United States Department of the Interior

BUREAU OF RECLAMATION
South-Central California Area Office
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Fresno, California 93721-1813

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SCC-423
ENV- 7.00
Cachuma

MAR 09 2012

Mr. Rodney McInnis
National Marine Fisheries Service
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4213

Subject: 2009 Annual Monitoring Report for Cachuma BO

Dear Mr. McInnis:

The Bureau of Reclamation (Reclamation) is pleased to provide the 2009 Annual Monitoring Report and Trend Analysis for The Biological Opinion of "*The Cachuma Project On The Santa Ynez River In Santa Barbara County, California*." This document is provided in support of Reasonable and Prudent Measure 11, Term and Condition 11.1, of the NMFS "*Biological Opinion: U.S. Bureau of Reclamation Operation and Maintenance of the Cachuma Project on the Santa Ynez River in Santa Barbara County, California*." Reclamation is working on a report to include information through 2010 monitoring activities, and will provide that document as soon as it is completed.

If you have any questions concerning this report, please contact me at (559) 487-5139 or Dr. Ned Gruenhagen at (559) 487-5227 or at (800) 735-2929 for the hearing impaired.

Sincerely,

David E. Hyatt
Supervisory Biologist

Enclosure

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2009 ANNUAL MONITORING REPORT AND TREND ANALYSIS

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

Prepared by:

CACHUMA OPERATION AND MAINTENANCE BOARD

for

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

SOUTH CENTRAL CALIFORNIA AREA OFFICE

FEBRUARY 29, 2012

Executive Summary

Monitoring results during Water Year 2009 (WY, 10/1/08 – 9/30/09) suggest that management actions undertaken by the Bureau of Reclamation (USBR or Reclamation) on the Lower Santa Ynez River (LSYR) are showing positive results in increasing the numbers of southern steelhead (*Oncorhynchus mykiss, O. mykiss*) even in a dry year. This report presents the data and summarizes the results of monitoring southern steelhead and water quality conditions in the LSYR below Bradbury Dam during WY2009. The report also contains observations and fish population trends for the period from WY2001 through WY2009. The monitoring tasks primarily occurred below Bradbury Dam in the LSYR watershed, which is approximately half the area (450 square miles) and stream distance (45 miles) to the ocean of the entire basin. Monitoring focused on three management reaches (Highway 154, Refugio, and Alisal reaches) on the LSYR mainstem and tributaries (Hilton, Quiota, El Jaro, and Salsipuedes creeks) known to have *O. mykiss* (Figure ES-1).

This report is intended to summarize the accumulated data and fulfill the annual reporting requirements of the Cachuma Project Biological Opinion (BO) for WY2009. The BO was issued by the National Marine Fisheries Service (NMFS) to Reclamation for the operation of the Cachuma Project. This report was prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division, and the monitoring effort was conducted by the Cachuma Conservation Release Board (CCRB) and Santa Ynez River Conservation District (ID#1) all on behalf of Reclamation. The water quality and fisheries monitoring tasks were carried out as described in the BO (NMFS, 2000), Biological Assessment (USBR, 2000), and LSYR Fish Management Plan (SYRTAC, 2000). Some deviations to the monitoring program as described in the WY2008 Annual Monitoring Report were necessary, specifically in relation to water quality monitoring and redd surveys. Modifications were necessary due to landowner access constraints, poor water clarity, and program evolution from acquired field knowledge. The report is organized into five sections: (1) introduction, (2) background information, (3) monitoring results for water quality and fisheries observations, (4) discussion addressing management questions posed in the BO with a trend analysis of the fisheries data since 2001, and (5) conclusions with recommendations. The appendices contain (A) a list of acronyms and abbreviations, (B) quality assurance and control procedures and (C) a list of photo points.

WY2009 was a dry year (only 13.66 inches of precipitation measured at Bradbury Dam; long-term average is 20.3 inches) with the majority of the rainfall occurring in November, December, and February. On 2/16/09, a storm event caused the sand bar at the mouth of the Santa Ynez River Lagoon to breach. River connectivity to the ocean was maintained after the breach for 30 days ending on 3/17/09. Bradbury Dam did not spill in WY2009. Target flows in Hilton Creek (2 cubic feet per second (cfs) minimum) and in the LSYR mainstem at Alisal Bridge (1.5 cfs) and Highway 154 Bridge (5 cfs) were maintained as described in the BO for the year after a spill (WY2008) with spill volume greater than 20,000 acre-feet. The dry winter provided limited passage opportunities for returning southern steelhead. There were no anadromous adult steelhead observed within the Santa Ynez River basin below Bradbury Dam. One anadromous steelhead observed at Hilton Creek in WY2008 on 3/5/08 (596 mm, 23.5 inches) was recaptured in WY2009 at Hilton Creek on 3/22/09 (605 mm, 23.8 inches). This fish did not return to the ocean and successfully over-summered in the Hilton Creek area. There were 135 out-migrating steelhead smolts recorded at the three migrant trapping sites (Hilton Creek, Salsipuedes Creek and LSYR mainstem near Santa Ynez) during the migration season. This was the third highest annual total of smolts on record and third in total migrant captures at 612 fish (Figure ES-2). These results indicate that management actions undertaken by Reclamation are increasing the number of southern steelhead even in a dry year. Reclamation has completed several actions for the benefit of southern steelhead since the BO was issued including: the Hilton Creek Watering System; the completed tributary passage enhancement projects on Hilton, Quiota, El Jaro, and Salsipuedes creeks; the bank stabilization projects on El Jaro Creek; and the implementation of the Passage Flow Supplementation Program.

Subject to funding availability, COMB's Fisheries Division makes the following recommendations to improve the monitoring program:

- Continue current 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 a one or two year period.
- Develop a monitoring program to better understand the interaction of *O. mykiss* and beavers (*Castor canadensis*) 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 in a timely manner so that the results can be reviewed, and improvements made for the following year's monitoring effort.
- Continue to work with other *O. mykiss* monitoring programs within the southern California steelhead Distinct Population Segment to improve the collective knowledge, collaboration and dissemination of information.

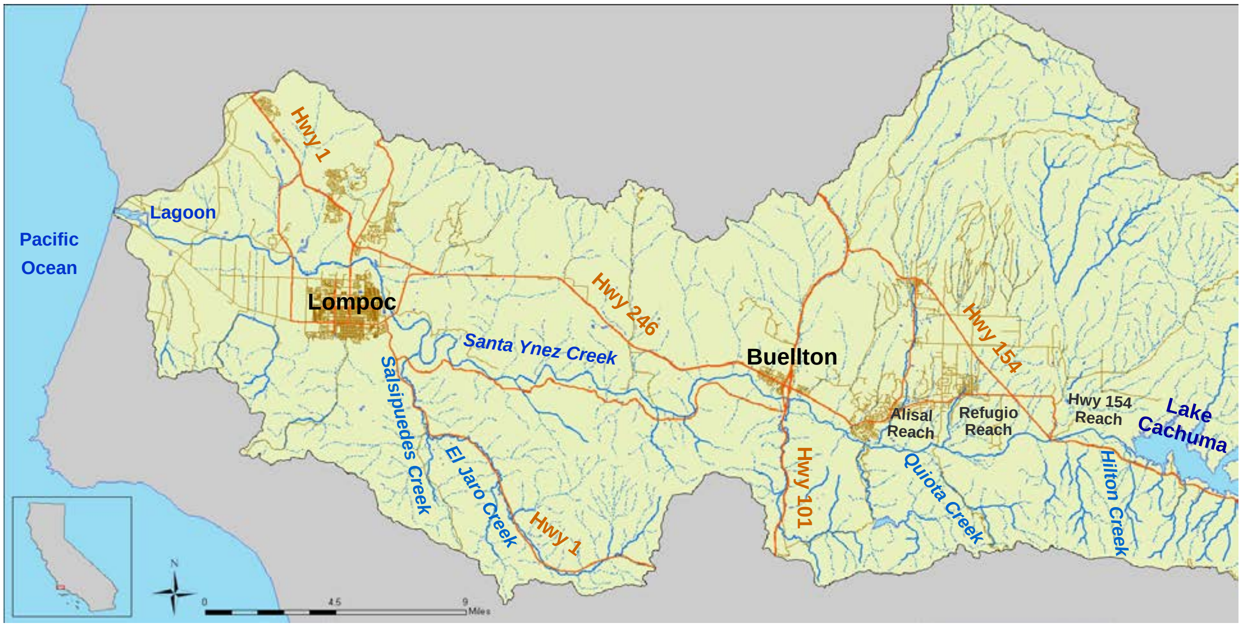

Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean to the west of Lompoc showing tributary creeks and management reaches of interest for the LSYR Fisheries Monitoring Program.

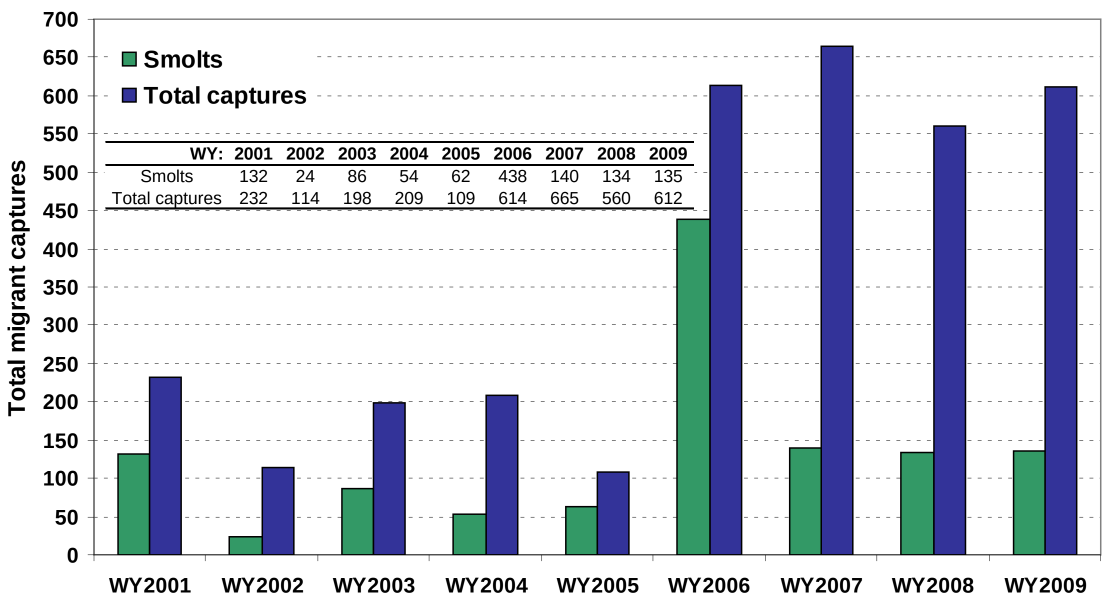

Figure ES-2: Total downstream smolts and migrant upstream and downstream *O. mykiss* captures at the three trapping sites within the LSYR basin from WY2001 to WY2009.

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WY2009 Annual Monitoring Report

1. Introduction

The Cachuma Project Biological Opinion (BO) requires the U. S. Bureau of Reclamation (USBR or Reclamation) 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)*
>
> ***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 2009 Annual Monitoring Report is to evaluate the effects of the Cachuma Project on steelhead in the Lower Santa Ynez River (LSYR) 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 2009 Annual Monitoring Report also presents findings and observations of trends from 2001-2009 as a continuation of the analyses presented in the 1993-2004 Synthesis Report (AMC, 2008) and 2008 Annual Monitoring Report (USBR, 2011). 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 Water Year 2009 (WY, 10/1/08 - 9/30/09) data summarized in this report describe the water year condition and the fishery observations. 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 its confluence with the mainstem).

WY2009 was classified as a dry year with 13.66 inches of rainfall recorded at Bradbury Dam (long-term average is 20.6 inches). Fish populations, in general, respond positively to above normal or wet years (Kjelson and Brandes, 1989; Marchetti and Moyle, 2001) as there is additional habitat available for migration, spawning and rearing, plus higher primary productivity with more allochthonous material being delivered to the stream. Populations of all trophic levels take advantage of the increased flow and food resources for increased survival. During dry years such as WY2009, there are fewer habitats available, less food supply and less opportunity for spawning and dry season rearing that cumulatively can result in the potential for a population decrease from the previous year. Although a dry year, WY2009 did have the third highest number of smolts and total migrant captures of *O. mykiss* at the three trapping sites within the LSYR since 2001 which could be a reflection of the high trapping efficiency compared to previous years.

2. Background

2.1. Historical context of the biological monitoring effort

Reclamation, in collaboration with the Cachuma Project Member Units and California Department of Fish and Game (CDFG), began the biological monitoring program for southern steelhead (*Oncorhynchus mykiss or O. mykiss*) in the LSYR in 1993. The 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), have been conducting the long-term Fisheries Monitoring Program and habitat enhancement projects within the LSYR on behalf of Reclamation in compliance with the BO. The Cachuma Operation and Maintenance Board (COMB) assumed those responsibilities in January of 2011. 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) and critical habitat was designated in 2000 and 2005 (NOAA, 2005). Further refinements occurred during 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). Three comprehensive data summaries were written that synthesized the results of the monitoring effort from 1993 to 1996 (SYRCC and SYRTAC, 1997), from 1993 to 2004 (AMC, 2008), and from 2005 to

2008 (USBR, 2011), all three were submitted to fulfill the required annual monitoring reports (T&C 11.1) for those years.

2.2. Meteorological and hydrological overview

The headwaters of the Santa Ynez River are located approximately 4,000 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 which is 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. The anadromous form of the species begins 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, review of the meteorological and hydrological conditions for each year is essential for the analysis and interpretation of the fisheries data collected during that 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 B.

3. Monitoring Results

The results from the WY2009 monitoring effort are organized by hydrologic condition (rainfall, stream runoff and ocean connectivity), passage supplementation, target flows, mixing of State Water Project (SWP) water, water quality, habitat quality, migration, reproduction and rearing, tributary enhancements (migration barrier removal), and additional investigations.

3.1. Hydrologic Condition

Precipitation, stream runoff and Bradbury Dam spills: Historically, water year type for the Santa Ynez River basin has been defined as a dry year when rainfall at Bradbury Dam is equal to or less than 15 inches, a normal year when rainfall is 15 inches to 22 inches, and a wet year when rainfall is equal to or greater than 22 inches (AMC, 2008). The California State Water Resources Control Board (SWRCB) uses different criteria that focuses on river runoff (in this case inflow to Cachuma Reservoir); a critical year when inflow is equal to or less than 4,550 acre-feet (af), dry year when inflow is between

15,366 af 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 (SWRCB, 2007). Due to the longstanding classification used in previous Adaptive Management Committee (AMC) reports, the SWRCB approach will not be used in this report although the designation would have been the same.

WY2009 had 13.66 inches of rainfall at Bradbury Dam and was therefore classified as a dry year (less than 15 inches) (Table 1). There was insufficient runoff over the water year to spill Lake Cachuma but the storm on 2/16/09 produced enough runoff to breach the sandbar at the Santa Ynez River Lagoon and create ocean connectivity for 30 days from 2/16/09 to 3/17/09. This was the seventeenth driest year on record (1953-2009) and fourth driest year since 2000. Historic minimum, maximum, and WY2009 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 western and eastern locations throughout the watershed, and wet and dry years.

There were 15 precipitation-events in WY2009 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). The majority of the storms in WY2009 occurred during November, December and February with the longest event lasting five days starting on 2/5/09 and concluding on 2/9/09. Annual flow hydrographs for the LSYR basin at the Narrows (USGS-11133000), 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.

Peak average daily discharge recorded by the USGS at the Narrows, Solvang and Los Laureles gauges occurred on 2/17/09 at 120 cfs, 2/16/09 at 106 cfs and 2/18/09 at 255 cfs, respectively. Instantaneous peak discharges at those gauges were 300 cfs on 2/16/09, 184 cfs on 2/16/09 and 275 cfs on 2/18/09, respectively. At these low discharge rates, no fluvial geomorphic changes to the channel occurred. Over half of the WY2009 rainfall fell in November 2008 (3.39 inches) and February 2009 (5.70 inches) with very little precipitation recorded from March onward. The effect of a dry spring resulted in very dry hydrologic conditions in the summer and fall of WY2009.

Annual hydrographs for Hilton and Salsipuedes creeks and along the LSYR mainstem at Solvang and the Narrows reflected low winter runoff and a dry spring with flows approaching zero by the end of June at the USGS gauge on Salsipuedes Creek (Figure 3). The Hilton Creek Watering System (HCWS) maintained a minimum baseflow above 2 cfs throughout the dry season creating excellent rearing and over-summering conditions for steelhead/rainbow trout (*O. mykiss)*.

Ocean connectivity: The Santa Ynez River lagoon was breached on 2/16/09 after a sequence of three storm events, and remained open for 30 days before closing on 3/17/09 for the rest of the year (Figures 2 and 3). This was slightly more than average (27 days) for dry years since 2001 (Table 4). Prior to the 2/16/09 storm, the lagoon had been closed since 5/19/08. Tributary flow, specifically from the Salsipuedes Creek drainage, was sufficient to breach the lagoon in WY2009.

Since WY2006, the lagoon has been monitored daily from Ocean Park (at the lagoon, see Figure ES-1) 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 (approximately 1.2 mile upstream of the lagoon) was used to determine when the lagoon was open.

Passage supplementation: The criteria to initiate passage supplementation as outlined in the BA (USBR, 1999; USBR, 2000), BO (NMFS, 2000) and an AMC technical memo (AMC, 2004), were never met during the water year. The cumulative flow in Salsipuedes Creek from December 1 never reached 1,000 af, and the water year turned out to be dry. Hence, the criteria developed by the AMC (2000) to not conduct passage supplementation during dry years (RPM 3) (NMFS, 2000) were successful. Therefore, at the end of WY2009, the full surcharge allotment from the Fish Passage Supplementation Account of 3,200 acre-feet reached in WY2008 was retained for future supplementation efforts**.**

Adaptive Management Account: The full allotment of 500 acre-feet for the Adaptive Management Account from the WY2008 spill event carried over at the end of WY2009 for future releases**.**

Target flows: Because the WY2008 spill volume was greater than 20,000 acre-foot, long-term BO established target flows of 5 cfs at Highway (Hwy) 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 WY2009 (Figure 3). The maximum recommended releases were exercised due to small tributary flow inputs. A higher than normal release was made starting on 5/19/09 to meet target flows at Alisal Bridge during a warming trend that lasted several days (Figure 2). On 7/20/09 and 8/31/09, daily flows at Alisal Bridge dropped below 1.5 cfs lasting for four days and one day, respectively. In either case, the flow rate did not drop below 1 cfs. Residual pool depths were maintained throughout the period. No fish strandings or mortalities were observed during that period. Procedures for increasing the releases were generated by Reclamation in 2007 that improved the program and the success of meeting target flow objectives (see the 2009 BO Compliance Report on Target Flow Compliance with Operational Guidelines). No modifications to the procedure guidelines are recommended.

Mixing of State Water Project Waters in the LSYR: Reclamation monitors downstream releases to comply with the less than 50% mixing criterion required by BO RPM 5.1 (NMFS, 2000) for release of State Water Project (SWP) water into the Santa Ynez River below Bradbury Dam by the Central Coast Water Authority (CCWA). The criterion was met for RPM 5.1 throughout WY2009 (Figure 4). 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 less than 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., oxygen reduction potential, specific conductance, total dissolved solids, 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 BA (USBR, 2000). In WY2009, 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 (thermographs): During WY2009, ten LSYR mainstem thermographs were deployed at five sites included the Long Pool (LSYR-0.5 (2)), the Santa Ynez River directly downstream of Long Pool and upstream of the Reclamation and Crawford-Hall property boundary (LSYR-0.51 (1)), 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)) with the number of units in parentheses (Figure 5 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 two were single unit deployments (placed near the bottom). These four pools on the LSYR mainstem were chosen due to monitoring of those habitats since 2005. Several previously monitored locations were discontinued because pool habitats shifted locations as the river meandered (LSYR-6.0 and LSYR-7.8), habitats dried up (LSYR-26.7), monitoring was discontinued such as the Stilling Basin (LSYR 0.0), and access was limited (two sites within the Santa Ynez River Lagoon).

There were six thermograph deployment sites in the tributaries during WY2009; Hilton Creek (Upper Release Point, HC-0.54) and near the LSYR confluence in lower Hilton Creek (HC-0.12) near the trapping site): Quiota Creek (QC-2.71) upstream of Crossing 7, Salsipuedes Creek (SC-3.8 just upstream of the confluence with El Jaro Creek and SC-1.2 near the trapping site), and El Jaro Creek (EJC-3.81 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. A previously monitored middle

Hilton Creek site was designed to evaluate thermal heating between the Upper and Lower Release Points (URP and LRP) but due to extensive riparian vegetation growth, this has ceased to be a concern and the location has been discontinued.

Mainstem thermographs: The six LSYR mainstem thermograph deployment locations and deployment schedule can be seen in Figure 5 and Table 5.

<u>Long Pool (LSYR-0.51)</u>

The Long Pool is approximately 100 feet wide at the widest point and 1,200 feet long. It is fed by two water sources when there is no spill or release from the outlet works; 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 4/14/09 and removed on 11/9/09. 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 21.6 °C at the surface location throughout the deployment period with typical warming during the summer and cooling in the fall (Figure 6). Maximum water temperatures in excess of 20 °C were observed from late June through the middle of July and corresponded with increased air temperatures. Maximum temperatures were mostly 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 1.8 to 4.8 °C with the greater variation occurring during the hottest summer months. Temperatures at the surface location were warmest in June and July.

Instrument malfunctions of the bottom unit resulted in data loss from 4/14/09 to 6/22/09. The bottom thermograph recorded maximum water temperature of 18.8 °C or less throughout the period (Figure 6). Daily variation at the bottom unit was less than 2.2 °C. Temperatures were warmest in July and August where daily maximum temperatures reached 18.9 °C and 18.3 °C, respectively.

<u>Downstream of Long Pool (LSYR-0.52)</u>

This bottom unit was deployed 300 feet downstream of the Long Pool from 4/23/09 to 11/9/09 and recorded similar temperatures as the surface Long Pool thermograph due to well mixed stream water in the monitored habitat. Maximum temperatures were observed in July and August at or below 21 °C and minimum temperatures below 17.5 °C throughout the period (Figure 7). Temperatures began to drop off by September for the rest of the year.

Encantado Pool (LSYR-4.9)

The thermograph vertical array deployment was from 4/14/09 to 11/9/09 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 6 feet). The deployment site was near the middle of the Encantado Pool which was approximately 400 feet long and averaged 30-feet wide and 5 feet deep. 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 26.0 °C in mid-July, peaking on 7/19/09, and gradually decreased throughout the rest of the period (Figure 8). Overall, daily maximum temperatures were greater than 23 °C from early May through late August. May 2009 was warmer than most Mays with the monthly average maximum air temperature 4 °C higher than average at Bradbury Dam. Minimum temperatures were below 20 °C over the recorded period. The 24-hour variation between maximum and minimum water temperatures was typically between 4-7 °C during the summer months. A cooling trend began in late August and continued through the end of the period into the fall.

The maximum temperature recorded for the bottom thermograph was 25.6 °C on 7/20/09. Water temperatures decreased from that point through the rest of the year. Overall, maximum temperatures remained less than 25 °C with the majority of readings less than 24 °C. The 24-hour variation between maximum and minimum water temperatures was greatest during the July-August timeframe and was typically between 1.3-6.1 °C.

7.3 Pool (LSYR-7.3)

This 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 4/14/09 and removed on 11/9/09 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. 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 large pool. 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 1990’s.

The surface thermograph recorded maximum temperatures below 25.3 °C for the entire monitoring period with only three days in the middle of August that were over 24 °C (Figure 9). The majority of the maximum temperatures remained near 23 °C during the summer period. Generally, the daily difference in maximum and minimum temperatures was greatest during the June-August timeframe, typically from 3.5-4.4 °C.

Maximum temperatures at the bottom unit were around 20 °C starting in late July and less than 20 °C starting in October throughout the rest of the monitoring period. Maximum daily temperatures of 22.2 °C were recorded in June, July, August, and

September. The 24-hour variation between maximum and minimum temperatures was greatest in late May into early June with readings from 2-4 °C. Bottom temperatures generally remained less than 20 °C except for a few days during August and September. Minimum temperatures at the warmest time of the year reached just over 20 °C or less.

Alisal Bedrock Pool (LSYR-10.2)

The thermograph vertical array was deployed on 4/15/09 and removed on 11/9/09 with the surface unit placed approximately 1-foot below the surface and bottom unit approximately 1-foot above the substrate in a 9 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 2009, no steelhead/rainbow trout 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 WY2009.

For most of June through September, maximum surface temperatures varied between 22 and 25.5 °C with the warmest day occurring on 7/15/09. Water temperatures were over 25 °C during a three day period from 7/14/09 to 7/16/09. Some of the warmest thermograph temperatures collected on the mainstem were measured at this location (Figure 10). Temperatures began cooling down in September and continued decreasing through the rest of the period. The 24-hour variation ranged from 2.0 °C to nearly 6.0 °C from June through September.

Water temperatures collected 1-foot above the bottom below the surface was greatest during May through June with the highest temperature recorded on 6/29/09 at 25.2 C. Following the end of June, bottom maximum water temperatures showed a several degree decline with daily values hovering between the 20-21 °C. The minimum bottom temperatures generally remained less than 20 °C except during the majority of August when 20 °C was exceeded. The 24-hour variation was greatest during May, June and October.

Avenue of the Flags (LSYR-13.9)

A single thermograph was deployed in a pool habitat approximately 250 feet downstream of the Avenue of the Flags Bridge in Buellton (LSYR-13.9) from 4/23/09 through 11/9/09. The unit was deployed approximately one-foot above the bottom of the habitat in 4.0 feet of water. The habitat was approximately 65 feet long, 20 feet wide at its widest point with a maximum depth of approximately 4 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. The upstream riffle bar was dry, however, cool water was seeping into the pool where the riffle bar met the pool habitat. Water temperatures remained cool in this habitat due to the percolation of cool water. The warmest temperatures occurred during an 18-day period from 5/26/09 to 6/12/09 when maximum water temperatures ranged from 20.8-24.5 °C and the river was still flowing (Figure 11). This was likely the last time during the year water was flowing over the riffle bar. As the water inflow switched from warm surface water to cool ground water on 6/13/09, there was a marked decrease in maximum surface water temperature. From this point on, maximum water temperatures did not exceed 21 °C except for a few days at the end of October during the first storms of the year.

LSYR Mainstem Longitudinal Comparisons

Longitudinal mainstem maximum daily water temperature changes with mainstem surface thermographs at the Long Pool, Encantado Pool, 7.3 Pool, Alisal Bedrock Pool and Avenue of the Flags are presented in Figure 12. The Avenue of the Flags thermograph was located one foot above the bottom in a 4 foot deep pool habitat, while the other four thermographs were located one foot below the surface of the monitored pools. In general, the 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 cooler than the Encantado Pool suggesting cooling from groundwater upwelling. Flow recorded at the USGS Solvang gauge supported the previous observation that surface flow dominated water temperature at the Avenue of the Flags habitat until June when surface flows dropped out and groundwater upwelling dominated. Cooler temperatures at that habitat prevailed through the rest of the monitoring period and were similar to observed temperatures at the Long Pool 13.9 miles upstream.

Tributary thermographs: The location of the six single thermograph deployments in the tributaries of the LSYR basin can be seen in Figure 5. Thermographs were deployed as wet season flows subsided and were picked up just prior to the beginning of the next wet season.

Upper Hilton Creek (HC-0.54)

A single thermograph was deployed 6 inches above the bottom of a pool habitat just downstream of the Upper Release Point (URP) of the HCWS from 4/14/09 to 11/9/09. 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 consistently around 14 °C with a slight increase over time (approximately 1 °C) and a 4 °C spike at the beginning of November (Figure 13). Lake Cachuma turned over (defined as complete mixing of the lake driven by water density instability when the lake was previously stratified) at the beginning of November which raised the ambient stream temperature by 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 4/14/09 to 11/9/09. Water temperatures collected at this location were similar to HC-0.54 with a half of a degree rise and a greater difference between maximum and minimum temperatures indicating very little thermal heating downstream (Figure 13). Overall, temperatures remained at or less than 15 °C except for the observed increase mentioned above in early November.

Quiota Creek (QC-2.71)

A single thermograph was deployed 6 inches above the bottom of the creek approximately 50 feet upstream of Crossing 7 on Refugio Road from 4/15/09 through 11/9/09. The unit was deployed at the bottom of a run habitat 40 feet long and 10 feet wide. 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 20.5 °C for the entire deployment with declining water temperatures beginning toward the end of July and lasting throughout the rest of the period (Figure 14). The 24-hour variation was greatest from June through August ranging from 4-5 °C, and decreased to between 1-2 °C in September.

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 4/15/09 to 11/9/09. The unit was placed in a pool habitat 6 inches above the bottom that formed during high flows in WY2008. The habitat was 50 feet long and 9 feet wide with a maximum depth of 4 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 20.5 °C throughout the period, possibly due to increased groundwater upwelling from the scoured channel bottom (Figure 15). The 24-hour difference between maximum and minimum temperatures ranged from 0.5 °C to 4 °C for the entire deployment period.

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 on the bottom of the stream from 4/15/06 to 11/9/09. This site had perennial flow and has held *O. mykiss* since monitoring began in 1993. The warmest daily temperatures were recorded in late June through early July where water temperatures just over 20 °C (Figure 16). Minimum daily temperatures were less than 16 °C throughout the period.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 4/15/09 through 11/9/09 within a run habitat with a maximum depth of 1 foot 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. Beaver activity was observed throughout the monitoring period. Maximum water temperatures were recorded at the end of June and beginning of July and were less than 27 °C (Figure 16). The difference between maximum and minimum temperature was greatest in the spring and then decreased through the monitoring period.

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 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 during 2009 in several locations within Salsipuedes Creek, Lower Hilton Creek and the LSYR Hwy 154 Reach (LSYR-0.0 to LSYR-3.2) and Refugio Reach (LSYR-4.8 to LSYR-7.8) (Table 6 and Figure ES-1). Representative data from deployments along the LSYR mainstem reaches and Salsipuedes Creek are discussed below. Deployments were made during the spring, summer, and fall to investigate potential diel variation in water quality conditions, specifically water temperatures and DO, in habitats where *O. mykiss* were present. Sonde temperature values were consistent with the thermograph data near these locations. CPBS owns and operates three sondes which are always calibrated prior to deployment and all three sondes are calibrated at the same time to assure all are recording the same values for each parameter.

Hwy 154 Reach and Lower Hilton Creek (LSYR-0.5, LSYR-0.55, and HC-0.12): Sondes were simultaneously placed at three different locations upstream of the Long Pool (LSYR-0.5) to investigate the water quality of the stream flow entering the Long Pool from Hilton Creek and two locations along the upper most part of the Hwy 154 Reach. A sonde was placed in the tail-out of the Stilling Basin (LSYR-0.21), the ford crossing just upstream of the Long Pool (LSYR-0.49) and above the confluence of Hilton Creek, and Lower Hilton Creek (HC-0.12). Two deployments were made in July (7/14-17/09 and 7/27-31/09) and one deployment was made in September (9/23-28/09).

The first deployment showed similar temperature patterns over the diel cycle within the two mainstem sites (LSYR-0.5, LSYR-0.55), representing the water quality coming out of the Stilling Basin, with temperatures generally ranged from 18.0 °C – 20.1 °C (Figure 17). Lower temperatures were recorded within lower Hilton Creek (HC-0.12) that ranged from 14.5 °C - 15.5 °C and were expected given the intake elevation of the HCWS at 65 feet of depth within Lake Cachuma. DO levels also showed a similar pattern within the two mainstem sites and ranging from 8-10 mg/l. The Lower Hilton Creek DO showed no diel fluctuation and ranged over the period from 9.6-9.8 mg/l during the entire deployment.

The second deployment (7/27/09-7/31/09) showed a similar pattern to the previous deployment but with a 1-2 °C increase in temperature within the two mainstem sites compared to the previous deployment, with temperatures ranging from 20 °C – 22.5 °C (Figure 18). The rise in temperature was most likely due to ambient temperature rise. Lower Hilton Creek temperatures were similar to the previous deployment in mid-July. DO levels were slightly lower within the two mainstem sites compared to the mid-July deployment, ranging from 7.5-9.5 mg/l. Lower Hilton Creek DO remained the same as the previous deployment.

The third deployment (9/23/09-9/28/09) illustrated temperatures dropping back down to the range of 18.0 °C – 21 °C within the two mainstem sites, with Hilton Creek continuing to have cool water ranging from 14.5 °C - 15.0 °C through the period (Figure 19). DO levels at all three locations were similar to the previous deployment, except for a slight increase in the difference minimum and maximum values between the two mainstem sites that was not as evident during previous deployments. The lack of an observed DO diel cycle in Lower Hilton Creek suggested consistent aeration from stream turbulence and low algae content.

7.3 Pool (LSYR-7.3): One sonde was deployed three separate times in the LSYR-7.3 Pool approximately 1.0 foot above the bottom in a 6 foot deep pool habitat in May, July, and August of 2009 (Figure 20). Water temperatures were relatively cool during the May deployment, with maximum temperatures fluctuating between 17.5 °C and 21.5 °C. During the July deployment, water temperatures were approximately 1-2 °C higher, with a similar diel temperature swing of about 4 °C as previously observed in May. The August deployment was similar to the July deployment, but with a smaller diel temperature fluctuation of approximately 3 °C. The DO concentrations ranged from 4.5 to 9.1 mg/L in May and 2.3 to 7.7 mg/L in August (Figure 20). The DO probe during the July deployment malfunctioned so data were not available. Low nighttime and high daytime DO values in August were indicative of high algae content. *O. mykiss* were observed in this habitat throughout the dry season suggesting salmonid survival through periods of high water temperatures and low DO concentrations over a 24-hour period.

Salsipuedes Creek Beaver Pool (SC-1.2): A 2.5-foot high beaver dam in Salsipuedes Creek (SC-1.2) created an extensive pool that remained throughout the dry season. A single sonde was placed in the beaver pool approximately 1 foot from the bottom in a 4 foot deep section of the pool. Five deployments were made between June and September of 2009 (Figure 21). Water temperatures during the 5 deployments showed similar patterns with approximately 3-4 °C of diel temperature flux and a temperature range of 18-25 °C. The late June deployment revealed the highest water temperatures, with 4 days of maximum temperatures in the afternoon over 26 °C. On the contrary, the late September deployment showed a rapid decrease in water temperatures during the middle of the deployment. Technical issues with the DO probe limited the available data during one of the four deployments (Figure 21). DO concentrations were best in June, lowest in early September and improved towards the end of September. DO concentrations were lowest at night, with a quick return to higher levels in the late morning during all of the deployments.

Lake Cachuma water quality profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 5/28/09, 7/2/09, 8/20/09, 10/22/09 and 12/4/09 (Figure 22). The lake was stratified throughout the summer and most of the fall with the thermocline ranging from 25 to 50 feet in depth. The lake went isothermal (even temperature to depth) between the 10/22/09 and 12/4/09 monitoring efforts, and corresponds to the observed water temperature data in Hilton Creek. The HCWS intake level at 65 feet of depth continues to be well below the thermocline where water temperatures are 14 °C or less throughout the period.

DO decreased with depth to a minimum of 0.2 mg/l near the bottom of the lake during the October survey. Surface DO ranged from 6 to 9 mg/L with a precipitous drop off at 30 to 60 feet of depth depending on the time of the year. The December survey exhibited a uniform DO to depth relationship suggesting thorough mixing after a lake turnover event. DO was low at the HCWS intake level but became 100% saturated after cascading over the rocks to Hilton Creek from each of the release points.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2009 within the LSYR Basin was conducted through photographic analysis using hand held cameras. 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, 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 provide the most representative vantage point to show the greatest changes over time. A list of photo points for WY2009 is provided in the appendices.

Mainstem photo point locations include all bridges from the Highway 154 Bridge to the Highway 246 Bridge (Robinson Bridge) near Lompoc (See Appendix C for a complete list). 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 Santa Ynez River Lagoon. Tributary photo points include various locations on 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 in WY2009, 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 23-26). At Hilton Creek, the HCWS provides year round flows resulting in a mature riparian canopy downstream of the URP. The riparian canopy continues to grow quickly in the reach between the URP and the Lower Release Point (LRP) (Figures 27-28). Continuous releases from the URP began at the end of 2005 upon completion of the Cascade Chute project in December of that year. Photo points for three locations within the Salsipuedes Creek drainage are also included (Figures 29-31)

3.4. Migration - Trapping

Migrating 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 WY2009 at: lower Hilton Creek (tributary farthest from the ocean) 0.14 miles upstream from the confluence with the mainstem LSYR (HC-0.14); lower Salsipuedes Creek (tributary closest to ocean) 0.7 miles upstream of the confluence with the mainstem LSYR (SC-0.7); and in the mainstem LSYR 7.3 miles downstream of

Bradbury Dam (LSYR-7.3). The sandbar at the mouth of the lagoon was open from 2/16/09 to 3/17/09, which provided access for *O. mykiss* to the LSYR and its tributaries for 30 consecutive days.

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 LSYR basin (Figures 6-16). Following the peak storm flows, water receded rapidly to a baseflow of approximately 6-8 cfs, most provided from the HCWS, which allowed any upstream migrating *O. mykiss* an opportunity to enter into the creek. A significant stormflow event occurred during February with a peak flow of about 50 cfs on 2/16/2009 (USGS gauge on Hilton Creek).

The migrant trapping program ran for approximately 21 weeks from mid-January through the first week in May (Table 7). The Hilton Creek and Salsipuedes Creek traps were deployed from the end of the second and fourth week in January, respectively, whereas the LSYR Mainstem Trap was deployed approximately a month later due to low flow and reduced migration potential. All traps were removed on 5/9/09 at the end of the migration season. Traps were checked every 4-6 hours throughout the period except when traps were pulled due to high flows (2/13/09-2/15/09) at the tributary trap sites only. The catch per unit effort (CPUE) standardizes catch data based on the extent of effort exerted for the number of fish captured over a particular time period with units shown in captures/day. The CPUE (Table 8) and timing of each migrant capture over a 24-hour period (Table 9) were tabulated. In general, more fish were captured during the last PM and first AM shifts (nighttime) than during the other two shifts (daytime) which may help steelhead avoid predation. There were 135 out migrating smolts and 612 total upstream and downstream captures between all three migrant traps. One anadromous steelhead was captured in WY2009 at the Hilton Creek trap (605 mm) which was a WY2008 anadromous steelhead that over-summered in the Hilton Creek area. WY2009 was a low capture year compared to WY2008 when 16 anadromous steelhead were observed at all three trapping locations.

Hilton Creek Migrant Traps: The Hilton Creek trapping effort was conducted over a 110 day period beginning on 1/19/09 and ending on 5/9/09 (Tables 7 and 8). Upstream (1.07 captures/day), downstream (2.76 captures/day) and total (3.84 captures/day) CPUE values for Hilton Creek were relatively high for the LSYR, but expected given the population density in Hilton Creek below the URP. A total of 422 fish (118 upstream and 304 downstream) were captured in the Hilton Creek traps during the WY2009 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 143 and 158 captures, respectively (Table 9). The two day time checks resulted in similar values at 25 and 96, 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 and cooler ambient temperatures), which results in a better chance of survival (Meehan and Bjornn, 1991).

The two-day storm in February required removing the trapping equipment for safety at both tributary locations and it was reinstalled after the peak of the hydrograph. This resulted in 110 functional trap days with a trapping efficiency of 98.2%. A total of 118 upstream migrants were captured during the period, ranging in size from 70 mm (2.8 inches) to 605 mm (23.8 inches) (Figure 32). The large 605 mm fish was one of the 16 anadromous adult steelhead captured in the LSYR basin in WY2008. It did not return to the ocean in WY2008 and successfully over-summered in the Hilton Creek area in WY2009 (Figure 33). That fish was identified through photos by its operculum spot configuration. A length-frequency distribution at 10 mm size intervals (Figure 32) shows a greater number of smaller fish were captured than larger fish, and shows 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.

A total of 304 downstream migrants were captured within the period, ranging in size from 66 mm (2.6 inches) to 596 mm (23.5 inches) (Figure 32). The downstream length-frequency distribution was less bi-modal than the upstream with a high number of 70-200 mm fish trapped, many of which many displayed smolting characteristics. 110 juvenile steelhead (smolts) were captured migrating downstream representing nearly 36% of the downstream migrating fish in Hilton Creek. It is possible that some of the other fish not showing smolting characteristics when captured did smolt at a later time while moving downstream. The majority of the fish captured moving downstream were less than 200 mm (7.9 inches). Of the downstream migrants captured, 25 of them were recaptured fish that had moved upstream earlier in the season.

WY2009 was a dry year and therefore limited the migration potential for *O. mykiss* throughout the LSYR basin. There was little correlation between migration and the few stormflow events that occurred during the wet season (Figure 34). As the migration season progressed (March to April), there was a higher incidence of smolts leaving the watershed in March and April as compared to previous years (Figure 35). The smolt out-migration usually occurs in Hilton Creek from February to May.

