WY2013 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

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Executive Summary

This report presents the data and summarizes the results of monitoring southern California steelhead/rainbow trout (*Oncorhynchus mykiss, O. mykiss*) and water quality conditions in the Lower Santa Ynez River (LSYR) below Bradbury Dam during Water Year 2013 (WY2013, 10/1/12 – 9/30/13). The report also incorporates observations of population trends and a listing of restoration efforts for the period from WY2001 through WY2013 as well as specific discussion of events that occurred during WY2013.

The monitoring tasks completed in WY2013 were performed below Bradbury Dam in the LSYR watershed or in Lake Cachuma, which is approximately half the drainage 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) and the Monte Arido Highland Biogeographic Population Group (BPG) in the Southern Steelhead Recovery Planning Area (NMFS, 2012). Monitoring focused on three management reaches (Highway 154, Refugio, and Alisal reaches) and the Cadwell Reach 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 gathered since the 2012 Annual Monitoring Summary (COMB, 2016) and fulfills the annual 2013 reporting requirements of the Cachuma Project Biological Opinion (BiOp). The BiOp 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 by the Cachuma Operation and Maintenance Board (COMB) with the monitoring and data analyses prepared by Cachuma Project Biology Staff (CPBS) of the COMB Fisheries Division. The water quality and fisheries monitoring tasks were carried out as described in the BiOp (NMFS, 2000), Biological Assessment (BA) (USBR, 2000), and LSYR Fish Management Plan (FMP) (SYRTAC, 2000). Some deviations to the monitoring program as described in the 2008, 2009, 2010, 2011, and 2012 Annual Monitoring Reports/Summaries were necessary, specifically in relation to water quality monitoring, redd surveys, and migrant trapping. Modifications were necessary due to landowner access constraints, poor water clarity, or 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 population trend analysis since 2001 and specific events in WY2013, 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 and (D) a list of reports generated during the year in support of the fisheries program and for BiOp compliance.

WY2013 was a very dry year (7.59 inches of precipitation measured at Bradbury Dam; long-term average, 1953-2013, is 20.4 inches) with the majority of the rainfall occurring in November, December, and January. This was the second driest year over the recording period with 2007 being the driest at 7.41 inches of rain at Bradbury Dam. The largest storm of WY2013 (1.37 inches of rain) occurred on 12/3/12. The LSYR lagoon was never opened to the ocean during the water year. Bradbury Dam did not spill during the water year. Since it was the second year after a spill (WY2011) and reservoir storage was greater than 120,000 acre-feet (af) at the beginning of the water year (142,970 af on 10/1/12), target flows for rearing were maintained at Hilton Creek (2 cubic feet per second (cfs) minimum) and the Highway 154 Bridge (5 cfs minimum) with no target flows to Alisal Bridge as described in the BiOp. Once lake storage dropped below 120,000 af on 6/3/13, the Highway 154 Bridge target flow was reduced to 2.5 cfs minimum for the rest of the water year. There was no fish passage supplementation due to not meeting the minimum criteria for a wetted watershed. A Water Rights (WR) 89-18 release was conducted from 7/15/13 until 12/2/13 during which 17,473 af were released over a period of 140 days.

There were four incidents of interruption of flow to Hilton Creek from the Hilton Creek Watering System (HCWS) on 3/1/13, 6/23/13, 7/8/13 and 9/23/13 with a cumulative total of 30 *O. mykiss* rescued and 143 mortalities. Due to an interpretation issue between Reclamation and NMFS regarding *O. mykiss* take limits from those incidents and take provisions in the BiOp Incidental Take Statement, no migrant trapping was conducted during WY2013. This was the first year since 1993 that no migrant trapping was done. Reproduction and population status could only be monitored through spawner (redd) surveys and snorkel surveys. This limited the potential for trend analyses.

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 only when there were observations of note.

Reclamation, with assistance from COMB, has completed many conservation actions for the benefit of southern steelhead since the BiOp 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 LSYR mainstem and Hilton Creek flow targets; and the implementation of the Fish Passage Supplementation Program. COMB was involved in the planning, design, permitting, and construction of these projects (except the Hilton Creek Watering System and fish passage in Hilton Creek) with funding from grants and the Cachuma Member Units. Descriptions, maps and photos of all habitat enhancement projects are presented in Section 4. Designs were completed and grants submitted to the California Department of Fish and Wildlife (CDFW) for another fish passage enhancement project on Quiota Creek.

The following are recommendations to improve the monitoring program of which some are subject to funding availability:

- Continue the monitoring program described in the revised BA (NMFS, 2000) and BiOp (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 with CDFW as a potential solution for monitoring migrants during high flow conditions when our current/conventional traps need to be removed;
- Evaluate risk of exceeding take limits associated with the migrant trapping program and analyze ways to optimize the monitoring effort while remaining below mandated take limits for juvenile and adult *O. mykiss*;
- Reclamation and COMB work together to propose increased juvenile and adult take limits to be incorporated in the ongoing Reconsultation process with NMFS;
- Continue annual development of a Migrant Trapping Plan that would be reviewed and approved by NMFS;
- Develop a focused study plan and seek funding to analyze stomach content of non-native piscivorous fish specifically in habitats known to support *O. mykiss* such as within the Highway 154, Refugio and Alisal reaches of the LSYR mainstem to better understand their *O. mykiss* predation;
- Continue to maintain and evolve landowner cooperation and gain access to new reaches for all monitoring tasks, particularly when conducting tributary project performance evaluations within upstream tributary reaches;
- Further develop the dry season water quality monitoring program elements for water temperature, dissolved oxygen concentration, and turbidity, specifically the use of multi-parameter detachable monitoring units (Sondes and U-26s) to address more specific monitoring objectives for habitat suitability for *O. mykiss* and other aquatic species;
- Incorporate turbidity into the year-round monthly lake profile water quality monitoring with temperature and dissolved oxygen at the HCWS intake barge, particularly near its intake hose at 65 feet of depth below the surface which is near the deepest point of the lake;
- Continue efforts to remove fish passage impediments within the LSYR basin as listed in the proposed actions of the BiOp, utilizing grant funding wherever possible, specifically within the Quiota Creek watershed;
- Further develop the LSYR *O. mykiss* scale inventory and analyses of growth rates, evidence of life-history strategies such as fresh verses marine water rearing, signs of spawning, etc. in support of ongoing fisheries investigations;
- Finalize the installation of temperature probes/loggers on the outlets of Bradbury Dam to measure water temperature of releases from the Outlet Works for documentation, BiOp compliance monitoring (18 ^{o}C maximum release temperature) and management, specifically establishing the procedure for data transfer and reporting;
- Further systemize photo point documentation by continuing to add sites associated with completed restoration projects, consistency in site locations and improve timing of taking photos to maximize the objective of the documentation;
- Engage local landowners to implement ways to reduce cattle impacts to tributary habitats on private lands within the LSYR basin;
- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin; and

- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS and the Monte Arido Highland Biogeographic Region to improve 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.

TABLE OF CONTENTS

TABLES and FIGURES

WY2013 Annual Monitoring Summary

1. Introduction

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

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

The objective of this WY2013 Annual Monitoring Summary is to present the monitoring data collected in 2013 and to use it in conjunction with previously collected data to evaluate the effects of the Cachuma Project on southern California steelhead/rainbow trout (*Oncorhynchus mykiss* or *O. mykiss*) in the Lower Santa Ynez River (LSYR) below Bradbury Dam. Data collected throughout Water Year 2013 (WY2013, 10/1/12-9/30/13) regarding steelhead/rainbow trout 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 WY2013 Annual Monitoring Summary also presents findings and observations of population trends from 2001-2013 when possible 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), 2010 Annual Monitoring Report (USBR, 2013), 2011 Annual Monitoring Summary (COMB, 2013), and 2012 Annual Monitoring Summary (COMB, 2016). 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 of the BiOp and provides scientific data to conduct trend analyses over time in association with habitat and migration enhancement projects.

The data summarized in this report describe the habitat conditions and the fishery observations in the LSYR during WY2013. This period roughly encompasses the reproductive cycle of steelhead, specifically migration, spawning, rearing, and oversummering 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 have been included in the previous water year's data as they show *O. mykiss* survival over the dry season. Throughout this 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 0.14 miles upstream of its confluence with the mainstem).

WY2013 was classified as a dry year with only 7.59 inches of precipitation recorded at Bradbury Dam. The long-term average (1953-2013) is 20.4 inches. WY2013 was second lowest year over the period of record, after WY2007 with 7.41 inches). This was the second lowest rainfall year since issuance of the 2000 BiOp with 6 of 13 years classified as dry (WY2007, WY2013, WY2002, WY2004, WY2012, and WY2009 listed in order of severity). Dry years, in general, are often associated with a reduction of the *O. mykiss* population due to the lack of flow, limited availability of habitat, and reduced or no ocean connectivity for anadromous repopulation (Lake, 2003; COMB, 2013). However, dry years can result in an increase in resident *O. mykiss* reproduction due to limited stormflow that can wash out redds. Migrant trapping was not conducted in WY2013 due to an interpretation issue of the BiOp take limits between Reclamation and NMFS. There were four incidents of interruption of flow to Hilton Creek from the Hilton Creek Watering System (HCWS) that resulted in relocation of 30 and mortality of 143 *O. mykiss*. Incident reports submitted to NMFS by Reclamation describe these events in more detail. It was unclear at the time of initiating the migrant trapping operation whether operational cumulative take would be associated with the take limits provided in the Incidental Take Statement in the BiOp. It was determined later in the year that that operational take was in a separate category and migrant trapping should have been conducted. This was the first year since the monitoring program began in 1993 that no migrant trapping was conducted. Reproduction and population status could only be monitored through spawner (redd) surveys and snorkel surveys which limited the potential for trend analyses across the datasets.

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 actions within the LSYR through the Cachuma Operation and Maintenance Board's (COMB) Fisheries Division, specifically the Cachuma Project Biology Staff (CPBS). It is Reclamation's obligation to comply with State and Federal law, including the 2000 BiOp. 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 BiOp (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 four Annual Monitoring Reports with trend analyses were completed for 2009 (USBR, 2012), 2010 (USBR, 2013), 2011 (COMB, 2013), and 2012 (COMB, 2016). 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 life history types or strategies (anadromous and resident) will be distinguished when 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 west of 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 storms 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 snorkel surveys and redd surveys followed established CDFW and NMFS protocols as described in the BiOp 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 and methods summarized in Appendix B.

3. Monitoring Results

The results from the WY2013 monitoring effort are organized by hydrologic condition (rainfall, stream runoff, and ocean connectivity), passage supplementation, usage of the Adaptive Management Account, target flows, Water Rights releases, release of State Water Project (SWP) water into the LSYR, water quality, habitat quality, *O. mykiss* 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). Using that methodology, a critically dry year is when inflow is equal to or less than 4,550 acre-feet (af); a dry year is when inflow is between 4,550 af and 15,366 af; a below normal year is when inflow is between 15,366 af and 33,707 af; a normal year is when inflow is between 33,708 and 117,842 af; and a wet year is 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 critically dry year at 2,981.5 af of computed inflow to Lake Cachuma.

WY2013 had 7.59 inches of rainfall at Bradbury Dam and was therefore classified as a dry year (less than 15 inches) (Table 1). Very little runoff occurred within the LSYR mainstem and tributaries in WY2013, and the mainstem did not connect with the LSYR lagoon except for the effluent from the waste water treatment plant in Lompoc. No flow was recorded at H-Street during the migration season of 2013, showing that the mainstem did not connect with the lagoon. In Salsipuedes Creek, the highest recorded flow at the U.S. Geological Survey (USGS) station at Jalama Bridge was 7.8 cfs, on December 24, 2012. Historic minimum, maximum, and WY2013 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 15 precipitation events in WY2013 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). A disappointing 7.59 inches of rain was recorded at Bradbury Dam in WY2013, with over half (4.37 inches) of the total recorded prior to the first of January. Only the month of December had precipitation totaling over two inches of rainfall and consequently had the highest monthly rainfall total for the water year (Table 3). The necessary triggers to implement a passage supplementation event were not met in WY2013. Lake Cachuma did not spill. A WR 89-18 water rights release was called for during the summer and fall period.

Peak discharge recorded by the USGS at the H-Street, Narrows, Solvang, and Los Laureles on the LSYR mainstem and at Salsipuedes Creek gauges was 0 cfs (year round), 41 cfs on 7/30/13 (during the WR 89-18 release), 142 cfs on 7/26/13 (during the WR 89-18 release), 0 cfs (year round), and 7.8 cfs on 12/24/12, respectively. At these low discharge rates, there were no fluvial geomorphic changes observed to the tributaries and LSYR mainstem channels.

Annual hydrographs for Salsipuedes Creek and along the Santa Ynez River at Los Laureles, Solvang, and the Narrows reflected low to no natural flow throughout the water year with the only increase in LSYR discharge occurring during the WR 89-18 releases (Figure 2). The HCWS maintained a minimum baseflow above 2 cfs throughout the water year creating favorable rearing and oversummering conditions for *O. mykiss* except during four incidents of interruption of flow to the creek from the HCWS on 3/1/13, 6/23/13, 7/8/13, and 9/23/13 with a duration of 10 hrs, 7 hrs, 5 mins, and 15 mins, respectively (Figure 3).

Ocean connectivity: The Santa Ynez River lagoon was not opened at all during WY2013 (Table 4). There was no flow at the H-Street USGS gauge throughout the year. The only input into the Santa Ynez River lagoon came from the waste water treatment plant at Lompoc. 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).

Passage supplementation: There were no passage supplementation events in WY2013 due to dry conditions through the winter and spring that resulted in several passage supplementation criteria not being met.

Adaptive Management Account: The Adaptive Management Committee (AMC) called for two Adaptive Management Account (AMA) water releases during WY2013. The first was a short duration release at the beginning of October, 2012, totaling 35 af to augment flows into the Refugio and Alisal reaches
. The second was at the end of June and beginning of July, 2013, for a total of 114 af to provide refreshing flows into the Refugio and Alisal reaches prior to commencing the Water Rights 89-18 release.

Target flows: Target flow requirements in WY2013 maintained a minimum of 2 cubic feet per second (cfs) for rearing in Hilton Creek through the HCWS and a minimum of 5 cfs at the Highway 154 Bridge with no target flows to Alisal Bridge as described in the BiOp. Once lake storage dropped below 120,000 af on 6/3/13, the Highway 154 Bridge target flow was reduced to 2.5 cfs minimum for the rest of the water year. Target flows at both sites were met throughout the water year except during the four interruptions of flow incidents at Hilton Creek that were listed above.

Water Rights Releases: Water Rights (WR 89-18) releases began on 7/15/13 and ended on 12/2/13, with a total release amount of 17,473 af over 140 days (Figure 2). Monitoring for fish movement and water quality was conducted by the CPBS as stipulated in the BiOp RPM 6 and the 2013 Study Plan. Snorkel surveys during the releases indicated *O. mykiss* were not encouraged to move downstream of Alisal Bridge throughout the WR 89-18 release. No fish were found stranded during the release or after ramp-down of the release. These findings were consistent with previous monitoring efforts during prior WR 89-18 releases. Further details of the 2013 WR 89-18 release are provided in the RPM 6 monitoring report submitted by Reclamation to NMFS (USBR, 2014).

Mixing of State Water Project Waters in the LSYR: Reclamation monitors downstream releases to comply with the 0% and 50% mixing criterion required by BiOp 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 throughout WY2013 (Figure 4). SWP water is mixed with water releases from Lake Cachuma in the Stilling Basin at the base of the dam. Since the issuance of the BiOp in 2000, the RPM 5.1 and the 50% mixing criterion have been met 100% of the time through WY2013.

3.2. Water Quality Monitoring within the LSYR Basin:

The critical water quality parameters for salmonid survival are water temperature and dissolved oxygen (DO) concentrations. These parameters were recorded at multiple locations within the LSYR basin during the dry season from May through November to track conditions for oversummering *O. mykiss* (Figure 5). Stream temperatures play a critical role in salmonid energy conversion by influencing the metabolic requirements for food and governing the rate of food processing as salmonids do not regulate their temperature physiologically, but do compensate for thermal conditions behaviorally by adjusting activity rates and metabolic demand in adverse thermal conditions (Nielson et al 1994). 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 at the top of 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 from spill events have necessitated modifying the thermograph deployment regime and locations described in the BA (USBR, 2000). The two data sources (thermographs and Sondes) will be discussed separately for the mainstem and tributaries.

Water temperature: During WY2013, thermographs were deployed in one of two configuration types: single units mostly in the tributaries and 3-unit vertical arrays at selected locations in the LSYR mainstem. There was an increase in monitoring locations undertaken in WY2013 to better understand the thermal regime in various mainstem and tributary habitats as it related to fish assemblages. At vertical array sites, thermograph units were consistently deployed with a surface (approximately 0.5 feet below the surface), middle (center of the water column), and bottom (0.5 feet above the bottom of the monitoring site). Single unit thermograph deployments within the LSYR mainstem and tributaries were uniformly positioned approximately 0.5 feet above the bottom of stream channel. Most monitoring locations were legacy sites and have been monitored since before the Cachuma Project BiOp (see previous Annual Monitoring Reports/Summaries) and were originally monitored specifically due to the presence of *O. mykiss* to evaluate seasonal rearing conditions as it relates to temperature. Keeping legacy sites that are sometimes absent of *O. mykiss* allows for comparison of how habitats respond to different flow regimes and water year types over time. Other sites were selected and monitored to evaluate the longitudinal thermal gradient along the LSYR mainstem or tributaries, to evaluate the presence of cold water refuge habitats, and to monitor the rearing conditions where *O. mykiss* were currently present, while some previously monitored locations in past years were discontinued due to habitat alterations (LSYR-7.3 and LSYR-9.6 for example), and access limitations (two sites within the Santa Ynez River Lagoon). All monitoring sites are presented in Figure 5 and listed in Table 5 with their type and deployment period:

There were 21 LSYR mainstem thermographs deployed at 9 sites and are listed below with the number of units in parentheses:

- The river channel immediately downstream of the stilling basin (LSYR-0.25 (1)),
- 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-0.62 (1));
- Encantado Pool (LSYR-4.95 (3));
- Double Canopy Pool (LSYR-7.65 (3));
- Head of Beaver Pool (LSYR-8.7 (3));
- Alisal Bedrock Pool (LSYR-10.2 (3));
- Avenue of the Flags (LSYR-13.9 (1)); and
- Cadwell Pool (LSYR-22.68 (3)).

In the tributaries, there were 12 thermograph deployment sites during WY2013, all of which were single unit deployments:

- Hilton Creek - HC-0.12 (1) and HC-0.54 (1);
- Quiota Creek - QC-2.66 (1) at Crossing 6;
- Salsipuedes Creek - SC-0.77 (1), SC-2.2 (1), SC-3.0 (1), SC-3.5 (1), and SC-3.8 (1);
- El Jaro Creek (a tributary of Salsipuedes Creek) - EJC-3.81 (1), EJC-5.4 (1), and EJC-10.82 (1); and
- Los Amoles Creek (a tributary to El Jaro Creek) - LAC-7.0 (1).

Two supplemental sites at Cross Creek Ranch (EJC-4.53) and Rancho San Julian (EJC-10.82) had pressure transducers deployed which recorded water temperature in addition to stream stage at the same interval as the thermographs. Several monitoring locations were discontinued due to the absence of observed fish over several years (Nojoqui Creek) or a sequence of impassable barriers prohibiting access for anadromous steelhead (San Miguelito Creek). A previously monitored middle Hilton Creek site was designed to evaluate thermal heating between the URP and Lower Release Point (LRP) but due to extensive riparian vegetation growth that has significantly reduced thermal heating, this has ceased to be a concern and the monitoring has been discontinued.

Results of the water quality monitoring effort are presented below. A discussion of the data will only be included if that site presented a concern to *O. mykiss* residing in those habitats or a particular observation of importance was made. 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.

<u>Downstream of Stilling Basin (LSYR-0.25)</u>

This temperature unit was deployed at the bottom of a run habitat immediately downstream of the Stilling Basin in approximately 2.0 feet of water with the unit 0.5 feet above the substrate. Water temperatures were collected from 4/26/13 through 12/3/13. Water temperatures at this location are greatly influenced by both low and high volume water releases from the Bradbury Dam outlet works. When water is released from the Outlet Works into the Stilling Basin at the base of the Dam, it is released from the cold hypolimnion at the bottom of the lake. The Stilling Basin is a relatively large body of water (approximately 700 feet long, 400 feet wide, and 30 feet deep at its maximum distance at each parameter). In the absence of high volume water releases from the Dam, the upper lens of the Stilling Basin water column heats while cooler water sinks to the bottom, particularly during the summer. As seen in Figure 6, there was a rapid rise in water temperatures during the third week of June coincident with a low volume water release from the Outlet Works of approximately 4.0 cfs that started on 6/24/13 and ended on 7/11/13 that was associated with the 6/23/13 interruption of flow event to Hilton Creek from the HCWS. The release filled the Stilling Basin and allowed some warm surface water to flow downstream and initiate the temperature increase of a 6-7°C in water temperatures immediately downstream of the Stilling Basin to nearly 26°C. Though no *O. mykiss* were directly observed from the bank, any rearing *O. mykiss* in this section of the river would have experienced severely stressful water temperatures during this time frame. Levels of deteriorating water quality conditions for *O. mykiss* in the Santa Ynez River were determined through a literature search conducted by DeVries (DeVries, 2013). Starting on 7/15/13, there was a WR 89-18 release with a starting flow rate of approximately 140 cfs. As seen in the Figure 6, there was a rapid decrease in water temperatures, with maximum water temperatures decreasing from near 25°C to

14.5°C. Maximum water temperatures remained near 18°C for the rest of the summer and then decreased throughout the rest of the fall.

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 approximately 9 feet. It is fed by two surface water sources when there is no spill or release from the Outlet Works: 1) any releases from Bradbury Dam through the Stilling Basin which would include the spillway, Outlet Works or Chute Release Point (CRP) of the HCWS; and 2) Hilton Creek proper, which includes the Upper Release Point (URP), Lower Release Point (LRP) of the HCWS, and upper basin creek flow. Both sources discharge directly into the Long Pool in two separate channels. The HCWS is a cooler water source than the Stilling Basin due to water being taken at 65 foot of depth in Lake Cachuma and delivered directly to the creek. Mixing of the two sources occurs within the first 200 feet of the Long Pool and well upstream of the thermograph vertical array location. *O. mykiss* are routinely observed rearing in this habitat when water visibility permits. The thermograph vertical array was deployed on 5/16/13 and removed on 11/24/13 at the deepest point of the pool. There continues to be concern that the presence of invasive piscivorous species (largemouth bass, smallmouth bass, and sunfish species) is limiting the colonization of the habitat by *O. mykiss*. This is based on visual observations of the lack of multi-year age classes within the habitat, particularly smaller 1-2 year old *O. mykiss*.

Maximum surface water temperatures mimicked the water temperature regime coming from the Stilling Basin as recorded at LSYR-0.25. Maximum temperatures increased from around 19°C to 23°C during the late June release from the Outlet Works (Figure 7). Water temperatures quickly decreased following the initiation of WR 89-18 from over 20°C to just over 15°C. Maximum surface water temperatures remained less than 19°C for the remainder of the deployment period. Average and minimum water temperatures remained less than 20.1°C for the entire deployment period.

Water temperatures at the middle and bottom units followed a similar pattern to that of the surface unit with the two units exhibiting cooler temperatures than the surface prior to the WR 89-18 releases but near identical temperatures after the releases and throughout the rest of the monitoring period (Figure 8 and Figure 9). Both units showed a corresponding brief temperature increase of several hours to 20°C following the initiation of the WR 89-18 release which pushed a pulse of warm water from the Stilling Basin downstream. Average and minimum water temperature remained less than 18°C for the entire deployment time, except for a brief period in the middle of August.

Diel fluctuations were greatest at the surface unit, particularly during the late June release and were in the general range of 2.5-5.7°C with less variation at the middle and bottom units respectively. The pool was thermally stratified prior to the WR 89-18 releases, and then was close to unithermal for the rest of the monitoring period. *O. mykiss* were observed in the Long Pool throughout the monitoring period.

Downstream of Long Pool (LSYR-0.62)

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 4/26/13 to 12/1/13 and recorded similar though slightly cooler temperatures (daily and hourly) compared to the Long Pool surface thermograph (Figure 10). The warm water lens from the Stilling Basin that was pushed downstream during the late June release was observed at this unit 0.62 miles downstream. Temperatures generally remained below 20°C except for a few days in late June and early July. Following initiation of WR 89-18 releases, water temperatures rapidly cooled and remained less than 20°C for the remainder of the deployment period. Diel variation remained between 1.0-3.0°C for the majority of the deployment 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 5/13/13 to 12/2/13 at the deepest point of the pool. Historically this habitat has had oversummering *O. mykiss* as was the case in WY2012 where between 2 to 7 *O. mykiss* were observed during snorkel surveys. In WY2013, there were 2 *O. mykiss* observed in this pool habitat as observed during the spring snorkel surveys, but due to poor water quality conditions that developed after water stopped flowing into the habitat, both fish likely perished as they were not observed again during the summer and fall snorkel surveys. Beaver activity (i.e., dam/den building and general movement through the habitat creating turbid conditions) was observed at this site periodically during the monitoring period.

Maximum surface water temperatures were greatest in late May through early June and reached over 26°C before the surface unit became dewatered (6/10/13 through 7/16/13) (Figure 11). Beginning on 7/16/13, water from the WR 89-18 release reached the site. Maximum temperatures generally remained less than 22°C for the remainder of the deployment period, with average and minimum temperatures remaining less than 20°C except for a few brief times in August and September.

In the absence of target flows or downstream water right releases, the Encantado Pool continued to diminish in size over the summer period. From 7/3/13 through 7/15/13, the middle thermograph was dewatered. Water temperatures at the middle unit prior to WR 89-18 releases followed a similar temperature trend compared to the surface unit (Figure 12). Maximum temperatures increased to 26°C prior to the unit becoming dewatered. Once the WR 89-18 release reached the site, there was a corresponding decrease in water temperature. Maximum water temperatures generally remained less than 22°C for the remainder of the monitoring period, while average and minimum temperatures generally remained less than 20°C.

The bottom unit remained wetted throughout the monitoring period and warmed to 23.4°C prior to the WR 89-18 release (Figure 13). Following the release, water temperatures within the habitat essentially became unithermal throughout the water column with all temperature units recording nearly the same temperatures.

Diel variation was greatest at the surface unit prior to the unit becoming dewatered and was generally within the 5.5°C range. The middle and particularly the bottom unit showed less diel variation prior to WR 89-18 water reaching the site, and identical diel variation to the top unit after WR 89-18 water reached the site.

Double Canopy Pool (LSYR-7.65)

The Double Canopy Pool is located directly upstream of the Refugio Bridge. The pool was approximately 350 feet long, 40 feet wide, and 4.5 feet deep at its deepest point. A vertical array was deployed from 7/3/13 to 12/3/13 where one *O. mykiss* was observed during the spring snorkel survey, but was not observed thereafter. Maximum water temperatures at the surface remained less than 25°C prior to the arrival of the WR 89-18 water front (Figure 14). Upon arrival of the water front, maximum water temperatures decreased to approximately 21°C before gradually warming to over 24°C as WR 89-18 flows decreased and summer progressed. Maximum temperatures were 1-3°C cooler at the middle and bottom temperature units prior to the release front (Figures 15 and 16). Once the WR 89-18 release front reached the site, unithermal conditions developed with essentially no change in water temperature between the surface, middle, and bottom units indicating complete mixing of the waters. Of note, both the middle and particularly the bottom unit recorded a short duration increase of approximately 1 degree in water temperature coincident with the arrival of the water front.

Diel variation was greatest following the arrival of the water front and generally remained from 5.0°C to 7.0°C during the warmest months before decreasing to less than 1.0°C near the end of the deployment period.

Head of Beaver Pool (LSYR-8.7)

This habitat is located approximately a quarter mile downstream of the Quiota Creek confluence with the Santa Ynez River. The habitat was approximately 730 feet long, 50 feet wide, and 7.1 feet at the deepest point while residual pool depth was maintained (water flowing out of the habitat downstream). A vertical array was deployed at this habitat from 5/16/13 through 12/4/13 in an area where two *O. mykiss* were observed during the spring snorkel survey. Both *O. mykiss* perished due to deteriorating water quality during the middle of the summer.

Prior to the arrival of WR-89-18, maximum surface water temperatures were generally less than 24°C (Figure 17). Average and minimum temperatures remained less than 20°C. Once the WR89-18 water reached the site, there was a brief temperature rise followed by rapid cooling that lasted for several weeks. Once Water Right releases were decreased, coupled with the onset of higher summer air temperatures, water temperatures started to rise in early August with two short duration periods of over 24°C before beginning to cool down in mid-September. The middle and bottom units were essentially identical in the data they recorded although the bottom unit was slightly cooler (Figures 18 and 19). Prior to the arrival of the WR 89-18 front, maximum water temperatures generally remained less than 22°C. Once the release front arrived, there was a temperature increase to 24°C followed by a rapid decrease to 22°C then steady warming through the beginning of September. The 24-hour temperature variation was greatest during the WR 89-18 releases with a variation of approximately 5 degrees.

<u>Alisal Bedrock Pool (LSYR-10.2)</u>

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 4/25/13 and removed on 12/4/13. It was positioned where rearing *O. mykiss* have been observed in past years. However, in WY2013, no steelhead/rainbow trout were observed in this habitat, only invasive warm water species. 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 WY2013. The surface unit was out of the water from 5/21/13 – 7/30/13 due to drying conditions and prior to the arrival of WR 89-18 water. The middle and bottom unit were out of the water 6/3/13 – 7/30/13 for the same reasons.

Surface, middle, and bottom daily maximum, average, and minimum temperatures nearly mimicked each other following the arrival of WR 89-18 releases (Figure 20-22). Surface temperatures were slightly warmer overall; however, the habitat showed significant mixing throughout the water column. Maximum temperatures generally remained between 21-24°C through the first part of September then gradually cooled for the remainder of the deployment.

<u>Avenue of the Flags (LSYR-13.9)</u>

A single thermograph was deployed in a pool habitat approximately 250 feet downstream of the Avenue of the Flags Bridge in Buellton (LSYR-13.9) from 4/25/13 through 12/12/13. 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 when it would dry out by middle of the summer. No *O. mykiss* were observed in this habitat.

The monitoring site showed a wide fluctuation in water temperature both before and after the arrival of WR 89-18 releases (Figure 23). Once WR 89-18 water reached the site, there was an approximate 1-2°C increase in overall water temperature. The warmest water temperature of the year was the beginning of September when temperatures reached 24.6°C, followed by seasonal cooling.

<u>Cadwell Pool (LSYR-22.68)</u>

A vertical array was deployed from 7/31/13 through 12/12/13 at the deepest point in the habitat (12 feet). The pool was approximately 490 feet long and 32 feet wide at the maximum point. This habitat has supported *O. mykiss* in the past but no *O. mykiss* were observed during WY2013. Fishing gear was observed at this habitat and poaching at this location cannot be ruled out.

The water temperature monitoring at the surface and middle units showed little variation throughout the water column with water temperatures remaining relatively similar across the deployment period (Figures 24-26). The bottom unit was several degrees cooler from August to the beginning of September. Maximum temperatures reached 26°C at the surface and middle units at the beginning of September, and peaked over 24 °C at the bottom unit, before cooling through the remainder of the deployment. While no *O. mykiss* were observed at this habitat, largemouth bass and carp were common.

LSYR Mainstem Longitudinal Comparisons

Longitudinal LSYR mainstem (maximum daily) water temperatures within mainstem surface thermographs at LSYR-0.51, LSYR-4.95, LSYR-7.65, LSYR-8.7, LSYR-10.2, LSYR-13.9 (bottom unit), and LSYR-22.68 are presented in Figure 27. Longitudinal maximum surface temperature comparison was complicated to interpret due to the variety of complex environmental variables all acting in conjunction with each other at each individual site (i.e., flow rate, riparian vegetation development/ riparian shading, ambient air temperatures, groundwater upwelling, pool stratification, etc.). In addition, the analysis only looks at a small portion of the overall habitat and does not reflect the general rearing potential throughout the water column of each of the habitats. For a more complete analysis of each specific habitat, see above.

Rearing flow releases from Bradbury Dam and Hilton Creek wet approximately 5.5 miles of the LSYR mainstem before disappearing underground then reappearing a short distance downstream. Dry season streamflow traditionally goes subsurface from LSYR-5.5 to LSYR-6.5 and is referred to as the dry gap. Less thermal heating within the first five miles is possible with higher magnitude releases (i.e., WR89-18), but during low flow summer releases, rearing release water is subject to greater thermal heating.

During the summer of WY2013, releases for rearing were conducted at approximately 7.6 cfs through the HCWS to meet Highway 154 target flows. Water releases at this rate kept that reach wetted and flowing. However, locations immediately downstream of the Highway 154 Bridge began to dry in late spring through the middle of July when much of the LSYR mainstem downstream of the Highway 154 Bridge was dry. Nearly all of the surface and middle temperature units at the vertical array locations were dewatered prior to July, leaving only a few isolated pool habitats (LSYR-4.95, LSYR-7.65, LSYR-8.7, and LSYR-10.2). With the exception of LSYR-4.95 which had the highest water temperatures of just over 26°C, water temperatures at the remaining locations were less than 24°C prior to the arrival of the WR 89-18 releases during the last two weeks of July (Figure 27).

Factors influencing stream surface temperatures along the longitudinal profile presented in Figure 27 are: 1) thermally warmed Stilling Basin surface water moving downstream resulting in an increase in stream temperature specifically where the reach was previously wetted; 2) dry cobble bars with extensive exposure to the sun that warm the leading edge of any released waters moving downstream that can cause elevated temperatures usually over a short period of time until the full rate of the release arrives and cools the water column thereafter; and 3) the arrival of a WR 89-18 release that elevates water temperatures (associated with the aforementioned factors) for a short period (1-2 hours) followed by a drop in water temperature to very favorable conditions to *O. mykiss*. Peak water temperatures recorded at each location associated with the arrival of the wetted front were: LSYR-0.51 (20°C), LSYR-4.95 (23°C), LSYR-7.65 (24°C), and LSYR-8.7 (24°C). An increase was not observed at LSYR-13.9. Once the front had passed, there was an overall cooling of 1-2°C in each of the monitored habitats except at LSYR 13.9. For the remainder of the year, water temperatures gradually warmed during the summer period peaking in early September. Thereafter water temperatures decreased across the system throughout the rest of the monitoring period. September peak temperatures were associated with a heat wave.

O. mykiss and Water Temperature Criteria within the LSYR Mainstem

With the exception of the Highway 154 Reach, the majority of the LSYR dried during the spring and summer of WY2013. Few habitats remained throughout the river and those that were present were not maintaining residual pool depth and continued to deteriorate prior to the WR 89-18 Release. No *O. mykiss* were observed downstream of the Highway 154 Reach just prior to and throughout the WR 89-18 releases. The remaining habitats were observed to be populated by invasive warm water species only, predominately largemouth bass, sunfish, and carp.

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

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 4/25/13 to 12/3/13. There was slight thermal warming documented between the upper and lower monitoring locations. Overall, temperatures warmed approximately 1°C during the entire deployment period, remaining between 14°-16°C (Figure 28). Very little thermal heating was observed from HC-0.54 to HC-0.12 due to a mature riparian canopy. As with the upper Hilton Creek monitoring location, an increase in water temperature from lake turnover was observed at the end of October.

Upper Hilton Creek (HC-0.54)

A single thermograph was deployed 0.5 feet above the bottom of a pool habitat where water from the Upper Release Point (URP) entered the creek channel from 4/25/13 to 12/3/13. The pool was approximately 15 feet long and 12 feet wide with a maximum depth of 3 feet. Water temperatures at this site were essentially stable, hovering between 14°-15°C during the entire deployment time with a slight rise through the summer and fall (Figure 29). Lake Cachuma turned over near the end of October when lake mixing raised the temperatures several degrees for a few weeks before decreasing for the rest of the monitoring period. *O. mykiss* occupied this habitat throughout the year.

Quiota Creek (QC-2.66)

A single thermograph was deployed at 0.5 feet above the bottom of the creek approximately 50 feet upstream of Crossing 6 on Refugio Road from 4/25/13 through 9/19/13. The unit was deployed at the bottom of a shallow pool habitat 20 feet long and 8 feet wide with a depth of approximately 2.5 feet. This site was selected because rearing *O. mykiss* have been routinely seen there as was the case in early WY2013. Unfortunately, due to the ongoing drought and declining flow in the creek, *O. mykiss* were not observed in this habitat. The thermograph was removed on 9/19/13 as the pool was nearly dry. During the period of deployment, water temperatures remained less than 20°C (Figure 30).

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 5/3/13 through 12/3/13 within a run habitat with a maximum depth of 1 foot. This site is approximately 300 feet upstream of the Santa Rosa Bridge and approximately 0.77 miles upstream of the confluence with the LSYR and just downstream of the migrant trapping site. *O. mykiss* were not observed at this monitoring site, however, beaver activity was evident throughout the deployment. This site recorded relatively high water temperatures compared to all other monitored tributary sites within the LSYR basin. Daily maximum temperatures varied between 22°C and nearly 28°C during the warmest period of the year (late June through early September) (Figure 31). Minimum temperatures hovered around 18°C with the 24-hour variation typically between 5°-9°C.

Salsipuedes Creek-Reach 2-Bedrock Section (SC-2.2)

A single thermograph was deployed in a pool habitat approximately 4 feet below the surface from 5/2/13 through 12/16/13. This is the first time a thermograph has been deployed at this location and was done in order to better understand the water temperature regime in this area. This is within Reach 2 which is a short bedrock section with deep pools, extending approximately 1/3 of a mile, and represented some of the only remaining viable habitat for rearing *O. mykiss* within the entire Salsipuedes/El Jaro creek watershed due to drying conditions from the current drought. The pool habitat is approximately 40 feet long, 15 feet wide, and 6 feet deep at its deepest point. *O. mykiss* have been routinely observed at this location when visibility permits. Water temperatures remained less than 21°C throughout the monitoring period except during the early portion of July when water temperatures approached 22°C (Figure 32).

Salsipuedes Creek – Highway 1 Bridge (SC-3.0)

A single thermograph was deployed in the pool habitat approximately 4 feet below the surface, directly downstream of the Highway 1 fish ladder from 5/2/13 through 12/10/13. The pool habitat was approximately 85 feet long and 18 feet wide with a maximum depth of 7-feet. This area routinely holds *O. mykiss* though none were observed in WY2013 due to turbid water conditions from beaver and cattle activities. This site is not routinely monitored and was done to better understand the temperature regime within the habitat that was holding oversummering *O. mykiss*. This thermograph location represents the top of Reach 4, the second significant bedrock section of the creek. Reach 4 is similar to Reach 2 in that there were numerous deep pools formed in the bedrock that offered excellent oversummering opportunities for rearing *O. mykiss*. Water temperatures were warmest in the beginning of July that were associated with a heat wave that elevated maximum stream temperatures to near 24°C before cooling for the remainder of the year (Figure 33). Another heat wave during early September produced a brief temperature episode of 22°C before cooling for the rest of the monitoring period.

Salsipuedes Creek – Jalama Bridge (SC-3.5)

A single thermograph was deployed in a pool habitat approximately 4 feet below the surface, directly downstream of the Jalama Bridge fish ladder from 5/2/13 through 12/10/13. The pool was approximately 30 feet long, 18 feet wide, and 6 feet in depth. This area routinely holds oversummering *O. mykiss* that were observed in this habitat during snorkel surveys in the spring and the fall of WY2013. Water temperatures remained less than 21°C except for 4 brief times in mid-May, mid-June, early July, and early September (Figure 34). Diel variation fluctuated between 1-4°C during the deployment time.

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 5/5/13 to 6/23/13. This site had perennial flow and held *O. mykiss* in upstream and downstream habitats since monitoring began in 1993. However, for the first time since 1993, Upper Salsipuedes Creek lost connection and spotted flowing to the confluence with El Jaro Creek due to effects from the drought. During the period of deployment and while water was present, maximum water temperature remained less than 22°C (Figure 35).

Lower El Jaro Creek Upstream of Salsipuedes Confluence (EJC-3.81)

A single thermograph was deployed approximately 50 feet upstream of the confluence of El Jaro Creek and Salsipuedes Creek from 5/2/13 to 12/10/13. The unit was placed in a pool habitat 0.5 feet above the bottom. The pool was formed during high flows in WY2008 and remained after WY2011 with extremely high flows. This was the same general location in which the unit had been deployed during previous years. 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 past snorkel surveys. *O. mykiss* were observed in the spring of WY2013.

Maximum water temperatures remained less than 18°C during the entire deployment time with a 24-hour variation of less than 1°C (Figure 36). *O. mykiss* were observed at this habitat during routine snorkel surveys. By early summer, this habitat was no longer flowing and was isolated by early summer. This monitoring location was influenced by groundwater upwelling and surface flows. In the decline or absence of surface flows, as was the case this year, cool water upwelling influenced the temperature regime at this habitat.

El Jaro Creek – Palos Colorados (EJC-5.4)

A single thermograph was deployed at 0.5 feet from the bottom of a boulder influenced pool habitat from 5/2/13 through 12/10/13. The habitat measured approximately 35 feet long, 7 feet wide and 3.5 feet deep. This was the first time that a thermograph was deployed in this section of the creek and was done to better understand potential oversummering rearing habitat for *O. mykiss* in El Jaro Creek. *O. mykiss*, including young of the year, juveniles and adults have been observed sporadically within this area over the past several years. This area is influenced by Palos Colorados Creek that joins with El Jaro Creek approximately 1/8 of a mile upstream of the monitoring pool. There are springs in the area each helping keep the area viable for rearing *O. mykiss*. Water temperatures remained relatively cool during the entire deployment time. Overall, water temperatures remained less than 22°C except for a few days in early July and generally ranged between 16°C to 21°C for daily maximum temperatures during the summer period (Figure 37). Beginning in the fall, water temperatures continued to drop until the unit was removed in December.

EL Jaro Creek – Rancho San Julian (EJC-10.82)

A single thermograph was deployed in a plunge pool habitat immediately downstream of the Rancho San Julian fish ladder from 5/2/13 through 12/11/13. The unit was deployed approximately 0.5 feet above the bottom in a 4.5 foot deep pool. When the unit was deployed, water was flowing through the ladder and plunge pool habitat. By 7/10/13, the fish ladder was dry and residual pool depth was not being maintained. The pool maintained itself for the year but no fish were observed. *O. mykiss* have regularly been observed within the plunge pool and fish ladder in past years; however, the drought has affected the fish population as no *O. mykiss* were observed in the upper sections of El Jaro Creek as large portions of the creek dried in the summer of WY2013. Water temperatures generally remained around 20°C or less during the entire deployment period (Figure 38)

Los Amoles Creek – Tributary to El Jaro – (LAC-7.0)

A single thermograph was deployed at 0.5 feet from the bottom of a corner scour pool habitat from 5/2/13 through 12/9/13. The habitat was 30 feet long, 15 feet wide, and 3.0 feet deep and was located approximately 1/8 of a mile upstream from the confluence with El Jaro Creek. Los Amoles Creek has regularly held various age classes of *O. mykiss* and spawning sites have been identified in the creek over the years. Drought conditions negatively impacted water flow through most of the creek with vast sections of the creek going dry in the summer of WY2013. An unnamed spring enters the creek approximately 150 yards upstream of the monitoring locations and provided the sole source of water for this section of the creek. Water temperatures in Los Amoles Creek were relatively cool during the entire deployment period, remaining less than 22°C for most of the monitoring period. Maximum temperatures peaked near 23°C in the beginning of September before decreasing through the fall (Figure 39). Daily variations were within 1-3°C for the deployment period.

Salsipuedes Creek Longitudinal Comparisons

Longitudinal maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 40 for the thermographs at Rancho San Julian (EJC-10.82), Los Amoles Creek (LAC7.0), Palos Colorados (EJC-5.4), lower El Jaro Creek (EJC-3.81), upper Salsipuedes Creek (SC-3.80), Salsipuedes Creek at Jalama Bridge (SC-3.5), Salsipuedes Creek at Highway 1 Bridge (SC-3.0), Salsipuedes Creek at Reach 2 (SC-2.20) and lower Salsipuedes Creek (SC-0.77). By early July, large sections of El Jaro Creek and to some extent Salsipuedes Creek began to dry out for the first time since monitoring began in 1993. The water temperatures presented in Figure 40 showed a general warming trend moving downstream in the watershed. The coolest water temperatures were observed in the more upstream areas where groundwater seeps provided cool inflow to the remaining habitats. Conversely, lower Salsipuedes (SC-0.77) had water flowing through the monitoring location for the entire year and that site recorded the warmest water temperatures in the entire watershed, likely due to warm ambient air temperatures influencing flowing water conditions. The deeper pools and bedrock habitats in and around SC-3.5, SC-3.0, and SC-2.2 showed consistently cooler temperatures throughout the monitoring period.

O. mykiss and Water Temperature Criteria within the Tributaries

The Salsipuedes/El Jaro Creek watershed is a dynamic system with many variables that influence water temperatures at any given time. The amount of surface flow, groundwater upwelling, ambient air temperatures, and presence/absence of riparian vegetation all combine to influence the thermal regime within individual aquatic habitats in the watershed. A wide range of temperatures were monitored within the watershed during 2013, illustrating the variable suitability of individual habitats for rearing *O. mykiss* as well as continued negative impacts of the current drought. Temperature monitoring within the watershed highlighted these variabilities of individual habitats. Although stream water temperatures appeared favorable for rearing *O. mykiss*, diminishing stream flows and the drying up of habitats reduced habitat availability. No *O. mykiss* were observed by snorkel surveys or bank observations in any habitat with declining flow, presumably as a result of deteriorating water quality conditions, and diminished residual pool depth (i.e., EJC-10.82, LAC-7.0, EJC-5.4, and EJC-3.81). Habitat suitability appeared better in the monitoring locations within Salsipuedes Creek due to a small amount of flowing water through the majority of the creek. Water temperature data at SC-3.5, SC-3.0, and SC-2.2 showed suitable water quality conditions and habitat availability throughout the majority of the year. The warmest water temperatures of nearly 28°C were recorded at SC-0.77 (Lower Salsipuedes Creek) in early July.

In Hilton Creek and Quiota Creek, water temperatures remained well below 18°C for the entire year and *O. mykiss* were observed throughout WY2013 in the watered reaches of the creek.

Water temperature and dissolved oxygen (Sondes): All of the WY2013 vertical array Sonde deployments (3 units – surface, middle, and bottom) were successful, with no probe issues throughout the period. The three Sondes were always calibrated prior to deployment and at the same time to assure all were recording the same values for each parameter. Diel water quality monitoring of key LSYR mainstem pool habitats continued in WY2013 and was focused on gathering data on the leading edge of the WR 89-18 releases within the Highway 154 and Refugio reaches. Three of the 6 vertical array locations were chosen on the LSYR mainstem for Sonde deployments based on their longitudinal distance from Lake Cachuma (LSYR-0.51, LSYR-4.95, and LSYR-7.65), water depth (all sites relatively deep), presence of *O. mykiss*, and ability to safely deploy equipment away from public view (Figures 5, 41 and 42). 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 at these locations. At some sites, Onset U-26 DO and temperature meters were deployed when the Sonde units were not available and there was a need for monitoring additional habitats further downstream to capture the leading edge of the WR 89-18 release.

Sonde deployments were made just prior to the WR 89-18 release flow arrival and were moved between habitats because of the limited number of available instruments. This shortened more than previous years the monitoring period prior to the arrival of the water rights front. The units were deployed for a period of 5 hours to 3 days and set to record water temperature and DO concentrations every 5 minutes. The data are presented as recorded and not aggregated such as shown for the thermographs. Sonde units were fixed to the same vertical arrays 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 within the LSYR-0.51 and LSYR-7.65 locations. The LSYR-4.95 pool was too shallow for all three units to be deployed, so only the top and bottom units were used at this site.

Long Pool (LSYR-0.51): The 2013 WR 89-18 release commenced at approximately 8:00 AM on 7/15/13, and 3 Sondes (surface, middle, and bottom) were deployed at the LSYR-0.5 Long Pool habitat (Figure 43). Sondes were in place for approximately 2 hours prior to flow arrival (just after 10:00), with pre-release temperatures ranging from 15.4°C at the surface and 14.3 °C at the bottom. The surface unit began to show a gradual increase in temperature from 10:30 through 11:45, while the middle and bottom Sondes started responding at 11:45 and 12:15, respectively. By 1:00 PM, temperatures at all three units were recording between 19.5°C – 20.0°C. This was an approximate 5°C increase in water temperatures throughout the water column over the course of a few hours. Water quality conditions were not stabilized during the sonde monitoring period. As shown by the thermograph data, temperatures declined rapidly after the warm water from the Stilling Basin passed this location and the water rights release water from the reservoir arrived.

Prior to the WR 89-18 release, DO concentrations ranged between 7.9 mg/l – 9.1 mg/l between the surface and bottom of the Long Pool (Figure 43). All three Sondes showed a general 1-3 mg/l increase in DO for the first few hours of the WR 89-8 release flow arrival, with a subsequent falling back to prior DO levels before the release.

Encantado Pool (LSYR-4.95): One surface and one bottom Sonde were placed in approximately 3.8 feet of water at LYSR-4.95 on 7/15/13, several hours before the WR 89-18 release flow arrival (Figure 44). It should be noted that the programmable Sondes cannot be left out of the water (DO probe will dry out and desiccate), which prevented putting an additional Sonde on the vertical tower prior to WR 89-18 Release flow arrival. Rearing habitat flow temperatures prior to the release were 20.1°C at the bottom and 22.0°C at the surface. Flow arrival occurred at approximately 19:45. Temperatures increased briefly and the pool became near unithermal to 22.5°C at the bottom and 22.8°C at the surface before declining over the next several hours.

DO conditions prior to WR 89-18 release arrival were extremely low at the bottom, ranging between 0.1 mg/l to 3.0 mg/l (Figure 44). Surface DO concentrations prior to arrival were much greater and ranged between 5.9 mg/l to 7.4 mg/l. As the release arrived, DO concentrations at the bottom increased from 0.2 mg/l at 19:40 to 5.0 mg/l at 19:45, and approached 7.0 mg/l by 21:00. Surface concentrations showed minor fluctuations (< 1 mg/l) within the first hour of flow arrival and gradually increased towards the end of the deployment.

7.65 Pool (LSYR-7.65): The CPBS quickly moved the Sondes from the upstream LSYR-4.95 habitat to the LSYR-7.65 habitat in order to capture rearing habitat flow information prior to the WR 89-18 release arrival. Unfortunately, only 30 minutes of data were captured prior to the arrival. At 12:15, temperatures before flow arrival ranged from 20.8°C at the bottom to 21.6°C at the surface (Figure 45). Within 20 minutes of flow arrival, surface and middle temperatures had reached 23.1°C and the bottom temperature recorded 22.9°C. Cooling was then observed until daylight began increasing water temperatures uniformly from top to bottom.

DO concentrations ranged from 1.9 mg/l at the bottom to 5.3 mg/l at the surface prior to flow arrival (Figure 45). Soon after WR 89-18 flow had reached the habitat, DO concentrations elevated to 7.4 mg/l at the bottom and middle and 8.1 mg/l at the top of the water column. Upon the initial arrival of the flow front, a drop in DO was observed that gradually increased to over 8 mg/l at all depths for the remainder of the deployment.

Lake Cachuma water quality profiles:

Water quality profiles were collected at Bradbury Dam near the intake of the HCWS on 3/4/13, 5/9/13, 7/12/13, 8/15/13, 9/30/13, and 10/30/13 (Figure 46). 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 BiOp. 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 did not occur until early March and the results showed that the lake was transitioning out of an isothermal (even lake temperature to depth) winter condition, with surface waters beginning to show signs of warming (Figure 46). The surface temperature was 12.03°C and the bottom temperature at 106.60 feet was 11.22°C. The next profile in May showed that surface waters had warmed to 19.09°C with a similar pattern of gradual cooling with depth. Lake profiles in July and August were nearly identical, illustrating stratified conditions with surface temperatures between 22.95°C – 23.34°C, warm water continuing down to the thermocline (at approximately 33-40 feet in depth) before cooling rapidly. The epilimnion (surface lens) was established in May but is most visible during the months of September and October with near identical water temperatures from the surface to 49 feet and 59 feet respectively, followed by a 3-10 feet metalimnion (thermocline, mid-water lens). The hypolimnion depth (lower lens) varied by the time of the year, but is most apparent during the September and October sampling, starting at 52 feet and 65 feet respectively (Figure 46). The WY2013 lake turnover event occurred towards the end of October into early November, which is similar to what had been observed in previous years.

