WY2015 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


Lake Cachuma at approximately 40% capacity

Prepared by:

CACHUMA OPERATION AND MAINTENANCE BOARD

FISHERIES DIVISION

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

OCTOBER 19, 2018

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Executive Summary

The WY2015 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 2015 (WY2015, 10/1/14 – 9/30/15). This 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 WY2015 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).

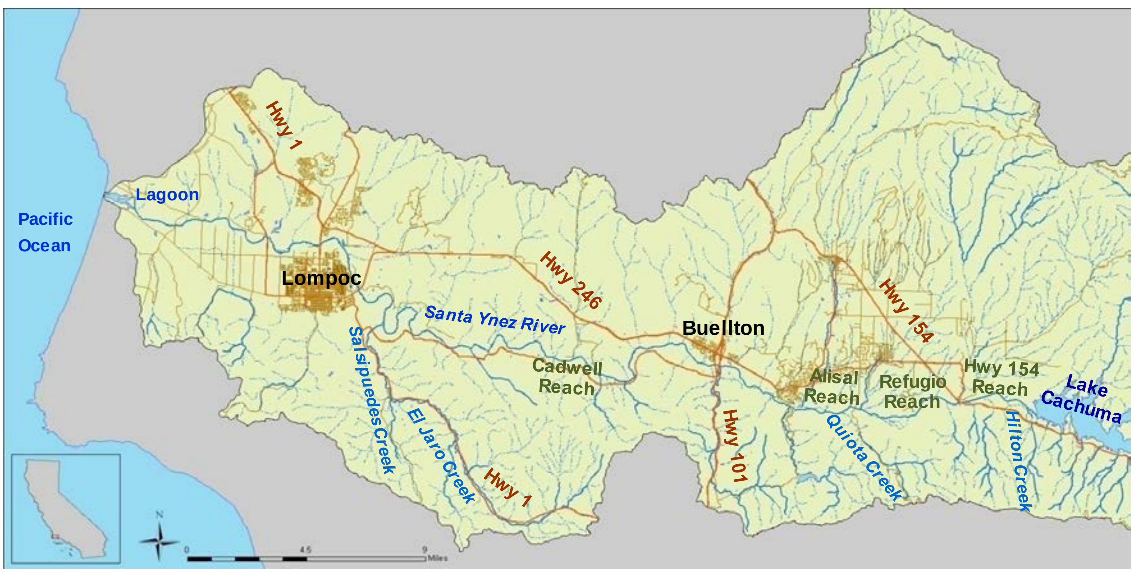

Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean west of Lompoc, showing tributary creeks and management reaches of interest for the LSYR Fisheries Monitoring Program.

This report summarizes data gathered since the WY2014 Annual Monitoring Summary (COMB, 2018) and fulfills the annual 2015 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 (USBR or 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 WY2015, some deviations to the monitoring program as described in the BiOp (NMFS, 2000), Biological Assessment (BA) (USBR, 2000), LSYR Fish Management Plan (FMP) (SYRTAC, 2000) and 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. A shortened version of this report, the WY2015 Annual Monitoring Report (AMR) is prepared by COMB-FD and provided by Reclamation to NMFS for compliance reporting established in the 2000 BiOp.

This 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.

WY2015 was a dry year (9.38 inches of precipitation measured at Bradbury Dam; long-term average, 1953-2015, is 20.04 inches) with the majority of the rainfall occurring in December. This was the sixth 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 WY2015 (3.43 inches of rain) occurred on 12/12/14. 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 fourth year after a spill (WY2011) and reservoir storage was less than 120,000 acre-feet (af) at the beginning of the water year (61,107 af on 10/1/14), 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 were not met. A Water Rights (WR) 89-18 release was conducted from 8/3/15 until 9/25/15 during which 10,603 af was released over a period of 54 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 10/22/14, 10/29/14, 12/11/14, 1/14/15, and 4/4/15. The cumulative total of *O. mykiss* rescues and mortalities was 2 and 0, 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 temperature is 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 HCWS and Cascade Chute Project in Hilton Creek) and was successful in acquiring grant funding for these projects from state and federal programs. These funds were supplemented by funding from the Cachuma Member Units which allowed for the construction of 9 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 3 was successfully completed in WY2015. The Cattle Exclusionary Fencing on Lower Salsipuedes Creek Project was completed in June of 2014 and reported here for the first time. Plans have moved forward for the completion of another fish passage project on Quiota Creek for Crossing 4 to be built in WR2016.

The following are recommendations of COMB-FD to improve the monitoring program within the parameters of the BiOp 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 Dual-Frequency Identification Sonar (DIDSON) in Salsipuedes Creek;
- Continue annual development and implementation of a Migrant Trapping Plan in collaboration with Reclamation 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 (during migrant trapping, fish rescue, and stranding surveys) specifically in habitats known to support *O. mykiss* and non-native fish;
- Encourage Reclamation to improve the reliability of their HCWS and HCEBS to deliver water and provide continuous flow to Hilton Creek without interruption;
- Collaborate with Reclamation regarding Critical Drought Conditions (i.e., flow adjustments to Hilton Creek and the LYSR mainstem, target flows, etc.) 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 within the LSYR mainstem and its tributaries 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;
- Continue to maintain the LSYR *O. mykiss* scale inventory and conduct analyses of growth rates, evidence of life-history strategies such as fresh versus marine water rearing, signs of spawning, etc. in support of ongoing fisheries investigations;
- Continue working with the US Geological Survey, specifically at all LSYR basin gauges, to obtain accurate real-time measurements and to identify appropriate transect locations for stage-discharge relationships.
- Develop a more fluid data recording and reporting procedure with regard to temperature probes on the Outlet Works of Bradbury Dam in order to keep track of the temperature of the water being released into 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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from 4/15/15 – 8/13/15 (the entire period of record); this unit was isolated (no inflow or outflow) and was essentially dry starting on 8/13/15.

WY2015 Annual Monitoring Report

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 WY2015 Annual Monitoring Summary (AMS) is to present the monitoring data collected in Water Year 2015 (WY2015, 10/1/14-9/30/15) 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 WY2015 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 variations 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), the WY2013 Annual Monitoring Summary (COMB, 2017), and the WY2014 Annual Monitoring Summary (COMB, 2018).

The data summarized in this report describe the habitat conditions and the fishery observations in the LSYR during WY2015. 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).

WY2015 was classified as a dry year with only 9.38 inches of precipitation recorded at Bradbury Dam (long-term average, 1953-2015, is 20.04 inches; sixth 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 8 of 15 years classified as dry (WY2007, WY2013, WY2002, WY2015, 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 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 result in an increase in resident *O. mykiss* reproduction due to limited stormflow events capable of washing out redds.

Migrant trapping was conducted in WY2015 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 to Hilton Creek from the Hilton Creek Watering System (HCWS) (10/22/14, 10/29/14, 12/11/14, 1/14/15, and 4/4/15) that resulted in relocating 2 *O. mykiss* with no mortalities. 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, CPBS), 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 six Annual Monitoring Reports/Summaries completed for 2009 (USBR, 2012), 2010 (USBR, 2013), 2011 (COMB, 2013), 2012 (COMB, 2016), 2013 (COMB, 2017), and 2014 (COMB, 2018). 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 storms of winter. Hence, review of the meteorological and hydrological conditions for each year is essential for the analysis and interpretation of the fisheries data collected during that year.

2.3. Watershed Condition for Southern California Steelhead

Southern California Steelhead and Rainbow Trout require cool water in order to spawn, rear, and survive the dry season and specifically hot summers below Bradbury Dam.

They require clean, well-oxygenated water during all life stages, especially for redd ventilation and during metabolically expensive activities such as upstream migration. In general, Southern California steelhead/rainbow trout appear adapted to average water temperatures below 20°C and dissolved oxygen (DO) concentrations within 10-7 mg/L. Historically, *O. mykiss* residing within the Santa Ynez River and associated tributaries had access to cooler headwaters throughout the watershed. After the construction of Bradbury dam in 1953, approximately half of the watershed was inaccessible to anadromous fish. Although it appears Southern California Steelhead can tolerate higher temperatures than steelhead residing further north, there are still stressful (sub-lethal) and lethal effects to individuals caught in pools above tolerable thresholds. Stressful and lethal stream temperatures and dissolved oxygen (DO) concentration limits for southern steelhead are not well defined. Most studies were conducted on *O. mykiss* from the north and in different hydrologic conditions. A literature review suggests a stream water temperature of 20°C is stressful, 24°C is severely stressful and 29°C is lethal, and DO concentrations at 5 mg/L is stressful and 3 mg/L is lethal for *O. mykiss* (Matthews and Berg, 1997; DeVries, 2013a; DeVries, 2013b). Observations of the *O. mykiss* population within the LSYR basin suggest these limits may not hold true in this area as LSYR basin fish are found in places with higher stream temperatures and lower DO concentrations. The thresholds are dependent upon life-stage, exposure time, and access to cool-water refugia.

2.4. 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 WY2015 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; an above 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/S reports, the SWRCB approach will not be used in this report, although the designation would have been a critically dry year at 4,006.7 af of computed inflow to Lake Cachuma.

WY2015 had 9.38 inches of rainfall at Bradbury Dam and was therefore classified as a dry year (less than 15 inches) (Table 1). The long-term average (1953-2015) at the dam was 20.04 inches. Very little runoff occurred within the LSYR mainstem and tributaries in WY2015, and the mainstem flow from the dam downstream was insufficient to connect with the LSYR lagoon. There were no days with recorded flow at H Street throughout the water year hence there was no mainstem connectivity to the lagoon and the berm to the ocean was not breached. Upstream migration opportunities from the lagoon or the ocean were non-existent due to low rainfall and limited stream runoff. In Salsipuedes Creek, the highest recorded flow at the USGS station at Jalama Bridge in WY2015 was 90.4 cfs, on 12/17/14. Historic minimum, maximum, and WY2015 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 12 precipitation events in WY2015 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). Only 9.38 inches of rain was recorded at Bradbury Dam in WY2015, with over half (5.88 inches) of the total recorded in December. No other month during the water year totaled over 1 inch of rainfall (Table 3). The necessary triggers to implement a passage supplementation event were not met in WY2015. In addition, a WR 89-18 Water Rights release was conducted during the summer and fall period from 8/3/15 to 9/25/15.

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 WY2015. To note, the Hilton Creek gauge (USGS-11125600) is a low flow gauge only (less than 50 cfs). The WR 89-18 release is easily seen in the figure.

Peak daily discharge recorded by the USGS at the Narrows on the LSYR mainstem and Salsipuedes gauges occurred on 9/23/15 at 6.81 cfs (peak WR 89-18 releases) and 12/17/14 at 5.57 cfs (storm flow), respectively. Peak daily discharge at the Solvang gauge of the LSYR mainstem was 129 cfs on 8/19/15 (peak WR 89-18 releases). It was dry most of the water year at the USGS Los Laureles gauge except in April with peak daily flows less than 5 cfs. The Hilton Creek Gauge (USGS-11125600), a low flow (less than 50 cfs) gauge only, recorded only one stormflow event from the upper basin associated with the 12/16/14 storm. The peak release from Bradbury Dam was approximately 156 cfs on 8/9/15 during the onset of the 2015 WR 89-18 Release. 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 oversummering 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 WY2015. This was the third year in a row with no connectivity to the ocean (Table 4). There was only one significant storm in the region throughout WY2015 (12/12/14) which occurred early in the wet season when the watershed was not saturated hence did not produce much runoff. 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 WY2015 were not consecutive and too small to produce significant runoff, resulting in rain which mostly soaked into the ground. For example, no storm in WY2015 produced any runoff at the Narrows or H Street Bridge USGS gauging stations.

Passage supplementation: There were no passage supplementation events in WY2015 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 was one Adaptive Management Committee (AMC) meeting during WY2015. Topics discussed were flow releases, water quality conditions, interruptions of flow to Hilton Creek, repairs of the HCWS, operation 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 (AMA).

Target flows: There were no spills from Bradbury Dam in WY2015, and reservoir storage remained under 120,000 AF, so long-term BiOp established target flows were 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 WY2015 except during the interruption of flow events at Hilton Creek (Figure 3).

Water Rights Releases: Water Rights releases are non-discretionary releases called for by the Santa Ynez River Water Conservation District (downstream Water Rights holders) as described in WR Order 89-18 (WR 89-18). In WY2015, these releases began on 8/3/15 and ended on 9/25/15, with a total release amount of 10,603 af over 54 days (Figure 2). This was an Above Narrows Account (ANA) release that reached just downstream of the Narrows gage near Lompoc. Monitoring for fish movement and water quality was conducted by the COMB-FD staff as described in BiOp RPM 6 and called for in the 2015 Study Plan (monitoring plan for WR 89-18 releases). 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 2015 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 water 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). SWP water can be delivered to Lake Cachuma through a by-pass system that eliminates having to use the penstock. The criterion was met for RPM 5.1 throughout WY2015 (Figures 4). 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 approximately May through November to track conditions for oversummering *O. mykiss*. The critical parameters for salmonid survival, water temperature and dissolved oxygen (DO) concentrations (only in the lake), were recorded. Additional water parameters were also monitored (i.e., specific conductance, Total Dissolved Solids, pH, and salinity) but not reported.

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 (Moyle, 2002). They can compensate for thermal conditions behaviorally by adjusting activity rates and metabolic demand in adverse thermal conditions (Nielson et al., 1994). Stream water temperatures are presented below for the LSYR mainstem and selected tributaries as well as lake water temperatures and DO concentrations.

Stream water temperatures were collected at various locations within the LSYR mainstem and its 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) (Figure 5). Since 1995, a thermograph network has been deployed in the LSYR 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). When presented, 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. 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. Several monitoring locations were added at the beginning of WY2013 to increase the understanding of the thermal regime in various LSYR mainstem and tributary habitats as it relates to fish assemblages.

Water temperature: During WY2015, 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 (Table 5). 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. 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). 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) 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 document 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 23 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 (2));

- 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, there were 11 monitoring sites, 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).
- 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).
- Los Amoles Creek – Tributary to El Jaro (LAC, 1 site):
  - LAC-Los Amoles Creek (LAC-7.0).

Again, all stream temperature monitoring locations are presented in Figure 5 with their deployment period and type in Table 5 and the observed fish species in each habitat in Table 6 for the LSYR mainstem and tributaries.

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

Stilling Basin (LSYR-0.20)

A 2-unit tower array was deployed at the tail out of the Stilling Basin from 7/2/15 through 11/3/15. The Stilling Basin is the largest habitat on the LSYR and measures approximately 866 feet long from the spillway to the downstream riffle crest, is approximately 482 feet wide at its midpoint, and is approximately 36 feet deep when at full capacity. The array was deployed near the tail out of the habitat in water depths that ranged from approximately 2.5 feet to 7.5 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 and more chance of mixing. 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.

Surface (Figure 6) and bottom (Figure 7) thermographs closely mimicked each other during the entire deployment period showing approximately a 2 °C stratification prior to the initiation of WR 89-18 releases which resulted in unithermal conditions. The upper lens of the Stilling Basin water temperatures exceeded 28°C at the surface unit with slightly cooler temperatures recorded at the bottom unit before WR 89-18 releases.

Water temperatures remained high until the onset of the WR 89-19 releases when temperatures abruptly decreased to less than 18°C immediately following the release. Temperatures remained cool and began to gradually warm once the releases stopped.

This habitat contained multiple non-native aquatic species that were observed 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 4/1/15 through 11/3/15 (Figure 8). Of note is the recorded drop in water temperature upon arrival and end of the WR 89-18 release and a heat wave experienced in mid-October that was also observed in the Stilling Basin. 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 HCEBS [Hilton Creek Emergency Backup System} installed in the winter 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 (the HCEBS comes from the bottom of the lake through the Outlet Works). 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 4/15/15 and removed on 11/3/15 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 carp [*Cyprinus carpio*]) that limit *O. mykiss* colonization due to predation and degradation of water quality. This conclusion is based on visual observations of the 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 observed in both the Stilling Basin and Long Pool 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, particularly during the onset of the WR 89-18 release when water temperatures increased approximately 2-3°C with thermally heated surface Stilling Basin water which was then replaced with cooler dam released waters (Figures 9-11). In addition, expected seasonal warming and cooling was observed throughout the year. With a few brief exceptions in July and early August, maximum surface water temperatures remained less than 24°C. After the WR 89-18 release, surface water temperatures remained less than 20°C for the remainder of the deployment with gradual warming of the surface waters as release flows were decreased.

Water temperatures recorded at the middle and bottom units were nearly identical, with the bottom being slightly cooler (Figures 10-11). The heated lens of surface water from the Stilling Basin did influence both the middle and bottom units in the Long Pool as flows progressed downstream. After the WR 89-19 release, a nearly 2°C (middle unit) and 3.5°C (bottom unit) brief increase in water temperatures was noted in association with warm weather in October.

Diel fluctuations of around 3-4°C were recorded at the surface unit and generally remained between 2-3°C until the beginning of October when diel fluctuations decreased to 2°C or less. Diel fluctuations at the middle and bottom units ranged from 1-2°C.

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 4/1/15 to 11/3/15 and recorded similar though slightly cooler temperatures (daily and hourly) compared to the Long Pool surface thermograph (Figure 12). After the start of WR 89-18 releases, water temperatures rapidly cooled and remained less than 20°C for several weeks during the higher volume releases. Water temperatures began to gradually warm as the WR 89-18 releases were decreased. Maximum temperatures generally were greater than 22°C prior to the WR 89-18 releases and were generally below that temperature after the WR 89-18 releases following a similar pattern to what was recorded within the Long Pool upstream. *O. mykiss* were observed during routine snorkel surveys in this habitat.

Encantado Pool (LSYR-4.95)

When full, the Encantado Pool is approximately 400 feet long, averaged 30-feet wide, and has a maximum depth of 7 feet. In the absence of target flows in the spring of WY2015, the Encantado Pool had diminished in size, lost residual pool depth and dried out. A vertical array was deployed on 9/10/15 and removed on 11/3/15 to monitor the WR 89-18 downstream release (Figures 13-15). Overall, the habitat was dry for most of the year. The Water Rights releases ended on 9/25/15 and the surface unit became dewatered due to diminishing water levels by 9/30/15. The entire habitat then dried out later that fall and the instruments were removed. One largemouth bass was found dead in that habitat once it dried out. Overall, surface water temperatures reached a maximum of just over 24°C at the end of September before the surface unit became dewatered and was removed. Water temperatures at the middle and bottom essentially mimicked each other. Maximum middle and bottom temperatures were less than 24°C during the remaining deployment. Diel variation was approximately 4°C across all 3 units. No *O. mykiss* inhabited this habitat unit in WY2015.

Double Canopy Pool (LSYR-7.65)

The Double Canopy Pool is located directly upstream of the Refugio Bridge. The pool is approximately 350 feet long, 40 feet wide, and 4.5 feet deep at its deepest point when the habitat is full. A vertical array was deployed from 9/10/15 to 11/3/15. Unlike the majority of the other mainstem monitoring locations, which were dry prior to WR 89-18 releases, this location was wetted though not maintaining residual pool depth. Surface and middle water temperatures were nearly identical and were slightly warmer compared to the bottom unit (Figures 16-18). Maximum surface, middle, and bottom water temperatures exceeded 24°C immediately following the arrival of WR 89-18 release water and steadily declined thereafter. Diel variations were greatest following the arrival of the water release front and generally remained from less than 1.0°C to nearly 4.0°C throughout the water column. Diel variation was slightly cooler on the bottom. 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 Santa Ynez River. The habitat is approximately 730 feet long, 50 feet wide, and 7.1 feet at the deepest point while residual pool depth is being maintained. A vertical array was deployed at this habitat on 9/10/15 to monitor WR 89-18 downstream releases and removed on 11/3/15. In the absence of target flows, the Head of Beaver Pool began to diminish in size, losing residual pool depth and drying out in the spring of WY2015. Water temperatures were only recorded during and after the WR 89-18 releases (Figures 19-21). The warmest water temperatures were recorded at the top and coolest at the bottom of the water column and diminished going into the fall. The water temperatures throughout the water column were similar. The surface unit was removed several weeks early due to being exposed to air as the habitat diminished following the end of the WR 89-18 releases. Minimum water temperatures essentially remained less than 20.5°C during the deployment period. Diel variation was greatest during September. Overall, diel variation ranged from 1.0°C to 4.0°C after arrival of the flow front. No *O. mykiss* were observed in this habitat but sunfish were present during the end of September.

Alisal Bedrock Pool (LSYR-10.2)

The Alisal Bedrock Pool is a corner scour pool habitat approximately 60 feet long and 40 feet wide with a maximum depth of 9 feet when full. A vertical array was deployed on 9/16/15 and removed on 11/3/15. The array was positioned where in past years rearing *O. mykiss* have been observed. Monitoring results showed nearly uni-thermal conditions between the middle and bottom of the water column during the entire deployment with surface temperatures slightly higher (Figures 22-24). Maximum temperatures at the surface approached 24.5°C with the arrival of the downstream Water Rights releases then cooled thereafter. At the beginning of October, the surface unit was tampered with most likely by the public. Overall, temperatures quickly declined to less than 21°C at the middle and bottom units in October. Daily variations generally ranged from less than 1°C to nearly 4°C. In WY2015, no *O. mykiss* were observed in this habitat prior to it drying out before WR 89-18 water reached the site. Non-native fish species were observed in this habitat during and after WR 89-18 releases.

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 9/10/15 through 11/3/15. The unit was deployed approximately 0.5 feet above the bottom of the habitat in the deepest part of the pool. The habitat was approximately 65 feet long and 20 feet wide at its widest point with a maximum depth of approximately 4 feet. The thermograph was deployed following the arrival of the WR 89-18 flow front due to the river corridor being dry prior. Water temperatures were greatest while water was flowing through the site, showing maximum temperatures greater than 25°C for several days (Figure 25). Once the downstream releases were stopped, the water temperatures quickly cooled down to less than 20°C and remained that way for the remainder of the deployment period. Diel variations while the habitat retained flowing stream water remained within approximately 3.5°C. No *O. mykiss* were observed in this habitat.

Cadwell Pool (LSYR-22.68)

A vertical array was deployed from 9/10/15 through 11/3/15 at the deepest point in the habitat (12 feet). The pool when full is approximately 490 feet long and 32 feet wide at the maximum point. A vertical array was deployed at this site (Figures 26-28). This habitat has supported *O. mykiss* in the past but due to the ongoing drought, lack of flow, and deteriorating water quality conditions, there were no *O. mykiss* observed in this habitat in WY2015, only carp. Maximum surface temperatures were just less than 26°C with gradual seasonal cooling observed as the year progressed. Minimum surface water temperatures remained greater than 20°C during September before decreasing to less than 20°C in October. The middle and bottom units were slightly cooler compared to the surface. Diel variations were fairly similar throughout the water column during the deployment, with September having the greatest variation of 3.0°C to 3.5°C, particularly at the surface.

LSYR Mainstem Longitudinal Comparisons

Longitudinal LSYR mainstem (maximum daily) water temperature at the surface thermographs for LSYR-0.51, LSYR-4.95, LSYR-7.65, LSYR-8.7, LSYR-10.2, LSYR-13.9, and LSYR-22.68 are presented in Figure 29. 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 presentation of each specific habitat, see above.

WY2015 was the fourth consecutive dry year and drought symptoms were observed throughout the LSYR mainstem and its tributaries. Because of the low reservoir elevation, rearing target flows were only available through the HCWS which delivered approximately 3.0 to 3.5 cfs of water to the creek and was the only source of water flowing into the LSYR mainstem that wetted less than 3.2 miles of the mainstem river (Highway 154 Reach). Most habitats contracted as flows diminished. Unlike previous years, water did not resurface at downstream locations as it had in the past. Much of the mainstem dried completely. Most of the mainstem surface units of 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 or disconnected. Notable exceptions were the monitoring locations immediately downstream of Bradbury (LSYR-0.20, 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. The drying of habitats made longitudinal comparison problematic. Extensive riparian vegetation died off due to the ongoing drought as observed within the Refugio, Alisal, and Avenue reaches in WY2015.

Factors influencing surface water temperatures along the longitudinal profile presented in Figure 29 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 any released waters moving downstream that can cause elevated temperatures usually over a short period of time until the full rate of the release arrives and cools the water column thereafter; and (3) the arrival of a WR 89-18 release that elevates water temperatures (associated with the aforementioned factors) for a short period (1-2 hours) followed by a drop in water temperature to favorable conditions for *O. mykiss*. During the WR 89-18 release from August through September, 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. Late season peak temperatures in October 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 above 24°C for a short duration at LSYR-4.95, LSYR-7.65, and LSYR-8.7. After the arrival of the water right release, longitudinal water temperatures were coolest at LSYR-0.51 and LSYR-4.95, and warmest at LSYR-22.68 that reached over 25°C.

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 WY2015. 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. 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 (LSYR-8.7). These habitat locations were inhabited by one or more species of largemouth bass, sunfish, and carp, and were completely dried out (except for LSYR-7.65) 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 3/25/15 to 11/11/15. Overall, water temperatures remained lower than 21°C and showed a warming trend across the monitoring period (Figure 30). This trend may be attributed to the typical seasonal warming observed every year, and the decrease in reservoir elevation due to the ongoing drought which reduced the cool water hypolimnion in the lake. Maximum water temperatures exceeded 18°C in the beginning of June and continued warming to approximately 21°C towards the end of October during a lake turnover event (a thermal dynamic event where colder and denser water develops towards the surface during the onset of colder atmospheric conditions in the fall with warmer water below causing a turnover or mixing of waters across the vertical profile of the lake water body resulting in unithermal conditions to depth). Minimum water temperatures exceeded 18°C starting in mid-September. These water temperatures reflect the warmest water temperatures on record for Hilton Creek since monitoring began and lake water was discharged to the creek from Lake Cachuma. Between the HC-0.54 and HC-0.12, water warmed slightly as the creek water moved downstream due to a mature riparian canopy shading the creek. *O. mykiss* were observed in Hilton Creek during routine snorkel surveys, hence were surviving the unusually warm water temperatures. Lower Hilton Creek represents some of the best spawning, rearing, and oversummering habitat in the upper portion of the LSYR.

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 entered the creek channel from 3/25/15 to 11/11/15. The pool was approximately 15 feet long and 12 feet wide with a maximum depth of 3 feet. The data showed a gradual seasonal warming from approximately 14°C in April to approximately 21°C towards the end of October when the lake turnover occurred and showed little influence by ambient air temperatures during the warmest portion of the year (Figure 31). *O. mykiss* occupied this habitat throughout the year.

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 4/15/15 through 7/20/15. 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 observed here over the years during past snorkel surveys. The thermograph was removed on 7/20/15 due to the habitat being nearly dry. While the unit was deployed, water temperatures were generally less than 18°C (Figure 32). The 24-hour variations ranged from <1.0°C to 3.0°C. No *O. mykiss* were observed at this site throughout the monitoring period.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 4/15/15 through 11/5/15 within a run habitat with a maximum depth of 1 foot, approximately 300 feet upstream of the Santa Rosa Bridge and approximately 0.77 miles upstream of the confluence with the LSYR. This site is also immediately downstream of the Salsipuedes Creek trapping location. Water temperatures at this site were noticeably lower compared to previous years and may be due to groundwater upwelling and a decrease in surface flow (drought), allowing the cooler groundwater water to exert more influence in the shrinking habitat. Overall, water temperatures generally remained less than 22°C except for a few days in July (Figure 33). *O. mykiss* were not observed at this monitoring site however, beaver dams and beaver activity were evident both upstream and downstream of the monitoring site.

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

A single thermograph was deployed in a pool habitat approximately 4-feet below the surface near the bottom, from 4/15/15 through 11/5/15. This is the third year a thermograph has been deployed at this location, as part of an effort to better understand the water temperature regime in this reach for *O. mykiss* rearing 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 that continue to hold water through the drought. The monitored habitat is approximately 40 feet long, 15 feet wide, and 6 feet deep at its deepest point.

Water temperatures were among the coolest at this monitoring location, with maximum water temperatures remaining less than 22°C throughout the monitoring period (Figure 34). Minimum temperatures during the heat of the summer were over 20°C during the warmest portion of the year. Daily variations during deployment ranged from <1.0°C to 3.0°C with most of the variations less than 1.0°C. *O. mykiss* have been routinely observed at this location when visibility permits but were not observed in WY2015. Spawning surveys often document *O. mykiss* redds in this reach of the creek.

Salsipuedes Creek – Highway 1 Bridge (SC-3.0)

A single thermograph was deployed in this pool habitat approximately 4-feet below the surface, near the bottom, directly downstream of the Hwy 1 fish ladder from 4/15/15 through 11/5/15. The pool habitat is approximately 85 feet long and 18 feet wide with a maximum depth of 7 feet. This is the third year a thermograph has been deployed at this location, and was done so to better understand the temperature regime throughout the creek, particularly in reaches that may have viable oversummering habitat for *O. mykiss*. This thermograph location represents the top of Reach 4, the second bedrock influenced section of the creek. Reach 4 is similar to Reach 2, both characterized by numerous deep pool habitats formed from bedrock, offering excellent oversummering opportunities for rearing *O. mykiss*.

Water temperatures showed gradual warming with maximum temperatures approaching 22°C (Figure 35). These recorded water temperatures were in general less than what was observed at this location in WY2014, when maximum temperatures approached 26°C. Beginning in October, a cooling trend started and continued for the remainder of the year. Diel variations remained less than 1.0°C throughout the deployment period. This area routinely holds *O. mykiss*, though none were observed in WY2015 due to turbid conditions from upstream beaver and cattle activities.

Salsipuedes Creek – Jalama Bridge (SC-3.5)

A single thermograph was deployed in a pool habitat approximately 4-feet below the surface, near the bottom, directly downstream of the Jalama Bridge fish ladder from 4/15/15 through 11/5/15. The pool is approximately 30 feet long, 18 feet wide and 6 feet in depth. This area routinely holds oversummering *O. mykiss*, which were observed during the fall snorkel survey (the habitat was too turbid in the spring and summer to snorkel survey due to upstream beaver activities).

Except for a few days in late July and early to the middle of August, maximum water temperatures generally remained less than 22°C during the warmest portion of the year (Figure 36). Minimum water temperatures generally exceeded 20°C about half of the time between mid-July and mid-August. Daily variations fluctuated between <1.0°C to 2°C during the deployment time.

Upper Salsipuedes Creek (SC-3.8)

For the second consecutive year since the LSYR fisheries studies began in 1993, Upper Salsipuedes Creek was dry during the spring of 2015. For the past 23 years of monitoring, 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 conceivably attributable to only anadromous steelhead. Low rainfall during WY2015 coupled with the fourth 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* in the past. In addition, Upper Salsipuedes Creek is thought to harbor one of the primary seed populations in the lower tributary system. Under improved flow conditions, this rearing habitat supplements recruitment in other reaches of the creek and the LSYR watershed overall. No *O. mykiss* were observed at this site during WY2015.

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 4/15/15 to 11/5/15. 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 deployment location from 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 WY2015 due to turbid conditions. The habitat went dry on approximately 8/14/15.

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 2015, cool water upwelling influenced the temperature regime at this habitat. Maximum water temperatures remained less than 20°C for the entire deployment period (Figure 37). 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 4/27/15 through 11/5/15. The habitat measured approximately 35 feet long, 7 feet wide and 3.5 feet deep. This was the third year a thermograph was deployed in this section of the creek and was done to better understand potential oversummering rearing habitat for *O. mykiss* in El Jaro Creek. *O. mykiss*, including young of the year, juveniles, and adults have been observed sporadically within this area over the past several years. This area is influenced by Palos Colorados Creek, which confluences with El Jaro Creek approximately 1/8 of a mile upstream of the monitoring pool. The monitoring site is influenced by a spring located 1200 feet upstream that maintains approximately 1 mile of wetted stream. The stream remains saturated even during the dry season and prolonged drought, creating viable rearing conditions for *O. mykiss*. Water temperatures remained relatively cool during the entire deployment period. Overall, maximum water temperatures remained less than 23°C during the warmest portion of the year (Figure 38). The 24-hour variation was greatest at the end of June through early September, generally ranging from 1°C to 3°C. No *O. mykiss* were observed at this location during all spawning (redd) surveys.

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 4/15/15 through 6/24/15. 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 6/17/15, the fish ladder was dry, along with the pool habitat. *O. mykiss* have regularly been observed within the plunge pool and fish ladder in past years; however, the drought has apparently eliminated *O. mykiss* from this section of El Jaro Creek. This includes in and around the San Julian Ranch, as large portions of the creek did not flow in the summer of WY2013 and WY2014, and was completely dry in WY2015. Water temperatures were low during the majority of the deployment period before the pool dried out (Figure 39).

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 4/15/15 through 11/5/15. The habitat is 30 feet long, 15 feet wide, 3.0 feet deep, and 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 impacted water flow through most of the creek, with vast sections of El Jaro Creek watershed being dry during the dry season of 2015. An unnamed spring enters the creek approximately 450 feet upstream of the monitoring locations and provides the sole source of water for that section of the creek. Maximum water temperatures in Los Amoles Creek were greater than 22°C for the majority of the summer period (Figure 40). Water temperatures exceeded 24°C on several occasions in August and September. Diel variations stayed within <1.0°C to 3.6°C for the entire year. 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 41 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). Also included in the graph is the Los Amoles Creek monitoring location (LAC-7.0) which is a tributary to El Jaro Creek and approximately 2.5 miles upstream of EJC-5.4.

Large sections of El Jaro and upper Salsipuedes creeks were dry during the summer and fall of 2015. Flow values measured at the USGS gauging station in Salsipuedes Creek (11132500) were low, ranging from a high of 0.15 cfs in May to a low of 0.02 cfs in November. Compared to WY2014, longitudinal maximum daily water temperatures were several degrees cooler at nearly every monitoring station in WY2015. Maximum daily temperatures in Figure 41 remained within a few degrees Celsius of each other regardless of where they were located. No particular pattern can be distinguished in the graph except that LAC-7.0 and EJC-5.4 were the warmest monitoring location while SC-3.0 and SC-0.77 were the coolest.

O. mykiss and Water Temperature Criteria within the Tributaries

The Salsipuedes/El Jaro Creek watershed is a dynamic system with many variables influencing water temperatures at any given time. The amount of surface flow, groundwater upwelling, ambient air temperatures, and presence/absence of riparian vegetation all influence the thermal regime within each habitat. In addition to the variables listed above, the region is experiencing its fourth straight year of drought conditions and tributary habitats throughout the watershed have contracted significantly. There was a wide range of temperatures monitored within the watershed during WY2015, illustrating the variable suitability of individual habitats for rearing *O. mykiss*.

Large sections of El Jaro Creek and Upper Salsipuedes Creek completely dried in WY2015. 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. The thermograph at EJC-3.81 was pulled in mid-August because the habitat was dry. In fact, the creek was dry upstream of both sites and only a few isolated pools were present downstream of Rancho San Julian. There was only one flowing section of El Jaro Creek resulting from the contribution of Palos Colorados Creek and a spring upstream of EJC-5.4. Upper Salsipuedes completely dried along with the confluence of El Jaro and Upper Salsipuedes. The groundwater resurfaced approximately 750 feet downstream of the El Jaro/Salsipuedes confluence, providing wetted conditions for approximately 3 miles until its confluence with the LSYR. Flow measured at the USGS gauging station (#11132500) was less than 0.05 cfs from June through late November.

There was high variability of water temperatures between sites within the El Jaro/Salsipuedes Creek watershed (Figure 41). One of the two remaining thermographs in El Jaro Creek was in the flowing section at EJC-5.4 (Palos Colorados), where maximum water temperatures fluctuated from 20°C- 23°C during the warmest portion of the year. This is compared to LAC-7.0, which manifested the highest recorded temperatures of the group, exceeding 23°C several times during the summer. The remaining monitoring locations; SC-0.77, SC-2.2, SC-3.0, and SC-3.5, in general remained less than 22°C for the deployment duration.

Monitoring temperature at several important habitat locations within the LSYR helps with establishing baseline temperature conditions, identification of optimal steelhead/rainbow trout habitat within the system, and measuring how the ongoing drought impacts stream temperature compared to the baseline. Some of the major findings from data collection within WY2015 include the contraction and desiccation of important freshwater habitat within El Jaro and Salsipuedes Creeks, the identification of optimal rearing temperatures for *O. mykiss* primarily within the bedrock sections of Lower Salsipuedes Creek, and no conditions at the established lethal criteria of 29^{o}C were measured (DeVries, 2013a; DeVries, 2013b).