Aggregating the Hilton Creek migrant capture data by week (Figure 36) indicates that there were more upstream migrants at the beginning of the season than at the end, and that downstream migrants dominated during the second half of the season. These out-migrants were predominantly smolts and were possibly responding 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 35, and Section 3.1).

Salsipuedes Creek Migrant Traps: The Salsipuedes Creek traps were deployed for 102 days from 1/27/09 to 5/9/09, with the trapping season lasting 104 days. The trapping efficiency was 98.1% (Table 8). The Salsipuedes Creek migrant traps were removed for 2 days due to stormflow events in mid-February. The total CPUE for the Salsipuedes Creek trapping effort for both upstream and downstream traps combined was 1.83 captures/day; 0.13 for upstream and 1.71 for downstream captures/day (Table 8). CPUE values were less in Salsipuedes Creek than in Hilton Creek due to the lower population density within the monitored reaches and less hydrologic connectivity due to a dry year. A total of 13 upstream migrants were captured during the period, ranging in size from 79 mm (3.1 inches – first year fish) to 203 mm (8.0 inches). Of the upstream migrants, all were identified as resident fish with two showing smolting characteristics. The two smolting fish were not recaptured heading back downstream suggesting they might have stayed in the creek for another year. A length-frequency distribution for upstream and downstream migrant captures (Figure 37**)** showed a dominance of smaller fish (<200 mm) and that the largest size class of fish moving through the system was in the downstream direction in the 70-100 mm size class range.

There were 174 downstream migrant captures during the period ranging in size from 56 mm (2.2 inches, a first year fish) to 202 mm (7.9 inches) (Figure 37**).** All of the captured fish appeared to be small resident juveniles (1+ year fish) or smolting fish leaving the basin. 24 smolts were captured (17 smolts and 7 pre-smolts) that represented 14% of the downstream migrants. This is an unusually small percentage of smolts exiting Salsipuedes Creek compared to previous years and may have been due to the absence of migratory cues (i.e., freshets) during the low precipitation year. The remaining fish captured were unusually small compared to previous year captures. Since WY2008 was a wet year and snorkel surveys observations showed young-of-the-year in the watershed, it was expected to see more fish smolting and moving out of the basin.

Generally, flows in Salsipuedes Creek increase swiftly in response to rainfall events once the watershed has become saturated and antecedent soil moisture conditions result in favor runoff from any rainfall event. This occurred only once in 2009 with a modest maximum flow of 67 cfs on 2/16/09 (Figure 38). Rainfall patterns in the Salsipuedes drainage can be independent of the rest of the LSYR watershed as precipitation is sometimes higher in the western tributary drainages than in the mainstem near 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 2/16/09 storm and subsequent opening of the lagoon on 2/17/09 where recorded flows at the USGS Salsipuedes Creek gauge were high, yet relatively low at the USGS Solvang LSYR mainstem gauge (Section 3.1). The most significant storm event of the 2009 migration season created a brief high flow window followed by a rapid reduction in flow back to baseflow levels of 2.7 cfs by 2/20/09. The first smolts were captured leaving the watershed on 2/17/09, one day following the single high flow event of the season (Figure 38). Of the smolt captures, 71% were captured in February, showing the rapid response of smolting fish in relation to important environmental cues (i.e., freshets). There were no smolts observed in January or May.

Of the 187 migrant captures in the Salsipuedes Creek traps during the WY2009 migration season, the majority was observed at the dawn and late evening trap checks (Table 9). This was similar to what was observed in Hilton Creek. Looking at the weekly distribution of captures over the migration season for Salsipuedes Creek (Figure 36), there was a migratory response prior to and after the single stormflow event with few fish moving during the rest of the season. Of the 187 total migrants captured, 164 (87.7%) of the fish were captured during a three week period from 2/5/09 through 2/25/09, again suggesting the importance of environmental cues triggering migratory responses in *O. mykiss*.

Comparison of Salsipuedes Creek and Hilton Creek Migrant Trapping Results: Salsipuedes Creek and Hilton Creek are two very different tributaries in terms of their hydrology (rainfall and runoff patterns) and biology (*O. mykiss* migration and population characteristics). Both creeks have hydrologic regimes typical of a Mediterranean type 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 near 0.5 cfs in the height 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 sparse 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 upstream 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 WY2009. 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.

A comparison of migrant captures in WY2009 between Hilton and Salsipuedes creeks is presented in Table 10. Due to continuous baseflow conditions, Hilton Creek had more migration potential and observed migrants than in Salsipuedes Creek. The single February storm did allow some fish to migrate within Salsipuedes Creek with 87.7% of the total migration captures occurring during a three week period around that storm. In contrast, only 18.5 % of the total migrants captured during the same timeframe were in Hilton Creek (78 of 421).

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 in May (Figure 35). However, WY2009 may represent one of the few years when smolting fish were first captured leaving Salsipuedes Creek with the first smolt being captured on 2/17/09. The first smolt captured in Hilton Creek was on 2/18/09. Salsipuedes Creek tends to produce smolts from February through April depending on the flow (see trend analysis in Section 4.4). Out-migrating smolts were early in WY2009 due to the low flow conditions. In contrast, the dominant smolt run in Hilton Creek tends to be from March through May. Over all, Hilton Creek produced significantly more smolts than Salsipuedes Creek in WY2009. The average smolt size by month was larger in Hilton Creek (153-170mm) compared to Salsipuedes Creek (141-165mm) indicating generally more favorable rearing conditions in Hilton Creek during this particular year.

LSYR Mainstem Trap: The mainstem LSYR trap was located at the lower end of the Refugio Reach (LSYR-7.3). The trap was installed 2/17/09 and removed on 5/9/09 with an 81 day trapping season and a 100% trapping efficiency (Tables 7 and 8). The reason for the later deployment was due to the low flow conditions and the presence of numerous beaver dams which effectively fragmented the migration corridor. There were only three fish captured during the migration season, all downstream migrants with two of them being smolts (Figures 35, 36, 39 and 40). The first fish captured was a smolt on 2/17/09 and the other two fish were captured on 2/18/09. The average length of the smolts were significantly larger (184 mm) than those captured in either Hilton or Salsipuedes creeks, which may reflect the more abundant food resources in the mainstem during the winter time of the year. These fish captures on the mainstem immediately followed the small stormflow event of 2/16/09. With only three fish captured, the CPUE for the mainstem was the lowest among all of the trap sites with 0.04 captures per day (Table 8). All of the fish were captured during the night time or early morning hours (Table 9).

3.5. Reproduction and Rearing

Redd Surveys: Redd surveys are typically conducted opportunistically in the mainstem and tributary habitats in the winter or early spring within the reaches where access is permissible along Salsipuedes, El Jaro (including Los Amoles and Ytias) and Hilton creeks, and the Refugio and Alisal reaches of the LSYR mainstem. (Figure ES-1) Therefore, year to year comparisons are difficult. WY2009 represented a poor year for anadromous steelhead migration within the LSYR basin as flows remained low in the mainstem and tributaries throughout the spawning season. No redd surveys were conducted during WY2009. However, successful production was evident by the presence of young-of-the-year within Hilton, El Jaro, and Salsipuedes creeks observed during routine snorkel surveys in the spring.

Snorkel surveys: The size class distribution of fish observed during the single-pass spring, summer and fall 2009 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 (October and November) is conducted before the first rainfall of the year 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. 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 (Figure 41) are predominately pool and run habitats where the majority of *O. mykiss* rear during the dry season. The total number of *O. mykiss* observed during all three snorkel surveys is shown in Figure 42 with all survey dates shown in Tables 11 and 14 for the LSYR mainstem and its tributaries.

Mainstem: Snorkel surveys were conducted during the spring (Refugio Reach and Alisal Reach), summer (Refugio Reach and Alisal Reach), and fall (Hwy 154 Reach, Refugio Reach, and Alisal Reach) in the LSYR (Tables 12 and 13). Since the LSYR experienced a dry condition and no spill occurred in WY2009, snorkel surveys were not conducted downstream of the Alisal Reach due to rapidly drying conditions in the late spring.

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 habitats below the Long Pool to the Reclamation property boundary. Poor water clarity during the spring and summer prohibited conducting these surveys but water quality conditions improved to allow for the fall snorkel survey. A large number of carp were observed in the Stilling Basin and the Long Pool and were thought to be the cause of the limited visibility in the Hwy 154 Reach. These non-native invasive species feed along the bottom (benthivores), 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 41 *O. mykiss* observed over approximately a quarter of a mile of run and pool habitat. The majority of the fish observed (34 fish, 83%) were within the 3-6 inch size category or smaller (juveniles) indicating successful spawning and over-summering (Table 13 and Figure 43). There were 6 fish (15%) greater than 6 inches observed.

Refugio Reach

During the spring survey, 20 habitats were snorkeled in the Refugio Reach which included 15 pool and 5 run habitats (Table 13). *O. mykiss* were observed in 6 of the 20 habitats, of which all were pool habitats. Overall, 39 *O. mykiss* were observed during the spring surveys, the majority (95%) of which were greater than 6 inches.

In the summer survey, the same 20 habitats were snorkeled that included 15 pool and 5 run habitats. Overall, 32 *O. mykiss* were observed during the summer survey, a modest decrease from the 39 observed in the spring. Again, the majority of the fish observed (31 fish, 97%) were greater than 6 inches (Figure 44). *O. mykiss* were observed in 11 of the 20 habitats, indicating potential movement from habitat to habitat within the Refugio Reach from the spring to the summer survey.

In the fall survey, the same 20 habitats were snorkeled as conditions were similar to those described above for the spring and summer surveys. There was a significant decrease in the number of fish observed from 32 in the summer to 19 in the fall (a 41% decrease). The largest decrease for any single habitat during this survey was in the pool habitat at LSYR-4.9; 11 fish observed in the summer and 2 fish observed in the fall. This was most likely due to predation, poaching, upstream migration or poor water quality (temperature and DO concentration, Section 3.2) 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

During the spring survey 19 habitats were snorkeled within the Alisal Reach which included 15 pools and 4 runs. The same numbers of *O. mykiss* were observed within the Alisal Reach in the spring as was observed in the Refugio Reach (39 fish) (Table 13). Habitats where *O. mykiss* were observed included 8 of the15 pool habitats and 1 of the 4 run habitats. Of the 39 fish observed in the Alisal Reach, 95% were greater than 6 inches (Figure 45). One habitat in particular held 15 fish, or 38% of the total number of fish observed in that reach, which was located approximately 1/2 mile downstream of Refugio Bridge.

During the summer survey that covered the same area and habitat units, 17 *O. Mykiss* were observed, a decrease of 56% from the spring survey. Fish were observed in 5 of the 15 pool habitats while none were observed in the 4 run habitats.

The fall survey resulted in only 7 *O. mykiss* observed within the Alisal Reach, a decrease of 59% from the same area and habitat units surveyed in the spring and summer. The habitats where fish were observed included 5 pool habitats. The decrease in numbers could be attributed to a combination of a seasonal decline in water quality, predation, and/or poaching.

Tributaries: Tributary snorkel surveys were conducted in the spring (Hilton, Quiota, Salsipuedes, and El Jaro Creeks), summer (Hilton, Quiota, and Salsipuedes Creeks) and fall (Hilton, Quiota, Salsipuedes, and El Jaro Creeks) (Table 14) and the results of those surveys are presented in Tables 15 and 16. 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 (Tables 15 and 16). Spring, summer, and fall surveys were planned and executed accordingly.

The 2009 spring survey resulted in 545 *O. mykiss* being observed, of which 42% were young-of-the-year less than 3 inches in length (Table 16 and Figure 46). This spring total was less than previous years within Hilton Creek. Fish less than 6 inches made up 83% of all the fish observed during that survey. A few larger fish were observed, but only 1 greater than 12 inches which was unusual given observations in the past of larger fish in greater numbers (USBR, 2011).

During the 2009 summer survey the total number of fish observed was 863, an increase of 318 *O. mykiss* (Figure 46). It is likely that young-of-the-year occupying shallow habitats during the spring survey moved to deeper habitats in the summer, allowing for surveyors to detect their presence during this second survey. The CPBS has observed this phenomenon in the past, both in the tributaries and the mainstem of the LSYR. In fact, the summer survey can represent the highest number of *O. mykiss* observations because of this phenomenon, particularly in Hilton Creek.

The CPBS observed 746 fish during the fall survey (Figure 46), a decrease from the summer. *O. mykiss* less than 6 inches represented 87% of all fish observed, with 65% falling in the 3-6 inch category (41% and 44% in the spring and summer, respectively). This is a typical pattern observed in Hilton Creek, with young-of-the-year growing and moving up in size class throughout the summer period.

Quiota Creek

Snorkel surveys were conducted along a short portion of Quiota Creek within the County road easement for Refugio Road, extending approximately 150 feet below Crossing 5 and continuing upstream to approximately 50 feet above Crossing 7 (Table 16). This area normally remains wet during the dry season, but exhibited drying streamflow conditions towards the lower end of the survey reach in the summer of 2009.

Snorkel surveys conducted in the spring resulted in 189 *O. mykiss* being observed of which 98% (185) were within the 0-3 inch size category. These were likely young-of-the-year produced earlier in the year (Figure 47). Four 3-6 inch fish were observed with no fish greater than 6 inches.

Between the spring and summer surveys, there was a 47% reduction in the number of fish observed (189 to 101 fish), however, similar size distribution percentages to those seen during the spring survey (Figure 47) were observed. Young-of-the-year (0-3 inches), while smaller in number, still comprised 88% 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 39 fish being observed (Figure 47). Unlike the previous two surveys, there appeared to be an upward size shift in the fish indicating growth of individuals in the remaining population. In the previous two surveys, young-of-the-year made up 98% and 88%, respectively of the total population, with 3-6 inch fish comprising 2% and 11%. In the fall survey, young-of-the-year made up 69% and fish in the 3-6 inch size category comprised 26% of the total.

Salsipuedes Creek

Normally five reaches of Salsipuedes Creek are snorkel surveyed every year. Reaches 1 through 4 of Salsipuedes Creek extend from the Santa Rosa Bridge upstream to the Jalama Road Bridge for a total length surveyed of 2.85 miles. Reach 5 extends upstream from the Jalama Bridge to the confluence with El Jaro Creek, a distance of approximately 0.45 mile long (Table 15). Water clarity remained good within Reach 5 throughout the survey period and surveys were conducted in the spring, summer and fall.

Snorkel surveys were attempted within Reaches 1-4 in Salsipuedes Creek during the spring, but beaver activity had caused excessive turbidity which prevented the CPBS from effectively surveying those reaches. During the summer, the water had cleared enough within Reach 2 for survey work to be completed and divers counted 18 *O. mykiss* (Figure 48). Even during the time of the summer survey, 72% (13 of 18) of the fish observed within Reach 2 were within the 0-3 inch size category. This was an indication of successful spawning activity in the winter/spring of 2009 within this lower reach of Salsipuedes Creek. Reach 2 was also the only feasible reach to snorkel in the fall, as excessive turbidity once again prevented accurate counts within Reaches 1, 3, and 4. In the fall, 6 *O. mykiss* were observed in Reach 2, all greater than 3 inches in length.

In the spring of 2009 the CPBS observed 95 *O. mykiss* within Reach 5 (Figure 49). Approximately 30% of the fish were 0-3 inches and another 64% of the fish were 3-6 inches. In the summer, 28 *O. mykiss* were observed within the same habitats. This was a 71% reduction than what was observed in the spring. By the fall, 20 *O. mykiss* were observed in Reach 5, with 70% of the fish falling within the 3-6 inch size category. As seen in other creeks, there was an overall decrease in the number of fish observed within Reach 5 (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 (Tables 15 and 16). The majority of all habitats available were 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 summer surveys were not conducted due to poor water clarity.

Divers observed 75 *O. mykiss* in the spring of 2009, of which 45% (34) were within the 0-3 inch size category, indicating successful spawning (Figure 50). The majority of the remaining fish observed (47%) were within the 3-6 inch size category with six larger fish between 6-9 inches observed.

As mentioned above, CPBS attempted a summer survey but conditions were too turbid to snorkel. However, divers returned in the fall and found that conditions had cleared enough to successfully complete the survey. There was a marked decrease in the number of fish observed from the spring (75) to the fall with 11 *O. mykiss* being observed, a decrease of 85% (Figure 50). As expected, there was also a shift in the size classes of those fish observed in the fall. Fish in the 3-6 inch size category made up 64% of the fish observed. The decrease in numbers was likely due to the reduction of available habitat, predation or poaching from the spring to fall period, while the size shift was 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 (Figures 51 and 52). 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 (*Gila orcuttii*) and fathead minnows (*Pimephales promelas*) were observed within Salsipuedes Creek.

Largemouth Bass: Largemouth bass were the most numerous of the introduced species observed during mainstem snorkel surveys in 2009 (Figure 51). During the spring survey, 160 largemouth bass were observed within the Refugio (142) and Alisal (18) reaches of the mainstem. In the summer, 239 largemouth bass were observed, 124 within Refugio Reach and 115 within Alisal Reach. In the fall, 261 were observed with 158 in the Refugio Reach and 103 within the Alisal Reach.

Sunfish Species: Sunfish species were less numerous than largemouth bass in 2009 within the Refugio and Alisal Reaches. A total of 38 sunfish were observed in the spring, 89 in the summer, and 23 in the fall (Figure 51). The majority of these fish were less than 6 inches in length and nearly all were located within pool habitats.

Catfish Species: Few catfish were observed in the habitats snorkeled within the mainstem (Figure 52). One catfish was observed in the Alisal Reach in the summer and one catfish was observed within the Refugio Reach in the fall. These numbers were less than previous years, although the cause of the decrease is unknown.

Carp: In 2009, 66 carp were observed within the Refugio and Alisal Reach in the spring (Figure 52). In the summer and fall, 48 and 65 carp were observed within the same reaches, respectively. There were numerous large carp in the Stilling Basin (LSYR-0.0) that were easily observed from the dam crest that year.

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.

No tributary projects were completed during WY2009. Design and grant proposal writing were completed for the Cross Creek Ranch Fish Passage Project on El Jaro Creek that was scheduled for construction in the fall of 2010. Tributary fish passage projects completed prior to WY2009 were the Hwy 1 Bridge and Jalama Road Bridge on Salsipuedes Creek and Cascade Chute on Hilton Creek (Figure 53), Rancho San Julian on El Jaro Creek (Figure 54) and Quiota Creek Crossing 6 (Figure 55); all of which are providing juvenile and adult fish passage and functioning as designed.

3.7. Additional Investigations

Genetic Analysis: Tissue samples from all of the migrant captures during WY2009 were sent to Dr. Carlos Garza of NOAA Southwest Science Center. The results are still forthcoming.

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. This survey is conducted in the fall prior to the steelhead migration season.

In the Refugio, Alisal, and Hwy 154 Reaches, 13 beaver dams were observed during the spring snorkel survey of WY2007, 18 in the spring snorkel survey of WY2008, and 19 in the February in WY2009. 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 water right release from the dam. Once flows receded, the beaver dams were still intact with several presenting passage barriers. This test release 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.

All of the beaver dams removed during the WY2008 spill event were essentially back in place during the February WY2009 survey that ranged in size from less than one-foot to greater than 3-feet in height.

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 surveys for *O. mykiss* within the LSYR drainage. The trend analysis is focused on data from WY2001 through WY2009. Summaries of the LSYR Fisheries Monitoring Program have been compiled for 1993-2004 (AMC, 2008) and 2005-2008 (USBR, 2011).

4.1. Are steelhead moving during the supplementation of migration flows? The Fish Passage Supplementation Program was not implemented in WY2009. There was so little precipitation that all the criteria were not met at any point during the year. As a result, the 3,200 acre-feet of the Fish Passage Account remained for use the following year.

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.

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 Erosion Control, 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 (Tables 17 and 18, Figures 53-55). 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 WY2001 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). In WY2009, there was one over-summering WY2008 anadromous steelhead migrant observed in Hilton Creek. 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 COMB, Reclamation or 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 scheduled to be removed in WY2010. 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 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 adult 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). Again, there were no anadromous adult steelhead observed in Salsipuedes Creek in WY2009.

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 a damaged low flow crossing with downstream plunge pool and a temporary bridge over top with 48-foot bottomless arched culvert and 4 rock weirs with constructed pools in between. Fish were observed in those pools immediately after the project was completed and young of the year *O. mykiss* were observed within the project area that following spring indicating successful spawning in that area. Fall snorkel surveys suggest that the project enhanced over-summering habitat as fish were present within the project site all year long. Further monitoring in subsequent years will provide greater insight into the biological performance of the project.

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

WY2009 was not a spill year but it was the year after a spill that occurred in WY2008 where the spill was greater that 20,000 acre-feet. Hence, maximum target flows were required at Hilton Creek (a minimum of 2 cfs), the Hwy 154 Bridge (5 cfs) and Alisal Bridge (1.5 cfs). Reclamation met those target flows except for a couple of days during heat waves in the summer at Alisal Bridge as was described in Section 3.1; no fish were harmed during that period and flow did not drop below 1 cfs. 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. No adjustments to the 1.5-cfs target flow guidelines are deemed necessary based on the WY2009 operations. Residual pool depths, within habitats in the LSYR mainstem, Refugio Reach, and Alisal Reach, were maintained throughout the year.

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 variance in precipitation and the associated streamflow for any given year. Rainfall (Table 19), year type (Figure 56), and stream discharge (Table 20) 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 URP, and the increase in the riparian canopy cover since 2000 (Figure 57). Prior to the installation of the HCWS, dry season thermal heating was evident and well as the stream drying up. As the riparian corridor canopy developed and the focus of the releases changed from the LRP and later to the URP (2005), water temperatures continually dropped with each successive year.

Analysis of the total upstream and downstream migrant captures at the Salsipuedes, LSYR mainstem, and Hilton Creek traps from WY2001 through WY2009 provides a comparison of the number of captures within the LSYR basin among the three trapping locations (Figure 58). The data show that in general 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, Salsipuedes Creek in WY2009 being an exception due to the number of out-migrants responding to dry year conditions. 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 WY2001 to WY2009 was generally above 85% except during wet years when high flows required removal of the traps, specifically during WY2001, WY2005 and WY2008 (Table 21). During the high flows and spill periods of WY2005 and WY2008, efficiencies at the mainstem trap ranged from 69% to 100%. The CPUE values were highest in Hilton Creek which is due to the high number of captures since the completion of the HSWS in 2001, and to the completion of the Cascade Chute project in 2005 that nearly doubled the habitat length and increased the total population and production potential of *O. mykiss*. Smolt production in Hilton Creek was greatest from 2006-2009 ranging from 83-215, with 2006 having the highest smolt total on record (Figure 59). Since completion of the HCWS, there has been 611 smolts identified leaving the Hilton Creek system. Smolt production in Salsipuedes is greatest during wet year types, or during average years when spring freshets trigger smolt movement. Since WY2001, there have been 577 smolts identified migrating out of the Salsipuedes Creek watershed. A 135 out migrating smolts and 612 total upstream and downstream captures were observed in WY2009 between all three migrant traps which was the third highest annual total on record for smolts and total captures (Figures 58 and 59).

There were more downstream migrants in wet years compared to dry and average years in Salsipuedes Creek and the mainstem trapping location. However, in Hilton Creek in WY2007 and WY2009 (dry years), a large number of fish migrated out of the basin in the spring, independent of identified environmental cues such as stormflow. During dry years, fish do not appear to move through the mainstem and Salsipuedes Creek because of a lack of environmental cues such as good passage stream flows, connectivity to the Santa Ynez River Lagoon and ocean, and possible passage impediments from beaver dams. The available trapping data over some years may 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, for example during WY2005 which was a wet year with one anadromous steelhead captured in Salsipuedes Creek only. There is generally a very low anadromous steelhead population throughout the southern California distinct population segment and the lack of capture data, even in wet years, may illustrate this observation.

Looking at migrant captures from WY2001 to WY2009 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 60-62). This is particularly evident in Salsipuedes Creek, with a much higher number of downstream than upstream migrants, especially in wet years. To contrast, the mainstem had low flow conditions in WY2007 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 1994 (Figure 59), even with trapping efficiencies of 92%, 86% and 69% at Hilton, Salsipuedes and Mainstem traps, respectively. 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. Smolt production showed a general trend upward particularly in Hilton Creek 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 63). Hilton Creek tends to produce smolts every year due to continuous streamflow from the HCWS. Whereas smolt production in Salsipuedes Creek and the mainstem varies depending on flow rates, with low flow years (i.e., WY2002, WY2007 and WY2009) showing lower numbers of out migrating smolts. Salsipuedes Creek tends to produce smolts in February through April depending on the flow regime with very low numbers seen at the beginning (January) and end of the season (May); WY2001, WY2005, WY2006, and WY2008 were a good example of that trend (Figure 63). The timing of the smolt run in Salsipuedes Creek tends to be earlier in the year (February through April) than in Hilton Creek (March through 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 was issued and therefore, potentially greater fecundity, from WY2001 through WY2009 (Figure 64 and Table 22). However, in dry years (WY2002, WY2007, and WY2009) there is a marked decrease in the migration potential and opportunities for larger fish as shown in the data. The increase in migrating adults during the other years 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 which has increased overall habitat and migration opportunities for migrating steelhead/rainbow trout.

The total number of *O. mykiss* observed during the spring, summer and fall snorkel surveys from WY2001 through WY2009 showed a general trend upward across wet years, and a decrease during the dry years (Table 23). Looking at each reach surveyed over the past five years (WY2005-WY2009), Refugio Reach (Figure 65) showed a general attrition or decrease 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 66) also had an increase in 3-6 inch fish in the summer and fall, and 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 predation or 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 have helped with this ongoing issue. Hilton Creek (Figure 67) 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 URP for flow releases. Snorkel surveying efforts from WY2005 through WY2009 in Quiota Creek (Figure 68), Salsipuedes Creek (Figure 69), and El Jaro Creek (Figure 70) 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 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. In general, there are smaller fish in Salsipuedes Creek than Hilton Creek and the overall numbers decrease in both streams over the dry season. 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 71). Of the three snorkel surveys, the spring survey showed the highest number of observed *O. mykiss*, except in dry years in WY2004, WY2007 and WY2009 when the summer survey had the highest counts. The data from WY2001 to WY2009 suggest a general upward trend for all reaches except above the URP (Reach 6). This is another example of the significant benefit the HCWS has had on steelhead in Hilton Creek.

There has been a general trend over the last five 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 24). This was particularly evident for carp. Impacts to *O. mykiss* from invasive species within the LSYR mainstem needs further study.

5. Conclusions and Recommendations

WY2009 was a dry year with rainfall totaling about 13.66 inches at Bradbury Dam. There was not sufficient upper basin flow to spill Lake Cachuma but there was one storm in February that produced enough runoff to breach the lagoon and open up the LSYR for passage for 30 days. Only one anadromous adult steelhead was observed in the LSYR basin on 3/22/09 in Hilton Creek but this was identified as an over-summering steelhead that entered the system in WY2008. No new ocean run steelhead were observed throughout the LSYR basin in WY2009. There were 135 out migrating smolts and 612 total upstream and downstream captures between all three migrant traps which was the third highest annual total on record for smolts and total captures. Given how dry the year was, these totals were noteworthy.

Southern steelhead had limited access to tributary spawning and rearing habitats due to low stream flow conditions throughout the migration season even though completed tributary projects on Hilton, Quiota, Salsipuedes and El Jaro Creeks did provide unimpeded passage when streamflow permitted. Target flows at Alisal Bridge, Hwy 154 Bridge and Hilton Creek were met throughout WY2009. Although a dry year, general trends within the LSYR basin continue to show 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 Distinct Population Segment is desirable to better understand population viability and restoration potential.

Recommendations to improve the monitoring program: Based on our observations and improved knowledge, the following suggestions are provided to improve the ongoing fisheries monitoring program in the LSYR and are the same as what was recommended in the 2008 Annual Monitoring Report given the close proximity of the analyses for both documents:

- Continue current 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 a one or two year period.
- Develop a monitoring program to better understand the interaction of *O. mykiss* and beavers (*Castor canadensis*) 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 as soon as possible 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 Distinct Population Segment to improve the collective knowledge, collaboration and dissemination of information.

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Table 1: WY2000 to WY2009 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)	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
2009	13.66	Dry	No	168,902	743.81	No	No

* Bradbury Dam rainfall (Cachuma) with a period of record = 57 years (1953-2009) and average rainfal of 20.6 inches

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

Table 2: WY2009 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed (source: County of Santa Barbara).

Location	Period of Record (years)	Min. Rainfall (Water Year) (in)	Max. Rainfall (Water Year) (in)	Rainfall (WY2009) (in)
Lompoc	40	5.31 (WY07)	34.42 (WY83)	10.39
Buellton	56	5.34 (WY89)	41.56 (WY98)	10.77
Solvang	46	6.47 (WY07)	43.87 (WY98)	11.65
Cachuma*	57	7.33 (WY07)	53.37 (WY98)	13.66
Gibraltar	91	9.24 (WY07)	73.12 (WY98)	15.27
Jameson	85	8.50 (WY07)	79.52 (WY69)	17.14

* Bradbury Dam rainfall. The Cachuma period of record was 57 years (1953-2009).

Table 3: (a) Storm events greater than 0.1 inches and (b) monthly rainfall totals at Bradbury Dam during WY2009. Dates reflect the starting day of the storm and not the storm duration.

(a)

#	Date	Duration (days)	Percipitation (inches)
1	10/31/2008	3	0.25
2	11/4/2008	1	0.19
3	11/26/2008	2	2.99
4	12/15/2008	3	1.91
5	12/22/2008	1	0.17
6	12/25/2008	2	0.34
7	1/22/2009	5	0.63
8	2/5/2009	5	2.60
9	2/14/2009	1	0.38
10	2/16/2009	3	2.38
11	2/22/2009	2	0.28
12	3/4/2009	2	0.59
13	3/22/2009	2	0.25
14	4/8/2009	2	0.19
15	6/5/2009	1	0.15

(b)

Month	Rain (inches)
October-08	0.15
November-08	3.39
December-08	2.46
January-09	0.65
February-09	5.70
March-09	0.85
April-09	0.19
May-09	0.00
June-09	0.16
July-09	0.00
August-09	0.03
September-09	0.08

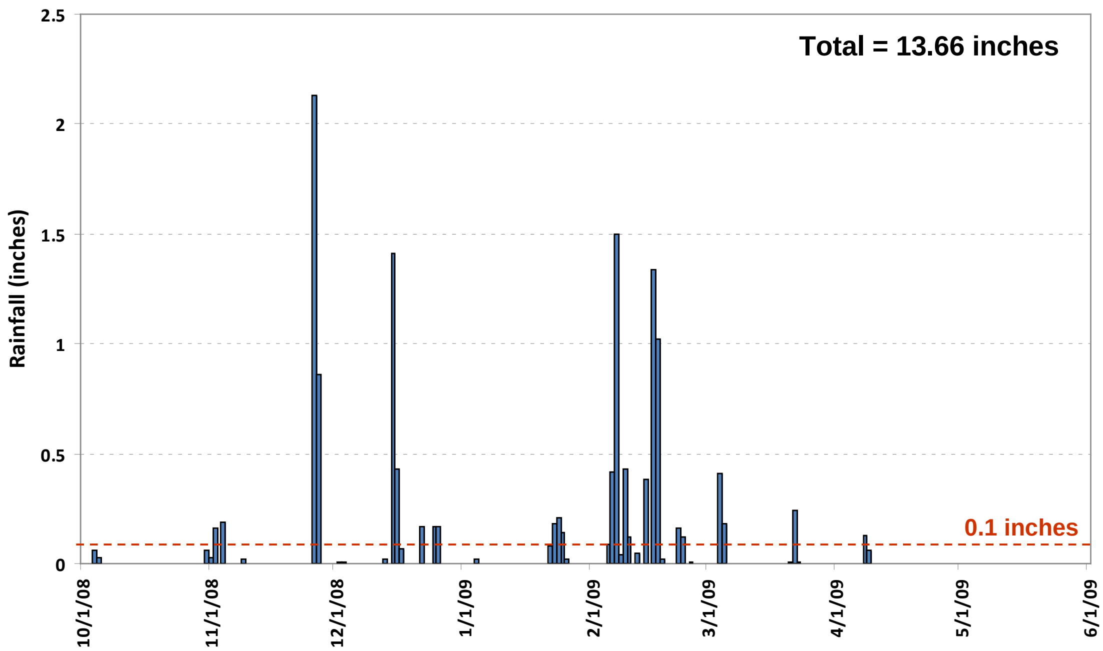


Figure 1: WY2009 Rainfall recorded at Bradbury Dam (USBR).

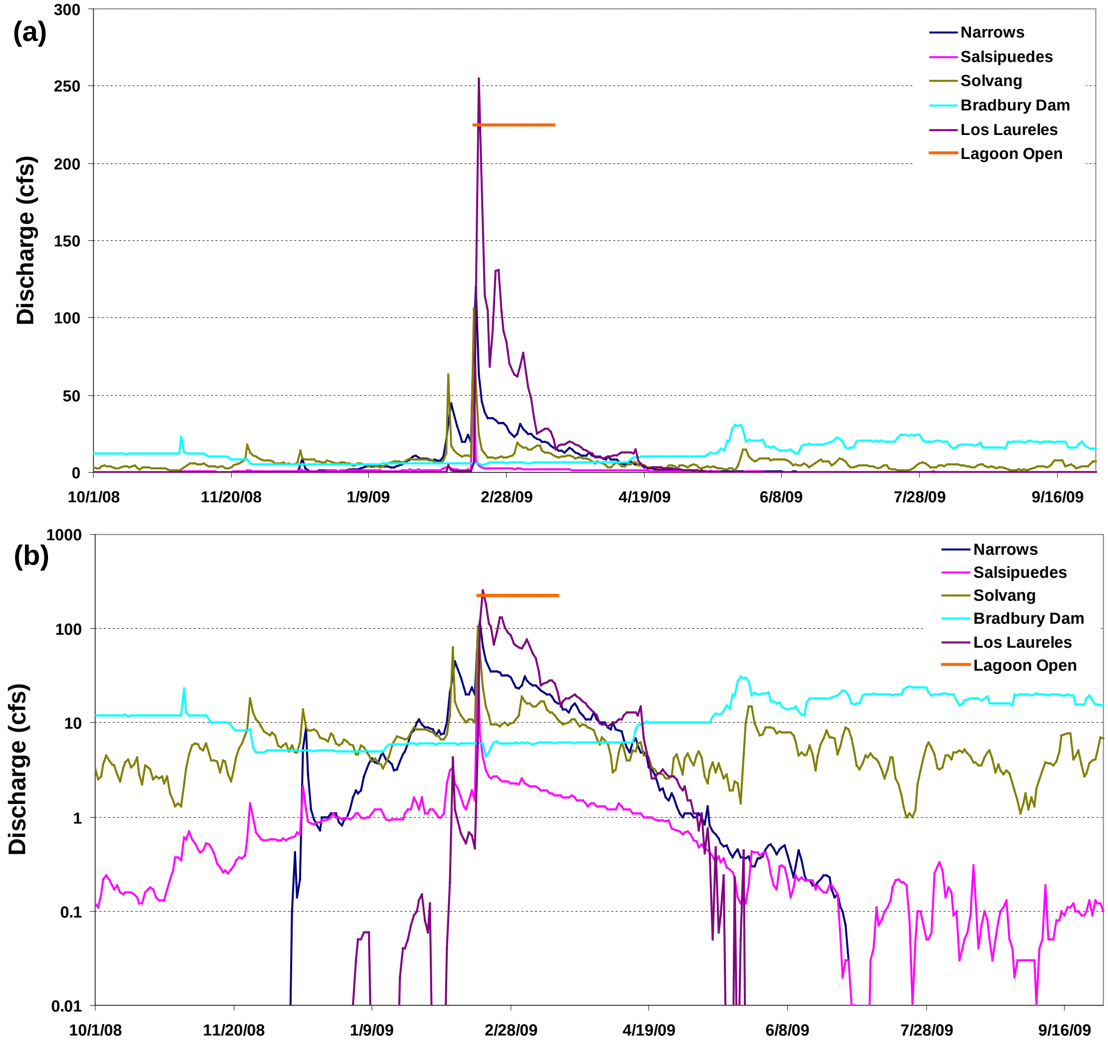


Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open in WY2009 with a (a) normal and (b) logarithmic distribution.

Table 4: Ocean connectivity, lagoon status and number of days during the migration season from WY2001 to WY2009.

Water Year	Year Type	Ocean Connectivity	Lagoon Status Open	Lagoon Status Closed	Lagoon Status # of Days	# of Days in Migration Season*
2001	Wet	Yes	1/22/2001	5/10/2001	109	109
2002	Dry	No	-	-	0	0
2003	Normal	Yes	12/21/2002	5/9/2003	150	140
2004	Dry	Yes	2/26/2004	3/22/2004	26	26
2005	Wet	Yes	12/28/2004	5/20/2005	144	141
2006	Wet	Yes	1/3/2006	-	271	151
2007	Dry	Yes	-	11/22/2006	52	0
2008	Wet	Yes	1/6/2008	5/19/2008	134	134
2009	Dry	Yes	2/16/2009	3/17/2009	30	30

*Migration Season is January through May.

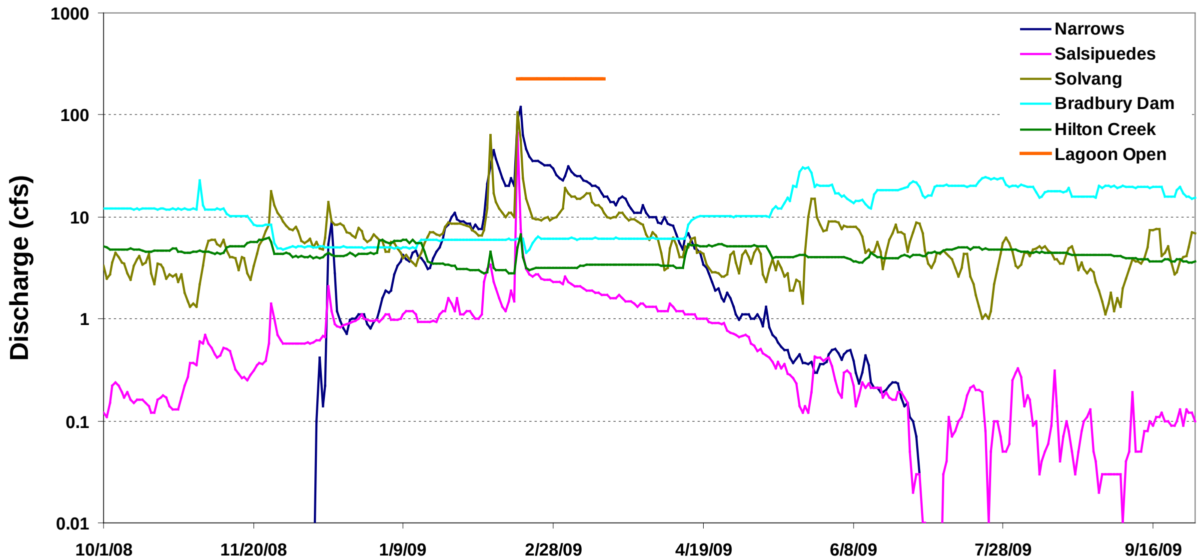


Figure 3: USGS average daily discharge at Hilton and Salsipuedes creeks in comparison to mainstem discharge at Solvang Bridge and Lompoc Narrows during WY2009. Duration of ocean connectivity (Lagoon Open) at the lagoon is also shown.

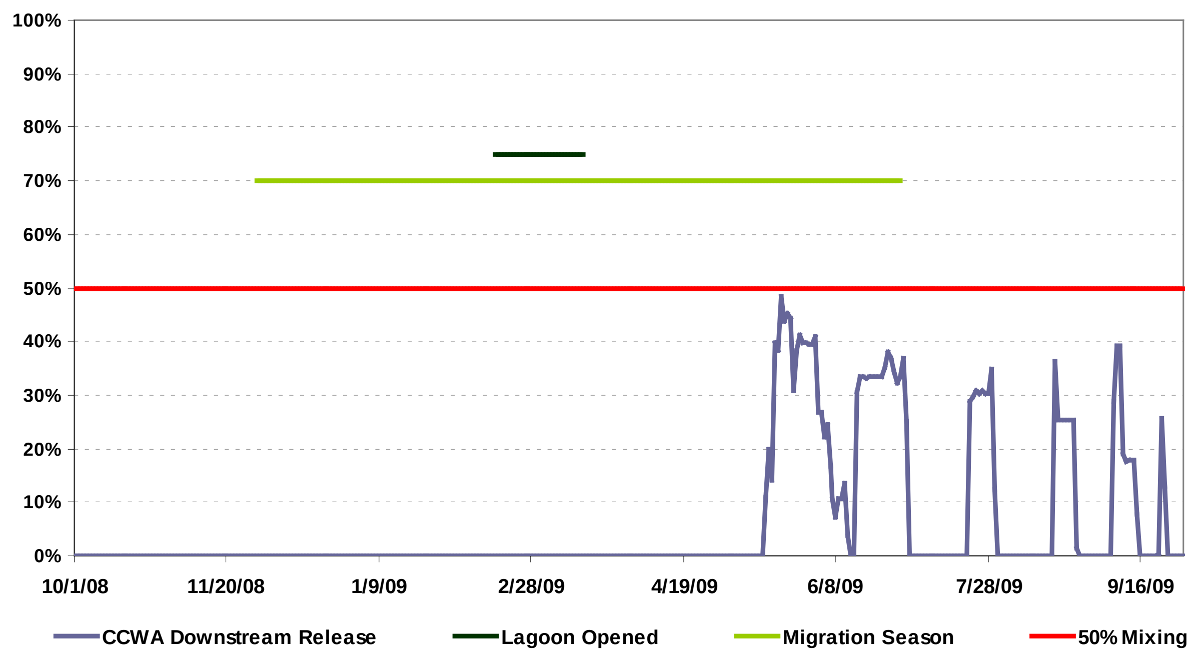


Figure 4: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during WY2009 and the migration season.

