2008 ANNUAL MONITORING REPORT AND TREND ANALYSIS FOR 2005-2008

for

THE BIOLOGICAL OPINION FOR THE OPERATION AND MAINTENANCE OF THE CACHUMA PROJECT ON THE SANTA YNEZ RIVER IN SANTA BARBARA COUNTY, CALIFORNIA

Prepared for:

NATIONAL MARINE FISHERIES SERVICE

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Executive Summary

This report presents the data and summarizes the results from the Water Year 2008 (WY, 10/1/07 – 9/30/30/08) monitoring efforts of southern steelhead and water quality conditions within the Lower Santa Ynez River (LSYR), and presents observations and trends from 2005 through 2008. This report is intended to fulfill the annual reporting requirements of the Cachuma Project Biological Opinion (BO) for WY2005 through WY2008. The fisheries and water quality monitoring tasks were conducted as described in the BO (NMFS, 2000), Biological Assessment (USBR, 2000) and LSYR Fish Management Plan (SYRTAC, 2000). Some deviations to the monitoring program were necessitated specifically in water quality monitoring due to landowner access limitations and redd surveys due to staffing limitations. The Results Section presents the WY2008 data and the Discussion Section addresses management questions posed in the Biological Opinion and presents a trend analysis of the fisheries data since 2005. The data from WY2005 to WY2007 are presented in the Appendices.

WY2008 was a wet year (22.6 inches at Bradbury Dam) with the majority of the rainfall occurring in January and February. Early winter season storms were sufficient to breach the Santa Ynez River Lagoon on 1/6/08 and maintain ocean connectivity through the middle of May (5/19/08). Bradbury Dam spilled on 1/30/08 but the lack of spring rains ended the spill on 3/22/08 and resulted in dry conditions for the rest of the year. Target flows in Hilton Creek (2 cfs minimum) and in the LSYR mainstem at Alisal Bridge (1.5 cfs) and Hwy 154 Bridge (10 cfs) were maintained. Winter stormflow provided passage opportunities for returning southern steelhead in that 16 anadromous steelhead were observed; 7 in Salsipuedes Creek, 2 in the LSYR mainstem and 7 in Hilton Creek. These were the first large anadromous steelhead observed within the LSYR mainstem and Hilton Creek since monitoring began in 1993. There were 134 out-migrating smolts recorded at the three trap sites, the third highest number since routine migration monitoring began in 2000. Management actions undertaken by Reclamation are showing positive results in that they are increasing the returns and numbers of southern steelhead, specifically due to the Hilton Creek Watering System, the completed tributary passage enhancement projects on Hilton, Quiota, El Jaro and Salsipuedes creeks and the releases of water from Bradbury Dam for meeting designated target flows.

Recommendations to improve the monitoring program include: (1) continue the long-term monitoring elements and improve the consistency of the monitoring effort, (2) investigate methods to conduct migrant trapping at higher flows, (3) refine seasonal water quality monitoring to address more specific objectives, (4) develop and implement short-term focused research projects, (5) develop a monitoring program to better understand the interactions of steelhead and beavers on the LSYR, (6) develop a monitoring program to better understand the interactions of steelhead and invasive warm water species within the LSYR basin, (7) complete the Annual Monitoring Report by December of each year, and (8) investigate ways to collaborate on regional fisheries studies to improve the collective understanding of southern steelhead.

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WY2008 Annual Monitoring Report

1. Introduction

The Cachuma Project Biological Opinion (BO) requires the U. S. Bureau of Reclamation (Reclamation or USBR) to provide an annual monitoring report to the National Marine Fisheries Service (NMFS) as stipulated in Reasonable and Prudent Measure (RPM) 11 and Term and Condition (T&C) 11.1 (NMFS, 2000) and further described in the Biological Assessment (USBR, 2000) and the Lower Santa Ynez River Fish Management Plan (FMP) (SYRTAC, 2000):

> ***RPM 11:*** "Reclamation shall provide NMFS with monitoring data and reports evaluating the effects of the proposed project on steelhead." *(Page 72)*
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> ***T&C 11.1:*** "Monitoring of the Cachuma Project shall occur as described above and as described in the revised project description (USBR, 2000) under the direction of a qualified biologist. Reclamation shall provide NMFS with yearly reports (unless otherwise noted) that include the data taken each year and preliminary data analysis. Especially important for monitoring the effects of the Cachuma Project will be monitoring of: steelhead movement during migration supplementation, successful access, spawning, and rearing of steelhead in previously inaccessible and/or access restricted tributary habitat, and mainstem flow targets and the condition of steelhead in the mainstem." *(Page 79)*

The objective of this 2008 Annual Monitoring Report is to evaluate the effects of the Cachuma Project on Santa Ynez River steelhead below Bradbury Dam by presenting and analyzing data collected throughout the year regarding steelhead population changes, their movement and reproductive success, target flow compliance, water quality conditions, and effectiveness of restoration activities. This 2008 Annual Monitoring Report also presents findings and observations of trends from 2005-2008 as a continuation of the analyses presented in the 1993-2004 Synthesis Report (AMC, 2008) and in the context of other drainages within the Southern California Steelhead Distinctive Population Segment (DPS). For selected data, trends from 2000-2008 are analyzed. The monitoring data from 2005 to 2007 are presented within the Appendices, and are intended to serve as the annual monitoring reports required for those years. From 2009 onward, Reclamation will submit annual monitoring reports for the preceding water year. The biological monitoring program as outlined in the revised Section 3 of the Cachuma Project Biological Assessment (USBR, 2000) incorporates all elements within RPM 11 and T&C 11.1 and provides the scientific data to answer the following questions:

- Are steelhead moving during the supplementation of migration flows?
- What is the success of steelhead access, spawning and rearing upstream of completed tributary passage enhancement projects?
- Is the Cachuma Project meeting mainstem and tributary flow targets as outlined in the BO?

- What are the trends in steelhead distribution, abundance and reproductive success in the mainstem of the LSYR and its major tributaries (i.e., condition and distribution of the steelhead population in the mainstem and its tributaries)?

The WY2008 (WY, 10/1/07 through 9/30/08) data summarized in this report describe the water year. This period roughly encompasses the reproductive cycle of steelhead; specifically migration, spawning, rearing, and over-summering as those activities relate to the wet and dry periods of the year. Although fall snorkel surveys at times occur in October or November, they will be included in the previous water year's data as they show survival success after the dry season. Throughout the report, LSYR stream network locations are assigned site-codes. These have two parts, an alphanumeric location code indicating the mainstem of the LSYR or a tributary (i.e., EJC for El Jaro Creek), and a distance measurement downstream of Bradbury Dam on the LSYR mainstem or upstream from the confluence of the mainstem with a tributary (e.g., LSYR-0.5 is the Long Pool, which is 0.5 miles downstream from the dam; or HC-0.14 is on Hilton Creek 0.14 miles upstream of the confluence with the mainstem).

WY2008 was classified as a wet year. Fish populations, in general, respond positively to above normal or wet years (Kjelson and Brandes, 1989; Marchetti and Moyle, 2001) as there is higher primary productivity with more allochthonous material being delivered to the stream. Populations of all tropic levels take advantage of the increased flow and food resources for increased survival. For southern steelhead, WY2008 was such a year as evidenced by an increase in the number of fish reported in many streams across the Southern California Steelhead DPS/ESU. Santa Ynez River returns showed a much larger increase than in previous years, and anadromous steelhead were observed in the LSYR mainstem and in Hilton Creek, a tributary just below Bradbury Dam, for the first time since monitoring began in 1993. This is evidence of the beneficial effects of the actions taken in support of the FMP and BO.

2. Background

2.1. Historical context of the biological monitoring effort

Reclamation, in collaboration with the Cachuma Project Member Units, began the biological monitoring program for southern steelhead (*Oncorhynchus mykiss or O. mykiss*) in the LSYR in 1993. The Cachuma Operation and Maintenance Board (COMB) and Cachuma Conservation Release Board (CCRB) in conjunction with the Santa Ynez River Water Conservation District, Improvement District No. 1 (ID#1), through the Cachuma Project Biology Staff (CPBS), implement the long-term Fisheries Monitoring Program and habitat enhancement projects within the LSYR on behalf of Reclamation in compliance with the BO and pursuant to the Federal Endangered Species Act. The program has evolved in scope and specificity of monitoring tasks as knowledge was gained and after *O. mykiss* were listed as endangered under the federal Endangered Species Act in 1997 (NMFS, 1997), specifically through the critical habitat designation in 2000 and 2005 (NOAA, 2005), the development of the Biological Assessment (BA) for the Cachuma Project (USBR, 1999), the issuance of the BO (NMFS, 2000) and subsequent guidance and regulatory documents (SYRTAC, 2000; USBR, 2000). Two comprehensive data summaries were written that synthesized the results of the monitoring effort from 1993 to 1996 (SYRCC and SYRTAC, 1997) and from 1993 to 2004 (AMC, 2008), both of which served to fulfill the required annual monitoring reports (RPM 11.1) for those years. This 2008 Annual Monitoring Report with trend analyses serves as the annual reporting compliance from 2005 through 2008.

2.2. Meteorological and hydrological overview

The headwaters of the Santa Ynez River are located approximately 4000 feet above sea level in the San Rafael Mountains. The river flows in a westerly direction for approximately 90 miles before reaching the Pacific Ocean near the City of Lompoc. The Santa Ynez River watershed is almost entirely contained within Santa Barbara County. There are three water supply reservoirs along the river: Jameson, Gibraltar, and Cachuma. Lake Cachuma essentially splits the watershed in half. This region has a Mediterranean-type climate typically warm and dry during the summer and cool and wet in the winter. Rainfall is highly variable throughout the watershed with long-term records showing that the region routinely experiences periods of wet and dry cycles that can last for several years. The majority of the rainfall occurs during the winter and spring (December-May) months with most rain falling from December through April of any given year. The wet season corresponds with the initiation of the migration and spawning season for *O. mykiss*. Both the anadromous and resident forms of the species begin to migrate to spawning locations once the sandbar at the mouth of the river is breached, and the tributaries begin flowing. This typically occurs some time after the first major storm of winter. Hence, the meteorological and hydrological conditions each year are essential for analysis and interpretation of the fisheries data collected during the year.

2.3. Monitoring and data quality assurance and control

Field monitoring activities for migrant trapping, snorkel surveys and redd surveys followed established CDFG and NMFS protocols as described in the BO and the literature (Hankin and Reeves, 1988; Dolloff et al., 1993). Monitoring water quality followed regulatory and industry guidelines for quality assurance and control which are presented in Appendix A.

3. Monitoring Results

The results from the 2008 monitoring effort are organized by river hydrology (rainfall, stream runoff and ocean connectivity), passage supplementation, target flows, mixing of State Water Project water, water quality, habitat quality, migration, reproduction and rearing, tributary enhancements (migration barrier removal), and additional investigations.

3.1. River Hydrology

Precipitation, stream runoff and Bradbury Dam spills: Water year type historically has been defined at Bradbury Dam as a dry year when rainfall is equal to or less than 15 inches, a normal year is 15 inches to 22 inches, and a wet year is equal to or greater than 22 inches (AMC, 2008). The California State Water Resources Control Board (SWRCB) uses a different criteria that focuses on inflow to a reservoir; a critical year when inflow is equal to or less than 4,550 acre-feet, dry year when inflow is between 15,366 and 33,707 af; a normal year when inflow is between 33,708 and 117,842 af; and a wet year when inflow is greater than 117,842 af. WY2008 had just over 22 inches of rainfall at Bradbury Dam and was classified as a wet year (SWRCB, 2007). There was sufficient runoff to spill Lake Cachuma starting on 1/30/08. This was the fourth wet year and fifth spill year since 2000 (Table 1). Historic minimum, maximum, and average rainfall data at six locations within the Santa Ynez River basin are presented in Table 2. The precipitation record shows high spatial and inter-year variability between low and high elevations, western and eastern locations throughout the watershed, and wet and dry years.

There were 10 precipitation events in WY2008 with rainfall equal to or greater than 0.1 inches of rain at Bradbury Dam (Table 3 and Figure 1). The majority of the storms occurred between December and February with the largest event lasting 8 days starting on 1/22/08 and concluding on 1/29/08. Annual flow hydrographs for the Lower Santa Ynez River basin at the Narrows, Salsipuedes Creek (USGS-11132500), Solvang (Alisal Bridge) (USGS-11128500), Bradbury Dam (Reclamation) and Los Laureles (USGS-11123500) (upstream of Lake Cachuma) gauges are shown in Figure 2. The dam began spilling on 1/30/08 with peak discharge occurring on 2/4/08 at 1,313 cfs and the spill ended on 3/22/08. There were 53 consecutive days of the spill with a total spill volume of 22,994 acre-feet. The spill plus tributary stream flow below the dam provided for 66 days of fish passage flows of 25 cfs or greater at Alisal Bridge (City of Solvang) from January 1 through May 30 (the migration season). This was the fifth spill year since the issuance of the BO in 2000 (water years 2000, 2001, 2005, 2006 and 2008) (Table 1).

Peak average daily discharge recorded by the USGS at the Narrows, Solvang and Los Laureles gauges occurred on 1/27/08 at 3,940 cfs, 1,890 cfs and 8,300 cfs, respectively. Instantaneous peak discharges at those gauges were 9,690 cfs, 5,990 cfs and 14,600 cfs recorded on 1/27/08, respectively. At these discharge rates, fluvial geomorphic changes to the channel configuration were possible given the historical record. Over half of the WY2008 rainfall fell in January and created favorable runoff conditions for fish passage through March. Although the wet season began with substantial rain and associated runoff, there were no significant rainfall or stormflow events in the spring, resulting in low runoff and baseflow conditions from April the end of the water year. The effect of a dry spring resulted in overall hydrologic conditions in the summer and fall of WY2008 more typical of a dry year type such as WY2007.

Water releases were conducted throughout the water year in compliance with the target flow terms specified in the BO (NMFS, 2000) for Hilton Creek and the LSYR mainstem at the Highway 154 and Alisal bridges. A higher than normal release was made on 6/26/08 to meet target flows at Alisal Bridge during a heat wave that lasted several days and is referred to as a refreshing flow (Figure 2).

Annual hydrographs for Hilton and Salsipuedes creeks and along the LSYR mainstem at Solvang and the Narrows reflected good winter runoff and a dry spring with flows approaching zero by September at the USGS gauge on Salsipuedes Creek (Figure 3). The Hilton Creek Watering System (HCWS) maintained a minimum baseflow above 4 cfs throughout the dry season creating excellent rearing and over-summering conditions for steelhead/rainbow trout (*O. mykiss)*. Flows were greater than 1.5 cfs at Solvang throughout the year except for six days towards the end of June with the lowest recorded flows during that period of 0.67 cfs. CPBS took instantaneous flow measurements during that time (Figure 4) and coordinated with Reclamation on the refreshing flow release.

Ocean connectivity: The Santa Ynez River lagoon was breached on 1/6/08 after a storm event on 1/4/08, and remained open for 134 days before closing on 5/19/08 for the rest of the year (Figures 2 and 3). This was about 30 days less than the average number of days during a wet year (164 days) (Table 4.) Prior to that early January storm, the lagoon had been closed since 11/22/06 and a relatively large berm had built up with an extensive lagoon that had flooded Ocean Park near the mouth (Figure 5). The storm was relatively large with 5.83 inches recorded at Bradbury Dam and the amount of accumulated water in the lagoon thoroughly washed out the berm, discharged a large fresh water plume into the ocean, and created ocean connectivity until May for steelhead passage.

Since WY2006, the lagoon has been monitored daily from Ocean Park during the migration season (December through June) with respect to the presence of the lagoon sandbar. From WY2001 to WY2005, the lagoon was monitored weekly and the flow at the USGS 13th Street gauge was carefully studied to determine when the lagoon was open.

Passage supplementation: The criteria to initiate passage supplementation as outlined in the Biological Assessment (USBR, 1999; USBR, 2000), BO (NMFS, 2000) and an Adaptive Management Committee technical memo (AMC, 2004), were never met prior to the dam spilling on 1/30/08. As a result, there was no passage supplementation in WY2008. There was only one small storm after the spill (0.38 inches at Bradbury Dam) on 5/24/08, but it did not significantly increase flows on the mainstem and did not meet the minimum flow requirement of 25 cfs at Solvang for passage supplementation. Therefore, at the end of WY2008, the full surcharge allotment from the Fish Passage Supplementation Account of 3,200 acre-feet was retained for future supplementation efforts**.**

Adaptive Management Account: The full allotment of 500 acre-feet for the Adaptive Management Account was received during the WY2008 spill event. No water from that account was used hence it was carried over at the end of WY2008 for future releases**.**

Target flows: Because the WY2008 spill volume was greater than 20,000 acre-foot, long-term BO established target flows of 10 cfs at Highway 154 Bridge, 1.5 cfs at Alisal Bridge (Solvang) and a minimum of 2 cfs in Hilton Creek through the HCWS were required and were met in WY2008 (Figure 3). The maximum recommended release was being used due to little tributary inputs. The only exception was in late June when target flows dropped below 1.5 cfs at Alisal Bridge for a period of six day (6/21/08 – 6/26/08) when the USGS recorded average daily flows ranging from 1.3 to 0.67 cfs (Figure 4). The heat wave experienced that week resulted in lower than anticipated flows at Alisal Bridge which were corrected with a refreshing flow release on 6/26/08 that reached

Alisal Bridge on 6/27/08 and lasted for three days. No fish strandings or mortalities were observed during that period. There were challenges meeting target flows in WY2007 at the Alisal Bridge. Procedures for increasing the releases were generated by Reclamation shortly thereafter that improved the program and success of meeting target flow objectives (see the 2009 BO Compliance Report on Target Flow Compliance with Operational Guidelines).

Mixing of State Water Project waters in the LSYR: Reclamation monitors downstream releases to comply with the 50% mixing criterion required by the BO RPM 5.1 (NMFS, 2000) for release of State Water Project (SWP) water into the Santa Ynez River by the Central Coast Water Authority (CCWA). The criterion was met for RPM 5.1 throughout WY2008 (Figures 6). SWP water is mixed with water releases from Lake Cachuma in the stilling basin at the base of the dam. Since the issuance of the BO in 2000, the 50% mixing criterion has been met 100% of the time during the migration season (December – June), when the lagoon was open, and flow was continuous to the ocean.

3.2. Water Quality Monitoring within the LSYR Basin:

Certain water quality parameters were monitored within the LSYR Basin during the dry season from May through November to track conditions for over-summering *O. mykiss*. Although other water quality parameters were recorded (i.e., ORP, specific conductance, TDS, pH, and salinity), the critical parameters for salmonid survival are water temperature and dissolved oxygen (DO) concentrations. Stream and lake water temperature and DO concentrations are presented below for the LSYR mainstem and selected tributaries.

Stream water temperatures were collected at various locations within the mainstem and tributaries of the LSYR with thermographs (recording continuously every hour), and dissolved oxygen concentrations with multi-parameter sondes through multiple day spot deployments (2-5 days at 15-minute or 30-minute intervals). Since 1995, a thermograph network has been deployed in the mainstem and tributaries downstream of Bradbury Dam as described in the BA (USBR, 2000) to monitor seasonal trends, diel variations, longitudinal and vertical gradients, and general temperature suitability for *O. mykiss*. Changes in channel configuration and associated pool habitats have necessitated modifying the thermograph deployment regime and locations described in the Watershed Monitoring Plan of the BA (USBR, 2000). Sonde deployments took into account specific habitat units and potential water quality issues for rearing *O. mykiss*, and locations were varied based on observed conditions. The two data sources (thermographs and sondes) will be discussed separately for the mainstem and tributaries.

Water temperature: During WY2008, nine LSYR mainstem thermographs were deployed at 5 sites included the Long Pool (LSYR-0.5 (2)), Encantado Pool (LSYR-4.9 (2)), LSYR-7.3 (2), Alisal Bedrock Pool (LSYR-10.2 (2)), and Avenue of the Flags (LSYR-13.9 (1)) (Figure 7 and Table 5). Four of those sites had vertical arrays (one unit near the top and one unit near the bottom of the water column), and one was a single unit deployment (placed near the bottom. These five pools on the LSYR mainstem were chosen due to monitoring of those habitats since 2005. Several previously monitored locations were discontinued due to habitat alterations (LSYR-6.0 and LSYR-7.8), dry conditions (LSYR-26.7), discontinuation of a monitoring site, such as the Stilling Basin (LSYR 0.0), and access limitations (two sites within the Santa Ynez River Lagoon). There were six thermograph deployment sites in the tributaries during WY2008; Hilton Creek (2: Upper Release Point and near the LSYR confluence), Quiota Creek (1: upstream of Crossing 7), Salsipuedes Creek (2: upper creek and near the trap site), and El Jaro Creek (1: upstream of the confluence with Salsipuedes Creek). The sites on Nojoqui Creek, San Miguelito Creek and middle Hilton Creek were discontinued due to the absence of observed fish over several years, a sequence of impassable barriers prohibiting access for anadromous steelhead, and redundancy in the monitoring program, respectively. The previously monitored middle Hilton Creek site was designed to evaluate thermal heating between the Upper and Lower Release Points but due to extensive riparian vegetation growth, this has ceased to be a concern and the location has been discontinued. Thermograph data have been aggregated and are presented by maximum, average, and minimum temperature over a 24-hour period (Table 6). Typical temperature patterns as well as anomalies are discussed for each pool location for the WY2008 data.

Mainstem thermographs: The five LSYR mainstem thermograph deployment locations and the maximum, average and minimum monthly thermograph readings for each site can be seen in Figure 7 and Table 6.

Long Pool (LSYR-0.5)

The Long Pool is approximately 100 feet wide at the widest point and 1000 feet long. It is fed by two water sources; the mainstem from the Stilling Basin (mostly from seepage under the dam) and Hilton Creek which is a cooler water source given that the HCWS intake was set at 65 feet deep in Lake Cachuma. Mixing of the two sources occurs within the first 200 feet of the Long Pool and well upstream of the thermograph locations. *O. mykiss* are routinely observed rearing in this habitat when water visibility permits. The thermograph vertical array was deployed on 5/14/08 and removed on 11/4/08. The top unit was approximately 1-foot below the surface and the bottom unit positioned approximately 1-foot above the substrate more than half way down the length and towards the middle of the Long Pool where it was approximately 9-feet deep.

Maximum water temperatures were less than 20.6 °C at the surface location throughout the deployment period with typical warming during the summer and cooling in the fall (Figure 8). The majority of the maximum temperatures were less than 20 °C during the warmest portion of the year most likely due to cool water releases through Hilton Creek. Diel fluctuations between minimum and maximum temperatures ranged from 2.0 to 5.5 °C with the greater variation occurring during the hottest summer months. Temperatures at the surface location were warmest in July and August where average maximum temperatures by month reached 19.5 °C and 19.4 °C, respectively (Table 6).

The bottom thermograph had a maximum water temperature of 17.6 °C or less throughout the period (Figure 8). Daily variation at the bottom unit was less than 1.5 °C.

Temperatures were warmest in July and August where average maximum temperatures reached 17.0 °C and 16.7 °C, respectively (Table 6**)**.

Encantado Pool (LYSR-4.9)

The thermograph vertical array deployment was from 5/15/08 to 11/10/08 with the top unit placed at approximately 1-foot below the surface and the bottom unit positioned approximately 1-foot from the bottom in the area of the pool with the greatest depth (approximately 9 feet). The deployment site was near the middle of the Encantado Pool which was approximately 400 feet long, averaged 30-feet wide, and had an average depth of 5-feet. This location was selected due to previously observed *O. mykiss* in the pool that continued to be observed throughout the deployment period.

The surface thermograph recorded maximum temperatures approaching 28 °C in mid-July, peaking on 7/12/08, and gradually decreased throughout the rest of the period (Figure 9). Overall, daily maximum temperatures were greater than 25 °C from early June through late August. Minimum temperatures were below 20 °C over the recording period. Average monthly maximum temperatures were greatest during July and August at 26.8 °C and 26.6 °C, respectively (Table 6**)**. The 24-hour variation between maximum and minimum water temperatures was typically between 7-10 °C during the summer months. A cooling trend began in late August and continued through the period.

The maximum temperature recorded for the bottom thermograph was just over 25 °C on 7/7/08, 5 days prior to the peak temperature for the surface unit. Water temperatures decreased from that point through November. Overall, maximum temperatures remained less than 25 °C with the majority of readings less than 24 °C (Figure 8). The 24-hour variation between maximum and minimum water temperatures was greatest during the July-August timeframe and typically was between 2-4.5 °C.

7.3 Pool (LSYR-7.3)

The pool habitat was approximately 60-feet long and 30-feet wide with a maximum depth of 5-feet. A vertical array thermograph was deployed at this pool on 5/15/08 and removed on 11/10/08 with the surface unit positioned approximately 1-foot below the surface and the bottom unit placed approximately 1-foot above the bottom of the pool. The bottom unit malfunctioned and temperatures were not recorded until July 30. Beaver dam building activity several hundred yards downstream increased the extent of the pool habitat by raising the water level and combining several pool habitats into one. Thermographs were positioned in an area where rearing *O. mykiss* were routinely observed during snorkel surveys. Between LSYR-5.60 and LSYR 6.40, stream flow went subsurface and reemerged at LSYR 6.40, a condition annually observed since monitoring began in the mid 1990s.

The surface thermograph recorded maximum temperatures at or below 25 °C for the entire monitoring period (Figure 10). Generally, the daily difference in maximum and minimum temperatures was greatest during the July-August timeframe, typically from 3.5-6.0 °C. On several days, temperature exceeded 24 °C during both July and August.

The average monthly maximum temperatures were greatest during July and August at 23.9 °C and 23.6 °C, respectively (Table 6**)**.

The bottom thermograph showed average monthly maximum temperatures were 22.4 °C during August and September (Table 6)**,** although data were not available for July when the surface unit recorded some of the highest temperatures. The maximum temperature was recorded on 9/7/08 at 23.1 °C (Figure 10).

Alisal Bedrock Pool (LSYR-10.2)

The thermograph vertical array was deployed on 6/15/08 and removed on 10/6/08 with the surface unit placed approximately 1-foot below the surface and bottom unit approximately 1-foot above substrate in an 8-foot deep pool. The deployment habitat was a corner scour pool approximately 60-feet long and 40-feet wide with a maximum depth of 9-feet. Due to the shape of the pool, stream inflow occurred at the mid-point of the pool. The array was positioned where in past years rearing *O. mykiss* have been observed, however, in 2008, no fish were observed in this habitat. This particular pool historically has been frequented by the public for purposes of recreation, and fishing gear was observed at this location on several occasions during WY2008.

Some of the warmest thermograph temperatures collected on the mainstem were measured at this location. The warmest temperature recorded on the surface was on 7/8/08 at 27.4 °C and sustained above 27 °C for several days (Figure 11). Temperatures began cooling in August and continued decreasing from the end of August through the rest of the period. Water temperatures collected 1-foot below the surface showed an average monthly maximum temperature greatest during July and August at 26.4 °C and 25.1 °C, respectively (Table 6**)**.

Avenue of the Flags (LSYR-13.9)

A single thermograph was deployed in a pool habitat under the Avenue of the Flags Bridge in Buellton (LSYR-13.9) from 5/15/08 through 10/6/08. The unit was deployed approximately in the middle of the habitat at a depth of about 2-feet. The habitat was approximately 40-feet long, 20-feet wide with a maximum depth of approximately 5-feet. The thermograph was attached to a cable and suspended from woody debris. This habitat became fragmented on several occasions during the course of the summer due to low flows. Two small steelhead/rainbow trout had been observed rearing in this habitat during the late spring but were not observed from July onward.

The warmest average monthly water temperature occurred in July and August at 25.1 °C and 23.6 °C, respectively (Table 6**)**. Water temperatures collected in the middle of July showed a general cooling trend (Figure 12).

LSYR Mainstem Comparisons

Maximum daily air temperatures from the Santa Ynez Valley Airport were plotted against the number of hours that maximum surface and bottom thermograph temperatures exceeded 20 °C, 22 °C, and 24 °C at the Encantado Pool (LSYR-4.9), 7.3 Pool (LSYR-7.3), and Alisal Bedrock Pool (LSYR-10.2) (Figures 13 and 14). The analysis was done to investigate potential thermal heating as the water moved downstream of the dam. These three habitats were selected because they traditionally have held over-summering *O. mykiss* and provided a good distribution of sites along the Refugio and Alisal reaches that would demonstrate thermal heating. The threshold temperatures chosen reflect published lethal limit values for steelhead (Bidgood, 1980; Cech and Myrick, 2004; Myrick and Cech, 2005); southern steelhead thresholds have not been established. In general, water temperatures at the three pool habitats were correlated with air temperatures and a response lag of 2 to 4 hours was noticed as expected between maximum daytime atmospheric and stream water temperatures. This was particularly evident during heat waves, for example during the weeks of 5/15/08 and 6/19/08. In general, the bottom thermographs recorded fewer hours per day of temperatures exceeding 20 °C, 22 °C, and 24 °C than the surface units at the three pools. Sustained high temperatures were most prevalent at the Encantado and Alisal Bedrock pools starting in mid June and continuing through the end of August, which corresponds with higher air temperatures.

Longitudinal mainstem maximum daily water temperature changes with mainstem surface thermographs at the Long Pool, Encantado Pool, 7.3 Pool and Alisal Bedrock Pool as well as furthest downstream at Avenue of the Flags are presented in Figure 15. The Avenue of the Flags thermograph was located two feet below the surface of the pool, while the other four thermographs were located one foot below the surface of the pool. Lowest temperatures were recorded at the Long Pool with highest values recorded at the Encantado Pool and Avenue of the Flags Pool. The 7.3 Pool was 2-3 °C lower than the Encantado Pool suggesting cooling from groundwater upwelling. There was a decrease in maximum water temperatures during the third week in May at all sites which corresponded to a cold weather period and also resulted in an increase in flows at Solvang thought to be due to a reduction in evapotranspiration.

Tributary thermographs: The location of the six single unit thermograph deployments in the tributaries of the LSYR, and the maximum, average and minimum monthly thermograph readings for each site can be seen in Figure 7 and Table 7. Thermographs were deployed as wet season flows subsided and were picked up just prior to wet season flows began. The maximum surface water temperatures at all thermograph tributary sites were below 21 °C during the spring, summer, and fall of 2008 except at the Upper Salsipuedes Creek site for two days and the Lower Salsipuedes Creek site for several days in June and most of July.

Upper Hilton Creek (HC-0.54)

A single thermograph was deployed at the bottom of a pool habitat just downstream to the upper release point of the HCWS from 5/15/08 to 11/4/08. The pool was approximately 15-feet long and 12-feet wide with a maximum depth of 3-feet. Water temperatures throughout the deployment period were consistent around 14 °C with a slight increase over time (<1 ^{o}C) and a 4 °C spike at the end of October (Figures 16). On 10/30/08, Lake Cachuma turned over as indicated by a rapid and short duration spike in temperature, with a maximum temperature of 17.9 °C. Without the effect of lake turnover, the 24-hour variation for the entire monitoring period was less than 1 °C.

Lower Hilton Creek (HC-0.12)

A single thermograph was deployed in a riffle habitat approximately 100-feet upstream of the confluence with the LSYR mainstem in approximately 1-foot of water from 5/15/08 to 11/4/08. Water temperatures collected at this location were very similar to those observed at the upper release point indicating little thermal heating across the distance, likely due to a well developed riparian corridor. Overall, temperatures remained at or less than 14 °C except for the lake turnover spike mentioned above on 10/30/08 for one day (Figure 16). The 24-hour variation was less than 2 °C without the turnover effect, and decreased over the monitoring period. Monthly average temperatures were consistent for the period with a slight increase over time (Table 7**)**.

Quiota Creek (QC-2.71)

A single thermograph was deployed on the bottom of the creek approximately 50-feet upstream of Crossing 7 on Refugio Road from 5/15/08 through 12/23/08. The unit was deployed at the bottom of a run habitat 40-feet long and 10-feet wide at a depth of approximately 0.8 feet. This section of Quiota Creek remains wet most years except during extreme drought conditions. This location routinely has had rearing *O. mykiss*. Water temperatures remained less than 21 °C for the entire deployment with declining water temperatures beginning toward the end of July and lasting throughout the rest of the period (Figure 17). The 24-hour variation was greatest from June through August ranging from 3-4 °C, and decreasing to between 1-2 °C in September. Monthly average temperatures reflected similar observations (Table 7**)**.

El Jaro Creek (EJC-3.81)

A single thermograph was deployed approximately 50-feet upstream of the confluence of the El Jaro Creek and Salsipuedes Creek from 5/20/08 to 11/4/08. The unit was placed in a newly formed pool habitat from high flows the previous winter. The habitat was 50-feet long and 9-feet wide with a maximum depth of 4-feet. The unit was deployed at the bottom of the habitat unit approximately 0.8 feet. Beaver activity was observed throughout the deployment period, with a small dam approximately 30-feet downstream. *O. mykiss* were observed in this pool during spring snorkel surveys. Recorded temperatures were some of the coolest water temperatures observed in the El Jaro Creek drainage and remained below 21 °C throughout the period, possibly due to increased groundwater upwelling from the scoured channel bottom (Figure 18a). The 24-hour difference ranged from 0.5 °C -2.0 °C for the entire deployment period. Maximum monthly average temperatures were recorded in July and decreased throughout the rest of the period (Table 7**)**.

Upper Salsipuedes Creek (SC-3.8)

A single thermograph was deployed in Upper Salsipuedes Creek, approximately 30-feet upstream of the confluence with El Jaro Creek. The unit was deployed in a shallow run habitat 15-feet long and 4-feet wide in approximately 0.5-feet of water from 5/16/08 to 11/4/08. This site had perennial flow and has routinely held *O. mykiss* since monitoring began in 1993. The warmest daily temperatures were recorded in June during two days when peak water temperatures exceeded 22 °C corresponding with two very warm days (Figure 18b). The June temperatures also represent the warmest days for the period of record. Maximum daily temperatures generally fluctuated between 18-21 °C through mid-September before declining at the onset of fall. The 24-hour difference generally remained between 5-6 °C for most of the deployment period. Maximum monthly average temperatures were recorded in August and decreased through November (Table 7**)**.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 5/21/08 through 8/7/08 within a run habitat with a maximum depth of 2 feet and approximately 300-feet upstream of the Santa Rosa Bridge and approximately 0.77 miles upstream of the confluence with the Santa Ynez River near the migration trap site. Beavers cut the riparian vegetation where the instrument was fastened and the unit was lost after 8/7/08. A replacement thermograph was not deployed due to concerns over beaver activity.

The recorded water temperature increased from May through July (Figure 18c). A brief spike in temperatures on 6/20/08 corresponded with a hot weather spell. The maximum temperature spike in July reaching above 30 °C was unusual and was speculated to have been reading the air temperature due to beaver activity observed in the area. Maximum monthly average temperatures were recorded in August (Table 7**).**

Water temperature and dissolved oxygen (sondes): Diel water quality monitoring has evolved over the years based on a greater understanding of summer rearing conditions for *O. mykiss* and improved monitoring technology since the issuance of the BO (NMFS, 2000). For example, spot measurement techniques have been replaced by programmable multi-parameter water quality sondes that can be deployed for several days and set to record at a specific time-step. Sondes are now deployed for 2 to 7 days at a time (Table 8) in habitats known to contain over-summering *O. mykiss*, and set to record every 15 or 30 minutes. This enables efficient data collection to pinpoint the time and duration of dissolved oxygen concentrations and temperature conditions over the diel cycle and across multiple days.

Sondes were deployed in several LSYR mainstem pool habitats within the Refugio and Alisal reaches during the summer and fall to investigate potential diel variation in water quality conditions, specifically water temperatures and dissolved oxygen concentrations (DO), in habitats where *O. mykiss* were present. Sonde temperature values were consistent with the thermograph data at these locations but are included with DO data presentations for comparison. CPBS owns and operates three sondes which are always calibrated at the same time to assure all are recording the same values for each parameter. Three pool habitats within the Refugio and Alisal reaches, each having over twenty *O. mykiss* juveniles and adults in summer, are discussed below where sondes were deployed multiple times to track water quality conditions over the dry season.

Meadowlark Pool (LSYR-5.4): Each year divers conducting snorkel surveys observe cool water upwelling entering the bottom and side of the Meadowlark Pool. Density differences between the upstream flow and intruding groundwater create a mirage phenomenon or shimmering effect that is easily observed and can be confirmed by placing one's hand at the point of the upwelling and feeling the temperature difference. To investigate the observation, three sondes were deployed laying on the channel bottom in the thalweg from 9/15/08 to 9/18/08; one placed 200 feet upstream of the pool, a second at the point of upwelling, and the third 75 feet downstream where the water was thought to be thoroughly mixed.

The results showed the expected diel pattern of daily thermal heating and cooling and the associated changes in DO affected by the photosynthetic cycle from all the aquatic plants (Figure 19). Maximum temperatures were greatest at the upstream location, climbing above 25 °C around 16:00 during 2 out of the 3 days. The downstream site followed the same pattern but 0.5-1.5 °C less for approximately 4 hours during the day. Temperatures for the upstream and downstream locations remained the same (within 0.5 ^{o}C) for approximately 20 hours over the 24-hour period. In contrast, the upwelling site showed little variance throughout the period, remaining at 19 °C regardless of the time of day which suggested a groundwater source that was not influenced by daily thermal heating or upstream flows.

The greatest difference in DO values over a 24-hour period was recorded at the upstream site with an approximate 7 mg/l diel swing of 7 to 14 mg/l. The diel pattern was common and expected showing the processes of aquatic plant photosynthesis and respiration. The downstream site showed an upward trend at the beginning of the day as expected followed by an unexpected decline to levels approaching 0 mg/l and lethal levels for fish at the bottom during the afternoon followed by a rise with the arrival of the evening hours. DO at the upwelling site was low and consistent at 2 mg/l that supported the suggestion of groundwater intrusion (Schlesinger, 1997).

Encantado Pool (LSYR-4.9): Multi-parameter sondes were deployed at two mainstem locations (LSYR-4.9 and LSYR-7.3 described in the section below) at various times during the summer and fall at a recording frequency of 30-minutes. The data from these multiple deployments were overlapped with the same time of day to allow comparisons of the recorded diel cycles over the deployment periods. Both sites were chosen due to the presence of juvenile and adult steelhead/rainbow trout.

A multi-parameter sonde was laid on the bottom of the Encantado Pool for two of the five deployments from July through October in the middle of a long pool complex at an approximate depth of 5 feet. The habitat contained rearing *O. mykiss* throughout all deployments. The deployment periods were 5-7 days.

Maximum temperatures were highest in July peaking at 26 °C in the late afternoon (Figure 20). The recorded data were similar during the 7/21/08, 7/29/08 and 8/7/08 deployments, and temperatures dropped starting at the end of August through the fall.

DO concentrations showed a typical diel pattern with the highest concentrations occurring in the mid-afternoon and peaked prior to the maximum water temperature. The fluctuation in DO concentrations ranged from 4 to over 13 mg/l, an 8-9 mg/l swing over a

24-hour period, and showed a slight decline in peak values in the fall. Although peak temperatures were high, suitable DO conditions prevailed and all *O. mykiss* survived the dry season (See Section 3.5).

7.3 Pool (LSYR-7.3): In the 7.3 Pool, a similar sonde deployment was used as in the Encantado Pool. Water temperatures were slightly cooler at this pool than at the Encantado Pool, peaking below 24 °C and the diel temperature swing was also smaller at 4 °C vs. 8 °C, respectively (Figure 21). Temperatures began to drop at the end of August with a 2-3 °C decrease in the fall. The unusual pattern in peak temperatures during the middle of the 8/14/08 deployment may have been caused by beaver activity in that pool habitat although beavers were never observed.

The pattern of DO concentrations was similar to the results at the Encantado Pool, but had lower maximum DO concentrations and daily differences. DO concentrations varied from 3.5 to 8 mg/l and changed to 4.5 to 7 mg/l in the fall. This pattern was consistent throughout the deployment period.

Lake Cachuma water quality profiles: Water quality profiles were collected at Bradbury Dam near the intake of the HCWS on 3/27/08 and 11/12/08 (Figure 22). The purpose was to collect temperature and dissolved oxygen measurements throughout the entire water column at 1-meter intervals, paying particular attention to the elevation of the HCWS intake at a depth of 65 feet. The monitoring effort is to assure that the depth of the adjustable intake hose for the HCWS is set to provide optimum temperature conditions for *O. mykiss* in Hilton Creek, at or below 18 °C as stipulated in the BO. From March to November Lake Cachuma dropped 10 feet and the profiles were not taken at exactly the same locations resulting in a difference of 27 feet in depth between the two profiles.

The March survey showed that the lake was in the initial stages of stratification with a developing thermocline at 40 feet of depth. Temperatures at the HCWS intake were just above 10 °C with a 6 °C temperature change from the top to the bottom of the water column. DO concentrations decreased with depth to a minimum of 5 mg/l. The November survey showed a 3.5 °C decrease in temperature with depth. Water temperatures at 65 feet were approximately 16 °C in November compared to about 11 °C at the end of March. Temperatures of water released in the HCWS had increased by 5 °C from March through November due to warming in the summer and decreased reservoir volume.

DO concentrations decreased with depth to a minimum of 5 mg/l and 0 mg/l, for the March and November profiles, respectively. The exact effects of the 2007 Zaca Fire on lake water quality were unknown although greater quantities of algae were observed in the lake than during previous years. Past surveys showed that Lake Cachuma has regularly experienced hypolimnetic oxygen depletion during the summer near the bottom of the lake. However, it is unusual to observe hypoxic conditions at a depth of 80 feet, 40 feet from the bottom of the lake. Water releases to Hilton Creek are oxygenated when cascaded over rocks from the release point to the creek channel.

Lake Cachuma experienced a strong turnover event in the fall that was observed during the fall snorkel survey along Hilton Creek, when a rapid change in water clarity from the HCWS prohibited completing the survey (Figure 23). As noted above, the thermograph and USGS temperature data for Hilton Creek during October showed a short duration temperature spike of 3.6 °C before returning to baseline conditions over a 14 hour period (Figure 23a). Previous lake profiles taken near the HCWS intake were included for comparison (Figure 23b). There were no fish mortalities observed. Annual fall lake turnover events have been routinely documented, but this event was more pronounced with a shorter duration temperature spike and prolonged turbidity than ever observed before. A large wind event most likely initiated the turnover event (Figure 23c) but an explanation for the unusual nature of this particularly strong turnover is unknown. The extended period of turbid water was such that the snorkel survey in upper Hilton Creek had to be suspended.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2008 within the LYSR Basin was conducted through photographic analysis using aerial imagery and hand held cameras. Aerial photographs were obtained from the Digital Globe 2008 Aerial Imagery Program conducted by the County of Santa Barbara for the entire County. Photographs were taken with digital cameras at designated locations (photo points) to track long-term and short-term changes that had occurred as a result of storm flows, large spill events, phreatophyte growth, pre- and post-project monitoring, changes in canopy coverage and type, periods of drought, and the successes of management activities in the drainage. Appropriate photo point locations are those that have the most representative vantage point to show the greatest change over time. A catalogue of photo points for 2005-2008 is provided in the appendices.

Mainstem photo point locations include all bridges from the Highway 154 Bridge to the Highway 246 Robinson Bridge near Lompoc. Several other mainstem photo point locations are located on Reclamation property near Bradbury Dam, several locations within the Refugio and Alisal reaches, and at the LSYR lagoon. Tributary photo points include Hilton, Quiota, Alisal, Nojoqui, Salsipuedes, El Jaro, and San Miguelito creeks.

A maturing and often closed canopy has enhanced habitat quality by shading the stream for rearing and over-summering *O. mykiss* within the LSYR basin. Due to the lack of any major flood or channel altering events, a mainstem riparian corridor has developed. It assists in establishing a central channel with improved canopy coverage, better shading of habitats, greater habitat complexity and more food sources for fish (Figures 24-27). Peak discharge at Solvang during WY2008 was 5,990 cfs recorded on 1/27/08, a magnitude insufficient to cause significant channel modifications. At Hilton Creek, due to the installation of the HCWS which provides year round flows, a mature riparian canopy has developed below the Lower Release Point (LRP), and is growing quickly in the reach between the Upper Release Point (URP) and LRP (Figures 28-29).

3.4. Migration - Trapping

Migrating populations of anadromous and resident *O. mykiss* were monitored through a long standing migrant trapping program. Three sets of paired upstream and downstream migrant traps were deployed in WY2008 at: lower Hilton Creek (tributary furthest from the ocean) 0.14 miles upstream from the confluence with the mainstem LSYR; lower Salsipuedes Creek (tributary closest to ocean) 0.7 miles upstream of the confluence with the mainstem LSYR; and in the mainstem LSYR 7.3 miles downstream of Bradbury Dam. The sandbar at the mouth of the lagoon was open from 1/6/08 to 5/19/08, so storm runoff in WY2008 provided unimpeded access to the LSYR and its tributaries from late January through the middle of April.

Hilton Creek flows are not representative of the typical hydrology seen in tributaries of the LSYR due to the HCWS providing a minimum of 2 cfs year round. Hence, baseflow is relatively high all year and the water temperature is significantly cooler compared to other tributaries within the LYSR basin (Figure 16 and Tables 6). Following the peak storm flows, water receded rapidly to a baseflow of approximately 6-8 cfs, allowing any upstream migrating *O. mykiss* an opportunity to enter into the creek. Three significant stormflow events occurred during January and February with peak flows ranging from 65 to 115 cfs (USGS gauge on Hilton Creek) (see Section 3.1).

The migrant trapping program ran for approximately 16 weeks from mid-January through mid-May (Table 9). The Hilton Creek and Salsipuedes Creek Traps were deployed from the end of the first week in January until May whereas the LSYR Mainstem Trap was deployed a month later and taken out a month earlier due to high flows and limited flow and migration potential, respectively. Traps were checked every 4-6 hours throughout the period except when traps were pulled due to high flows. The catch per unit effort (CPUE) standardizes catch data based on the amount of effort exerted for the number of fish captured over a particular time period with units shown in captures/day. The CPUE (Table 10) and timing of each migrant capture over a 24-hour period (Table 11) were tabulated. In general, more fish were captured during the last PM and first AM shifts (nighttime) than during the other two shifts (daytime). An order of magnitude higher number of anadromous steelhead were captured in WY2008 compared to previous years and the results are summarized in Table 12 and Figure 30. The most likely origin from the genetic analyses for the 16 anadromous steelhead also are presented in Figure 30 (Garza, 2009).

Hilton Creek Migrant Traps: The Hilton Creek trapping effort was conducted over a 129 day period beginning on 1/7/08 and ending on 5/14/08 (Table 9). Upstream (1.5 captures/day), downstream (2.6 captures/day) and total (4.0 captures/day) CPUE values for Hilton Creek were relatively high for the LSYR, but expected given the population density in Hilton Creek below the Upper Release Point. A total of 477 fish (175 upstream and 302 downstream) were captured in the Hilton Creek traps during the WY2008 migration season. The majority of migrant captures occurred during the first early morning check (06:00-10:00) and second late night check (21:00-01:00) with 146 and 199 captures, respectively (Table 11). The two day time checks resulted in similar values at 61 and 71, which were less than half of the early morning and late night time checks. The pattern suggests that steelhead are more apt to migrate at night than during the day which is related to more favorable environmental conditions (predation reduction, cooler temperatures and higher abundance of food) that results in a better chance of survival (Meehan and Bjornn, 1991).

Due to several high flow events in January and February, the equipment was removed for safety and reinstalled after the peak of the hydrograph. This resulted in 118 functional trap days with a trapping efficiency of 91.5%. A total of 175 upstream migrants were captured during the period, ranging in size from 44 mm (1.7 inches) to 691 mm (27.2 inches). Of the upstream migrants, 5 were identified as ocean run steelhead ranging in size from 564 mm (22.2 inches) to 691 mm (27.1 inches). A length-frequency distribution at 10 mm size intervals (Figure 31) showed a greater number of smaller fish were captured than larger fish, and a slight bi-modal distribution indicating that a wide range of age classes of fish (size) migrated through the system during the year - a typical observation from years past.

In addition to the 5 upstream migrating anadromous steelhead, 2 downstream ocean run steelhead were captured; 578 mm (22.8 inches) and 617 mm (24.3 inches). These fish had not been fin clipped, indicating that they moved into the creek sometime during a storm flow period when the traps were removed. Two other confirmed steelhead were recaptured leaving the creek, and were identified by clipped caudal fins. These were the first confirmed steelhead observed in Hilton Creek since the monitoring program began in 1993. Four of the seven were thought to be Hilton Creek progeny; a further discussion of the genetics results is presented below (Garza, 2009).

A total of 302 downstream migrants were captured within the period, ranging in size from 46 mm (1.8 inches, young of the year) to 691 mm (27.2 inches) (Figure 31). The downstream length-frequency distribution was more bi-modal than the upstream with a high number of 140-180 mm fish trapped, of which most were smolts. 82 juvenile steelhead were captured (61 smolts and 21 pre-smolts) migrating downstream representing nearly 27% of the downstream migrating fish in Hilton Creek. The remaining fish captured were spawned out adults and small resident fish moving or redistributing within the creek following storm events. It is possible that some of the other fish not showing smolting characteristics when captured did smolt at a later time. The majority of the fish captured moving downstream were less than 209 mm (8.2 inches). Of the downstream migrants captured, 35 of them were recaptured fish that had moved upstream earlier in the season.

The greatest number of migrant captures for both upstream and downstream fish was associated with stormflow events when fish could migrate and readily relocate within the creek (Figure 32). All seven adult steelhead (not including recaptures) were trapped between 2/7/08 and 3/23/08 following the large storm events in late January. Four of the seven fish were captured in March (Table 12). Flow at the time of each individual steelhead capture ranged from 8.0 cfs to 9.2 cfs at the USGS Hilton Creek gauge just downstream of URP. Flow measured at the Narrows and Solvang gauges at the time of each capture ranged from 428 cfs to 62 cfs indicating good fish passage conditions below Solvang. The number of days after a storm with good migration flows to the ocean, and during which anadromous steelhead were captured, ranged from 5-14 days coinciding with the determined number of passage days in the guidance document after peak stormflow events (150 cfs to 25 cfs) under pre-dam conditions (14 days) (NMFS, 2000; AMC, 2004).

As the migration season progressed, there was a higher incidence of downstream captures leaving the watershed, specifically smolts but also some spawned out adults. During this later part of the season there were fewer upstream migrants captured suggesting that the majority of spawning adults were either already in the creek or had spawned. The smolt out-migration is a typical phenomenon seen yearly in Hilton Creek from February to May (Figure 33). This year the highest number of smolts observed was in April.

Aggregating the Hilton Creek migrant capture data by week (Figure 34) indicates that more fish were captured during the first 6 weeks of trapping which corresponded to the greater stormflow period of the year. There were more downstream than upstream migrant captures except during the first week of January, February and March of the season. There was an increase in downstream captures towards the end of the migration season possibly due to an increase in the photoperiod (defined as the length of the day) and general ambient temperature, as well as a reduction in natural streamflow (Figure 32, and Section 3.1). These out-migrants were typically smolts or spawned out adults. With the exception of when the traps were removed during storm events, *O. mykiss* were captured every week in Hilton Creek throughout the migration season.

Salsipuedes Creek Migrant Traps: The Salsipuedes Creek traps were deployed for 116 days from 1/7/08 to 5/1/08, with 100 functional trap days and a trapping efficiency of 86.2% (Table 9). The Salsipuedes Creek migrant traps were removed for 16 days due to high stormflow events in late January and February. The total CPUE for the Salsipuedes Creek trapping effort for both upstream and downstream traps combined was 0.8 captures/day; 0.2 for upstream and 0.6 for downstream captures/day (Table 10). CPUE values were less in Salsipuedes Creek than at Hilton Creek due to the lower population density within the monitored reaches. A total of 16 upstream migrants were captured during the period, ranging in size from 84 mm (3.3 inches – first year fish) to 701 mm (27.6 inches – anadromous adult). Of the upstream migrants, 6 were identified as ocean run steelhead ranging in size from 608 mm (23.9 inches) to 701 mm (27.6 inches) (Table 12). A length-frequency distribution for upstream migrant captures (Figure 34**)** showed three groups of fish; small fish and most likely first year fish at 70-99 mm (2.8-3.9 inches), 170-280 mm (6.7-11 inches) fish, and large adults at 496-701 mm (19.5-27.6 inches). The largest fish captured in Salsipuedes Creek was the largest steelhead caught in the LSYR since monitoring began in 1993 at 701 mm (27.6 inches).

There were 62 downstream migrant captures during the period ranging in size from 50 mm (2.0 inches, a first year fish) to 496 mm (19.5 inches, anadromous steelhead) (Figure 35**).** The majority of captures were small (1+ year fish) or smolting fish leaving the basin. The one confirmed downstream ocean run steelhead had not been marked (caudal fin clip) indicating that it moved into the creek sometime during high flows when the traps were removed in late January or February. 51 smolts were captured (41 smolts and 8 pre-smolts) that represented 90% of the downstream migrants. The remaining fish captured were spawned out adults and small resident fish moving within the creek. Some of the other downstream migrants may have turned into smolts as they made their way to the lagoon and ocean.

Flows in Salsipuedes Creek increased swiftly in response to rainfall events once the watershed was saturated and antecedent soil moisture conditions favored rapid runoff from any rainfall event (Figure 35). Rainfall patterns in the Salsipuedes drainage can be independent of the rest of the LSYR watershed as precipitation can be higher in the western tributary drainages than in the mainstem towards Lake Cachuma and upstream. This can produce a significant amount of stream discharge sufficient to breach the berm at the lagoon, while the hydrograph for the rest of the Santa Ynez River watershed may show little change. This was exemplified in the 1/4/08 storm and subsequent opening of the lagoon on 1/6/08 where recorded flows at the USGS Salsipuedes Creek gauge were high, yet relatively low at the USGS Solvang LSYR mainstem gauge (Figure 2, Section 3.1). Salsipuedes Creek received significant rainfall towards the end of January causing two peaks in the hydrograph, one nearly 1,000 cfs and the other approaching 1,100 cfs. Those events combined with the February storms created favorable flow conditions for upstream migration through mid-April. In contrast, streamflow associated with Hilton Creek for the same storm event was much lower. All of the upstream and downstream migrant captures in Salsipuedes Creek occurred on the receding limb of storm hydrographs and throughout the dry spring. From late March through mid-April there was an increase in the number of downstream migrants, which coincided with the smolt run out of Salsipuedes Creek. Anadromous steelhead were captured for several days following the peak flows resulting from the late January and February storms. Three additional upstream steelhead were captured between mid-March and mid-April showing that instream conditions were favorable for adult steelhead migration into Salsipuedes Creek from the Santa Ynez River mainstem. The one out-migrating steelhead was not a recapture and was a female who may have spawned upstream and was heading back to the ocean.

All Salsipuedes Creek anadromous steelhead were captured between 2/4/08 and 4/14/08 (Table 12 and Figure 36). Flow at the time of each individual capture ranged from 3.4 cfs to 36 cfs at the Salsipuedes Creek USGS gauge at Jalama Road Bridge. Flows at the Narrows ranged from 18 cfs to 1,160 cfs. The number of days after significant storms ranged from 7-30 days. Flows continued to decline in Salsipuedes Creek from the end of March through the rest of the migration season. The last three anadromous steelhead captured were upstream migrants that had navigated low flow conditions ranging from 3.4 cfs to 5.6 cfs at the USGS Salsipuedes Creek gauge, and were not observed out-migrating during the rest of the season.

There were 78 migrant captures (16 upstream and 62 downstream) in the Salsipuedes Creek traps during the 2008 migration season. Fish moved at all times of the day although there were greater numbers observed at the dawn and early evening trap checks

(Table 11). The first smolt out-migrant was observed in February with the greatest number recorded in April. This was similar to what was observed in Hilton Creek (Figure 33). There were no smolts observed in May.

Looking at the weekly distribution of captures over the migration season for Salsipuedes Creek (Figure 34), relatively low numbers of *O. mykiss* were captured each week prior to the end of March through mid-April when there was an increase in the number of out-migrants that corresponded to the annual smolt run. At least one fish was captured about every week during the migration season except when high flows required removing the traps or when flows were too low for passage at the end of the season.

Comparison of Salsipuedes Creek and Hilton Creek Migrant Trapping Results: Salsipuedes Creek and Hilton Creek are two very different tributaries in terms of their rainfall and runoff patterns and *O. mykiss* migration and population characteristics. Both creeks have hydrologic regimes typical of a Mediterranean-like climate with flashy streams and high inter/intra-year runoff variability. The watershed area for Salsipuedes Creek is larger than that of Hilton Creek, and at times receives more rainfall during any given rainfall event due to its westerly location. Hilton Creek has an artificially sustained baseflow greater than 2 cfs, whereas in the upper reaches of Salsipuedes Creek and its largest tributary El Jaro Creek, baseflows approach only 0.5 cfs in the peak of the dry season.

The *O. mykiss* population between the two creeks exhibit differences in spawning, rearing, and over-summering characteristics. Hilton Creek has good habitat quality with the Long Pool just downstream of the confluence with the LSYR mainstem, but has limited stream length and spawning gravel. Whereas the Salsipuedes Creek system has extensive stream mileage but only fair habitat quality due to low dry season flows and a predominance of fine sediment substrate (AMC, 2008). The result is earlier resident migration in Hilton Creek due to greater early season baseflows, later smolt migration due to favorable water quality conditions, and later steelhead arrival in Hilton Creek due to its greater distance from the ocean. For Salsipuedes Creek, the results suggest that smaller 1- to 2-year class fish migrate with stormflow and sustained recessional flows. Previous years have exhibited a higher potential for anadromous steelhead to migrate into Salsipuedes Creek due to its close proximity to the ocean, although this was not true in WY2008 given that there was an equal number of anadromous adults observed in Hilton Creek and Salsipuedes Creek. Rearing conditions in Hilton Creek are more favorable than in Salsipuedes Creek due to cooler year-round water conditions, stable baseflow, and a less impacted watershed.

Out-migrating smolts are traditionally first seen at Hilton Creek and continue to have some level of smolt migration until the end of the migration season at the end of May (Figure 33). Salsipuedes Creek tends to produce smolts in March and April depending on the flow regime with very low numbers at the beginning (January) and end (May) of the season. In contrast, the largest smolt run in Hilton Creek tends to be in April and May. Over all, Hilton Creek produced more smolts in WY2008 than Salsipuedes Creek, as expected, given the very dry conditions in the summer of WY2007, which had a greater impact on Salsipuedes Creek fish than on Hilton Creek fish. In the less than 200 mm size class fish (Table 13), there were 61 smolts and 21 pre-smolts captured in Hilton Creek compared to 42 smolts and 8 pre-smolts captured in Salsipuedes Creek. However, there were more smolts between 200-299 mm captured in Salsipuedes Creek than in Hilton Creek.

While rearing conditions appear to support better overall production in Hilton Creek based on the number of fish captured during the migration season and observed during snorkel surveys, the average size of upstream migrants was greater in Salsipuedes Creek, whereas the average size of downstream migrating fish was greater in Hilton Creek.

LSYR Mainstem Trap: The mainstem LSYR trap was located at the lower end of the Refugio Reach (LSYR-7.3) and was first deployed in WY2006. It was not installed in WY2007 due to low flow conditions and no migration potential, but was in place during WY2008 after Lake Cachuma spilled (1/30/08) once the flows receded to a safe deployment level. In WY2008, the trap was installed for 61 days from 2/7/08 to 4/7/08. There was a total of 42 functional trap days with a trapping efficiency of 68.9% (Table 9). The mainstem migrant traps were removed for 19 days due to high flow from storm events and the dam spilling with subsequent high flows. The number of functional trap days was less than half that recorded at the two tributary trap locations due to low streamflow at the beginning of the season, and one week of high flows during the onset of the spill event. This trap does not get installed until there is an increase in flow along the mainstem from contributing tributary flow that establishes a migration corridor, which usually occurs after the tributary trap deployments. Few fish were captured in the mainstem trap resulting in low CPUE captures/day values for upstream (0.1 captures/day), downstream (0.02 captures/day) and total (0.1 captures/day) (Table 10).

A total of 4 upstream migrants were captured between 2/7/08 and 4/7/08 that ranged in size from 218 mm (8.6 inches – resident trout) to 678 mm (26.7 inches – anadromous steelhead) (Figure 37). Of the upstream migrants, 2 were identified as ocean run steelhead and measured 600 mm (23.6 inches) and 678 mm (26.7 inches). Both steelhead captured were well out on the recessional limb of a storm hydrograph (Figure 38). There was only one downstream migrant captured which was a smolt that measured 271 mm (10.7 inches) and was captured on 3/28/08. Although its migration downstream coincided with smolts leaving Hilton Creek, it was not a recapture since it was significantly larger than an average Hilton Creek smolt (Figure 34).

Until Bradbury dam spills, flow in the LSYR mainstem is directly related to tributary contributions with some additional flow added through the releases from the HCWS. Once the dam spills, upper basin flows dominate the storm hydrograph, and flows can be orders of magnitude higher and extend over a longer period of time. Large flows, though, complicate the trapping effort and result in a lower trapping efficiency than in the flashier (short duration) tributary trap deployment sites. The relationship between migration and flow in the mainstem is still uncertain, mainly due to the low number of fish captured and the extended high flow periods when trapping is not possible.

The spill began on 1/30/08 and ended on 3/22/08. Anadromous steelhead were captured when flows at the USGS Solvang gauge were 139 cfs (2/10/08) and 37 cfs (3/18/08) indicating that migrating steelhead are able to negotiate portions of the mainstem when flows are as low as 37 cfs (Figure 38). The number of days since the last storm event at the time of steelhead capture ranged from 3 to 8 days (Table 12). The lagoon was open for all of the LSYR mainstem trap deployment. The single downstream migrating smolt was captured when flows were 16 cfs.

A total of 5 *O. mykiss* (4 upstream and 1 downstream) were captured at the LSYR mainstem trap. Migrant captures followed the observed pattern in Hilton Creek where more migrants were captured during the late night (21:00-01:00) and early morning (06:00-10:00) trapping periods (Table 11).

3.5. Reproduction and Rearing

Redd Surveys: Redd surveys have been conducted opportunistically in the mainstem and tributary habitats once a year in the last winter or early spring within the reaches where access is permissible along Salsipuedes and El Jaro (including Los Amoles and Ytias) Creeks and the Refugio and Alisal reaches of the LSYR mainstem. Therefore, year to year comparisons are somewhat difficult. WY2008 represented a good year for anadromous steelhead captures within the LSYR basin and several large redds were observed within the tributaries and the Refugio and Alisal reaches of the LSYR mainstem.

Anadromous steelhead redds were differentiated from resident redd sites based on their dimensions. It was assumed that many of the larger redds identified (3 feet in length or greater) were those of spawning anadromous steelhead. Three redds were found in Salsipuedes Creek during the second week of February, the largest measuring 6 feet long and the smallest 2 feet long, and ranging from 1.3 to 2.5 feet in wide (Table 14). All of these redds were observed near or upstream of the Jalama Road Bridge (approximately 3.5 miles upstream of the confluence with the LSYR). No *O. mykiss* were observed actively constructing any of the redd sites. Seven redd sites were identified on 3/6/08 in Los Amoles Creek, a tributary to El Jaro and Salsipuedes Creeks. Most of these redds were large measuring from 3.5 to 5 feet long and 1.5 to 3.0 feet wide. Four redds were identified in Hilton Creek on 2/21/08, varying in size from 2.5 to 6 feet long and from 2 to 2.8 feet wide. Two redds were identified in the mainstem on 3/10/08; one in the Refugio Reach (LSYR-4.9-7.8) measuring 4.5 feet long by 2 feet wide and one in the Alisal Reach (LSYR-7.8-10.5) near the Quiota Creek confluence measuring 6 feet long by 3 feet wide. Both of these redds were relatively large and were thought to be from anadromous steelhead.

Late spring snorkel surveys conducted in both the mainstem and tributaries yielded some of the highest counts of young of the year *O. mykiss* compared to previous years (see the following section). Those high numbers coupled with the redd survey data highlighted the success of the WY2008 spawning season.

Snorkel surveys: The size class distribution of fish observed during the single-pass spring, summer and fall WY2008 snorkel surveys within the LSYR mainstem and its tributaries was tabulated in 3 inch size classes of fish. Standard and accepted single-pass snorkel survey protocols were followed (Hankin and Reeves, 1988). The spring survey (May and June) records the baseline condition after the spawning season and prior to the critical summer rearing season by documenting the number and location of over-summering *O. mykiss*. The summer survey (August and September) evaluates the number of *O. mykiss* and instream conditions at or just after the most critical time of the year for over-summering fish. The fall survey is conducted before the first rainfall of the year (October and November) and evaluates the success of over-summering *O. mykiss*. Surveys are done immediately after the period of interest to record the condition and population at the end of that period. For example, spring surveys are conducted at the very end of the spring or beginning of the summer. Surveys are conducted across the same spatial extent for each of the three annual surveys for survey to survey and year to year comparisons, and are primarily determined by access and suitable habitat (Figure 39). Factors such as turbidity, low visibility due to overgrown aquatic and riparian vegetation, beaver activity, and lack of water can influence that objective and diminish the spatial extent of any of the three surveys as conditions change throughout the year. The snorkel survey locations are predominately pool and run habitats where the majority of *O. mykiss* rear during the dry season. The total of *O. mykiss* observed during all three snorkel surveys is shown in Figure 40 for the LSYR mainstem and its tributaries.

Mainstem: Snorkel surveys were conducted during the spring (Refugio Reach, Alisal Reach, Avenue of the Flags Reach, and Cadwell Reach), summer (Refugio Reach and Alisal Reach), and fall (Hwy 154 Reach, Refugio Reach, and Alisal Reach) in the LSYR (Tables 15 and 16). As habitats dried up or water quality conditions deteriorated to the point of not being suitable, they were dropped from the snorkel surveying effort.

Hwy 154 Reach

Although the Hwy 154 Reach extends from the Stilling Basin to the Hwy 154 Bridge, due to access constraints, the only areas snorkeled were within the Long Pool and the short run habitat below the Long Pool to the Reclamation property boundary. Poor water clarity during the spring and summer resulted in only being able to conduct the fall snorkel survey. A large number of carp in the Stilling Basin and the Long Pool were observed and were thought to be the cause of the limited visibility. These non-native invasive species feed along the bottom, stir up the substrate, and create turbid conditions. Specifically, the Long Pool was too turbid to effectively snorkel during the spring and summer with visibility less than 4 feet. The fall survey resulted in 133 *O. mykiss* observed over approximately a quarter of a mile of run and pool habitat. The majority of the fish observed (108 fish, 81%) were within the 3-6 inch size category or smaller (juveniles) indicating successful spawning and over-summering (Table 17 and Figure 41). There were 25 fish (19%) greater than 6 inches observed.

Refugio Reach

During the spring survey, there were 21 habitats snorkeled in the Refugio Reach which included 14 pool and 7 run habitats (Table 17). *O. mykiss* were observed in 14 of the 21 habitats. Habitats where *O. mykiss* were not observed included 6 pool and 1 run habitats. Overall, 190 *O. mykiss* were observed during the spring surveys, the majority of which (80%) were less than 6 inches. There were also 4 large fish (610-686 mm, or 24-27 inches) observed that appeared to be over-summering anadromous steelhead.

In the summer survey, 18 habitats were snorkeled including 12 pool and 6 run habitats. The remaining 3 habitats that were not snorkeled, located between 5.6 and 5.9 miles downstream of Bradbury Dam (LSYR-5.6-5.9), were dry. Despite this dry section of river channel, 528 *O. mykiss* were observed, an increase of 338 fish. The majority of the fish observed (470 fish, 89%) were less than 6 inches (Figure 42). Of the four large fish observed in the spring, only 2 were seen in the summer survey. Two habitats, LSYR-4.9 and LSYR-5.5, showed the greatest increase in fish numbers (61 and 118, respectively) nearly all of which were less than 6 inches.

In the fall survey, the same 18 habitats were snorkeled as conditions were similar to those described above for the summer survey. There was a significant decrease in the number of fish observed from 528 in the summer to 263 in the fall (a decrease of 265 fish or 50%) with nearly every habitat showing a decrease (Figure 42). The largest decrease for any single habitat during this survey was the pool habitat at LSYR-5.5; 118 fish observed in the summer and no fish observed in the fall. This was most likely due to predation, upstream migration or poor water quality (temperature and DO concentration) at this site even though there was some flow entering the pool during the entire dry season and there were no water clarity issues.

Alisal Reach

Far fewer fish were observed in the Alisal Reach compared to the Refugio Reach of the LSYR mainstem (Table 17). During the spring survey there were 18 habitats snorkeled which included 12 pools and 6 runs. Habitats where *O. mykiss* were observed included 3 of the12 pool habitats and 3 of the 6 run habitats. A total of 26 fish were observed in the Alisal Reach, 92% of which were 6 inches or less (Figure 43). One habitat in particular held 17 fish, or 65% of the total number of fish observed in that reach, which was located near the Quiota Creek confluence. Considering the size of the fish observed in that habitat (less than 6 inches), it is possible that those *O. mykiss* could have originated from the redd observed on 3/10/08 in that area.

During the summer survey that covered the same area and habitat units, there was over a fourfold increase in the number of fish observed. 118 *O. mykiss* were recorded compared to 26 in those same habitats during the spring survey, the majority of which were less than 6 inches (96%). *O. mykiss* were observed in 7 of the 12 pool habitats and 3 of the 6 run habitats suggesting that fish were moving to preferred over-summer refugia. The increase in the number of small fish indicated good spawning success.

The fall survey resulted in only 42 observed fish, a decrease of 76 fish over the same area and habitat units surveyed in the spring and summer. Of the 42 observed fish, 81% were less than 6 inches. The majority of the habitats where fish numbers decreased were those located immediately downstream of the Refugio Bridge, even though this section of the river remained wet throughout the year.

Avenue of the Flags Reach

The Avenue of the Flags Reach was snorkeled only in the spring (Table 17). Of the entire reach snorkeled, only 4 contained *O. mykiss*; 3 pools and 1 run habitat. The majority of the fish observed were less than 6 inches (Figure 44). The majority of this reach dried in the summer and those areas that did remain wet were of poor habitat value in terms of water quality with maximum water temperatures reaching well above 25^{o} C (Figure 11). No other habitats were snorkeled during the remainder of the year due to lack of water or poor water quality (temperature and dissolved oxygen concentration) and water clarity.

Cadwell Reach

The Cadwell Reach was snorkeled only in the spring. Suitable *O. mykiss* habitat, defined as having sufficient pool depth, extent and cover, was present but not abundant. A total of 5 pool habitats were snorkeled with no *O. mykiss* observed. This area was dry or of poor habitat value during the summer and fall surveys, hence, no snorkeling was conducted.

Tributaries: Tributary snorkel surveys were conducted in the spring (Hilton, Quiota, and Salsipuedes Creeks), summer (Hilton, Quiota, Salsipuedes, and El Jaro Creeks), and fall (Hilton, Quiota, Salsipuedes and El Jaro Creeks) (Tables 18 and 19). Hilton Creek was divided into 6 reaches and Salsipuedes Creek into 5 reaches that corresponded to fluvial geomorphic breaks in the creek morphology.

Hilton Creek

Snorkel surveys were conducted in the entire creek from the confluence with the LSYR to the Reclamation property boundary 100 feet above the URP of the HCWS (Table 20). Spring and summer surveys were completed as planned, but the fall survey was conducted only from the confluence upstream 1100 feet (Reaches 1-3) due to Lake Cachuma turning over mid-way through the survey, causing sustained turbidity.

The spring survey resulted in the greatest number of *O. mykiss* observed during WY2008 (2,210), of which 60% were young-of-the-year less than 3 inches in length (Table 20 and Figure 45). Fish less than 6 inches made up 94% of all the fish observed during that survey. A few larger fish were observed, but none greater than 12 inches.

