MEMBER UNITS EXHIBIT NUMBER 31

Table of Contents

2.0 Hydrology

2.1 Precipitations and Lake Cachuma Inflow

1998

The winter of 1997-1998 was an extraordinary rain year. Beginning June 1997, the National Oceanic and Atmospheric Administration predicted a strong El Nino event, which was comparable to that of 1982-1983, the strongest El Nino on record. Historically, strong El Nino events have corresponded to above normal rainfall amounts throughout California. During the 1982-1983 El Nino, Southern California received over 200% the normal rainfall.
A typically rainfall year records amounts from September 1 through August 31.

Several storms of moderate to high intensity passed through the watershed from late November 1997 through January 1998 bringing the totals for the month to over 150% of normal. However, during February 1998, rain fell during more than half the month bringing the monthly totals to over 600% of normal, which resulted in tremendous flooding throughout Santa Barbara County. March was close to average, while April and May measured the highest totals ever recorded. To provide an indication as to the variability of rainfall throughout the watershed, Lake Cachuma recorded over 50 inches of rain, while Gibralter Reservoir measured 72.66 inches of rain. All told, rainfall amounts varied between 206% - 271% of normal for Santa Barbara County (1998 Santa Barbara County Flood Control) **(Table 2.1-2).**

Table 2.1-2 1998 Monthly Rainfall Data (inches) at Lake Cachuma

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainfall 1998	6.09	23.30	3.40	2.90	3.36	0.03	0	0	0.58	0.12	0.48	1.31
Rainfall 1999	3.19	1.54	5.71	3.23	.02	.07	.05	.02	.03	0	1.62	0

By the end of January 1998, the watershed was saturated and primed for runoff. The reservoir elevation at this time was nearly 18 feet from spill (732.0 feet). The first major storm of February occurred from February 1 through February 3, which resulted in peak inflow into Cachuma of about 40,000 cubic feet per second (cfs) and caused the lake to spill on February 3, 1998. The yearly peak inflow into Cachuma occurred at 4:00 pm on February 23 when runoff into the lake reached approximately 50,000 cfs.

1999

El Niño and La Niña are opposite phases of the El Niño-Southern Oscillation (ENSO) cycle, with La Niña sometimes referred to as the cold phase of ENSO and El Niño as the warm phase of ENSO. The amount of rain and climatic conditions experienced by Southern California during 1999 was typical of a La Nina event. La Nina events are characterized by cooler winter temperatures and average or below average rainfall. In 1999, only 15.48 inches of rain fell at the

Lake Cachuma monitoring location, compared to 41.57 inches in 1998. More than half of the rainfall was recorded during March and April. Computed inflow into the Lake Cachuma was greatest in April with 5089 acre-feet of water for the entire month. Actual measured flow was greatest on March 26 (365 cfs) following several storm events.

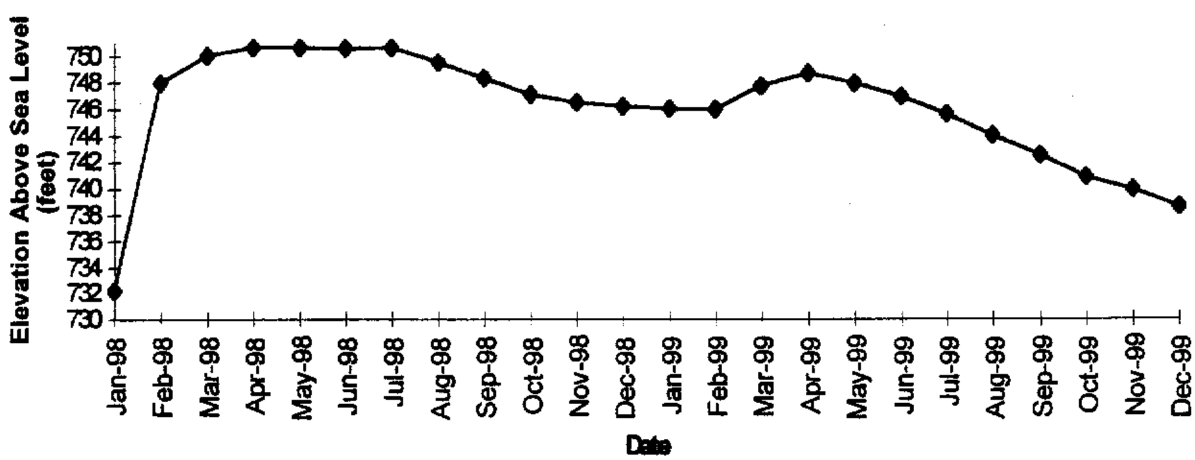
2.2 Lake Cachuma Elevations

1998

For the first time since its construction, Cachuma Reservoir operations were modified significantly to reduce possible flooding in the lower Santa Ynez River. In anticipation of continued storm activity throughout the year, the Bureau of Reclamation (BOR) began a 'pre-release' of water prior to subsequent storms to minimize the magnitude of the peak runoff downstream of Lake Cachuma. The result was a time delay between lower tributary runoff, and upper mainstem runoff, which reduced the total runoff magnitude. The new procedure proved to be enormously successful by reducing the peak flows in the lower watershed as much as 40% (1998 Santa Barbara County Flood Control).

The spill of 1998 lasted from February 3 through July 21,during which approximately 386,019 acre-feet (af) of water was spilled to the ocean. Lake elevation fluctuated slightly between February and July, but generally remained near maximum (750.75) **(Figure 2.2-1).**

Figure 2.2-1 1998 End of the Month Lake Elevations at Bradbury Dam



1999

Due to the amount of rain received during 1998 thereby filling the reservoir, in addition to there being no significant downstream water releases in 1999, it was suspected that the winter of 1999 would create runoff conditions that would allow the reservoir to spill for the second consecutive year. The few storm events during the winter of 1999 was nearly enough to spill the reservoir, however, reservoir elevation reached its maximum on April 27 with a water elevation of 748.79

feet. In the following months, lake elevation continued to decrease through Fish Account releases, evaporation, seepage, and south coast diversions to a end of the year elevation of 738.64 feet.

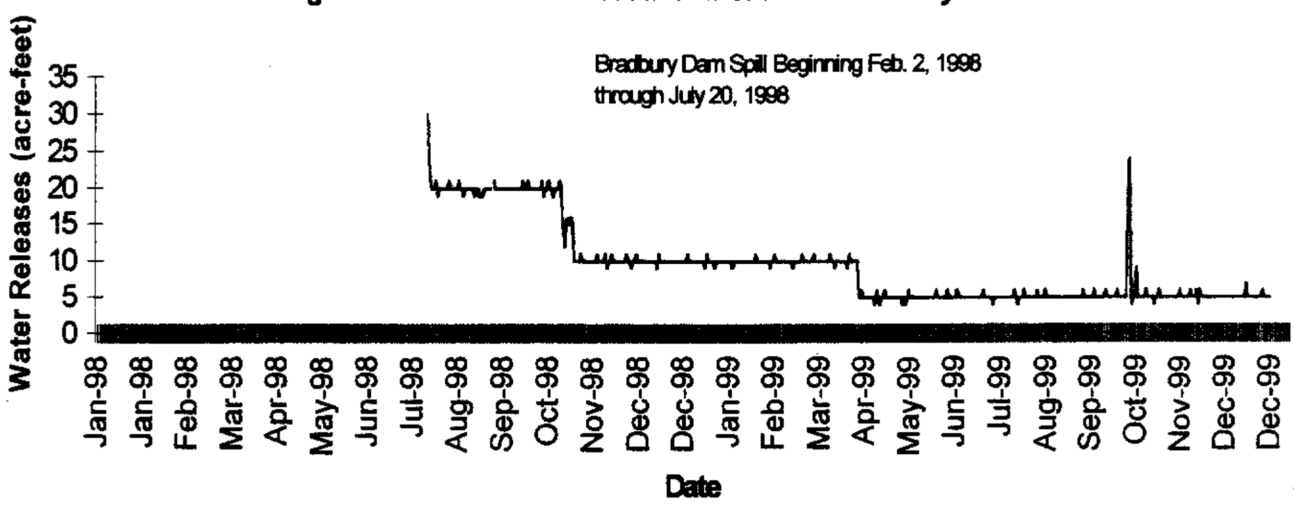
2.3 Fish Account and WR 89-18 Water Releases

The Fish Reserve Account is a volume of water within Lake Cachuma dedicated to protection and enhancement of fish downstream of Bradbury Dam. It is managed to reflect annual and inter-annual variations in hydrologic conditions, under the direction of the SYRTAC. Reclamation has given permission for the establishment of the Fish Reserve Account by allowing a surcharge of 0.75 feet in the reservoir.

1998

There was 2,600 af of water allocated to the Fish Account in 1998. Flow patterns allowed the Fish Account to be surcharged twice. Fish Account releases were initiated July 21, 1998, the day when the spill officially stopped, at a rate of 10 cfs (20 af/day). Releases continued at 10 cfs through the summer and early fall before being reduced to 5 cfs (10 af/day) on October 20 **(Figure 2.3-1).** The saturated watershed, in conjunction with tributary contributions and fish account releases allowed the mainstem SYR to flow uninterrupted to the lagoon. Typically, flow begins to diminish with the onset of summer. Due to the tremendous rainfall, no WR 89-18 downstream water releases were made during 1998.

Figure 2.3-1. 1998 Fish Account Releases at Bradbury Dam



1999

In 1999, Fish Account allocation was 2000 af. Since there were no spills, which would have allowed the Account to be surcharged, no additional water was allocated. End of the year fish account usage, however, exceeded what was allocated as a result of higher Fish Account releases to maintain and enhance mainstem habitat downstream of the Spill Basin during the adult migration period. A total of 2,427 af of water was released from the fish account in 1999. The extra 427 af of water was 'borrowed' from other water accounts with the expectation that the water would be 'paid back' over the next three years (142 af/year).

Releases were maintained at 10 cfs from January 1 through April 20, 1999 when they were reduced to 5 cfs for the remainder of the year. Additional water was used during a two day period in early October when testing of the Hilton Creek watering system was conducted.

2.4 Mainstem Hydrograph

1998

Flow was measured at various locations downstream of Bradbury Dam to monitor the seasonal flow patterns within the Santa Ynez River during the 10 cfs sustained release. Flow was monitored at miles 3.4, 7.9, 10.5, 13.9, 24.0, and 30.0. Unlike previous years (since 1994), flow at the above monitoring locations persisted throughout the entire year. Seasonally, flow tends to decrease as one moves downstream in the watershed, particularly during the summer due to evaporation, transpiration, agricultural and municipal groundwater pumping. Flow losses measured at downstream monitoring locations were generally between 10-30%. Flow losses at all monitoring locations were greatest in mid-August. Following mid-August, flows tended to increase to greater than 10 cfs at most monitoring locations. By fall, both sunlight and water usage tends to decrease resulting in an increase in mainstem flow beginning in the fall **(Figure 2.4-1 through 2.4-6).**

1999

The winter of 1999 was more typical of an average rain year. Releases from Bradbury Dam were a constant 5.0 cfs up to mid April when flows were decreased to 2.5 cfs for the remainder of the year. Flow was measured at the same monitoring locations used during 1998. Since 1999 did not have the magnitude rain events as was seen during 1998, the mainstem flow monitoring locations reflect the typical summer and fall hydrology as observed in normal and dry years (1994, 1996, 1997). Even with a charged watershed and a sustained release of between 2.5 and 5.0 cfs, mainstem flow downstream of the Highway 154 Bridge begins to drastically decrease around May at all monitoring locations. In fact, most of the monitoring locations had to be abandoned due to lack of water to conduct flow measurements. The only flow transect remaining during the summer was at Alisal Bridge (mile 10.5) which measured as low as 1.0 cfs during the summer months. While most of the mainstem flow monitoring locations were dry, there were several areas between monitoring locations that remained wetted during the summer. Most of these areas existed directly downstream of riffle bars where water would upwell and begin to flow for short distances downstream. By October mainstem flow had increased slightly as observed in previous years however transect locations remained dry. The only result observable quality to the increased flows was to move the downstream most wetted edge downstream a few hundred feet.

Figure 2.4-1 1998 Flow Data at Mile 3.4 - 10 cfs Release at Bradbury Dam - Decreased to 5 cfs 10/20/98. 1999 Flow with 5 cfs Release at Bradbury Dam - Decreased to 2.5 cfs 4/20/99.

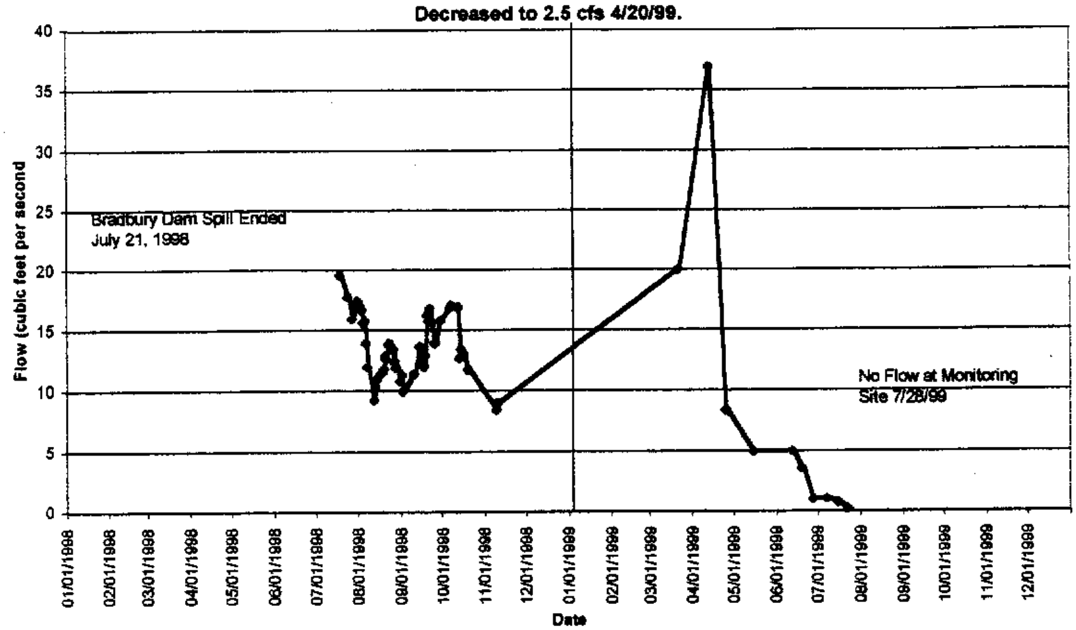


Figure 2.4-2 Flow at Mile 7.8 - 10 cfs Release at Bradbury Dam - Decreased to 5 cfs on 10/20/98. 1999 Flow with 5 cfs Release at Bradbury Dam - Decreased to 2.5 cfs on 4/20/99

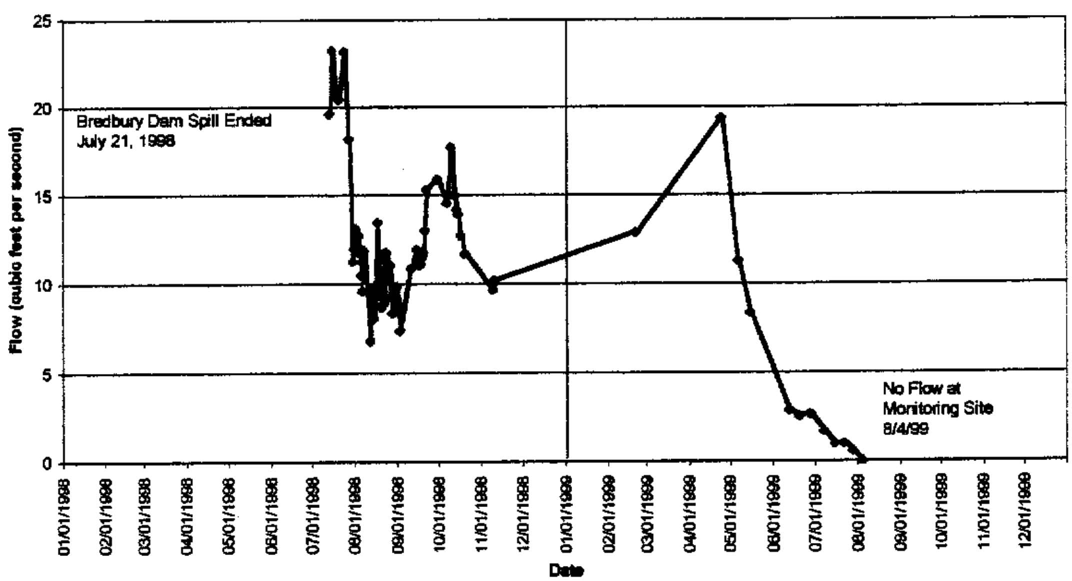


Figure 2.4-3 1998 Flow Data at Mile 10.5 - 10 cfs Release at Bradbury Dam - Decreased to 5 cfs 10/20/98. 1999 Flow with 5 cfs Release at Bradbury Dam - Decreased to 2.5 cfs 4/20/99

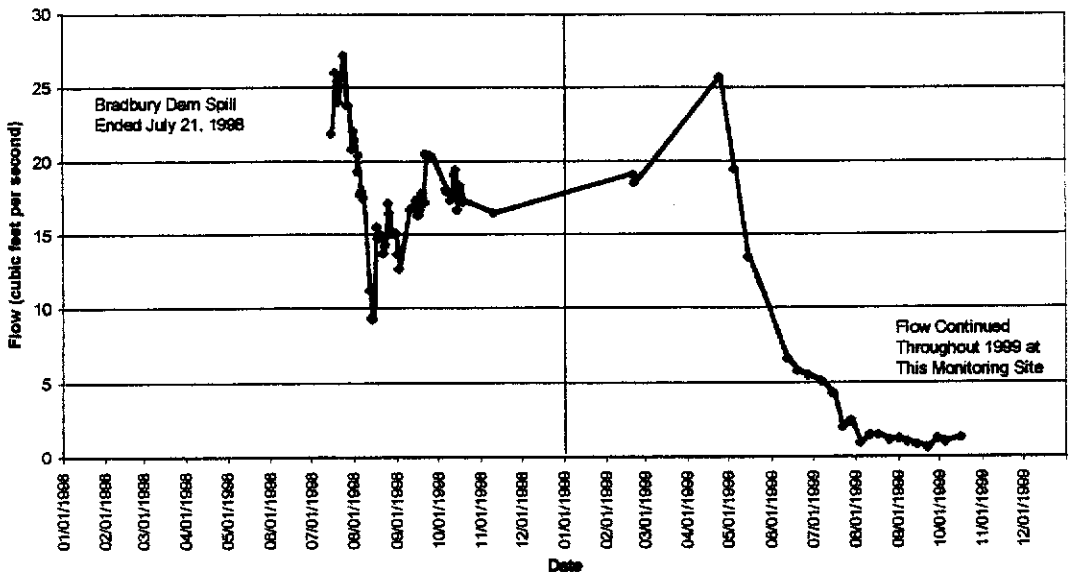


Figure 2.4-4 1998 Flow Data at Mile 13.9 - 10 cfs Release at Bradbury Dam - Decreased to 5 cfs 10/20/98. 1999 Flow Data with 5 cfs Release at Bradbury Dam - Decreased to 2.5 cfs 4/20/99

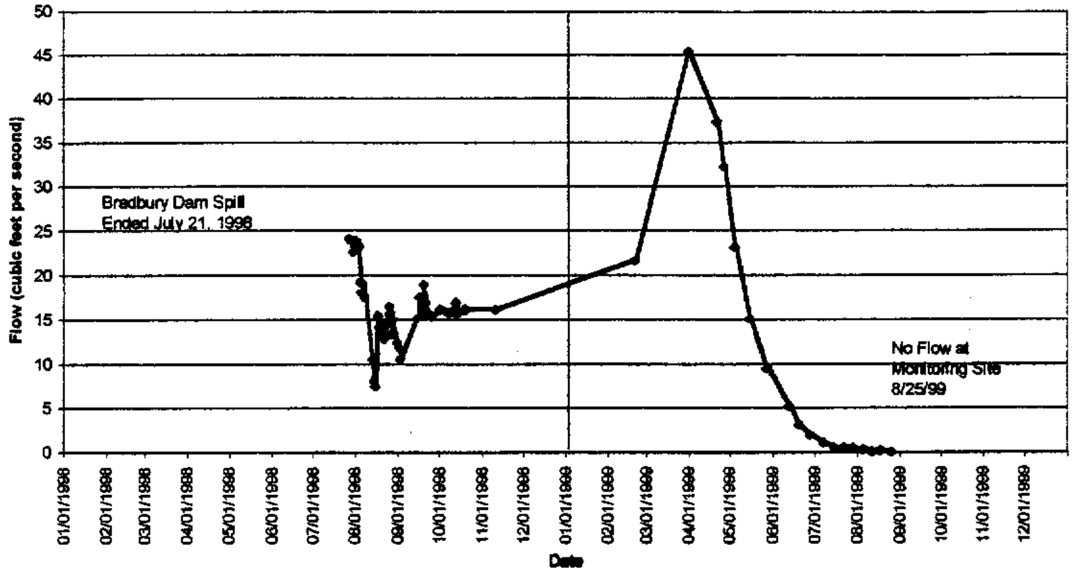
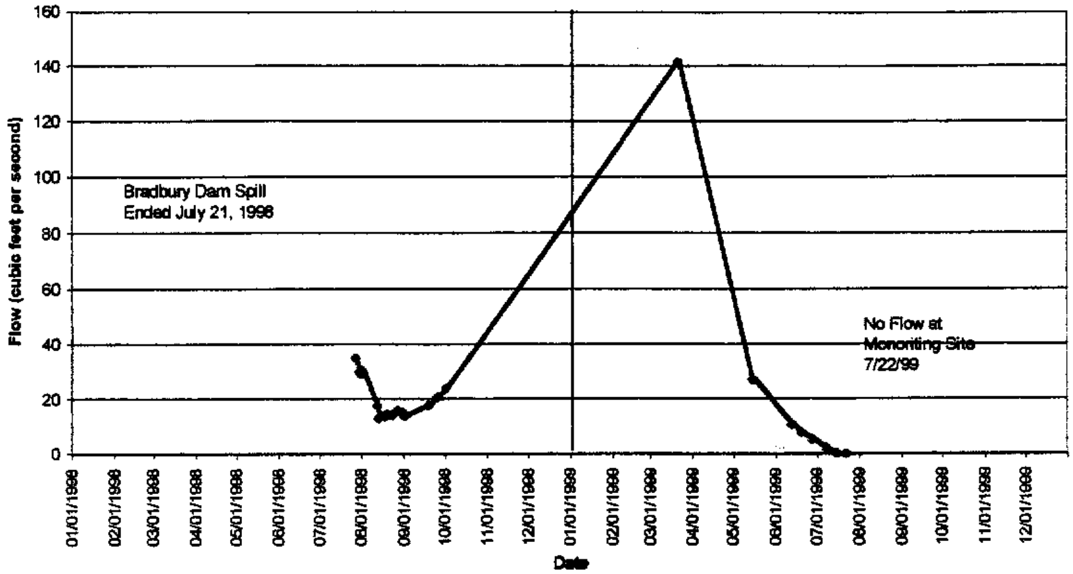


Figure 2.4-5 Flow Data at Mile 24.0 - 10 cfs Release at Bradbury Dam - Decreased to 5 cfs 10/20/98. 1999 Flow with 5 cfs Release at Bradbury Dam - Decreased to 2.5 cfs 4/20/99

Figure 2.4-6 1998 Flow Data at Mile 30 - 10 cfs Release at Bradbury Dam - Decreased to 5 cfs 10/20/98.
1999 Flow with 5 cfs Release at Bradbury Dam - Decreased to 2.5 cfs 4/20/99



2.5 Tributary Hydrograph

1998

Flow was measured in Hilton, Nojoqui, Lower Salsipuedes, and San Miguelito Creeks to monitor the seasonal flow patterns within the Santa Ynez River tributaries **(Figure 2.5-1 through 2.5-4)**. Generally, tributary flow persisted longer and at higher levels compared to previous years. During the onset of summer, flow in lower Hilton persisted until early August before losing continuity with the SYR. Flow in the upper creek at the BOR property boundary, and in the passage impediment region (bedrock pools) continued through 1998. Nojoqui Creek showed a similar pattern when compared to Hilton. Flow in El Jaro, Upper, and Lower Salsipuedes, and San Miguelito Creeks had measured levels 1-3 cfs higher during the summer compared to previous years. Typically, water in the tributaries with persistent flow reached baseline conditions by mid-July and early August.

1999

Hydrologic patterns in 1999 were similar to those observed in 1998. But unlike 1998, flow in most of the tributaries dried at the monitoring locations. The only exceptions being Salsipuedes and San Miguelito Creeks which had persistent flow throughout the year. Both Hilton and Nojoqui Creeks dried in the lower sections. However, both creeks had water flowing in the upper portion of their watersheds. Flow patterns in the tributaries were more indicative of average and dry years as observed in 1994, 1996 and 1997.

Figure 2.5-1 1998-1999 Hilton Creek Flow Measurements

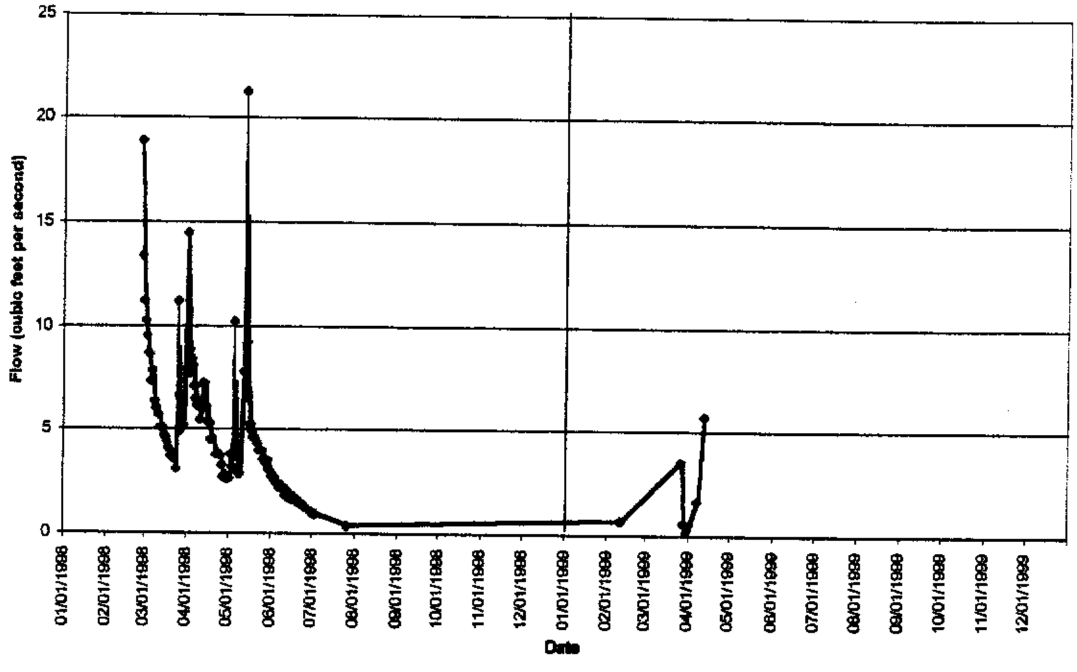


Figure 2.5-2 1998-1999 Nojoqui Creek Flow Measurements

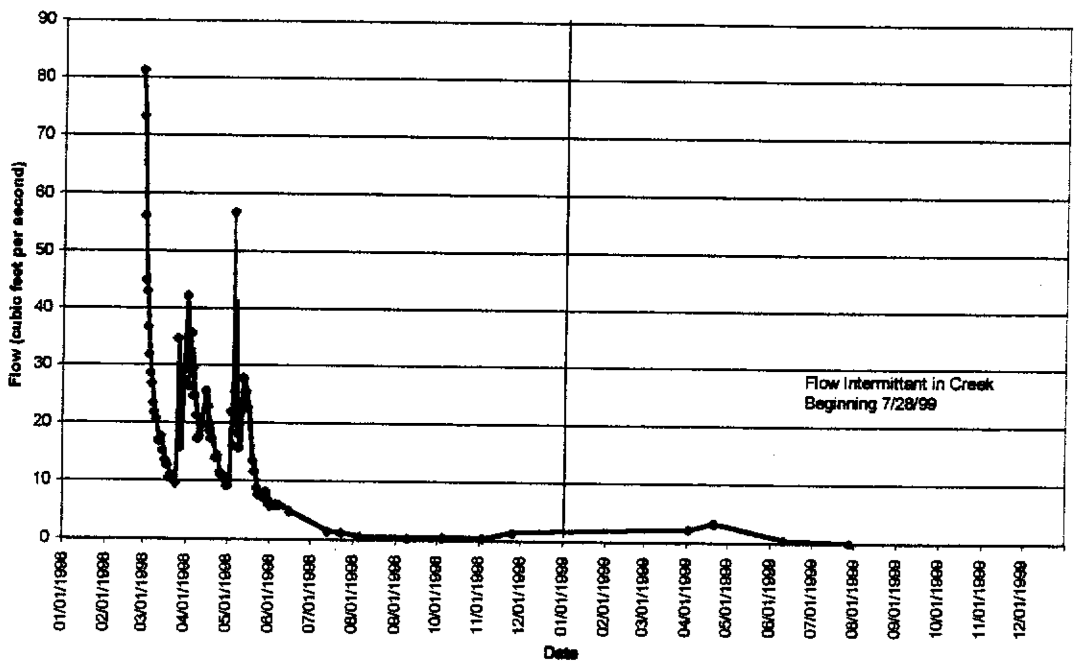


Figure 2.5-3 1998-1999 Flow Measurements in Lower Salsipuedes Creek, 1500 feet Upstream of the Santa Ynez River Confluence

