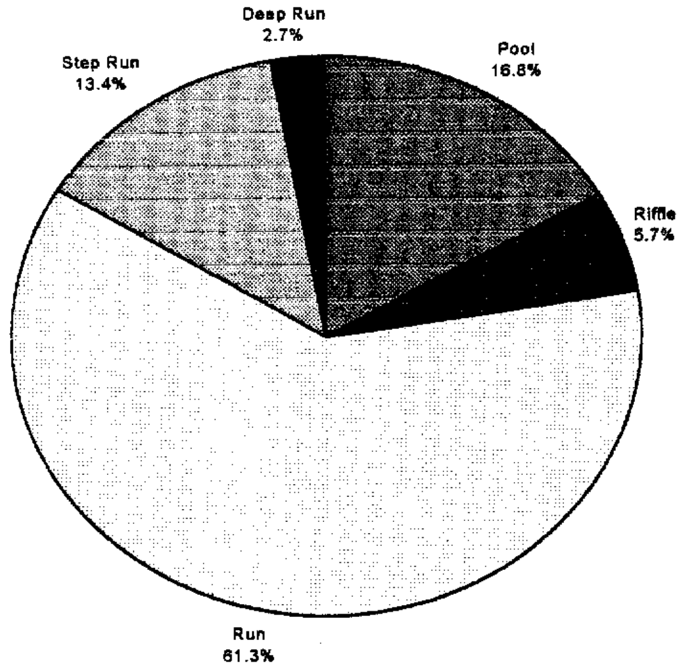
Percent Unit Coverage

Average percent shelter ranged between 15-40% in all habitat types. Pools had the greatest average shelter (32.5%) and were dominated by terrestrial vegetation and boulders. Riffles averaged 22.0% shelter and was dominated by aquatic vegetation rootwads and boulders. Runs averaged 25.8% shelter and were dominated by aquatic and terrestrial vegetation and boulders. Shelter in deep runs was dominated by boulders and rootwads and averaged 15.0%. The single step run was sheltered by boulders which comprised 40.0% of the unit shelter.

Substrate Composition

Substrate composition varied by habitat type in El Jaro Creek. Pools and deep runs were dominated by silt-sand-clay and sub-dominated by boulders and gravels. Riffles and runs were both dominated by gravels, but riffles were sub-dominated by small and large cobbles and runs were sub-dominated by silt-sand-clay and large cobbles.

Figure 4.2.2-3. 1996 Habitat Type Composition by Length - El Jaro Creek



5.0 Fisheries Surveys

Fish sampling in the SYR and tributaries in 1996-1997 consisted of migrant trapping to determine timing and numbers of adult and juvenile (smolt) steelhead/rainbow trout migrating into and out of the SYR watershed. Additionally, snorkel surveys and bank observations (redd surveys) were conducted to assess fish utilization of instream habitats.

5.1 Migrant Trapping

5.1.1 Methods

In 1996, migrant trapping was conducted in the mainstem SYR, Salsipuedes, and Hilton Creeks only. Trapping was not conducted on Alisal, Quiota, and Nojoqui Creeks due to insufficient water and/or denied access by private landowners. In 1997, migrant trapping was conducted in the mainstem SYR, Salsipuedes, San Miguelito, Nojoqui, Alamo Pintado, and Hilton Creeks. Trapping was not initiated in both Alisal and Quiota Creeks due to denied access. Only downstream traps were deployed in Alamo Pintado, Nojoqui, and San Miguelito Creeks in 1997 to capture any migrants that previously moved upstream during high flow events, or to capture any juvenile smolts moving downstream. Upstream traps were not deployed in these creeks due to the presence of upstream or low flow passage barriers which would prevent upstream migration **(Figure 5.1-1 Inserted Map from Synthesis Report)**. Length of time the trap operated depended upon rainfall/runoff.

In tributaries, a 5x6x3 foot PVC fyke trap with a 3/4 inch plywood bottom was used to capture migrating fish. Traps were positioned with the fyke pointing upstream to capture upstream migrating fish. Another trap was used with the fyke pointing downstream to capture downstream migrating fish. Attached to the PVC trap frame was one-inch diameter Cintoflex plastic netting. On either side of the trap, panels were used to block migration and direct fish into the trap. Every panel consisted of two eight foot long sections of steel channeling (each piece of channeling with 48 1 3/4 inch holes punched in them) separated by a two or three foot piece of PVC pipe. Number of panels used depended upon stream width. Once the panels were deployed on either side of the trap, five-foot long pieces of one inch diameter electrical conduit was placed vertically through the holes in the channeling. Width between each piece of conduit was approximately 1 1/4 inch. The mainstem trap was an 8x8x4 fyke trap, with the weir portion constructed after the Alaskan style A-frame weir.

Traps were cleaned of debris and checked daily for migrating fish in the morning. Where possible, the traps were again checked in the afternoon. Trapped fish were removed and measured to the nearest millimeter fork length. Scales were collected from the right side of each fish, one inch below the posterior portion of the dorsal fin, and just above the lateral line. If the scales were imbedded, the alternate scale sample site was located on the right side near the caudal peduncle. A small, one-centimeter piece of tissue was removed for genetic analysis from the tip of the upper lobe of the caudal fin. Each tissue sample was cut in half; one piece going to the Project, and the other piece going to CDFG

Region 5 to archive. Each captured fish was described and any blemishes or wounds recorded for future identification.

5.1.2 Results

Mainstem

In 1996, upstream migrant trapping was conducted in the Alisal Reach, approximately 8.7 miles downstream of Bradbury Dam. Trapping was initiated on February 29, 1996 coincident with a storm event that breached the lagoon mouth at Ocean Park. One 9.8 inch steelhead/rainbow trout was captured on March 15, 1996.

In 1997, river flow was similar in the mainstem compared to 1996, with Fish Account releases from Lake Cachuma ranging between 3.0-5.0 cfs. Additionally, the majority of rainfall occurred by the end of January. The mainstem trap was in operation from January 3 through May 31, 1997. One 406 mm (16.0 inch) upstream migrant was captured on January 4. Prior to capture, a storm moved through the area on January 2-3 dropping nearly one inch of rain which may have triggered the upstream movement.

Hilton Creek

Hilton Creek is located directly downstream of Bradbury Dam. Both upstream and downstream migrant traps were located approximately 100 feet upstream of the confluence with the SYR.

In 1996, trapping was initiated in Hilton Creek on February 23 coincident with a storm event, and ended on February 25 due to loss on continuity with the SYR. No fish were captured in the trap, but three steelhead/rainbow trout entered the creek before the trap was deployed. Flows receded quickly, and the fish were stranded once continuity with the SYR was lost. Two of the fish were captured and removed, and the third disappeared, probably due to bird or raccoon predation. A few other storms occurred, but were of insufficient magnitude to cause significant runoff.

In 1997, Upstream migrant trapping was initiated in Hilton Creek from January 23 through February 8, coincident with several rain events, which generated runoff in the creek. A total of 10 upstream migrants were captured ranging in size between 340-457 mm (13.4-18.0 inches). Though water was still flowing in the creek, the upstream migrant trap was removed on February 8 due to insufficient water flowing in the trap. Trapping was again initiated on April 2, coincident with a 5.0 cfs release from the newly installed Hilton Creek Pump/Siphon. One additional steelhead/rainbow trout was captured on April 3 measuring 425 mm (16.7 inches). While no redd excavations or spawning activities were discovered during bank surveys, yoy were observed in the creek on subsequent bank and snorkel surveys.

No downstream migrating steelhead/rainbow trout were captured in either 1996 or 1997.

