2011 ANNUAL MONITORING SUMMARY 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 by:

CACHUMA OPERATION AND MAINTENANCE BOARD

FISHERIES DIVISION

CONSISTENT WITH REQUIREMENTS SET FORTH IN THE 2000 CACHUMA PROJECT BIOLOGICAL OPINION

JUNE 28, 2013

Executive Summary

This report presents the data and summarizes the results of monitoring southern steelhead and water quality conditions in the Lower Santa Ynez River (LSYR) below Bradbury Dam during Water Year 2011 (WY, 10/1/10 – 9/30/11). The report also incorporates references to observations and fish population trends for the period from WY2001 through WY2011 for comparative purposes. Fish monitoring during WY2011 suggests that management actions undertaken by the U. S. Bureau of Reclamation (USBR or Reclamation) on the LSYR continue to positively influence trends in the number of southern steelhead (*Oncorhynchus mykiss*, *O. mykiss*) in the basin.

The monitoring tasks completed in WY2011 were performed below Bradbury Dam in the LSYR watershed or in Lake Cachuma, 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 support suitable habitat for *O. mykiss* (Figure ES-1).

This report summarizes data accumulated since the 2010 Annual Monitoring Summary (USBR, 2013) and is intended to fulfill the annual reporting requirements of the Cachuma Project Biological Opinion (BO) for WY2011. The BO was issued by the National Marine Fisheries Service (NMFS) to Reclamation in 2000 for the operation of the Cachuma Project (NMFS, 2000). This report was prepared on behalf of USBR by the 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 (BA) (USBR, 2000), and LSYR Fish Management Plan (SYRTAC, 2000). Some deviations to the monitoring program as described in the WY2008, WY2009, and WY2010 Annual Monitoring Summaries 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 used in the report, (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.

WY2011 was a wet year (31.09 inches of precipitation measured at Bradbury Dam; long-term average is 20.7 inches) with the majority of the rainfall occurring in December, February, and March. On 12/17/10, a large storm event caused the sand bar at the mouth of the Santa Ynez River Lagoon to breach on 12/20/10. River connectivity to the ocean was maintained after the breach throughout the rest of the water year (285 days). Bradbury Dam spilled on 3/20/11, after a large storm that began on 3/19/11 and continued spilling for 53 consecutive days until 5/13/11 for a total spill volume of 85,755 acre-feet (AF). Peak discharge from the Dam on 3/21/11 reached 20,196 cfs and peak discharge at the USGS Narrows gauge was 26,900 cfs which was the third highest flow rate at the Narrows since 2001 (42,300 cfs on 3/6/01 and 28,800 cfs on 1/11/05). The reservoir was fully surcharged twice during the year, once just prior to the end of the spill on 5/5/11 and again on 5/27/11 after an Adaptive Management Account release (5/14/11-5/25/11, 500 acre-feet). Since it was a year of a spill and the spill volume was greater than 20,000 acre-feet, target flows to Hilton Creek (2 cubic feet per second (cfs) minimum) , the Highway 154 Bridge (10 cfs minimum), and Alisal Bridge (1.5 cfs) were maintained after the spill throughout the rest of the water year as described in the BO. There was no fish passage supplementation or Water Right (WR) 89-18 releases due to a very wet spring and elevated stream discharge across the LSYR basin into the summer.

The winter and spring provided passage opportunities for returning ocean run southern steelhead and downstream out-migrating smolts from late December through late May. Three migrant traps at lower Hilton Creek, lower Salsipuedes Creek, and LSYR mainstem near the town of Santa Ynez were operated during the migration season (January through May). Eight anadromous adult steelhead were observed; all at the Salsipuedes Creek migrant trap with one of those Salsipuedes Creek fish recaptured at the Hilton Creek migrant trap. Fish ranged in size from 242 mm (9.5 inches) to 528 mm (20.8 inches). The smaller fish were thought to be Santa Ynez River lagoon fish due to their size and bright silver coloration. No anadromous steelhead were observed at the LSYR Mainstem migrant trap possibly due to having to remove the traps during the high flow event in March.

There were 249 downstream migrant steelhead smolts and 481 total captures recorded at the three trapping sites; 407 were juveniles (less than 10 inches) and 74 were adults (equal to or greater than 10 inches) (Figure ES-2 (a)). This was the second highest annual total number of smolts captured (WY2006 was the highest at 446 smolts) and fifth in total migrant captures (WY2007 was the highest at 667 captures) since WY2001. The downstream smolts captured and released included 176 at Salsipuedes Creek, 14 at LSYR mainstem, and 59 at Hilton Creek traps. It was the second highest year in the number of LSYR mainstem trap captures at 20 fish (WY2010 was the highest at 30 captures) since those traps were first deployed in WY2006. The total number of captures was up by over a hundred fish compared to the previous year and more than double compared to any of the initial 5 years of the BO (WY2001-WY2005) the majority of which were juveniles and most were smolts. The number of upstream migrants is comparable over the past three years (WY2009-2011) and greater than the number captured in the initial five years of the BO (2001-2005). In order to normalize migrant numbers across years with varying levels of trapping effort, catch per unit effort (CPUE) was determined by taking the total number of captures divided by the total number of trapping days for each trap site (Figure ES-2 (b)). WY2006 showed an increase in the number of *O. mykiss* likely resulting from the completion of the Hilton Creek Cascade Chute project in 2005 that doubled the amount of habitat available for *O. mykiss* within the release area of the Hilton Creek

Watering System (HCWS). CPUE in 2011 remained higher than that measured in the years before full implementation of the HCWS and removal of the Cascade Chute barrier. The exception to this pattern is 2001, a wet year with high CPUE in both Hilton and Salsipuedes Creeks. In general, it is expected that CPUE values would be lower in wet years when traps need to be pulled due to high flow events and higher in dry years when trapping efficiency would be at a maximum. Identifying CPUE generalizations and trends are complicated by inter/intra annual hydrologic variability that influence migration and reproduction potential, and the completion of habitat restoration projects (tributary projects and dam releases) that open up additional habitat for a net increase in standing population.

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. 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 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 fish passage enhancement 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 BA (NMFS, 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.
- Further investigate utilizing Dual-Frequency Identification Sonar (DIDSON) technologies as a potential solution for monitoring migrants during high flow conditions when our current/conventional traps need to be removed. Look for partners for this monitoring effort given the high cost of a DIDSON operation. 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.
- Continue monthly lake water temperature and dissolved oxygen profiles at the HCWS intake barge from April through December to consistently monitor Lake Cachuma water quality conditions to depth particularly at the intake hose elevation of 65 feet for the HCWS.
- Continue to improve photo-point documentation by systematically taking data, adding sites associated with completed restoration projects, and improving exact

site locations and photo cataloging methods to best record changes in habitat features such as channel form and riparian habitat.

- Continue to evolve the use of seasonal field biologists to maximize their utility specifically in the area of data entry, equipment repair, and general logistics of the overall monitoring program.
- Continue to develop the LSYR *O. mykiss* scale inventory and analyses of growth rates, evidence of life-history strategies such as fresh vs. marine water, signs of spawning, etc. in support of ongoing fisheries investigations.
- Install temperature probes/loggers on the outlets of Bradbury Dam to measure water temperature of releases from the outlet works for documentation and management.
- Monitor LSYR temperature downstream of the Stilling Basin before the Hilton Creek confluence for comparison of recorded values in lower Hilton Creek.
- Engage local landowners to implement ways to reduce cattle impacts to tributary habitats on private lands within the LSYR basin.
- 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 fish species within the LSYR basin. Based upon the AMC's recommendations, Reclamation should determine and implement future studies and actions needed.
- Develop and implement a monitoring program for the Santa Ynez River lagoon that would be reviewed and approved by the AMC.
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS to improve our collective knowledge, collaboration, and dissemination of information.

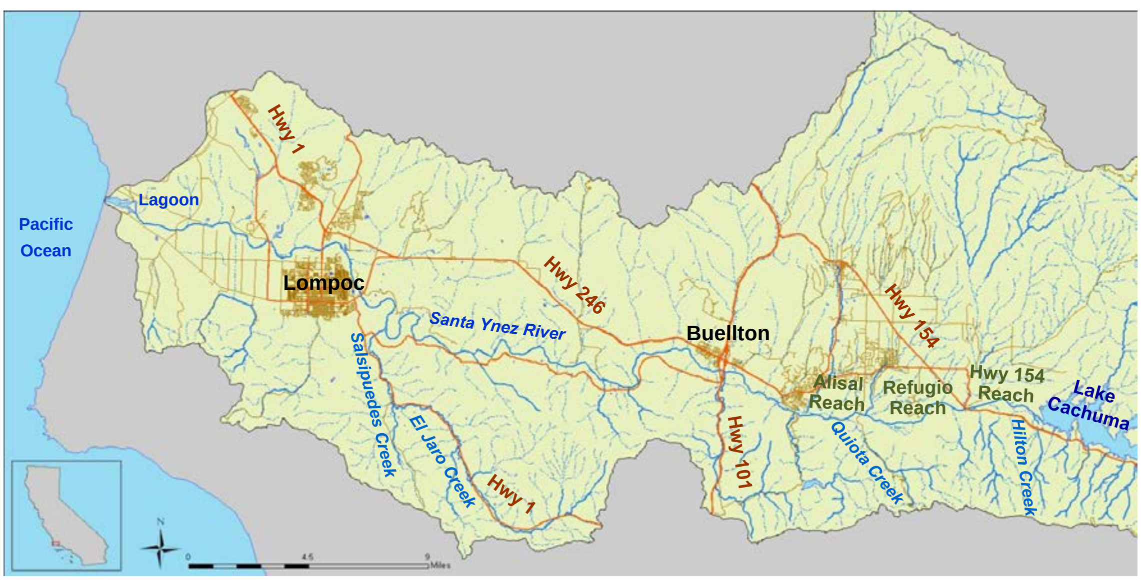
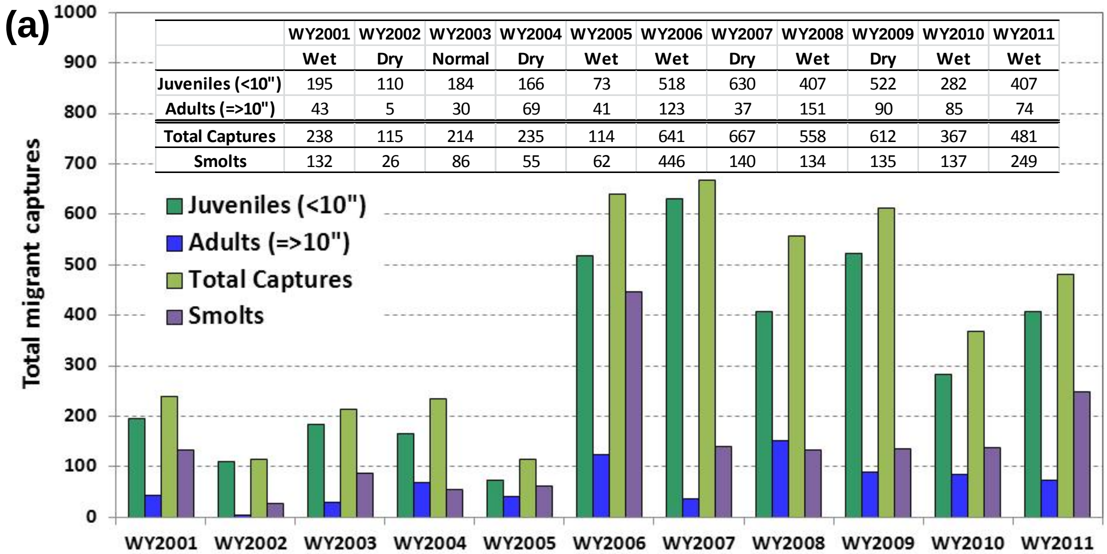


Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean to the west of Lompoc showing tributary creeks and management reaches of interest for the LSYR Fisheries Monitoring Program.



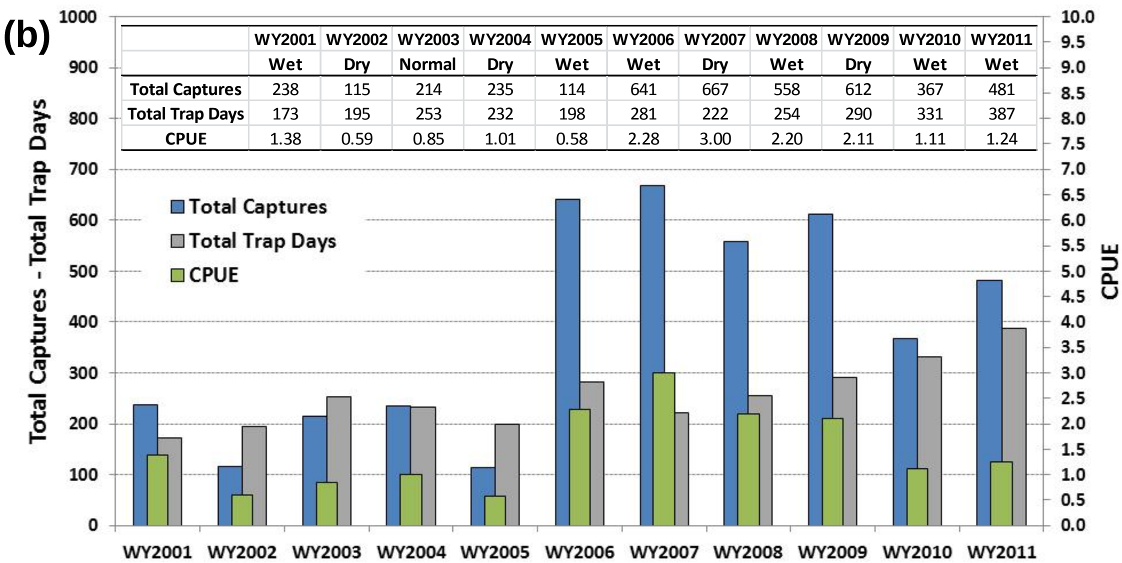


Figure ES-2: Summary of migrant *O. mykiss* captures (including recaptures) at the three trapping sites within the LSYR basin from WY2001 to WY2011: specifically (a) juvenile (less than 10 inches), adults (10 inches or greater), total captures (juvenile and adults), and smolts; and (b) total captures, total trap days (the sum of functional trap days at each trapping location), and CPUE.

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WY2011 Annual Monitoring Summary

1. Introduction

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

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

The objective of this 2011 Annual Monitoring Summary is to evaluate the effects of the Cachuma Project on southern California steelhead (*Oncorhynchus mykiss* or *O. mykiss*) in the Lower Santa Ynez River (LSYR) below Bradbury Dam. Data collected throughout WY2011 regarding steelhead population changes, movements and reproductive success, target flow compliance, water quality conditions, and the effectiveness of restoration activities are analyzed and presented in this report. The 2011 Annual Monitoring Summary also presents findings and observations of trends from 2001-2011 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), 2009 Annual Monitoring Report (USBR, 2012), and 2010 Annual Monitoring Report (USBR, 2013). 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 habitat conditions and the fishery observations in the LSYR during WY2011. 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 *O. mykiss* 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 river-mile distance 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; HC-0.14 is on Hilton Creek and 0.14 miles upstream of its confluence with the mainstem).

WY2011 was classified as a wet year with 31.09 inches of precipitation recorded at Bradbury Dam (long-term average is 20.7 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 tropic levels take advantage of the increased flow and food resources for increased growth and survival that cumulatively can result in the potential for a population increase for *O. mykiss* from the previous year. WY2011 had the second 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, even with a lower migrant trapping efficiency due to heavy runoff and spill conditions.

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 Wildlife (CDFW, previously known as 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 LSYR through the CPBS on behalf of Reclamation in compliance with the 2000 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 were incorporated in the monitoring program 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 prepared that synthesized the results of the monitoring effort from 1993 to 1996 (SYRCC and SYRTAC, 1997), from 1993 to 2004 (AMC, 2009), and from 2005 to 2008 (USBR, 2011); and two Annual Monitoring Reports with trend analyses were completed for 2009 (USBR, 2012) and 2010 (USBR, 2013). All reports were submitted to NMFS to fulfill the Annual Monitoring Reporting requirements (T&C 11.1) for those years.

Rainbow trout (coastal rainbow/freshwater resident) and southern California steelhead are the same species (*O. mykiss*) and visually indistinguishable except for the larger size of a returning ocean run steelhead and color differences 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 freshwater 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 on the river: Jameson, Gibraltar, and Cachuma. Lake Cachuma essentially splits the watershed area 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 CDFW 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 WY2011 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 wet year at 151,344 af of computed inflow to Lake Cachuma.

WY2011 had 31.09 inches of rainfall at Bradbury Dam and was therefore classified as a wet year (more than 22 inches) (Table 1). There was sufficient runoff over the water year to spill Lake Cachuma and enough runoff to breach the sandbar at the LSYR Lagoon and create ocean connectivity from 12/20/11 through the rest of the water year, 285 consecutive days. This was the 10th wettest year on record (1953-2011) and 3rd wettest year since 2000. Historic minimum, maximum, and WY2011 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 WY2011 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). Over two inches of rainfall fell in each of the following months: October, December, February, and March with the highest cumulative total in March at 11.85 inches (Table 3). There was very little to no precipitation in April and from May to the end of the water year. The large rainfall event in March and subsequent spill event through May produced higher than normal flow conditions in the LSYR mainstem and tributaries into the summer, eliminating the need for a passage supplementation event or a WR 89-18 water rights release.

The majority of the rainfall in WY2011 occurred during two separate events. The first event arrived on 12/17/10 and lasted 7 days with a total of 7.22 inches recorded at Bradbury Dam. This was one of the largest December storms on record. The second large rain event also lasted 7 days beginning on 3/19/11 and ending 3/25/11 but totaled 11.49 inches, and was considered one of the highest precipitation events in March on record. Bradbury Dam spilled on 3/20/11 (10:00 AM) after this event and continued spilling for 53 consecutive days until 5/13/11 (12:00 PM) for a total spill volume of 85,755 acre-feet (AF). Peak discharge from the Dam reached 20,196 cfs on 3/21/11 and 26,900 cfs on the same day at the USGS Narrows gauge which was the third highest flow rate at the

Narrows since 2001 (42,300 cfs on 3/6/01 and 28,800 cfs on 1/11/05). The reservoir was fully surcharged twice during the year, once just prior to the end of the spill on 5/5/11 and again on 5/27/11 after an Adaptive Management Account release (5/14/11-5/25/11, 500 acre-feet). 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 on the LSYR mainstem and at Salsipuedes gauges occurred on 3/21/11 at 16,200 cfs, 11,100 cfs, 9,200 cfs (3/20/11), and 1,630 cfs, respectively. Instantaneous peak discharges at those gauges were 26,900 cfs on 3/21/11, 23,400 cfs on 3/20/11, 17,600 on 3/20/11, and 3,510 cfs on 3/20/11, respectively. At these discharge rates, fluvial geomorphic changes were observed to the tributaries and mainstem channels. Specifically, scouring and mass wasting were observed in many locations within the Salsipuedes Creek drainage where the channel continues in incise through the alluvial terraces. The LSYR mainstem exhibited extensive aggregation and degradation within the area of the high flow channel that filled in or created refuge habitats for *O. mykiss* as well as complete channel migration in certain areas. Some mainstem riparian vegetation was removed but not as extensively as years past with similar river discharge rates.

Annual hydrographs for Salsipuedes Creek and along the Santa Ynez River at Los Laureles, Solvang, and the Narrows reflected higher than normal spring runoff through June (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: The Santa Ynez River lagoon breached on 12/20/10 after a large storm event that occurred on 12/17/10 (7.22 inches of rain recorded at Bradbury Dam), and remained open for the remainder of the water year, 285 consecutive days (Figures 2 and 3 and Table 4). Of those consecutive days, 151 days were during the migration season (January - May) for *O. mykiss*. Another significant storm impacted the basin on 3/19/11, which spilled Lake Cachuma from 3/20/11 to 5/13/11.

Since WY2006, the presence of the lagoon sandbar has been monitored daily from Ocean Park (at the lagoon, see Figure ES-1) during the wet season (November 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: There were no passage supplementation events in WY2011 due to wet conditions through the winter and spring that resulted in good conditions for migration without supplementation. Bradbury Dam spilled from 3/20/11 to 5/13/11. Since the spill occurred well into spring, there was no need for a passage supplementation for the remainder of the migration season. Due to the large spill event and that the reservoir was surcharged for a second time on 5/27/11, all passage supplementation water was fully recharged in WY2011 and will be used in subsequent years.

Adaptive Management Account: An Adaptive Management Committee (AMC) meeting was initiated by the CPBS on 5/13/11 at 11:30 AM to discuss the end of the spill, the presence of steelhead adults and migrating smolts within the LSYR, and the potential use of the Adaptive Management Account (AMA) water to continue to support downstream smolt and upstream adult migration. The AMC approved and Reclamation implemented an AMA release that began on 5/14/11 and ended on 5/24/11 that used the full 500 acre-feet of the AMA over a 10 day period. The release was successful in providing additional flow within the LSYR mainstem to encourage downstream smolt and spawned out adult steelhead to migrate to the ocean. Details can be seen in a 6/22/11 AMC Memo (CPBS, 2011b).

Target flows: The WY2011 spill volume was greater than 20,000 acre-feet, so the long-term BO established target flows of 10 cfs at Highway 154 Bridge, 1.5 cfs at Alisal Bridge (Solvang), and a minimum of 2 cfs in Hilton Creek through the HCWS were required and met in WY2011 (Figure 3). The maximum recommended release schedule was exercised despite higher than normal tributary inputs throughout the year. In fact, the minimum daily mean flow recorded during the dry season at the USGS gauge at Alisal Bridge was over 6 cfs. Flows at the Solvang gauge were generally between 8-12 cfs throughout most of WY2011, well above the minimum target flow of 1.5 cfs at Alisal Bridge. This was likely due to the late season spill that occurred from Bradbury Dam in March, coupled with late season tributary runoff within the basin. With higher than normal flows, residual pool depths were maintained throughout the period within the Refugio and Alisal reaches of the LSYR mainstem. No fish strandings or mortalities were observed throughout the oversummering period, as flows within the mainstem remained relatively high throughout the year.

On 3/25/11 while ramping down the spill from Bradbury Dam following established criteria, a 431.8 mm (17 in) *O. mykiss* became stranded in a scour pool just downstream of where the SWP pipeline crosses the high flow channel downstream of the Reclamation property boundary. The fish was captured and successfully relocated back to the low flow LSYR mainstem channel and an incident report was sent to NMFS on 4/5/11. That pipeline is scheduled to be lowered well below the floodplain elevation in the summer of WY2013 that will eliminate the issue.

Mixing of State Water Project Waters in the LSYR: Reclamation monitors downstream releases to comply with the 50% mixing criterion required by BO RPM 5.1 (NMFS, 2000) for release of State Water Project (SWP) water into the Santa Ynez River below Bradbury Dam by the Central Coast Water Authority (CCWA). The criterion was met for RPM 5.1 throughout WY2011 (Figures 4). SWP water is mixed with water releases from Lake Cachuma in the Stilling Basin at the base of the dam. On 10/20/10 the SWP water release into the LSYR was greater than 50% (53%) but it was not during the migration season or when the river was connected to the ocean. Since the issuance of the

BO in 2000, the 50% mixing criterion has been met 100% of the time during the migration season (December – June), when the lagoon was open, and flow was continuous to the ocean.

3.2. Water Quality Monitoring within the LSYR Basin:

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

Stream water temperatures were collected at various locations within the mainstem and tributaries of the LSYR with thermographs (recording continuously every hour), and dissolved oxygen concentrations with multi-parameter sondes through multiple day spot deployments (2-5 days at 15-minute or 30-minute intervals). Since 1995, a thermograph network has been deployed in the mainstem and tributaries downstream of Bradbury Dam as described in the BA (USBR, 2000), to monitor seasonal trends, diel variations, longitudinal and vertical gradients, and general temperature suitability for *O. mykiss*. Changes in channel configuration and associated pool habitats have necessitated modifying the thermograph deployment regime and locations described in the BA (USBR, 2000). In WY2011, sonde deployments took into account specific habitat units and potential water quality issues for rearing *O. mykiss*, and locations were varied based on observed conditions. The two data sources (thermographs and sondes) will be discussed separately for the mainstem and tributaries.

Stream water temperature and DO concentrations for stressful and lethal conditions have not been specifically established for southern California steelhead. A literature review suggests water temperature criteria for *O. mykiss* to be stressful at 20 ^{o}C, severely stressful at 24 ^{o}C, and lethal at 29 ^{o}C (USBR, 1999; Myrick and Cech, 2001; Deas et al., 2004; Spina, 2007; Carter, 2008; Atkinson et al., 2011). Stream water DO concentrations reach stressful conditions for *O. mykiss* at 5 mg/l and lethal conditions at 3 mg/l or less (EPA, 1986; USBR, 1999). R2 Resources Consultants conducted a thorough literature review and analyzed stream temperature and DO concentrations as they relate to water right and habitat flow releases for the LSYR that provide greater detail on the determined criteria and river water quality conditions (DeVries, 2013c; DeVries, 2013b; DeVries, 2013a). These criteria will be referenced in the following water quality data evaluation for the LSYR and its tributaries.

Water temperature: During WY2011, thermographs were deployed in several configuration types: single units mainly in the tributaries and 3-unit vertical arrays in the LSYR mainstem. In total, 19 thermographs were deployed at 8 sites on the LSYR mainstem that included:

- Long Pool (LSYR-0.51 (3)),

- Santa Ynez River directly downstream of Long Pool and upstream of the Reclamation and Crawford-Hall property boundary (LSYR-0.68 (1)),
- Encantado Pool (LSYR-4.95 (3)),
- LSYR-7.2 (3),
- LSYR-9.7 (3),
- Alisal Bedrock Pool (LSYR-10.2 (3)),
- Avenue of the Flags (LSYR-13.9 (1)), and
- Cadwell Pool (LSYR-22.8 (2)).

The station number and number of thermograph units at each site are given in parentheses. Site location and deployment period are presented in Figure 5 and Table 5.

At 5 of the 6 vertical array sites on the LSYR mainstem, thermograph units were consistently deployed with surface (approximately 0.5 feet below the surface), middle (center of the water column), and bottom (0.5 feet above the bottom) units at each monitoring site. The monitoring location at LSYR-22.8 had a 2 unit thermograph deployment configuration: the surface and bottom only due to lack of available instruments. Single unit thermograph deployments within the LSYR mainstem (2 sites) and tributaries (6 sites) were uniformly positioned approximately 0.5 feet above the bottom of stream channel. At two tributary monitoring locations, pressure transducers with temperature loggers were used instead of thermographs due to conjunctive monitoring of water surface elevations. Most monitoring locations were legacy sites and have been monitored since before the Cachuma Project BO (see previous Annual Monitoring Summarys). Other sites were monitored due to the presence of *O. mykiss*.

There were 6 thermograph deployment sites in the tributaries during WY2011:

- Hilton Creek near the LSYR confluence near the trapping site (HC-0.12),
- Hilton Creek just downstream of the HCWS Upper Release Point (URP) (HC-0.54),
- Quiota Creek upstream of Crossing 7 (QC-2.71),
- Salsipuedes Creek near the trapping site (SC-1.2),
- Salsipuedes Creek just upstream of the confluence with El Jaro Creek (SC-3.8), and
- El Jaro Creek just upstream of the confluence with Salsipuedes Creek (EJC-3.81).

Two additional sites at Cross Creek Ranch (EJC-4.53) and Rancho San Julian (EJC-10.82) had pressure transducers deployed which recorded water temperature at the same interval as the thermographs and were added into the water quality analyses.

NMFS conducted a temperature study in the LSYR in 2011 using thermographs set up in three unit arrays. In order to collaborate and share data between NMFS and CPBS, a mid-water column unit was added to the vertical arrays deployed by CPBS. Due to insufficient thermographs available at the initial deployment, some middle thermographs have a shorter period of record. NMFS data are not presented in this Annual Monitoring Summary.

Data from all sites monitored by CPBS are presented in figures and tables, and a brief discussion of the data is given. Data presentations include daily minimum, average, and maximum water temperatures as well as hourly data during the highest maximum water temperatures recorded over the period at that site. Surface, middle, and bottom units of the vertical arrays are presented in separate graphs where the habitat depth is given in the text and the actual placement depth of the instrument is presented in the caption of each associated figure.

Mainstem thermographs: The LSYR mainstem single and vertical array thermograph deployment locations and deployment schedule can be seen in Figure 5 and Table 5. The data are presented by site from upstream to downstream.

Long Pool (LSYR-0.51)

The Long Pool is approximately 100 feet wide at the widest point and 1,200 feet long with a maximum depth of 9 feet. It is fed by two water sources when there is no spill or release from the outlet works; the chute release which is part of the HCWS that releases water directly into the Stilling Basin / LSYR mainstem below the dam and Hilton Creek proper (URP and LRP of the HCWS and upper natural basin creek flow) which discharges directly into the Long Pool. The HCWS is a cool water source that takes water at the 65 foot level below the surface in Lake Cachuma. Mixing of the two sources (LSYR mainstem and Hilton Creek) occurs within the first 200 feet of the Long Pool and well upstream of the thermograph vertical array location within the Long Pool. *O. mykiss* are routinely observed rearing in this habitat when water visibility permits. The thermograph vertical array was deployed at the deepest point of the pool at 9 feet on 5/3/11 and removed on 11/11/11.

Maximum surface water temperatures recorded by the surface unit were less than 21.7 °C throughout the deployment period with typical warming during the summer and cooling in the fall (Figure 6). Diel (24-hour) fluctuations between minimum and maximum temperatures during the warmest period of the year ranged from 3.0 °C to 5.2 °C. Maximum temperatures recorded by the middle unit were 18 °C or less with a diel fluctuation of approximately 2 °C (Figure 7). The bottom unit had similar maximum temperatures to the middle unit but the diel variation was slightly less (Figure 8). *O. mykiss* were observed in the Long Pool throughout the monitoring period.

Downstream of Long Pool (LSYR-0.68)

This single unit was deployed 300 feet downstream of the Long Pool in a shallow run habitat with a maximum depth of 2 feet from 5/3/11 to 11/11/11 and recorded similar though slightly cooler temperatures (daily and hourly) compared to the Long Pool surface thermograph (Figure 9). Temperatures were greatest from mid-June through the beginning of August, but still remaining less than 21 °C except for one day during the monitoring period. *O. mykiss* were observed throughout the monitoring period.

Encantado Pool (LSYR-4.95)

The Encantado Pool was approximately 400 feet long, averaged 30-feet wide, and had a maximum depth of 7 feet. A vertical array was deployed from 6/8/11 to 11/8/11 at the deepest point of the pool. Historically this habitat has had oversummering *O. mykiss*. Beaver activity was observed at this site periodically during the monitoring period.

Maximum daily surface temperatures reached 26 °C and minimum temperatures remained above 17 °C until October when the temperatures dropped through the rest of the fall (Figure 10). Diel fluctuations were between 4 °C and 6 °C and lessened into the fall. Temperatures and diel fluctuations were less at the middle (Figure 11) and bottom (Figure 12). *O. mykiss* were observed throughout the monitoring period.

7.2 Pool (LSYR-7.2)

This pool habitat was approximately 275 feet long and 45 feet wide with a maximum depth of 4.5 feet. A vertical array was deployed from 6/8/11 to 11/8/11 in this pool habitat where *O. mykiss* were observed throughout the period. A channel changing spill event in March 2011 altered the habitat at the location monitored during WY2010 by eliminating the pool, which required staff to relocate the monitoring point upstream a tenth of a mile to a suitable pool habitat. The vertical array was placed in the area of greatest depth adjacent to a bedrock structure with inflow into the pool occurring approximately 20-feet upstream of the deployment point.

Maximum daily temperatures at this site climbed above 25 °C during July and August with diel fluctuations of 4 °C to 6 °C (Figure 13). Conditions were near uni-thermal going to depth looking at the middle (Figure 14) and bottom units (Figure 15).

9.7 Pool (LSYR-9.7)

This habitat was a shallow pool 35 feet long and 15 feet wide with thick willow cover at the upstream end. Maximum depth of the pool was 4.0 feet and the vertical array was deployed at the deepest point from 6/10/11 to 11/8/11. Similar to the pool habitat at LSYR-7.2, the spill event in March 2011 caused the channel to shift in this area which completely filled in the pool monitored in WY2010 and required moving the monitoring point downstream approximately a tenth of a mile to a pool habitat with *O. mykiss* present. There was sufficient flow to connect upstream and downstream habitats and permit fish to move between habitats.

Water temperature conditions were near uni-thermal throughout the period at the surface (Figure 16), middle (Figure 17), and bottom (Figure 18) units suggesting the absence of cool groundwater upwelling. *O. mykiss* were observed just upstream and downstream as well as within (fall) the deployment location during the monitoring period suggesting fish could readily move between the three adjacent habitats. Maximum and minimum daily temperatures were just above 26 ^{o}C and 20 ^{o}C, respectively during the hottest period of the year (August), which ranged from stressful to severely stressful conditions. The diel variation remained between 4-5 °C during the warmest portion of the year.

Alisal Bedrock Pool (LSYR-10.2)

The Alisal Bedrock Pool was a corner scour pool habitat approximately 60 feet long and 40 feet wide with a maximum depth of 9 feet. The vertical array was deployed on 5/3/11, removed on 11/10/11, and positioned where in past years rearing *O. mykiss* have been observed. However, in 2011, 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 WY2011.

Starting in mid-June and continuing through early September, surface daily maximum temperatures were generally greater than 24 °C with the warmest reading occurring on 7/6/11 at 26.6 °C (Figure 19). Based upon the literature described above, these temperatures can be characterized as severely stressful for steelhead. The diel temperature fluctuated from 3.5 °C to 6.1 °C during the warmest period of the year. Some of the warmest thermograph temperatures recorded on the LSYR mainstem were measured at this location. The mid-water unit was deployed from 8/3/11 through 11/7/11 and showed daily maximum and average temperatures approximately 2 °C lower than the surface unit but the minimum temperatures were similar suggesting daytime heating and nighttime cooling to uni-thermal conditions (Figure 20). The bottom unit followed a similar pattern until June when cooler conditions prevailed over the diel cycle, the pattern shifting back to diel fluctuation from 7/1/11 through 7/23/11, then back to little change over the 24-hour period until November (Figure 21). Observed changes with the bottom unit were not associated with downloading or moving of the instruments by CPBS. Temperatures began cooling down in September and continued decreasing through the rest of the period.

Avenue of the Flags (LSYR-13.9)

A single thermograph was deployed in a pool habitat approximately 250 feet downstream of the Avenue of the Flags Bridge in Buellton (LSYR-13.9) from 5/2/11 through 11/9/11. The unit was deployed approximately 0.5 feet above the bottom of the habitat in the deepest part of the pool. The habitat was approximately 65 feet long and 20 feet wide at its widest point with a maximum depth of approximately 4 feet. This habitat remained wetted and flowing throughout the entire monitoring period, unlike most years. No *O. mykiss* were observed in this habitat.

The warmest water temperatures occurred during the first part of July with maximum daily temperatures reaching 25 °C that coincided with a heat wave and a basin wide spike in water temperatures at nearly all thermograph monitoring locations (Figure 22). Water temperatures were less than 24 °C for the majority of the summer with a high temperature of 25.1 °C occurring on 7/6/11. These were stressful t severely stressful conditions for *O. mykiss* according to the literature.

Cadwell Pool (LSYR-22.8)

A vertical array (surface and bottom units only) was deployed from 7/19/11 through 11/9/11 at the deepest point in the habitat (15 feet). The pool was approximately 490 feet long and 32 feet wide at the maximum point. This habitat had flow and *O. mykiss* present throughout the monitoring period.

Highest daily maximum temperatures at the surface unit reached a severely stressful temperature of 26 °C once during the monitoring period with minimum temperatures at a stressful level of approximately 20 °C during the warmest months of the year (Figure 23). Water temperatures at the bottom unit ranged from 19 °C to 21 °C during the recorded period suggesting pool stratification (Figure 24). *O. mykiss* were observed throughout the monitoring period.

LSYR Mainstem Longitudinal Comparisons

Longitudinal mainstem maximum daily water temperature changes with mainstem surface thermographs at LSYR-0.5, LSYR-4.95, 7.2 Pool, LSYR-9.7, LSYR-10.2 and LSYR-22.8 are presented in Figure 25. Dry season streamflow traditionally goes subsurface from LSYR-5.5 to LSYR-6.5 and is referred to as the dry gap. Highest water temperatures were recorded at the LSYR-9.7 and Alisal Bedrock Pool (LSYR-10.2) pools specifically at the beginning of July that was associated with a heat wave. Surface temperatures farther upstream (LSYR-0.51, LSYR-4.95, and LSYR-7.2) were cooler than sites downstream (LSYR-9.7 and LSYR-10.2) even with the geomorphic control at the downstream end of the dry gap where surface flows were observed. The Cadwell Pool (LSYR-22.8) had temperatures comparable to the Encantado Pool (LSYR-4.95).

O. mykiss and Water Temperature Criteria within the LSYR Mainstem

All water temperature monitoring sites below the Hwy 154 Bridge in the LSYR mainstem exhibited extended periods of temperatures greater than the established criteria for stressful conditions at 20 ^{o}C, some well above the established severely stressful level of 24 ^{o}C, from the surface to the bottom of the habitat. No lethal conditions at the established criteria of 29 ^{o}C were observed. *O. mykiss* survived in LSYR mainstem refuge habitats even under stressful or severely stressful conditions, specifically at LSYR-4.95, LSYR-7.2, LSYR-9.7, and LSYR-22.8 as determined by the late fall snorkel survey.

Tributary thermographs: The tributary single thermograph deployment locations and deployment schedule can be seen in Figure 5 and Table 5. The data are presented by site from upstream to downstream.

Upper Hilton Creek (HC-0.54)

A single thermograph was deployed 0.5 feet above the bottom of a pool habitat just downstream of the URP of the HCWS from 5/2/11 to 11/11/11. The pool was approximately 15 feet long and 12 feet wide with a maximum depth of 3 feet. Water temperatures in this reach were elevated during the June and early July compared to previous years due to sustained natural Hilton Creek background flow from upstream of the URP (Figure 26). Natural background flows with higher ambient water temperatures were observed through the first part of July and influenced water temperatures downstream below the URP. Once natural flow ceased, the temperature signal was predominately from the cool water supplied by HCWS releases. Water temperatures were very consistent at approximately 16 °C for the rest of the dry season. Lake Cachuma turned over in early November as can be seen at the end of the recording period.

Lower Hilton Creek (HC-0.12)

This single thermograph was deployed in a riffle habitat approximately 100 feet upstream of the confluence with the LSYR mainstem in approximately 1 foot of water from 5/3/11 to 11/11/11. The dominance of higher temperature water associated with natural upper basin flow in May and June was not as apparent in lower Hilton Creek most likely due to the additional releases from the LRP (Figure 27). Very little thermal heating was observed from HC-0.54 to HC-0.12 due to a mature riparian canopy (Figure 87).

Quiota Creek (QC-2.71)

A single thermograph was deployed 0.5 feet above the bottom of the creek approximately 50 feet upstream of Crossing 7 on Refugio Road from 5/2/11 through 11/9/11. The unit was deployed at the bottom of a run habitat 40 feet long and 10 feet wide with a depth of approximately 1 foot. This site was selected because it remains wet most years except during extreme drought conditions and rearing *O. mykiss* have been routinely seen there. Maximum water temperatures remained between 18 °C and 20 °C during the warmest period of the year (July-October) with temperatures below 18 °C during the spring and fall (Figure 28). The warmest daily maximum temperature occurred on July 6 at 21.3 °C and diel temperature fluctuations were less than 4 °C during July through October.

Upper Salsipuedes Creek (SC-3.8)

A single thermograph was deployed in Upper Salsipuedes Creek, approximately 30 feet upstream of the confluence with El Jaro Creek. The unit was deployed 0.5 feet from the bottom in a shallow run habitat 15 feet long, 4 feet wide, and approximately 1 foot deep from 5/2/11 to 11/7/11. This site had perennial flow and held *O. mykiss* in upstream and downstream habitats since monitoring began in 1993. The warmest daily maximum temperatures were recorded in early July when water temperatures reached 21.2 °C (Figure 29). Diel daily maximum temperature variations during the warmest period of the year ranged from 2-4 °C before decreasing to 1-3 °C during the fall.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 5/2/11 through 11/7/11 within a run habitat with a maximum depth of 1 foot and approximately 300 feet upstream of the Santa Rosa Bridge and approximately 0.77 miles upstream of the confluence with the LSYR near the migrant trap site. *O. mykiss* were not observed at this monitoring site. This site recorded relatively high water temperatures compared to all other monitored tributary sites within the LSYR basin. By early June, maximum daily temperatures were exceeding 24 °C with a peak of 27.7 °C recorded on 7/7/12 (Figure 30). Maximum daily water temperatures remained high until the middle of September when temperatures decreased into the fall. The diel variation ranged from approximately 5.6-8.7 °C.

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

A pressure transducer (stage and temperature logger) was deployed at the downstream outlet of the San Julian Fish Ladder from 1/1/11 to 12/10/11. The unit was deployed approximately 18-inches below the surface in the last and most downstream pool within the ladder which is essentially the plunge pool, a 4.5 feet deep habitat at the outlet of the ladder. This is the first time water temperatures have been monitored in the upper portion of the El Jaro Creek watershed. Overall, daily maximum water temperatures remained less than 22 °C except for a brief period at the beginning of June (Figure 31). Diel fluctuations 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 fish ladder and downstream plunge pool.

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

A pressure transducer was deployed from 1/1/11 to 12/10/11 just upstream of the step pools installed as part of the Cross Creek Fish Passage Enhancement Project in 2009 that provides fish passage over the historic Cross Creek Ranch low flow crossing. The unit was placed 0.5 feet above the channel bottom in a shallow run approximately 1-foot deep. Since the installation of the fish passage project at this site, *O. mykiss* have been routinely observed rearing just downstream in the pools created by the project.

Maximum daily temperatures reached 25 °C during the early July heat wave; most of the maximum temperatures were below 23 °C (Figure 32). Diel temperature fluctuations were greatest during the warm summer period (4-6 °C) before decreasing rapidly at the beginning of October. In general, temperatures at this site were approximately 2 ^{o}C warmer than what was observed at the EJC-10.82 site during the warmest times of the year.

Lower El Jaro Creek (EJC-3.81)

A single thermograph was deployed approximately 50 feet upstream of the confluence of El Jaro Creek and Salsipuedes Creek from 5/2/11 to 11/7/11. The unit was placed in a pool habitat 0.5 feet above the bottom. The pool was formed during high flows in WY2008. This is the same general location the unit has been deployed previously. The habitat was 50 feet long and 9 feet wide with a maximum depth of 4 feet. *O. mykiss* were routinely observed in this pool during snorkel surveys. Beaver activity was observed throughout the deployment period, with a small dam located approximately 30 feet downstream of the monitoring site.

Large variations in temperature (4-6 ^{o}C minimum to maximum) were observed at this location compared to previous years (1-3 ^{o}C) suggesting a dominance of baseflow verses cooler groundwater upwelling (Figure 33). This is primarily due to stormflows that scoured floodplain vegetation and caused riparian canopy loss and a greater chance for thermal heating as well as unusually high upstream baseflow from a wet year. Peak water temperatures of 25.7 °C occurred during the early July heat wave. Diel temperature fluctuations were greatest from May through the end of August (3.0-6.5 °C) before decreasing to 1-2.5 °C into the fall.

Salsipuedes Creek Longitudinal Comparisons

Longitudinal maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 34 for the thermographs and pressure transducers 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). Maximum daily temperatures decreased going upstream within the watershed with the highest values recorded at the bottom of the drainage (SC-0.77). Lowest temperatures were seen in upper El Jaro Creek (EJC-10.82). All sites with *O. mykiss* in the vicinity remained at or below 25 °C during the monitoring period.

O. mykiss and Water Temperature Criteria within the Tributaries

Established stressful conditions at 20 ^{o}C were not observed in Hilton Creek but were observed only for a short period of time during July in Quiota Creek, upper Salsipuedes Creek, and upper El Jaro Creek. Lower Salsipuedes and El Jaro creeks exhibited extended periods of stressful to severely stressful (24 ^{o}C) conditions specifically at SC-0.77, EJC-4.53, and EJC-3.81; *O. mykiss* did survived in these habitats. No lethal conditions at the established criteria of 29 ^{o}C were observed.

Water temperature and dissolved oxygen (sondes): Diel water quality monitoring has evolved over the years based on a greater understanding of summer rearing conditions for *O. mykiss* and improved monitoring technology since the issuance of the 2000 Cachuma Project BO. For example, spot measurement techniques have been replaced by programmable multi-parameter water quality sondes that can be deployed for several days and set to record at a specific time-step. Sondes are now deployed for 2 to 7 days at a time in habitats known to contain over-summering *O. mykiss*, and set to record water temperature and DO concentrations every 15 or 30 minutes. This enables efficient data collection to pinpoint the time and duration of water quality conditions over the diel cycle and across multiple days. The data are presented as recorded and not aggregated such as shown for thermograph data for minimum, average and maximum values.

In 2011, sondes were deployed at several locations within the Refugio and Alisal reaches of the LSYR (Table 6). Sondes were fixed to the same vertical array towers as utilized with the thermograph deployments at 0.5 feet below the water surface, mid-water column and 0.5 feet above the pool bottom (Figure 35). Sonde deployments were done during the summer and fall to investigate potential diel variation in water temperatures and DO concentrations, in habitats where *O. mykiss* were present. Three vertical array locations were chosen on the LSYR mainstem for sonde deployment based on their longitudinal distance from Lake Cachuma (LSYR-4.95, LSYR-7.2, and LSYR-9.7), water depth (all sites relatively deep), presence of *O. mykiss*, and ability to safely deploy equipment away from public view (Figures 5 and 36). The data are presented by site with all deployments on the same graph keeping the hour of the day consistent for temporal comparisons. Sonde water temperature values were consistent with the thermograph data near these locations. Some of the vertical array sonde deployments in 2011 had probe malfunctions and the CPBS worked closely with the manufacturer throughout the period to replace/fix several of the optic DO probes. CPBS always calibrated the three sondes prior to deployment and at the same time to assure all are recording the same values for each parameter.

Encantado Pool (LSYR-4.95): There were two deployments in 2011 within the Encantado Pool, one in July and one in October (Figure 37). Three sondes were simultaneously placed at the surface, middle, and bottom of the pool at its maximum depth (7 feet). July had the greatest diel temperature fluctuation (19.1 °C – 25.0 °C) compared to October (16.9 °C – 20.0°C) at all three depths, with the surface sonde showing the greatest difference in temperature during the 24-hour period. DO concentrations in July at the middle and bottom units (surface unit malfunctioned) ranged from stressful to non-stressful levels (approximately 4.0-13.6 mg/l) over the period (Figure 38). All three sondes were successful in recording DO concentrations during the October deployment where minimum values approached 2 mg/l at all depths towards the end of the deployment period. The surface DO concentration ranged between lethal to non-stressful levels (2.5-7.4 mg/l), with the bottom unit ranging between 2.2-6.3 mg/l. *O. mykiss* were observed at this location throughout 2011 although nighttime DO concentrations were below established lethal levels of 3 mg/l.

7.2 Pool (LSYR-7.2): Sonde deployments at this new location (LSYR-7.2 vs. LSYR7.3 during previous years) were made in July, August, and October in 2011 (Figure 39). Three sondes were simultaneously placed at the surface, middle of the water column, and bottom of the pool in an area 4.5 feet deep. Temperatures during the July and August deployments were similar at all depths showing little stratification and ranged from 18.2 to severely stressful levels (24.8 °C), with similar diel fluctuations observed at all three sonde depths. The October deployment showed cooler water temperatures and less periodicity. The pool appeared to be uni-thermal with nearly identical temperatures observed at all three depths during the entire deployment. *O. mykiss* were observed at this location during the three snorkel surveys in 2011. DO sensor malfunctions occurred at one or more depths during all three sonde deployments (Figure 40). Similar DO concentrations were observed at all depths during the July deployment where the units were functioning and ranged from 3.5-12.6 mg/l that were well below the established stressful level of 5 mg/l at nighttime. The bottom unit during the August deployment was quite different than the middle unit with values ranging from 1.7-10.7 mg/l (well below established lethal levels of 3 mg/l at night) and 3.7-12.1 mg/l, respectively. In October, the range was 5.0-12.9 mg/l at the surface and 4.9-12.8 mg/l at the bottom units. Even though established stressful and lethal levels of DO concentration were observed, *O. mykiss* prevailed throughout the monitoring period.

9.7 Pool (LSYR-9.7): This location had a maximum depth of 4 feet hence only two sondes were deployed within the vertical array (0.5 feet below the surface and 0.5 feet above the bottom). Deployments were made in July, August, and November (Figure 41). Water temperatures during the July and August deployments ranged from stressful to severely stressful levels (19.8-26.2 °C) and were nearly identical at the surface and bottom depths, suggesting uni-thermal conditions. November recorded cooler temperatures ranging between 15.0-19.6 °C, less diel fluctuation, and continued uni-thermal conditions. The surface DO probe malfunctioned during the July period (Figure 42). Similar DO concentrations were recorded during other deployments at the surface and bottom units that generally ranged from 4-9 mg/l in July, 4-10 mg/l in August, and 6-8 mg/l in November.

Lake Cachuma water quality profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 1/21/11, 7/6/11, 8/12/11, 9/26/11, 10/27/11, and 11/17/11 (Figure 43). The purpose of collecting lake profiles is to gather vertical temperature and DO concentrations to assure that the depth of the adjustable intake hose for the HCWS is set to provide optimum conditions for *O. mykiss* in Hilton Creek, at or below 18 °C as stipulated in the BO. The HCWS intake has been set at a depth of 65 feet below the water surface, and temperatures of the released water have been well below 18 °C since the beginning of the HCWS. Lake profile measurements are taken approximately 50 feet away from the HCWS intake pipe so that the submerged monitoring equipment is not sucked into the intake.

The first profile in January revealed that the lake was in an isothermal (even temperature to depth) condition, with nearly identical temperatures from the surface of the lake to the bottom (Figure 43). Temperatures ranged only from 11.3 to 11.9 °C between the surface and bottom at a depth of 148 feet. The next profile in July showed a very warm surface temperature of 24.8 °C, with a non-distinct thermocline and gradually cooler water with depth. In August, a truly stratified condition was noticeable with surface temperatures hovering between 22-23 °C down to the thermocline (at approximately 33 feet in depth) where the temperature dropped off steeply. The lake continued to be stratified in September and October despite the fact that surface temperatures were beginning to fall and the thermocline was deepening. The final lake profile conducted on 11/17/11 showed that the lake had experienced a turnover event. The surface temperature had dropped all the way down to 15.8 °C and was nearly isothermal all the way down to 75 feet below the surface. The temperature at the very bottom (121 feet) was only two degrees cooler at 13.8 °C. The timing of 2011 lake turnover at approximately the end of October through the beginning of November was similar to previous years.

DO concentrations were between 7.8-9.6 mg/l at the surface of the lake during all profiles in 2011 (Figure 43). The highest DO concentrations at all depths were recorded during the January profile. In fact, DO concentrations in January remained above 7.4 mg/l at all depths of the reservoir. The July and November lake profiles showed a precipitous drop in DO concentrations going to depth at 26 feet and 79 feet, respectively, a pattern that has been observed in previous years.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2011 within the LSYR Basin was conducted through photo documentation, specifically by maintaining a long standing record of photo point locations using digital cameras. Photographs were taken at designated locations (photo points) to track long-term and short-term changes that had occurred as a result of storm flows, spill events, phreatophyte growth, changes in canopy coverage and type, periods of drought, and the results of management activities in the drainage. Appropriate photo point locations are those that provide the best vantage point to show representative changes over time. A list of WY2011 photo points is provided in Appendix C (Table C-1)**.**

LSYR 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 within 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 (Figure C-1).

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A maturing and often closed canopy has enhanced habitat quality by shading the stream for rearing and over-summering *O. mykiss* within the LSYR basin, although the canopy does not preclude the occurrence of stressful to severely stressful water temperatures during the summer period in mainstem reaches located more than approximately 5.0 miles downstream of Bradbury Dam. A large spill event occurred in WY2011 with a peak discharge from Bradbury Dam of 20,196 cfs on 3/21/11. Flows within the lower section of the LSYR mainstem were higher due to tributary influences (i.e., peak flow at the Narrows was 26,900 cfs), and some changes in the channel morphology were evident once flows receded. Some sections of the LSYR mainstem channel migrated laterally as much as several hundred feet due to the high flows. However, most of the riparian corridor in the LSYR mainstem was still intact once the high flows receded and the photo record for WY2011 shows this even though the photos were taken at different times of the year and under different flow conditions (Figures 44-47).

The HCWS has been providing year round flows to Hilton Creek for over a decade which has resulted in a mature riparian canopy downstream of the URP (Figures 48-49). The reach between the URP and LRP is still undergoing rapid riparian growth due to the fact that continuous flows from the URP began 6 years after the LRP was initially turned on (2005 onward). This reach is gradually filling in with larger trees (willows, alders, sycamores, and cottonwoods) and replacing the dense understory of Mulefat found between the two release points. Changes in habitat along the Salsipuedes drainage can be seen in Figures 50-52.

3.4. Migration - Trapping

Migrating anadromous and resident *O. mykiss* were monitored as part of a long standing migrant trapping program. Three sets of paired upstream and downstream migrant traps were deployed in January of 2011 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 LSYR 7.3 miles downstream of Bradbury Dam (LSYR-7.3). The sandbar at the mouth of the lagoon was open from 12/20/10 through the rest of the water year, which provided access for *O. mykiss* to the LSYR and its tributaries for 264 consecutive days during the migration season (January through May) and 285 consecutive days during WY2011 (Table 4).

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 a minimum of 2 cfs year round. Hence, baseflow is relatively high all year and the water temperature is significantly cooler compared to other tributaries within the LSYR basin (Figures 26-33).

Following the peak storm flows, stream discharge receded rapidly to a baseflow of approximately 6-8 cfs, mostly from the HCWS, which allowed upstream migrating *O. mykiss* an opportunity to enter into the creek from the Long Pool throughout the year.

The migrant trapping program ran for 153 days from January 6 through the June 9, 2011 (Table 7). The Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps were deployed (1/6/11) and removed (6/9/11) on the same day. Traps were checked every 4-6 hours throughout the period except when traps were pulled due to anticipated high stormflow events (Table 7 and Figures 2 and 3). Lake Cachuma spilled starting on 3/20/11 that resulted in the mainstem trap being out of service until 4/28/11 (39 days) when flows receded to the point where trapping activities could take place. 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. Recaptured fish were included in the migration count but mortalities and young-of-the-year (YOY) were not. The CPUE (Table 8) and timing of each migrant capture over a 24-hour period (Table 9) were tabulated. In general, more fish were captured during the last PM (21:00-01:00) and first AM shifts (05:00-9:00) or nighttime than during the other two shifts (9:00-13:00 and 17:00-21:00) or daytime which is a documented life history strategy to avoid predation during migration (Mains and Smith, 1964; Krcma and Raleigh, 1970; Meehan and Bjornn, 1991; Brege et al., 1996). Others found that elevated turbidity can also reduce predation specifically during stormflow events suggesting migration during the receding limb of storm hydrographs (Knutsen and Ward, 1991; Gregory and Levings, 1998).

WY2011 was a wet year with the fifth highest total number of *O. mykiss* migrant captures (481), second highest smolt (249), and second highest anadromous adult steelhead (9) at the three trapping sites within the LSYR since 2001. Eight of the 9 anadromous steelhead were captured at the Salsipuedes trap, 5 were ocean run that ranged in size from 481-528 mm (18.9-20.8 in) and 3 were thought to be LSYR Lagoon fish due to their smaller length, relatively large girth, and silver coloration that ranged in size from 242-315 mm (9.5-12.4 in). There is a debate whether lagoon fish should be included as anadromous adult steelhead but will be included as such for this report. The ninth anadromous adult steelhead was captured in the Hilton Creek trap and was a recaptured Salsipuedes Creek steelhead (Figure 61).

There were 249 total out-migrating smolts observed at the three trap sites; 59, 176, and 14 at Hilton, Salsipuedes, and the LSYR mainstem traps, respectively (Figures 54 and 55). Peak smolt migration months were March and April at Salsipuedes Creek, March at Hilton Creek, and May at the LSYR mainstem traps. Late season flows and a 500 af AMA release (CPBS, 2011b) after the end of the spill assisted mainstem smolt migration.

Hilton Creek Migrant Traps: The Hilton Creek trapping effort was conducted over a 153 day period (Tables 7 and 8). Upstream (0.59 captures/day), downstream (1.00 captures/day), and total (1.59 captures/day) CPUE values for Hilton Creek were lower compared to previous years, and was lower than Salsipuedes Creek in downstream and total CPUE. Historically, yearly captures have been greater in Hilton Creek than in

Salsipuedes Creek, particularly in the last 5 years. There were two storms in February and one storm in March that required removing the trapping equipment from Hilton Creek for safety for 2, 2, and 9 days, respectively, and traps were reinstalled after the peak of the storm hydrograph. This resulted in 140 functional trap days with a trapping efficiency of 91.5%. A total of 223 *O. mykiss* (83 upstream and 140 downstream) were captured in the Hilton Creek traps during the WY2011 migration season, a significant reduction compared to WY2009 and down slightly from WY2010. More migrant captures occurred during the first early morning check (06:00-10:00) and second late night check (21:00-01:00) although this pattern was more pronounced at the other two trap sites with no artificial flow (Table 9). *O. mykiss* capture by week can be seen in Figure 54.

There were 83 upstream migrant captures in Hilton Creek during the period, ranging in size from 68 mm (2.7 inches) to 481 mm (18.9 inches) (Figure 55). The 481 mm fish was captured on 4/1/11 and classified as a recaptured Salsipuedes Creek anadromous steelhead that was first captured on 3/11/11, 21 days prior. Of the upstream migrants captured, 9 of them were recaptures. This length-frequency distribution at 10 mm size intervals showed a greater number of smaller fish were captured than larger fish and a slight tri-modal distribution indicating that a wide range of age classes of fish (size) migrated through the system during the year; a typical observation from years past.

A total of 140 downstream migrants were captured within the period, ranging in size from 64 mm (2.5 inches) to 490 mm (19.3 inches) (Figure 55). The downstream length-frequency distribution had a similar pattern to upstream captures, a higher frequency of smaller fish with a slight tri-modal distribution but with the highest concentration of captures in the 140-200 mm size range (a typical size range for LSYR smolts). 59 juvenile steelhead (smolts) were captured migrating downstream representing 42% of the downstream migrating fish in Hilton Creek. It is possible that some of the other *O. mykiss* not showing smolting characteristics when captured did smolt at a later time while moving downstream. The majority (84%) of the *O. mykiss* captured moving downstream were less than 200 mm (7.9 inches). Of the downstream migrants captured, 22 of them were recaptured fish that had moved upstream earlier in the season and some showed signs of having spawned. Looking at the average size of smolt captured per month, there is a steady but gradual increase in the average size of smolt leaving Hilton Creek (Figure 56). In February the average smolt size leaving Hilton Creek was 158.7 mm and by May it was 173.8 mm. From a life history perspective, larger smolts have a distinct survival advantage over smaller fish (Bond, 2006).

WY2011 was a wet year with high migration potential for *O. mykiss* throughout the LSYR basin, particularly after the large March storm event that spilled the reservoir. There was only a slight correlation between *O. mykiss* migration and the 3/19/11 stormflow event; other events showed no correlation across the wet season (Figure 57). As the migration season progressed, there was a higher incidence of downstream captures leaving the watershed, specifically late in the season after the large March event through early June due to higher spring flows. The majority of smolts exited Hilton Creek during March, April, and May (26, 12, and 11, respectively of a total of 59) (Figure 53). Aggregating the Hilton Creek migrant capture data by week (Figure 54) indicated that there were more downstream migrants captured at the middle and end of the migration season than at the beginning (i.e., smolts); upstream capture was more towards the beginning of the season (i.e., spawners). Out-migrants, especially after the March event, were predominantly smolts and were likely responding to an increase then decrease in flow, photoperiod (defined as the length of the day), seasonal ambient temperature increases, and a reduction in natural streamflow.

Salsipuedes Creek Migrant Traps: The Salsipuedes Creek traps were deployed for 137 days of the 153 day trapping season with a trapping efficiency of 89.5% (Table 7). The Salsipuedes Creek migrant traps were removed twice in February, once in March, and once in May for 2, 2, 11 and 1 days, respectively. Upstream (0.28 captures/day), downstream (1.45 captures/day), and total (1.74 captures/day) CPUE values for Salsipuedes Creek were higher compared to previous years likely due to favorable migration conditions (Table 8). CPUE values were greater in Salsipuedes Creek than in Hilton Creek, which has not been the case for several years. There were a total of 238 *O. mykiss* (39 upstream and 199 downstream) captured in the Salsipuedes Creek trap during the WY2011 migration season, which was the second highest number of captures since WY2001 (WY2006 being the highest at 248). Of the 238 total fish captured in Salsipuedes Creek, 209 (88%) of them were less than 200 mm in size. The timing of migrant captures indicated that more fish were observed during the first early morning check (06:00-10:00) and second late night check (21:00-01:00) than the late morning (10:00-14:00) and early evening (17:00-21:00) trap checks (Table 9). *O. mykiss* capture by week can be seen in Figure 55. A length-frequency distribution for upstream and downstream migrant captures (Figure 58**)** showed a dominance (95%) of smaller fish (<250 mm) with only a few larger fish comprised of anadromous steelhead.

A total of 39 upstream migrants were captured during the period, ranging in size from 82 mm (3.2 inches – first year *O. mykiss*) to 528 mm (20.8 inches – anadromous steelhead). Of the upstream migrants, 5 were identified as anadromous steelhead, and 3 were classified as potential LSYR lagoon steelhead based on length, girth, and coloration (Figure 59). The 5 anadromous steelhead ranged in size from 481 mm (18.9 inches) to 528 mm (20.8 inches). The first steelhead was captured on 1/24/11 and the last was captured on 4/10/11. The timing of these anadromous steelhead was similar to previous years with good winter and spring runoff (for example in WY2008 with the first fish caught on 2/24/08 and the last on 3/29/08). Suspected LSYR lagoon fish ranged in size from 242 mm (9.5 inches) to 315 mm (12.4 inches) and were assumed to have migrated from the LSYR lagoon based on their length, girth, and silvery coloration; a noticeable departure in appearance from a typical adult resident fish (Figure 59). The first of these fish was captured on 1/24/11 with the remaining two captured on 5/6/11. There were 10 upstream migrating pre-smolts suggesting the fish were holding in the creek before moving downstream. Of the upstream migrant captures, 3 were recaptures from downstream migrants caught at the Salsipuedes Creek trap.

There were 199 downstream migrant captures during the period ranging in size from 72 mm (2.8 inches, a first year fish) to 357 mm (14.1 inches) (Figure 60). Of the downstream captures, 15 of them were recaptures. All of the captured *O. mykiss* were small resident juveniles (1+ year fish), smolts leaving the basin, or a few resident adults. No out-migrating anadromous steelhead kelts were captured. 176 smolts were captured (102 smolts and 74 pre-smolts) that represented 88% of the total downstream migrants. This was the second highest smolt capture since WY2001 (WY2006 being the highest at 218). Of the 199 total downstream migrants captured, 183 (92%) were less than 200 mm. As observed in Hilton and seen in previous years the average smolt size increased as the season progressed (Figure 56). In January, the average smolt size was 107.1 mm (4.2 inches) and by May the average smolt size was 176.9mm (6.9 inches).

