WY2014 ANNUAL MONITORING SUMMARY

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

APRIL 10, 2018

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Executive Summary

The WY2014 Annual Monitoring Summary (AMS) 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 2014 (WY2014, 10/1/13 – 9/30/14). The report also incorporates historical context of the water year type since WY2000, advancements of identified tributary restoration projects and recommendations for the next water year's monitoring efforts.

The monitoring tasks completed in WY2014 were performed below Bradbury Dam in the LSYR watershed and 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).

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.

This report summarizes data gathered since the WY2013 Annual Monitoring Summary (COMB, 2017) and fulfills the annual 2014 reporting requirements of the Cachuma Project Biological Opinion (BiOp). The BiOp was issued by the National Marine Fisheries Service (NMFS) to U.S. Department of the Interior Bureau of Reclamation (Reclamation) in 2000 for the operation and maintenance of the Cachuma Project (NMFS, 2000). This report was prepared by the Cachuma Operation and Maintenance Board (COMB) Fisheries Division (FD) with the monitoring and data analyses prepared by COMB-FD staff. In WY2014, some deviations to the monitoring program as described in the BiOp (NMFS, 2000), Biological Assessment (BA) (USBR, 2000), and LSYR Fish Management Plan (FMP) (SYRTAC, 2000) and the prior Annual Monitoring Reports/Summaries were necessary, specifically in relation to water quality monitoring, redd surveys, and migrant trapping. The modifications were required due to landowner access constraints, drought related conditions, 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, 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.

WY2014 was a dry year (9.96 inches of precipitation measured at Bradbury Dam; long-term average, 1953-2014, is 20.2 inches) with the majority of the rainfall occurring in February and March. This was the seventh driest year over the period of record with 2007 being the driest at 7.41 inches of rain at Bradbury Dam. The largest storm of WY2014 (6.75 inches of rain) occurred on 2/28/14. 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 third year after a spill (WY2011) and reservoir storage was less than 120,000 acre-feet (af) at the beginning of the water year (91,681 af on 10/1/13), target flows for rearing were maintained at Hilton Creek (2 cubic feet per second (cfs) minimum) and the Highway 154 Bridge (2.5 cfs minimum) with no target flows to Alisal Bridge as described in the BiOp. There was no fish passage supplementation because the minimum criteria for a wetted watershed was not met. A Water Rights (WR) 89-18 release was conducted from 8/18/14 until 11/11/14 during which 4,697 af were released over a period of 85 days.

During the water year, there were five incidents of unplanned interruption of flow to Hilton Creek from the Hilton Creek Watering System (HCWS) on 10/25/13, 3/1/14, 3/11/14, 3/26/14, and 5/25/14. The cumulative total of *O. mykiss* rescues and mortalities was 604 and 250, respectively. Detailed reports were submitted to NMFS by Reclamation for each incident.

Migrant trapping was conducted this year under a modified plan (reduced duration and functional trap days) to assure juvenile and adult take limits would not be exceeded. Reproduction and population status was monitored through spawner (redd) surveys and snorkel surveys.

Stream water quality data (temperature and dissolved oxygen concentration) are presented for the LSYR mainstem below Bradbury Dam and its tributaries where *O. mykiss* historically have been observed. Given the complexity of the dataset, details are summarized in the Monitoring Results Section (3.2) only when there were observations of note, such as the presence of native and non-native fish species.

Since the issuance of the BiOp in 2000, Reclamation with assistance from COMB, has completed many conservation actions for the benefit of southern steelhead including: the construction and operation of the HCWS; the completion of tributary passage enhancement projects on Hilton, Quiota, El Jaro, and Salsipuedes creeks; the completion of the bank stabilization and erosion control projects on El Jaro Creek; water releases to maintain the LSYR mainstem and Hilton Creek flow targets; and the implementation and management of the Fish Passage Supplementation Program. COMB was involved in the planning, design, permitting, and construction of all the tributary projects (except the Hilton Creek Watering System and Cascade Chute Project in Hilton Creek) and was successful in acquiring grant funding for these project from state and federal programs. These funds were supplemented by funding from the Cachuma Member Units which allowed for the construction of 8 projects restoring access to the streams in the lower Santa Ynez River Watershed for steelhead. A description, map and photos of all habitat enhancement projects are presented in Section 4. The fish passage project at Quiota Creek Crossing 1 was successfully completed in WY2014. Plans have moved forward for the completion of another fish passage project on Quiota Creek for Crossing 3 to be built in WR2015.

The following are recommendations to improve the monitoring program and are not listed by priority; some are subject to funding availability:

- Continue to implement the monitoring program described in the revised BA (USBR, 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;
- Continue the collaboration with CDFW regarding operation of their DIDSON in Salsipuedes Creek;
- Continue annual implementation of a Migrant Trapping Plan that would be reviewed and approved by NMFS to assure compliance with take limits set forth in the 2000 BiOp;
- Conduct basic stomach content analyses of non-native piscivorous fish whenever possible specifically in habitats known to support *O. mykiss* and non-native fish;
- Encourage Reclamation to improve the reliability of their HCWS to deliver water and provide continuous flow to Hilton Creek without interruption;
- Collaborate with Reclamation regarding Critical Drought Conditions and downstream water releases for the fishery during drought conditions;
- Continue to maintain and improve relationships with landowners to foster cooperation and gain access to additional reaches for all monitoring tasks, and particularly when conducting tributary project performance evaluations within upstream tributary reaches;
- 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 continue to maintain the LSYR *O. mykiss* scale inventory and conduct 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;

- Move towards a more fluid data recording and reporting procedure of the data from the temperature probes on the Outlet Works of Bradbury Dam to measure water temperature being released to the Stilling Basin, specifically to document BiOp compliance (18 ^{o}C maximum release temperature);
- 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.

TABLE OF CONTENTS

TABLES and FIGURES

Figure 28: 2014 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 July 1-October 1; this unit was an isolated pool habitat prior to the arrival of the WR89-18 release.

Figure 29: 2014 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 July 1-October 1; this unit was an isolated pool habitat prior to the arrival of the WR89-18 release.

Figure 30: 2014 Longitudinal maximum surface water temperatures at the Long Pool (LSYR-0.50), Encantado Pool (LSYR-4.95), Double Canopy Pool (LSYR-7.65), Head of Beaver Pool (LSYR-8.7), Alisal Bedrock Pool (LSYR-10.20), Avenue of the Flags Pool (LSYR-13.90, bottom of pool), and Cadwell Pool (LSYR-22.68) with daily flow (discharge) at the Hilton Creek and Solvang (at the Alisal Bridge) USGS gauges.

Figure 31: 2014 HC-0.12 (Lower Hilton Creek) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

Figure 32: 2014 HC-0.54 (Upper Hilton Creek) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1. Included in the graph is a Hilton Creek dewatering incident where the thermographs was exposed to air.

Figure 33: 2014 QC-2.66 (Quiota Creek) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period April 23-July 9. The unit was removed from the site on July due to lack of water.

Figure 34: 2014 SC-0.77 (Lower Salsipuedes Creek) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

Figure 35: 2014 SC-2.20 (Salsipuedes Creek Reach 2 Bedrock Section) bottom (4.0 feet) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period from July 1-October 1.

Figure 36: 2014 SC-3.0 (Salsipuedes Creek 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 from July 1-October 1.

Figure 37: 2014 SC-3.5 (Salsipuedes Creek 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 from July 1-October 1.

WY2014 Annual Monitoring Summary

1. Introduction

The 2000 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 WY2014 Annual Monitoring Summary (AMS) is to present the monitoring data collected in Water Year 2014 (WY2014, 10/1/13-9/30/14) and to provide preliminary data analysis. Data collected on Southern California steelhead/rainbow trout (*Oncorhynchus mykiss* or *O. mykiss*) in the Lower Santa Ynez River (LSYR) below Bradbury Dam throughout WY2014 regarding (1) hydrologic condition, (2) water quality, (3) habitat quality, (4) migration, and (5) reproduction and rearing are analyzed and presented in this report. 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. Observations of population trends from 2001-2014 are 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), 2012 Annual Monitoring Summary (COMB, 2016), and the WY2013 Annual Monitoring Summary (COMB, 2017).

The data summarized in this report describe the habitat conditions and the fishery observations in the LSYR during WY2014. This period roughly encompasses the annual reproductive cycle of steelhead; including migration, spawning, rearing, and oversummering as those activities relate to the wet and dry periods of the year. Although fall snorkel surveys occur in October or November (of the following water year), they have been included in the current water year's annual report 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).

WY2014 was classified as a dry year with only 9.96 inches of precipitation recorded at Bradbury Dam (long-term average, 1953-2014, is 20.2 inches; seventh lowest year over the period of record with WY2007 being the lowest at 7.41 inches). This was the fourth lowest rainfall year since issuance of the 2000 BiOp with 7 of 14 years classified as dry (WY2007, WY2013, WY2002, WY2014, WY2004, WY2012, and WY2009 listed in order of severity). Dry years, in general, are often associated with a reduction of the *O. mykiss* population. This may be due to the lack of flow, limited availability of habitat, and reduced or no ocean connectivity for anadromous reproduction (Lake, 2003; COMB, 2013). However, dry years can increase resident *O. mykiss* reproduction potentially due to limited storm flows that can wash out redds.

Migrant trapping was conducted in WY2014 and all BiOp take limits were followed. Reproduction and population status was monitored through spawner (redd) surveys and snorkel surveys.

There were five incidents of unplanned interruption of flow (10/25/13, 3/1/14, 3/11/14, 3/26/14, and 5/25/14) to Hilton Creek from the Hilton Creek Watering System (HCWS) that resulted in relocation of 604 and mortality of 250 *O. mykiss*. In each case, a report with details was submitted by Reclamation to NMFS and these incidents will only be discussed below in the context of monitored water quality and observed fish through migrant trapping and snorkel surveys.

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)), and others, 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 (FD), specifically the COMB-FD staff (previously referred to as the Cachuma Project Biology Staff, COMB-FD staff), for Reclamation in compliance with the 2000 BiOp. The program has evolved in scope and specificity of monitoring tasks after southern California steelhead were listed as endangered under the federal Endangered Species Act in 1997 (NMFS, 1997) and since critical habitat was designated in 2000 and 2005 (NOAA, 2005). Further refinements were incorporated into the monitoring program during the development of the BA for the Cachuma Project

(USBR, 1999), after the issuance of the BiOp (NMFS, 2000) and through 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 five Annual Monitoring Reports with trend analyses were completed for 2009 (USBR, 2012), 2010 (USBR, 2013), 2011 (COMB, 2013), 2012 (COMB, 2016), and 2013 (COMB, 2017). All reports fulfilled the annual monitoring reporting requirements set forth in the BiOp (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 migrating to the ocean (NMFS, 2012). The two life history types or strategies (anadromous and resident) will be distinguished when possible throughout this report.

2.2. Meteorological and hydrological overview

The headwaters of the Santa Ynez River are located approximately 4,000 feet above sea level in the San Rafael Mountains. The river flows in a westerly direction for approximately 90 miles before reaching the Pacific Ocean near the City of Lompoc. The Santa Ynez River watershed is almost entirely contained within Santa Barbara County, with only a small eastern portion in Ventura County. There are three water supply reservoirs on the river: Jameson, Gibraltar, and Cachuma. Lake Cachuma essentially divides 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. Historically, the majority of the rainfall occurs during the winter and spring (December-May) months with most rain falling from December through April. The migration and spawning season for *O. mykiss* corresponds with the initiation of the wet season, and these activities overlap in both the anadromous and resident forms. The anadromous form of the species begins to migrate to spawning locations once the sandbar at the mouth of the river is breached, and the tributaries begin flowing. This typically occurs sometime after the first major storm of winter. Hence, review of the meteorological and hydrological conditions for each year is essential for the analysis and interpretation of the fisheries data collected during that year.

2.3. Monitoring and data quality assurance and control

Field monitoring activities for migrant trapping, snorkel surveys, and redd surveys followed established CDFW and NMFS protocols as described in the 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 in Appendix B.

3. Monitoring Results

The results from the WY2014 monitoring effort are organized by (1) hydrologic condition, (2) water quality, (3) habitat quality, (4) migration of *O. mykiss*, (5) reproduction and rearing, (6) tributary enhancements project monitoring, and (7) additional investigations.

3.1. Hydrologic Condition

Precipitation, stream runoff, and Bradbury Dam spills: Historically, water year type for the Santa Ynez River basin has been defined as a dry year when rainfall at Bradbury Dam is equal to or less than 15 inches, a normal year when rainfall is 15 inches to 22 inches, and a wet year when precipitation (e.g., rainfall) is equal to or greater than 22 inches (AMC, 2008). The California State Water Resources Control Board (SWRCB) uses different criteria that focus on river runoff (in this case inflow to the Cachuma Reservoir); a critically dry year when inflow is equal to or less than 4,550 acre-feet (af); a dry year when inflow is between 4,550 af and 15,366 af; a below normal year when inflow is between 15,366 af and 33,707 af; a normal year when inflow is between 33,708 and 117,842 af; and a wet year when inflow is greater than 117,842 af (SWRCB, 2011). Due to the longstanding classification used in previous AMR/AMS reports, the SWRCB approach will not be used in this report, although the designation would have been a dry year at 3,842.5 af of computed inflow to Lake Cachuma.

WY2014 had 9.96 inches of rainfall at Bradbury Dam and was therefore classified as a dry year (less than 15 inches) (Table 1). The long-term average (1953-2014) at Bradbury Dam as recorded by Reclamation is 20.2 inches. Very little runoff occurred within the LSYR mainstem and tributaries in WY2014, and the mainstem flow from the dam downward was insufficient to connect with the LSYR lagoon. Only 27 days of flow was recorded at H Street during the migration season of 2014, 25 of which were consecutive with a flow rate of from 0.9 cfs to 9.8 cfs which wasn't enough to connect with the lagoon and breach the berm to the ocean. Upstream migration opportunities from the lagoon or the ocean were non-existent due to low rainfall and subsequent runoff. In Salsipuedes Creek, the highest recorded flow at the USGS station at Jalama Bridge was 38 cfs, on February 28. Historic minimum, maximum, and WY2014 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 10 precipitation events in WY2014 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). Only 9.96 inches of rain was recorded at Bradbury Dam in WY2014, with nearly half (4.11 inches) of the total recorded in February. The months of February and March had precipitation totaling over three inches of rainfall each month (Table 3). The necessary triggers to implement a passage supplementation event were not met in WY2014. In addition, a WR 89-18 water rights release was conducted during the summer and fall period from 8/18/14 to 11/11/14.

Annual flow hydrographs for the LSYR basin at the Narrows (USGS-11133000), Salsipuedes Creek (USGS-11132500), Solvang (Alisal Bridge) (USGS-11128500), Bradbury Dam (Reclamation), and Los Laureles (USGS-11123500) (upstream of Lake Cachuma) gauges are shown in Figure 2. The lagoon did not open to the ocean in WY2014. To note, Hilton Creek gauge (USGS-11125600) w is a low flow gauge only (less than 50 cfs).

Peak daily discharge recorded by the USGS at the Narrows on the LSYR mainstem and Salsipuedes gauges occurred on 2/28/14 at 69 cfs and 38 cfs, respectively. Peak daily discharge at the Solvang and Los Laureles gauge of the LSYR mainstem was 80 cfs and 60 cfs on 3/1/14, respectively. The Hilton Creek Gauge (USGS-11125600, a low flow (less than 50 cfs) gauge only, did not record any stormflow events from the upper basin throughout the water year. Peak releases from Bradbury Dam were 143 cfs on 8/20/14 during the onset of the 2014 WR 89-18 Release.

Instantaneous peak discharges at the Narrows and Salsipuedes gauges on 2/28/14 were 185 cfs and 158 cfs, respectively. Instantaneous peak discharge at the Solvang gauge occurred on 2/28/14 at 133 cfs. Instantaneous peak discharge at the Los Laureles gauge was recorded on 3/1/14 at 263 cfs. None of these discharge rates were high enough to cause any changes to the channel or banks within the LSYR. Only localized scour of small vegetation within the wetted channel was observed at a few locations.

Annual hydrographs along the Santa Ynez River at Los Laureles, Solvang, Narrows and Salsipuedes Creek gauges show lower than normal spring runoff conditions throughout the basin (Figure 2). Aside from the 5 outages associated with failure of the HCWS, baseflows above 2 cfs within Hilton Creek were maintained throughout the water year creating favorable rearing and over-summering conditions for *O. mykiss* (Figure 3).

Ocean connectivity: 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). The Santa Ynez River lagoon did not breach during WY2014. This was the second year in a row with no connectivity to the ocean (Table 4). There was only one large storm in the region throughout WY2014 that occurred at the end of February and beginning of March with a rainfall total of 6.75 inches. The remaining storms were not of sufficient magnitude to generate the stream discharge needed to connect to the lagoon and breach the sandbar, allowing upstream anadromous passage. In addition, storms in 2014 were smaller and not consecutive to produce significant runoff, resulting in the rain from most of the storms simply soaking into the ground. For example, the largest storm of the season occurred on 2/28/14, which resulted in a maximum flow rate of 185 cfs at 11:15AM at the Narrows USGS gauging station. Flow from the 2/28/14 storm reached the H Street USGS gauging station on 3/2/14 at 22:45PM, which was 11.5 hours after the maximum flow rate was recorded at the Narrows gauge located 3.5miles upstream of the H Street Bridge. The flow peaked at 6.3 cfs at the H Street gauge and decreased back to zero by 3/4/14 at 10:45AM, providing no opportunity for upstream migration from the lagoon/ocean interface. By 3/30/14, flow had decreased to 1.0 cfs at the Narrows.

Passage supplementation: There were no passage supplementation events in WY2014 due to dry conditions that resulted in passage supplementation criteria not being met. Passage supplementation protocols are designed to avoid releases in dry years per RPM 3.

Adaptive Management Actions: There were 9 Adaptive Management Committee (AMC) meetings during WY2014. Topics discussed were interruptions of flow to Hilton Creek, repairs of the Hilton Creek Watering System (HCWS), installation of the Hilton Creek Emergency Backup System, and drought conditions across the LSYR basin. No flow allocations were made by the AMC from the Adaptive Management Account.

Target flows: There were no spills from Bradbury dam in WY2014, and reservoir elevation remained under 120,000 AF, so long-term BiOp established target flows are 2.5 cfs at the Hwy 154 Bridge under these conditions with a minimum of 2 cfs released into Hilton Creek. Required target flows were met in WY2014 except during the interruption of flow events at Hilton Creek (Figure 3).

Water Rights Releases: Water Rights (WR 89-18) releases are non-discretionary releases called for by the downstream water rights holders as described in WR Order 89-18. In 2014, these releases began on 8/18/14 and ended on 11/11/14, with a total release amount of 4,697 af over 85 days. This was an Above Narrows Account (ANA) release that reached just downstream of the Avenue of the Flags Bridge in Buellton. Monitoring for fish movement and water quality was conducted by the COMB-FD staff as stipulated in the BiOp RPM 6 and the 2014 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 2014 WR 89-18 release are provided in the RPM 6 monitoring report submitted by Reclamation to NMFS (USBR, 2015).

Mixing of State Water Project Waters in the LSYR: Reclamation monitors downstream releases to comply with the 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. The Central Coast Water Authority (CCWA) in collaboration with Reclamation delivers SWP waters to Lake Cachuma. SWP water is mixed with water releases from Lake Cachuma in the penstock and Stilling Basin at the base of the dam. Lake Cachuma water enters Hilton Creek through the Hilton Creek water delivery system and flows through Hilton Creek into the Long Pool. The determined point for mixing is the Long Pool that receives both water sources (Outlet Works and HCWS). The criterion was met for RPM 5.1 throughout WY2014 except one single day (3/2/14) when the mix percentage reached 66.8% (Figure 4). When this event occurred, the river was not connected to the ocean nor was it at any time through the water year. Low flows persisted throughout the migration season and the river was never connected with the lagoon in WY2014. Since the issuance of the BiOp in 2000, the 50% mixing criterion has been met

100% of the time during the migration season (December – June), when the lagoon was open, and flow was continuous with the ocean.

3.2. Water Quality Monitoring within the LSYR Basin:

Water quality parameters were monitored within the LSYR Basin during the dry season from April/May through November/December to track conditions for over-summering *O. mykiss* (Figure 5 and Table 5). The critical water quality parameters for salmonid survival, water temperature and dissolved oxygen (DO) concentrations, were recorded and are presented below. Additional water quality parameters (i.e., ORP, specific conductance, TDS, pH, and salinity) were monitored but not present.

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 are not able to regulate their temperature physiologically. They can 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 beginning of every hour) and dissolved oxygen concentrations with multi-parameter sondes through multiple day spot deployments (2-5 days at 15-minute or 60-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 slightly 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 LSYR mainstem and tributaries.

Results of water quality monitoring are presented in all cases, but described only if the habitat contained *O. mykiss*, non-native aquatic species, or there was an observation of particular importance. For reference, a table was prepared with the monitoring sites (habitat name and Stream ID) and whether fish were present or absent during the monitoring period (Table 6). Water quality 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. There was an increase in monitoring locations undertaken beginning in WY2013 to increase the understanding of the thermal regime in various mainstem and tributary habitats as it relates to fish assemblages.

Water temperature: During WY2014, thermographs were deployed in one of two configurations: single units mainly in the tributaries and 3-unit vertical arrays at selected pool locations within the LSYR mainstem. At vertical array sites, thermographs 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) units. The results of each unit 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 associated figure caption. 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 now sometimes absent of *O. mykiss* allows for a 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, to evaluate the presence of cold water refuge habitat, and to monitor the rearing conditions where *O. mykiss* were present, while some previously monitored locations were discontinued due to habitat alterations (i.e., LSYR-7.3 and LSYR-9.6) or access limitations (2 sites within the Santa Ynez River Lagoon).

In addition, several monitoring locations were discontinued due to the absence of observed fish over several years (Nojoqui Creek), a sequence of impassable barriers prohibiting access for anadromous steelhead (San Miguelito Creek), or a dry stream reach in Salsipuedes Creek (SC-3.80) due to the ongoing drought. A previously monitored middle Hilton Creek site was designed to evaluate thermal heating between the Upper Release Point (URP) and Lower Release Point (LRP) but due to extensive riparian vegetation growth that has significantly reduced thermal heating, this has ceased to be a concern and the monitoring has been discontinued.

There were 24 thermograph units deployed at 10 sites on the LSYR mainstem which are listed below with the number of units in parentheses:

- The tail out of the Stilling Basin (LSYR-0.20 (3));
- The river channel immediately downstream of the Stilling Basin (LSYR-0.25 (1));
- Long Pool (LSYR-0.51 (3));
- LSYR directly downstream of Long Pool and upstream of 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 during WY2014, there were 11 sites monitored, each with single unit deployments:

- Hilton Creek (2 sites):
    - HC-lower (HC-0.12); and

    - HC-upper (HC0.54).
- Quiota Creek (QC, 1 site):
    - QC-Crossing 6 (QC-2.66).
- Salsipuedes Creek (SC, 4 sites):
    - SC-lower (SC-0.77);
    - SC-Reach 2 (SC-2.2);
    - SC-Highway 1 Bridge (SC-3.0); and
    - SC-Jalama Bridge (SC-3.5);
    - SC-upper (SC-3.8, legacy site but dry and not monitored).
- Los Amoles Creek – Tributary to El Jaro (LAC, 1 site):
    - LAC-Los Amoles Creek (LAC-7.0).
- El Jaro Creek (EJC, 3 sites):
    - EJC-lower (EJC-3.81);
    - EJC-Palos Colorados (EJC-5.4); and
    - EJC-Rancho San Julian (EJC-10.82).

All stream temperature monitoring locations are presented in Figure 5 with their deployment period and type in Table 5 for the LSYR mainstem and tributaries.

Mainstem thermographs: The data are presented by site from upstream to downstream.

Stilling Basin (LSYR-0.2)

A 3-unit array was deployed at the tail out of the Stilling Basin from 5/9/14 through 12/3/14. The Stilling Basin is the largest habitat on the LSYR and measures approximately 866 feet long from the spillway to the downstream riffle crest, 482 feet wide at its midpoint, and 36 feet deep when at full capacity. The array was deployed near the tail out of the habitat in water depths that ranged from 6.44 feet to 7.48 feet during the deployment as various release rates raised and lowered the Stilling Basin water surface elevation. In the absence of high flow dam releases, the upper lens of the Stilling Basin water column heats while cooler water sinks to the bottom, particularly during the summer when there is extensive thermal heating with no riparian vegetation canopy cover. As release rates increase, water travels through the Stilling Basin faster with less chance for thermal heating. Hence, the dam release rate can influence the thermal profile of the Stilling Basin because those releases come from the cold hypolimnion at the bottom of the lake through the penstock and discharge at the Outlet Works.

Results from the surface (Figure 6), middle (Figure 7), and bottom (Figure 8) thermographs at the Stilling Basin closely mimicked each other during the entire deployment period indicating near uni-thermal conditions from the surface to 7.48 feet of depth. Water temperatures gradually increased following unit deployment and were coincident with low level releases (approximately 5 cfs) from the Outlet Works. A low magnitude release started on 5/26/14 (due to HCWS failure and the need to make target flows downstream) that increased flow from 1.5 cfs to 5.5 cfs and then decreased back to 1.5 cfs on 6/13/14 (HCWS repair). Water temperatures decreased 1-3°C with the initiation of the release. Once the releases decreased to less than 5 cfs in June, maximum surface water temperatures gradually rose to nearly 24°C before rapidly decreasing to lower than 18°C following the start of WR 89-18 downstream water rights releases on 8/18/14. Water temperatures remained cool and continued to decrease following the end of the WR 89-18 releases into the fall.

The Stilling Basin contained multiple non-native aquatic species that survived throughout the monitoring period. No *O. mykiss* were observed during periodic bank surveys. No routine snorkel surveys were conducted in this habitat due to its size and turbidity.

Downstream of Stilling Basin (LSYR-0.25)

This temperature unit was deployed at the bottom of a run habitat immediately downstream of the Stilling Basin in approximately 2.5 feet of water with the unit 6 inches above the substrate. Water temperatures were collected from 4/1/14 through 12/1/14 (Figure 9). Of note are the responses in water temperature to two separate releases from the Bradbury Dam Outlet Works that occurred in WY2014. The first release was the previously described low magnitude release that started on 5/26/14 (due to HCWS failure and the need to make target flows downstream) and lasted until 6/13/14 (HCWS repair). Water temperatures immediately downstream of the Stilling Basin showed a corresponding slight increase with arrival of the release at the end of May, followed by a decrease as the release continued into early June. Water temperatures remained depressed until the low magnitude release ended in June, then steadily increased until the start of the WR89-18 release on 8/18/14. Water temperatures at this site dropped sharply after the arrival of the WR89-18 release and remained cool for the remainder of the monitoring period through the dry season. No *O. mykiss* or aquatic species were observed during routine snorkel surveys or bank observations near the monitoring location.

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 over 9 feet. It is fed by two water sources when there is no spill or release from the Outlet Works: (1) LSYR mainstem flow from the Chute Release Point (CRP) which is part of the HCWS that releases water directly into the Stilling Basin, and (2) Hilton Creek proper (URP and LRP of the HCWS and any upper basin natural creek flow) both flow sources confluence directly into the Long Pool in two separate arms of that pool habitat. HCWS is a cool water source because its intake is set at 65 feet of depth in Lake Cachuma. Mixing of Hilton Creek and LSYR mainstem flow occurs within the first 200 feet of the Long Pool, well upstream of the thermograph vertical array. *O. mykiss* are routinely observed rearing in this habitat when water visibility permits. The thermograph vertical array was deployed on 4/29/14 and removed on 12/3/14 at the deepest point of the pool at 9 feet of depth. The Long Pool is inhabited by several invasive species (largemouth bass [*Micropterus salmoides*], smallmouth bass [*Micropterus dolomieu*], sunfish species [*Lepomis*], and common carp [*Cyprinus carpio*]) that may limit *O. mykiss* colonization likely due to predation and degradation of water quality. Visual observations during this year's routine snorkel surveys noted a lack of multi-year age classes within the habitat, particularly smaller 1-2 year old *O. mykiss*. In addition, chronic turbidity which can negatively affect salmonids was also observed in both the Stilling Basin and Long Pool, potentially due to the presence of large numbers of carp and beaver which stir up bottom sediment with their activity.

Water temperatures in the Long Pool showed some temperature spikes coincident with increased dam releases followed by rapid cooling. During the onset of the WR 89-18 release, water temperatures increased approximately 3-4°C with thermally heated surface Stilling Basin water, which was then replaced with cooler dam released waters (Figures 10-12). In addition, expected seasonal warming and cooling was observed throughout the year, with one exception (mid-July). Maximum surface water temperatures remained lower than 24°C throughout the majority of deployment, with only a one-day peak above this level in mid-July. Following the WR 89-18 release, surface water temperatures remained lower than 22°C for the remainder of the deployment. The 24-hour temperature variation was generally around 4°C.

Water temperatures recorded at the middle and bottom units were nearly identical with the bottom being slightly cooler (Figures 11-12). The low flow releases that lasted from 5/26/14 to 6/13/14 resulted in an approximately 2-3°C increase in water temperature at all three units due to the out movement of thermally heated surface Stilling Basin waters. During the initial WR 89-19 release, a 3-4°C temperature increase was observed at the middle and bottom units before declining rapidly to around 18°C or lower for the remainder of the deployment period.

Diel fluctuations of around 4°C were greatest at the surface unit and generally remained between 2-4°C until the beginning of October when diel fluctuations decreased to 2°C and less. Diel fluctuations at the middle and bottom units ranged from 1-2°C, and were slightly larger following the arrival of the WR89-18 release.

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 4/29/14 to 12/1/14 and recorded similar though slightly cooler temperatures compared to the Long Pool surface thermograph (Figure 13). The warm water lens from the Stilling Basin that was pushed downstream during the low volume releases in late-May was observed at this site. Following the low flow releases early in the deployment period, maximum water temperatures increased gradually to over 22°C and fluctuated between 21°C to over 23°C until the WR 89-18 releases started, when water temperatures rapidly cooled and remained lower than 20°C for the remainder of the deployment period. With the exception of a few days at the beginning of July, minimum water temperatures remained lower than 20°C, prior to the WR 89-18 release. After the release, minimum temperatures were 18°C or lower. During all routine snorkel surveys, *O. mykiss* were observed.

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 in the late spring. In the absence of target flows or downstream water rights releases, the Encantado Pool began to diminish in size, losing residual pool depth and finally drying out by mid-June. A vertical array was deployed on 4/29/14 and removed on 6/6/14 due to lack of water in a drying habitat. The array was redeployed on

8/20/14 and removed on 12/3/14 to monitor the WR 89-18 release. The recorded data are presented in Figures 14 through 16 for the surface, middle and bottom units, respectively. No *O. mykiss* inhabited this habitat in WY2014. Largemouth bass and carp were found dead at this site as the habitat dried out prior to the arrival of the water right release.

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 5/7/14 to 12/6/14 (Figures 17-19). Unlike the majority of the other mainstem monitoring locations, water levels maintained residual pool depth at this habitat before, during and after WR 89-18 releases. Prior to the WR 89-18 releases, maximum daily water temperatures reached over 26°C at the surface unit and remained below 22°C at the bottom unit (Figures 17-19). The releases lowered the surface water temperatures to between 20°C to 24°C until the end of September when water temperatures decreased through the rest of the fall and monitoring period. Prior to the arrival of the WR 89-18 release front, diel variation was greatest at the surface unit with up to an 8°C daily range; after the arrival of the release front, diel variation decreased and generally remained less than 4.0°C at the surface. Prior to the arrival of the release front, diel variation at the middle and bottom units was only approximately 1°C; after the arrival of the release, diel variation increased to 2-3°C at these units. No *O. mykiss* were observed during routine snorkel surveys although largemouth bass, sunfish species, and carp were seen throughout the monitoring period.

Head of Beaver Pool (LSYR-8.7)

This habitat is located approximately ¼ mile downstream of the Quiota Creek confluence with the LSYR. The habitat is approximately 730 feet long, 50 feet wide, and 7.1 feet at the deepest point. A vertical array was deployed at this habitat on 5/7/14 and removed on 7/14/14 due to drying conditions and redeployed 8/23/14 through 12/5/14 (Figures 20-22). No *O. mykiss* were observed in this habitat but warm water non-native fish (carp and largemouth bass) were found dead here in the dried out habitat prior to the arrival of the WR 89-18 release, with no aquatic species observed here throughout the rest of the monitoring period.

Alisal Bedrock Pool (LSYR-10.2)

The Alisal Bedrock Pool was a corner scour pool habitat approximately 60 feet long and 40 feet wide with a maximum depth of 9 feet in late spring. A vertical array was deployed on 4/28/14, removed on 6/29/14 due to a lack of water, and was not redeployed after the arrival of the WR 89-18 release due to difficulty maintaining the instruments in a highly visited swimming hole (Figures 23-25). This unit was positioned where in past years rearing *O. mykiss* have been observed. However, in WY2014, no *O. mykiss* or non-native fish species were observed in this habitat prior to it drying out or after WR 89-18 water reached the site.

Avenue of the Flags (LSYR-13.9)

A single thermograph was deployed in a pool habitat approximately 250 feet downstream of the Avenue of the Flags Bridge in Buellton (LSYR-13.9) from 4/28/14 through 7/8/14.

The habitat was approximately 65 feet long, 20 feet wide at its widest point with a maximum depth of approximately 4 feet in late spring (Figure 26). This habitat remained wetted and flowing throughout the entire monitoring period, unlike most years. No *O. mykiss* or other aquatic species were observed in this habitat. The unit was removed on 7/7/14 due to drying conditions.

Cadwell Pool (LSYR-22.68)

A vertical array was deployed from 5/7/14 through 10/8/14 at deepest point in the habitat (12 feet). The pool was approximately 490 feet long and 32 feet wide at the maximum point in the late spring. A vertical array was deployed at this site (Figures 27-29). This habitat has supported *O. mykiss* in the past but likely due to the ongoing drought, lack of flow, and deteriorating water quality conditions (particularly dissolved oxygen), there were no *O. mykiss* or other fish species observed in this habitat in WY2014. WR 89-18 releases did not reach this site.

LSYR Mainstem Longitudinal Comparisons

Longitudinal LSYR mainstem (maximum daily) water temperature at the surface thermographs for LSYR-0.51, LSYR-4.95, 7.65 Pool, LSYR-8.7, LSYR-10.2, LSYR-13.9, and LSYR-22.68 are presented in Figure 30. 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 this area is referred to as the dry gap. During low flow summer releases, rearing release water was subject to thermal heating as it passed downstream. For example, as the 5/26/14 release peaked at 5 cfs, maximum daily water temperatures in the Highway (Hwy) 154 Reach (at the Long Pool and Reclamation property boundary sites) increased 2-3°C and stabilized at approximately 20-22°C. Less thermal heating occurs within the first five miles with higher magnitude releases like the WR89-18 flows.

During the summer and fall of WY2014, rearing flows of 4.7-5.5 cfs (9.0-11.0 af) were released through the Bradbury Dam Outlet Works and the HCWS. Release of the majority of the flow (4 cfs) was through the HCWS with the remainder (~1.0 cfs) going into and passing through the Stilling Basin. A HCWS flow failure occurred on 5/26/14 and continued to the middle of June during which time flow was released through the Outlet Works exclusively until the HCWS was repaired. The reduced volume of flows combined with ambient temperatures likely caused an increase in water temperature of approximately 2-3°C (see individual graphs for LSYR-0.51 and LSYR-0.62).

WY2014 was the third consecutive dry year and drought symptoms were observed throughout the LSYR mainstem and tributaries. Most habitats contracted as flows diminished. Unlike previous years, water did not resurface at downstream locations as it had in the past and, prior to WR 89-18 releases, much of the mainstem dried completely. Most of the mainstem surface temperature monitoring locations at the vertical arrays were being exposed to air starting in May and by July most of the habitats downstream of the Hwy 154 Reach were completely dry (LSYR-4.95, LSYR-8.7, LSYR-10.2, and LSYR-13.9, for example). The drying of habitats made longitudinal comparison problematic. Notable exceptions were the monitoring locations immediately downstream of Bradbury (LSYR-0.2, LSYR-0.25, LSYR-0.51 and LSYR-0.62) that remained wetted with flowing conditions to the Hwy 154 Bridge. The two remaining locations at LSYR-7.65 and LSYR-22.68 were isolated diminishing pool habitats that did not retain residual pool depths.

Factors likely influencing surface water temperatures along the longitudinal profile presented in Figure 30 are: (1) thermally-warmed Stilling Basin surface water moving downstream resulting in an increase in stream temperature; (2) dry cobble bars with extensive exposure to the sun that warm the leading edge of release waters causing temporarily elevated temperatures; and (3) the arrival of a WR 89-18 release that elevates water temperatures (as described above) for a short period (1-2 hours) followed by a drop in water temperature to favorable conditions for *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) as can be seen in the data presented for each site. An increase was not observed at LSYR-13.9. Once the front had passed, there was an overall cooling of 3-4°C in each of the monitored habitats except at LSYR 13.9. During the WR89-18 release from August to November, thermal heating of about 3-4°C was observed at sites downstream of the Hwy 154 reach compared to the sites near the dam. 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.

At monitoring locations within one mile of the dam, there was an immediate decrease in water temperatures with the arrival of the WR 89-18 release as cool water from the bottom of the lake influenced habitats downstream. At locations further downstream, the influence of the cool water diminished after the Encantado Pool (LSYR-4.95). As the flow progressed downstream, maximum surface water temperatures at the leading edge of the front reached 24.4°C for a short duration at LSYR-4.95 and LSYR-8.7. Longitudinal water temperatures were coolest at LSYR-7.65 with a maximum of 23.8°C during the first days of the release and decreased thereafter. The greatest maximum longitudinal surface temperatures that were recorded occurred at LSYR-22.68 and approached 25°C. Water from the downstream release did not reach this habitat since it was an ANA release and the temperature results reflect an isolated and diminishing pool habitat.

O. mykiss and Water Temperature Criteria within the LSYR Mainstem

With the exception of the Hwy 154 Reach, the majority of the LSYR dried during the spring and summer of WY2014. Few habitats remained throughout the river and those that were present were not maintaining residual pool depth and continued to decrease prior to the WR 89-18 Release. No *O. mykiss* were observed downstream of the Hwy 154 Reach just prior to and throughout the WR 89-18 releases (Table 6). The remaining habitats were observed to have no invasive warm water species except for the Encantado Pool (LSR-4.95), Double Canopy Pool (LSYR 7.65), and the Head of Beaver Pool which were inhabited by largemouth bass, sunfish, and carp and all dried out by the middle of the summer prior to the release.

Tributary thermographs: The data are presented by site from downstream to upstream along the creek.

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 4/1/14 to 12/1/14. Overall, water temperatures remained lower than 18°C except for two HCWS interruption of flow incidents that exposed the temperature unit to the air for 15 days in late May and June and again briefly in the middle of August (Figure 31). The lake turnover event observed at the beginning of November showed an observable temperature change. There was slight thermal warming documented between the upper and lower monitoring locations. Overall, temperatures warmed approximately 1°C during the entire deployment period and were well within the suitable range for rearing *O. mykiss* (Figure 31). Suitable water temperatures for O. mykiss is thought to be less than 20°C (DeVries, 2013). Very little thermal heating was observed from HC-0.54 to HC-0.12 due to a mature riparian canopy. *O. mykiss* were observed in lower Hilton Creek during the spring and summer snorkel surveys but were not seen in the fall due to turbid water conditions that precluded snorkeling.

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 URP enters the creek channel; from 4/1/14 to 12/1/14. The pool was approximately 15 feet long and 12 feet wide with a maximum depth of 3 feet. The temperature of the water exiting through the URP into Hilton Creek show gradual seasonal warming with readings between 14°C (April) to 18°C (lake turnover-November) and hovering around the 16°C mark during the majority of the deployment time (Figure 32) and showed little influence by ambient air temperatures during the warmest portion of the year. *O. mykiss* occupied this habitat throughout the year. Of note in the figure are the 15-day period when the HCWS failed (5/26/14 through 6/10/14), exposing the unit to air and the lake turnover event at the beginning of November that raised water temperatures exiting the URP to nearly 18°C for approximately 2-weeks before cooling through the rest of the monitoring period. With the exception of the HCWS interruption of flow incident and the lake turnover event, diel variations were less than 1°C.

Quiota Creek (QC-2.66)

A single thermograph was deployed 0.5 feet above the bottom of the creek approximately 50 feet upstream of Crossing 6 on Refugio Road from 4/23/14 through 7/9/14. The unit was deployed at the bottom of a deep run habitat 30 feet long and 10 feet wide with a depth of approximately 1.5 foot. This site was selected because rearing *O. mykiss* have been routinely observed during yearly snorkel surveys. The unit was removed on 7/9/14 due to the habitat being nearly dry. All *O. mykiss* perished at or near this site due to the ongoing drought and lack of water as observed during site visits. While the unit was deployed, water temperatures were generally lower than 18°C, remaining well within temperature regime suitable for rearing *O. mykiss* (Figure 33). The 24-hour variation ranged from <1.0°C to 4°C.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 4/1/14 through 12/1/14 within a run habitat with a maximum depth of 1 foot, approximately 300 feet upstream of the Santa Rosa Road Bridge and approximately 0.77 miles upstream of the confluence with the LSYR. This site is also near the Salsipuedes Creek trapping location. *O. mykiss* were not observed at this monitoring site. However, beaver activity was evident throughout the deployment. This site recorded the highest water temperatures in the Salsipuedes/El Jaro watershed during WY2014 (Figure 34). Maximum temperatures were regularly higher than 24°C and were higher than 26°C for one day in late July. Minimum temperatures remained lower than 20°C for the entire deployment. Diel fluctuations ranged from approximately 4-7°C.

Salsipuedes Creek-Reach 2-Bedrock Section (SC-2.20)

A single thermograph was deployed in a pool habitat approximately 4-feet below the surface from 4/23/14 through 12/1/14. This is the second year a thermograph has been deployed at this location and was done so in order to better understand the water temperature regime in this reach, which was particularly important in identifying creek sections with remaining flow and adequate *O. mykiss* rearing conditions during the prolonged drought. Reach 2 is a short bedrock section with deep pools, extends approximately 1/3 of a mile, and represents some of the only remaining viable habitat for rearing *O. mykiss* within the entire Salsipuedes/El Jaro creek watershed due to the presence of numerous bedrock formed pools. The monitored habitat is approximately 40 feet long, 15 feet wide, and 6-feet deep at its deepest point. *O. mykiss* were observed at this site in the spring but were not seen thereafter due to turbid water conditions that precluded snorkel surveys. *O. mykiss* redds were documented in the area during the late winter and spring.

Water temperatures at this monitoring location were among the coolest observed in Salsipuedes Creek watershed, with maximum water temperatures remaining lower than 22°C throughout the monitoring period (Figure 35). Minimum temperatures during the warmest part of the summer exceeded 20°C. Daily variation during deployment ranged from <1.0°C to 3.0°C with most of the variation less than 1.0°C.

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 Hwy 1 fish ladder from 4/23/14 through 12/1/14. The pool habitat is approximately 85 feet long and 18 feet wide with a maximum depth of 7-feet. This area typically holds rearing *O. mykiss* though none were observed in WY2014 likely due to turbid conditions from beaver and cattle activities. This is the second year a thermograph has been deployed at this location and was done to better understand the temperature regime throughout the creek, particularly in reaches that may sustain viable oversummering habitat for *O. mykiss*. This thermograph location represents the top of Reach 4, the second significant bedrock influenced section of the creek. Reach 4 is similar to Reach 2 as there are numerous deep pool habitats formed in the bedrock that offer excellent oversummering opportunities for rearing *O. mykiss*.

Water temperatures showed rapid warming in the beginning of July and approached maximum daily temperatures of 26°C near the end of July. A cooling trend started at the beginning of September and continued for the remainder of the year (Figure 36). Diel variation was greatest from the end of June to the end of August with variation of approximately 3.0°C to 4.5°C. Variation was less during the spring and fall of the year. *O. mykiss* were not observed at this location due to turbid water conditions which precluded snorkeling.

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 4/23/14 through 12/1/14. The pool is approximately 30 feet long, 18 feet wide and 6 feet in depth. This area routinely holds oversummering *O. mykiss* though no *O. mykiss* were observed in this habitat during snorkel surveys in the spring and the fall of 2014 due to turbid conditions from upstream beaver activities.

Maximum water temperatures hovered around 22°C during the warmest portion of the year (Figure 37). Minimum water temperatures generally remained near 20°C except for a few days during heat of the summer when temperatures approached 21°C for brief periods in time. Daily variation fluctuated between approximately less than 1°C to 3°C during the deployment time.

Upper Salsipuedes Creek (SC-3.8)

For the first time since the LSYR fisheries studies be began in 1993, Upper Salsipuedes Creek was dry during the spring of 2014 and no water quality monitoring was conducted. For the past 22 years, Upper Salsipuedes Creek has remained one of the most important reaches of the creek because of its optimal rearing conditions for *O. mykiss*. Past snorkel and redd surveys have documented many different age classes of *O. mykiss* in addition to large redd excavations that can only come from anadromous steelhead. Poor rainfall during WY2014 coupled with the third straight year of an ongoing severe drought has dried a significant portion of Upper Salsipuedes Creek. This is particularly concerning considering this reach has provided excellent rearing opportunities for oversummering *O. mykiss* and is thought to be one of the primary seed populations in the lower tributary system that allows for recruitment in other reaches of the creek and LSYR watershed under better flow conditions during the rearing period. No *O. mykiss* were observed at this site during WY2014.

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 4/23/14 to 12/1/14. The unit was placed in a pool habitat 0.5 feet above the bottom. The pool was formed during high flows in WY2008. This is the same general location the unit has been deployed in 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 though none were observed during WY2014 due to turbid conditions.

Prior observations indicate that this monitoring location is influenced by upwelling groundwater and surface flows. In the absence of surface flows, as was the case in 2014, cool water upwelling influenced the temperature regime at this habitat. Maximum water temperatures remained lower than 18°C except for an approximate one month period from mid-July through mid-August (Figure 38). The diel fluctuation remained less than 1°C for the entire deployment.

El Jaro Creek – Palos Colorados (EJC-5.4)

A single thermograph was deployed 0.5 feet from the bottom of a boulder dominated pool habitat from 4/23/14 through 12/1/14. The habitat measured approximately 35 feet long, 7 feet wide and 3.5 feet deep. This area is influenced by Palos Colorados Spring that joins El Jaro Creek approximately 1/8 of a mile upstream of the monitoring pool. In WY2014, contribution from the spring kept an approximate 0.5 mile portion of the reach wetted over the summer. Water temperatures remained relatively cool during the entire deployment time. Overall, water temperatures remained well below 21°C except for a few days in early July and generally ranged between 16°C to almost 20°C during the deployment period (Figure 39). The 24-hour variation was greatest at the end of June through early July, and smallest during the late summer months, generally ranging from <1.0°C to 3.4°C during the deployment period. No *O. mykiss* were observed at this location throughout the year.

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 4/23/14 through 6/28/14. 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. On 6/28/14, the fish ladder was dry and residual pool depth was not sustaining and the unit was removed from the habitat. *O. mykiss* have regularly been observed within this plunge pool and fish ladder in past years; however, the drought has eliminated *O. mykiss* from this habitat. Water temperatures were low, below 18°C, during the majority of the deployment period and then increased after mid-June until the habitat went dry (Figure 40).

Large sections of El Jaro Creek and Upper Salsipuedes Creek completely dried in WY2014 (and in WY2013). The thermograph deployed at the Rancho San Julian (EJC-10.82) was removed in late June due to drying conditions which continued throughout the remainder of the year. By the end of the monitoring period, no wetted habitat was observed upstream of that spot and only a few isolated pools were present downstream of Rancho San Julian with only one flowing section of creek near EJC-5.4 that extended for approximately 0.3 miles downstream. The confluence between El Jaro and Upper Salsipuedes completely dried with Upper Salsipuedes also going dry.

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

A single thermograph was deployed 0.5 feet from the bottom of a corner scour pool habitat from 4/23/14 through 12/1/14. The habitat is 30 feet long, 15 feet wide, and 3.0 feet deep and is 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 have negatively affected water flow through most of the creek with vast sections of the creek running dry. A spring enters the creek approximately 150 yards upstream of the monitoring location and provides the sole source of water for that section of the creek. Water temperatures in Los Amoles Creek were relatively cool during the entire deployment period, remaining below 22°C (Figure 41). Daily variation ranged within <1.0°C to 3.6°C for the entire period. No *O. mykiss* were observed at this location.

Salsipuedes Creek Longitudinal Comparisons

Longitudinal maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 42 for the thermographs at Rancho San Julian (EJC-10.82), Palos Colorados (EJC-5.4), lower El Jaro Creek (EJC-3.81), Salsipuedes Creek at Jalama Bridge (SC-3.5), Salsipuedes Creek at Highway 1 Bridge (SC-3.0), Salsipuedes Creek in the Reach 2 Bedrock Section (SC-2.20), and lower Salsipuedes Creek (SC-0.77). Maximum daily temperatures generally decreased in an upstream direction within the watershed with the highest values recorded at the Lower Salsipuedes (SC-0.77 and SC-3.0) monitoring site, which were shallow habitats. The lowest temperatures were recorded at EJC-3.81, which was fed solely by cool groundwater upwelling in the absence of surface flows.

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 contribute to influence the thermal regime within individual habitats in the watershed. In addition to the above listed variables, the region has undergone its third straight year of drought conditions and tributary habitat throughout the watershed has been reduced. There was a wide range of temperatures monitored within the watershed during WY2014, illustrating the variable suitability of individual habitats for rearing *O. mykiss*.