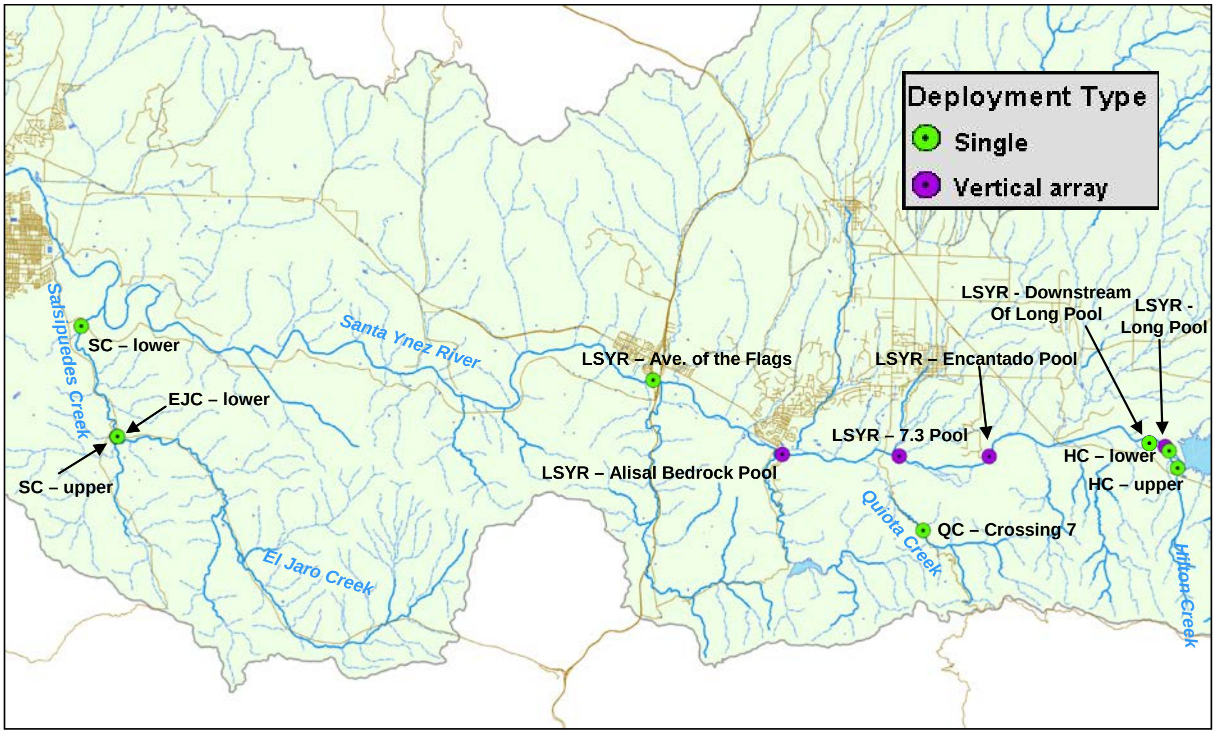


Figure 5: Thermograph single and vertical array deployment locations within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are very close together with overlapping symbols.

Table 5: 2009 thermograph network locations and period of record.

	Location Name	Stream ID	Type	Deployment Date	Retrieval Date	Period of Record (days)
Mainstem	LSYR - Long Pool	LSYR-0.5	Vertical Array	4/14/2009	11/9/2009	209
	LSYR - Downstream of Long Pool	LSYR-0.51	Single	4/23/2009	11/9/2009	200
	LSYR - Encantado	LSYR-4.95	Vertical Array	4/14/2009	11/9/2009	209
	LSYR -7.3 Pool	LSYR-7.3	Vertical Array	4/14/2009	11/9/2009	209
	LSYR - Alisal BR Pool	LSYR-10.2	Vertical Array	4/15/2009	11/9/2009	208
	LSYR - Avenue of the Flags	LSYR-13.9	Single	4/23/2009	11/9/2009	200
Tributaries	Hilton Creek (HC) - lower	HC-0.12	Single	4/14/2009	11/9/2009	209
	Hilton Creek (HC) - upper	HC-0.54	Single	4/14/2009	11/9/2009	209
	Quiota Creek (QC)	QC-2.71	Single	4/14/2009	11/9/2009	209
	Salsipuedes Creek (SC) - lower	SC-0.77	Single	4/15/2009	11/9/2009	208
	Salsipuedes Creek (SC) - upper	SC-3.8	Single	4/15/2009	11/9/2009	208
	El Jaro Creek (EJC) - lower	EJC-3.81	Single	4/15/2009	11/9/2009	208

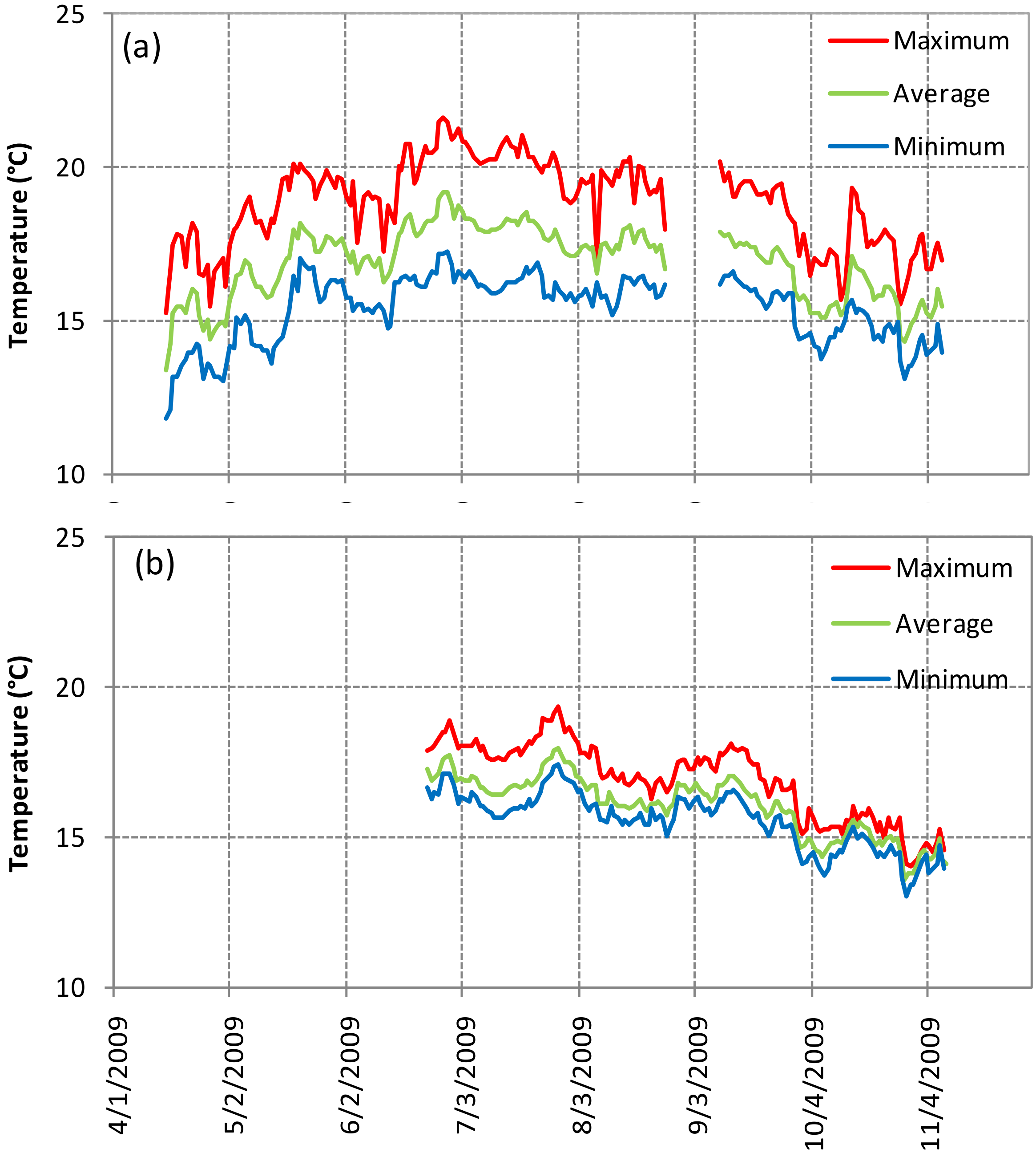


Figure 6: 2009 Long Pool (LSYR-0.51) thermograph maximum, average, and minimum daily values for the (a) surface (1 foot) and (b) bottom units (8 feet); the bottom unit malfunctioned during the first period of the deployment.

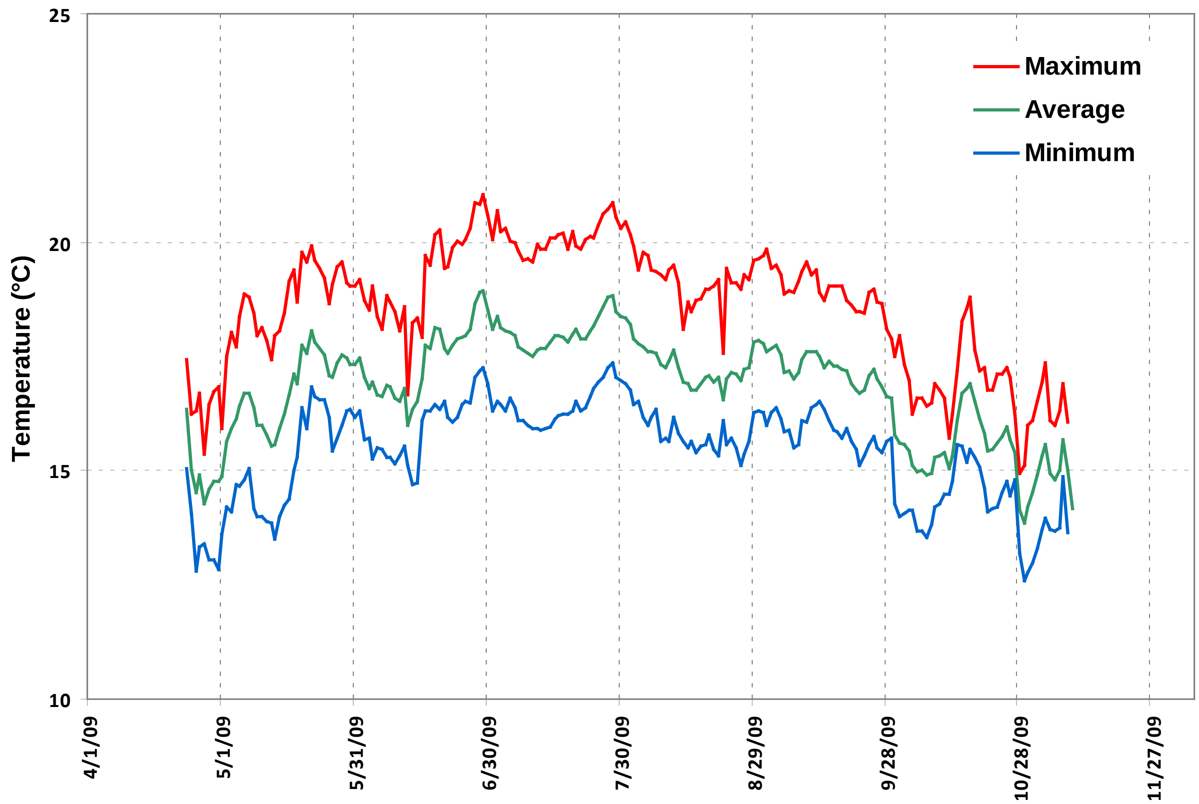


Figure 7: 2009 Reclamation property boundary downstream of the Long Pool.(LSYR-0.52) for thermograph maximum, average, and minimum daily values for the bottom in a shallow pool habitat.

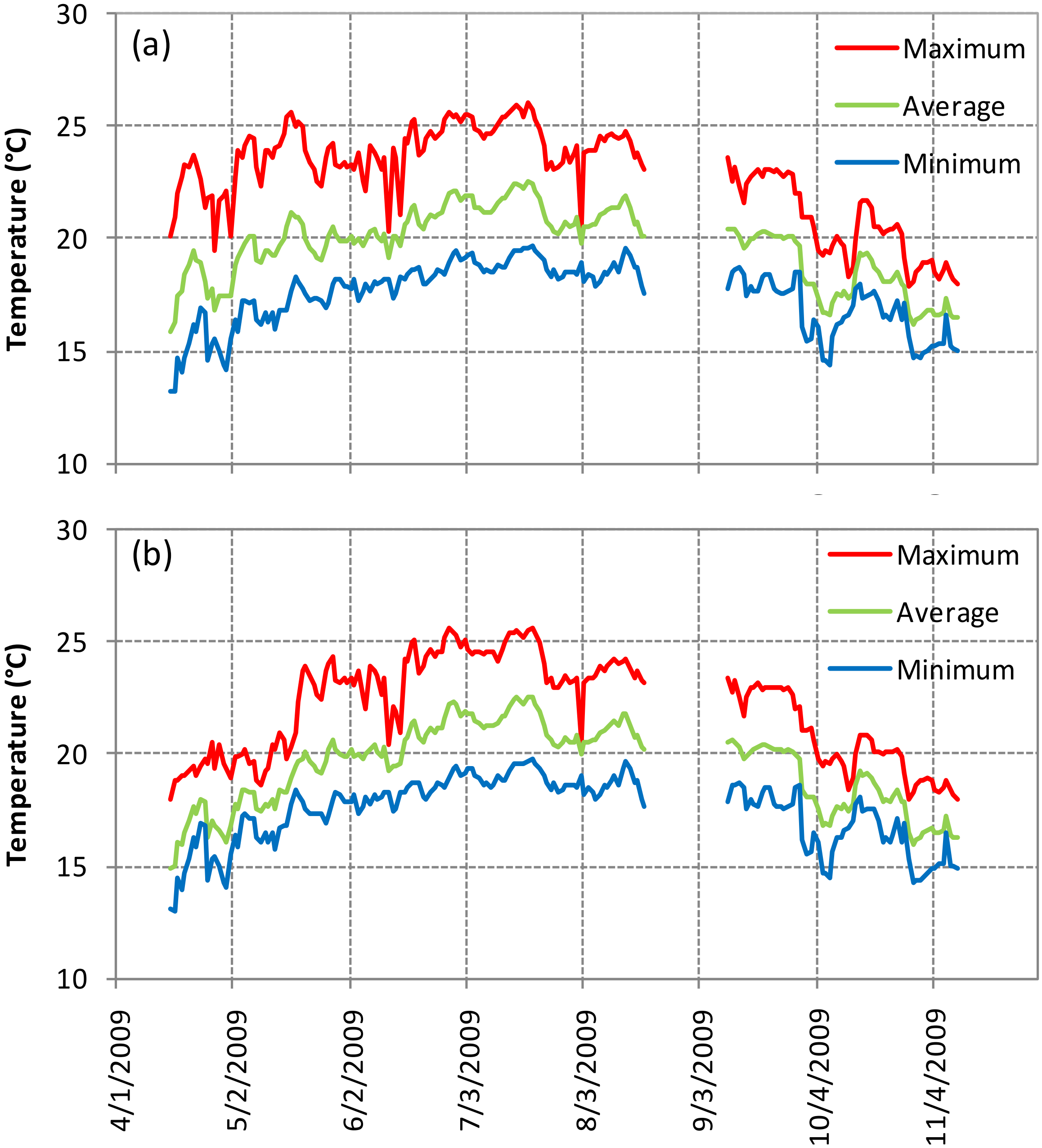


Figure 8: 2009 Encantado Pool (LSYR-4.9) thermograph maximum, average, and minimum daily values for (a) surface (1 foot) and (b) bottom unit (5 feet).

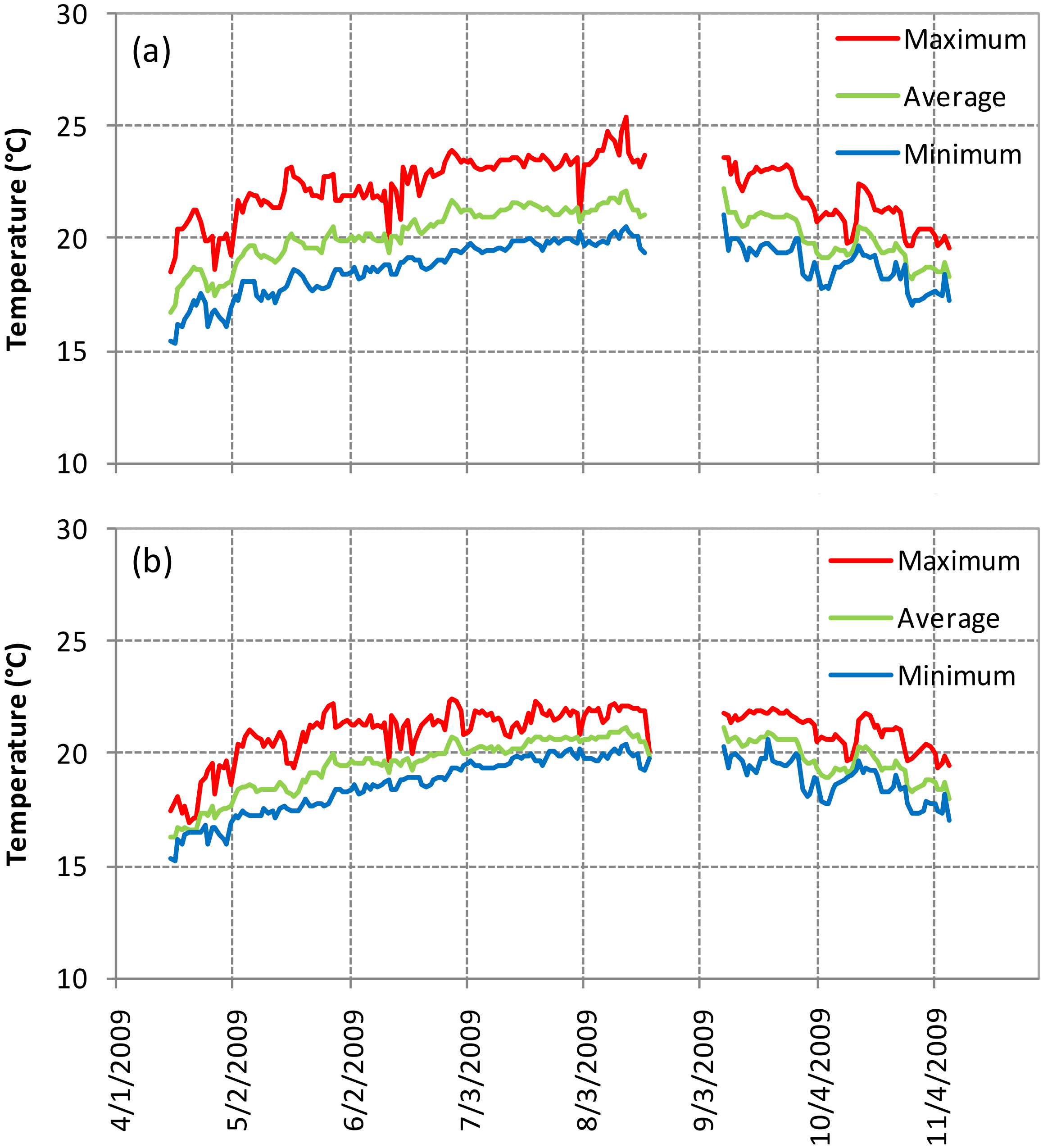


Figure 9: 2009 7.3 Pool (LSYR-7.3) thermograph maximum, average, and minimum daily values for the (a) surface (1 foot) and (b) bottom unit (5 feet).

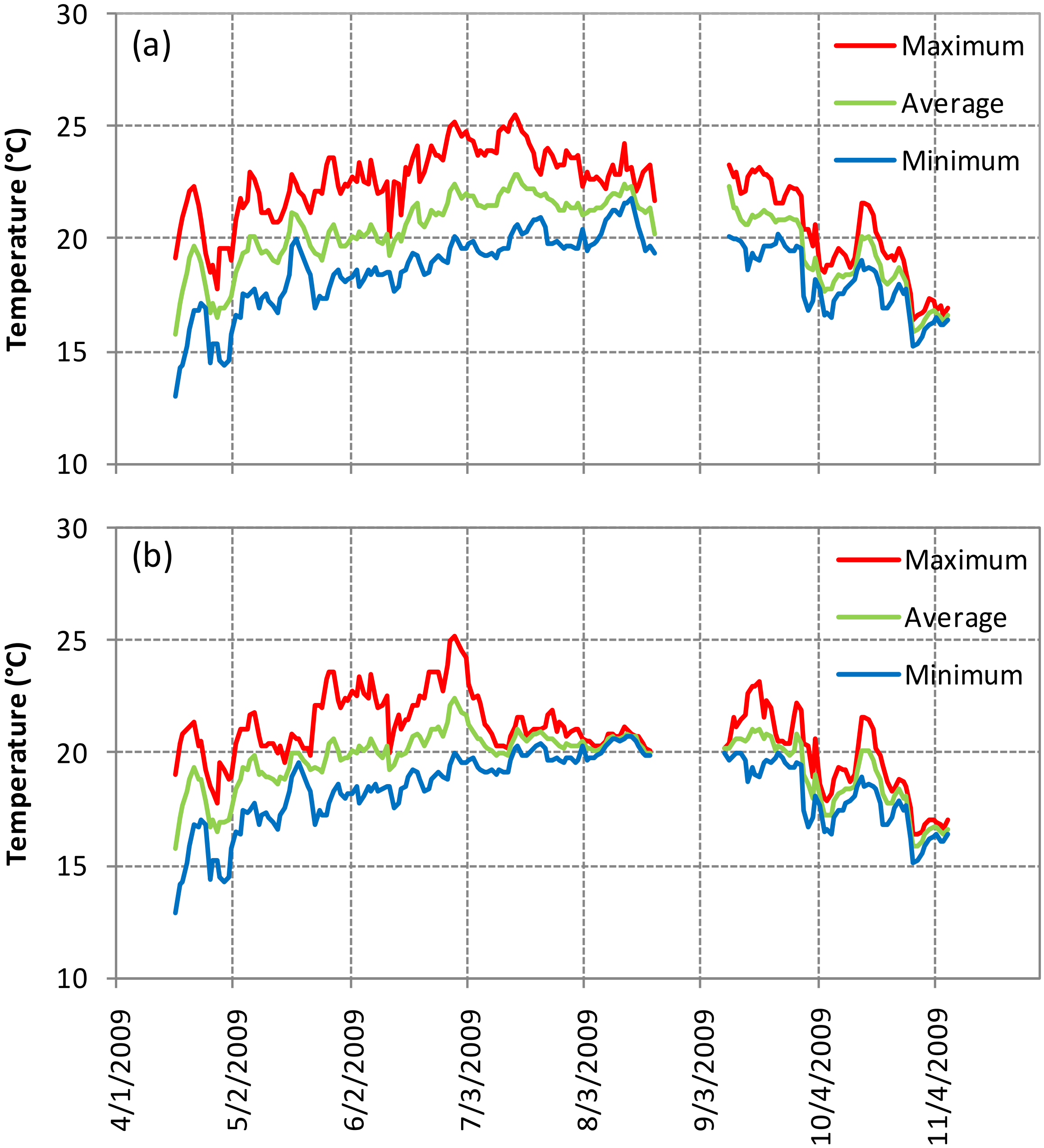


Figure 10: 2009 Alisal Bedrock Pool (LSYR-10.2) thermograph maximum, average, and minimum daily values for the (a) surface (1 foot) and (b) bottom unit (8 feet).

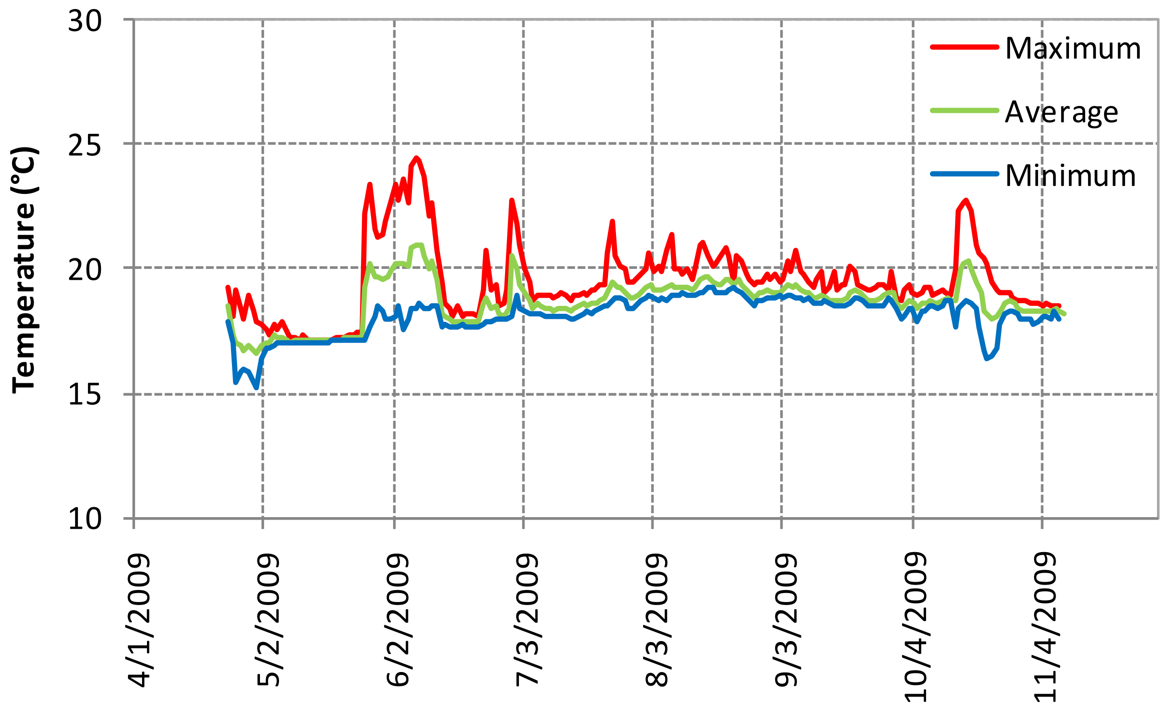


Figure 11: 2009 Avenue of the Flags (LSYR-13.9) thermograph maximum, average, and minimum daily values for the bottom thermograph (3 feet).

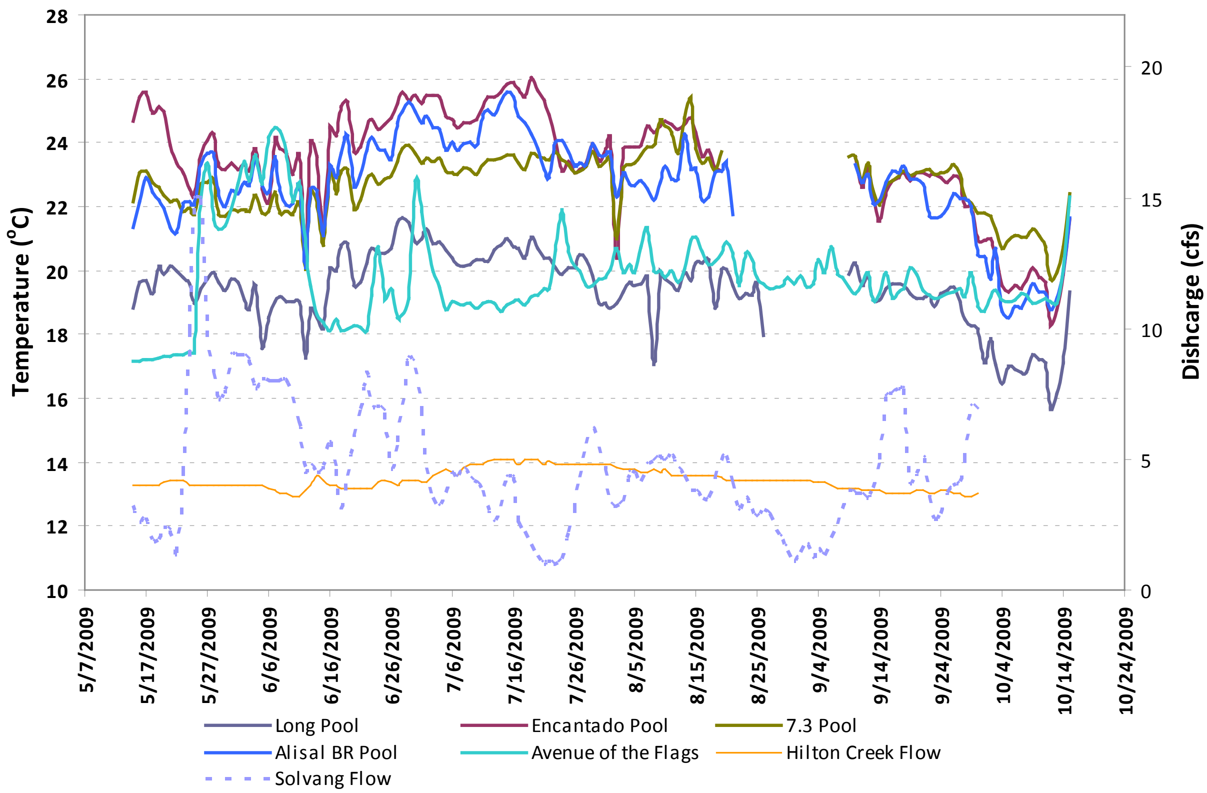


Figure 12: 2009 Longitudinal maximum surface water temperatures at the Long Pool (LSYR-0.5), Encantado Pool (LSYR-4.9), 7.3 Pool (LSYR-7.3), the Alisal Bedrock Pool (LSYR-10.2), and Avenue of the Flags (LSYR-13.9) with daily flow (discharge) at the Hilton Creek and Solvang (near the Alisal Bridge) USGS gauges.

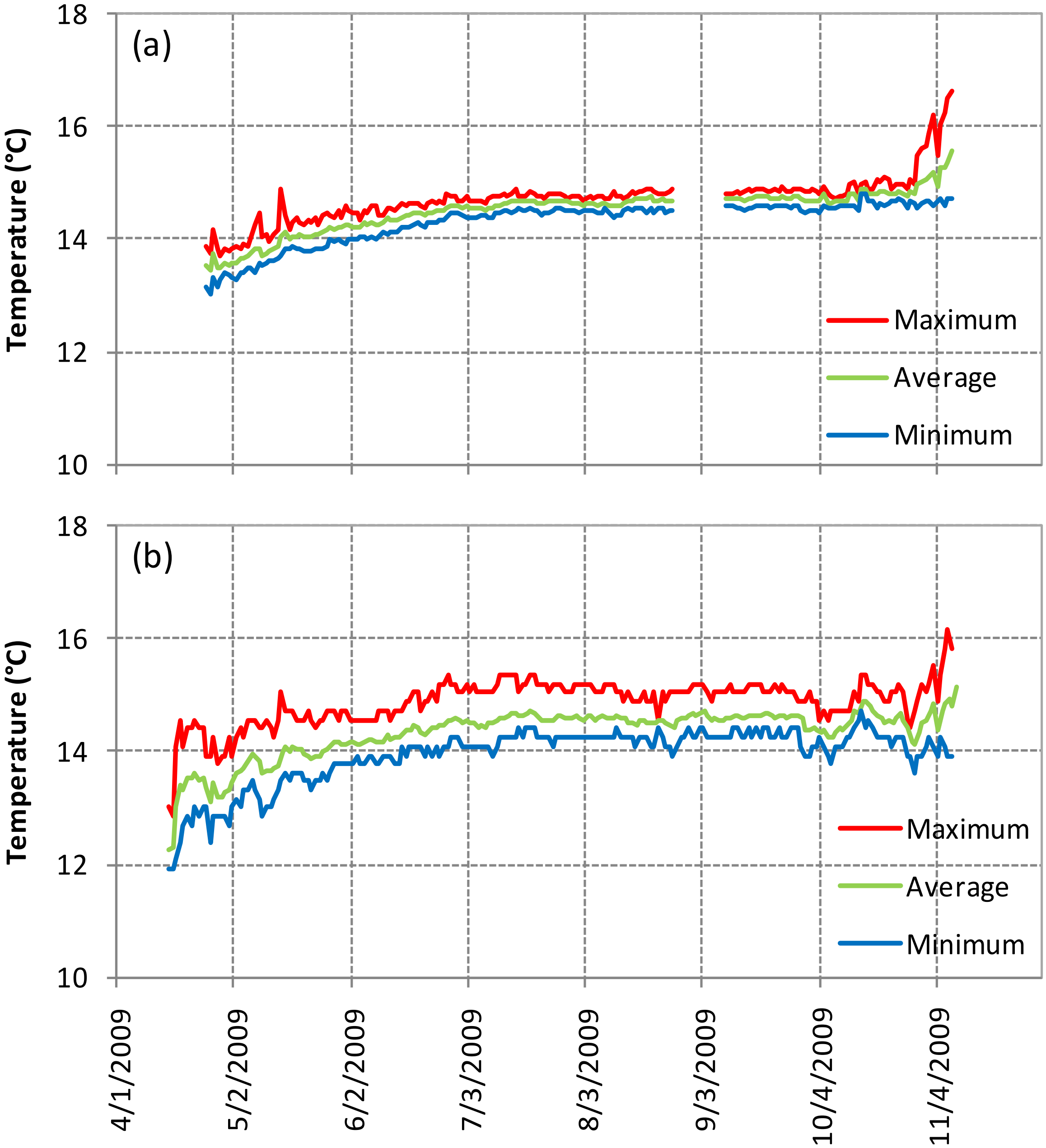


Figure 13: 2009 Thermograph maximum, average, and minimum daily values for the (a) lower Hilton Creek (HC-0.12) and (b) upper Hilton Creek (HC-0.54) temperature units.

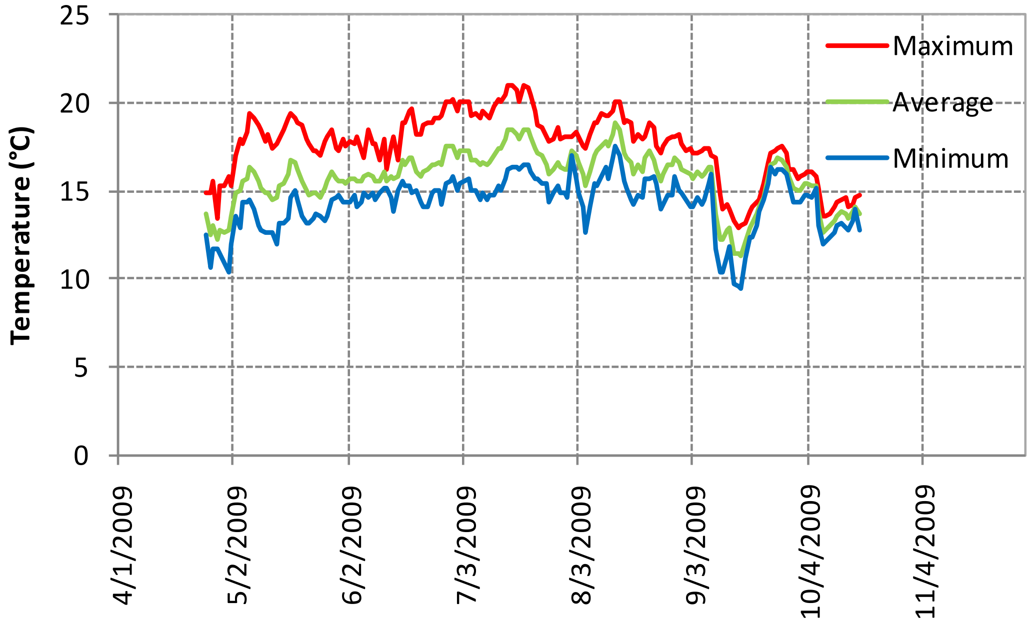


Figure 14: 2009 Thermograph maximum, average, and minimum daily values for the Quiota Creek (QC-2.71) temperature unit.

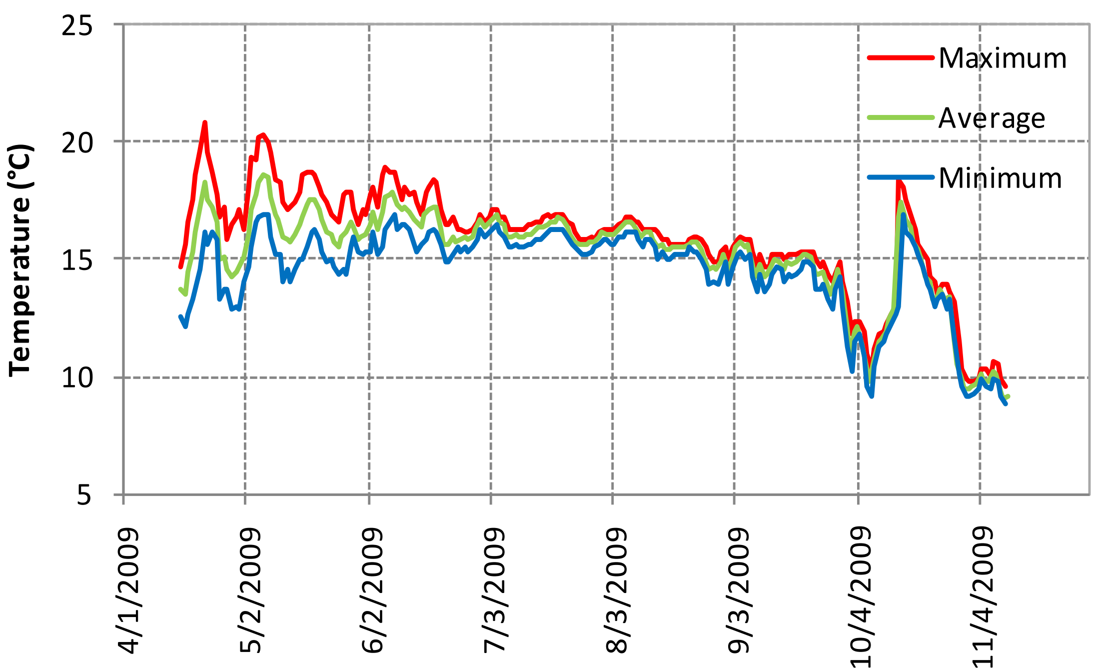


Figure 15: 2009 Thermograph maximum, average, and minimum daily values for El Jaro Creek (EJC-3.81), 50-feet upstream of the confluence with Salsipuedes Creek.

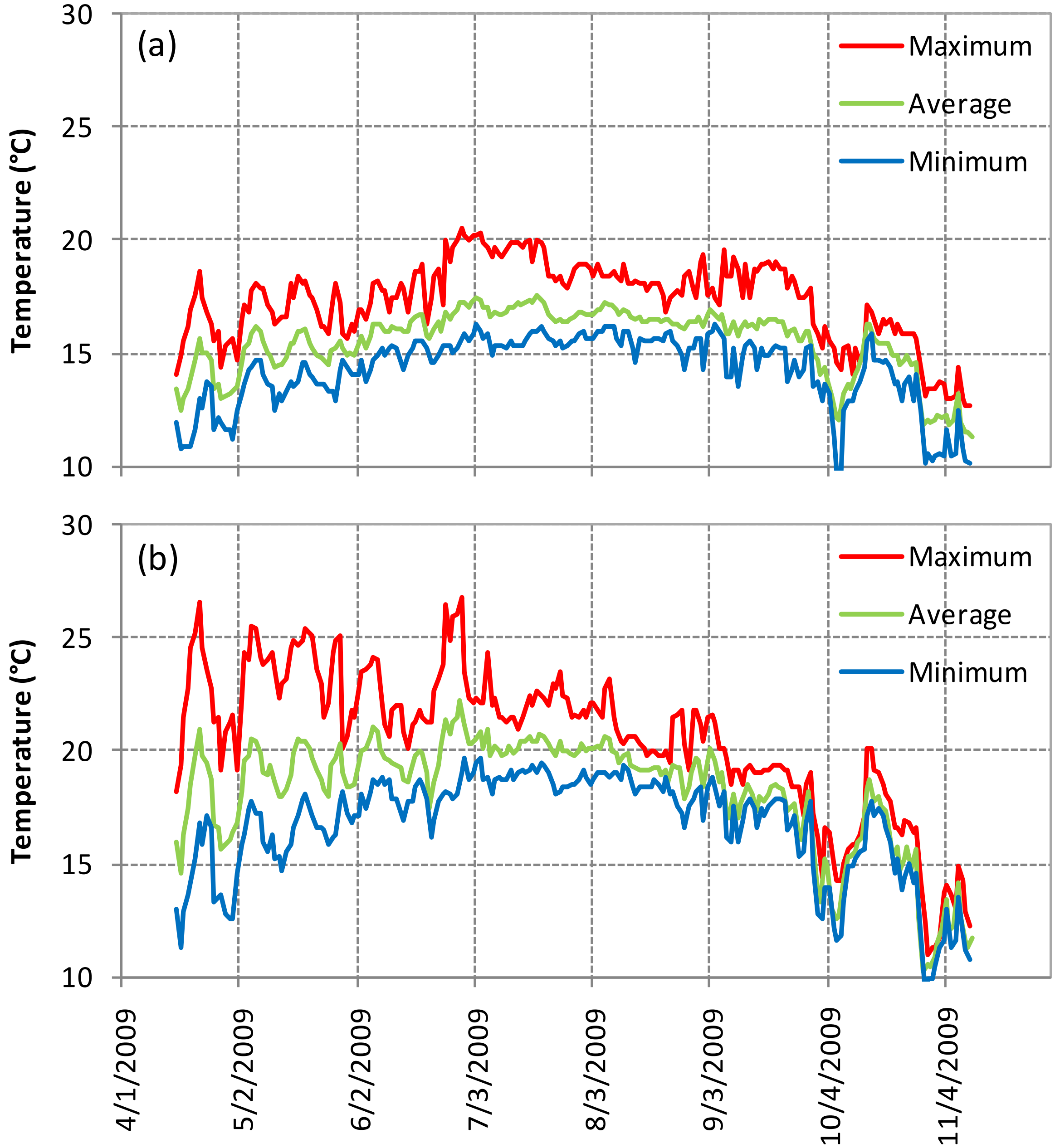


Figure 16: 2009 water temperatures at (a) upper Salsipuedes Creek (SC-3.8), 30 feet upstream of confluence with El Jaro Creek, and (b) lower Salsipuedes Creek (SC-0.77), approximately 200 yards upstream of Santa Rosa Bridge.