During the summer survey, the total number of fish observed was 1,519, a 31% reduction compared to the previous survey (Figure 45). The summer survey also showed an increase in the 3-6 inch size category and a decrease in the 0-3 inch size category, signifying the growth pattern of oversummering young-of-the-year *o. mykiss* within Hilton Creek. Fish less than 6 inches comprised 93% (compared to 94% in spring) but fish 0-3 inches and 3-6 inches made up 42% and 51%, respectively, compared to 60% and 34% in the spring, a notable shift in size distribution. 55% of the observed fish were below the LRP, while 45% were above the LRP.

Fall snorkel surveys were conducted beginning on 10/30/08 with water clarity ranging from 6-8 feet. *O. mykiss* numbers observed were comparable to those found in the summer. Divers returned on 11/4/08 to complete the survey on the upper half of Hilton Creek, and observed a noticeable decrease in water clarity (2-3 feet). Divers were unable to complete the survey due to the poor visibility that was sustained throughout the remainder of the fall after. A rapid lake turn-over at the end of October brought turbid conditions to the creek through the HCWS (Figure 23, WQ section). Hence, only the first 1100 feet from the confluence upstream could be snorkeled. A total of 738 *O. mykiss* were observed in those reaches. The majority of the fish observed (70%) were within the 3-6 inch size category and 23% were within the 0-3 inch size category which supported the previous observation of an increase in the size class of fish observed (Figure 45).

<u>Quiota Creek</u>

Snorkel surveys were conducted along a short portion of Quiota Creek within the County of Santa Barbara road easement for Refugio Road, extending approximately 150 feet below Crossing 5 and continuing upstream to approximately 50 feet above Crossing 7 (Table 20). This area normally remains wet during the dry season and exhibited perennial streamflow conditions throughout WY2008.

Snorkel surveys conducted in the spring resulted in 243 *O. mykiss* being observed of which 77% were within the 0-3 inch size category. These were likely young-of-the-year produced earlier in the year (Figure 46). Twelve 6-9 inch fish were observed with no fish greater than 9 inches.

Between the spring and summer surveys, there was a 66% reduction in the number of fish observed (162 fish), however with similar size distribution percentages as seen during the summer survey (Figure 46). Young-of-the-year (0-3 inches), while in smaller numbers, still comprised 75% of the total number of *O. mykiss* observed.

Numbers continued to decline during the fall snorkel survey across the same survey area as flows diminished and habitats shrunk with a total of 67 fish being observed (Figure 46). Unlike the previous two surveys, there appeared to be an upward size shift in the fish indicating growth of the remaining population. In the previous two surveys, young-of-the-year made up 77% and 75% respectively of the total population, with 3-6 inch fish comprising 18% and 17%. In the fall survey, young-of-the-year made up 43% and fish in the 3-6 inch size category comprised 46% of the total.

<u>Salsipuedes Creek</u>

Reaches 1 through 4 of Salsipuedes Creek extended from the Santa Rosa Bridge upstream to the Jalama Road Bridge for a total length surveyed of 2.85 miles (Table 20). Reach 5 extended upstream from the Jalama Bridge to the confluence with El Jaro Creek, and was approximately 0.45 mile long.

In the spring of 2008, snorkel surveys were not conducted within Reaches 1-4 because of the presence of beavers whose nocturnal activities stirred up the bottom and created turbid conditions that persisted throughout the spring. However, the water clarity within

Reach 5 was clear enough for the spring survey to be conducted. In Reach 5, a total of 308 *O. mykiss* were observed over approximately 0.45 miles. The majority of the fish (76%) were within the 0-3 inch size category indicating successful spawning within the area (Figure 47). The majority of the remaining fish were within the 3-6 inch size category (20%). A large *O. mykiss* (21-24 inches) was observed in a pool habitat downstream of the Jalama Road Bridge Fish Ladder, and based on its size was likely an anadromous steelhead.

Summer snorkel surveys were conducted in Reaches 1-4 only within the area absent of beavers (a small portion of Reach 1 and most of Reach 2). A total of 216 *O. mykiss* were observed, with 63% in the 0-3 inch size category indicating that successful spawning had occurred (Figure 47). There were 51 fish observed within the 3-6 inch size category (24%) which were likely fish spawned last year and, therefore, an indication of successful rearing in the creek. No fish greater than 12 inches was observed. Beaver activity was present throughout Reach 5, including numerous new dams and fresh beaver markings. An accurate count of *O. mykiss* was not possible in Reach 5 during the summer because of very poor water clarity.

Fall snorkel surveys in Reaches 1-4 were again attempted but were not feasible due to extremely turbid conditions caused by beaver activity. Surveying was completed within Reach 5 where 226 *O. mykiss* were observed. There was a 27% decrease in the number of fish observed in the same reaches between the spring and fall surveys (308 to 226) (Figure 47). As seen in other creeks, there was an overall decrease in the number of fish observed (predation, mortality, and/or movement), coupled with a decrease in the 0-3 inch size class and an increase in the 3-6 inch size class, indicating growth and successful rearing of the remaining fish.

El Jaro Creek

Snorkel surveys were conducted in El Jaro Creek from its confluence with Salsipuedes Creek upstream approximately 0.4 miles (Table 20). The majority of all habitats available was snorkeled and included predominately pool and run habitats that were deep enough for divers to survey. Beaver activity was observed within this tributary as well, and spring surveys were not conducted due to poor water clarity.

Water clarity was much better in the summer and divers observed 405 *O. mykiss,* of which 85% (344) were within the 0-3 inch size category, indicating successful spawning (Figure 48). The majority of the remaining fish observed (15%) were within the 3-6 inch size category with two larger fish, both less than 12 inches observed.

There was a marked decrease in the number of fish observed during the fall survey from 405 to 151, a decrease of nearly 63% (Figure 48), as well as a shift in the size classes of those fish observed. Fish in the 0-3 and 3-6 inch size category made up 45% and 52% of the fish observed, respectively. The decrease in numbers is likely due to the reduction of available habitat from the summer to fall period, while the size shift is likely due to an increase in growth where rearing conditions were favorable.

Other Fish Species Observed: There were many introduced species observed inhabiting the LSYR mainstem during the spring, summer and fall snorkel surveys. The vast majority of introduced fish were warm water game species that also inhabit Lake Cachuma. When the dam spills, these non-native fish may pass over the spillway, colonize portions of the lower river, and possibly establish reproducing populations within scattered areas of the LSYR. The most numerous non-native species observed during snorkel surveys included largemouth bass (*Micropterus salmoides*), three sunfish species including bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and redear sunfish (*Lepomis microlophus*), common carp (*Cyprinus carpio*), and two catfish species; the black bullhead (*Ameriurus melas*), and the channel catfish (*Ictalurus punctatus*). Bass, sunfish and catfish are known predators of *O. mykiss*, particularly the younger life stages. Carp and catfish can stir up the bottom of the substrate and greatly increase turbidity. No introduced non-native predator fish were observed in any of the three tributary snorkel surveys, although the introduced arroyo chub and fathead minnows were observed within Salsipuedes Creek. There has been a general trend over the last four years towards an increase in the number of non-native fish populating the Refugio and Alisal reaches of the LSYR, specifically largemouth bass, carp, and sunfish due to continuous target flows to the Alisal Bridge since WY2005 (Table 21).

Largemouth Bass: Largemouth bass were the most numerous of the introduced species observed during snorkel surveys (Figure 49). In the WY2008 summer snorkel survey, over 500 were observed within the Refugio and Alisal Reaches, most less than 6 inches in length. Lesser numbers were observed in the Refugio Reach than in the Alisal Reach during the summer with a reversed relationship observed in the fall. Largemouth bass were found in nearly every habitat snorkeled in the summer and fall surveys, but were most numerous in pools. Only four largemouth bass were observed during the spring survey.

Sunfish Species: Sunfish species were also found in nearly every habitat snorkeled in the summer and fall, but were more numerous in pool habitats with abundant cover in the Alisal Reach than the Refugio Reach (Figure 49). Approximately 250 were observed during the summer and 100 observed during the fall within the Alisal Reach alone. The majority of these fish were less than 6 inches in length. Far fewer sunfish were observed in the Refugio Reach during both the summer and fall surveys with no sunfish observed during the spring snorkel survey.

Catfish Species: Few catfish were observed in the habitats snorkeled within the mainstem (Figure 49). One catfish was observed during the spring, summer, and fall in the Refugio Reach, and one observed in the Alisal Reach during the summer only. These numbers were less than previous years, although the cause of the decrease is unknown.

Carp: Carp have not been regularly observed during snorkel surveys within the LSYR mainstem prior to WY2008. After Bradbury Dam spilled and the Stilling Basin (LSYR-0.0) and Long Pool (LSYR-0.5) began to clear in the spring, it was noticed that carp had dispersed downstream and inhabited the mainstem below Bradbury Dam. Carp were so numerous near the surface of the Stilling Basin that they were easily observed from the road across the dam crest. Snorkel surveys within the Refugio and Alisal Reaches confirmed that carp were inhabiting areas downstream of the Hwy 154 area as well. Carp were observed in the spring, summer, and fall within several habitats of the Refugio and Alisal reaches.

3.6. Tributary Enhancement Project Monitoring

During any tributary enhancement project, biological monitoring is conducted per the BO (RPM 8) and project permitting requirements. This includes pre-, post- and during-site monitoring for *O. mykiss*, and relocating any fish present to outside of the project area, as well as monitoring water quality to assure there are no impacts to stream water being discharged downstream of the project area.

Two tributary projects were under construction at the close of WY2008 and were finished by December, 2008.

- El Jaro Creek Rancho San Julian: A 62-foot fish ladder was installed through a concrete apron across El Jaro Creek that protected a center channel bridge pier, which was a 7-foot fish passage barrier (Figure 50). The low and high flow configuration fish ladder with auxiliary watering system was successfully installed as designed, and now provides juvenile and adult passage to upstream spawning and rearing habitats. All biological and construction oversight was conducted by the CPBS and the project engineer throughout construction of the project, as stipulated by all of the project permits.

- Quiota Creek Crossing 6: A damaged low flow crossing and temporary bridge at Crossing 6 of Refugio Road on Quiota Creek were removed, and a 48-foot bottomless arched culvert was installed with vegetated bank slope protection. Four rock weirs were also installed for grade control which created four pool habitats, and the site was re-vegetated with native plants (Figure 51). Juvenile and adult *O. mykiss* now have year round volitional passage and enhanced habitat within that reach of the stream. CPBS and the project engineer conducted all required biological and construction oversight.

A total of 39 and 132 *O. mykiss* were relocated prior to and during construction of the El Jaro Creek Rancho San Julian and Quiota Creek Crossing 6 projects, respectively. No fish were harmed during the relocation process. There were no water quality issues throughout the project. Final reports were submitted to NMFS and CDFG on 5/19/09 by Reclamation for both projects that further detailed all biological monitoring and fish relocation activities.

3.7. Additional Investigations

Genetic Analysis: Four genetic studies focused on Santa Ynez River *O. mykiss* populations have been completed to date that include studies conducted by Dr. Jennifer Nielsen of the U.S. Geological Survey (Nielson et al., 2003), Glenn Greenwald of the U.S. Fish and Wildlife Service (Greenwald and Campton, 2005), and Dr. Carlos Garza of NOAA Southwest Science Center (Girman and Garza, 2006; Garza and Clemento, 2008). The Garza and Clemento 2008 report made three significant conclusions:

- Hatchery fish are not interbreeding with native fish and wild and hatchery fish populations remain genetically distinct.
- *O. mykiss* populations in the Santa Ynez River are primarily of coastal steelhead ancestry and are related to populations in other southern and south-central California rivers.
- Below and above dam populations are related but distinctions by watershed were identified.

Since 1998, all migrant tissue samples collected have been sent to Dr. Garza to be genetically analyzed at the NOAA Southwest Science Center at U.C. Santa Cruz. Dr. Garza and his team investigated familiar and regional relationships with the captured Santa Ynez River *O. mykiss* and compared them to other samples received from researchers throughout the west coast. A total of 1,692 tissue samples collected from 1998 to 2007, were analyzed and summarized in the 2008 report. 225 tissue samples were sent to the lab in WY2008, and Dr. Garza provided the following summary of the 16 anadromous steelhead sampled that year (Garza and Clemento, 2010):

- 5 of the 7 steelhead caught in the Salsipuedes Creek trap were most likely progeny of that creek.
- 4 of the 7 steelhead caught in the Hilton Creek trap were most likely progeny of that creek.
- 1 of the 2 steelhead caught in LSYR mainstem trap was from Quiota Creek the confluence of which was very close to the trap location.

The results were consistent with expectations that population dynamics of fish in the southern steelhead DPS are influenced by both self-recruitment and migration in a regional population context. Further analysis of the LSYR genetic database would broaden the understanding of growth rates of those recaptured ocean-run steelhead.

Beaver Activity: The North American Beaver (*Castor canadensis*) was introduced into the Santa Ynez River system in the late 1940s (Hensley, 1946; Baker and Hill, 2003; CDFG, 2005). The presence of this non-native species was initially scattered and isolated in a few areas within the LSYR mainstem. Over time and with the increased amount of flow in the river since 2000, the number and spatial distribution of beavers and their dams have increased throughout the LSYR mainstem. Beaver dams are now present well below Alisal Bridge and in the tributaries, particularly in the Salsipuedes drainage. Whether beaver dams and associated beaver ponds positively or negatively effect migrating, rearing, and over-summering *O. mykiss* is under question. Well established beaver dams can be of sufficient strength and magnitude to remain in place during stormflows, and may create passage impediments and/or barriers for migrating fish during low to moderate flows. Beaver dams can also affect operational flows of the Fish Passage Supplementation Program, target flow releases, and downstream water right releases. For example, the challenges in meeting target flows at Alisal Bridge in WY2007 was associated with beaver dams, which attenuated the release by spreading and ponding target flow waters and led to the need for greater water releases to meet target flow objectives. As a result of increased beaver activity in the watershed, an additional monitoring element has been added to the fisheries program to track the extent (size) and distribution (location) of beaver dams within the mainstem and tributaries below Bradbury Dam so that the established flow release programs can be operated as intended.

In the Refugio, Alisal, and Hwy 154 Reaches, there were 13 beaver dams were observed in the June survey of WY2007 and 18 in the June survey of WY2008. Observations show that nearly all of the dams identified in WY2007 withstood releases of up to 250 cfs during a test of the Bradbury Dam outlet works facilitated by a WR 89-18 right release from the dam without being compromised. Once flows receded the dams were still intact and several functioning as passage barriers. This release discharge rate was well above maximum passage supplementation releases of 150 cfs, suggesting that beaver dams may need to be breached or removed during passage supplementation until a beaver management program can be established.

During the WY2008 spill, flows from Bradbury Dam were sufficient to completely remove all mainstem beaver dams within the Refugio and Alisal reaches. Peak flow from Bradbury Dam was 750 cfs on 2/26/08. Tributary flows were also high enough that winter to remove all of the dams in the Salsipuedes Creek drainage. However, the June LSYR mainstem and tributary surveys again showed active beaver dam construction, demonstrating that beavers can sustain high flows and return to reconstruct in-channel dams.

4. Discussion

This section has been organized to answer each of the regulatory study questions inferred in Term and Condition 11.1 of the BO. Within the context of those questions, an evaluation of tributary projects completed and proposed is presented, as well as a trend analysis of migrant captures and snorkel surveyed for *O. mykiss* both within the LSYR drainage and across the southern steelhead DPS/ESU. The trend analysis is focused on data from WY2005 through WY2008, but includes some longer-term trends from WY2000 through WY2008. Complete datasets for WY2005 through WY2007 are presented in the appendices; data prior to that are presented in the 1993-2004 Synthesis Report.

4.1. Are steelhead moving during the supplementation of migration flows? The Fish Passage Supplementation Program was not implemented in WY2008. All of the criteria were met by 1/23/8 (the period was within the migration season of January and May, the lagoon was open to the ocean, the cumulative flow at the Salsipuedes USGS gauge was greater than 1,000 acre-feet, flows were greater that 25 cfs at Alisal, and at least one storm had previously occurred in January). However, Bradbury Dam spilled on 1/30/08 prior to the arrival of the next storm that would have initiated the Fish Passage Supplementation Program. The spill ended on 3/22/08 and no storms of sufficient magnitude occurred during the rest of the migration season to trigger passage supplementation.

The Real-Time Decision Group (RTDG), designated by the Adaptive Management Committee to oversee and assist Reclamation in implementing the monitoring program, met in December prior to the migration season to review the program's operational procedures. The RTDG communicated regularly throughout the migration season. No water from the WY2008 passage supplementation account was used.

Prior to the WY2006 spill, two storms were supplemented, each extending the passage period to a minimum of 14 days. Migrating fish were observed at the mainstem trap during both passage supplementation events (RTDG and CPBS, 2007). This was the first year the passage supplementation program was implemented.

4.2. What is the success of steelhead access, spawning and rearing upstream of completed tributary passage enhancement projects?

By December 2008, six tributary passage enhancement projects had been completed within the LSYR basin: Salsipuedes Creek Highway 1 Bridge Fish Ladder, Salsipuedes Creek Jalama Road Bridge Fish Ladder, El Jaro Creek Rancho San Julian Fish Ladder, Quiota Creek Crossing 6 Bridge, and Hilton Creek Cascade Chute Project as well as the Hilton Creek Watering System (HCWS) that supplies water year round to Hilton Creek from Lake Cachuma. Each of these projects either removed a passage barrier for adult and juvenile *O. mykiss* or provided stream flows that enhanced passage and increased the potential for rearing and spawning.

In the case of Hilton Creek, the observed number of *O. mykiss* has greatly increased with the installation of the HCWS in 2000 that now provides year round flow of 2 cfs or greater to 3,000 feet of the stream. Initially, only the first 1,500 feet of the stream was accessible to fish due to a fish passage barrier at the Cascade Chute on Hilton Creek. However, this was removed in 2005 which opened up the remaining 1,500 feet. The observed number of fish during the three annual snorkel surveys ranged from 20 to 500 prior to the HCWS, 500 to 1,000 between WY2000 and WY2005, and 1,000 to 3,000 after WY2005. The upward population trend was also seen in the trapping data for Hilton Creek. There has been an overall increase in the number of Hilton Creek smolts observed, particularly since 2005. Finally, seven anadromous steelhead migrated into Hilton Creek in WY2008 which were the first steelhead observed in that creek since monitoring began in 1993; 4 of those fish were progeny of Hilton Creek (Garza and Clemento, 2010). The monitoring results and population trends indicate that current management actions are having a significant positive effect by increasing the number of *O. mykiss* present within Hilton Creek. Removal of the remaining fish passage barrier on Hilton Creek at the Highway 154 culvert has become infeasible due to legal challenges by the landowner and associated regulatory constraints, which has prevented completion of this passage enhancement project by Reclamation and Caltrans.

The three tributary passage enhancement projects within the Salsipuedes/El Jaro Creek watershed have opened up a total of 15.3 miles of spawning and rearing habitat within that basin. The remaining barrier on El Jaro Creek at Cross Creek Ranch was only a partial barrier and was removed in WY2009. The number of observed *O. mykiss* in Salsipuedes/El Jaro Creek is highly dependent on the amount of dry season baseflow for rearing and over-summering, and the magnitude and timing of wet season stormflow that play an important role in the spawning success. Fish have been observed moving through all three installed fish ladders, and are over-summering within the watershed above the completed enhancement projects. Access for snorkel surveys above the Jalama Road Bridge historically has been very limited making data gathering difficult. However, access has recently improved which will assist in long-term trend analyses. In WY2008, seven anadromous steelhead were observed at the Salsipuedes trap, which were 3 more than in any other year since monitoring began in 1993. Five of those fish were progeny of Salsipuedes Creek (Garza and Clemento, 2010). The estimated origin of the remaining fish is presented in Figure 30 (Section 3.4).

There are eight remaining migration barriers on Quiota Creek, all of which are under design and will be systematically removed as funding becomes available. The passage enhancement project at Crossing 6 removed a partial barrier and opened up 3.1 miles of spawning and rearing habitat. The project replaced one plunge pool with 4 weir and pool sequences that contained fish after the first storm of the year in WY2008. Further monitoring in subsequent years will provide greater insight into the biological performance of the project. Of note was that one of the anadromous steelhead observed at the mainstem trap (located 1.1 miles from the confluence with the LSYR mainstem) was from Quiota Creek (Garza and Clemento, 2010), suggesting that anadromy is still present in Quiota Creek and that removing the remaining barriers will be of further benefit to southern steelhead.

Substantial advancement was made in WY2008 regarding completion of the tributary passage enhancement projects. Reclamation completed two voluntary tributary projects in December 2008 (Rancho San Julian on El Jaro Creek and Crossing 6 on Quiota Creek), and one tributary project in the BO was completed in WY2009 (Cross Creek Ranch on El Jaro Creek). Budgeted funding has been secured to complete the design work for the remaining six Quiota Creek projects, grant funding has been obtained to replace Crossing 2 with a 60-foot bottomless arched culvert in WY2011 and two grant applications are pending for Crossings 1 and 7, all on Quiota Creek (a list of pending tributary projects and their status is provided in Tables 22 and 23). Before and after photographs from the three projects completed prior to WY2008 are presented in Figure 52. Quiota Creek will be the focus of Reclamation’s efforts for tributary passage enhancement projects until all are completed.

4.3. Is the Cachuma Project meeting mainstem and tributary flow targets as outlined in the BO?

WY2008 was a spill year with a spill greater that 20,000 acre-feet and Reclamation met LSYR mainstem (10 cfs or greater at Hwy 154 Bridge and 1.5 cfs or greater at Alisal Bridget) and tributary (2 cfs or greater within Hilton Creek) target flows throughout the year, as stipulated in the BO, except for a six day period when flows ranged from 0.7 to 1.3 cfs at Alisal Bridge towards the end of June (see Section 3.2 for a full description). New operational guidelines put into place in WY2007 have greatly improved the success of meeting target flows at Alisal Bridge and will continue to evolve as knowledge is gained. Residual pool depths within habitats in the LSYR mainstem, Refugio and Alisal reaches, were maintained throughout the year.

Prior to WY2008, target flows were met annually within Hilton Creek and at the Highway 154 Bridge for the LSYR mainstem. Only in June of WY2007 were there difficulties meeting target flows at Alisal Bridge, which prompted the development of new operational guidelines that were developed in July of that year.

The guidelines developed for maintaining the target flows at Alisal Bridge recommended that an annual review of the operating guidelines be conducted in order to improve performance. In May 2008 the USGS gauged flow and CPBS spot flow measurements at the Solvang Bridge showed that flow dropped below 5 cfs. This is a trigger outlined in the guidelines to increase baseflow releases above the level for meeting Highway 154 targets. In June 2008, the recommended release rate for maintaining the Alisal Bridge target flow was 14 cfs; however, from June 9 through June 18, releases were at a lower level (12 cfs). On June 21, 2008, the flows started dipping below 1.5 cfs at Alisal Bridge. If the recommended releases were followed in the month of June, the refreshing flow release on June 26 may not have been necessary. It is recommended to follow the guidelines in place at the beginning of the year and make adjustments at the end of the year through the review process. No adjustments to the 1.5-cfs target flow guidelines are deemed necessary based on the 2008 operations.

4.4. What are the trends in steelhead distribution, abundance and reproductive success in the mainstem of the LSYR and its major tributaries (i.e., condition and distribution of the steelhead population in the mainstem and its tributaries)?

Long-term steelhead population trends are related to precipitation and the associated streamflow for any given year. Rainfall (Table 24), year type (Figure 53), stream discharge (Table 25) provide background for the following discussion. Integral to the population trends within Hilton Creek are the installation of the HCWS (2000), the removal of the migration barrier at the Cascade Chute (2005) and subsequent use of the Upper Release Point (URP), and the increase in the riparian canopy cover since 2000 (Figure 54). Prior to the installation of the HCWS, dry season thermal heating was evident. As the riparian corridor canopy developed and the focus of the releases changed from the Lower Release Point (LRP) and later to above the LRP (2005), water temperatures continually dropped with each progressive year.

Analysis of the total upstream and downstream migrant captures at the Salsipuedes, LSYR mainstem, and Hilton Creek traps from WY2000 through WY2008 provides a comparison of the number of captures within the LSYR basin among the three trapping locations (Figure 55). The data show that there is an upward trend of upstream and downstream migrants captured at Hilton Creek and no particular pattern at the other two sites, although there were more migrant captures in wetter years. Mainstem migrant traps were first deployed in WY2006, but were not deployed in WY2007 due to the extremely dry conditions and no passage opportunities throughout the season. The migrant trapping period is approximately the same between Hilton and Salsipuedes Creeks, whereas it differs at the LSYR mainstem site due to fewer number of trapping days when traps had to be removed for high flows during spill events and early season low flow conditions with no migration potential.

The trapping efficiency for the three trap sites from WY2000 to WY2008 was generally above 85% except for the first two years of monitoring. During the high flows and spill periods of WY2005 and WY2008, efficiencies at the mainstem trap ranged from 69%-83% (Table 26). The CPUE was highest in Hilton Creek which may be due to the completion of the Cascade Chute project that nearly doubled the habitat length and increased the total population of *O. mykiss*. There were more downstream migrants in wet years compared to dry years in Salsipuedes Creek. However, in Hilton Creek in WY2007, a large number of fish migrated out of the basin in the spring, even with consistent baseflow conditions, habitat complexity, and good mature riparian canopy cover (Figure 55). During dry years, fish do not appear to move through the mainstem because of a lack of connectivity to the LYSR lagoon and ocean, as well as passage impediments from beaver dams. This was also observed at Salsipuedes Creek in WY2007. The available trapping data over all years did not represent the entire migration season as traps had to be removed during high flow events when *O. mykiss* could be moving through the system. This situation is demonstrated by the relatively low number of upstream migrants in WY2005 and the extended period of high flows in the LSYR mainstem that year when the traps were not deployed.

Looking at migrant captures from WY2005 to WY2008 in relation to the annual hydrographs for the three trap sites, the data suggest that *O. mykiss* migrate on the recessional limb of storm hydrographs (Figures 56-58). WY2007 had some upstream and downstream migration in Salsipuedes Creek, with a much higher number of downstream than upstream migrants; whereas, the mainstem had low flow conditions that year that did not allow for either upstream or downstream migration. Years with good recessional limb flows in the spring in Salsipuedes Creek appeared to have triggered smolt migration out of the basin.

More anadromous steelhead were observed in WY2008 than during any other year since the migration monitoring effort began in 2000 (Figure 59). This suggests that the management actions in the BO undertaken by Reclamation are improving migration opportunities and habitat conditions for the LSYR steelhead population below Bradbury Dam, particularly above the Alisal Bridge and within Hilton Creek. Smolt production showed a general trend upward particularly when comparing the early years of BO implementation to the more recent years.

Since the installation of the HCWS, out migrating smolts have historically first been seen at Hilton Creek, and continue to be observed throughout the migration season until the end of May (Figure 60). Hilton Creek tends to produce smolts every year due to continuous streamflow from the HCWS. Whereas smolt production in Salsipuedes Creek varies depending on flow rates, with low flow years (i.e., WY2002 and WY2007) showing lower numbers of out migrating smolts. Salsipuedes Creek tends to produce smolts in March and April depending on the flow regime with very low numbers seen at the beginning (January) and end of the season (May); WY2008 was a good example of that trend. The timing of the significant smolt run in Salsipuedes Creek tends to be earlier in the year (March and April) than in Hilton Creek (April and May).

Larger fish have greater fecundity than smaller fish (Snyder, 1983; Bond, 2006; Lackey et al., 2006). Aggregating the capture data for *O. mykiss* equal to or greater than 400 mm (15.7 inches) in length showed a distinct upward trend in the number of larger migrants in the LSYR basin since the BO, and therefore, potentially greater fecundity, from WY2000 through WY2008 (Figure 61 and Table 27). This increase in migrating adults is presumably due to the completion of tributary barrier removal projects, the Fish Passage Supplementation Program, and the established target flow regime in the LSYR mainstem.

The total number of *O. mykiss* observed during the spring, summer and fall snorkel surveys from WY2000 through WY2008 showed a general trend upward across wet years, and a decrease during the dry years (Table 28). Looking at each reach surveyed over the period, Refugio Reach (Figure 62) showed a general attrition of the number of fish observed over the dry season, and a shift from smaller to larger fish. The large increase in the 3-6 inch class size could be due to the retraction of the fish from riffle and run habitats to refugia pools that are regularly and more easily surveyed, as well as movement of fish from the Hwy 154 Reach. The Alisal Reach (Figure 63) also had an increase in 3-6 inch fish in the summer and fall, but a general decrease in the number of fish over the dry season, including a reduction in the number of large fish (15 inches or greater). The reduction in abundance of larger fish might have been caused by poaching by people recreating in the area, evidenced by observed fishing gear left on the bank in this reach. Greater signage, increased policing, and public outreach might help with this issue which is ongoing. Hilton Creek (Figure 64) had an increase in the overall number of fish after WY2005 with the removal of the Cascade Chute migration barrier and the increased use of the HCWS Upper Release Point for flow releases. Snorkel surveying efforts from WY2005 through WY2008 in Quiota Creek (Figure 65), Salsipuedes Creek (Figure 66), and El Jaro Creek (Figure 67) have not been consistent making comparisons across years difficult. Quiota Creek maintains natural flow in most years above Crossing 5 allowing fish to survive the dry season, although total numbers do tend to drop in the fall as the fish increase in size and the habitat area shrinks. The influence of beavers along Salsipuedes Creek has increased over the years. Their activities of building dams and pools raised the turbidity in the stream making snorkel surveys difficult. Reach 5 was the only consistently snorkeled stretch of the stream due to lack of beaver activity. Changes in property access during WY2008 partly inhibited snorkeling in Reaches 1-4. Greater numbers of smaller fish were observed in Salsipuedes Creek than in Hilton Creek with the number of fish, in general, decreasing over the dry season. In WY2008, several larger fish were observed during the summer survey that was not seen later that year. In El Jaro Creek, the number and size of fish observed generally decreased between the summer and fall surveys, and more young-of-the-year and 3-6 inch fish were observed in WY2008 than in the previous two years suggesting a good spawning year and higher survival rate.

Hilton Creek has been divided into 6 reaches by geomorphologic breaks (Figure 68). Of the three snorkel surveys, the spring survey showed the highest number of observed *O. mykiss*. The data from WY2000 to WY2008 suggest a general trend upward for all reaches except above the URP (Reach 6). This is another example of the significant benefit of the HCWS to improve steelhead habitat.

Comparison with Other Watersheds within the DPS/ESU: There are few steelhead monitoring programs within the southern steelhead DPS/ESU. Reclamation's efforts on the Santa Ynez River are the most extensive and of the longest duration of them all. Monitoring programs from the southern California border northward are as follows: San Mateo Creek (Camp Pendleton, CDFG), Topanga Creek (Rosi Dagit, citizens group), Santa Clara River (United Water Conservation District), Ventura River (Casitas Municipal Water District), and Santa Ynez River (Reclamation, being implemented by CCRB and ID No. 1). There is no monitoring program for southern steelhead within the Santa Maria River watershed (Sisquoc and Cuyama Rivers).

WY2008 was an unusual year across the southern steelhead DPS/ESU due to the number and geographic extent of anadromous steelhead observed. Steelhead were observed from San Juan Creek in San Diego County to San Luis Obispo County (Figure 69). Santa Barbara's South Coast saw fish in San Pedro (2), Atascadero (4), Mission (6) and Carpinteria (3) Creeks. A regional comparison of population trends has never been done; a task that is now being taken on by the Tri-County Fish Team (San Luis Obispo, Santa Barbara, and Ventura Counties). In addition, researchers at the NOAA Southwest Science Center at UC Santa Cruz have investigated genetic comparisons of *O. mykiss* across the DPS/ESU (Girman and Garza, 2006; Garza and Clemento, 2008). Further attention to integrate the LSYR monitoring results with regional population dynamics is recommended.

Southern steelhead DPS/ESU smolt and anadromous adult data from WY2000 to WY2008 was gathered from migration season monitoring programs in other watersheds (Table 29 and Figure 69). The data for basin to basin comparisons were provided by Rosi Dagit for Topanga Creek (Dagit and Garza, 2010), Steve Howard of the United Water Conservation Water District for the Santa Clara River (Howard, 2010) and Scott Lewis of the Casita Municipal Water District for the Ventura River (Casitas Municipal Water District, 2000-2008). Of these four datasets, observations from the Santa Ynez and Santa Clara rivers were most comparable in level of effort and monitoring techniques (Figure 70). During only one of those years, the Santa Clara River did produce more smolts than the Santa Ynez River (2000). In addition, there were more anadromous adult steelhead observed in the Santa Ynez River than in the Santa Clara River in all but one year (2001), with WY2008 being particularly productive. Return rates, in this case a simple ratio of adults over smolts for each year, suggest that the Santa Ynez River is providing a greater return potential than what was observed on the Santa Clara River (Figure 71).

The other watersheds named above, with their respective monitoring programs, had limited data and number of years of observation. Careful comparative and collaborative monitoring is needed throughout the DPS/ESU to better understand the species and the results of recovery actions undertaken to date. The Santa Ynez River basin is showing signs of a population increase, and the available data indicate that management actions undertaken by Reclamation are having a positive effect on the steelhead population and their habitat extent, particularly in the tributaries and management reaches of the LSYR mainstem.

5. Conclusions and Recommendations

WY2008 was a wet year with rainfall totaling about 22 inches at Bradbury Dam. The dam spilled from 1/30/08 to 3/22/08, and the majority of precipitation and associated runoff occurred prior to March. There was no significant rainfall in the spring resulting in low runoff and baseflow conditions starting in April onward. The result of a dry spring and warm summer made for very dry conditions throughout the summer and fall which produced river conditions more akin to a dry year type.

Southern steelhead had good access to tributary spawning and rearing habitats due to: 1) streamflow and recessional flow throughout the basin in the winter and part of the spring; 2) completed tributary projects on El Jaro and Quiota Creeks; and 3) target flows to Alisal Bridge throughout WY2008. General trends within the LSYR basin showed a positive increase in the southern steelhead population with more anadromous steelhead observed since the inception of the BO in 2000. Continuation of the long-term monitoring program within the LSYR is essential for tracking changes in population dynamics, as restoration efforts are completed and adaptive management actions move forward. Further collaboration with other monitoring programs within the southern California steelhead DPS/ESU is desirable to better understand population viability and restoration potential.

Recommendations to improve the monitoring program: The following suggestions are provided to improve the ongoing fisheries monitoring program in the LSYR:

- Continue monitoring elements for long-term trend analyses and improve consistency of the monitoring effort for better year to year comparisons.
- Further investigate ways to conduct migrant trapping at higher flows.
- Refine the dry season water quality monitoring program elements (thermographs and sonde deployments) to reduce redundancy and address more specific objectives.
- Develop short-term research questions to address regulatory and management concerns with obtainable goals within one or two years.
- Develop a monitoring program to better understand the interaction of *O. mykiss* and beavers within the LSYR, and develop management actions as determined necessary.
- Develop a monitoring program to better understand the interaction of *O. mykiss* and invasive warm water species within the management reaches of the LSYR basin, and develop management actions as determined necessary.
- Complete the Annual Monitoring Report by December each year so that the results can be reviewed, and improvements made in a timely manner for the following year's monitoring effort.
- Continue to work with other *O. mykiss* monitoring programs within the southern steelhead DPS/ESU to improve the collective knowledge, collaboration and dissemination of information.

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Results
Figures and Tables

3. Monitoring Results

3.1. River Hydrology

Table 1: WY2000 to WY2008 rainfall at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Water Year	Rainfall Bradbury* (in)	Year Type**	Spill	Reservoir Condition Storage (max) (af)	Reservoir Condition Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.5	Normal	Yes	192,948	750.83	No	Yes
2001	31.8	Wet	Yes	194,519	751.34	No	No
2002	8.8	Dry	No	173,308	744.99	No	Yes
2003	19.8	Normal	No	130,784	728.39	No	No
2004	10.6	Dry	No	115,342	721.47	No	Yes
2005	44.4	Wet	Yes	197,649	753.11	No	No
2006	24.5	Wet	Yes	197,775	753.15	Yes	No
2007	7.4	Dry	No	180,115	747.35	No	Yes
2008	22.6	Wet	Yes	196,365	752.70	No	No

* Bradbury Dam rainfall (Cachuma) period of record = 56 years (1953-2008) with an average rainfall of 20.6 inches.

** Year Type: dry =< 15 inches, average = 15 to 22 inches, wet => 22 inches.

Table 2: WY2008 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed.

Location	Period of Record (years)	Min. Rainfall (Water Year) (in)	Max. Rainfall (Water Year) (in)	Ave. Rainfall (Period of Record) (in)	Rainfall (Water Year 2008) (in)
Lompoc	39	5.31 (WY07)	34.42 (WY83)	14.97	13.54
Buellton	55	5.34 (WY89)	41.56 (WY98)	17.30	19.31
Solvang	45	6.47 (WY07)	43.87 (WY98)	19.26	17.54
Cachuma*	56	7.33 (WY07)	53.37 (WY98)	20.6	22.59
Gibraltar	90	9.24 (WY07)	73.12 (WY98)	26.88	31.65
Jameson	84	8.50 (WY07)	79.52 (WY69)	29.58	32.01

* Bradbury Dam - Rainfall. The Cachuma period of record was 56 years (1953-2008).

Table 3: Precipitation events greater than 0.1 inches at Bradbury Dam and their duration in days during WY2008.

#	Date	Precipitation (in)	Storm Duration (d)
1	10/13/2007	0.25	2
2	12/7/2007	0.19	2
3	12/18/2007	2.20	2
4	1/4/2008	5.83	4
5	1/22/2008	10.74	8
6	2/3/2008	1.02	2
7	2/20/2008	0.18	1
8	2/22/2008	1.13	4
9	3/16/2008	0.46	1
10	5/24/2008	0.38	1

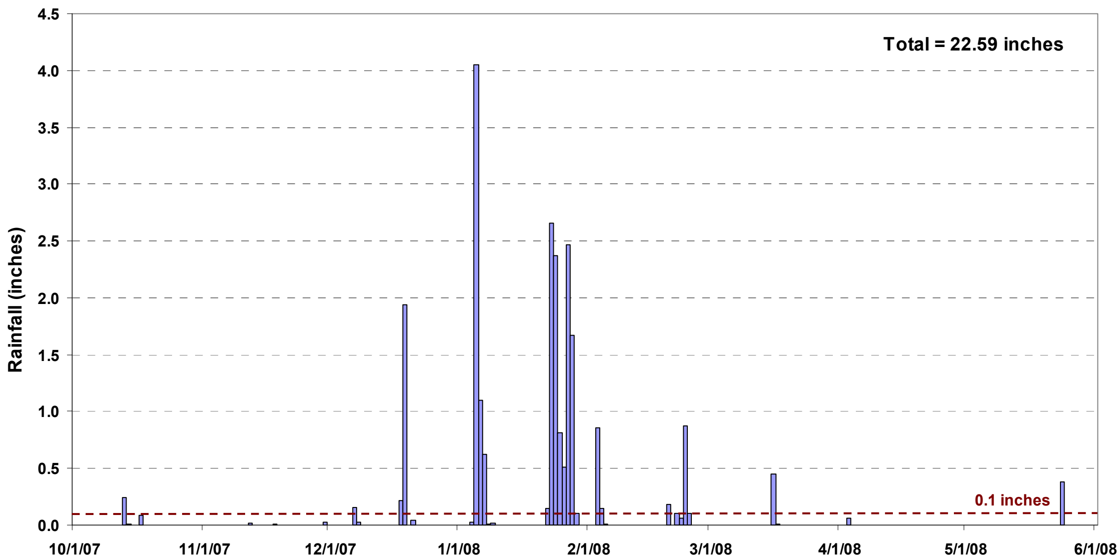


Figure 1: Rainfall in WY2008 recorded at Bradbury Dam (USBR).

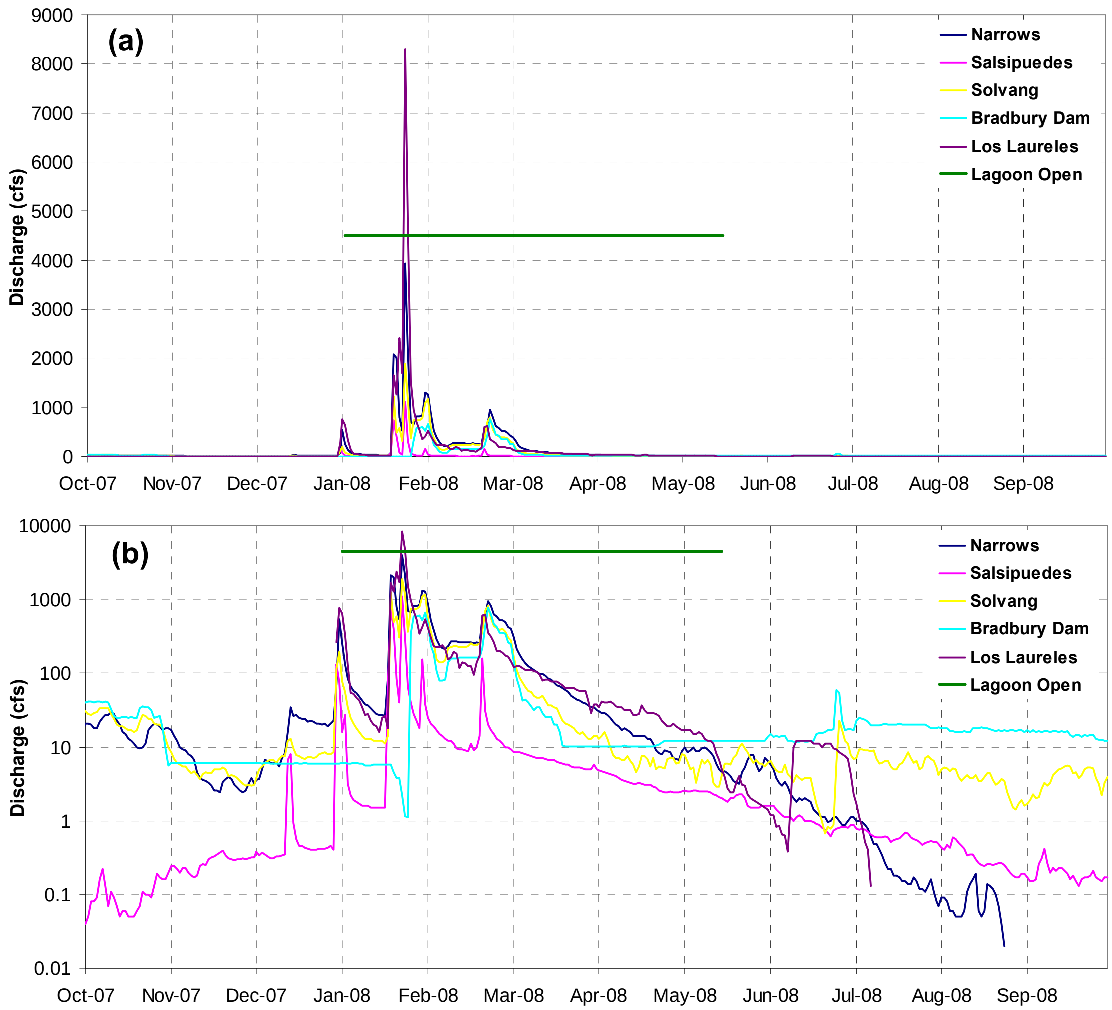


Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open in WY2008 with a (a) normal and (b) logarithmic distribution.

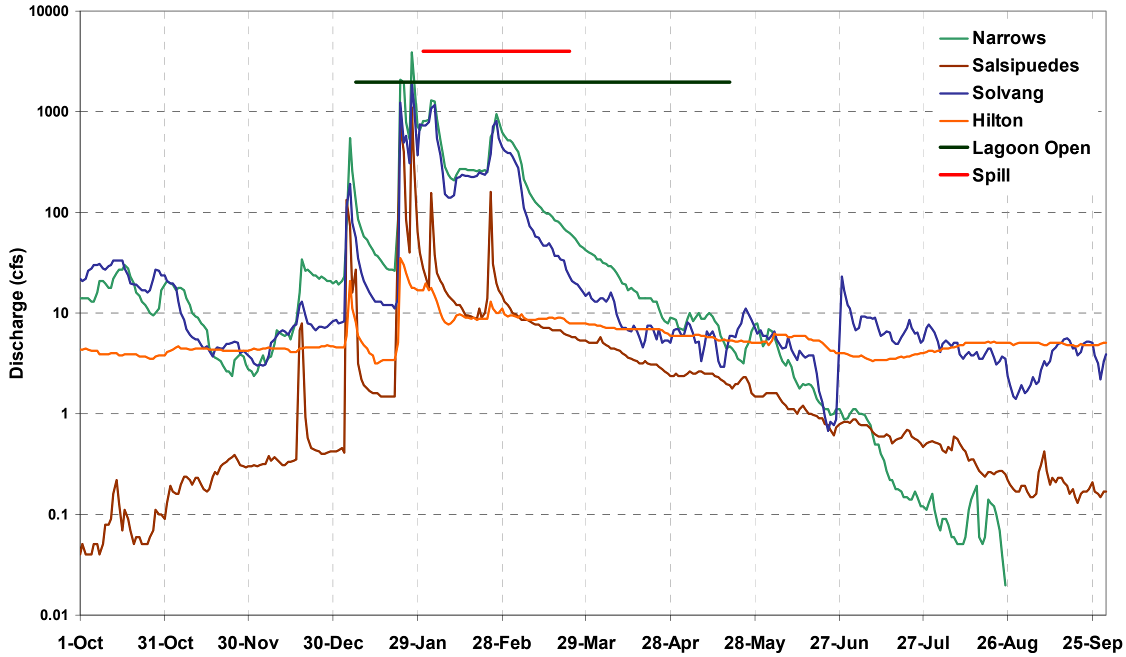


Figure 3: USGS average daily discharge at Hilton and Salsipuedes creeks in comparison to mainstem discharge at Solvang Bridge and the Narrows near Lompoc during WY2008. The duration of the spill and the period the lagoon was open are also shown.

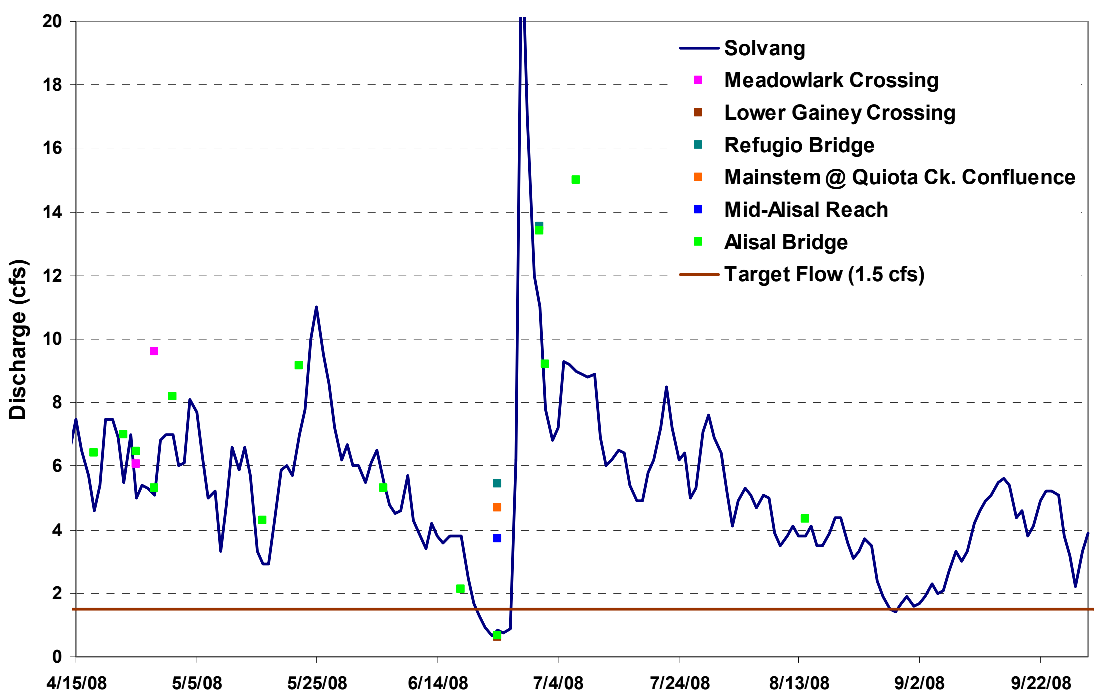


Figure 4: Instantaneous flow measurements by CPBS within the Refugio and Alisal reaches of the LSYR from April through September, 2008 with the USGS average daily discharge at Alisal Bridge (Solvang) and target flow amount of 1.5 cfs.

Table 4: Ocean connectivity and lagoon status from WY2001 to WY2008.

Water Year	Year Type	Ocean Connectivity	Lagoon Status: Opened	Closed	# of days	# of days in migration season*
2001	Wet	Yes	1/22/01	5/10/01	109	109
2002	Dry	No	-	-	0	0
2003	Normal	Yes	12/21/02	5/19/03	150	140
2004	Dry	Yes	2/26/04	3/22/04	26	26
2005	Wet	Yes	12/28/04	5/20/05	144	141
2006	Wet	Yes	1/3/06	/**	271	152
2007	Dry	Yes	/	11/22/06	52	0
2008	Wet	Yes	1/6/08	5/19/08	134	128

* Migration season: January 1 through May 31.

** Remained open.

Figure 5: Santa Ynez River lagoon conditions in late December 2007 just prior to the breaching of the sand berm on 1/6/08.

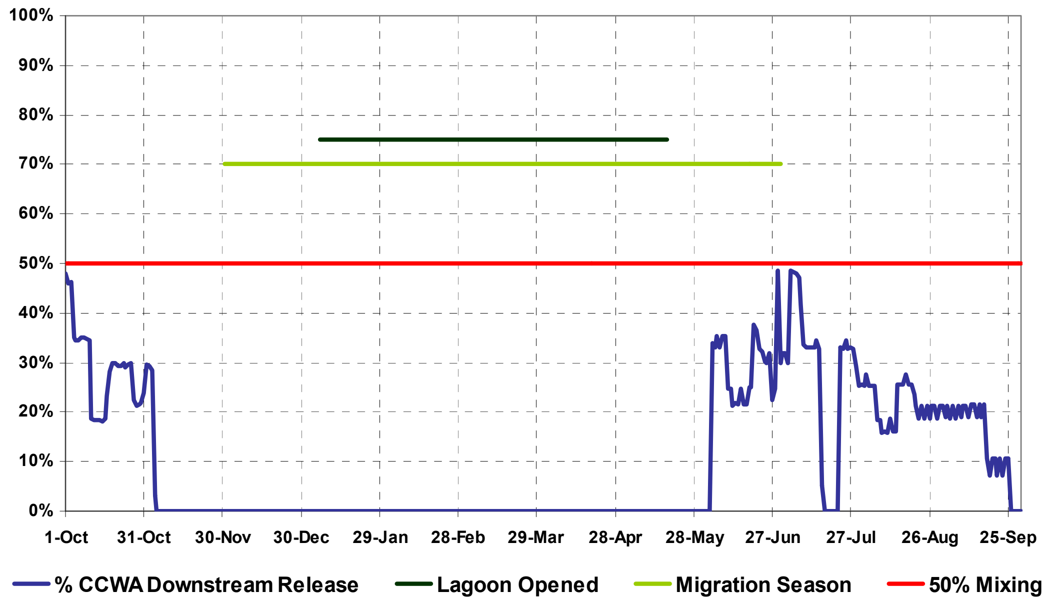


Figure 6: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the migration season and while the lagoon was open to the ocean in WY2008.

3.2. Water Quality within the LYSR Basin

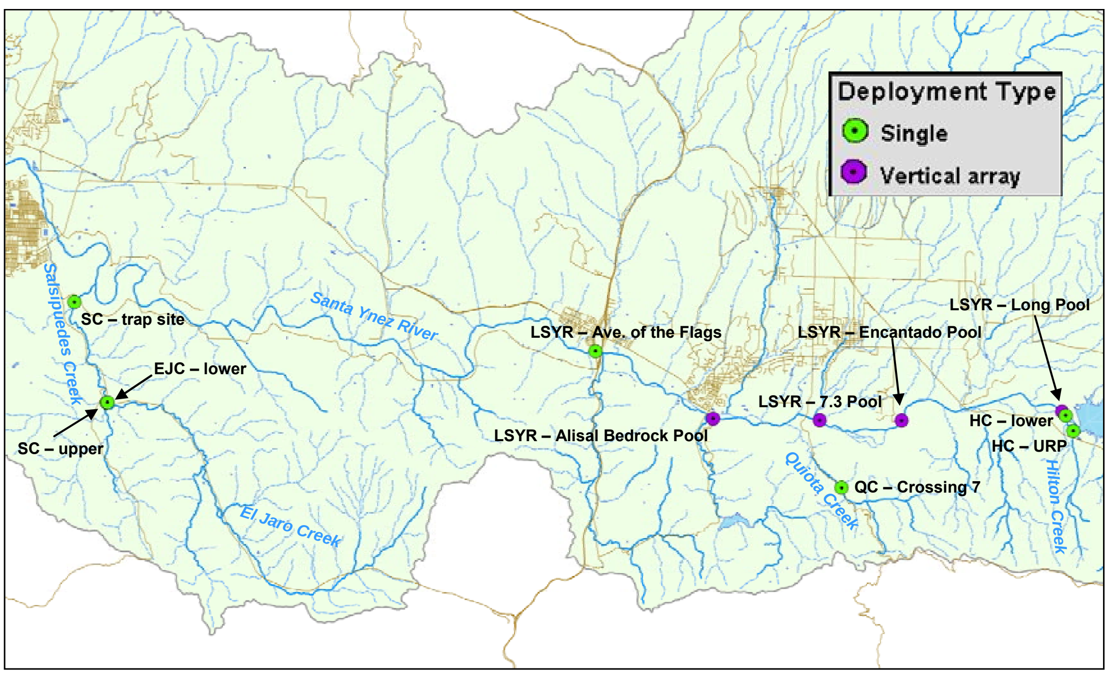


Figure 7: Thermograph single and vertical array deployment locations within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are very close together with overlapping symbology.

Table 5: 2008 thermograph network locations and period of record.

	Location Name	Stream ID	Type	Deployment Date	Retrieval Date	Period of Record (days)
Mainstem	Long Pool	LSYR-0.5	Vert Array	5/14/2008	11/4/2008	175
	Encantado	LSYR-4.9	Vert Array	5/15/2008	11/10/2008	180
	7.3 Pool	LSYR-7.3	Vert Array	5/15/2008	11/10/2008	180
	Alisal BR Pool	LSYR-10.2	Vert Array	6/15/2008	10/6/2011	114
	Avenue of Flags	LSYR-13.9	Single	5/15/2008	10/6/2011	145
Tributaries	Lower Hilton	HC-0.12	Single	5/15/2008	11/4/2008	176
	Upper Hilton	HC-0.54	Single	5/15/2008	11/4/2008	176
	Quiota	QC-2.71	Single	5/15/2008	12/23/2008	223
	Lower Salsipuedes	SC-1.2	Single	5/21/2008	8/7/2008	72
	Upper Salsipuedes	SC-3.8	Single	5/16/2008	11/4/2008	175
	El Jaro	EJC-4.1	Single	5/20/2008	11/4/2008	179

Table 6: LSYR mainstem monthly maximum, average, and minimum water temperatures (°C) based on averaging the daily data within each month for the 4 vertical array and 1 single thermograph deployment sites.

	Long Pool			**Encantado Pool**			**7.3 Pool**			**Alisal Bedrock Pool**		
	(Surface)			***(Surface)***			***(Surface)***			***(Surface)***		
Month	(max)	(avg)	(min)	(max)	(avg)	(min)	(max)	(avg)	(min)	(max)	(avg)	(min)
May	17.2	15.2	13.5	23.8	19.6	16.3	20.8	18.7	17.0	n/a	n/a	n/a
June	19.0	16.6	14.9	25.9	21.0	17.4	22.6	19.9	17.8	25.0	21.7	18.7
July	19.5	17.4	16.0	26.8	22.2	19.0	23.9	21.2	19.2	26.4	22.4	19.5
Aug	19.4	17.1	15.6	26.6	22.2	19.1	23.6	21.4	19.6	25.1	22.3	19.9
Sept	18.1	16.3	15.0	25.0	20.8	18.0	22.8	20.8	19.3	23.4	21.3	19.3
Oct	16.6	15.0	13.9	21.2	17.9	15.6	20.9	19.4	18.2	21.7	20.3	18.7
Nov	16.1	15.2	14.7	19.0	16.6	15.1	19.8	18.8	18.0	n/a	n/a	n/a
	(Bottom)			***(Bottom)***			***(Bottom)***			***(Bottom)***		
Month	(max)	(avg)	(min)	(max)	(avg)	(min)	(max)	(avg)	(min)	(max)	(avg)	(min)
May	14.8	13.9	13.3	19.7	18.1	16.8	n/a	n/a	n/a	n/a	n/a	n/a
June	16.1	15.4	14.9	21.0	19.2	17.7	n/a	n/a	n/a	21.0	19.7	18.7
July	17.0	16.4	16.0	23.0	21.0	19.4	n/a	n/a	n/a	25.8	22.1	19.6
Aug	16.7	16.0	15.5	22.4	20.6	19.2	22.4	20.8	19.4	21.7	20.8	20.0
Sept	16.0	15.4	14.9	21.9	19.9	18.3	22.4	20.6	19.2	n/a	n/a	n/a
Oct	14.7	14.3	14.0	19.4	17.2	15.6	20.6	19.3	18.0	n/a	n/a	n/a
Nov	15.5	15.0	14.6	18.4	16.5	15.3	19.5	18.6	17.8	n/a	n/a	n/a

	Ave. of the Flags		
	(Bottom)		
Month	(max)	(avg)	(min)
May	22.6	19.2	16.5
June	22.8	19.7	17.7
July	25.1	21.8	19.6
Aug	23.6	21.9	20.5
Sept	22.8	21.3	19.8
Oct	21.7	20.7	19.6
Nov	n/a	n/a	n/a

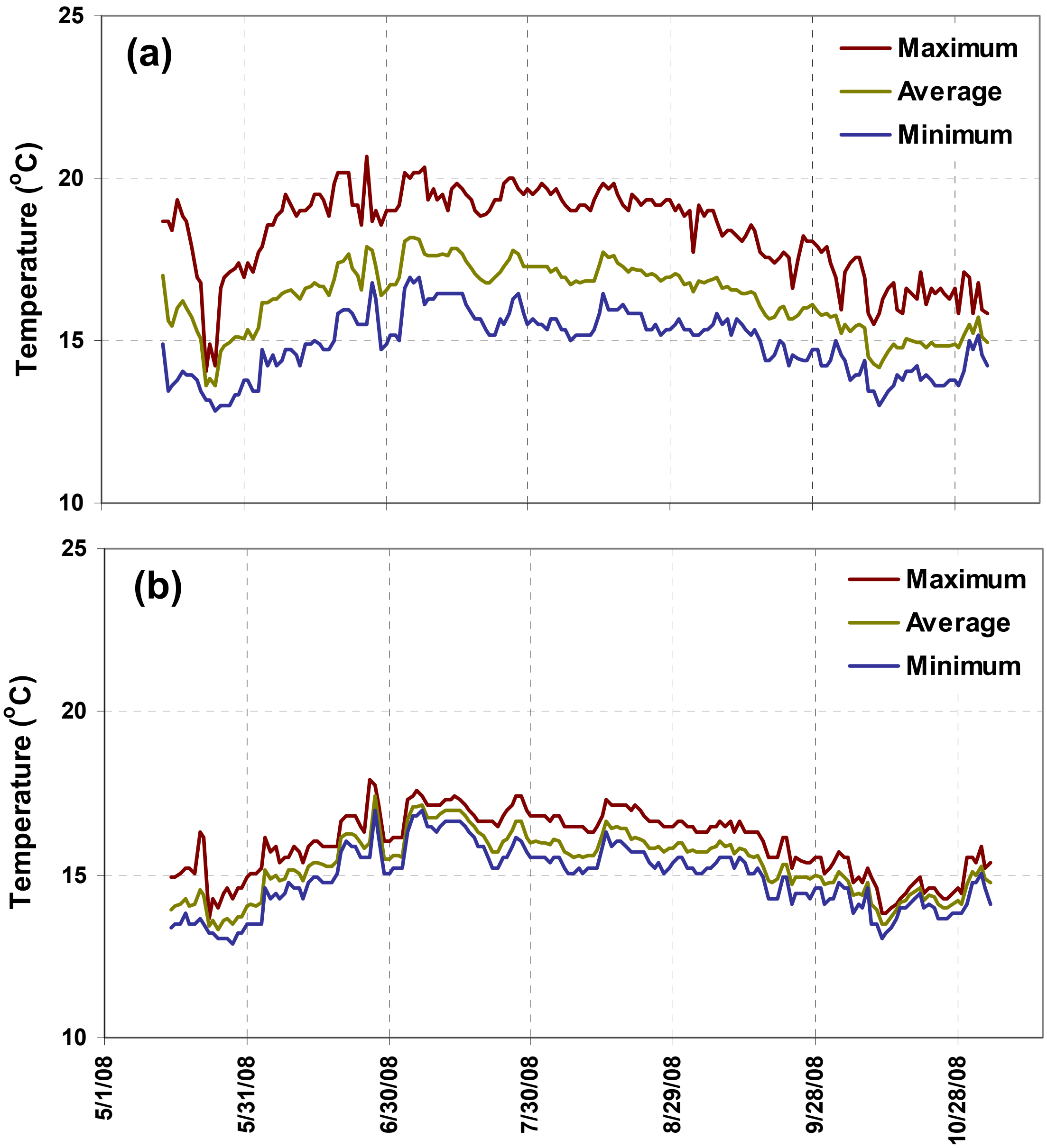


Figure 8: Long Pool (LSYR-0.5) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

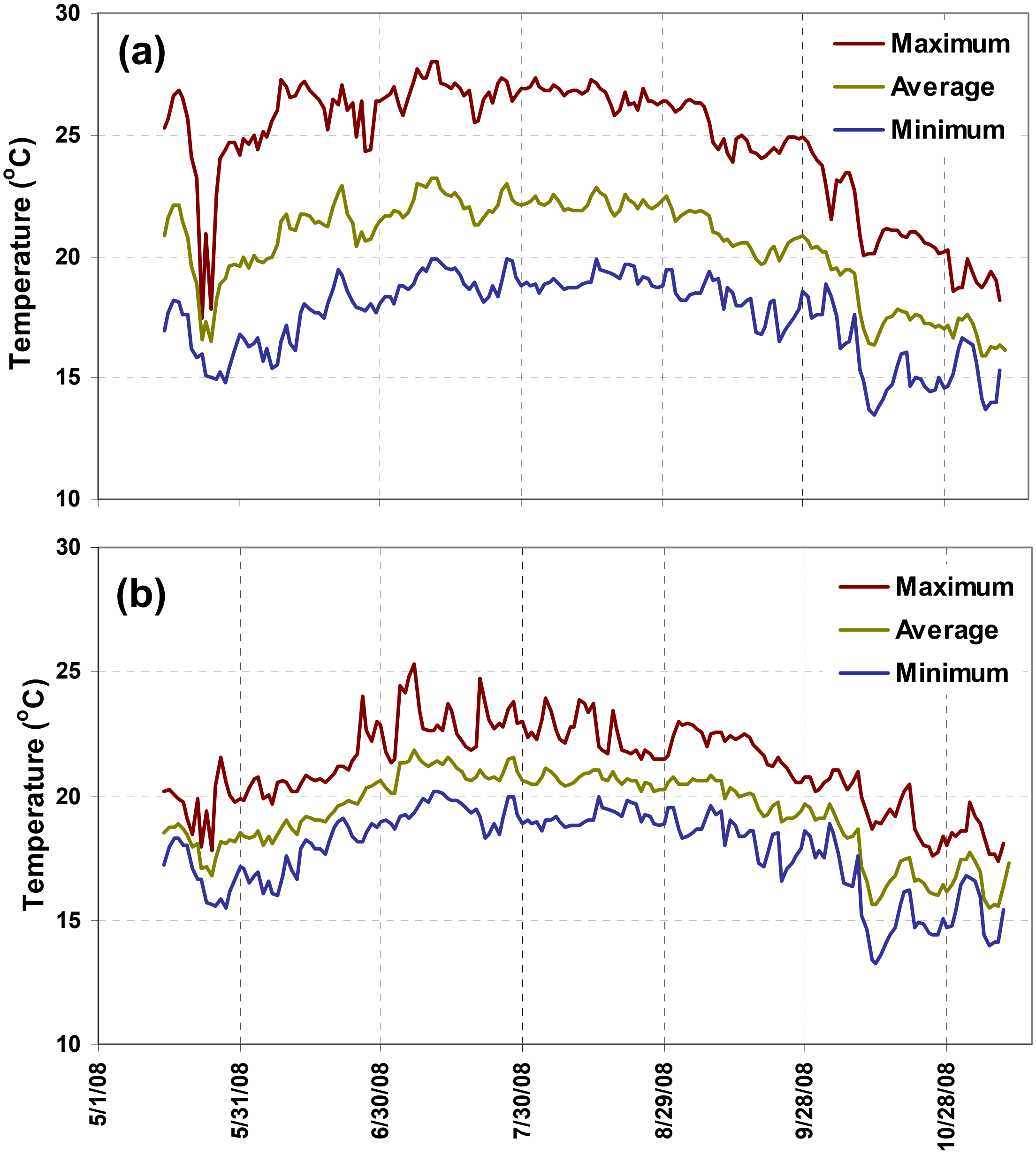


Figure 9: Encantado (LSYR-4.9) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

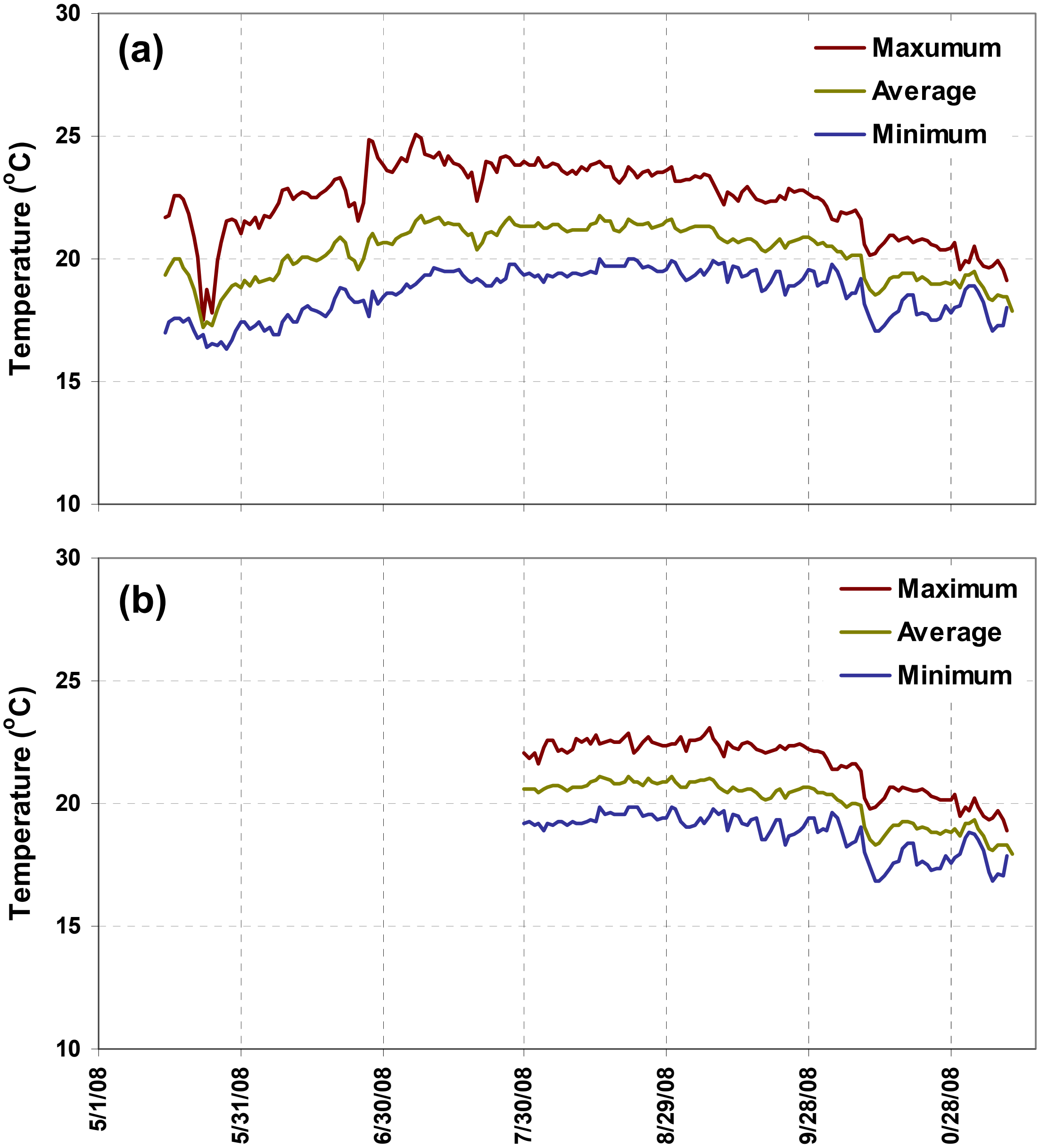


Figure 10: 7.3 Pool (LSYR-7.3) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

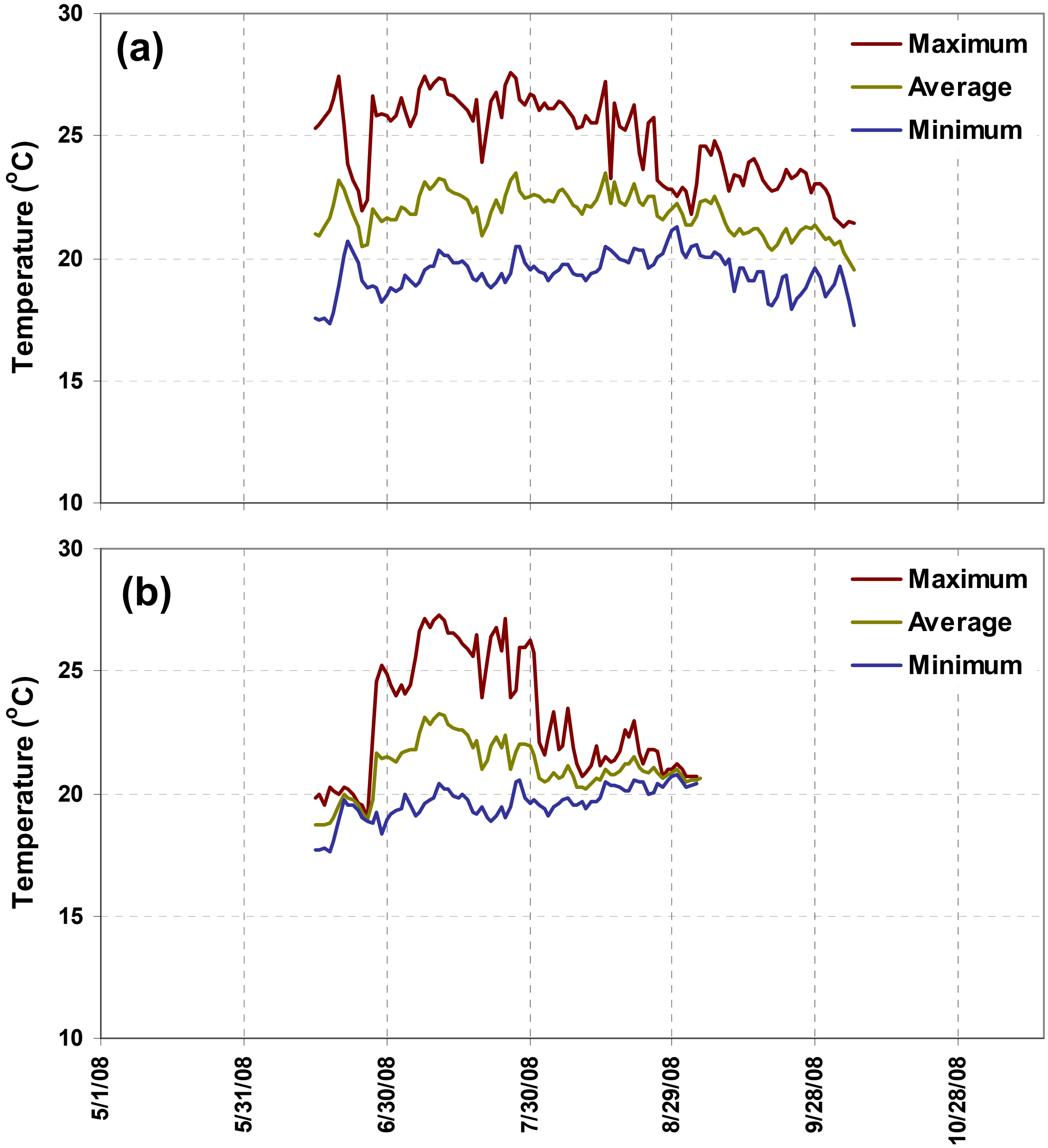


Figure 11: Alisal Bedrock Pool (LSYR-10.2) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

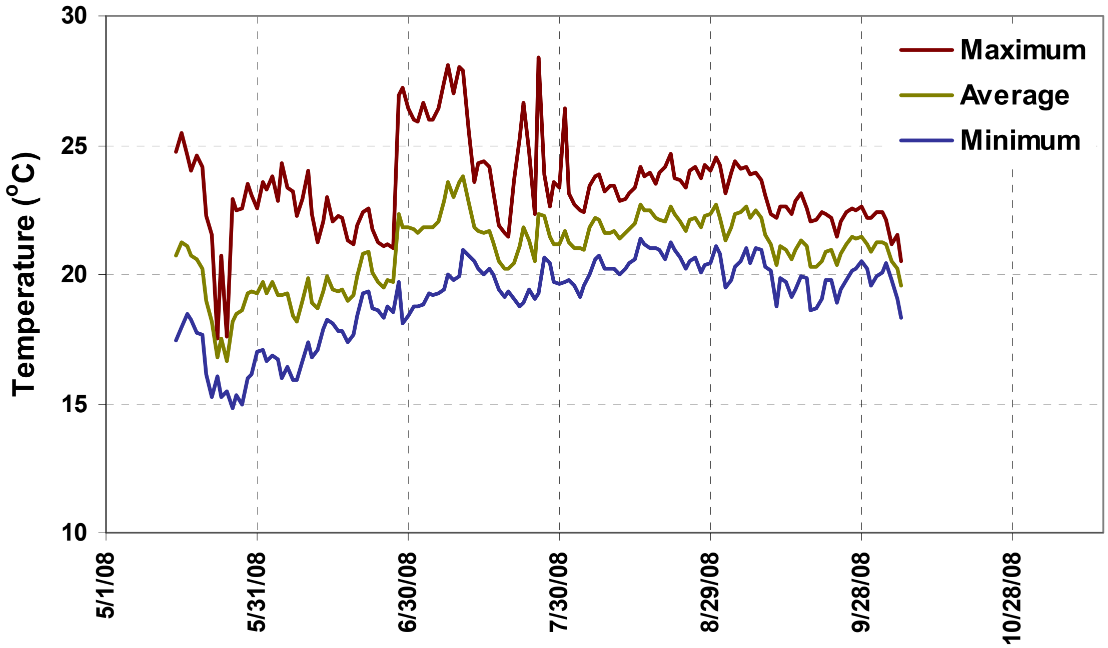


Figure 12: Avenue of the Flags (LYSR-13.9) thermograph maximum, average and minimum daily values for a bottom unit.