Lake Cachuma water quality profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 3/18/15, 4/29/15, 6/11/15, 7/13/15, 8/31/15, 9/23/15, and 10/27/15 (Figure 42). 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. Lake profiles are not obtained from the deepest part of the lake; rather, profiles are obtained near the HCWS intake to look at water quality conditions going to Hilton Creek. 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 HCWS intake has been set at a depth of 65 feet below the water surface, and temperatures of the released water were well below 18°C prior to WY2015. However, due to lowering reservoir elevations (less stratification to provide cooler water), water temperatures being released through the HCWS went above 18°C for the first time beginning in August of WY2015.

The first profile of the year was measured in March and showed relatively cool temperatures from top to bottom, ranging from 13.3°C – 16.6°C (Figure 42a). The second profile in late April generally showed a 2°C increase at all depths compared to the March profile. Summertime profiles from June through September showed warm surface waters ranging from 22.0°C – 23.3°C, with the thermocline depth between 15-49 feet. During the same months, bottom temperatures ranged between 16.7°C – 19.0°C. The final lake profile in October showed relatively warm and uniform temperatures from the surface to the bottom of the lake. The surface temperature was 20.7°C and the bottom temperature (at 62 feet) was 20.3°C, a difference of only 0.4°C suggesting that the lake had turned over prior to this monitoring date and water over 18 °C was being delivered to Hilton Creek.

DO concentrations at the surface of the lake were highest (9.58 mg/L) during the March lake profile, with a subsequent drop in DO concentration during each successive profile (Figure 42b). Hypolimnetic oxygen depletion at depth was beginning to occur during the first few profiles, with almost zero DO near the bottom during the July through September profiles. DO concentration levels during the last profile in October also suggested that the lake had turned over, as concentrations were generally uniform throughout the water column (5.6 mg/L – 6.7 mg/L).

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2015 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 2015. 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 WY2015 photo points is provided in Appendix C (Table C-1 and Table C-2). The locations of all photo point sites are 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 comparisons between 2005 and 2015 show LSYR mainstem riparian vegetation growth since the initiation of BiOp target flows to Alisal Bridge, approximately 10.5 miles downstream from Bradbury Dam (Figures 43-47). While there are a few instances within the mainstem riparian corridor of significant willow, sycamore, and cottonwood growth in excess of 15 feet, in general riparian vegetation is exhibiting signs of stress and die-off from the drought. The last Bradbury Dam spill event occurred in WY2011. Since WY2011, the region has experienced 4 consecutive years of dry conditions and decreased flows in the mainstem.

Tributary photo point comparisons between 2005 and 2015 are presented in Figures 48-52. 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 48-49). Larger trees (willows, alders, sycamores, and cottonwoods) are replacing the smaller understory within the drainage. Salsipuedes and El Jaro Creeks showed rapid recolonization of riparian vegetation in WY2015 due to four consecutive years of below average rainfall and an absence of channel changing flow events (Figures 50-52). Large flows are important in both the LSYR mainstem and its tributaries as they clear out potential passage barriers/impediments and remove debris/silt and generally clean out potential spawning locations for *O. mykiss.*

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), and 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 required by NMFS to remain below the BiOp established Incidental Take Statement (ITS) limits.

WY2015 was the second year since issuance of the 2000 Cachuma Project BiOp that 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.

To stay within the limits of the ITS and to maximize data gathering with limited take, the trapping effort was 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. A 12-inch HDPE pipe approximately 15-feet long was secured to the back of the traps below the water level that allowed any fish within the trap to continue to move downstream unhindered. During the WY2015 trapping season, the HDPE pipe was attached to the trap, but was not employed as juvenile take was not exceeded.

In past years, 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).

WY2015 represented the fourth consecutive year of dry conditions (the drought was official proclaimed by the County on 1/24/14) with a greatly reduced number of storms and limited migration opportunities for *O. mykiss*, particularly in the LSYR mainstem downstream of Highway 154 Bridge and all of Salsipuedes Creek. Hilton Creek offered the only opportunity to capture upstream and downstream migrating fish due to the HCWS which provided enough water to allow upstream migrating resident *O. mykiss* on Reclamation property and in the Highway 154 Reach to access the creek to spawn. Both upstream and downstream migrant traps were installed at Hilton Creek on 3/10/15 and removed on 5/15/15 (Table 7). Catch per unit effort (CPUE) for the WY2015 migrant trapping effort is presented in Table 9 and described in the Discussion Section.

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 during the receding limb of storm hydrographs (Knutsen and Ward, 1991; Gregory and Levings, 1998). The COMB-FD staff 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).

The development of an unusually strong El Nino event influenced the region during WY2015. The event was expected to generate a wet cycle of storm systems that would impact the Southern California region during the winter. While the El Nino was strong, it did not deliver the expected rainfall. In fact, rainfall patterns in WY2015 were very scattered in nature and small in magnitude throughout the wet season and did not contribute to any significant runoff during the migration period. The cumulative years of drought and the dry antecedent moisture conditions in the soil significantly reduced potential runoff events capable of generating significant and long lasting migration cues (i.e., increased flow). A total of 9.38 inches of rain fell in WY2015, 62.7% (5.88 inches) of which fell in the first half of December during three separate storm events and did not create significant runoff due to the low antecedent soil conditions. Rainfall totals continued to decline during what is supposedly the wettest time of the year with only 0.82 inches of rain recorded at Bradbury Dam in January, 0.51 inches in February, 0.08 inches in March, and 0.36 inches in April. In a departure from previous years, measurable rain was recorded at Bradbury Dam in nearly every month during the summer and early fall (August being the exception) (Table 3). This was primarily due to the unusually warm moist atmosphere (El Nino) which created scattered thunderstorm events across the area.

The lack of significant storms contributed to poor migration opportunities in the mainstem and tributaries due to lack of flow. For example, in Salsipuedes Creek between 1/1/15 and 5/20/15, maximum flow rates were less than 0.62 cfs (2/9/15) during the migration period which is not enough flow to allow fish to move past critical riffles. In the LSYR mainstem, flows quickly attenuated from a high of 5.9 cfs (Solvang) on 1/1/15 to 0.0 cfs on 3/37/15. Again, migrant trap deployment times are presented in Table 7.

Hilton Creek Migrant Traps: There were 24 upstream migrants captured from 3/10/15 through 5/15/15 ranging in size from 144 mm (5.7 inches) to 395 mm (15.6 inches) (Figure 53a). The majority of the upstream fish were captured in March (20) and the remainder captured in April (4). No upstream migrating fish were captured in May. There were 10 upstream migrating *O. mykiss* identified as juveniles (≤ 254 mm) and 14 identified as adults (> 254mm) (Figure 54 and Table 10). There were 110 downstream migrants captured from 3/10/15 through 5/15/15, ranging in size from 109 mm (4.3 inches) to 395mm (15.6 inches) (Figures 53 and 54). Of those, 26 of the downstream migrating fish were classified as adults with 6 of those recaptures and 4 identified as smolts and the rest identified as residents. The remaining fish (84) were classified as juveniles. In total, 67 (60.9%) of the 110 downstream migrating fish were classified as having smolting characteristics of which 41 (37.2%) were classified as smolts and 26 (23.6%) classified as pre-smolts. There were 21 smolts captured in March with the majority of the smolts captured during April (45) (Figure 55). The average size of the smolting fish in March was 179.9 mm and decreased slightly to 178.6 mm by April showing that good rearing conditions were available during the spring timeframe (Figure 56). Of note, independent of any flow cues to trigger downstream migration, smolts were recorded leaving the creek soon after the traps were installed with the first smolt captured on 3/12/15, and two days after the traps were installed (Figure 57).

Of the 134 fish captured migrating upstream and downstream, 120 (89.6%) were captured during the second evening and first morning trap checks showing that the majority of migrating fish are moving during the hours of darkness when predation possibilities are reduced (Table 8).

Salsipuedes Creek Migrant Traps: No trapping was conducted in Salsipuedes Creek due to very low flow conditions and zero migration opportunities (Figures 53 and 58, and Table 7). The four consecutive years of dry conditions coupled with the lack of channel changing flow events had created a dense, nearly impenetrable riparian vegetation corridor that made it challenging for fish to move any distances. Under these conditions riffle crests are too shallow to allow movement (and contain abundant leaf drift) which essentially creates a small dam at many riffle crests, thereby preventing lateral movement in any direction by *O. mykiss* in the creek. At no point during the migration season was Salsipuedes Creek flow greater than 0.62 cfs, and there was no connection of the LSYR mainstem to the lagoon in WY2015.

LSYR Mainstem Trap: No trapping was conducted at the LSYR mainstem trapping location in WY2015. Mainstem flow recorded at the USGS Solvang gauge (11128500) showed zero flow on 3/27/15 with much of the mainstem continuing to go dry for the rest of the migration season.

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, and El Jaro [including Los Amoles and Ytias] creeks) in the winter and spring within the reaches where access is permitted. WY2015 was a poor year for resident and anadromous steelhead migration within the LSYR basin as neither the lagoon breached, nor did the LSYR mainstem flow to the lagoon at any point during the migration season. Fragmented habitat, beaver dams, and low flows essentially eliminated longitudinal *O. mykiss* movement within the LSYR 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 WY2015 due to dry conditions and the absence of any stormflows that would allow fish to move and spawn (except in the Hwy 154 Reach near the dam).

Survey results are presented for the tributaries in Table 11 and Table 12. Redd 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 9 sites in Hilton Creek and 3 sites in Salsipuedes. Surveyors noted that many potential spawning locations in the creeks listed above were buried in leaf litter or silt as no significant flow events occurred to clean the substrate and create a migratory corridor for spawning opportunities.

The first and second spawning sites of the season were observed in Salsipuedes Creek on 2/4/15, as well as another redd site observed on 3/5/15 for a total of 3. In Hilton Creek, the first redd sites were identified on 2/10/15 (2) followed by 3/12/15 (6), and 3/25/15 (1) for a total of 9 (Table 12). All redd sites were constructed by resident *O. mykiss* based on the smaller excavation dimensions compared to past excavations by larger anadromous steelhead. Very low flow conditions were present in the remaining creeks which prevented movement of fish and limited spawning opportunities.

Survey results for WY2015 in Salsipuedes Creek (3 redds) were especially concerning considering that in WY2012 there were 55 sites identified within the same area. While there were more redd excavations observed in WY2015 compared to WY2014, there were no young of the year *O. mykiss* observed anywhere in Salsipuedes or Hilton creeks. The fact that no progeny have been observed in the past two years in either creek highlights the poor conditions presently being experienced by *O. mykiss* in each creek.

There were 4 redds identified in the mainstem during WY2015, all within Reclamation property immediately downstream of the Long Pool on 3/10/15 (Table 13).

Snorkel surveys: Snorkel surveys in WY2015 were conducted in the spring, summer, and fall within the LSYR mainstem (Figures 59-60 and Table 14). Surveys within the tributaries were more limited due to the ongoing drought (i.e., lack of water and/or poor visibility). 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 baseline conditions after the spawning season and prior to the critical summer rearing season. Spring surveys are designed to document the number and location of YOY produced, as well as the standing crop of *O. mykiss* going into the oversummering period. Summer surveys were conducted in the LSYR mainstem in September, commensurate with the during-release phase of the WR 89-18 Release. Fall LSYR mainstem snorkel surveys were followed soon after the summer survey due to the need for post-release surveys of the WR 89-18 Release. Fall surveys are meant to evaluate the population of oversummering *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 influenced that objective and diminished the spatial extent of some of the three surveys as conditions changed 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) were snorkeled. The results of the surveys are broken out by 3-inch size classes of fish. The total number of *O. mykiss* observed during all three snorkel surveys is shown in Figure 60 with all survey dates shown in Tables 14 and 17 for the LSYR mainstem and its tributaries.

In summary, *O. mykiss* were observed in the Hwy 154 Reach (5 in the spring and 6 in the 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 (Tables 15 and 16, and Figures 61-65). All tributary data are presented in Table 17 and 18, and Figures 66-70). In Hilton Creek, a total of 132 *O. mykiss* were observed in spring and 135 *O. mykiss* were observed in the fall (no summer survey was conducted in Hilton Creek due to poor visibility). No *O. mykiss* were observed in Quiota Creek during spring, summer and fall surveys. During spring surveys, no *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. In Salsipuedes Creek (Reach 5), no surveys were conducted in the spring and summer due to turbid and/or dry conditions. In Salsipuedes Creek (Reach 5), surveyors were able to complete a fall snorkel survey and observed 3 *O. mykiss*. No surveys were conducted in El Jaro Creek, due to turbid and/or dry conditions.

LSYR 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 60). 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) (Figures 59-61, and Tables 15 and 16). The visibility within the Hwy 154 Reach downstream of the Long Pool allowed snorkel surveys to be conducted during the spring and fall in WY2015. 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. A total of 5 *O. mykiss* were observed in the reach below the Long Pool to the Reclamation property boundary during the spring survey (LSYR-0.5 to LSYR-0.7). There were 1 0-3 inch, 1 3-6 inch, 2 6-9 inch and 1 9-12 inch *O. mykiss* observed during that survey. As mentioned above, a WR 89-18 Release was conducted in WY2015, which called for post-release surveys within the Hwy 154 Reach soon after the release was over. Divers returned to the Hwy154 Reach in October to conduct a post WR 89-18 snorkel survey. The COMB-FD staff observed a total of 6 *O. mykiss* during this fall survey.

<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 (Figures 59-60 and Figure 62). Snorkel surveys (spring, summer, and fall) were conducted in relation to the timing of the 2015 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 (Table 15 and Table 16). No *O. mykiss* were observed within any habitat during the spring, summer, or fall snorkel surveys within the Refugio Reach. This marks the second time since the initiation of target flows to Alisal Bridge (LSYR-10.5) that *O. mykiss* haven't been observed within the Refugio Reach the entire year.

<u>*Alisal Reach*</u>

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figures 59-60, and Figure 63). Snorkel surveys (spring, summer, and fall) were conducted in relation to the timing of the 2015 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 (Table 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 second time since the initiation of target flows to Alisal Bridge (LSYR-10.5) that *O. mykiss* haven't been observed within the Refugio Reach the entire year.

*Avenue of the Flags Reac*h

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) (Figures 59-60, Figure 64, and Tables 15-16). The river towards the upper half of the reach has noticeably been changed by anthropogenic means, insofar as where Buellflat, Granite, and other mining companies have been altering the riparian channel. The downstream half of the reach consists of a mature, unaltered riparian canopy. The COMB-FD staff attempted a spring snorkel survey in the Avenue of the Flags Reach in July, but conditions had already deteriorated and it was dry (LSYR-11.4). With WR 89-18 Release flows extending down past the Avenue of the Flags Reach in the summer, the COMB-FD staff conducted surveys in the summer (“during-release”) and fall (“post-release”). 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, or fall snorkel surveys.

Cadwell Reach

The mainstem downstream of the Avenue of Flags Bridge is mostly comprised of private property that is categorized into sub-reaches (Sanford, Cadwell, Cargasacchi, etc.) where the COMB-FD staff has been granted access. Due to a large spill event (peak releases from Bradbury Dam of approximately 14, 250 cfs with 31.09 inches of rain at the dam that water year; see the Discussion Section for further historical hydrologic context) and subsequent *O. mykiss* observations in the lower reaches of the LSYR in WY2011, the staff uses the Cadwell Reach as one of the permanent monitoring locations for both snorkel activities and water quality monitoring (Figures 59-60, Figure 65, and Tables 15-16). The Cadwell Property (LSYR-22.0-23.0) contains one large bedrock pool approximately 18 feet in depth with several smaller pools located further upstream that can provide rearing habitat during wet years as has been observed. No *O. mykiss* were observed within the reach during any of the three WY2015 surveys. Like other locations further upstream, the majority of the reach was drying out with residual pool depth not being maintained during the spring of 2015.

Tributaries: Tributary snorkel surveys were conducted in the spring, summer, and fall in WY2015 at most of the long-term monitoring locations within Hilton, Quiota, Salsipuedes, and El Jaro creeks (Figure 59 and Table 17).

Hilton Creek

Hilton Creek surveys are conducted on Reclamation property from the confluence of the LSYR mainstream 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 (Figures 59 and 60, and Tables 17-19). 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. However, lowering lake levels due to the extended drought caused elevated turbidity within Hilton Creek and only a spring snorkel survey was conducted, albeit with low confidence because of water quality conditions. The summer survey was not possible and the fall survey was limited to the lower half of the creek.

The COMB-FD staff conducted spring snorkel surveys in July within Hilton Creek, but the survey was hampered by poor visibility. A total of 132 *O. mykiss* were observed across 5 reaches of Hilton Creek on Reclamation property, despite poor water clarity conditions for divers (Tables 18-19 and Figure 66). With that being said, the total number of trout observed was likely a low estimate. Of the 132 trout observed, 70 (53%) were in the 0-3 inch size class, 48 (36%) were 3-6 inches, 9 (7%) were 6-9 inches and 5 (4%) were 9-12 inches.

Divers returned to Hilton Creek several times during the summer to conduct snorkel surveys but the visibility was poor. The COMB-FD staff noted that visibility was less than 2 feet, rendering snorkel surveys impossible.

Visibility was moderately better within Hilton Creek in the fall after the lake turned over and divers snorkeled the creek on 10/22/15-10/23/15. Flows of approximately 3.7 cfs were being released from the URP with poor visibility at the top of Reach 4 and all of Reach 5 (closer to the URP) and better visibility within downstream reaches (Reach 1-3). Divers were confident in fish counts from Reach 1 through Reach 3 but began encountering fair visibility within Reach 4 near the LRP. Divers stopped surveying above the LRP due to poor visibility. A total of 135 *O. mykiss* were observed between Reach 1 and Reach 4; 36 (27%) 0-3 inch, 73 (54%) 3-6 inch, 22 (16%) 6-9 inch and 4 (3%) 9-12 inch fish detected.

Quiota Creek

As part of the regular monitoring program, divers snorkeled a section of Quiota Creek between Crossing 5 to Crossing 7, which had historically remained wetted throughout the oversummering period before the prolonged drought (Figure 59, Figure 67 and Tables 17-19). WY2015 was another below-average rain year and several of the normally perennial sections of the creek were dry by summer. The spring survey on 6/15/15 indicated that flow conditions within Quiota Creek were already declining. Several habitats were fragmented and some of the larger pools were losing residual pool depth. No *O. mykiss* were observed within the historic Crossing 5 to Crossing 7 reach. Available habitat continued to shrink during the summer and fall with most of the creek going dry. Only a few isolated (less than 1-foot deep) habitats remained and only bank observations were needed to determine no fish were present.

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 the Santa Rosa Bridge (on Santa Rosa Road) upstream to the Jalama Road Bridge, a distance of approximately 2.85 stream miles (Figure 68). Reach 5 extends upstream from Jalama Road Bridge to the confluence of El Jaro Creek, a distance of approximately 0.45 miles (Figure 59 and 69, and tables 17-19). Reach 5 has been a historic monitoring location because of its reliable stream flow, water clarity, presence of

O. mykiss, and relatively easy access. Spring and summer surveys within Reach 5 of Salsipuedes Creek were hampered by poor visibility and lack of flowing water (although water was present). In November, divers were able to complete a partial fall survey with only 3 *O. mykiss* observed within the habitats that were clear enough to detect fish. Divers noted that most Reach 5 habitats were too turbid to snorkel, and the last 5 habitat units up to the El Jaro/Upper Salsipuedes Creek confluence were dry.

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 59 and 70, and Tables 17-19). Personnel attempted to snorkel El Jaro Creek in early June 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 WY2015.

Other Fish Species Observed: All warm-water species in the LSYR mainstem are counted during the routine snorkel surveys conducted in the spring, summer, and fall (Figures 71 and 72). Fish species that inhabit Lake Cachuma are often found throughout the LSYR mainstem downstream of the lake. Typically, the most numerous species observed during snorkel surveys include largemouth bass (*Micropterus salmoides*), three sunfish species including bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and redear sunfish (*Lepomis microlophus*), common carp (*Cyprinus carpio*), and two catfish species specifically the black bullhead (*Ameriurus melas*) and the channel catfish (*Ictalurus punctatus*). It is thought that these fish travel downstream during spill events from the lake to the lower river via the Bradbury Dam spillway (not the penstock due to high pressure and small aperture release valves), take up residency in the Stilling Basin or habitats downstream and reproduce as conditions allow. Bass, sunfish and catfish are known predators of *O. mykiss*, particularly the younger life stages. Carp and catfish can stir up the bottom of the substrate and greatly reduce water clarity. Warm-water species are generally not observed in any of the three tributary drainages (Salsipuedes, Quiota, and Hilton) that the COMB-FD staff monitors. However, snorkel survey results within lower Hilton Creek in the spring and summer contained numerous warm-water fish in WY2015.

Hilton Creek

In the spring the COMB-FD staff observed 4 largemouth bass (3 0-3 inch and 1 3-6 inch) within Reach 1 in lower Hilton Creek. In the fall, divers observed many warm-water species within the same reach. Largemouth bass counts in lower Hilton Creek included 15 0-3 inch, 6 3-6 inch, 39 6-9 inch, and 1 9-12 inch fish. Green sunfish were also prevalent within lower Hilton Creek and included 18 0-3 inch and 1 3-6 inch fish. With lowering reservoir elevation and increased temperatures in Hilton Creek in the summer and fall of WY2015, warm-water species likely found Reach 1 of Hilton Creek more hospitable compared to previous years. URP minimum temperatures within Hilton Creek were over 20°C during the time of the fall snorkel survey. Prior to this water year, it was uncommon to observe non-native fish species in Hilton Creek.

LSYR mainstem

Largemouth Bass: As part of RPM-6 WR 89-18 Release surveys, divers snorkeled the available habitat downstream of the Long Pool (LSYR-0.5) to the Reclamation property boundary in the pre- and post-release phases of the release. The COMB-FD staff counted 30 0-3 inch, 3 3-6 inch, and 1 6-9 inch largemouth bass within this short reach in the pre-release survey in late July. Post-release surveys within the same reach counted 103 0-3 inch, 19 3-6 inch and 1 6-9 inch largemouth bass. The number of bass observed during this particular survey accounted for 95% of the fish divers encountered, the remaining fish were *O. mykiss* with 6 observed.

A total of 29 largemouth bass (15 in the Refugio Reach and 14 in the Alisal Reach) were observed during spring LSYR mainstem snorkel surveys (Figure 71). In the summer, the number observed dropped to 4 within each reach for a total of 8 largemouth bass. By the fall, largemouth bass totals were 26 in the Refugio Reach and 25 in the Alisal Reach.

Sunfish Species: Several types of sunfish species (green, red-ear and bluegill) are found within the LSYR and Lake Cachuma. They can be difficult to distinguish in juvenile form, and since most are observed in sub-adult form, all three species are lumped into a single sunfish category. Only 2 sunfish were observed in the Refugio Reach during spring snorkel surveys, with none observed in the Alisal Reach (Figure 71). In the summer, or during WR 89-18 Release surveys, no sunfish were observed in the Refugio Reach while 22 were observed in the Alisal Reach. By the fall, or post-release survey, 2 were found in Refugio and 59 were found in the Alisal reaches, respectively.

Catfish Species: There are two species of catfish present in the LSYR mainstem, bullhead and channel catfish, although they have been infrequently observed over the past several years. Although the COMB-FD staff differentiates between them during routine snorkel surveys, they are lumped into a single catfish category for the purposes of this report. In WY2015, no catfish were observed during any of the spring, summer, or fall surveys within the LSYR mainstem (Figure 72).

Carp: Just as was the case the previous two years, hundreds of carp were observed from the bank of the Stilling Basin (LSYR-0.0) and Long Pool (LSYR-0.51) within the Hwy 154 Reach. Carp remained prevalent in the Stilling Basin and Long Pool as observed from the bank but surveyors were unable to snorkel those habitats due to poor visibility that was likely due to carp activity. Deteriorating conditions within Lake Cachuma were also likely contributing to the poor water clarity within the Highway 154 Reach, as the visibility within Lake Cachuma was also poor throughout most of WY2015. Carp were observed during the spring, summer, and fall within the Refugio Reach, totaling 13, 2 and 8, respectively (Figure 72). No carp were observed within the Alisal Reach during spring and summer surveys. Most of the Alisal Reach was dry in the spring, prior to WR 89-18 releases. Although no carp were observed in the Alisal Reach during the first two surveys of WY2015, 10 juvenile (3-6 inch) carp were observed during the post-release, or fall snorkel survey. They were observed within a single pool habitat just upstream of Alisal Bridge (LSYR-10.5). This habitat, including a long stretch of river above and below the habitat, was completely dry in the spring. The carp observed during the fall survey at this location indicate carp dispersal (presumably from upstream habitats) during the summertime releases.

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 WY2015, the Quiota Creek Crossing 3 Project was completed (December of WY2015). This project removed an Arizona-type crossing and replaced it with a 53-foot bottomless arched culvert. Due to concerns about a large willow directly in the thalweg of the new stream alignment just upstream of the new bridge, it was removed from the channel center and successfully replanted in an adjacent bank in a safer location. In addition, a large oak tree upstream of the new bridge was severely undercut and in danger of falling, so additional rock slope protection was placed around the oak and fill was carefully placed below to shore up the root structure from further erosion. A second construction element was added to fix a high-flow erosional scarp that had formed upstream of the new bridge. This scarp could have continued to grow and eventually allow the creek to flank the new structure. Prior to removal of the low water crossing, this impediment was considered a partial barrier to *O. mykiss* within Quiota Creek.

The Quiota Creek Crossing 3 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 3, 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 (including the Cattle Exclusionary Fencing Project), 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 WY2015 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 set by 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 WY2015, beavers continued to inhabit the Salsipuedes/El Jaro Creek watershed. 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 WY2015, the COMB-FD 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). The survey also included LSYR mainstem tributaries where beaver have been known to populate (i.e., Salsipuedes Creek watershed).

Dams were classified as barriers, impediments, or passable, utilizing CDFW passage criteria, as well as active or non-active. In order for upstream migrating *O. mykiss* to pass over barriers, CDFW criteria state 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.

Over the past 5 years, the number, extent, and size of beaver dams has fluctuated in both the mainstem and tributaries. In 2011, Bradbury Dam spilled, removing many beaver dams and an indeterminate number of individual beavers disappeared in both the LSYR mainstem and tributaries either through the high flows or burying their dens. This was especially true in the Salsipuedes/El Jaro creeks 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. Mainstem dams identified in WY2015 (108) represent a further decrease (121 in WY2014) in the number and extent of beaver dams within the watershed. This is primarily due to the fact that WY2015 was the fourth year of dry conditions with surface flows disappearing in many locations throughout the mainstem creating unfavorable conditions for beavers. Several beaver carcasses were observed by COMB-FD staff in dried stretches of river during routine surveys in WY2015 (Figure 73). In addition, the number of barrier dams continues to decrease from a high of 92 in WY2013 to the current number of 56 in WY2015. Of the 108 total dams identified, only 21 were classified as active meaning that there was evidence of recent beaver activity, the remainder (87) were classified as inactive as these areas were dry with the beavers either having moved to places where water was available or perishing. There were, 56 (51.9%) which were classified as barriers, 37 (34.3%) as impediments, and 15 (13.9%) as passable to migrating fish. There was one dam in the Highway 154 Reach, 13 dams in the Refugio Reach, 16 dams in the Alisal Reach, 16 dams in the Avenue reach, 60 from the Avenue of the flags reach downstream to the Narrows, and 2 on Vandenberg Airforce Base. Barrier dams were found in every reach. The number and extent of beaver dams identified in WY2015 serves to illustrate the extent of habitat fragmentation caused by the dams within the LSYR. There were 4 dams identified that were between 3-4 feet in height, and one dam that was greater than 4 feet in height.

There were 21 beaver dams identified in the Salsipuedes/El Jaro watershed; 11 in Salsipuedes and 10 in El Jaro Creek (Table 20). Less than half of the dams were classified as barriers (10) with 5 impediment dams and 6 passible dams in the watershed. Of the 21 sites identified, only 6 were classified as active. The majority of the dams were smaller in stature compared to the mainstem dams with only 2 dams higher than 2 feet in height. As seen in the mainstem, areas where beavers are no longer active correspond with locations that have dried out during the drought. The active beaver dams that do remain present an added navigation problem to fish looking to find mates and reproduce. Besides creating barriers or impediments to migration, the dams are also removing critical spawning areas used by *O. mykiss*.

4. Discussion

This section provides (4.1) additional historical context for the WY2015 results presented above, specifically since the issuance of the 2000 BiOp, (4.2-4.4) discussion as needed on specific topics of interest or concern, and (4.5) the 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), 2013 (COMB, 2017), and 2014 (COMB, 2018).

4.1. Water Year Type Since WY2000

The rainfall (Table 21), runoff (Table 22), and water year type with the years that Lake Cachuma spilled (Figure 74) are presented since WY2000.

4.2. 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 Creek is an order of magnitude larger than Hilton), hydrology (rainfall and flow patterns, and hydrologic regime), land use (chaparral, agriculture, and cattle ranching), and biology (*O. mykiss* migration and population characteristics). Both creeks have hydrologic regimes typical of a Mediterranean-type climate with flashy streams and high inter/intra-year runoff variability. The watershed area for Salsipuedes Creek is larger than that of Hilton Creek, and at times receives more rainfall during any given precipitation event due to its more westerly location. In general, smaller watersheds have sharper recessional storm hydrographs, and Hilton Creek has an artificially sustained baseflow greater than 2 cfs year round. In contrast, 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 WY2015 for the second year in a row. 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.

From past observations, 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 oversummering 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. Comparatively, Salsipuedes Creek system has extensive stream mileage but only fair habitat quality due to low dry season flows, limited pool habitat for oversummering, 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 oversummer. 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 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. For the Hilton Creek, the trapping season was 65 days long with 65 functional trap days for a 100% trapping efficiency for both upstream and downstream traps. The migrant traps were able to remain deployed the entire season due to the general absence of meaningful stormflow events. The CPUE for upstream migrants was 0.37 fish/day while the CPUE for downstream migrating fish was 1.69 fish/day for a combined total of 2.06 fish/day (Table 9). Again, no trapping was conducted at the Salsipuedes Creek or LSYR mainstem traps.

The difference in historic smolt migration timing (or lack thereof in Salsipuedes Creek in WY2015) between the two creeks since the beginning of migrant trapping in the mid-1990s illustrates the complicated environmental variables acting on each system (i.e., baseflow, stormflow, photo period, lunar cycle, temperature, and natural vs. artificial flow regimes). In the absence of flow cues, migration still occurs in Hilton Creek and is likely due to factors beyond streamflow, whereas in Salsipuedes Creek, it appears historically that the primary migration cue is elevated flow rates.

Because of the abbreviated trapping season and the fact that only one of the three trapping locations was functional, migration patterns and trends cannot be analyzed in either of the creeks. A breakout of size and type of migrating *O. mykiss* is provided in Table 10.

4.3. 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, Quiota Creek Crossing 3, Salsipuedes Creek Cattle Exclusionary Fencing (not included in the specific fish passage enhancement project tables but described below), as well as the HCWS and HCEBS which supplies water year round to Hilton Creek from Lake Cachuma (Tables 23 and 24, and Figures 75, 76, and 77). Two additional tributary passage enhancement projects were completed as of the date of this report: Quiota Creek Crossing 0A and Quiota Creek Crossing 4.

The HCWS has transformed Hilton Creek into a dense riparian zone where there is little thermal heating from the URP to the confluence with the LSYR mainstem (Figures 48-49). 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 79). 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 full 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 habitats.

Cattle Exclusionary Fencing Project: A cattle exclusionary fencing project was completed on Rancho Salsipuedes on the lower reaches of Salsipuedes Creek (Figures 80 and 81). Cattle were accessing the creek by isolated trails down the steep embankments into the creek and moving laterally up and down the stream negatively affecting the stream water quality and riparian corridor vegetation. The objective of the project was to cut off those access points for cattle and alternatively provide drinking water access through a few specific points with no potential for lateral creek movement. Cattle were successfully fenced out of approximately 2.5 stream miles and 3 watering corridors were installed for extremely limited access to the creek for cattle drinking. Also 2 large off-channel watering troughs were installed outside of the riparian corridor to further keep cattle out of the stream. The project was completed in the winter of 2014 (reported in this AMS for the first time) and the benefits to the aquatic habitats and riparian corridor have already been noticed. The project was funded through a Fish America Foundation grant and the Cachuma member units through COMB. The project had a high benefit-cost ratio due to the low cost of the project and extensive improvement to the health of the aquatic ecosystem for *O. mykiss* and other aquatic species. The project required a cooperative landowner and cattle rancher who the COMB-FD staff is in routine communication with to assure his cattle are safe and that the infrastructure of the project is functioning as designed.

4.4. Water Hyacinth Discovery and Removal

Invasive water hyacinth (*Eichhornia crassipes*) was first discovered in the LSYR during beaver dam surveys in December 2013 approximately 2 miles downstream of the Avenue of the Flags Bridge in Buellton (Figure 82). The infestation extended approximately 1.2 miles downstream and was contained within that section of the river channel. The source of the infestations was likely an overflowing ornamental pond from an adjacent property that accidently spread the plant to the river during the heavy rains of WY2011. The discovery of the weed was particularly concerning considering the destructive potential of this plant once it becomes established in water ways. Water hyacinth has been identified by the International Union for Conservation of Nature (ICUN) as one of the 100 most aggressive invasive species and recognized as one of the top 10 worst weeds in the world. It is native to the Amazon Basin in South America and has emerged as a major weed in more than 50 countries in the tropical and subtropical regions of the world with profuse and profound impacts. In California, the weed has caused severe ecological impacts in the Sacramento-San Joaquin River Delta by: 1) destroying biodiversity, 2) depleting oxygen and reducing water quality, 3) providing breeding grounds for pests and other vectors, and 4) generally blocking waterways hampering agriculture, fisheries, recreation, and hydropower (Villamagna and Murphy, 2010) .

Removal efforts by the COMB-FD started in October of 2014 at the upstream end of the infestation with crews working methodically in a downstream direction. Crews would use hands, rakes, nets, and ropes to detach the floating mats, pushing/pulling large sections of the weed to the shoreline where crews would remove it from the water and place it in piles or in large plastic bags for later pickup (Figure 83). All water hyacinth was disposed of in an agriculture field and tilled into the soil. Hand removal was determined to be the best option in removing the plants from the waterway due to the thick riparian corridor and difficulty in maneuvering vehicles adjacent to infestation patches. In December 2014, additional assistance was provided by California Conservation Corp personnel during two intensive field days (Figure 84).

Following removal efforts, members of the COMB-FD continue to periodically walk the infestation zone 1-2 times per month throughout WY2015 and beyond. During each visit, biologists regularly found small patches of water hyacinth scattered throughout the infestation zone. Biologists would collect, photograph, and then distribute the hyacinth into the agriculture field to be tilled into the soil at a later date. In total, several tons of the water hyacinth were removed from the river during WY2015. COMB-FD staff will continue to monitor the situation.

4.5. Status of WY2014 Annual Monitoring Report recommendations

The following is a status report (i.e., completed, ongoing, no longer applicable, or should carry forward to next year) for all the recommendations listed in the WY2014 Annual Monitoring Report to improve the monitoring program pending available funding:

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

- Continue the collaboration with CDFW regarding operation of their DIDSON in Salsipuedes Creek;
    - Status: This recommendation is being followed and is ongoing.

- Continue annual implementation of a Migrant Trapping Plan in collaboration with Reclamation that would be reviewed and approved by NMFS to assure compliance with take limits set forth in the 2000 BiOp;
    - Status: This recommendation is being followed and is ongoing.

- Conduct basic stomach content analyses of non-native piscivorous fish whenever possible specifically in habitats known to support *O. mykiss* and non-native fish;
    - Status: This recommendation is being followed and is ongoing whenever possible in association with any trapping effort.

- Encourage Reclamation to improve the reliability of their HCWS to deliver water and provide continuous flow to Hilton Creek without interruption;
    - Status: This recommendation is being followed and is ongoing for the HCWS and HCEBS.

- Collaborate with Reclamation regarding Critical Drought Conditions and downstream water releases for the fishery during drought conditions;
    - Status: This recommendation is being followed and is ongoing as possible.

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

- Continue efforts to remove fish passage impediments within the LSYR basin as listed in the proposed actions of the BiOp, utilizing grant funding wherever possible, specifically within the Quiota Creek watershed;
    - Status: This recommendation is being followed and is ongoing. A grant has been written for the Quiota Creek Crossing 4 Project for next year.