Table 6: Water quality sonde deployments during the 2009 dry season.

Habitat	Location	Deployment Dates 5/22-5/27/09	6/2-6/9/09	6/24-7/1/09	7/1-7/7/09	7/14-7/17/09	7/22-7/24/09	7/27-7/31/09	8/10-8/14/09	8/18-8/21/09	9/23-9/28/09	9/28-10/1/09
Pool "Crawdad"	LSYR-7.1	x			x				x			
7.3 Pool	LSYR-7.3	x			x				x			
Downstream of Beaver Dam	LSYR-7.5	x			x				x			
Salsipuedes Ck. below beaver dam	SC-1.15		x	x			x			x		x
Salsipuedes Ck. within beaver dam	SC-1.20		x	x			x			x		x
Salsipuedes Ck. above beaver dam	SC-1.25		x	x			x			x		x
Tail-out of Stilling Basin	LSYR-0.4					x		x			x	
100' upstream of ford crossing	LSYR-0.45					x		x			x	
Lower Hilton Creek	HC-0.12					x		x			x	

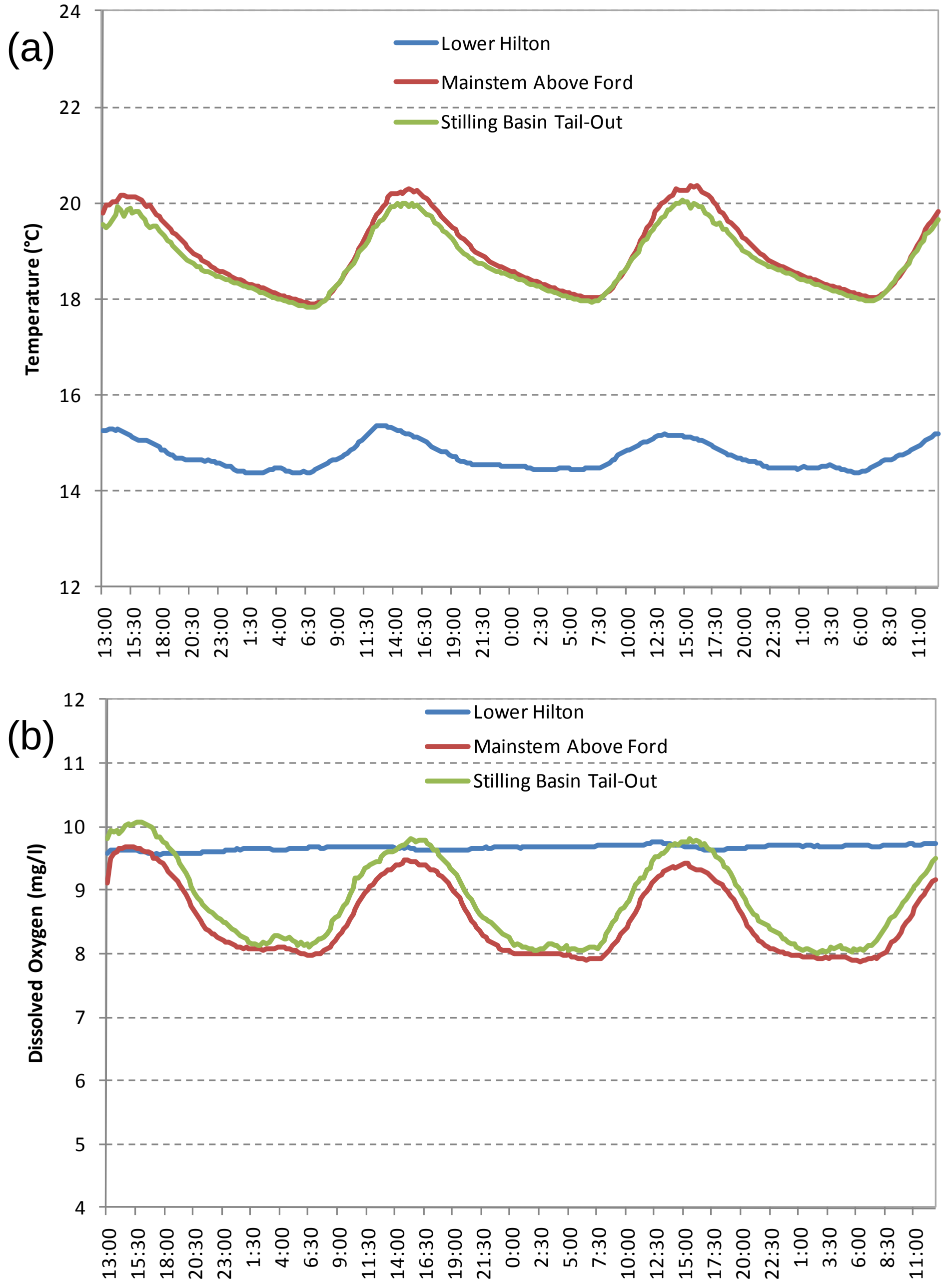


Figure 17: LSYR Hwy 154 Reach at the historic road crossing 100 feet upstream of the ford crossing (LSYR-0.45) and the tail-out of the Stilling Basin (LSYR-0.4) in comparison to the lower Hilton (HC-0.12) sonde deployments from 7/14/09 through 7/17/09 (beginning and end days are partial days) for (a) temperature and (b) dissolved oxygen.

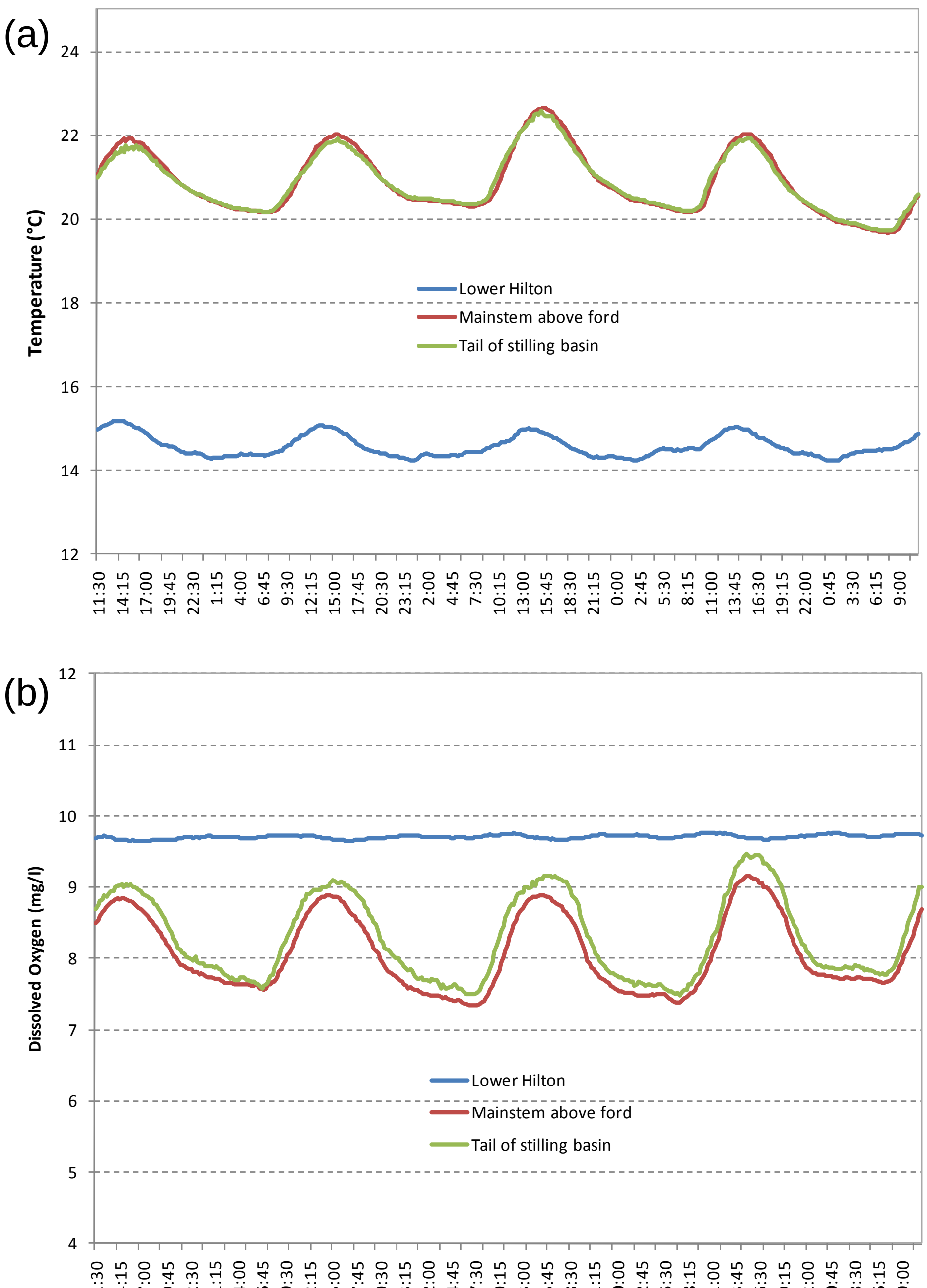


Figure 18: LSYR Hwy 154 Reach at the historic road crossing 100 feet upstream of the ford crossing (LSYR-0.45) and the tail-out of the Stilling Basin (LSYR-0.4) in comparison to the lower Hilton (HC-0.12) sonde deployments from 7/29/09 through 7/31/09 (beginning and end days are partial days) for (a) temperature and (b) dissolved oxygen.

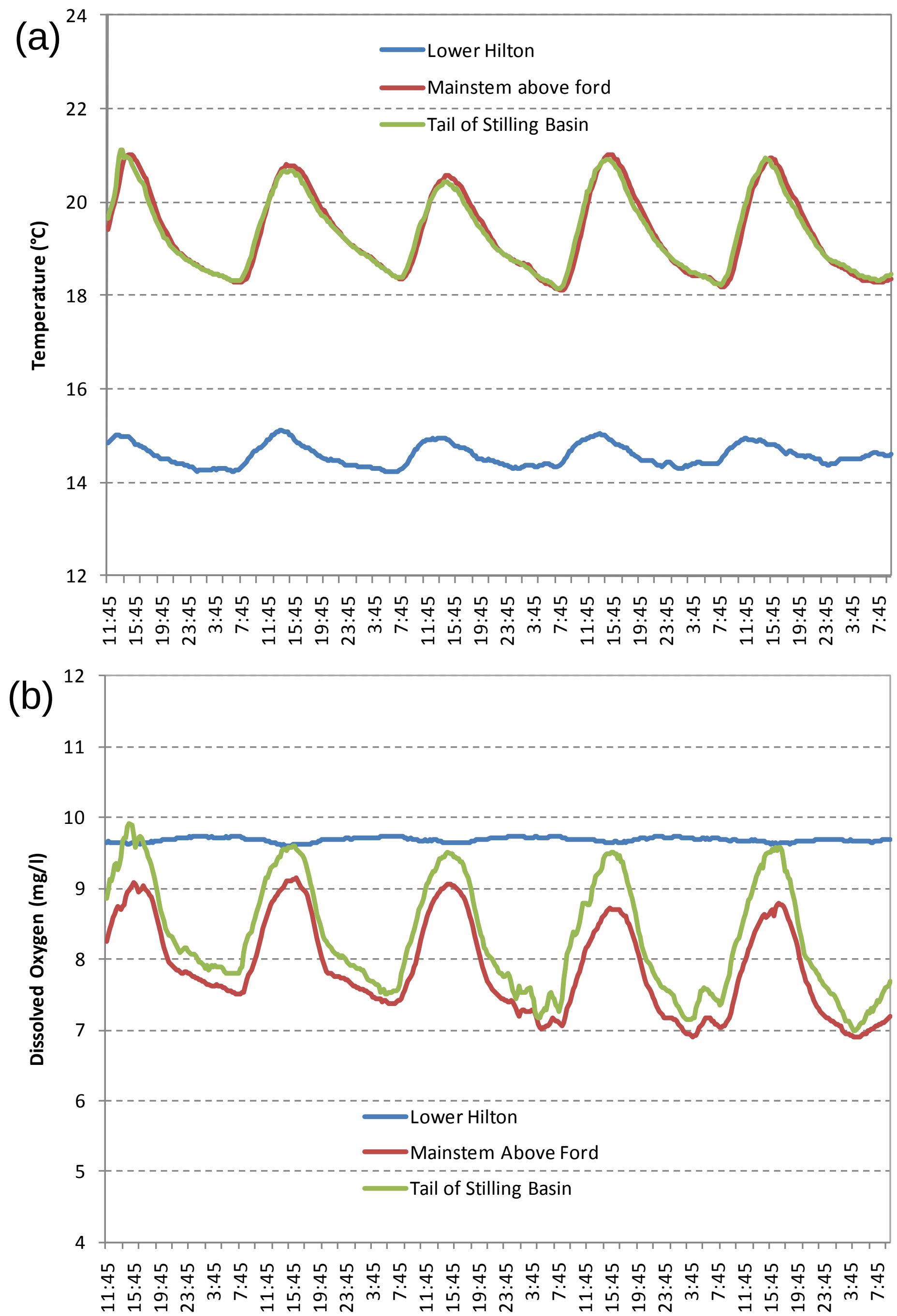


Figure 19: LSYR Hwy 154 Reach at the historic road crossing 100 feet upstream of the ford crossing (LSYR-0.45) and the tail-out of the Stilling Basin (LSYR-0.4) in comparison to the lower Hilton (HC-0.12) sonde deployments from 9/23/09 through 9/28/09 (beginning and end days are partial days) for (a) temperature and (b) dissolved oxygen.

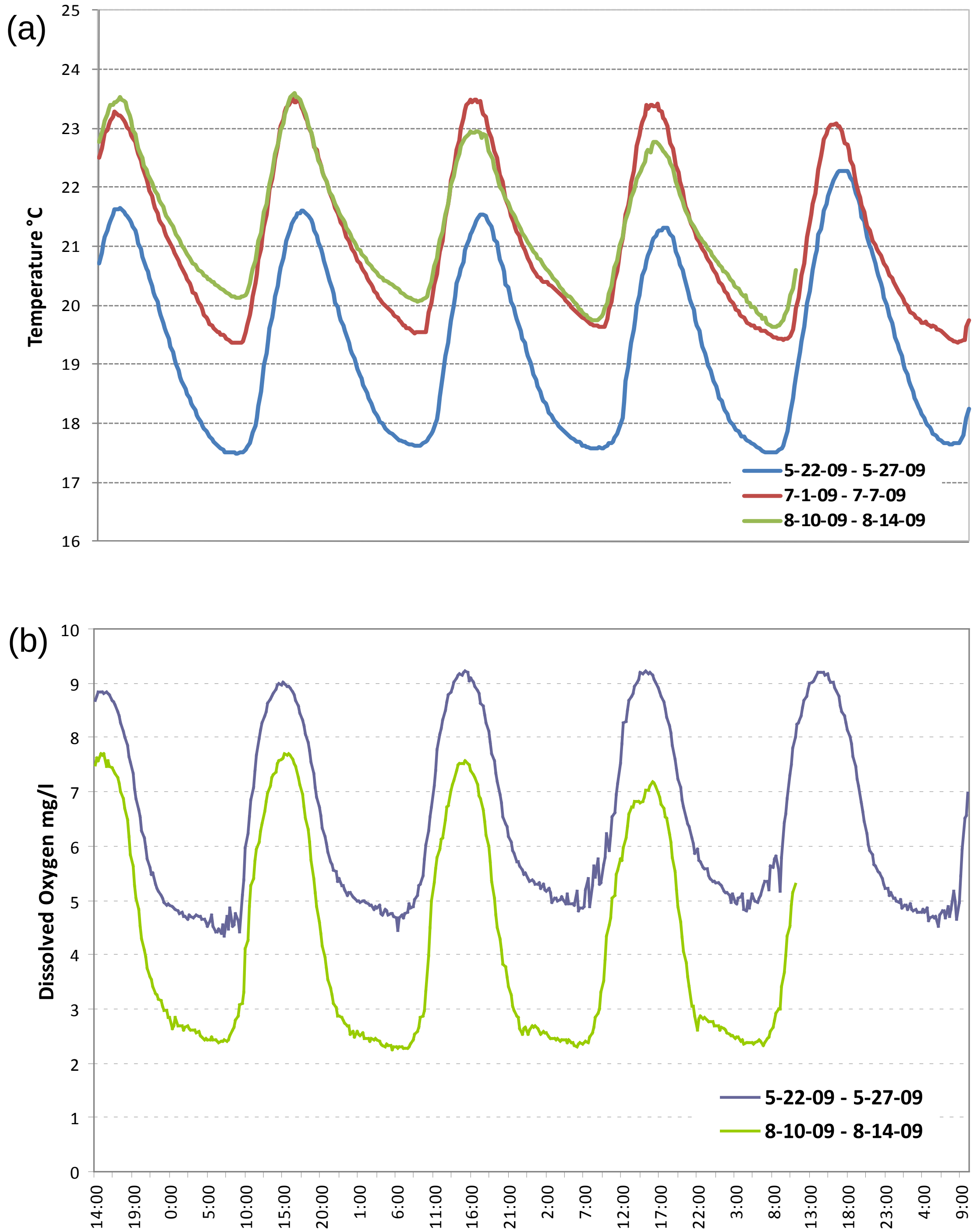


Figure 20: LSYR 7.3 Pool diel (a) water temperature and (b) dissolved oxygen concentrations during 3 deployments in May, July, and August matched up at the same start time.

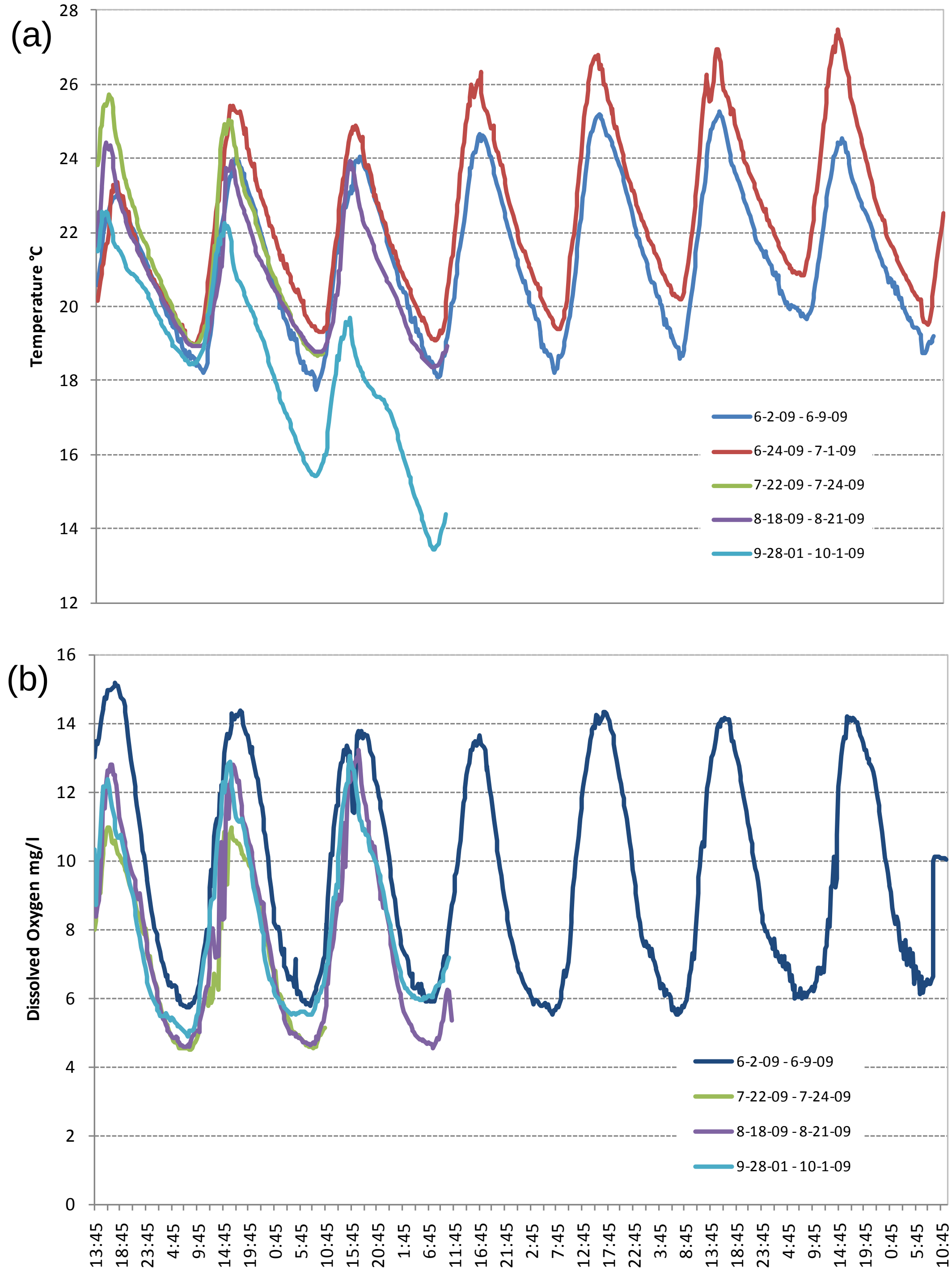


Figure 21: Salsipuedes Creek beaver pool (SC-1.2) diel (a) water temperature and (b) dissolved oxygen

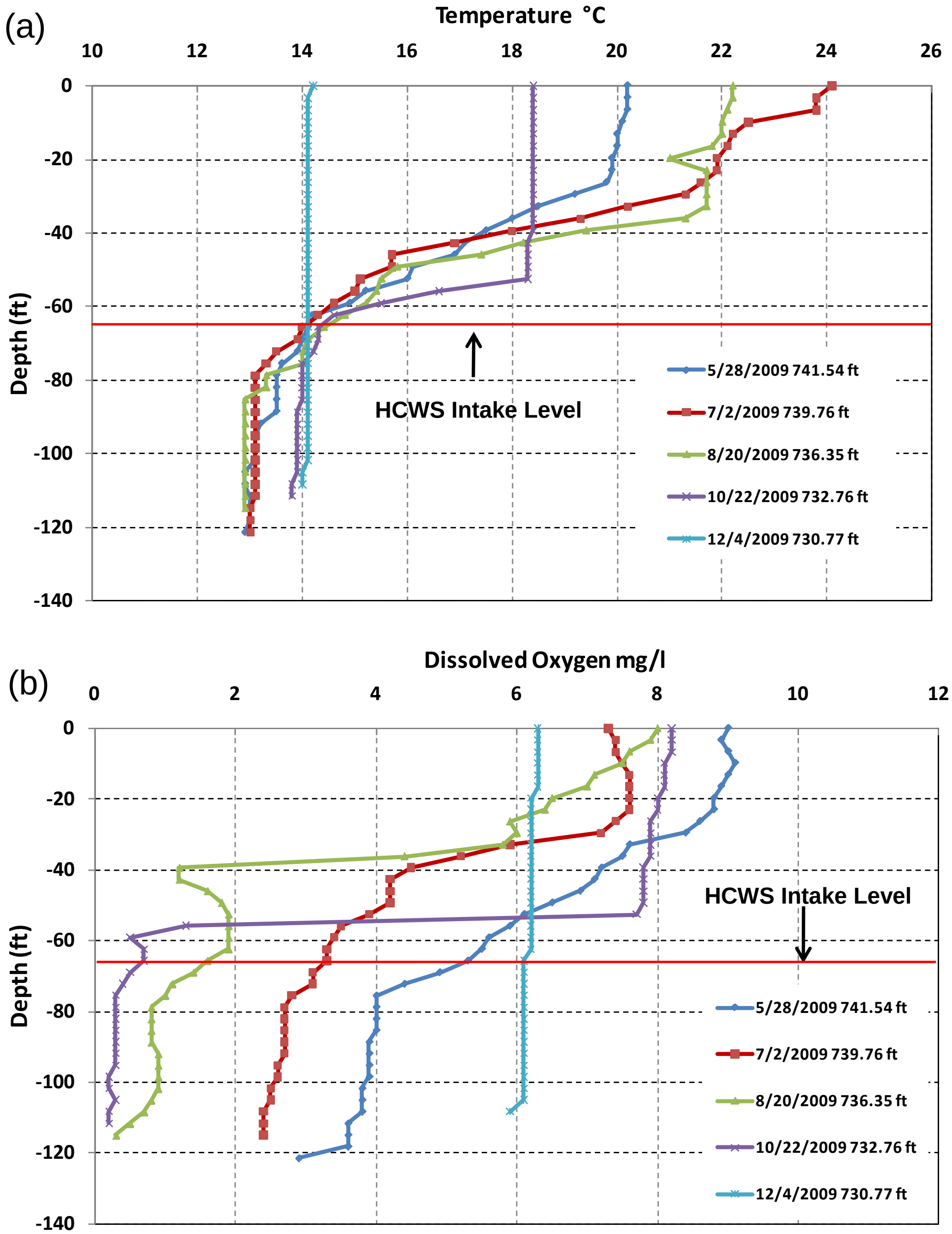


Figure 22: Lake Cachuma water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS. HCWS intake hose level was set at 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

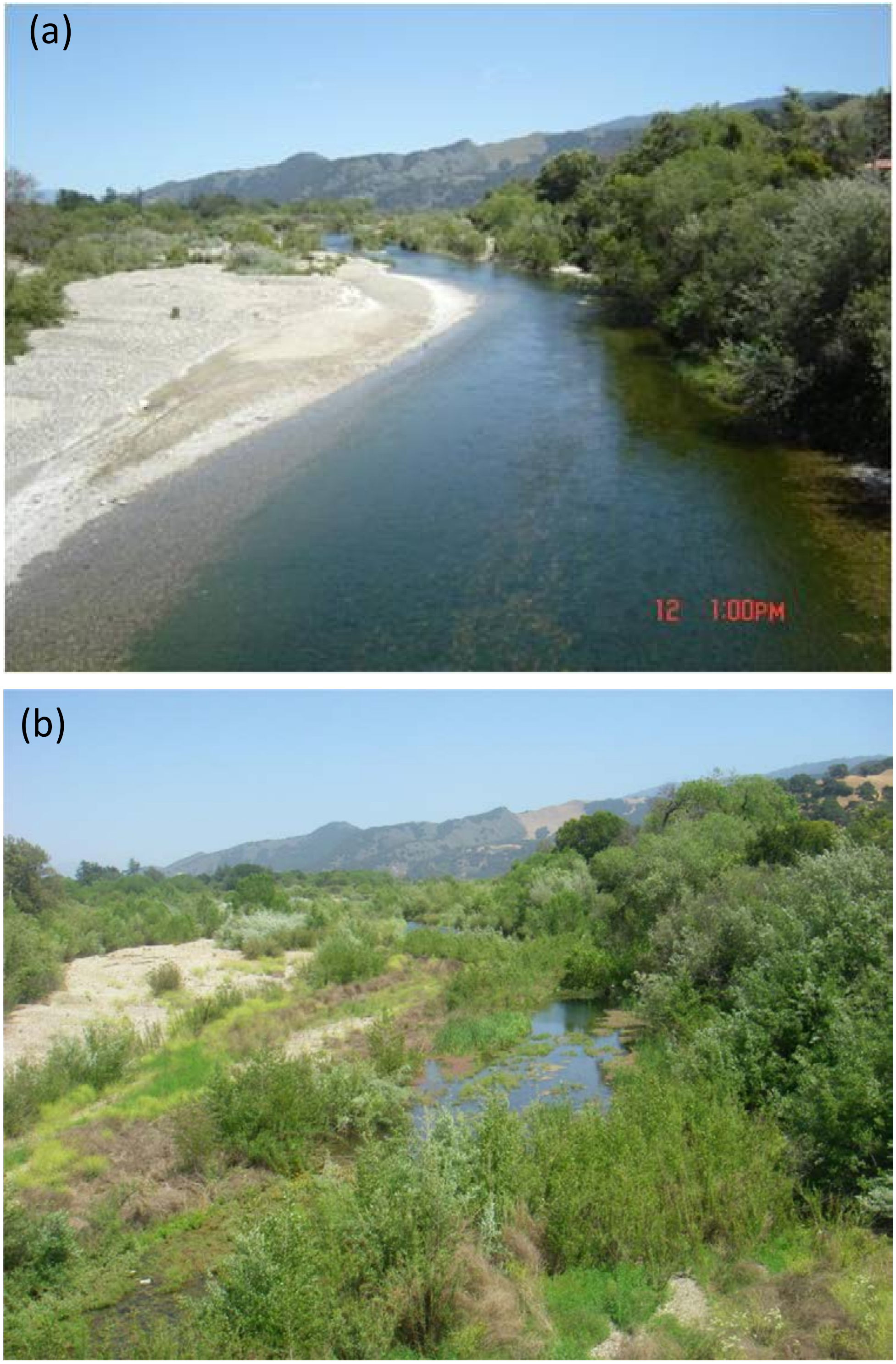


Figure 23: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) May 2009.

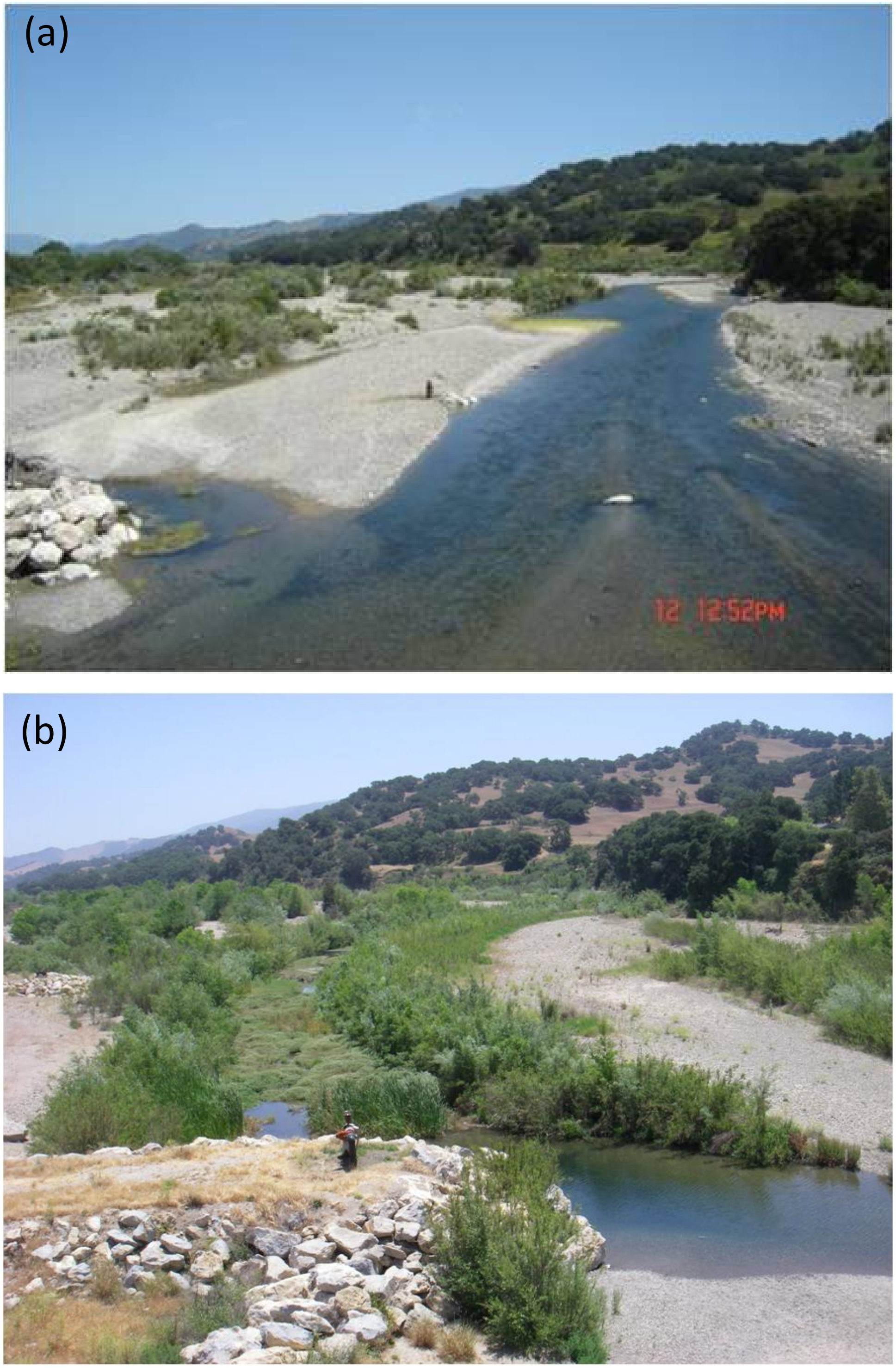


Figure 24: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) May 2009.

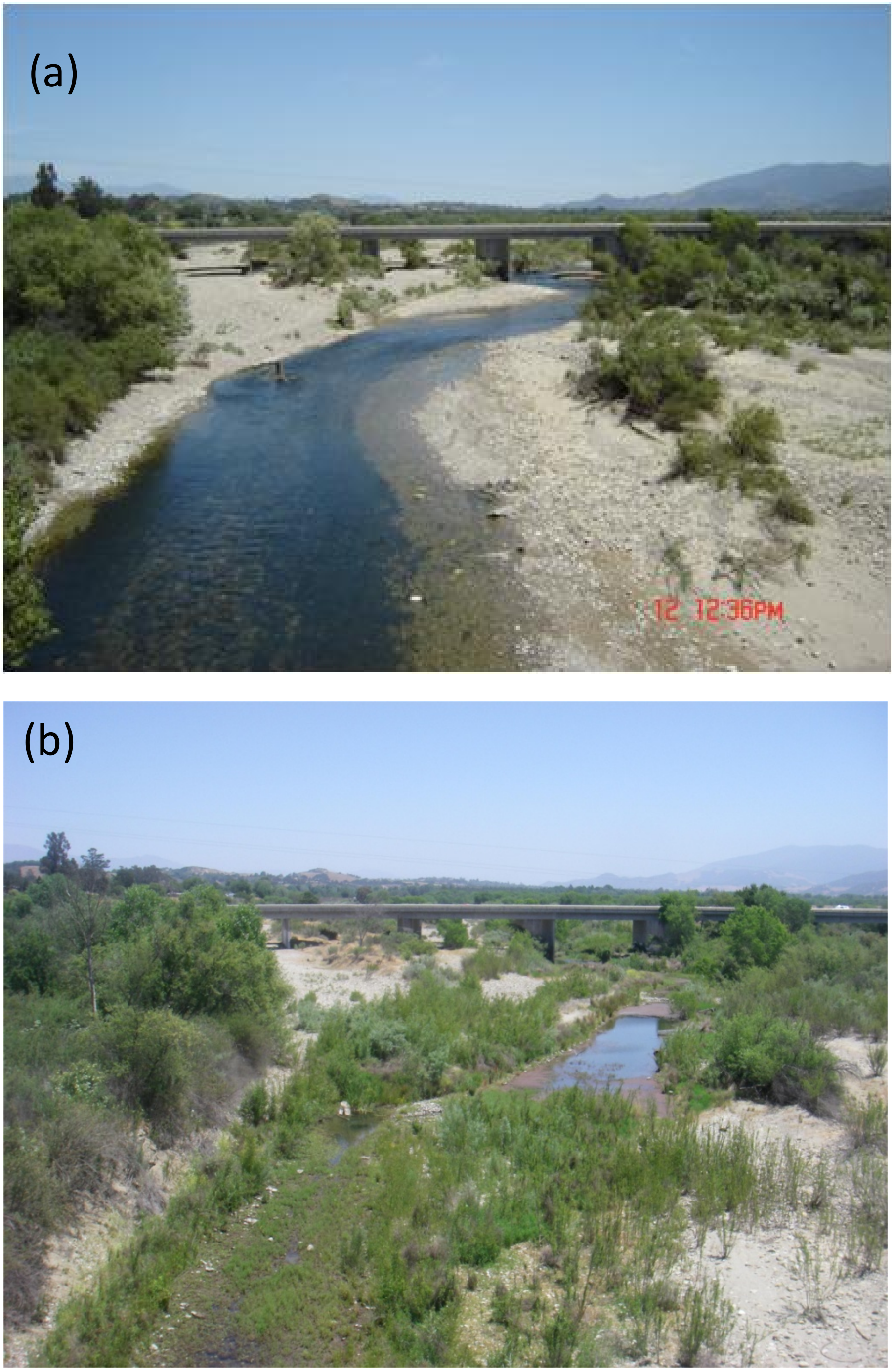


Figure 25: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) May 2009.

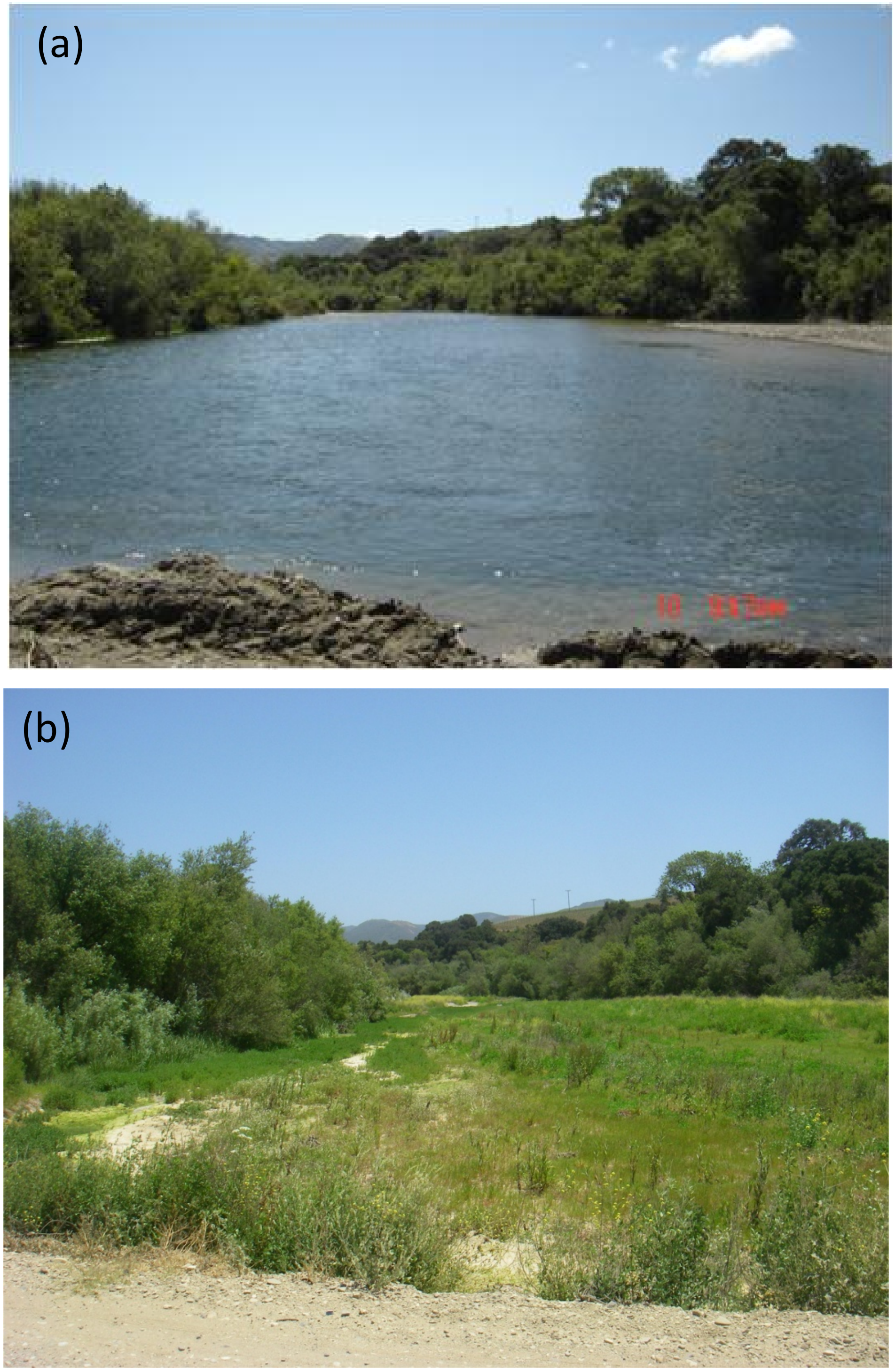


Figure 26: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) May 2009.