Large sections of El Jaro Creek and Upper Salsipuedes Creek completely dried in WY2014. The thermograph deployed at the San Julian Ranch (EJC-10.82) was removed in late June due to drying conditions which continued throughout the remainder of the year. In fact, by the end of the monitoring period, no wetted habitat was observed upstream of that spot and only a few isolated pools were present downstream of Rancho San Julian with only one flowing section of creek near EJC-5.4 that extended for approximately 0.3 miles downstream. The confluence between El Jaro and Upper Salsipuedes completely dried with Upper Salsipuedes also dry. A small pool in El Jaro Creek immediately upstream of the confluence (EJC-3.81) persisted throughout the year with water quality information collected. Water flow infiltrates back to the surface approximately 250 yards downstream of the El Jaro/Salsipuedes confluence providing wetted conditions to near the confluence with the LSYR (approximately 3 miles). Flow measured at the USGS gauging station (1132500) was less than 0.05 cfs from late May through late November.

There was a high variability of water temperatures between sites within the El Jaro/Salsipuedes creek watershed (Figure 42). At the end of the monitoring period, one of the two remaining thermographs in El Jaro Creek was in the flowing section at EJC-5.4 (Palos Colorados) where temperatures remained lower than 21°C for the entire deployment. Los Amoles Creek (LAC-7.0), a tributary to El Jaro Creek recorded similar maximum water temperatures as EJC-5.4. The warmest maximum water temperatures were recorded at SC-3.0 (Highway 1) and SC-0.77 (Lower Salsipuedes) where maximum water temperatures were above 24°C on several days between early July and mid-August. The duration of the high temperatures at SC-3.0 was typically 1-3 hours (maximum 7 hours on 7/21/14) with a higher duration at SC-0.77 of 3-6 hours and for more days than SC-3.0. Maximum water temperatures at SC-3.5 (Jalama Bridge) hovered slightly above and slightly below 22°C during the warmest portion of the year while temperatures at SC-2.2 (Salsipuedes R2) were lower than 22°C. The coldest water temperatures were recorded in the isolated pool habitat directly upstream of the confluence (EJC-3.81) with Upper Salsipuedes Creek where maximum water temperatures did not exceed 19°C.

Temperature monitoring within the watershed highlights the variability of individual habitats, with portions of El Jaro Creek and Salsipuedes Creek as having the best water temperatures for rearing *O. mykiss* and locations such as Lower Salsipuedes showing the most inhospitable rearing conditions. Within Salsipuedes Creek, SC-0.77 and SC-3.0 exhibited several periods of stressful (20^{o}C) to severely stressful (24^{o}C) conditions. No conditions at the established lethal criteria of 29^{o}C were measured.

Water temperature and dissolved oxygen (sondes): Sondes were deployed within two habitats in Hilton Creek (HC-0.14 and HC-0.21) in WY2014. Sonde deployments shifted from the LSYR mainstem to Hilton Creek in WY2014 in order to assess water quality suitability for *O. mykiss*. Sonde water temperature values were consistent with the thermograph data near these locations. COMB-FD staff calibrated the sondes prior to deployment and at the same time to assure all were recording the same values for each parameter.

Hilton Creek (HC-0.25): Sonde deployments were made within Hilton Creek during a prolonged HCWS outage that lasted several weeks at the end of May into June (5/25/14-

6/10/14). The only flow provided to Hilton Creek during the outage was from daily water truck deliveries to the LRP, which kept the majority of lower Hilton Creek wetted. Five consecutive sonde deployments were made at the "Spawning Pool" (HC-0.25) within Hilton Creek between 5/28/14 - 6/13/14 during that time period (Figure 43). *O. mykiss* were present within this pool during the entire deployment period. A single sonde was placed in a 5-foot deep section of the pool at the mid-water column. The sonde was programmed to record temperature and DO in 15-minute intervals.

Water temperatures during the period ranged from 13.4°C – 17.6°C, with lower temperatures being recorded towards the beginning of the deployment (Figure 43). Diel fluctuation was generally 1-2 °C with peak temperatures in the late afternoon or evening. DO values ranged from 6.6 mg/l – 9.8 mg/l, with higher DO values observed towards the end of the deployment (Figure 43a). After the HCWS became operational, higher DO values were recorded by the afternoon of 6/10/14.

Hilton Creek (HC-0.2): Six consecutive deployments were made within a shallow pool habitat (HC-0.14) between 5/28/14 – 6/13/14 (Figure 43). *O. mykiss* were present within this pool during the entire deployment period.

A single sonde was placed on the pool bottom in approximately 3 feet of water. Water temperatures ranged between 13.3°C – 19.0°C, with lower temperatures towards the beginning of the deployment (Figure 43b). DO concentrations showed a large diel cycle and ranged between 2.8 mg/l – 9.5 mg/l during the period when the HCWS was not operational (Figure 43b). Once the HCWS became operational, DO levels stabilized and remained above 9.4 mg/l for the remainder of the deployment.

Lake Cachuma water quality profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 1/16/14, 3/13/14, 5/9/14, 6/30/14, 7/29/14, 8/26/14, 9/30/14, and 11/18/14 (Figure 44). 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 was 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 profile recorded in January showed isothermal (even temperature to depth) winter conditions, ranging from 11.3°C – 11.6°C (Figure 44a). March and May lake profiles revealed that the surface of the lake was beginning to warm, with surface temperatures at 16.6°C and 18.3°C, respectively. Summertime profiles from June through September ranged from 22.0 °C to 24.4°C, with the thermocline at 20-46 feet. During the same timeframe, bottom temperatures remained steady between 15.4°C – 16.0°C. The final lake profile in November showed that the lake had turned over as temperatures were uniform from top (17.3°C) to bottom (17.1°C).

DO concentrations were highest at the lake surface in January and March at 9.73 mg/l and 9.84 mg/l, respectively (Figure 44b). January DO conditions were similar throughout the entire water column (9.43 mg/l at the bottom), whereas March concentrations decreased with depth with the lowest reading being 6.83 mg/l at the deepest measurement. From June through September, hypolimnetic oxygen was depleted with almost no oxygen present within the bottom 25 feet of the reservoir. As discussed above, the lake had turned over just prior to the last lake profile in November resulting in measured DO concentrations ranged between 8.01 mg/l at the surface down to 7.12 mg/l at the bottom.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2014 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 documents the changes at various locations from 2005 to 2014. 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 WY2014 photo points is provided in Appendix C (Table C-1 and Table C-2). The location of all sites a presented in Figure C-1.

LSYR mainstem photo point locations include all bridges from the Hwy 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.

Photo point comparison between 2005 and 2014 shows mainstem riparian vegetation growth since the initiation of BiOp target flows to Alisal Bridge, approximately 10.5 miles downstream from Bradbury Dam (Figures 45-49). Sections of the mainstem that were nearly devoid of vegetation in 2005 now show abundant growth with willow, sycamore, and cottonwood trees in excess of 15 feet in height. However, trees observed in the LSYR mainstem riparian corridor were beginning to show signs of stress from the ongoing drought and lack of flow from drought conditions. Stressful conditions were likely exacerbated by the fact that long-term target flows were no longer required. The last Bradbury Dam spill event occurred in WY2011. Since then, the region has experienced 3 consecutive years of drought and decreased flows in the mainstem.

Photo documentation within Hilton Creek continues to show a maturing riparian zone, particularly within the reach between the URP and LRP which was initially activated in 2005 (Figures 50-51). Larger trees (willows, alders, sycamores, and cottonwoods) are replacing the smaller understory within the drainage. Salsipuedes and El Jaro Creeks showed recolonization of riparian vegetation in WY2014 due to three consecutive years of below average rainfall that did not cause channel scouring events and the loss of riparian vegetation (Figures 52-54). However, large flows are important in both the mainstem and tributaries as they clear out potential passage barriers/impediments and remove debris/silt and generally clean out potential *O. mykiss* spawning locations of fine sediments.

3.4. Migration - Trapping

Migrant trapping activities to monitor both migrating anadromous and resident *O. mykiss* have been conducted on the Santa Ynez River and/or several of its tributaries every year since 1993. There were a few exceptions to this due to the endangered listing of steelhead (2000), threatened listing of California red-legged frog (1998) which caused trapping delays due to scientific permitting issues during those years, and WY2013 due to a misinterpretation of a NMFS request by Reclamation. Results from this year's migrant trapping effort cannot be compared to past years due to the truncated trapping effort.

In WY2014 for the first year since issuance of the 2000 Cachuma Project BiOp, NMFS required staying within the juvenile (110) and adult (150) take limits as described within the BiOp Incidental Take Statement (ITS) even though juvenile take had been exceeded multiple times since 2000 and was reported to NMFS. In some previous years, the adult take limit was reached but not exceeded; hence the juvenile take exceedance was the concern.

As a result of take exceedance during prior monitoring years, migrant trapping operations were evaluated and modified to better ensure take would not be exceeded. To stay within the limits of the BiOp ITS and to maximize data gathering with limited take, the trapping effort focused on upstream adult migration early in the season and downstream smolt (juvenile) migration from the middle to the end of the season. The downstream traps were modified to allow for a pass-through gate system that allowed the trap to be easily opened and closed plus the trapping season was postponed until February to further reduce the risk of exceeding the take limit. The juvenile take limit of 110 individuals was reached on 4/30/14, at which point all migrant traps were removed for the rest of the migration season. There were only 37 adult captures over the monitoring period which was well below the adult take limit.

Three sets of paired upstream and downstream migrant traps were deployed for various periods of time at: (1) lower Hilton Creek (tributary farthest from the ocean) 0.14 miles upstream from the confluence with the mainstem LSYR (HC-0.14); (2) Lower Salsipuedes Creek (tributary closest to ocean) 0.7 miles upstream of the confluence with the mainstem LSYR (SC-0.7); and (3) in the LSYR mainstem LSYR 7.3 miles downstream of Bradbury Dam (LSYR-7.3). A modified trapping regime was developed by Reclamation and COMB-FD staff to address NMFS' take concerns (described above). Additionally, 2014 represented the third consecutive year of drought conditions with a greatly reduced number of storms and elevated flow events, which greatly limited opportunities for *O. mykiss* upstream or downstream migration. As a result, trap installation and operation at each of the three locations differed depending on ambient flow conditions.

Migrant traps were installed at Hilton Creek on 2/20/14 (upstream trap) and 3/26/14 (downstream trap activated), at Salsipuedes on 3/3/14 (both traps), and on the LSYR mainstem on 3/2/14 (both traps) (Table 7). The Salsipuedes Creek and LSYR mainstem traps were only deployed for a short period of time when flows were elevated enough for fish migration. No LSYR mainstem flow made it to the ocean, and the lagoon remained closed throughout WY2014.

Nighttime fish movement is a well-documented adaptation to avoid predation during migration (Mains and Smith, 1964; Krcma and Raleigh, 1970; Meehan and Bjornn, 1991; Brege et al., 1996). Others found that elevated turbidity can also reduce predation specifically during stormflow events suggesting migration often occurs during the receding limb of storm hydrographs (Knutsen and Ward, 1991; Gregory and Levings, 1998). The Cachuma Project checks each trap a minimum of 4 times per 24-hour period. Fish captures are recorded into the following time categories; 1st AM (05:00-10:00), 2nd AM (10:01-14:00), 1st PM (18:00-22:00) and 2nd PM (22:01-01:59) depending on when they were captured (Table 8).

Rainfall patterns in WY2014 were scattered in nature and very low in magnitude through January with only 1.68 inches of rain recorded at Bradbury Dam from October 2013 through January 2014. February (4.11 inches) and March (3.52 inches) had greater rainfall but the cumulative years of drought and the dry antecedent moisture conditions in the watershed reduced potential runoff events capable of generating significant and long lasting migration flow. For example, in Hilton Creek, flow rates increased briefly in February from 4.0 cfs to 6.5 cfs before decreasing back to less than 4.0 cfs within a few days. The brief 6.5 cfs measurement represented the highest natural flow rate achieved with natural back ground flow in all of WY2014. Similarly, in Salsipuedes Creek in March, flow briefly flashed to nearly 200 cfs, but decreased to less than 1.0 cfs in less than one week. Hence, the Salsipuedes Creek traps were only deployed for a short 10 day period when flows were elevated enough for fish migration. No LSYR mainstem flow made it to the ocean, and the lagoon remained closed in WY2014.

Hilton Creek Migrant Traps: There were 46 upstream migrants captured from 2/20/14 through 4/30/14 ranging in size from 104 mm (4.1 inches) to 420 mm (16.5 inches) (Figure 55). There were 18 upstream migrating *O. mykiss* identified as juveniles (≤ 254 mm) and 28 identified as adults (≥255 mm). The majority of the upstream fish were captured in February (22) and March (19) with a few captured in April (5). The majority of the adults were captured in February and March as they moved upstream to spawn. There were 78 downstream migrants captured from 3/26/14 through 4/30/16, ranging in size from 78 mm (3.1 inches) to 420 mm (16.5 inches) (Figure 56). Only 8 of the downstream migrating fish were classified as adults, including one recapture. The remaining fish were classified as juveniles of which 46 (58.9%) were classified as having smolting characteristics; sixteen (20.5%) were classified as smolts and eighteen (23.1%) as pre-smolts. The majority of the smolts were captured during April (39) (Figure 57). The average size of the smolting fish in March was 138.1 mm and increased to 152.4 mm by April, indicating that good rearing conditions were present during the spring (Figure

58). Of note in Figure 59 (which shows upstream migration versus flow) is the cluster of upstream migrating *O. mykiss* prior to and after the HCWS failure on 3/1/14 showing that fish were actively migrating into the creek, likely to spawn, during this timeframe when flows ranged from 3.5 cfs to 4.0 cfs. Smolts began to leave the creek beginning at the end of March and continued to out-migrate through April suggesting that flow is not the sole triggering cue to begin the smolt migration in Hilton Creek.

Of the 124 fish captured migrating upstream and downstream in Hilton Creek, 92 (74.2%) were captured during the second evening and first morning trap checks, indicating that the majority of migrating fish are moving during the hours of darkness when predation possibilities are likely reduced (Knutsen and Ward, 1991; Gregory and Levings, 1998) (Table 8).

Salsipuedes Creek Migrant Traps: There were only three upstream migrants captured in the Salsipuedes Creek trap during the 10 day deployment from 3/3/14 to 3/13/14 (Figures 55 and 60). One adult (255 mm) *O. mykiss* was captured on 3/5/14 and 2 juvenile *O. mykiss* were captured on 3/6/14. All of the upstream fish were captured following a small storm event that increased flow to the creek to approximately 38 cfs before rapidly decreasing to less than 1.0 cfs (Figure 61). There were 10 downstream migrants captured during the same 10-day timeframe, and all were captured following the brief flow event over a three day period: with 1 captured on 3/3/14, 7 captured on 3/4/14, and 2 captured on 3/5/14. All of the downstream migrants captured were smolts and ranged in size from 100 mm (3.9 inches) to 215 mm (8.5 inches) (Figure 60). The average size of the smolts captured in Salsipuedes Creek was 154.6 mm (Figure 58).

Of the 13 fish captured migrating upstream and downstream, 12 (92.3%) were captured during the 2nd PM and 1st AM trap checks, showing once again that the majority of migrating fish are moving during the hours of darkness when predation possibilities are reduced (Table 8).

Comparison of Salsipuedes Creek and Hilton Creek Migrant Trapping Results: Salsipuedes Creek and Hilton Creek are two very different tributaries in terms of their watershed and channel size (Salsipuedes is an order of magnitude larger than Hilton), hydrology (rainfall and flow patterns, and hydrologic regime), land use (chaparral, agriculture, and cattle ranching), and biology (*O. mykiss* migration and population characteristics) (AMC, 2009). Both creeks have hydrologic regimes typical of a Mediterranean-type climate with flashy streams and high inter/intra-year runoff variability. The watershed area for Salsipuedes Creek is larger than that of Hilton Creek, and at times receives more rainfall during any given precipitation event due to its more westerly location. Smaller watersheds have sharper recessional storm hydrographs, and Hilton Creek has an artificially sustained baseflow greater than 2 cfs year around, whereas in the upper reaches of Salsipuedes Creek and its largest tributary, El Jaro Creek, baseflows typically approach 0.5 cfs during the dry season; however, the ongoing drought dried large stretches of both El Jaro and upper Salsipuedes creeks during the dry season of WY2014. Trapping results from previous years suggest that out-migrant *O. mykiss* smolts in both creeks are most likely to migrate towards the ocean/lagoon when elevated flow opportunities occur.

The *O. mykiss* populations of the two creeks exhibit differences in timing of upstream migration and spawning activity, as the creeks exhibit differences in rearing and spawning habitat availability, and in over-summering habitat characteristics (i.e., water quality, flow, and habitat complexity). Hilton Creek has good rearing habitat quality with continuous flows (refuge pools with instream structure components and a mature riparian canopy) and discharges into the Long Pool along the LSYR mainstem, but has limited stream length and sparse spawning gravel. Whereas the Salsipuedes Creek system has extensive stream mileage but only fair habitat quality due to low dry season flows, limited pool habitat for over-summering, a predominance of fine sediment in the substrate, and high water temperatures in the lower portion of the creek during the dry season (AMC, 2009). Resident *O. mykiss* upstream migration occurs earlier in Hilton Creek than in Salsipuedes Creek due to greater availability of water in the mainstem immediately below the dam where resident *O. mykiss* have been documented to over-summer. Smolts leaving Hilton Creek have a longer migration time than smolts leaving Salsipuedes Creek because of the greater distance between the creek and the ocean. *O. mykiss* in Hilton Creek potentially have a longer seasonal smolt migration period compared to fish in Salsipuedes Creek due to more favorable water quality conditions near the dam, which can diminish common environmental cues for out migration (i.e., low versus high water temperatures and continuous versus intermittent baseflow greater than 2 cfs). Steelhead arrival likely occurs later in Hilton Creek compared to Salsipuedes Creek due to its greater distance from the ocean.

The catch per unit effort (CPUE) standardizes catch based on the extent of effort exerted for the number of fish captured over a particular time period, with units shown in captures/day. The upstream and downstream traps were deployed in Hilton Creek on separate days with the downstream trap operated in such a manner as to reduce the potential for juvenile take (i.e., limiting the number of juveniles captured early in the season to help prolong the trapping effort before reaching ITS limits). For the Hilton Creek upstream trap, the trapping season was 70 days long with 61 functional trap days (Table 9). The trap was out of operation for a total of 9 days following two separate HCWS failures. The CPUE for upstream migrants was 0.75 fish/day with a trapping efficiency of 87% which included the periods when traps were not functional due to flow interruption by the HCWS failures. The downstream migrant trapping season was 34 days long with 27 functional trap days. The CPUE for downstream migrants was 2.89 fish/day with a trapping efficiency of 79%. Combined CPUE when the traps were functioning at the same time was 3.64 fish/day. For Salsipuedes Creek, both upstream and downstream traps were installed and removed on the same day. The CPUE at the Salsipuedes trap site was 1.3 fish/day with a 100% trapping efficiency (Table 9).

The size differences between *O. mykiss* captured in each creek reflects the overall habitat conditions influencing growth and survivability. For example, larger fish and a greater number of fish were captured in Hilton Creek compared to Salsipuedes Creek. While the Salsipuedes Creek watershed is significantly larger than the Hilton Creek watershed, better over summering rearing conditions were present in and around Hilton Creek (i.e., the Long Pool and Hwy 154 Reach) which allowed for greater survivability of *O. mykiss* (Table 10). Conversely, far fewer and significantly smaller fish were captured in Salsipuedes Creek, which is an indication of the negative pressures on the population driven by the drought.

In WY2014, rainfall measured at Bradbury Dam was 9.96 inches and the year was classified as dry (i.e., < 15 inches of rain). The sandbar at the mouth of the lagoon did not open during WY2014 and large portions of the LSYR mainstem remained dry during the entire migration period. Instream flows in the river, as monitored at the USGS gauging stations, indicate that flow conditions were not suitable for migration throughout the lower watershed, including Salsipuedes Creek, during the entire migration season. During the 2014 migration season, 104 out of the 137 migrants (76%) were captured in either the 2nd PM or the 1st AM check, the hours of darkness. For comparison, in WY2012, 77% of the migrating fish were captured during the hours of darkness (Table 8).

A total of 56 smolts were captured in WY2014: 46 at Hilton Creek with an average size of 150.2 mm (5.9 inches) and 10 at Salsipuedes Creek with an average size of 154.6 mm (6.1 inches) (Figure 58). In Hilton Creek, the first smolt was captured the first day the downstream trap was activated and it is likely that more smolts left the creek before the trap was activated based on past years' trapping results. The smolts leaving Hilton Creek were moving independent of a natural flow cue, which contrasts to observations in Salsipuedes Creek, where all 10 smolts were captured immediately following the first elevated flows of the season (a 38 cfs storm event), and once flows decreased to 1.6 cfs, the smolt migration out of Salsipuedes ceased. The difference in smolt migration timing between the two creeks illustrates the complicated environmental variables acting on each system (i.e., stream water temperature, natural versus artificial flow regime, elevated storm flows, and some suggest photo period [length of the day] and the lunar cycle). In the absence of flow cues, migration still occurs in Hilton Creek (particularly in dry years), and the difference in migration timing between the two streams is likely due to the consistently higher base flow that is released into the creek compared to Salsipuedes Creek; in Salsipuedes Creek, it appears that the primary migration cue is elevated flow rates.

Because of the relatively late start and early finish of the abbreviated trapping season, migration patterns and trends cannot be analyzed in either of the creeks for comparison to previous years' data. The WY2014 data show the rapid behavioral response by juvenile fish to the first freshet of the migration season (Figure 61). The data illustrated the importance of stormflow and its associated downstream migration response, especially in Salsipuedes Creek.

LSYR Mainstem Trap: Trapping was conducted in the LSYR mainstem for a period of 7 days from 3/3/14 to 3/9/14 because only one period of elevated flow with sufficient magnitude for fish migration occurred during the trapping season. No *O. mykiss* were captured. For the LSYR mainstem, both upstream and downstream traps were installed and removed on the same days. The CPUE at the mainstem trap site was 0 fish/day with a

100% trapping efficiency across the 7-day trapping period (Table 9). Dry or very low flow conditions throughout the mainstem eliminated upstream or downstream migration opportunities in the mainstem during WY2014.

3.5. Reproduction and Rearing

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

Redd Surveys: Redd (spawning) surveys are typically conducted opportunistically once a month in the LSYR mainstem (Refugio and Alisal reaches) and bi-monthly in the tributaries (Hilton, Salsipuedes, El Jaro [including Los Amoles and Ytias] creeks) in the winter and spring within the reaches where access is permitted. WY2014 was a difficult year for resident and anadromous steelhead migration within the LSYR basin, with few elevated flow events providing little to no migration opportunities throughout the watershed. The lagoon did not breach to the ocean nor did the mainstem flow to the lagoon at any point during the migration season. Fragmented habitat, beaver dams, and low flows appear to have reduced longitudinal *O. mykiss* movement within the mainstem and tributaries (except Hilton Creek which maintained connectivity with the LSYR mainstem due to HCWS releases). Spawning conditions were so poor that no spawning surveys were conducted in the LSYR mainstem in WY2014 due to dry conditions and the absence of any stormflows (except in the Hwy 154 Reach).

Redd survey results are presented for the tributaries in Table 11 and Table 12. Surveys within the LSYR tributaries began in mid-January and ended in April. Due to the low flow conditions and continuing drought, spawning locations were localized to 17 sites in Hilton Creek and 2 sites in Salsipuedes Creek for a total of 19 redds observed. Surveyors noted that many potential spawning habitats in the creeks listed above were buried in leaf litter or silt as no significant flow events occurred to expose and clean spawning gravels.

The first spawning site of the season was observed in Hilton Creek on 1/14/14 where 4 separate redds were discovered throughout the creek. Spawning peaked in February with 7 additional redds documented, followed by another 4 redds documented in March, and 2 more redds observed in April (Table 12). Two redds were observed in Salsipuedes Creek in February, both near bedrock influenced sections of the creek adjacent to deep pool habitats. All redd sites observed in WY2014 were small and likely constructed by resident *O. mykiss* based on the smaller excavation dimensions of the redd compared to observations of past excavations by larger anadromous steelhead in WY2008 and WY2011. Very low flow conditions were present in the remaining creeks, which prevented movement of fish and limited spawning opportunities.

The number of redds observed in WY2014 in Salsipuedes Creek were very low compared to previous years; only 2 redds were observed in WY2014, compared to55 spawning sites identified within the same survey area in WY2012. This constitutes a 96.7% reduction in spawning sites in just 2 years and illustrates the impact of the drought during the *O.*

mykiss spawning season. No redds were observed in El Jaro, Los Amoles, or Ytias creeks during WY2014 (Table 12).

No redds surveys were conducted below the Hwy 154 Reach in the LSYR mainstem and no redds were identified in the Hwy 154 Reach during WY2014 (Table 13). Reaches that were dry do not provide spawning habitat and thus were not surveyed.

Snorkel surveys: The COMB-FD staff conducted snorkel surveys in WY2014 during the spring, summer and fall within the LSYR mainstem and its tributaries (Figure 62 and Table 14). Standard and accepted single-pass snorkel survey protocols were followed (Hankin and Reeves, 1988). Spring snorkel surveys were completed in July and were meant to record conditions after the spawning season (January-May) and prior to the critical summer rearing season. Spring surveys document the number and location of YOY produced, as well as the standing crop of *O. mykiss* going into the over-summering period. Due to a late season WR 89-18 release, and commensurate with the goals of RPM 6, summer snorkel surveys in the LSYR mainstem (considered "during-release" surveys for RPM 6) were conducted in October. Fall LSYR mainstem snorkel surveys were conducted in November. Fall surveys are meant to evaluate the population of over-summering *O. mykiss* going into the following water year.

The COMB-FD staff applied the same level of effort for each of the three surveys and covered 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 COMB-FD staff continues to solicit landowner cooperation and gain access to new reaches, particularly when conducting tributary project performance evaluations within upstream tributary reaches.

Snorkel survey locations 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 separated into 3-inch size classes of fish. The total numbers of *O. mykiss* observed during all three snorkel surveys are shown in Figure 63 and Table 16 with all survey dates shown in Tables 13 and 16 for the LSYR mainstem and its tributaries.

In summary, *O. mykiss* were observed in the Hwy 154 Reach (124 in spring, 78 in summer, and 21 in fall), and no *O. mykiss* were observed in the Refugio, Alisal, and Avenue of the Flags LSYR mainstem reaches during the spring, summer, and fall surveys. In Hilton Creek, a total of 254 *O. mykiss* were observed in spring and in summer (no fall survey was conducted in Hilton Creek due to poor visibility). During spring surveys, 3 *O. mykiss* were observed in Quiota Creek and 30 *O. mykiss* were observed in Salsipuedes Creek (Reach 1-4), and no summer or fall surveys were conducted, due to turbid and/or dry conditions. No surveys were conducted in El Jaro Creek, due to turbid or dry conditions.

Mainstem: LSYR mainstem snorkel surveys were conducted during the spring, summer, and fall within the Hwy 154, Refugio, Alisal, and Avenue of the Flags reaches (Figure 62). Spring surveys carefully locate all dry season rearing habitats for *O. mykiss* after wet season runoff and spawning (winter and spring). The summer and fall surveys then focus on those habitats with associated surveys in the habitats between to assure no fish were missed.

<u>*Hwy 154 Reach*</u>

Although the Hwy 154 Reach extends from the Stilling Basin (LSYR-0.0) to the Hwy 154 Bridge (LSYR-3.2), due to access constraints and the size and poor clarity of the Stilling Basin and the Long Pool, the only areas snorkeled were the habitats below the Long Pool to the Reclamation property boundary (LSYR-0.5 to LSYR-0.7) (Figure 62 and Table 15). The visibility within the Hwy 154 Reach downstream of the Long Pool allowed snorkel surveys to be conducted during all three snorkel surveys in WY2014. The Long Pool continued to be hampered by poor visibility and divers couldn't accurately assess the fish assemblage within the pool during any of the survey attempts.

Snorkel survey results for the Hwy 154 Reach are shown in Figures 63 and 64 and Tables 13, 14 and 15. A total of 142 *O. mykiss* were observed in the reach below the Long Pool to the Reclamation property boundary (LSYR-0.5 to LSYR-0.7) during the spring survey. Of the fish observed, 90 (63%) fell into the 0-3 inch size category, and 30 (21%) fell within the 3-6 inch size category. The remainder of *O. mykiss* observed in the spring was 6-9 inches (14 fish, or 10%) and 9-12 inches (8 fish, or 6%).

As mentioned above, a WR 89-18 release was conducted in WY2014, which necessitated slightly different timing of the routine snorkel surveys depending on the reach surveyed and the WR 89-18 release schedule. Divers returned to the Hwy 154 Reach in August to conduct a WR 89-18 pre-release survey, which was applied here as the regular summertime survey. The COMB-FD staff observed a total of 78 *O. mykiss* during this summertime survey, comprised of 15 (19%) 0-3 inch fish, 52 (67%) 3-6 inch fish, 2 (3%) 6-9 inch fish, and 9 (12%) 9-12 inch fish. This was a 45% drop in *O. mykiss* observations compared to the spring survey conducted a month earlier.

Fall snorkel surveys were conducted in November 2014 in association with the post-release RPM 6 surveys. A total of 21 *O. mykiss* were observed in the fall in two size classes, 14 (67%) 3-6 inch fish and 7 (33%) 6-9 inch fish. This final WY2014 count in the 154 Reach was an 85.2% reduction in the number of *O. mykiss* observed in the spring.

<u>*Refugio Reach*</u>

The Refugio Reach ranges from the Hwy 154 Bridge (LSYR-3.2) downstream to Refugio Bridge (LSYR-7.8); however, the section of river between LSYR-3.2 to LSYR-4.9 is not snorkeled due to access limitations (Figure 62 and Table 15). Snorkel surveys (spring, summer, and fall) were conducted in relation to the timing of the 2014 WR 89-18 release, as well as the predetermined number and location of habitats snorkeled. A total of 7 habitat units were visited during each survey; 6 pool habitats and 1 run habitat. Snorkel survey results for the Refugio Reach are shown in Figure 63 and in Tables 14, 15, and 16.

No *O. mykiss* were observed within any habitat during the spring, summer, or fall snorkel surveys within the Refugio Reach. This marks the first time since the initiation of target flows in 2005 that *O. mykiss* haven't been observed within the Refugio Reach across all snorkel surveys in a water year.

Alisal Reach

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figure 62 and Table 15). Snorkel surveys (spring, summer, and fall) were conducted in relation to the timing of the 2014 WR 89-18 release, as well as the predetermined number and location of habitats snorkeled. A total of 7 habitat units were snorkeled during each survey; 6 pool habitats and 1 run habitat (Tables 14 and 15). This was done to match the level of effort in the Refugio Reach. Snorkel survey results for the Alisal Reach are shown in Figure 63 and in Tables 14, 15, and 16. No *O. mykiss* were observed during any of the spring, summer, or fall snorkel surveys within the Alisal Reach. This marks the first time since the initiation of target flows in 2005, inclusive of flows to Alisal Bridge (LSYR-10.5) during the year of a spill and the year thereafter, that *O. mykiss* have not been observed within the Alisal Reach across all snorkel surveys in a water year.

Avenue of the Flags Reach

The Avenue of the Flags Reach is located from Alisal Bridge (LSYR-10.5) down to the Avenue of the Flags Bridge (LSYR-13.9) (Figure 62 and Tables 15 and 16). The upstream portion of this reach includes altered habitats 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 COMB-FD staff conducted a spring snorkel survey in the Avenue of the Flags Reach in July. Conditions had already deteriorated and most of the area was completely dry. Only a few wetted pools remained and no live fish of any species were observed, except for dead carp and largemouth bass were seen in a de-watered pool adjacent to the gravel mine (LSYR-11.4).

After WR 89-18 release flows reached the Avenue of the Flags Reach in the summer, the COMB-FD staff conducted surveys in October (considered the summer and "during-release" survey) and in November (considered the fall and "post-release" survey). A total of 9 habitat units were surveyed, comprised of 4 runs and 5 pools. No *O. mykiss* were observed within the Avenue of the Flags Reach during any of the spring, summer and fall snorkel surveys (Figure 63 and Tables 14-16).

Tributaries: Tributary snorkel surveys were conducted in the spring, summer, and fall in WY2014 at most of the long-term monitoring locations within Hilton, Quiota, Salsipuedes, and El Jaro creeks (Figure 62 and Table 17). Salsipuedes Creek Reach 5 and El Jaro Creek were not surveyed during WY2014 due to turbid and/or dry conditions.

Hilton Creek

Hilton Creek surveys are conducted on Reclamation property from the confluence of the LSYR upstream to the Reclamation property boundary, which is approximately 100 feet above the URP of the HCWS and a total distance of approximately 3,000 feet (Figure 62 and Tables 17 and 18). Hilton Creek is divided into 6 reaches, separated by geomorphic breaks in creek and channel morphology. Because Hilton Creek is supplemented with year-round flow, is relatively short, and contains high densities of *O. mykiss*, all habitats within Hilton Creek are snorkeled and have been since the installation of the HCWS in 2001.

In the spring of WY2014, a long-duration flow interruption of the HCWS occurred between 5/25/14 – 6/10/14. In total, 543 *O. mykiss* were rescued and released in the Long Pool (LSYR-0.5) and 217 *O. mykiss* mortalities were recovered by COMB-FD staff. As a result of this flow interruption, the regular spring snorkel survey was delayed until July to not further affect the fishery. Figures 63 and 65 and Tables 17, 18 and 19 show the results of the snorkel surveys in Hilton Creek. In June, a total of 254 *O. mykiss* were observed across 5 reaches of Hilton Creek, with 60 (24%) falling into the 0-3 inch size category and 155 (61%) falling into the 3-6 inch size category (Figure 65). Only 12 *O. mykiss* were observed upstream of the LRP (Reach 5), which was the result of the majority of fish within that reach being removed during the aforementioned HCWS interruption of flow incident and associated fish rescue.

The summer snorkel survey conducted by the COMB-FD staff in September counted the same number (254) of *O. mykiss* as was observed during the spring survey. However, an upward size shift was observed from the spring to the summer with only 6 (2%) of the *O. mykiss* in the 0-3 inch size category. The highest totals during the summer survey were fish in the 3-6 inch size category with 192 (76%) of the total being observed.

The COMB-FD staff attempted a fall snorkel survey within Hilton Creek but the visibility was too poor to accurately conduct a count. The visibility ranged between 1-2 feet and surveyors could not see the bottom of most habitat units. A combination of low lake elevations and lake turnover had created turbid conditions which lasted for the remainder of the calendar year.

Quiota Creek

A section of Quiota Creek, located between Crossing 5 to Crossing 7, typically contains perennial flow and habitat which COMB-FD staff routinely snorkels (Figure 62 and Table 17). WY2014 was another dry year and the conditions within this drainage continued to deteriorate during the oversummering period.

Surface water during the spring survey was already showing signs of going underground, as the first few (normally wetted) habitats within this historic reach were already dry. A total of 3 *O. mykiss* were observed, with 1 (0-3 inch) and 2 (3-6 inch) fish observed (Figures 63 and 66, and Table 18 and Table 19).

Wetted conditions continued to diminish during the summer and fall and the COMB-FD staff did not conduct summer or fall surveys within the drainage due to dry conditions. The majority of the normally perennial section of Quiota Creek had gone dry by August.

Salsipuedes Creek

Lower Salsipuedes Creek contains five reaches that the COMB-FD staff separates by fluvial geomorphic changes in the stream channel. Reaches 1 through 4 are located between Santa Rosa Bridge (on Santa Rosa Road) and the Jalama Road Bridge upstream, a distance of approximately 2.85 stream miles. Reach 5 extends upstream from Jalama Road Bridge to the confluence of El Jaro Creek, a distance of approximately 0.45 mile (Figure 62 and Table 18). Reach 5 has been a historic monitoring location because of its reliable water clarity, continuous flow, presence of *O. mykiss*, and relatively easy access.

The COMB-FD staff attempted to snorkel survey various reaches in Salsipuedes Creek during the spring. However, poor visibility was present throughout the entire drainage which prevented an accurate assessment of the fish population. Where visibility permitted in Reaches 1-4, divers observed 30 *O. mykiss* scattered in various pool habitats during the spring survey. Observed were the following size classes of fish: 5 (0-3 inch), 6 (3-6 inch), 12 (6-9 inch), 5 (9-12 inch), and 1 (12-15 inch) (Figures 63 and 67, and Tables 17, 18, and 19).

Water quality conditions worsened during the summer and fall that prohibited snorkel surveys. With little flowing water, sections going dry for the first time in the history of the project, and chronic turbidity from cattle and beaver activity, the COMB-FD staff was not able to conduct additional snorkel surveys due to poor visibility for the remainder of the year.

El Jaro Creek

A 0.40 mile long section of El Jaro Creek, just upstream of its confluence with Salsipuedes Creek, is typically surveyed by the COMB-FD staff in the spring, summer, and fall of each year (Figures 62 and 63, and Tables 17, 18, and 19). Personnel attempted to snorkel El Jaro Creek in July but poor visibility and limited surface water prevented any snorkel counts. By mid-summer, the majority of this reach was completely dry and only a few, isolated turbid pools remained. No snorkel surveys were conducted in El Jaro Creek in WY2014.

Other Fish Species Observed: Non-native species in the LSYR mainstem are part of the COMB-FD staff snorkel count during spring, summer, and fall snorkel surveys (Figures 68 and 69). In general, fish species inhabiting Lake Cachuma are commonly found throughout the LSYR mainstem. Typically, the most numerous species observed during snorkel surveys include largemouth bass, three sunfish species including bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and redear sunfish (*Lepomis microlophus*), common carp, and two catfish species; the black bullhead (*Ameriurus melas*), and the channel catfish (*Ictalurus punctatus*). Bass (*Micropetrus spp.*), sunfish (*Lepomis spp.*) and catfish are known predators of *O. mykiss*, particularly the younger life stages. Carp and catfish (*Ictalusus spp.*) can stir up the bottom of the substrate and greatly reduce water clarity. Warm-water species are rarely observed in any of the three tributary drainages (Salsipuedes, Quiota, and Hilton) that the COMB-FD staff monitors. In September of WY2014, however, divers observed 21 largemouth bass ranging in size from 2-9 inches in Lower Hilton Creek within the first 250 feet of its confluence with the LSYR mainstem. The introduced arroyo chub (*Gila orcuttii*) and fathead minnow (*Pimephales promelas*) are regularly observed within the Salsipuedes Creek drainage.

Largemouth Bass: Similar to what was observed in WY2013, the warm-water species with the highest snorkel counts inhabiting the LSYR mainstem was largemouth bass in WY2014 (Figures 68 and 69). Snorkel surveys in the spring within the Refugio Reach and Alisal reaches resulted in 10 and 12 largemouth bass, respectively. Largemouth bass counts during the summer survey increased to 111 in the Refugio Reach (many were young of the year), with only 5 observed in the Alisal Reach during that same period. By the fall, largemouth bass counts had dropped to 67 in the Refugio Reach and had risen slightly to 9 within the Alisal Reach.

Sunfish Species: There are multiple centrarchid sunfish species (green, red-ear and bluegill) inhabiting the LSYR mainstem, which can be especially difficult to distinguish in juvenile form. All three species are lumped into a single sunfish category for the purposes of this report. A total of 5 sunfish were observed in the Refugio Reach and 5 sunfish in the Alisal Reach during LSYR mainstem spring snorkel surveys (Figure 68b). During the summer survey, 8 sunfish were observed within the Refugio Reach, and no sunfish were observed in the Alisal Reach. The COMB-FD staff only recorded 1 sunfish, during the final fall survey, within the Alisal Reach (0 in Refugio Reach).

Catfish Species: There are two species of *Ictalurid* catfish known to be present in the LSYR mainstem, bullhead and channel catfish. Although the COMB-FD staff differentiates between them during routine snorkel surveys, they're reported as a single catfish category for the purposes of this report. In WY2014, no catfish were observed during any of the spring, summer, and fall surveys within the LSYR mainstem (Figure 69a).

Carp: Despite hundreds of carp being observed from the bank in the Stilling Basin (LSYR-0.0) and Long Pool (LSYR-0.5) within the Hwy 154 Reach, very few were observed downstream within the Refugio and Alisal reaches during WY2014 snorkel surveys (Figure 69b). Carp were so prevalent in the Stilling Basin and Long Pool that surveyors were unable to snorkel those habitats due to poor visibility that was likely caused by carp feeding behavior. Deteriorating conditions within Lake Cachuma were also likely contributing to the poor water clarity within the Hwy 154 Reach, as the visibility within Lake Cachuma was also poor throughout most of WY2014. During all three snorkel surveys, 5 carp were observed within a single pool habitat within the Refugio Reach (Figure 69b). No other carp were observed within the Refugio and Alisal reaches of the LSYR mainstem in WY2014.

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 from water being discharged to stream habitats downstream of the project area. In WY2014, the Quiota Creek Crossing 1 Project was completed (December of WY2014). This project removed an Arizona-type crossing and replaced it with a 60-foot bottomless arched culvert with one constructed riffle. Prior to removal, this impediment was considered a partial barrier to *O. mykiss* within Quiota Creek.

The Quiota Creek Crossing 1 project did not require the removal or relocation of *O. mykiss* because that portion of the stream was completely dry throughout the construction period. Project monitoring details for Crossing 1, including all plans 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, vegetation maintenance (watering, weeding) and photo documentation were all conducted in accordance with the post-project monitoring requirements at each location.

3.7. Additional Investigations

Genetic Analysis: Tissue samples from all of the migrant captures during WY2014 were sent to Dr. Carlos Garza of NOAA Southwest Science Center at UC Santa Cruz. Results suggest captured and sampled migrating *O. mykiss* showed a strong genetic correlation to their streams of origin.

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 expanded in large numbers from Bradbury Dam to the Narrows. Portions of the LSYR mainstem downstream of the Lompoc Waste Water Treatment Plant (WWTP) and upstream of the Santa Ynez River lagoon have also been colonized. In addition and as of WY2014, beavers successfully inhabited the Salsipuedes/El Jaro Creek watershed and there appears to be 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 inundate riffles and runs, modifying habitats 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. Beaver dams 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*; thus, may be reducing the amount of available spawning areas in the system. 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 several day period in December and January of WY2014, the COMB-FD staff 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 Santa Ynez River (approximately LSYR-34.4), except within the Hwy 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 Waste Water Treatment Plant (approximately LSYR-42.0) to the lagoon (approximately LSYR-46.6).

Dams were classified as barriers, impediments, or passable, utilizing CDFW passage criteria. In order for upstream 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 of 121 beaver dams were identified within the LSYR mainstem downstream of Bradbury Dam, 62 (51%) which were classified as barriers, 28 (23%) as impediments, and 31 (26%) as passable to migrating fish (Figure 70, Table 20). There was one dam in the Hwy 154 Reach, 13 dams in the Refugio Reach, 14 dams in the Alisal Reach, 11 dams in the Avenue reach, 77 from the Avenue of the flags reach downstream to the Narrows, 2 near the Lompoc Waste Water Treatment Plant, and 3 on Vandenberg Airforce Base. Barrier dams were found in every reach. The number and extent of beaver dams identified in WY2014 serves to illustrate the extent of habitat fragmentation caused by the dams within the LSYR. There were 15 dams identified that were between 3-4 feet in height, and one dam that was greater than 4 feet (6 ft) in height (Table 20).

There were 36 beaver dams identified in the Salsipuedes/El Jaro Creek watershed; 19 dams in Salsipuedes Creek and 17 dams in El Jaro Creek (Table 20). The majority of the dams were classified as barriers (28) with 7 impediment dams and one passible dam in the watershed. The number and extent of the dams identified in the tributaries in WY2014 illustrate the extent of habitat fragmentation caused by dams. There were also two dams found in Hilton Creek that were constructed in a lower side channel and did not impede migration through the main creek channel.

Over the past 5 years, the number, extent, and size of beaver dams has fluctuated in both the LSYR mainstem and its tributaries. In WY2011, Bradbury Dam spilled, removing many beaver dams and killing or relocating an indeterminate number of individual beavers in both the mainstem and tributaries either through the high flows or burying their dens. This was especially true in the Salsipuedes/El Jaro Creek watershed where only 5 beaver dams were identified in WY2011 (Table 20). The highest total of dams identified in both the mainstem (132) and tributaries (36) occurred in WY2013. Dams identified in WY2014 represent a slight decrease in the number of mainstem (121) compared to the previous year and represent an 8% decrease. There was a one dam increase in the tributaries from 35 to 36 in 2014. It is expected that if the current drought continues, both the number and extent of beaver dams will decrease as less water and habitat is available for beavers.

4. Discussion

This section provides (1) discussion as needed, (2) additional information for historical context for the WY2014 results presented above specifically since the issuance of the 2000 BiOp, and (3) status of last year's Annual Report recommendations. Summaries of the LSYR Fisheries Monitoring Program (Annual Monitoring Reports/Summaries) 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), 2012 (COMB, 2016), and 2013 (COMB, 2017).

4.1. Water Year Type Since WY2001

The rainfall (Table 21), runoff (Table 22), and water year type with the years Lake Cachuma spilled (Figure 71) are presented since WY2001.

4.2. Tributary Passage Enhancement Projects

By December 2014, nine (twelve as of the date of this report) tributary passage enhancement projects had been completed within the LSYR basin: Salsipuedes Creek Highway 1 Bridge Fish Ladder, Salsipuedes Creek Jalama Road Bridge Fish Ladder, Hilton Creek Cascade Chute, El Jaro Creek Rancho San Julian Fish Ladder, Quiota Creek Crossing 6 Bridge, Cross Creek Ranch Fish Passage Project on El Jaro Creek, Quiota Creek Crossing 2 Bridge, Quiota Creek Crossing 7 Bridge, Quiota Creek Crossing 1 as well as the HCWS which supplies water year round to Hilton Creek from Lake Cachuma (Tables 22 and 23, and Figures 72, 73, and 74). Three additional tributary passage enhancement projects were completed as of the date of this report: Quiota Creek Crossing 0A, Quiota Creek Crossing 3, and Quiota Creek Crossing 4 (Tables 23 and 24).

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 (Figure 51). In 2005, completion of the Hilton Creek Cascade Chute Project doubled the available habitat for *O. mykiss* in the watered section of Hilton Creek (Figure 74). In addition to the tributary passage enhancement projects mentioned above, there were three bank stabilization and erosion control projects that were completed in 2004 on El Jaro Creek. All these tributary projects removed passage barriers for adult and juvenile *O. mykiss*, reduced sediment supply to the stream, and/or provided for passage, spawning, and rearing of *O. mykiss* upstream of the project area. Many of the completed tributary projects also enhanced the footprint of the project by creating additional pools and refuge habitat, and by increasing native riparian vegetation.

All documented anthropogenic passage impediments within the Salsipuedes/El Jaro Creek watershed have been removed, allowing for adult and juvenile *O. mykiss* passage throughout the stream (Tables 23 and 24). Fish have been observed moving through all of the fish passage facilities, and in cases where fish ladders were installed, fish are using the ladders for refuge and oversummering habitat.

4.3. Status of WY2013 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 WY2013 Annual Monitoring Summary to improve the monitoring program pending available funding:

- Continue the monitoring program described in the revised BA (USBR, 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 with CDFW as a potential solution for monitoring migrants during high flow conditions when the current/conventional traps need to be removed;

- Status: COMB-FD staff continues to work closely with CDFW monitoring and evaluating the results of their deployed DIDSON just downstream of the Salsipuedes Creek trap site.

- 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: COMB-FD staff continues to evolve the Annual Migrant Trapping Plan to assure no exceedance of take while gathering the greatest amount of valuable data.

- Reclamation and COMB work together to propose increased juvenile and adult take limits to be incorporated in the ongoing Reconsultation process with NMFS;
  - Status: This is being worked on during the Reconsultation process and COMB-FD staff are providing historical data and analyses as requested by Reclamation for their discussions with NMFS.
- Continue annual development of a Migrant Trapping Plan that would be reviewed and approved by NMFS;
  - Status: This recommendation is being followed and is ongoing.

- 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 Hwy 154, Refugio and Alisal reaches of the LSYR mainstem to better understand their *O. mykiss* predation;
  - Status: COMB-FD staff have applied for additional coverage under the CDFW Scientific Collection Permits to undertake this recommendation.

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

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

- 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;
  - Status: The appropriate probe for the Sonde has been purchased and is routinely in use during all lake profile water quality monitoring.

- 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 being followed and is ongoing.

- 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;
    - 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, specifically establishing the procedure for data transfer and reporting;
    - Status: This has proven to be challenging as it requires collaboration between CCWA, Reclamation and COMB. The monitoring probes are in place. Recording and transferring of the data is being worked on. Hence this recommendation will be carried forward to next year.

- 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 being followed and is ongoing.

- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin;
    - Status: This continues to be a valuable recommendation with progress being addressed through the Reconsultation process between Reclamation and NMFS.

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

5. Conclusions and Recommendations

WY2014 was the third consecutive year of drought with only 9.96 inches of rainfall recorded at Bradbury Dam. As a result, Lake Cachuma did not spill, the lagoon did not open to the ocean nor connect with the mainstem, and thus, there was no ocean connectivity with the LSYR mainstem 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 for the duration of the water year. Reproduction in the LSYR basin was observed through redd surveys within only Salsipuedes Creek and Hilton Creek; no redds were observed during surveys in El Jaro, Los Amoles, and Ytias creeks. The limited 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 due drying conditions. Interruptions of flow to Hilton Creek due to failures of the HCWS adversely affected the aquatic life in the stream and decreased the overall population of *O. mykiss* in the creek. The long-term drought continued to make over summer rearing difficult for the fishery in the basin.