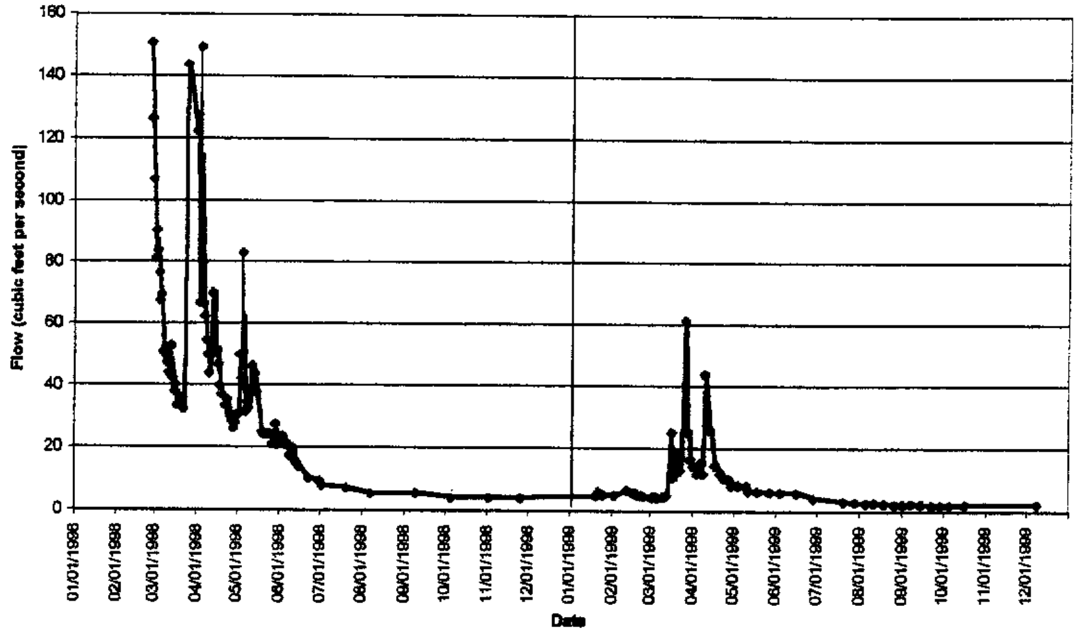
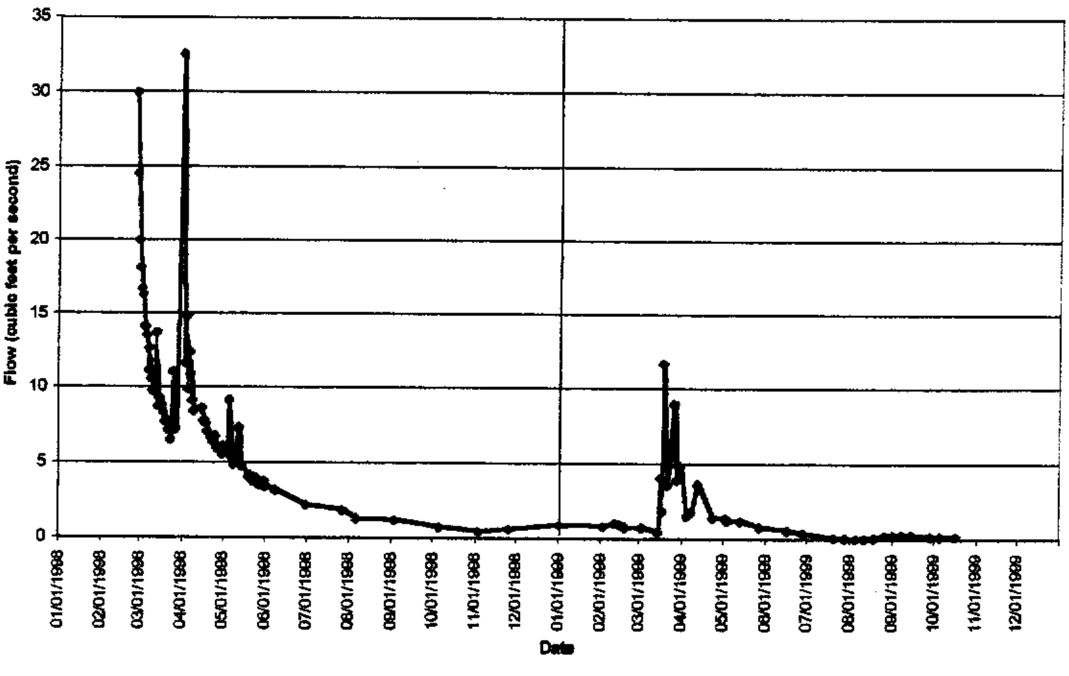


Figure 2.5-4 San Miguelito Creek Flow Measurements



3.0 Water Quality

Water quality parameters, mainly temperature and dissolved oxygen, were monitored in Lake Cachuma, the lower mainstem SYR, the SYR lagoon, and five tributaries downstream of Bradbury Dam. The studies examined seasonal patterns as well as longitudinal gradients along the mainstem. Air temperatures, which affect water temperatures, were 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 oversummer 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 the northern region of this species range, not Southern California. Southern California rainbow trout/steelhead have probably 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

1998 –1999

Air temperatures were recorded at the town 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. In fact, air temperatures remained fairly constant during the course of the year with slight warming recorded during the summer months, and slight cooling during the winter. Comparison between both years shows that there is little difference in the temperature regime from 1998 through 1999. Maximum air temperatures at the Santa Ynez Airport were up to 10 C warmer during the summer and early fall of both years. Significant warming was observed to occur around mid-July and continue through the mid portion of October before cooling. Ambient air temperatures for both towns are presented in **Figure 3.2-1 and Figure 3.2-2.**

Figure 3.2-1 1998-1999 Maximum, Average and Minimum Air Temperatures at Santa Ynez Airport

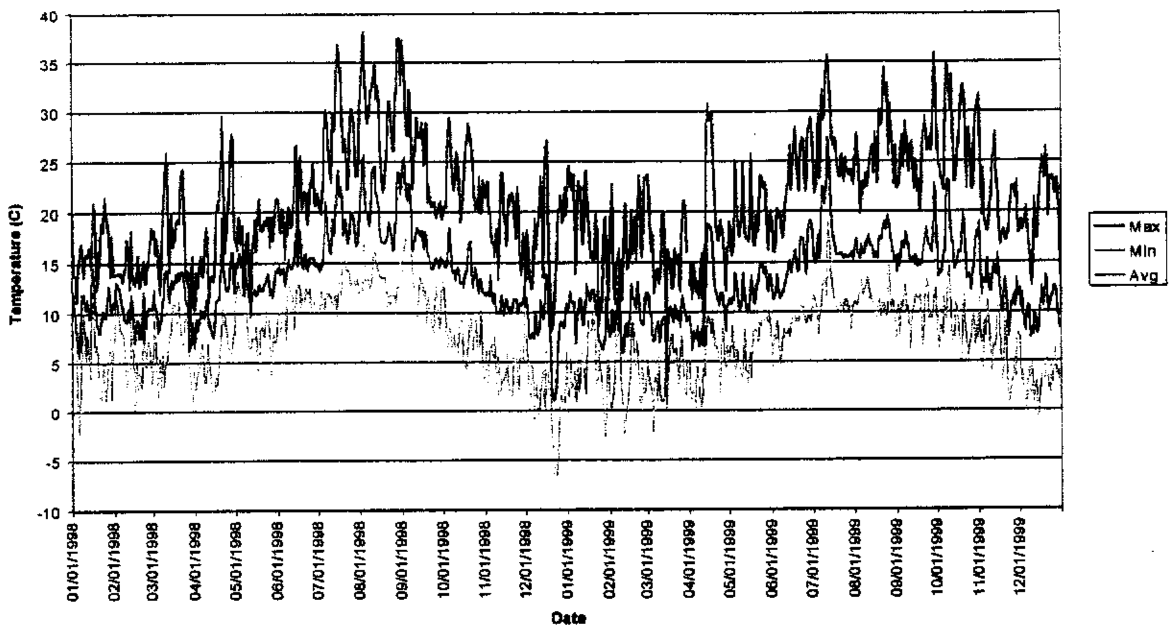
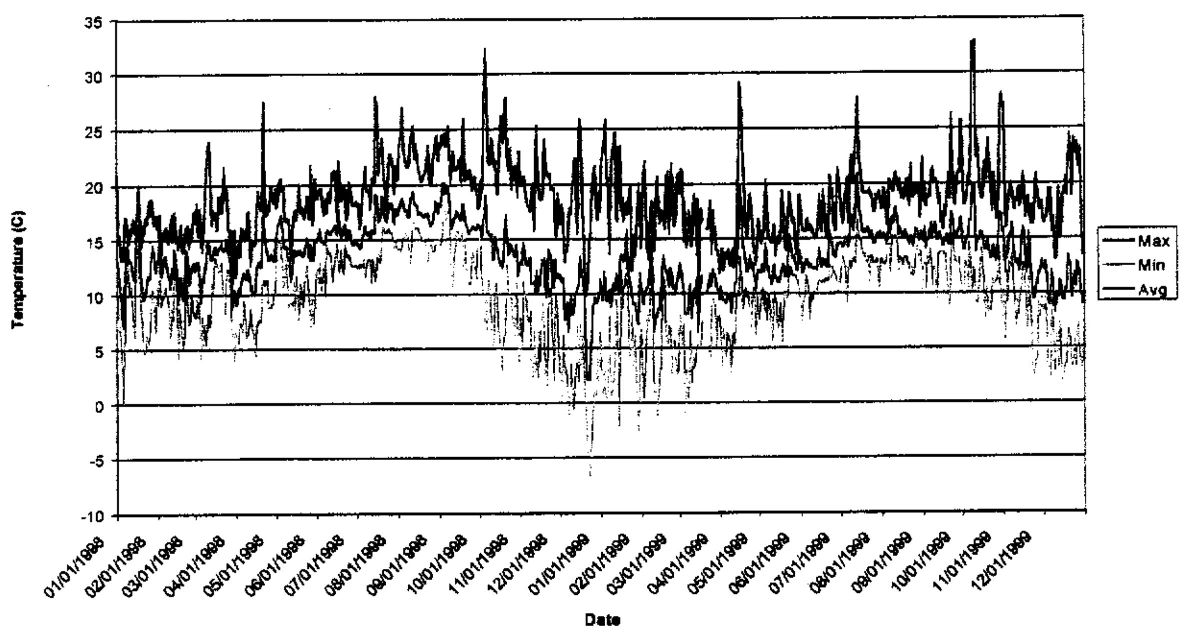


Figure 3.2-2 1998-1999 Maximum, Average, and Minimum Air Temperatures at Lompoc



3.3 Lake Cachuma Temperature and Dissolved Oxygen Profiles

Thermal stratification is a direct result of heating by the sun, and is probably the most important physical event in a lake's annual cycle. During thermocline formation, the sun heats the water surface. The wind stirs this warmer lighter water down to a depth where the turbulence is eventually dissipated. This depth becomes the thermocline. The thermocline is established at a depth that is shallow in relation to the depth at which sunlight penetrates. Most heat is absorbed in the first few meters and to extend further down must be physically stirred by wind or convection-induced turbulence (Goldman and Horne 1983). The regions formed during stratification are the epilimnion (warmer less dense upper layer), hypolimnion (cooler denser lower layer), and the metalimnion (area between epilimnion and hypolimnion).

At the beginning of summer in temperate lakes, there is usually a high concentration of oxygen in the hypolimnion. However, as summer progresses, oxygen in the hypolimnion of eutrophic (high nutrient level) lakes decreases due to decomposition of organic matter. The oxygen decline in the hypolimnion is due to the productivity of the epilimnion. Since there are more organisms of all types in the epilimnion, that equals more dead and decomposing material that will sink through the hypolimnion to the lake bottom. Therefore, the hypolimnetic oxygen level of a lake can be used to estimate the overall productivity (Goldman and Horne 1983).

3.3.1 Methods

Lake Cachuma, a Bureau of Reclamation water supply reservoir in Southern California has routinely experienced severe hypolimnetic oxygen depletion during the summer months when the lake stratifies (Satoris and Boehmke 1984). Dissolved oxygen and temperature profiles were measured at three locations in Lake Cachuma by BOR personnel in an aeration study between 1980-1984 **(Figure 3.3-1 Location Map)**. The BOR originally chose these sites to document oxygen depletion at the upper, middle, and lower portions of the reservoir. The TAC monitoring locations duplicate those of the BOR study to the closest extent possible. The purpose of the current TAC studies is to gather information on:

- Longitudinal and vertical water quality at various lake locations
- Anoxic conditions within the region where water is released for downstream purposes
- Depth of water quality conditions preferable for STL/RBT in relation to the proposed Hilton Creek pump/siphon
- A historical data base documenting the timing of stratification and turnover within the lake

Station #1 is located directly upstream of Bradbury Dam at the deepest portion of the lake (40-45 meters).

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 (upper lake).

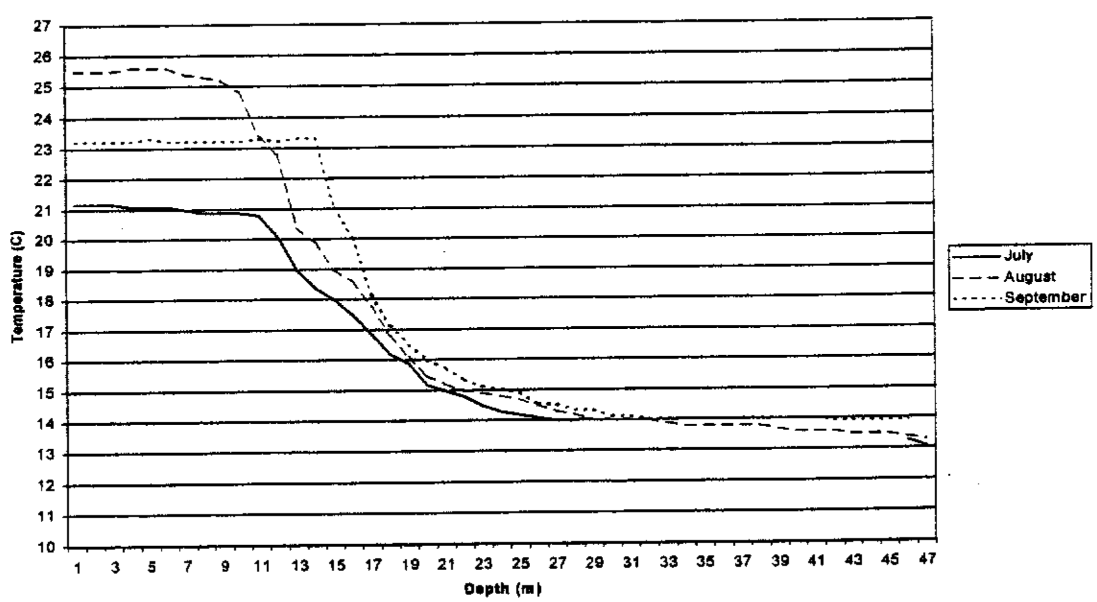
1998 Vertical profiles of dissolved oxygen and temperature were performed during three surveys conducted in July, August and September. 1999 measurements were conducted in May, July, August, and October. Profiles were measured using a Yellow Springs Instrument (YSI) Model 57 Oxygen Meter. Measurements were taken by boat at one meter intervals from the surface to the bottom of the lake.

3.3.2 Results

Temperature 1998

As observed in previous years data, thermal stratification shows a similar development in both timing and depth when comparing all three locations. For ease of illustration, discussion of both temperature and dissolved oxygen will center on data collected at the deepest monitoring location: Site #1 Bradbury Dam. Thermal stratification was firmly established by July, and continued that way through the next two months. The epilimnion remained fairly constant during each month, usually ranging between 0-15 meters (0-49 feet). This upper layer remained warm during the monitoring period, ranging between 21-25.5 C **(Figure 3.3.2-1)**. The formation of the metalimnion varied from month to month, usually beginning between 11-15 meters (38-49 feet) and extending down to approximately 20 meters (65 feet). Temperatures within this region gradually cooled to about 15 C as depth increased. The location of the hypolimnion remained constant throughout the monitoring period starting at 20 meters and extending to the bottom of the reservoir (45 meters or 146 feet). Temperatures within the hypolimnion ranged between 13-15 C.

Figure 3.3.2-1. 1998 Water Temperature Profile at Bradbury Dam

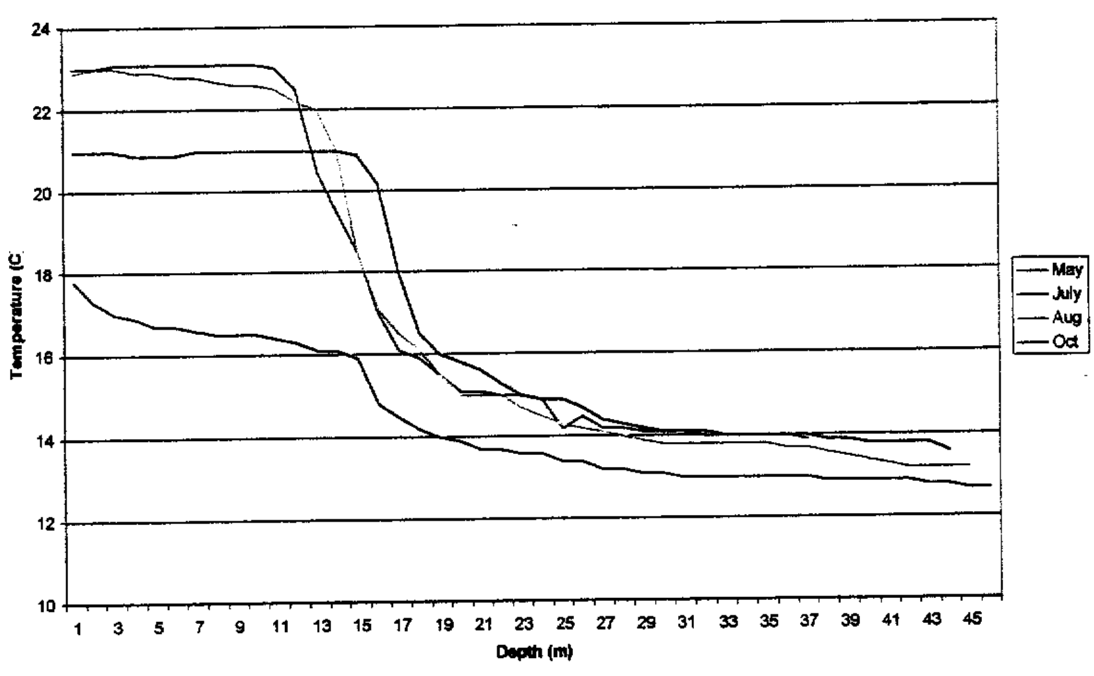


Temperature data gathered from profiles will also be used to determine the appropriate depth to remove water for the Hilton Creek Pump/Siphon. A criterion of 18 C was determined by the Biological Subcommittee to be the maximum temperature for any water released into Hilton Creek. The maximum depth at which water temperature was at least 18 C varies from year to year, but is usually around 20 meters. Lake turnover, while not illustrated in the above data set, usually occurs by December or January of each year.

Temperature 1999

Temperature profiles measured during 1999 show a fairly wide range of eplimnion temperatures ranging from around 17 C in May and increasing to 23 C during the July and August monitoring dates **(Figure 3.3.2-1a)**. Data recorded during the October monitoring showed slight cooling within the surface waters with eplimnion temperatures decreasing to around 21 C. Stratification within the lake appeared to be forming during May as evident by the slight gradient to cooler temperatures as depth increased (17-13 C). During the later monitoring times, stratification is firmly established as indicated by the steeper gradient to cooler temperatures from the surface to the deeper portion of the lake (23-14 C). Hypolimnion formation remained consistent during the monitoring times, usually occurring at about 18 meters with temperatures between 15-16 C. Hypolimnion temperatures gradually cooled to 13-14 C from 18 meters down to 43 meters. Hypolimnion temperatures did not change much during the monitoring times, usually ranging between 13-14 C at the lowest portions of the lake. However, the water temperatures at the approximate location of the water removal for the Hilton Creek Pump/Siphon (20 meters) ranged from 14-16 C.

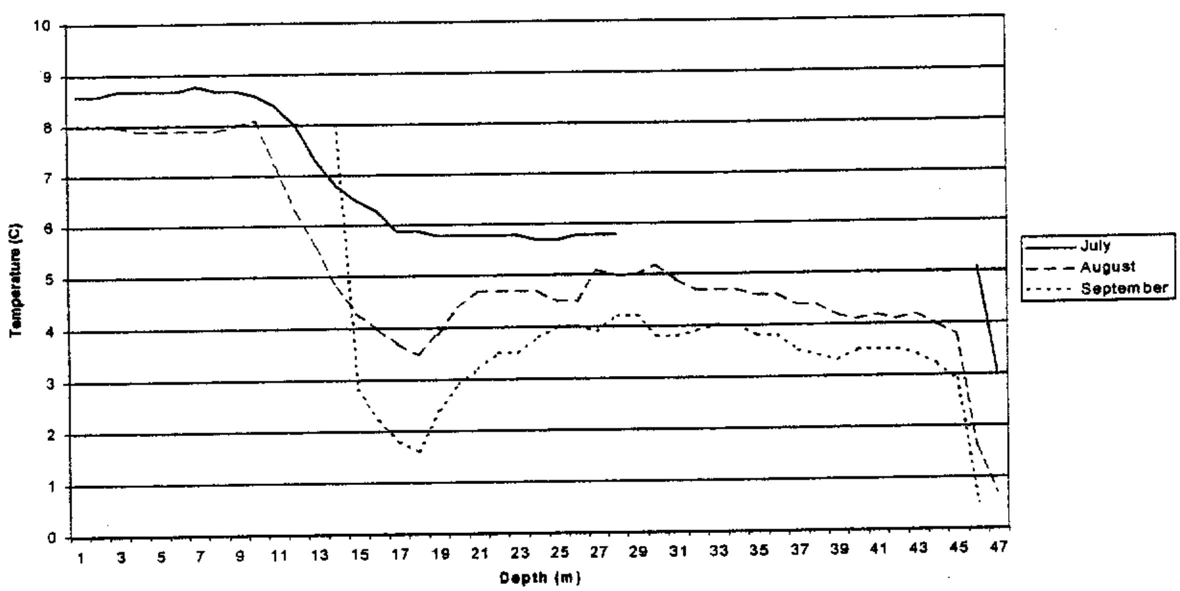
Figure 3.3.2-1a 1999 Lake Cachuma Temperature Profile at Bradbury Dam



Dissolved Oxygen 1998

Dissolved oxygen levels in the lake show decreasing concentrations at each strata level. Concentrations were greatest in the epilimnion with levels between 8.0-8.5 mg/L during each month **(Figure 3.3.2-2)**. As depth increases, dissolved oxygen decreases. Metalimnion dissolved oxygen levels varied between 2.0-5.8 mg/L depending upon the month. September recorded the lowest concentrations and July the highest. Unlike previous years data, dissolved oxygen levels in the majority of the hypolimnion remained between 3.0-5.0 mg/L. Usually these hypolimetic oxygen levels are closer to zero.

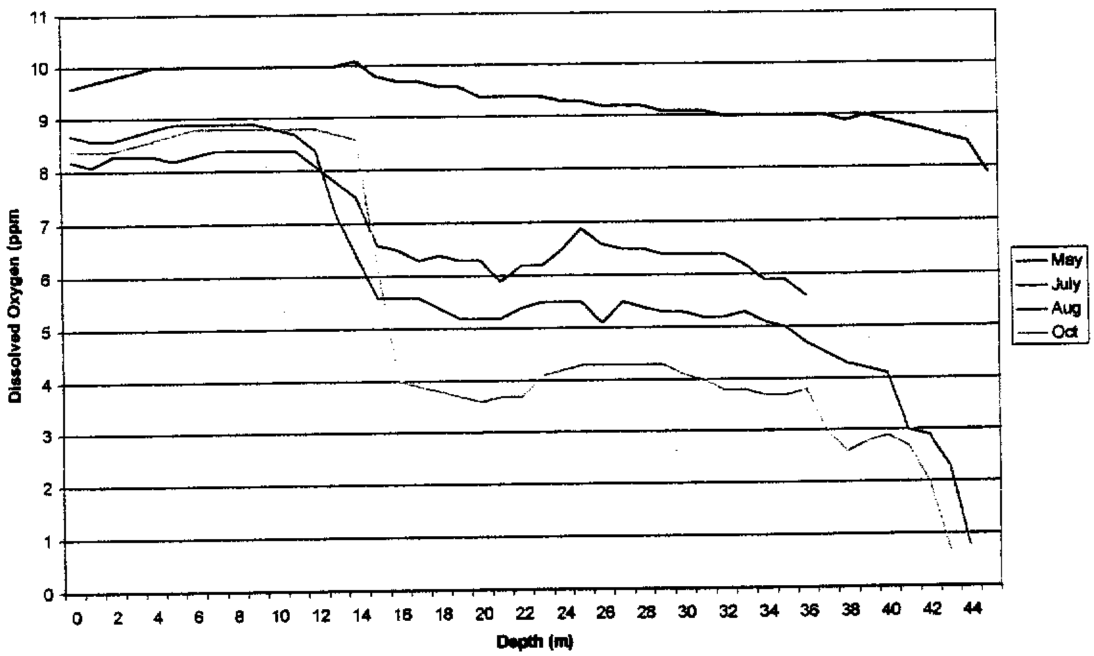
Figure 3.3.2-2. 1998 Dissolved Oxygen Profile at Bradbury Dam



Dissolved Oxygen 1999

Dissolved oxygen profiles measured during May show that stratification within the lake had not yet formed as indicated by nearly uniform DO concentrations (8-10 Mg/L) **(Figure 3.3.2-2a)**. The remaining profile dates show nearly identical epilimnion DO concentrations. However, as the months progress, there is a continuing decrease in the hypolimnion DO concentrations from around 6 Mg/l in July to between 1-4 Mg/l in October. The fact that there is no anoxic condition developing in the summer months is unusual based upon past years studies. Typically, anoxic conditions are observed to develop during the summer months and continue through until fall turnover. However, the past two years have recorded DO concentrations well above the anoxic level. Goldman and Horne (1983) suggest that a heavy flushing rain at the beginning of spring can easily decimate phytoplankton blooms, thereby reducing the likelihood of anoxic conditions developing within the deeper portions of certain lakes. This may have been the case over the last few years at Lake Cachuma. Both 1995 and 1998 created tremendous runoff events that created spill conditions during the spring of both years.

Figure 3.2.2-2a 1999 Lake Cachuma Dissolved Oxygen Profile at Bradbury Dam



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 refuges 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.

In 1998, 22 thermographs were deployed throughout the lower SYR (13) and tributaries (9) from the spill basin at Bradbury Dam to the lagoon at Vandenburg Air Force Base **(Figure 3.4-1 Map Insert)**. In 1999 a total of 19 thermographs were deployed throughout the lower SYR (11) and tributaries (8). Diminished flow conditions prevented thermograph deployment at one location within the mainstem and one of the tributaries.

The Project used Optic Stowaway thermographs set to record hourly temperatures. The daily average, daily maximum, and daily minimum temperatures for each thermograph were calculated using Excel macros. Thermographs were placed in small metal pipe or PVC 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 was 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 3.4-1 Location (Refer to Figure 3.4-1)	**Habitat unit width (ft)**	**Total habitat length (ft)**	**Average depth (ft)**	**Maximum depth (ft)**
#5	S.basin-At outlet works (1)	N/A	N/A	N/A	N/A
#6	Long pool mile 0.5 (2)	129	1273	3.8	10.1
#11	Refugio X mile 3.4 **1998 only** (2)	38	60	1.9	3.4
#12	Refugio Pool Habitat at mile 6.0 (2)	35	75	2.3	4.5
[illegible]	Alisal Unit 45 mile 7.8 **1999 only** (2)	44	85	2.4	8.0
#16	Alisal Bridge mile 10.5 (1)	30 (est)	50 (est)	2.0 (est)	4.5 (est)
#18	Buellton - mile 13.9 (1)	35	95	2.0	3.5
#20	Cargasachi mile 24 (1)	3	35	2.0	3.0
#24	Lagoon at Ocean Park - mile 46.5 (2)	85	N/A	varied	Varied

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

SITES THAT NO LONGER EXIST
#23 LAGOON
#19 Winter
#27 - Lower Nojoqui
#'s 13, 14, 15

NEW SITES
S. Mig
[illegible]

3.4.1.1 Highway 154 Reach

Spill Basin

The thermograph in the spill basin was deployed adjacent to the outlet works where downstream water releases are made. The unit was attached to a cable and suspended in approximately five feet of water. The unit was in operation for the duration of 1999. No unit was deployed during the 1998 monitoring period.

Downstream of Spill Basin

One thermograph was deployed in a run habitat 150 feet downstream of spill basin to monitor water temperature conditions at the Hilton Creek fish relocation point. The unit was attached to a piece of small woody debris and was in operation from July through mid-November 1998.

Long Pool

A vertical array was deployed approximately 1000 feet downstream from the spill basin. The surface unit was deployed from April through November 1998, with some data recorded for the beginning of January

The bottom unit has a near continuous data log from early January through early November 1998. Thermograph malfunction resulted in a gap in the data set between mid-June and mid-August 1998. 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 at 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 deployed both a surface and bottom unit at this location. Both units were in operation from April through November 1998 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). The bottom unit was deployed in a area of suspected cool water upwelling.

Refugio Pool Habitat at Mile 6.0

This pool habitat is located approximately six miles downstream of Bradbury Dam. Young of the year and adult steelhead/rainbow trout were observed in this habitat during the July snorkel surveys. Subsequently, a thermograph array was deployed at this location from July through

December to monitor the remaining summer and fall water quality conditions. Thermographs were deployed here to monitor temperature conditions of oversummering steelhead/rainbow trout. The units were held in a protective PVC enclosure and attached to large woody debris. 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 (4.0 feet).

3.4.1.3 Alisal Reach

Alisal Bridge

The Alisal Bridge is located approximately 10.5 miles downstream of Bradbury Dam. Temperature monitoring of the pool unit was initiated after snorkel surveys identified juvenile and adult steelhead/rainbow trout inhabiting the site. Only a single surface unit was deployed at this location from July through September 1998.

Alisal Pool Habitat at Mile 7.9

This pool habitat is located roughly 200 yards downstream form Refugio Bridge and approximately 7.9 miles downstream from Bradbury Dam. The project deployed a thermograph array at this location beginning May of 1999 and continuing through the end of the year. The surface unit is deployed at one foot below the surface, while the lower unit is deployed at the bottom in the area of greatest depth (8.0 feet).

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, and approximately 13.6 miles downstream of Bradbury Dam. The thermograph was deployed from January through November 1998. The unit was deployed in a run habitat in the area of maximum depth (3.0 ft).