- 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;
    - Status: This recommendation is being followed and is ongoing, but greater effort is needed for more complete analyses.

- 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);

- Status: This continues to be difficult as Reclamation does not routinely record the data nor input the recorded temperature values into their digital database. Further encouragement is suggested.

- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin; and
  - 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

WY2015 was the fourth consecutive year of dry conditions with only 9.38 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 the Highway 154 reach, Salsipuedes Creek and Hilton Creek; no redds were observed during surveys in Quiota, 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 to drying conditions. Interruptions of flow to Hilton Creek due to failures of the HCWS disturbed the aquatic life in the stream. Two *O. mykiss* individuals required relocation and no mortalities were found in the creek. The long-term drought continued to make oversummer 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 (consistent with WY2014 recommendations) are provided by the COMB-FD's staff to improve the ongoing fisheries monitoring program in the LSYR basin in accordance with the BiOp, BA and FMP:

- 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 Dual-Frequency Identification Sonar (DIDSON) in Salsipuedes Creek;
- Continue annual development and implementation of a Migrant Trapping Plan in collaboration with Reclamation 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 (during migrant trapping, fish rescue, and stranding surveys) specifically in habitats known to support *O. mykiss* and non-native fish;
- Encourage Reclamation to improve the reliability of their HCWS and HCEBS to deliver water and provide continuous flow to Hilton Creek without interruption;
- Collaborate with Reclamation regarding Critical Drought Conditions (i.e., flow adjustments to Hilton Creek and the LYSR mainstem, target flows, etc.) 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 within the LSYR mainstem and its tributaries 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;
- Continue to maintain the LSYR *O. mykiss* scale inventory and conduct analyses of growth rates, evidence of life-history strategies such as fresh versus marine water rearing, signs of spawning, etc. in support of ongoing fisheries investigations;
- Continue working with the US Geological Survey, specifically at all LSYR basin gauges, to obtain accurate real-time measurements and to identify appropriate transect locations for stage-discharge relationships.
- Develop a more fluid data recording and reporting procedure with regard to temperature probes on the Outlet Works of Bradbury Dam in order to keep track of the temperature of the water being released into 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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3. Monitoring Results

Table 1: WY2000 to WY2015 rainfall at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Water Year	Rainfall Bradbury* (in)	Year Type**	Spill	Reservoir Condition Storage (max) (af)	Reservoir Condition Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.50	Normal	Yes	192,948	750.83	No	Yes
2001	31.80	Wet	Yes	194,519	751.34	No	No
2002	8.80	Dry	No	173,308	744.99	No	Yes
2003	19.80	Normal	No	130,784	728.39	No	No
2004	10.60	Dry	No	115,342	721.47	No	Yes
2005	44.41	Wet	Yes	197,649	753.11	No	No
2006	24.50	Wet	Yes	197,775	753.15	Yes	No
2007	7.40	Dry	No	180,115	747.35	No	Yes
2008	22.59	Wet	Yes	196,365	752.70	No	No
2009	13.66	Dry	No	168,902	743.81	No	No
2010	23.92	Wet	No	178,075	747.05	Yes	Yes
2011	31.09	Wet	Yes	195,763	753.06	No	No
2012	12.69	Dry	No	180,986	748.06	No	No
2013	7.57	Dry	No	142,970	733.92	No	Yes
2014	9.96	Dry	No	91,681	710.00	No	Yes
2015	9.38	Dry	No	60,992	691.09	No	Yes

* Bradbury Dam rainfall (Cachuma) period of record = 58 years (1953-2015) with an average rainfall of 20.04 inches.

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

Table 2: WY2015 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 (WY2015) (in)
Lompoc	439	1955	61	14.51	5.31	2007	34.42	1983	8.03
Buellton	233	1955	61	16.80	5.87	2014	41.56	1998	6.94
Solvang	393	1965	51	18.55	6.47	2007	43.87	1998	7.12
Santa Ynez	218	1951	65	15.81	6.58	2007	36.36	1998	8.11
Cachuma*	USBR	1953	63	20.04	7.41	2007	53.65	1998	9.38
Gibraltar	230	1920	96	26.45	8.50	2013	73.12	1998	13.11
Jameson	232	1926	90	29.01	8.50	2007	79.52	1969	14.23

* 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 WY2015; 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	11/1/2014	0.85	No	No
2	12/2/2014	1.76	No	No
3	12/12/2014	3.43	No	Yes
4	12/16/2014	0.68	Yes	No
5	1/11/2015	0.67	No	No
6	1/27/2015	0.14	No	No
7	2/8/2015	0.44	No	No
8	4/8/2015	0.12	No	No
9	4/26/2015	0.24	No	No
10	5/8/2015	0.23	No	No
11	6/10/2015	0.42	No	No
12	9/15/2015	0.15	No	No

(b)

Month	Rain (in.)
October-14	0
November-14	0.87
December-14	5.88
January-15	0.82
February-15	0.51
March-15	0.08
April-15	0.36
May-15	0.26
June-15	0.42
July-15	0.03
August-15	0
September-15	0.15
Total:	**9.38**

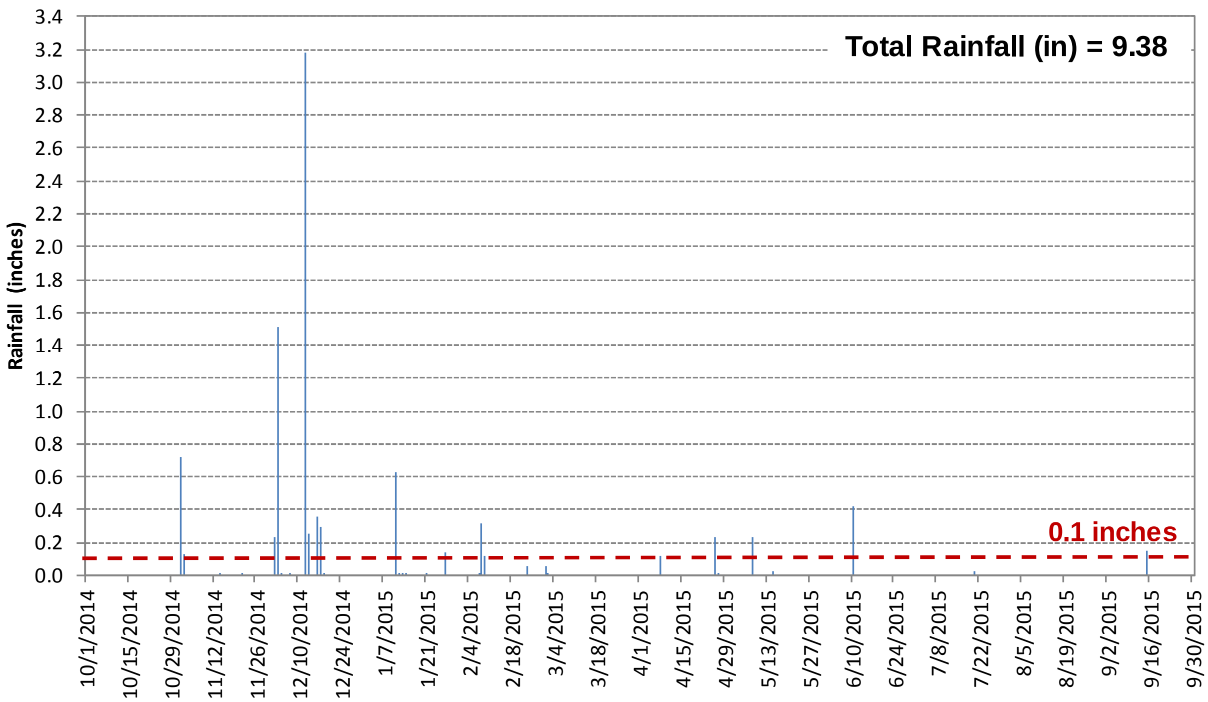


Figure 1: Rainfall in WY2015 recorded at Bradbury Dam (USBR).

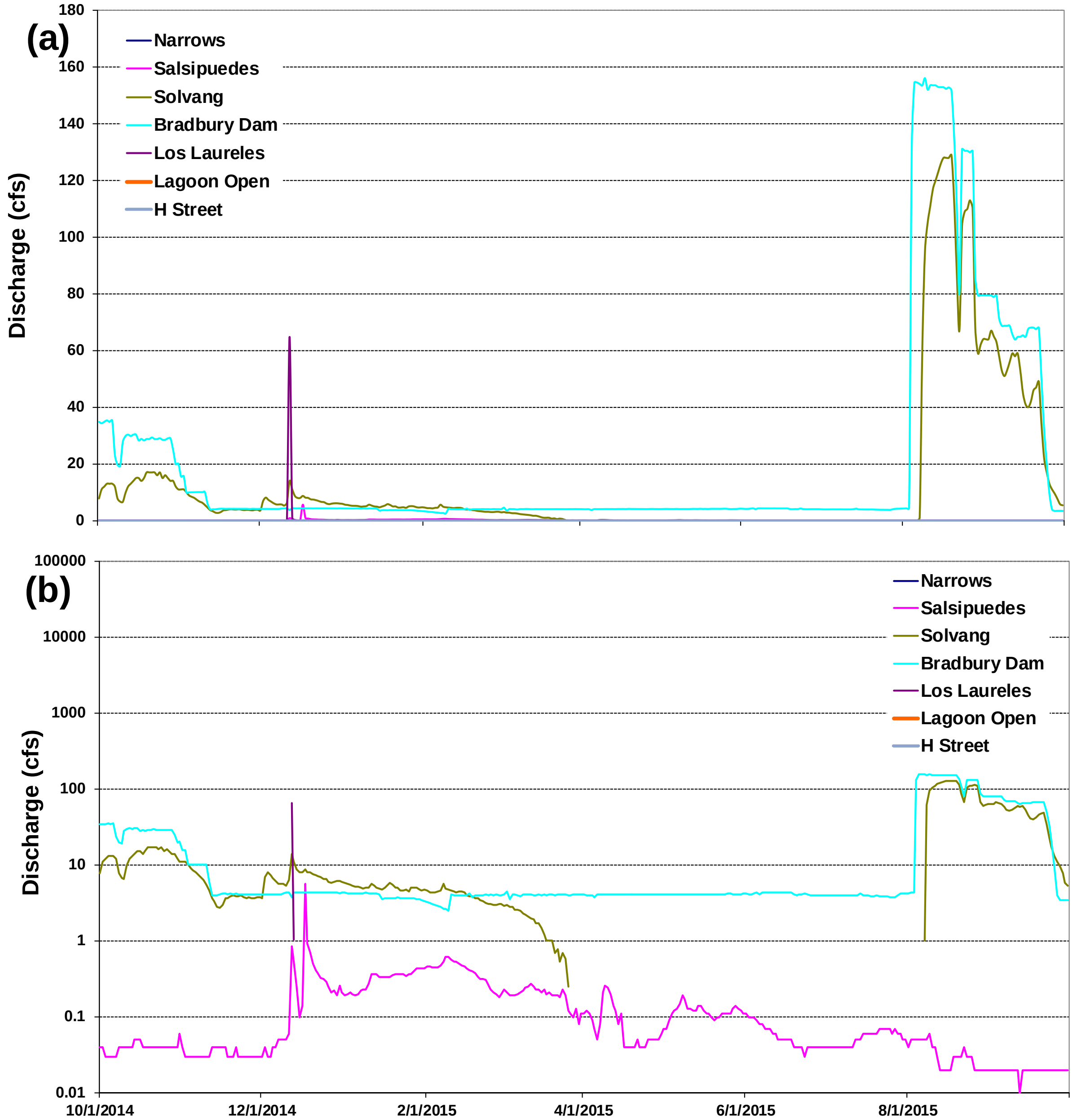


Figure 2: Santa Ynez River and tributary average daily discharge in WY2015 with a (a) normal and (b) logarithmic distribution; the Santa Ynez River lagoon was not open in WY2015 (source USGS and USBR).

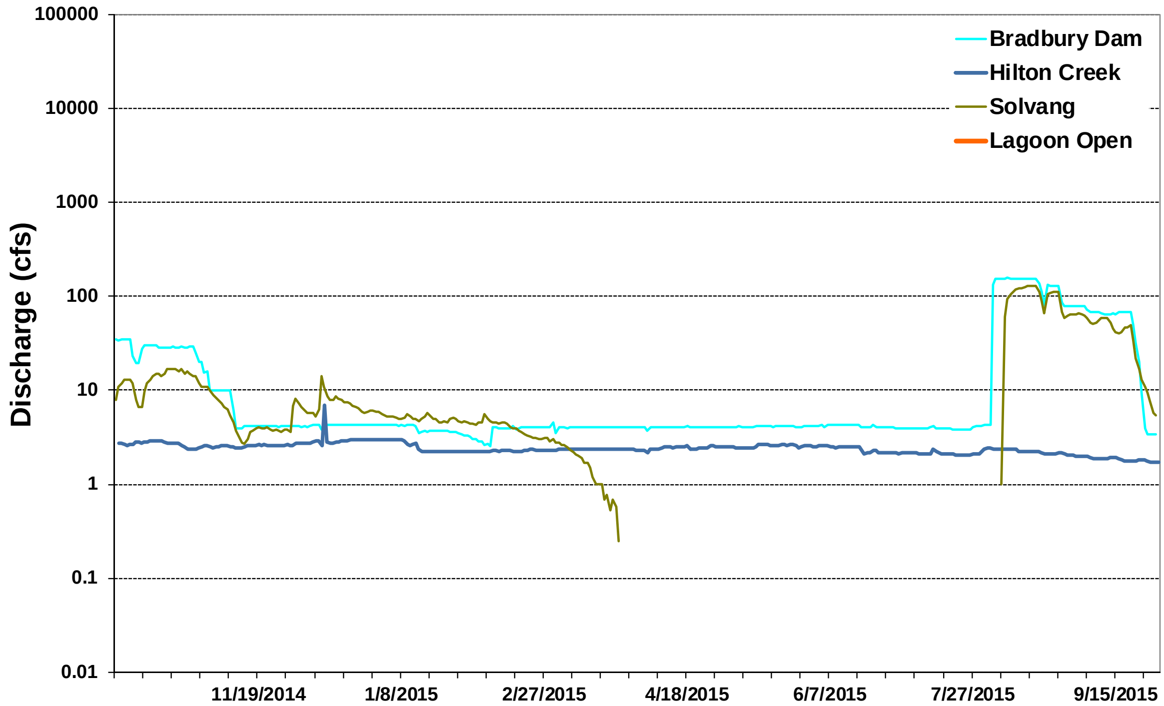


Figure 3: Average daily discharge at Hilton Creek, just downstream of the Upper Release Point, the LSYR mainstem at Solvang (Alisal Bridge) and Bradbury Dam during WY2015; the Hilton Creek USGS gauge is a low flow gauge hence does not record much above 50 cfs; the lagoon was not open during WY2015.

Table 4: Ocean connectivity, lagoon status and number of days open during the migration season from WY2001 to WY2015.

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
2015	Dry	No	-	-	0	0
*Migration Season is January through May.						
**Lagoon opened and closed several times during the water year.						

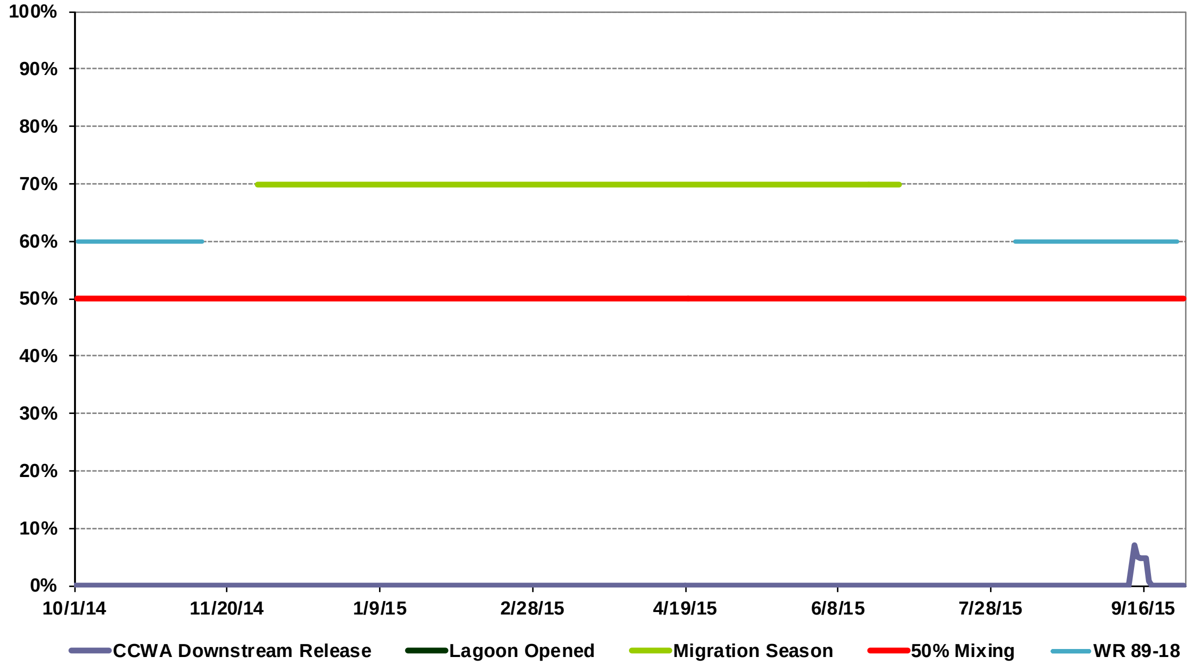


Figure 4: Percentage of CCWA water released from Bradbury Dam downstream to the Long Pool and the Lower Santa Ynez River during the WY2015 migration season; the lagoon was not open throughout the monitoring period.

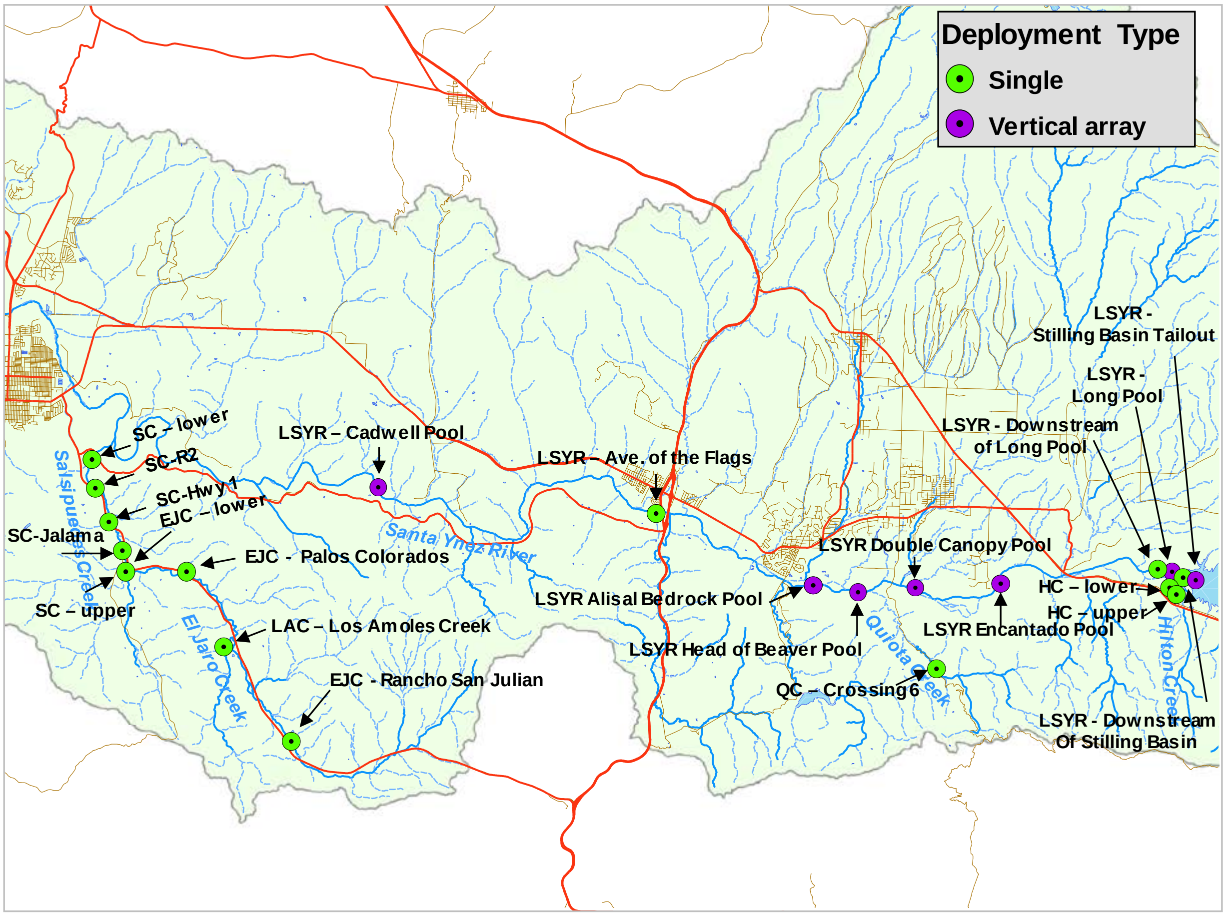


Figure 5: Thermograph single and vertical array deployment locations in WY2015 within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are very close together with overlapping symbols.

Table 5: 2015 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-0.20	Vertical Array	7/2/15	11/3/2015	121
	LSYR - D/s of Stilling Basin	LSYR-0.25	Single	4/1/2015	11/3/2015	212
	LSYR - Long Pool	LSYR-0.51	Vertical Array	4/15/2015	11/3/2015	198
	LSYR - D/s of Long Pool	LSYR-0.62	Single	4/1/2015	11/3/2015	212
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	9/10/2015	11/3/2015	53
	LSYR - Double Canopy	LSYR-7.65	Vertical Array	9/10/2015	11/3/2015	53
	LSYR - Head of Beaver	LSYR-8.7	Vertical Array	9/10/2015	11/3/2015	53
	LSYR - Alisal Bedrock Pool	LSYR-10.2	Vertical Array	9/16/2015	11/3/2015	47
	LSYR - Avenue of the Flags	LSYR-13.9	Single	9/10/2015	11/3/2015	53
	LSYR - Cadwell Pool	LSYR-22.68	Vertical Array	9/10/2015	11/3/2015	53
Tributaries	Hilton Creek (HC)-lower	HC-0.12	Single	3/25/2015	11/11/2015	226
	HC-upper	HC-0.54	Single	3/25/2015	11/11/2015	226
	Quiota Creek (QC)-Crossing 6	QC-2.66	Single	4/15/2015	7/20/2015	95
	Salsipuedes Creek (SC)-lower-Reach 1	SC-0.77	Single	4/15/2015	11/5/2015	200
	SC-Reach 2-Bedrock Section	SC-2.2	Single	4/15/2015	11/5/2015	200
	SC-Reach 4-Hwy 1 Bridge	SC-3.0	Single	4/15/2015	11/5/2015	200
	SC-Reach 5-Jalama Bridge	SC-3.5	Single	4/15/2015	11/5/2015	200
	SC-upper at El Jaro confluence	SC-3.8	Single		Dry	
	El Jaro Creek (EJC)-Lower-Confluence	EJC-3.81	Single	4/15/2015	8/13/2015	118
	EJC-Palos Colorados	EJC-5.4	Single	4/27/2015	11/5/2015	188
	EJC-Rancho San Julian Bridge	EJC-10.82	Single	4/15/2015	6/24/2015	69
	Los Amoles Creek (LAC)-Creek Crossing	LAC-7.0	Single	4/15/2015	11/5/2015	200

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

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	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, B, C	
		Downstream of Long Pool	LSYR-0.62	O, B	ns	O, B
Reach 2	Refugio	Encantado	LSYR-4.95	Dry		B
		Corner Scour	LSYR-5.9	Dry		B
		Double Canopy Pool	LSYR-7.65	B, S, C	B, C	B, S, C
	Alisal	Car Pool	LSYR-7.8	B	B	B, S
		Quiota Confluence Pool	LSYR-8.2		B	
		Head of Beaver Pool	LSYR-8.7	Dry	S	
		Rip-Rap Pool	LSYR-10.49	Dry	S	B, S, C
Reach 3	Ave. of the Flags	Ave. of the Flags (HWY 101)	LSYR-13.9	Dry		
	Cadwell	Cadwell Pool	LSYR-22.68	C	C	C
Tributaries:						
Hilton	Reaches 1-5		HC-00 to HC-0.54	O	ns	O
Quiota	Crossings 1-9		QC-1.82 to QC-3.21			
Salsipuedes	Reaches 1-4		SC-00 to SC-3.0	ns	ns	ns
	Reach 5		SC-3.5	ns	ns	O
El Jaro	Upstream of Confluence		EJC-3.81 to EJC-9.8	ns	ns	Dry

* O - *O. mykiss*, B - bass, S - sunfish, C - carp, blank means zero observed.
ns - not snorkeled due to turbidity.

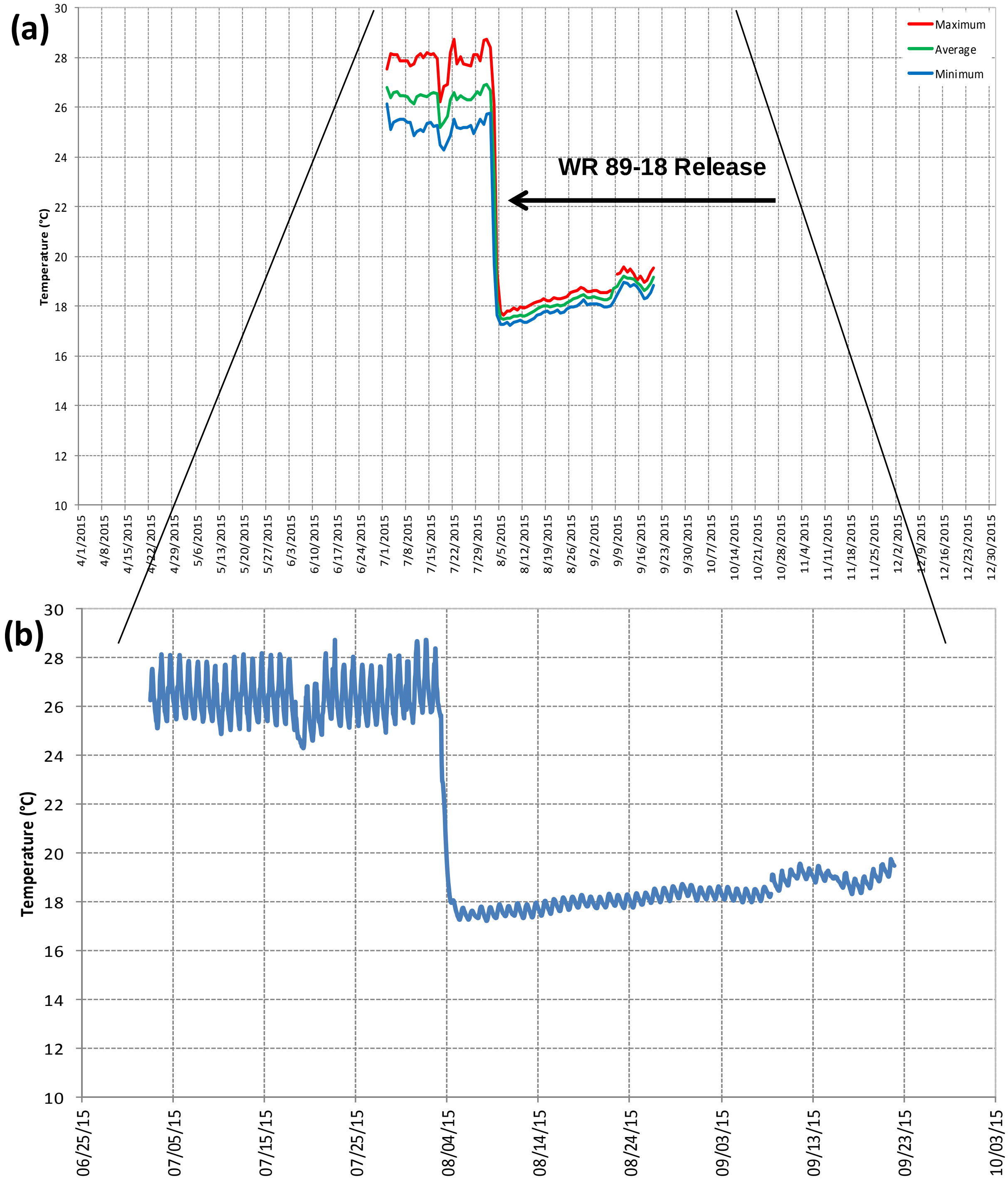


Figure 6: 2015 LSYR-0.2 (Stilling Basin tail out) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of record.

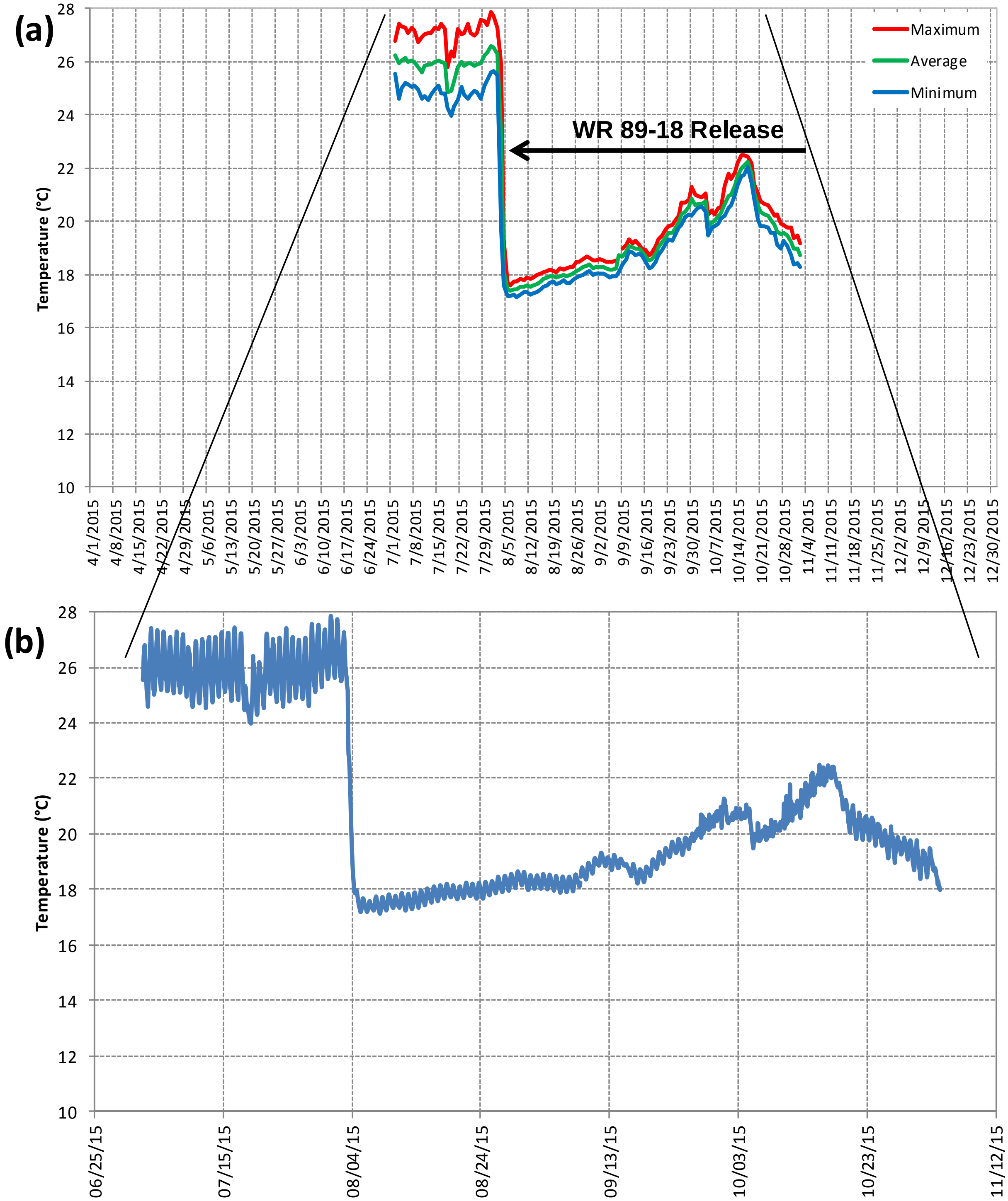


Figure 7: 2015 LSYR-0.2 (Stilling Basin tail out) bottom (7.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of record.

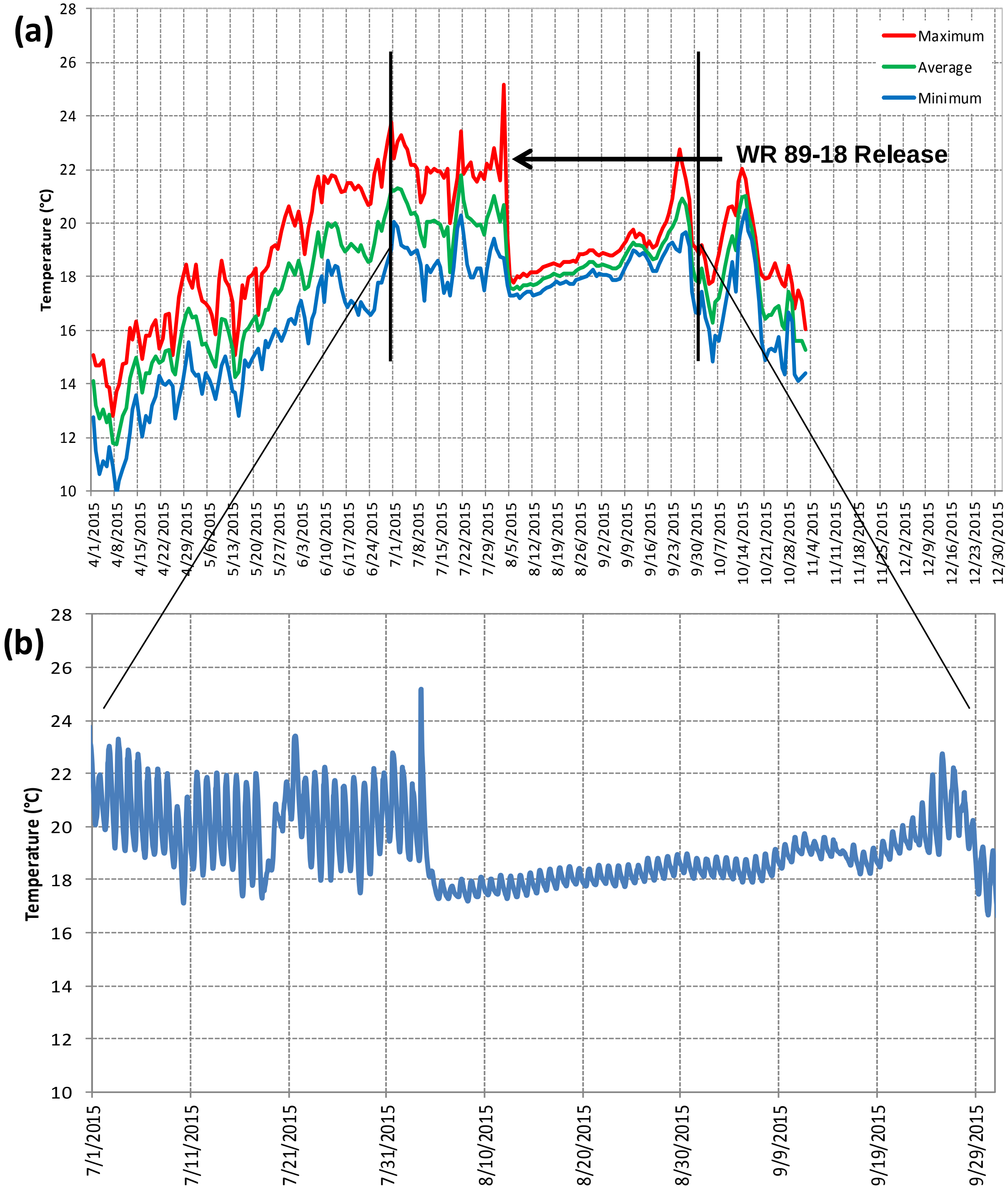


Figure 8: 2015 LSYR-0.25 (Downstream of the Stilling Basin) bottom (1.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period 7/1/15 – 10/1/15.

