United States Department of the Interior

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Mid-Pacific Region
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CACHUMA O&M BOARD

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

Subject: 2010 Annual Monitoring Report for Cachuma BO

Dear Mr. McInnis:

The Bureau of Reclamation (Reclamation) is pleased to provide the 2010 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 National Marine Fisheries Service's, "*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 2011 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, NGruenhagen@usbr.gov, or at 800-735-2929 for the hearing impaired.

Sincerely,

David E. Hyatt
Supervisory Biologist

Enclosure

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2010 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:

U.S. BUREAU OF RECLAMATION

SOUTH CENTRAL CALIFORNIA AREA OFFICE

JANUARY 28, 2013

Executive Summary

This report presents the data and summarizes the results of monitoring southern steelhead and water quality conditions in the LSYR below Bradbury Dam during Water Year 2010 (WY, 10/1/09 – 9/30/10). The report also incorporates references to observations and fish population trends for the period from WY2001 through WY2010 for comparative purposes. Fish monitoring during WY2010 suggests that management actions undertaken by the Bureau of Reclamation (USBR or Reclamation) on the Lower Santa Ynez River (LSYR) continue to positively influence trends in numbers of southern steelhead (*Oncorhynchus mykiss*, *O. mykiss*) in the basin.

The monitoring tasks completed in WY2010 were primarily performed below Bradbury Dam in the LSYR watershed, which is approximately half the area (450 square miles) and stream distance (48 miles) to the ocean compared to the entire watershed. The area is within the Southern California Steelhead Distinct Population Segment (DPS). 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 summarizes data accumulated since the 2009 Annual Monitoring Report and is intended to fulfill the annual reporting requirements of the Cachuma Project Biological Opinion (BO) for WY2010. The BO was issued by the National Marine Fisheries Service (NMFS) to Reclamation for the operation of the Cachuma Project (NMFS, 2000). This report was prepared by Reclamation with the monitoring and data analyses prepared by Cachuma Operation and Maintenance Board (COMB), Cachuma Project Biology Staff (CPBS) of the Fisheries Division, in cooperation with the Cachuma Conservation Release Board (CCRB) and Santa Ynez River Water Conservation District, Improvement District No. 1 (ID#1). 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 and WY2009 Annual Monitoring Reports 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, (C) a list of photo points, (D) and a list of reports generated during the year in support of the fisheries program and for BO compliance.

WY2010 was a wet year (23.92 inches of precipitation measured at Bradbury Dam; long-term average is 20.6 inches) with the majority of the rainfall occurring in January, February, and April. On 1/18/10, a large storm event caused the sand bar at the mouth of the Santa Ynez River Lagoon to breach on 1/19/10. River connectivity to the ocean was maintained after the breach for 107 days ending on 5/6/10. Bradbury Dam did not spill in WY2010 and reservoir storage was above 120,000 acre feet. Hence, target flows in Hilton Creek (2 cubic feet per second (cfs) minimum) and Highway 154 Bridge (5 cfs minimum) were maintained, and there was no target flow requirement at Alisal Bridge as described in the BO. The last spill event was in WY2008 with a spill volume greater than 20,000 acre-feet. A Water Right (WR) 89-18 release was conducted from 8/2/10 through 11/2/10 for 92 days.

There were two passage supplementation releases from Lake Cachuma on 2/6/10 and 4/1/10 that extended steelhead migration potential to over 14 days for each of the two events. Migrating *O. mykiss* were observed at the mainstem trap during both events. The winter provided passage opportunities for returning southern steelhead particularly during January and the two passage supplementation events. Only one anadromous adult steelhead was observed within the Santa Ynez River basin below Bradbury Dam in WY2010. This fish was captured at the Salsipuedes Creek downstream trap on 3/5/10. It measured 634 mm (25 in) long. There were 137 downstream migrant steelhead smolts recorded at the three trapping sites (Hilton Creek, Salsipuedes Creek and LSYR mainstem near Santa Ynez) during the migration season. The fish ranged in size from 125 mm (4.9 in) to 270 mm (10.6 in). This was the third highest annual total number of smolts captured and fifth in total migrant captures at 367 fish since WY2001 (Figure ES-2). More captures (n=30) were made in the LYSR in WY2010 since the LSYR migrant traps were first deployed here in WY2006. Any variance in the total number of captures presented in previous Annual Monitoring Reports relate to inclusion of recaptures into the totals in this report. The marked decrease in total captures in WY2010 compared to the previous four years was possibly due to a very dry year in WY2009 that caused an overall decrease in the fish population. Specifically, total migrant captures at the two tributary trap sites declined from the previous year (187 to 79 and 422 to 258 at Salsipuedes and Hilton Creek traps, respectively). However, migrant captures at the mainstem trap site increased from WY2009 to WY2010, 3 to 30 captures respectively.

Stream water quality data (temperature and dissolved oxygen concentration) are presented for the LSYR mainstem below Bradbury Dam and its tributaries where steelhead historically have been observed. No specific water quality concern was observed. Given the complexity of the dataset, details are summarized in the Monitoring Results Section (3.2) below.

Reclamation has completed several actions for the benefit of southern steelhead since the BO was issued including: the Hilton Creek Watering System (HCWS); the completed tributary passage enhancement projects on Hilton, Quiota, El Jaro, and Salsipuedes creeks; the bank stabilization and erosion control projects on El Jaro Creek; maintenance of the mainstem and Hilton Creek flow targets; and the implementation of the Fish Passage Supplementation Program. Designs were completed and grants submitted for another project on Quiota Creek.

Subject to funding availability, the following are recommendations to improve the monitoring program:

- Continue the monitoring program described in the revised Biological Assessment (2000) to evaluate *O. mykiss* and their habitat within the LSYR for long-term trend analyses and improve consistency of the monitoring effort for better year to year comparisons.
- Investigate Dual-Frequency Identification Sonar (DIDSON) technologies as a potential solution for monitoring migrants during high flow conditions. DIDSON monitoring should be done as a complement to, and not a replacement for, current migrant trapping activities.
- Continue to refine the dry season water quality monitoring program elements for water temperature and dissolved oxygen concentration, specifically the use of the sondes to address more specific monitoring and research objectives.
- Conduct regular monthly lake profiles at the HCWS intake barge from April through December to more consistently monitor Lake Cachuma water quality conditions at depth particularly at the intake hose elevation of 65 feet for the HCWS.
- Re-evaluate and improve photo-point locations establishing a more regimented photo-documentation effort to record changes in habitat features such as channel form and riparian habitat.
- Further utilize seasonal field biologists to maximize their utility specifically in the area of data entry, equipment repair, and general logistics of the overall monitoring program.
- The Adaptive Management Committee (AMC) should be convened to address the potential effects to *O. mykiss* from beavers and beaver dams as well as warm water predatory species within the LSYR basin. Based upon the AMC's recommendations, Reclamation shall determine and implement future studies and actions needed.
- Complete the Annual Monitoring Report as soon as possible after the end of the water year so that the results can be reviewed, and improvements made in a timely manner for the following year's monitoring effort.
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS to improve our collective knowledge, collaboration, and dissemination of information.

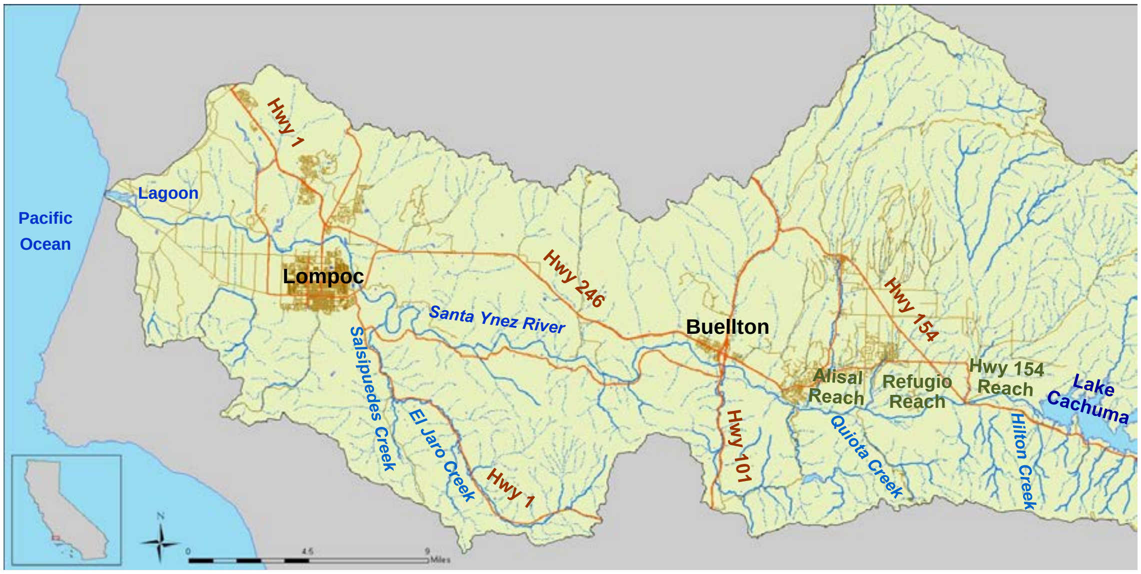
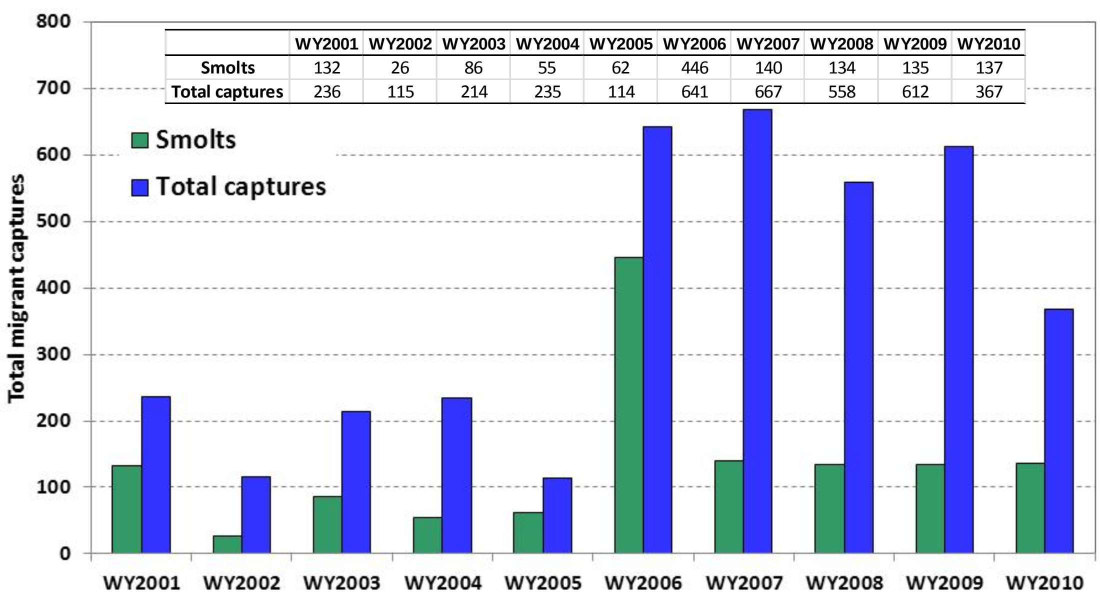


Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean to the west of Lompoc showing tributary creeks and management reaches of interest for the LSYR Fisheries Monitoring Program.



	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010
Smolts	132	26	86	55	62	446	140	134	135	137
Total captures	236	115	214	235	114	641	667	558	612	367

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 WY2010, including recaptures.

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WY2010 Annual Monitoring Report

1. Introduction

The Cachuma Project Biological Opinion (BO) requires the U. S. Bureau of Reclamation Department of Interior, (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 (BA) (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 2010 Annual Monitoring Report is to evaluate the effects of the Cachuma Project on steelhead (*Oncorhynchus mykiss*, *O. mykiss*) in the Lower Santa Ynez River (LSYR) below Bradbury Dam. Data collected throughout WY2010 regarding steelhead population changes, movements and reproductive success, target flow compliance, water quality conditions, and the effectiveness of restoration activities are analyzed and presented. This 2010 Annual Monitoring Report also presents findings and observations of trends from 2001-2010 as a continuation of the analyses presented in the 1993-2004 Synthesis Report (AMC, 2009), 2008 Annual Monitoring Report and Trend Analysis for 2005-2008 (USBR, 2011), and the 2009 Annual Monitoring Report (USBR, 2012). 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 data summarized in this report describe the condition and the fishery observations during WY2010. 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 after the dry season. Throughout the report, LSYR stream network locations are assigned alpha-numeric site-codes 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 and 0.14 miles upstream of its confluence with the mainstem).

WY2010 was classified as a wet year with 23.92 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 the year prior (WY2009), there is less habitat, food and opportunity for spawning; dry season rearing is poorer which cumulatively may adversely affect populations in the following year. WY2010 had the third highest number of smolts captured that were migrating downstream, but only the fifth highest total migrant captures of *O. mykiss* at the three trapping sites within the LSYR since 2001.

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 *O. mykiss* in the LSYR in 1993. Since then, the Cachuma Project Member Units have funded and conducted the long-term Fisheries Monitoring Program and habitat enhancement within the LYSR through the CPBS on behalf of Reclamation in compliance with the BO. The program has evolved in scope and specificity of monitoring tasks 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 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, 2009), from 2005 to 2008 (USBR, 2011), and 2009 (USBR, 2012), all four data summaries were submitted to NMFS to fulfill the required annual monitoring reporting requirements (T&C 11.1) for those years.

Rainbow trout (coastal rainbow) and southern steelhead are the same species (*O. mykiss*) and visually indistinguishable except for the larger size of a returning ocean run steelhead and color of an outmigrating smolt (silver with blackened caudal fin) observed during the latter half of the migration season. Rainbow trout (non-anadromous or freshwater resident) can remain in the freshwater life-history strategy for several years, or even generations, before exhibiting smolting characteristics and returning to the ocean (NMFS, 2012). The two will be distinguished as best as possible throughout the report.

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 migration and spawning season for *O. mykiss* corresponds with the initiation of the wet season, and these activities overlap in 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 sometime 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). Water quality monitoring followed regulatory and industry guidelines for quality assurance and control, which are presented in Appendix B.

3. Monitoring Results

The results from the WY2010 monitoring effort are organized by hydrologic condition (rainfall, stream runoff and ocean connectivity), passage supplementation, target flows, release of State Water Project (SWP) water into the LSYR, water quality, habitat quality, *O. mykiss* 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 precipitation (e.g., rainfall) is equal to or greater than 22 inches (AMC, 2008). The California State Water Resources Control Board (SWRCB) uses different criteria that focus on river runoff (in this case inflow to the Cachuma Reservoir); a critically dry year when inflow is equal to or less than 4,550 acre-feet (af); a dry year when inflow is between 4,550 af and 15,366 af; a below normal 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 AMC reports, the SWRCB approach will not be used in this report, although the designation would have been a normal year at 56,627 af of computed inflow to Lake Cachuma.

WY2010 had 23.92 inches of rainfall at Bradbury Dam and was therefore classified as a wet year (more than 22 inches) (Table 1). Historic minimum, maximum, and WY2010 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 within the watershed as well as between wet and dry years.

There were 18 precipitation-events in WY2010 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). The majority of the storms in WY2010 occurred during December, January, February, and April with the longest event lasting six days starting on 1/18/10 and concluding on 1/23/10. 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. The Hilton Creek gauge (USGS-11125600) was not included because that is a low flow gauge only (less than 50 cfs). The period that the lagoon was open to the ocean was incorporated into the figure.

Peak daily discharge recorded by the USGS at the Narrows, Solvang and Los Laureles gauges occurred on 1/21/10 at 2,130 cfs, 549 cfs, and 1,500 cfs, respectively. Instantaneous peak discharges at those gauges were 3,660 cfs on 1/21/10, 1,770 cfs on 1/21/10 and 4,080 cfs on 1/20/10, respectively. At these discharge rates, no substantial fluvial geomorphic changes were observed to the tributary or mainstem channels. Over two inches of rainfall fell in each of the following months: October, December, January, February, and April with the highest cumulative total in January at 10.34 inches (Table 3). There was very little to no precipitation in November and from May to the end of the water year. October 2009 had an unusually large rainfall event with 2.20 inches falling during the middle of the month. A dry spring resulted in dry hydrologic conditions in the summer and fall of WY2010 and triggered a Water Rights 89-18 (WY 89-18) release for 92 days from 8/2/10 through 11/2/10 (Figure 2).

Annual hydrographs for Salsipuedes Creek and along the Santa Ynez River at Los Laureles, Solvang, and the Narrows reflected appreciable winter and spring runoff through April. Conditions dried from May onward, with flows approaching zero by the end of June at the USGS gauge at Los Laureles, Solvang and the Narrows (Figure 2). The HCWS maintained a minimum baseflow above 2 cfs throughout the water year creating favorable rearing and over-summering conditions for *O. mykiss* (Figure 3).

Ocean connectivity: There was insufficient runoff to spill Lake Cachuma, but tributary flow, specifically from the Salsipuedes Creek drainage, was sufficient to breach the sandbar in WY2010. The Santa Ynez River lagoon was monitored daily by a Lompoc resident, and the sandbar was breached on 1/19/10 after a large storm that began on 1/18/10 (9.74 inches at Bradbury Dam). It remained open for 107 days before closing on 5/6/10 for the rest of the year, except for two days when the lagoon temporarily closed on 4/2/10 and 4/3/10 (Figures 2 and 3). This duration was well below the average for wet years (153 days) since 2001 (Table 4). Prior to the 1/18/10 storm, the lagoon had been closed since 3/17/09.

Since WY2006, presence of the lagoon sandbar has been monitored daily from Ocean Park (at the lagoon, see Figure ES-1) during the migration season (December through June) 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: WY2010 was a wet year and the criteria to initiate passage supplementation as outlined in the BA (USBR, 1999; USBR, 2000), BO RPM 3 (NMFS, 2000) and an AMC technical memo (AMC, 2004), were met on 1/21/10. The cumulative flow in Salsipuedes Creek from December 1 reached 1,636 af that day, the lagoon was open to the ocean, and all tributaries to the LSYR mainstem were flowing. The AMC appointed the Real Time Decision Group (RTDG) to work with Reclamation to carry out the Fish Passage Supplementation Program. The RTDG had met several times to discuss watershed conditions before conducting the first passage supplementation event from 2/6/10 to 2/22/10 in association with the 2/5/10 storm event. Of the 3,200 af of the Fish Passage Supplementation Account, 1,454 af and 1,380 af were released in the first (2/6/10 to 2/22/10) and second (4/1/10 to 4/16/10) passage events, respectively, leaving 350 af unused and were carried over at the end of WY2010 (16 af were used in a false forecast on 3/7/10).

Two resident *O. mykiss* were captured at the LSYR mainstem trap during the first supplementation event. No smolts or anadromous steelhead were captured at the LSYR mainstem trap during this first passage supplementation event. However, one adult steelhead measuring 634 mm (or 25.0 in) was captured moving downstream in Salsipuedes Creek on 3/5/10, 11 days following the completion of the 2/6/10 supplementation event. It’s possible, based on this fish’s coloration and condition that it moved into Salsipuedes Creek sometime within the previous two to three weeks when the Salsipuedes Trap was removed due to high flows.

The second passage supplementation event was initiated on 4/1/10 in conjunction with a storm on 3/31/10. The 3/31/10 storm was predicted as being a moderate storm event that would have met all of the required triggers for passage supplementation. As it turned out, the storm weakened as it approached the coast, which resulted in less rain than predicted. A total of 0.04 inches rainfall fell at Bradbury Dam. The release started 10 hours before the storm arrived, well before the change in forecast. The RTDG decided that there was more biological benefit to continue the passage supplementation than to cancel it 10 hours into the release. Additional storms were also predicted in the near future and the biological benefit was considered to be high for out-migrating fish based on trapping data (i.e., smolts were passing through the Hilton Trap but had not shown up at the LSYR Mainstem Trap yet). The tributary migrant trap at Salsipuedes Creek also indicated smolts were moving downstream prior to the 3/31/10 passage supplementation event and the RTDG felt that additional flows would benefit those out-migrants. There were 16 passage days during this period, all of which were generated from the supplementation release. During this second release, 21 smolts and 1 resident *O. mykiss* were captured downstream in the LSYR Mainstem Trap. This represented 73.3% of all migrant captures for the migration season within the LSYR Mainstem Trap. This was the largest number of smolts ever captured at that trap site since it was installed in WY2006. There were no anadromous adult steelhead or upstream migrating *O. mykiss* captured during this second passage supplementation. Further details can be seen in the 2010 Fish Passage Supplementation Report (RTDG and CPBS, 2010).

The migrant captures associated with those two passage supplementation events comprise 80% of the total LSYR mainstem trap captures during WY2010 with the last event being more significant. This suggests the Passage Supplementation Program benefits migrating steelhead and that the program should be continued.

Adaptive Management Account: The full allotment of 500 af for the Adaptive Management Account from the WY2008 spill event carried over at the end of WY2010 for future releases**.**

Target flows: The previous spill event with a spill volume greater than 20,000 af was in WY2008 which triggered long-term target flows during that water year and the following year (WY2009). Target flows, as established in the BO, were 10 cfs (WY2008) then 5 cfs (WY2009) at Highway (Hwy) 154 Bridge, 1.5 cfs at Alisal Bridge (Solvang), and a minimum of 2 cfs in Hilton Creek through the HCWS. In WY2010, which was not a spill year, target flows were only required at Hwy 154 Bridge (5 cfs) and in Hilton Creek (a minimum of 2 cfs through the HCWS) (Figure 3). No target flows were required to Alisal Bridge. There is no USGS stream discharge gauge at the Hwy 154 Bridge, hence Reclamation maintains target flows at that site following NMFS approved operational guidelines produced by Stetson Engineers on behalf of Reclamation (Table 23) (Stetson Engineers, 2004) that was subsequently updated (Table ES-1) (Stetson Engineers, 2011). The maximum recommended releases were made due to small tributary flow inputs. No fish strandings or mortalities were observed during the dry season within the Hwy 154 Reach, Refugio Reach, Alisal Reach, or within Hilton Creek, and no modifications to the procedure guidelines are recommended.

Water Rights Releases: Water Rights (WR 89-18) releases began on 8/2/10 and ended on 11/2/10, with a total release amount of 8,646 af over 92 days (USBR et al., 2012). Monitoring for fish movement and water quality was conducted by the CPBS as stipulated in the BO RPM 6 and the 2010 Study Plan. Snorkel surveys during the releases indicated *O. mykiss* were not encouraged to move downstream of Alisal Bridge throughout the WR 89-18 release. No fish were found stranded during the release or after ramp-down of the release. These findings were consistent with previous monitoring efforts during prior WR 89-18 releases. Further details of the 2010 WR 89-18 release are provided in the RPM 6 monitoring report submitted by Reclamation to NMFS (USBR et al., 2012).

Mixing of State Water Project Waters in the LSYR: Central Coast Water Authority (CCWA) supplies State Water Project (SWP) water to Lake Cachuma through the Bradbury Dam Outlet Works. If Reclamation is conducting releases through the Outlet Works at the same time, SWP water also may be released contemporaneously but this release must follow specific criteria outlined in the BO. Reclamation operates facilities so releases comply with the less than 50% mixing criteria described in RPM 5 of the BO (NMFS, 2000). The criterion was met throughout WY2010 since no SWP water was released or mixed (Figure 4) when flow was continuous in the LSYR mainstem and the sandbar was open. Since the issuance of the BO in 2000, the less than 50% mixing criterion always has been met during the non-migration season (July-November). The "no mixing" criterion always has been met 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:

Water quality was monitored within the LSYR Basin during the dry season from May through November to track conditions for over-summering *O. mykiss*. The critical parameters for salmonid survival, water temperature and dissolved oxygen concentration (DO) concentrations, were consistently recorded. At other times, water quality parameters logged included ORP, specific conductance, TDS, pH, and salinity. Stream and lake water temperatures and DO concentrations are presented below in this section for the LSYR mainstem, selected tributaries and Lake Cachuma.

Stream water temperatures were collected at various locations (Figure 5) within the mainstem and tributaries of the LSYR with Onset programmable thermographs (water temperature loggers recording continuously every hour) or with Solinst non-vented pressure transducers with temperature loggers. DO concentrations were recorded with programmable YSI 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 in place in the mainstem and tributaries downstream of Bradbury Dam, as described in the BA, to monitor seasonal trends, diel variations, longitudinal and vertical gradients, and general temperature suitability for *O. mykiss* (USBR, 2000). Changes in channel configuration and associated pool habitat, as well as landowner access issues. have necessitated modifying the thermograph deployment regime and locations described in the BA (USBR, 2000). In WY2010, sonde deployments targeted 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 LSYR mainstem and its tributaries.

Water temperature (thermographs): During WY2010, thermographs were deployed in several configuration types: single units (1 or single) mainly in the tributaries and 2-unit vertical arrays (2 or vertical array) in the mainstem. All totaled, 12 LSYR mainstem thermographs were deployed at 7 sites: the Long Pool (LSYR-0.5 (n=2)), the Santa Ynez River directly downstream of Long Pool and upstream of the Reclamation and Crawford-Hall property boundary (LSYR-0.51 (n=1)), Encantado Pool (LSYR-4.9 (n=2)), LSYR-7.3 (n=2), LSYR-9.6 (n=2), Alisal Bedrock Pool (LSYR-10.2 (n=2)), and the Avenue of the Flags Pool (LSYR-13.9 (n=1)) (Figure 5 and Table 5). Five 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). The top unit of the vertical array was positioned approximately 1 foot below the surface and the bottom unit placed approximately 1 foot above the bottom at each sites. All array locations in pool habitats on the LSYR mainstem were chosen on the basis that they were known to have previously supported *O. mykiss* sometime after 2001, However, several previously monitored locations were discontinued due to habitat alterations (LSYR-6.0 and LSYR-7.8), dry conditions (LSYR-26.7), discontinuation of a monitoring site, such as the Stilling Basin (LSYR 0.0), and access limitations (two sites within the Santa Ynez River Lagoon).

During 2010, additional water temperature and DO concentration data were collected in the mainstem that will be analyzed and the results presented in separate reports. The reports will focus on three mainstem pools (LSYR-4.9, LSYR-7.3, and LSYR-9.6) in which a more comprehensive vertical array of water temperatures and DO concentrations were measured.

There were eight single thermograph deployment sites in the tributaries during WY2010 (Figure 5 and Table 5): Hilton Creek Upper Release Point (HC-0.54) and near the LSYR confluence in lower Hilton Creek downstream of the trapping site (HC-0.12); Quiota Creek upstream of Crossing 7(QC-2.71); Salsipuedes Creek just upstream of the confluence with El Jaro Creek (SC-3.8) and near the trapping site just over a half mile upstream of the confluence with the LSYR mainstem (SC-0.77); El Jaro Creek at Rancho San Julian (EJC-10.82), Cross Creek Ranch (EJC-4.53), and lower El Jaro Creek upstream of the confluence with Salsipuedes Creek (EJC-3.81). The last two sites used Solinst non-vented pressure transducers with temperature loggers instead of Onset thermographs; the resolution and precision of the two instruments were similar (Appendix B) hence those two sites were included in the thermograph network. The sites on Nojoqui Creek, San Miguelito Creek, and middle Hilton Creek were discontinued due to the absence of observed fish over several years of monitoring, 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 Release Point (URP) and Lower

Release Point (LRP) but due to extensive riparian vegetation growth, this has ceased to be a concern and monitoring at that location has been discontinued.

The thermograph data have been aggregated by daily (24-hour) maximum, average, and minimum values for ease of review for the following LSYR mainstem and tributary locations.

Mainstem thermographs: The seven LSYR mainstem thermograph deployment locations and deployment schedule can be seen in Figure 5 and Table 5. Each site will be discussed separately.

Long Pool (LSYR-0.51)

The Long Pool is approximately 1,200 feet long and 100 feet wide at the widest point. 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 leakage from the spillway gates), and Hilton Creek, which is a cooler water source given that the HCWS intake was set 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, when water visibility permits, rearing in this habitat. The thermograph vertical array was deployed on 4/30/10 and removed on 12/14/10. The monitoring site was located more than half way down the length and towards the middle of the Long Pool at one of the deeper locations of the habitat, where it was approximately 9-feet deep.

Maximum surface water temperatures were less than 21.1 °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 21 °C were observed briefly on July 15, but they generally remained less than 20 °C during the hotter months of the year. This was likely due to cool water releases through Hilton Creek and the extensive canopy growth along that creek since the operation of the HCWS. Diel temperature fluctuations ranged from 1.5 °C and 5.1 °C, with the greater variation occurring during June and July. Temperatures at the surface location were warmest in June and July. The WR 89-18 release from 8/2/10 to 11/2/10 initially dropped the daily maximum water temperature by 5 °C, which then increased 10 days later to a level 1-3 °C below pre-release conditions. Temperatures decreased further after October.

The bottom thermograph recorded maximum water temperature of 18.9 °C or less throughout the period and generally remained less than 17 °C for the entire deployment period (Figure 6). Daily variation at the bottom unit was unusually less than 2.0 °C during the deployment. Temperatures were warmest in August and September, when daily maximum temperatures reached 18.4 °C and 18.9 °C, respectively. The arrival of the WR 89-18 release caused a 1 °C decrease in temperature at the bottom of the Long Pool which then increased about 10 days later to a level above pre-release conditions by 1-2 °C and then decreased after October.

Downstream of Long Pool (LSYR-0.52)

This bottom unit was deployed 300 feet downstream of the Long Pool from 4/30/10 to 12/14/10 and recorded similar temperatures compared to the surface Long Pool thermograph due to well mixed stream water in the monitored habitat. Maximum temperatures were observed in June and July that were below 21 °C and minimum temperatures below 16.6 °C throughout the period (Figure 7). The water temperature pattern for the WR 89-18 release was very similar to the Long Pool surface unit.

Encantado Pool (LSYR-4.9)

The vertical array thermograph was deployment from 6/2/10 to 11/12/10, and was positioned in the middle of the pool where the depth was greatest (approximately 6 feet). The Encantado Pool 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 the beginning of June and middle of July, peaking on 7/18/10 at 26.1 °C, an August peak of 23.1 °C on 8/25/10, and gradually decreased throughout the rest of the period (Figure 8). Overall, daily maximum temperatures ranged from 23 °C to 26 °C from June to the beginning of August when the WR 89-18 releases arrived. Afterward, the daily maximum temperatures initially dropped by 5-6 °C, then warmed up 2-3 °C over several days, then gradually cooled throughout the rest of the monitoring period. The 24-hour variation between maximum and minimum water temperatures was typically between 4-7 °C during June and July. A cooling trend began in September and continued through the end of the monitoring period.

Bottom maximum temperatures generally remained less than 22 °C prior to WR 89-18 releases. The maximum temperature recorded for the bottom thermograph was 24.7 °C on 8/2/10 upon arrival of the WR 89-18 release, suggesting mixing across the water column. Temperatures above 24 °C lasted less than an hour and daily maximum water temperature decreased by 3 °C for approximately 10 days before returning to near pre-release conditions before gradually declining in September and the fall. The 24-hour variation between maximum and minimum water temperatures was greatest during the August-September timeframe and was typically between 2-5 °C.

7.3 Pool (LSYR-7.3)

This pool habitat was approximately 510 feet long and 31 feet wide with a maximum depth of 5.5 feet. Dam building activity by beavers that occurred several hundred yards downstream increased the extent of the pool habitat by raising the water level and combined several pool habitats into one large pool. The vertical array was positioned in a pool habitat where rearing *O. mykiss* were routinely observed during snorkel surveys. The deployment period was from 6/2/10 to 11/12/10, and was positioned in the middle of the pool where the depth was greatest, approximately 5.5 feet deep. Between LSYR-5.60 and LSYR 6.40, stream flow went subsurface and reemerged at LSYR 6.40, a condition observed annually since monitoring began in the mid 1990's.

The surface thermograph recorded maximum temperatures below 24.1 °C for the entire monitoring period with the warmest temperatures occurring at the end of August (Figure 9). The maximum temperatures remained around 22 °C during most of the summer. Generally, the daily difference in maximum and minimum temperatures was greatest during the June-August timeframe, typically from 3.2-5.6 °C. When the WR 89-18 release arrived in August, the daily maximum temperatures initially dropped by about 2 °C, then warmed up by 2-3 °C, and then gradually decreased in September through the fall.

Maximum daily temperatures at the bottom unit were less than 21 °C in the months of June and July. At the onset of WR 89-18 water releases, maximum daily temperatures increased 1-2 °C and then dropped 1-2 °C for several days. This followed a pattern similar to the surface unit, with a 4 °C fluctuation between maximum and minimum temperatures and recorded values decreasing through the fall.

Alisal Upwell Site (LSYR-9.6)

The thermograph vertical array was deployed from 6/2/10 to 11/12/10, and was positioned at the greatest pool depth (approximately 5.5 feet). This habitat has cool groundwater upwelling into this pool from the bottom of the upstream gravel bar and from several seeps near the water line. The pool is approximately 30 feet wide, 40 feet long, and approximately 5.5 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 a peak temperature of 25.1 °C on 7/27/10 and then decreased (Figure 10). Water temperatures reached 24 °C in early June during an early summer heat wave. Overall, daily maximum temperatures ranged from 20 °C to 25 °C from June to the beginning of August when the WR 89-18 release arrived. The temperature at that time was noticeably reduced followed by the pattern exhibited by the upstream temperature units; an initial drop, then warming followed by gradual cooling throughout the fall. The 24-hour variation between maximum and minimum water temperatures was typically 3-6 °C during June and July. A cooling trend began in September and continued through the end of the monitoring period.

Bottom maximum temperatures steadily warmed from June until the arrival of the WR 89-18 releases; values during that period generally remained less than 21 °C with the majority of readings less than 20 °C. The maximum temperature recorded across the period was 23.7 °C on 8/25/10. Temperatures declined during the rest of the monitoring season. The 24-hour variation between maximum and minimum water temperatures was greatest during August and September, and ranged 2-5 °C.

WR 89-18 releases were detected with an initial brief increase in temperature followed by a drop in temperature for several days, then increased again through 8/25/10 before gradually dropping in temperature through the rest of the fall at both the surface and bottom units.

Alisal Bedrock Pool (LSYR-10.2)

The thermograph vertical array was deployed on 5/12/10 and removed on 12/14/10 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 2010, 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 WY2010.

For most of June through September, maximum surface temperatures varied between 20 and 24.8 °C with the warmest day occurring on 7/19/10 (Figure 11). The warmest temperatures occurred in July prior to WR 89-18 releases. Water temperatures never exceeded 25 °C at the surface. Some of the warmest mainstem thermograph temperatures collected were measured at this location. The surface temperature dropped by about 3 °C with WR 89-18 releases followed by gradual warming in August. Temperatures began cooling in September and decreased through the rest of the period. The 24-hour variation ranged from 1.7 °C to 5.0 °C from June through September. From the beginning of the monitoring period until 5/21/10, the recorded temperatures were very similar at the surface and bottom units indicating uni-thermal conditions; thereafter, temperatures at these locations diverged.

Maximum temperatures at the bottom unit were less than 22 °C in the months of June and July with little variance between maximum and minimum daily temperatures (Figure 11). The WR 89-18 water releases caused a 1 °C rise in daily maximum temperature for a short period of time then dropped 1 °C for several days before following a pattern similar to the surface unit with a 2-5 °C fluctuation between maximum and minimum temperatures.

Avenue of the Flags Pool (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 4/30/10 through 12/12/10. The unit was deployed approximately 1-foot above the bottom of the habitat in 4 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. Historically, this habitat has not held *O. mykiss* over the dry season and no fish were present in 2010.

From April to the beginning of June, water was flowing across the riffle bar upstream of the thermograph monitoring location resulting in the general observed pattern of heating then cooling over a 24-hour period (Figure 12). Maximum temperatures approached 23 °C and minimum temperatures remained less than 17 °C while the river was flowing up until June. The riffle bar upstream went dry at the beginning of June, and no surface flow entered the pool, but the pool persisted most likely due to groundwater upwelling. Bottom water temperatures remained cool with only a 0.5 ^{o}C increase through the beginning of August; this was an unusual observation that needs further investigation.

The re-establishment of flow from the WR 89-18 releases resulted in an increase in maximum daily water temperature of 7 °C, followed by a difference of 3-5 °C between maximum and minimum temperature values. Maximum values were recorded on 8/24/10 at 24.2 °C then decreased through the rest of the recording period.

LSYR Mainstem Longitudinal Comparisons

A comparison of the longitudinal maximum daily water temperature changes among the mainstem surface thermographs at the Long Pool, Encantado Pool, 7.3 Pool, 9.6 Pool, Alisal Bedrock Pool, and Avenue of the Flags are presented in Figure 13. The Avenue of the Flags thermograph was located on 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, surface water temperatures increased or remained stable going downstream with the lowest temperatures being recorded at the Long Pool and highest values recorded at either the Encantado Pool or the 7.3 pool. Recall that flow into the 7.3 Pool was coming from emerging groundwater after the dry gap (LSYR-5.60 and LSYR 6.40) when there were no WR 89-18 releases. Surprisingly, the Avenue of the Flags monitoring location showed water temperature conditions similar, though slightly cooler, to those recorded at the Encantado Pool after the arrival of the WR 89-18 releases.

Tributary thermographs: The location and deployments for the eight single thermograph deployments in the tributaries of the LSYR basin are shown in Figure 5 and Table 5. Thermographs were deployed as wet season flows subsided and were removed 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 of the HCWS from 4/30/10 to 12/13/10. 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 14-15 °C and remained relatively stable until late October when a 3 °C spike occurred signifying a lake turnover event (Figure 14). Turnover typically occurs in late October through early November in Lake Cachuma. In 2010, the mixing took several days to complete as indicated by the fluctuating water temperature recorded in Hilton Creek. *O. mykiss* were observed rearing in this area.

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 4/30/10 to 12/14/10. Water temperatures collected at this location were similar to HC-0.54 with just less than a degree rise between the upper (HC-0.54) and lower (HC-0.12) sites (Figure 14). There was a greater difference between maximum and minimum temperatures at this site compared to the upstream site due a small amount of thermal heating downstream. Overall, temperatures remained relatively stable from 15-16 °C, except for the observed increase mentioned above in late October due to the lake turning over. *O. mykiss* were observed rearing in this area.

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 5/3/10 through 12/13/10. The unit was deployed at the bottom of a run habitat 40 feet long and 10 feet wide at a depth of approximately 0.8 feet. This section of Quiota Creek remains wet most years. *O. mykiss* have routinely been observed at this location. Water temperatures generally remained less than 20 °C except for brief period during the middle of July when temperatures exceeded 21 °C. Towards the end of July, water temperatures began cooling that continued until the thermographs were removed during the second week of December.

Water temperatures remained less than 21.1 °C for the entire deployment period. Water temperatures declined after a heat wave in the middle of July (Figure 15). The 24-hour variation ranging from 3-6 °C from May through early August, but decreased to 1-2 °C in September.

Upper Salsipuedes Creek (SC-3.8)

A single thermograph was deployed from 5/3/10 to 12/16/10 in Upper Salsipuedes Creek, approximately 30 feet upstream of the confluence with El Jaro Creek. The unit was deployed on the bottom of the stream in a shallow run that was approximately 0.5 feet deep, 15 feet long and 4 feet wide. This site had perennial flow and has been observed to hold *O. mykiss* periodically since monitoring began in 1993. The warmest daily temperatures were recorded in early June at just over 20 °C (Figure 16). Minimum daily temperatures were less than 16 °C throughout the period. The maximum 24-hour variation in temperatures was 1.7-5.1 °C during the period of deployment

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 5/3/10 through 12/16/10 within a run habitat with a maximum depth of 1 foot, 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. Maximum water temperatures exceeded 25 °C on several occasions from late May into early July (Figure 16). The variation in recorded daily maximum temperature was greatest in Lower Salsipuedes then all other mainstem and tributary monitoring locations, ranging between 5-11 °C during the warmest days and 4-9 °C through the beginning of September. Traditionally, *O. mykiss* have been observed rearing in this area.

Lower El Jaro Creek (EJC-3.81)

A single thermograph was deployed approximately 50 feet upstream of the confluence of the El Jaro Creek and Salsipuedes Creek from 5/3/10 to 12/16/10. The unit was placed in a pool habitat 6 inches above the bottom that formed during high flows in WY2008. This is the same general location the unit has been deployed at in previous years. 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 located approximately 30 feet downstream of the monitoring site. *O. mykiss* were routinely observed in this pool during snorkel surveys.

Recorded water temperatures were some of the coolest water temperatures observed in the El Jaro/Salsipuedes Creek drainage and remained below 20.5 °C throughout the period, possibly due to groundwater upwelling in the area (Figure 17). The 24-hour difference between maximum and minimum temperatures ranged from 0.5 °C to 3.2 °C for the entire deployment period.

El Jaro Creek at Cross Creek Ranch (EJC-4.53)

A pressure transducer was deployed on a concrete ford crossing on Cross Creek Ranch to record water temperature. The pressure transducer was inserted into a metal cylinder and attached to the concrete structure approximately 1-foot below the surface. The unit was deployed from 5/3/10 to 12/7/10 at the tail end of a shallow run habitat immediately upstream of the Cross Creek Fish Passage Enhancement Project. Since the installation of the fish passage project at this site, *O. mykiss* have been routinely observed rearing in this area.

Average and minimum water temperatures remained less than 20 °C, except for a brief period during the first week of June (Figure 18). Maximum water temperatures remained less than 25 °C with highest values recorded during that first week of June and around the 9/1/10. Daily variations were greatest during the warm summer period (4-6 °C) before decreasing rapidly at the beginning of October.

El Jaro Creek at Rancho San Julian (EJC-10.82)

A pressure transducer was deployed at the downstream outlet of the San Julian Fish Ladder from 5/3/10-12/7/10. The unit was deployed in the last shallow pool within the ladder, approximately 18-inches below the surface. This is the first time water temperatures have been monitored in the upper portion of the El Jaro Creek watershed. Overall, water temperatures remained less than 22 °C except for a brief period at the beginning of June (Figure 19). Daily variation ranged from 3-5 °C during the warmest portion of the year, and dropped to less than 1 °C during the fall. Throughout the year, rearing *O. mykiss* inhabited the ladder proper, as well as the pool immediately downstream,

Salsipuedes Creek Longitudinal Comparisons

Longitudinal mainstem maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 20 for the bottom thermographs at Rancho San Julian (EJC-10.82), Cross Creek Ranch (EJC-4.53), lower El Jaro Creek (EJC-3.81), upper Salsipuedes Creek (SC-3.80), and lower Salsipuedes Creek (SC-0.77). The highest maximum temperatures for the watershed (over 26 °C) were recorded at lower Salsipuedes Creek in late May and the middle of July. Temperatures decreased from July through the fall. El Jaro Creek at Cross Creek Ranch site recorded maximum daily water temperatures approaching 25 °C in early June and September. All other sites had maximum daily temperatures less than 23 °C for the period. Upper Salsipuedes and Lower El Jaro Creek experienced upwelling in the area and remained relatively cool.

Water temperature and dissolved oxygen concentration (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 YSI 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 at a 15- or 30-minute interval. This enables efficient stream water quality data collection to pinpoint the time and duration of dissolved oxygen concentrations (DO) and temperature conditions over the diel cycle and across multiple days. CPBS operates three sondes which are always calibrated prior to deployment. All three sondes are calibrated at the same time to assure all are recording the same measurements for each parameter (Appendix B).

In 2010, sondes were deployed in several locations within the LSYR in the Refugio and Alisal reaches (Table 6). Three vertical array sites were chosen based on their longitudinal distance from Lake Cachuma (LSYR-4.9, LSYR-7.3, and LSYR-9.6, Figure 5), water depth (5 to 6 feet deep), presence of *O. mykiss*, and ability to safely deploy equipment away from public view (Figures 21-23). Three vertical array sondes (top, middle and bottom of the water column) were deployed at each site. 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. The Sonde DO data for those three habitats during the WR 89-18 release front will be analyzed and the results presented in a separate report.

Sonde temperature values were consistent with the thermograph data near these locations. 2010 LSYR mainstem sonde data are presented below in figures showing the same diel, or 24-hour, period but overlapped with each deployment that was approximately once a month for five months.

LSYR-4.9 Encantado Pool: There were four deployments in 2010 between July and November within the Encantado Pool (Table 6 and Figure 24). Three sondes were simultaneously placed at the top, middle, and bottom of the water column in a pool habitat approximately 6 feet deep.

The first deployment in July showed the greatest diel water temperature fluctuation, specifically at the top and middle sondes, generally ranging from 18.0 °C – 23.5 °C for both locations. The mid-August deployment showed uni-thermal temperatures at all three sonde depths. The October and November deployments had a drop in temperatures at all three depths with values generally ranging from 15.6 °C to 18.7 °C.

DO remained fairly stable with minimal fluctuation at all three depths during all four deployments (Figure 25). In general, DO from top to bottom ranged from 4-6 mg/l during the early morning to 8-12 mg/l during the late afternoon with the lowest values occurring during the pre-dawn hours. The bottom sonde DO concentrations were higher than the top sonde DO concentrations during most of the deployments. This was likely due to the abundant aquatic vegetation found at the bottom of the pool that emits DO through daytime photosynthesis (Figure 21).

7.3 Pool (LSYR-7.3): Four deployments were made in 2010 between July and November within the 7.3 Pool (Table 6 and Figure 26). Three sondes were simultaneously placed at the top, middle, and bottom of the water column in a pool approximately 5 feet deep.

The first deployment in July recorded the highest surface temperature (22.5 °C) of all the deployments, however, after the first day the top sonde broke free of the mounting bracket and fell to the bottom. The true maximum temperature that day may not have occurred yet since it was only 14:15 when the sonde broke free. The top sonde during the mid-August deployment showed temperatures generally ranging from 17.0 °C to 22.5 °C, while the October and November deployments ranged from 16.9 °C to 19.9 °C.

Prior to the onset of WR 89-18 releases, the DO concentrations in July showed anoxic conditions in the early morning hours ranging from 0-1.2 mg/l from the bottom to the surface sonde (Figure 27). As noted above, the July surface sonde broke free of the sonde tower and fell to the bottom. In the late afternoon, July DO concentrations ranged from 5.6-10.1 mg/l from the bottom to the surface. The remaining sonde deployments in August-November showed a marked increase in DO concentrations compared to the July and before the WR 89-18 release.

9.6 Pool (LSYR-9.6): There were also four vertical array deployments in 2010 between July and November within the 9.6 Pool (Table 6 and Figure 28). Three sondes were simultaneously placed at the top, middle, and bottom of the water column in a pool approximately 5 feet deep.

The top temperatures in July ranged from 19.0 °C to 21.4 °C while bottom temperatures ranged from 17.9 °C to 19.2 °C. The remaining sonde deployments from late-August through November showed uni-thermal conditions with temperatures cooling from the summer through fall.

The July vertical array deployment showed low DO levels at all depths during the early morning hours, ranging from a low of 0.16 mg/l at the bottom to a low of 1.35 mg/l at the top (Figure 29). Even the maximum surface sonde DO levels were below 7 mg/l during the July deployment. The late August and early October DO values ranged from 5.6-9.2 mg/l at all three depths, which was much higher compared to the values observed in July prior to the WR 89-18 release. DO decreased during the final deployment in November with values ranging from 3.8-7.2 mg/l, which was expected considering that the WR 89-18 release had ceased at the beginning of the month.

Lake Cachuma water quality profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 4/23/10, 8/19/10, 10/14/10, and 11/16/10 (Figure 30). The purpose was to collect temperature and DO measurements throughout the entire water column at 1-meter intervals, paying particular attention to the constant 65 foot depth of the HCWS intake. The monitoring effort tracks lake water quality conditions and assures that the depth of the adjustable intake hose for the HCWS provides water at or below 18 °C or *O. mykiss* in Hilton Creek through the HCWS, as stipulated in the BO.

The first profile in April showed the lake was beginning to transition from an isothermal (uni-thermal, even temperature to depth) to a stratified condition, with slightly higher temperatures found from the mid to upper water column (Figure 30). By August, the lake was stratified with surface temperatures between 22- 23 °C down to the metalimnion or thermocline (at approximately 25 to 60 feet in depth) and hypolimnion temperatures of approximately 14 ^{o}C. The October profile illustrated fall conditions were settling in with surface temperatures dropping to 20.5 °C, and the beginning of the thermocline extending down to 40 feet in depth. Sometime between October and the final profile in November, Lake Cachuma experienced a lake turnover event. November surface temperatures had dropped to 16.6 °C and the bottom temperature unit was at 14.4 °C. These relatively uniform temperatures from top to bottom were an indication that turnover had occurred.

DO concentrations ranged from 8.3-9.0 mg/l at the surface of the lake during 2010 (Figure 30). During the April profile, DO concentrations were the highest recorded in 2010 (at nearly all depths), with bottom values remaining over 4.9 mg/l at a depth of 125 feet. The August, October, and November profiles showed an abrupt drop in DO concentrations from 26 feet (August) to 72 feet (November) all the way to the bottom of the lake where DO concentrations approached 0 mg/l.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2010 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 relating to 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 changes over time. A list of photo points for WY2010 is provided in Appendix C (Table C-1).

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

A maturing and developing tree/shrub canopy has enhanced habitat quality by shading the stream for rearing and over-summering *O. mykiss* within the Hwy 154 Reach and to a lesser extent within the Refugio and Alisal reaches of the LSYR. Due to the lack of any major flood or channel altering event in WY2010, a mainstem riparian corridor continued to develop. It assists in establishing a central channel with improved canopy coverage, better shading of river habitats, greater habitat complexity and more food sources for fish (Figures 31-39). At Hilton Creek, the HCWS provides year round flows resulting in a mature riparian canopy downstream of the Upper Release Point (URP). The riparian canopy continues to grow quickly in the reach between the URP and the Lower Release Point (LRP) (Figures 35-36). Continuous releases from the URP began at the end of 2005 upon completion of the Cascade Chute project in December of that year.

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 WY2010 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 LSYR mainstem 7.3 miles downstream of Bradbury Dam (LSYR-7.3). The sandbar at the mouth of the lagoon was open from 1/19/10 to 5/6/10, which provided access for *O. mykiss* from the ocean to the LSYR and its tributaries for 107 days.

Hilton Creek flows, particularly during the summer, are not representative of the typical hydrology seen in tributaries of the LSYR due to the HCWS providing relatively cool water at a minimum of 2 cfs year round. Hence, baseflow is comparatively high and water temperatures relatively low year round compared to other tributaries within the LSYR basin (Figures 14-20). Following the peak storm flows, water receded rapidly to an artificial baseflow of approximately 6-8 cfs, mostly from the HCWS, which allowed any upstream migrating *O. mykiss* an opportunity to enter into the creek from the Long Pool throughout the year. Several storms occurred during the 2010 trapping season which necessitated the temporary removal of migrant traps.