In general, flows in Salsipuedes Creek increase swiftly in response to rainfall events once the watershed is saturated. Early December rains saturated the basin and provided favorable runoff conditions well into June (Figure 2). Rainfall patterns in the Salsipuedes drainage can be independent of the rest of the Santa Ynez River watershed as precipitation is sometimes higher in the western tributary drainages than in the mainstem near Lake Cachuma and upstream. This can produce sufficient stream discharge to breach the berm at the LSYR lagoon, while the hydrograph for the rest of the Santa Ynez River watershed may show little change. This was exemplified in the 12/19/10 storm and subsequent opening of the lagoon on 12/20/10 where recorded daily average flows at the USGS Salsipuedes Creek gauge were high (281 cfs), yet relatively low at the USGS Solvang LSYR mainstem gauge (151 cfs) (Section 3.1). Because of the early wet weather and continued moderate-large rainfall events, the lagoon remained open through the rest of the water year due to upper basin and tributary flows. In Salsipuedes Creek, the most significant storm event of the WY2011 migration season occurred on 3/20/11 with a peak flow of 3,510 cfs requiring removing the migrant traps for 11 days.

Migration within Salsipuedes Creek was correlated with storm runoff with more captures occurring during the receding limb of a storm hydrograph (Figure 60). This was particularly evident with upstream migration, adult steelhead specifically. The greatest number of downstream migrating smolts were captured in March (69) and April (50) and comprise 68% of all smolt captures; 19 smolts captured in January, 29 in February, 9 in May, 0 in June (Figure 53). Between 4/21/11 and 4/29/11, there were 33 smolts captured (19%). Nearly all of the smolts were captured during the late evening check and first morning check, showing that smolt movement is predominately occurring at nighttime. Smolt captures trailed off in the beginning of May when flow conditions dropped below 10 cfs at the USGS Salsipuedes gage.

Comparison of Salsipuedes Creek and Hilton Creek Migrant Trapping Results: Salsipuedes Creek and Hilton Creek are two very different tributaries in terms of their size (Salsipuedes is an order of magnitude larger than Hilton), hydrology (rainfall and flow patterns, and hydrologic regime), land use (chaparral, 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; smaller watersheds have sharper recessional storm hydrographs), and 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 0.5 cfs during the dry season. Out-migrant *O. mykiss* in Salsipuedes Creek are most likely migrating to the ocean/lagoon whereas out-migrants from Hilton Creek could be moving to the ocean/lagoon (anadromous) or to the Long Pool and refuge habitat in the Hwy 154 Reach (residents).

The *O. mykiss* population between the two creeks exhibit differences in spawning time and habitat, rearing habitat, and over-summering characteristics (i.e., water quality). Hilton Creek has good habitat quality (refuge pools with structure and a mature riparian canopy) 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, limited pool habitat for over-summering, a predominance of fine sediment substrate, and high water temperatures in the lower portion of the creek (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 and anadromous 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 such as WY2011. 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 more pristine watershed with less human impact.

A comparison of migrant captures in WY2011 between Hilton and Salsipuedes creeks is presented in Table 10. Early storms created favorable migration opportunities throughout the basin beginning in early January 2011, particularly in Salsipuedes Creek which had a 300 cfs flow event on 1/2/11 that initiated an early smolt run compared to previous years. Comparing base flows during the migration season showed that Salsipuedes Creek had greater flow and higher peak flow throughout the period compared to Hilton Creek, and more *O. mykiss* captured moving downstream, particularly smolts, in Salsipuedes Creek.

Out-migrating smolts are traditionally first seen at Hilton Creek and continue to have some level of out migrating smolt until the end of the migration season in May (Figure 53). That was partially true in WY2011. Migrant traps were installed on both creeks on 1/6/11 with the first smolts captured in Salsipuedes Creek on 1/7/11. The first smolt captured in Hilton Creek was on 1/15/11. Salsipuedes Creek had more out-migrating smolts in January through April than in Hilton Creek, and the opposite condition was observed in May and June. Overall, Salsipuedes had 176 smolts out-migrants compared to 59 smolts from Hilton. The size of smolts were greater in Hilton Creek (141.5 mm-

160.7 mm) compared to Salsipuedes Creek (107.1 mm-150.6 mm) during January-March, but smaller than Salsipuedes in April (164.0 mm vs. 166.3 mm) and May (173.8 mm-176.9 mm) (Figure 56). March and April coincided with the greatest smolt movement in each creek with 38 being captured in Hilton and 119 being captured in Salsipuedes Creek.

Eight anadromous adult steelhead (5 ocean run and 3 potential LSYR lagoon fish) were observed in Salsipuedes Creek and one anadromous adult steelhead was captured in Hilton Creek, a Salsipuedes Creek recapture. That recaptured fish was initially captured going upstream at Salsipuedes Creek on 3/11/11 and measured 481 mm (18.9 inches). The fish was not recaptured going downstream and most likely migrated out in association with the 3/19/11 large storm event and proceeded to swim approximately 37 miles up the LSYR mainstem to Hilton Creek where it was recaptured on 4/1/11, a period of 21 days during which time the fish did not change size (Figure 61 and Table 11).

LSYR Mainstem Trap: The mainstem LSYR trap operated for 110 days in the 153 day trapping season with a 71.9% trapping efficiency (Table 7). The mainstem trap was removed for two 2-day periods in February due to high stormflows and a 39-day period in March (3/19/11 through 4/28/11) coinciding with the spill event. Traps were redeployed on 4/28/11 as flows approached 100 cfs. The number of captures was far less than at Hilton Creek partly due to high flows from the spill when traps were removed and historically less fish are observed at this site compared to the high number of migrants observed at Hilton Creek. Upstream, downstream, and total CPUE values were 0.04, 0.15, and 0.18 captures/day, respectively, which were low but not unexpected given the low migration rate observed at the LSYR mainstem trap since trapping began in WY2006 and the few number of functional trap days due to sustained high spill flow rates (Table 8). There were 20 migrant captures, 4 upstream and 16 downstream. As with the other two traps, more *O. mykiss* were captured during the first early morning check (06:00-10:00) and second late night trap checks (Table 9). No captures of *O. mykiss* occurred prior to the reservoir spilling and all recorded captures were in May once the traps were redeployed.

A total of 4 upstream adult migrants were captured between 5/3/11 and 5/25/11, ranging in size from 272-474 mm (10.7-18.7 inches) (Figure 62). All captures appeared to be resident *O. mykiss* based on size, coloration, and scale analyses. The two 5/3/11 captures were larger *O. mykiss* and were initially thought to be potential LSYR lagoon fish based on their appearance but after a careful analysis of their scales, it was determined that these fish were most likely Hwy 154 Reach *O. mykiss* that came downstream during the spill event and were migrating back upstream in May (Figure 63). Both of these fish showed evidence of spawning during the previous year (WY2010) located near the outer edge of the scale, while the Salsipuedes Creek capture showed nearly continuous growth throughout the scale with no spawning checks. Both mainstem captures exhibited relatively little growth after the last year’s spawning, indicating freshwater and not saltwater growth. Morphological comparisons show resident coloring on the LSYR mainstem fish and silvery coloring on the Salsipuedes Creek steelhead.

There were 16 downstream migrant captures from 5/1/11 through 5/29/11, 14 of which were classified as smolts or pre-smolts (Table 10). According to flow data recorded at the USGS Solvang gauge, movement of both upstream and downstream migrants occurred at flow rates between 66 cfs (5/1/11) and 16 cfs (5/29/11), which corresponded to the receding limb of the winter and spring hydrograph (Figures 2 and 64). All smolts were captured in May and the total number was higher than what was observed at either of the tributary trapping locations during the same month (Figure 53). As with other years where direct comparisons can be made of the average smolt size moving out of Salsipuedes, Hilton, and the LSYR mainstem traps, smolts captured in the mainstem trap are consistently larger than those captured in the tributaries, suggesting favorable growth conditions during the out-migration period of the year. The average smolt size in the mainstem was 180.1 mm (7 inches) which was several millimeters larger than smolts captured in either Hilton or Salsipuedes creeks (Table 10). On 5/25/11, a 376 mm (14.8 in) resident adult migrated upstream but was found dead (carcass) upstream of the trap site 2 days later likely due to heron predation from the observed injuries (Table 11 and Figure 65).

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 (spawning) surveys are typically conducted opportunistically once a month in the LSYR mainstem (Refugio and Alisal reaches) and tributaries (Salsipuedes, El Jaro (including Los Amoles and Ytias), and Hilton creeks) in the winter and spring within the reaches where access is permitted. WY2011 was a good year for potential anadromous steelhead migration within the LSYR basin as flows remained moderate in the mainstem and tributaries into the summer and the lagoon remained open throughout the spawning season. Survey results are presented for the tributaries in Table 12 and LSYR mainstem in Table 13. Over the entire spawning season, no redds were observed in the LSYR mainstem management reaches. On the other hand, there were many redds in the tributaries particularly the Salsipuedes Creek drainage (32); Quiota Creek watershed had 2 and Hilton Creek watershed had 7 for a total of 41 tributary redds.

Redd surveys began in mid-January as high December rainfall allowed for lagoon breaching and potential anadromous steelhead migration into the LSYR. No redds were observed in January throughout all of the regularly surveyed tributary reaches. On 2/2/11, the first 2 redds of the season were observed in Lower Salsipuedes Creek. The CPBS also observed redds in Hilton Creek (1), Quiota Creek (1), and Los Amoles Creek (8) during the remainder of February. One of the redds in Los Amoles Creek measured 7 feet in length indicating successful migration and spawning by at least one anadromous female adult steelhead.

March spawning surveys revealed 10 additional redds in El Jaro Creek, 3 on 3/3/11 and 7 on 3/9/11. One additional redd was documented on Quiota Creek in March. The large 3/19/11 storm most likely washed out the February through mid-March redds in lower

Salsipuedes Creek with few YOYs observed during the annual spring snorkel survey. Some of the redds observed in mid-January may have produced YOYs prior to the high flow events that occurred in March, but it is unclear if they were able to survive such high flow rates.

The CPBS continued spawning surveys in April and May and found additional redd building activity. There were 7 redds observed in April; 3 in Los Amoles Creek, 2 in El Jaro Creek, and 2 in Hilton Creek (Table 12). May redd surveys showed continued spawning activity with 10 additional redds observed in El Jaro Creek (3), Ytias Creek (3), and Hilton (4) creeks. It should be noted that one of the redds in El Jaro Creek measured 8 feet in length and one of the redds in Ytias Creek measured 5.7 feet in length. Both of these spawning sites were likely created by at least one anadromous female adult due to the size of the redd and the amount of coarse material disturbed within the redd site. The CPBS revisited both of these areas in the subsequent weeks and months and observed numerous YOYs in and around the redds.

LSYR mainstem redd surveys were conducted once a month in February, April, and May within the Refugio and Alisal reaches and no redds were observed. The February survey was conducted during low flows with numerous intact beaver dams. The April and May surveys were conducted during much higher flows since Bradbury Dam was continuing to spill after the 3/19/11 rain event. The CPBS noted the difficulty in accurately assessing spawning sites at these high flows, particularly during the April survey where flows at Alisal Bridge (LSYR-10.5) were approximately 200 cfs.

Snorkel surveys: CPBS conducted protocol snorkel surveys in 2011 during the spring, summer and fall within the LSYR mainstem and its tributaries. Standard and accepted single-pass snorkel survey protocols were followed (Hankin and Reeves, 1988). Snorkel surveys were delayed several weeks in 2011 due to the large spill event in the spring, subsequent high flows, and late spawning that was observed during redd surveys. The spring survey (June and July) recorded 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) evaluated 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) evaluated the results of over-summering *O. mykiss* and recorded the condition and population at the end of that period. For example, spring surveys are conducted at the end of the spring or beginning of the summer. Surveys are conducted across the same spatial extent and same level of effort 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, 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 addition, the CPBS continues to solicit landowner cooperation and gain access to new reaches, particularly when conducting tributary project performance evaluations within upstream tributary reaches.

Snorkel survey locations (Figure 66) within the LSYR mainstem were predominately pool habitats where the majority of *O. mykiss* reared during the dry season. However, in the tributaries the full suite of habitat types (pool, run, riffle, and glide) was snorkeled. The results of the surveys are broken out by 3-inch size classes of fish. The total number of *O. mykiss* observed during all three snorkel surveys is shown in Figure 67 with all survey dates shown in Tables 14 and 17 for the LSYR mainstem and its tributaries.

Mainstem: LSYR mainstem snorkel surveys were conducted during the spring, summer, and fall within the Hwy 154, Refugio, Alisal, and Avenue of the Flags reaches, as well as downstream of Avenue of the Flags Reach to Robinson Bridge near Lompoc (Cadwell Reach) (Figure 66). As high winter stream flows recede, *O. mykiss* retreat to habitats more suited for over-summering. Hence, spring surveys carefully locate all dry season rearing habitats for *O. mykiss* after wet season runoff and spawning (winter and spring). The summer and fall surveys then focus on those habitats with associated surveys in the habitats between to assure no fish were missed.

Hwy 154 Reach

Although the Hwy 154 Reach extends from the Stilling Basin (LSYR-0.0) to the Hwy 154 Bridge (LSYR-3.2), due to access constraints and the size of the Stilling Basin, the only areas snorkeled were within the Long Pool and the habitats below the Long Pool to the Reclamation property boundary (LSYR-0.5 to LSYR-0.7) (Figure 66 and Table 15). Water clarity was sufficient to conduct all three surveys; however, the CPBS noted an increase in turbidity during the fall survey. A large number of carp were observed in the Stilling Basin and the Long Pool and were thought to be the cause of 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 turbid during all three surveys with visibility less than 4 feet which compromised the ability of the divers to see and provide conclusive observations.

The annual snorkel survey results are shown in Figure 68 and Tables 15 and 16. The spring survey had 57 *O. mykiss* observed in this reach. The majority of the fish observed were juveniles with 44% within the 0-3 inch size category and 49% within the 3-6 inch size category. The summer survey resulted in 114 *O. mykiss* observed, with a decrease in the percentage of 0-3 inch size fish (29%) and an increase of 3-6 inch fish (61%). The fall survey was complicated by poor water clarity and the number of *O. mykiss* observed dropped from 114 in the summer to 34 in the fall. The majority of fish observed were within the 3-6 inch size category (85%).

Refugio Reach

The Refugio Reach extends from the Hwy 154 Bridge (LSYR-3.2) downstream to Refugio Bridge (LSYR-7.8) although from LSYR-3.2 to LSYR-5.0 (just upstream of the Meadowlark Crossing) is not snorkeled due to access limitations (Figure 66 and Table 15). There were 34 habitats snorkeled within the Refugio Reach during the spring, which included 26 pool and 8 run habitats (Tables 15 and 16) with 56 *O. mykiss* observed of which the majority were within the 3-6 inch size category (54%) (Figure 69). The CPBS surveyed 20 habitats (13 of which were pools) during the summer survey within the

Refugio Reach; 39 *O. mykiss* observed and only 15% of those fish were within the 3-6 inch size category, suggesting fish growth and more fish in larger size classes since the spring survey. Of significance was one particular fish in the 21-24 inch size category that was observed within the LSYR-7.2 pool, which was not observed by the CPBS during the spring survey. This fish appeared to be an anadromous adult steelhead, did not have an evident fin clip from a winter/spring trapping program sample, and was very lanky (spawned out) in appearance.

The same habitats were snorkel surveyed two months later during the fall survey and 25 *O. mykiss* were observed (Figure 70). A relatively even distribution of size classes was observed between 3 and 15 inches in length. The single potential anadromous adult steelhead that was observed during the summer survey was observed within the same habitat (LSYR-7.2) during the fall survey and remained lanky and lethargic in appearance.

Density of *O. mykiss* observed within the Refugio Reach were 19, 13 and 8 fish per mile during the spring, summer, and fall snorkel surveys, respectively. A decrease in population density was expected over the dry season as a greater than 50% attrition rate (the percentage decrease in number of observed *O. mykiss* between the spring and fall snorkel surveys) has been observed in 5 of the last 10 years.

<u>*Alisal Reach*</u>

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figure 66 and Table 15). In the spring, 27 habitats were surveyed within the Alisal Reach; 15 pools, 8 runs, 3 riffles, and 1 glide (Tables 15 and 16). A total of 38 *O. mykiss* were observed during the spring which included 2 YOYs in the 0-3 inch size category. Since these were the only YOY observed within both the Refugio and Alisal Reaches during the spring and the CPBS did not observe redds or spawning fish in these areas during redd surveys, it is likely that these fish had hatched in either Hilton Creek or the Hwy 154 Reach of the LSYR prior to the large spill event in March and moved downstream during the high flow event. The size category with the highest total in the spring was 12-15 inches, 13 of the 38 *O. mykiss* observed.

Summer surveys included 25 snorkeled habitats with 1 less pool and riffle compared to the spring survey (Figure 70 and Tables 15 and 16). The number of *O. mykiss* observed in the summer increased to 39, a gain of 1 fish. Aside from not observing the 2 YOYs (which may have moved or grown into a larger size class), the remaining size classes were consistent with the spring survey.

The same habitats were snorkeled in the fall as during the summer surveys and 36 *O. mykiss* were observed within the Alisal Reach (Figure 70). No fish smaller than 6 inches were observed, indicating successful growth of the smaller size classes previously observed. The number of *O. mykiss* observed between the spring and fall changed very little which was a departure from previous years and not typical of the normal attrition seen within the Alisal Reach.

Population densities of *O. mykiss* for the Alisal Reach remained consistent at 14, 14 and 13 fish per mile during the spring, summer, and fall snorkel surveys, respectively. The consistency throughout the dry season was not expected and was most likely due to high baseflows throughout the period from a wet year that sustained the habitats and kept the attrition rate at only 5% compared to an average of over 50% since 2001.

Avenue of the Flags Reach

The Avenue of the Flags Reach extends from Alisal Bridge (LSYR-10.5) down to the Avenue of the Flags Bridge (LSYR-13.9) (Figure 66 and Table 15). This reach includes a stretch of highly altered habitat where Buellflat, Granite, and other companies had historically mined river gravels but haven't been mining in the active channel for several years. Within the historical mining footprint, there was one large pool habitat that on occasion has over-summering *O. mykiss*.

The CPBS surveyed 29 habitats within the Avenue of the Flags Reach during the spring survey, which included 22 pools, 4 glides, and 3 run habitats (Figure 71 and Tables 15 and 16). There were 7 *O. mykiss* observed in the spring with 1 fish in the 3-6 inch size class, 1 fish in the 18-21 inch size class, and the rest were in between (Figure 72). The largest *O. mykiss* observed (18-21 inches) appeared to be an anadromous adult based on its silvery appearance and large caudal fin. It was found in the single large pool within the historic gravel mining operation. No fin clip was evident on the top of the caudal fin, indicating that the CPBS did not catch that fish during routine migrant trapping in the winter and spring.

There was a drop in the number of *O. mykiss* observed during the summer survey with only 4 fish observed. However, the single potential anadromous adult that was observed during the spring was detected during the summer in the same habitat. There was no change in the number of *O. mykiss* observed from the summer to the fall surveys.

Cadwell Reach

Within the LSYR mainstem below the Avenue of the Flags Bridge to Lompoc there are multiple sub-reaches (Sanford, Cadwell, Cargasacchi, etc.) (Figure 66 and Table 15). Since WY2011 was a wet year that included a late season spill event and LSYR mainstem flows persisted throughout the summer downstream to the Lompoc plain approximately 34 miles downstream of the dam (Figure 2, USGS Narrows gauge), those sub-reaches were snorkel surveyed.

Of all the sub-reaches snorkeled during the spring survey, 9 habitats were surveyed and only in the Cadwell sub-reach (LSYR-22.0-23.0) were *O. mykiss* observed (Figures 72 and Tables 15 and 16). Within that sub-reach, there was a deep pool approximately 13 feet deep that was formed in association with a bedrock shelf and contained 10 *O. mykiss* during the spring survey, 7 of which were 9-12 inches and 3 of which were 12-15 inches. Two additional but shallower pools upstream of the deep bedrock pool also contained a single 12-15 inch *O. mykiss* bringing the total for the sub-reach to 12.

The summer survey found *O. mykiss* only within the Cadwell sub-reach, but this time there were 23 *O. mykiss* within the deep Cadwell pool, an increase of 13 at this single habitat compared to the spring, and only 1 *O. mykiss* was upstream of that pool for a total of 24 fish observed. The fall survey found a total of 40 *O. mykiss* within the Cadwell sub-reach, 35 in the large pool and 5 within the two habitats upstream and all were between 9-18 inches in length. An explanation for the increase was uncertain beyond retraction of available habitats as the flows receded and that the water clarity improved and the amount of aquatic vegetation decreased making it easier to see the bottom of the pool. This was the first time *O. mykiss* had been observed over-summering in these habitats.

Tributaries: Tributary snorkel surveys were conducted in the spring, summer, and fall at all of the long-term monitoring locations within Hilton, Quiota, Salsipuedes, and El Jaro creek (Figure 66 and Table 17).

<u>Hilton Creek</u>

Snorkel surveys within Hilton Creek are conducted from the LSYR confluence upstream to the Reclamation property boundary, approximately 100 feet above the URP of the HCWS and a total distance of approximately 3,000 feet (Figure 66 and Table 18). Hilton Creek was divided into 6 reaches that corresponded to fluvial geomorphic breaks in the creek morphology. Because of the density of *O. mykiss* in the stream, supplemented HCWS flows, and short linear distance of the creek, all habitats within Hilton Creek are snorkeled and have been since the installation of the HCWS in 2001.

Spring, summer, and fall Hilton Creek snorkel surveys results were presented in Figure 73 and Tables 18 and 19. The CPBS counted 1,139 *O. mykiss* during the spring survey, with 736 (65%) of the fish falling within the 0-3 inch size category. The second and third highest size class category was in the 3-6 inch and 6-9 inch range, with 285 (25%) and 82 (7%) observed, respectively. The remaining fish observed were from larger size classes up to a maximum of 18-21 inches. 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. WY2011 was no exception with all of the YOYs observed in the spring. The summer survey saw a modest increase in *O. mykiss* numbers with 1,195 observed. The typical size shift that has been observed during previous years was seen, with a fall in 0-3 inch *O. mykiss* to 443, or 37% of the total. Fish in the 3-6 inch category accounted for 52% of the total fish observed, up from the 25% counted in the spring. The fall survey had a total of 1,147 fish, with nearly identical size class percentages as observed during the summer survey. The typical decrease in *O. mykiss* numbers observed between the spring and fall surveys did not occur in WY2011 as the fish count within Hilton Creek appeared to hold steady during all three surveys.

Population densities of *O. mykiss* for snorkeled reaches of Hilton Creek were 2,056, 2,157, and 2,070 fish per mile during the spring, summer, and fall snorkel surveys, respectively. The consistency throughout the dry season was to be expected due to steady baseflow conditions provided by the HCWS. Attrition rates since 2001 and the installation of the HCWS have averaged approximately 10%.

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 upstream to approximately 50 feet above Crossing 7 (Figure 66 and Table 17). This area normally remains wet during the dry season, particularly in years with high rainfall such as WY2011.

Snorkel surveys conducted in the spring resulted in 130 *O. mykiss* being observed of which 52% (68) were within the 0-3 inch size category (Figure 74 and Tables 18 and 19). This is a lower percentage of YOYs than what has been observed during previous spring surveys possibly due to large flows in March that washed out redds or displaced YOYs downstream with high stream discharge. *O. mykiss* within the 3-6 inch category made up a significant portion of the spring count at 46% (56). These were fish likely produced in WY2010. Six fish between 6-9 inches were also observed with no fish greater than 9 inches detected. The summer survey count was 167 *O. mykiss* which was an increase from the spring and the percentages of size classes shifted slightly to larger fish. This trend was also observed in the fall with 180 *O. mykiss* observed. It should be noted that 42 *O. mykiss* were removed from the Quiota Creek Crossing 2 Project prior to the summer survey that began in September and will be reported in the 2012 Annual Monitoring Summary. Those fish were relocated to pool and run habitats between Crossing 5 and Crossing 7, which were within routine snorkel surveyed reaches of Quiota Creek. The number of fish, size classes, and release locations were discussed in further detail in the Fish Relocation Report (CPBS, 2011a) that was sent to NMFS in September and the End of Project Report (COMB, 2012)**.** The increase in observed fish during the fall survey could be attributed to a reduction in the habitat extent within Quiota Creek that concentrated the fish in the remaining refuge habitats. Similar size classes were present from the summer survey, with 48% of the total within the 0-3 inch size class and 44% of the total within the 3-6 inch size class, suggesting growth rates are not comparable to Hilton Creek or the LSYR mainstem.

Quiota Creek population densities of *O. mykiss* for the snorkeled reaches were 1,182, 1,518, and 1,636 fish per mile during the spring, summer, and fall snorkel surveys, respectively. The increase was due to a reduction in the extent of available habitat as the wetted extent of the creek diminished over the dry season and fish took refuge in the snorkeled reaches. The increase in population density was unusual as in past years there has been a decrease with an approximate 49% attrition rate since 2001.

Salsipuedes Creek

Lower Salsipuedes Creek contains five reaches that are broken up by fluvial geomorphic break points. 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 (Figure 66 and Table 18).

Reaches 1 through 4 were surveyed only in the spring during WY2011, as poor visibility prevented accurate surveying in the summer and fall possibly due to extensive beaver activity. There were 176 *O. mykiss* observed during the spring survey with no YOYs observed (Figure 75 and Tables 18 and 19). This was unusual compared to previous spring surveys since monitoring began in the late 1990s. Equally remarkable was the number of larger *O. mykiss* observed specifically 116 (66%) fish within the 6-9 inch and 38 (22%) fish within the 9-12 inch categories. High stormflows in March most likely washed out redds and hatched out YOYs leading to the low number of 0-3 inch fish observed. Possibly higher baseflow conditions provided cooler water, a greater habitat extent, and more food supply that encouraged medium sized fish (6-9 and 9-12 inch) to remain in the system and not migrate to the ocean.

The water clarity remained good within Reach 5 of Salsipuedes Creek and surveys were conducted in the spring, summer, and fall. This relatively short reach tends to have less beaver activity compared to the sections further downstream and might be an explanation for the clearer water conditions. In the spring 82 *O. mykiss* were observed within Reach 5 (Figure 76). Only 1 *O. mykiss* in the 0-3 inch size class was seen, similar to what was observed within the downstream reaches of Salsipuedes Creek. Surveyors counted 39 fish (48% of the total) between 3-6 inches and 37 fish (45% of the total) between 6-9 inches, which were likely *O. mykiss* from a previous year's cohort. During the summer survey, there was a slight drop in *O. mykiss* totals down to 62. There was an increase in the percentage of 6-9 inch fish (65%) and a decrease in the percentage of 3-6 inch fish (26%), indicating successful growth during the spring to summer period. The fall survey total was 79 *O. mykiss*, a similar number to the spring survey. There was little attrition between the spring and fall periods which is a good indication of higher than normal baseflows and favorable over-summering conditions within this reach of Salsipuedes Creek.

Reach 5 population density for *O. mykiss* was relatively consistent during the spring, summer, and fall snorkel surveys with totals of 182, 138, and 176, respectively; an attrition rate of only 4%. Normally, the population density decreases over the dry season with attrition rates well over 50%.

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 (Figure 66 and Tables 17, 18, and 19). This is the regular survey reach that the CPBS visits each year and is part of the long-term dataset. Surveyors did not encounter poor visibility within this reach of El Jaro Creek.

The CPBS observed 56 *O. mykiss* during the spring survey of lower El Jaro Creek, of which only 2 (4%) were 0-3 inch fish (Figure 77). This was yet another indication of poor spawning production within the drainage, likely due to high flows in March. The majority of fish observed in the spring were 3-6 inches (73%), with the remaining fish within the 6-9 inch size class (23%). It is likely that the majority of *O. mykiss* observed in the spring within El Jaro Creek were progeny of the WY2010 cohort. The summer survey was nearly identical to the spring with 58 *O. mykiss* observed with a slight shift to the larger size classes with no YOYs, 66% (38) 3-6 inch category fish, and several fish falling within the 9-12 inch size class. The fall survey found 43 *O. mykiss* showing yet another shift upward with 49% (21) within the 3-6 inch size class and 44% (19) within the 6-9 inch size class. Although the total number of fish within El Jaro Creek dropped between the spring and fall survey, it appeared as though higher baseflows and cooler summer conditions allowed for good survival over the summer within the drainage.

Population densities for the snorkeled reaches of El Jaro Creek for *O. mykiss* were 160, 166, and 123 for the spring, summer, and fall snorkel surveys, respectively. That attrition rate of 23% was less than the average rate of 40% since 2001.

Other Fish Species Observed: There were many non-native species observed inhabiting the LSYR mainstem during the spring, summer, and fall snorkel surveys (Figures 78 and 79). Common were warm water game species that also inhabit Lake Cachuma and can wash downstream during spill events and then 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 include largemouth bass (*Micropterus salmoides*), three sunfish species including bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and redear sunfish (*Lepomis microlophus*), common carp (*Cyprinus carpio*), and two catfish species; the black bullhead (*Ameriurus melas*), and the channel catfish (*Ictalurus punctatus*). Bass, sunfish and catfish are known predators of *O. mykiss*, particularly the younger life stages of *O. mykiss*. Carp and catfish can stir up the bottom of the substrate and greatly increase turbidity. No introduced non-native predator fish were observed in any of the three tributary snorkel surveys, although the introduced arroyo chub (*Gila orcuttii*) and fathead minnows (*Pimephales promelas*) have been observed within Salsipuedes Creek.

Largemouth Bass: In WY2011 largemouth bass were the most numerous warm-water species observed during LSYR snorkel surveys (Figure 78). The spring survey within the Refugio and Alisal Reaches of the LSYR mainstem found relatively few largemouth bass, 12 within the Refugio Reach and 4 within the Alisal Reach. Flows within the LSYR mainstem during the time of the spring surveys were still between 10-20 cfs, and it is likely that many of the bass were still occupying shallow pool and run habitats that were not snorkeled.

Many largemouth bass were observed during the summer snorkel surveys with 221 bass recorded within the Refugio Reach and 213 bass observed within the Alisal Reach. By the end of summer, flows were lower and habitats had shrunk which promoted fish to congregate in the remaining refuge habitats. The fall survey saw a large increase in the number of bass in the Refugio Reach (622) and a small increase in the Alisal Reach (229) compared to the summer survey.

Sunfish Species: The number of sunfish observed during the spring snorkel survey was low in comparison to previous spring surveys in the Refugio (14) and Alisal (26) reaches (Figure 78). Summer survey results found 67 and 81 sunfish within the Refugio and Alisal reaches, respectively. The fall survey found an overall decrease in sunfish observed within the Refugio (38) and Alisal (50) reaches.

Catfish Species: The past few years have resulted in few catfish sightings within the LSYR mainstem. WY2011 was no exception as no catfish were detected within the Refugio and Alisal Reaches of the mainstem during all three snorkel surveys (Figure 79).

Carp: In WY2011, 52 carp were observed within the Refugio and Alisal reaches in the spring (Figure 79). In the summer and fall, 74 and 61 carp were observed within the same reaches, respectively. Hundreds of large carp in the Stilling Basin (LSYR-0.0) and Long Pool (LSYR-0.5) were easily observed from the dam crest during WY2011. However, their numbers were not tabulated within the Hwy 154 Reach due to poor visibility within the Stilling Basin and Long Pool.

3.6. Tributary Enhancement Project Monitoring

During every tributary enhancement project, biological monitoring is conducted per the BO (RPM 8) and project permitting requirements. This includes pre-project and post-project monitoring, as well as during construction site monitoring for *O. mykiss*, during which any fish present are re-located to outside of the project area, as well as monitoring water quality to assure there are no impacts to stream water being discharged downstream of the project area. No tributary enhancement projects were completed in WY2011 although the Quiota Creek Crossing 2 Project was started in September of WY2011 but completed in November of WY2012. That project will be reported in the 2012 Annual Monitoring Summary.

3.7. Additional Investigations

Genetic Analysis: Tissue samples from all of the migrant captures during WY2011 were sent to Dr. Carlos Garza of NOAA Southwest Science Center at UC Santa Cruz. The results are still forthcoming.

Beaver Activity: The North American Beaver (*Castor canadensis*) according to some of the literature was introduced into the Santa Ynez River system in the late 1940s (Hensley, 1946; Baker and Hill, 2003; CDFG, 2005). The presence of this species in the 1940s was initially scattered and isolated in a few areas within the LSYR mainstem.

Over time and with the increased amount of flow in the river since 2000 as a result of the target flow requirements of the 2000 BO, the number and spatial distribution of beavers and their dams have increased substantially throughout the LSYR mainstem. Once Lake Cachuma surcharged for the first time and the long-term target flow were initiated in 2005, beaver dams are now present in large numbers from the Bradbury Dam to the Narrows as well as portions of the LSYR mainstem downstream of the Lompoc Waste Water Treatment Plant near the Santa Ynez River lagoon. In addition, beavers now successfully inhabit the Salsipuedes/El Jaro Creek watershed and each year there are more beaver dams observed further upstream. Well established beaver dams can be of sufficient strength and breadth to remain in place during stormflows, and may create passage impediments and/or barriers for migrating fish during low to moderate flows.

Beaver dam and the associated ponds often change riffles and runs into pools that can lead to greater thermal heating of stream water, can retard downstream migrating of juvenile and adults, increase siltation, and crease ideal habitat for bass, catfish, and carp. Also, beaver dams can affect operational flows of the Fish Passage Supplementation Program, target flow releases, and downstream water right releases. For example, the challenges in meeting target flows at Alisal Bridge in WY2007 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 number, extent (size), and distribution (location) of beaver dams within the LSYR mainstem and tributaries below Bradbury Dam. This survey is conducted prior to the steelhead migration season.

In January of WY2011, the CPBS completed the LSYR mainstem beaver dam survey from the dam (LSYR-0.0) to just downstream of the Salsipuedes Creek confluence with the Santa Ynez River (approximately LSYR-34.4), except within the Hwy 154 Reach on the San Lucas Ranch (due to lack of access). Surveys were conducted over a three-day period between 1/24/11 and 1/26/11 (Figure 80). A total of 82 beaver dams were found within the LSYR mainstem below the dam, many of which were determined to be partial or complete barriers to migration during low to moderate flows. Several storms occurred in the watershed in December 2010 and LSYR mainstem flows were elevated on several occasions. The USGS gages recorded maximum flows of 1,756 cfs on 12/20/10 at the Narrows and 655 cfs on 12/19/10 at Solvang, yet many beaver dams prevailed and were recorded in the January 2011 survey. Only 5 beaver dams were found in Salsipuedes/ El Jaro Creek drainage, a significant reduction from 25 dams observed in WY2010 most likely due to peak discharge recorded at the USGS Salsipuedes gage of 687 cfs on 12/19/10 that washed out many dams.

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 WY2010 Annual Monitoring Summary. 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 WY2011. The rainfall (Table 20), runoff (Table 21), and water year type with the years Lake Cachuma spilled (Figure 81) are presented over the period for reference for this trend analyses. Summaries of the LSYR Fisheries Monitoring Program have been compiled for 1993-1997 (SYRCC and SYRTAC, 1997),1993-2004 (AMC, 2008), 2005-2008 (USBR, 2011), 2009 (USBR, 2012), and 2010 (USBR, 2013).

4.1. Are steelhead moving during the supplementation of migration flows? Yes. The Fish Passage Supplementation Program was successfully conducted and migrating *O. mykiss* were observed in WY2006 (RTDG and CPBS, 2007) and WY2010 (RTDG and CPBS, 2010). The Program was not implemented in WY2011 due to not meeting the established criteria prior to the reservoir spilling in March. The Real-Time Decision Group (RTDG), designated by the Adaptive Management Committee to oversee and assist Reclamation in implementing the monitoring program, met in December prior to the migration season to review the program's operational procedures. The RTDG communicated regularly throughout the migration season. The Fish Passage Account (FPA) and Adaptive Management Account (AMA) were filled when Lake Cachuma was surcharged for a second time on 5/27/11. A study is needed to determine if Passage Supplementation releases can function as intended given the current criteria and number and magnitude of LSYR beaver dams below Bradbury Dam.

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

By December 2011, eight tributary passage enhancement projects were completed within the LSYR basin: Salsipuedes Creek Highway 1 Bridge Fish Ladder, Salsipuedes Creek Jalama Road Bridge Fish Ladder, Hilton Creek Cascade Chute, El Jaro Creek Rancho San Julian Fish Ladder, Quiota Creek Crossing 6 Bridge, Cross Creek Ranch Fish Passage Project on El Jaro Creek, and Quiota Creek Crossing 2 Bridge as well as the HCWS which supplies water year round to Hilton Creek from Lake Cachuma (Tables 22 and 23, Figures 82-86). 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 48, 49, and 86). In addition, three bank stabilization and erosion control projects were completed on El Jaro Creek. Each of these projects listed above 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 0.68-1.09. Between WY2006 and WY2011, after installation of the HCWS and completion of the Cascade Chute Project, the range was 223 and 643 with a corresponding CPUE range of 1.59-5.79 (Table 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). Only one adult anadromous steelhead was observed at the Hilton Creek trap in WY2011, a recaptured Salsipuedes Creek steelhead, although others were observed downstream in the LSYR mainstem during routine spring, summer, and fall snorkel surveys. 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 WY2011, 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 22 and 23). 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 24 and 25). The total number of migrant captures between WY2006 and WY2011 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 are 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). In WY2011, 5 anadromous steelhead and 3 possible LSYR lagoon steelhead were observed in Salsipuedes Creek. 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 7 was funded and fixed in WY2012) remaining migration barriers on Quiota Creek, all of which are under design and will be systematically removed as funding becomes available (Tables 22 and 23). The passage enhancement project at Crossing 2 removed a partial barrier and opened up 3.4 miles of spawning and rearing habitat (Figure 86). Further monitoring in subsequent years will provide greater insight into the biological performance of this project and future projects along Quiota Creek, specifically at Crossing 2 (2011), Crossing 7 (2012), Crossing 1 (2013), and Crossing 0 (2014).

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

Yes. WY2011 was a spill year with a spill greater than 20,000 acre-feet; hence target flows were required at Hilton Creek (a minimum of 2 cfs), the Highway 154 Bridge (10 cfs), and Alisal Bridge (1.5 cfs) (Figures 2, 3, and 81). Reclamation met all target flows at all locations throughout WY2011. Because of the wet hydrologic conditions, no additional releases were made for the Alisal Bridge flow targets, which were satisfied through the combination of tributary inflows and releases for the Highway 154 targets. In fact, flows at Alisal Bridge were generally 4 to 6 times higher (6-9 cfs) than the required minimum flow of 1.5 cfs during the warmest months of the year (July through September). This was largely due to Reclamation releasing maximum target flows on top of a saturated basin that had experienced good spring rains. The CPBS also noted higher than normal baseflows within the LSYR tributaries during the dry season, which also contributed to higher flows within the LSYR mainstem.

Operational guidelines put into place in WY2007 have improved the operational success of meeting target flows at Alisal Bridge as required in the 2000 BO and will continue to evolve as knowledge is gained. No changes to the 1.5-cfs target flow guidelines are recommended based on WY2011 operations. Residual pool depths within habitats in the Refugio Reach and Alisal reaches of the LSYR mainstem were maintained throughout the year due to meeting target flows.

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 20), year type (Figure 81), and stream discharge (Table 21) provide background for the following trend discussion from WY2001 to WY2011. 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 portions of the LSYR mainstem, specifically the Hwy 154 Reach. The riparian corridor canopy within Hilton Creek is in the process of rapid development, and water temperatures continue to be ideal for *O. mykiss* over-summering conditions due to the lack of thermal heating with a closed and maturing riparian canopy from the URP to the confluence with the LSYR mainstem (Figure 87). The LSYR mainstem is still likely to experience greater thermal heating and extensive phreatophyte and algal growth because of limited riparian corridor canopy even though more and maturing riparian vegetation has been observed in the Refugio and Alisal reaches since target flows to Alisal Bridge (Figures 26, 45, and 46).

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 the BO, much of those reaches had no flow or low flow likely 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, specifically the Hwy 154 Reach, 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 streams have been predominantly of the resident life-history form due to migration barriers downstream. Now that all of the barriers within the Salsipuedes Creek 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 ten original barriers located within Quiota Creek are systematically being removed and an incremental increase of anadromous fish is expected as barriers are eliminated.

Prior to BO target flows, the distribution of *O. mykiss* within the LSYR mainstem was mainly confined to the Hwy 154 Reach (LSYR-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, WY2008, and WY2011, which triggered mandatory target flows from WY2001 to WY2002, WY2005 to WY2009, and WY2011 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 81) (NMFS, 2000). From WY2005 to WY2011, *O. mykiss* have been observed during all three snorkel surveys within the Refugio and Alisal reaches of the LSYR mainstem, not always in the same habitats or number of habitats, although the ultimate fate of the observed fish was unknown (Table 26).

Analysis of the total upstream and downstream migrant captures at the Salsipuedes, LSYR mainstem, and Hilton Creek traps from WY2001 through WY2011 provides a comparison of the number of captures within the LSYR basin across the three trapping locations (Table 24 and Figure 88). 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. Trapping efficiency for WY2011 was relatively high at Salsipuedes and Hilton Creek (89.5 % and 91.5%, respectively) with a long-term average (WY2001-WY2011) of 90.0% and 92.0%, respectively. Long-term average trapping efficiency at the LSYR mainstem site in WY2006 and WY2008-WY2011 was 86.0% with lower efficiencies due to the lengthy spill events from Bradbury Dam in WY2006, WY2008, and WY2011 when the traps were removed. The CPUE values were highest within Salsipuedes Creek in WY2011, with 1.74 captures per day. Hilton Creek ranked a close second with 1.59 captures per day. Long-term CPUE averages at Salsipuedes and Hilton creeks were 1.08 and 2.23, respectively. The CPUE values in Hilton Creek tend to be higher than at Salsipuedes Creek and the LSYR mainstem sites due to a higher population density since WY2006. WY2011 was unusual in that the CPUE for Salsipuedes Creek (1.74 captures/day) was higher than observed at Hilton Creek (1.59 captures/day) since WY2006.

The total number of upstream and downstream fish captured (Figure 88) within Hilton Creek ranged from 52 to174 with an average of 90 during the period of WY2001 through WY2005. That range increased to 223-643 captures with an average of 400 during the period of WY2006 through WY2011; the change being associated with the completion of the Cascade Chute Project and continuous HCWS releases from the URP. The increase in captures at Hilton Creek suggests that management actions by Reclamation have improved instream and over-summering conditions within this drainage. Although the trapping data show a general upward trend at Hilton Creek, there is no particular discernible pattern at the other two trapping sites. WY2010 had the most mainstem captures (30) since the LSYR migrant traps were first deployed in WY2006.

The total number of smolt captures at all three traps has been relatively consistent from WY2007 through WY2010, ranging from 134 to 140, but with spikes in the total number in WY2006 and WY2011 (Figure 89). Since the installation of the HCWS in WY2001, there has been 718 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 has been a large increase in the number of observed smolts in Hilton Creek since 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. The total of smolt out-migrating at Salsipuedes Creek was higher during wet years than normal or dry years; specifically in averaged values 116, 83, and 49 captures, respectively, since WY2001. WY2011 was the second highest smolt count at 249; WY2006 recorded 446 smolts. There is less of a correlation with Hilton Creek smolt production and year type (wet, normal, or dry) because it is not subject to natural ambient flow conditions such as Salsipuedes Creek. For example, there were only 2 smolts observed in Salsipuedes Creek and 138 smolts observed in Hilton Creek in WY2007 (a dry year), illustrating how important streamflow is regarding the number of smolts observed (Figure 89).

Anadromous steelhead captures from WY2001 to WY2011 did not show a corresponding upward trend with the increase in smolt production across the period (Figure 89). 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. As an example, WY2011 had 9 steelhead (5 ocean run, 3 lagoon, and 1 recapture) observed that were possibly WY2008 and WY2010 cohorts. Ocean conditions impacting anadromous adult returns were not known.

WY2008 and WY2011 were two recent wet years with heavy runoff and good migration conditions where anadromous adults were captured, particularly in the upstream traps during the receding limb of storm hydrographs (Figure 90). Although the two years were similar in stream discharge characteristics, the anadromous steelhead caught were quite different between the two years. WY2008 fish were larger, caught at all three trapping locations, and were only caught during February and March; no recognizable LSYR lagoon fish were observed. The WY2011 fish were relatively small, 3 were possibly LSYR lagoon fish, were captured at only two trap sites, and one went up Salsipuedes only to be recaptured 21 days later at the Hilton Creek trap approximately 37 miles upstream. The difference between those two years could be attributed to a shorter time period in the ocean or less ocean productivity. Awaited genetics analyses from the NOAA Southwest Fisheries Science Center should provide some insights in the origin and life-history strategy of those fish.

Looking at migrant captures from WY2001 to WY2011 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 91-93). 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 in the LSYR basin 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 94). Hilton Creek tends to produce smolts every year due to continuous streamflow from the HCWS. Whereas the number of smolts observed 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 annual flow regime with 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 depending on streamflow (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 and a return to that pattern in WY2011 (Figure 95 and Table 25). During WY2009 and WY2010 there were fewer larger fish observed possibly due to the severity of the dry year in WY2009 that may have resulted in more difficult survival conditions for larger than smaller fish. The increase in migrating adults prior to WY2009 and in WY2011 was 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*. In general, the overall numbers of observed *O. mykiss* decrease in both Salsipuedes and Hilton creeks over the dry season.

The total number of *O. mykiss* observed during the spring, summer, and fall snorkel surveys from WY2001 through WY2011 showed a general trend upward across wet years and a decrease during the dry years (Table 26). WY2010 (classified as a wet year) was the exception, particularly within the LSYR mainstem although there were two passage supplementation releases that year that likely enabled *O. mykiss* to move downstream for a longer period of the migration season (Figures 96 and 97). WY2011 had higher numbers of *O. mykiss* observed in the Refugio and Alisal reaches and Quiota Creek than during WY2010; Hilton and Salsipuedes creeks were lower than during WY2010 possibly due to high stormflows that washed out redds and moved fish out of the system.

Hilton Creek (Figure 98 and Table 26) had an increase in the overall number of *O. mykiss* 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 WY2011 in Quiota Creek (Figure 99), Salsipuedes Creek (Figure 100), and El Jaro Creek (Figure 101) 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; average attrition rate since 2001 is approximately 49%. 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 in Salsipuedes Creek was the only consistently snorkeled stretch of the stream due to the lack of beaver activity. Spring snorkel surveys within Salsipuedes Creek (Reach 5) and El Jaro Creek showed relatively low numbers of *O. mykiss* for a wet year, 82 and 56, respectively, likely due to the extremely high flow event that occurred in the middle of the spawning season. Counts of *O. mykiss* in WY2011 were lower and more representative of a dry year, possibly due to high wet season flows that washed many fish downstream.

Hilton Creek has been divided into 6 reaches by geomorphologic breaks (Figure 101). 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 was likely due to some attrition, predation, and downstream dispersal out of the Hilton Creek basin into the LSYR mainstem. There was a distinct upward size shift in the fish observed during the snorkel surveys indicating excellent rearing conditions throughout the creek (Figure 102). Data from WY2001 to WY2011 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 27). Impacts to *O. mykiss* from invasive species within the LSYR mainstem, particularly piscivorous fish, needs further study.

4.5. Status of 2010 Annual Monitoring Summary 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 2010 Annual Monitoring Summary by Reclamation to improve the monitoring program pending available funding:

- 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.
    - Status: This recommendation is being followed and is ongoing.

- 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.

    - Status: CPBS has initiated discussions with CDFW, NMFS, other Southern California Steelhead DPS monitoring groups to consider a collaborative DIDSON monitoring effort due to the high instrumentation and training costs. This investigation is ongoing.

- 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.
    - Status: A more systematic water quality monitoring program is being followed and this recommendation is ongoing.

- 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.
    - Status: This recommendation is being followed and is ongoing.

- 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.
    - Status: This recommendation is being followed and is ongoing.

- 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.
    - Status: This recommendation is being followed and is ongoing.

- The AMC should be convened to address the potential effects to *O. mykiss* from beavers and beaver dams as well as warm water predatory fish species within the LSYR basin. Based upon the AMC's recommendations, Reclamation shall determine and implement future studies and actions needed.
    - Status: This recommendation was not addressed but should carry forward to next year given the importance of the suggested investigations.

- Complete the Annual Monitoring Summary 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.
    - 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 Summary.
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS to improve our collective knowledge, collaboration, and dissemination of information.
    - Status: Collaborative relationships continue to be developed between CPBS and fisheries biologists working on the Ventura River, Santa Clara

River, Carpinteria Creek, Topanga Creek, and Malibu Creek. These relationships should continue to be developed particularly in the areas of sharing data, monitoring techniques, data analyses, and restoration ideas.

5. Conclusions and Recommendations

WY2011 was a very wet year with rainfall totaling 31.09 inches at Bradbury Dam and Lake Cachuma spilling 85,755 af over 53 days (3/20/11 – 5/13/11). There was sufficient precipitation in December to saturate the LSYR basin and produce sufficient runoff to breach the LSYR lagoon and provide ocean conductivity throughout the rest of the water year. A large storm in March caused the lake to spill and late season rains in May facilitated relatively high baseflow conditions well into the summer. No passage supplementation for fish migration or WR 89-18 releases was conducted. Water quality conditions remained acceptable for *O. mykiss* in many habitats with fish for over-summering as observed by high survival rates over the dry season most likely due to elevated baseflow conditions.

WY2011 was the second highest year since WY2001 in the number of out-migrating smolts (249) and fifth highest in total migrant captures (481) of *O. mykiss* at the three trapping locations within the LSYR basin. Five anadromous steelhead and 3 possible lagoon steelhead were captured at the Salsipuedes Creek trap; one of those fish was caught 21 days later at the Hilton Creek trap approximately 37 miles upstream. No *O. mykiss* were injured or perished due to the trapping operation and one *O. mykiss* carcass was found upstream of the LSYR mainstem site with apparent heron wounds to the head.

Redd or spawning surveys showed active spawning in the tributaries (41 redds in Salsipuedes/El Jaro, Quiota, and Hilton creeks), but spring snorkel surveys did not reflect a high level of reproduction success in Salsipuedes and El Jaro creeks, possibly due to high flow events washed out or displacing spawning sites . Snorkel survey *O. mykiss* counts in Hilton Creek were similar to WY2010 and slightly higher than WY2010 in Quiota Creek. The Refugio and Alisal reaches of the LSYR mainstem showed a modest increase in oversummering *O. mykiss* in WY2011 compared to WY2010, although the ultimate fate of the observed fish was unknown.

Monitoring tributary and LSYR mainstem populations 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 changes to the population, as restoration efforts are completed and adaptive management actions are realized. Collaboration with other local monitoring programs within the Southern California Steelhead DPS is desirable to better understand population viability and restoration potential at a regional scale.

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 BA (NMFS, 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.
- Further investigate utilizing Dual-Frequency Identification Sonar (DIDSON) technologies as a potential solution for monitoring migrants during high flow conditions when our current/conventional traps need to be removed. Look for partners for this monitoring effort given the high cost of a DIDSON operation. 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.
- Continue monthly lake water temperature and dissolved oxygen profiles at the HCWS intake barge from April through December to consistently monitor Lake Cachuma water quality conditions to depth particularly at the intake hose elevation of 65 feet for the HCWS.
- Continue to improve photo-point documentation by systematically taking data, adding sites associated with completed restoration projects, and improving exact site locations and photo cataloging methods to best record changes in habitat features such as channel form and riparian habitat.
- Continue to evolve the use of seasonal field biologists to maximize their utility specifically in the area of data entry, equipment repair, and general logistics of the overall monitoring program.
- Continue to develop the LSYR *O. mykiss* scale inventory and analyses of growth rates, evidence of life-history strategies such as fresh vs. marine water, signs of spawning, etc. in support of ongoing fisheries investigations.
- Install temperature probes/loggers on the outlets of Bradbury Dam to measure water temperature of releases from the outlet works for documentation and management.
- Monitor LSYR temperature downstream of the Stilling Basin before the Hilton Creek confluence for comparison of recorded values in lower Hilton Creek.
- Engage local landowners to implement ways to reduce cattle impacts to tributary habitats on private lands within the LSYR basin.
- The AMC should be convened to address the potential effects to *O. mykiss* from beavers and beaver dams as well as warm water predatory fish species within the LSYR basin. Based upon the AMC's recommendations, Reclamation should determine and implement future studies and actions needed.
- Develop and implement a monitoring program for the Santa Ynez River lagoon that would be reviewed and approved by the AMC.
- 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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USBR. 2013. 2010 Annual Monitoring Summary and trend analysis. Prepared for the National Marine Fisheries Service by the Cachuma Operation and Maintenance Board for USBR, U.S. Bureau of Reclamation (USBR).

WY2011 Annual Monitoring Summary
Results
Figures and Tables

3. Monitoring Results

Table 1: WY2000 to WY2011 rainfall at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Water Year	Rainfall Bradbury* (in)	Year Type**	Spill	Reservoir Condition Storage (max) (af)	Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.50	Normal	Yes	192,948	750.83	No	Yes
2001	31.80	Wet	Yes	194,519	751.34	No	No
2002	8.80	Dry	No	173,308	744.99	No	Yes
2003	19.80	Normal	No	130,784	728.39	No	No
2004	10.60	Dry	No	115,342	721.47	No	Yes
2005	44.41	Wet	Yes	197,649	753.11	No	No
2006	24.50	Wet	Yes	197,775	753.15	Yes	No
2007	7.40	Dry	No	180,115	747.35	No	Yes
2008	22.59	Wet	Yes	196,365	752.70	No	No
2009	13.66	Dry	No	168,902	743.81	No	No
2010	23.92	Wet	No	178,075	747.05	Yes	Yes
2011	31.09	Wet	Yes	195,763	753.06	No	No

* Bradbury Dam rainfall (Cachuma) period of record = 58 years (1953-2011) with an average rainfall of 20.7 inches.

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

Table 2: WY2011 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed (source: County of Santa Barbara and USBR).

Location	Station	Initial Year	Period of Record	Long-term Average	Minimum Rainfall		Maximum Rainfall		Rainfall (WY2011)
	(#)	(date)	(years)	(in)	(in)	(WY)	(in)	(WY)	(in)
Lompoc	439	1955	57	14.87	5.31	2007	34.42	1983	26.75
Buellton	233	1955	57	17.31	6.3	2007	41.56	1998	21.26
Solvang	393	1965	51	19.26	6.47	2007	43.87	1998	26.41
Santa Ynez	218	1951	61	16.21	6.58	2007	36.36	1998	26.34
Cachuma*	USBR	1953	59	20.60	7.33	2007	53.37	1998	31.09
Gibraltar	230	1920	92	26.94	9.24	2007	73.12	1998	38.99
Jameson	232	1926	86	29.58	8.5	2007	79.52	1969	39.40

* Bradbury Dam USBR rainfall.

Table 3: (a) Storm events greater than 0.1 inches and (b) monthly rainfall totals at Bradbury Dam during WY2011. Dates reflect the starting day of the storm and not the storm duration.

(a)

#	Date	Precipitation (in.)
1	10/6/2010	0.80
2	10/19/2010	0.38
3	10/25/2010	0.10
4	10/30/2010	0.82
5	11/8/2010	0.26
6	11/20/2010	1.08
7	12/6/2010	0.59
8	12/17/2010	7.22
9	12/26/2010	0.63
10	12/29/2010	0.95
11	1/6/2011	1.58
12	1/31/2011	0.24
13	2/17/2011	2.58
14	2/26/2011	0.68
15	3/3/2011	0.28
16	3/19/2011	11.49
17	5/17/2011	0.32
18	6/5/2011	0.34

(b)

Month	Rain (in.)
October-10	2.24
November-10	1.42
December-10	9.48
January-11	1.84
February-11	3.36
March-11	11.85
April-11	0.14
May-11	0.42
June-11	0.34
July-11	0.00
August-11	0.00
September-11	0.00
	31.09

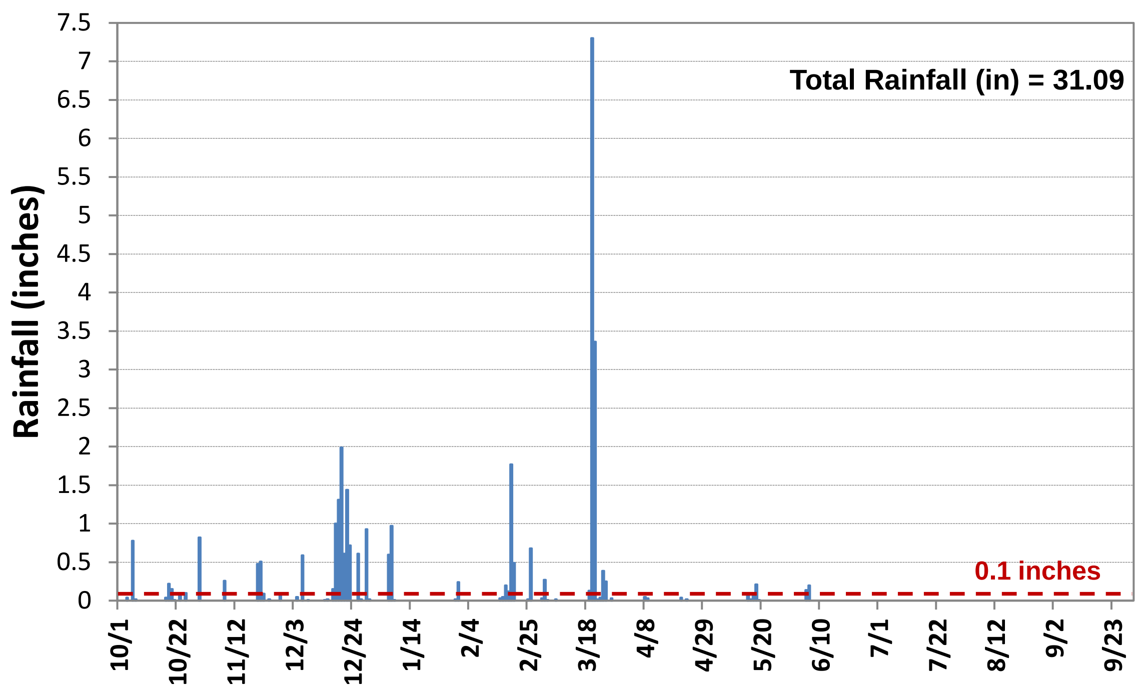


Figure 1: Rainfall in WY2011 recorded at Bradbury Dam (USBR).

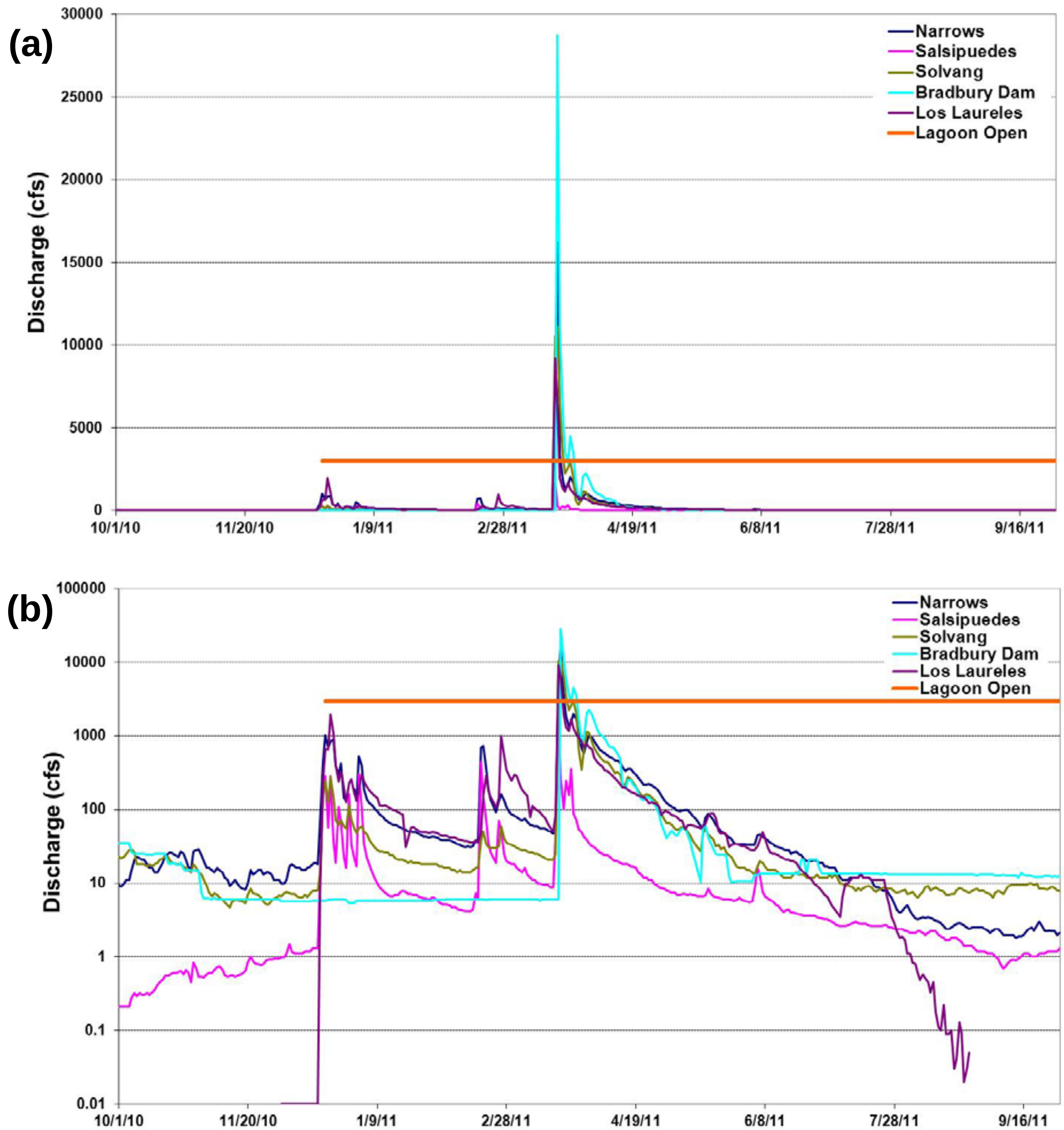


Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open in WY2011 with a (a) normal and (b) logarithmic distribution.