Salsipuedes Creek

Salsipuedes Creek enters the SYR approximately one half mile upstream from the Highway 246 Bridge near the city of Lompoc. Both upstream and downstream traps were constructed approximately 75 yards upstream from the Santa Rosa Road Bridge at the tailout of a pool/run habitat. The trap and panels spanned an approximate 30-foot section of the creek.

Upstream trapping was initiated on February 9 and ended on July 1, 1996. Two steelhead/rainbow trout were captured in 160 days of functional trapping in Salsipuedes Creek. The trap was not functioning for a total of ten days due to high flows and debris problems. One migrant was captured on February 14 and measured almost 14 inches in length. The other was captured on March 1 and measured about 13.5 inches in length. Both captures were made several days after peak runoff events in the mainstem.

In 1997, Upstream migrant trapping was initiated in Salsipuedes Creek on December 13, 1996 and continued through May 23, 1997. A total of 34 rainbow trout/steelhead migrated upstream into the trap or were netted upstream of the trap. Fish ranged in size between 125-580mm (4.9-22.8 inches) **(Figure 5.1.2-1),** with 6% captured in February, 47% in March, and 47% in April. (**Figure 5.1.2-2**). Fish captured in February may have reacted to a small storm event, which dropped a slight amount of rain (measured at Lake Cachuma). Essentially no rain fell within the basin in March (0.02 inches) or April, the months when the majority of the upstream migrants were captured.

Downstream migrant trapping was initiated on January 4 and ended on July 1, 1996. Four downstream migrating steelhead/rainbow trout were captured in 166 days of functional trapping. The trap was not functioning for a period of ten days due to high flows and debris problems. Two of the downstream migrating rainbow trout/steelhead exhibited smolting characteristics (i.e., deciduous scales, darkened fin margins, silvery apperence). They were captured on April 15 and April 18 and measured 131 mm (5.2 inches) and 153 mm (6.0 inches) respectively. Two other juvenile rainbow trout/steelhead, which did not exhibit visible smolting characteristics, were captured on February 6 and March 18 and measured 132 mm (5.2 inches) and 187 mm (7.4 inches) respectively.

In 1997, the downstream migrant trap was deployed for the period between November 1, 1996 through May 31, 1997. The purpose for the early deployment was to take advantage of early storm events and document if juvenile or smolting steelhead/rainbow trout would move to the ocean. A total of 12 downstream migrating rainbow trout/steelhead were captured during the deployment time **(Figure 5.1.2-3)**. One small rainbow trout/steelhead was captured on December 16, 1997 and measured 73 mm (2.9 in.). The fish did not exhibit smolting characteristics, and probably moved downstream as a result high flows or cooler water temperature conditions. The majority of the downstream migrants were captured between March 8 through April 14 with the last six migrants captured within a seventeen-day period from March 25 through April 10. Two of the downstream migrants had clipped fins indicating they had been previously

Figure 5.1.2-1. 1997 Salsipuedes Migrant Trapping Size Distribution

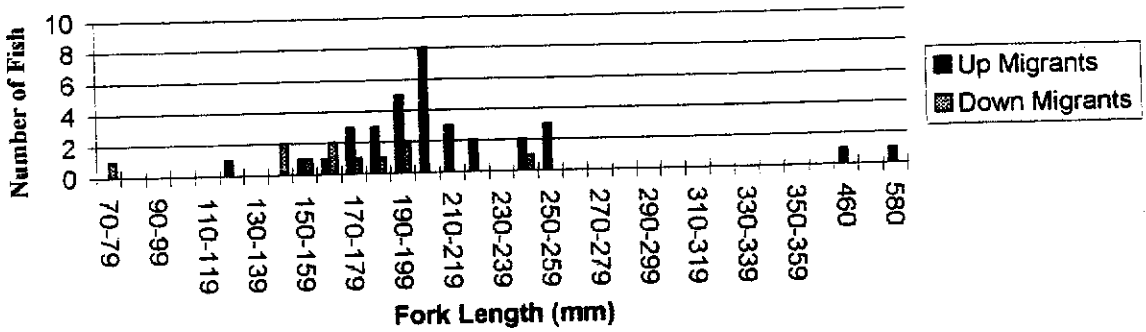


Figure 5.1.2-2. 1997 Upstream Migrant Catch/Week - Salsipuedes Creek

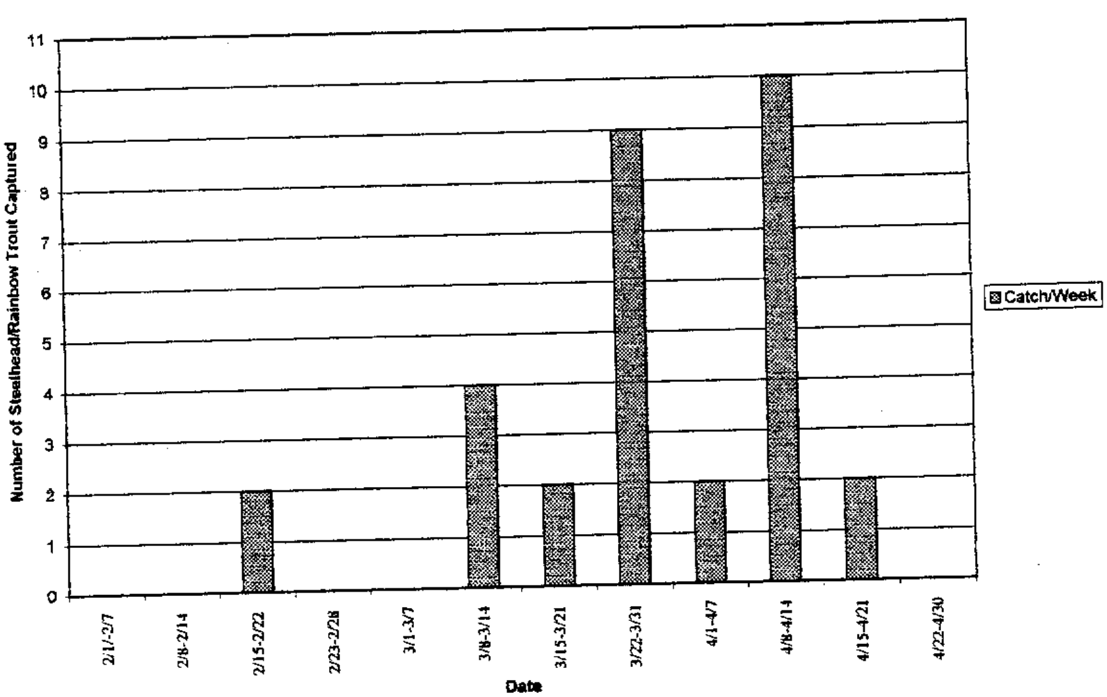
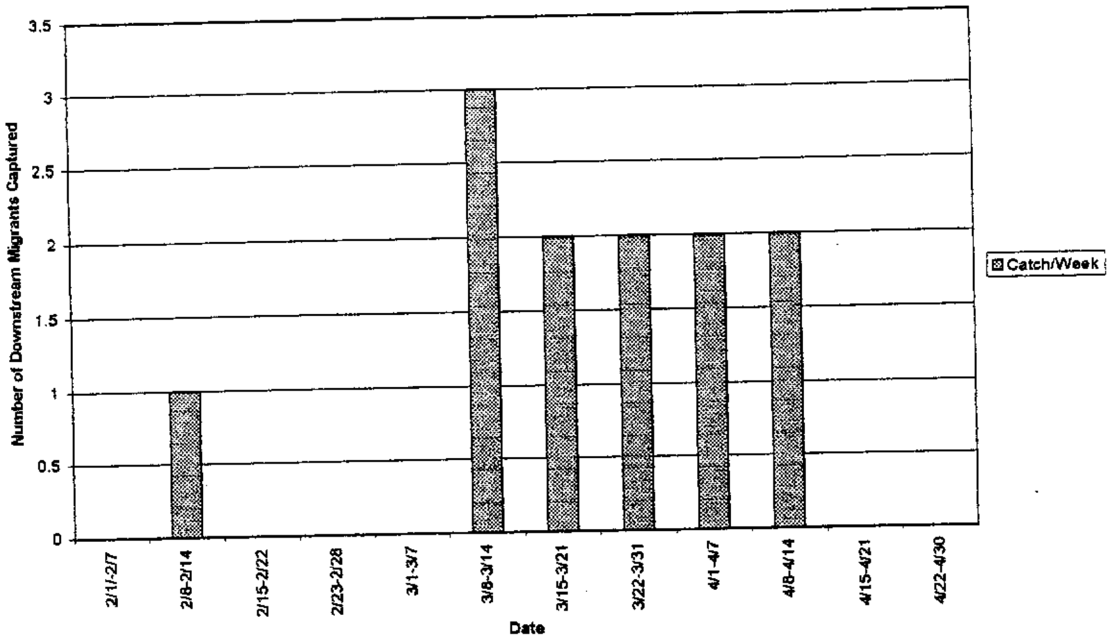