The migrant trapping program ran for approximately 17 weeks (117 days) from mid-January through the second week in May (Table 7). The Hilton Creek and Salsipuedes Creek traps were deployed on 1/23/10 and the mainstem trap was deployed on 1/27/10. All traps were removed on 5/20/10 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 storm flows or spill events (Table 7 and Figures 2 and 3). Recaptured fish were included in the migration count but mortalities and young-of-the-year (YOY) were not. 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 analyzed. In general, more fish were captured during the last PM (21:00-01:00) and first AM shifts (05:00-9:00) than during the other two shifts (9:00-13:00 and 17:00-21:00) which is a documented life history strategy to avoid predation during migration (Mains and Smith, 1964; Krcma and Raleigh, 1970; Brege et al., 1996). Others found that elevated turbidity can also reduce predation specifically during stormflow events (Knutsen and Ward, 1991; Gregory and Levings, 1998).

While WY2010 was classified as a wet year, only one confirmed anadromous steelhead was captured, a 634 mm (25.0 in) female going downstream at Salsipuedes Creek on 3/5/10, which presumably spawned upstream in either Salsipuedes or El Jaro Creeks.

Late season flow conditions were conducive for the smolt run observed in the mainstem and tributaries with a total of 137 steelhead smolts captured, mostly in April (Figure 40). Looking at the total number of captures by week for all three trapping locations, suggests early and relatively continuous movement of fish in Hilton Creek, mostly out migrants in Salsipuedes Creek in March onward, and mainstem fish moving in association with the larger storm flow events of the year in February and late season storm flow or passage supplementation events in April (Figures 2 and 41).

Hilton Creek Migrant Traps: The Hilton Creek trapping effort was conducted over a 117 day period beginning on 1/23/10 and ending on 5/20/10 with total functional trapping days of 111 (Table 7). The Hilton Creek traps were removed once in January, twice in February, and once in April for a total of 6 days due to stormflow conditions, resulting in 111 total functional trapping days with a trapping efficiency of 94.9%, which was slightly lower than WY2009 at 98% due to more stormflow events. Upstream (0.96 captures/day), downstream (1.36 captures/day) and total (2.32 captures/day) CPUE values for Hilton Creek were relatively high compared to the other trapping locations, but expected given the higher population density in Hilton Creek below the URP and the limited natural upstream flow that reduced the distribution potential during the year (Table 8). There were fewer fish captured in Hilton Creek in WY2010 (a wet year) than in WY2009 (a dry year). A total of 258 fish (107 upstream and 151 downstream) were captured in the Hilton Creek traps during the WY2010 migration season compared to 422 fish (118 upstream and 304 downstream) in the previous year. Analysis of capture data showed the majority of migrant captures in WY2010 occurred during the first early morning check (06:00-10:00) and second late night check (21:00-01:00) (Table 9).

A total of 107 upstream migrants were captured during the period, ranging in size from 61 mm (2.4 in) to 477 mm (18.8 in), 10 of which were recaptures (Figure 42). There were 5 YOY captured in the upstream trap that were not enumerated as migrating fish. No anadromous steelhead were captured in Hilton Creek in WY2010, however, there were several resident fish in excess of 14 inches that did migrate up the creek to spawn most likely coming from the Hwy 154 Reach or Long Pool on the LSYR mainstem. The length-frequency analysis at 10 mm size intervals showed a bi-modal distribution for upstream migrants indicating that there were several year classes of *O. mykiss* migrating into Hilton Creek (Figure 42). The majority of the upstream fish captured (92 of 107) were between 80-300 mm (3.1-11.8 in) in length. There were no upstream mortalities but two carcasses showing advanced decomposition floated down and were caught on the upstream panels of the trap.

A total of 151 downstream migrants were captured within the period, ranging in size from 70 mm (2.8 in) to 495 mm (19.5 in) , 21 of which were recaptured fish that had moved upstream earlier in the season (Figure 42). There were 11 YOYs captured in the downstream trap that were not enumerated. The downstream length-frequency distribution was less bi-modal than the upstream distribution with a cluster of fish in the 100-200 mm (3.9-7.8 in) range of which many were smolts and a smaller cluster from 230-300 mm (9.1-11.8 in). Of the 151 downstream migrant captures, 46 were steelhead smolts representing 30% of the total downstream catch. It is likely that some of the other captured downstream migrants not showing smolting characteristics could have smolted at a later time while moving downstream below the trap suggesting a possible larger number of smolts from Hilton Creek than reported. Some of those downstream migrants were just resident fish returning to the Long Pool or Highway 154 Reach. 99 of the 151 downstream migrant captures were less than 200 mm (7.9 in). Two of the smolts captured leaving Hilton Creek were later captured at the mainstem trap location 7.3 miles downstream and will be discussed in the mainstem trapping section. There was one upstream mortality, a 171 mm (6.7 in) fish that showed no signs of decay.

Since WY2010 was a wet year, there were better migration conditions throughout the LSYR watershed, although there was little correlation between storm flow and when Hilton Creek fish migrated (Figure 43). Fish generally migrated in Hilton Creek regardless of the flow conditions. As the migration season progressed, there was a higher incidence of downstream captures leaving the watershed, specifically smolts. The majority of smolts exited Hilton Creek during March and April (33 of 46 smolts) (Figure 40). There were more upstream migrants captured at the beginning than at the end of the season, and that downstream migrants were split nearly evenly between the first and second half of the migration season (Figure 41).

Salsipuedes Creek Migrant Traps: The Salsipuedes Creek traps were deployed for 110 days from 1/23/10 to 5/20/10. The trapping season lasted 117 days and trapping efficiency was 94% (Table 7). This was slightly less efficient than in WY2009 (98%) due to more stormflow. Migrant traps were removed on 5 separate occasions due to high flow events: once in January, three times in February, and once in April for a total of 7 days. The total CPUE for the Salsipuedes Creek trapping effort for both upstream and downstream traps combined was 0.72 captures/day; 0.05 for upstream and 0.66 for downstream captures/day (Table 8). CPUE values were less in Salsipuedes Creek than in Hilton Creek most likely due to the lower fish population density and a natural flow regime within the Salsipuedes Creek drainage. There were fewer fish captured in Salsipuedes Creek in WY2010 (a wet year) than in WY2009 (a dry year). A total of 79 fish (6 upstream and 73 downstream) were captured in the Salsipuedes Creek traps during the WY2010 migration season compared to 187 fish (13 upstream and 174 downstream) in the previous year. Analysis of capture data showed the majority of migrant captures in WY2010 occurred during the first (17:00-21:00) and second (21:00-01:00) night time checks (Table 9). This was different than observed at Hilton Creek in that more fish were moving during the first evening shift than the first morning shift.

A total of 6 upstream migrants were captured during the period, ranging in size from 112 mm (4.4 in) to 274 mm (10.8 in). One of the upstream migrants was a recapture that had come up on 2/28/10, downstream on 3/1/10 and finally upstream again on 3/3/10. There were no YOYs observed in the trap. A length-frequency distribution for upstream migrant captures (Figure 44**)** showed two small groupings of fish sizes from 110-149 mm (4.3-5.9 in) and 230-279 mm (9.1-11.0 in). There were no upstream mortalities or carcasses observed.

There were 73 downstream migrant captures during the monitoring period. The fish ranged in size from 71 mm (2.8 in, a first year fish) to 634 mm (25.0 inches, a returning anadromous adult steelhead) (Figure 44). Two YOY were observed in the downstream trap. The length frequency histogram showed a relatively uniform bell shaped distribution centered around 180 mm (7.1 in) that were migrating out of Salsipuedes Creek and were 1-3 year old fish (from scale analyses). With the exception of the large steelhead, most of the captured fish were smolts leaving the basin or possibly small resident juveniles moving within the basin. There were 67 smolts captured that represented 92% of the downstream migrants. The percentage of smolts exiting Salsipuedes Creek is typically high compared to resident fish. Few smolts were trapped in February (2/10/20) but catch nearly quadrupled in March, before peaking in April (Figure 40). There were no smolts captured in January or May. There was 1 downstream YOY mortality with no carcasses found in the Salsipuedes Creek trap.

Generally, flows in Salsipuedes Creek increased swiftly in response to rainfall events once the watershed had become saturated and antecedent soil moisture conditions allowed for runoff from mid-January onward. There were three significant flow events to impact Salsipuedes Creek; the first on January 21 (549 cfs), the second on February 5 (416 cfs), and the third on February 27 (186 cfs) (Figure 46). 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 of the reservoir in the upper basin. This can produce a significant amount of runoff with sufficient stream discharge to breach the berm at the lagoon of the mouth of the Santa Ynez River, while the hydrograph for the rest of the Santa Ynez River watershed may show little change. Salsipuedes Creek did have sufficient discharge after a mid-January storm to breach the lagoon on 1/19/10 in 2010. In general, storms that struck the area were basin wide in nature and the hydrographs at Solvang and Salsipuedes were similar during most storms. Storm events were not sufficient to spill Lake Cachuma. The third stormflow event of the migration season at the end of February and beginning of March triggered a strong downstream migratory response including multiple smolts and the only anadromous adult capture for the year on 3/5/10.

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), land use (agriculture and cattle ranching), 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 year around, whereas in the upper reaches of Salsipuedes Creek and its largest tributary, El Jaro Creek, baseflows approach near 0.5 cfs during the dry season.

The *O. mykiss* population between the two creeks exhibit differences in spawning time, rearing (habitat types), and over-summering characteristics (i.e., water quality). Hilton

Creek has good habitat quality and flows into 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, 2009). The result is earlier resident *O. mykiss* upstream migration in Hilton Creek due to greater availability of water in the mainstem immediately below the dam, a longer smolt migration season due to favorable water quality conditions which can diminish some environmental cues for migration (for example water temperature and continuous baseflow greater than 2 cfs), and later steelhead arrival in Hilton Creek due to its greater distance from the ocean.

For Salsipuedes Creek, the analysis indicates that the majority of the 1- to 2-year class fish migrating with stormflow are smolts, compared to a high mixing of resident fish in Hilton Creek captures. Previous years have exhibited a higher potential for anadromous steelhead to migrate into Salsipuedes Creek due to its close proximity to the ocean, particularly during wet year types. Rearing conditions in Hilton Creek are more favorable and fish populations more dense than in Salsipuedes Creek due to cooler year-round water conditions, stable baseflow, and a less impacted watershed.

A comparison of migrant captures in WY2010 between Hilton and Salsipuedes creeks is presented in Table 10. With WY2010 classified as a wet year, favorable migratory conditions were present throughout the LSYR watershed from mid-January through April. Hilton Creek had more migration potential and observed migrants than in Salsipuedes Creek (total captures of 258 verses 79). However, the Hilton Creek smolt production was only 30% of the total downstream captures (46 smolts of 151 downstream captures) compared to 92% (67 smolts of 73 downstream captures) for Salsipuedes Creek. Given the migration distance from Hilton Creek to the ocean (approximately 48 river miles), it is likely that some downstream migrants smolted after passing through the Hilton Creek trap. In general, migratory fish, especially smolts, tend to respond more quickly to environmental cues such as stormflow in Salsipuedes Creek than in Hilton Creek, and downstream migrating residents can smolt between the Hilton and LSYR mainstem traps (Table 11).

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 40). This was the case in WY2010. The first smolt captured in Hilton Creek was on 1/26/10. 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 first captured in Salsipuedes Creek on 2/10/10. Smolt migration at all three trapping locations peaked in April. Salsipuedes Creek produced more smolts than Hilton Creek trap (and the LYSR mainstem trap combined) during WY2010. The average smolt size by month was smaller in Hilton Creek (156-173mm) compared to Salsipuedes Creek (176-185mm) and the mainstem (213-241) (Table 10). CPBS have routinely observed (from the stream bank) fish with smolt characteristics in both the mainstem and Salsipuedes aggressively feeding during the day when flow conditions are suitable for movement, suggesting that migrating fish are feeding to support migration and to increase in size prior to entering the lagoon and/or the ocean. This life-history strategy and observation are discussed below in the LSYR mainstem trapping results.

LSYR Mainstem Trap: The mainstem LSYR trap was located at the lower end of the Refugio Reach (LSYR-7.3). The trap was installed on 1/27/10, a few days following the tributary trap deployment, and was removed on 5/20/10. The trapping season lasted 113 days with 110 functional trap days for a 97.3% trapping efficiency (Table 7). The LSYR mainstem traps were removed once in February and once at the very end of March for a total of 3 days due to stormflow conditions. Upstream (0.02 captures/day), downstream (0.25 captures/day) and total (0.27 captures/day) CPUE values for the LYSR mainstem trap were relatively low compared to the tributary trapping locations (Table 8). A total of 30 fish (2 upstream and 28 downstream) were captured in the LSYR mainstem traps during the WY2010 migration season compared to 6 fish (3 upstream and 3 downstream) in the previous year, presumably due to the two passage supplementation events in 2010; 2 captures during the first event and 22 captures during the second event for a total of 24 captures or 80%. Details on these captures are presented in the 2010 Fish Passage Supplementation Report (RTDG and CPBS, 2010). Analysis of capture data showed the majority of migrant captures in WY2010 occurred during the first early morning check (06:00-10:00) and second late night check (21:00-01:00), similar to what was observed at the Hilton Creek trap (Table 9).

There were 2 upstream migrant captures; both were resident adults at 265 mm (10.4 in) and 314 mm (12.4 in), the first associated with a stormflow event and the second 4 days after the end of a passage supplementation event (Figures 47 and 48). No YOYs, mortalities, or carcasses were observed.

Of the 28 downstream migrants captured, 24 were associated with passage supplementation events and 21 of those were out-migrating smolts during the second event, suggesting the importance of this Passage Supplementation Program, particularly later in the migration season (Figures 46 and 47). From the length-frequency distribution, most captures were smolts with just 3 resident fish that were at the higher length range (278, 301, and 312 mm, or 10.9, 11.9, and 12.3 in). There were 3 recaptures all of which were smolts that had previously been captured at the Hilton Creek trap earlier in the year (Table 11). Their travel time to the LSYR mainstem trap varied from 77 days to 26 hours depending on the time of the year they migrated downstream from Hilton Creek; the later in the year, the faster they migrated. The 1/23/10 and 3/3/10 Hilton Creek migrants were identified as downstream resident fish but then went through the smoltification process while traveling down to the LSYR mainstem trap where they were identified as smolts on 4/10/10 and 4/13/10, respectively. Smolt sizes collected at the mainstem trap site were larger compared to smolts captured at the tributary locations. This suggests the mainstem may provide food sources that enable smolts to grow while migrating downstream. This supports the literature findings for the life-history strategy that larger smolts have a greater survival rate (Bond, 2006). One Hilton Creek smolt (4/1/10 at 06:16) traveled 7.8 miles downstream to the LSYR mainstem trap in approximately 26 hours where it was captured and identified as a recaptured (4/2/10 0 7:58). The times listed were the moment the fish were netted within the migrant trap. The other two recaptures were later identified through genetic analysis by Dr. Carlos Garza at the NOAA Southwest Fisheries Science Center at UC Santa Cruz.

3.5. Reproduction and Rearing

Reproduction and rearing of *O. mykiss* in the LSYR basin were monitored through redd surveys (winter and spring) and snorkel surveys (end of the spring, summer and fall). The results are presented below.

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. WY2010 represented a reasonable year for potential anadromous steelhead migration within the LSYR basin as flows remained moderate in the mainstem and tributaries, and the lagoon remained open throughout the majority of the spawning season. Seven redds were located in Hilton Creek and 22 were found in Salsipuedes Creek (with tributaries including El Jaro, Los Amoles and Ytias creeks). No redds were observed in the Refugio and Alisal reaches of the LSYR (Table 12). The first observation of spawning activities in Hilton Creek was on 2/24/10, when 7 redds were recorded. These measured between 2.2-4.0 feet in length. No redds were subsequently observed in Hilton Creek. In March, redd building activity began in earnest within the Salsipuedes Creek basin. Twenty-two redds were observed throughout the basin during the spawning season; 2 in Salsipuedes Creek, 17 in El Jaro Creek, and 3 in Los Amoles Creek. Sixteen redds were measured and none were greater than 3.5 feet long, likely indicating that they were made by resident and not anadromous fish spawning. One additional redd found within El Jaro Creek on 3/10/10 appeared to have been built at least 4-6 weeks earlier, since YOYs were observed in and around the redd site. One redd was observed in El Jaro Creek at Cross Creek Ranch. This site is associated with a tributary fish passage project at that site in 2009. Additional redd surveys were conducted within Salsipuedes Creek and Hilton Creek in April, but no additional redds were found.

Flow conditions within the LSYR mainstem were not conducive for anadromous steelhead spawning in WY2010, with only a few moderate flow events in the winter and spring. The largest flow event, at 607 cfs recorded at the USGS Alisal Bridge gauge, occurred in mid-January with several smaller flow events from February through April. The CPBS conducted redd surveys within the Hwy 154, Refugio, and Alisal Reaches of the LSYR mainstem in late March, but did not observe any redd sites. Numerous beaver dams were observed during the survey, possibly presenting difficult migration conditions for any potential anadromous spawning adults.

Snorkel surveys: The CPBS conducted snorkel surveys three times during 2010: late in the spring, summer and fall within the LSYR mainstem and its tributaries (Figure 48). The results of the surveys were 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 YOY and 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. Areas snorkeled were predominately pool habitats where the majority of *O. mykiss* are known to rear during the dry season. However, in the tributaries the full suite of habitat types (pool, run, riffle, and glide) was snorkeled. The total number of *O. mykiss* observed during all three snorkel surveys is shown in Figure 50 with all survey dates and results shown in Tables 13 through 18 for the LSYR mainstem and its tributaries. 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.

In 2010, a WR 89-18 release was conducted over a period of 92 days. RPM 6 in the Cachuma Project BO required snorkel surveys to be carried out before, during and after the release using a three-pass snorkel survey methodology. Also, survey locations were extended to the lower portion of the LSYR basin to better track potential fish movement downstream of Alisal Bridge (within Reach 3). Details of that monitoring effort were provided to NMFS as required by RPM 6 (USBR et al., 2012) and will not be discussed in this report except for the Refugio and Alisal reaches which were part of the long-term monitoring effort (Figure 49).

Mainstem: Snorkel surveys were conducted during the spring, summer, and fall within the 154 Reach, Refugio Reach, and Alisal Reach in the LSYR (Tables 13, 14 and 15); each survey was done with the same level of effort. Snorkel surveys below the Alisal Reach were conducted in association with the WR 89-18 releases and the results were presented in the report for RPM 6 (USBR et al., 2012).

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 prohibited accurate counts of *O. mykiss* during the fall survey, but the numbers observed are still provided in this report. 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 during the fall survey. 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 all three of the surveys (spring, summer, and fall) with visibility less than 4 feet. The CPBS have been unable to accurately assess the fish population within the Long Pool ever since large numbers of carp started occupying the Long Pool.

The spring survey in the Hwy 154 Reach resulted in 142 *O. mykiss* observed over approximately a quarter of a mile of run and pool habitat (Tables 14 and 15 and Figure 50). The majority of the fish observed (106 fish, 75%) were within the 0-3 inch size category or smaller (juveniles) indicating successful spawning. There were 4 fish (3%) greater than 6 inches observed. The summer survey resulted in 158 *O. mykiss* observed within the Hwy 154 Reach, with a decrease in 0-3 inch size fish (54 fish, 34%) and an increase of 3-6 inch fish (99, 63%). As previously mentioned, the CPBS had difficulty in accurately enumerating *O. mykiss* during the fall survey due to poor water clarity. However, 31 *O. mykiss* were observed, 21 of which were within the 3-6 inch size category.

Refugio Reach

Spring surveys within the LSYR mainstem are usually more comprehensive than summer and fall surveys because the CPBS needs to determine which habitats contain *O. mykiss* after the completion of the high flow period (winter and spring). Once locations of *O. mykiss* are determined in the spring survey, the same habitats are revisited in the summer and fall.

During the spring survey, 18 habitats were snorkeled within the Refugio Reach, which included 12 pool, 5 run, and 1 riffle (Tables 14 and 15, and Figure 51). A total of 15 *O. mykiss* were observed in 5 of the 18 habitats, 4 of the 5 were pool habitats. All of the fish were over 6 inches in length, indicating that no spawning occurred within this reach in 2010. The CPBS surveyed 15 habitats (14 of which were pools) during the summer survey within the Refugio Reach. A total of 4 *O. mykiss* were observed, all were over 6 inches in length. The same 15 habitats were surveyed during the fall, but only 2 *O. mykiss* were observed (both over 6 inches).

Alisal Reach

In the spring, the CPBS surveyed 32 habitats within the Alisal Reach (Table 14 and 15, and Figure 52). There were more run habitats (17) snorkeled than pool habitats (15) during the survey. A total of 23 *O. mykiss* were observed in 7 pools and 2 runs, with 57% (13) of the fish in the 6-9 inch category. In the summer, 8 *O. mykiss* were observed in 4 pools and 1 run habitat. Interestingly, none of the *O. mykiss* were within the 6-9 inch category, indicating that either some of the fish grew into a larger size class, moved outside of the Alisal Reach, or perished. Surveyors in the fall revisited the same habitats and observed 10 *O. mykiss*, all over 9 inches in length.

Tributaries: Tributary snorkel surveys were conducted in the spring, summer, and fall at all of the long-term monitoring locations (Hilton, Quiota, Salsipuedes, and El Jaro Creeks) (Table 16). The results of those surveys are presented in Tables 17 and 18. 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 within Hilton Creek were conducted from the confluence with the LSYR to the Reclamation property boundary, approximately 100 feet above the Upper Release Point (URP) of the HCWS (Table 16). Because of the densities of *O. mykiss* and the short linear distance of the creek, all habitats within Hilton Creek were snorkeled.

Spring, summer, and fall snorkel surveys were conducted in Hilton Creek in 2010 (Tables 17 and 18, and Figure 53). The spring survey resulted in 1,256 *O. mykiss* observed, with 864 (69%) of the fish falling within the 0-3 inch size category. There were only 5 fish in the 9-12 inch category with 1 fish in the 12-15 inch category. Based on many consecutive years of snorkel observations, redd building activity, and yearly trapping results, Hilton Creek has become a prime location for juvenile production. 2010 was no exception with many YOYs observed in the spring. A slight increase in fish totals was observed in the summer, with 1,328 *O. mykiss* observed. It is likely that YOYs 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. An upward size shift was already noticeable with 48% of the fish within the 0-3 inch size category. Fish in the 3-6 inch category had increased to 46%, up from 25% observed in the spring. A moderate decrease in fish numbers was observed in the fall, with 990 *O. mykiss* observed. It's possible that some fish moved out of the system and into the LSYR below the Hilton Creek confluence. Over 66% of the fish were 3-6 inches, indicating successful growth and over-summering of the juveniles produced in the spring.

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 fall of 2010. In fact, the first three habitats were completely dry during the last (fall) survey.

Spring snorkel surveys resulted in 114 *O. mykiss* being observed of which 85% (97) were within the 0-3 inch size category (Tables 17 and 18, and Figure 54). These were likely YOYs produced earlier in the year. Fifteen 3-6 inch fish were observed with 2 fish greater than 6 inches. Between the spring and summer surveys, there was an 18% reduction in the number of fish observed (114 to 93 fish), with a similar size distribution to those seen during the spring survey. YOYs (0-3 inches), while smaller in number, still comprised 73% of the total number of *O. mykiss* observed. The number of *O. mykiss* severely declined during the fall snorkel survey across the same survey area as flows diminished and habitats shrunk with a total of 38 fish being observed. Unlike the previous two surveys, there appeared to be an upward size shift in the fish indicating growth of the remaining population. In the previous two surveys, YOYs made up 85% and 73%, respectively of the total population, with 3-6 inch fish comprising 13% and 20%. In the fall survey, YOYs and 3-6 inch size fish made up 53% and 42% of the total observed, respectively.

Salsipuedes Creek

Lower Salsipuedes Creek contains five reaches (Figure 48) that are broken up by geomorphic changes to the creek bed. Reaches 1 through 4 extend from the Santa Rosa Bridge upstream to the Jalama Road Bridge for a total length 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 16).

Reaches 1 through 4 were surveyed in the spring and the summer, but poor visibility prevented accurate surveying in the fall. Spring surveys revealed 415 *O. mykiss* with 97% of the fish falling within the 0-3 inch size category (Tables 17 and 18, and Figure 55). This was strong evidence that successful spawning had occurred within the lower reaches of Salsipuedes Creek in 2010. The CPBS counted 216 *O. mykiss* in the summer within Reaches 1-4, with 51% of the fish in the 0-3 inch size class. Fish in the 3-6 inch size class had increased to 47% of the total observations in the summer, up from 1% of the spring observations. This meant that the remaining juveniles from the spring survey were growing, despite a 48% reduction in population from the spring to the summer. Snorkel surveys were attempted in the fall, but beaver activity had caused excessive turbidity which prevented the CPBS from effectively surveying those reaches.

Water clarity remained good within Reach 5 throughout the survey period and surveys were conducted in the spring, summer and fall. In the spring of 2010 the CPBS observed 303 *O. mykiss* within Reach 5 (Tables 17 and 18 and Figure 56). Of all the fish observed, 84% (255) were YOYs produced in the winter and spring of 2010. Although this is a slightly lower percentage of YOYs than observed in Reaches 1 through 4 (97%), it still shows that spawning occurred throughout all of the Salsipuedes Creek reaches snorkeled by the CPBS. In the summer, 217 *O. mykiss* were observed, 59% (127) were 0-3 inches and 40% (86) were 3-6 inches. The CPBS observed 96 *O. mykiss* during the fall survey, with 79% (76) falling within the 0-3 size category. Although there was a greater percentage of 0-3 inch fish observed in the fall (79%) compared to the summer (59%), there were far fewer fish observed in total.

El Jaro Creek

El Jaro Creek was snorkeled from its confluence with Salsipuedes Creek upstream approximately 0.4 miles in the spring, summer, and fall (Table 16). This is the regular survey reach that the CPBS visits each year and is part of the long-term data set. It should be noted that divers encountered several areas of turbidity (likely due to beaver activity) during the summer survey, and the totals for that particular survey were likely lower than the actual fish population at the time of the survey.

The spring survey count on El Jaro Creek totaled 105 *O. mykiss*, with 78% of the fish falling into the 0-3 inch size class (Tables 17 and 18, and Figure 57). This was a similar observation to what had been observed in all of the reaches of Salsipuedes Creek (downstream of El Jaro Creek), with the majority of the population appearing to be YOYs produced in the winter and spring of 2010.

Water clarity during the summer survey within El Jaro Creek was poor in several locations. As a result, the total number of *O. mykiss* observed was 48. This was a 54% reduction from what was observed in the spring and probably not representative of the actual population during the survey. The CPBS during the final fall survey observed 89 *O. mykiss*, with 61% (54) in the 0-3 inch length category.

Other Fish Species Observed: There were many introduced species observed inhabiting the LSYR mainstem during the spring, summer and fall snorkel surveys (Figures 58 and 59). 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. Typically, 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 specifically 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 minnow (*Pimephales promelas*) were observed within Salsipuedes Creek.

Largemouth Bass: Largemouth bass were the most numerous warm-water species observed during LSYR mainstem snorkel surveys in 2010 (Figure 58). There were 53 largemouth bass observed within the Refugio (26) and Alisal (27) reaches of the mainstem in the spring. The number of largemouth bass nearly tripled in the summer with a total of 137 observed within the two reaches. The numbers observed in the fall increased to 213 largemouth bass; 69 within the Refugio Reach and 144 within the Alisal Reach.

Sunfish Species: There were 60 sunfish (3 species) observed during the 2010 spring snorkel survey within the Refugio (8) and Alisal (52) reaches of the LSYR mainstem with a similar total number of largemouth bass per habitat (Figure 58). A drop in sunfish numbers was observed in the summer with a total of 26 in both reaches. In the fall, only 7 sunfish were observed within the Refugio Reach; no sunfish were observed within the Alisal Reach. Nearly all of the sunfish observed in 2010 were found in pool habitats.

Catfish Species: The past few years have resulted in few catfish sightings within the LSYR mainstem. 2010 was no exception with only 1 bullhead catfish observed within the Alisal Reach during the spring survey (Figure 59). No other catfish were observed during the summer or fall snorkel surveys.

Carp: In 2010, 28 carp were observed within the Refugio and Alisal Reach in the spring (Figure 59). In the summer and fall, 59 and 76 carp were observed within the same reaches, respectively. There were numerous large carp in the Stilling Basin (LSYR-0.0) and the Long Pool (LSYR-0.5) that were easily observed from the dam crest or banks.

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.

The Cross Creek Ranch Fish Passage Project on El Jaro Creek was completed in the late summer and fall of 2009 (August-November), but is described in this report since the majority of the construction activity occurred in WY2010. The project modified an existing historic low flow concrete crossing on El Jaro Creek by installing a series of five rock weirs within the active channel to allow fish passage through the area (Figures 60). Approximately 250 feet of channel bank was also restored by removing exotic plant species, pipe and wire revetments, gabion baskets, and concrete rip-rap that were previously placed there by the existing landowner.

The stream was dry upon initiation of project construction with only a small wetted area located under the low flow crossing. Prior to the onset of construction activities, CPBS captured 32 threespine stickleback (*Gasterosteus aculeautus*) from that small wetted area (less than 6 inches deep) and relocated them upstream; no fish were harmed. No other fish species were found within the project site for the duration of the project. Details of the fish relocation effort are in the Fish Relocation Report that was submitted to NMFS and CDFG (CPBS, 2009). Although there was a lack of surface water within the project area, two holes were dug (one upstream and one downstream of the crossing) so that a de-watering system could be installed to prevent water from entering the construction zone. Groundwater extracted from the holes was sent to an off-channel settling basin, and any sediment coming through the pipes remained within the basin while clear water passed through a culvert back into El Jaro Creek. At the end of the project the de-watering systems were removed and natural creek flow began to infiltrate the project area at the onset of the winter season. Details of the project can be reviewed in the End of Project Compliance Report (COMB, 2009).

Approximately 575 trees and shrubs were planted during the revegetation process. Willows were planted in and around the weirs and within the vegetated rock slope protection. The other trees and shrubs were planted on the slopes of the channel and the terraces of the banks. Approximately 6,000 square feet of the project area was hydro-mulched and seeded. The rest of the project area was broadcast seeded. An irrigation system for dry season watering was also installed and has been maintained and operated by the landowner.

Project performance for fish passage and structural stability of the instream elements is evaluated and reported to NMFS and CDFG every fall. The CPBS will re-visit the project site to verify the success of the site revegetation and whether or not additional plantings or rock weir repairs are necessary.

3.7. Additional Investigations

Genetic Analysis: Tissue samples from all of the migrant captures during WY2010 were sent to Dr. Carlos Garza of NOAA Southwest Science Center at UC Santa Cruz. The results are still forthcoming.

Beaver Activity: According to some scientific literature, 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 the issuance of the BO in 2000, the number and spatial distribution of beavers and their dams have increased throughout the LSYR mainstem. Whether beaver dams and associated beaver ponds positively or negatively affect migrating, rearing, and over-summering *O. mykiss* is unknown. 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 conducted during 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 were 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.

Beaver dams were surveyed on 1/18/10 and a total of 128 beaver dams were observed ranging in height from less than 1 foot to greater than 4 feet throughout the LSYR drainage where access was available, which included its tributaries (Figure 61). Beaver dams of that magnitude may cause impediments for upstream or downstream migrating salmonids. Surveys in the Salsipuedes/El Jaro Creek watershed up past Rancho San Julian (EJC-10.82) resulted in an additional 25 beaver dams identified, the largest being just under 4 feet high.

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, and 60 in WY2010. 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 considered when conducting a passage supplementation event.

4. Discussion

This section has been organized to answer each of the regulatory study questions implied in T&C 11.1 of the BO as presented in the introduction of this report as well as present the status of the recommendations listed in the WY2009 Annual Monitoring Report. 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 WY2010. The rainfall (Table 19), runoff (Table 20), and water year type with the years Lake Cachuma spilled (Figure 62) are presented over the period for reference for the following trend analyses. Summaries of the LSYR Fisheries Monitoring Program have been compiled for 1993-2004 (AMC, 2008), 2005-2008 (USBR, 2011), and 2009 (COMB, 2012).

4.1. Are steelhead moving during the supplementation of migration flows? Yes. The Fish Passage Supplementation Program augmented flows during two storms in WY2010, both of which recorded *O. mykiss* migrating through the LSYR mainstem trap, particularly during the later season event in April. This was the second year that this program was implemented since inception, WY2006 being the first (RTDG and CPBS, 2007). The first passage supplementation event in WY2010 was initiated on 2/6/10 and the second was on 3/31/10, both providing more than 14 days of passage (flows greater than 25 cfs at Alisal Bridge). Trapping efforts in the LSYR mainstem during these events showed two resident downstream migrating adults moved during the first event and 22 migrants moved during the second event, 21 of which were smolts. Details are described above in Section 3.1 and in the 2010 Fish Passage Supplementation Report (RTDG and CPBS, 2010).

The Passage Supplementation Program in WY2010 increased the number of passage days during two supplemented storms (2/6/10 and 3/31/10) to over 14 days in both cases. There were 59 passage days during the migration season, of which supplementation accounted for 33 of those days (56%). Trapping data from WY2010 as well as from WY2006 suggested that passage supplementation does assist migrating *O. mykiss* within the LSYR mainstem with 80% and 93% of all mainstem captures for the migration season occurring during supplementation releases, respectively.

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

By December 2010, six tributary passage enhancement projects had been completed within the LSYR basin: Salsipuedes Creek Highway 1 Bridge Fish Ladder, Salsipuedes Creek Jalama Road Bridge Fish Ladder, El Jaro Creek Rancho San Julian Fish Ladder, Quiota Creek Crossing 6 Bridge, Cross Creek Ranch Fish Passage Project on El Jaro Creek, and Hilton Creek Cascade Chute Project as well as the Hilton Creek Watering System (HCWS) which supplies water year round to Hilton Creek from Lake Cachuma

(Tables 21 and 22, Figures 61 and 64-66). The HCWS also benefits the fish by promoting riparian vegetation growth that shades the creek and provides improved habitat and water quality with little to no thermal heating from the URP to the confluence (Figures 35, 36 and 66). In addition, three bank stabilization and erosion control projects were completed on El Jaro Creek. Each of these projects removed a passage barrier for adult and juvenile *O. mykiss*, reduced sediment supply to the stream, or provided stream flows that enhanced passage and increased the potential for rearing and spawning of *O. mykiss* upstream of the project and in some cases within the project area.

The success of the HCWS and Hilton Creek Cascade Chute Project has been well documented to date. Prior to the HCWS, the total number of migrant captures between WY2001 and WY2005 ranged between 50 and 174 with a CPUE range of 0.52-1.09. Between WY2006 and WY2010, after installation of the HCWS and completion of the Cascade Chute Project, the range was 258 and 643 with a corresponding CPUE range of 2.32-5.79 (Tables 23 and 24). The same upward population trend was observed for *O. mykiss* during the three annual snorkel surveys after the installation of the HCWS and completion of the Cascade Chute Project, particularly after WY2005 (Table 25). In WY2008, seven anadromous adult steelhead were observed at the Hilton Creek trap which was the first time in the history of the monitoring program that ocean run steelhead were observed in Hilton Creek. Four of those steelhead were progeny of Hilton Creek fish and were most likely WY2005 or WY2006 cohorts (Garza and Clemento, 2010). These results indicate that current management actions are having a positive effect by increasing the number of *O. mykiss* particularly anadromous fish present within Hilton Creek.

As of WY2010, the Salsipuedes/El Jaro Creek watershed has been completely opened up to fish passage due to the tributary passage enhancement projects within the basin, allowing passage above removed barriers (Tables 21 and 22). The last remaining barrier at El Jaro Creek at Cross Creek Ranch (EJC-4.53) was removed at the beginning of WY2010 (Figure 60). Fish have been observed moving through all of the installed fish ladders and passage projects, and over-summering was occurring within the entire watershed above eliminated passage barriers. The total number of migrant captures between WY2001 and WY2005 ranged between 20 and186 with corresponding CPUE values of 0.20 to 2.07 (Tables 23 and 24). The total number of migrant captures between WY2006 and WY2010 ranged from 24 to 248 with corresponding CPUE values of 0.22 to 2.02. These numbers reflect the difficulty in assessing year to year comparisons, as the number of observed migrants varied between years and specific trends in the trapping data to date were not apparent. However, in WY2008, seven anadromous adult steelhead were observed at the Salsipuedes Creek trap, which were 3 more than in any other year since monitoring began in 1993 and five of those fish were progeny of Salsipuedes Creek fish (Garza and Clemento, 2010). It is anticipated that the combined effect of all these tributary projects within the basin will show a positive population trend with time in both the trapping and snorkel data collected. In addition, the CPBS is working with landowners on potential projects to improve aquatic and riparian corridor habitat and water quality within the drainage through exclusionary cattle fencing to encourage new riparian growth and to improve aquatic habitat.

There are seven (Crossing 2 was funded and fixed in WY2011) remaining migration barriers on Quiota Creek, all of which are under design and will be systematically removed as funding becomes available (Tables 21 and 22). The passage enhancement project at Crossing 6 removed a partial barrier and opened up 3.1 miles of spawning and rearing habitat (Figure 65). The project replaced one plunge pool with 4 weir and pool sequences that have successfully contained spawning and over-summering fish since the project was completed. Further monitoring in subsequent years will provide greater insight into the biological performance of this project and future projects along Quiota Creek, specifically and during the near future at Crossing 2 (2011), Crossing 7 (2012), and Crossing 1 (2013).

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

Yes. WY2010 was neither a spill year nor the year after a spill since Lake Cachuma last spilled in WY2008 (Figure 62). Hence, required target flows were 5 cfs at the Hwy 154 Bridge (LSYR-3.2) but were not required at Alisal Bridge (LSYR-10.5). With the two passage supplementation releases that occurred during the winter and spring of WY2010 (2/6/10 and 3/31/10), flows within the LSYR mainstem remained relatively high into the beginning of summer. Flows at Alisal Bridge began to drop off in June and July but remained well above target flows at the Hwy 154 Bridge until a WR 89-18 release was initiated on 8/2/10. The water rights release continued for 92 days ending 11/2/10, and kept LSYR mainstem flows well above flow targets throughout the summer and fall period.

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 62), and stream discharge (Table 20) provide background for the following trend discussion from WY2001 to WY2010. The combination of the HCWS and target flow releases within the LSYR mainstem have provided good rearing and over-summering conditions for *O. mykiss* inhabiting these portions of the LSYR basin. The riparian corridor canopy within Hilton Creek is in the process of rapid development, and water temperatures have continually dropped with each successive year due to less thermal heating from progressively more closed riparian canopy (Figure 66). Although temperatures within Hilton Creek have been improved for *O. mykiss*, the LSYR mainstem is still likely to experience extensive phreatophyte and algae growth due to greater thermal heating and limited riparian corridor canopy (Figure 13).

The distribution of *O. mykiss* within Hilton Creek and the LSYR down to Alisal Bridge has changed since WY2001 due to the HCWS, Cascade Chute Project, and the required BO target flows. Prior to required BO target flows and HCWS releases, much of these reaches had intermittent flow with poor water quality conditions, specifically high temperatures and low DO concentrations during the dry season. Fish now rear in Hilton Creek and sections of the LSYR mainstem year-round rather than being subject to diminishing summertime flows and deteriorating water quality across the dry season. Natural flows in Salsipuedes Creek and Quiota Creek have been sufficient to support a year-round *O. mykiss* population in the upper watersheds since the monitoring program began. Populations within the upper reaches of these basins have been predominantly of the resident life-history strategy due to migration barriers downstream. Now that all of the barriers within the Salsipuedes Creek basin and some of the barriers within Quiota Creek have been opened to fish passage, the anadromous component of the *O. mykiss* population can access a much larger area within the LSYR basin. The nine original barriers located within Quiota Creek are systematically being removed and an incremental increase of anadromous fish is expected as barriers are eliminated.

The distribution of *O. mykiss* within the LSYR mainstem, prior to BO target flows, was mainly confined to the Hwy 154 Reach (LYSR-0.0 to LSYR-3.2) with perennial flow and tolerable water quality conditions during the over-summering period. Bradbury Dam spilled in WY2001, WY2005, WY2006, and WY2008, which triggered mandatory target flows from WY2001 to WY2002 and WY2005 to WY2009 down to Alisal Bridge (LSYR-10.5) for the year of and year after a spill that exceeded 20,000 acre-feet and when steelhead were present within the Alisal and Refugio reaches (Figures ES-1 and 62) (NMFS BO, 2000). From WY2001 to WY2010, *O. mykiss* have been continuously observed during all three snorkel surveys within the Refugio and Alisal reaches of the LSYR mainstem except in in WY2004 when no fish were observed due to extremely dry conditions (Table 25).

Analysis of the total upstream and downstream migrant captures at the Salsipuedes, LSYR mainstem, and Hilton Creek traps from WY2001 through WY2010 provides a comparison of the number of captures within the LSYR basin across the three trapping locations (Figure 64 and Table 24). The migrant trapping period was approximately the same between Hilton and Salsipuedes creeks during each year whereas it was slightly different at the LSYR mainstem site during each year due to early season low flow conditions with no migration potential and fewer number of trapping days when traps had to be removed for extended periods of high flows during spill events (Table 23).

The total number of upstream and downstream fish captured within Hilton Creek ranged from 50 to174 with an average of 90 during the period of WY2001 through WY2005 (Figure 67). That range increased to 258-643 captures with an average of 435 during the period of WY2006 through WY2010; the change being associated with the completion of the Cascade Chute Project. The increase in captures at Hilton Creek suggested that management actions by Reclamation have improved instream and over-summering conditions within this drainage.

Although the trapping data shows a general upward trend at Hilton Creek, there is no particular discernible pattern at the other two trapping sites besides that higher migrant captures were typically observed during wetter years (Figures 67). WY2010 had the most mainstem captures (30) since the LSYR migrant traps were first deployed inWY2006.

Any variance in the total number of captures presented in previous Annual Monitoring Reports related to including recaptures into the totals in Figures 68 and 69. The trapping efficiency for the three trap sites from WY2001 to WY2010 was generally above 85% except during wet years when high flows required removal of the traps, specifically during WY2001, WY2005 and WY2008 (Table 23).

The total number of smolt captures at all three traps has been relatively consistent from WY2007 through WY2010, ranging from 134 to 140 (Figure 68). Since the installation of the HCWS in WY2001, there had been 659 smolts identified leaving the Hilton Creek system; zero smolts and only resident fish were observed in Hilton Creek prior to that date. From WY2006 onward, there was an order of magnitude increase in smolts observed after the completion of the Cascade Chute Project. The actual number of smolts that out-migrated from Hilton and Salsipuedes creeks likely was higher than recorded since traps were not in place during high flow events. Total smolt production out of Salsipuedes Creek was higher during wet years than average and dry years; specifically 303, 83 and 49 captures, respectively, since WY2001.

Anadromous steelhead captures from WY2001 to WY2010 did not show a corresponding upward trend with the increase in smolt production across the period (Figure 68). The exception was in WY2008 when 16 steelhead were observed, presumably all cohorts from the two previous wet years, in WY2005 and WY2006, with extended ocean connectivity and high stream flows. WY2008 was an unusual year across the DPS with more steelhead observed than normal in multiple watersheds, specifically along the South Coast and in the Ventura River (USBR, 2011). An increase in the number of anadromous steelhead is anticipated given the high number of wet years of the last decade, the greater number of outmigrating smolts and the increased number of completed tributary projects. Ocean conditions impacting anadromous adult returns is not known.

Looking at migrant captures from WY2001 to WY2010 in relation to the annual hydrographs for the three trap sites, the data suggested that *O. mykiss* often migrated on the recessional limb of storm hydrographs (Figures 69-71). This is particularly evident in Salsipuedes Creek and the LSYR mainstem traps with a much higher number of downstream and upstream migrants during wet years. The LSYR mainstem trap was first installed in WY2006 and was not in place in WY2007 since it was an extremely dry year with no migration flows. The pattern was similar at Hilton Creek but with variation since the HCWS provided flows sufficient for upstream and downstream migration throughout the season.

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 the season in May (Figure 72). Hilton Creek tends to produce smolts every year due to continuous streamflow from the HCWS. Whereas smolt production in Salsipuedes Creek and the LSYR 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 migration season (May). The timing of the smolt run in Salsipuedes Creek tends to be shorter and earlier in the year (February through April) than in Hilton Creek (February 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 from WY2001 through WY2008 (Figure 73 and Table 24). During the past two years however (WY2009 and WY2010) there have been fewer larger fish observed possibly due to the severity of the dry year in WY2009 that possibly resulted in more difficult survival conditions for larger than smaller fish. The increase in migrating adults prior to WY2009 is possibly 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 *O. mykiss*.

The total number of *O. mykiss* observed during the spring, summer and fall snorkel surveys from WY2001 through WY2010 showed a general trend upward across wet years and a decrease during the dry years (Table 25). WY2010 (classified as a wet year) was the exception, particularly within the LSYR mainstem (Figures 74 and 75). There were two passage supplementation releases that likely enabled *O. mykiss* to move downstream for a longer period of the migration season. Snorkel surveys from WY2005 to WY2010 within the Refugio and Alisal reaches showed relatively low numbers during all three surveys in WY2010. This was not indicative of a wet year, such as what was observed during the previous two wet years in WY2006 and WY2008, and possibly suggests the severity of the dry conditions in WY2009.

Hilton Creek (Figure 76) 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 WY2010 in Quiota Creek (Figure 77), Salsipuedes Creek (Figure 78), and El Jaro Creek (Figure 79) do not reveal any particular pattern beyond a general reduction in numbers of fish observed from the spring to the fall surveys. Quiota Creek maintains natural flow in most years above Crossing 5 allowing fish to survive the dry season, although total numbers 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 WY2010, the spring snorkel survey within Reach 5 had the highest observation total (303 *O. mykiss*) than any of the previous years. The same survey also revealed the highest total (105 *O. mykiss*) within El Jaro Creek during the spring, indicating successful spawning within the adjacent reaches of Salsipuedes and El Jaro creeks.

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 of fish observed generally decreased between the summer and fall surveys and more YOYs 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 80). The spring and summer surveys within Hilton Creek generally show the highest number of observed *O. mykiss*, with a tapering off of the numbers in the fall. This reduction is likely due to some attrition, predation, and downstream dispersal out of the Hilton Creek basin into the LSYR mainstem. Data from WY2001 to WY2010 suggest an upward trend for all reaches of Hilton Creek except for Reach 6 above the URP. This section of creek typically dries during the summer months due to natural flow only.

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 mainstem, specifically largemouth bass, carp, and sunfish, due to continuous target flows to the Alisal and Hwy 154 bridges since WY2005 (Table 26). This was particularly evident for carp. Impacts to *O. mykiss* from invasive species within the LSYR mainstem, particularly pisc1vores, needs further study.

4.5. Status of 2009 Annual Monitoring Report recommendations:

The following is a status report (i.e., completed, ongoing, no longer applicable, or should carry forward to next year) for all the recommendations listed in the 2009 Annual Monitoring Report by Reclamation to improve the monitoring program pending available funding:

- Continue current monitoring elements for long-term trend analyses and improve consistency of the monitoring effort for better year-to-year comparisons.
    - Status: This recommendation is being followed and is ongoing.

- Further investigate ways to conduct migrant trapping at higher flows.
    - Status: CPBS has been looking into DIDSON technology for high flow fish migration monitoring. Instrumentation and training costs are extensive hence CPBS is considering a collaborative venture with other steelhead monitoring programs within the DPS. This investigation is ongoing.

- Refine the dry season water quality monitoring program elements (thermographs and sonde deployments) to reduce redundancy and address more specific objectives.
    - Status: A more systematic water quality monitoring effort has been implemented to normalize deployment times, recording frequency, data downloads and analyses, and QA/QC procedures. Sondes use was focused on monitoring WR 89-18 releases for pre-, during- and post-conditions. A more specific and focused effort with the Sondes has proven to be beneficial.

- Develop short-term research questions to address regulatory and management concerns with obtainable goals within a one or two year period.

- Status: This was not done during WY2010 and should be included in the recommendations for this Annual Monitoring Report.

- 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.
    - Status: Although an annual inventory of beaver dam locations and dam heights has become a routine monitoring task, additionally a more focused study is needed to further our understanding of the relationship between these two species. Hence, this recommendation should carry forward into this Annual Monitoring Report.

- 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.
    - Status: Snorkel surveys now incorporate a more rigorous counting and documentation of invasive warm water species. Understanding the interaction of O. mykiss and warm water species will require a focused research effort and should be a continued recommendation for future monitoring activities.

- 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.
    - Status: This continues to be a challenge due to the magnitude of data presented in the report and document review prior to submittal to NMFS. This should continue to be a recommendation and objective of the Annual Monitoring Report.

- 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.
    - Status: Collaborative relationships have been developed between CPBS and fisheries biologist working on the Ventura River, Santa Clara River, Topanga Creek and Malibu Creek. These relationships should continue to be developed particularly in the areas of sharing data, monitoring techniques and restoration ideas.

5. Conclusions and Recommendations

WY2010 was a wet year with rainfall totaling 23.92 inches at Bradbury Dam. Despite being a wet year, there was insufficient inflow into Lake Cachuma to cause a spill event. There were two passage supplementation releases in WY2010, which provided additional migration opportunities for *O. mykiss* within the LSYR basin. Trapping highlights in WY2010 included one anadromous adult female steelhead (634 mm, 25 in) captured in Salsipuedes Creek heading downstream on 3/5/10, and 21 smolts captured at the LSYR Mainstem Trap during the second passage supplementation release. There were 137 out migrating smolts between all three migrant traps which was the third highest on record since the issuance of the Cachuma Project BO.

Due to above average rainfall and two passage supplementation events, WY2010 had 65 days with flows equal to or greater than 25 cfs at Alisal Bridge (minimum flow amount for fish passage) and the lagoon was open to the ocean. The completed tributary projects within Hilton, Quiota, Salsipuedes and El Jaro creeks provided passage and allowed *O. mykiss* to move freely within their respective drainages. Target flows at the Hwy 154 Bridge and Hilton Creek were met throughout WY2010. Population trends within the LSYR continue to show upward movement particularly within Hilton Creek. Monitoring tributary populations within Quiota and Salsipuedes/El Jaro creeks and the LSYR mainstem has resulted in observations that fluctuate by water-year type, instream flows, spawning success, and over-summering conditions. The continuation of the long-term monitoring program within the LSYR is essential for tracking the change in population dynamics, as restoration efforts are completed and adaptive management actions move forward. Collaboration with other local monitoring programs within the southern steelhead DPS is desirable to better understand population viability and restoration potential.