3.4.1.5 Cargasachi Reach

A single bottom thermograph was deployed in a run habitat downstream of the Santa Rita crossing adjacent to the Cargasachi Ranch, and approximately 25 miles downstream of Bradbury Dam. Several units were deployed at this location from April through November 1998. Unfortunately, on two separate occasions, vandals removed two thermographs, one in August and another in September resulting in a loss of data during most of the summer.

3.4.1.6 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. A vertical array was deployed from January through November at Ocean Park which is adjacent to the lagoon ocean interface. The surface unit recorded a continuous data set during the deployment time. However, several thermograph malfunctions occurred to the bottom unit resulting in a loss of data from June through November.

3.4.2 Results

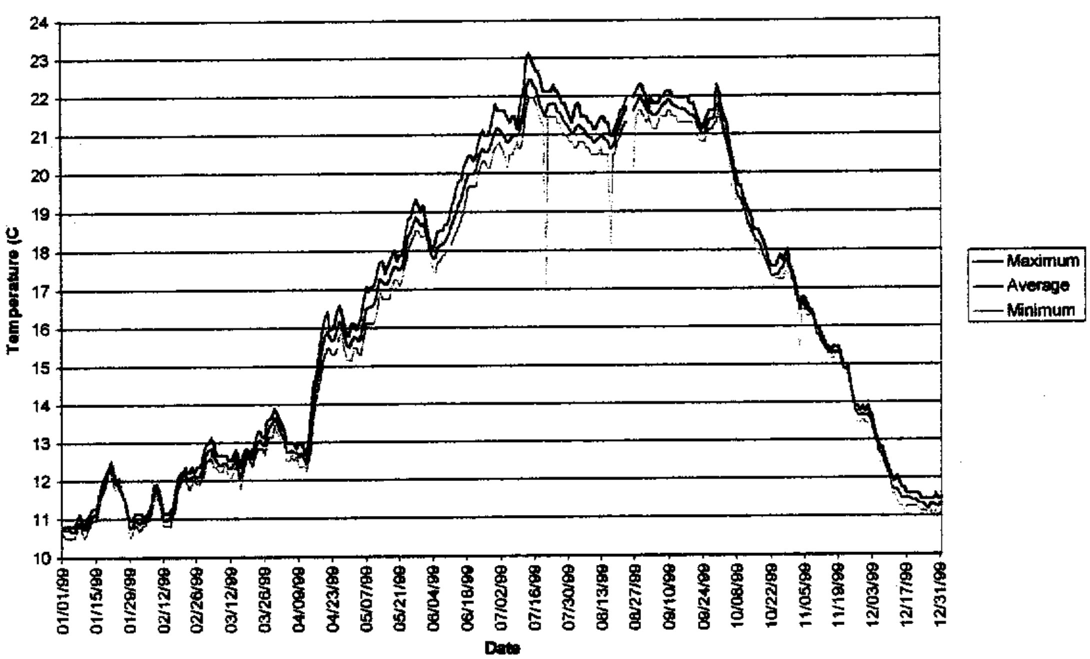
3.4.2.1 Seasonal Patterns and Diel Variations

Highway 154 Reach

Spill Basin

Water temperatures measured at the outlet works represent actual water temperatures being released from Bradbury Dam into the SYR. Temperatures generally remained cool during the winter, spring and fall and were usually less than 20 C **(Figure 3.4.2.1-1)**. However, beginning in June and continuing through the end of September, temperatures increased to a maximum of 23 C in early July, and generally remained between 21-23 C during the warmest portion of the season. The fact that there is little variation between maximum and average temperatures shows that there is very little heating of the waters at the outlet point.

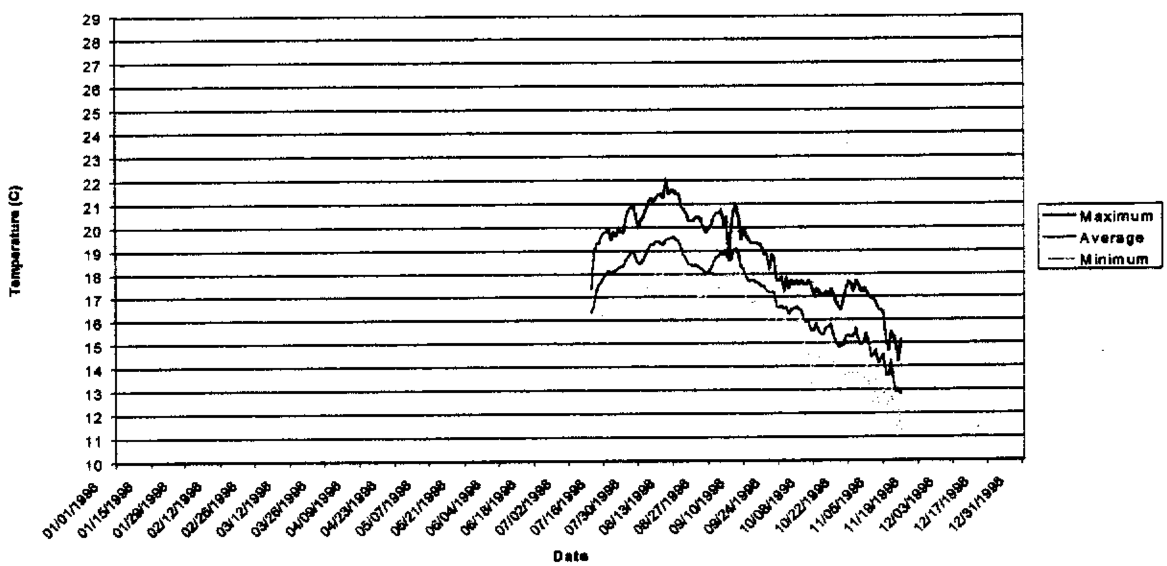
Figure 3.4.2.1-1 1999 Spill Basin - Unit Deployed within Spill Basin 3 Feet Below the Surface



Downstream of Spill Basin

Due to the close proximity to Bradbury Dam, water temperatures stayed cool during the warmest portion of the summer. Maximum temperatures remained between 20-22 C from July through mid-September before decreasing sharply in the fall **(Figure 3.4.2.1-1a)**. Average temperatures during the entire deployment time stayed below 20 C. The thermograph was removed in November to prevent loss during the storm season. Young of the year steelhead/rainbow trout were regularly observed at this location throughout 1998.

Figure 3.4.2.1-1a. 1998 Water Temperatures between the Spill Basin and Long Pool (Fish Relocation Point from Hilton Creek)



Long Pool - Surface Unit (Mile 0.5)

1998

Average and maximum water temperatures during the spring remained less than 19.0 C **(Figure 3.4.2.1-2)**. Very little variation was recorded between average and maximum temperatures with the exception of the period between mid June and early July when the surface float failed. In July after the float replacement, maximum temperatures varied between 21-24.3 C through early October. Daily variation generally remained steady between 4-5 C. During the fall, water temperatures decreased to less than 19 C, and the daily variation dropped to between 2-3 C.

1999

Water temperatures measured in 1999 were consistently warmer than those measured during 1998. Month for month, temperatures were approximately 1 C warmer for any given day. Overall, temperatures remained less than 20 C until mid-June when a rapid warming trend began and continued through the end of September. With the exception of the summer, daily variation typically ranged between 1-3 C. Once the warming trend started, daily variation increased to a consistent 4-4.5 C.

Long Pool - Bottom Unit

1998

Water temperatures at the bottom of Long Pool were significantly cooler compared to surface temperatures. Generally, both maximum and average water temperatures remained less than 20 C during the entire deployment time, providing cool water refuge for oversummering steelhead/rainbow trout **(Figure 3.4.2.1-3)**. Additionally, daily variation was substantially reduced (<1.0 C) compared to the surface unit. A thermograph malfunction occurred from late June through early August and no temperatures were recorded for that time. However, when looking at the data before and after the malfunction time it can be assumed that temperatures did not exceed 20 C.

1999

As observed in 1998, water temperatures measured at the bottom of long pool were substantially cooler compared to surface temperatures. When comparing the two years, bottom temperatures were 1-2 C warmer in 1999. There were two different occasions where thermograph malfunctions resulted in losses of data (May and September). Additionally, a temperature anomaly was recorded between mid July and mid August. It is suspected that members of the general public or possible beaver activity caused the bottom unit to be placed higher within the water column thereby recording the higher than expected water temperatures.

Figure 3.4.2.1-2 1998-1999 Long Pool Surface Water Temperatures

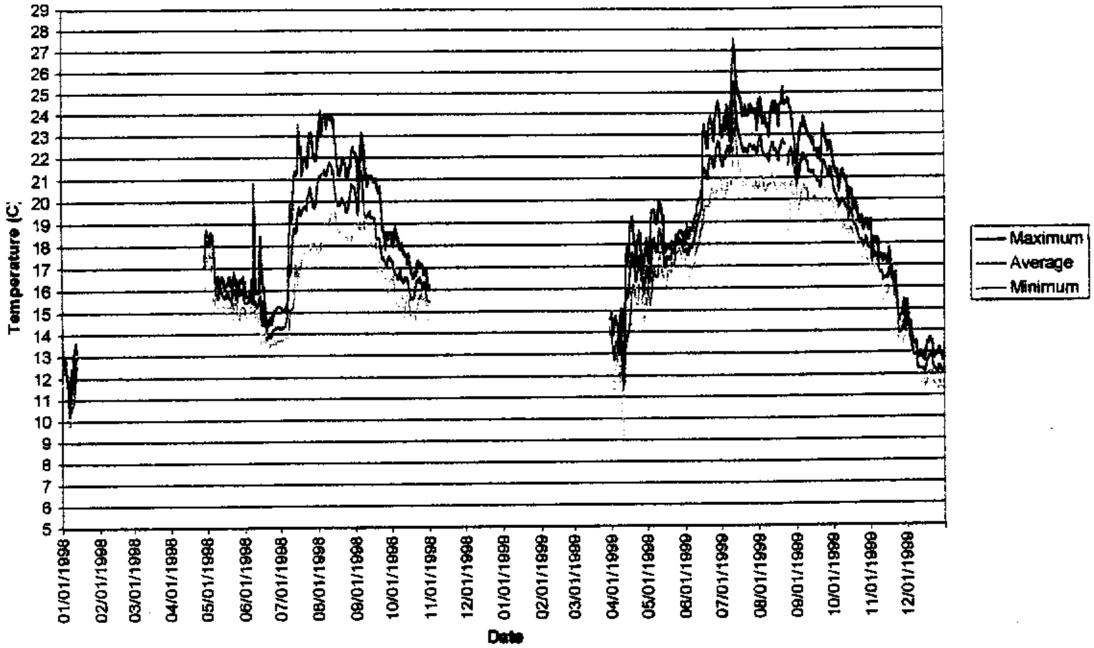
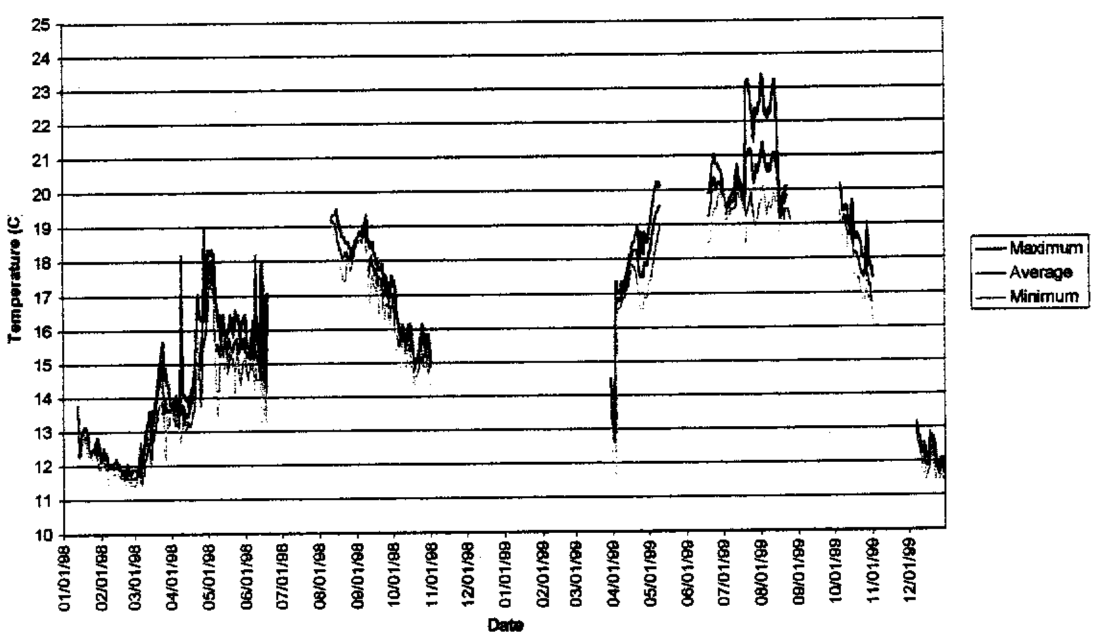


Figure 3.4.2.1-3 1998-1999 Water Temperature - Long Pool Bottom Unit - Deployed in 10 Feet of Water



Refugio Reach - Refugio X - Surface Unit (Mile 3.4)

Surface water temperatures show a rapid warming trend beginning in early July. Maximum surface temperatures generally remained greater than 25 C from July until mid-September **(Figure 3.4.2.1-4).** Average temperatures remained greater than 22 C during most of the summer. Daily variation remained between 6-8 C during the summer, and decreased to 4-6 C for the spring and winter.
The unit was moved to a location approximately ¼ mile upstream in July to monitor water quality conditions of oversummering steelhead/rainbow trout which were observed during the July snorkel surveys. Steelhead/rainbow trout were observed monthly at this location during routine thermograph maintenance. Both adult and juvenile successfully oversummered in this pool unit in.

Refugio X - Bottom Unit

The bottom thermograph was also moved and redeployed in an area of perceived cool water upwelling that was inhabited by young of the year and adult steelhead/rainbow trout. The bottom unit recorded decreased water temperatures, and a decreased amount of daily variation compared to surface temperatures **(Figure 3.4.2.1-5).** During the summer, maximum water temperatures were a couple of degrees cooler and usualy did not exceeding 25.5 C. Average temperatures generally remained less than 22 C during the same timeframe. Daily variation remained between 3-5.5 C during the summer, and between 0-4 C during the spring and fall.

Refugio Reach at Mile 6.0 - Surface and Bottom Unit

1998

Both a surface and bottom thermograph was deployed at this location following snorkel surveys that identified young of the year and adult steelhead/rainbow trout inhabiting the pool site. The pool was suspected of providing cool water upwelling for oversummering steelhead/rainbow trout. When comparing surface and bottom units, no upwelling or stratification was observed. In fact, essentially no differences in temperatures were recorded **(Figure 3.4.2.1-6 and 3.4.2.1-7).** The units were in operation from early July through early December. Both maximum temperatures and daily variation were greatest in the summer with maximum temperatures between 25-26 C and daily variation between 5-7 C. Average temperatures generally remained between 21-23 C during the summer. By mid-September, temperatures decreased rapidly and daily variation decreased to between 3-5 C. Young of the year and adult steelhead/rainbow trout were observed every month when downloading the thermographs.

1999

Temperature data collected in 1999 differ significantly in the summer when compared to 1998 data. Comparison of data shows nearly identical temperature regime at the surface and bottom units during the late spring and early summer. However, during the mid to late portion of summer, water temperatures measurements to the bottom unit recorded significantly cooler water temperatures compared to the surface, indicating probable cool water upwelling. The bottom unit recorded temperatures between 19.5 C-22 C from mid-July through early September, while the surface unit recorded temperatures varying between 19.5-24 C for the same time frame. While the difference in maximum temperature is only two degrees Celsius, the overall diel variation at the bottom site was only

Figure 3.4.2.1-4. 1998 Refugio X Surface Water Tempertures - Mile 3.4

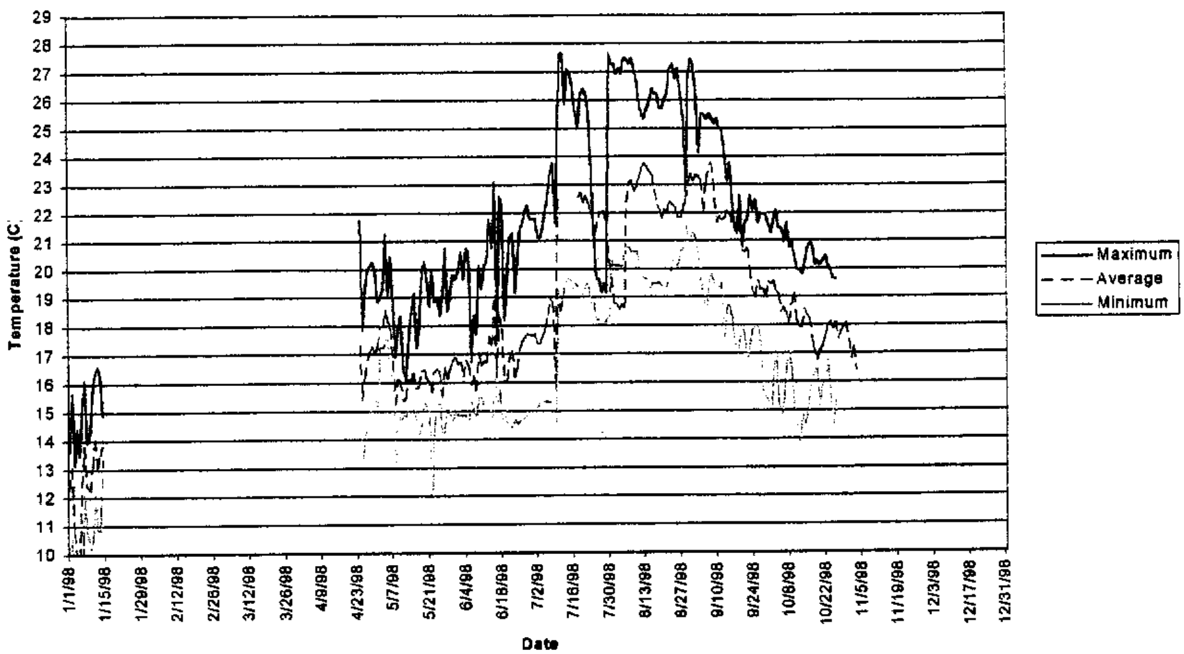


Figure 3.4.2.1-5. 1998 Refugio X Site - Bottom Unit - Mile 3.4

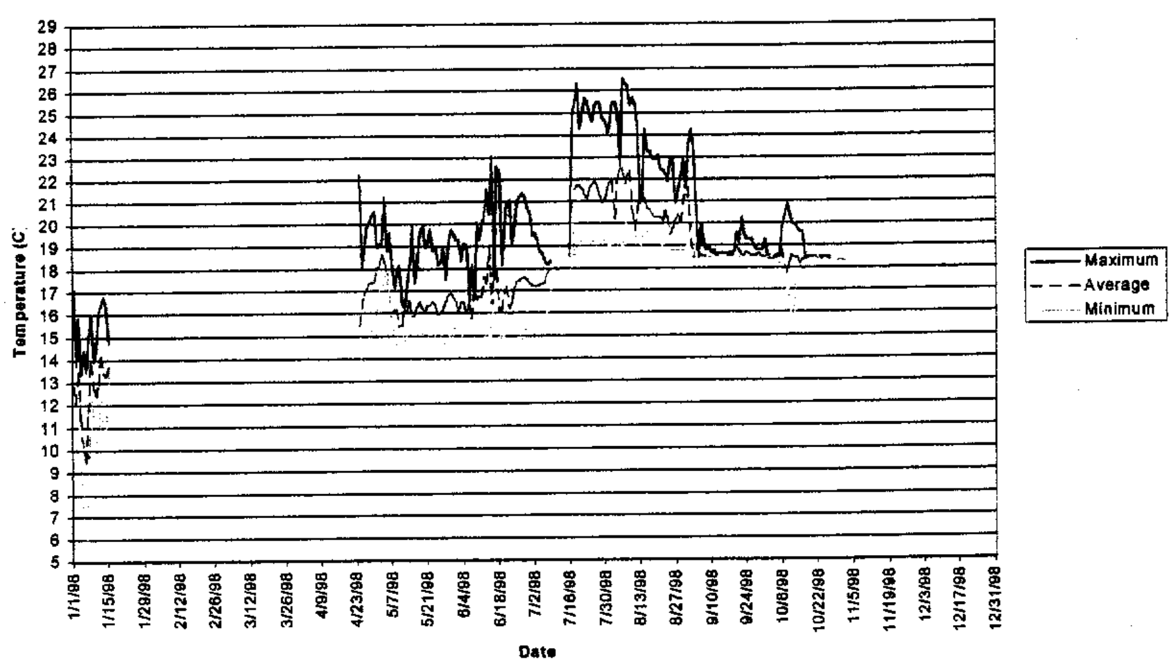


Figure 3.4.2.1-6 1998-1999 Water Temperatures at Surfaec of Pool Habitat at Mile 6.0

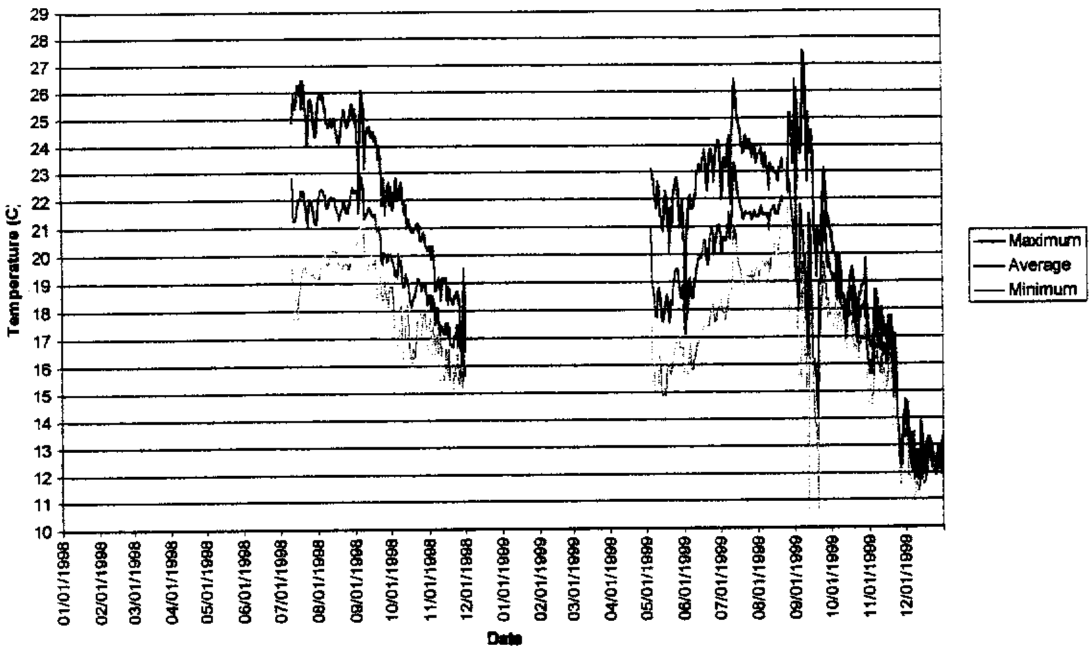
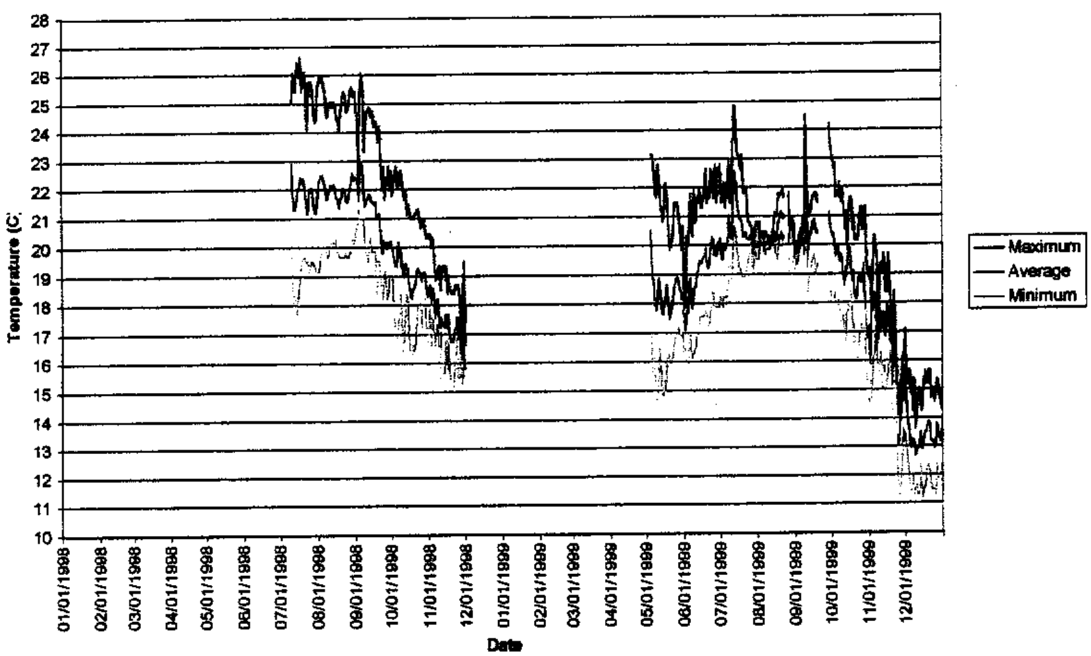


Figure 3.4.2.1-7 1998-1999 Water Temperature at Bottom (4.0 feet) of Pool Habitat at Mile 6.0



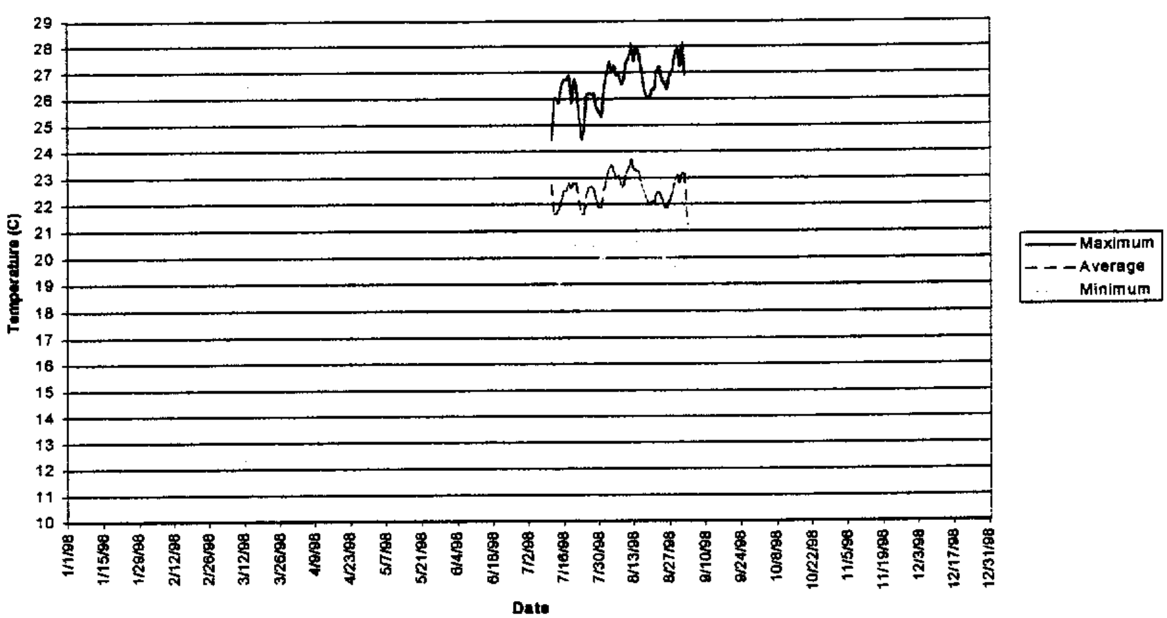
about 1 C where at the surface, the diel variation was closer to 4-5 C. Additionally, there was a interesting temperature anomaly recorded at the surface for a one month period between September and October. During this time frame, there is a large fluctuation in both the maximum and minimum water temperatures, sometimes up to 16 C. This much variation suggests that there are factors other than environmental factors, which are affecting the temperature unit. Large temperature swings as recorded are usually indicative of the unit being removed from the water and exposed to air.

Alisal Reach

Alisal Bridge - Mile 10.5

A surface unit was in operation from early July through mid September. Maximum temperatures remained between 26-28.2 C during the summer/early fall deployment time **(Figure 3.4.2.1-8)**. These maximum temperatures were among the highest recorded for the mainstem thermographs. Average water temperatures generally remained between 22-24.8 C. Daily variation remained between 5-7 C and was consistent with other mainstem monitoring locations.