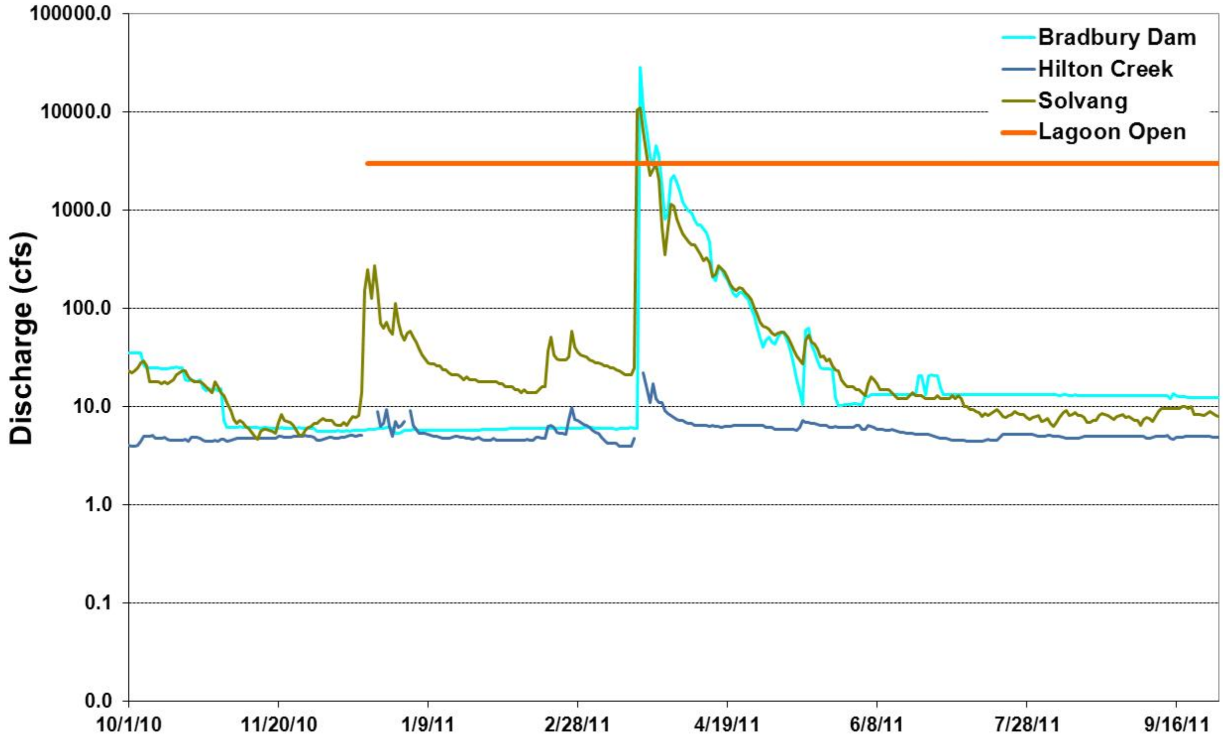


Figure 3: USGS average daily discharge at Hilton Creek just below the Upper Release Point, the LSYR mainstem at Alisal Bridge and from Bradbury Dam during WY2011. Duration of ocean connectivity (Lagoon Open) at the lagoon is also shown. The Hilton Creek gauge is a low flow gauge and hence does not record much above 50 cfs.

Table 4: Ocean connectivity, lagoon status and number of days during the migration season from WY2001 to WY2011.

Water	Year	Ocean	Lagoon Status			# of Days Open in
Year	Type	Connectivity	Open	Closed	# of Days	Migration Season*
2001	Wet	Yes	1/22/01	5/10/01	109	109
2002	Dry	No	-	-	0	0
2003	Normal	Yes	12/21/02	5/9/03	150	140
2004	Dry	Yes	2/26/04	3/22/04	26	26
2005	Wet	Yes	12/28/04	5/20/05	144	141
2006	Wet	Yes	1/3/06	-	271	151
2007	Dry	Yes	-	11/22/06	52	0
2008	Wet	Yes	1/6/08	5/19/08	134	134
2009	Dry	Yes	2/16/09	3/17/09	30	30
2010	Wet	Yes	1/0/00	1/0/00	0	107
2011	Wet	Yes	12/20/12	-	285	264
*Migration Season is January through May.						

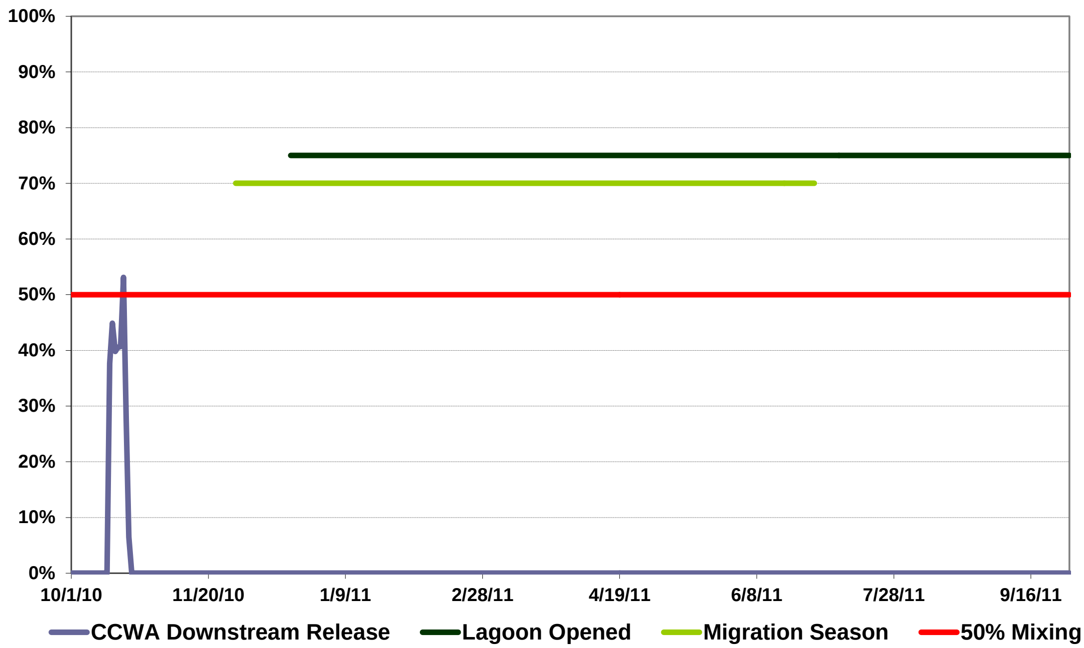


Figure 4: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the WY2011 migration season.

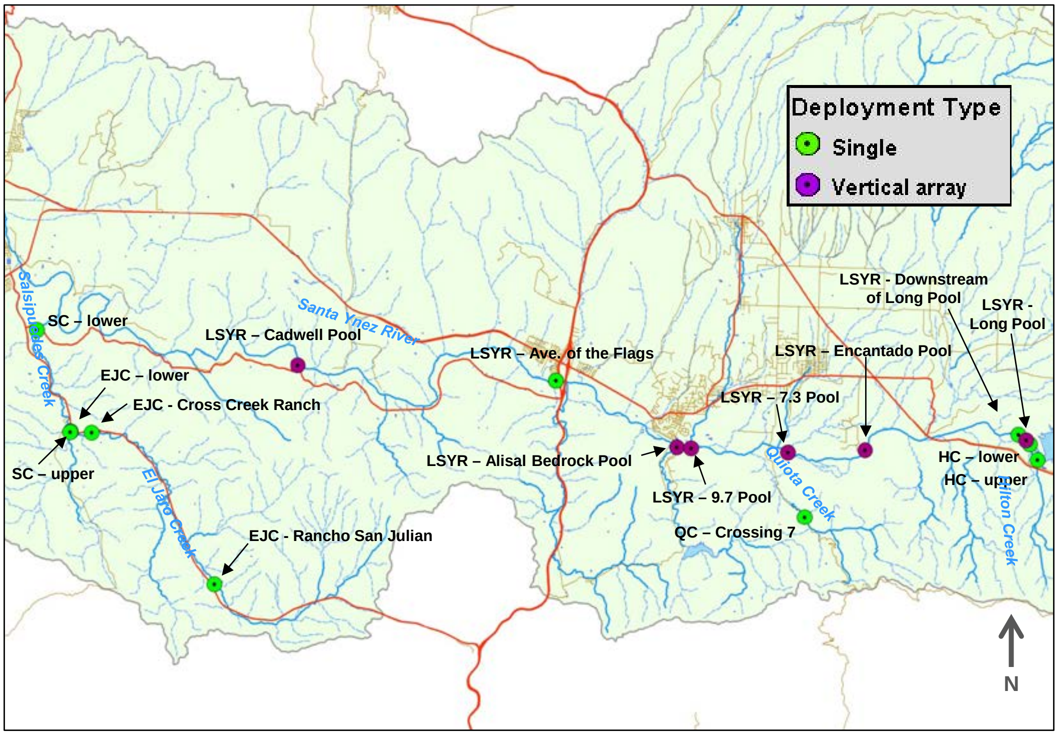


Figure 5: Thermograph single and vertical array deployment locations in WY2011 within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are very close together with overlapping symbols.

Table 5: 2011 thermograph network locations and period of record listed from upstream to downstream.

	Location Name	Stream ID	Type	Deployment Date	Retrieval Date	Period of Record (days)
Mainstem	LSYR - Long Pool	LSYR-0.51	Vertical Array	5/3/2011	11/11/2011	188
	LSYR - Downstream of Long Pool	LSYR-0.68	Single	5/3/2011	11/11/2011	188
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	6/8/2011	11/8/2011	150
	LSYR - 7.2 Pool	LSYR-7.2	Vertical Array	6/8/2011	11/8/2011	150
	LSYR - 9.7 Pool	LSYR-9.7	Vertical Array	6/10/2011	11/8/2011	148
	LSYR - Alisal Bedrock Pool	LSYR-10.2	Vertical Array	5/3/2011	11/10/2011	187
	LSYR - Avenue of Flags Pool	LSYR-13.9	Single	5/2/2011	11/9/2011	187
	LSYR - Cadwell Pool	LSYR-22.8	Vertical Array	7/19/2011	11/9/2011	110
Tributaries	Hilton Creek (HC) - upper	HC-0.54	Single	5/3/2011	11/11/2011	188
	HC - lower	HC-0.12	Single	5/2/2011	11/11/2011	189
	Quiota Creek (QC) - Crossing 7	QC-2.71	Single	5/2/2011	11/9/2011	187
	Salsipuedes Creek (SC) - upper	SC-3.8	Single	5/2/2011	11/7/2011	185
	SC - lower	SC-0.77	Single	5/2/2011	11/7/2011	185
	El Jaro Creek (EJC) - R. San Julian	EJC-10.82	Single	1/1/2011	12/10/2011	339
	EJC - Cross Creek Ranch	EJC-4.53	Single	1/1/2011	12/10/2011	339
	EJC - lower	EJC-3.81	Single	5/2/2011	11/7/2011	185

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

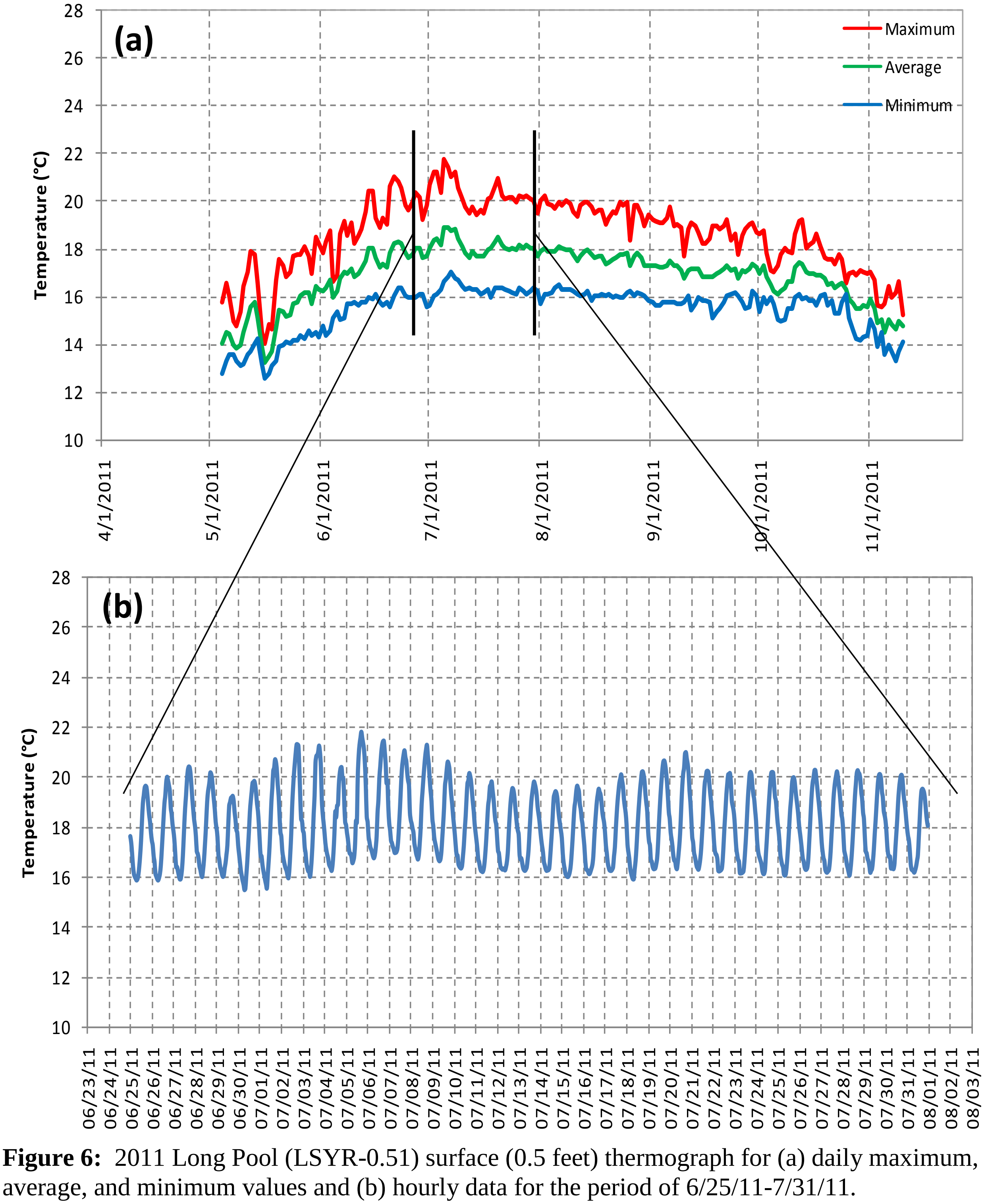


Figure 6: 2011 Long Pool (LSYR-0.51) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 6/25/11-7/31/11.

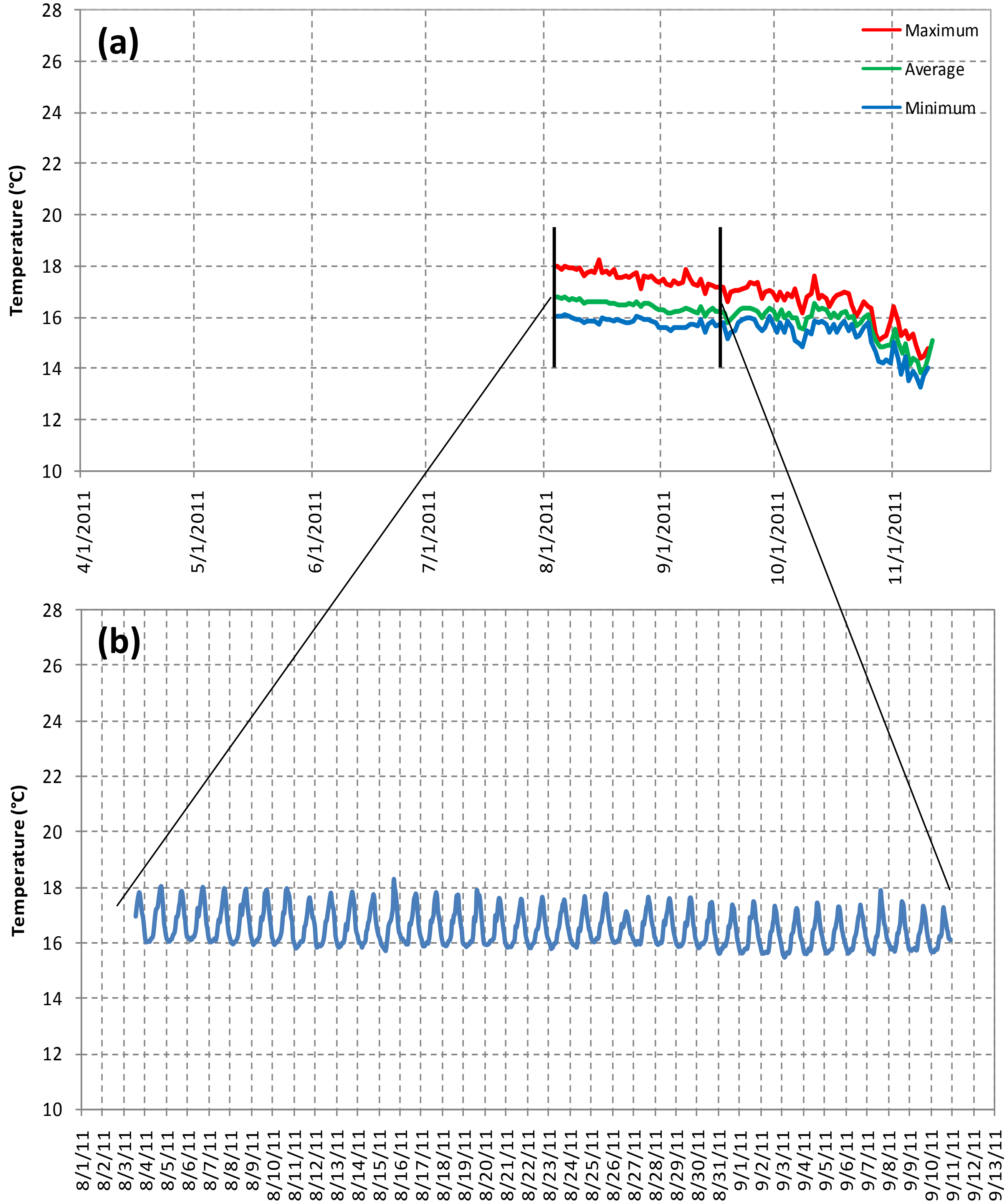


Figure 7: 2011 Long Pool (LSYR-0.51) middle (4.5 foot) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 8/3/11-9/11/11.

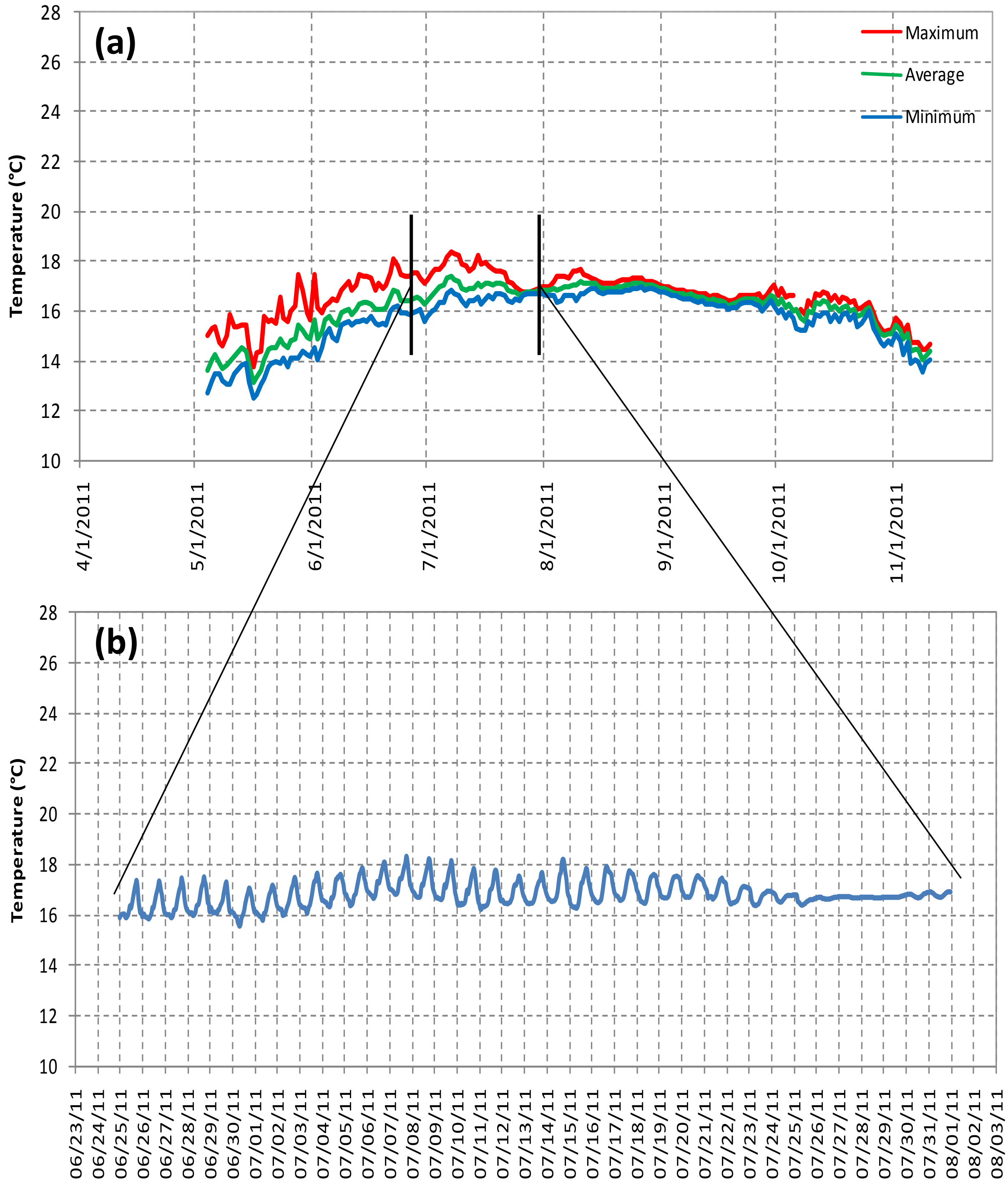


Figure 8: 2011 Long Pool (LSYR-0.51) bottom (8.5 foot) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 6/25/11-7/31/11.

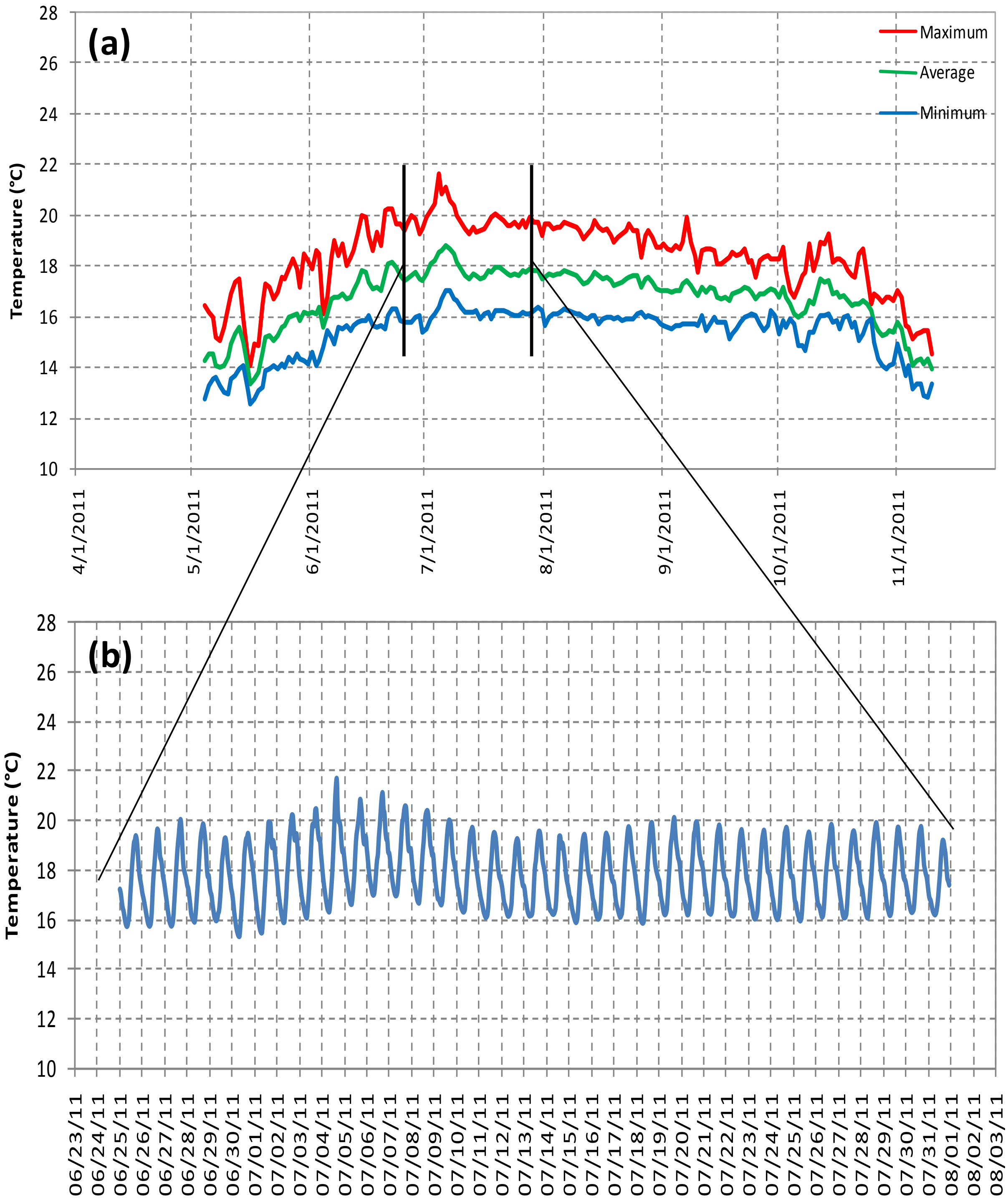


Figure 9: 2011 Reclamation property boundary downstream of the Long Pool (LSYR-0.68) bottom (1.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 6/25/11-7/31/11.

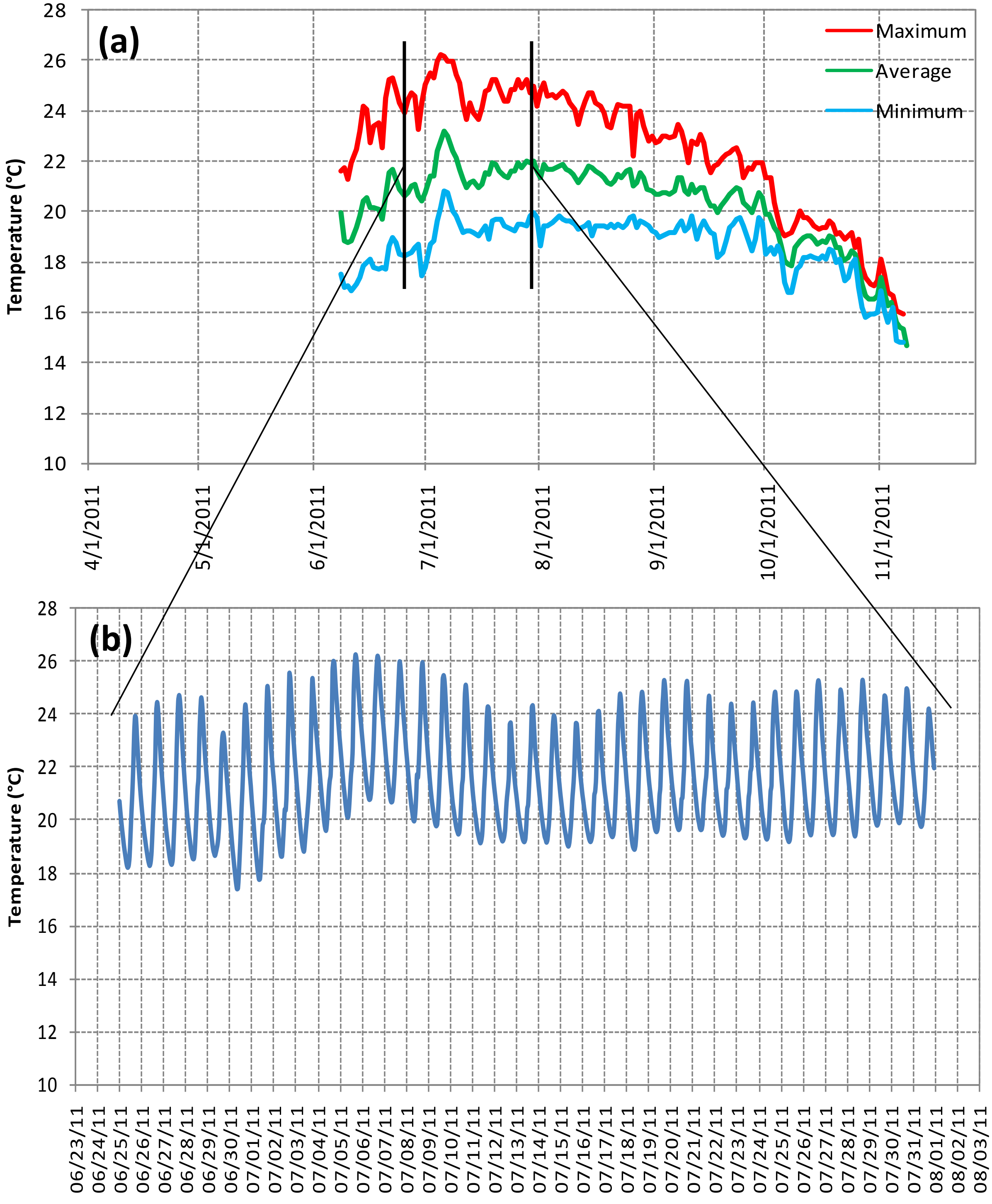


Figure 10: 2011 Encantado Pool (LSYR-4.95) surface (2.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/11-7/31/11.

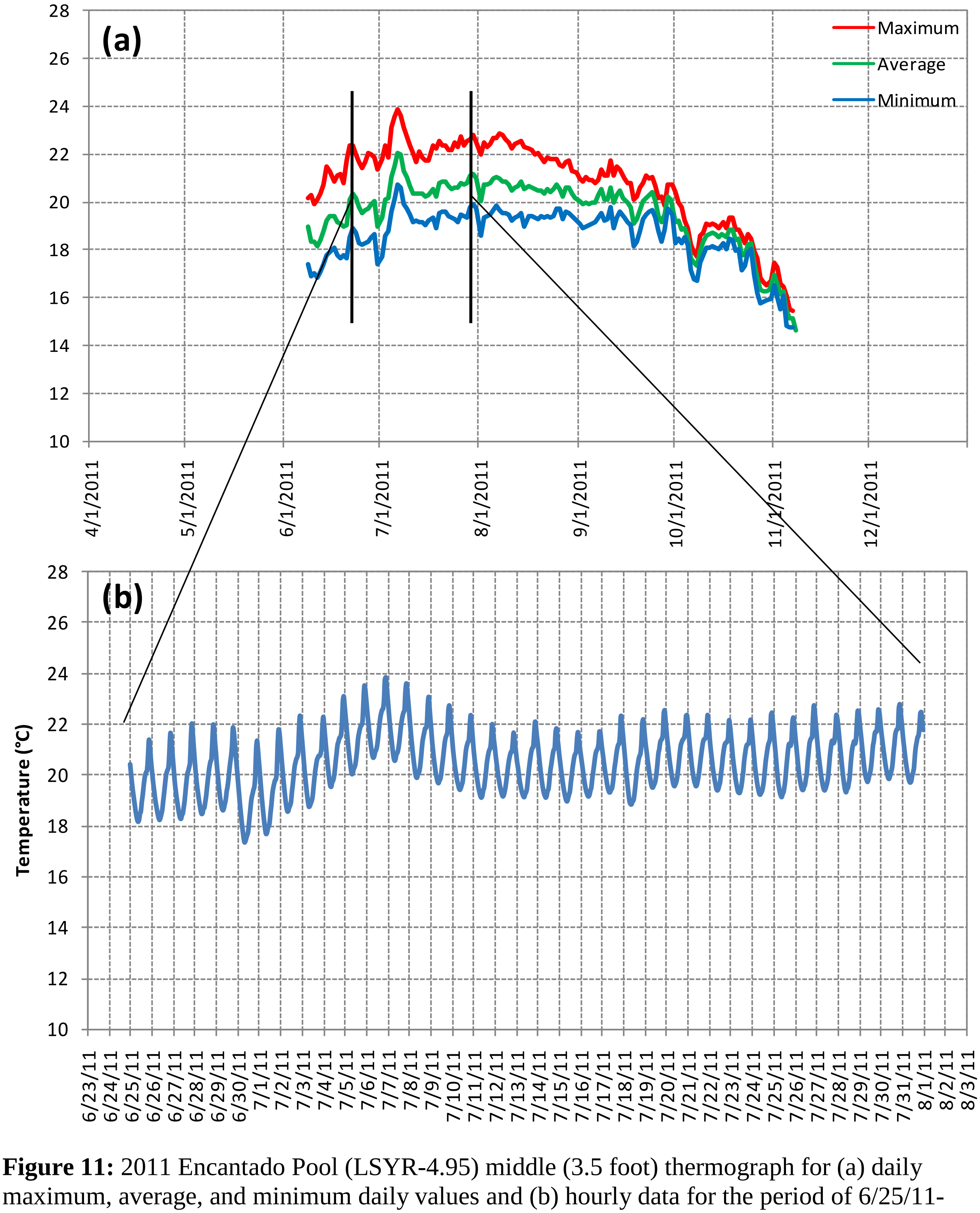


Figure 11: 2011 Encantado Pool (LSYR-4.95) middle (3.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/11-7/31/11.

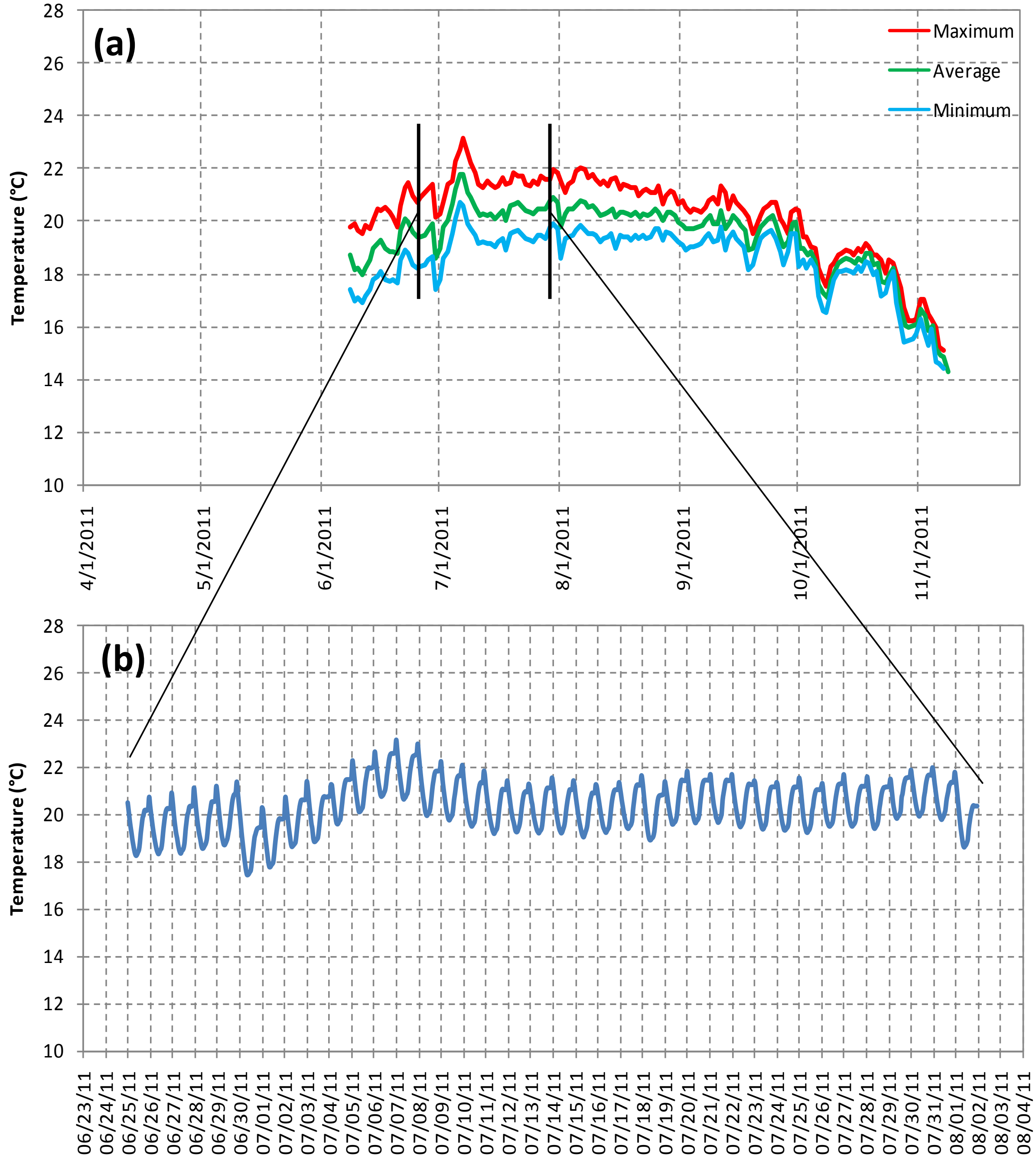


Figure 12: 2011 Encantado Pool (LSYR-4.95) bottom (6.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/11-7/31/11.

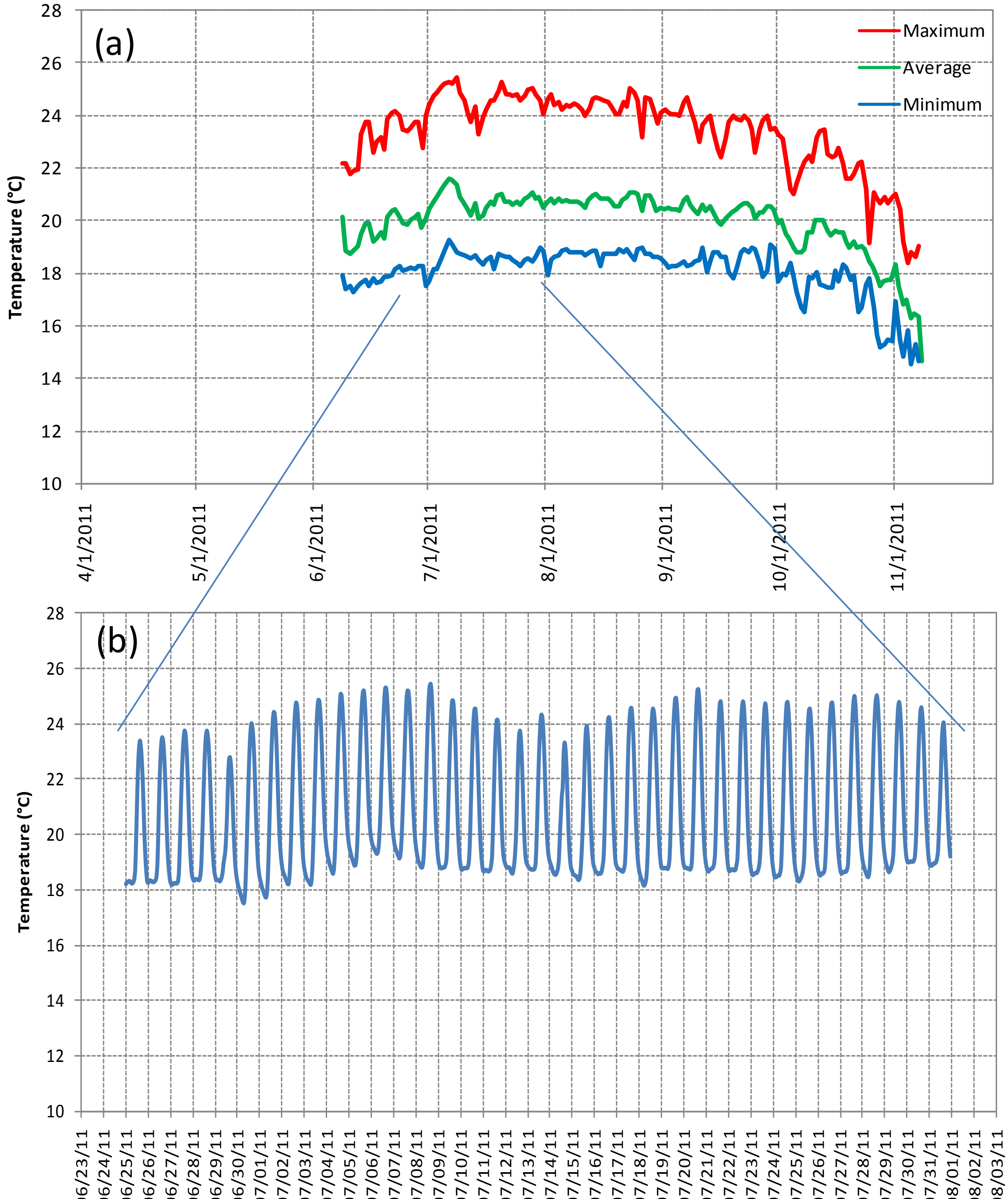


Figure 13: 2011 7.2 Pool (LSYR-7.2) surface (0.5 feet) thermograph (a) daily maximum, average, and minimum values and (b) hourly data for the period 6/25/11-7/31/11.

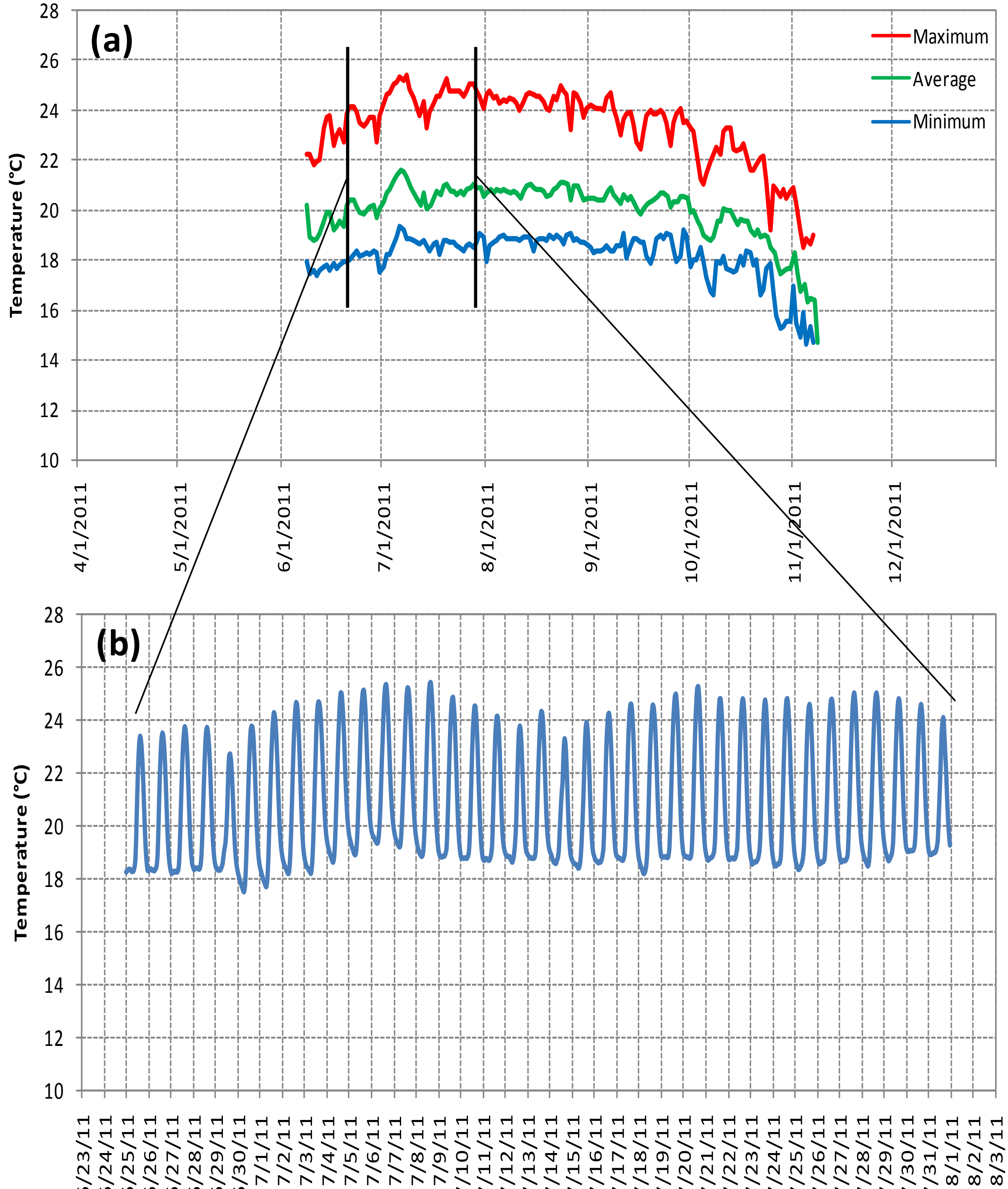


Figure 14: 2011 7.2 Pool (LSYR-7.2) middle (2.25 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

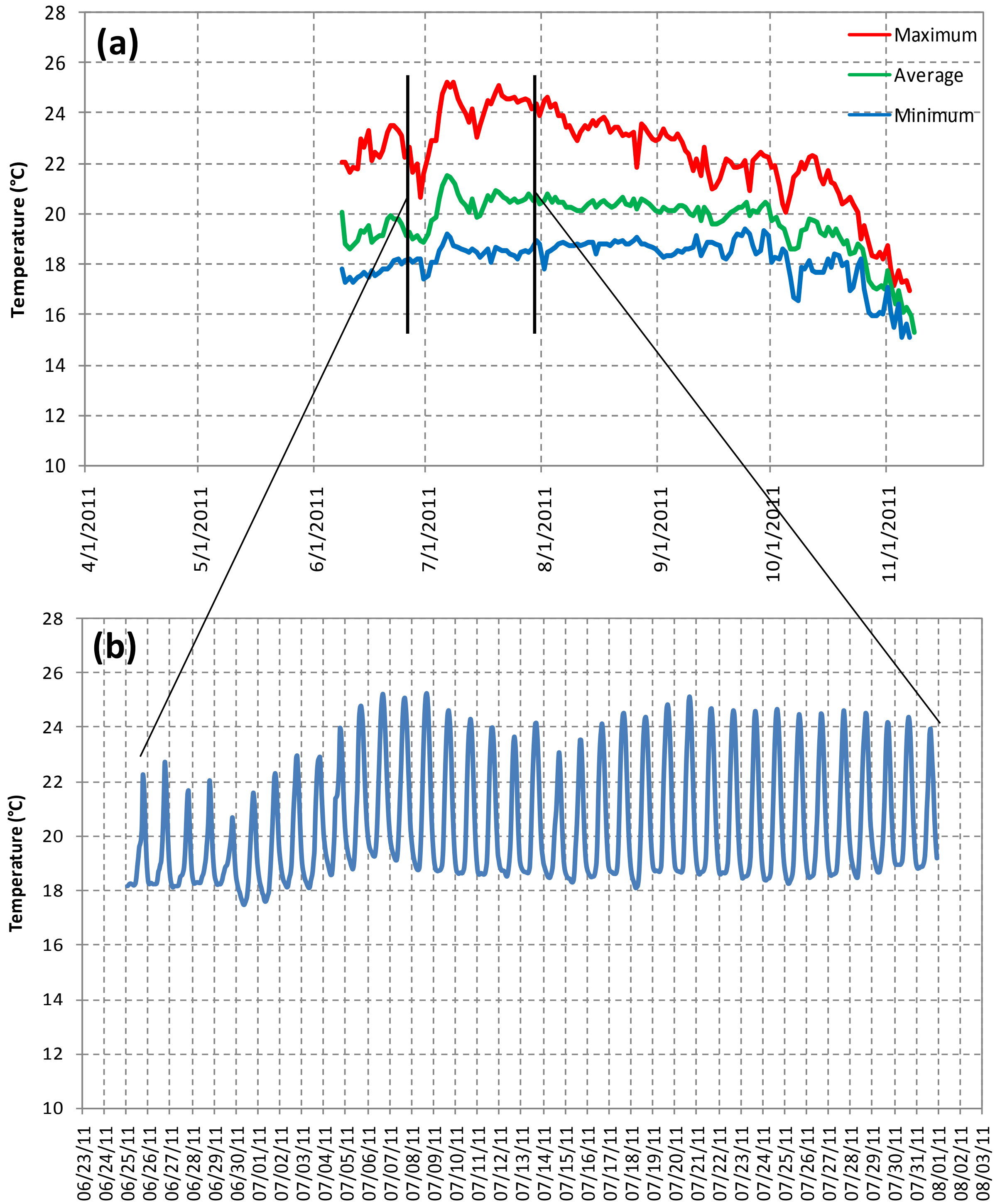


Figure 15: 2011 7.2 Pool (LSYR-7.2) bottom (4 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

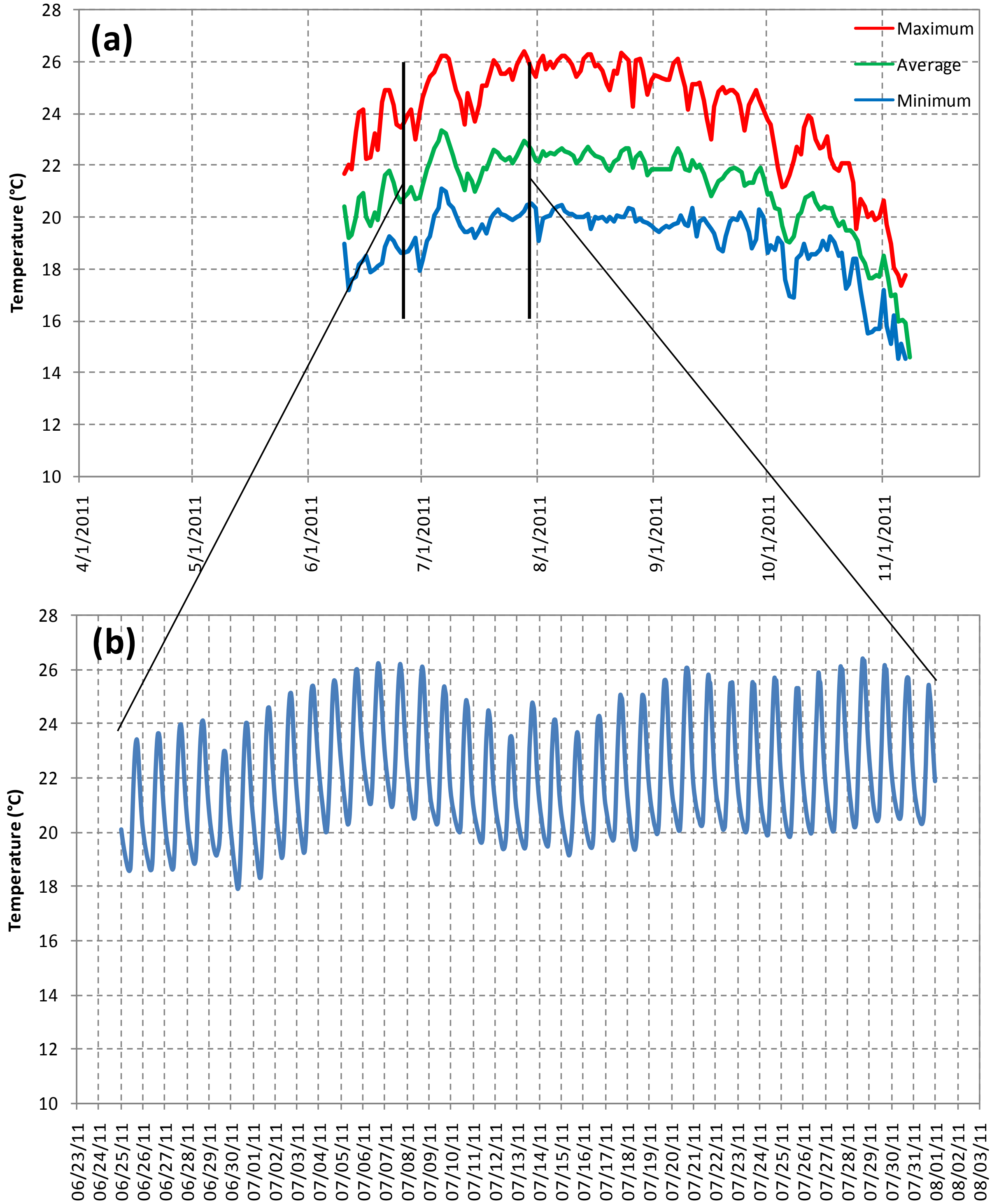


Figure 16: 2011 9.7 Pool (LSYR-9.7) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

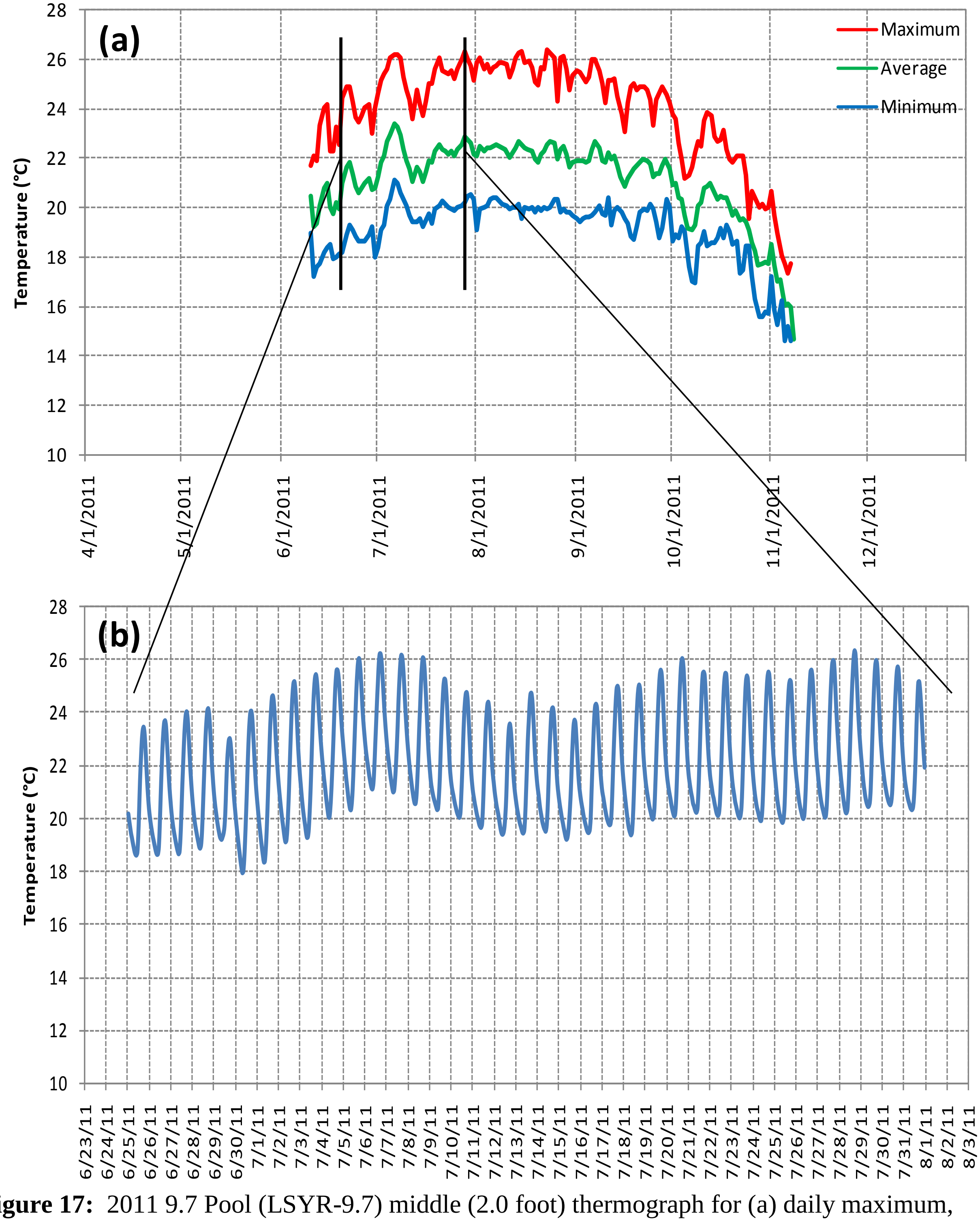


Figure 17: 2011 9.7 Pool (LSYR-9.7) middle (2.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

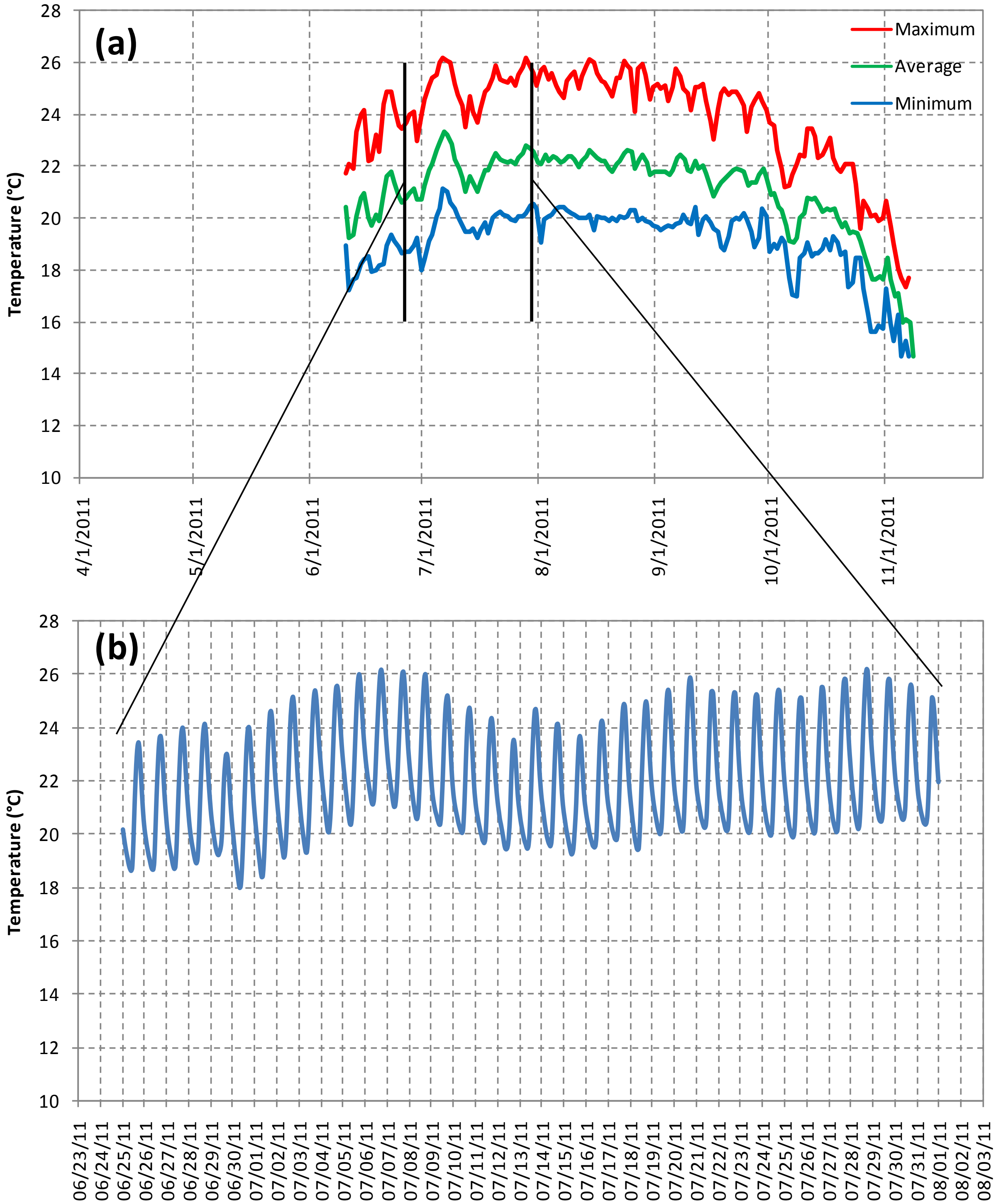


Figure 18: 2011 9.7 Pool (LSYR-9.7) bottom (3.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

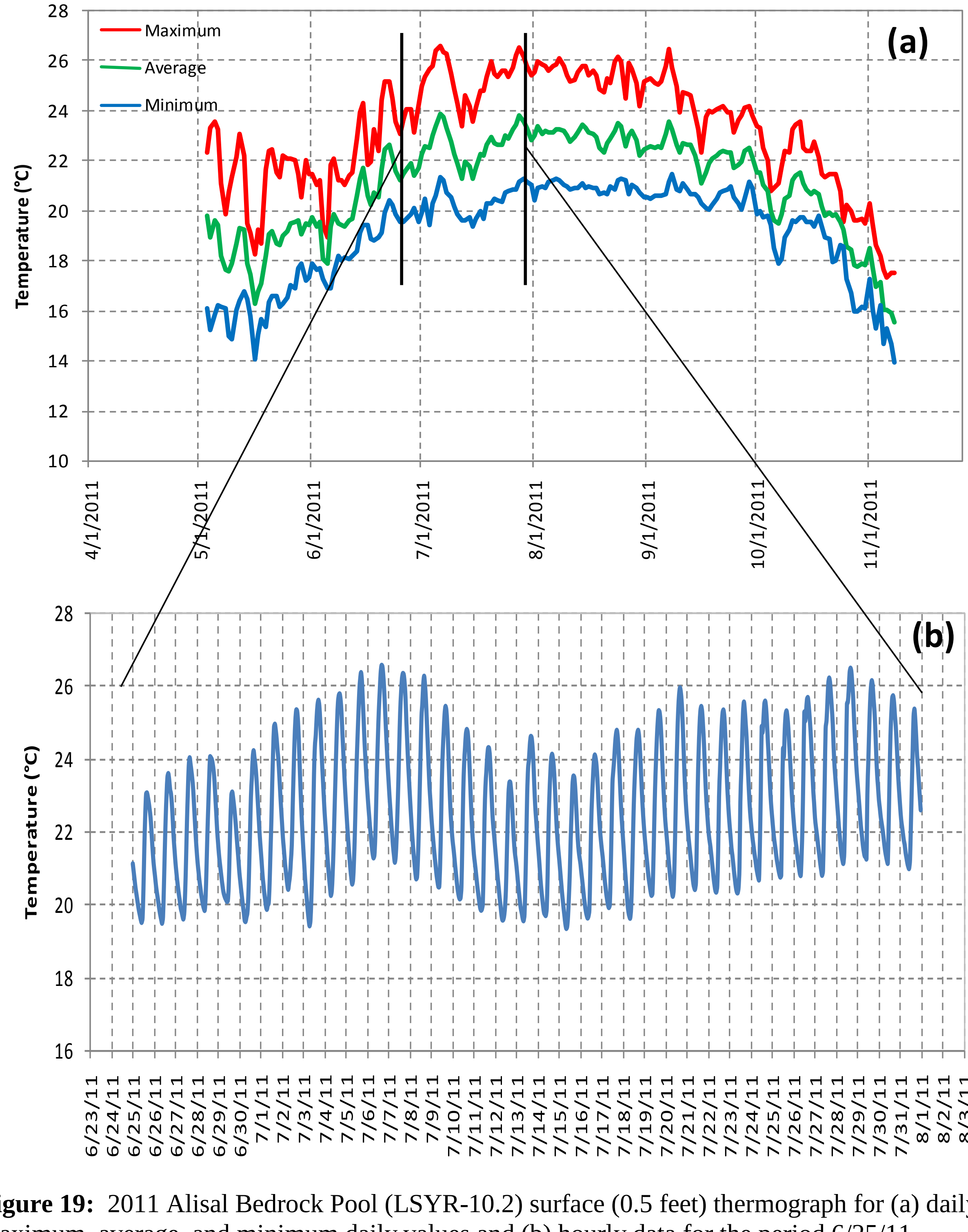


Figure 19: 2011 Alisal Bedrock Pool (LSYR-10.2) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

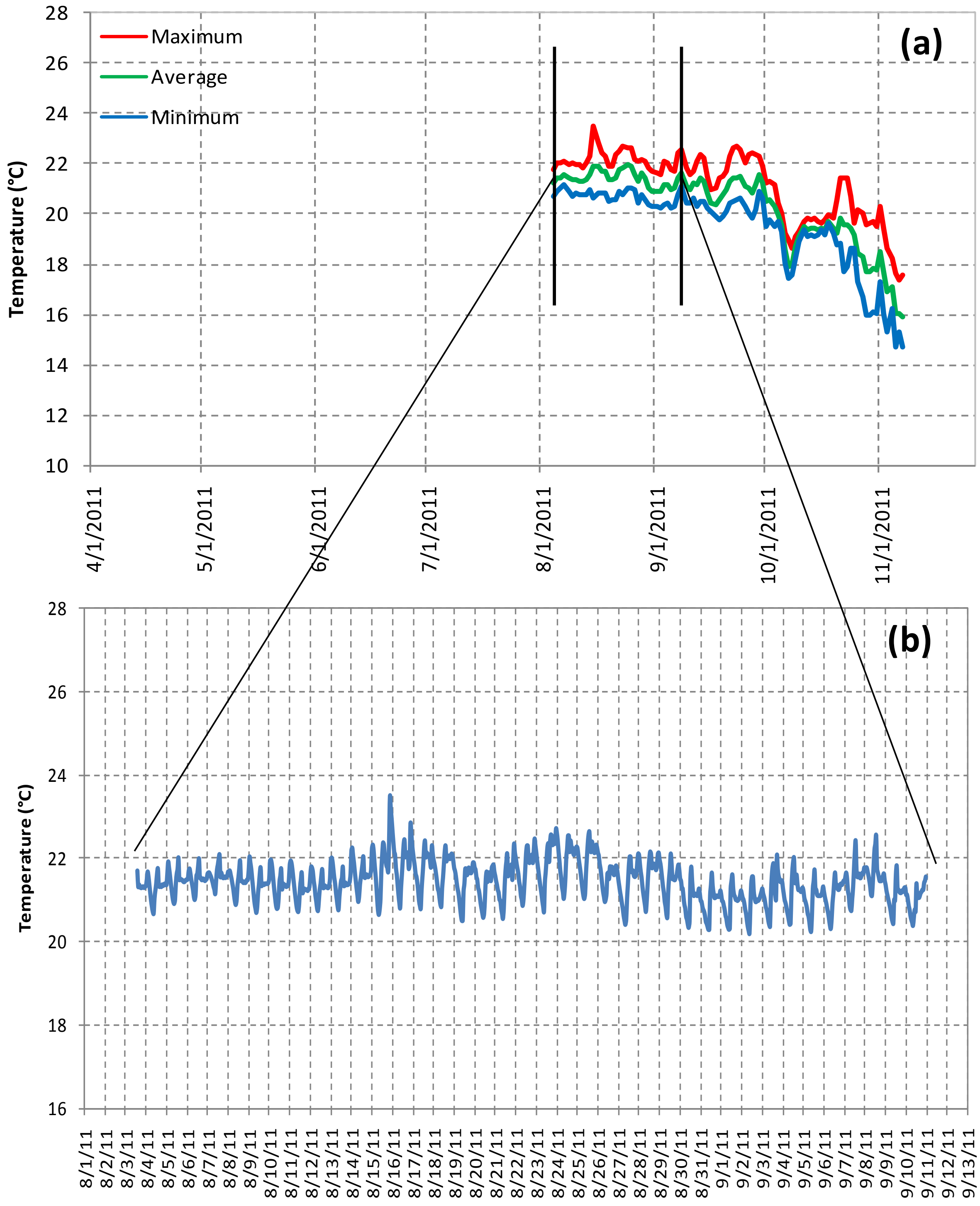


Figure 20: 2011 Alisal Bedrock Pool (LSYR-10.2) middle (4.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 8/3/11-9/11/11.