Lake Cachuma experiences hypoliminic oxygen depletion towards the bottom nearly every year in the late summer and fall, particularly once stratification becomes firmly established in the summer. During the March and May sampling, lake stratification was beginning to form. DO concentrations ranged from 10.5 mg/l and 9.5 mg/l at the surface respectively to 9.4 mg/l and 5.8 mg/L at the bottom respectively (Figure 46). As the lake became more stratified (July through October), surface DO concentrations remained greater than 7.2 mg/L while DO concentrations decreased starting at the metalimnion, decreasing rapidly to near zero in the hypolimnion during August, September, and October. Observations suggest that the placement of the HCWS intake at approximately 65 feet of depth within the lake continuous to be below the thermocline and meets the objective of cool water delivery to Hilton Creek.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2013 within the LSYR Basin continued to be done via photo documentation, specifically by maintaining a long standing record of photo point locations using digital cameras. The comparison provided in the following figures document the changes at various locations from 2005 to 2013. 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 WY2013 photo points is provided in Appendix C (Table C-1 and Table C-2)**.**

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, Ytias, and San Miguelito creeks (Figure C-1).

In WY2013, target flows to the Alisal Bridge were no longer required as dictated by the Cachuma Project BiOp. As a consequence, much of the LSYR mainstem dried prior to the initiation of WR89-18 water releases. Photo documentation along the LSYR mainstem recorded the change in vegetation at each site from spring of 2005 to spring of 2013 (Figures 47-50). The photo sequence showed an increase in riparian vegetation cover from previous years at most locations; however, riparian areas that became dewatered by mid-summer due to the ongoing drought showed signs of stress with drying leaves and some mortality of young trees with shallow root systems (i.e., alders and willows).

Photo documentation within Hilton Creek continues to show a maturing riparian zone, particularly within the reach between the URP and LRP where releases were initiated in 2005 (Figures 51-52). Larger trees (willows, alders, sycamores, and cottonwoods) are replacing the smaller understory within the drainage. Salsipuedes and El Jaro Creeks showed rapid recolonization of riparian vegetation in WY2013 due to the lack of any high flow and scouring events (Figures 53-55).

3.4. Migration – Trapping

Migrant trapping was not conducted in WY2013 as described above. This was the first time this monitoring task was suspended since 1993. *O. mykiss* populations were only monitored through redd and snorkel surveys as presented below.

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 (spawner) surveys are typically conducted one to two times per month in the LSYR mainstem (Highway 154, 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. A total of 6 rounds of redd surveys were conducted over the season. WY2013 was a poor year for potential anadromous steelhead migration within the LSYR basin as storm flows were so insignificant that the lagoon was not breached and LSYR mainstem flow was very limited during the migration season of WY2013. Fragmented habitat, beaver dams, and low to no stream flows essentially eliminated possible longitudinal *O. mykiss* movement within the LSYR mainstem and up into the tributaries. Spawning conditions were extremely poor in WY2013 in the LSYR mainstem with the only mainstem redd site observed in the Highway154 Reach immediately downstream of the Long Pool with none observed in the Refugio Reach and Alisal Reach, but 37 in total were observed in the tributaries (Table 7). Redd survey data by month for the LSYR mainstem and its tributaries are presented in Table 8.

Redd surveys within the LSYR tributaries began in late January and ended in late April. There were 37 redd sites documented in the tributaries: 13 in Hilton, 1 in Quiota, 11 in

Salsipuedes, 11 in El Jaro, and 1 in Los Amoles creeks. Spawning peaked in March with over half (20) of the 37 redd sites identified in nearly every tributary during that month. Because the lagoon remained closed for the migration season with no possibility of anadromous steelhead to migrate, only resident *O. mykiss* were able to spawn within the LSYR.

The first spawning site of the season was observed within Hilton Creek on 1/24/13, two days before the first spawning site was identified in Hilton Creek in WY2012 (1/26/12). Redds observed in February and March accounted for 69% of the redds documented in Hilton Creek. In WY2012, peak spawning in the tributaries was observed in March and April, and likely had to do with better flow during those months compared to WY2013. In the remaining tributaries, spawning was first observed in February (Salsipuedes and El Jaro creeks), March (Quiota Creek), and April (Los Amoles Creek).

Young-of-the-Year (YOY) *O. mykiss* from the above identified redds were first observed in Hilton Creek on 3/1/13 approximately 200 yards downstream of the USGS gauging station and 37 days from when the first redd was identified on 1/24/13. Looking at *O. mykiss* incubation rates, the water temperature at the time of redd identification was just over 11°C. At around 11°C, it takes approximately 31 days for eggs to incubate and begin to hatch from the gravels which roughly correspond with the first YOY sighting within the creek (Piper, 1986).

The first redds in Salsipuedes and El Jaro creeks were identified on 2/25/13 and 2/27/13, respectively. YOYs were first observed in Salsipuedes and El Jaro Creek at several separate locations on 4/8/13 and were 43 days from when the first redd was identified in the creeks. Temperature information was not available to compare incubation rates with Hilton Creek.

Snorkel surveys: The CPBS conducted snorkel surveys in WY2013 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). Spring surveys began in May and continued through June. These surveys record the baseline condition after the spawning season and prior to the critical summer rearing season by documenting the number and location of YOY and oversummering older *O. mykiss*. Summer surveys (conducted in August-September) evaluated the number of *O. mykiss* and instream conditions at or just after what is considered to be the most stressful time of the year for oversummering fish. Fall surveys (November-December) evaluated the population of oversummering *O. mykiss* going into the following water year.

The CPBS applied the same level of effort for each of the three surveys and across the same spatial area during the spring, summer, and fall. However, 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. The CPBS continues to solicit landowner cooperation and gain access to reaches, particularly when conducting tributary project performance evaluations within upstream tributary reaches.

Snorkel survey locations (Figure 56) 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 57 with all survey dates shown in Tables 9 and 10 for the LSYR mainstem and its tributaries.

Mainstem: LSYR mainstem snorkel surveys were conducted during the spring, summer, and fall within the Highway 154, Refugio, Alisal, and Avenue of the Flags reaches, as well as downstream of Avenue of the Flags Reach to just upstream of the City of Lompoc (Cadwell Reach) (Figures 56-57 and Tables 9-11). 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 surveying in between to assure no fish were missed.

Highway 154 Reach

Although the Highway 154 Reach extends from the Stilling Basin (LSYR-0.0) to the Highway 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 56 and Table 9). Water clarity within the Highway 154 Reach downstream of the Long Pool was sufficient to conduct all three snorkel surveys in WY2013. Visibility within the Long Pool was fair (at best), likely due to the numerous carp observed from the bank in the Stilling Basin and Long Pool creating localized turbidity, in addition to nocturnal beaver activity. Carp are known for feeding along the bottom (benthivores), stirring up the substrate and creating poor water clarity (Roberts et al., 1995; Moyle, 2003). Visibility within the Long Pool was in the 4-6 foot range which compromised the ability of divers to accurately count fish species within the pool, hence no official counts were made within this large habitat, only presence-absence.

Snorkel survey results for the Highway 154 Reach are shown in Figure 58 and Tables 10 and 11. A total of 142 *O. mykiss* were observed in the spring survey in the reach below the Long Pool to Reclamation property boundary (LSYR-0.5 to LSYR-0.7). Of the fish observed, 111 (78%) fell within the 0-3 inch size category, 20 (14%) fell within the 3-6 inch size category. The remainder of *O. mykiss* observed in the spring were 6-9 inches (9) (6%) and 9-12 inches (2) (2%).

During the summer survey, 23 *O. mykiss* were observed, with no fish observed within the 0-3 inch or greater than 9 inch size categories. There was also a reduction in the number of 3-6 inch fish observed (14), which may be the result of marginal water clarity that reduced the observational distance of surveyors, mortality, or predation. The number of *O. mykiss* in the 6-9 inch range remained the same.

Fall snorkel survey totals yielded an increase in the number of *O. mykiss* observed to 71. As in the summer, there were no fish within the 0-3 inch size class and a reduction to only 5 within the 3-6 inch range. Of note was the large increase in the 6-9 inch size class which increased from 9 to 57. A combination of several factors may have contributed to that increase in the fall including; 1) emigration from upstream or downstream habitats during the year, 2) rapid growth due to abundant food resources, or 3) marginal visibility reduced observational distances in previous surveys resulting in fewer fish observed than were actually present. Additionally, there were 9 fish identified in the 9-12 inch size class.

Refugio Reach

The Refugio Reach extends from the Highway 154 Bridge (LSYR-3.2) downstream to Refugio Bridge (LSYR-7.8); however, the area between LSYR-3.2 and LSYR-4.9 is not snorkeled due to access limitations (Figure 56 and Table 9). There were 21 habitats snorkeled within the Refugio Reach during the spring survey, 20 of which were considered pool habitats (Tables 10 and 11). Beaver dams, dense aquatic vegetation, and low/no flow turned many of the run habitats into dry habitats or shallow pools. A total of 3 *O. mykiss* were observed in the spring, all over 12 inches in length up to the 15-18 inch size category (Figure 59). The CPBS surveyed 27 habitats during the summer survey within the Refugio Reach. A total of 2 *O. mykiss* were observed, single fish in the 15-18 inch size class and 18-21 size class. The same 27 habitats were revisited during the fall survey with the same two fish observed within the same habitat (LSYR-4.95).

No YOY or juvenile *O. mykiss* were observed in the Refugio Reach during WY2013, indicating that successful spawning did not occur within the reach. The three adult *O. mykiss* in the spring were observed in two separate habitats; the Encantado Pool (LSYR-4.95) and the Double Canopy Pool (LSYR-7.65). The single fish holding at LSYR-7.65 in the spring survey was found and had perished as the habitat dried out. Two adult *O. mykiss* were observed within the Encantado Pool (LSYR-4.95) in the summer (during WR 89-18 Release survey), as well as in the fall survey (post WR 89-18 Release survey).

Alisal Reach

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figure 56 and Table 9). A total of 26 habitat units were snorkeled (or visited if dry) in the spring survey, including 22 pools and 4 runs (Tables 10 and 11). A total of 5 adult *O. mykiss* were observed in the spring, with a spread of size classes ranging from 12-15 inches (2), 15-18 inches (2) and 18-21 inches (1) (Figure 60). The same locations were revisited in the summer and fall during routine snorkel surveys.

Only one *O. mykiss* in the 15-18 inch size class residing in a pool habitat was observed during the summer survey. The other 4 fish likely perished due to deteriorating water quality conditions, predation, or poaching as no upstream or downstream migration was possible. No *O. mykiss* were observed within the Alisal Reach during the fall snorkel survey.

Avenue of the Flags Reach

The area of 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 56 and Table 9). The upstream portion of this reach includes the altered habitat where various companies historically mined river gravels. Within the historical mining footprint, one large pool habitat was deemed appropriate for snorkeling based on previous *O. mykiss* observations in that location.

The CPBS attempted to snorkel 14 habitats within the Avenue of the Flags Reach in the spring, but drying conditions throughout the reach made any snorkeling attempts impossible due to extremely poor water clarity or lack of water. All of the habitats that were still wetted were not maintaining residual pool depth and had diminished significantly in size and volume going into the summer. For example, the pool near Buellflat (described above) had reduced in size to approximately 20 feet long, 10 feet wide, and 1.5 feet deep from spring to early summer. Approximately 15 carp were observed milling around within this barely sustaining habitat in July. No other fish species were observed and the pool completely dried several days later.

Summer and fall snorkel surveys (during and post-WR 89-18 Release) were conducted within the same habitats and no *O. mykiss* were observed, despite flowing conditions and a fully connected reach due to high summer releases.

Cadwell Reach

The mainstem downstream of the Avenue of Flags Bridge is mostly comprised of private property that is categorized into sub-reaches (Sanford, Cadwell, Cargasacchi, etc.) where the CPBS has been granted access (Figure 56 and Table 9). Due to the large spill event and subsequent *O. mykiss* observations in the lower reaches of the LSYR in WY2011, the CPBS uses the Cadwell Reach as one of the permanent monitoring locations for both snorkel activities and water quality monitoring.

The Cadwell Property (LSYR-22.0-23.0) contains one large bedrock pool approximately 13 feet in depth with several smaller pools located further upstream that can provide rearing habitat during wet years as has been observed. No *O. mykiss* were observed within the reach during any of the three WY2013 surveys and like other locations further upstream, the majority of the reach was drying out with residual pool depth not being maintained prior to the WR 89-18 Release in the summer (Tables 10 and 11).

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 creeks (Figure 56 and Tables 12-14).

Hilton Creek

Surveys in Hilton Creek take place from the confluence of the LSYR 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 56 and Table 12). This drainage is divided into 6 reaches (Figure 80), separated by geomorphic breaks in creek and channel morphology. Because of year-round supplemented flows, short linear distance of creek channel, and high densities of *O. mykiss*, 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 are presented in Figures 57 and 61 and Tables 13 and 14. A total of 675 *O. mykiss* were observed during the spring snorkel survey, with 410 (60.7%) of the fish falling within the 0-3 inch size category. For comparison, 62%, 65%, and 69% of *O. mykiss* in the 0-3 inch size category were counted in 2012, 2011 and 2010 spring surveys, respectively. Other size class categories of note in the WY2013 spring counts were 3-6 inches (184 at 27.3%), 6-9 inches (71 at 10.5%), and 9-12 inches (10 at 1.5%).
The summer survey within Hilton Creek revealed a total of 739 *O. mykiss*, which was an increase (9.5%) from what was observed in the spring. As mentioned in previous Annual Monitoring Reports/Summaries, the summer snorkel count is often higher than the spring count most likely due to YOY attaining a greater size over time and moving out of the channel margin habitat in the spring into deeper water with better feeding opportunities in the summer where they are more easily detected by snorkelers.

The percentage of fish during the summer survey in the 0-3 inch size class shrank to 43% (identical to 2012), while the 3-6 inch size class grew to 47% of the total (compared to 49% in 2012). The two remaining size classes changed very little between the spring and summer surveys.

The size shift in *O. mykiss* continued into the fall with the 0-3 inch fish population shrinking to 25.1% (186) of the total while fish in the 3-6 inch size category increased to 65.5% (485) of the population. These growth shifts from smaller to larger size classes indicate that Hilton Creek is providing excellent oversummering and rearing opportunities for *O. mykiss* in the creek. Additionally, snorkel counts between the summer and fall were 739 and 741, respectively which suggests that there was potential for emigration into or out of the creek and little attrition between the summer and fall time period.

<u>*Quiota Creek*</u>

A short section of Quiota Creek is routinely snorkeled within the County road easement for Refugio Road, extending approximately 150 feet below Crossing 5 upstream to approximately 50 feet above Crossing 7 (Figure 56 and Table 12). This section of drainage normally remains wetted during the dry season, particularly in years with above average rainfall. WY2013 was a dry year and the lower section of the reach was dry in the summer and fall.

Surface flows in the spring of WY2013 were maintained throughout the regular snorkel survey reach of Quiota Creek. The CPBS observed a total of 31 *O. mykiss*, 10 of which were in the 0-3 inch size class and represented 32% of the population observed (Figure 62 and Tables 13 and 14). These fish were not YOYs, but holdover rearing fish from the previous year as no redds were identified during redd surveys within that snorkeled area. The majority of the *O. mykiss* observed (18) were within the 3-6 inch size class and represented 58% of the population.

Water quality conditions, due to the low rainfall of the past two consecutive years, began to deteriorate following the spring survey. By summer, runs had become dewatered and pool habitats isolated with only 2 *O. mykiss* observed, 1 in the 3-6 inch size class and 1 in the 6-9 inch size class. By fall, conditions had worsened and only 1 fish in the 6-9 inch size class was observed.

Salsipuedes Creek

There are five reaches in Lower Salsipuedes Creek that are broken up by fluvial geomorphic changes in the stream channel. 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 56 and Table 12). Reach 5 continues to be a more consistent monitoring location due to reliable water clarity compared to the lower reaches of the drainages. It is thought that the lack of cattle activity and minimal beaver activity within Reach 5 allows for more consistent snorkeling opportunities throughout the year.

The CPBS surveyed Reaches 1 through 4 in mid-June (spring survey) in WY2013. A total of 444 *O. mykiss* were observed of which the majority were YOY in the 0-3 inch size class and made up 91% (405) of the population observed indicating successful spawning (Figure 63 and Tables 13 and 14). There were 26 (6%) fish observed in the 3-6 inch size class and small numbers in larger size classes. The largest fish was in the 15-18 inch size class.

Between the spring and fall surveys, there was a 71% reduction in the number of *O. mykiss* observed (444 to 127), almost entirely of fish within the 0-3 inch size class. *O. mykiss* numbers within the 0-3 inch size class decreased from 405 to 63. Conversely, there was a shift in the 3-6 inch size class between the two surveys from 26 to 48 showing that in some habitats, there was sufficiently good water quality and oversummering habitat to allow fish to grow within some of snorkeled areas within the creek.

The number of YOYs produced in WY2013 was significantly smaller than was observed in WY2012, but remains a clear indication of successful spawning in the drainage, despite WY2013 being a very dry year with limited migration opportunities. Spawning sites within the basin were not subject to scour or destructive processes as flows remained relatively low during the spawning season. Fish were observed in Reaches 2, 4, and 5 with most of the fish observed in Reach 2 in the spring and Reach 4 in the fall.

Summer surveys were challenging because water clarity conditions were generally too turbid to accurately detect fish in nearly every reach (except Reach 2) and affected the accuracy of counts. The primary causes of turbidity were the presence of cattle in the creek corridor, beaver activities, and abundant crayfish populations in pool habitats that, when disturbed, created large plumes of turbidity when they moved. This was especially problematic during low flow conditions.

Water clarity in Reach 5 was good during the spring and fall and poor during the summer as described above. Reach 5 in particular was impacted to a greater extent due to two consecutive years of drought with several riffles and runs locations completely drying out, a phenomenon that has not occurred since studies started in 1993. Overall, there were 113 *O. mykiss* observed in the spring with fish in the 0-3, 3-6 and 6-9 inch size classes making up 37%, 57% and 6% of the population, respectively (Figure 64 and Tables 13 and 14). By the fall, total *O. mykiss* observations fell to 52 fish, with 15%, 50%, 23%, 10% and 2% within the 0-3, 3-6, 6-9, 9-12 and 12-15 size classes, respectively.

El Jaro Creek

The regularly snorkeled section of El Jaro Creek is located from its confluence with Salsipuedes Creek upstream approximately 0.40 miles (Figure 56 and Table 12). Surveyors found fair snorkeling conditions during the spring survey, but were unable to conduct surveys in the summer and fall due to dry creek conditions in the majority of the habitats. The CPBS observed only 3 *O. mykiss* during the spring survey, 1 in the 0-3 inch size class and 2 in the 6-9 inch size class (Figure 65 and Tables 13 and 14). By the summer, the El Jaro Creek snorkel sites had been reduced to either completely dry or isolated turbid pool habitats. By fall, nearly all of the El Jaro Creek snorkel area was dry and no fish were observed.

Other Fish Species Observed: The CPBS observed many non-native species inhabiting the LSYR mainstem during the spring, summer, and fall snorkel surveys (Figures 66 and 67). Common were warm water game species, some piscivorous, that also inhabit Lake Cachuma and can wash downstream during spill events and then colonize portions of the lower river, and 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 substrate and greatly increase turbidity. Typically, warm water species are not observed in any of the three tributary drainages (Salsipuedes, Quiota, and Hilton) that the CPBS monitors. The introduced arroyo chub (*Gila orcuttii*) and fathead minnow (*Pimephales promelas*) are regularly observed within the Salsipuedes Creek drainage.

Largemouth Bass: The non-native species with the highest snorkel counts inhabiting the LSYR mainstem continues to be largemouth bass. Results from WY2013 surveys can be found in Figure 66. Spring snorkel surveys within the Refugio and Alisal reaches revealed 126 (46 less than and the rest greater than 6 inches, no YOYs) and 116 (10 less than and the rest greater than 6 inches, no YOYs) largemouth bass, respectively. Following the spring snorkel survey and prior to the initiation of WR 89-18 releases in July, mainstem flow conditions were deteriorating and many of the habitats had dried or had become stagnant isolated shallow pools. Water flow ceased at the USGS gauging station in Solvang on 4/25/13 and dry conditions continued until WR 89-18 release water reached the gauging station on 7/17/13. The summer survey took place during the flow equilibrium in September when flow was reduced to allow for steady and continuous recharge into the groundwater basin. Divers noted an increase in the number of largemouth bass observed in both the Refugio and Alisal reaches to 829 (781 less than and the rest greater than 3 inches) and 187 (155 less than and the rest greater than 3 inches), respectively, with the largest size class increase in 0-3 inch suggesting successful spawning within or upstream of those reaches.

Overall, largemouth bass numbers declined in the fall survey in the Refugio and Alisal reaches to 42 and 23, respectively. There are several possible reasons for the decline in overall bass numbers including: predation by fish and birds, poaching by the general public, and/or the bass continued to move downstream with the flows and did not reside for a long period of time in the snorkeled habitat units. Downstream movement of bass has been observed during previous WR 89-18 releases.

Sunfish Species: Green sunfish, redear sunfish, and bluegill were observed during routine snorkel surveys in WY2013 and combined into a single sunfish category for the purposes of this report. A total of 9 sunfish in the Refugio Reach and 19 sunfish in the Alisal Reach were counted in the LSYR mainstem during spring snorkel surveys (Figure 66). Unlike the increase in largemouth bass observed in the summer, sunfish populations decreased to 8 in the Refugio Reach and 0 in the Alisal Reach over the summer and decreased further to 3 sunfish observed in the fall in the Refugio Reach only. Based on observations and snorkel data, sunfish, unlike largemouth bass, did not appear to move downstream with WR89-18 releases.

Catfish Species: Bullhead and channel catfish are combined into a single catfish category for the purposes of this report. In WY2013, there were no catfish observed in either the Refugio or Alisal reaches (Figure 67).

Carp: The number of carp observed in WY2013 declined in both the Refugio and Alisal reaches between the spring and summer surveys. In the spring, surveyors observed 166 adult carp; 20 in the Refugio Reach and 146 in the Alisal Reach (Figure 67). As mentioned above, much of the mainstem dried prior to initiation of WR-89-18 releases and the vast majority of the carp observed during the spring perished. Overall numbers remained low during the summer with 12 carp observed, 11 of which were in the Refugio Reach. In the fall carp numbers increased to 17 in the Refugio Reach but decreased to 0 in the Alisal Reach.

It should be noted that hundreds of carp in the Stilling Basin (LSYR-0.0) and Long Pool (LSYR-0.5) were observed from the dam crest and banks of the LSYR. However, carp numbers were not tabulated within these two large pool habitats due to poor visibility during all three survey periods.

3.6. Tributary Enhancement Project Monitoring

All tributary enhancement projects are subject to biological monitoring and permitting requirements as stipulated in the BiOp (RPM 8). This includes pre- and post-project monitoring, as well as monitoring during construction. Construction monitoring of *O. mykiss* includes relocating fish 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. In WY2013, the Quiota Creek Crossing 7 Project was completed (November of WY2013). This project removed an Arizona type crossing and replaced it with a 60-foot bottomless arched culvert. This impediment was considered a partial barrier to *O. mykiss* within Quiota Creek due to insufficient pool depth for the required jump height.

The Quiota Creek Crossing 7 Project required the capture, removal, and relocation of *O. mykiss*. A Species Relocation Report was sent to NMFS on 10/1/12, which served as the compliance measure for the Programmatic Biological Opinion issued to CDFW from NMFS for southern steelhead (COMB, 2012). A total of 13 *O. mykiss* were captured (1 mortality included) and relocated to suitable locations above and below the project site. Project monitoring details for Crossing 7, including fish relocation datasheets, Dewatering Plan, Fish Relocation Plan, and post-project monitoring results have all been sent to the appropriate regulatory agencies.

Post-project monitoring continued at completed tributary enhancement projects within Salsipuedes, El Jaro, Quiota, and Hilton creeks. Snorkel surveys, redd surveys, water quality, hydrologic modeling conducted by our design engineer, vegetation maintenance (watering, weeding), and photo documentation were all conducted in accordance with the post-project monitoring requirements of each location.

3.7. Additional Investigations

Genetic Analysis: Tissue samples from all of the migrant captures have been sent annually to Dr. Carlos Garza of NOAA Southwest Science Center at UC Santa Cruz. Since migrant trapping was not conducted in WY2013, no tissue samples were submitted for this year.

Beaver Activity: The North American Beaver (*Castor canadensis*), according to all of the scientific literature found on the historic and current distribution of beaver in North America, was introduced into the Santa Ynez River system sometime in the late 1940s to help foster the fur trade following World War II (Hensley, 1946; Baker and Hill, 2003; CDFG, 2005).

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 BiOp, the number and spatial distribution of beavers and their dams have increased throughout the LSYR mainstem. After Lake Cachuma was surcharged for the first time and the long-term target flows were initiated in 2005, beaver dams developed in large numbers from the Bradbury Dam to the Narrows. Portions of the LSYR mainstem downstream of the Lompoc Waste Water Treatment Plant (WWPT) and upstream of the Santa Ynez River lagoon have also been colonized. 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 *O. mykiss* during low to moderate flows.

Beaver dams and the associated ponds often change riffles and runs into pools that can lead to greater thermal heating of stream water, can inhibit movement of juvenile and adult fish, increase siltation, and increase ideal habitat for bass, catfish, and carp. They also fragment habitats and reduce migration opportunities during low flow periods. Additionally, beaver dams are typically built at the control point of pool habitats which are the prime spawning areas for resident and anadromous *O. mykiss*. 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 and concern about the effectiveness of the Fish Passage Supplementation Program, 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.

Over a multiple day period in December of WY2013, the CPBS completed the LSYR mainstem beaver dam survey from the dam (LSYR-0.0) to approximately the Narrows, downstream of the Salsipuedes Creek confluence with the LSYR (approximately LSYR-34.4), except within the Highway 154 Reach on the San Lucas Ranch (due to lack of access). The survey also included the section of the river downstream of the Lompoc WWTP (approximately LSYR-42.0).

Dams were classified as barriers, impediments, or passable, utilizing CDFW passage criteria. In order for migrating *O. mykiss* to pass over barriers, CDFW criteria states that the depth of a pool at the downstream end of a passage barrier needs to be 1.5 times the height of a dam to allow fish passage. Surveyors measured each dam height then measured the depth of the downstream habitat to determine if a fish could make the jump at the flow rate at the time of the survey. Dams were classified as barriers if the habitat downstream was less than 1.5 times the height of the dam. Barrier dams were large in height and were typically built at habitat control points (i.e., riffles) resulting in minimal depth downstream to allow fish to jump over the dams. Barrier dams spanned the river channel with no flanking flows. Impediment dams were generally smaller in height, had greater depths at their downstream side and/or were flanked by flow along one or both channel margins which would allow fish to swim around the impediment. Passable barriers were all small in height with deeper habitats immediately downstream of the dam with some measure of flanking present.

A total 167 beaver dams were identified within the LSYR mainstem downstream of Bradbury Dam, 92 (69.7 %) of which were classified as barriers, 2 (1.5%) as impediments, and 38 (28.8%) as passable to migrating fish (Figure 68). There were 2 dams observed in the Highway 154 Reach, 10 in the Refugio Reach, 15 in the Alisal Reach, 13 in the Avenue of the Flags Reach, 92 downstream of the Avenue of the Flags to the Narrows, and 5 in and around the Lompoc WWTP. Barrier dams were found in every reach; 2 in the Highway 154 Reach, 9 in the Refugio Reach, 12 in the Alisal Reach, and 59 from the Avenue of the Flags downstream to the Narrows. All 5 of the beaver dams around the Lompoc WWTP were classified as barriers.

There were 35 beaver dams identified in Hilton and Salsipuedes/El Jaro watersheds; one at the lower section of Hilton Creek that dammed a side channel habitat of Hilton Creek, 13 in Salsipuedes Creek, and 21 in El Jaro Creek. There were 24 of the 35 tributary dams that were classified as barriers to migrating fish. The Hilton Creek dam was classified as a barrier, but this dam could be beneficial because its location removes one potential avenue of invasive species recruitment into Hilton Creek from the area downstream of the Stilling Basin to the ford crossing and does not affect upstream or downstream migration from Hilton Creek to the Long Pool and vice versa. There were 8 dams classified as barriers on Salsipuedes Creek and 15 classified as barriers on El Jaro Creek.

4. Discussion

This section discusses results of monitoring and habitat restoration in support of the endangered southern steelhead within the LSYR since the issuance of the 2000 Cachuma Project BiOp, specifically the implied questions in T&C 11.1. This trend analysis focused on data from WY2001 through WY2013. Due to no migrant trapping in WY2013 and reduced visibility for snorkel surveys in the summer and fall, population trends will be limited to spawner, spring snorkel and beaver dam surveys. Specific discussions will be provided on the 4 interruption of flow incidents in Hilton Creek this year and a summary of all tributary projects completed to date since issuance of the 2000 BiOp. The rainfall (Table 15), runoff (Table 16), and water year type with the years Lake Cachuma spilled (Figure 69) are presented over the period for general reference. 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), 2010 (USBR, 2013), 2011 (COMB, 2013), and 2012 (COMB, 2016). This section has been broken out by restoration projects, target flows, Hilton Creek incidents, population trends, drying of Refugio and Alisal reaches, and the status of 2012 AMS recommendations.

4.1. Habitat and Passage Enhancement Projects

Habitat and passage enhancement projects were slow to get going but by WY2006 the number of completed projects accelerated and the resulting *O. mykiss* population increase was notable within the LSYR basin. By December 2012 of WY2013, there were eight habitat and passage enhancement projects completed since WY2001, four of which were proposed actions in the BiOp (Tables 18 and 19). Those projects are: Salsipuedes Creek Highway 1 Bridge Fish Ladder, Salsipuedes Creek Jalama Road Bridge Fish Ladder, Hilton Creek Cascade Chute Project (HCCCP), El Jaro Creek Rancho San Julian Fish Ladder, Quiota Creek Crossing 6 Bridge, Cross Creek Ranch Fish Passage Project on El Jaro Creek (backwatering with step pools), Quiota Creek Crossing 2 Bridge, and Quiota Creek Crossing 7 Bridge as well as the HCWS which supplies water year round to Hilton Creek from Lake Cachuma (Figures 70-72). The HCWS has transformed Hilton Creek into a dense riparian zone where there is little thermal heating from the URP to the confluence with the LSYR mainstem (Figures 73 and 80). In addition, there were three completed bank stabilization and erosion control projects on El Jaro Creek. All of these projects removed a passage barrier for adult and juvenile *O. mykiss*, reduced fine sediment loading to the stream, or provided stream flows for passage, spawning, and rearing of *O. mykiss* upstream of the project areas. Many of the completed tributary projects also enhanced the footprint of the project area by creating additional pools, refuge, passage corridors for aquatic and terrestrial species, and native riparian vegetation.

The combination of the HCWS and HCCCP has provided excellent oversummering conditions for *O. mykiss* within the Hilton Creek drainage. Prior to the HCCCP, the total number of migrant captures between WY2001 and WY2005 ranged between 50 and 174 with a CPUE range of 0.68-1.09 fish/day. Between WY2006 and WY2012, after the completion of the HCCCP, the range was 174 and 643 with a corresponding CPUE range of 1.59-5.79 fish/day. In WY2012, a total of 174 *O. mykiss* were captured but it was an abbreviated trapping season due to the request from NMFS to Reclamation that take limits not be exceeded this particular season. Because of a truncated trapping season, caution should be used with comparing WY2012 trapping results with totals from previous years. Again, migrant trapping was not conducted in WY2013.

Snorkel surveys also demonstrated an upward population trend during the three annual passes through Hilton Creek, particularly after WY2005 when the HCCCP was completed. In addition, eight confirmed anadromous adult steelhead have been observed at the Hilton Creek trap, seven in WY2008 and one in WY2011. Since WY2012 and WY2013 were dry years with little to no connectivity between the river and ocean, upstream migration of anadromous adults from the ocean to Hilton Creek was not possible.

All man-made known passage impediments within the Salsipuedes/El Jaro Creek watershed have been removed as of WY2009, allowing for adult and juvenile *O. mykiss* passage throughout the stream network. Fish have been observed moving through all of the fish passage facilities, and in many cases, fish are using the fish ladders for refuge and oversummering habitat. The total annual number of migrant captures between WY2001 and WY2005 ranged between 20 and 186 with corresponding CPUE values of 0.20 to 2.07fish/day (the break point set at WY2006 prior to and after completing all El Jaro Creek projects). The total number of migrant captures between WY2006 and WY2012 ranged from 11 to 248 with corresponding CPUE values of 0.22 to 2.02 fish/day. The low of 11 captures in Salsipuedes Creek occurred in WY2012, due largely to an abbreviated trapping program as mentioned above.

The benefits of all of the fish passage projects in the Salsipuedes/El Jaro Creek watershed will likely show a positive trend in adult and juvenile migration with time and increased stream flow. It was difficult to demonstrate the benefits in WY2012 and WY2013 due to extremely dry years, low stream flow, and a truncated trapping season. The CPBS continues to work with private landowners on potential projects to improve aquatic and riparian corridor habitat and water quality within the drainage.

Eight migration barriers remain on Quiota Creek, including two newly discovered migration barriers (Crossings 0A and 0B), all of which are under design for removal and will be systematically removed as funding becomes available (Tables 17 and 18). The most recent completed project (Quiota Creek Crossing 7) removed a partial barrier and opened up 1.46 miles of spawning and rearing habitat (Figure 71). When the full suite of barriers has been removed along Quiota Creek, greater insight into the biological performance of all passage fixes will be possible. Construction was completed on Crossing 1 in 2014, Crossing 3 in 2015, Crossings 4 and 0A in 2016 period. Crossings 5 and 8 are proposed for construction in the fall of 2017 pending design approval and permits.

4.2. Target Flows

Target flows (rearing support) have been met every year with few exceptions since issuance of the BiOp at Hilton Creek (minimum of 2 cfs), Highway 154 Bridge (10, 5, 2.5 or 0 cfs depending on spill and reservoir storage), and Alisal Bridge (1.5 cfs the year of and after a spill greater than 20,000 af with *O. mykiss* observed in the Refugio and Alisal reaches) (NMFS, 2000). Although WY2013 was a very dry year, target flows at Hilton Creek and the Highway 154 Bridge were met throughout the year, except during power outages and equipment failure that resulted in interruptions of flow to the creek.

4.3. Hilton Creek Interruption of Flow Incidents

There were 4 incidents of interruptions of flow to Hilton Creek from the HCWS in WY2013 (Table 19). Since the installation of the HCWS in 1999 and modification in 2004, water has been delivered by gravity from Lake Cachuma to Hilton Creek at the URP, LRP and/or CRP. In WY2013, lake levels dropped below the point where gravity feed was possible and the pumps on the HCWS Pumping Barge needed to be activated on 7/8/13 for the first time in the history of the infrastructure. The HCWS Pumping Barge consists of 2 electrical pumps that are connected to the grid by submersible cables, with a backup diesel generator on the dam crest. Causes for those interruptions were varied and in each case the Fish Rescue Team was mobilized to survey and perform fish rescues/relocations if needed or collect mortalities if found. NMFS was informed by Reclamation as each event occurred and incident reports were submitted to Reclamation by CPBS and then sent to NMFS.

The duration of the 3/1/13 incident was over 10 hours. It occurred in the middle of the spawning season and affected several identified redds, one in particular with adult mortalities found on the dewatered redd. The 6/23/14 event was of shorter duration (7 hrs) but had a greater number of mortalities (87) mostly due to the timing of the incident at night when the Fish Rescue Team could not thoroughly and safely conduct stream surveys. There were more juvenile than adult total mortalities across the 4 incidents (Table 20) but the cumulative and long-term effect of these incidents on the *O. mykiss* population in Hilton Creek has not been determined.

4.4. Population Trends in LSYR Basin

O. mykiss: Steelhead population trends vary in response to a number of factors, including precipitation and streamflow within the LSYR mainstem and tributaries. Rainfall (Table 15), water year type (Figure 69), and stream discharge (Table 16) provide helpful background information on the population trend discussion from WY2001 to WY2013. Target flow releases, mostly through the HCWS, have provided good rearing and oversummering conditions for *O. mykiss* within the LSYR mainstem, particularly within the Highway 154 Reach. Hilton Creek and portions of the LSYR mainstem continue to see rapid riparian canopy growth, particularly in areas with perennial flow nearest to Bradbury Dam (Figures 51-52). Thermal heating within Hilton Creek is near non-existent due to a mature canopy, while the LSYR mainstem still experiences thermal heating and algal growth because of a limited riparian canopy, particularly in its lower reaches. However, a maturing riparian corridor has been observed in the Refugio and Alisal reaches since target flows to Alisal Bridge encompass both reaches (Figures 47-48).

O. mykiss now routinely rear within Hilton Creek and reaches of the LSYR that sustain year-round flow, specifically the Highway 154 Reach and the Refugio and Alisal reaches of the LSYR mainstem when target flows are being met to the Alisal Bridge (LSYR-10.5). Other lower basin tributaries such as Quiota Creek and Salsipuedes/El Jaro Creeks contain natural flows that maintain wetted sections throughout the year. Year-round *O. mykiss* populations within those drainages have been observed in all different year types (wet, dry, and normal) since the monitoring program began. Since all of the man-made barriers within the Salsipuedes Creek basin have been remediated, the anadromous component of the *O. mykiss* population can gain access to the entire watershed, provided that streamflow and lagoon breaching allows for upstream migration. The process of removing passage barriers within Quiota Creek is still in progress.

The distribution of *O. mykiss* within the LSYR mainstem prior to the 2000 BiOp was mainly confined to the Highway 154 Reach (LSYR-0.0 to LSYR-3.2), which contained perennial flow and appropriate water quality conditions for fish downstream of Bradbury Dam. Beginning in WY2001, target flows downstream to Alisal Bridge became mandatory in spill years as well as the year after a spill event. Spill years occurred at Bradbury Dam in WY2001, WY2005, WY2006, WY2008, and WY2011. These spill events triggered mandatory target flows from WY2001 to WY2002, WY2005 to WY2009, and WY2011 to WY2012 down to Alisal Bridge (LSYR-10.5) for the year of and year after a spill that exceeded 20,000 af and when *O. mykiss* were present within the Alisal and Refugio reaches (Figure ES-1) (NMFS, 2000). From WY2005 to WY2013, *O. mykiss* have been observed within the Refugio and Alisal reaches of the LSYR mainstem during the oversummering period. Oversummering fish are typically observed in pool habitats within those reaches, although not necessarily in the same locations. This is particularly true after large spill events when channel altering flows can create, fill in, or move habitat units within the LSYR mainstem.

The WY2012 total upstream and downstream migrant captures at the Salsipuedes, LSYR mainstem, and Hilton Creek traps were presented in the 2012 Annual Monitoring

Summary. Since migrant trapping was not conducted in WY2013, migration trends with this dataset will not be discussed. *O. mykiss* population trends will be addressed through redd (spawner) survey and snorkel survey results.

Redd survey results suggest that *O. mykiss* have been successfully spawning in the tributaries with less evidence of spawning in the LSYR mainstem management reaches (Table 21). Although these surveys have been conducted for many years, the level of effort has been comparable since WY2010. The results suggest the importance of the tributaries over the LSYR mainstem for favorable and important habitats for reproduction.

The total number of *O. mykiss* observed during the spring, summer, and fall snorkel surveys from WY2001 through WY2013 showed a general trend upward across wet years and a decrease during the dry years (Table 22 and Figures 74-79). There were fewer *O. mykiss* observed in the Refugio and Alisal reaches starting in WY2012 and even fewer in WY2013 compared to WY2011. This is likely due to these being consecutive dry years. The number of fish recorded in Quiota, Salsipuedes and El Jaro creeks was lower in WY2013 compared to the previous year. Again this is likely due to it being a second dry year with reduced stream flows. Even the populations in Hilton Creek showed a decrease that was due to the various interruptions of flow to the creek.

The only reach/stream in WY2013 that didn't show a decrease in total populations observed from the spring to the fall snorkel surveys was Hilton Creek (Table 22). Historically, attrition from the spring to the fall has been routinely observed, particularly in the Refugio and Alisal reaches. The exception has been Hilton Creek, due to sustaining flows provided by the HCWS. But, in contrast to previously observed inter-annual trends, the *O. mykiss* population in WY2013 dropped considerably in Hilton Creek compared to WY2012 with totals approaching numbers observed in WY2003.

Hilton Creek (Figure 76 and Table 22) had an increase in the overall number of *O. mykiss* after WY2005 with the removal of the Cascade Chute migration barrier (HCCCP) and the increased use of the HCWS URP for flow releases. Snorkel survey efforts from WY2005 through WY2013 in Quiota Creek (Figure 77), Salsipuedes Creek (Figure 78), and El Jaro Creek (Figure 79) do not reveal any particular pattern beyond a general reduction in numbers of fish observed from the spring to the fall surveys.

Hilton Creek has been divided into 6 reaches by geomorphologic breaks (Figure 80). Historically, the spring and summer surveys within Hilton Creek generally show the highest number of observed *O. mykiss*, with a slight tapering off of the numbers in the fall (Table 22). This reduction was likely due to some attrition, predation, and downstream dispersal out of the Hilton Creek basin into the LSYR mainstem. Some years there is a slight increase of the observed population from the spring to the fall where fish could be migrating out of the mainstem into the creek or into more visible habitats from margin habitats. There was a distinct upward size shift in the fish observed during the snorkel surveys from spring to fall indicating good rearing conditions throughout the creek. Data from WY2001 to WY2013 suggest an upward size 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.

Non-Native Fish Species: There has been a general trend over the last five years towards an increase in the number of non-native fish in the Refugio and Alisal reaches of the LSYR mainstem, specifically largemouth bass, carp, and sunfish, due to continuous target flows to the Alisal and Highway 154 Bridges since WY2005 (Table 23). The number of largemouth bass reached the highest levels recorded so far in the Refugio and Alisal reaches, totaling 1,118 fish during the fall WY2012 survey and 1,016 in the summer of WY2013. Impacts to *O. mykiss* from invasive species within the LSYR mainstem, particularly piscivorous fish, needs further study, specifically stomach analyses of those non-native piscivorous fish species.

Beavers: The southern steelhead and the North American beaver have co-existed on the LSYR since before southern steelhead were listed as endangered in 1997. Under question are whether beaver are native or introduced to the Santa Ynez River and whether their existence in the river supports steelhead recovery. Research on steelhead-beaver interactions is limited in southern California, specifically how beavers affect steelhead during 1) the winter/spring migration with flashy and highly variable runoff regimes, and 2) the summer rearing period with sustained dry and hot conditions.

In an effort to track the amount of beaver activity in the LSYR basin, CPBS has been conducting beaver dam surveys from Bradbury Dam to the Santa Ynez River lagoon and up into the LSYR tributaries where accessible. The survey is a considerable effort and takes more than a month to complete. The results suggest that there is a healthy population of beavers, particularly in the LSYR mainstem (Table 24). There are no beavers in Hilton Creek (except for around the confluence where they occasionally disperse up from the LSYR mainstem) or Quiota Creek but beaver occupy Salsipuedes Creek up into the El Jaro Creek drainage. WY2010 and WY2011 had a large flow event that depressed and possibly disbursed the beaver population. This was reflected in the WY2011 and WY2012 counts, only to show a rebound in WY2013. Potential management strategies for steelhead and a growing population of beaver and other exotic species should be investigated in the context of steelhead preservation, dam releases for steelhead migration and dry-season rearing, and habitat restoration.

4.5 Drying of the Refugio and Alisal Reaches; Encantado Pool:

During WY2013, there were no target flows to Alisal Bridge and on 6/4/13 the Highway 154 Bridge target flows were decreased from 5.0 cfs to 2.5 cfs for the duration of the year as stipulated in the BiOp as lake storage went below 120,000 af. Regular Adaptive Management Committee (AMC) meetings were held during the spring and through the summer where discussions addressed the drying conditions in the Refugio and Alisal reaches and possible options to keep the resident *O. mykiss* in those reaches alive until WR 89-18 releases commenced later in the summer. Frequent snorkel surveys and water quality monitoring started in April of 2013 to determine the status of the remaining resident *O. mykiss* in those reaches specifically at the Encantado Pool (LSYR-4.95) and Double Canopy Pool (LSYR-7.65) in the Refugio Reach, and Car Pool (LSYR-8.05), Historic Beaver Pool (LSYR-8.70), and Corrugated Pipe Run (LSYR-9.85) in the Alisal Reach (Table 25). All fish were adults of varying size, the largest being 18-21 inches in the Historic Beaver Pool. Fish moved around a bit within different habitats but by June conditions were deteriorating and the previously observed *O. mykiss* began to disappear. Two large pond aerators were installed in the Encantado Pool and pool water was pumped into the air and dropped back into the pool in an effort to increase DO concentrations at night in that habitat (Figure 81). The effort improved DO conditions. By the beginning of July, the turbidity in that habitat from beaver and non-native fish activities made effective snorkeling impossible. No *O. mykiss* were observed at that point in the Alisal Reach and only one fish was seen in the Double Canopy Pool prior to the WR 89-18 release. No fish were observed in the Refugio or Alisal reaches throughout the WR 89-18 release (USBR, 2014).

4.6 Status of 2012 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 2012 Annual Monitoring Summary to improve the monitoring program pending available funding:

- Continue the monitoring program described in the revised BA (NMFS, 2000) and BiOp (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.
    - Status: This recommendation is being followed and is ongoing.

- 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. Continue the partnership with CDFW for DIDSON deployment and comparison with the current migrant trapping effort.
    - Status: CPBS established a collaborative monitoring effort with CDFW to deploy a DIDSON just downstream of the Salsipuedes trap with continued deployment in the coming years. CPBS will receive training from CDFW on this instrumentation. This recommendation is ongoing.

- Evaluate risk of exceeding take limits associated with the migrant trapping program and analyze ways to optimize the monitoring effort while remaining below mandated take limits for juvenile and adult *O. mykiss*.
    - Status: CPBS continues to evolve the Annual Migrant Trapping Plan to assure no exceedance of take while gathering the most amount of data possible. Efforts have been initiated to contract a consultant for modeling advice for monitoring optimization.

- Investigate with NMFS ways to increase the amount of juvenile and adult take limits within the BiOp Incidental Take Statement (ITS) such that the migrant trapping program can continue without unreasonable limitations.

- Status: CPBS has communicated with NMFS to this regard. The recommendation by NMFS is to assist Reclamation with their Reconsultation effort which has been done and continues to be done.

- Develop a Migrant Trapping Plan that is reviewed and approved by NMFS.
    - Status: Developing a Migrant Trapping Plan has now become an annual responsibility for the CPBS which is submitted to Reclamation for review who then submits it to NMFS. To date, no comments have been received from NMFS except to stay below established take limits.

- Continue to solicit landowner cooperation and gain access to new reaches for all monitoring tasks, particularly when conducting tributary project performance evaluations within upstream tributary reaches;
    - Status: This recommendation is a long-term goal and is therefore 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 objectives;
    - Status: A more systematic water quality monitoring program is being followed and this recommendation is ongoing.

- Conduct monthly lake water temperature and dissolved oxygen profiles at the HCWS intake barge year round to consistently monitor Lake Cachuma water quality conditions to depth particularly at the intake hose elevation of 65 feet for the HCWS.
    - Status: This recommendation is being followed and is ongoing.

- Continue efforts to remove fish passage impediments within the LSYR basin as listed in the proposed actions of the BiOp utilizing grant funding wherever possible; specifically within the Quiota Creek watershed;
    - Status: This recommendation is a long standing effort and is ongoing.

- Continue the use of seasonal 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.

- Continue to develop the LSYR *O. mykiss* scale inventory and analyses of growth rates, evidence of life-history strategies such as fresh verses marine water rearing, signs of spawning, etc. in support of ongoing fisheries investigations.
    - Status: This recommendation is being followed and is ongoing.

- Finalize the installation of temperature probes/loggers on the outlets of Bradbury Dam to measure water temperature of releases from the Outlet Works for documentation, BiOp compliance monitoring (18 ^{o}C maximum release

temperature) and management. Part of that effort is to establish the procedure for data transfer and reporting.
   - Status: The instrumentation has been installed and algorithms for flow weighted determination of Outlet Works water temperature releases. Remaining is to establish the procedure for data transfer and reporting.

- Further systemize photo point documentation by continuing to add sites associated with completed restoration projects, consistency in site locations and improve timing of taking photos to maximize the objective of the documentation
   - Status: This recommendation is being followed and is ongoing.

- Engage local landowners to implement ways to reduce cattle impacts to tributary habitats on private lands within the LSYR basin.
   - Status: This recommendation is a long-term goal and is ongoing.

- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin.
   - Status: Steps to address this recommendation have been initiated. CPBS will be hosting a seminar on this topic at the SRF Conference in Santa Barbara in WY2014. Hence, this effort is ongoing.

- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS to improve collective knowledge, collaboration, and dissemination of information.
   - Status: This recommendation is being followed and is ongoing.

5. Conclusions and Recommendations

WY2013 was the second driest year on record with only 7.59 inches of rainfall at Bradbury Dam. As a result, Lake Cachuma did not spill and there was no ocean connectivity throughout the water year. The year was too dry to meet the criteria for fish passage supplementation. BiOp target flows for *O. mykiss* were met at Hilton Creek and Highway 154 Bridge across the water year. Reproduction in the LSYR basin was observed through redd surveys within the Highway 154 Reach and Salsipuedes, El Jaro, Los Amoles, Quiota, and Hilton creeks. Spawning success was substantiated through spring, summer, and fall snorkel surveys. Water quality conditions were difficult for *O. mykiss* survival in the Refugio and Alisal reaches where all fish either migrated out or perished prior to the initiation of WR 89-18 releases.

Monitoring tributary and LSYR mainstem *O. mykiss* populations has resulted in observations that fluctuate by water year type, instream flows, spawning success, and oversummering conditions. The continuation of the long-term monitoring program within the LSYR basin is essential for tracking population trends, particularly as restoration efforts are completed and adaptive management actions are realized. Collaboration with other local monitoring programs within the Southern California Steelhead DPS and

Monte Arido Highland Biogeographical Region is desirable to better understand population viability and restoration potential at a regional scale.

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

- Continue the monitoring program described in the revised BA (NMFS, 2000) and BiOp (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 with CDFW as a potential solution for monitoring migrants during high flow conditions when our current/conventional traps need to be removed;
- Evaluate risk of exceeding take limits associated with the migrant trapping program and analyze ways to optimize the monitoring effort while remaining below mandated take limits for juvenile and adult *O. mykiss*;
- Reclamation and COMB work together to propose increased juvenile and adult take limits to be incorporated in the ongoing Reconsultation process with NMFS;
- Continue annual development of a Migrant Trapping Plan that would be reviewed and approved by NMFS;
- Develop a focused study plan and seek funding to analyze stomach content of non-native piscivorous fish specifically in habitats known to support *O. mykiss* such as within the Highway 154, Refugio and Alisal reaches of the LSYR mainstem to better understand their *O. mykiss* predation;
- Continue to maintain and evolve landowner cooperation and gain access to new reaches for all monitoring tasks, particularly when conducting tributary project performance evaluations within upstream tributary reaches;
- Further develop the dry season water quality monitoring program elements for water temperature, dissolved oxygen concentration, and turbidity, specifically the use of multi-parameter detachable monitoring units (Sondes and U-26s) to address more specific monitoring objectives for habitat suitability for *O. mykiss* and other aquatic species;
- Incorporate turbidity into the year-round monthly lake profile water quality monitoring with temperature and dissolved oxygen at the HCWS intake barge, particularly near its intake hose at 65 feet of depth below the surface which is near the deepest point of the lake;
- Continue efforts to remove fish passage impediments within the LSYR basin as listed in the proposed actions of the BiOp, utilizing grant funding wherever possible, specifically within the Quiota Creek watershed;
- Further develop the LSYR *O. mykiss* scale inventory and analyses of growth rates, evidence of life-history strategies such as fresh verses marine water rearing, signs of spawning, etc. in support of ongoing fisheries investigations;
- Finalize the installation of temperature probes/loggers on the outlets of Bradbury Dam to measure water temperature of releases from the Outlet Works for documentation, BiOp compliance monitoring (18 ^{o}C maximum release

temperature) and management, specifically establishing the procedure for data transfer and reporting;

- Further systemize photo point documentation by continuing to add sites associated with completed restoration projects, consistency in site locations and improve timing of taking photos to maximize the objective of the documentation;
- Engage local landowners to implement ways to reduce cattle impacts to tributary habitats on private lands within the LSYR basin;
- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin; and
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS and the Monte Arido Highland Biogeographic Region to improve collective knowledge, collaboration, and dissemination of information.