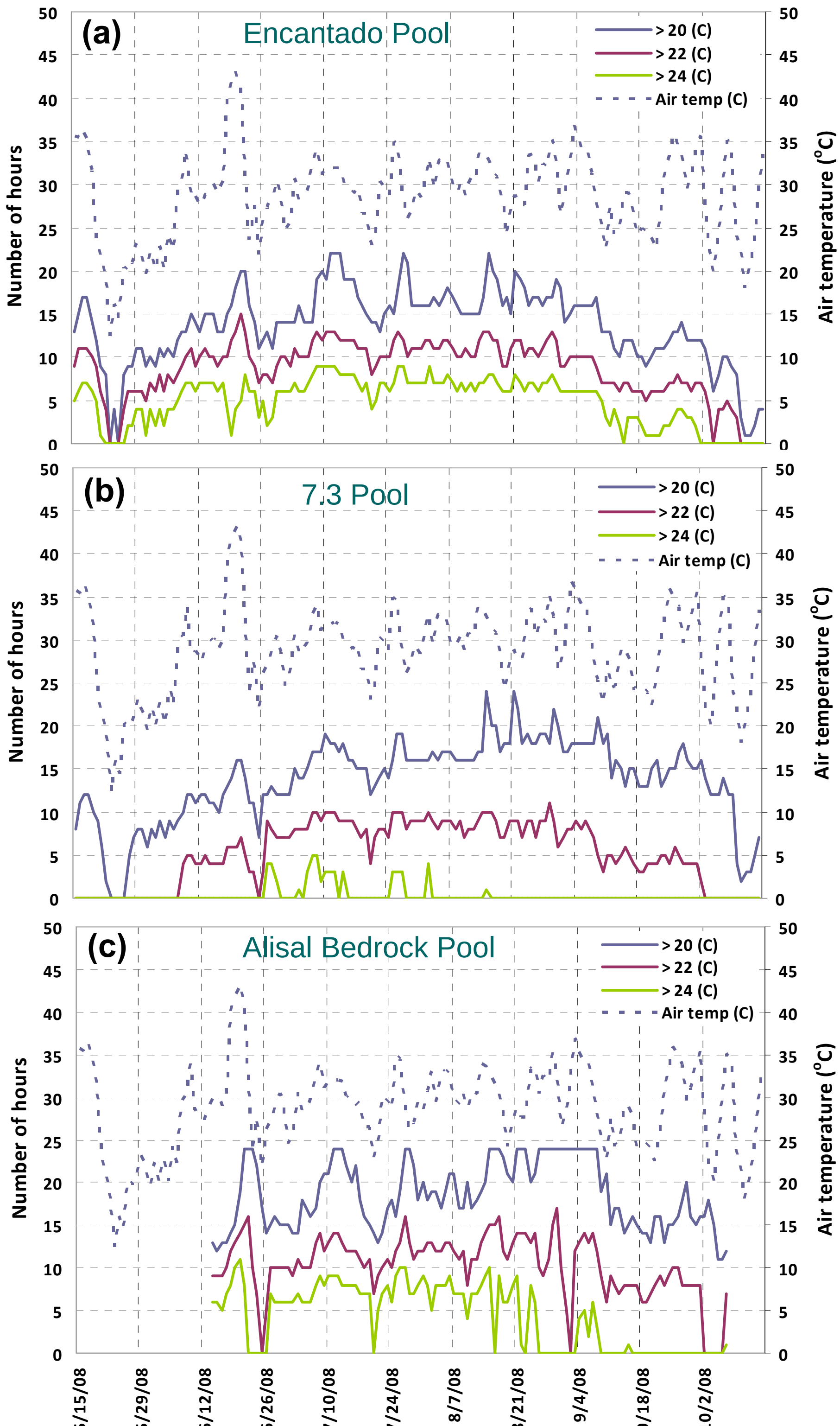


Figure 13: Number of hours during a 24-hour period that maximum water temperatures from surface thermographs exceeded 20 °C, 22 °C and 24 °C at the (a) Encantado Pool (LSYR-4.9), (b) 7.3 Pool (LSYR-7.3), and (c) Alisal Bedrock Pool (LSYR-10.2) with maximum daily air temperatures at the Santa Ynez Valley Airport.

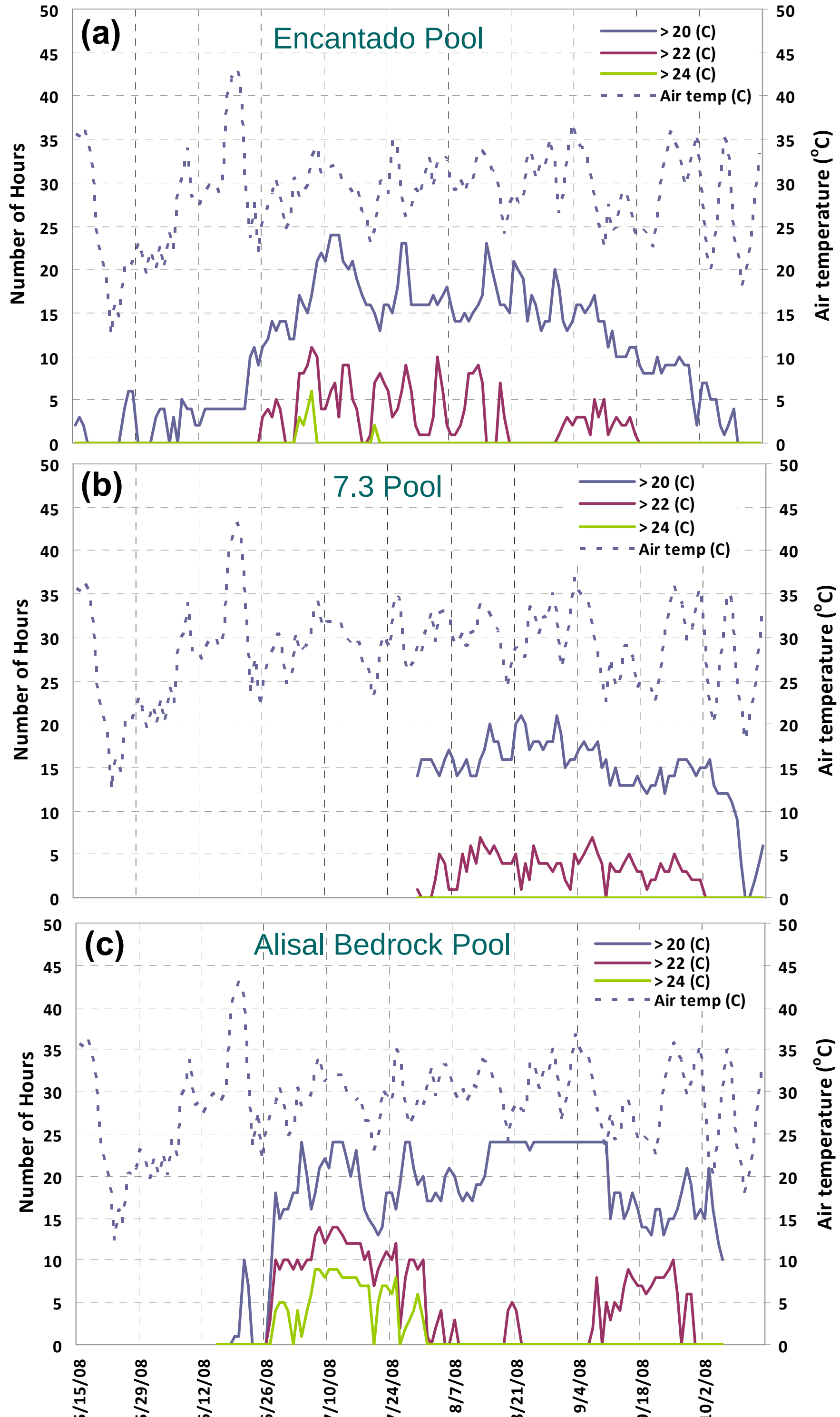


Figure 14: Number of hours during a 24-hour period that maximum water temperatures from bottom thermographs exceeded 20 °C, 22 °C and 24 °C at the (a) Encantado Pool (LSYR-4.9), (b) 7.3 Pool (LSYR-7.3) (data not available May-July), and (c) Alisal Bedrock Pool (LSYR-10.2) with maximum daily air temperatures at the Santa Ynez Valley Airport.

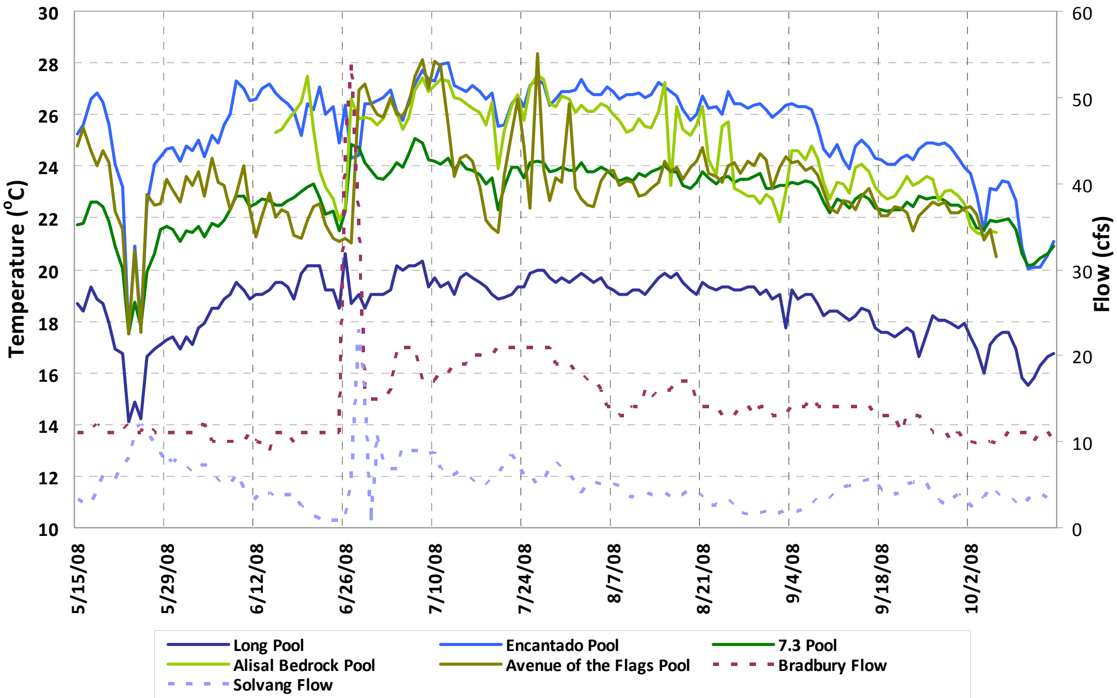


Figure 15: Longitudinal surface thermograph maximum water temperatures at the Long Pool (LSYR-0.5), Encantado Pool (LSYR-4.9), 7.3 Pool (LSYR-7.3), Alisal Bedrock Pool (LSYR-10.2), and Avenue of the Flags (LSYR-13.9) with daily flow from Bradbury Dam and at the USGS gauge at Solvang.

Table 7: Tributary monthly maximum, average, and minimum water temperatures (°C) based on averaging the daily data within each month for the 6 single thermograph deployment sites; 2 on Hilton Creek, 1 on Quiota Creek, 1 on El Jaro Creek, and 2 on Salsipuedes Creek.

	Upper Hilton Ck			**Lower Hilton Ck**		
Month	(max)	(avg)	(min)	(max)	(avg)	(min)
May	13.7	13.4	13.1	13.4	12.8	12.3
June	13.9	13.6	13.4	13.9	13.2	12.7
July	13.9	13.8	13.7	13.8	13.4	13.1
Aug	13.9	13.9	13.8	13.9	13.5	13.3
Sept	14.1	14.1	14.0	14.1	13.7	13.4
Oct	14.4	14.2	14.2	14.1	13.7	13.3
Nov	14.6	14.4	14.3	14.1	13.9	13.7

	Quiota Ck		
Month	(max)	(avg)	(min)
May	16.9	14.8	13.3
June	19.0	16.1	14.2
July	20.1	17.7	16.1
Aug	19.7	17.7	15.9
Sept	17.2	16.6	16.0
Oct	14.7	13.4	12.1
Nov	13.6	12.7	11.7

	El Jaro Ck			**Upper Salsipuedes Ck**			**Lower Salsipuedes Ck**		
Month	(max)	(avg)	(min)	(max)	(avg)	(min)	(max)	(avg)	(min)
May	18.4	16.5	14.9	17.9	15.4	13.4	19.1	16.8	15.0
June	18.9	18.0	17.0	19.4	16.5	14.2	22.4	19.3	17.0
July	19.6	18.9	18.3	19.9	17.7	16.1	26.2	21.5	18.9
Aug	18.6	18.1	17.6	20.0	17.5	16.1	26.8	21.8	19.0
Sept	16.5	16.2	15.9	18.6	16.4	15.0	n/a	n/a	n/a
Oct	13.0	12.5	12.2	14.8	13.1	11.5	n/a	n/a	n/a
Nov	14.5	14.3	13.9	15.3	14.4	13.8	n/a	n/a	n/a

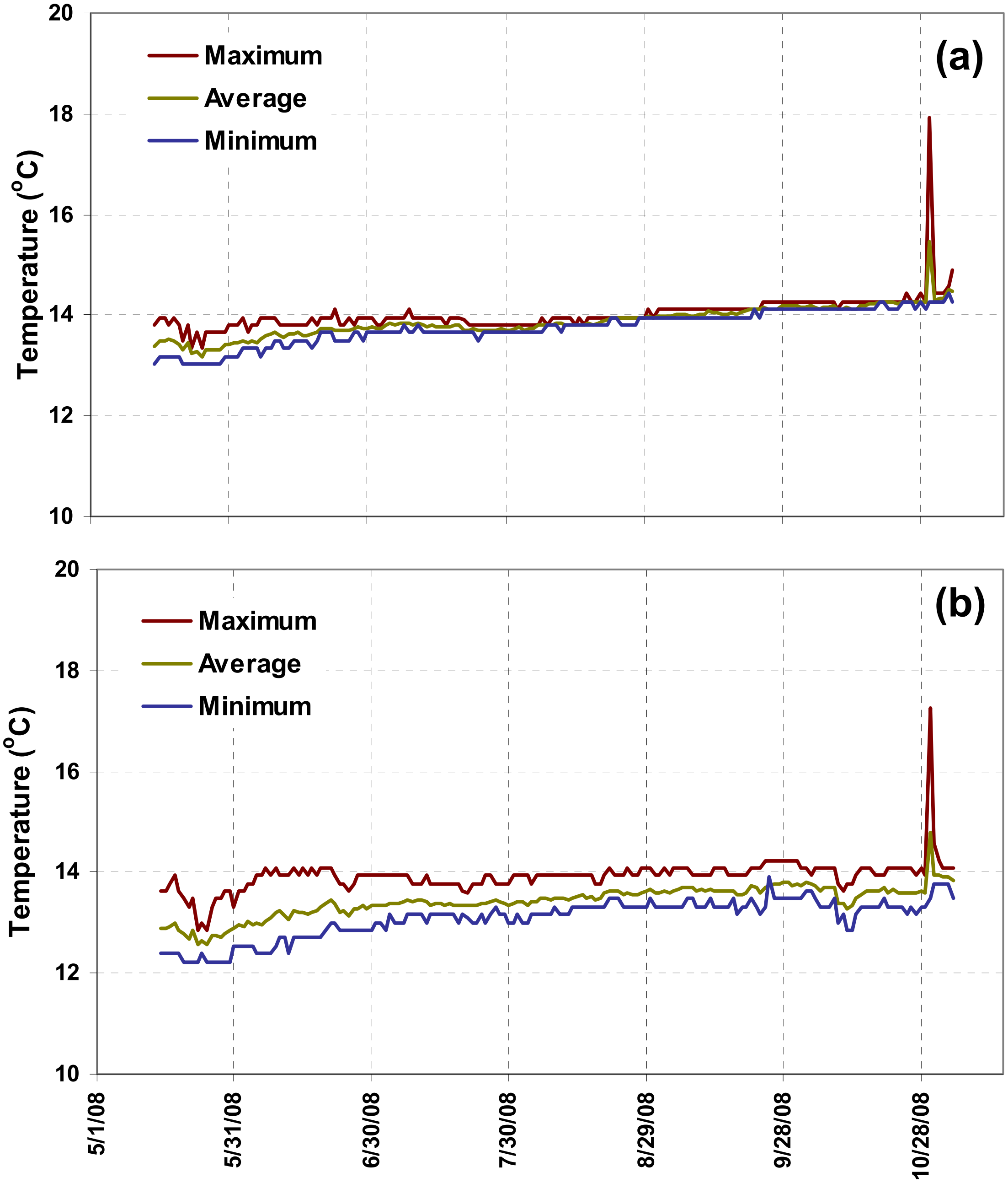


Figure 16: Thermograph maximum, average and minimum daily values for the (a) upper Hilton Creek (HC-0.54) and (b) lower Hilton Creek (HC-0.12) units. Temperature spike in late October was from the lake turnover event.

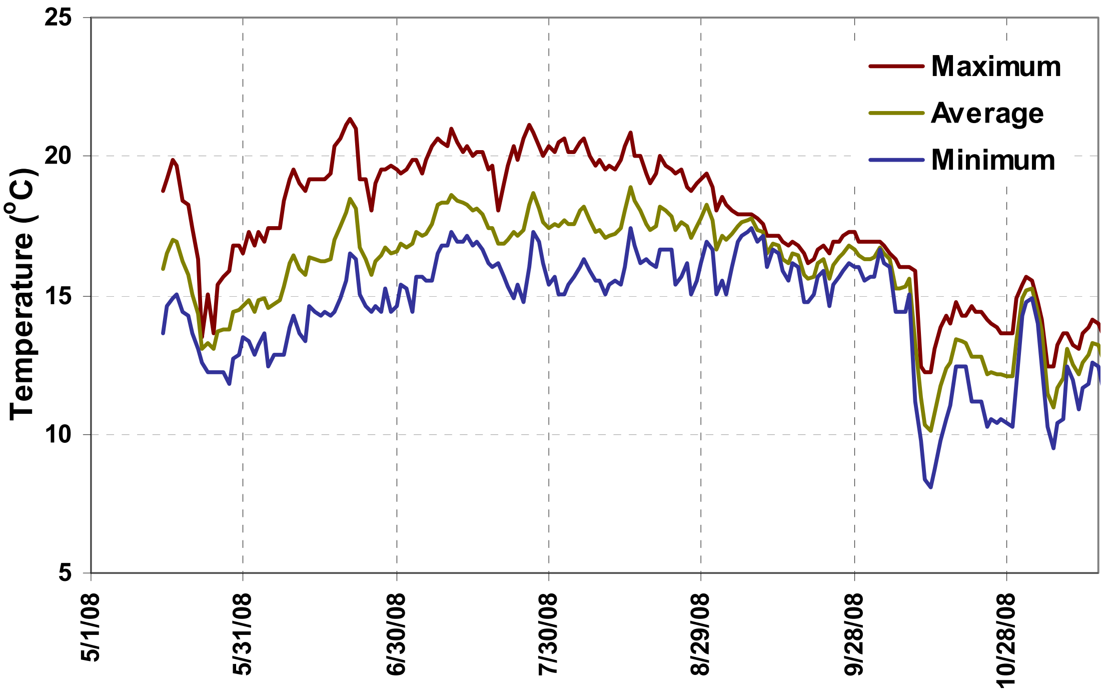


Figure 17: Thermograph maximum, average and minimum daily values for the Quiota Creek (QC-2.71) unit.

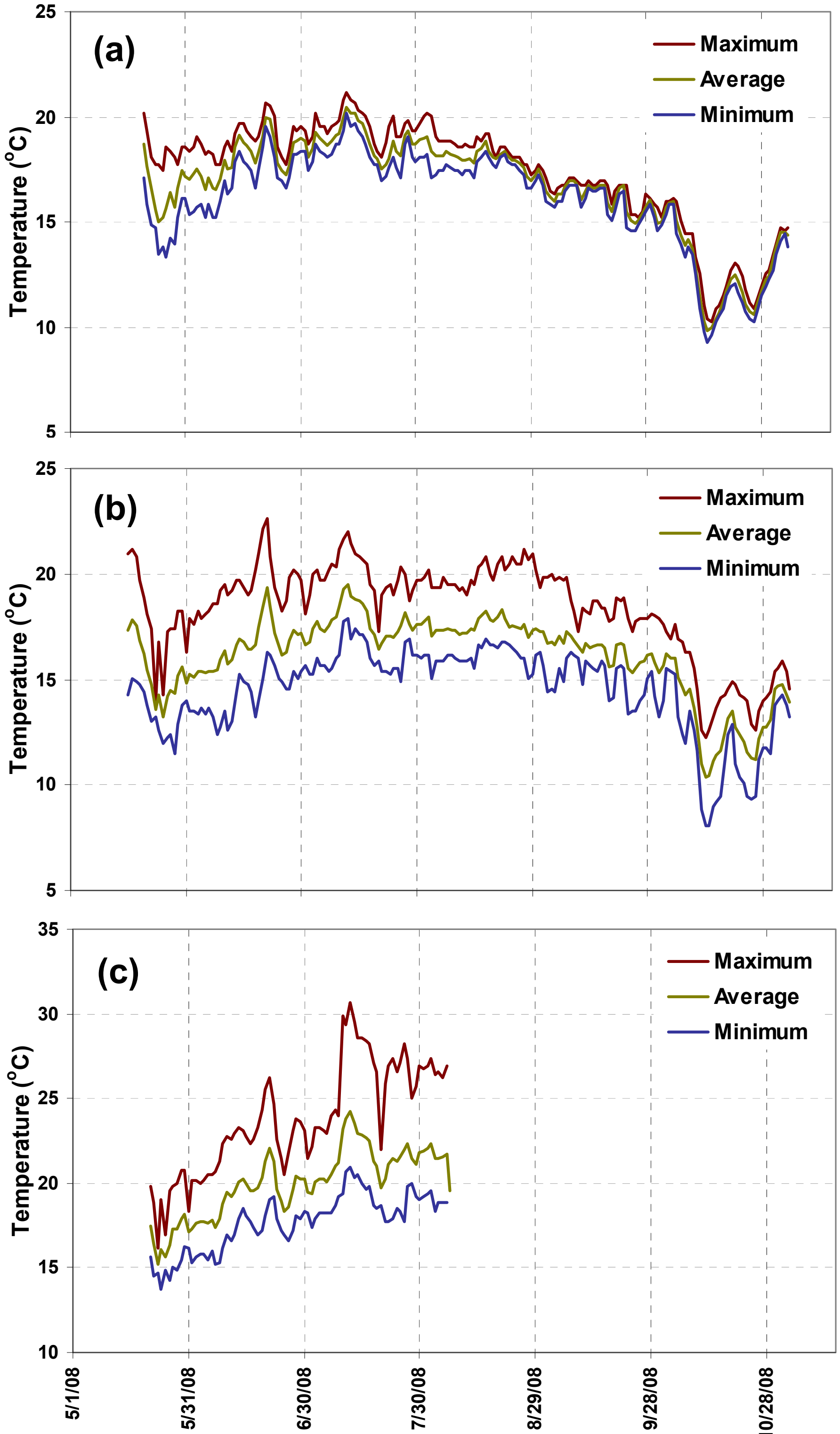


Figure 18: Thermograph maximum, average and minimum daily values for the (a) El Jaro Creek (EJC-3.81), (b) upper Salsipuedes Creek (SC-3.8), and (c) lower Salsipuedes Creek (SC-0.77) units.

Table 8: Water quality sonde deployments during the 2008 dry season.

Habitat	Location	7/21-25/08 (5 days)	7/29-8/4/08 (6 days)	8/7-14/08 (6 days)	8/14-19/08 (5 days)	8/26-9/2/08 (7 days)	9/15-18/08 (3 days)	9/22-29/08 (7 days)	10/6-9/08 (3 days)	10/16-21/08 5 days)
		Deployment Dates:								
Encantado	**LSYR-4.9**									
(Top)					X			X		
(Middle)		X	X	X		X			X	
(Bottom)					X			X		
Upper Meadowlark Run	**LSYR-5.36**						X			
Meadowlark Pool	**LSYR-5.4**									
Coldwater upwelling site							X			
75' d/s of head							X			
Long Deep Pool	**LSYR-6.85**		X	X					X	
Pool "Crawdad"	**LSYR-7.0**					X				X
7.3 Pool	**LSYR-7.3**		X	X	X	X		X		X

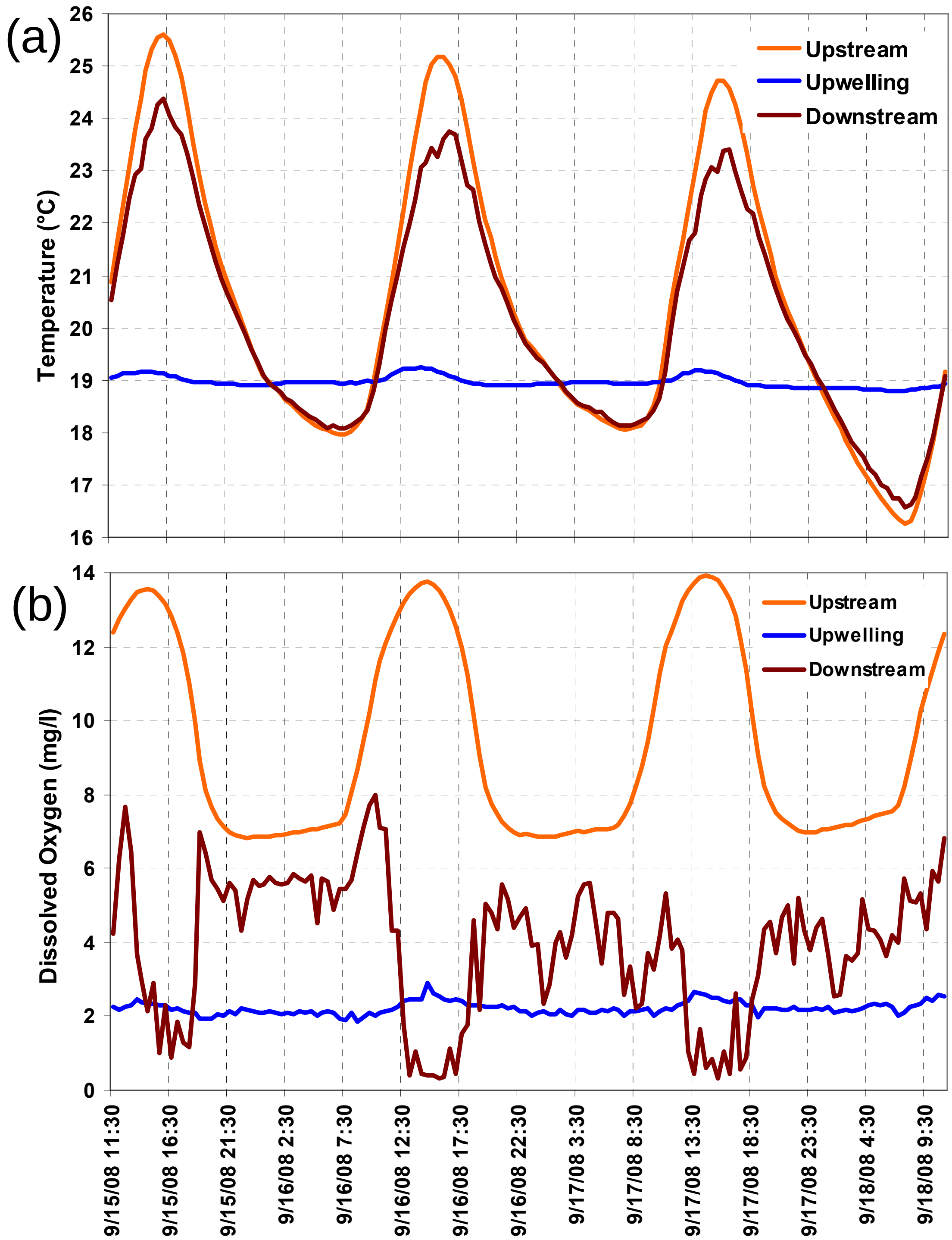


Figure 19: Meadowlark Pool (LSYR 5.4) three sonde bottom of water column deployment locations from 9/15/08 to 9/18/08 showing (a) water temperature and (b) dissolved oxygen concentrations 200 feet upstream of the pool (upstream), middle of the pool where strong upwelling was observed (upwelling) and 75 feet downstream of the middle of the pool (downstream).

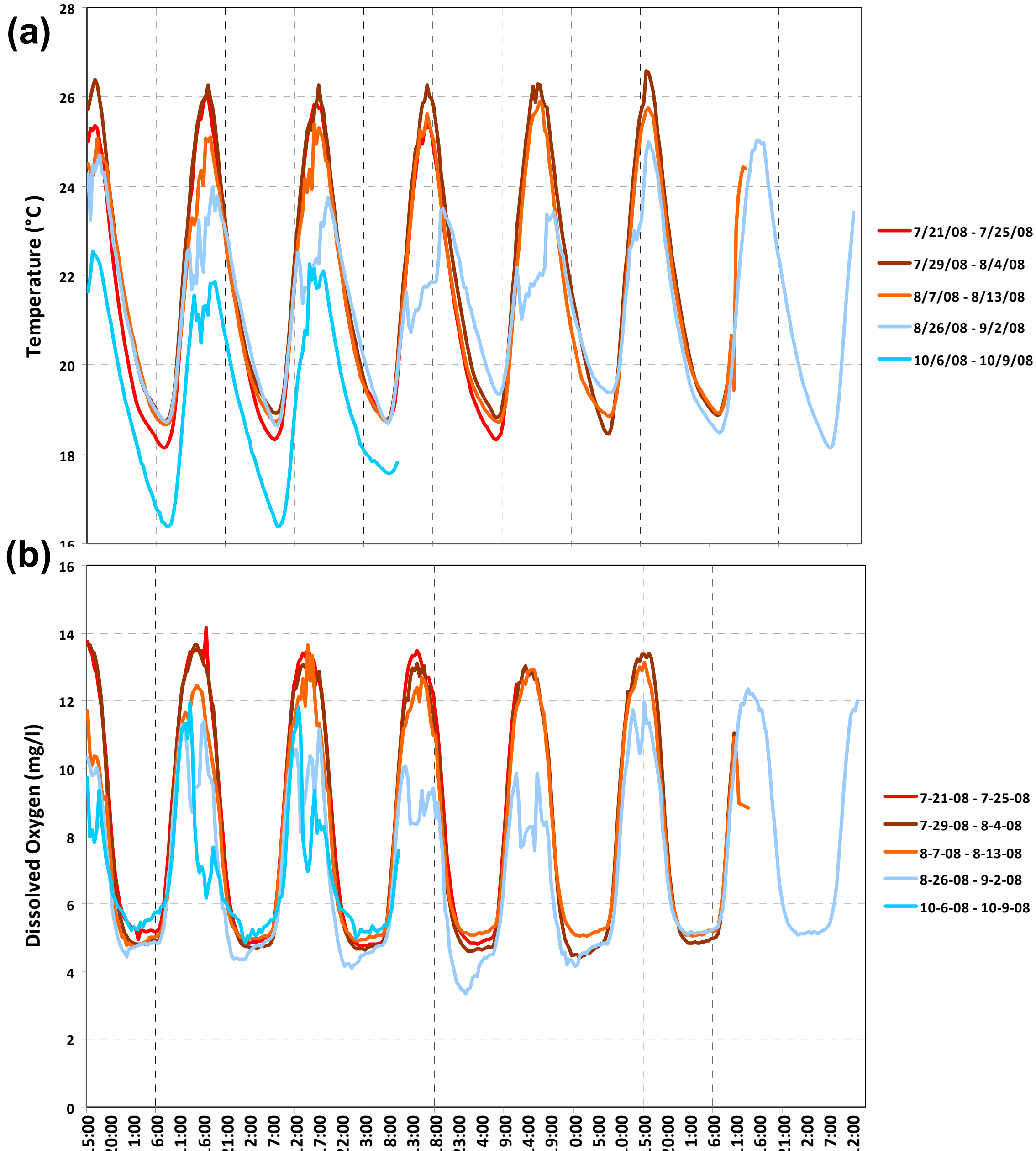


Figure 20: Encantado Pool (LSYR 4.9) diel mid-water column deployment location: (a) water temperature and (b) dissolved oxygen concentration fluctuations during five deployments in July, August and October, matched up at the same start time.

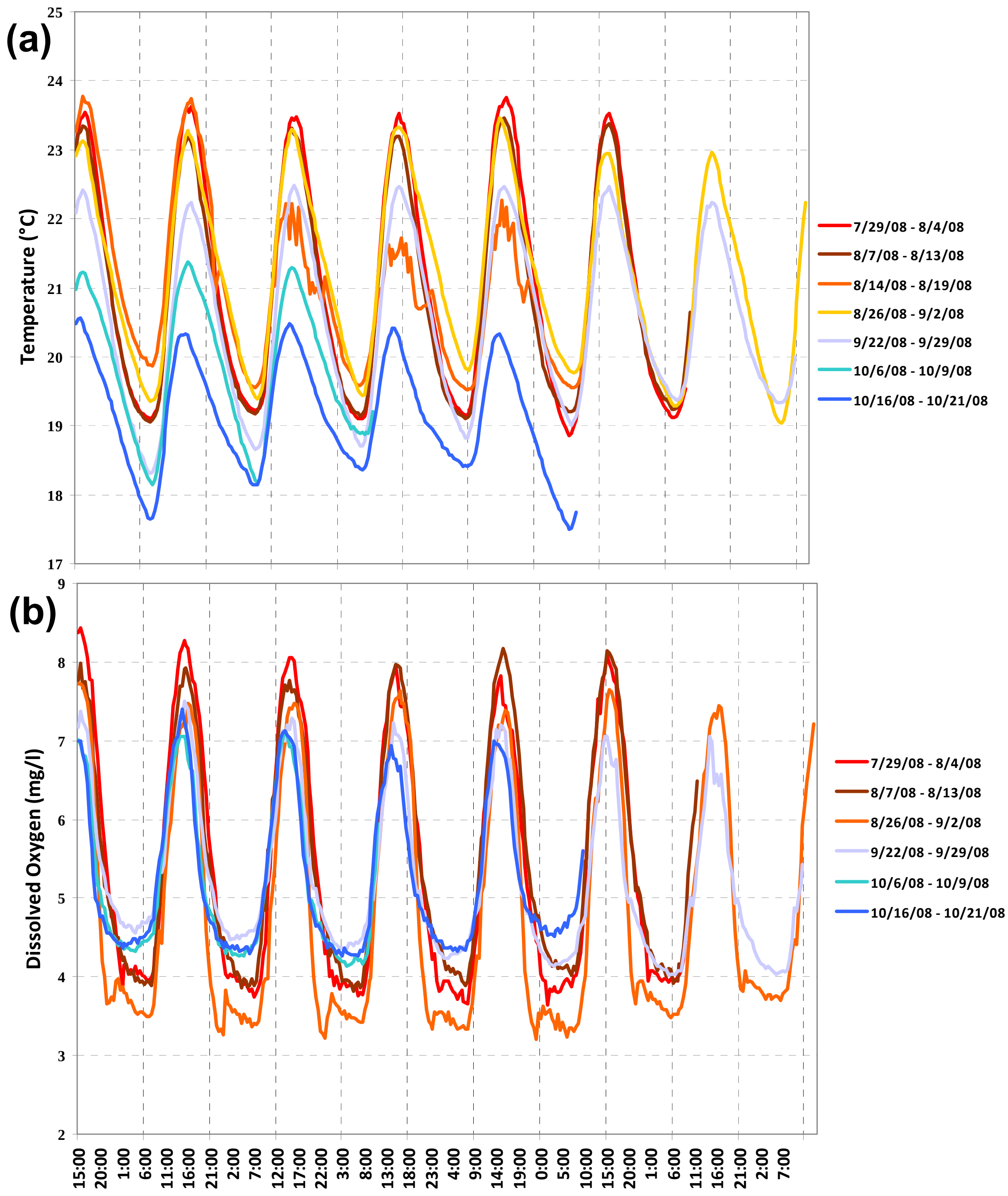
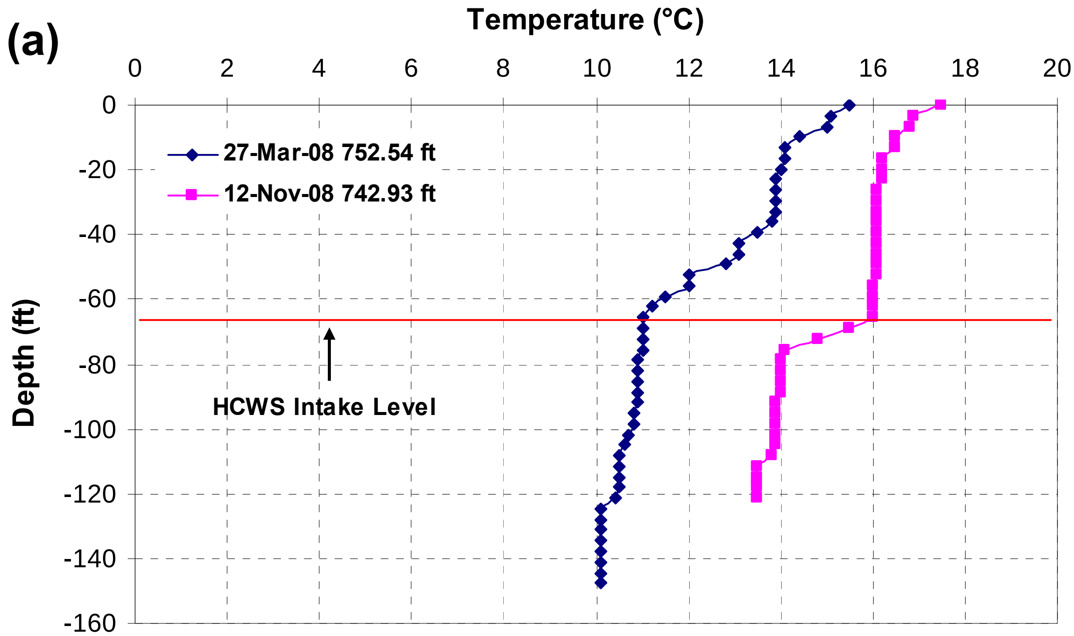


Figure 21: 7.3 Pool (LSYR 7.3) diel mid-water column deployment location: (a) water temperature and (b) dissolved oxygen concentration fluctuations during seven deployments in July, August, September and October, matched up at the same start time.



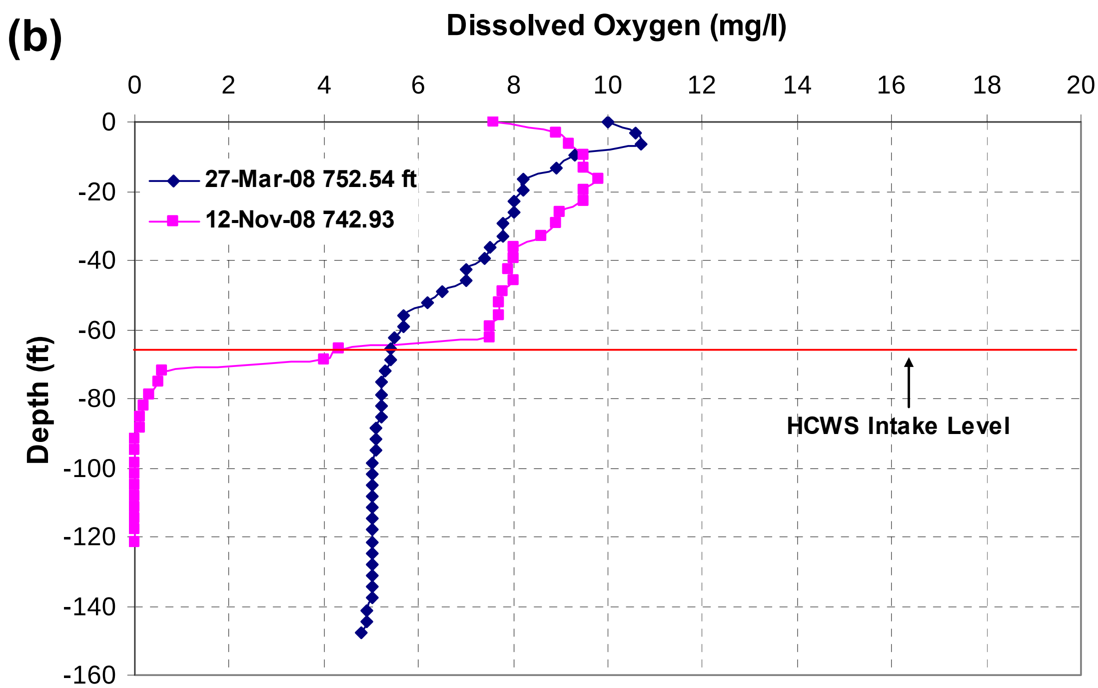


Figure 22: Lake Cachuma water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS. HCWS intake hose level was set at 65 feet of depth throughout the monitoring period.

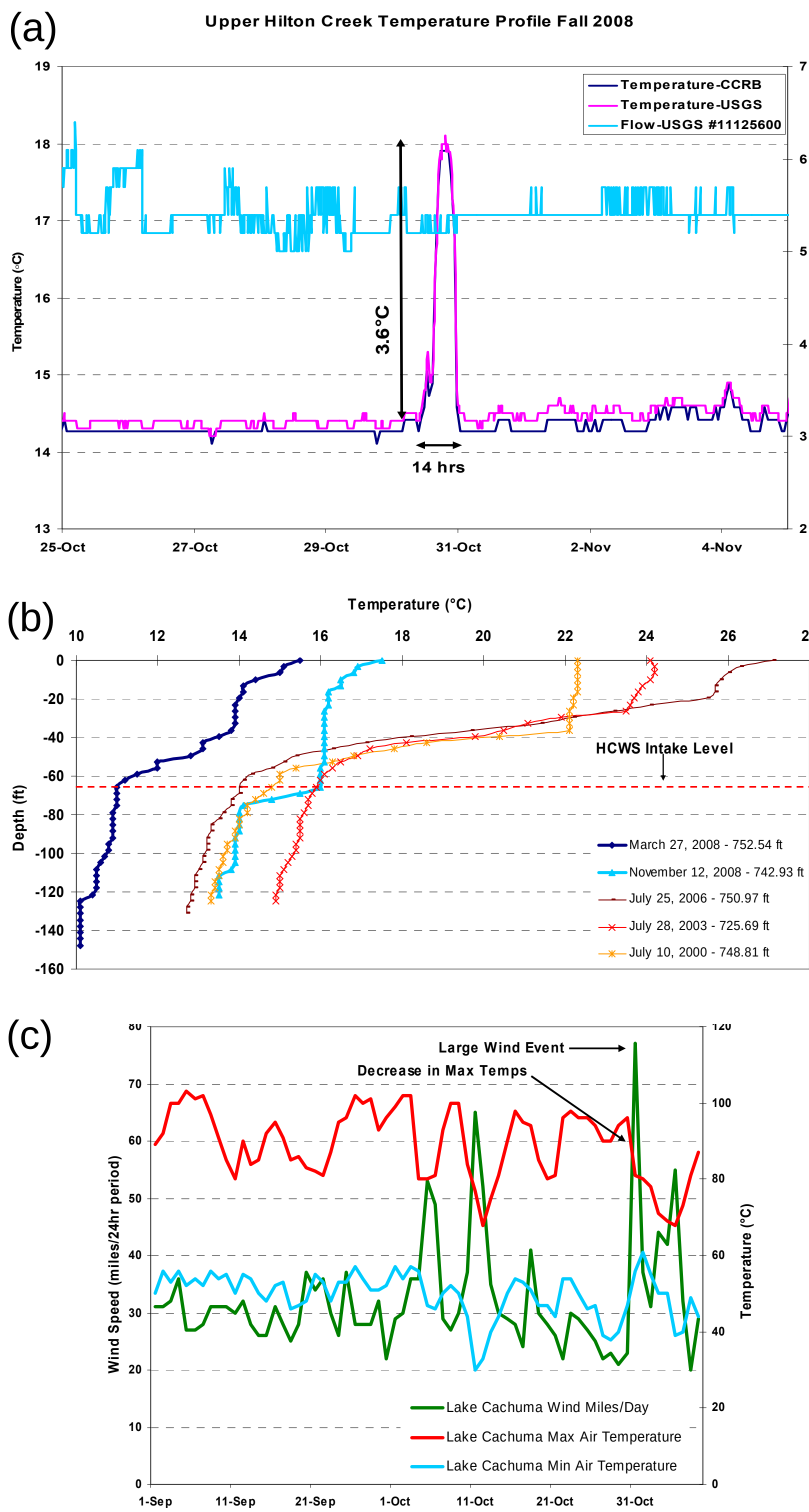


Figure 23: Lake Cachuma 10/30/08 turnover event: (a) observed with USGS temperature data within Hilton Creek, (b) comparative lake profiles, and (c) fall wind speeds and air temperatures at the lake.

3.3. Habitat Quality within the LYSR Basin

Figure 24: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) July 2008.

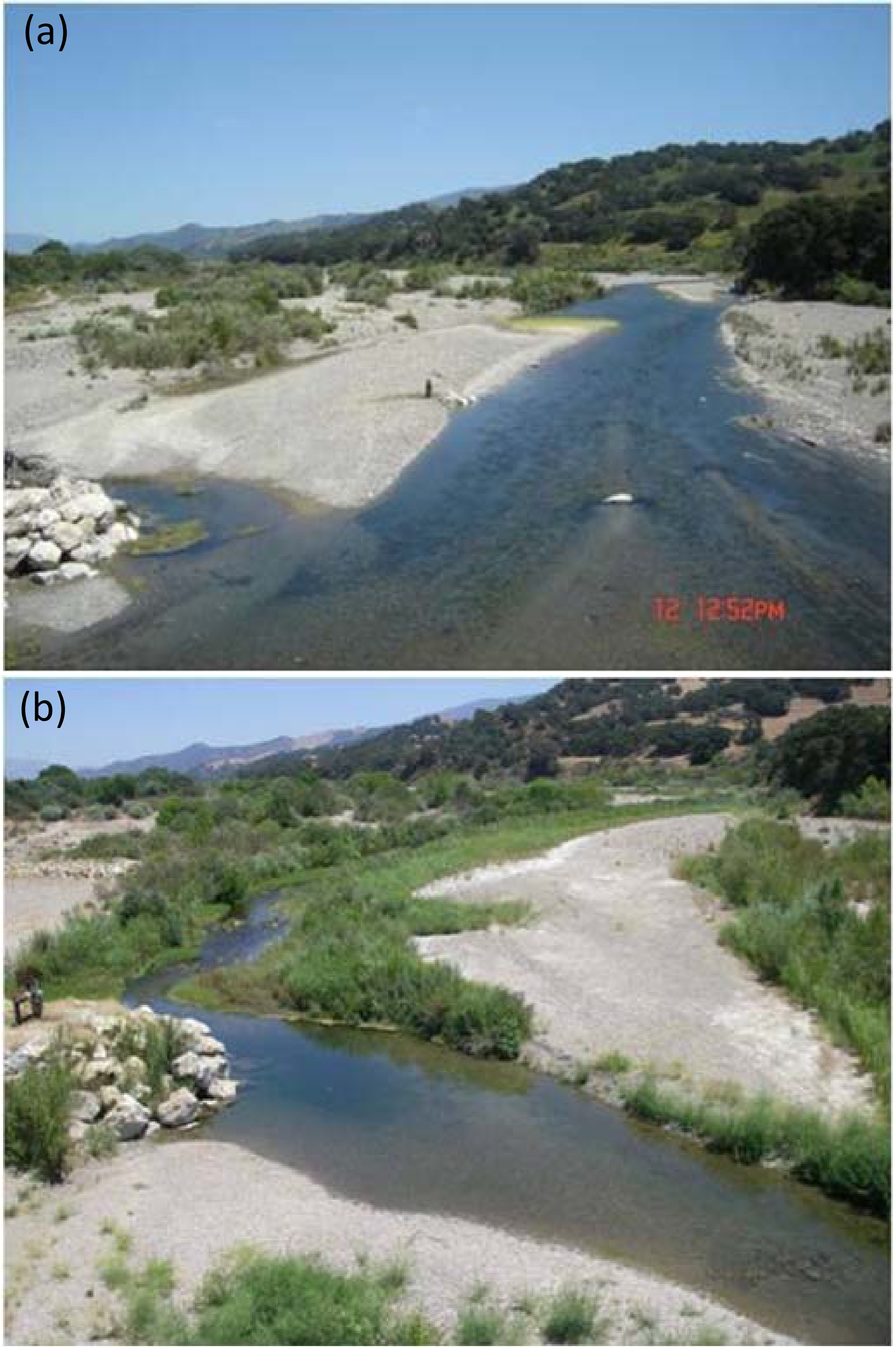


Figure 25: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) July 2008.

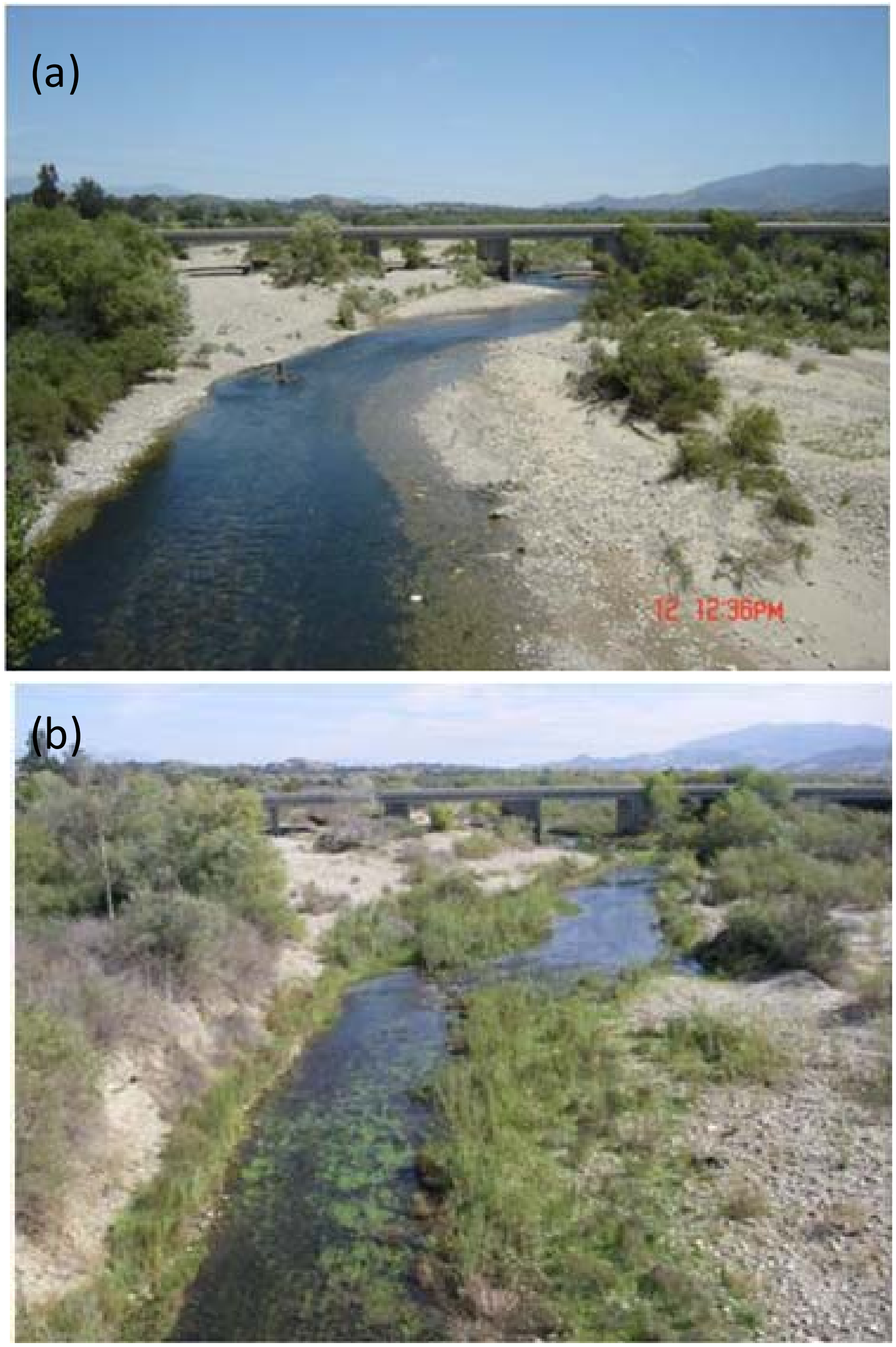


Figure 26: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) October 2007.

Figure 27: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) October 2007.

Figure 28: Photo point (M-22) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) July 2008.

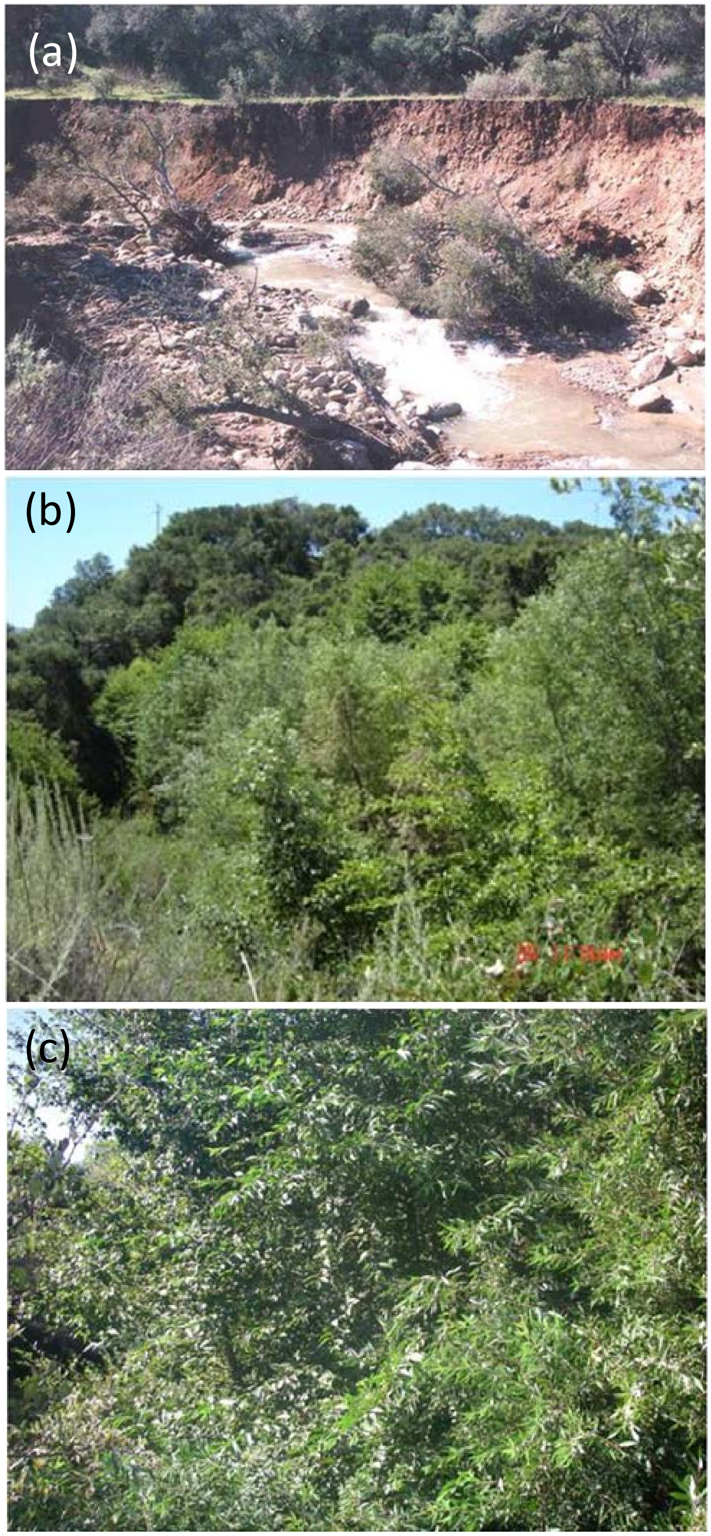


Figure 29: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) September 2007.

3.4. Migration - Trapping

Table 9: WY2008 migrant trap deployments.

Location	Date Traps Deployed (dates)	Date Traps Removed (dates)	Date Traps Removed (storm event) (dates)	Date Traps Installed (storm event) (dates)	# of Days Not Trapping (days)
Hilton	1/7/2008	5/14/2008	1/22/2008	1/29/2008	7
			2/2/2008	2/4/2008	2
			2/23/2008	2/25/2008	2
				Total:	***11***
Salsipuedes	1/7/2008	5/1/2008	1/22/2008	1/30/2008	8
			2/2/2008	2/4/2008	2
			2/21/2008	2/26/2008	5
			4/2/2008	4/3/2008	1
				Total:	***16***
Mainstem	2/7/2008	4/7/2008	2/14/2008	3/4/2008	19
				Total:	***19***

Table 10: WY2008 Catch Per Unit Effort (CPUE) for each of the trapping locations.

Location	Upstream Captures (#)	Downstream Captures (#)	Functional Trap Days (days)	Trap Season (days)	Trapping Efficiency (%)	CPUE (Upstream) (captures/day)	CPUE (Downstream) (captures/day)	CPUE (Total) (captures/day)	Mean Flow* (cfs)
Hilton	175	302	118	129	91.5	1.5	2.6	4.0	9
Salsipuedes	16	62	100	116	86.2	0.2	0.6	0.8	32
Mainstem	4	1	42	61	68.9	0.1	0.02	0.1	171

*Mean flow was calculated from the daily discharge recorded at the nearest USGS gauging station.

Table 11: Number of migrant captures associated with each trap check over 24-hours in WY2008.

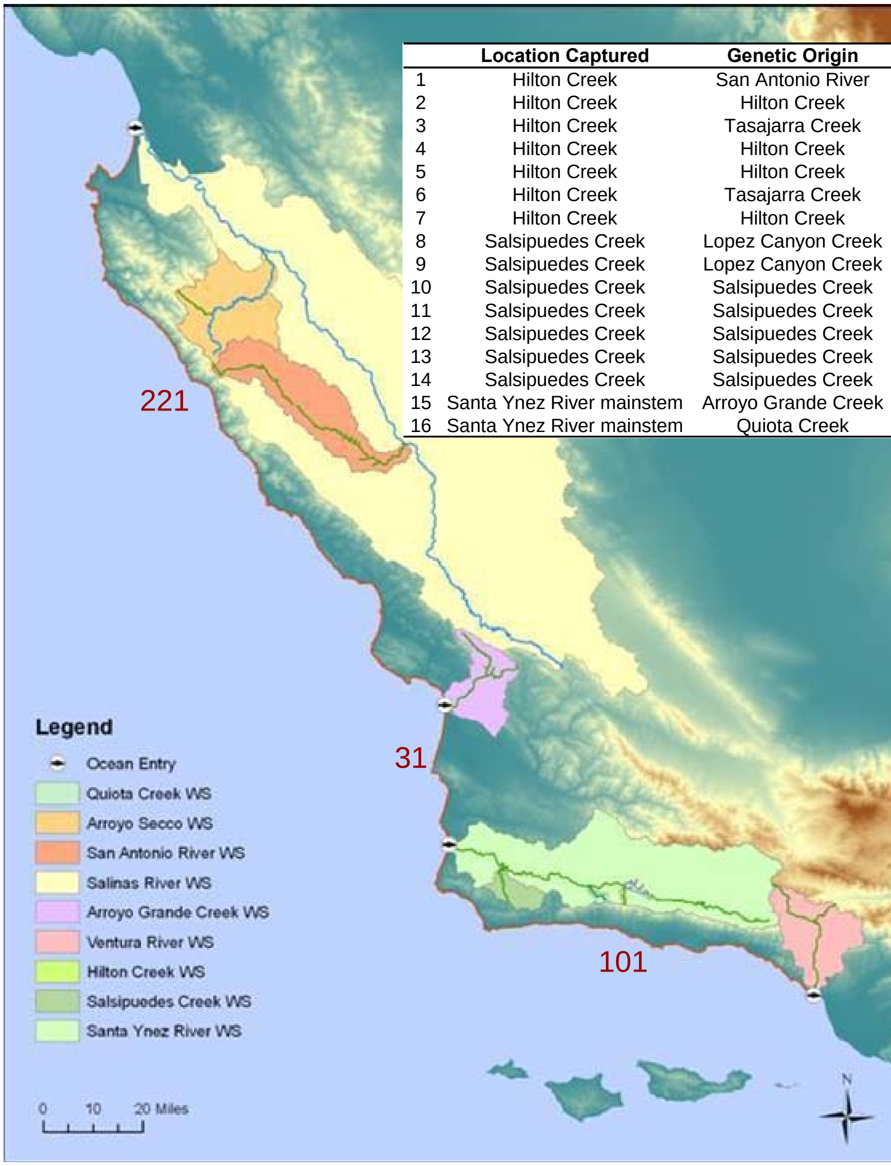
Location	Trap	Trap check: 1st AM	2nd AM	1st PM	2nd PM	Total
Salsipuedes	Upstream	7	2	3	4	16
	Downstream	22	9	24	7	62
	Total:	***29***	***11***	***27***	***11***	**78**
Mainstem	Upstream	2	1	0	1	4
	Downstream	0	0	0	1	1
	Total:	***2***	***1***	***0***	***2***	**5**
Hilton	Upstream	56	30	27	62	175
	Downstream	90	31	44	137	302
	Total:	***146***	***61***	***71***	***199***	**477**

Table 12: WY2008 ocean run steelhead (anadromous) captures at the three trap locations with stream flow at the closest USGS gauge, flows at the USGS gauge at Narrows and Solvang and days since the last storm event.

	Date Captured	Location	Size	Direction	Flow when Captured*	Mainstem Flow at Time Narrows	Mainstem Flow at Time Solvang	Days since last storm event	Date range - last storm to capture
			(mm)	(US/DS**)	(cfs)	(cfs)	(cfs)	(#)	(dates)
1	2/4/2008	Salsipuedes	640	US	36	1260	1160	7	1/28-2/4
2	2/5/2008	"	701	US	23	860	555	8	1/28-2/5
3	2/7/2008	"	496	DS	19	392	252	10	1/28-2/7
4	2/17/2008	"	635	US	9.3	263	227	15	2/3-2/17
5	3/25/2008	"	663	US	5.6	55	20	10	3/16-3/25
6	3/29/2008	"	675	US	5.2	42	15	14	3/16-3/29
7	4/14/2008	"	608	US	3.4	18	6.6	30	3/16-4/14
8	2/10/2008	Mainstem	678	US	139	222	139	8	2/3-2/10
9	3/18/2008	"	600	US	37	84	37	3	3/16-3/18
10	2/7/2008	Hilton	659	US	8.7	392	252	10	1/28-2/7
11	2/11/2008	"	578	DS	8.6	210	147	5	2/3-2/7
12	2/16/2008	"	691	US	9.0	264	229	14	2/3-2/16
13	3/4/2008	"	617	DS	9.2	428	305	12	2/22-3/4
14	3/5/2008	"	563	US	9.1	397	279	13	2/22-3/5
15	3/7/2008	"	660	US	8.9	216	110	15	2/22-3/7
16	3/23/2008	"	688	US	8.0	62	23	8	3/16-3/23

* Nearest USGS flow gauge (daily average discharge).

** US/DS - upstream vs downstream.



	Location Captured	Genetic Origin	County	Score
1	Hilton Creek	San Antonio River	Monterey	55%
2	Hilton Creek	Hilton Creek	Santa Barbara	100%
3	Hilton Creek	Tasajarra Creek	Monterey	88%
4	Hilton Creek	Hilton Creek	Santa Barbara	100%
5	Hilton Creek	Hilton Creek	Santa Barbara	100%
6	Hilton Creek	Tasajarra Creek	Monterey	99%
7	Hilton Creek	Hilton Creek	Santa Barbara	90%
8	Salsipuedes Creek	Lopez Canyon Creek	San Luis Obispo	75%
9	Salsipuedes Creek	Lopez Canyon Creek	San Luis Obispo	56%
10	Salsipuedes Creek	Salsipuedes Creek	Santa Barbara	98%
11	Salsipuedes Creek	Salsipuedes Creek	Santa Barbara	100%
12	Salsipuedes Creek	Salsipuedes Creek	Santa Barbara	100%
13	Salsipuedes Creek	Salsipuedes Creek	Santa Barbara	100%
14	Salsipuedes Creek	Salsipuedes Creek	Santa Barbara	100%
15	Santa Ynez River mainstem	Arroyo Grande Creek	San Luis Obispo	70%
16	Santa Ynez River mainstem	Quiota Creek	Santa Barbara	100%

Figure 30: Location of watersheds and the specific streams in green that contributed steelhead to the Santa Ynez River in WY2008. The numbers in red indicate the coastal distance from the outlet of the watershed of genetic origin to the outlet of the Santa Ynez River; the Ventura River watershed was included due to being second on percentage score for one steelhead. The table insert if from Garza, 2010.

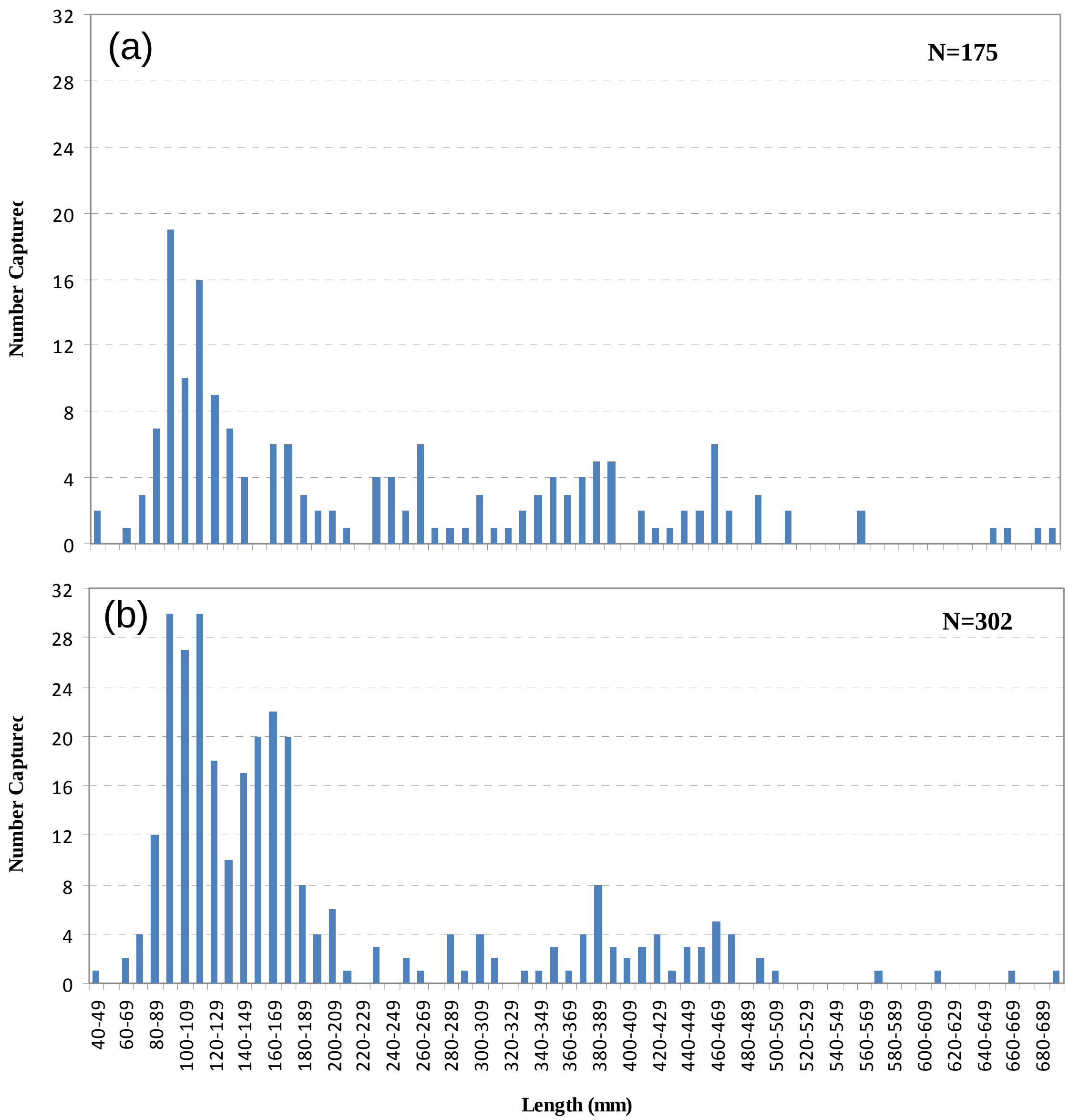


Figure 31: WY2008 Hilton Creek trap length-frequency histogram in 10 millimeter intervals for the (a) upstream and (b) downstream migrant captures.