Figure 5.1.2-3. 1997 Downstream Migrant Catch/Week - Salsipuedes Creek



captured moving upstream. The majority of the downstream exhibited typical smolting characteristics.

Alamo Pintado Creek

A downstream migrant trap was deployed in the creek on February 1, 1997 and removed on April 5 when flow was too low to allow downstream migration. No migrating steelhead/rainbow trout were captured. Alamo Pintado is a problematic tributary to trap. Moving bars of fine sediments and sand constantly filled the trap every tow or three days, especially at flows greater than 2-3 cfs. Large amounts of leaf and tree debris exasperated this problem, causing the weir to act as a dam. The trap had to be regularly removed for several hours to an entire day to allow the build-up sediment bar to pass downstream.

Nojoqui Creek

A downstream migrant trap was deployed in the creek from January 27 through March 9, 1997. No migrating steelhead/rainbow trout were captured. Nojoqui Creek provides good quality spawning and rearing habitat in the upper reaches, along with cooler water temperatures in the summer. However, no steelhead/rainbow trout have been documented in the creek to date.

San Miguelito Creek

The upper portion of the creek is characterized as having a narrow channel with a well developed riparian corridor, and adequate spawning habitat. The lower two miles of the creek is described as a concrete storm channel which eventually empties into the SYR at V Street in Lompoc. A downstream trap was in operation from February 22 through Nay 29, 1997. One downstream migrant was captured on April 28, and measured 147 mm (5.8 inches) and weighed 38.7g.

5.2 Redd Surveys

5.2.1 Methods

The amount of space required by steelhead for spawning depends on the size and behavior of the spawners and the quality of the spawning area. Large fish make large redds, and poor-quality spawning areas may force females to make several redds. Water temperature during incubation affects the rate of embryo and alevin development and the capacity of water for dissolved oxygen, and (beyond certain limits) survival of the young fish. In general, the higher the temperature the faster the rate of development and the shorter the incubation period and time of emergence. For example, time to 50% hatch for steelhead and rainbow trout require about 85 days and 4 C (39.2 F) and 26 days at 12 C (53.6 C) (Bjornn and Reiser 1991).

In 1996, redd surveys were conducted on April 8 and 25 in Upper and Lower Salsipuedes, and El Jaro Creek. In 1997, redd surveys were expanded to take place every two weeks beginning in January, and were conducted in Salsipuedes, El Jaro, San Miguelito, Nojoqui, Alamo Pintado, and Hilton Creeks. Once redd excavations or spawning activity was identified, flagging with the date and redd number were attached to riparian vegetation adjacent to identified excavations. Length and width of redd excavations were measured to the nearest 0.1 inch using a stadia rod. Four depth and velocity measurements were recorded at the excavation: one at the head of the excavation, and three across the egg deposition area. A Marsh-McBirney FlowMate Model 2000 was used to measure velocities.

5.2.2 Results

1996

Two spawning surveys were conducted in Salsipuedes and El Jaro Creeks between April 8 and April 25 in which 13 different redds were identified. Three redds were identified in Lower Salsipuedes Creek between Santa Rosa Road and the Salsipuedes/El Jaro confluence. Seven redds were identified in Upper Salsipuedes Creek upstream of the confluence, and seven were identified in El Jaro Creek, all within a quarter-mile of the confluence. Redd dimensions and velocity characteristics were recorded (**Table 5.2.2-1**).

Table 5.2.2-1 Redd dimensions and current velocities (ft/sec) for rainbow trout/steelhead redds in Salsipuedes and El Jaro Creeks, April 8 and April 25, 1996

Redd #	Head Velocity (ft/sec)	Pit Velocity (ft/sec)	Length (ft)	Width (ft)
Salsipuedes				
1	.97	.88	3.0	2.0
2	.97	.91	1.6	1.6
3	1.23	1.45	2.8	1.7
4	.57	.63	3.0	1.8
5	2.58	1.53	4.0	2.0
6	2.08	1.76	6.0	2.5
7	.67	.59	2.0	1.5
El Jaro				
1	.76	.93	2.8	1.7
2	1.19	.86	5.0	2.3
3	.97	.83	2.7	2.0
4	.68	.87	3.0	1.8
5	.87	.81	4.5	2.2
6	.82	.55	3.5	2.0

1997

Redd and spawning surveys were conducted in the mainstem and all tributaries where property access was granted. No redds were identified on the mainstem, however, redds were identified on three tributaries: Salsipuedes (Upper and Lower), El Jaro, and San Miguelito Creeks **(Table 5.2.2-2)**. There were 25 redds total documented in both Upper and Lower Salsipuedes Creek, 18 in El Jaro Creek, and 49 in San Miguelito Creek. No redds were identified in Hilton Creek, although, spawning did take place since yoy were observed during various bank and snorkel surveys. The largest redds in total area excavated were observed in lower Salsipuedes and El Jaro Creeks. The smaller redd excavations were observed on upper Salsipuedes and San Miguelito Creeks. Spawning in all areas began in mid-March, and concluded by mid-April in Salsipuedes and El Jaro Creeks. Spawning in San Miguelito Creek continued up to May 8. Salsipuedes, both the upper and lower creek, documented all the spawning activity over a seventeen day period. El Jaro and San Miguelito Creeks had spawning activity documented over a 31

Table 5.2.2-2 1997 Redd dimensions and current velocities for rainbow trout/steelhead redds in Salsipuedes, El Jaro, and San Miguelito Creeks