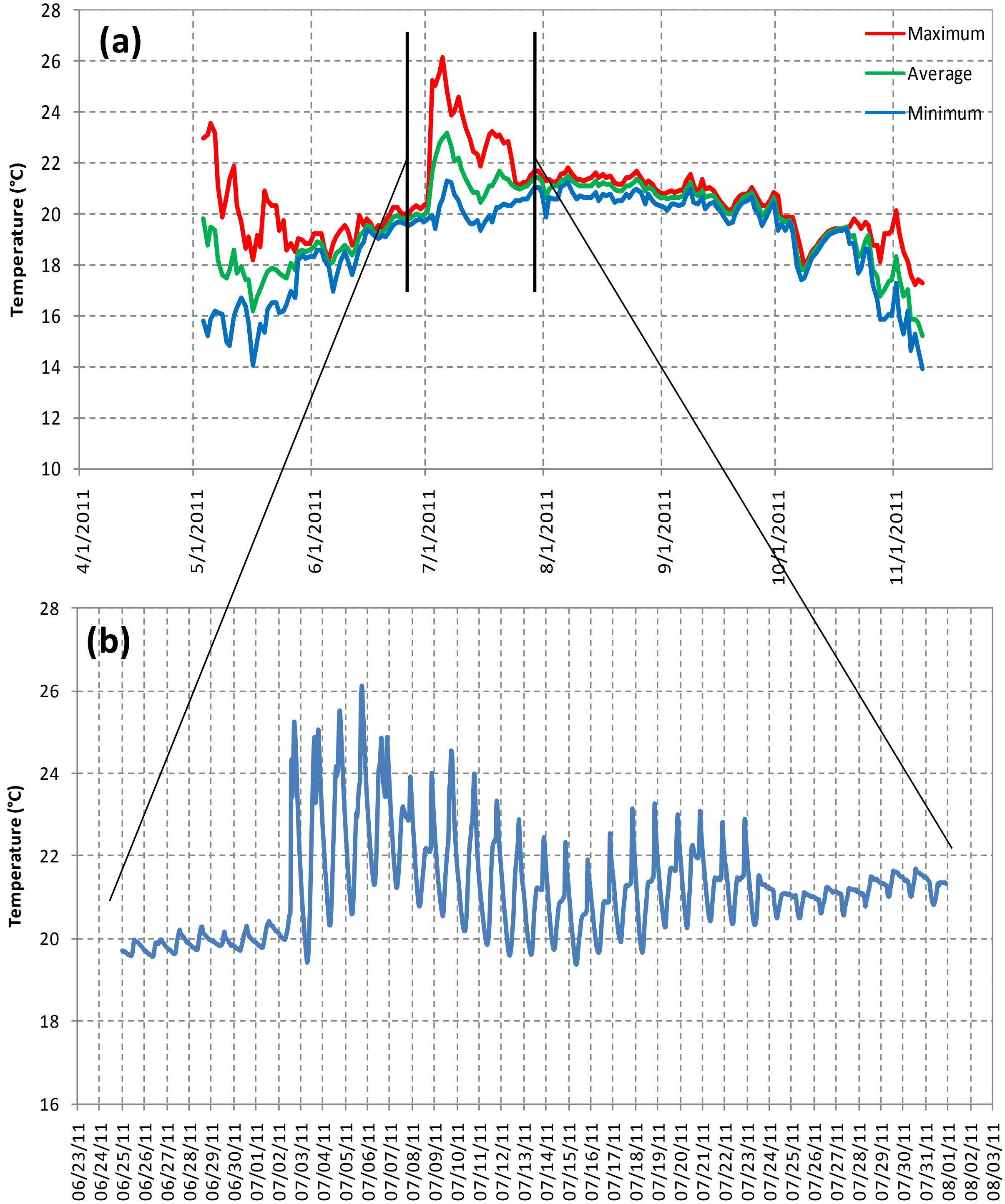


Figure 21: 2011 Alisal Bedrock Pool (LSYR-10.2) bottom (8.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

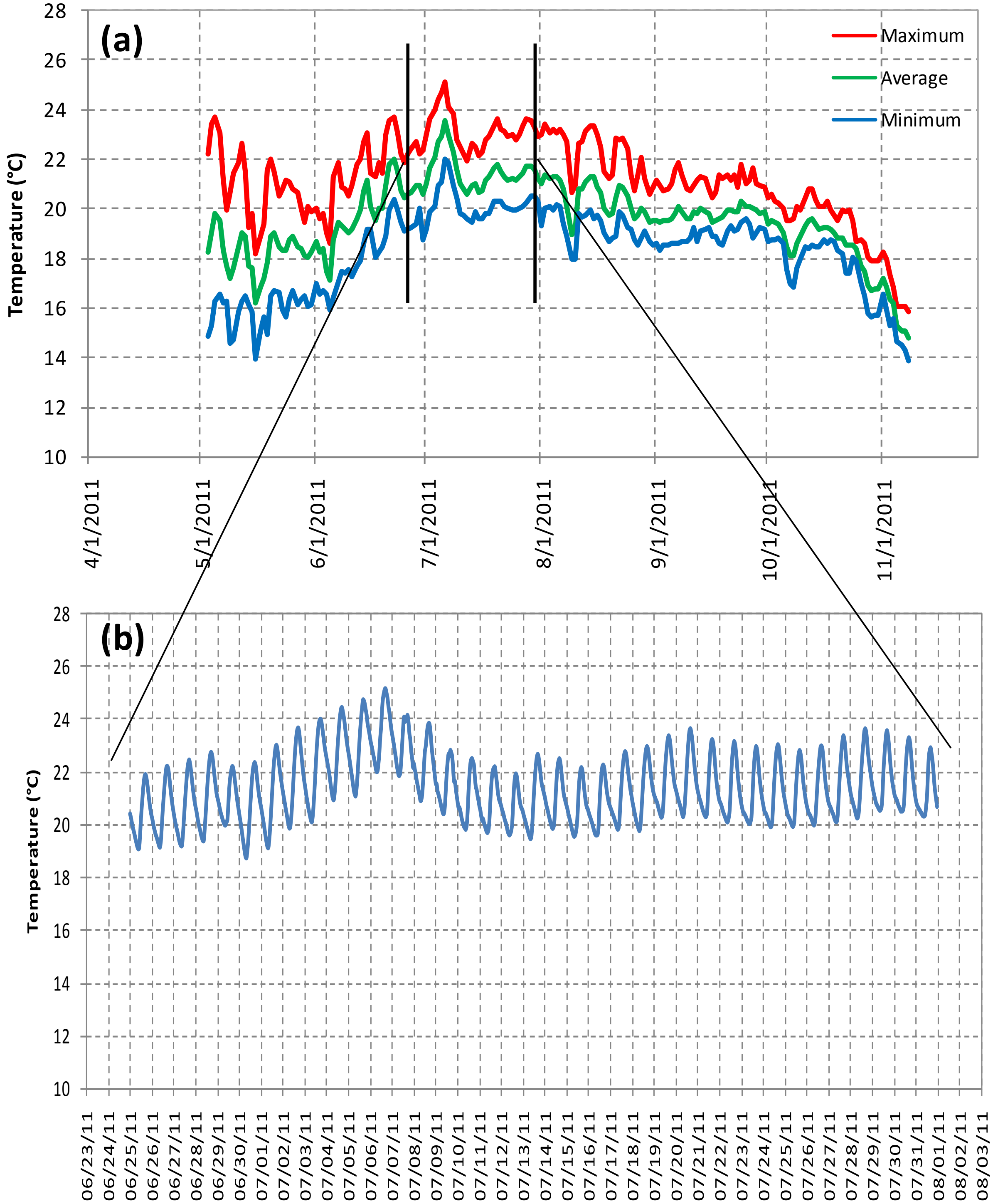


Figure 22: 2011 Avenue of the Flags Pool (LSYR-13.9) bottom (3.5 feet) thermograph daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

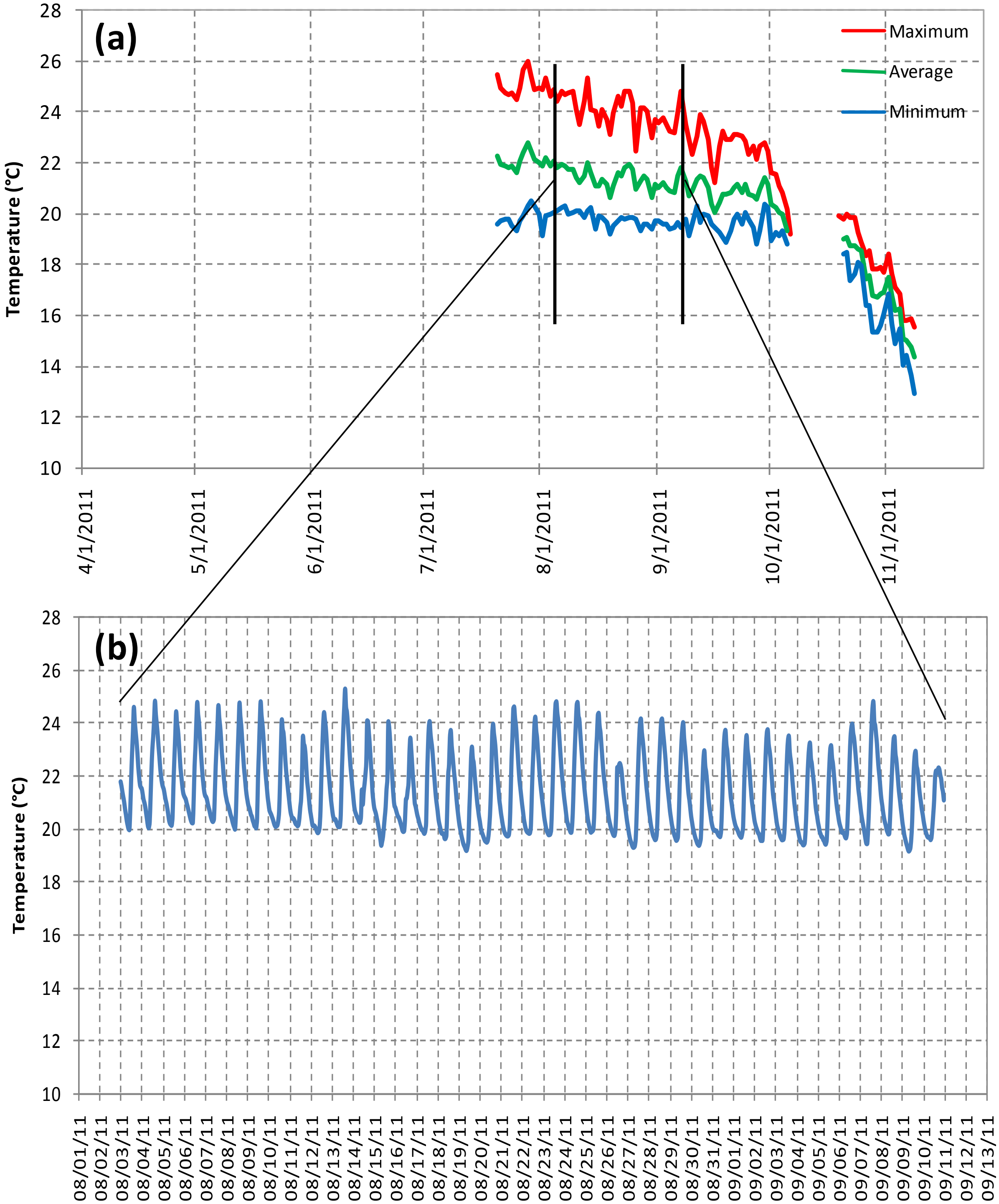


Figure 23: 2011 Cadwell Pool (LSYR-22.8) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 8/3/11-9/10/11.

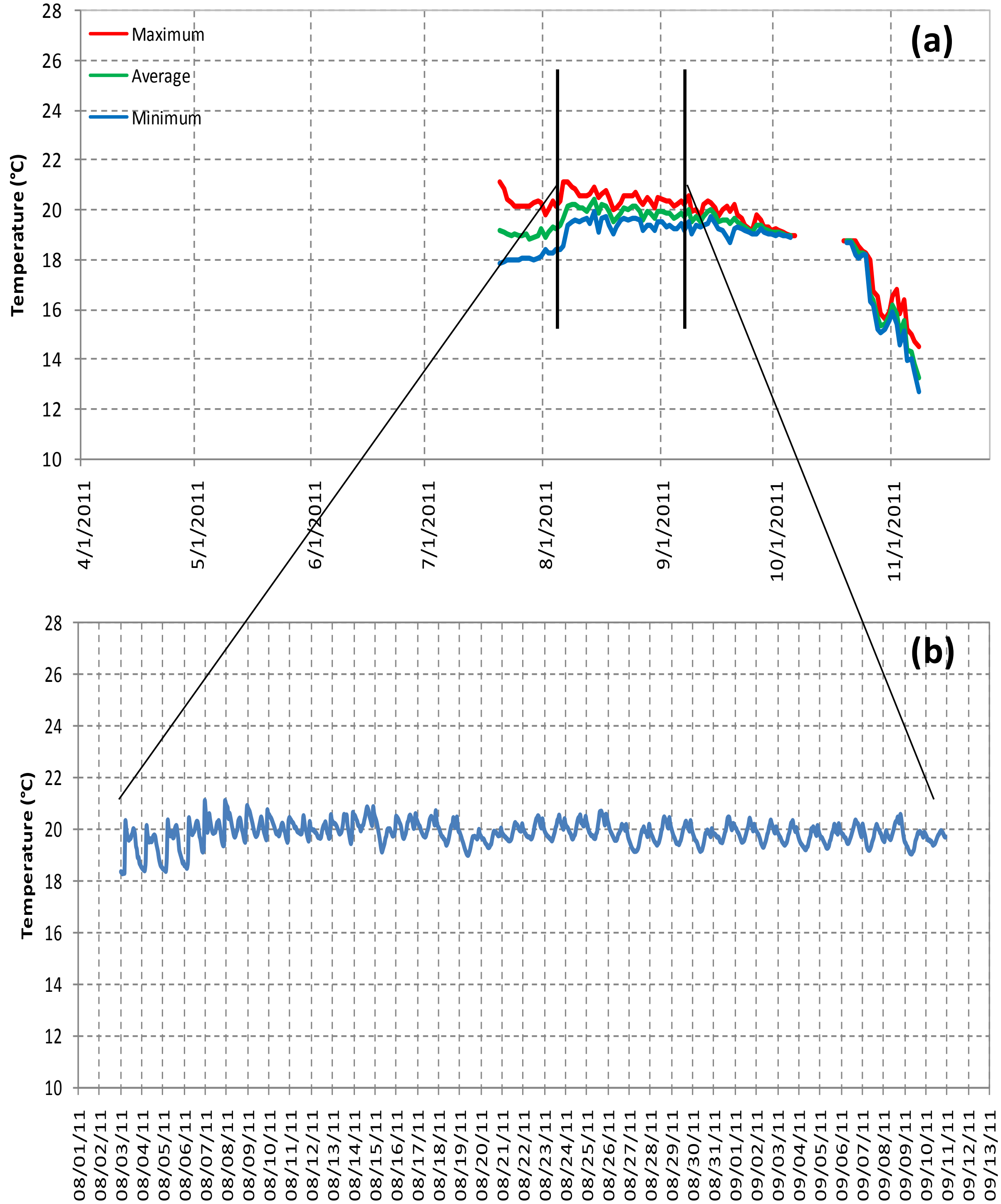


Figure 24: 2011 Cadwell Pool (LSYR-22.8) bottom (14.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 8/3/11-9/10/11.

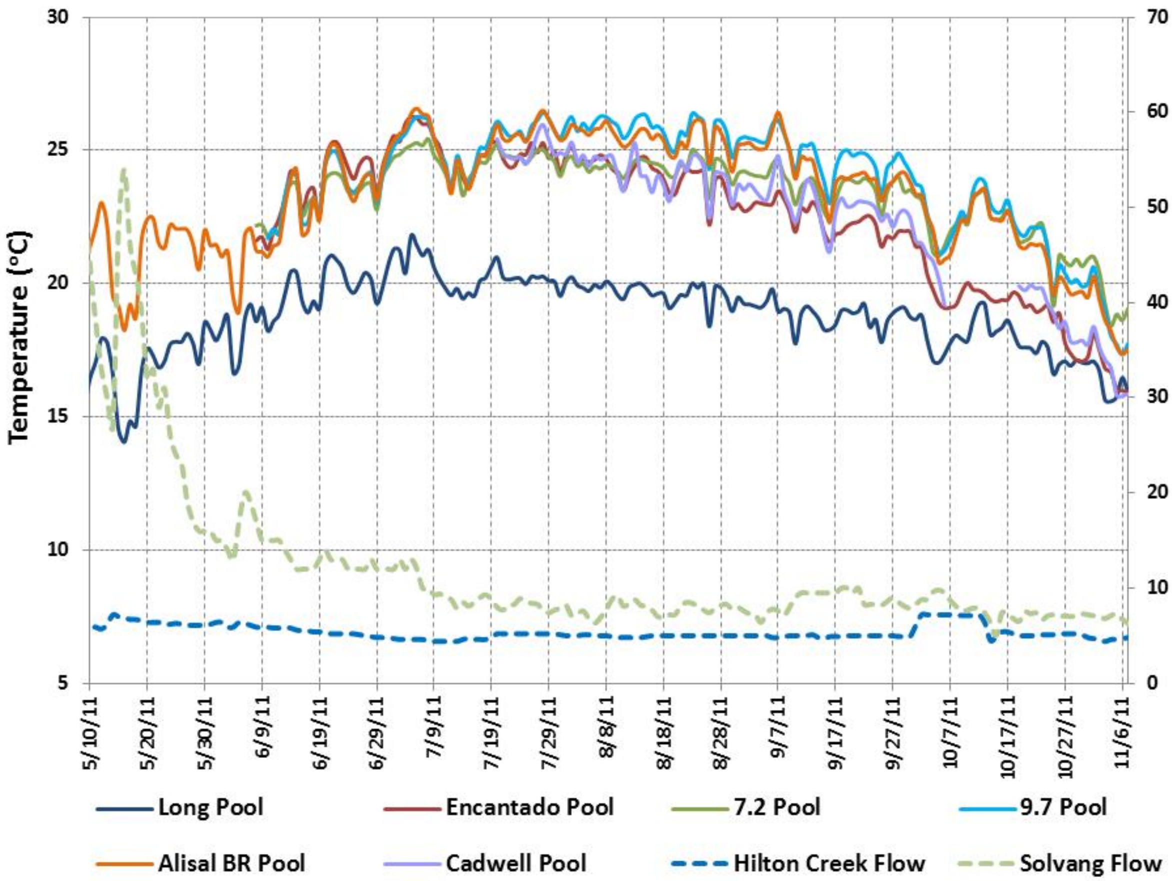


Figure 25: 2011 Longitudinal maximum surface water temperatures at the Long Pool (LSYR-0.5), 7.3 Pool (LSYR-7.2), 9.7 pool (LSYR-9.7), Alisal Bedrock Pool (LSYR-10.2), and Cadwell Pool (LSYR-22.8) with daily flow (discharge) at the Hilton Creek and Solvang (at the Alisal Bridge) USGS gauges.

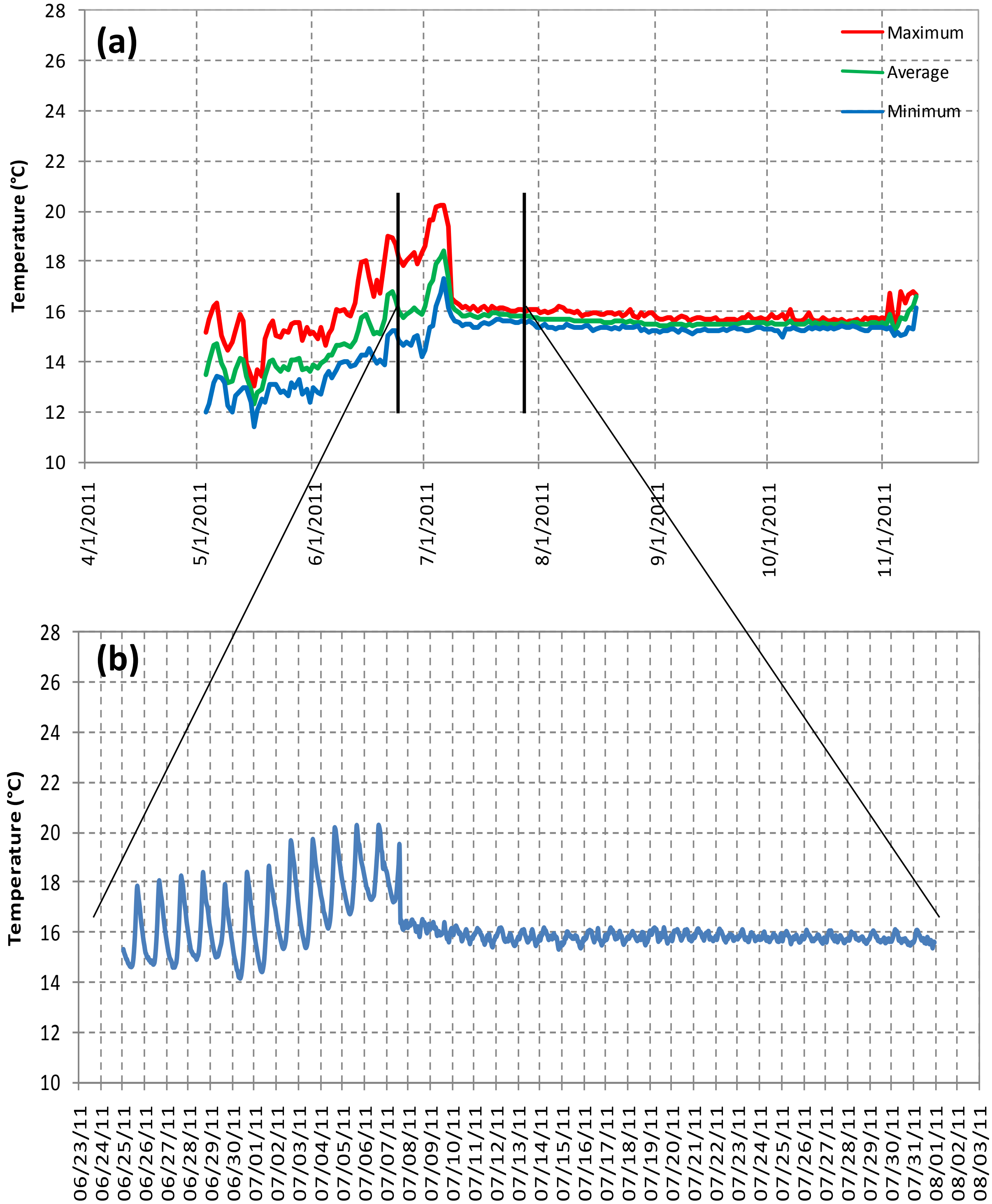


Figure 26: 2011 Upper Hilton Creek (HC-0.54) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

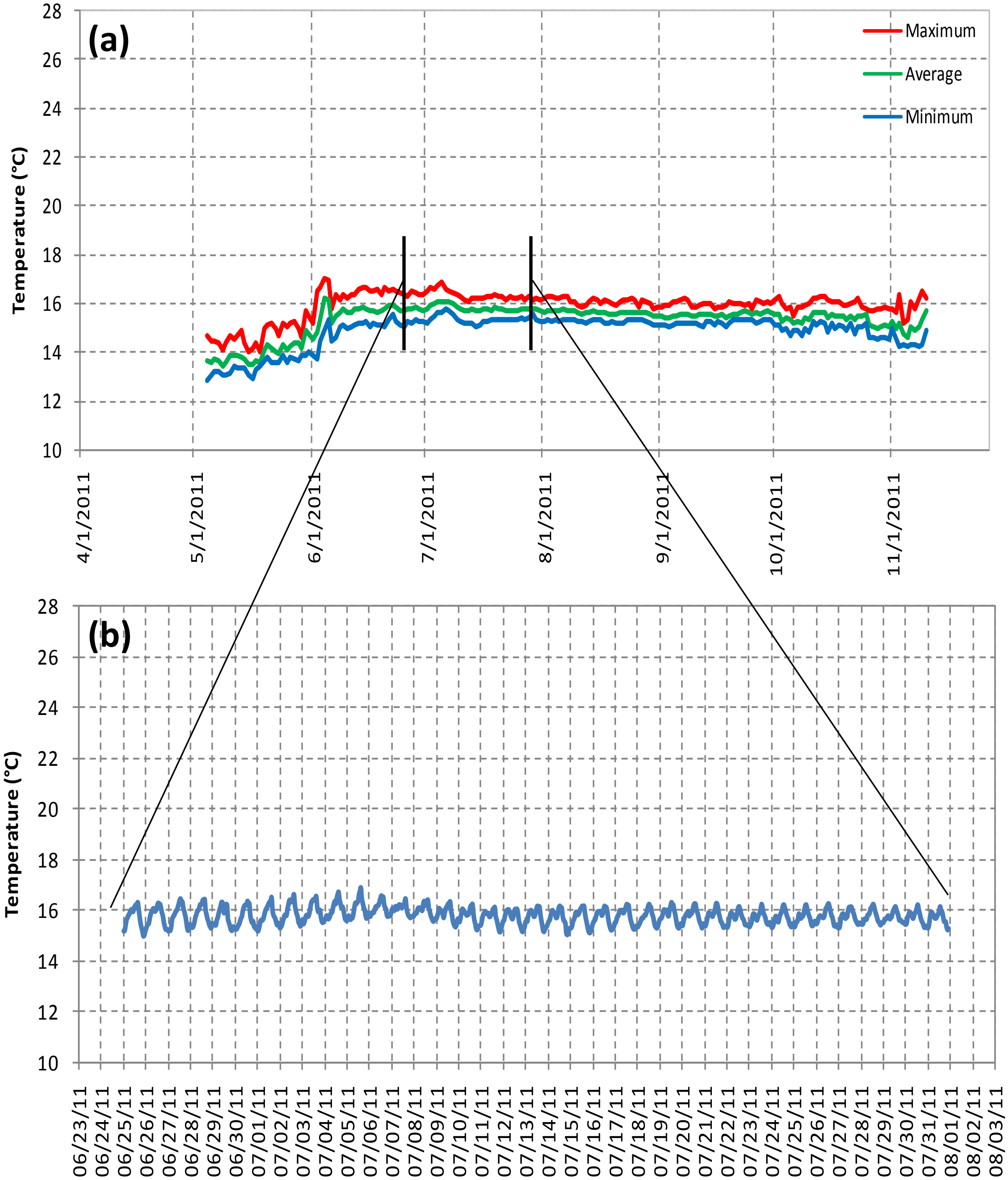


Figure 27: 2011 Lower Hilton Creek (HC-0.12) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

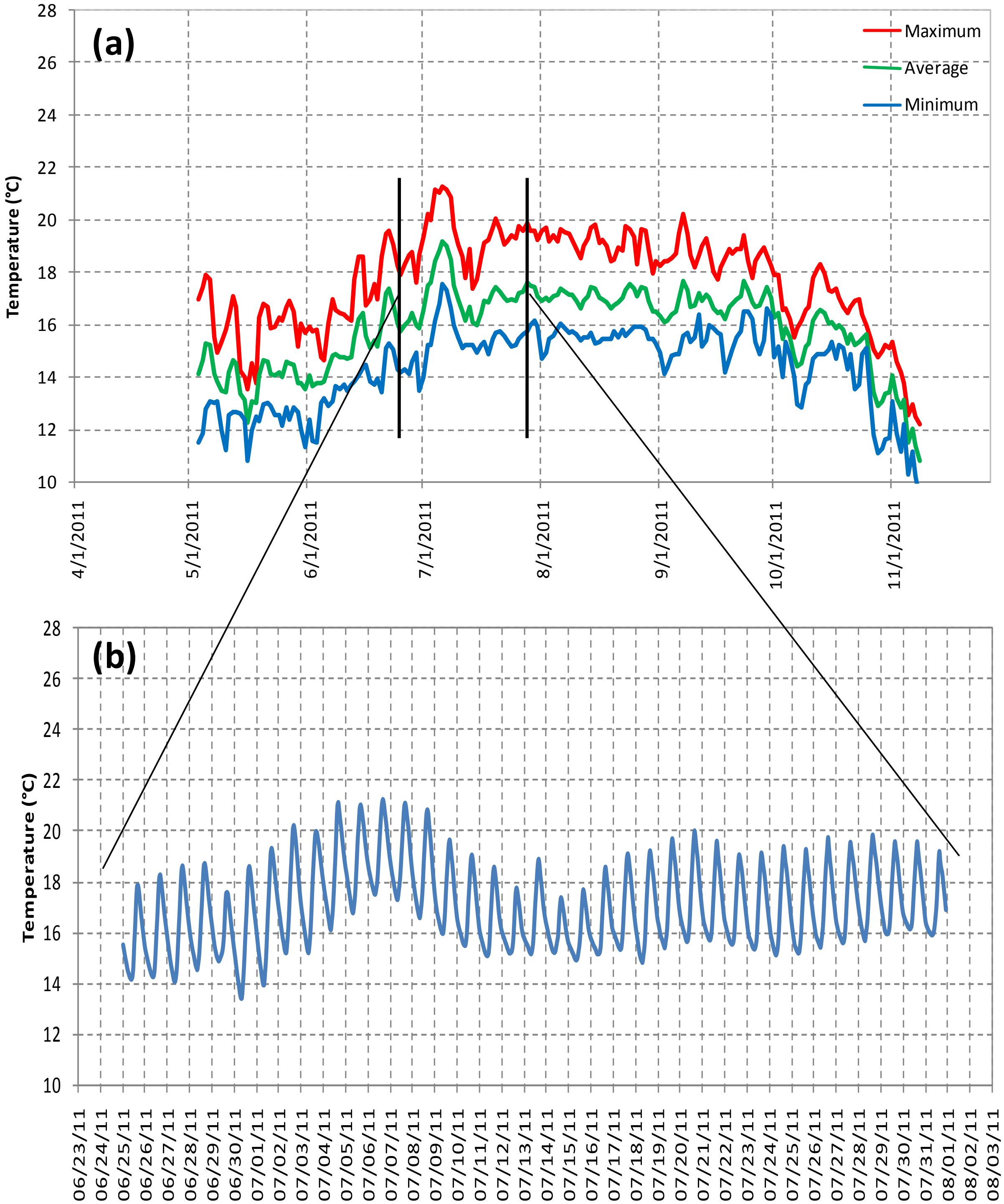


Figure 28: 2011 Quiota Creek (QC-2.71) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

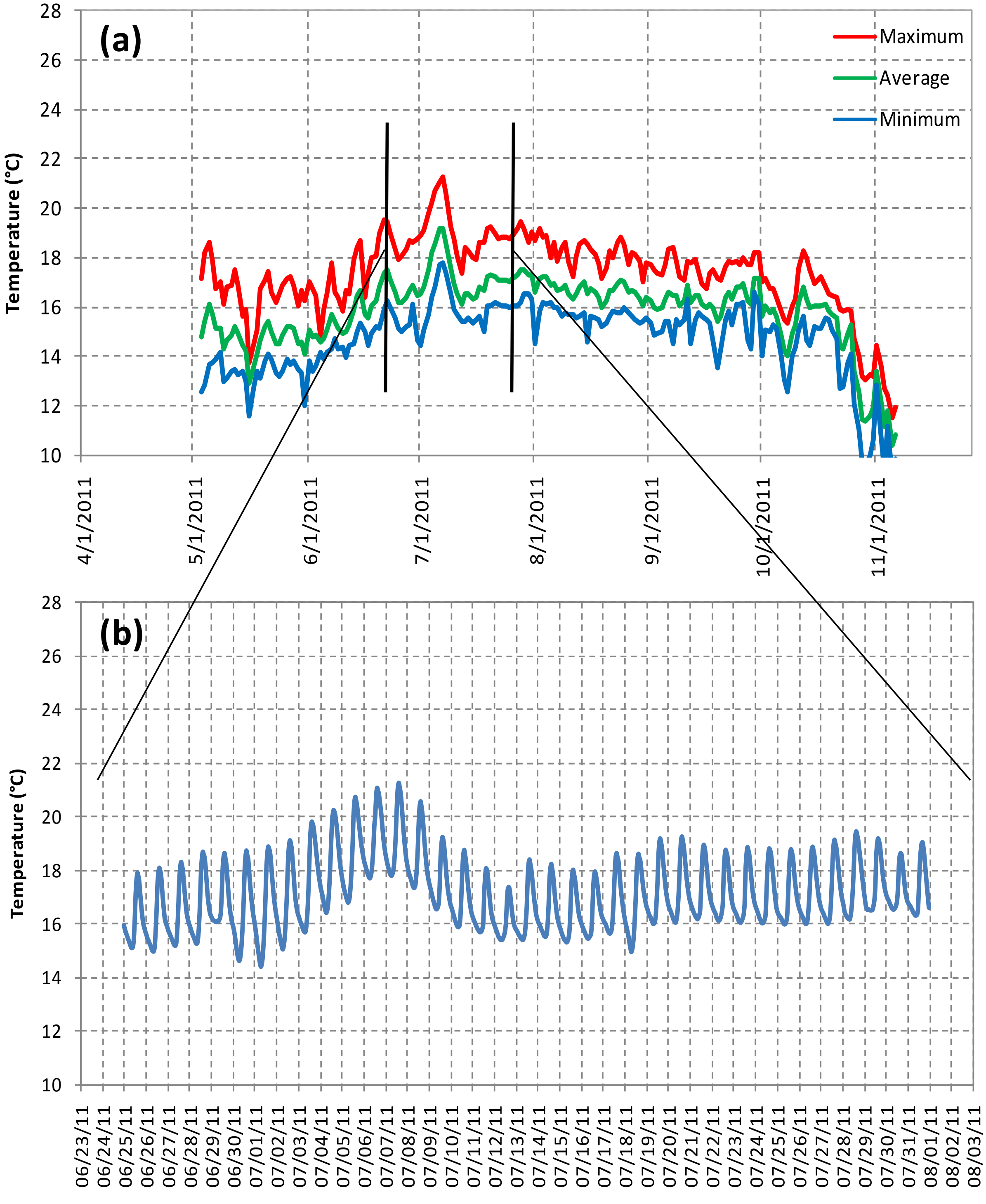


Figure 29: 2011 Upper Salsipuedes Creek (SC-3.8) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

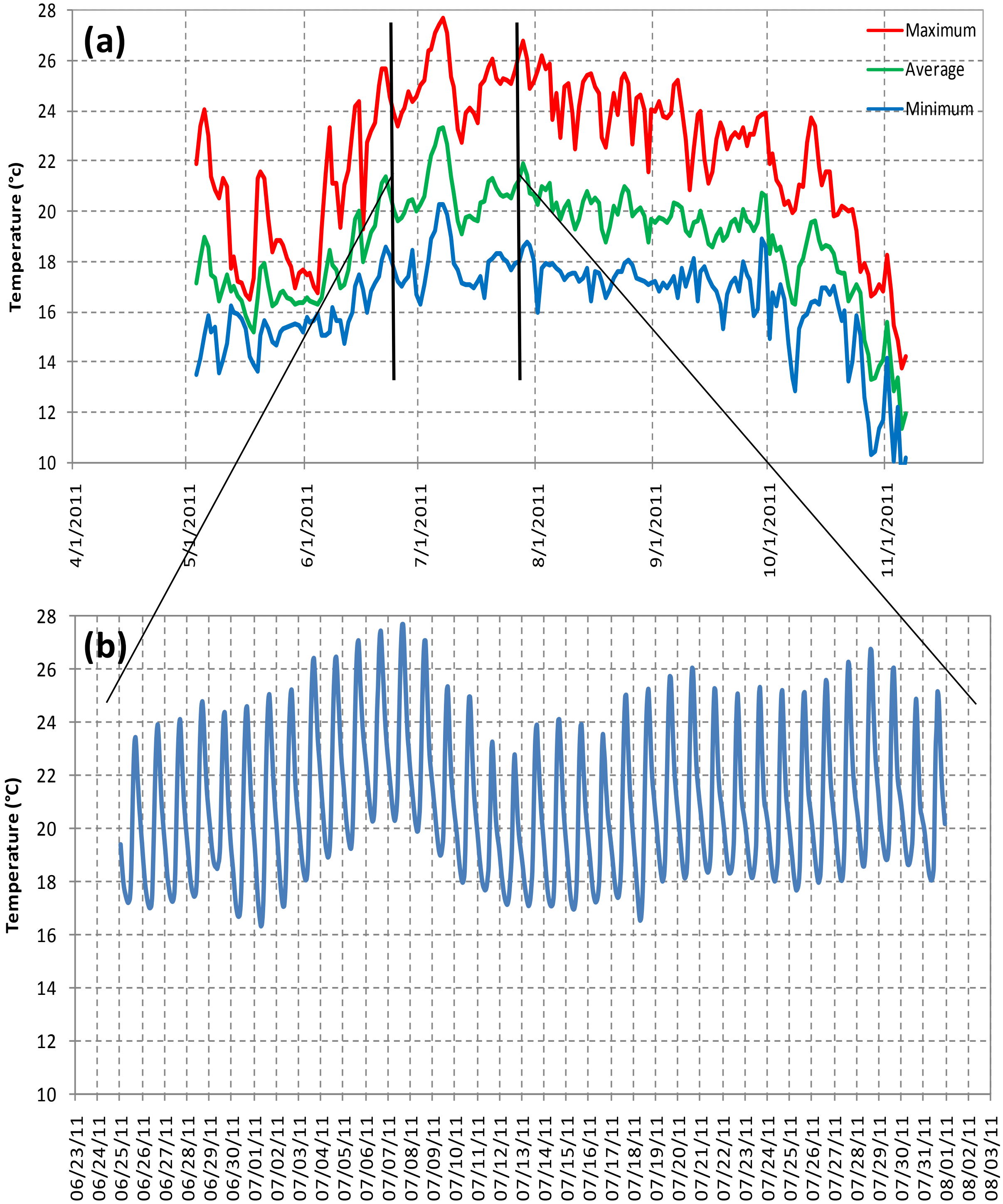


Figure 30: 2011 Lower Salsipuedes Creek (SC-0.77) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

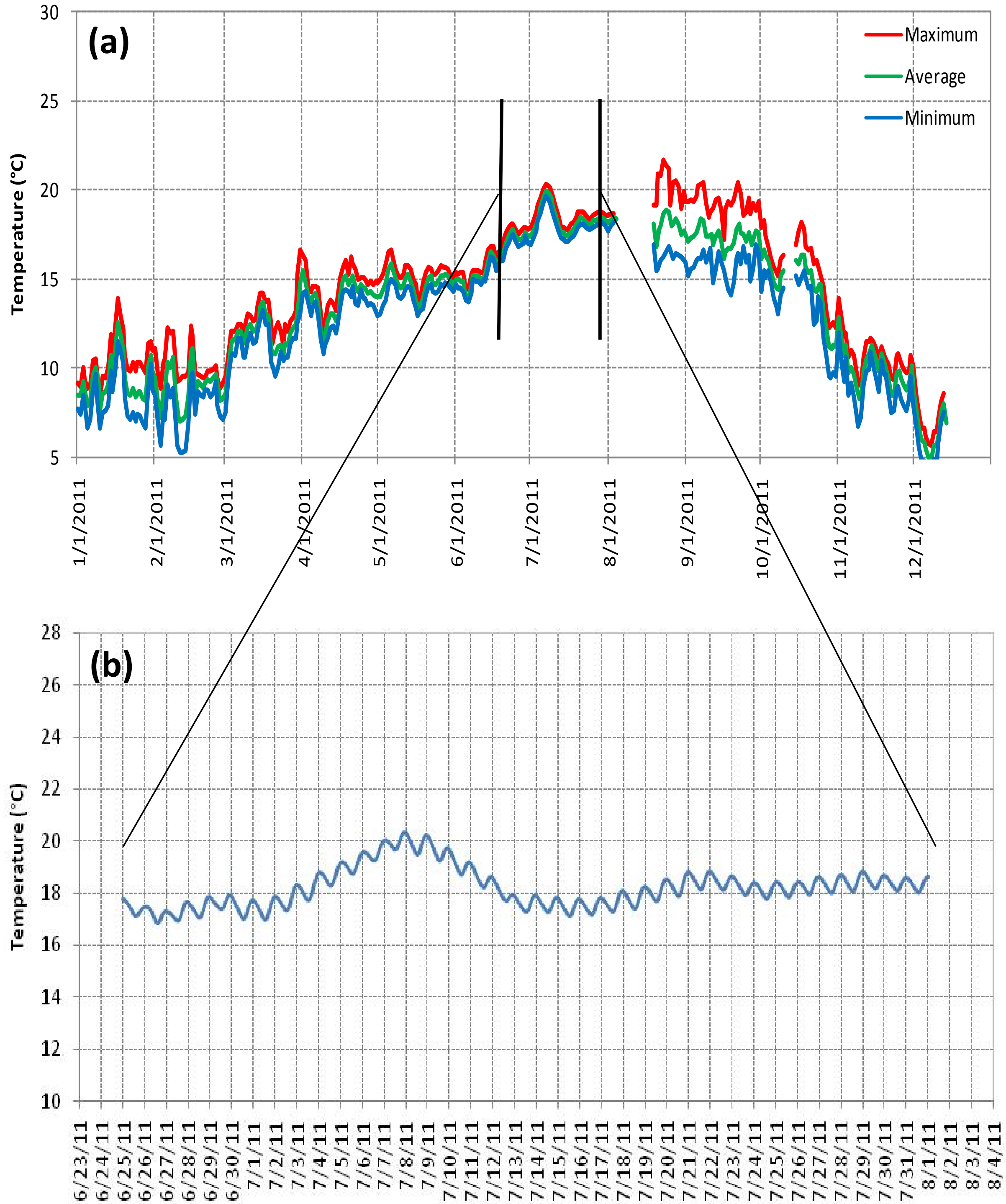


Figure 31: 2011 El Jaro Creek (EJC-10.82) at the Rancho San Julian Fish Ladder thermograph (1.5 feet) for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

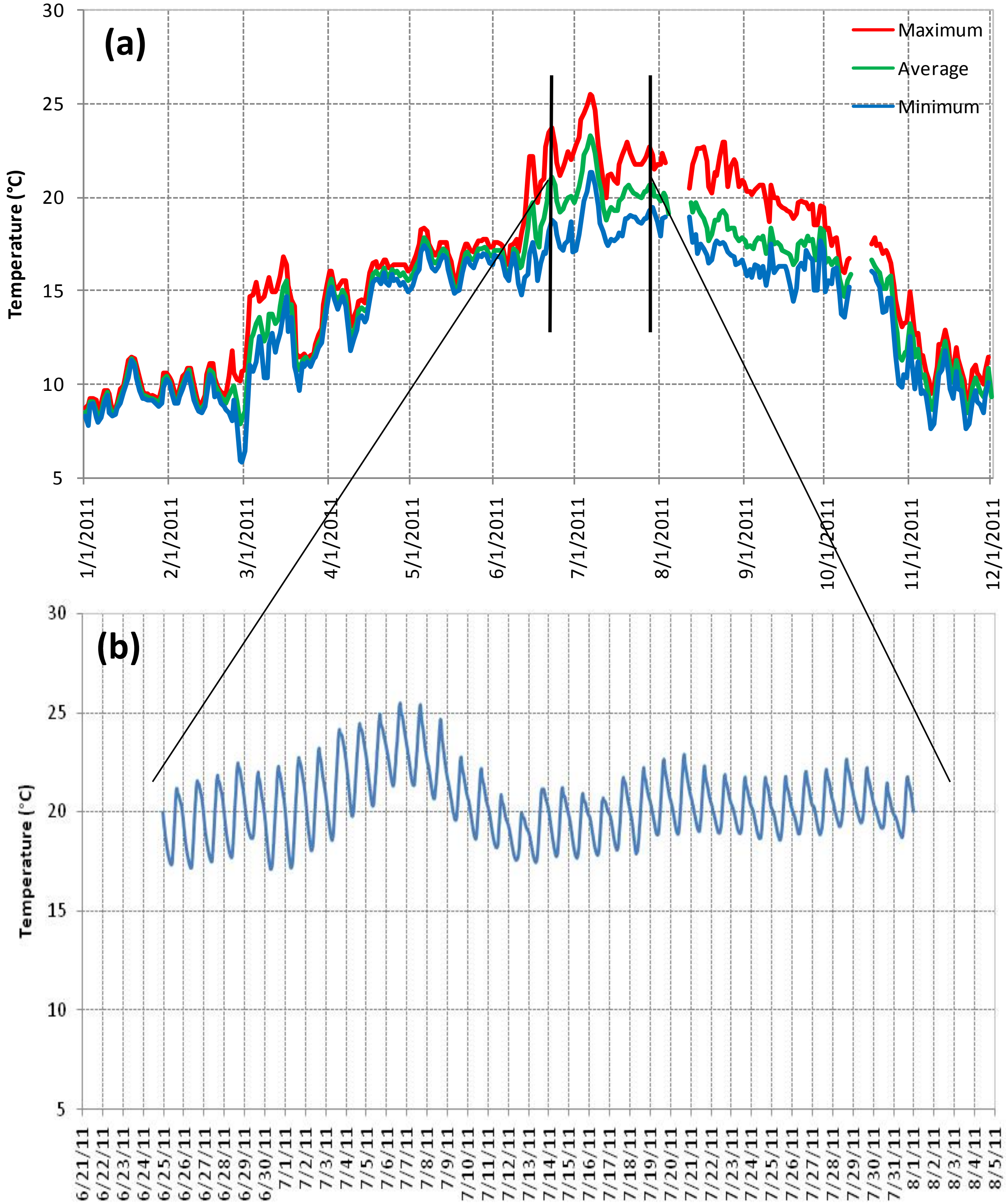


Figure 32: 2011 El Jaro Creek (EJC-4.53) Cross Creek Fish Passage Enhancement Project thermograph (0.5 feet) for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

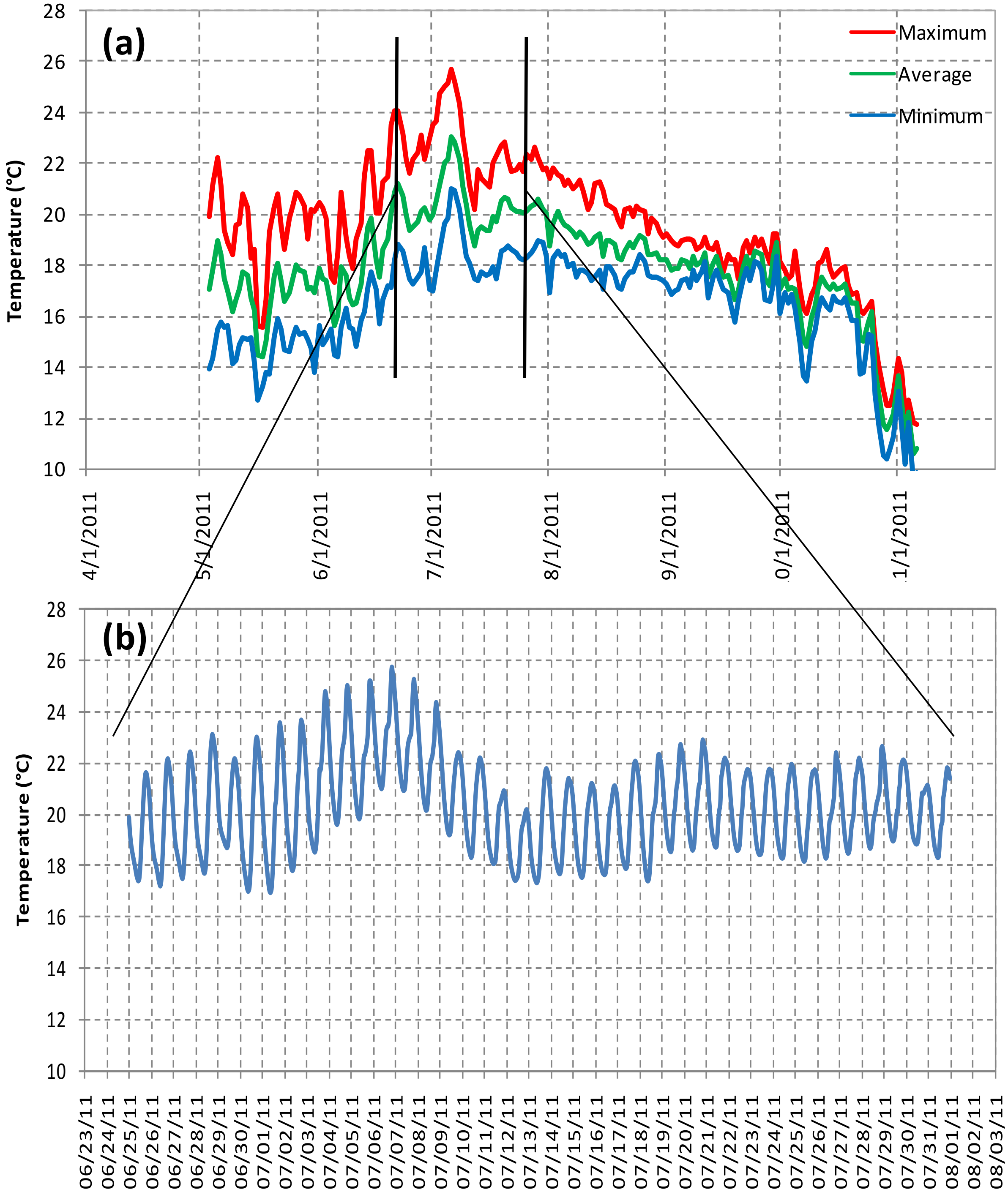


Figure 33: 2011 Lower El Jaro Creek (EJC-3.81) bottom (3.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 6/25/11-7/31/11.

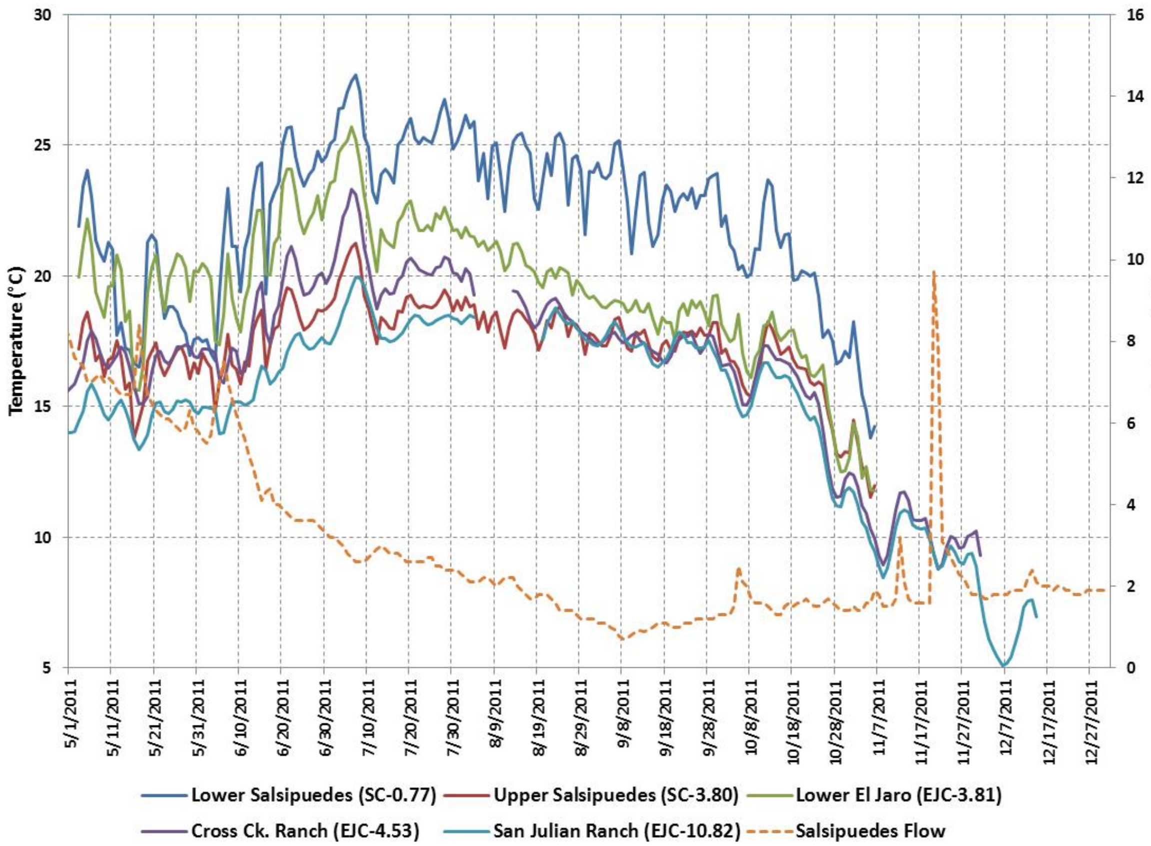


Figure 34: 2011 Longitudinal maximum daily water temperatures within the Salsipuedes Creek watershed which included El Jaro Creek at Rancho San Julian (EJC-10.82), Cross Creek Ranch (EJC-4.53), lower El Jaro Creek (EJC-3.81), upper Salsipuedes Creek (SC-3.8), and upper Salsipuedes Creek (SC-0.77).

Table 6: Water quality sonde deployments during the 2011 dry season.

Habitat	Location	Deployment Schedule:							
		7/18-7/21/11	7/21-7/25/11	7/25-7/28/11	8/15-8/18/11	8/18-8/22/11	10/21-10/24/11	10/24-10/27/11	11/2-11/4/11
Encantado Pool	LSYR-4.95		x				x		
7.2 Pool	LSYR-7.2			x		x		x	
9.7 Pool	LSYR-9.7	x			x				x

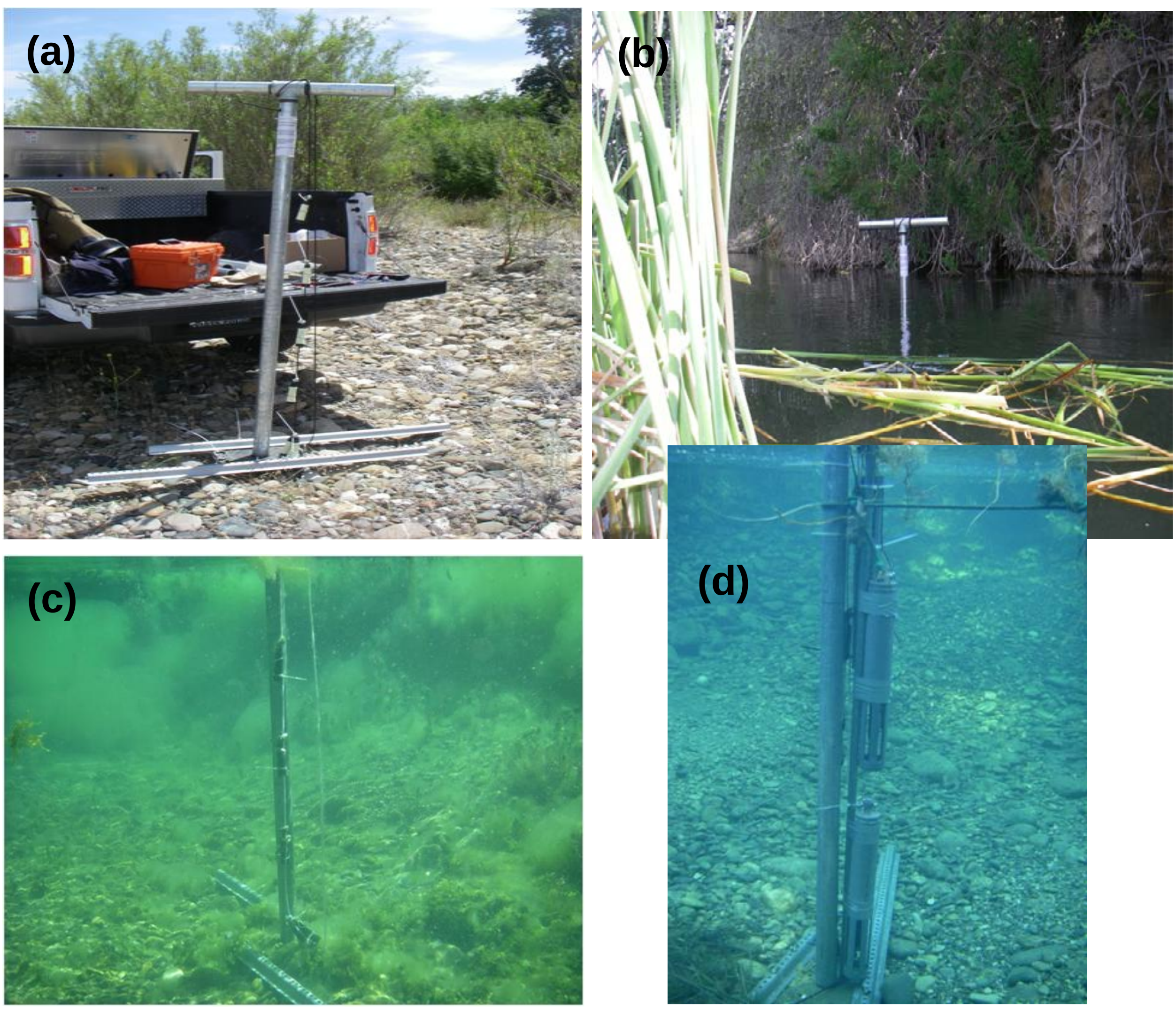


Figure 35: General instrument tower deployment showing the tower (a) being assembled, (b) after deployment, and underwater with (c) thermographs and (d) sondes plus thermographs.