Figure 3.4.2.1-8. 1998 Water Temperature at Alisal Bridge - Surface Unit - Mile 10.5



Avenue of the Flags Reach

Avenue of the Flags Bridge - Mile 13.9

1998

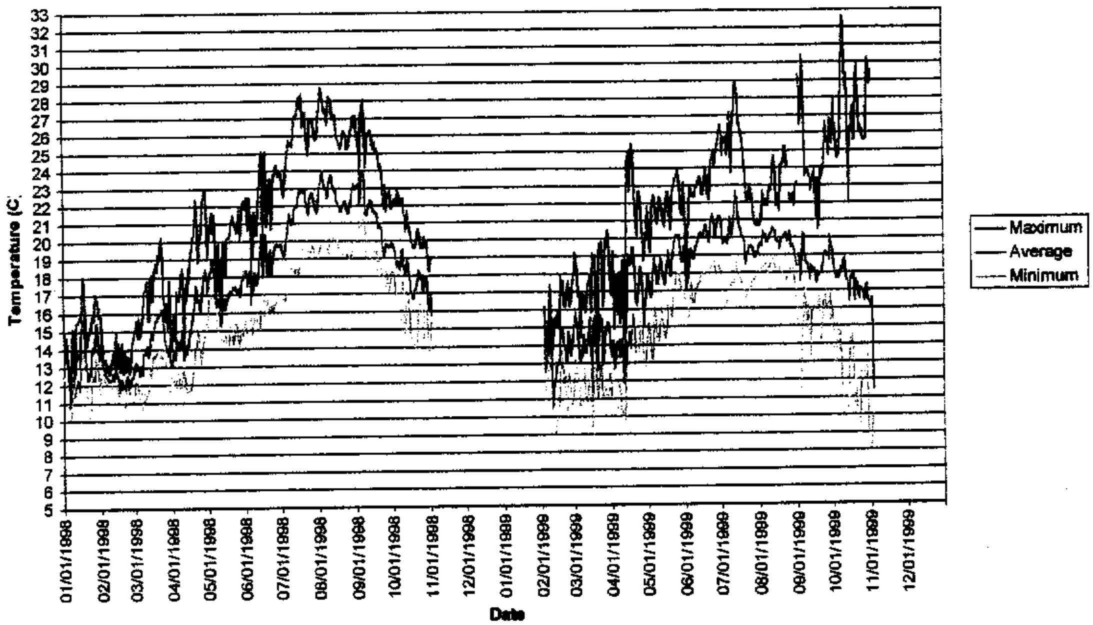
Water temperatures collected at the Avenue of the Flags Bridge represent the most continuous data set available for the mainstem. Comparison of the Avenue graph to other mainstem surface graphs reveals similarities in the spikes and dips in the seasonal temperature regime. While some variation between thermograph sites is expected, the Avenue graph can be used to help fill in some of the missing information at other surface locations. Both water temperatures and daily variations increased in June with the onset of summer. Maximum summer water temperatures at the Avenue of the Flags Bridge were the highest recorded for any mainstem thermograph. By early-July, significant warming was recorded with maximum temperatures varying between 25-28.9 C from July through mid-September **(Figure 3.4.2.1-9)**. Average temperatures usually remained between 21-23 C however, on several occasions average temperatures reached 24 C. Daily variation during the warmest portion of the summer varied between 6-9 C. During the spring, fall, and winter, temperatures were generally less than 22 C and daily variation was between 1-6 C.

1999

Temperature data collected in 1999 shows nearly identical similarities when compared with 1998 temperature data. In 1999, a warming trend is shown to begin during the early portion of April with water temperatures continuing to warm through mid July. Months with the warmest temperatures included July, September and October. While the later two months recorded warmer temperatures than during the summer, it should be noted that mainstem flow conditions were essentially non-existent and that the water present represented upwelling type conditions. These higher than expected temperatures are a result of the thermograph unit being exposed to conditions not representative of a flowing water system. In fact, there was essentially a large muddy puddle at this location for the above mentioned period.

This should also be mentioned for the period of time from mid July through late August. During this time frame, water temperatures were much cooler than was recorded at other mainstem thermograph locations. This is probably due to true upwelling type conditions at the monitoring location or directly upstream of the monitoring location. By late October, general flow conditions had been reduced to the point where the thermograph was removed before it was exposed to the air.

Figure 3.4.2.1-9 1998-1999 Water Temperature at Avenue of the Flags Bridge - Bottom Unit (Run Habitat) - Mile 13.9



Cargasachi Reach

Cargasachi Ranch - Mile 24.0

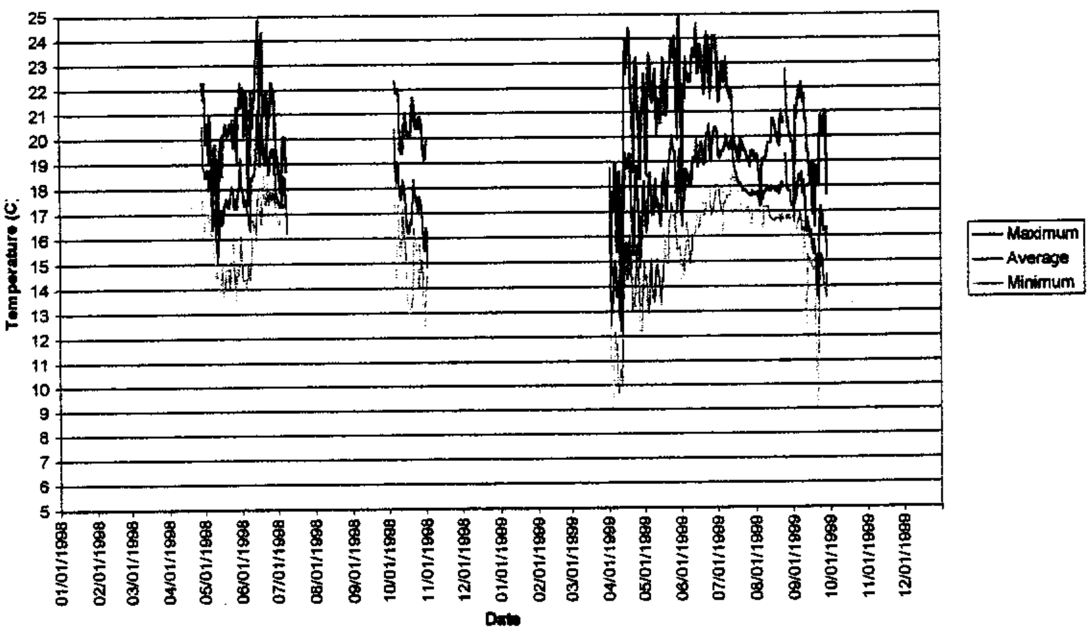
1998

Several thermographs were deployed in the reach during from mid- April through early November 1998. The Cargasachi Reach area is heavily frequented by members of the public for recreation purposes. Unfortunately, on two occasions, once in August and again in September, the cable and thermographs within the protective enclosures were missing from the deployment site. Searches for the missing units were conducted around the general area of the deployment site, however, the thermographs were not found. Data was retrieved for the period from April through early July, and for most of October **(Figure 3.4.2.1-10)**. Temperature conditions remained cool through most of the spring, with maximum temperatures around 22 C or less, and average temperatures less than 20 C. The water temperatures started to warm somewhat in June, but remained similar to spring conditions except for two occasions where spikes of nearly 25 C were recorded. Generally, average temperatures remained less than 20.

1999

Water temperature data collected in 1999 extended from April through September. After September, water ceased to flow at the monitoring location and the thermograph was removed. Data collected shows interesting similarities when compared with the Avenue of the Flags unit. From April through July, temperatures show a typical warming trend developing, with maximum temperatures around 23-25 C, and average temperatures around 18-20.5 C. Usually, temperatures in August and September are similar to those in June and July. However, beginning in mid-July, a dramatic cooling trend was recorded with temperatures decreasing between 4-5 C from maximums around 24-25 C. This cooling trend extended from July through the end of the monitoring period (September). The cooling trend, like Avenue of the Flags is coincident with a decrease in water flow and probably reflects upwelling type conditions.

Figure 3.4.2.1-10 1998-1999 Water Temperature at Cargasachi Reach - Bottom Unit (Run Habitat) - Mile 26



Santa Ynez Lagoon

1998

Water flowed into the lagoon for the majority of the year due to saturation of the watershed during the 1998 storms, and continued releases of 10 cfs from the Fish Account. Surface temperatures in the Santa Ynez Lagoon show a general seasonal warming and cooling pattern. Both temperatures and the diel variation increased during the summer and early fall at the surface unit. Surface temperatures were surprisingly warm at Ocean Park compared to previous years. During the summer, surface temperatures stayed between 23-25 C while average temperatures generally remained less than 20 C **(Figure 3.4.2.1-11)**. Diel variation was greatest during the summer with 24-hour temperature differences between 5-8 C. Fall, spring, and winter temperatures were generally less than 20 C with a diel variation of between 1-3 C.

Water temperature data is missing from June through August at the bottom deployment site due to thermograph malfunction. During the spring and fall, water temperatures generally remained less than 20 C. Diel variation was also much lower compared to the surface with differences of only 0-2 C **(Figure 3.4.2.1-12)**.

1999

Surface water temperatures generally remained several degrees cooler compared to 1998 temperatures. Temperatures warmed gradually beginning in the spring and reached the maximum for the season during July and August with temperatures between 20-24 C. By September, water temperatures abruptly cooled and generally remained less than 20 C for the remainder of the year. Very little 24-hour variation was noted during the surface deployment.

Bottom temperatures were generally 3-4 degrees cooler compared to surface temperatures. Typically, water temperature did not exceed 22 C at the bottom thermograph. Diel variation was remained between 1-2 C during the entire deployment time.

Figure 3.4.2.1-11 1998-1999 Water Temperature at Ocean Park, Santa Ynez River Lagoon - Surface Unit (1 foot below surface)

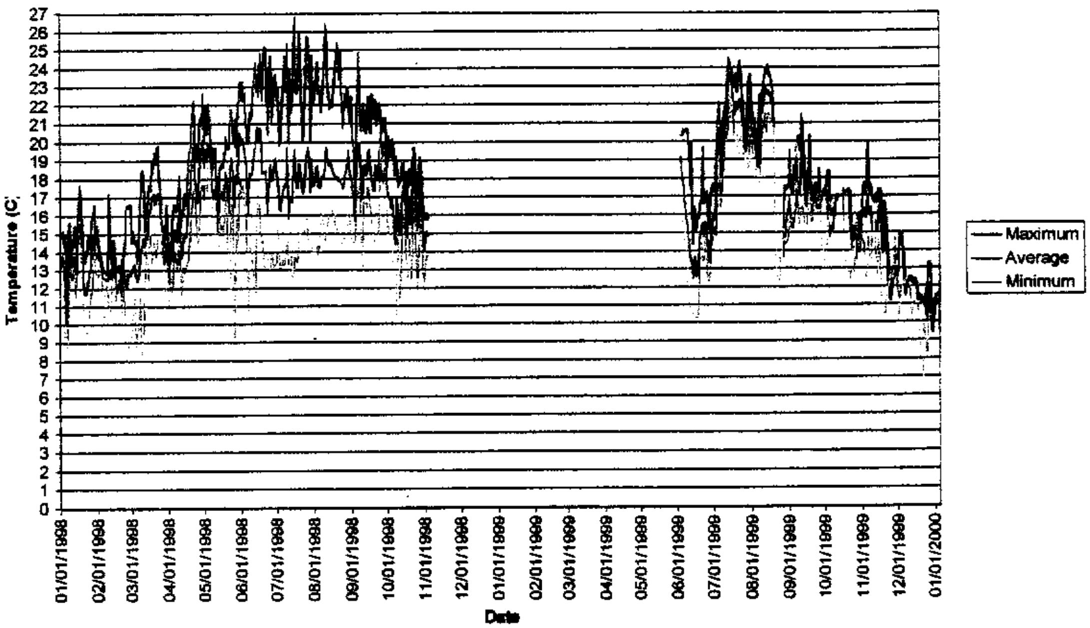
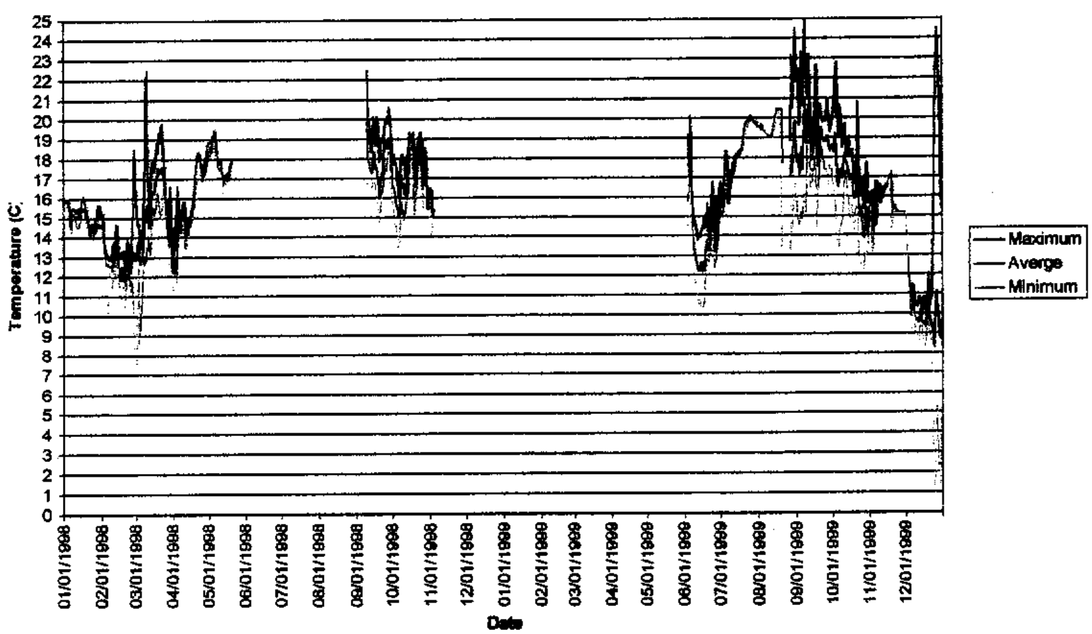


Figure 3.4.2.1-12 1998-1999 Water Temperature at Ocean Park, Santa Ynez River Lagoon - Bottom Unit (4-6 feet deep)



3.5 Mainstem Diurnal Oxygen and Water Temperature Monitoring

During late spring and extending into early fall, the SYR exhibits tremendous algae production in most of its surface waters. This abundant algae growth can have adverse effects to most fish species, particularly in the hours prior to dawn. During the day when photosynthesis is taking place, algae growth can saturate the water column with dissolved oxygen. Conversely, during the nighttime hours, algae metabolism, bacterial decomposition, and invertebrate respiration can remove significant amounts of dissolved oxygen from overlying water causing oxygen depletion.
Salmonids function normally at dissolved concentrations of 7.75 mg/L; exhibit various distress symptoms at 5-6 mg/L; and are often negatively affected at 4.25 mg/L (Barnhardt 1986). Warmwater species such as largemouth bass, and cool water species like salmonids may be able to survive when DO concentrations are relatively low (< 5.0 mg/L), but growth, food conversion efficiency, and swimming performance will be adversely affected (Bjorne 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.

3.5.1 Methods

In 1998, diurnal measurements of DO and water temperature were measured on August 27, September 1, and September 11, 1998. Measurements were made in pool, riffle, and run habitats at one foot intervals throughout the water column. The locations were as follows: Long Pool (mile 0.5), Refugio X (mile 3.4), Refugio Bridge (mile 7.9), Alisal Bridge (mile 10.5), and Avenue of the Flags Bridge (mile 13.9).

In 1999, DO and water temperature were measured on June 14, June 15, August 4, August 5, and August 30 at the same mainstem locations described above.

Measurements at each site were taken twice daily using a Yellow Springs Instrument Model 57 Dissolved Oxygen Meter. Measurements were taken at the deepest portion of the habitat unit. Only one measurement was obtained in riffle and run habitats due to shallower depths. Morning measurements were taken before or at first light to insure measurements of the lowest dissolved oxygen concentration during the 24-hour period. Evening measurements were recorded between the hours of 4:00-6:00 p.m. to insure levels of highest dissolved oxygen for the 24-hour period.

3.5.2 Results

1998
Unlike past years, flow in the mainstem persisted throughout the entire year. Measurements taken at the Long Pool showed much higher dissolved oxygen concentrations in the morning hours compared with downstream locations. Measurements within pool and adjacent, riffle and run habitats were consistently greater than 6.0 mg/L except at the 10 foot mark within the Long Pool which measured 3.92 mg/L in September **(Table 3.5.2-1 in Appendix 1)**. All other downstream monitoring locations recorded dissolved oxygen concentrations less than 5.0 mg/L. Morning water temperatures generally varied between 17.3-18.5 C.

Measurements taken at mile 3.4 showed morning dissolved concentrations varying between 4.14-5.60 mg/L during all three monitoring dates. Surprisingly riffle and run habitats had similar dissolved oxygen concentrations compared to pool habitats indicating that the oxygen depletion is not localized to pool habitats. In fact, morning measurements taken directly within a riffle bubble curtain showed concentrations of only 5.35 mg/L. Morning water temperatures varied between 19.6-21.4 C.

The lowest morning dissolved oxygen concentrations were measured in the habitats directly downstream of the Refugio Bridge. Measurements in the pool habitats rarely exceeded 4.0 mg/L, and decreased to as little as 2.6 mg/L at the bottom of the pool (steelhead/rainbow trout oversummered within this pool habitat). Riffle and run habitat readings were slightly higher, but did not exceed 5.2 mg/L during the monitoring times. Morning water temperatures varied between 19.8-20.8 C.

Morning measurements taken at the Alisal Bridge were always greater than 5.0 mg/L and usually varied between 5.1-6.1 mg/L in pool, riffle and run habitats. Morning water temperatures varied between 19.9-20.8 C.

Morning measurements taken at the Avenue of the Flags was similar to the Alisal Bridge location. Morning readings varied between 4.4-6.0 mg/L in pool, riffle, and run habitats. Morning water temperatures varied between 19.8-20.8 mg/L.

Evening dissolved oxygen concentrations were always greater than 9.0 mg/L at every monitoring location. While dissolved oxygen concentrations were high, so were evening water temperatures. With the exception of the long pool, evening water temperatures varied between 24.0-26.2 C. Long pool water temperatures generally varied between 18.6-21.1 C.

1999

During the diurnal sampling, flow within the mainstem was slowly approaching no flow conditions at several areas. During the June sampling, there was still continuity from the dam downstream to mile 13.9. However, as the summer progressed, the mainstem became fragmented with alternating dry and flowing regions. The end result was that some of the pools with very low DO concentrations had essentially no water flowing within the habitats, and were relying more on upwelling to keep the habitats wetted.

Measurements taken during the June timeframe indicate relatively low DO concentrations in the morning hours at most mainstem monitoring locations. Concentrations were greater than 5 mg/L at all locations except the pool habitat at mile 13.9 (4.6 mg/L) and the lower two feet in the pool habitat at mile 7.8 (2.12-2.42 mg/L). At the long pool, DO concentrations remained relatively high during the morning hours (8.05-6.02 mg/L). Run and riffle habitats generally had DO concentrations greater than 5.2 mg/L **(Table 3.5.2-1 in Appendix 1).**

DO concentrations during the early August monitoring were significantly reduced compared to June measurements. Additionally, flow was low or non-existent at several of the monitoring locations. DO was highest at the long pool location, particularly in run and riffle habitats (>7.6 mg/L). The long pool itself had concentrations greater than 5 mg/L within the upper three feet of the water column. However, from three feet down to 10 feet, DO concentrations dropped significantly (4.81-3.03 mg/L).

At monitoring locations further downstream, DO concentrations were significantly lower, particularly in the pool unit at mile 7.8. Concentrations at this site decreased from 1.89 mg/L at the surface to 0.27 at 4 feet during the morning hours. Sites further downstream (mile 10.5) had flowing conditions during the entire year, but also had very low DO concentrations (3.36-2.84 mg/L). Measurements taken during the later portion of August showed DO concentrations even lower that during the early August monitoring. At mile 7.8, DO varied from 1.14-0.87 mg/L, while at mile 10.5, DO varied from 3.65-3.41. As mentioned above, flow persisted through the monitoring location at mile 10.5, while at mile 7.8, agricultural runoff, or no flow conditions persisted during the later portion of the summer.

Water quality measurements taken in the evenings had consistently higher DO concentrations, generally greater than 6.0 mg/L with most locations greater than 10 mg/L. Afternoon water temperatures were generally higher and usually varied between 19-24 C. Morning water temperatures were generally cooler and were usually between 17-21 C.

3.6 Lagoon Water Quality

Estuaries and lagoon are the most complex bodies of water commonly encountered by limnologists, and they are also 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 freshwater, and large areas of shallow, turbid water overlying 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.

3.6.1 Methods

Lagoon water quality was monitored at three sites, during August 27, November 12, and December 3, 1998. During 1999, water quality monitoring was conducted during two one-week intervals (June and October) when passive trapping was being conducted. In 1999, only temperature, DO, salinity, and conductivity data was collected.

Site #1 was located directly across from Ocean Park. Site #2 was located at the approximate location of the 35th Street Bridge. Site #3 was located approximately 200 yards downstream from the river entrance. The field crew used a 14-foot aluminum boat provided by the US Fish and Wildlife Service to monitor water quality. The crew entered the lagoon at Ocean Park and proceeded upstream to the various monitoring locations. At each site, a visual transect was established across the lagoon channel. Sounding was conducted to determine the area of maximum depth and measurements were taken at the deepest area along each transect. Measurements were made at one-foot intervals using a Hydrolab Datasonde 3 Water Quality Meter (provided by US Fish and Wildlife Service). The following water quality parameters were measured: temperature (C), dissolved oxygen (mg/L), specific conductance (umhos), pH, salinity (ppt), and redox potential (mv).

3.6.2 Results

1998

Lagoon water depth fluctuated several feet between months depending on if the lagoon was open or closed, and if the tide was coming in or going out. Lagoon depth was shallowest during the August monitoring, and deepest during the December monitoring. Since the mainstem SYR flowed for the entire year, the lagoon was in a constant state of flux. Steady outflow prevented the sandbar from becoming established resulting in lagoon depths usually less than four feet.

Temperature - Site #1: Water temperatures were coolest at this location during each monitoring period. Summer temperatures ranged between 17.4-19.2 C. Fall and winter temperatures were slightly cooler and generally ranged between 11.0-12.0 C **(Table 3.6-1 in Appendix II)**. No stratification was observed.

Site #2 - mid lagoon: Water temperatures at site #2 were warmest during August (22.94 C). During November and December, water temperatures typically varied between 11.5-15.3 C with no evidence of stratification developing.

Site #3 - upper lagoon: The warmest water temperatures recorded during the monitoring period occurred in August (24.7 C). After August, water temperatures remained between 11.5-15.8 C. No evidence of stratification was observed to develop.

Dissolved Oxygen - DO concentrations at all three sites remained greater than 7.3 mg/L during months when monitoring was conducted. While no anoxic conditions were observed to develop, minor stratification of DO was observed in December at Site #2. The lowest DO concentration was measured at the very bottom of the monitoring site (4.0 feet).

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. Salinity increases the amount of dissolved ionic matter in the water thus giving increased conductivity measurements as salinity increases. Thus, conductivity was greatest at Site #1, Ocean Park during the 1998 surveys. Lower concentrations were recorded at sites #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 concentrations of about 0.5 ppt (Lind 1985). Additionally, the presence of dissolved salts increases the density of water.

Ocean Park (site #1) recorded the highest salinity measurements during each of the three surveys. Typically, salinity varied from near freshwater concentrations at the surface to near seawater near at the bottom. Measurements at site #2 (mid-lagoon) were the most varied when comparing the three sample sites. When the lagoon was open, salinity measurements were close to freshwater concentrations. When the lagoon was closed, salinity measurements showed a similar pattern at site #1 with near freshwater concentrations at the surface and near seawater at the bottom. Site # 3 showed a similar profile (brackish) when compared with site #2 in November when the lagoon was closed. When the lagoon was open in August and December, salinity concentrations were near freshwater.

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 often in the range of 6.0-8.0 (Lind 1985). The combination of decompositional processes in the hypolimnion 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 showed very little variation during the monitoring program. Since the lagoon remained open for the majority of the year, very little stratification developed including no anoxic or near anoxic conditions at the mud surface interface. The pH measurements remained between 7.93-8.68 during the monitoring period.

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).

As stated earlier, the dissolved oxygen concentration throughout the water column remained well above anoxic conditions. The resulting redox measurements reflect this also. Redox remained between 347-512 mv during each monitoring period indicating little decompositional processes at work.

1999

Water quality data did not differ significantly between the June and October monitoring period. During the June monitoring, lagoon depth was shallow due to the lagoon being open. In fact, in June, lagoon depth at the monitoring locations did not exceed 3 feet. Additionally, since the lagoon was open, it prevented stagnant conditions from developing and consequently, no anoxic conditions were observed. Too, no stratification of temperature or DO was observed within the water column since flowing conditions within the lagoon prevailed.

During the October monitoring time, conditions were similar to what was observed in May; the lagoon was open and free flowing conditions existed. Also, the lagoon depth was comparable to that of the May survey. However, during the fourth day of monitoring, the phase of the moon in addition to high tides raised the lagoon depth significantly creating highly variable salinity conditions throughout the lagoon. No water quality was taken during this time at sites 1 and 2.

Temperature: During the May survey, water quality was generally 1-6 C cooler at site #1 compared to other sites due to marine influences and proximity to the ocean. Typically, water temperatures varied between 14-19 C at site #1. At sites 2 and 3, water temperature was almost identical except for the first day of sampling when site #3 was approximately 2.5 C warmer than site #2. For the remainder of the monitoring period, water temperatures varied between 16-24 C with both site #2 and #3 having essentially the same temperatures.

During the October monitoring period, essentially the same conditions were observed as during the May timeframe. Site #1 was generally cooler than the other two sites, with site #3 generally being the warmest.

Dissolved Oxygen: No significant patterns in DO stratification or anoxic conditions were observed to occur during May. Generally, DO remained greater than 9.0 mg/L during the monitoring period.
In October, DO monitoring was only conducted on the first day due to instrument malfunction. On that particular day, DO exceeded 7.9 mg/L at all locations and was generally greater than 10 mg/L. No significant stratification or anoxic conditions were observed.

Salinity/Conductivity:

During the May sampling period, salinity/conductivity showed the greatest amount of variation at sites 1 and 2. Typically, concentrations were closer to freshwater within the first 1 foot of the water column. As depth increased, so did the concentration of salinity and conductivity. Usually the lower 2-3 feet held near seawater concentrations. However, during several monitoring days, salinity concentrations were near freshwater at site #2, while on other days there were freshwater concentrations at the surface, and near saltwater concentrations at the bottom. Site #3 had freshwater concentrations during the entire May sampling period.

Nearly identical conditions were recorded during the October monitoring period. The only difference was during the later portion of the monitoring period when the surge of seawater from the high tides and moon phase pushed a large slug of ocean water into the lagoon. At this time, salinity/conductivity conditions were near saltwater at site #3 with a freshwater lens at the surface.

3.7 Tributary Water Temperature Monitoring

3.7.1 Methods

In 1998 and 1999, nine Optic Stowaway thermograph were deployed in five tributaries to the SYR: Hilton (3), Nojoqui (1), Salsipuedes (2), El Jaro (1), and San Miguelito Creek (2). The principal 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 thermograph were deployed in run habitats, with the exception of the middle unit in Hilton Creek, which was deployed in a pool habitat.

Hilton Creek

Three thermographs were deployed in Hilton Creek: 1) Upper creek at the BOR/Crawford property boundary approximately 2,924.5 feet upstream from the confluence, 2) Spawning pool, approximately 1200 feet upstream of the confluence pool, and 3) The lower creek approximately 100 feet upstream of the confluence. Both the upper and lower monitoring thermographs were deployed in run habitats, while the middle site was deployed in a pool habitat. Due to the tremendous rain year of 1998, both the upper and middle monitoring sites retained water throughout the year and thermographs were left to collect data. The lower thermograph was removed at the end of July due to attenuation of creek flow. Deployment times varied between each monitoring site. The upper creek site was deployed in the beginning of June. The spawning pool thermograph was deployed in the beginning of March, while the lower thermograph was deployed in the beginning of April. In 1999, only one unit was deployed (spawning pool) due to insufficient creek flow

Nojoqui Creek

The thermograph in Nojoqui Creek was deployed from January through November 1998 with a break in the data from March through mid May when storm flows removed the tree the unit was attached to. The deployment site was located 200 feet downstream from the 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 in approximately 2.0 feet of water. The unit was removed from the water at the end of 1998 to prevent thermograph loss during any high flow events. The unit was redeployed during May of 1999 and continued to record data until August 17, 1999 when the thermograph was removed from the creek due to lack of water.

Salsipuedes Creek

Two temperature units were deployed in Salsipuedes Creek in 1998-1999. The first unit was located 100 feet upstream of the confluence with El Jaro Creek. The second unit was deployed approximately 1200 feet upstream of the Santa Ynez River confluence. The upper unit was deployed from January through November and was located in a shady run in approximately 2.0 feet of water. The unit was placed in a protective enclosure and cabled to a tree.

The lower unit was deployed from January through November with a break in the data from early January through mid-April when storm flows removed the tree where the thermograph was attached.

El Jaro Creek

A thermograph was deployed in El Jaro Creek during both 1998 and 1999. During the winter of 1999, the thermograph was removed to prevent its loss during any high flow events. The thermograph was redeployed in Late April 1999. During both years, the unit was placed in protective enclosure in a run/pool habitat 2.0 feet deep and cabled to a nearby tree approximately 150 feet upstream of the Salsipuedes Creek confluence.

San Miguelito Creek

Two thermographs were deployed in San Miguelito Creek. The upper thermograph was deployed near San Miguelito Park adjacent to where the rescued Hilton Creek steelhead/rainbow trout were relocated. San Miguelito Park is located approximately 5 miles upstream of the Santa Ynez River confluence. The purpose of this deployment site was to evaluate thermal conditions in the creek for the rescued fish. Deployment time for the upper site was from mid June through early November 1998, and from April through December 1999. The upper unit was placed in a protective enclosure in 2.0 feet of water and cabled to a nearby tree.

The lower unit was located directly downstream from the migrant trap location (3 miles upstream of SYR confluence). The unit was deployed from early March through November 1998, and from April through December 1999. The unit was placed in a protective enclosure in a run habitat approximately 2.0 feet deep.