Date Observed	Redd #	Head Depth (ft)	Head Velocity (ft/sec)	Pit Depth (ft)	Pit Velocity (ft/sec)	Avg. Tail Depth (ft)	Avg. Tail Velocity (ft/sec)	Length (ft)	Width (ft)	Substrate Size (mm)
					Salsipuedes Creek					
03/26/97	1	0.40	1.44	0.75	1.30	0.40	1.50	5.30	2.10	3 - 25
03/26/97	2	0.50	1.76	0.80	1.51	0.50	1.42	4.00	2.20	3 - 35
03/26/97	3	0.50	1.86	0.60	1.61	0.30	1.58	2.50	1.10	3 - 25
03/26/97	4	0.45	1.89	0.60	1.49	0.33	1.83	3.20	1.40	3 - 25
03/26/97	5	0.50	1.76	0.60	1.62	0.35	1.69	3.40	1.60	3 - 25
04/08/07	6	0.40	1.13	0.60	1.17	0.18	1.28	2.70	8.00	3 - 35
04/08/07	7	0.35	1.11	0.40	1.33	0.23	1.39	1.40	1.70	3 - 40
04/10/07	8	0.70	1.71	0.80	1.46	0.55	1.85	5.00	2.00	3 - 35
04/10/07	9	0.45	1.37	0.65	1.05	0.37	1.38	3.20	1.90	3 - 35
04/10/07	10	0.45	1.34	0.65	1.13	0.35	1.38	4.50	2.20	3 - 35
04/10/07	11	0.55	1.68	0.65	1.65	0.50	1.56	4.50	2.00	3 - 35
04/11/07	12	0.55	1.50	0.60	1.34	0.41	1.60	4.50	2.60	3 - 40
04/11/07	13	0.40	1.92	0.60	1.56	0.32	1.95	6.50	2.20	3 - 40
04/11/07	14	0.25	1.53	0.60	0.88	0.28	1.37	7.50	2.20	3 - 35
					Upper Salsipuedes Creek					
03/12/97	1	0.25	1.19	0.45	1.25	0.33	1.35	1.30	0.90	3 - 20
03/12/97	2	0.45	1.61	0.60	1.49	0.30	1.75	2.20	1.60	3 - 20
03/12/97	3	0.25	1.47	0.35	1.01	0.20	1.24	1.60	0.70	3 - 20
03/12/97	4	0.30	1.16	0.45	0.93	0.23	1.14	2.80	1.80	3 - 30
03/18/97	5	0.35	1.66	0.45	1.56	0.25	2.01	2.50	1.10	3 -20
03/18/97	6	0.30	1.35	0.50	0.73	0.35	1.02	4.30	2.30	3 - 25
03/18/97	7	0.40	1.79	0.60	1.62	0.32	1.52	3.40	1.80	3 - 25
03/18/97	8	0.50	0.81	0.60	0.78	0.47	1.06	3.40	1.30	3 - 20
03/27/97	9	0.30	1.54	0.35	1.29	0.18	1.21	2.00	1.10	3 - 35
03/27/97	10	0.25	1.72	0.40	1.04	0.23	1.20	2.50	1.30	3 - 35
03/27/97	11	1.25	1.31	0.30	1.24	0.20	1.22	2.10	1.10	3 - 35
					El Jaro Creek					
03/12/97	1	0.50	0.60	0.65	0.61	0.50	0.79	2.50	1.10	3 - 30
03/12/97	2	0.50	1.27	0.70	1.17	0.40	1.23	2.10	1.10	3 - 15
03/18/97	3	0.60	1.20	0.65	1.19	0.30	1.60	4.30	1.40	3 - 15
03/18/97	4	0.45	0.83	0.70	0.76	0.43	1.25	6.50	4.00	3 - 25
03/18/97	5	0.55	0.61	0.50	0.44	0.20	0.93	3.00	1.50	3 - 25
03/18/97	6	0.50	0.93	0.70	0.85	0.45	1.19	5.20	3.30	3 - 15
03/27/97	7	0.45	0.84	0.80	0.38	0.57	0.76	2.80	1.20	3 - 20
03/27/97	8	0.65	0.53	0.70	0.74	0.50	0.76	2.70	1.50	2 - 15
03/27/97	9	0.35	1.05	0.50	0.81	0.27	1.12	4.00	2.00	3 - 20
03/27/97	10	0.55	1.06	0.60	0.97	0.30	1.52	2.50	2.00	3 - 25
03/27/97	11	0.30	0.86	0.45	0.95	0.33	1.12	2.50	1.50	3 - 25
03/27/97	12	0.40	0.70	0.50	0.58	0.27	0.78	2.70	1.60	3 - 20
04/11/07	13	0.40	0.48	0.45	0.57	0.23	0.48	4.00	1.90	3 - 35
04/11/07	14	0.25	0.93	0.40	0.77	0.25	1.23	3.50	1.60	3 - 35
04/11/07	15	0.40	0.46	0.60	0.46	0.35	0.64	4.50	2.00	3 - 35
04/11/07	16	0.35	0.84	0.50	0.81	0.30	0.93	4.70	2.90	3 - 35

Table 5.2.2-2 1997 Redd dimensions and current velocities for rainbow trout/steelhead redds in Salsipuedes, El Jaro, and San Miguelito Creeks

	Redd #	Head Depth (ft)	Head Velocity (ft/sec)	Pit Depth (ft)	Pit Velocity (ft/sec)	Avg. Tail Depth (ft)	Avg. Tail Velocity (ft/sec)	Length (ft)	Width (ft)	Substrate Size (mm)
					El Jaro Creek					
04/11/07	17	0.60	1.14	0.75	0.96	0.58	0.84	4.60	2.50	3 - 35
04/11/07	18	0.30	1.06	0.50	0.52	0.32	1.50	3.60	1.70	3 - 35
					San Miguelito Creek					
03/20/97	1	0.30	0.82	0.45	0.73	0.25	0.78	0.90	0.60	3 - 15
03/20/97	2	0.35	1.13	0.45	1.03	0.30	1.03	1.20	0.70	3 - 20
03/20/97	3	0.25	1.26	0.40	1.05	0.22	1.06	1.60	0.70	3 - 20
03/20/97	4	0.35	1.13	0.45	1.08	0.25	1.17	0.80	0.60	3 - 20
03/20/97	5	0.25	1.19	0.40	1.23	0.32	1.20	1.30	0.90	3 - 20
03/28/97	6	0.30	0.83	0.50	0.76	0.27	0.91	2.30	2.60	3 - 20
03/28/97	7	0.35	0.60	0.50	0.62	0.35	0.85	2.30	1.60	3 - 20
03/28/97	8	0.30	1.12	0.55	0.85	0.32	1.07	2.10	1.70	3 - 25
03/28/97	9	0.30	0.97	0.45	0.88	0.17	0.92	1.40	0.70	3 - 25
03/28/97	10	0.30	0.97	0.40	0.91	0.27	1.00	3.10	2.00	na
03/28/97	11	0.25	0.80	0.30	0.73	0.17	0.85	1.30	0.80	3 - 30
03/28/97	12	0.50	0.86	0.65	0.69	0.32	0.93	4.60	1.80	3 - 30
03/28/97	13	0.30	0.84	0.40	0.73	0.17	0.89	3.10	1.40	3 - 30
04/14/07	14	0.20	1.09	0.30	1.24	0.18	1.16	3.00	1.50	3 - 40
04/14/07	15	0.15	0.74	0.35	0.80	0.18	0.91	4.00	1.80	3 - 25
04/14/07	16	0.25	0.61	0.30	0.57	0.13	0.59	3.60	1.60	5 - 25
04/14/07	17	0.30	0.75	0.40	0.83	0.22	0.91	2.20	1.00	3 - 32
04/14/07	18	0.15	0.71	0.20	0.60	0.07	0.39	1.30	0.80	3 - 32
04/14/07	19	0.30	0.97	0.35	0.93	0.22	0.89	2.50	1.40	3 - 20
04/14/07	20	0.25	0.95	0.30	0.94	0.18	0.95	2.00	1.20	3 - 20
04/14/07	21	0.20	0.95	0.25	0.80	0.12	0.72	1.50	0.80	3 - 20
04/14/07	22	0.15	0.54	0.2	0.71	0.12	0.70	2.40	1.10	3 - 20
04/15/07	23	0.20	0.99	0.3	0.87	0.12	0.98	2.50	1.30	3 - 20
04/15/07	24	0.30	0.95	0.35	0.83	0.15	0.89	2.20	1.10	3 - 20
04/15/07	25	0.20	0.81	0.3	0.86	0.2	0.85	4.00	2.10	3 - 25
04/15/07	26	0.25	0.80	0.35	0.79	0.22	0.83	2.30	1.10	3 - 25
04/15/07	27	0.40	0.58	0.5	0.56	0.42	0.81	3.20	1.20	3 - 15
04/15/07	28	0.50	0.84	0.55	0.75	0.43	0.75	2.90	1.30	3 - 20
04/15/07	29	0.25	0.79	0.5	0.76	0.17	0.46	3.00	1.20	3 - 20
04/16/07	30	0.20	1.01	0.3	0.82	0.13	0.74	4.90	1.90	3 - 20
04/16/07	31	0.40	0.80	0.5	0.80	0.23	0.97	4.00	1.70	3 - 25
04/16/07	32	0.25	0.39	0.25	0.41	0.15	0.45	2.20	1.00	3 - 20
04/16/07	33	0.30	0.97	0.35	0.97	0.23	1.01	2.00	1.10	3 - 20
04/16/07	34	0.25	0.71	0.45	1.05	0.27	1.30	4.40	1.60	3 - 27
04/16/07	35	0.30	1.03	0.45	0.92	0.2	1.53	3.10	1.50	5 - 35
04/16/07	36	0.20	0.82	0.25	0.94	0.13	0.67	3.50	1.20	3 - 25
04/16/07	37	0.20	0.88	0.40	0.96	0.2	1.23	4.50	2.90	3 - 25
04/16/07	38	0.40	1.16	0.50	0.66	0.22	0.88	4.60	2.20	3 - 25
04/16/07	39	0.40	0.81	0.50	0.70	0.35	0.92	3.80	1.60	3 - 25
04/16/07	40	0.40	0.46	0.60	0.48	0.33	0.95	3.50	1.60	3 - 25