6. References

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WY2013 Annual Monitoring Summary
Results
Figures and Tables

3. Monitoring Results

Table 1: WY2000 to WY2013 rainfall at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Water Year	Rainfall Bradbury* (in)	Year Type**	Spill	Reservoir Condition Storage (max) (af)	Reservoir Condition Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.50	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
2012	12.69	Dry	No	180,986	748.06	No	No
2013	7.59	Dry	No	142,970	733.92	No	Yes

* Bradbury Dam rainfall (Cachuma) period of record = 58 years (1953-2013) with an average rainfall of 20.4 inches.

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

2013 Max Storage and Elevation was on October 1, 2012 at 142,970 af.

Table 2: WY2013 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 (WY2013)
	(#)	(date)	(years)	(in)	(in)	(WY)	(in)	(WY)	(in)
Lompoc	439	1955	58	14.74	5.31	2007	34.42	1983	7.25
Buellton	233	1955	58	17.15	6.3	2007	41.56	1998	7.79
Solvang	393	1965	48	19.01	6.47	2007	43.87	1998	6.82
Santa Ynez	218	1951	62	16.06	6.58	2007	36.36	1998	6.89
Cachuma*	USBR	1953	60	20.40	7.33	2007	53.37	1998	7.59
Gibraltar	230	1920	93	26.74	9.24	2007	73.12	1998	8.50
Jameson	232	1926	87	29.36	8.5	2007	79.52	1969	10.23

* Bradbury Dam USBR rainfall.

Table 3: (a) Storm events greater than 0.1 inches and (b) monthly rainfall totals at Bradbury Dam during WY2013; dates reflect the starting day of the storm and not the storm duration.

(a)

#	Date	Precipitation (in.)
1	10/20/2012	0.10
2	11/16/2012	0.86
3	12/3/2012	1.37
4	12/13/2012	0.35
5	12/18/2012	0.39
6	12/23/2012	0.45
7	12/26/2012	0.22
8	12/29/2012	0.63
9	1/6/2013	0.44
10	1/11/2013	0.21
11	1/24/2013	1.1
12	2/8/2013	0.22
13	2/20/2013	0.17
14	3/6/2013	0.74
15	3/31/2013	0.22

(b)

Month	Rain (in.)
October-12	0.12
November-12	1.34
December-12	2.95
January-13	1.75
February-13	0.40
March-13	0.80
April-13	0.19
May-13	0.02
June-13	0.00
July-13	0.02
August-13	0.00
September-13	0.00
Total:	**7.59**

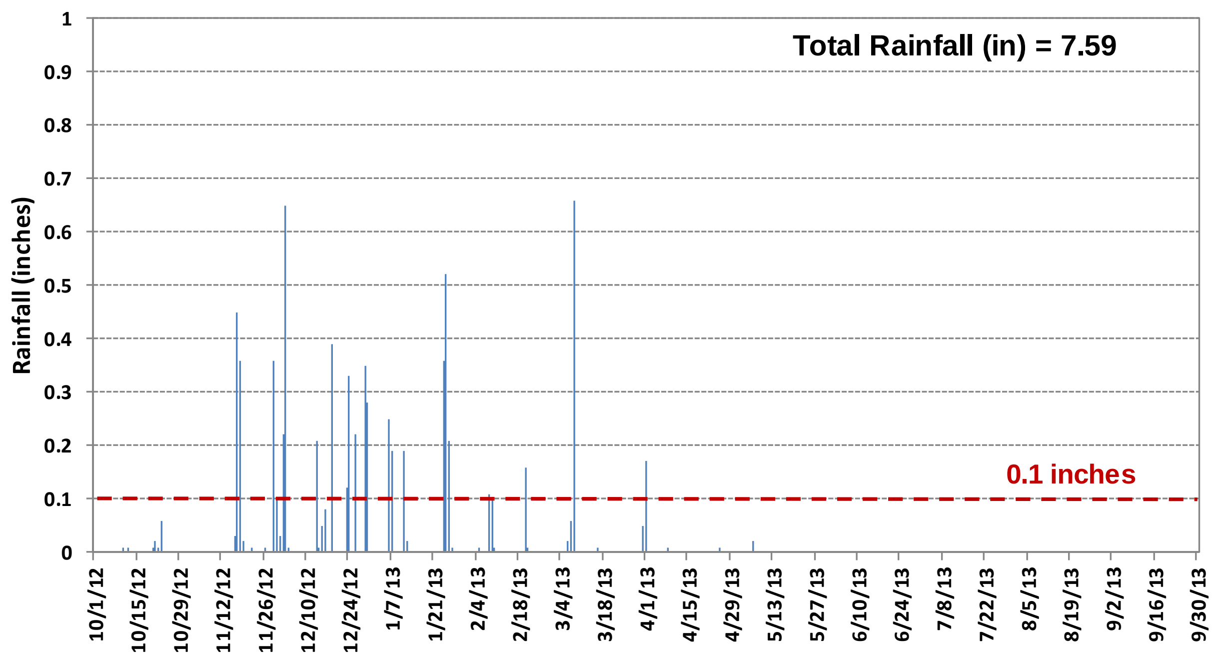


Figure 1: Rainfall in WY2013 recorded at Bradbury Dam (USBR).

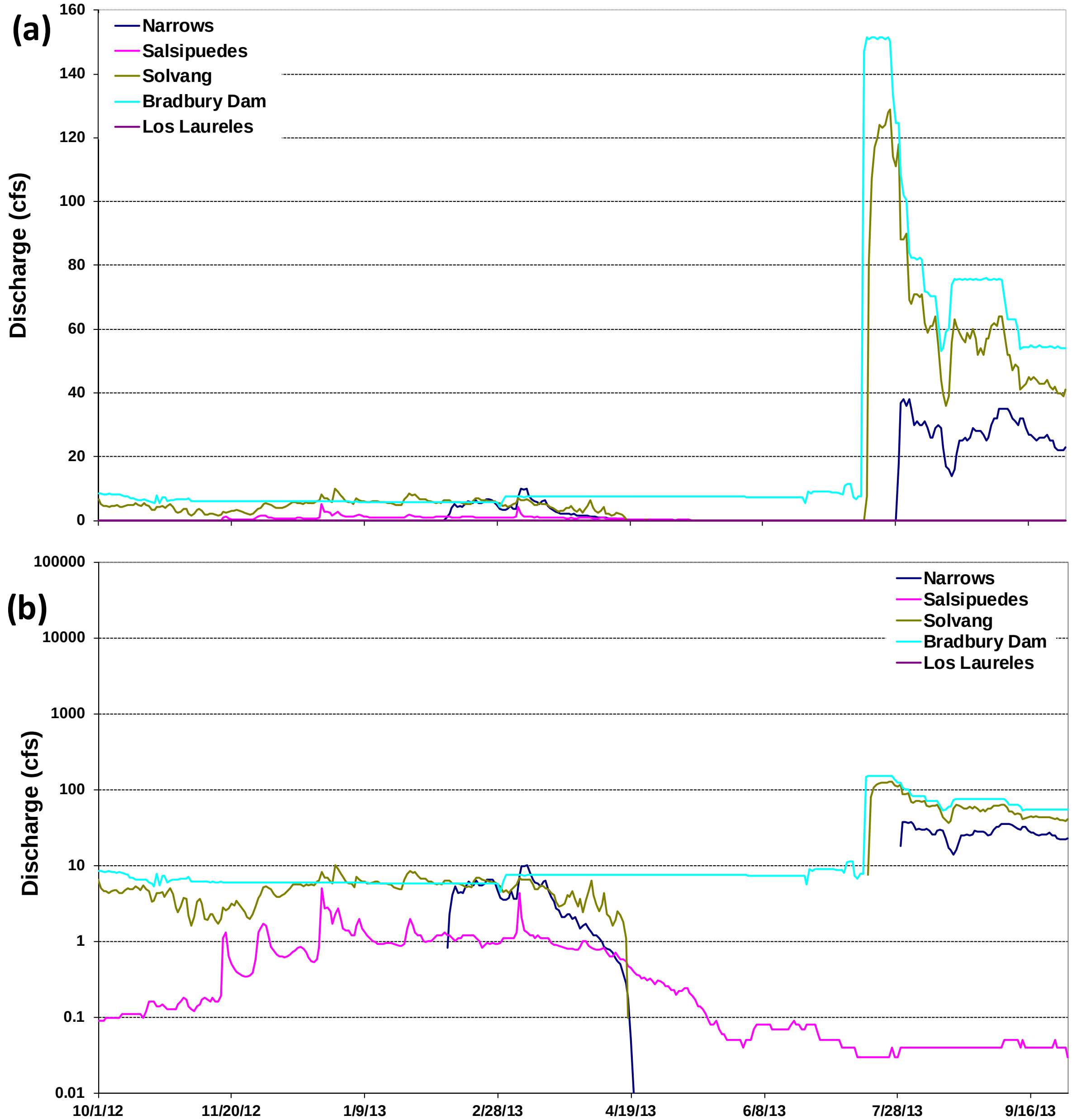


Figure 2: Santa Ynez River average daily discharge in WY2013 with a (a) normal and (b) logarithmic distribution; the Santa Ynez River lagoon was not open in WY2013, as shown in orange (source: USGS and USBR).

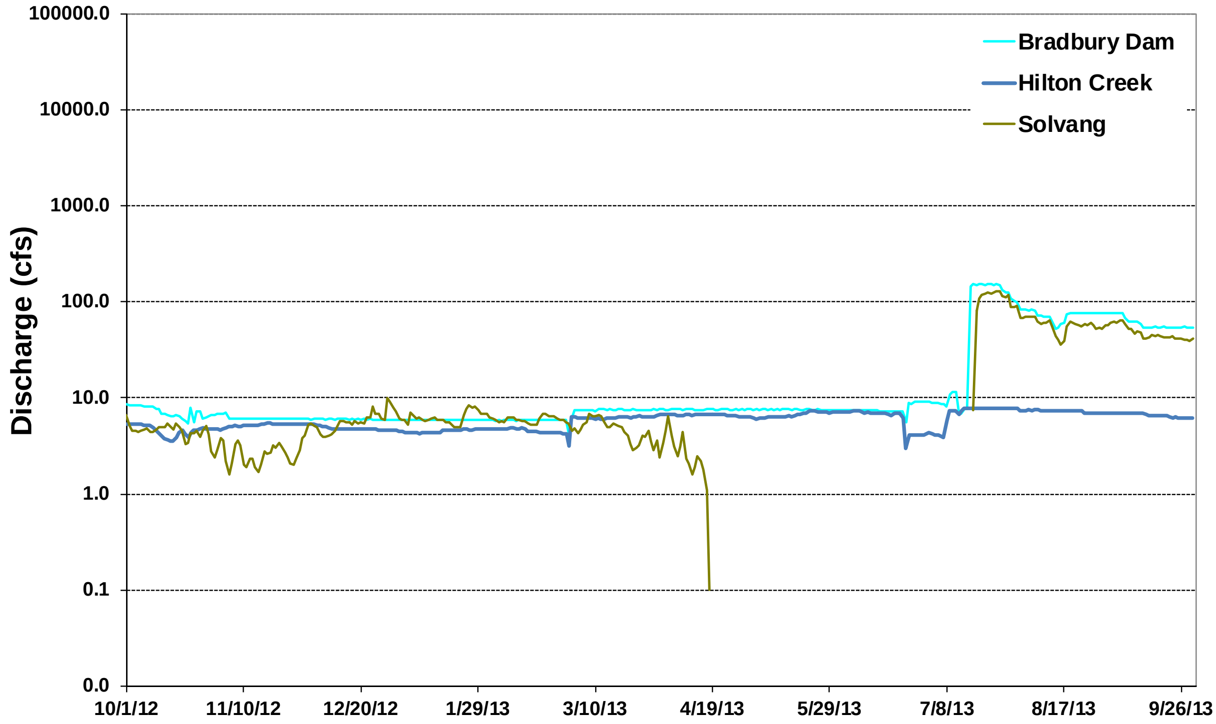


Figure 3: Average daily discharge at Hilton Creek just below the Upper Release Point, the LSYR mainstem at Solvang (Alisal Bridge) and Bradbury Dam during WY2013; the Hilton Creek USGS gauge is a low flow gauge hence does not record much above 50 cfs and the lagoon was not open during WY2013.

Table 4: Ocean connectivity, lagoon status and number of days during the migration season from WY2001 to WY2013.

Water Year	Year Type	Ocean Connectivity	Lagoon Status Open	Closed	# of Days	# of Days Open in Migration Season*
2001	Wet	Yes	1/22/01	5/10/01	109	109
2002	Dry	No	-	-	0	0
2003	Normal	Yes	12/21/02	5/9/03	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	1/19/10	5/6/10	107	107
2011	Wet	Yes	12/20/12	-	285	151
2012	Dry	Yes	-	5/17/12**	86	34
2013	Dry	No	-	-	0	0

* Migration Season is January through May.

** Lagoon opened and closed several times during the water year.

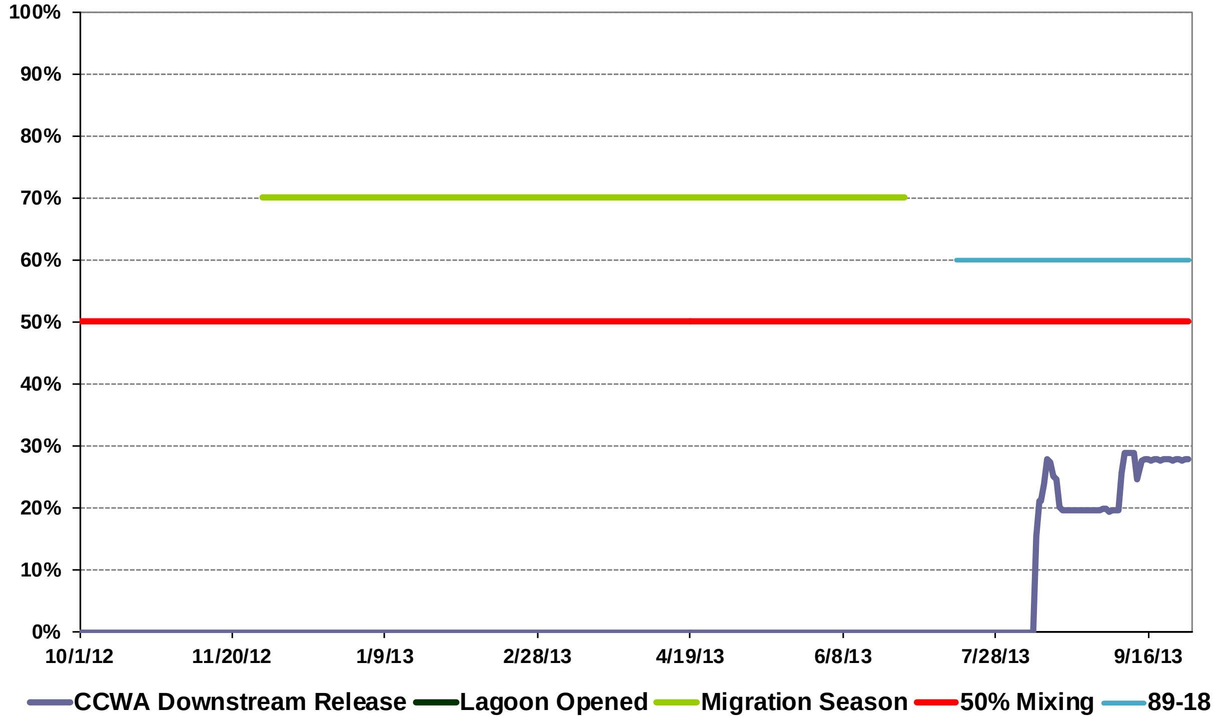


Figure 4: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the WY2013 migration season.

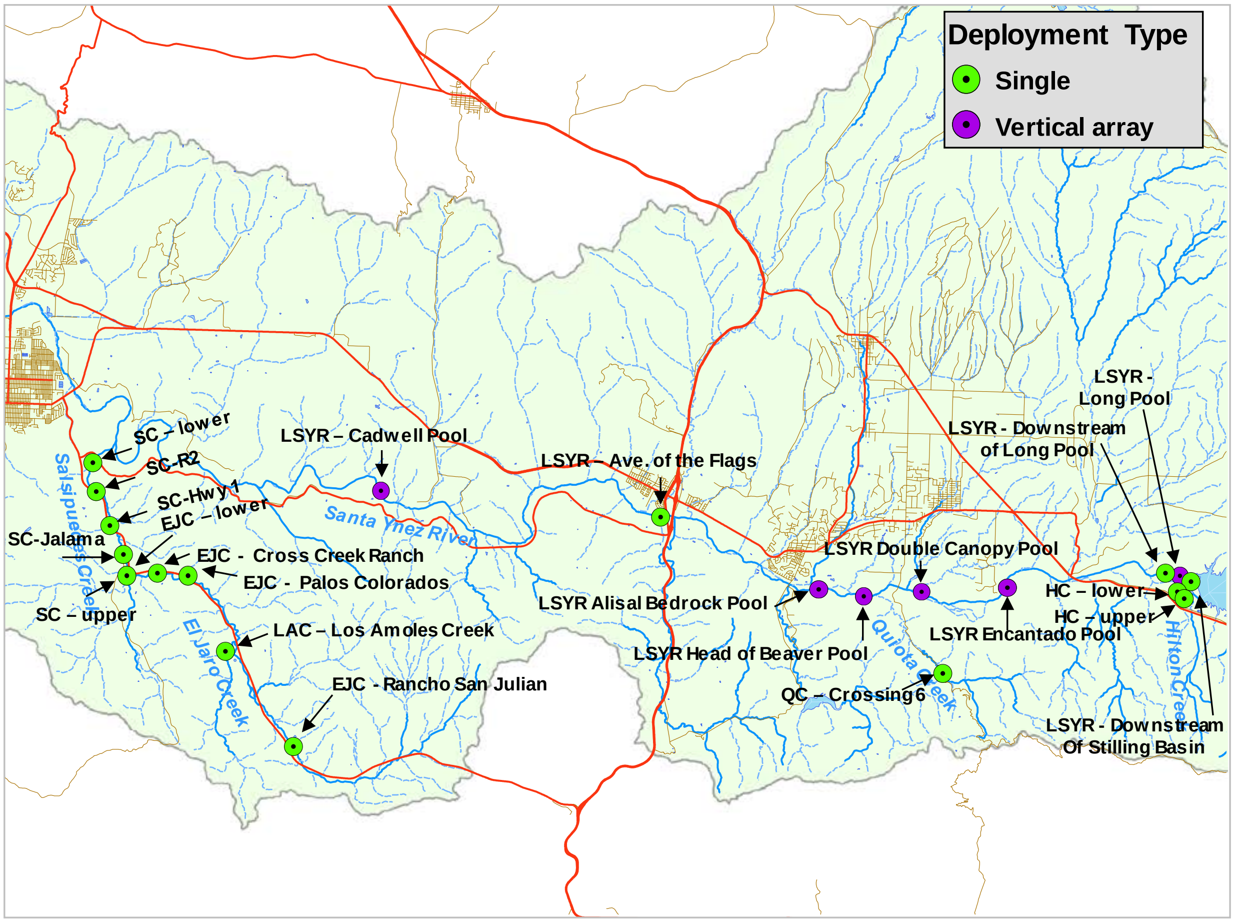


Figure 5: Thermograph single and vertical array deployment locations within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek) in WY2013; El Jaro Creek site and upper Salsipuedes Creek sites are very close together with overlapping symbols.

Table 5: 2013 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 - downstream of Stilling Basin	LSYR-0.25	Single	4/26/2013	12/3/2013	217
	LSYR - Long Pool	LSYR-0.51	Vertical Array	5/16/2013	11/24/2013	188
	LSYR- downstream of Long Pool	LSYR-0.62	Single	4/26/2013	12/1/2013	215
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	5/13/2013	12/2/2013	199
	LSYR - Double Canopy Pool	LSYR-7.65	Vertical Array	7/3/2013	12/3/2013	150
	LSYR - Head of Beaver Pool	LSYR-8.7	Vertical Array	5/16/2013	12/4/2013	198
	LSYR - Alisal Bedrock Pool	LSYR-10.2	Vertical Array	4/25/2013	12/4/2013	219
	Avenue of Flags	LSYR-13.9	Single	4/25/2013	12/12/2013	227
	LSYR - Cadwell Pool	LSYR-22.68	Vertical Array	7/31/2013	12/12/2013	132
Tributaries	Hilton Creek (HC) - Lower	HC-0.12	Single	4/25/2013	12/3/2013	218
	HC - Upper	HC-0.54	Single	4/25/2013	12/3/2013	218
	Quiota Creek (QC) - Crossing 6	QC-2.66	Single	4/25/2013	9/19/2013	144
	Salsipuedes Creek (SC) - Lower - Reach 1	SC-0.77	Single	5/2/2013	12/3/2013	211
	SC - Reach 2 - Bedrock Section	SC-2.2	Single	5/2/2013	12/16/2013	224
	SC - Reach 4 - Hwy 1 Bridge	SC-3.0	Single	5/2/2013	12/10/2013	218
	SC - Reach 5 - Jalama Bridge	SC-3.5	Single	5/2/2013	12/10/2013	218
	SC - upper at El Jaro confluence	SC-3.8	Single	5/2/2013	6/24/2013	52
	El Jaro Creek (EJC) - Lower-Confluence*	EJC-3.81	Single	5/2/2013	12/10/2013	218
	EJC - Palos Colorados*	EJC-5.4	Single	5/2/2013	12/10/2013	218
	EJC - Rancho San Julian Bridge*	EJC-10.82	Single	5/2/2013	12/10/2013	218
	Los Amoles Creek (LAC) - Creek Crossing	LAC-7.0	Single	5/2/2013	12/9/2013	217

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

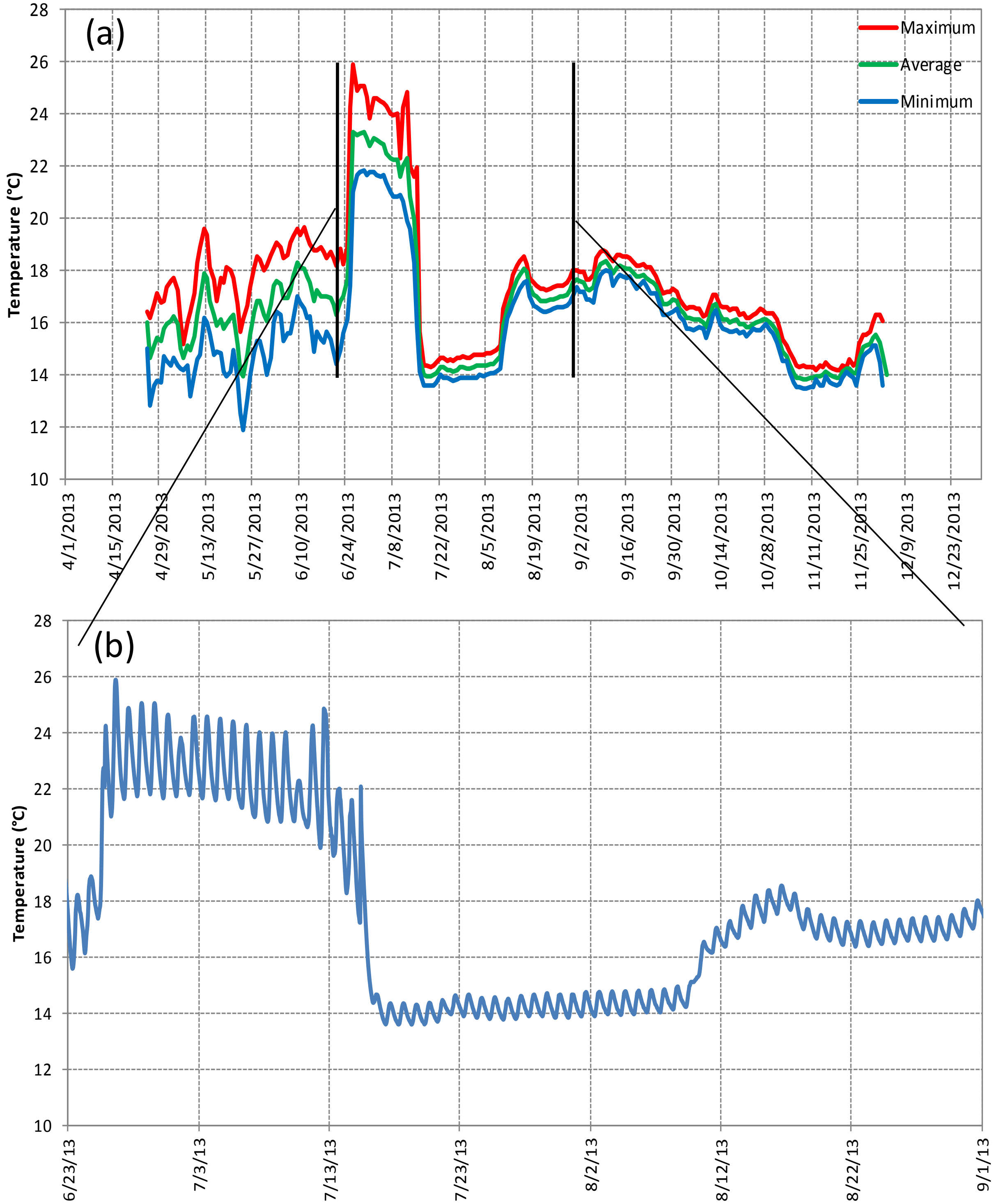


Figure 6: 2013 LSYR-0.25 (downstream of the Stilling Basin) bottom (1.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 6/23/13-9/1/13.

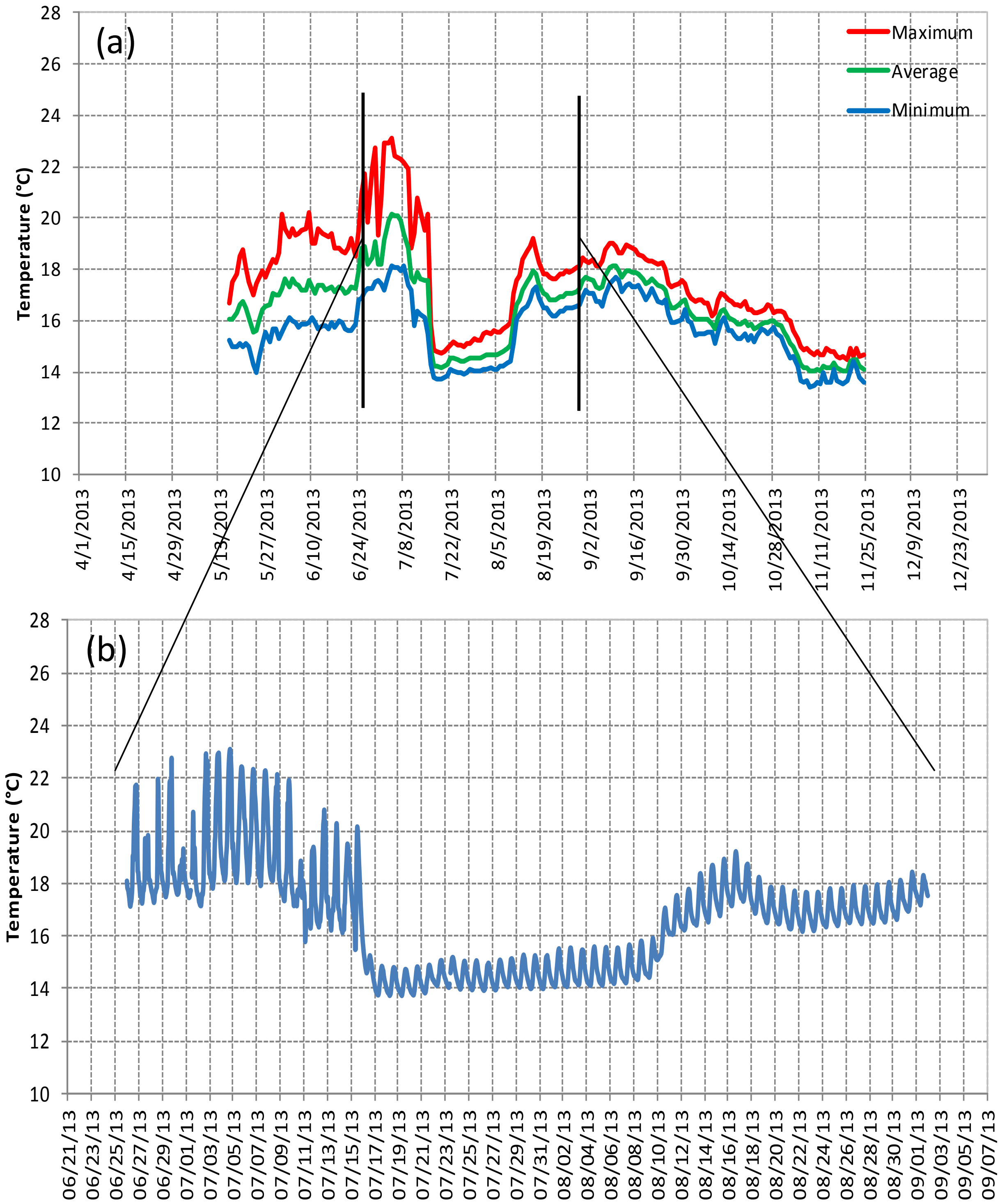


Figure 7: 2013 LSYR-0.51 (Long Pool) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 6/22/13-9/1/13.

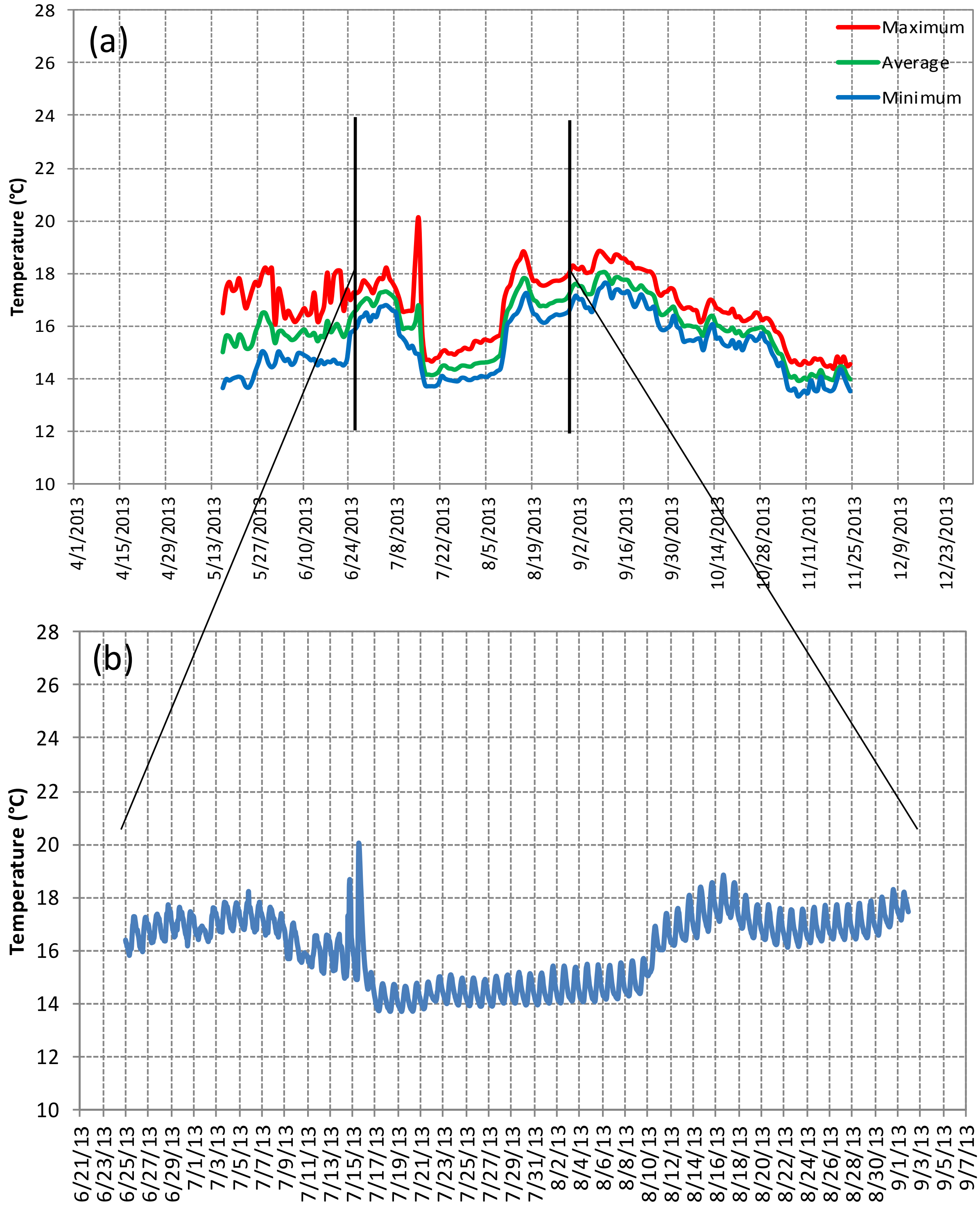


Figure 8: 2013 LSYR-0.51 (Long Pool) middle (4.5 foot) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 6/25/13-9/1/13.

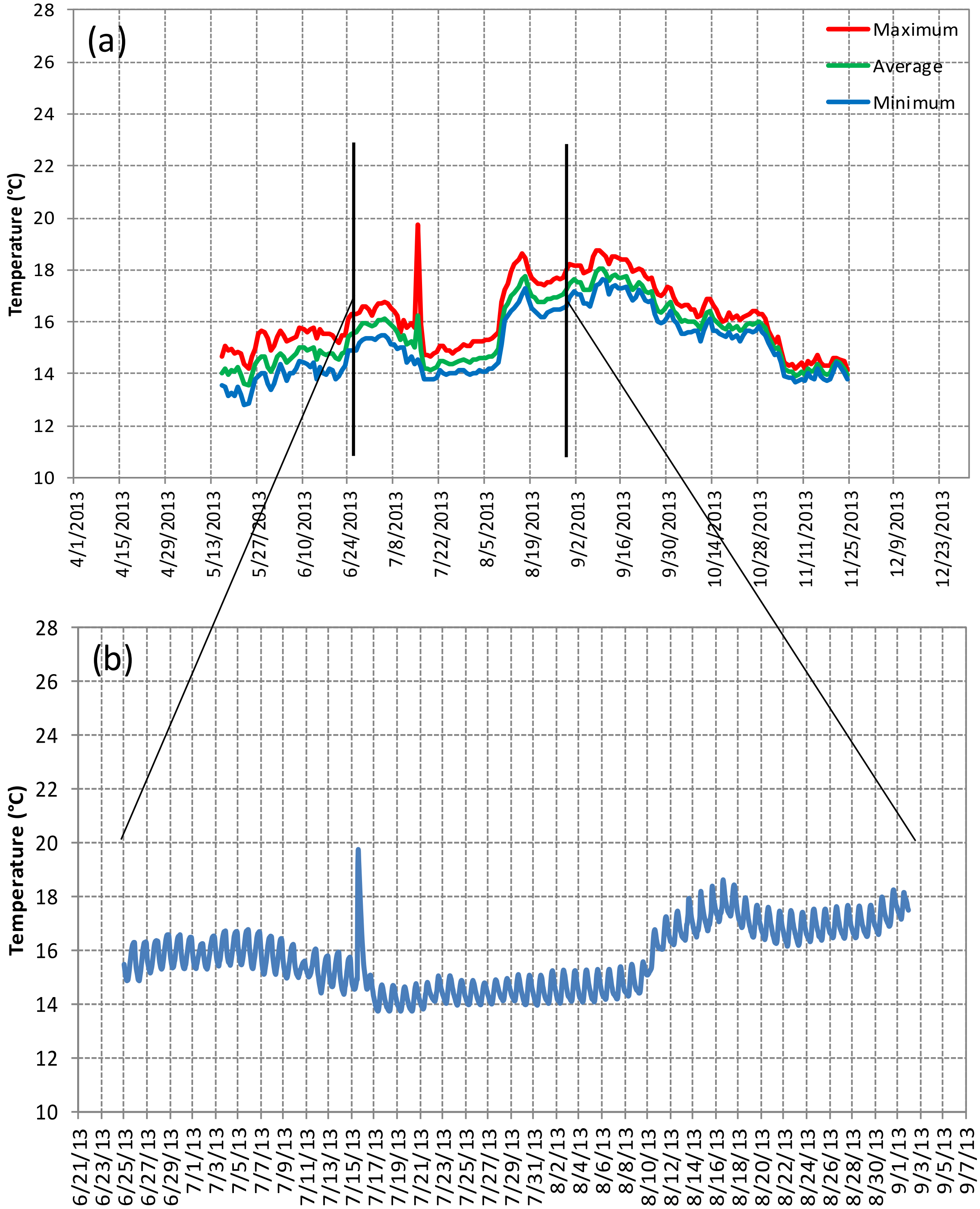


Figure 9: 2013 LSYR-0.51 (Long Pool) bottom (9.0 foot) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 6/25/13-9/1/13.

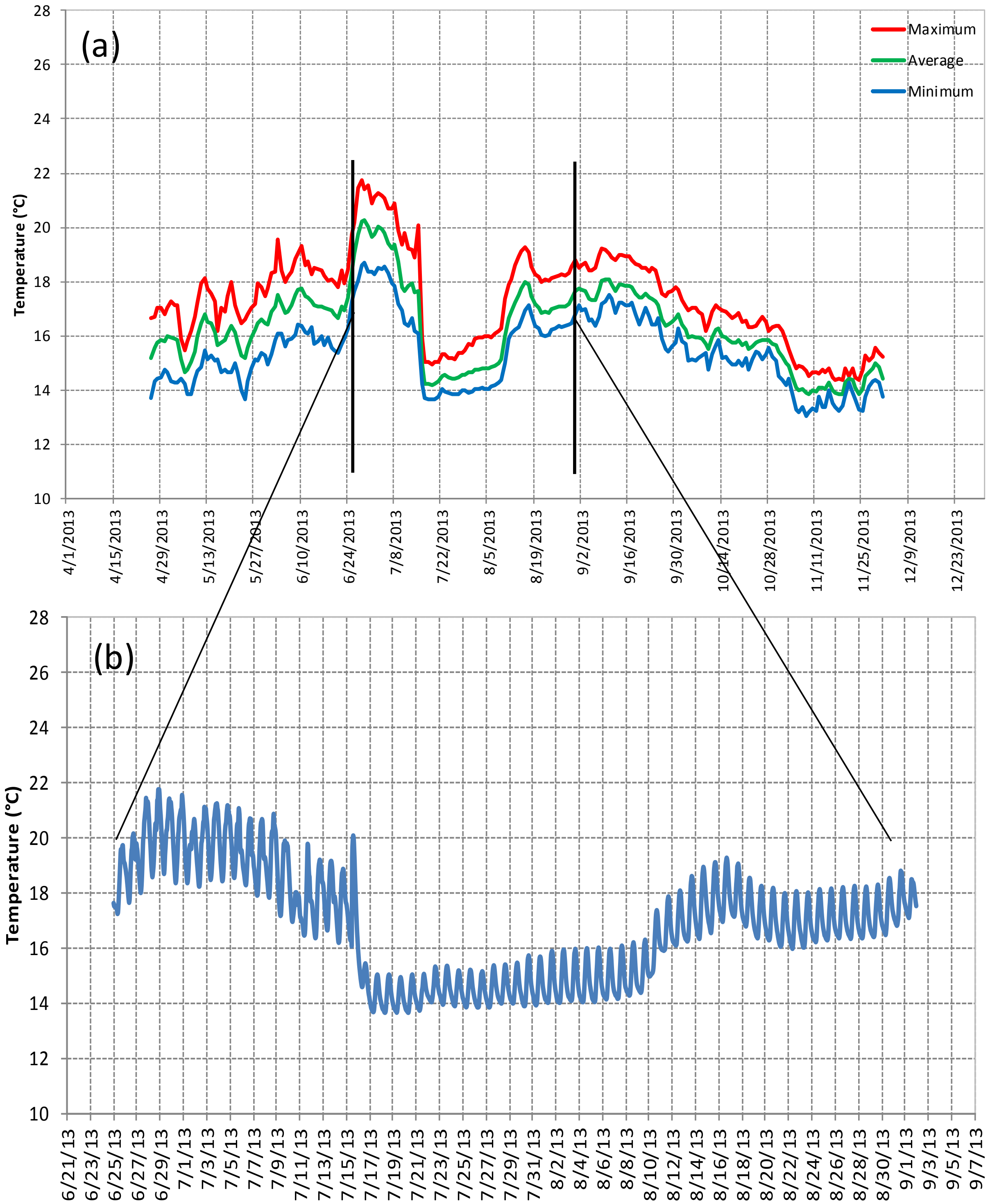


Figure 10: 2013 Reclamation property boundary at LSYR 0.62 (downstream of the Long Pool) bottom (2.0 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 6/25/13-9/1/13.

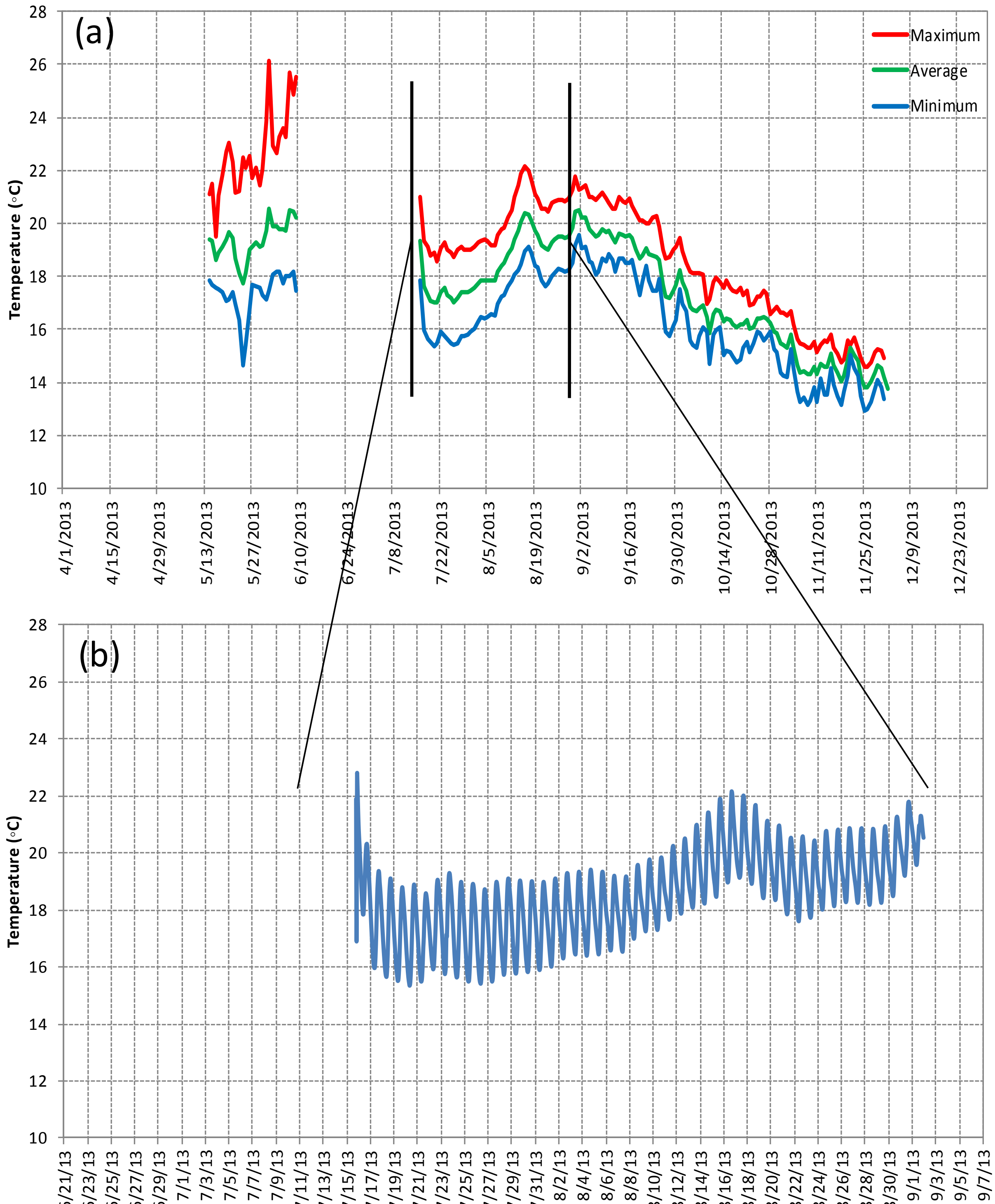


Figure 11: 2013 LSYR-4.95 (Encantado Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 7/16/13-9/2/13; the surface thermograph was out of the water for the period of 6/10/13-7/16/13.

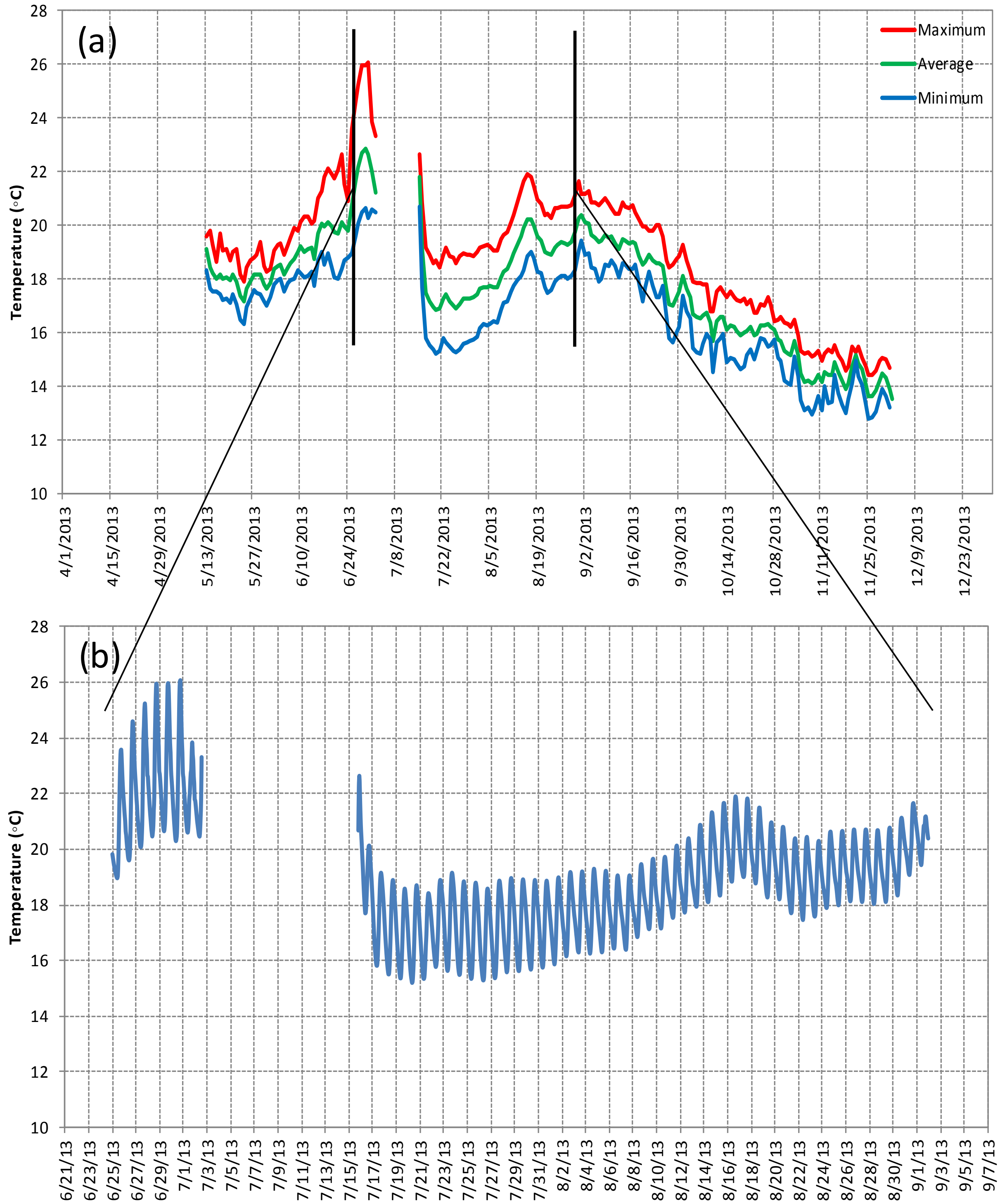


Figure 12: 2013 LSYR-4.95 (Encantado Pool) middle (3.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13; the middle unit was out of the water for the period of 7/3/13 to 7/15/13.

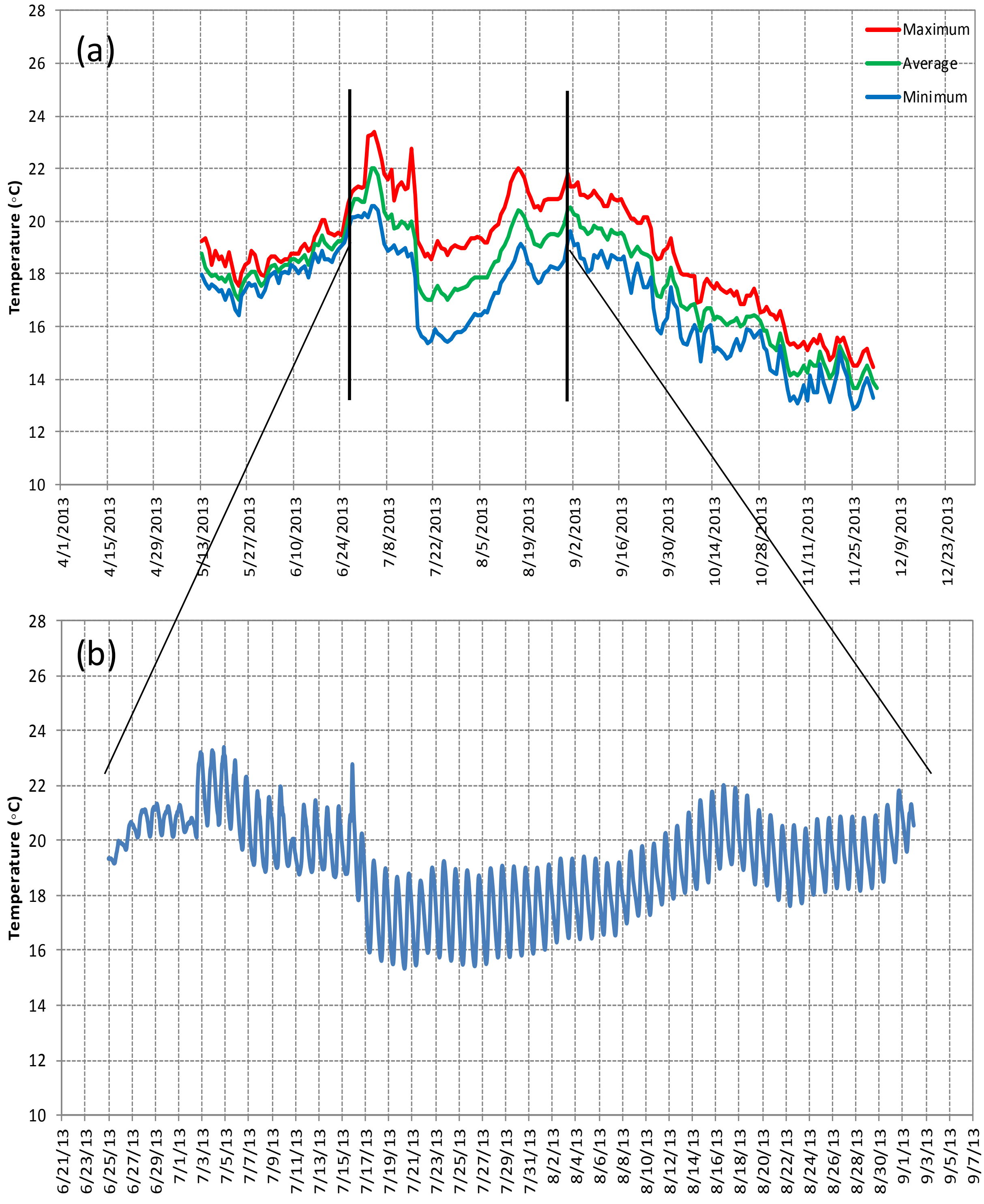


Figure 13: 2013 LSYR-4.95 (Encantado Pool) bottom (7.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/1/13.