3.7.2 Results

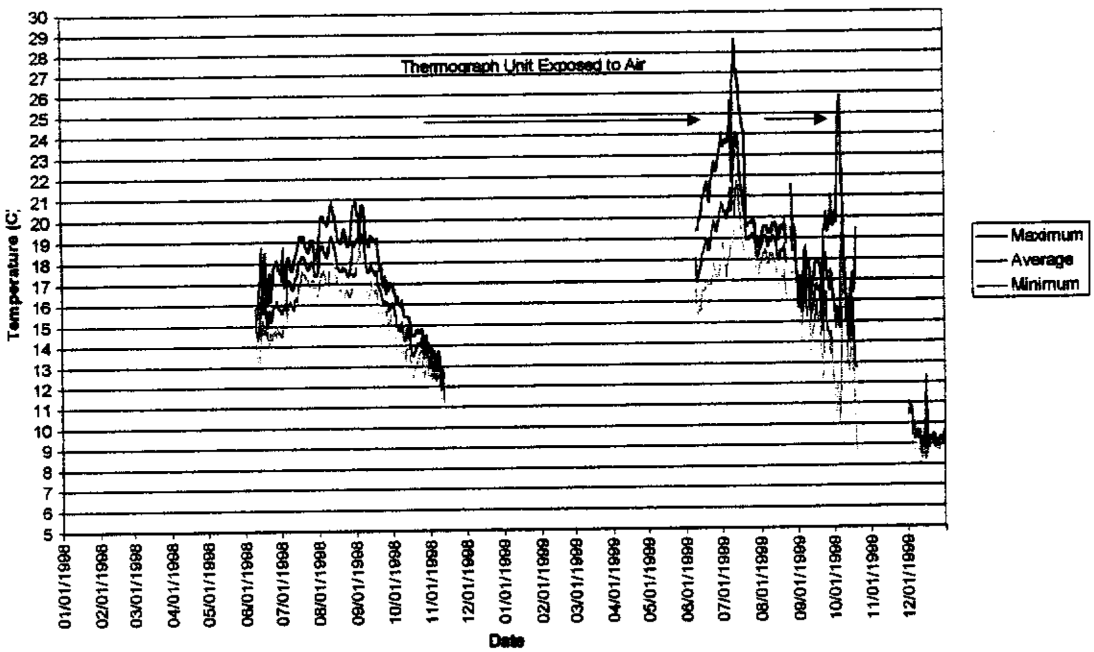
Hilton Creek

Hilton Creek began flowing into the Santa Ynez following several large storm events in early January. Thermographs were not deployed into the creek until March or later for fear of loosing the units during high flow events. The large amount of rainfall during the winter of 1997-98 generated constant flow conditions throughout the summer and fall in the upper portion of Hilton Creek, something that had not been documented previously. While the lower portions of the creek did dry during the summer, several pools persisted in the mid-portion of the creek, which provided oversummering habitat for the remaining young of the year not removed during the fish rescue of late June.

Upper Hilton Creek

Seasonal patterns and diel variation 1998: A thermograph was deployed in the upper portion of Hilton Creek on BOR property to evaluate thermal heating between potential between the upper and lower portions of the creek on BOR property. Data collected indicate that this portion of the creek has some of the coolest water temperatures compared to other tributaries. Riparian vegetation and canopy are well established upstream of the BOR property line. While maximum water temperatures gradually increased from June through early September, they never exceeded 21 C, and generally remained less than 20 C (**Figure 3.7.2-1**). Water temperatures rapidly cooled after September. Daily variations generally remained around 3-4 C during the summer months and 1-2 C during the fall and early winter.

Figure 3.7.2-1 1998-1999 Water Temperature - Upper Hilton Creek at BOR Property Boundary



Seasonal patterns and daily variation 1999: water temperatures recorded during the monitoring period reflect some of the cooler tributary temperatures within the watershed. Water flow gradually decreased as the year progressed, leaving the thermograph exposed to air on two occasions (mid-July and early-October). At one point during the late summer, the unit had to be relocated downstream to a pool area that remained wetted. Flow at the beginning of the monitoring period was estimated to be 0.5 cfs. By the end of the year, upstream flow had been reduced to a trickle. With the exception of the two times when the thermograph was exposed to air, maximum water temperatures remained less than 20 C. Daily variation was also low, usually varying only 1-3 C during the deployment time.

Middle Hilton Creek

Seasonal patterns and daily variation: For the period before June and after September, water temperatures remained less than 20 C. Daily variation varied between 2-5 C before June, and between

1-2 C after September. However, for the period from mid June through the end of August, both the maximum water temperatures and daily variation increased significantly **(Figure 3.7.2-2)**. Maximum water temperatures increased steadily from approximately 20 C in early June to nearly 26 C in early August. Average water temperatures generally remained less than 20 C except for two times in early and late August when temperatures were slightly greater than 21 C. Daily variation during the summer was usually around 5 C. It was noted that the diel increase in water temperature corresponded to both an increase in air temperature during the summer months, and to a drop in flow. Additionally, comparison with the upper site shows an increase of approximately 2.0 C in the average water temperature, and approximately 5 C in the maximum water temperature during the critical summer months.

Temperature data collected within this pool is significant in the fact that young of the year steelhead/rainbow trout oversummered within this habitat. The temperatures recorded provide some insight to thermal tolerances of these fish. Throughout the summer months, water continued to trickle (< 0.1 cfs estimated) into the habitat providing at least a minimal contribution of fresh water.

Lower Hilton Creek

Seasonal pattern and diel variation: Water temperatures remained less than 20 C until early June **(Figure 3.7.2-3)**. From June through the end of July (thermograph removal), maximum water temperature increased to nearly 28 C. The large increase in temperature corresponds to both a decrease in flow, and an increase in air temperatures. Average temperatures were less than 20 C until mid July when they increased to over 21 C. The thermograph was removed on July 31 due to insufficient water in the lower creek. Diel variation was somewhat greater in the lower creek compared to the other two monitoring locations. Variation prior to June was between 2-7 C. After June and continuing through July, variation was generally between 8-12 C.

Nojoqui Creek

Seasonal pattern and diel variation 1998: Water temperatures gradually heated through the spring and summer. Maximum temperatures reached 27 C in early July and generally remained in excess of 24 C until mid August when water temperatures began to decrease **(Figure 3.7.2-4)**. Average temperatures remained less than 20 C except for a month and a half period from July through mid August when temperatures were near 22 C. Diel variation was generally around 5 C during the spring and summer months. Anomalous temperature readings were recorded during February resulting from storm events that placed the thermograph out of the water. Subsequent storms in March removed the tree the where the thermograph was attached. This fact was not discovered until May during which time a new thermograph was deployed.

Seasonal pattern and diel variation 1999: Overall, water temperatures were significantly cooler in 1999 compared to 1998. From April through July, temperatures gradually warmed to maximums between 20-25 C. Generally, average temperatures remained less than 20 C during the monitoring period.

Lower Salsipuedes Creek

Seasonal pattern and diel variation: Water temperatures collected in lower Salsipuedes Creek were the highest recorded of any of the tributaries during 1998. This can probably be attributed to a loss of riparian vegetation caused by destructive high flow events during the winter. Significant warming began in early June with recorded maximum temperatures ranging between 21-27 C **(Figure 3.7.2-5)**. These maximum temperatures are unusual in the fact that there is such a wide variability in the temperatures during deployment time, particularly during the summer. From July through early September, maximum temperatures do remain fairly constant, usually varying between 24-28 C with temperatures exceeding 29 C on two occasions in early August and once again in early September. Average temperatures generally remained greater than 20 C from July through mid September with peaks of 23 C. Diel variations usually varied between 2-6 C during the spring and summer.

Seasonal pattern and diel variation 1999: Water temperatures were generally cooler in 1999 compared to 1998, particularly during the summer monitoring period. This could be due to the fact that riparian growth had began to come back, or that the summer of 1999 was slightly cooler than 1998. Maximum temperatures were generally greater than 22 C during May through October, and remained between 25-28 C from mid June through the beginning of September. Average temperatures were less than 20 C except during July and August when they were generally between 20-22 C. Diel variation was also less pronounced compared to 1998. Typically, variation was between 5-8 C during 1999.

Figure 3.7.2-2. 1998 Water Temperature - Hilton Creek 1000 ft. Upstream of Confluence with SYR (Middle Creek)

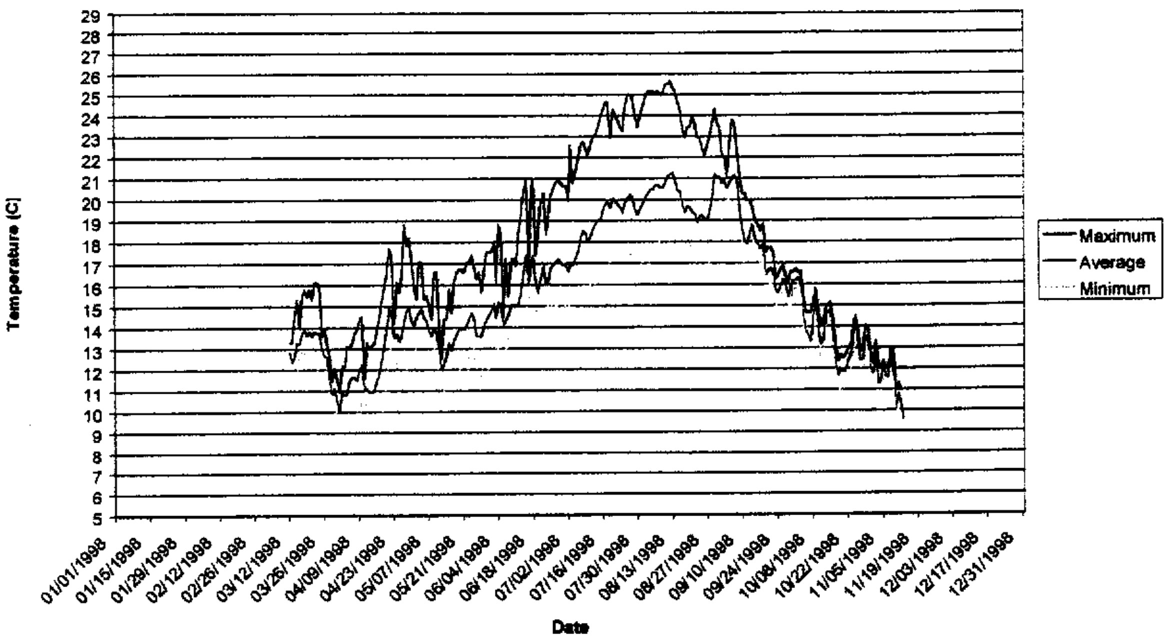


Figure 3.7.2-3. 1998 Water Temperature - Lower Hilton Creek 100 ft. Upstream of SYR Confluence

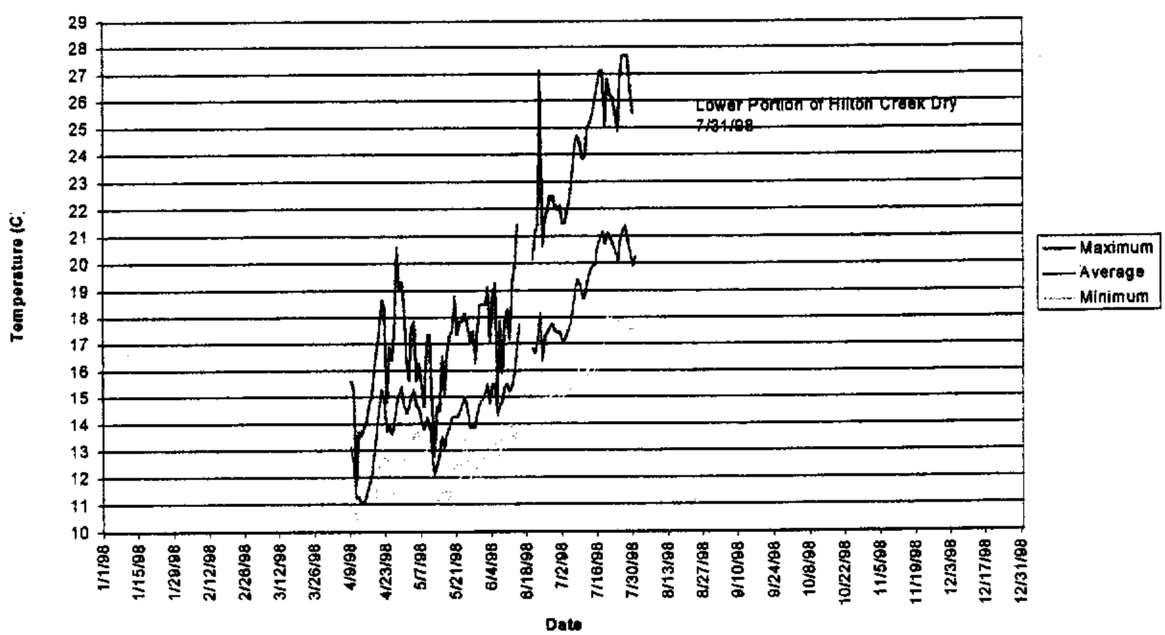


Figure 3.7.2-4 1998-1999 Water Temperature - Nojoqui Creek - 1.5 Miles Upstream of SYR Confluence

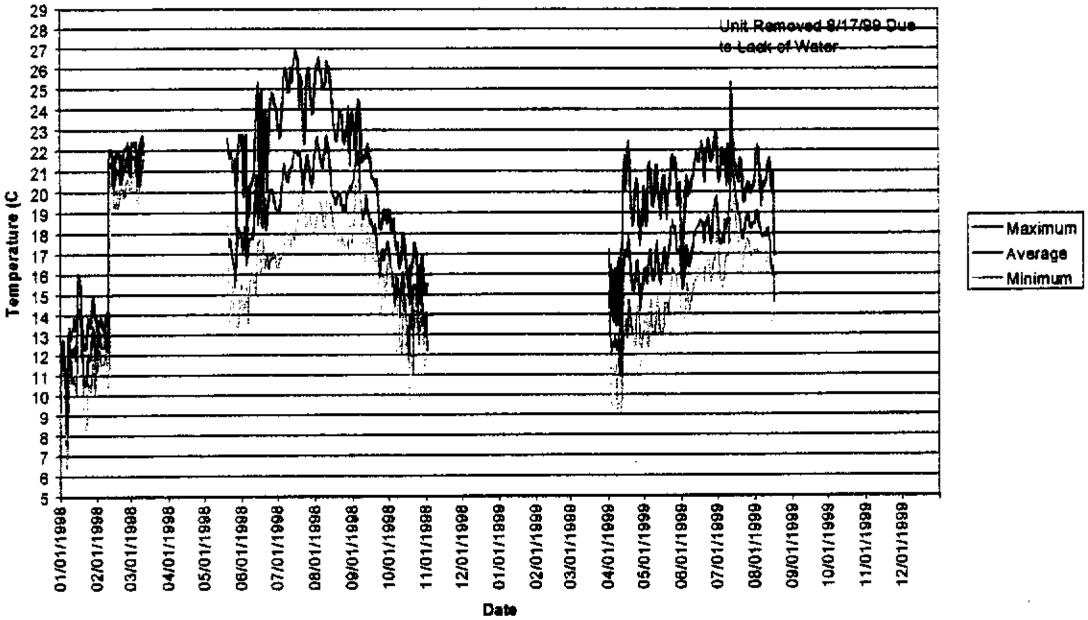
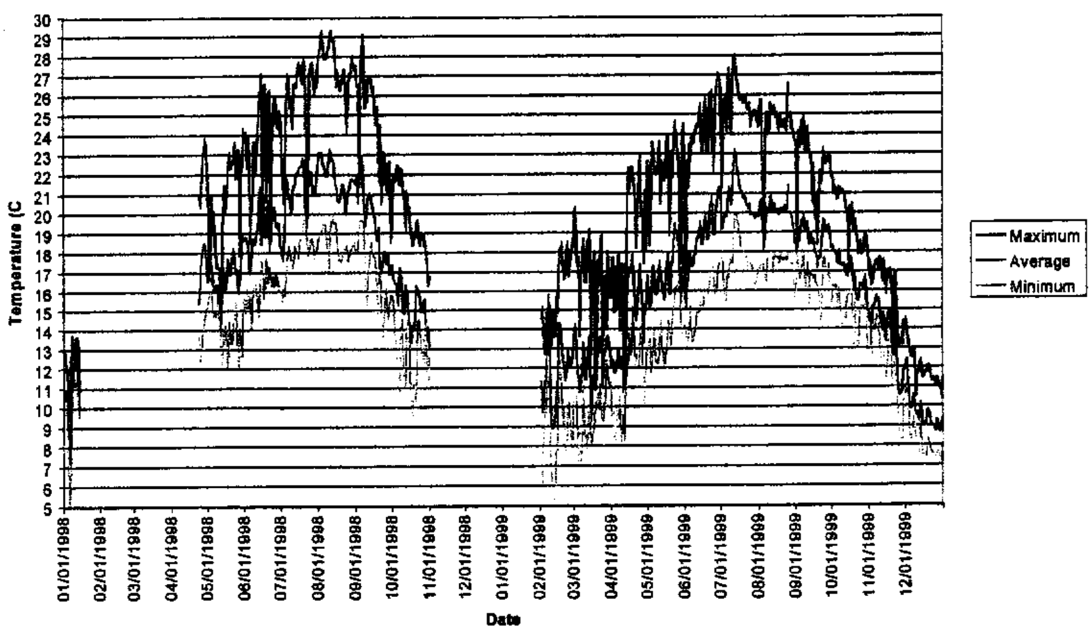


Figure 3.7.2-5 1998-1999 Water Temperature - Lower Salsipuedes Creek - 1500 Feet Upstream of Santa Ynez River Confluence



Upper Salsipuedes Creek

Seasonal patterns and diel variation: Water temperatures, particularly maximum temperatures were higher when compared to previous years, probably a result of riparian vegetation being removed during the winter of 1998. However, temperatures were generally cooler compared to both lower Salsipuedes and El Jaro Creeks. Typically, maximum temperatures ranged between 17-25 C during the summer months **(Figure 3.7.2-6)**. During the warmer portions of summer, maximum temperatures remained between 22-25 C. Average temperatures typically remained less than 20 C except for a few days when it approached 20.5 C. This is not typical considering that past data has not recorded average temperature greater than 20 C. Diel variation usually varied between 4-7 C during the spring and summer.

Seasonal patterns and diel variation 1999: Water temperatures collected in 1999 were significantly cooler compared to 1998. In fact, maximum temperatures generally remained less than 22 C, while average temperatures remained less than 18 C. These substantially cooler temperatures could be a result of riparian vegetation becoming established within upper Salsipuedes Creek, thereby reducing the amount of solar radiation influencing the water temperatures. One notable spike in water temperature, which corresponds to other monitoring locations, was recorded in the beginning of July when temperatures increased nearly 1.5 C. This event is interesting to note because it illustrates how air temperatures directly affect water temperatures. In fact, air temperatures recorded at the Santa Ynez Airport showed a similar spike in the maximum temperature.

El Jaro Creek

Seasonal patterns and diel variation 1998: Water temperatures in El Jaro Creek began to rapidly increase beginning in early June. From June through early September, maximum water temperatures were usually greater than 24 C and on a few occasions reached 28 C **(Figure 3.7.2-7)**. Average temperatures were greater (20-23 C) compared to Upper Salsipuedes Creek, particularly during summer. An anomalous data set was observed from April through mid May resulting from the thermograph being buried after a storm event. Diel variation usually varied between 2.5-6 C during the spring and summer.

Seasonal patterns and diel variation 1999: Water temperatures, particularly average temperature, were significantly cooler in 1999 compared to 1998 temperatures. In fact, except for the month of July, average temperatures remained less than 20 C, which is something that has not happened during the course of the temperature monitoring. Maximum temperatures showed rapid warming beginning June and continued with that trend through mid-July. Interestingly, the cooling trend that normally happens around September, was observed to start sometime after mid-July.

Figure 3.7.2-6 1998-1999 Water Temperature - Upper Salsipuedes Creek - 150 Feet Upstream of El Jaro Creek Confluence

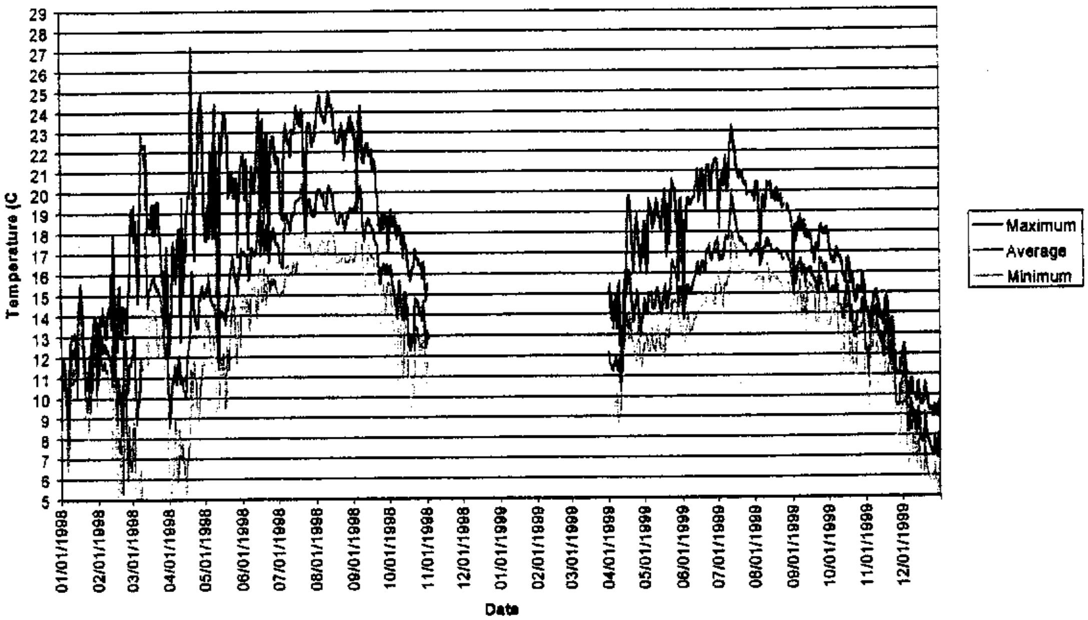
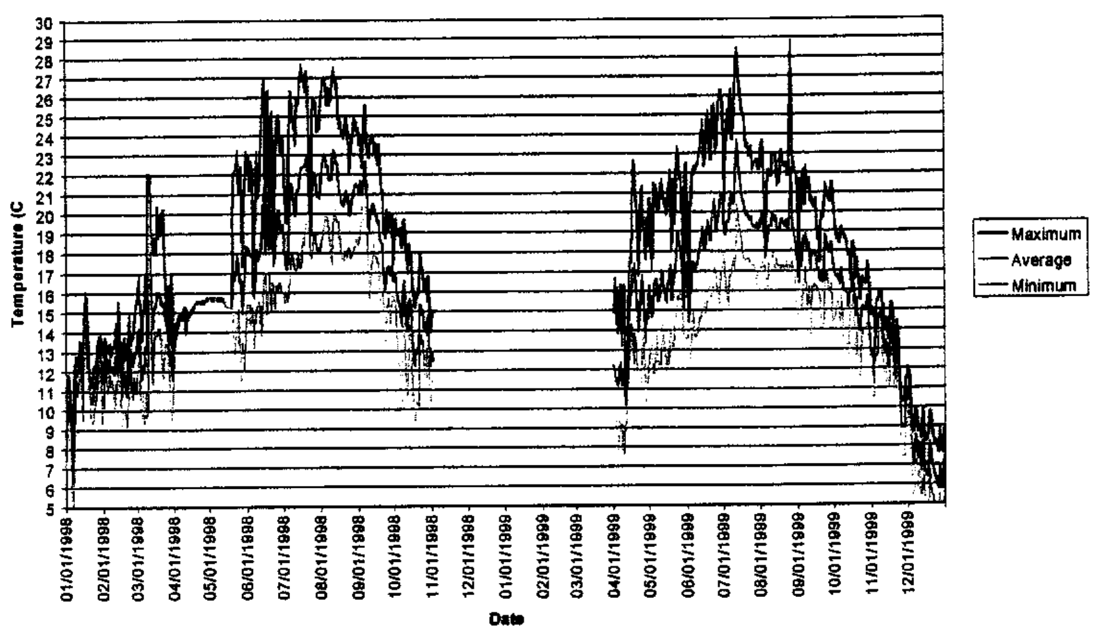


Figure 3.7.2-7 1998-1999 Water Temperature - El Jaro Creek - 150 Feet Upstream of Salsipuedes Creek Confluence



San Miguelito Creek

Lower Creek

Seasonal pattern and diel variation 1998: Water temperatures in lower San Miguelito Creek remained relatively low during the deployment time. Maximum temperatures did not exceed 21.5 C **(Figure 3.7.2-8)**. However, data is missing (mid-July through early September due to thermograph malfunction) when water temperatures are usually at their maximum. Average temperatures never exceeded 18 C. Diel variation usually varied between 3-6 C during the spring and summer.

Seasonal pattern and diel variation 1999: Unlike the other tributaries, comparison of water temperatures between the two years shows very little difference. Average water temperatures during the summer of 1999 remained well below 20 C, while maximum temperatures generally remained less than 21 C. Diel variation usually varied between 3-6 C during the entire deployment time.

Upper Creek

Seasonal patterns and diel variation 1998: Surprisingly, water temperatures were slightly higher in the upper creek compared to the lower creek. Maximum temperatures typically ranged between 17-23 C during the summer **(Figure 3.7.2-9)**. Average temperatures never exceeded 20 C. Diel variation usually varied between 2-5 C during the deployment time.

Seasonal patterns and diel variation 1999: Water temperatures were significantly cooler in 1999 compared to 1998. In fact, maximum water temperature remained less than 20 C during except for a few days in July when maximum temperatures approached 23 C. Average temperatures remained less than 18 C except for one warm day in July. Diel variation during the deployment time varied between 0.5-5.0 C.

Figure 3.7.2-8 1998 Water Temperature - Lower San Miguelito Creek - 3 Miles Upstream of Santa Ynez River Confluence at Migrant Trap Site

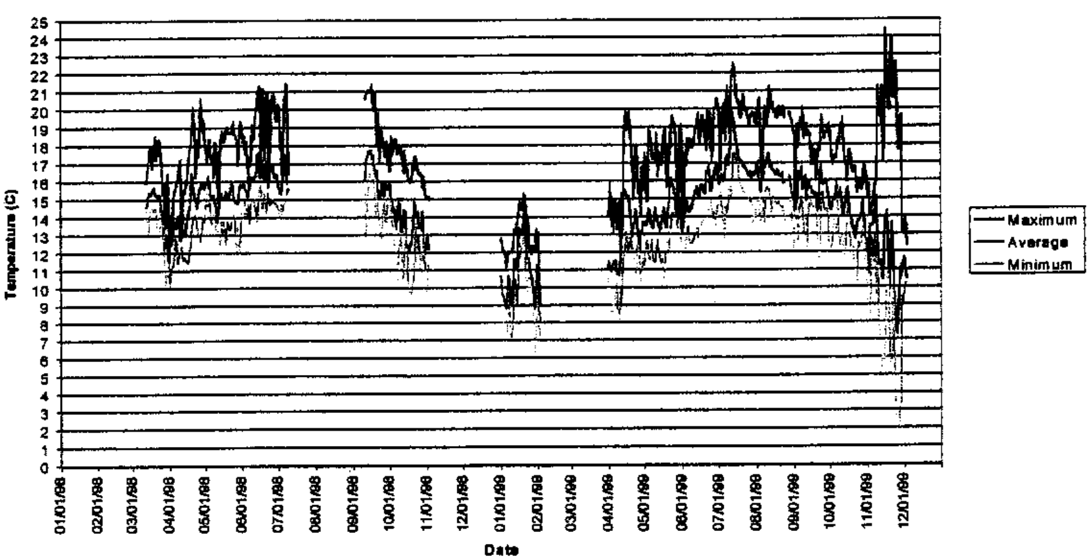
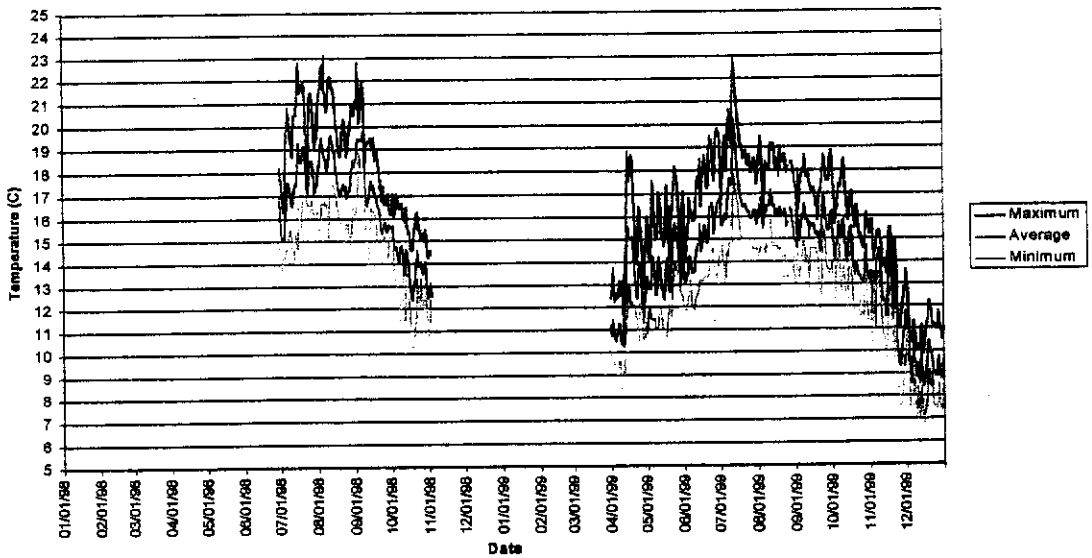


Figure 3.7.2-9 1998-1999 Water Temperature - San Miguelito Park - 5 Miles Upstream of Santa Ynez River Confluence



4.0 Habitat Characterization

Aquatic habitat measurements play an integral role in fishery 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 preferences to determine if habitat parameters are limiting and which type of habitat improvements may be beneficial. The quantity and quality of aquatic 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.

4.1 Methods

Habitat typing was conducted in Hilton, Nojoqui, Upper and Lower Salsipuedes, and El Jaro Creeks during June 1998 for the purpose of:

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

Habitat typing was conducted within the tributaries during 1996. However, the methodology used was slightly different than the techniques employed in the 1997 habitat typing of the mainstem. In order to remain consistent with the type of habitat information collected in both the mainstem and tributaries, it was decided that a reevaluation of the habitats in the tributaries was necessary.

Habitat typing in the tributaries used a Level III classification as described by California Department of Fish and Game Salmonid Stream Habitat Restoration Manual. Habitat types were identified by riffle, run, pool (scour and dammed), and glide.

- Riffles are characterized by turbulent flow with a typically coarser substrate than units directly upstream and downstream. Substrate is usually cobble dominated, some of which may be partially exposed.
- Runs are fast water areas with shallow gradient, typically with a substrate ranging in size from gravel to cobble with no major flow obstructions. Runs are usually deeper than riffles and appear to have little or no turbulent flow.
- Scour pools are characterized by areas of sediment removal, slow water velocities and a highly variable substrate with the greatest depth typically at the head or middle of the pool. Dammed pools are characterized by the material causing the impoundment. These pools are typically deepest at the tail of the pool and have

more fines than scour pools and fill with sediment at a more rapid rate

- Glides are characterized by a uniform channel bottom, low to moderate flow velocities, and little or no turbulent flow. Substrates are usually cobble, gravel, and sand.