Table 5.2..2-2 1997 Redd dimensions and current velocities for rainbow trout/steelhead redds in Salsipuedes, El Jaro, and San Miguelito Creeks

	Redd #	Head Depth (ft)	Head Velocity (ft/sec)	Pit Depth (ft)	Pit Velocity (ft/sec)	Avg. Tail Depth (ft)	Avg. Tail Velocity (ft/sec)	Length (ft)	Width (ft)	Substrate Size (mm)
					San Miguelito Creek					
04/16/07	41	0.20	1.04	0.40	0.96	0.22	0.87	3.40	1.20	3 - 20
04/16/07	42	0.25	1.09	0.45	0.87	0.3	0.71	2.00	1.70	3 - 20
04/16/07	43	0.40	0.51	0.50	0.58	0.13	0.69	4.60	2.00	3 - 25
04/29/07	44	0.25	0.91	0.35	0.83	0.18	0.97	3.10	1.50	3 - 25
04/29/07	45	0.30	0.62	0.40	0.65	0.28	0.39	1.60	1.20	3 - 20
04/30/07	46	0.25	1.32	0.40	1.39	0.18	1.07	3.60	1.90	3 - 25
04/30/07	47	0.35	0.72	0.45	0.82	0.3	0.72	2.10	0.90	3 - 20
05/08/97	48	0.30	0.56	0.40	0.50	0.2	0.67	3.20	1.40	3 - 25
05/08/97	49	0.3	0.24	0.30	0.09	0.1	0.49	3.00	1.80	3 - 25

and a 49 day period respectively. Water temperatures (thermograph records) through the period of spawning activity showed that both lower and upper Salsipuedes, El Jaro, and San Miguelito Creeks had very similar average temperature ranges of 15.1, 13.9, 14.7, and 13.8 C (56.8-59.2 F) respectively. According to Piper et al (1986), eggs exposed to these temperature ranges could be expected to hatch within 19-24 days, given optimal water quality conditions.

5.3 Snorkel Surveys

5.3.1 Methods

Routine snorkel surveys in 1996 and 1997 provide the primary source of information on fish distribution in the SYR. The following is a list of fish species observed during snorkel surveys and their relative abundance in each study reach. Snorkel surveys were reduced to twice/year in 1997; once in June and again in October. During the June surveys, only the Refugio, Weister and Cargasachi reaches could be snorkeled. Both the Highway 154 and Alisal reaches had poor visibility or were completely dry which prevented surveys. In October, only the Highway 154 (except long pool) and Alisal reaches were snorkeled. The endangered listing for Southern California steelhead prevented further snorkel surveys in October.

The purpose of both mainstem and tributary snorkel surveys was to: (1) determine if successful spawning of migrating STL/RBT occurred, by observing young of the year, (2) determine the presence or absence of juvenile and/or adult STL/RBT in the mainstem and tributaries, and (3) determine and document fish species composition and relative abundance in each tributary.

Following habitat typing activities in both the mainstem and tributaries, habitat types were stratified (pool, riffle, and run) and snorkel sites were randomly selected to be evenly distributed throughout each study reach. Snorkel surveys were conducted using two person crews. Observers traversed the habitat unit, from downstream to upstream, counting fish by species by 3 inch size class (one inch size class when possible), within their respective lanes. At least two passes were made with a 30 minute interval between each pass. Data collected included: number of each species/lifestage by pass, length of habitat unit sampled, and duration of each pass. In 1997, the same habitats were again snorkeled in June and October. Poor water visibility conditions in June prevented many mainstem units from being snorkeled. Snorkel surveys were conducted in Salsipuedes Creeks from November through December 1996, in June 1997, and partially in October 1997. In addition, work constraints, and the listing of the southern range of steelhead as endangered in mid-October prevented a complete snorkel survey of both the mainstem and tributaries.

5.3.2 Results

5.3.2.1 Mainstem

Arroyo Chub

Arroyo chub *(Gila orcutti)* is an introduced species in the SYR, but is a native fish species to coastal streams of Southern California. It has adapted to the rigors of seasonal changes in coastal streams, particularly the warm summer months. It feeds extensively on aquatic algae and invertebrates associated with such plants. Breeding takes place in the spring when water conditions are optimal for fry production.

In 1996, arroyo chub were most abundant, and were exclusive to the Refugio Reach **(Table 5.3.2-1)**. Chub were observed predominantly in pool habitats, particularly in July, although moderate numbers were also observed in run habitats. No chub were observed in riffle habitats. The July snorkel survey was conducted prior to WR 89-18 releases. In August, numbers dropped dramatically. This decline in abundance followed initiation of WR 89-18 flow releases from Cachuma Reservoir (in mid-July), a substantial increase in the number of largemouth bass observed in the reach, and the disappearance of the extensive algal mats that had become established in the river. By September, only four chub were observed during the snorkel survey.

The Refugio reach was snorkeled in June of 1997. In the June snorkel surveys, there were only 6 arroyo chub observed in the entire Refugio Reach. All chub were observed in run habitats. An additional 30 arroyo chub were observed in step run habitats in the Cargasachi, again in June.

Stickleback

Threespine stickleback *(Gasterosteus aculeatus)* are a native species with wide distribution in California. They are a small, (adults 3 inches or less), short lived species that generally reach greatest abundance during the summer months. Sticklebacks are repeat spawners during the breeding season and populations can expand rapidly under good conditions (Wang 1986). They feed primarily on small invertebrates that they pick

Table 5.3.2-1 Distribution of Arroyo Chub in 1996-97 Visual Surveys

Reach	Month/Year	# of Habitat Type Surveyed	# of Fish Observed
		7 Pools	1373
Refugio	Jul-96	2 Runs	208
		7 Pools	103
	Aug-96	3 Runs	300
		5 Pools	6
		11 Runs	0
	Jun-97	1 Deep Run	0
		5 Pools	0
		7 Runs	0
Cargasachi	Jun-97	2 step Runs	30

off the substrate after a series of short jerky advances, between which they hang motionless in the water. This feeding behavior, coupled with their small size, makes them potential food for a number of fish species (McGinnis 1984). However, their spines function well in protecting them from predation. Stickleback can tolerate a wide range of environmental conditions including low dissolved oxygen, fluctuating temperatures, and variable salinity. Some populations are anadramous, spending most of their adult life in saltwater. Other populations complete their life cycles in freshwater.