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 COMB-FD staff to improve the ongoing fisheries monitoring program in the LSYR in accordance with the BiOp:

- Continue to implement the monitoring program described in the revised BA (USBR, 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;
- Continue the collaboration with CDFW regarding operation of their DIDSON in Salsipuedes Creek;
- Continue annual implementation of a Migrant Trapping Plan that would be reviewed and approved by NMFS to assure compliance with take limits set forth in the 2000 BiOp;
- Conduct basic stomach content analyses of non-native piscivorous fish whenever possible specifically in habitats known to support *O. mykiss* and non-native fish;
- Encourage Reclamation to improve the reliability of their HCWS to deliver water and provide continuous flow to Hilton Creek without interruption;
- Collaborate with Reclamation regarding Critical Drought Conditions and downstream water releases for the fishery during drought conditions;
- Continue to maintain and improve relationships with landowners to foster cooperation and gain access to additional reaches for all monitoring tasks, and particularly when conducting tributary project performance evaluations within upstream tributary reaches;

- 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 continue to maintain the LSYR *O. mykiss* scale inventory and conduct 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;
- Move towards a more fluid data recording and reporting procedure of the data from the temperature probes on the Outlet Works of Bradbury Dam to measure water temperature being released to the Stilling Basin, specifically to document BiOp compliance (18 ^{o}C maximum release temperature);
- 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.

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WY2014 Annual Monitoring Report
Results
Figures and Tables

3. Monitoring Results

Table 1: WY2000 to WY2014 rainfall at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases (source: USBR).

Water Year	Rainfall Bradbury[1] (in)	Year Type[2]	Spills[3] (af)	Reservoir Condition Storage (max) (af)	Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.50	Normal	6,067	192,948	750.83	No	Yes
2001	31.80	Wet	112,313	194,519	751.34	No	No
2002	8.80	Dry	0	173,308	744.99	No	Yes
2003	19.80	Normal	0	130,784	728.39	No	No
2004	10.60	Dry	0	115,342	721.47	No	Yes
2005	44.41	Wet	260,078	197,649	753.11	No	No
2006	24.50	Wet	62,869	197,775	753.15	Yes	No
2007	7.40	Dry	0	180,115	747.35	No	Yes
2008	22.59	Wet	22,994	196,365	752.70	No	No
2009	13.66	Dry	0	168,902	743.81	No	No
2010	23.92	Wet	0	178,075	747.05	Yes	Yes
2011	31.09	Wet	85,755	195,763	753.06	No	No
2012	12.69	Dry	0	180,986	748.06	No	No
2013	7.59	Dry	0	142,970	733.92	No	Yes
2014	9.96	Dry	0	91,681	710.00	No	Yes

[1] Bradbury Dam rainfall (Cachuma) period of record = 62 years (1953-2014) with an average rainfall of 20.2 inches.

[2] Year Type: dry =< 15 inches, average = 15 to 22 inches, wet => 22 inches.

[3] Spill volume includes releases to Hilton Creek during that time.

Table 2: WY2014 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 (date)	Period of Record (years)	Long-term Average (in)	Minimum Rainfall (in)	Minimum Rainfall (WY)	Maximum Rainfall (in)	Maximum Rainfall (WY)	Rainfall (WY2014) (in)
Lompoc	439	1955	59	14.87	5.31	2007	34.42	1983	7.2
Buellton	233	1955	59	17.31	6.3	2007	41.56	1998	5.87
Solvang	393	1965	53	19.26	6.47	2007	43.87	1998	7.41
Santa Ynez	218	1951	63	16.21	6.58	2007	36.36	1998	7.92
Cachuma*	USBR	1953	62	20.20	7.33	2007	53.37	1998	9.96
Gibraltar	230	1920	94	26.94	9.24	2007	73.12	1998	11.88
Jameson	232	1926	88	29.58	8.5	2007	79.52	1969	12.48

* Bradbury Dam USBR rainfall.

Table 3: Rainfall by (a) storm events greater than 0.1 inches and (b) monthly rainfall totals at Bradbury Dam during WY2014; dates reflect the starting day of the storm and not the storm duration.

(a)

#	Date	Precipitation (in.)	SC 10 cfs	Los L 10 cfs
1	10/28/2013	0.28	No	No
2	11/20/2013	0.71	No	No
3	11/29/2013	0.43	No	No
4	12/7/2013	0.17	No	No
5	2/3/2014	0.25	No	No
6	2/6/2014	0.40	No	No
7	2/28/2014	6.75	Yes	Yes
8	3/26/2014	0.11	No	No
9	3/30/2014	0.12	No	No
10	4/1/2014	0.57	No	No

(b)

Month	Rain (in.)
October-13	0.34
November-13	1.14
December-13	0.18
January-14	0.02
February-14	4.11
March-14	3.52
April-14	0.65
May-14	0
June-14	0
July-14	0
August-14	0
September-14	0
Total:	**9.96**

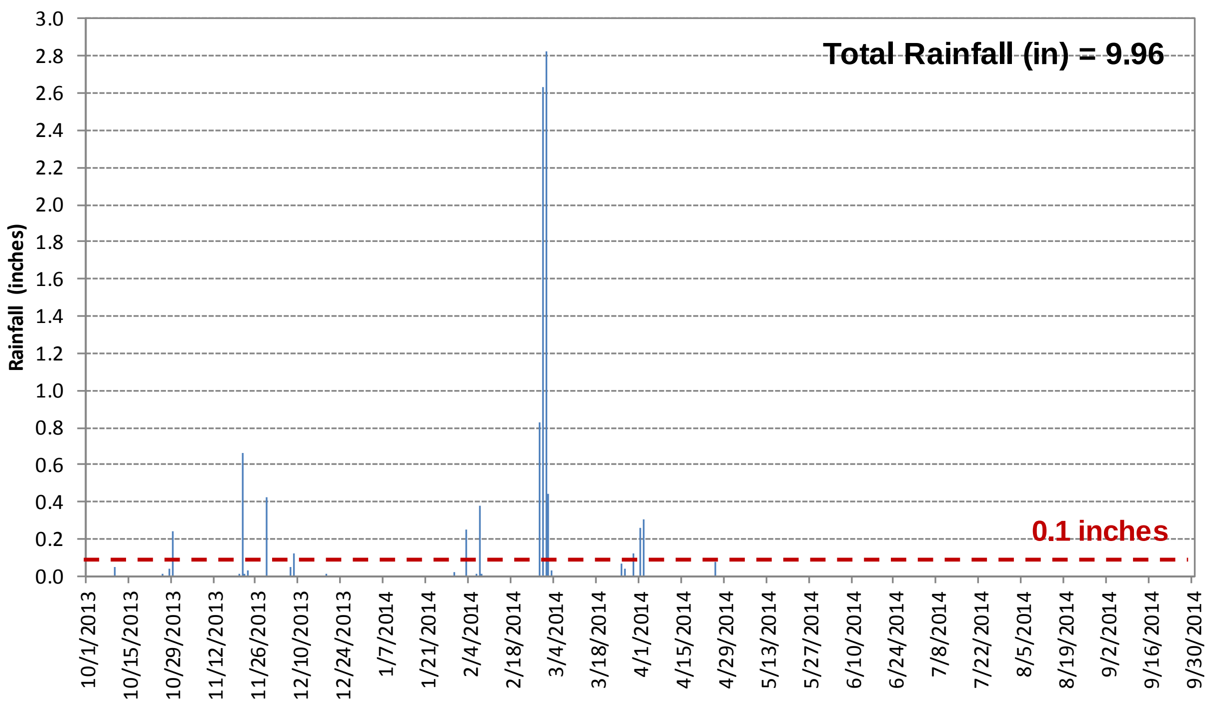


Figure 1: Rainfall in WY2014 recorded at Bradbury Dam (USBR).

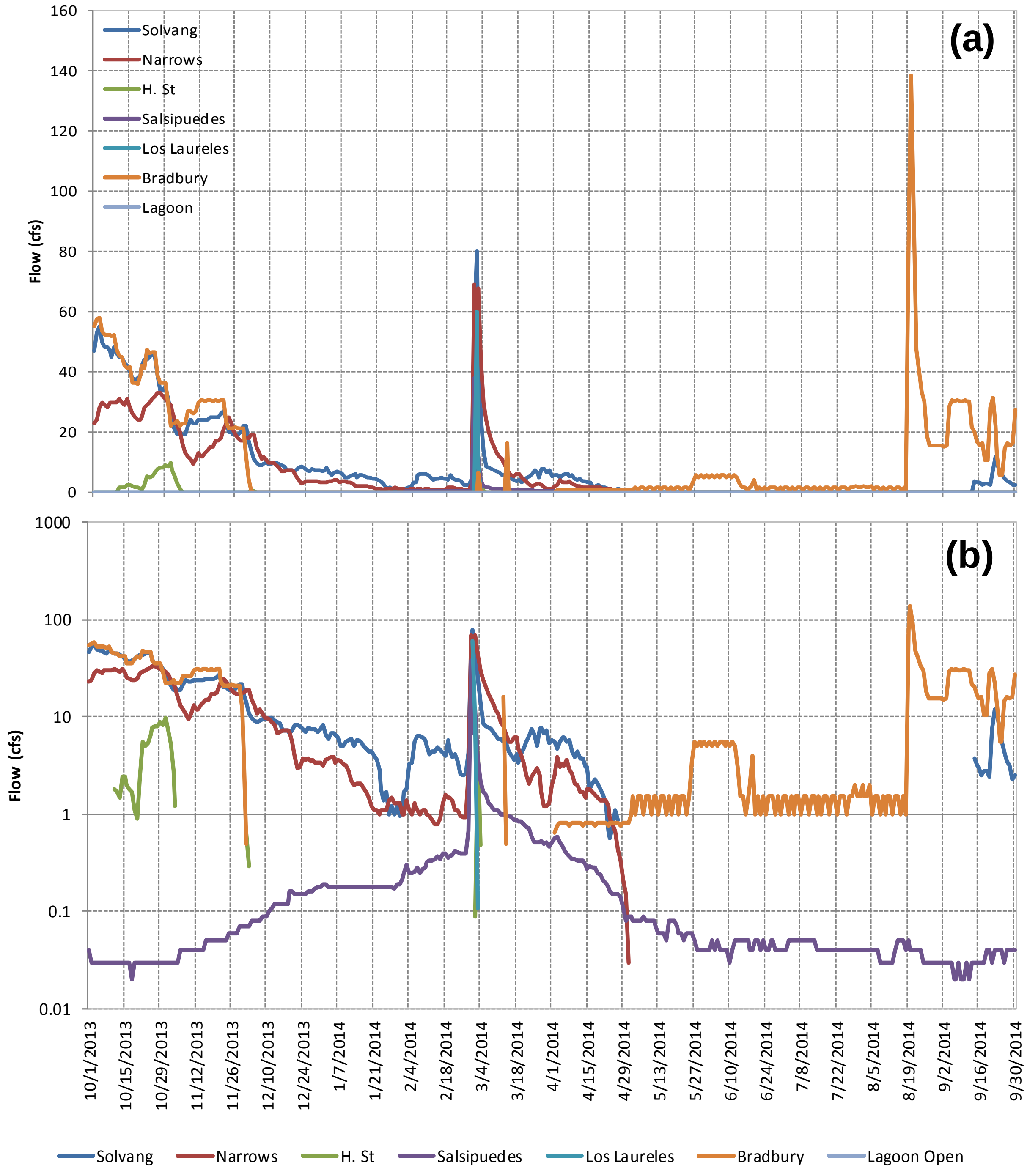


Figure 2: Santa Ynez River average daily discharge in WY2014 with a (a) normal and (b) logarithmic distribution; the Santa Ynez River lagoon was not open in WY2014 (source: USGS and USBR).

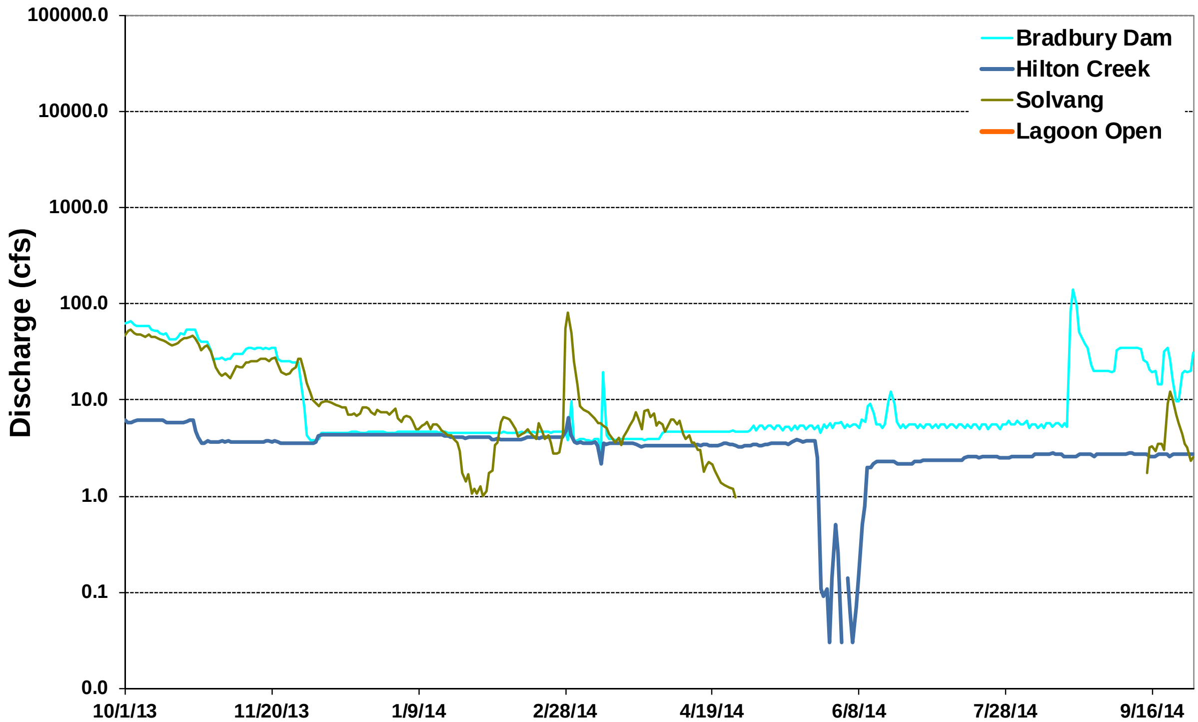


Figure 3: Average daily discharge at Hilton Creek, just below the Upper Release Point, the LSYR mainstem at Solvang (Alisal Bridge) and Bradbury Dam during WY2014; the Hilton Creek USGS gauge is a low flow gauge hence does not record much above 50 cfs; the lagoon was not open during WY2014.

Table 4: Ocean connectivity, lagoon status and number of days during the migration season from WY2001 to WY2014.

Water	Year	Ocean	Lagoon Status			# of Days Open in
Year	**Type**	**Connectivity**	**Open**	**Closed**	**# of Days**	**Migration Season***
2001	Wet	Yes	1/22/01	5/10/01	109	109
2002	Dry	No	-	-	0	0
2003	Normal	Yes	12/21/02	5/9/03	150	140
2004	Dry	Yes	2/26/04	3/22/04	26	26
2005	Wet	Yes	12/28/04	5/20/05	144	141
2006	Wet	Yes	1/3/06	-	271	151
2007	Dry	Yes	-	11/22/06	52	0
2008	Wet	Yes	1/6/08	5/19/08	134	134
2009	Dry	Yes	2/16/09	3/17/09	30	30
2010	Wet	Yes	1/19/10	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
2014	Dry	No	-	-	0	0

* Migration Season is January through May.
** Lagoon opened and closed several times during the water year.

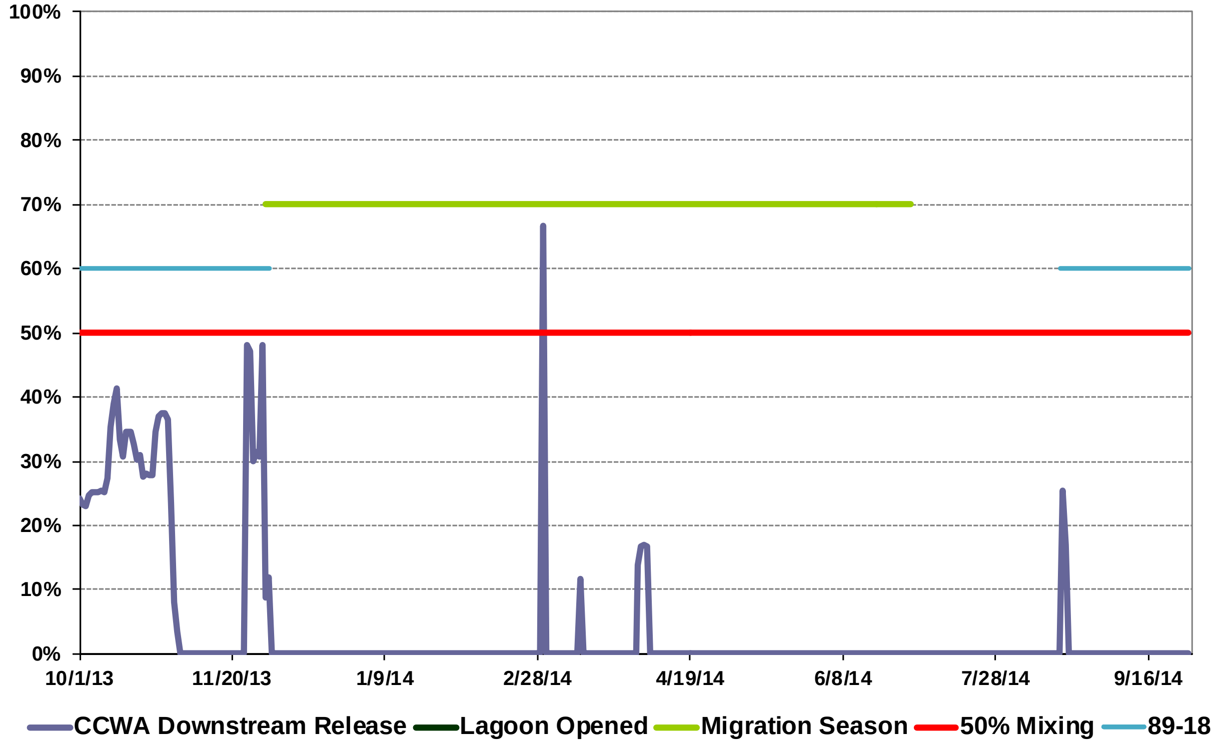


Figure 4: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the WY2014 migration season; the lagoon was not open throughout the monitoring period.

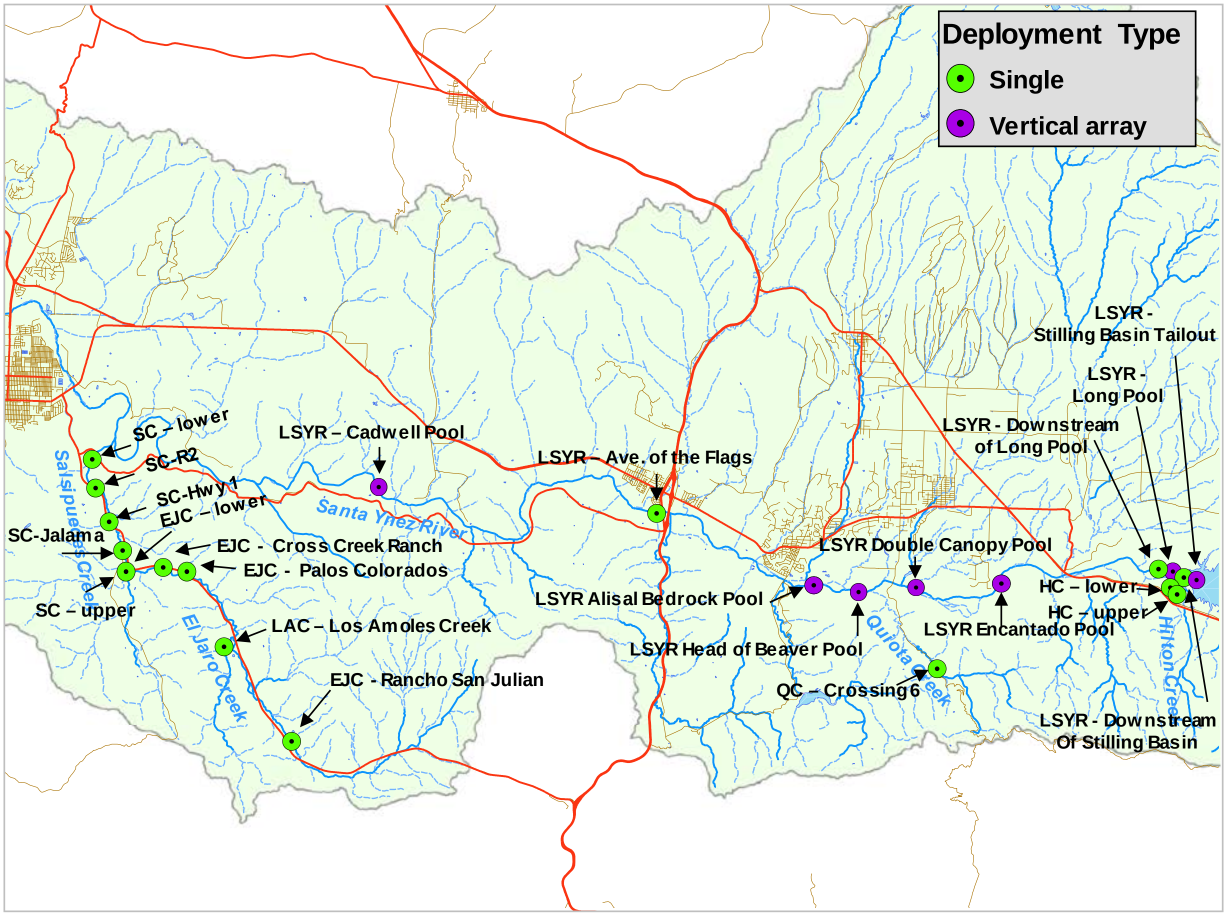


Figure 5: Thermograph single and vertical array deployment locations in WY2014 within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are very close together with overlapping symbols.

Table 5: 2014 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	Stilling Basin - Tail	LSYR-0.10	Vertical Array	5/9/14	12/3/2014	204
	LSYR - D/s of Stilling Basin	LSYR-0.25	Single	4/1/2014	12/1/2014	240
	LSYR - Long Pool	LSYR-0.51	Vertical Array	4/29/2014	12/3/2014	214
	LSYR-D/s of Long Pool	LSYR-0.68	Single	4/29/2014	12/1/2014	212
	LSYR - Encantado Pool**	LSYR-4.95	Vertical Array	4/29/2014	6/6/2014	37
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	8/20/2014	12/3/2014	103
	LSYR - Double Canopy Pool	LSYR-7.65	Vertical Array	5/7/2014	12/6/2014	209
	LSYR - Head of Beaver Pool**	LSYR-8.7	Vertical Array	5/7/2014	7/14/2014	67
	LSYR - Head of Beaver Pool	LSYR-8.7	Vertical Array	8/23/2014	12/5/2014	102
	LSYR - Alisal Bedrock Pool**	LSYR-10.2	Vertical Array	4/28/2014	6/29/2014	61
	LSYR - Avenue of Flags**	LSYR-13.9	Single	4/28/2014	7/8/2014	70
	LSYR - Cadwell Pool	LSYR-22.68	Vertical Array	5/7/2014	10/8/2014	151
Tributaries*	Hilton Creek (HC)-lower	HC-0.12	Single	4/1/2014	12/1/2014	240
	HC-upper	HC-0.54	Single	4/1/2014	12/1/2014	240
	Quiota Creek-Crossing 6**	QC-2.66	Single	4/23/2014	7/9/2014	76
	Salsipuedes Creek (SC)-lower-Reach 1	SC-0.77	Single	4/1/2014	12/4/2014	243
	SC-Reach 2-Bedrock Section	SC-2.2	Single	4/23/2014	12/1/2014	218
	SC-Reach 4-Hwy 1 Bridge	SC-3.0	Single	4/23/2014	12/1/2014	218
	SC-Reach 5-Jalama Bridge	SC-3.5	Single	4/23/2014	12/1/2014	218
	SC-upper at El Jaro confluence	SC-3.8	Single	Dry		
	El Jaro Creek (EJC)-Lower-Confluence	EJC-3.81	Single	4/23/2014	12/1/2014	218
	EJC-Palos Colorados	EJC-5.4	Single	4/23/2014	12/1/2014	218
	EJC-Rancho San Julian Bridge**	EJC-10.82	Single	4/23/2014	6/28/2014	65
	Los Amoles Creek (LAC)-Creek Crossing	LAC-7.0	Single	4/23/2014	12/1/2014	218

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

**Instruments removed due to drying habitat; some mainstem locations had instruments redeployed for WR89-18 downstream releases.

Table 6: Water quality monitoring sites with *O. mykiss* and/or non-native warm water fish species presented as present/absent for reference with the water quality data; blanks indicate no fish species were observed.

Reach or Creek	Sub-Reach	Habitat Name	Stream ID	Observed Fish Species* Spring	Summer	Fall
LSYR Mainstem:						
Reach 1	Hwy 154	Stilling Basin	LSYR-0.2	B, C	B, C	B, C
		Long Pool	LSYR-0.51	O, C	C	O, C
		Downstream of Long Pool	LSYR-0.62	O, B	not snorkeled	O, B
Reach 2	Refugio	Encantado	LSYR-4.95	Dry**		
		Corner Scour	LSYR-5.9	Dry	B, S	
		Double Canopy Pool	LSYR-7.65	B, S, C	B, C	B, C
	Alisal	Car Pool	LSYR-7.8	B, S	B	B, S
		Quiota Confluence Pool	LSYR-8.2	B, S		
		Head of Beaver Pool	LSYR-8.7			
		Bedrock Pool	LSYR-10.2			
Reach 3	Ave. of the Flags	Ave. of the Flags	LSYR-13.9	Dry		
	Cadwell	Cadwell Pool	LSYR-22.68			
Tributaries:						
Hilton	Reaches 1-5	-	HC-00 to HC-0.54	O	O	ns
Quiota	Crossings 1-9	-		O	ns	ns
Salsipuedes	Reaches 1-4	-		O	ns	ns
	Reach 5	-		ns	ns	ns
El Jaro	Upstream of Confluence	-		ns	Dry	Dry

* O - *O. mykiss* , B - largemouth bass, S - sunfish species, C - carp, and blank means zero observed.
** Carp and largemouth bass were found in the dried out pool habitat.
ns - not snorkeled due to turbidity.

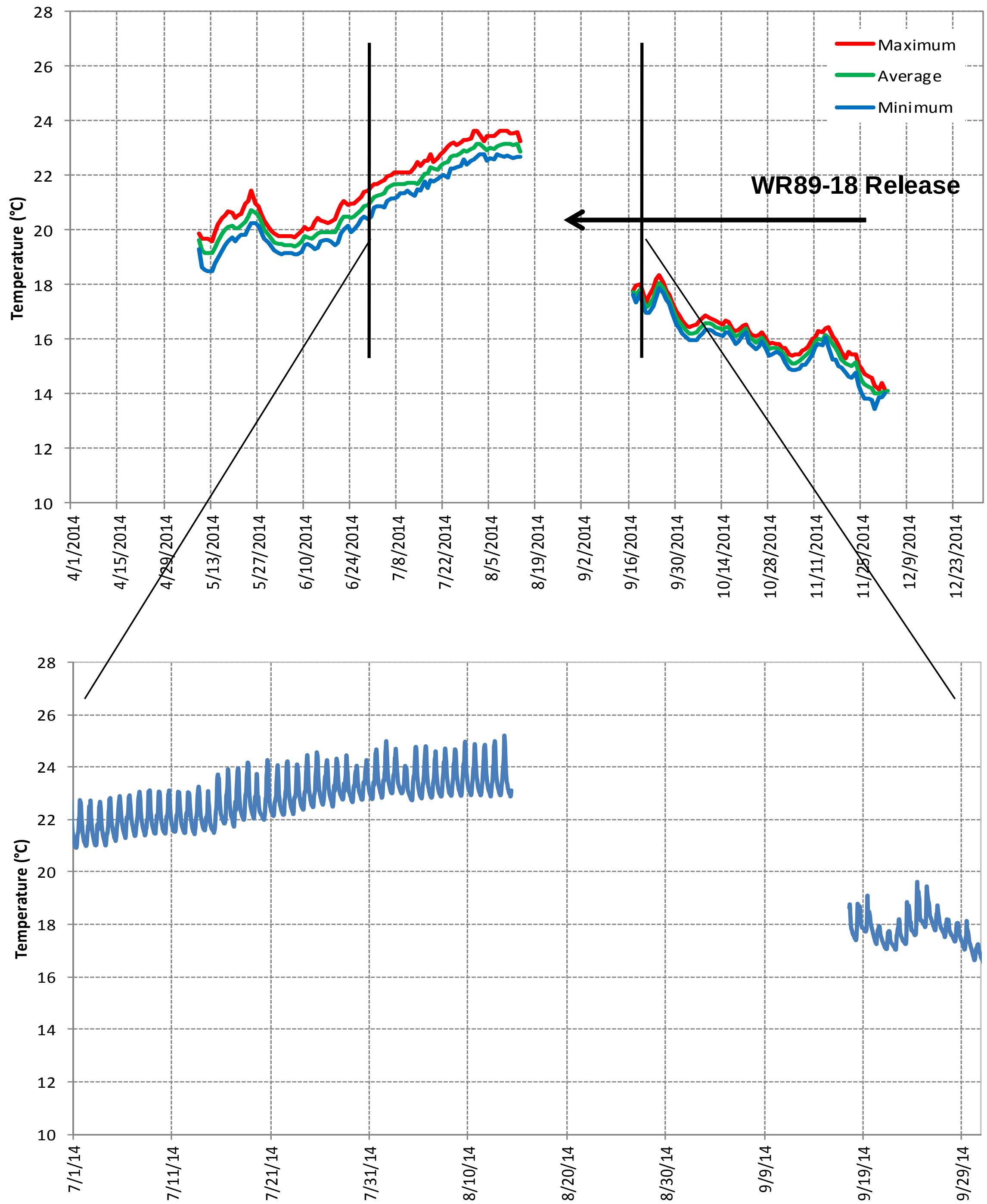


Figure 6: 2014 LSYR-0.10 (Stilling Basin tailout) surface (1.0 foot) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period July 1-October 1.

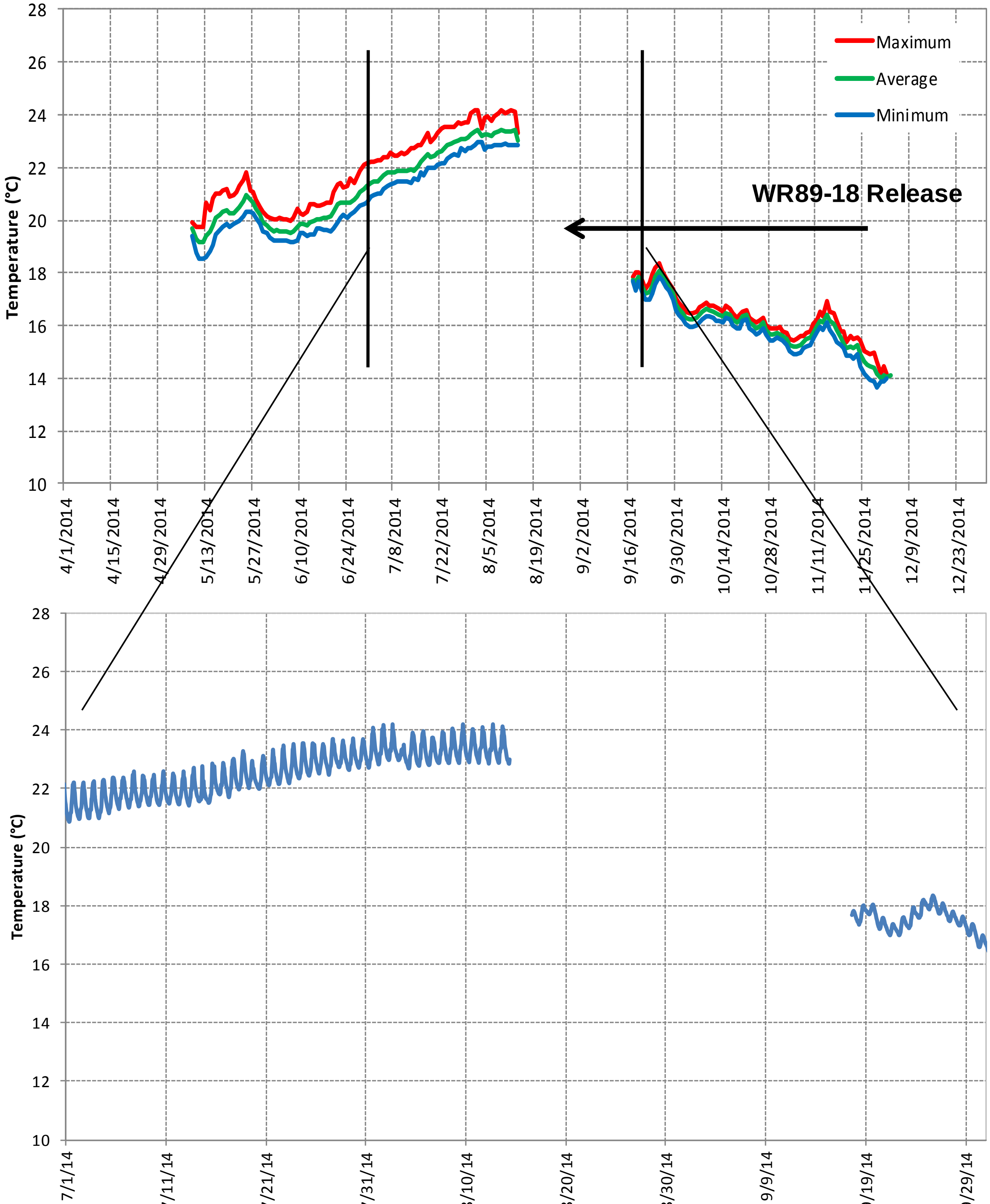


Figure 7: 2014 LSYR-0.10 (Stilling Basin tailout) middle (3.5 feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period July 1-October 1.

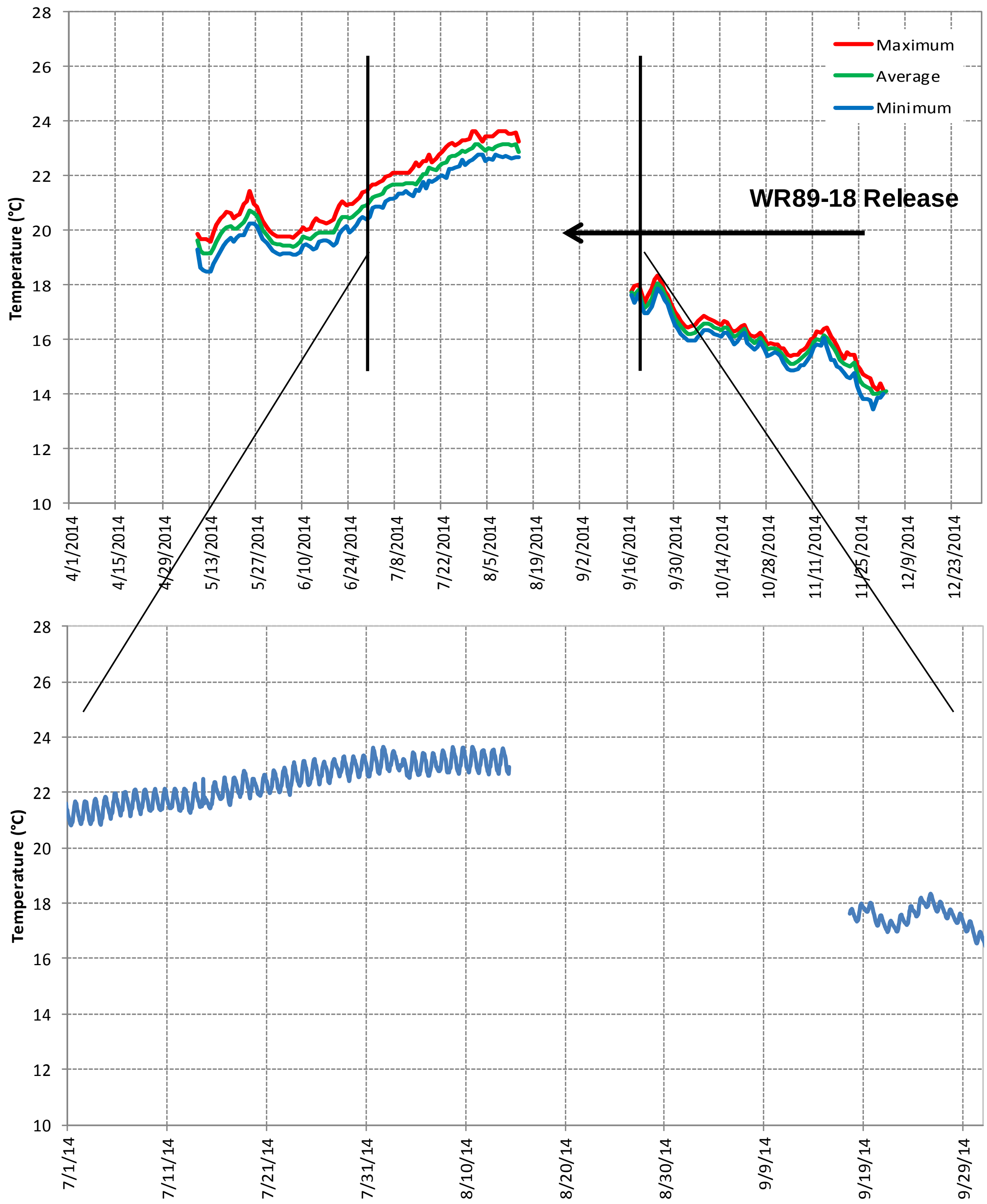


Figure 8: 2014 LSYR-0.10 (Stilling Basin tailout) bottom (7.0 feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period July 1-October 1.

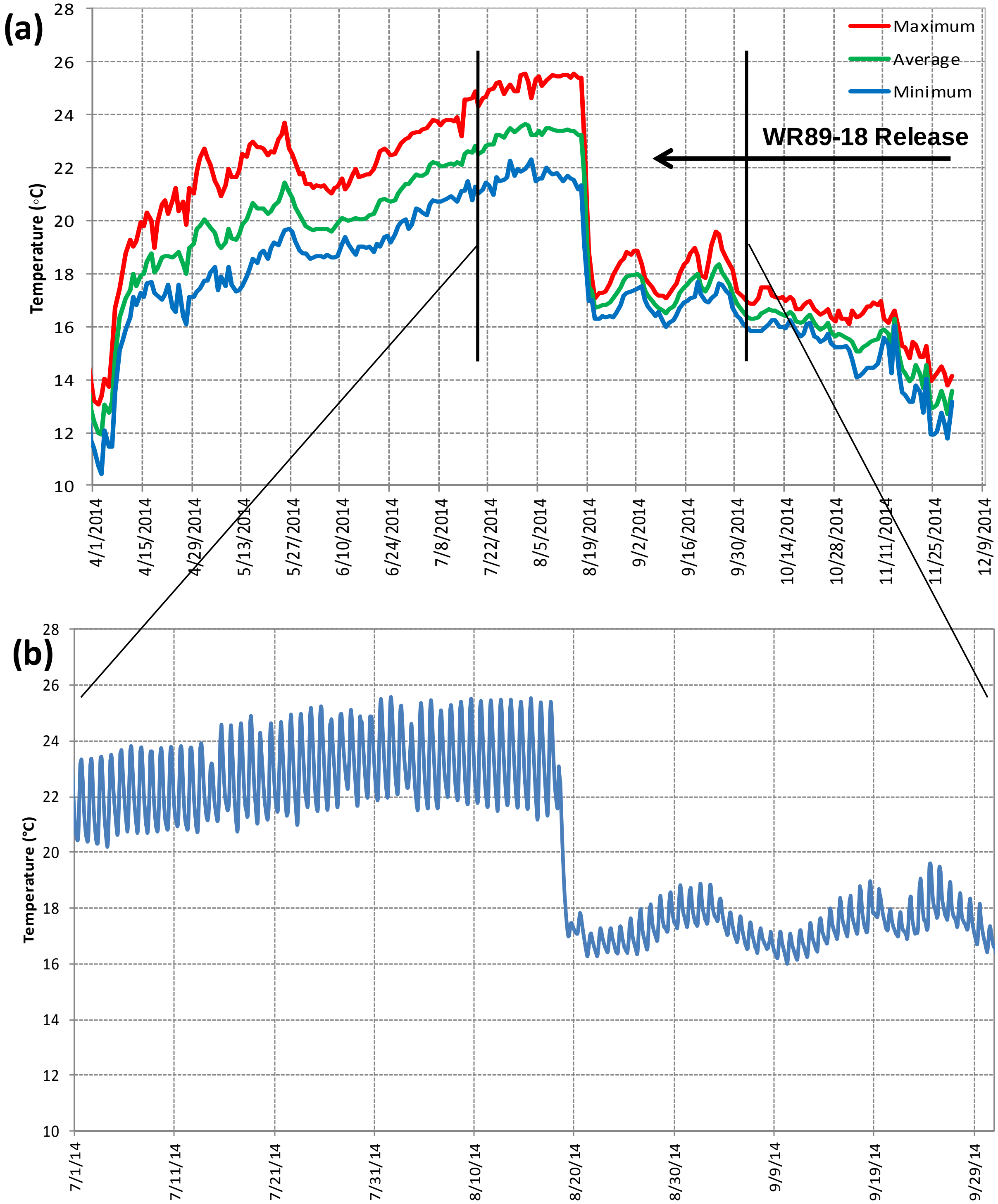


Figure 9: 2014 LSYR-0.25 (Downstream of the Stilling Basin) bottom (2.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period July 1-October 1.

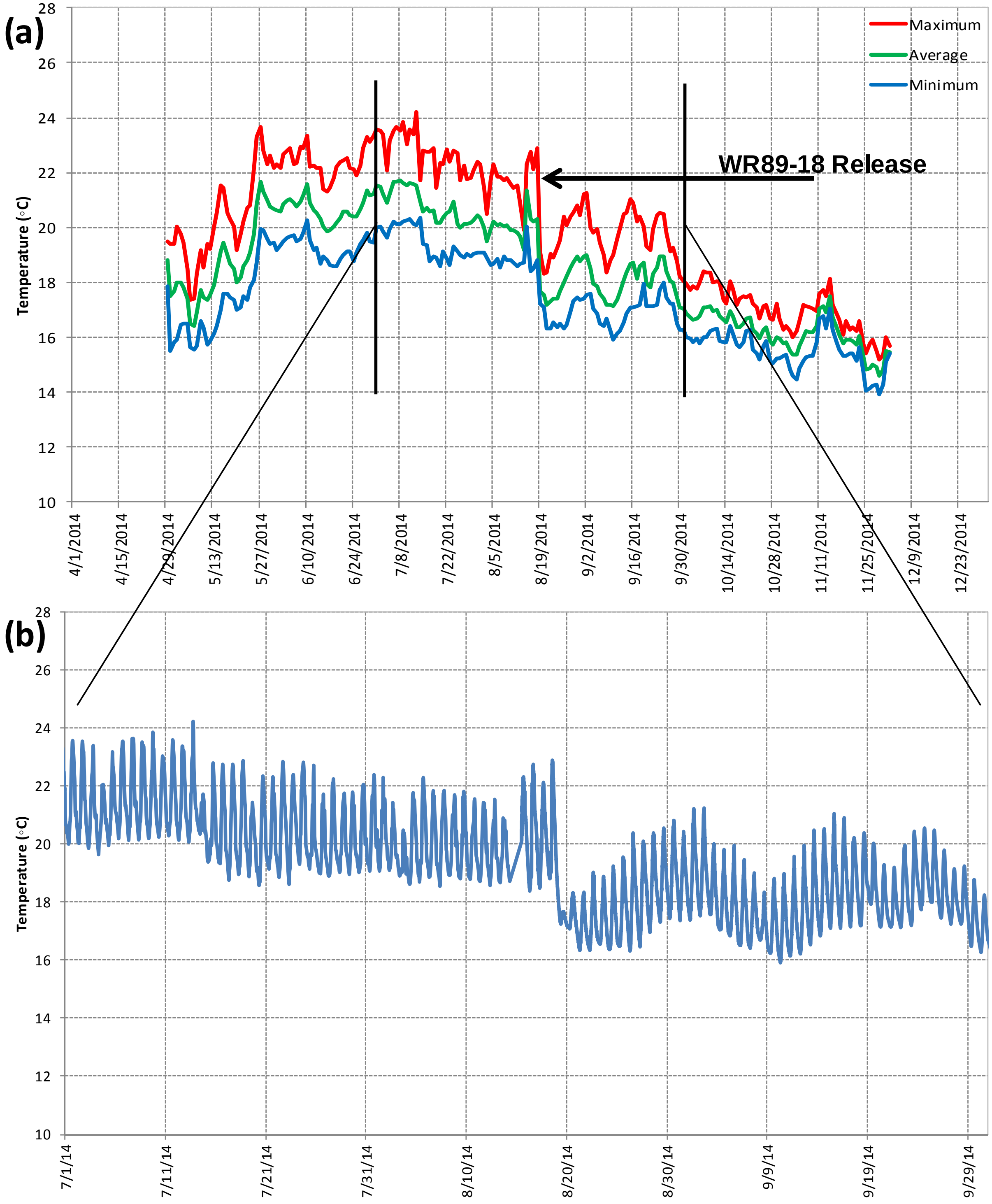


Figure 10: 2014 LSYR-0.51 (Long Pool) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of July 1-October 1.

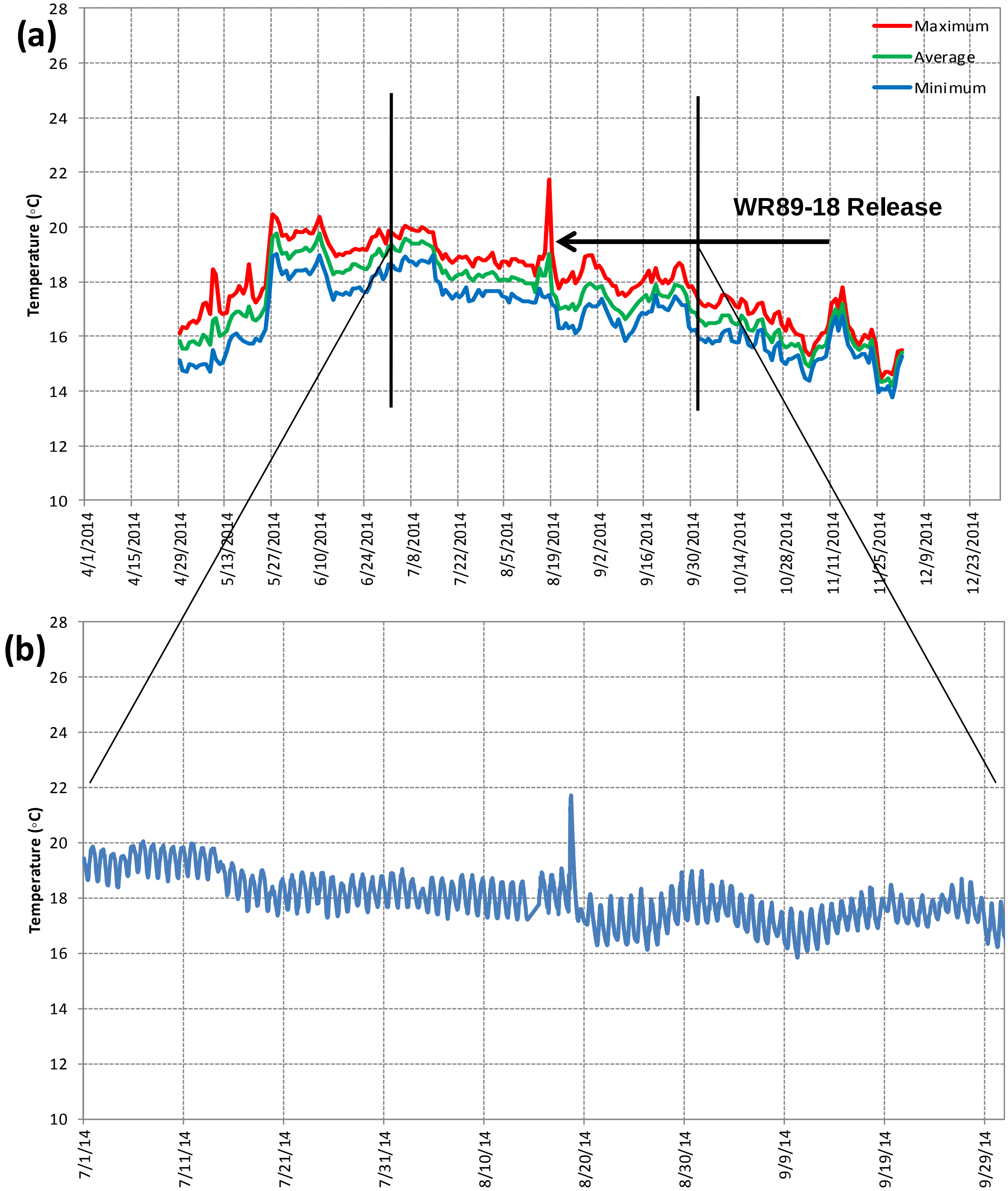


Figure 11: 2014 LSYR-0.51 (Long Pool) middle (4.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of July 1-October 1.