Recommendations to improve the monitoring program: Based on observations and improved knowledge, the following suggestions are provided by COMB's CPBS to improve the ongoing fisheries monitoring program in the LSYR**:**

- Continue the monitoring program described in the revised Biological Assessment (2000) to evaluate *O. mykiss* and their habitat within the LSYR for long-term trend analyses and improve consistency of the monitoring effort for better year to year comparisons.
- Investigate Dual-Frequency Identification Sonar (DIDSON) technologies as a potential solution for monitoring migrants during high flow conditions. DIDSON monitoring should be done as a complement to, and not a replacement of, current migrant trapping activities.
- Continue to refine the dry season water quality monitoring program elements for water temperature and dissolved oxygen concentration, specifically the use of the sondes to address more specific monitoring and research objectives.
- Conduct regular monthly lake profiles at the HCWS intake barge from April through December to more consistently monitor Lake Cachuma water quality conditions at depth particularly at the intake hose elevation of 65 feet for the HCWS.
- Re-evaluate and improve photo-point locations establishing a more regimented photo-documentation effort to record changes in habitat features such as channel form and riparian habitat.
- Further utilize seasonal field biologists to maximize their utility specifically in the area of data entry, equipment repair, and general logistics of the overall monitoring program.
- The AMC should be convened to address the potential effects to *O. mykiss* from beavers and beaver dams as well as warm water predatory species within the

LSYR basin. Based upon the AMC's recommendations, Reclamation shall determine and implement future studies and actions needed.

- Complete the Annual Monitoring Report as soon as possible after the end of the water year so that the results can be reviewed, and improvements made in a timely manner for the following year's monitoring effort.
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS to improve our collective knowledge, collaboration, and dissemination of information.

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WY2010 Annual Monitoring Report
Results
Figures and Tables

3. Monitoring Results

Table 1: WY2000 to WY2010 rainfall at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Water Year	Rainfall Bradbury* (in)	Year Type**	Spill	Reservoir Condition Storage (max) (af)	Reservoir Condition Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.5	Normal	Yes	192948	750.83	No	Yes
2001	31.8	Wet	Yes	194519	751.34	No	No
2002	8.8	Dry	No	173308	744.99	No	Yes
2003	19.8	Normal	No	130784	728.39	No	No
2004	10.6	Dry	No	115342	721.47	No	Yes
2005	44.41	Wet	Yes	197649	753.11	No	No
2006	24.5	Wet	Yes	197775	753.15	Yes	No
2007	7.4	Dry	No	180115	747.35	No	Yes
2008	22.59	Wet	Yes	196365	752.7	No	No
2009	13.66	Dry	No	168902	743.81	No	No
2010	23.92	Wet	No	178075	747.05	Yes	Yes

* Bradbury Dam rainfall (Cachuma) period of record = 58 years (1953-2010) with an average rainfall of 20.6 inches.

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

Table 2: WY2010 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 (WY2010) (in)
Lompoc	40	5.31 (WY07)	34.42 (WY83)	19.48
Buellton	56	5.34 (WY89)	41.56 (WY98)	18.51
Solvang	46	6.47 (WY07)	43.87 (WY98)	21.21
Cachuma*	58	7.33 (WY07)	53.37 (WY98)	23.92
Gibraltar	91	9.24 (WY07)	73.12 (WY98)	33.44
Jameson	85	8.50 (WY07)	79.52 (WY69)	33.51

* Bradbury Dam rainfall. The Cachuma period of record was 58 years (1953-2010).

Table 3: (a) Storm events greater than 0.1 inches and (b) monthly rainfall totals at Bradbury Dam during WY2010. Dates reflect the starting day of the storm and not the storm duration.

(a)

#	Date	Duration (days)	Precipitation (in.)
1	10/13/2009	3	2.20
2	12/7/2009	2	0.61
3	12/11/2009	3	2.09
4	12/14/2009	2	0.12
5	12/22/2009	1	0.13
6	1/13/2010	1	0.25
7	1/18/2010	6	9.74
8	1/27/2010	1	0.35
9	2/5/2010	3	2.00
10	2/10/2010	1	0.48
11	2/20/2010	2	0.16
12	2/22/2010	1	0.18
13	2/25/2010	2	0.16
14	2/27/2010	3	1.88
15	3/4/2010	1	0.16
16	4/5/2010	1	0.19
17	4/12/2010	2	2.13
18	4/21/2010	3	0.76

(b)

Month	Rain (in.)
October-09	2.20
November-09	0.00
December-09	3.00
January-10	10.34
February-10	4.92
March-10	0.26
April-10	3.15
May-10	0.05
June-10	0
July-10	0
August-10	0
September-10	0
Total:	**23.92**

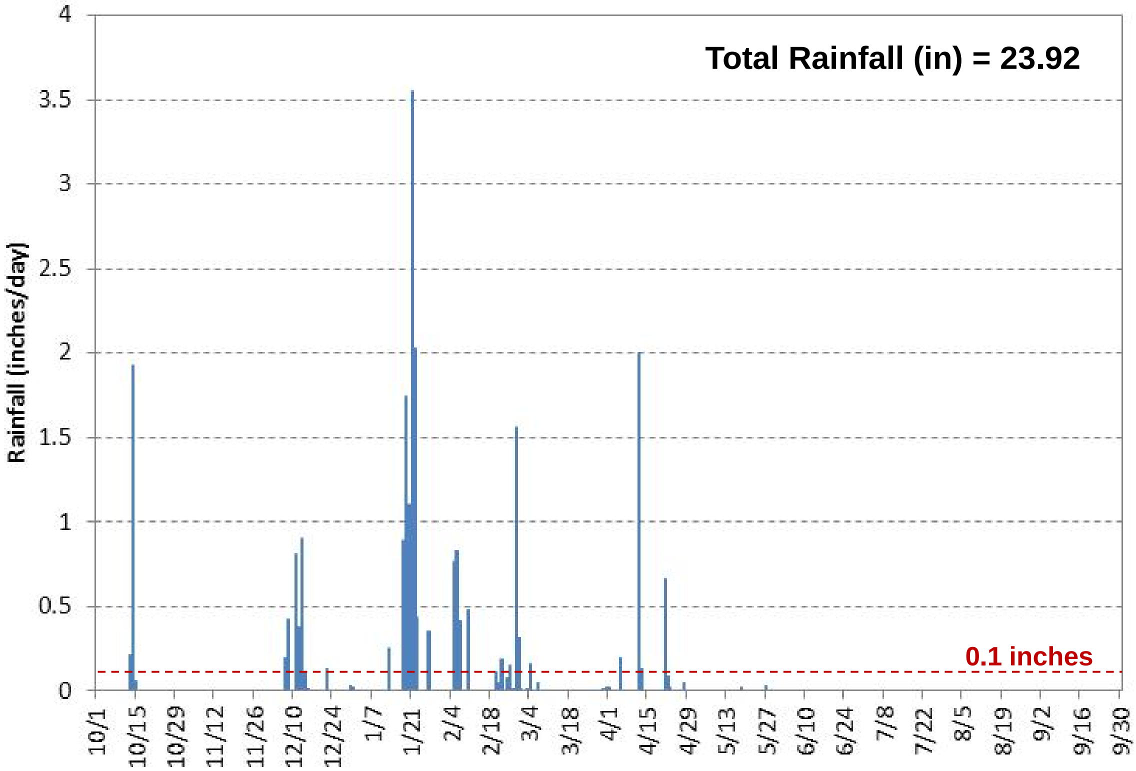


Figure 1: Rainfall in WY2010 recorded at Bradbury Dam (USBR).

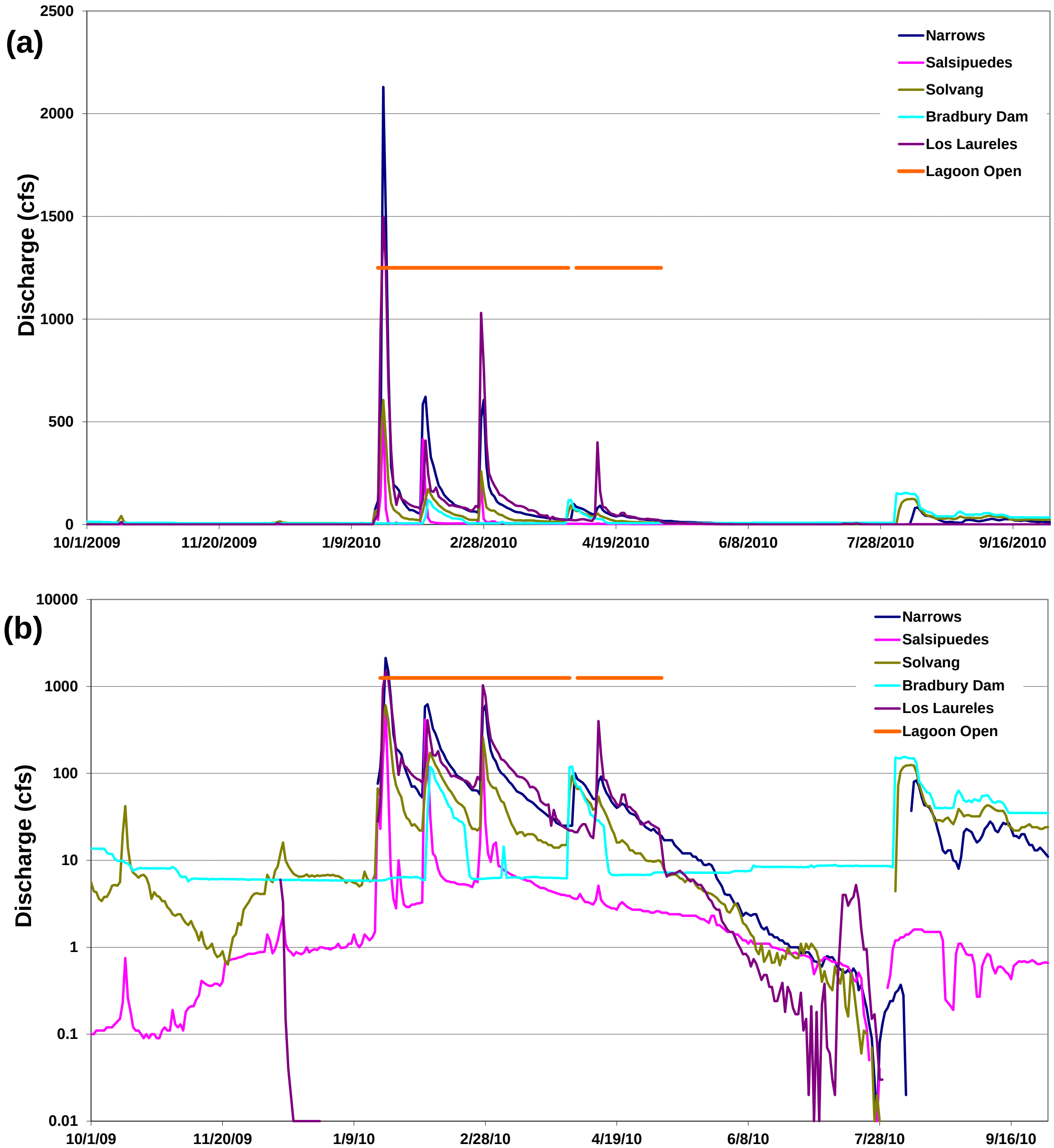


Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open in WY2010 with a (a) normal and (b) logarithmic distribution.

Table 4: Ocean connectivity, lagoon status and number of days during the migration season from WY2001 to WY2010.

Water Year	Year Type	Ocean Connectivity	Lagoon Status Open	Closed	# 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
2010	Wet	Yes	1/19/2010	5/6/2010	107	107

*Migration Season is January through May.

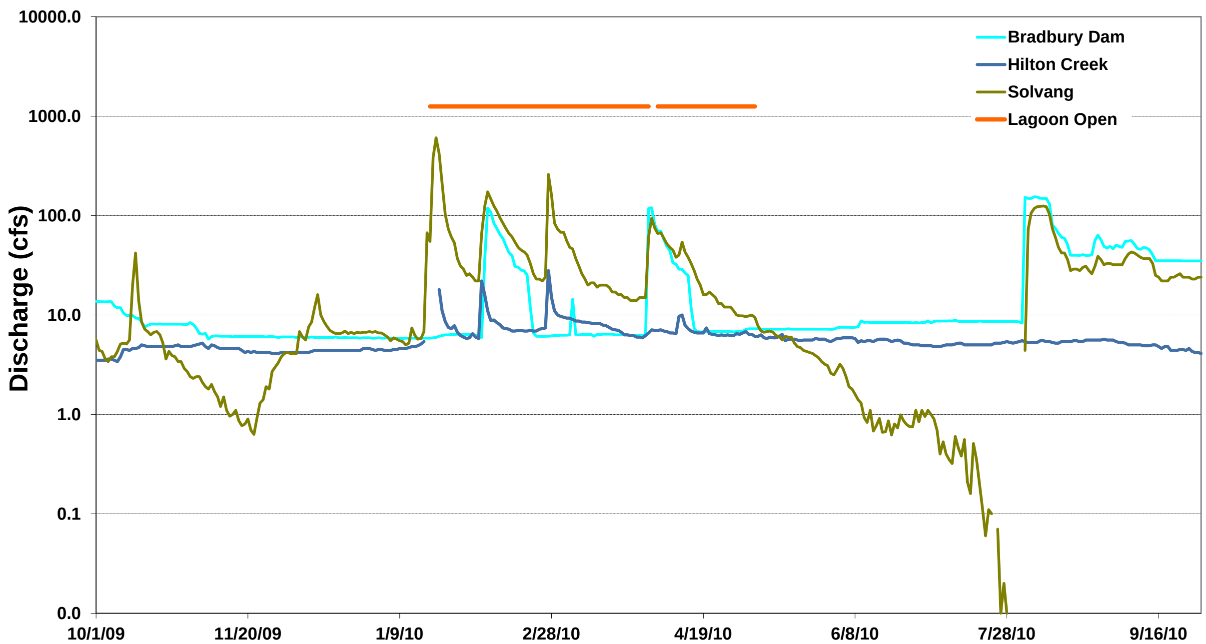


Figure 3: USGS average daily discharge at Hilton Creel just below the Upper Release Point, the LSYR mainstem at Alisal Bridge and from Bradbury Dam during WY2010. Duration of ocean connectivity (Lagoon Open) at the lagoon is also shown.

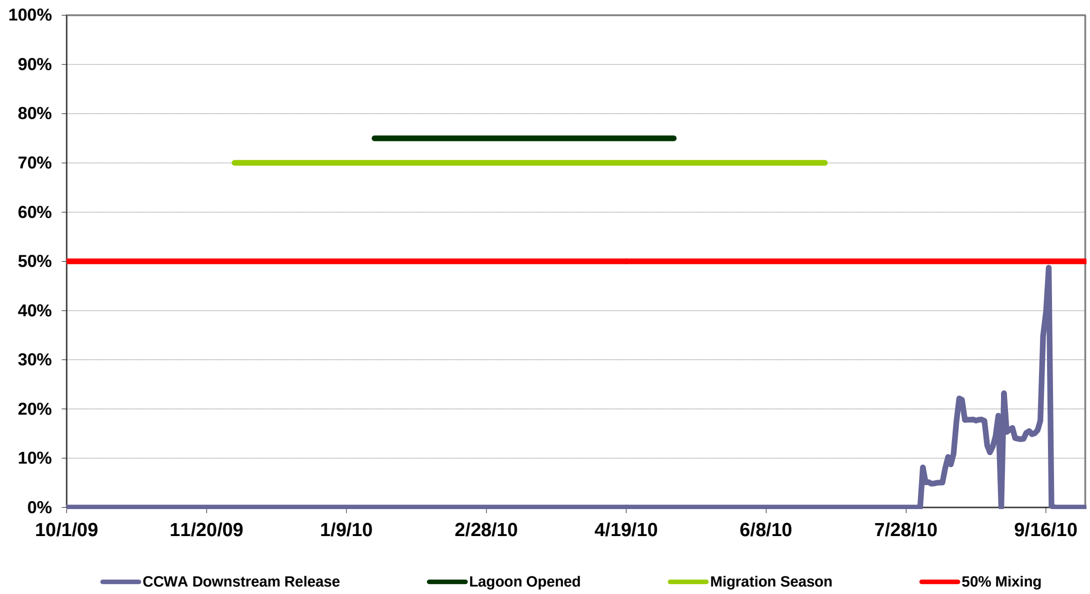


Figure 4: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the WY2010 migration season.

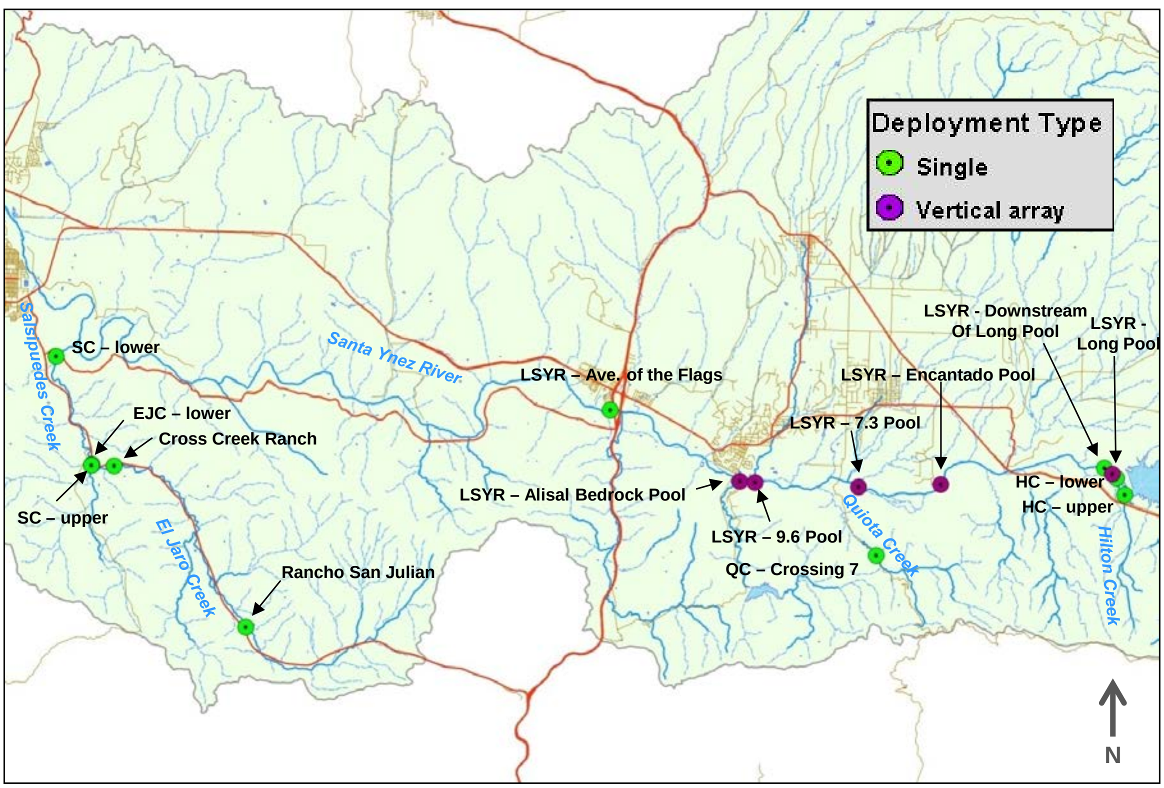


Figure 5: Thermograph single and vertical array deployment locations within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are very close together with overlapping symbols.

Table 5: 2010 thermograph network locations and period of record.

	Location Name	Stream ID	Type	Deployment Date	Retrieval Date	Peroid of Record (days)
Mainstem	LSYR - Long Pool	LSYR-0.51	Vertical Array	4/30/2010	12/14/2010	224
	LSYR - Downstream of Long Pool	LSYR-0.52	Single	4/30/2010	12/14/2010	224
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	6/2/2010	11/12/2010	160
	7.3 Pool	LSYR-7.3	Vertical Array	6/2/2010	11/12/2010	160
	9.6 Pool	LSYR-9.6	Vertical Array	6/2/2010	11/12/2010	160
	LSYR-Alisal Bedrock Pool	LSYR-10.2	Vertical Array	5/12/2010	12/14/2010	212
	LSYR - Avenue of the Flags Pool	LSYR-13.9	Single	4/30/2010	12/13/2010	223
Tributaries	Hilton Creek (HC) - lower	HC-0.12	Single	4/30/2010	12/14/2010	224
	Hilton Creek (HC) - upper	HC-0.54	Single	4/30/2010	12/13/2010	223
	Quiota Creek (QC) - crossing 7	QC-2.71	Single	5/3/2010	12/13/2010	220
	Salsipuedes Creek (SC) - lower	SC-0.77	Single	5/3/2010	12/16/2010	223
	Salsipuedes Creek (SC) - upper	SC-3.80	Single	5/3/2010	12/16/2010	223
	EL Jaro Creek (EJC) - lower	EJC-3.81*	Single	5/3/2010	12/16/2010	223
	Cross Creek Ranch	EJC-4.53	Single	5/3/2010	12/7/2010	214
	Rancho San Julian	EJC-10.82	Single	5/3/2010	12/7/2010	214

*Stream distances for El Jaro Creek (a tributary of Salsipuedes Creek) are to the confluence with the LSYR mainstem.

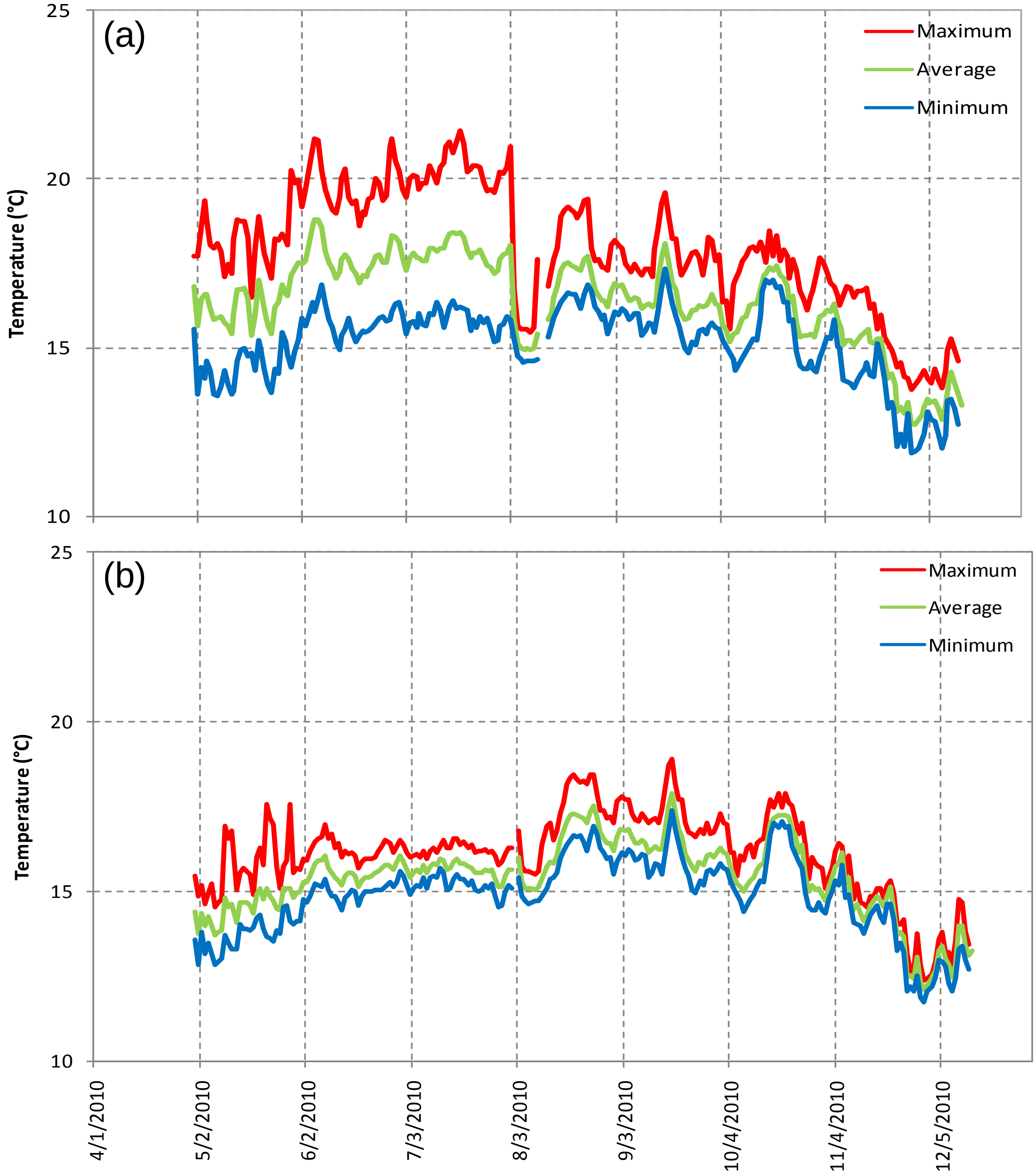


Figure 6: 2010 Long Pool (LSYR-0.51) thermograph maximum, average, and minimum daily values for the (a) surface (1 foot) and (b) bottom units (8 feet).

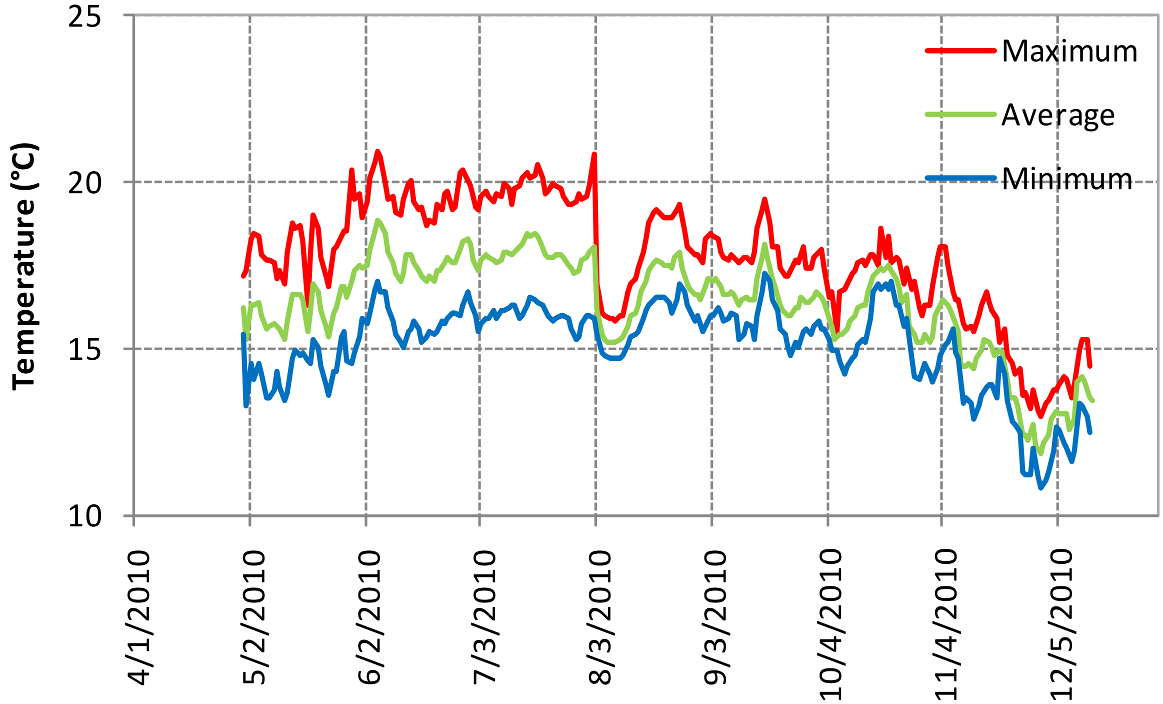


Figure 7: 2010 Reclamation property boundary downstream of the Long Pool (LSYR-0.52) for thermograph maximum, average, and minimum daily values for the bottom in a shallow pool habitat 2-foot deep.

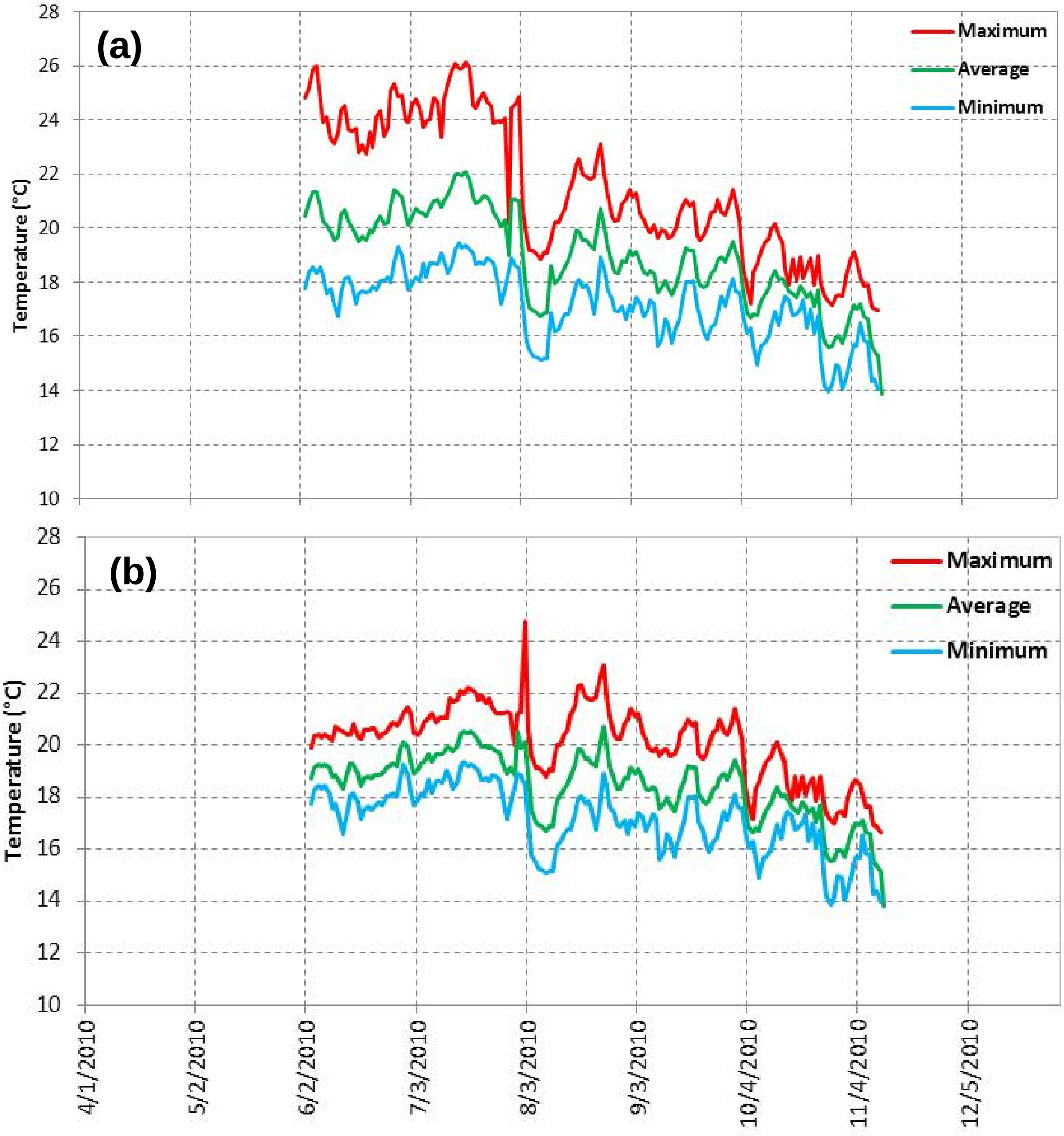
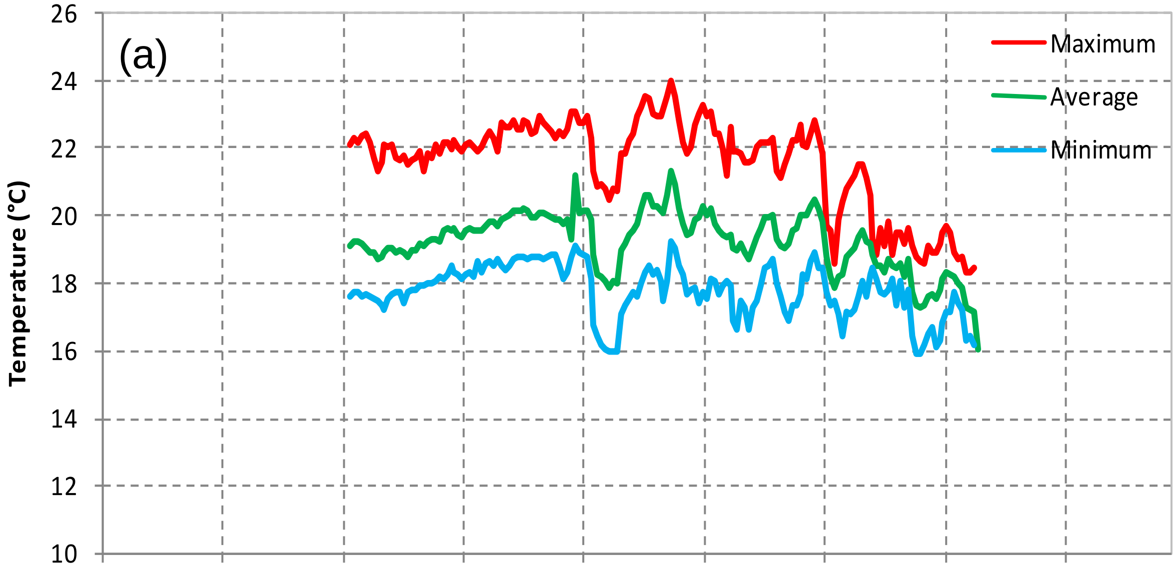


Figure 8: 2010 Encantado Pool (LSYR-4.95) thermograph maximum, average, and minimum daily values for (a) surface (1 foot) and (b) bottom unit (5 feet).



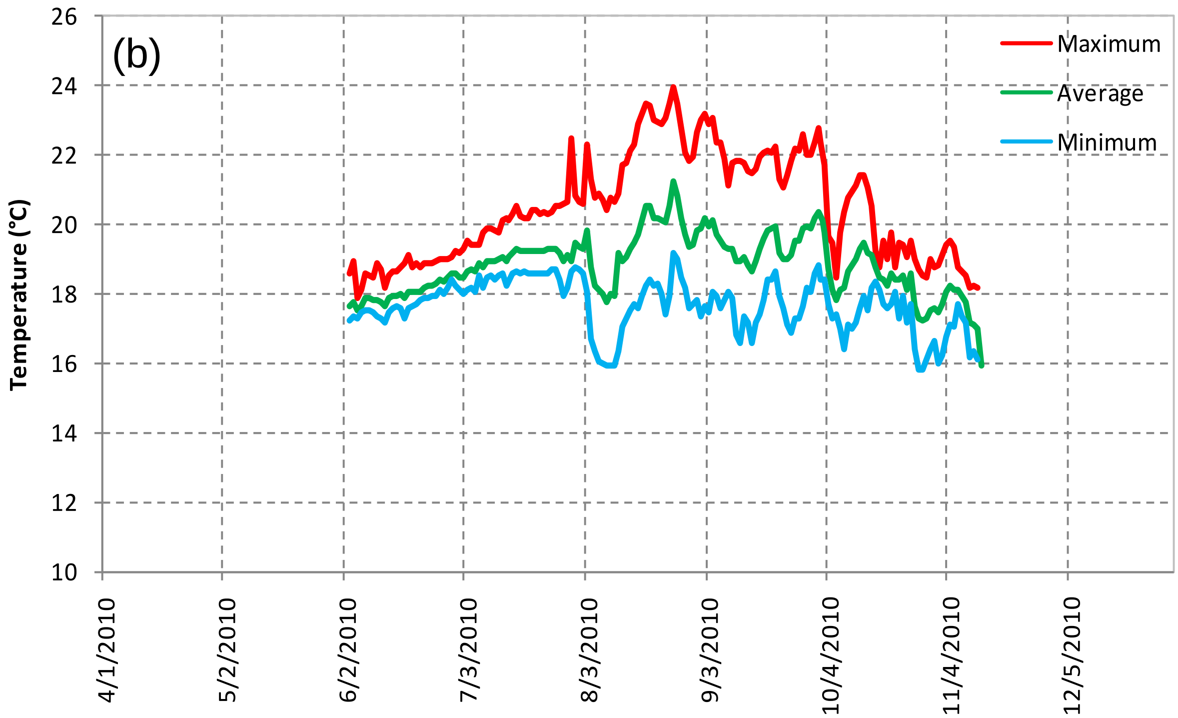


Figure 9: 2010 7.3 Pool (LSYR-7.3) thermograph maximum, average, and minimum daily values for the (a) surface (1 foot) and (b) bottom unit (5 feet).

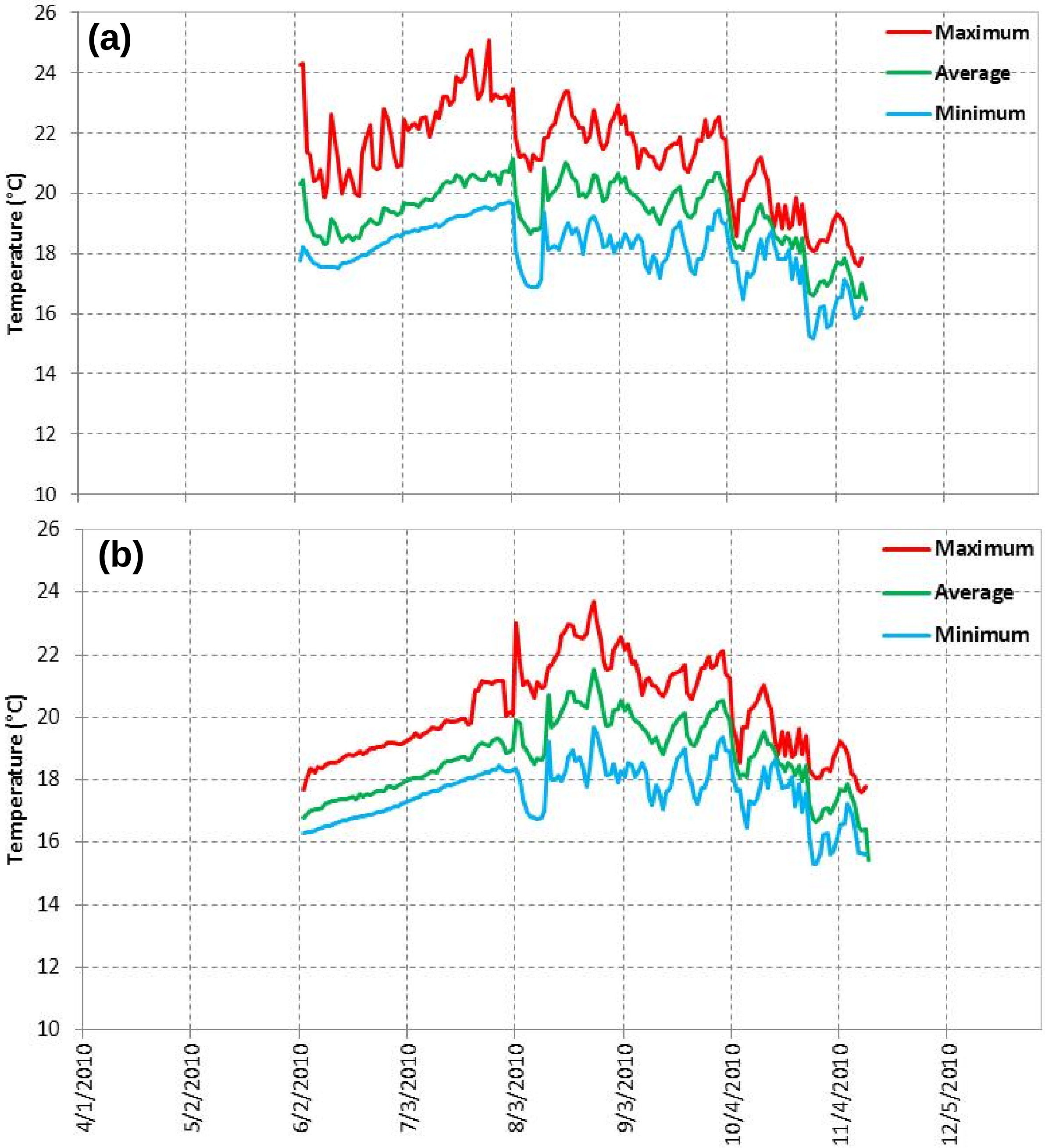


Figure 10: 2010 9.6 Pool (LSYR-9.6) thermograph maximum, average, and minimum daily values for the (a) surface unit at 1-foot below surface and (b) bottom unit at 5.5-feet below the surface.

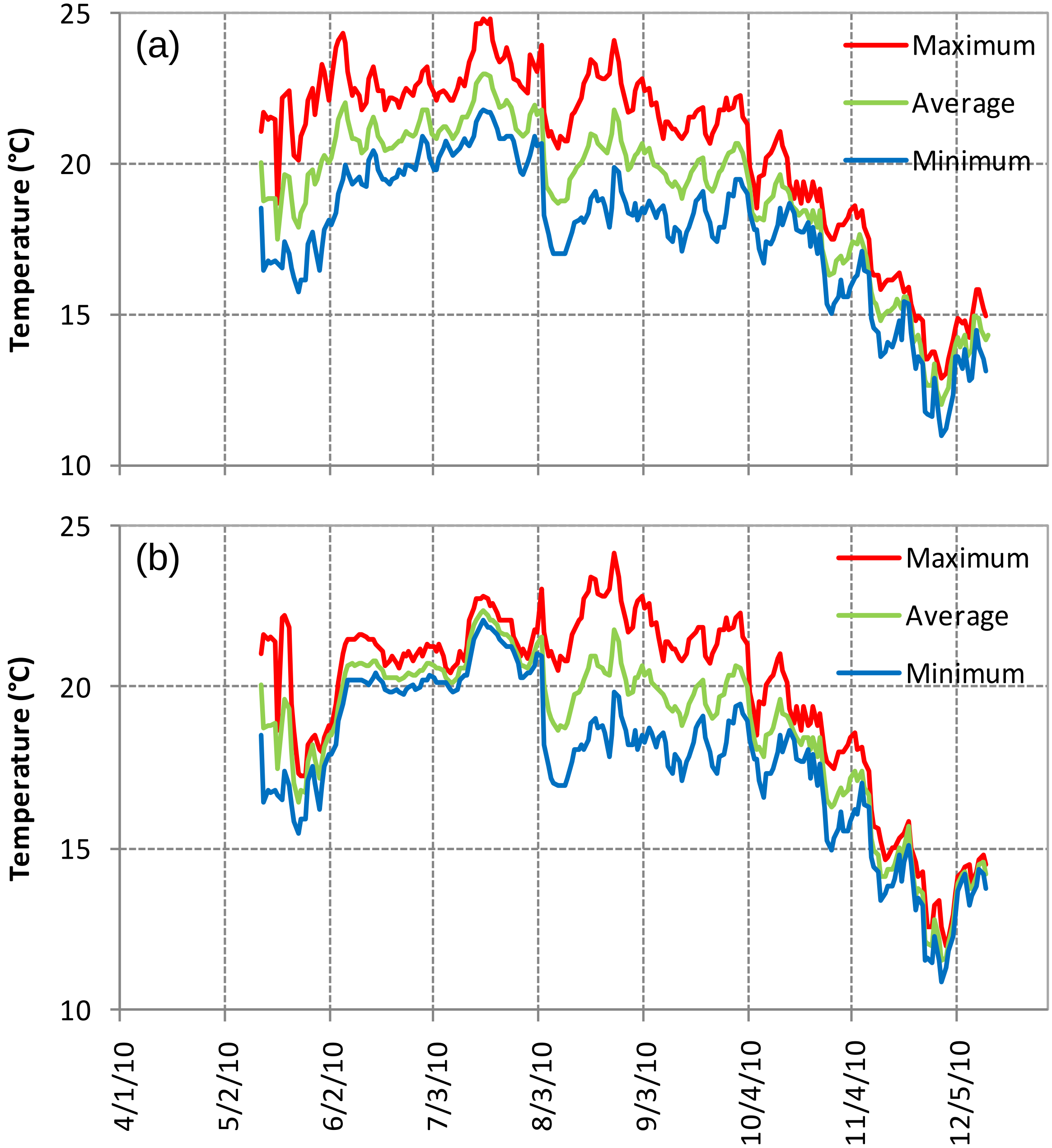


Figure 11: 2010 Alisal Bedrock Pool (LSYR-10.2) thermograph maximum, average, and minimum daily values for the (a) surface (1 foot) and (b) bottom unit (8 feet).

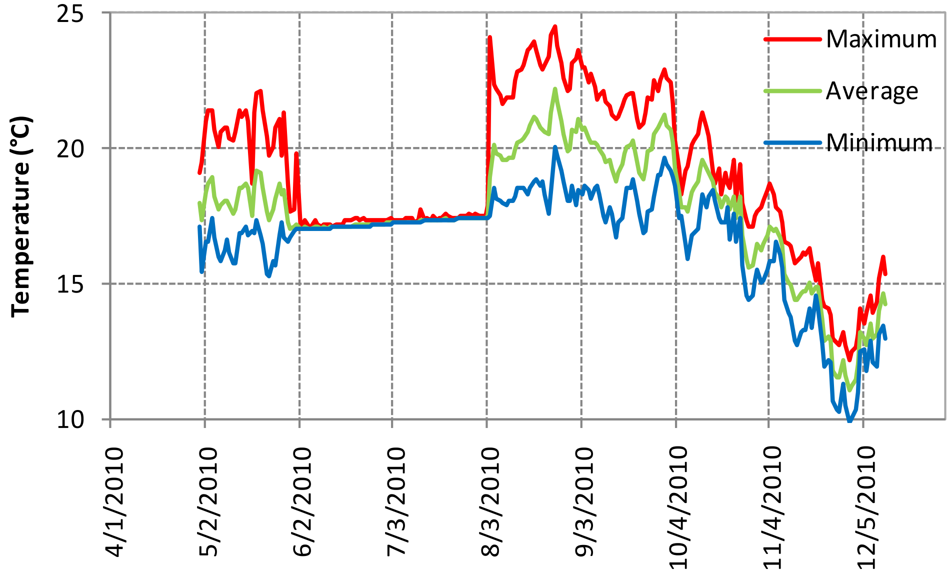


Figure 12: 2010 Avenue of the Flags Pool (LSYR-13.9) thermograph maximum, average, and minimum daily values for the bottom thermograph (3 feet).

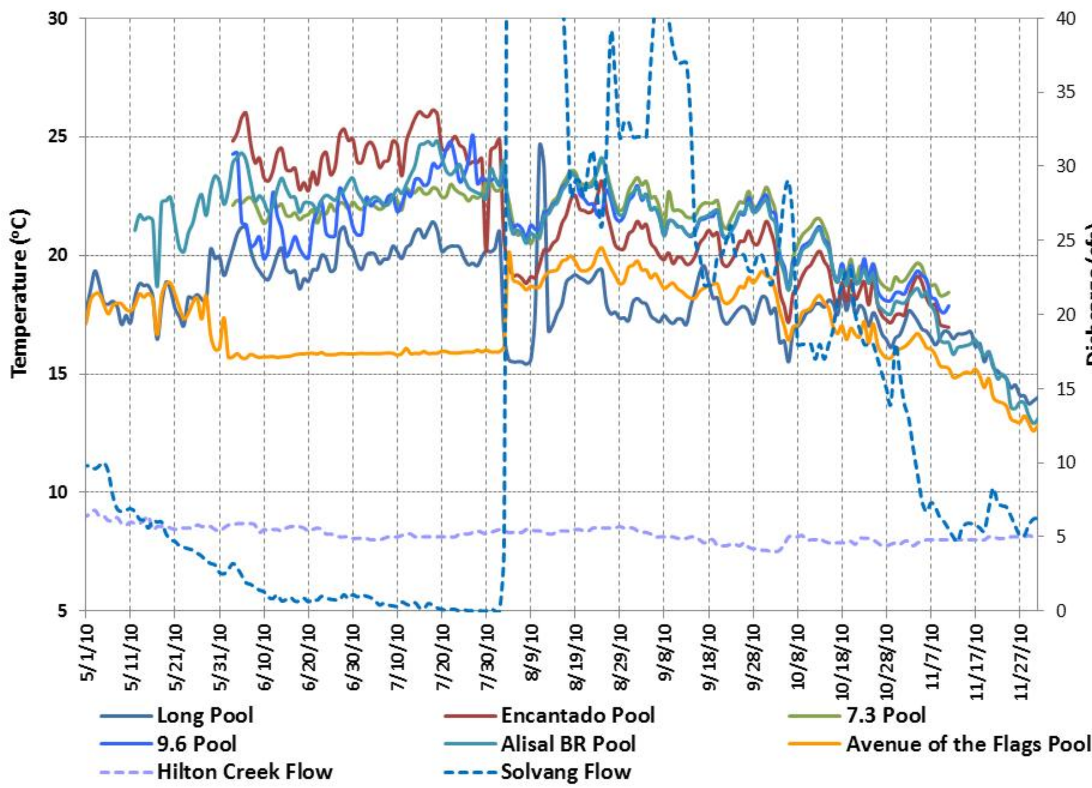


Figure 13: 2010 Longitudinal maximum surface water temperatures at the Long Pool (LSYR-0.5), 7.3 Pool (LSYR-7.3), 9.6 pool (LSYR-9.6), Alisal Bedrock Pool (LSYR-10.2), and Avenue of the Flags Pool (LSYR-13.9) with daily flow (discharge) at the Hilton Creek and Solvang (near the Alisal Bridge) USGS gauges.