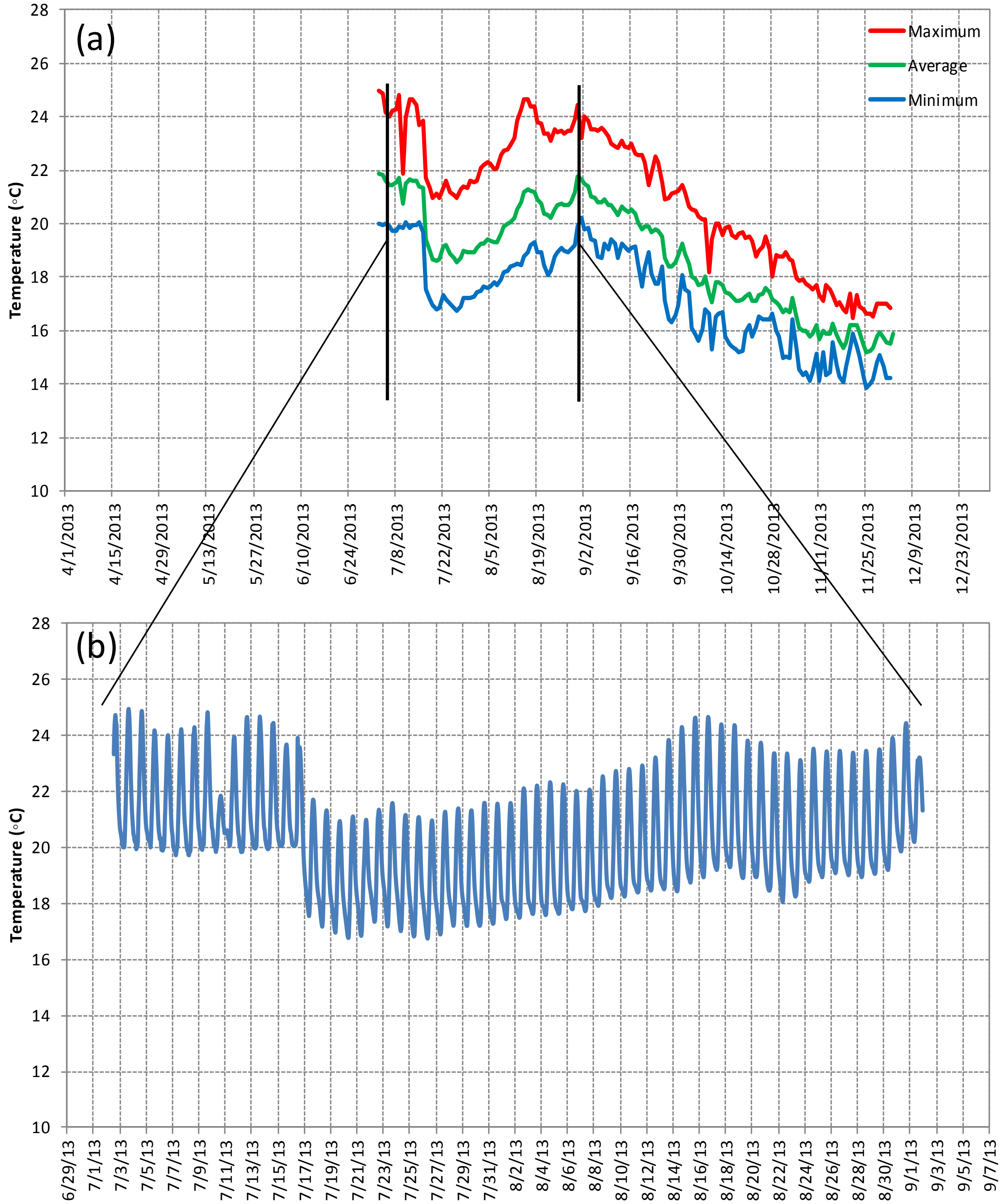


Figure 14: 2013 LSYR-7.65 (Double Canopy Pool) surface (1.0 feet) thermograph (a) daily maximum, average, and minimum values and (b) hourly data for the period 7/2/13-9/1/13.

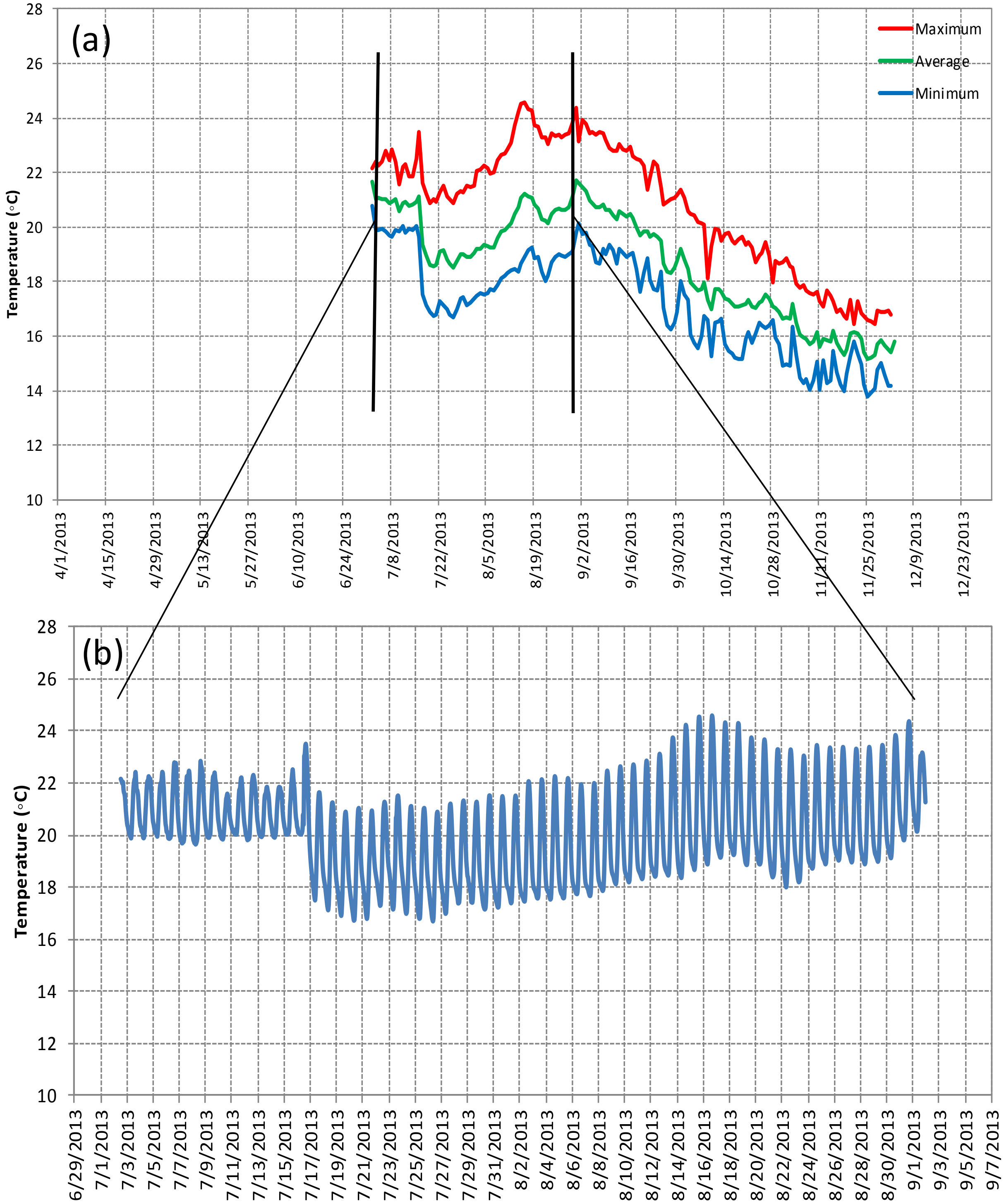


Figure 15: 2013 LSYR-7.65 (Double Canopy Pool) middle (2.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 7/2/13-9/2/13.

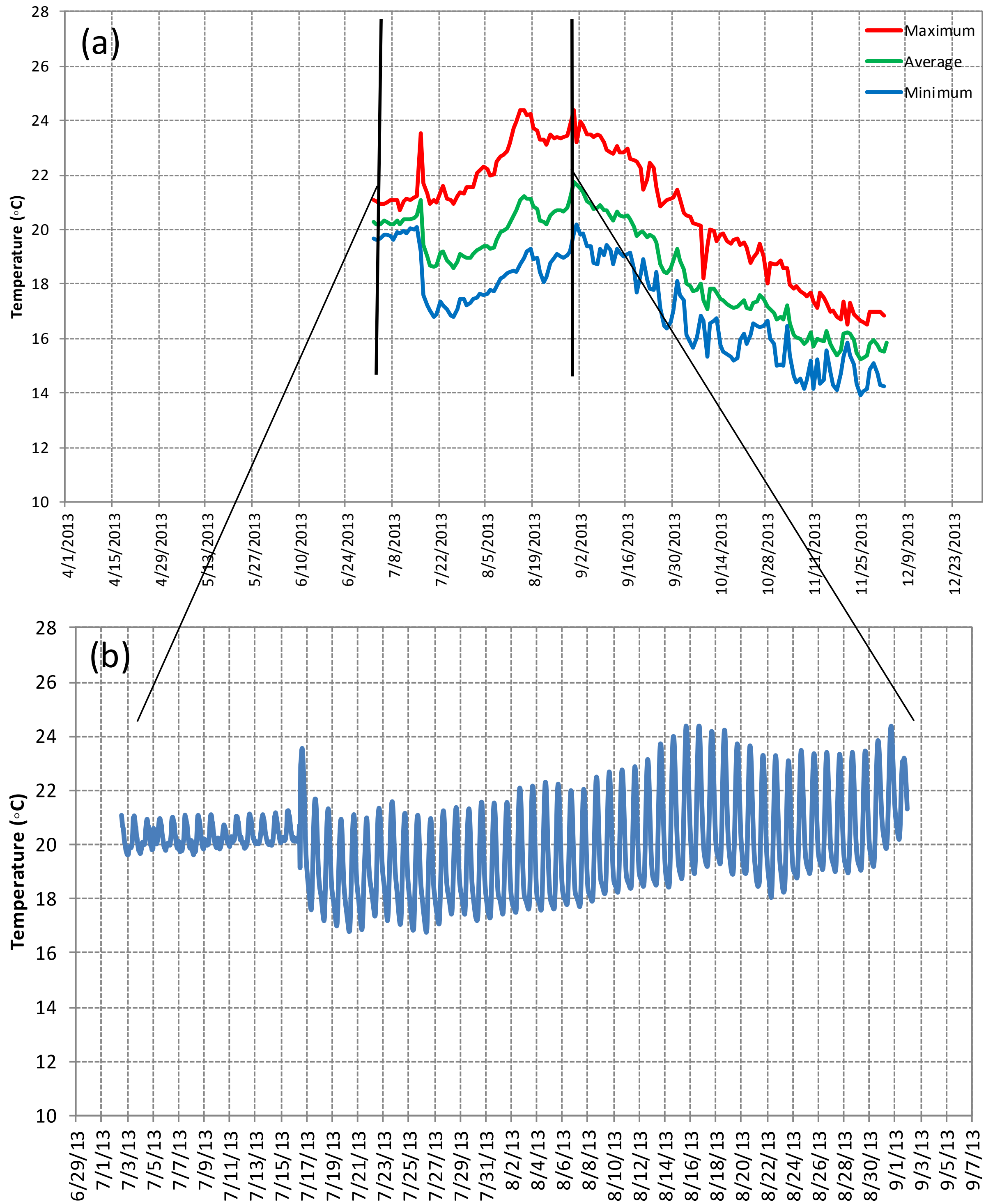


Figure 16: 2013 LSYR-7.65 (Double Canopy Pool) bottom (4 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 7/2/13-9/2/13.

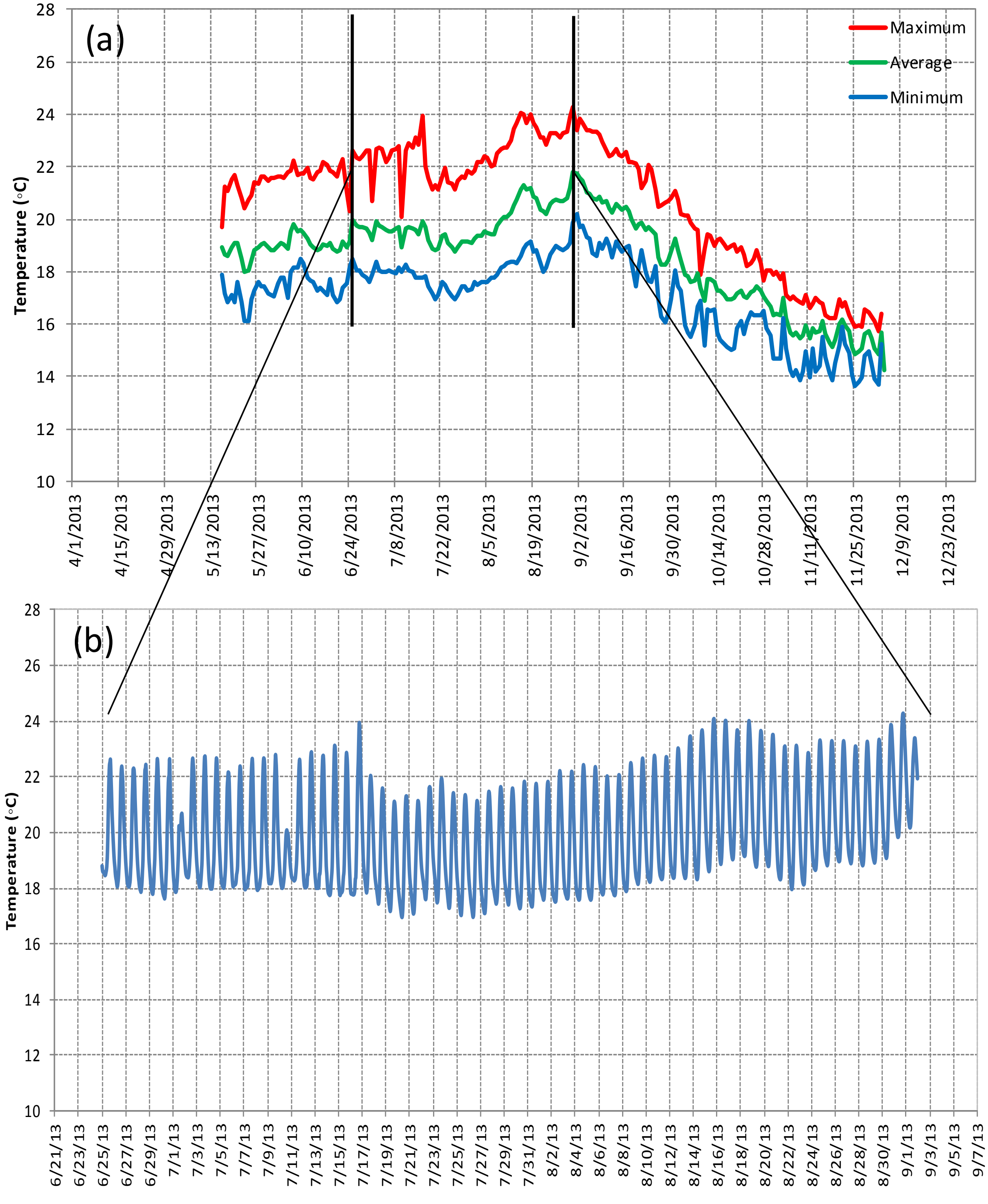


Figure 17: 2013 LSYR-8.7 (Head of Beaver Pool) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13.

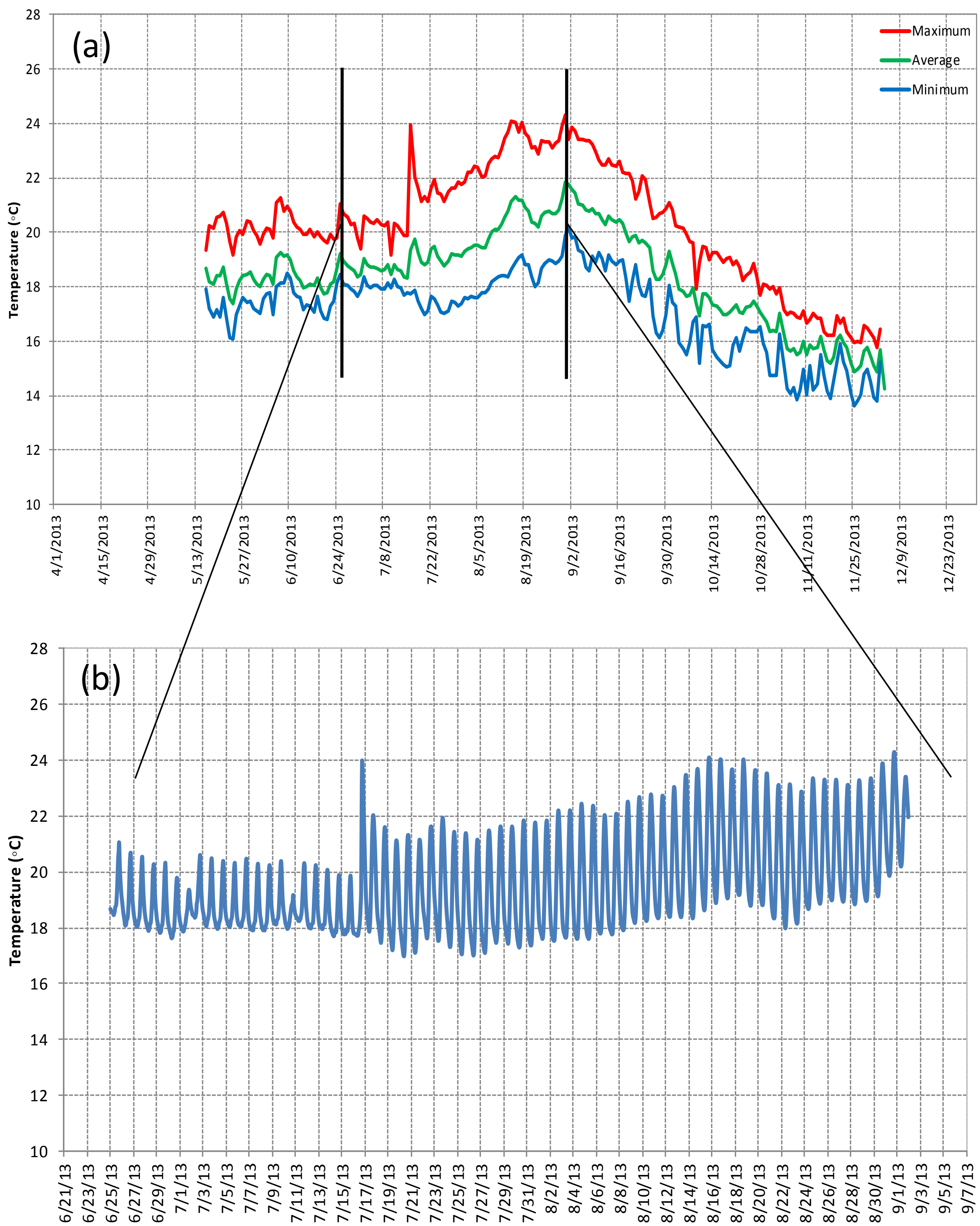


Figure 18: 2013 LSYR-8.7 (Head of Beaver Pool) middle (2.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13.

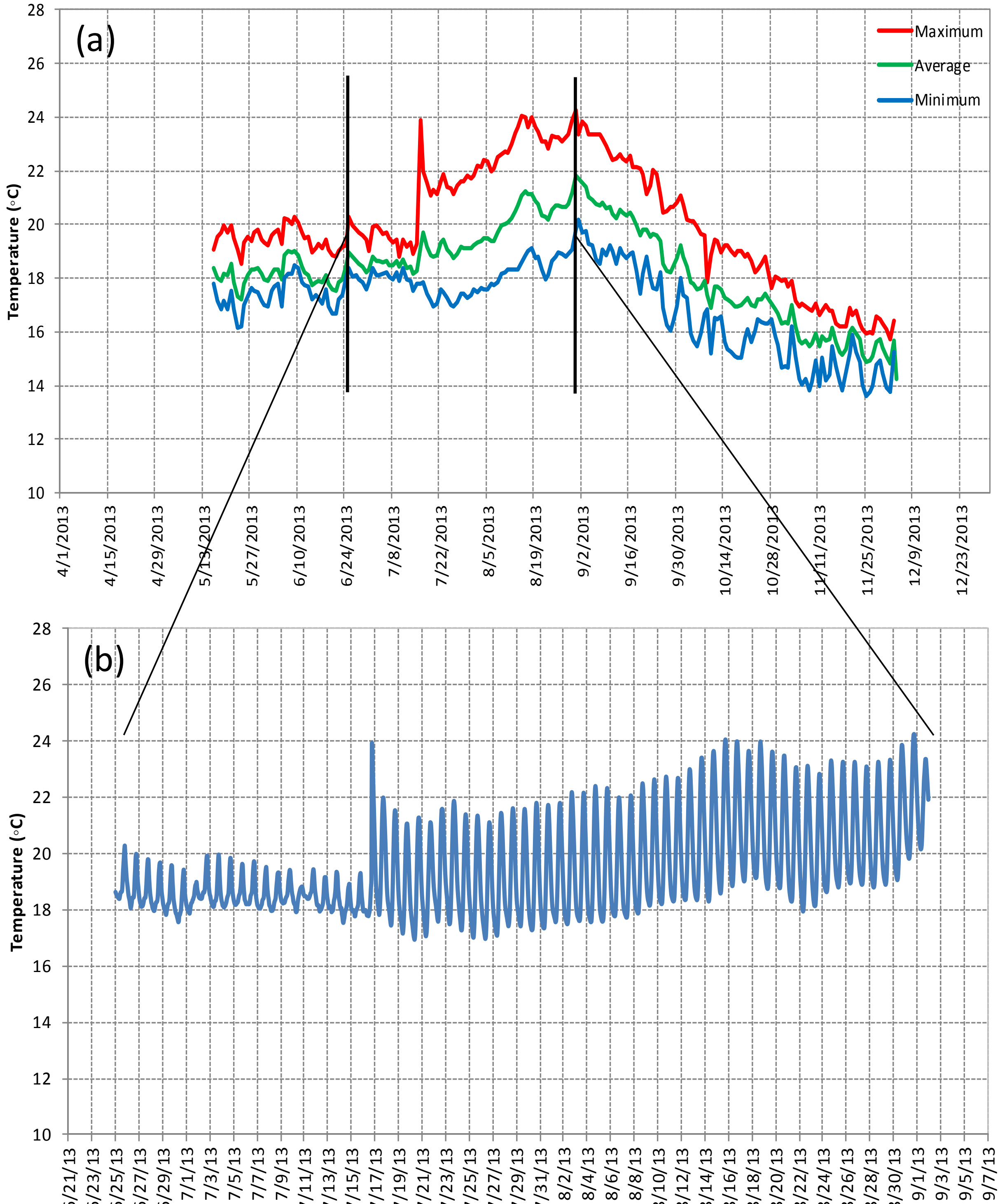


Figure 19: 2013 LSYR-8.7 (Head of Beaver Pool) bottom (4.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13.

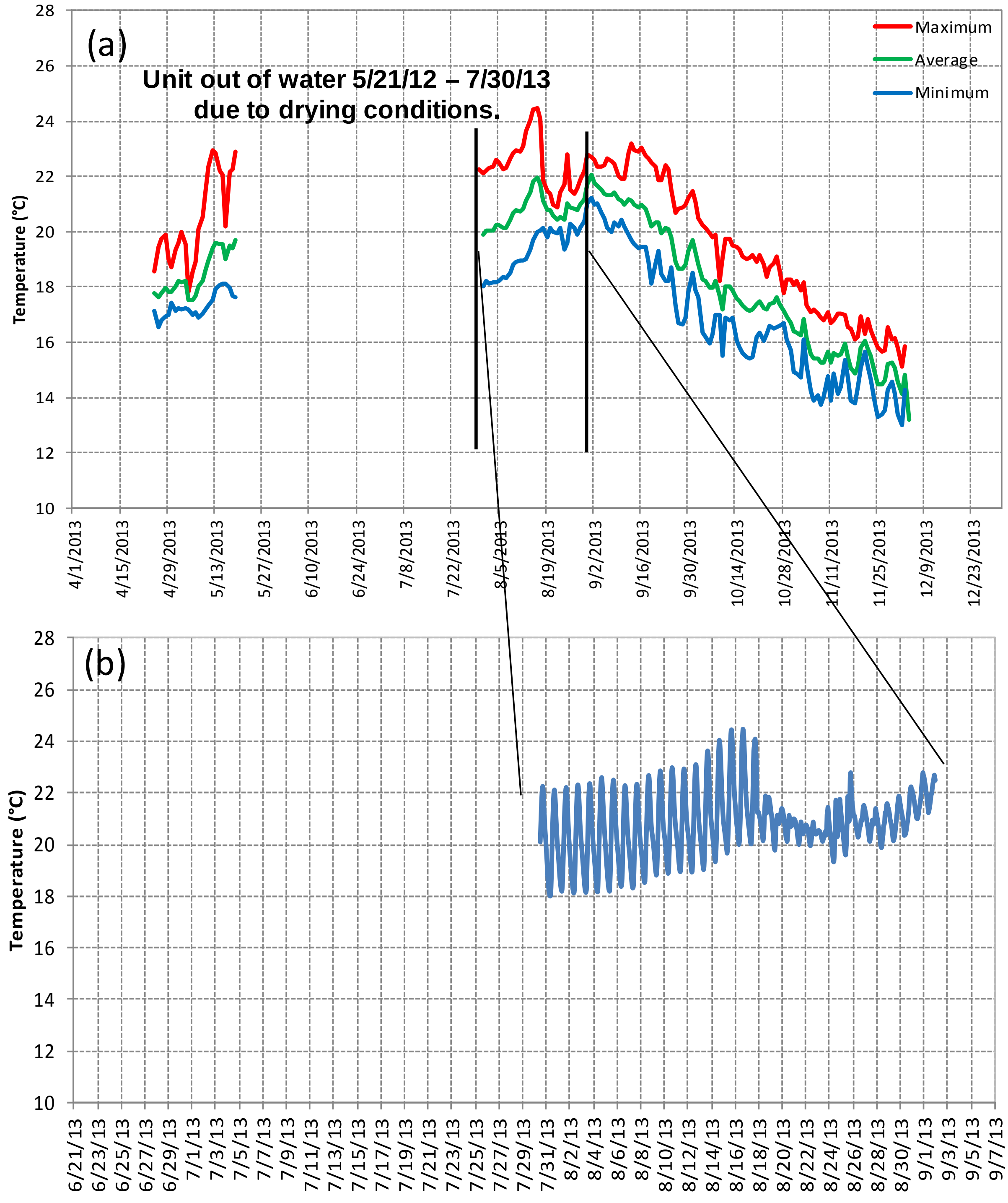


Figure 20: 2013 LSYR-10.2 (Alisal Bedrock Pool) surface (1.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13; this habitat unit was dry prior to the arrival of the WR89-18 release.

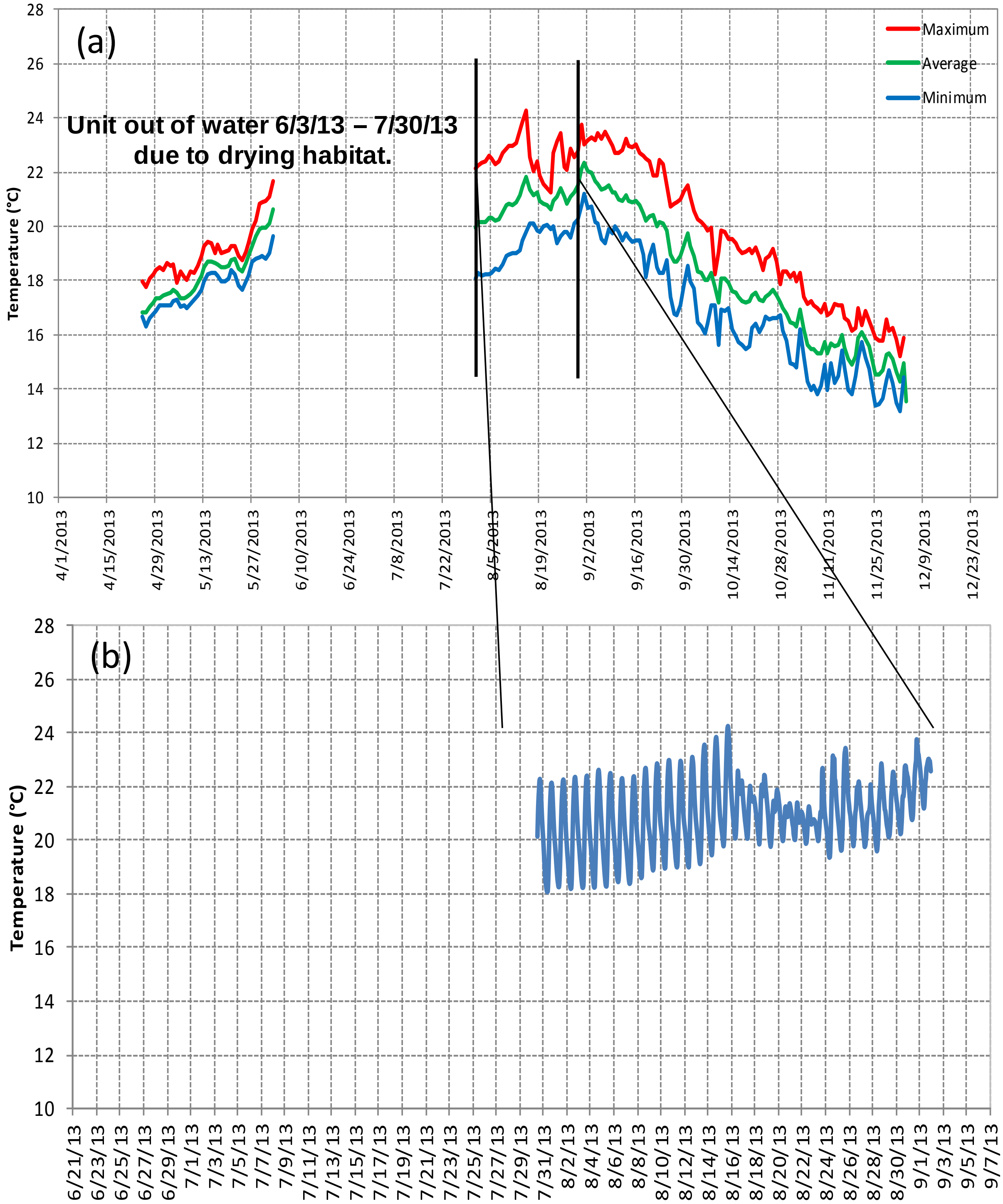


Figure 21: 2013 LSYR-10.2 (Alisal Bedrock Pool) middle (4.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13; this habitat was dry prior to the arrival of the WR89-18 release.

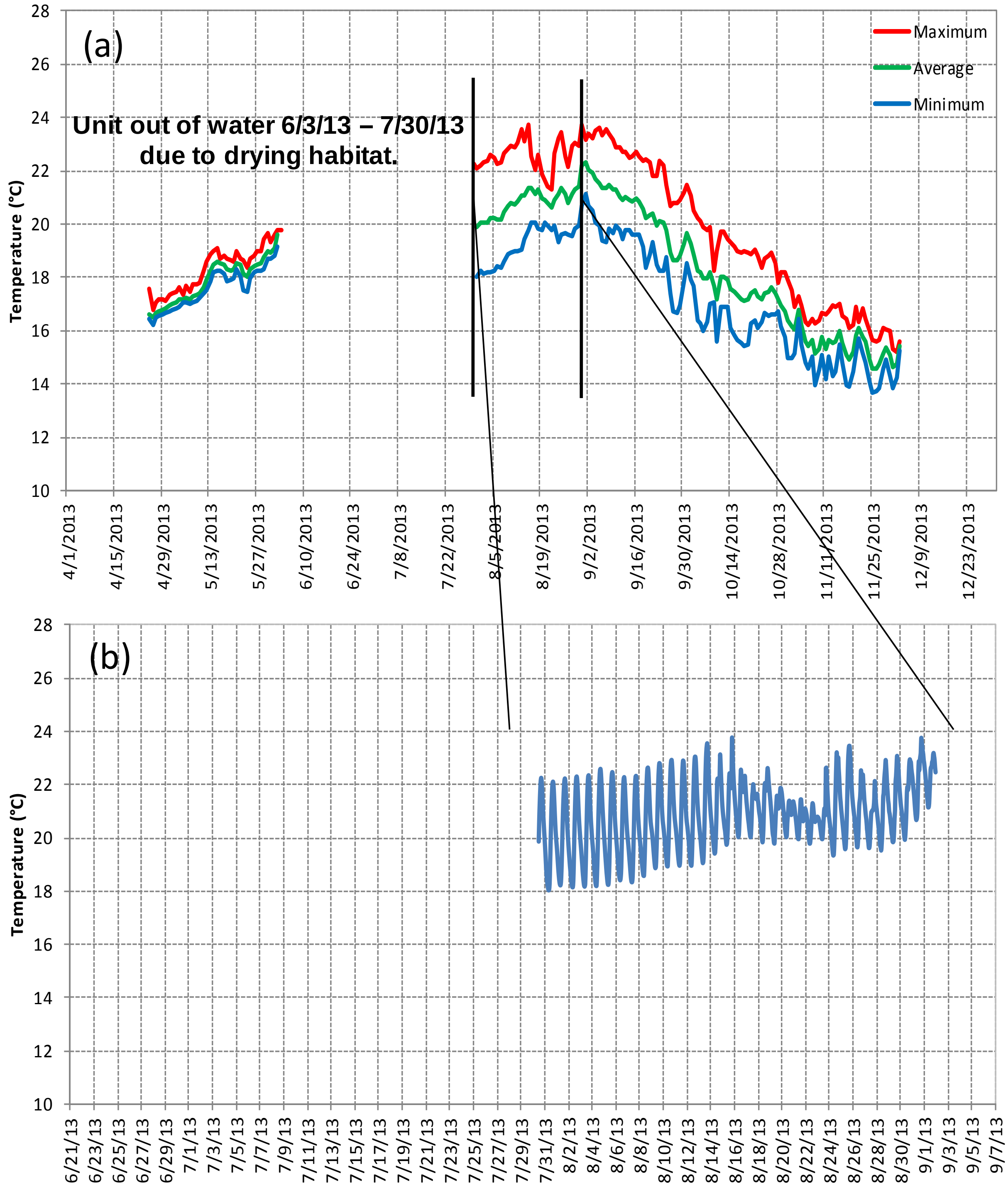


Figure 22: 2013 LSYR-10.2 (Alisal Bedrock Pool) bottom (9.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13; this habitat was dry prior to the arrival of the WR89-18 release.

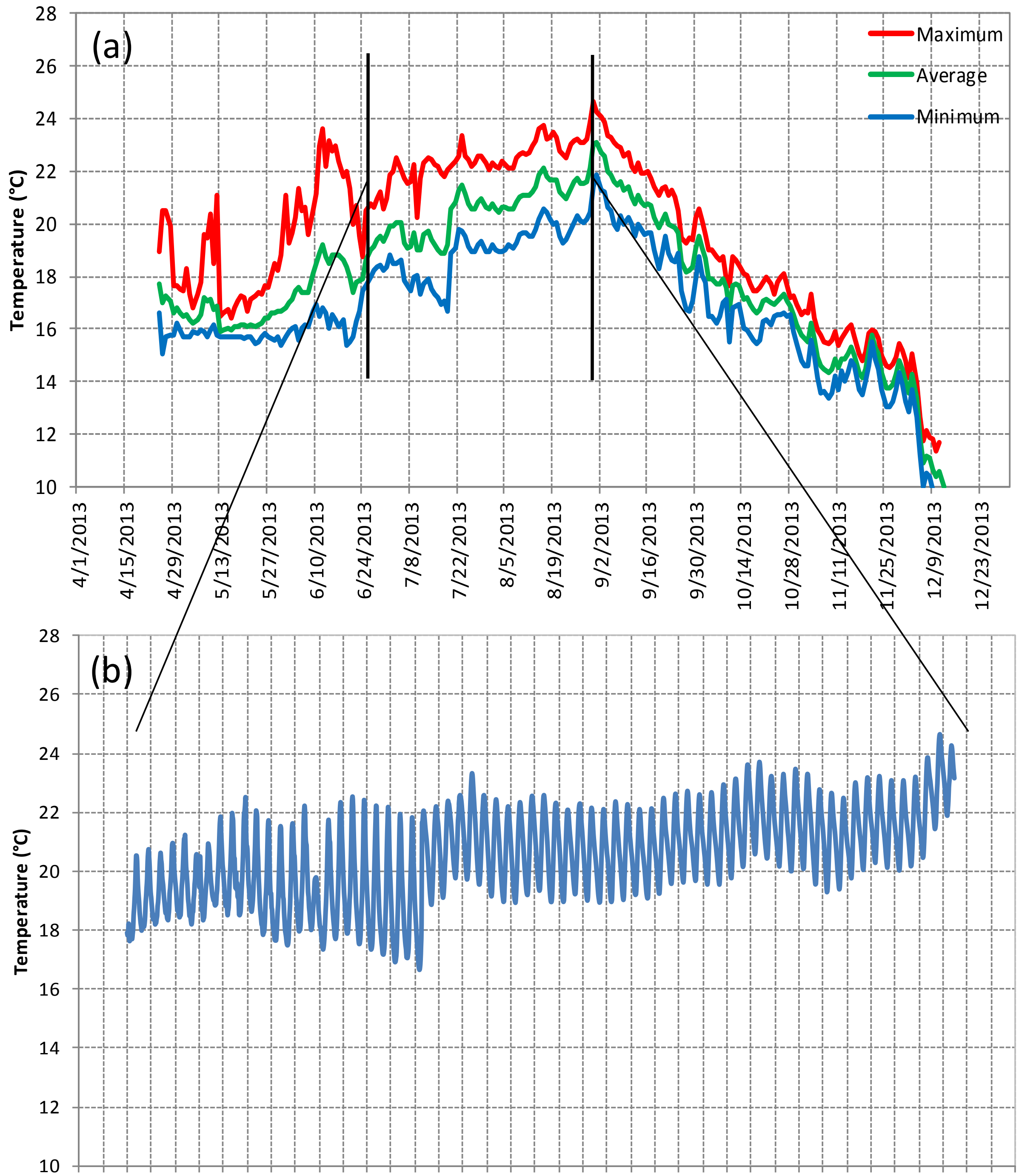


Figure 23: 2013 LSYR-13.9 (Avenue of the Flags) bottom (3.0 feet) thermograph daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13.

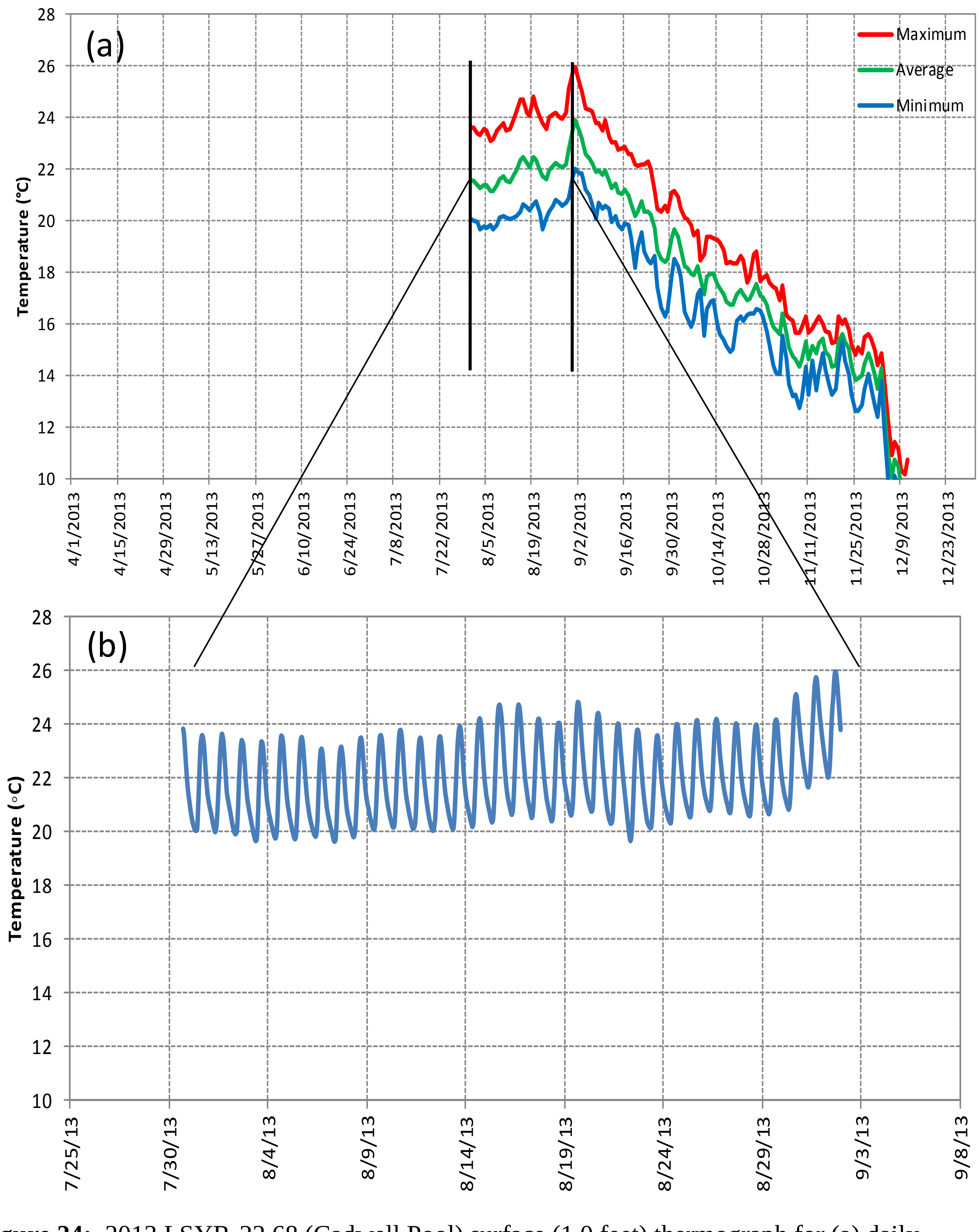


Figure 24: 2013 LSYR-22.68 (Cadwell Pool) surface (1.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/31/13 to 9/2//13; this habitat unit was an isolated pool prior to the arrival of the WR89-18 release.

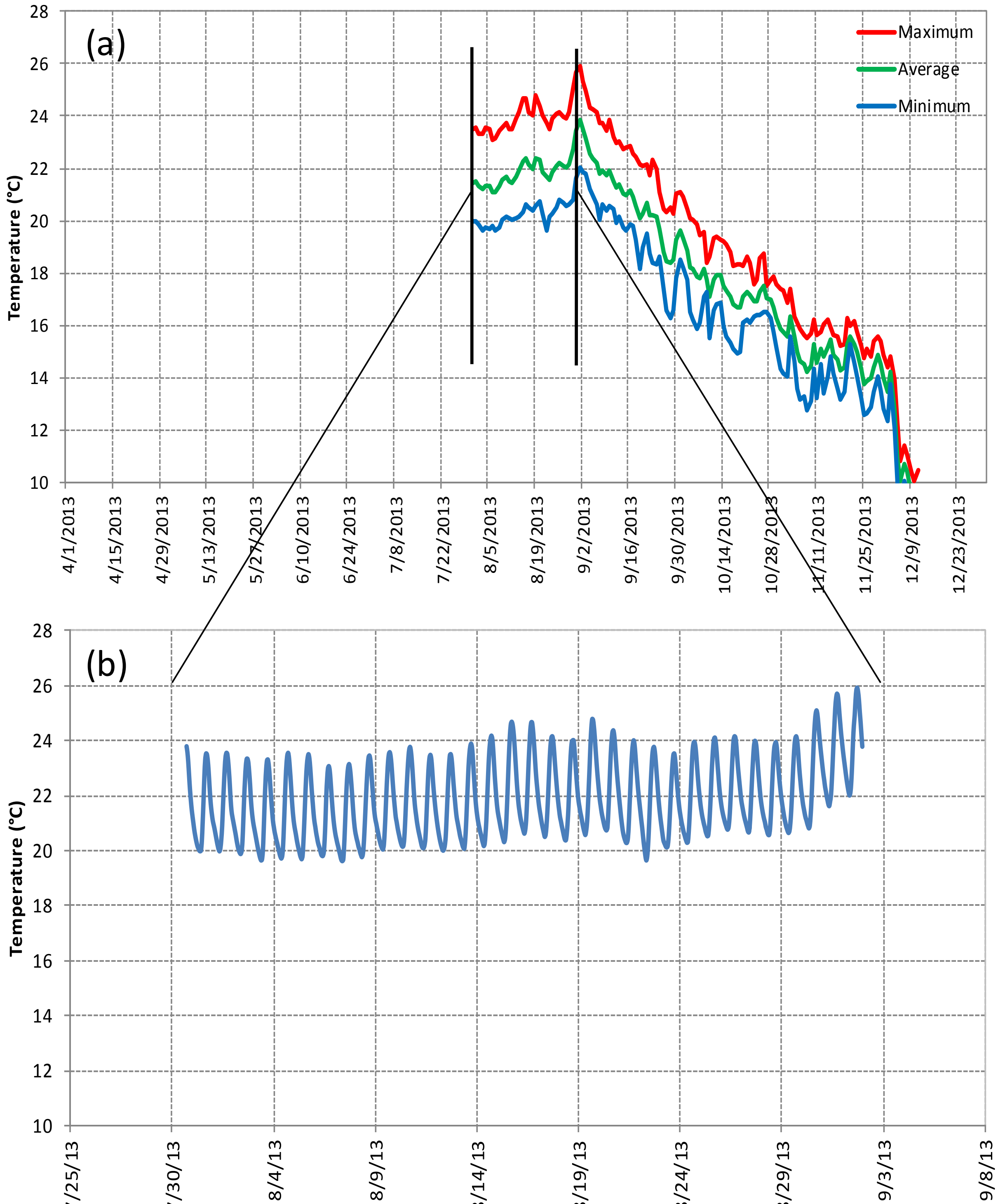


Figure 25: 2013 LSYR-22.68 (Cadwell Pool) middle (6.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 7/31/13-9/2/13; this unit was an isolated pool habitat prior to the arrival of the WR89-18 release.

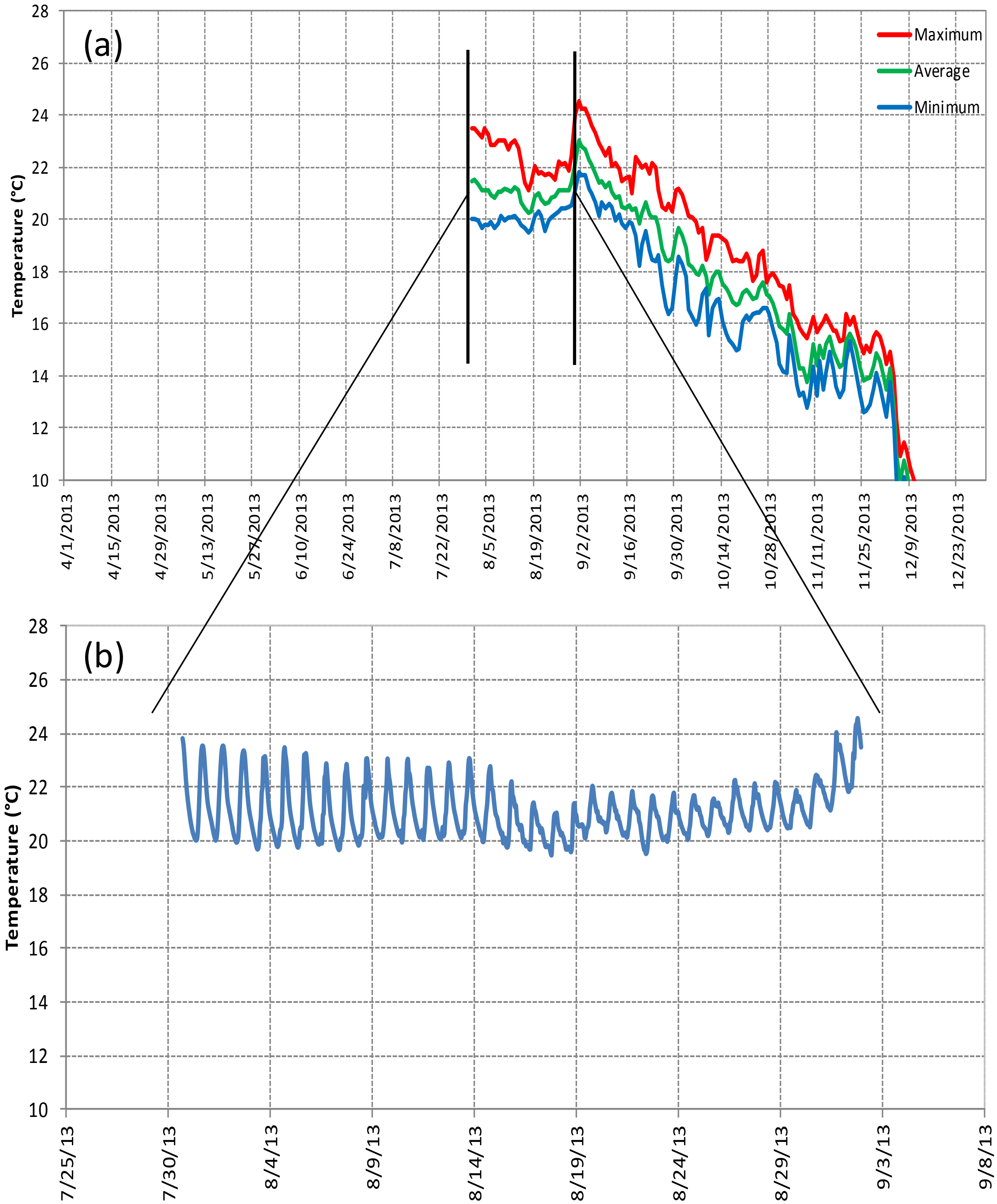


Figure 26: 2013 LSYR-22.68 (Cadwell Pool) bottom (12.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 7/31/13-9/2/13; this unit was an isolated pool habitat prior to the arrival of the WR89-18 release.

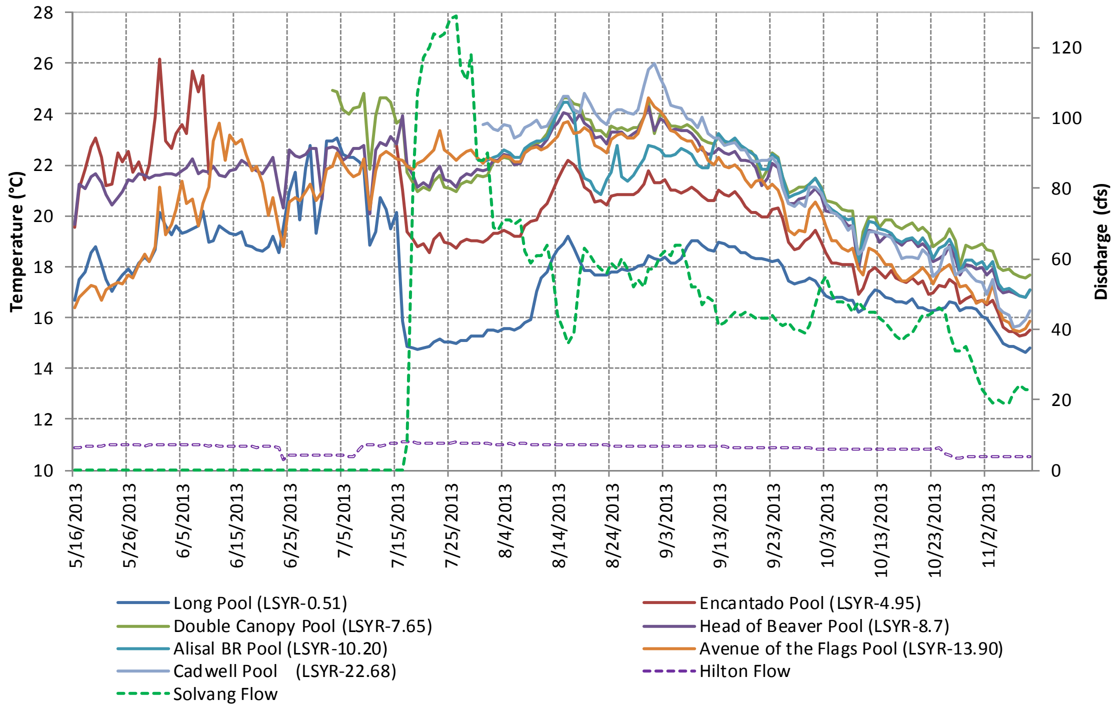


Figure 27: 2013 Longitudinal maximum surface water temperatures at the Long Pool (LSYR-0.51), Encantado Pool (LSYR-4.95), Double Canopy Pool (LSYR-7.65), Head of Beaver Pool (LSYR-8.7), Alisal Bedrock Pool (LSYR-10.2), Avenue of the Flags Pool (LSYR-13.9, bottom of pool), and Cadwell Pool (LSYR-22.68) with daily flow (discharge) at the Hilton Creek and Solvang (Alisal Bridge) USGS gauges.