Figure 27: Photo point (M-22) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) May 2009.

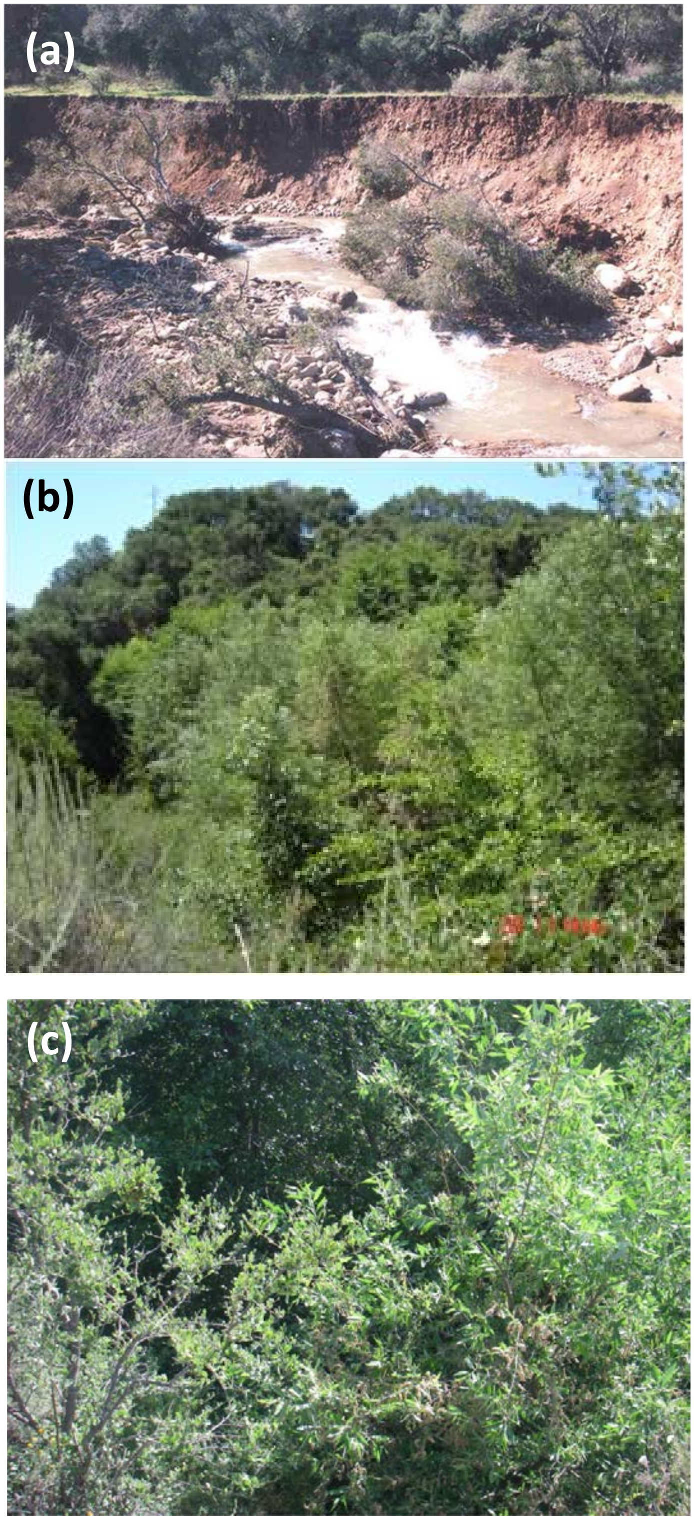


Figure 28: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) May 2009.

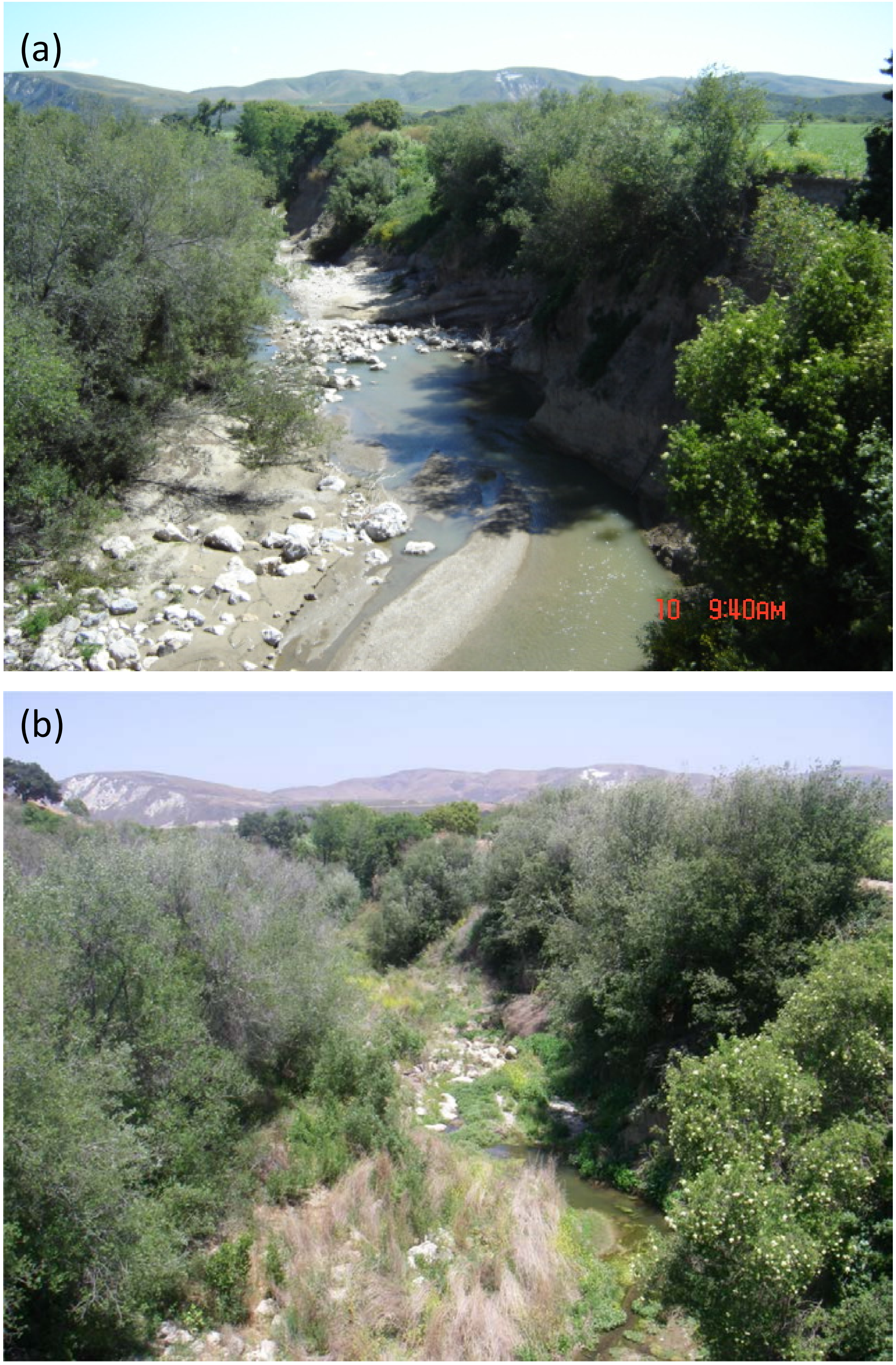


Figure 29: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) May 2009.

Figure 30: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) November 2008; no photo point was taken in WY2009.

Figure 31: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) November 2008; no photo point was taken in WY2009.

3.4 Migrant Trapping

Table 7: WY2009 migrant trap deployments.

Location	Date Traps Deployed (dates)	Date Trap Removed (dates)	Date Traps Removed (storm event) (dates)	Date Traps Installed (post storm event) (dates)	# of Days Not Trapping (days)
Hilton	1/19/2009	5/9/2009	2/13/2009	2/15/2009	2
				Total:	2
Salsipuedes	1/27/2009	5/9/2009	2/13/2009	2/15/2009	2
				Total:	2
Mainstem	2/17/2009	5/9/2009			0
				Total:	0

Table 8: WY2009 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	118	304	110	112	98.2	1.07	2.76	3.84	4.0
Salsipuedes	13	174	102	104	98.1	0.13	1.71	1.83	2.0
Mainstem	0	3	81	81	100.0	0.00	0.04	0.04	9.5

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

Table 9: Number of migrant captures associated with each trap check over 24-hours in WY2009.

Location	Trap	Trap Check 1st AM	2nd AM	1st PM	2nd PM	Total
Salsipuedes	Upstream	2	0	3	8	13
	Downstream	34	2	78	60	174
	Total:	36	2	81	68	187
Mainstem	Upstream	0	0	0	0	0
	Downstream	1	0	0	2	3
	Total:	1	0	0	2	3
Hiton	Upstream	44	12	18	44	118
	Downstream	99	13	78	114	304
	Total:	143	25	96	158	422

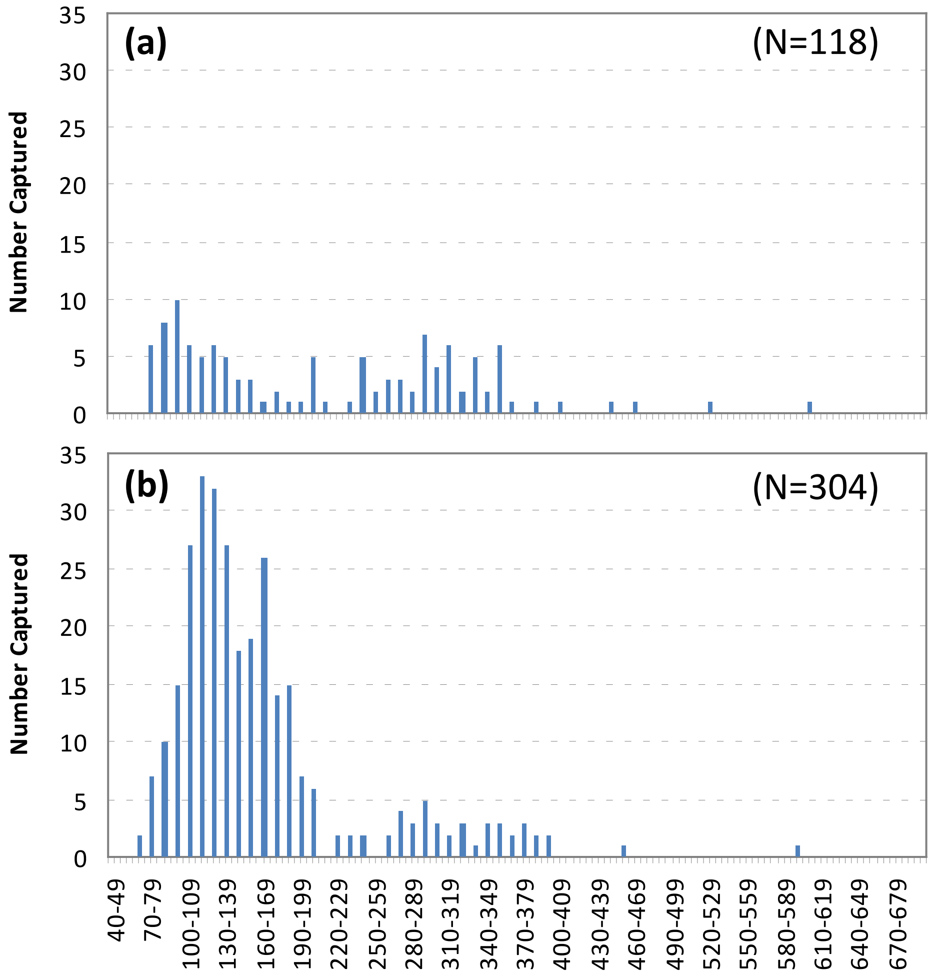


Figure 32: WY2009 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

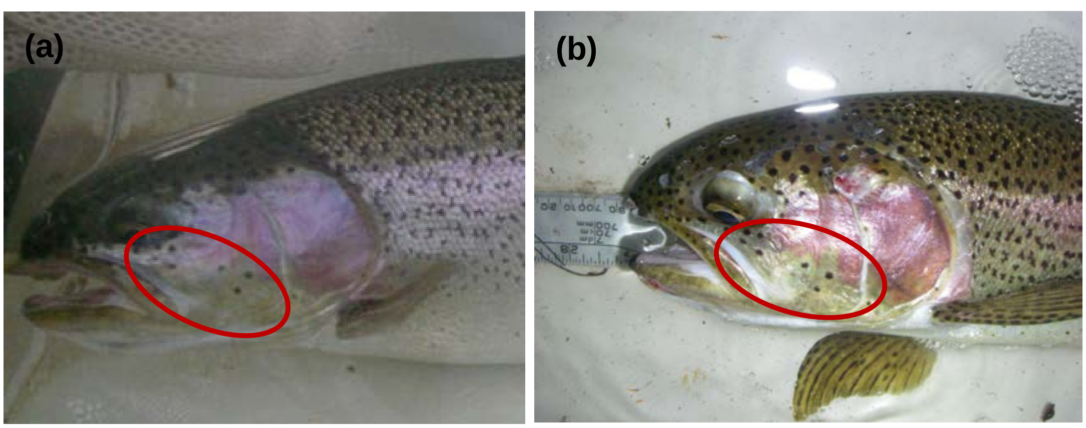


Figure 33: Steelhead migrant capture at Hilton Creek during WY2008 on (a) 3/5/08 and WY2009 on (b) 3/22/11 with an identical operculum spot configuration between the two captures.

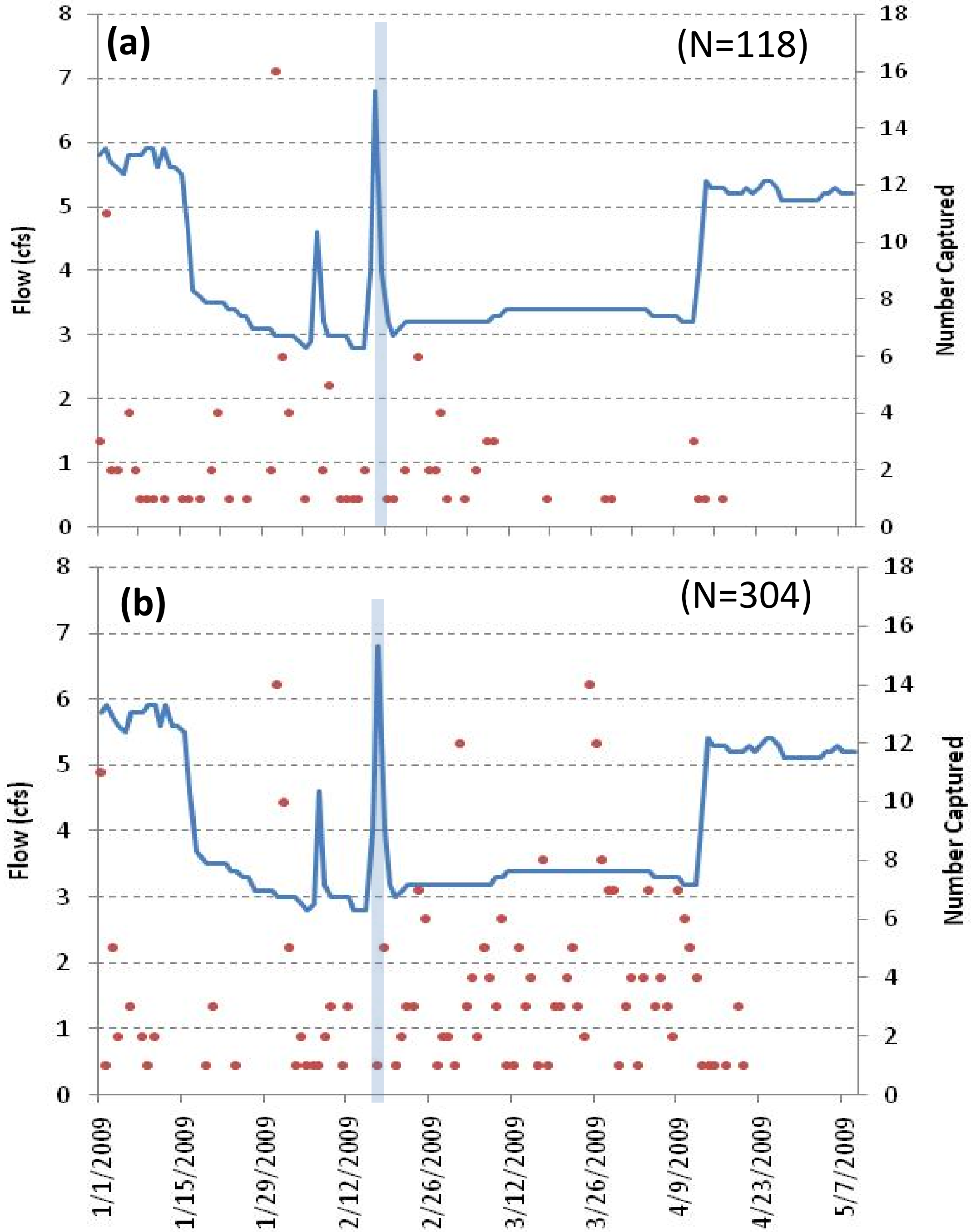


Figure 34: WY2009 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

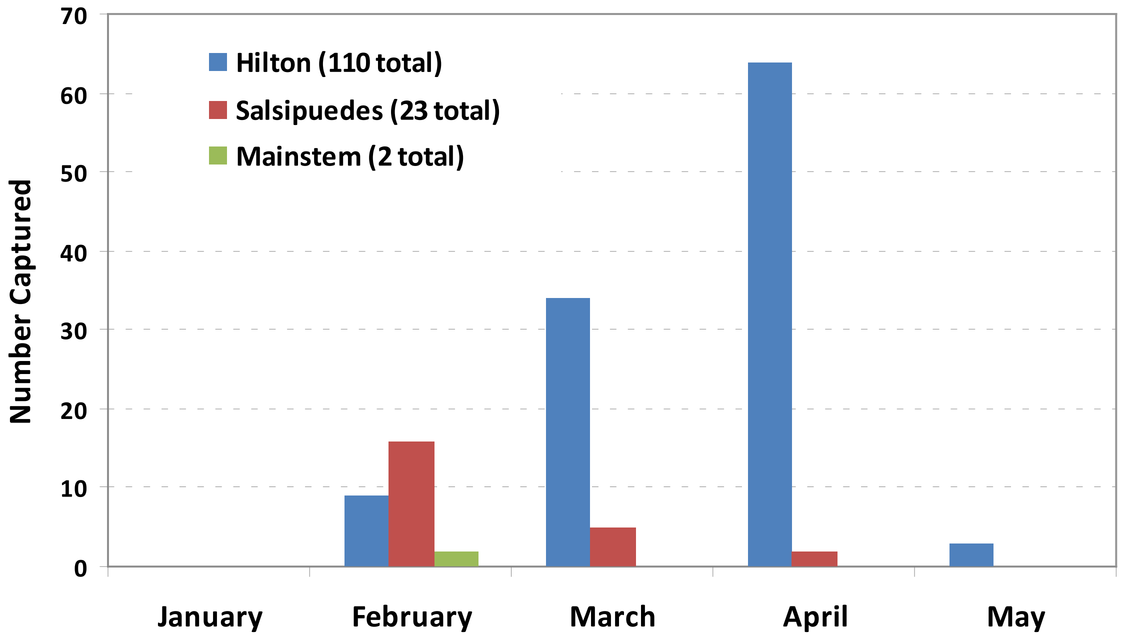


Figure 35: Timing of smolt migration observed at the Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps in WY2009.

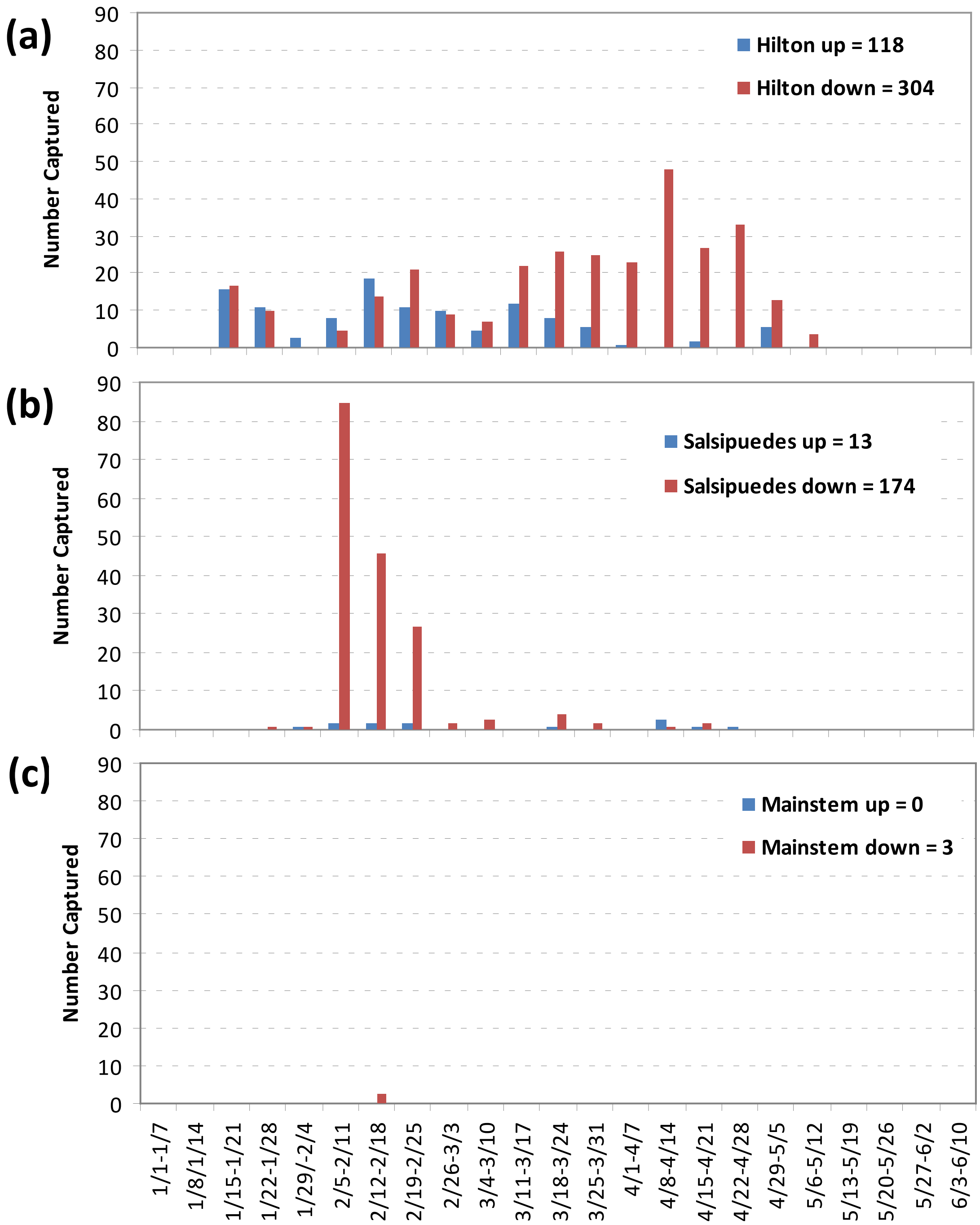


Figure 36: WY2009 paired histogram of weekly upstream and downstream captures by trap site for: (a) Hilton Creek, (b) Salsipuedes Creek, and (c) LSYR Mainstem.

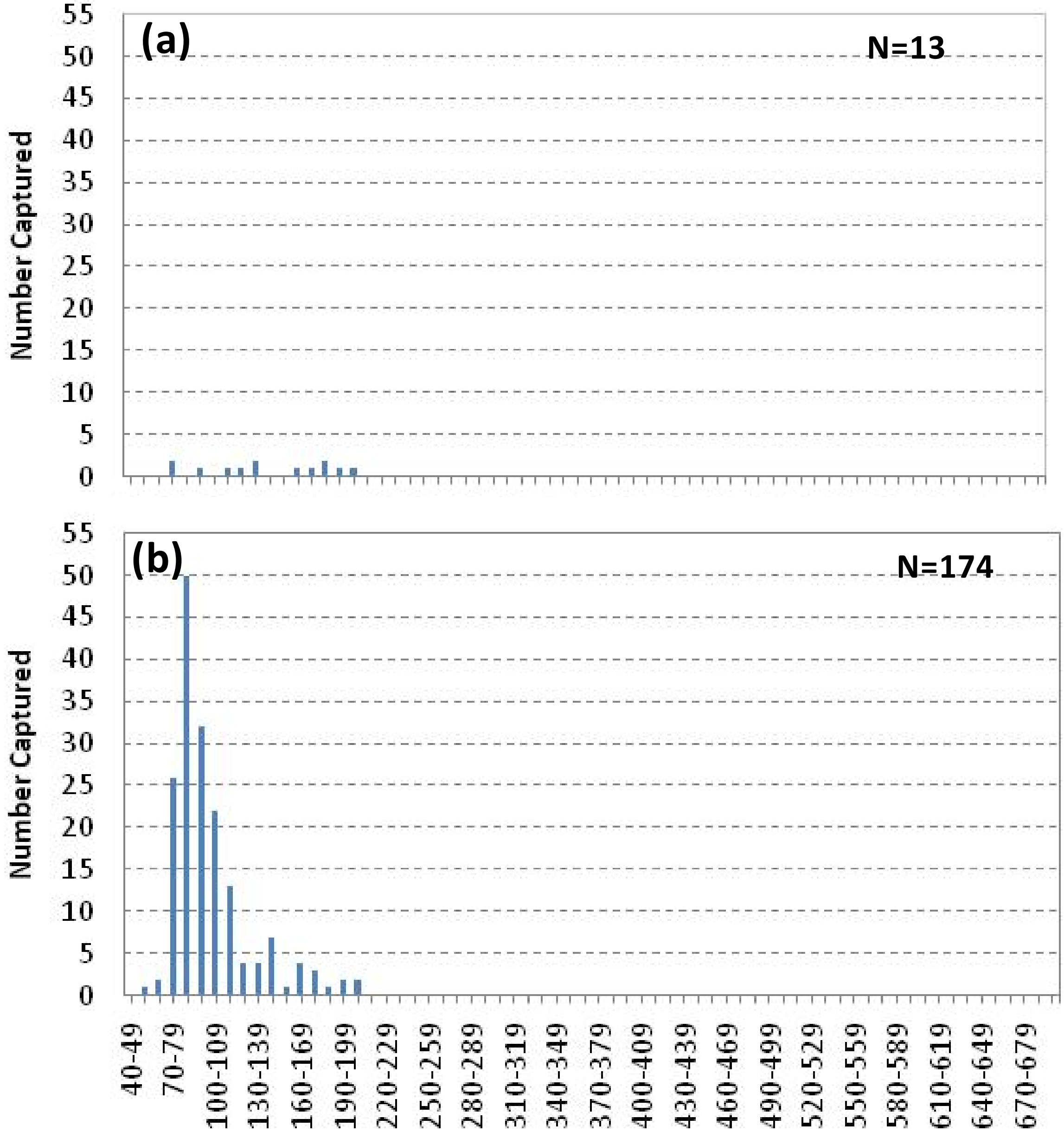


Figure 37: WY2009 Salsipuedes Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

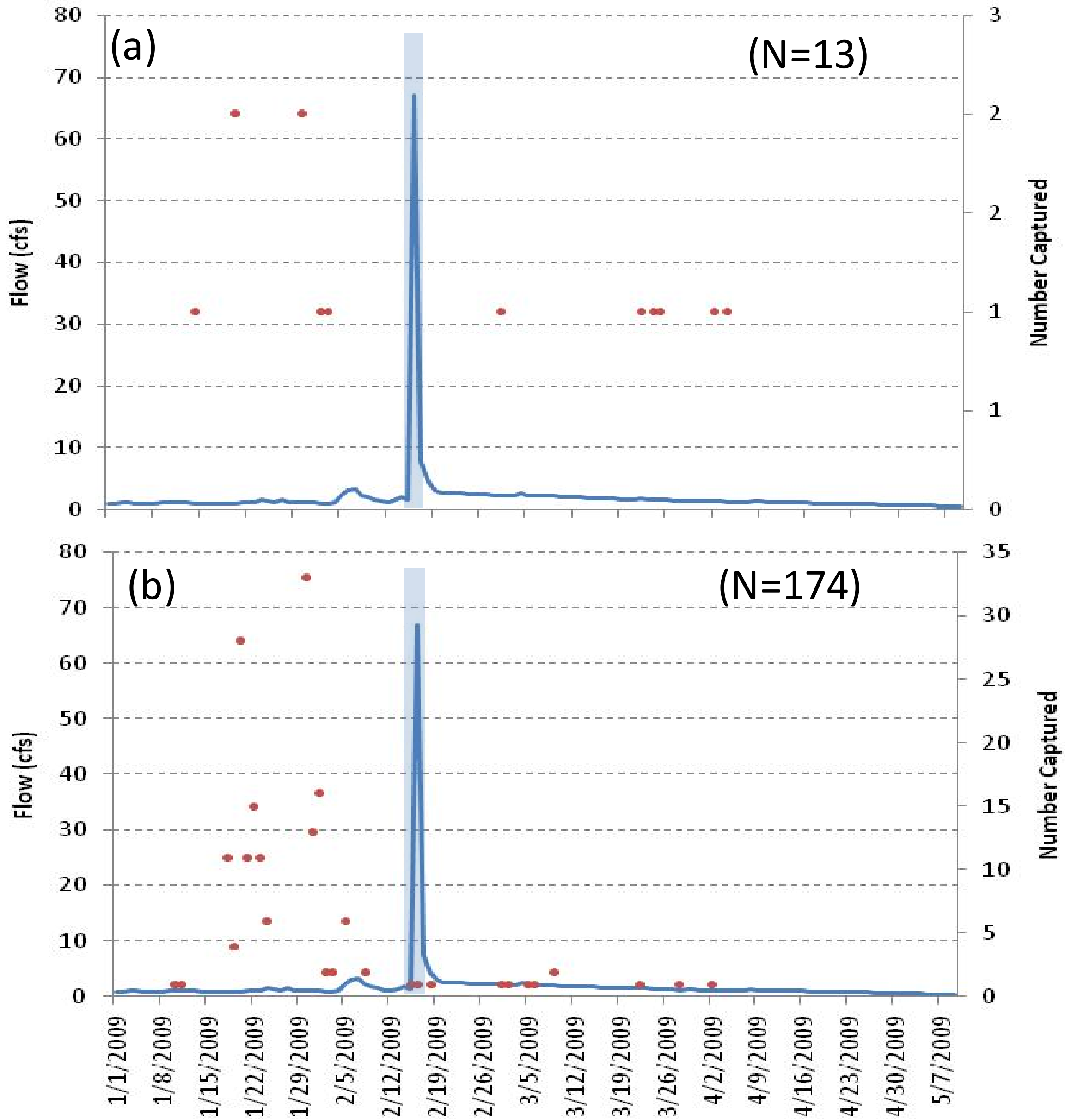


Figure 38: WY2009 Salsipuedes Creek migrant captures (red dots) vs. flow for (a) upstream and (b) downstream migrants. The blue rectangles bracket times when migrant traps were removed due to storm events.

Table 10: Tributary upstream and downstream migrant captures for Hilton and Salsipuedes Creeks in WY2009. Blue lettering represents breakdown of smolts, pre-smolts, and resident trout for each size category; there were 110 and 23 smolts and pre-smolts observed at Hilton and Salsipuedes traps, respectively.

Hilton Captures (#)	Size (mm)	Salsipuedes Captures (#)
	Upstream Traps	
0	>700	0
0	650-699	0
1	600-649	0
0	550-599	0
1	500-549	0
1	450-499	0
2	400-450	0
27	300-399	0
29	200-299	1
33	101-199	9
24	<100	3
118	**Total**	**13**
	Downstream Traps	
0	>700	0
0	650-699	0
0	600-649	0
1	550-599	0
0	500-549	0
1	450-499	0
0	400-449	0
23	300-399	0
26	200-299	2
7	*Smolts*	*1*
0	*Pre-Smolt*	*0*
19	*Res*	*1*
219	101-199	61
72	*Smolts*	*16*
31	*Pre-Smolt*	*5*
116	*Res*	*40*
34	<100	111
0	*Smolts*	*0*
0	*Pre-Smolt*	*1*
34	*Res*	*110*
304	**Total**	**174**

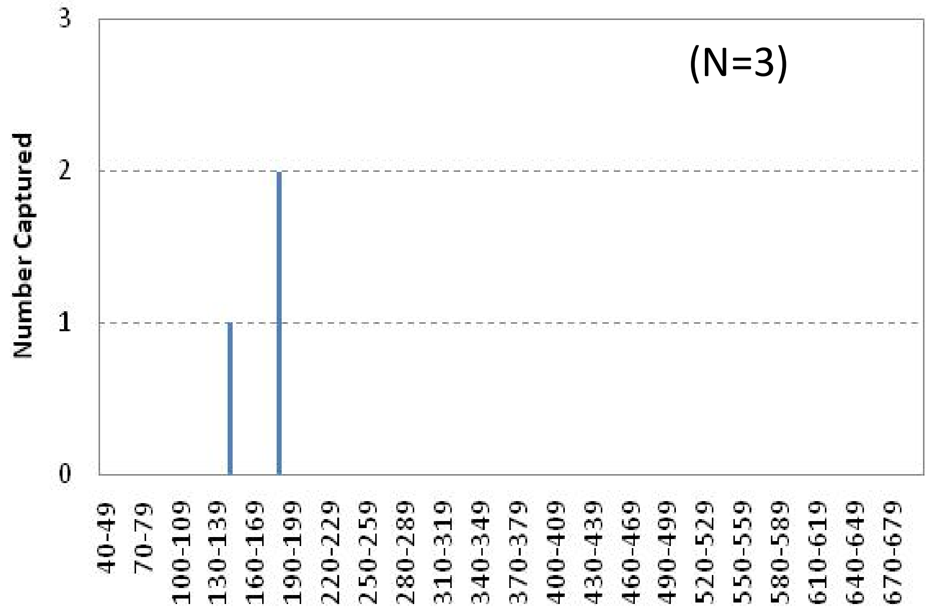


Figure 39: WY2009 Santa Ynez River Mainstem trap length-frequency histogram in 10-millimeter intervals for downstream captures only. No upstream captures at the mainstem trap site in 2009.

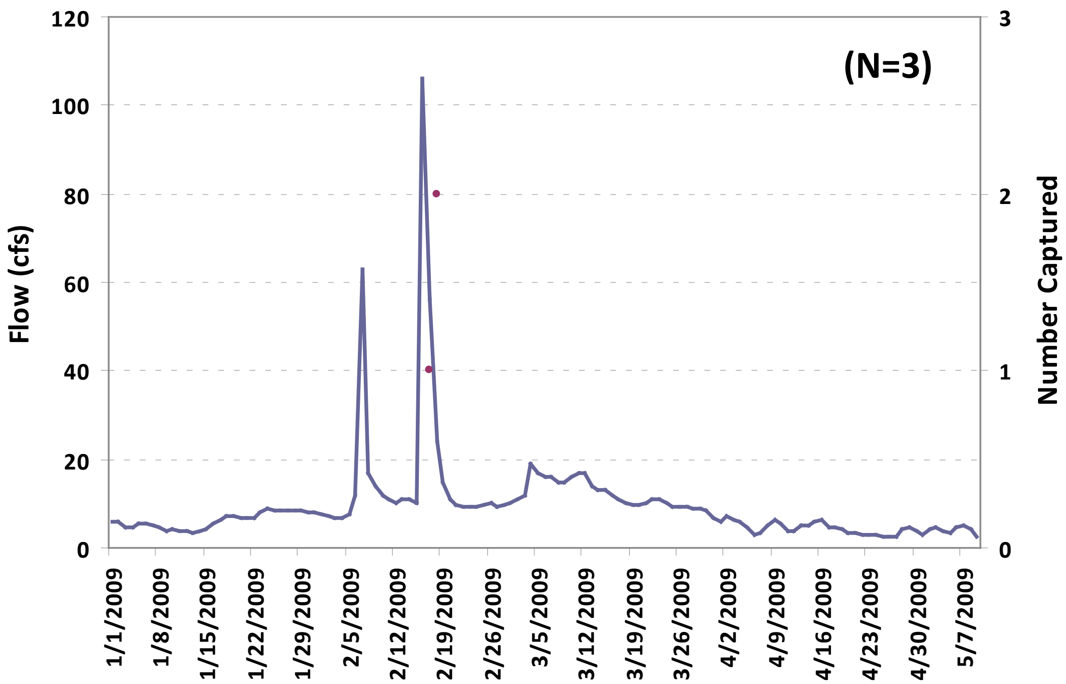


Figure 40: WY2009 Santa Ynez River Mainstem migrant captures (red dots) vs. flow for downstream migrant captures. No upstream captures at the mainstem trap site in 2009.