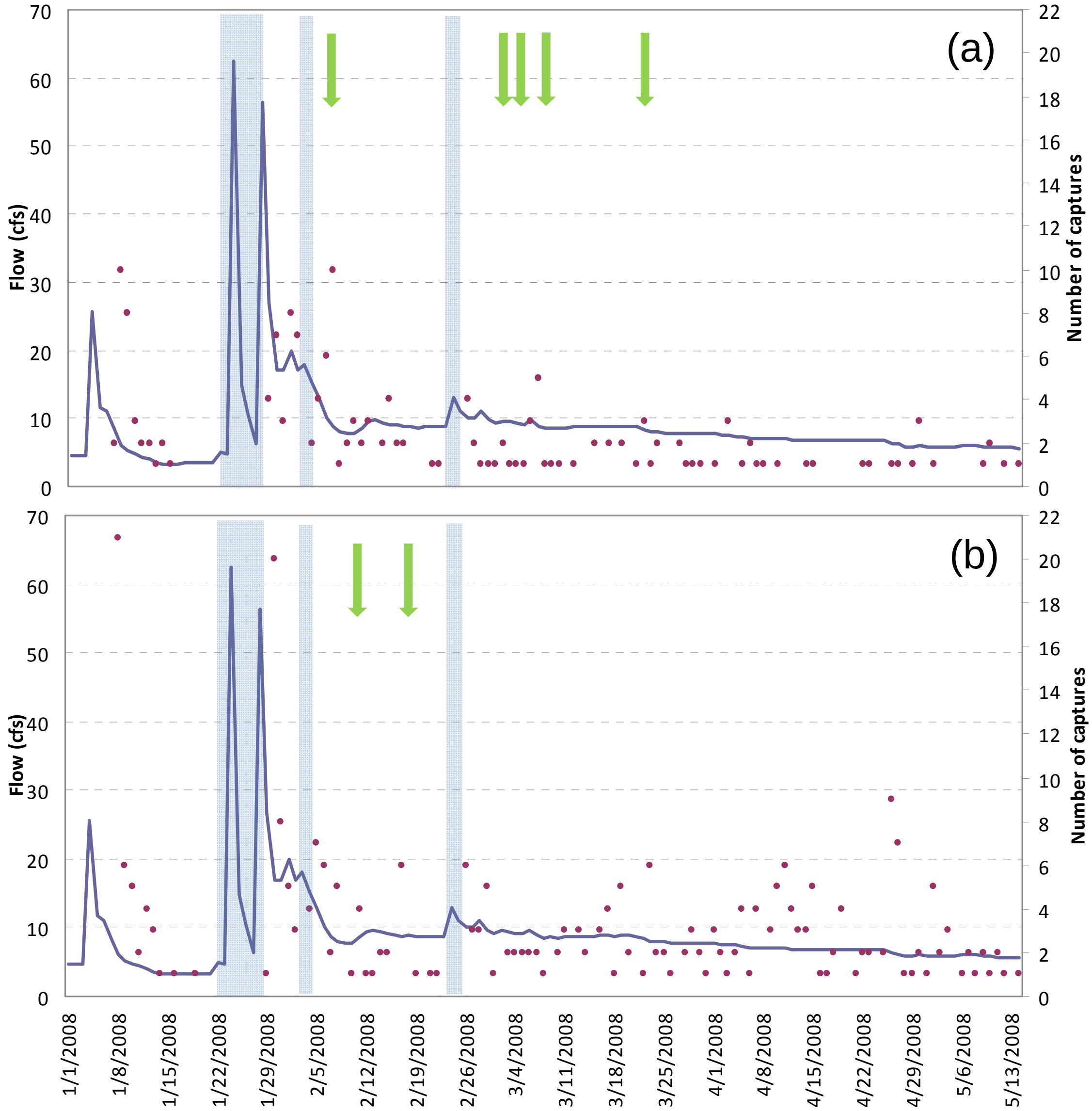


Figure 32: WY2008 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. Green arrows denote the days when anadromous steelhead were captured. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

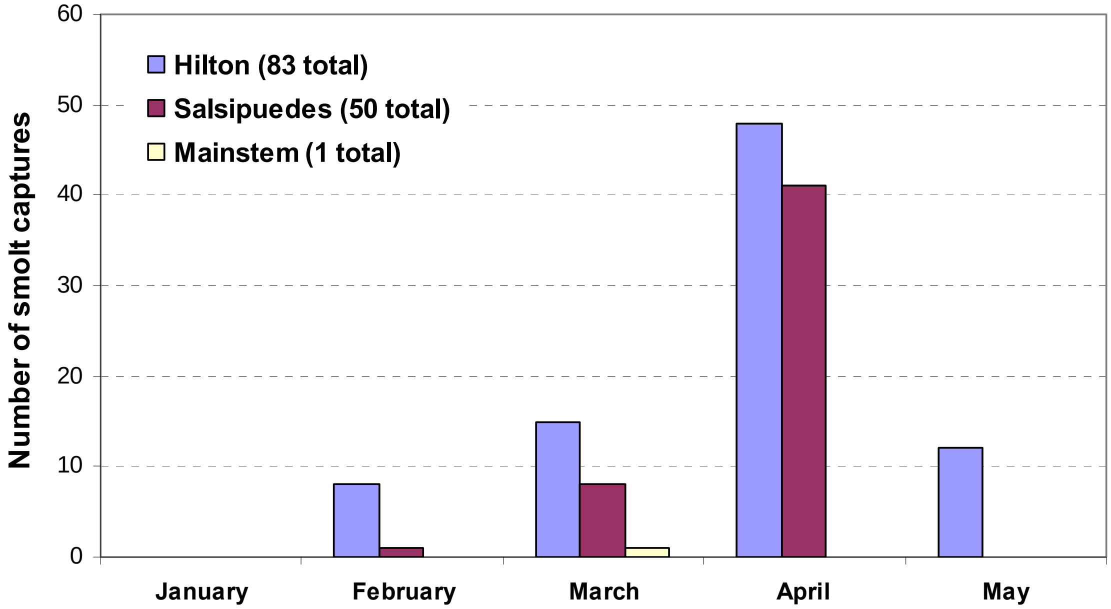


Figure 33: Timing of smolt migration observed at the Hilton Creek, Salsipuedes Creek and LSYR mainstem traps in WY2008.

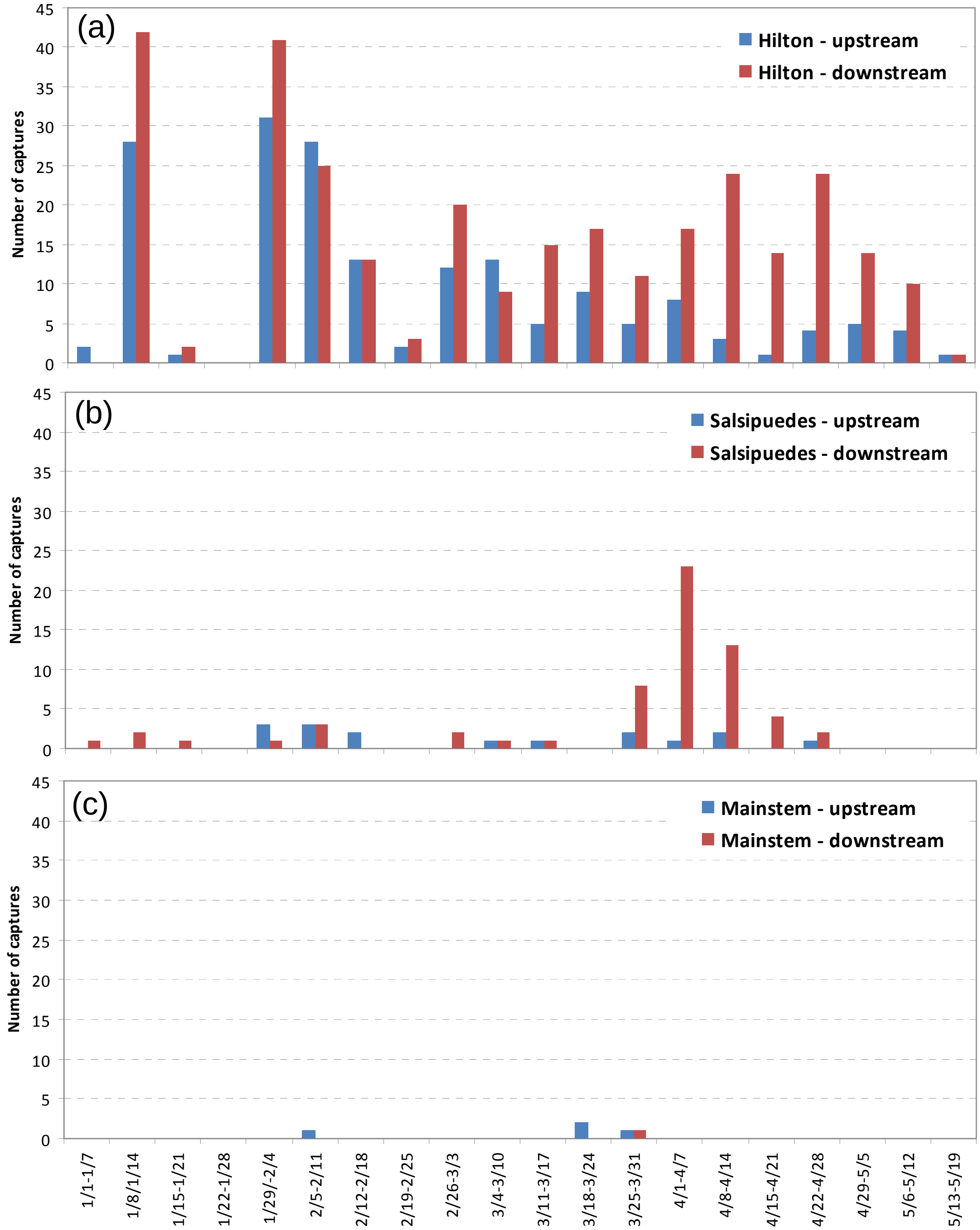


Figure 34: WY2008 paired histogram of weekly upstream and downstream migrant captures by creek: (a) Hilton Creek, (b) Salsipuedes Creek, and (c) LSYR Mainstem.

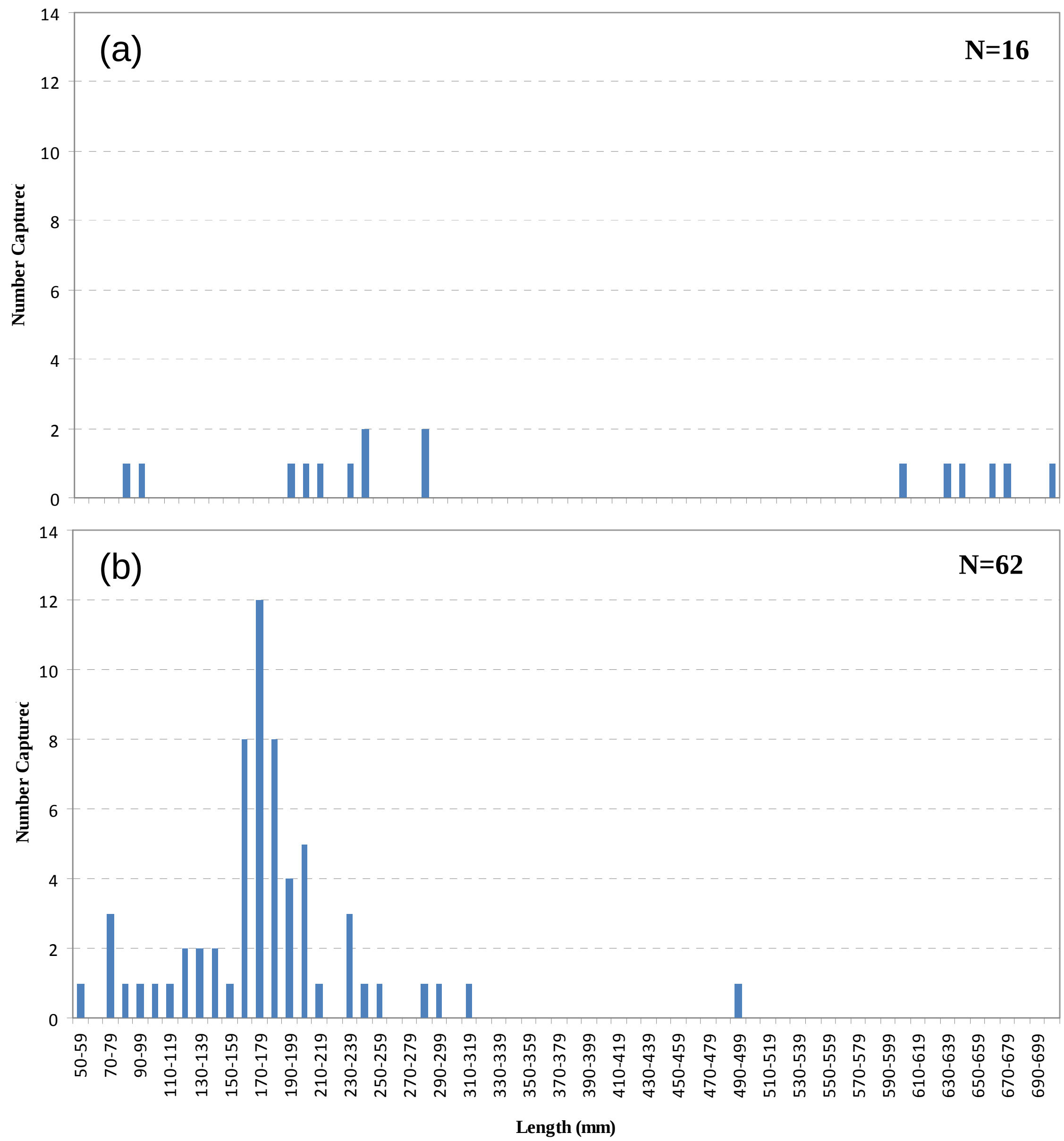


Figure 35: WY2008 Salsipuedes Creek trap length-frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

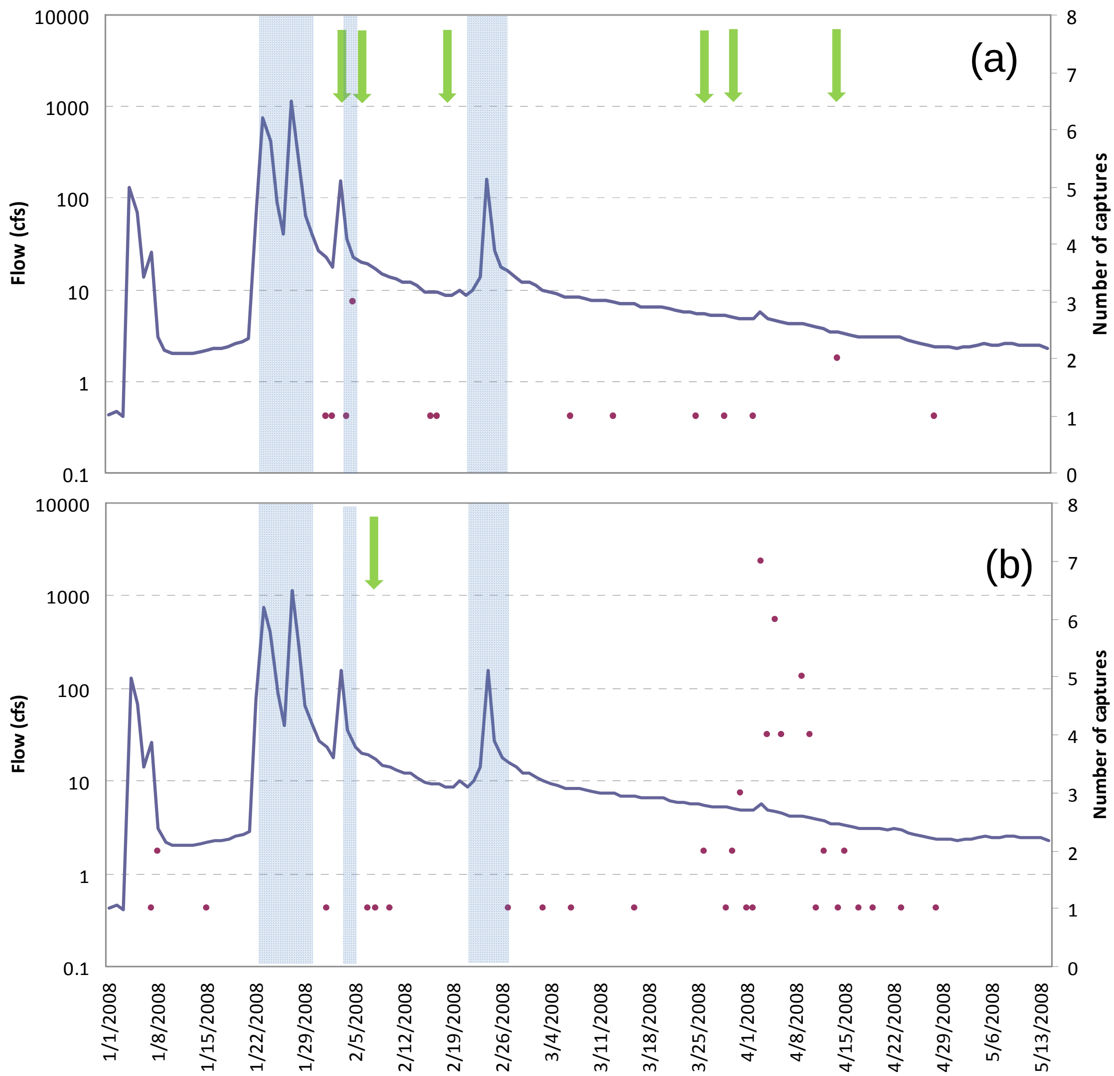


Figure 36: WY2008 Salsipuedes Creek migrant captures (red dots) vs. flow: upstream migrant captures and (b) downstream migrant captures. Green arrows denote the days when anadromous steelhead were captured. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

Table 13: Tributary upstream and downstream migrant captures for Hilton and Salsipuedes creeks in WY2008.

Hilton Captures (#)		Size (mm)		Salsipuedes Captures (#)
		Upstream Traps		
0		>700		1
4		650-699		2
0		600-649		3
2		550-599		0
2		500-549		0
13		450-499		0
6		400-450		0
31		300-399		0
22		200-299		7
63		101-199		1
32		<100		2
175		**Total**		**16**
		Downstream Traps		
0		>700		0
2		650-699		0
1		600-649		0
2		550-599		0
1		500-549		0
14		450-499		0
13		400-449		1
27		(300-399		1
18		200-299		13
	4	*Smolts*	*9*	
	2	*Pre-Smolt*	*1*	
	12	*Res*	*3*	
177		101-199		41
	58	*Smolts*	*33*	
	18	*Pre-Smolt*	*7*	
	101	*Res*	*1*	
49		<100		6
	0	*Smolts*	*0*	
	1	*Pre-Smolt*	*0*	
	48	*Res*	*6*	
304		**Total**		**62**

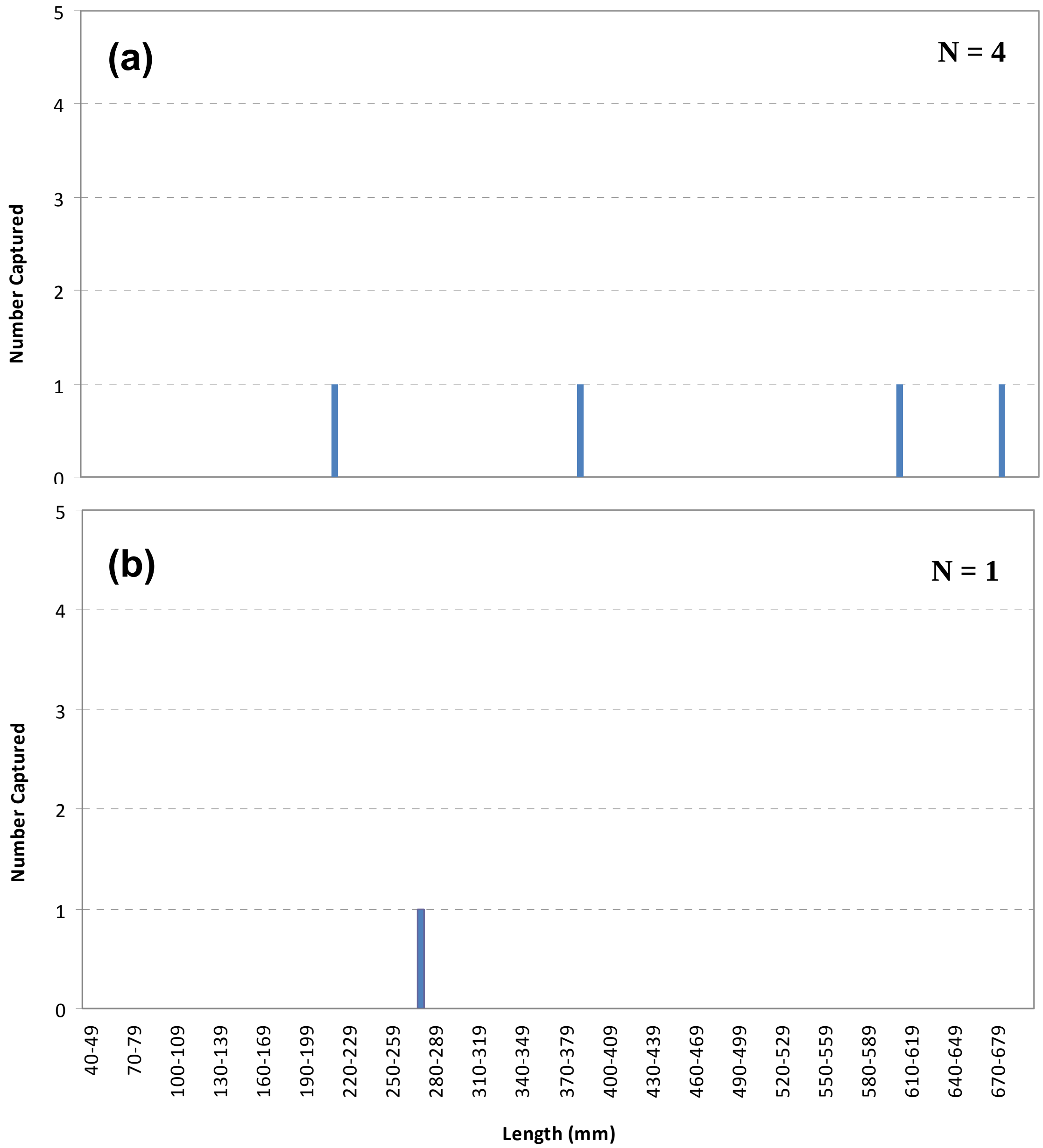


Figure 37: WY2008 LSYR Mainstem trap length-frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

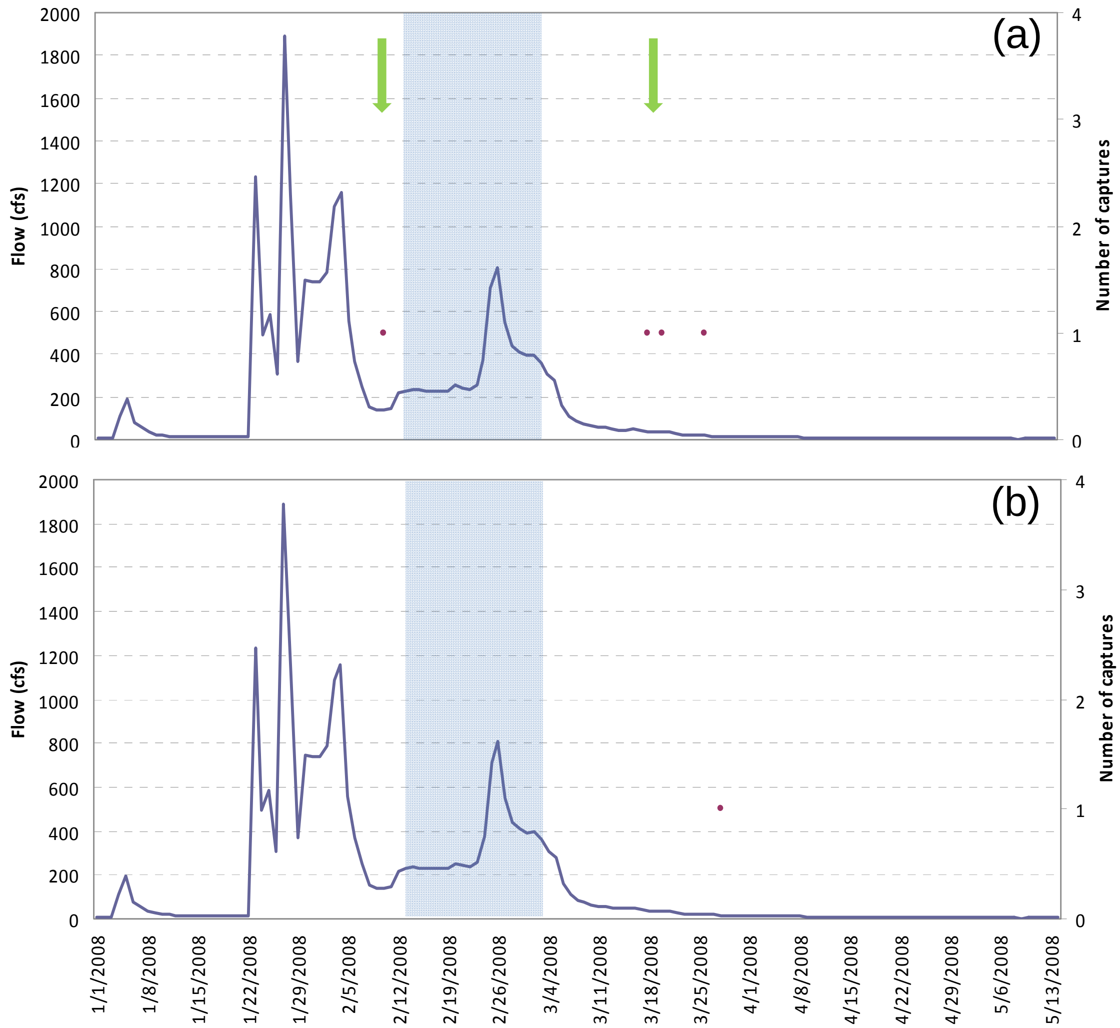


Figure 38: WY2008 LSYR Mainstem migrant captures (red dots) vs. flow: upstream migrant captures and (b) downstream migrant captures. Green arrows denote the days when anadromous steelhead were captured. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

3.5. Reproduction and Rearing

Table 14: WY2008 redd surveys; the distances surveyed are provided in Table 15.

Location	Date	Redd: #	Length	Width
Tributary Redds				
Salsipuedes Creek	2/11/2008	1	6	2.5
	2/12/2008	2	2	1.3
	2/12/2008	3	3.5	2
Hilton Creek	2/21/2008	1	6	2
	2/21/2008	2	3.5	2.5
	2/21/2008	3	4.5	2.8
	2/21/2008	4	2.5	2
Los Amoles Creek tributary of: El Jaro and Salsipuedes creeks	3/6/2008	1	5	2.5
	3/6/2008	2	4	2.5
	3/6/2008	3	3.5	1.5
	3/6/2008	4	3.5	1.5
	3/6/2008	5	4	2
	3/6/2008	6	4	2
	3/6/2008	7	5	3
LSYR Mainstem Redds				
Alisal Reach	3/10/2008	1	6	3
Refugio Reach	3/10/2008	1	4.5	2

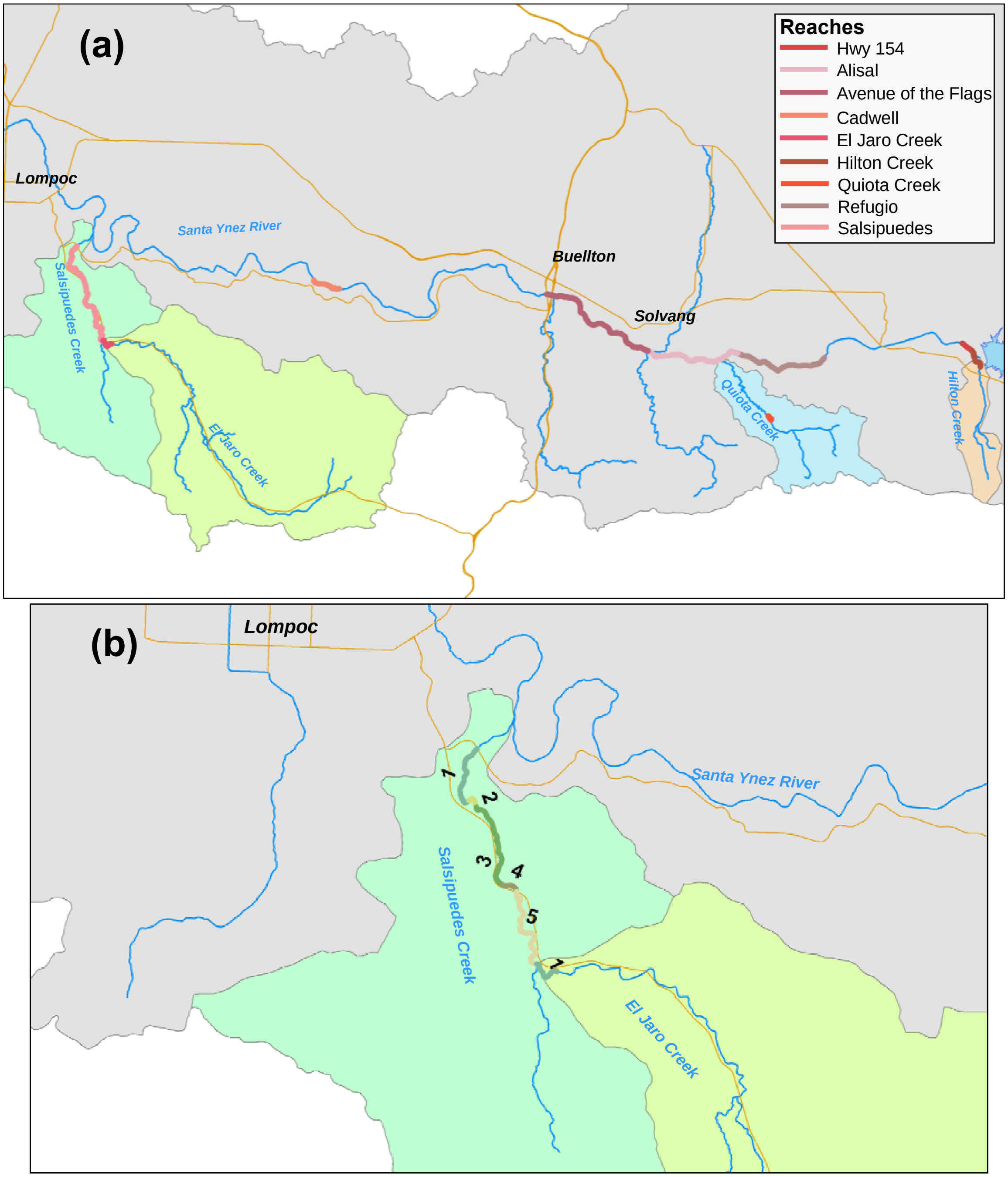


Figure 39: Stream reaches snorkel surveyed in WY2008 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

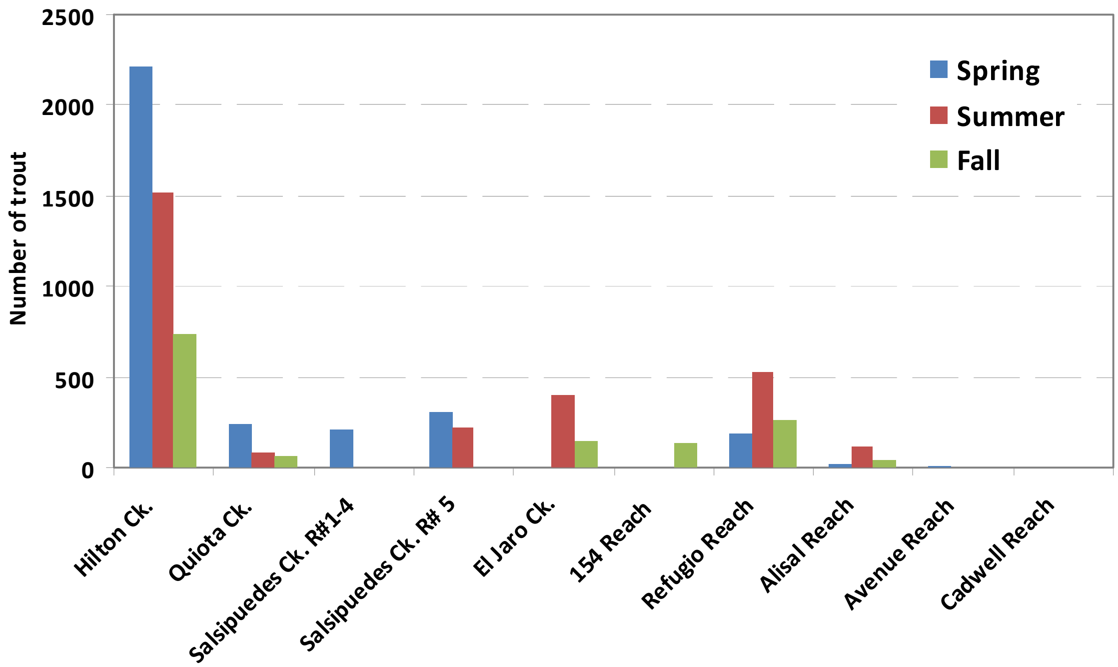


Figure 40: 2008 LSYR steelhead/rainbow trout observed during spring, summer and fall snorkel surveys. The fall Hilton Creek survey was only partially completed due to poor visibility.

Table 15: 2008 Mainstem snorkel survey schedules.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	n/s-turbid
(LSYR-0.2 to LSYR-0.7)	Summer	n/s-turbid
	Fall	10/7/2008
Refugio Reach	Spring	5/5/2008 and 5/28/2008
(LSYR-4.9 to LSYR-7.8)	Summer	9/3-9/4/2008
	Fall	10/22-10/23/2008
Alisal Reach	Spring	5/22/2008 and 5/29/2008
(LSYR-7.8 to LSYR-10.5)	Summer	9/4/2008 and 9/16/2008
	Fall	10/28-10/29/2008
Avenue Reach	Spring	6/16/2008
(LSYR-10.5 to LSYR-13.9)	Summer	n/s-dry
	Fall	n/s-dry
Cadwell Reach	Spring	6/17/2008
(LSYR-22.1 to LSYR-22.7)	Summer	n/s-dry
	Fall	n/s-dry
*n/s = no survey		

Table 16: LSYR mainstem spring, summer and fall snorkel survey results with the miles surveyed; reaches not surveyed (n/a) were due to visibility issues or no water.

Mainstem	Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hwy 154 Reach	n/a	n/a	133	0.26
Refugio Reach	190	528	263	2.95
Alisal Reach	26	118	42	2.80
Avenue Reach	6	n/a	n/a	1.90
Cadwell Reach	0	n/a	n/a	0.81

Table 17: LSYR mainstem spring, summer and fall snorkel survey results broken out by three inch size classes.

Survey	Reach	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hwy 154	Not snorkeled due to turbidity									
	Refugio	68	83	1	14	14	4	1	1	4	**190**
	Alisal	18	6	0	2	0	0	0	0	0	**26**
	Avenue	0	4	0	1	1	0	0	0	0	**6**
	Cadwell	0	0	0	0	0	0	0	0	0	**0**
Summer	Hwy 154	Not snorkeled due to turbidity									
	Refugio	23	447	21	6	17	8	4	0	2	**528**
	Alisal	2	111	3	0	0	2	0	0	0	**118**
	Avenue	Not snorkeled due to low flow									
	Cadwell	Not snorkeled due to low flow									
Fall	Hwy 154	8	100	20	4	1	0	0	0	0	**133**
	Refugio	1	217	11	14	15	4	1	0	0	**263**
	Alisal	0	34	7	0	1	0	0	0	0	**42**
	Avenue	Not snorkeled due to low flow									
	Cadwell	Not snorkeled due to low flow									

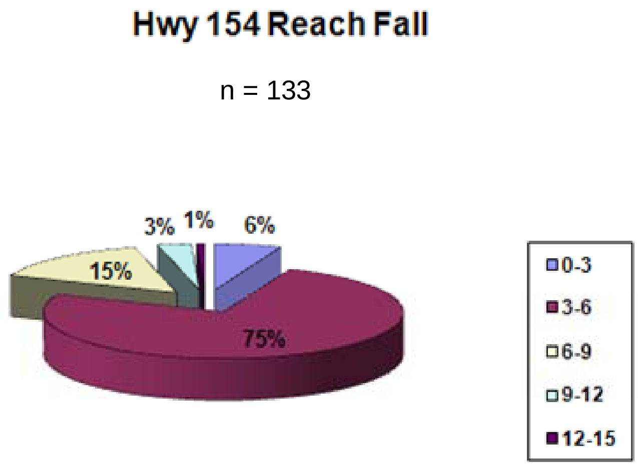


Figure 41: 2008 Hwy 154 Reach fall snorkel survey with size classes of fish observed in inches.

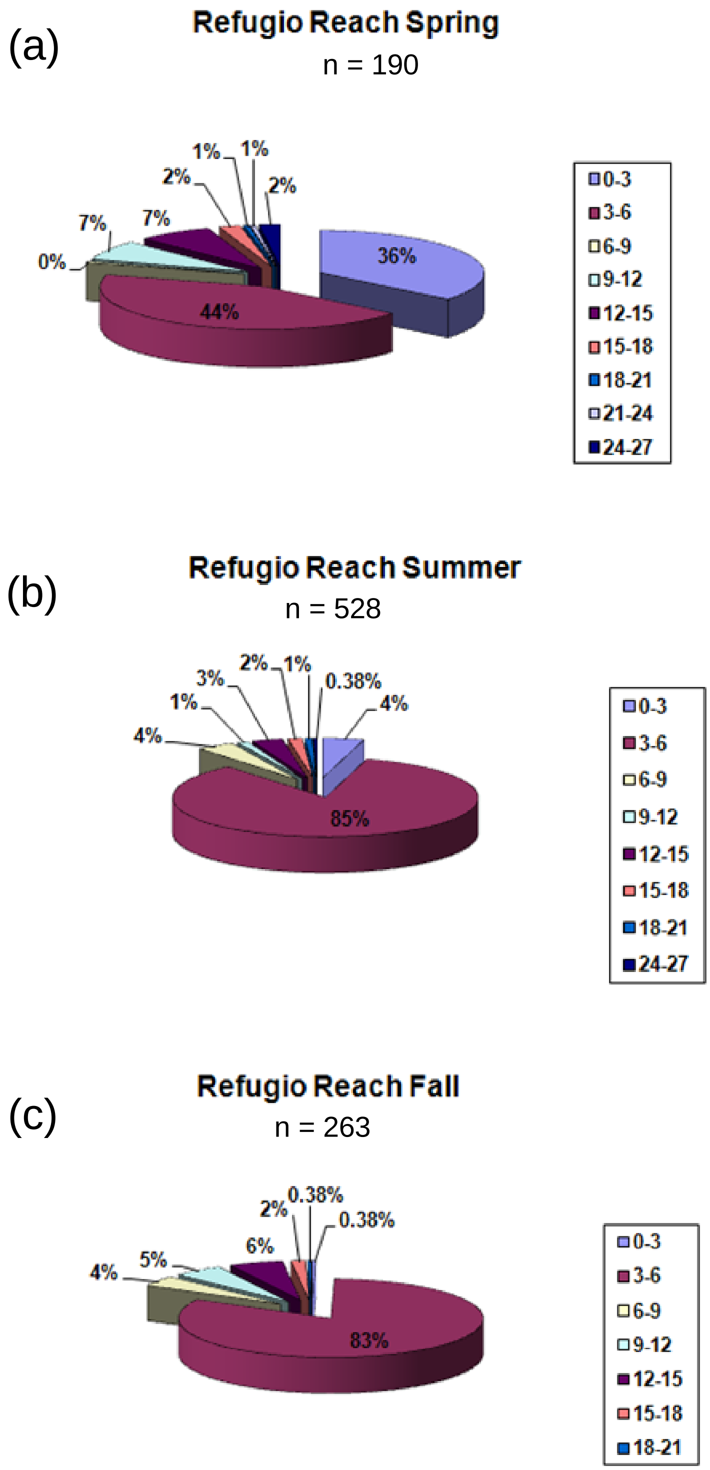


Figure 42: 2008 Refugio Reach snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

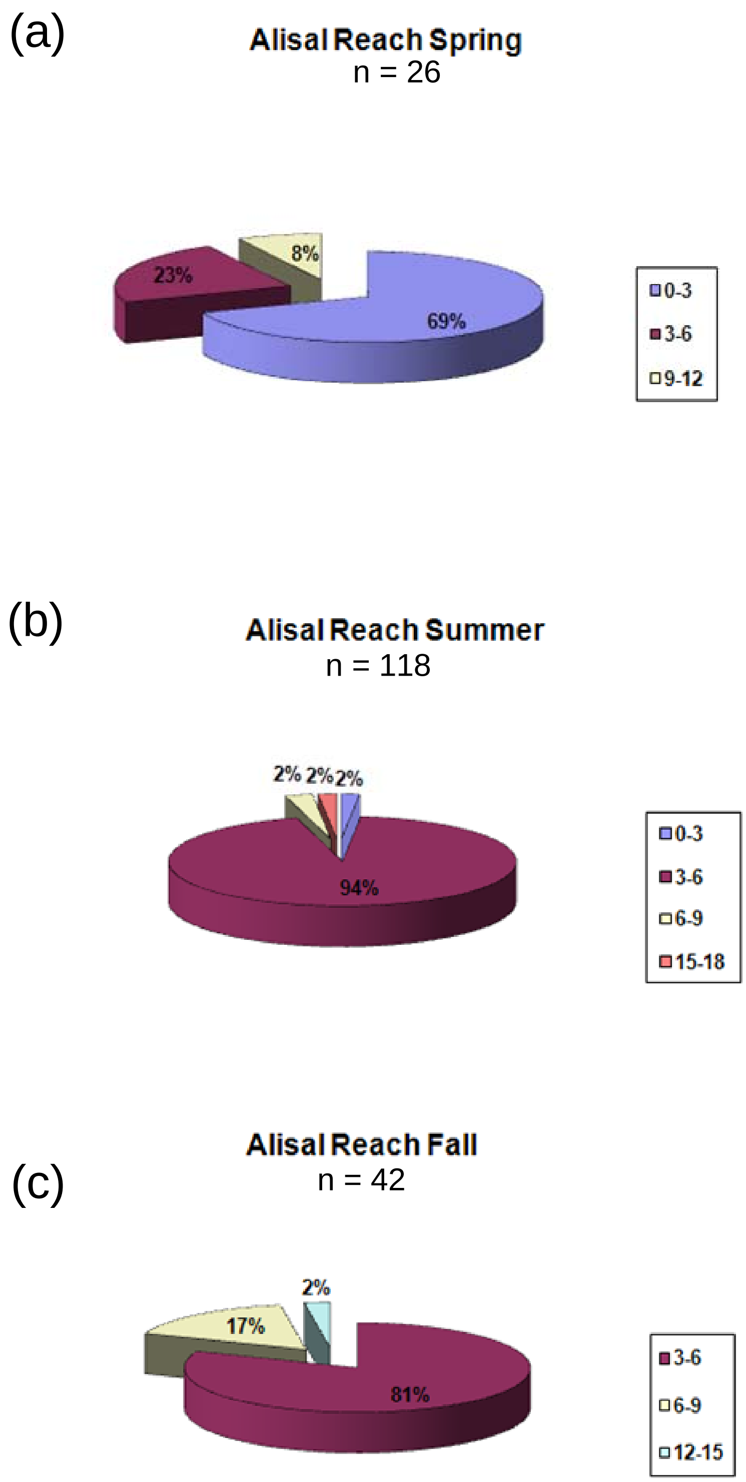


Figure 43: 2008 Alisal Reach snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

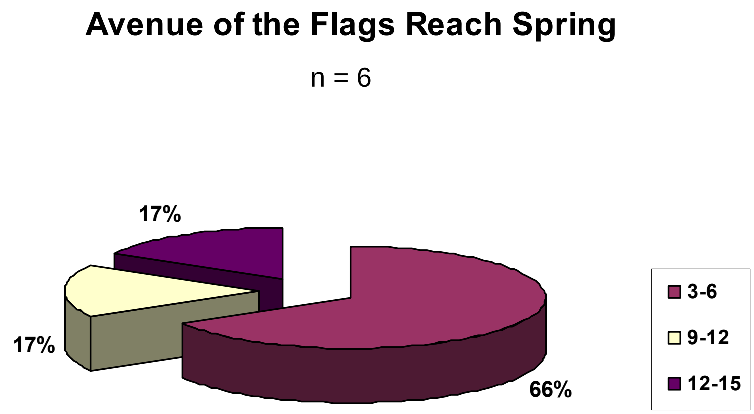


Figure 44: 2008 Avenue of the Flags Reach spring snorkel survey with size classes of fish observed in inches.

Table 18: 2008 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Date
Hilton Creek	Spring	6/17/2008 and 7/3/2008
(HC-0.0 to HC-0.54)	Summer	9/9-9/10/2008
	Fall	10/30/2008 and 11/4/2008
Quiota Creek	Spring	7/15/2008
(QC-2.58 to QC-2.73)	Summer	9/4/2008
	Fall	10/10/2008
Salsipuedes Creek	Spring	7/15/2008
(SC-1.2 to SC-3.75)	Summer	7/28-7/29/2008
	Fall	9/22/2008
El Jaro Creek	Spring	n/s-turbid
(ELC-0.0 to ELC-0.4)	Summer	7/22/2008
	Fall	10/8/2008
*n/s = no survey		

Table 19: Steelhead/rainbow trout observed and miles surveyed during all tributary snorkel surveys.

Tributaries		Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hilton Creek					
	Reach 1	643	401	432	0.133
	Reach 2	251	246	255	0.050
	Reach 3	43	37	51	0.040
	Reach 4	181	147	n/a	0.075
	Reach 5	1029	684	n/a	0.242
	Reach 6	63	4	n/a	0.014
	Total:	***2210***	***1519***	***738***	***0.554***
Quiota Creek		243	81	67	0.11
Salsipuedes Creek	(Reach 1-4)	n/a	216	n/a	2.85
Salsipuedes Creek	(Reach 5)	308	n/a	226	0.45
El Jaro Creek		n/a	405	151	0.35

Table 20: Tributary spring, summer and fall snorkel survey results broken out by three inch size classes.

Survey	Reach	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hilton	1318	749	127	12	3	1				**2210**
	Quiota	188	43	12	0	0	0	0	0	0	**243**
	Salsipuedes (R1-4)	135	52	24	5	0	0	0	0	0	**216**
	Salsipuedes (R-5)	232	62	9	3	1	0	0	1	0	**308**
	El Jaro	342	61	1	1	0	0	0	0	0	**405**
Summer	Hilton	634	785	88	11	1	0	0	0	0	**1519**
	Quiota	61	14	6	0	0	0	0	0	0	**81**
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	Not snorkeled due to turbidity									
	El Jaro	Not snorkeled due to turbidity									
Fall	Hilton	168	521	44	5	0	0	0	0	0	**738**
	Quiota	29	31	7	0	0	0	0	0	0	**67**
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	149	69	6	2	0	0	0	0	0	**226**
	El Jaro	68	79	4	0	0	0	0	0	0	**151**

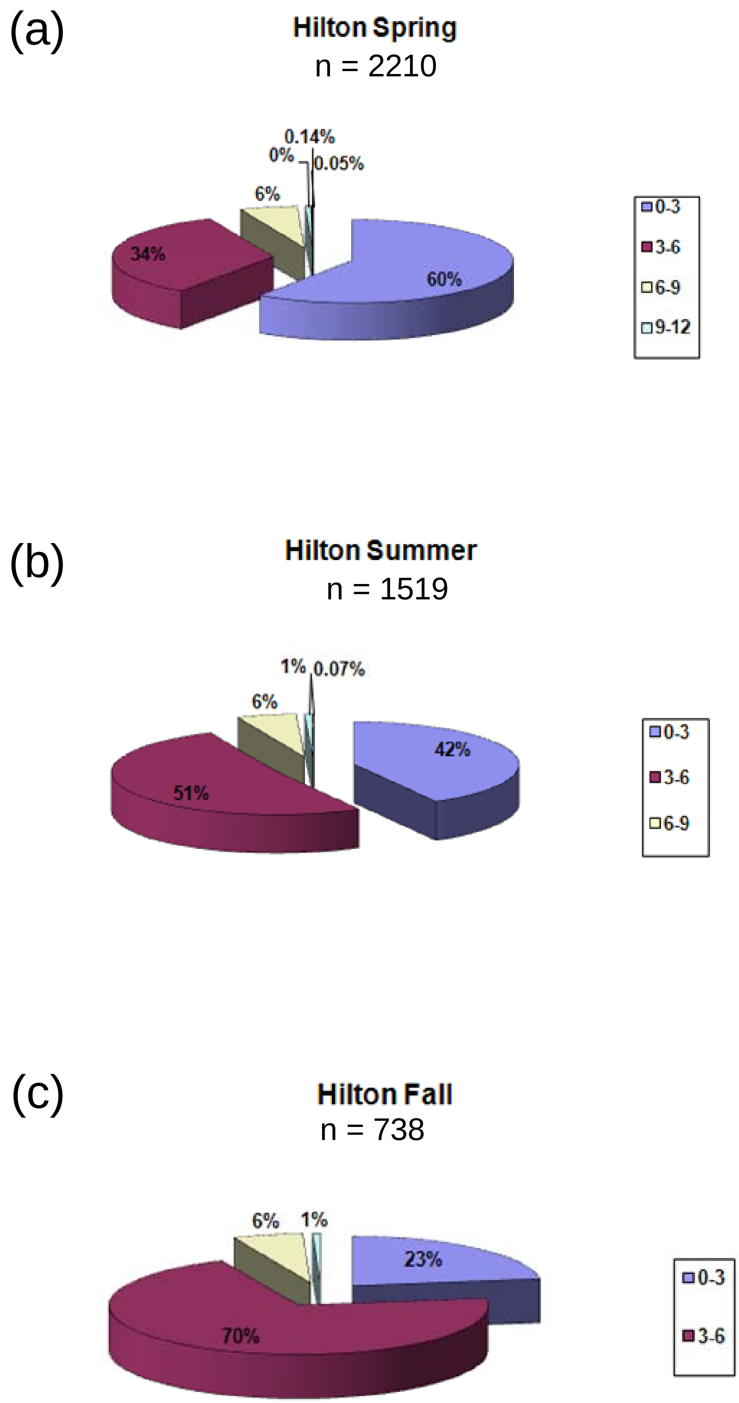


Figure 45: 2008 Hilton Creek snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

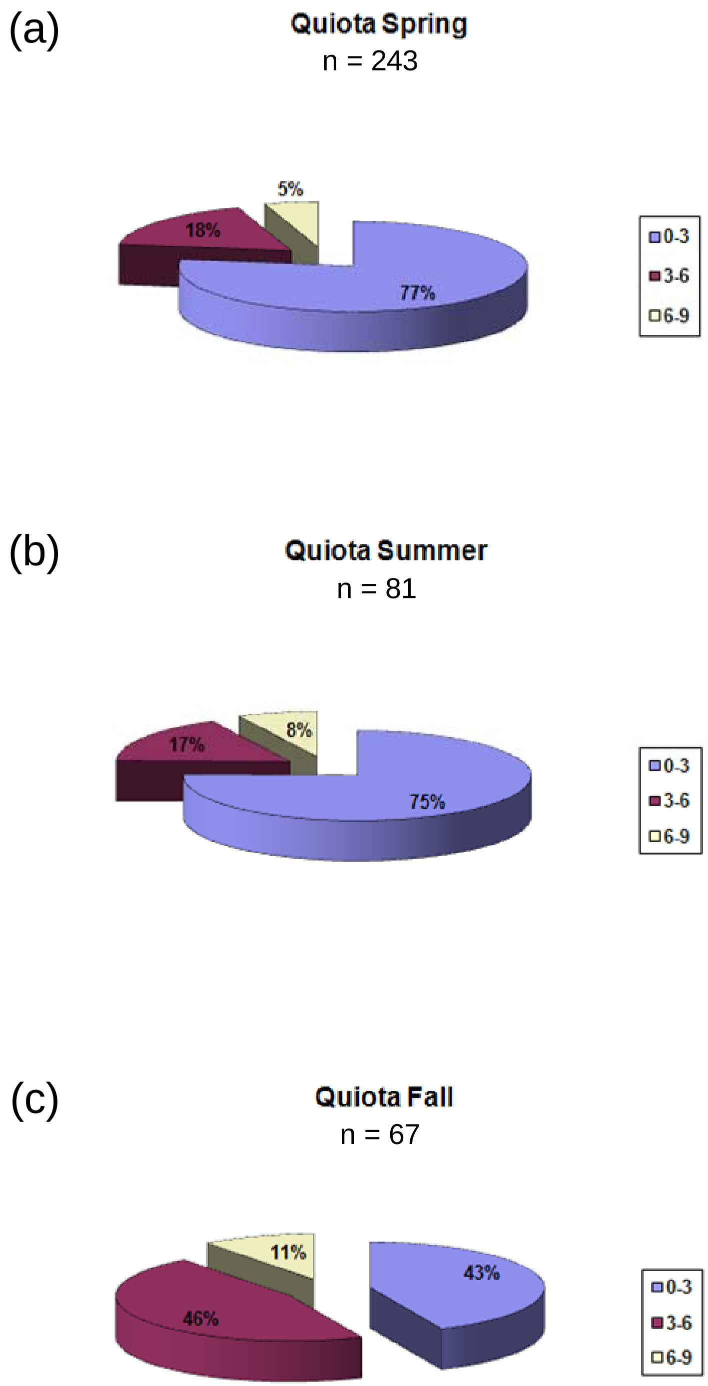
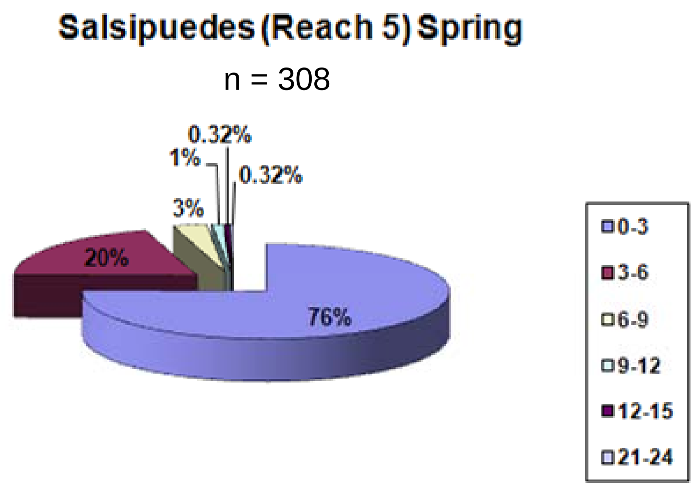
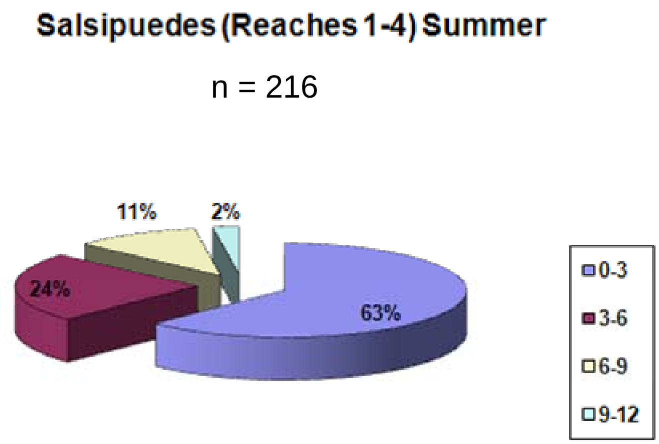


Figure 46: 2008 Quiota Creek snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a)



(b)



(c)

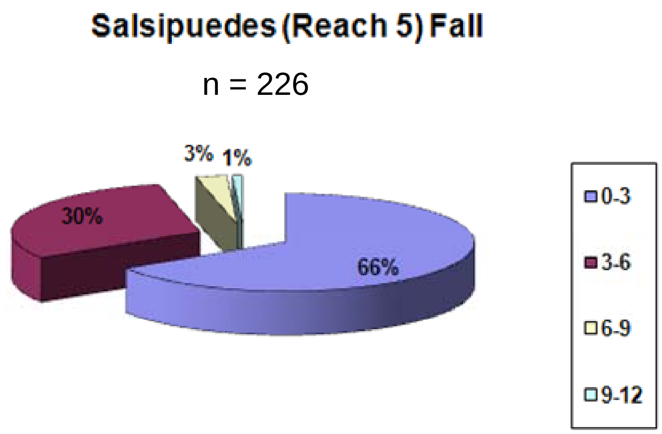


Figure 47: 2008 Salsipuedes Creek snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

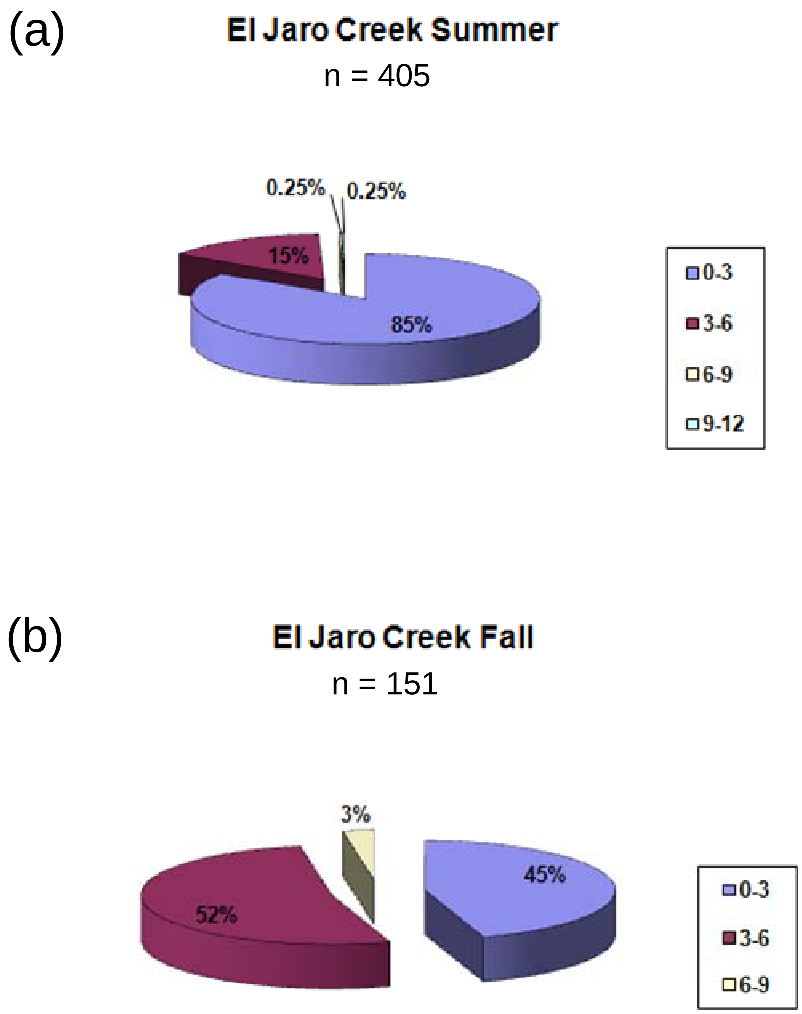


Figure 48: 2008 El Jaro Creek snorkel survey with size classes of fish observed in inches; (a) spring and (b) fall.

Table 21: Observed number of largemouth bass, sunfish and catfish within the Refugio and Alisal reaches of the LSYR during the spring, summer and fall snorkel surveys from WY2005 to WY2008. The reaches and level of effort were the same as for snorkel surveys for *O. mykiss*.

Water Year:	2005	2006	2007	2008
Largemouth Bass				
Spring	0	7	35	4
Summer	20	3	33	626
Fall	237	2	56	508
Sunfish				
Spring	4	9	34	0
Summer	34	41	3	262
Fall	22	1	18	155
Catfish				
Spring	2	0	3	1
Summer	6	55*	2	2
Fall	200*	0	3	1

* Juvenile bullhead catfish.

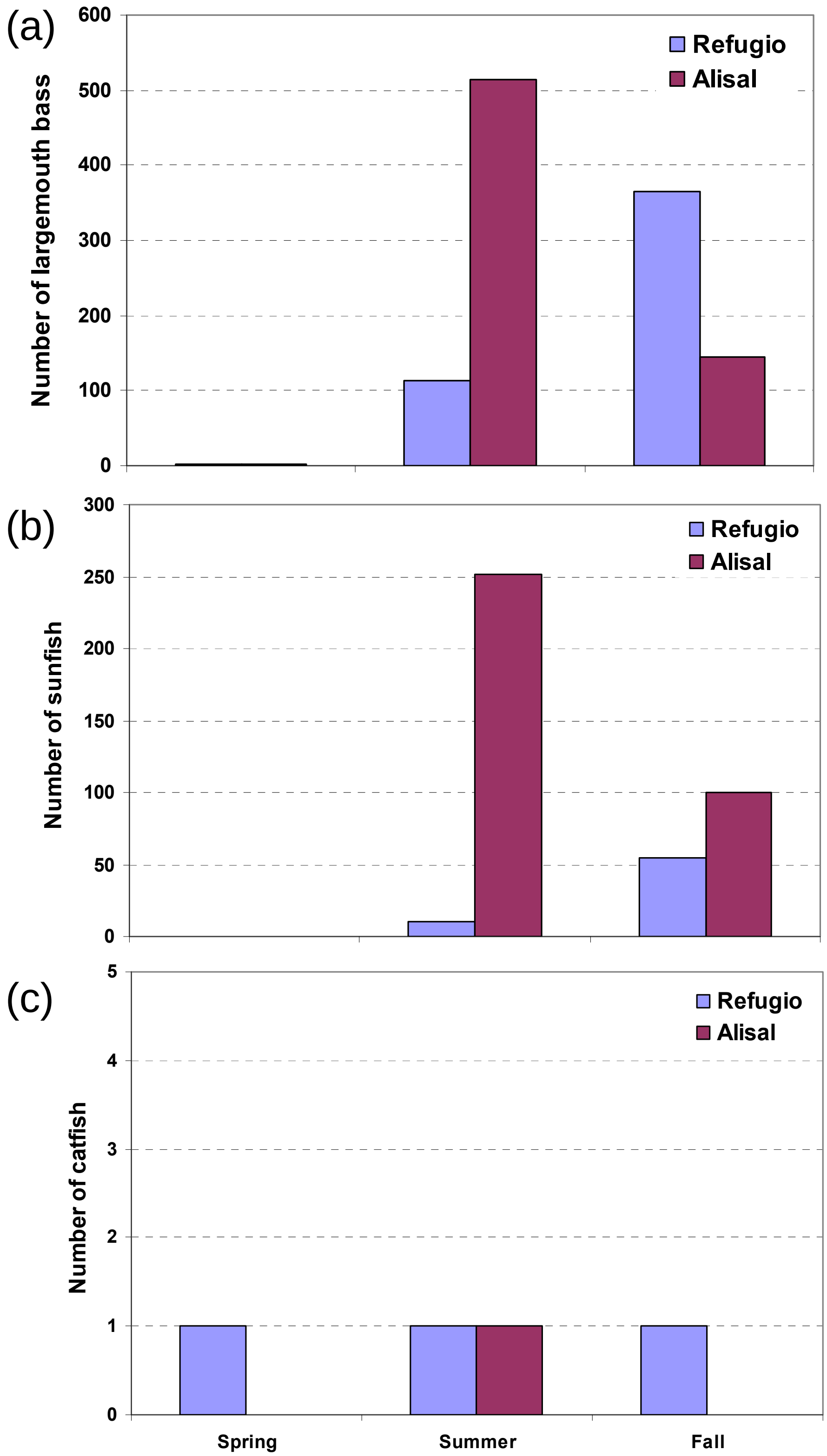


Figure 49: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2008 within the Refugio and Alisal reaches: (a) largemouth bass, (b) sunfish, and (c) catfish.

3.6. Tributary Enhancements – Migration Barrier Removal

Figure 50: Fish passage and habitat restoration in the fall of 2008 at Rancho San Julian on El Jaro Creek.

Figure 51: Fish passage and habitat restoration in the fall of 2008 at Refugio Road on Quiota Creek Crossing 6.

4. Discussion

Table 22: Biological Opinion (BO) tributary project inventory with the completion date specified in the BO and their status to date.

Tributary Projects	BO Expected Completion Date	Current Status (as of January 2011)
Hwy 1 Bridge on Salispuedes Creek	2001	Completed (2002)
Cross Creek Ranch on El Jaro Creek	2005	Completed (2009)
Hwy 101 Culvert on Nojoqui Creek	2005	Proposed removal from BO[1]
Quiota Creek Crossing 1	2003	In design
Quiota Creek Crossing 3	2003	In design
Quiota Creek Crossing 4	2003	In design
Quiota Creek Crossing 5	2003	In design
Quiota Creek Crossing 7	2003	In design[2]
Quiota Creek Crossing 9	2003	In design
Cascade Chute Passage on Hilton Creek	2000	Completed (2005)
Hwy 154 Culvert on Hilton Creek	2002	Proposed removal from BO[1]
Total:	**11**	
Projects completed and in design:	***9***	
Projects suggested to be removed:	***2***	

1. Project proposed for removal from the BO as requested in this analysis.
2. Partial grant funding secured with the rest submitted in a pending grant applications.

Table 23: Non-BO tributary projects already completed or proposed with their status to date.

Tributary Projects	Current Status (as of January 2011)
Jalama Road Bridge on Salsipuedes Creek	Completed (2004)
San Julian Ranch on El Jaro Creek	Completed (2008)
Quiota Creek Crossing 2	In design[1]
Quiota Creek Crossing 6	Completed (2008)
Quiota Creek Crossing 8	In design
Total:	**5**
Projects completed:	***3***
Projects remaining:	***2***

1. Grant received for full construction funding for the project.

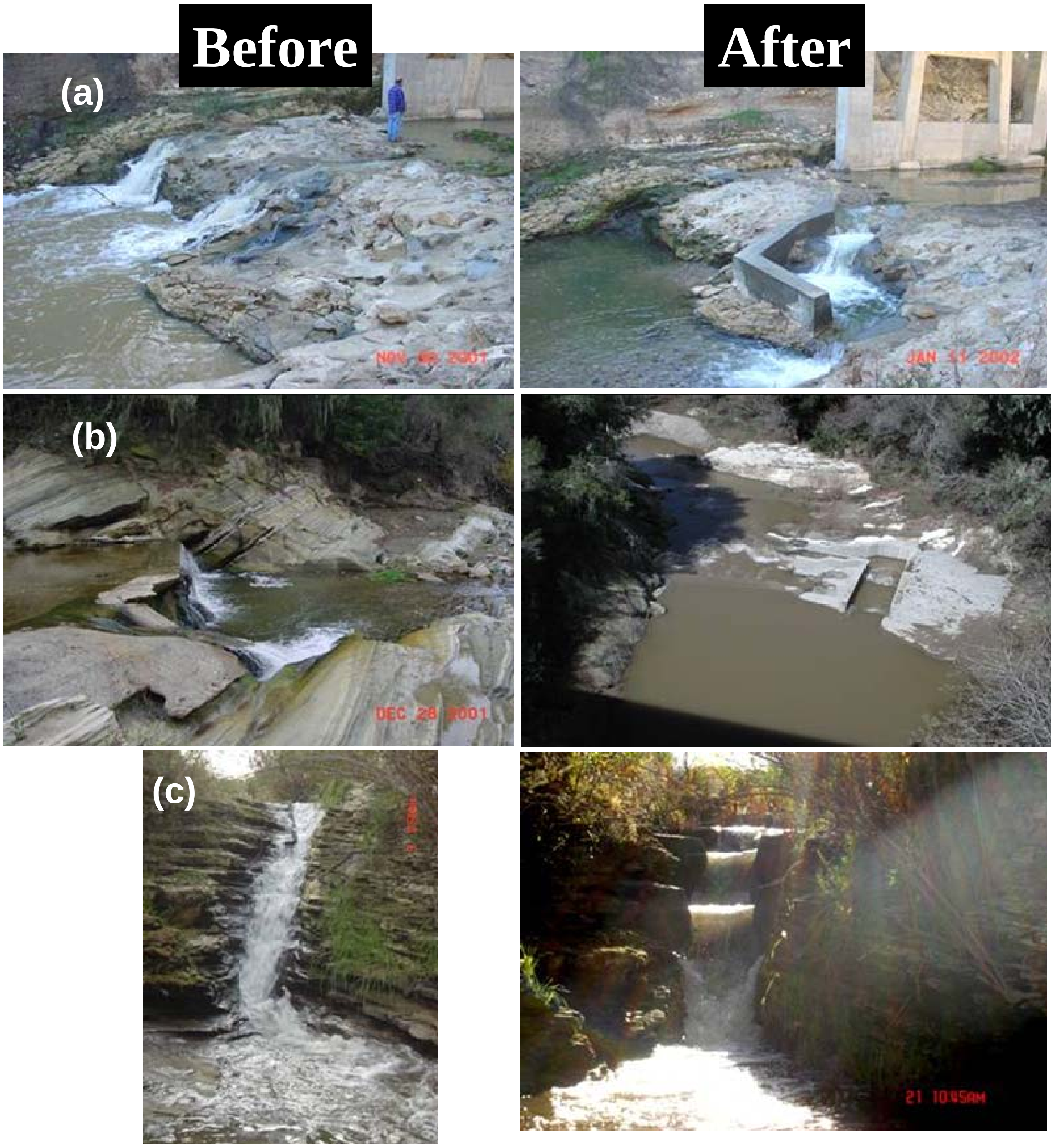


Figure 52: Fish passage and habitat restoration at (a) Hwy 1 Bridge on Salsipuedes Creek (completed in 2002), (b) Jalama Road Bridge on Salsipuedes Creek (completed in 2004), and (c) Cascade Chute barrier on Hilton Creek (completed in 2005).