In 1996, stickleback distribution was similar to that of arroyo chub (**Table 5.3.1-2**): virtually absent in the Highway 154 reach, abundant in the Refugio reach, moderately abundant in the Alisal Reach, and present in low numbers in the Cargasachi reach. Like arroyo chub, the majority of sticklebacks were found in pools in the Refugio and Alisal reaches the two reaches with most abundant growths of algae. Counts were greatest in July followed by a substantial decrease in August with stickleback nearly disappearing by September. Declines in the Refugio reach were associated with an increase in observations of largemouth bass, particularly bass greater than six inches in length. The decline in stickleback abundance followed loss of extensive algal mats that had developed in many habitats due to WR 89-18 releases.

In June 1997, stickleback distribution was most abundant in the Refugio and Cargasachi reaches (June), with the majority observed in run habitats, and lesser numbers observed in both pool and deep run habitats. No stickleback were observed in the Highway 154 (October) or Weister Ranch (June) reaches. Only two sticklebacks were observed in a pool habitat in the Alisal reach during October.

Bass

Largemouth bass *(Micropterus salmoides)*, and to a far lesser degree smallmouth bass *(Micropterus dolomieui)* have been observed in the lower SYR. Largemouth bass are the largest of the Centrarchids, and are relatively long-lived, warm water species that becomes piscivourous at a surprisingly small size (McGinnis 1984). They prefer warm

Table 5.3.2-2 Distribution of Stickleback in 1996-97 Visual Surveys

Reach	Month/Year	# of Habitat Type Surveyed	# of Fish Observed
Refugio	Jul-96	7 Pools	2307
		3 Runs	400
	Aug-96	7 Pools	242
		3 Runs	347
	Jun-97	5 Pools	3025
		11 Runs	10320
		1 Deep Runs	800
Alisal	May-96	4 Pools	2002
		1 Run	12
	Jun-96	2 Pools	400
	Jul-96	5 Pools	136
	Aug-96	1 Pool	1
		1 Run	8
Cargasachi	Jun-97	5 Pools	0
		7 Runs	10800
		2 Step Runs	400

water temperatures (13-27 C), and can tolerate relatively low dissolved oxygen conditions.

In 1996, the greatest number of observations of larger size classes of largemouth bass was in pools in the Highway 154 reach, primarily in the long pool **(Table 5.3.1-1)**. Conversely, yoy and juvenile bass were more abundant in the Refugio and Alisal reaches and less abundant in the Cargasachi reach. In the Refugio and Alisal reaches, bass were more abundant in pool habitats and less abundant in run habitats. Numbers of bass less than six-inch increased dramatically in August (after WR 89-18). Numbers remained nearly identical in most habitats during August and September, with a significant decrease seen in October. Moderate numbers of both size ranges of bass were observed in mostly pool habitats in the Avenue of the Flags reach in September.

In the June surveys of 1997, the majority of bass greater than six inches were nearly evenly distributed in the Refugio, Weister, and Cargasachi reaches. The vast majority of bass less than three inches, and greater than six inches were exclusive to the Refugio reach. In October, the long pool was not snorkeled surveys, and consequently very few fish were observed in the Highway 154 reach. Numbers of bass in the Alisal reach in October were substantially greater compared to the combined totals of bass observed in the June survey. This is probably a result of bass movement downstream with the WR 89-18 releases. Over 95% of the bass observed were in the 3-6 and 6-9 inch size category.

Table 5.3.2-3. Distribution of Largemouth Bass in 1996-97 Visual Surveys

Reach	Month/Year	# of Habitat Type Surveyed	# of Fish Observed > 6 Inches	# of Fish Observed < 6 Inches
		3 Pools	23	731
Highway 154	May-96	4 Runs	0	0
		3 Pools	22	596
	Jun-96	4 Runs	0	8
		3 Pools	36	163
	Aug-96	4 Runs	0	0
		6 Pools	14	106
Refugio	Jul-96	3 Runs	1	18
		7 Pools	164	164
	Aug-96	3 Runs	6	27
		5 Pools	4	
		11 Runs	38	14
	Jun-97	1 Deep Run	0	4 4
		4 Pools	84	27
Alisal	May-96	1 Run	16	5
	Jun-96	2 Pools	51	6
		6 Pools	40	8
	Jul-96	2 Runs	1	6
		7 Pools	250	43
	Aug-96	2 Runs	48	18
		5 Pools	2	16
Weister	Jun-97	6 Runs	0	1
		5 Pools	3	7
		7 Runs	9	14
Cargasachi	Jun-97	2 Step Runs	0	0

Smallmouth bass are also relatively long-lived, but are less picivourous than largemouth bass, and have a greater reliance on insect food. Aside from preferring cooler water temperatures (10-21 C), its biology is similar to the largemouth bass. Smallmouth bass inhabit flowing waters in rivers, in addition to lakes.

Smallmouth bass were observed in the lower SYR immediately downstream of Bradbury Dam, mostly in the long pool. Smallmouth bass nests and eggs (with males guarding the nests) were observed in the tail of the spill basin and in the confluence pool in the Highway 154 reach. Bass were observed in one unit in the Refugio reach, and three units in the Alisal reach up through August, but were not seen after August in any reach except the Highway 154 reach. No smallmouth bass were observed in 1997.

Prickly Sculpin

The Prickly Sculpin *(Cottus asper)* is the most widely distributed of the sculpins in California. They are small fish, rarely exceeding 10 cm (4 inches). Sculpins are tolerant to a wide range of environmental conditions. During the day, they normally go unnoticed due to their excellent protective coloration and their habit under bottom objects. At night they are active feeders on a variety of bottom dwelling invertebrates, particularly insect larvae (McGinnis 1984). Spawning takes place during the spring. The male scoops out a depression under a rock where the female lays adhesive eggs to the underside of the rock. One female may lay up to 11,000 eggs.

Sculpin were observed in the highest concentrations all habitats in the Highway 154 reach during May through October. Observations were higher prior to WR 89-18 releases compared to after. Sculpin observations were virtually nonexistent in all other reaches. In 1997, sculpin were observed in low numbers in the Highway 154 reach only.

Pacific Lamprey

Pacific lamprey *(Lampetra tridentata)* is the largest species of lamprey that migrates upstream into California waters, with adults attaining lengths up to 0.6 m. The adult stage lives for only one or two years and inhabits estuaries and nearby ocean areas. Most spawning takes place between late spring and early summer. Spawning is surprisingly similar to that of salmonids, with both sexes constructing nests by removing stones and gravel from circular plots about the diameter of their body. Newly hatched ammocete larvae move downstream with the current to areas of greater organic bottom debris, where they take up a filter feeding existence. They remain buried throughout most of their five to seven year larvae life. They metamorphose at about 15 cm and move downstream to the estuary and sea to begin the parasitic phase of their life cycle.

Lampreys were not observed during snorkel surveys, however, three were captured during the 1996 mainstem migrant trapping (see mainstem migrant trapping). No lamprey were observed or captured during the 1997 season.

Rainbow Trout/Steelhead

Rainbow trout *(Oncorhynkis mykiss)* and steelhead (the anadramous form of the rainbow trout) are native to the drainage of Pacific North America. Steelhead are relatively long lived, feed on forage fish in the ocean, and can attain large size. Rainbow trout that remain in streams (residents) live in the stream their entire lives, feed mainly on insects, and are not especially large at maturity. The time of spawning is usually consistent from year to year in a given stream but can differ by a month or more among stream in the same region. Young rainbow trout and steelhead have a variety of migration patterns that vary with local conditions; control mechanisms appear to range from mostly genetic to mostly environmental. The time when steelhead smolts migrate to the sea appears to be controlled by photoperiod, but is influenced at times by other environmental factors such as flow, temperature, and lunar phase.