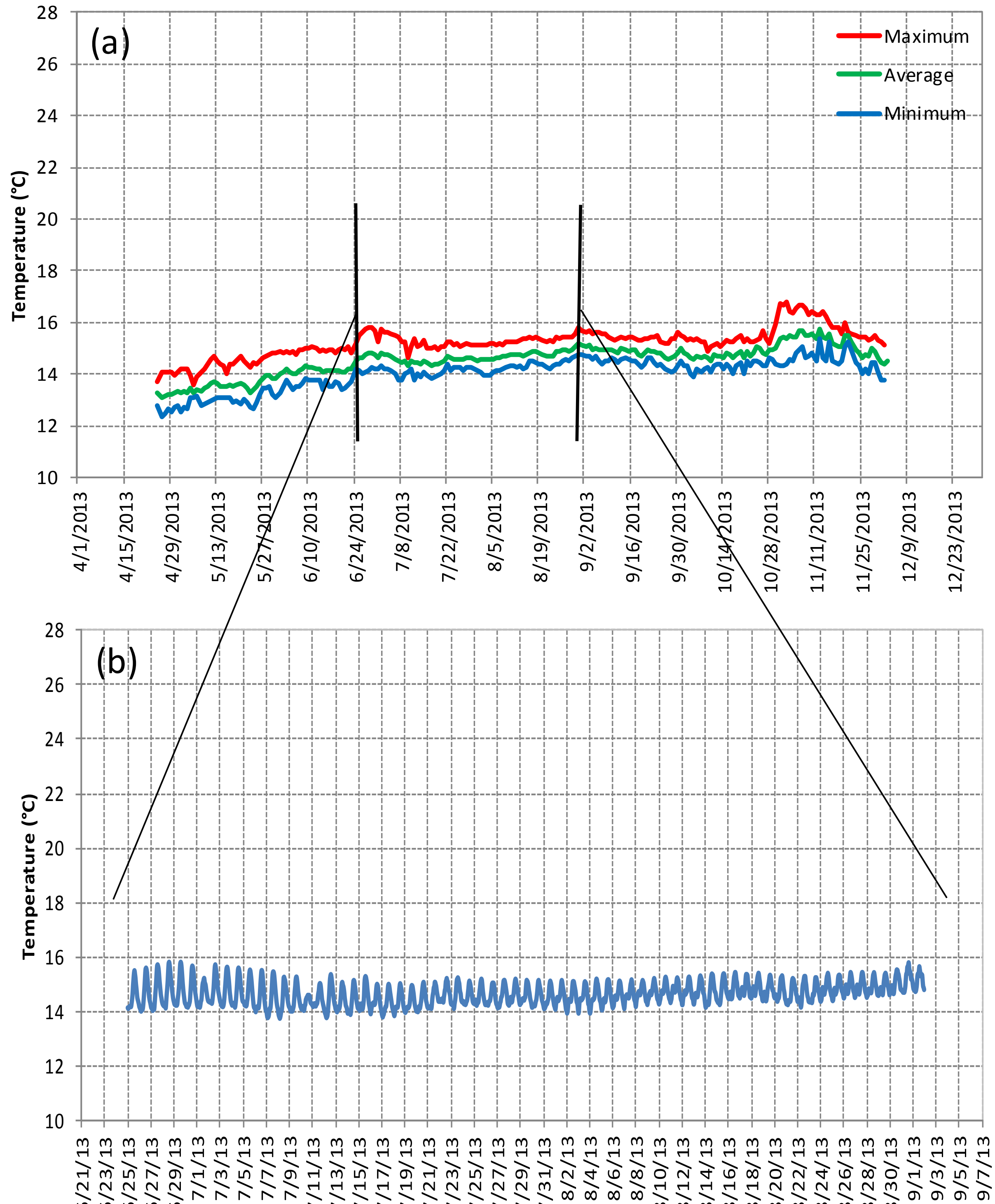


Figure 28: 2013 Lower Hilton Creek (HC-0.12) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13.

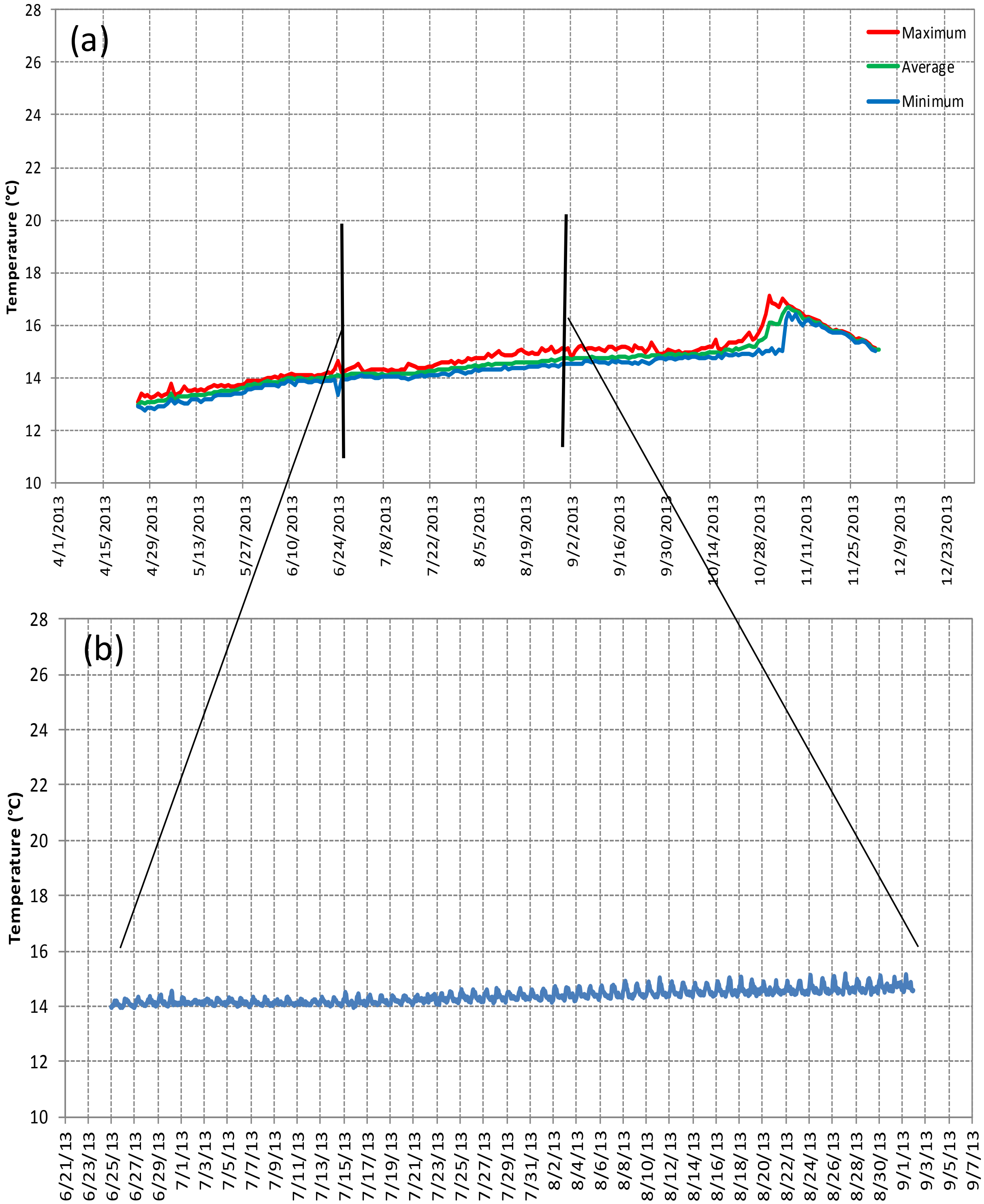


Figure 29: 2013 Upper Hilton Creek (HC-0.54) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13.

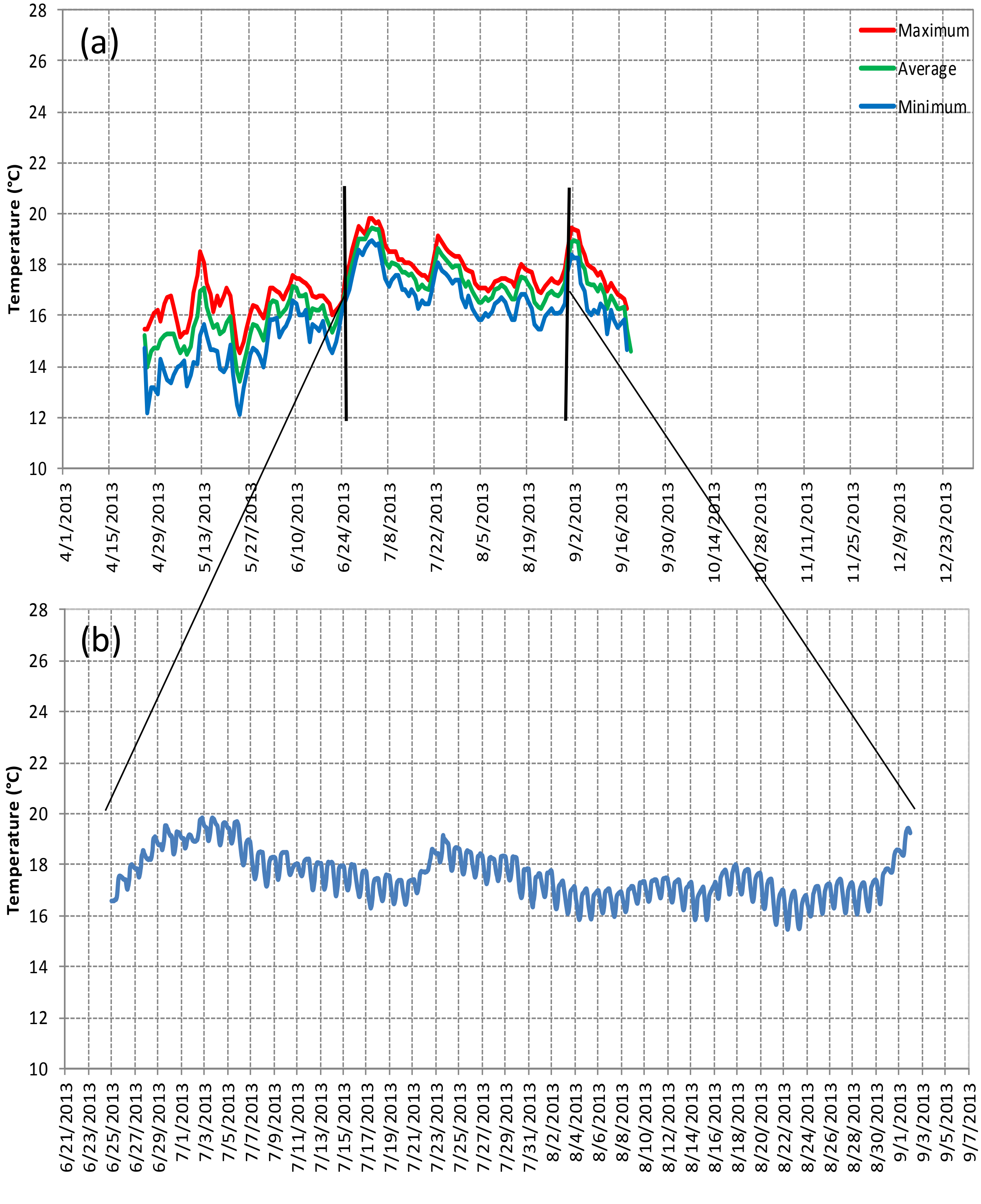


Figure 30: 2013 Quiota Creek (QC-2.66) bottom (2.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13; the unit was removed from the site on 9/19/13 due to lack of water.

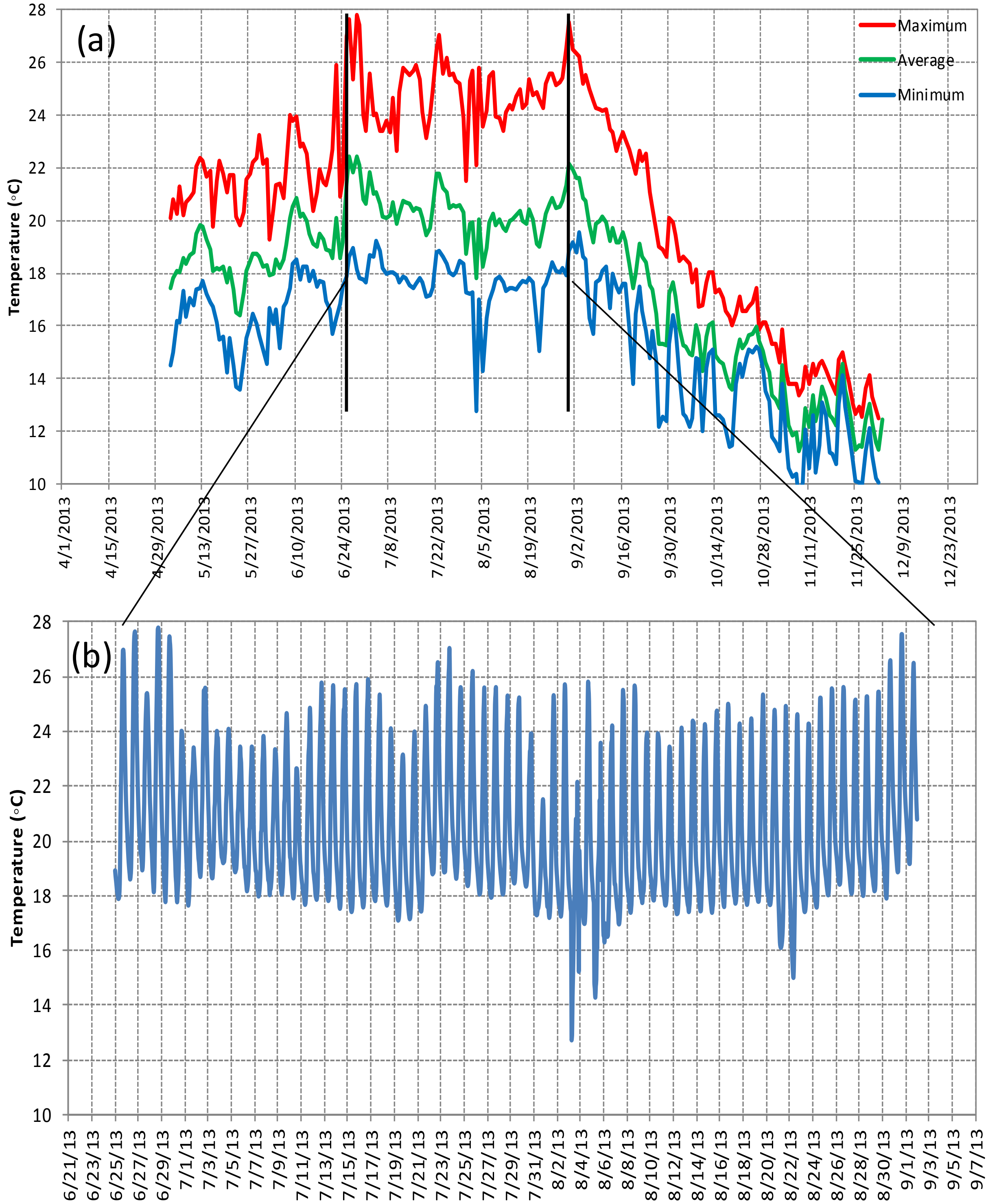


Figure 31: 2013 Salsipuedes Creek (SC-0.77 – Lower Creek) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 6/25/13-9/2/13.

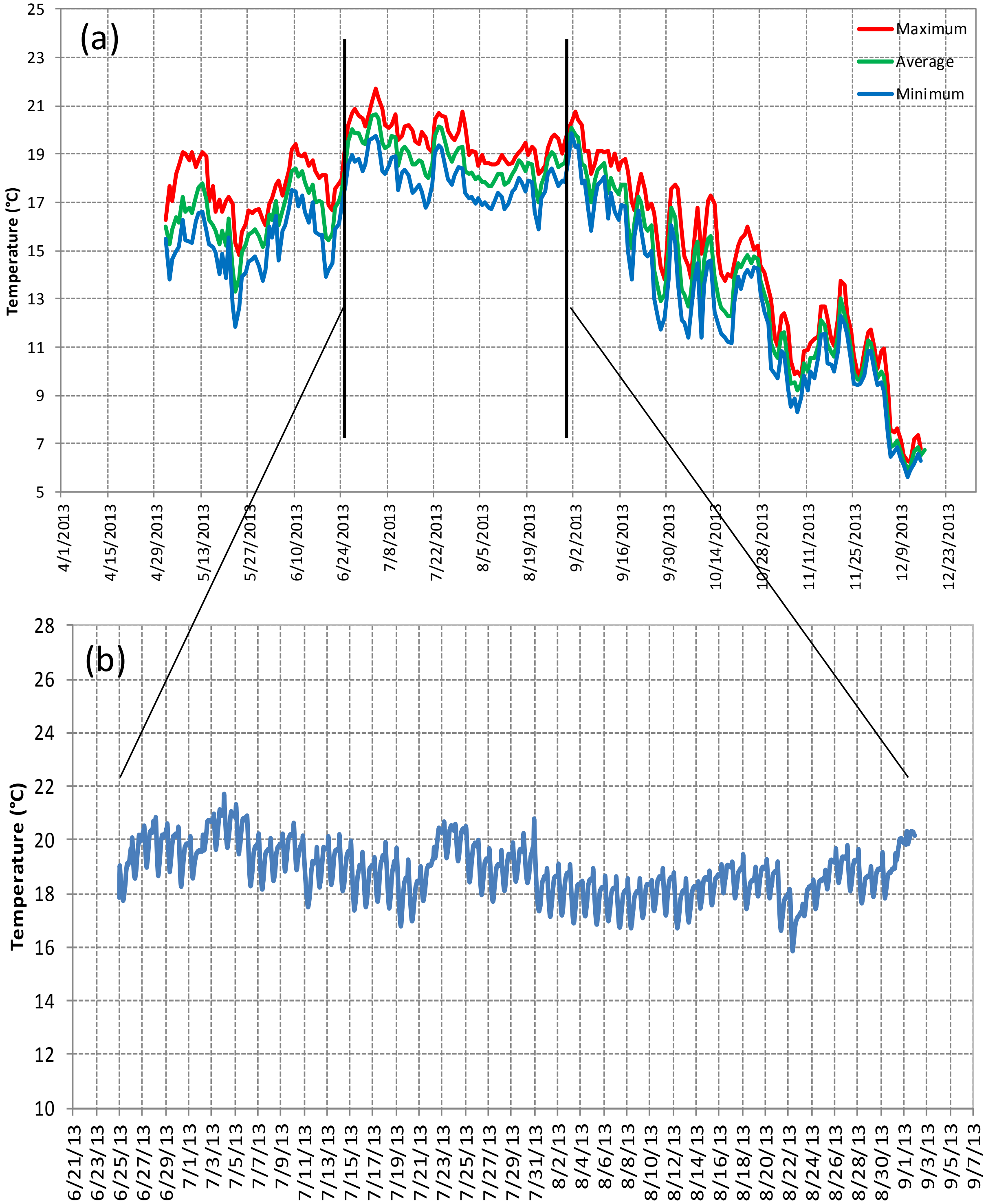


Figure 32: 2013 Salsipuedes Creek (SC-2.2 - Reach 2 Bedrock Section) bottom (5.5 feet) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period of 6/25/13-9/2/13.

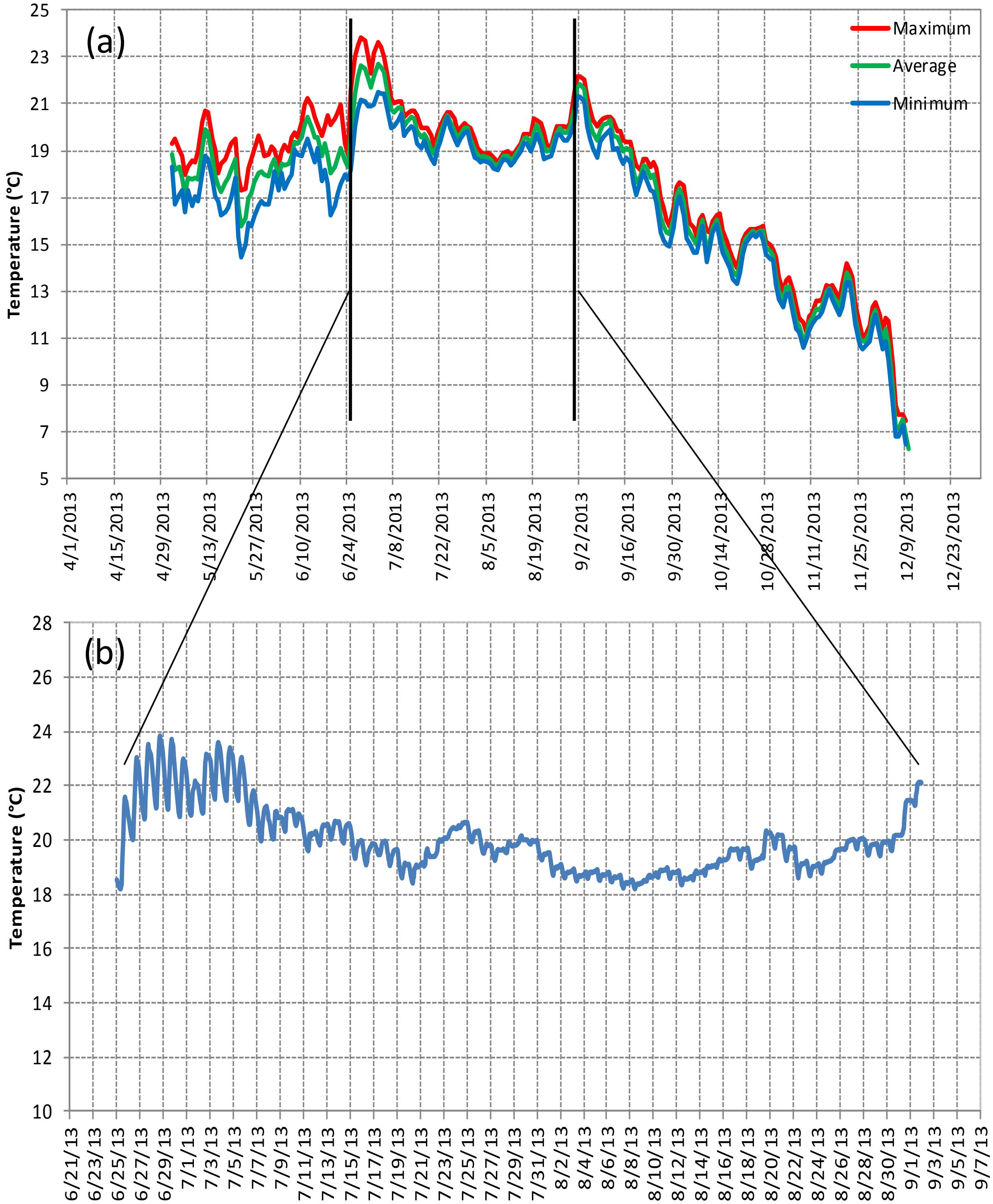


Figure 33: 2013 Salsipuedes Creek (SC-3.0 - Highway 1 Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 6/25/13-9/2/13.

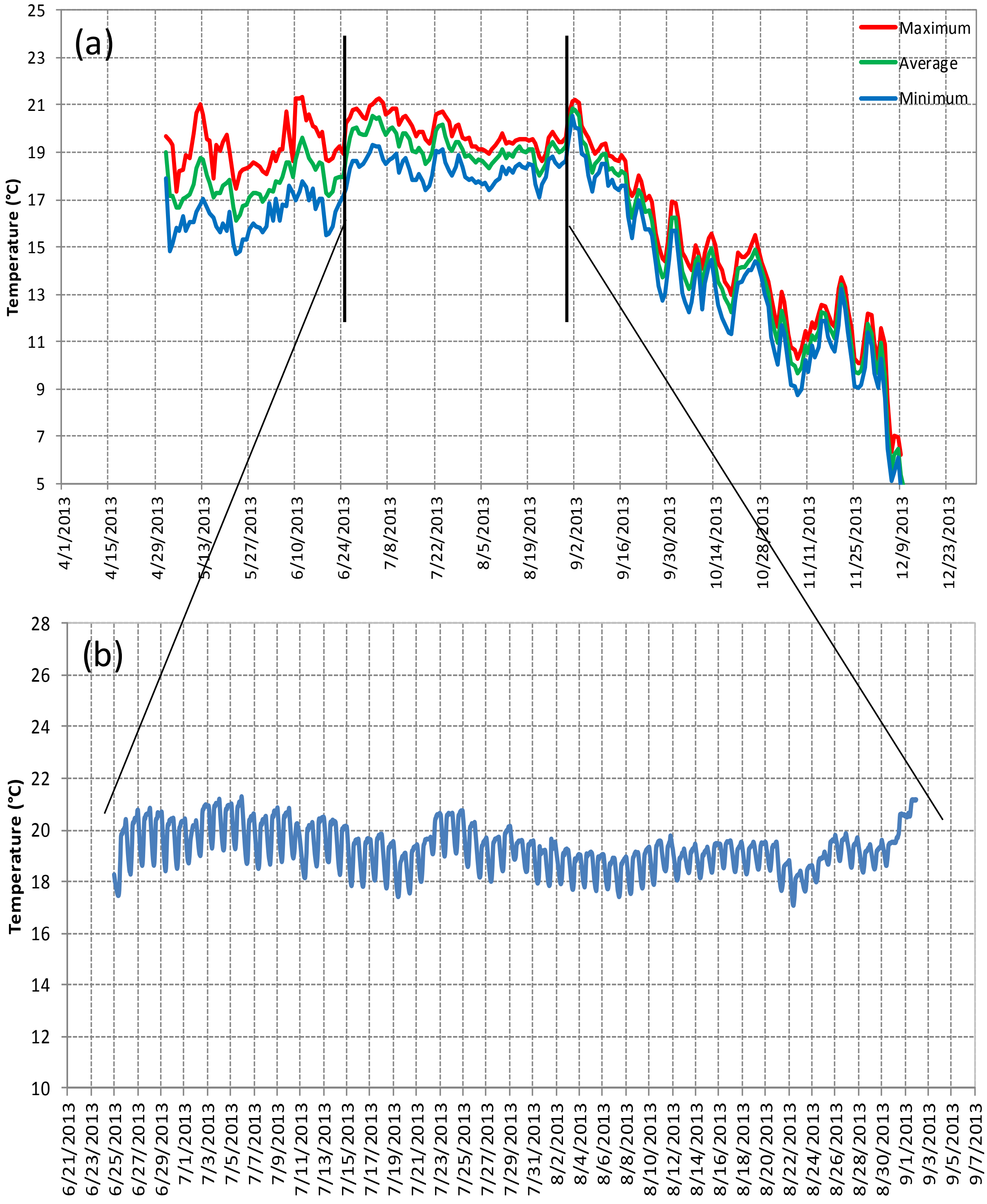


Figure 34: 2013 Salsipuedes Creek (SC-3.5 - Jalama Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 6/25/13-9/2/13.

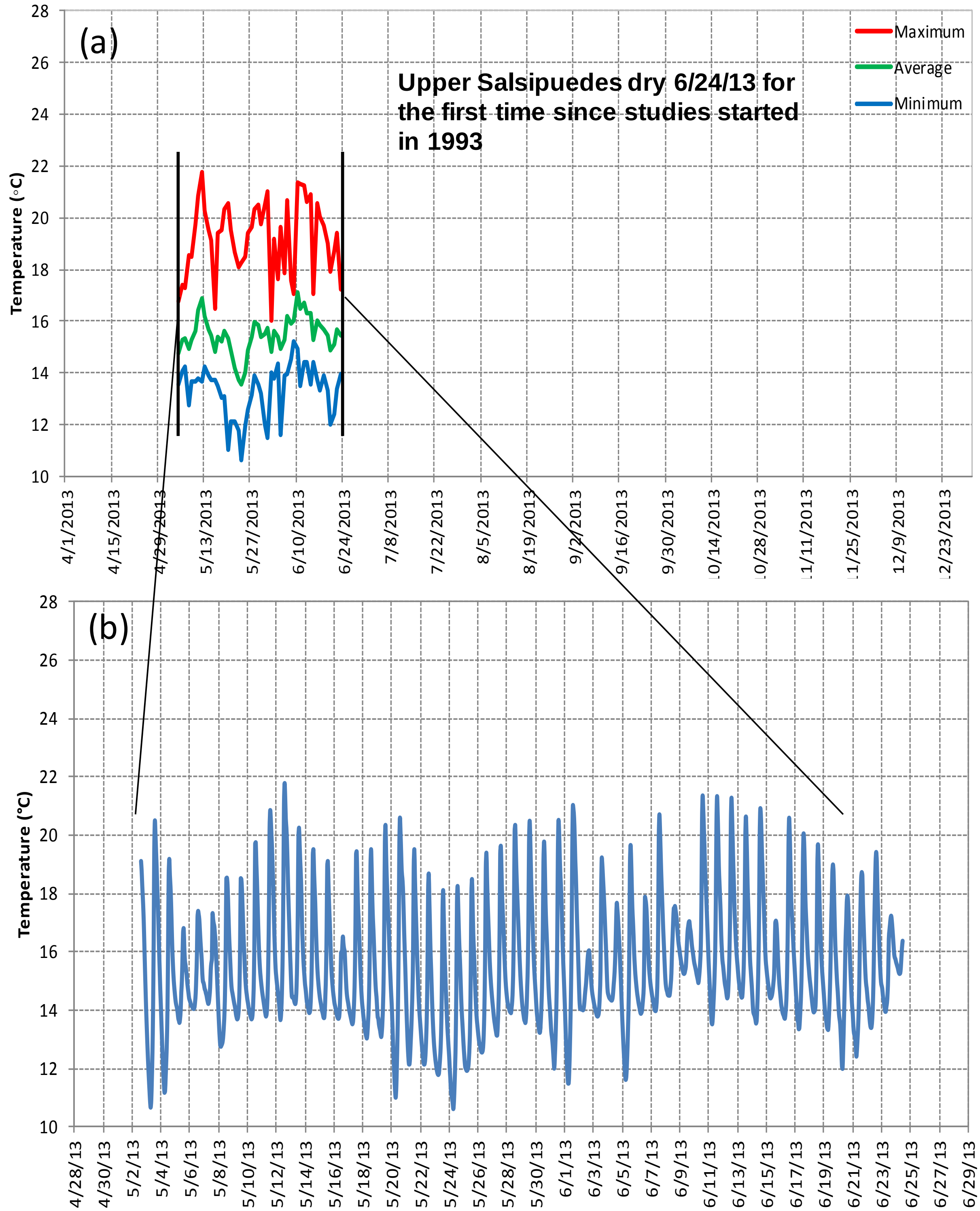


Figure 35: 2013 Upper Salsipuedes Creek (SC-3.8 - Upper Salsipuedes Creek at Confluence with El Jaro Creek) bottom (0.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire deployment and (b) hourly measurements for the period of 5/3/13-6/24/13.

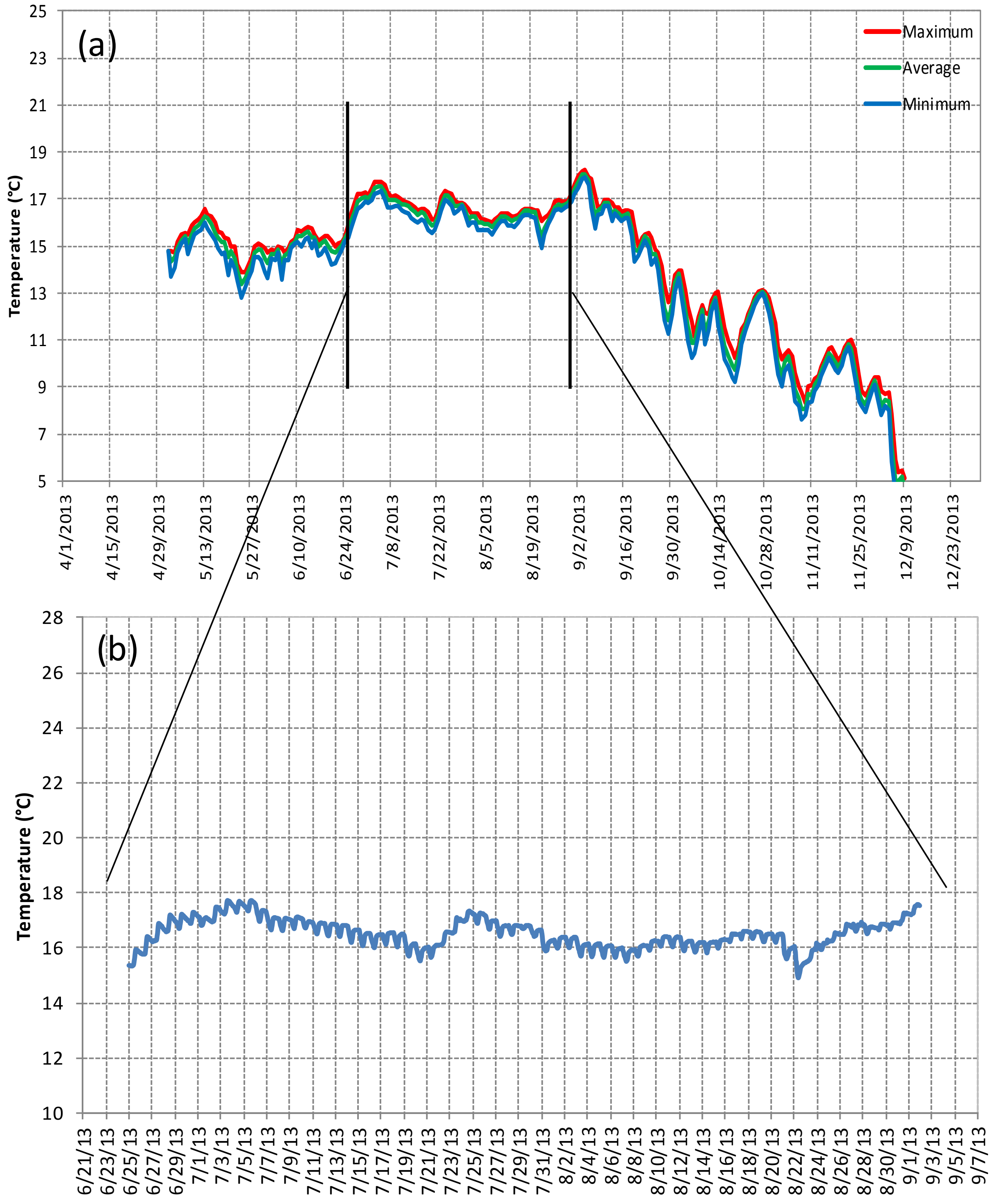


Figure 36: 2013 El Jaro Creek (EJC-3.81 – lower confluence) bottom (3.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 6/25/13-9/2/13.

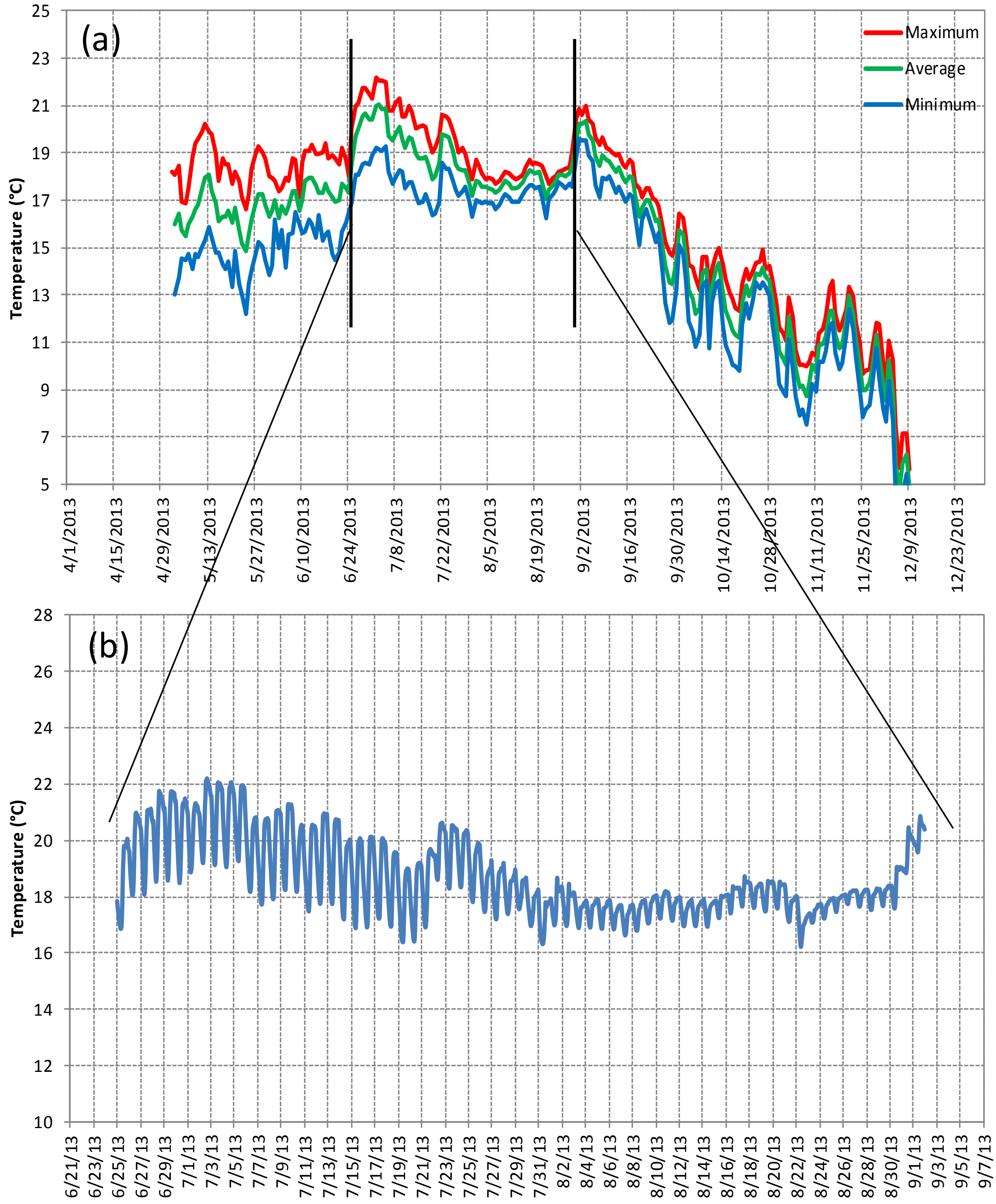


Figure 37: 2013 El Jaro Creek (EJC-5.4 - Palos Colorados Pool Habitat) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 6/25/13-9/2/13.

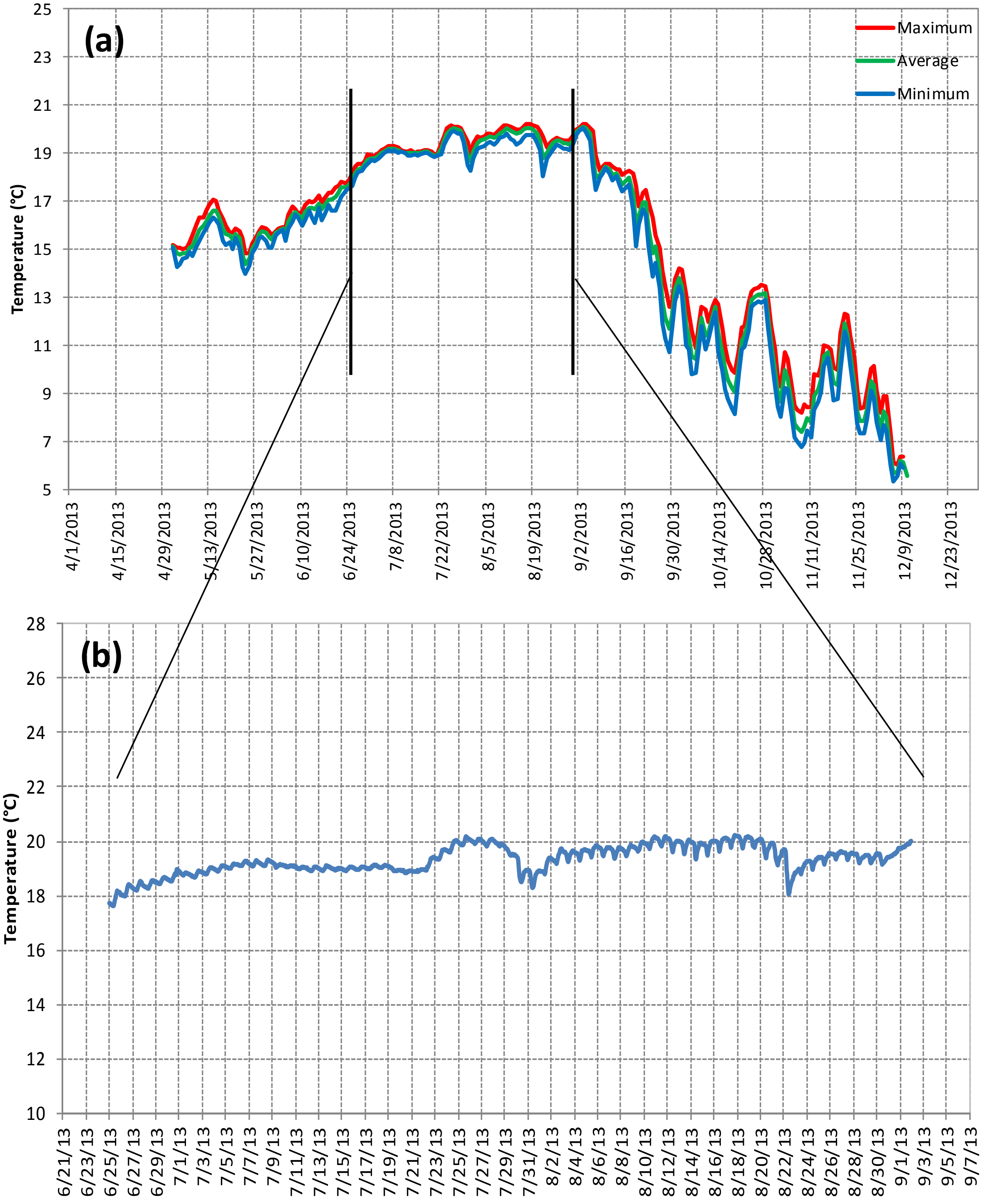


Figure 38: 2013 El Jaro Creek (EJC-10.82 – Rancho San Julian Fish Ladder) bottom (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 6/25/13-9/2/13.

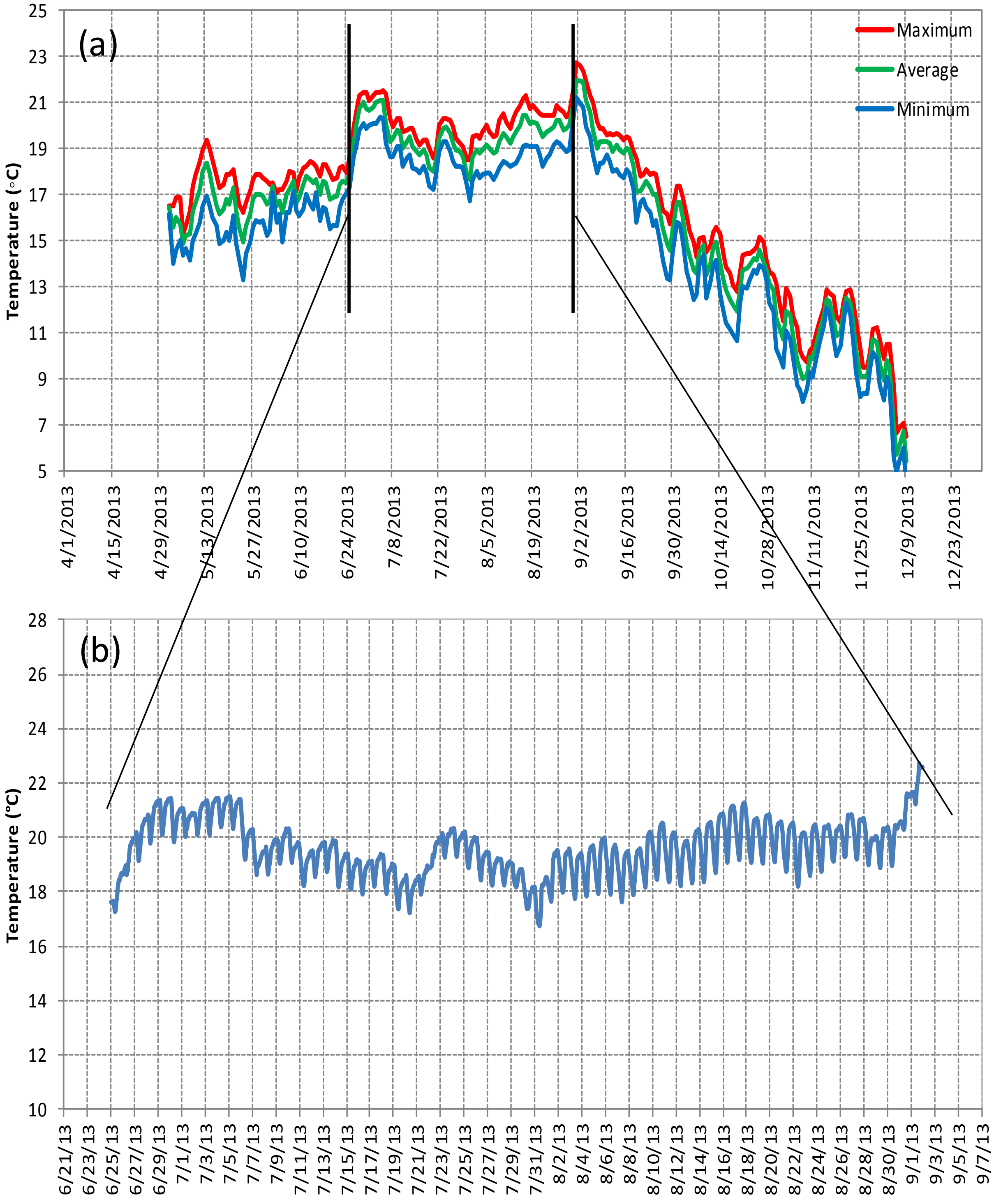


Figure 39: 2013 Los Amoles Creek (LAC-7.0 - Los Amoles Creek at Ford Crossing) bottom (2.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 6/25/13-9/2/13.

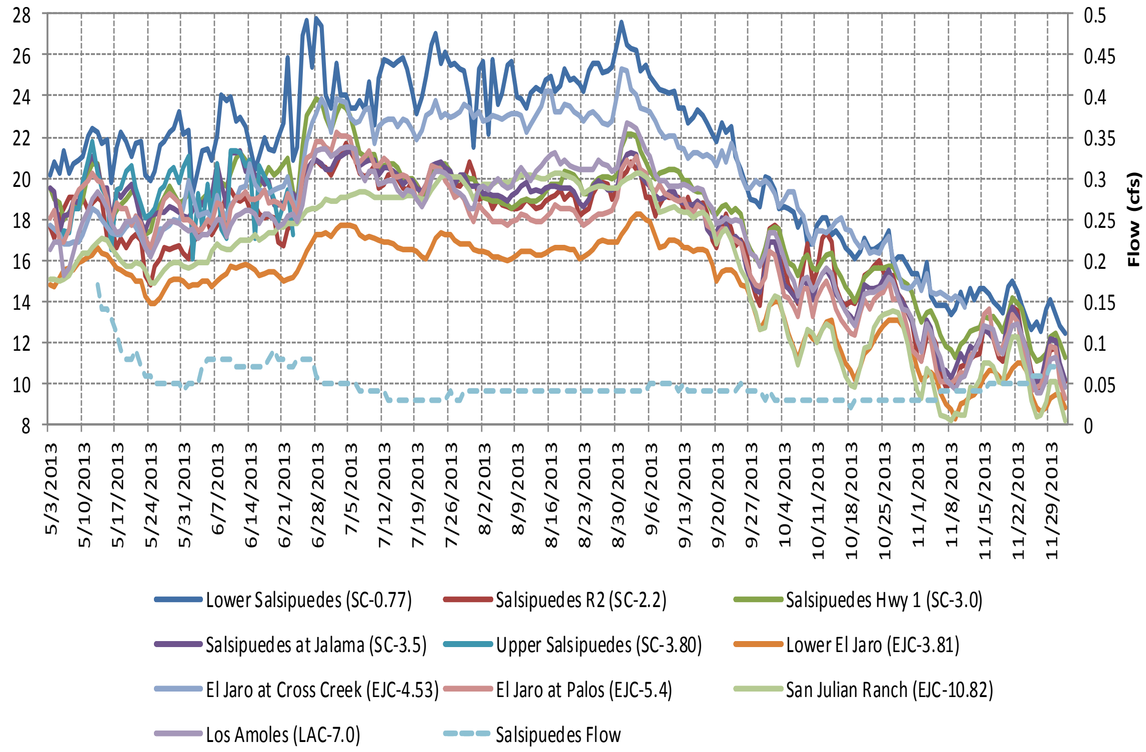


Figure 40: 2013 Longitudinal maximum daily water temperatures within the Salsipuedes Creek watershed which included El Jaro Creek at Rancho San Julian (EJC-10.82), Palos Colorados (EJC-5.4), Cross Creek Ranch (EJC-4.53), lower El Jaro Creek (EJC-3.81), upper Salsipuedes Creek (SC-3.8), at Jalama Bridge (SC-3.5), at Highway 1 (SC-3.0), at Bedrock Section (SC-2.2), and at lower Salsipuedes Creek (SC-0.77) versus flow (cfs).

Table 6: Water quality Sonde deployments during the WY2013 dry season.