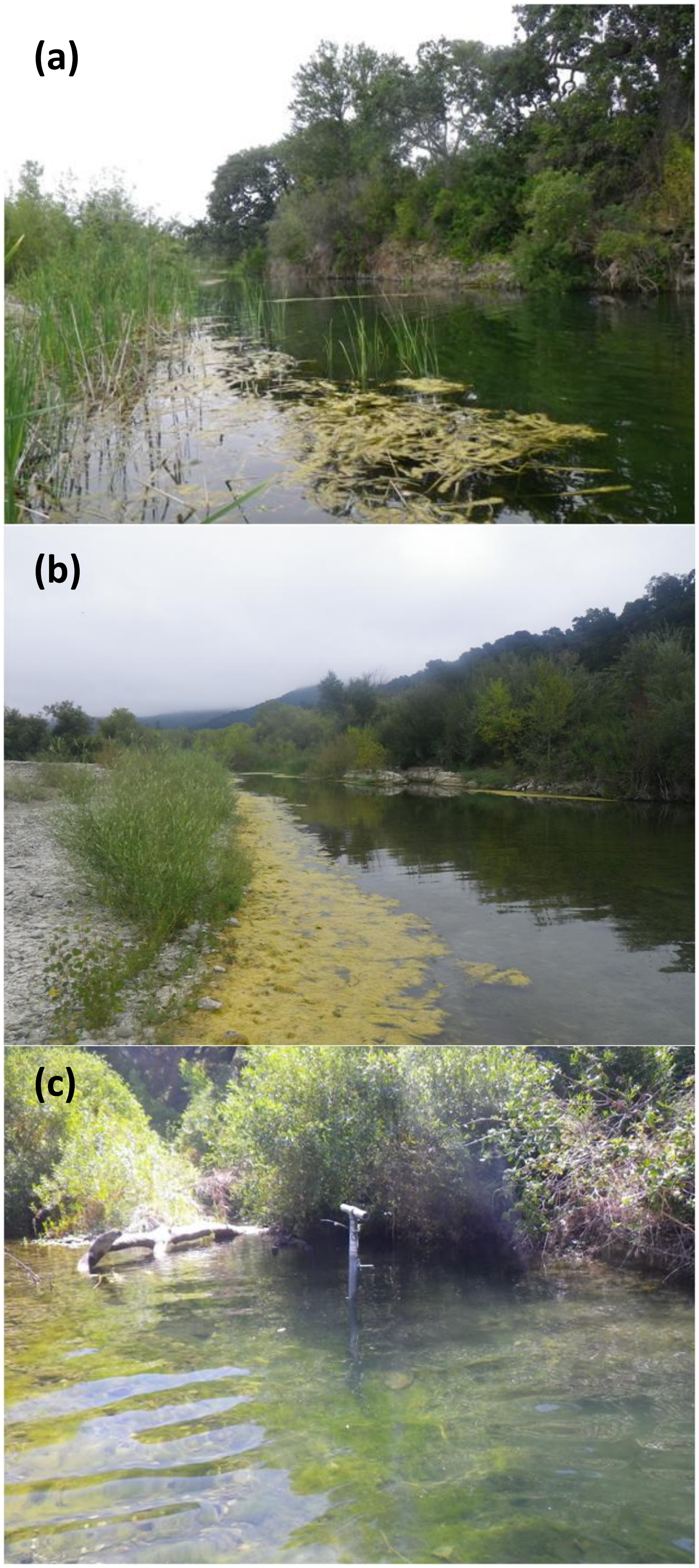


Figure 36: 2011 sonde vertical array locations at (a) LSYR-4.95, (b) LSYR-7.2, and (c) LSYR-9.7 showing deployed infrastructure.

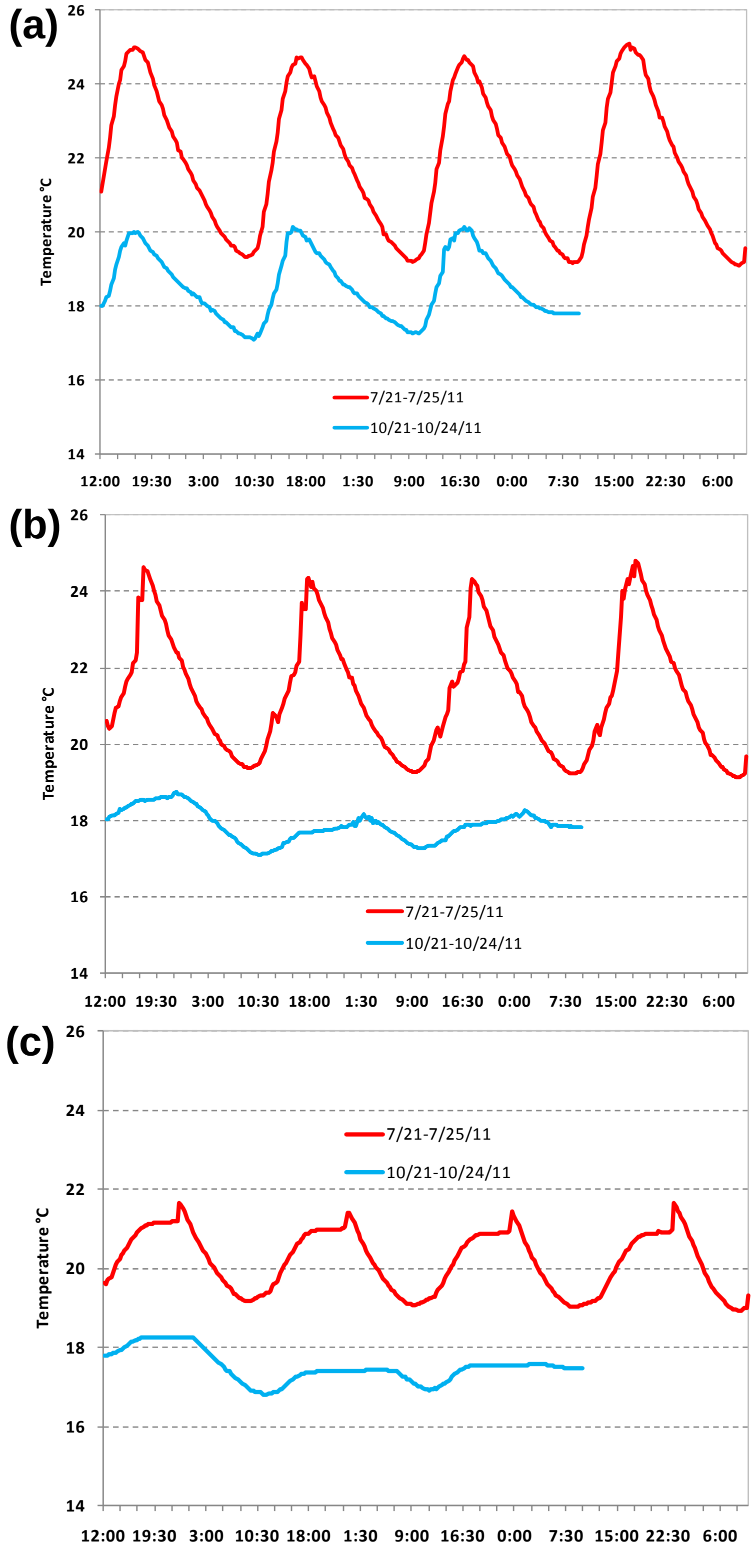


Figure 37: 2011 Encantado Pool (LSYR-4.95) sonde water temperatures during two deployments over the dry season at the (a) surface, (b) middle, and (c) bottom of the water column.

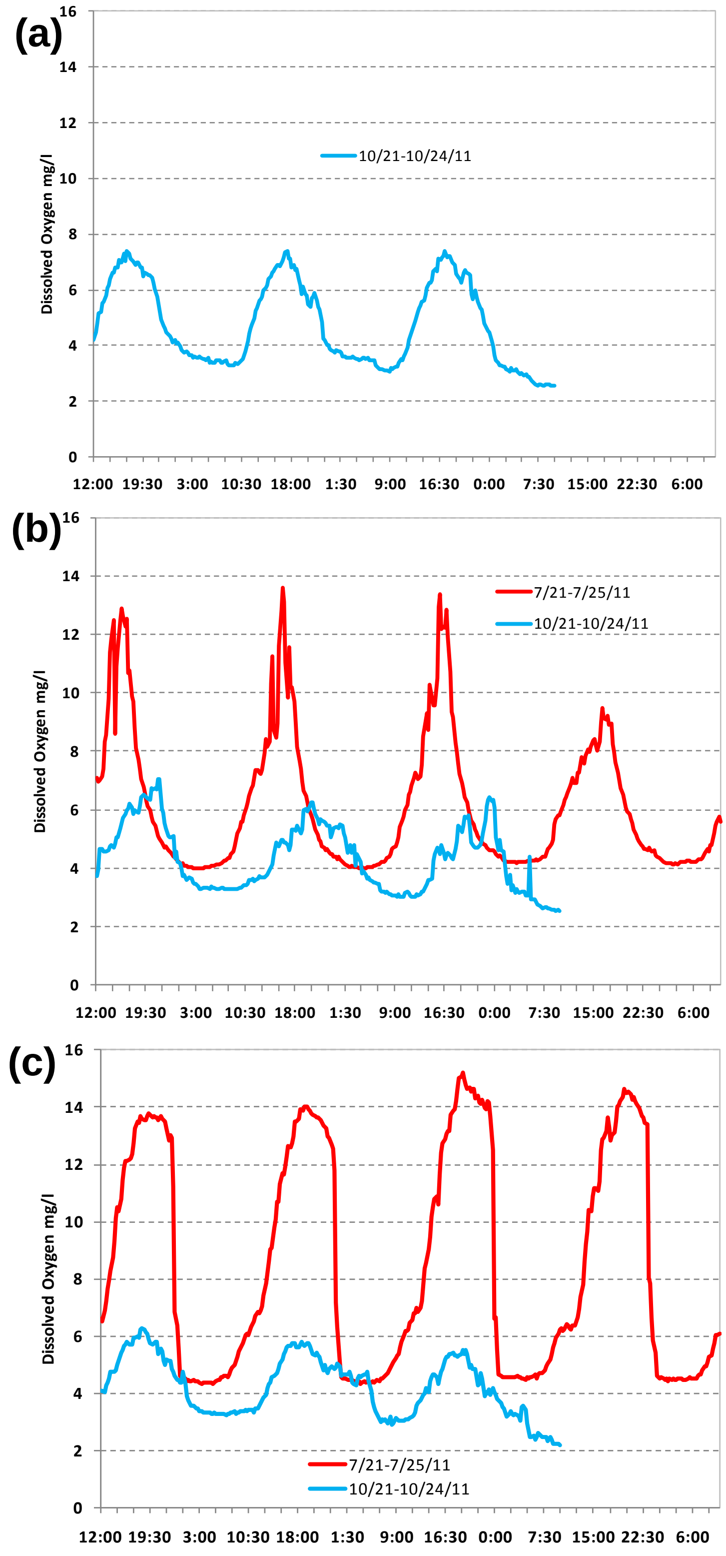


Figure 38: 2011 Encantado Pool (LSYR-4.95) sonde dissolved oxygen concentrations during two deployments over the dry season at the (a) surface, (b) middle, and (c) bottom of the water column. The surface DO probe malfunctioned during the July deployment.

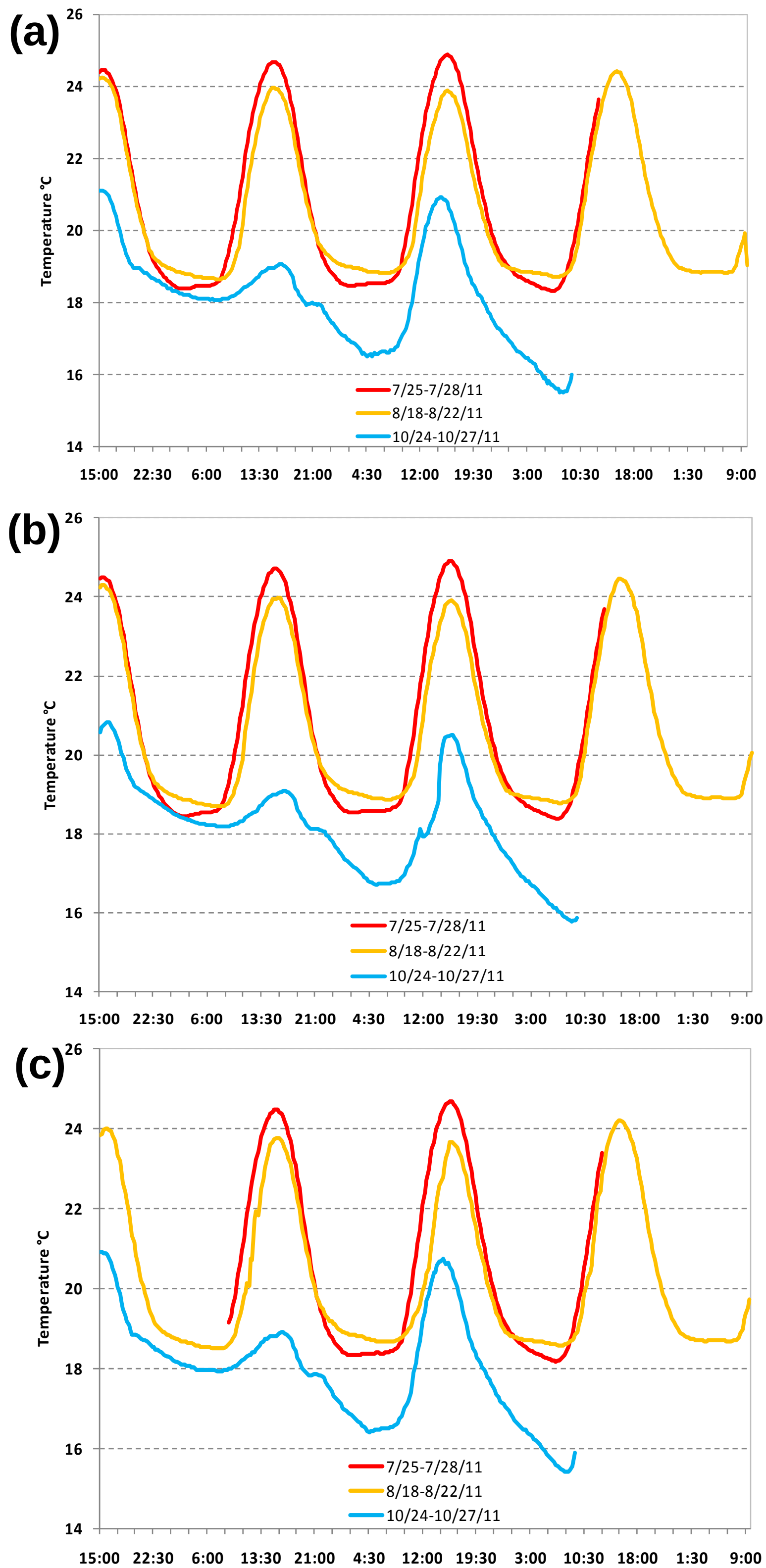


Figure 39: 2011 7.2 Pool (LSYR-7.2) sonde water temperatures during three deployments over the dry season at the (a) surface, (b) middle, and (c) bottom of the water column.

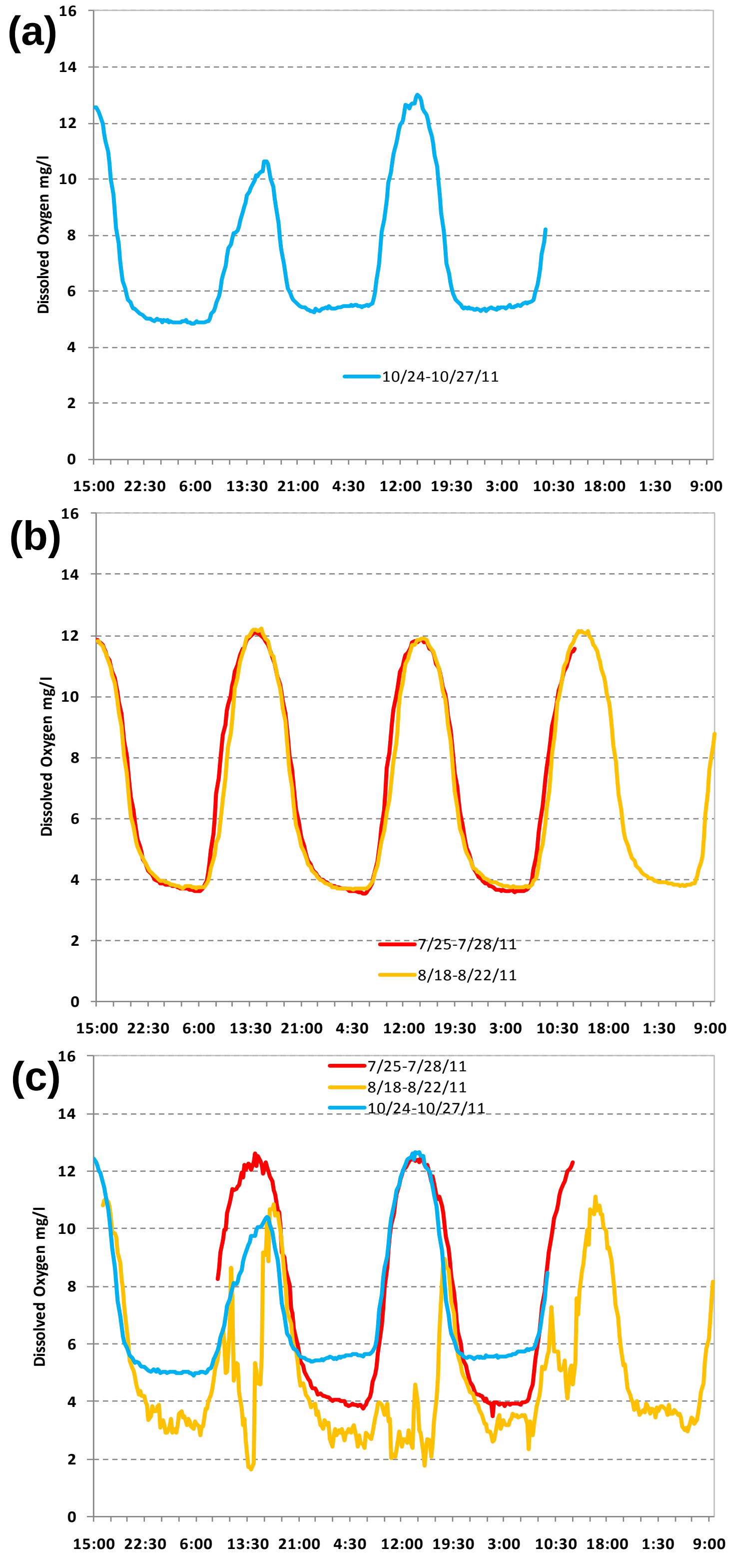


Figure 40: 2011 7.2 Pool (LSYR-7.2) sonde dissolved oxygen concentrations during three deployments over the dry season at the (a) surface, (b) middle, and (c) bottom of the water column. Several DO malfunctions occurred at this location.

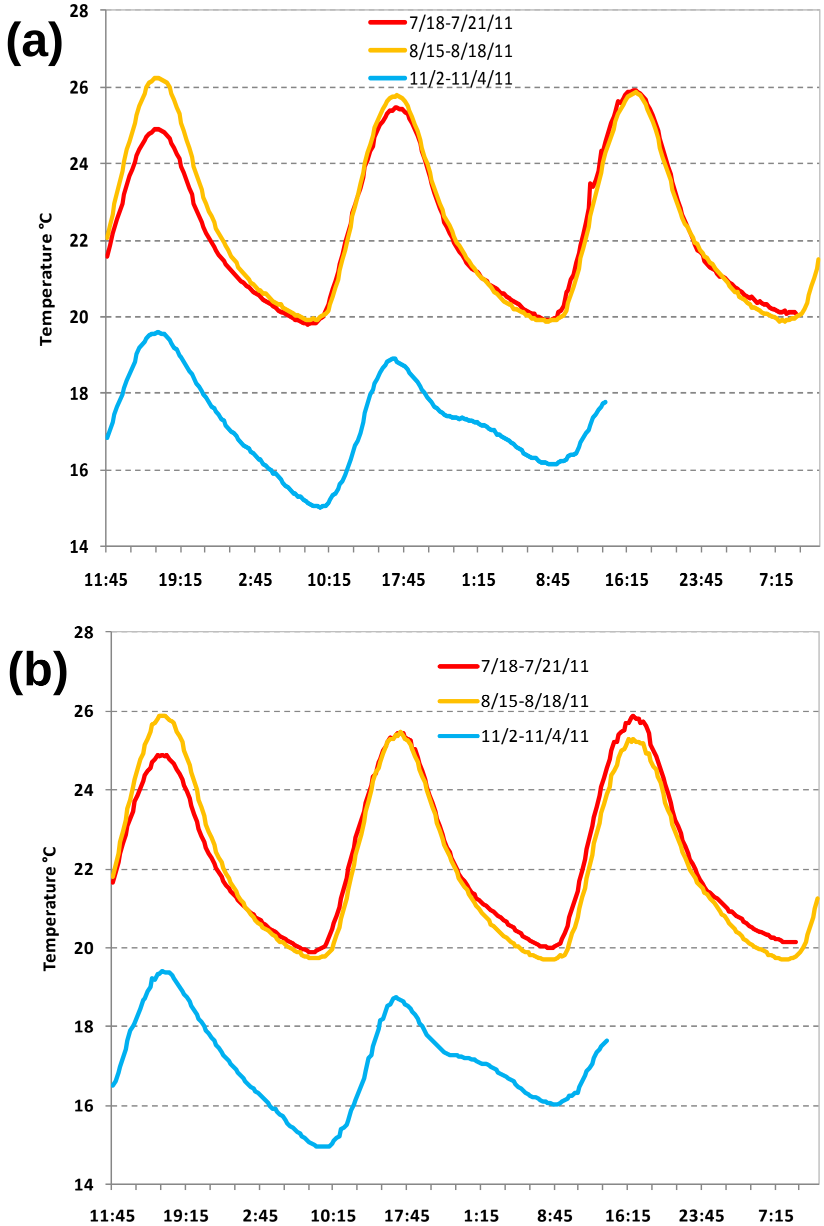


Figure 41: 2011 9.7 Pool (LSYR-9.7) sonde water temperatures during three deployments over the dry season at the (a) surface, and (b) bottom of the water column. This habitat was not deep enough for a middle sonde to be deployed.

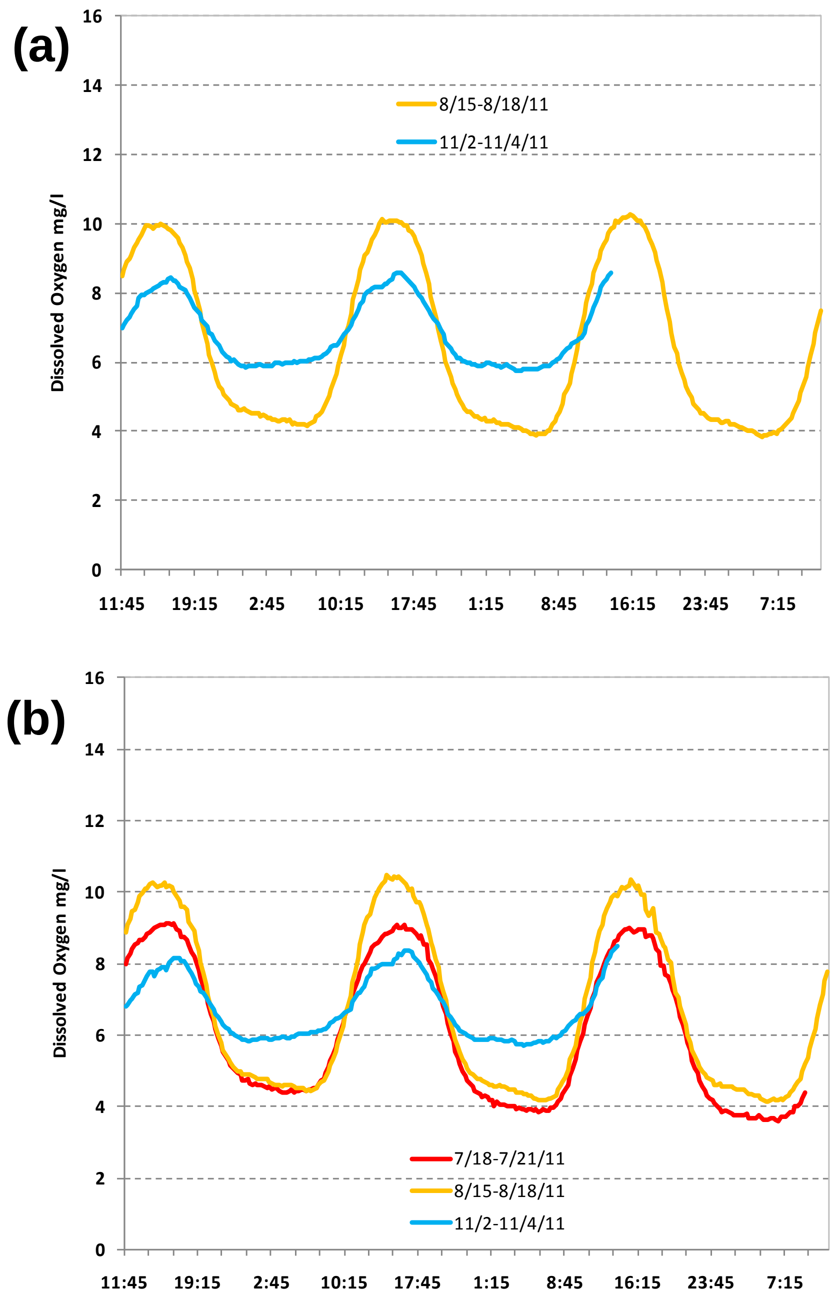
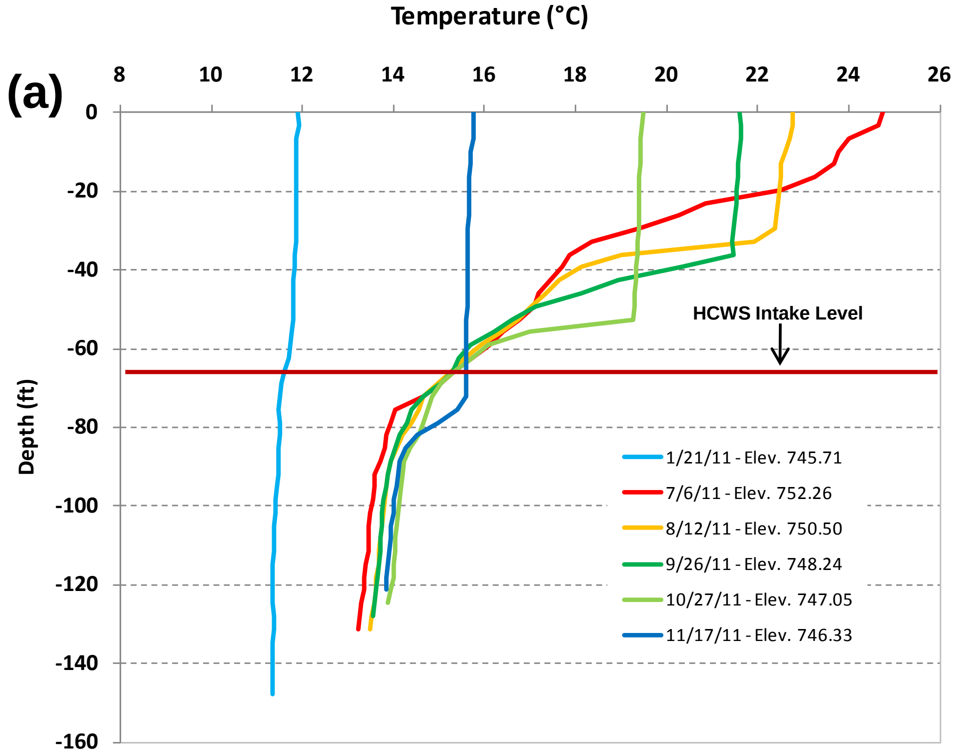


Figure 42: 2011 9.7 Pool (LSYR-9.7) sonde dissolved oxygen concentrations during three deployments over the dry season at the (a) surface, and (b) bottom of the water column. This habitat was not deep enough for a middle sonde to be deployed.



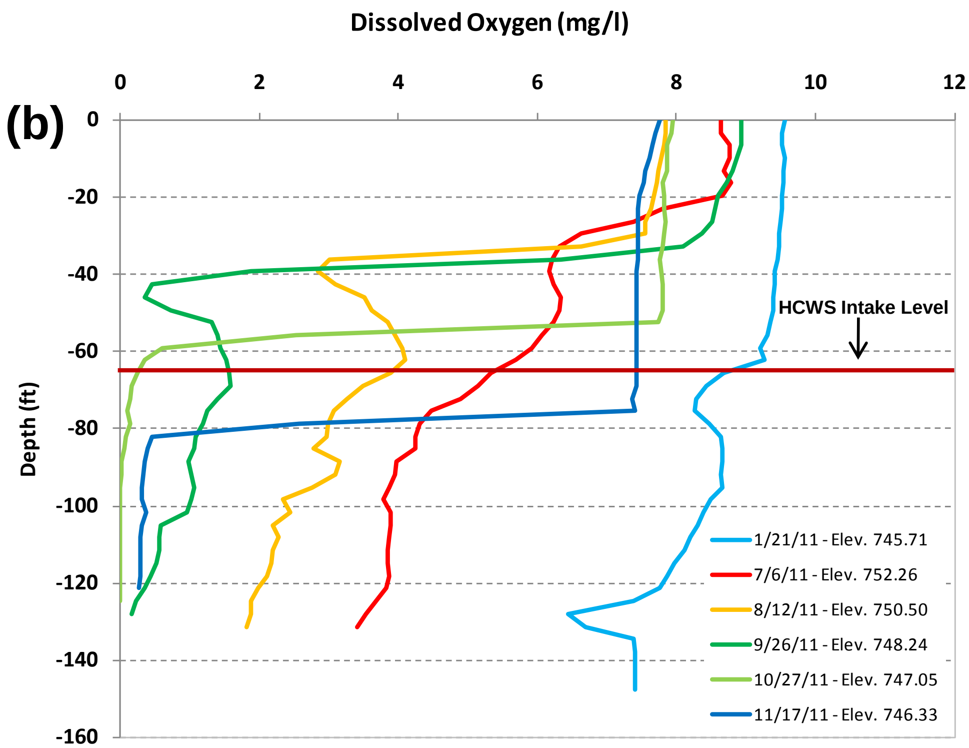


Figure 43: Lake Cachuma 2011 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS. HCWS intake hose level was set at 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

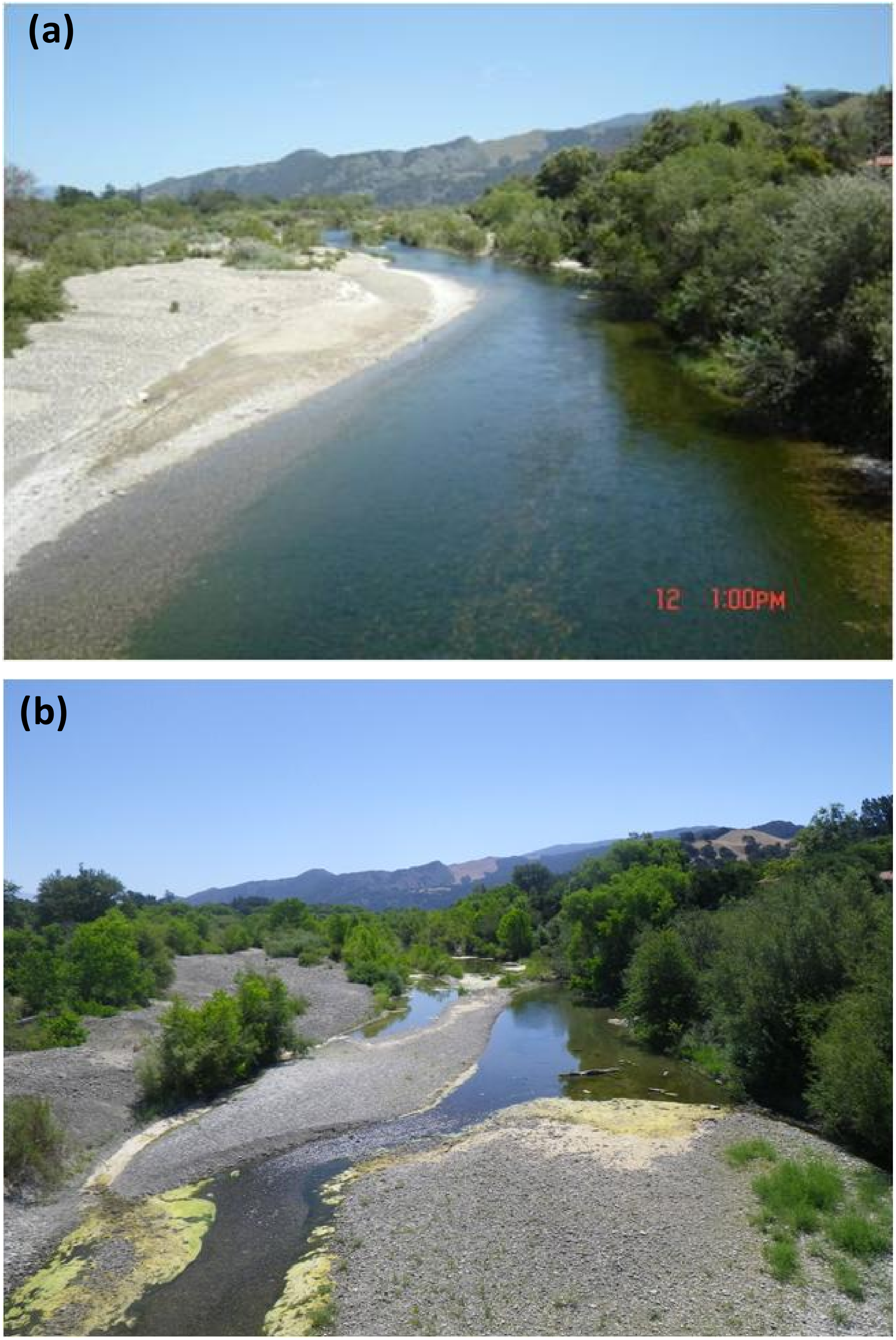


Figure 44: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) July 2011.

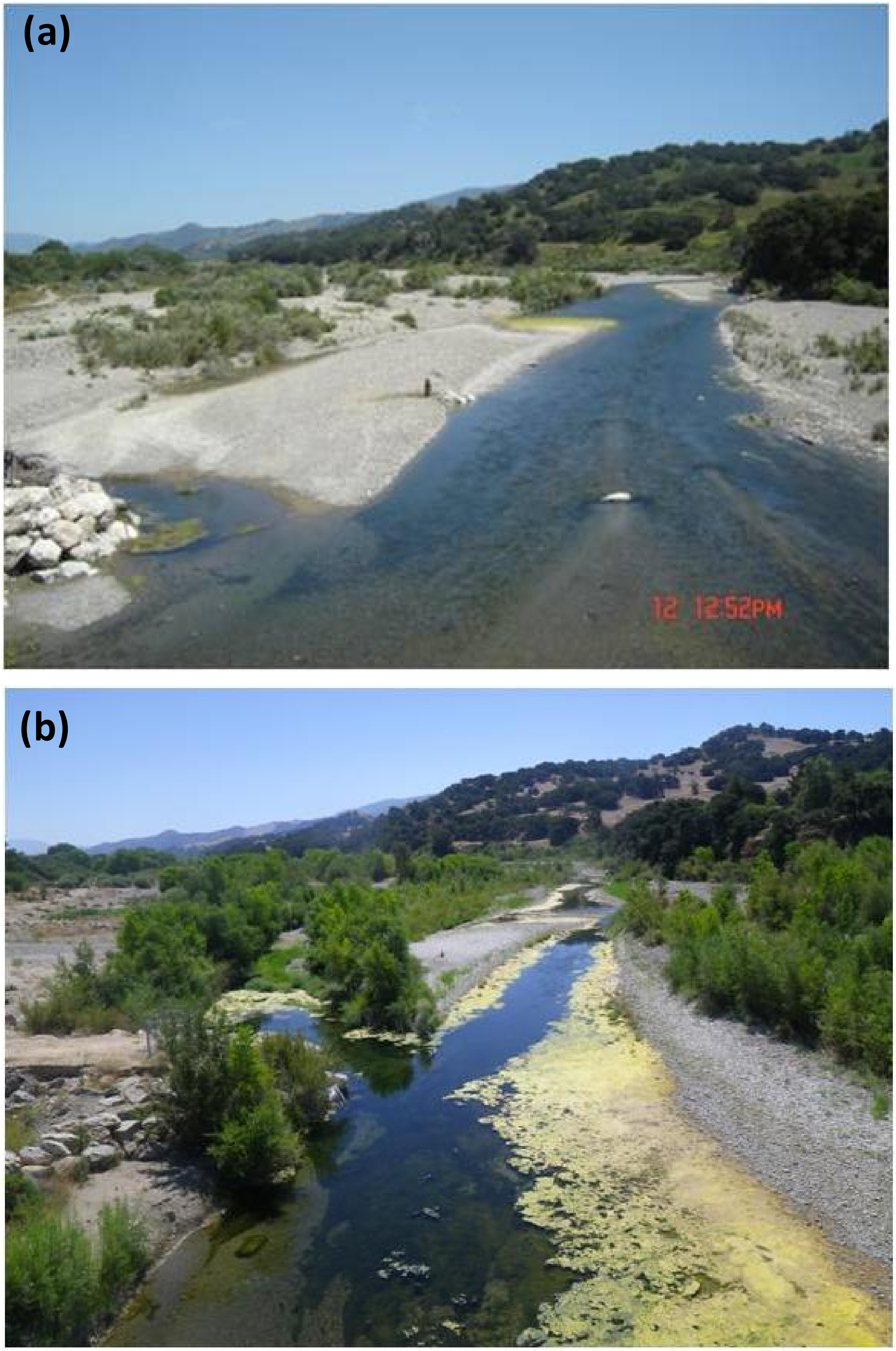


Figure 45: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) July 2011.

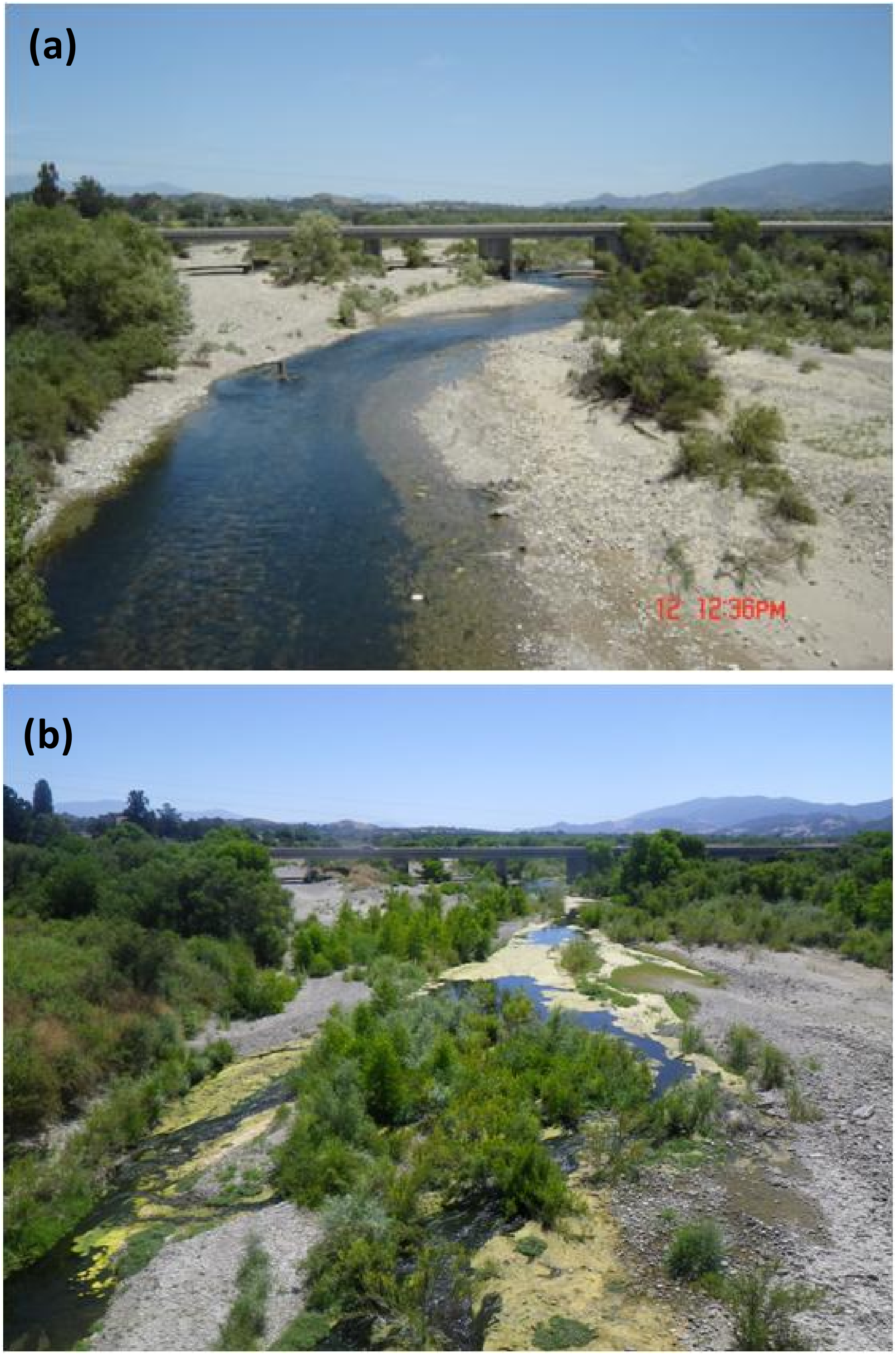


Figure 46: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) July 2011.

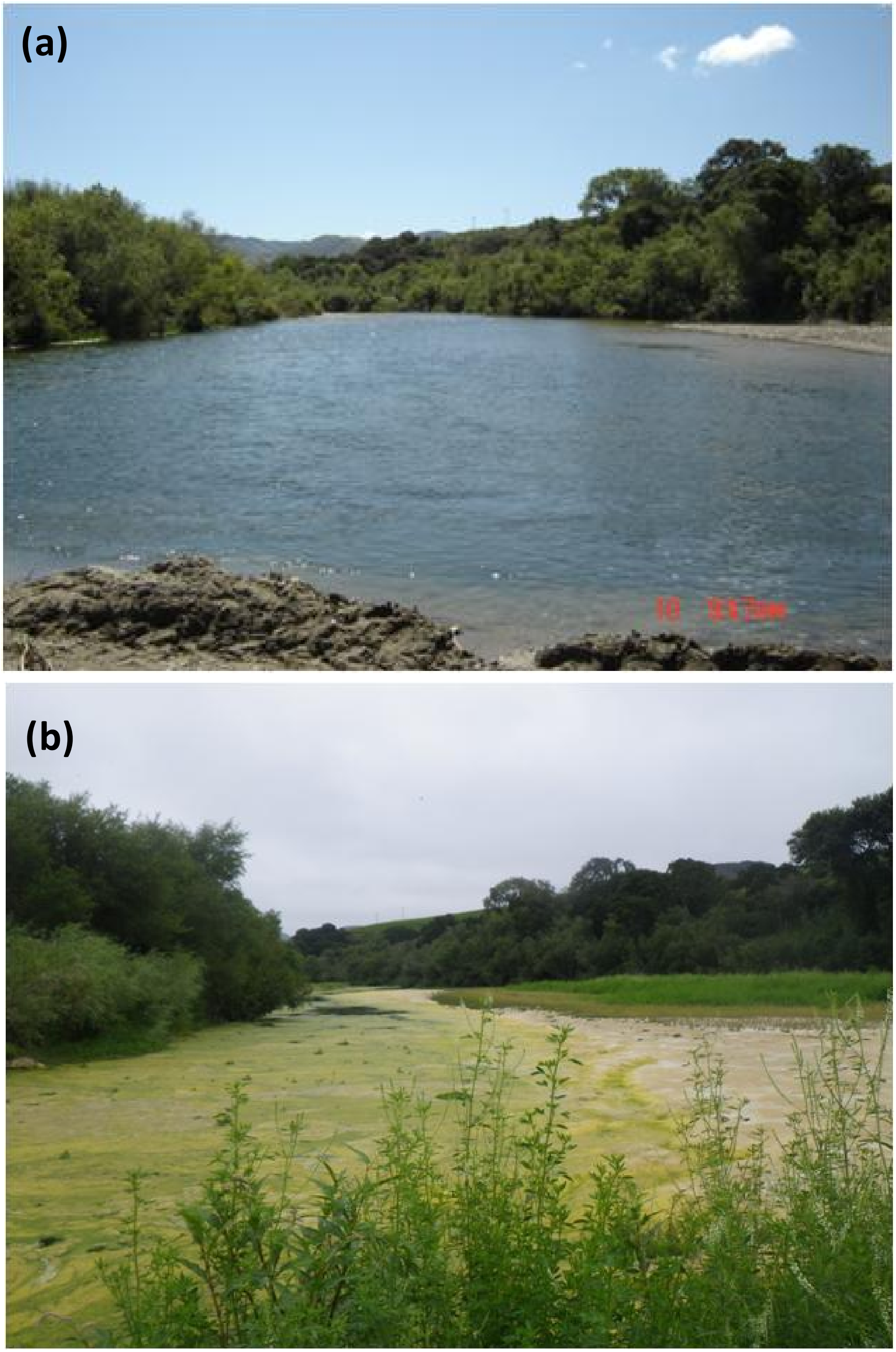


Figure 47: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) August 2011.

Figure 48: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) September 2011.

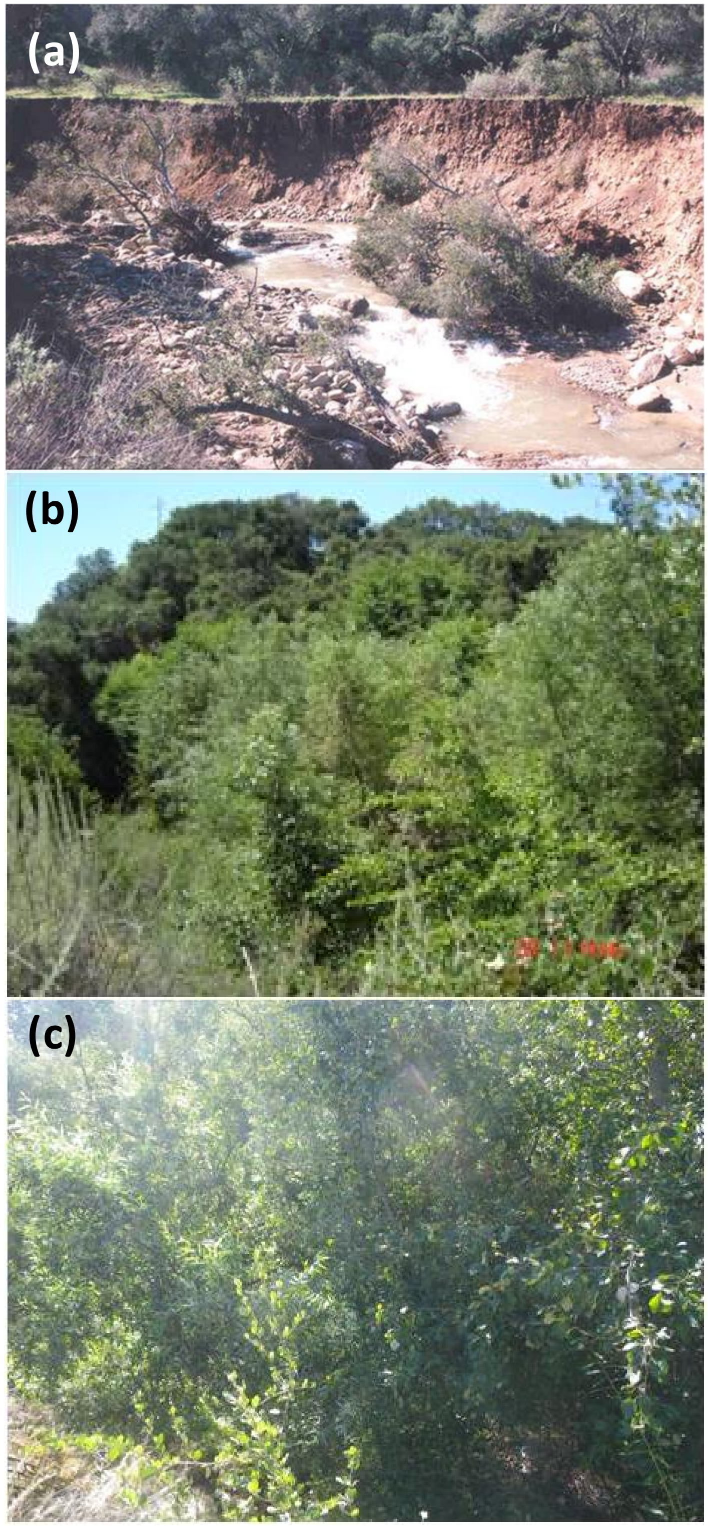


Figure 49: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) October 2011.

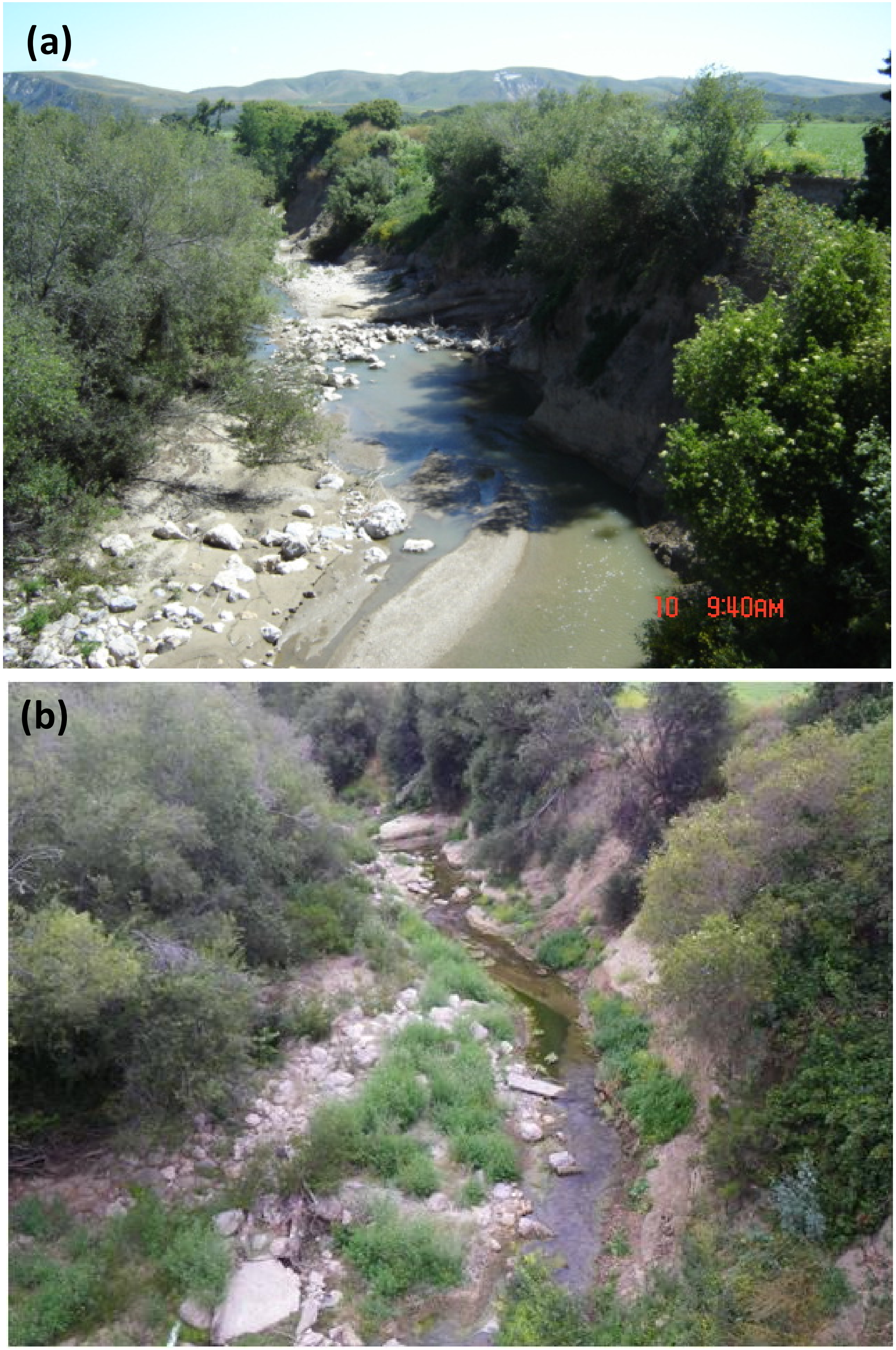


Figure 50: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) August 2011.

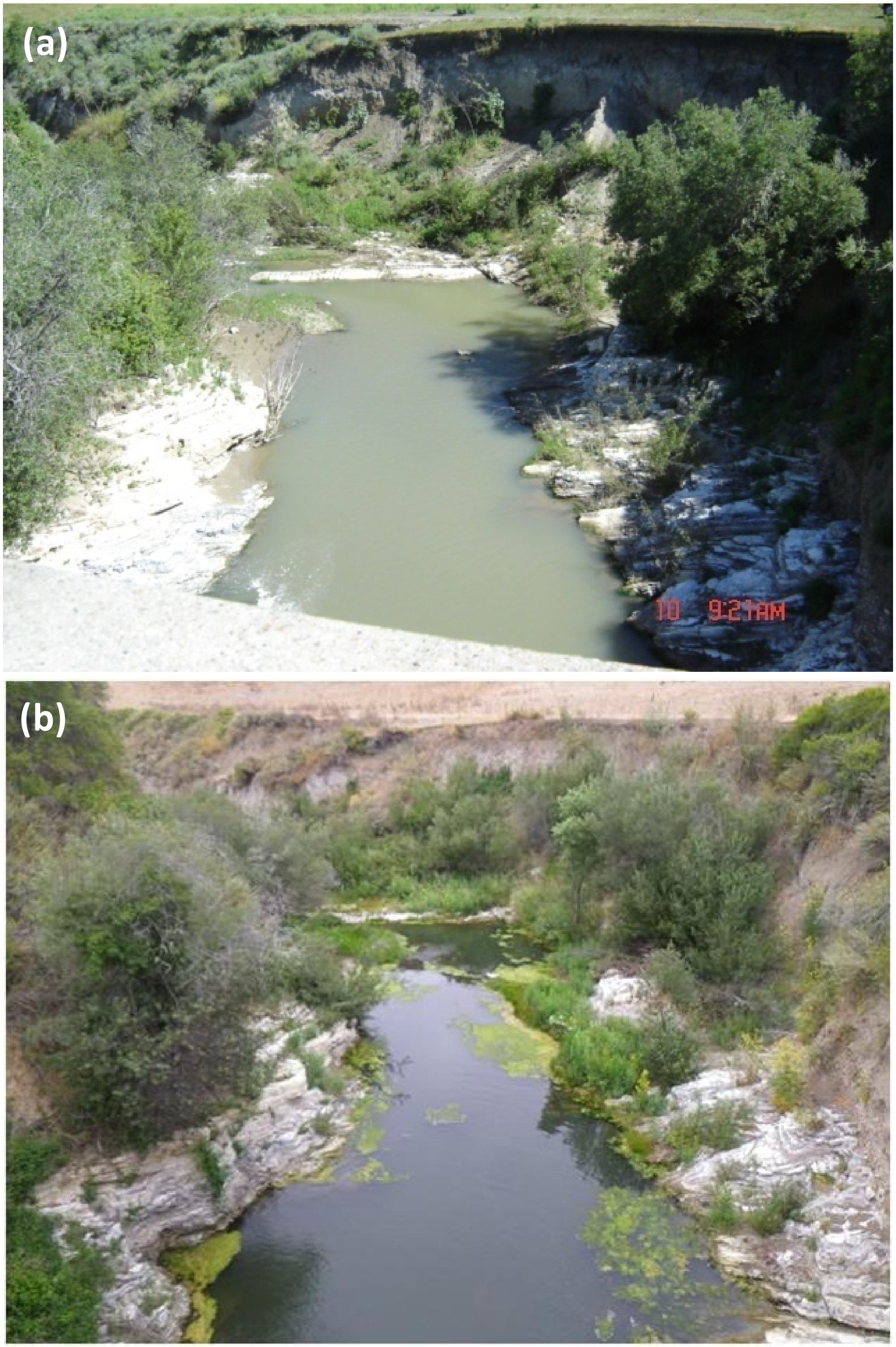


Figure 51: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) November 2008; no photo point was taken in August 2011.

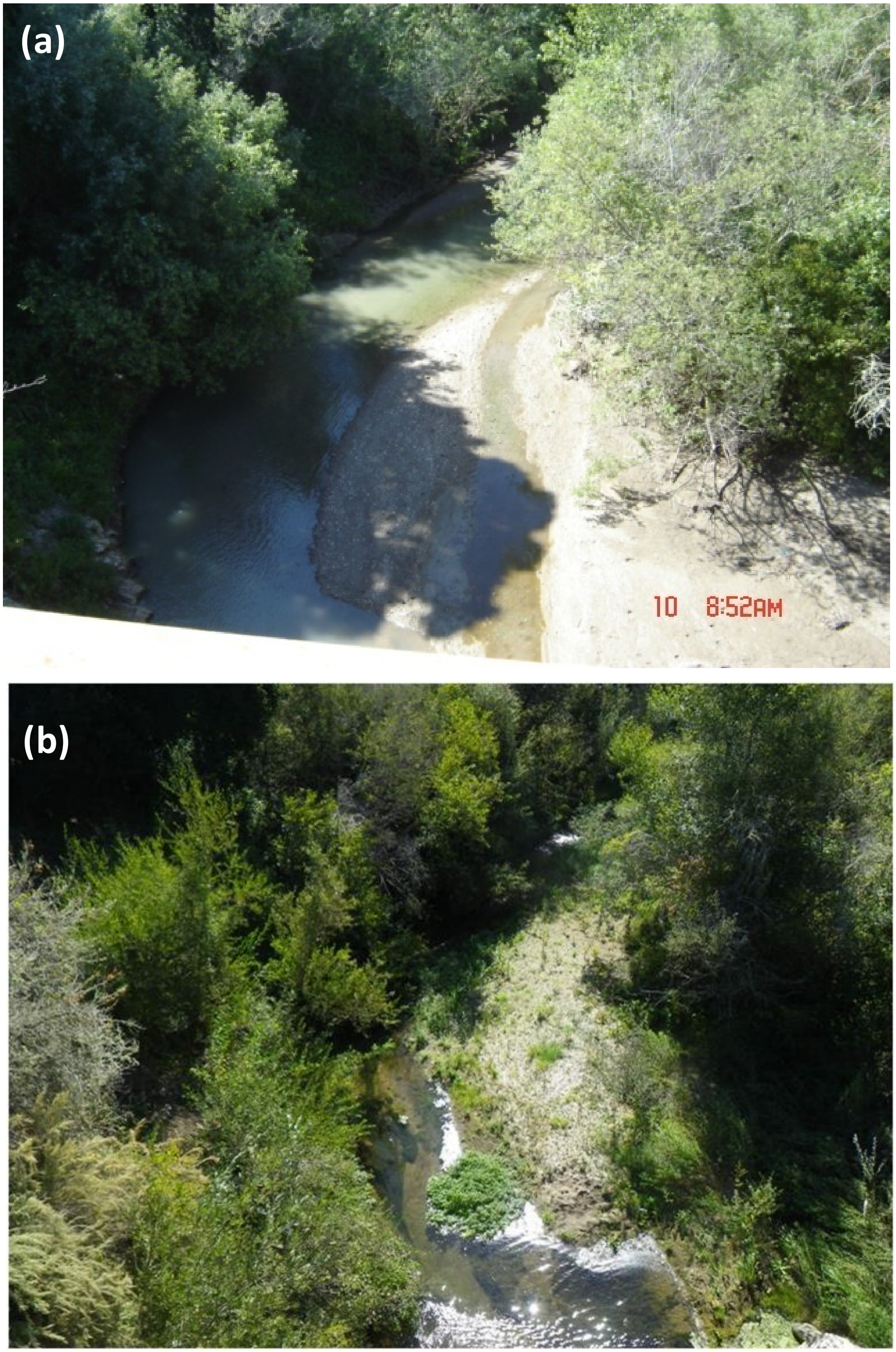


Figure 52: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) October 2011.

3.4 Migrant Trapping

Table 7: WY2011 migrant trap deployments.

Location	Date Traps Deployed (dates)	Date Trap Removed (dates)	Date Traps Removed (storm event) (dates)	Date Traps Installed (Storm Event) (dates)	# of Days Not Trapping (days)	Functional Trapping Days (days)	Functional Trapping % (days)
Hilton	1/6/2011	6/9/2011	2/18/2011	2/20/2011	2		
			2/25/2011	2/27/2011	2		
			3/19/2011	3/28/2011	9		
	Total:	153		**Total:**	13	140	91.5%
Salsipuedes	1/6/2011	6/9/2011	2/18/2011	2/20/2011	2		
			2/25/2011	2/27/2011	2		
			3/19/2011	3/30/2011	11		
			5/10/2011	5/11/2011	1		
	Total:	153		**Total:**	16	137	89.5%
Mainstem	1/6/2011	6/9/2011	2/18/2011	2/20/2011	2		
			2/25/2011	2/27/2011	2		
			3/19/2011	4/28/2011	39		
	Total:	153		**Total:**	43	110	71.9%

Table 8: WY2011 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)	Avg Flow	Median Flow
	(#)	(#)	(days)	(days)	(%)	(Captures/day)	(Captures/day)	(Captures/day)	(cfs)	(cfs)
Hilton	83	140	140	153	91.5	0.59	1.00	1.59	8.5	6.2
Salsipuedes	39	199	137	153	89.5	0.28	1.45	1.74	35.7	8.8
Mainstem	4	16	110	153	71.9	0.04	0.15	0.18	345.0	30

*Average (avg) 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 WY2011.

Location	Trap	Trap Check				Total
		1st AM	2nd AM	1st PM	2nd PM	
Salsipuedes	Upstream	16	6	7	10	39
	Downstream	87	13	13	86	199
	Total:	103	19	20	96	238
Mainstem	Upstream	2	1	0	1	4
	Downstream	5	2	1	8	16
	Total:	7	3	1	9	20
Hilton	Upstream	32	8	21	22	83
	Downstream	35	13	46	46	140
	Total:	67	21	67	68	223

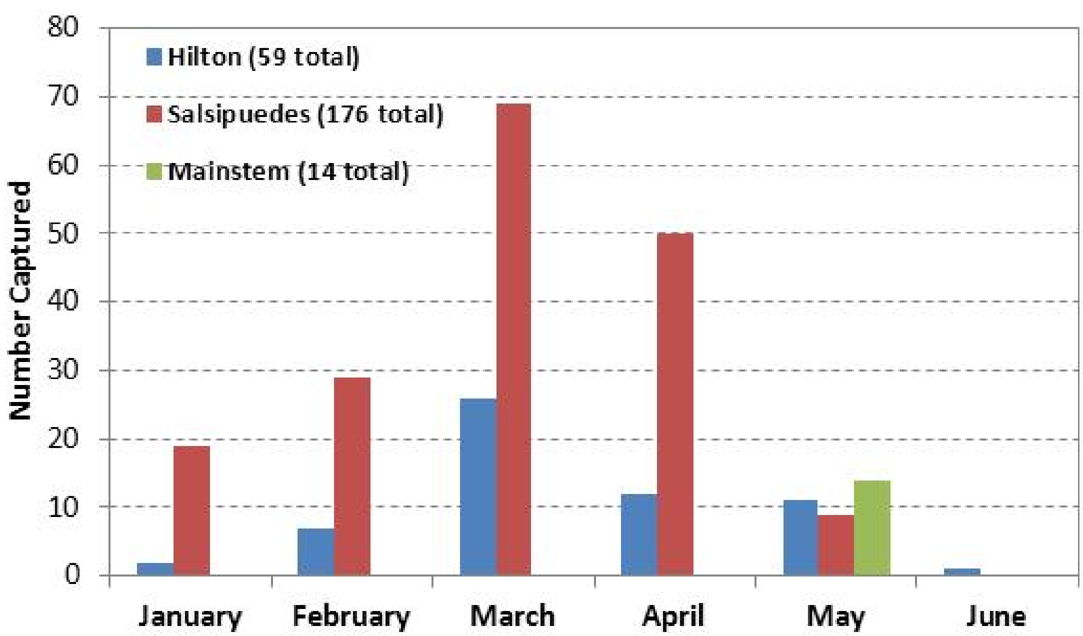


Figure 53: Timing of smolt migration observed at the Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps in WY2011.