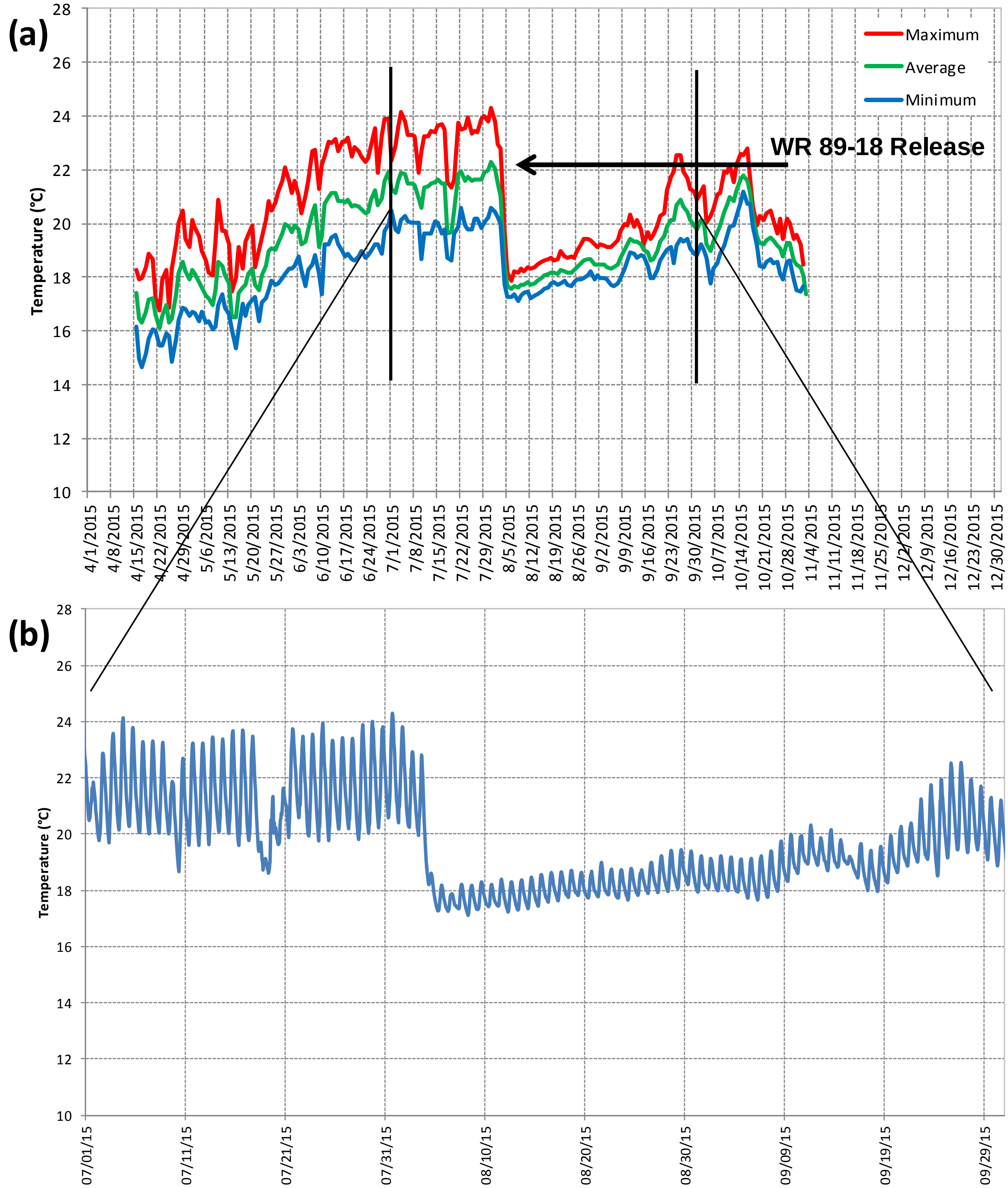


Figure 9: 2015 LSYR-0.51 (Long Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 7/1/15 – 10/1/15.

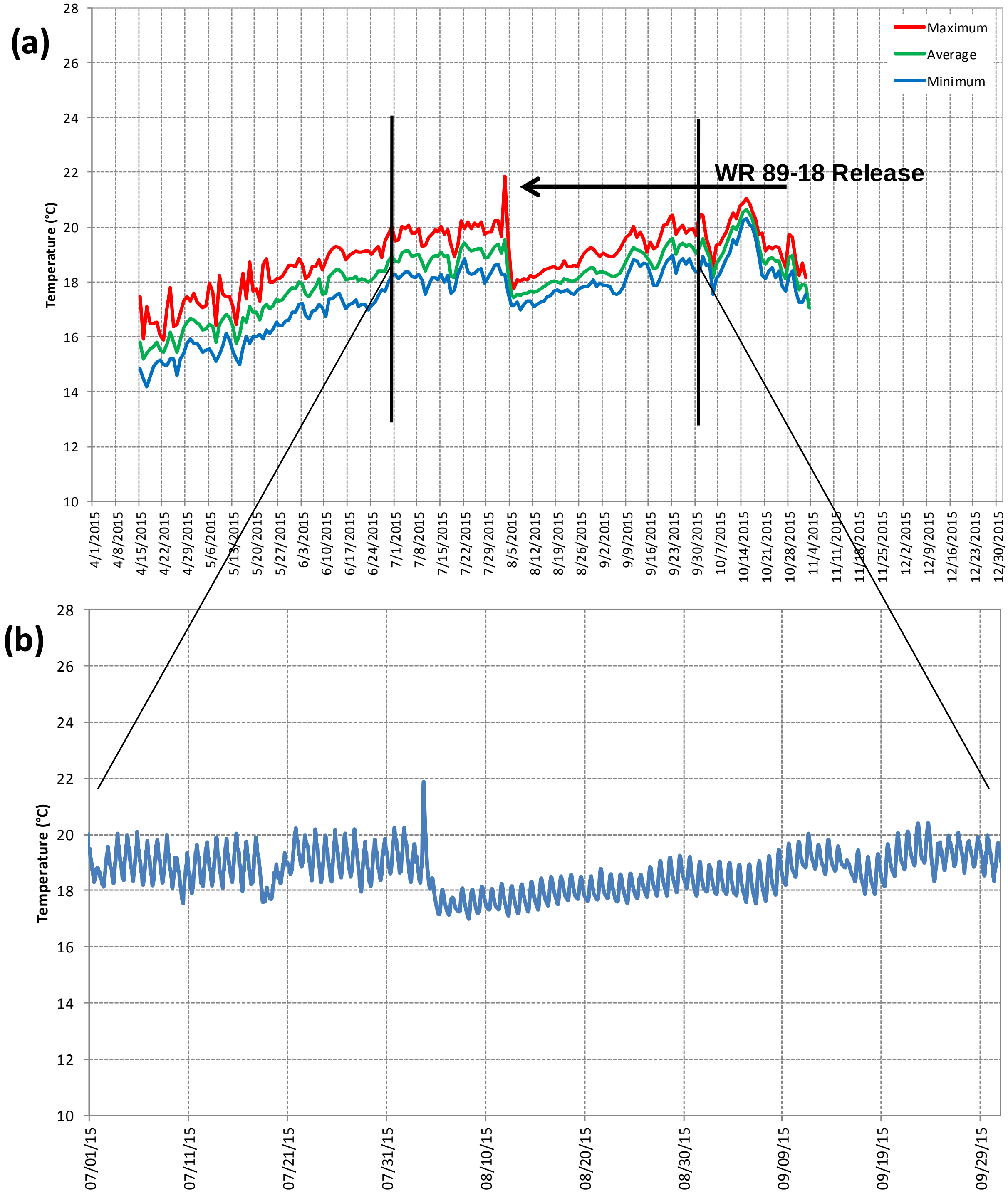


Figure 10: 2015 LSYR-0.51 (Long Pool) middle (4.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 7/1/15 – 10/1/15.

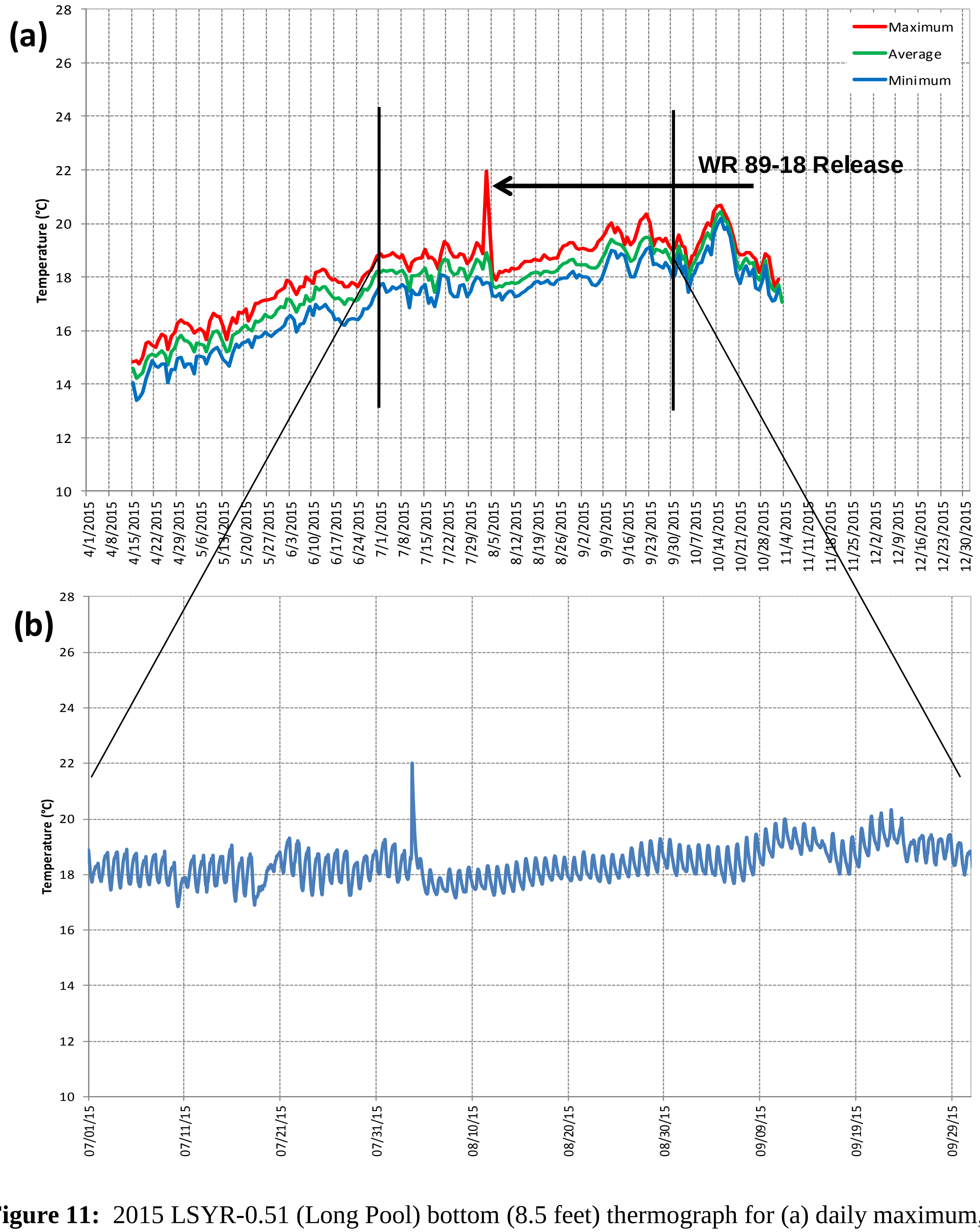


Figure 11: 2015 LSYR-0.51 (Long Pool) bottom (8.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 7/1/15 – 10/1/15.

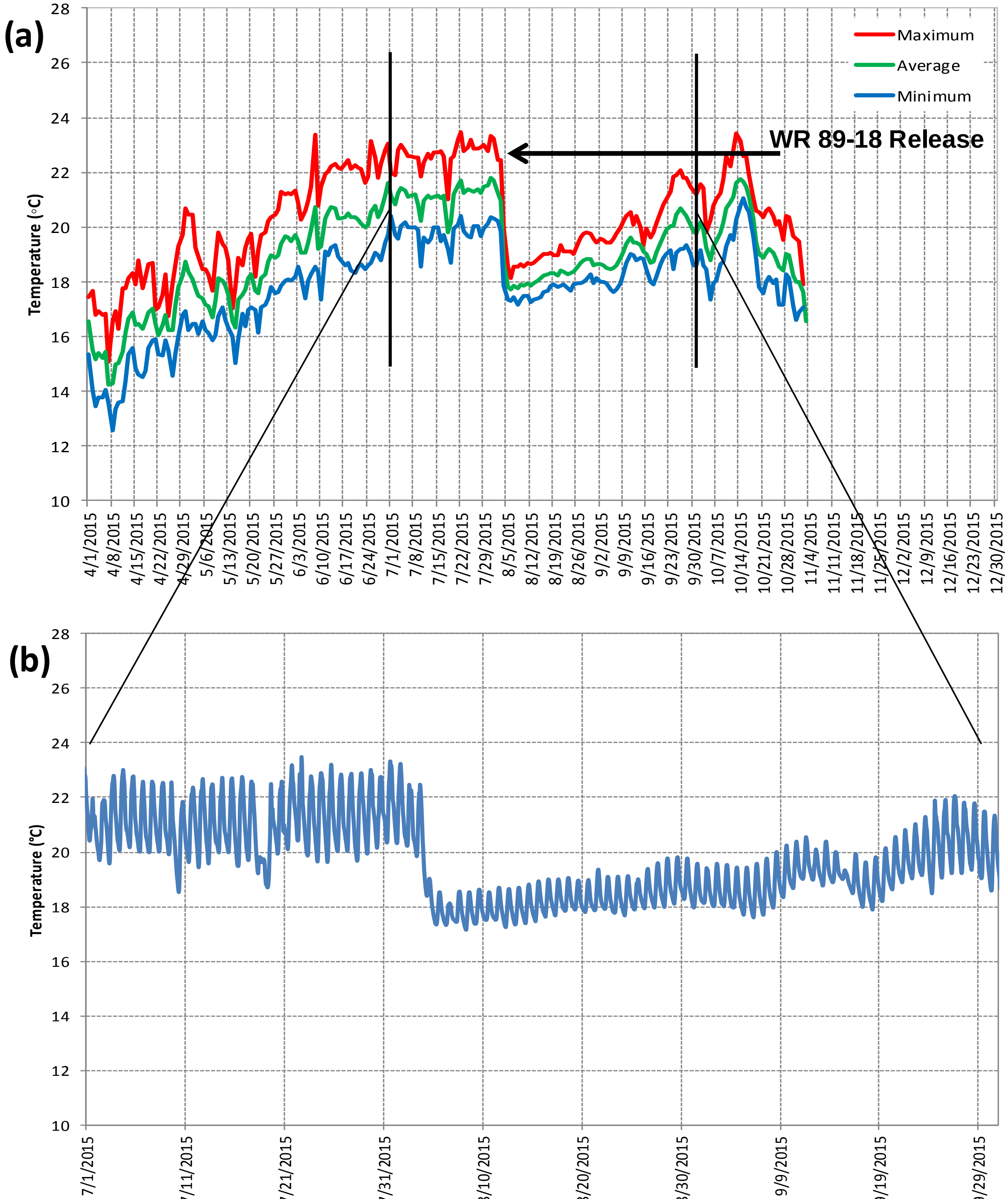


Figure 12: 2015 Reclamation property boundary LSYR 0.62 (downstream of the Long Pool) bottom (2.0 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 7/1/15 – 10/1/15.

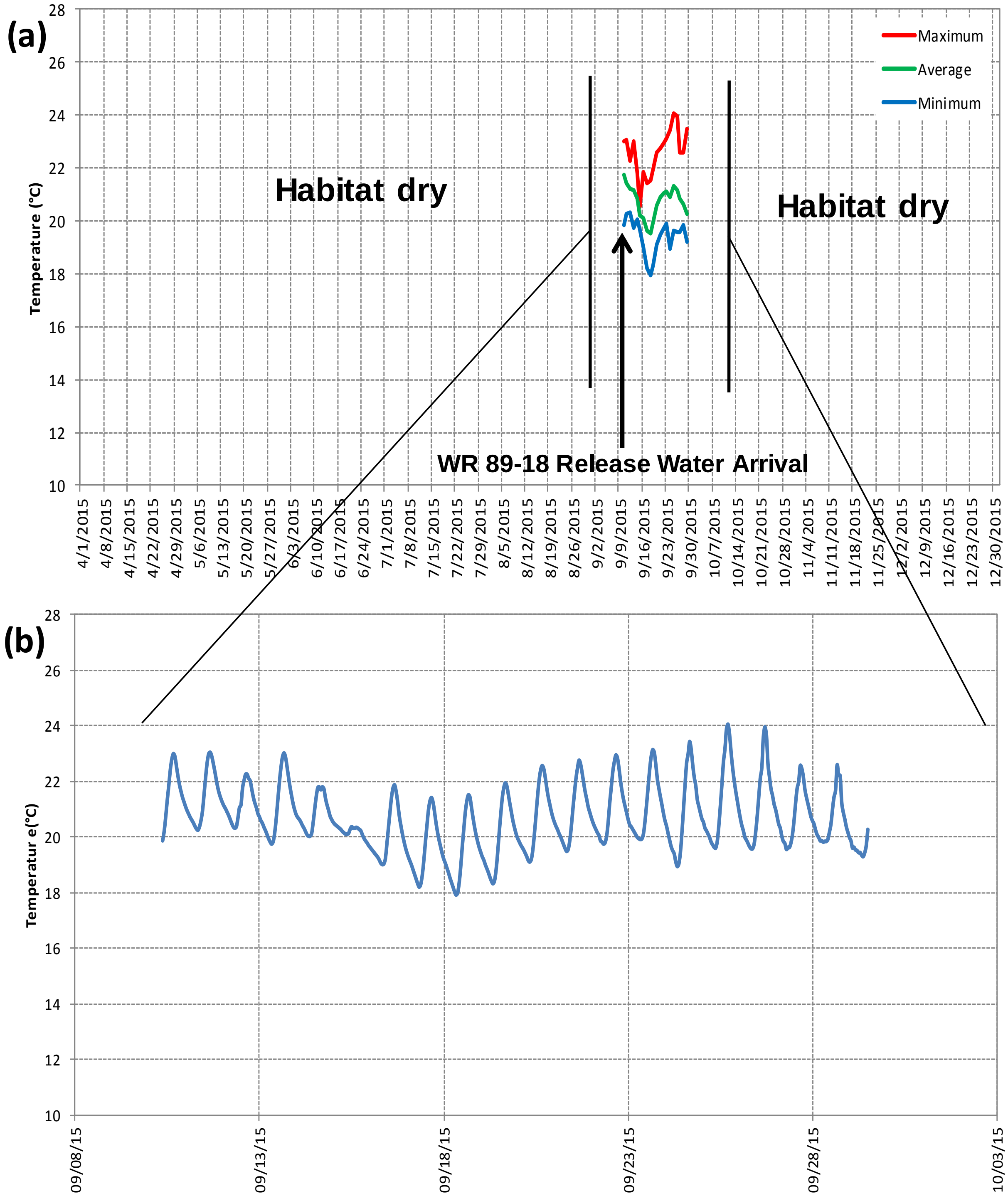


Figure 13: 2015 LSYR-4.95 (Encantado Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 9/10/15 – 10/5/15; the habitat was dry prior to WR89-18 water reaching the site.

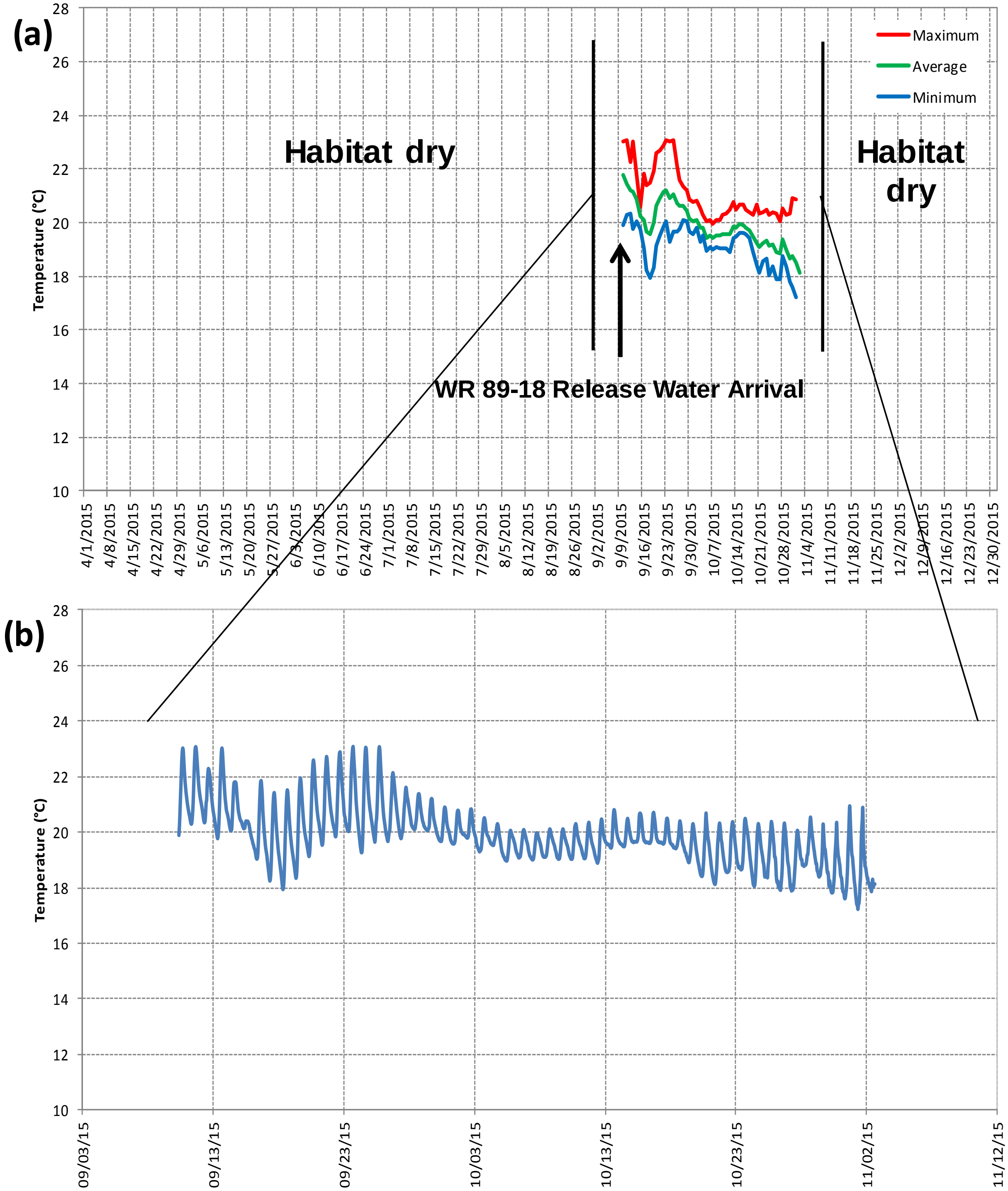


Figure 14: 2015 LSYR-4.95 (Encantado Pool) middle (3.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of record 9/10/15 – 11/3/15.

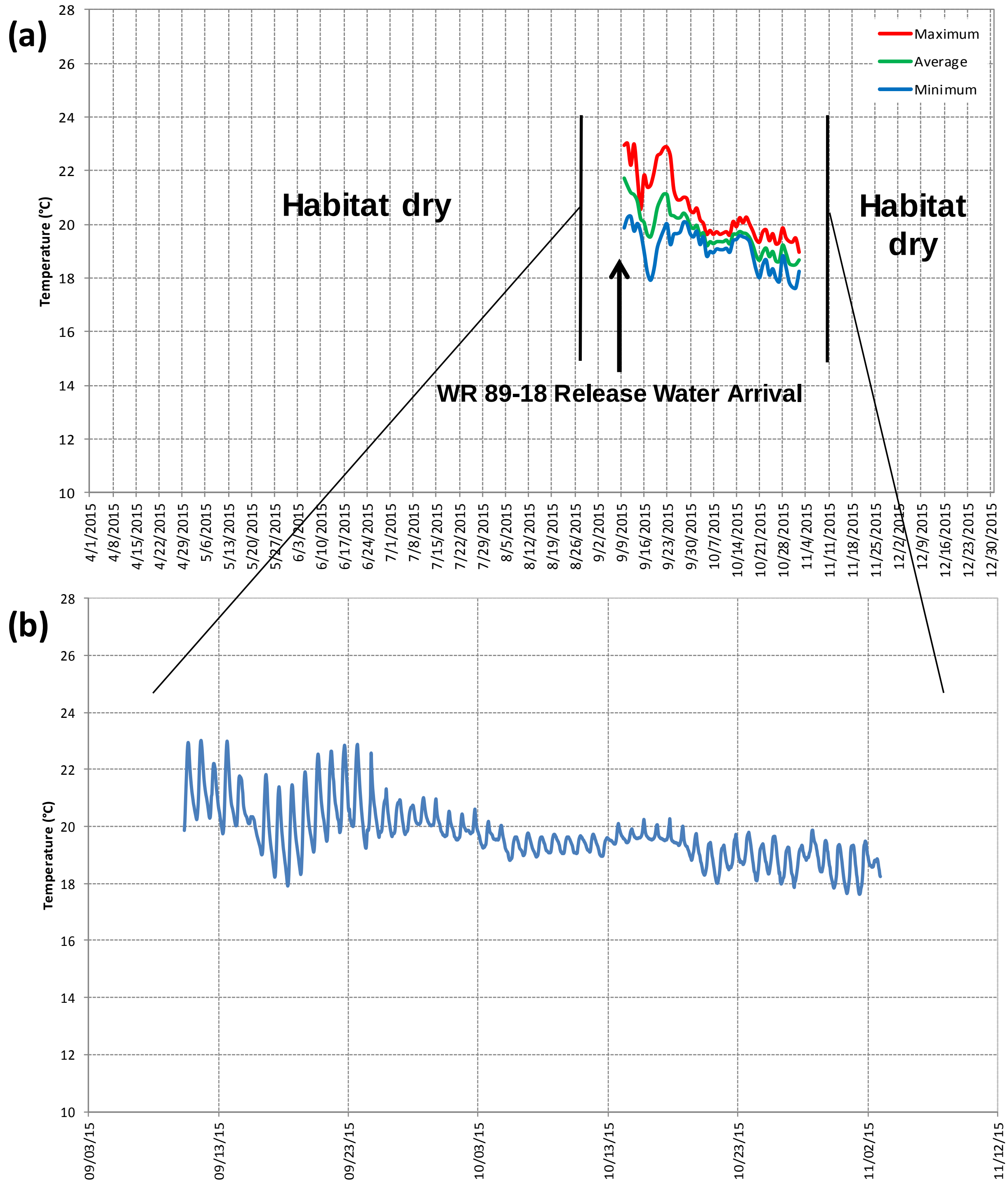


Figure 15: 2015 LSYR-4.95 (Encantado Pool) bottom (6.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of 9/10/15 – 11/3/15.

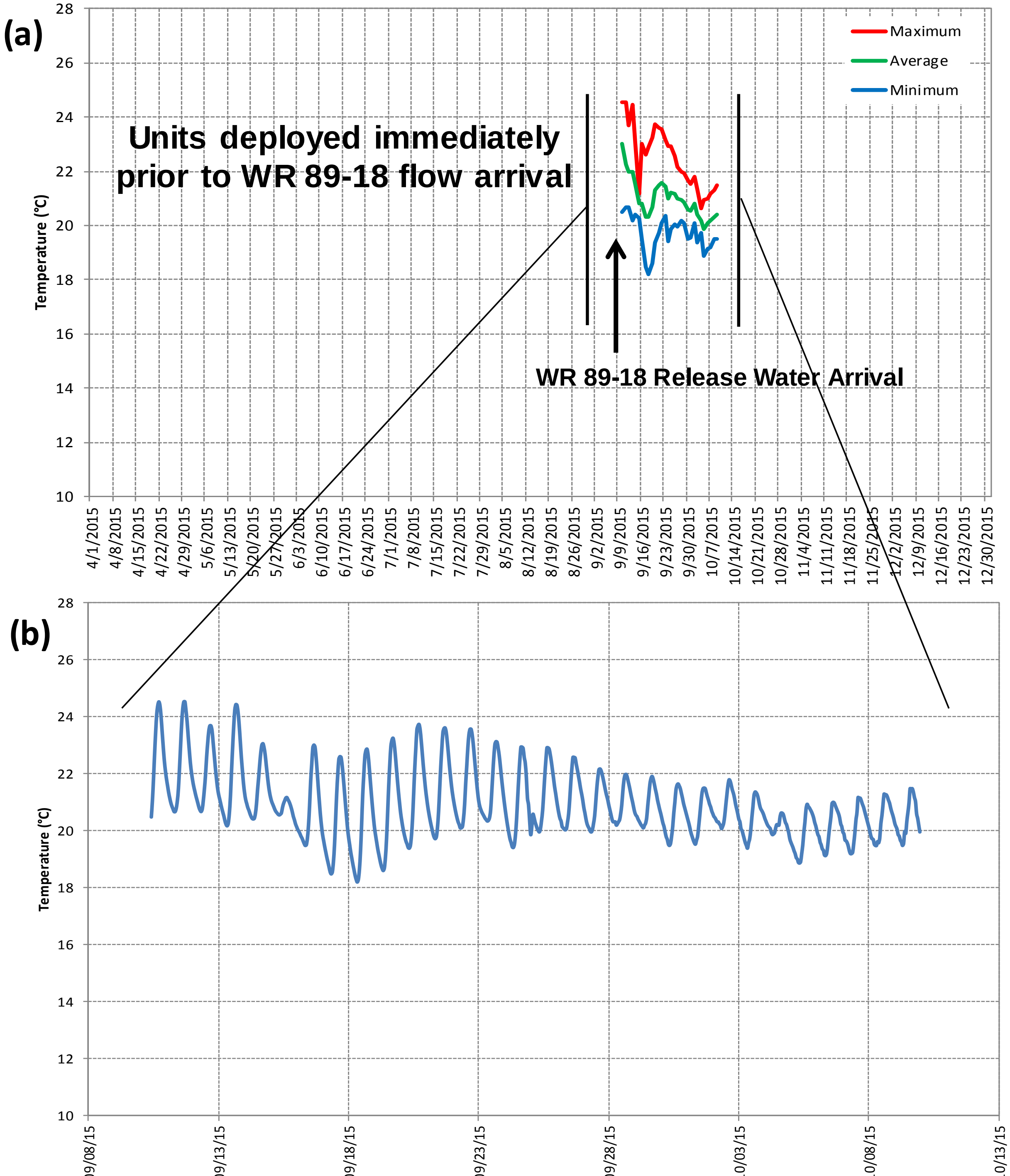


Figure 16: 2015 LSYR-7.65 (Double Canopy Pool) surface (1.0 foot) thermograph (a) daily maximum, average, and minimum values and (b) hourly data for the period 9/10/15 – 10/9/15; thermographs were deployed just prior to the arrival of the WR89-18 release.

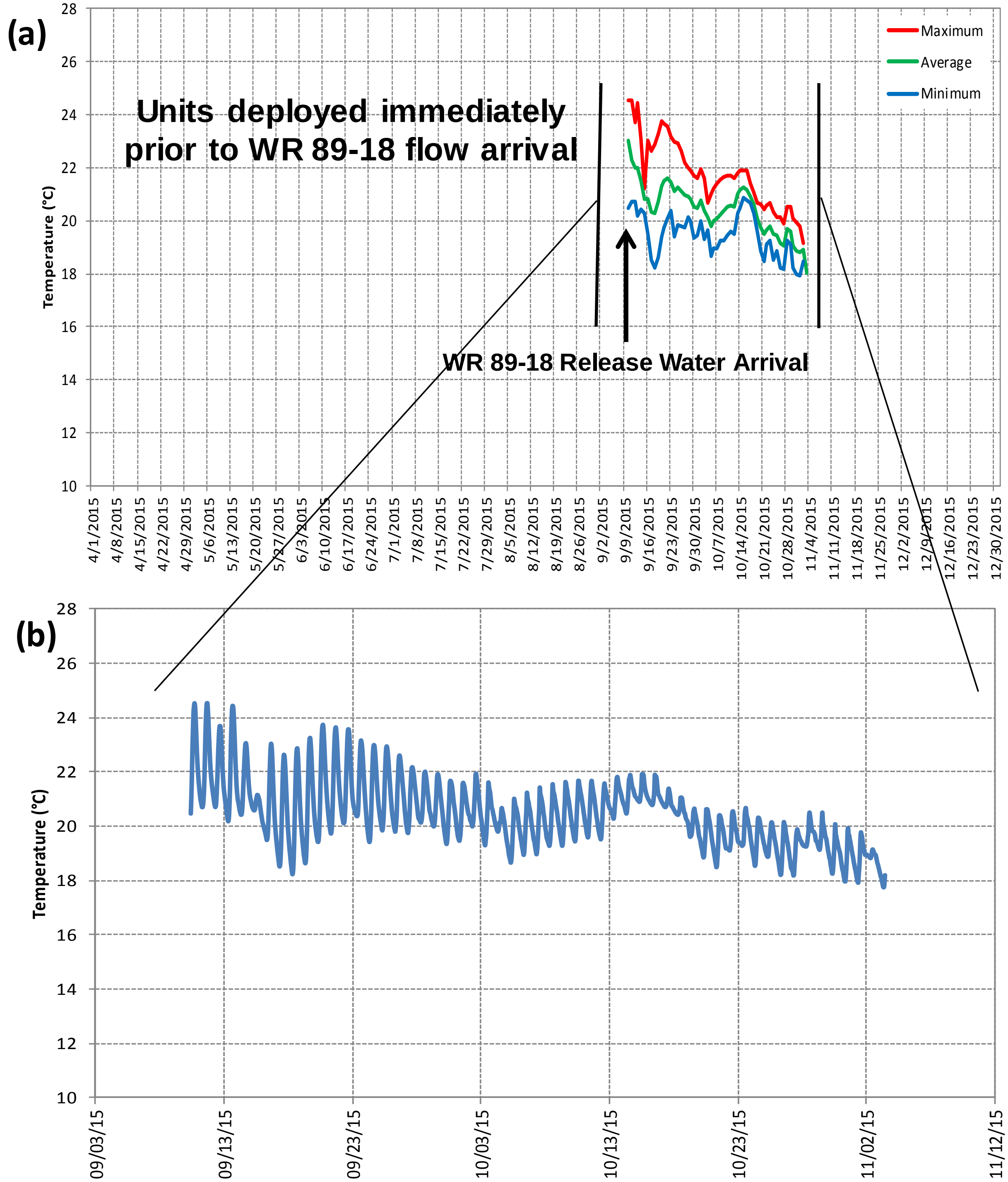


Figure 17: 2015 LSYR-7.65 (Double Canopy Pool) middle (2.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 11/3/15.