Habitat	Location	Deployment Schedule: 7/15/2013	7/15/13-7/16/13	7/16/13-7/18/13
Long Pool	LSYR-0.5	X		
Encantado Pool	LSYR-4.95		X	
Double Canopy Pool	LSYR-7.6			X

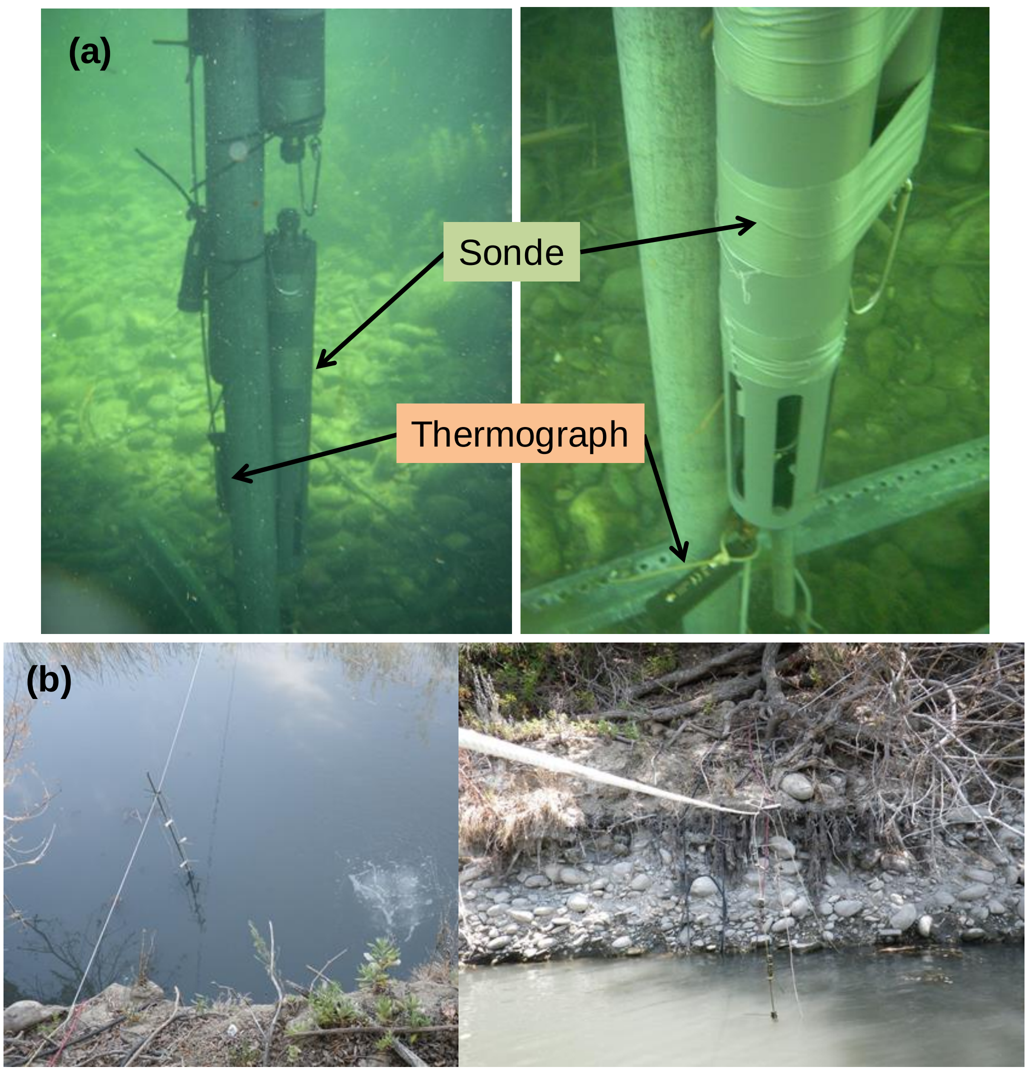


Figure 41: General Sonde deployment configuration across the vertical profile with thermographs in (a) WY2012 with clear and (b) WY2013 with turbid water conditions.

Figure 42: WY2013 Sonde vertical array locations at (a) LSYR-0.51, (b) LSYR-4.95, and (c) LSYR-7.65; the red line indicates the instrument tower location.

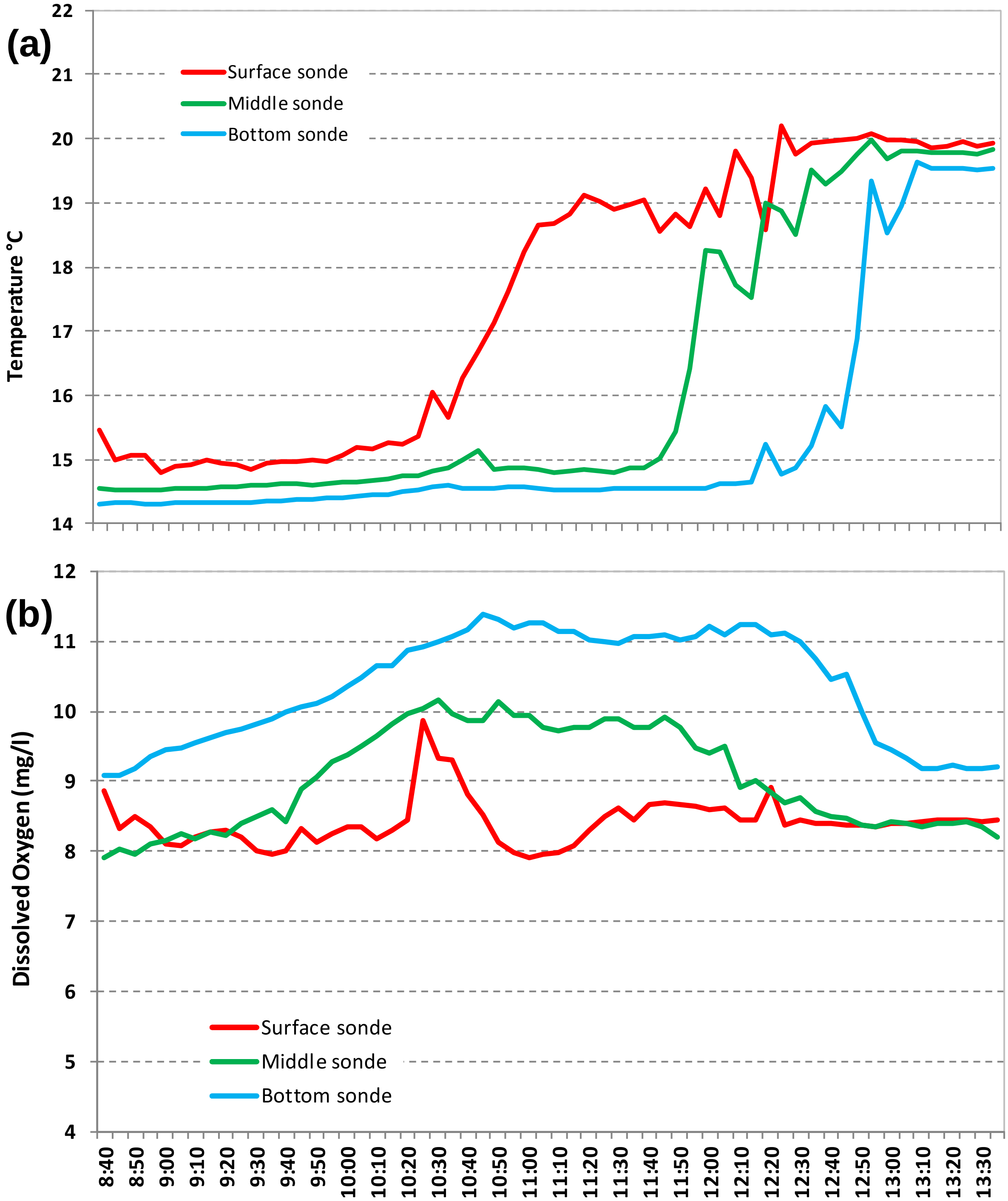


Figure 43: 2013 Long Pool (LSYR-0.51) vertical array Sonde results just prior, during and after the arrival of the WR 89-18 releases on 7/15/13 for (a) water temperature and (b) dissolved oxygen; the release arrived just after 10:00.

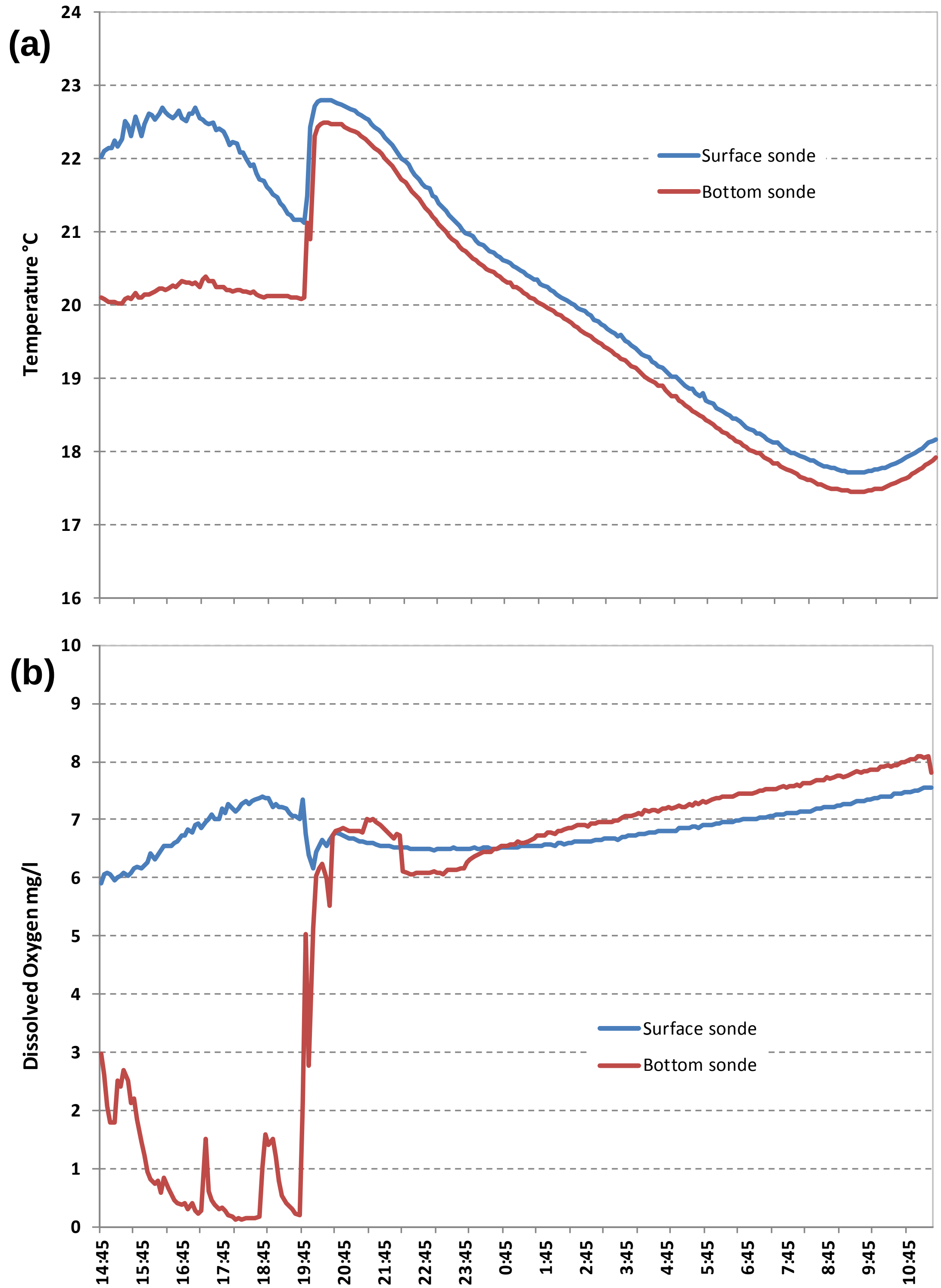


Figure 44: 2013 Encantado Pool (LSYR-4.95) Sonde quality during the mid-July deployment for (a) water temperature and (b) dissolved oxygen; WR 89-18 releases arrived at approximately 19:45.

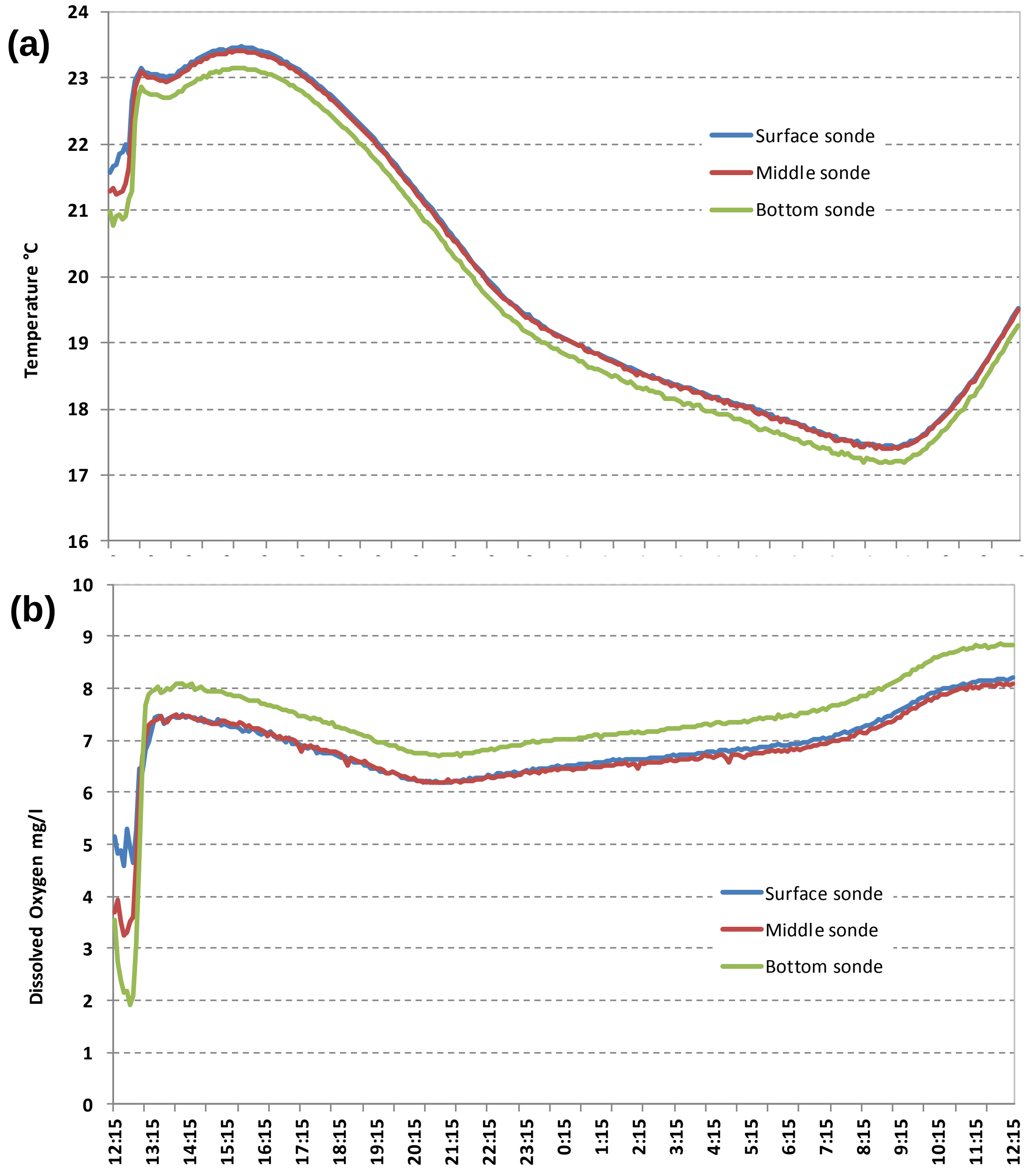
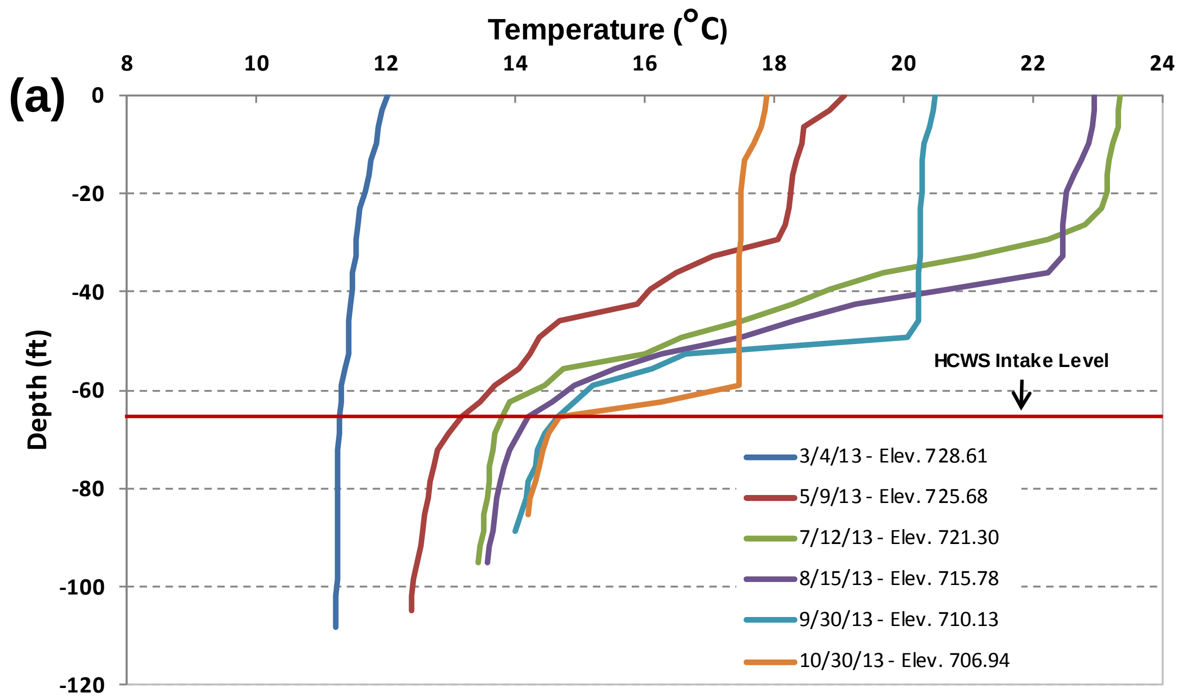


Figure 45: 2013 Double Canopy Pool (LSYR-7.65) Sonde water quality during the mid-July deployment for (a) water temperature and (b) dissolved oxygen.



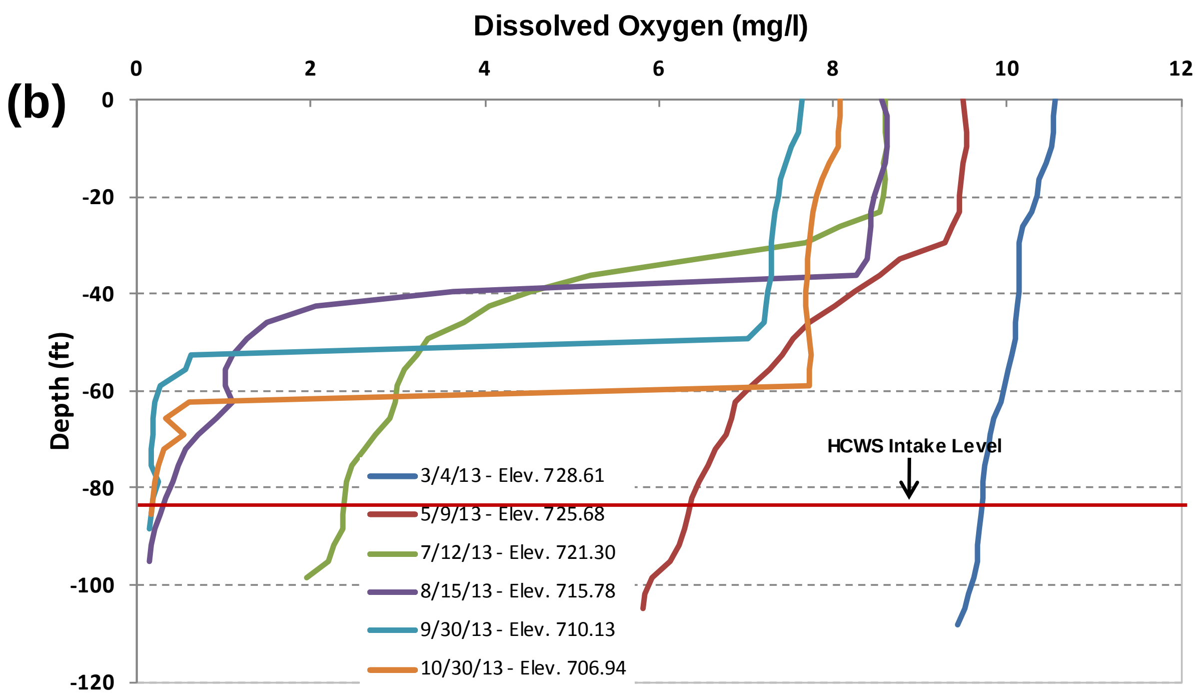


Figure 46: Lake Cachuma 2013 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS. HCWS intake hose level was set at 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

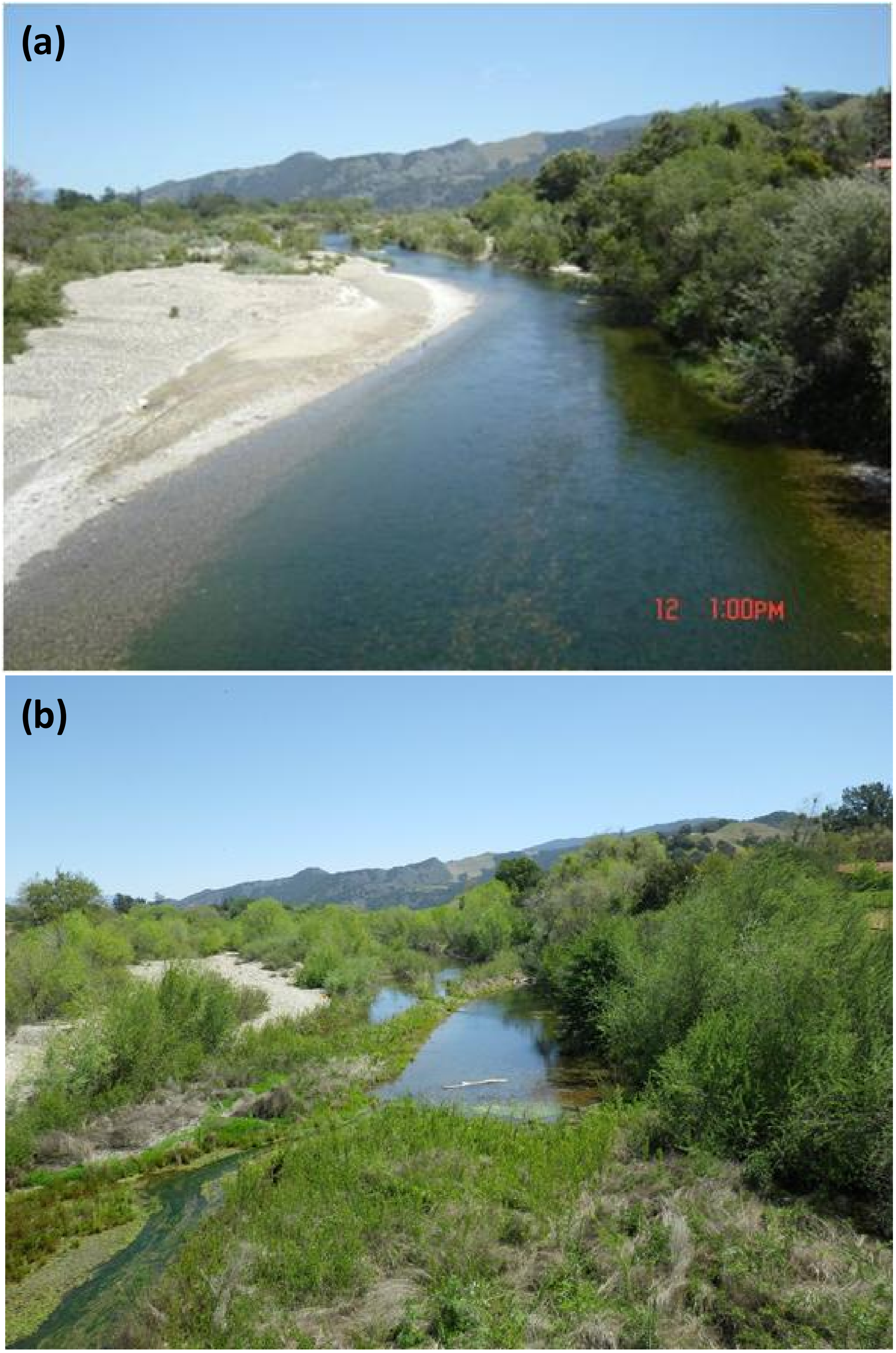


Figure 47: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) April 2013.

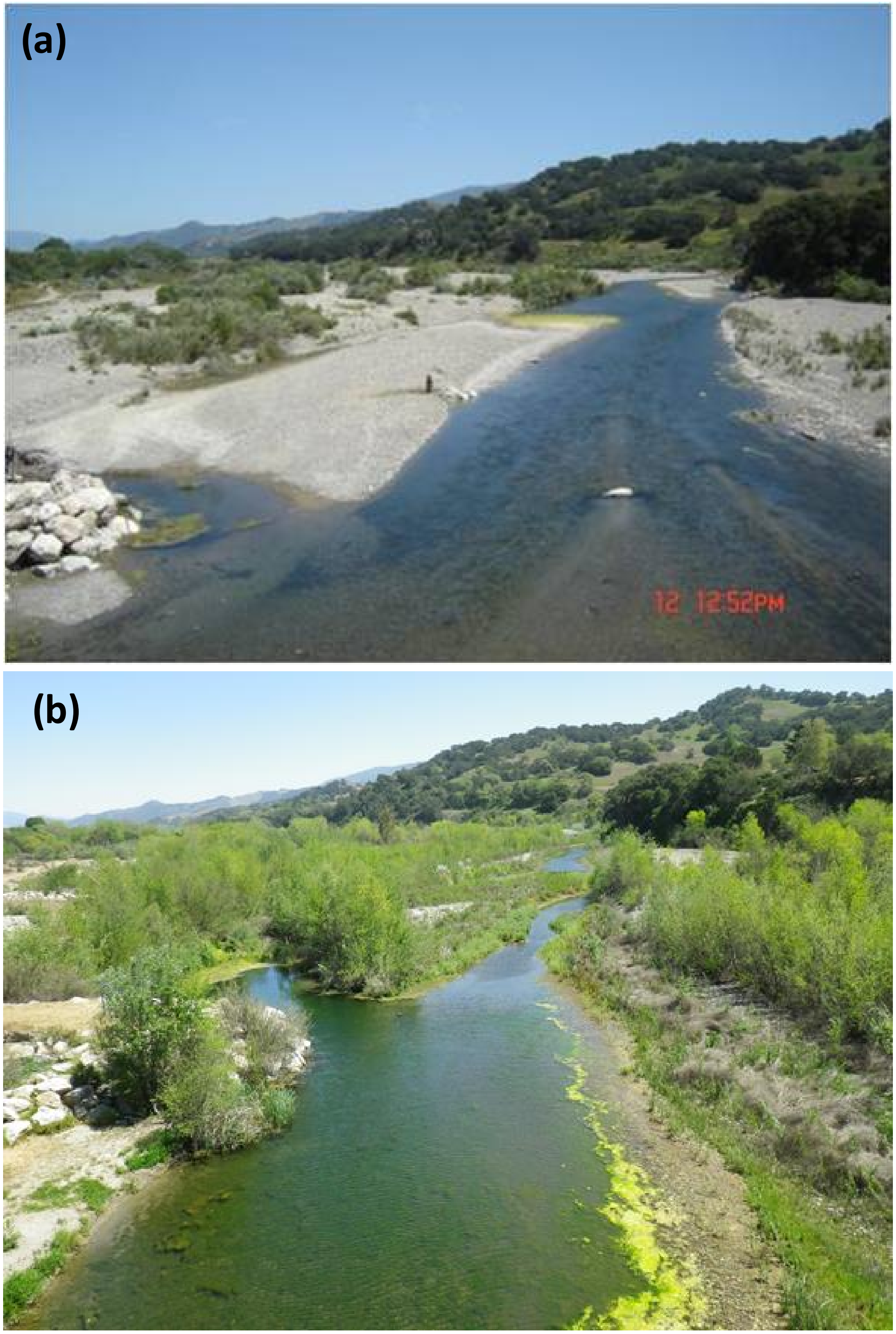


Figure 48: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) April 2013.

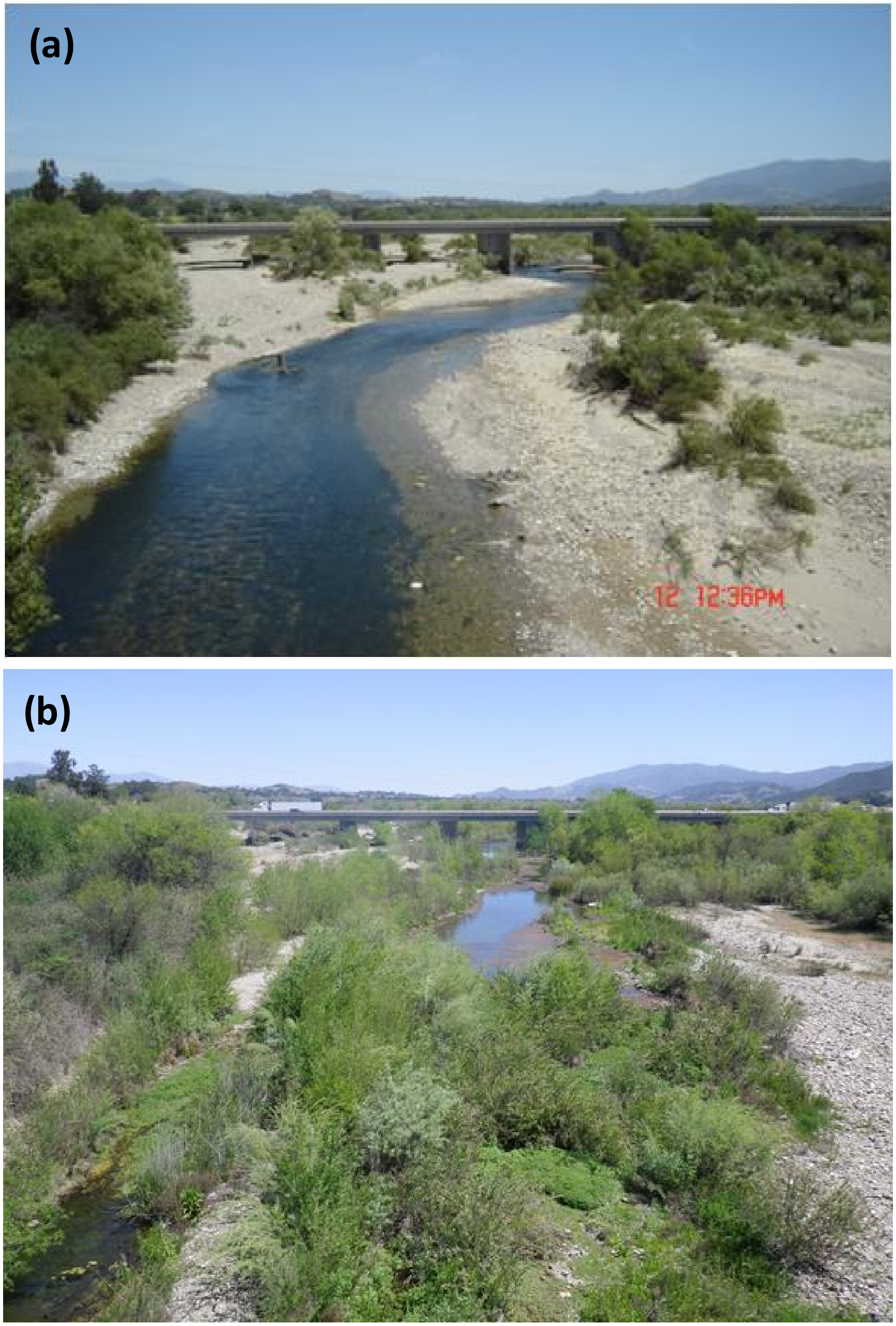


Figure 49: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) April 2013.

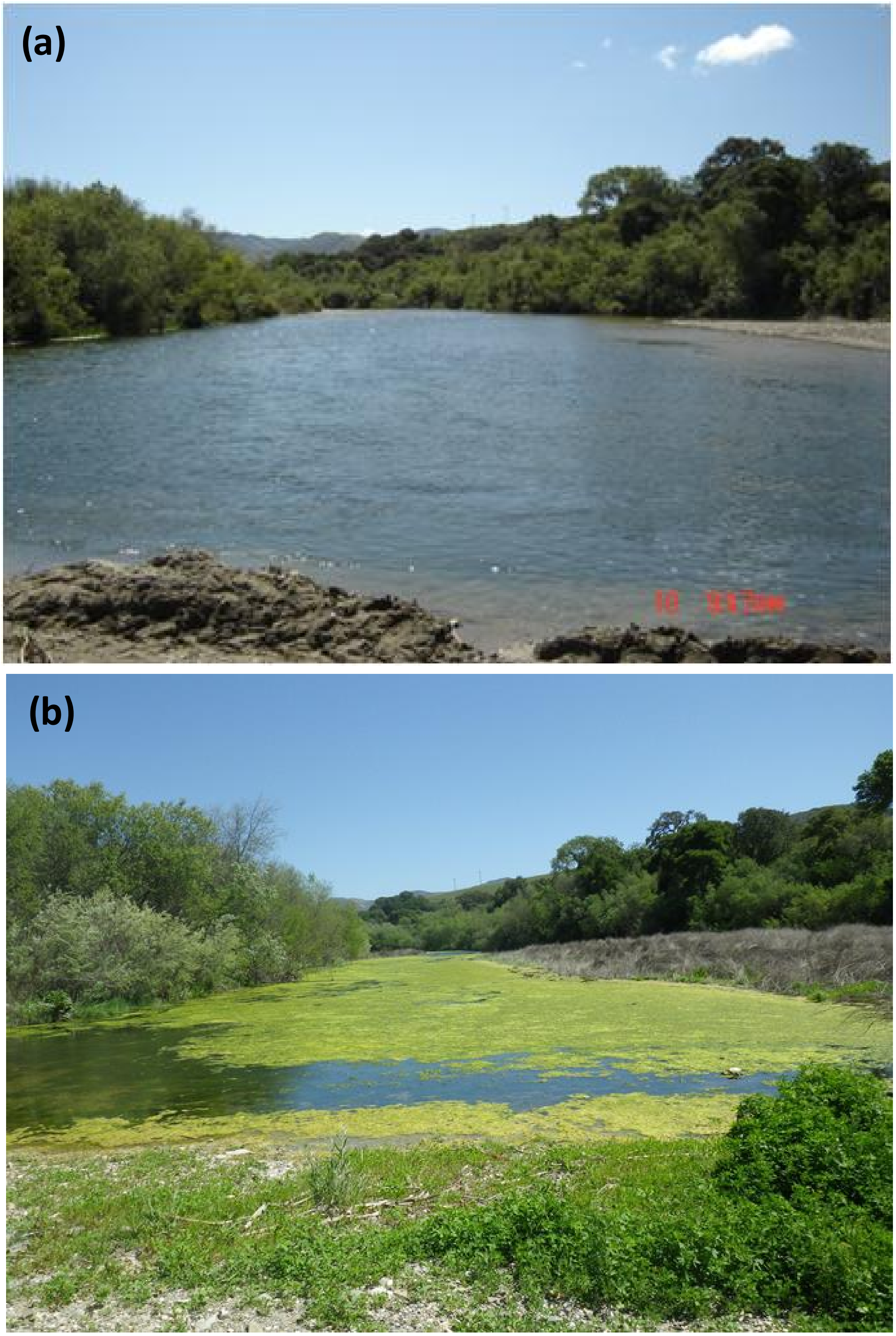


Figure 50: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) April 2013.

Figure 51: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) April 2013.

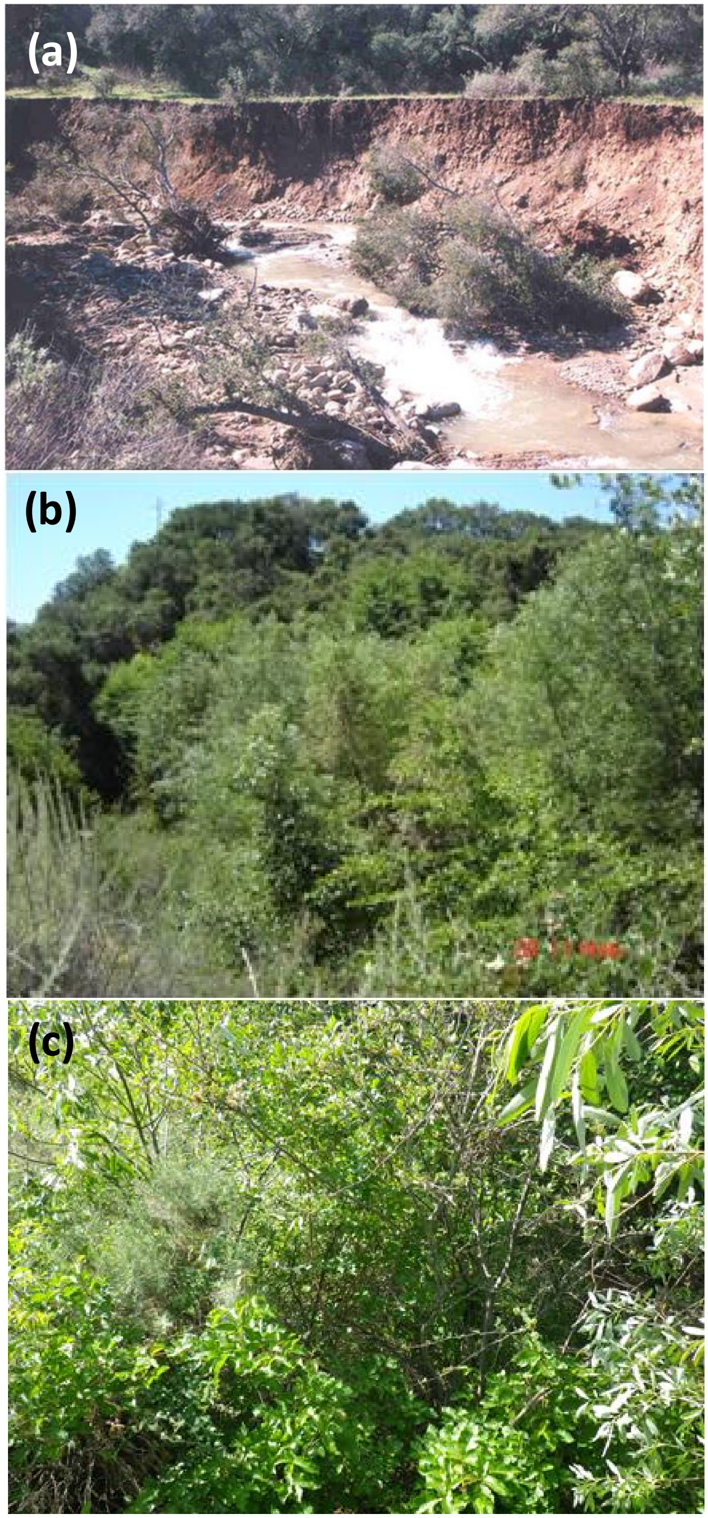


Figure 52: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) April 2013.

Figure 53: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) April 2013.

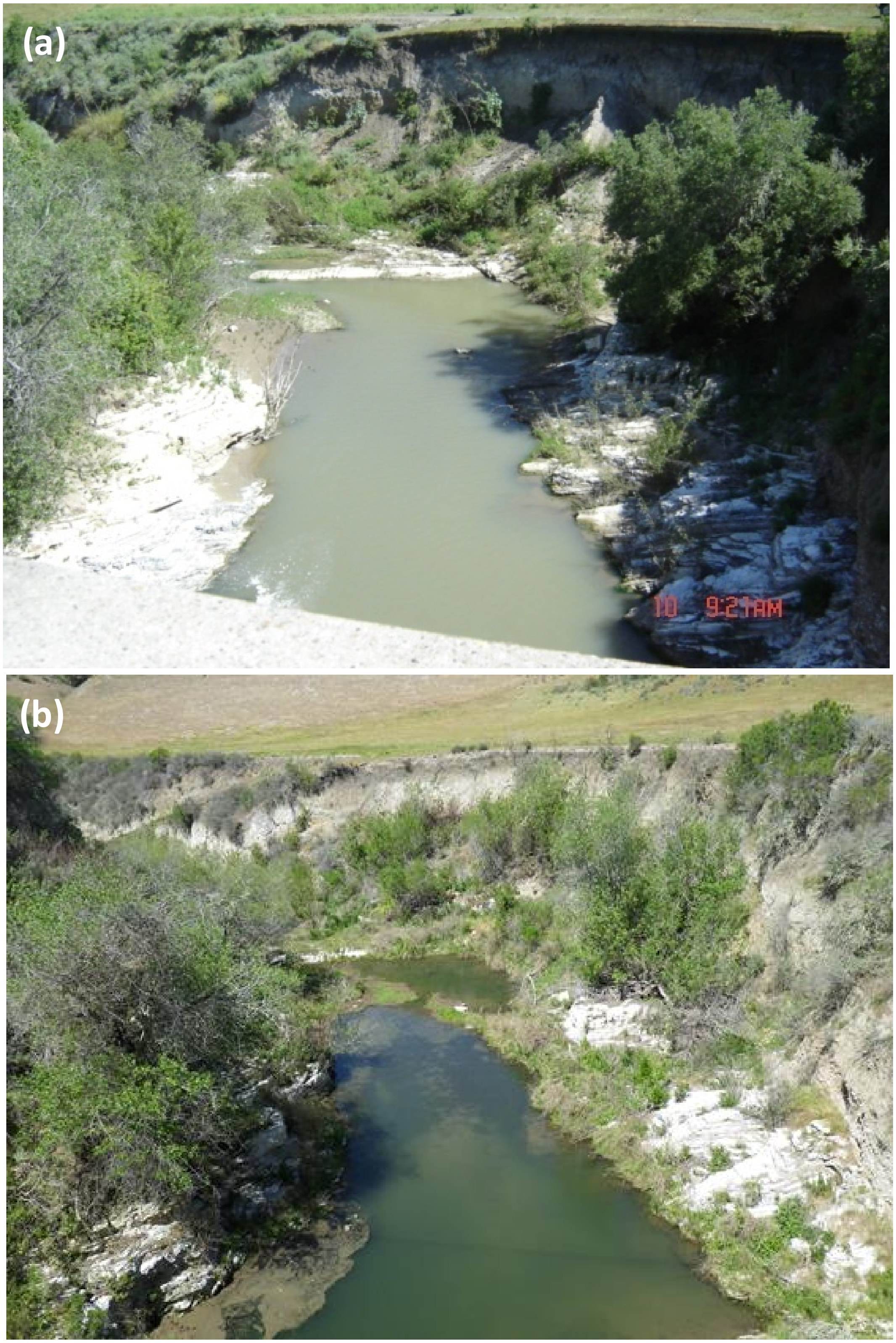


Figure 54: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) November 2008; no photo point was taken in April 2013.

Figure 55: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) April 2013.

3.4. Migrant Trapping

There was no migrant trapping conducted in WY2013.

3.5. Reproduction and Rearing

Table 7: WY2013 tributary and mainstem redd survey results; lengths and widths are given in feet and Salsipuedes Creek watershed includes Upper Salsipuedes, El Jaro, Yitias, Los Amoles creeks and one mainstem redd in the Hignway 154 Reach.

2013 Redd Surveys									
Location	Date	Redd#	*Length	**Width	Location	Date	Redd#	*Length	**Width
Hilton Creek	1/24/2013	1	3.3	1.3	El Jaro Creek	2/27/2013	1	2.7	0.7
	1/24/2013	2	4.3	1.7		2/27/2013	2	1.9	0.8
	2/19/2013	3	3.9	2.1		2/27/2013	3	2.3	1.2
	2/19/2013	4	3.8	1.7		3/20/2013	4	3.4	1.3
	2/19/2013	5	2.5	1.2		3/21/2013	5	1.4	0.7
	2/28/2013	6	2.7	1.2		3/21/2013	6	1.9	0.9
	2/28/2013	7	4.5	1.5		3/21/2013	7	1.9	0.8
	3/14/2013	8	2.0	1.1		3/21/2013	8	1.6	0.6
	3/14/2013	9	2.5	1.0		3/21/2013	9	2.9	1.0
	3/14/2013	10	3.1	1.2		3/21/2013	10	2.3	1.0
	3/18/2013	11	2.6	1.1		3/28/2013	11	1.6	0.6
	4/8/2013	12	2.6	1.3	Los Amoles Creek	4/1/2013	1	1.7	0.7
	4/8/2013	13	2.6	1.4	HWY 154	2/20/2013	1	2.7	1.2
Quiota	3/28/2013	1	n/a[1]	n/a					
Salsipuedes Creek	2/25/2013	1	5.7	1.2					
	2/25/2013	2	3.1	1.4					
	3/19/2013	3	4.5	1.9					
	3/19/2013	4	2.3	1.0					
	3/19/2013	5	2.7	1.3					
	3/20/2013	6	4.5	1.7					
	3/20/2013	7	2.3	0.9					
	3/20/2013	8	3.3	1.4					
	3/20/2013	9	2.7	1.3					
	4/10/2013	10	2.6	0.9					
	4/10/2013	11	2.1	1.1					

* Pit length plus tail spill length.

** Average of all width measurement.

1 Fish constructing redd, no data collected.

Table 8: WY2013 LSYR mainstem management reaches (Highway 154, Refugio and Alisal reaches) and tributary redd survey results by month.

2013 Mainstem Redd Surveys					
	January	February	March	April	Total
Hwy 154	0	1	0	0	1
Refugio	0	0	0	0	0
Alisal	0	0	0	0	0
Total:	**0**	**1**	**0**	**0**	**1**

2013 Tributary Redd Surveys					
	January	February	March	April	Total
Hilton	2	5	4	2	13
Quiota	0	0	1	0	1
Salsipuedes	0	2	7	2	11
El Jaro	0	3	8	0	11
Los Amoles	0	0	0	1	1
Ytias	0	0	0	0	0
Total:	**2**	**10**	**20**	**5**	**37**

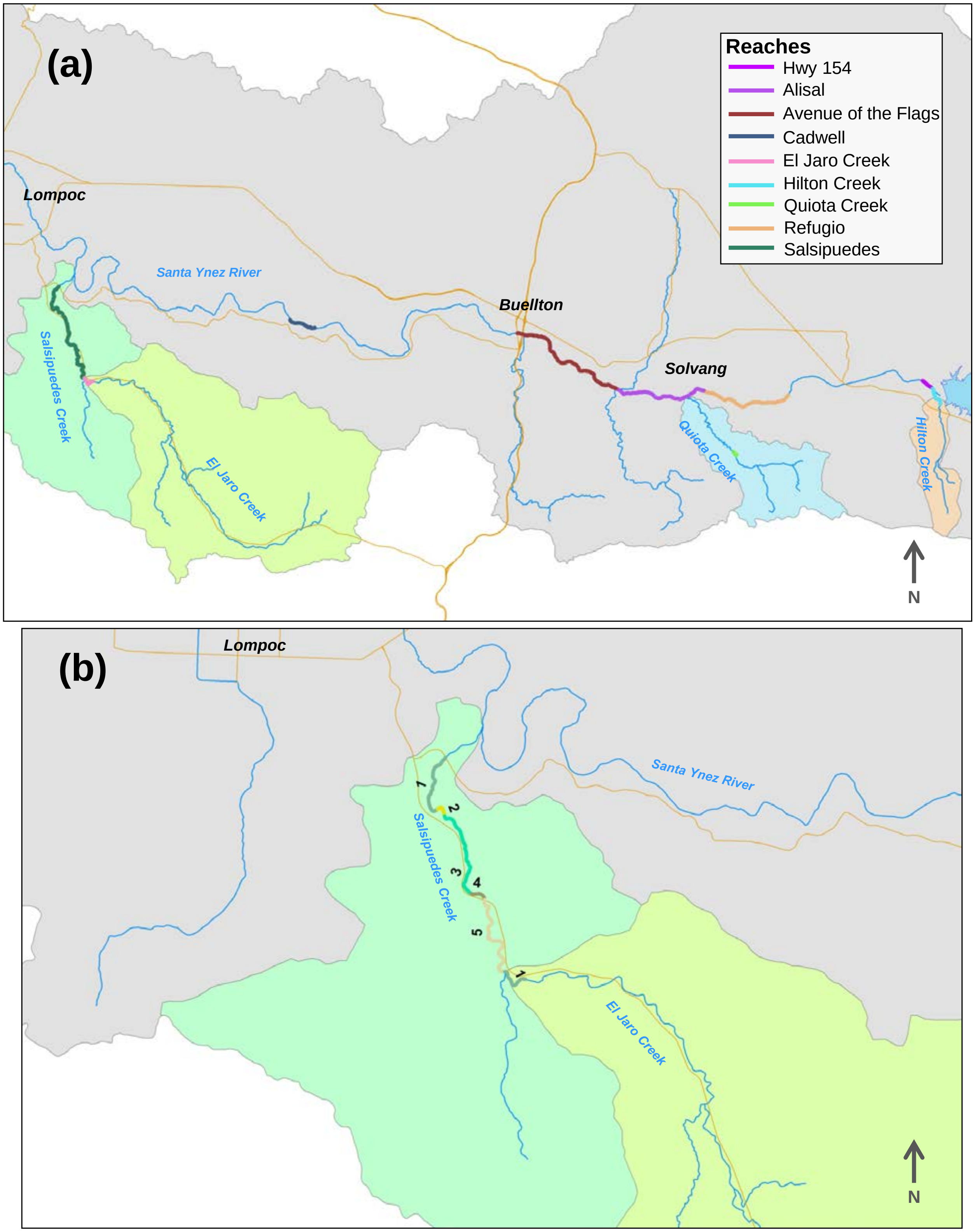


Figure 56: Stream reaches snorkel surveyed in WY2013 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

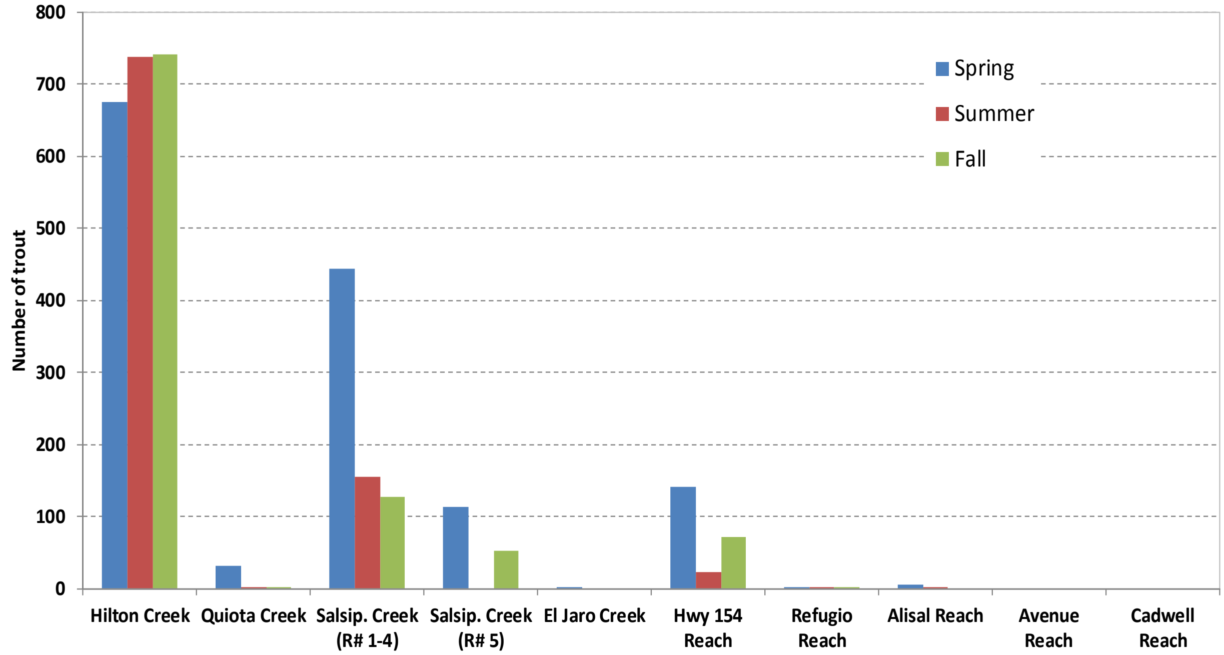


Figure 57: WY2013 LSYR steelhead/rainbow trout observed during spring, summer and fall snorkel surveys.