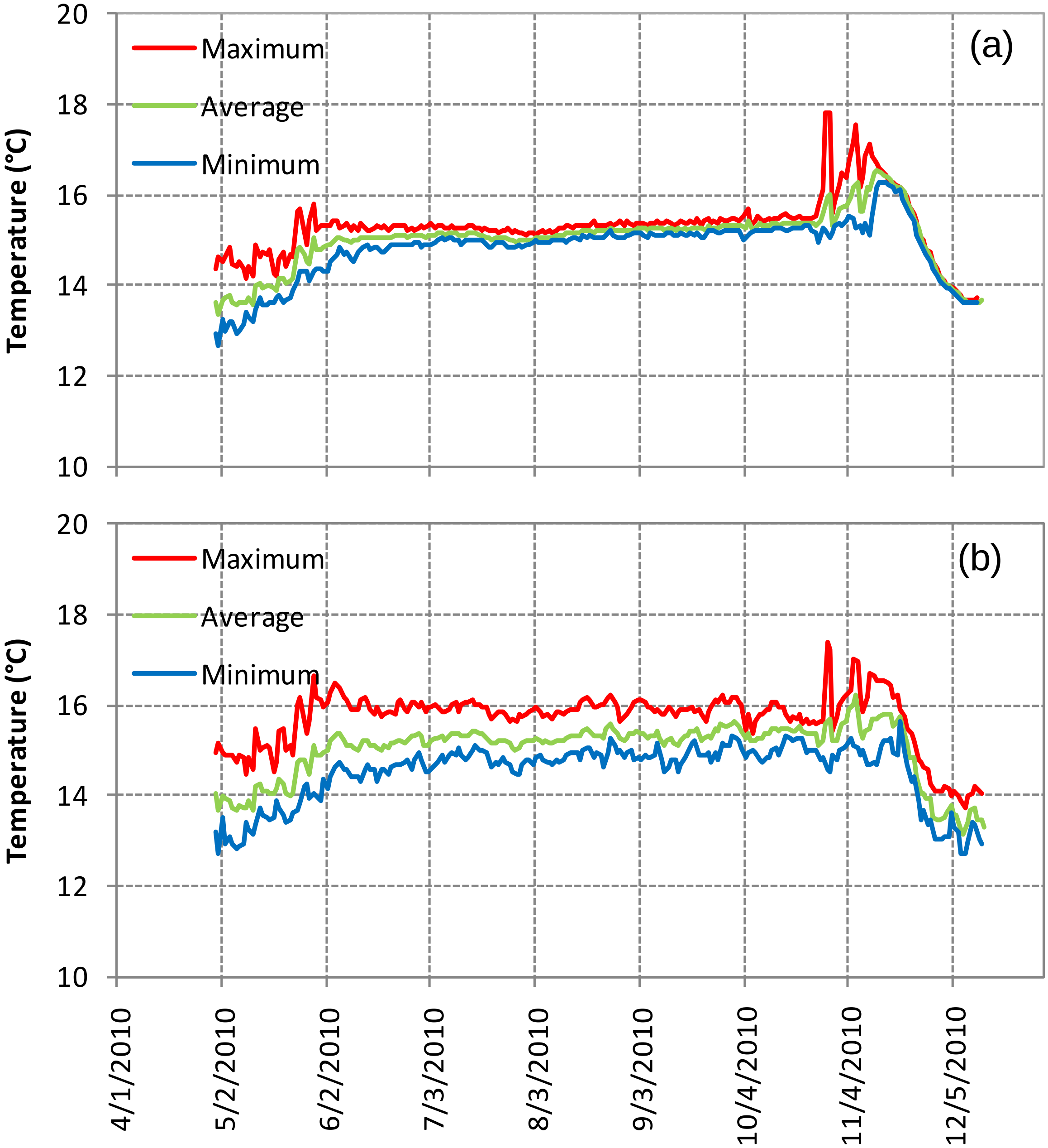


Figure 14: 2010 Thermograph maximum, average, and minimum daily values for the (a) lower Hilton Creek (HC-0.12) and (b) upper Hilton Creek (HC-0.54) temperature units.

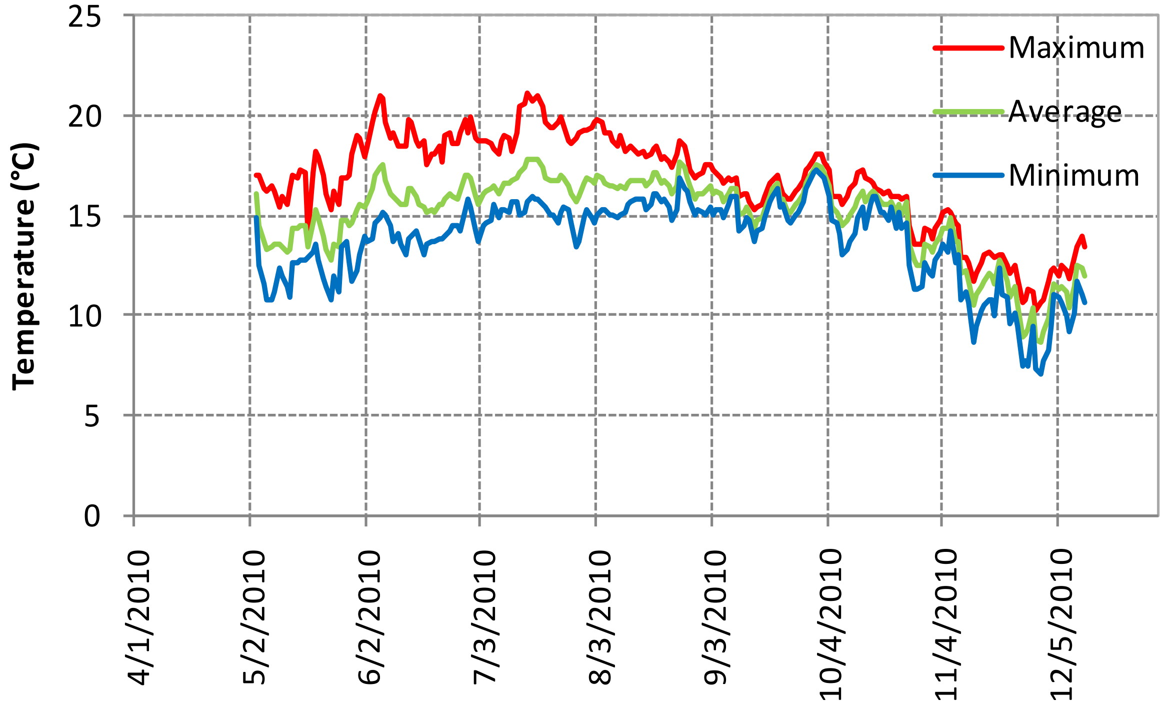


Figure 15: 2010 Thermograph maximum, average, and minimum daily values for the Quiota Creek (QC-2.71) temperature unit.

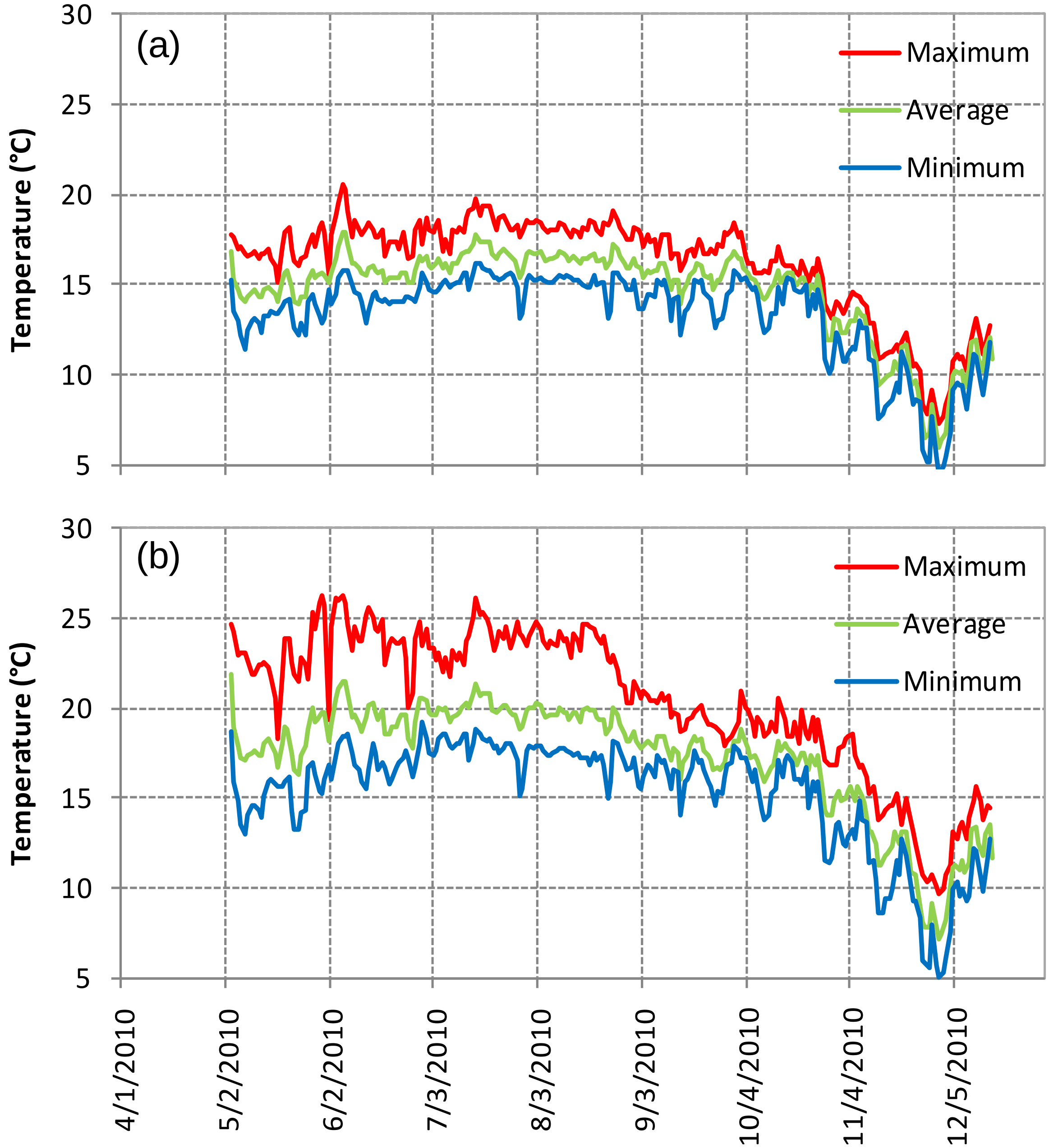


Figure 16: 2010 water temperatures at (a) upper Salsipuedes Creek (SC-3.8), 30 feet upstream of confluence with El Jaro Creek, and (b) lower Salsipuedes Creek (SC-0.77), approximately 200 yards upstream of Santa Rosa Bridge.

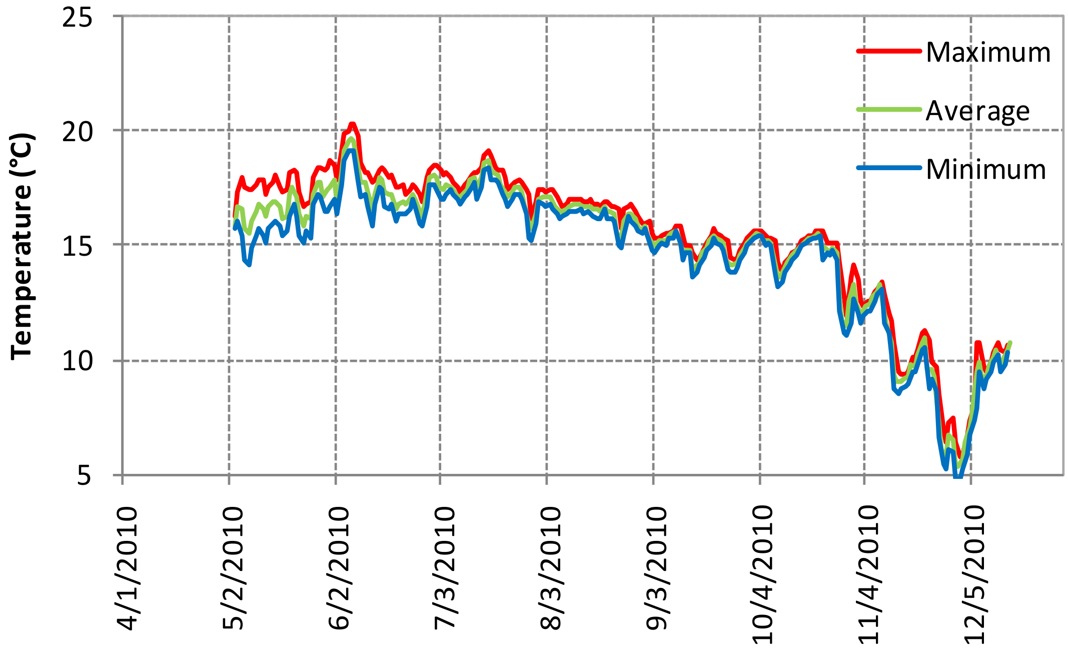


Figure 17: 2010 Thermograph maximum, average, and minimum daily values for El Jaro Creek (EJC-3.80), 50-feet upstream of the confluence with Salsipuedes Creek.

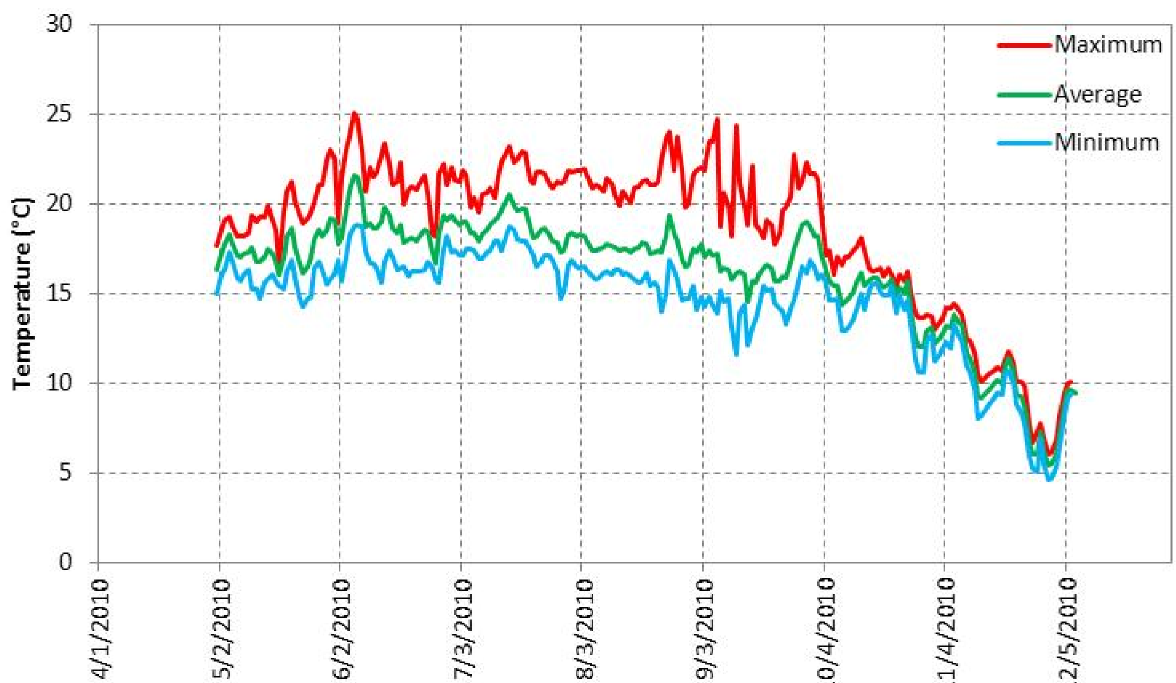


Figure 18: 2010 water temperatures at EJC-4.53, at upper side of the concrete low flow crossing on Cross Creek Ranch.

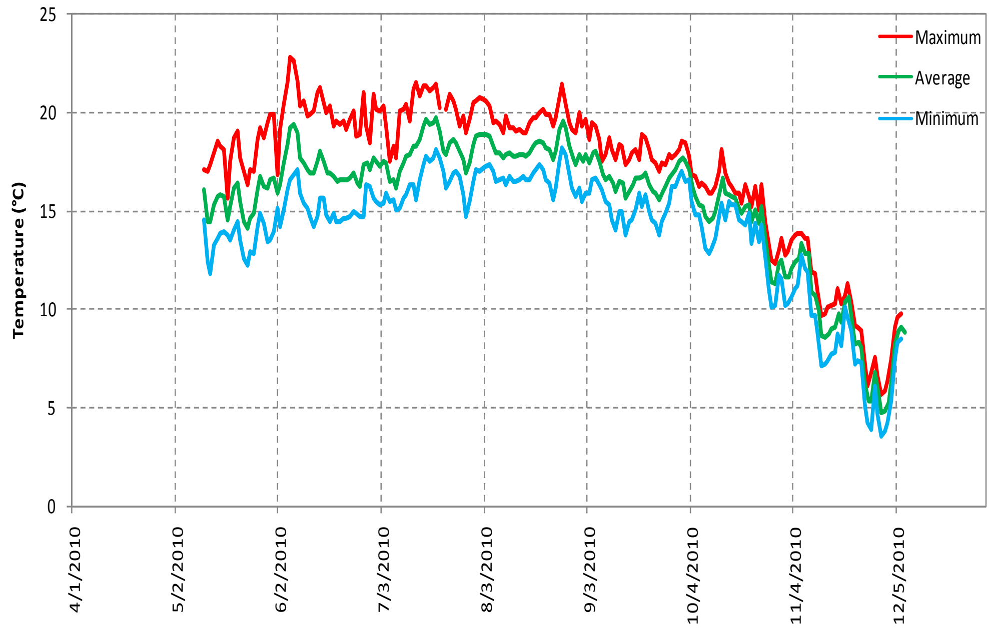


Figure 19: 2010 water temperatures at EJC-10.82, unit deployed at downstream end of the fish ladder at Rancho San Julian.

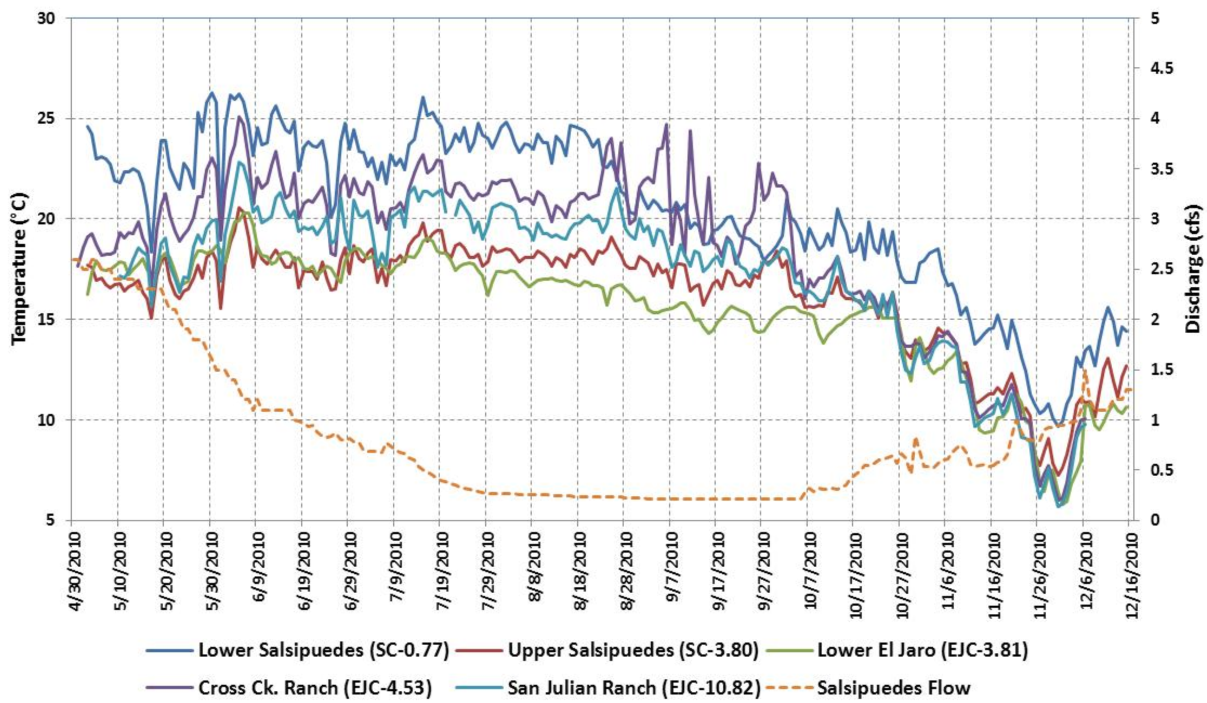


Figure 20: 2010 Longitudinal maximum surface water temperatures within the Salsipuedes Creek watershed which included El Jaro Creek at Rancho San Julian (EJC-10.82), Cross Creek Ranch (EJC-4.53), lower El Jaro Creek (EJC-3.81), upper Salsipuedes Creek (SC-3.80), and upper Salsipuedes Creek (SC-0.77).

Table 6: Water quality sonde deployments during the 2010 dry season.

Habitat	Location	Deployment Schedule:											
		7/6-7/9/10	7/12-7/15/10	7/19-7/22/10	8/11-8/13/10	8/17-8/19/10	8/30-9/2/10	10/6-10/8/10	10/15-10/18/10	10/19-10/21/10	11/3-11/5/10	11/5-11/8/10	11/8-11/10/10
Encantado Pool	LSYR-4.9	X				X				X		X	
7.3 Pool	LSYR-7.3		X		X				X		X		
9.6 Pool	LSYR-9.6			X			X	X					X

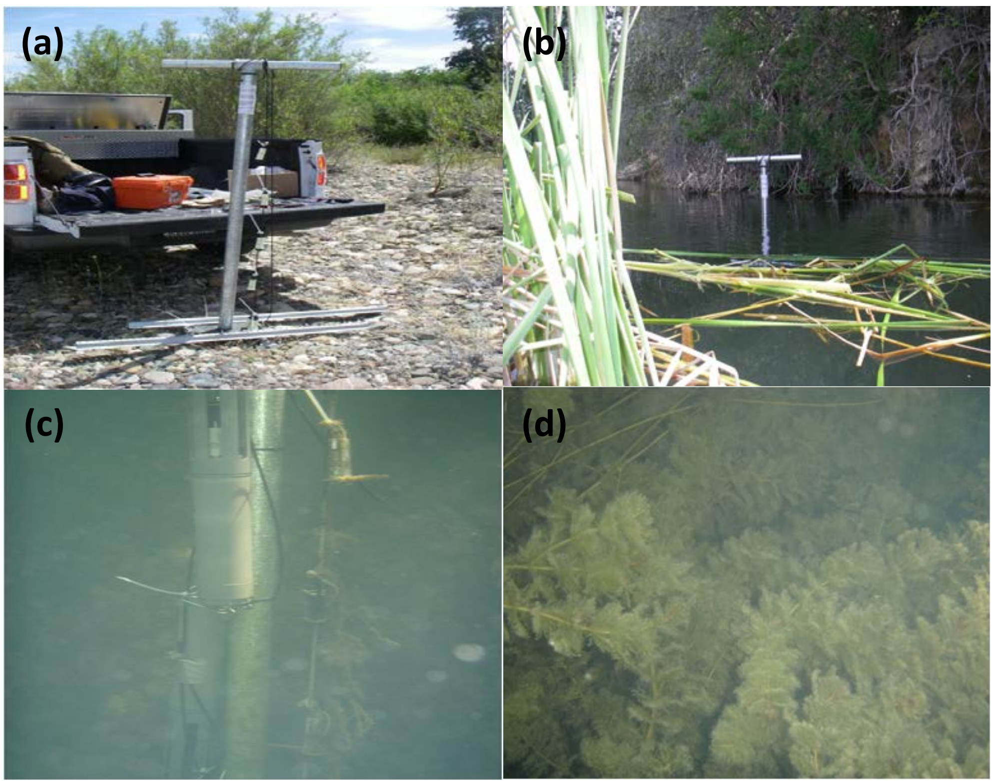


Figure 21: 2010 sonde vertical array at the Encantado Pool (LSYR-4.9) showing the (a) infrastructure prior to entering the water, (b) deployed infrastructure, (c) instruments underwater, and (d) aquatic vegetation on the bottom of the pool.

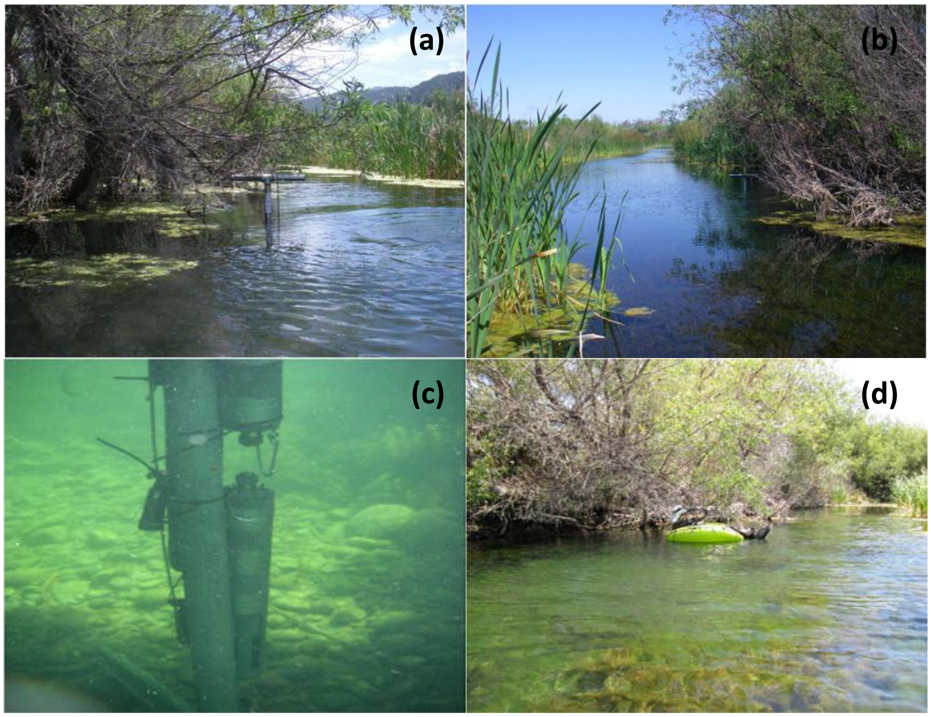


Figure 22: 2010 sonde vertical array at the 7.3 Pool (LSYR-7.3) showing the (a) deployed infrastructure, (b) upstream view, (c) instruments underwater, and (d) download procedure.

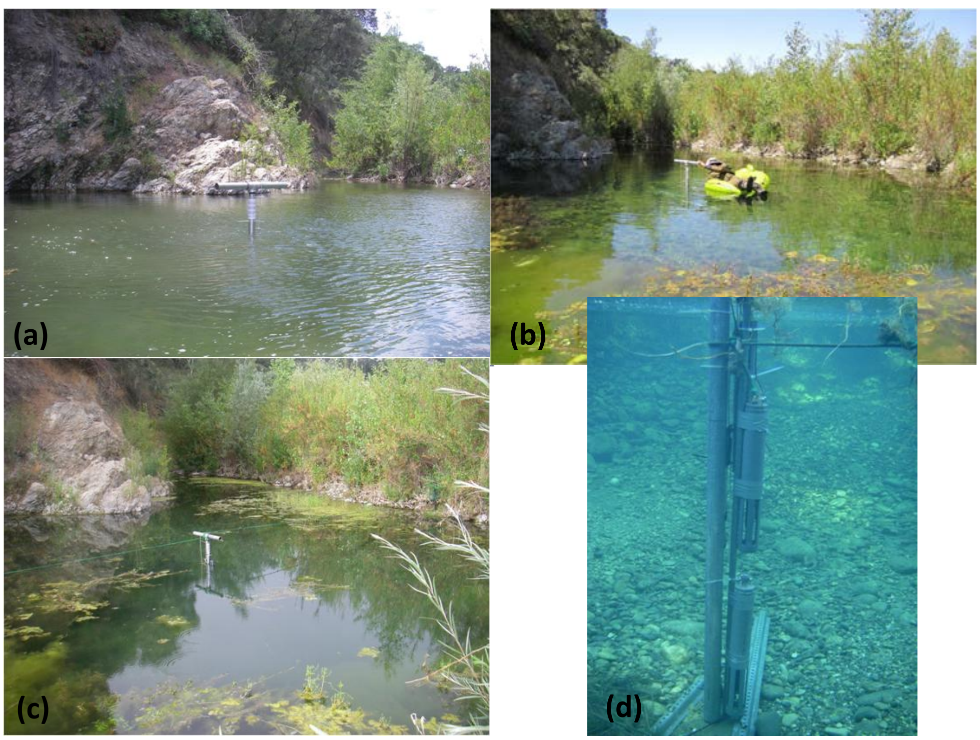


Figure 23: 2010 sonde vertical array at the 9.6 Pool (LSYR-9.6) showing the (a) deployed infrastructure, (b) download procedure, (c) infrastructure after stabilization, and (d) underwater view.

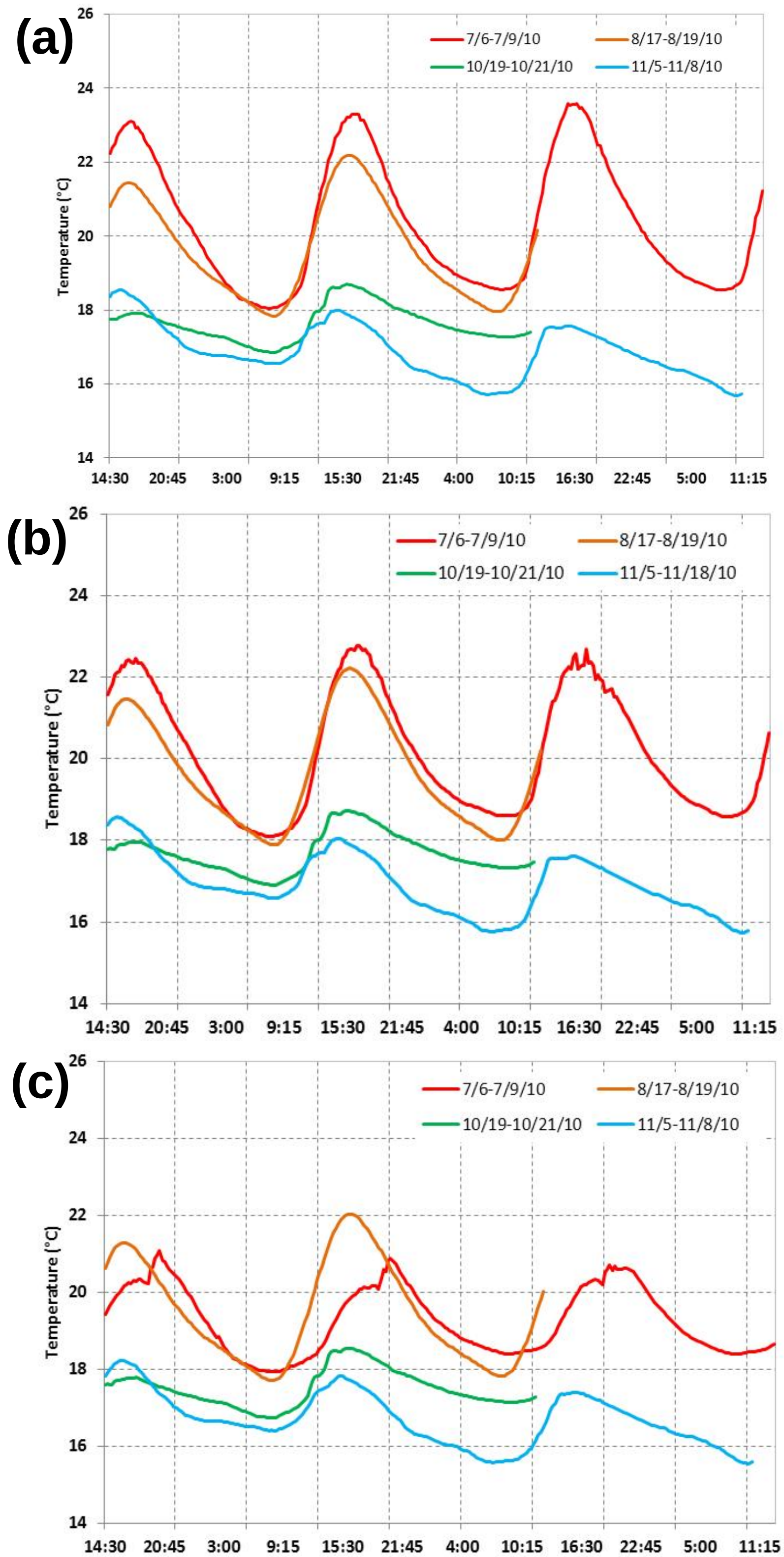


Figure 24: 2010 Encantado Pool (LSYR-4.9) sonde water temperatures during five deployments over the dry season at the (a) top, (b) middle, and (c) bottom of the water column.

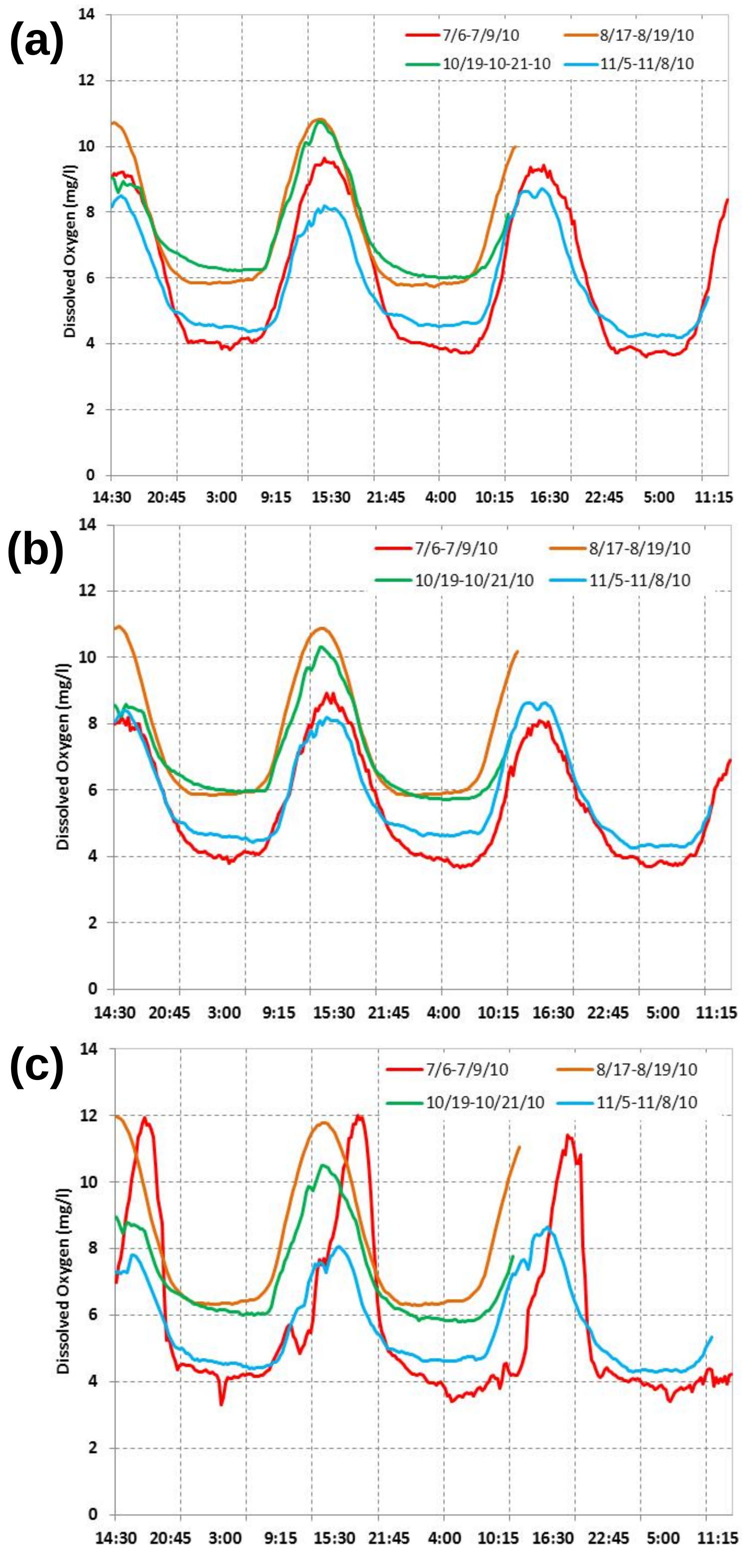


Figure 25: 2010 Encantado Pool (LSYR-4.9) sonde dissolved oxygen concentrations during five deployments over the dry season at the (a) top, (b) middle, and (c) bottom of the water column.

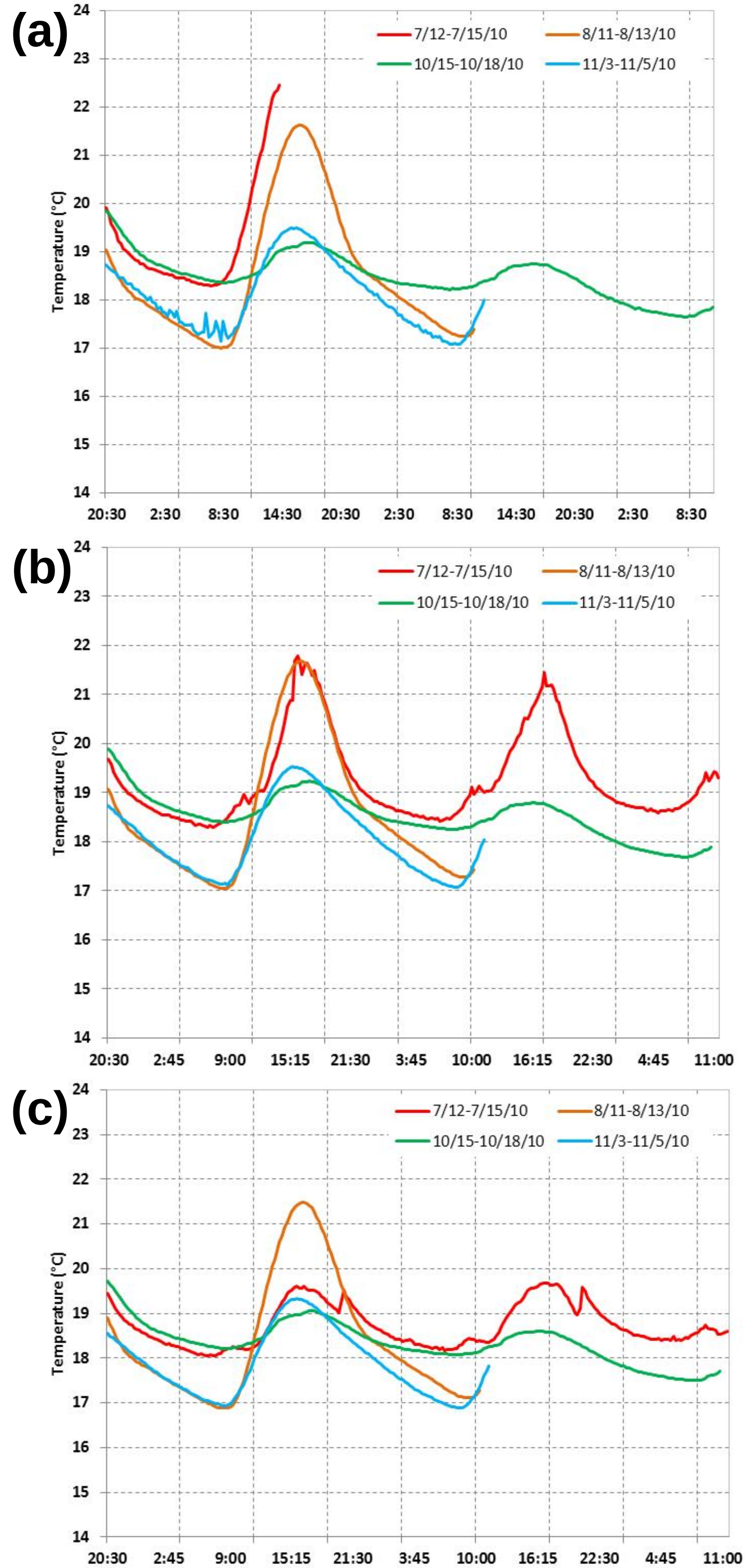


Figure 26: 2010 7.3 Pool (LSYR-7.3) sonde water temperatures during five deployments over the dry season at the (a) top, (b) middle, and (c) bottom of the water column.

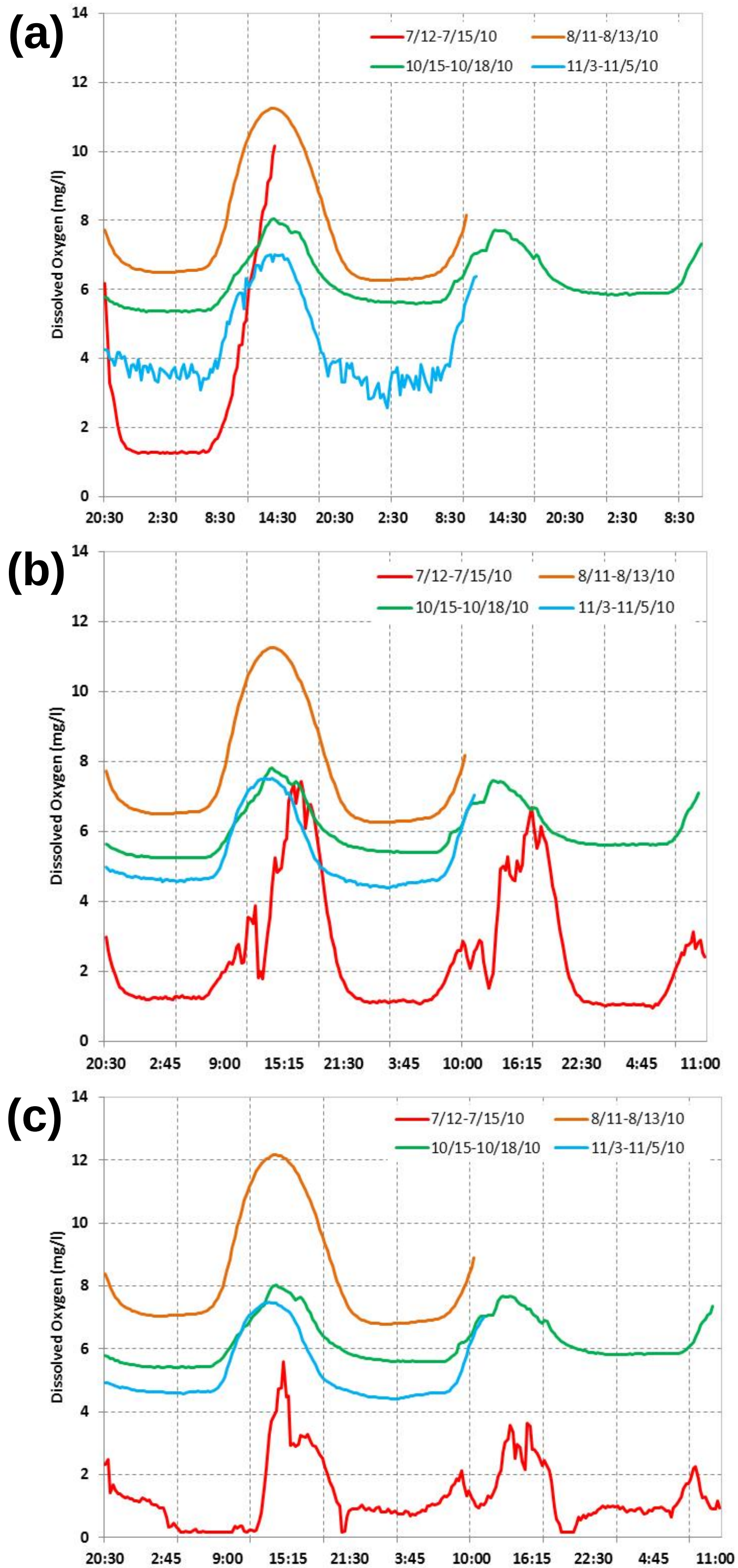


Figure 27: 2010 7.3 Pool (LSYR-7.3) sonde dissolved oxygen concentrations during five deployments over the dry season at the (a) top, (b) middle, and (c) bottom of the water column.

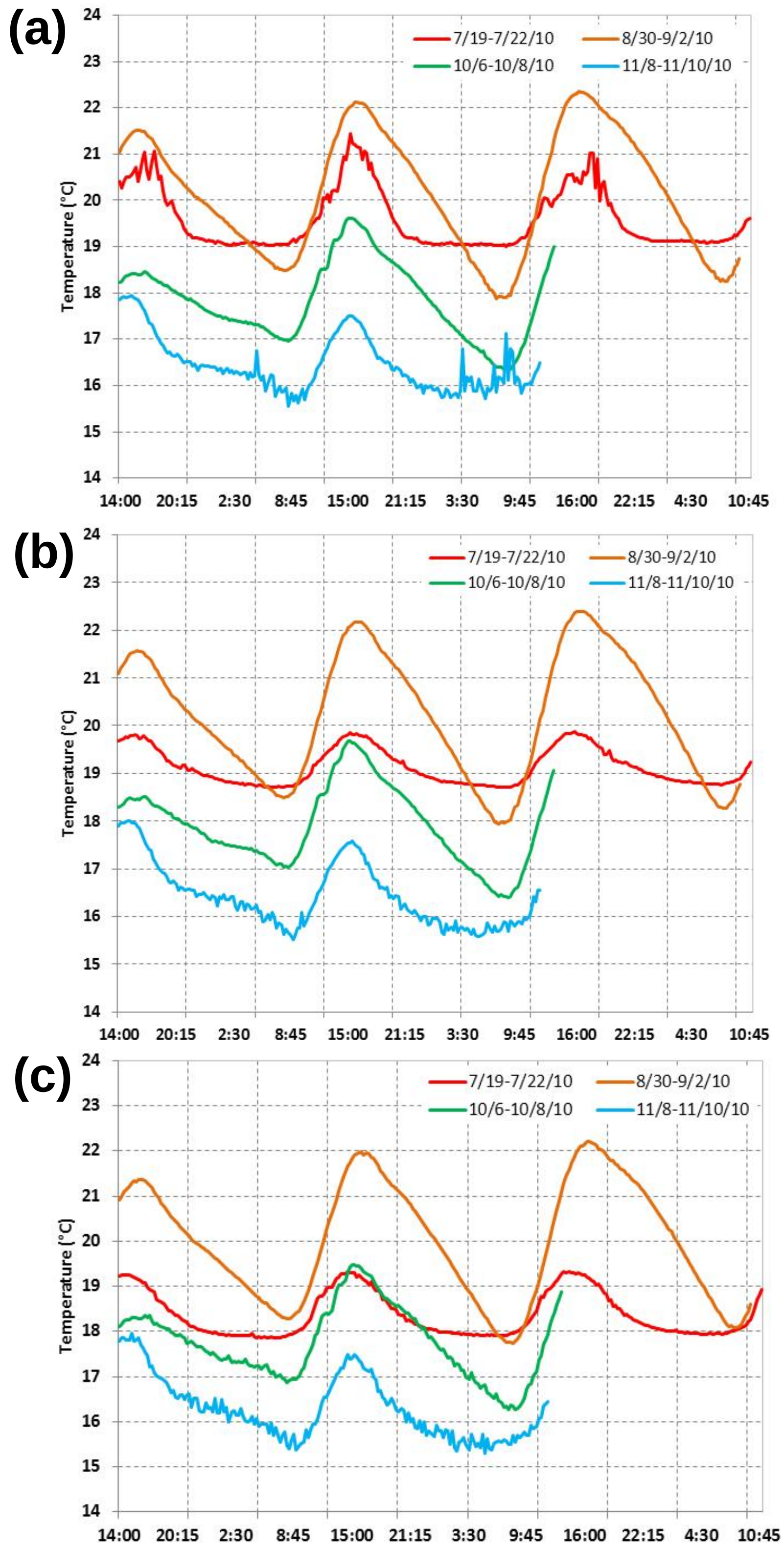


Figure 28: 2010 9.6 Pool (LSYR-9.6) sonde water temperatures during five deployments over the dry season at the (a) top, (b) middle, and (c) bottom of the water column.

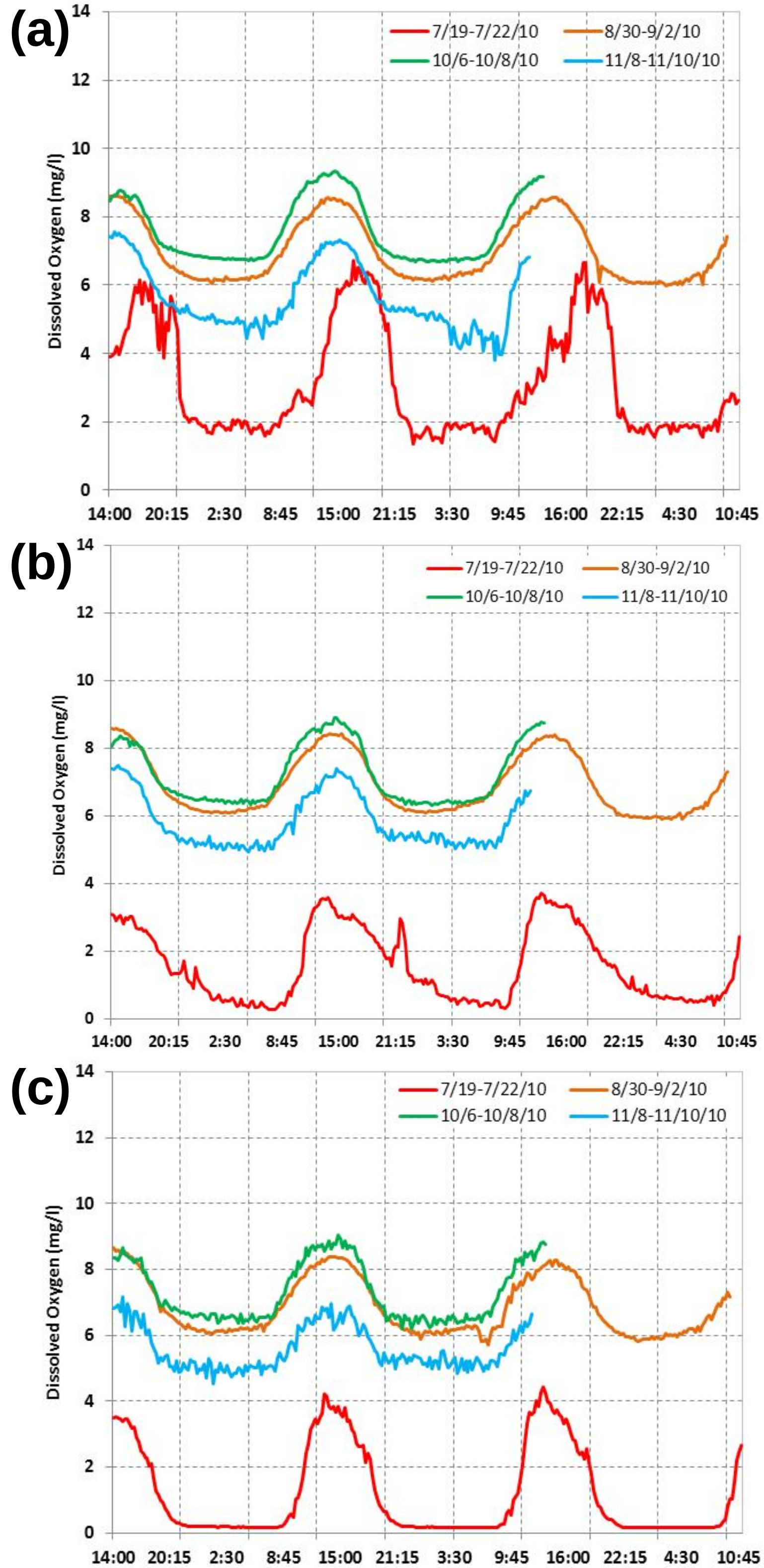


Figure 29: 2010 9.6 Pool (LSYR-9.6) sonde dissolved oxygen concentrations during five deployments over the dry season at the (a) top, (b) middle, and (c) bottom of the water column.