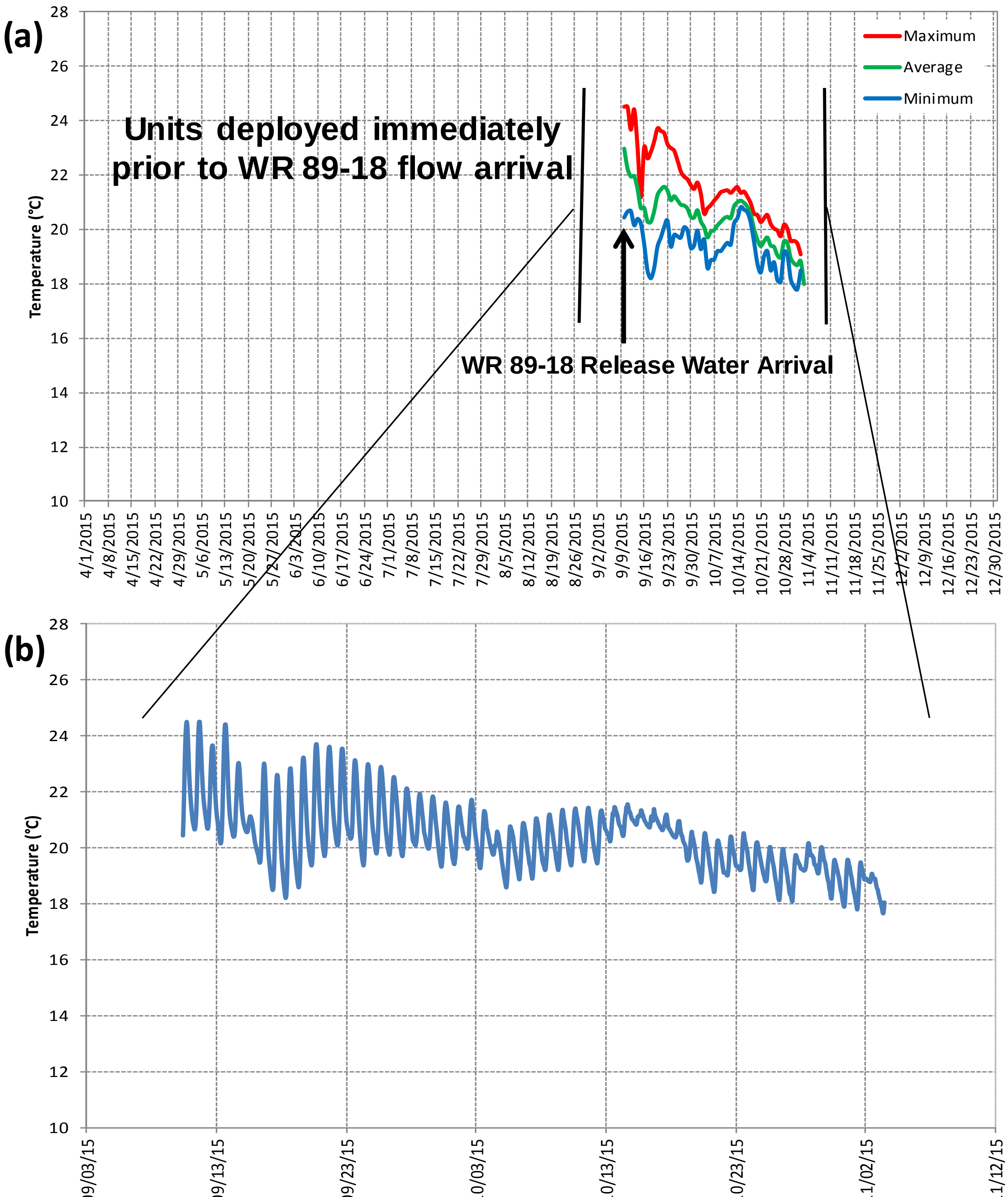


Figure 18: 2015 LSYR-7.65 (Double Canopy Pool) bottom (4.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 11/3/15.

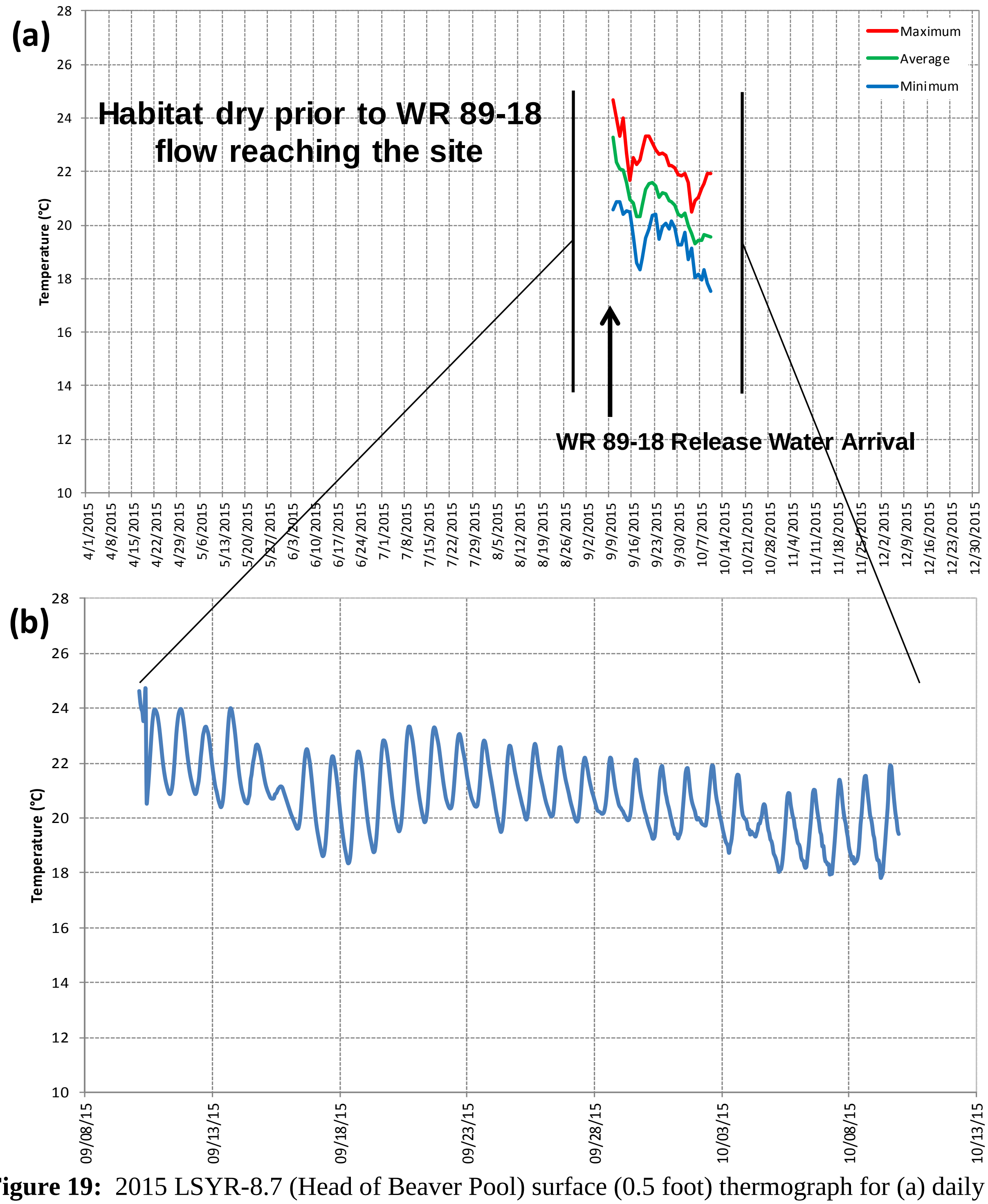


Figure 19: 2015 LSYR-8.7 (Head of Beaver Pool) surface (0.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 10/26/15; habitat unit dry prior to WR89-18 releases.

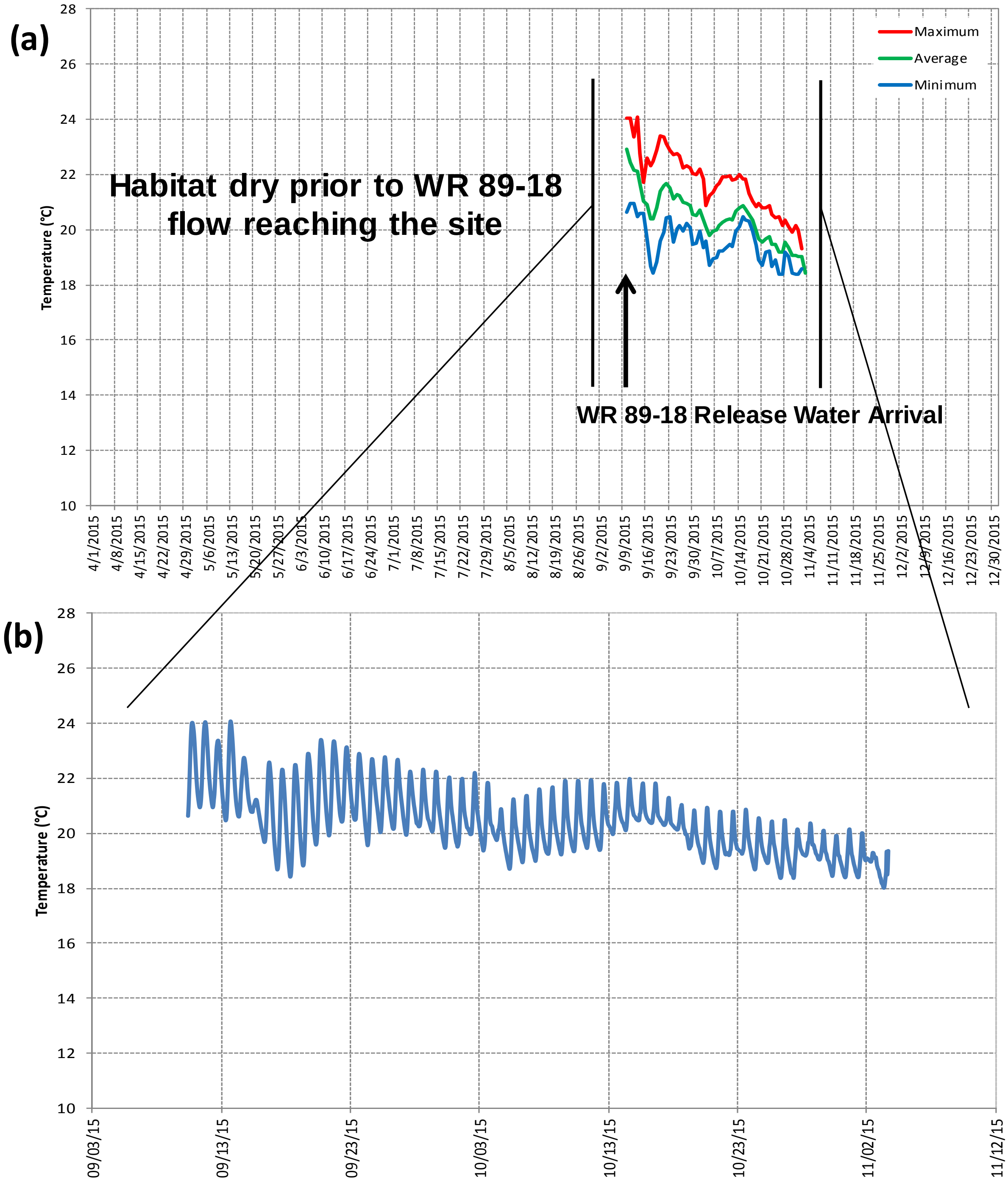


Figure 20: 2015 LSYR-8.7 (Head of Beaver Pool) middle (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 11/3/15; habitat unit was dry prior to WR89-18 releases.

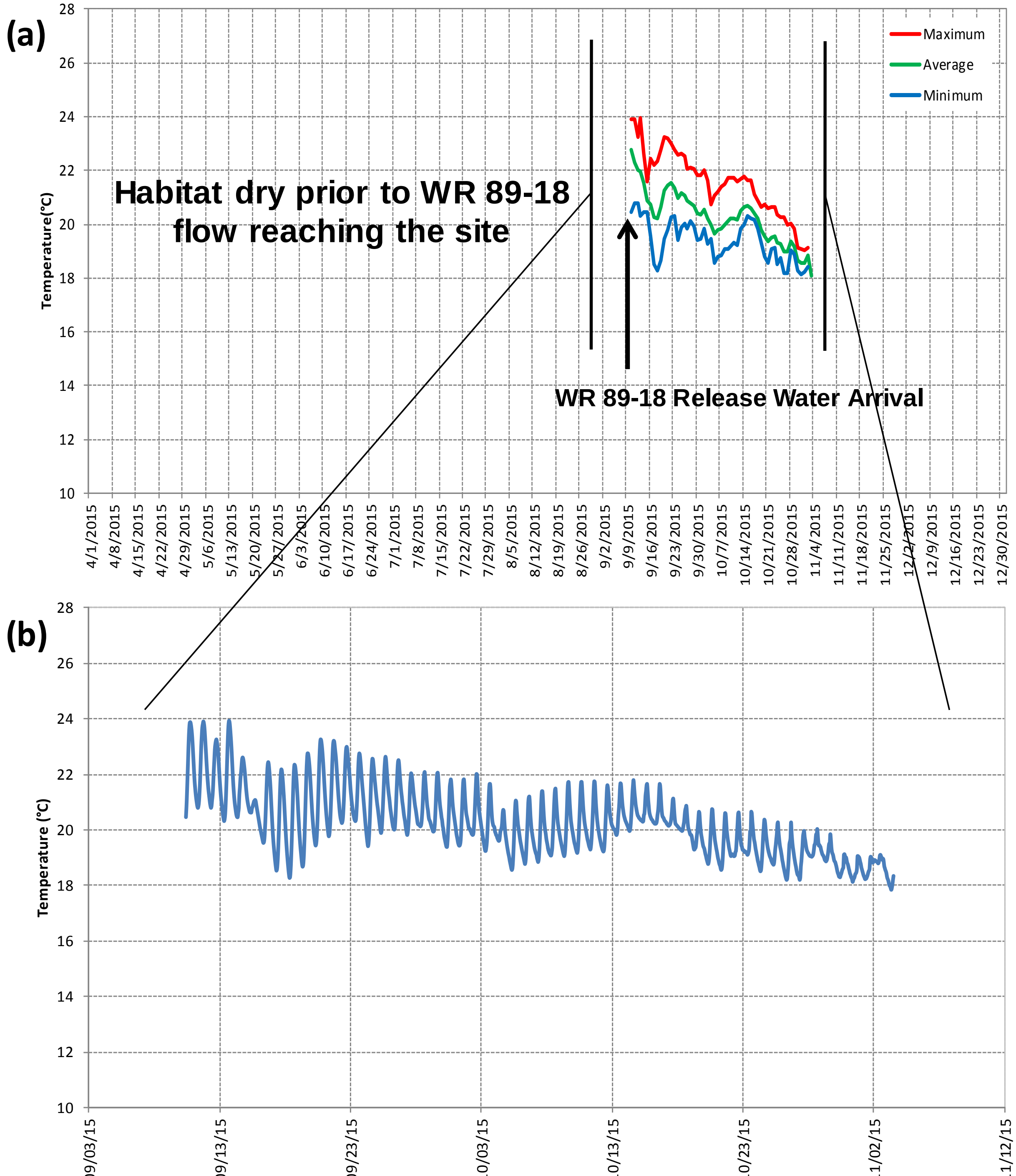


Figure 21: 2015 LSYR-8.7 (Head of Beaver Pool) bottom (4.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 11/3/15; habitat unit was dry prior to WR89-18 reaching the site.

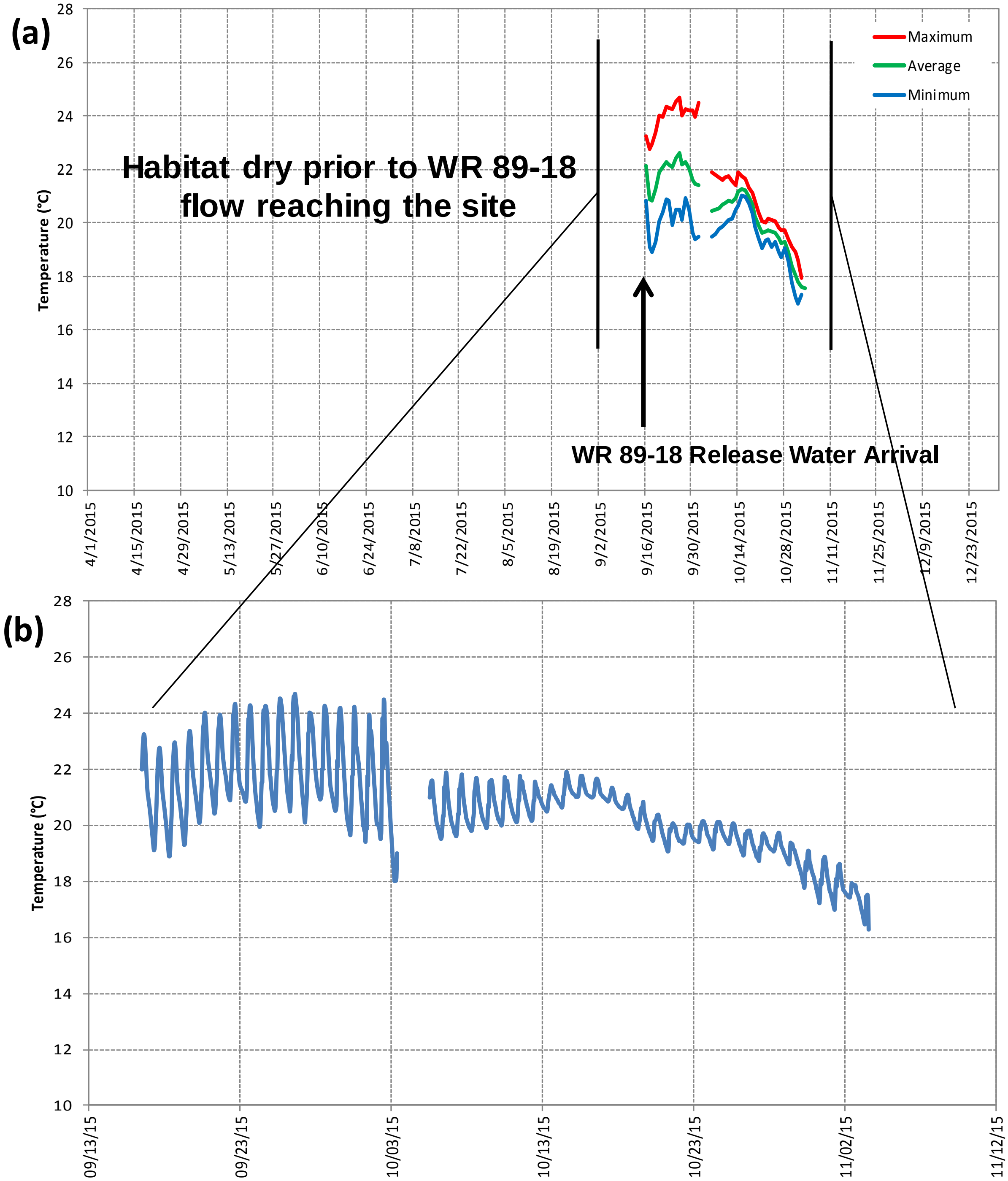


Figure 22: 2015 LSYR-10.2 (Alisal Bedrock Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period of 9/16/15 – 11/3/15; the surface unit was out of the water from 10/2/15 – 10/5/15.

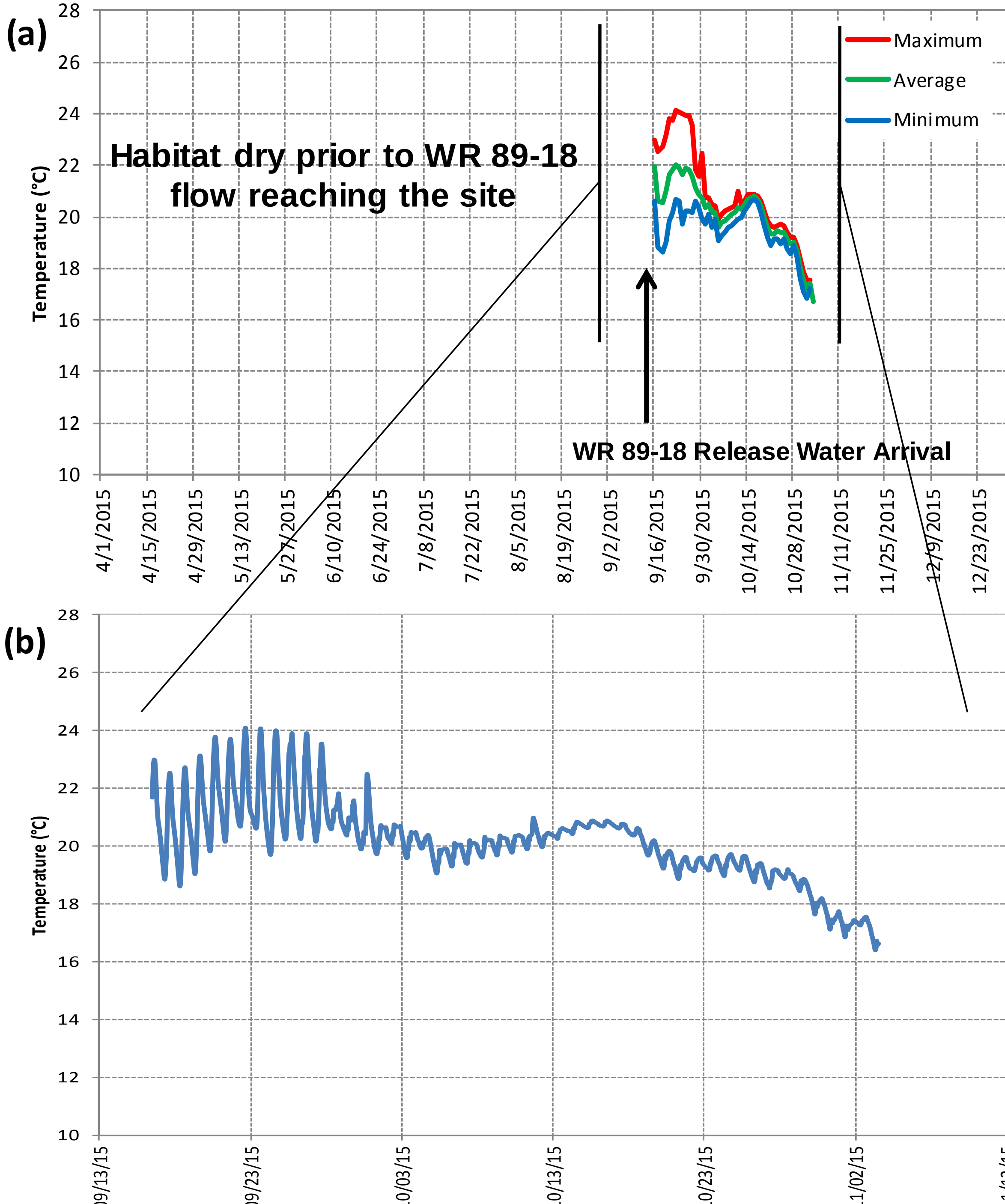


Figure 23: 2015 LSYR-10.2 (Alisal Bedrock Pool) middle (4.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/16/15 – 11/3/15; this habitat was dry prior to the arrival of the WR89-18 release.

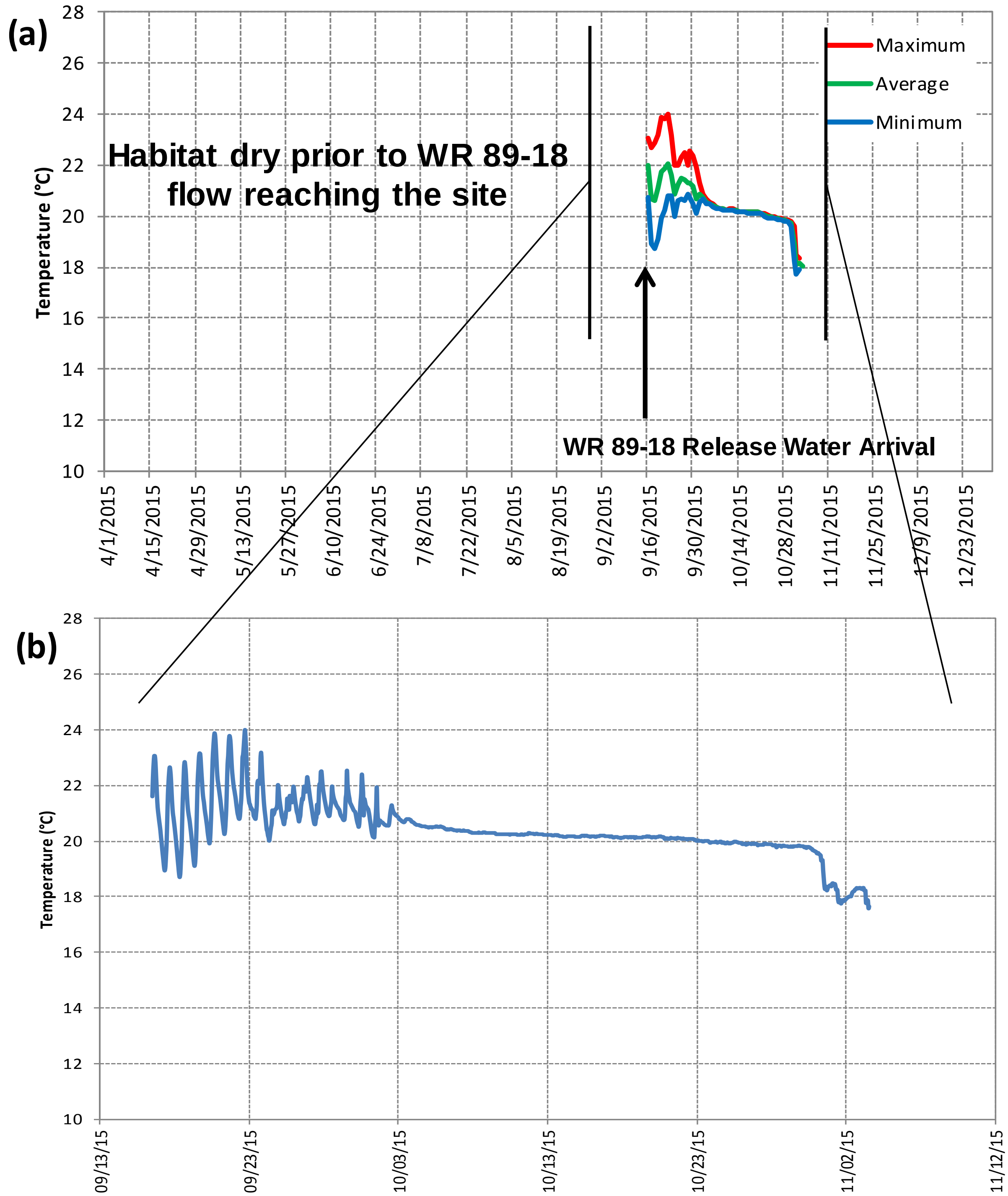


Figure 24: 2015 LSYR-10.2 (Alisal Bedrock Pool) bottom (8.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/16/15 – 11/3/15; this habitat was dry prior to the arrival of the WR89-18.

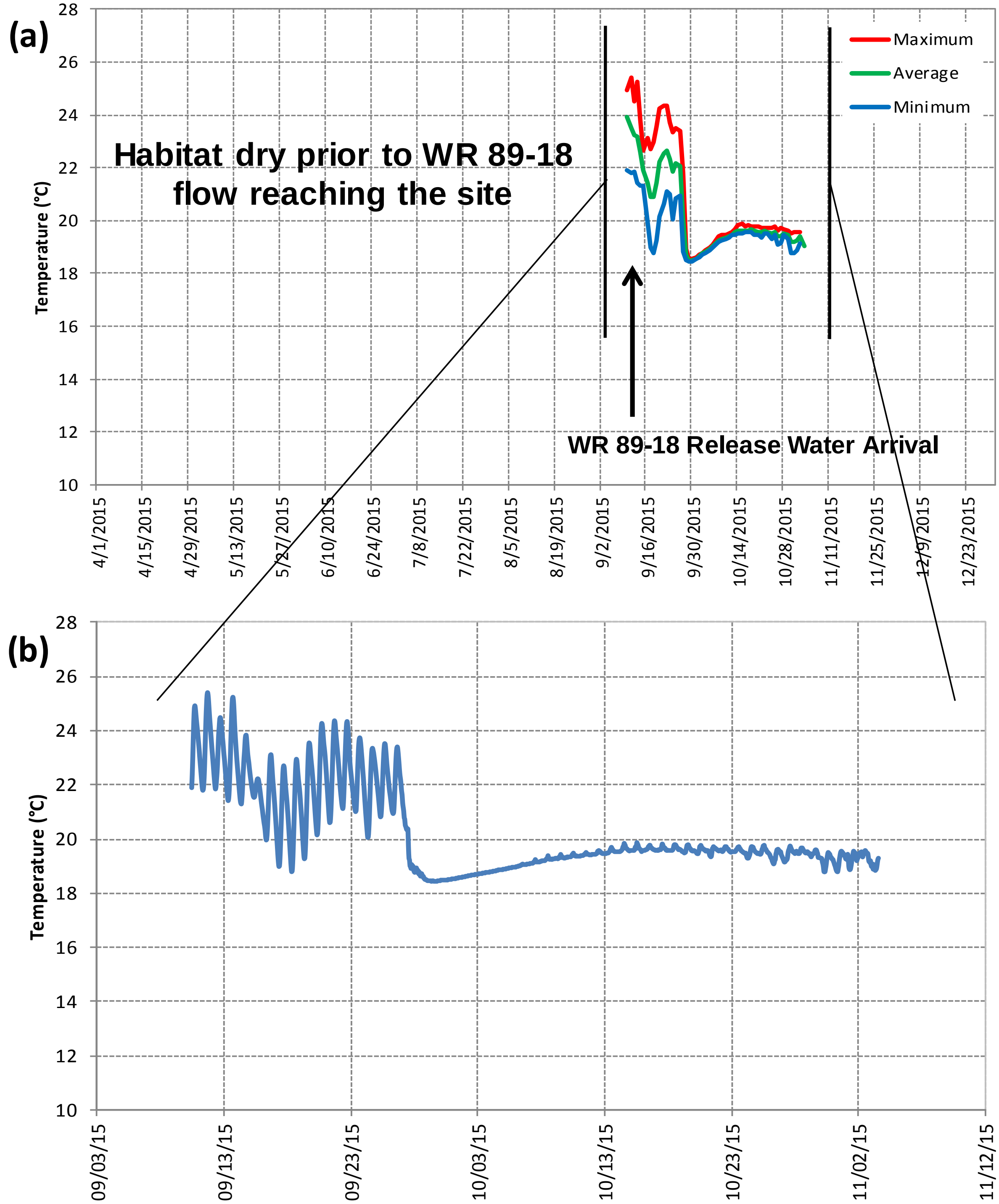


Figure 25: 2015 LSYR-13.9 (Avenue of the Flags) bottom (3.0 feet) thermograph daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 11/3/15; the habitat unit was dry prior to WR89-18 water reaching the site.

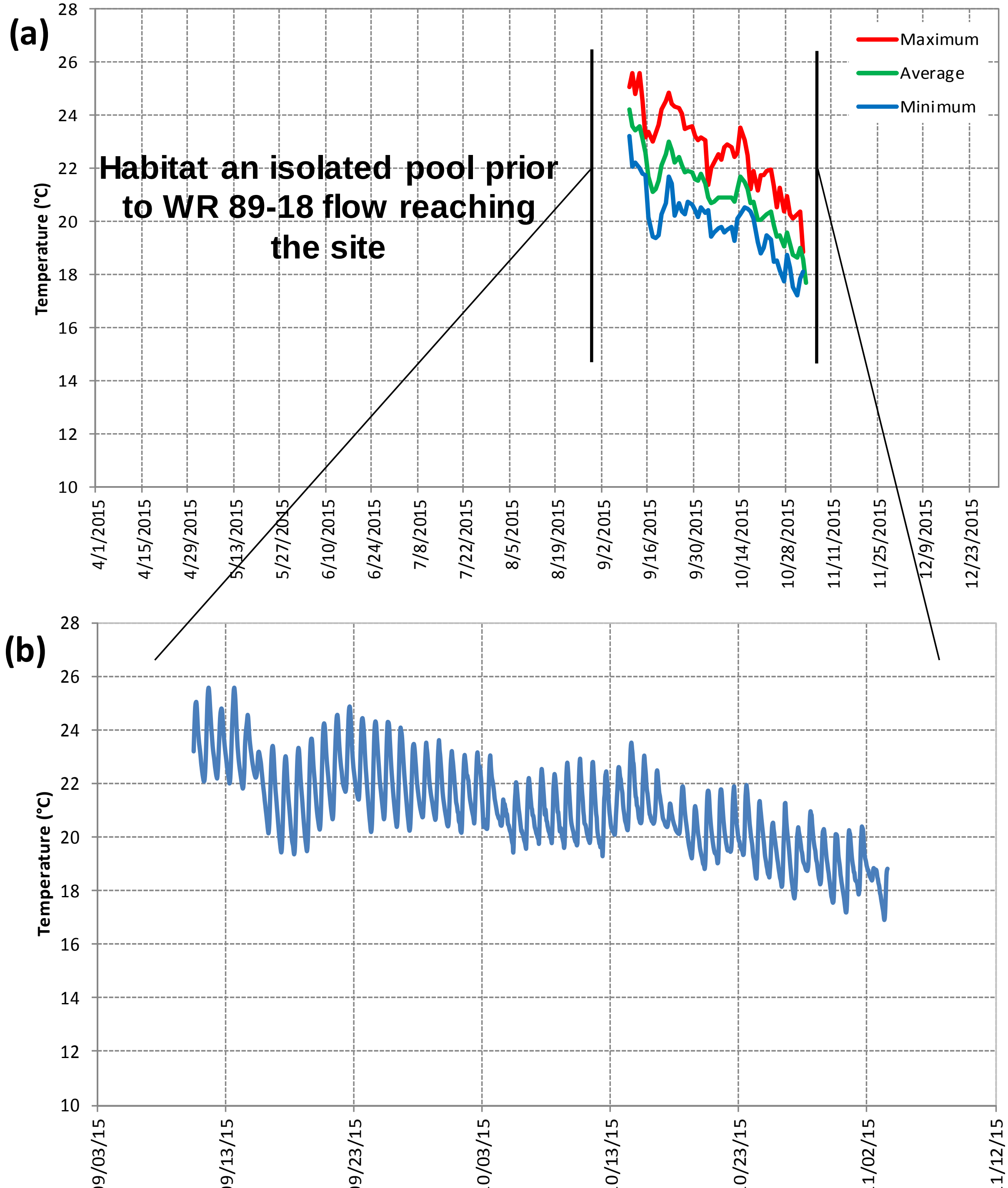


Figure 26: 2015 LSYR-22.68 (Cadwell Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the 9/10/15 – 11/3/15.

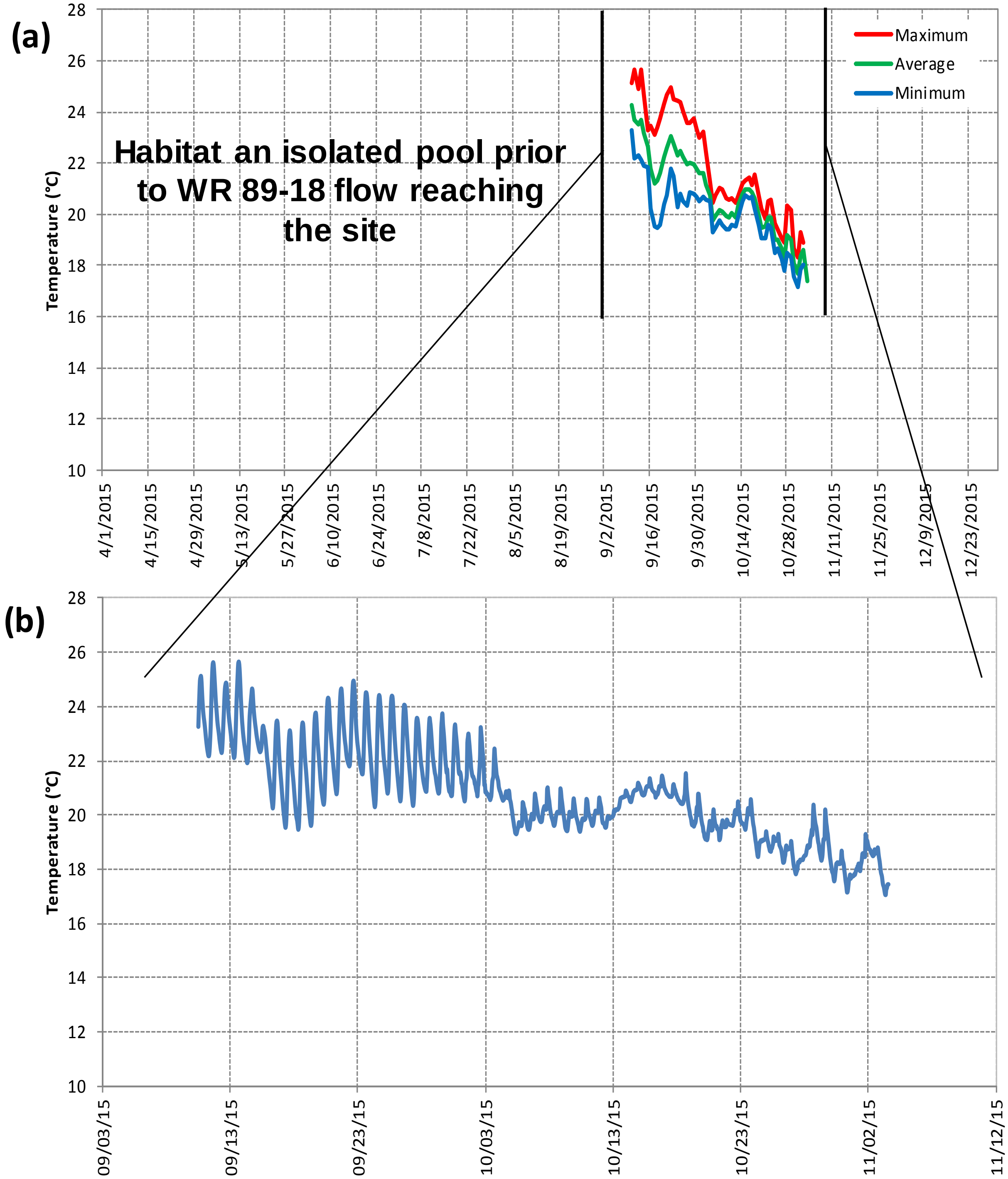


Figure 27: 2015 LSYR-22.68 (Cadwell Pool) middle (6.0 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 11/3/15.