Table 9: WY2013 LSYR mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	6/6/2013
(LSYR-0.2 to LSYR-0.7)	Summer	9/19/2013
	Fall	12/2/2013
Refugio Reach	Spring	5/21/2013
(LSYR-4.9 to LSYR-7.8)	Summer	9/9/13 - 9/10/13
	Fall	12/2/13 - 12/3/13
Alisal Reach	Spring	5/23/2013
(LSYR-7.8 to LSYR-10.5)	Summer	9/11/13 - 9/12/13
	Fall	12/3/13 - 12/4/13
Avenue Reach	Spring	n/s*
(LSYR-10.5 to LSYR-13.9)	Summer	9/16/13 - 9/17/13
	Fall	12/10/13 - 12/12/13
Reach 3 Downstream of Avenue	Spring	n/s
(LSYR-13.9 to LSYR-25.0)	Summer	9/17/13 - 9/18/13
	Fall	12/12/13 - 12/16/13
*n/s = no survey		

Table 10: WY2013 *O. mykiss* observed and miles surveyed during all LSYR mainstem snorkel surveys; the level of effort was the same for each survey.

Mainstem	Spring (# of *O. mykiss*)	Summer (# of *O. mykiss*)	Fall (# of O. mykiss)	Survey Distance (miles)
Hwy 154 Reach	142	23	71	0.26
Refugio Reach	3	2	2	2.95
Alisal Reach	5	1	0	2.80
Avenue of the Flags Reach	0	0	0	3.4
Cadwell Reach	0	0	0	0.3

Table 11: LSYR mainstem spring, summer, and fall snorkel survey results in WY2013 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	111	20	9	2						142
	Refugio					2	1				3
	Alisal					2	2	1			5
	Avenue										0
	Cadwell										0
Summer	Hwy 154		14	9							23
	Refugio						1	1			2
	Alisal						1				1
	Avenue										0
	Cadwell										0
Fall	Hwy 154		5	57	9						71
	Refugio						1	1			2
	Alisal										0
	Avenue										0
	Cadwell										0

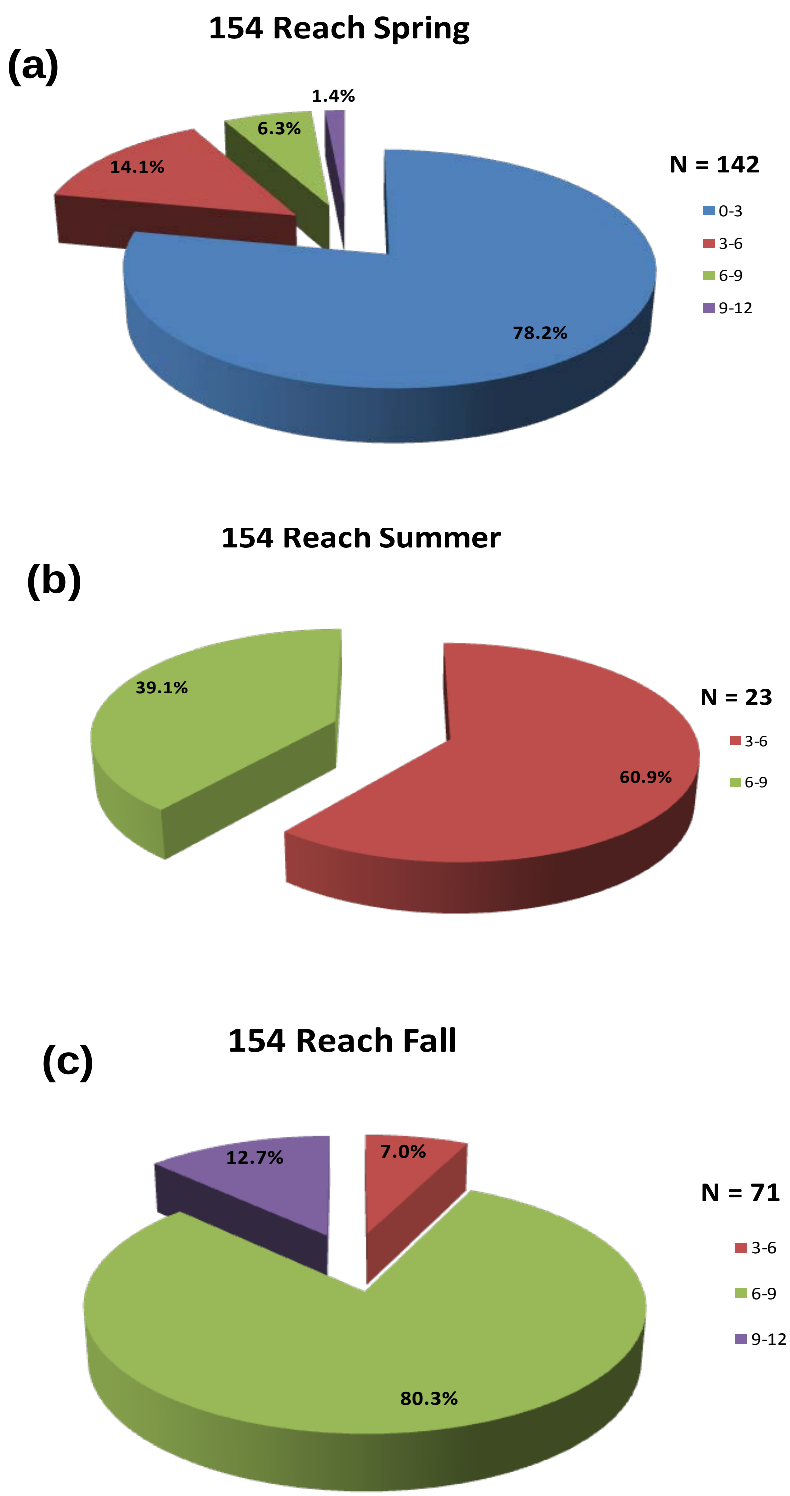


Figure 58: WY2013 Highway 154 Reach fall snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

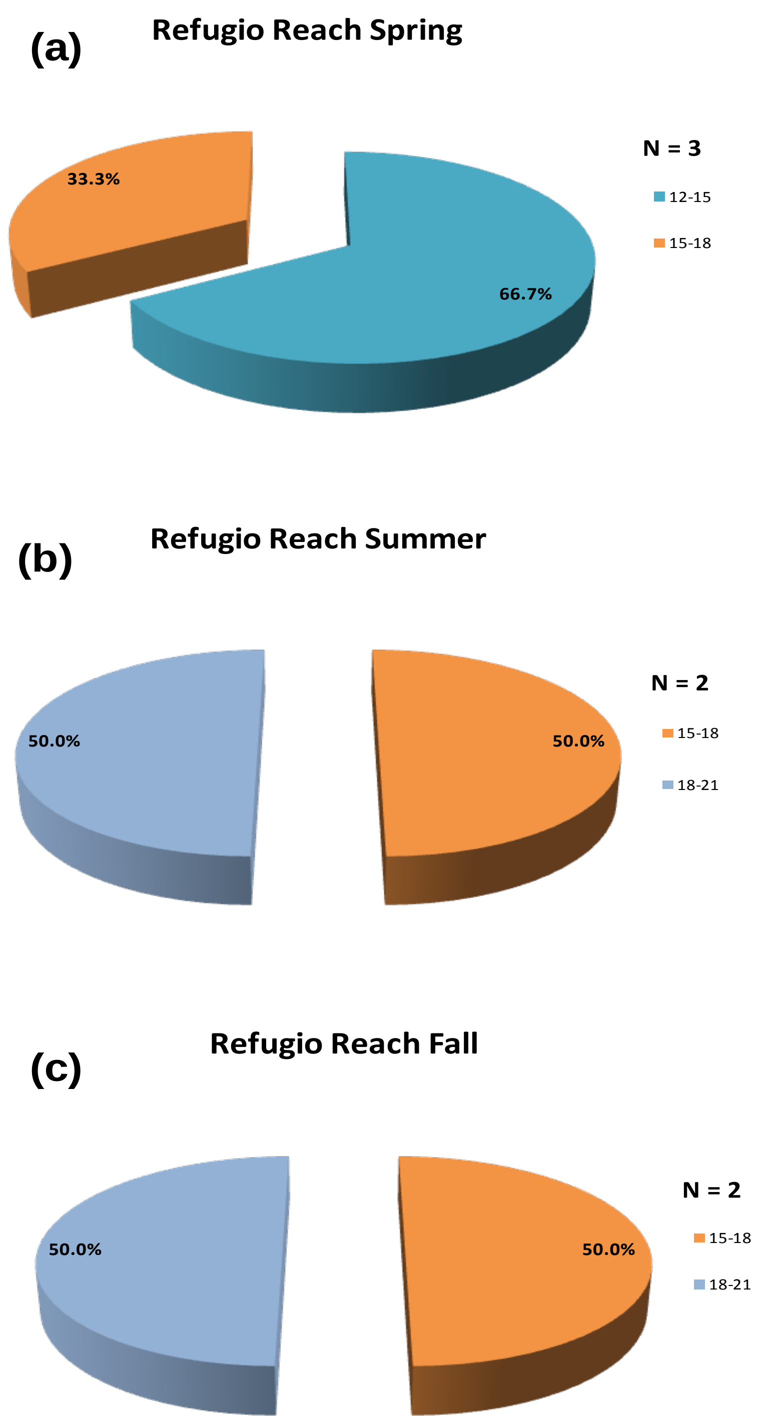
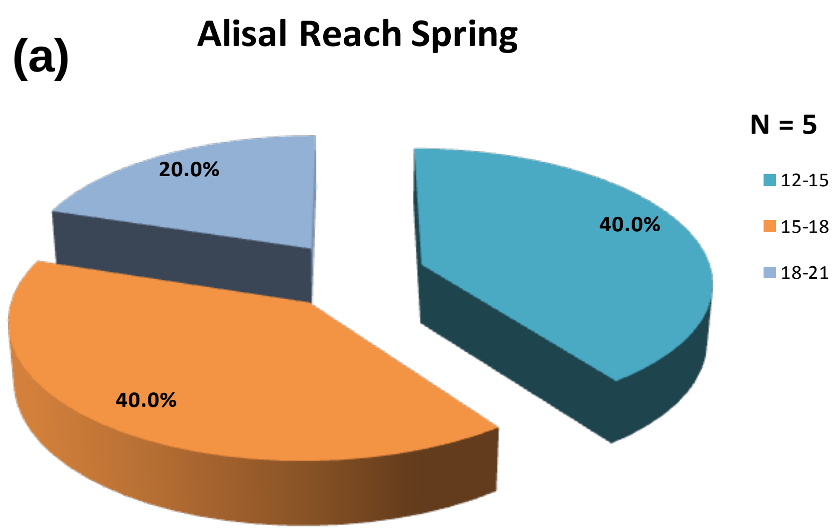
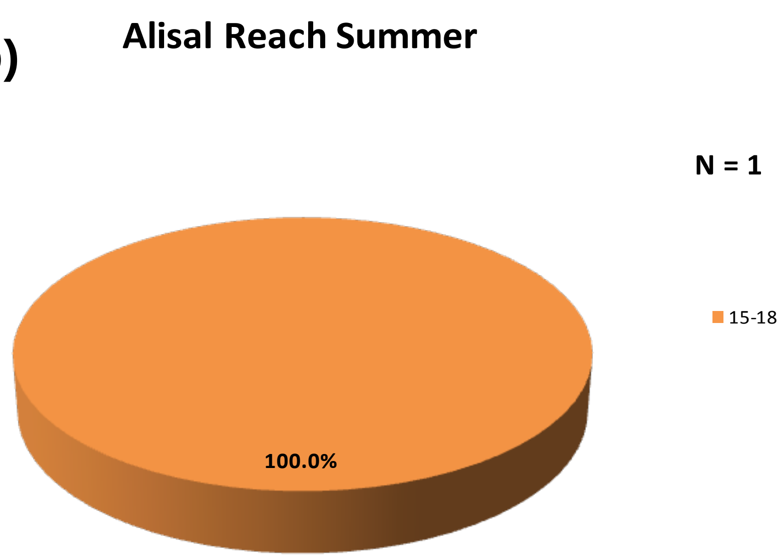


Figure 59: WY2013 Refugio Reach snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a)



(b)



(c) **Alisal Reach Fall**

None observed

Figure 60: WY2013 Alisal Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

Table 12: WY2013 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	6/26/2013**
(HC-0.0 to HC-0.54)	Summer	8/20/13 - 8/22/13
	Fall	11/12-13 - 11/13/13
Quiota Creek	Spring	6/20/13
(QC-2.58 to QC-2.73)	Summer	9/10/13
	Fall	11/7/13
Salsipuedes Creek	Spring	6/18/13
(Reaches 1-4)	Summer	8/20/13
	Fall	11/6/13 - 11/7/13
Salsipuedes Creek	Spring	6/18/13
(Reach 5)	Summer	n/s*
	Fall	11/6/13
El Jaro Creek	Spring	6/18/13
(ELC-0.0 to ELC-0.4)	Summer	n/s
	Fall	n/s
*n/s = no survey		
**survey completed 2 days after second dewatering incident		

Table 13: WY2013 *O. mykiss* observed and miles surveyed during all tributary snorkel surveys; the level of effort was the same for each survey.

Tributaries	Spring (# of *O. mykiss*)	Summer (# of *O. mykiss*)	Fall (# of O. mykiss)	Survey Distance (miles)
Hilton Creek				
Reach 1	60	127	97	0.133
Reach 2	59	95	123	0.050
Reach 3	76	52	77	0.040
Reach 4	147	184	187	0.075
Reach 5	333	281	257	0.242
Reach 6	0	0	0	0.014
Total:	***675***	***739***	***741***	***0.554***
Quiota Creek	31	2	1	0.11
Salsipuedes Creek (Reach 1-4)	444	155	127	2.85
Salsipuedes Creek (Reach 5)	113	n/a	52	0.45
El Jaro Creek	3	n/a	n/a	0.35
n/a = no survey, turbid conditions				

Table 14: WY2013 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	410	184	71	10						675
	Quiota	10	18	3							31
	Salsipuedes (R 1-4)	405	26	9	1	2	1				444
	Salsipuedes (R-5)	42	64	7							113
	El Jaro	1		2							3
Summer	Hilton	320	349	64	6						739
	Quiota		1	1							2
	Salsipuedes (R 1-4)	106	46	3							155
	Salsipuedes (R-5)	n/a									
	El Jaro	n/a									
Fall	Hilton	186	485	66	4						741
	Quiota			1							1
	Salsipuedes (R 1-4)	63	48	12	2	1	1				127
	Salsipuedes (R-5)	8	26	12	5	1					52
	El Jaro	n/a									

n/a = no survey, turbid conditions

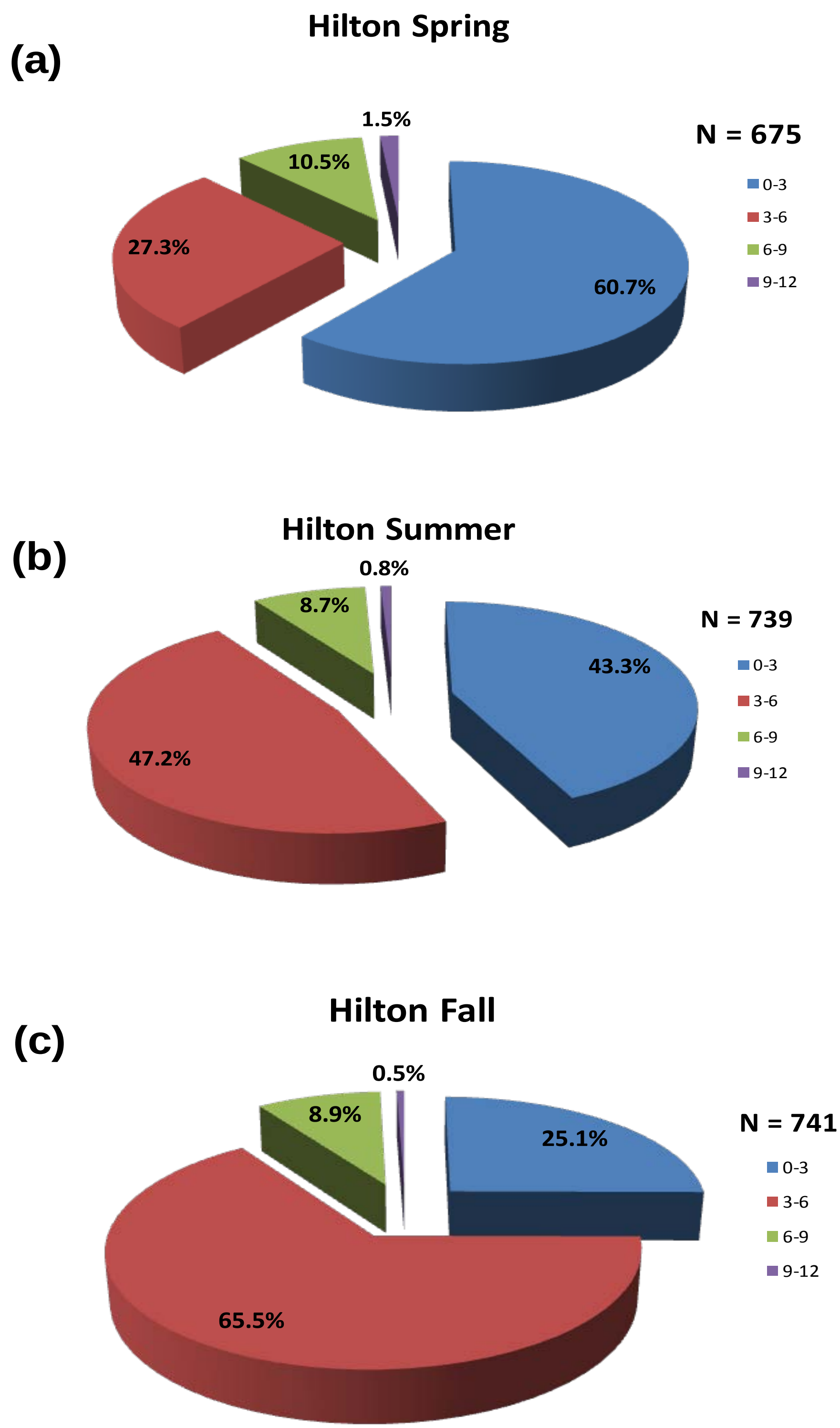


Figure 61: WY2013 Hilton Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

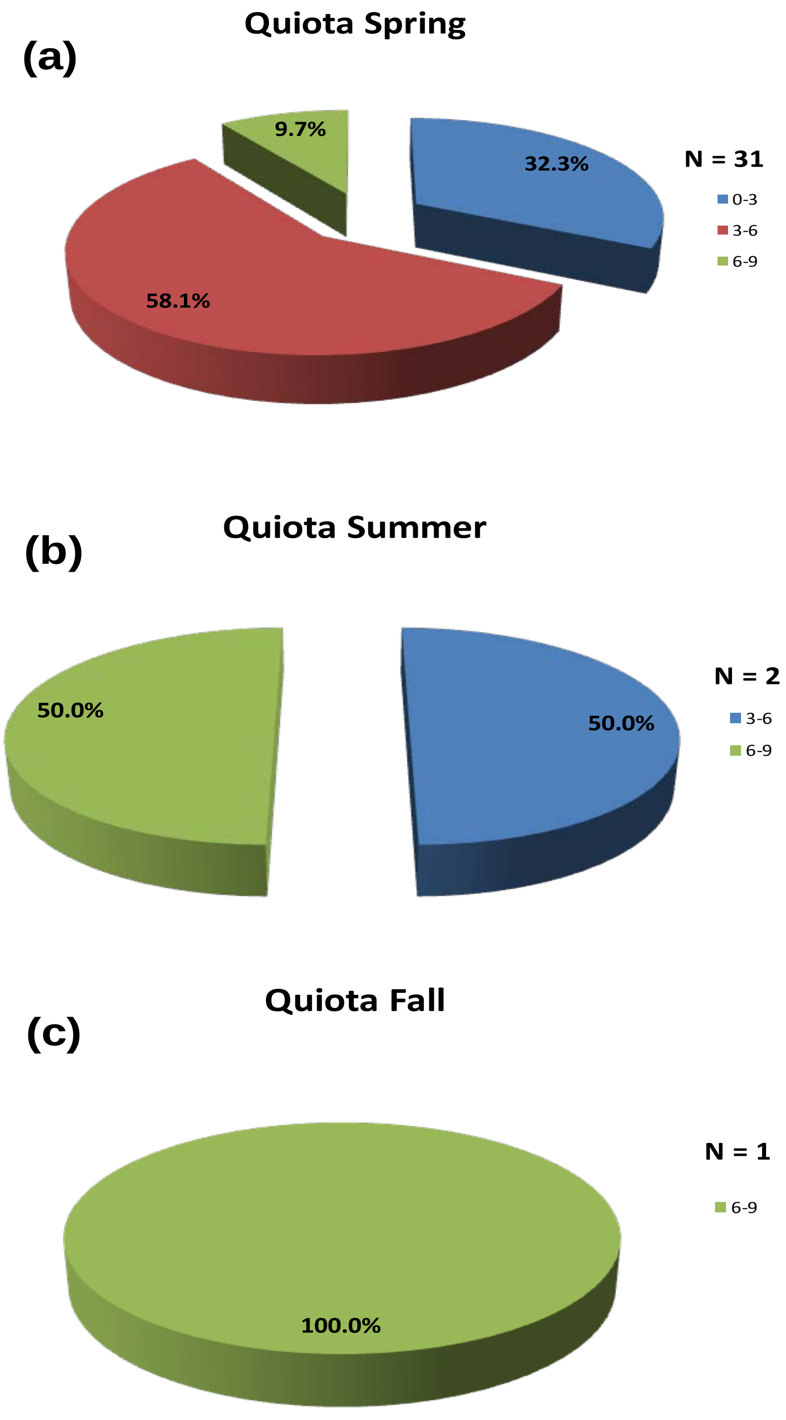


Figure 62: WY2013 Quiota Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

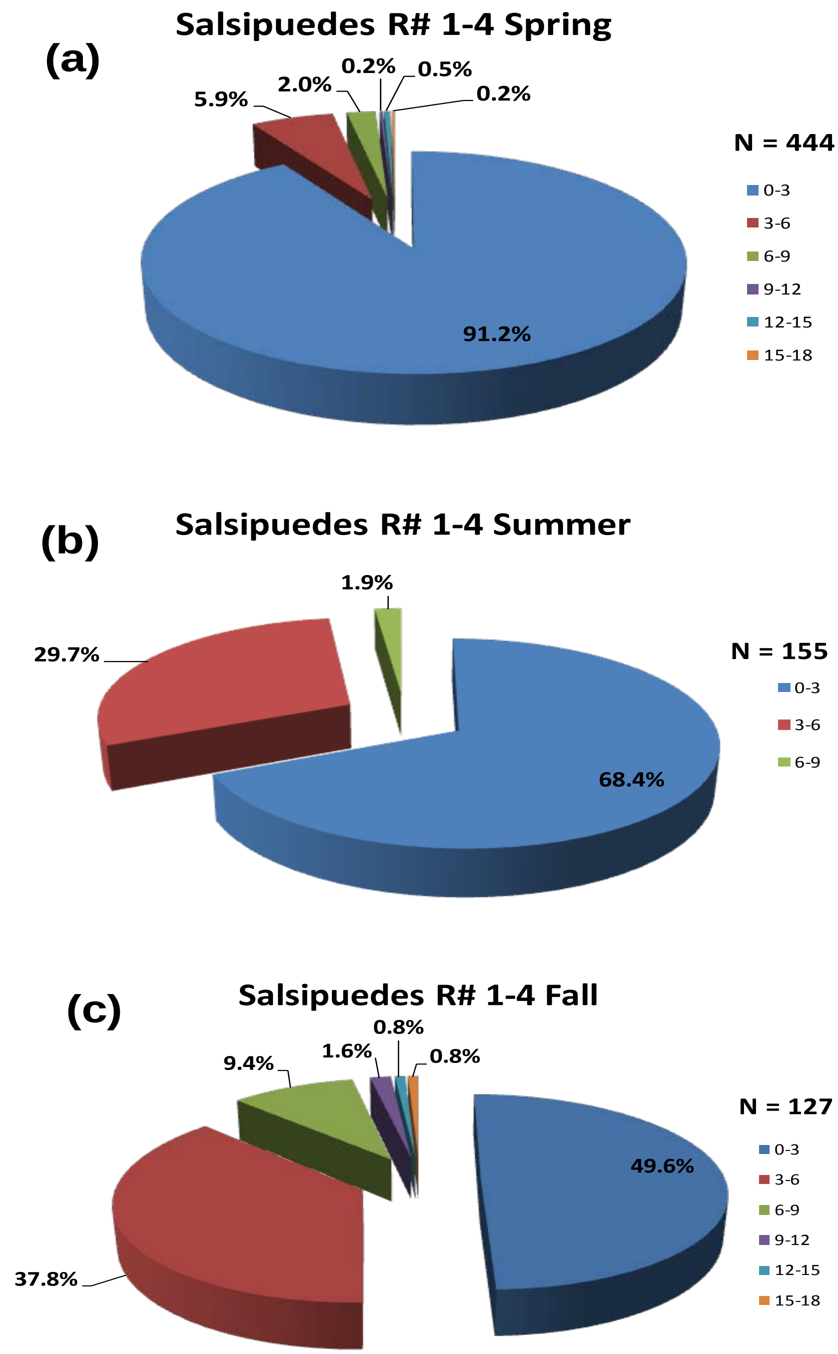
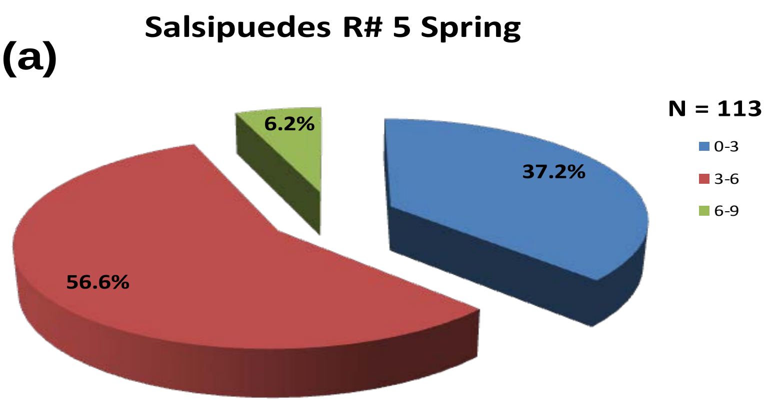


Figure 63: WY2013 Salsipuedes Creek reaches 1-4 snorkel survey with size classes (range) of fish observed in inches; (a) spring, and (b) summer.

(a)



(b)

Salsipuedes R# 5 Summer

n/a, turbid conditions

(c)

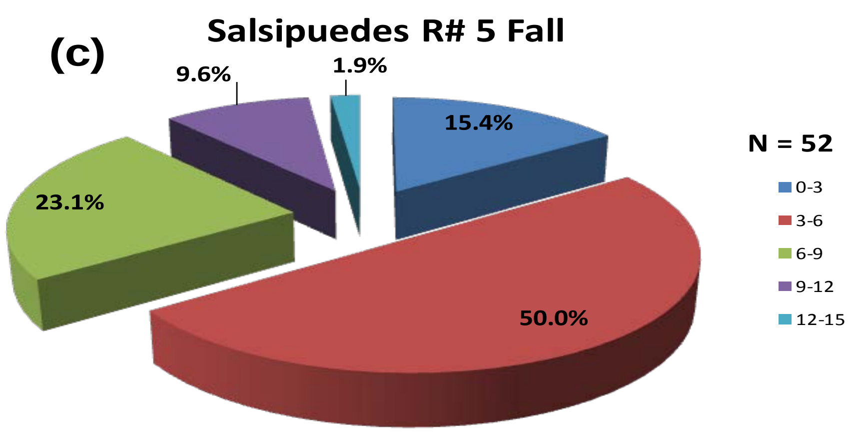
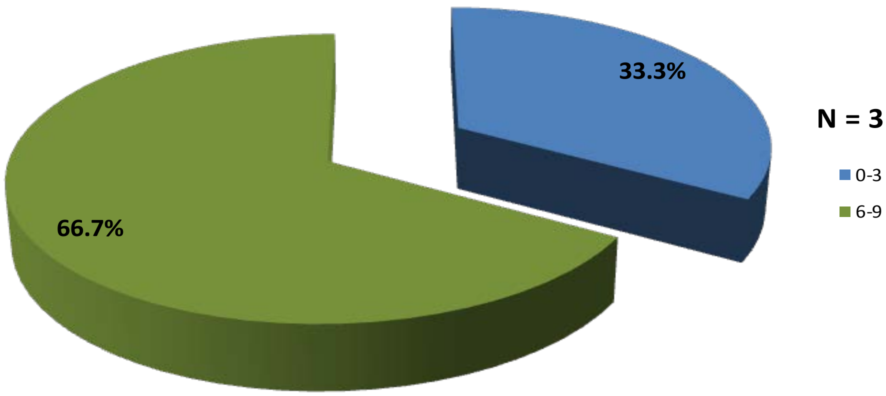


Figure 64: WY2013 Salsipuedes Creek Reach 5 surveys with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a)

El Jaro Spring



(b)

El Jaro Summer

n/a, turbid and mostly dry conditions

El Jaro Fall

(c)

n/a, dry conditions

Figure 65: WY2013 El Jaro Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

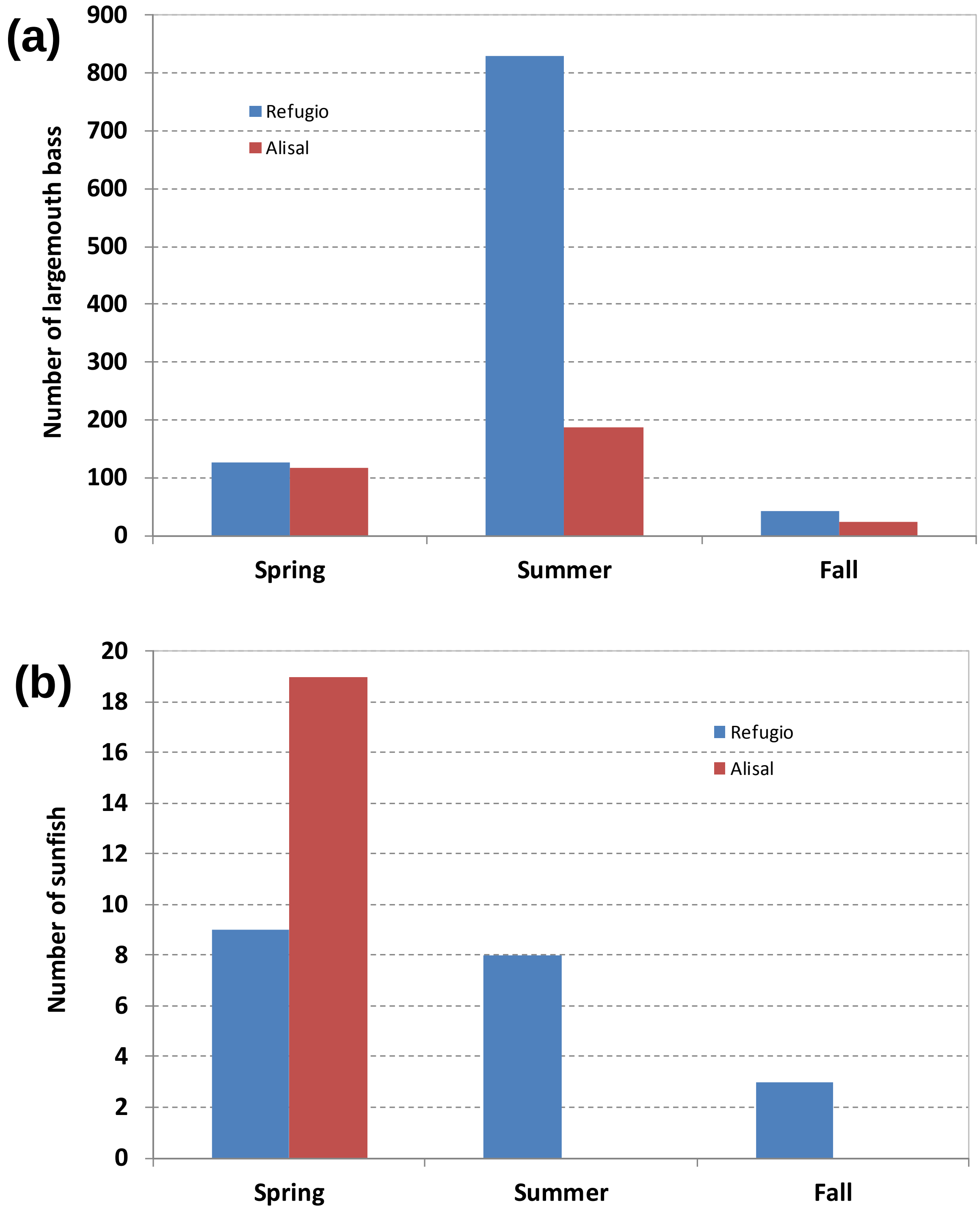
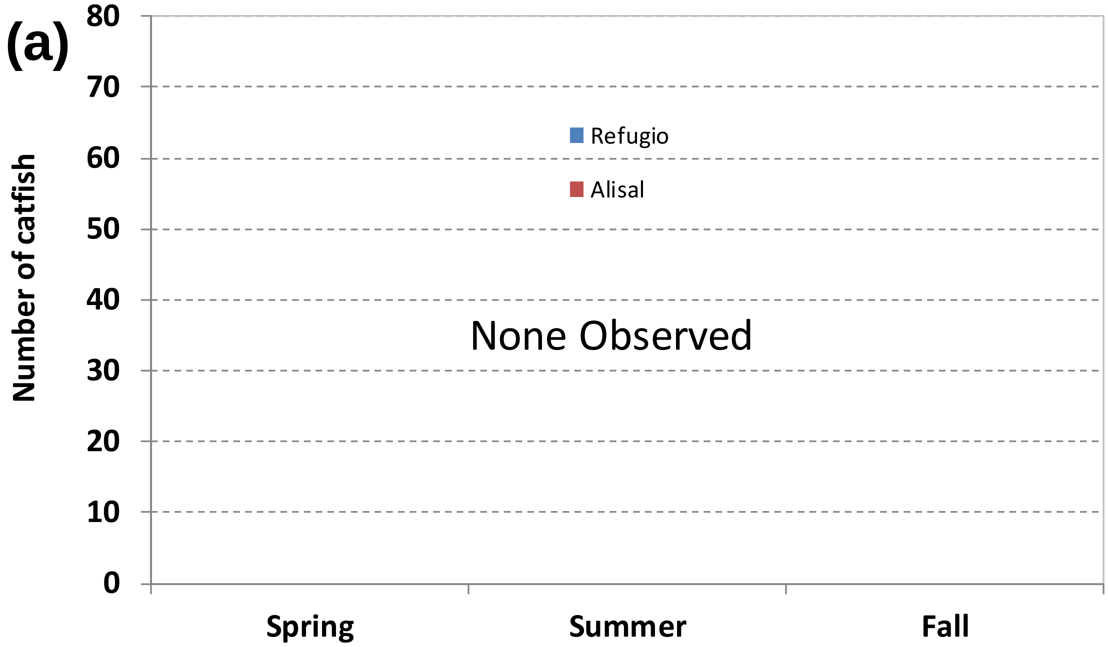


Figure 66: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2013 within the Refugio and Alisal reaches: (a) largemouth bass and (b) sunfish.



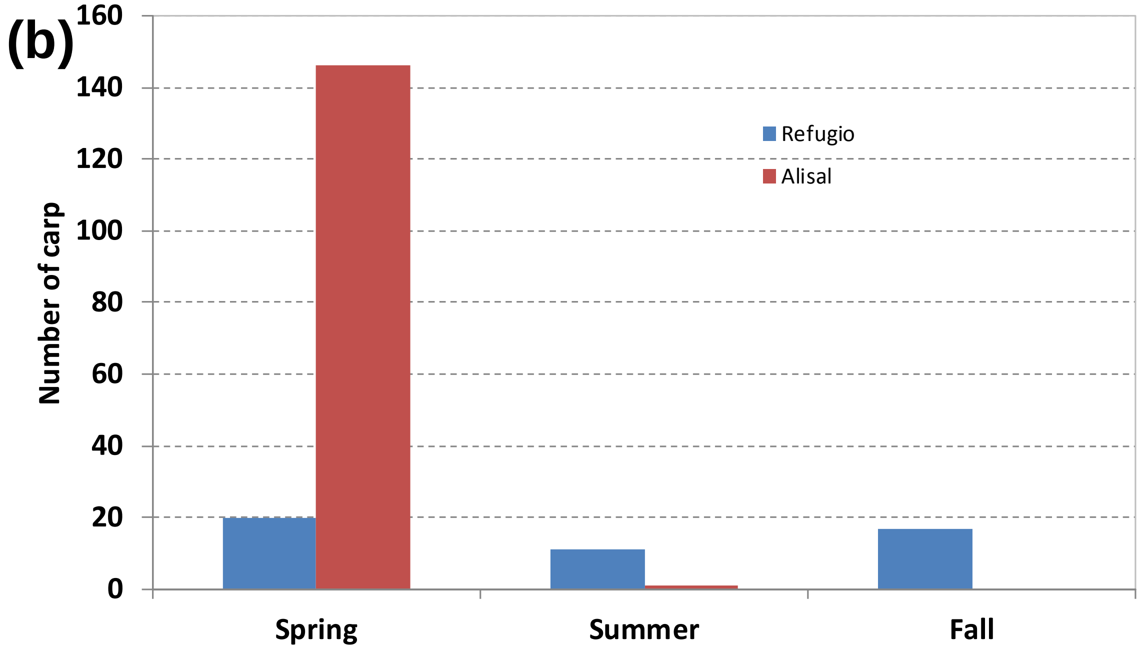
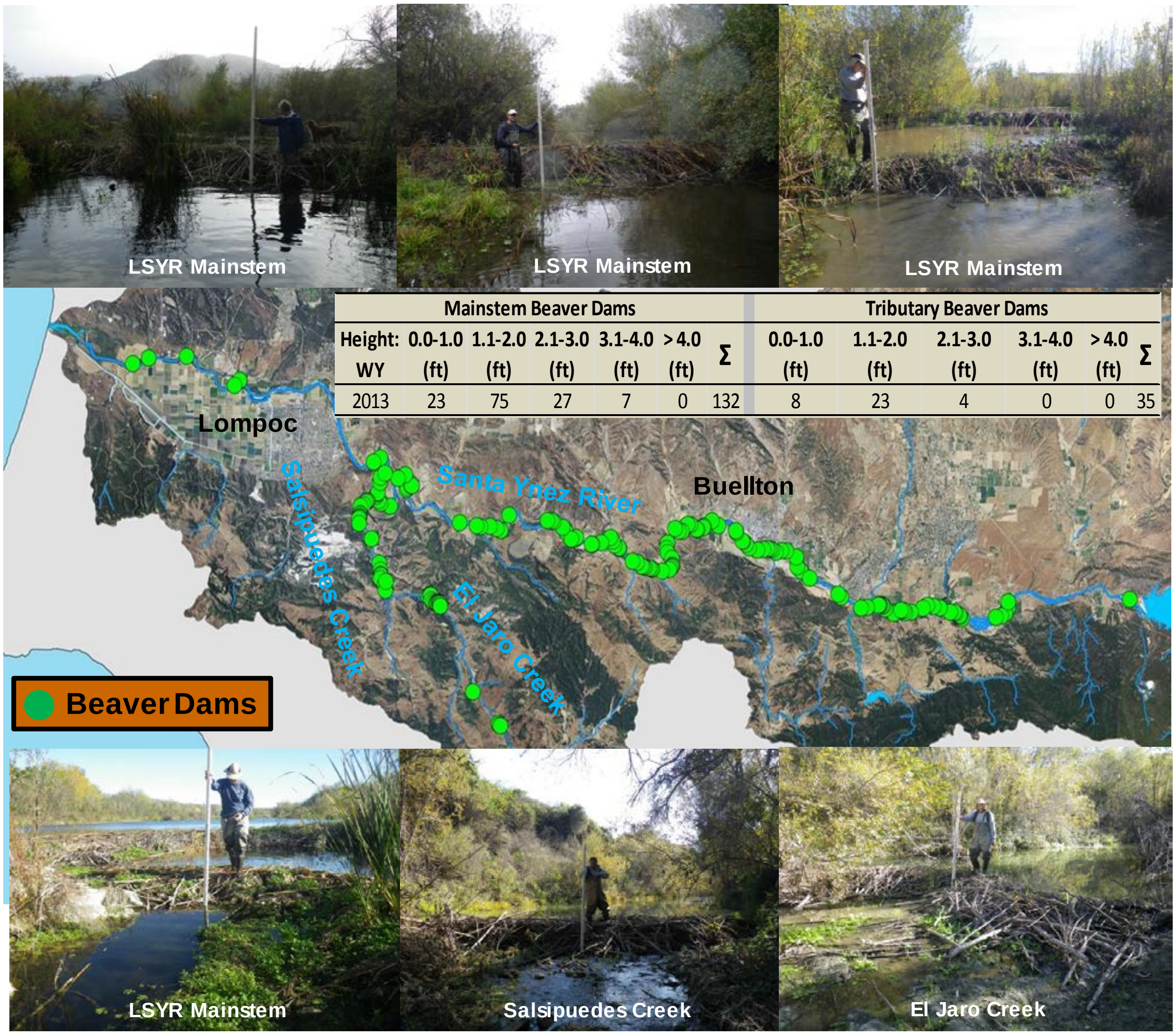


Figure 67: Observed (a) catfish and (b) carp during the spring, summer and fall snorkel surveys in WY2013 within the Refugio and Alisal reaches.



	Mainstem Beaver Dams						Tributary Beaver Dams					
Height: WY	0.0-1.0 (ft)	1.1-2.0 (ft)	2.1-3.0 (ft)	3.1-4.0 (ft)	> 4.0 (ft)	Σ	0.0-1.0 (ft)	1.1-2.0 (ft)	2.1-3.0 (ft)	3.1-4.0 (ft)	> 4.0 (ft)	Σ
2013	23	75	27	7	0	132	8	23	4	0	0	35

Figure 68: Spatial extent of beaver dams from the WY2013 survey within the LSYR drainage where 132 dams were observed in the mainstem and 35 observed in the Salsipuedes Creek watershed.

WY2013 Annual Monitoring Report
Trend Analysis
Figures and Tables

4. Discussion

Table 15: Monthly rainfall totals at Bradbury Dam from WY2000-WY2013.

Month	Water Years:													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Oct	0	2.64	0.62	0	0	6.38	0.48	0.16	0.34	0.15	2.2	2.24	0.47	0.12
Nov	1.62	0	3.27	2.5	1.2	0.33	1.64	0.2	0.06	3.39	0	1.42	2.82	1.34
Dec	0	0.09	2.66	6.73	2.03	13.25	0.73	1.59	2.39	2.46	3	9.48	0.35	2.95
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	1.58	1.75
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	0.43	0.40
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	3.63	0.80
Apr	4.73	1.35	0.13	2.15	0	1.27	4.89	0.81	0.06	0.19	3.15	0.14	3.21	0.19
May	0.01	0.06	0.12	2.33	0	0.51	1.56	0	0.38	0	0.05	0.42	0.02	0.02
Jun	0.04	0	0	0.02	0	0.04	0	0	0	0.16	0	0.34	0.00	0.00
Jul	0	0.06	0	0.01	0	0	0	0	0	0	0	0.00	0.00	0.00
Aug	0	0	0	0	0	0	0	0	0	0.03	0	0.00	0.00	0.00
Sept	0	0	0.08	0	0	0.03	0	0.17	0	0.08	0	0.00	0.18	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***	***12.69***	***7.57***

Table 16: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2013.

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		WY2012		WY2013	
	Solvang (cfs)	Narrows (cfs)	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	7.3	0.998	25	17.5	2.97	0	6.8	0	19.8	18.3	7.59	4.28	4.5	0
Nov	5.8	0.996	7.36	8.54	5.8	0	1.6	0	6.94	12.8	8.33	11.1	2.7	0
Dec	7.74	9.98	6.61	13.2	7.01	1.02	6.9	0	53.1	203.3	7.91	14.6	5.8	0
Jan	9.37	15.3	265	496.3	6.14	5.11	73	184	27.6	85.8	7.97	16.9	6.3	0
Feb	10.4	18.6	401.1	490.1	17.7	33.4	72	181	24	100.3	7.46	14.1	6.0	3.6
Mar	8.82	10.7	93.9	158.4	12.1	18.6	26	68	1441	1267	6.01	11.7	4.8	4.5
Apr	4.52	1.43	8.46	18.9	4.39	5.23	35	51	321.5	422	8.82	14.7	1.7	0.54
May	1.47	0.475	6.3	6.77	5.05	0.648	6.1	13	39	70.8	5.56	5.53	0	0
Jun	1.93	0.13	5.05	2.49	7.08	0.275	1.3	1.8	13.9	29.4	4.73	0.519	0	0
Jul	35.8	1.39	7.09	0.42	3.51	0	0.4	0.5	9.28	10.7	4.58	0.033	51.0	3
Aug	55.2	30.8	3.68	0.069	3.72	0	53	22	7.8	3.05	4.88	0	59.1	27
Sep	31	23.4	3.76	0	4.08	0	30	19	8.5	2.22	6.60	0	47.9	28

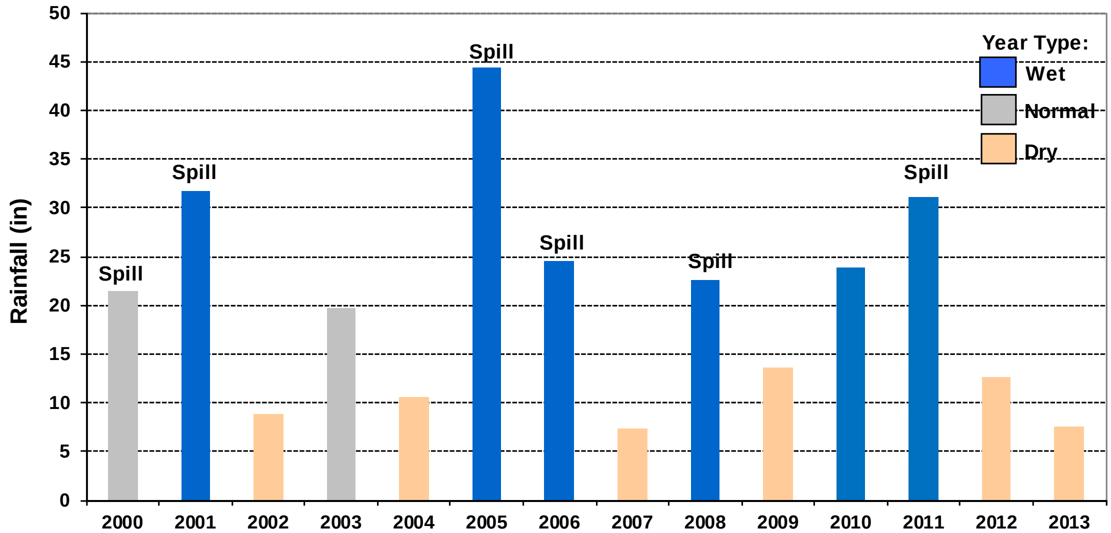


Figure 69: Water year type (wet, normal and dry) and spill years since the issuance of the BiOp in 2000: year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 17: BiOp tributary project inventory with the completion date specified in the BiOp and their status to date; completed projects are listed by calendar year.

Tributary Projects	BO Expected Completion Date	Current Status (as of May 2013)
Highway 1 Bridge on Salispuedes Creek	2001	Completed (2002)
Cross Creek Ranch on El Jaro Creek	2005	Completed (2009)
Highway 101 Culvert on Nojoqui Creek	2005	Proposed removal from BiOp[1]
Quiota Creek Crossing 1	2003	In design (fall 2014)[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)
Highway 154 Culvert on Hilton Creek	2002	Proposed removal from BiOp[1]
Total:	**11**	
Projects completed and in design:	***9***	
Projects suggested to be removed:	***2***	
1. Project proposed for removal from the BiOp .		
2. Grants have been submitted for funding.		

Table 18: Non-BiOp 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 (fall 2014)[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.	

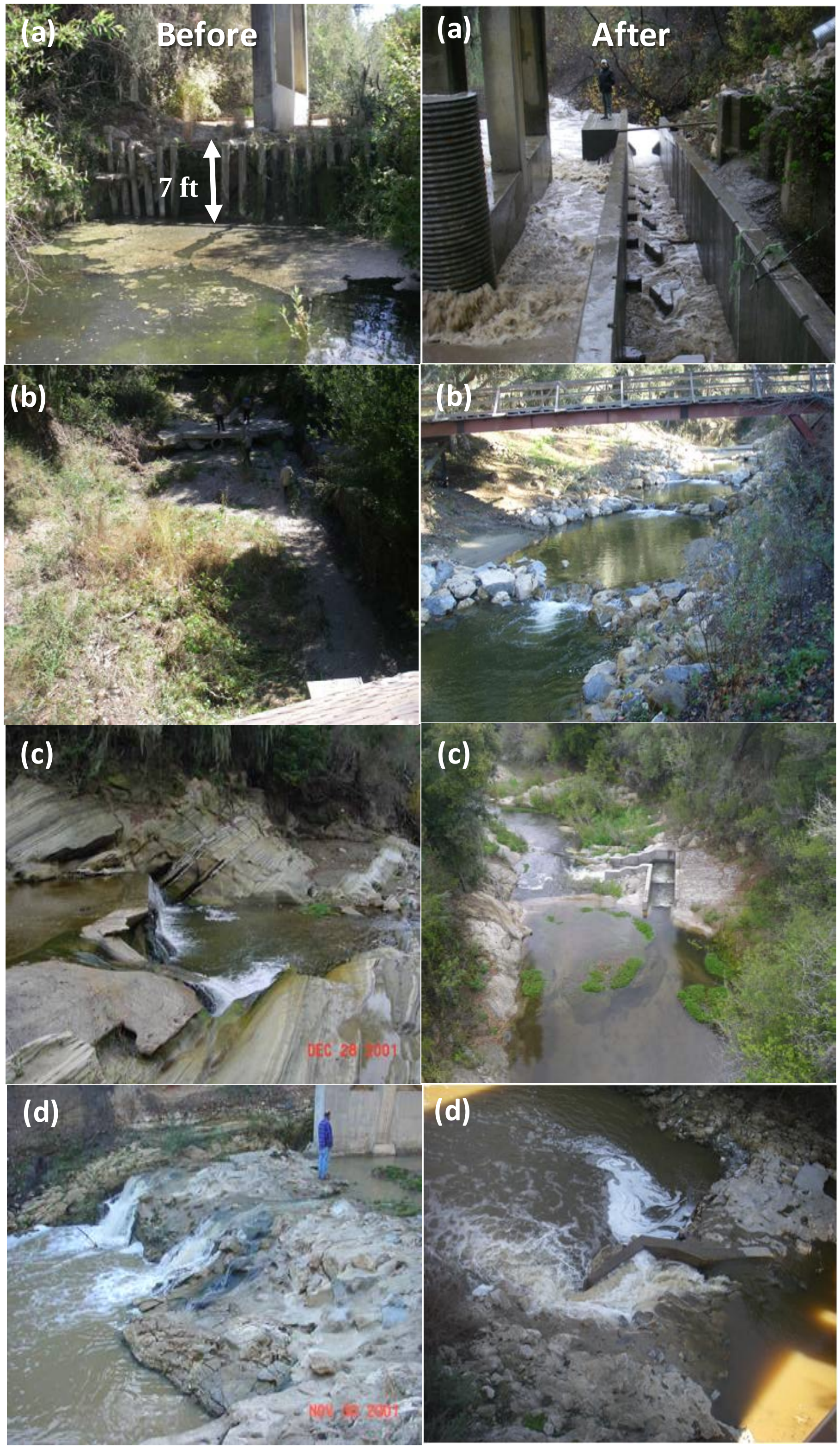


Figure 70: Fish passage and habitat restoration at (a) Rancho San Julian Bridge on El Jaro Creek (2008), (b) Cross Creek Ranch on El Jaro Creek (2009), (c) Jalama Road Bridge on Salsipuedes Creek (2004), and (d) Highway 1 Bridge on Salsipuedes Creek (2002).