Table 24: Monthly rainfall totals at Bradbury Dam from WY2000-WY2008.

Month	Water Year (inches):								
	2000	2001	2002	2003	2004	2005	2006	2007	2008
Oct	0.00	2.64	0.62	0.00	0.00	6.38	0.48	0.16	0.34
Nov	1.62	0.00	3.27	2.50	1.20	0.33	1.64	0.20	0.06
Dec	0.00	0.09	2.66	6.73	2.03	13.25	0.73	1.59	2.39
Jan	1.94	8.40	0.87	0.06	0.32	10.30	7.82	1.30	16.57
Feb	10.37	5.71	0.24	3.56	6.52	9.22	3.06	3.03	2.33
Mar	2.76	13.44	0.79	2.40	0.48	3.08	4.31	0.15	0.46
Apr	4.73	1.35	0.13	2.15	0.00	1.27	4.89	0.81	0.06
May	0.01	0.06	0.12	2.33	0.00	0.51	1.56	0.00	0.38
Jun	0.04	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.00
Jul	0.00	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Aug	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sept	0.00	0.00	0.08	0.00	0.00	0.03	0.00	0.17	0.00
Total:	21.47	31.75	8.78	19.76	10.55	44.41	24.49	7.41	22.59

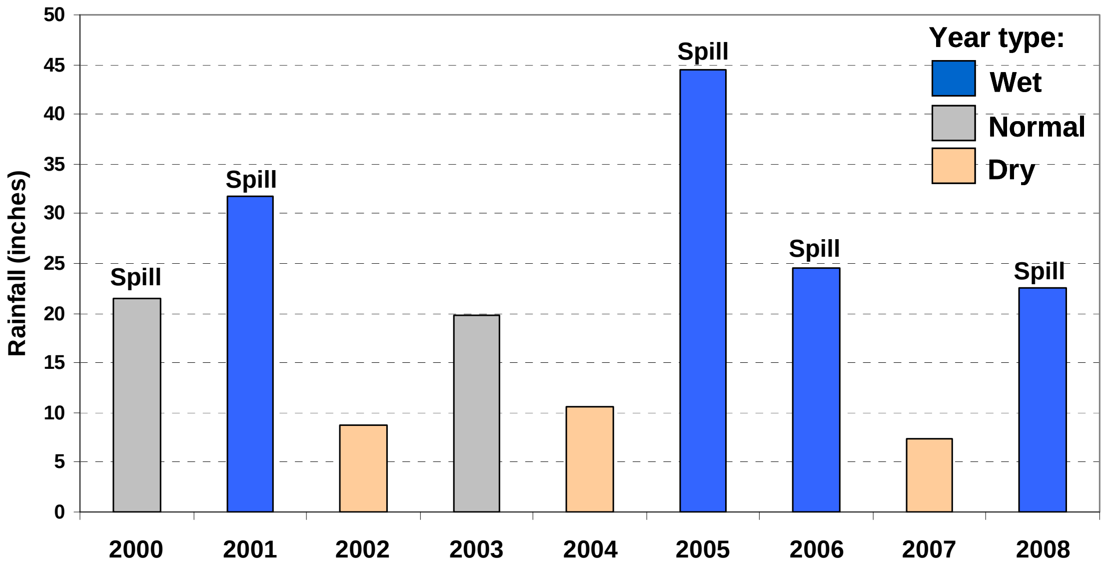


Figure 53: Year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defines as dry (=< 15 inches), Normal (15 to 22 inches) and Wet (=> 22 inches) at Bradbury Dam.

Table 25: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2005-WY2008.

Month	WY2005		WY2006		WY2007		WY2008	
	Solvang (cfs)	***Narrows*** (cfs)	***Solvang*** (cfs)	***Narrows*** (cfs)	***Solvang*** (cfs)	***Narrows*** (cfs)	***Solvang*** (cfs)	***Narrows*** (cfs)
Oct	31.1	29.4	6.05	9.41	7.3	0.998	25	17.5
Nov	6.35	14.2	6.94	16	5.8	0.996	7.36	8.54
Dec	293.2	478.5	10.7	20.1	7.74	9.98	6.61	13.2
Jan	2,556	2,765	40	79.4	9.37	15.3	265	496.3
Feb	2,296	2,555	12.2	28.0	10.4	18.6	401.1	490.1
Mar	776.6	929.3	51.2	86.1	8.82	10.7	93.9	158.4
Apr	206.8	300.8	1,317	1,053	4.52	1.43	8.46	18.9
May	104.3	150.7	131.9	139.6	1.47	0.475	6.3	6.77
Jun	13.8	32.7	20.1	26.5	1.93	0.13	5.05	2.49
Jul	9.15	14.0	7.83	4.76	35.8	1.39	7.09	0.42
Aug	6.35	2.86	4.69	0.975	55.2	30.8	3.68	0.069
Sep	6.02	4.15	5.7	1.0	31.0	23.4	3.76	0

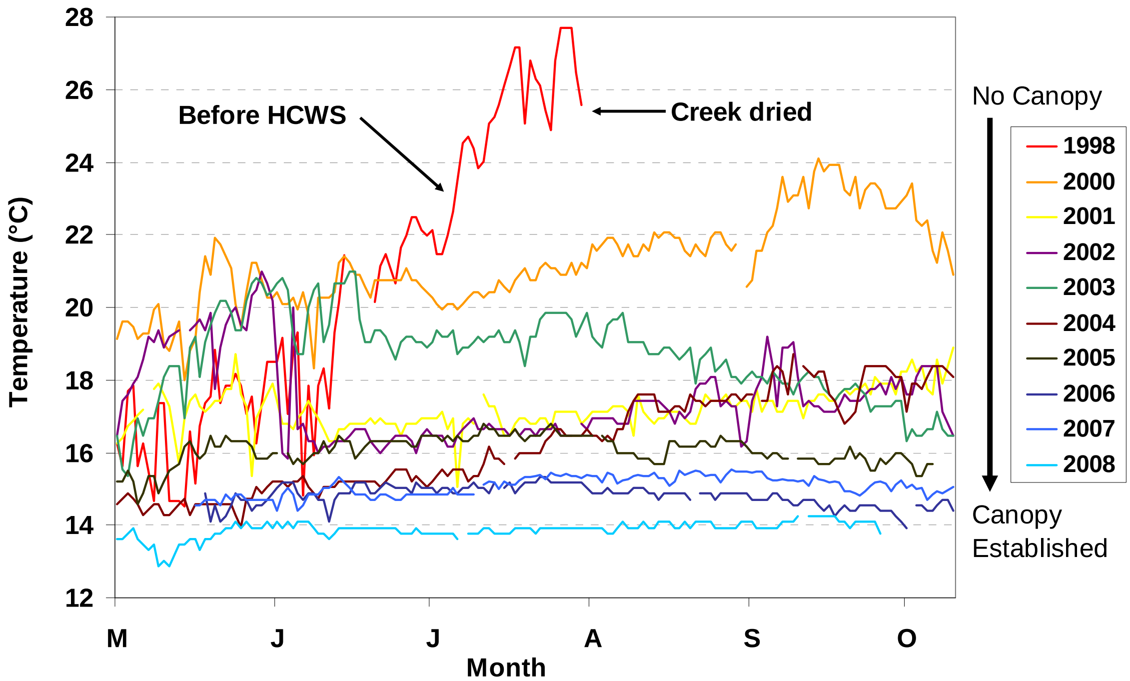


Figure 54: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2008.

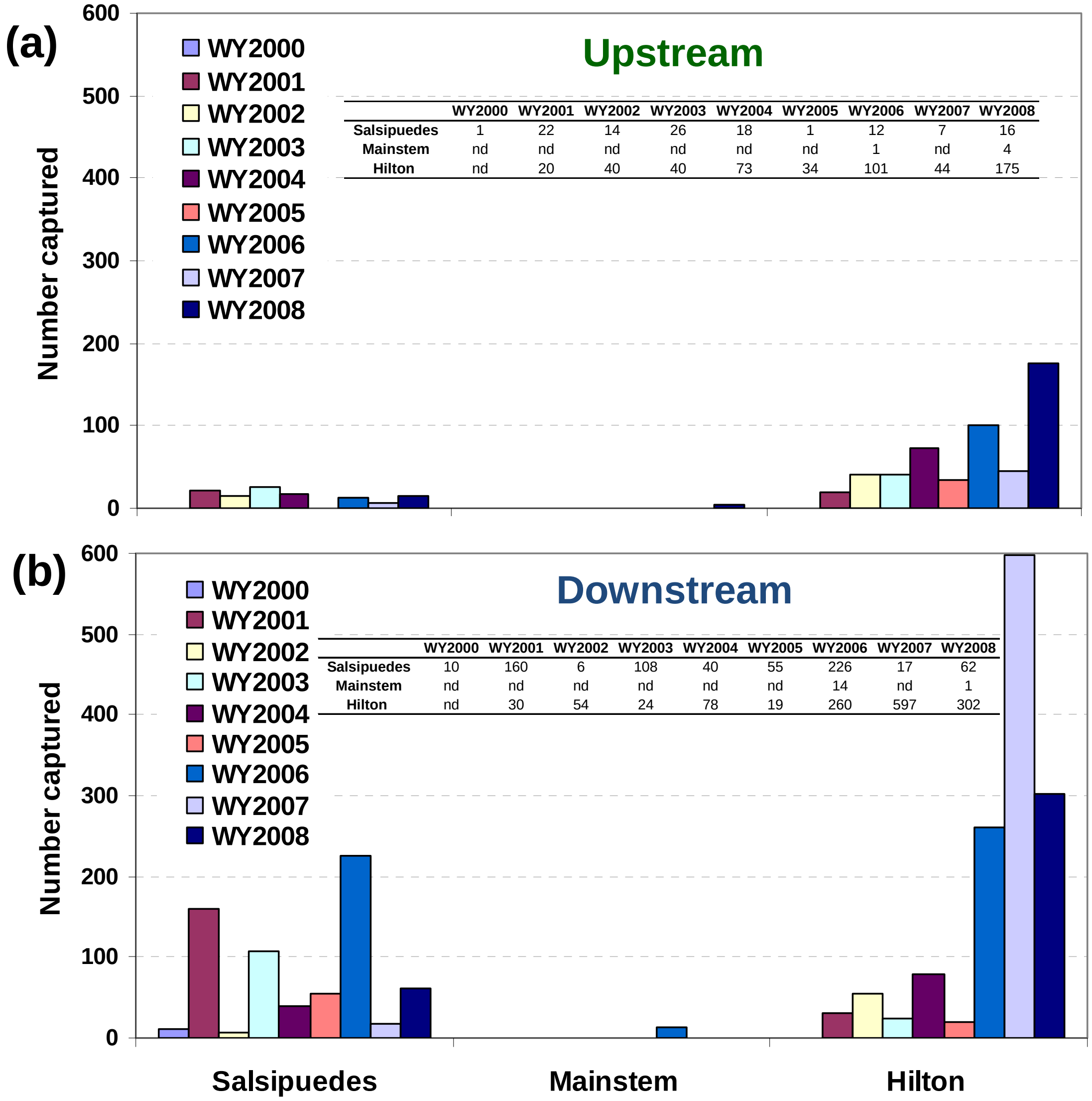


Figure 55: Upstream and downstream migrant capture totals for WY2000-WY2008 for the Salsipuedes Creek, LSYR Mainstem and Hilton Creek traps. The LSYR Mainstem traps were not deployed prior to WY2005 (no access) and WY2007 (low flow).

Table 26: Trapping season statistics for WY2000 through WY2008.

	Salsipuedes Creek								
	WY2000	*WY2001*	*WY2002*	*WY2003*	*WY2004*	*WY2005*	*WY2006*	*WY2007*	*WY2008*
Trapping season	178	119	101	133	122	122	132	116	116
Days out of service	84	28	0	15	5	38	20	4	16
Functional Trap Days	94	91	101	118	117	84	112	112	100
Efficiency	52.8%	76.5%	100%	88.7%	95.9%	69.8%	84.9%	96.6%	86.2%
CPUE U/S & D/S	0.12	2.0	0.2	1.14	0.48	0.7	2.1	0.2	0.8
Rain Year Class.	Normal	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet
	LSYR Mainstem								
	*WY2000**	*WY2001**	*WY2002**	*WY2003**	*WY2004**	*WY2005**	*WY2006*	*WY2007***	*WY2008*
Trapping season	-	-	-	-	-	-	34	-	61
Days out of service	-	-	-	-	-	-	2	-	19
Functional Trap Days	-	-	-	-	-	-	32	-	42
Efficiency	-	-	-	-	-	-	94.1%	-	68.9%
CPUE U/S & D/S	-	-	-	-	-	-	0.44	-	0.10
Rain Year Class.	Normal	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet
	Hilton Creek								
	WY2000	*WY2001*	*WY2002*	*WY2003*	*WY2004*	*WY2005*	*WY2006*	*WY2007*	*WY2008*
Trapping season	59	123	100	134	122	127	132	116	129
Days out of service	45	39	0	11	1	22	7	4	11
Functional Trap Days	14	84	100	123	121	105	125	112	118
Efficiency	23.7%	68.3%	100%	91.8%	99.2%	82.7%	94.7%	97.0%	91.5%
CPUE U/S & D/S	0	0.60	0.95	0.53	1.25	0.41	2.88	5.72	4.00
Rain Year Class.	Normal	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet

* Not deployed

** Too dry to install

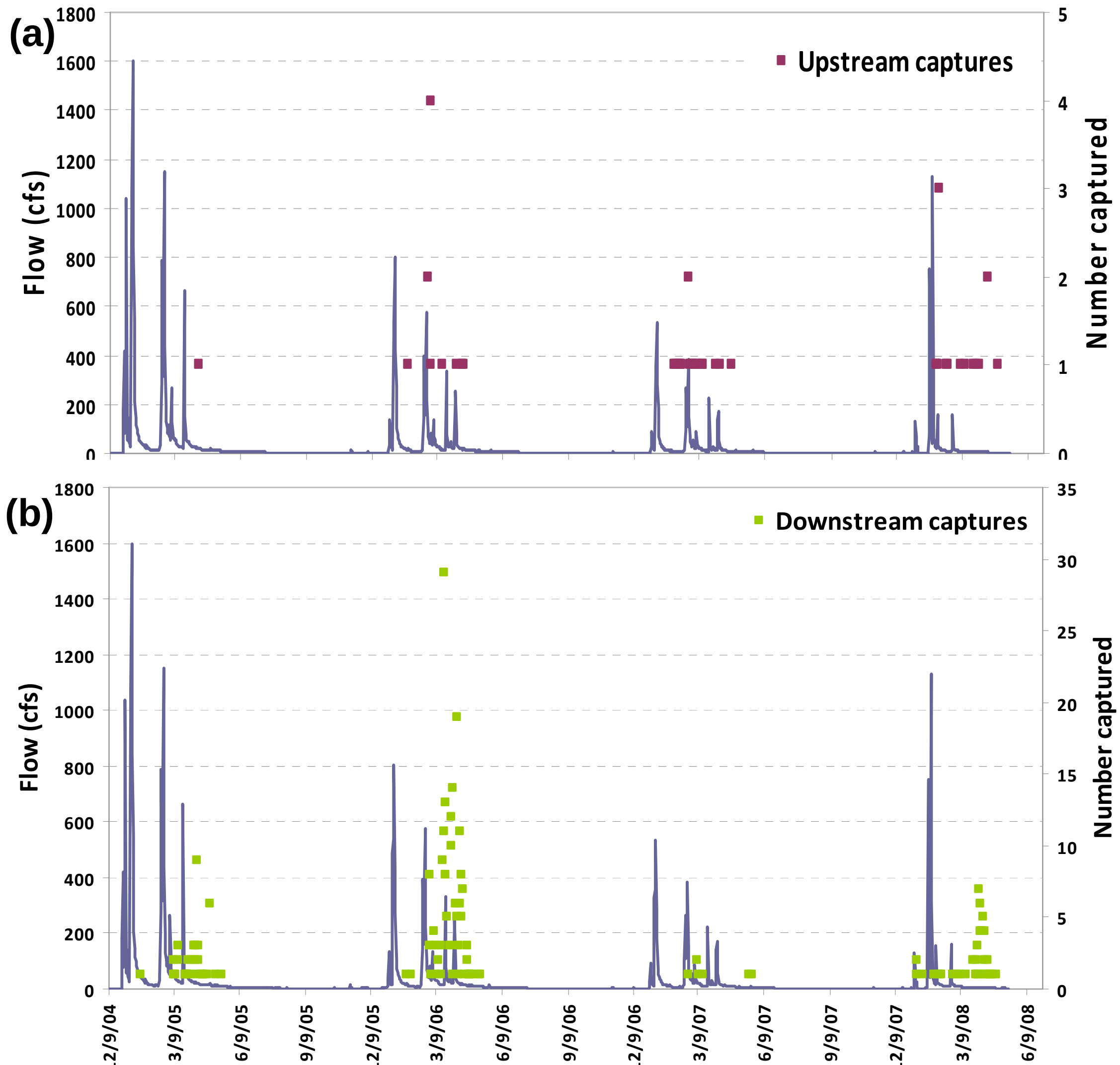


Figure 56: WY2005-WY2008 (s) upstream and (b) downstream migrant captures at the Salsipuedes Creek trap. Average daily flow data were from the USGS Salsipuedes gauge on the LYSR. Traps were removed just prior to peak storm flow events.

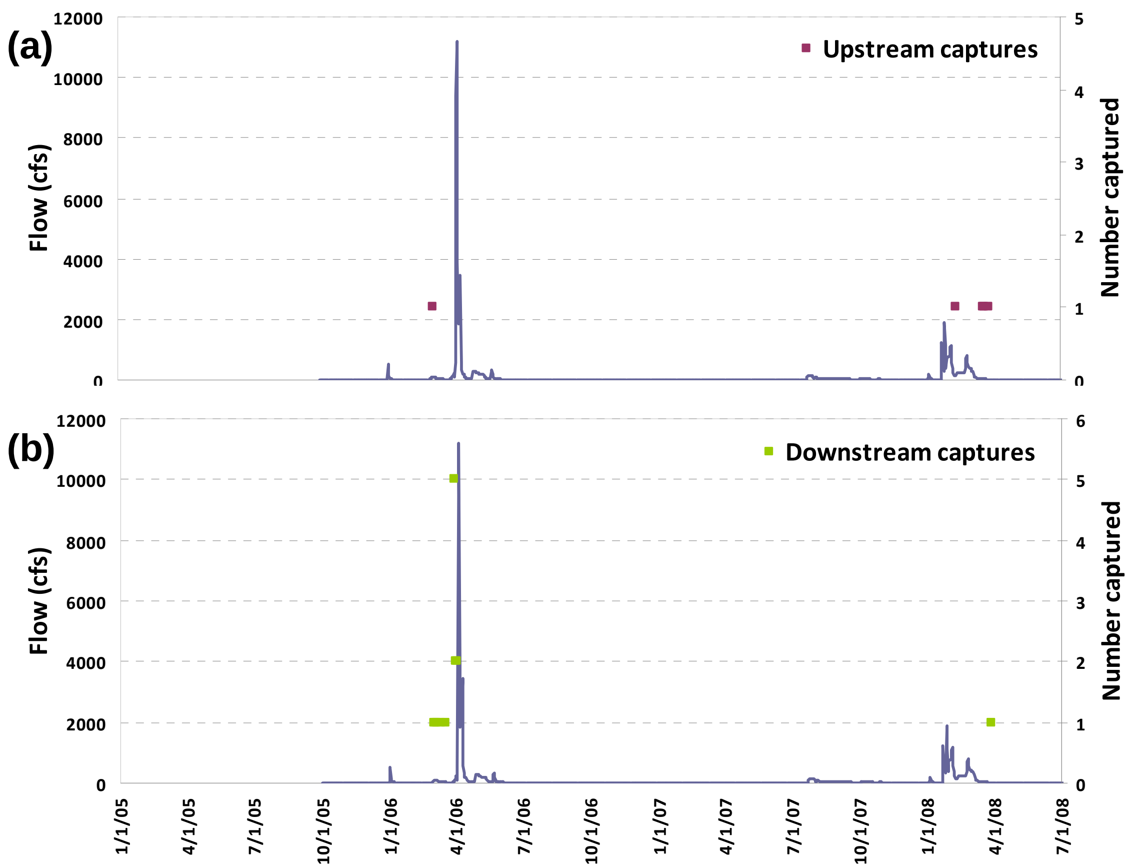


Figure 57: WY2005-WY2008 (s) upstream and (b) downstream migrant captures at the LYSR Mainstem trap. Average daily flow data were from the USGS Solvang gauge on the LYSR. Traps were removed just prior to peak storm flow events. The LSYR Mainstem traps were not deployed in WY2005 and WY2007.

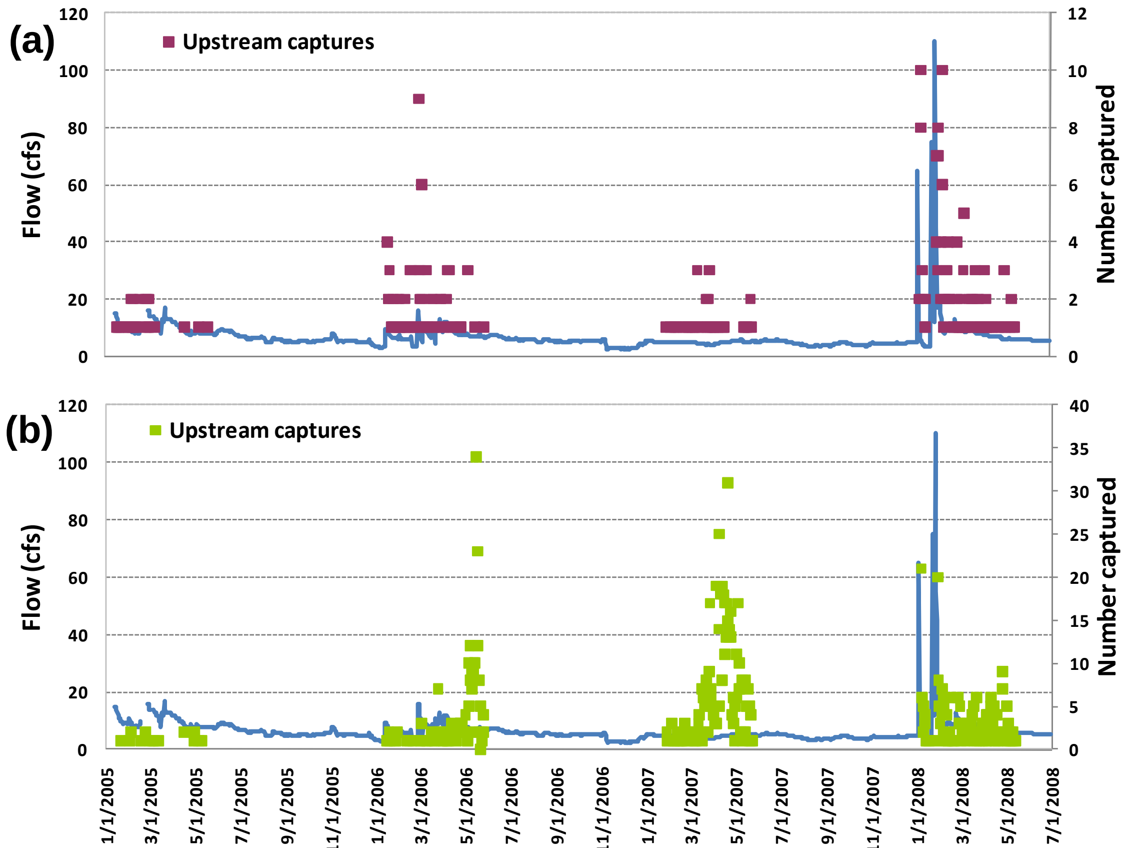
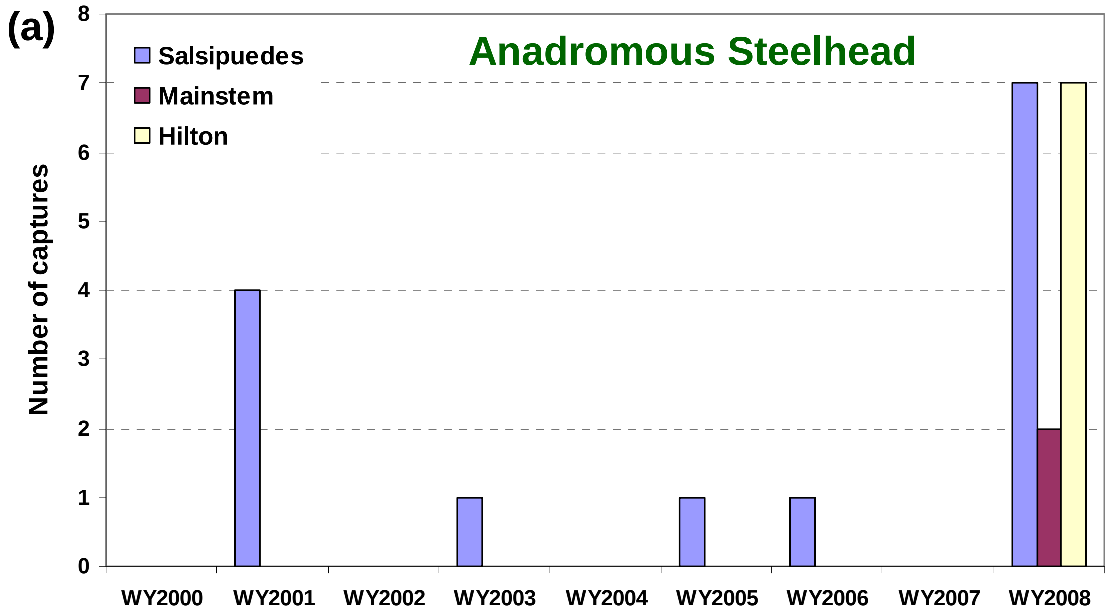
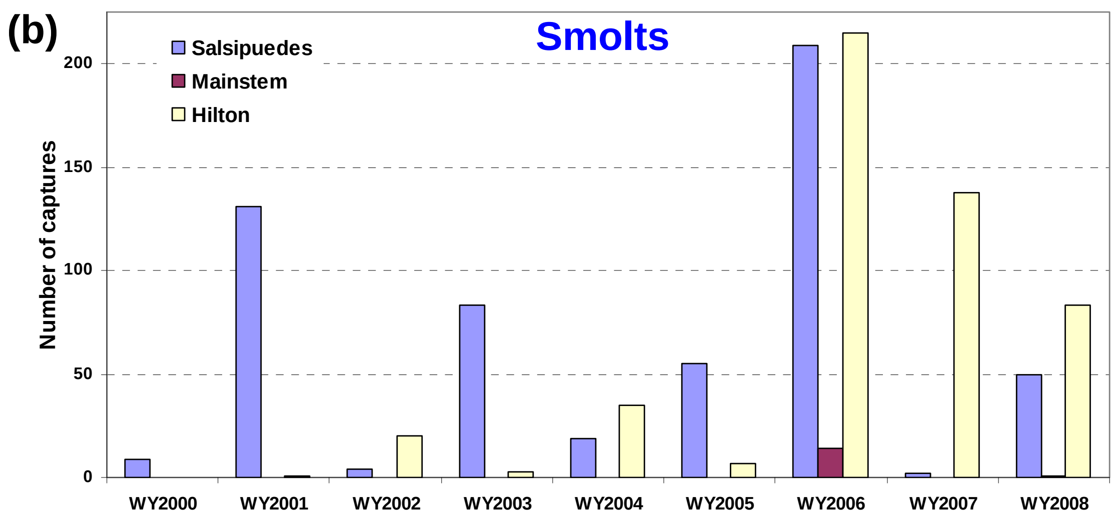


Figure 58: WY2005-WY2008 (s) upstream and (b) downstream migrant captures at the Hilton Creek trap. Average daily flow data were from the USGS Hilton Creek gauge just below the upper release point of the HCWS. Traps were removed just prior to peak storm flow events.



	WY2000	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008
Salsipuedes	0	4	0	1	0	1	1	0	7
Mainstem	-	-	-	-	-	-	0	0	2
Hilton	0	0	0	0	0	0	0	0	7
Total	*0*	*4*	*0*	*1*	*0*	*1*	*1*	*0*	*16*



	WY2000	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008
Salsipuedes	9	131	4	83	19	55	209	2	50
Mainstem	-	-	-	-	-	-	14	-	1
Hilton	-	1	20	3	35	7	215	138	83
Total	*9*	*132*	*24*	*86*	*54*	*62*	*438*	*140*	*134*

Figure 59: (a) Anadromous steelhead and (b) smolt captures from WY2000 throughWY2008 at the Salsipuedes Creek, LSYR Mainstem, and Hilton Creek traps. The mainstem trap was first installed in the spring of 2006 and was not deployed in WY2007.

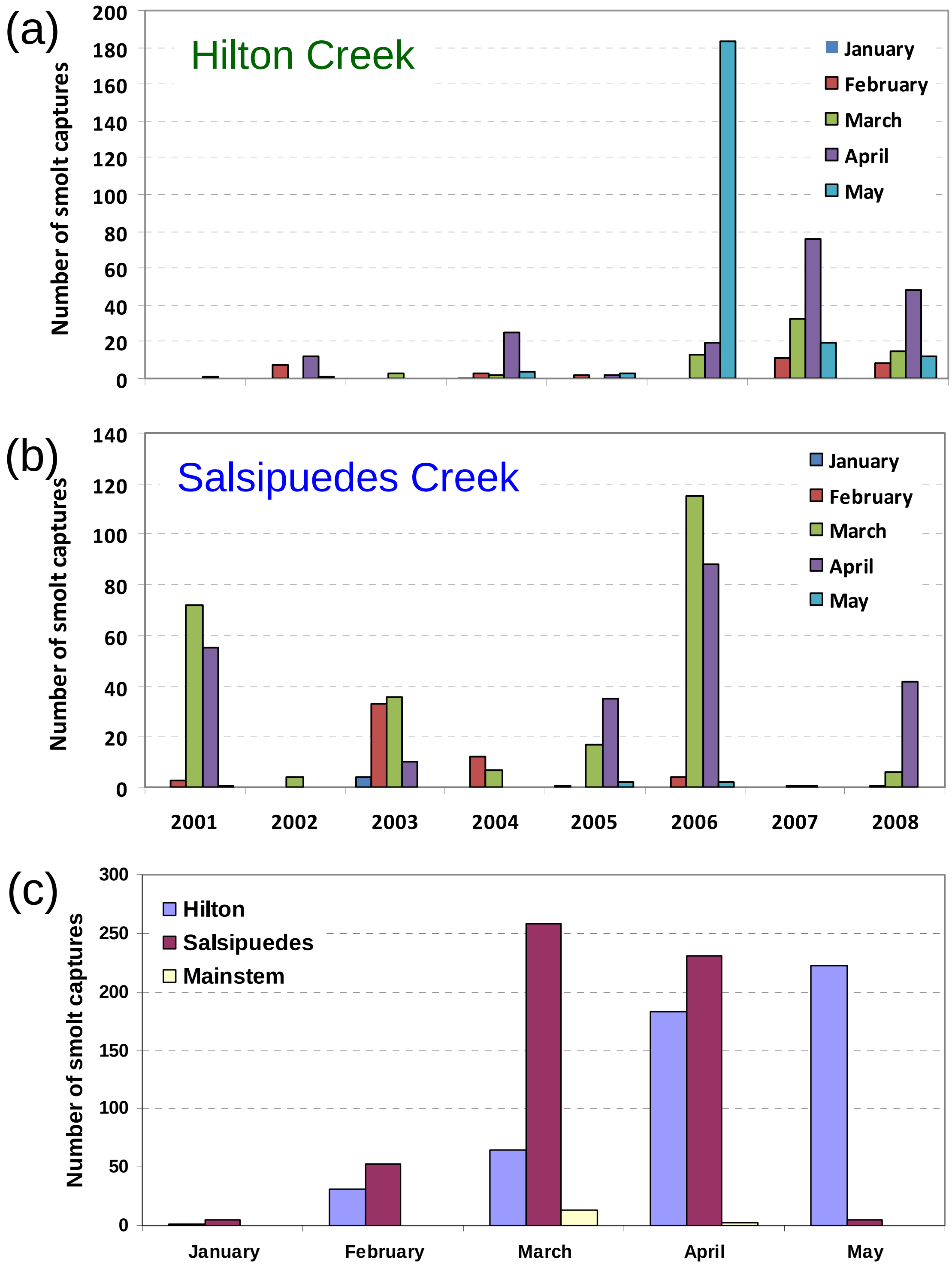


Figure 60: Timing of smolt migration observed at (a) Hilton and (b) Salsipuedes creeks from WY2001 through WY2008; (c) a tabulation of all the years of smolt captures (WY2001-WY2008) by month.

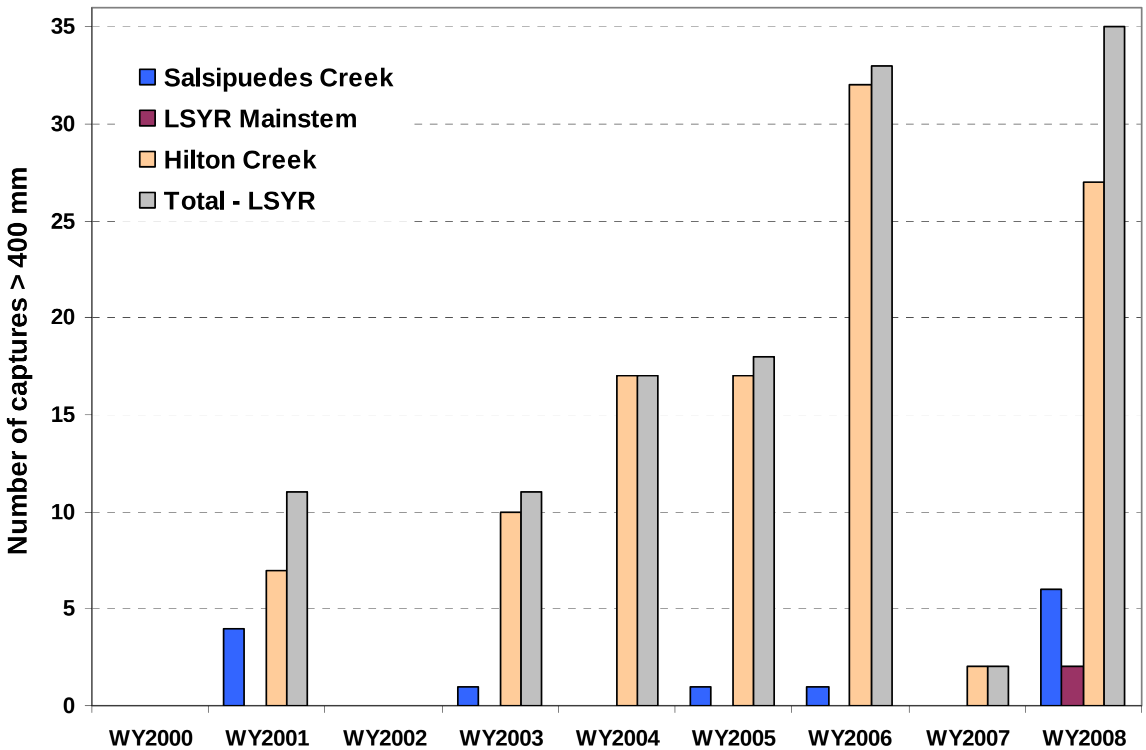


Figure 61: Migrant captures equal to or larger than 400 mm (15.7 inches) observed at the three trap sites from WY2000 through WY2008. The LSYR Mainstem trap was first installed in WY2006 and was not deployed in WY2007 due to low flows.

Table 27: Tributary upstream and downstream migrant captures for Hilton and Salsipuedes creeks.

WY2005	WY2006	WY2007	WY2008		WY2005	WY2006	WY2007	WY2008
	Hilton Creek Upstream					Salsipuedes Creek Upstream		
0	0	0	0	>700	0	0	0	1
0	0	0	4	650-699	1	0	0	2
0	0	0	0	600-649	0	0	0	3
0	1	0	2	550-599	0	0	0	0
2	2	0	2	500-549	0	1	0	0
7	9	0	13	450-499	0	0	0	0
8	20	2	6	400-450	0	0	0	0
7	28	11	31	300-399	0	5	0	0
6	9	4	22	200-299	0	5	2	7
4	17	15	63	101-199	0	1	5	1
0	15	12	32	<100	0	0	0	2
34	**101**	**44**	**175**	**Total**	**1**	**12**	**7**	**16**
	Downstream					Downstream		
0	0	0	0	>700	0	0	0	0
0	0	0	2	650-699	0	*0*	0	0
0	0	0	1	600-649	0	*0*	0	0
0	0	0	1	550-599	0	*0*	0	0
2	2	0	1	500-549	0	0	0	0
0	4	0	14	450-499	0	*0*	0	0
5	5	4	13	400-450	0	*0*	0	1
3	15	16	27	300-399	0	*2*	1	1
2	13	9	18	200-299	9	17	3	13
1	*11*	*6*	*4*	*Smolts*	*9*	*11*	*0*	*9*
0	*0*	*0*	*2*	*Pre-Smolt*	*0*	*2*	*0*	*1*
1	*2*	*3*	*12*	*Res*	*0*	*4*	*3*	*3*
6	45	362	176	101-199	46	184	12	41
6	*33*	*92*	*58*	*Smolts*	*45*	*130*	*1*	*33*
0	*5*	*40*	*18*	*Pre-Smolt*	*1*	*49*	*1*	*7*
0	*7*	*229*	*101*	*Res*	*0*	*5*	*10*	*1*
1	176	206	49	<100	0	23	1	6
0	*1*	*0*	*0*	*Smolts*	*0*	*4*	*0*	*0*
0	*166*	*0*	*1*	*Pre-Smolt*	*0*	*16*	*0*	*0*
1	*9*	*206*	*48*	*Res*	*0*	*3*	*1*	*6*
19	**260**	**597**	**302**	**Total**	**55**	**226**	**17**	**62**

Table 28: WY2000-2008 spring, summer and fall snorkel survey results for the LSYR mainstem Refugio and Alisal reaches and, Hilton Creek, Quiota Creek, Salsipuedes Creek and El Jaro Creek reaches. Only Reach 5 data from Salsipuedes Creek are presented due to a more consistent surveying effort.

Snorkel Survey:	WY2000	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008
Year-type:	*Normal*	*Wet*	*Dry*	*Normal*	*Dry*	*Wet*	*Wet*	*Dry*	*Wet*
Refugio Reach									
Spring	0	147	1	9	0	49	211	35	190
Summer	n/a	n/a	3	n/a	n/a	63	242	19	528
Fall	0	6	56	15	0	80	208	12	263
Alisal Reach									
Spring	17	123	2	0	0	18	134	54	26
Summer	4	11	3	n/a	n/a	21	89	39	118
Fall	0	1	2	n/a	0	11	85	9	42
Hilton Creek									
Spring	n/a	1163	624	564	510	1517	2740	1316	2210
Summer	454	1324	139	554	1046	1303	1891	1319	1519
Fall	n/a	1420	n/a	381	n/a	1272	2016	n/a	738*
Quiota Creek									
Spring	67	273	359	49	22	n/a	n/a	n/a	243
Summer	87	168	n/a	49	n/a	n/a	142	201	81
Fall	n/a	161	n/a	n/a	n/a	n/a	84	78	67
Salsipuedes Creek									
Spring	n/a	43	n/a	18	n/a	n/a	109	202	n/a
Summer	2	n/a	n/a	n/a	n/a	110	131	n/a	308
Fall	n/a	n/a	n/a	7	n/a	134	74	76	226
El Jaro Creek									
Spring	n/a	61	10	19	n/a	n/a	35	30	n/a
Summer	n/a	19	n/a	10	n/a	25	35	n/a	405
Fall	n/a	39	n/a	n/a	n/a	3	18	n/a	151

n/a: conditions too turbid to snorkel.

* Only half of the normal survey reach was snorkeled.

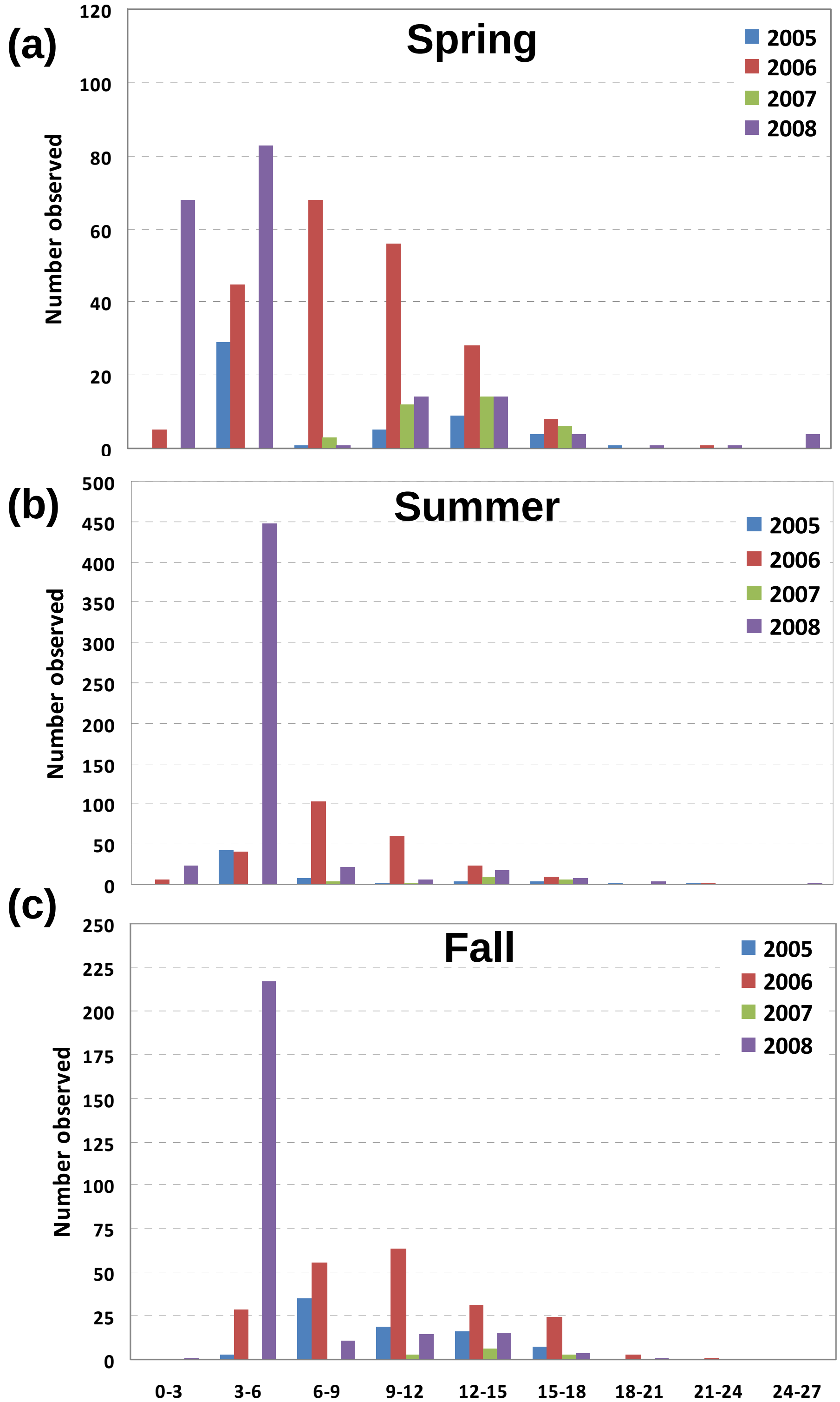


Figure 62: WY2005-2008 (a) spring, (b) summer and (c) fall snorkel survey results for the LSYR mainstem Refugio Reach broken out by 3 inch size classes.

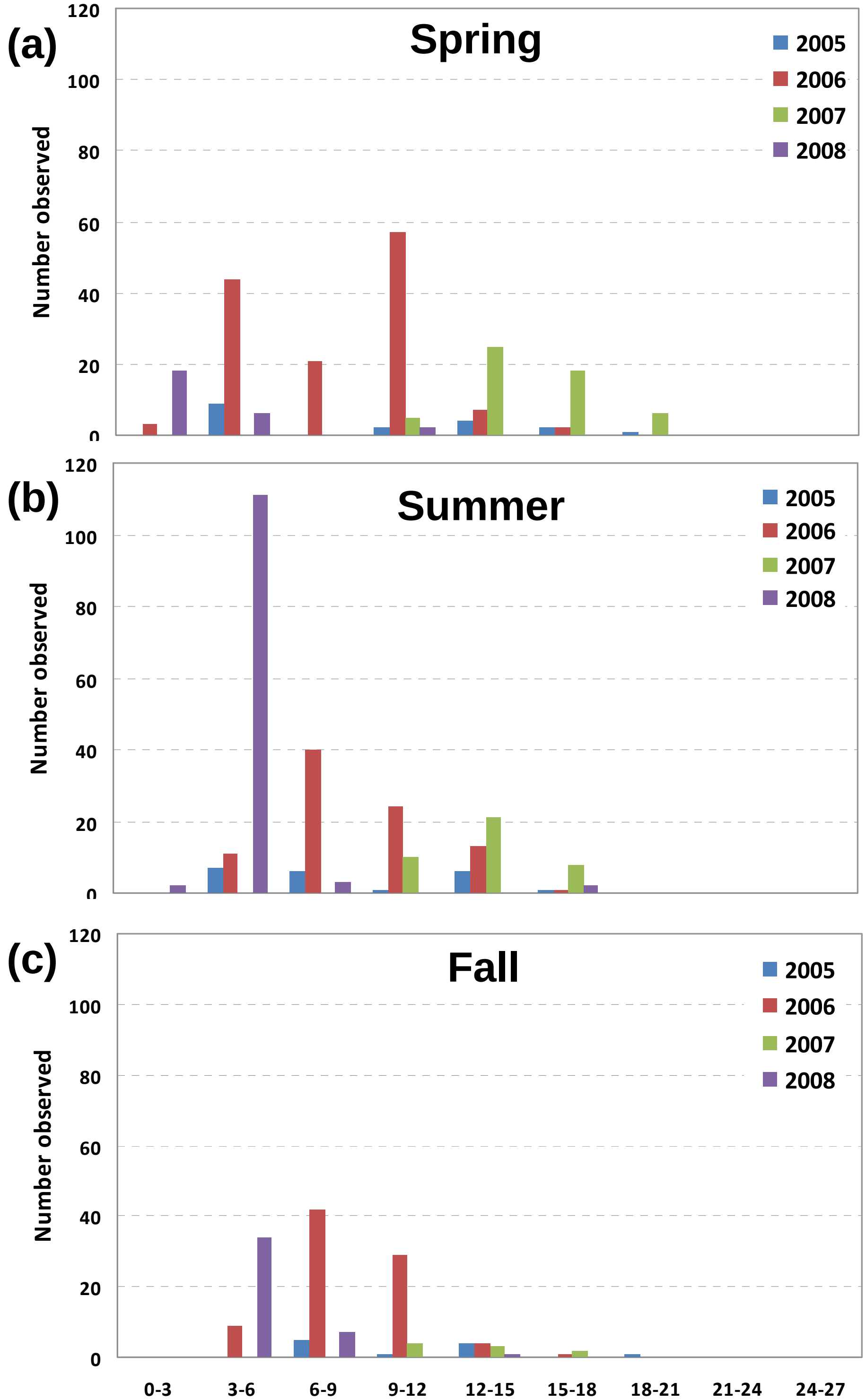


Figure 63: WY2005-2008 (a) spring, (b) summer and (c) fall snorkel survey results for the LSYR mainstem Alisal Reach broken out by 3 inch size classes.

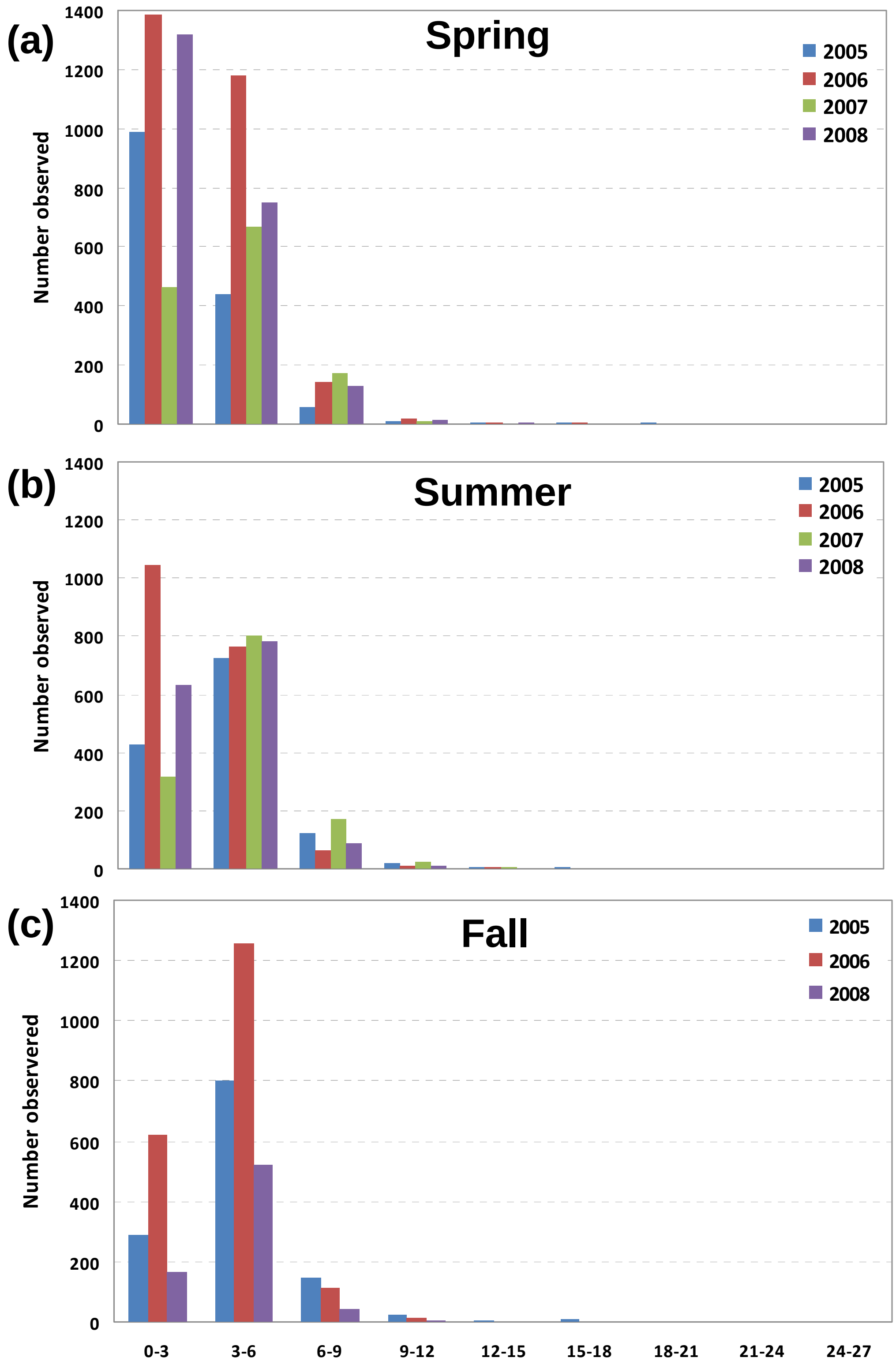


Figure 64: WY2005-2008 (a) spring, (b) summer and (c) fall snorkel survey results for Hilton Creek broken out by 3 inch size classes. Only half of the WY2008 snorkel survey was completed due to visibility issues.

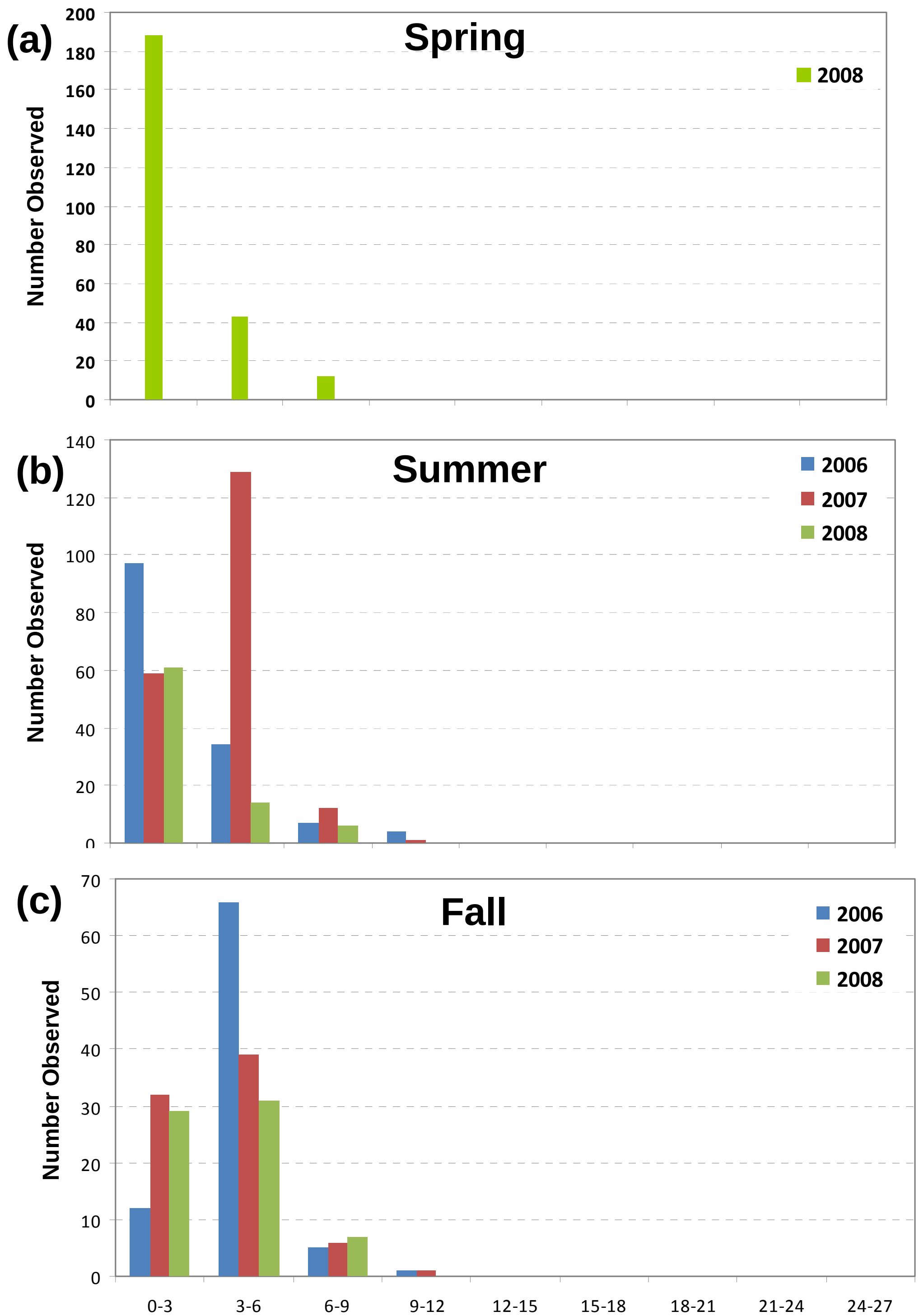


Figure 65: WY2005-2008 (a) spring, (b) summer and (c) fall snorkel survey results for Quiota Creek broken out by 3 inch size classes.

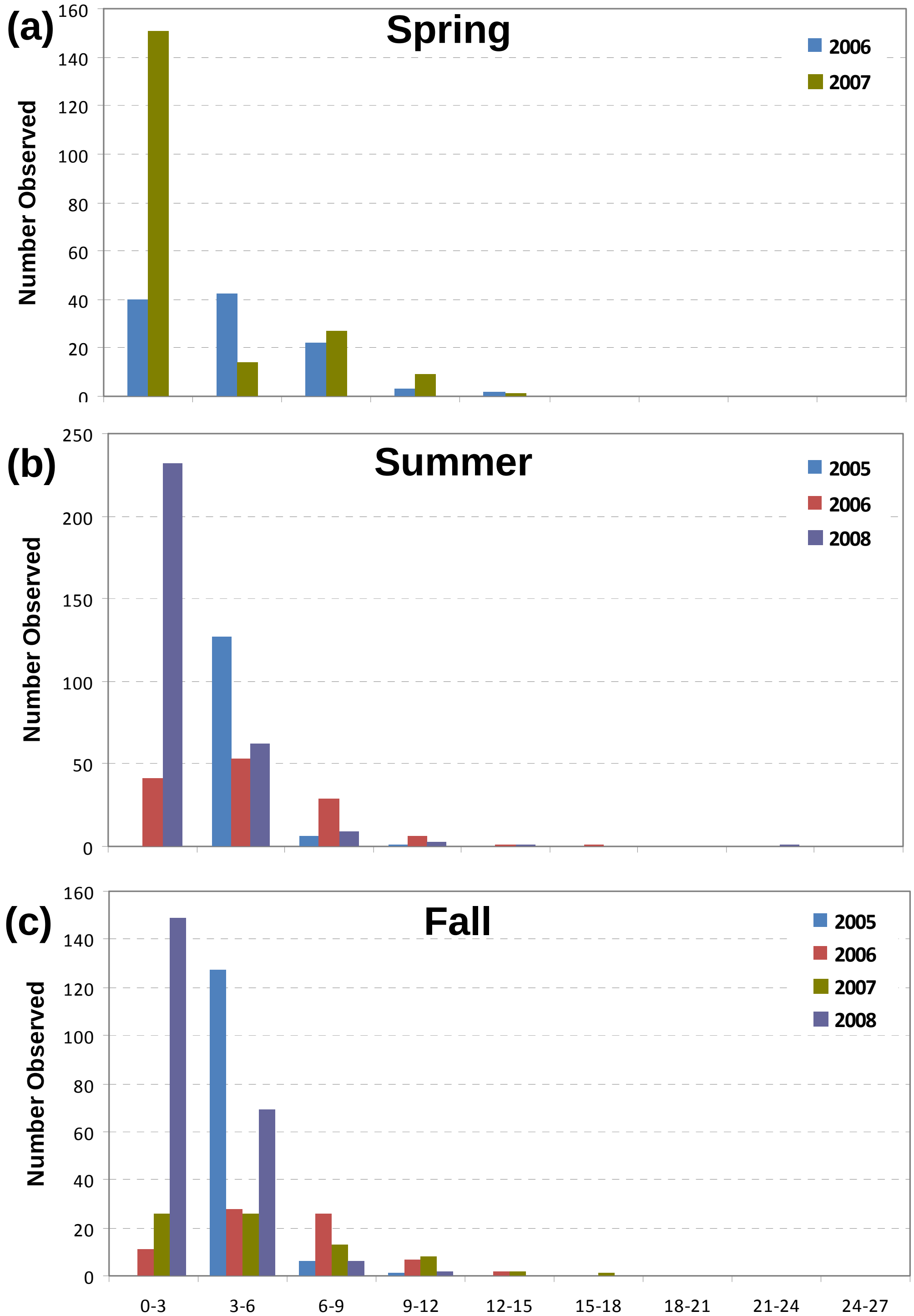


Figure 66: WY2005-2008 (a) spring, (b) summer and (c) fall snorkel survey results for Salsipuedes Creek broken out by 3 inch size classes. Totals are only from Reach 5 for comparison.

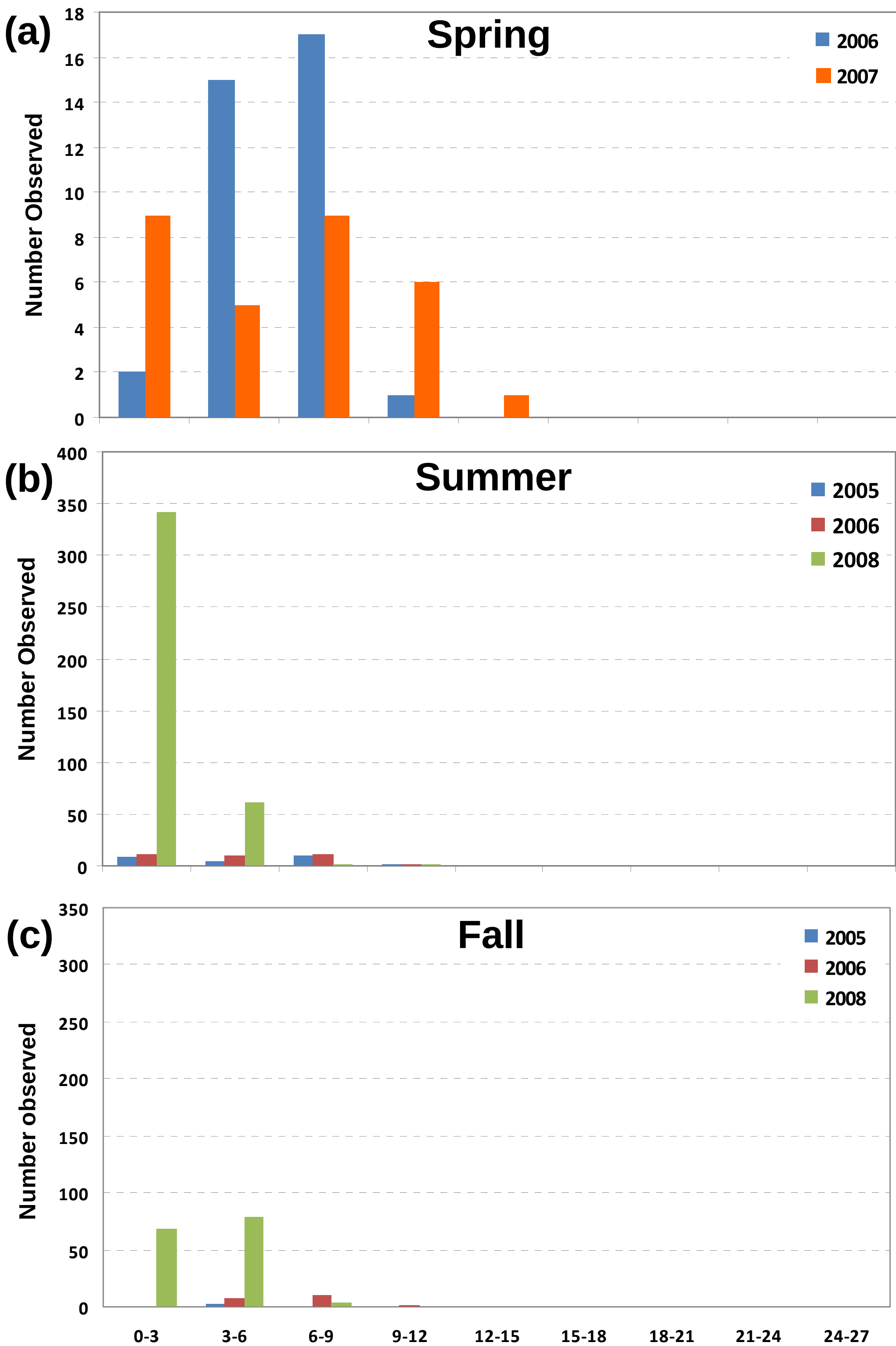
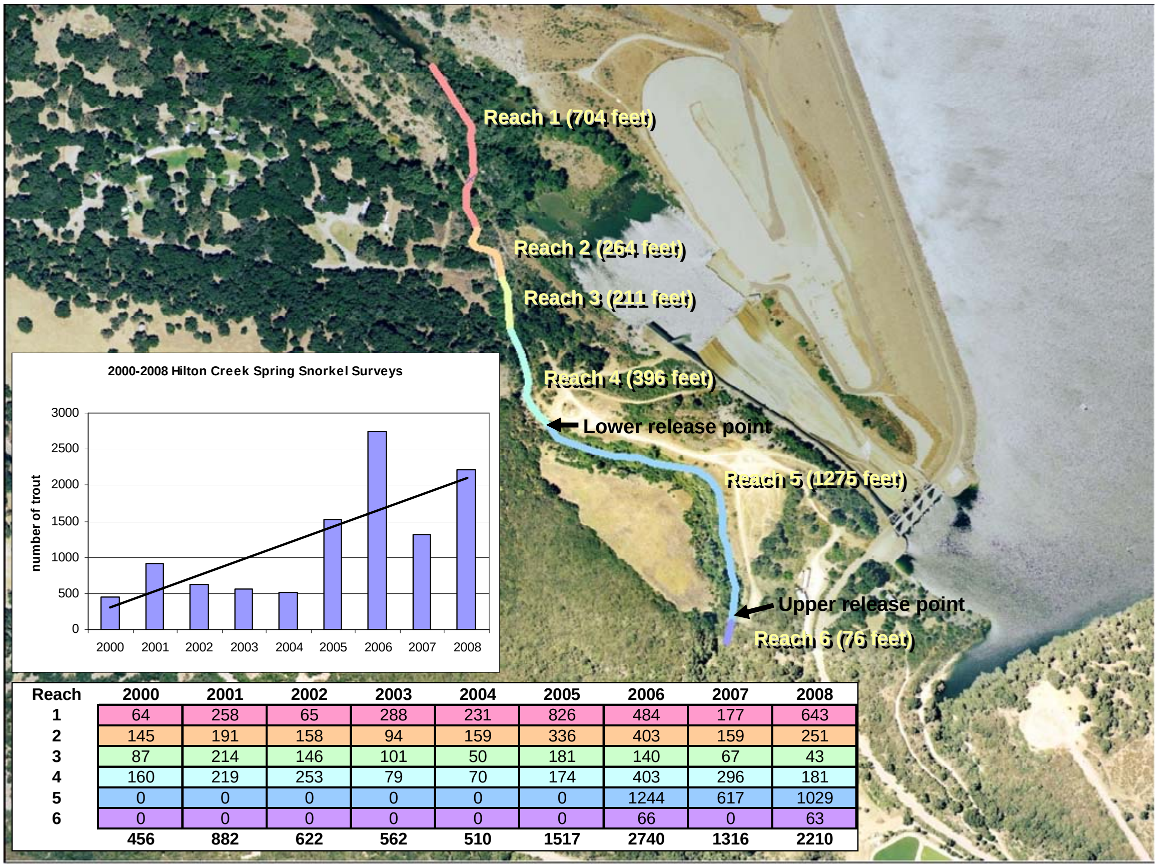


Figure 67: WY2005-2008 (a) spring, (b) summer and (c) fall snorkel survey results for El Jaro Creek broken out by 3 inch size classes.



Reach	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	64	258	65	288	231	826	484	177	643
2	145	191	158	94	159	336	403	159	251
3	87	214	146	101	50	181	140	67	43
4	160	219	253	79	70	174	403	296	181
5	0	0	0	0	0	0	1244	617	1029
6	0	0	0	0	0	0	66	0	63
	456	882	622	562	510	1517	2740	1316	2210

Figure 68: Hilton Creek reaches snorkeled with trend analysis from the spring snorkel surveys in 2000 through 2008.

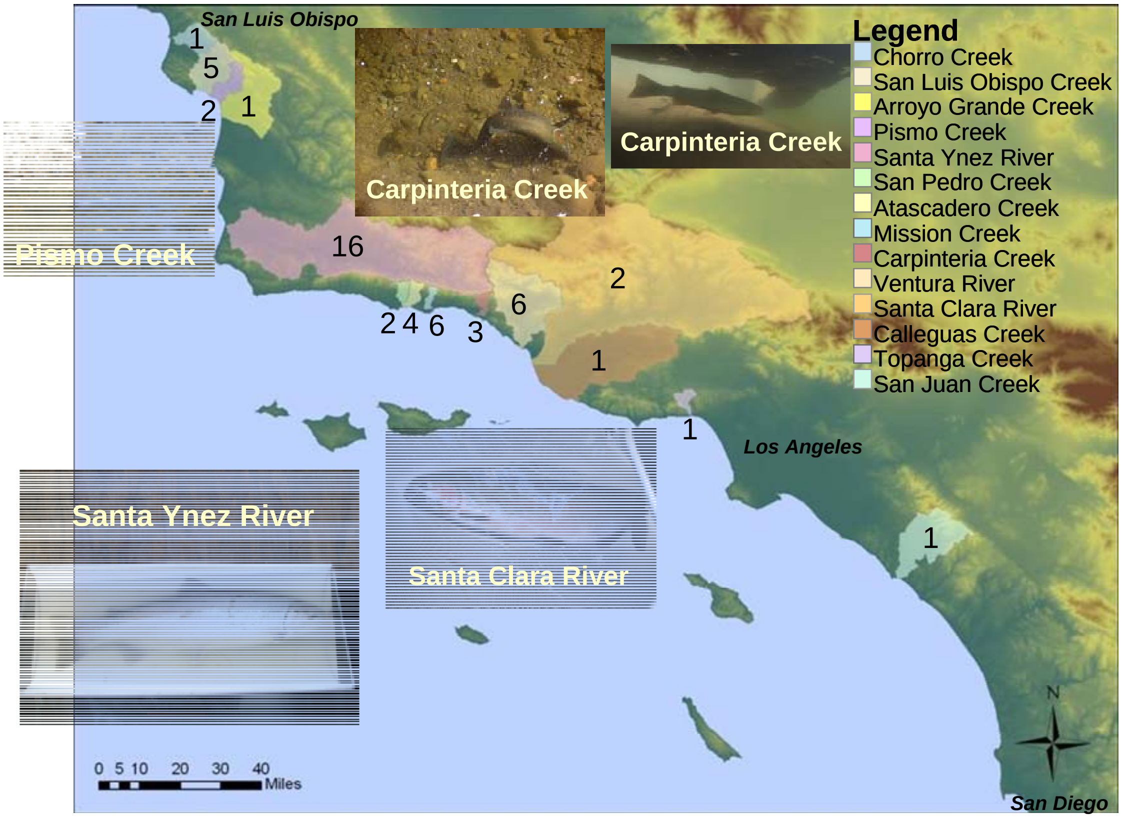


Figure 69: Anadromous steelhead observed in WY2008 from San Luis Obispo to San Diego.

Table 29: Southern steelhead DPS/ESU smolt and anadromous adult data from 2000 to 2008.