Additional information includes: habitat unit length, width, depth, maximum depth, percent instream shelter, percent total canopy, right and left bank dominate vegetation types, and any relevant comments with respect to landmarks, landslides, barriers, or changes in channel substrate.

4.2 Results

4.2.1 Hilton Creek

The heavy rains of 1998 significantly altered the channel configuration of lower Hilton by extending the creek approximately 300 feet further downstream before it meets with the SYR. The storms also added complexity to many individual habitat throughout the creek by increasing the amount of small and large woody debris, creating undercut banks, increasing depth of pools, and providing additional instream cover in the form of large boulders.

Hilton Creek was habitat typed on June 2 through June 3, 1998. Flow measurements during the survey averaged 2.76 cfs. A total of 2,974.5 feet of creek was surveyed in which 56 habitats were identified. Riffles comprised the majority of habitats (59.3%), followed by runs (30.8%), and pools (9.9%).

The creek was split into two reaches (upper and lower) at a passage impediment located approximately 1381 feet upstream of the confluence with the SYR (**Table 4.2.1-1 and Table 4.2.1-2**). Nearly twice as many pool and riffle habitats are present in the lower reach compared to the upper reach. Overall, the basic habitat measurements are similar between the upper and lower creek. Pools tend to be somewhat longer, wider, and deeper in the lower creek while riffles and runs tend to be longer and wider in the upper portion of the creek. Spawning sized gravels are present in moderate to good concentrations at the tail end of most pools and some runs.

Table 4.2.1-1 Average Habitat Measurements in Lower Hilton Creek

Habitat Type	Number Measured	Average Length (feet)	Average Width (feet)	Average Depth (feet)
Pool	7	30.5	14.4	1.95
Riffle	15	52.3	9.7	0.66
Run	11	33.9	8.7	0.88

Table 4.2.1-2 Average Habitat Measurements in Upper Hilton Creek

Habitat Type	Number Measured	Average Length (feet)	Average Width (feet)	Average Depth (feet)
Pool	4	20.5	12.4	1.5
Riffle	8	114.0	12.0	0.69
Run	8	62.8	10.3	0.85

Percent Canopy

Percent canopy is low in lower Hilton, with the majority of habitats having zero canopy. However, most of the lower Hilton flows through a narrow steep sided bedrock channel region, which shades the creek during most of the day. The first 997 feet of upper Hilton (directly upstream of impediment) has essentially zero canopy. Recruitment of riparian vegetation within this region is poor due to a widening of the flood plain, which creates a higher velocity/scour region when flows are high. It is also suspected that groundwater is located at a greater depth since this region is typically the first to dry once flows begin to attenuate. The remaining 596 feet of Hilton that is on BOR property has significantly more canopy, typically averaging between 50-75%.

Percent Shelter

Percent shelter is a relative measure of the quantity and composition of instream shelter. Instream shelter is composed of those elements within a stream channel that provide protection from predation, areas of reduced water velocity in which fish can rest and conserve energy, and separation between territorial units to reduce density related competition.

Percent shelter between the different habitat types remained consistent throughout both upper and lower portions of Hilton Creek. Typically, the majority of habitats had greater than 50% unit shelter, with the majority of shelter composed of aquatic vegetation, boulders, and whitewater.

4.2.2 Nojoqui Creek

Nojoqui Creek was habitat typed over a five-day period from June 5 through June 10, 1998. A total of 16,784 feet of creek was typed in which 105 habitats were identified. Flow measured during the survey averaged 5.3 cfs. Runs were the primary habitat type identified comprising 63.3% of the creek. Riffles and glides comprised 17.2% and 15.5% respectively. Fourteen pools were identified which comprised 4% of the overall survey (670 feet).

Percent Canopy

Percent canopy is essentially non-existent through the first 8,500 feet of the creek. The majority of the units had values of zero canopy, although a few units in this region had values of up to 75%. Canopy values increase slightly to roughly 25% over the next 4,500 feet before increasing again to between 50-75% for the remaining portion of the creek surveyed. Cattle influences and the absence of water in the lower creek during summer appear to be directly related to the absence of riparian vegetation and canopy.

Percent Shelter

Habitat complexity is very limited in the lower portion of Nojoqui Creek. Most of the shelter in this region is comprised of aquatic vegetation (surface algae) with some bedrock ledges. Overall, the complexity of individual habitat units tends to increase upstream of the cattle influenced areas. Instream cover typically ranged between 50-100% in these areas, with the primary constituents being aquatic algae, boulders, undercut banks, and terrestrial vegetation. Algae is still present in the upper sections, however not in the high percentages observed in the lower portion of the creek.

Twenty-eight habitats were selected for snorkel surveys and more detailed habitat analysis. Habitats selected comprised 26.6 % of the total habitat units identified. Individually, selected units comprised 50 % of pools, 15% of riffles, 31% of runs, and 20% of the glide habitat **(Table 4.2.2-1)**.

Table 4.2.2-1 Average Habitat Measurements of Revisited Units in Nojoqui Creek

Habitat Type	Number Measured	Average Length (feet)	Average Width (feet)	Average Depth (feet)
Pool	7	47.4	18.4	2.4
Riffle	5	76.2	16.4	0.81
Run	13	207.5	16.7	0.96
Glide	3	133.0	18.8	1.1

The amount of shelter in pool habitats was consistently greater than 50% with the main components being aquatic algae and terrestrial vegetation. Additional components present included small woody debris, root masses, and boulders. Riffle habitats had greater amounts of instream cover available, usually exceeding 75%, with the main components being aquatic vegetation and white water. Lesser components included terrestrial vegetation and boulders. Instream cover in run habitats generally did not exceed 50% coverage. Main cover components in run habitats consisted of aquatic algae and boulders. Lesser components included terrestrial vegetation and root masses. Glide habitats like run habitats did not exceed 50% coverage with the main component consisting almost entirely of aquatic algae.

4.2.3 Lower Salsipuedes Creek

Lower Salsipuedes Creek was habitat typed over a three-day period from June 22 through June 24, 1998. A total of 18,942 feet of creek was surveyed and habitat typed. Flow measured during habitat typing averaged 9.3 cfs. Runs dominated the habitat composition of the creek (73.7%).

Glides and riffles comprised 14.7% and 7.4% respectively. Fifteen pool habitats with a total linear distance of 780 feet made up the remaining 4.1% of the habitat. Side channels comprised approximately 2.0% of the linear habitat.

Percent Canopy

Both riparian vegetation and canopy was greatly affected following the heavy winter rains of 1998. The high flows removed a large percentage of the streamside riparian vegetation throughout the creek. Most of that vegetation was in the form of small willows which was responsible for contributing significant portions of canopy to the creek. Trees were routinely scoured during the 1998 storms from portions of the creek bank six feet above the mean summer water level. Approximately 68% of the units typed had zero canopy recorded. The remaining habitats had canopy values not exceeding 50%. Observations after the heavy rain year of 1995 showed similar scour conditions and that canopy conditions greatly improved over the next 1 to 2 years as new vegetation establishes itself.

Twenty-two habitats were selected for snorkel surveys and more detailed habitat analysis. Habitats selected comprised 25.0 % of the total habitat units identified. Individually, selected units comprised 47 % of pools, 25% of riffles, 25% of runs, and 25% of the glide habitat **(Table 4.2.3-1)**.

Table 4.2.3-1 Average Habitat Measurements of Revisited Units in Lower Salsipuedes Creek

Habitat Type	Number Measured	Average Length (feet)	Average Width (feet)	Average Depth (feet)
Pool	7	74.0	20.1	2.10
Riffle	4	58.5	27.8	0.68
Run	8	270.5	22.8	1.07
Glide	3	229.0	25.1	0.96

Pool habitats had shelter valued predominately in the 25% range. Only two of the seven pools had shelter values of 50%. The main cover type was aquatic algae with some habitats having small percentages of bubble curtains, boulders and undercut banks. Riffle habitats varied between 50-75% shelter with the main components being aquatic algae and bubble curtains. Lesser amounts of bedrock ledges and boulders were also available in riffle habitats. Runs were widely varied in the amount of shelter provided within the habitat, with values ranging between 25-75%. The primary cover consisted of aquatic vegetation and terrestrial vegetation. Undercut banks and bedrock ledges were also present but in much lower percentages. The cover present in glides was generally less than 50% with the main constituents being aquatic vegetation and terrestrial vegetation. Nearly equal percentages undercut banks and bedrock ledges were also present

4.2.4 Upper Salsipuedes Creek

The scour effects of the winter of 1998 were most notable in Upper Salsipuedes Creek. Many of the habitats were cleared of riparian vegetation. In addition, the scouring effectively channelized a significant portion of the creek removing much of the instream and habitat complexity. Only four habitats were documented in 1,296 feet of surveyed stream: 2 runs (1,187 feet), one riffle (94 feet), and one small pool (15 feet). Flow was estimated to be 2.5 cfs. Canopy varied between 25-75%. Percent shelter varied between 25-100% with the main components comprised of terrestrial vegetation. Due to the shallow depth and lack of suitable snorkel sites, no snorkeling was conducted in Upper Salsipuedes Creek in 1998.

4.2.5 El Jaro Creek

El Jaro Creek was habitat typed on July 7, 1998. A total of 4,548 feet of stream was habitat typed. Flow was measured to be 5.9 cfs. Run and riffle habitats occurred in equal amounts throughout the creek (39.3%). Pools and glides comprised 14.3% and 7.1% respectively. Four pools were identified which totaled only 125 feet of stream surveyed.

Percent Canopy

Canopy was relatively sparse for the first 2,290 feet upstream of the confluence with Upper Salsipuedes Creek. Coverage ranged from 25-100% with the majority of habitats having closer to 25% canopy. The remaining 2,258 feet of habitat surveyed had essentially zero canopy in the majority of the habitats.

Percent Shelter

Instream cover ratings were generally high in the first 2,290 feet of surveyed habitat. Cover values were usually 75%. Most of the habitats were complex with respect to the different types of cover available. The main components in this lower section include: terrestrial vegetation, aquatic vegetation, white water, and boulders. The remaining half of the creek surveyed has moderate amount of cattle activity associated with it. The amount of coverage and instream cover types diminishes within this section. Instream cover values were generally less than 50%. The types of cover included: aquatic vegetation, boulders, and some whitewater.

Ten habitats were selected for snorkel surveys and more detailed habitat analysis. Habitats selected comprised 36% of the total habitat units identified. Individually, selected units comprised 100% of pool, 27% of riffle, and 27% of run habitats **(Table 4.2.5-1).**

Table 4.2.5-1 Average Habitat Measurements of Revisited Units in El Jaro Creek

Habitat Type	Number Measured	Average Length (feet)	Average Width (feet)	Average Depth (feet)
Pool	4	31.2	23.7	1.7
Riffle	3	52.3	22.6	1.0
Run	3	393.0	15.5	1.03

Pool habitats had shelter ratings ranging from 25-75% with two pools having values of 50%. The main types of cover were aquatic vegetation and white water. Lesser percentages of cover included boulders, terrestrial vegetation, and small woody debris. Riffle cover ranged between 50-75% with the components comprised of aquatic vegetation, boulders, and white water. Run coverage ranged between 25-75% and had a similar composition to riffle habitats.

Table 3.5.2-1 1998 Santa Ynez River Diurnal Water Quality Measurements

27-Aug-98
Site #1, Long Pool, River Mile 0.5 10% algal cover
10 cfs release from Bradbury

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**424a**	**1717p**	**424a**	**1717p**
Surface	18.4	21.1	n/a	10.69
1	18.4	20.9		10.8
2	18.3	20.7		11.25
3	18.1	19.9		11.09
4	17.8	19.2		11.06
5	17.4	18.4		15.08
6	17.4	18.3		13.6
7	17.3	18.2		12.61
8	17.3	18.3		10.68
9	17.3	18.6		13.3
10	17.3			

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**420a**	**1747p**	**420a**	**1747p**
Surface	17.1	19.1	8.04	11.7

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**424a**	**1745p**	**424a**	**1745p**
Surface	17.1	11.6	7.87	11.6

27-Aug-98
Site #2, 3.4 Miles Downstream of Bradbury Dam, Pool Habitat 15% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**721a**	**1643p**	**721a**	**1643p**
Surface	19.7	26.1	5.0	13.4
1	19.8	26	5.0	13.2
2	19.8	25.8	5.1	12.8
3	19.8	25.7	5.1	12.1
4	19.8	25.5	5.1	11.5

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**716a**	**1638p**	**716a**	**1638p**
Surface	19.4	27.5	5.6	13.4

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**718a**	**1640p**	**718a**	**1640p**
Surface	19.4	27.5	5.3	>20.0

Table 3.5.2-1 1998 Santa Ynez River Diurnal Water Quality Measurements

08/27/1998

Site #3 - 7.9 Miles Downstream of Bradbury Dam, Pool Habitat, 25% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**630a**	**1658p**	**630a**	**1658p**
Surface	19.9	25.8	4.1	12.7
1	19.9	25.4	4.1	11.3
2	19.9	24.6	4	11.1
3	19.9	24.5	3.8	11.8
4	19.9	24.5	2.6	12.5

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**624a**	**1652p**	**624a**	**1652p**
Surface	19.7	26.3	5.2	11.8

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**619a**	**1646p**	**619a**	**1646p**
Surface	19.7	26.3	4.7	12.3

08/27/1998

Site #4 - 10.5 Miles Downstream of Bradbury Dam, Pool Habitat, 25% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**529a**	**1744p**	**529**	**1744p**
Surface	19.8	25.1	6.0	9.6
1	19.8	25.1	6.0	9.4
2	19.9	25.0	6.0	9.3
3	19.9	25.0	6.0	9.3
4	19.9	25.0	5.9	9.2

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**548a**	**1755p**	**548a**	**1755p**
Surface	19.7	25.2	6.1	10.1

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**541a**	**1738p**	**541a**	**1738p**
Surface	19.9	25.3	5.8	9.5
1	20	25.3	5.8	9.5
2	20	25.3	5.6	9.5

Table 3.5.2-1 1998 Santa Ynez River Diurnal Water Quality Measurements

08/27/1998
Site #5 - 13.9 Miles Downstream of Bradbury Dam, Pool Habitat, 25% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**438a**	**1825p**	**438a**	**1825p**
Surface	19.2	25.3	5.2	9.9
1	19.2	25.2	5.1	9.8
2	19.2	25.2	5.1	9.7
3	19.2	25.1	5.1	9.4

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**459a**	**1821p**	**459a**	**1821p**
Surface	19.1	25.6	5.2	10.2

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**450a**	**1837p**	**450a**	**1837p**
Surface	19.3	25.2	5.0	9.8

01-Sep-98
Site #1, Long Pool, River Mile 0.5 10% algal cover
10 cfs release from Bradbury

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**430a**	**1702p**	**430a**	**1702p**
Surface	19.6	21.9	9.4	10.5
1	19.4	22	8.5	10.5
2	19	21.8	7.3	10.7
3	18.9	20.8	7.5	11.3
4	18.5	20	6.4	11.5
5	18.4	19	6.3	11.5
6	18.3	18.7	6.3	13.6
7	18.3	18.6	6.4	11.3
8	18.3	18.6	6.2	9.7
9	18.2	18.7	6.3	8.7
10	18.4	19	3.9	8.7

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**455a**	**1720p**	**455a**	**1720p**
Surface	17.9	19.6	8.1	11.8

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**450a**	**1725p**	**450a**	**1725p**
Surface	17.9	19.7	8.1	11.8

Table 3.5.2-1 1998 Santa Ynez River Diurnal Water Quality Measurements

01-Sep-98
Site #2, 3.4 Miles Downstream of Bradbury Dam, Pool Habitat 15% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**520a**	**1625p**	**520a**	**1625p**
Surface	21.4	27.3	4.8	13.1
1	21.3	27.1	4.7	13
2	21.3	27.1	4.6	13.1
3	21.3	26.8	4.6	12.8
4	21.3	26.6	4.2	12.4

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**526a**	**1633p**	**526a**	**1633p**
Surface	21.2	4.9	4.9	>20.0

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**525a**	**1631p**	**525a**	**1631p**
Surface	21.2	28.7	4.1	>20.0

09/01/1998
Site #3 - 7.9 Miles Downstream of Bradbury Dam, Pool Habitat, 30% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**701a**	**1701p**	**701a**	**1701p**
Surface	20.8	27.1	4.06	11
1	20.8	26.8	3.78	10.9
2	20.7	26.2	3.65	10.5
3	20.7	25.2	3.59	9.9
4	20.7	24.6	3.48	9.6
5	20.7	24.4	3.5	9.4
6	20.7	24.4	3.47	9

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**449a**	**1644p**	**449a**	**1644p**
Surface	20.8	27.0	5	11.2

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**438a**	**1635p**	**438a**	**1635p**
Surface	20.8	27.2	4.9	11.5

Table 3.5.2-1 1998 Santa Ynez River Diurnal Water Quality Measurements

09/01/1998

Site #4 - 10.5 Miles Downstream of Bradbury Dam, Pool Habitat, 25% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**554a**	**1813p**	**554a**	**1813p**
Surface	20.8	25.2	6.1	9
1	20.8	25.2	5.9	8.9
2	20.8	25.2	5.9	8.8
3	20.8	25.2	5.7	8.8
4	20.8	24.9	5.1	7.6

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**547a**	**1807p**	**547a**	**1807p**
Surface	20.7	26.0	6.1	9.7

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**538a**	**1754p**	**538a**	**1754p**
Surface	20.8	26.2	6	9.5
1	20.8	26	5.9	9.4
2	20.8	25.9	5.8	9.2

09/01/1998

Site #5 - 13.9 Miles Downstream of Bradbury Dam, Pool Habitat, 25% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**634a**	**1912p**	**634a**	**1912p**
Surface	20.5	25.8	4.8	8.4
1	20.6	25.8	4.7	8.3
2	20.7	25.7	4.6	8.2
3	20.8	25.5	4.4	7.9

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**629a**	**1909p**	**629a**	**1909p**
Surface	20.4	26.0	4.9	8.4

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**624a**	**1904p**	**624a**	**1904p**
Surface	20.7	25.9	4.8	8.7

Table 3.5.2-1 1998 Santa Ynez River Diurnal Water Quality Measurements

09/11/1998

3.4 Miles Downstream from Bradbury Dam, Pool Habitat, 25 % Algal Coverage

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**535a**	**N/A**	**535a**	**N/A**
Surface	19.6		5.0	
1	19.7		4.97	
2	19.7		4.94	
3	19.7		4.96	
4	19.7		4.88	

09/11/1998

7.9 Miles Downstream from Bradbury Dam, Pool Habitat, 25% algal coverage

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**504a**	**N/A**	**504a**	**N/A**
Surface	20		4.4	
1	20		4.4	
2	20.1		4.53	
3	20.1		3.99	
4	20.1		4.08	

Table 3.5.2-1 1999 Santa Ynez Diurnal Water Quality Measurements

14-Jun-99
Site #1, Long Pool, River Mile 0.5 0% algal cover
2.5 cfs release from Bradbury

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**550a**	**1640p**	**550a**	**1640p**
Surface	19.4	22.4	8.5	9.3
1	19.4	22.4	8.48	9.32
2	19.4	22.4	8.51	9.32
3	19.3	22.3	8.22	9.34
4	18.7	22.3	7.09	9.41
5	18.5	19.4	6.6	8.74
6	18.2	19.1	6.61	8.41
7	18.2	19	6.67	8.21
8	18	19	6.16	8.36
9	17.9	19	6.02	8.37

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**604a**	**1708p**	**604a**	**1708p**
Surface	18.1	21.4	8.61	10.88

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**606a**	**1706p**	**606a**	**1706p**
Surface	18.1	21.5	8.35	11.25

14-Jun-99
Site #2, 3.4 Miles Downstream of Bradbury Dam, Pool Habitat 1% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**505a**	**1758p**	**505a**	**1758p**
Surface	18.4	28.2	6.4	10.92
1	18.5	28.2	6.3	10.86
2	18.5	28.1	6.28	10.85
3	18.4	27.8	6.32	11.28

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**457a**	**1751p**	**457a**	**1751p**
Surface	18	28.0	5.33	11.77

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**458a**	**1750p**	**458a**	**1750p**
Surface	17.2	28.0	5.64	10.86

Table 3.5.2-1 1999 Santa Ynez Diurnal Water Quality Measurements

14-Jun-99

Site #3, 7.8 Miles Downstream of Bradbury Dam, Pool Habitat 15% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**507a**	**1622p**	**507a**	**1622p**
Surface	17.3	27.2	5.0	15.28
1	17.3	26.7	5.1	14.85
2	17.2	22	5.09	10.92
3	17.2	21.3	2.42	10.94
4	17.1	19.7	2.12	11.46

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**512a**	**1643p**	**512a**	**1643p**
Surface	17.1	26.1	6.72	12.7

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**511a**	**1641p**	**511a**	**1641p**
Surface	17.1	26.2	6.74	12.43

15-Jun-99

Site #4, 10.5 Miles Downstream of Bradbury Dam, Pool Habitat 30% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**539a**	**1717p**	**539a**	**1717p**
Surface	16.8	25.7	5.54	12.43
1	16.8	25.7	5.48	12.46
2	16.8	25.6	5.53	12.47
3	16.8	25.7	5.61	12.40

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**541a**	**1709p**	**541a**	**1709p**
Surface	16.7	25.8	5.69	12.74

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**543a**	**1711p**	**543a**	**1711p**
Surface	16.7	25.8	5.66	12.91

Table 3.5.2-1 1999 Santa Ynez Diurnal Water Quality Measurements

15-Jun-99

Site #5, 13.9 Miles Downstream of Bradbury Dam, Pool Habitat 0% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**539a**	**1717**	**539a**	**1717**
Surface	18.1	22.1	4.68	9.88
1	18.1	22.1	4.66	9.97

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**605a**	**1803p**	**605a**	**1803a**
Surface	18.1	22.1	5.4	9.9

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**604a**	**1805p**	**604a**	**1805p**
Surface	18.1	22.1	5.21	10.03

04-Aug-99

Site #1, 0.5 Miles Downstream of Bradbury Dam, Pool Habitat 20% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**631a**	**1655p**	**631a**	**1655p**
Surface	21.6	24.4	8.34	9.76
1	21.6	24.2	8.33	9.91
2	21.6	24	7.98	10.02
3	20.7	23.5	4.81	10.40
4	20.2	21.9	4.01	10.47
5	19.9	20.7	3.97	9.58
6	19.9	20.3	3.48	9.82
7	19.7	19.8	3.64	8.32
8	19.7	19.6	3.39	5.60
9	19.6	19.6	3.97	4.60
10	19.8	19.5	3.03	

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**614a**	**1725p**	**614a**	**1725p**
Surface	20.2	25.1	7.6	13.14

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**616a**	**1735p**	**616a**	**1735p**
Surface	20.1	6.8	24.9	10.04

Table 3.5.2-1 1999 Santa Ynez Diurnal Water Quality Measurements

04-Aug-99

Site #3, 7.8 Miles Downstream of Bradbury Dam, Pool Habitat 60% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**518a**	**1829p**	**518a**	**1829p**
Surface	19	23.1	1.89	>20
1	18.9	22.4	1.50	16.26
2	18.7	21.1	0.63	>20
3	18.5	19.5	0.32	17.19
4	18.5	19.2	0.27	10.55

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**512a**	**1643p**	**512a**	**1643p**
Surface	dry		dry	

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**511a**	**1641p**	**511a**	**1641p**
Surface	dry		dry	

05-Aug-99

Site #4, 10.5 Miles Downstream of Bradbury Dam, Pool Habitat 30% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**515a**	**1856p**	**515a**	**1856p**
Surface	18.1	24.5	3.36	14.50
1	18.1	24.5	3.41	14.61
2	18.1	24.3	3.28	12.56
3	18.1	23.9	2.84	10.90

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**523a**	**1902p**	**523a**	**1902p**
Surface	18.2	23.8	2.87	12.66

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**521a**	**1912p**	**521a**	**1912p**
Surface	18.1	14.6	2.98	15.13

Table 3.5.2-1 1999 Santa Ynez Diurnal Water Quality Measurements

05-Aug-99
Site #5, 13.9 Miles Downstream of Bradbury Dam, Pool Habitat 70% algal coverage

Pool Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**550a**	**1835p**	**550a**	**1835p**
Surface	17.7	20.3	2.32	6.31
1	17.7	20.3	2.28	6.26

Riffle Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**557a**	**1825p**	**557a**	**1825p**
Surface	18.1	22.2	3.05	7.41

Run Habitat

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**554a**	**1825p**	**554a**	**1828p**
Surface	18	22.9	2.81	6.26

30-Aug-99
Site #3, 7.8 Miles Downstream of Bradbury Dam, Pool Habitat 45% algal coverage

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**630a**	**n/a**	**630a**	**n/a**
Surface	18.4		1.14	
1	18.4		1.13	
2	18.4		1.12	
3	18.4		0.92	
4	18.4		0.87	

Table 3.5.2-1 1999 Santa Ynez Diurnal Water Quality Measurements

30-Aug-99

Site #2a, 6.0 Miles Downstream of Bradbury Dam, Pool Habitat 95% algal coverage

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**740a**	**n/a**	**740a**	**n/a**
Surface	21		7.20	
1	21		7.05	
2	21		6.65	
3	20.9		6.11	
4	20.8		5.15	

Site 4, 10.5 Miles Downstream of Bradbury Dam, Pool Habitat 5% algal coverage

30-Aug-99

	Temperature (C)		Dissolved Oxygen (mg/L)	
	Morning	**Evening**	**Morning**	**Evening**
Depth (ft)	**715a**	**n/a**	**715a**	**n/a**
Surface	18.2		3.65	
1	18.2		3.52	
2	18.2		3.42	
3	18.2		3.41	

5.0 Fishery Surveys

The 1998-1999 fish sampling in the lower SYR consisted of migrant trapping in the tributaries to determine timing and relative 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.

On August 18, 1997, the National Marine Fisheries Service (NMFS) listed the southern California coast steelhead/rainbow trout as an endangered species. Consequently, any 'take' of steelhead after October 17, 1997 was prohibited under the Endangered Species Act (ESA). The NMFS received the SYRTAC application on September 16, 1997 to 'take' federally listed steelhead for scientific purposes under the ESA of 1973. Typically, NMFS takes between 60 to 120 days to process applications. Unfortunately, the processing took closer to 180 days and the permit was not received until March 23, 1998. As a result, trapping for upstream and downstream migrants was postponed until late March 1998.

It is difficult to determine the amount of information lost before trapping could officially begin. 1998 was a tremendous rain year with the season totals ranking either #1 or #2 at all of the county monitoring locations. However, there were a significant number of days between January-March when trapping was not possible due to high flow conditions. It can be assumed that the migration totals for both up/down migrants would have been higher if the traps were deployed in January.

5.1 Migrant Trapping

5.1.1 Methods

In 1998, migrant trapping was conducted in Hilton, Nojoqui, Salsipuedes, and San Miguelito Creeks **(Figure 5.1-1)**. Upstream and downstream migrant traps were deployed in each creek with the exception of San Miguelito where only a downstream trap was deployed. An upstream trap was not deployed in San Miguelito Creek due to the presence of numerous and significant upstream passage barriers which prevent upstream migration of steelhead into this creek. The duration of trap deployment was dependent upon rainfall/runoff.

In 1999, migrant trapping was conducted in Salsipuedes and San Miguelito Creeks on a continuous basis from January through June. Hilton Creek was trapped opportunistically following several storm events that generated enough flow to provide a corridor for migrating steelhead/rainbow trout. Nojoqui Creek was not trapped due to insufficient runoff during storm events. As in 1998, only a downstream migrant trap was deployed in San Miguelito.

A 5x6x3 foot PVC fyke trap with a 3/4-inch plywood bottom was used to capture migrating fish. Tarps were positioned with the fyke opening pointing upstream to capture upmigrating fish. Another trap was positioned either directly upstream, or beside the upmigrating trap, with the fyke pointing downstream to capture down migrating fish. Attached to the PVC frame was one-inch diameter plastic poultry netting. On either side of the trap, panels were used to block migration and direct fish into the traps. Each panel consisted of two eight-foot long sections of steel channeling (each piece of channeling with 48 1-3/4 holes punched through them) with the bottom channeling at the water level, and the top piece approximately two feet higher. Number of panels used was dependent upon stream width. Once the panels were deployed on either side of the trap, four foot long (sometimes five foot long) pieces of one inch diameter electrical conduit was placed vertically through each hole in the channeling. Width between each piece of conduit was approximately 1 1/4 inch.

Traps were cleaned of debris and checked daily for migrating fish in the morning. Depending upon stream conditions (debris loads and storm events), traps were sometimes checked in the afternoon. Captured steelhead were measured to the nearest fork length. Scales were collected from the right side of each fish, one inch below the posterior portion of the dorsal fin, and directly above the lateral line. If scales were imbedded, the alternate scale removal site was located on the right side of the fish near the caudal peduncle. A small, one-centimeter piece of tissue was removed from the tip of the upper lobe of the caudal fin for genetic analysis. Each tissue sample was cut in half, with one piece going to the project, and the other piece going to CDFG Region 5 biologist to archive. Each captured steelhead/rainbow trout was described and any blemishes or wounds were recorded for future identification. As part of the handling protocol required by the NMFS federal collection permit, water temperatures were measured prior to fish handling. If water temperatures were greater than 20 C (68 F), captured fish were immediately released without data being taken from them (size estimated).

5.1.2 Results

Hilton Creek

1998

Hilton Creek is a small tributary located immediately downstream of Bradbury Dam. Runoff from the heavy winter rains significantly altered the lower portion of the creek. One particular heavy rain event moved the confluence of Hilton Creek approximately 400 feet downstream. This resulted in Hilton Creek emptying out in a heavily vegetated portion of the riparian zone near the head of Long Pool. Consequently, attraction flows were very limited and no migration was documented until a subsequent storm split the creek channel, which allowed the creek to meet with the SYR approximately 150 feet downstream from its historic confluence. Attraction flows were more suitable at this location. One day following the channel split, upstream adult migration was documented. Both up/down migrant traps were deployed approximately 100 feet upstream of the new confluence with the SYR.