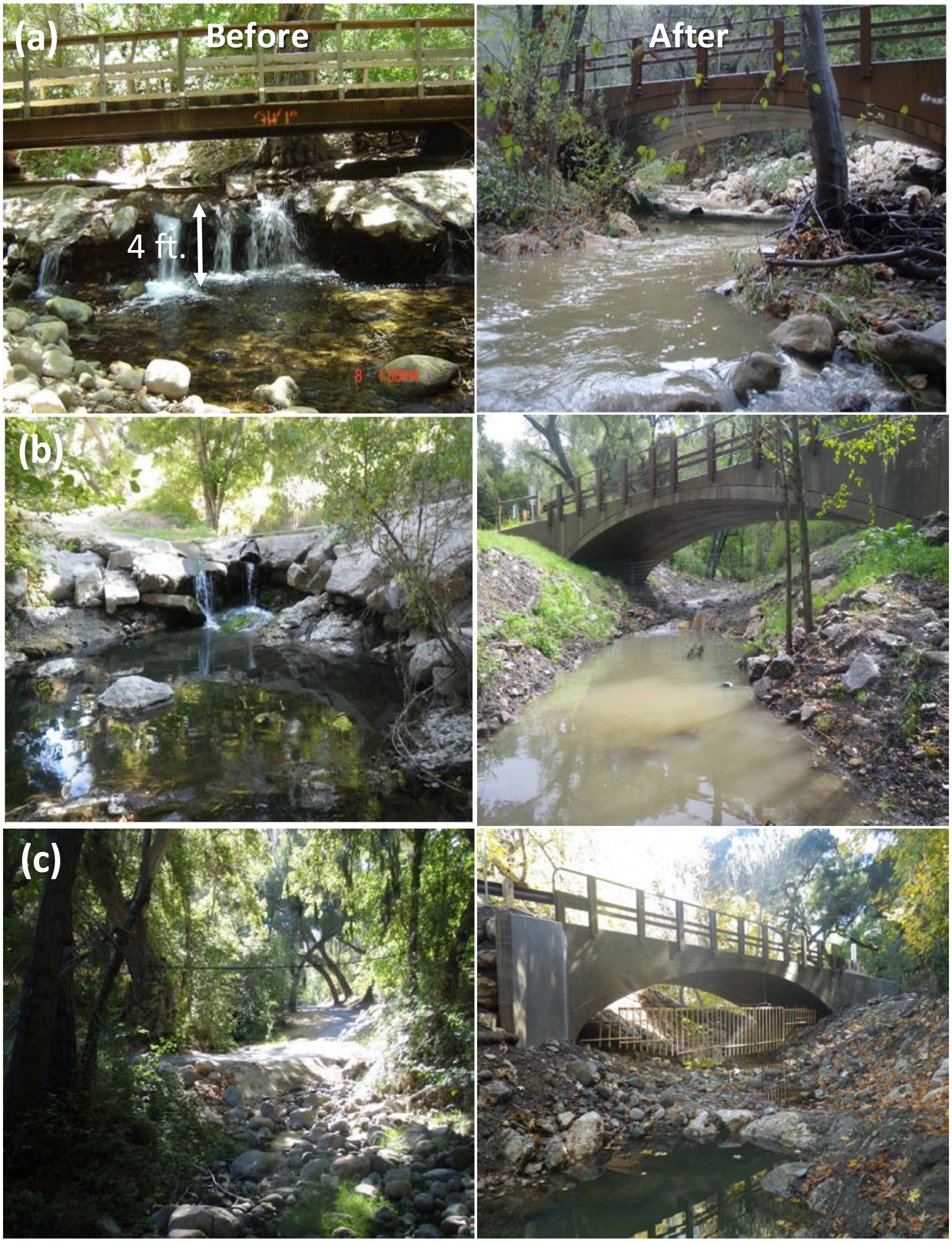


Figure 71: Fish passage and habitat restoration at (a) Quiota Creek Crossing 6 (in 2008), (b) Quiota Creek Crossing 2 (in 2011), and (c) Quiota Creek Crossing 7 (in 2012).

Figure 72: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

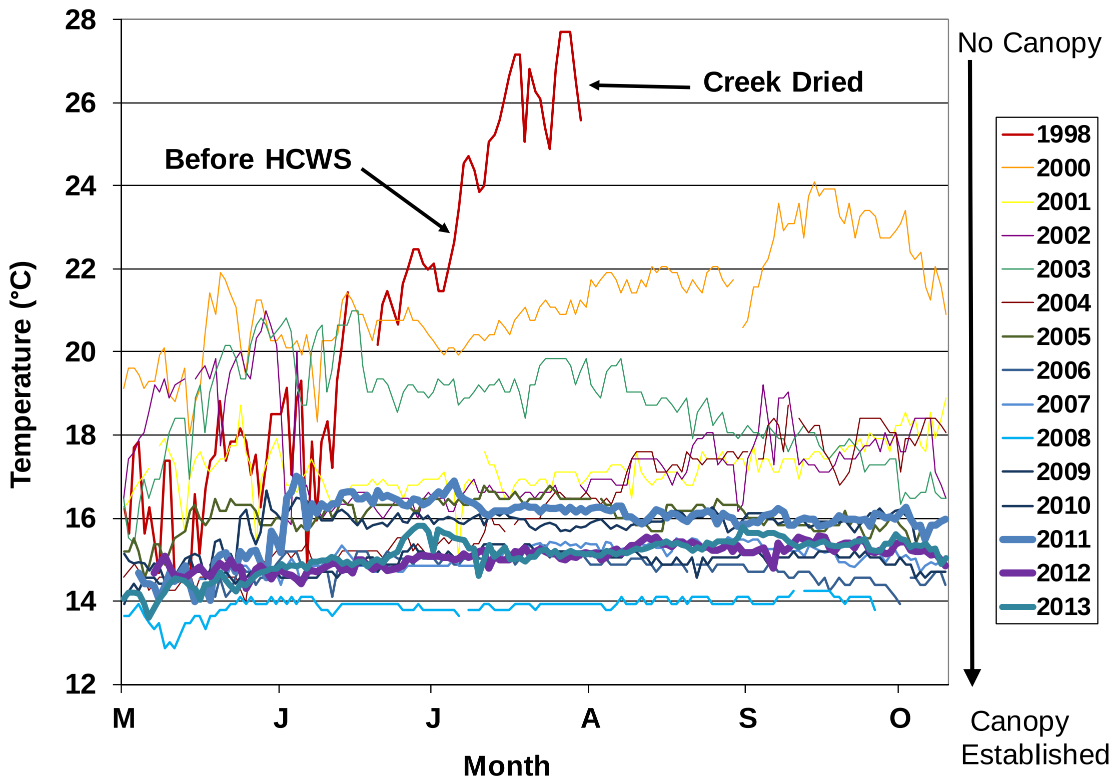


Figure 73: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2013, the last three years are shown with a wider curve.

Table 19: Summary list of interruption of flow incidents to Hilton Creek from the HCWS in WY2013.

Date	ΔQ	Incident Report	Q-stop (24 hr)	Q-start (24 hr)	Duration (hrs/mins)	Rescues (#)	Mortalities (#)	CPBS (#)	CDFW (#)	Cause
3/1/2013	Yes	Yes	2:00	12:30	10.5 hrs	25	56	5	-	Siphon broke
6/23/2013	Yes	Yes	21:45	4:45	7 hrs	1	87	3	-	Brown out
7/8/2013	Yes	Yes	10:08	10:13	<5 mins	0	0	4	3	Gravity to Pump
9/23/2013	Yes	Yes	8:00	8:15	15 mins	4	0	7	2	Scheduled power outage
Totals:	**4**					**30**	**143**			

Table 20: Details of O. mykiss rescues and mortalities during the 4 interruption of flow incidents at Hilton Creek in WY2013.

	Rescues				Mortalities			
	YOY	Juvenile	Adult	Σ	YOY	Juvenile	Adult	Σ
3/1/2013	0	19	6	25	0	53	3	56
6/23/2013	0	1	0	1	1	85	1	87
7/8/2013	0	0	0	0	0	0	0	0
9/23/2013	0	4	0	4	0	0	0	0
Totals:	**0**	**24**	**6**	**30**	**1**	**138**	**4**	**143**

Table 21: Redd (spawner) survey results of the annual totals from WY2010 to WY2013 by tributary and reach of the LSYR basin.

Water Year:	2010	2011	2012	2013
Year Type:	Wet	Wet	Dry	Dry
Tributaries:				
Hilton	7	7	7	13
Quiota	0	2	6	1
Salsipuedes	2	2	16	11
El Jaro	17	16	26	11
Los Amoles	3	11	7	1
Ytias	n/s	3	1	0
LSYR Mainstem:				
Hwy 154	0	0	0	1
Refugio	0	0	0	0
Alisal	0	0	0	0
TOTAL:	**29**	**41**	**63**	**38**

Table 22: WY2001-WY2013 *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	WY2012	WY2013
Year-type:	*Wet*	*Dry*	*Normal*	*Dry*	*Wet*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Wet*	*Dry*	*Dry*
Refugio Reach													
Spring	147	1	0	0	49	211	35	190	39	15	56	24	3
Summer	n/a	3	n/a	n/a	63	242	19	528	32	4	39	21	2
Fall	6	2	n/a	0	80	208	12	263	19	2	25	16	2
Alisal Reach													
Spring	123	3	0	0	18	134	54	26	39	23	38	27	5
Summer	11	3	n/a	n/a	21	89	39	118	17	8	39	21	1
Fall	1	1	n/a	0	11	85	9	42	7	10	36	10	0
Hilton Creek													
Spring	1163	624	564	510	1517	2740	1316	2210	545	1256	1139	924	675
Summer	1324	139	554	1046	1303	1891	1319	1519	863	1328	1195	1080	739
Fall	1420	n/a	381	n/a	1272	2016	n/a	738*	746	990	1147	1073	741
Quiota Creek													
Spring	273	359	49	22	n/a	n/a	n/a	243	189	114	130	186	31
Summer	168	n/a	49	n/a	n/a	142	201	81	101	93	167	n/a	2
Fall	161	n/a	n/a	n/a	n/a	84	78	67	39	38	180	50	1
Salsipuedes Creek (R#5)													
Spring	43	n/a	18	n/a	n/a	109	202	n/a	95	303	82	450	113
Summer	n/a	n/a	n/a	n/a	110	131	n/a	308	28	217	62	513	n/a
Fall	n/a	n/a	7	n/a	134	74	76	226	20	96	79	261	52
El Jaro Creek													
Spring	61	10	19	n/a	n/a	35	30	n/a	75	105	56	186	3
Summer	19	n/a	10	n/a	25	35	n/a	405	n/a	48	58	n/a	n/a
Fall	39	n/a	n/a	n/a	3	18	n/a	151	11	89	43	n/a	n/a

n/a: conditions either too turbid to snorkel or dry.

* Only half of the normal survey reach was snorkeled.

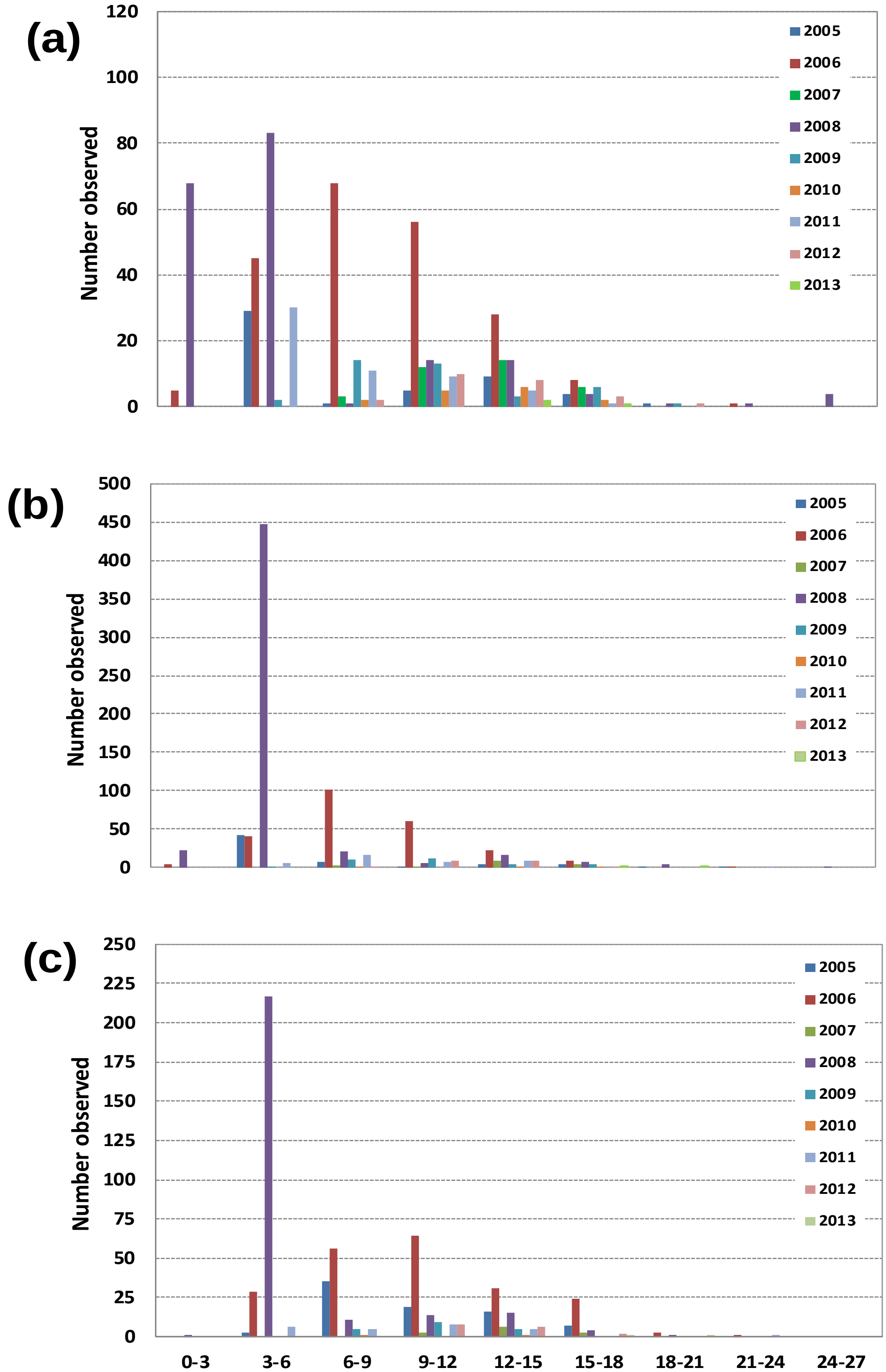


Figure 74: WY2005-WY2013 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for the LSYR mainstem Refugio Reach broken out by 3 inch size classes.

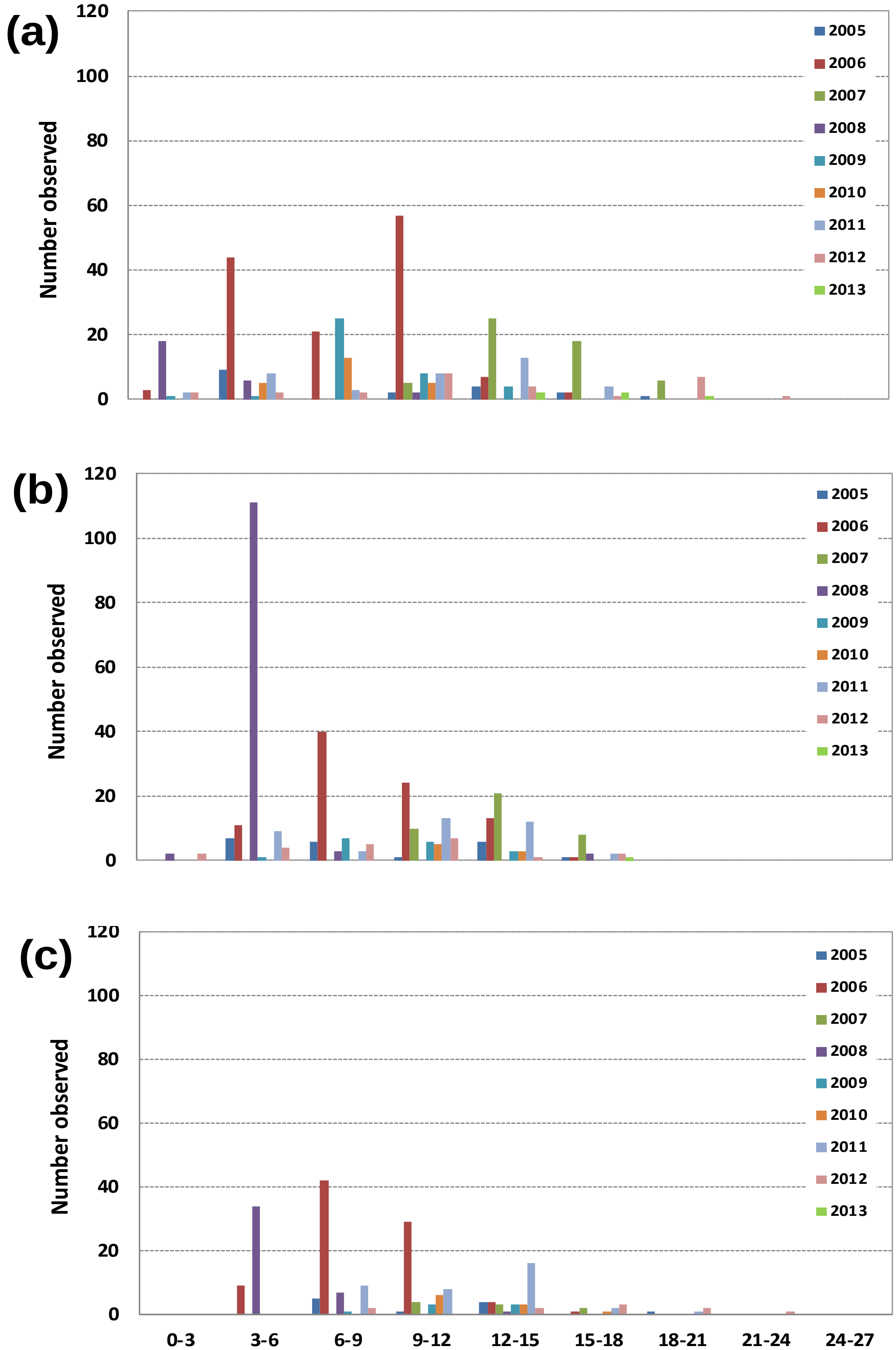


Figure 75: WY2005-WY2013 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for the LSYR mainstem Alisal Reach broken out by 3 inch size classes.

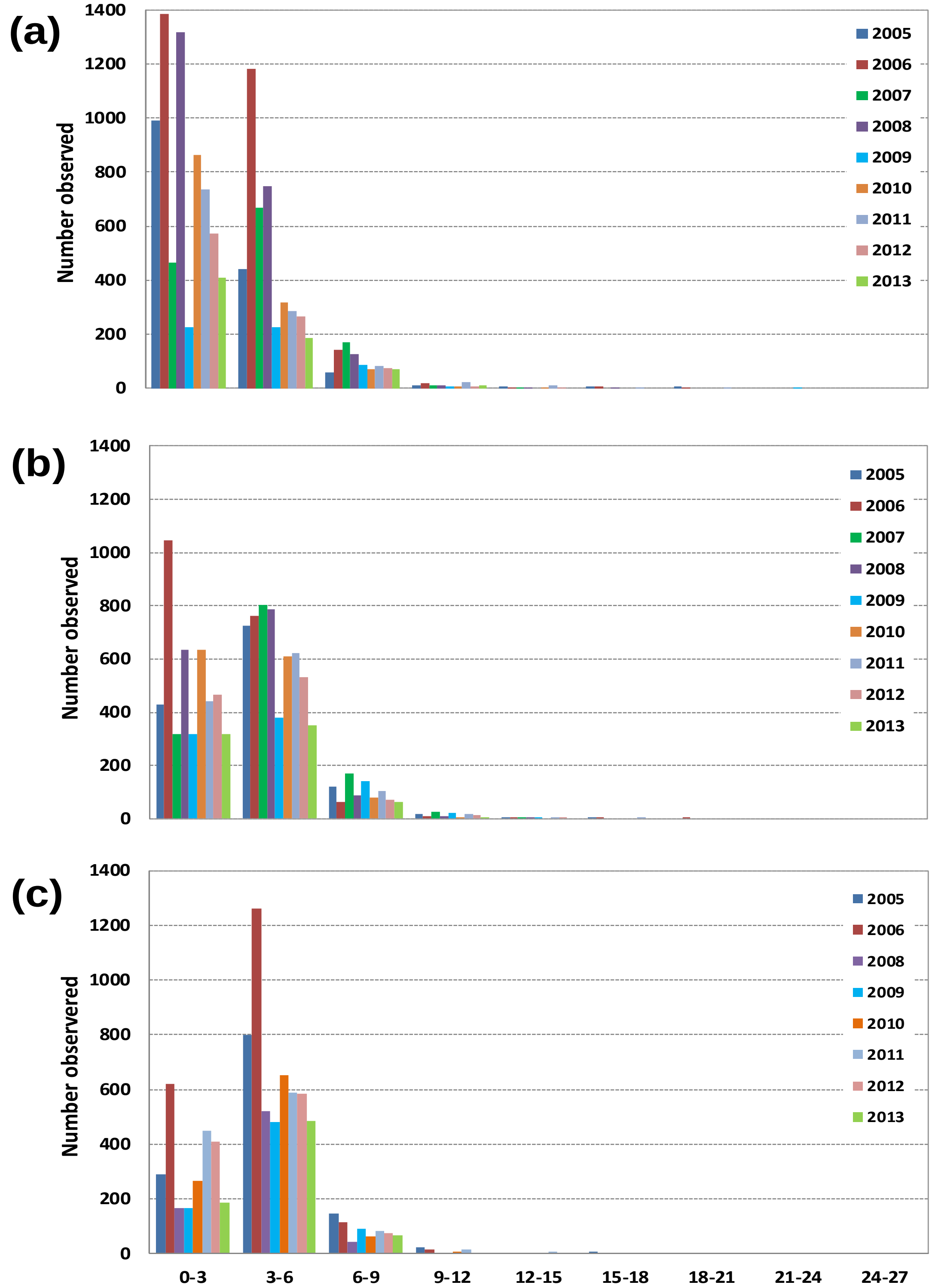


Figure 76: WY2005-WY2013 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Hilton Creek broken out by 3 inch size classes. Only half of the WY2008 fall snorkel survey was completed due to visibility issues.

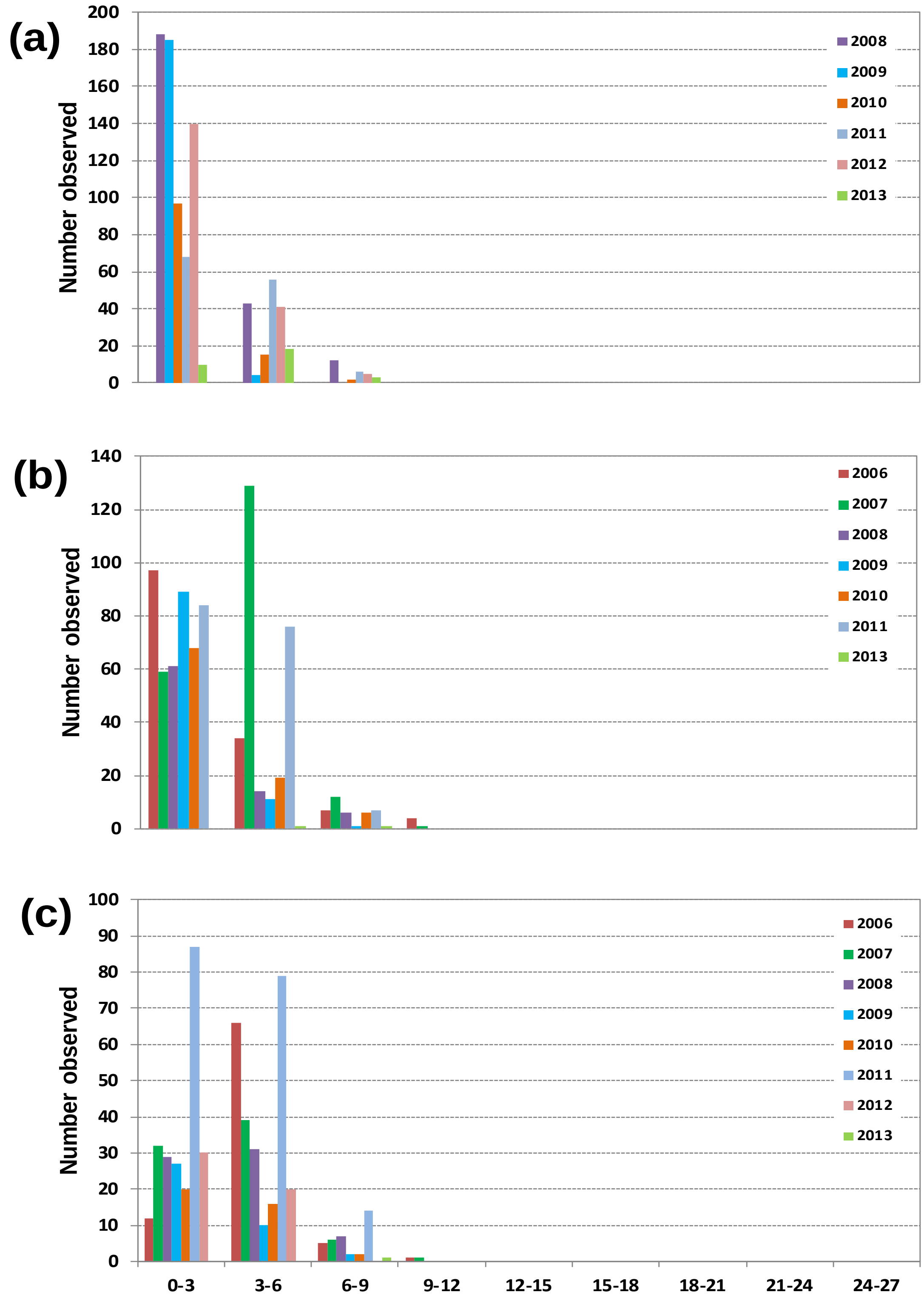


Figure 77: WY2006-WY2013 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Quiota Creek broken out by 3 inch size classes.

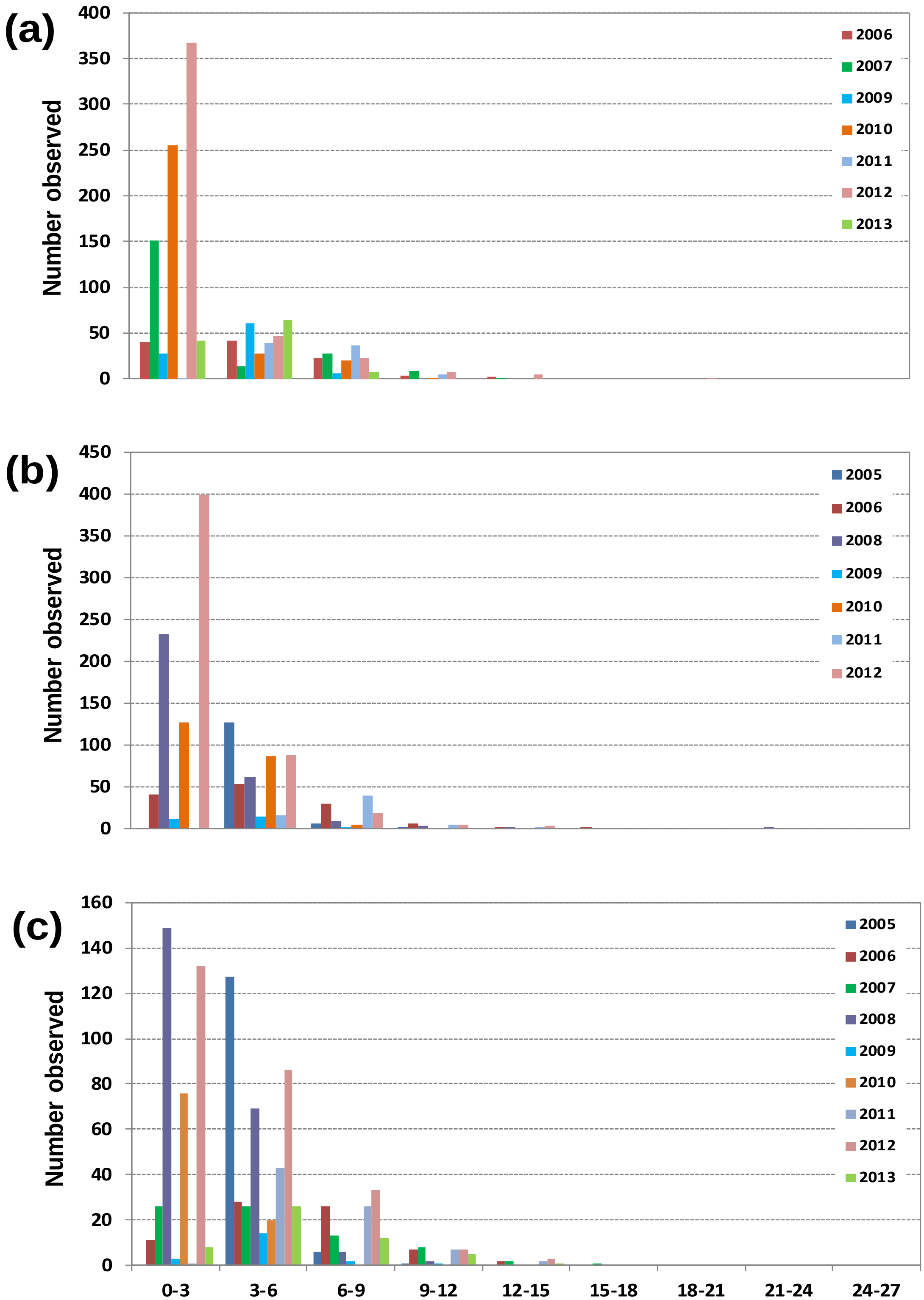


Figure 78: WY2005-WY2013 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for Salsipuedes Creek broken out by 3 inch size classes. Totals are only from Reach 5 for comparison.

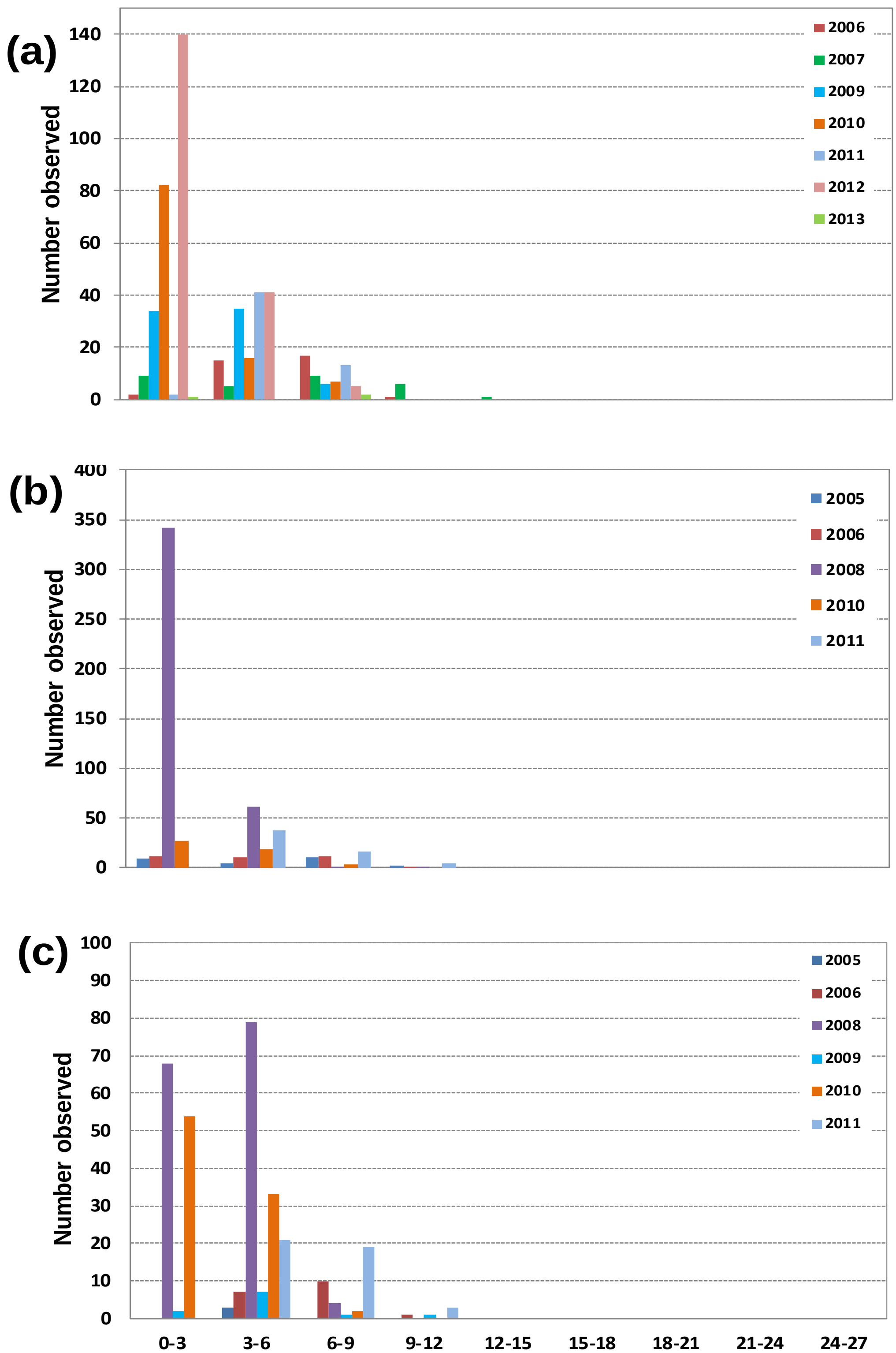
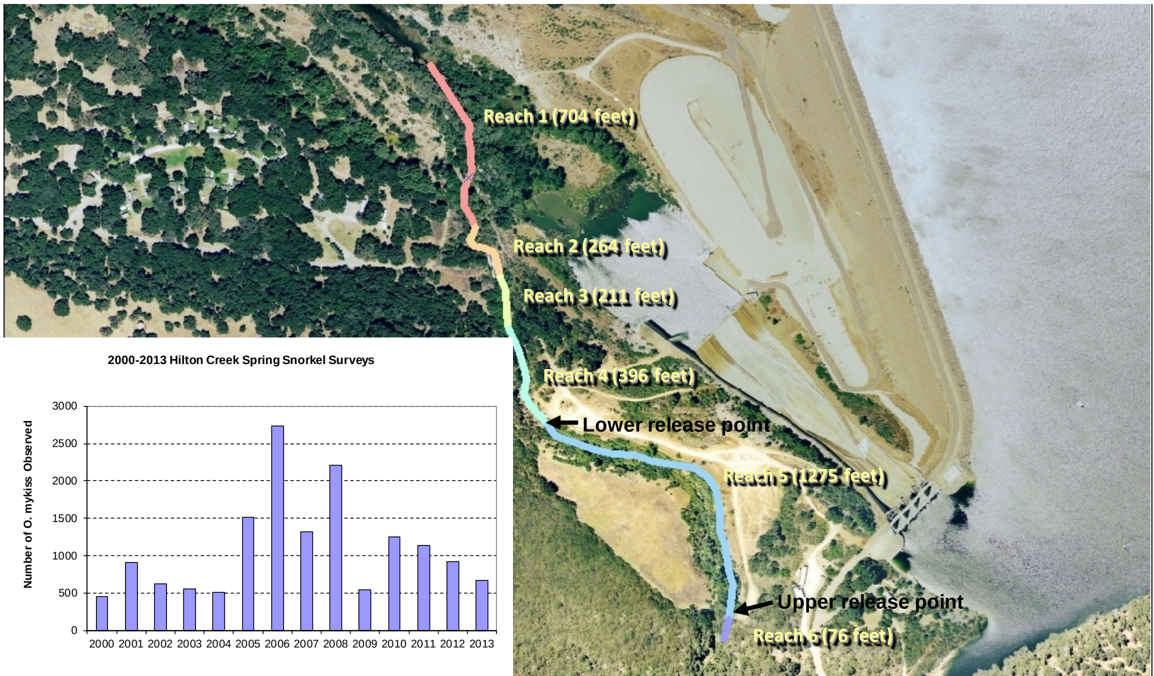


Figure 79: WY2005-WY2013 (a) spring, (b) summer, and (c) fall *O. mykiss* snorkel survey results for El Jaro Creek broken out by 3 inch size classes.



Reach	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	64	258	65	288	231	826	484	177	643	174	377	433	229	60
2	145	191	158	94	159	336	403	159	251	62	129	143	98	59
3	87	214	146	101	50	181	140	67	43	19	58	69	54	76
4	160	219	253	79	70	174	403	296	181	116	125	142	111	147
5	0	0	0	0	0	0	1244	617	1029	174	507	316	416	333
6	0	0	0	0	0	0	66	0	63	0	60	36	16	0
Total:	**456**	**882**	**622**	**562**	**510**	**1517**	**2740**	**1316**	**2210**	**545**	**1256**	**1139**	**924**	**675**

Figure 80: Hilton Creek reaches snorkeled with observed *O. mykiss* trend analysis from the spring snorkel surveys in 2000 through 2013. The embedded graph and table present number of *O. mykiss* observed. The Cascade Chute migration barrier was removed in December of 2005.

Table 23: WY2001-2013 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	WY2012	WY2013
Largemouth Bass													
Spring	78	147	184	22	0	7	35	4	160	53	16	371	242
Summer	57	881	Dry	172	20	3	33	626	239	137	434	807	1016
Fall	57	374	0	290	237	2	56	508	261	213	851	1118	65
Sunfish													
Spring	67	40	7	5	4	9	34	0	38	60	40	42	28
Summer	18	11	Dry	1	34	41	3	262	89	26	148	41	8
Fall	8	9	0	0	22	1	18	155	23	7	88	45	3
Catfish													
Spring	7	2	0	0	2	0	3	1	0	1	0	6*	0
Summer	0	0	Dry	0	6	55*	2	2	1	0	0	77*	0
Fall	1	2	0	2	200*	0	3	1	1	0	0	0	0
Carp													
Spring	0	0	0	0	0	9	138	50	66	28	52	42	166
Summer	0	0	Dry	0	178**	46	159	88	48	59	74	88	12
Fall	0	0	0	0	282**	10	190	69	65	76	61	98	17

* Juvenile bullhead catfish
** Mostly juvenile bullhead catfish

Table 24: WY2010 to WY2013 number and size of beaver dams in the LSYR mainstem and its tributaries (Hilton and Salsipuedes/El Jaro creeks) broken out by height.

	Mainstem Beaver Dams						Tributary Beaver Dams					
Height: WY	0.0-1.0 (ft)	1.1-2.0 (ft)	2.1-3.0 (ft)	3.1-4.0 (ft)	> 4.0 (ft)	Σ	0.0-1.0 (ft)	1.1-2.0 (ft)	2.1-3.0 (ft)	3.1-4.0 (ft)	> 4.0 (ft)	Σ
2010	3	65	40	17	3	128	0	17	5	3	0	25
2011	5	34	31	10	2	82	3	1	1	0	0	5
2012*	9	38	23	4	0	74	5	6	3	0	0	14
2013	23	75	27	7	0	132	8	23	4	0	0	35

* Total number of dams in 2012 is 76, two did not have height measuements

Table 25: Spring 2013 *O. mykiss* residents in the Refugio and Alisal reaches.

Reach	Location*	Habitat	*O. mykiss* Size Class (inches):							
			0-3	3-6	6-9	9-12	12-15	15-18	18-21	Total
Refugio	LSYR-4.95	Encantado Pool					1	1		2
	LSYR-7.65	Double Canopy Pool					1	1		2
							Refugio Reach Total:			4
Alisal	LSYR-8.05	Car Pool						1		1
	LSYR-8.70	Historic Beaver Pool						1	1	2
	LSYR-9.85	Corrigated Pipe Run				1				1
							Alisal Reach Total:			4

Figure 81: Aeration efforts at the Encantado Pool (LSYR-4.95) during the summer of WY2013.

Appendices

A. Acronyms and Abbreviations

AF: Acre Foot
AMC: Adaptive Management Committee
AMR: Annual Monitoring Report
AMS: Annual Monitoring Summary
BA: Biological Assessment
BiOp: Biological Opinion
BPG: Biogeographic Population Group
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
CRP: Chute Release Point
DIDSON: Dual-Frequency Identification Sonar
DO: Dissolved Oxygen Concentration
DPS: Distinct Population Segment
EJC: El Jaro Creek
HC: Hilton Creek
HCWS: Hilton Creek Watering System
Hwy: Highway
ID: Improvement District
ITS: Incidental Take Statement
LRP: Lower Release Point
LSYR: Lower Santa Ynez River
NMFS: National Marine Fisheries Service
NOAA: National Oceanic Atmospheric Administration
O. mykiss: *Oncorhynchus mykiss*, steelhead/rainbow trout
ORP: Oxidation Reduction Potential
RPM: Reasonable and Prudent Measure
QC: Quiota Creek

RTDG: Real Time Decision Group

SMC: San Miguelito Creek

SWP: State Water Project

SWRCB: California State Water Resources Control Board

SYRCC: Santa Ynez River Consensus Committee

SYRTAC: Santa Ynez River Technical Advisory Committee

T&C: Terms and Conditions

TDS: Total Dissolved Solids

URP: Upper Release Point

USBR: United States Bureau of Reclamation (Reclamation)

USGS: United States Geological Survey

WR: Water Right

WY: Water Year (October 1 through September 30)

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

B. QA/QC Procedures

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

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

Parameter	Instrument	Calibration Frequency	Timing	Standard or Calibration Instrument Used
Temperature	Thermograph	Annually	Spring	Water/ice bath to assure factory specifications and comparability between units.
Dissolved Oxygen	YSI -6920 (650 MDS) - DO meter ONSET -U26 DO Data Logger	Monthly	Monthly when in use	At a minimum, water saturated air, according to manufacturer's instructions. ONSET logger sensor good for 6 months, then replaced.
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
ONSET U-26 Dissolved Oxygen Data Logger	Dissolved Oxygen	mg/l	0 to 20 mg/l	0.02	0.2 mg/l up to 8 mg/l, 0.5 mg/l from 8 to 20 mg/l
	Temperature	°C	-5 to 40	0.02	0.2
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 thermographs are 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.

ONSET (U-26) DO/Temp Data Logger

These units were added in WY-2013 to accompany other DO measuring devices (sondes) in order to measure additional monitoring locations. Steel cables with ¼ inch u-bolts are used to fasten U-26 loggers 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. These data loggers require HOBOware software (USB interface cable) and a communication device for downloading. Units are factory calibrated and once initialized, can record DO/temperature for a period of 6 months before being returned to the factory for a new sensor cap.

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 except for some minor tampering of the deployment cable by kids at the Encantado habitat site only.

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.

ONSET data are transferred to a communication device through a USB interface cable and then downloaded to a HOBOware software program. Once the data has been transferred, it’s converted to a CSV 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.

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 2002-2013 in the spring, summer, and fall. After 2005 and continuing through 2010, photo points were scaled down and taken at irregular intervals. All photo points taken in WY2013 are listed in Tables B-1 and B-2 and were taken at more regular intervals as recommended in the 2010 Annual Monitoring Report. 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.

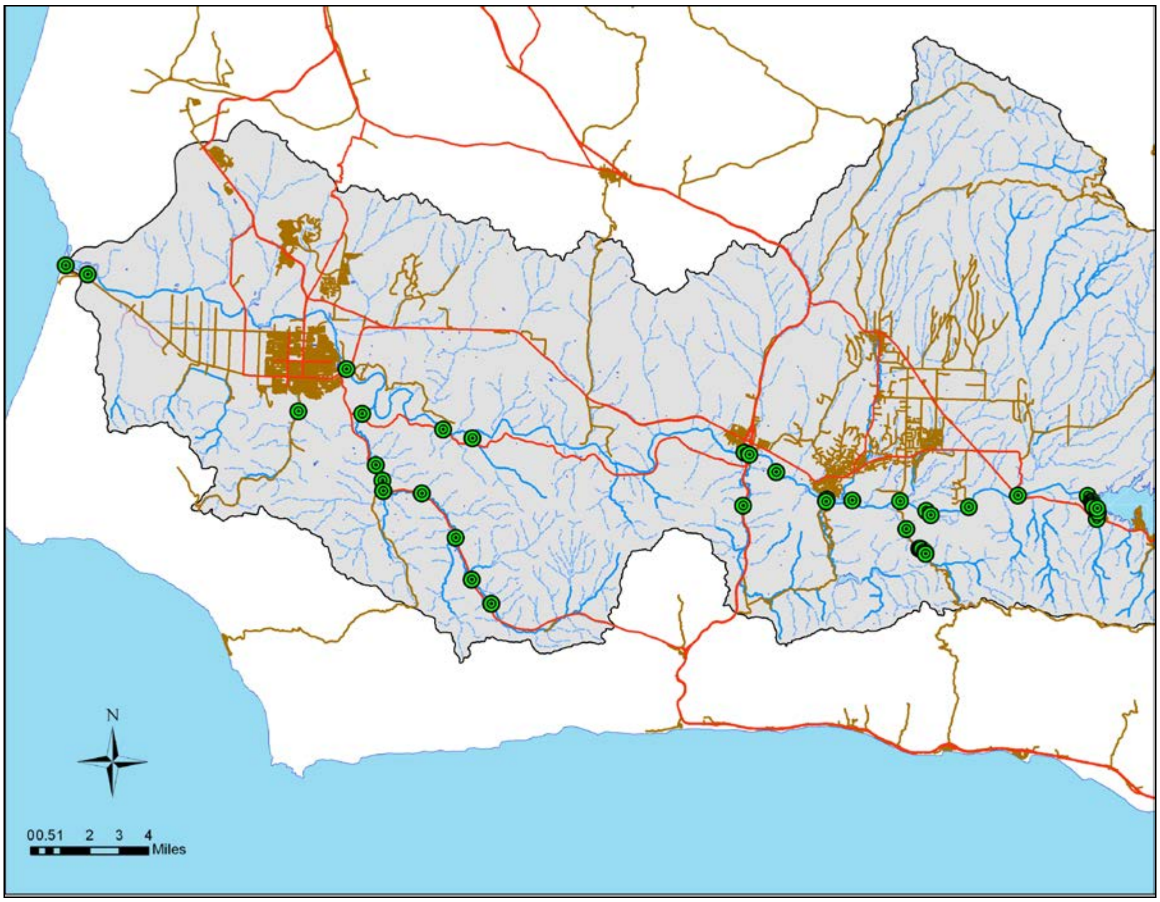


Figure C-1: WY2013 photo point locations.

Table C-1: WY2013 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	4/9	5/15
M1	Lower Hilton Creek, photo d/s at ford crossing	X	
M2a	Bluffs overlooking long pool, photo u/s	X	
M2b	Bluffs overlooking long pool, photo d/s	X	
M3	Highway 154 culvert on Hilton Creek, photo u/s	X	
M4	Highway 154 culvert on Hilton Creek, photo d/s	X	
M5	Highway 154 Bridge, photo u/s	X	
M6	Highway 154 Bridge, photo d/s		
M7	Meadowlark crossing, photo u/s		
M8	Meadowlark crossing, photo d/s		
M9	Lower Gainey crossing, beaver dam, photo u/s	X	
M10	Lower Gainey crossing, beaver dam, photo d/s	X	
M11a	Lower Gainey crossing, photo u/s	X	
M11b	Lower Gainey crossing, photo d/s	X	
M12	Refugio Bridge, photo u/s	X	
M13	Refugio Bridge, photo d/s	X	
M14	Alisal Bridge, photo u/s	X	
M15	Alisal Bridge, photo d/s	X	
M17	Mid-Alisal Reach, photo u/s	X	
M18	Mid-Alisal Reach, photo d/s	X	
M19	Avenue of the Flags Bridge, photo u/s	X	
M20	Avenue of the Flags Bridge, photo d/s	X	
M21	Sweeney Road crossing, photo u/s	X	
M22	Sweeney Road crossing, photo d/s	X	
M23	Highway 246 (Robinson) Bridge, photo u/s	X	
M24	Highway 246 (Robinson) Bridge, photo d/s	X	
M25	LSYR Lagoon on railroad bridge, photo u/s		X
M26	LSYR Lagoon on railroad bridge, photo d/s		X
M27	LSYR at 35th St. Bridge, photo d/s		X
M28	LSYR at 35th St. Bridge, photo u/s	X	X
M29	LSYR Lagoon upper reach, photo d/s	X	X
M30	LSYR Lagoon upper reach, photo u/s		X
M31	Slick Gardener X-ing, looking across towards hwy		
M32	Slick Gardener X-ing, looking d/s	X	
M33	Slick Gardener X-ing, looking u/s	X	

Table C-2: 2013 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	4/9	5/15
T1	Hilton trap site, photo u/s	X	
T2	Hilton trap site, photo d/s		
T3	Hilton at ridge trail, photo d/s	X	
T4	Hilton at ridge trail, photo u/s	X	
T5	Hilton at telephone pole, photo d/s	X	
T6	Hilton at telephone pole, photo u/s	X	
T7	Hilton at tail of spawning pool, photo u/s		
T8	Hilton impediment/tributary, photo d/s	X	
T9	Hilton impediment/tributary, photo u/s	X	
T10	Hilton just u/s of URP, photo d/s	X	
T11	Hilton road above URP, photo d/s	X	
T12	Hilton road above URP, photo u/s	X	
T14	Hilton from hard rock toe, photo d/s	X	
T15	Hilton from hard rock toe, photo u/s	X	
T16	Quiota Creek at 5th crossing, photo d/s	X	
T17	Quiota Creek at 5th crossing, photo u/s	X	
T18	Quiota Creek at 6th crossing, photo d/s	X	
T19	Quiota Creek at 6th crossing, photo u/s	X	
T20	Quiota Creek at 7th crossing, photo d/s	X	
T21	Quiota Creek at 7th crossing, photo u/s	X	
T22	Quiota Creek below 1st crossing, photo d/s	X	
T23	Alisal Creek from Alisal Bridge, photo u/s	X	
T24a	Alisal Creek from Alisal Bridge, photo u/s	X	
T24b	Alisal Creek from Alisal Bridge, photo d/s	X	
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s		X
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s		X
T27	Nojoqui/LSYR confluence, photo u/s		X
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s		
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s		
T39	Salsipuedes Creek at Hwy 1 Bridge, photo d/s	X	
T40	Salsipuedes Creek at Hwy 1 Bridge, photo u/s	X	
T41	Salsipuedes Creek at Jalama Bridge, photo d/s	X	
T42	Salsipuedes Creek at Jalama Bridge, photo u/s	X	
T43	El Jaro/Upper Salsipuedes confluence, photo u/s	X	
T44	Upper Salsipuedes/El Jaro confluence, photo u/s	X	
T45	Upper Salsipuedes/El Jaro confluence, photo d/s	X	
T48	El Jaro Creek above El Jaro confluence, photo u/s	X	
T49	El Jaro Creek above El Jaro confluence, photo d/s	X	
T52	Ytias Creek Bridge, photo d/s		
T53	Ytias Creek Bridge, photo u/s		
T54	El Jaro Creek 1st Hwy 1 Bridge, photo d/s		
T55	El Jaro Creek 1st Hwy 1 Bridge, photo u/s		
T56	El Jaro Creek 2nd Hwy 1 Bridge, photo d/s		
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s		
T58	El Jaro Creek 3rd Hwy 1 Bridge, photo d/s		
T59	El Jaro Creek 3rd Hwy 1 Bridge, photo u/s		
T60	San Miguelito Creek at crossing, photo d/s		X
T61	San Miguelito Creek at Stillman, photo u/s		X
T62	Rancho San Julian Bridge, photo d/s	X	
T63	Rancho San Julian Bridge, photo u/s	X	

D. List of Supplemental Reports Created During WY2013

- 2011 Annual Monitoring Summary with Trend Analyses (COMB, 2013a).
- 2012 Annual Monitoring Summary with Trend Analyses (COMB, 2016).
- Quiota Creek Crossing 7 End of Project Report (COMB, 2013b)
- CDFW-FRGP Grant Proposal for Quiota Creek Crossing 0 Project
- 2013 WR 89-18 Release Study Plan
- WY2013 Migrant Trapping Plan
- HC Incident Reports (3/1/13, 6/23/13, 7/8/13, 9/23/13)

E. References

COMB, 2013a. 2011 Annual Monitoring Summary and Trend Analysis. Prepared for the Bureau of Reclamation and the National Marine Fisheries Service, Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2013b. End of Project Compliance Report, Fish Passage Improvement on Crossing 7, Quiota Creek. Compliance Report, Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2016. 2012 Annual Monitoring Summary and Trend Analysis. Cachuma Operation and Maintenance Board (COMB), Fisheries Division.