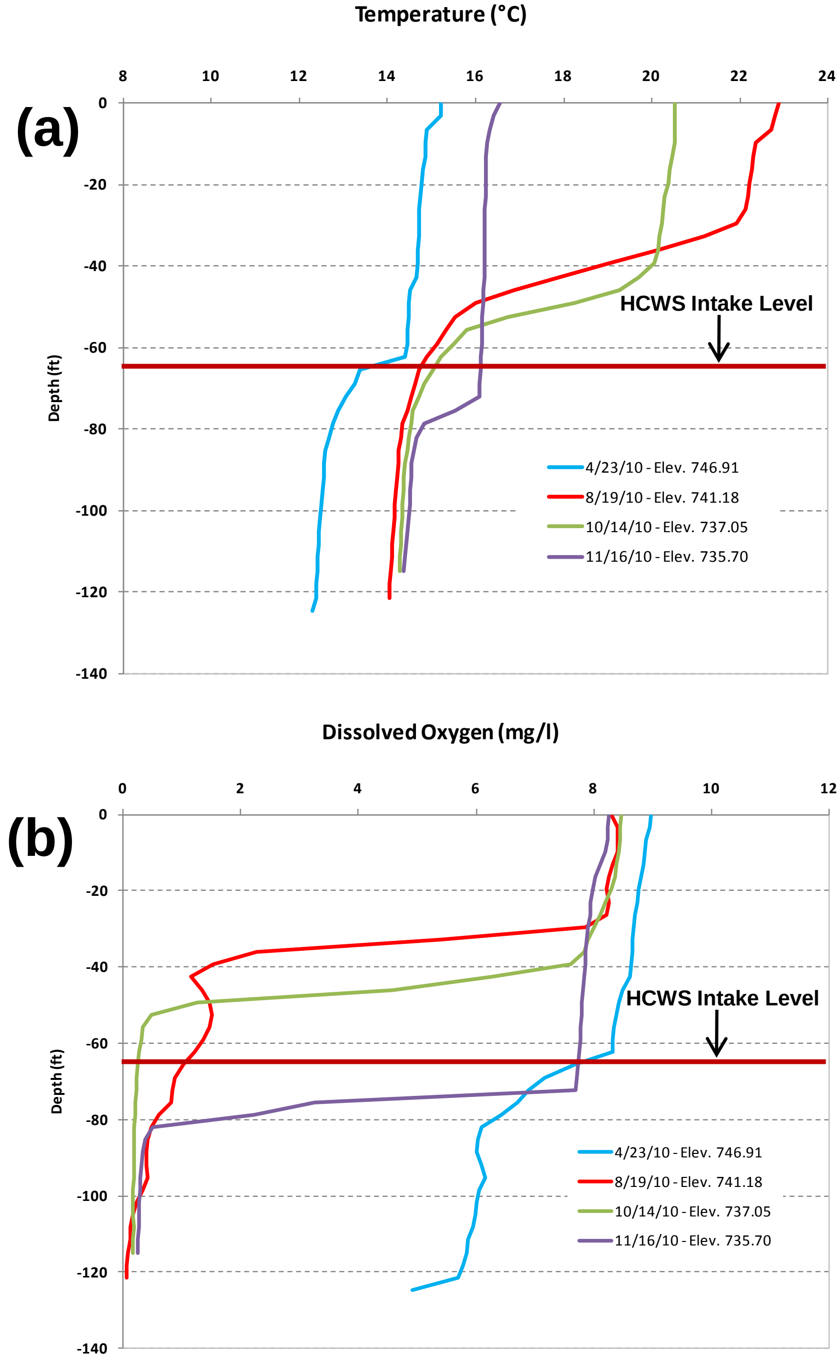


Figure 30: Lake Cachuma 2010 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS. HCWS intake hose level was set at 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

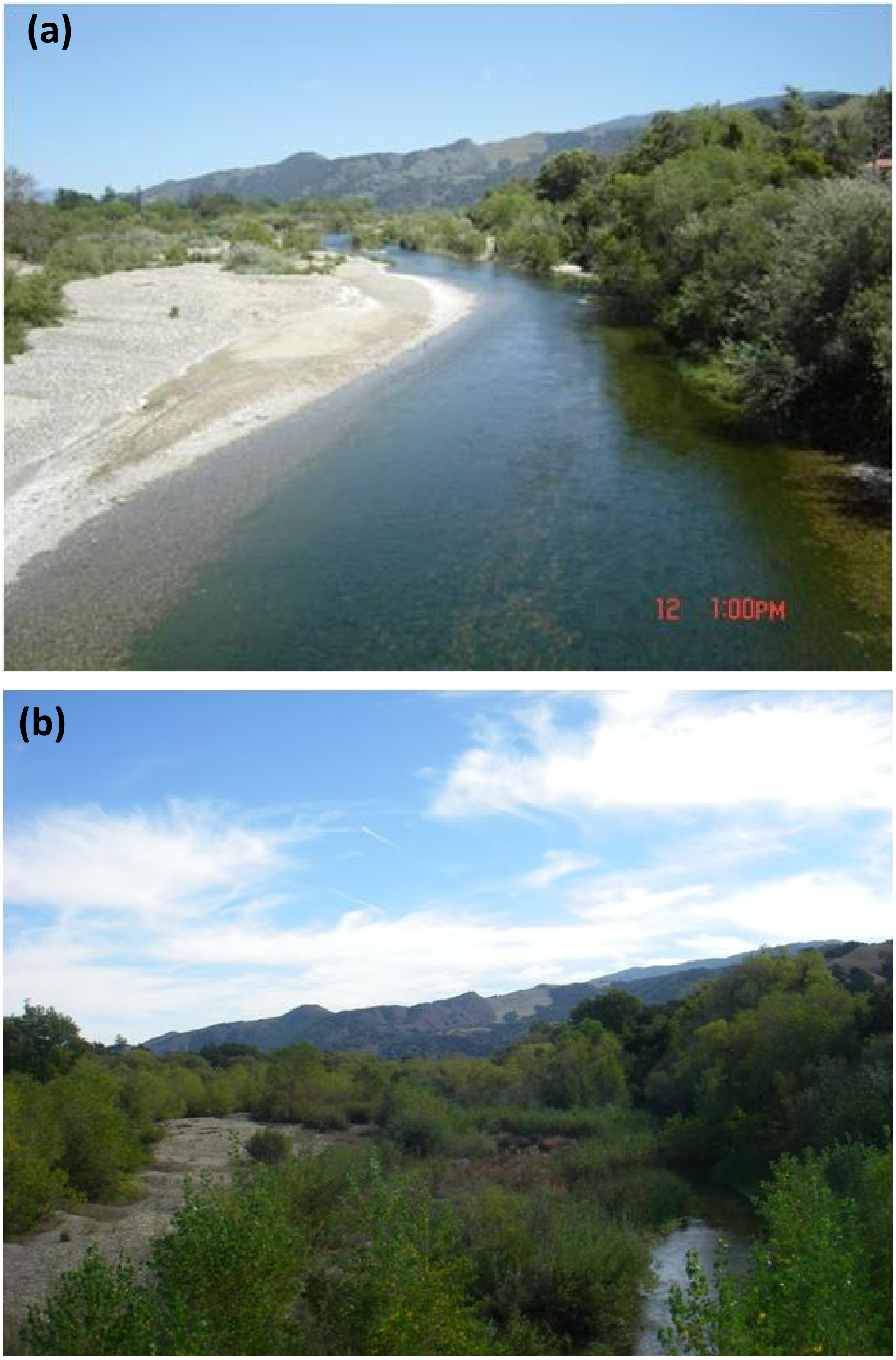


Figure 31: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) October 2010.

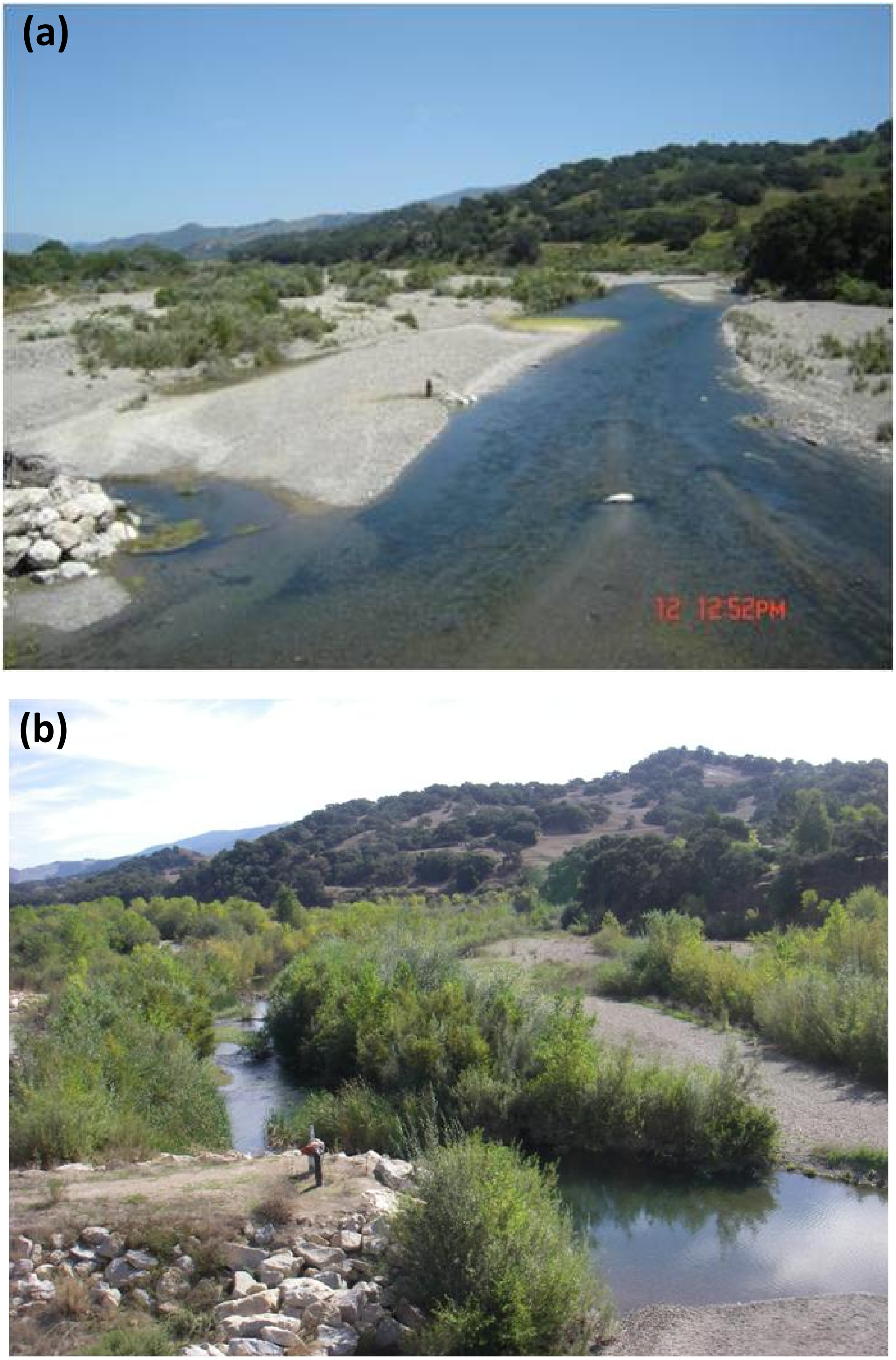


Figure 32: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) October 2010.

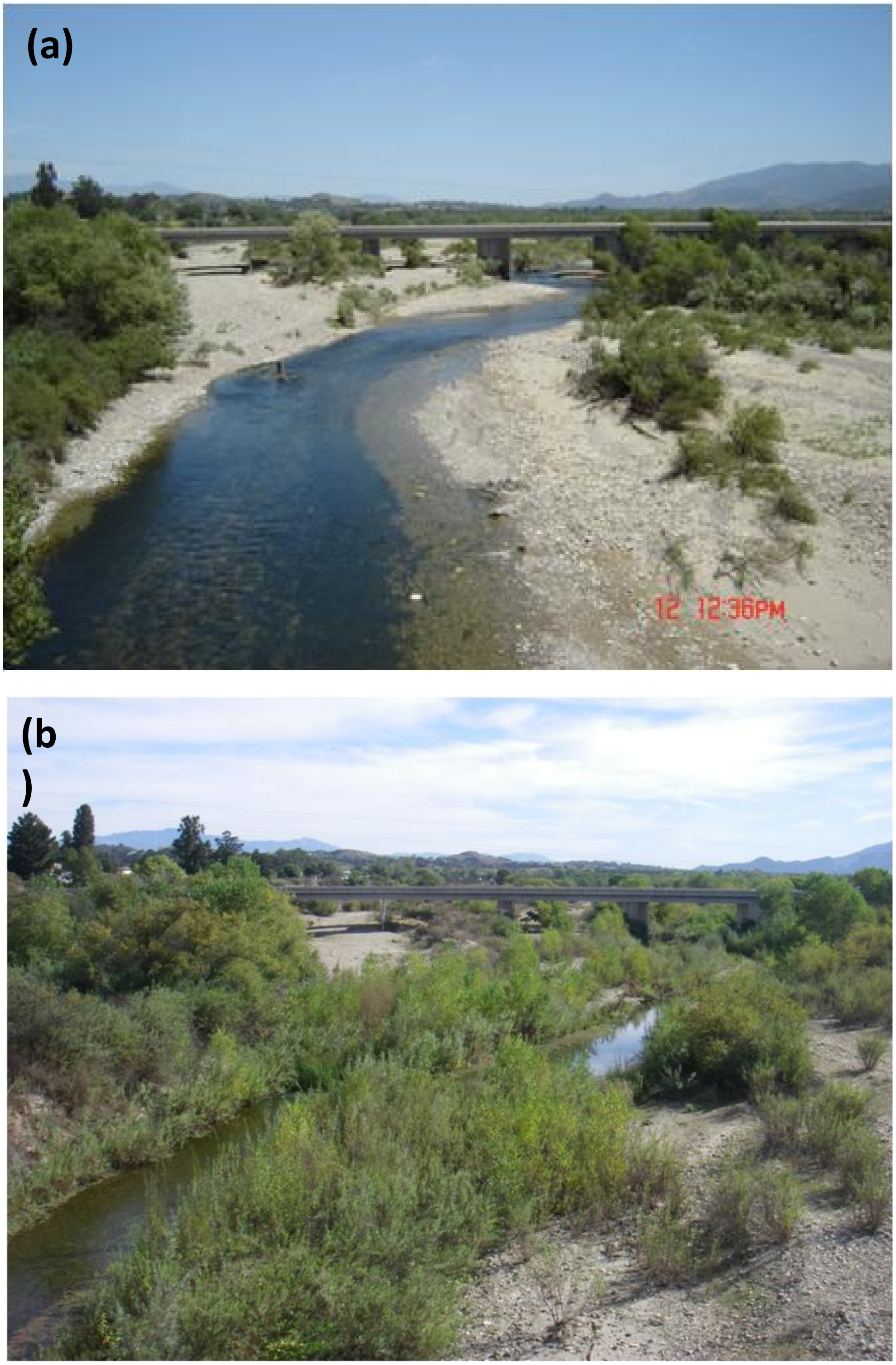


Figure 33: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) October 2010.

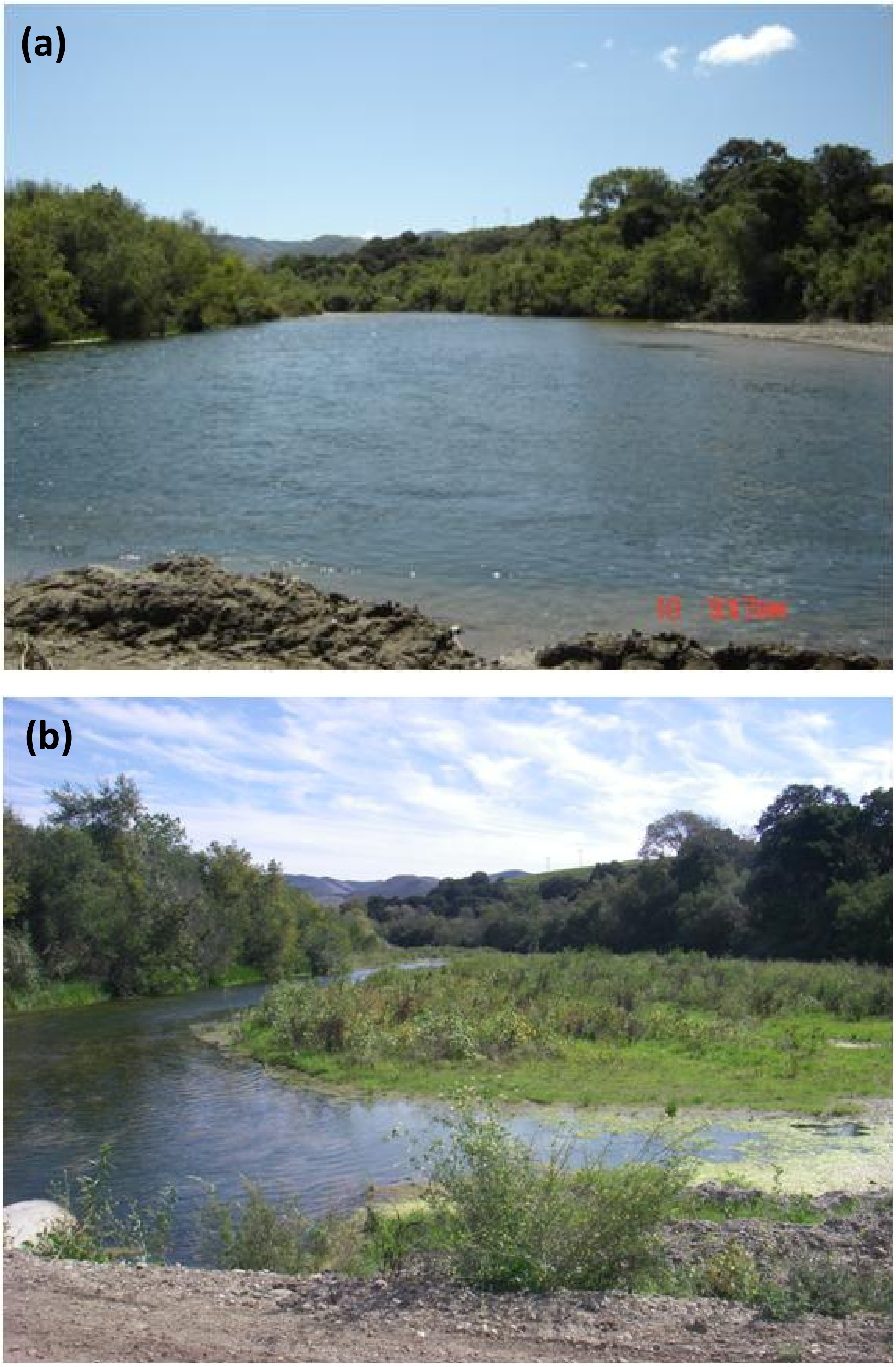


Figure 34: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) October 2010.

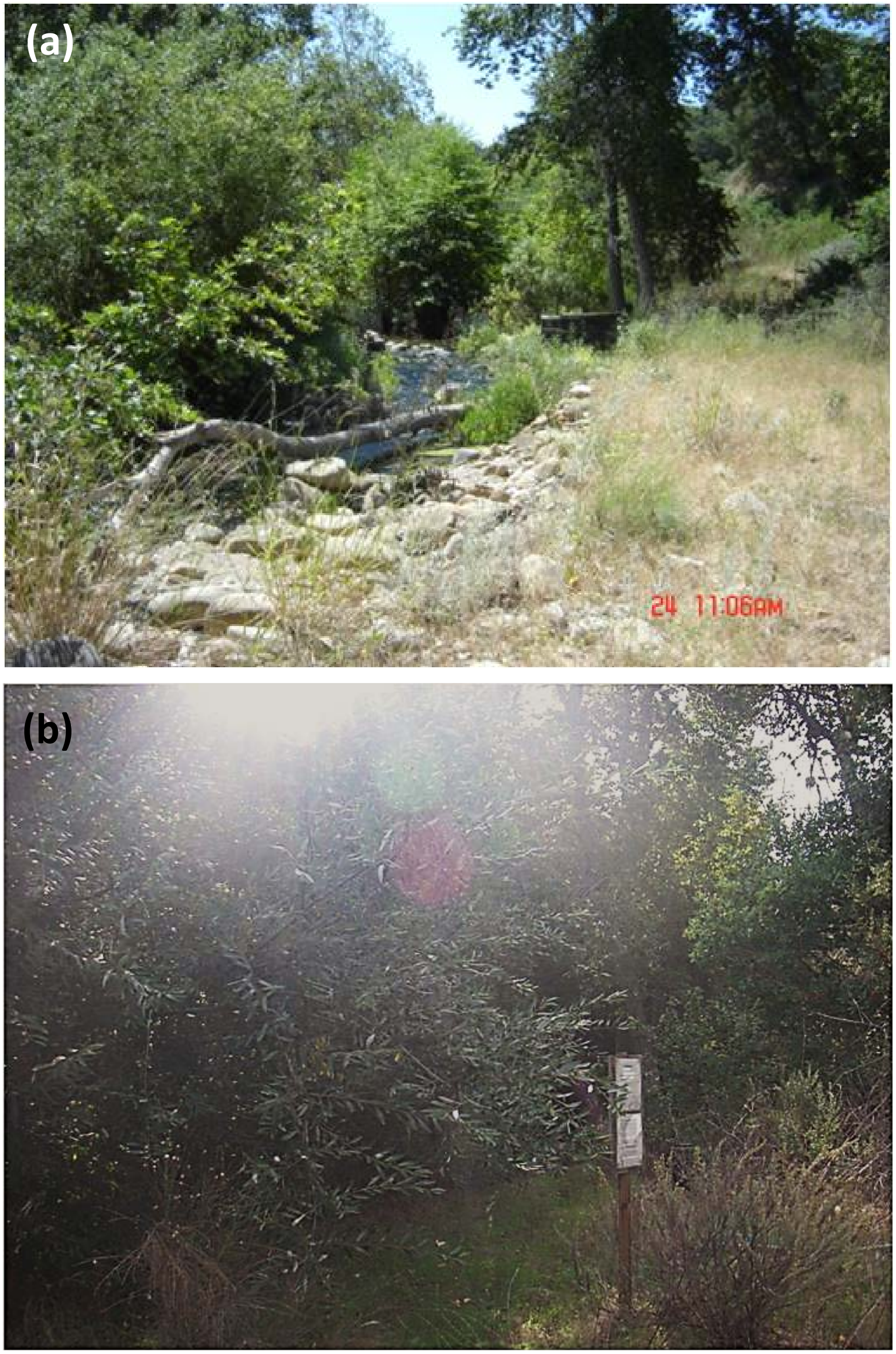


Figure 35: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) October 2010.

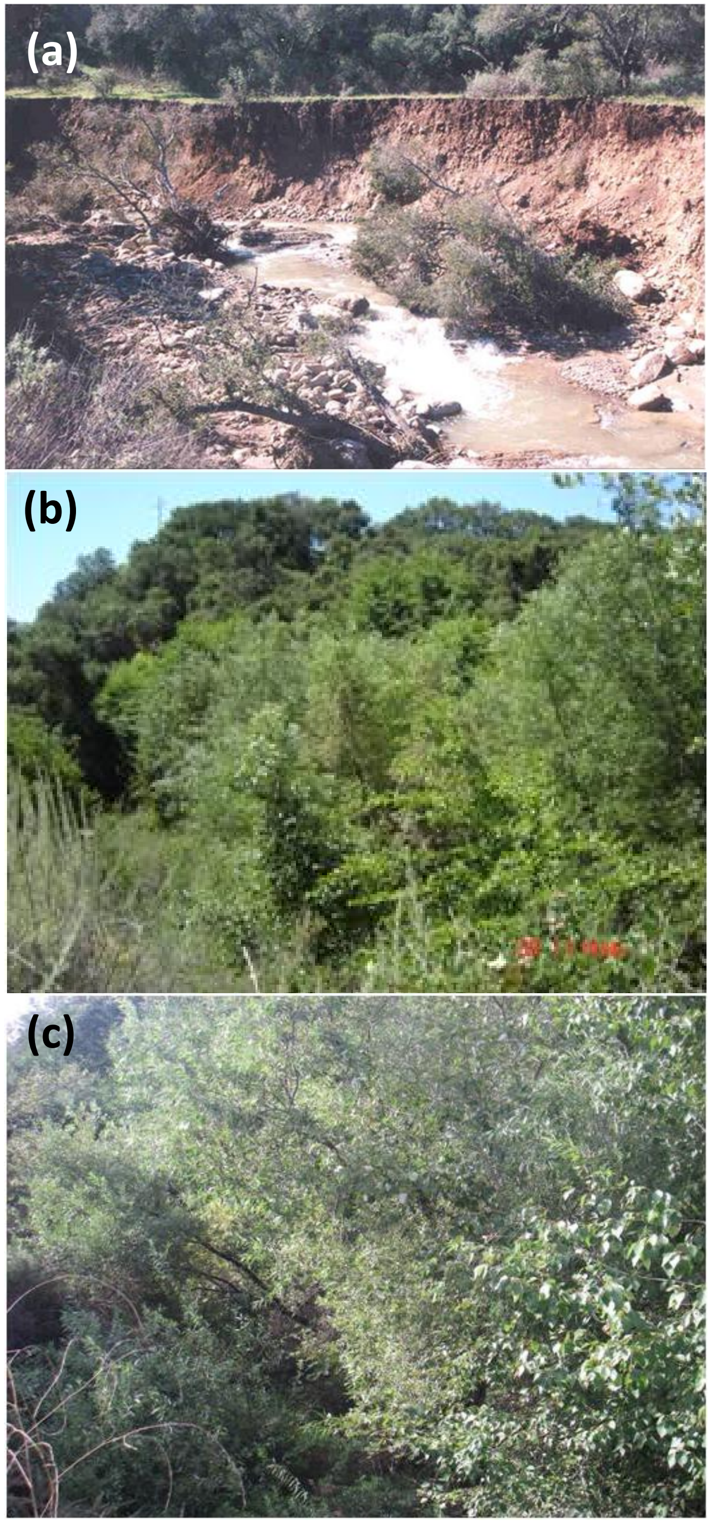


Figure 36: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) October 2010.

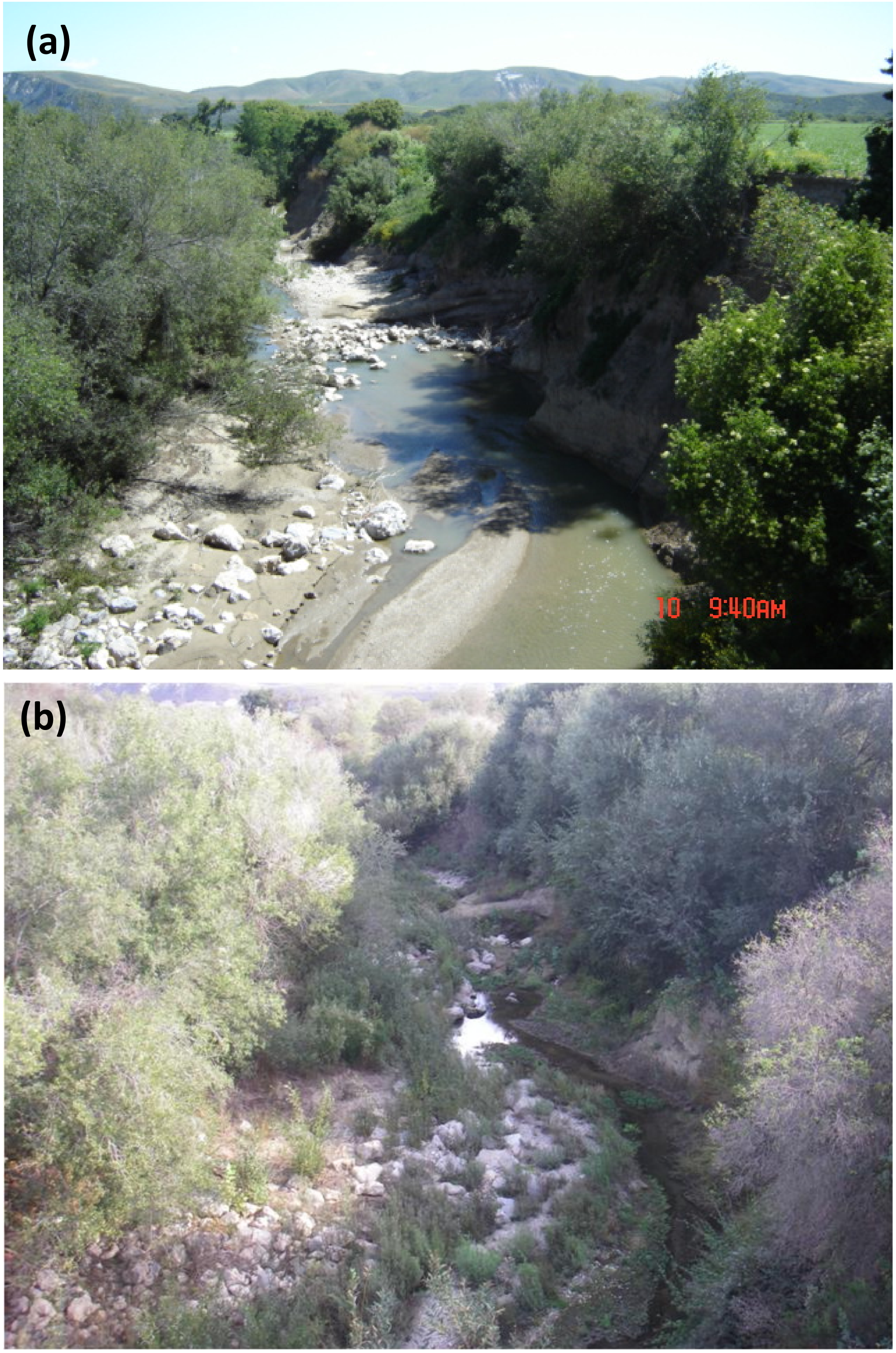


Figure 37: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) October 2010.

Figure 38: 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 October 2010.

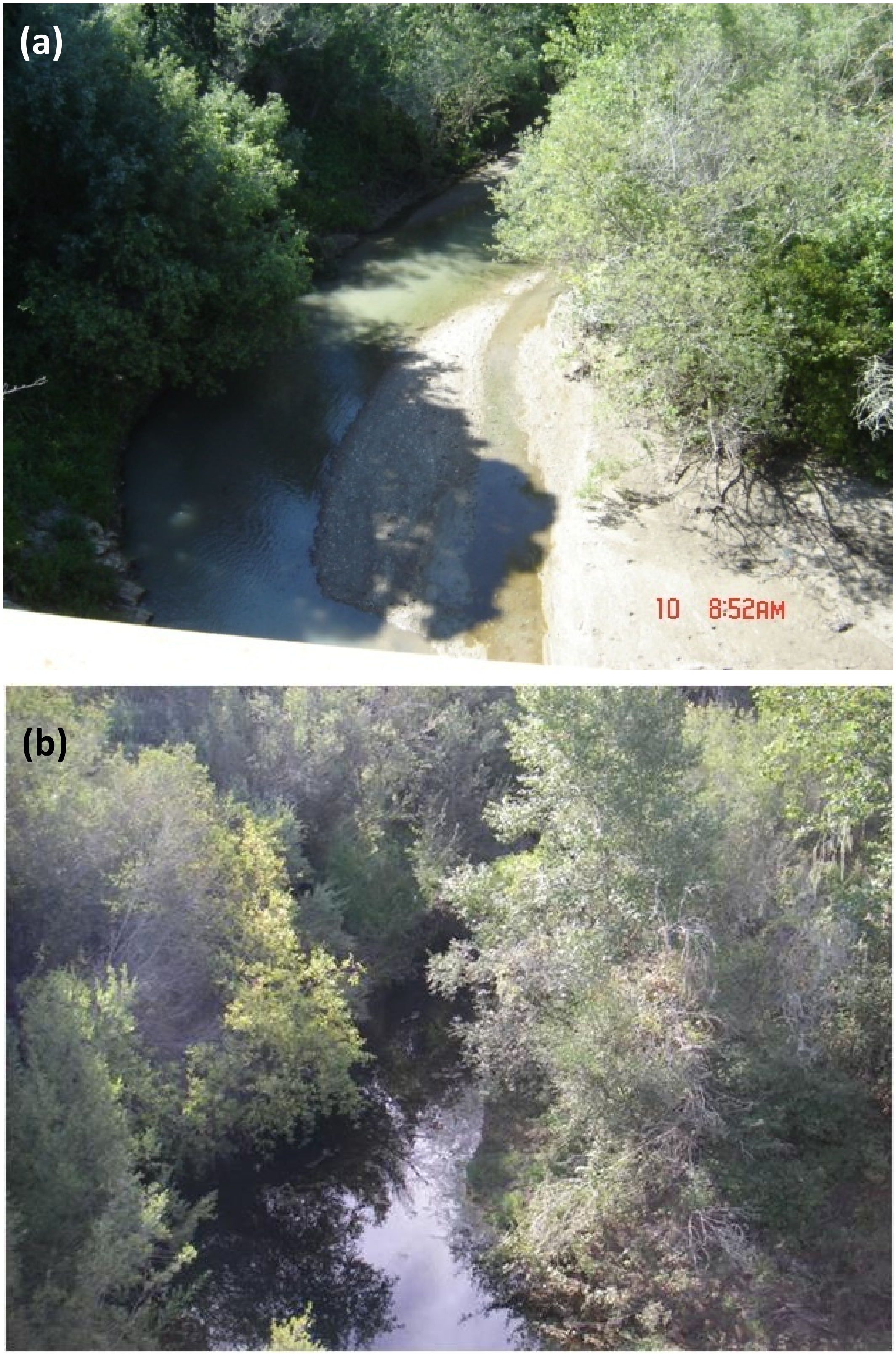


Figure 39: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) October 2010.

3.4 Migrant Trapping

Table 7: WY2010 migrant trap deployments.

Location	Date Traps Deployed	Date Trap Removed	Date Traps Removed (storm event)	Date Traps Installed (storm event)	# of Days Not Trapping	Functional Trapping Days	Functional Trapping %
	(dates)	(dates)	(dates)	(dates)	(days)	(days)	(days)
Hilton	1/23/2010	5/20/2010	1/26/2010	1/27/2010	1		
			2/5/2010	2/7/2010	2		
			2/26/2010	2/28/2010	2		
			4/11/2010	4/12/2010	1		
	Total:	117		**Total:**	6	111	94.9%
Salsipuedes	1/23/2010	5/20/2010	1/26/2010	1/27/2010	1		
			2/5/2010	2/7/2010	2		
			2/9/2010	2/10/2010	1		
			2/26/2010	2/28/2010	2		
			4/11/2010	4/12/2010	1		
	Total:	117		**Total:**	7	110	94.0%
Mainstem	1/27/2010	5/20/2010	2/5/2010	2/7/2010	2		
			3/31/2010	4/1/2010	1		
	Total:	113		**Total:**	3	110	97.3%

Table 8: WY2010 Catch Per Unit Effort (CPUE) for each trapping location.

Location	Upstream Captures	Downstream Captures	Functional Trap Days	Trap Season	Trapping Effeciency	CPUE Upstream	CPUE Downstream	CPUE (Total)	Ave Flow*
	(#)	(#)	(days)	(days)	(%)	(Captures/day)	(Captures/day)	(Captures/day)	(cfs)
Hilton	107	151	111	117	94.9%	0.96	1.36	2.32	6.3
Salsipuedes	6	73	110	117	94.0%	0.05	0.66	0.72	17.5
Mainstem	2	28	110	113	97.3%	0.02	0.25	0.27	48.6

* Average (Ave) flow was calculated from the daily discharge recorded at the nearest USGS gauging station during the period when the traps were deployed.

Table 9: Number of migrant captures, including recaptures but not young-of-the-year, associated with each trap check at each trapping location over 24-hours in WY2010.

Location	Trap	Trap Check				Total
		1st AM	2nd AM	1st PM	2nd PM	
Salsipuedes	Upstream	1	1	4	0	6
	Downstream	11	8	20	34	73
	Total:	12	9	24	34	79
Mainstem	Upstream	0	1	0	1	2
	Downstream	8	4	2	14	28
	Total:	8	5	2	15	30
Hiton	Upstream	36	11	20	40	107
	Downstream	39	14	12	85	150
	Total:	75	25	32	125	257

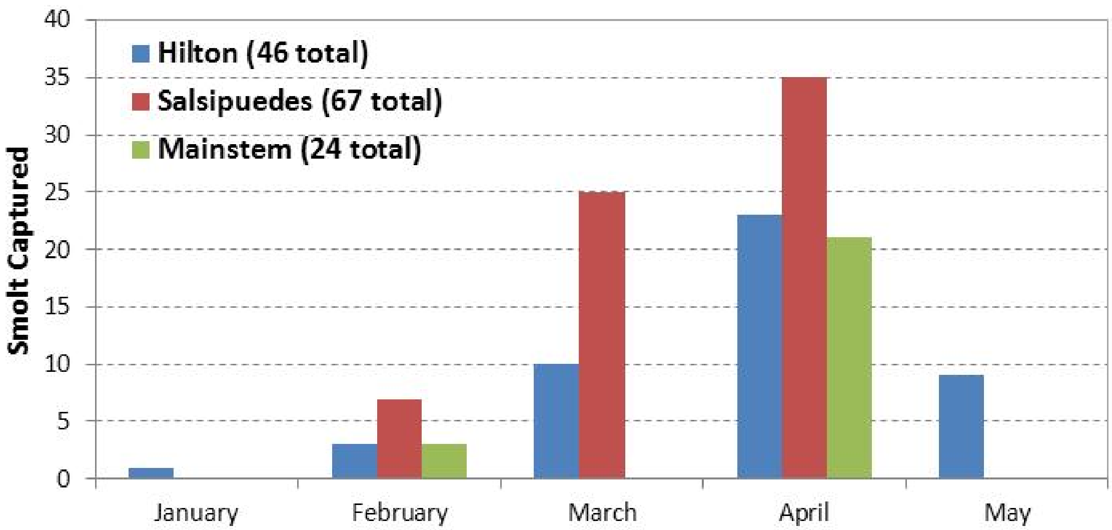


Figure 40: Timing of smolt migration observed at the Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps in WY2010.

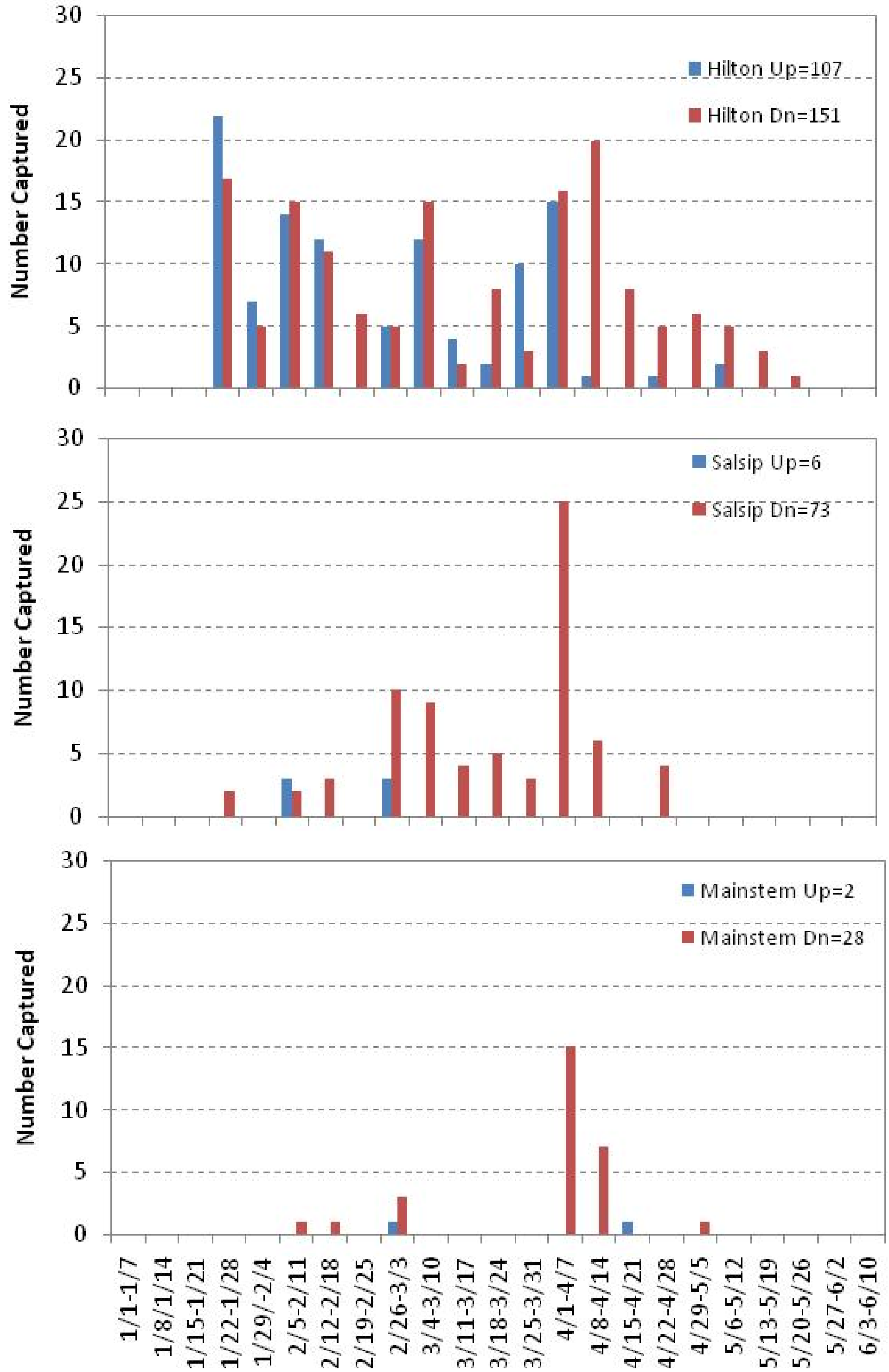


Figure 41: WY2010 paired histogram of weekly upstream and downstream captures by trap site for: (a) Hilton Creek, (b) Salsipuedes Creek, and (c) LSYR Mainstem.

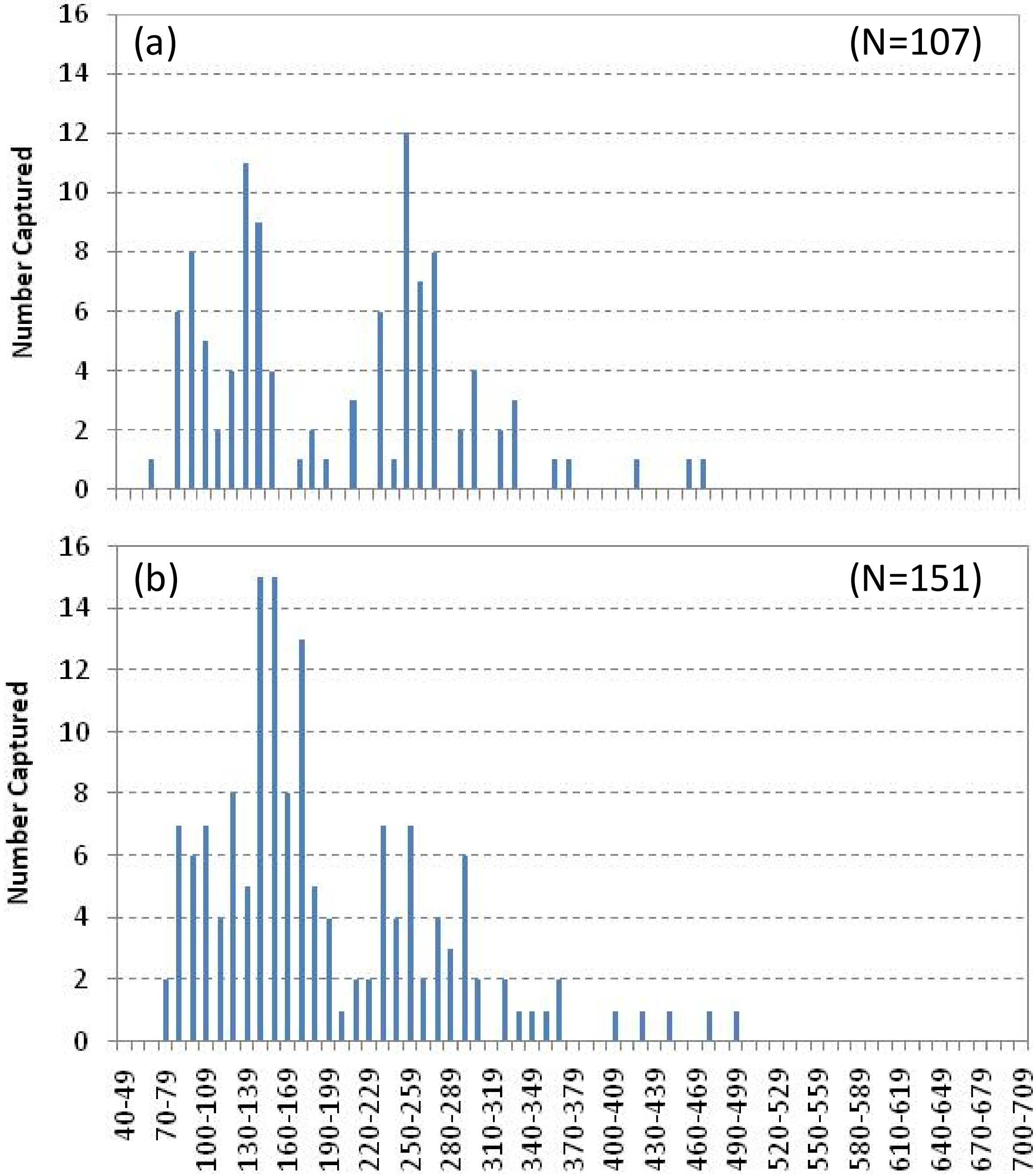


Figure 42: WY2010 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

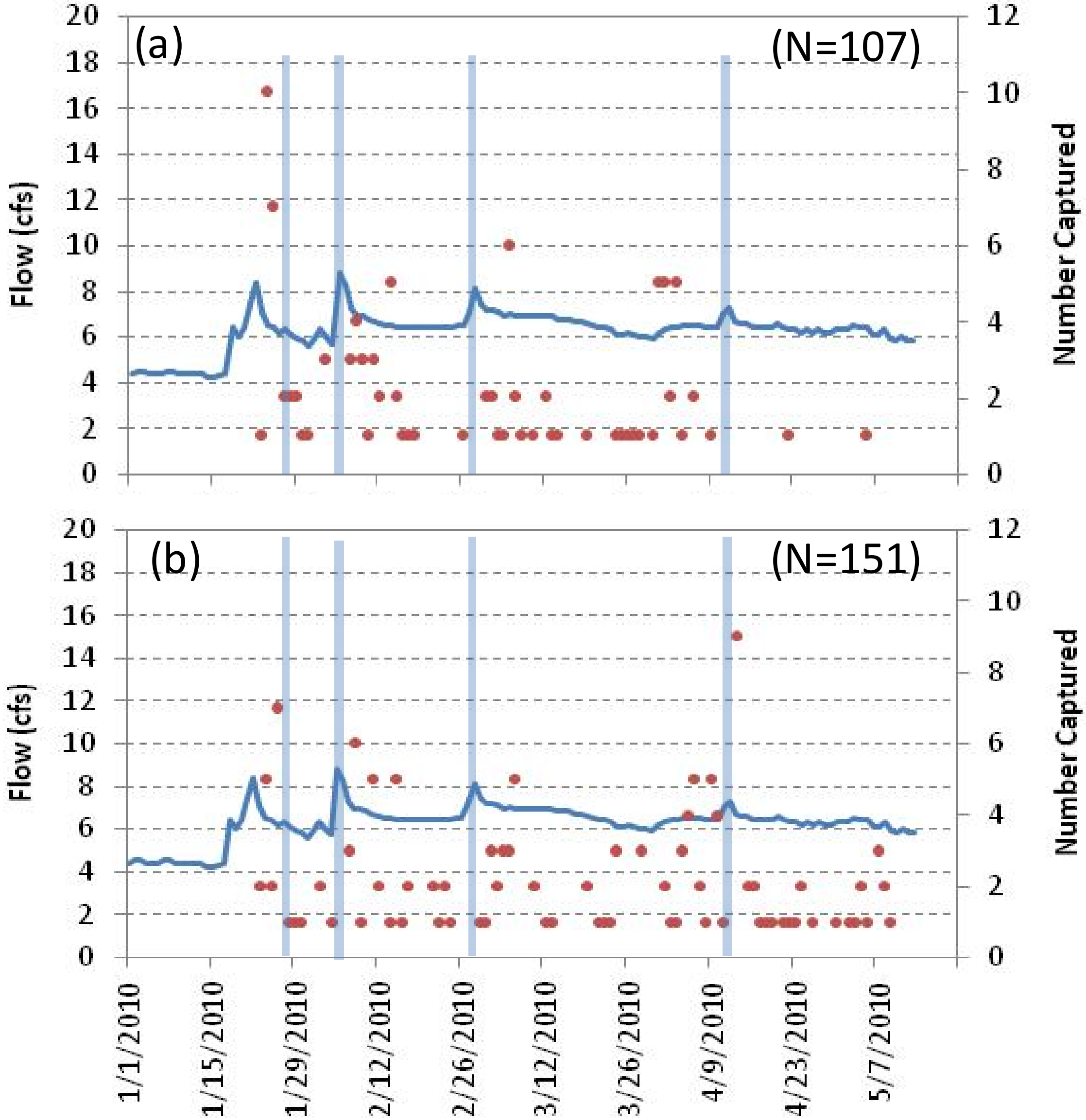


Figure 43: WY2010 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

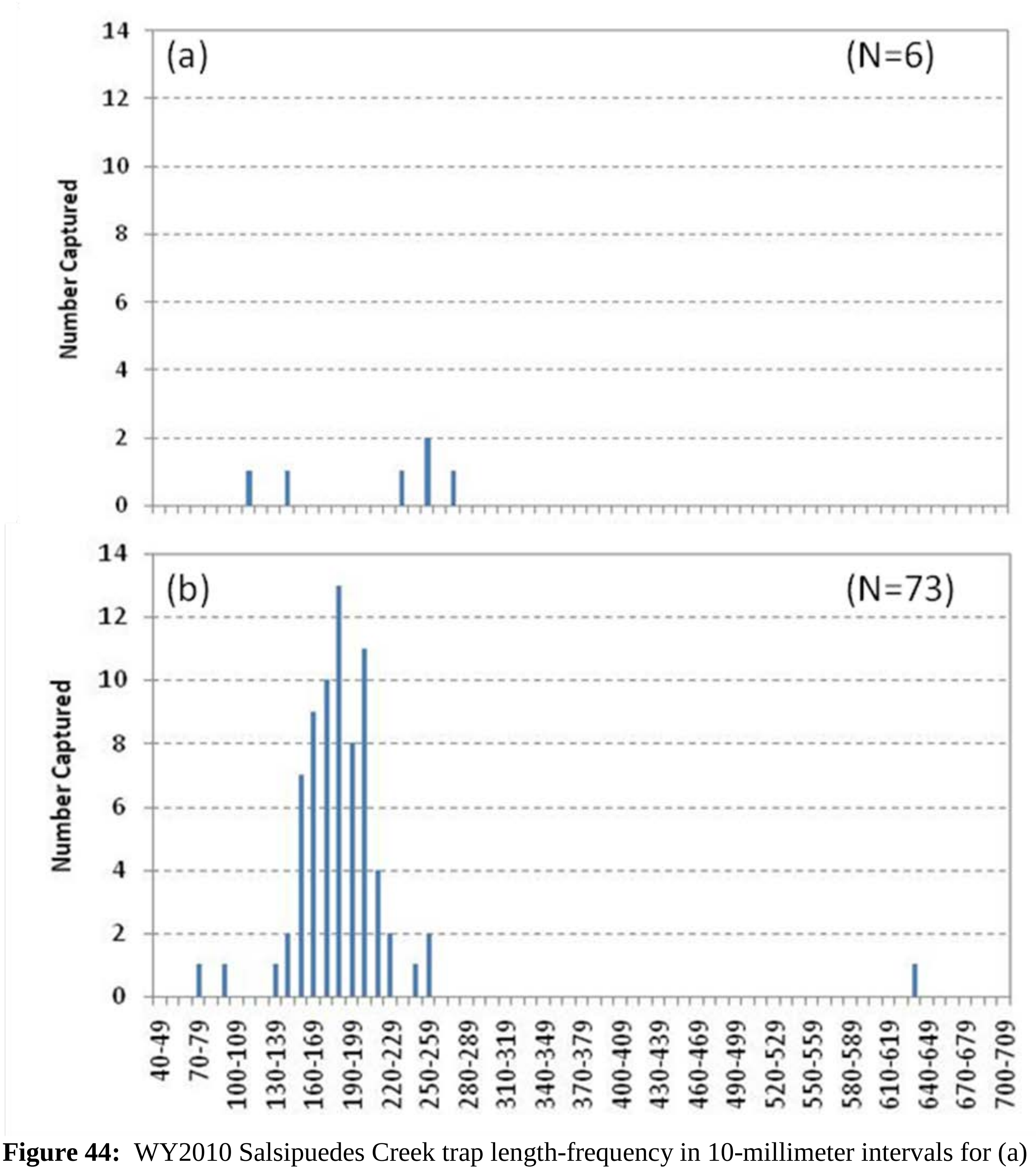


Figure 44: WY2010 Salsipuedes Creek trap length-frequency in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

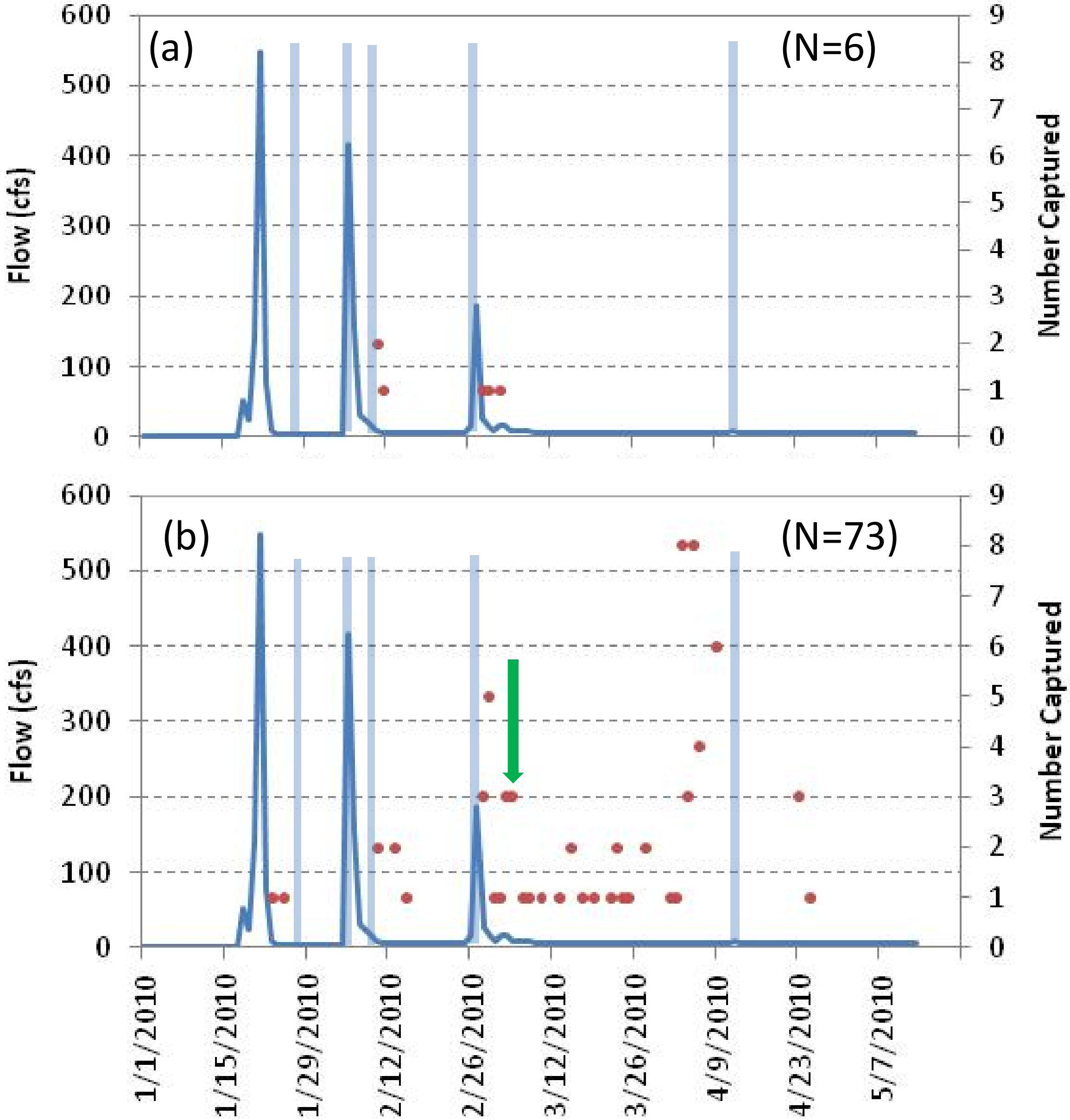


Figure 45: WY2010 Salsipuedes Creek migrant captures (red dots) vs. flow for (a) upstream and (b) downstream migrants. The blue rectangles bracket times when migrant traps were removed due to storm events, and the green arrow denotes when a downstream adult steelhead was captured.