Migrant trapping of Hilton Creek began on March 26 and ended on June 1, 1998. Several rain events during the deployment time rendered the trap inoperable for a total of 15 days. A total of four upstream migrants were captured ranging in size from 374-495mm (14.7-19.5 inches) **(Table 5.1.2-1)**. The upstream migrants were captured between April 5 and May 4, 1998. Three of the four fish appeared to be female. Sex was not determined for the remaining fish. One downstream migrant was captured on May 14 and was identified as an upstream migrant captured on May 4. Unfortunately, members of the general public killed the fish while it was in the downstream trap a short time before the trap was checked. Both CDFG and NMFS enforcement was notified of the incident and the carcass was turned over to CDFG Game Wardens as evidence.

1999

Migrant trapping was conducted opportunistically in Hilton Creek when flows were sufficient to allow for upstream migration. Traps were deployed on three separate occasions from March 26 through April 16. Length of deployment was dependent upon storm runoff, and usually lasted between 3-5 days before flows became too small to safely trap without potential harm to any captured steelhead/rainbow trout. No upstream or downstream migrants were captured during the deployment time, and no migrants were observed within Hilton Creek during the migration period.

Table 5.1.2-1 1998 Tributary Upstream and Downstream Migrant Captures

Creek	**Hilton**		**Nojoqui**		**Salsipuedes**		**San Miguelito**	
	Up	Down	Up	Down	Up	Down	Up	Down
Number Captured 1998	4	1	2	1	1	17	0	0
Number Captured 1999	0	0	0	0	40	6	0	1

Nojoqui Creek

Nojoqui Creek is a small tributary that joins the SYR directly upstream of the Highway 101 Bridge near the town of Buellton. Previous years trapping have not documented migration or any steelhead/rainbow trout utilization within the tributary. Habitat within the mid portion of the creek appears to have appropriate canopy and instream cover for both spawning and rearing of steelhead/rainbow trout. However, only cyprinid and centrarchid species have been observed. It is speculated that unlike several other creeks in the basin, Nojoqui does not have a remnant population of steelhead/rainbow trout within its watershed. Land use activities, coupled with the recent drought effectively dried the creek for several years during the late 1980's and early 1990's. With no remnant seed population within the creek, very small numbers of adults returning from the ocean, and low numbers within the lower watershed, it is highly unlikely that steelhead/rainbow trout could establish a sustained population within Nojoqui Creek in the near future

Migrant trapping began March 30 and continued to June 1, 1998. The trap was not functioning for 15 days during the above time period due to high flows from rain events. As stated above, no utilization by resident or anadramous steelhead/rainbow trout was documented prior to 1998. However, both upstream and downstream migration was documented in 1998 in Nojoqui Creek **(Table 5.1.2-1).** Two upstream migrants were captured on April 20, 1998 measuring 214mm (8.4 inches) and 385 mm (15.2 inches). Captured fish were identified as one male (214mm) and one female (385mm). A downstream migrant was also captured on April 27 measuring 223 mm (8.7 inches). Sex was not determined on the downmigrant.

No trapping was conducted in 1999 in Nojoqui Creek due to insufficient stream flows.

Salsipuedes Creek

Salsipuedes Creek enters the SYR approximately one half mile upstream of the Highway 246 Bridge near the city of Lompoc. The Salsipuedes-El Jaro Creek system is the largest drainage in the lower river and the first creek steelhead/rainbow trout can migrate into from the ocean. Runoff from the creek is usually significant enough to breach the lagoon in years when the mainstem runoff is low.

1998

Trapping for both up and down migrants began on March 30, 1998. Upstream trapping continued to June 1 while downstream trapping was continued until July 1, 1998. Both the upstream and downstream traps were not in operation for 15 days due to high water. One upstream migrating steelhead/rainbow trout measuring 197 mm (7.8 inches) was captured on April 21, 1998 **(Table 5.1.2-1)**. A total of 17 downmigrants were captured ranging in size from 139 mm (5.4 inches) to 660 mm (26.0 inches) **(Figure 5.1.2-1).** The majority (88%) of downmigrants were between 139mm-259mm (5.4-10.2 inches) in size with most being captured from March 30 through April 19, 1998 **(Figure 5.1.2-2)**. Most of the juveniles captured exhibited smolting characteristics.

1999

In 1999, trapping for both upstream and downstream migrants began in late December of 1998. Both upstream and downstream migrant trapping was conducted until June 28. Both traps were not operating for a total of 10 days (4 days in January, 1 in February, 4 in March, and 1 in April) due to high water resulting from storm runoff. A total of 40 upstream migrating steelhead/rainbow trout were captured from February 1 through April 27, 1999. Upstream migrants ranged in size from 225-690 mm (8.9-27.2 inches) **(Figure 5.1.2-1a)**. The majority of the upstream migrants (82.5%) were between 260-379mm (10.2-14.9 inches) with most being captured from February 15 through April 19, 1999 **(Figure 5.1.2-2a)**. As observed in **Figure 5.1.2-2a**, there were typically 1 to 5 upstream migrants captured for any given week. However, during the week March 15, there were 17 upstream migrants captured. In fact, following a storm event early in the week, 15 upstream migrants were captured in one morning, suggesting that the migrants were staging within the mainstem and were waiting for flows to increase to allow them to migrate upstream.

There were 6 downstream migrating adults and smolts captured from February 19 through May 4, 1999. Four of the six downstream migrants were captured from March 18 to April 4, with three of the four exhibiting smolting characteristics. Downstream migrants ranged in size from 158-350 mm (6.2-13.8 inches) **(Figure 5.1.2-1)**. Also, ten previously captured adults were trapped as they migrated out of the system after spawning. Seven of the previously captured fish recaptured from March 2 through March 18. The remaining 3 were recaptured from April 13 through April 25.

Figure 5.1.2-1 1998-1999 Size Distribution of Downstream Migrants in Salsipuedes Creek

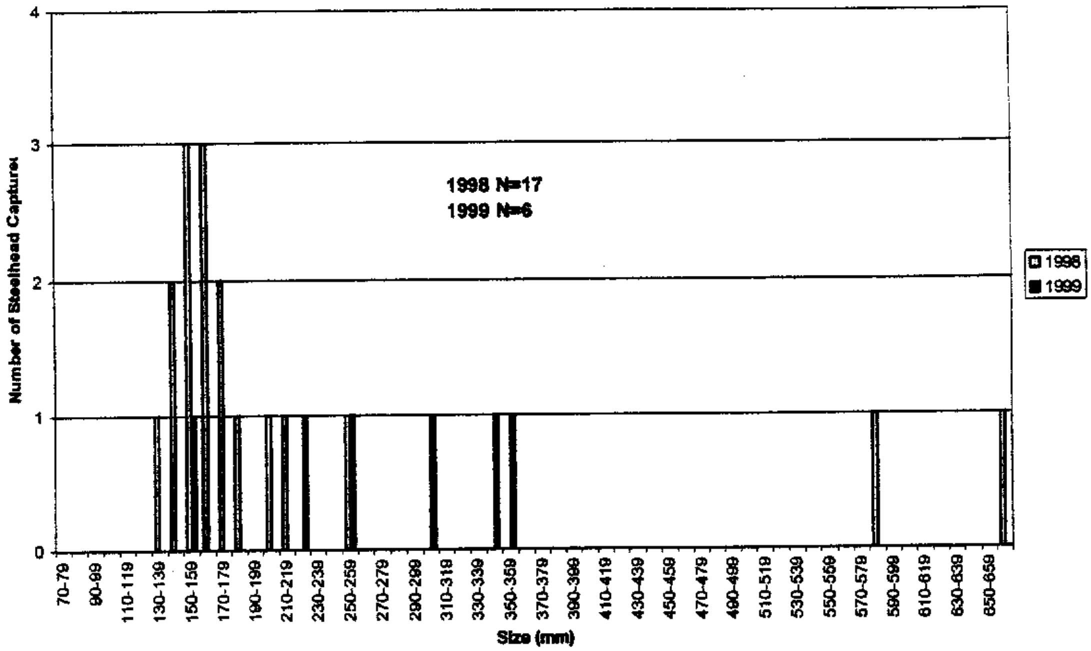


Figure 5.1.2-1a 1999 Size Distribution of Upstream Migrants in Salsipuedes Creek

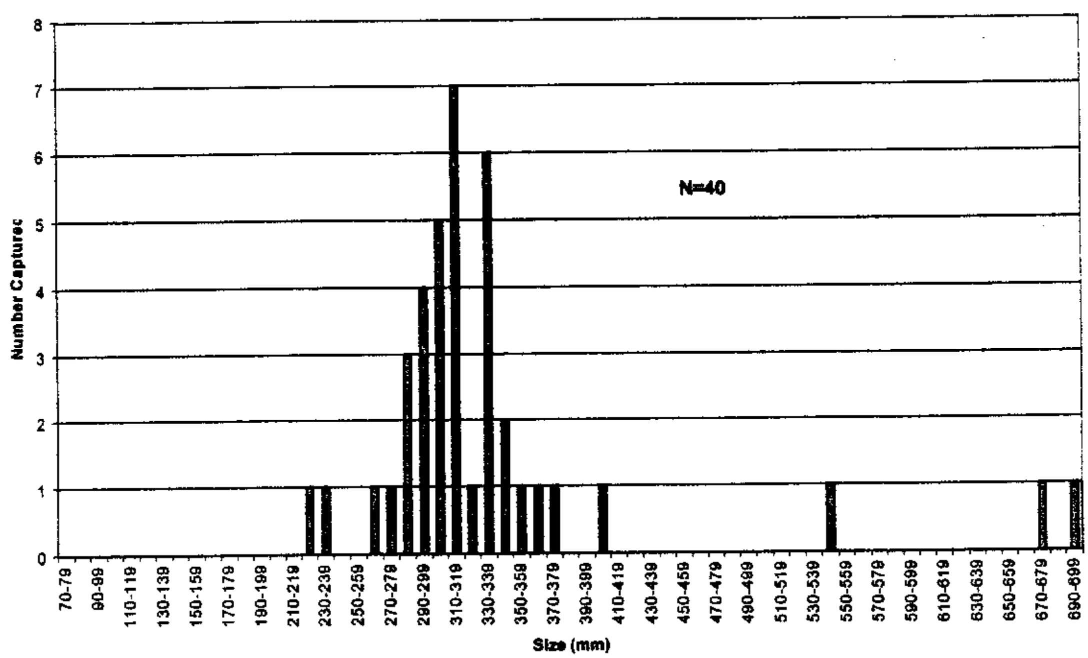


Figure 5.1.2-2. 1998 Timing of Migrant Captured in Salsipuedes Creek

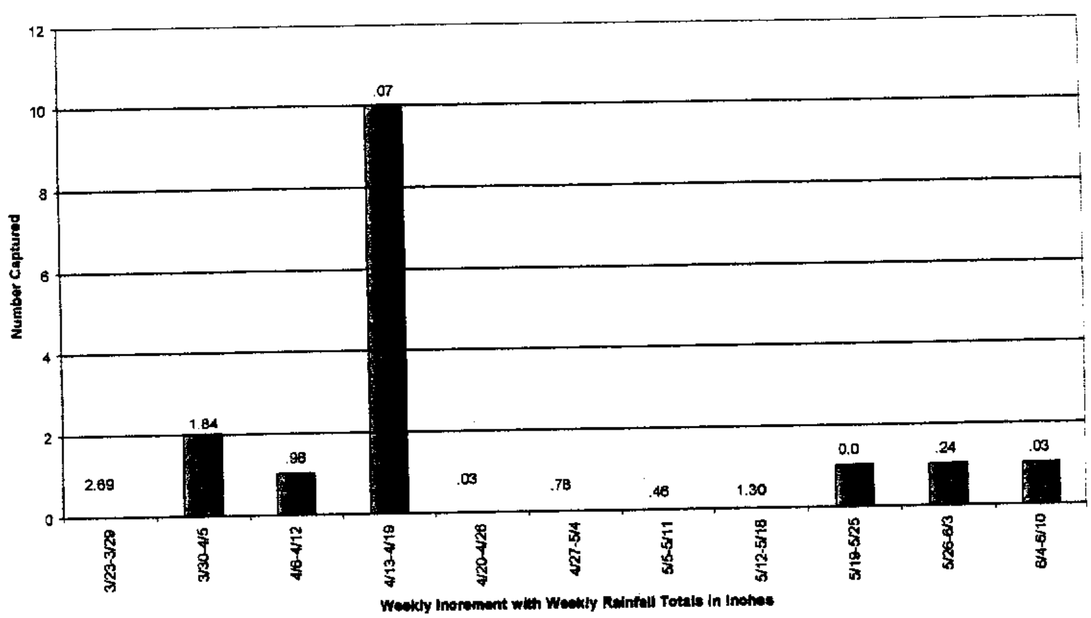
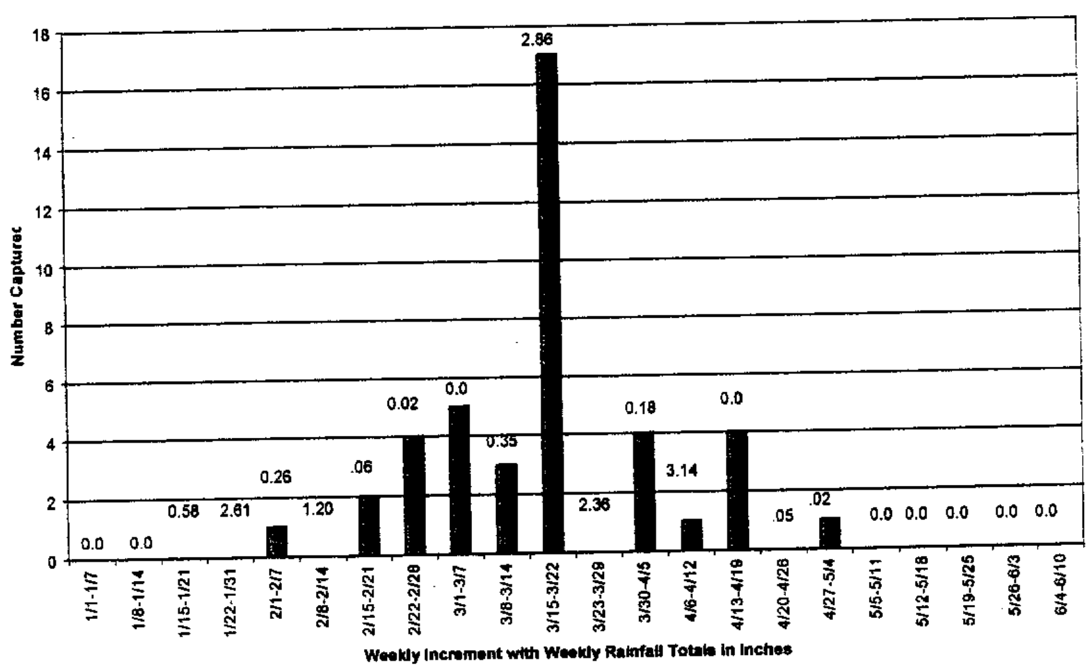


Figure 5.1.2-2a 1999 Timing of Upstream Migrants Captured in Salsipuedes Creek



San Miguelito Creek

San Miguelito Creek flows into the SYR at the city of Lompoc near V Street. It is the lower most creek that enters the SYR. Unfortunately, the lower two miles of the creek is a concrete box structure, which completely impedes all upstream migration. The creek above the culvert has a narrow channel with a well developed riparian corridor and a self-sustaining population of resident rainbow trout. Due to the significant and numerous upstream passage barrier, only a downstream migrant trap was deployed in San Miguelito Creek.

Downstream migrant trapping began on April 6, 1998 and continued through June 1, 1998. The trap was not in operation for 14 days due to storm events during the deployment time. No downstream migrating steelhead/rainbow trout were captured.

In 1999, downstream trapping was initiated on January 1 and continued through June 28, 1999. The trap was not in operation for 10 days due to high runoff from storm events. One downstream migrating rainbow trout measuring 140 mm (5.5 inches) was captured on March 14. The fish did not exhibit smolting characteristics.

5.2 Redd Surveys

The amount of space required by steelhead for spawning depends on the size and behavior of the spawners and the quantity and 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 egg development and the shorter the incubation period and the 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 F) (Bjornn and Reiser 1991).

5.2.1 Methods

In 1998, redd surveys were conducted in the mainstem reaches: Avenue of the Flags, Alisal, Refugio, and Highway 154, and in the following tributaries: Hilton, Nojoqui, Salsipuedes, El Jaro, and San Miguelito Creeks. Surveys began December 1997 and continued through May 1998.

In 1999, redd surveys were conducted in the same mainstem reaches and tributaries listed above. Surveys began in January 1999 and continued through May of 1999.

Surveyors would proceed in an upstream direction. Once redd excavations or spawning activity was identified, flagging with the date and redd number was attached to riparian vegetation adjacent to the site. Length and width of the redd excavation were measured to the nearest 0.1 foot 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

1998

Very few redds were documented in either the mainstem or tributaries during 1998. While the heavy winter rains created flow conditions conducive to upstream and downstream migration, those same flows created very turbid conditions throughout the lower watershed. Mainly bank failures in addition to runoff from grazing and agricultural exasperated the turbid conditions even when high flows receded. In fact, visibility was so poor that no surveys were conducted in February (over 23 inches of rain) or the majority of March and April 1998, the time when most spawning is observed. Surveys were conducted when water clarity permitted on an opportunistic basis.

Redds were identified in Upper Salsipuedes (3), Hilton (2), and San Miguelito Creeks (1) during the 1998 surveys. Most of the redds were documented during a one week period from March 23 through March 27 when water clarity conditions cleared sufficiently to allow for bank observations. While no redds were documented in the mainstem, Quiota, and Nojoqui Creeks, successful spawning was documented in the form of young of the year production in the mainstem (Highway 154, Refugio Reach, Alisal Reach) and Quiota Creek. No young of the year were observed in Nojoqui Creek.

Another drawback to the large amount of rain during the winter of 1998 was the timing of certain rain events. Both Salsipuedes and San Miguelito Creeks in particular experienced high flows from storm activity in March and April that almost certainly covered or destroyed any redds previously observed or constructed. Snorkel surveys and bank observations discussed later indicate that little or no production was documented in the above creeks during 1998.

1999

Surveys conducted in 1999 were significantly more successful in documenting spawning activity compared to the 1998 surveys. This greater level of success was mainly due to lower magnitude storm events that created less turbid and shorter duration runoff. Mainstem redds were identified mostly in the Highway 154 Reach (6), however, there was one additional redd documented in the Refugio Reach at mile 6.0. The first mainstem redds were noted in the Highway 154 Reach on February 14. The remaining 5 redds were observed between March 9 and March 24. Tributary redds were documented in Lower Salsipuedes Creek (48), Upper Salsipuedes Creek (16), and San Miguelito Creek (35) **(Table 5.2.2-1)**. Spawning activities in Lower Salsipuedes were observed from February 13 through April 28. Upper Salsipuedes redd activity was observed from February 27 through April 29, while San Miguelito noted spawning activity from February 17 through May 13. No redds were documented in El Jaro Creek in 1999, however, young of the year were observed in several pool habitats during the June and October snorkel surveys indicating that successful spawning did take place in the creek.

Table 5.2.2-1. 1998-1999 Spawning Observations by Creek

Hilton		Nojoqui		Lower Salsipuedes		Upper Salsipuedes		El Jaro		San Miguelito	
1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
2	0	0	0	0	48	3	16	0	0	1	35

5.3 Snorkel Surveys

Snorkel surveys conducted in June 1998 provide the primary source of information on fish distribution in the lower SYR. According the long-term study plan, snorkel surveys are to be conducted two times per year, once in June and again in October. Surveys were conducted in June 1998 in the mainstem, Nojoqui, Salsipuedes, and El Jaro Creeks. Surveys were not conducted in October 1998 in the tributaries or portions of the mainstem due to poor visibility and time constraints with other field activities.

In 1999, snorkel surveys were conducted in July and December in the mainstem reaches, Upper and Lower Salsipuedes Creek, and El Jaro Creek.

The purpose of 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, and 3) determine and document fish species composition and relative abundance in each location.

5.3.1 Methods

Heavy winter flows significantly altered many habitats previously snorkeled by the project. Time constraints prevented habitat surveys to reassess past snorkel sites. Instead, the entire portions of Alisal, Refugio, and Hwy 154 Reaches were snorkeled (where access was permitted). Those habitats that were too shallow to snorkel were observed from the bank. All other pool and run habitats were snorkeled by a two person crew making one pass through the habitats. Data collected is consistent with the methods described below for the tributaries.

Following habitat typing activities in 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 and 3-inch size categories (one inch size categories when possible), within their respective lanes.

5.3.2 Results - 1998 and 1999

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.

No arroyo chub were documented in the mainstem SYR during the 1998 surveys.

In June 1999, arroyo chub were documented in both the Alisal and Refugio Reaches. Low numbers were observed in the Refugio Reach with 15 being documented in 4 pool habitats, and 152 documented in a single run habitat. A significantly greater number were observed in the Alisal Reach with 1108 being observed in 6 pool habitats, and 515 being observed in 3 run habitats. The number of arroyo chub observed was directly proportional to the number of largemouth bass present in the habitats. Habitats with no bass generally had a greater number of chub present, while habitats with small to moderate numbers of bass had few or no chubs present indicating that the chub is probably a primary source of food for bass. The presence of steelhead/rainbow trout within a habitat did not appear to have any significance to the overall number of arroyo chub present. Surveys conducted during the winter of 1999 documented no arroyo chub present within the snorkeled habitat units.

Stickleback

Threespine stickleback (*Gasterosteus aculeatus*) is a native species with a wide distribution in California. Sticklebacks are a small, (adults 3 inches or less), short-lived species that generally reaches its 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 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 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 lifecycle in freshwater.

In 1998, several thousand sticklebacks were observed in predominately pool habitats and some run habitats in both the Alisal and Refugio Reaches. Exact numbers for each individual habitat type were not recorded due to their general high abundance throughout each reach. Observations indicate that larger concentrations were observed in the deeper pool habitats. None were observed in the Highway 154 Reach.

In June 1999, low numbers of stickleback were documented in both run and pool habitats within the Highway 154 reach. Overall numbers were somewhat greater within the Refugio Reach with 1425 being observed in 4 pool habitats, and 60 being observed in a single run habitat. The numbers of stickleback were greatest in the Alisal Reach with 3750 being observed in 6 pool habitats, and 880 being observed in 3 run habitats.

Bass

Largemouth Bass (*Micropterus salmonides*), 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 become piscivurous at a surprisingly small size (McGinnis 1984). They prefer warm water temperatures (13-27 C), and can tolerate relatively low dissolved oxygen conditions.

Surprisingly, very few largemouth bass were observed in the Refugio, Alisal, or Highway 154 reaches during the snorkel surveys in 1998. Typically, various size classes, particularly young of the year (yoy) bass are found throughout the above reaches during the summer snorkeling period. However, the only yoy largemouth bass were observed in the Refugio Reach in one pool habitat directly downstream of Refugio Bridge. Approximately 46 yoy largemouth bass (2.5-3.5 inches), and two adult bass (10 inches) were observed in the above pool habitat. Additionally, four adult largemouth bass (> 12 inches) were observed in the Long Pool (Highway 154 Reach).

A possible explanation as to the low population numbers could be success attributed to the fish removal program in both the Long Pool and the spill basin in 1997. There were 16 adult largemouth bass removed from the Long Pool, and an additional 237 removed from the spill basin. The removal of these fish from the system, coupled with the heavy flows throughout the spring may have created conditions detrimental to the usually successful largemouth bass production observed in the spring.

Smallmouth bass were only observed in the Long Pool during the June snorkeling period. There were 35 smallmouth observed, with the majority (31) greater than 12 inches in length. A large proportion of these fish were observed at the head of Long Pool where the greatest concentrations of yoy steelhead/rainbow trout were observed.

In June 1999, bass observed in the Highway 154 Reach were localized to the Long Pool. Overall numbers of largemouth bass were notably small compared to previous years. Only 8 largemouth bass were observed, 7 being greater than 12 inches. There were also an additional 8 smallmouth bass observed, with 7 being greater than 12 inches. Smallmouth bass were only observed in the Highway 154 reach. Smallmouth bass were observed near the inlet to the long pool where greater concentrations of young steelhead/rainbow trout have been observed in past years.

No bass were observed in the Refugio Reach in July 1999. However, a total of 34 were observed in the Alisal Reach, with 30 being observed in one pool habitat directly downstream of the Refugio Road Bridge. Most of the bass were within the 6-9 inch size category. A survey conducted in the winter noted a total of 12 bass in the above pool habitat, with 6 bass being within the 10-11 inch size category and an additional 2 in the greater than 12 inch size category. No other bass were observed in the mainstem during the winter survey.

Prickly Sculpin

The Prickly Sculpin (*Cottus asper*) is the most widely distributed of the sculpin in California. They are small fish, rarely exceeding 10 cm (4 inches). Sculpin are tolerant to a wide range of environmental conditions. During the day, they normally go unnoticed due to their excellent protective coloration and ability to hide 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.

In 1998, sculpin were observed in the highest concentrations in the Refugio Reach, and in low numbers in the Highway 154 Reach. Several hundred sculpin were observed in predominately pool and deep run habitats in the Refugio Reach. In the Highway 154 Reach, sculpin were only observed at the head on Long Pool.

In 1999, sculpin were observed in low numbers in pool and run habitats of both the Highway 154 and Alisal Reaches. No sculpin were observed in the Refugio Reach.

Steelhead/Rainbow Trout

Rainbow Trout (*Oncorhynchus mykiss*) and steelhead (the anadramous form of rainbow trout) are native to the drainage of Pacific North America. The steelhead is relatively long lived, feed on forage fish in the ocean, and can attain larger sizes than rainbow trout that remain in streams. Those trout that remain in streams (resident) 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 streams 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.

While no spawning activity was documented in the mainstem SYR in 1998, a significant amount of production was observed in the form of yoy. A total of 1,235 steelhead/rainbow trout, most yoy, were observed in the Alisal, Refugio, and Highway 154 Reaches. The majority of the fish were observed in the Refugio Reach.

In the Alisal Reach, there were 269 steelhead/rainbow trout observed. The vast majority of the fish were observed in pool habitats (**Table 5.3.2-1**). Over half of the yoy in particular were documented in a large scour pool directly downstream of the Refugio Bridge. The remaining fish were distributed relatively evenly throughout the reach. Riffle habitats were not snorkeled due to visibility problems associated with shallow water depth and abundant algae growth. Bank observations did not yield any steelhead/rainbow trout inhabiting riffle habitats. There is little likelihood of steelhead/rainbow trout inhabiting riffle habitats due to warm water temperatures recorded during the survey. During the course of the survey, surface water temperatures increased from 20.5 C (9:22am) to 25.5 C (1:40pm). Feeding behavior was observed during the morning hours before water temperatures began to increase to stressful levels. When water temperatures approached the higher end of those recorded, steelhead/rainbow trout were concentrated in areas where stratification and/or upwelling was noted. When disturbed by the surveyors, fish would stray from these refuge areas for only a short time before returning.

Table 5.3.2-1 Number of Steelhead/Rainbow Trout Observed in the Alisal Reach July 14, 1998

	Pools	Runs	Glide
Size Class (inches)	1500 Feet Surveyed	905 Feet Surveyed	900 Feet Surveyed
2.5	1	1	0
3-6	221	18	3
10-13	10	0	0
14-16	10	0	0
16-19	4	1	0
Total Observed	246	20	3

The highest concentration of steelhead/rainbow trout (720) was observed in the Refugio Reach. The majority were observed inhabiting pool habitats; particularly two pool habitats around mile 3.4 (**Table 5.3.2-2)**. Only one riffle habitats was snorkeled. Other riffle habitats had similar problems with visibility described above. During the course of the survey, surface water temperatures increased from 22.2 C (11:00am) to 25.0 C (2:40pm). Feeding behavior and use of refuge areas was similar to those described in the Alisal Reach.

Table 5.3.2-2 Numbers of Steelhead/Rainbow Trout Observed in the Refugio Reach July 15, 1998

	Pools	Runs	Glides	Riffles
Size Class (inches)	590 Feet Surveyed	1030 Feet Surveyed	170 Feet Surveyed	70 Feet Surveyed
2.5	0	3	0	0
3-6	499	171	7	6
6-9	5	0	0	0
9-12	1	0	0	0
12-14	2	0	0	0
14-16	13	0	0	0
16-18	5	7	0	0
> 22	1	0	0	0
Total Observed	526	181	7	6

The Highway 154 Reach was snorkeled on two occasions. The first survey was conducted on July 22 and included the portion of BOR property both downstream and upstream of the Long Pool. The Long Pool itself was not snorkeled until September 30 when visibility conditions improved. For purposes of discussion, the observations for both surveys are compiled in **Table 5.3.2-3.**

Steelhead/rainbow trout were distributed in various concentrations throughout the Highway 154 Reach. The majority of the yoy were observed in the section from the Crawford/BOR property line upstream to the tail of Long Pool. The greatest number of fish observed was within the 3-6 inch size category. While no redds were documented within this reach, the possibility that spawning activity took place in this portion of the mainstem cannot be ruled out. Another place the yoy might have originated could be Hilton Creek. Nearly all of the adult steelhead/rainbow trout greater than 12 inches were observed in the Long Pool. Most of these fish were actually within the 14-16 inch size category. The largest steelhead/rainbow trout observed was between 18-20 inches.