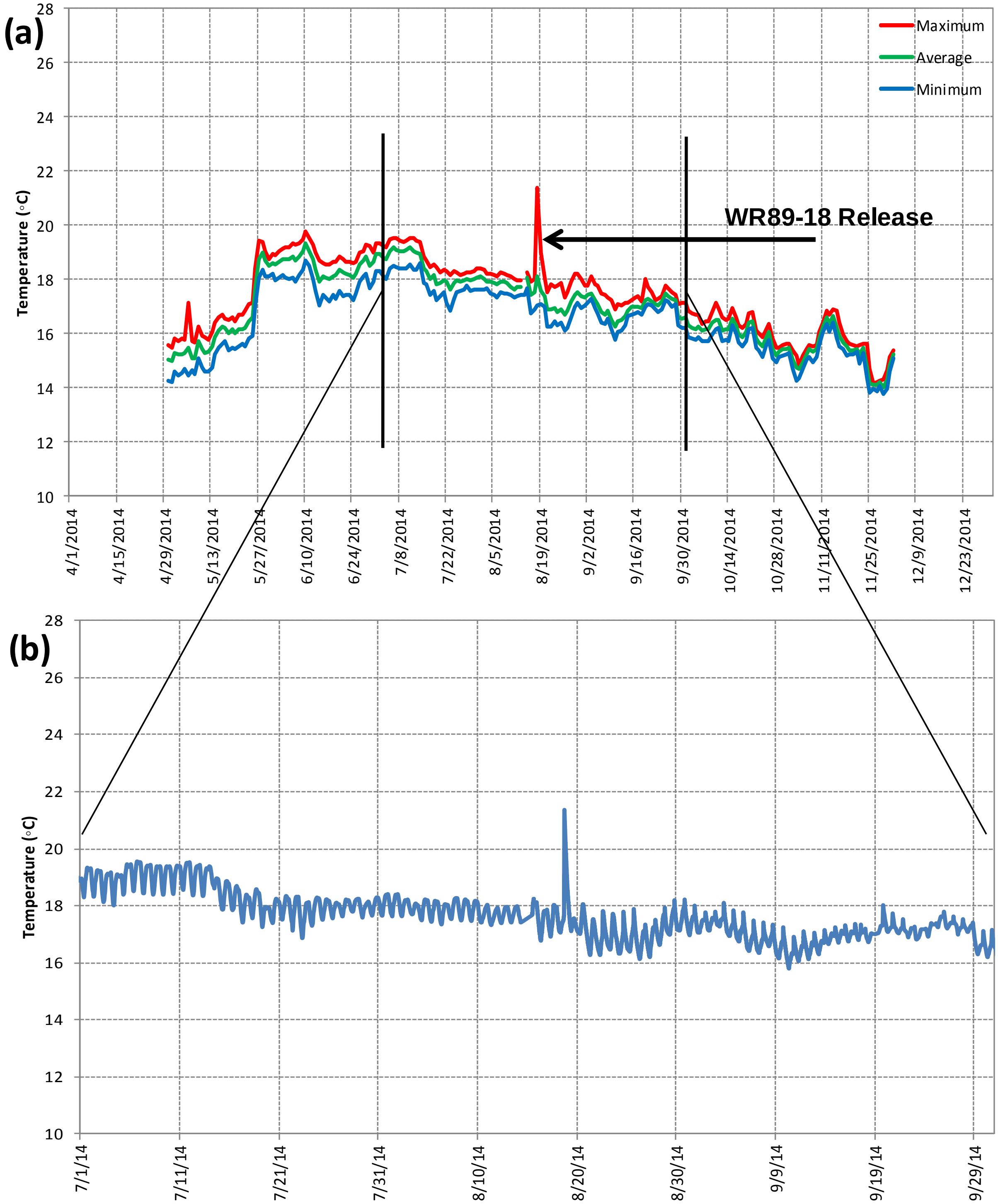


Figure 12: 2014 LSYR-0.51 (Long Pool) bottom (8.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of July 1-October 1.

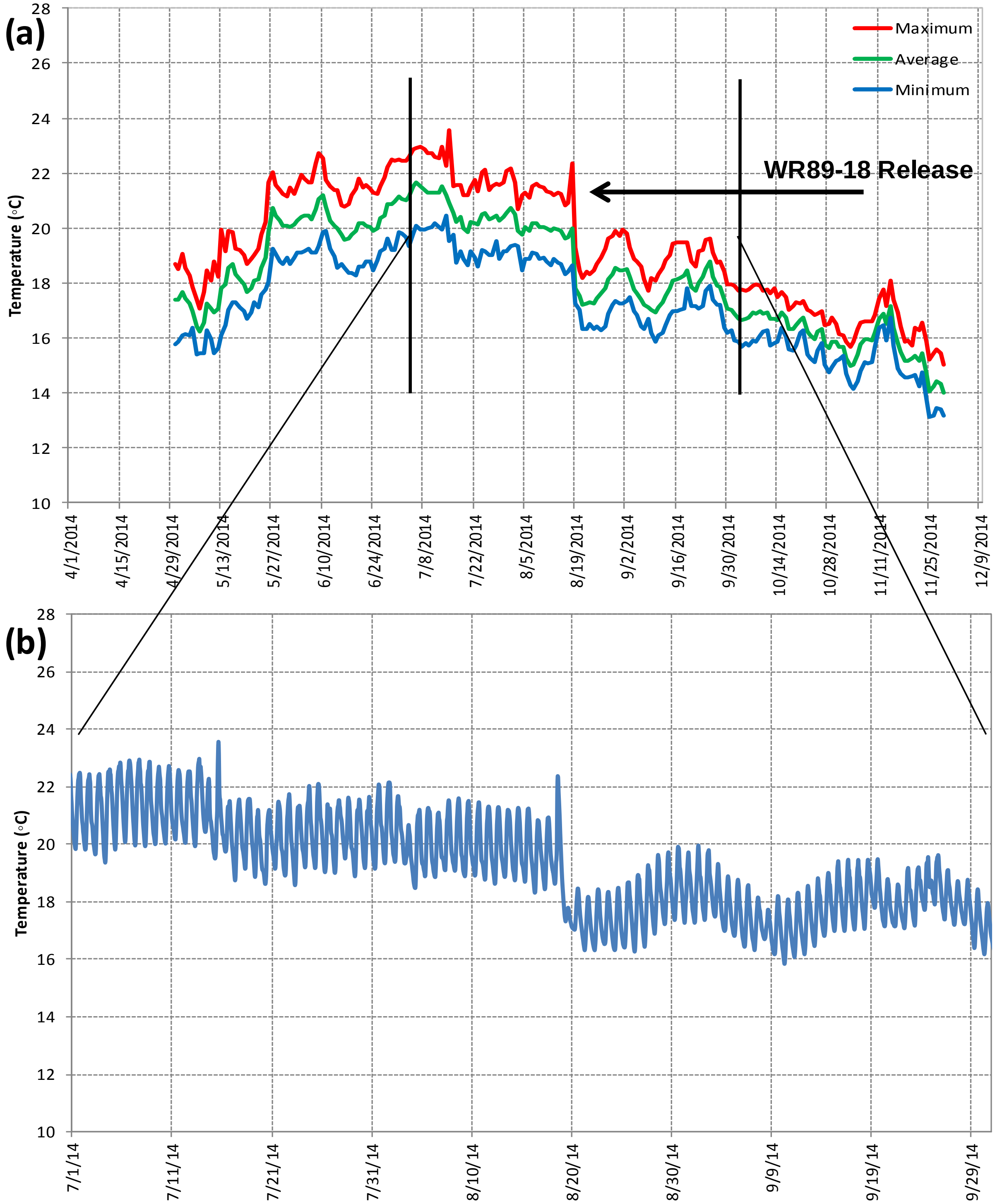


Figure 13: 2014 Reclamation property boundary LSYR 0.68 (Downstream of the Long Pool) bottom (1.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of July 1-October 1.

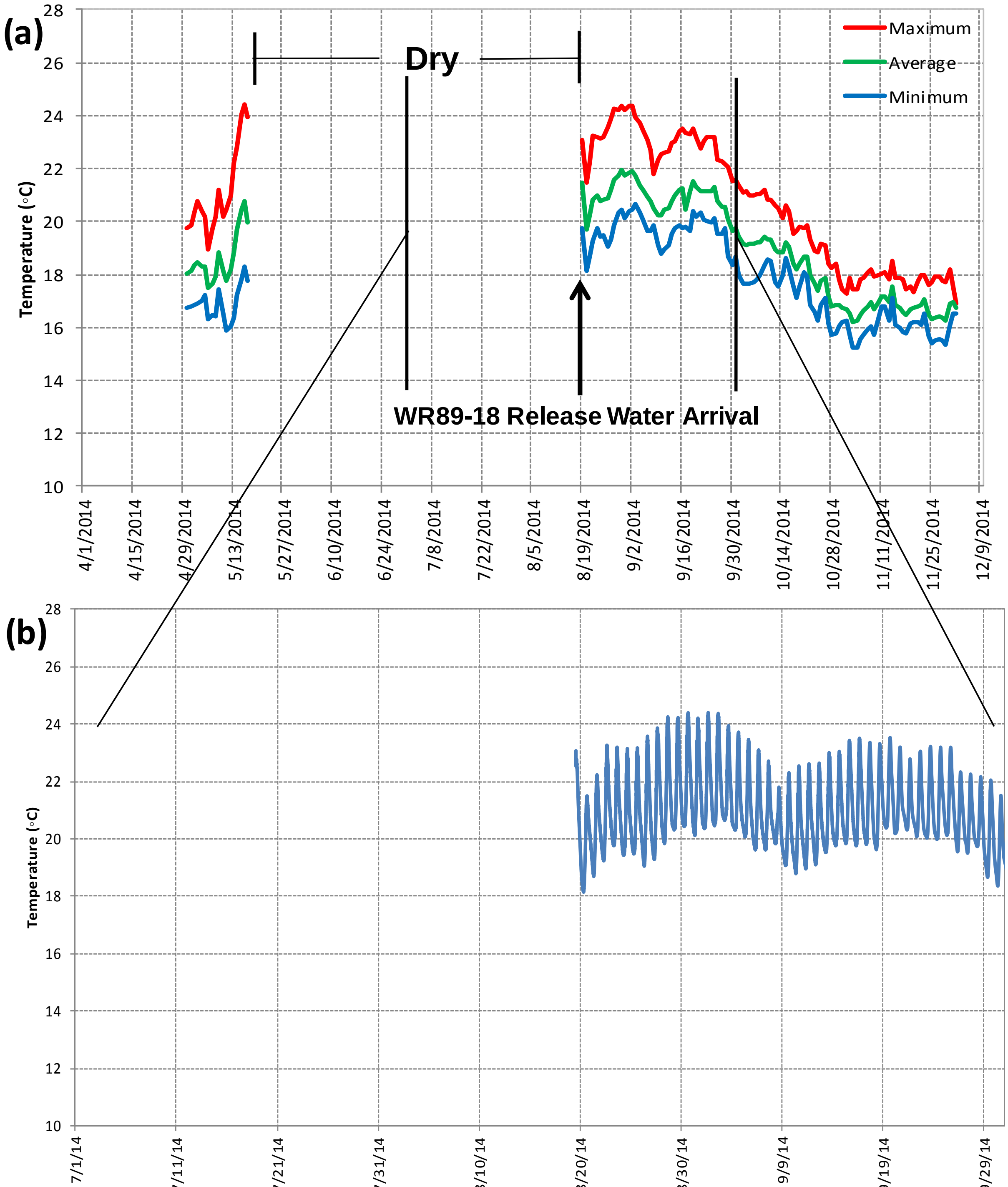


Figure 14: 2014 LSYR-4.95 (Encantado Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of July 1-October 1; WR89-18 releases reached the site on 8/19/14.

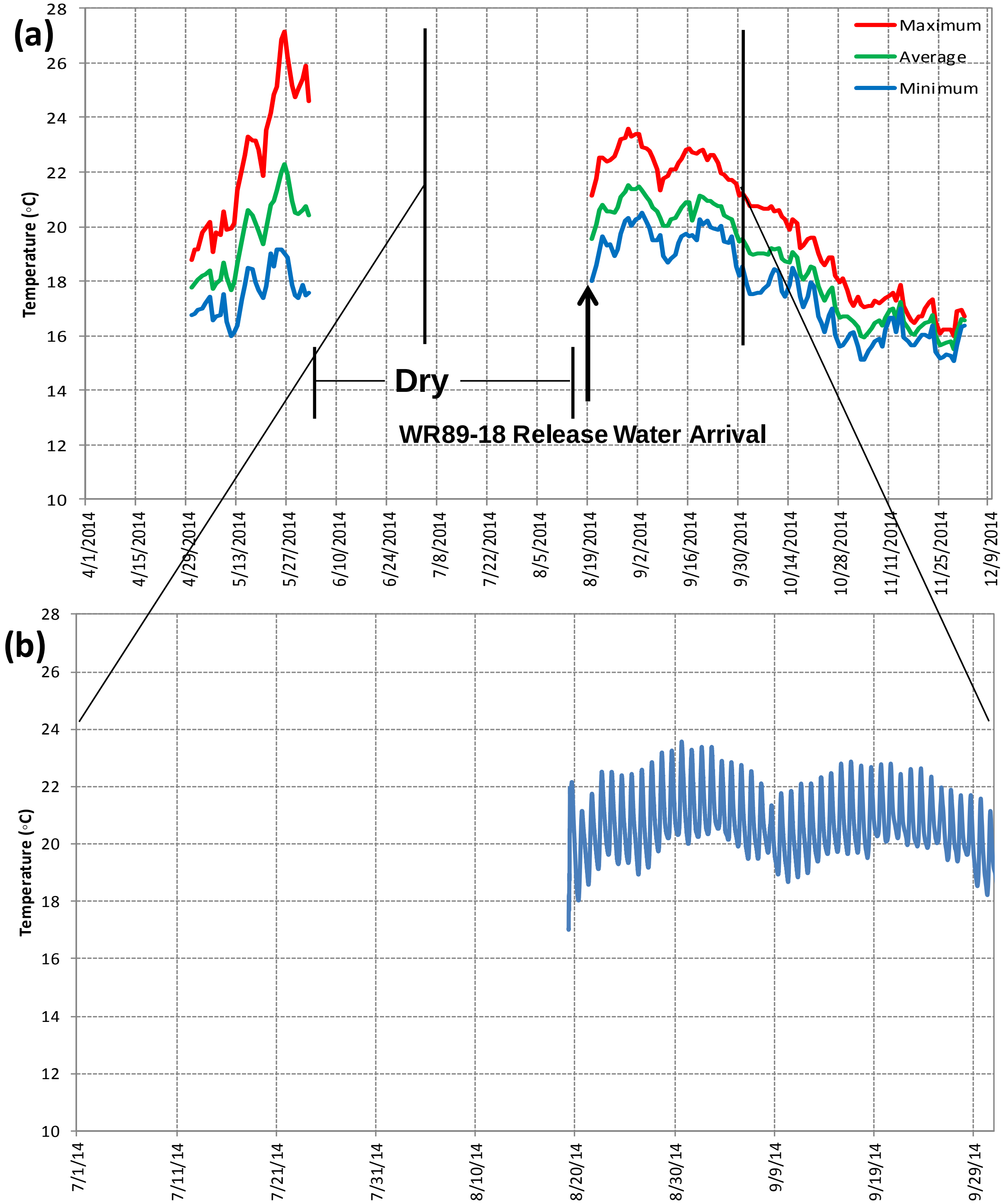


Figure 15: 2014 LSYR-4.95 (Encantado Pool) middle (3.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of July 1-October 1; WR89-18 reached the site on 8/19/14.

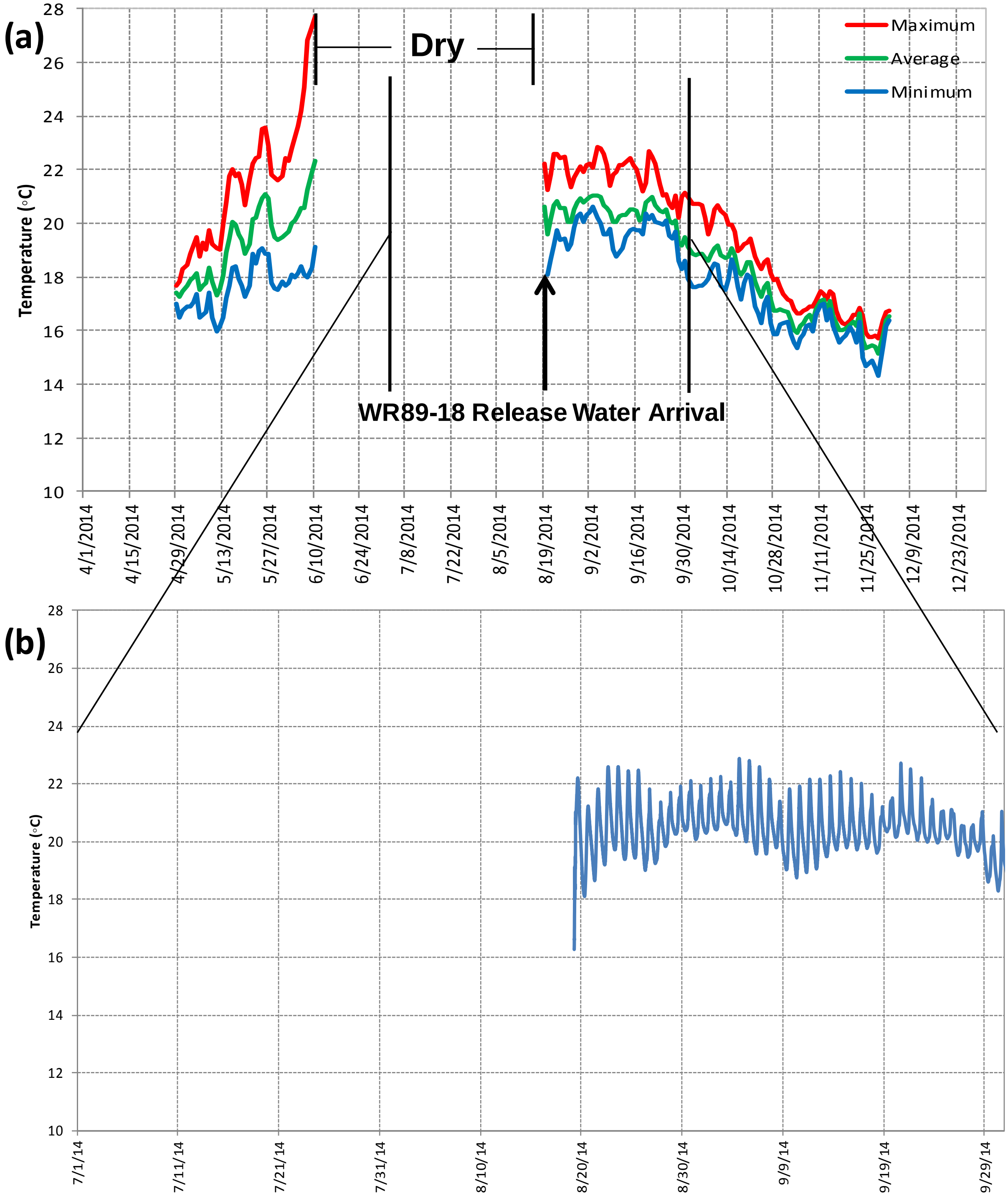


Figure 16: 2014 LSYR-4.95 (Encantado Pool) bottom (6.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of July 1-October 1; WR89-18 reached the site on 8/19/14.

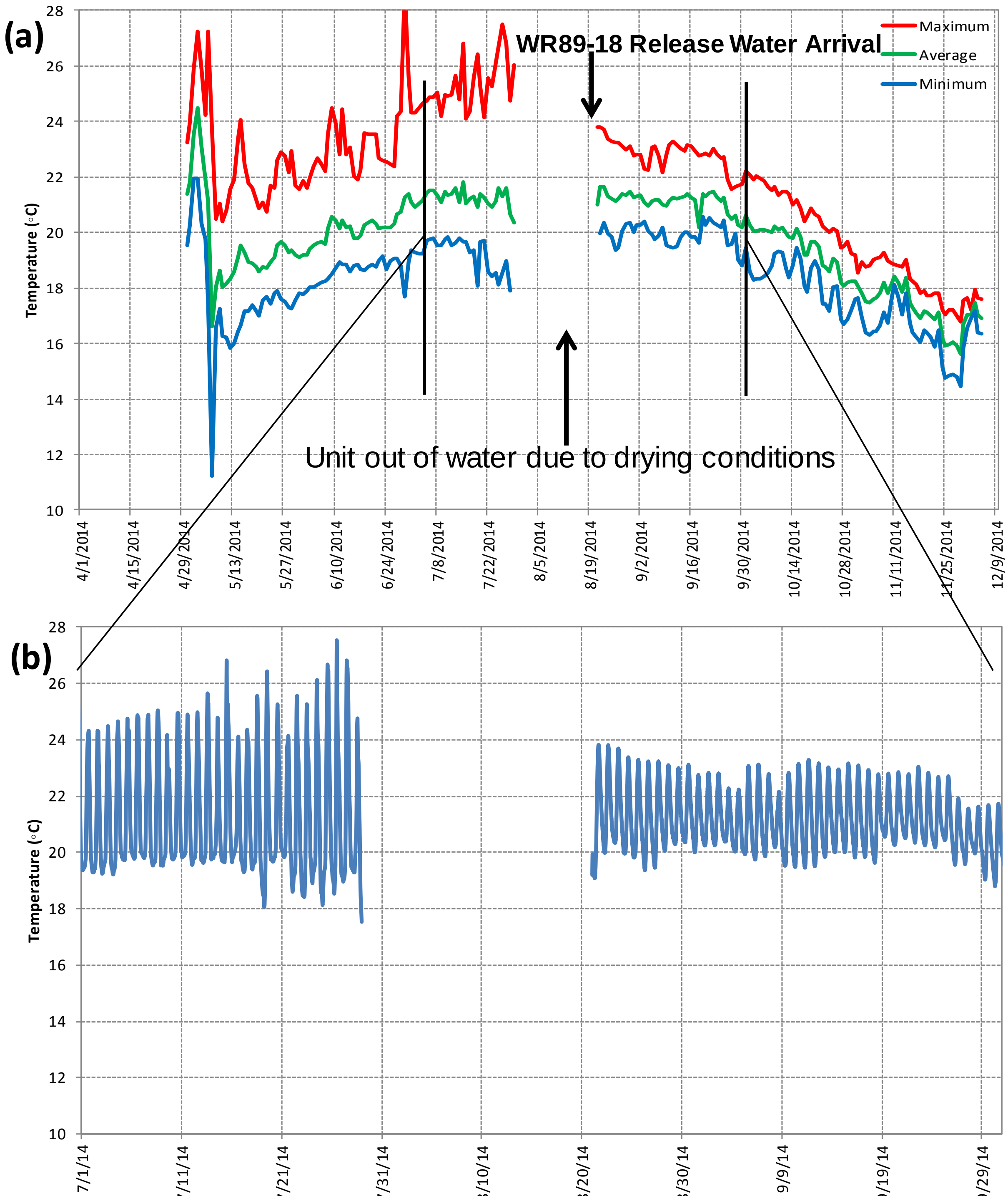


Figure 17: 2014 LSYR-7.65 (Double Canopy Pool) surface (1.0 foot) thermograph (a) daily maximum, average, and minimum values and (b) hourly data for the period July 1-October 1.

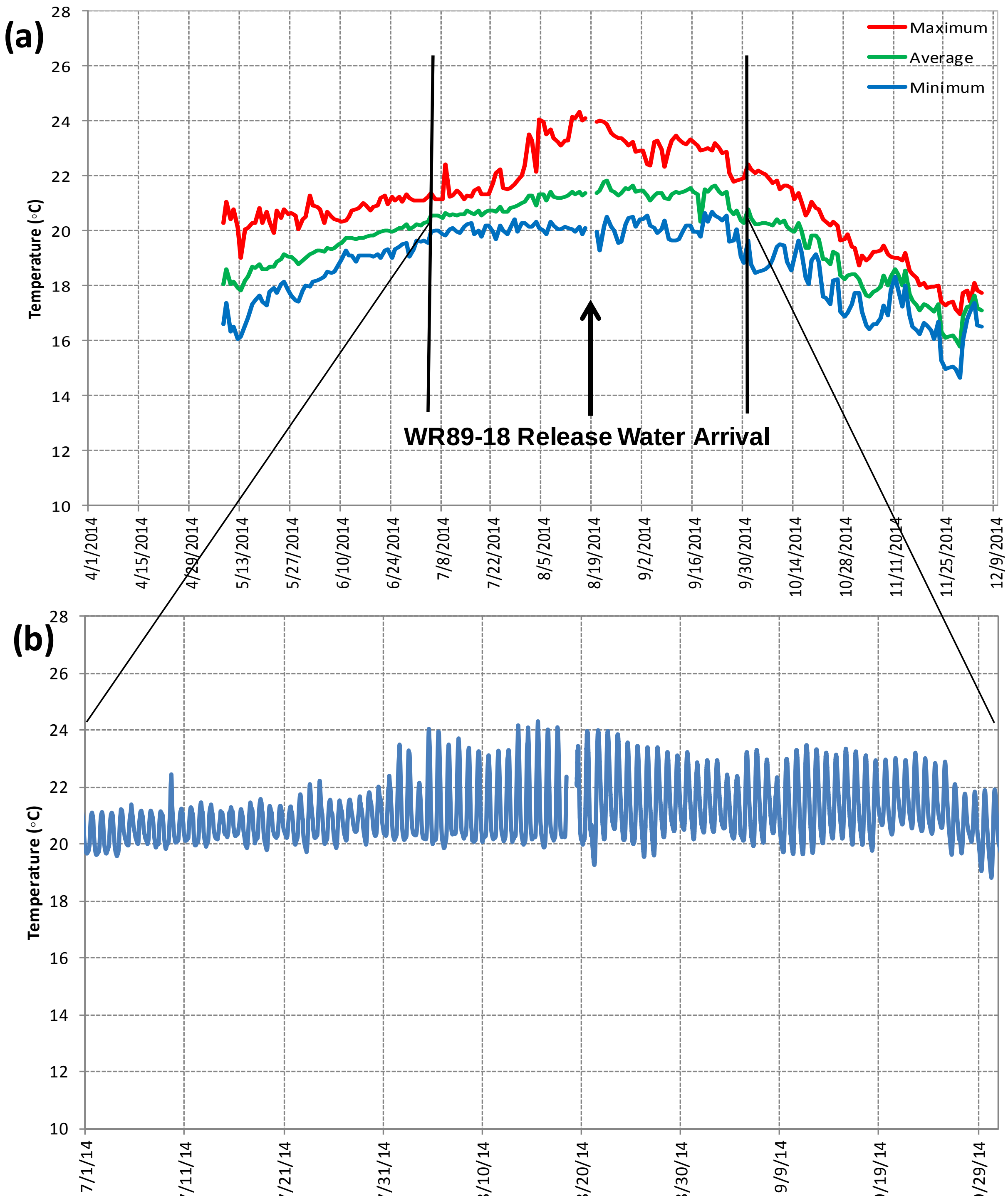


Figure 18: 2014 LSYR-7.65 (Double Canopy Pool) middle (2.25 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

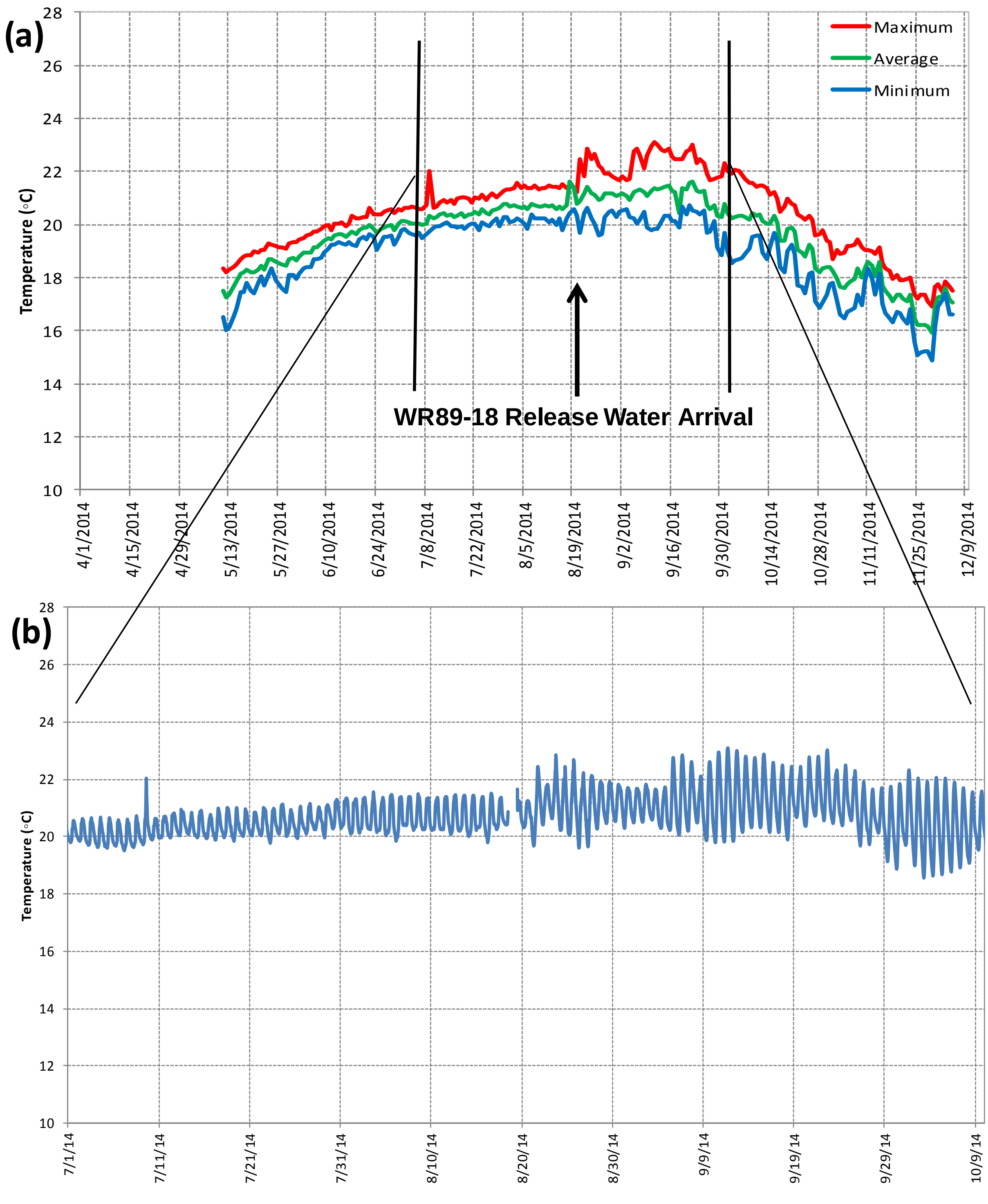


Figure 19: 2014 LSYR-7.65 (Double Canopy Pool) bottom (4.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

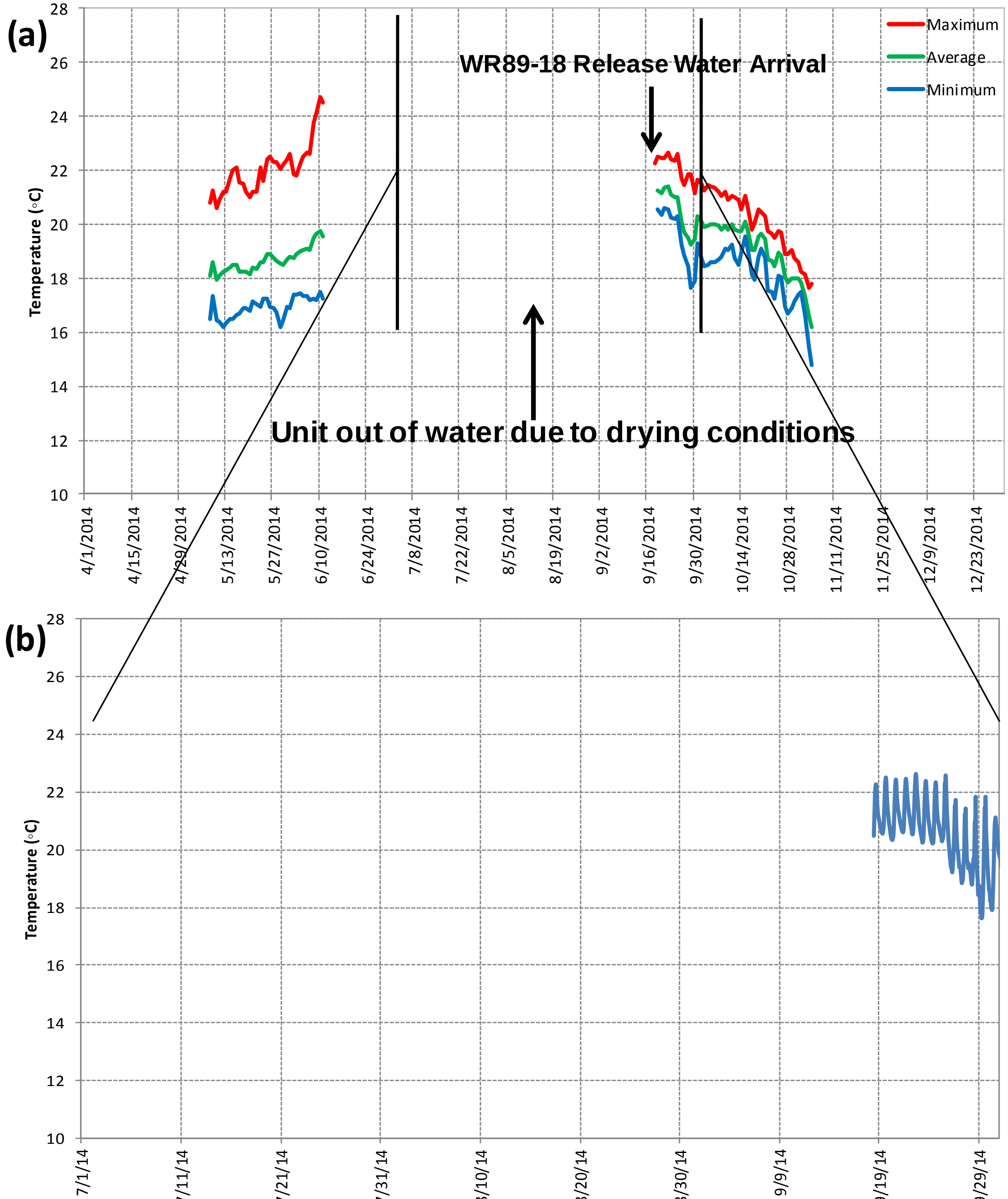


Figure 20: 2014 LSYR-8.7 (Head of Beaver Pool) surface (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

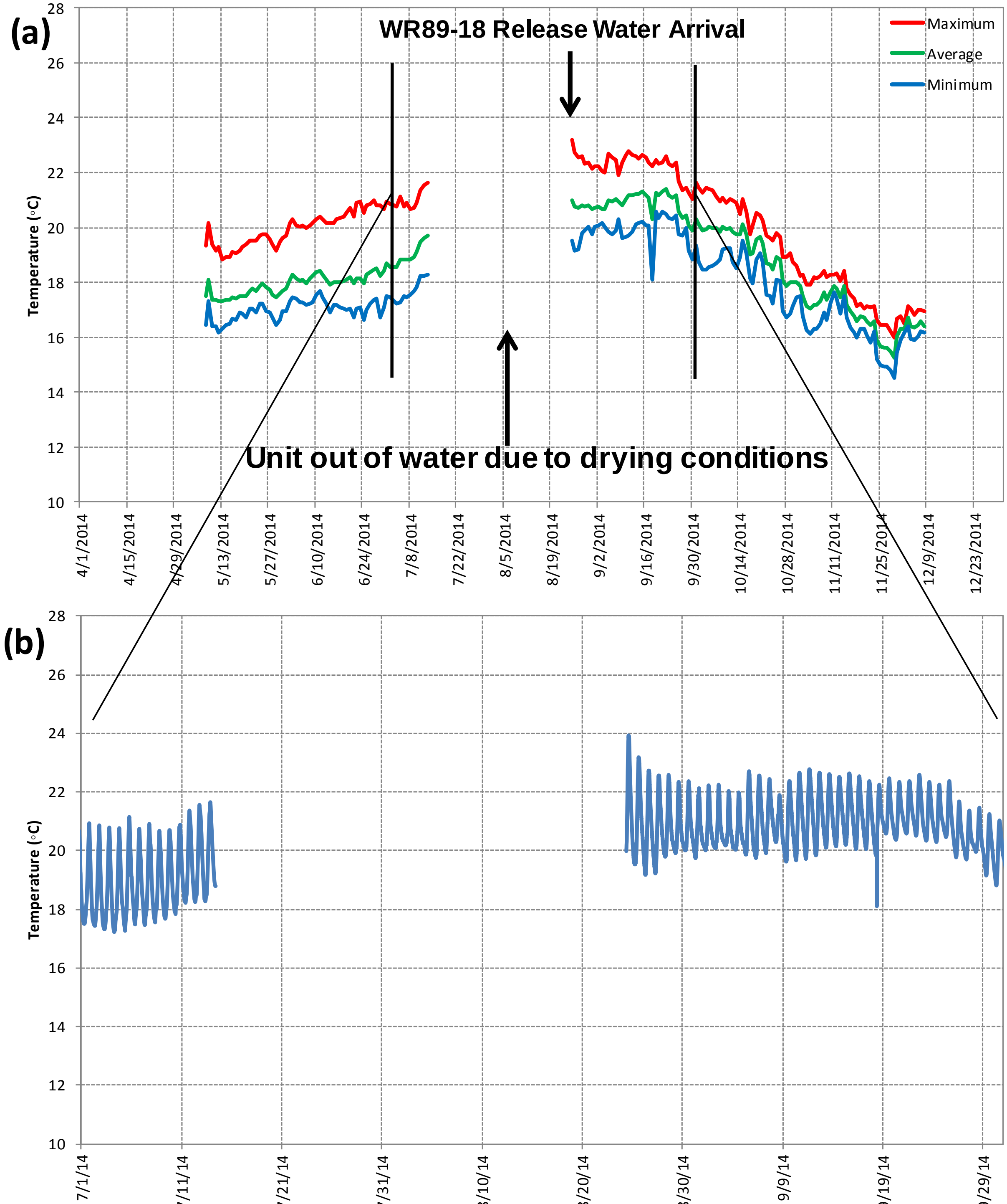


Figure 21: 2014 LSYR-8.7 (Head of Beaver Pool) middle (3.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

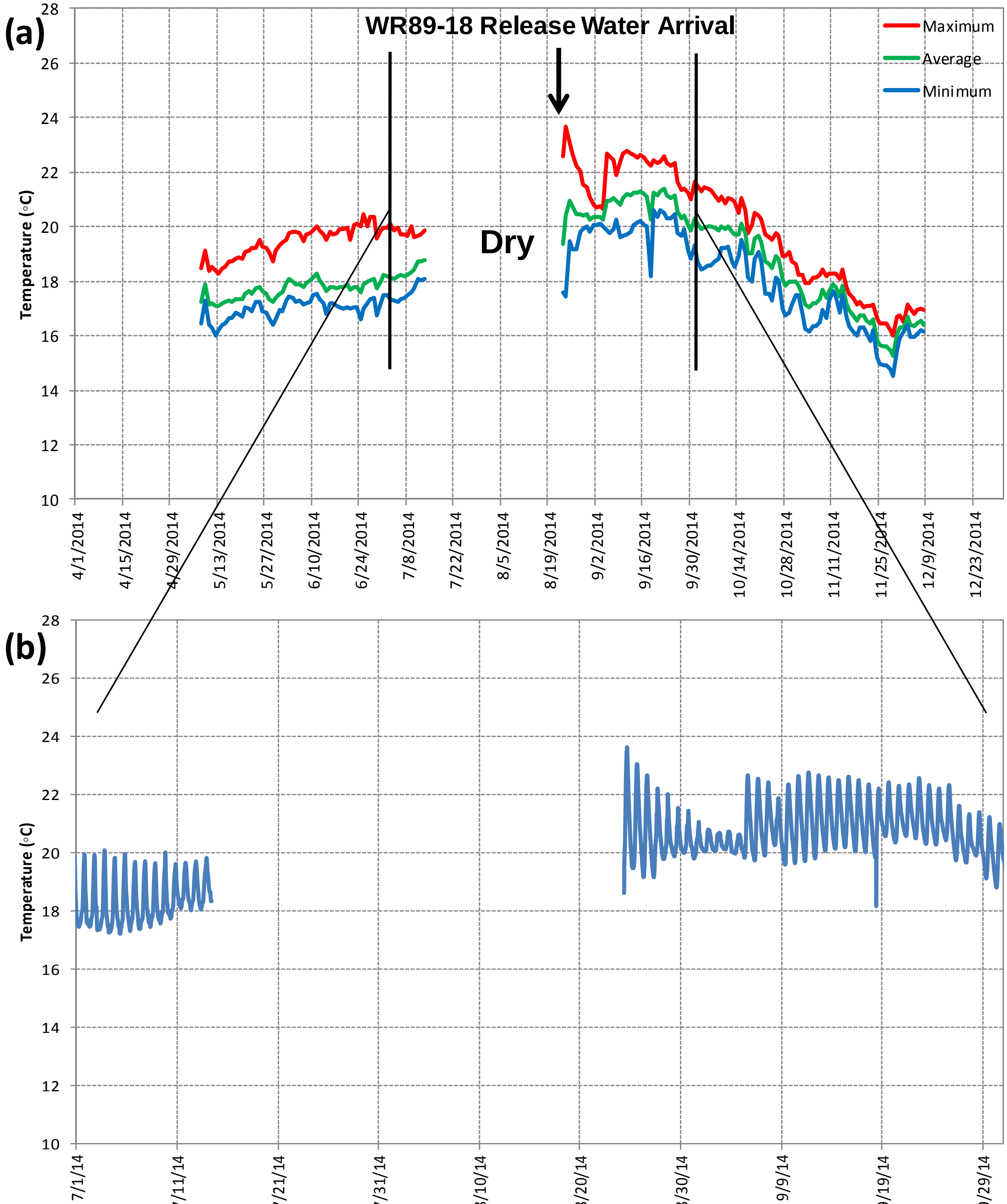


Figure 22: 2014 LSYR-8.7 (Head of Beaver Pool) bottom (6.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

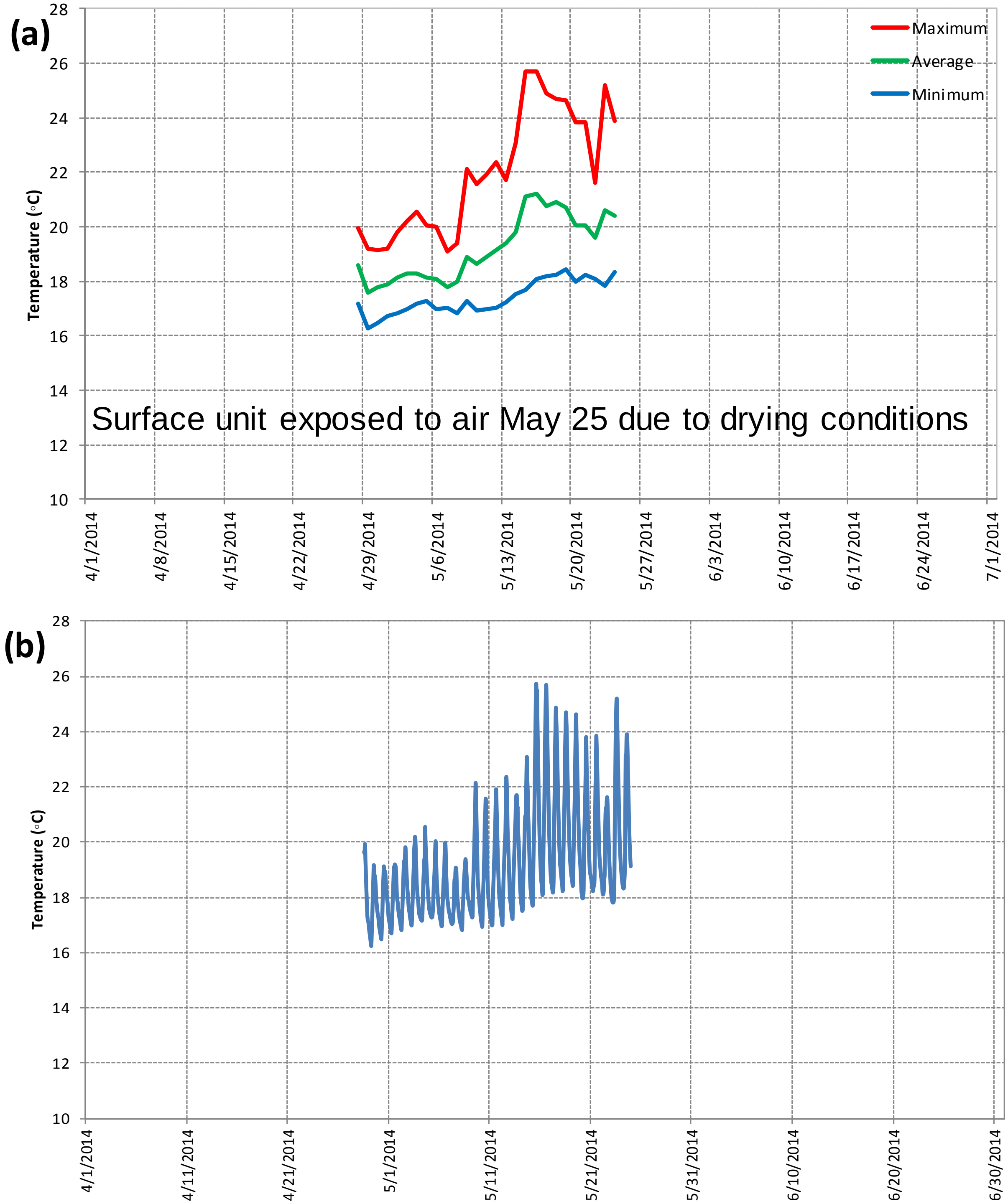


Figure 23: 2014 LSYR-10.2 (Alisal Bedrock Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period April 1-July 1; this habitat unit was dry prior to the arrival of the WR89-18 release.