River	2000		2001		2002		2003		2004		2005		2006		2007		2008	
	*Ss**	*Sa***	*Ss*	*Sa*	*Ss*	*Sa*	*Ss*	*Sa*	*Ss*	*Sa*	*Ss*	*Sa*	*Ss*	*Sa*	*Ss*	*Sa*	*Ss*	*Sa*
Santa Ynez	9	0	132	4	26	0	86	1	54	0	62	1	438	1	140	0	134	16
Ventura	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	4	nd	0	nd	6
Santa Clara	839	2	119	2	3	0	41	0	2	0	0	0	14	0	12	0	133	2
Topanga[1]	nd	nd	0	6	0	3	14	1	0	0	0	0	9	2	0	5	1	1

* Ss -steelhead smolts
** Sa -steelhead returns (adults)
1 "Sa"s were defined as > 500mm and were from summer snorkel surveys.
ND - no data

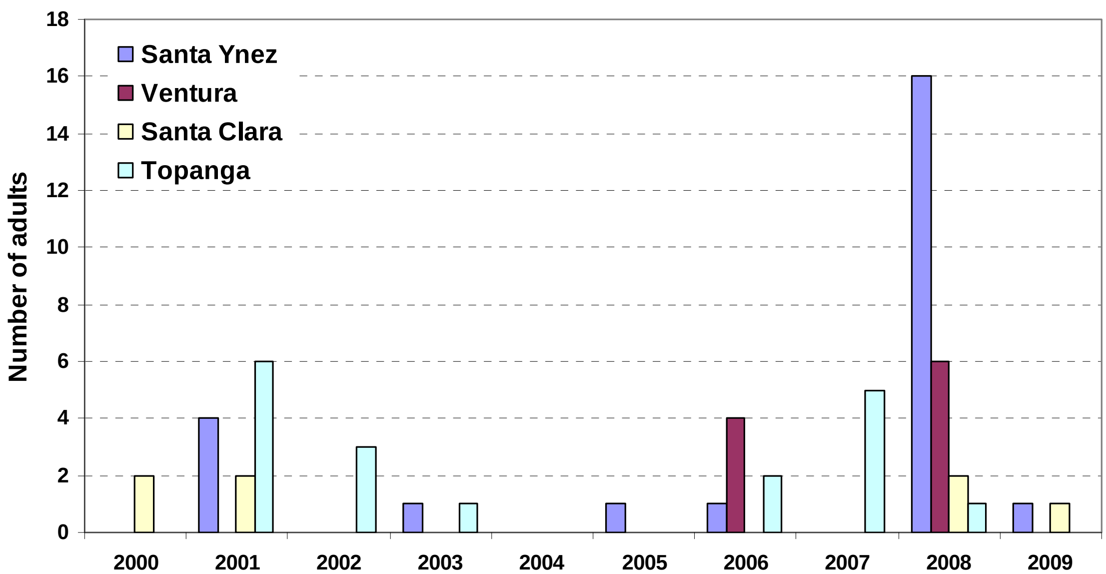


Figure 70: Southern steelhead DPS/ESU anadromous adult data from 2000 to 2008 observed within the Topanga Creek, Santa Clara River, Ventura River and the Santa Ynez River.

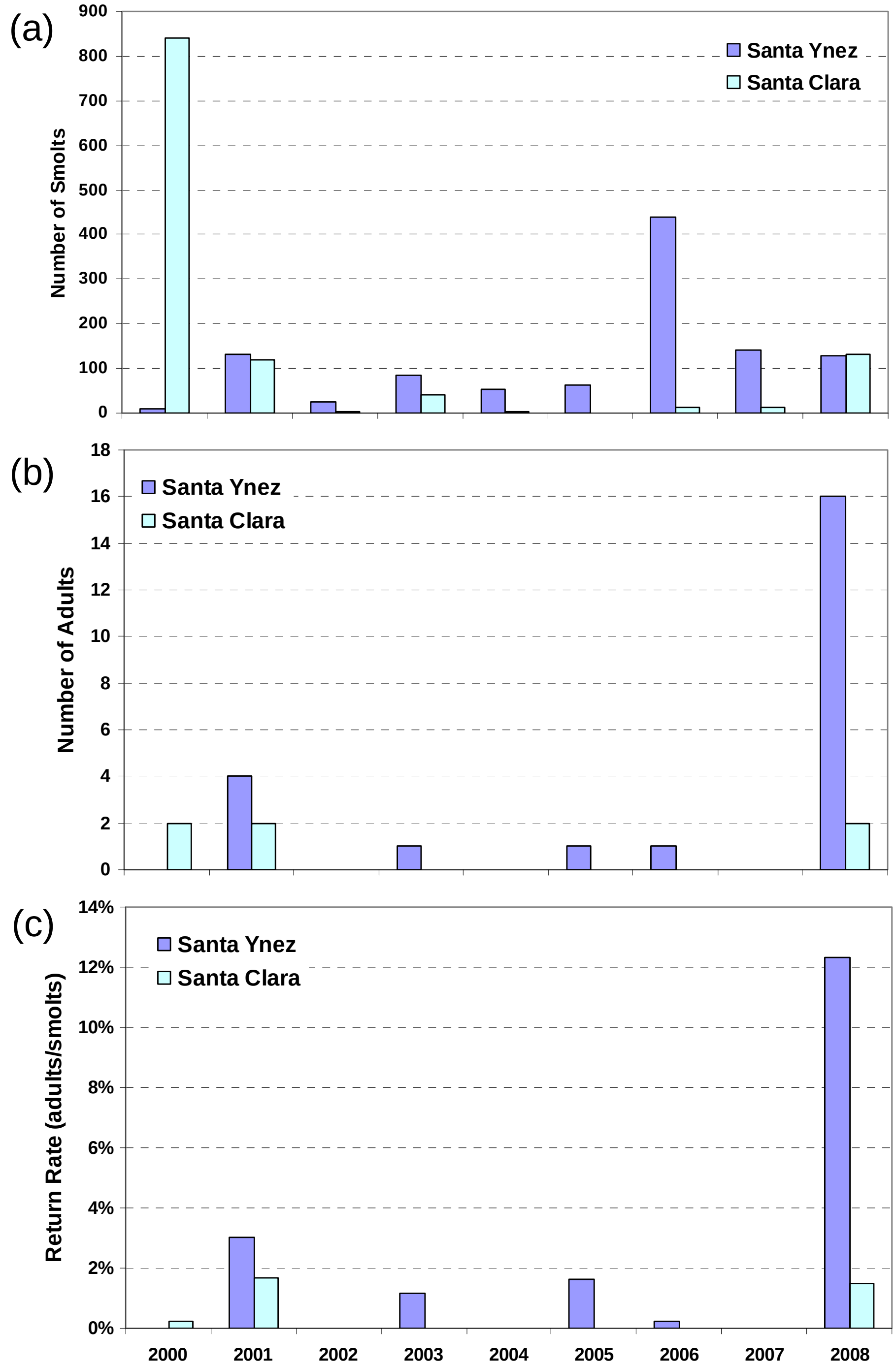


Figure 71: Number of smolts, anadromous adult steelhead and return rates (adults/smolts) for the Santa Ynez and Santa Clara rivers from 2000 to 2008.

Appendices

A. QA/QC Procedures

The Cachuma Project Biology Staff (CPBS) maintains and calibrates water quality and flow meter equipment that is used on the LSYR mainstem and tributaries. Water quality equipment is generally used from the spring (May-June) through the fall (October-November). Flow meters are used throughout the year to gather spot flow information, particularly during periods of stormflow in the winter and spring, as well as during the summertime period to monitor whether target flows are being met within the LSYR mainstem. The calibration procedures and timing for water quality and flow meter equipment can be found in Table A-1 (Calibration). The parameters and specifications of each instrument are listed in Table A-2 (instrument calibration, parameters and specifications). All meters on the multi-parameter Sondes are calibrated by the manufacturer or CPBS following manufacturer protocols.

Table A-1: Calibration procedures for thermographs, sonde probes, and flow meters.

Parameter	Instrument	Calibration Frequency	Timing	Standard or Calibration Instrument Used
Temperature	Thermograph	Annually	Spring	Water/ice bath to assure factory specifications and comparability between units.
Dissolved Oxygen	YSI -6920 (650 MDS) - DO meter	Monthly	Monthly when in use	At a minimum, water saturated air, according to manufacturer's instructions.
pH	YSI -6920 (650 MDS) - pH meter	Monthly	Monthly when in use	pH buffer 7.0 and 10.0
Conductivity	YSI -6920 (650 MDS) - Conductivity meter	Monthly	Monthly when in use	Conductivity standard 700 and 2060 μmhos/cm or μS/cm
Redox	YSI -6920 (650 MDS) - Redox	Monthly	Monthly when in use	Factory calibrated
Turbidity	YSI -6920 (650 MDS) - Nephelometer	Monthly	Monthly when in use	For clear ambient conditions use an 1.0 NTU standard, for turbid conditions use an 10.0 NTU standard
TDS	YSI-6920	None	When in use	Conversion from specific conductance to TDS by use of a multiplyer in the instrument
Stream Discharge	Marsh-McBirney 2000 Electromagnetic Flow-Mate	Monthly	Weekly when in use	The probe is lowered into a bucket filled with water and allowed to stand for 10 minutes

Table A-2: Parameters and specifications for thermographs, sonde probes, and flow meters.

Instrument	Parameters Measured	Units	Detection Limit	Sensitivity	Accuracy/Precision
Optic Stow-Away (Thermographs)	Temperature	°C	-5	±0.01	0.01, calibration dependent
YSI 650 MDS Multi-Probe Model 6920	Temperature	°C	-5	±0.01	± 0.15
	Dissolved Oxygen	mg/l, % saturation	0, 0	±0.01, 0.1	0 to 20 mg/l or ± 0.2 mg/l, whichever is greater. ± 0.2 % of reading or 2 % air saturation, whichever is greater
	Salinity	ppt	0	±0.01	± 1 % of reading or 0.1 ppt, whichever is greater
	pH	none	0	±0.01	± 0.2
	ORP	mV	-999	±0.1	± 20
	Turbidity	NTU	0	±0.1	± 0.5 % of reading or 2 NTU, whichever is greater
	Specific Conductance @ 25°C	mS/cm	0	±0.001 to 0.1, range dependent	± 0.5 % of reading + 0.001 mS/cm
Marsh McBirney Flow-Mate Model 2000	Stream Velocity	ft/sec	0.01	±0.01	± 0.05

Thermographs

Steel cables with ¼ inch u-bolts are used to fasten thermographs to trees, rocks, and root masses when deployed. Single units are deployed in run habitats at the bottom. Vertical arrays are deployed in pool habitats with the surface unit attached to a float (one foot below the surface), and the bottom unit deployed at the bottom. The instruments are downloaded monthly via a remote downloading shuttle and transferred to a computer back at the office where daily maximum, average, and minimum temperatures are calculated using a Visual Basic for Application (VBA) macro run in Excel and displayed in graphical form. If a thermograph shows any unexpected results or data anomalies when the data are reviewed, it is re-calibrated and tested before deployment back into the field.

Sondes (6920 probes)

After calibration, the sonde is programmed on site to collect data for a specified amount of time and the calibration cap (attached when the sonde is in standby mode) is replaced by the slotted field cap that protects the water quality instruments from impact damage while allowing water to pass over the instruments. The sonde is then deployed in the lower third of the water column at the deepest point in the pool habitat, typically at the same location where rearing steelhead/rainbow trout are observed to be holding. The unit is deployed at a fixed elevation within the water column depending on the objective of the deployment. Precautionary measures are always taken to hide the sonde from the general public, especially in places that are easily accessible (i.e., close to road crossings). Once the specified time has elapsed, surveyors return to the deployment location and download the information in the field from the sonde to the YSI 650. The sonde is then reprogrammed and placed in another location or taken back for calibration. If a sonde shows any unexpected results or data anomalies when the data are reviewed, it is re-calibrated and tested before deployment back into the field.

Electromagnetic Flow-Meter

Flows are measured using a Marsh McBirney Flow Mate (model 2000) and a top setting rod. When a transect has been established the flow meter is activated and uses a filter value of 15 seconds which averages the flow rate over a 15 second period and displays the result in the instrument display. Surveyors are careful to note the readings from the instrument with respect to the visual flow rate, making sure that the values being displayed are within the expected range of flow. Surveyors keep a constant eye on the electromagnetic probe so that no algae or debris moving downstream is blocking the field or getting caught on the probe. Once each station is measured, the recorder calculates flow by multiplying width (x) depth (x) velocity to determine flow in feet/second at each station. The recorded values are calculated two to three times in the field to insure a correct flow value has been obtained.

Data QA/QC and Database Storage

There were no unusual conditions, unexplainable outliers, logistical problems, vandalism, or operator error of note. There were some isolated issues with optical thermograph failure but once noticed, the instrument was replaced immediately.

Optic thermograph data transferred to a shuttle in the field are downloaded to the Boxcar program, converted to a text file, and then exported to Microsoft Excel. Once the data has been transferred to Excel, outliers and anomalous data are easily seen when put into graphical form.

Sonde data that has been transferred to a field pc (650 MDS) is then downloaded to an EcoWatch program. The data is then exported into Microsoft Excel. Once the data has been transferred to Excel, outliers and anomalous data are easily seen when put into graphical form.

Spot flow data obtained from flow meters are put directly into Microsoft Excel from the data sheets used in the field.

Outlier resolution

Water quality instruments that are deployed in the field and retrieved at a later date oftentimes have anomalous readings at the very start and end of deployment. This is caused by a unit being out of water just prior to deployment, which occurs right after a unit has been programmed for deployment and is taken down to a specific habitat. The same situation occurs at the end of deployment when a unit is removed from the water and downloaded. The other situation causing poor data occurs when a wetted habitat becomes dry. This usually takes place in the summer in locations far downstream of Bradbury Dam, below target flow areas. When the water quality data is ultimately transferred to a computer, outliers are easily identified and removed.

B. Photo Points/Documentation

Photo points were taken regularly from 2002-2005 in the spring, summer, and fall. After 2005 and continuing through 2008, photo points were scaled down and taken at irregular intervals (Tables B-1 and B-2). The reason for discontinuing some photo point locations was that many sites were not depicting long-term changes. Furthermore, some locations had either become so overgrown with vegetation or were no longer showing any visible change.

Table B-1: Photo points on the LSYR mainstem. "X's" denote photos taken.

LSYR Mainstem Photo Point ID	Location/Description	1/05	3/05	5/05	7/05	9/05	3/07	9/07	10/07	7/08
M1	Lower Hilton Creek, photo d/s at ford crossing	x		x		x				
M2a	Bluffs overlooking long pool, photo u/s			x		x				
M2b	Bluffs overlooking long pool, photo d/s			x		x				
M3	Highway 154 culvert on Hilton Creek, photo u/s	x	x			x				
M4	Highway 154 culvert on Hilton Creek, photo d/s	x	x			x				
M5	Highway 154 bridge, photo u/s	x		x		x				
M6	Highway 154 bridge, photo d/s	x		x		x				
M7	Meadowlark crossing, photo u/s			x		x			x	
M8	Meadowlark crossing, photo d/s			x		x			x	
M9	Lower Gainey crossing, beaver dam, photo u/s					x			x	
M10	Lower Gainey crossing, beaver dam, photo d/s					x			x	
M11a	Lower Gainey crossing, photo u/s			x		x				
M11b	Lower Gainey crossing, photo d/s			x		x				
M12	Refugio bridge, photo u/s			x		x			x	x
M13	Refugio bridge, photo d/s			x		x			x	x
M14	Alisal bridge, photo u/s		x	x		x			x	x
M15	Alisal bridge, photo d/s		x	x		x			x	x
M17	Mid-Alisal reach, photo u/s			x		x			x	
M18	Mid-Alisal reach, photo d/s			x		x			x	
M19	Avenue of the Flags bridge, photo u/s		x	x		x			x	
M20	Avenue of the Flags bridge, photo d/s		x	x		x			x	
M21	Sweeney Road crossing, photo u/s	x		x		x			x	
M22	Sweeney Road crossing, photo d/s	x		x		x			x	
M23	Highway 246 bridge, photo u/s	x		x		x			x	
M24	Highway 246 bridge, photo d/s	x		x		x			x	
M25	LSYR Lagoon on railroad bridge, photo u/s	x		x		x				
M26	LSYR Lagoon on railroad bridge, photo d/s	x		x		x				
M27	LSYR at 35th st. bridge, photo d/s			x		x				
M28	LSYR at 35th st. bridge, photo u/s					x				
M29	LSYR Lagoon upper reach, photo d/s			x		x				
M30	LSYR Lagoon upper reach, photo u/s	x		x		x				

Table B-2: Photo points on the LSYR tributaries. “X’s” denote photos taken.

Tributary Photo Point ID		1/05	3/05	5/05	7/05	9/05	3/07	9/07	10/07	7/08
T1	Hilton trap site, photo u/s	x				x	x	x		x
T2	Hilton trap site, photo d/s	x				x			x	
T3	Hilton at ridge trail, photo d/s	x				x	x	x		
T4	Hilton at ridge trail, photo u/s					x	x	x		
T5	Hilton at telephone pole, photo d/s	x				x	x	x	x	
T6	Hilton at telephone pole, photo u/s	x				x	x	x		
T7	Hilton at tail of spawning pool, photo u/s	x				x	x		x	
T8	Hilton impediment/tributary, photo d/s	x				x			x	
T9	Hilton impediment/tributary, photo u/s	x				x			x	
T10	Hilton just u/s of U.R.P., photo d/s	x		x		x			x	
T11	Hilton road above U.R.P., photo d/s	x		x		x	x	x		
T12	Hilton road above U.R.P., photo u/s	x		x		x	x	x		
T14	Hilton from hard rock toe, photo d/s	x		x		x				
T15	Hilton from hard rock toe, photo u/s	x		x		x				
T16	Quiota Creek at 5th crossing, photo d/s	x		x		x			x	x
T17	Quiota Creek at 5th crossing, photo u/s	x		x		x			x	x
T18	Quiota Creek at 6th crossing, photo d/s	x		x		x			x	x
T19	Quiota Creek at 6th crossing, photo u/s	x		x		x			x	x
T20	Quiota Creek at 7th crossing, photo d/s	x				x			x	x
T21	Quiota Creek at 7th crossing, photo u/s	x		x		x			x	x
T22	Quiota Creek below 1st crossing, photo d/s			x		x			x	x
T23	Alisal Creek from Alisal Bridge, photo u/s		x	x		x			x	x
T24a	Alisal Creek from Alisal Creek bridge, photo u/s		x	x		x			x	x
T24b	Alisal Creek from Alisal Creek bridge, photo d/s		x	x		x				x
T25	Nojoqui Creek at 4th Hwy 101 bridge, photo u/s	x				x				
T26	Nojoqui Creek at 4th Hwy 101 bridge, photo d/s	x				x				
T27	Nojoqui/LSYR confluence, photo u/s	x				x				
T28	Salsipuedes Creek at S.R. bridge, photo u/s	x		x		x			x	x
T29	Salsipuedes Creek at S.R. bridge, photo d/s	x		x		x			x	x
T39	Salsipuedes Creek at Hwy 1 bridge, photo d/s	x			x	x				
T40	Salsipuedes Creek at Hwy 1 bridge, photo u/s	x		x	x	x				
T41	Salsipuedes Creek at Jalama bridge, photo d/s	x	x	x	x	x				
T42	Salsipuedes Creek at Jalama bridge, photo u/s	x	x	x		x				
T43	El Jaro/Upper Salsipuedes confluence, photo u/s	x		x	x	x				
T44	Upper Salsipuedes/El Jaro confluence, photo u/s	x				x				
T45	Upper Salsipuedes/El Jaro confluence, photo d/s	x		x	x	x				
T48	El Jaro Creek above El Jaro confluence, photo u/s	x		x		x				
T49	El Jaro Creek above El Jaro confluence, photo d/s	x				x				
T52	Ytias Creek bridge, photo d/s					x				
T53	Ytias Creek bridge, photo u/s					x				
T54	El Jaro Creek 1st Hwy 1 bridge, photo d/s	x	x	x		x				
T55	El Jaro Creek 1st Hwy 1 bridge, photo u/s	x		x		x				
T56	El Jaro Creek 2nd Hwy 1 bridge, photo d/s	x	x		x	x				
T57	El Jaro Creek 2nd Hwy 1 bridge, photo u/s	x	x		x	x				
T58	El Jaro Creek 3rd Hwy 1 bridge, photo d/s	x				x				
T59	El Jaro Creek 3rd Hwy 1 bridge, photo u/s	x				x				
T60	San Miguelito Creek at crossing, photo d/s			x		x				
T61	San Miguelito Creek at Stillman, photo u/s			x		x				

C. Data tables and figures for WY2005 through WY2007 (rainfall, flow, trapping, snorkel, water quality, and lake profiles)

1. WY2005 Data

All data are reported by Water Year (October 1, 2004 through September 30, 2005) except water quality and snorkel survey data which is reported by the calendar year since these monitoring efforts continue into the fall. No Lake Cachuma profile data were taken in WY2005.

Table C-1: WY2005 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed. 2005 classified as a "wet" year.

Location	Period of Record (years)	Min. Rainfall (Water Year) (in)	Max. Rainfall (Water Year) (in)	Rainfall (Water Year 2005) (in)
Lompoc	36	6.14 (WY88)	34.42 (WY83)	25.30
Buellton	52	5.34 (WY89)	41.56 (WY98)	39.64
Solvang	42	7.37 (WY89)	43.87 (WY98)	36.94
Cachuma*	54	8.41 (WY 90)	53.37 (WY98)	43.65
Gibraltar	87	10.40(WY02)	73.12 (WY98)	69.25
Jameson	81	9.41 (WY02)	79.52 (WY69)	70.17

*Bradbury Dam - Rain.

Table C-2: Storm events greater than 0.1 inch at Bradbury Dam during WY2005.

#	Storm Date	Precipitation (in)
1	10/17/2004	4.38
2	10/27/2004	2.00
3	11/4/2004	0.28
4	12/5/2004	0.25
5	12/27/2004	14.64
6	1/7/2005	8.39
7	1/27/2005	0.27
8	2/11/2005	0.46
9	2/18/2005	8.43
10	2/28/2005	1.21
11	3/9/2005	0.39
12	3/22/2005	1.55
13	3/28/2005	0.16
14	4/28/2005	0.71
15	5/6/2005	0.4

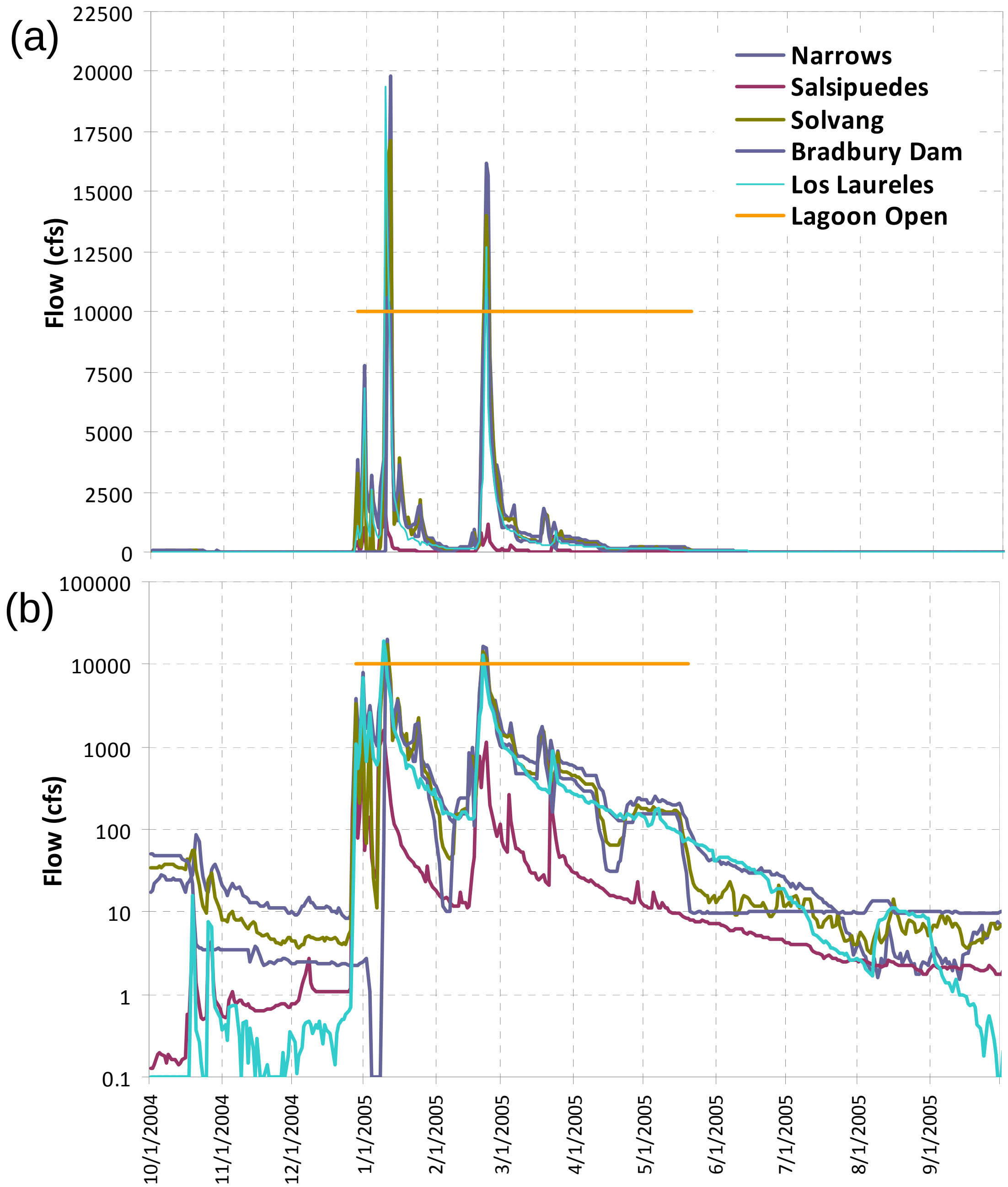


Figure C-1: Stream discharge and the period when the Santa Ynez River lagoon was open in WY2005 with a (a) normal and (b) logarithmic distribution. Lagoon opening coincided with the large flow event in early January. Lagoon closure determined when flow at H Street reached zero. Target flows were met throughout the period.

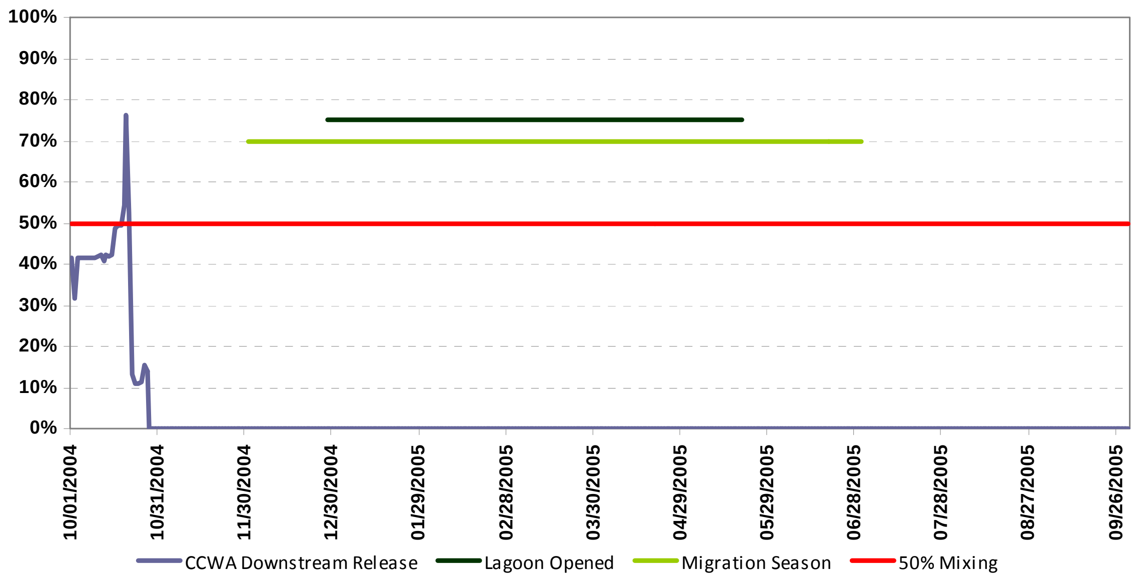


Figure C-2: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the migration season and while the lagoon was open to the ocean in WY2005.

Table C-3: 2005 thermograph network locations and period of record.

	Location Name	Stream ID	Type	Deployment Date	Retrieval Date	Period of Record (days)
Mainstem	Long Pool	LSYR-0.5	Vertical Array	4/15/2005	9/20/2005	158
	Meadowlark	LSYR-5.4	Single	4/19/2005	10/4/2005	168
	Sycamore Pool	LSYR-5.8	Vertical Array	5/23/2005	12/21/2005	212
	Lower Gainey	LSYR-6.5	Single	5/17/2005	12/21/2005	218
	Mid-Alisal Pool	LSYR-9.2	Vertical Array	5/25/2005	12/13/2005	202
	Avenue of Flags	LSYR-13.9	Single	4/19/2005	12/19/2005	244
Tributaries	Lower Hilton	HC-0.12	Single	4/16/2005	10/7/2005	174
	Middle Hilton	HC-0.25	Single	4/16/2005	10/7/2005	174
	Upper Hilton	HC-0.54	Single	4/16/2005	10/7/2005	174
	Quiota	QC-2.71	Single	4/19/2005	12/21/2005	246
	Lower Salsipuedes	SC-1.2	Single	6/7/2005	12/16/2005	192
	Upper Salsipuedes	SC-3.8	Single	4/19/2005	12/4/2005	229
	El Jaro	EJC-4.1	Single	4/19/2005	10/12/2005	176

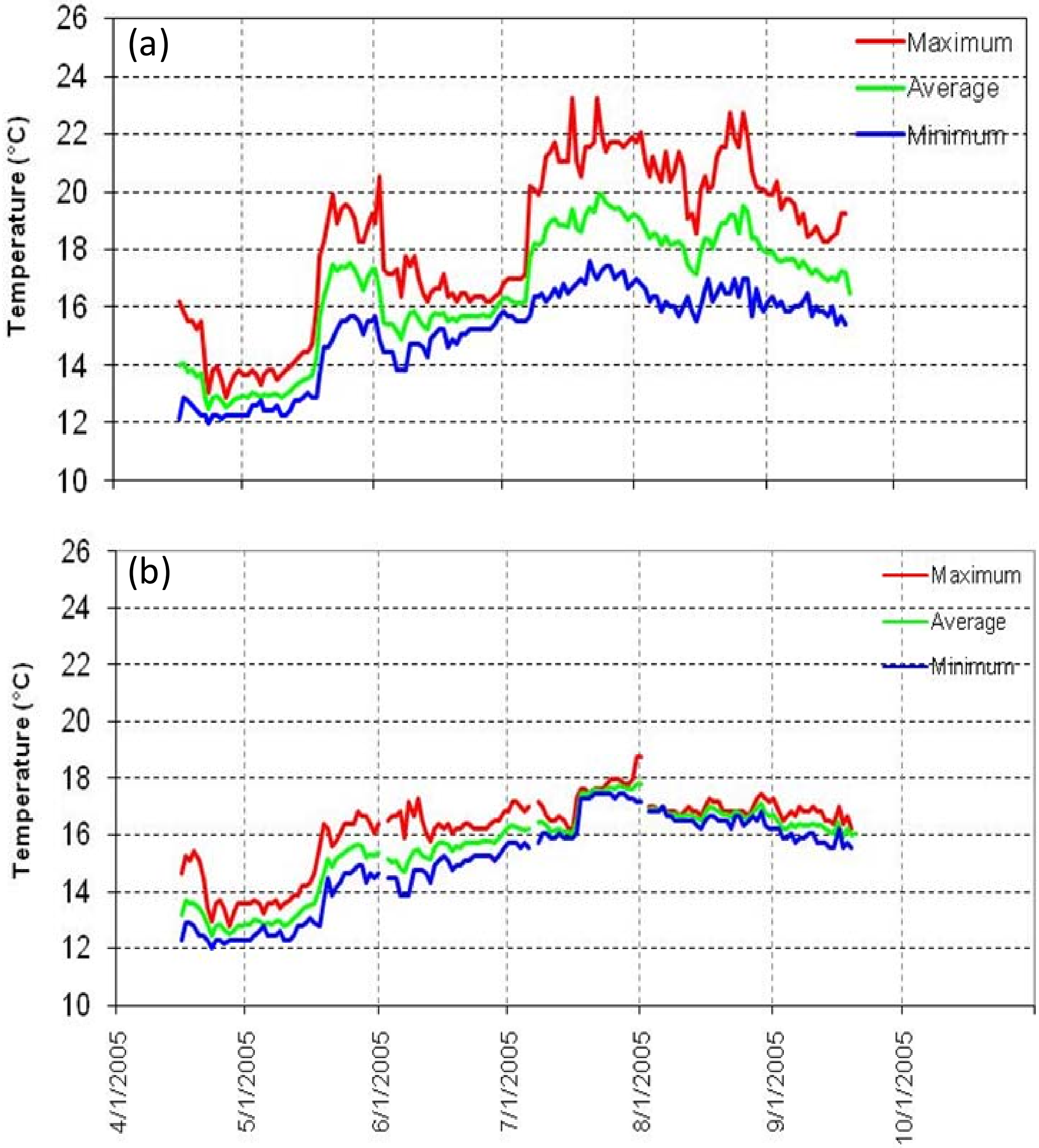


Figure C-3: 2005 Long Pool (LYSR-0.5) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

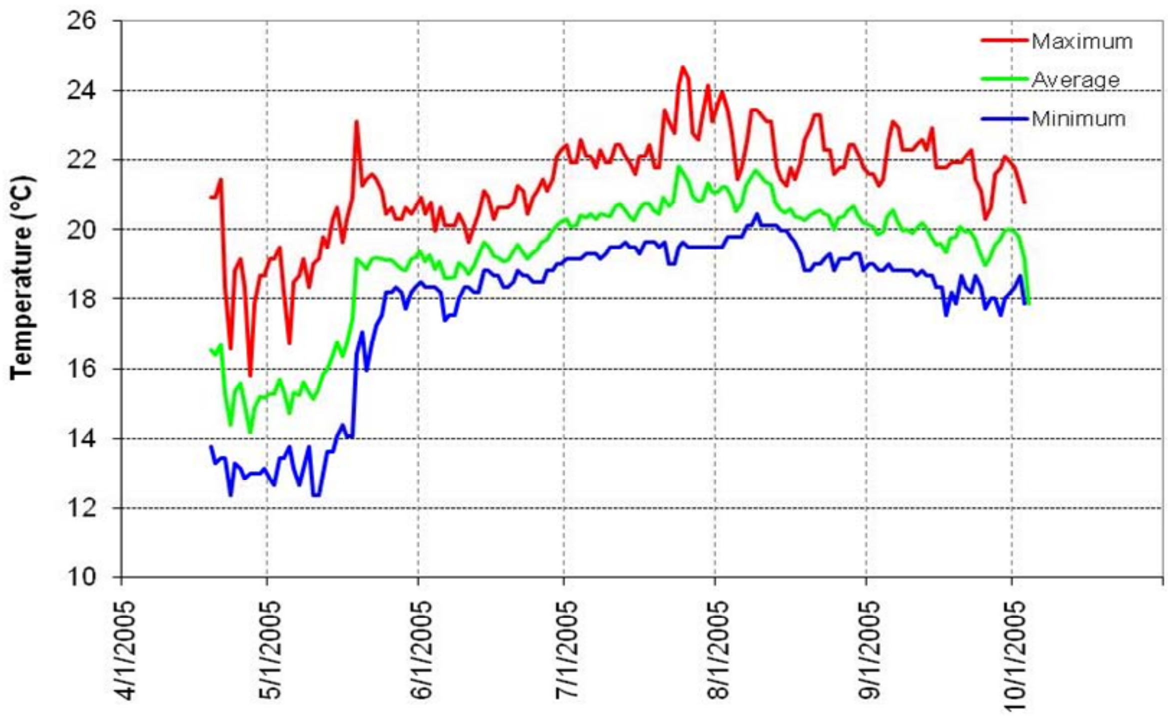


Figure C-4: 2005 LYSR-4.9 Meadowlark Pool - thermograph maximum, average and minimum daily values for the bottom unit (approximately 2.5-feet deep).

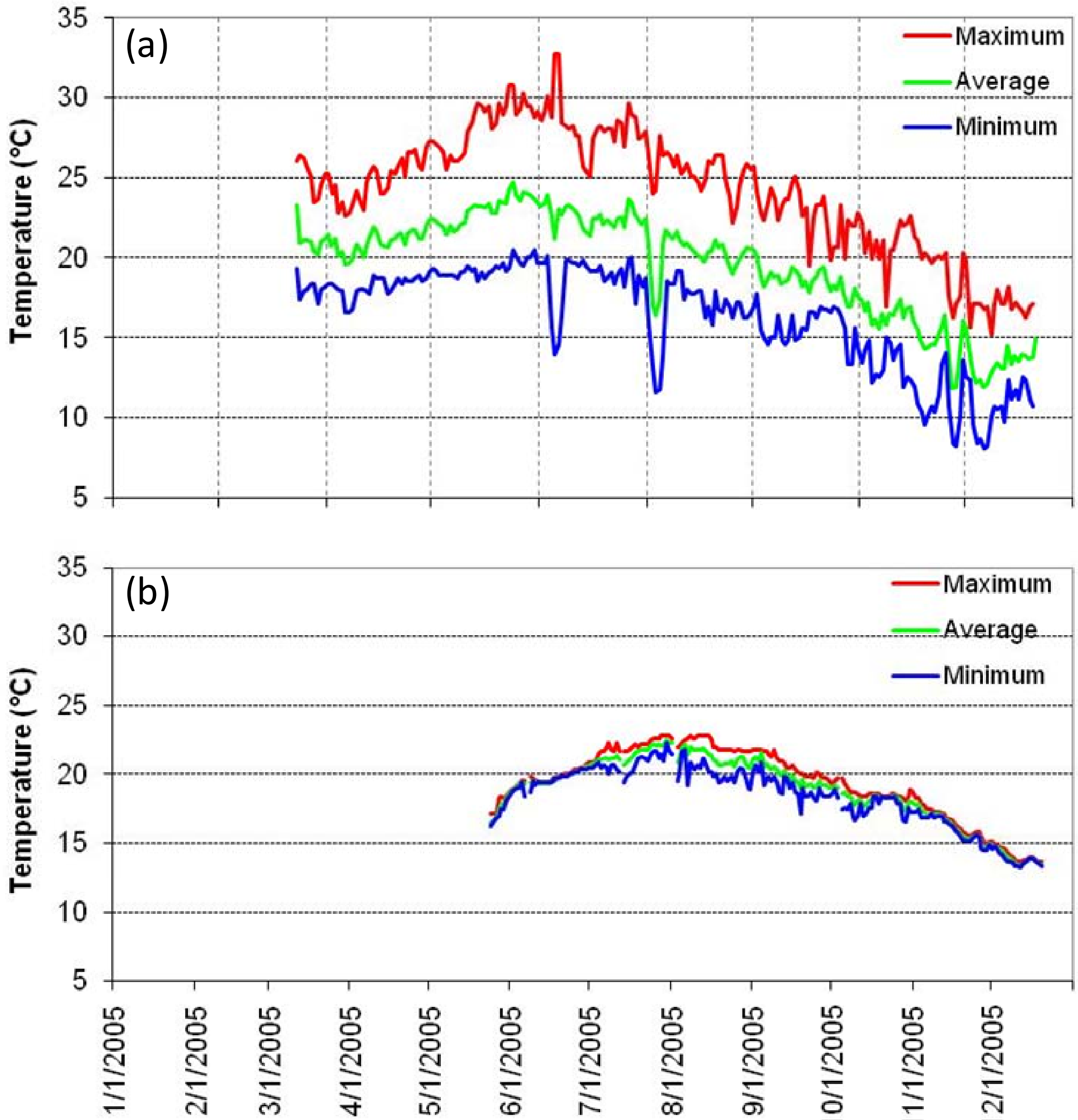


Figure C-5: 2005 Sycamore Pool (LYSR-5.8) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

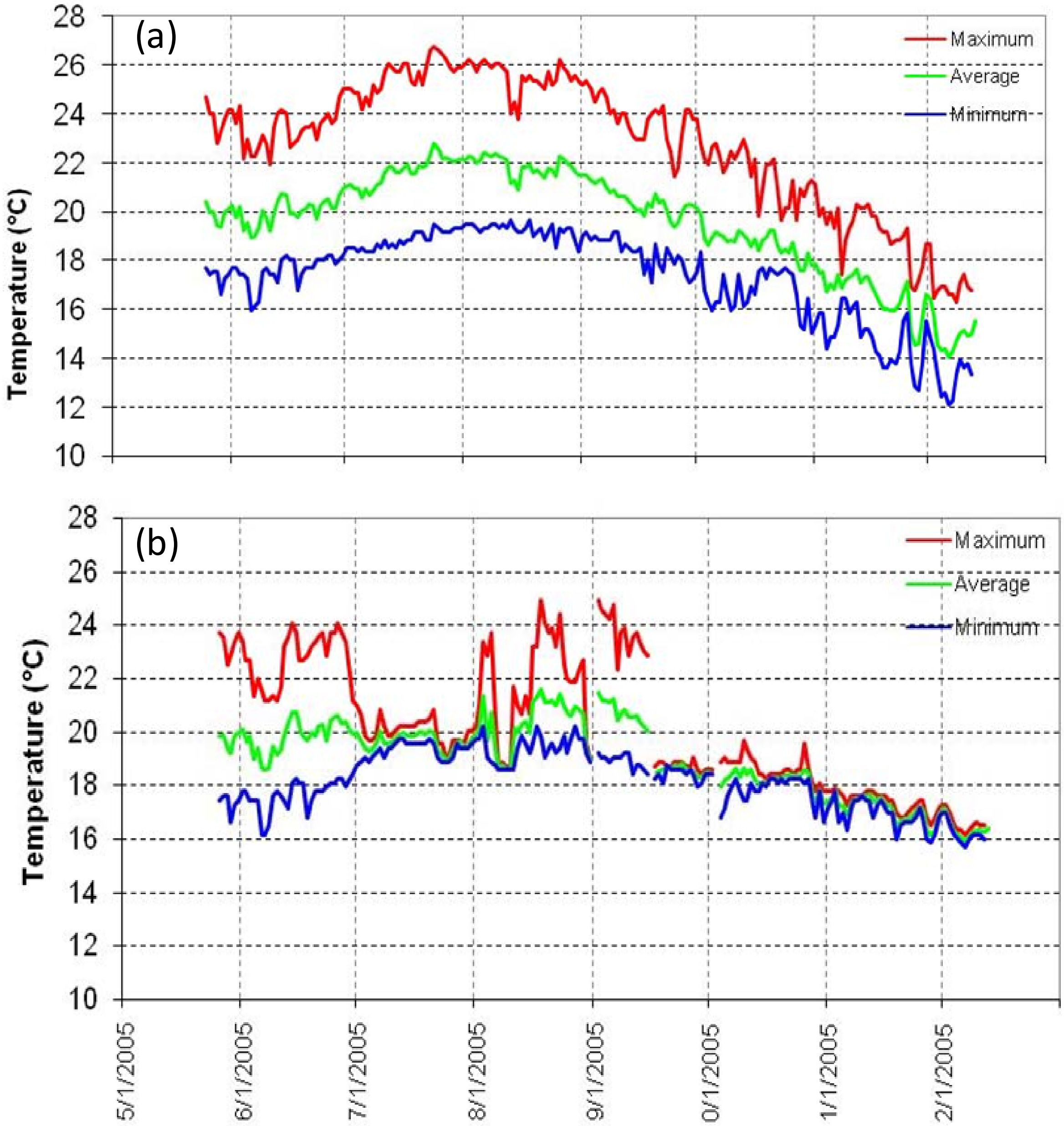


Figure C-6: 2005 Mid-Alisal Pool (LYSR-9.2) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

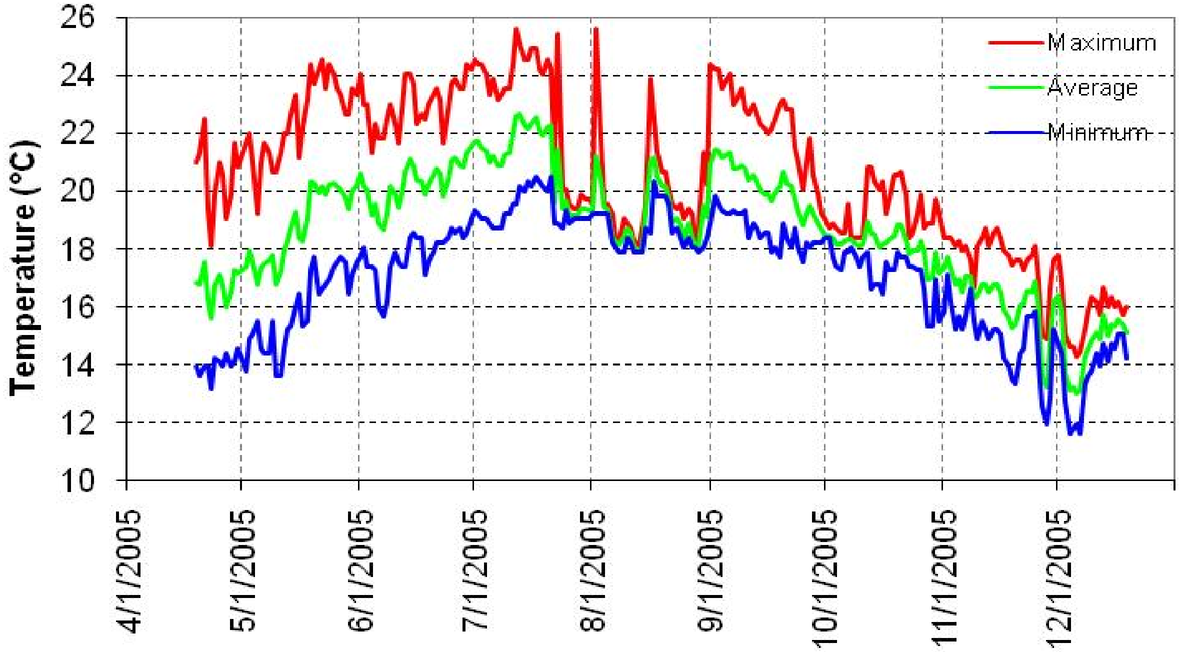


Figure C-7: 2005 Avenue of the Flags (LYSR-13.9) thermograph maximum, average and minimum daily values for the bottom unit.

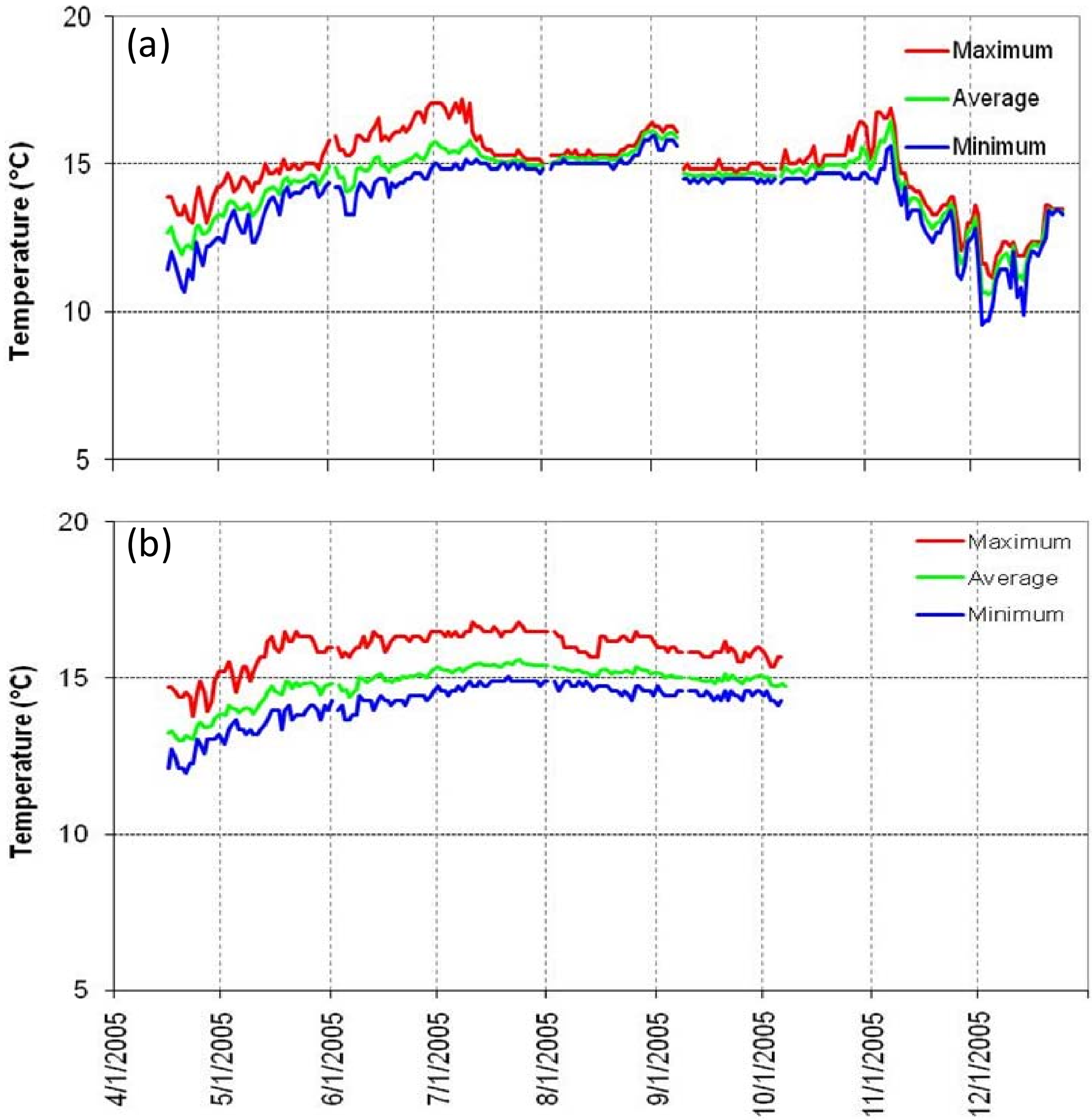


Figure C-8: 2005 thermograph maximum, average and minimum daily values for the (a) lower Hilton Creek (HC-0.12) and (b) upper Hilton Creek (HC-0.54) units.

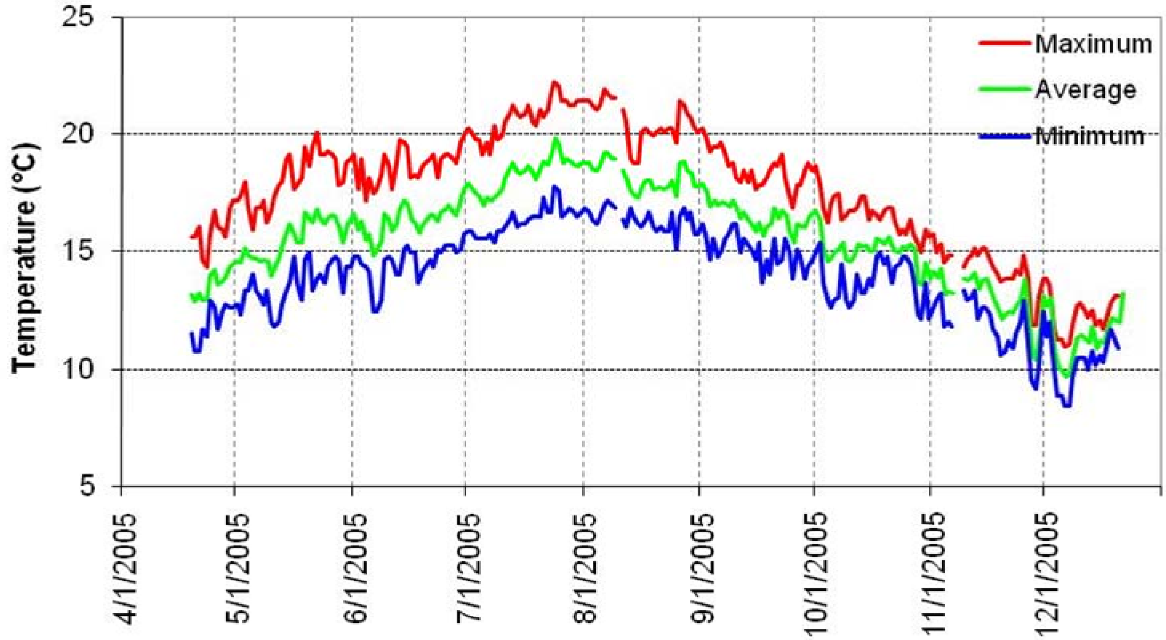


Figure C-9: 2005 thermograph maximum, average and minimum daily values for the Quiota Creek (QC-2.71) unit.

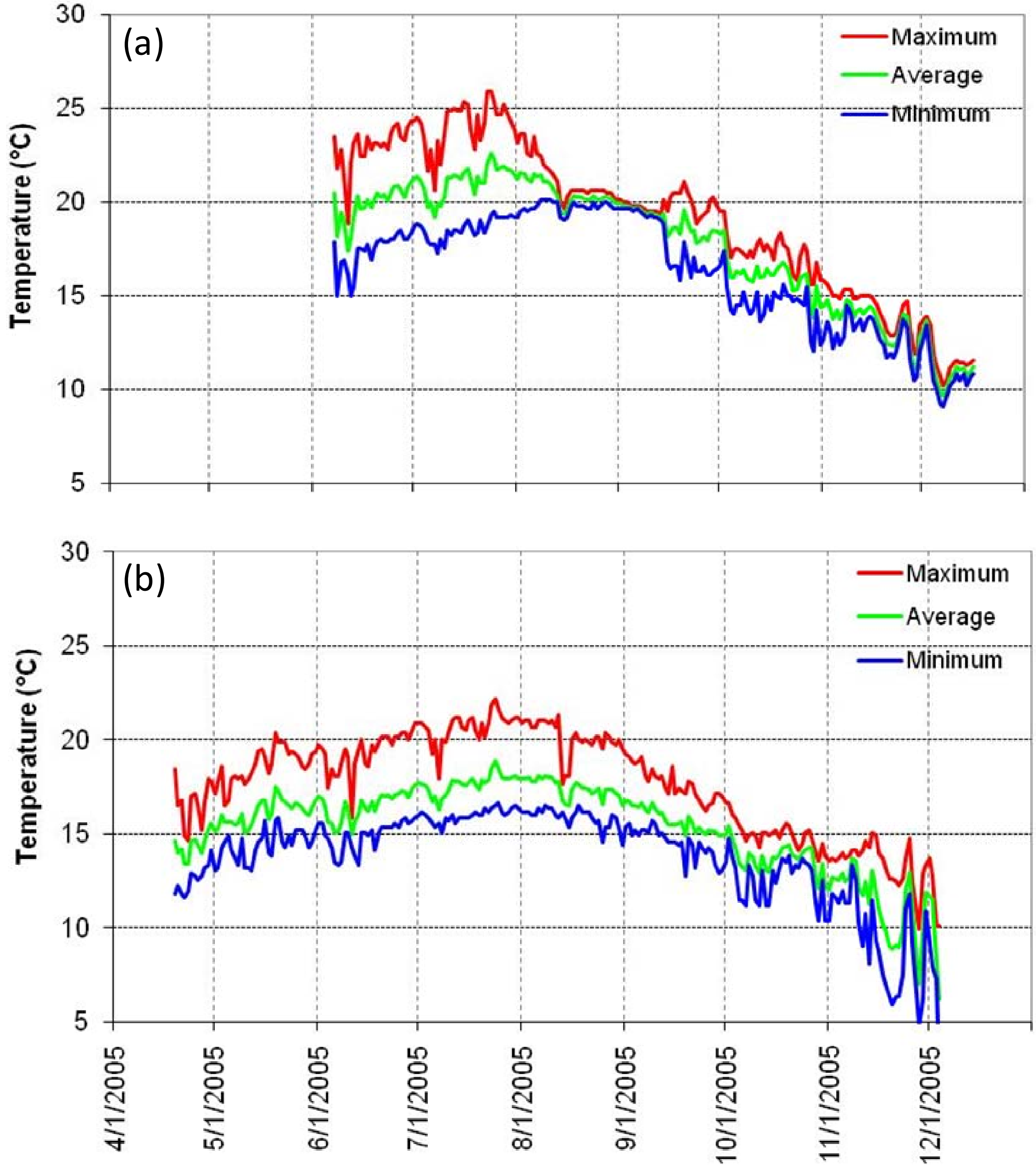


Figure C-10: 2005 thermograph maximum, average and minimum daily values for the (a) lower Salsipuedes Creek (SC-0.77), and (b) upper Salsipuedes Creek (SC-3.8) units.

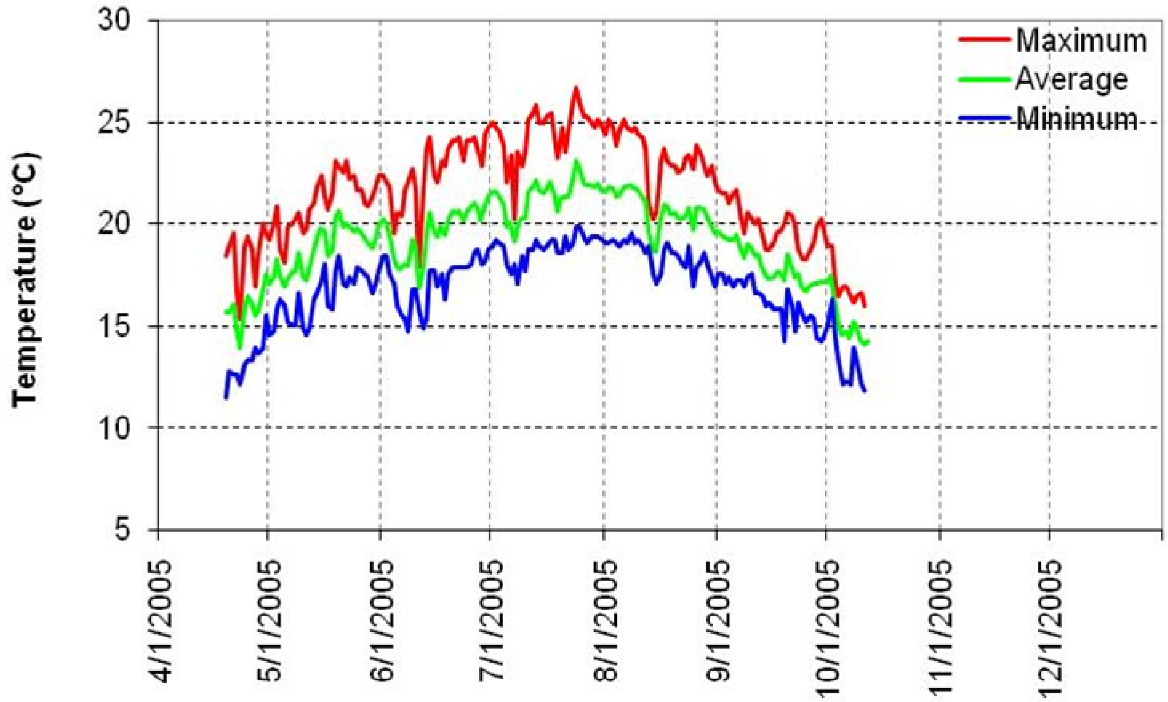


Figure C-11: 2005 thermograph maximum, average and minimum daily values for the El Jaro Creek (EJC-3.71) unit.

Table C-4: 2005 sonde deployment locations and dates; middle (half the pool depth).

Location Name	Stream ID	Deployment Date	Sonde Water Column Location	Estimated Pool Depth (ft)
Meadowlark Pool	LSYR-5.4	May 17-18, 2005	Middle	5.5
		June 1-2, 2005	Middle	5
		June 30-July 1, 2005	Middle	5
		July14-15, 2005	Middle	5
		Aug 11-12, 2005	Middle	4.5
		Aug 17-20, 2005	Middle	4.5
		Aug 26-28, 2005	Middle	4.5
Sycamore Pool	LSYR-5.8	Sept 9-12, 2005	Middle	6
		Sept 15-19, 2005	Middle	6
		Sept 26-29, 2005	Middle	6
		Oct 4-7, 2005	Middle	6
Lower Gainey	LSYR-6.0	May 16, 2005	Middle	4.5
		June 2, 2005	Middle	4.5
		June 21, 2005	Middle	4
		June 28, 2005	Middle	4
		July 19, 2005	Middle	4
7.3 Pool	LSYR-7.3	June 27-28, 2005	Middle	5.5
		July 12-13, 2005	Middle	5
		July 18-19, 2005	Middle	5
		July 25-26, 2005	Middle	5
		Aug 9-10, 2005	Middle	5
		Aug 23-24, 2005	Middle	5
		Sept 12-13, 2005	Middle	5
		Sept 20-22, 2005	Middle	5
		Sept 30-Oct 4, 2005	Middle	5
		Oct 18- Oct 21, 2005	Middle	5
		Oct 28- Oct 31, 2005	Middle	5
		Nov 4 - Nov 8, 2005	Middle	5
		Nov 22 - Nov 28, 2005	Middle	5
Quiota Conf Pool	LSYR-8.4	August 3-4, 2005	Middle	4.5
Mid-Alisal Pool	LSYR-9.2	May 25-26, 2005	Middle	6.5
		July 6-7, 2005	Middle	6
		July 20-21, 2005	Middle	6
		Sept. 1-2, 2005	Middle	6
Fallen Oak Pool	LSYR-9.7	May 24-25, 2005	Middle	3.5

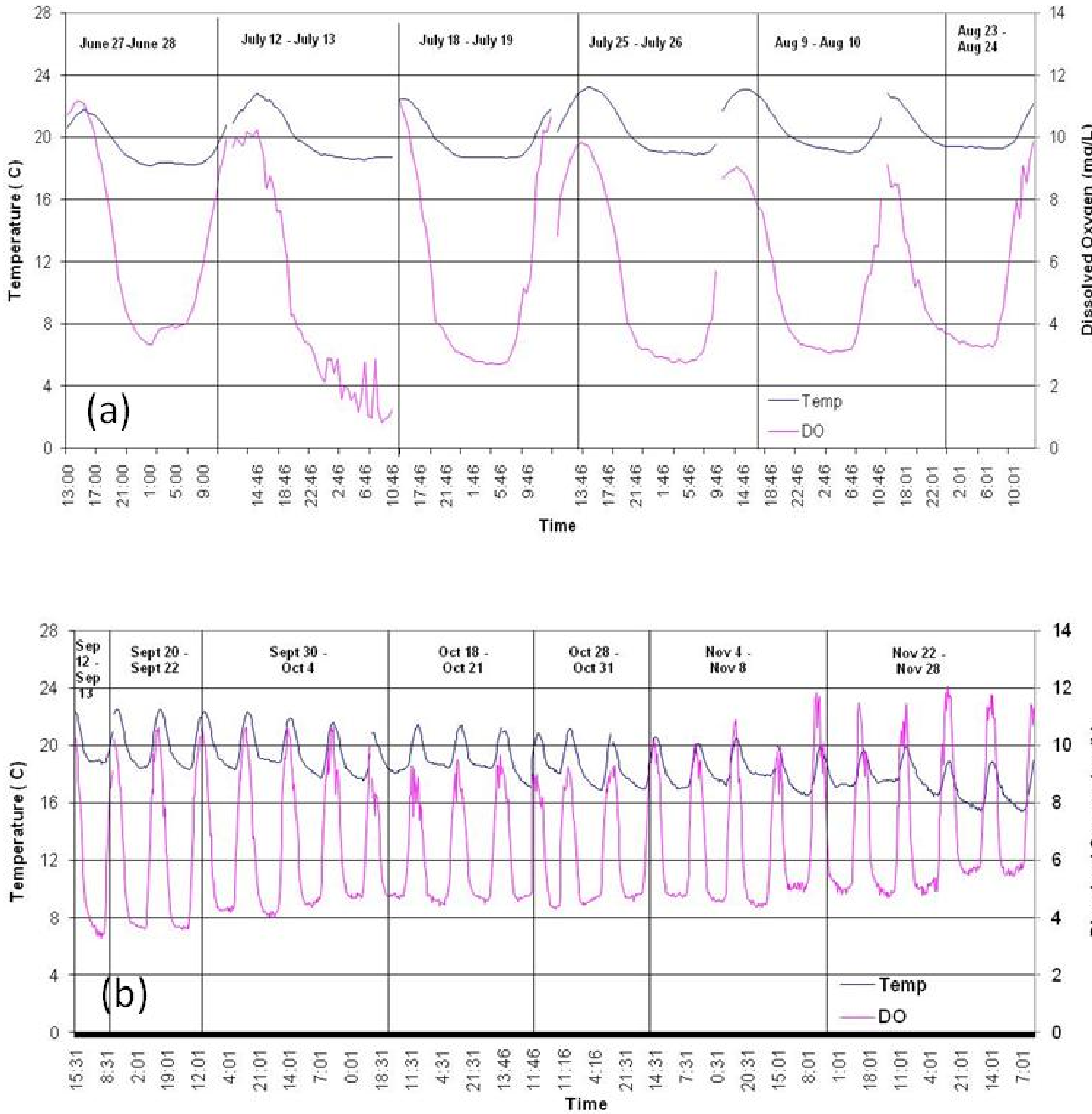


Figure C-12: 2005 temperature and dissolved oxygen data at LSYR-7.3. This site had several juvenile and adult steelhead/rainbow trout inhabiting the pool habitat. The sonde was deployed at this site to monitor summer and fall rearing conditions for the fish present and represents the largest sonde data set for 2005. Panel (a) were data collected from June through August and panel (b) were data collected from September through November. See Table C-4 for deployment depths.

Table C-5: WY2005 migrant trap deployments.

Location	Date Traps Deployed (dates)	Date Traps Removed (dates)	Date Traps Removed (storm events) (dates)	Date Traps Installed (storm events) (dates)	# of Days Not Trapping (days)
Hilton	1/15/2005	5/21/2005	1/25/2005	1/30/2005	5
			2/17/2005	2/24/2005	7
			3/17/2005	3/25/2005	8
			5/4/2005	5/6/2005	2
				Total:	**22**
Salsipuedes	1/20/2005	5/21/2005	1/25/2005	1/30/2005	5
			2/14/2005	3/9/2005	23
			3/17/2005	3/25/2005	8
			5/4/2005	5/6/2005	2
				Total:	**38**

Table C-6: WY2005 Catch Per Unit Effort (CPUE) for each trapping location.