Table 5.3.2-3 Highway 154 Snorkel Survey Observations July 22 and September 30, 1998

Size Class (inches)	BOR to Long Pool (600 feet)	Long Pool (1500 feet)	Long Pool to Ford (200 feet)	Ford to Spill Basin (350 feet)
0-3	8	0	13	2
3-6	135	20	40	21
6-9	5	0	0	0
9-12	0	2	0	0
>12	1	47	0	0
Total Observed	149	22	53	23

1999

Pools and runs were snorkeled opportunistically through the entire three miles of the Alisal Reach. Riffles and some shallow run habitats were survey using bank observation techniques. A total of 53 steelhead/rainbow trout were observed, primarily in pool habitats **(Figure 5.3.2-1a)**. Most of the fish (46) observed in pool habitats were in the 6-9 inch size category. The majority of steelhead/rainbow trout were observed in two pool habitats where abundant cover and cool water refuge were available. Only two steelhead/rainbow trout were observed in run habitats and both were in the 3-6 inch size category. During the later portions of the summer and continuing into the fall, portions of the Alisal Reach, predominately shallow run and riffle habitats completely dried, thereby isolating various sections of the reach. All of the pool habitats where steelhead/rainbow trout were observed during the July snorkel surveys persisted. However, due to the fragmented flow conditions, most of the pool habitats had very little water flowing into them, which resulted in stagnant conditions in many locations. All of the habitats that persisted were watered by upwelling conditions. Follow up snorkel surveys during the winter resulted in only one steelhead/rainbow trout being observed. The single fish measured 12 inches and successfully oversummered in a pool located near Alisal Bridge. Also, this section, due to the upstream hydrologic conditions, allowed for small flows to persist during the critical oversummering period, which resulted in the pool habitat not being in a stagnant condition. Dissolved oxygen measurements taken during the summer noted slightly higher oxygen concentrations at this pool habitat compared to other pool habitats where greater numbers of steelhead/rainbow trout were observed. It is almost certain that the low dissolved oxygen conditions experienced by the oversummering steelhead/rainbow trout were lower than they could be expected to survive. Another possibility is that low DO conditions resulted in stressful conditions that made the fish more susceptible to predation. Other fish species (bass, catfish, sunfish) that are more tolerant to low DO conditions were observed to successfully oversummer in the same pool habitats. In fact, catfish in one pool habitat in the Alisal took over the only upwelling location where steelhead/rainbow trout were previously observed. Consequently, no steelhead/rainbow trout were observed at this location during subsequent snorkel surveys.

Table 5.3.2-1a Number of Steelhead/Rainbow Trout Observed in the Alisal Reach July 8, 1999

	Pools	Runs	Glide
Size Class (inches)	945 Feet Surveyed	450 Feet Surveyed	No Glides were Sampled
2.5	0	0	0
3-6	0	2	0
6-9	46	0	0
9-12	4	0	0
> 12	1	0	0
Total Observed	51	2	0

Compared to 1998, few steelhead/rainbow trout were observed in the Refugio Reach. Shallow water conditions prevented snorkeling in many of the habitats. Those habitats that were not snorkeled were surveyed using bank observation techniques. A total of 9 steelhead/rainbow trout were observed in pool habitats in the Refugio Reach **(Figure 5.3.2-2a)**. None were observed in run habitats. Overall, flow and general aquatic conditions were marginal in the Refugio Reach compared to other mainstem reaches. Generally, habitats were significantly more fragmented with larger portions of dry habitat and stagnant pool conditions. In fact, two of the larger pools where in 1998 large numbers of yoy steelhead/rainbow trout were observed were dry in July of 1999. Follow up snorkel surveys conducted in the winter did not yield any steelhead/rainbow trout observations. Unlike the follow up surveys in the Alisal Reach, no other fish species were observed during the winter snorkel surveys in the Refugio Reach.

Table 5.3.2-2a Numbers of Steelhead/Rainbow Trout Observed in the Refugio Reach July 14, 1999

	Pools	Runs	Glides	Riffles
Size Class (inches)	590 Feet Surveyed	45 Feet Surveyed	Not Snorkeled	Not Snorkeled
0-3	0	0	0	0
3-6	0	0	0	0
6-9	8	0	0	0
9-12	1	0	0	0
> 12	0	0	0	0
Total Observed	9	0	0	0

5.3.2.2 Tributary Snorkel Surveys 1998-1999

<u>Lower Salsipuedes Creek</u>

There were 22 habitats selected for snorkel surveys in 1998. Of the habitats surveyed, 7 pools comprised 47% of all pools identified, 8 runs, 4 riffles and 3 glides comprised 25% respectively of all runs, riffles and glides identified during 1998 habitat typing. Snorkel surveys were only conducted in July during 1998.

In 1999, snorkel surveys were conducted in July, and again in December. During the July sampling period, there were 8 pools and 8 runs sampled, corresponding with those sites sampled in 1998. Total length of habitats surveyed in July was 310 feet and 785 feet respectively. In the December sampling period, 11 pools and 8 runs were snorkeled totaling 480 feet and 395 feet respectively. The purpose for including the additional pool habitats in the December snorkel survey was to document the presence of steelhead/rainbow trout in pool habitats they were not previously observed in (via bank observations) during the July snorkel survey. The presence of abundant quantities of water crest prevented snorkel surveys in nearly half of the linear distance of the run habitats slated for snorkeling.

Arroyo Chub

Arroyo chub were the most abundant fish species observed during the 1998 snorkel surveys. About 50% (2,166) of the chub were observed in run habitats with the majority observed between the Highway 1 Bridge and Jalama Bridge. Another 10% (423) were observed in pool habitats with the remaining 40% (1766) being observed in glide habitats. Proportionately, glides were the chubs preferred habitat.

As documented in 1998, chub were the most numerous fish species observed during the 1999 snorkel surveys. Overall numbers remained fairly constant between the two surveys with 2225 being observed in July and 2734 being observed in December. Pools had nearly the same numbers observed between the two surveys (1310 and 1266). However, run habitats showed a large increase in population between July (915) and December (1468). The abundant watercrest (providing cover and macroinvertebrate production) present in the run habitats in the December survey probably contributed to the increase in the overall population.

Stickleback

There were 422 stickleback observed in Lower Salsipuedes Creek in 1998. Distribution of stickleback among the various habitat types remained fairly even with pools holding 38% (160), runs holding 26% (110), and glides holding 36% (152). Since stickleback are very prolific and can spawn more than once during a given season, their population probably increased during the remaining portion of the year.

Stickleback populations showed a large increase in population between the two snorkel surveys (381 and 1009). Pools seemed to be the preferred habitat for the stickleback with over 60% being observed in pool habitats during both surveys. Between the two surveys, there was a 70-75% increase in overall numbers in both the pool and run habitats.

Bass, Bullhead, Sunfish, and Minnows

In 1998, very few of these fish were observed within the lower creek. There were a total of 50 sunfish and 2 black bullhead observed. No largemouth bass or minnow species were observed in the snorkeled units. Most of the sunfish and one bullhead were observed in one pool habitat 3/4 of a mile upstream of Santa Rosa Bridge. The remaining sunfish were observed mostly in riffle and run habitats.

In 1999, only 2 green sunfish were observed in a single pool habitat during the July snorkel survey. However, an additional 25 green sunfish were observed in 3 pool habitats during the December survey. One small largemouth bass was also observed in one of the above pool habitats. The presence of significant amounts of woody debris in one of the habitats probably contributed to the sunfish not being observed during the July survey.

Steelhead/Rainbow Trout

1998

Several age classes of steelhead/rainbow trout were observed within the lower creek. Unfortunately, the timing of March and April rain events probably contributed to the poor numbers of yoy observed within the creek. Most of the steelhead/rainbow trout were observed in pool habitats and were within the 8-11 inch size category **(Figure 5.3.2-1)**. Lesser numbers were observed in the 6-8 inch size category. Run habitats held a modest number of steelhead/rainbow trout (25), most within the 6-8 inch size category **(Figure 5.3.2-2)**. An additional four steelhead/rainbow trout were observed in riffle habitats well downstream of the 10,000 foot mark.

No yoy were documented during the 1998 snorkel surveys in the lower creek.

Snorkel sites were scattered throughout approximately 20,000 feet of Salsipuedes Creek. The greatest majority of fish were observed upstream of the 12,000 foot mark (Highway 1 Bridge) **(Figure 5.3.2-3)**. Lesser numbers were observed in various run and pool habitats between 4000-10000 feet upstream of the Santa Rosa Bridge. Most of the fish in the creek were observed in three pool habitats between the Highway 1 and Jalama Bridges (upstream of the 10,000 foot mark).

1999

Yoy production was much improved in Lower Salsipuedes Creek compared to 1998. Overall, 32 yoy were observed during the July survey with most inhabiting run habitats **(Figure 5.3.2-2)**. The yoy were generally observed in relatively abundant cover areas, typically habitats with undercut banks, root masses and overhanging terrestrial vegetation. Fewer juvenile and adult steelhead/rainbow trout were observed during the June 1999 survey. Probable causes for this were considered to be the result of poor yoy production documented in 1998. However, during the December snorkel survey, a large increase in the numbers of juvenile and adult fish was documented. Most of these fish were documented in pool habitats, the same pool habitats where few juvenile and adult steelhead/rainbow trout were observed during the July surveys **(Figure 5.3.2-1)**. Based upon these observations, it is speculated that during the course of the summer, the older steelhead/rainbow trout (juvenile and adults) are remaining in refuge habitats until water temperatures begin to cool during the fall. Since a large proportion of pools are sampled in Salsipuedes Creek, the refuge habitats do not appear to be entirely pool habitats, but instead run or glide habitats. Undercut bank areas coupled with cool water upwelling may be providing the necessary cool water that allows these fish to successfully oversummer in the creek. Additionally, the vast majority of the juvenile and adult steelhead/rainbow trout observed during December survey were documented upstream of the 10,000 foot mark, with most of those observed upstream of the 16,000 foot mark **(Figure 5.3.2-3)**. The presence of these fish so close to the confluence with El Jaro Creek suggests that the fish are originating in either El Jaro Creek, or Upper Salsipuedes Creek. Too, the fact that so many were observed in previously unoccupied habitats indicates that once water temperatures become tolerable (sometime in Fall) the steelhead/rainbow trout are moving into areas with more available space and food supply.

In 1999, the majority (82.6%) of the steelhead/rainbow trout were observed between 10,000-19,000 feet upstream of the SYR confluence, with 50% of those observed upstream of the 16,000 foot mark.

Figure 5.3.2-1. 1998-1999 Lower Salsipuedes Creek Snorkel Surveys - Pool Habitats

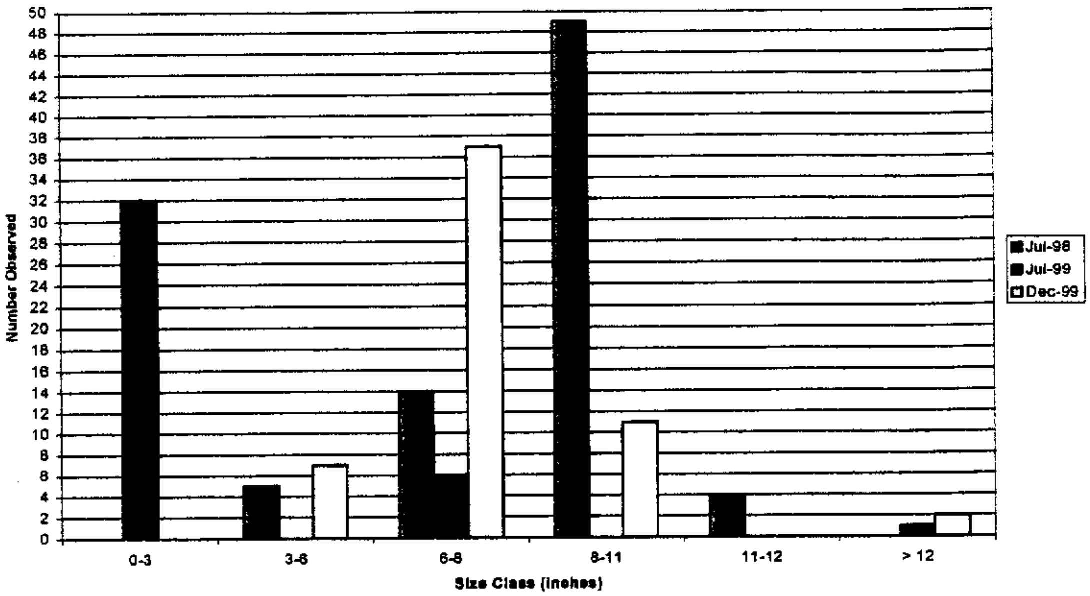


Figure 5.3.2-2. 1998-1999 Lower Salsipuedes Snorkel Survey - Run Habitats

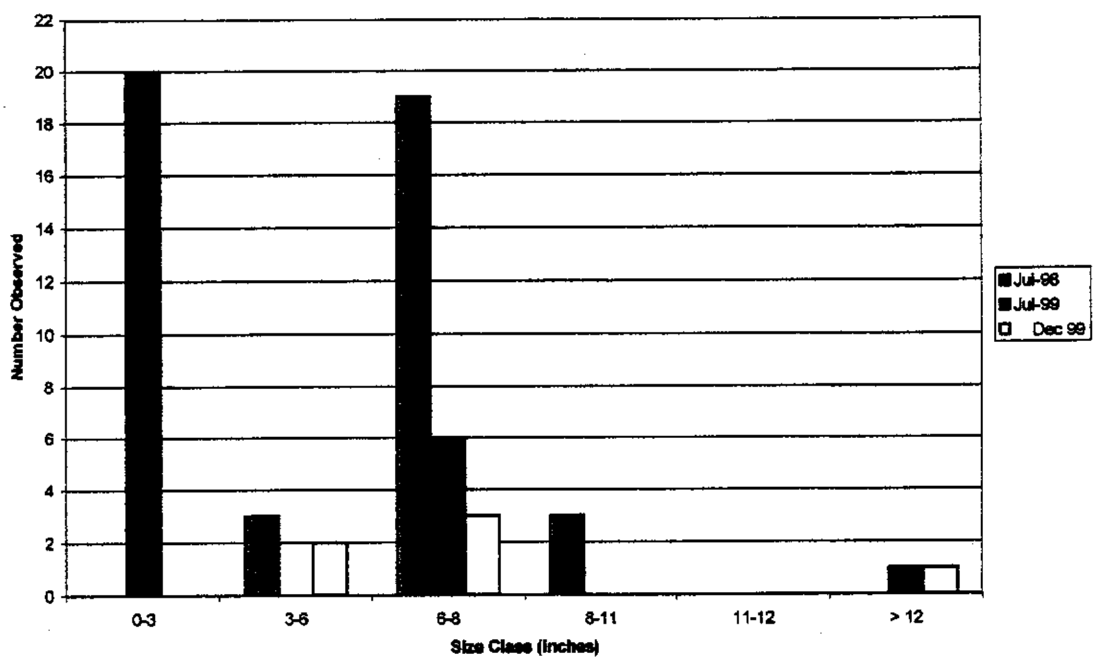
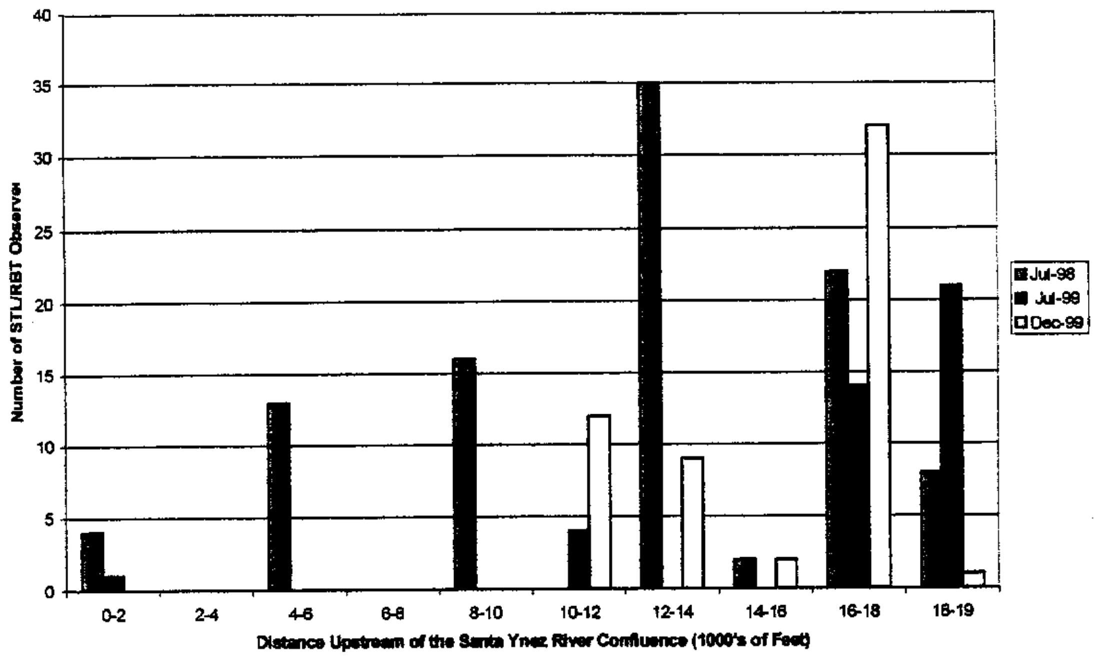


Figure 5.3.2-3. 1998-1999 Fish Distribution in Lower Salsipuedes Creek



El Jaro Creek 1998-1999

There were 10 habitats selected for snorkel surveys in 1998. Of the habitats surveyed, 4 pools comprised 100% of all pools identified, 3 runs and 3 riffles comprised 27% respectively of all runs, and riffles identified during 1998 habitat typing.

In 1999, snorkel surveys were conducted in July and again in December. During the July sampling period, there were 3 pools, 1 riffle, and 8 runs, sampled, corresponding with those sites sampled in 1998. Total length of habitat surveyed in July was 100 feet, 40 feet, and 555 feet respectively. Due to the lack of instream complexity and shallow depth of the run habitats selected, most of the run habitats could be observed via bank observations. Additional run habitats were sampled in July and December 1999 to provide a more comprehensive snorkel survey of El Jaro Creek. During the December survey, 4 pools, 2 riffles, and 5 runs were sampled. Total length of habitat surveyed in December was 128 feet, 65 feet, and 315 feet respectively. Abundant instream vegetation prevented snorkeling of some of the run habitats.

Arroyo Chub

Arroyo chub were the most abundant fish species observed during the 1998 snorkel surveys in El Jaro Creek. About 53% (600) of the chub were observed in run habitats. Another 31% (351) were observed in pool habitats with the remaining 16% (178) being observed in riffle habitats.

In 1999, chub were again the most numerous fish species observed in the creek. There were 1448 observed during the July survey with 25.9% in pool habitats, 11.0% in riffle habitats, and 63.1% in run habitats. Chub populations decreased dramatically by the December survey with only 287 being observed in pool and run habitats (83.5% reduction). Again, run habitats seemed to be the preferred habitat with 86.1%.

Stickleback

Very few stickleback (51) were observed in El Jaro Creek during the 1998 snorkel surveys. Distribution of stickleback was localized to run habitats (50) with only one observed in pool habitats. Since stickleback are very prolific and can spawn more than once during a given season, their population probably increased during the remaining portion of the year.

In 1999, runs seemed to be the preferred habitat of stickleback. During the July survey, a total of 67 were observed, with 50 being documented in run habitats. In the December survey, the discrepancy between preferred habitats was even greater with 120 total sticklebacks being observed with 118 of those documented in run habitats.

Steelhead/Rainbow Trout

Several age classes of steelhead/rainbow trout were observed within lower El Jaro Creek during the 1998 snorkel surveys. Unfortunately, the timing of March and April rain events probably contributed to the poor numbers of yoy observed within the creek. Abundance of steelhead/rainbow trout in July 1998 was equal in both pool (14) and run habitats (14). Pool habitats held larger fish with eight being observed in the 6-8 inch size category, and the remaining six observed in the 8-11 inch size category **(Figure 5.3.2-4).** Run habitats held smaller fish compared to pool habitats with eight fish observed in the 3-6 inch size category and six in the 6-8 inch size category. Riffle habitats held a total of eight fish, all within the 3-6 inch size category **(Figure 5.3.2-5).**

In 1999, El Jaro Creek was snorkeled in July and again in December. Pool habitats held the most fish with 20 being observed in July and 18 being observed in December. Most of the fish observed during the July survey were in the 0-3 and 6-8 inch size category **(Figure 5.3.2-4).** By December there was a slight population shift in pool habitats with the majority of the fish being in the 3-6 and 6-8 inch size category. The population shift could easily be the result of yoy growing to larger sizes between the two surveys. Run habitats held significantly fewer fish than pool habitats **(Figure 5.3.2-5).** In July 10 fish were observed in run habitats, with a nearly even distribution between the size classes. By December, only 3 steelhead/rainbow trout were observed in run habitats indicating that the fish were probably redistributing themselves once water temperatures cooled during the fall. Young of the year were seen in both pool and run habitats, although the numbers observed were low. The fact that there was steelhead/rainbow trout production is encouraging since there were no redds documented in the creek during spawning surveys. No fish less than three inches (yoy size) were documented in either habitat types during the December survey suggesting that these fish grew and/or redistributed themselves between the two surveys.

Figure 5.3.2-4. 1998-1999 El Jaro Creek Snorkel Survey - Pool Habitats

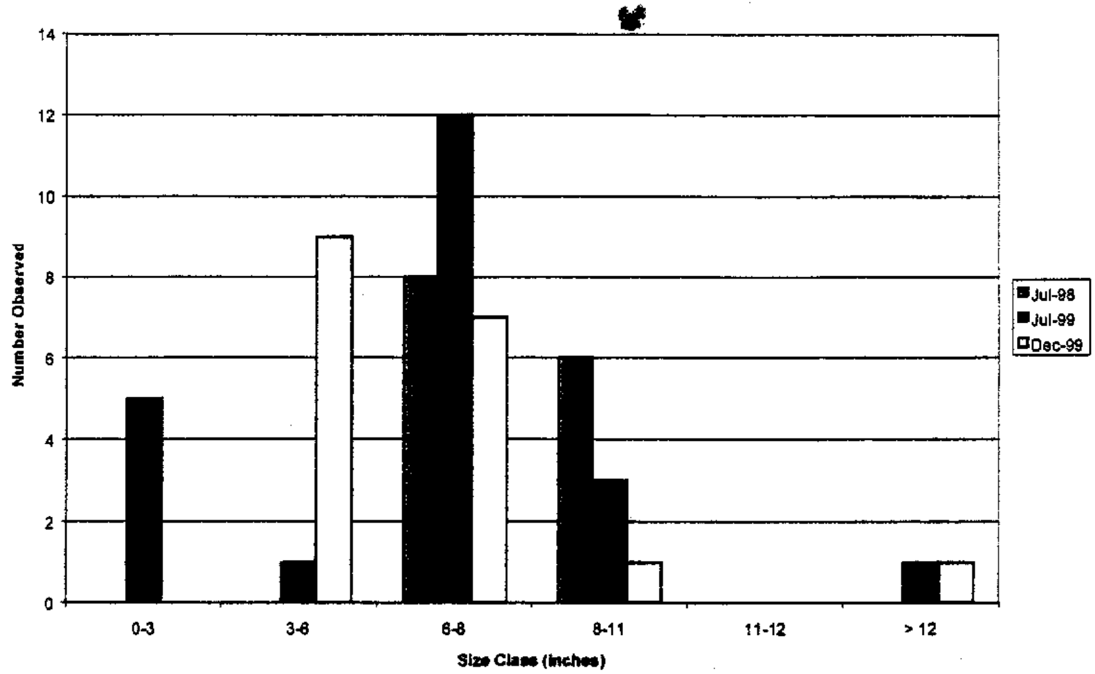
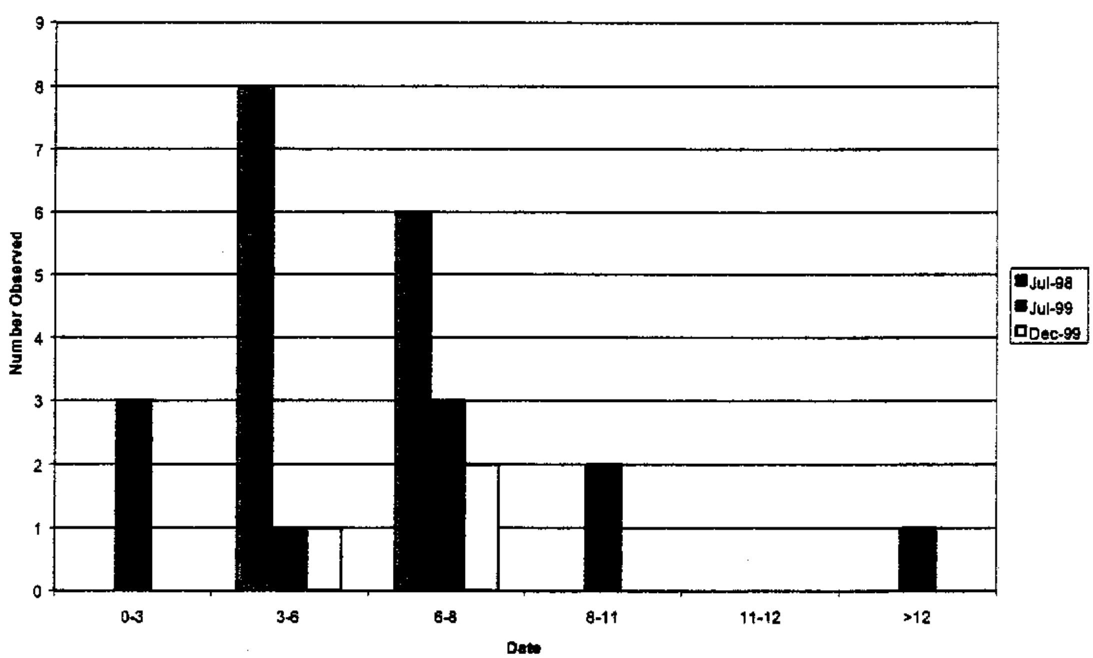


Figure 5.3.2-5. 1998-1999 El Jaro Creek Snorkel Survey - Run Habitats



Nojoqui Creek

Of the 105 habitats identified in Nojoqui Creek, 28 were revisited to conduct snorkel surveys in 1998. Of the habitats surveyed, 7 pools comprised 50% of all pools identified, 13 runs, 5 riffles and 3 glides comprised 31%, 15%, and 20% respectively of all runs, riffles and glides identified during 1998 habitat typing.

No snorkel surveys were conducted in Nojoqui Creek during 1999.

Arroyo Chub

A tremendous number of arroyo chub were observed within Nojoqui Creek (10,467). Run habitats held the highest abundance 48% (5,000), followed by pool habitats 34% (3,549), and glide habitats 13% (1,410). Riffle habitats held the remaining 5% (508).

Stickleback

A total of 354 stickleback were observed in Nojoqui Creek. The majority were observed in run (57%), and pool (34%) habitats. The remaining 6% were distributed in riffle and glide habitats.

Sunfish

There were 11 green sunfish observed in Nojoqui Creek. The fish were observed exclusively in two pool habitats and varied in size between 3-6 inches.

Steelhead/Rainbow Trout

Steelhead/rainbow trout utilization within Nojoqui Creek has been essentially non-existent during the course of the TAC studies. 1998 was the first year steelhead/rainbow trout were observed oversummering in Nojoqui Creek. There was one fish, nine inches in length observed in a run habitat.

5.4 Hilton Creek Fish Rescue

The lower portion of Hilton Creek is an intermittent stream that provides spawning and rearing habitat for steelhead/rainbow trout. During years when rainfall is high, the ability of steelhead/rainbow trout to utilize the lower creek for both spawning and rearing increases. Typically during dry and average years, flow within the lower creek does not persist long enough for the fish to complete their life-cycle. However, in years like 1998, flow conditions are optimal for steelhead to spawn and have successful hatching of their offspring. While good rain years can provide water flow conditions necessary for steelhead/rainbow trout to complete their life-cycle, late spring and early summer are times when both water quality and flow in lower Hilton Creek begins to diminish. Without intervention, any fish production within the lower creek could be lost unless they are relocated to a suitable location to complete their life-cycle.

5.4.1 Methods

1998

Fish rescue operations were initiated in the morning hours to insure water temperatures would be at their coolest. Operations began on June 23 and continued through June 25. Water temperatures and dissolved oxygen concentrations were monitored regularly. If water temperatures exceeded 20 C, rescue operations would be suspended until the following morning. Fish rescue operations were conducted using both seining and electrofishing techniques. Seining techniques were localized to deeper pool habitats. When seining, a two or three person crew would use a block seine to isolate the pool habitat at the downstream end. The crew would then proceed to seine the pool starting from the upstream end and progressing downstream being careful to keep the bottom portion of the seine at the bottom of the substrate. All captured fish were placed in 5 gallon buckets for transport either to the mainstem SYR midway between the spill basin and long pool, or to a waiting DFG hatchery truck. Electrofishing techniques were utilized for the majority of the creek. Electrofishing was conducted using a Smith-Rot electrofisher Model 12A. This particular model utilizes Programmable Output Waveforms, which helps prevent damage to fish, increases electrofishing time per battery, and extends the range of water conductivities for electrofishing. The electrofisher was set for Standard Pulses at 60 Hz and 200 volts. A six-person crew conducted the electrofishing survey: one electrofisher, three netters, and two bucket persons who shuttled the captured fish to the release site.

5.4.2 Results

Rescue operations were initiated at 0730 on June 23 using seining techniques. A block net was placed at the lower portion of the creek in a shallow run habitat, directly upstream from the lowermost riffle. Several seine passes were then attempted through the run section, resulting in three yoy captured. It was collectively decided with the various resource agencies personnel present that with the abundant cover provided to the yoy by cobbles and boulders that electrofishing techniques would generate a higher capture rate in the time allowed. One pass was made through approximately 600 feet of the lower creek. A total of 353 yoy were captured and relocated to the release site **(Table 5.4.2-1)**.

Table 5.4.2-1. Number of Steelhead/Rainbow Trout Captured During Hilton Creek Fish Rescue

Date	**June 23**		**June 24**		**June 25**	
Age Class	Adult	YOY	Adult	YOY	Adult	YOY
Number Captured	0	353	0	331	2	147

On June 24, the electroshocking crew worked an additional 400 feet upstream then made a second pass through the lower 600 feet, and again through the previous 400 feet. A total of 331yoy captured, 283 from electrofishing, and 48 from seining. Of the 331 captured, 153 were relocated via hatchery truck to San Miguelito Creek. The remaining yoy were released to the mainstem.

Rescue operations, seining only, continued on June 25. Approximately 250 feet of creek was sampled. There were 147 yoy and 2 adult steelhead/rainbow trout captured and removed from this section. All captured fish were relocated to the mainstem SYR.

Additional fish rescues were conduced on an opportunistic basis throughout the summer when refuge pools started drying. Approximately 35 additional yoy were relocated to the mainstem from Hilton Creek.