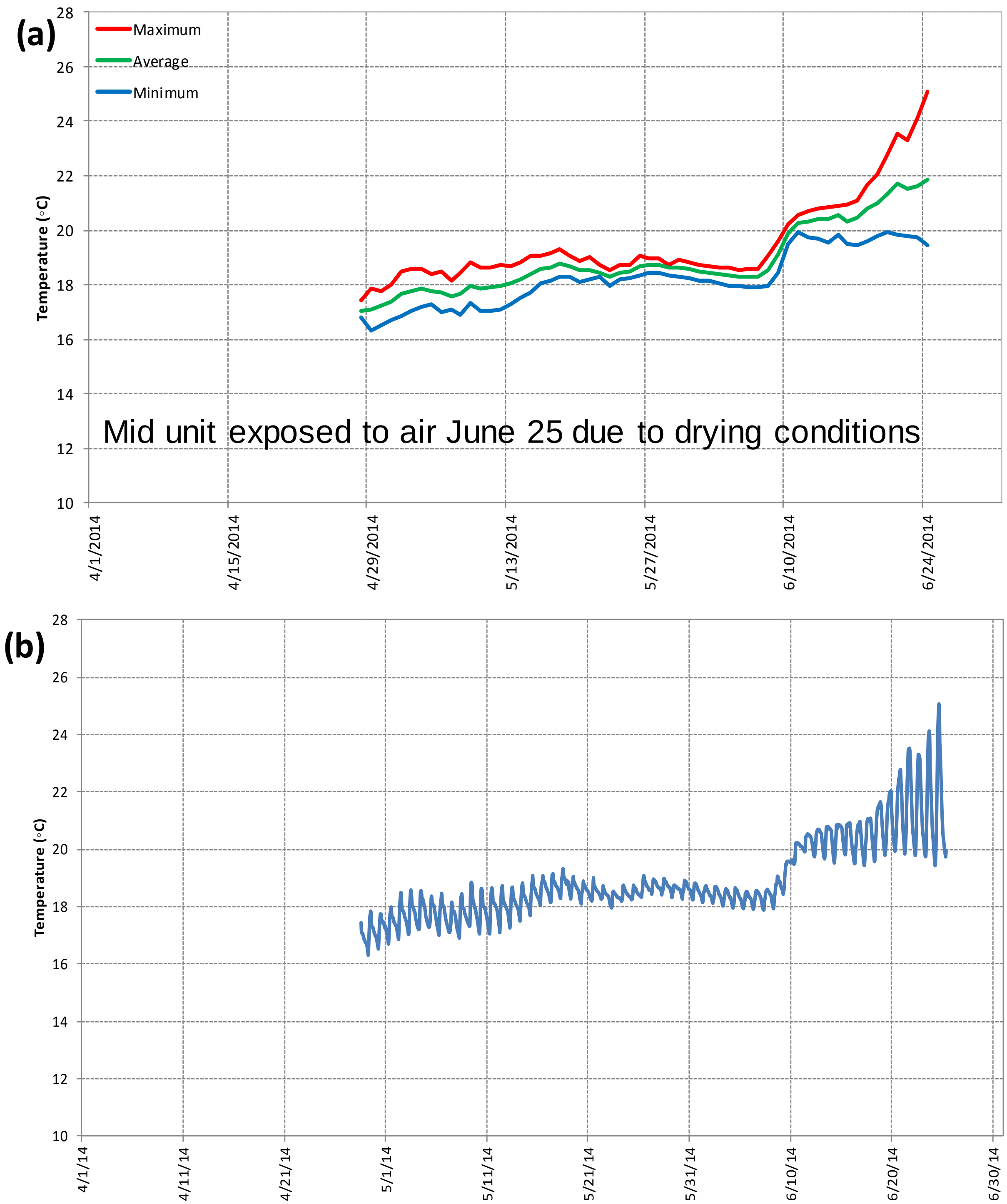
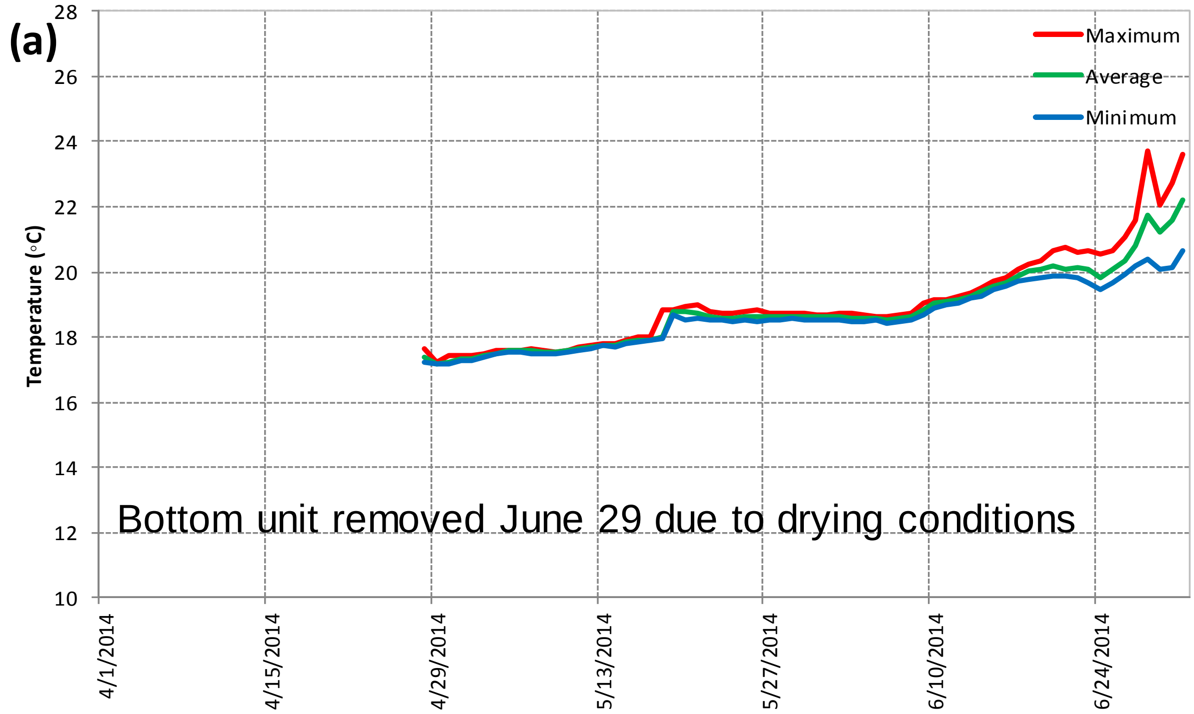


Figure 24: 2014 LSYR-10.2 (Alisal Bedrock Pool) middle (4.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period April 1-July 1; this habitat was dry prior to the arrival of the WR89-18 release.



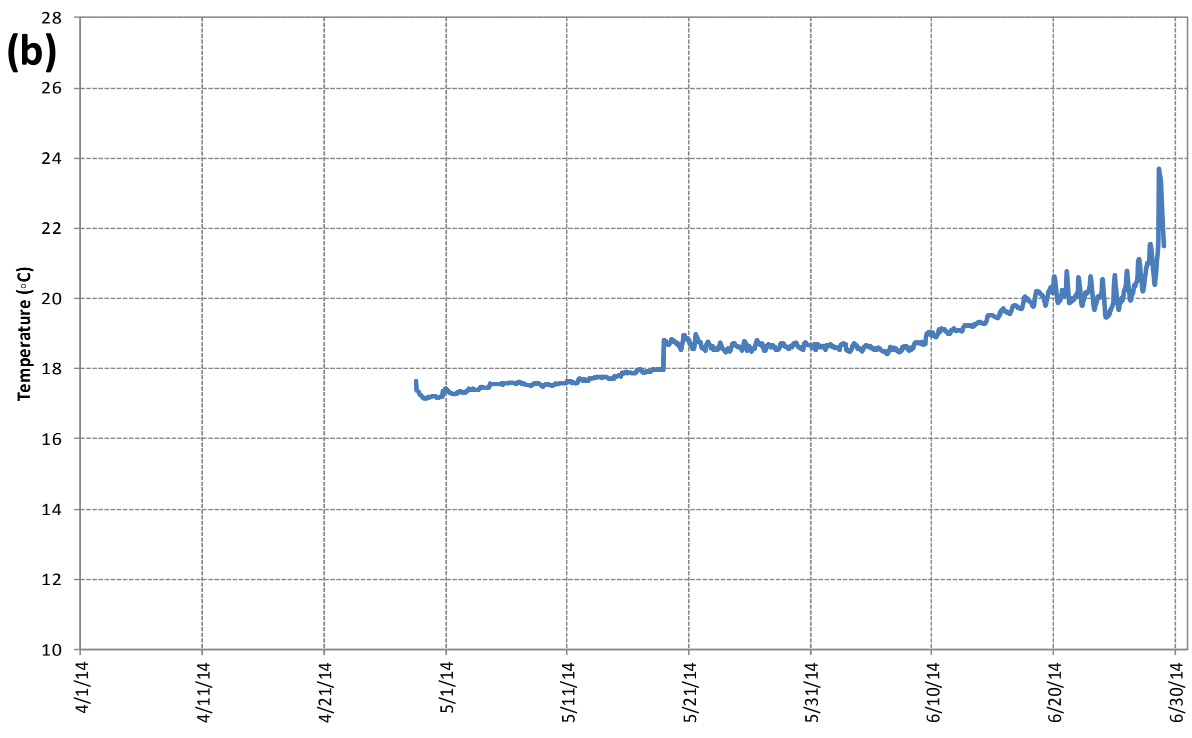
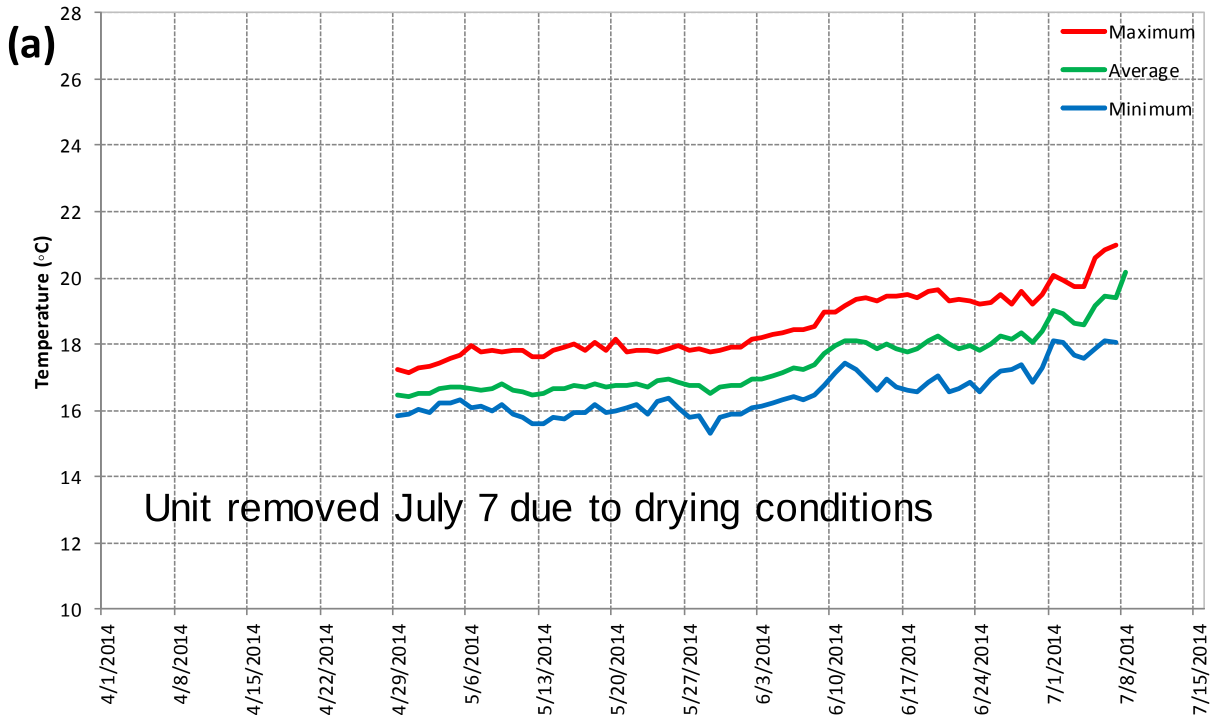


Figure 25: 2014 LSYR-10.2 (Alisal Bedrock Pool) bottom (8.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period April 1-July 1; this habitat was dry prior to the arrival of the WR89-18 release.



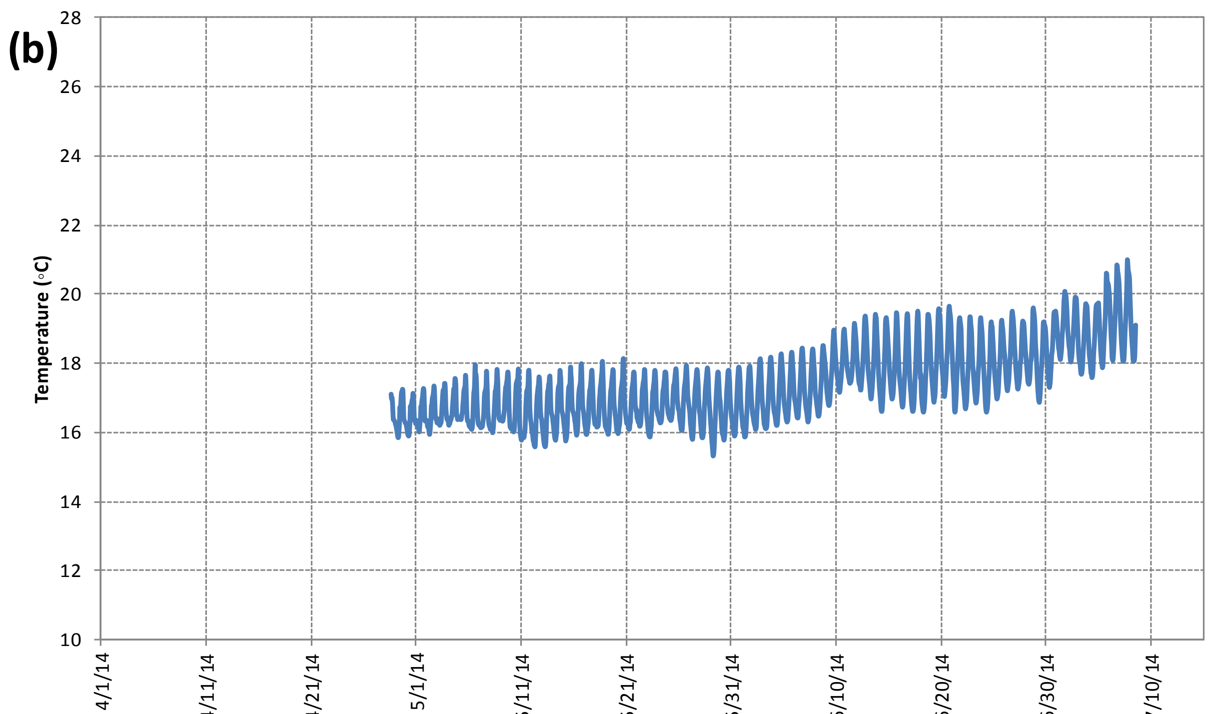


Figure 26: 2014 LSYR-13.9 (Avenue of the Flags) bottom (3.0 feet) thermograph daily maximum, average, and minimum daily values and (b) hourly data for the period April 29-July 7.

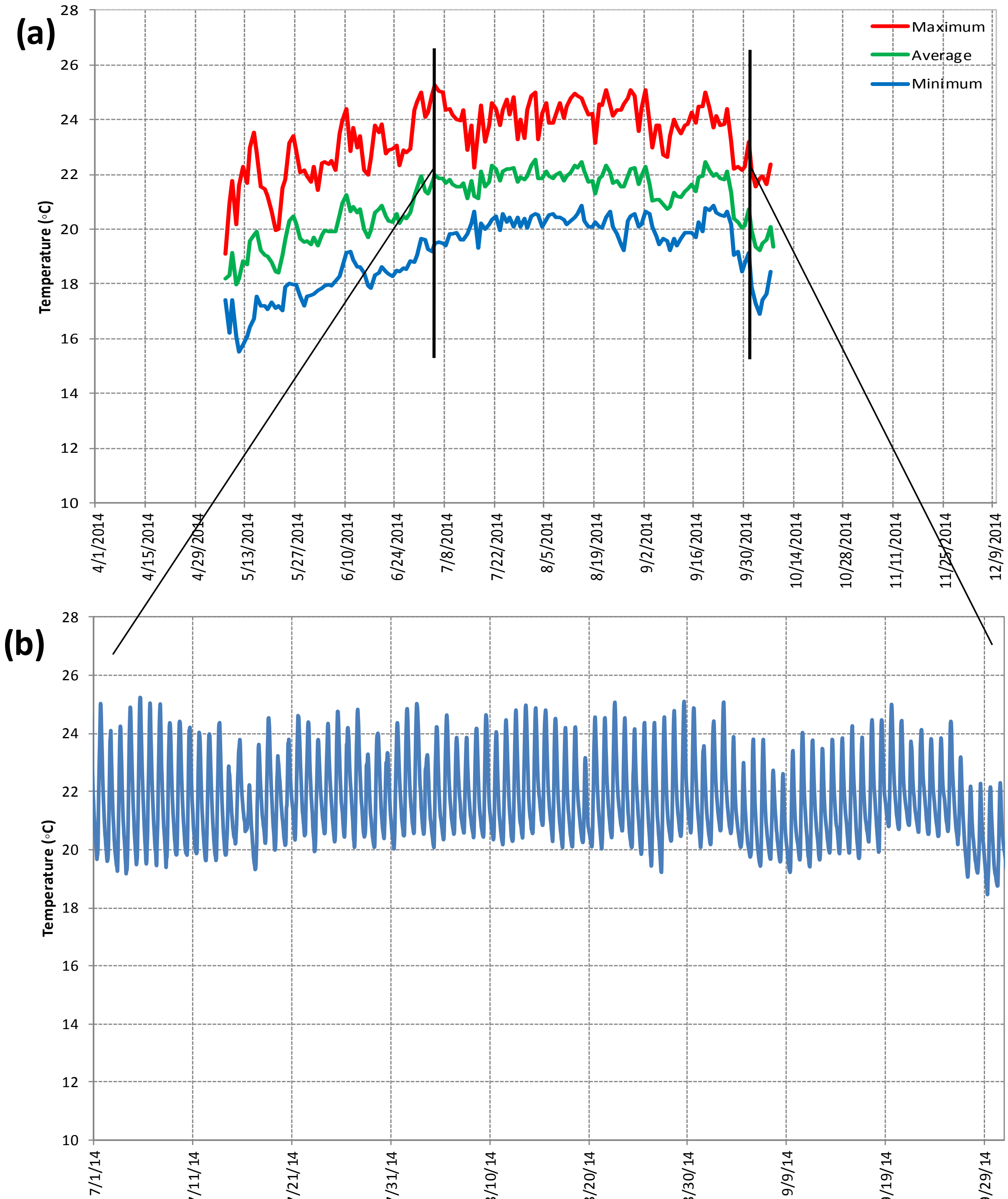


Figure 27: 2014 LSYR-22.68 (Cadwell Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the July 1-October 1; this habitat unit was an isolated pool prior to the arrival of the WR89-18 release.

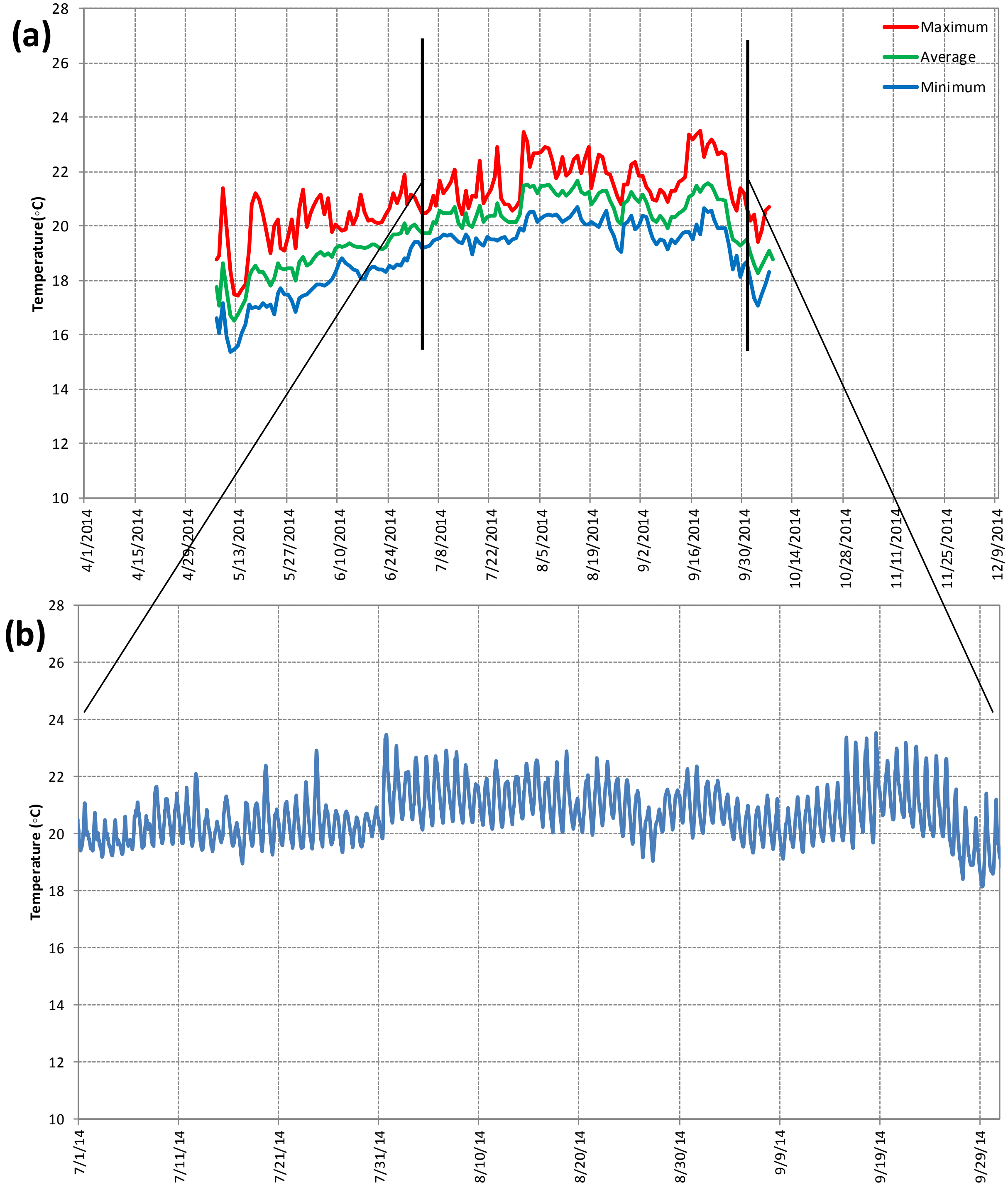


Figure 28: 2014 LSYR-22.68 (Cadwell Pool) middle (6.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1; this unit was an isolated pool habitat prior to the arrival of the WR89-18 release.

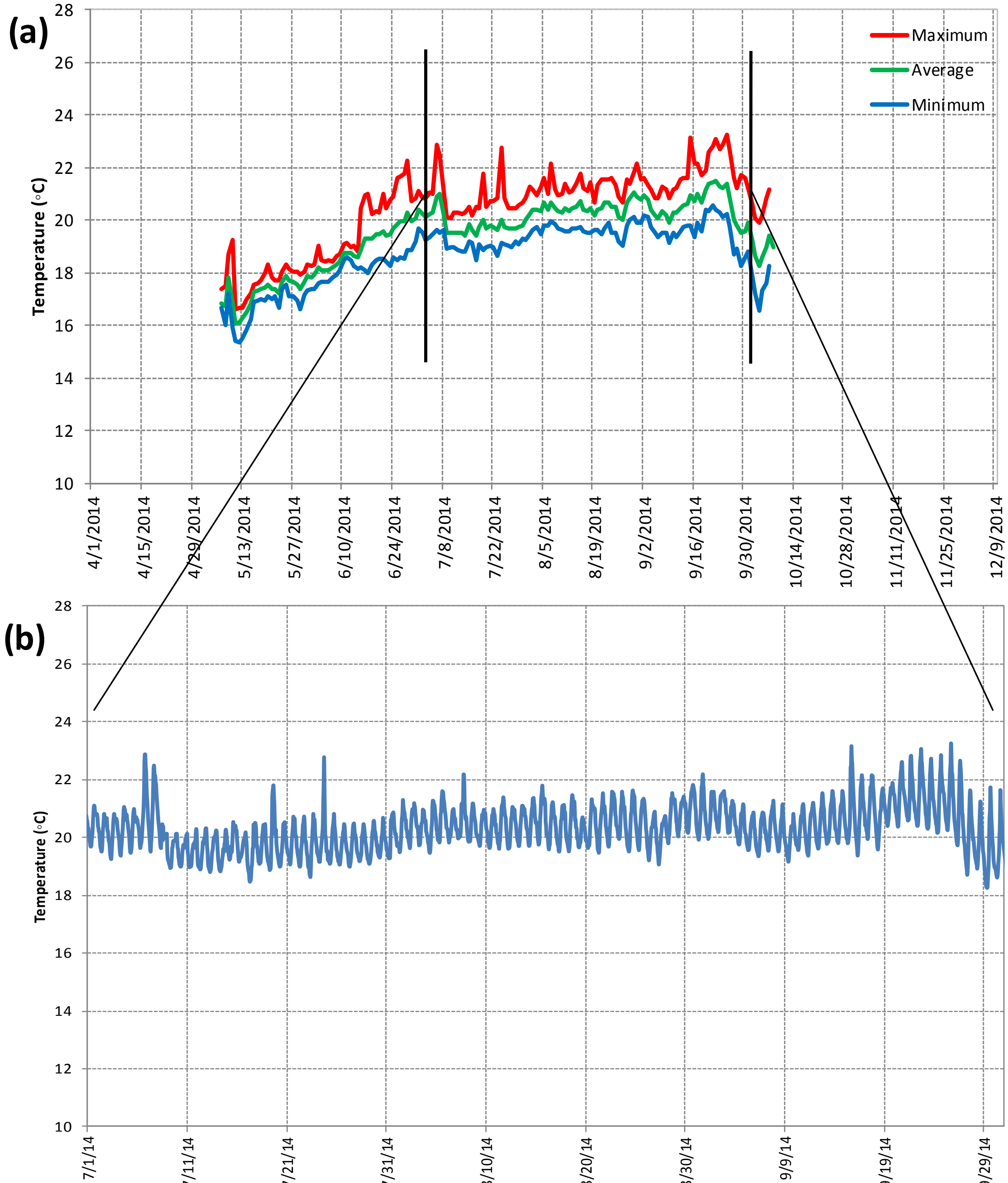


Figure 29: 2014 LSYR-22.68 (Cadwell Pool) bottom (12.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1; this unit was an isolated pool habitat prior to the arrival of the WR89-18 release.

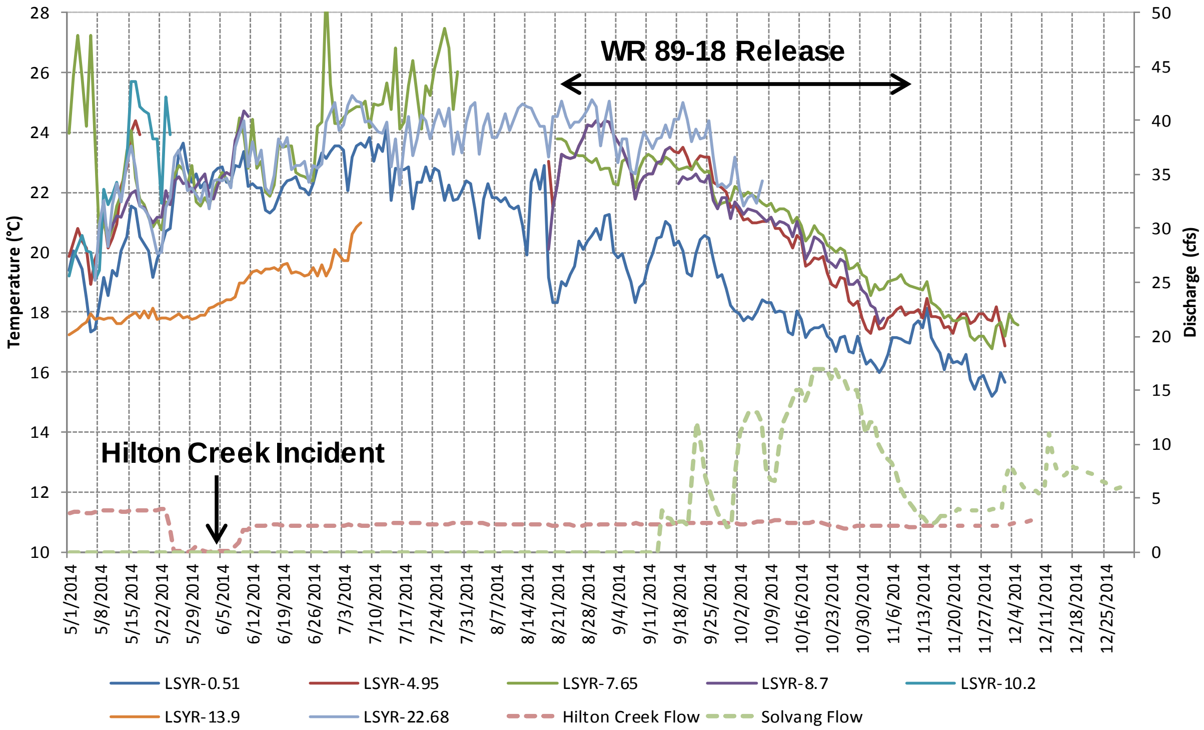


Figure 30: 2014 Longitudinal maximum surface water temperatures at the Long Pool (LSYR-0.50), Encantado Pool (LSYR-4.95), Double Canopy Pool (LSYR-7.65), Head of Beaver Pool (LSYR-8.7), Alisal Bedrock Pool (LSYR-10.20), Avenue of the Flags Pool (LSYR-13.90, bottom of pool), and Cadwell Pool (LSYR-22.68) with daily flow (discharge) at the Hilton Creek and Solvang (at the Alisal Bridge) USGS gauges.

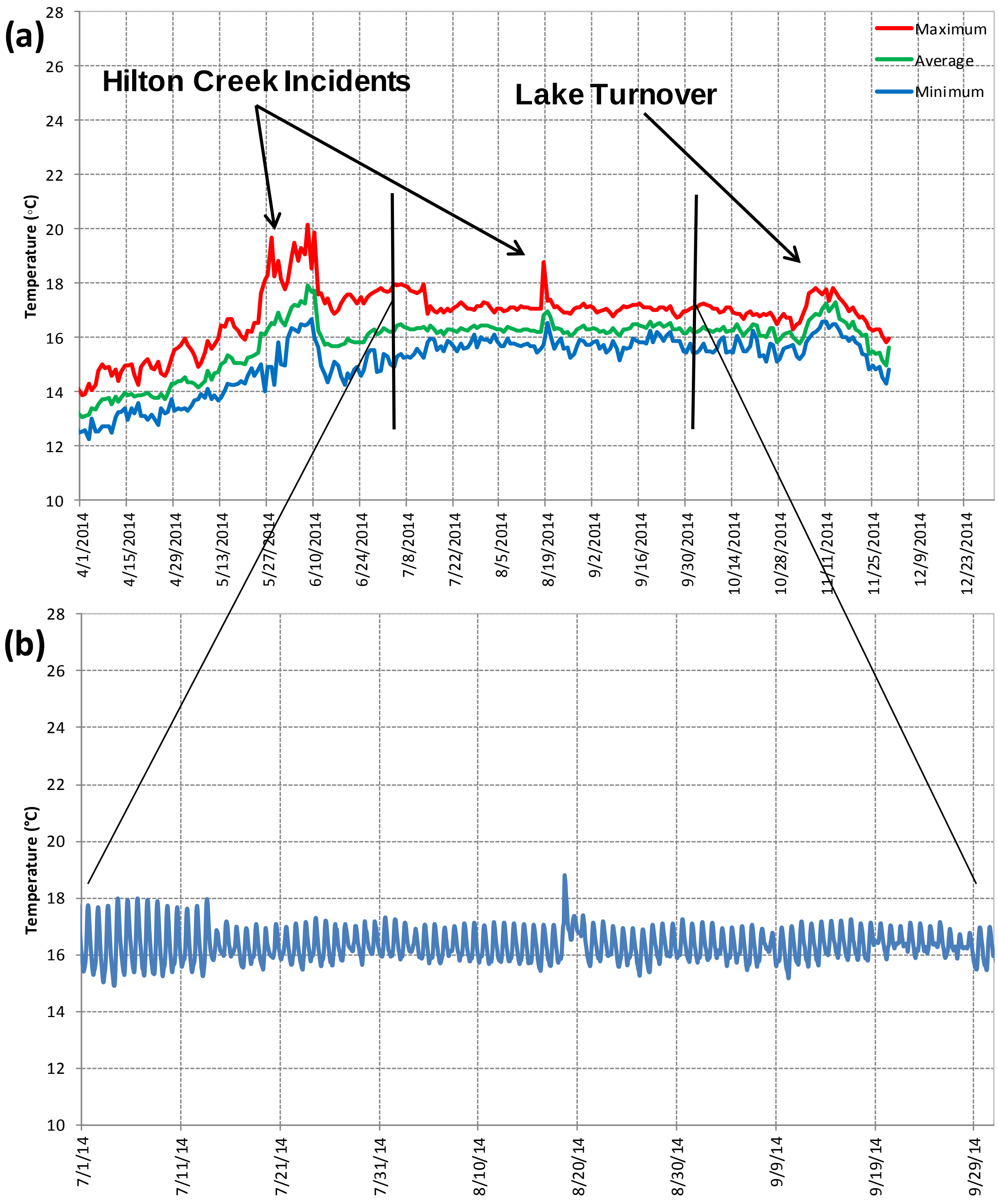


Figure 31: 2014 HC-0.12 (Lower Hilton Creek) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

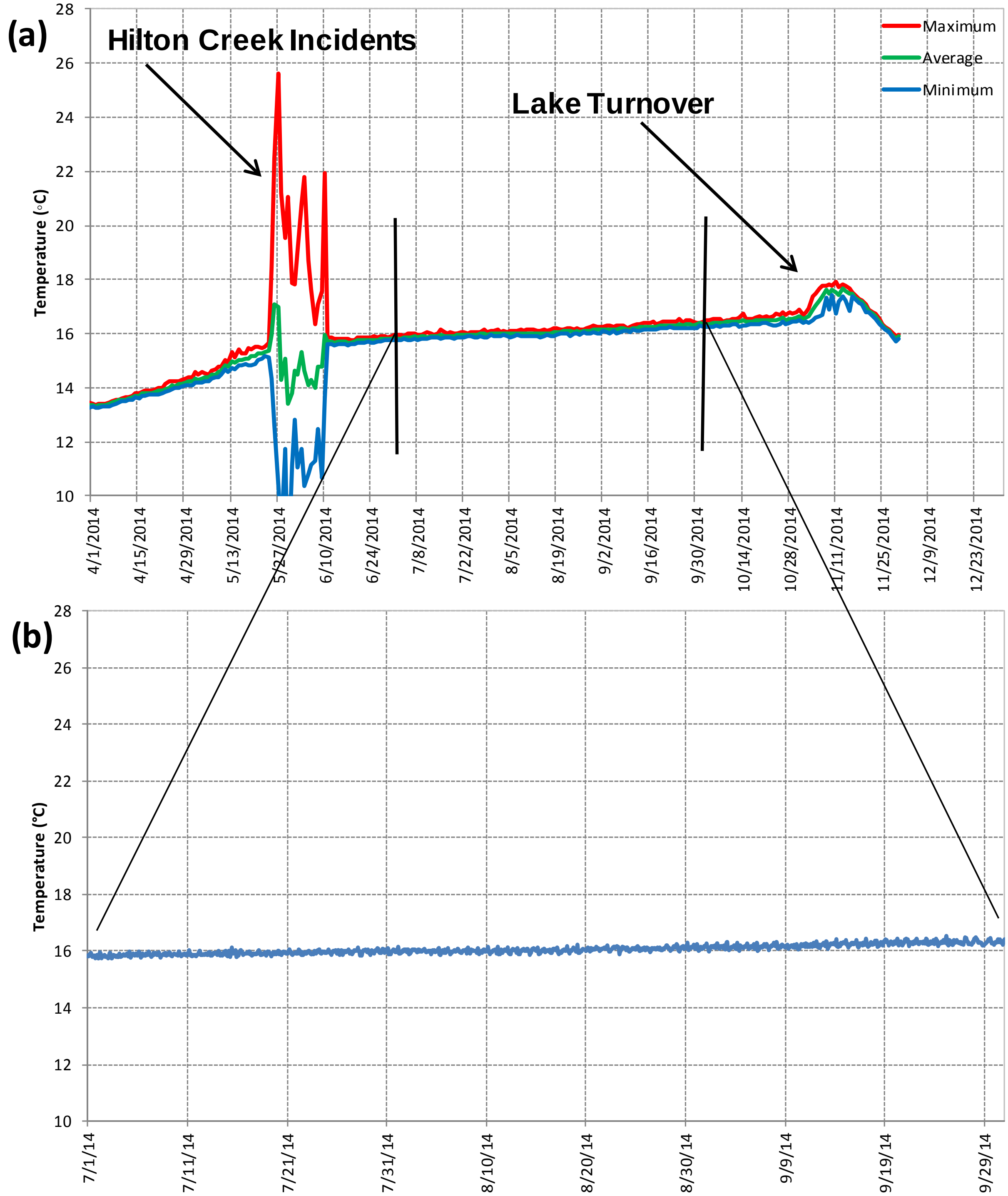
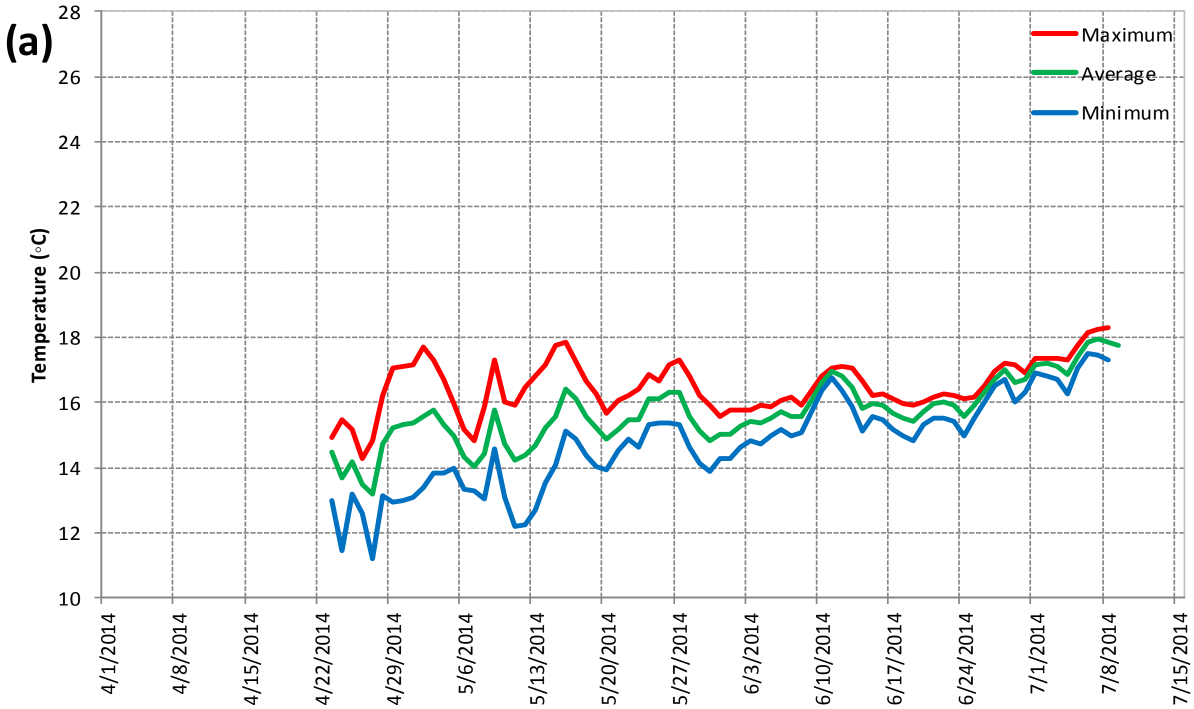


Figure 32: 2014 HC-0.54 (Upper Hilton Creek) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1. Included in the graph is a Hilton Creek dewatering incident where the thermographs was exposed to air.



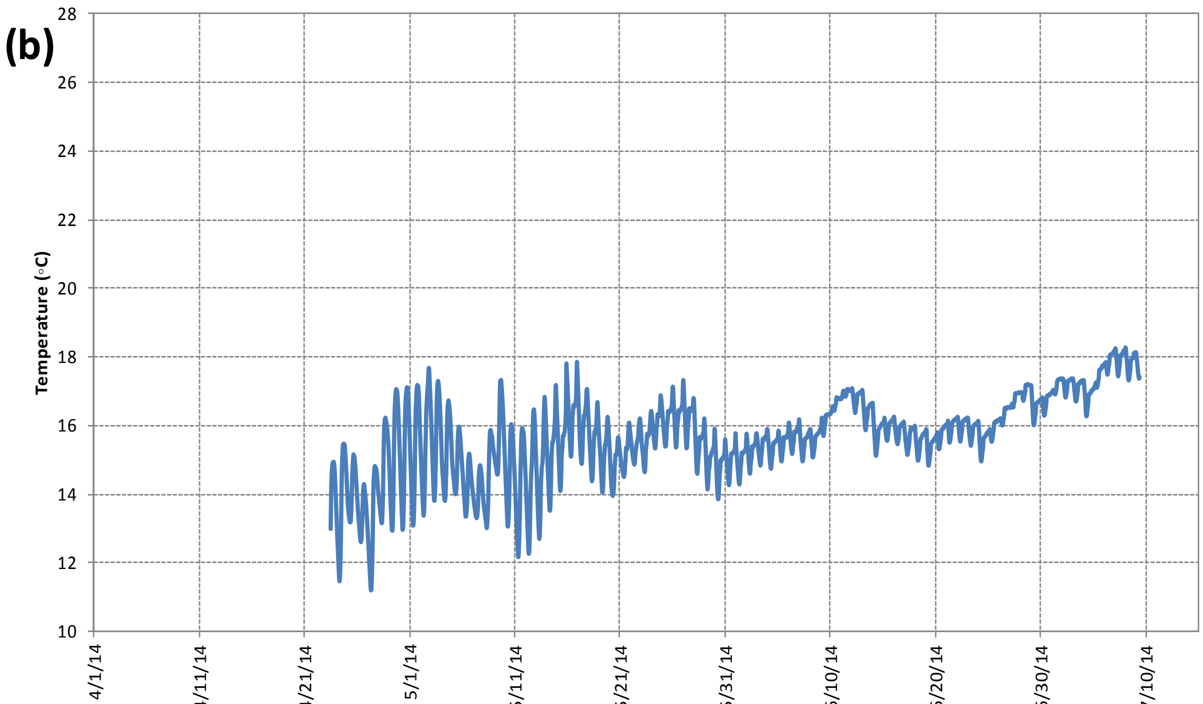


Figure 33: 2014 QC-2.66 (Quiota Creek) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period April 23-July 9. The unit was removed from the site on July due to lack of water.

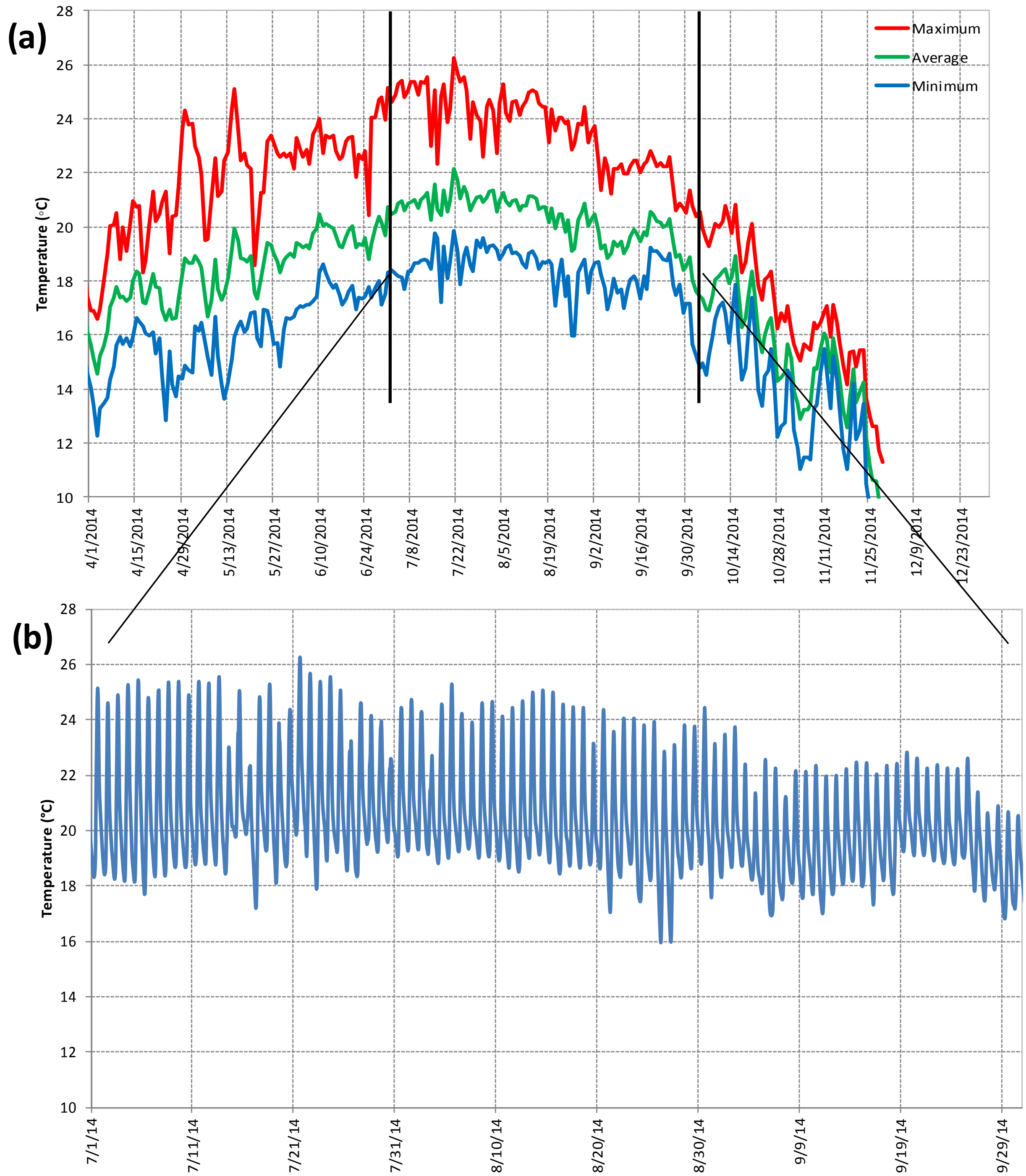


Figure 34: 2014 SC-0.77 (Lower Salsipuedes Creek) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period July 1-October 1.

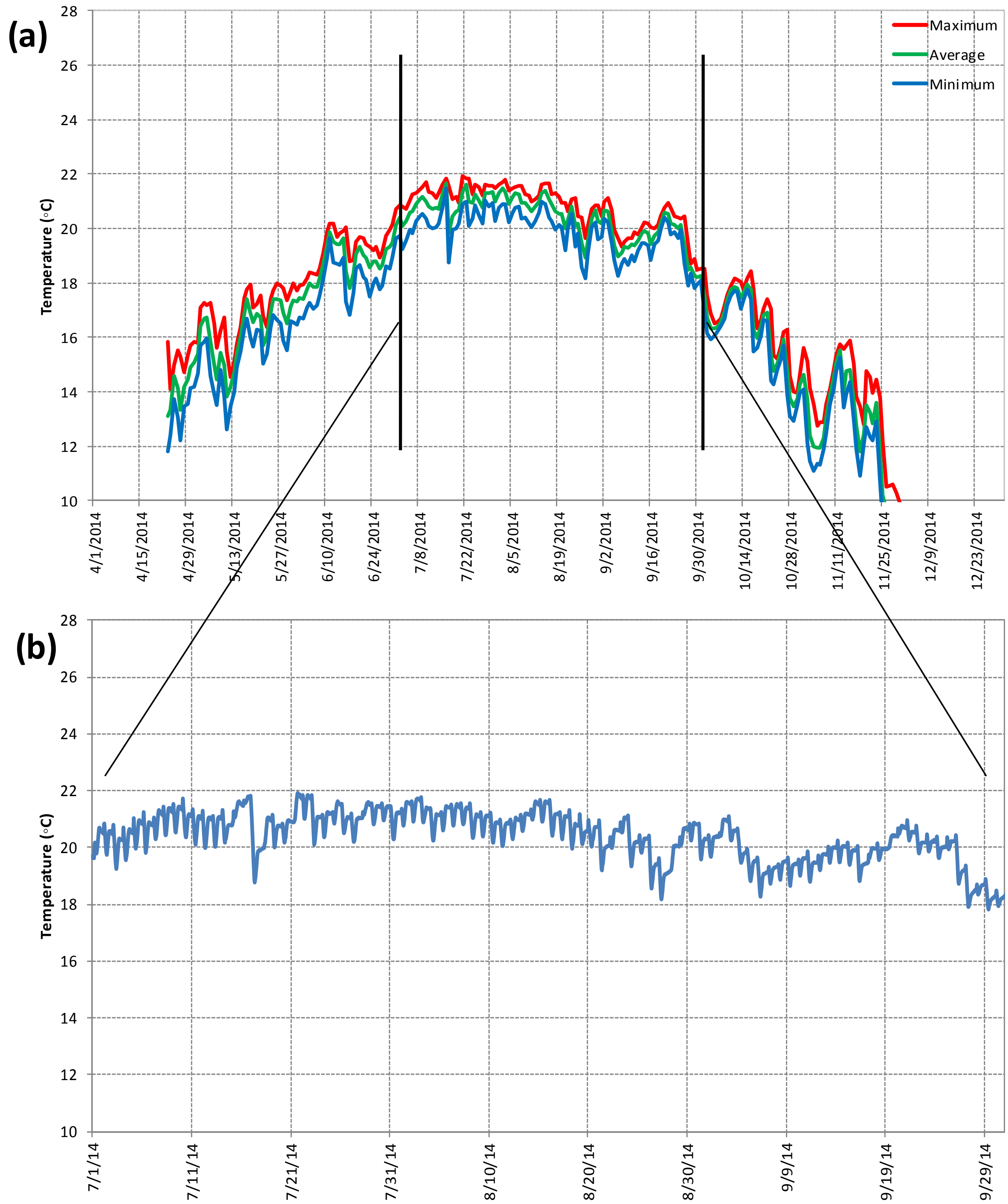


Figure 35: 2014 SC-2.20 (Salsipuedes Creek Reach 2 Bedrock Section) bottom (4.0 foot) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period from July 1-October 1.