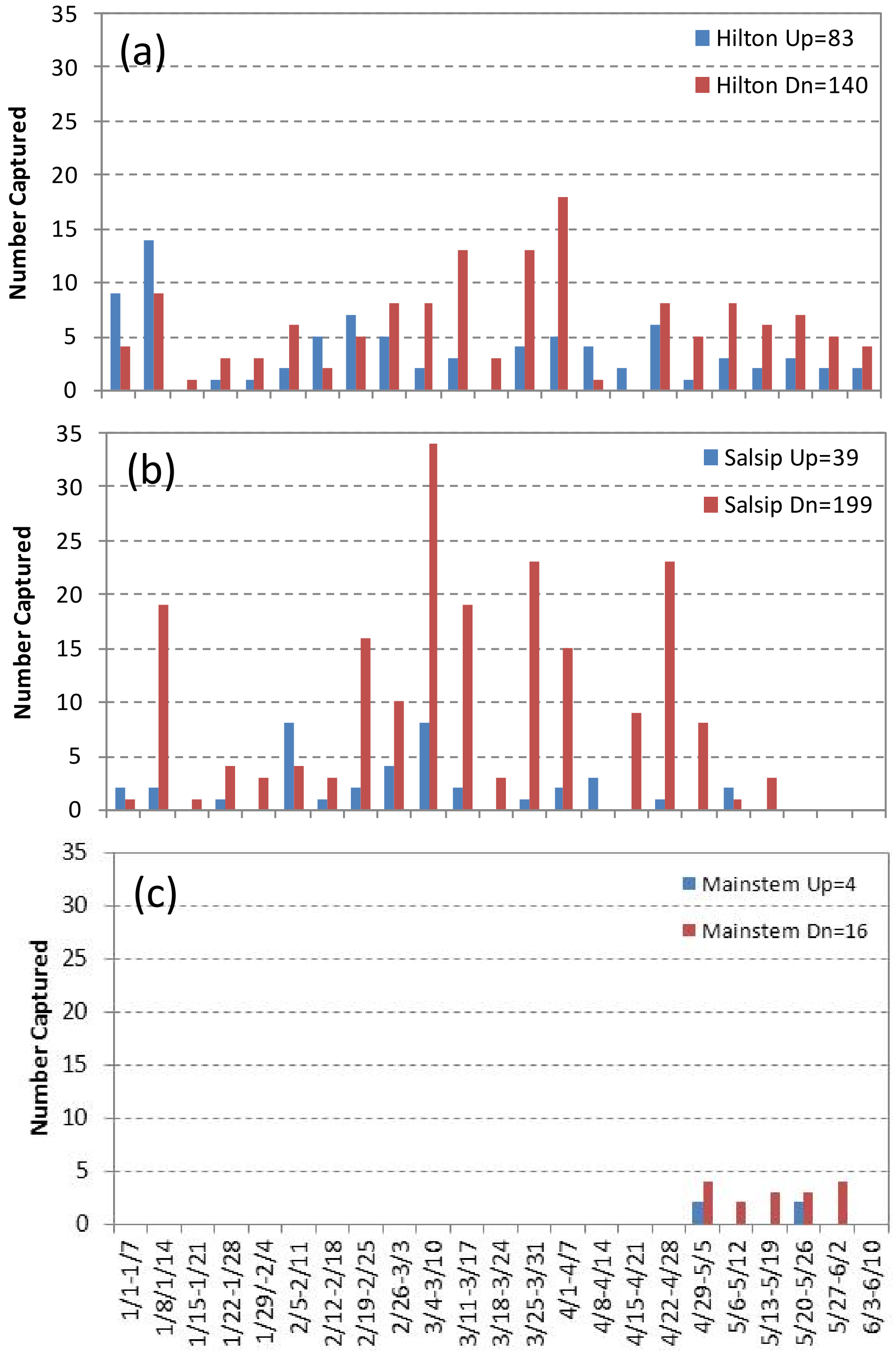


Figure 54: WY2011 paired histogram of weekly upstream and downstream captures by trap site for: (a) Hilton Creek, (b) Salsipuedes Creek, and (c) LSYR Mainstem.

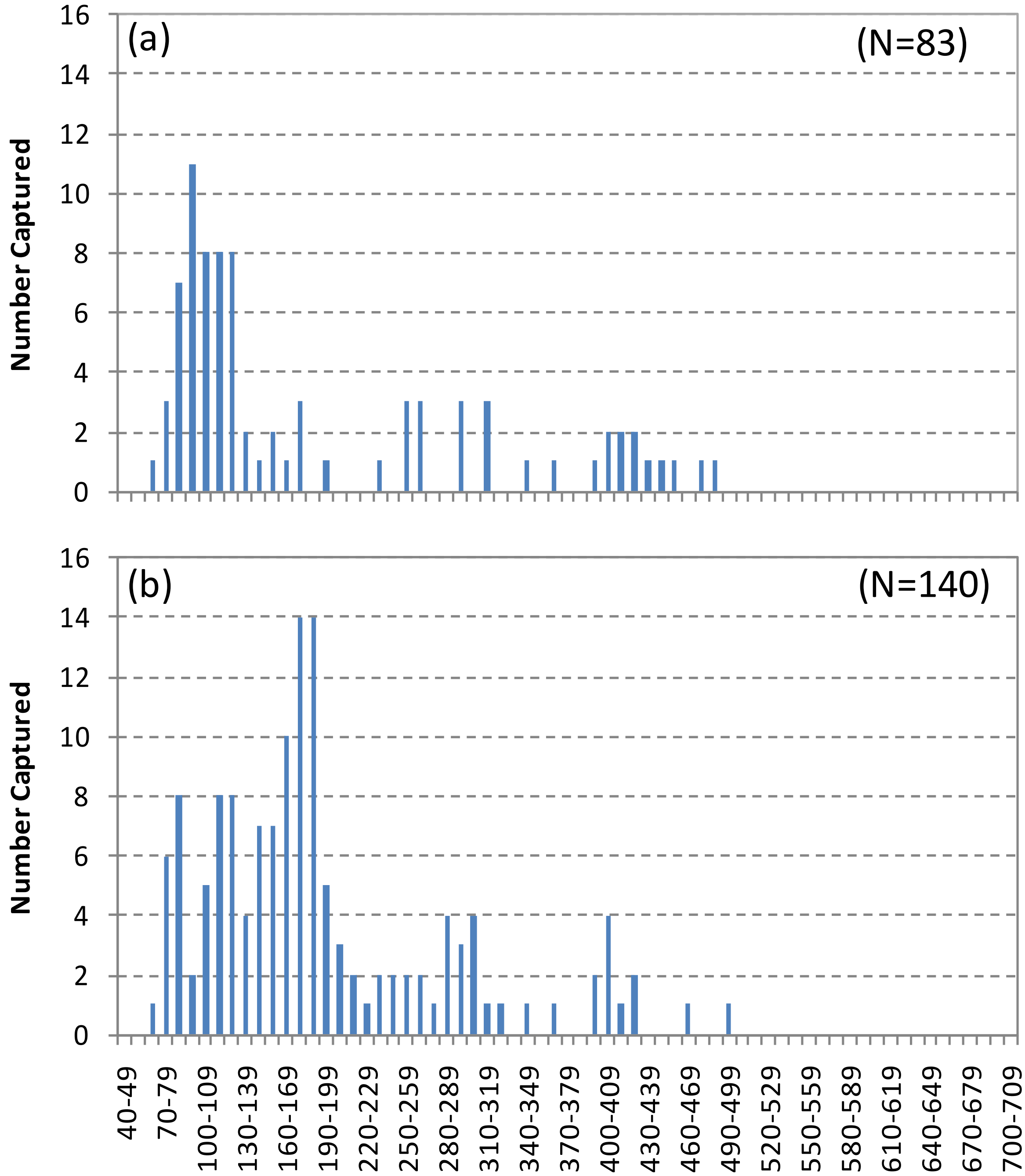
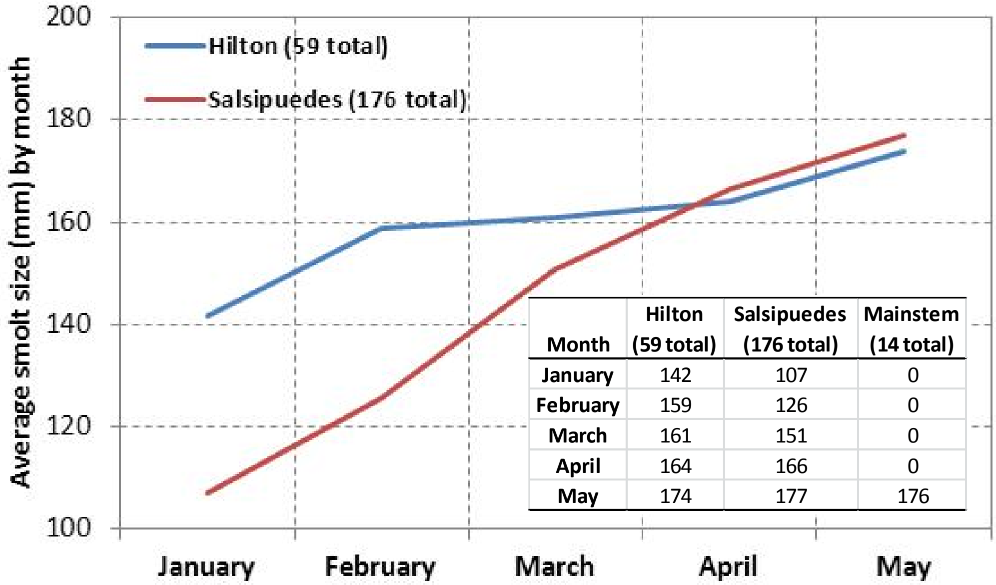


Figure 55: WY2011 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.



Month	Hilton (59 total)	Salsipuedes (176 total)	Mainstem (14 total)
January	142	107	0
February	159	126	0
March	161	151	0
April	164	166	0
May	174	177	176

Figure 56: WY2011 monthly average smolt size in mm at the three trapping sites; the LSYR mainstem site graph was not shown.

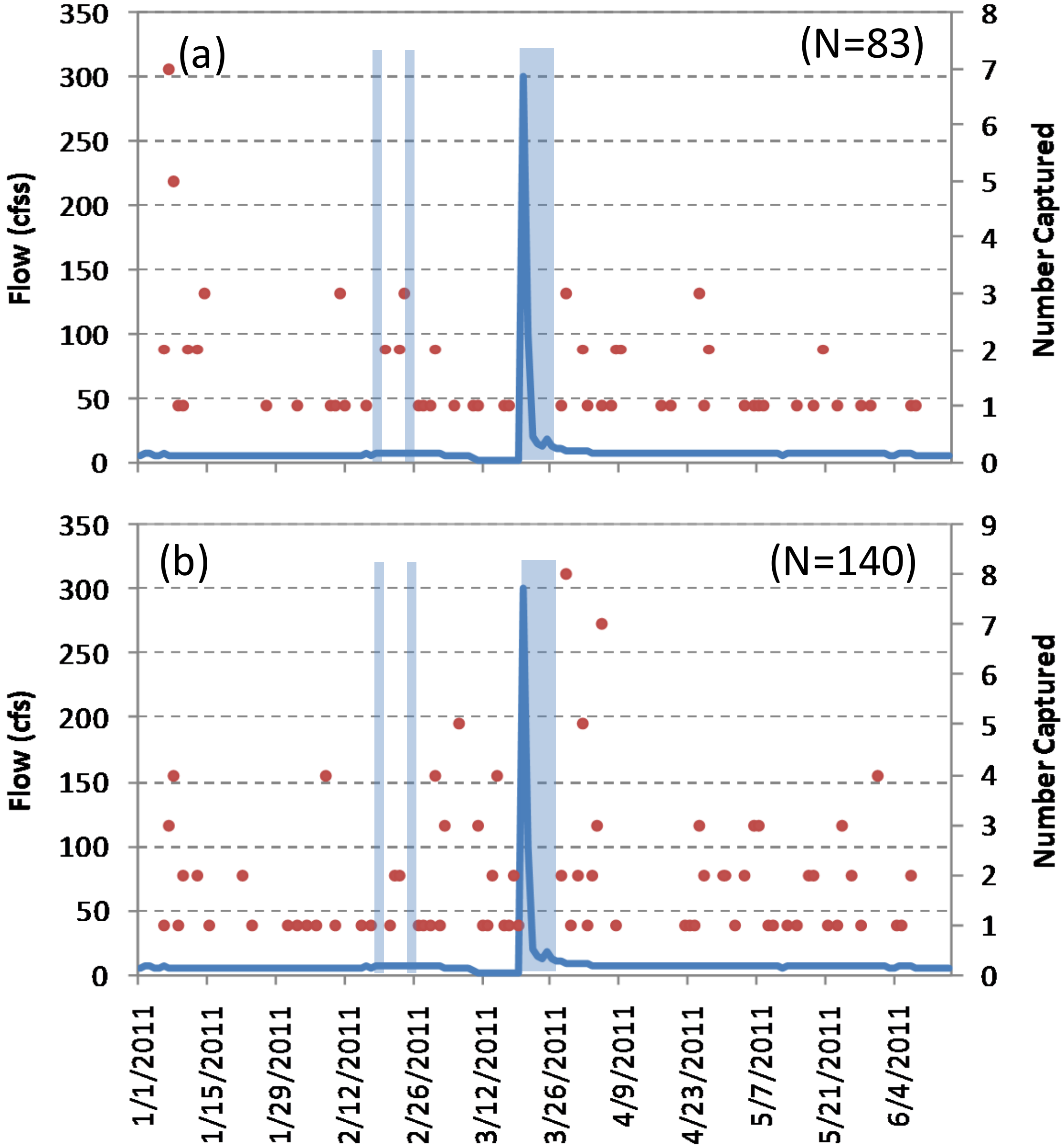


Figure 57: WY2011 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures. The blue rectangles bracket times when migrant traps were removed due to stormflow events.

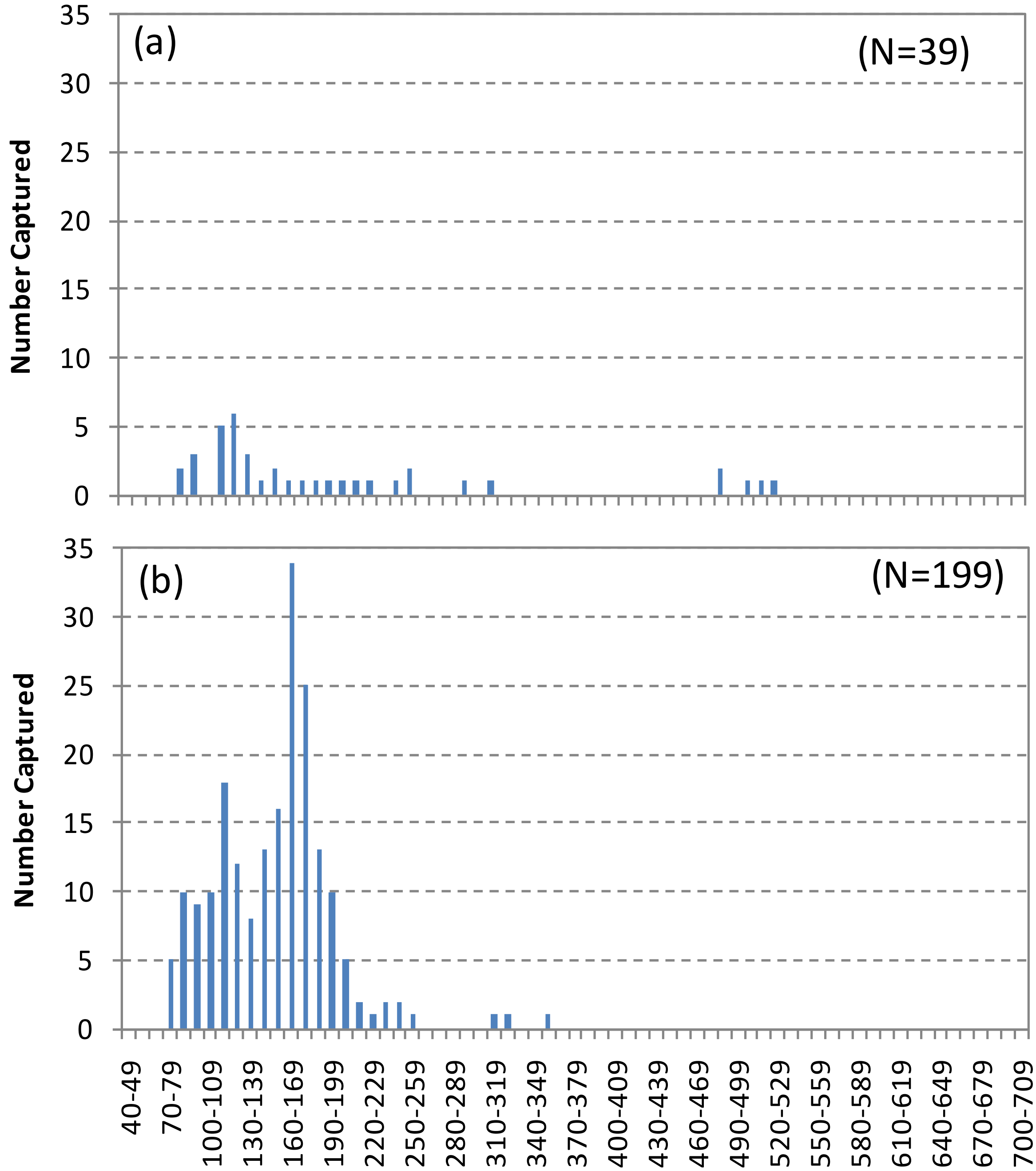


Figure 58: WY2011 Salsipuedes Creek trap length-frequency in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

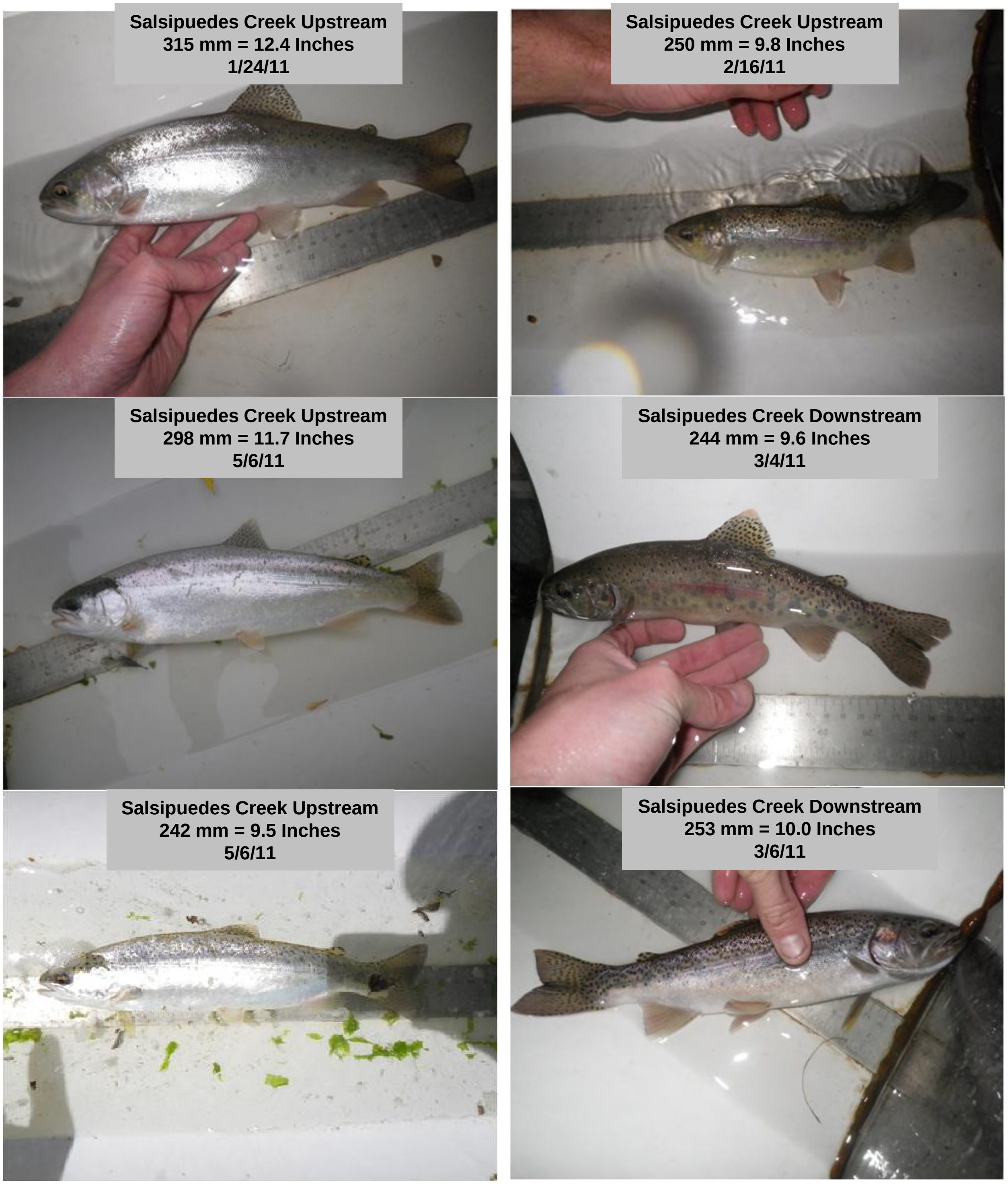


Figure 59: WY2011 Salsipuedes Creek potential LSYR lagoon fish caught on 1/24/11 and 5/6/11 in the left column and similar sized resident *O. mykiss* in the right column that depict the difference in origin between the two.

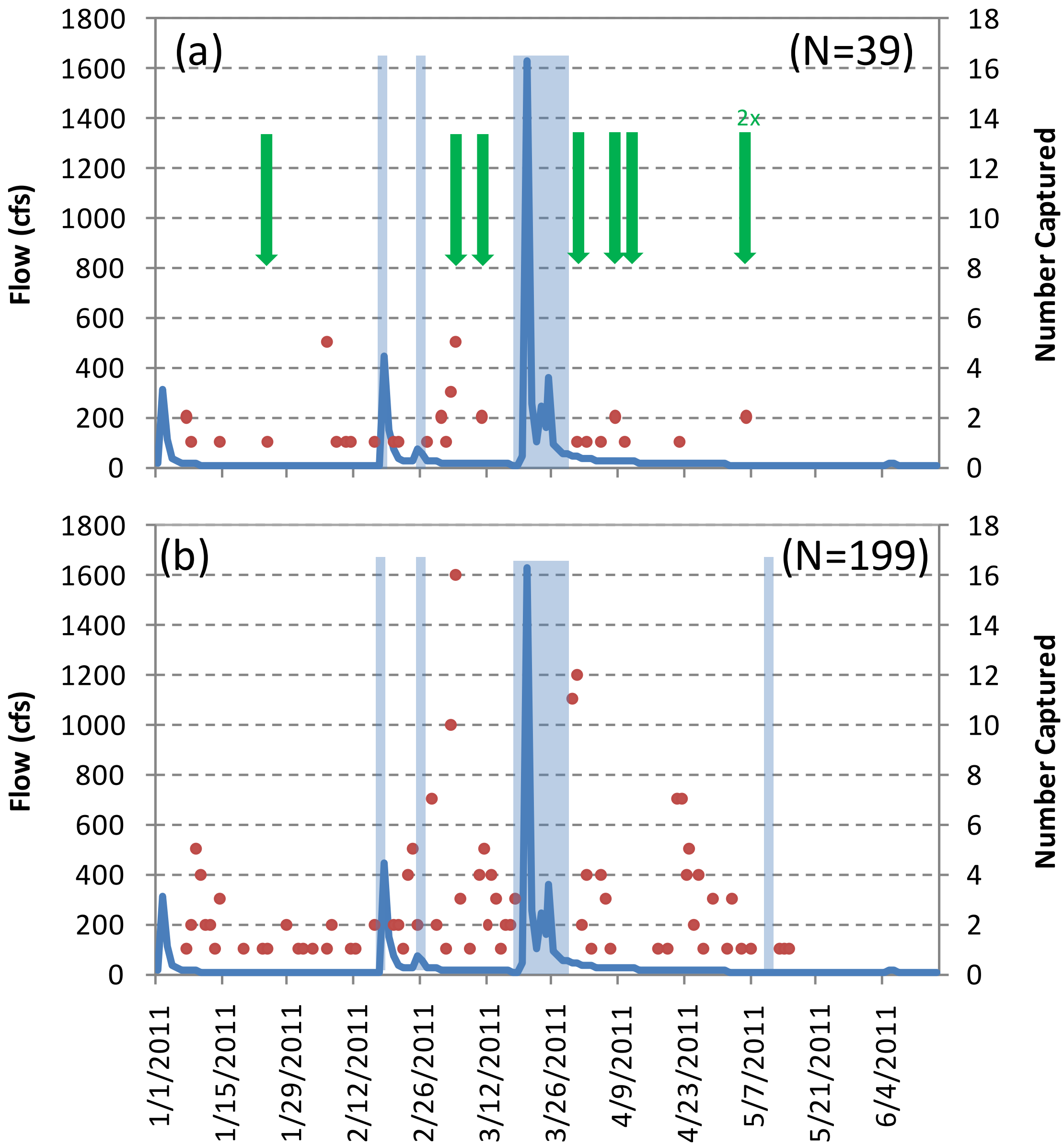


Figure 60: WY2011 Salsipuedes Creek migrant captures (red dots) vs. flow for (a) upstream and (b) downstream migrants. The blue rectangles bracket times when migrant traps were removed due to storm events, and the green arrow denotes when an adult steelhead was captured.

Table 10: Upstream and downstream migrant captures for Hilton Creek, Salsipuedes Creek, and the Mainstem in WY2011. Blue lettering represents breakdown of smolts, pre-smolts, and resident trout for each size category; there were 59, 176, 14 smolts and pre-smolts observed at Hilton, Salsipuedes, and the LSYR mainstem traps, respectively.

Hilton Captures		Size		Salsipuedes Captures
(#)		(mm)		(#)
		Upstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
0		550-599		0
0		500-549		3
0		450-499		2
11		400-450		0
6		300-399		1
10		200-299		7
34		101-199		21
22		<100		5
83		**Total**		**39**
		Downstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
0		550-599		0
0		500-549		0
2		450-499		0
7		400-449		0
10		300-399		3
22		200-299		13
	4	*Smolts*	*2*	
	0	*Pre-Smolt*	*1*	
	18	*Res*	*10*	
82		101-199		158
	36	*Smolts*	*100*	
	17	*Pre-Smolt*	*55*	
	29	*Res*	*3*	
17		<100		25
	0	*Smolts*	*0*	
	2	*Pre-Smolt*	*18*	
	15	*Res*	*7*	
140		**Total**		**199**

Size	Mainstem Captures	
(mm)		(#)
Upstream Trap		
>700		0
650-699		0
600-649		0
550-599		0
500-549		0
450-499		2
400-450		0
300-399		1
200-299		1
101-199		0
<100		0
Total		**4**
Downstream Trap		
>700		0
650-699		0
600-649		0
550-599		0
500-549		0
450-499		0
400-450		0
300-399		1
200-299		5
Smolts	*5*	
Pre-Smolt	*0*	
Res	*0*	
101-199		9
Smolts	*6*	
Pre-Smolt	*3*	
Res	*0*	
<100		1
Smolts	*0*	
Pre-Smolt	*0*	
Res	*1*	
Total		**16**

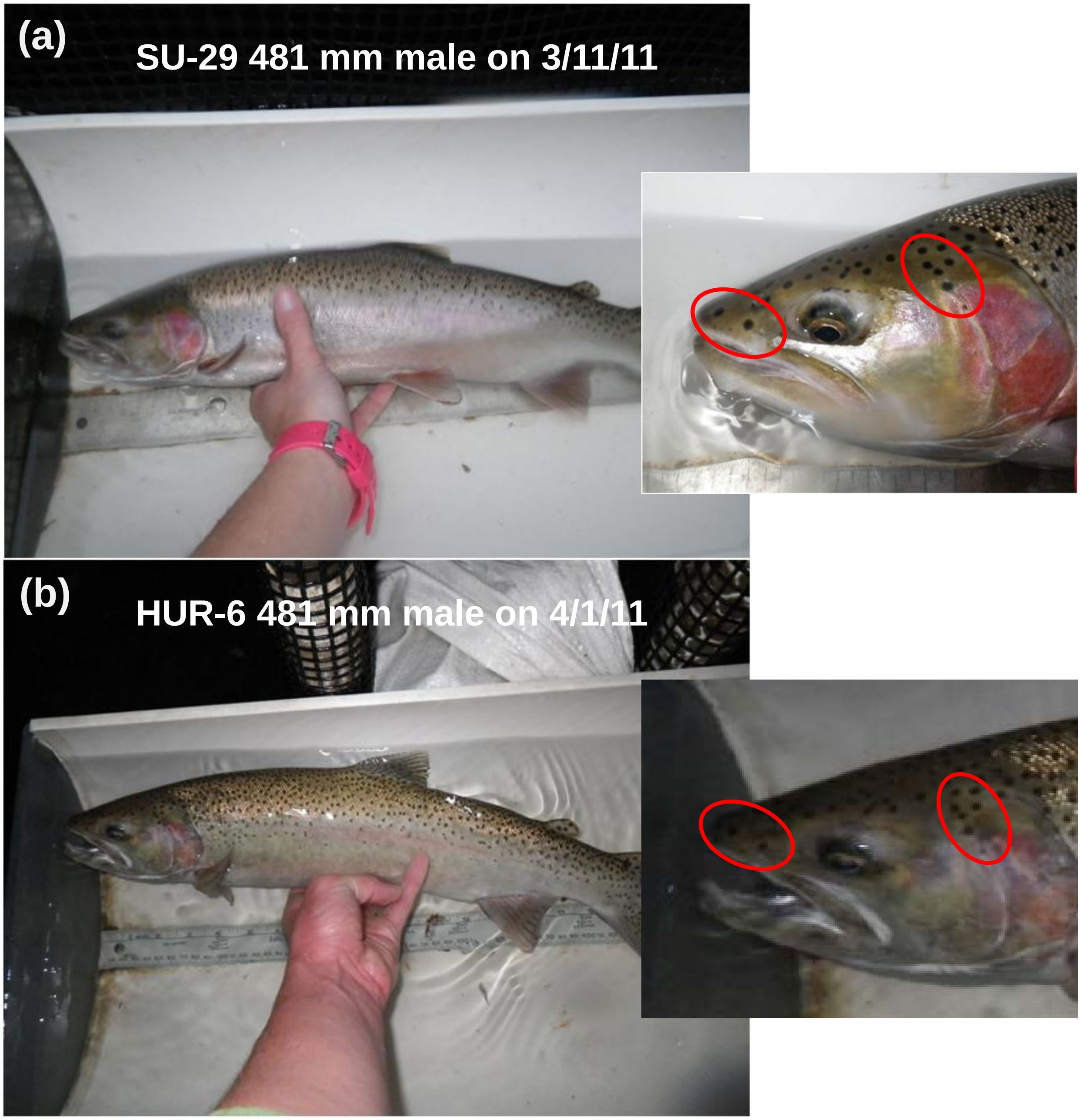


Figure 61: WY2011 adult steelhead captured at (a) Salsipuedes Creek on 3/11/11 and again at (b) Hilton Creek on 4/1/11 showing identical spot patterns.

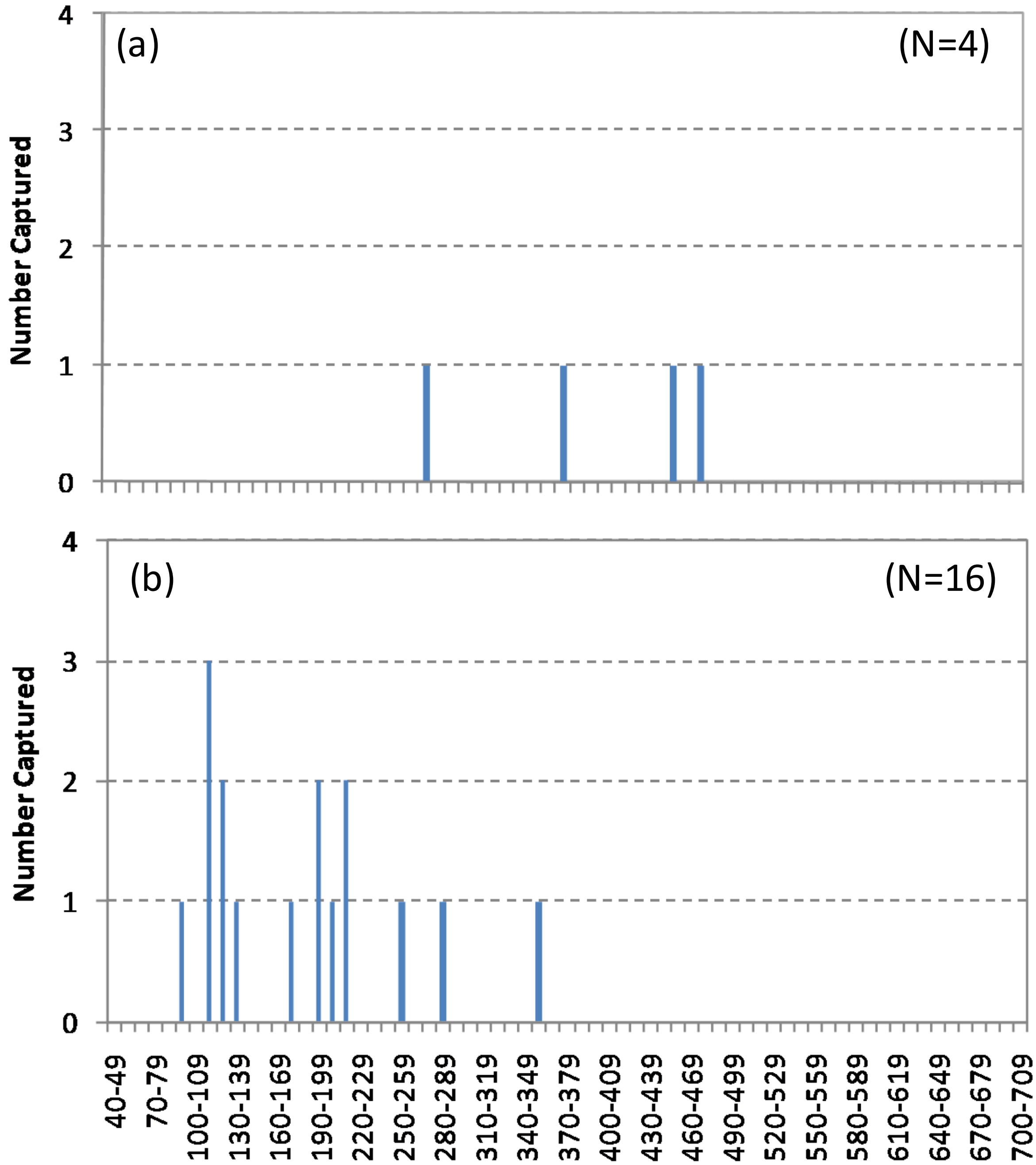


Figure 62: WY2011 LSYR mainstem trap length-frequency in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

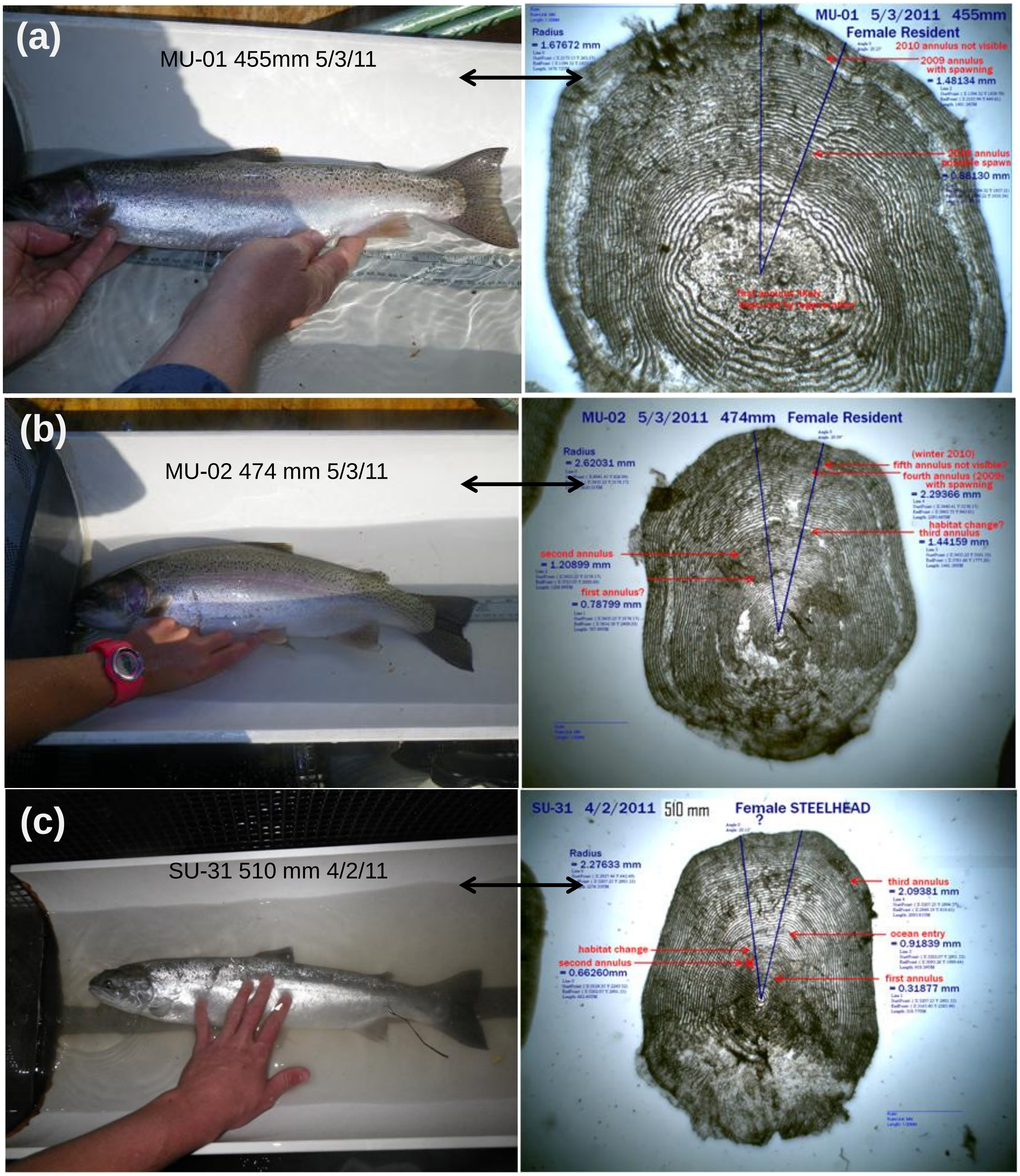


Figure 63: A photo collage showing (a) LSYR mainstem upstream 455 mm (17.9 in) migrant capture, (b) LSYR mainstem upstream 474 mm (18.7 in) migrant capture, and (c) Salsipuedes Creek upstream 510 mm (20.1 in) migrant capture for comparison, with their associated scale analysis.

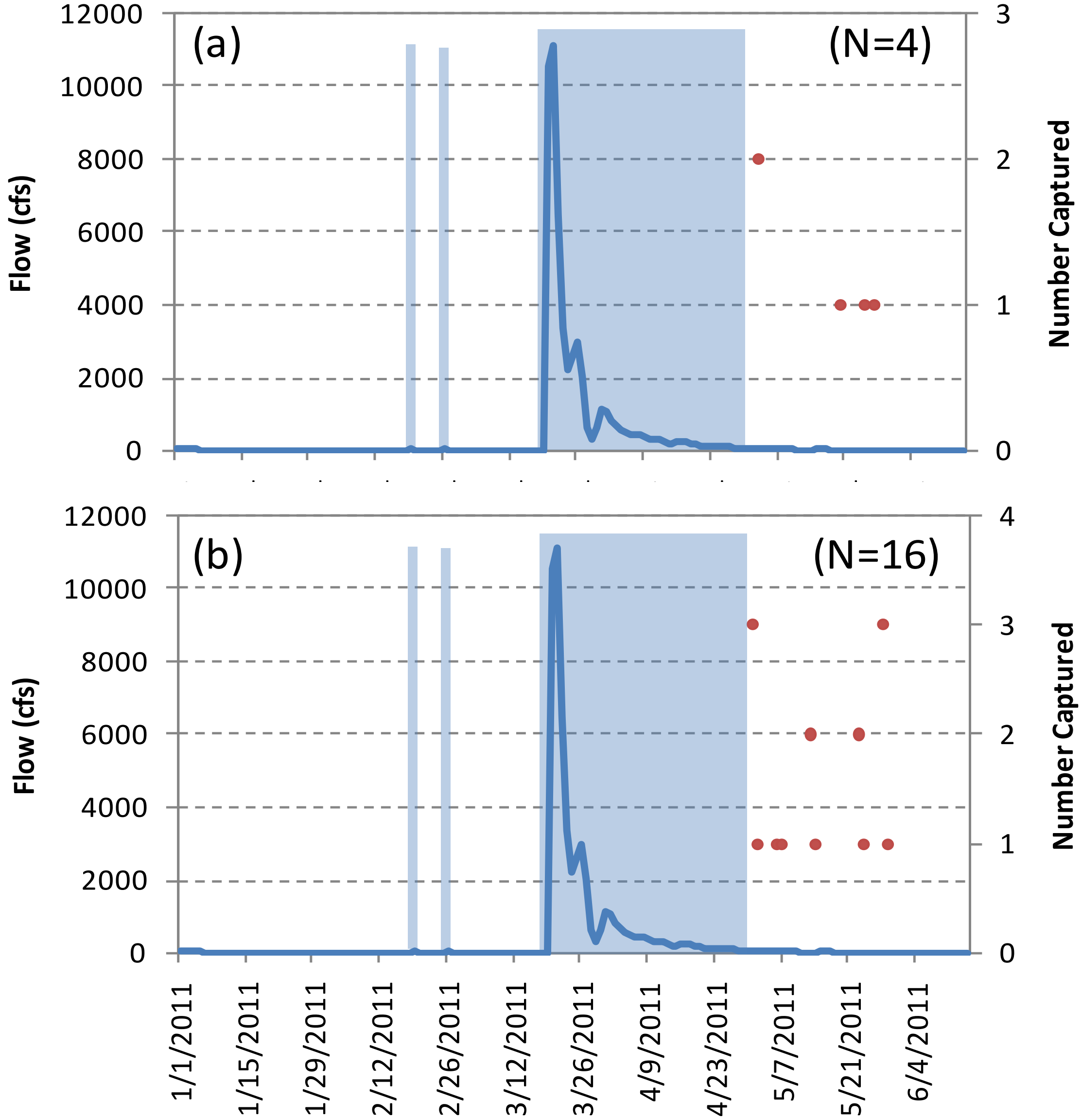


Figure 64: 2011 Santa Ynez River mainstem migrant captures (red dots) vs. flow for (a) upstream and (b) downstream migrants. The blue rectangles bracket times when migrant traps were removed due to storm events.

Table 11: Summary of recapture highlights during the 2011 trapping season.

Capture Location					Recapture Location					Time
(Trap*)	(Direction)	(Date)	Size (mm)	Type	(Trap*)	(Direction)	(Date)	Size (mm)	Type	Between Captures
SC	Upstream	3/11/11	481	Steelhead	HC-R-06	Upstream	4/1/11	481	Steelhead	21
MS	Upstream	5/25/11	376	Resident	MS-C	Found**	5/27/11	378	Resident	2

*HC - Hilton Creek, MS - LSYR mainstem, and SC - Salsipuedes Creek trap sites; R - recapture and C - carcus.

** Fish was found upstream of the trap, dead with a deep puncture wound on the head (likely heron predation).

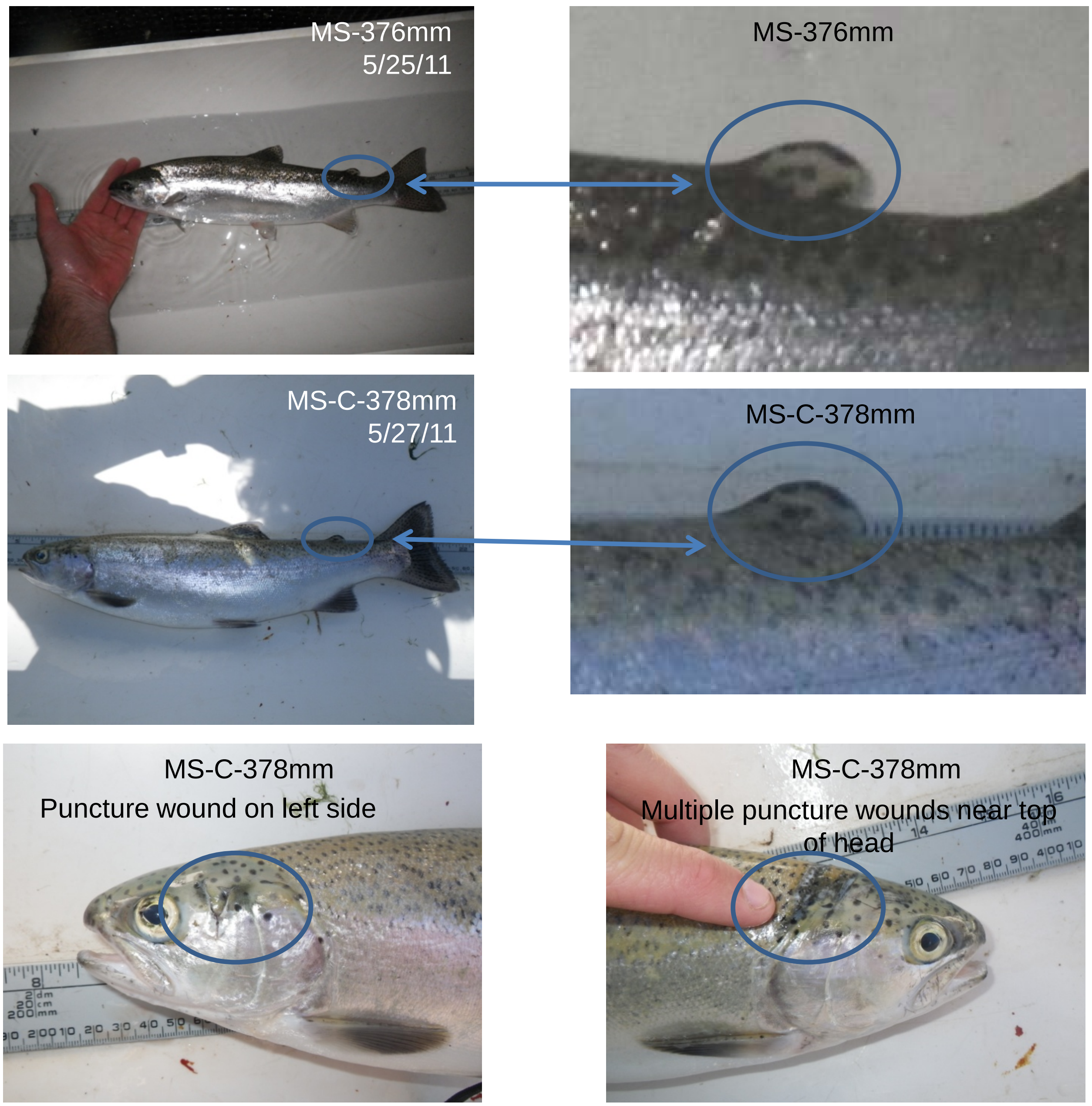


Figure 65: LSYR mainstem trap site on 5/25/11 upstream migrant resident and the same fish found dead on 5/27/11 upstream of the trap with heron puncture wounds to the back of the head.

Table 12: WY2011 tributary redd survey results; lengths and widths are given in feet and Salsipuedes Creek watershed includes Upper Salsipuedes, El Jaro, Yitias, and Los Amoles creeks.

Location	Date	Redd:			Location	Date	Redd:		
		#*	Length	Width			#*	Length	Width
Los Amoles Creek	1/17/2011	No redds observed			El Jaro Creek	3/9/2011	SC15	3.7	1.3
Salsipuedes Creek	1/18/2011	No redds observed					SC16	4.5	1.5
Upper Salsipuedes Creek	1/18/2011	No redds observed					SC17	2.1	1
El Jaro Creek	1/18/2011	No redds observed					SC18	2.5	1.1
Hilton Creek	1/18/2011	No redds observed					SC19	2.2	0.9
El Jaro Creek (RSJ)	1/20/2011	No redds observed					SC20	3	1.1
Salsipuedes Creek	2/2/2011	SC1	1.7	0.8			SC21	2.5	0.9
		SC2	2.7	1.8	Los Amoles Creek	4/11/2011	SC22	4.2	1.8
El Jaro Creek	2/3/2011	SC3	2.6	1.2			SC23	3.1	1.4
El Jaro Creek	2/8/2011	No redds observed					SC24	4.1	1.2
El Jaro Creek	2/9/2011	No redds observed			Salsipuedes Creek	4/12/2011	No redds observed		
Hilton Creek	2/17/2011	HC1	3	1.8	Upper Salsipuedes Creek	4/14/2011	No redds observed		
					El Jaro Creek	4/14/2011	SC25	3.9	2
Quiota Creek	2/17/2011	QC1	1.2	0.8	El Jaro Creek	4/18/2011	SC26	2.8	1
Los Amoles Creek	2/28/2011	SC4	4	1.5	Quiota Creek	4/19/2011	No redds observed		
		SC5	2.8	1.2	Hilton Creek	4/19/2011	HC2	3.8	1.5
		SC6	4	1.5			HC3	4.7	2.4
		SC7	4.2	1.1	Salsipuedes Creek	5/4/2011	No redds observed		
		SC8	2.5	1.5	El Jaro Creek	5/5/2011	SC27	3	1.3
		SC9	3	1			SC28	8	3.2
		SC10	7	2			SC29	3.2	1.2
		SC11	2.6	1	Los Amoles Creek	5/5/2011	No redds observed		
Salsipuedes Creek	3/2/2011	No redds observed			El Jaro Creek	5/10/2011	No redds observed		
Upper Salsipuedes Creek	3/2/2011	No redds observed			Ytias Creek	5/10/2011	SC30	5.7	2
El Jaro Creek	3/3/2011	SC12	3.2	1.5			SC31	2.7	1
		SC13	1.9	0.7			SC32	2.7	1
		SC14	2.5	1.2	Hilton Creek	5/11/2011	HC4	4	1.5
							HC5	2	0.9
Quiota Creek	3/7/2011	QC2	1.9	0.8			HC6	5.5	2.5
Hilton Creek	3/7/2011	No redds observed					HC7	3.5	1
					Quiota Creek	5/11/2011	No redds observed		

* Redd counts are enumerated by watershed where SC - Salsipuedes Creek, QC - Quiota Creek, and HC - Hilton Creek.

Table 13: WY2011 LSYR mainstem redd survey results within the management reaches (Refugio and Alisal reaches); lengths and widths are given in feet.

Location	Date	Redd:		
		#	Length	Width
Refugio	2/28/2011	No redds observed		
Alisal	2/28/2011	No redds observed		
Refugio	4/20/2011	No redds observed		
Alisal	4/20/2011	No redds observed		
Refugio	5/9/2011	No redds observed		
Alisal	5/9/2011	No redds observed		

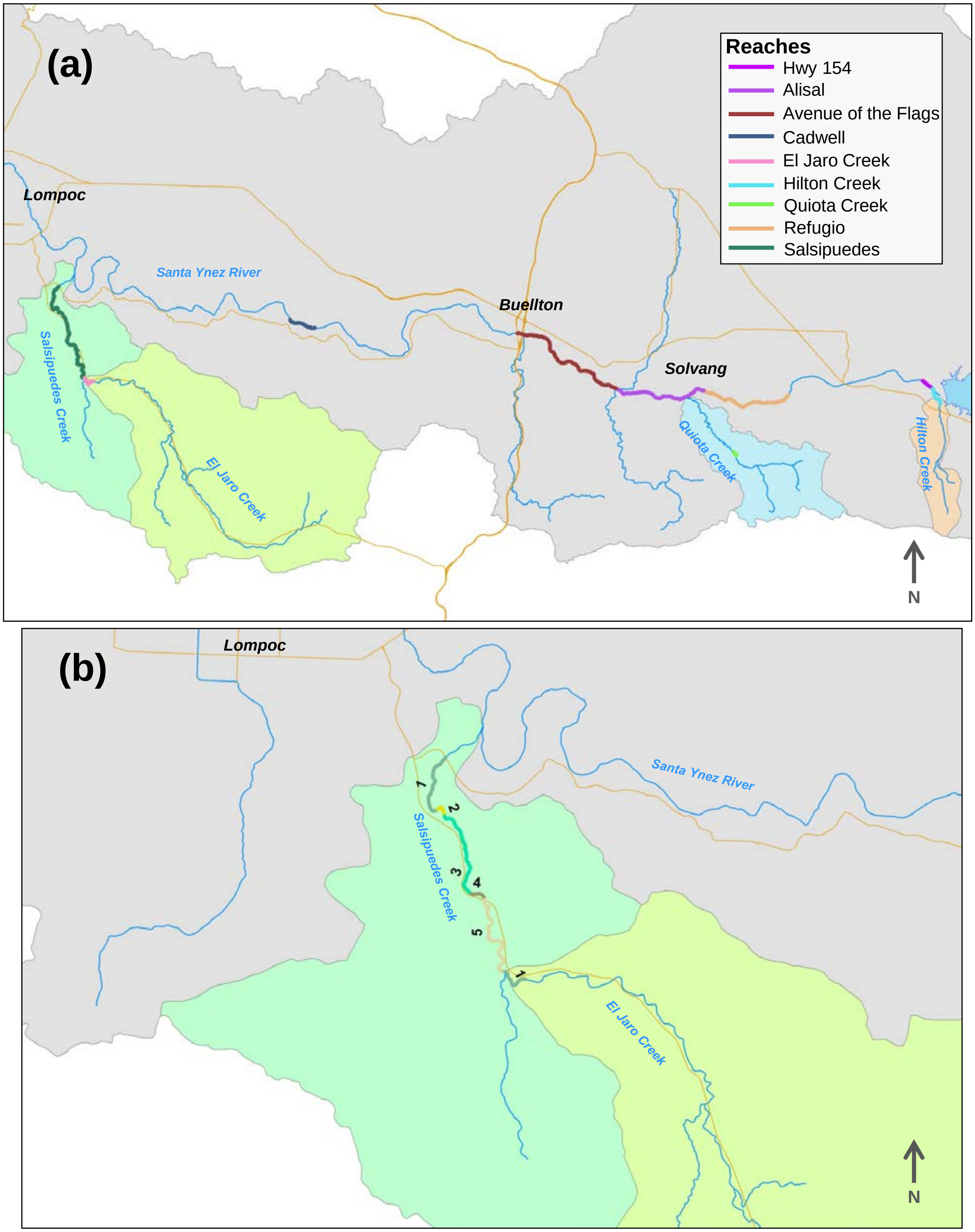


Figure 66: Stream reaches snorkel surveyed in WY2011 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

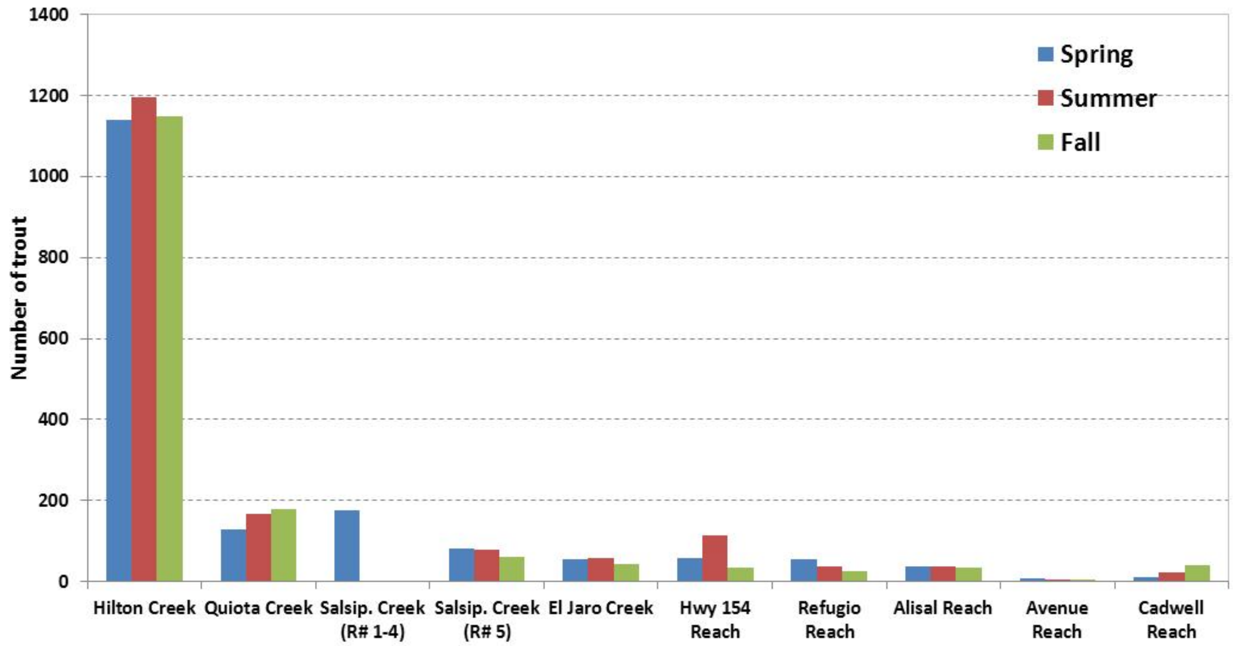


Figure 67: 2011 LSYR steelhead/rainbow trout observed during spring, summer and fall snorkel surveys.

Table 14: 2011 LSYR mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	6/16/11
(LSYR-0.2 to LSYR-0.7)	Summer	8/17/11
	Fall	10/24/11
Refugio Reach	Spring	6/15-6/16/11
(LSYR-4.9 to LSYR-7.8)	Summer	8/16/11
	Fall	10/21/11 & 10/24/11
Alisal Reach	Spring	6/14/11
(LSYR-7.8 to LSYR-10.5)	Summer	8/15-8/16/11
	Fall	10/20-10/21/11
Avenue of the Flags Reach	Spring	6/20-6/21-11
(LSYR-10.5 to LSYR-13.9)	Summer	8/17/11
	Fall	10/19-10/20/11
Reach 3 / Cadwell	Spring	6/21/11
(LSYR-13.9 to LSYR-25.0)	Summer	8/17/11
	Fall	10/17/11

Table 15: LSYR mainstem spring, summer, and fall snorkel survey results in 2011 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	57	114	34	0.26
Refugio Reach	56	39	25	2.95
Alisal Reach	38	39	36	2.80
Avenue of the Flags Reach	7	4	4	3.4
Cadwell Sub-Reach	12	24	40	0.3

Table 16: LSYR mainstem spring, summer, and fall snorkel survey results in 2011 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	25	28	4							57
	Refugio	0	30	11	9	5	1				56
	Alisal	2	8	3	8	13	4				38
	Avenue	0	1	1	2	2	0	1			7
	Cadwell	0	0	0	7	5					12
Summer	Hwy 154	33	70	11							114
	Refugio	0	6	16	7	9	0	0	1		39
	Alisal	0	9	3	13	12	2				39
	Avenue	0	1	0	1	0	1	1			4
	Cadwell	0	0	0	4	20					24
Fall	Hwy 154	3	29	2							34
	Refugio	0	6	5	8	5	0	0	1		25
	Alisal	0	0	9	8	16	2	1			36
	Avenue	0	1	0	0	2	0	1			4
	Cadwell	0	0	0	10	28	2				40

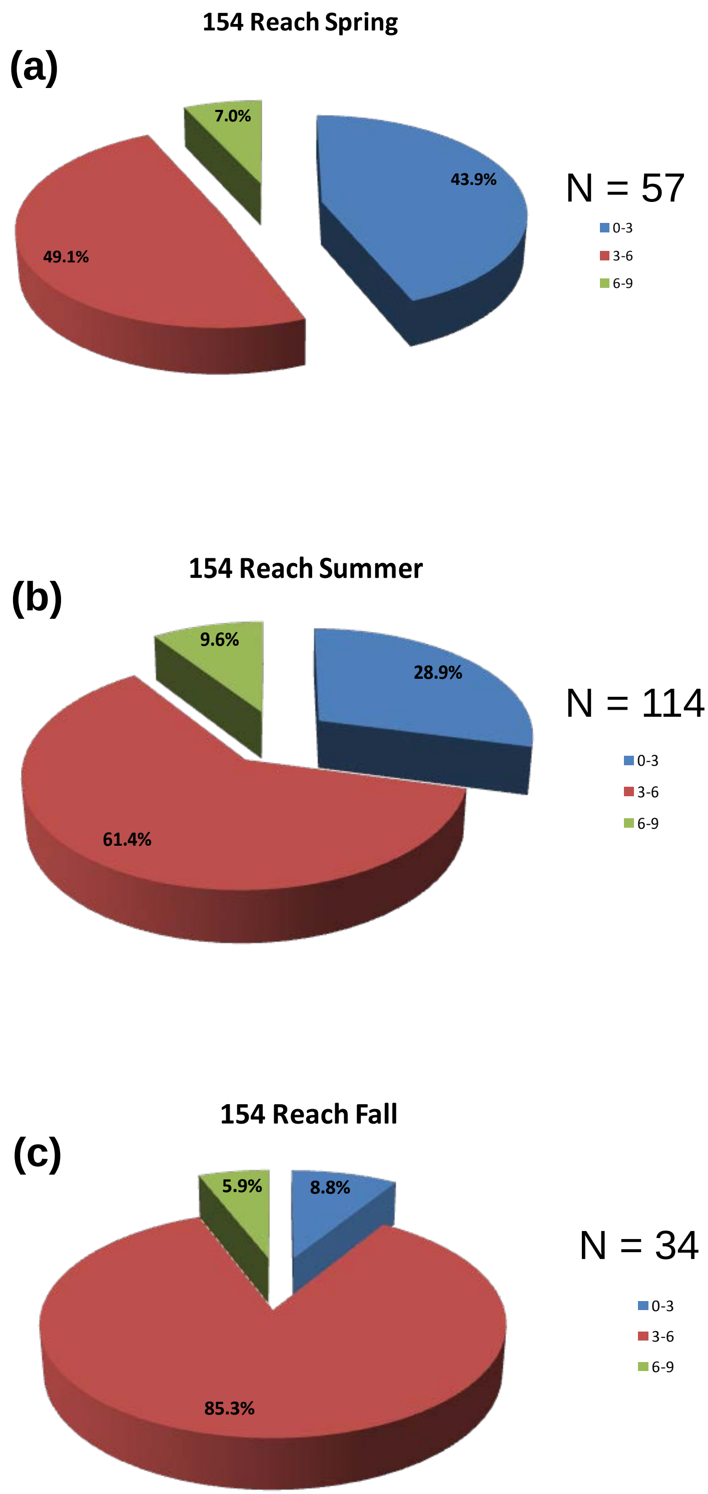


Figure 68: 2011 Hwy 154 Reach snorkel survey with size classes (range) of fish observed in inches for (a) spring, (b) summer, and (c) fall.