Table 10: Tributary upstream and downstream migrant captures for Hilton and Salsipuedes creeks in WY2010. Blue lettering represents breakdown of smolts, pre-smolts, and resident trout for each size category; there were 46 and 67 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
0		600-649		0
0		550-599		0
0		500-549		0
2		450-499		0
1		400-450		0
11		300-399		0
39		200-299		4
39		101-199		2
15		<100		0
107		**Total**		**6**
		Downstream Traps		
0		>700		0
0		650-699		0
0		600-649		1
0		550-599		0
0		500-549		0
2		450-499		0
3		400-450		0
9		300-399		0
38		200-299		20
	1	*Smolts*	*18*	
	1	*Pre-Smolt*	*0*	
	36	*Res*	*2*	
84		101-199		50
	40	*Smolts*	*48*	
	4	*Pre-Smolt*	*1*	
	40	*Res*	*1*	
15		<100		2
	0	*Smolts*	*0*	
	0	*Pre-Smolt*	*0*	
	15	*Res*	*2*	
151		**Total**		**73**

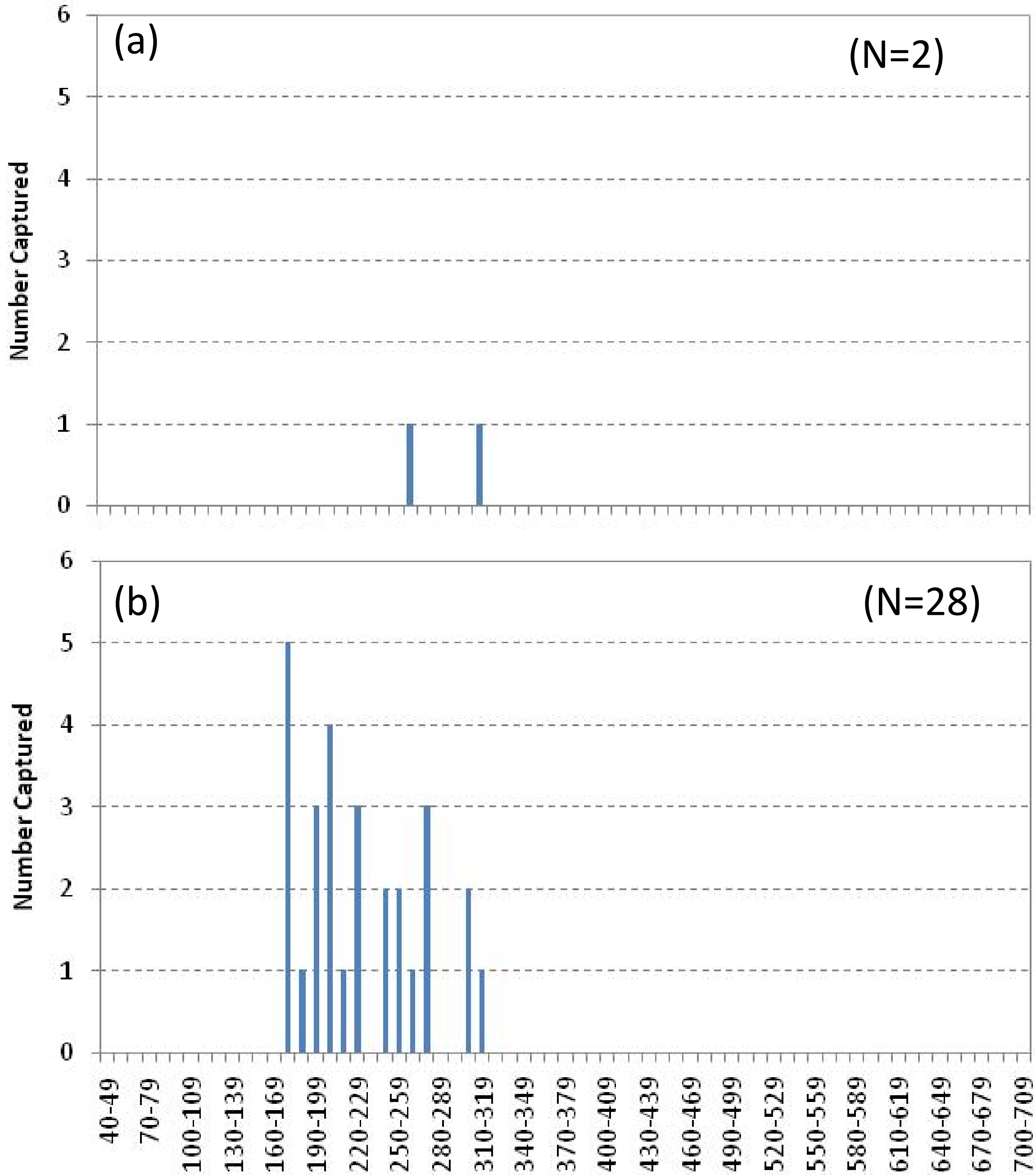


Figure 46: WY2010 LSYR mainstem trap length-frequency in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

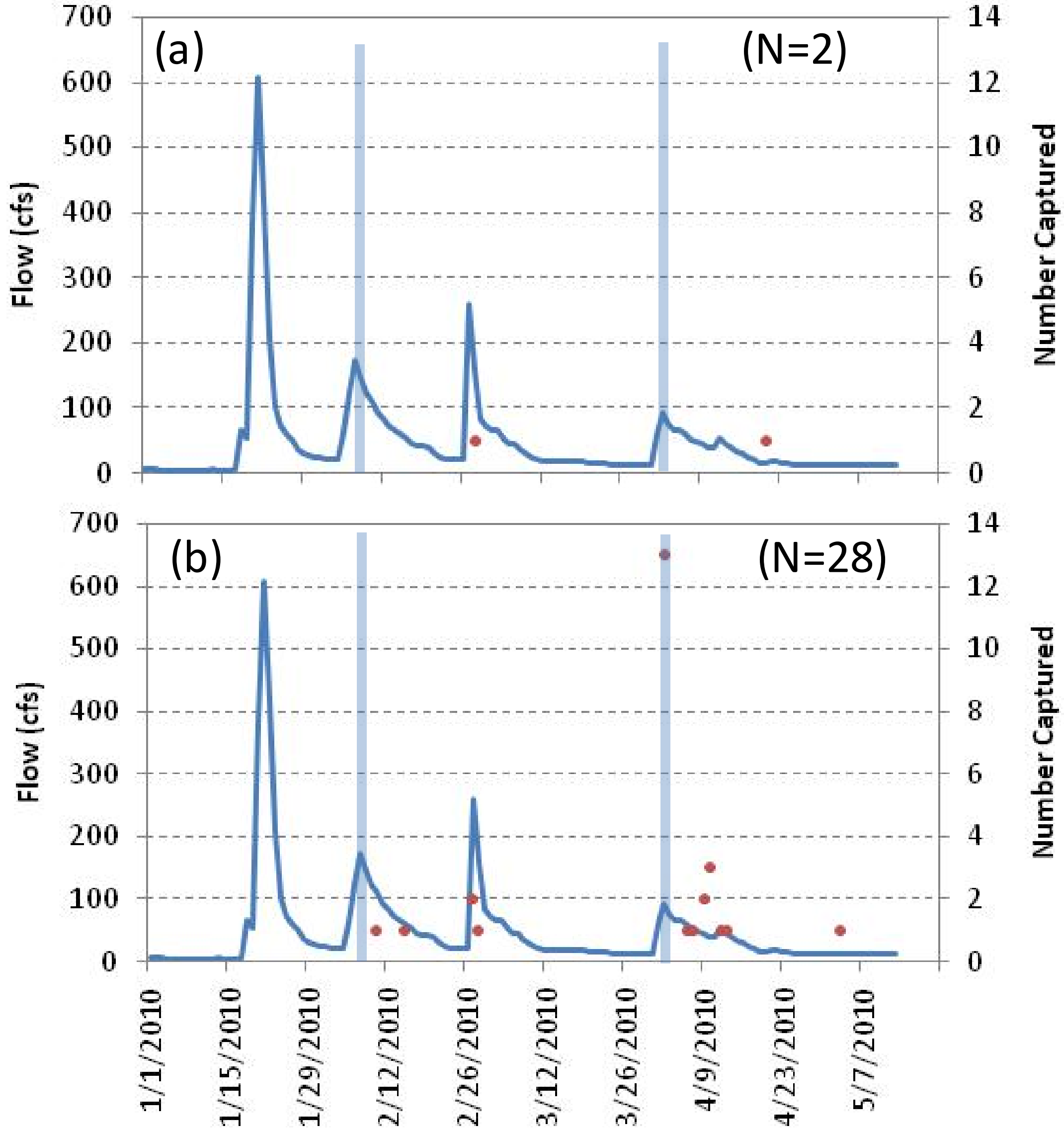


Figure 47: 2010 Santa Ynez River mainstem migrant captures (red dots) vs. flow for (a) upstream and (b) downstream migrants. The blue rectangles bracket times when migrant traps were removed due to storm events.

Table 11: Summary of recaptured fish at the LSYR mainstem trap from Hilton Creek trap.

Capture Location					Recapture Location					Time Between
(Trap)	(Direction)	(Date)	Size (mm)	Type	(Trap)	(Direction)	(Date)	Size (mm)	Type	Captures
HC*	Downstream	1/23/2010	146	Res**	Main***	Downstream	4/10/2010	194	Smolt	77 days
HC	Upstream	3/3/2010	122	Res	Main	Downstream	4/13/2010	175	Smolt	40 days
HC	Downstream	4/1/2010	185	Smolt	Main	Downstream	4/2/2010	185	Smolt	26 hours
*HC - Hilton Creek										
** Res - resident										
*** Main - LSYR mainstem										

Table 12: WY2010 redd surveys, the distances surveyed are provided in Tables 13 and 14.

Location	Date	Redd: #**	Length	Width
Tributary Redds:				
El Jaro Creek*	2/1/2010	No redds observed		
Salsipuedes Creek	2/3/2010	No redds observed		
Upper Salsipuedes Creek	2/3/2010	No redds observed		
El Jaro Creek	2/3/2010	No redds observed		
El Jaro Creek	2/3/2010	No redds observed		
Hilton Creek	2/24/2010	H1	3.9	2.2
Hilton Creek	2/24/2010	H2	4	2.5
Hilton Creek	2/24/2010	H3	2.2	1.6
Hilton Creek	2/24/2010	H4	2.6	1.4
Hilton Creek	2/25/2010	H5	2.4	1.5
Hilton Creek	2/25/2010	H6	3.9	2.3
Hilton Creek	2/25/2010	H7	3.3	2
Salsipuedes Creek	3/10/2010	S1	2.5	1.5
Salsipuedes Creek	3/12/2010	S2	2.8	1.9
El Jaro Creek	3/12/2010	No redds observed		
El Jaro Creek	3/15/2010	S3	1.4	0.9
El Jaro Creek	3/15/2010	S4	3.1	2
El Jaro Creek	3/15/2010	S5	1.8	1
El Jaro Creek	3/15/2010	S6	2	1.4
El Jaro Creek	3/15/2010	S7	3.3	1.9
El Jaro Creek	3/15/2010	S8	1.4	0.8
El Jaro Creek	3/15/2010	S9	2.5	1.4
El Jaro Creek	3/15/2010	S10	2.4	3
El Jaro Creek	3/15/2010	S11	1.8	1.2
El Jaro Creek	3/15/2010	S12	1.7	1.2
Los Amoles Creek*	3/16/2010	S13	1.5	1.3
Los Amoles Creek	3/16/2010	S14	1.1	0.8
Los Amoles Creek	3/16/2010	S15	1.8	1.1
El Jaro Creek	3/22/2010	S16	1.7	1
El Jaro Creek	3/22/2010	S17	1.8	1.2
El Jaro Creek	3/23/2010	S18	3.5	2.2
El Jaro Creek	3/23/2010	S19	1.2	1
El Jaro Creek	3/23/2010	S20	1.6	1.1
El Jaro Creek	3/23/2010	S21	2.5	1.6
El Jaro Creek (Cross Ck)	5/10/2010	S22	4	1.8
Salsipuedes Creek	4/14/2010	No new redds observed		
Hilton Creek	4/23/2010	No new redds observed		
LSYR Mainstem Redds:				
Alisal Reach	3/24/2010	No Redds Observed		
Refugio Reach	3/26/2010	No Redds Observed		
154 Reach	3/26/2010	No Redds Observed		
* A tributary of Salsipuedes Creek.				
** H - Hilton Creek and S - Salsipuedes Creek drainages.				

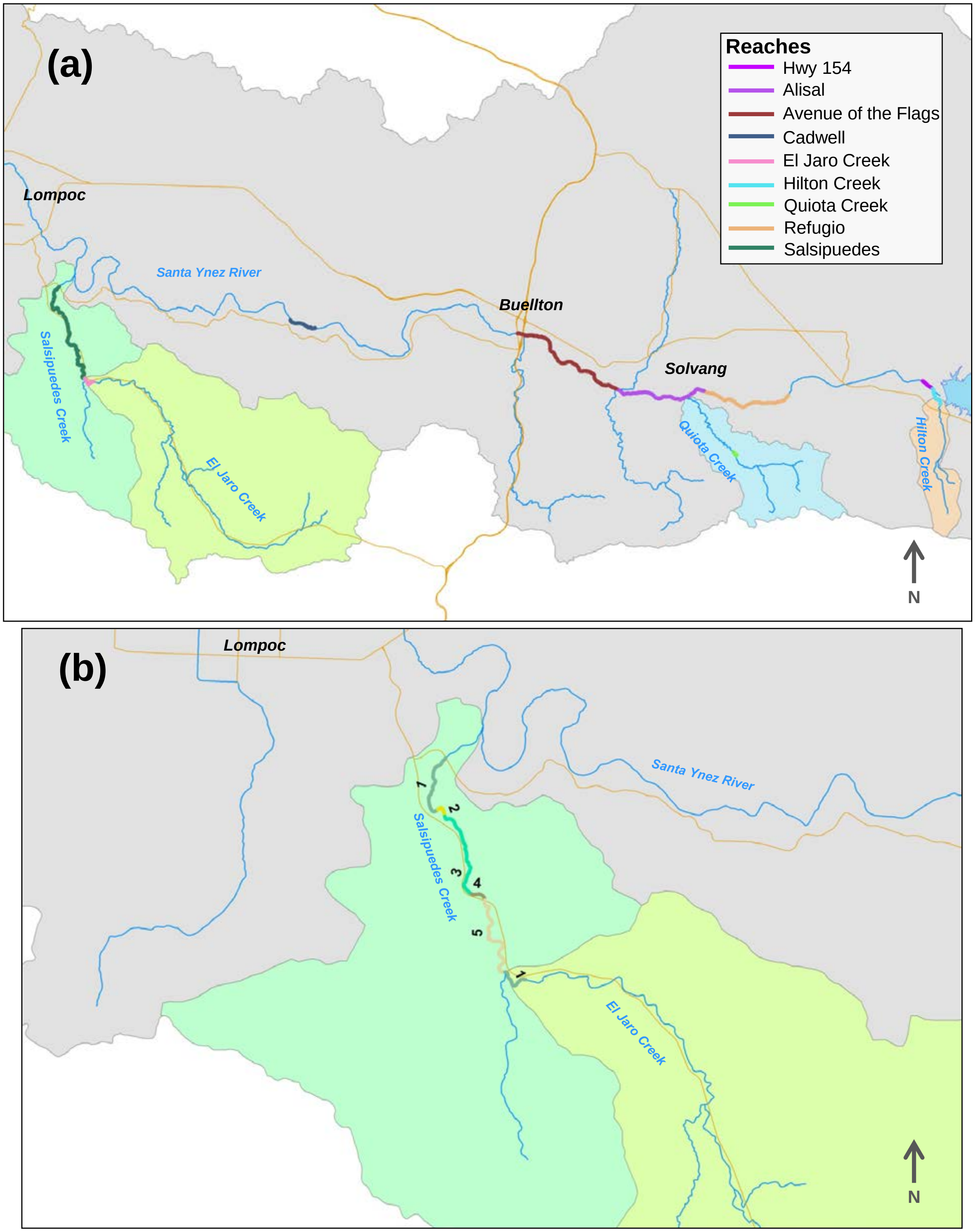


Figure 48: Stream reaches snorkel surveyed in WY2010 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

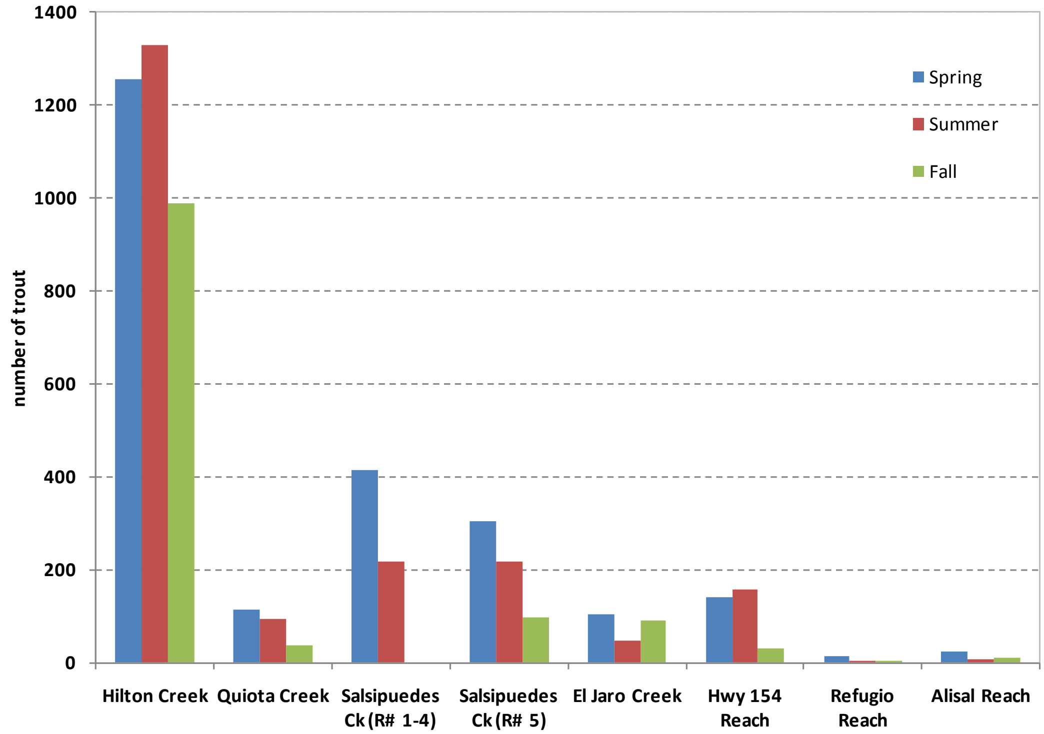


Figure 49: 2010 LSYR steelhead/rainbow trout observed during spring, summer and fall snorkel surveys.

Table 13: 2010 Mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	6/10/2010
(LSYR-0.2 to LSYR-0.7)	Summer	7/28/2010
	Fall	11/16/2010
Refugio Reach	Spring	6/7/10 & 6/8/10
(LSYR-4.9 to LSYR-7.8)	Summer	9/15/10 & 9/17/10
	Fall	11/8/10 & 11/9/10
Alisal Reach	Spring	6/3/10 & 6/7/10
(LSYR-7.8 to LSYR-10.5)	Summer	9/17/10 & 9/21/10
	Fall	11/9/10 & 11/10/10
*n/s = no survey		

Table 14: LSYR mainstem spring, summer and fall snorkel survey results in 2010 with the miles surveyed; the level of effort was the same for each snorkel survey.

Mainstem	Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hwy 154 Reach	142	158	31	0.26
Refugio Reach	15	4	2	2.95
Alisal Reach	23	8	10	2.80

Table 15: 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	106	32	3	1						**142**
	Refugio			2	5	6	2				**15**
	Alisal		5	13	5						**23**
Summer	Hwy 154	54	99	4	1						**158**
	Refugio			1		2	1				**4**
	Alisal				5	3					**8**
Fall	Hwy 154	4	21	6							**31**
	Refugio			1		1					**2**
	Alisal				6	3	1				**10**

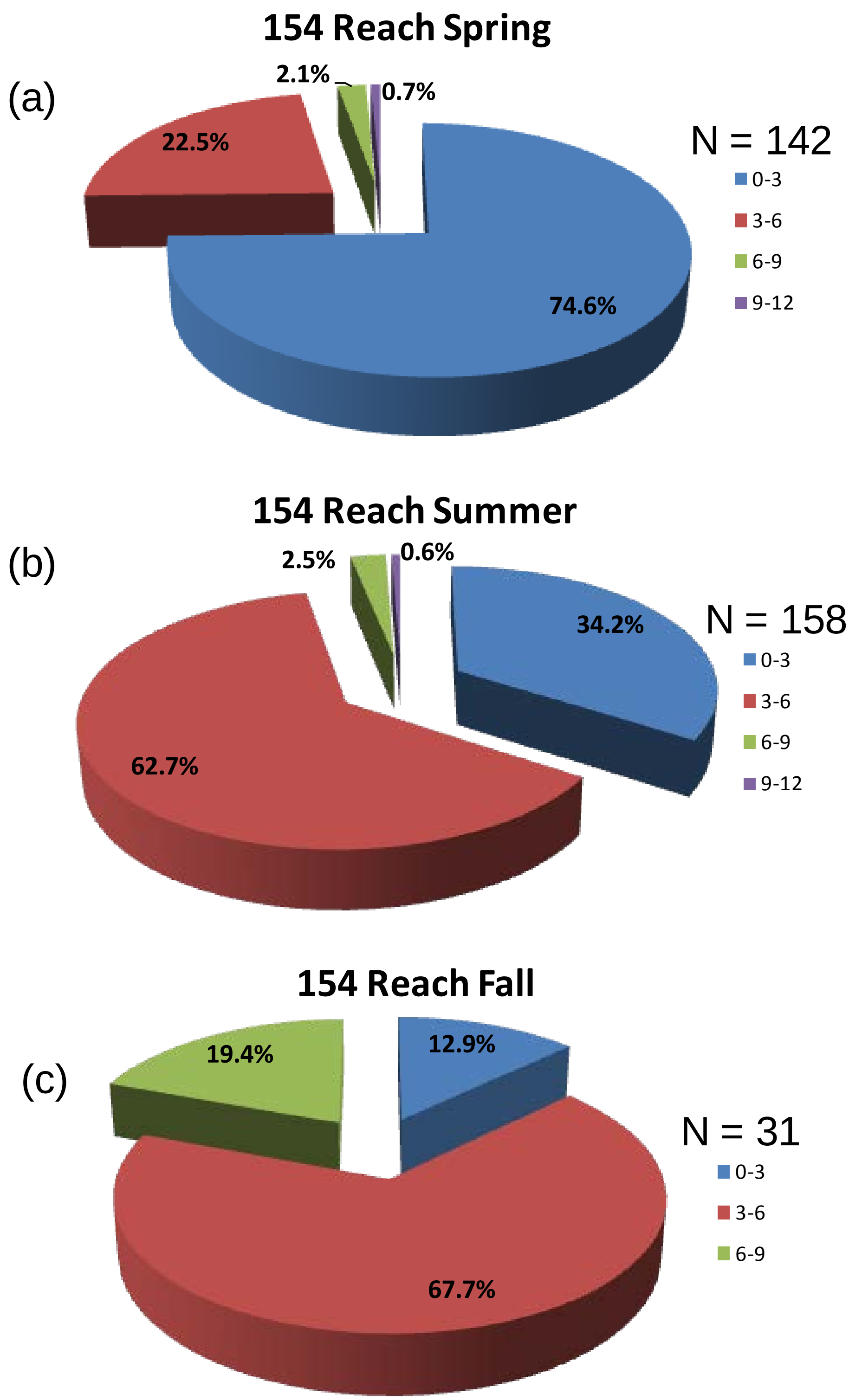


Figure 50: 2010 Hwy 154 Reach fall snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

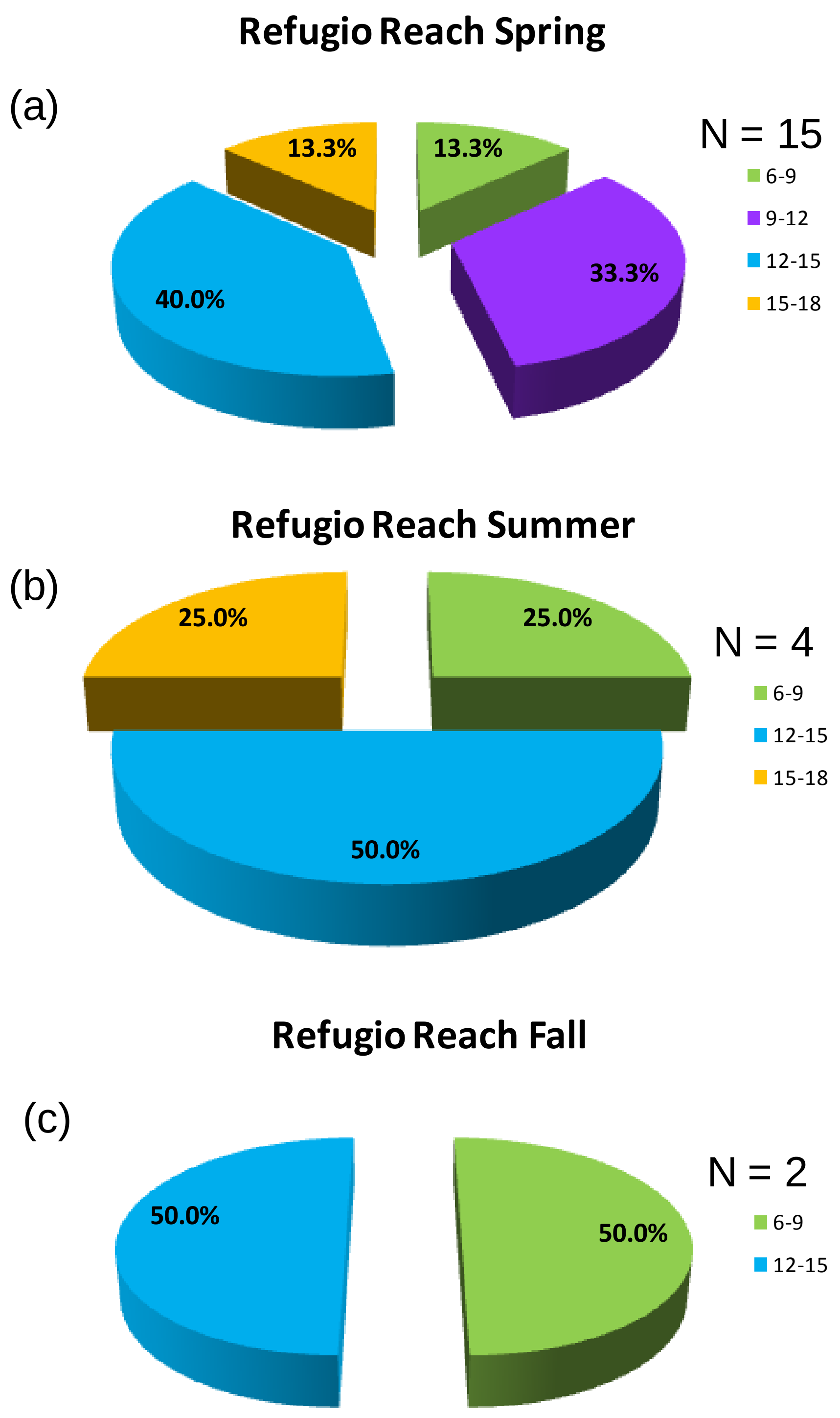


Figure 51: 2010 Refugio Reach snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

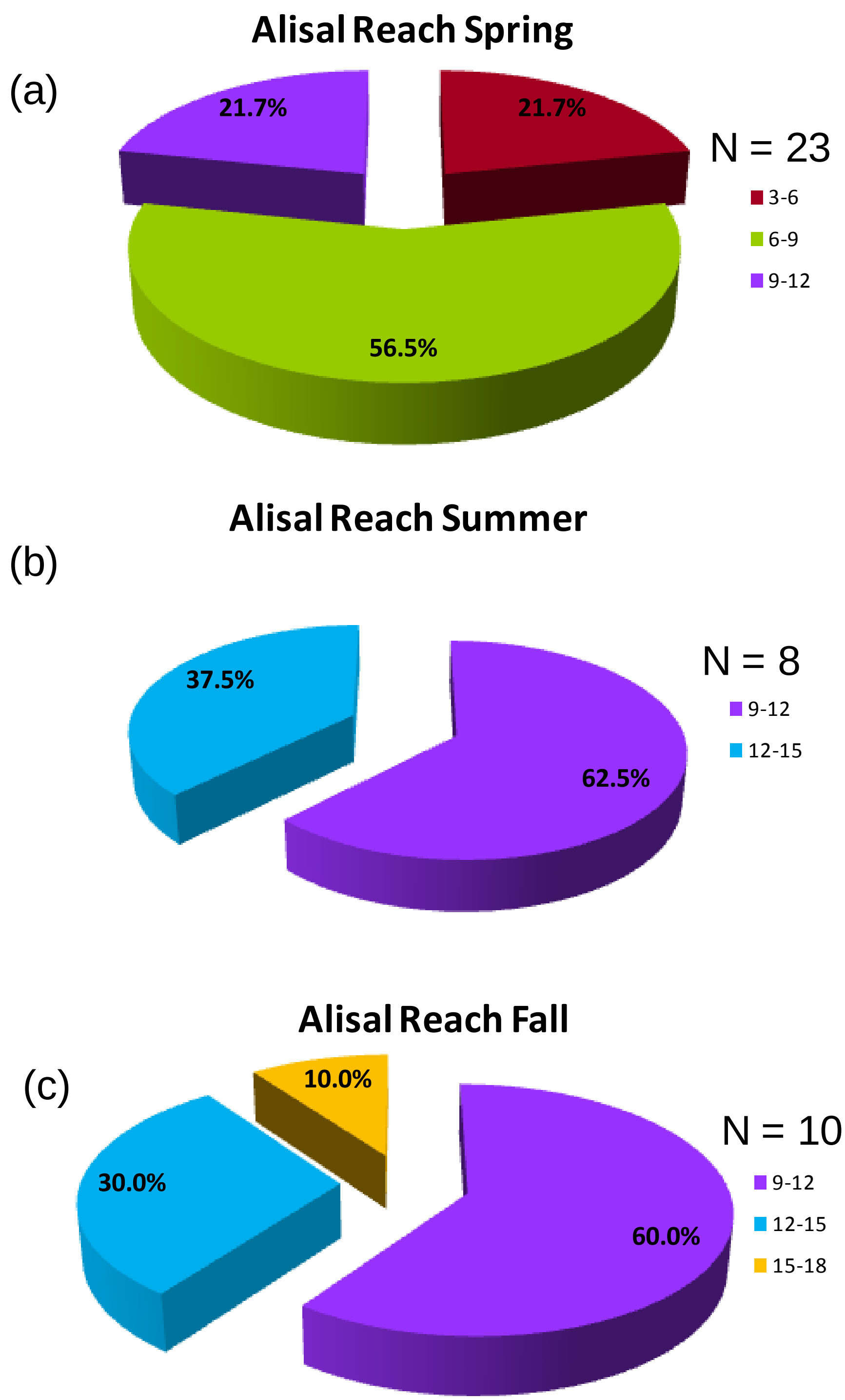


Figure 52: 2010 Alisal Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

Table 16: 2010 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	6/14/2010
(HC-0.0 to HC-0.54)	Summer	8/18/2010
	Fall	10/26/2010
Quiota Creek	Spring	6/9/2010
(QC-2.58 to QC-2.73	Summer	8/30/2010
	Fall	11/3/2010
Salsipuedes Creek	Spring	5/18-5/19 & 5/24/10
(SC-1.2 to SC-3.75)	Summer	8/31/2010 & 9/2/10
	Fall	10/29/10 & 11/1/10
El Jaro Creek	Spring	5/24/2010
(ELC-0.0 to ELC-0.4)	Summer	9/7/2010
	Fall	10/29/2010

Table 17: Steelhead/rainbow trout observed and miles surveyed during all tributary snorkel surveys; the level of effort was the same for each survey.

Tributaries	Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hilton Creek				
Reach 1	377	288	213	0.133
Reach 2	129	208	127	0.050
Reach 3	58	76	38	0.040
Reach 4	125	210	162	0.075
Reach 5	507	542	450	0.242
Reach 6	60	4	0	0.014
Total:	***1256***	***1328***	***990***	***0.554***
Quiota Creek	114	93	38	0.11
Salsipuedes Creek (Reach 1-4)	415	216	n/s	2.85
Salsipuedes Creek (Reach 5)	303	217	96	0.45
El Jaro Creek	105	48	89	0.35
*n/s = no survey				

Table 18: 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	864	317	69	5	1					**1256**
	Quiota	97	15	2							**114**
	Salsipuedes (R1-4)	402	4	9							**415**
	Salsipuedes (R-5)	255	27	20	1						**303**
	El Jaro	82	16	7							**105**
Summer	Hilton	636	608	78	6						**1328**
	Quiota	68	19	6							**93**
	Salsipuedes (R1-4)	109	101	6							**216**
	Salsipuedes (R-5)	127	86	4							**217**
	El Jaro	27	18	3							**48**
Fall	Hilton	265	654	62	8	1					**990**
	Quiota	20	16	2							**38**
	Salsipuedes (R1-4)		Not snorkeled due to turbidity								
	Salsipuedes (R-5)	76	20								**96**
	El Jaro	54	33	2							**89**

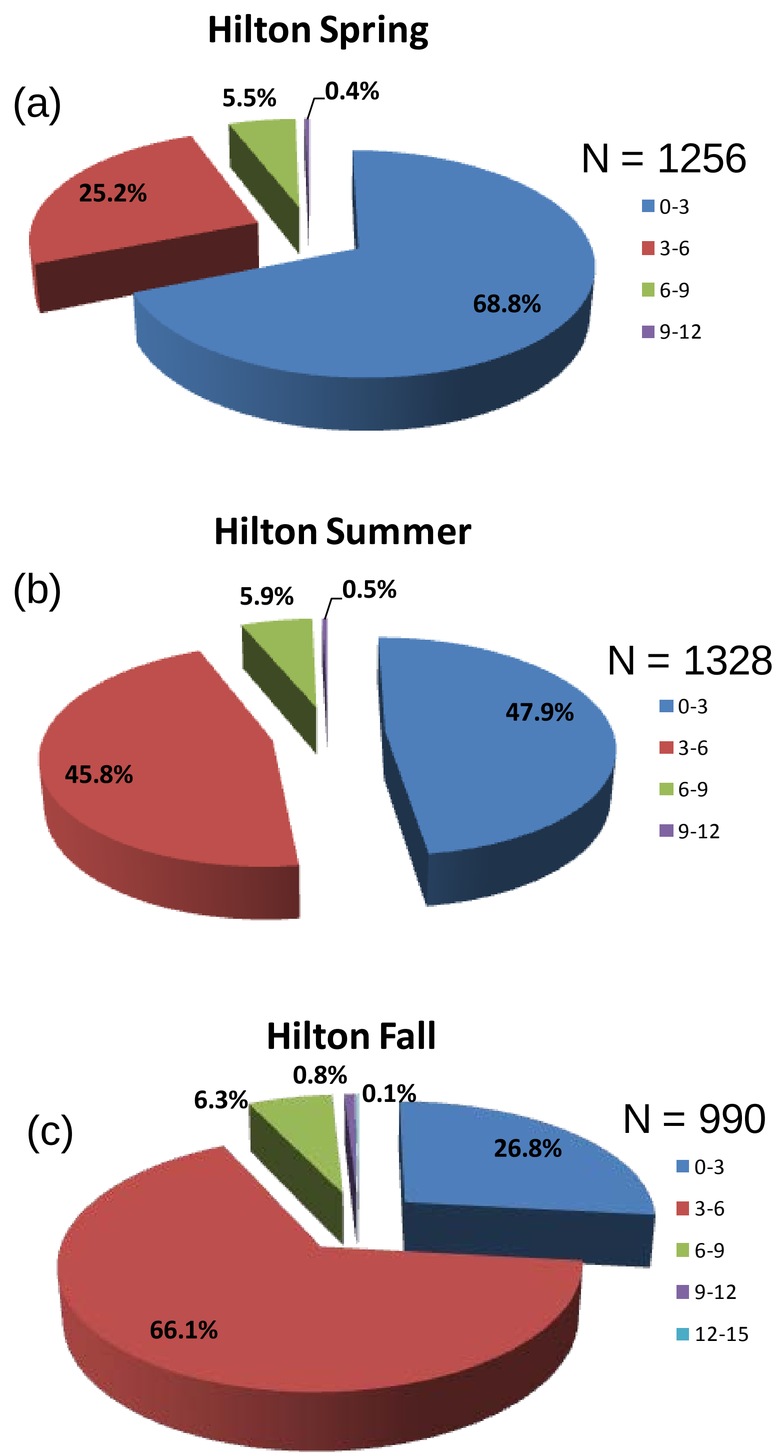


Figure 53: 2010 Hilton Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

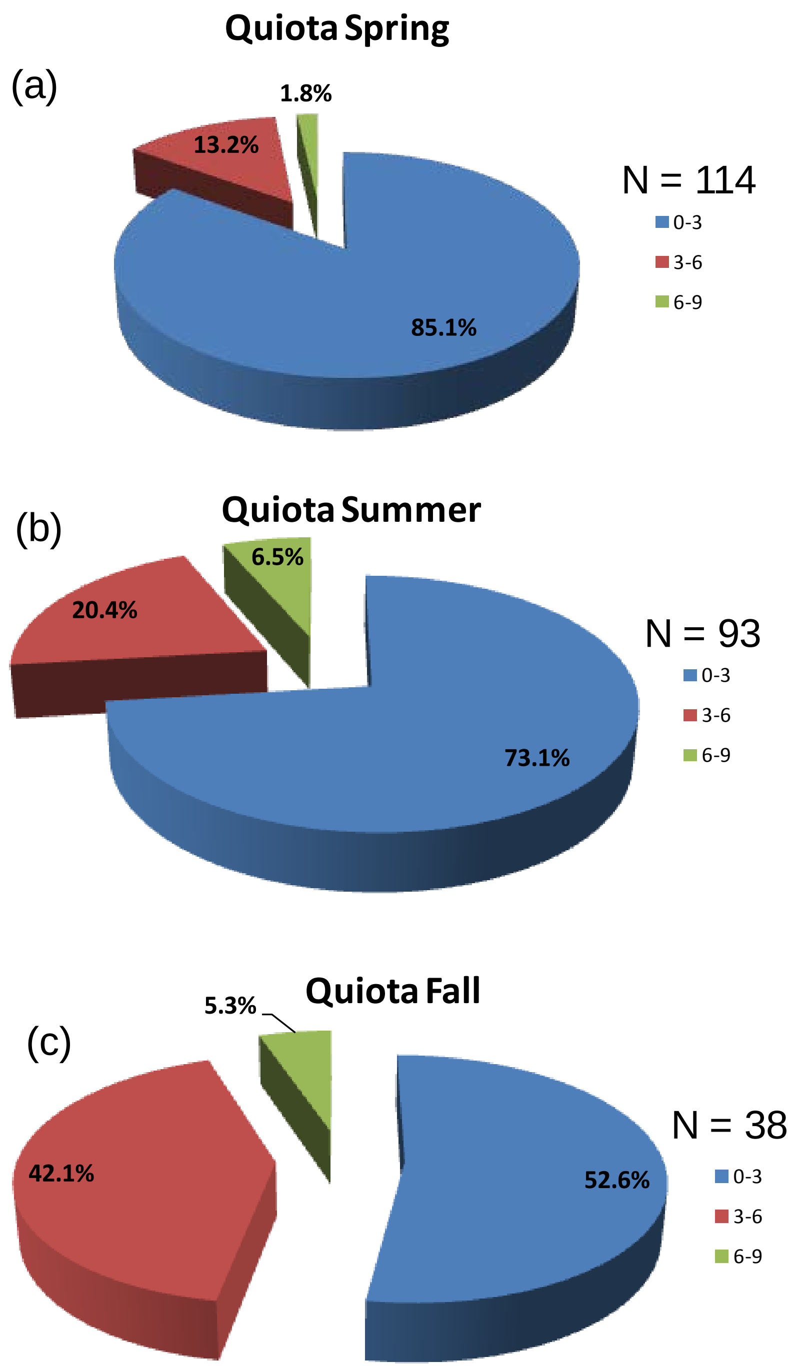


Figure 54: 2010 Quiota Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

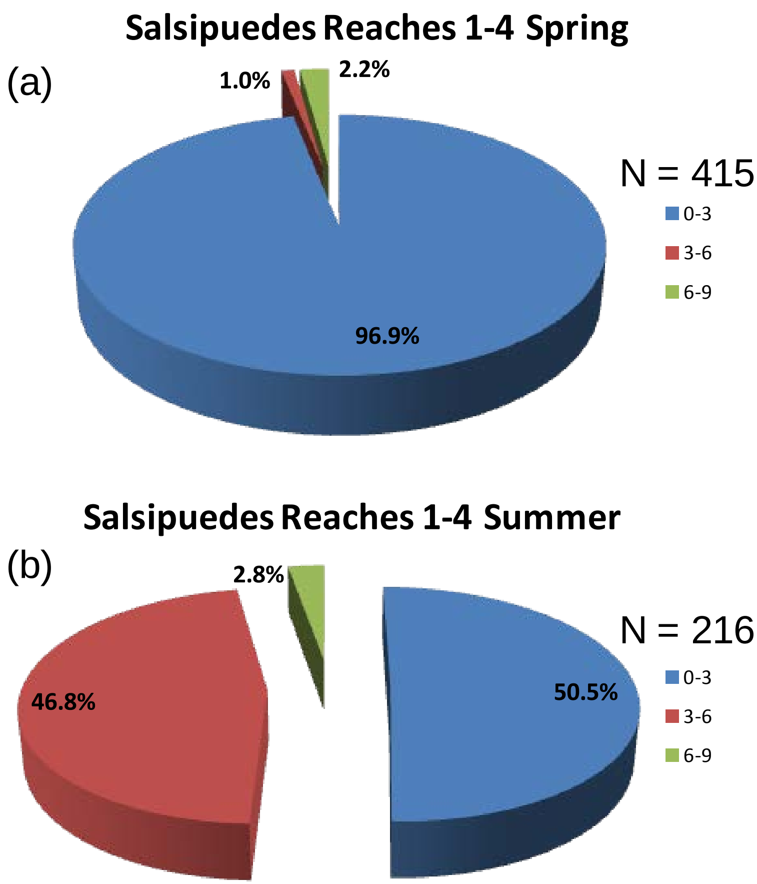


Figure 55: 2010 Salsipuedes Creek reaches 1-4 snorkel survey with size classes (range) of fish observed in inches; (a) spring, and (b) summer.