Rainbow trout/steelhead have been observed in the upper three reaches of the SYR during the 1996 snorkel surveys. The greatest numbers of rainbow trout steelhead adults were consistently observed in the Highway 154, primarily in the long pool. Rainbow trout/steelhead were observed in four units in the Refugio reach (3 pools and 1 run), but persisted only in habitat unit # 17 (mile 6.0). Observed numbers were greatest in September and consisted of fish between 6-12 inches. In the Alisal reach, rainbow trout/steelhead were observed in two pool habitats, and persisted in low numbers in units #20 and #28. All fish were observed to be between 7-12 inches. By October, no rainbow trout/steelhead were observed in the SYR proper.

5.3.2.2 Tributary Snorkel Surveys

In 1996, one snorkel survey was initiated in randomly selected habitat units in late November, and was completed by early December. Most of the selected sites were sampled in lower Salsipuedes Creek. Unfortunately, two-thirds of the habitats in El Jaro Creek, and all of upper Salsipuedes were not sampled due to poor visibility and storm events. One complete snorkel survey was conducted in Salsipuedes and El Jaro Creeks in June, in addition to a partial snorkel survey of lower Salsipuedes in October.

There were two snorkel surveys conducted in 1997, one in June which was a complete survey, and another in October that was a partial survey of lower Salsipuedes Creek. The October survey could not be completed due to time constraints with other ongoing studies, in additions to the listing of the Southern California Steelhead as Endangered on October 14, 1997.

Lower Salsipuedes Creek

In 1996, one snorkel survey was conducted in 29 of the 33 revisited habitat units in Lower Salsipuedes. Often times, more fish of all species were observed on the second pass. There were 5 pools, 6 riffles, 14 runs, and 4 deep runs surveyed using a single diver. In 1997, 26 habitats were snorkeled: 5 pools, 5 riffles, 11 runs, 4 deep runs, and one step run.

Arroyo Chub

Arroyo chub were the most abundant fish species observed in both 1996 and 1997 **(Table 5.3.2-3)**. In 1996, more than half of the fish were observed in 7 of the 14 run habitats. Nearly 400 were observed in three of the five pool habitats and slightly greater then 400 were observed in all four deep run habitats. Chub observations were more numerous downstream of Jalama Bridge in both years. Nearly half of the chub in 1997 were observed in run habitats, and approximately 1/3 were observed in pool habitats. Chubs observed in deep run accounted for almost a third of the observations.

Stickleback

There were 1208 stickleback observed in the lower creek in 1996, and 2934 observed in 1997. More than half (620) were observed in run habitats in 1996, but a greater proportion were (405) observed in the four run habitats. Only 180 were observed in pools. Sticklebacks were the only fish species observed in riffles in the lower creek, and were not observed upstream of Jalama Bridge. Most of the stickleback observed in 1997

Table 5.3.2-3. 1996-97 Snorkel Survey Results

1996 Lower Salsipuedes Creek Snorkel Survey Reults (November-December)

					Rainbow Trout/Steelhead			
Habitat	**Stick.**	**Gambusia**	**Chub**	**Fathead**	**0-3**	**3-6**	**6-9**	**9-12**
5 Pools	180	12	376	0	3	22	2	7
4 Deep Run	405	42	402	0	2	5	0	0
6 Riffle	3	0	0	0	0	0	0	0
14 Runs	620	67	953	19	7	10	0	0
Total=	**1208**	**121**	**1731**	**19**	**12**	**37**	**2**	**7**

1997 Lower Salsipuedes Creek Snorkel Survey Results (June)

					Rainbow Trout/Steelhead				
Habitat	**Stick.**	**Gambusia**	**Chub**	**Fathead**	**0 -3**	**3 - 6**	**6 - 9**	**9 - 12**	**≥ 12 (in)**
5 Pool	825	0	1026	15	18	0	149	10	6
5 Riffle	69	0	30	0	1	0	0	0	0
11 Run	1290	0	1450	1	7	0	17	0	0
4 Deep Run	750	0	705	0	7	0	6	0	0
1 Step Run	0	0	0	0	0	0	0	0	0
Total =	**2934**	**0**	**3211**	**16**	**33**	**0**	**172**	**10**	**6**

1997 Lower Salsipuedes Creek Snorkel Survey Results (October)

					Rainbow Trout/Steelhead			
Habitat	**Stick.**	**Gambusia**	**Chub**	**Fathead**	**0 -3**	**3 - 6**	**6 - 9**	**9 - 12**
7 Pools	586	60	262	0	0	7	29	0
5 Runs	250	50	630	0	0	1	1	0
Total =	**836**	**110**	**892**	**0**	**0**	**8**	**30**	**0**

1996 El Jaro Snorkel Survey Results (June)

					Rainbow Trout/Steelhead			
Habitat	**Stick.**	**Gambusia**	**Chub**	**Fathead**	**0 -3**	**3 - 6**	**6 - 9**	**9 - 12**
1 Pool	4	0	8	0	1	1	0	0
3 Riffle	0	0	0	0	2	0	0	0
1 Run	60	0	6	0	0	0	0	0
1 Deep Run	0	0	0	0	0	1	1	0
Total =	**64**	**0**	**14**	**0**	**3**	**2**	**1**	**0**

1997 El Jaro Snorkel Survey Results (June)

					Rainbow Trout/Steelhead				
Habitat	**Stick.**	**Gambusia**	**Chub**	**Fathead**	**0 -3 (in)**	**3 - 6 (in)**	**6 - 9 (in)**	**9 - 12 (in)**	**≥ 12 (in)**
5 Pools	800	0	590	0	7	31	9	0	0
4 Riffles	70	200	35	0	7	0	0	0	0
6 Runs	910	200	790	0	29	20	2	0	0
2 Deep Runs	55	0	104	0	2	0	0	0	0
1 Step Run	50	0	100	0	0	0	0	0	0
Total =	**1885**	**400**	**1619**	**0**	**45**	**51**	**11**	**0**	**0**

Table 5.3.2-3. 1996-97 Snorkel Survey Results

1997 Upper Salsipuedes Creek Snorkel Survey Results (June)

					Rainbow Trout/Steelhead			
Habitat	Stick.	Gambusia	Chub	Fathead	0 -3 (in)	3 - 6 (in)	6 - 9 (in)	9 - 12 (in)
3 Pools	25	0	4	0	25	4	1	0
2 Riffles	3	0	0	0	0	0	0	0
5 Runs	73	0	22	0	29	5	0	0
2 Step Run	28	0	5	0	2	0	0	0
Total =	**129**	**0**	**31**	**0**	**56**	**9**	**1**	**0**

were in run and deep run habitats (1290,750 respectively). There were 825 observed in pools, and 69 observed in riffles.

Bass, Bullhead, Sunfish, and Minnows

Few of these warmwater species were observed in the lower creek in 1996. Nearly all of the fish were observed in one pool habitat downstream from Jalama Bridge. Bullhead were the most numerous (22) with two being greater than twelve inches. Six largemouth bass between 6-12 inches were also observed. In addition, five sunfish and 20 fathead minnows were observed in run habitats. In June 1997, no bass were observed in the lower creek. However, green sunfish observations increased significantly to 53 with the vast majority observed in pool habitats. Green sunfish were the most numerous warm water species observed. Only 2 bullhead were observed during the surveys.