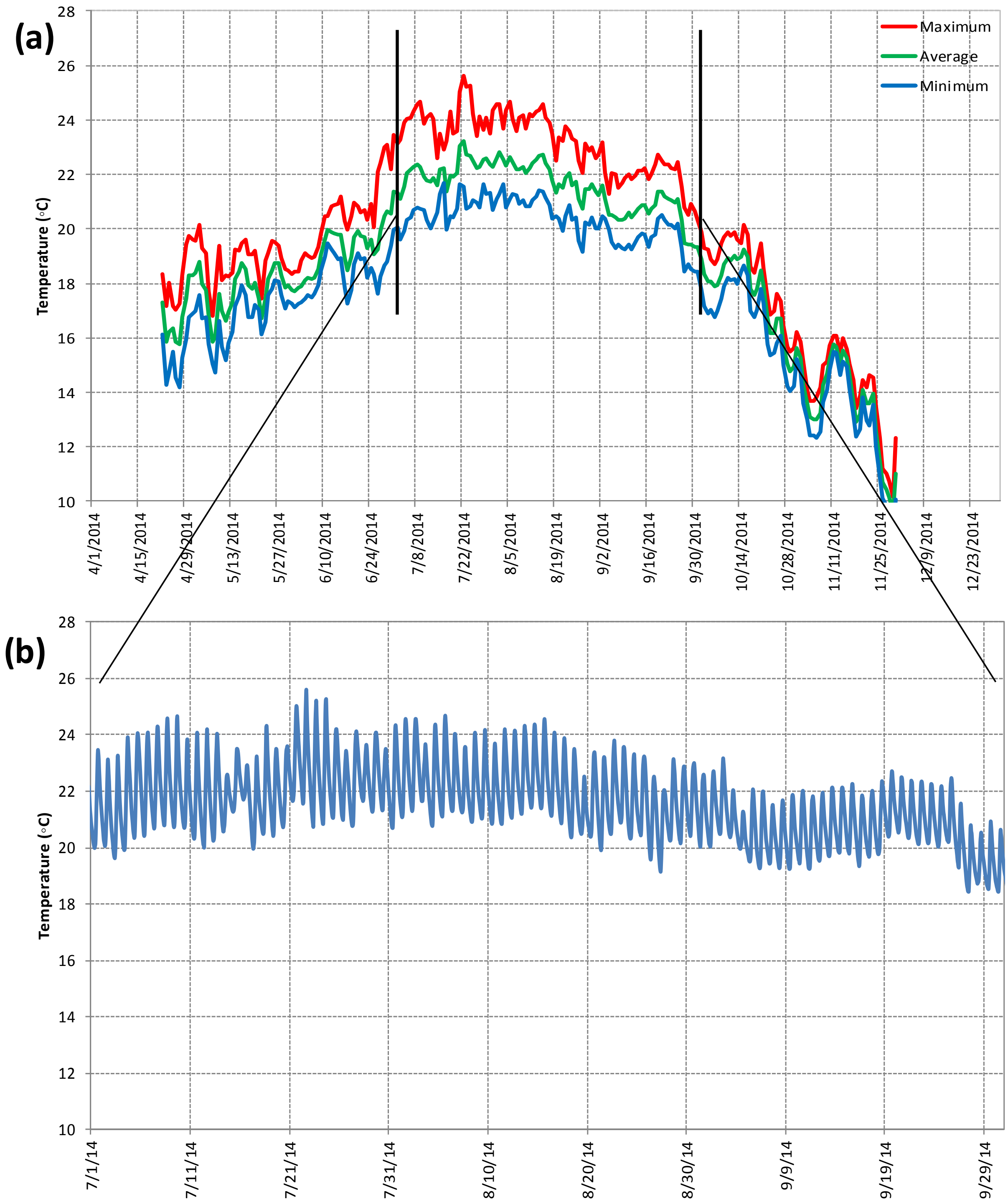


Figure 36: 2014 SC-3.0 (Salsipuedes Creek Highway 1 Bridge Pool Habitat) bottom (4.0 foot) water temperature for (a) maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from July 1-October 1.

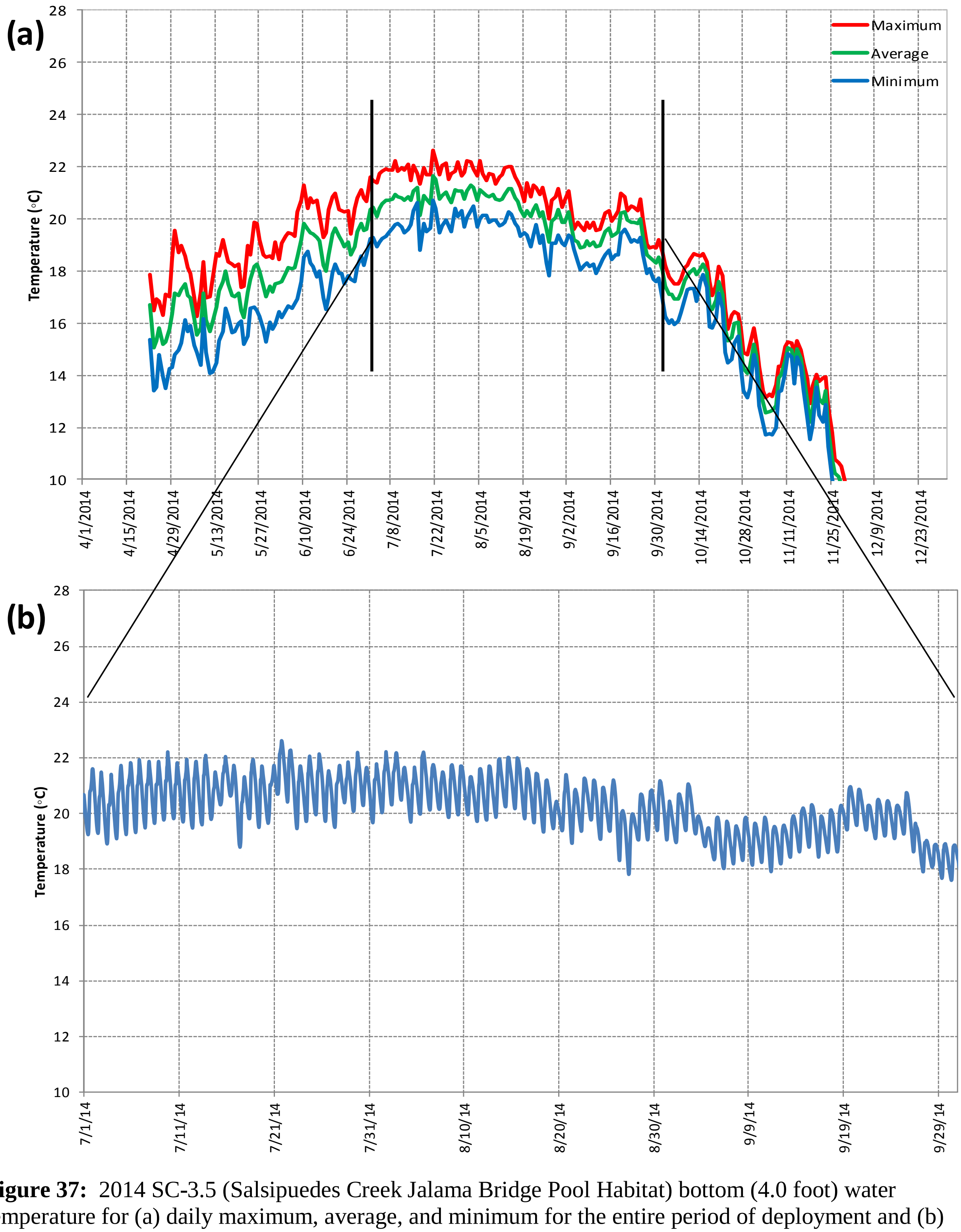


Figure 37: 2014 SC-3.5 (Salsipuedes Creek Jalama Bridge Pool Habitat) bottom (4.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from July 1-October 1.

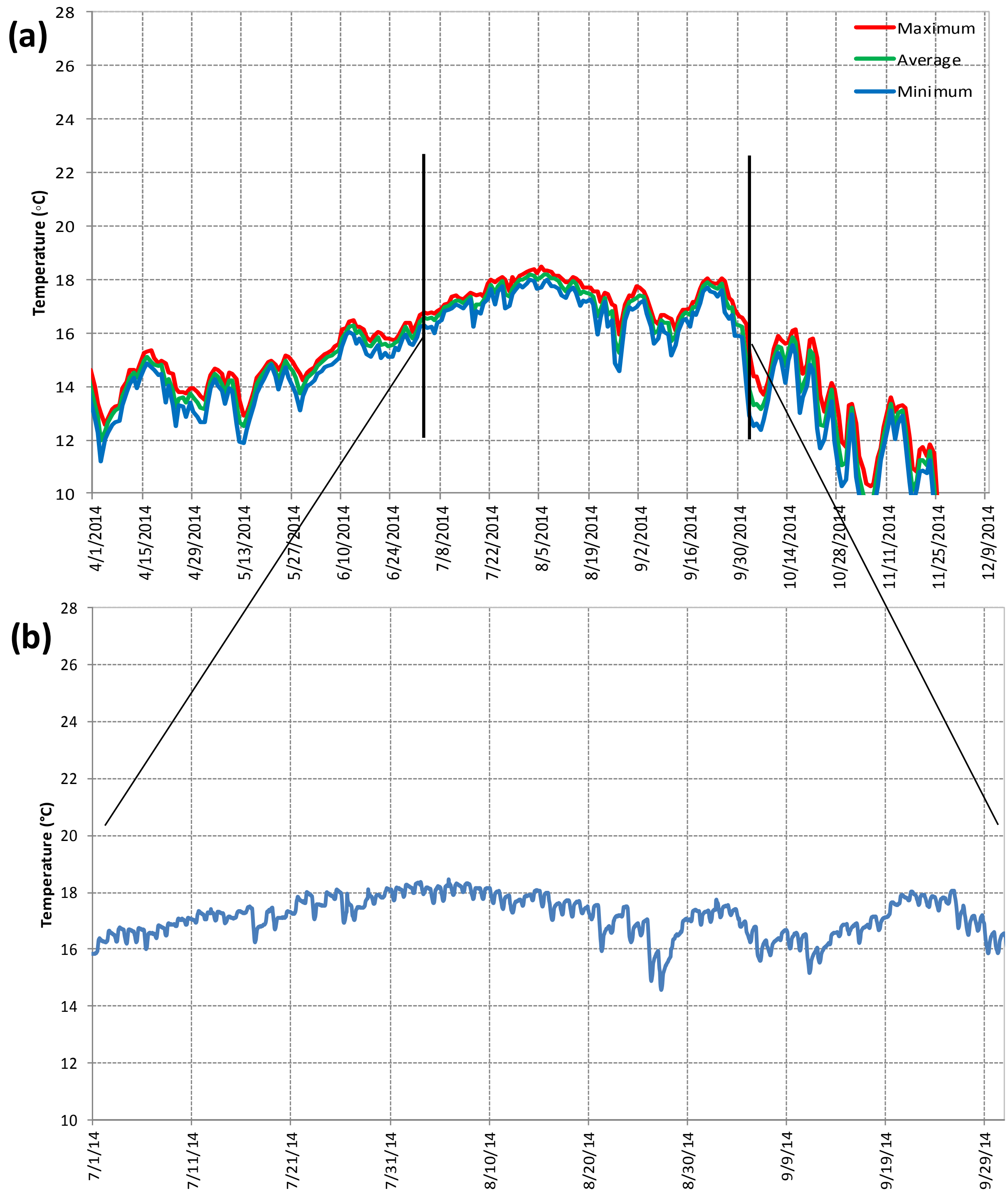


Figure 38: 2014 EJC-3.81 – Directly upstream of the Upper Salsipuedes Creek confluence - bottom (3.5 foot) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from July 1-October 1.

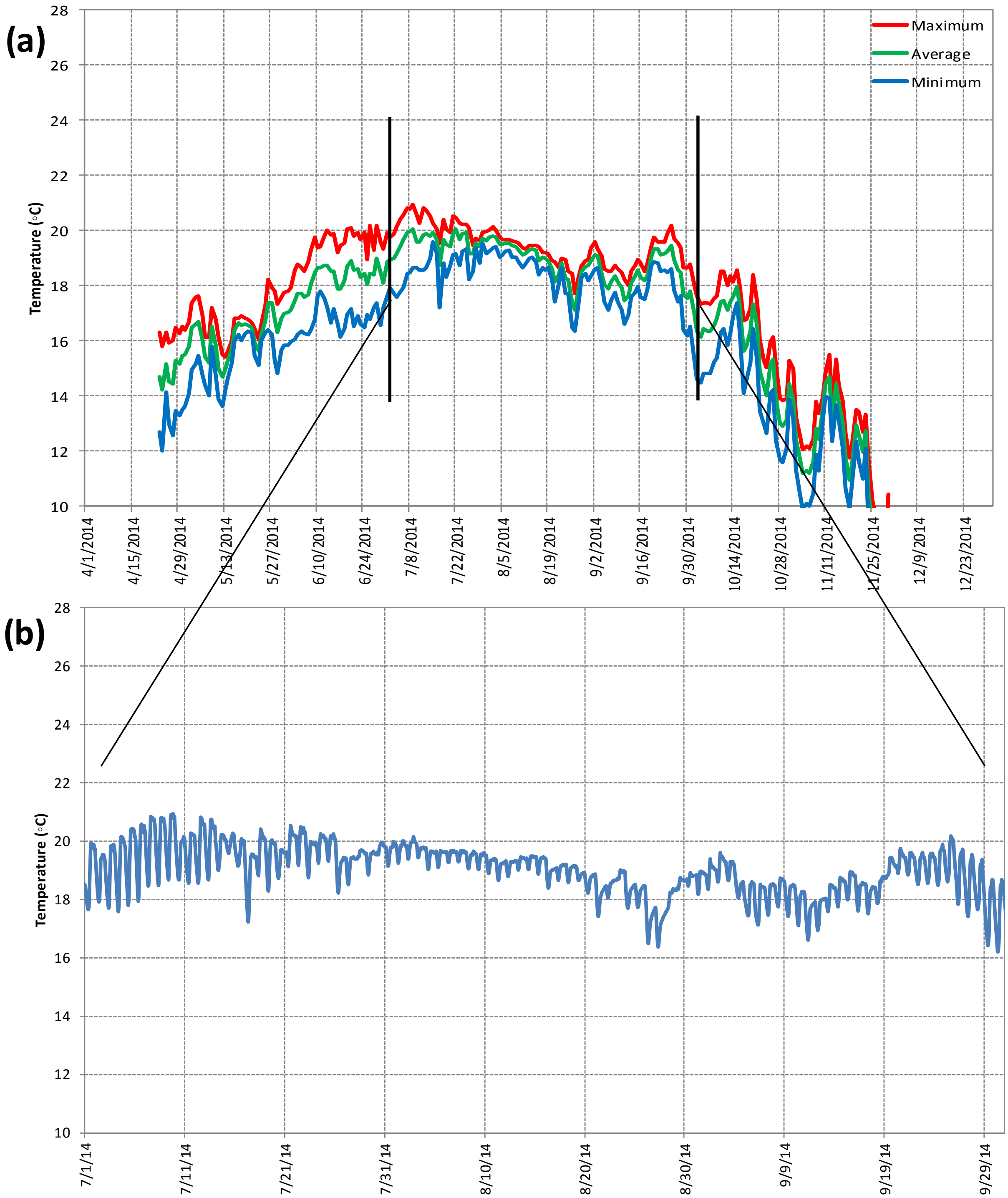
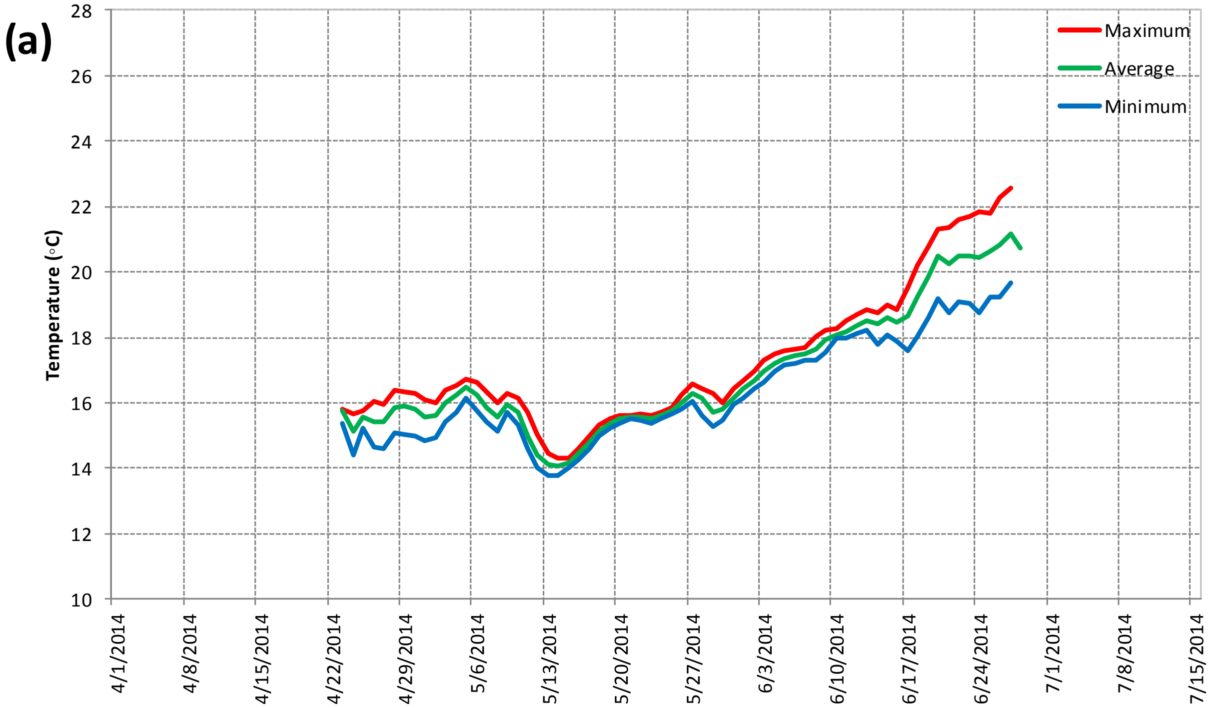


Figure 39: 2014 EJC-5.4 (El Jaro Creek Palos Colorados Pool Habitat) bottom (3.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from July 1-October 1.



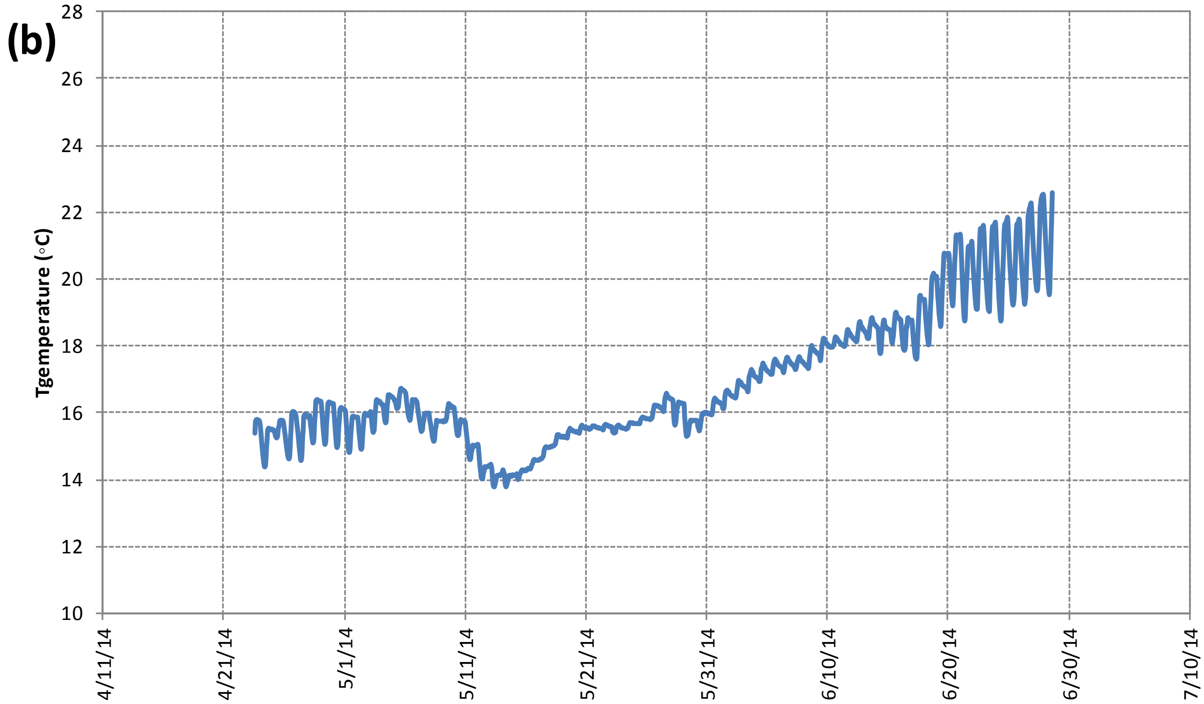


Figure 40: 2014 EJC-10.82 (El Jaro Creek Rancho San Julian Fish Ladder) bottom (1.5 foot) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of deployment before it was removed on June 28.

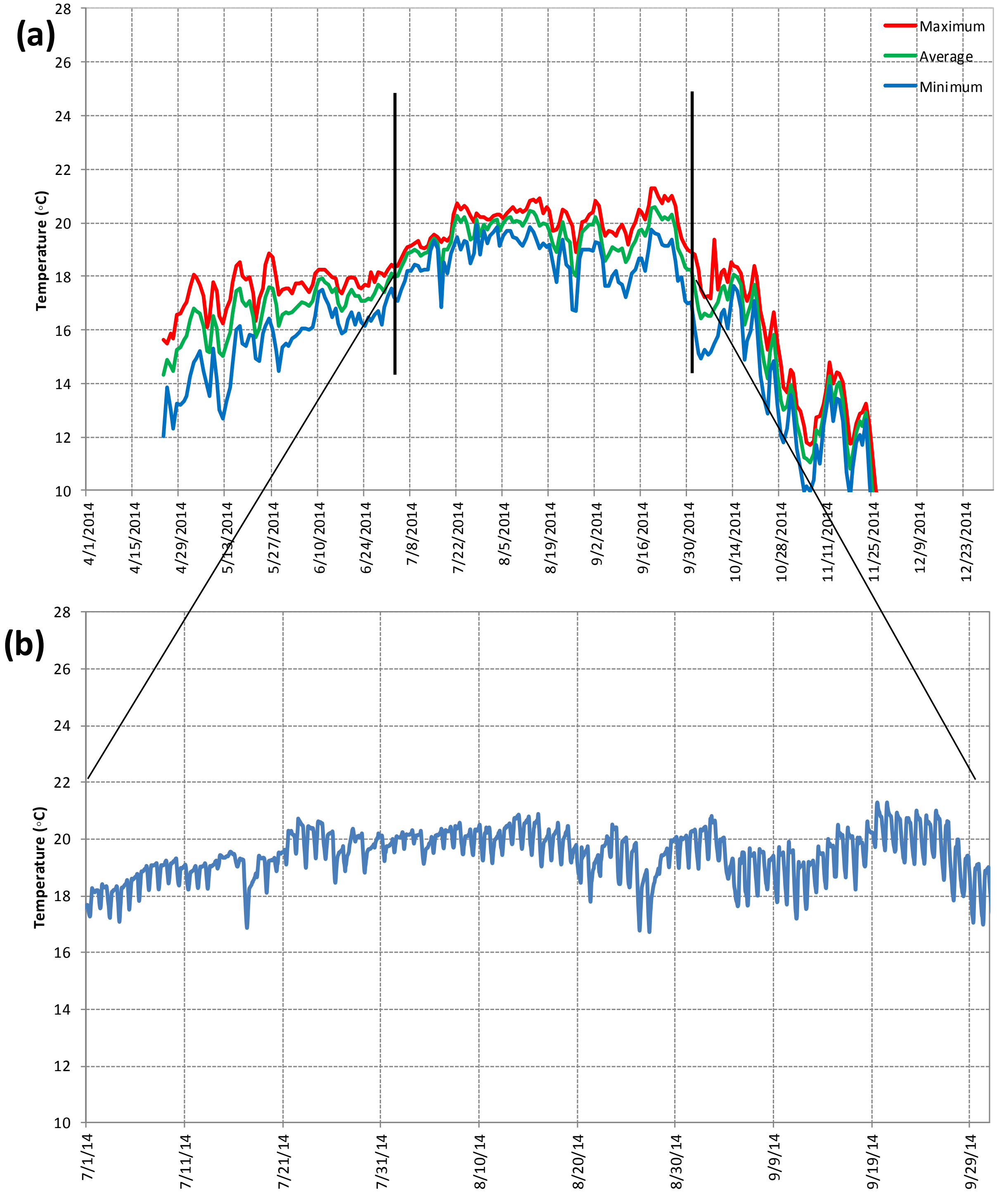


Figure 41: 2014 LAC-7.0 (Los Amoles Creek at Ford Crossing) bottom (3.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from July 1-October 1. Los Amoles was dry approximately 150 feet upstream of the thermograph location.

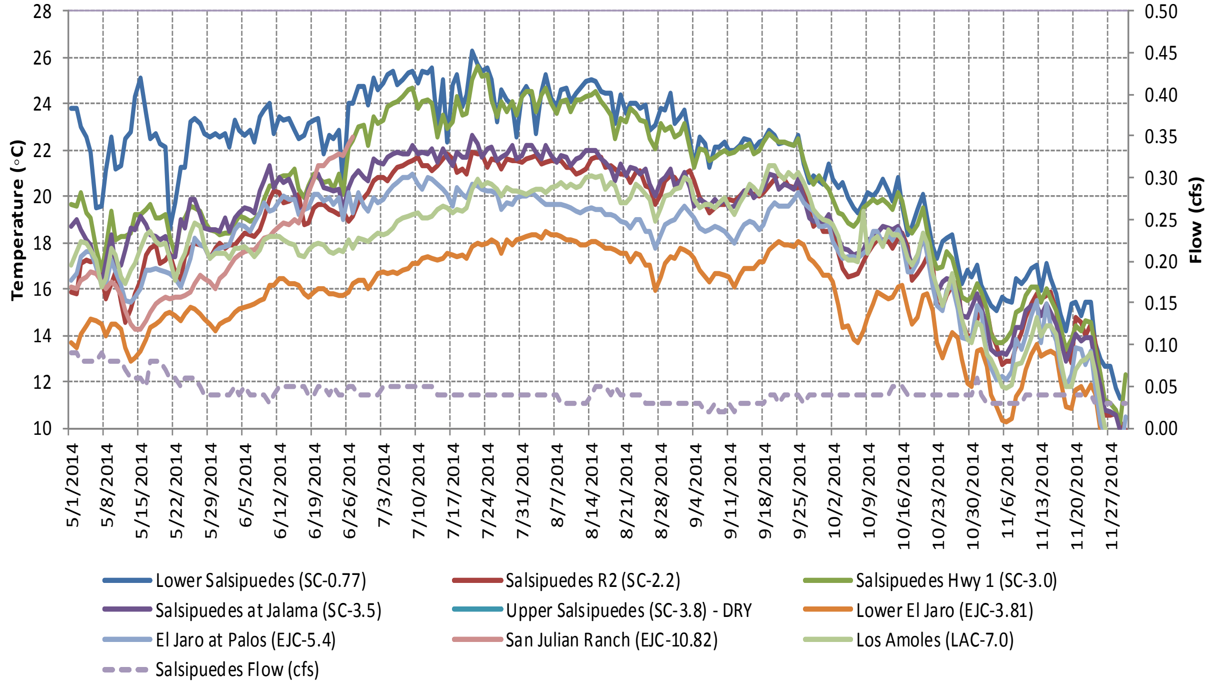


Figure 42: 2014 Longitudinal maximum daily water temperatures within the Salsipuedes Creek watershed which included El Jaro Creek at Rancho San Julian (EJC-10.82), Palos Colorados (EJC-5.4), lower El Jaro Creek (EJC-3.81), at Jalama Bridge (SC-3.5), at Highway 1 (SC-3.0), at Bedrock Section (SC-2.2), and at lower Salsipuedes Creek (SC-0.77) versus flow (cfs).

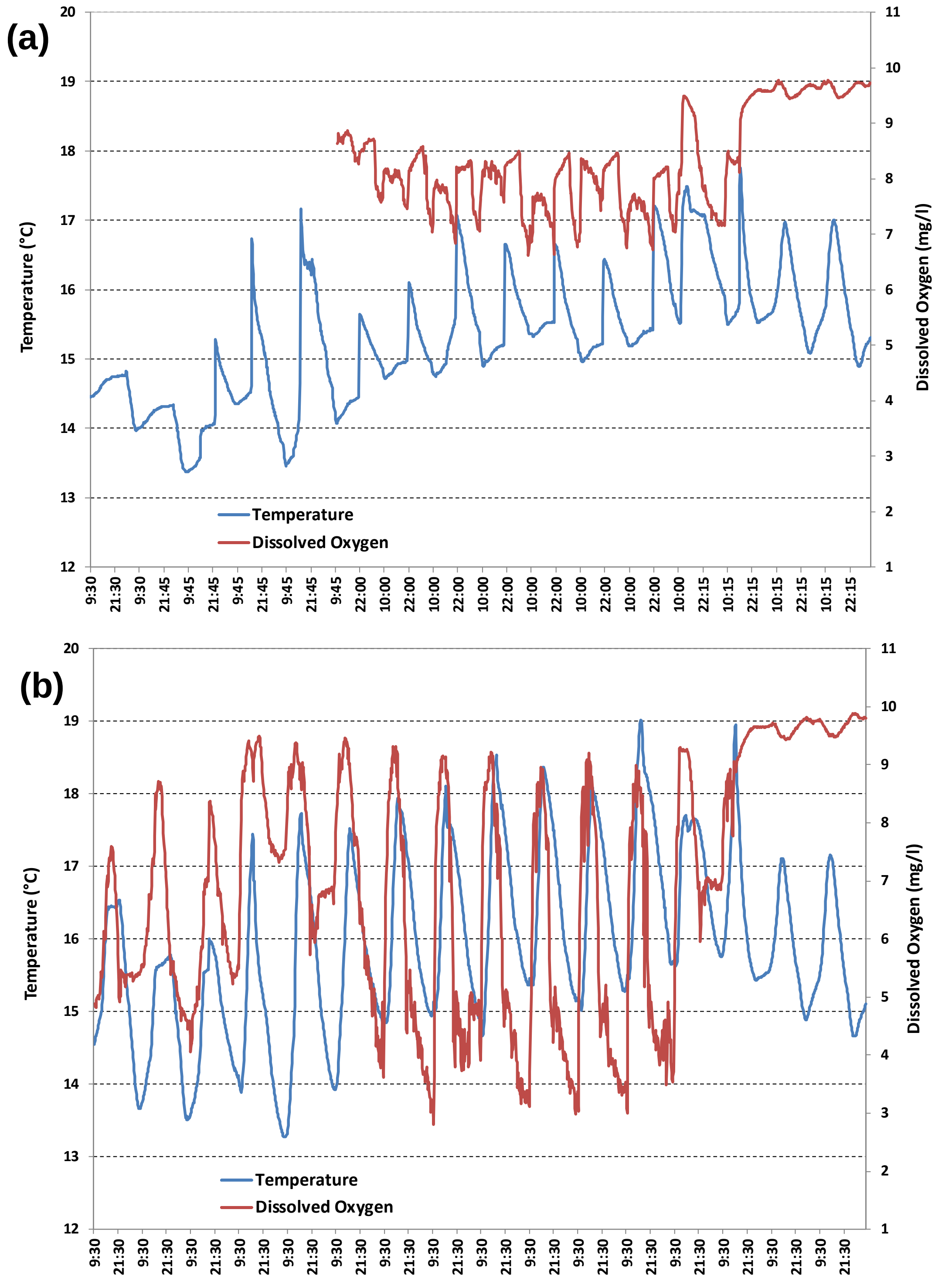


Figure 43: Hilton Creek sonde deployments from 5/28/14 – 6/13/14 showing temperature and dissolved oxygen at (a) the Spawning Pool (HC-0.25), and (b) the Perched Boulder Pool (HC-0.21). Deployments were made during a prolonged HCWS outage.

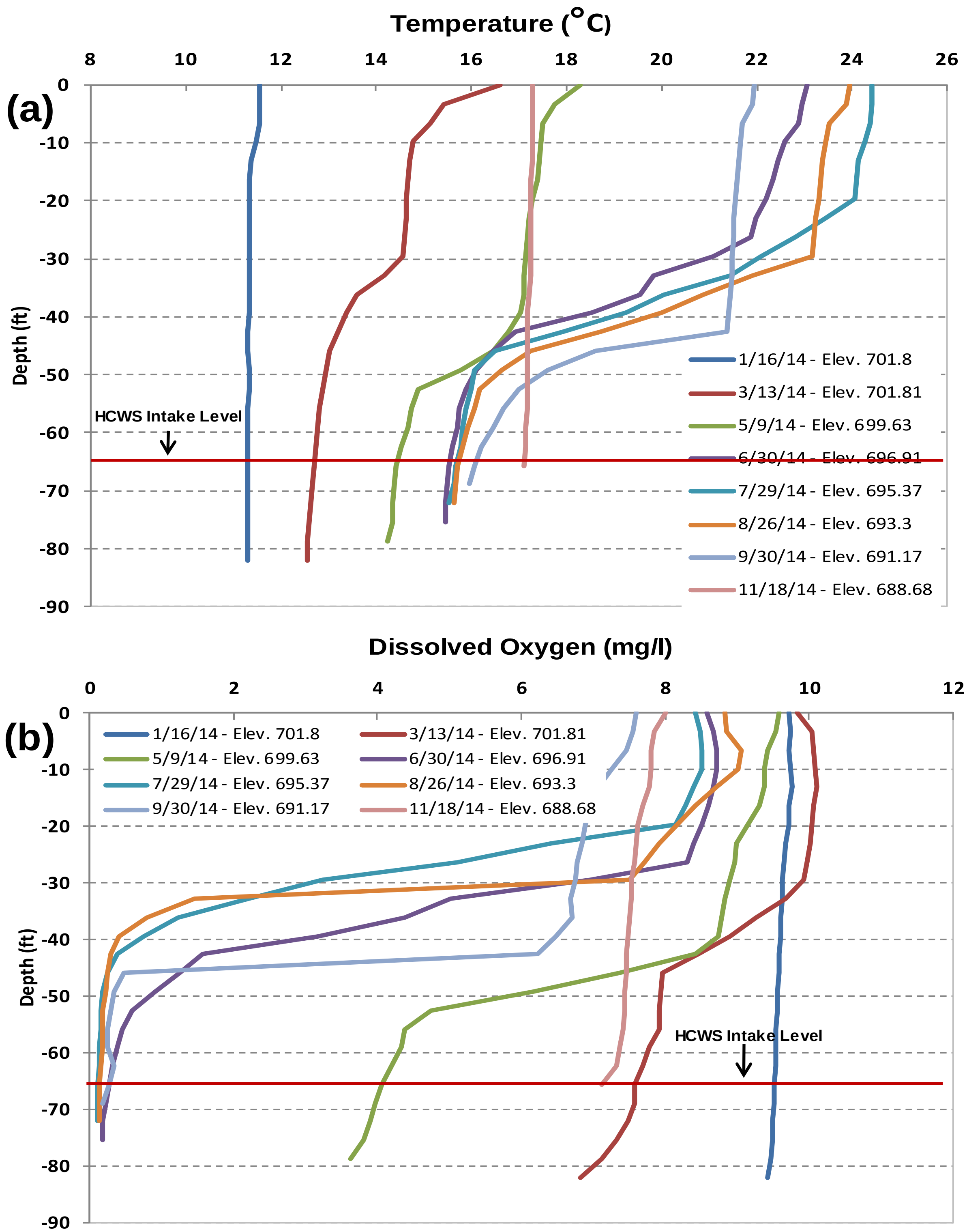


Figure 44: Lake Cachuma 2014 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS. HCWS intake hose level was set at 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

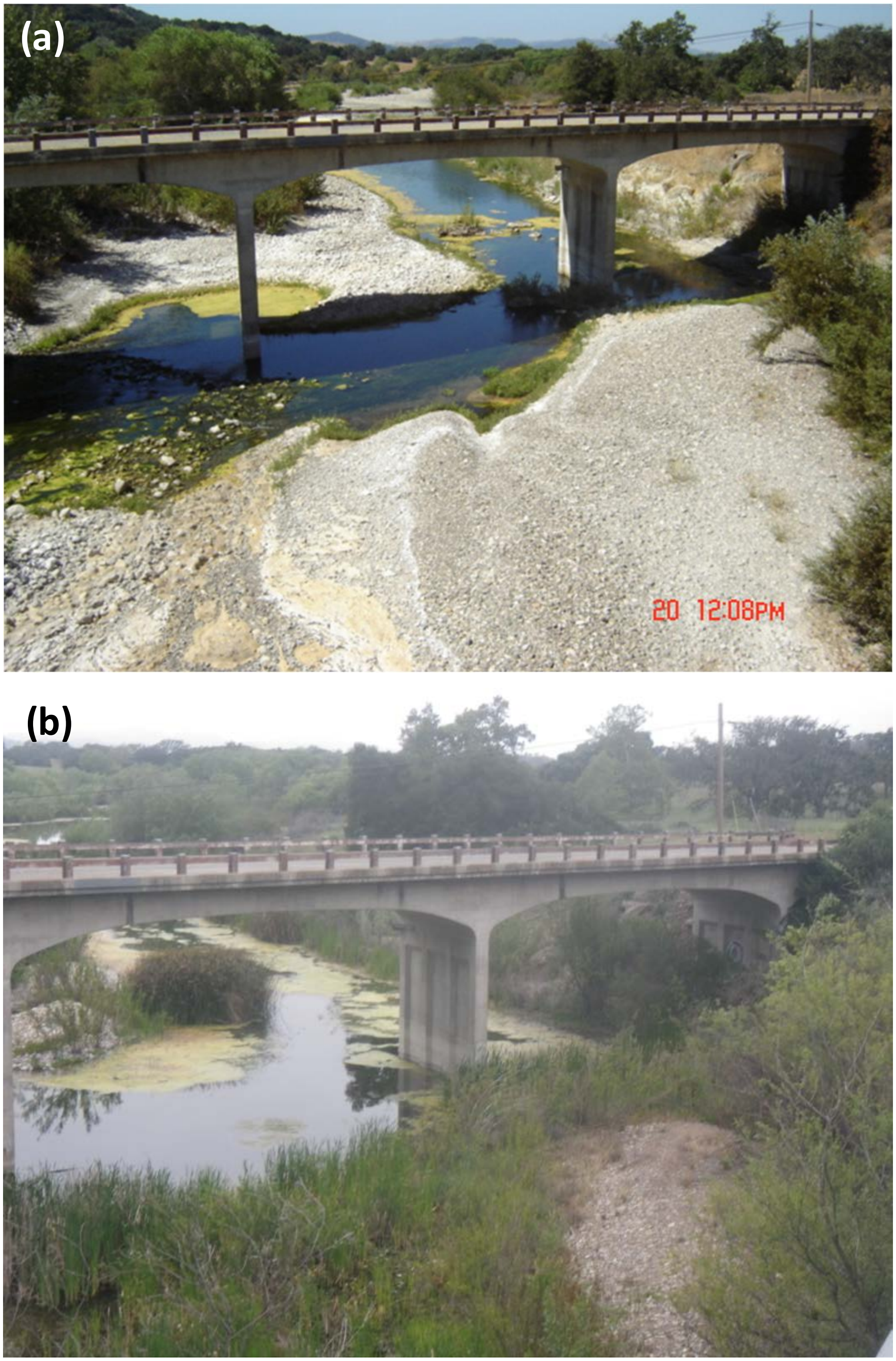


Figure 45: Photo Point (M-6) collected at Highway 154 Bridge looking downstream in (a) September 2005 and (b) April 2014.

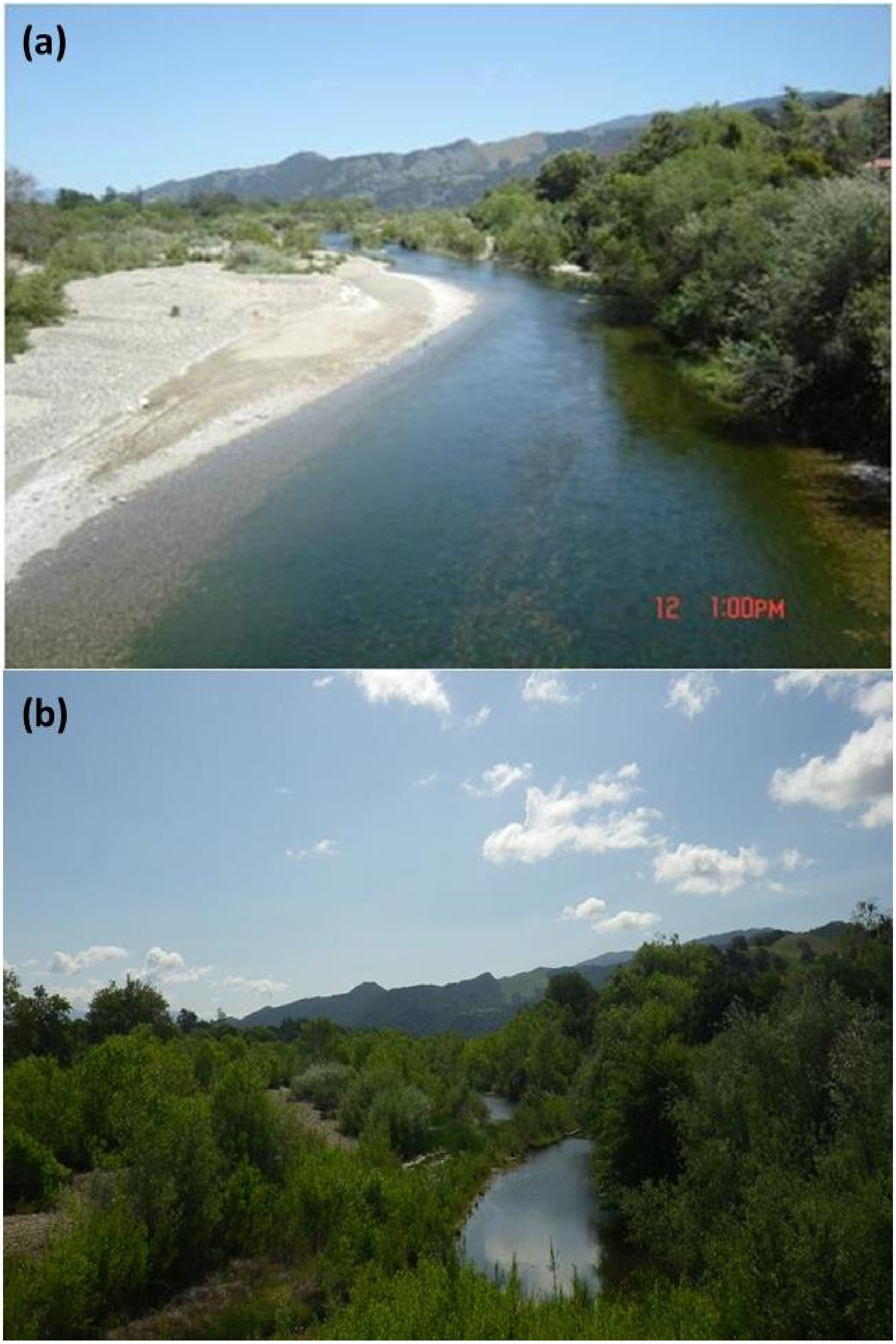


Figure 46: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) May 2014.

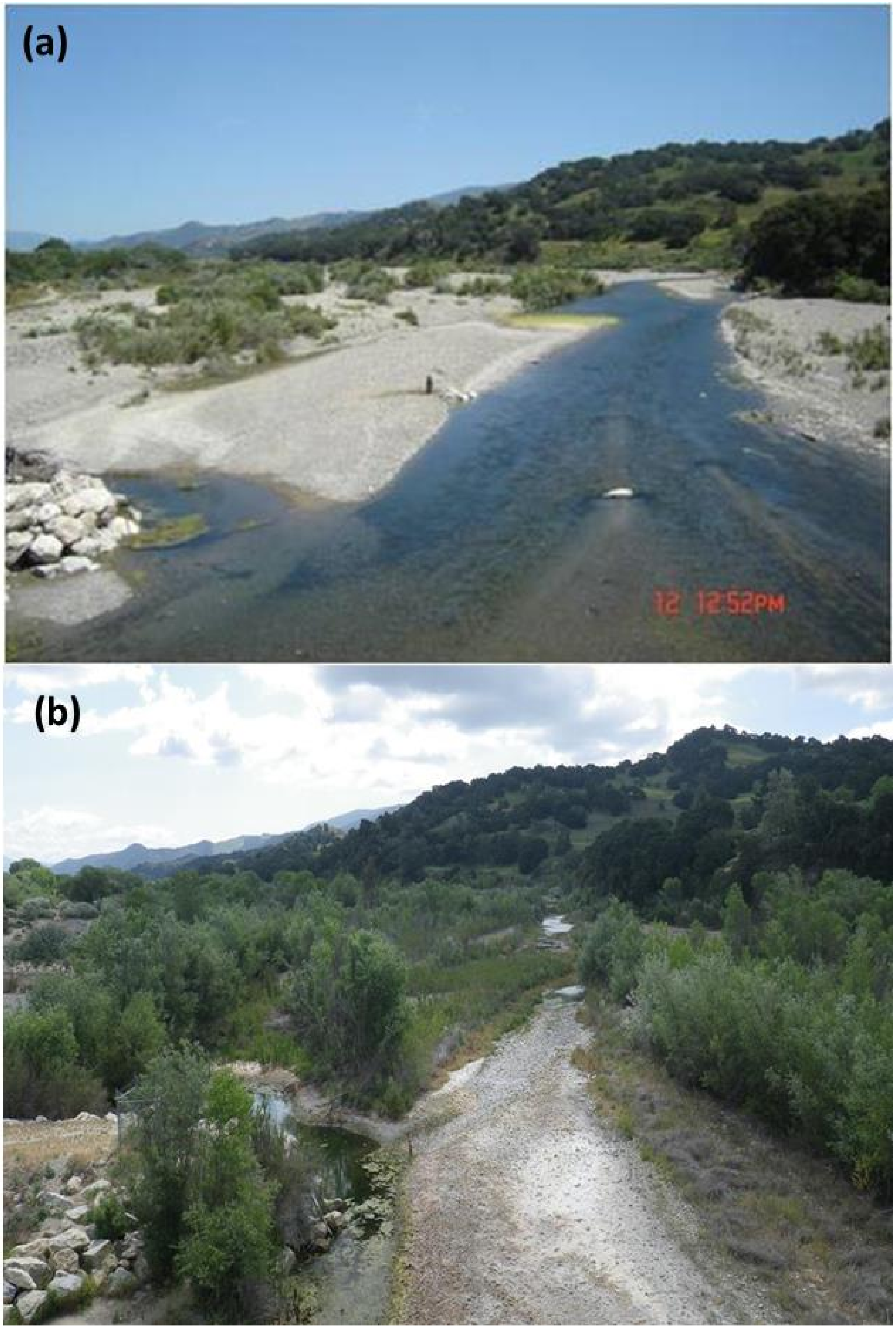


Figure 47: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) May 2014.

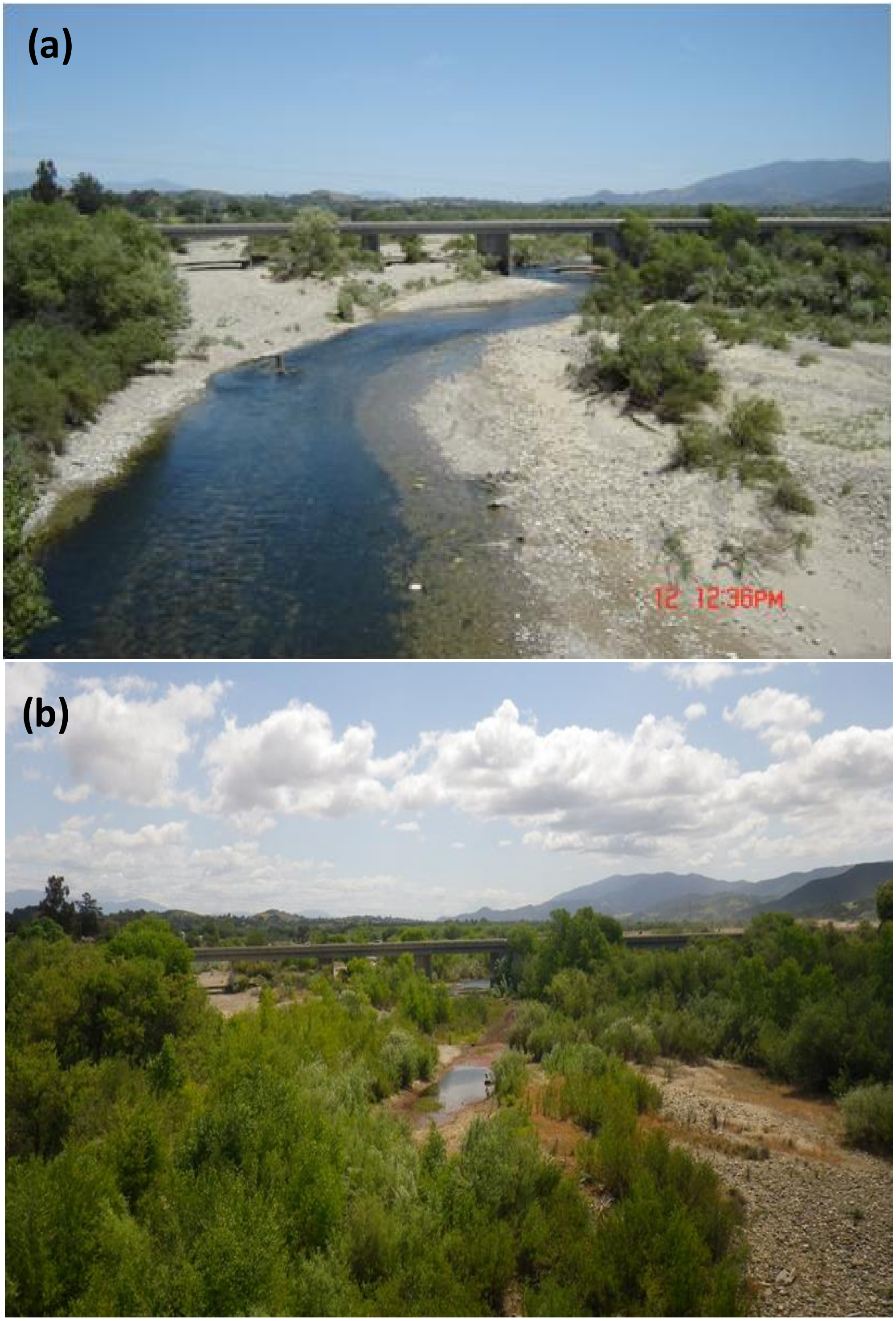


Figure 48: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) May 2014.