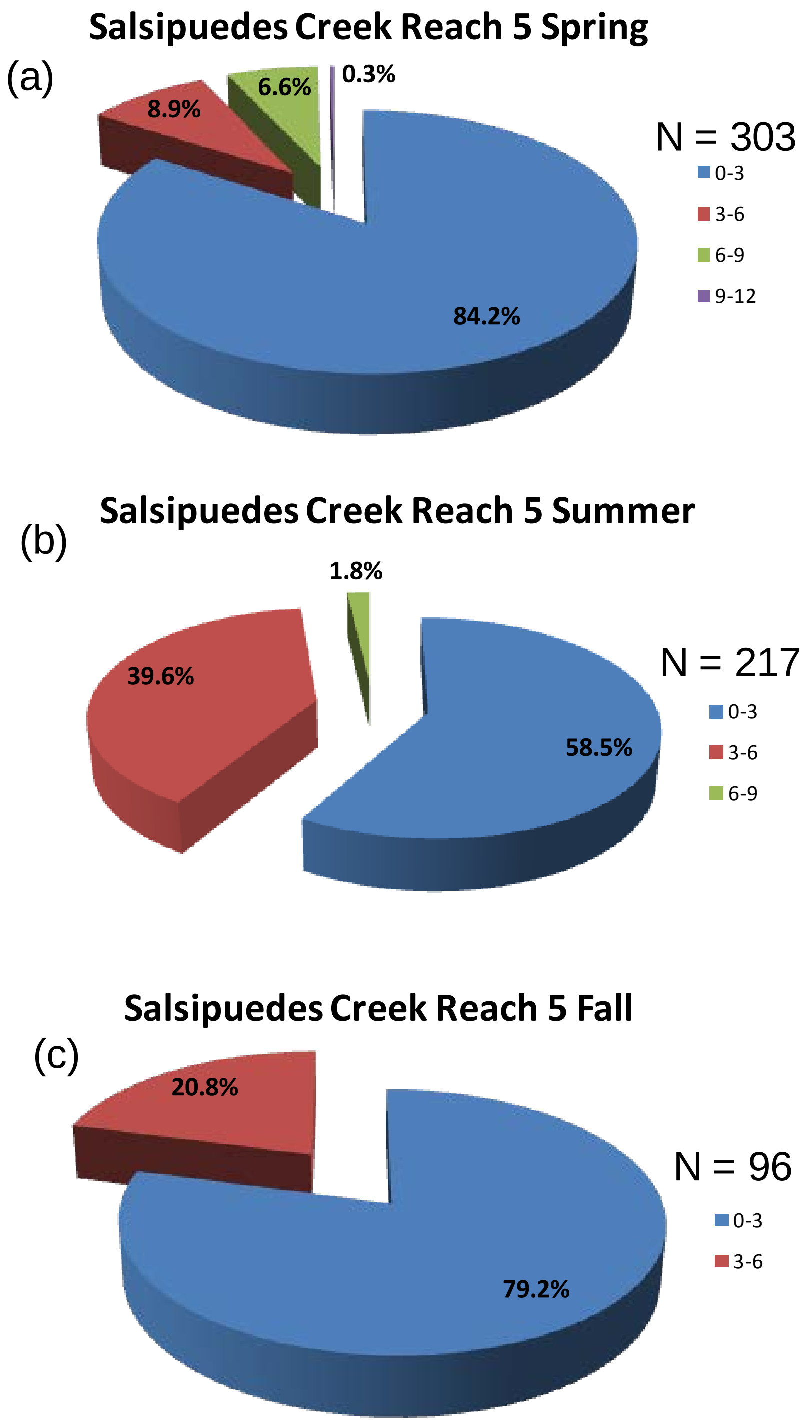


Figure 56: 2010 Salsipuedes Creek Reach 5 survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

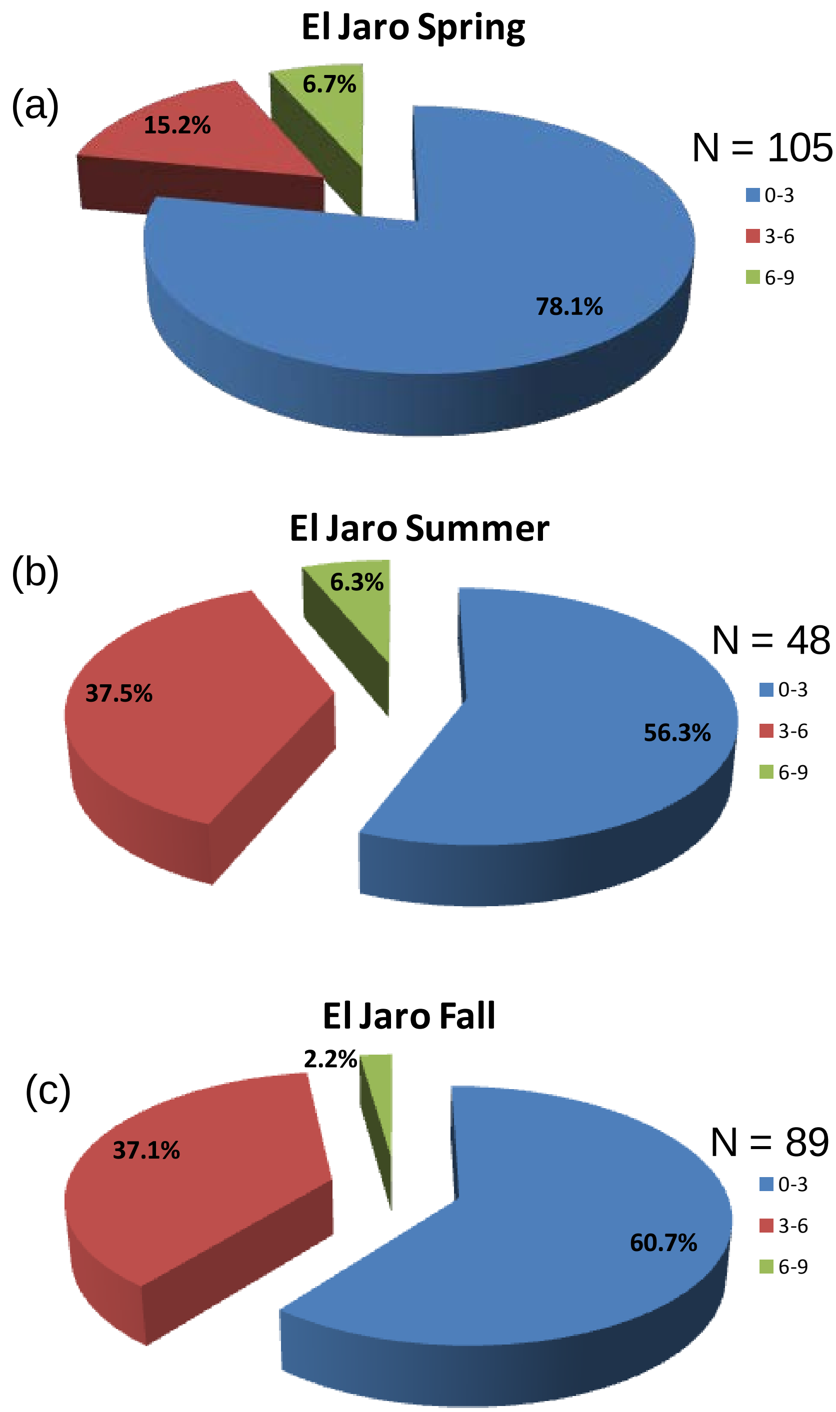


Figure 57: 2010 El Jaro Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

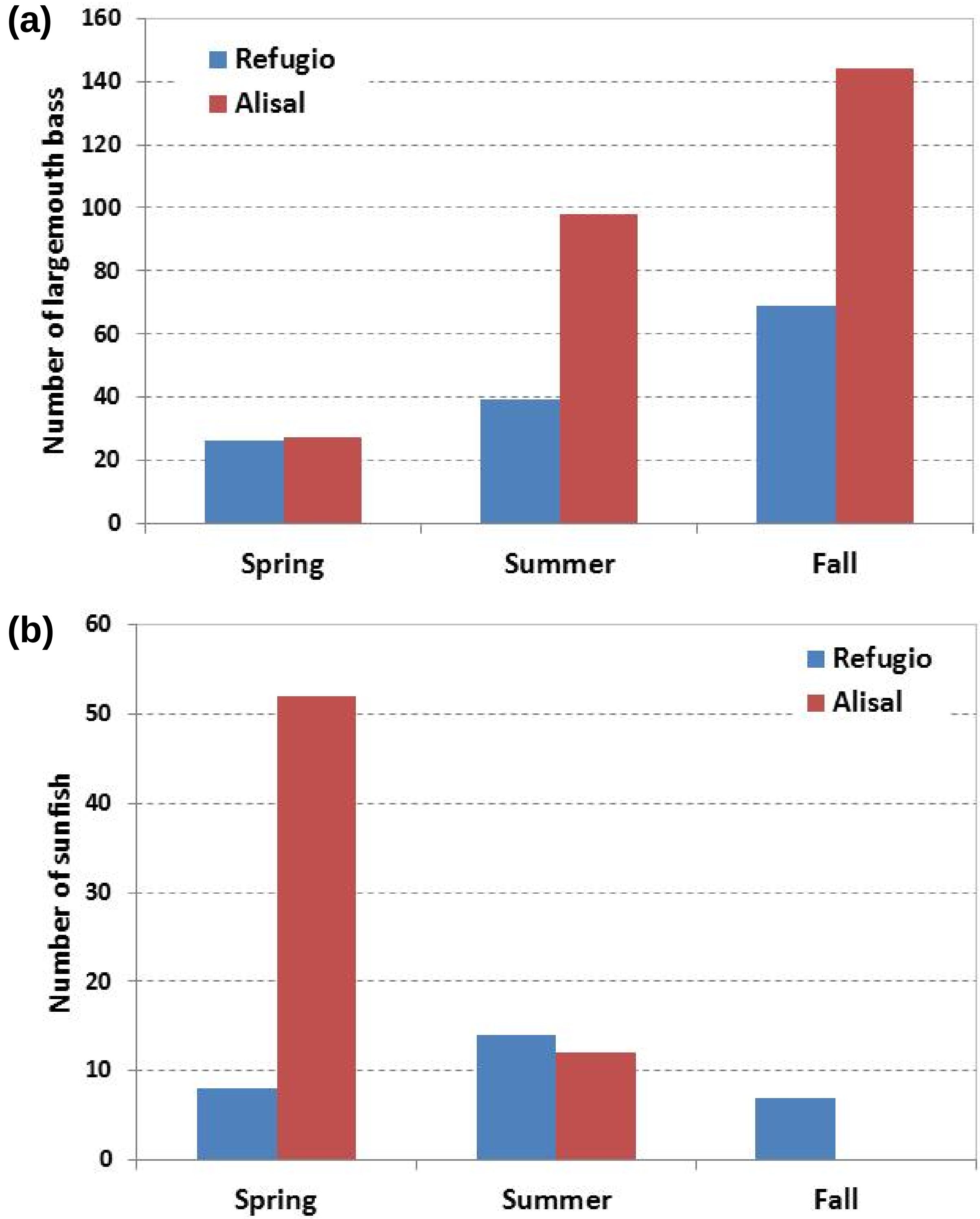


Figure 58: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2010 within the Refugio and Alisal reaches: (a) largemouth bass and (b) sunfish.

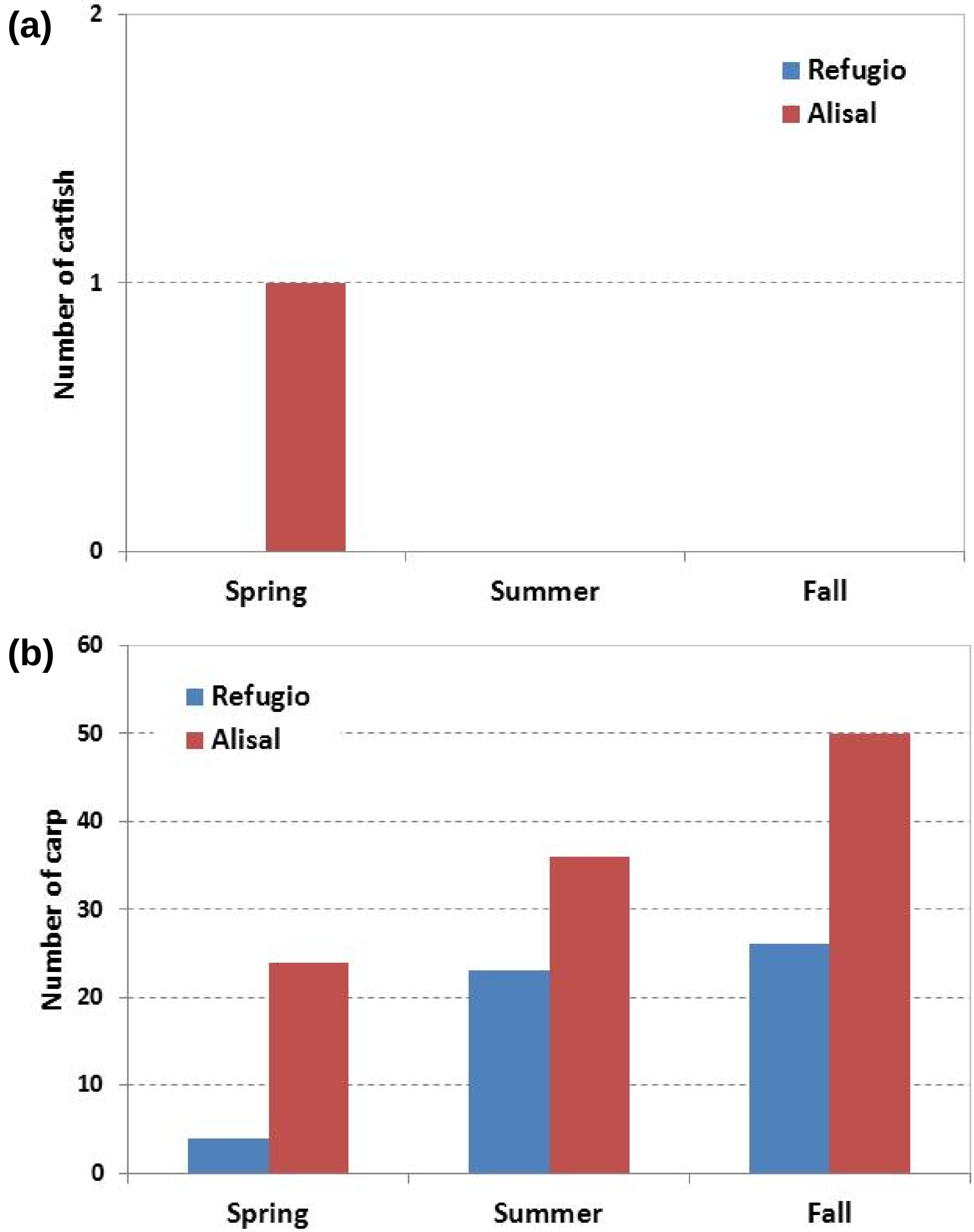


Figure 59: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2010 within the Refugio and Alisal reaches: (a) catfish, and (b) carp.

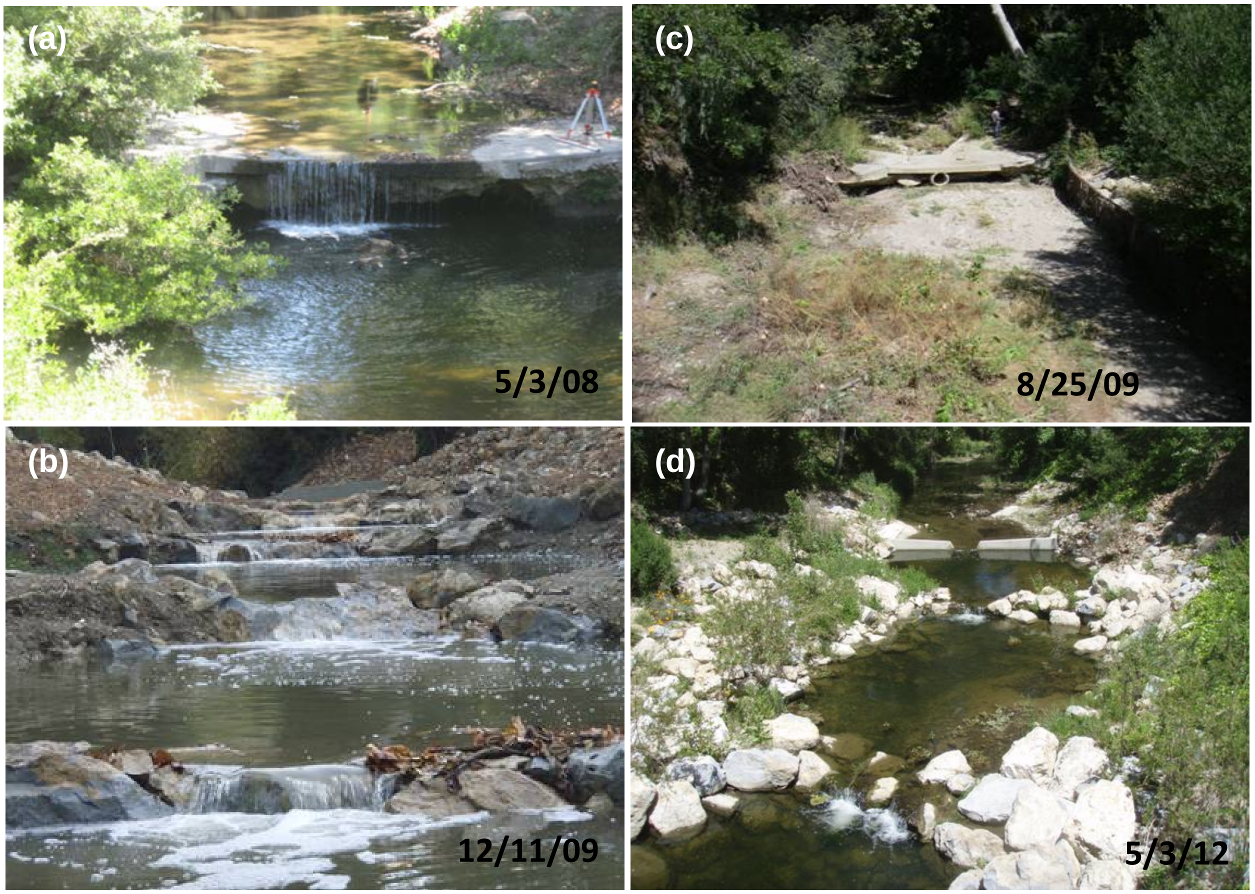


Figure 60: Fish passage enhancement project at Cross Creek Ranch on lower El Jaro Creek, a tributary of Salsipuedes Creek, that was completed in the late fall of 2009: (a and b) pre-construction, (c) the beginning of the winter after construction and (d) approximately three years after construction in 2012.

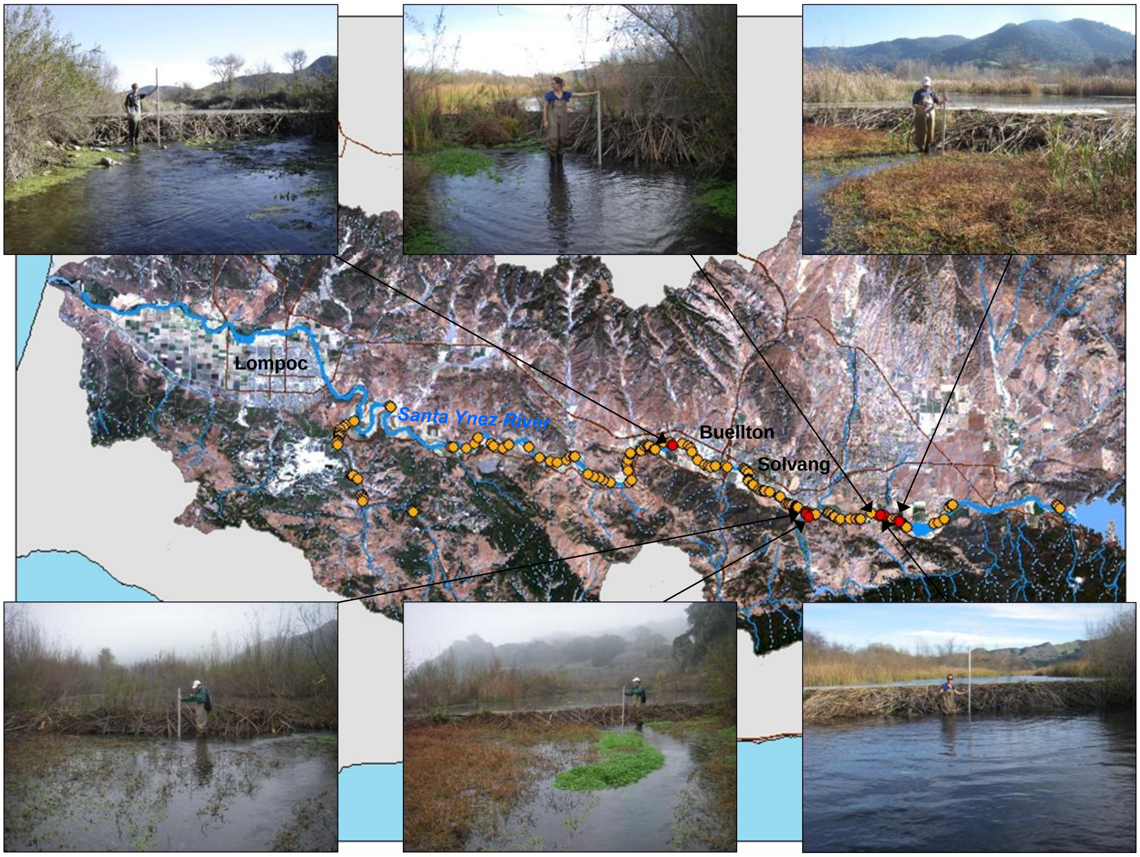


Figure 61: Spatial extent of beaver dams from the 1/18/10 survey within the LSYR drainage where 128 dams were observed in the LSYR basin.

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4. Discussion

Table 19: Monthly rainfall totals at Bradbury Dam from WY2000-WY2010.

Month	Water Years:										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Oct	0.00	2.64	0.62	0.00	0.00	6.38	0.48	0.16	0.34	0.15	2.20
Nov	1.62	0.00	3.27	2.50	1.20	0.33	1.64	0.20	0.06	3.39	0.00
Dec	0.00	0.09	2.66	6.73	2.03	13.25	0.73	1.59	2.39	2.46	3.00
Jan	1.94	8.40	0.87	0.06	0.32	10.30	7.82	1.30	16.57	0.65	10.34
Feb	10.37	5.71	0.24	3.56	6.52	9.22	3.06	3.03	2.33	5.70	4.92
Mar	2.76	13.44	0.79	2.40	0.48	3.08	4.31	0.15	0.46	0.85	0.26
Apr	4.73	1.35	0.13	2.15	0.00	1.27	4.89	0.81	0.06	0.19	3.15
May	0.01	0.06	0.12	2.33	0.00	0.51	1.56	0.00	0.38	0.00	0.05
Jun	0.04	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.00	0.16	0.00
Jul	0.00	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
Sept	0.00	0.00	0.08	0.00	0.00	0.03	0.00	0.17	0.00	0.08	0.00
Totals:	*21.47*	*31.75*	*8.78*	*19.76*	*10.55*	*44.41*	*24.49*	*7.41*	*22.59*	*13.66*	*23.92*

Table 20: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2010.

Month	WY2001		WY2002		WY2003		WY2004		WY2005	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	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		WY2007		WY2008		WY2009		WY2010	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	6.1	9.4	7.3	1.0	25.0	17.5	3.0	0.0	6.8	0.0
Nov	6.9	16.0	5.8	1.0	7.4	8.5	5.8	0.0	1.6	0.0
Dec	10.7	20.1	7.7	10.0	6.6	13.2	7.0	1.0	6.9	0.0
Jan	40.0	79.4	9.4	15.3	265.0	496.3	6.1	5.1	73.0	184.0
Feb	12.2	28.0	10.4	18.6	401.1	490.1	17.7	33.4	72.0	181.0
Mar	51.2	86.1	8.8	10.7	93.9	158.4	12.1	18.6	26.0	68.0
Apr	1317.0	1053.0	4.5	1.4	8.5	18.9	4.4	5.2	35.0	51.0
May	131.9	139.6	1.5	0.5	6.3	6.8	5.1	0.6	6.1	13.0
Jun	20.1	26.5	1.9	0.1	5.1	2.5	7.1	0.3	1.3	1.8
Jul	7.8	4.8	35.8	1.4	7.1	0.4	3.5	0.0	0.4	0.5
Aug	4.7	1.0	55.2	30.8	3.7	0.1	3.7	0.0	53.0	22.0
Sep	5.7	1.0	31.0	23.4	3.8	0.0	4.1	0.0	30.0	19.0

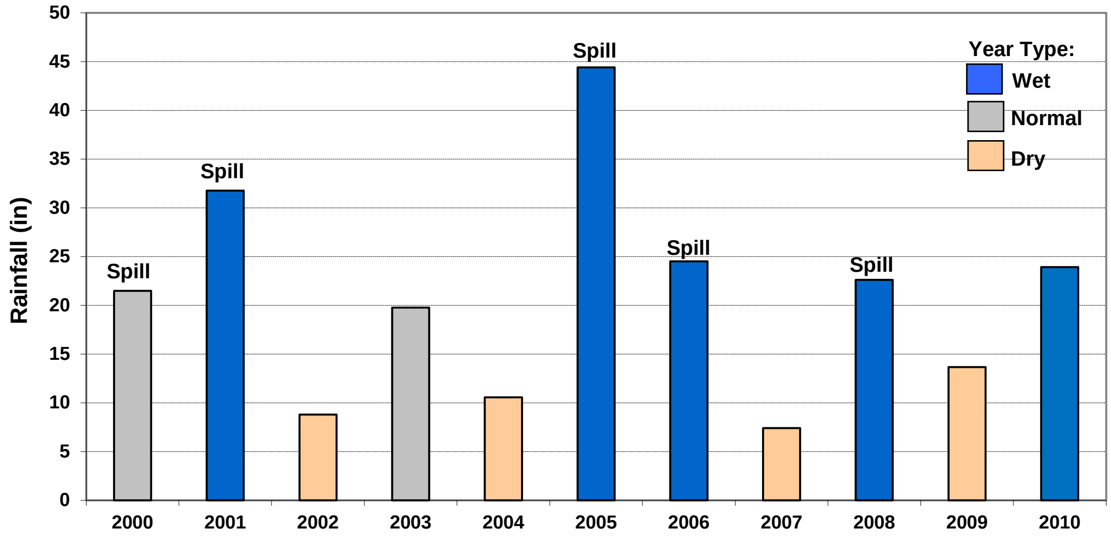


Figure 62: Water year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 21: 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 (fall 2013)[2]
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	Completed (2012)
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. Grants have been submitted for funding.

Table 22: 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 (fall 2011)[1]
Quiota Creek Crossing 6	Completed (2008)
Quiota Creek Crossing 8	In design
Total:	**5**
Projects completed:	***3***
Projects remaining:	***2***
1. Grant funding has been secured.	

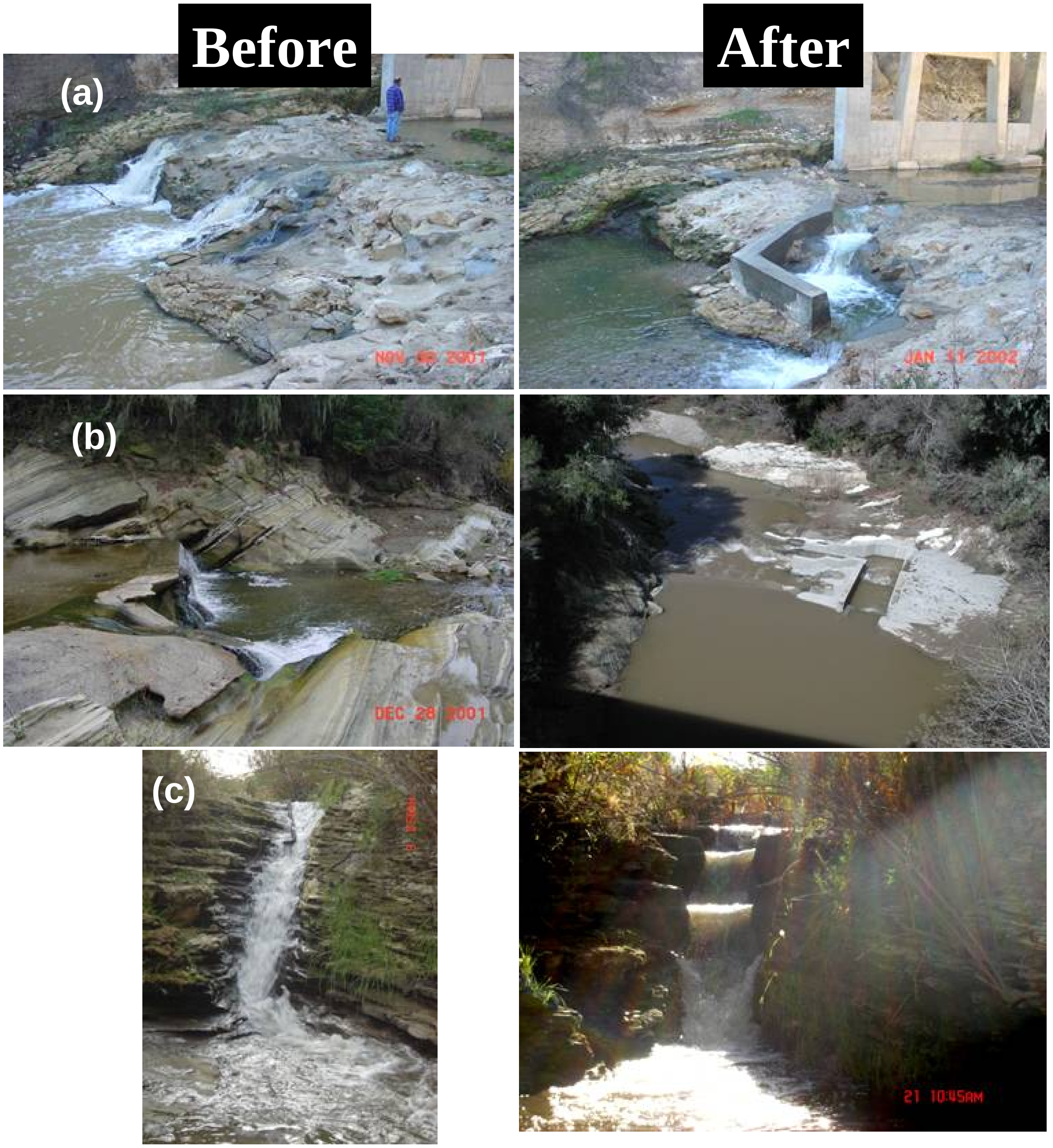


Figure 63: Fish passage and habitat restoration at (a) Hwy 1 Bridge on Salsipuedes Creek (completed in 2002), (b) Jalama Road Bridge on Salsipuedes Creek (completed in 2004), and (c) Cascade Chute barrier on Hilton Creek (completed in 2005).

Figure 64: Fish passage and habitat restoration in the fall of 2008 at Rancho San Julian on El Jaro Creek.

Figure 65: Fish passage and habitat restoration in the fall of 2008 at Refugio Road on Quiota Creek Crossing 6.

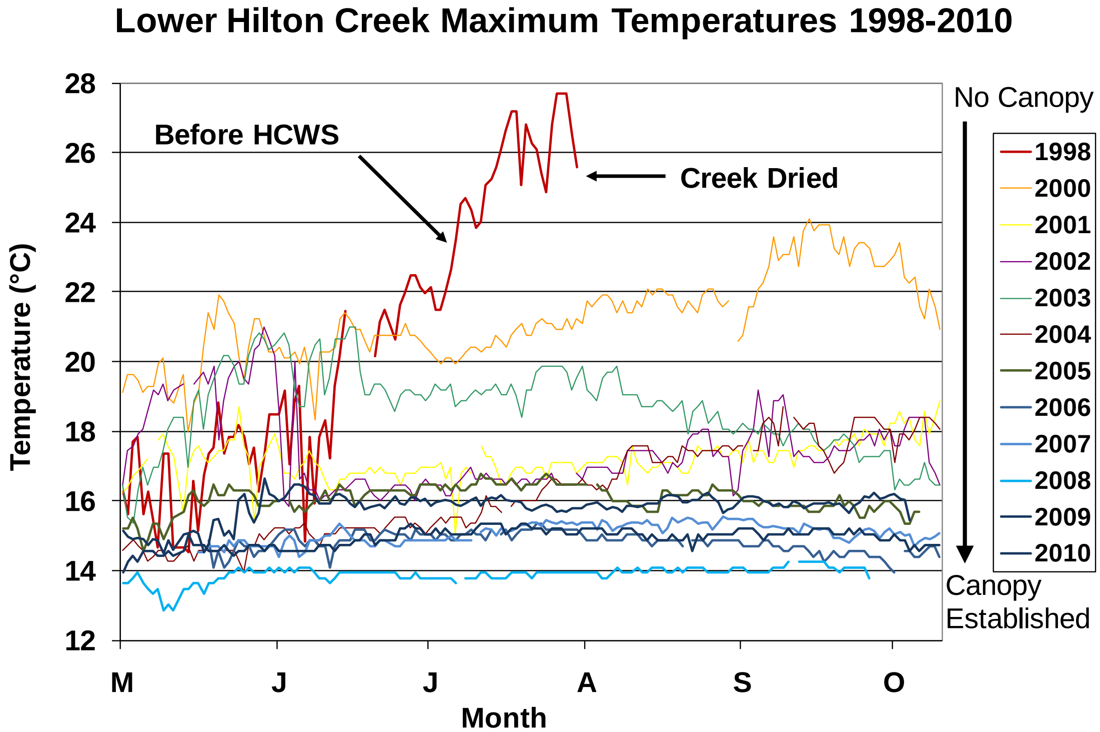


Figure 66: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2010.

Table 23: Trapping season statistics for WY2001 through WY2010.

Salsipuedes Creek										
	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010
Year Type	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet
Trapping Season	117	99	132	120	122	131	115	114	102	117
Days Out of Service	27	1	9	4	35	8	4	16	2	7
Functional Trap Days	90	98	123	116	87	123	111	98	100	110
Efficiency	77%	99%	93%	97%	71%	94%	97%	86%	98%	94%
CPUE US & DS[1]	2.07	0.20	1.07	0.53	0.64	2.02	0.22	0.80	1.87	0.72

LSYR Mainstem										
	WY2001*	WY2002*	WY2003*	WY2004*	WY2005*	WY2006	WY2007**	WY2008	WY2009	WY2010
Year Type	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet
Trapping Season	-	-	-	-	-	35	-	60	82	113
Days Out of Service	-	-	-	-	-	2	-	20	0	3
Functional Trap Days	-	-	-	-	-	33	-	40	82	110
Efficiency	-	-	-	-	-	94%	-	67%	100%	97%
CPUE US & DS	-	-	-	-	-	0.45	-	0.13	0.04	0.27

Hilton Creek										
	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010
Year Type	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	wet
Trapping Season	121	98	132	120	122	131	115	127	110	117
Days Out of Service	38	1	11	4	11	8	4	11	2	6
Functional Trap Days	83	97	121	116	111	125	111	116	108	111
Efficiency	69%	99%	92%	97%	91%	95%	97%	91%	98%	95%
CPUE US & DS	0.60	0.95	0.60	1.09	0.52	3.02	5.79	4.09	3.91	2.32

1 US & DS: upstream and downstream.
* Not deployed
** Too dry to install

Table 24: WY2001 through WY2010 tributary upstream and downstream *O. mykiss* captures for Hilton and Salsipuedes Creeks.

Water Year:											Water Year:									
2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Hilton Creek											**Salsipuedes Creek**									
Upstream											***Upstream***									
0	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	0	4	0	0	650-699	1	0	1	0	1	0	0	2	0	0
0	0	0	0	0	0	0	0	1	0	600-649	0	0	0	0	0	0	0	3	0	0
0	0	0	0	0	1	0	2	0	0	550-599	1	0	0	0	0	0	0	0	0	0
0	0	1	0	2	2	0	2	1	0	500-549	0	0	0	0	0	1	0	0	0	0
3	0	0	6	8	9	0	13	1	2	450-499	1	0	0	0	0	0	0	0	0	0
4	0	9	11	9	21	2	6	2	1	400-450	1	0	0	0	0	0	0	0	0	0
2	0	10	24	9	31	11	31	27	11	300-399	5	3	0	1	0	6	0	0	0	0
1	0	2	7	7	10	4	22	29	39	200-299	7	3	3	10	0	5	2	7	1	4
9	38	14	23	4	17	15	63	33	39	101-199	7	8	22	9	0	3	5	1	9	2
1	1	8	15	0	15	12	32	24	15	<100	0	0	3	0	0	0	0	2	3	0
20	**39**	**44**	**86**	**39**	**106**	**44**	**175**	**118**	**107**	**Total**	**23**	**14**	**29**	**20**	**1**	**15**	**7**	**16**	13	6
Downstream											***Downstream***									
0	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	0	2	0	0	650-699	0	0	0	0	0	*0*	0	0	0	0
0	0	0	0	0	0	0	1	0	0	600-649	1	0	0	0	0	*0*	0	0	0	1
0	0	0	0	0	0	0	1	1	0	550-599	0	0	0	0	0	*0*	0	0	0	0
1	0	1	1	2	3	0	1	0	0	500-549	1	0	0	0	0	0	0	0	0	0
2	0	1	2	0	5	0	14	1	2	450-499	2	0	0	0	0	*0*	0	0	0	0
5	0	3	9	5	6	4	12	0	3	400-450	0	0	0	0	0	*0*	0	1	0	0
1	0	2	7	3	20	16	27	23	9	300-399	5	0	0	0	0	*2*	1	1	0	0
0	5	1	5	2	16	9	18	26	38	200-299	19	2	2	3	9	18	3	13	2	20
0	4	0	3	1	11	6	4	7	1	Smolts	8	1	2	0	9	11	0	9	1	18
0	0	0	1	0	0	0	2	0	1	Pre-Smolt	0	0	0	1	0	2	0	1	0	0
0	1	1	1	1	5	3	12	19	36	Res	11	1	0	2	0	5	3	3	1	2
20	43	11	44	6	44	364	175	219	84	101-199	134	4	98	17	46	183	12	41	61	50
1	18	3	28	6	33	92	58	72	40	Smolts	121	3	55	8	45	132	1	33	16	48
0	0	0	2	0	5	40	18	31	4	Pre-Smolt	2	0	21	2	1	45	1	7	5	1
19	25	8	14	0	6	232	99	116	40	Res	11	1	22	7	0	6	10	1	40	1
1	7	10	20	1	178	206	49	34	15	<100	1	0	12	21	0	30	1	6	111	2
0	0	0	1	0	1	0	0	0	0	Smolts	0	0	0	9	0	5	0	0	0	0
0	0	0	0	0	164	0	1	0	0	Pre-Smolt	0	0	5	0	0	23	0	0	1	0
1	7	10	19	1	13	206	48	34	15	Res	1	0	7	12	0	2	1	6	110	2
30	**55**	**29**	**88**	**19**	**272**	**599**	**300**	**304**	**151**	**Total**	**163**	**6**	**112**	**41**	**55**	**233**	**17**	**62**	**174**	**73**

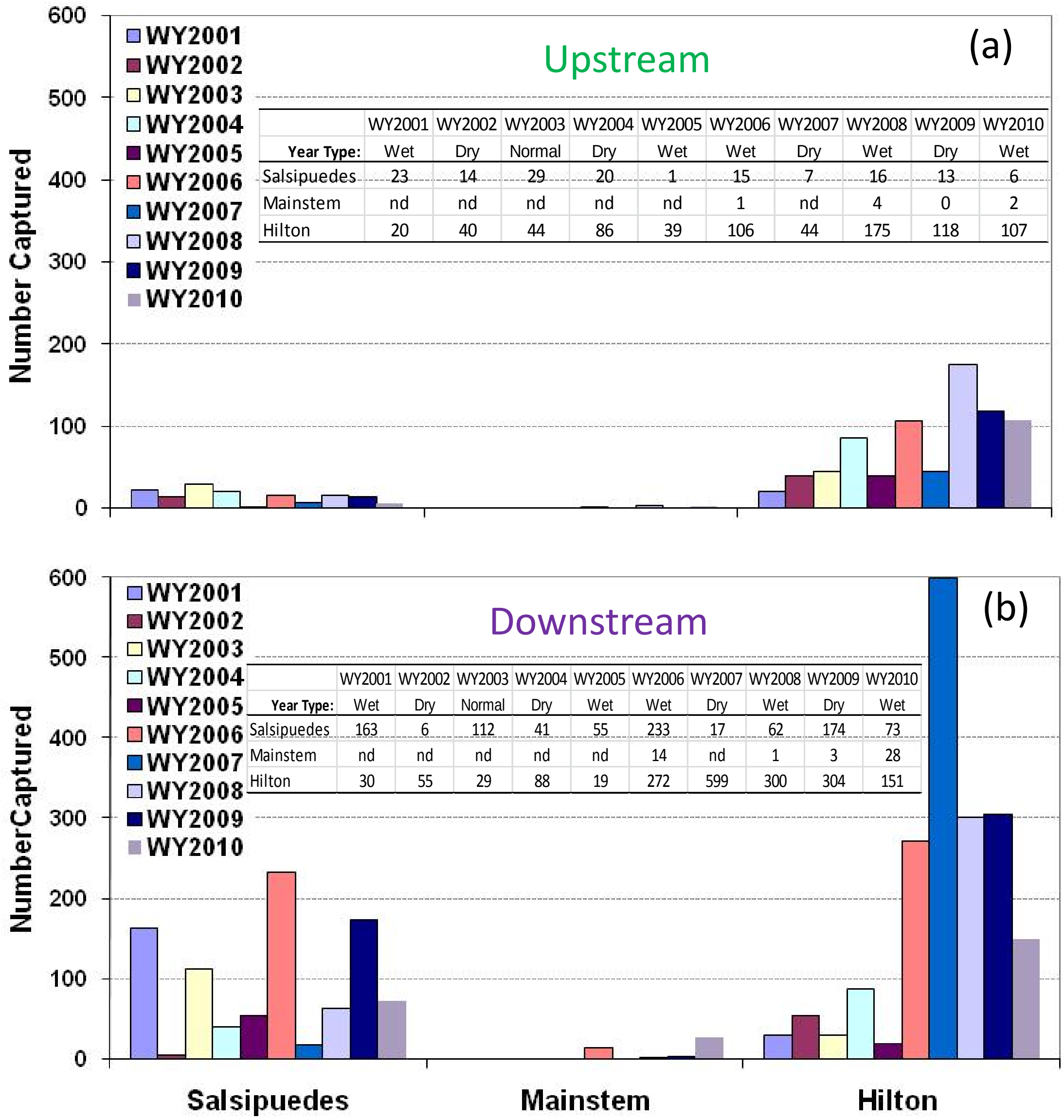
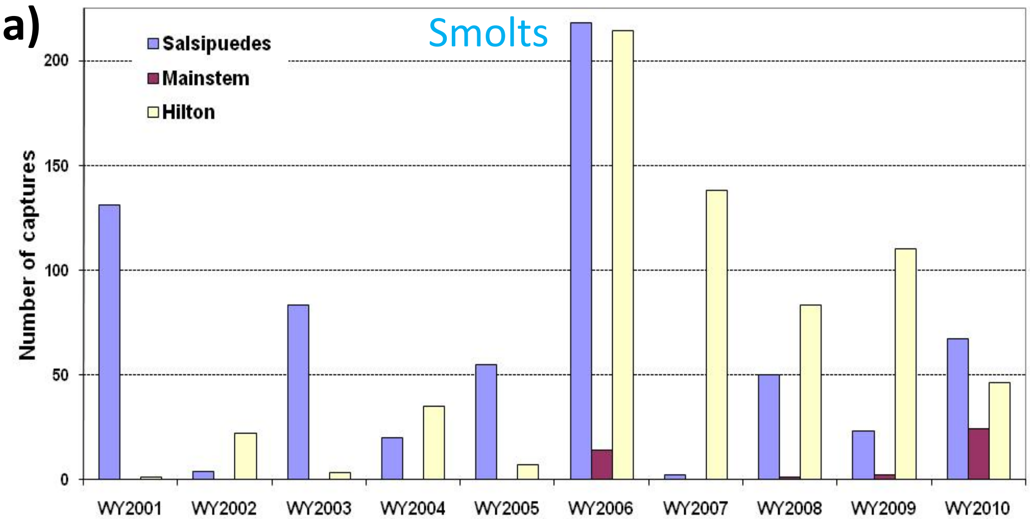


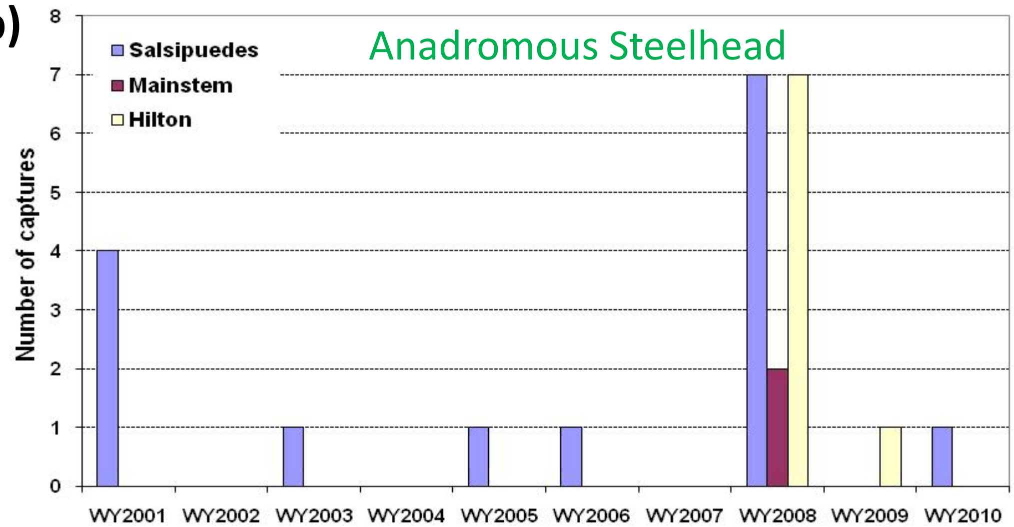
Figure 67: (a) Upstream and (b) downstream migrant *O. mykiss* totals for WY2001-WY2010 for the Salsipuedes Creek, LSYR Mainstem, and Hilton Creek traps. The LSYR Mainstem traps were not deployed prior to WY2005 (no access) and WY2007 (low flow).

(a)



	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet
Salsipuedes	131	4	83	20	55	218	2	50	23	67
Mainstem	-	-	-	-	-	14	-	1	2	24
Hilton	1	22	3	35	7	214	138	83	110	46
Total	***132***	***26***	***86***	***55***	***62***	***446***	***140***	***134***	***135***	***137***

(b)



	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet
Salsipuedes	4	0	1	0	1	1	0	7	0	1
Mainstem	-	-	-	-	-	0	0	2	0	0
Hilton	0	0	0	0	0	0	0	7	1	0
Total	***4***	***0***	***1***	***0***	***1***	***1***	***0***	***16***	***1***	***1***

Figure 68: (a) Smolt and (b) anadromous steelhead captures from WY2001 through WY2010 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.

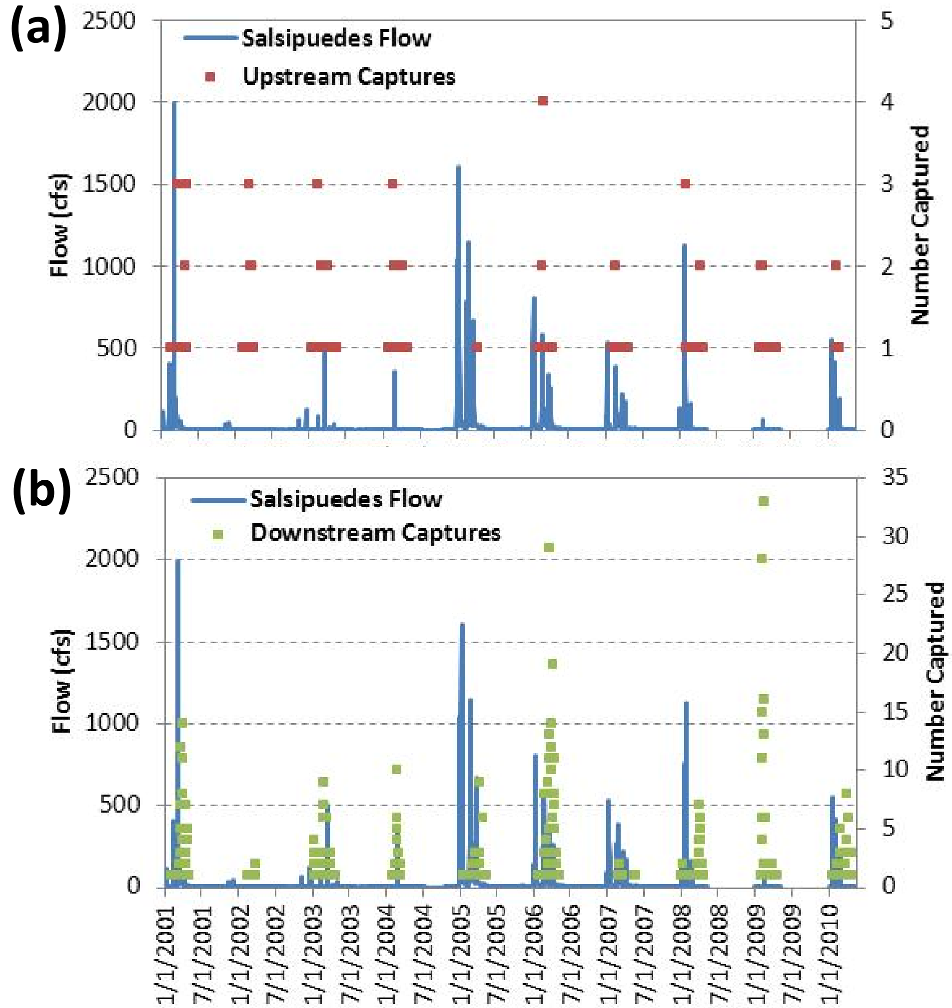


Figure 69: WY2001-WY2010 (a) upstream and (b) downstream migrant *O. mykiss* captures at the Salsipuedes Creek trap. Average daily flow data were from the USGS Salsipuedes gauge on the LSYR. Traps were removed just prior to peak storm flow events.

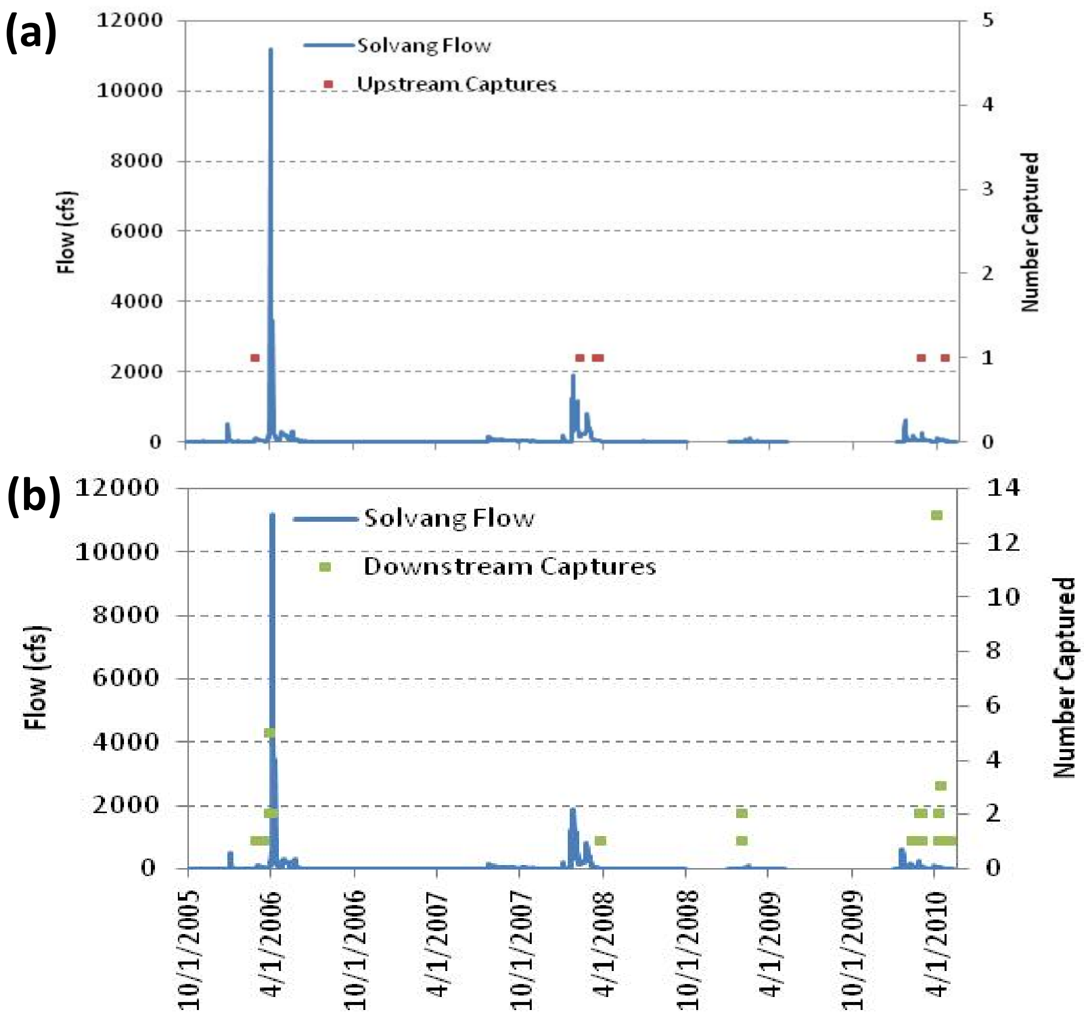


Figure 70: WY2005-WY2010 (a) upstream and (b) downstream migrant *O. mykiss* captures at the LSYR Mainstem trap. Average daily flow data were from the USGS Solvang gauge on the LSYR. Traps were removed just prior to peak storm flow events. The LSYR Mainstem traps were not deployed in WY2005 and WY2007.