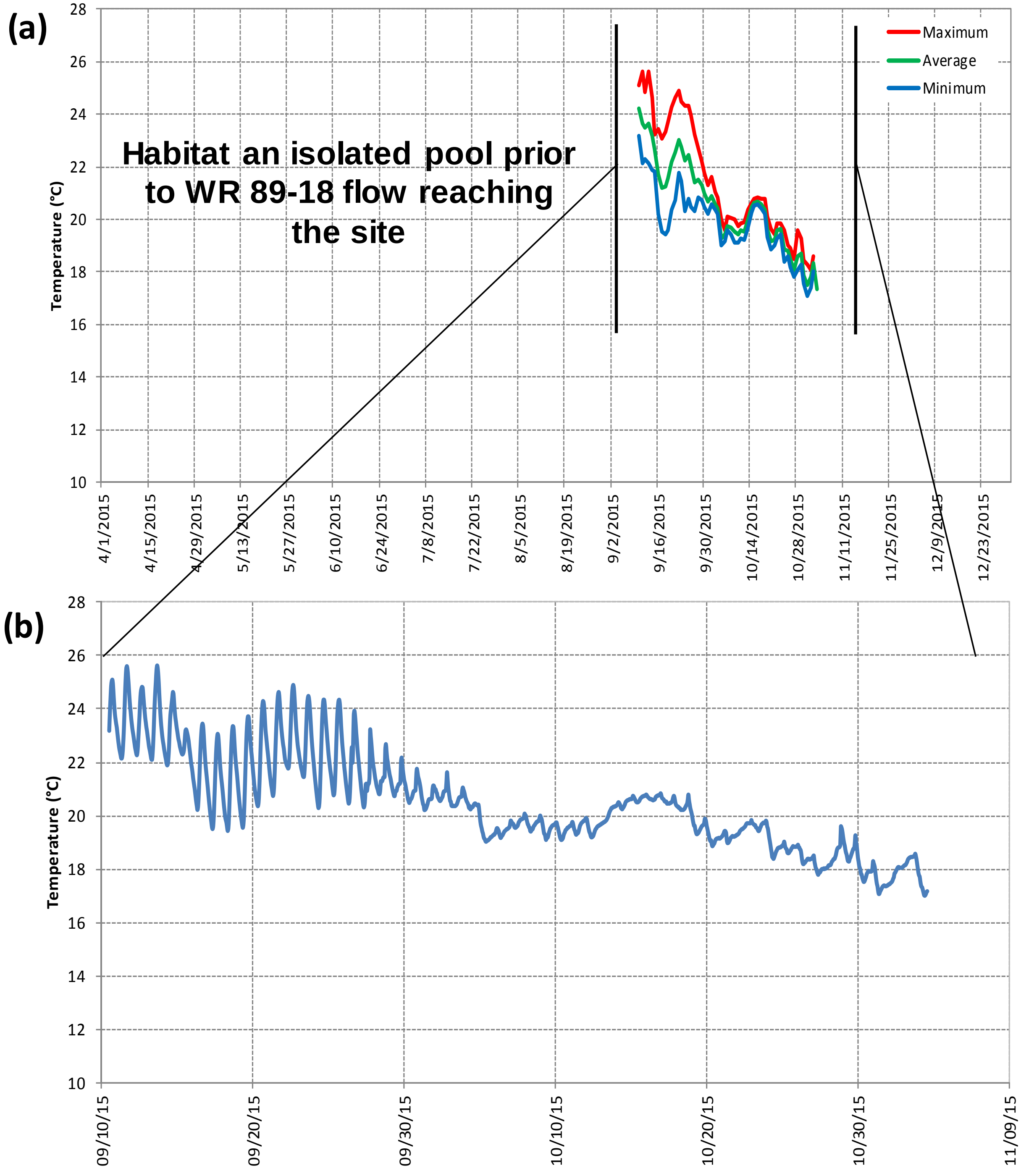


Figure 28: 2015 LSYR-22.68 (Cadwell Pool) bottom (12.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 9/10/15 – 11/3/15.

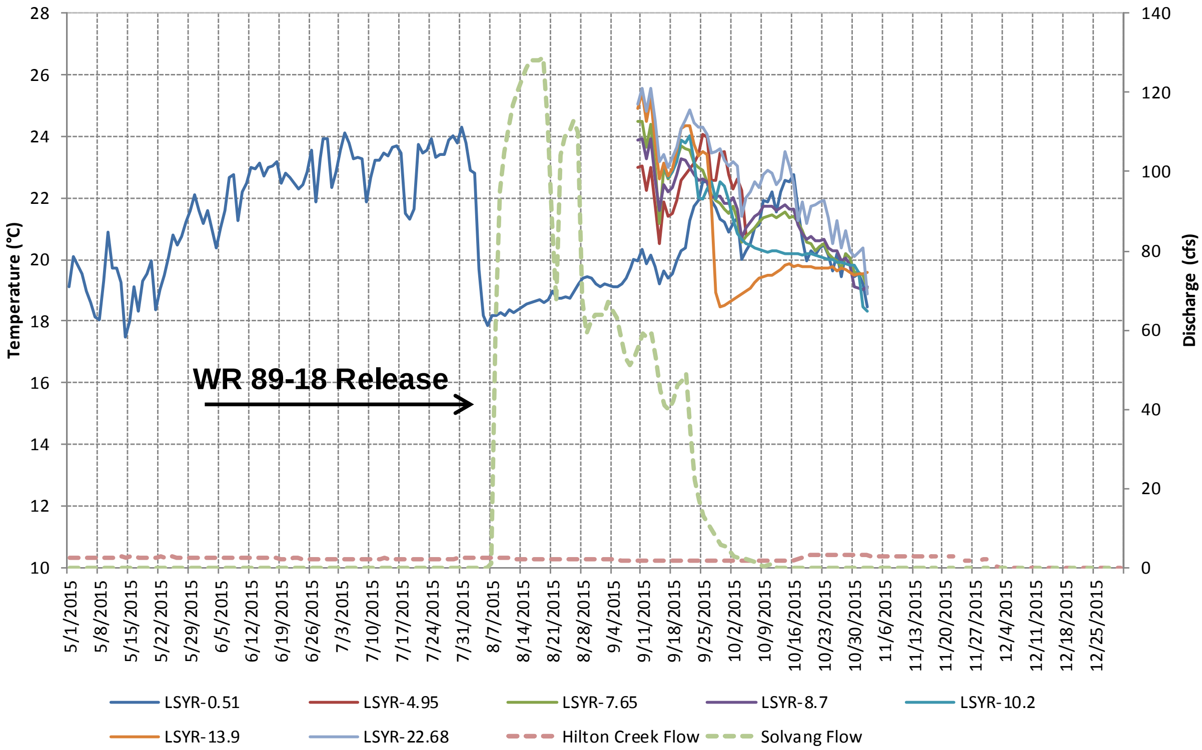


Figure 29: 2015 Longitudinal maximum surface water temperatures at: downstream of the Long Pool (LSYR-0.51), Encantado Pool (LSYR-4.95), Double Canopy Pool (LSYR-7.65), Head of Beaver Pool (LSYR-8.7), Alisal Bedrock Pool (LSYR-10.20), Avenue of the Flags Pool (LSYR-13.90, bottom of pool), and Cadwell Pool (LSYR-22.68) with daily flow (discharge) at the Hilton Creek and Solvang (at the Alisal Bridge) USGS gauges.

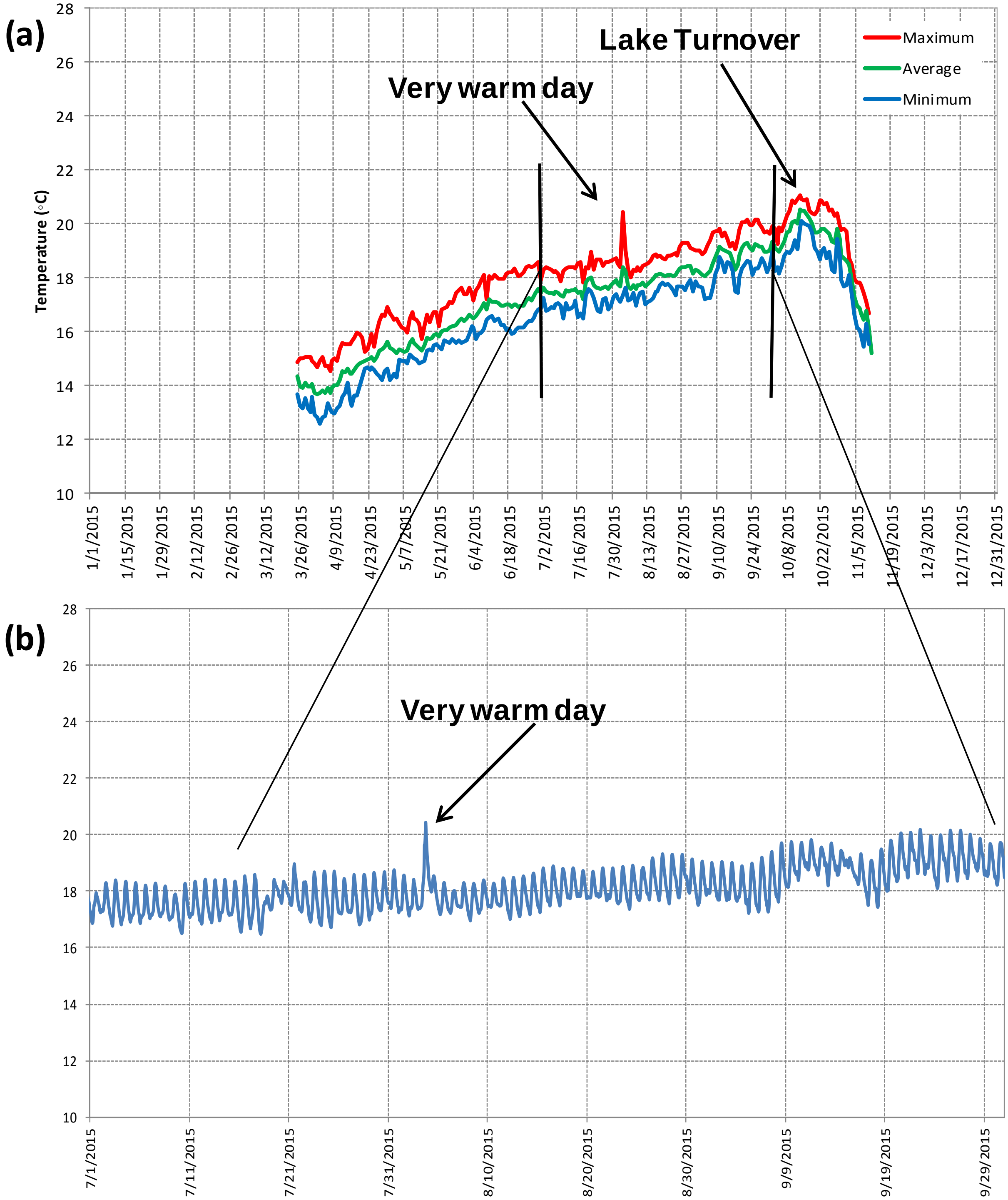


Figure 30: 2015 Lower Hilton Creek (HC-0.12) bottom (0.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 7/1/15 – 10/1/15; shown in the graph is a temperature increase during a very warm day and a lake turnover event near the end of the deployment period.

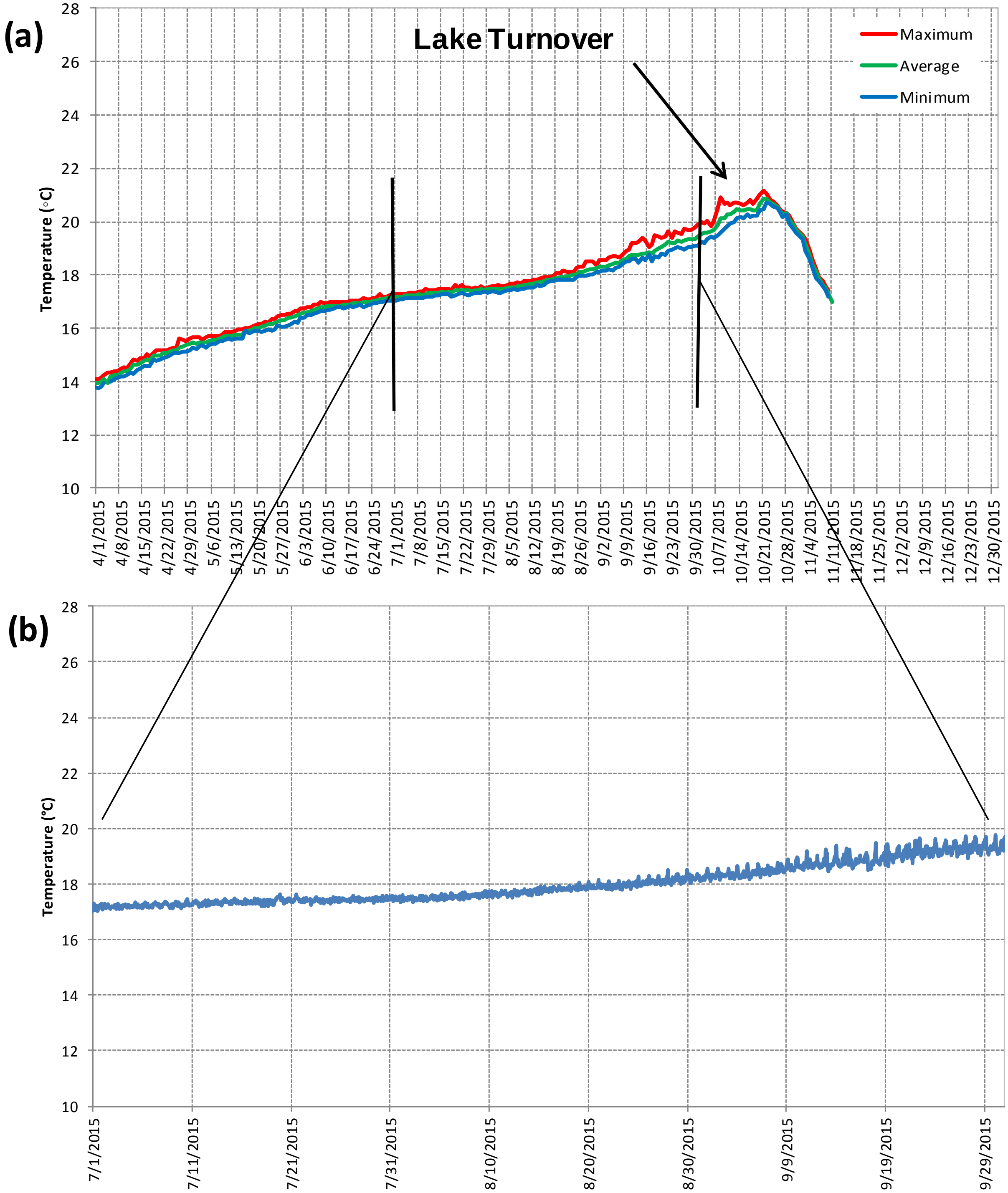
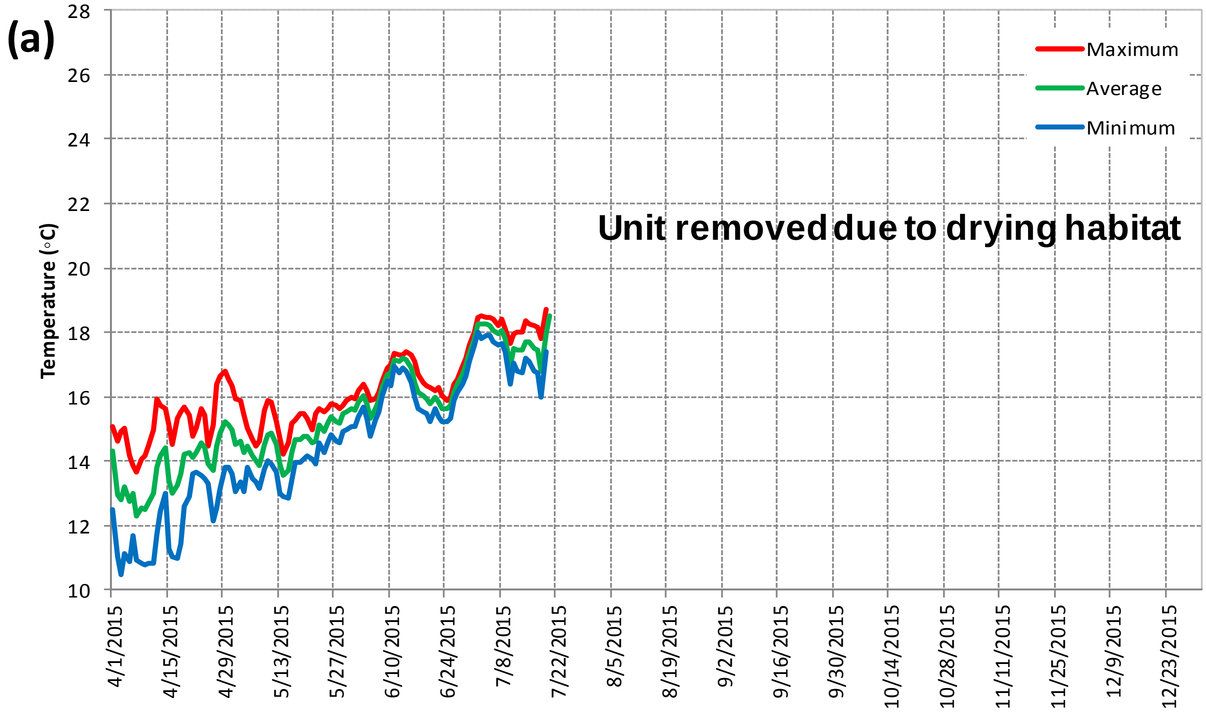


Figure 31: 2015 Upper Hilton Creek (HC-0.54) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 7/1/15 – 10/1/15; shown in the graph is a lake turnover event near the end of the deployment period.



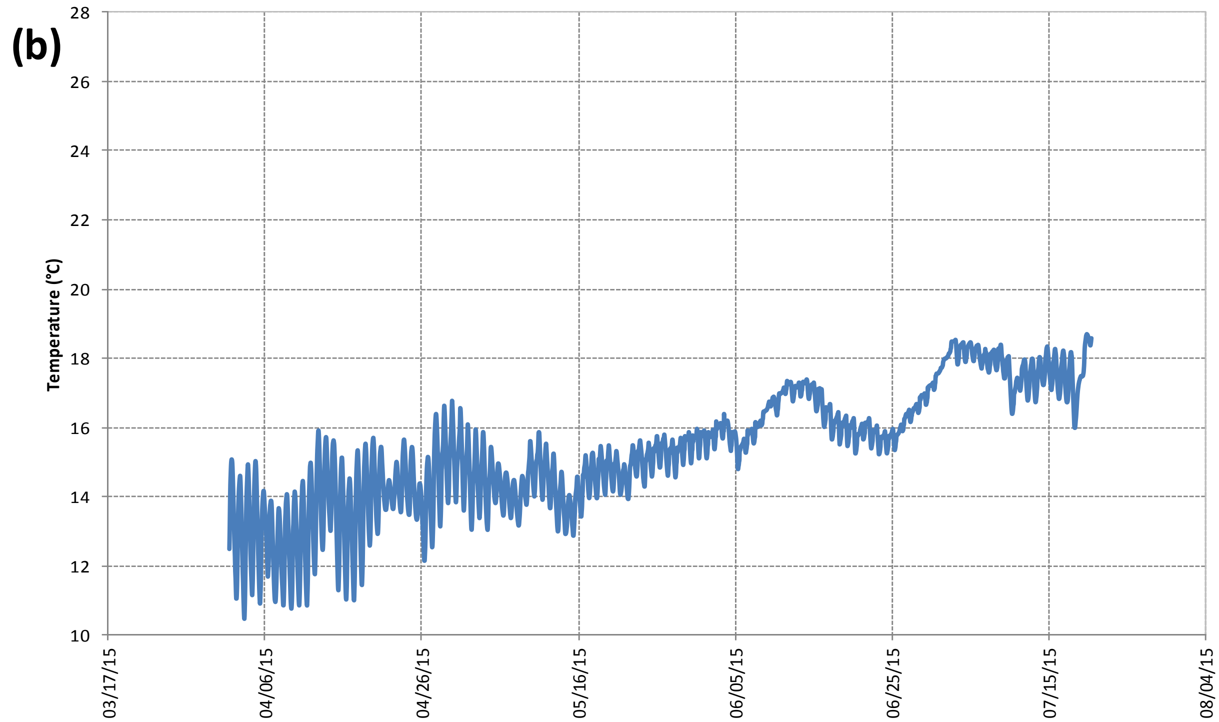


Figure 32: 2015 Quiota Creek (QC-2.66) bottom (0.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 4/1/15 – 7/22/15 (the entire period of deployment); the unit was removed from the site due to lack of water.

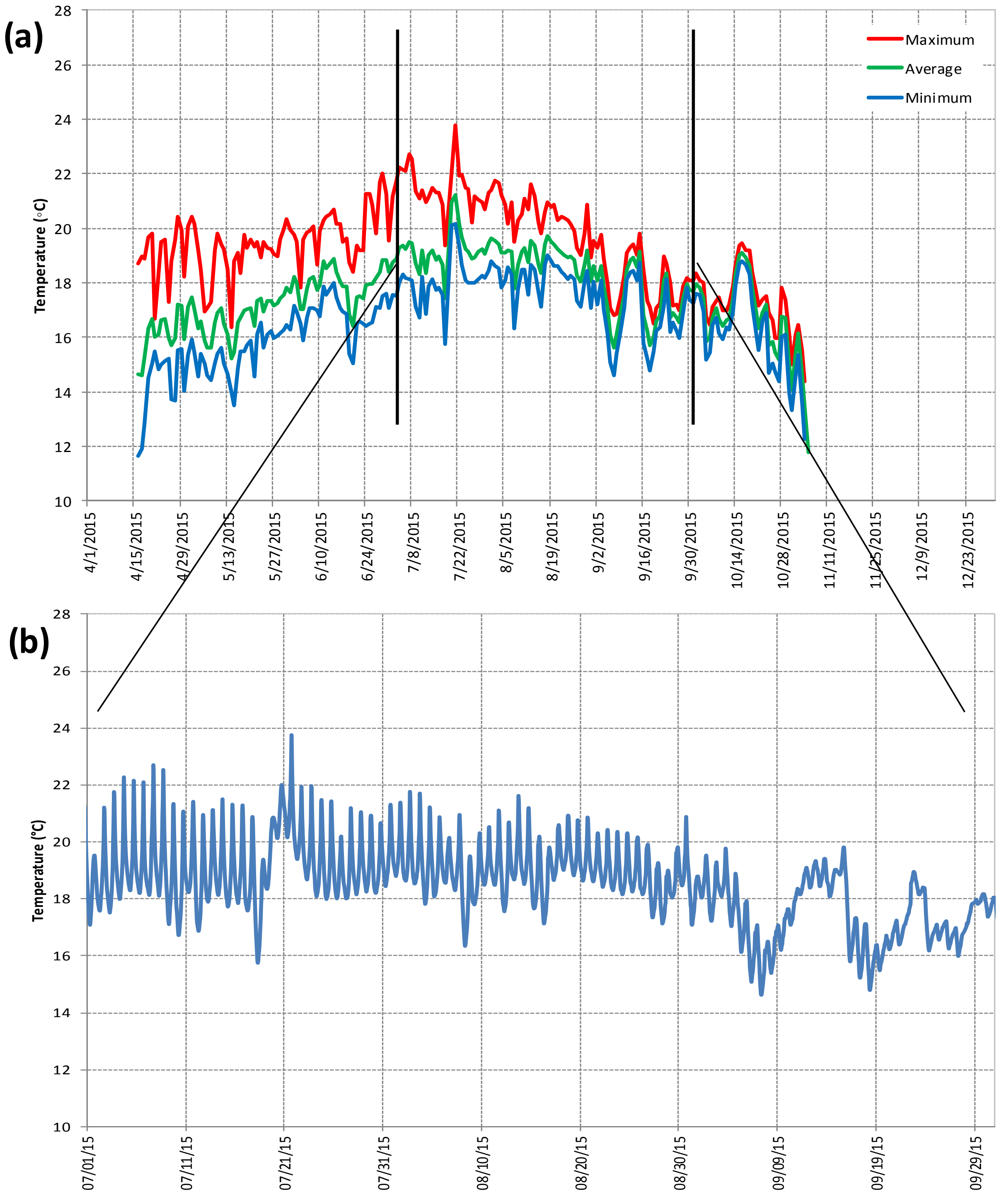


Figure 33: 2015 Lower Salsipuedes Creek (SC-0.77) bottom (0.5 foot) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the period 7/1/15 – 10/1/15.

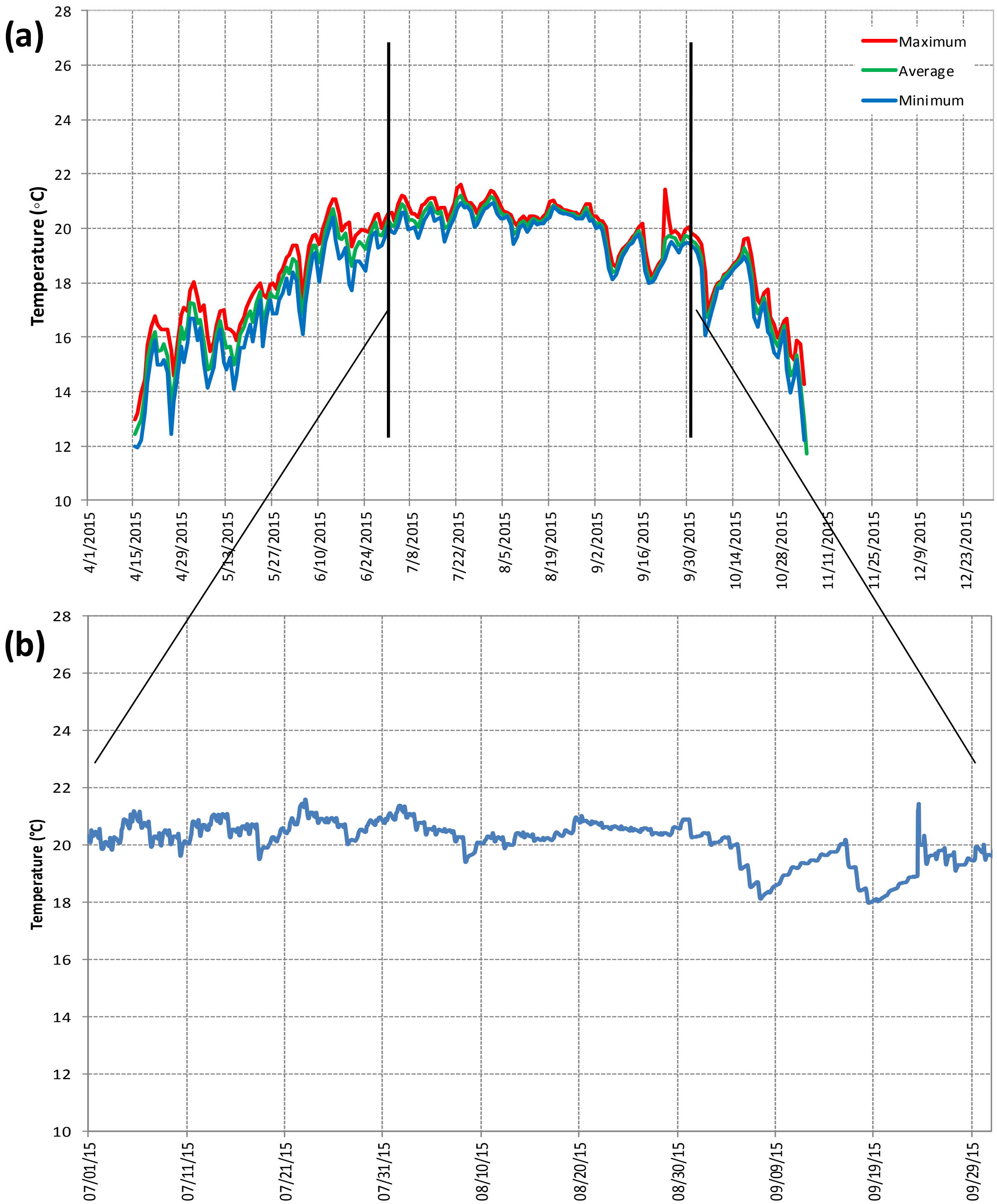


Figure 34: 2015 SC-2.20 (Reach 2 Bedrock Section) bottom (4.0 feet) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period from 7/1/15 – 10/1/15.

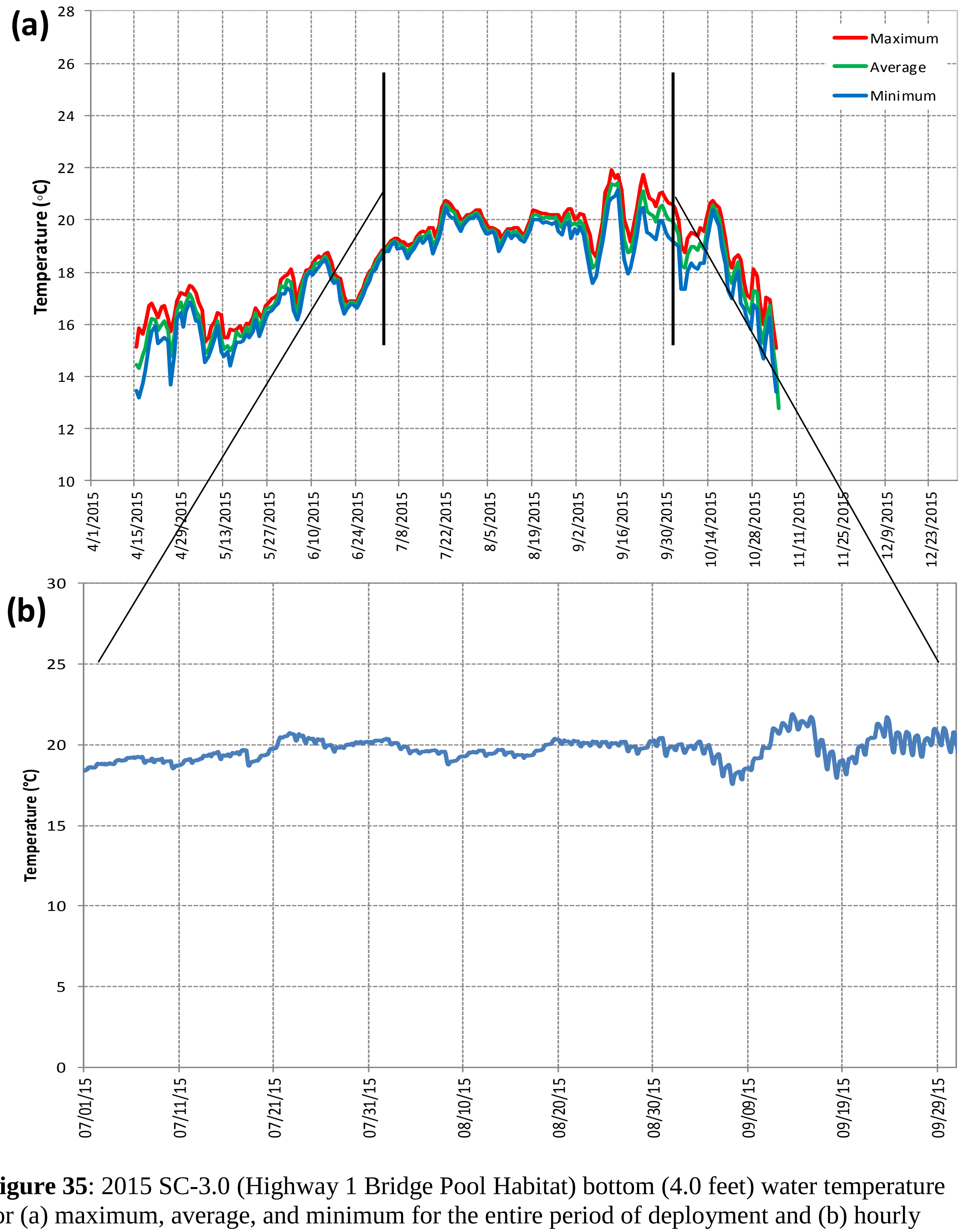


Figure 35: 2015 SC-3.0 (Highway 1 Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/15 – 10/1/15.

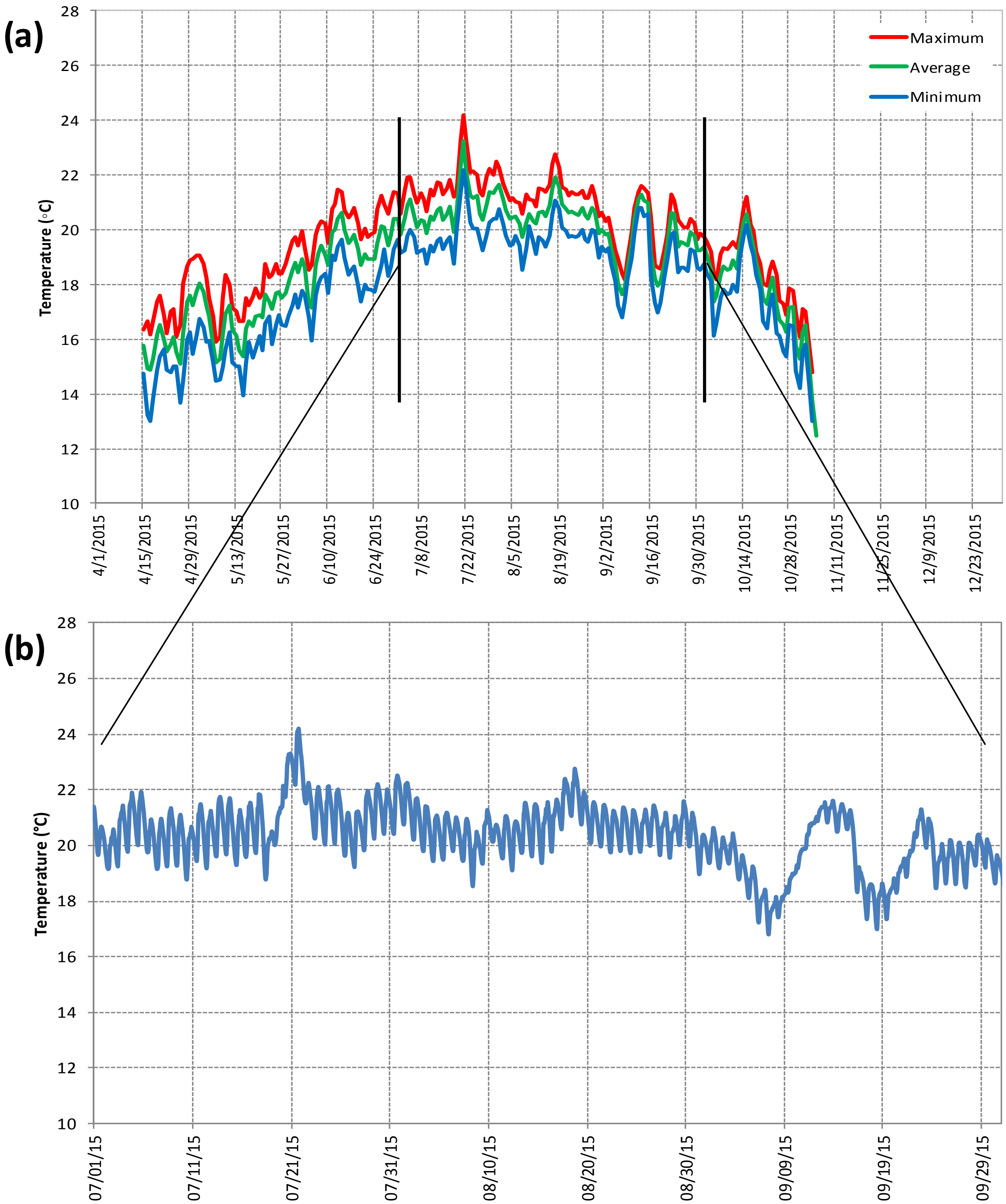


Figure 36: 2015 SC-3.5 (Jalama Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/15 – 10/1/15.