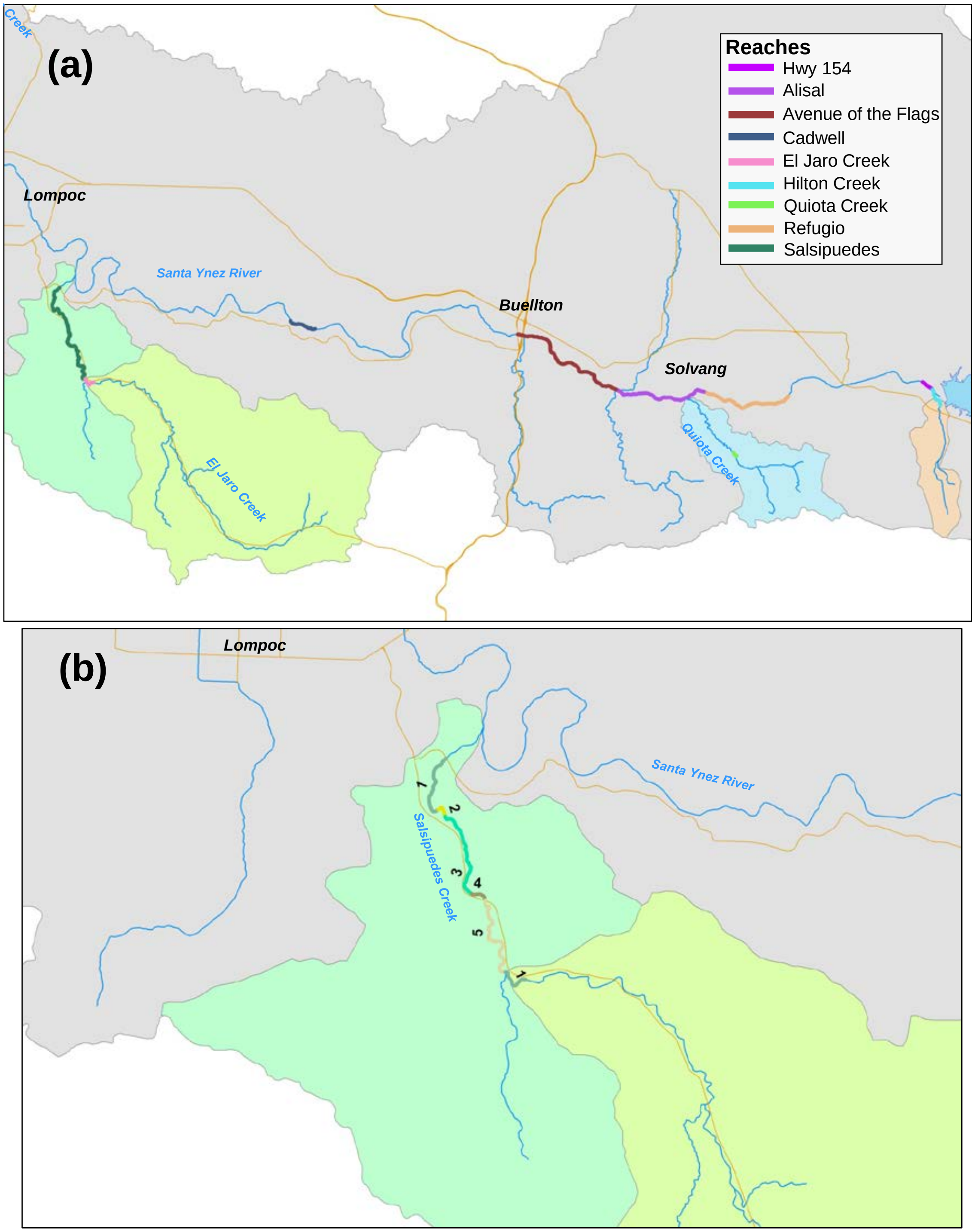


Figure 41: Stream reaches snorkel surveyed in WY2009 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

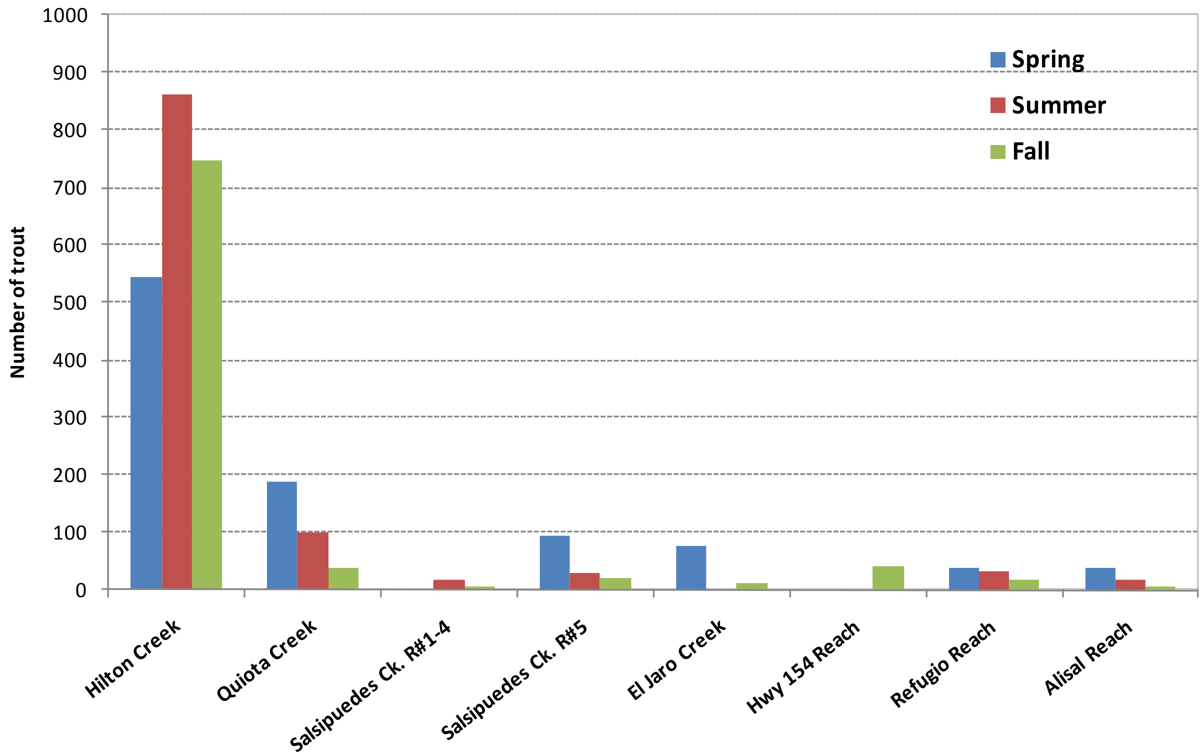


Figure 42: 2009 LSYR steelhead/rainbow trout observed during spring, summer and fall snorkel surveys.

Table 11: 2009 Mainstem snorkel survey 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	10/22/2009
Refugio Reach	Spring	5/18/2009 & 5/22/2009
(LSYR-4.9 to LSYR-7.8)	Summer	7/25/2009 & 8/5-8/6/2009
	Fall	10/20/2009 & 10/21/2009
Alisal Reach	Spring	5/18/2009
(LSYR-7.8 to LSYR-10.5)	Summer	7/28/2009 & 8/4/2009
	Fall	10/19/2009 & 10/20/2009

Table 12: LSYR mainstem spring, summer and fall snorkel survey results in 2009 with the miles surveyed.

Mainstem	Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hwy 154 Reach	n/a	n/a	41	0.26
Refugio Reach	39	32	19	2.95
Alisal Reach	39	17	7	2.80

Table 13: 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		2	14	13	3	6	1			**39**
	Alisal	1	1	25	8	4					**39**
Summer	Hwy 154			Not snorkeled due to turbidity							
	Refugio		1	11	12	4	4				**32**
	Alisal		1	7	6	3					**17**
Fall	Hwy 154	1	34	6							**41**
	Refugio			5	9	5					**19**
	Alisal			1	3	3					**7**

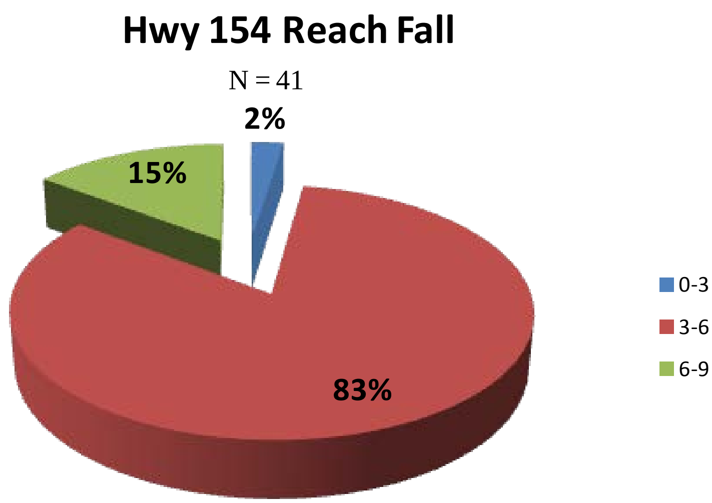


Figure 43: 2009 Hwy 154 Reach fall snorkel survey with size classes of fish observed in inches.

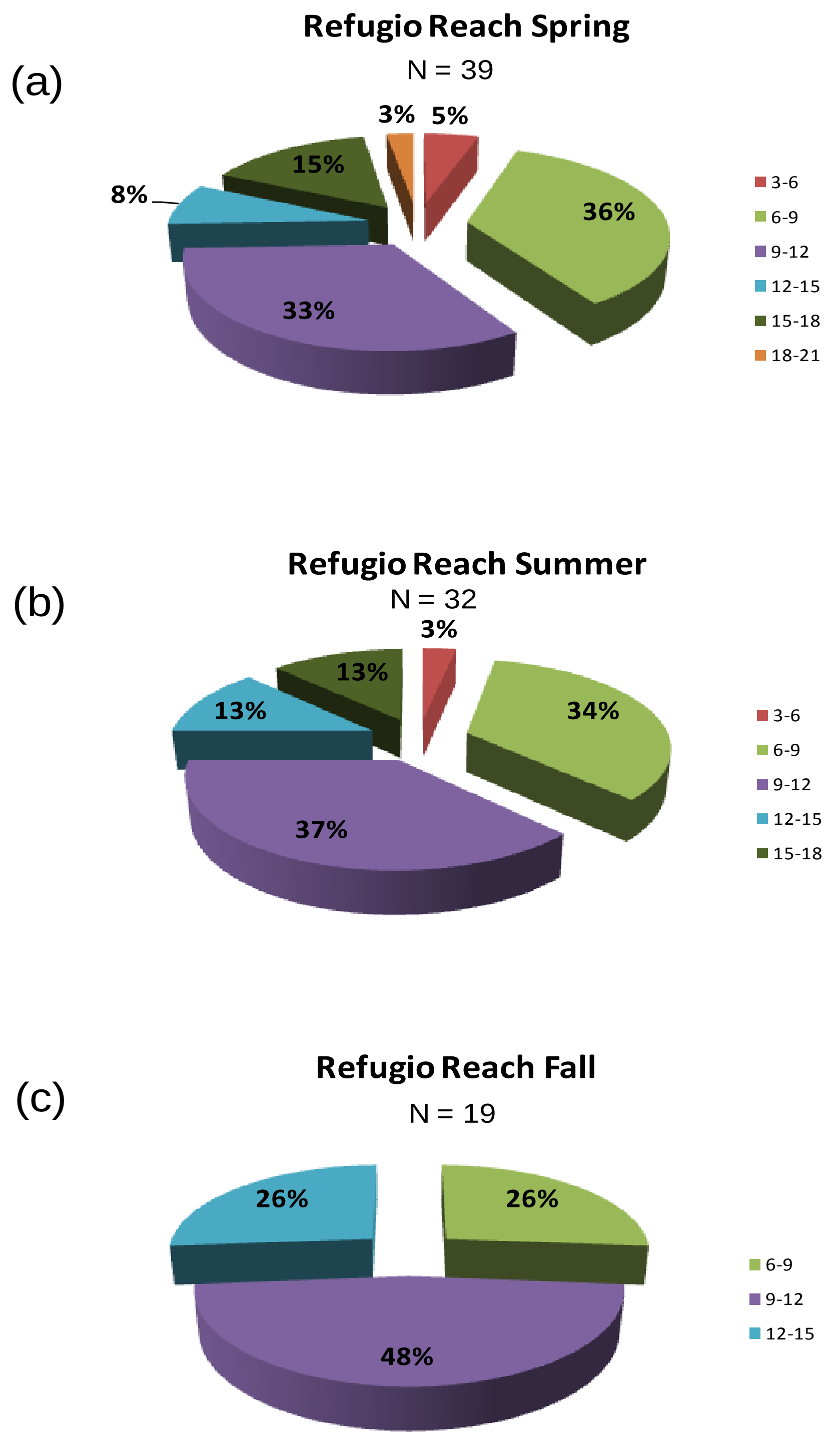


Figure 44: 2009 Refugio Reach snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

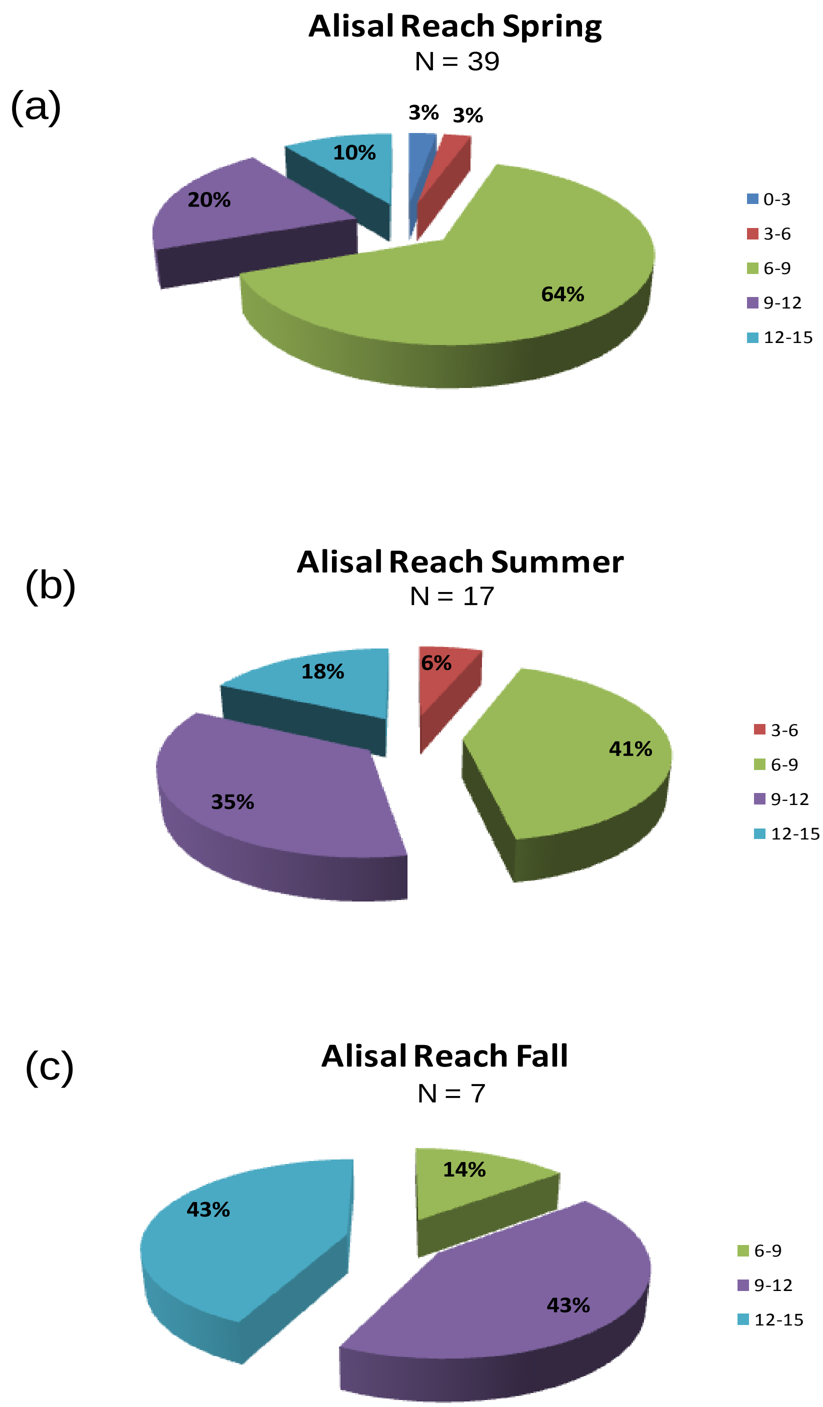


Figure 45: 2009 Alisal Reach snorkel survey size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

Table 14: 2009 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	6/9/2009
(HC-0.0 to HC-0.54)	Summer	8/10/2009 & 8/13/2009
	Fall	10/26/2009 & 10/27/2009
Quiota Creek	Spring	6/2/2009
(QC-2.58 to QC-2.73)	Summer	8/18/2009
	Fall	10/21/2009
Salsipuedes Creek	Spring	6/1/2009
(SC-1.2 to SC-3.75)	Summer	8/20/2009
	Fall	10/28/2009 & 10/29/2009
El Jaro Creek	Spring	6/1/2009
(ELC-0.0 to ELC-0.4)	Summer	n/s-turbid
	Fall	10/29/2009
*n/s = no survey		

Table 15: 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	174	226	151	0.133
	Reach 2	62	113	96	0.050
	Reach 3	19	26	29	0.040
	Reach 4	116	132	171	0.075
	Reach 5	174	366	299	0.242
	Reach 6	0	0	0	0.014
	Total:	***545***	***863***	***746***	***0.554***
Quiota Creek		189	101	39	0.11
Salsipuedes Creek		n/a	18	6	0.17
	Reach 2	n/a	18	6	0.17
	Reach 5	95	28	20	0.45
El Jaro Creek		75	n/a	11	0.35

Table 16: 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	227	224	88	5				1		**545**
	Quiota	185	4								**189**
	Salsipuedes (R1-4)	Not snorkeled due to turbidity									
	Salsipuedes (R-5)	28	61	6							**95**
	El Jaro	34	35	6							**75**
Summer	Hilton	319	380	140	21	3					**863**
	Quiota	89	11	1							**101**
	Salsipuedes (R1-4)*	13	2	2	1						**18**
	Salsipuedes (R-5)	11	15	2							**28**
	El Jaro	Not snorkeled due to turbidity									
Fall	Hilton	167	482	93	4						**746**
	Quiota	27	10	2							**39**
	Salsipuedes (R1-4)*	0	5	1							**6**
	Salsipuedes (R-5)	3	14	2	1						**20**
	El Jaro	2	7	1	1						**11**

* Only Reach 2 was snorkeled.

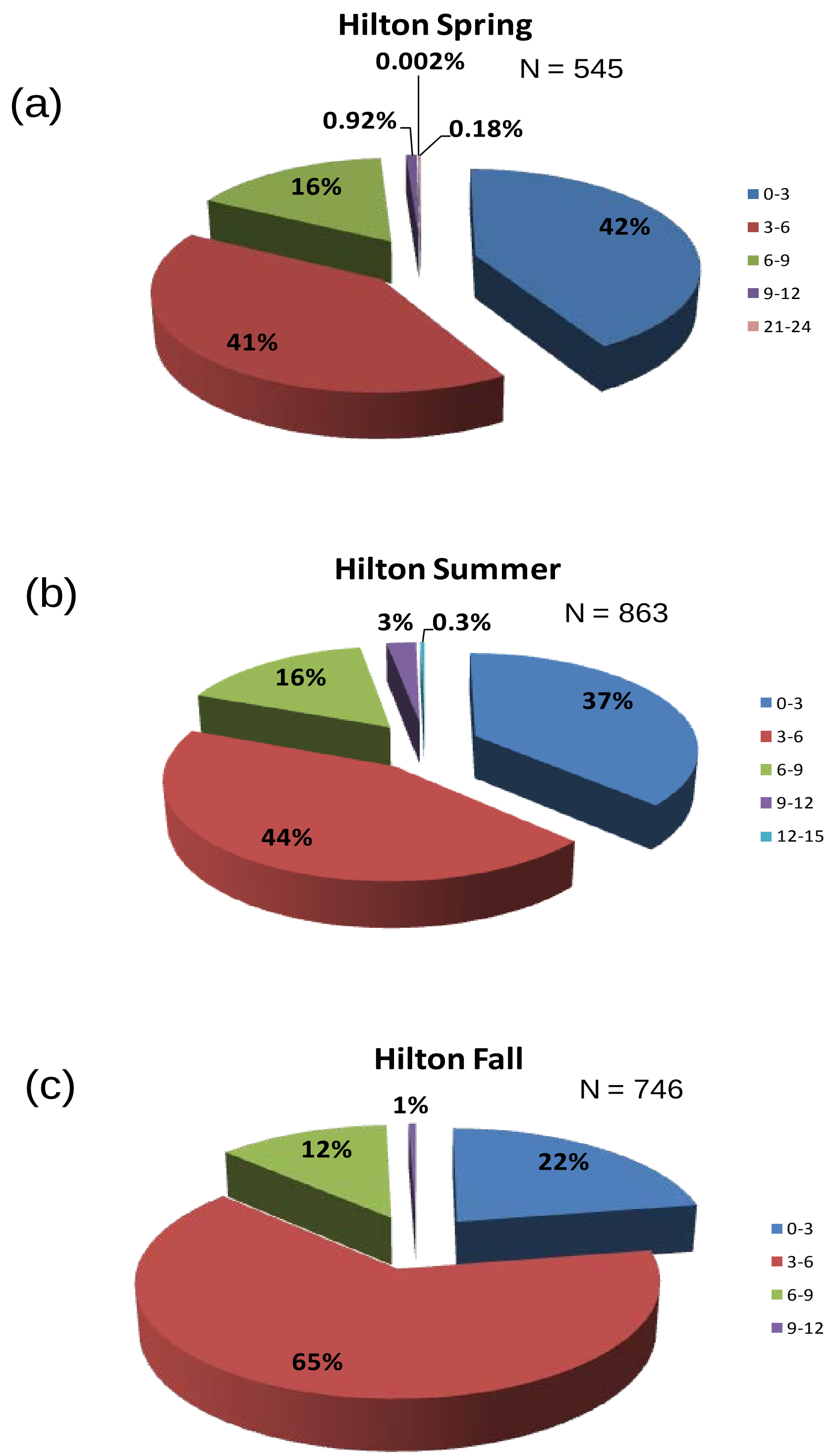


Figure 46: 2009 Hilton Creek snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

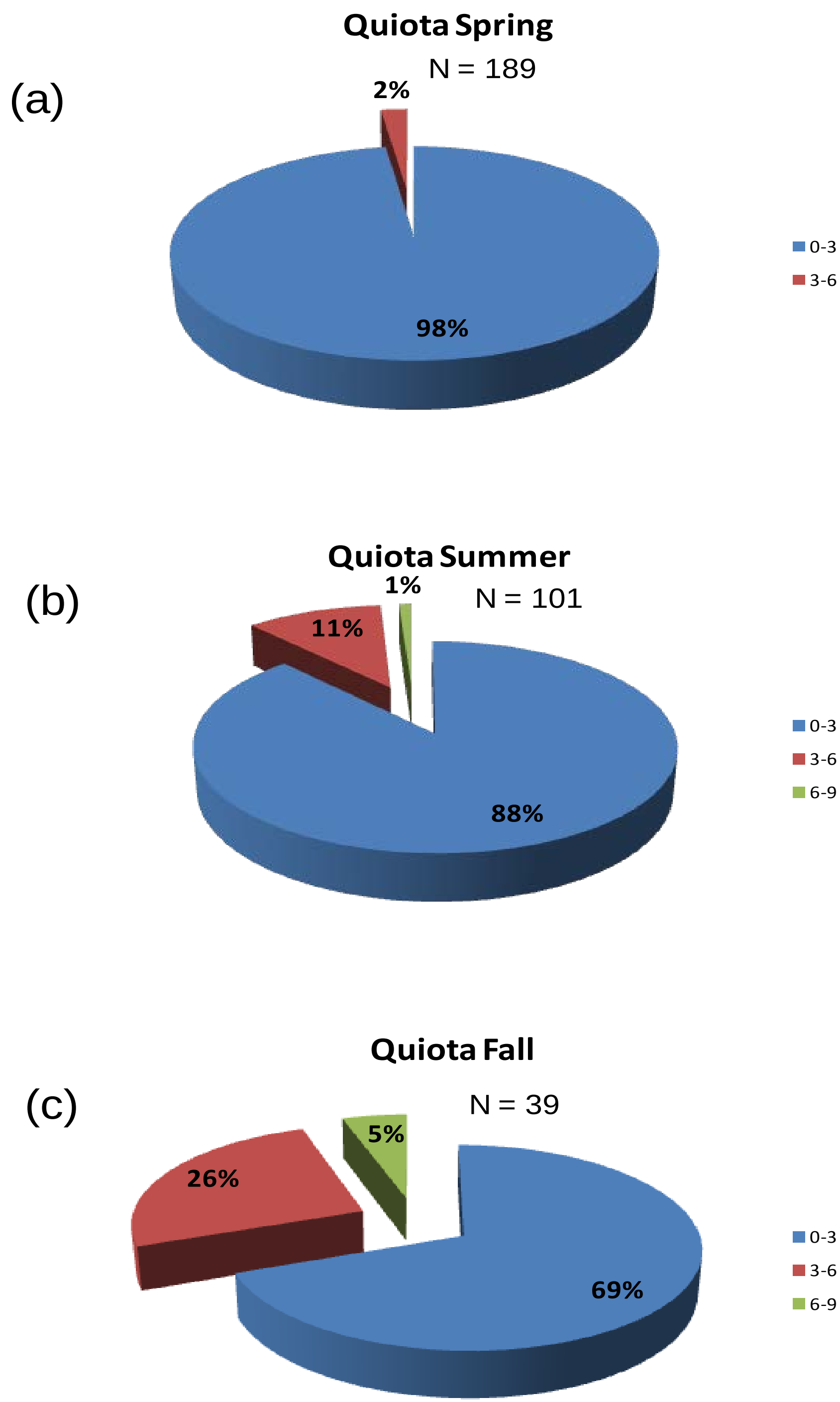
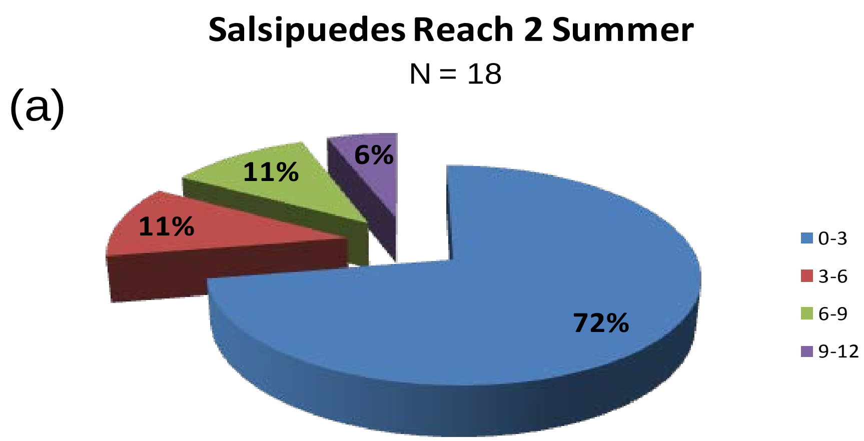


Figure 47: 2009 Quiota Creek snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.



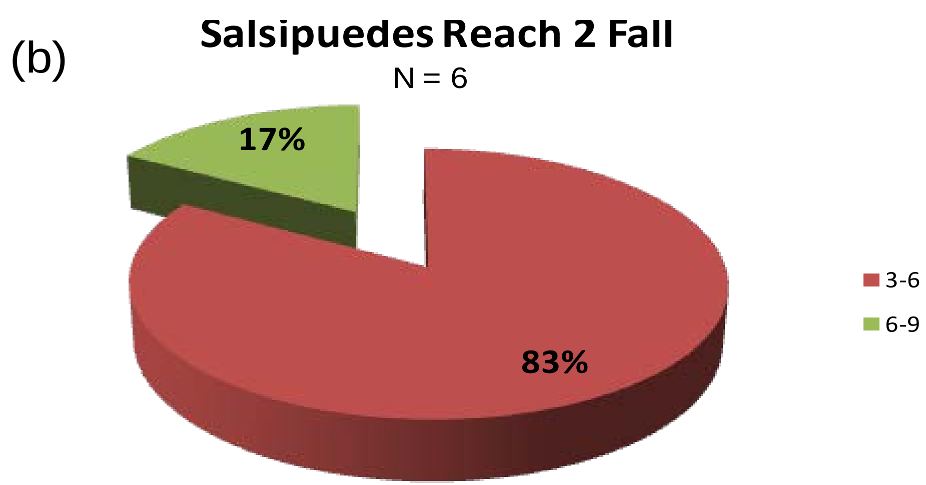


Figure 48: 2009 Salsipuedes Creek Reach 2 snorkel survey with size classes of fish observed in inches; (a) spring, (b) summer, and (c) fall.

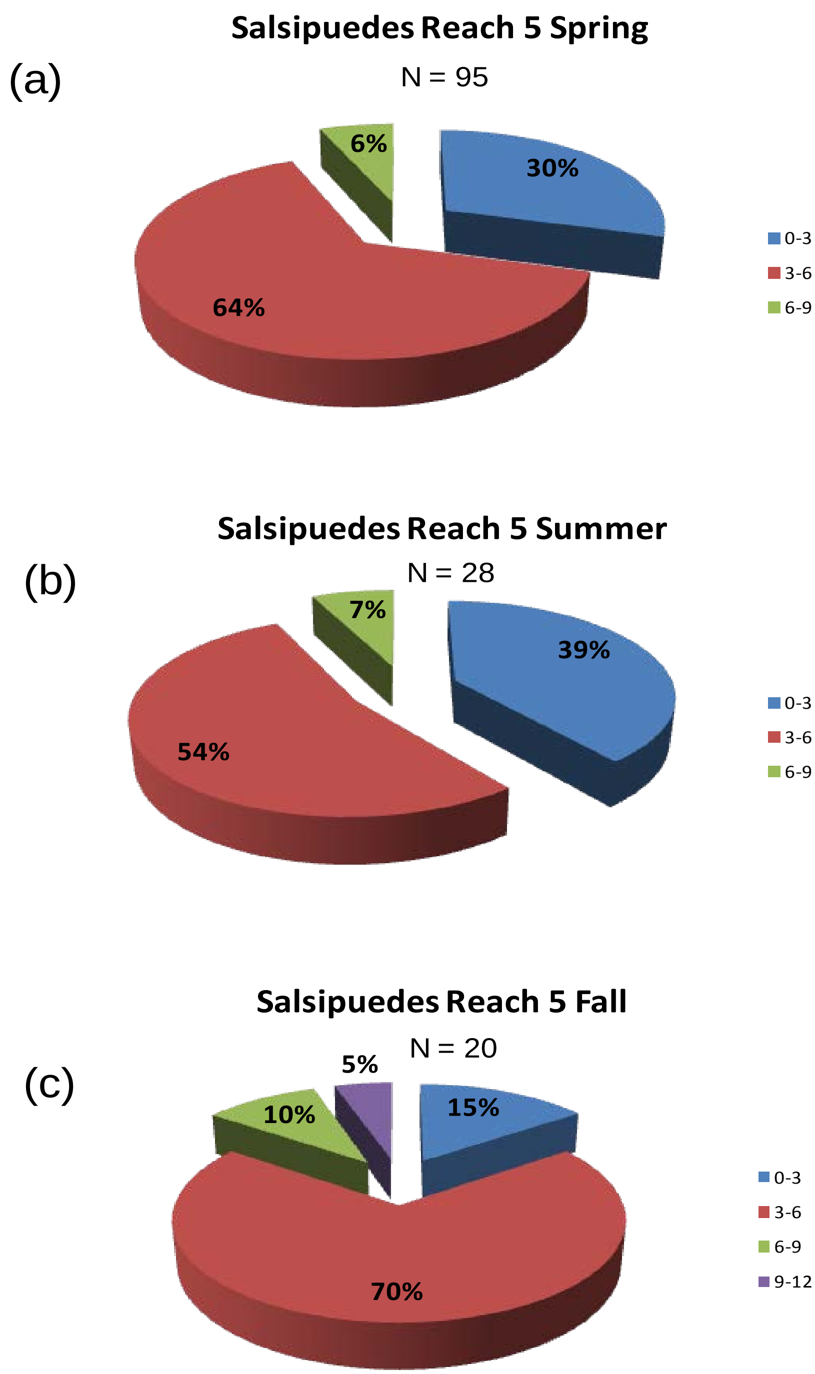


Figure 49: 2009 Salsipuedes Creek Reach 5 survey with size classes of fish observed in inches; (a) spring and (b) fall.

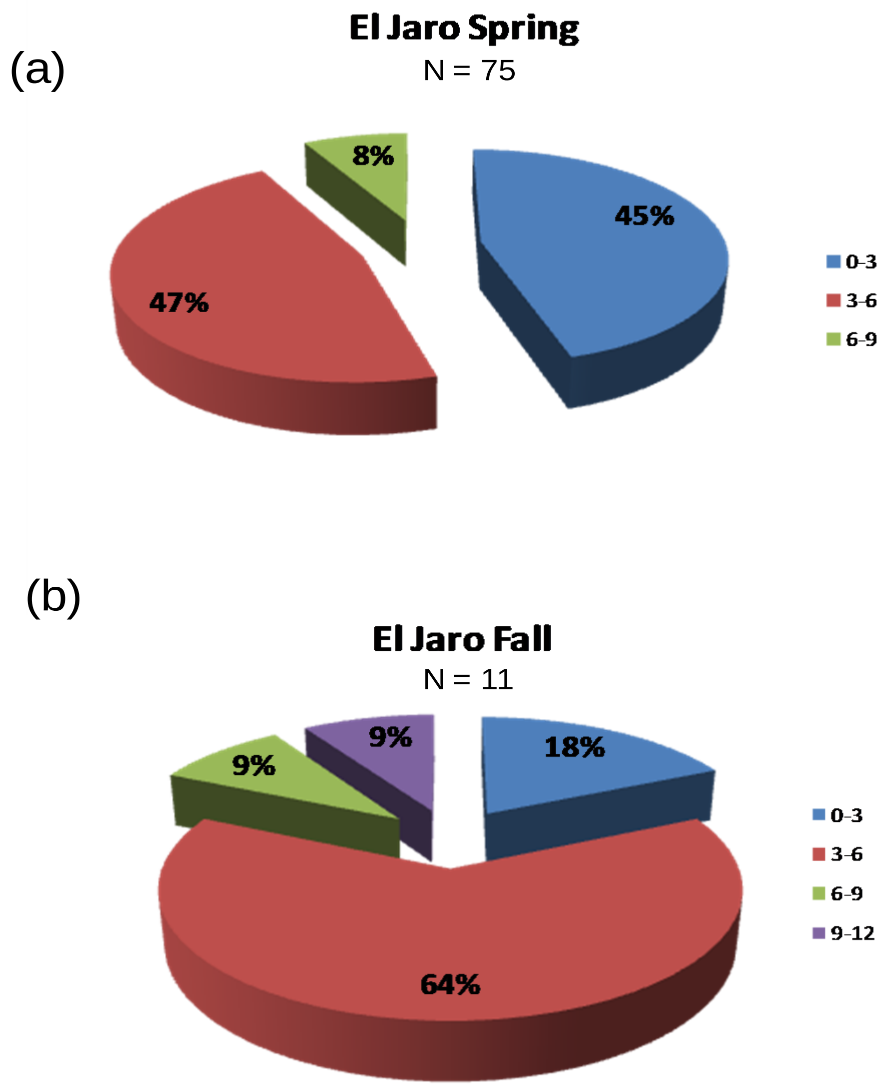


Figure 50: 2009 El Jaro Creek snorkel survey with size classes of fish observed in inches; (a) spring and (b) fall.

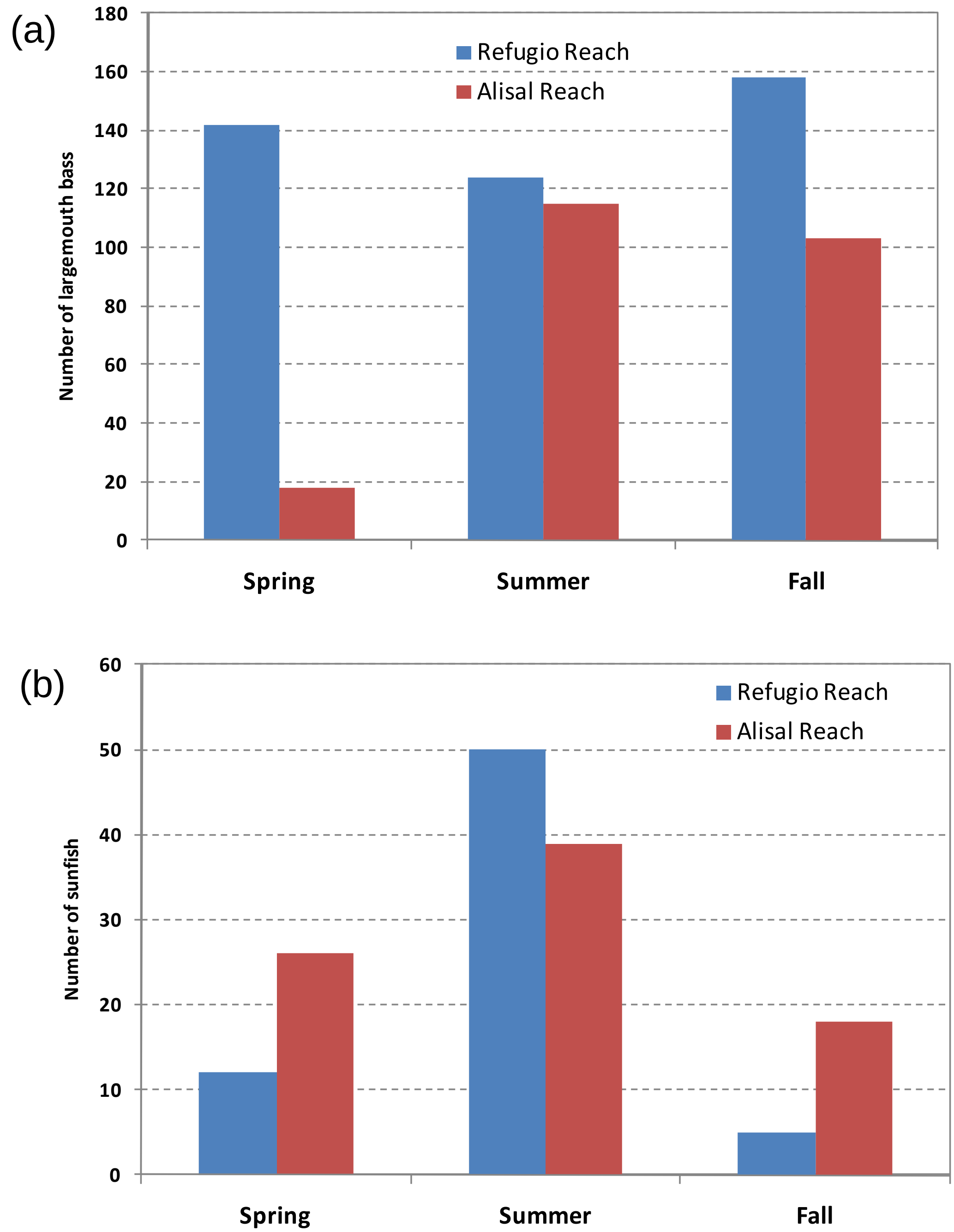


Figure 51: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2009 within the Refugio and Alisal reaches: (a) largemouth bass and (b) sunfish.

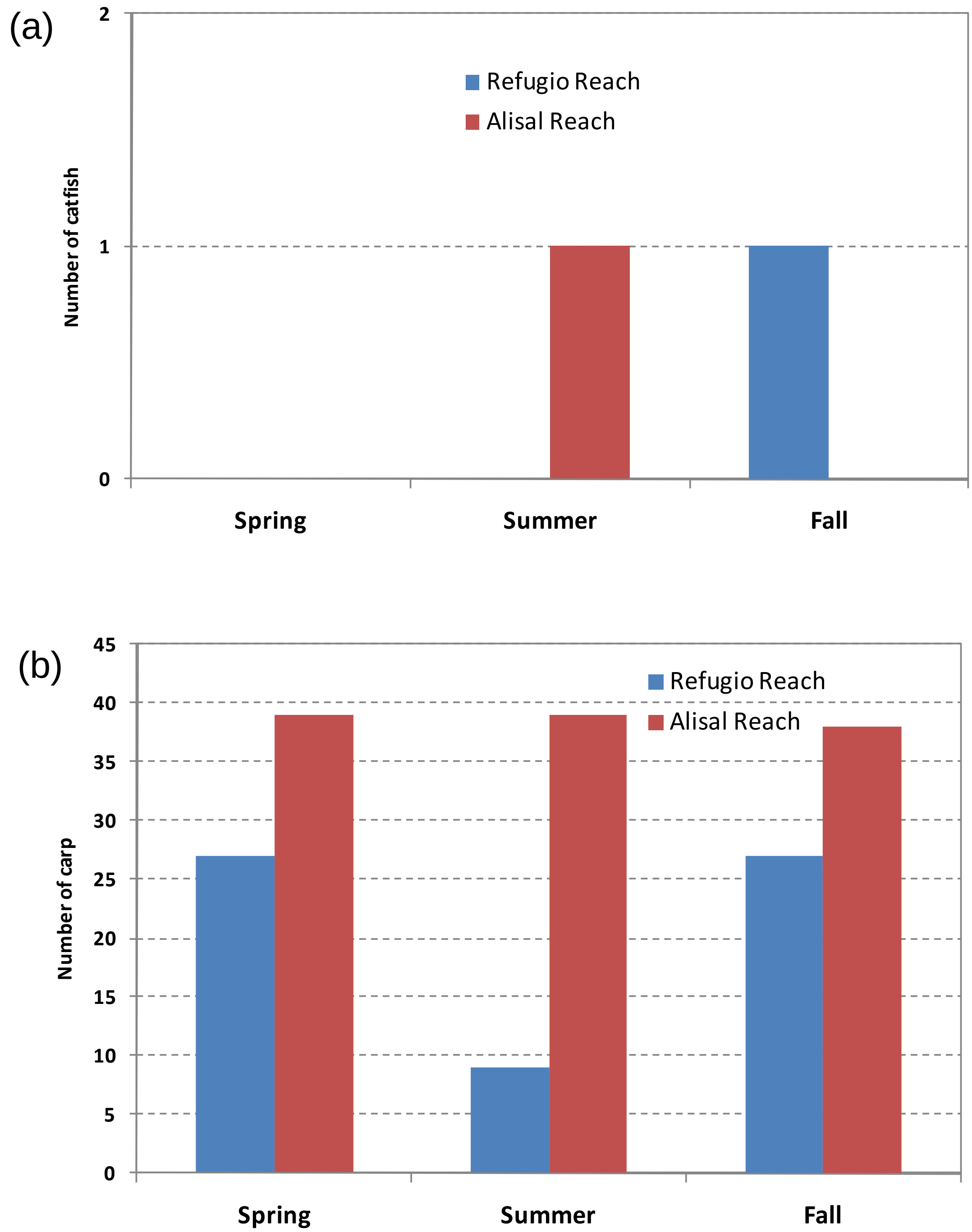


Figure 52: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2009 within the Refugio and Alisal reaches: (a) catfish, and (b) carp.

4. Discussion

Table 17: Biological Opinion (BO) tributary project inventory with the completion date specified in the BO and their status to date. Completed projects are listed by calendar year.

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 18: Non-BO tributary projects already completed or proposed with their status to date. Completed projects are listed by calendar year.

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.