Location	Upstream Captures (#)	Downstream Captures (#)	Functional Trap Days (days)	Trap Season (days)	Trapping Effeciency (%)	CPUE Upstream (Captures/day)	CPUE Downstream (Captures/day)	CPUE (Total) (Captures/day)	Mean Flow (cfs)
Hilton	33	19	105	127	82.7%	0.31	0.18	0.50	10.1
Salsipuedes	1	55	84	122	68.9%	0.01	0.65	0.67	66.2
Mainstem	Mainstem trap not installed in 2005								

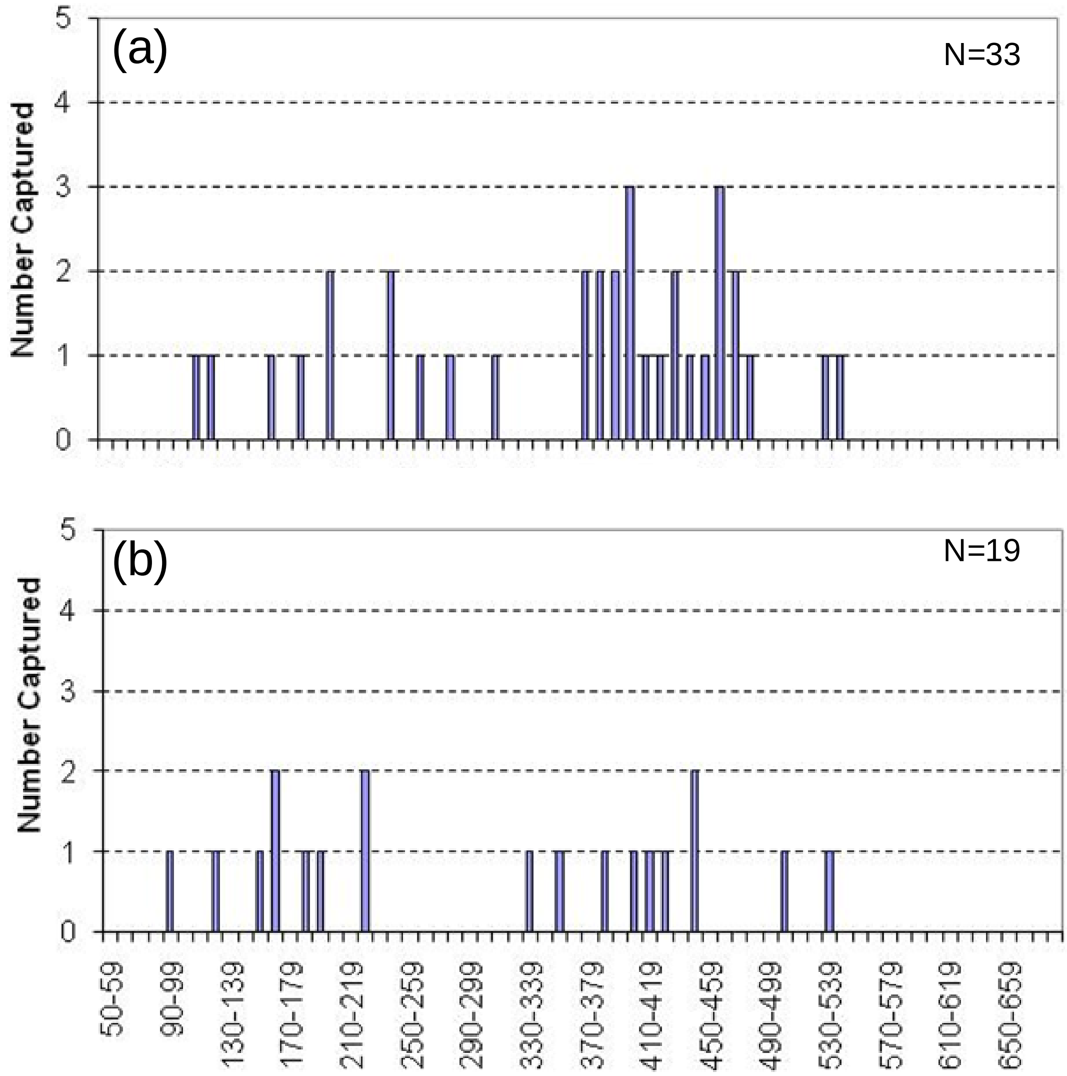


Figure C-13: WY2005 Hilton Creek trap length-frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

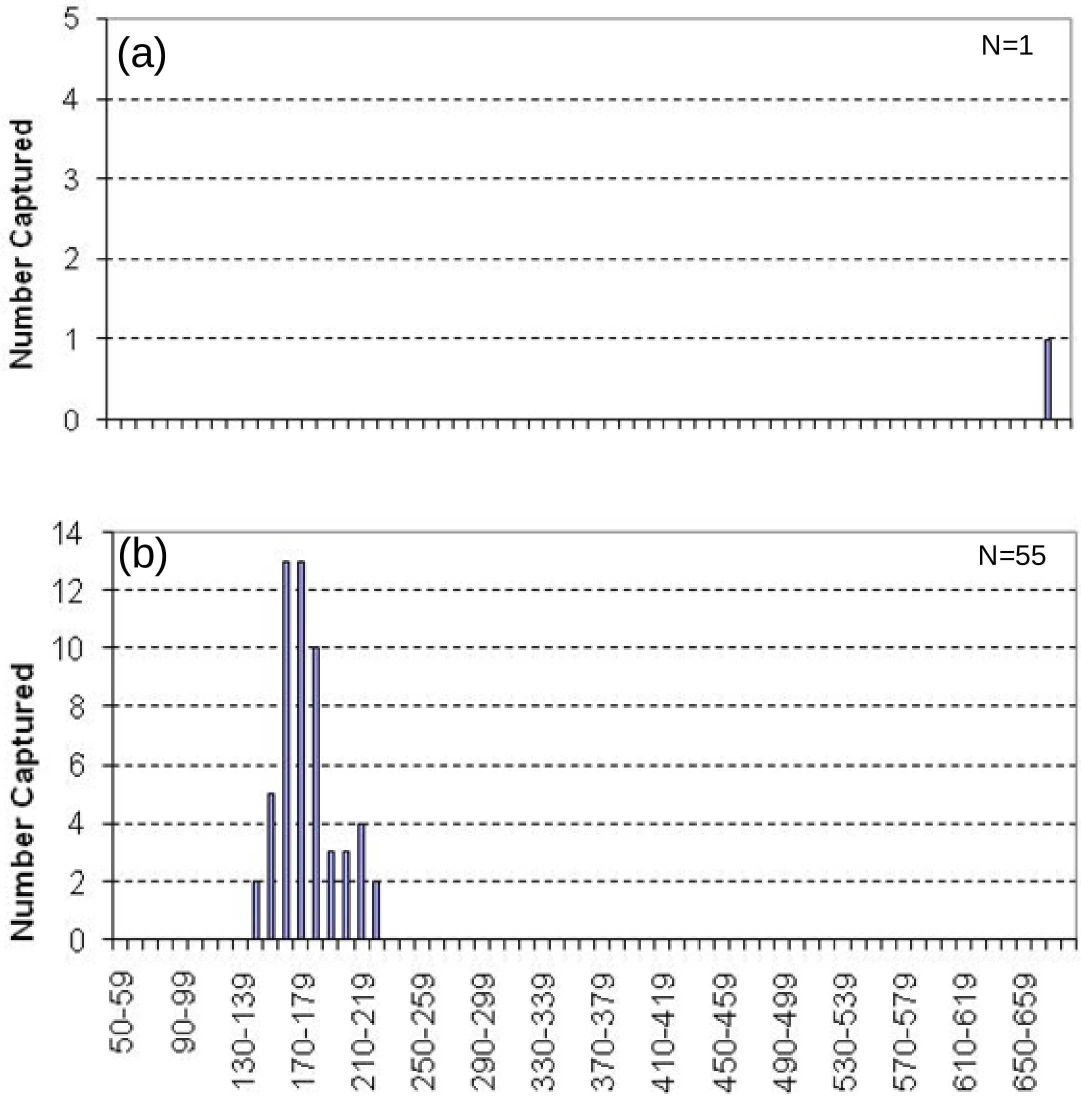


Figure C-14: WY2005 Salsipuedes Creek length frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

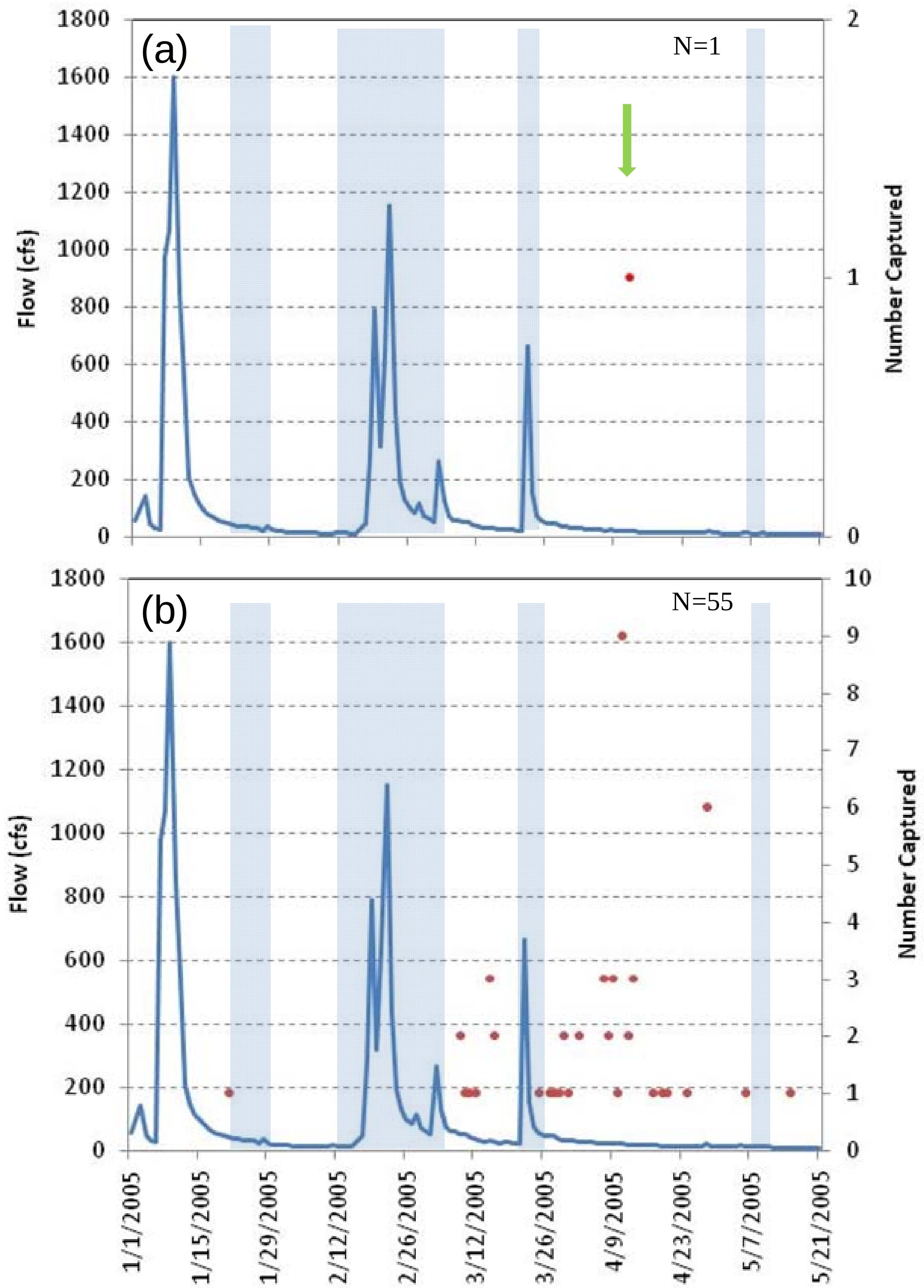


Figure C-15: WY2005 Salsipuedes Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The green arrow denotes the day when an anadromous steelhead was captured. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

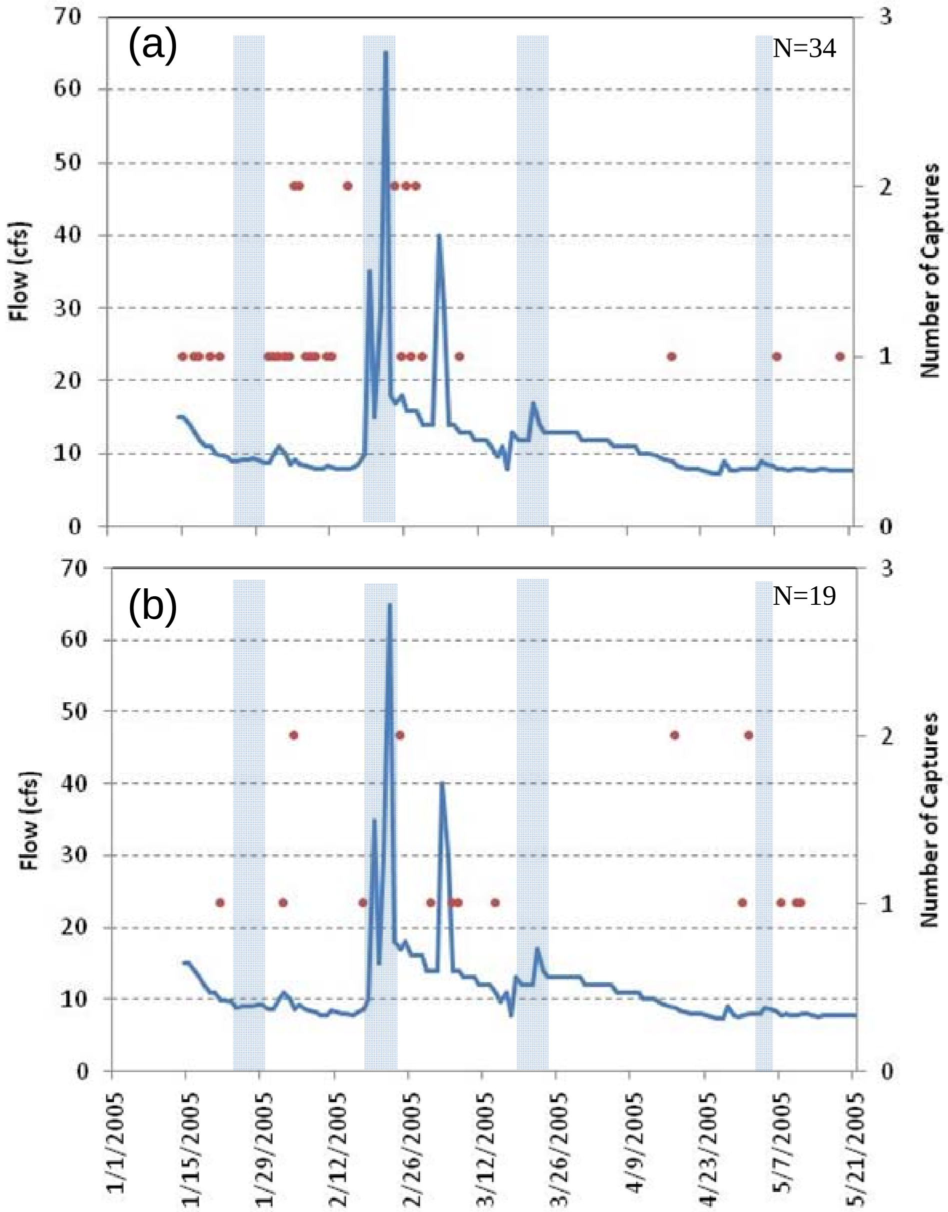


Figure C-16: WY2005 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

Table C-7: WY2005 Tributary upstream and downstream migrant captures for Hilton and Salsipuedes Creek.

Hilton Captures (#)	Size (mm)	Salsipuedes Captures (#)
	Upstream Traps	
0	>700	0
0	650-699	1
0	600-649	0
0	550-599	0
2	500-549	0
7	450-499	0
8	400-450	0
7	300-399	0
6	200-299	0
4	101-199	0
0	<100	0
34	**Total**	**1**
	Downstream Traps	
0	>700	0
0	650-699	0
0	600-649	0
0	550-599	0
2	500-549	0
0	450-499	0
5	400-449	0
3	300-399	0
2	200-299	9
1	*Smolts*	*9*
0	*Pre-Smolt*	*0*
1	*Res*	*0*
6	101-199	46
6	*Smolts*	*45*
0	*Pre-Smolt*	*1*
0	*Res*	*0*
1	<100	0
0	*Smolts*	*0*
0	*Pre-Smolt*	*0*
1	*Res*	*0*
19	**Total**	**55**

Table C-8: 2005 mainstem snorkel schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	n/s-turbid
(LSYR-0.2 to LSYR-0.7)	Summer	n/s-turbid
	Fall	n/s-turbid
Refugio Reach	Spring	6/13/05-6/14/05
(LSYR-4.9 to LSYR-7.8)	Summer	7/29/05-8/2/05 & 8/31/05
	Fall	10/4/05-10/5/05 &11/2/05
Alisal Reach	Spring	6/14/05-6/15/05
(LSYR-7.8 to LSYR-10.5)	Summer	7/28/05-7/29/05
	Fall	10/3/05-10/5/05
Avenue Reach	Spring	n/s
(LSYR-10.5 to LSYR-13.9)	Summer	n/s
	Fall	n/s
Cadwell Reach	Spring	n/s
(LSYR-22.1 to LSYR-22.7)	Summer	n/s
	Fall	n/s

*n/s = no survey

Table C-9: 2005 mainstem snorkel results.

Survey	Reach	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hwy 154	Not snorkeled due to turbidity									
	Refugio	0	29	1	5	9	4	1	0	0	**49**
	Alisal	0	9	0	2	4	2	1	0	0	**18**
	Avenue	Not snorkeled									
	Cadwell	Not snorkeled									
Summer	Hwy 154	Not snorkeled due to turbidity									
	Refugio	0	77	13	4	7	8	6	2	**0**	**117**
	Alisal	0	7	6	1	6	1	0	0	0	**21**
	Avenue	Not snorkeled									
	Cadwell	Not snorkeled									
Fall	Hwy 154	Not snorkeled due to turbidity									
	Refugio	0	4	52	19	17	11	0	0	**0**	**103**
	Alisal	0	0	10	1	7	2	2	0	**0**	**22**
	Avenue	Not snorkeled									
	Cadwell	Not snorkeled									

Table C-10: 2005 tributary snorkel schedule.

Tributaries/Stream Miles	Season	Date
Hilton Creek	Spring	6/23/2005
(HC-0.0 to HC-0.54)	Summer	9/6/2005
	Fall	10/21/2005
Quiota Creek	Spring	n/s
(QC-2.58 to QC-2.73)	Summer	n/s
	Fall	n/s
Salsipuedes Creek (R1-4)	Spring	n/s-turbidity
(SC-1.2 to SC-3.49)	Summer	n/s-turbidity
	Fall	n/s-turbidity
Salsipuedes Creek R-5	Spring	n/s-turbidity
SC-3.49 to SC-3.75	Summer	7/13/2005
	Fall	9/8/2005
El Jaro Creek	Spring	n/s-turbidty
(ELC-0.0 to ELC-0.4)	Summer	7/13/2005
	Fall	9/12/2005

*n/s = no survey

Table C-11: 2005 tributary snorkel results.

Survey	Creek	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hilton	991	440	58	11	7	5	5	0	0	**1517**
	Quiota	Not snorkeled									
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	Not snorkeled due to turbidity									
	El Jaro	Not snorkeled due to turbidity									
Summer	Hilton	429	723	122	19	7	3	0	0	0	**1303**
	Quiota	Not snorkeled									
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	46	57	5	2	0	0	0	0	0	**110**
	El Jaro	9	4	10	2	0	0	0	0	0	**25**
Fall	Hilton	288	801	147	22	5	9	0	0	0	1272
	Quiota	Not snorkeled									
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	0	127	6	1	0	0	0	0	0	**134**
	El Jaro	0	3	0	0	0	0	0	0	0	**3**

2. WY2006 Data

All data are reported by Water Year (October 1, 2005 through September 30, 2006) except water quality and snorkel survey data which is reported by the calendar year since these monitoring efforts continue into the fall.

Table C-12: WY2006 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed.

Location	Period of Record (years)	Min. Rainfall (Water Year) (in)	Max. Rainfall (Water Year) (in)	Rainfall (Water Year 2006) (in)
Lompoc	37	6.14 (WY88)	34.42 (WY83)	16.77
Buellton	53	5.34 (WY89)	41.56 (WY98)	19.19
Solvang	43	7.37 (WY89)	43.87 (WY98)	18.3
Cachuma*	55	8.41 (WY 90)	53.37 (WY98)	24.38
Gibraltar	88	10.40(WY02)	73.12 (WY98)	32.31
Jameson	82	9.41 (WY02)	79.52 (WY69)	31.17

*Bradbury Dam - Rain.

Table C-13: Storms events greater than 0.1 inch at Bradbury Dam during WY2006.

#	Storm Date	Precipitation (in)
1	10/18/2005	0.4
2	11/9/2005	1.64
3	12/2/2005	0.53
4	12/26/2005	0.14
5	12/31/2005	7.54
6	1/14/2006	0.23
7	2/18/2006	0.53
8	2/27/2006	2.53
9	3/3/2006	0.78
10	3/6/2006	0.25
11	3/10/2006	0.82
12	3/17/2006	0.55
13	3/21/2006	0.11
14	3/26/2006	0.18
15	3/28/2006	1.46
16	4/1/2006	0.24
17	4/3/2006	3.67
18	4/11/2006	0.18
19	4/14/2006	0.59
20	4/26/2006	0.17
21	5/21/2006	1.54

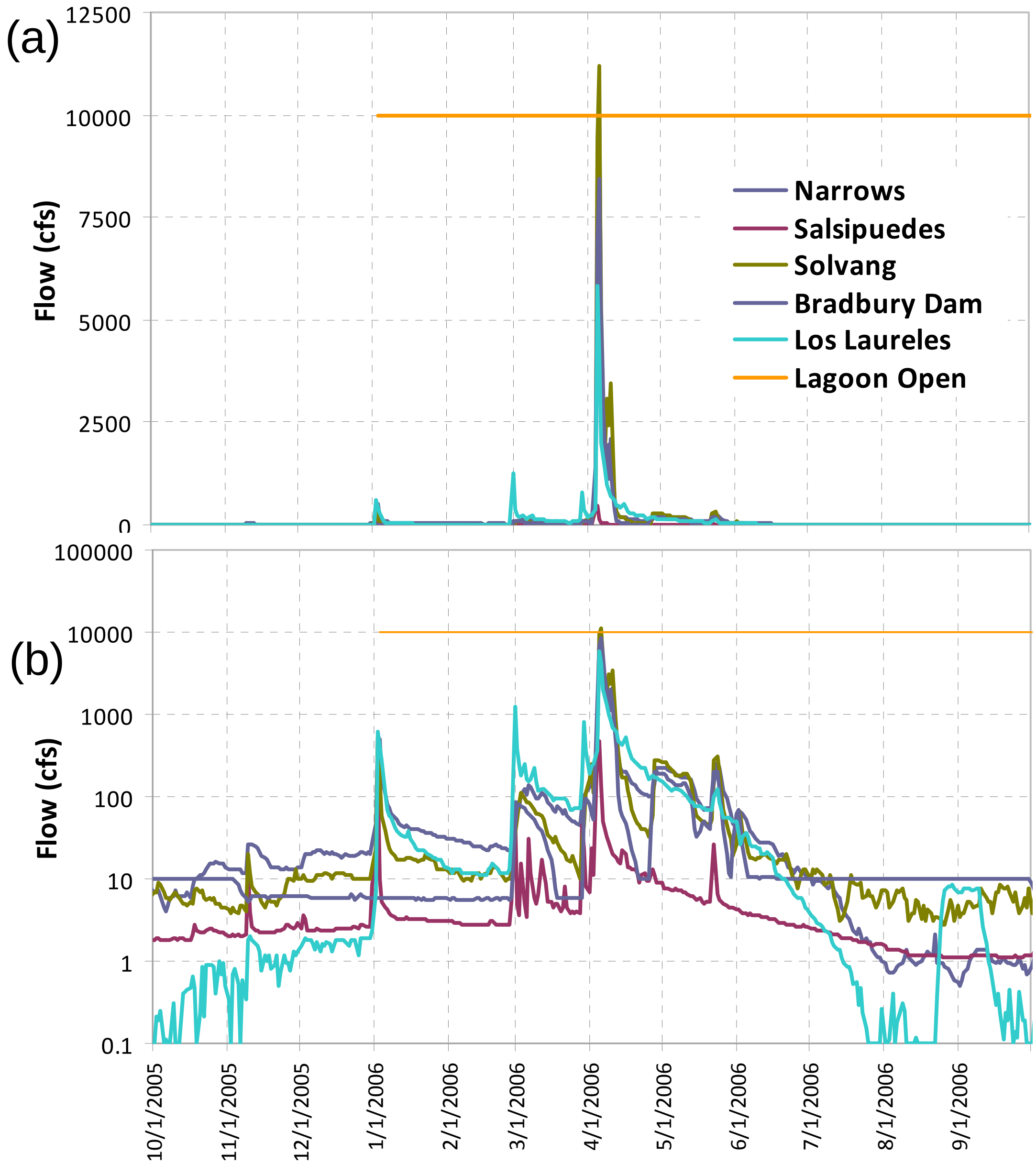


Figure C-17: Stream discharge and the period when the Santa Ynez River lagoon was open in WY2006 with a (a) normal and (b) logarithmic distribution. Target flows were met throughout the period.

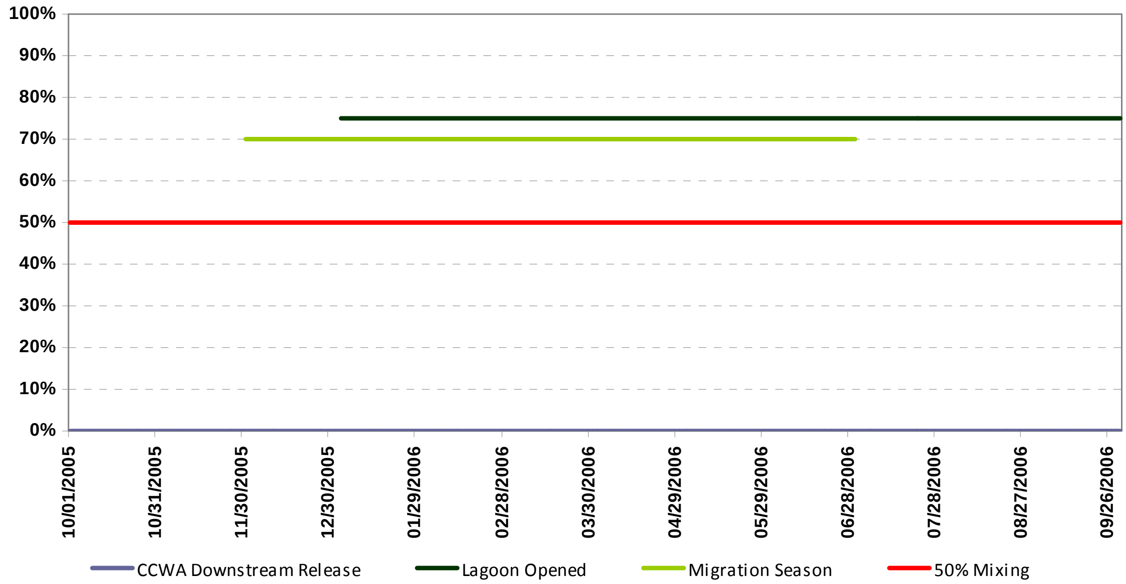


Figure C-18: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the migration season and while the lagoon was open to the ocean in WY20065.

Table C-14: 2006 thermograph network locations and period of record.

	Location Name	Stream ID	Type	Deployment Date	Retrieval Date	Period of Record (days)
Mainstem	Long Pool	LSYR-0.5	Vertical Array	7/18/2006	11/6/2006	111
	Encantado	LSYR-4.9	Vertical Array	6/23/2006	11/6/2006	136
	7.3 Pool	LSYR-7.3	Vertical Array	6/23/2006	11/6/2006	136
	Alisal BR Pool	LSYR-10.2	Vertical Array	6/22/2006	11/6/2006	137
	Avenue of Flags	LSYR-13.9	Single	6/17/2006	11/6/2006	142
Tributaries	Lower Hilton	HC-0.12	Single	5/18/2006	11/6/2006	172
	Middle Hilton	HC-0.25	Single	5/18/2006	11/6/2006	172
	Upper Hilton	HC-0.54	Single	5/18/2006	11/6/2006	172
	Quiota	QC-2.71	Single	5/3/2006	11/6/2006	187
	Lower Salsipuedes	SC-1.2	Single	5/3/2006	11/6/2006	187
	Upper Salsipuedes	SC-3.8	Single	5/3/2006	11/6/2006	187
	El Jaro	EJC-4.1	Single	5/3/2006	11/6/2006	187

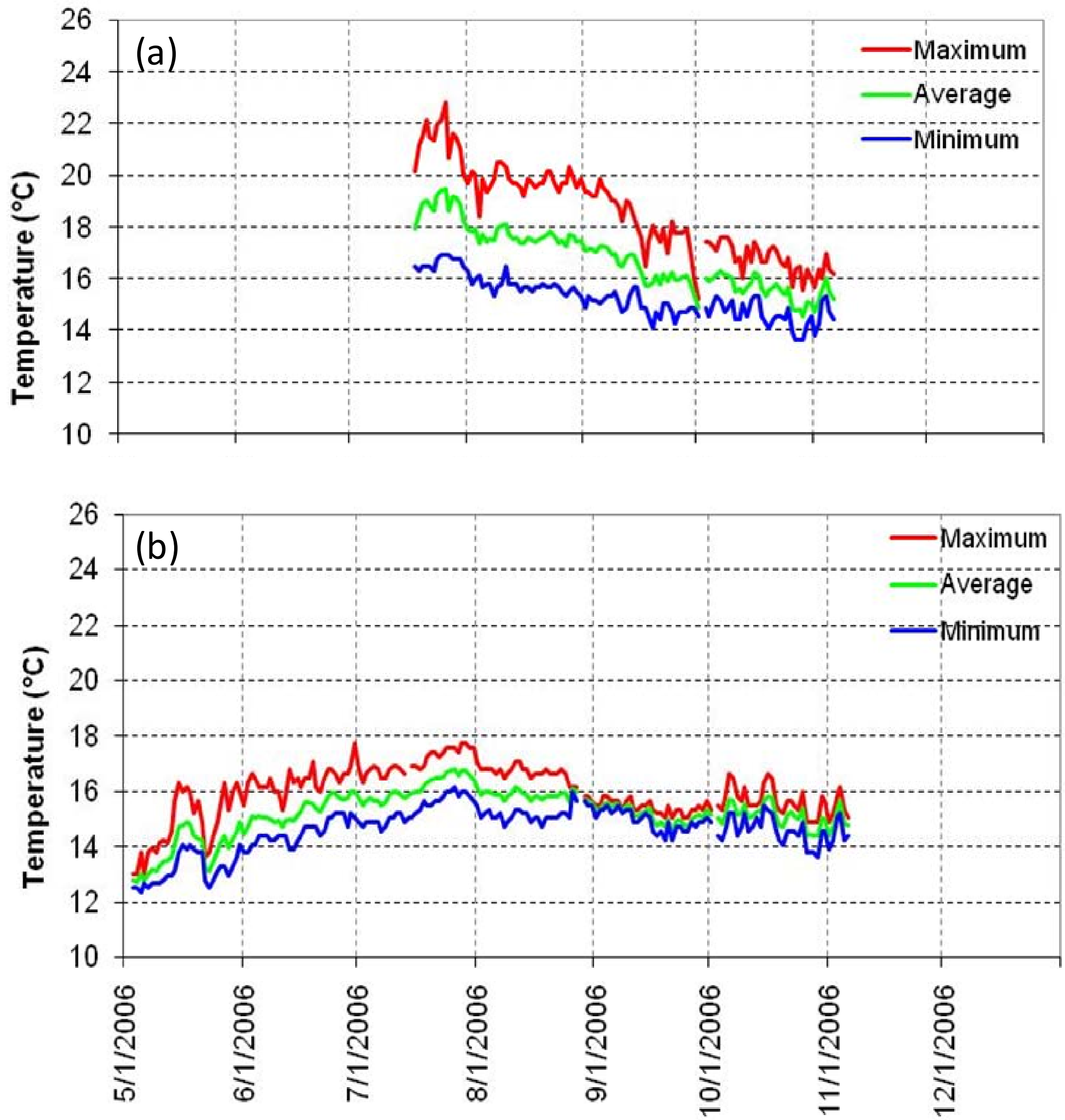


Figure C-19: 2006 Long Pool (LYSR-0.5) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

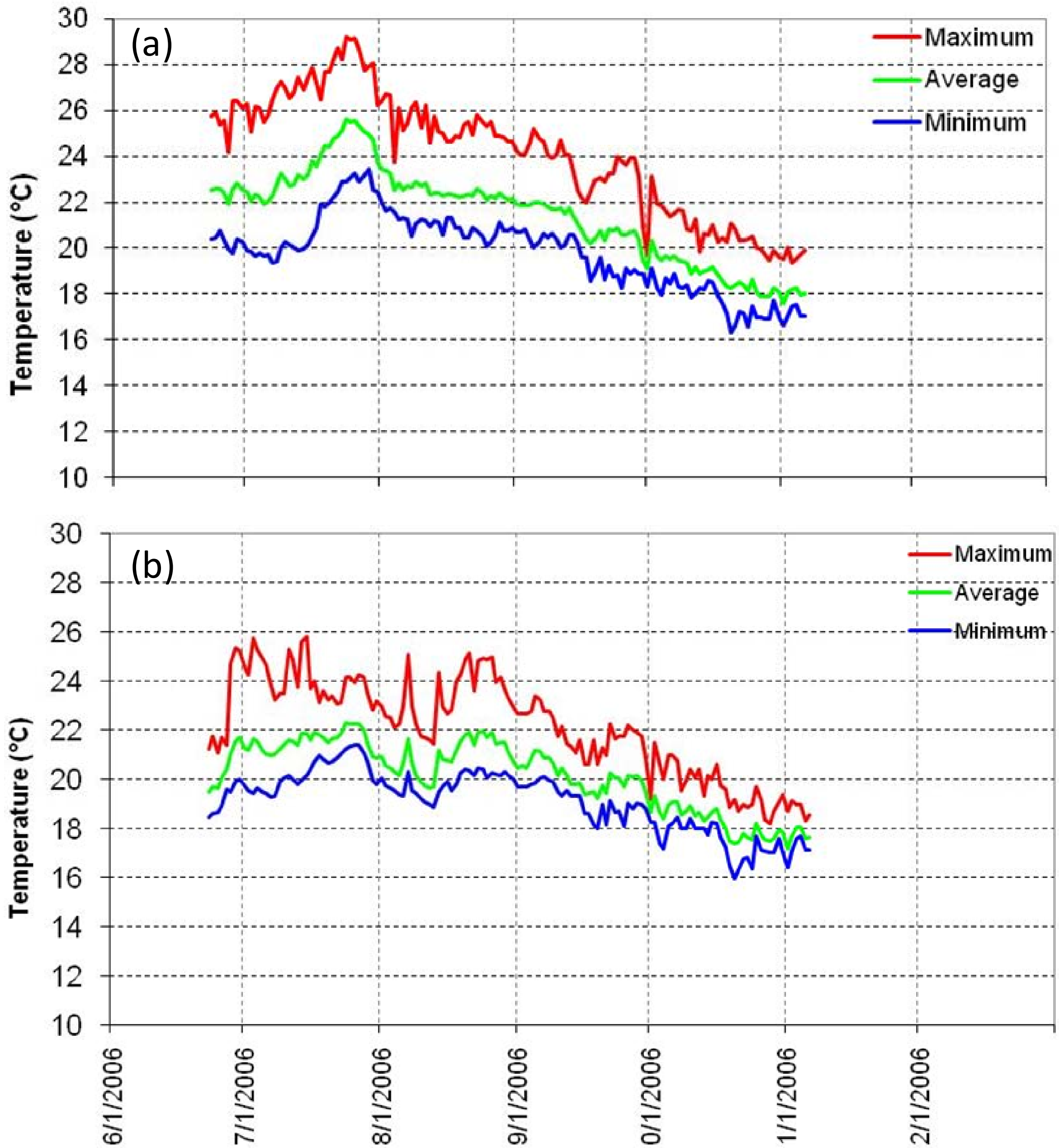


Figure C-20: 2006 Encantado Pool (LYSR-4.9) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

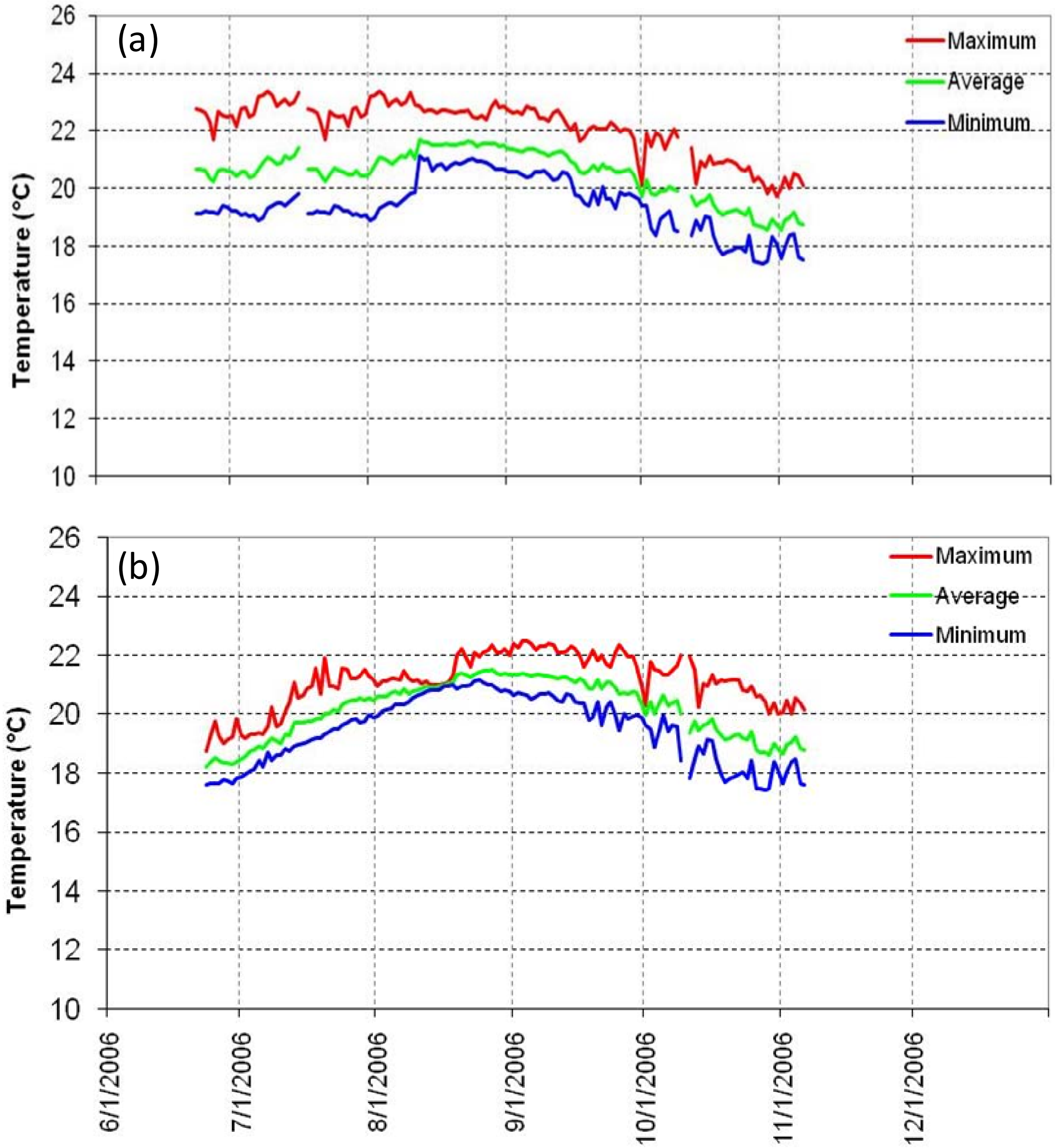


Figure C-21: 2006 LYSR-7.3 thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

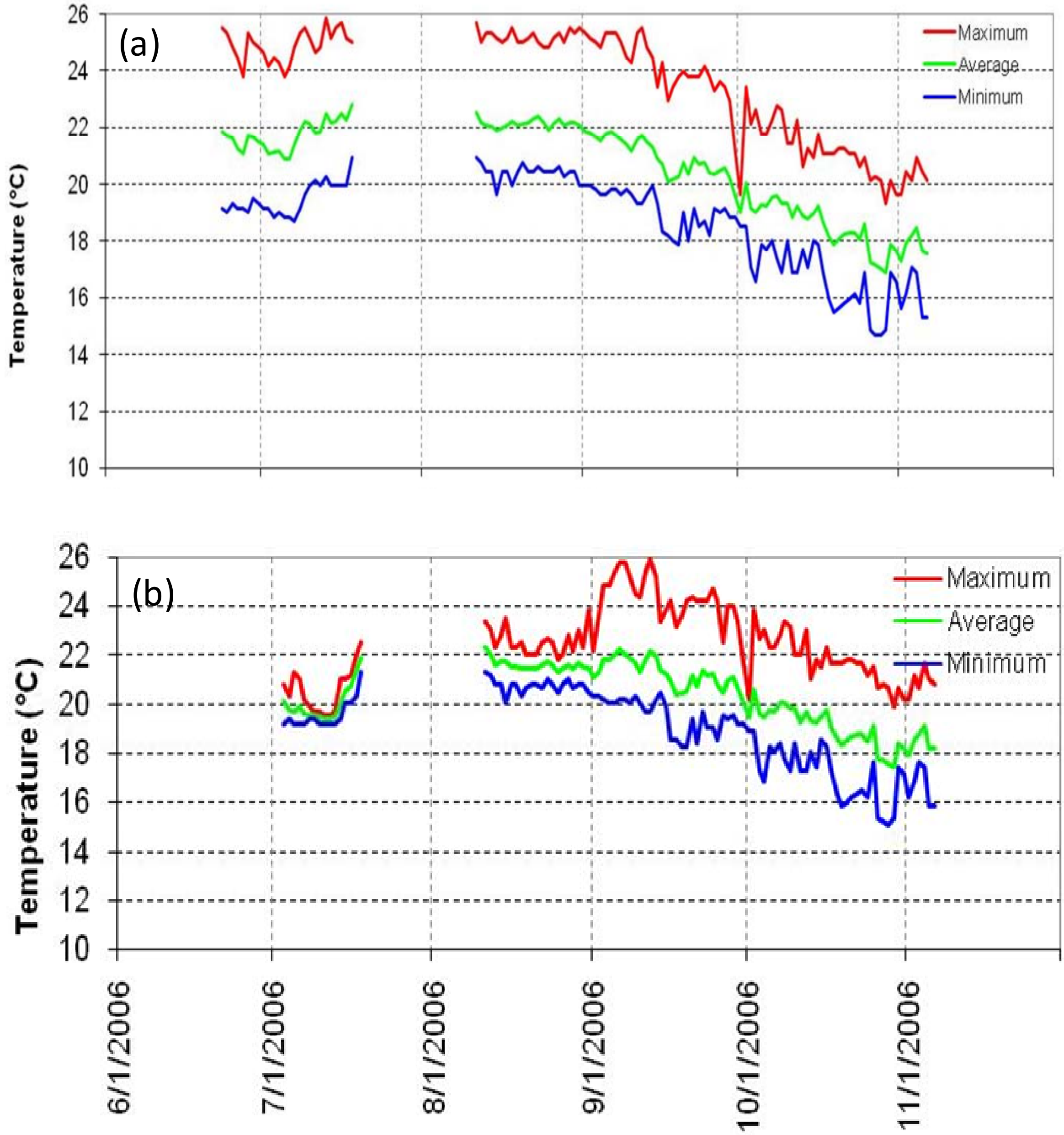


Figure C-22: 2006 Alisal Bedrock Pool (LYSR-10.2) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

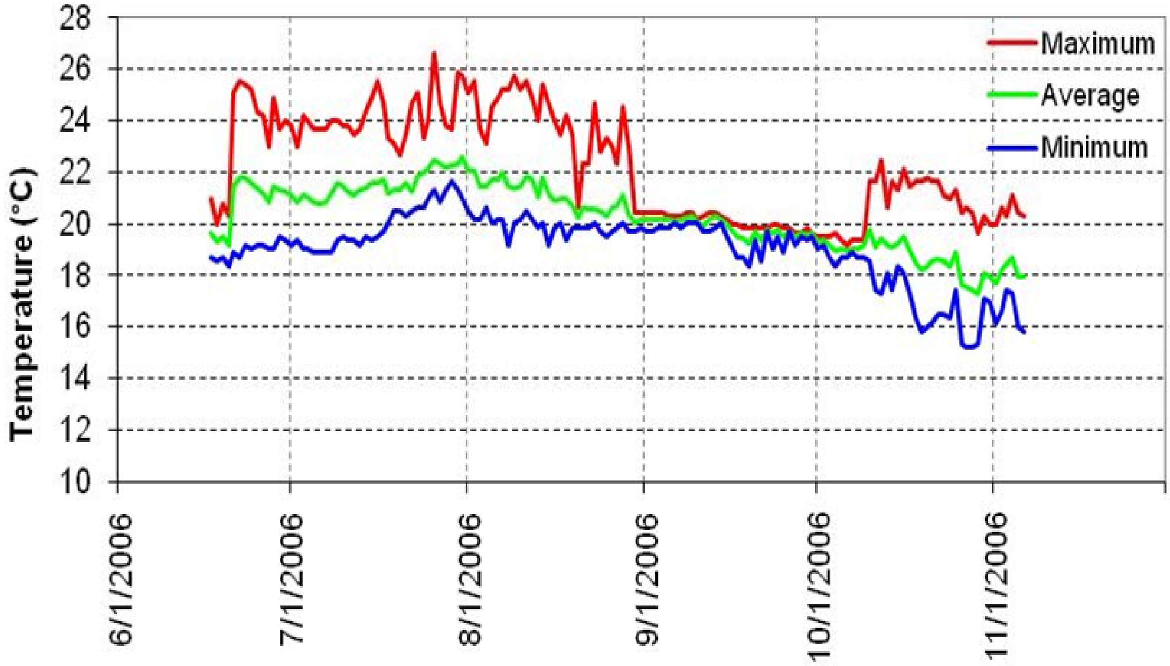


Figure C-23: 2006 Alisal Rip-Rap Pool (LYSR-10.49) thermograph maximum, average and minimum daily values for the bottom unit (3-feet below the surface).

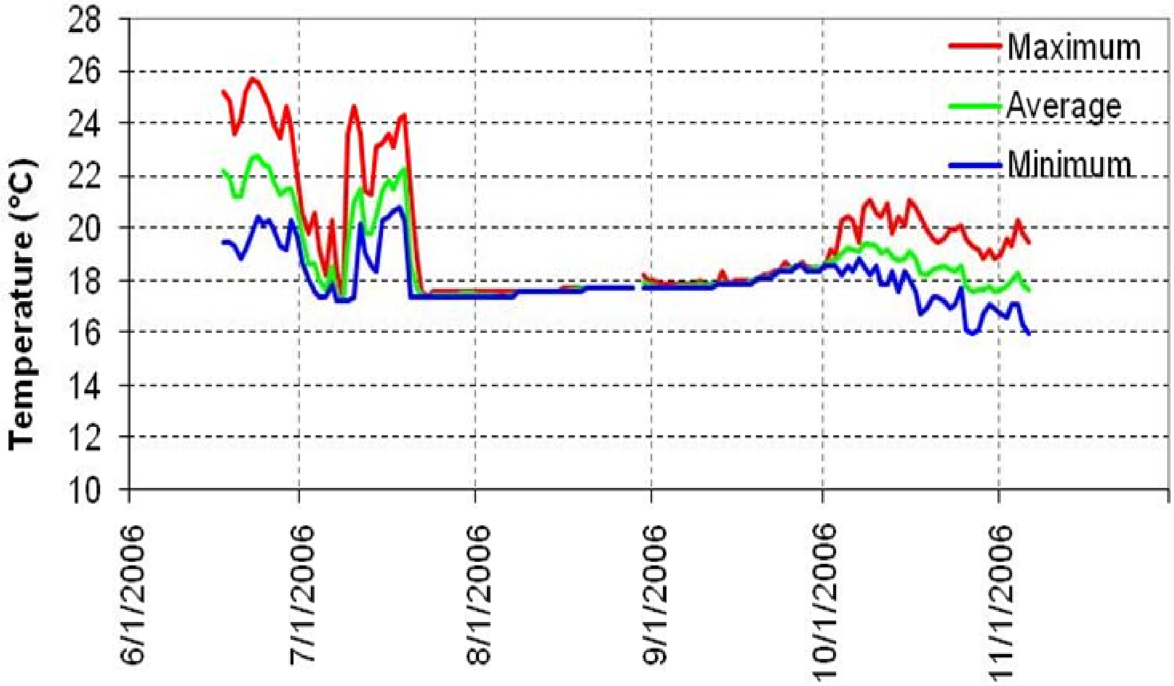


Figure C-24: 2006 Avenue of the Flags (LYSR-13.9) thermograph maximum, average and minimum daily values for the bottom unit (3-feet below the surface).

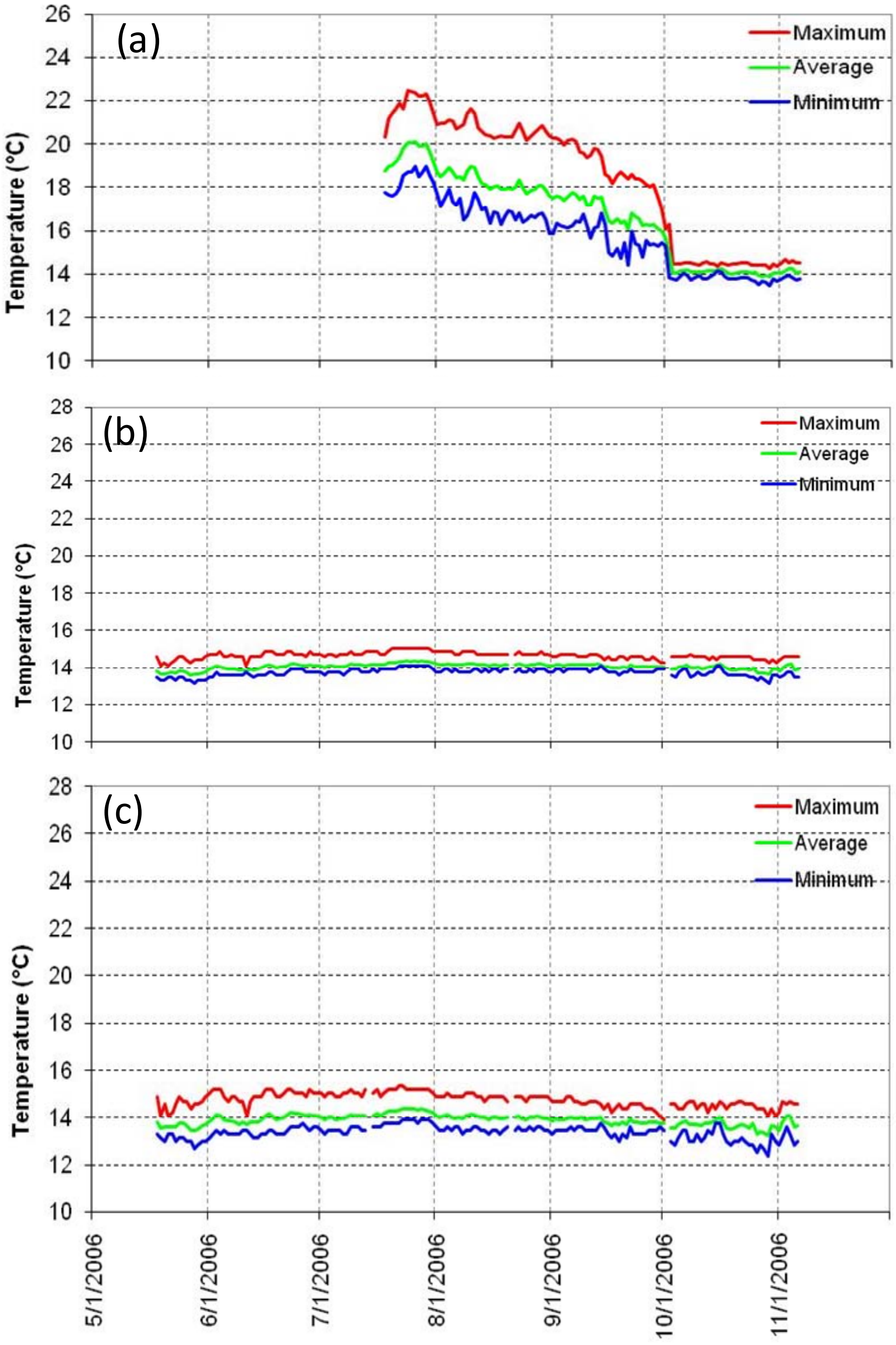


Figure C-25: 2006 Hilton Creek thermograph maximum, average and minimum daily values for (a) HC-0.54, (b) HC-0.25 and (c) HC-0.12.

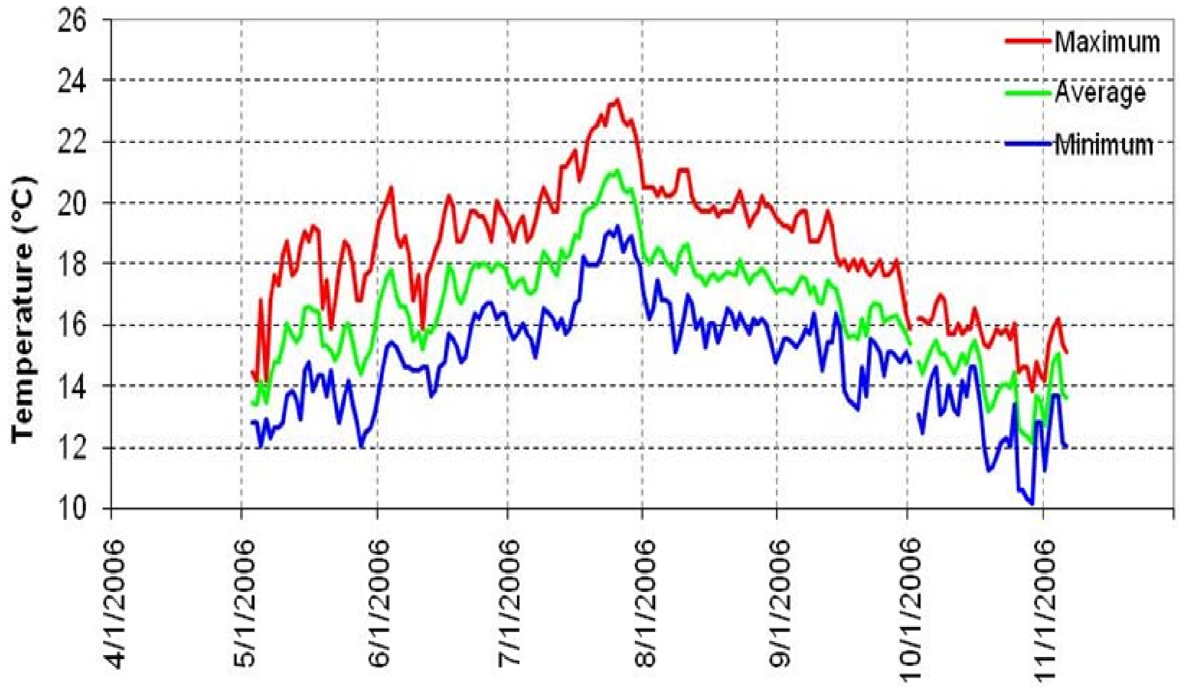


Figure C-26: 2006 thermograph maximum, average and minimum daily values for the Quiota Creek (QC-2.71) unit.

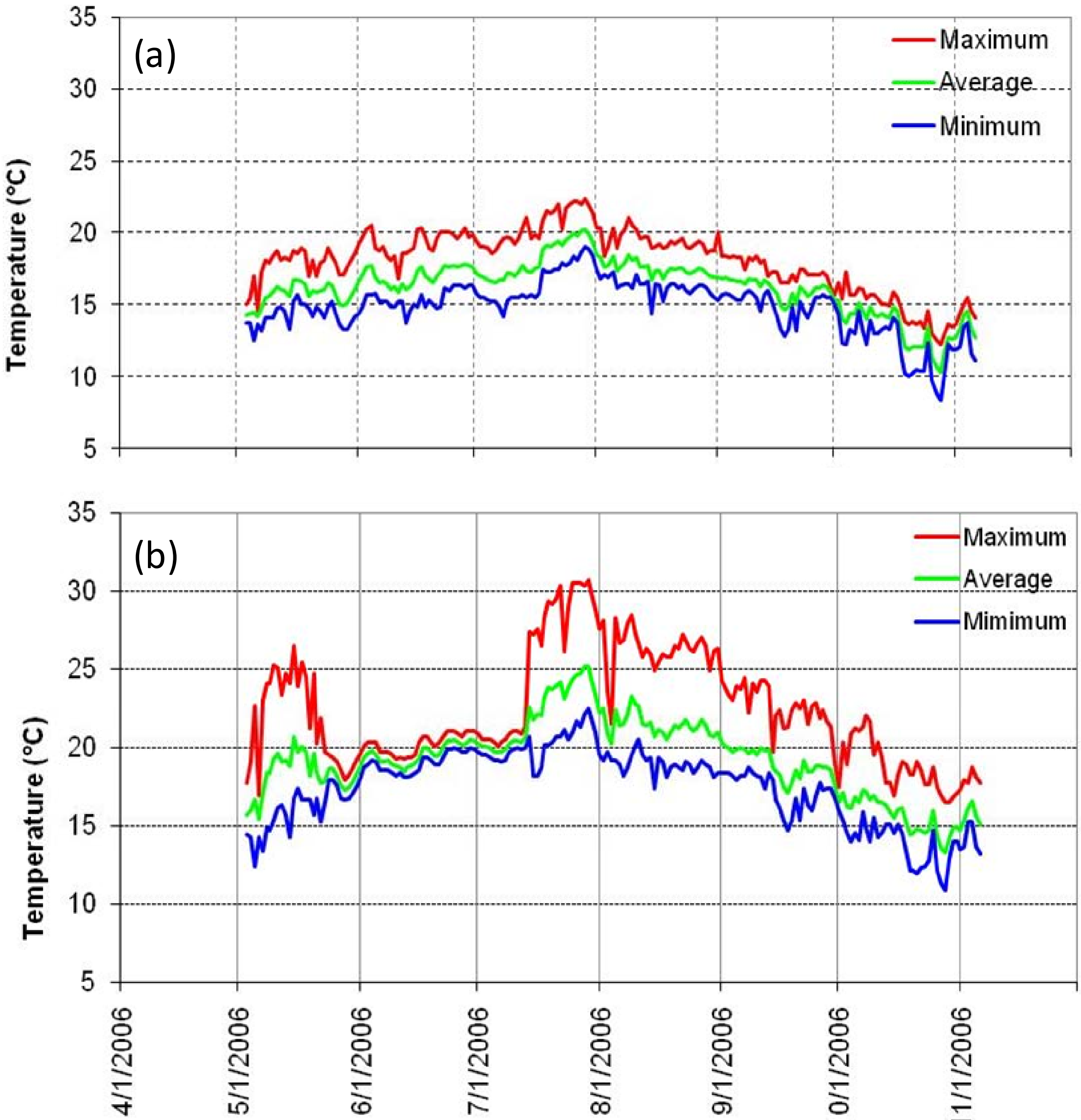


Figure C-27: 2006 thermograph maximum, average and minimum daily values for the (a) upper Salsipuedes Creek (SC-3.8), and (b) lower Salsipuedes Creek (SC-0.77) units.

Figure C-28: 2006 thermograph maximum, average and minimum daily values for the El Jaro Creek (EJC-3.71) unit.

Table C-15: 2006 sonde deployment locations and dates; surface (6 inches below the surface), middle (half the pool depth), and bottom (2 inches above the bottom).

Location Name	Stream ID	Deployment Date	Sonde Water Column Location	Estimated Pool Depth (ft)
Stilling Basin	LSYR-0.1	Aug 11 - Aug 14, 2006	Surface	20
		Aug 11 - Aug 14, 2006	Middle	20
		Aug 11 - Aug 14, 2006	Bottom	20
		Aug 14 - Aug 16, 2006	Surface	20
		Aug 14 - Aug 16, 2006	Middle	20
		Aug 14 - Aug 16, 2006	Bottom	20
Long Pool Tail	LSYR-0.6	Aug 21 - Aug 23, 2006	Middle	3
Encantado Pool	LSYR-4.9	Aug 8 - Aug 11, 2006	Surface	5
		Aug 8 - Aug 11, 2006	Bottom	5
		Aug 31 - Sept 5, 2006	Surface	5
		Aug 31 - Sept 5, 2006	Bottom	5
		Sept 28 - Oct 3, 2006	Surface	5
		Sept 28 - Oct 3, 2006	Bottom	5
		Oct 12 - Oct 16, 2006	Surface	5
		Oct 12 - Oct 16, 2006	Bottom	5
Meadowlark Pool	LYSR-5.4	Nov 30 - Dec 5, 2005	Middle	4.5
		June 26 - June 30, 2006	Middle	4.5
		July 25 - July 28, 2006	Middle	4
		Aug 8 - Aug 11, 2006	Middle	4
		Aug 28 - Aug 31, 2006	Middle	4
		Sept 20 - Sept 25, 2006	Middle	4
Baby Beaver Pool	LYSR 6.5	July 13 - July 14, 2006	Middle	4.5
		July 28 - July 31, 2006	Middle	4.5
		Aug 28 - Sept 5, 2006	Middle	4.5
		Sept 28 - Oct 3, 2006	Middle	4.5
		Oct 12 - Oct 16, 2006	Middle	4.5
		Nov 10 - Nov 14	Middle	4.5
Small Scour Pool	LYSR-6.7	July 13 - July 14, 2006	Middle	3.5
		July 28 - July 31, 2006	Middle	3.5
		Sept 9 - Sept 11, 2006	Middle	3.5
Mite Pool (7.1 Pool)	LYSR-7.1	July 25 - July 28, 2006	Middle	4
		Aug 2 - Aug 4, 2006	Surface	4
		Aug 2 - Aug 4, 2006	Bottom	4
		Sept 7 - Sept 11, 2006	Surface	4
		Sept 7 - Sept 11, 2006	Bottom	4
		Oct 3 - Oct 6, 2006	Surface	4
		Oct 3 - Oct 6, 2006	Bottom	4
7.3 Pool	LYSR-7.3	June 22-June 26, 2006	Middle	5.5
		July 3 - July 6, 2006	Middle	5
		July 13 - July 17, 2006	Middle	5
		July 24 - July 28, 2006	Middle	5
		Aug 2 - Aug 4, 2006	Middle	5
		Aug 28 - Aug 31, 2006	Middle	5
		Sept 20 - Sept 25, 2006	Middle	5
		Oct 3 - Oct 7, 2006	Middle	5
		Nov 10 - Nov 13, 2006	Middle	5
Quiota Confluence	LSYR-8.4	July 7 - July 11, 2006	Middle	5.5
		July 28 - July 31, 2006	Middle	5.5
		Aug 28 - Aug 31, 2006	Middle	5.5
		Sept 20 - Sept 25, 2006	Middle	5.5
		Nov 11 - Nov 14, 2006	Middle	5.5
Mid Alisal Pool	LSYR-9.2	Aug 4 - Aug 7, 2006	Surface	7
		Aug 4 - Aug 7, 2006	Bottom	7
		Sept 13 - Sept 18, 2006	Surface	7
		Sept 13 - Sept 18, 2006	Bottom	7
Fallen Oak	LSYR-9.7	Aug 4 - Aug 7, 2006	Middle	3.5
		Sept 13 - Sept 18, 2006	Middle	3.5

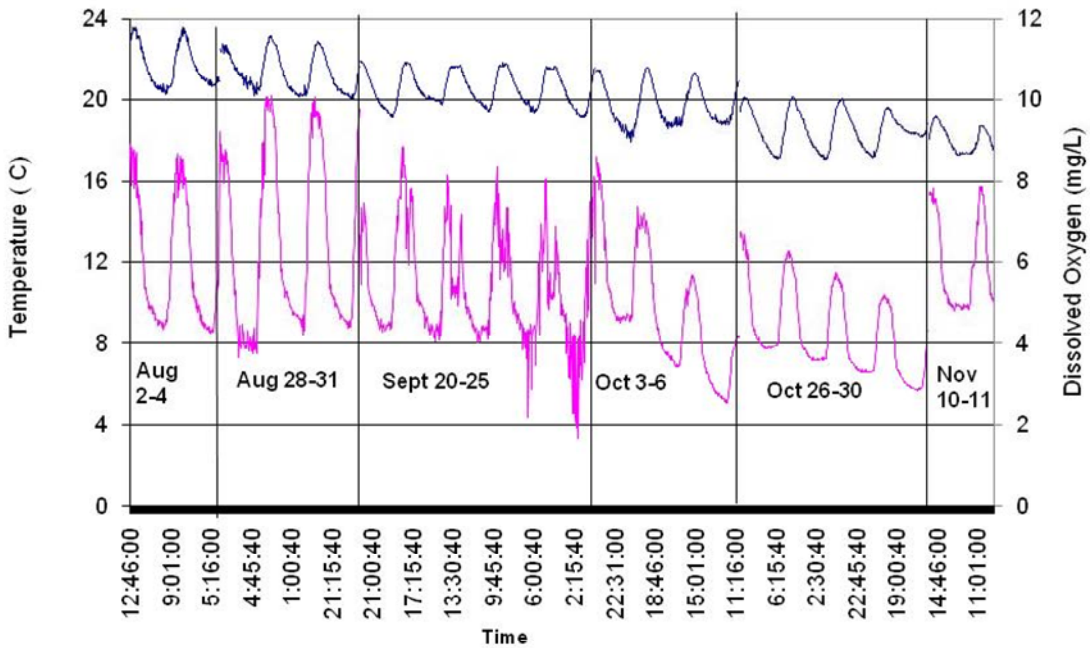


Figure C-29: 2006 temperature and dissolved oxygen data at LSYR 7.3. This site had several juvenile and adult steelhead/rainbow trout inhabiting the pool habitat. The sonde was deployed at this site to monitor summer and fall rearing conditions for the fish present and represents the largest sonde data set for 2006. See Table C-15 for deployment depths.

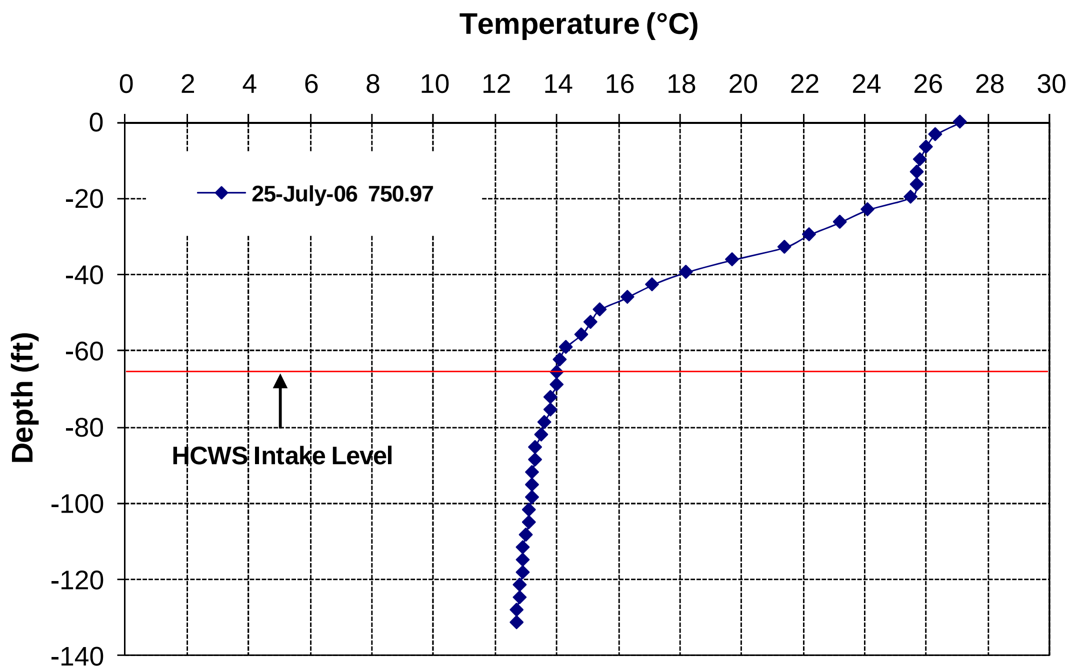


Figure C-30: WY2006 Lake Cachuma profile data taken near the HCWS intake barge on July 25, 2006.

Table C-16: WY2006 migrant trap deployments.

Location	Date Traps Deployed (dates)	Date Traps Removed (dates)	Date Traps Removed (storm events) (dates)	Date Traps Installed (storm events) (dates)	# of Days Not Trapping (days)
Hilton	1/16/2006	5/27/2006	3/27/2006	3/29/2006	2
			4/3/2006	4/6/2006	3
			5/21/2006	5/22/2006	1
				Total:	**6**
Salsipuedes	1/16/2006	5/27/2006	2/26/2006	2/28/2006	2
			3/2/2006	3/7/2006	6
			3/10/2006	3/13/2006	4
			3/27/2006	3/29/2006	2
			4/2/2006	4/6/2006	5
			5/21/2006	5/22/2006	1
				Total:	**20**
Mainstem	2/28/2006	4/3/2006	3/27/2006	3/29/2006	2
			4/3/2006 (spill)	Not Installed	
				Total:	**2**

Table C-17: WY2006 Catch Per Unit Effort (CPUE) for each trapping location.

Location	Upstream Captures (#)	Downstream Captures (#)	Functional Trap Days (days)	Trap Season (days)	Trapping Effeciency (%)	CPUE Upstream (Captures/day)	CPUE Downstream (Captures/day)	CPUE (Total) (Captures/day)	Mean Flow (cfs)
Hilton	101	260	126	132	94.7%	0.80	2.06	2.87	7.6
Salsipuedes	12	226	112	132	84.9%	0.11	2.02	2.13	39.7
Mainstem	1	14	32	34	94.1%	0.03	0.44	0.47	73.6

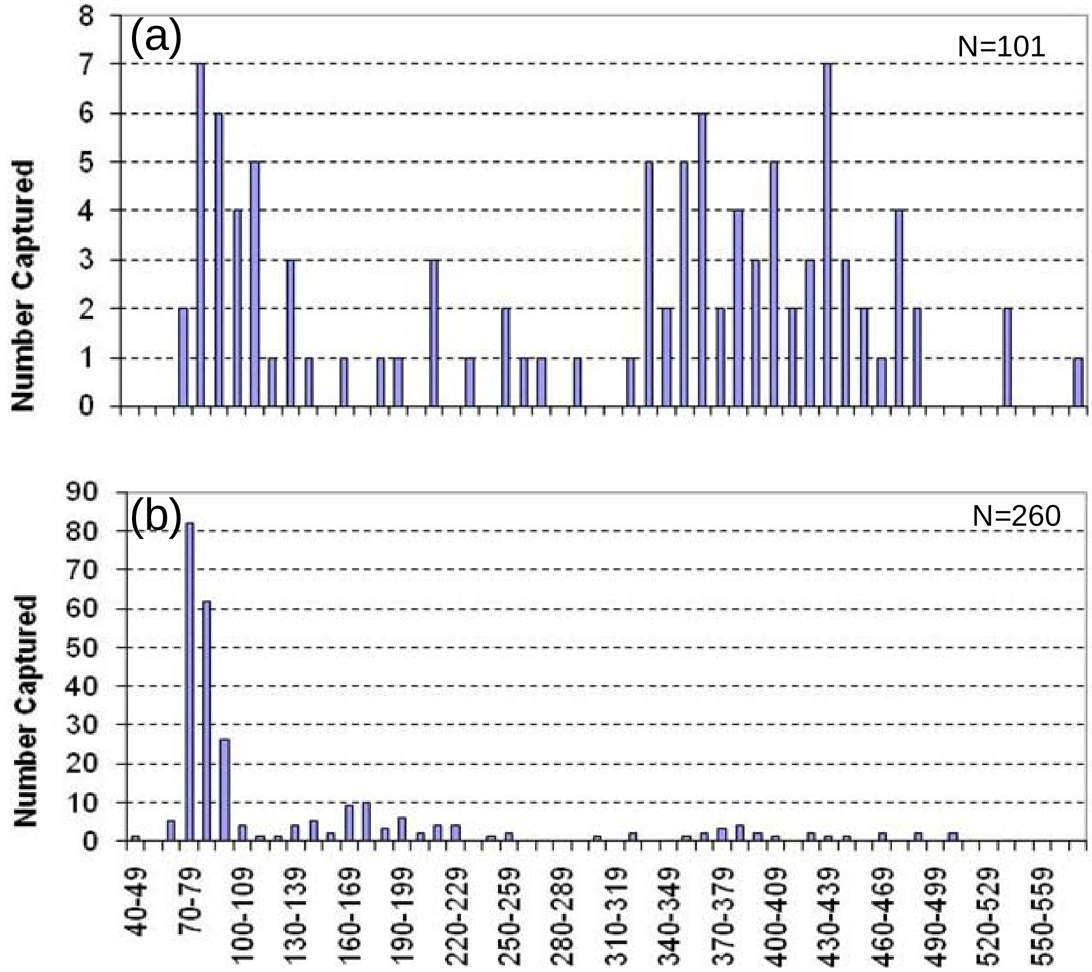


Figure C-31: WY2006 Hilton Creek length frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

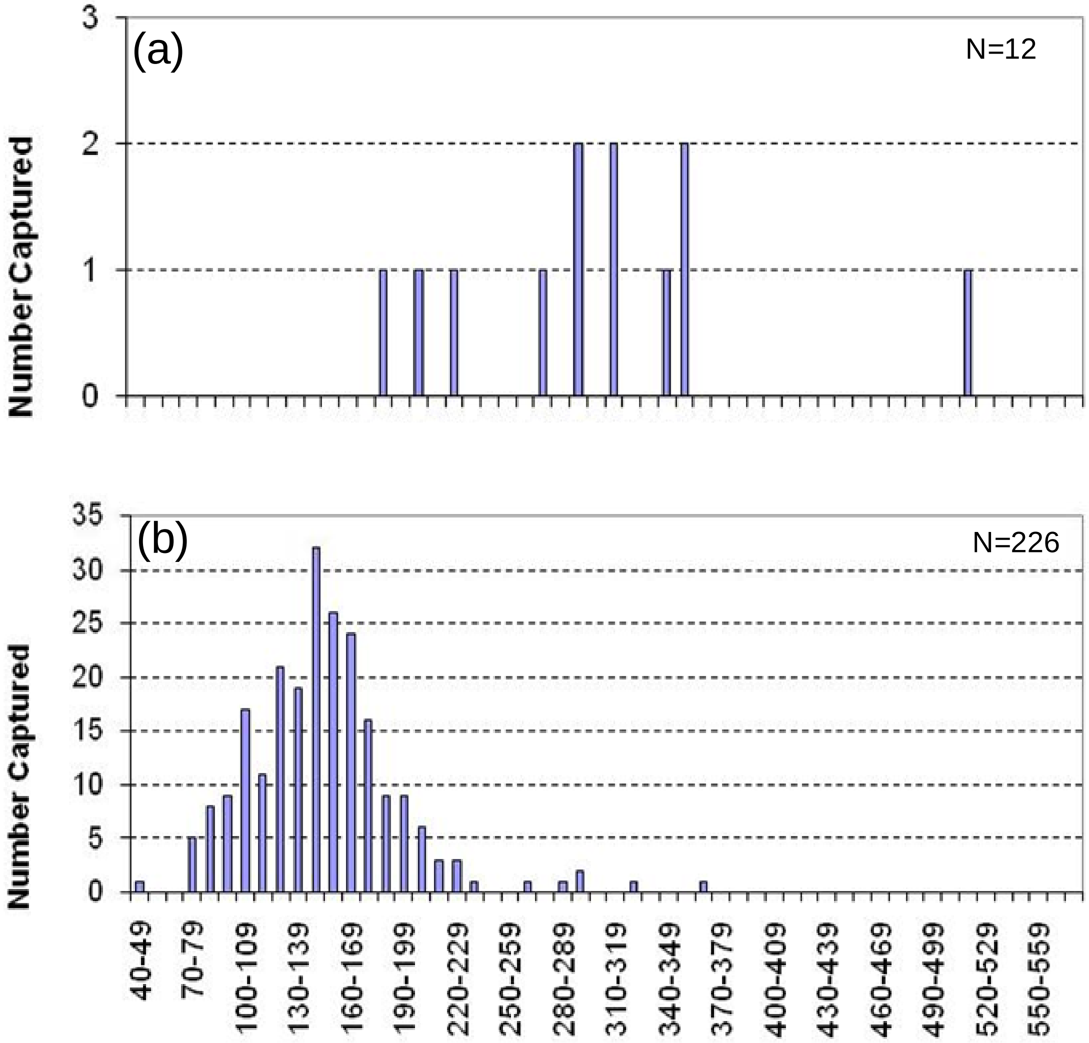


Figure C-32: WY2006 Salsipuedes Creek trap length frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

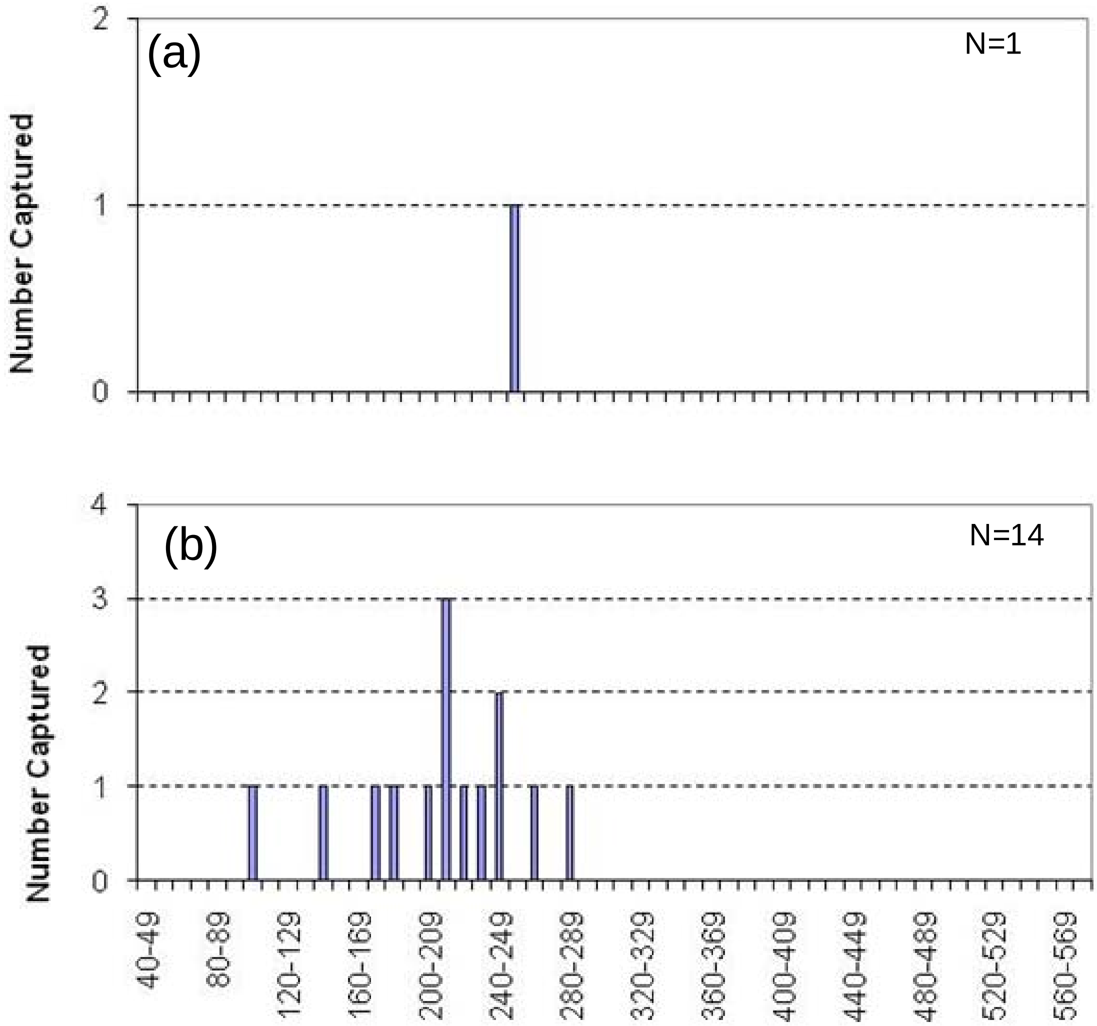


Figure C-33: WY2006 Mainstem trap length frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

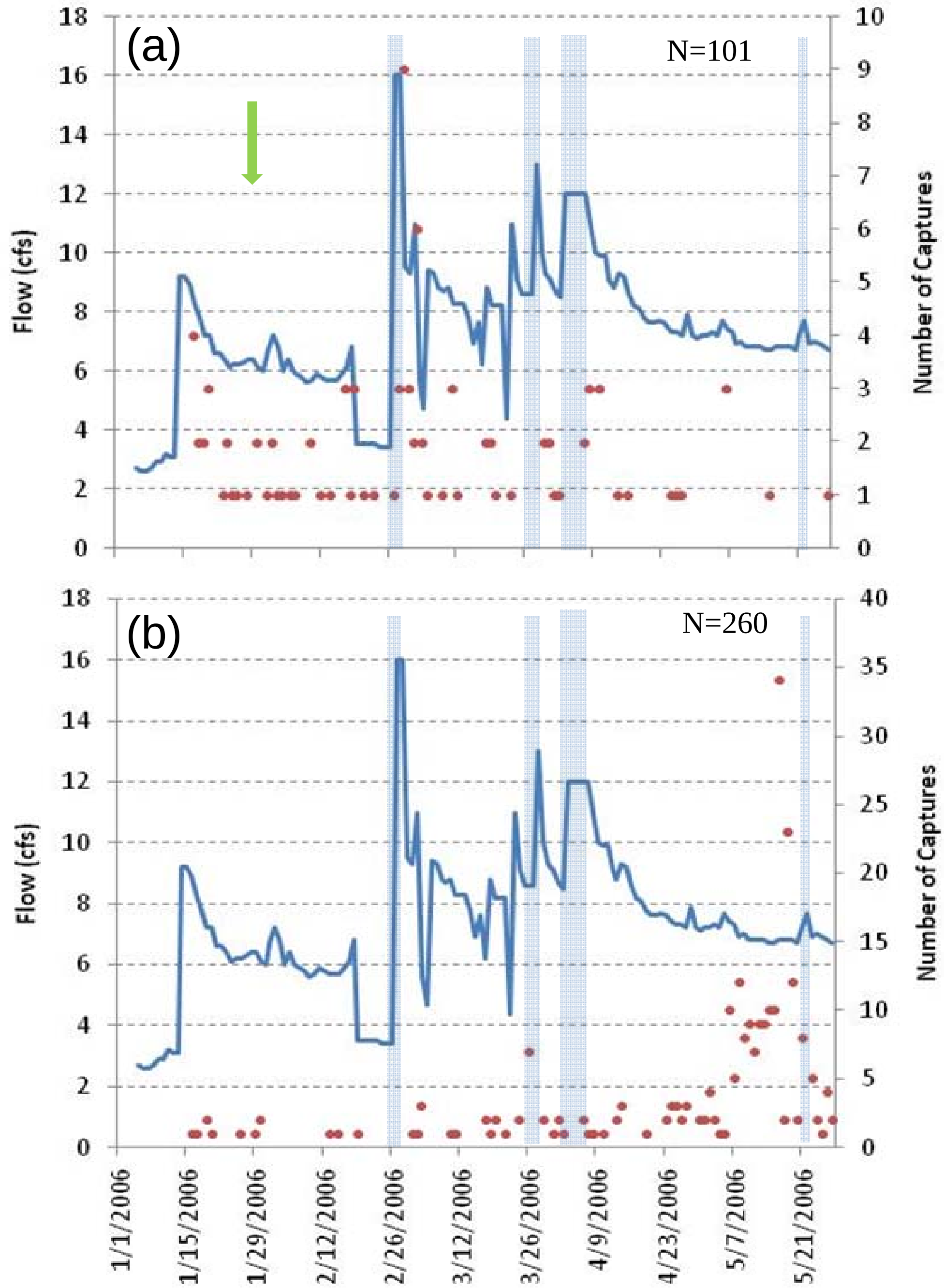


Figure C-34: WY2006 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The green arrow denotes the day when an anadromous steelhead was captured. The blue rectangles bracket times when migrant traps were removed due to storm flows.