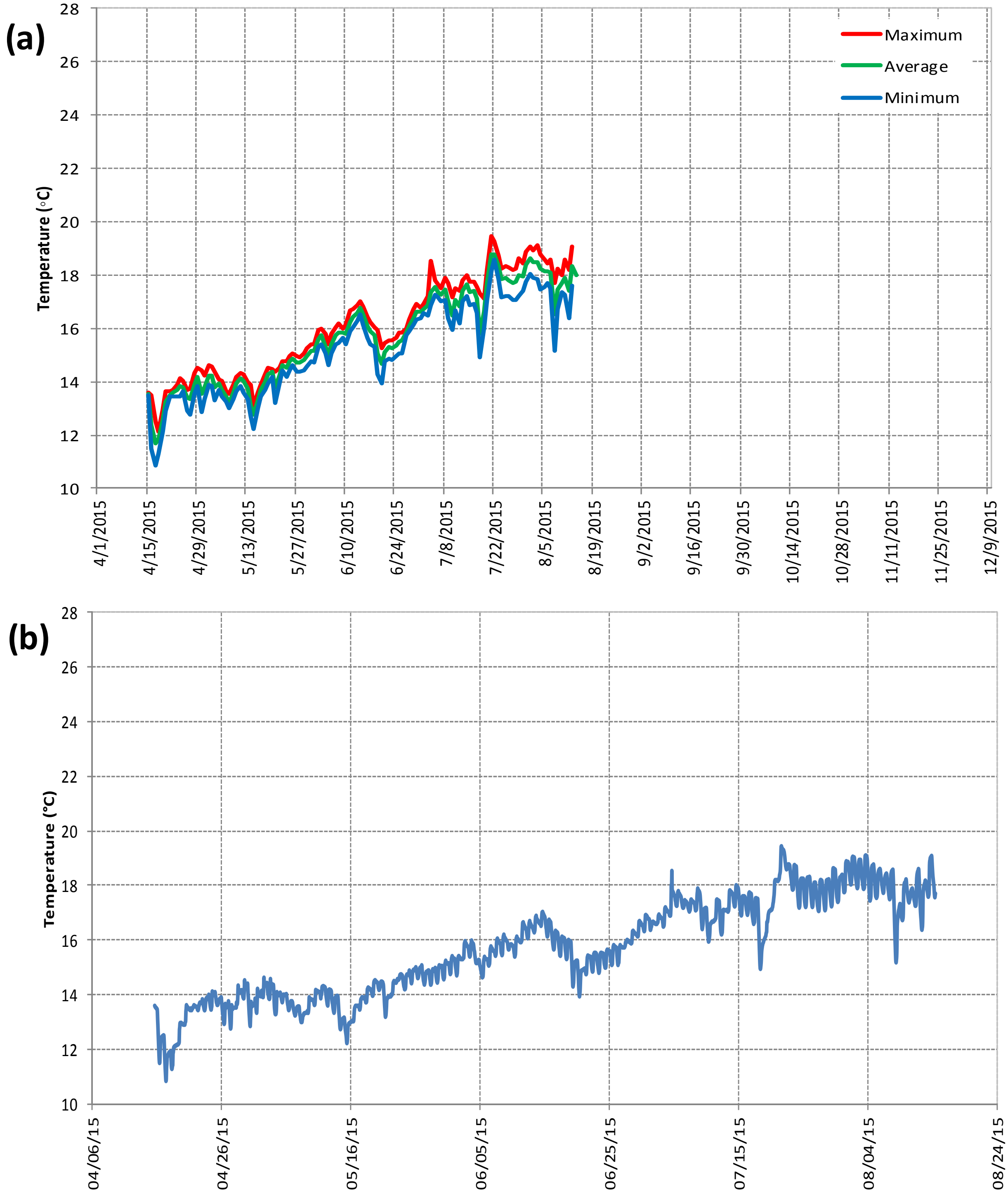


Figure 37: 2015 EJC-3.81 – Directly upstream of the Upper Salsipuedes Creek confluence – bottom (4.0 feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 4/15/15 – 8/13/15 (the entire period of record); this unit was isolated (no inflow or outflow) and was essentially dry starting on 8/13/15.

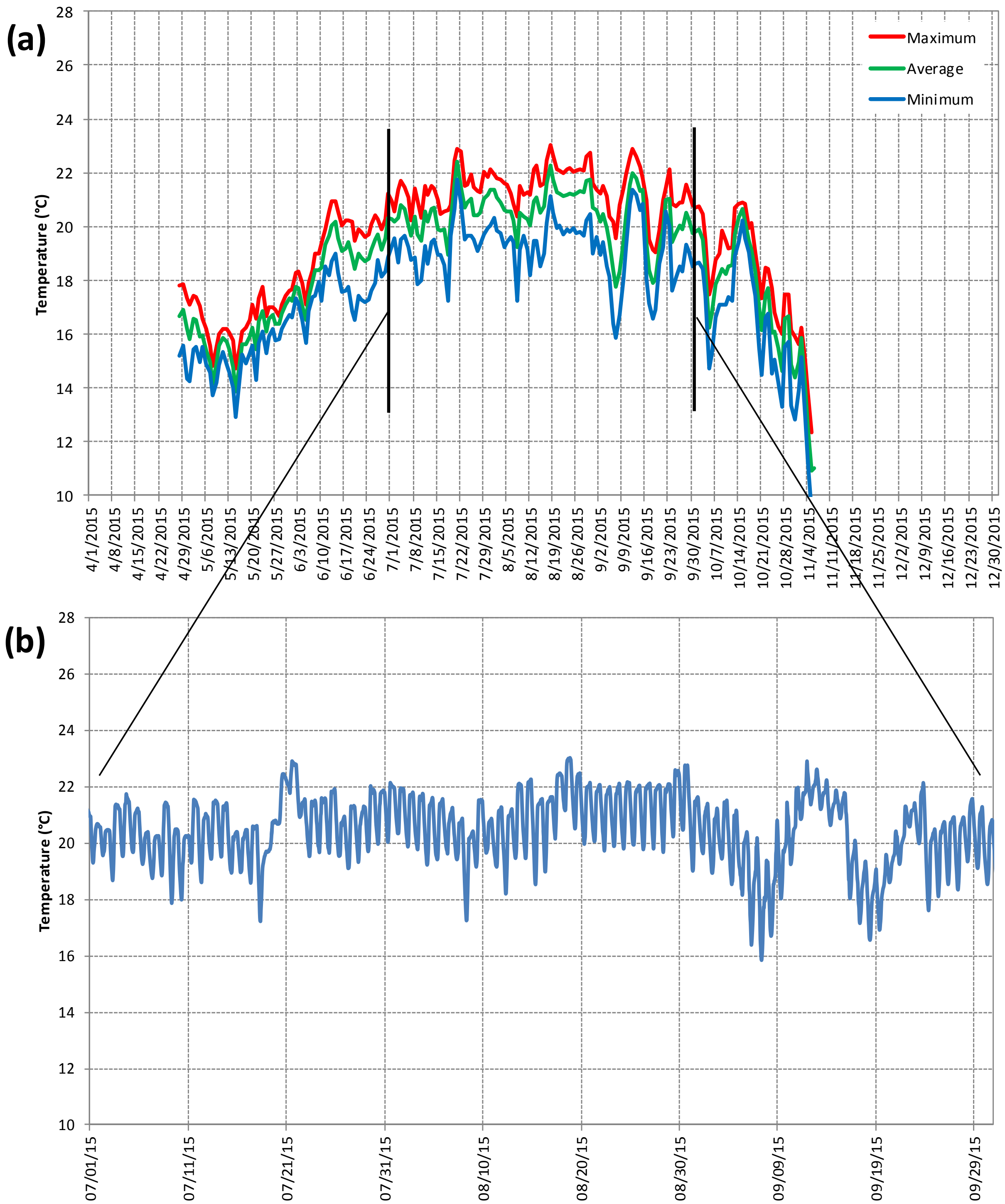


Figure 38: 2015 EJC-5.4 (Palos Colorados Pool Habitat) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/15 – 10/1/15.

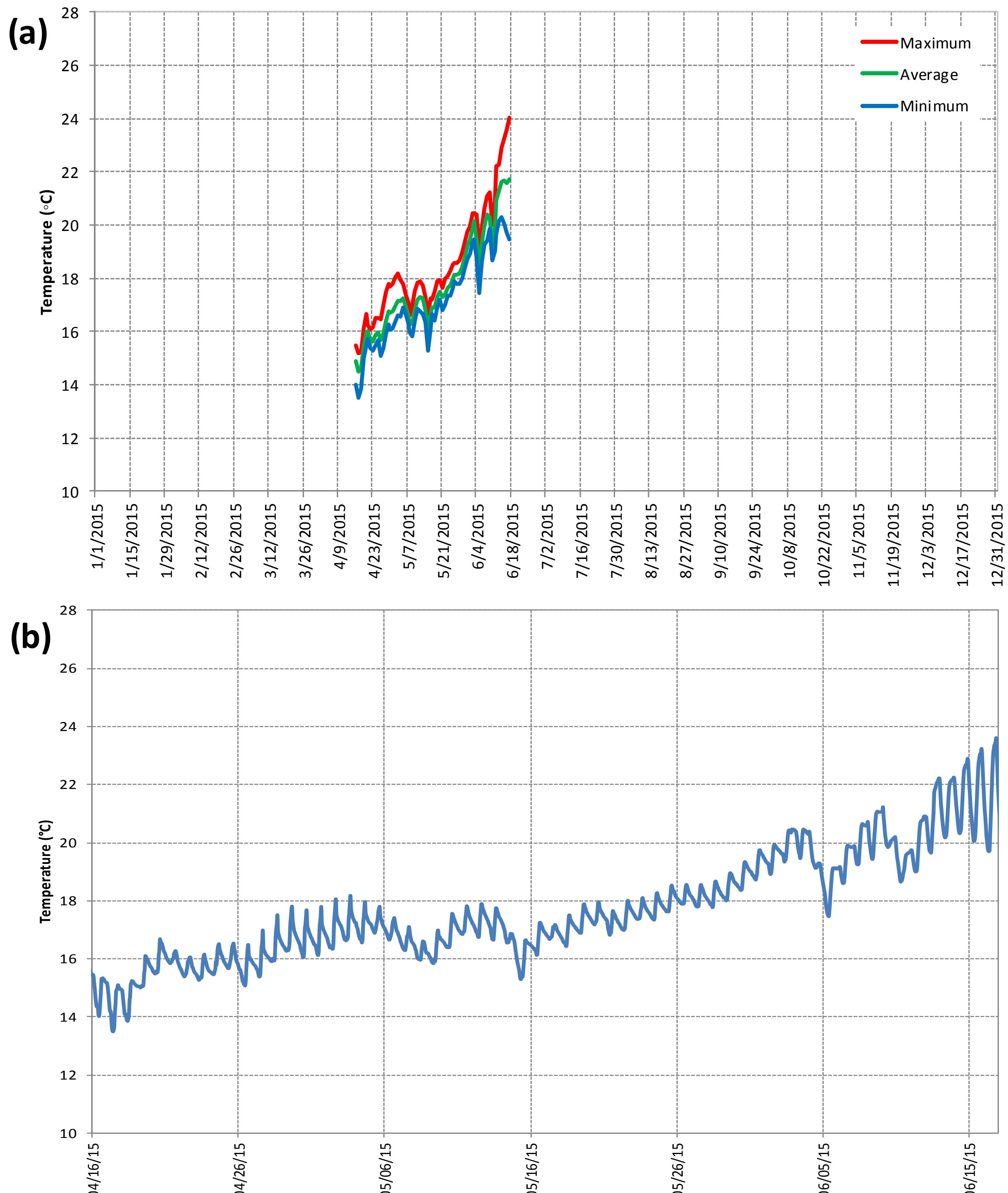


Figure 39: 2015 EJC-10.82 – water temperature at Rancho San Julian Fish Ladder bottom (2.5 feet) for (A) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of deployment; the thermograph was removed from the habitat on 6/24/15 due to drying conditions.

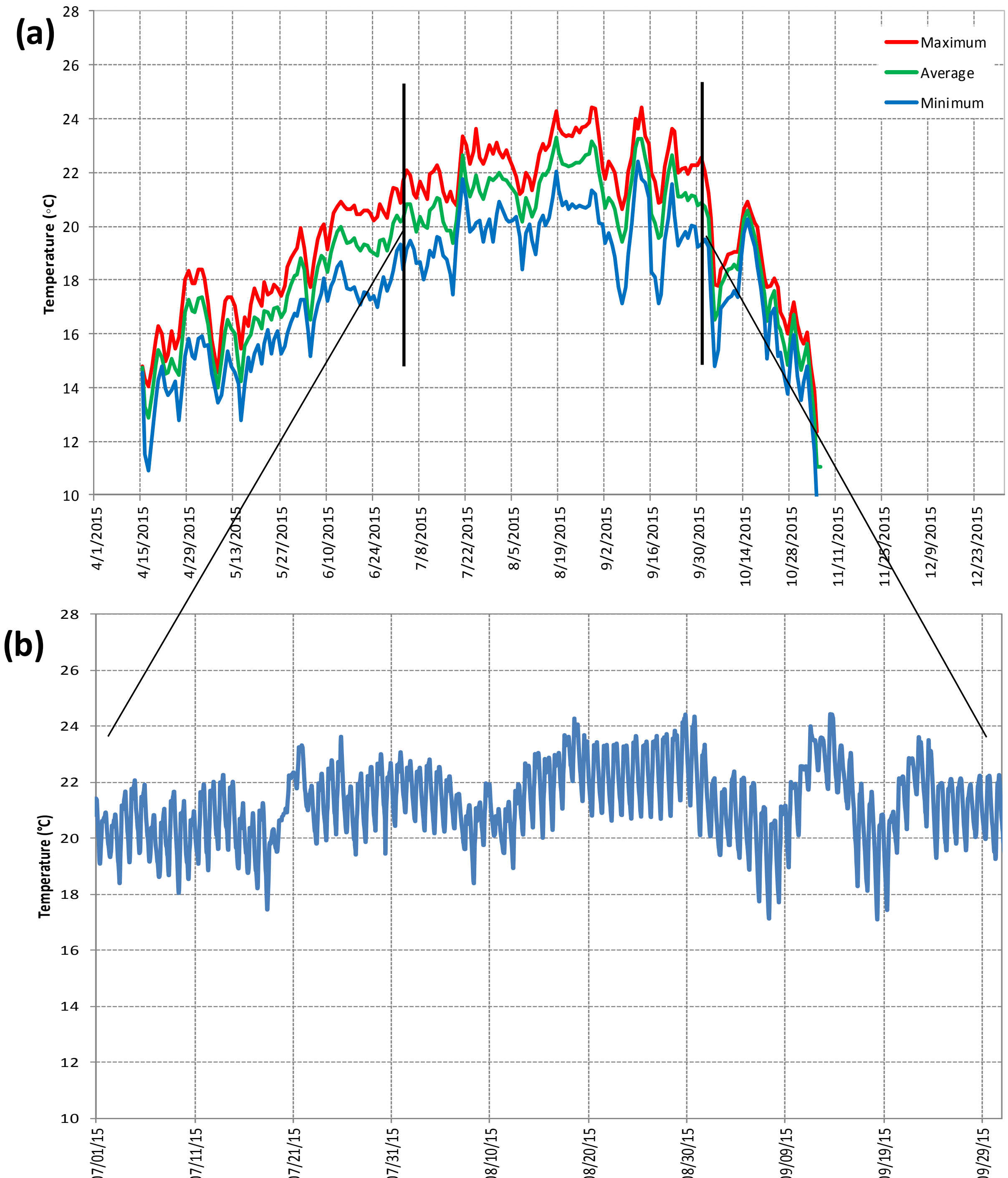


Figure 40: 2015 LAC-7.0 (Los Amoles Creek at Ford Crossing) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from7/1/15 – 10/1/15; Los Amoles was dry approximately 150 feet upstream of the thermograph location.

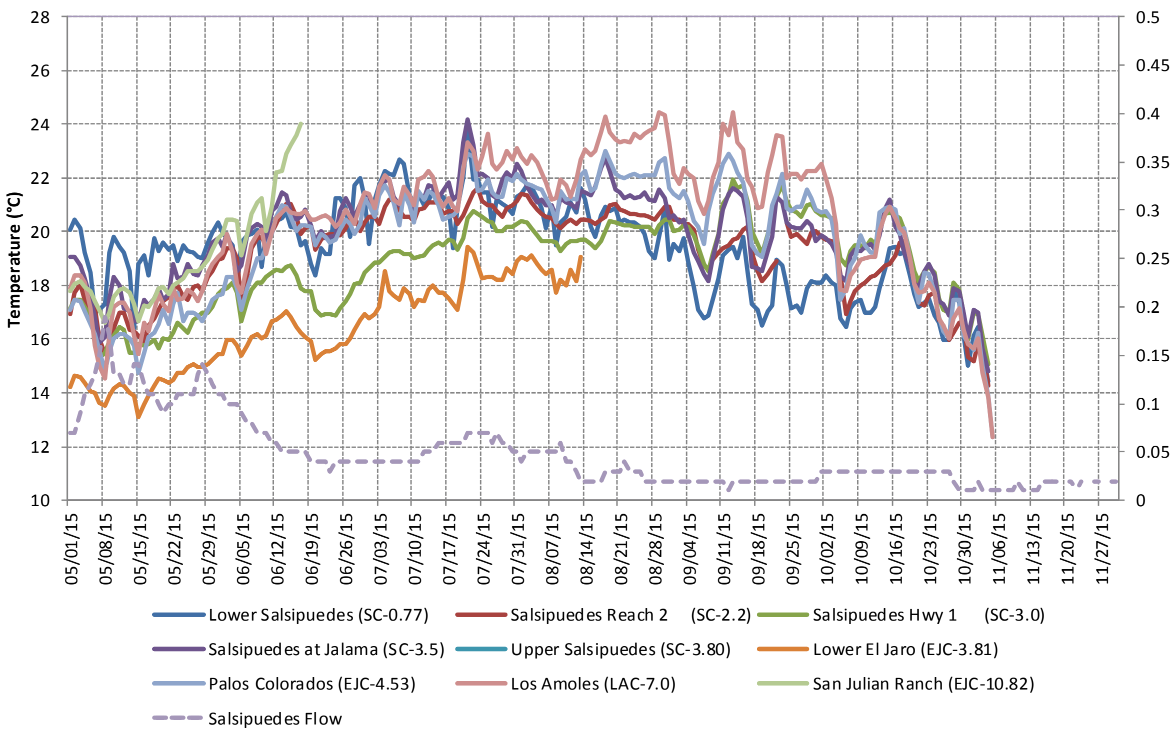


Figure 41: 2015 Longitudinal maximum daily water temperatures within the Salsipuedes Creek watershed which included El Jaro Creek at Rancho San Julian (EJC-10.82), Palos Colorados (EJC-5.4), lower El Jaro Creek (EJC-3.81), at Jalama Bridge (SC-3.5), at Highway 1 (SC-3.0), at Bedrock Section (SC-2.2), at lower Salsipuedes Creek (SC-0.77), and at Los Amoles Creek (LAC-7.0) as tributary to El Jaro Creek, versus flow (cfs) measured at the Salsipuedes Creek USGS gauging station.

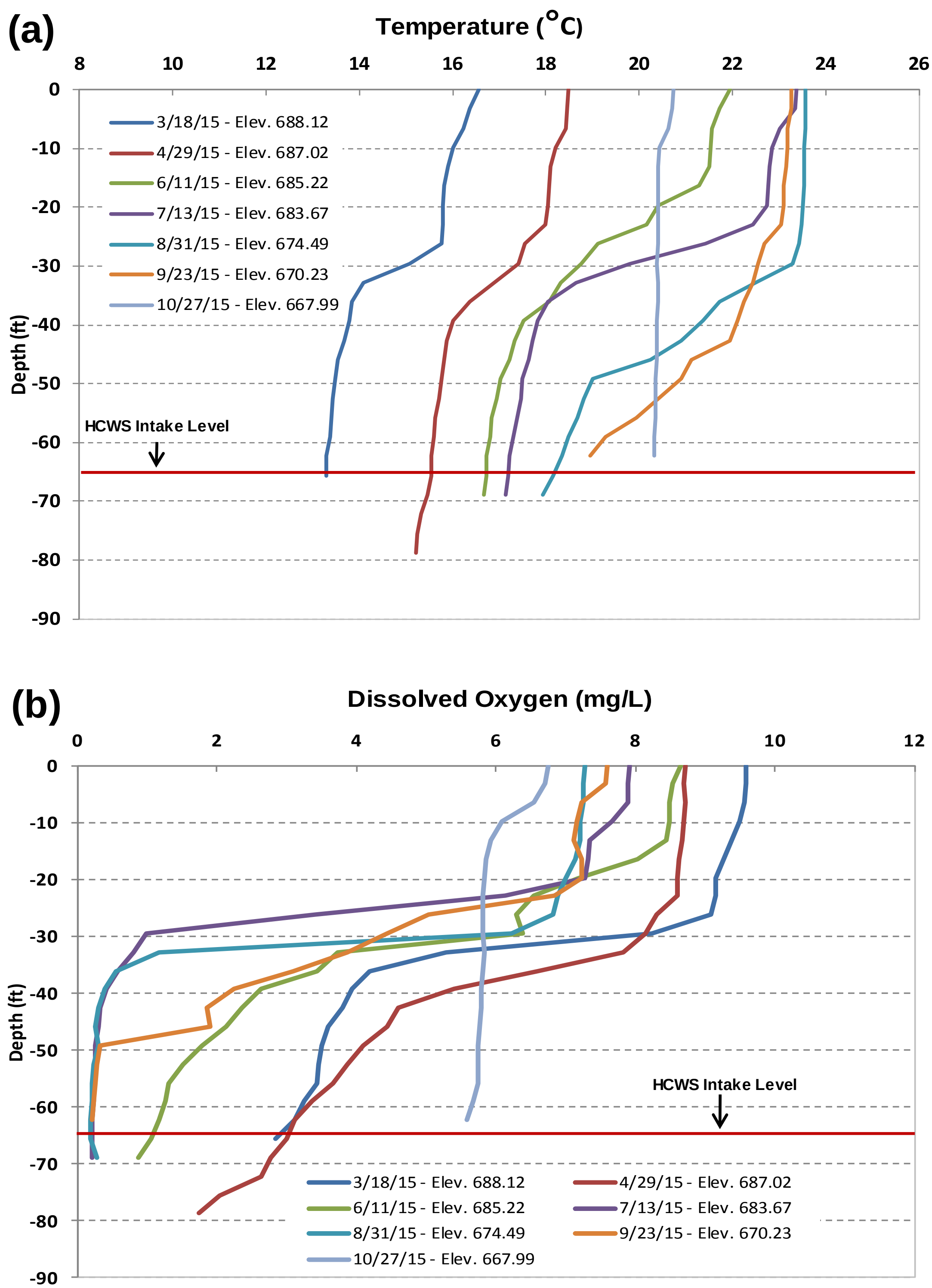


Figure 42: Lake Cachuma 2015 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS. HCWS intake hose level was set at 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

Figure 43: Photo points (M-6) collected at Highway 154 Bridge looking downstream in (a) September 2005 and (b) June 2015.

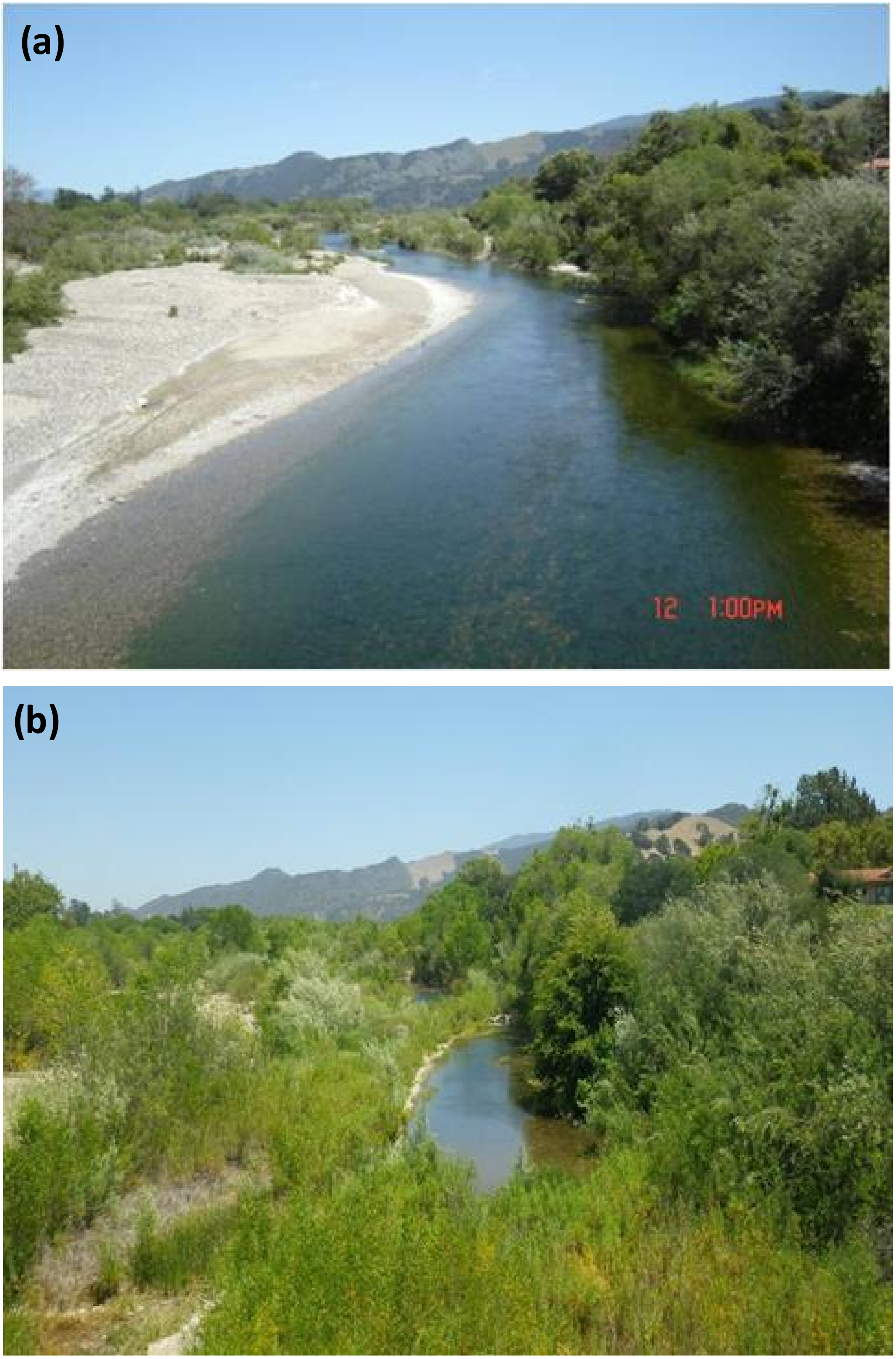


Figure 44: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) June 2015.

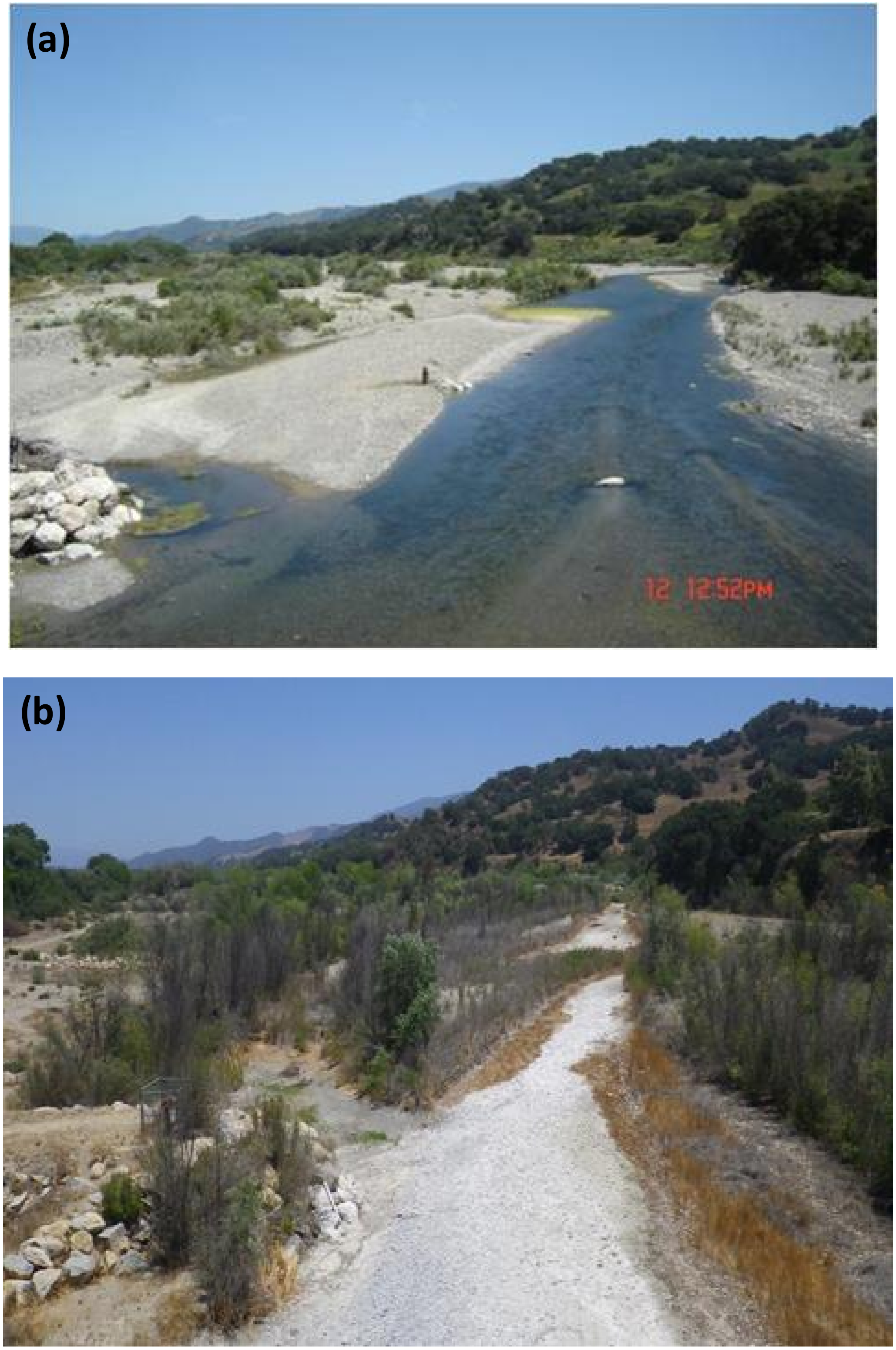


Figure 45: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) June 2015; note all the dead riparian vegetation.

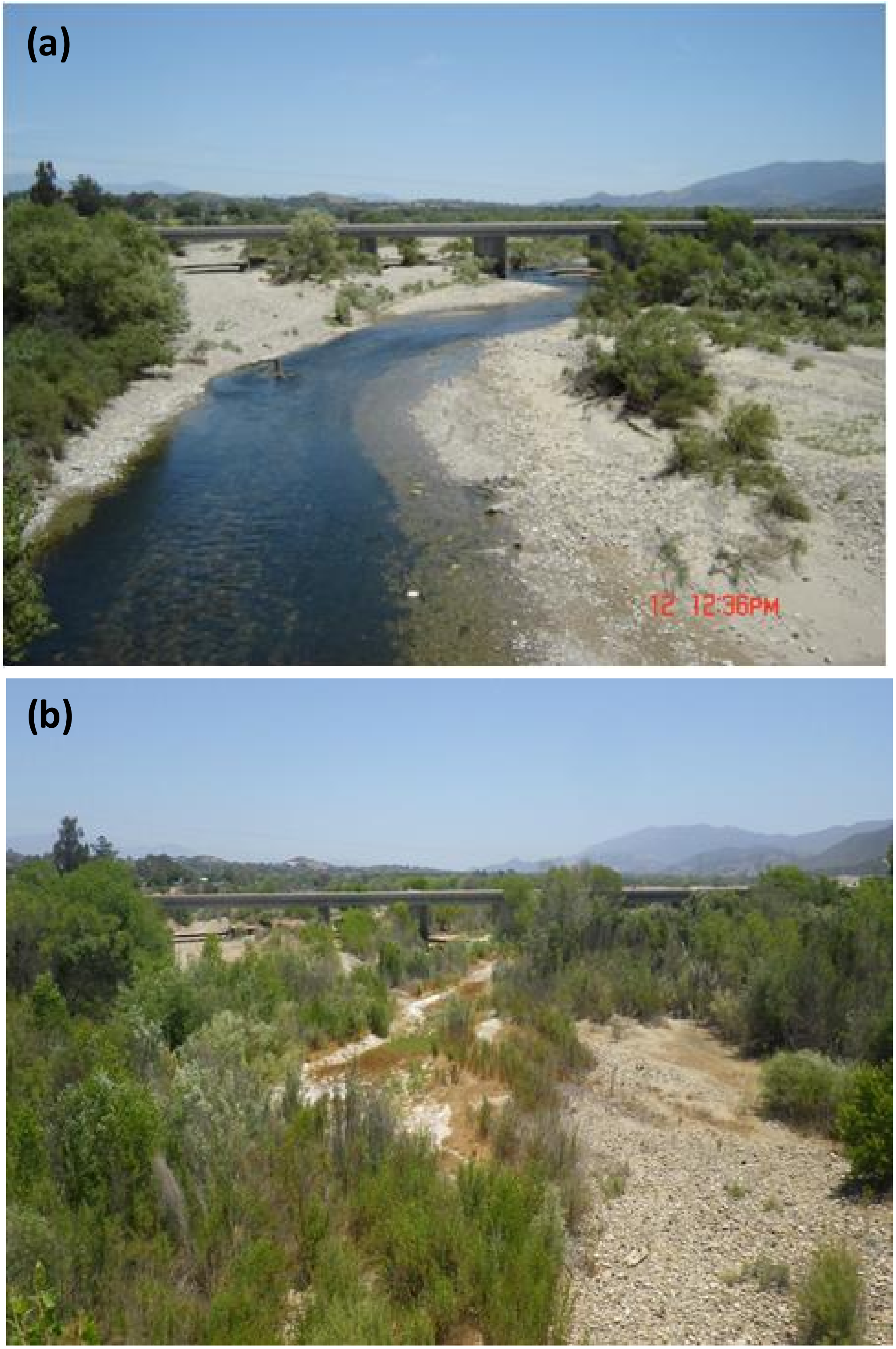


Figure 46: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) June 2015.