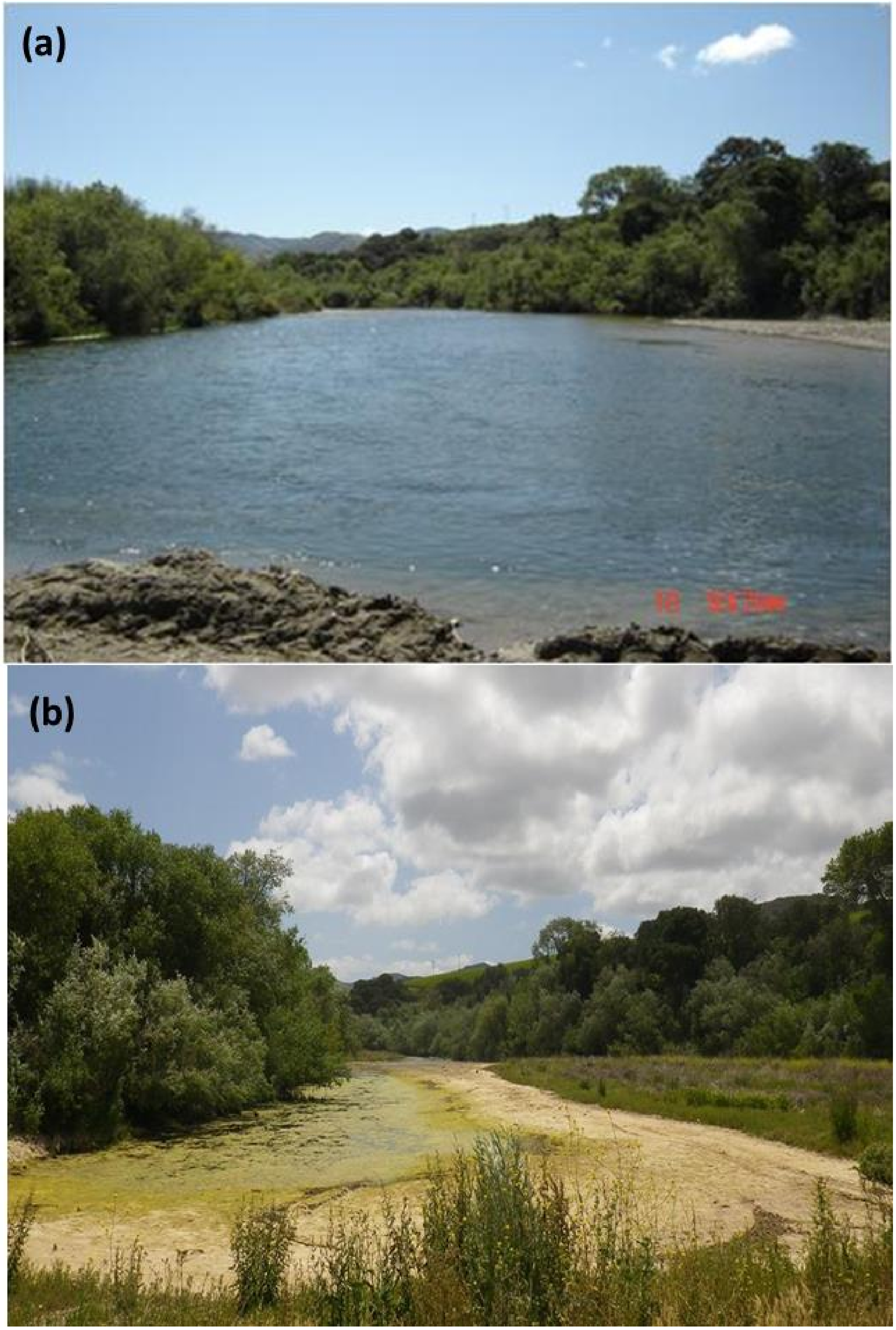


Figure 49: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) May 2014.

Figure 50: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) April 2014.

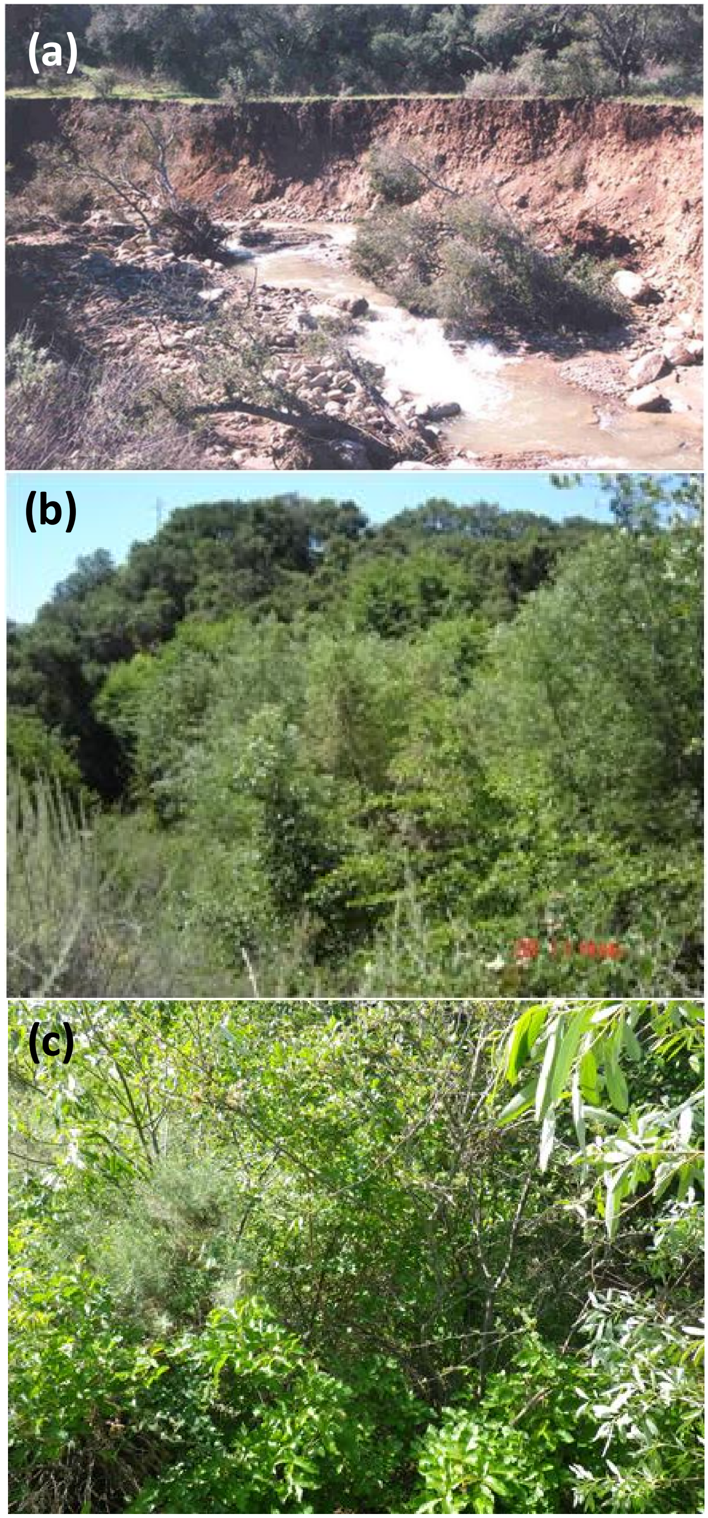


Figure 51: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) April 2014.

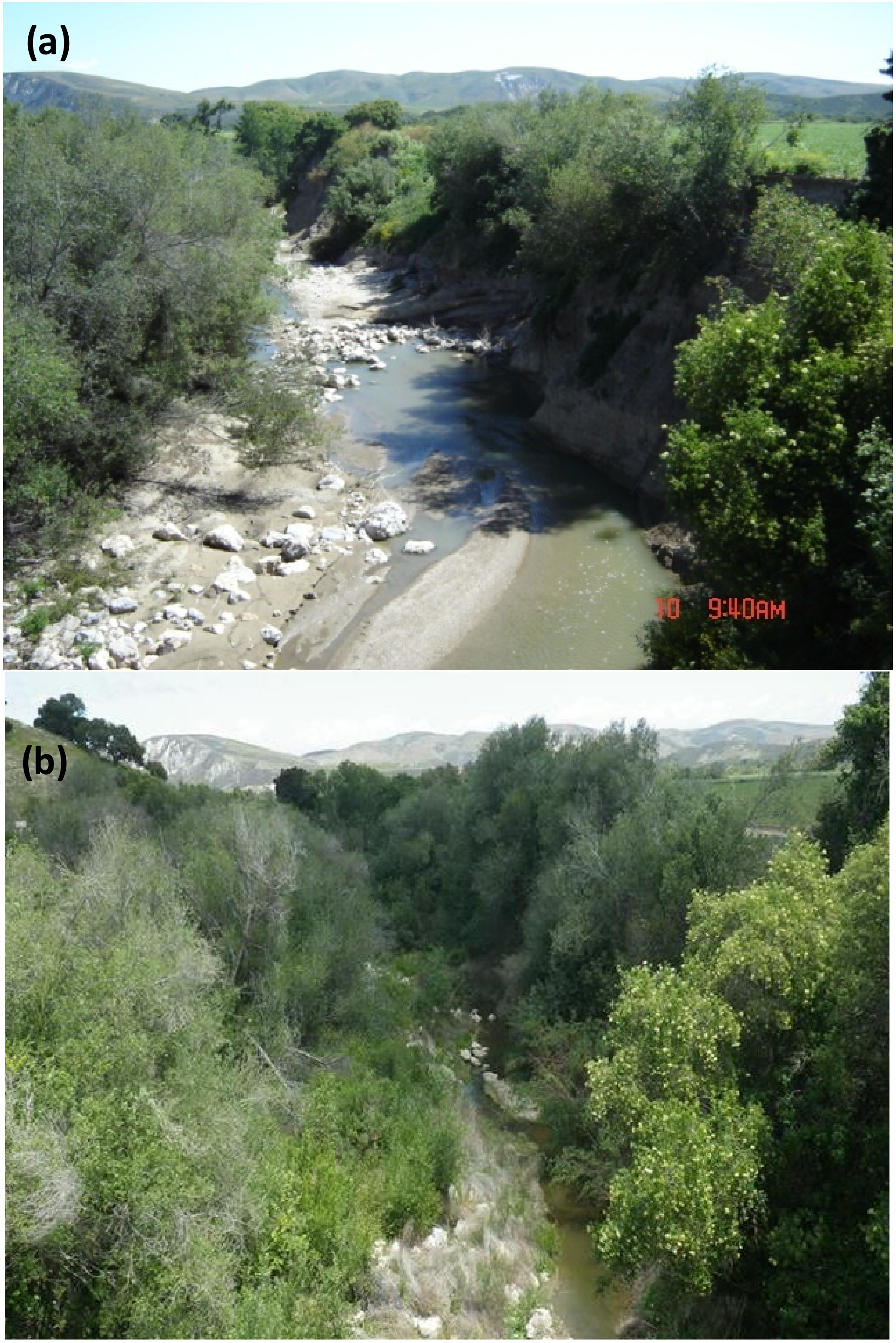


Figure 52: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) April 2014.

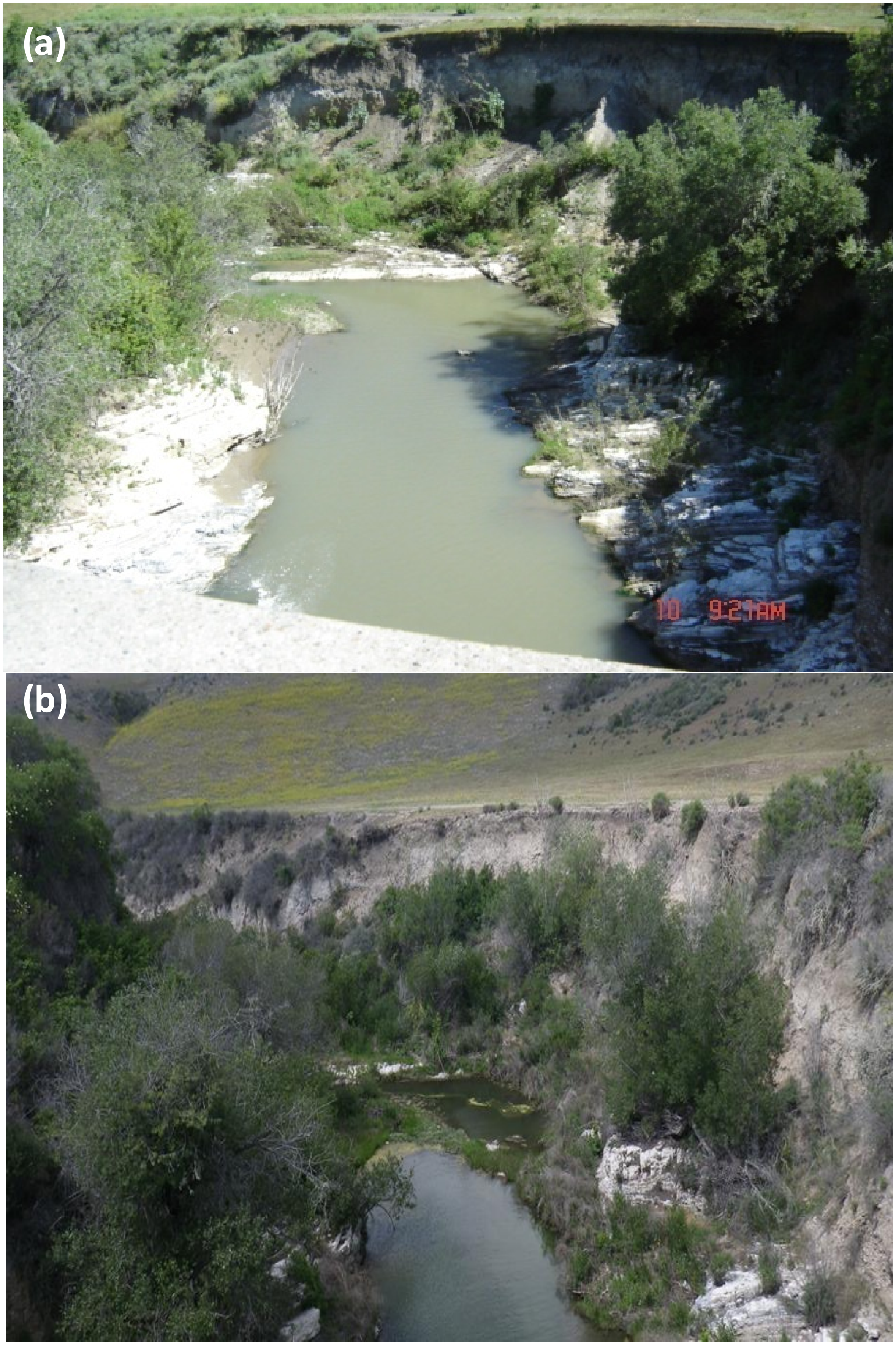


Figure 53: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in (a) May 2005 and (b) May 2014.

Figure 54: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) May 2014.

3.4 Migrant Trapping

Table 7: WY2014 migrant trap deployments.

Trap Location	Date Traps Deployed	Date Trap Removed	Date Traps Removed (storm event)	Date Traps Installed (Storm Event)	# of Days Not Trapping	Functional Trapping Days	Functional Trapping %
	(dates)	(dates)	(dates)	(dates)	(days)	(days)	(days)
Hilton Creek	2/20/2014	4/30/2014	2/28/2014	3/2/2014	4		
(upstream trap)			3/12/2014	3/17/2014	5		
	Total:	**70**		**Total:**	**9**	61	87%
Hilton Creek	3/26/2014	4/30/14	3/12/2014	3/17/2014	5		
(downstream trap)			4/5/2014	4/7/2014	2		
	Total:	**34**		**Total:**	**7**	27	79%
Salsipuedes Creek	3/3/2014	3/13/2014	None		0		
(both traps)	**Total:**	**10**		**Total:**	**0**	10	100%
LSYR Mainstem	3/2/2014	3/9/2014	None		0		
(both traps)	**Total:**	**7**		**Total:**	**0**	7	100%

Table 8: Number of migrant captures, including recaptures but not young-of-the-year, associated with each trap check at each trapping location over 24-hours in WY2014; the LSYR mainstem trap data were not included since no fish was captured during the period.

Location	Trap	Trap Check					Total
		1st AM	2nd AM	1st PM	2nd PM		
		(05:00-10:00)	(10:01-14:00)	(18:00-22:00)	(22:01-01:59)		
Hilton	Upstream	11	6	16	13		46
	Downstream	28	4	6	40		78
	Total:	39	10	22	53		124
Salsipuedes	Upstream	2	0	0	1		3
	Downstream	2	0	1	7		10
	Total:	4	0	1	8		13

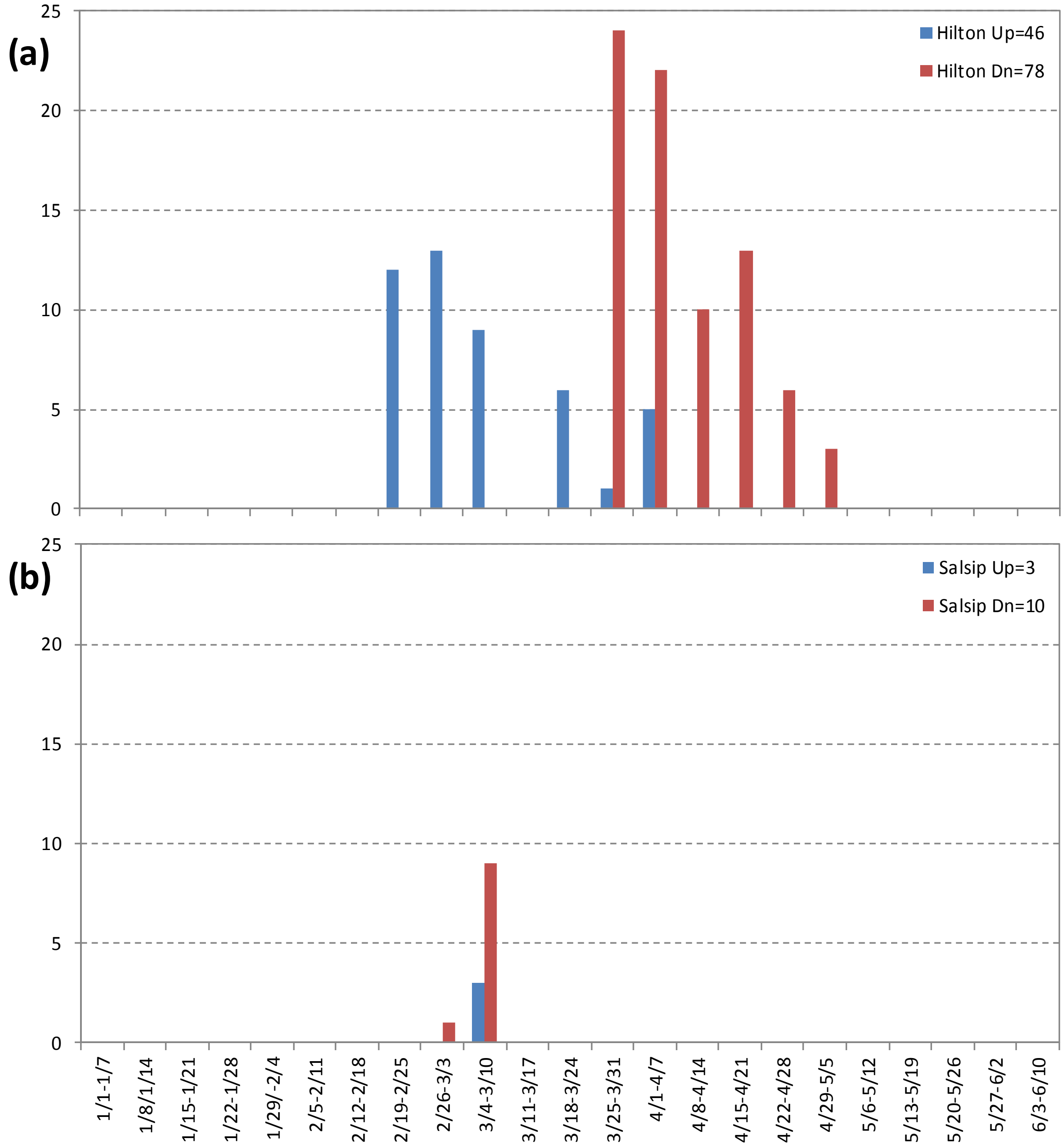


Figure 55: WY2014 paired histogram of weekly upstream and downstream captures by trap site for: (a) Hilton Creek and (b) Salsipuedes Creek; no *O. mykiss* were captured at the mainstem trap in WY2014.

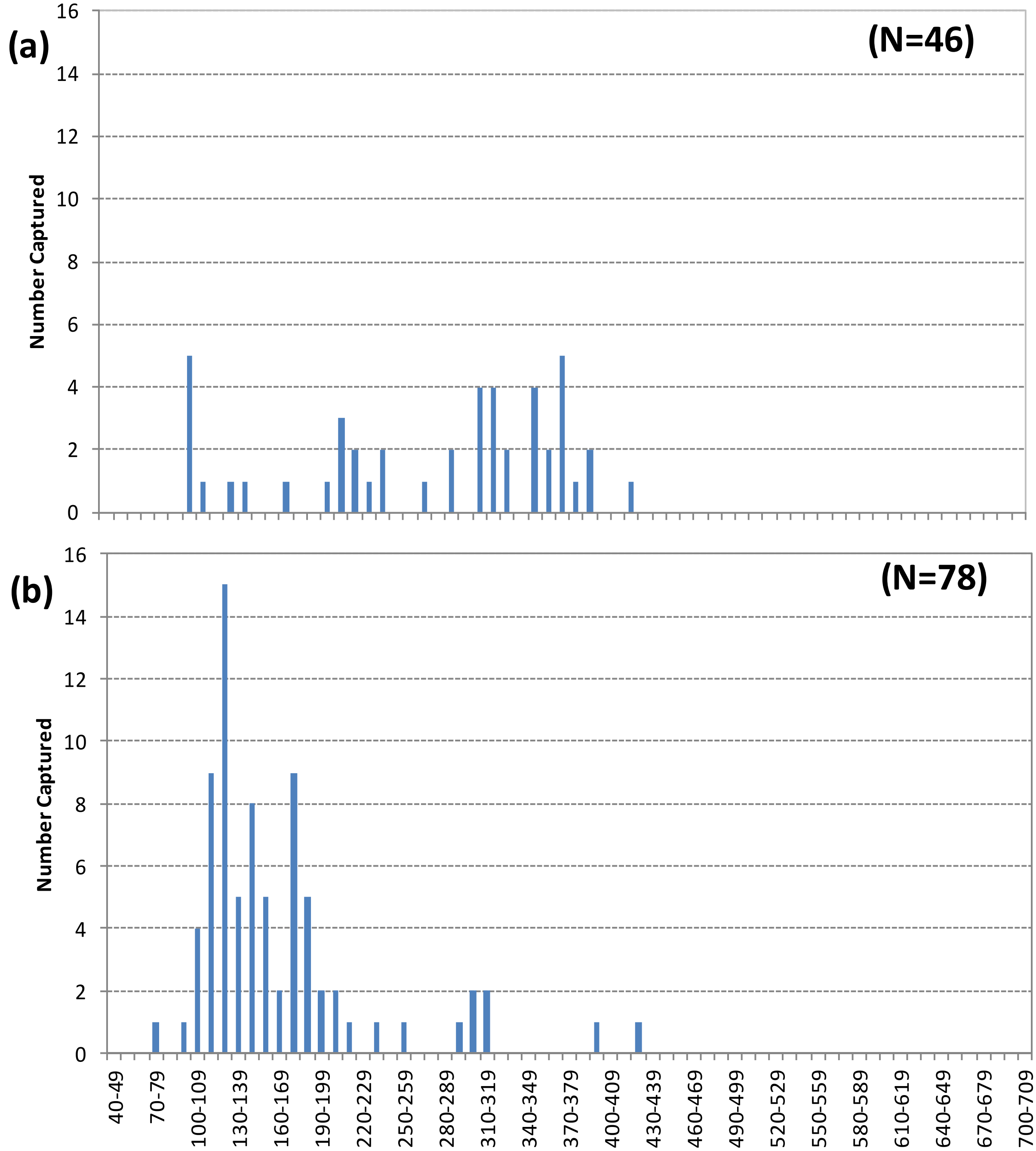


Figure 56: WY2014 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

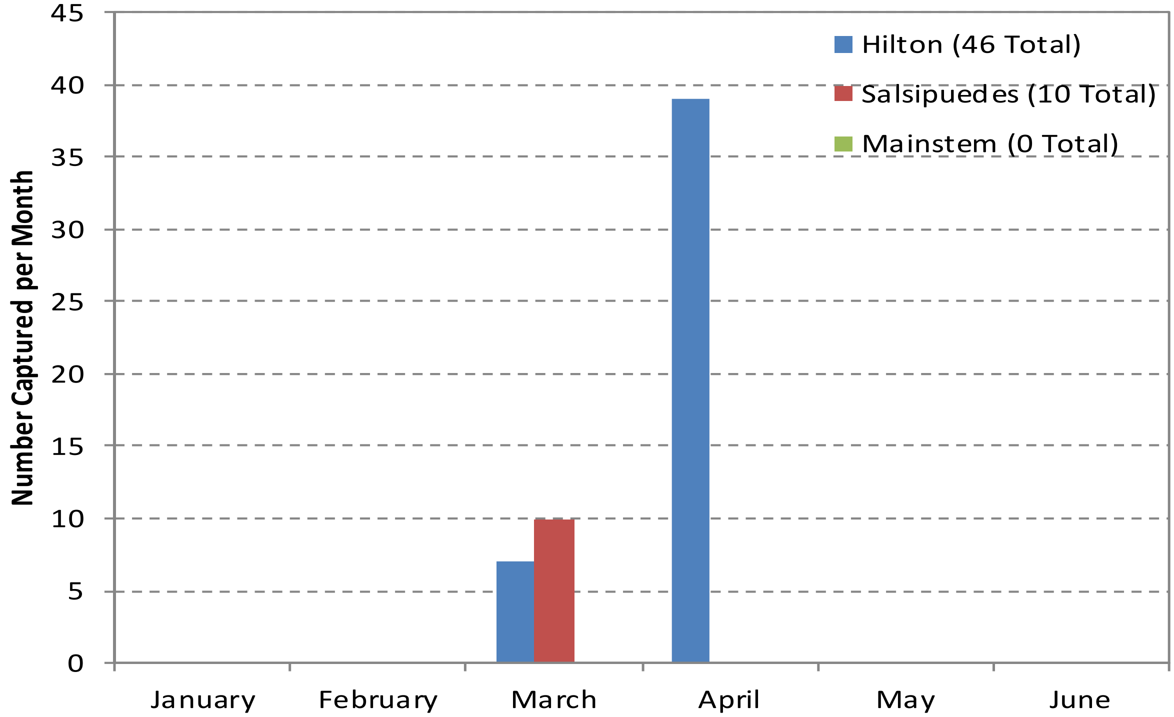


Figure 57: Monthly smolt captures observed at the Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps in WY2014.

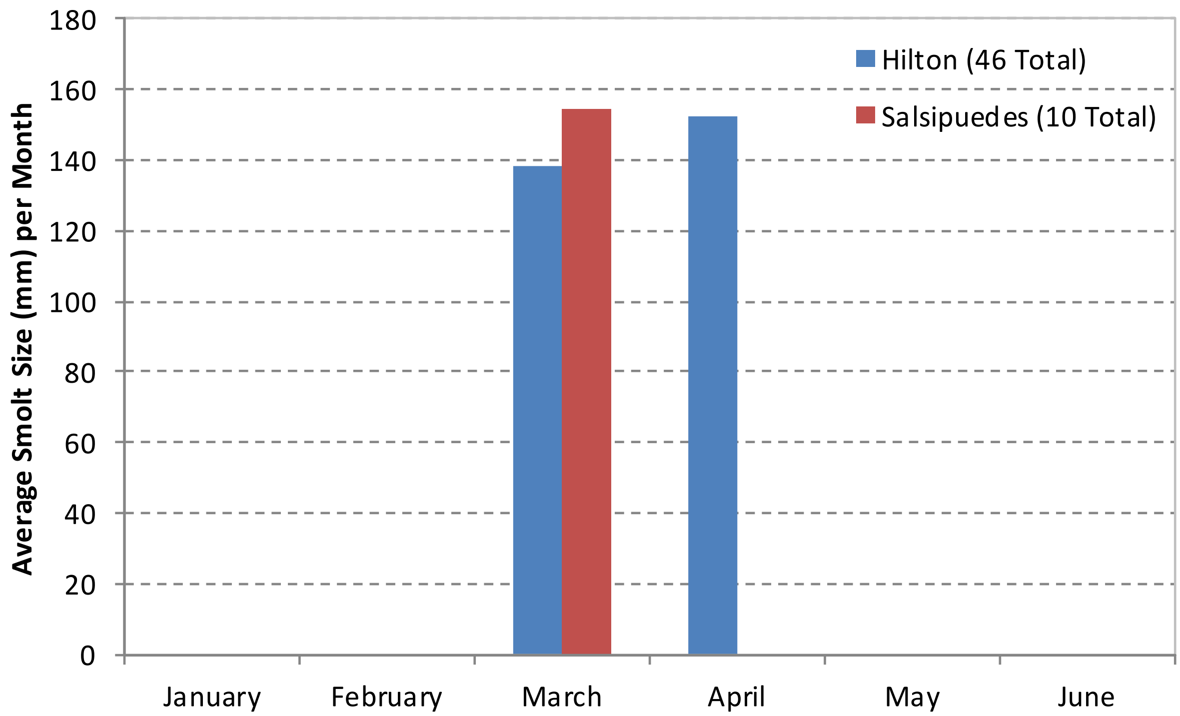


Figure 58: WY2014 monthly average smolt size in mm at the trapping sites where *O. mykiss* were captured.

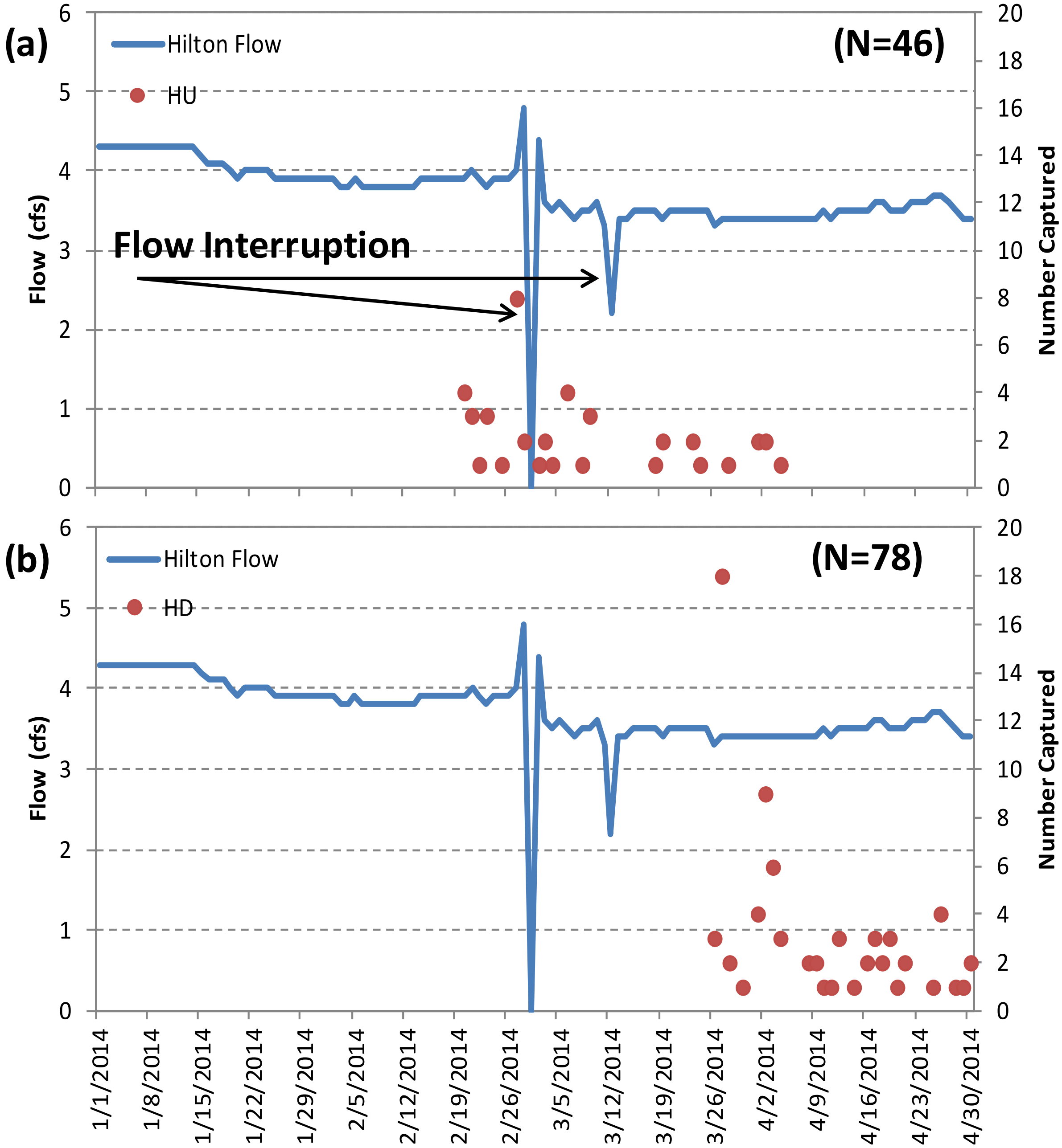


Figure 59: WY2014 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures; shown in the graph are two separate flow interruptions from the HCWS.

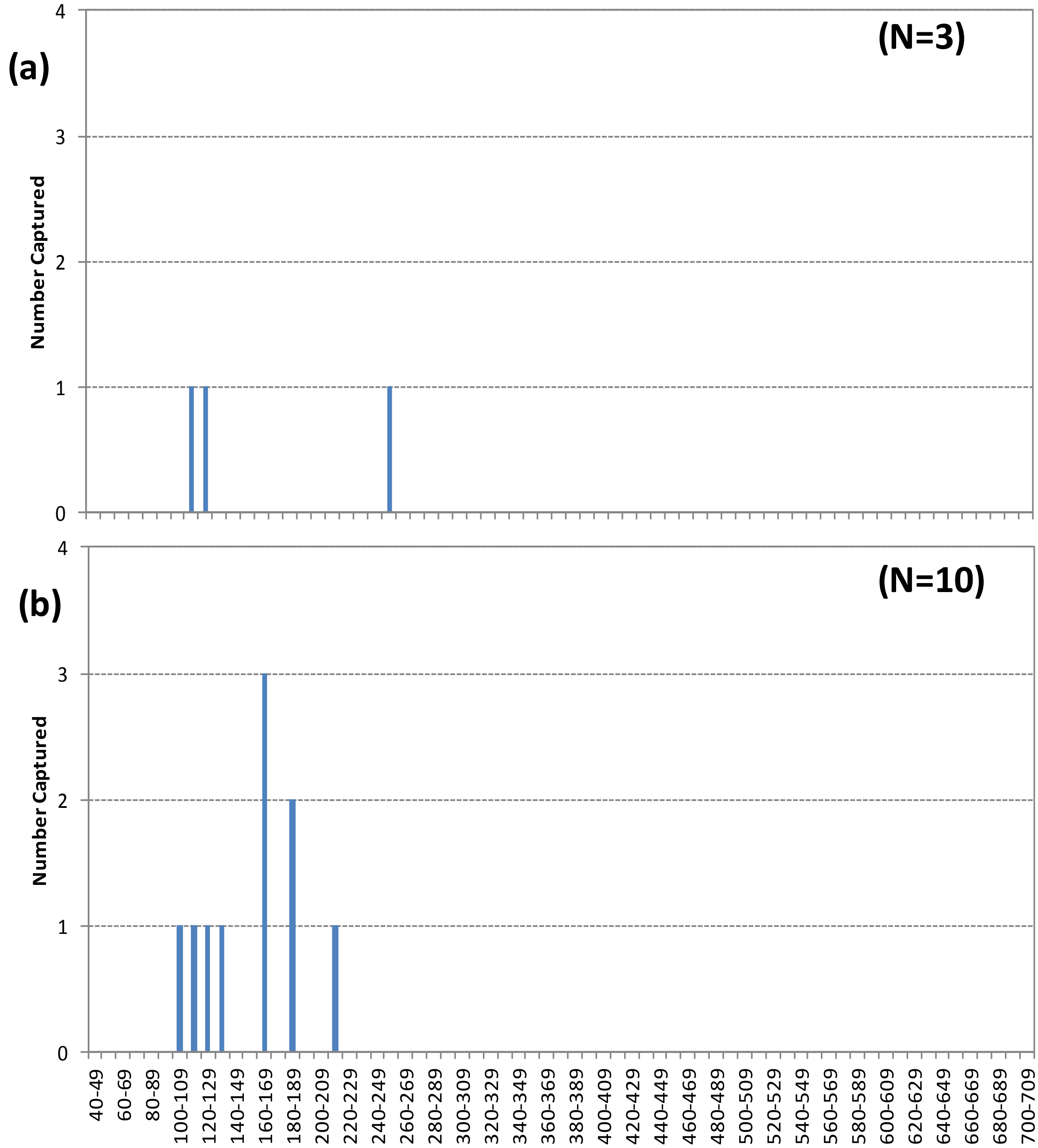


Figure 60: WY2014 Salsipuedes Creek trap length-frequency in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

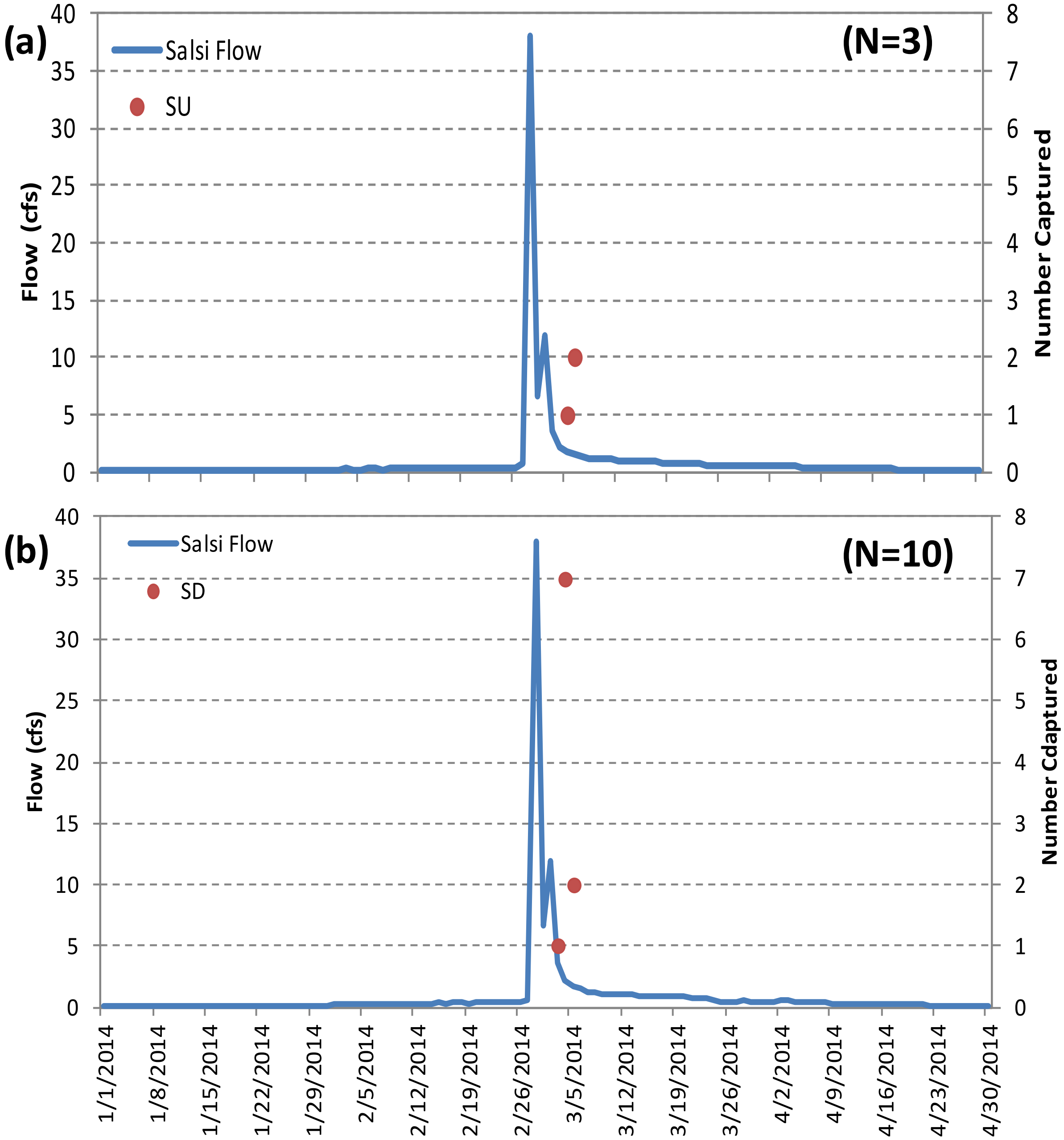


Figure 61: WY2014 Salsipuedes Creek migrant captures (red dots) vs. flow for (a) upstream and (b) downstream migrants.

Table 9: WY2014 Catch Per Unit Effort (CPUE) for each trapping location.

Location	Upstream Captures	Downstream Captures	Functional Trap Days	Trap Season	Trapping Effeciency	CPUE Upstream	CPUE Downstream	CPUE (Total)	Avg Flow	Median Flow
	(#)	(#)	(days)	(days)	(%)	(Captures/day)	(Captures/day)	(Captures/day)	(cfs)	(cfs)
Hilton UP	46	~	61	70	87%	0.75	~	0.75	3.7	3.8
Hilton DN	~	78	27	34	79%	~	2.89	2.89	3.7	3.8
Salsipuedes	3	10	10	10	100%	0.30	1.00	1.30	0.9	0.3
Mainstem	0	0	7	7	100%	0.00	0.00	0.00	6.0	4.7

Table 10: Tributary upstream and downstream migrant captures for Hilton Creek and Salsipuedes Creek in WY2014. Blue lettering represents breakdown of smolts, pre-smolts, and resident trout for each size category; there were 46 and 10 smolts and pre-smolts observed at the Hilton and Salsipuedes traps respectively.

Hilton Captures (#)		Size (mm)		Salsipuedes Captures (#)
		Upstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
0		550-599		0
0		500-549		0
0		450-499		0
1		400-449		0
24		300-399		0
12		200-299		1
9		100-199		2
0		<99		0
46		**Total**		**3**
		Downstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
0		550-599		0
0		500-549		0
0		450-499		0
1		400-449		0
5		300-399		0
6		200-299		1
	1	*Smolts*	*1*	
	1	*Pre-Smolt*	*0*	
	4	*Res*	*0*	
64		100-199		9
	16	*Smolts*	*3*	
	27	*Pre-Smolt*	*6*	
	21	*Res*	*0*	
2		<99		0
	0	*Smolts*	*0*	
	1	*Pre-Smolt*	*0*	
	1	*Res*	*0*	
78		**Total**		**10**

Table 11: WY2014 tributary redd survey results; lengths and widths are given in feet and Salsipuedes Creek watershed includes Upper Salsipuedes, El Jaro, Ytias, and Los Amoles creeks.

2014 Redd Surveys				
Location	Date	Redd#	*Length	**Width
Tributary Redds				
Hilton Creek	1/14/2014	1	1.7	0.5
	1/14/2014	2	2.1	0.7
	1/14/2014	3	4.3	1.8
	1/14/2014	4	1.7	1.1
	2/4/2014	5	2.9	1.7
	2/6/2014	6	3.1	1.6
	2/6/2014	7	3	1.2
	2/4/2014	8	4.5	2.3
	2/26/2014	9	3.3	1.4
	2/26/2014	10	2.7	1.0
	2/26/2014	11	2.4	1.2
	3/9/2014	12	6.9	2.7
	3/9/2014	13	3.1	1.5
	3/9/2014	14	2.6	0.9
	3/9/2014	15	2.9	1.1
	4/3/2014	16	5.6	1.8
	4/3/2014	17	2.1	1.0
	2/24/2014	1	2.1	0.7
	2/24/2014	2	4.3	1.8
*= pit length plus tail spill length				
**=average of all width measurement				

Table 12: WY2014 tributary redd observations by month and location.

2014 Tributaries					
	January	February	March	April	Total
Hilton	4	7	4	2	17
Quiota	0	0	n/s	n/s	0
Salsipuedes	0	2	n/s	n/s	2
El Jaro	0	0	n/s	n/s	0
Los Amoles	0	0	n/s	n/s	0
Ytias	0	0	n/s	n/s	0
Total:	4	9	4	2	19
n/s=not surveyed-impossible spawning conditions due to drought					

Table 13: WY2014 LSYR mainstem redd survey results within the management reaches (Highway 154, Refugio and Alisal reaches).