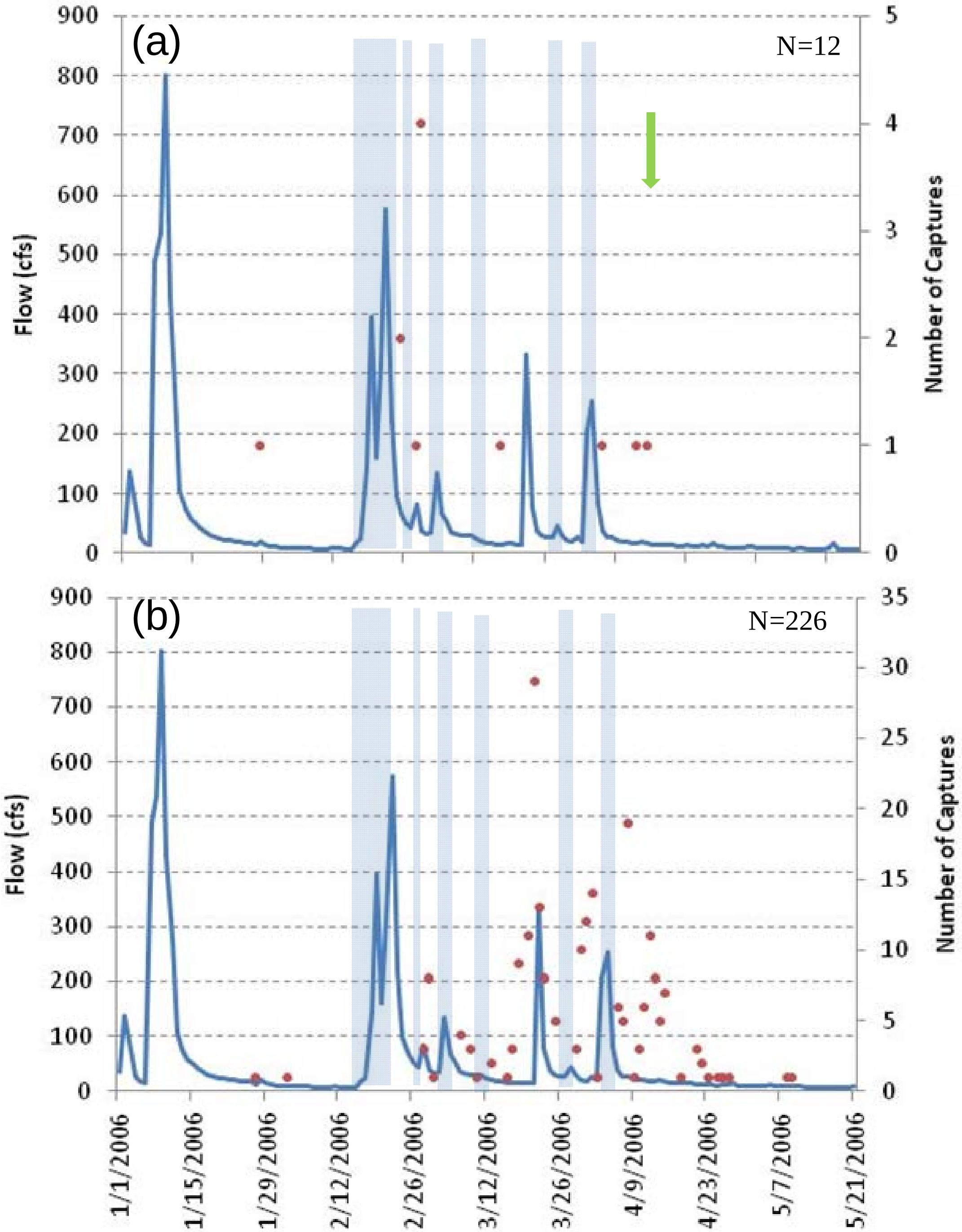


Figure C-35: WY2006 Salsipuedes Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The green arrow denotes the day when an anadromous steelhead was captured. The blue rectangles bracket times when migrant traps were removed due to storm flows.

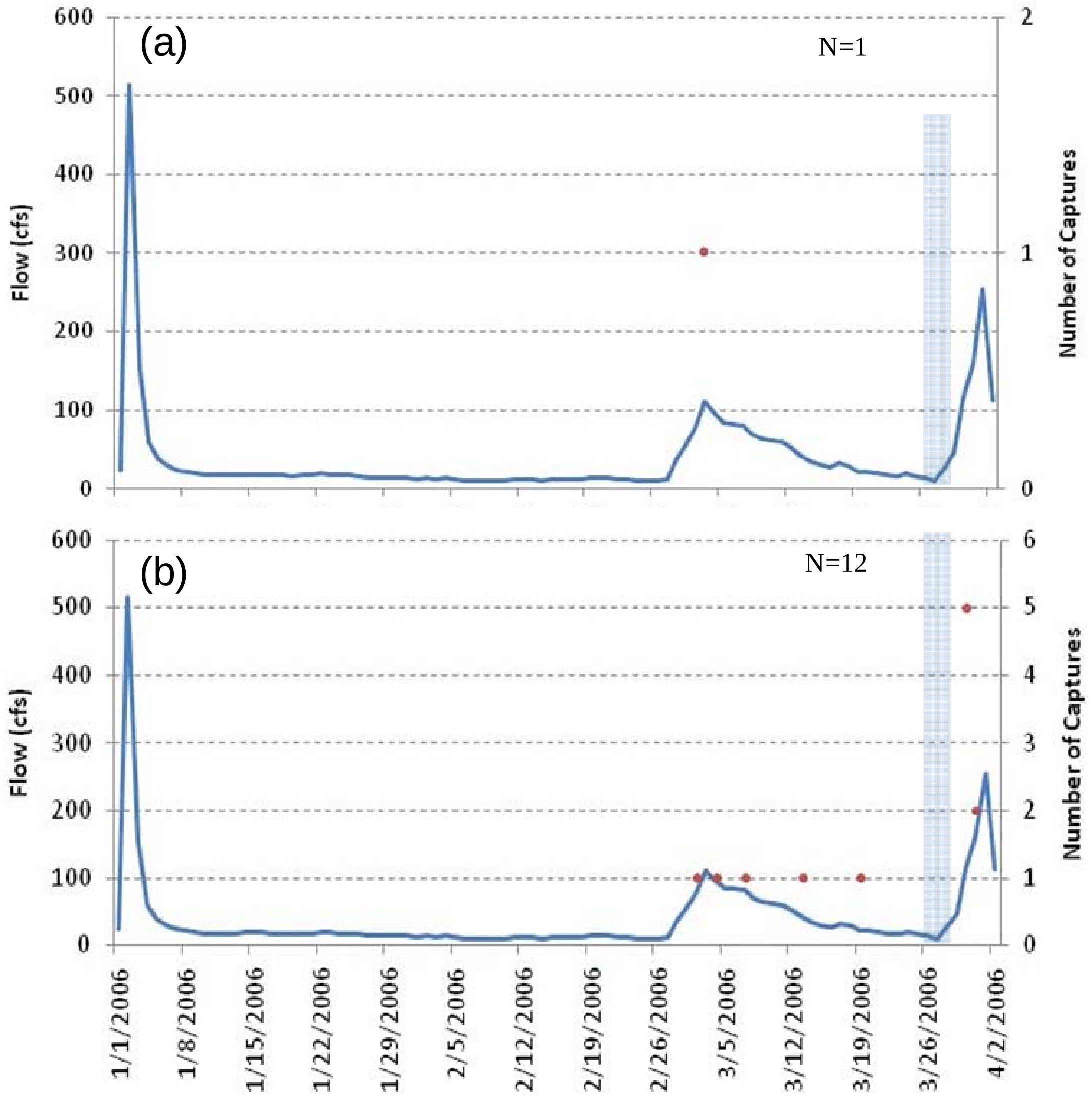


Figure C-36: WY2006 Mainstem migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The blue rectangles bracket times when migrant traps were removed due to storm flows.

Table C-18: WY2006 tributary upstream and downstream migrant captures for Hilton and Salsipuedes Creeks.

Hilton Captures (#)		**Size (mm)**		**Salsipuedes Captures (#)**
		Upstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
1		550-599		0
2		500-549		1
9		450-499		0
20		400-450		0
28		300-399		5
9		200-299		5
17		101-199		1
15		<100		0
101		**Total**		**12**
		Downstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
0		550-599		0
2		500-549		0
4		450-499		0
5		400-449		0
15		(300-399mm)		2
13		(200-299mm)		17
	11	*Smolts*	*11*	
	0	*Pre-Smolt*	*2*	
	2	*Res*	*4*	
45		(101-199mm)		184
	33	*Smolts*	*130*	
	5	*Pre-Smolt*	*49*	
	7	*Res*	*5*	
176		(<100mm)		23
	1	*Smolts*	*4*	
	166	*Pre-Smolt*	*16*	
	9	*Res*	*3*	
260		**Total**		**226**

Table C-19: 2006 mainstem snorkel schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	n/s-turbidty
(LSYR-0.2 to LSYR-0.7)	Summer	8/15/2006
	Fall	n/s-turbidty
Refugio Reach	Spring	5/4/2006
(LSYR-4.9 to LSYR-7.8)	Summer	6/20/2006
	Fall	8/8/06 & 10/11/06-10/12/06
Alisal Reach	Spring	5/12/2006
(LSYR-7.8 to LSYR-10.5)	Summer	6/21/2006
	Fall	8/7/06 & 10/10/06-10/11/06
Avenue Reach	Spring	n/s-poor vis
(LSYR-10.5 to LSYR-13.9)	Summer	8/9/14-8/14/06
	Fall	n/s-dry
Cadwell Reach	Spring	n/s
(LSYR-22.1 to LSYR-22.7)	Summer	n/s
	Fall	n/s

*n/s = no survey

Table C-20: 2006 mainstem snorkel results.

Survey	Reach	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hwy 154	Not snorkeled due to turbidity									
	Refugio	0	10	11	4	3	2	2	0	0	**32**
	Alisal	0	3	47	14	8	4	2	1	0	**79**
	Avenue	Not snorkeled									
	Cadwell	Not snorkeled									
Summer	Hwy 154	Not snorkeled due to turbidity									
	Refugio	5	45	68	56	28	8	0	1	0	**211**
	Alisal	3	44	21	57	7	2	0	0	0	**134**
	Avenue	0	2	11	13	6	1	0	0	0	**33**
	Cadwell	Not snorkeled									
Fall	Hwy 154	Not snorkeled due to turbidity									
	Refugio	0	29	56	64	31	24	3	1	0	**208**
	Alisal	0	9	42	29	4	1	0	0	0	**85**
	Avenue	Not snorkeled									
	Cadwell	Not snorkeled									

Table C-21: 2006 tributary snorkel schedule.

Tributaries/Stream Miles	Season	Date
Hilton Creek	Spring	6/27/2006
(HC-0.0 to HC-0.54)	Summer	8/17/2006
	Fall	10/31/2006
Quiota Creek	Spring	n/s
(QC-2.58 to QC-2.73)	Summer	8/14/2006
	Fall	11/2/2006
Salsipuedes Creek (R1-4)	Spring	n/s-turbidity
(SC-1.2 to SC-3.49)	Summer	n/s-turbidity
	Fall	n/s-turbidity
Salsipuedes Creek R-5	Spring	7/5/2006
SC-3.49 to SC-3.75	Summer	8/30/2006
	Fall	10/23/2006
El Jaro Creek	Spring	7/5/2006
(ELC-0.0 to ELC-0.4)	Summer	8/30/2006
	Fall	10/23/2006

*n/s = no survey

Table C-22: 2006 tributary snorkel results.

Survey	Creek	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hilton	1386	1181	143	20	4	5	1	0	0	**2740**
	Quiota	Not snorkeled									
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	40	42	22	3	2	0	0	0	0	**109**
	El Jaro	2	15	17	1	0	0	0	0	0	**35**
Summer	Hilton	1044	764	65	11	5	1	1	0	0	**1891**
	Quiota	97	34	7	4	0	0	0	0	0	**142**
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	41	53	29	6	1	1	0	0	0	**131**
	El Jaro	11	10	11	1	0	0	0	0	0	**33**
Fall	Hilton	620	1260	116	16	1	2	1	0	0	**2016**
	Quiota	12	66	5	1	0	0	0	0	0	**84**
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	11	28	26	7	2	0	0	0	0	**74**
	El Jaro	0	7	10	1	0	0	0	0	0	**18**

3. WY2007 Data

All data are reported by Water Year (October 1, 2006 through September 30, 2007) except water quality and snorkel survey data which is reported by the calendar year since these monitoring efforts continue into the fall. There were no sonde deployments throughout the year due to dry conditions, extremely low dry-season flows and few fish in the LSYR mainstem. No Lake Cachuma profile data were taken in WY2007.

Table C-23: WY2007 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed.

Location	Period of Record (years)	Min. Rainfall (Water Year) (in)	Max. Rainfall (Water Year) (in)	Rainfall (Water Year 2007) (in)
Lompoc	38	5.32 (WY07)	34.42 (WY83)	5.32
Buellton	54	5.34 (WY89)	41.56 (WY98)	7.00
Solvang	44	6.84 (WY07)	43.87 (WY98)	6.84
Cachuma*	56	7.46 (WY07)	53.37 (WY98)	7.46
Gibraltar	89	10.03 (WY07)	73.12 (WY98)	10.03
Jameson	83	8.92 (WY07)	79.52 (WY69)	8.92

*Bradbury Dam - Rain.

Table C-24: Storm events greater than 0.1 inch at Bradbury Dam during WY2007.

#	Storm Date	Precipitation (in)
1	10/2/2006	0.12
2	11/27/2006	0.2
3	12/9/2006	0.99
4	12/22/2006	0.11
5	12/27/2006	0.43
6	1/27/2007	1.02
7	1/31/2007	0.22
8	2/11/2007	0.52
9	2/19/2007	0.86
10	2/23/2007	0.75
11	2/27/2007	0.89
12	4/20/2007	0.89
13	9/22/2007	0.13

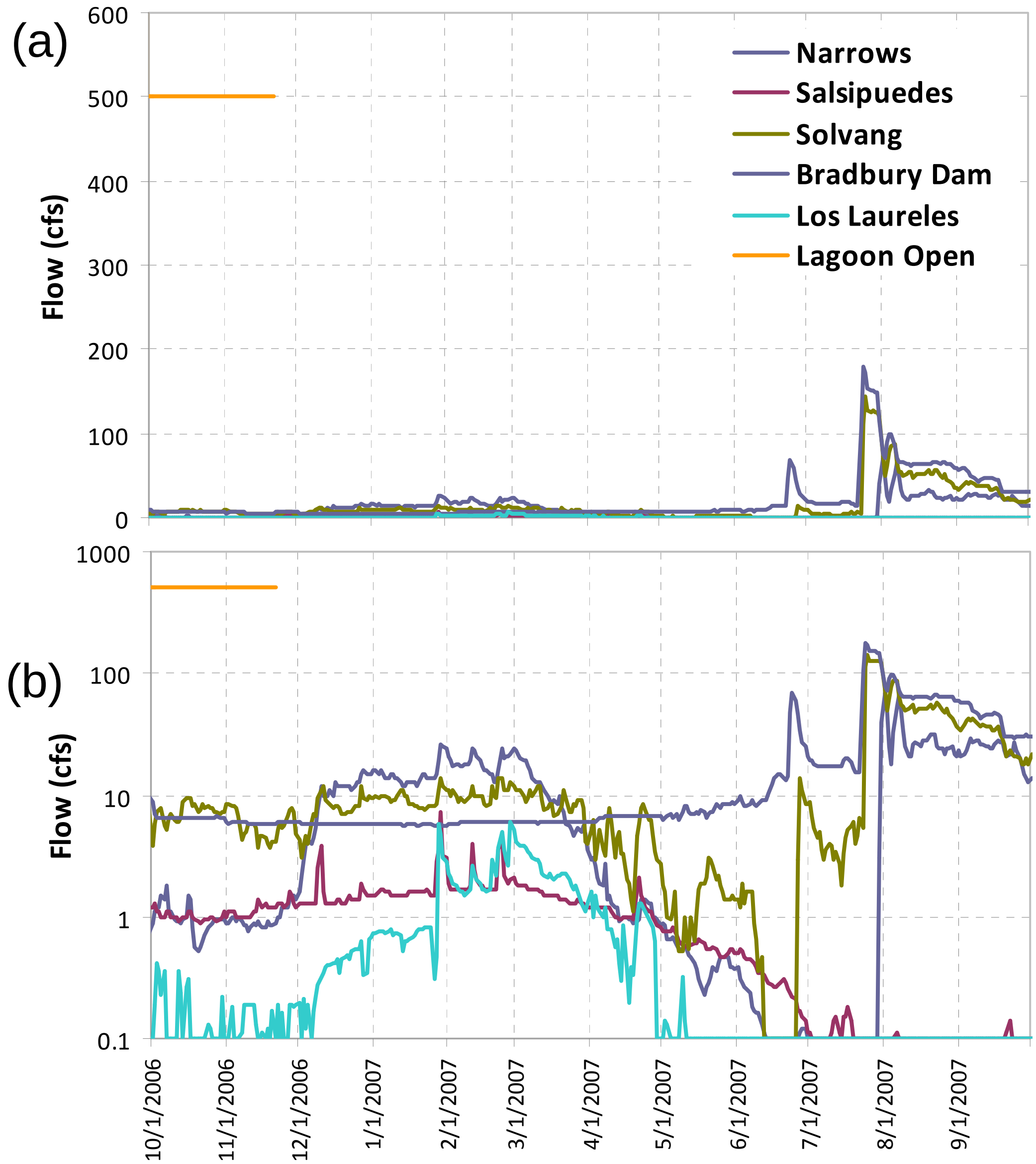


Figure C-37: Stream discharge and the period when the Santa Ynez River lagoon was open in WY2006 with a (a) normal and (b) logarithmic distribution.

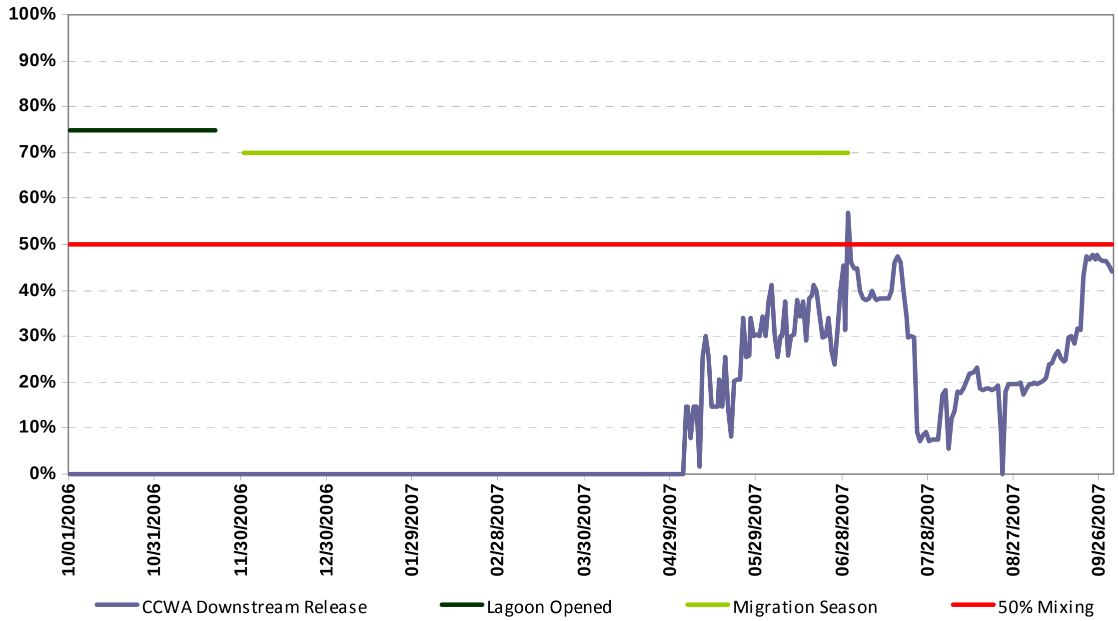


Figure C-38: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the migration season and while the lagoon was open to the ocean in WY2007.

Table C-25: 2007 thermograph network locations and period of record.

	Location Name	Stream ID	Type	Deployment Date	Retrieval Date	Period of Record (days)
Mainstem	Long Pool	LSYR-0.5	Vertical Array	5/15/2007	1/2/2008	232
	Encantado	LSYR-4.9	Vertical Array	6/28/2007	1/2/2008	188
	7.3 Pool	LSYR-7.3	Vertical Array	5/16/2007	1/2/2008	231
	Alisal BR Pool	LSYR-10.2	Vertical Array	5/16/2007	1/2/2008	231
	Avenue of Flags	LSYR-13.9	Single	5/15/2007	1/2/2008	232
Tributaries	Lower Hilton	HC-0.12	Single	5/15/2007	1/2/2008	232
	Middle Hilton	HC-0.25	Single	5/15/2007	1/2/2008	232
	Upper Hilton	HC-0.54	Single	7/12/2007	1/2/2008	174
	Quiota	QC-2.71	Single	5/15/2007	1/2/2008	232
	Lower Salsipuedes	SC-1.2	Single	5/15/2007	1/2/2008	232
	Upper Salsipuedes	SC-3.8	Single	5/16/2007	1/2/2008	231
	El Jaro	EJC-4.1	Single	5/16/2007	1/2/2008	231
	El Jaro - San Julian	EJC-9.8	single	5/16/2007	1/2/2008	231

Figure C-39: 2007 Long Pool (LYSR-0.5) thermograph maximum, average and minimum daily values for the bottom unit (9-feet in depth).

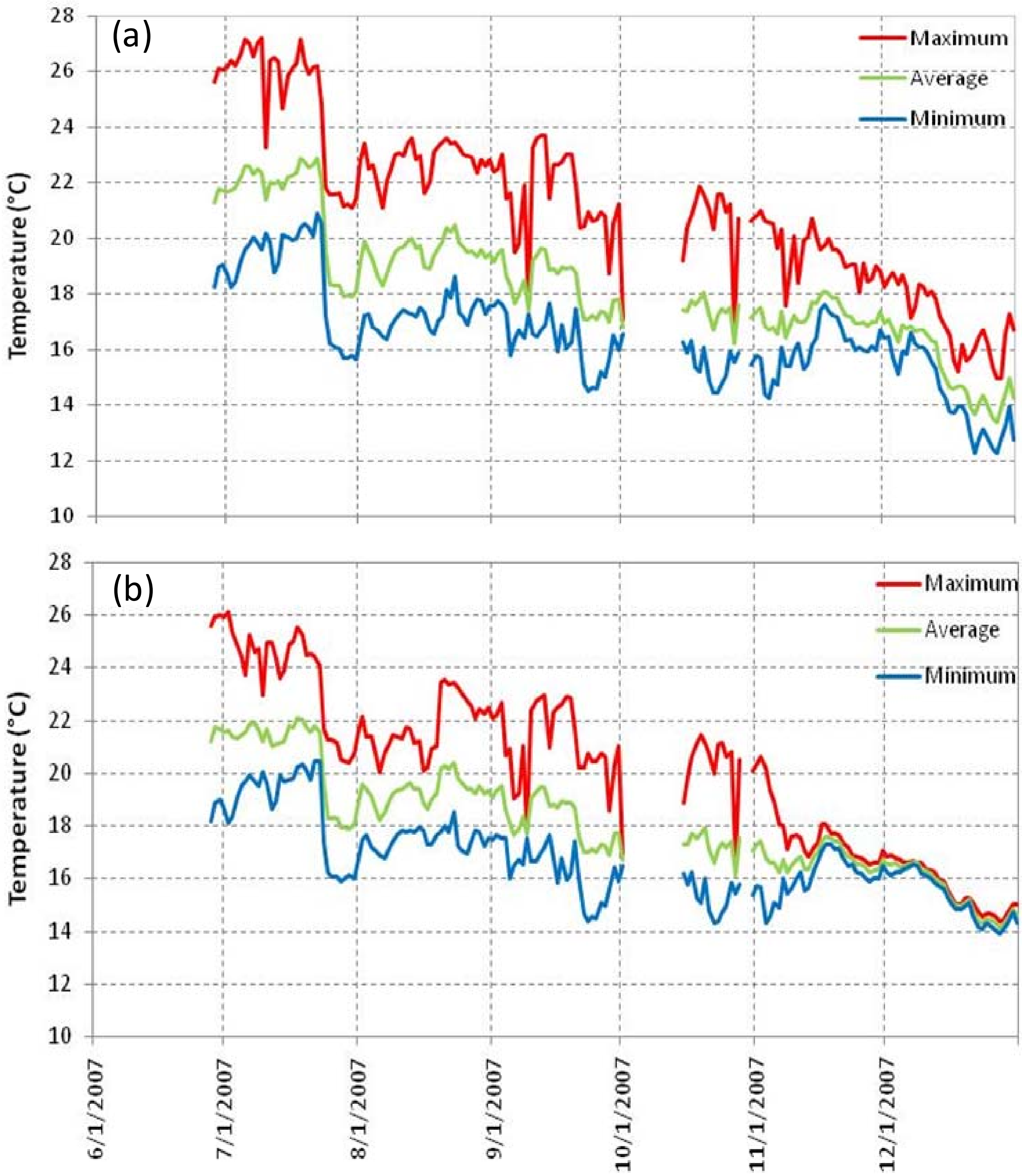


Figure C-40: 2007 Encantado Pool (LYSR-4.9) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

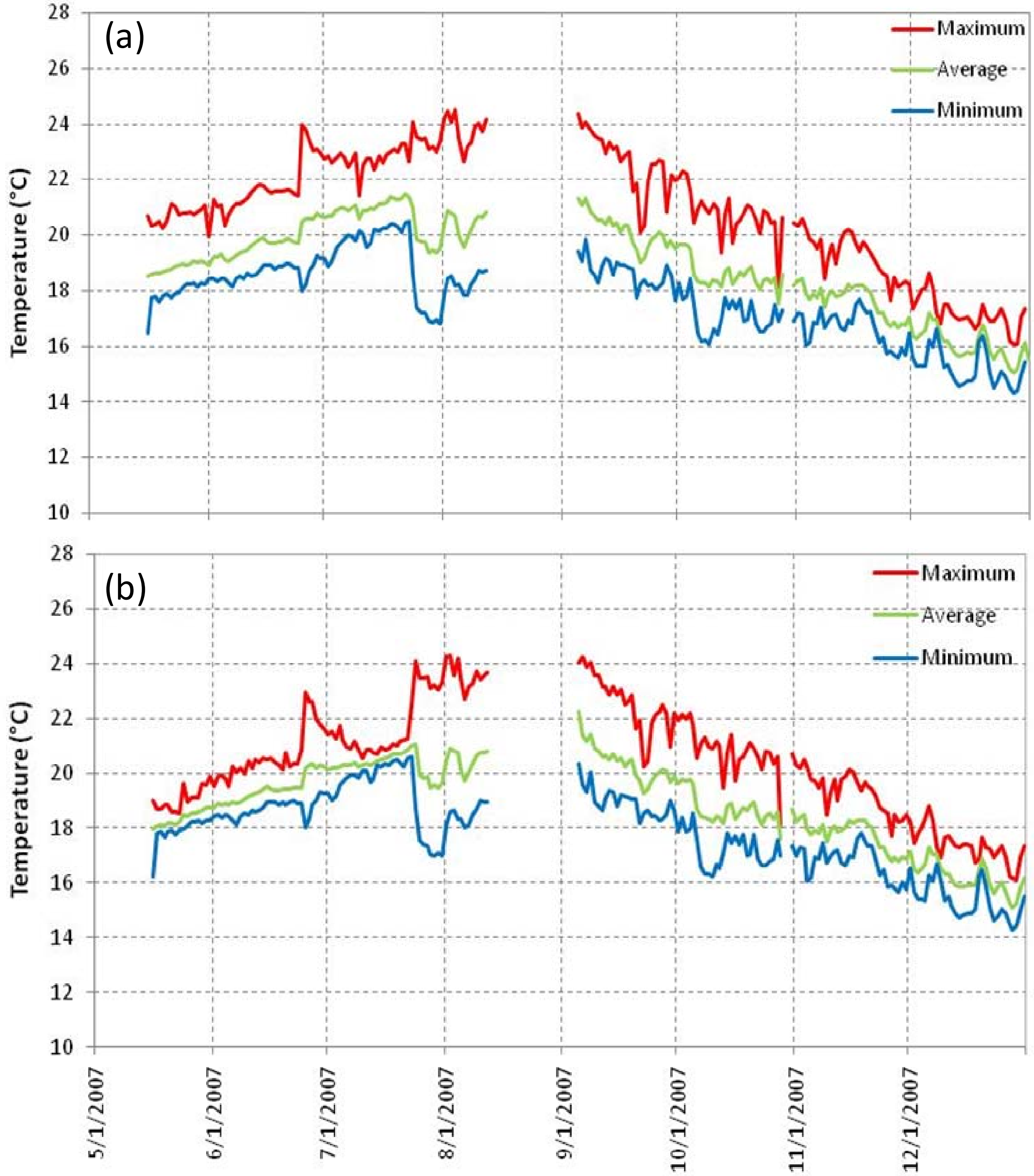


Figure C-41: 2007 LYSR-7.3 thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

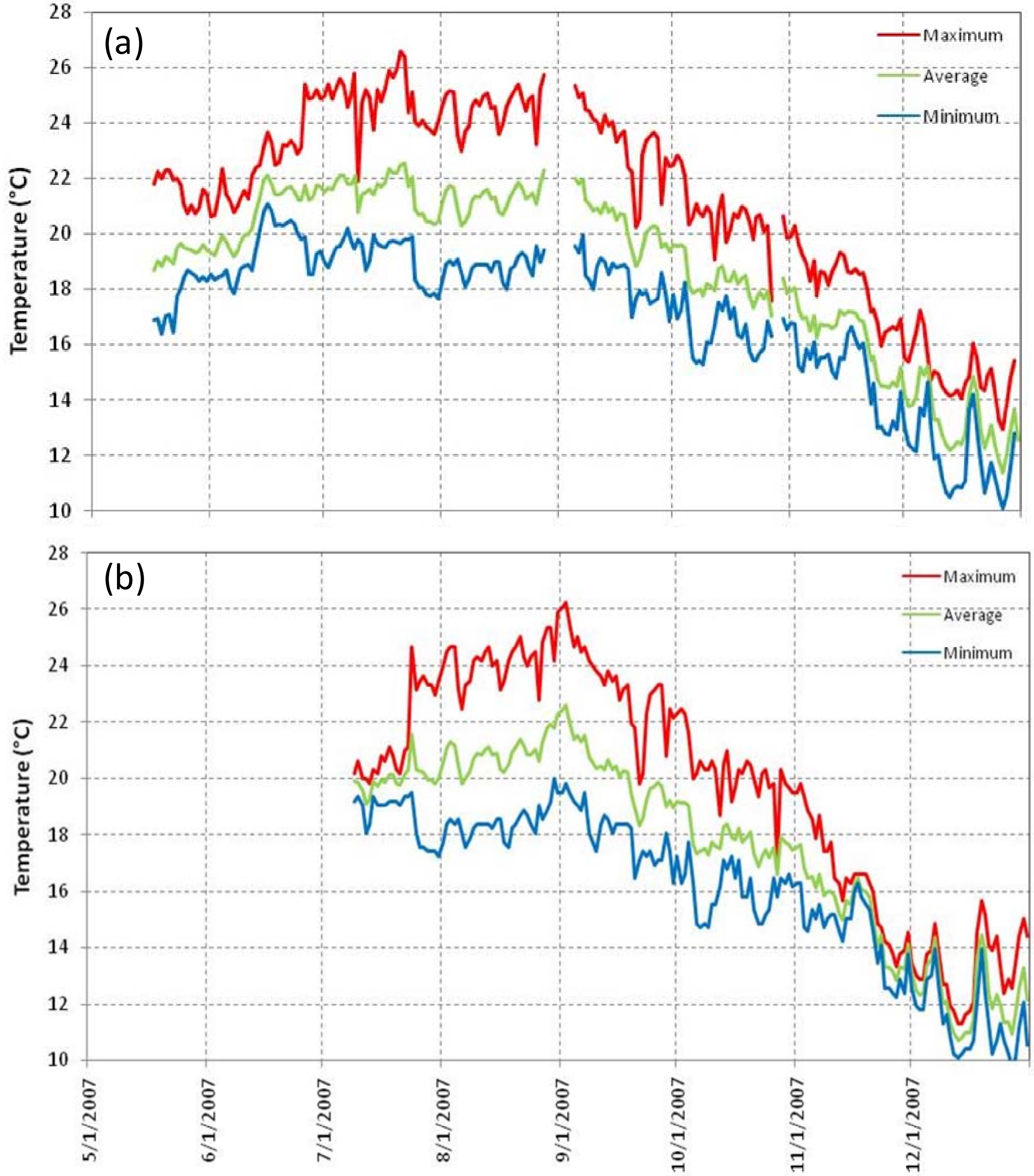


Figure C-42: 2007 Alisal Bedrock Pool (LYSR-10.2) thermograph maximum, average and minimum daily values for the (a) surface unit and (b) bottom unit.

Figure C-43: 2007 Avenue of the Flags (LYSR-13.9) thermograph maximum, average and minimum daily values for the bottom unit (3-feet below the surface).

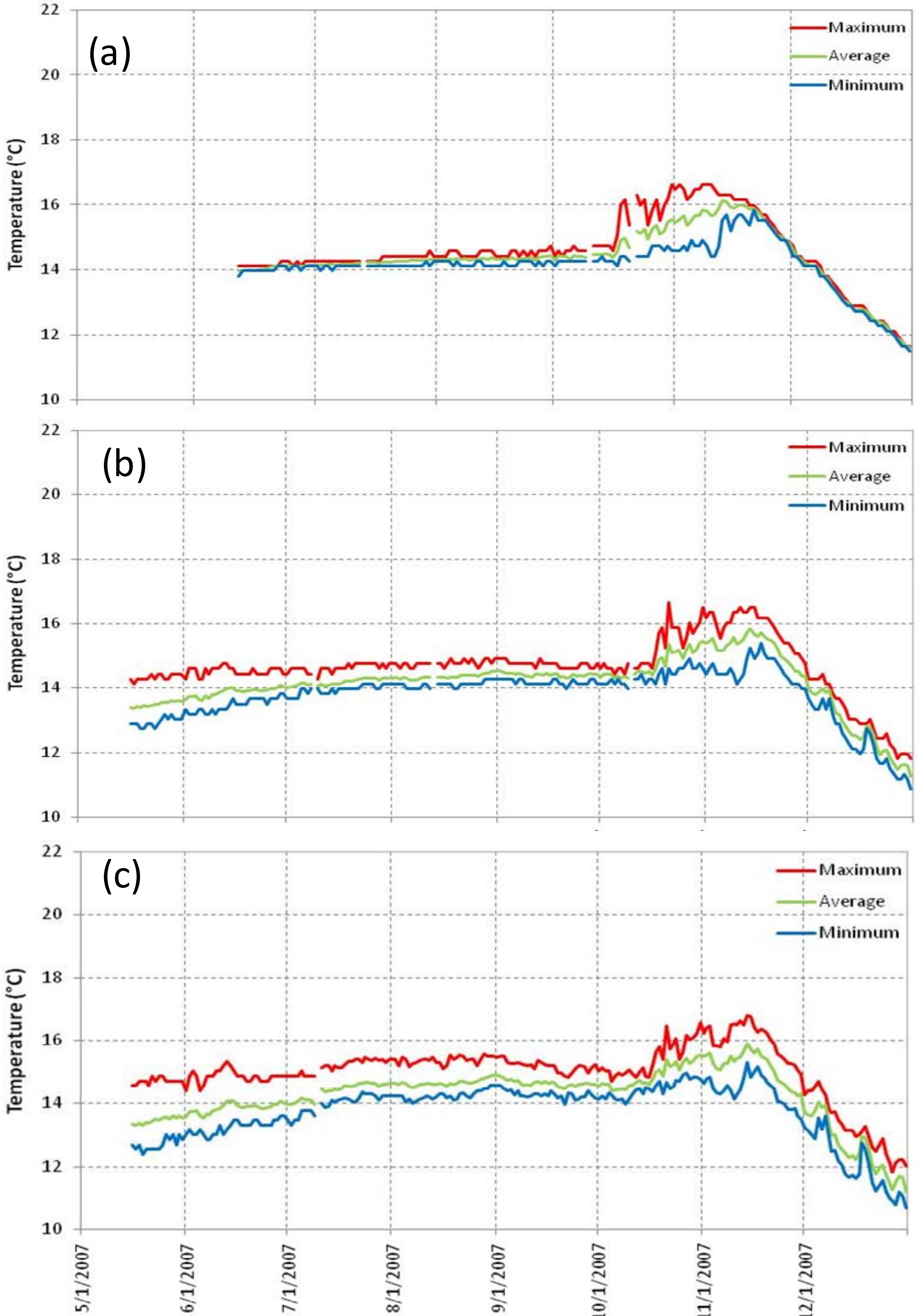


Figure C-44: 2007 Hilton Creek thermograph maximum, average and minimum daily values for (a) HC-0.54, (b) HC-0.25 and (c) HC-0.12.

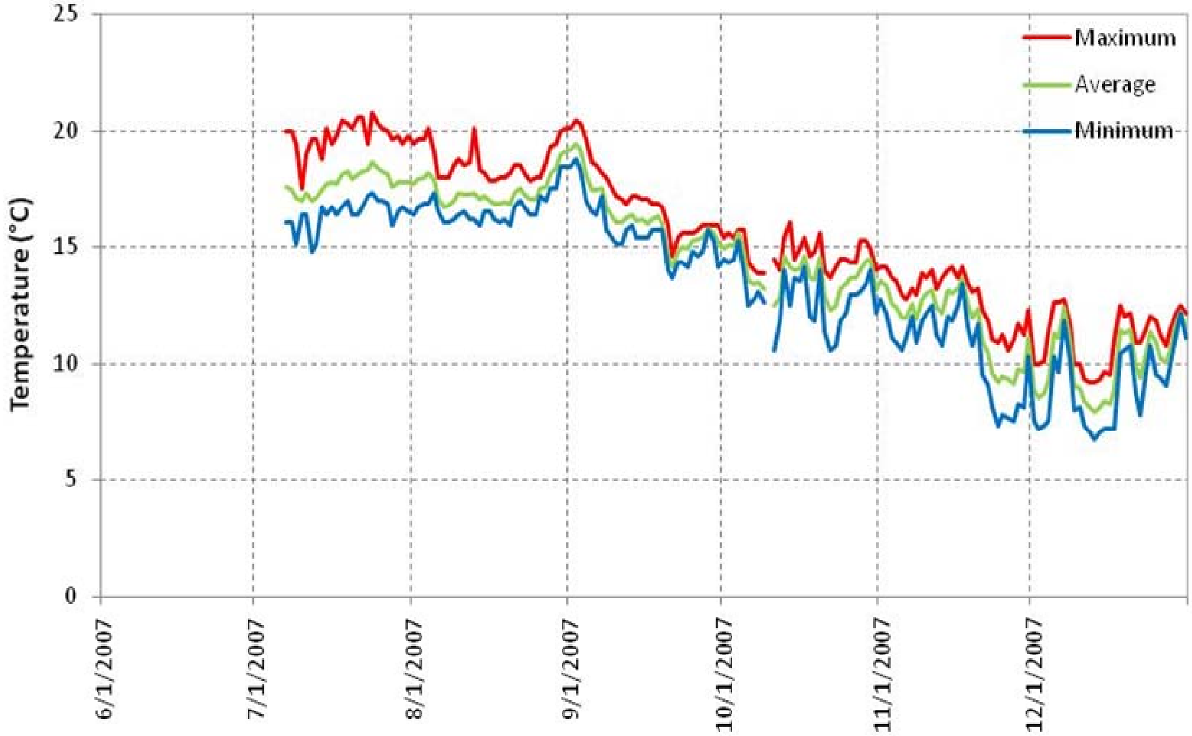


Figure C-45: 2007 thermograph maximum, average and minimum daily values for the Quiota Creek (QC-2.71) unit.

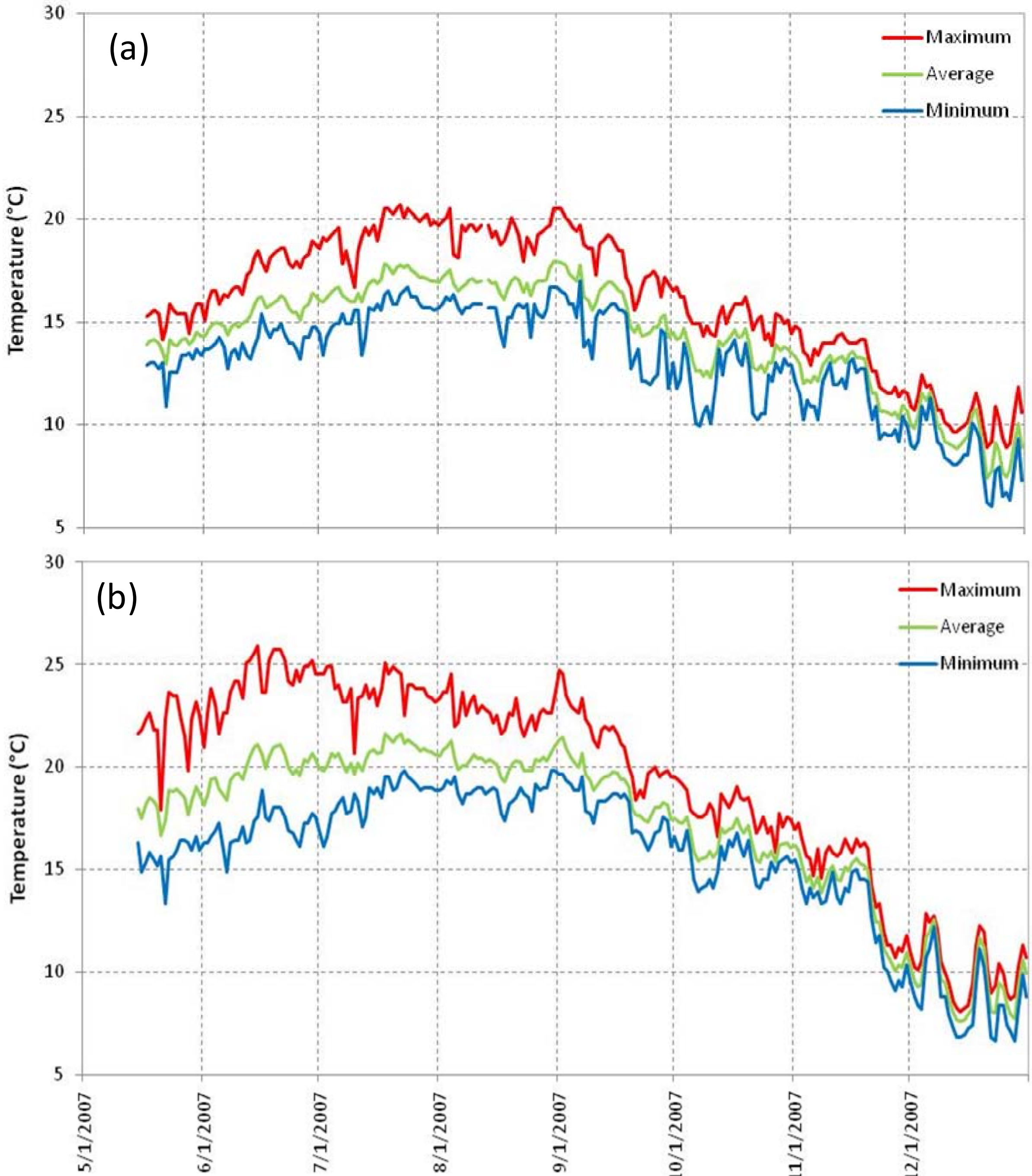


Figure C-46: 2007 thermograph maximum, average and minimum daily values for the (a) upper Salsipuedes Creek (SC-3.8), and (b) lower Salsipuedes Creek (SC-0.77) units.

Table C-26: WY2007 migrant trap deployments.

Location	Date Traps Deployed (dates)	Date Traps Removed (dates)	Date Traps Removed (storm events) (dates)	Date Traps Installed (storm events) (dates)	# of Days Not Trapping (days)
Hilton	1/29/2007	5/24/2007	2/9/2007	2/11/2007	2
			2/22/2007	2/23/2007	1
				Total:	**4**
Salsipuedes	1/29/2007	5/24/2007	1/30/2007	1/31/2007	1
			2/9/2007	2/11/2007	2
			2/22/2007	2/23/2007	1
				Total:	**4**

Table C-27: WY2007 Catch Per Unit Effort (CPUE) for each trapping location.

Location	Upstream Captures (#)	Downstream Captures (#)	Functional Trap Days (days)	Trap Season (days)	Trapping Effeciency (%)	CPUE Upstream (Captures/day)	CPUE Downstream (Captures/day)	CPUE (Total) (Captures/day)	Mean Flow (cfs)
Hilton	44	597	112	116	96.6	0.39	5.33	5.72	4.7
Salsipuedes	7	17	112	116	96.6	0.06	0.15	0.21	28.7
Mainstem	Mainstem trap not installed in 2007								

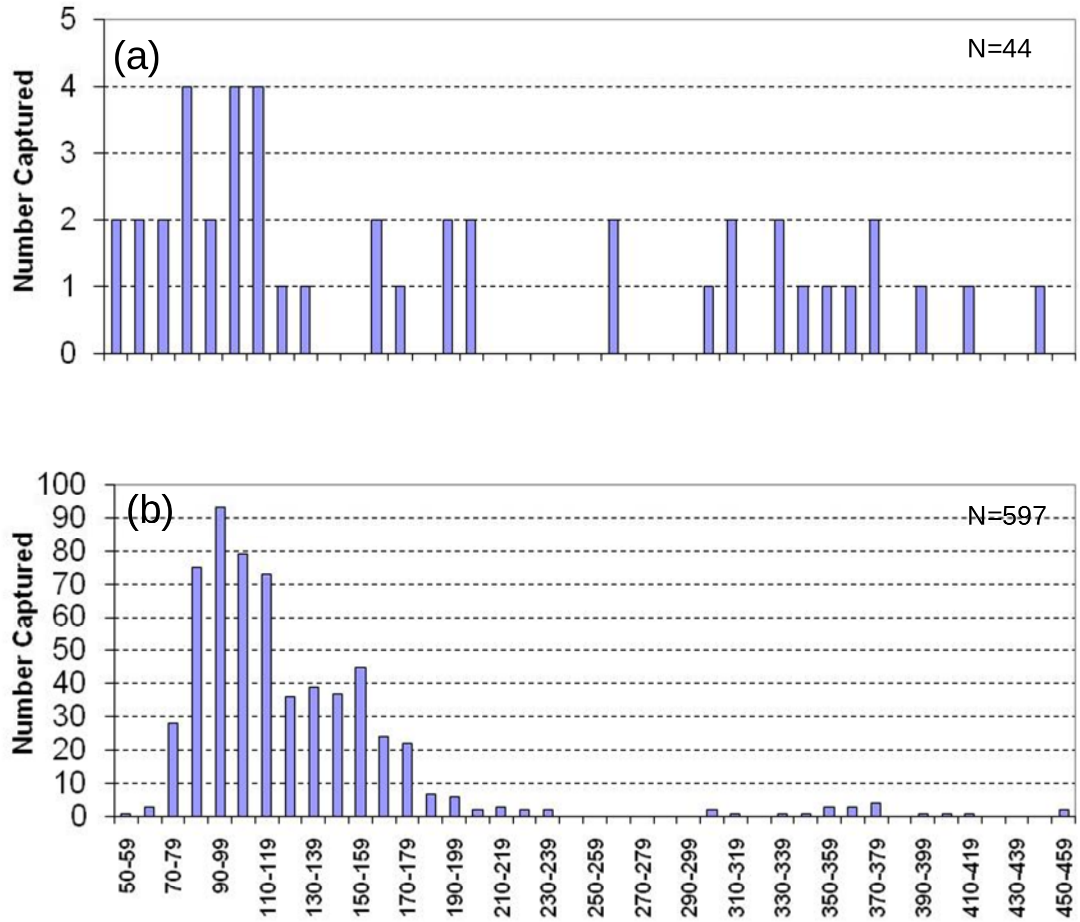


Figure C-47: WY2007 Hilton Creek trap length-frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

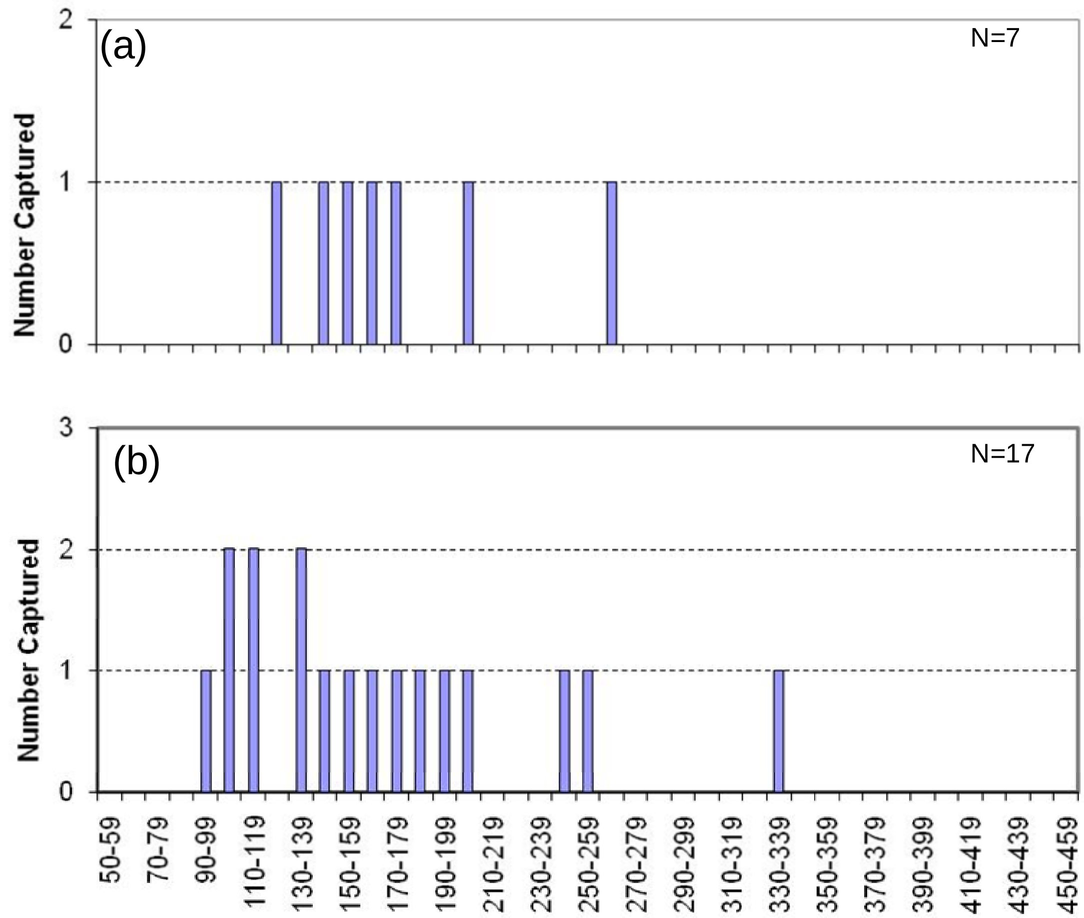


Figure C-48: WY2007 Salsipuedes Creek trap length-frequency histogram in 10 millimeter intervals for (a) upstream and (b) downstream migrant captures.

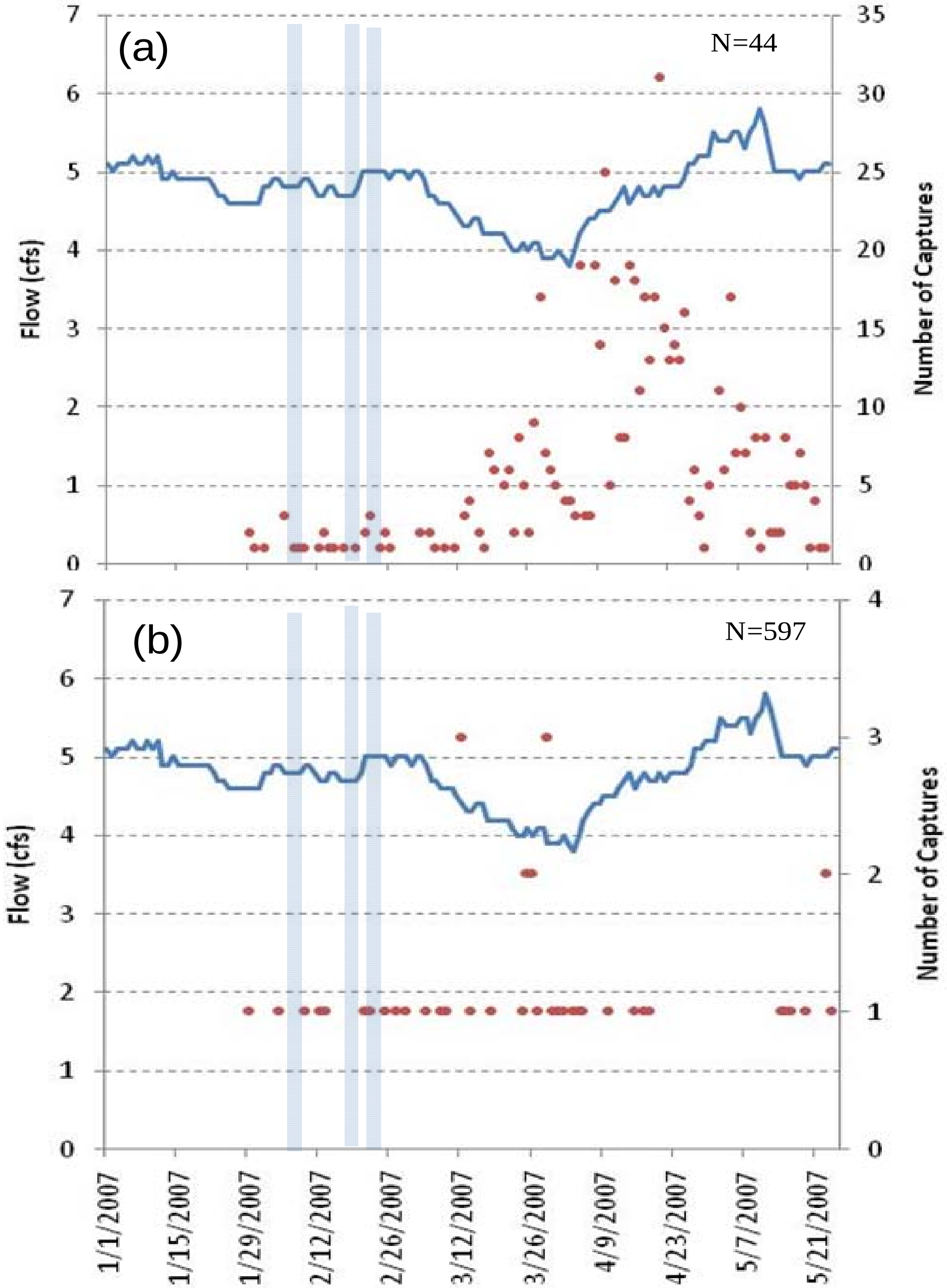


Figure C-49: WY2007 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The blue rectangles bracket times when migrant traps were removed due to storm flow events.

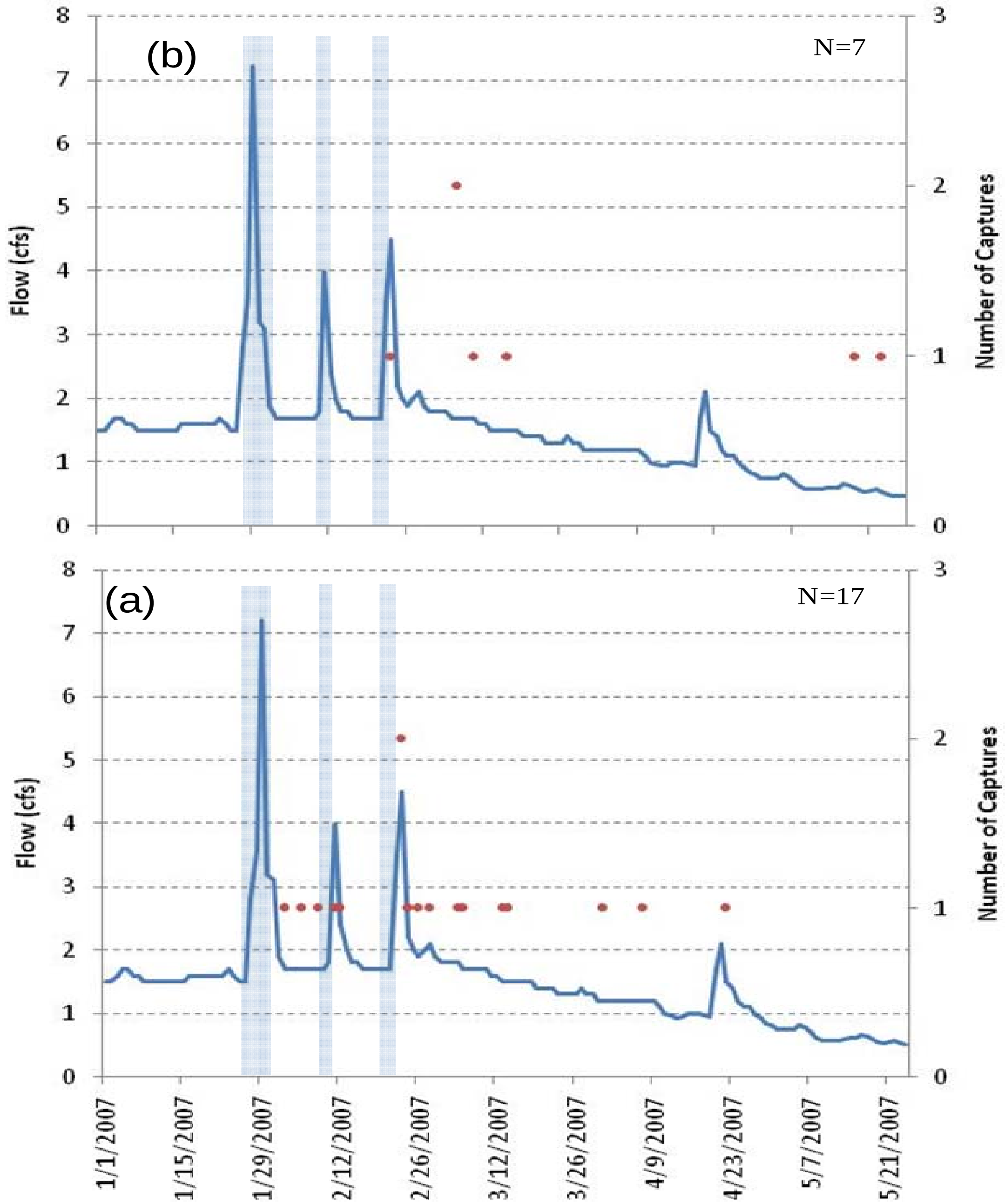


Figure C-50: WY2007 Salsipuedes Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The blue rectangles bracket times when migrant traps were removed due to storm flow events.

Table C-28: WY2007 tributary upstream and downstream migrant captures for Hilton and Salsipuedes Creeks.

Hilton Captures (#)	Size (mm)	Salsipuedes Captures (#)
	Upstream Traps	
0	>700	0
0	650-699	0
0	600-649	0
0	550-599	0
0	500-549	0
0	450-499	0
2	400-450	0
11	300-399	0
4	200-299	2
15	101-199	5
12	<100	0
44	**Total**	**7**
	Downstream Traps	
0	>700	0
0	650-699	0
0	600-649	0
0	550-599	0
0	500-549	0
0	450-499	0
4	400-449	0
16	(300-399	1
9	200-299	3
6	*Smolts*	*0*
0	*Pre-Smolt*	*0*
3	*Res*	*3*
362	101-199	12
92	*Smolts*	*1*
40	*Pre-Smolt*	*1*
229	*Res*	*10*
206	<100	1
0	*Smolts*	*0*
0	*Pre-Smolt*	*0*
206	*Res*	*1*
597	**Total**	**17**

Table C-29: 2007 mainstem snorkel schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	n/s-turbidity
(LSYR-0.2 to LSYR-0.7)	Summer	7/19/2007
	Fall	11/5/2007
Refugio Reach	Spring	5/23/07-5/24/07
(LSYR-4.9 to LSYR-7.8)	Summer	7/17/07-7/18/07
	Fall	11/6/07-11/8/07
Alisal Reach	Spring	5/23/2007
(LSYR-7.8 to LSYR-10.5)	Summer	7/16/07-7/17/07
	Fall	11/8/07-11/9/07
Avenue Reach	Spring	7/19/2007
(LSYR-10.5 to LSYR-13.9)	Summer	8/27/2007
	Fall	11/12/2007
Cadwell Reach	Spring	7/20/2007
(LSYR-22.1 to LSYR-22.7)	Summer	8/30/2007
	Fall	11/13/2007

*n/s = no survey

Table C-30: 2007 mainstem snorkel survey results.

Survey	Reach	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hwy 154	Not snorkeled-turbidity									
	Refugio	0	0	3	12	14	6	0	0	0	**35**
	Alisal	0	0	0	5	25	18	6	0	0	**54**
	Avenue	0	0	0	0	0	0	0	0	0	**0**
	Cadwell	0	0	0	0	0	0	0	0	0	**0**
Summer	Hwy 154	14	55	7	0	0	0	0	0	0	**76**
	Refugio	1	0	3	5	5	1	0	0	0	**15**
	Alisal	0	0	0	10	21	8	0	0	0	**39**
	Avenue	0	0	0	0	0	0	0	0	0	**0**
	Cadwell	0	0	0	0	0	0	0	0	0	**0**
Fall	Hwy 154	0	17	20	0	0	0	0	0	0	**37**
	Refugio	0	0	0	3	6	3	0	0	0	**12**
	Alisal	0	0	0	4	3	2	0	0	0	**9**
	Avenue	0	0	0	0	0	0	0	0	0	**0**
	Cadwell	0	0	0	0	0	0	0	0	0	**0**

Table C-31: 2007 tributary snorkel schedule.

Tributaries/Stream Miles	Season	Date
Hilton Creek	Spring	6/25/2007
(HC-0.0 to HC-0.54)	Summer	9/11/07-9/12/07
	Fall	n/s-turbidity
Quiota Creek	Spring	6/27/2007
(QC-2.58 to QC-2.73)	Summer	9/21/2007
	Fall	n/s-low flow
Salsipuedes Creek (R1-4)	Spring	n/s-turbidity
(SC-1.2 to SC-3.49)	Summer	n/s-turbidity
	Fall	n/s-turbidity
Salsipuedes Creek R-5	Spring	5/30/2007
SC-3.49 to SC-3.75	Summer	n/s-turbidity
	Fall	9/27/2007
El Jaro Creek	Spring	5/31/2007
(ELC-0.0 to ELC-0.4)	Summer	n/s-dry
	Fall	n/s-dry
El Jaro Creek	Spring	**1/4/07-1/11/-7
(ELC-9.8 to ELC-10.5)	Summer	n/s
	Fall	n/s

*n/s = no survey

**-pre fish ladder project survey

Table C-32: 2007 tributary snorkel results.

Survey	Creek	Length Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hilton	463	670	171	10	2	0	0	0	0	**1316**
	Quiota	59	129	12	1						**201**
	Salsipuedes (R1-4)	n/s-poor visibility from beaver activity									
	Salsipuedes (R-5)	151	14	27	9	1					**202**
	El Jaro	9	5	9	6	1					**30**
Summer	Hilton	318	802	168	26	5	0	0	0	0	**1319**
	Quiota	32	39	6	1						**78**
	Salsipuedes (R1-4)	n/s-poor visibility from beaver activity									
	Salsipuedes (R-5)	n/s-poor visibility from beaver activity									
	El Jaro	n/s-turbidity									
Fall	Hilton	n/s-poor visibility from lake turnover									
	Quiota	n/s-poor visibility									
	Salsipuedes (R1-4)	n/s-poor visibility from beaver activity									
	Salsipuedes (R-5)	26	26	13	8	2	1				**76**
	El Jaro	n/s-poor visibility									