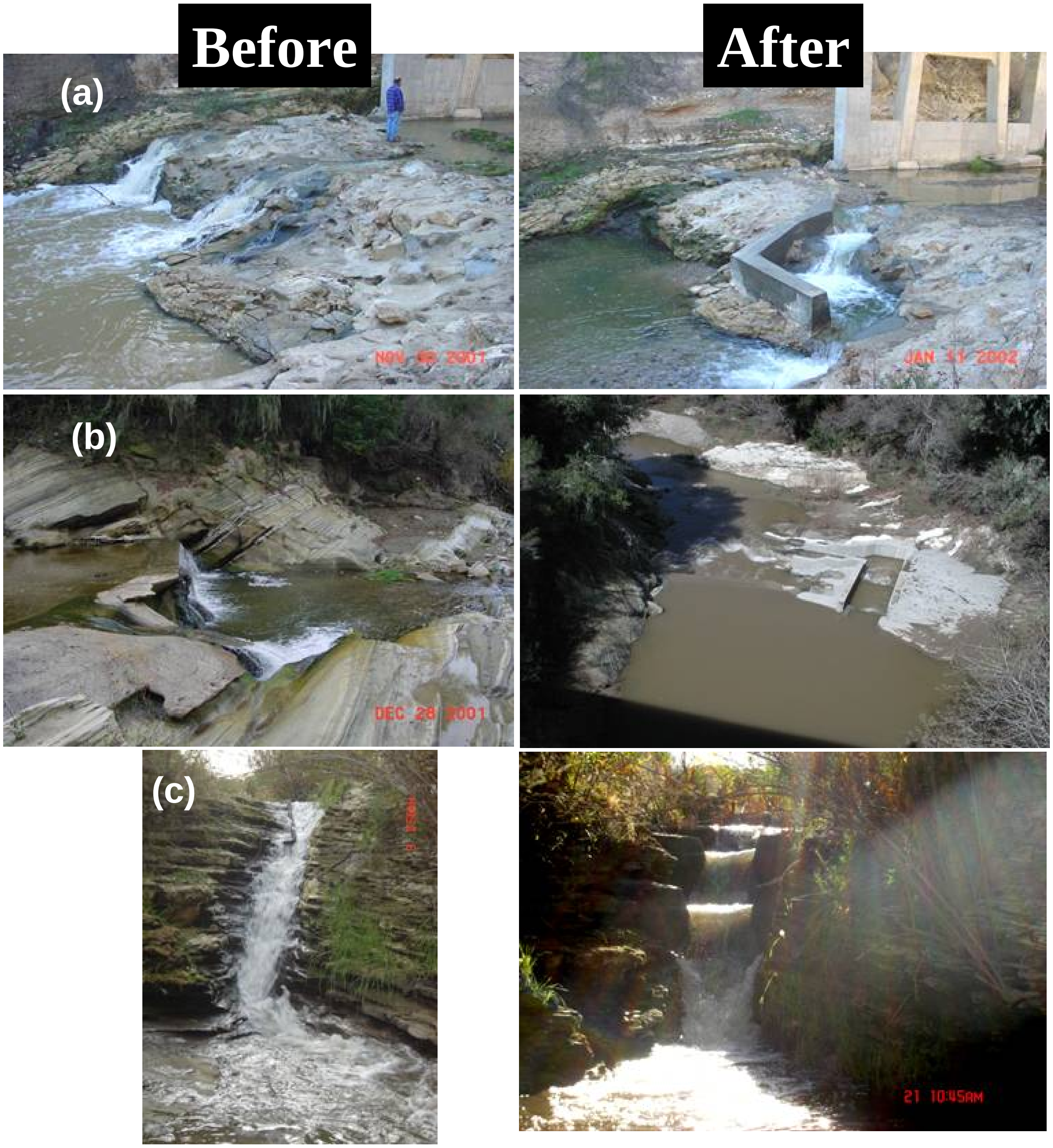


Figure 53: Fish passage and habitat restoration at (a) Hwy 1 Bridge on Salsipuedes Creek (completed in 2002), (b) Jalama Road Bridge on Salsipuedes Creek (completed in 2004), and (c) Cascade Chute barrier on Hilton Creek (completed in 2005).

Figure 54: Fish passage and habitat restoration in the fall of 2008 at Rancho San Julian on El Jaro Creek.

Figure 55: Fish passage and habitat restoration in the fall of 2008 at Refugio Road on Quiota Creek Crossing 6.

Table 19: Monthly rainfall totals at Bradbury Dam from WY2000-WY2009.

Month	Water Year (inches):									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Oct	0.00	2.64	0.62	0.00	0.00	6.38	0.48	0.16	0.34	0.15
Nov	1.62	0.00	3.27	2.50	1.20	0.33	1.64	0.20	0.06	3.39
Dec	0.00	0.09	2.66	6.73	2.03	13.25	0.73	1.59	2.39	2.46
Jan	1.94	8.40	0.87	0.06	0.32	10.30	7.82	1.30	16.57	0.65
Feb	10.37	5.71	0.24	3.56	6.52	9.22	3.06	3.03	2.33	5.7
Mar	2.76	13.44	0.79	2.40	0.48	3.08	4.31	0.15	0.46	0.85
Apr	4.73	1.35	0.13	2.15	0.00	1.27	4.89	0.81	0.06	0.19
May	0.01	0.06	0.12	2.33	0.00	0.51	1.56	0.00	0.38	0
Jun	0.04	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.00	0.16
Jul	0.00	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0
Aug	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Sept	0.00	0.00	0.08	0.00	0.00	0.03	0.00	0.17	0.00	0.08
Total:	21.47	31.75	8.78	19.76	10.55	44.41	24.49	7.41	22.59	13.66

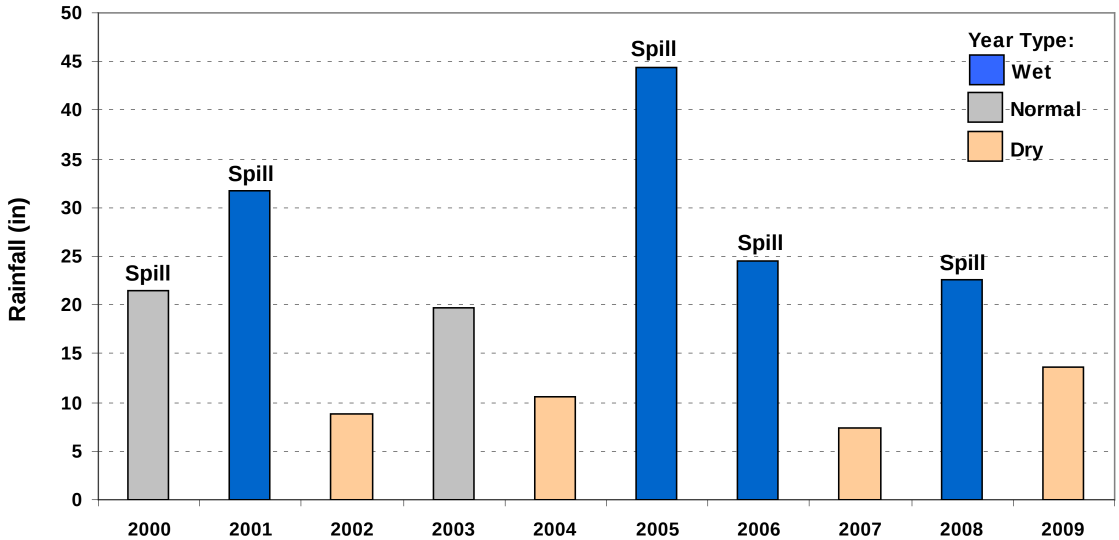


Figure 56: Year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defines as dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 20: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2009.

Month	WY2001 Solvang (cfs)	WY2001 Narrows (cfs)	WY2002 Solvang (cfs)	WY2002 Narrows (cfs)	WY2003 Solvang (cfs)	WY2003 Narrows (cfs)	WY2004 Solvang (cfs)	WY2004 Narrows (cfs)	WY2005 Solvang (cfs)	WY2005 Narrows (cfs)
Oct	n/d	20.6	n/d	2.1	23.3	18.8	0.0	0.0	31.1	29.4
Nov	n/d	14.8	n/d	12.3	8.1	15.2	0.0	0.0	6.4	14.2
Dec	n/d	14.9	n/d	25.2	22.3	55.5	0.0	0.0	293.2	478.5
Jan	37.3	75.3	n/d	24.6	10.7	26.7	1.6	1.5	2556.0	2765.0
Feb	n/d	321	n/d	21.6	12.7	27.0	9.0	38.4	2296.0	2555.0
Mar	n/d	3,378	n/d	13.4	24.0	70.2	4.3	12.4	776.6	929.3
Apr	n/d	207.3	n/d	3.9	14.9	22.3	0.3	1.5	206.8	300.8
May	n/d	57.5	n/d	1.4	9.8	19.5	0.0	0.1	104.3	150.7
Jun	n/d	13.6	n/d	0.5	1.6	4.0	0.0	0.0	13.8	32.7
Jul	n/d	5.1	n/d	0.1	0.0	0.6	53.2	3.7	9.2	14.0
Aug	n/d	2.5	64.8	24.2	0.0	0.1	59.4	30.9	6.4	2.9
Sep	n/d	2.2	37.2	28.9	0.0	0.0	39.3	24.0	6.0	4.2

Month	WY2006 Solvang (cfs)	WY2006 Narrows (cfs)	WY2007 Solvang (cfs)	WY2007 Narrows (cfs)	WY2008 Solvang (cfs)	WY2008 Narrows (cfs)	WY2009 Solvang (cfs)	WY2009 Narrows (cfs)
Oct	6.1	9.4	7.3	1.0	25.0	17.5	3.0	0.0
Nov	6.9	16.0	5.8	1.0	7.4	8.5	5.8	0.0
Dec	10.7	20.1	7.7	10.0	6.6	13.2	7.0	1.0
Jan	40.0	79.4	9.4	15.3	265.0	496.3	6.1	5.1
Feb	12.2	28.0	10.4	18.6	401.1	490.1	17.7	33.4
Mar	51.2	86.1	8.8	10.7	93.9	158.4	12.1	18.6
Apr	1317.0	1053.0	4.5	1.4	8.5	18.9	4.4	5.2
May	131.9	139.6	1.5	0.5	6.3	6.8	5.1	0.6
Jun	20.1	26.5	1.9	0.1	5.1	2.5	7.1	0.3
Jul	7.8	4.8	35.8	1.4	7.1	0.4	3.5	0.0
Aug	4.7	1.0	55.2	30.8	3.7	0.1	3.7	0.0
Sep	5.7	1.0	31.0	23.4	3.8	0.0	4.1	0.0

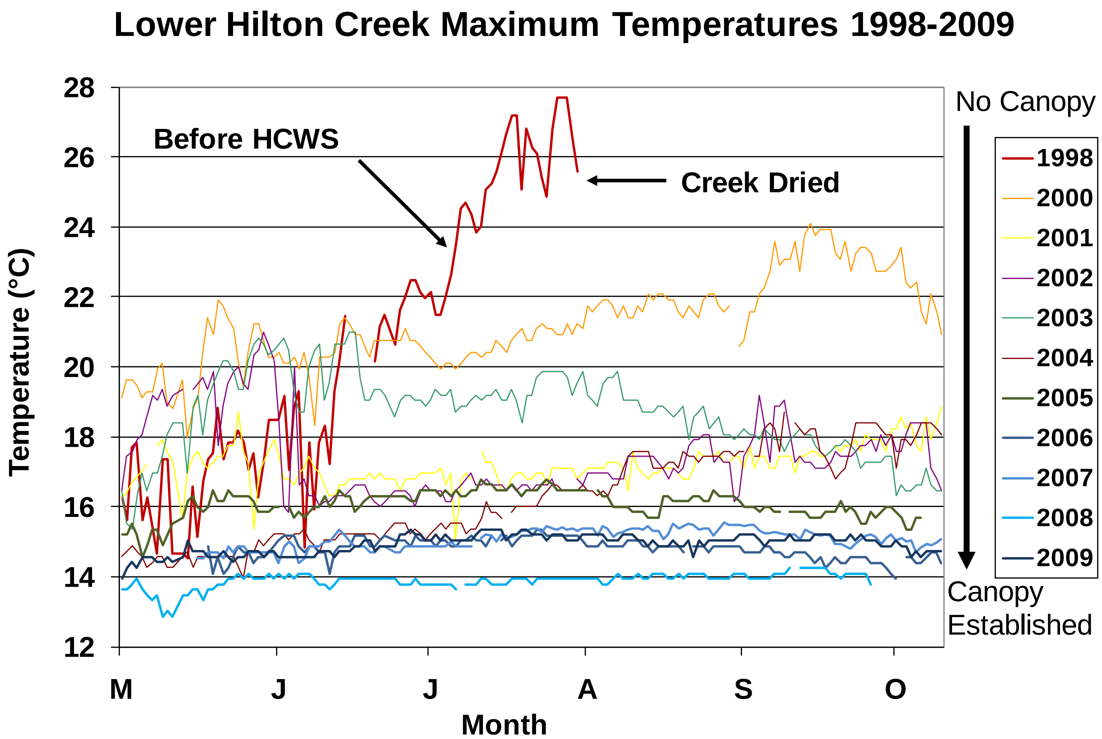


Figure 57: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2009.

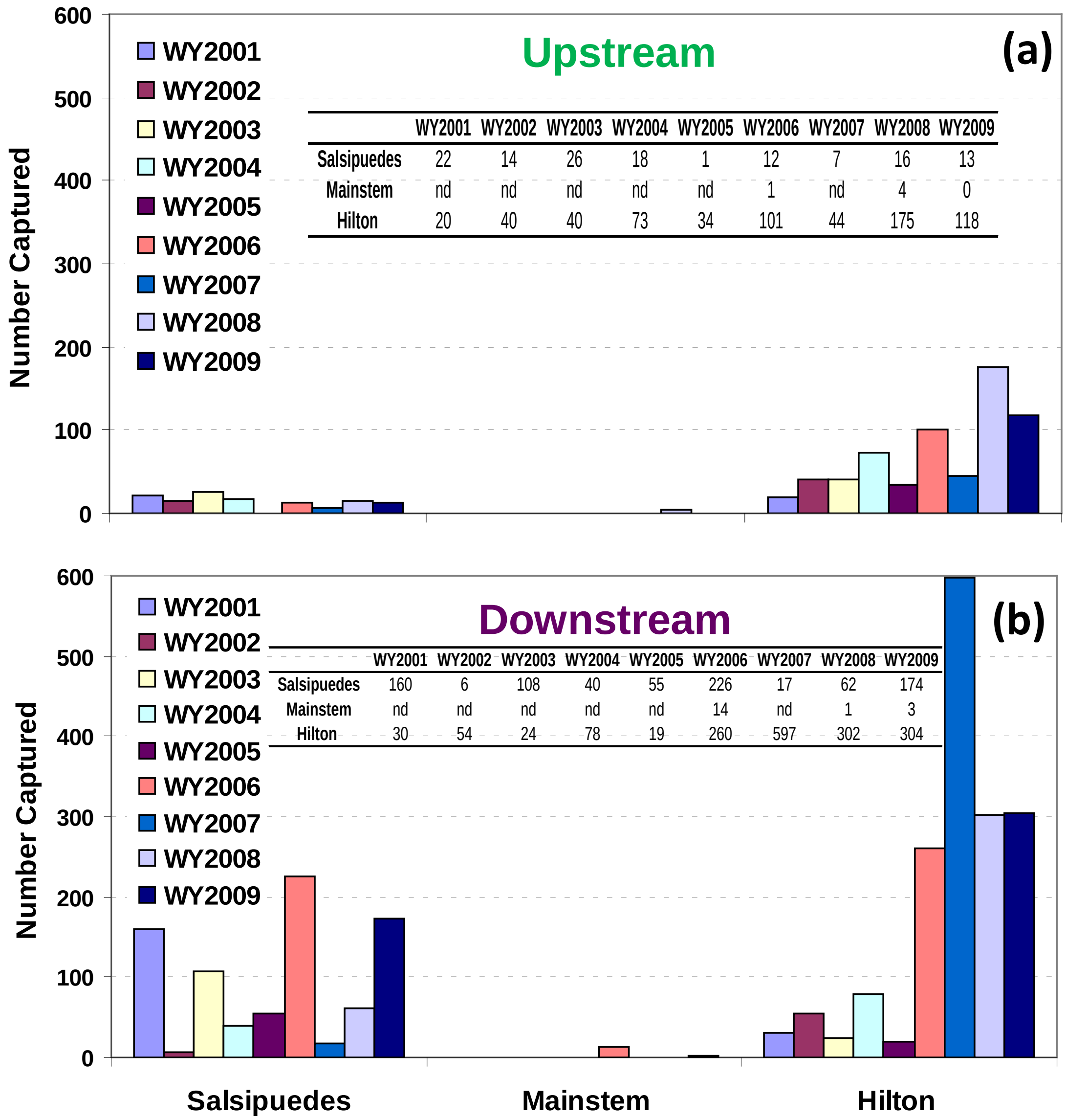


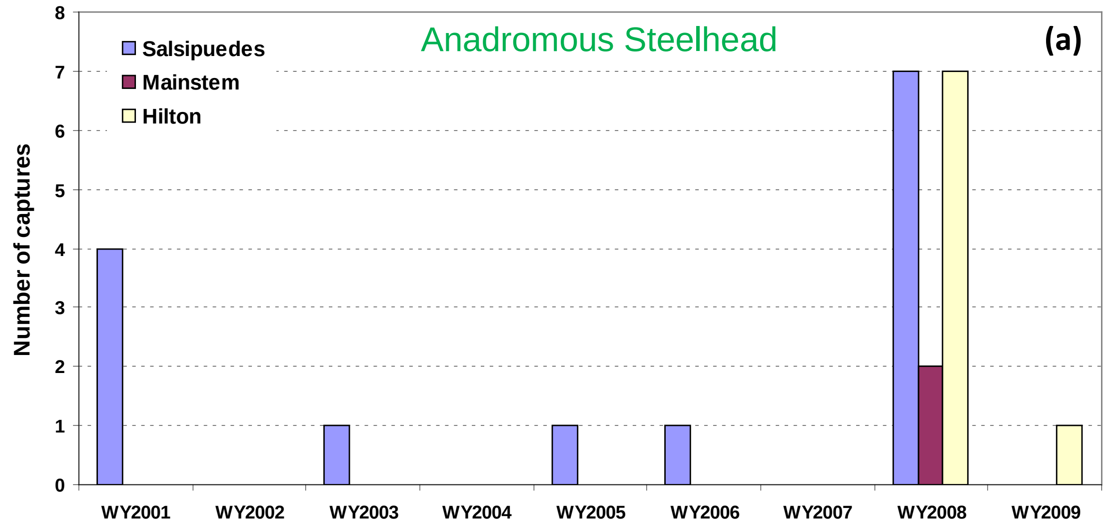
Figure 58: (a) Upstream and (b) downstream migrant capture totals for WY2001-WY2009 for the Salsipuedes Creek, LSYR Mainstem, and Hilton Creek traps. The LSYR Mainstem traps were not deployed prior to WY2005 (no access) and WY2007 (low flow).

Table 21: Trapping season statistics for WY2001 through WY2009.

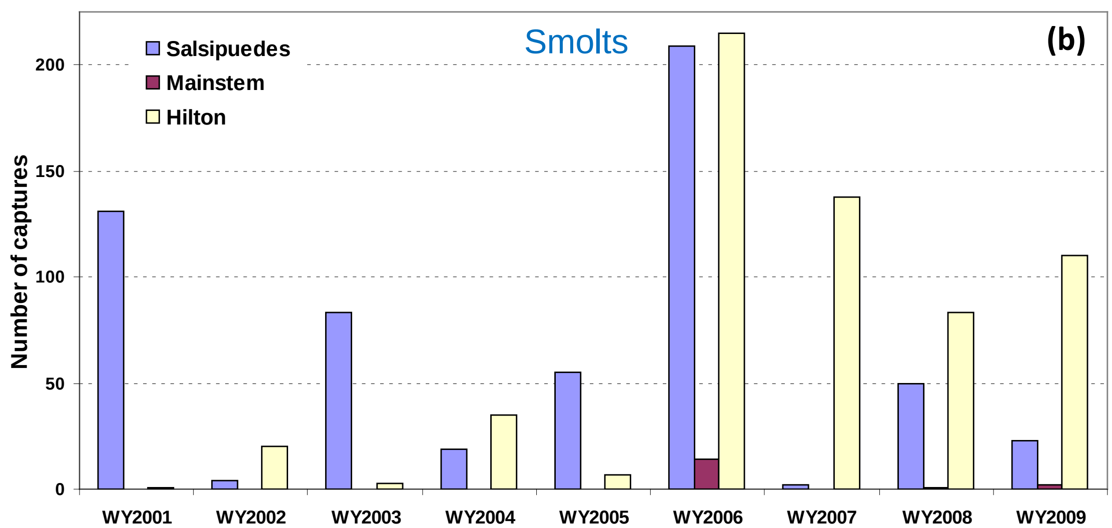
					Salsipuedes Creek				
	WY2001	*WY2002*	*WY2003*	*WY2004*	*WY2005*	*WY2006*	*WY2007*	*WY2008*	**WY2009**
Trapping season	119	101	133	122	122	132	116	116	104
Days out of service	28	0	15	5	38	20	4	16	2
Functional Trap Days	91	101	118	117	84	112	112	100	102
Efficiency	76.5%	100%	88.7%	95.9%	69.8%	84.9%	96.6%	86.2%	98.1%
CPUE U/S & D/S	2.0	0.2	1.14	0.48	0.7	2.1	0.2	0.8	1.83
Rain Year Class.	Wet	Dry	Avg	Dry	Wet	Wet	Dry	Wet	Dry
					LSYR Mainstem				
	*WY2001**	*WY2002**	*WY2003**	*WY2004**	*WY2005**	*WY2006*	*WY2007***	*WY2008*	**WY2009**
Trapping season	-	-	-	-	-	34	-	61	81
Days out of service	-	-	-	-	-	2	-	19	0
Functional Trap Days	-	-	-	-	-	32	-	42	81
Efficiency	-	-	-	-	-	94.1%	-	68.9%	100%
CPUE U/S & D/S	-	-	-	-	-	0.44	-	0.10	0.04
Rain Year Class.	Wet	Dry	Avg	Dry	Wet	Wet	Dry	Wet	Dry
					Hilton Creek				
	WY2001	*WY2002*	*WY2003*	*WY2004*	*WY2005*	*WY2006*	*WY2007*	*WY2008*	**WY2009**
Trapping season	123	100	134	122	127	132	116	129	112
Days out of service	39	0	11	1	22	7	4	11	2
Functional Trap Days	84	100	123	121	105	125	112	118	114
Efficiency	68.3%	100%	91.8%	99.2%	82.7%	94.7%	97.0%	91.5%	98.2%
CPUE U/S & D/S	0.60	0.95	0.53	1.25	0.41	2.88	5.72	4.00	3.83
Rain Year Class.	Wet	Dry	Avg	Dry	Wet	Wet	Dry	Wet	Dry

* Not deployed

** Too dry to install



	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009
Salsipuedes	4	0	1	0	1	1	0	7	0
Mainstem	-	-	-	-	-	0	0	2	0
Hilton	0	0	0	0	0	0	0	7	1
Total	*4*	*0*	*1*	*0*	*1*	*1*	*0*	*16*	*1*



	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009
Salsipuedes	131	4	83	19	55	209	2	50	23
Mainstem	-	-	-	-	-	14	-	1	2
Hilton	1	20	3	35	7	215	138	83	110
Total	*132*	*24*	*86*	*54*	*62*	*438*	*140*	*134*	*135*

Figure 59: (a) Anadromous steelhead and (b) smolt captures from WY2000 through WY2009 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.

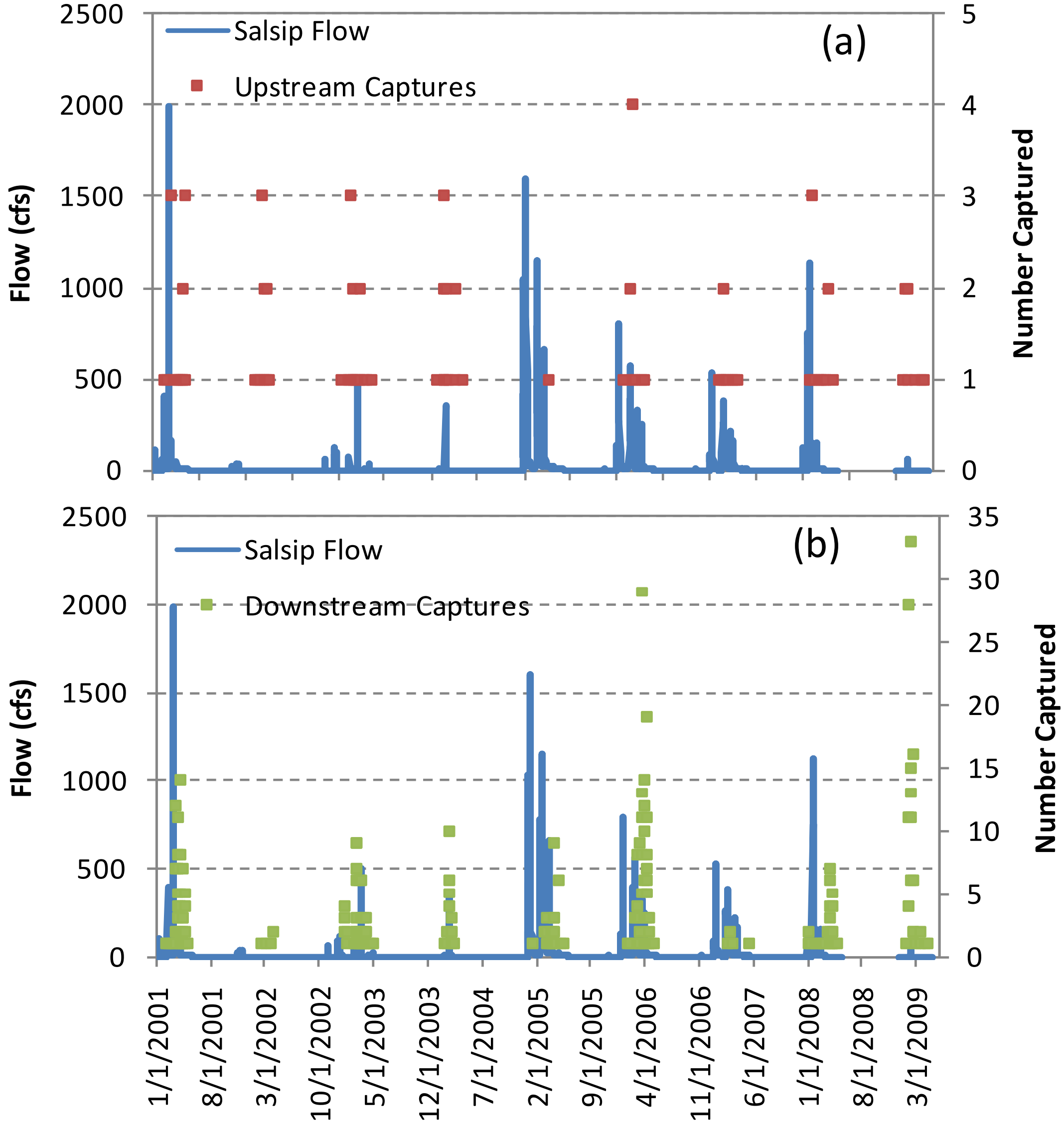


Figure 60: WY2001-WY2009 (a) upstream and (b) downstream migrant captures at the Salsipuedes Creek trap. Average daily flow data were from the USGS Salsipuedes gauge on the LSYR. Traps were removed just prior to peak storm flow events.

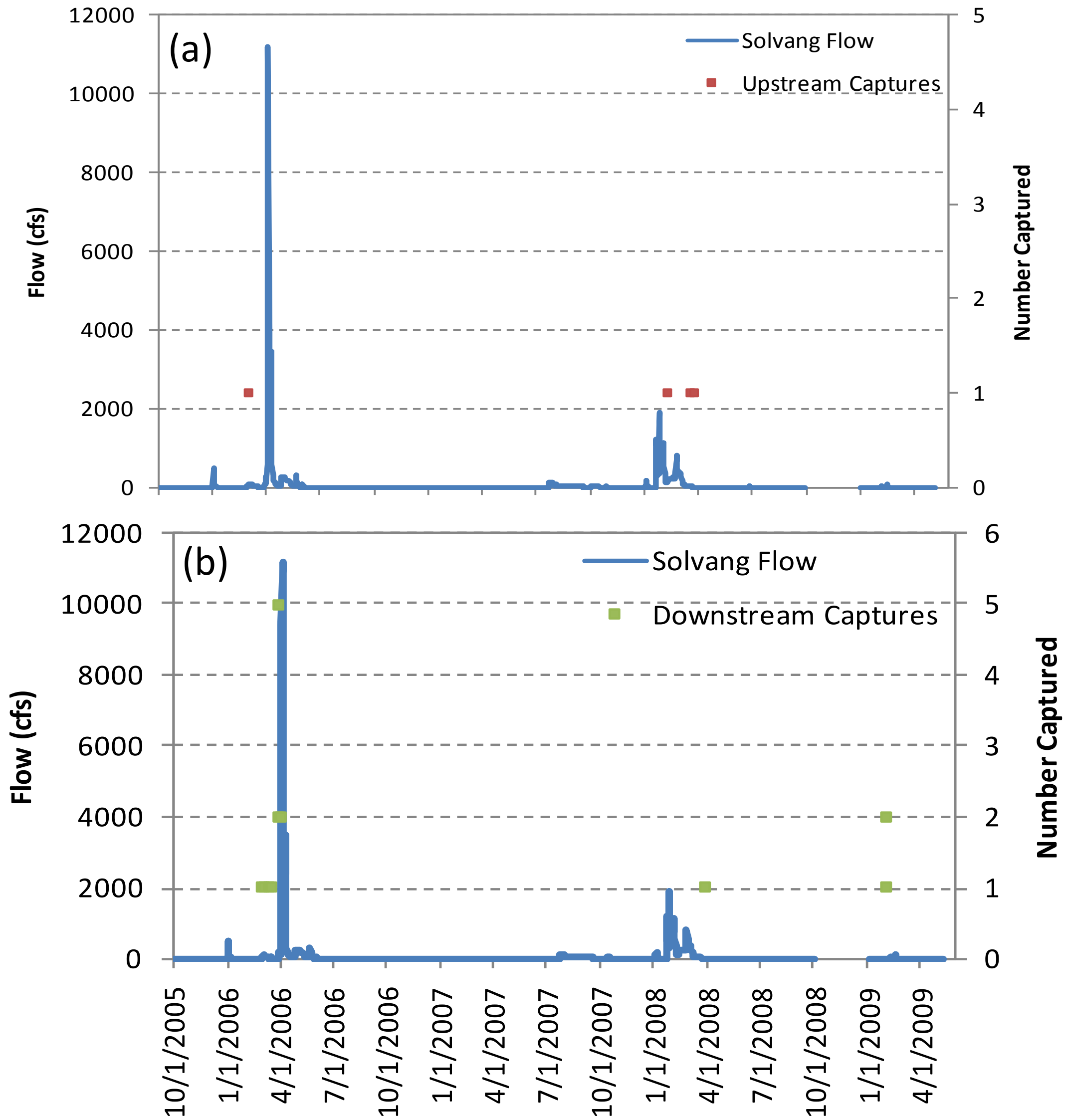


Figure 61: WY2005-WY2009 (a) upstream and (b) downstream migrant captures at the LSYR Mainstem trap. Average daily flow data were from the USGS Solvang gauge on the LSYR. Traps were removed just prior to peak storm flow events. The LSYR Mainstem traps were not deployed in WY2005 and WY2007.

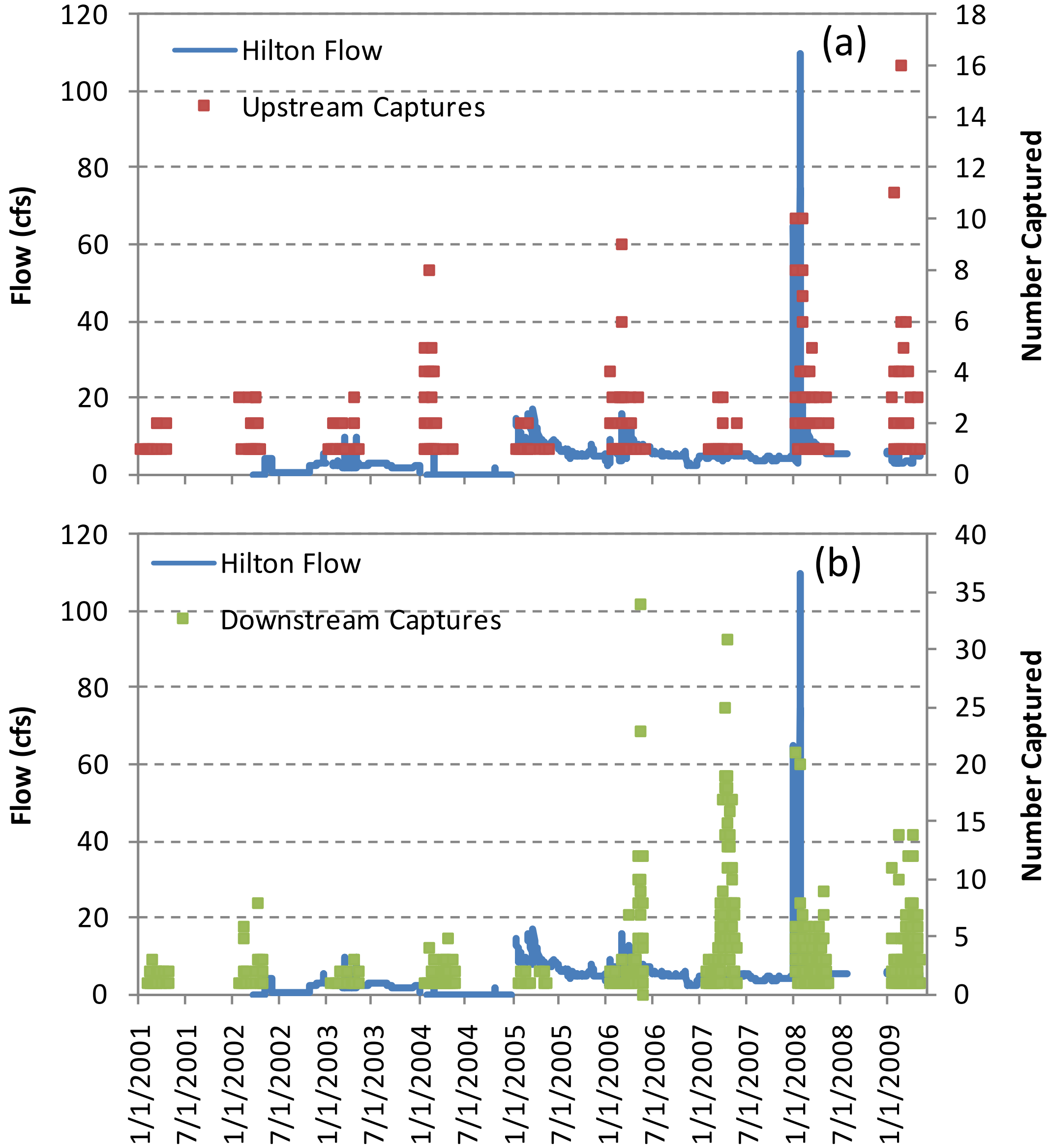


Figure 62: WY2001-WY2009 (a) upstream and (b) downstream migrant captures at the Hilton Creek trap. Average daily flow data were from the USGS Hilton Creek gauge just below the upper release point of the HCWS. Traps were removed just prior to peak storm flow events.

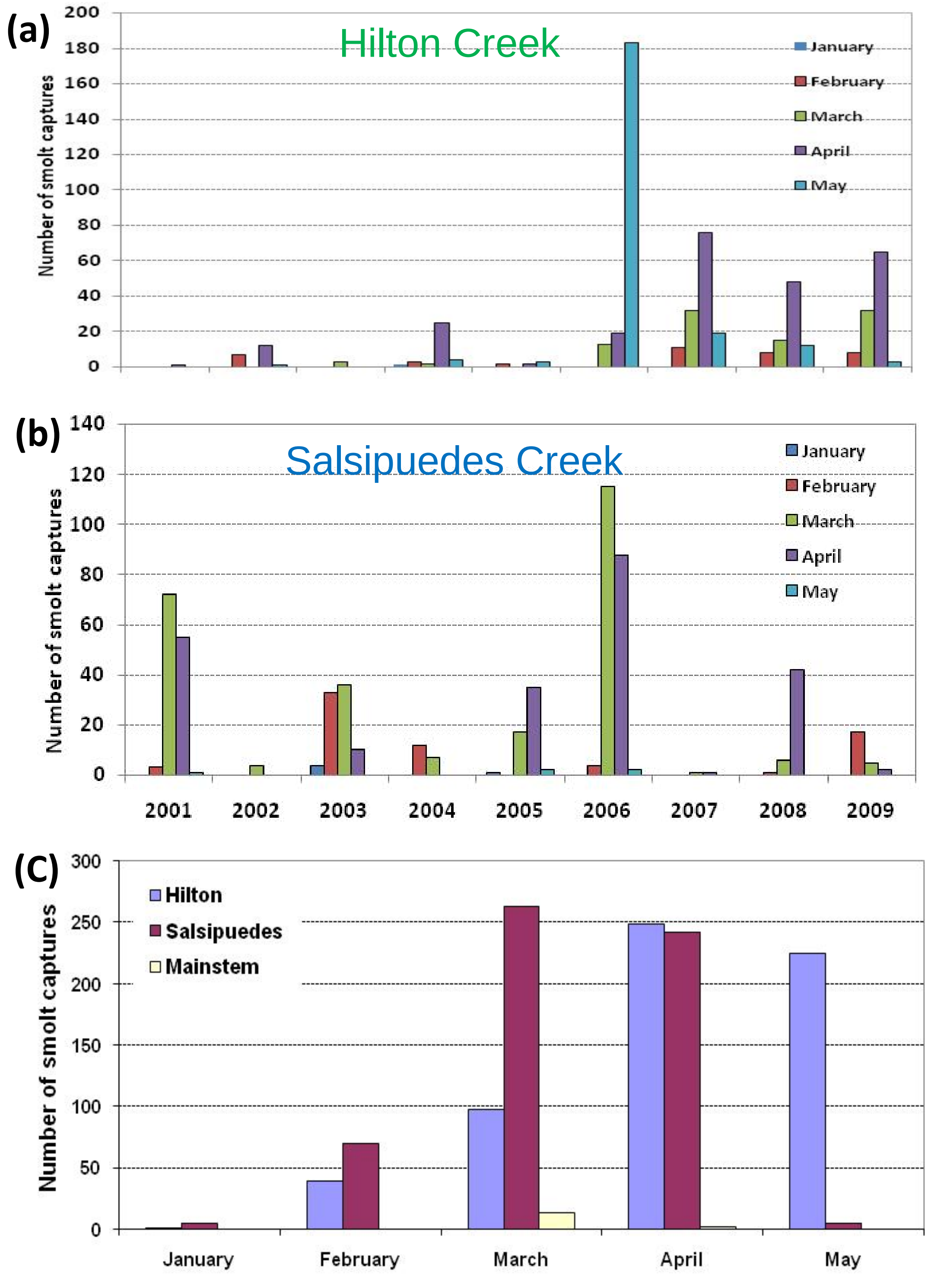


Figure 63: Timing of smolt migration observed at (a) Hilton and (b) Salsipuedes creeks from WY2001 through WY2009; (c) a tabulation of all the years of smolt captures (WY2001-WY2009) by month.

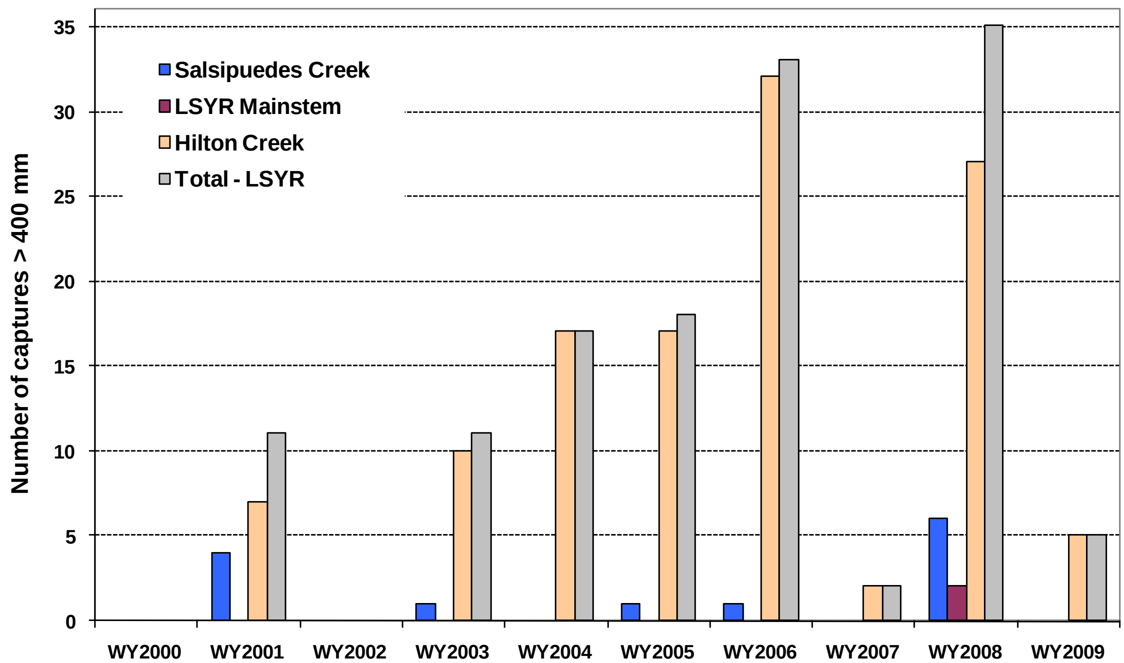


Figure 64: Migrant captures equal to or larger than 400 mm (15.7 inches) observed at the three trap sites from WY2000 through WY2009. The LSYR Mainstem trap was first installed in WY2006 and was not deployed in WY2007 due to low flows.