2014 Mainstem					
	January	**February**	**March**	**April**	**Total**
Hwy 154	0	0	0	0	0
Refugio	n/s	n/s	n/s	n/s	n/s
Alisal	n/s	n/s	n/s	n/s	n/s
Total:	0	0	0	0	0
n/s=not surveyed-impossible spawning conditions due to drought					

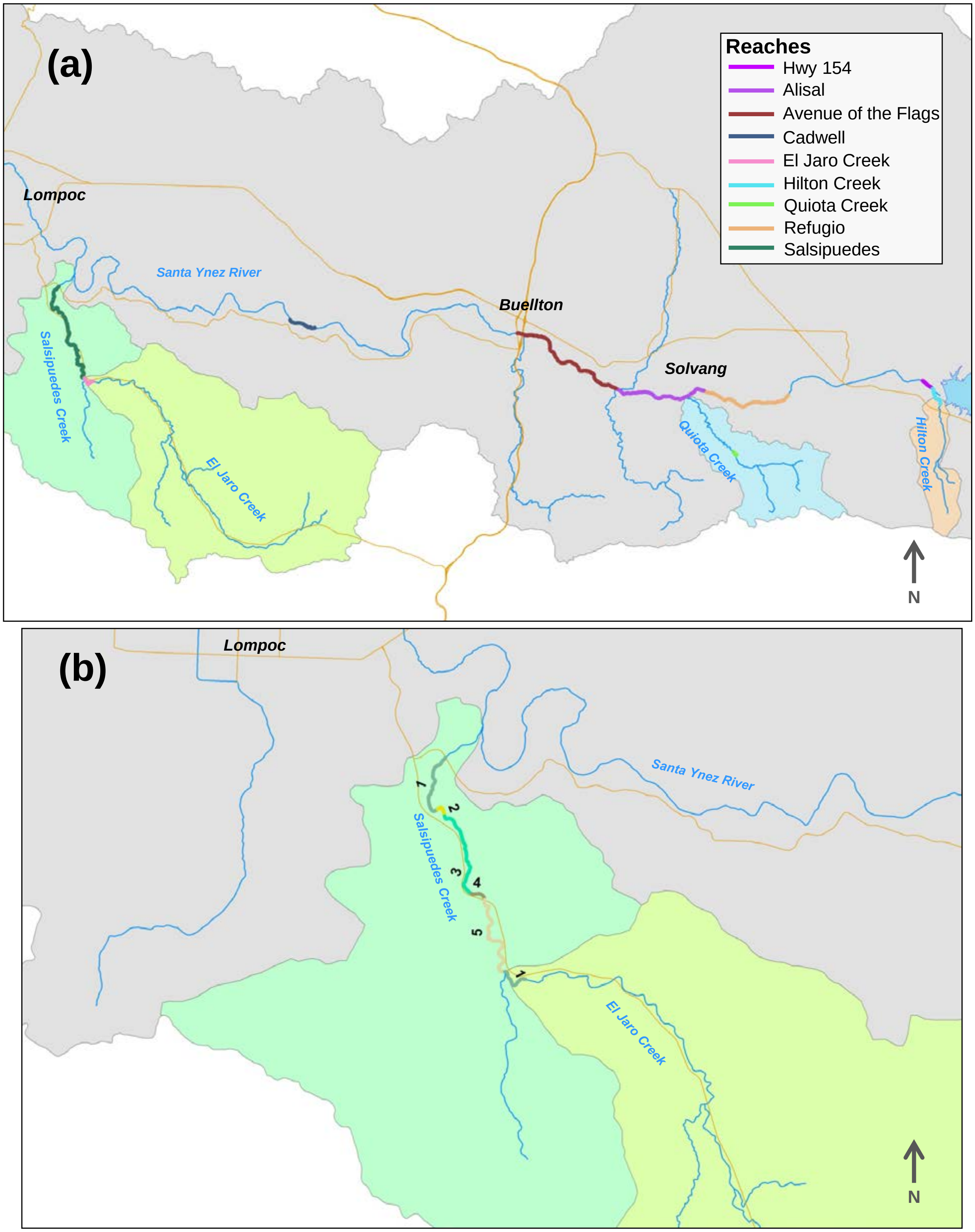


Figure 62: Stream reaches snorkel surveyed in WY2014 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

Table 14: 2014 LSYR mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	7/9/2014
(LSYR-0.2 to LSYR-0.7)	Summer	8/14/2014
	Fall	11/25/2014
Refugio Reach	Spring	7/23/14 - 7/24/14
(LSYR-4.9 to LSYR-7.8)	Summer	10/14/14 - 10/15/14
	Fall	11/11/14 - 11/13/14
Alisal Reach	Spring	7/23/14 - 7/24/14
(LSYR-7.8 to LSYR-10.5)	Summer	10/15/14 - 10/16/14
	Fall	11/13/14 - 11/25/14
Avenue Reach	Spring	7/29/2014
(LSYR-10.5 to LSYR-13.9)	Summer	10/16/14 - 10/29/14
	Fall	11/10/14 - 11/18/14

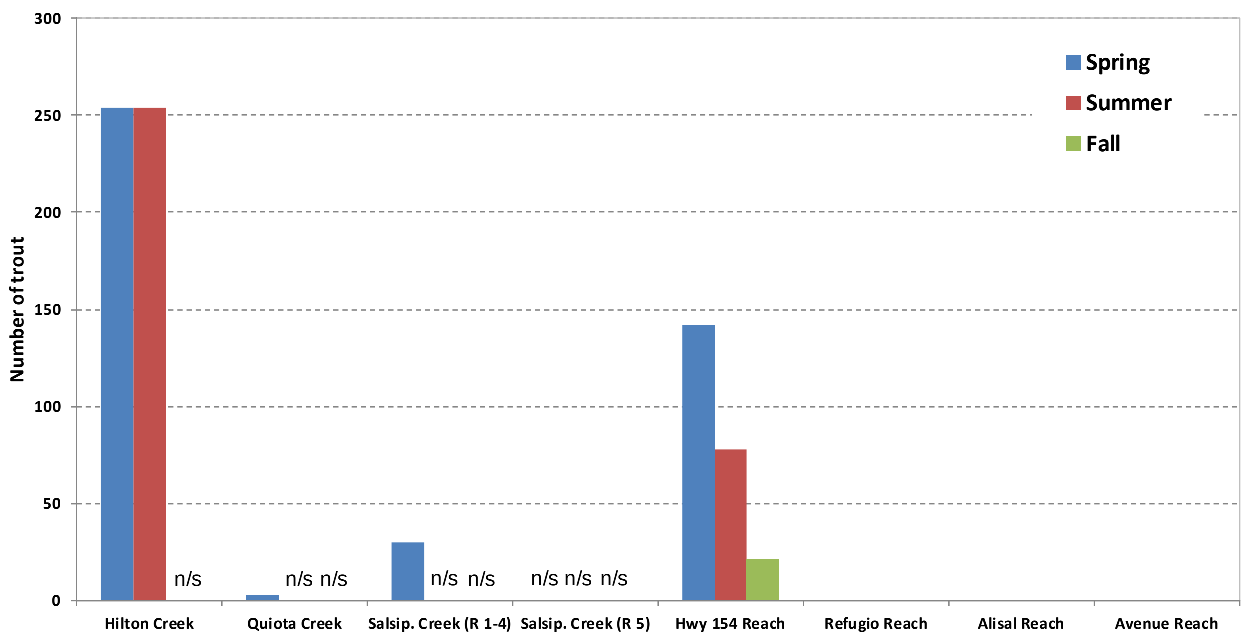


Figure 63: WY2014 LSYR steelhead/rainbow trout observed during spring, summer and fall snorkel surveys; other reaches were not surveyed (n/s – no survey, turbid or dry conditions).

Table 15: LSYR mainstem spring, summer, and fall snorkel survey results in 2014 with the miles surveyed; the level of effort was the same for each snorkel survey.

Mainstem	Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hwy 154 Reach	142	78	21	0.26
Refugio Reach	0	0	0	2.95
Alisal Reach	0	0	0	2.80
Avenue Reach	0	0	0	3.4

Table 16: LSYR mainstem spring, summer, and fall snorkel survey results in 2014 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	90	30	14	8						142
	Refugio										0
	Alisal										0
	Avenue										0
Summer	Hwy 154	15	52	2	9						78
	Refugio										0
	Alisal										0
	Avenue										0
Fall	Hwy 154		14	7							21
	Refugio										0
	Alisal										0
	Avenue										0

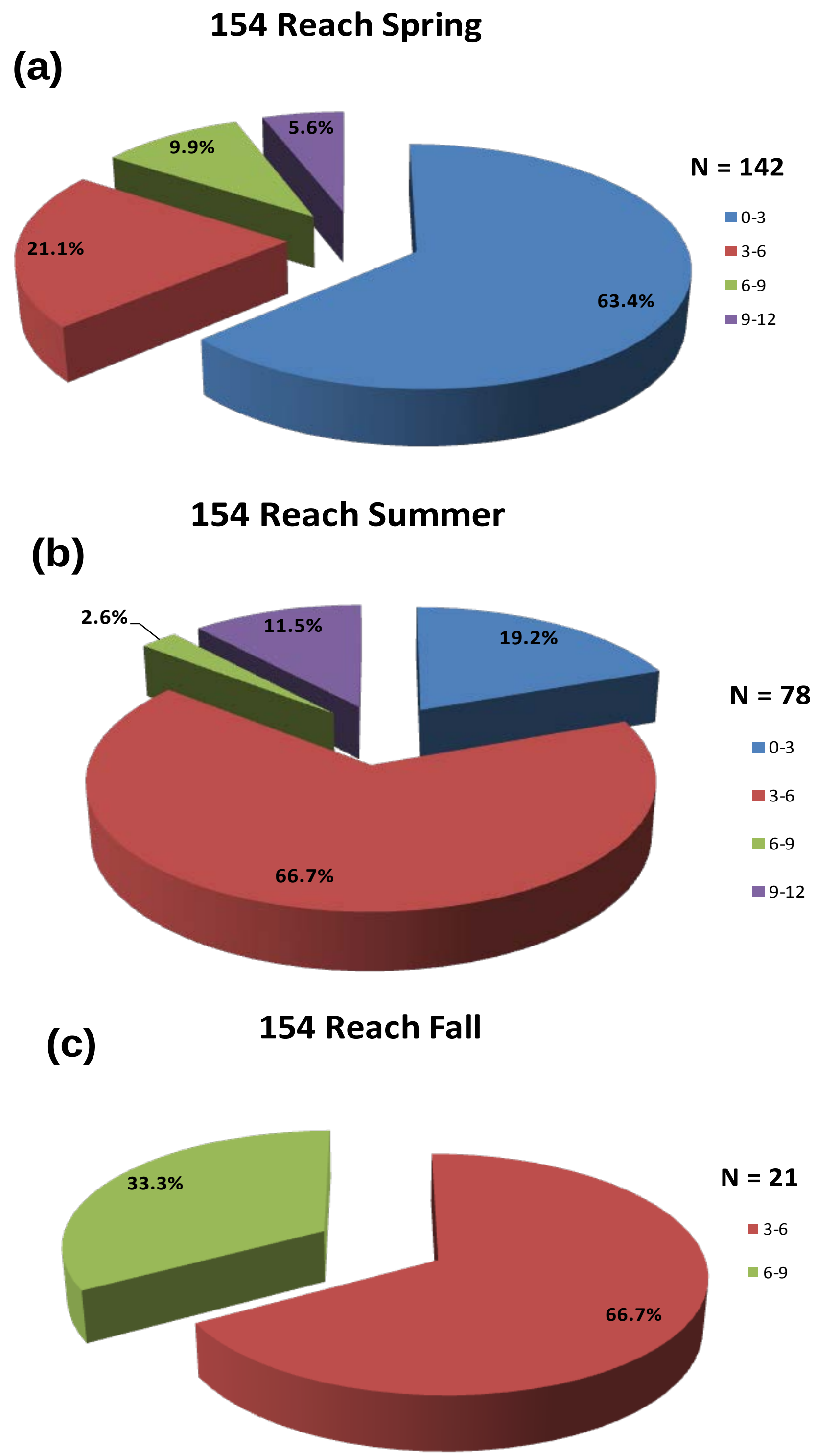


Figure 64: 2014 Hwy 154 Reach fall snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

Table 17: 2014 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	7/10/2014
(HC-0.0 to HC-0.54)	Summer	9/15/2014
	Fall	n/s*
Quiota Creek	Spring	7/9/2014
(QC-2.58 to QC-2.73)	Summer	n/s
	Fall	n/s
Salsipuedes Creek	Spring	7/7/2014
(Reach 1-4)	Summer	n/s
	Fall	n/s
Salsipuedes Creek	Spring	n/s
(Reach 5)	Summer	n/s
	Fall	n/s
El Jaro Creek	Spring	n/s
(ELC-0.0 to ELC-0.4)	Summer	n/s
	Fall	n/s
*n/s = no survey, turbid or dry conditions.		
*Lake turnover and low lake elevation caused poor visibility.		

Table 18: WY2014 *O. mykiss* observed and miles surveyed during all tributary snorkel surveys; the level of effort was the same for each survey.

Tributaries	Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hilton Creek				
Reach 1	38	33	n/a	0.133
Reach 2	52	66	n/a	0.050
Reach 3	25	27	n/a	0.040
Reach 4	127	112	n/a	0.075
Reach 5	12	16	n/a	0.242
Reach 6	0	0	n/a	0.014
Total:	***254***	***254***	***n/a****	***0.554***
Quiota Creek	3	n/a	n/a	0.11
Salsipuedes Creek (Reach 1-4)	30	n/a	n/a	2.85
Salsipuedes Creek (Reach 5)	n/a	n/a	n/a	0.45
El Jaro Creek	n/a	n/a	n/a	0.35

n/a = no survey, turbid conditions

*Lake turnover and low lake elevation caused poor visibility

Table 19: WY2014 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	38	52	25	127	12					254
	Quiota	3									3
	Salsipuedes (R 1-4)	5	6	13	5	1					30
	Salsipuedes (R-5)	n/a									
	El Jaro	n/a									
Summer	Hilton	33	66	27	112	16					254
	Quiota	n/a									
	Salsipuedes (R 1-4)	n/a									
	Salsipuedes (R-5)	n/a									
	El Jaro	n/a									
Fall	Hilton	n/a*									
	Quiota	n/a									
	Salsipuedes (R 1-4)	n/a									
	Salsipuedes (R-5)	n/a									
	El Jaro	n/a									

n/a = no survey, turbid conditions or dry

* Lake turnover and low lake elevation caused poor visibility

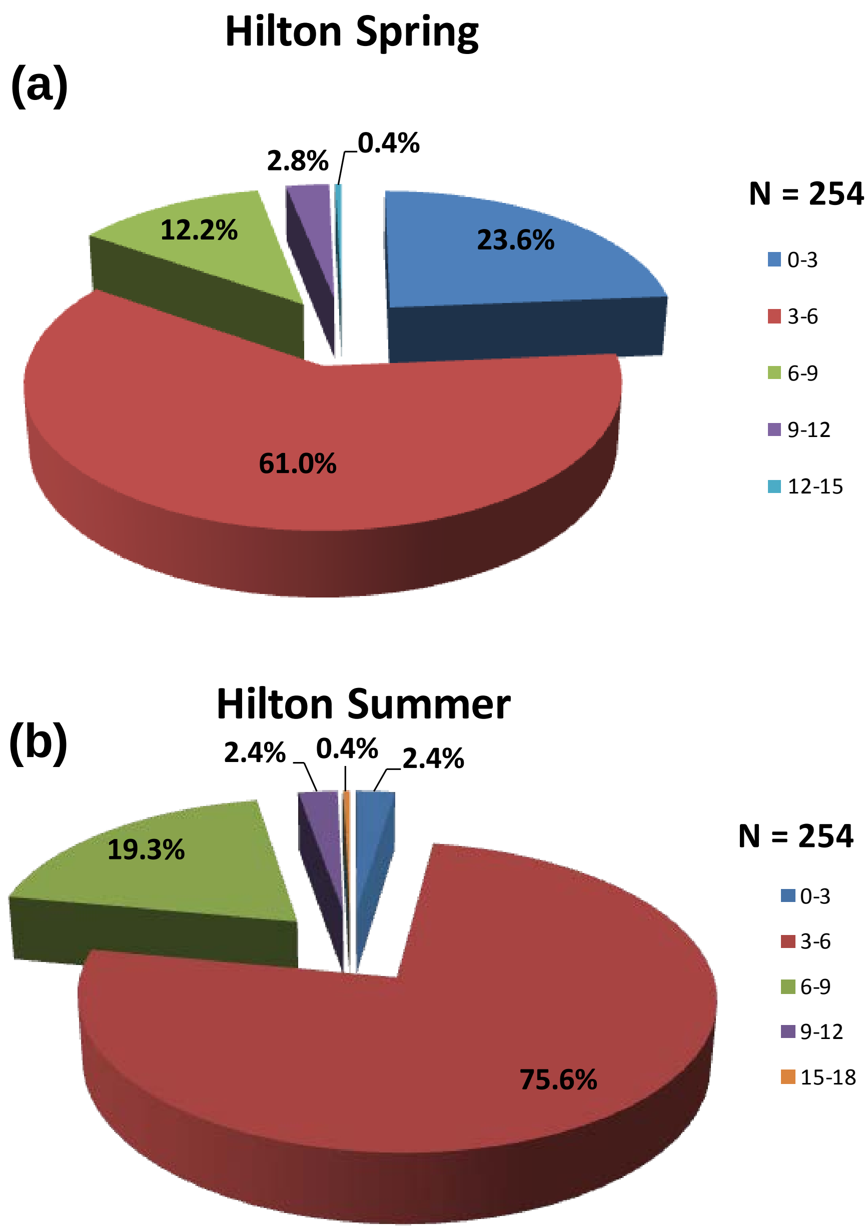


Figure 65: 2014 Hilton Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, and (b) summer.

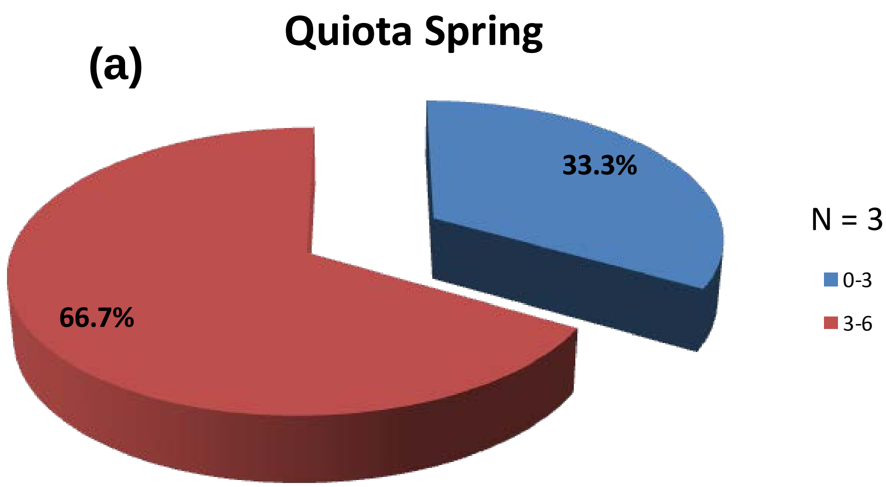


Figure 66: 2014 Quiota Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring.

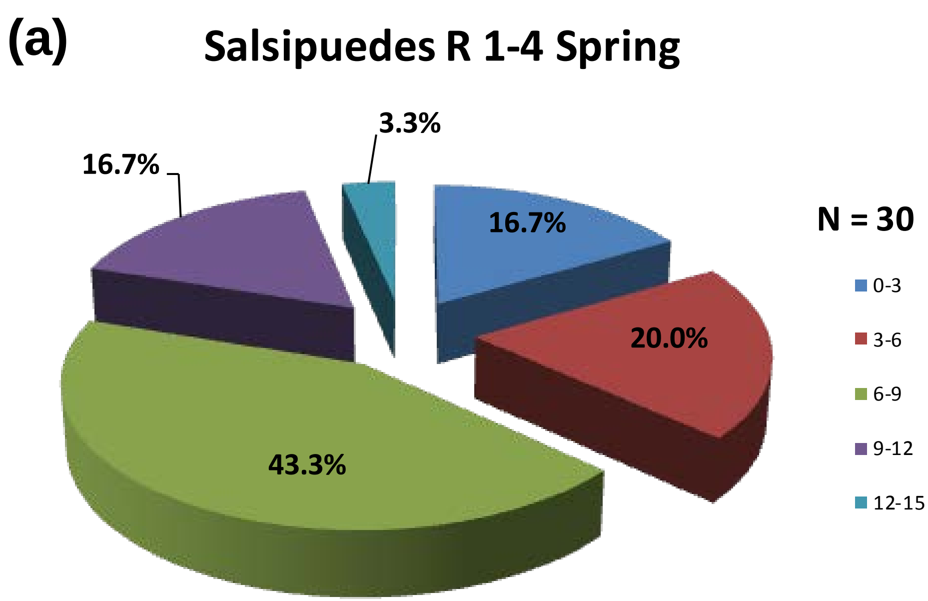
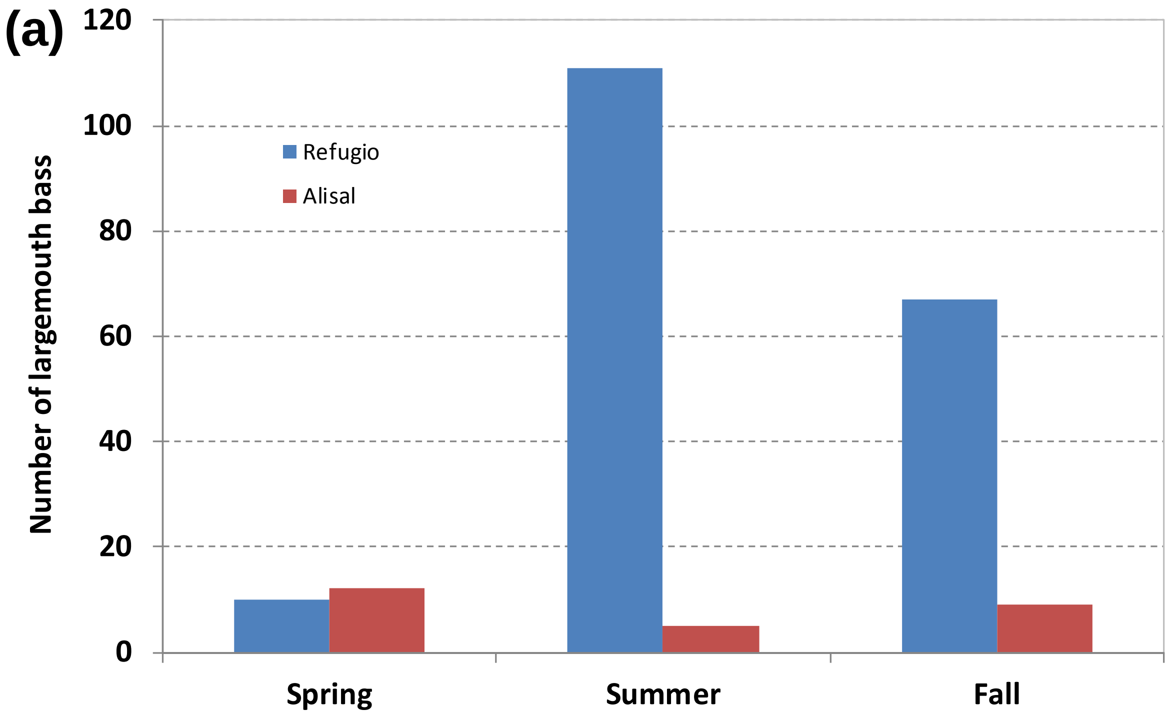


Figure 67: 2014 Salsipuedes Creek reaches 1-4 snorkel survey with size classes (range) of fish observed in inches; (a) spring.



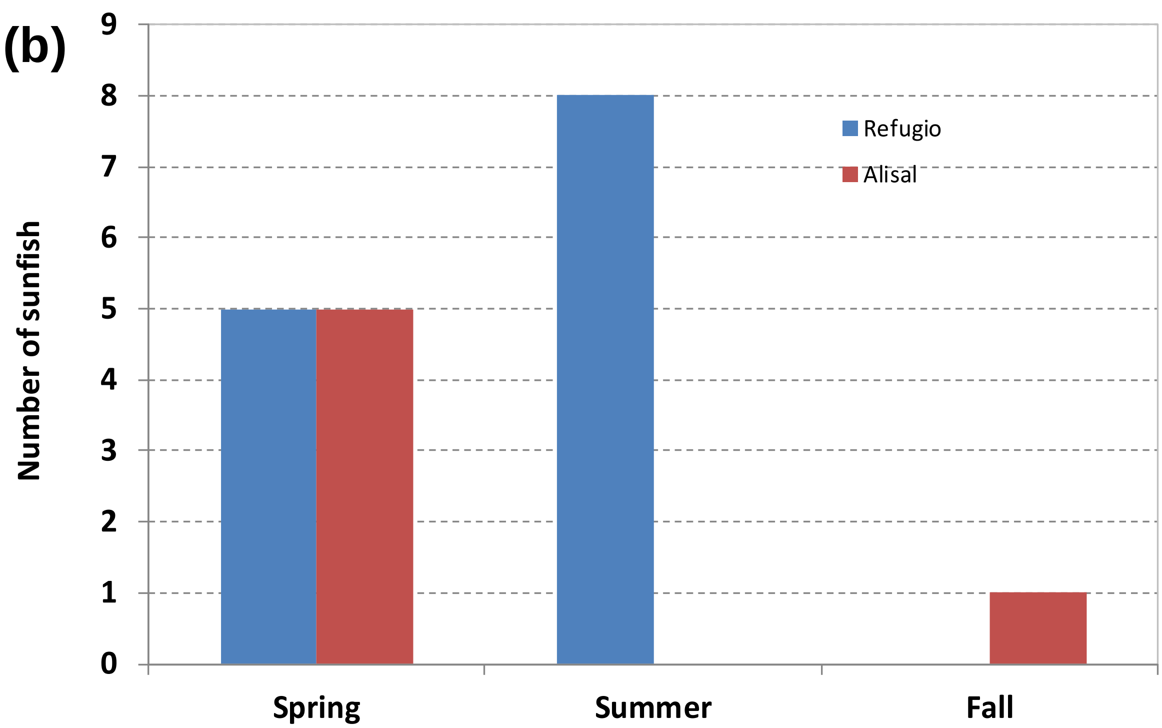


Figure 68: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2014 within the Refugio and Alisal reaches: (a) largemouth bass and (b) sunfish.

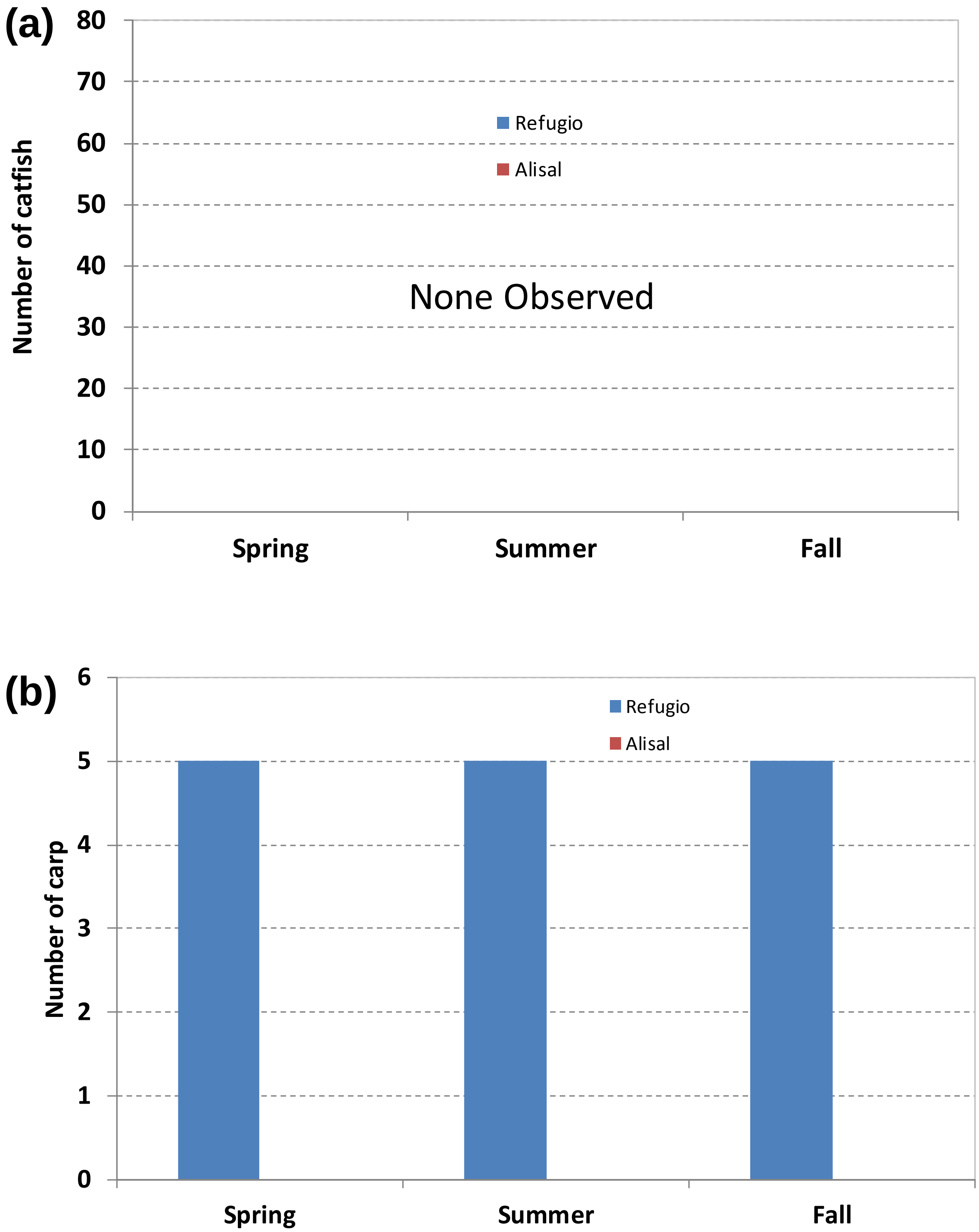


Figure 69: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2014 within the Refugio and Alisal reaches: (a) catfish, and (b) carp.

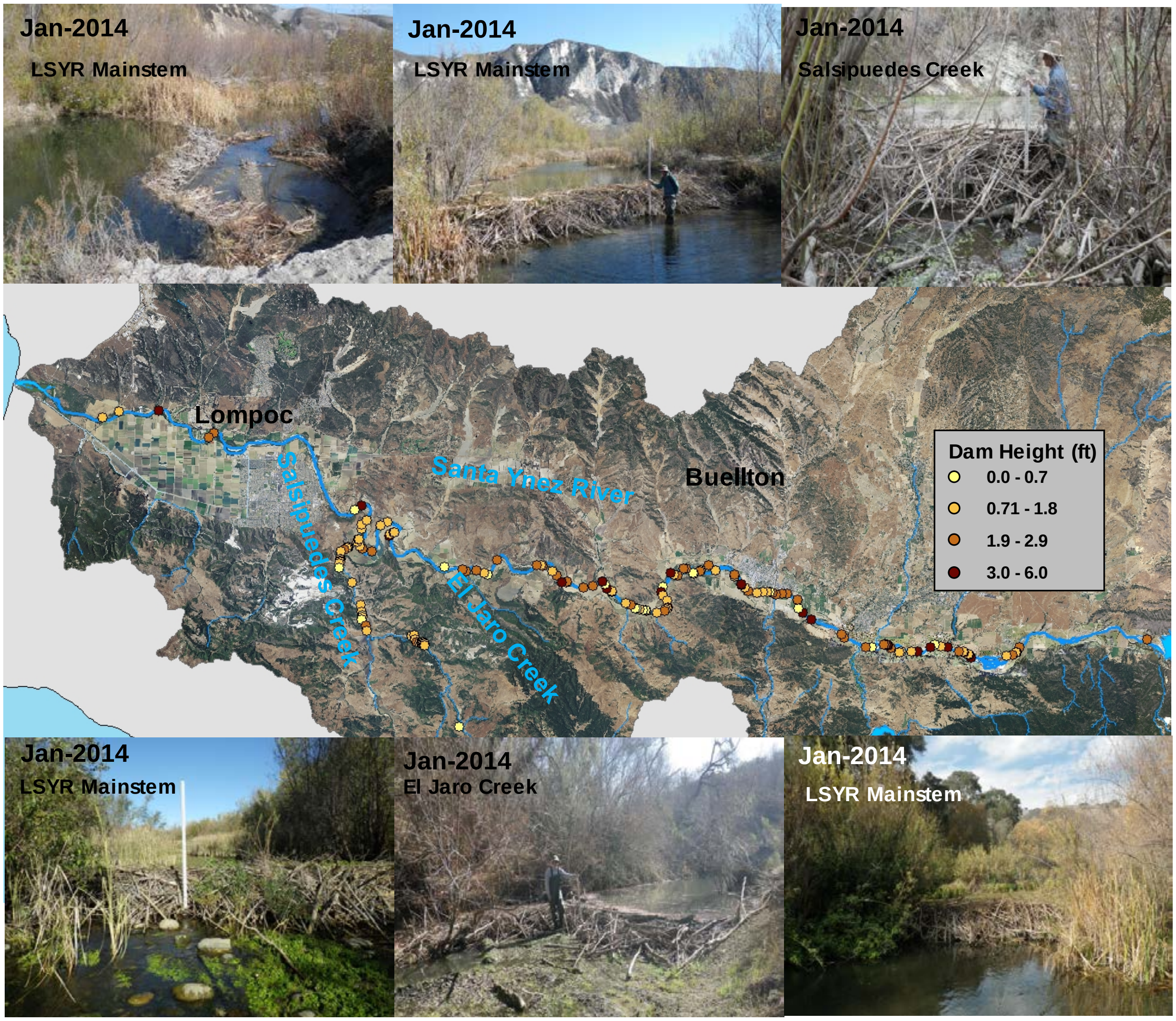


Figure 70: Spatial extent of beaver dams from the WY2014 survey within the LSYR drainage where 76 dams were observed in the mainstem and 14 observed in the Salsipuedes Creek watershed.

Table 20: WY2010-WY2014 beaver dams in the LSYR mainstem and Salsipuedes/El Jaro Creek broken out by height.

	Mainstem Beaver Dams						Tributary Beaver Dams					
Height Year	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
WY2010	3	65	40	17	3	128	0	17	5	3	0	25
WY2011	5	34	31	10	2	82	3	1	1	0	0	5
WY2012*	9	38	23	4	0	74	5	6	3	0	0	14
WY2013	23	75	27	7	0	132	8	23	4	0	0	35
WY2014	21	48	36	15	1	121	10	24	2	0	0	36

* There are 76 mainstem beaver dams in 2012, two were not measured.

WY2014 Annual Monitoring Report
Discussion
Figures and Tables

4. Discussion

Table 21: Monthly rainfall totals at Bradbury Dam from WY2000-WY2014.

Month	Water Years:														
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
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	0.34
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	1.14
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	0.18
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	0.02
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	4.11
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	3.52
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	0.65
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	0
Jun	0.04	0	0	0.02	0	0.04	0	0	0	0.16	0	0.34	0	0	0
Jul	0	0.06	0	0.01	0	0	0	0	0	0	0	0.00	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0.03	0	0.00	0	0	0
Sept	0	0	0.08	0	0	0.03	0	0.17	0	0.08	0	0.00	0.18	0	0
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***	***9.96***

Table 22: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2014.

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	
	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
Nov	5.8	0.996	7.36	8.54	5.8	0	1.6	0	6.94	12.8	8.33	11.1
Dec	7.74	9.98	6.61	13.2	7.01	1.02	6.9	0	53.1	203.3	7.91	14.6
Jan	9.37	15.3	265	496.3	6.14	5.11	73	184	27.6	85.8	7.97	16.9
Feb	10.4	18.6	401.1	490.1	17.7	33.4	72	181	24	100.3	7.46	14.1
Mar	8.82	10.7	93.9	158.4	12.1	18.6	26	68	1441	1267	6.01	11.7
Apr	4.52	1.43	8.46	18.9	4.39	5.23	35	51	321.5	422	8.82	14.7
May	1.47	0.475	6.3	6.77	5.05	0.648	6.1	13	39	70.8	5.56	5.53
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
Jul	35.8	1.39	7.09	0.42	3.51	0	0.4	0.5	9.28	10.7	4.58	0.033
Aug	55.2	30.8	3.68	0.069	3.72	0	53	22	7.8	3.05	4.88	0
Sep	31	23.4	3.76	0	4.08	0	30	19	8.5	2.22	6.60	0

Month	WY2013		WY2014	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	4.5	0	42.6	28.8
Nov	2.7	0	22.7	17.1
Dec	5.8	0	8.9	8.1
Jan	6.3	0	4.3	2.2
Feb	6	3.6	6	3.6
Mar	4.8	4.5	10.6	12.3
Apr	1.7	0.54	3	1.8
May	0	0	0	0
Jun	0	0	0	0
Jul	51	3	0	0
Aug	59.1	27	0	0
Sep	47.9	28	2.7	0

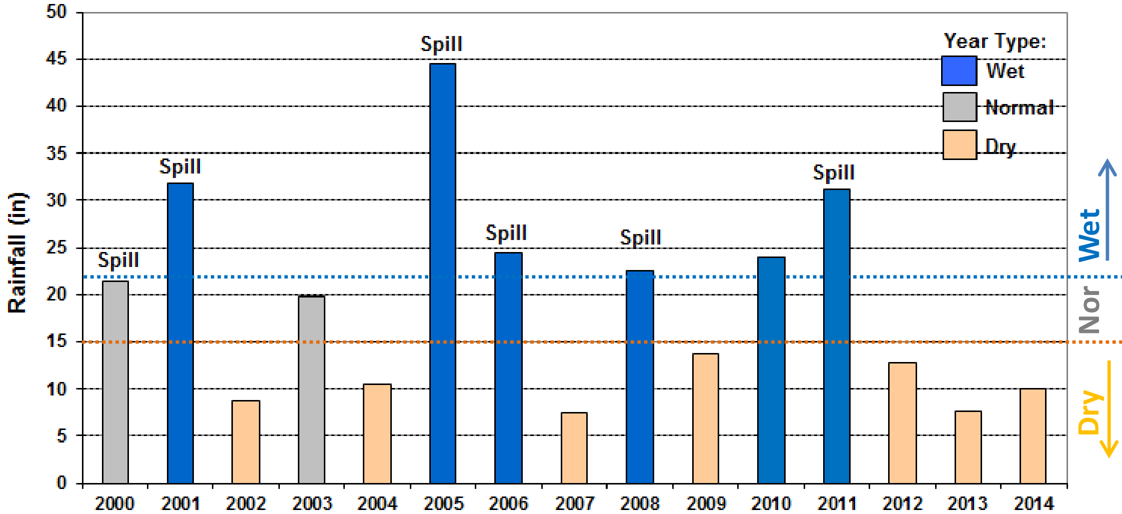


Figure 71: Water year type (wet, normal and dry) and spill years since the issuance of the BiOp in 2000. Year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 23: 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 December 2016)
Hwy 1 Bridge on Salispuedes Creek	2001	Completed (2002)
Cross Creek Ranch on El Jaro Creek	2005	Completed (2009)
Hwy 101 Culvert on Nojoqui Creek	2005	Proposed removal from BiOp[1]
Quiota Creek Crossing 1	2003	Completed (2013)
Quiota Creek Crossing 3	2003	Completed (2015)
Quiota Creek Crossing 4	2003	Completed (2016)
Quiota Creek Crossing 5	2003	In design[2]
Quiota Creek Crossing 7	2003	Completed (2012)
Quiota Creek Crossing 9	2003	In design[2]
Cascade Chute Passage on Hilton Creek	2000	Completed (2005)
Hwy 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 24: 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 December 2016)
Jalama Road Bridge on Salsipuedes Creek	Completed (2004)
San Julian Ranch on El Jaro Creek	Completed (2008)
Quiota Creek Crossing 0A	Completed (2016)
Quiota Creek Crossing 0B	In design
Quiota Creek Crossing 2	Completed (2011)
Quiota Creek Crossing 6	Completed (2008)
Quiota Creek Crossing 8	In design[2]
Total:	**7**
Projects completed:	***5***
Projects remaining:	***2***
1. Grant funding has been secured.	
2. Grants have been submitted for funding.	

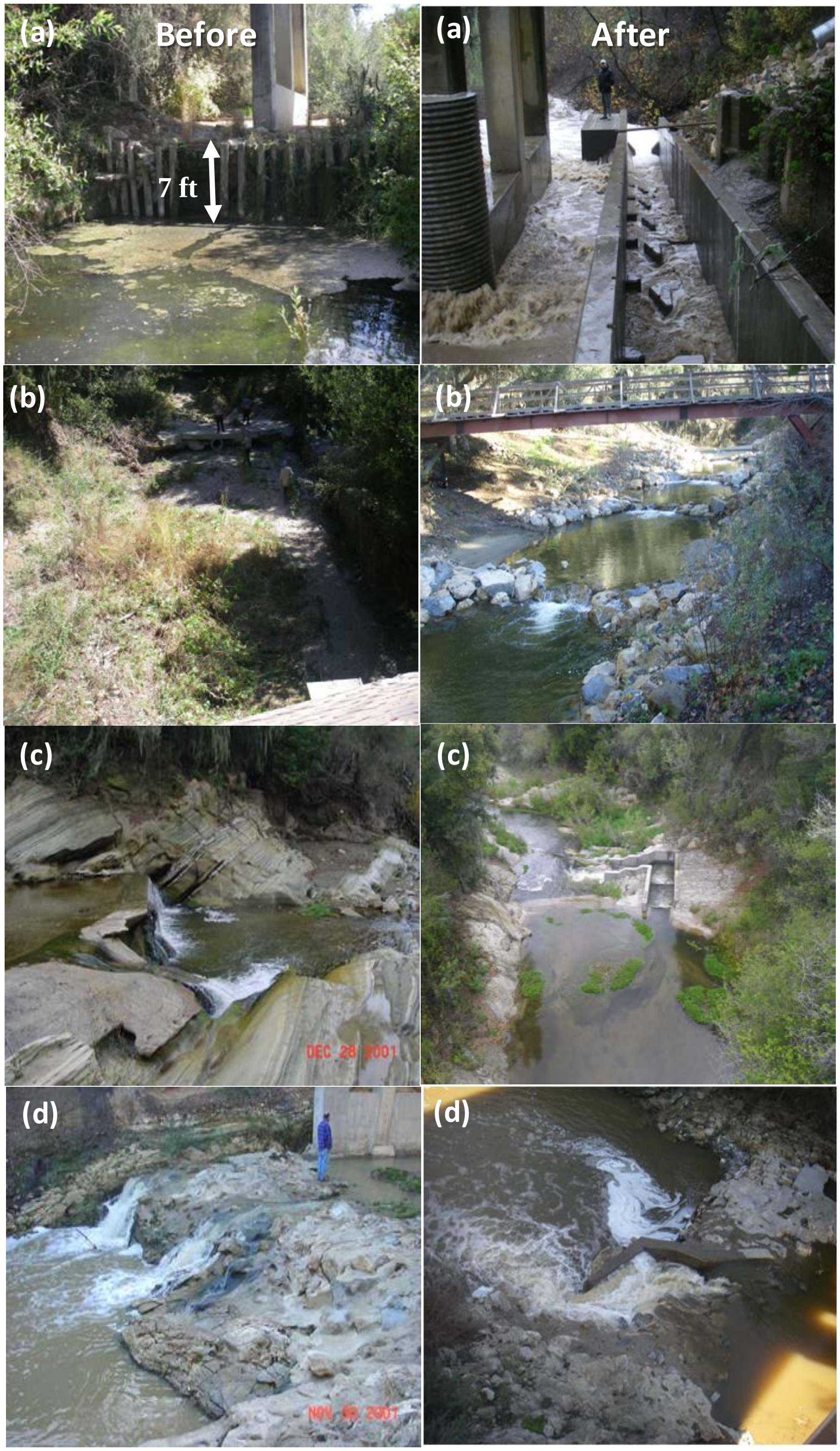


Figure 72: Fish passage and habitat restoration at: at (a) Rancho San Julian Bridge on El Jaro Creek (2008), (b) Cross Creek Ranch on El Jaro Creek (2009), (c) Jalama Road Bridge on Salsipuedes Creek (2004), and (d) Highway 1 Bridge on Salsipuedes Creek (2002).

Figure 73: Fish passage and habitat restoration at a) Quiota Creek Crossing 6 (2008), (b) Quiota Creek Crossing 2 (2011), (c) Quiota Creek Crossing 7 (2013), and (d) Quiota Creek Crossing 1 (2014).

Figure 74: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

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 have been transferred to Excel, outliers and anomalous data are easily seen when put into graphical form.

Sonde data that have been transferred to a field pc (650 MDS) are then downloaded to an EcoWatch program. The data are then exported into Microsoft Excel. Once the data have 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 have been transferred, the material is converted to a CSV file and then exported to Microsoft Excel. Once the data have 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 are 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.

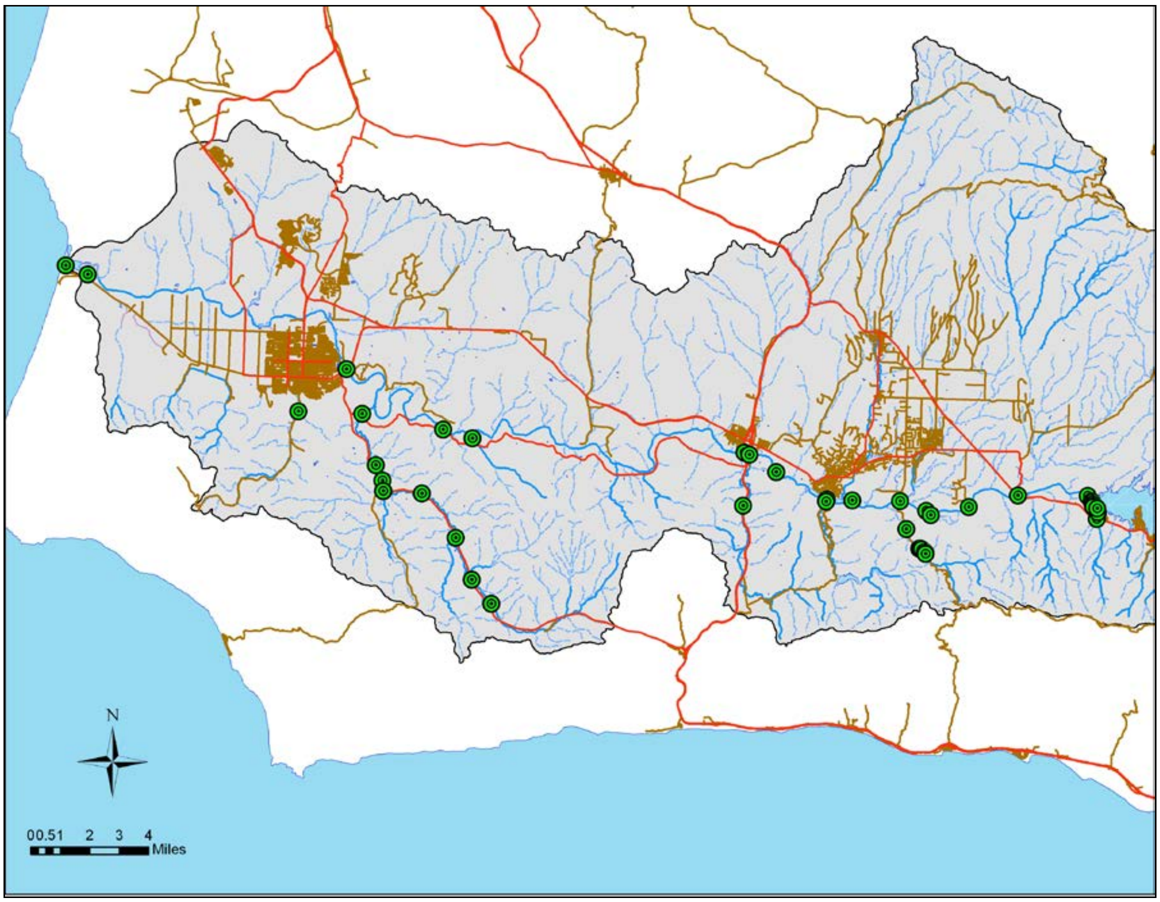


Figure C-1: WY2014 photo point locations.

Table C-1: WY2014 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	4/25	5/6
M1	Lower Hilton Creek, photo d/s at ford crossing		
M2a	Bluffs overlooking long pool, photo u/s		
M2b	Bluffs overlooking long pool, photo d/s		
M3	Highway 154 culvert on Hilton Creek, photo u/s	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	X	
M7	Meadowlark crossing, photo u/s		X
M8	Meadowlark crossing, photo d/s		X
M9	Lower Gainey crossing, beaver dam, photo u/s		X
M10	Lower Gainey crossing, beaver dam, photo d/s		X
M11a	Lower Gainey crossing, photo u/s		X
M11b	Lower Gainey crossing, photo d/s		X
M12	Refugio Bridge, photo u/s		X
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		
M18	Mid-Alisal Reach, photo d/s		
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
M29	LSYR Lagoon upper reach, photo d/s		
M30	LSYR Lagoon upper reach, photo u/s		
M31	Slick Gardener X-ing, looking across towards hwy		
M32	Slick Gardener X-ing, looking d/s		
M33	Slick Gardener X-ing, looking u/s		

Table C-2: WY2014 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	4/25	5/6
T1	Hilton trap site, photo u/s	X	
T2	Hilton trap site, photo d/s		
T3	Hilton at ridge trail, photo d/s		
T4	Hilton at ridge trail, photo u/s		
T5	Hilton at telephone pole, photo d/s		
T6	Hilton at telephone pole, photo u/s	X	
T7	Hilton at tail of spawning pool, photo u/s	X	
T8	Hilton impediment/tributary, photo d/s	X	
T9	Hilton impediment/tributary, photo u/s	X	
T10	Hilton just u/s of URP, photo d/s	X	
T11	Hilton road above URP, photo d/s		
T12	Hilton road above URP, photo u/s		
T14	Hilton from hard rock toe, photo d/s		
T15	Hilton from hard rock toe, photo u/s		
T16	Quiota Creek at 5th crossing, photo d/s		X
T17	Quiota Creek at 5th crossing, photo u/s		X
T18	Quiota Creek at 6th crossing, photo d/s		X
T19	Quiota Creek at 6th crossing, photo u/s		X
T20	Quiota Creek at 7th crossing, photo d/s		X
T21	Quiota Creek at 7th crossing, photo u/s		X
T22	Quiota Creek below 1st crossing, photo d/s		X
T23	Alisal Creek from Alisal Bridge, photo u/s		X
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		
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s		
T27	Nojoqui/LSYR confluence, photo u/s		
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s		X
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s		X
T39	Salsipuedes Creek at Hwy 1 Bridge, photo d/s		X
T40	Salsipuedes Creek at Hwy 1 Bridge, photo u/s		X
T41	Salsipuedes Creek at Jalama Bridge, photo d/s		X
T42	Salsipuedes Creek at Jalama Bridge, photo u/s		X
T43	El Jaro/Upper Salsipuedes confluence, photo u/s		
T44	Upper Salsipuedes/El Jaro confluence, photo u/s		
T45	Upper Salsipuedes/El Jaro confluence, photo d/s		
T48	El Jaro Creek above El Jaro confluence, photo u/s		
T49	El Jaro Creek above El Jaro confluence, photo d/s		
T52	Ytias Creek Bridge, photo d/s		X
T53	Ytias Creek Bridge, photo u/s		X
T54	El Jaro Creek 1st Hwy 1 Bridge, photo d/s		X
T55	El Jaro Creek 1st Hwy 1 Bridge, photo u/s		X
T56	El Jaro Creek 2nd Hwy 1 Bridge, photo d/s		X
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s		X
T58	El Jaro Creek 3rd Hwy 1 Bridge, photo d/s		X
T59	El Jaro Creek 3rd Hwy 1 Bridge, photo u/s		X
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		
T63	Rancho San Julian Bridge, photo u/s		

D. List of Supplemental Reports Created During WY2014

- 2012 Annual Monitoring Summary with Trend Analyses (COMB, 2016).
- 2013 Annual Monitoring Report with Trend Analysis (COMB, 2017).
- Quiota Creek Crossing 1 End of Project Report (COMB, 2014).
- CDFW-FRGP Grant Proposal for Quiota Creek Crossing 3 Project
- 2014 WR 89-18 Release Study Plan.
- WY2014 Migrant Trapping Plan.
- HC Incident Reports (10/25/13, 3/1/14, 3/11/14, 3/26/14, and 5/25/14)

E. References

COMB, 2014. End of Project Compliance Report, Fish Passage Improvement on Crossing 1, Quiota Creek. Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2016. 2012 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, 2017. 2013 Annual Monitoring Report and Trend Analysis. Prepared for the Bureau of Reclamation and the National Marine Fisheries Service, Cachuma Operation and Maintenance Board (COMB), Fisheries Division.