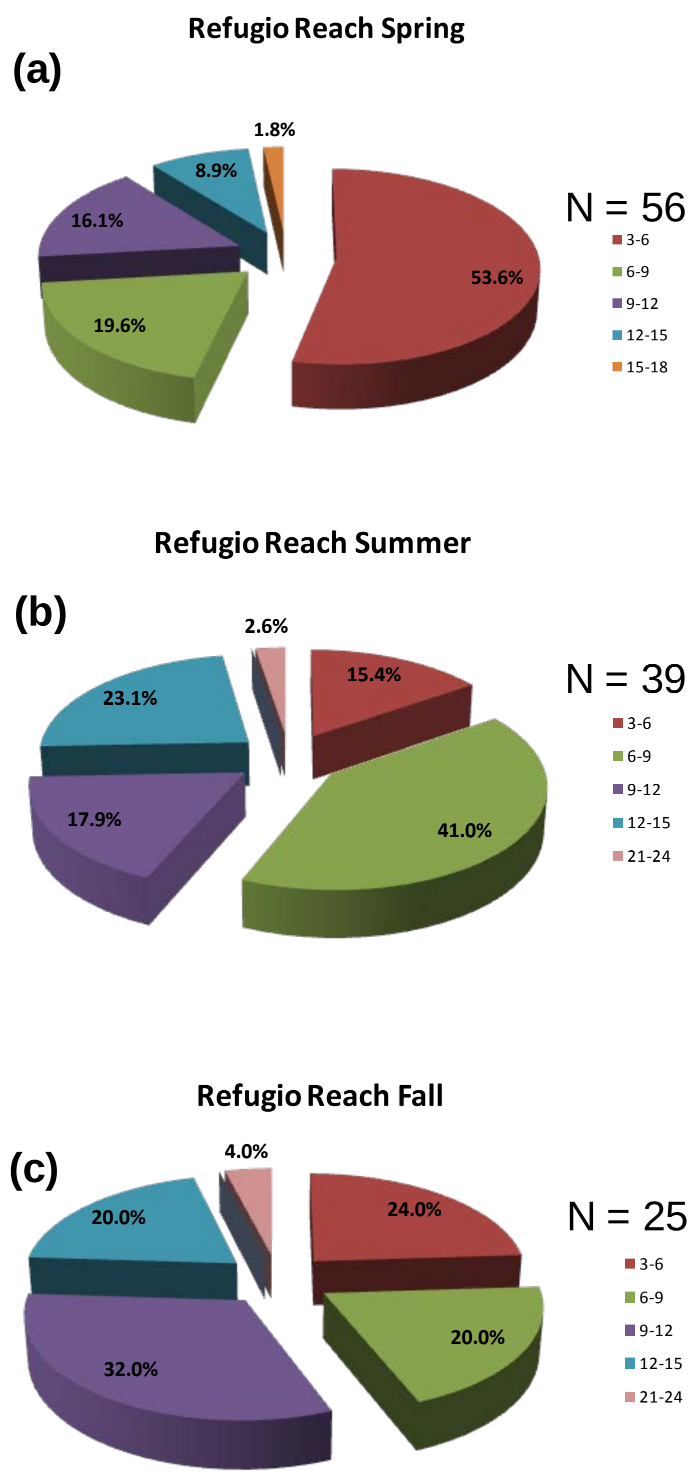


Figure 69: 2011 Refugio Reach snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

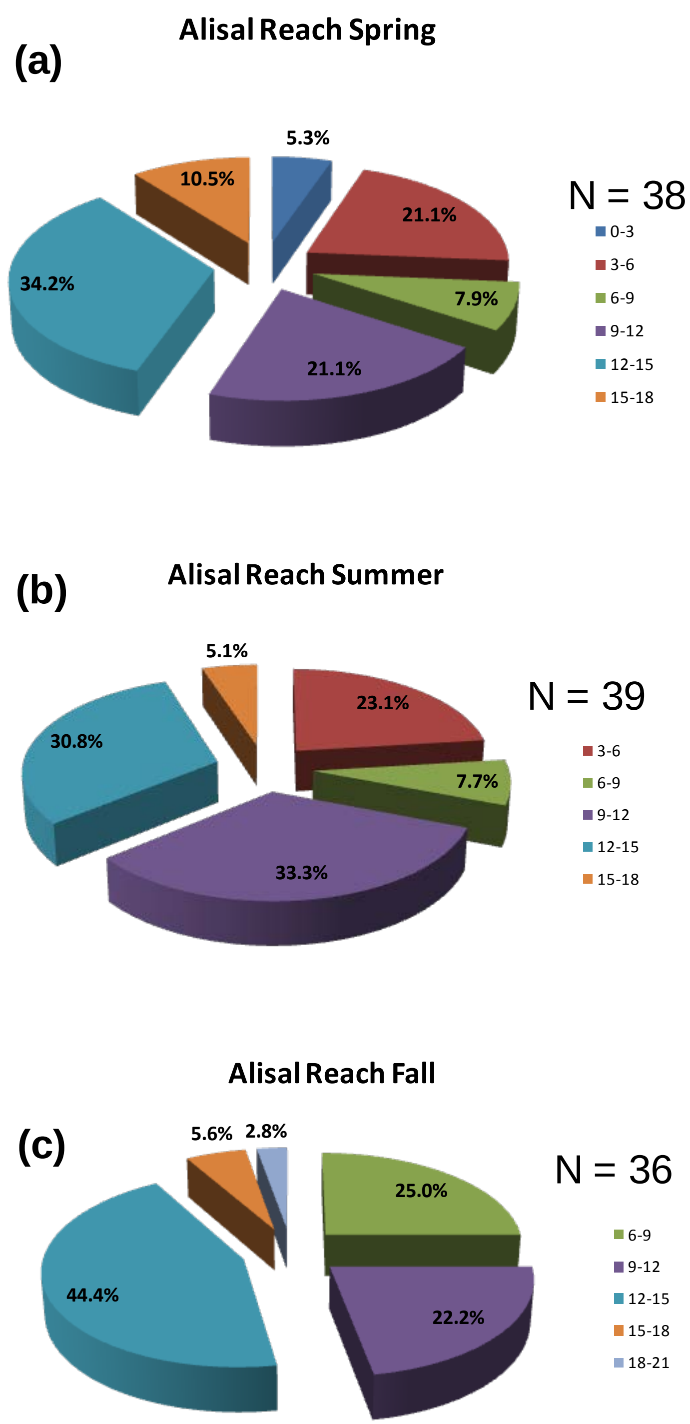


Figure 70: 2011 Alisal Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

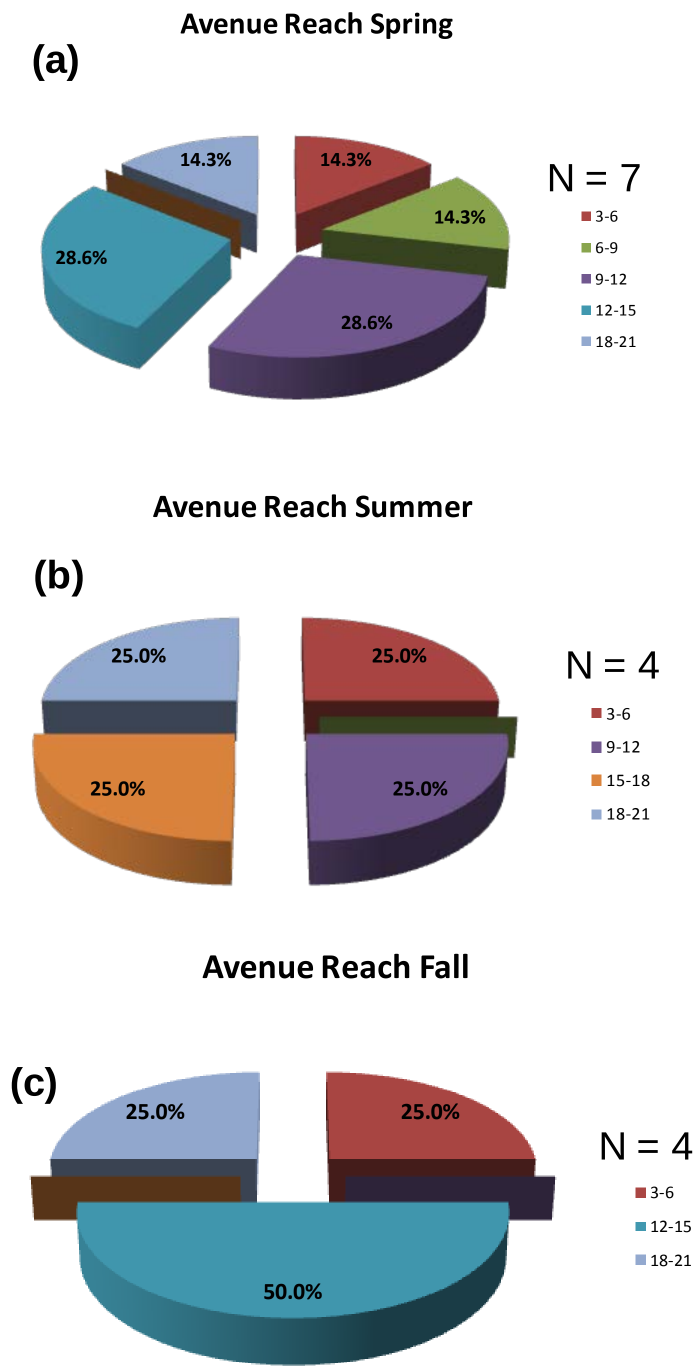


Figure 71: 2011 Avenue of the Flags Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

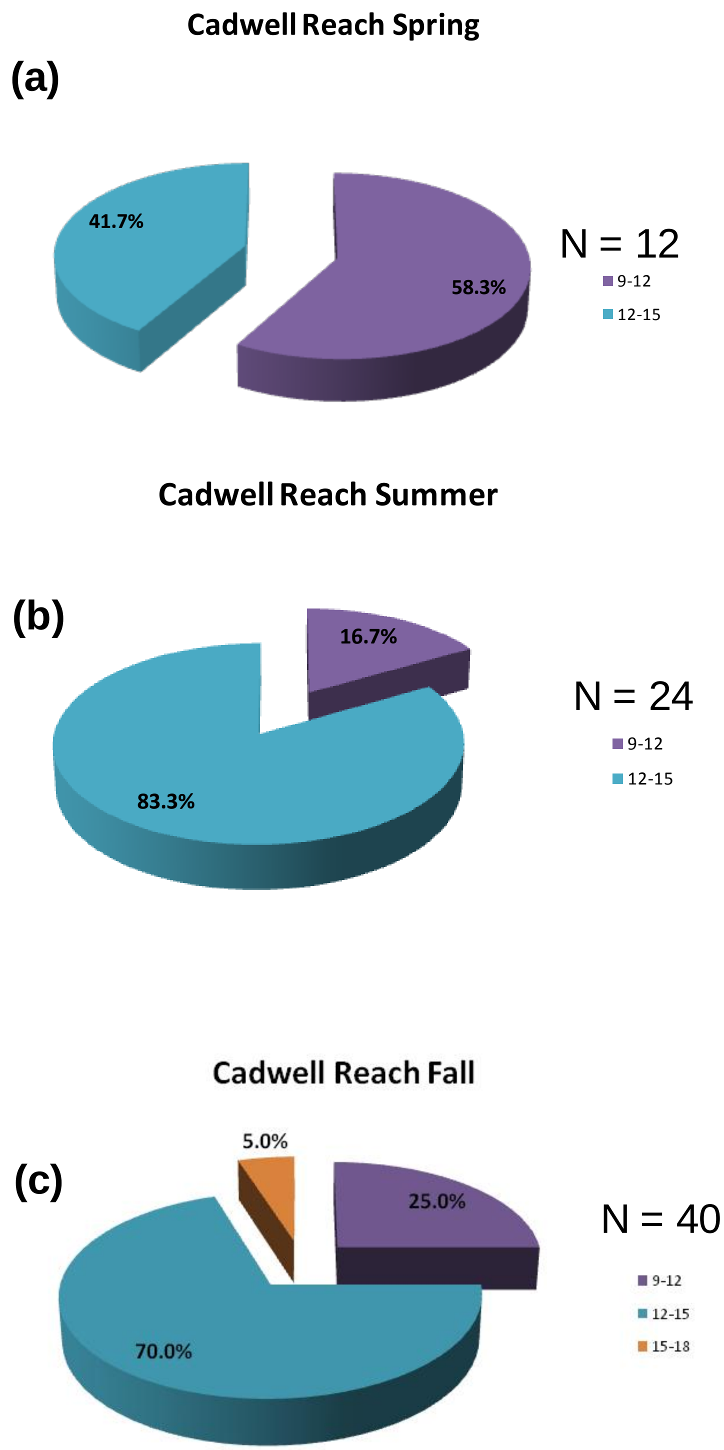


Figure 72: 2011 Cadwell Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

Table 17: 2011 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	7/18-7/19/11
(HC-0.0 to HC-0.54)	Summer	9/29-9/30/11
	Fall	11/2-11/3/11
Quiota Creek	Spring	6/29/11
(QC-2.58 to QC-2.73)	Summer	9/27/11
	Fall	10/25/11
Salsipuedes Creek	Spring	6/28/11
(Reach 5)	Summer	8/23/11
	Fall	10/3/11
El Jaro Creek	Spring	6/28/11
(ELC-0.0 to ELC-0.4)	Summer	10/3/11
	Fall	11/7/11

Table 18: *O. mykiss* 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	433	354	315	0.133
Reach 2	143	121	130	0.050
Reach 3	69	50	73	0.040
Reach 4	142	152	128	0.075
Reach 5	316	497	482	0.242
Reach 6	36	21	19	0.014
Total:	***1139***	***1195***	***1147***	***0.554***
Quiota Creek	130	167	180	0.11
Salsipuedes Creek (Reach 1-4)	176	n/s	n/s	2.85
Salsipuedes Creek (Reach 5)	82	62	79	0.45
El Jaro Creek	56	58	43	0.35
n/s = no survey, turbid conditions				

Table 19: 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	736	285	82	24	9	2	1			1139
	Quiota	68	56	6							130
	Salsipuedes (R 1-4)	0	16	116	38	5	1				176
	Salsipuedes (R-5)	1	39	37	5						82
	El Jaro	2	41	13							56
Summer	Hilton	443	621	105	17	7	2				1195
	Quiota	84	76	7							167
	Salsipuedes (R 1-4)					n/s					
	Salsipuedes (R-5)	0	16	40	5	1					62
	El Jaro	0	38	16	4						58
Fall	Hilton	451	588	85	14	6	2	1			1147
	Quiota	87	79	14							180
	Salsipuedes (R 1-4)					n/s					
	Salsipuedes (R-5)	1	43	26	7	2					79
	El Jaro	0	21	19	3						43

n/s = no survey, turbid conditions

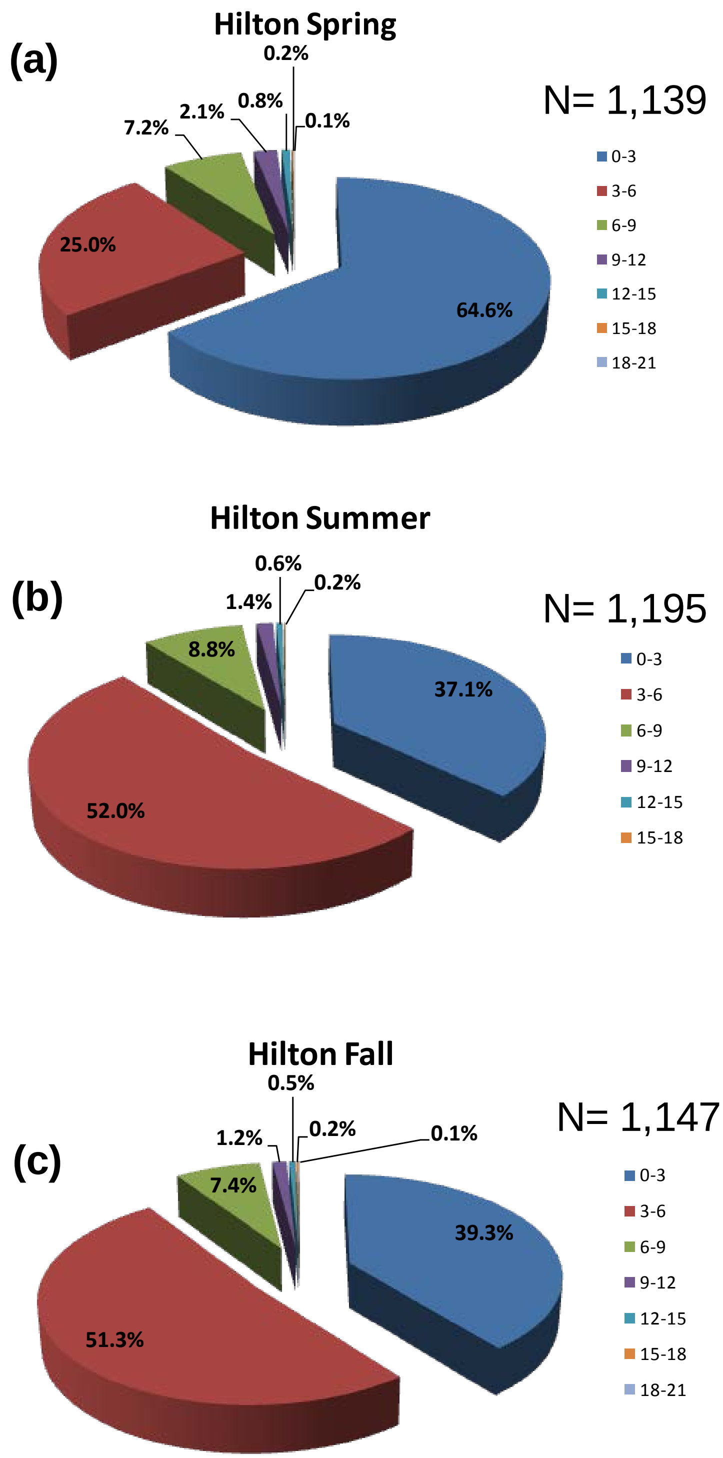


Figure 73: 2011 Hilton Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

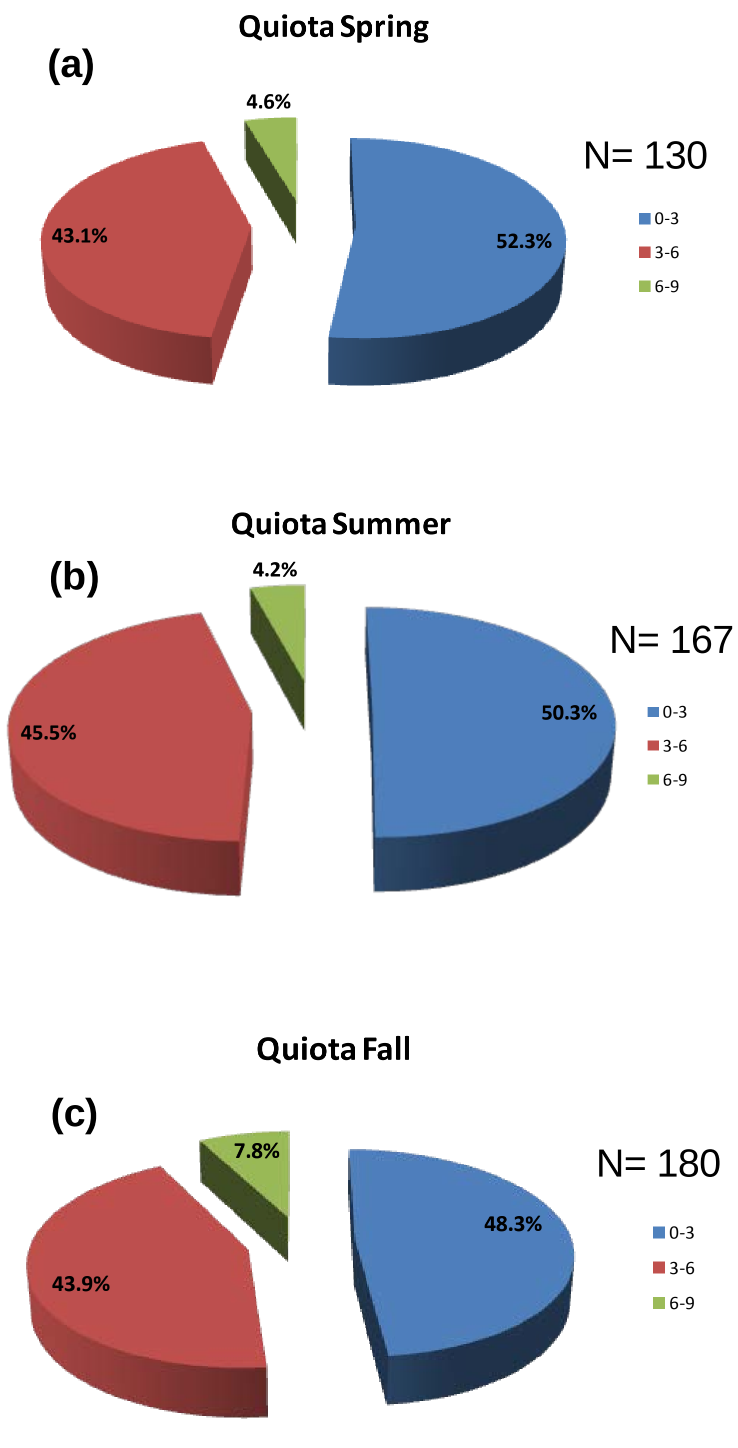


Figure 74: 2011 Quiota Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

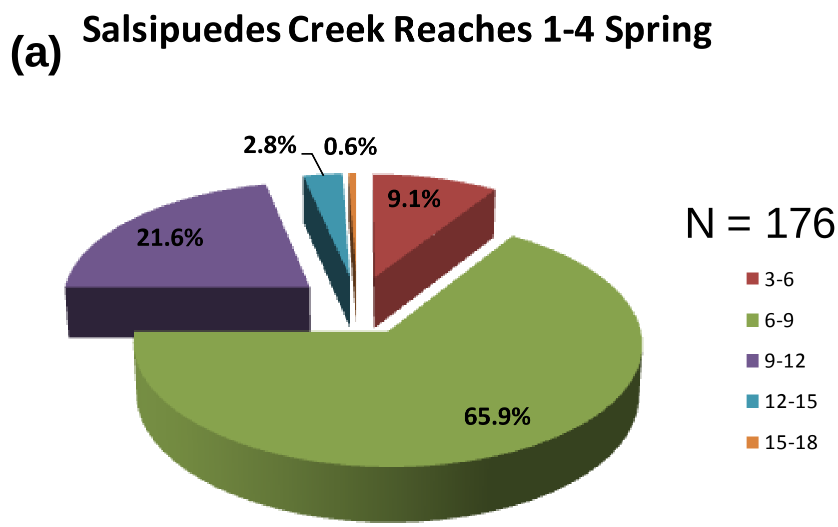


Figure 75: 2011 Salsipuedes Creek reaches 1-4 snorkel survey with size classes (range) of fish observed in inches; (a) spring, and (b) summer.

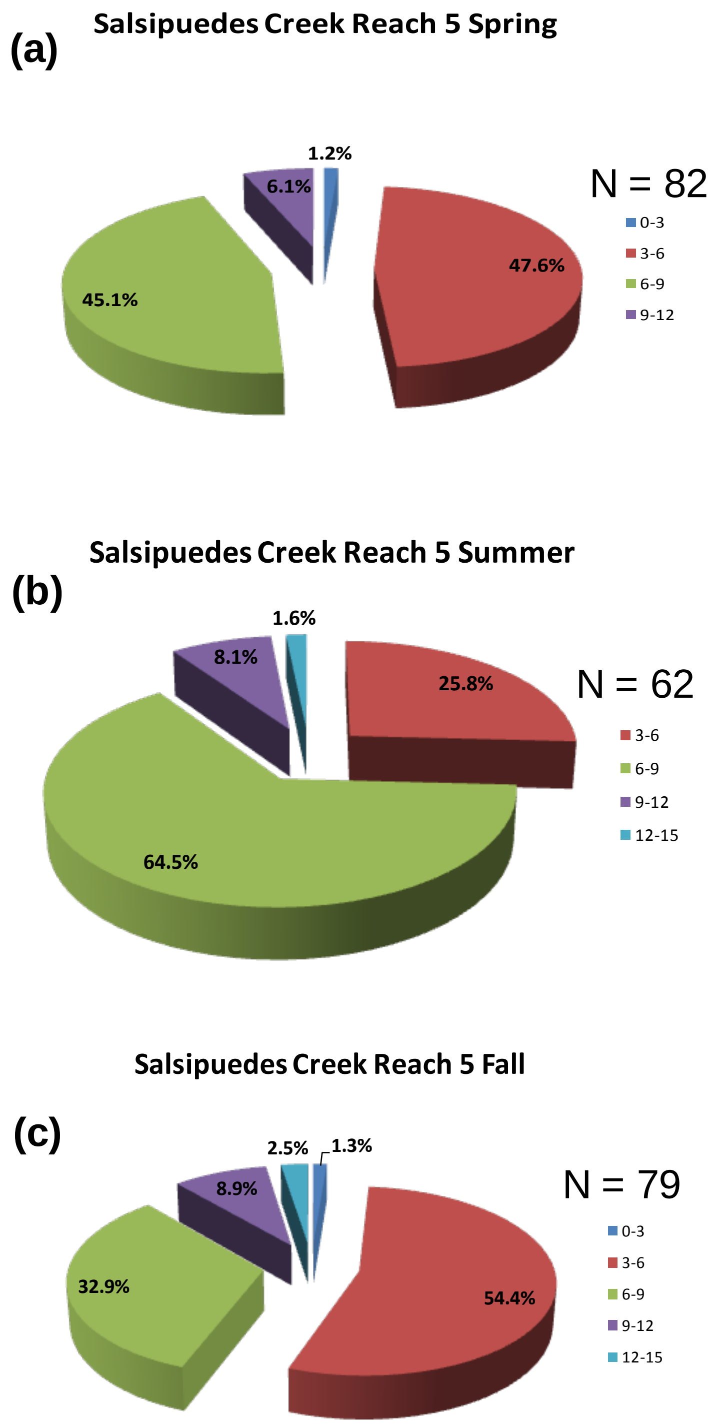


Figure 76: 2011 Salsipuedes Creek Reach 5 survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

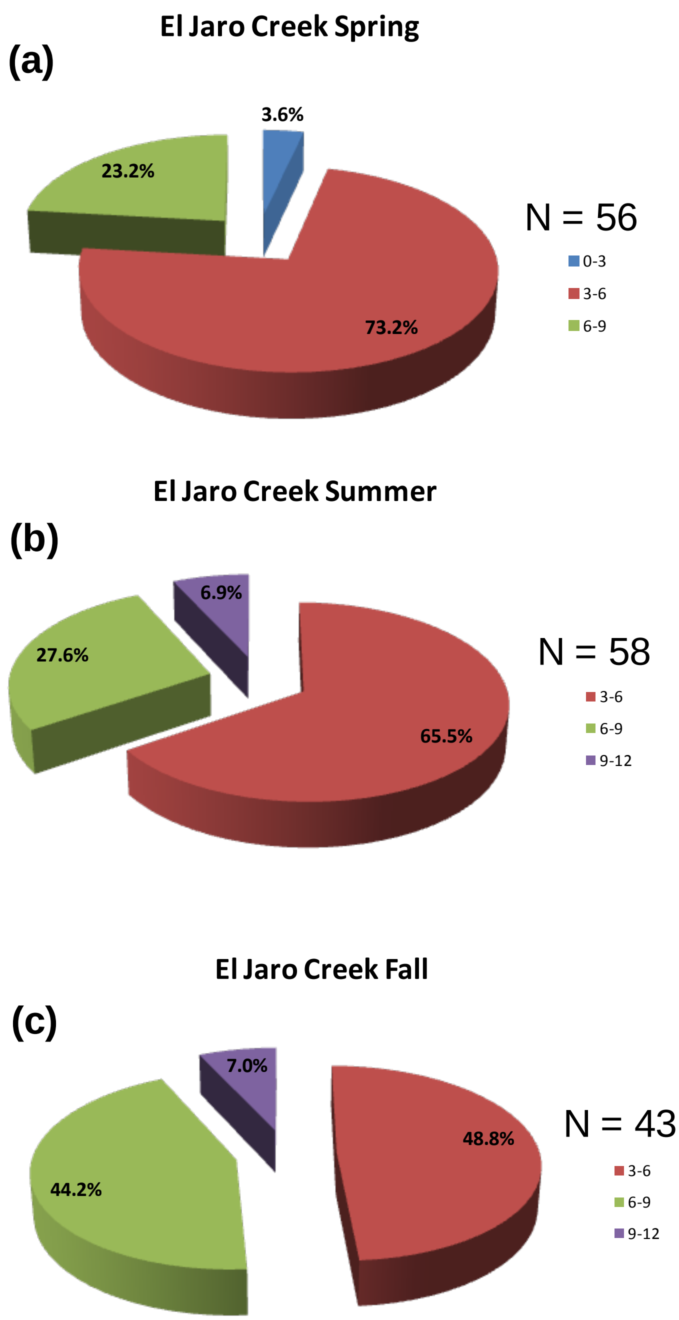
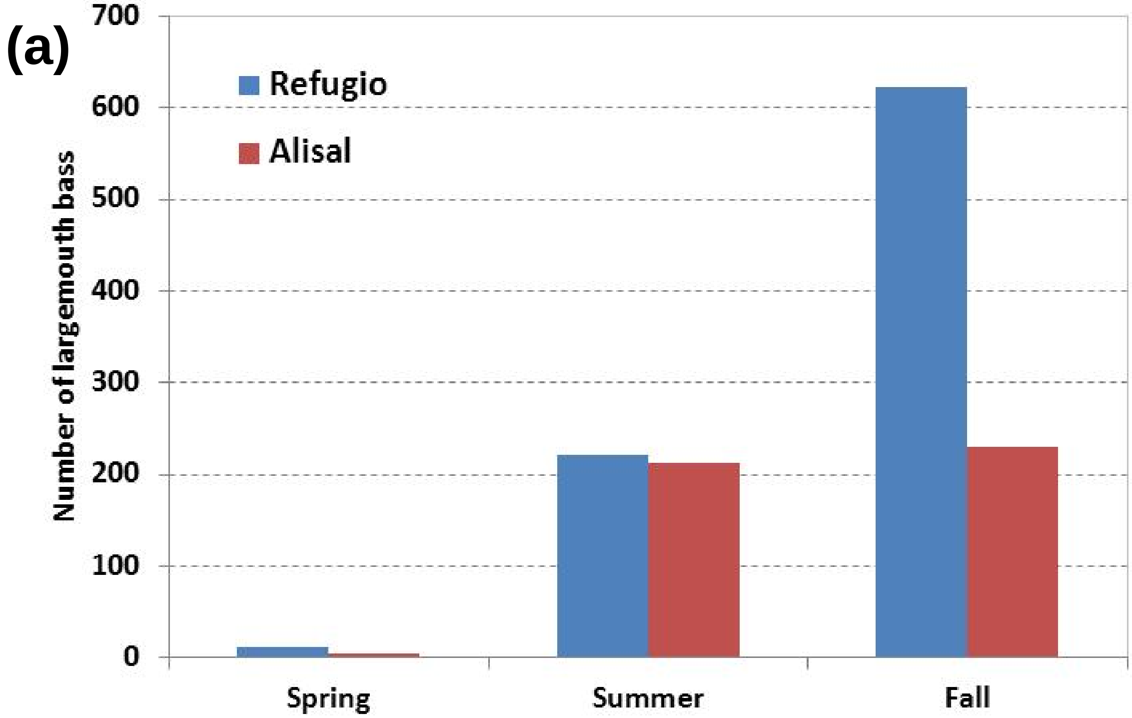


Figure 77: 2011 El Jaro Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.



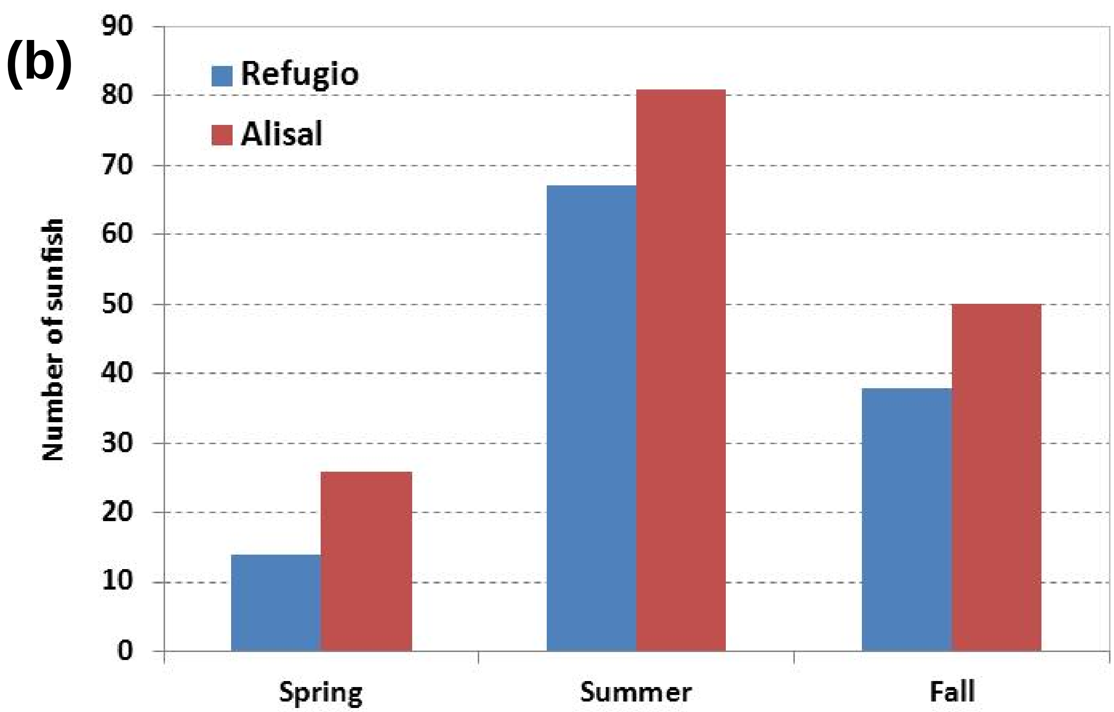


Figure 78: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2011 within the Refugio and Alisal reaches: (a) largemouth bass and (b) sunfish.

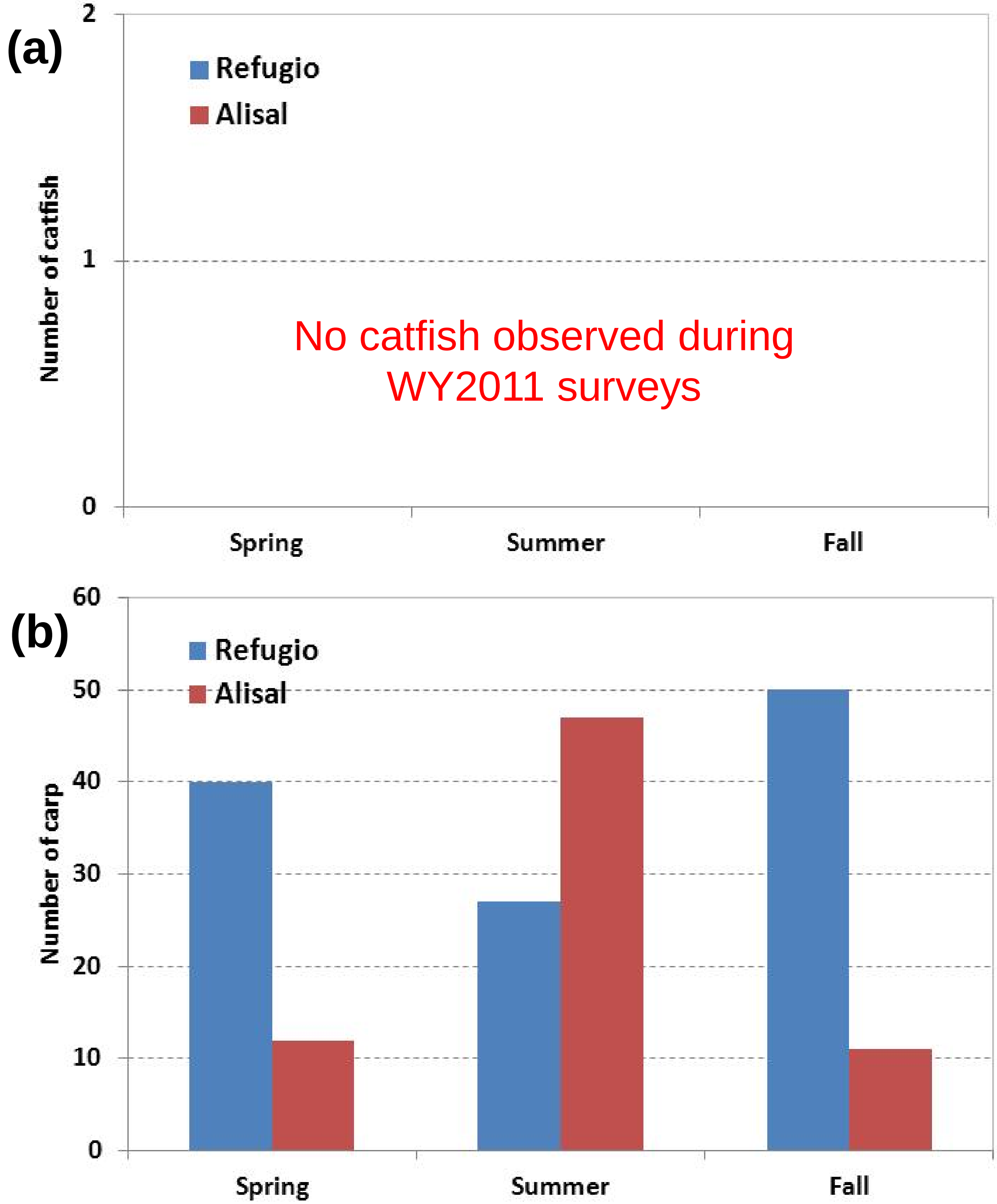


Figure 79: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2011 within the Refugio and Alisal reaches: (a) catfish, and (b) carp.

Figure 80: Spatial extent of beaver dams from the WY2011 survey within the LSYR drainage where 87 dams were observed in the LSYR basin.

4. Discussion

Table 20: Monthly rainfall totals (inches) at Bradbury Dam from WY2000-WY2011.

Month	Water Years:											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
Oct	0	2.64	0.62	0	0	6.38	0.48	0.16	0.34	0.15	2.2	2.24
Nov	1.62	0	3.27	2.5	1.2	0.33	1.64	0.2	0.06	3.39	0	1.42
Dec	0	0.09	2.66	6.73	2.03	13.25	0.73	1.59	2.39	2.46	3	9.48
Jan	1.94	8.4	0.87	0.06	0.32	10.3	7.82	1.3	16.57	0.65	10.34	1.84
Feb	10.37	5.71	0.24	3.56	6.52	9.22	3.06	3.03	2.33	5.7	4.92	3.36
Mar	2.76	13.44	0.79	2.4	0.48	3.08	4.31	0.15	0.46	0.85	0.26	11.85
Apr	4.73	1.35	0.13	2.15	0	1.27	4.89	0.81	0.06	0.19	3.15	0.14
May	0.01	0.06	0.12	2.33	0	0.51	1.56	0	0.38	0	0.05	0.42
Jun	0.04	0	0	0.02	0	0.04	0	0	0	0.16	0	0.34
Jul	0	0.06	0	0.01	0	0	0	0	0	0	0	0.00
Aug	0	0	0	0	0	0	0	0	0	0.03	0	0.00
Sept	0	0	0.08	0	0	0.03	0	0.17	0	0.08	0	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*	*31.09*

Table 21: Monthly average stream discharge (cfs) at the USGS Solvang and Narrows gauges during WY2001-WY2011.

Month	WY2001		WY2002		WY2003		WY2004		WY2005		WY2006	
	Solvang (cfs)	Narrows (cfs)	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	2.06	23.3	18.8	0	0	31.1	29.4	6.05	9.41
Nov	n/d	14.8	n/d	12.3	8.11	15.2	0	0	6.35	14.2	6.94	16
Dec	n/d	14.9	n/d	25.2	22.3	55.5	0	0.023	293.2	478.5	10.7	20.1
Jan	37.3	75.3	n/d	24.6	10.7	26.7	1.6	1.54	2556	2765	40	79.4
Feb	n/d	321	n/d	21.6	12.7	27	8.96	38.4	2296	2555	12.2	28
Mar	n/d	3378	n/d	13.4	24	70.2	4.25	12.4	776.6	929.3	51.2	86.1
Apr	n/d	207.3	n/d	3.93	14.9	22.3	0.295	1.46	206.8	300.8	1317	1053
May	n/d	57.5	n/d	1.44	9.83	19.5	0	0.098	104.3	150.7	131.9	139.6
Jun	n/d	13.6	n/d	0.515	1.64	3.97	0	0	13.8	32.7	20.1	26.5
Jul	n/d	5.08	n/d	0.094	0.011	0.637	53.2	3.69	9.15	14	7.83	4.76
Aug	n/d	2.53	64.8	24.2	0	0.106	59.4	30.9	6.35	2.86	4.69	0.975
Sep	n/d	2.15	37.2	28.9	0	0	39.3	24	6.02	4.15	5.7	1

Month	WY2007		WY2008		WY2009		WY2010		WY2011	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	7.3	0.998	25	17.5	2.97	0	6.8	0	19.8	18.3
Nov	5.8	0.996	7.36	8.54	5.8	0	1.6	0	6.94	12.8
Dec	7.74	9.98	6.61	13.2	7.01	1.02	6.9	0	53.1	203.3
Jan	9.37	15.3	265	496.3	6.14	5.11	73	184	27.6	85.8
Feb	10.4	18.6	401.1	490.1	17.7	33.4	72	181	24	100.3
Mar	8.82	10.7	93.9	158.4	12.1	18.6	26	68	1441	1267
Apr	4.52	1.43	8.46	18.9	4.39	5.23	35	51	321.5	422
May	1.47	0.475	6.3	6.77	5.05	0.648	6.1	13	39	70.8
Jun	1.93	0.13	5.05	2.49	7.08	0.275	1.3	1.8	13.9	29.4
Jul	35.8	1.39	7.09	0.42	3.51	0	0.4	0.5	9.28	10.7
Aug	55.2	30.8	3.68	0.069	3.72	0	53	22	7.8	3.05
Sep	31	23.4	3.76	0	4.08	0	30	19	8.5	2.22

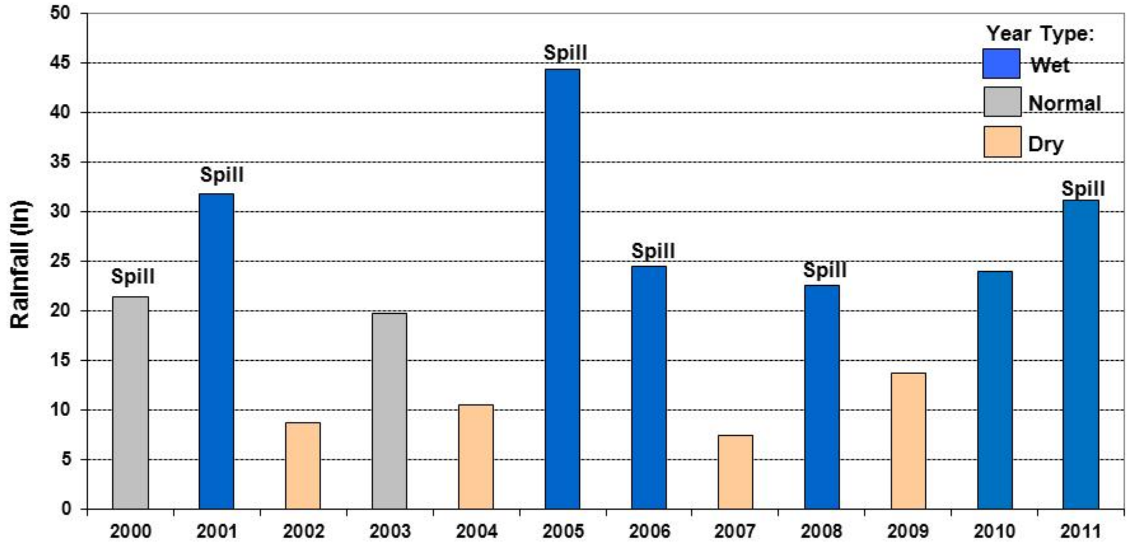


Figure 81: Water year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 22: 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 May 2013)
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 23: 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 May 2013)
Jalama Road Bridge on Salsipuedes Creek	Completed (2004)
San Julian Ranch on El Jaro Creek	Completed (2008)
Quiota Creek Crossing 0	In design[2]
Quiota Creek Crossing 2	Completed (2011)
Quiota Creek Crossing 6	Completed (2008)
Quiota Creek Crossing 8	In design
Total:	**6**
Projects completed:	***4***
Projects remaining:	***2***
1. Grant funding has been secured.	
2. Grants have been submitted for funding.	

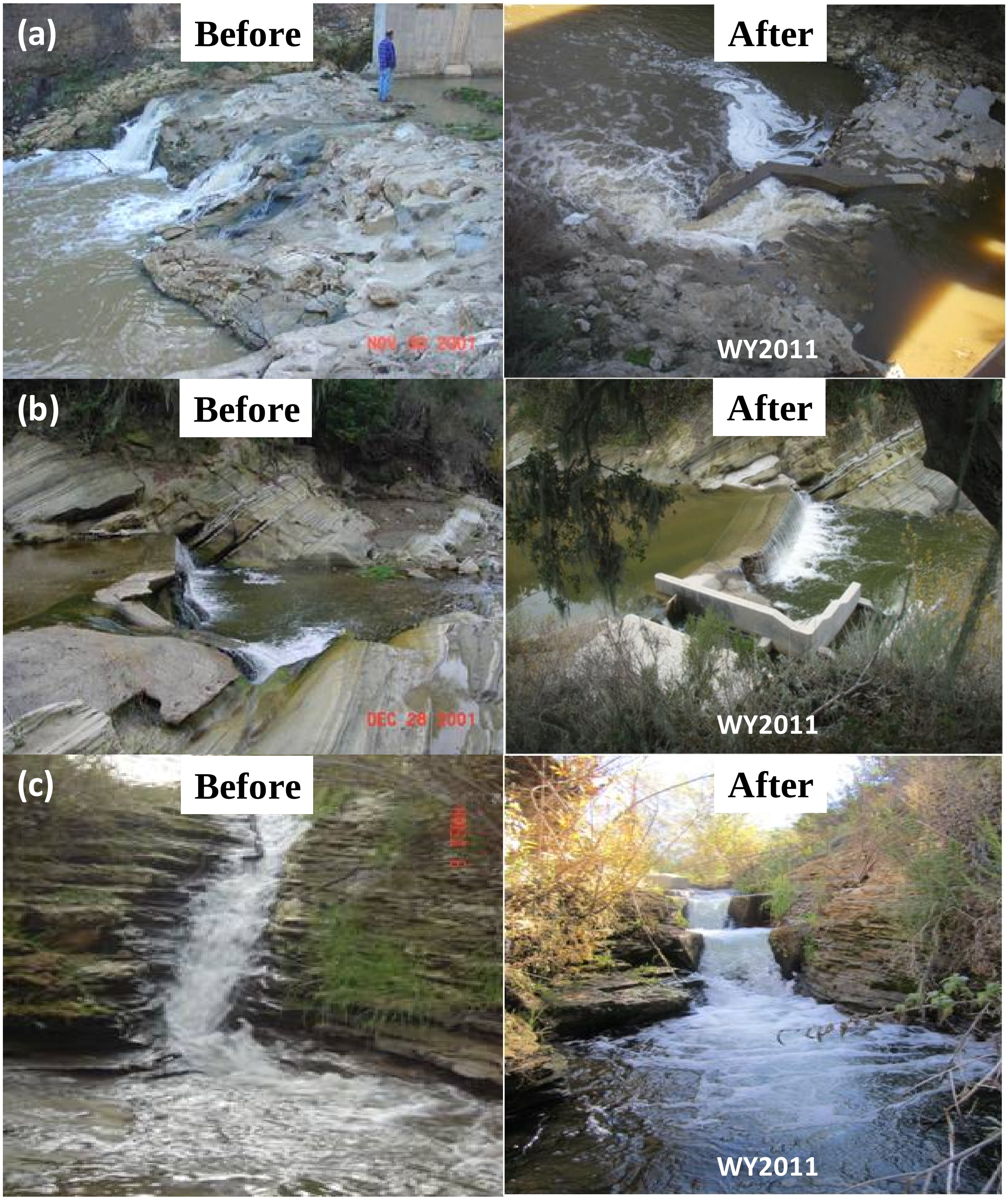


Figure 82: Fish passage and habitat restoration at (a) Hwy 1 Bridge on Salsipuedes Creek (completed in 2002), (b) Jalama Road Bridge on Salsipuedes Creek (completed in 2004), and (c) Cascade Chute barrier on Hilton Creek (completed in 2005).

Figure 83: Fish passage and habitat restoration in the fall of 2008 at Rancho San Julian on El Jaro Creek.

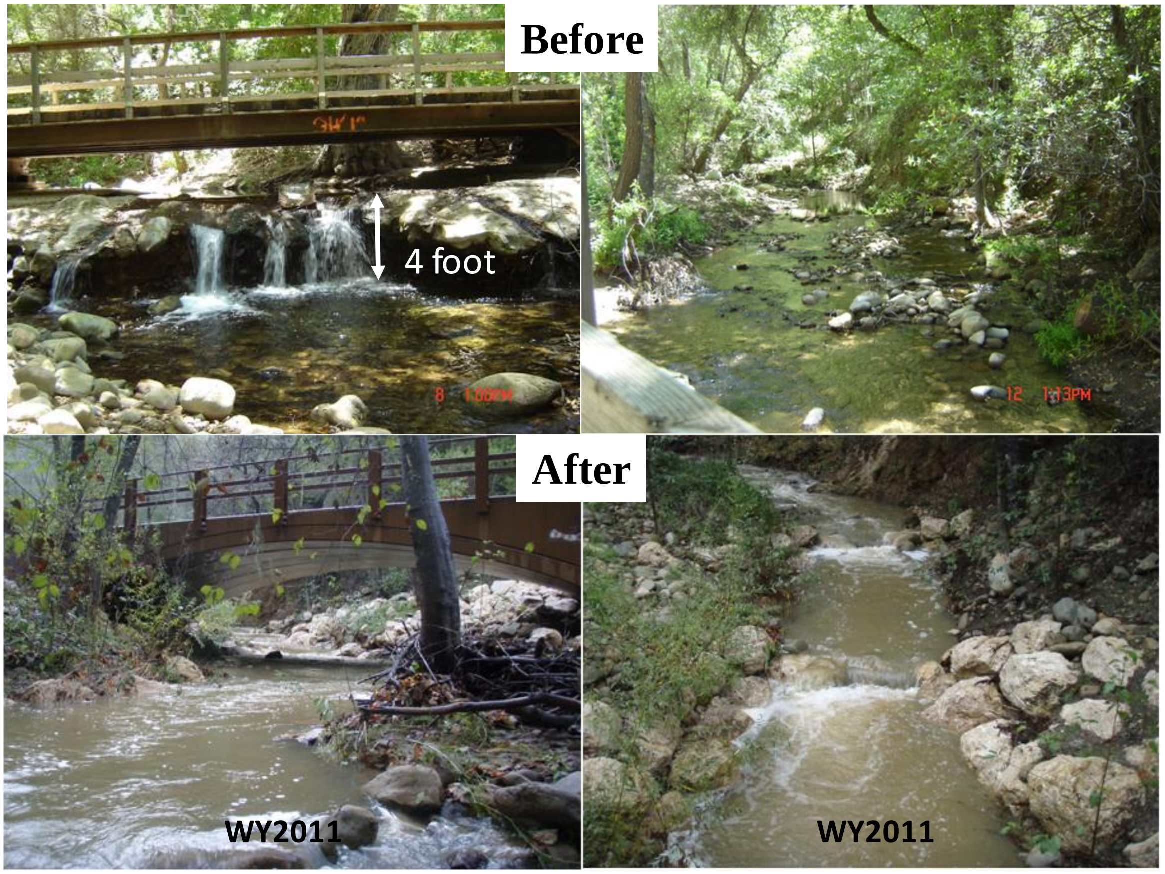


Figure 84: Fish passage and habitat restoration in the fall of 2008 at Refugio Road on Quiota Creek Crossing 6.

Figure 85: Fish passage and habitat restoration in the fall of 2009 at Cross Creek Ranch on El Jaro Cree, a tributary of Salsipuedes Creek and the Santa Ynez River.

Figure 86: Fish passage and habitat restoration in the fall of 2011 at Refugio Road on Quiota Creek Crossing 2 from before (top) and after (bottom).

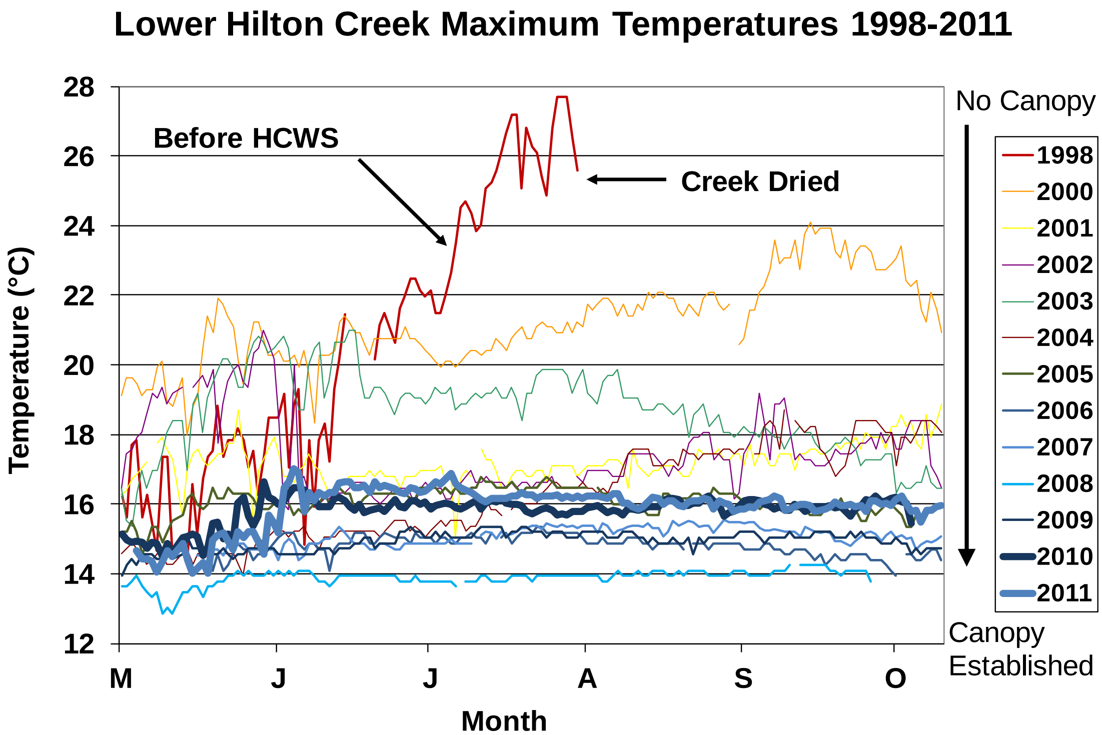


Figure 87: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2011, the last two years are shown with a wider curve.

Table 24: Trapping season statistics for WY2001 through WY2011 with CPUE.

Salsipuedes Creek

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011
Year Type	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet
Trapping season	117	99	132	120	122	131	115	114	102	117	153
Days out of service	27	1	9	4	35	8	4	16	2	7	16
Functional Trap Days	90	98	123	116	87	123	111	98	100	110	137
Efficiency	77%	99%	93%	97%	71%	94%	97%	86%	98%	94%	90%
CPUE U/S & D/S	2.07	0.20	1.07	0.53	0.64	2.02	0.22	0.80	1.87	0.72	1.74

LSYR Mainstem

	WY2001*	WY2002*	WY2003*	WY2004*	WY2005*	WY2006	WY2007**	WY2008	WY2009	WY2010	WY2011
Year Type	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet
Trapping season	-	-	-	-	-	35	-	60	82	113	153
Days out of service	-	-	-	-	-	2	-	20	0	3	43
Functional Trap Days	-	-	-	-	-	33	-	40	82	110	110
Efficiency	-	-	-	-	-	94%	-	67%	100%	97%	72%
CPUE U/S & D/S	-	-	-	-	-	0.45	-	0.13	0.04	0.27	0.18

Hilton Creek

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011
Year Type	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet
Trapping season	121	98	132	120	122	131	115	127	110	117	153
Days out of service	38	1	11	4	11	6	4	11	2	6	13
Functional Trap Days	83	97	121	116	111	125	111	116	108	111	140
Efficiency	69%	99%	92%	97%	91%	95%	97%	91%	98%	95%	92%
CPUE U/S & D/S	0.63	0.97	0.60	1.09	0.52	3.02	5.79	4.09	3.91	2.32	1.59

* Not deployed
** Too dry to install

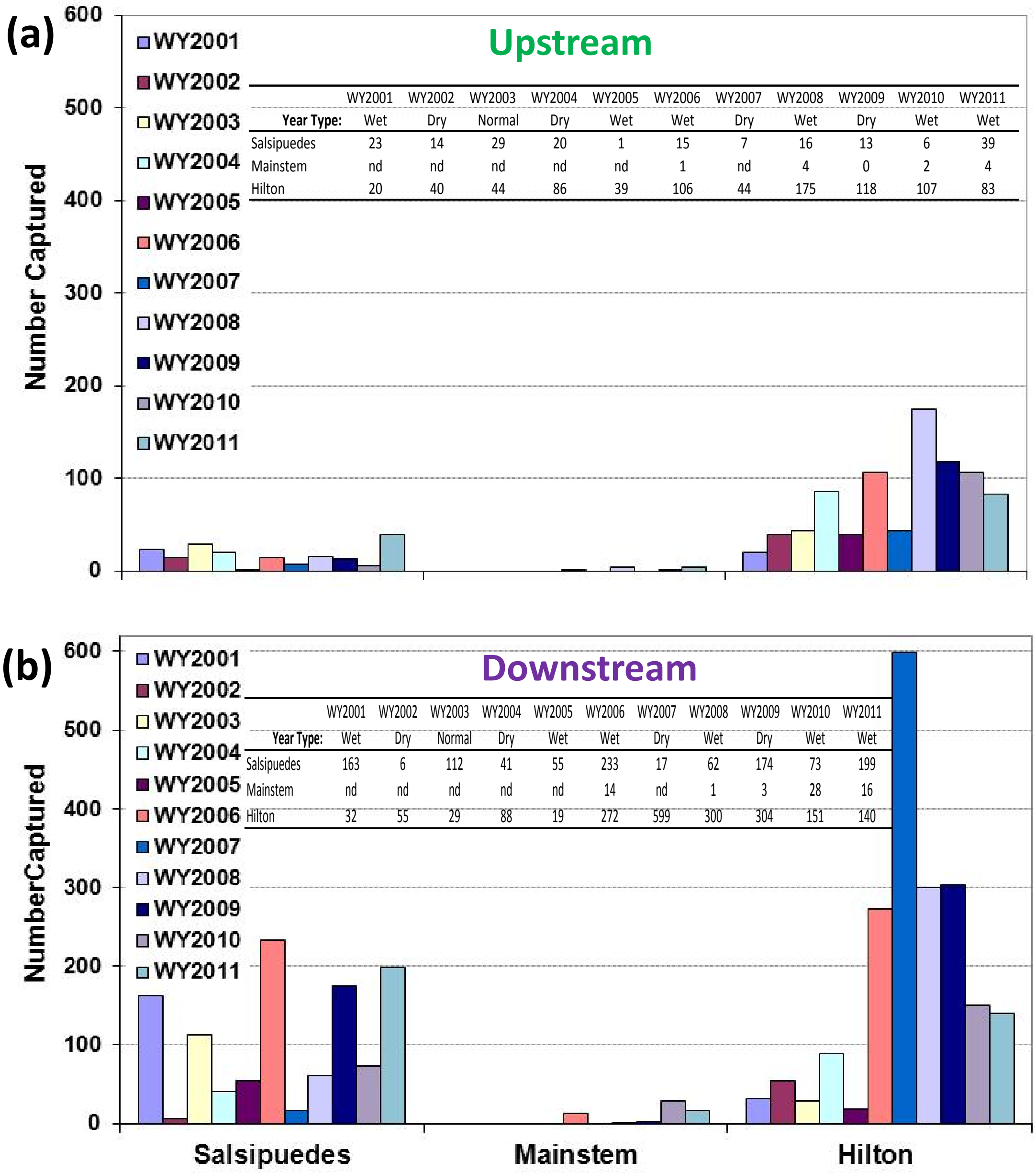
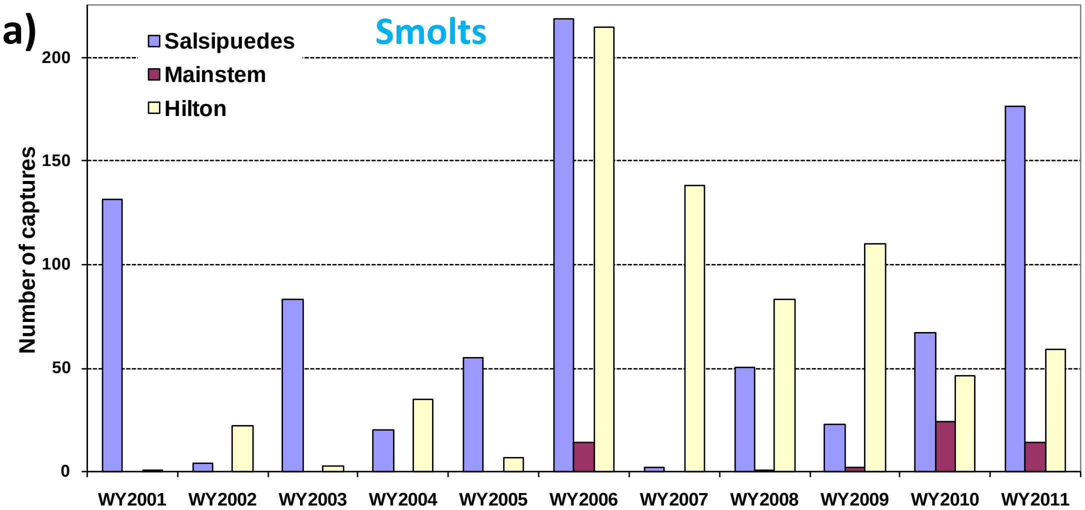


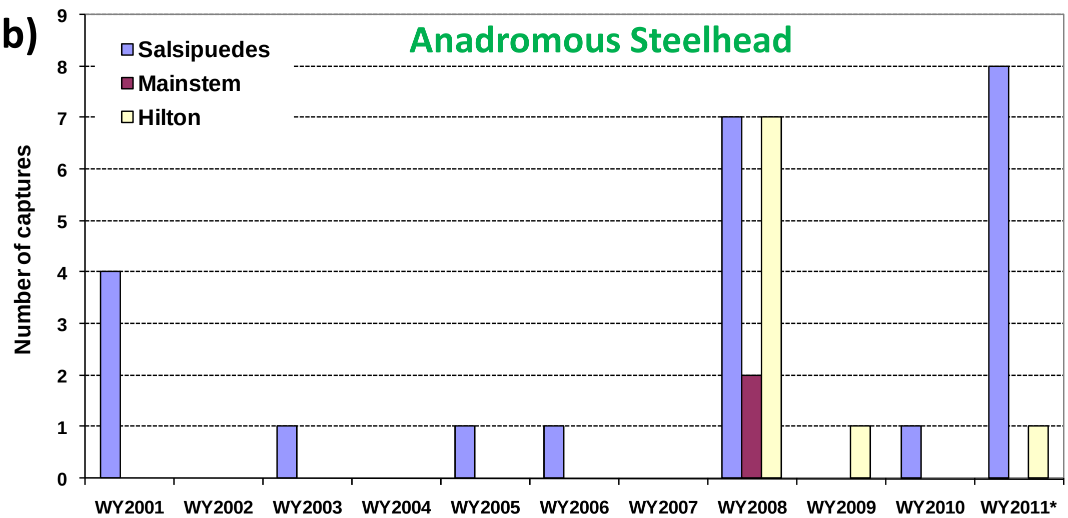
Figure 88: (a) Upstream and (b) downstream migrant *O. mykiss* totals (including recaptures) from WY2001 through WY2011 for the Salsipuedes Creek, LSYR Mainstem, and Hilton Creek traps. The LSYR Mainstem traps were not deployed prior to WY2005 (no access) and WY2007 (low flow).