Table 22: WY2001 through WY2009 tributary upstream and downstream migrant captures for Hilton and Salsipuedes creeks.

WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009		WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009
				Hilton Creek Upstream										Salsipuedes Creek Upstream				
0	0	0	0	0	0	0	0	0	>700	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	4	0	650-699	1	0	1	0	1	0	0	2	0
0	0	0	0	0	0	0	0	1	600-649	0	0	0	0	0	0	0	3	0
0	0	0	0	0	1	0	2	0	550-599	1	0	0	0	0	0	0	0	0
0	0	1	0	2	2	0	2	1	500-549	0	0	0	0	0	1	0	0	0
3	0	0	6	7	9	0	13	1	450-499	1	0	0	0	0	0	0	0	0
4	0	9	11	8	20	2	6	2	400-450	1	0	0	0	0	0	0	0	0
2	0	10	23	7	28	11	31	27	300-399	4	3	0	1	0	5	0	0	0
1	0	2	5	6	9	4	22	29	200-299	7	3	2	10	0	5	2	7	1
9	38	10	21	4	17	15	63	33	101-199	7	8	20	7	0	1	5	1	9
1	1	8	7	0	15	12	32	24	<100	0	0	3	0	0	0	0	2	3
20	**39**	**40**	**73**	**34**	**101**	**44**	**175**	**118**	**Total**	**22**	**14**	**26**	**18**	**1**	**12**	**7**	**16**	**13**
				Downstream										Downstream				
0	0	0	0	0	0	0	0	0	>700	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	2	0	650-699	0	0	0	0	0	*0*	0	0	0
0	0	0	0	0	0	0	1	0	600-649	1	0	0	0	0	*0*	0	0	0
0	0	0	0	0	0	0	1	1	550-599	0	0	0	0	0	*0*	0	0	0
1	0	1	1	2	2	0	1	0	500-549	1	0	0	0	0	0	0	0	0
2	0	1	2	0	4	0	14	1	450-499	1	0	0	0	0	*0*	0	0	0
5	0	2	6	5	5	4	13	0	400-450	0	0	0	0	0	*0*	0	1	0
1	0	1	3	3	15	16	27	23	300-399	4	0	0	0	0	*2*	1	1	0
0	5	1	5	2	13	9	18	26	200-299	19	2	2	2	9	17	3	13	2
0	*4*	*0*	*3*	*1*	*11*	*6*	*4*	*7*	*Smolts*	*8*	*1*	*2*	*0*	*9*	*11*	*0*	*9*	*1*
0	*0*	*0*	*1*	*0*	*0*	*0*	*2*	*0*	*Pre-Smolt*	*0*	*0*	*0*	*1*	*0*	*2*	*0*	*1*	*0*
0	*1*	*1*	*1*	*1*	*2*	*3*	*12*	*19*	*Res*	*1*	*1*	*0*	*1*	*0*	*4*	*3*	*3*	*1*
20	42	8	43	6	45	362	176	219	101-199	134	4	94	17	46	184	12	41	61
1	*17*	*3*	*28*	*6*	*33*	*92*	*58*	*72*	*Smolts*	*121*	*3*	*55*	*8*	*45*	*130*	*1*	*33*	*16*
0	*0*	*0*	*2*	*0*	*5*	*40*	*18*	*31*	*Pre-Smolt*	*2*	*0*	*21*	*2*	*1*	*49*	*1*	*7*	*5*
19	*25*	*5*	*13*	*0*	*7*	*229*	*101*	*116*	*Res*	*11*	*1*	*18*	*7*	*0*	*5*	*10*	*1*	*41*
1	7	10	18	1	176	206	49	34	<100	1	0	12	21	0	23	1	6	111
0	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*0*	*Smolts*	*0*	*0*	*0*	*6*	*0*	*4*	*0*	*0*	*0*
0	*0*	*0*	*0*	*0*	*166*	*0*	*1*	*0*	*Pre-Smolt*	*0*	*0*	*5*	*0*	*0*	*16*	*0*	*0*	*1*
1	*7*	*10*	*17*	*1*	*9*	*206*	*48*	*34*	*Res*	*1*	*0*	*7*	*15*	*0*	*3*	*1*	*6*	*110*
30	**54**	**24**	**78**	**19**	**260**	**597**	**302**	**304**	**Total**	**161**	**6**	**108**	**40**	**55**	**226**	**17**	**62**	**174**

Table 23: WY2001-2009 *O. mykiss* 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:	**WY2001**	**WY2002**	**WY2003**	**WY2004**	**WY2005**	**WY2006**	**WY2007**	**WY2008**	**WY2009**
Year-type:	***Wet***	***Dry***	***Normal***	***Dry***	***Wet***	***Wet***	***Dry***	***Wet***	***Dry***
				Refugio Reach					
Spring	147	1	9	0	49	211	35	190	39
Summer	n/a	3	n/a	n/a	63	242	19	528	32
Fall	6	56	15	0	80	208	12	263	19
				Alisal Reach					
Spring	123	2	0	0	18	134	54	26	39
Summer	11	3	n/a	n/a	21	89	39	118	17
Fall	1	2	n/a	0	11	85	9	42	7
				Hilton Creek					
Spring	1163	624	564	510	1517	2740	1316	2210	545
Summer	1324	139	554	1046	1303	1891	1319	1519	863
Fall	1420	n/a	381	n/a	1272	2016	n/a	738*	746
				Quiota Creek					
Spring	273	359	49	22	n/a	n/a	n/a	243	189
Summer	168	n/a	49	n/a	n/a	142	201	81	101
Fall	161	n/a	n/a	n/a	n/a	84	78	67	39
				Salsipuedes Creek					
Spring	43	n/a	18	n/a	n/a	109	202	n/a	95
Summer	n/a	n/a	n/a	n/a	110	131	n/a	308	28
Fall	n/a	n/a	7	n/a	134	74	76	226	20
				El Jaro Creek					
Spring	61	10	19	n/a	n/a	35	30	n/a	75
Summer	19	n/a	10	n/a	25	35	n/a	405	n/a
Fall	39	n/a	n/a	n/a	3	18	n/a	151	11

n/a: conditions too turbid to snorkel.

* Only half of the normal survey reach was snorkeled.

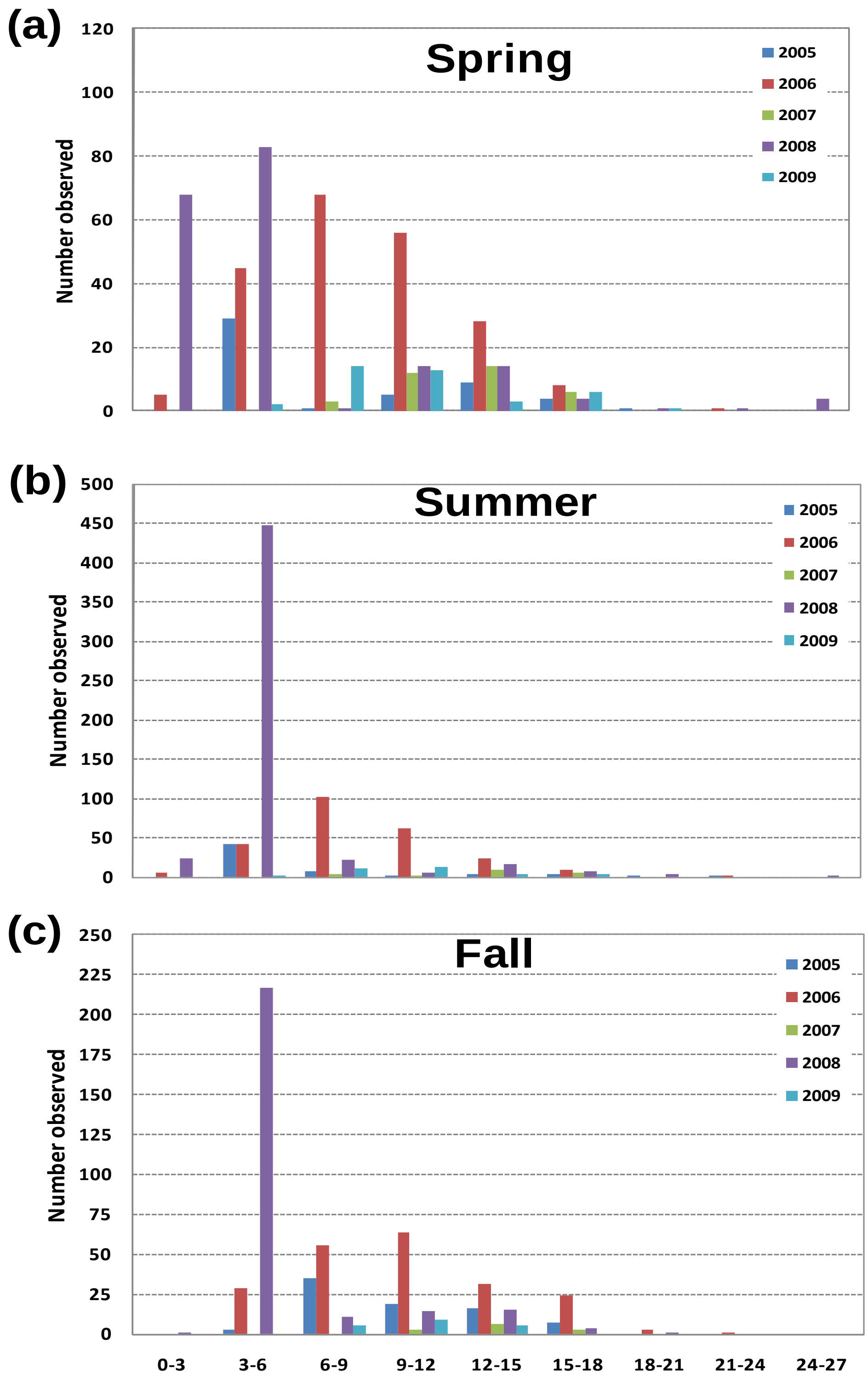


Figure 65: WY2005-2009 (a) spring, (b) summer, and (c) fall snorkel survey results for the LSYR mainstem Refugio Reach broken out by 3 inch size classes.

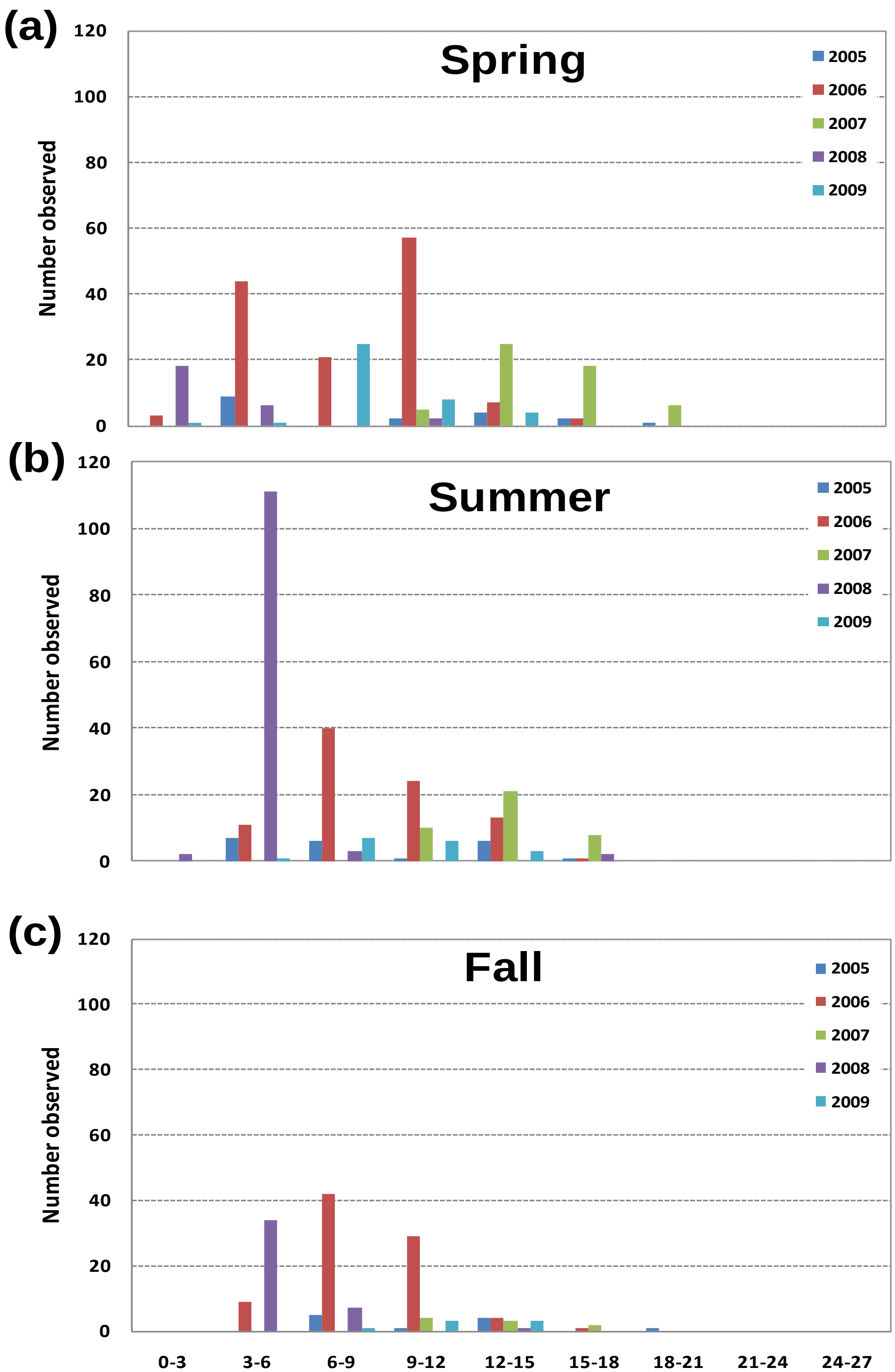


Figure 66: WY2005-2009 (a) spring, (b) summer, and (c) fall snorkel survey results for the LSYR mainstem Alisal Reach broken out by 3 inch size classes.

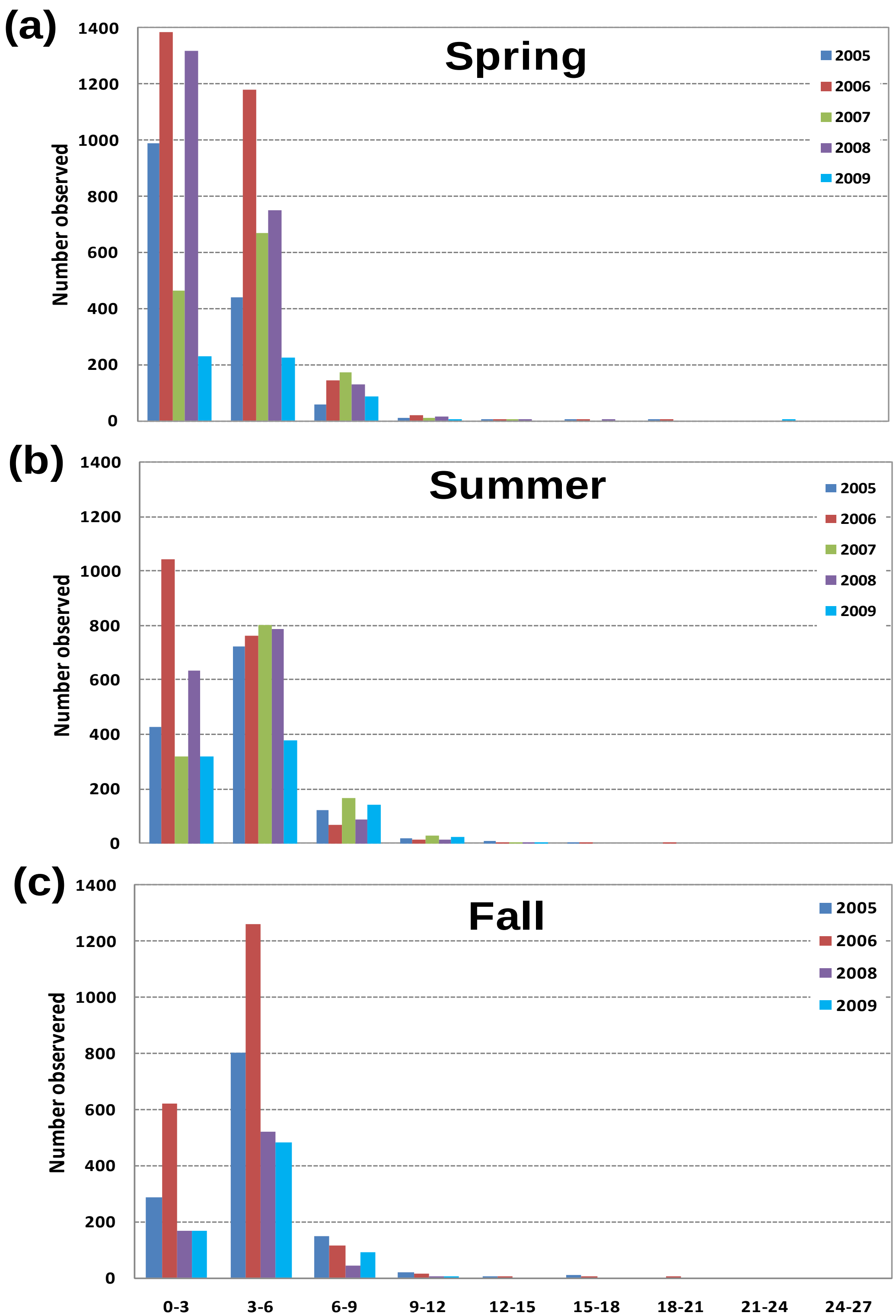


Figure 67: WY2005-2009 (a) spring, (b) summer, and (c) fall snorkel survey results for Hilton Creek broken out by 3 inch size classes. Only half of the WY2008 fall snorkel survey was completed due to visibility issues.

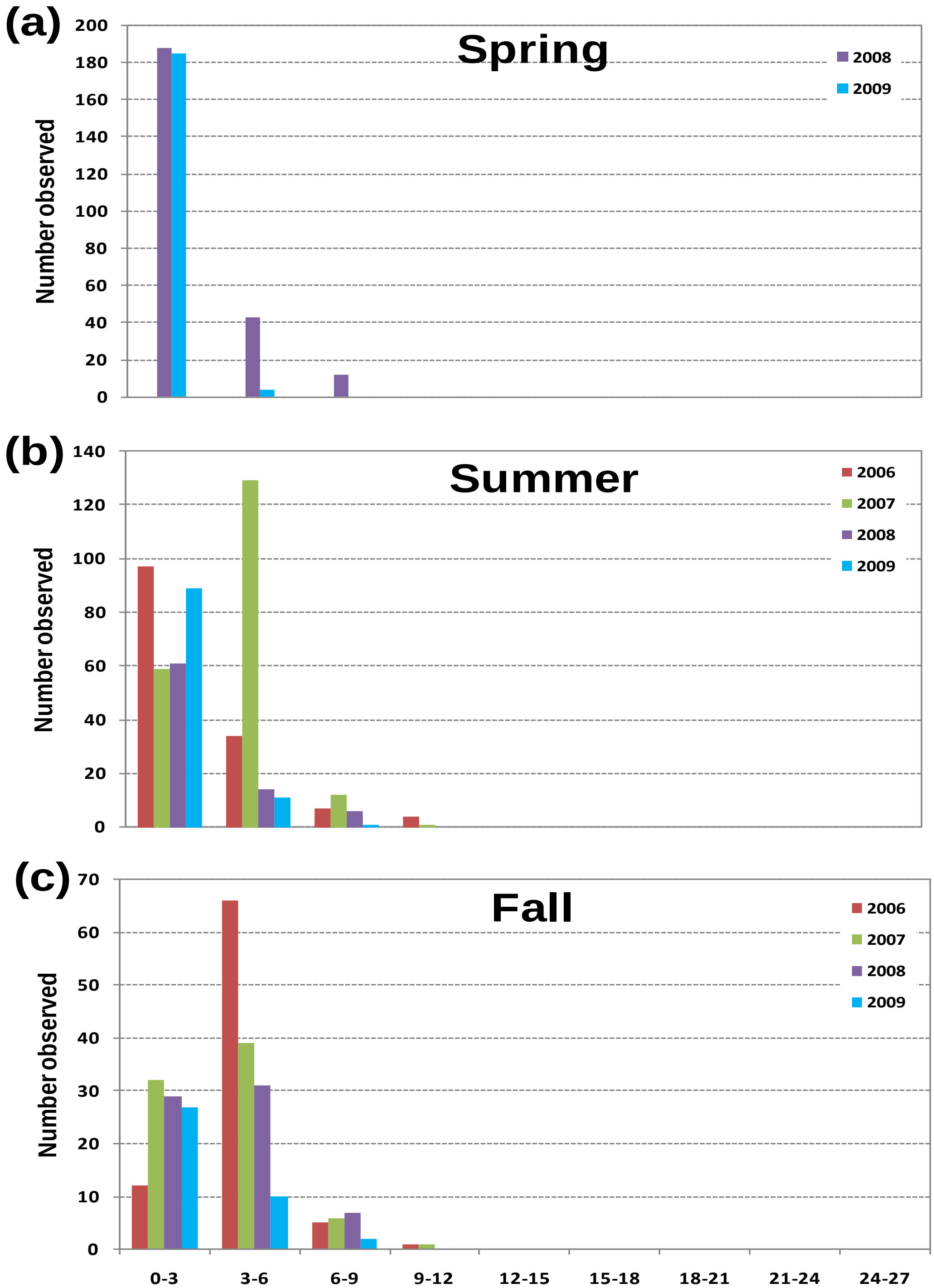


Figure 68: WY2005-2009 (a) spring, (b) summer, and (c) fall snorkel survey results for Quiota Creek broken out by 3 inch size classes.

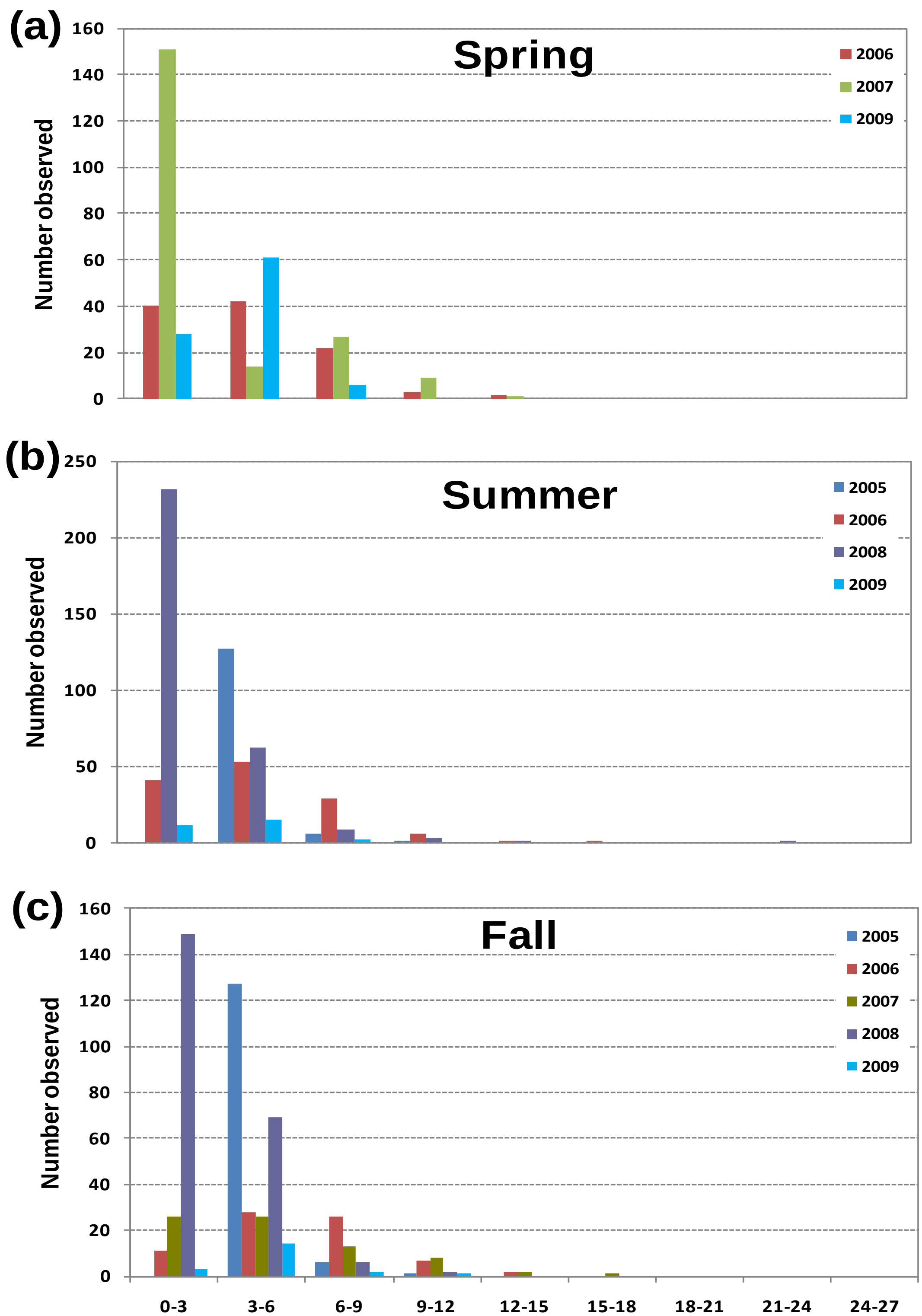


Figure 69: WY2005-2009 (a) spring, (b) summer, and (c) fall snorkel survey results for Salsipuedes Creek broken out by 3 inch size classes. Totals are only from Reach 5 for comparison.

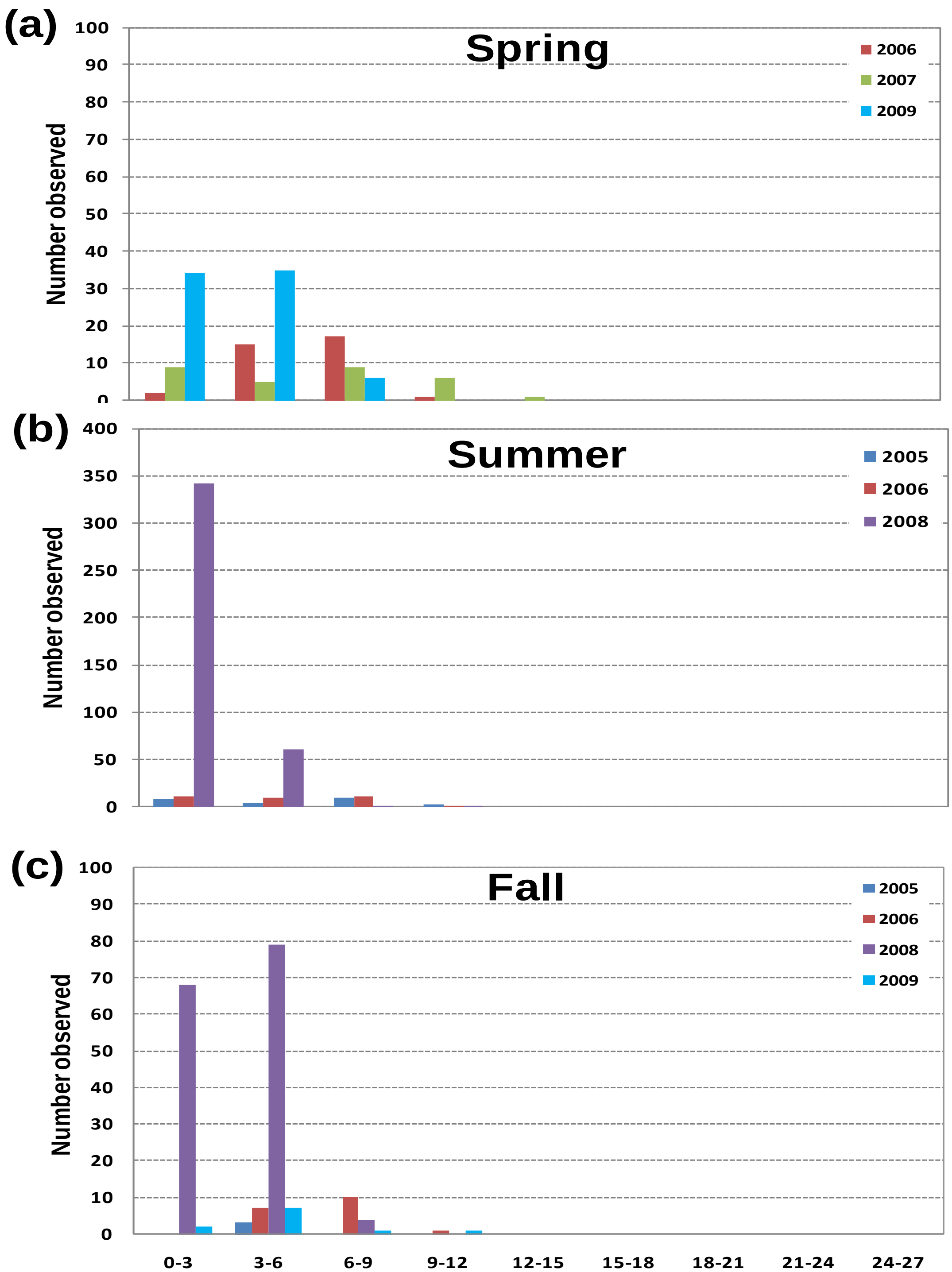
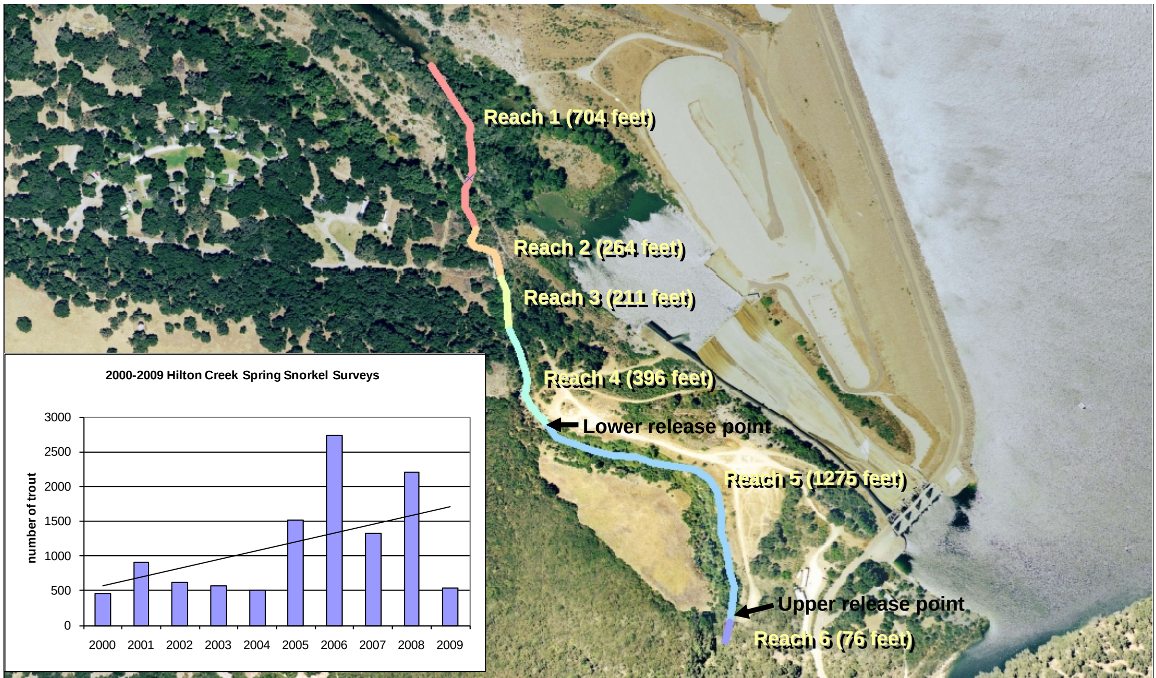


Figure 70: WY2005-2009 (a) spring, (b) summer, and (c) fall snorkel survey results for El Jaro Creek broken out by 3 inch size classes.



Reach	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	64	258	65	288	231	826	484	177	643	174
2	145	191	158	94	159	336	403	159	251	62
3	87	214	146	101	50	181	140	67	43	19
4	160	219	253	79	70	174	403	296	181	116
5	0	0	0	0	0	0	1244	617	1029	174
6	0	0	0	0	0	0	66	0	63	0
Total:	456	882	622	562	510	1517	2740	1316	2210	545

Figure 71: Hilton Creek reaches snorkeled with trend analysis from the spring snorkel surveys in 2000 through 2009. The Cascade Chute migration barrier was removed in December of 2005.

Table 24: WY2001-2009 warm-water species spring, summer and fall snorkel survey results for the LSYR mainstem Refugio and Alisal reaches combined.

Water Year:	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009
Largemouth Bass									
Spring	78	147	184	22	0	7	35	4	160
Summer	57	881	Dry	172	20	3	33	626	239
Fall	57	374	0	290	237	2	56	508	261
Sunfish									
Spring	67	40	7	5	4	9	34	0	38
Summer	18	11	Dry	1	34	41	3	262	89
Fall	8	9	0	0	22	1	18	155	23
Catfish									
Spring	7	2	0	0	2	0	3	1	0
Summer	0	0	Dry	0	6	55*	2	2	1
Fall	1	2	0	2	200*	0	3	1	1
Carp									
Spring	0	0	0	0	0	9	138	50	66
Summer	0	0	Dry	0	178**	46	159	88	48
Fall	0	0	0	0	282**	10	190	69	65

* Juvenile bullhead catfish.

** Mostly juvenile carp.

Appendices

A. Acronyms and Abbreviations

AF: Acre Foot
MC: Adaptive Management Committee
BO: Biological Opinion
CCRB: Cachuma Conservation Release Board
CCWA: Central Coast Water Authority
CDFG: California Department of Fish and Game
CFS: Cubic Feet per Second
COMB: Cachuma Operation and Maintenance Board
CPBS: Cachuma Project Biology Staff
CPUE: Catch Per Unit Effort
DO: Dissolved Oxygen Concentration
EJC: El Jaro Creek
HC: Hilton Creek
HCWS: Hilton Creek Watering System
Hwy: Highway
LRP: Lower Release Point
LSYR: Lower Santa Ynez River
NMFS: National Marine Fisheries Service
NOAA: National Oceanic Atmospheric Administration
O. mykiss: *Oncorhynchus mykiss*, steelhead/rainbow trout
ORP: Oxidation Reduction Potential RPM: Reasonable and Prudent Measure
QC: Quiota Creek
RTDG: Real Time Decision Group
SMC: San Miguelito Creek
SWP: State Water Project
SWRCB: California State Water Resources Control Board
SYRCC: Santa Ynez River Consensus Committee
SYRTAC: Santa Ynez River Technical Advisory Committee
TDS: Total Dissolved Solids
URP: Upper Release Point
USBR: United States Bureau of Reclamation (Reclamation)
USGS: United States Geological Survey
WY: Water Year (October 1 through September 30)

B. 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

<u>Thermographs</u>

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 half a foot above the substrate. 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. After any thermograph download, each unit is wiped off to reduce algae and sediment buildup.

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 2002-2009 in the spring, summer, and fall. After 2005 and continuing through 2009, photo points were scaled down and taken at irregular intervals. All photo points taken in WY2009 are listed in 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: 2009 photo points on the LSYR mainstem. "X's" denote photos taken, d/s downstream and u/s upstream.

LSYR Mainstem Photo Point ID	Location/Description	5/09	11/09
M1	Lower Hilton Creek, photo d/s at ford crossing		
M2a	Bluffs overlooking long pool, photo u/s		
M2b	Bluffs overlooking long pool, photo d/s		
M3	Highway 154 culvert on Hilton Creek, photo u/s		
M4	Highway 154 culvert on Hilton Creek, photo d/s		
M5	Highway 154 Bridge, photo u/s	x	
M6	Highway 154 Bridge, photo d/s	x	
M7	Meadowlark crossing, photo u/s	x	
M8	Meadowlark crossing, photo d/s	x	
M9	Lower Gainey crossing, beaver dam, photo u/s		
M10	Lower Gainey crossing, beaver dam, photo d/s		
M11a	Lower Gainey crossing, photo u/s		
M11b	Lower Gainey crossing, photo d/s		
M12	Refugio Bridge, photo u/s	x	x
M13	Refugio Bridge, photo d/s	x	x
M14	Alisal Bridge, photo u/s	x	x
M15	Alisal Bridge, photo d/s	x	x
M17	Mid-Alisal Reach, photo u/s		
M18	Mid-Alisal Reach, photo d/s		
M19	Avenue of the Flags Bridge, photo u/s	x	x
M20	Avenue of the Flags Bridge, photo d/s	x	x
M21	Sweeney Road crossing, photo u/s	x	x
M22	Sweeney Road crossing, photo d/s	x	x
M23	Highway 246 (Robinson) Bridge, photo u/s	x	
M24	Highway 246 (Robinson) Bridge, photo d/s	x	
M25	LSYR Lagoon on railroad bridge, photo u/s		
M26	LSYR Lagoon on railroad bridge, photo d/s		
M27	LSYR at 35th St. Bridge, photo d/s		
M28	LSYR at 35th St. Bridge, photo u/s		
M29	LSYR Lagoon upper reach, photo d/s		
M30	LSYR Lagoon upper reach, photo u/s		

Table B-2: 2009 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	5/09	11/09
T1	Hilton trap site, photo u/s	x	
T2	Hilton trap site, photo d/s	x	
T3	Hilton at ridge trail, photo d/s	x	
T4	Hilton at ridge trail, photo u/s	x	
T5	Hilton at telephone pole, photo d/s	x	
T6	Hilton at telephone pole, photo u/s	x	
T7	Hilton at tail of spawning pool, photo u/s	x	
T8	Hilton impediment/tributary, photo d/s		
T9	Hilton impediment/tributary, photo u/s		
T10	Hilton just u/s of URP, photo d/s		
T11	Hilton road above URP, photo d/s		
T12	Hilton road above URP, photo u/s		
T14	Hilton from hard rock toe, photo d/s		
T15	Hilton from hard rock toe, photo u/s		
T16	Quiota Creek at 5th crossing, photo d/s	x	
T17	Quiota Creek at 5th crossing, photo u/s	x	
T18	Quiota Creek at 6th crossing, photo d/s	x	
T19	Quiota Creek at 6th crossing, photo u/s	x	
T20	Quiota Creek at 7th crossing, photo d/s	x	
T21	Quiota Creek at 7th crossing, photo u/s	x	
T22	Quiota Creek below 1st crossing, photo d/s	x	
T23	Alisal Creek from Alisal Bridge, photo u/s	x	x
T24a	Alisal Creek from Alisal Bridge, photo u/s	x	x
T24b	Alisal Creek from Alisal Bridge, photo d/s		
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s	x	
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s		
T27	Nojoqui/LSYR confluence, photo u/s		
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s	x	x
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s	x	x
T39	Salsipuedes Creek at Hwy 1 Bridge, photo d/s		x
T40	Salsipuedes Creek at Hwy 1 Bridge, photo u/s		x
T41	Salsipuedes Creek at Jalama Bridge, photo d/s		x
T42	Salsipuedes Creek at Jalama Bridge, photo u/s		x
T43	El Jaro/Upper Salsipuedes confluence, photo u/s		
T44	Upper Salsipuedes/El Jaro confluence, photo u/s		
T45	Upper Salsipuedes/El Jaro confluence, photo d/s		
T48	El Jaro Creek above El Jaro confluence, photo u/s		
T49	El Jaro Creek above El Jaro confluence, photo d/s		
T52	Ytias Creek Bridge, photo d/s		
T53	Ytias Creek Bridge, photo u/s		
T54	El Jaro Creek 1st Hwy 1 Bridge, photo d/s		
T55	El Jaro Creek 1st Hwy 1 Bridge, photo u/s		
T56	El Jaro Creek 2nd Hwy 1 Bridge, photo d/s		
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s		
T58	El Jaro Creek 3rd Hwy 1 Bridge, photo d/s		
T59	El Jaro Creek 3rd Hwy 1 Bridge, photo u/s		
T60	San Miguelito Creek at crossing, photo d/s		
T61	San Miguelito Creek at Stillman, photo u/s		