Rainbow Trout/Steelhead

Several size and age classes of rainbow trout/steelhead were observed in the lower creek in 1996. A total of 58 rainbow trout/steelhead were observed, half ranging between 3-6 inches. Most of the 3-6 inch fish were observed in pool and deep run habitats, while trout less than three inches were observed in run habitats. All rainbow trout/steelhead greater than 6 inches were observed in pool habitats downstream of Jalama Bridge. Significantly greater numbers of rainbow trout/steelhead were observed in June 1997 than in 1996. A total of 221 rainbow trout/steelhead were observed in 1997 in lower Salsipuedes Creek. There were 172 trout observed in the 6-9 inch size category, with 149 observed in pool habitats, and 23 observed in both run and deep run habitats. There were 33 fish in the 0-3 inch size category observed, with most again being observed in pool habitats. The vast majority of rainbow trout/steelhead were observed in pool habitats, illustrating the importance these habitats play in completing the life cycle of rainbow trout/steelhead.

Upper Salsipuedes Creek

Upper Salsipuedes Creek holds less variety of fish species when compared to lower

Salsipuedes and El Jaro Creeks. Only stickleback, arroyo chub, and rainbow trout/steelhead were observed in the upper creek. A total of 12 habitats were snorkeled in 1997: 3 pool, 2 riffle, 5 runs, and 2 step runs. Sticklebacks were the most numerous with 129 being observed, mostly in run habitats. Arroyo chub (31) were observed almost exclusively in run habitats. There were a total of 66 rainbow trout/steelhead observed in the upper creek with the majority (56) in the 0-3 inch size catagory. The majority of the trout inhabited both pool and run habitats.

El Jaro Creek

Only 7 of 21 selected units were snorkeled in 1996: 1 pool, 3 runs, and 3 riffles. A total of 69 stickleback, 21 chub, and 6 rainbow trout/steelhead were observed. Nearly all of the stickleback were observed in run habitats. Chub observations were divided between both pool and run habitats. Rainbow trout/steelhead observations were evenly divided between all three habitat types. The pool habitat held two trout, one trout in the 0-3 inch size category, and another in the 3-6 inch size category. Two trout less than three inches were observed in one riffle habitat, and two other trout were observed in run habitats.

Eighteen habitats were snorkeled in June 1997. Snorkeled habitats consisted of 5 pools, 4 riffles, 6 runs, 2 deep runs, and one step run. Stickleback, gambusia, chub, and rainbow trout/steelhead comprised all fish observations. Stickleback (1,885) and chub (1,619) were the most numerous fish observed with the majority of the fish inhabiting pools and runs. There were 400 gambusia observed with even distributed in both riffle and run habitats. A total of 107 rainbow trout/steelhead were observed in the creek. Counts were nearly even between the 0-3 (45) and 3-6 (51) inch size category. An additional 11 trout were observed in the 6-9 inch size category. The majority of the smaller fish were observed in run habitats, while the majority of the larger size categories were observed in pool habitats.

Hilton Creek

Two snorkel surveys were conducted in Hilton Creek, one on July 21 and another on October 14, 1997. There were 26 rainbow trout/steelhead observed in the creek during the July survey, 19 of which were between 2-4 inches in length. Most of the fish, particularly the smaller size classes were observed in the lower section of the creek, inhabiting both run and small pool habitats. The larger fish were observed in the spawning pool habitat. Similar observations were noted in the October survey with the exception of fewer fish being observed (19). Seven of the fish observed in the October survey were within the 3-6 size category, and five were in the 6-9 inch category.

5.4 Long Pool and Spill Basin Fish Removal

5.4.1 Long Pool Fish Removal Program

The BOR initiated a fish removal plan utilizing passive capture techniques in the Long Pool. The duration of the trapping was 15 consecutive days from March 17 through March 31, 1997. All captured fish (except rainbow trout/steelhead) were relocated to Lake Cachuma. Captured rainbow trout/steelhead were measured, described, and tagged using PIT (Passive Intagrated Transponder) tags before being released back into the long pool. Three fyke-type traps were used to capture fish. Fish species captured included largemouth bass, sunfish species (green, redear, bluegill, and black crappie), bullhead, channel catfish, sculpin, and rainbow trout/steelhead (**Table 5.4-1**). A total of 165 fish were captured not including 131 southwestern pond turtles, a Federally listed species of Special Concern. Of the 165 fish captured, 94 were bass, sunfish, and catfish, which are likely to opportunistically feed upon the various life-cycles of rainbow trout/steelhead. Sculpins accounted for the remaining 71 captured fish of which the majority were captured during the last 5 days of the trapping program. Nearly half (45) of the bass, sunfish, and catfish were captured during the first five days of the trapping program. Fewer (24) were captured during the next 5 days, and only 15 were captured during the last 5 days of the trapping program. Cumulatively, the various species of sunfish made up 33% of the total number of fish captured.

Table 5.4-1 Long Pool Fish Capture Results

Species	Number Captured	Average Length (in)	Average Weight (lb)	Percent of total
Catfish	7	22.4	5.9	4
Bullhead	6	13.5	2.0	4
Crappie	3	9.8	0.5	2
Bluegill	12	5.9	0.4	7
Redear	18	8.8	0.4	11
Green	22	10.4	1.2	13
Sculpin	71	N/A	N/A	43
Largemouth	16	13.0	1.5	10
Steelhead	10			6
Total	**165**			**100**

5.4.2 Spill Basin Fish Removal Program

A fish removal program was initiated in the Lake Cachuma spill basin on April 6, 1997. The cooperative effort included members of the SYRTAC field crew, USFWS, CDFG, and the BOR. The spill basin had previously been dewatered to a minimum pool whose dimensions were approximately 200 feet by 100 feet with a uniform depth of two feet. The field crews pulled a 100 foot long nylon seine (1.0 inch dimensions) along the bottom of the spill basin from one end to the other. Captured fish were netted from the enclosure and transferred to a holding tank which was lifted via crane over the spill basin retaining wall (40 feet high) to a station where the fish were measured and weighed before being released into Lake Cachuma. A total of 1028 fish were removed from the spill basin (**Table 5.4-2**) of which catfish comprised nearly half of the fish captured, followed by largemouth bass, sunfish species (crappie, bluegill, redear, green), and smallmouth bass. All rainbow trout/steelhead (11) were removed from the spill basin and relocated into Hilton Creek where they were PIT tagged before being released into the creek.

Table 5.4-2 Spill Basin Fish Removal Results.

Species	**Number Captured**	**Average Length (in)**	**Average Weight (lb)**	**Percent of Total**
Catfish	493	25.9	7.1	48
Bullhead	2	N/A	N/A	<0.1
Crappie	13	13.4	1.9	1
Bluegill	78	7.6	0.7	8
Redear	62	10.2	1.8	6
Green	1	5.3	0.5	<0.1
Sculpin	50	N/A	N/A	5
Largemouth	237	15.0	2.8	23
Smallmouth	61	13.6	1.9	6
Steelhead	11			1
Goldfish	8			1
Eel	2			<0.1
Total	**1028**			**99**

5.5 Passive Integrated Transponder Tagging

Rainbow trout/steelhead captured in the long pool with passive techniques, and those removed from the spill basin were PIT tagged. The purpose of PIT tagging the fish was to gather information on movement during the spawning season. Captured fish with PIT tags would provide valuable information on growth, movement, and timing of migration runs into the various tributaries. A total of 12 rainbow trout/steelhead were captured and tagged. All tagged fish were released into pool habitats downstream of the passage impediment in Hilton Creek. Subsequent surveys at the fish release point noted a sizeable reduction in the numbers of steelhead/rainbow trout. It is highly probable that many of the fish were poached by anglers since several fishermen were observed fishing in the creek by BOR personnel.