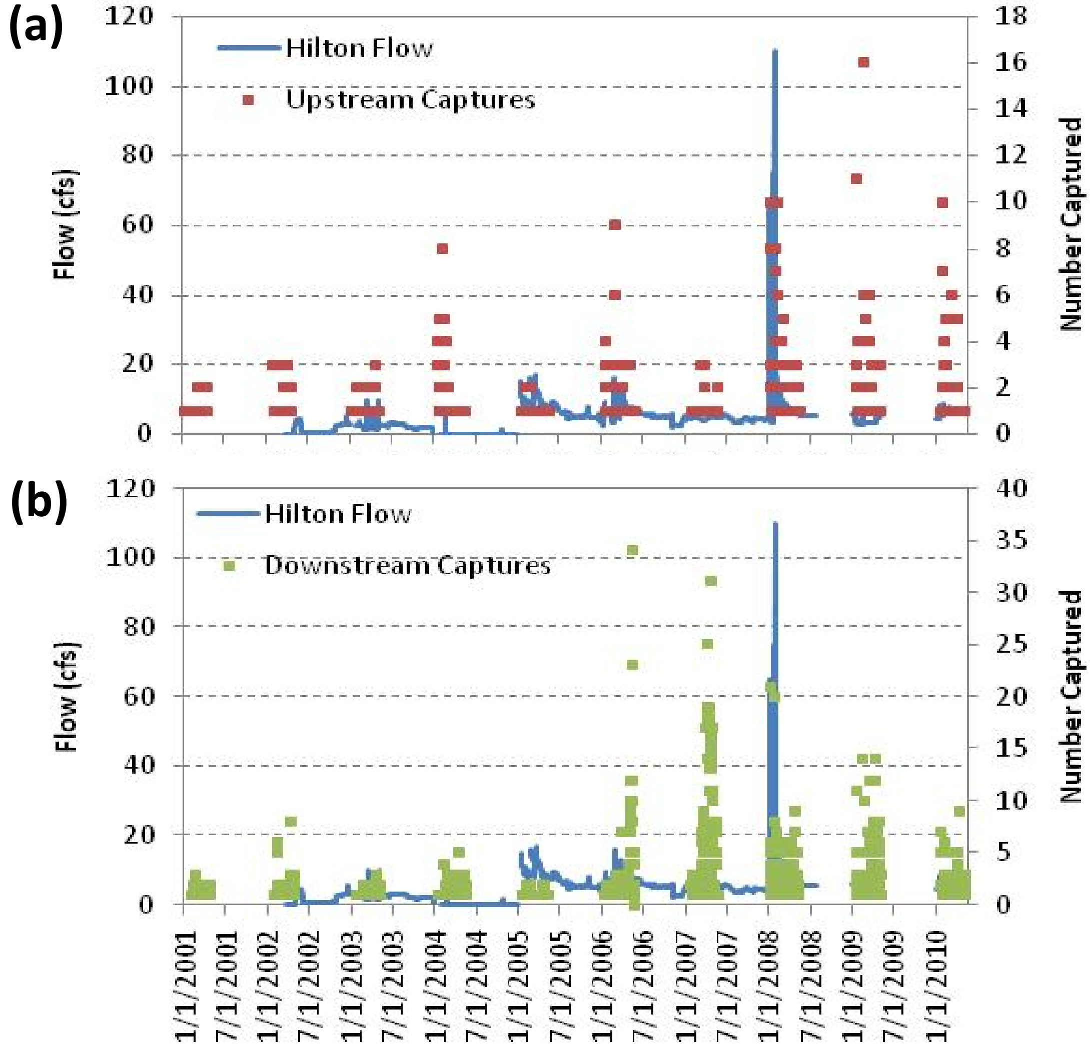


Figure 71: WY2001-WY2010 (a) upstream and (b) downstream migrant *O. mykiss* captures at the Hilton Creek trap. Average daily flow data were from the USGS Hilton Creek gauge just below the upper release point of the HCWS. Traps were removed just prior to peak storm flow events.

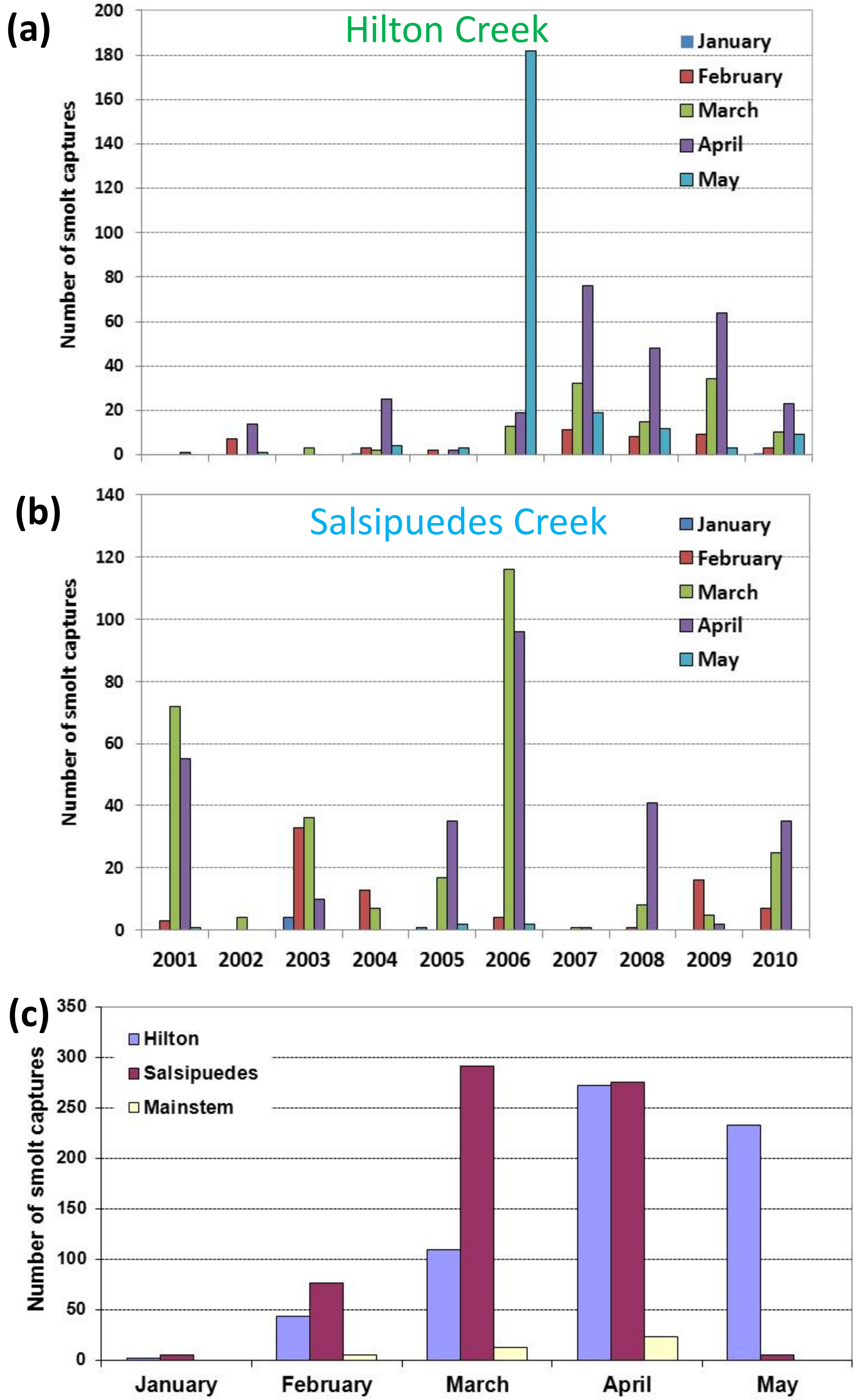


Figure 72: Timing of smolt migration observed at (a) Hilton and (b) Salsipuedes creeks from WY2001 through WY2010; (c) a tabulation of all the years of smolt captures (WY2001-WY2010) by month.

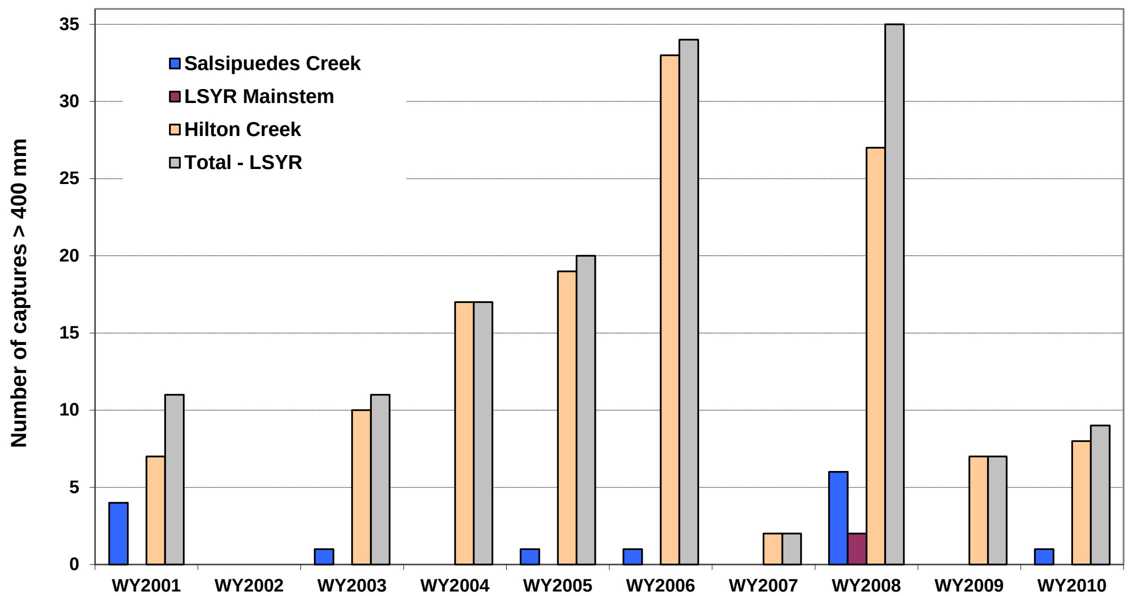


Figure 73: Migrant *O. mykiss* captures equal to or larger than 400 mm (15.7 inches) observed at the three trap sites from WY2000 through WY2010. The LSYR Mainstem trap was first installed in WY2006 and was not deployed in WY2007 due to low flows.

Table 25: WY2001-2010 *O. mykiss* spring, summer and fall snorkel survey results for the LSYR mainstem Refugio and Alisal reaches and the 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	WY2010
Year-type:	*Wet*	*Dry*	*Normal*	*Dry*	*Wet*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*
Refugio Reach										
Spring	147	1	0	0	49	211	35	190	39	15
Summer	n/a	3	n/a	n/a	63	242	19	528	32	4
Fall	6	2	n/a	0	80	208	12	263	19	2
Alisal Reach										
Spring	123	3	0	0	18	134	54	26	39	23
Summer	11	3	n/a	n/a	21	89	39	118	17	8
Fall	1	1	n/a	0	11	85	9	42	7	10
Hilton Creek										
Spring	1163	624	564	510	1517	2740	1316	2210	545	1256
Summer	1324	139	554	1046	1303	1891	1319	1519	863	1328
Fall	1420	n/a	381	n/a	1272	2016	n/a	738*	746	990
Quiota Creek										
Spring	273	359	49	22	n/a	n/a	n/a	243	189	114
Summer	168	n/a	49	n/a	n/a	142	201	81	101	93
Fall	161	n/a	n/a	n/a	n/a	84	78	67	39	38
Salsipuedes Creek										
Spring	43	n/a	18	n/a	n/a	109	202	n/a	95	303
Summer	n/a	n/a	n/a	n/a	110	131	n/a	308	28	217
Fall	n/a	n/a	7	n/a	134	74	76	226	20	96
El Jaro Creek										
Spring	61	10	19	n/a	n/a	35	30	n/a	75	105
Summer	19	n/a	10	n/a	25	35	n/a	405	n/a	48
Fall	39	n/a	n/a	n/a	3	18	n/a	151	11	89

n/a: conditions too turbid to snorkel.

* Only half of the normal survey reach was snorkeled.

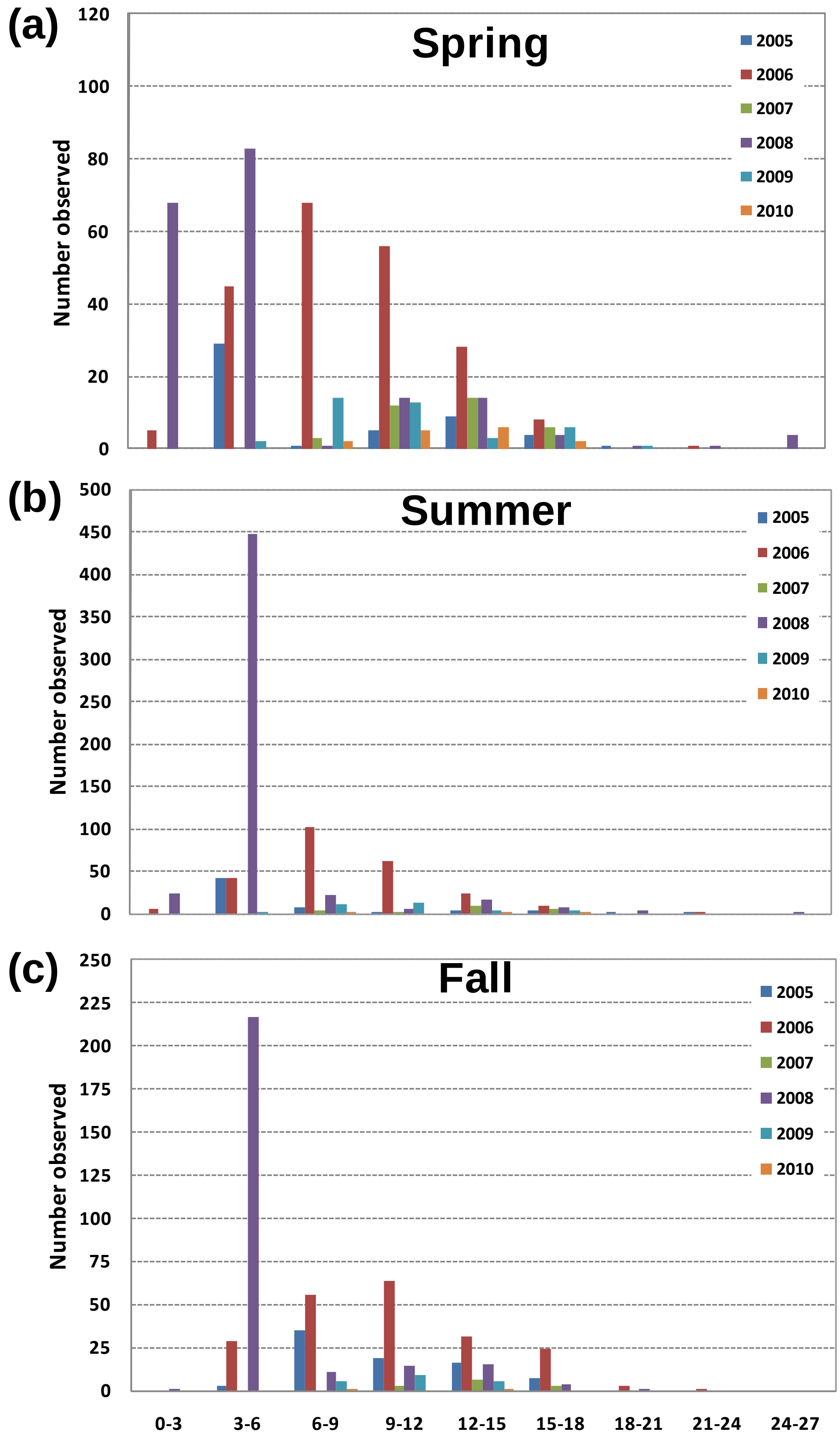


Figure 74: WY2005-2010 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for the LSYR mainstem Refugio Reach broken out by 3 inch size classes.

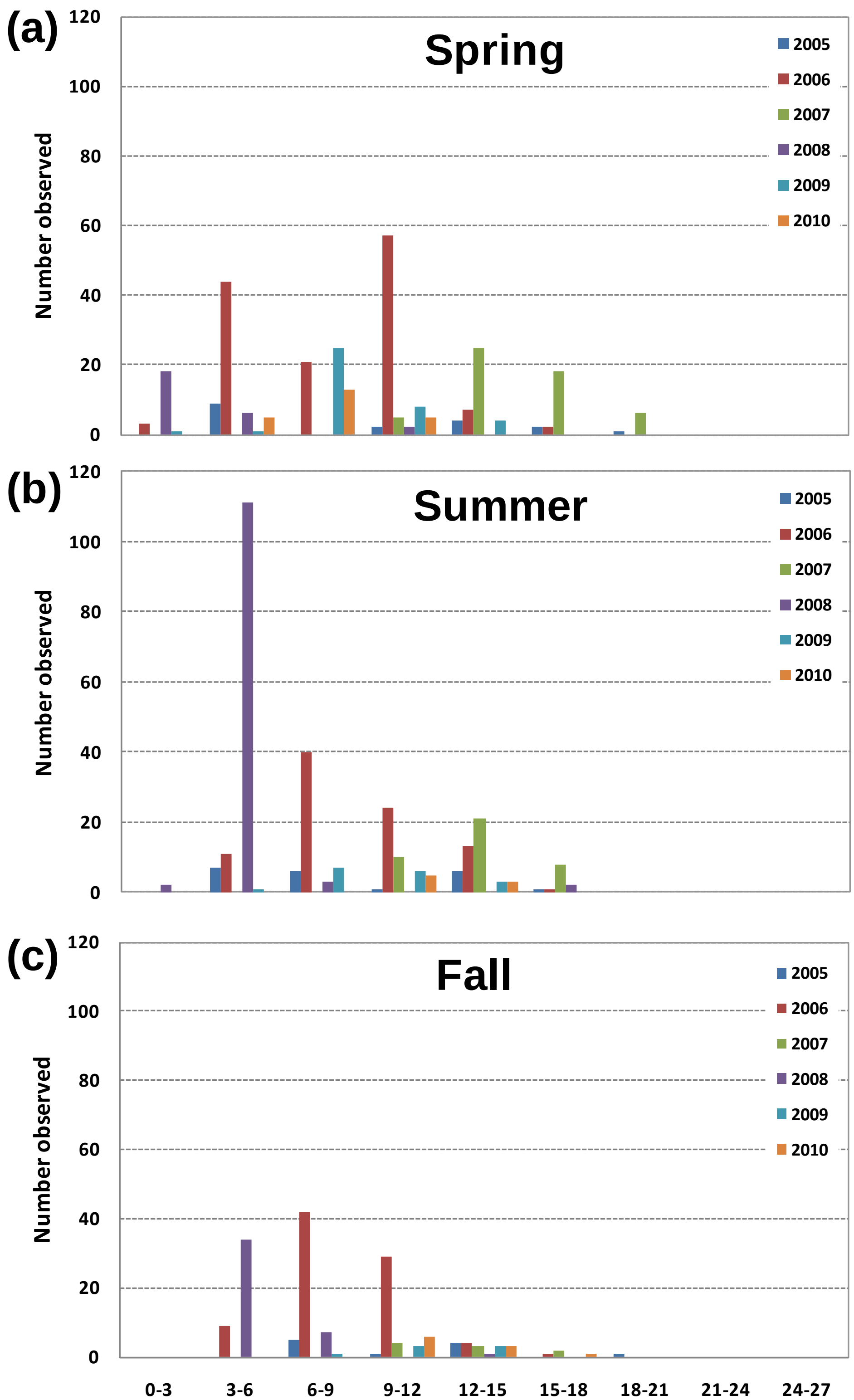


Figure 75: WY2005-2010 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for the LSYR mainstem Alisal Reach broken out by 3 inch size classes.

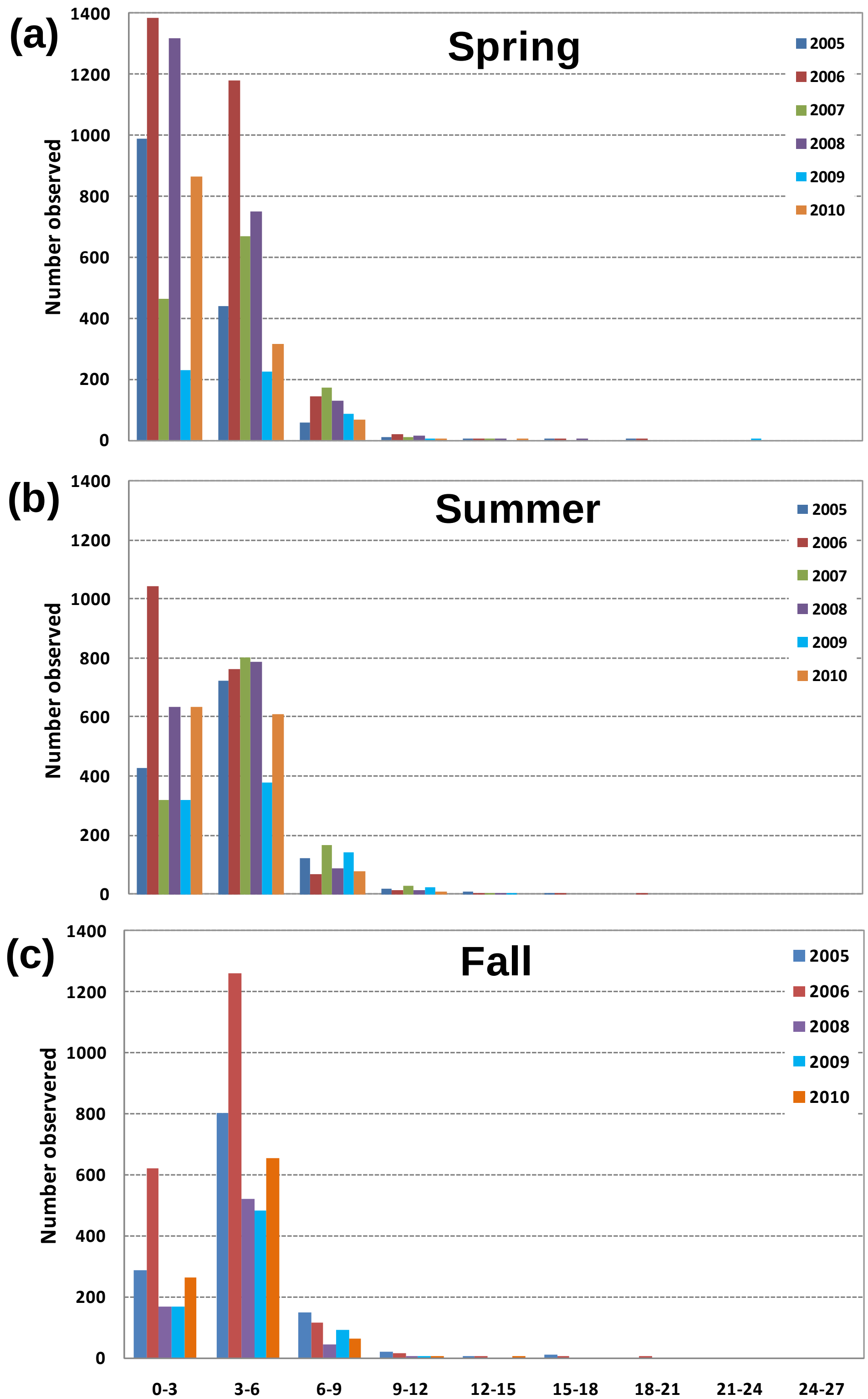


Figure 76: WY2005-2010 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Hilton Creek broken out by 3 inch size classes. Only half of the WY2008 fall snorkel survey was completed due to visibility issues.

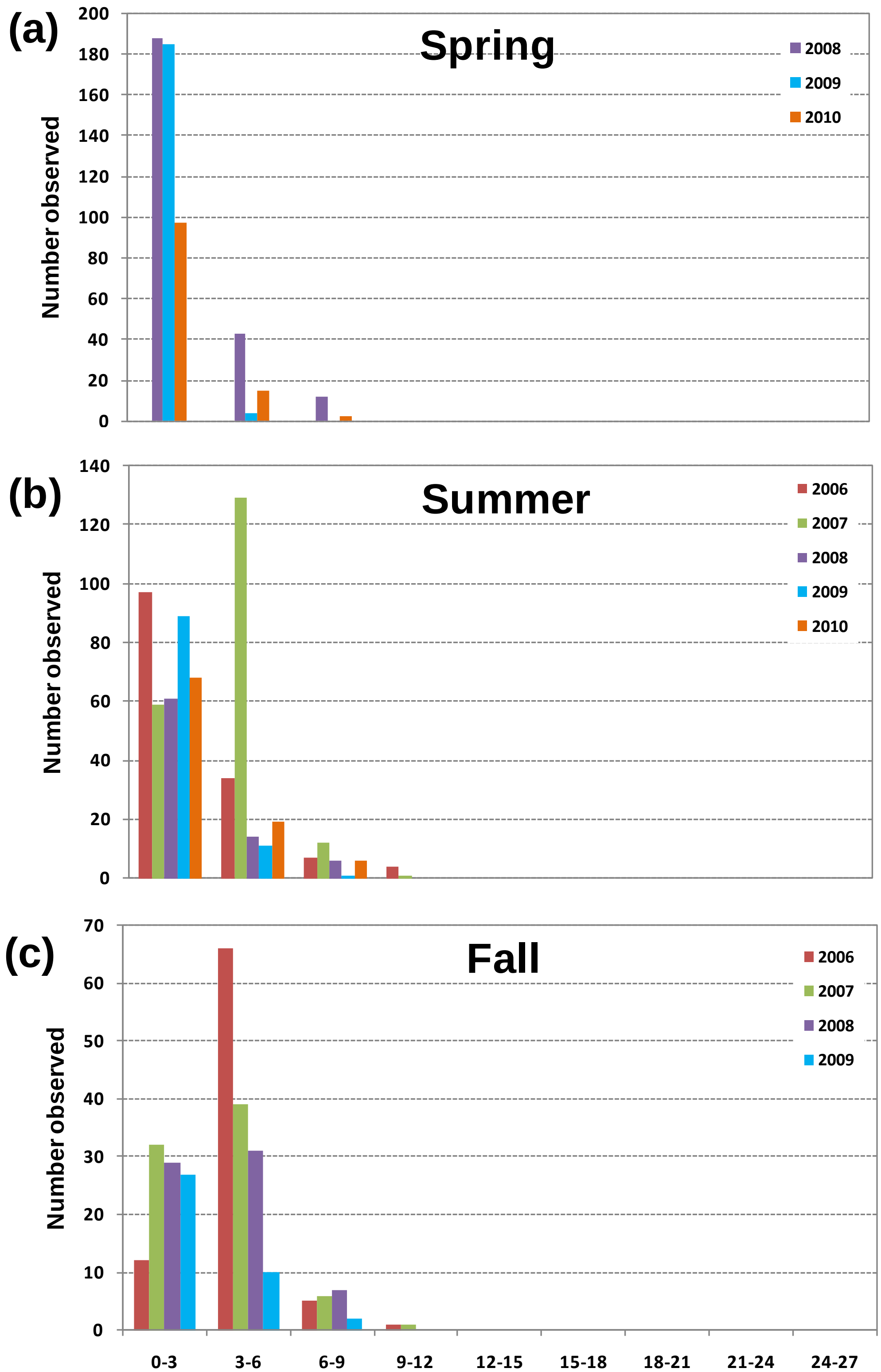


Figure 77: WY2005-2010 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Quiota Creek broken out by 3 inch size classes.

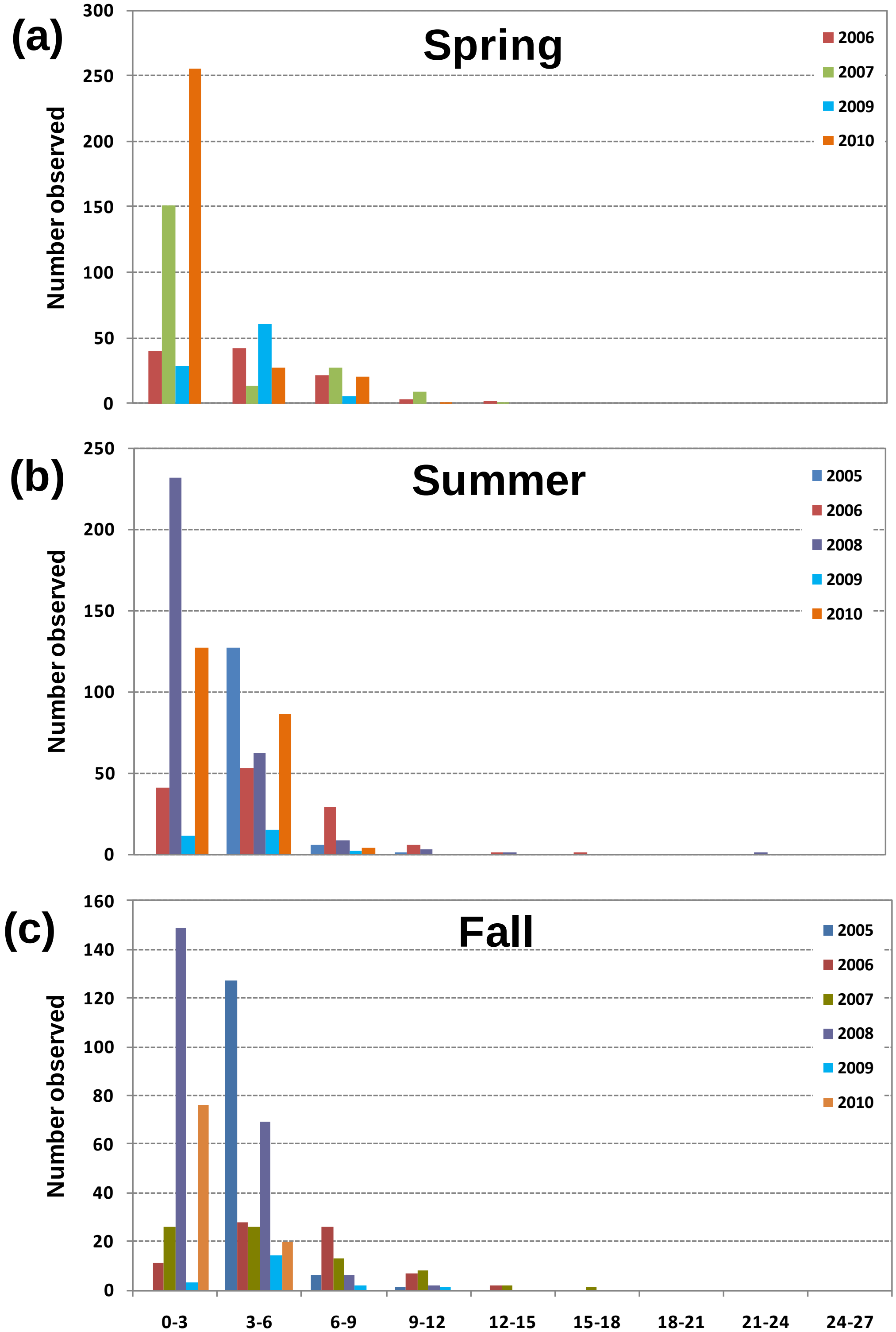


Figure 78: WY2005-2010 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Salsipuedes Creek broken out by 3 inch size classes. Totals are only from Reach 5 for comparison.

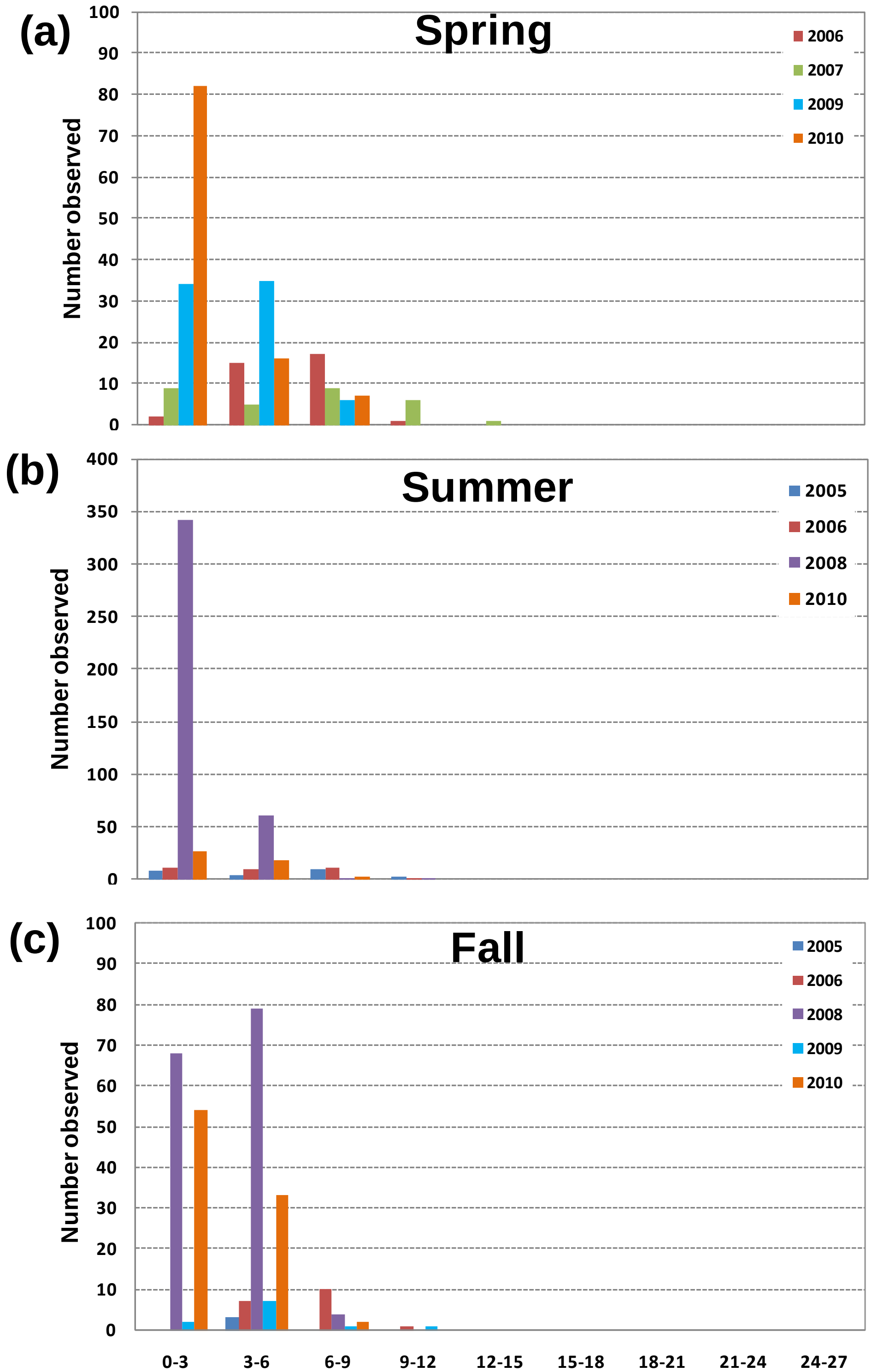
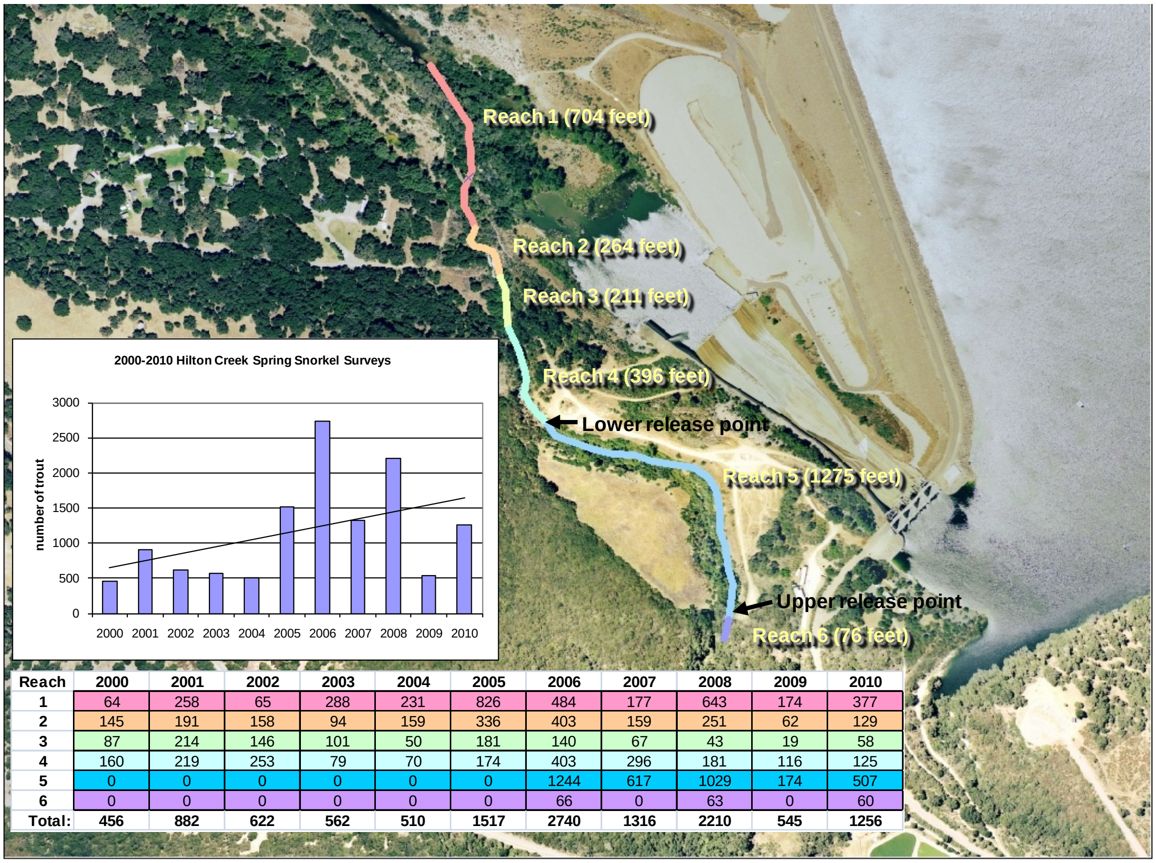


Figure 79: WY2005-2010 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for El Jaro Creek broken out by 3 inch size classes.



Reach	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	64	258	65	288	231	826	484	177	643	174	377
2	145	191	158	94	159	336	403	159	251	62	129
3	87	214	146	101	50	181	140	67	43	19	58
4	160	219	253	79	70	174	403	296	181	116	125
5	0	0	0	0	0	0	1244	617	1029	174	507
6	0	0	0	0	0	0	66	0	63	0	60
Total:	456	882	622	562	510	1517	2740	1316	2210	545	1256

Figure 80: Hilton Creek reaches snorkeled with observed *O. mykiss* trend analysis from the spring snorkel surveys in 2000 through 2010. The embedded graph and table present number of *O. mykiss* observed. The Cascade Chute migration barrier was removed in December of 2005.

Table 26: WY2001-2010 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	WY2010
Largemouth Bass										
Spring	78	147	184	22	0	7	35	4	160	53
Summer	57	881	Dry	172	20	3	33	626	239	137
Fall	57	374	0	290	237	2	56	508	261	213
Sunfish										
Spring	67	40	7	5	4	9	34	0	38	60
Summer	18	11	Dry	1	34	41	3	262	89	26
Fall	8	9	0	0	22	1	18	155	23	7
Catfish										
Spring	7	2	0	0	2	0	3	1	0	1
Summer	0	0	Dry	0	6	55*	2	2	1	0
Fall	1	2	0	2	200*	0	3	1	1	0
Carp										
Spring	0	0	0	0	0	9	138	50	66	28
Summer	0	0	Dry	0	178**	46	159	88	48	59
Fall	0	0	0	0	282**	10	190	69	65	76
* Juvenile bullhead catfish.										
** Mostly juvenile carp.										

Appendices

A. Acronyms and Abbreviations

AF: Acre Foot
AMC: Adaptive Management Committee
AMR: Annual Monitoring Report
BA: Biological Assessment
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
DIDSON: Dual-Frequency Identification Sonar
DO: Dissolved Oxygen Concentration
DPS: Distinct Population Segment
EJC: El Jaro Creek
HC: Hilton Creek
HCWS: Hilton Creek Watering System
Hwy: Highway
ID: Improvement District
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

T&C: Terms and Conditions

TDS: Total Dissolved Solids

URP: Upper Release Point

USBR: United States Bureau of Reclamation (Reclamation)

USGS: United States Geological Survey

WR: Water Right

WY: Water Year (October 1 through September 30)

YOY: Young of the year *O. mykiss*.

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 B-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
Water Level & Temperature	Solinst Levelogger 3301	Annually	Spring	Factory calibrated
Atmospheric Pressure	Solinst Barologger 3301	Annually	Spring	Factory calibrated

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

Instrument	Parameters Measured	Units	Detection Limit	Sensitivity	Accuracy/Precision
Marsh McBirney Flow-Mate Model 2000	Stream Velocity	ft/sec	0.01	±0.01	± 0.05
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
YSI Temperature/Dissolved Oxygen Probe Model 550A	Temperature	°C	-5	±0.1	± 0.3
	Dissolved Oxygen	mg/l, % saturation	0	±0.01, 0.1	± 0.3 mg/l or ± 2 % of reading, whichever is greater. ± 0.2 % air saturation or ± 2 % of reading, whichever is greater
YSI Temperature/Dissolved Oxygen Probe Model 57	Temperature	°C	0.1	±0.1 (manual readout, not digital)	± 0.5 °C plus probe which is ± 0.1 % °C
	Dissolved Oxygen	mg/l	0.1	±0.1 (manual readout, not digital)	± 0.1 mg/l or ± 1%, whichever is greater
Optic Stow-Away (Thermographs)	Temperature	°C	-5	±0.01	0.01, calibration dependent
Solinst Levelogger 3301	Water Level	ft	0.002	.001 % Full Scale	±0.01 ft., 0.3 cm
Solinst Levelogger 3301	Temperature	°C	0.003	0.003	±0.05 °C
Solinst Barologger 3301	Atmospheric Pressure	ft	0.002	.002 % Full Scale	±0.003 ft., 0.1 cm

Thermographs

Steel cables with ¼ inch u-bolts are used to fasten thermographs to trees, rocks, and root masses when deployed. Single units are deployed in run habitats at the bottom 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.

Levelogger/Barologger

The levelogger measures surface water levels by recording changes in absolute pressure (water column pressure and barometric pressure). The levelogger also records temperature. The barologger functions and communicates similarly to the levelogger, but is used above the water level to record ambient barometric pressure in order to barometrically correct data recorded by the leveloggers. These units are deployed within Hilton Creek, the LSYR mainstem at vertical array locations, the Cross Creek Ranch Fish Passage Improvement Project, and within the Rancho San Julian Fish Ladder. The main purpose of the levelogger and barologger is to establish rating curves at fish passage projects and to record water levels within the LSYR mainstem. The leveloggers are also used to verify water temperatures with respect to thermograph deployments within the basin. Both of these units have a lifetime factory calibration and do not require recalibration if used in the specified range. Each unit is tested in the spring (prior to deployment) to verify that each unit is functioning properly.

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.

C. 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.

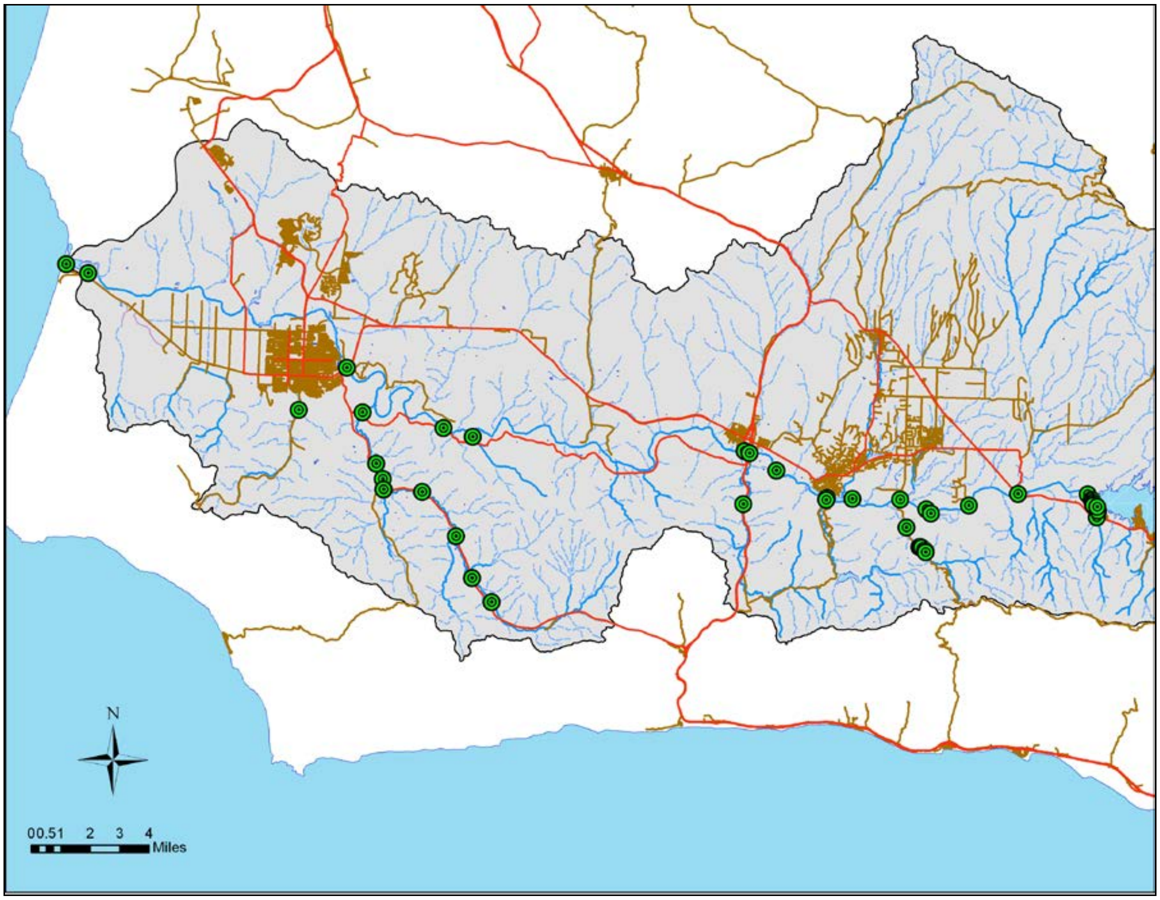


Figure C-1: 2010 photo point locations.

Table C-1: 2010 photo points on the LSYR mainstem. "X's" denote photos taken, downstream (d/s) and upstream (u/s).

LSYR Mainstem Photo Point ID	Location/Description	6/10	10/10
M1	Lower Hilton Creek, photo d/s at ford crossing		x
M2a	Bluffs overlooking long pool, photo u/s		x
M2b	Bluffs overlooking long pool, photo d/s		x
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	x
M6	Highway 154 Bridge, photo d/s	x	x
M7	Meadowlark crossing, photo u/s		x
M8	Meadowlark crossing, photo d/s		x
M9	Lower Gainey crossing, beaver dam, photo u/s		x
M10	Lower Gainey crossing, beaver dam, photo d/s		x
M11a	Lower Gainey crossing, photo u/s		x
M11b	Lower Gainey crossing, photo d/s		x
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	x	
M18	Mid-Alisal Reach, photo d/s	x	
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
M22	Sweeney Road crossing, photo d/s		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		x
M26	LSYR Lagoon on railroad bridge, photo d/s		x
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 C-2: 2010 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	6/10	10/10
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		x
T9	Hilton impediment/tributary, photo u/s		x
T10	Hilton just u/s of URP, photo d/s		x
T11	Hilton road above URP, photo d/s		x
T12	Hilton road above URP, photo u/s		x
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	x
T17	Quiota Creek at 5th crossing, photo u/s	x	x
T18	Quiota Creek at 6th crossing, photo d/s	x	x
T19	Quiota Creek at 6th crossing, photo u/s	x	x
T20	Quiota Creek at 7th crossing, photo d/s	x	x
T21	Quiota Creek at 7th crossing, photo u/s	x	x
T22	Quiota Creek below 1st crossing, photo d/s	x	x
T23	Alisal Creek from Alisal Bridge, photo u/s		
T24a	Alisal Creek from Alisal Bridge, photo u/s		x
T24b	Alisal Creek from Alisal Bridge, photo d/s		x
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s		x
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s		x
T27	Nojoqui/LSYR confluence, photo u/s		x
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s		x
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s		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		x
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s		x
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		

D. List of Supplemental Reports Created in WY2010

- 2010 Fish Passage Supplementation Report (RTDG and CPBS, 2010).
- El Jaro Creek Cross Creek Ranch Project, Fish Relocation Report (CPBS, 2009).
- El Jaro Creek Cross Creek Ranch Project, End of Project Report (CPBS, 2009).
- 2010 Genetics Analysis Report (Garza, 2010).
- Cachuma Project Biological Opinion, Reasonable and Prudent Measure 6, Steelhead/Rainbow Trout Movement During 2010 Water Rights Releases (USBR, CPBS, SYRWCD, 2012).
- Reasonable and Prudent Measure 8.19 and Performance Evaluation of the Rancho San Julian Fish Ladder Fish Passage Project on El Jaro Creek (CPBS, 2012).