(a)



	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet
Salsipuedes	131	4	83	20	55	218	2	50	23	67	176
Mainstem	-	-	-	-	-	14	-	1	2	24	14
Hilton	1	22	3	35	7	214	138	83	110	46	59
Total	132	26	86	55	62	446	140	134	135	137	249

(b)



	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011*
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet
Salsipuedes	4	0	1	0	1	1	0	7	0	1	8
Mainstem	-	-	-	-	-	0	0	2	0	0	0
Hilton	0	0	0	0	0	0	0	7	1	0	1
Total	4	0	1	0	1	1	0	16	1	1	9

* Hilton steelhead recaptured on 4/1/11 was originally captured in Salsipuedes Creek on 3/11/11.

Figure 89: (a) Smolt and (b) anadromous steelhead captures from WY2001 through WY2011 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.

WY2008 Adult Steelhead

WY2008 Adult Steelhead Captures					
#	#	Location	Direction	Size (mm)	Date
1	1	Salsipuedes	US	640	2/4
2	2	Salsipuedes	US	701	2/5
3	3	Salsipuedes	DS	496	2/7
4	4	Salsipuedes	US	635	2/17
5	5	Salsipuedes	US	663	3/25
6	6	Salsipuedes	US	675	3/29
7	1	Mainstem	US	678	2/10
8	2	Mainstem	US	600	3/18
9	1	Hilton	US	659	2/7
10	2	Hilton	DS	578	2/11
11	3	Hilton	US	691	2/16
12	4	Hilton	US	510	2/26
13	5	Hilton	DS	617	3/4
14	6	Hilton	US	563	3/5
15	7	Hilton	US	660	3/7
16	8	Hilton	US	688	3/23

WY2011 Adult Steelhead

WY2011 Adult Steelhead Captures					
#	#	Location	Direction	Size (mm)	Date
1	1	Salsipuedes	US	315*	1/24
2	2	Salsipuedes	US	528	3/5
3	3	Salsipuedes	US	481	3/11
4	4	Salsipuedes	US	490	4/2
5	5	Salsipuedes	US	458	4/8
6	6	Salsipuedes	US	507	4/10
7	7	Salsipuedes	US	298*	5/6
8	8	Salsipuedes	US	242*	5/6
9	1	Hilton	US	481**	4/1

* Lagoon Steelhead.
** Recaptured Steelhead from Salsipuedes Creek 3/11.

Figure 90: WY2008 and WY2011 anadromous steelheads captured within the LSYR basin.

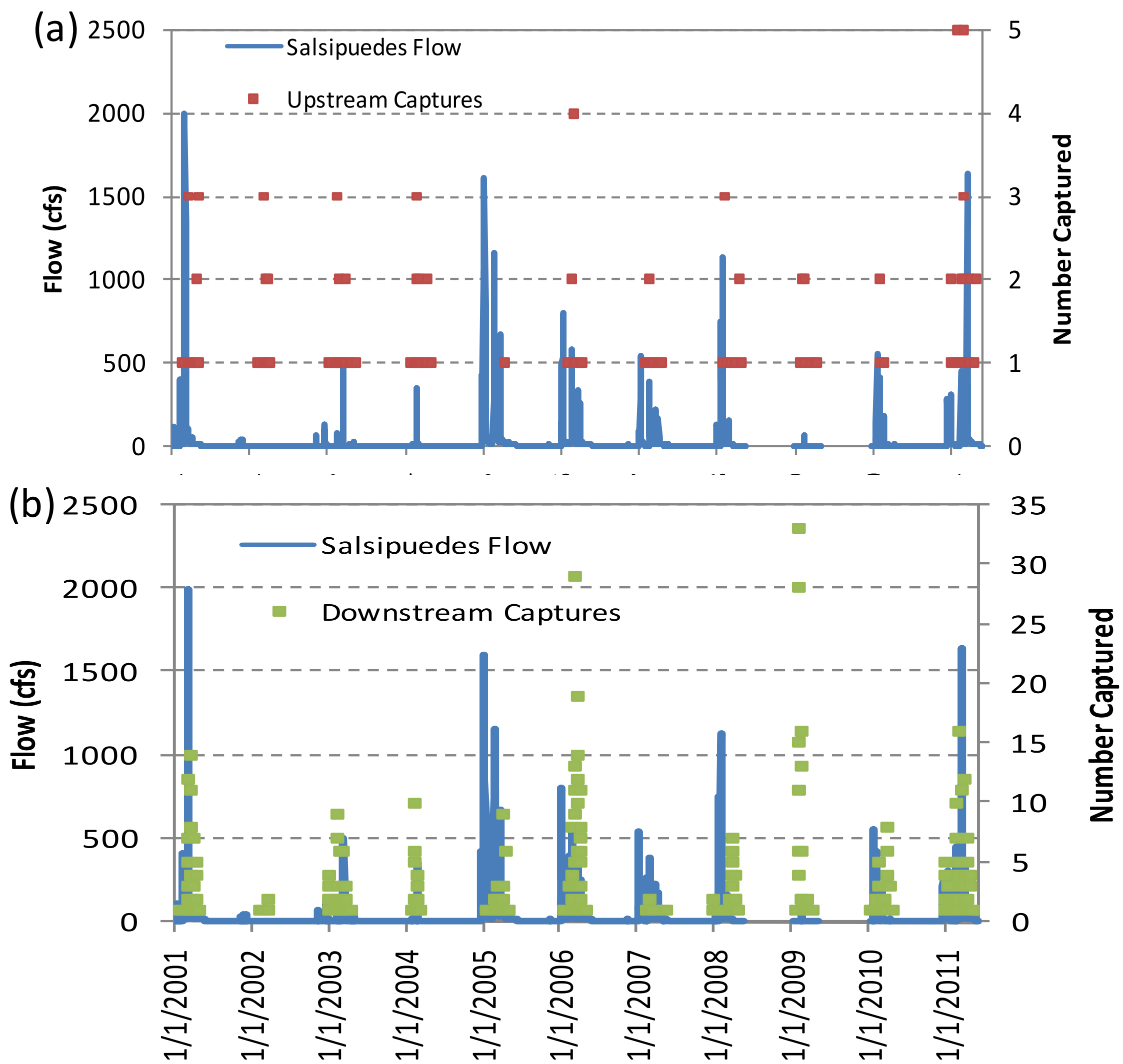


Figure 91: WY2001-WY2011 (a) upstream and (b) downstream migrant *O. mykiss* captures at the Salsipuedes Creek trap. Average daily flow data were from the USGS Salsipuedes gauge on the LSYR. Traps were removed just prior to peak storm flow events.

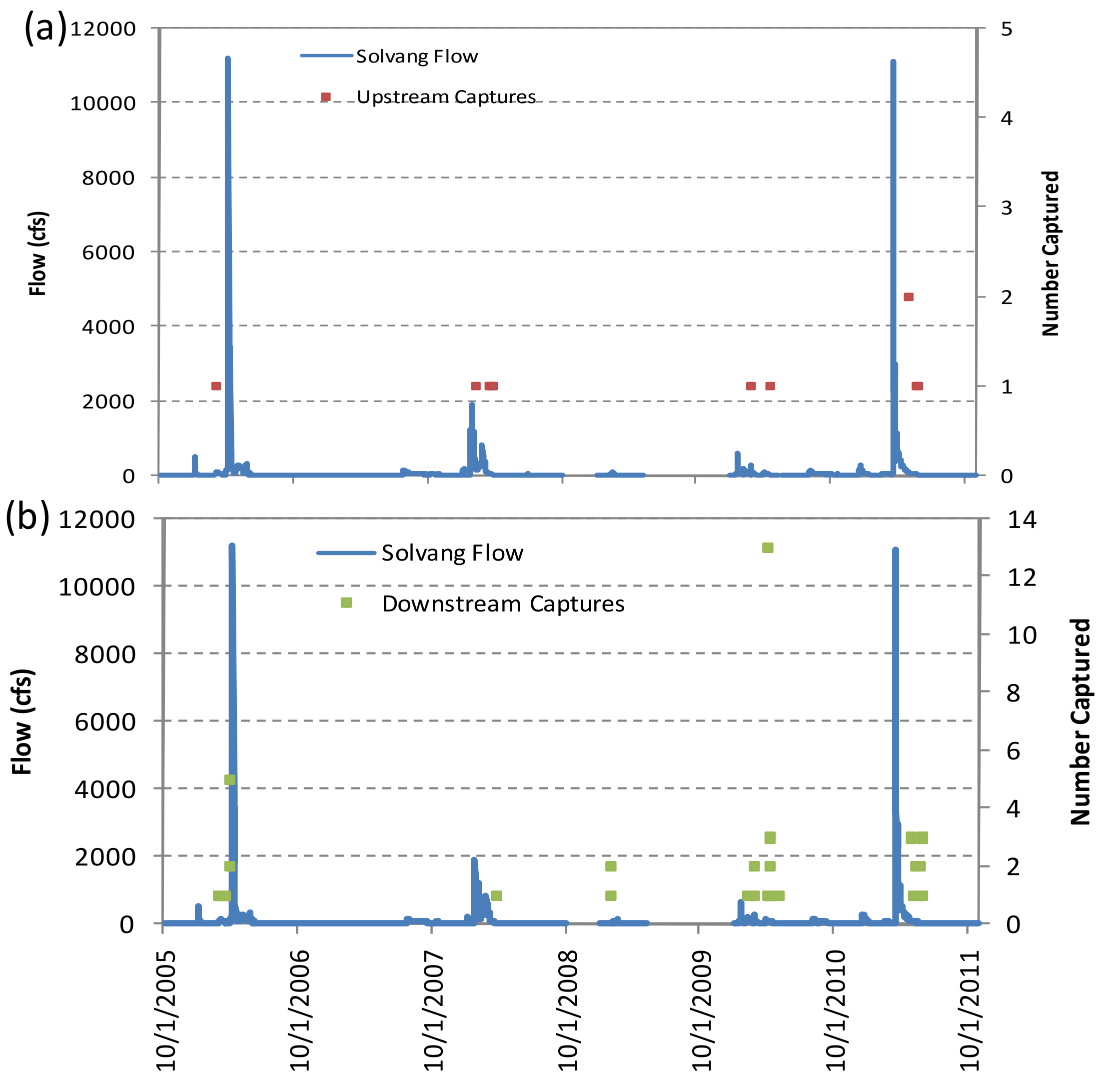


Figure 92: WY2005-WY2011 (a) upstream and (b) downstream migrant *O. mykiss* captures at the LSYR Mainstem trap. Average daily flow data were from the USGS Solvang gauge on the LSYR. Traps were removed just prior to peak storm flow events. The LSYR Mainstem traps were not deployed in WY2005 and WY2007.

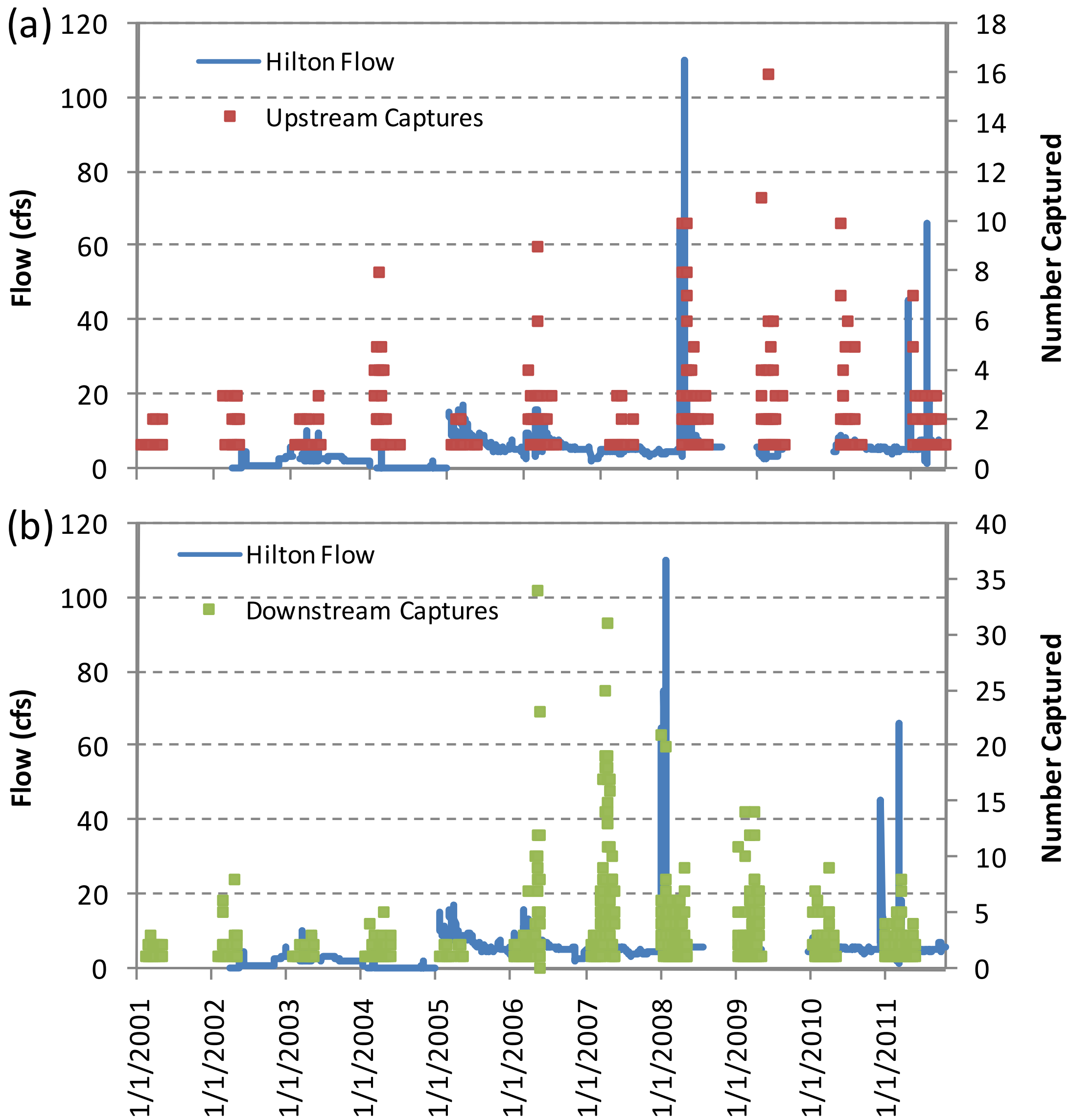


Figure 93: WY2001-WY2011 (a) upstream and (b) downstream migrant *O. mykiss* captures at the Hilton Creek trap. Average daily flow data were from the USGS Hilton Creek gauge just below the upper release point of the HCWS. Traps were removed just prior to peak storm flow events.

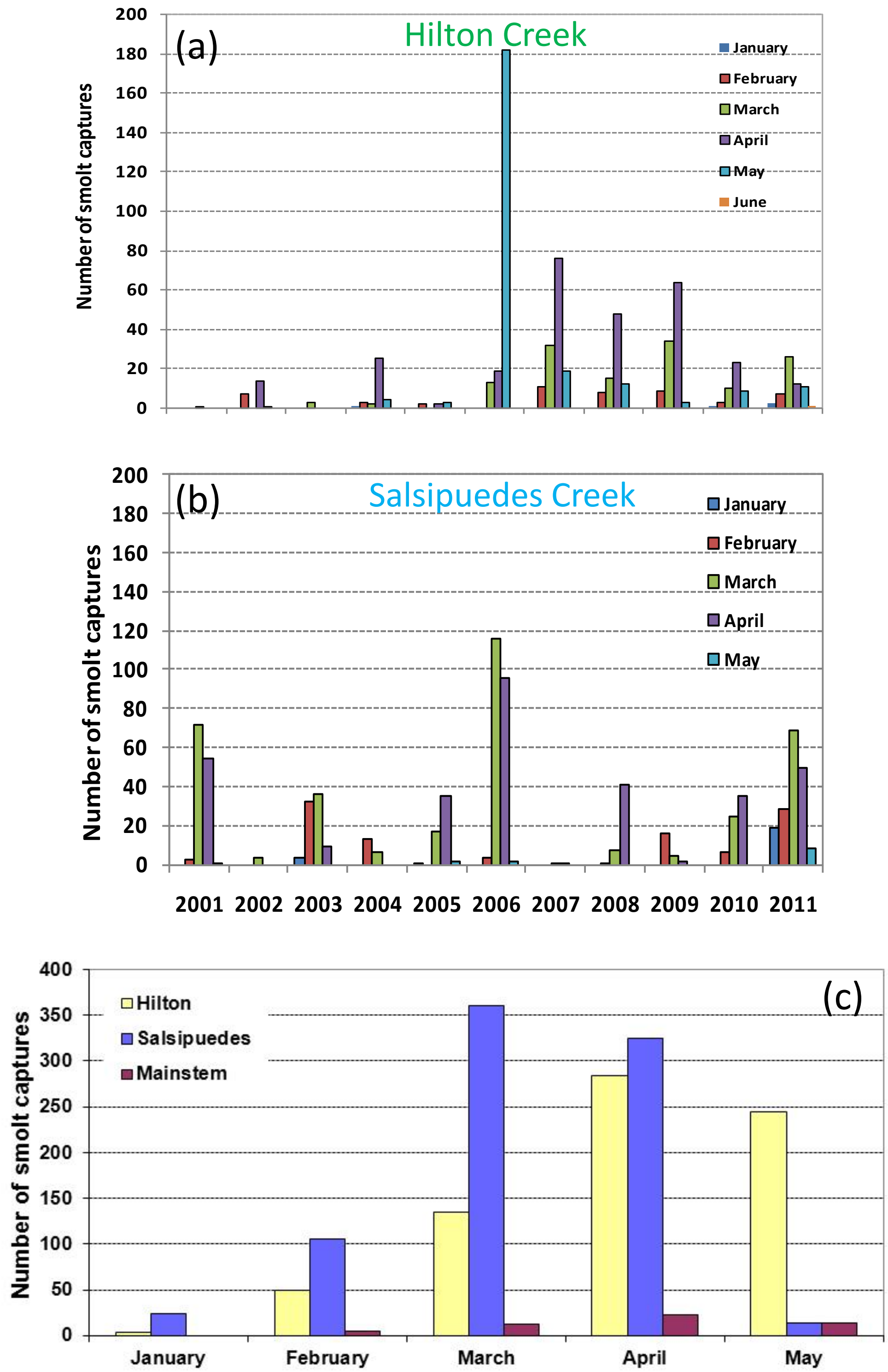


Figure 94: Timing of smolt migration observed at (a) Hilton and (b) Salsipuedes Creeks from WY2001 through WY2011; (c) a tabulation of all the years of smolt captures (WY2001-WY2010) by month.

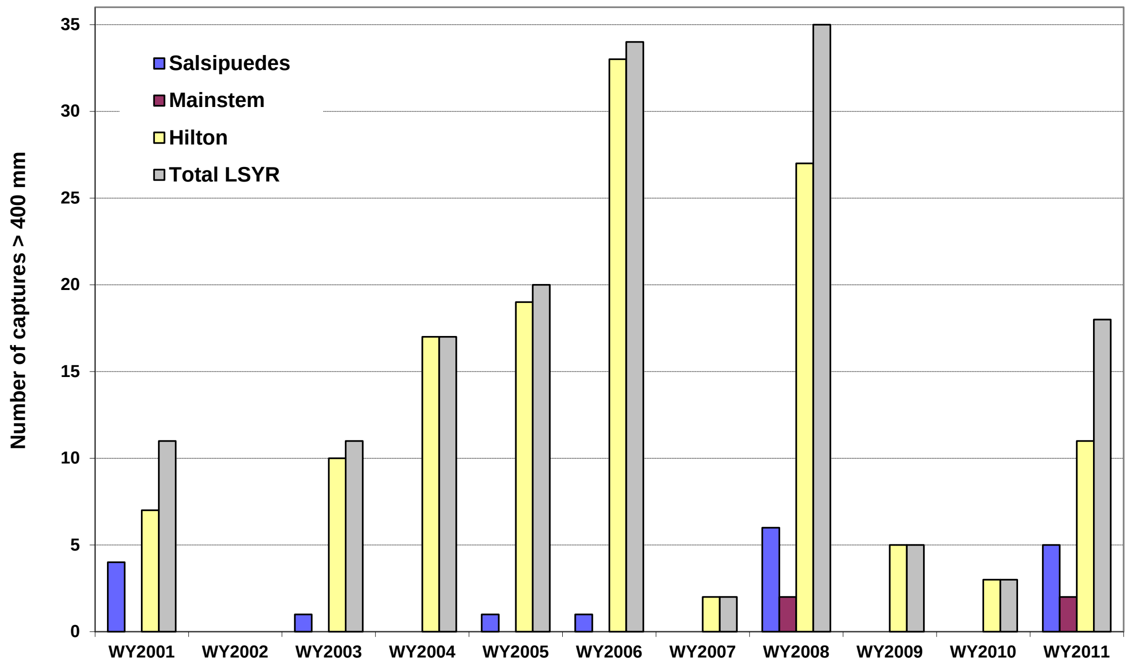


Figure 95: Migrant *O. mykiss* captures equal to or larger than 400 mm (15.7 inches) observed at the three trap sites from WY2001 through WY2011. The LSYR Mainstem trap was first installed in WY2006 and was not deployed in WY2007 due to low flows.

Table 25: WY2001 through WY2011 tributary upstream and downstream *O. mykiss* captures for Hilton and Salsipuedes Creeks (numbers in blue are subtotals of the numbers above).

WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011		WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011
Hilton Creek												Salsipuedes Creek										
Upstream												Upstream										
0	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	0	4	0	0	0	650-699	1	0	1	0	1	0	0	2	0	0	0
0	0	0	0	0	0	0	0	1	0	0	600-649	0	0	0	0	0	0	0	3	0	0	0
0	0	0	0	0	1	0	2	0	0	0	550-599	1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	2	2	0	2	1	0	0	500-549	0	0	0	0	0	1	0	0	0	0	3
3	0	0	6	8	9	0	13	1	2	0	450-499	1	0	0	0	0	0	0	0	0	0	2
4	0	9	11	9	21	2	6	2	1	11	400-450	1	0	0	0	0	0	0	0	0	0	0
2	0	10	24	9	31	11	31	27	11	6	300-399	5	3	0	1	0	6	0	0	0	0	1
1	0	2	7	7	10	4	22	29	39	10	200-299	7	3	3	10	0	5	2	7	1	4	7
9	38	14	23	4	17	15	63	33	39	34	101-199	7	8	22	9	0	3	5	1	9	2	21
1	1	8	15	0	15	12	32	24	15	22	<100	0	0	3	0	0	0	0	2	3	0	5
20	**39**	**44**	**86**	**39**	**106**	**44**	**175**	**118**	**107**	**83**	**Total**	**23**	**14**	**29**	**20**	**1**	**15**	**7**	**16**	**13**	**6**	**39**
Downstream												Downstream										
0	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	0	2	0	0	0	650-699	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	600-649	1	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	1	1	0	0	550-599	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	2	3	0	1	0	0	0	500-549	1	0	0	0	0	0	0	0	0	0	0
2	0	1	2	0	5	0	14	1	2	2	450-499	2	0	0	0	0	0	0	0	0	0	0
5	0	3	9	5	6	4	12	0	3	7	400-450	0	0	0	0	0	0	0	1	0	0	0
1	0	2	7	3	20	16	27	23	9	10	300-399	5	0	0	0	0	2	1	1	0	0	3
0	5	1	5	2	16	9	18	26	38	22	200-299	19	2	2	3	9	18	3	13	2	20	13
0	4	0	3	1	11	6	4	7	1	4	Smolts	8	1	2	0	9	11	0	9	1	18	2
0	0	0	1	0	0	0	2	0	1	0	Pre-Smolt	0	0	0	1	0	2	0	1	0	0	1
0	1	1	1	1	5	3	12	19	36	17	Res	11	1	0	2	0	5	3	3	1	2	10
22	43	11	44	6	44	364	175	219	84	82	101-199	134	4	98	17	46	183	12	41	61	50	158
1	18	3	28	6	33	92	58	72	40	36	Smolts	121	3	55	8	45	132	1	33	16	48	100
0	0	0	2	0	5	40	18	31	4	17	Pre-Smolt	2	0	21	2	1	45	1	7	5	1	55
21	25	8	14	0	6	232	99	116	40	30	Res	11	1	22	7	0	6	10	1	40	1	3
1	7	10	20	1	178	206	49	34	15	17	<100	1	0	12	21	0	30	1	6	111	2	25
0	0	0	1	0	1	0	0	0	0	0	Smolts	0	0	0	9	0	5	0	0	0	0	0
0	0	0	0	0	164	0	1	0	0	2	Pre-Smolt	0	0	5	0	0	23	0	0	1	0	18
1	7	10	19	1	13	206	48	34	15	15	Res	1	0	7	12	0	2	1	6	110	2	7
32	**55**	**29**	**88**	**19**	**272**	**599**	**300**	**304**	**151**	**140**	**Total**	**163**	**6**	**112**	**41**	**55**	**233**	**17**	**62**	**174**	**73**	**199**

Table 26: WY2001-WY2011 *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	WY2011
Year-type:	*Wet*	*Dry*	*Normal*	*Dry*	*Wet*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Wet*
Refugio Reach											
Spring	147	1	0	0	49	211	35	190	39	15	56
Summer	n/a	3	n/a	n/a	63	242	19	528	32	4	39
Fall	6	2	n/a	0	80	208	12	263	19	2	25
Alisal Reach											
Spring	123	3	0	0	18	134	54	26	39	23	38
Summer	11	3	n/a	n/a	21	89	39	118	17	8	39
Fall	1	1	n/a	0	11	85	9	42	7	10	36
Hilton Creek											
Spring	1163	624	564	510	1517	2740	1316	2210	545	1256	1139
Summer	1324	139	554	1046	1303	1891	1319	1519	863	1328	1195
Fall	1420	n/a	381	n/a	1272	2016	n/a	738*	746	990	1147
Quiota Creek											
Spring	273	359	49	22	n/a	n/a	n/a	243	189	114	130
Summer	168	n/a	49	n/a	n/a	142	201	81	101	93	167
Fall	161	n/a	n/a	n/a	n/a	84	78	67	39	38	180
Salsipuedes Creek (R#5)											
Spring	43	n/a	18	n/a	n/a	109	202	n/a	95	303	82
Summer	n/a	n/a	n/a	n/a	110	131	n/a	308	28	217	62
Fall	n/a	n/a	7	n/a	134	74	76	226	20	96	79
El Jaro Creek											
Spring	61	10	19	n/a	n/a	35	30	n/a	75	105	56
Summer	19	n/a	10	n/a	25	35	n/a	405	n/a	48	58
Fall	39	n/a	n/a	n/a	3	18	n/a	151	11	89	43

n/a: conditions too turbid to snorkel.
* Only half of the normal survey reach was snorkeled.

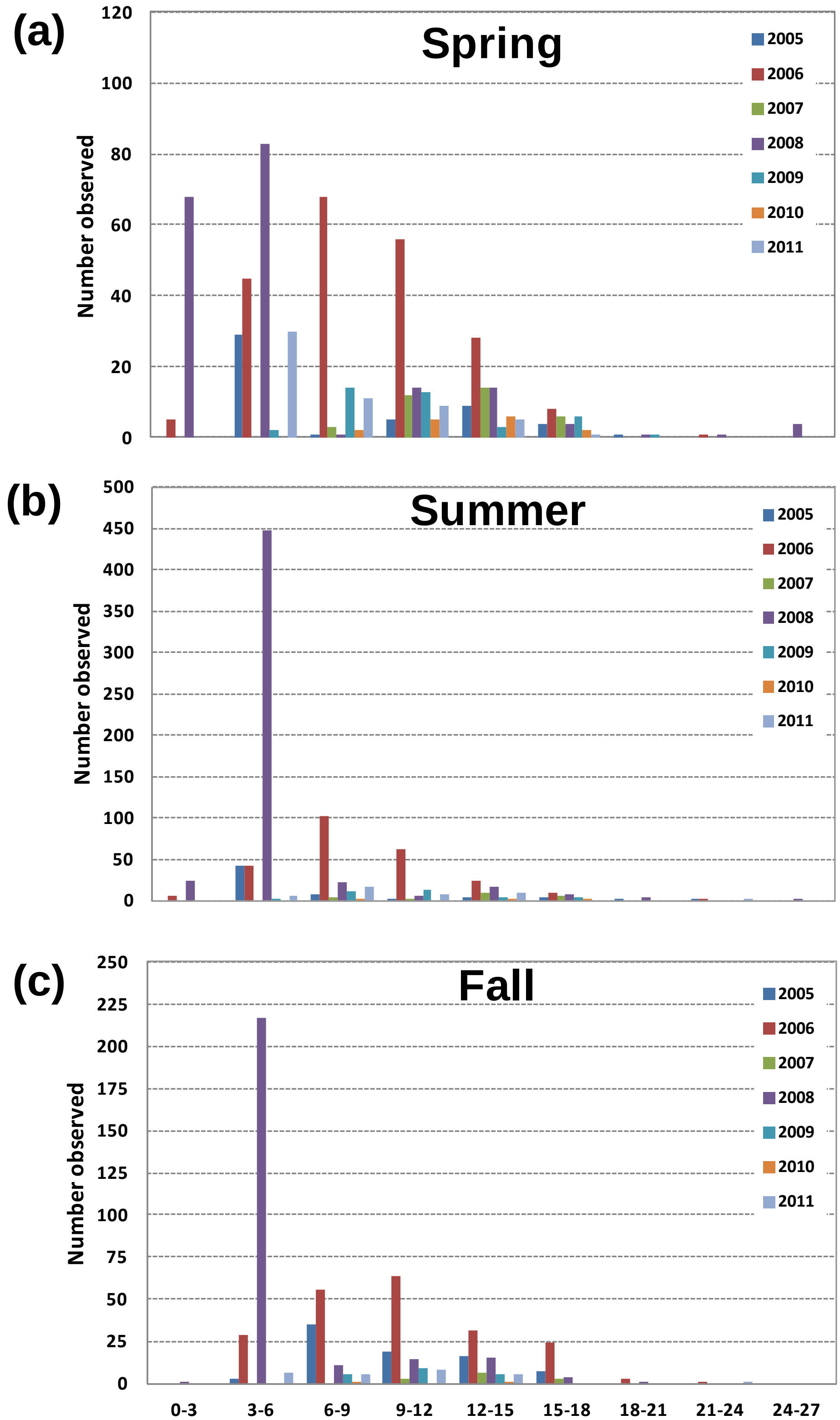


Figure 96: WY2005-WY2011 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for the LSYR mainstem Refugio Reach broken out by 3 inch size classes.

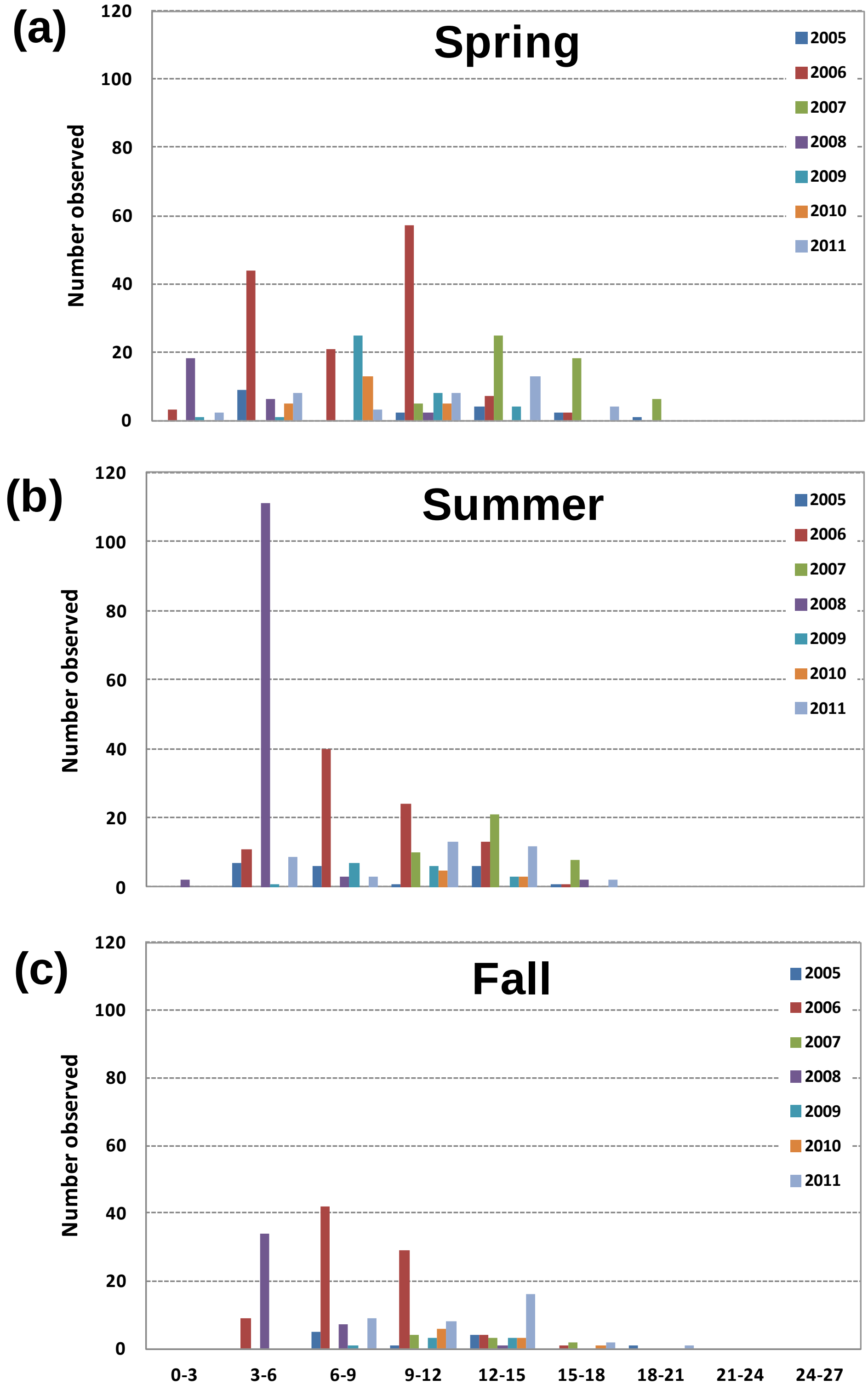


Figure 97: WY2005-WY2011 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for the LSYR mainstem Alisal Reach broken out by 3 inch size classes.

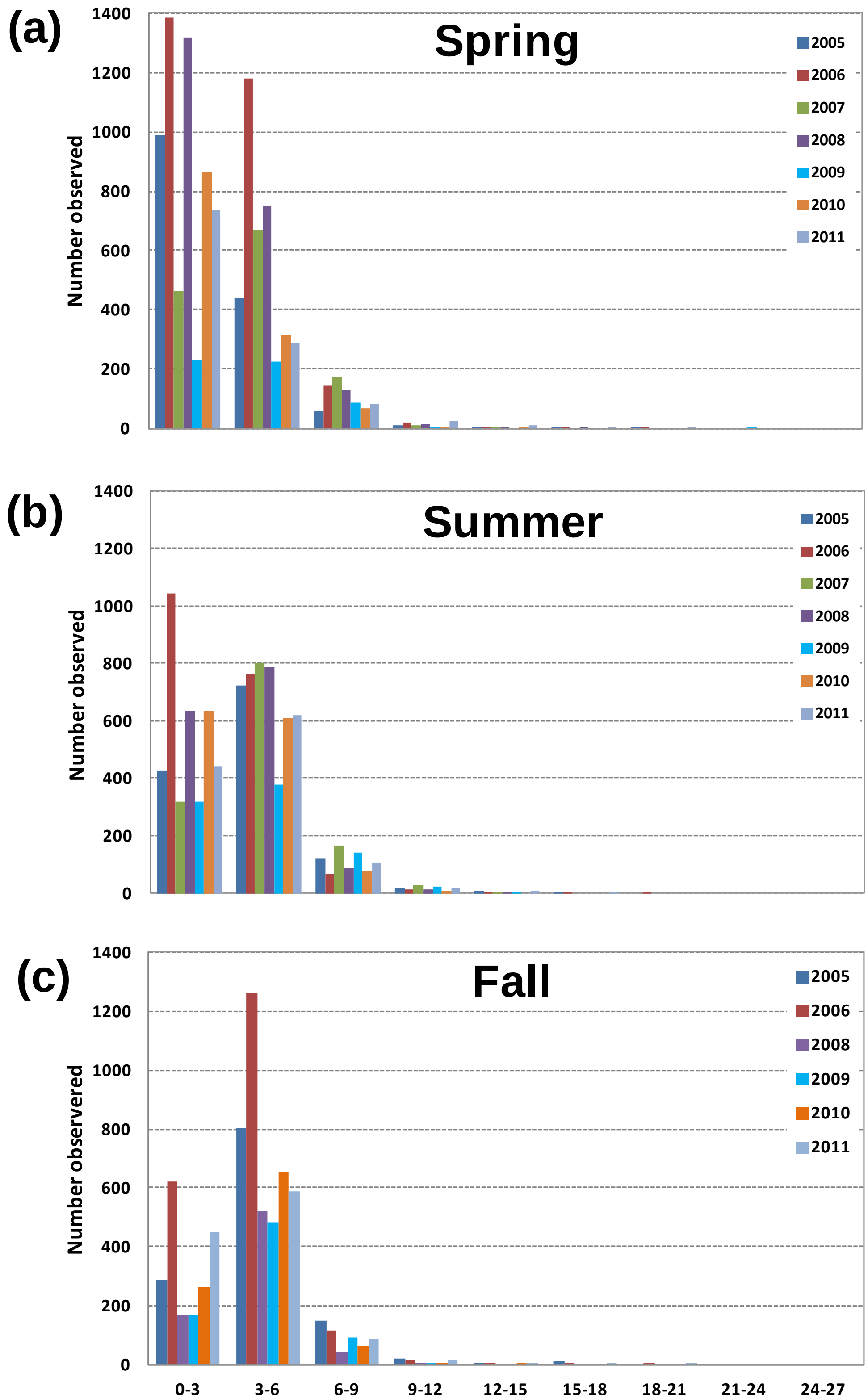


Figure 98: WY2005-WY2011 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Hilton Creek broken out by 3 inch size classes. Only half of the WY2008 fall snorkel survey was completed due to visibility issues.

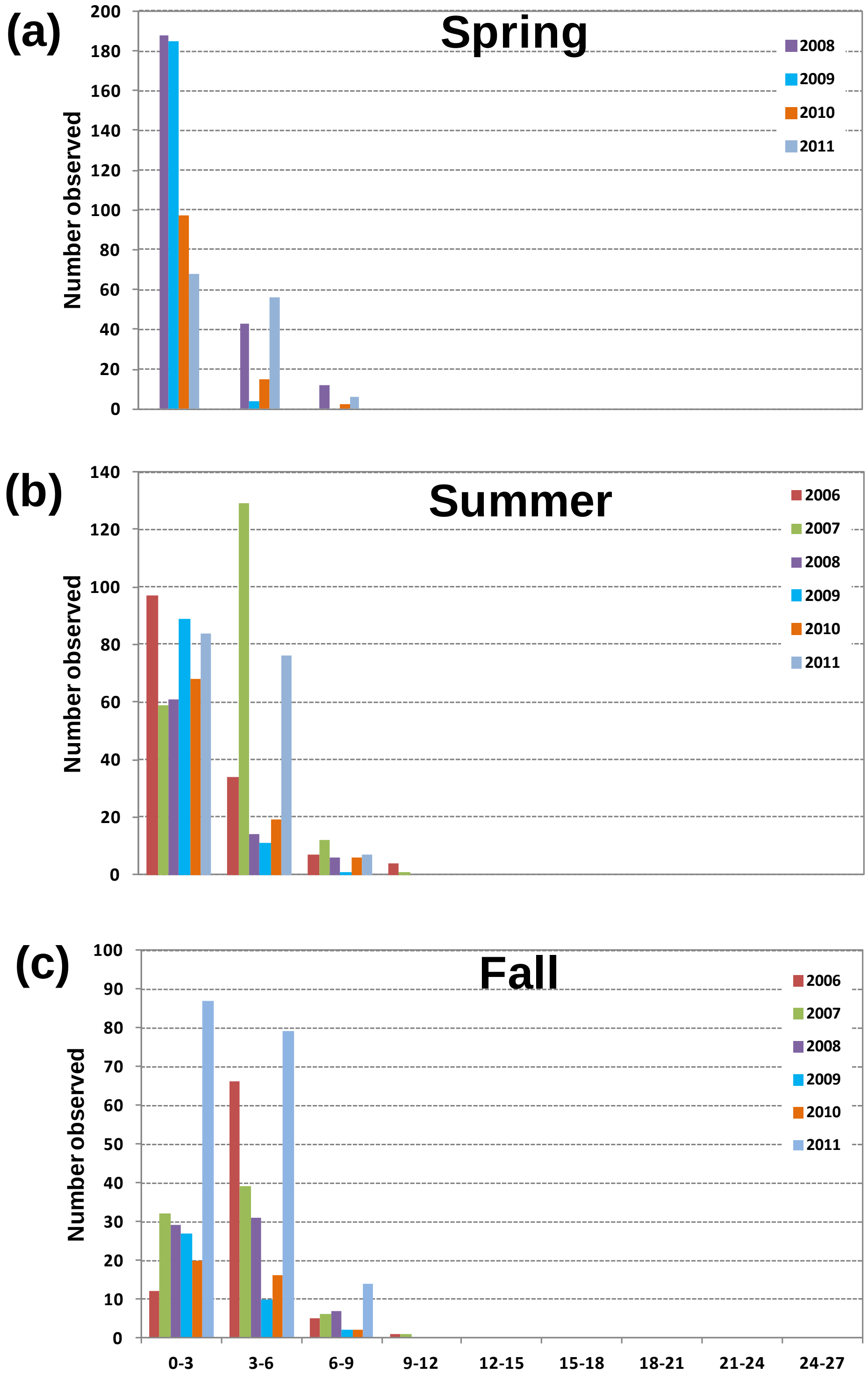


Figure 99: WY2006-WY2011 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Quiota Creek broken out by 3 inch size classes.

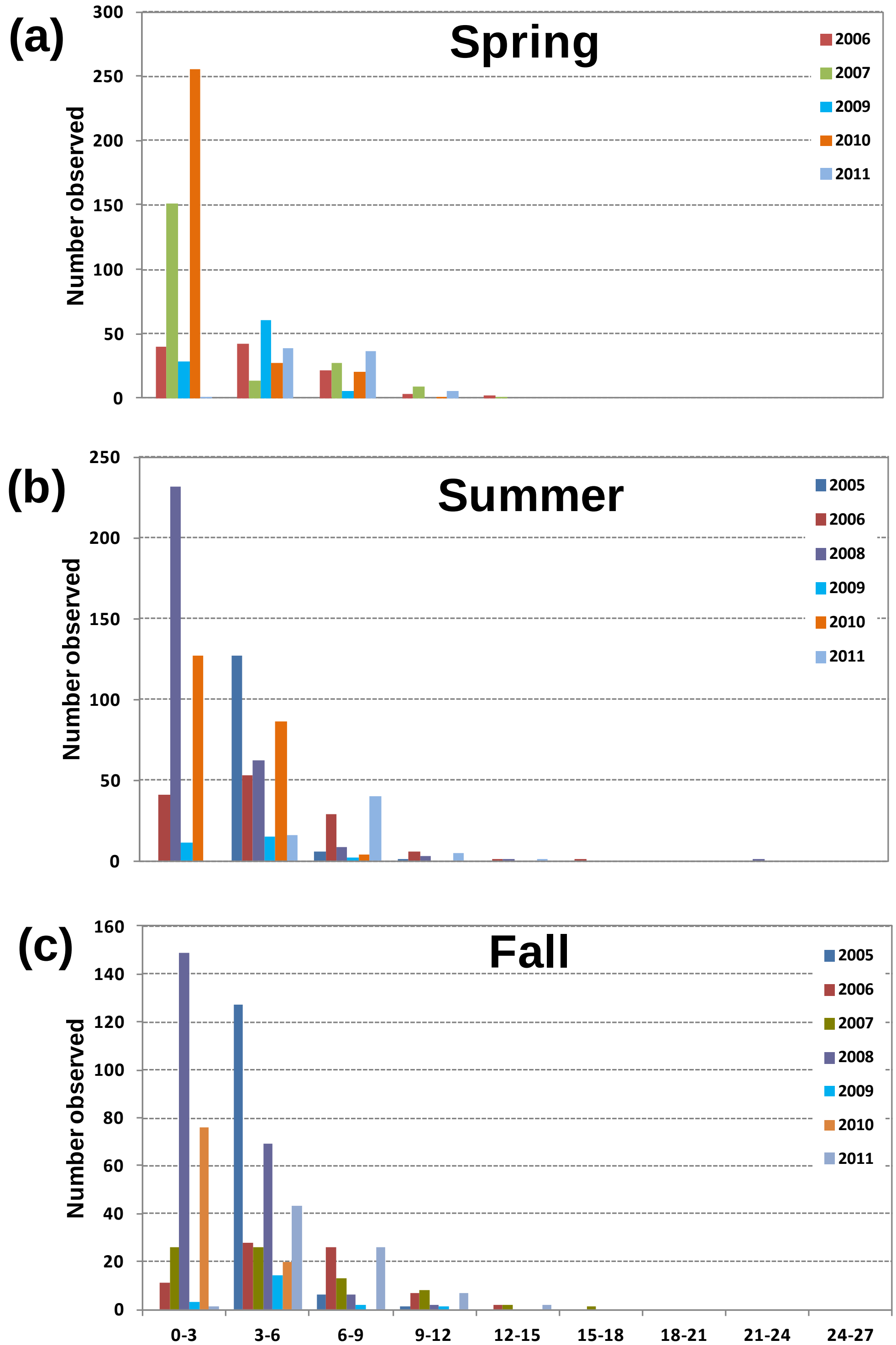


Figure 100: WY2005-WY2011 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Salsipuedes Creek broken out by 3 inch size classes. Totals are only from Reach 5 for comparison.

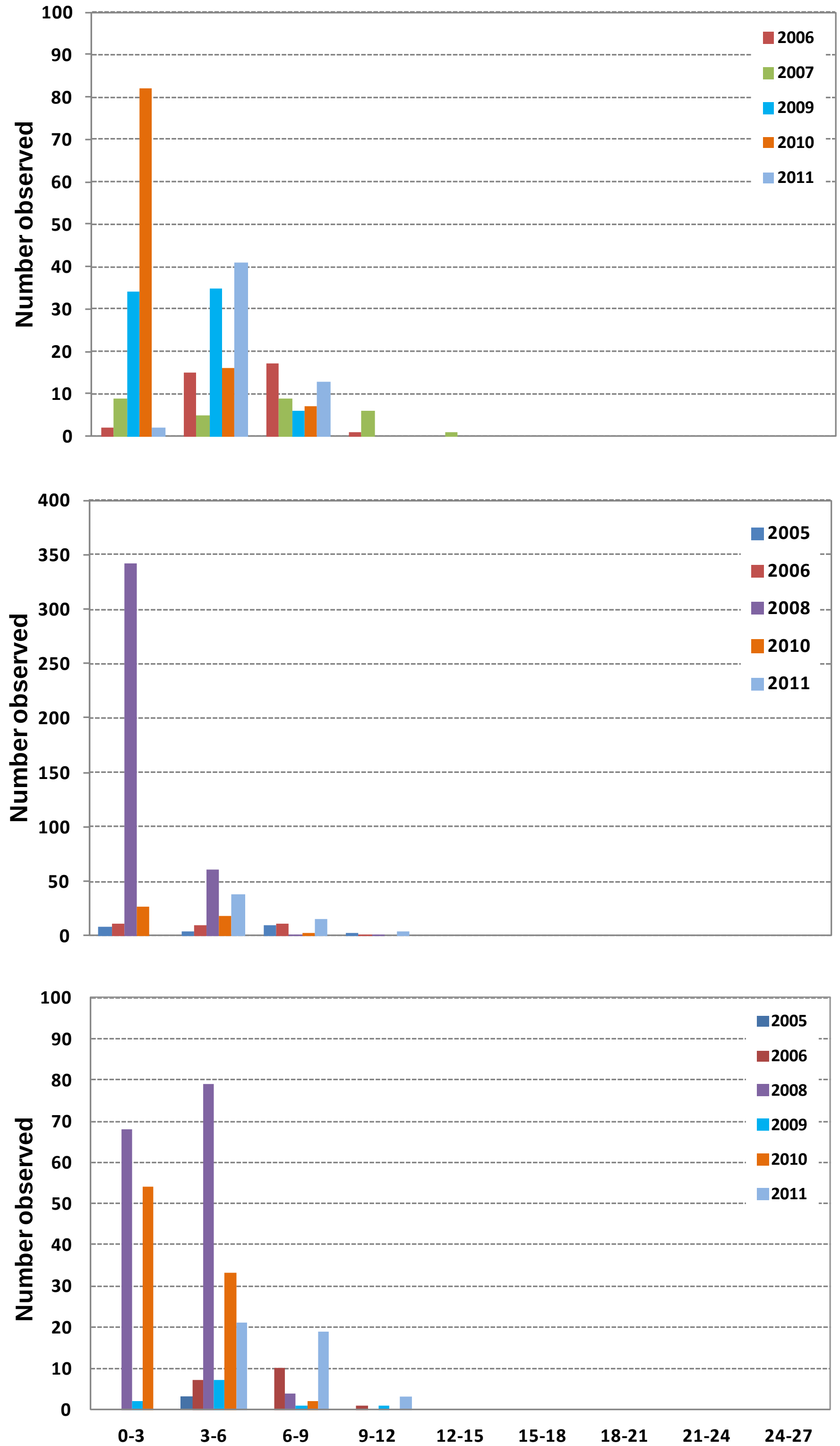
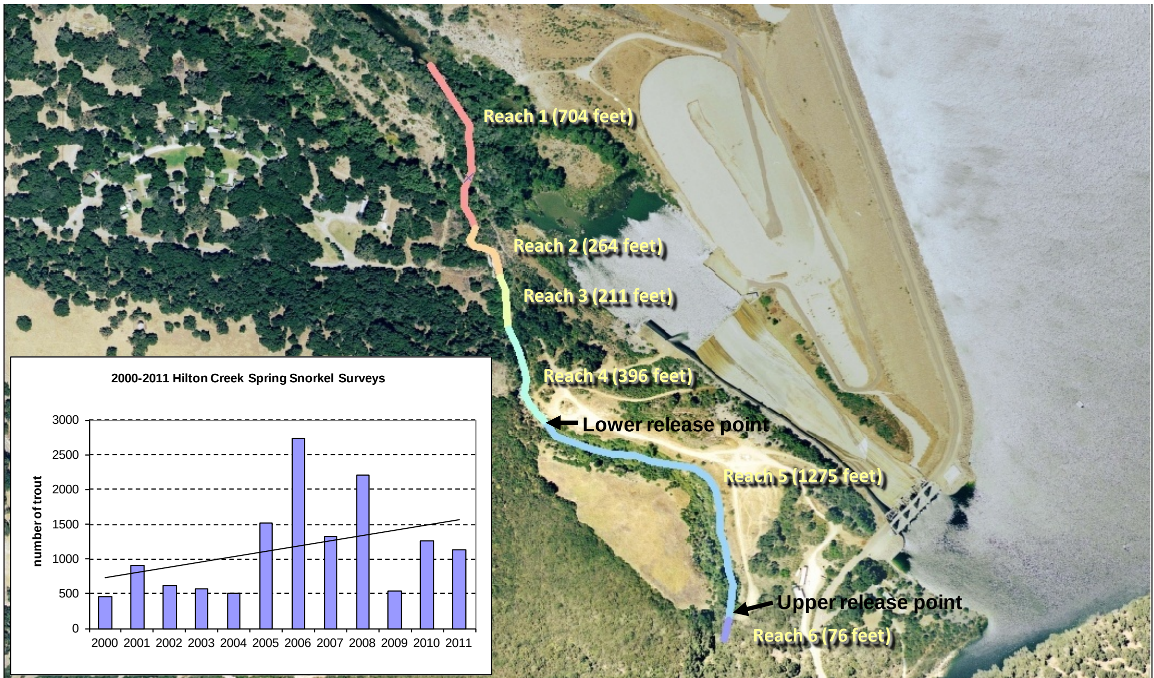


Figure 101: WY2005-WY2011 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for El Jaro Creek broken out by 3 inch size classes.



Reach	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	64	258	65	288	231	826	484	177	643	174	377	433
2	145	191	158	94	159	336	403	159	251	62	129	143
3	87	214	146	101	50	181	140	67	43	19	58	69
4	160	219	253	79	70	174	403	296	181	116	125	142
5	0	0	0	0	0	0	1244	617	1029	174	507	316
6	0	0	0	0	0	0	66	0	63	0	60	36
Total:	456	882	622	562	510	1517	2740	1316	2210	545	1256	1139

Figure 102: Hilton Creek reaches snorkeled with observed *O. mykiss* trend analysis from the spring snorkel surveys in 2000 through 2011. The embedded graph and table present number of *O. mykiss* observed. The Cascade Chute migration barrier was removed in December of 2005.

Table 27: WY2001-2011 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	WY2011
Largemouth Bass											
Spring	78	147	184	22	0	7	35	4	160	53	16
Summer	57	881	Dry	172	20	3	33	626	239	137	434
Fall	57	374	0	290	237	2	56	508	261	213	851
Sunfish											
Spring	67	40	7	5	4	9	34	0	38	60	40
Summer	18	11	Dry	1	34	41	3	262	89	26	148
Fall	8	9	0	0	22	1	18	155	23	7	88
Catfish											
Spring	7	2	0	0	2	0	3	1	0	1	0
Summer	0	0	Dry	0	6	55*	2	2	1	0	0
Fall	1	2	0	2	200*	0	3	1	1	0	0
Carp											
Spring	0	0	0	0	0	9	138	50	66	28	52
Summer	0	0	Dry	0	178**	46	159	88	48	59	74
Fall	0	0	0	0	282**	10	190	69	65	76	61

* Juvenile bullhead catfish.

** Mostly juvenile carp.

Appendices

A. Acronyms and Abbreviations

AF: Acre Foot

AMA: Adaptive Management Account

AMC: Adaptive Management Committee

AMS: Annual Monitoring Summary

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

FPA: Fish Passage Account

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 B-1 (Calibration). The parameters and specifications of each instrument are listed in Table B-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 2002-2011 in the spring, summer, and fall (Figure C-1). After 2005 and continuing through 2010, photo points were scaled down and taken at irregular intervals. All photo points taken in WY2011 are listed in Tables C-1 and C-2 and were taken at more regular intervals as recommended in the 2010 Annual Monitoring Summary. 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.

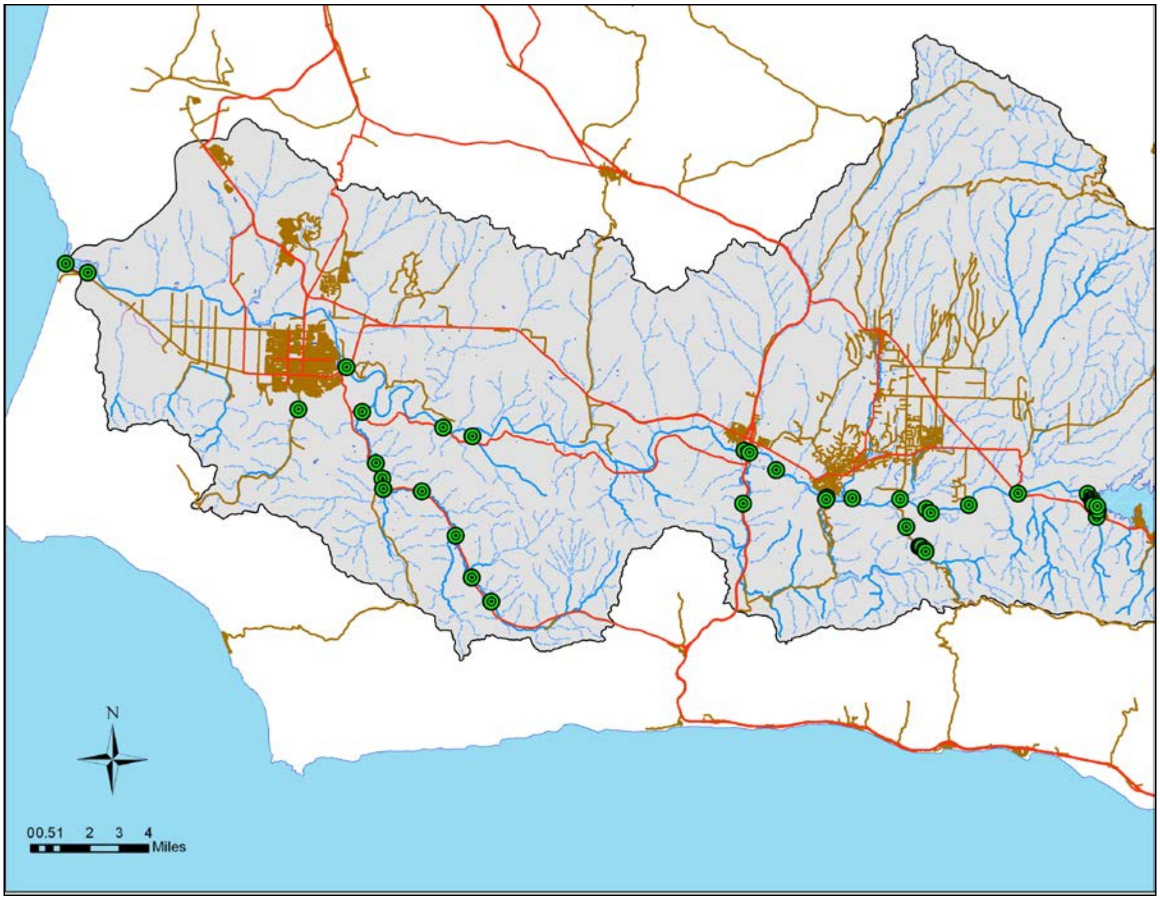


Figure C-1: WY2011 photo point locations.

Table C-1: 2011 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	1/11	3/11	8/11	10/11
M1	Lower Hilton Creek, photo d/s at ford crossing				
M2a	Bluffs overlooking long pool, photo u/s		x		x
M2b	Bluffs overlooking long pool, photo d/s		x		x
M3	Highway 154 culvert on Hilton Creek, photo u/s				
M4	Highway 154 culvert on Hilton Creek, photo d/s				
M5	Highway 154 Bridge, photo u/s			x	
M6	Highway 154 Bridge, photo d/s			x	
M7	Meadowlark crossing, photo u/s				x
M8	Meadowlark crossing, photo d/s				x
M9	Lower Gainey crossing, beaver dam, photo u/s				
M10	Lower Gainey crossing, beaver dam, photo d/s				
M11a	Lower Gainey crossing, photo u/s				
M11b	Lower Gainey crossing, photo d/s				
M12	Refugio Bridge, photo u/s	x	x	x	
M13	Refugio Bridge, photo d/s	x	x	x	
M14	Alisal Bridge, photo u/s	x	x	x	x
M15	Alisal Bridge, photo d/s	x	x	x	x
M17	Mid-Alisal Reach, photo u/s				
M18	Mid-Alisal Reach, photo d/s				
M19	Avenue of the Flags Bridge, photo u/s		x	x	x
M20	Avenue of the Flags Bridge, photo d/s		x	x	x
M21	Sweeney Road crossing, photo u/s			x	x
M22	Sweeney Road crossing, photo d/s			x	x
M23	Highway 246 (Robinson) Bridge, photo u/s		x	x	x
M24	Highway 246 (Robinson) Bridge, photo d/s		x	x	x
M25	LSYR Lagoon on railroad bridge, photo u/s			x	x
M26	LSYR Lagoon on railroad bridge, photo d/s			x	x
M27	LSYR at 35th St. Bridge, photo d/s				x
M28	LSYR at 35th St. Bridge, photo u/s				x
M29	LSYR Lagoon upper reach, photo d/s				
M30	LSYR Lagoon upper reach, photo u/s				

Table C-2: 2011 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	1/11	3/11	8/11	10/11
T1	Hilton trap site, photo u/s				
T2	Hilton trap site, photo d/s				
T3	Hilton at ridge trail, photo d/s		x		x
T4	Hilton at ridge trail, photo u/s		x		x
T5	Hilton at telephone pole, photo d/s				
T6	Hilton at telephone pole, photo u/s				x
T7	Hilton at tail of spawning pool, photo u/s				
T8	Hilton impediment/tributary, photo d/s				
T9	Hilton impediment/tributary, photo u/s				
T10	Hilton just u/s of URP, photo d/s				
T11	Hilton road above URP, photo d/s				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	
T23	Alisal Creek from Alisal Bridge, photo u/s				x
T24a	Alisal Creek from Alisal Bridge, photo u/s				
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				
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s			x	x
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s			x	x
T39	Salsipuedes Creek at Hwy 1 Bridge, photo d/s	x		x	x
T40	Salsipuedes Creek at Hwy 1 Bridge, photo u/s	x		x	x
T41	Salsipuedes Creek at Jalama Bridge, photo d/s	x		x	x
T42	Salsipuedes Creek at Jalama Bridge, photo u/s	x		x	
T43	El Jaro/Upper Salsipuedes confluence, photo u/s			x	
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 during WY2011

- 2005-2008 Annual Monitoring Report with Trend Analyses (USBR, 2011).
- Reasonable and Prudent Measure 8.19 and Performance Evaluation of the Rancho San Julian Fish Ladder Fish Passage Project on El Jaro Creek (CPBS, 2013).
- Reasonable and Prudent Measure 8.19 and Performance Evaluation of the Quiota Creek Fish Passage Project at Crossing 6 (CPBS, 2013).
- Report on the 2011 AMA Release (CPBS, 2011).
- 3/25/11 Stranding Incident Report at the CCWA Pipeline downstream of Bradbury (CPBS, 2011).
- Quiota Creek Crossing 2 Bottomless-Arched Culvert Project, Species Relocation Report (CPBS, 2011).