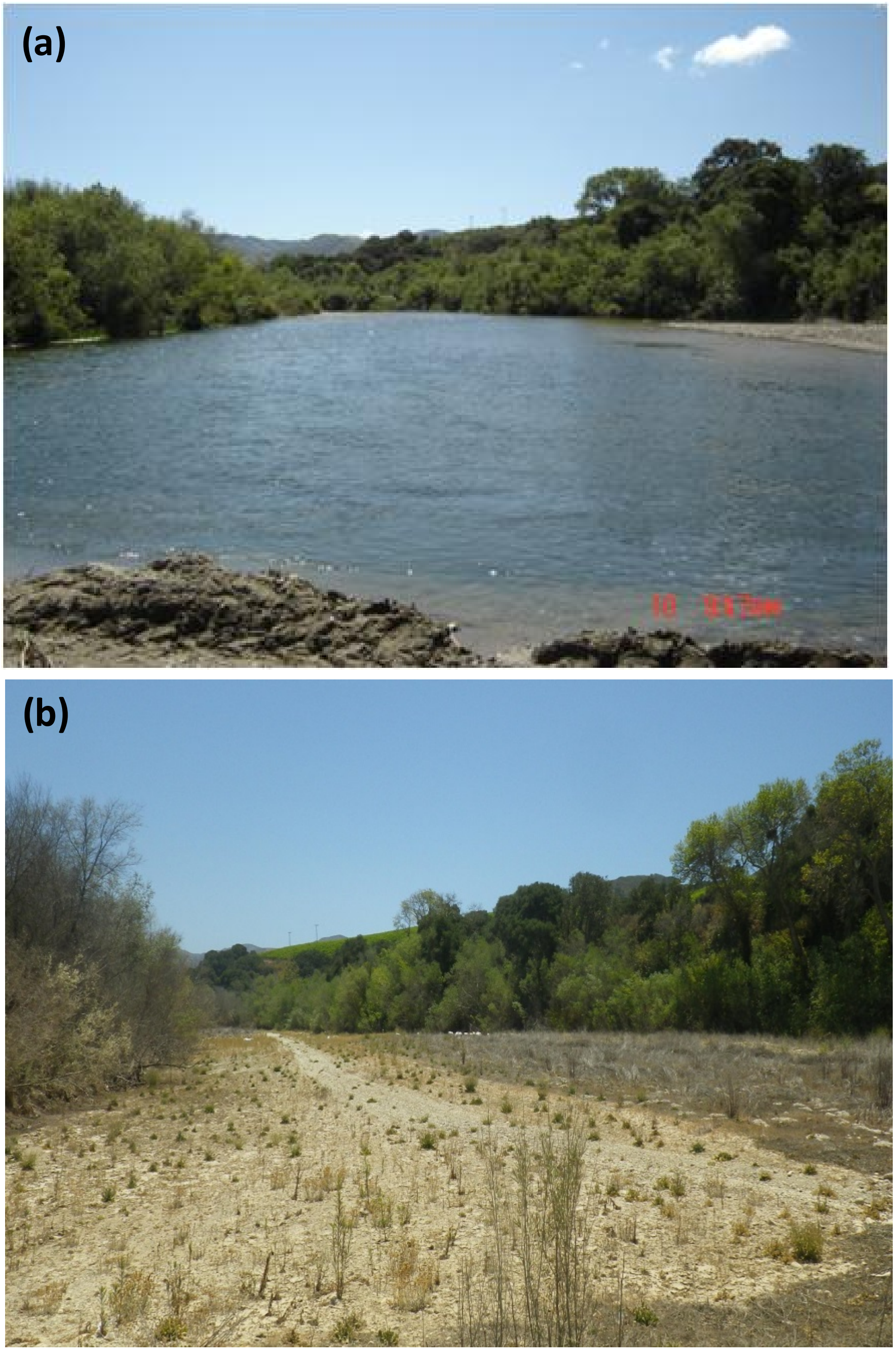


Figure 47: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) June 2015.

Figure 48: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) June 2015.

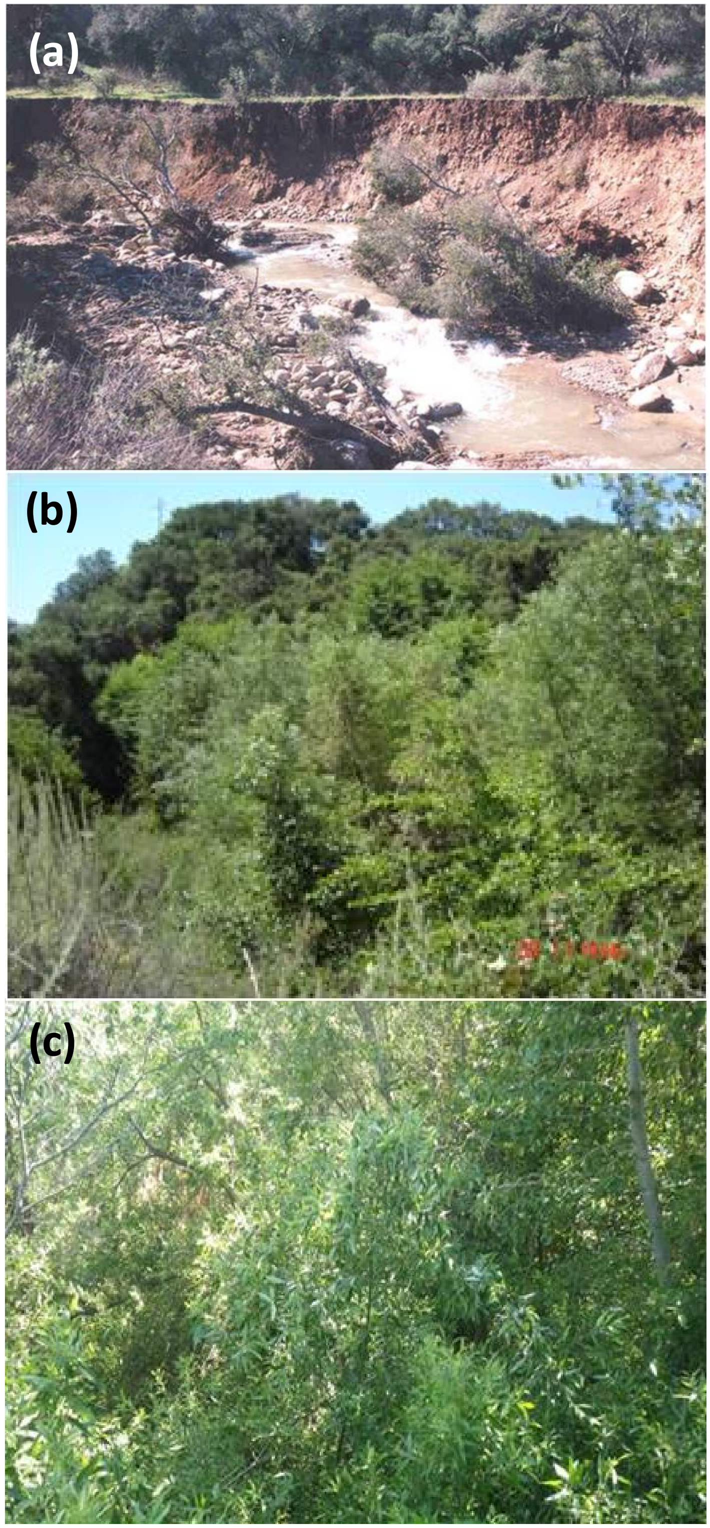


Figure 49: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) June 2015.

(b)

Figure 50: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) June 2015.

Figure 51: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) June 2015.

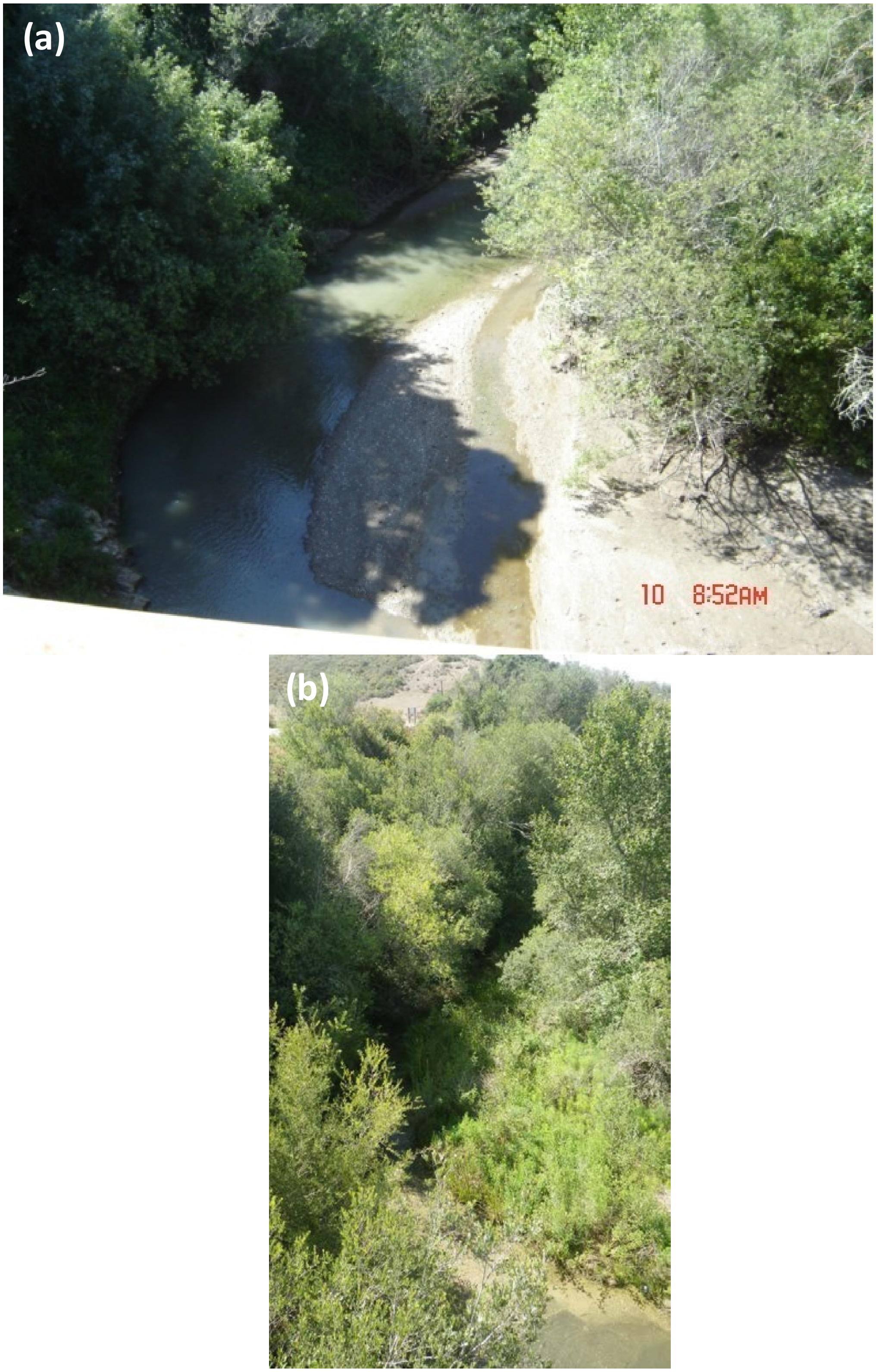


Figure 52: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) June 2015.

3.4 Migrant Trapping

Table 7: WY2015 migrant trap deployments.

Location	Date Traps Deployed	Date Trap Removed	Date Traps Removed (storm event)	Date Traps Installed (Storm Event)	# of Days Not Trapping	Functional Trapping Days	Functional Trapping %
	(dates)	(dates)	(dates)	(dates)	(days)	(days)	(days)
Hilton u/s Trap	3/10/2015	5/15/2015					
	Total:	65		**Total:**	0	65	100%
Hilton d/s Trap	3/10/2015	5/15/15					
	Total:	65		**Total:**	0	65	100%
Salsipuedes	Not Installed - Too Dry						
	Total:	N/A		**Total:**	0	N/A	N/A
Mainstem	Not Installed - Too Dry						
	Total:	N/A		**Total:**	0	N/A	N/A

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 WY2015.

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	13	3	0	8		24
	Downstream	33	10	1	66		110
	Total:	46	13	1	74		134
Salsipuedes	Upstream	0	0	0	0		0
	Downstream	0	0	0	0		0
	Total:	0	0	0	0		0

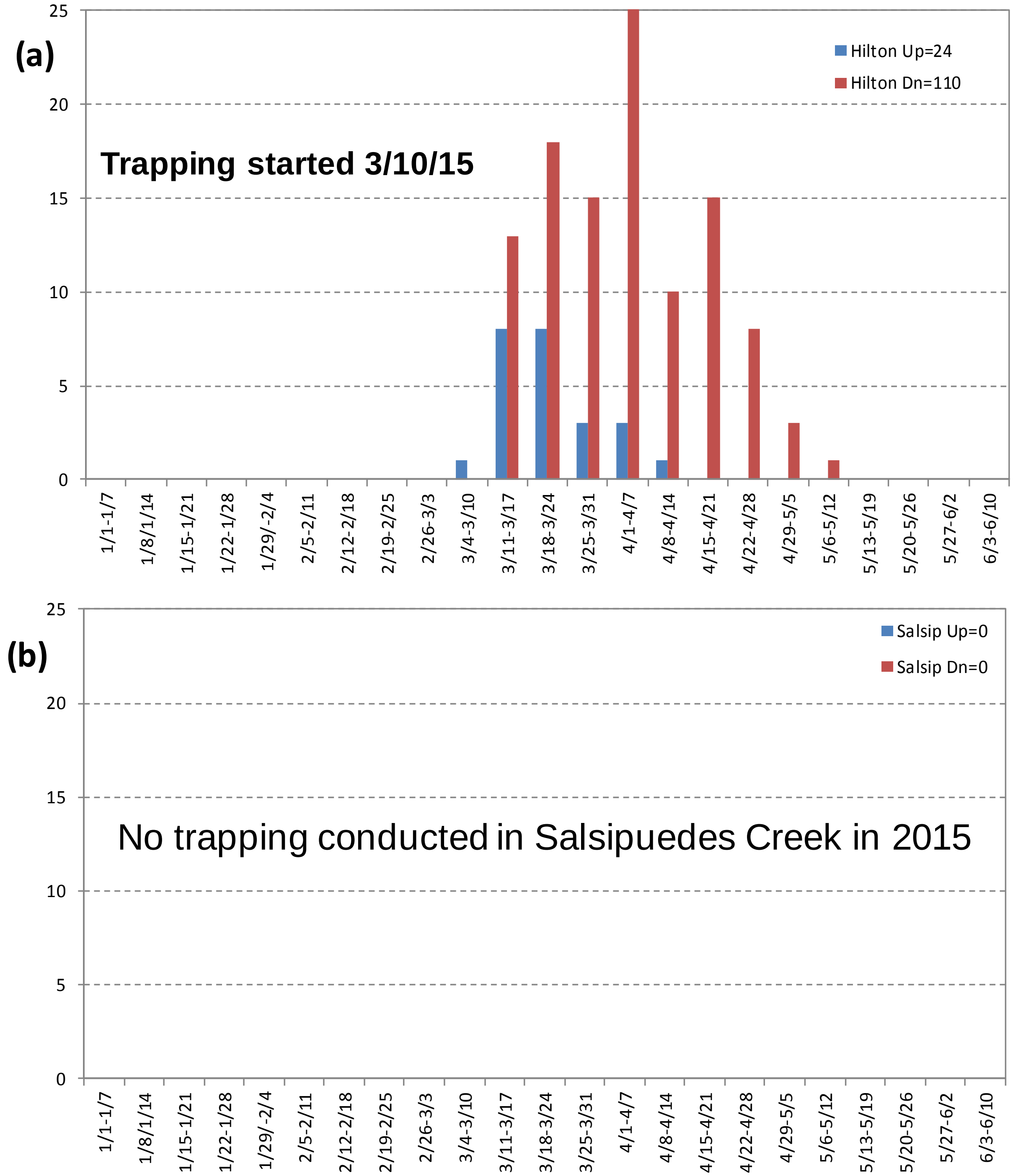


Figure 53: WY2015 paired histogram of weekly upstream and downstream captures by trap site for: (a) Hilton Creek and (b) Salsipuedes Creek.

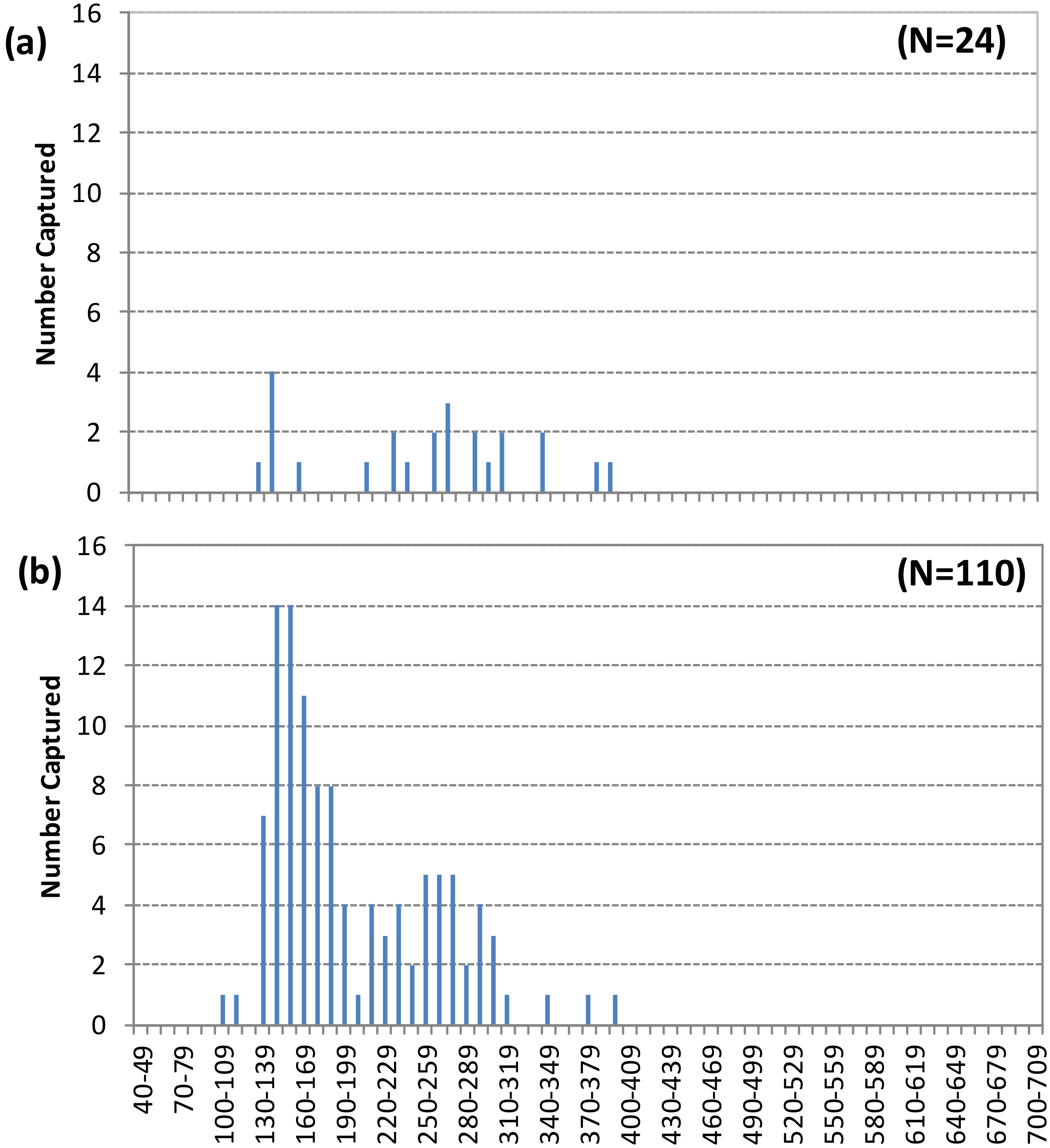


Figure 54: WY2015 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

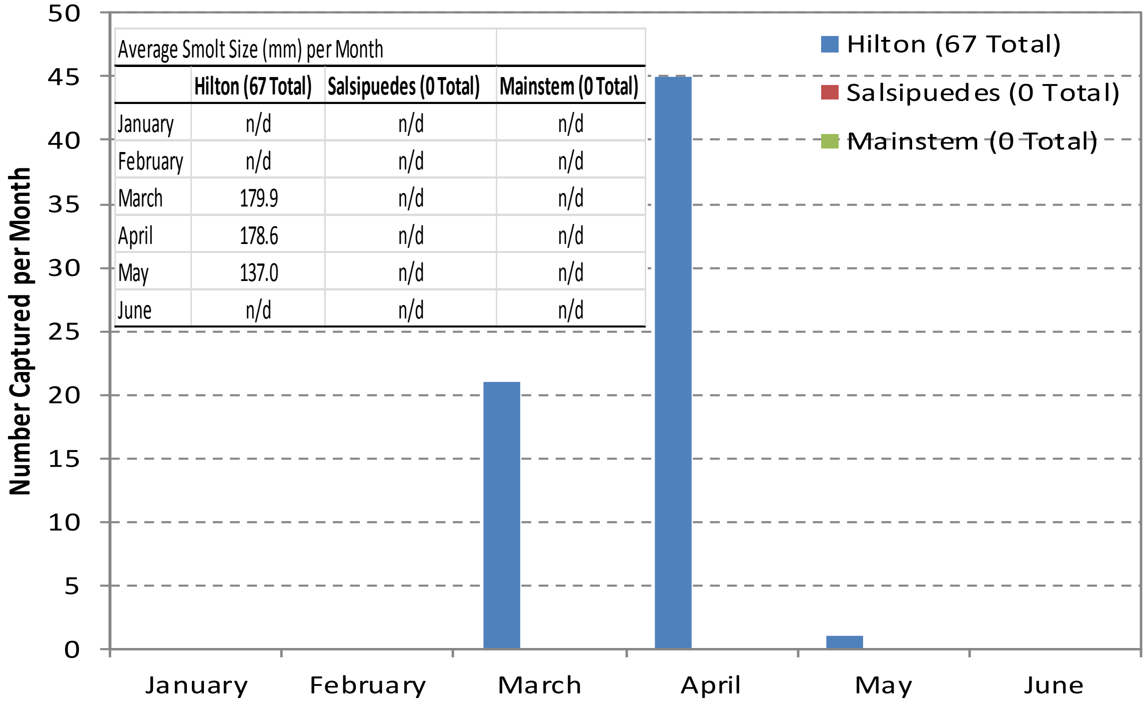


Figure 55: Timing of smolt migration observed at the Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps in WY2015 and average smolt size per month (embedded table) for each site.

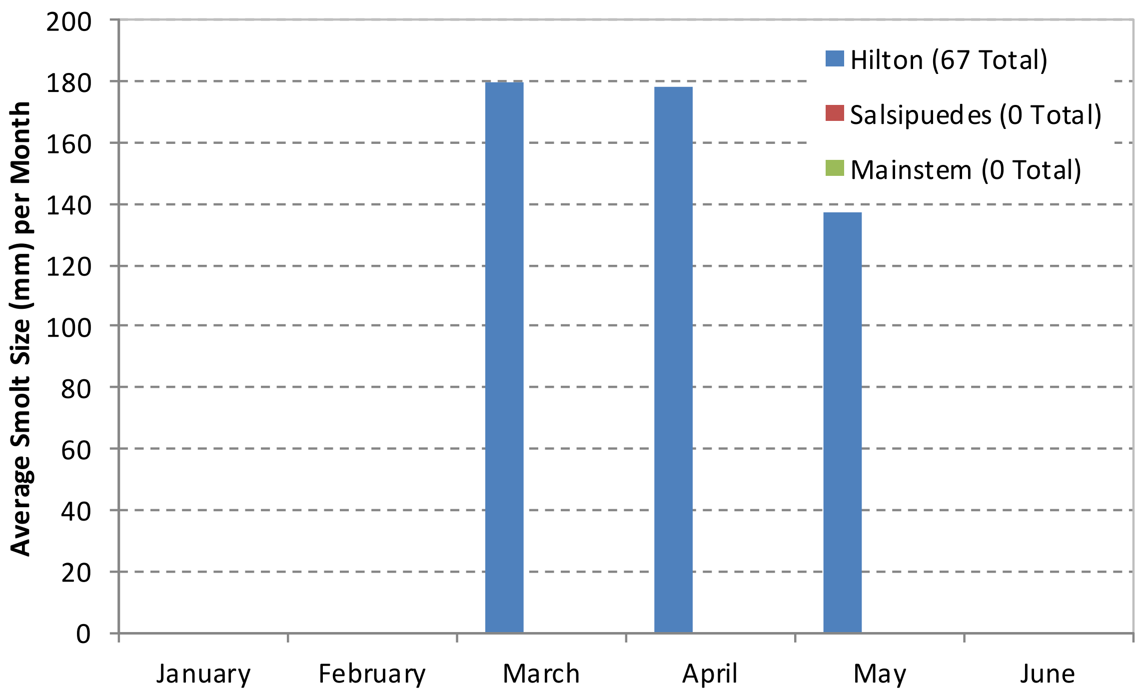


Figure 56: WY2015 monthly average smolt size in mm at the three trapping sites; no trapping conducted on Salsipuedes Creek or the mainstem in WY2015.

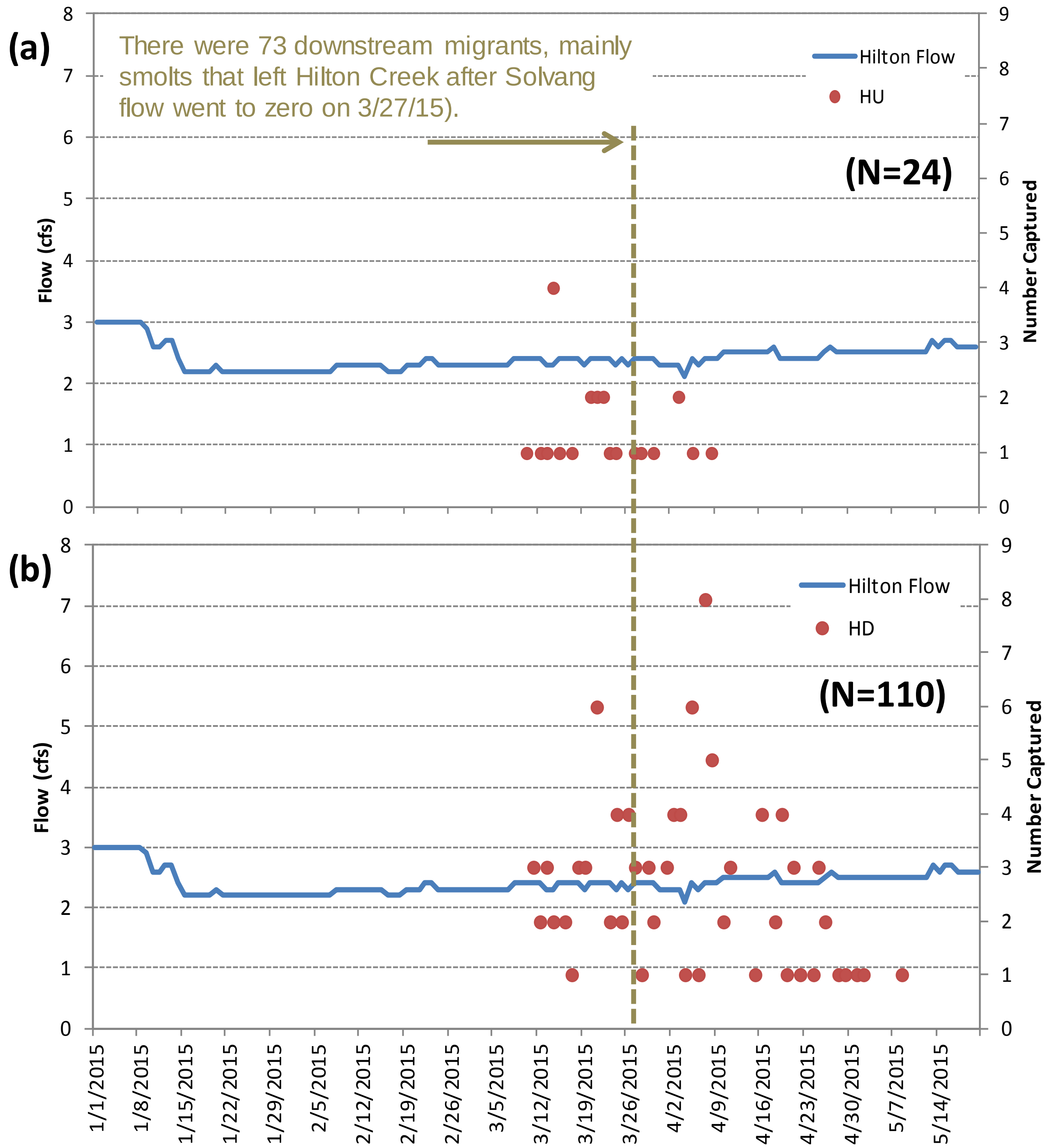


Figure 57: WY2015 Hilton Creek migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures; trapping started on 3/10/15 and ended on 5/15/15.

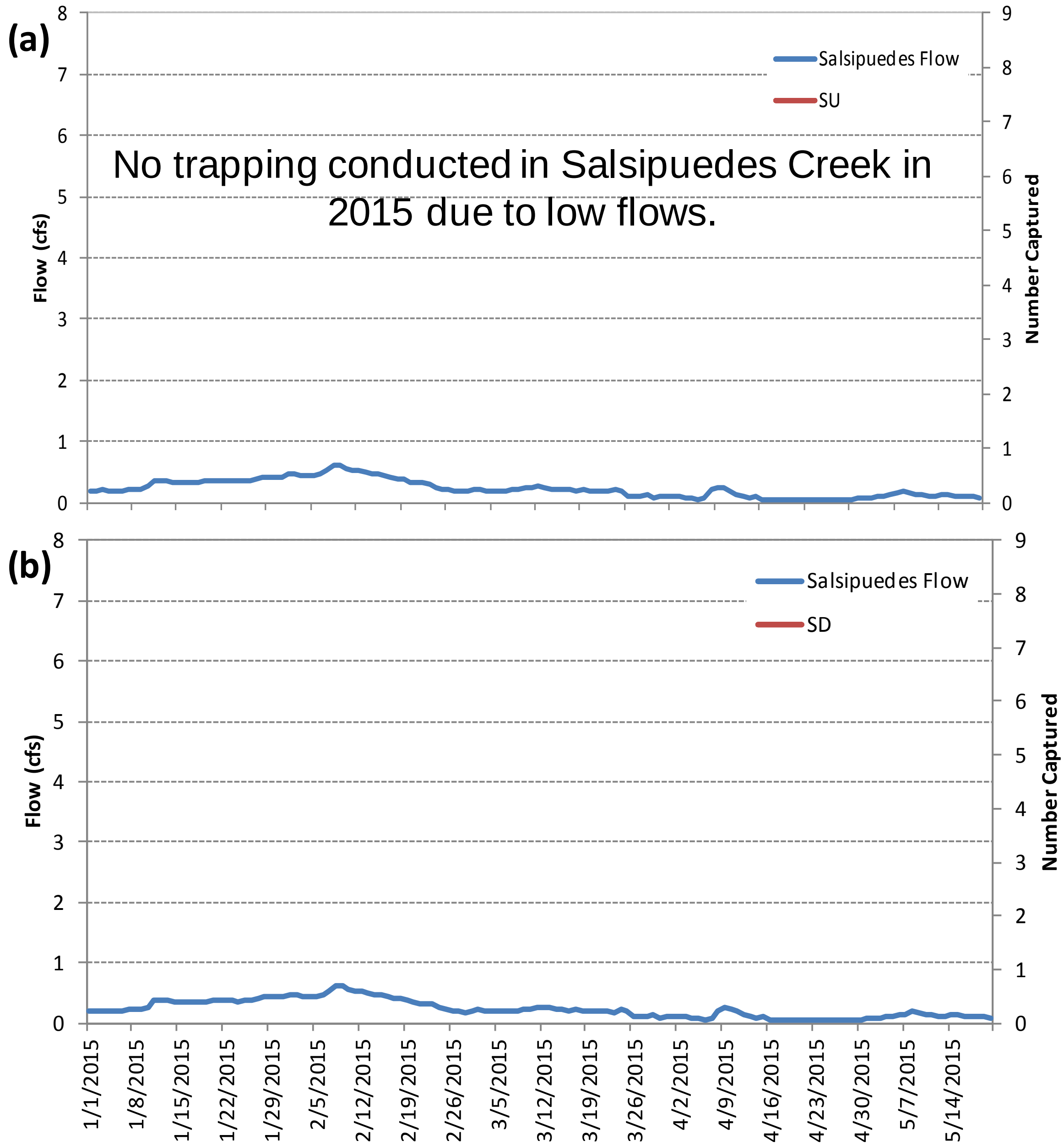


Figure 58: WY2015 Salsipuedes Creek migrant captures (red dots) vs. flow for (a) upstream and (b) downstream migrants. Flow was not greater than 0.6 cfs during the entire migration season.

Table 9: WY2015 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	24	~	65	65	100%	0.37	0	0.37	2.4	2.4
Hilton DN	~	110	65	65	100%	0	1.69	1.69	2.4	2.4
Salsipuedes	0	0	N/A	N/A	N/A	N/A	N/A	N/A	0.2	0.2
Mainstem	0	0	N/A	N/A	N/A	N/A	N/A	N/A	2.3	2.1

Table 10: Tributary upstream and downstream migrant captures for Hilton Creek and Salsipuedes Creek (not trapped) in WY2015. Blue lettering represents breakdown of smolts, pre-smolts, and resident trout for each size category.

Hilton Captures		Size		Salsipuedes Captures
(#)		(mm)		(#)
		Upstream Traps		
0		>700		
0		650-699		
0		600-649		
0		550-599		
0		500-549		
0		450-499		
0		400-449		
7		300-399		
11		200-299		
6		100-199		
0		<99		
24		**Total**		
		Downstream Traps		
0		>700		
0		650-699		
0		600-649		
0		550-599		
0		500-549		
0		450-499		
0		400-449		
7		300-399		
35		200-299		
	11	*Smolts*		
	3	*Pre-Smolt*		
	21	*Res*		
68		100-199		
	30	*Smolts*		
	23	*Pre-Smolt*		
	15	*Res*		
0		<99		
	0	*Smolts*		
	0	*Pre-Smolt*		
	0	*Res*		
110		**Total**		

Table 11: WY2015 redd survey results in the LSYR tributaries and mainstem; lengths and widths are given in feet and Salsipuedes Creek watershed includes Upper Salsipuedes, El Jaro, Yitias, and Los Amoles creeks.

2015 Redd Surveys				
Location	Date	Redd#	*Length	**Width
Tributary Redds				
Hilton Ck	2/10/2015	1	3.40	1.4
	2/10/2015	2	1.40	2.2
	3/12/2015	3	3.00	1.3
	3/12/2015	4	4.00	1.2
	3/12/2015	5	1.90	0.8
	3/12/2015	6	3.90	1.8
	3/12/2015	7	2.20	0.9
	3/12/2015	8	2.90	1.2
	3/25/2015	9	3.90	1.7
Salsipuedes Ck	2/4/2015	1	2.00	1.0
	2/4/2015	2	1.70	0.9
	3/5/2015	3	2.00	1.4
LSYR Redds				
HWY 154	3/10/2015	1	4.70	2.1
	3/10/2015	2	3.20	1.4
	3/10/2015	3	3.30	1.4
	3/10/2015	4	3.30	1.2
*pit length plus tail spill length		**16**		
**average of all width measurement				

Table 12: WY2015 tributary redd observations by month and location.

2015 Tributaries					
	January	February	March	April	Total
Hilton Ck	0	2	7	0	9
Quiota Ck	0	0	0	n/s	0
Salsipuedes Ck	0	2	1	n/s	3
El Jaro Ck	0	0	0	n/s	0
Los Amoles CK	0	0	0	n/s	0
Ytias Ck	0	0	0	n/s	0
Total:	0	4	8	0	12
n/s not surveyed due ot extreme low water					

Table 13: WY2015 LSYR mainstem redd survey results within the management reaches (Hwy 154, Refugio and Alisal reaches).

2015 Mainstem					
	January	February	March	April	Total
Hwy 154	0	0	4	0	4
Refugio	0	0	Dry	Dry	0
Alisal	0	0	Dry	Dry	0
Total:	**0**	**0**	**4**	**0**	**4**

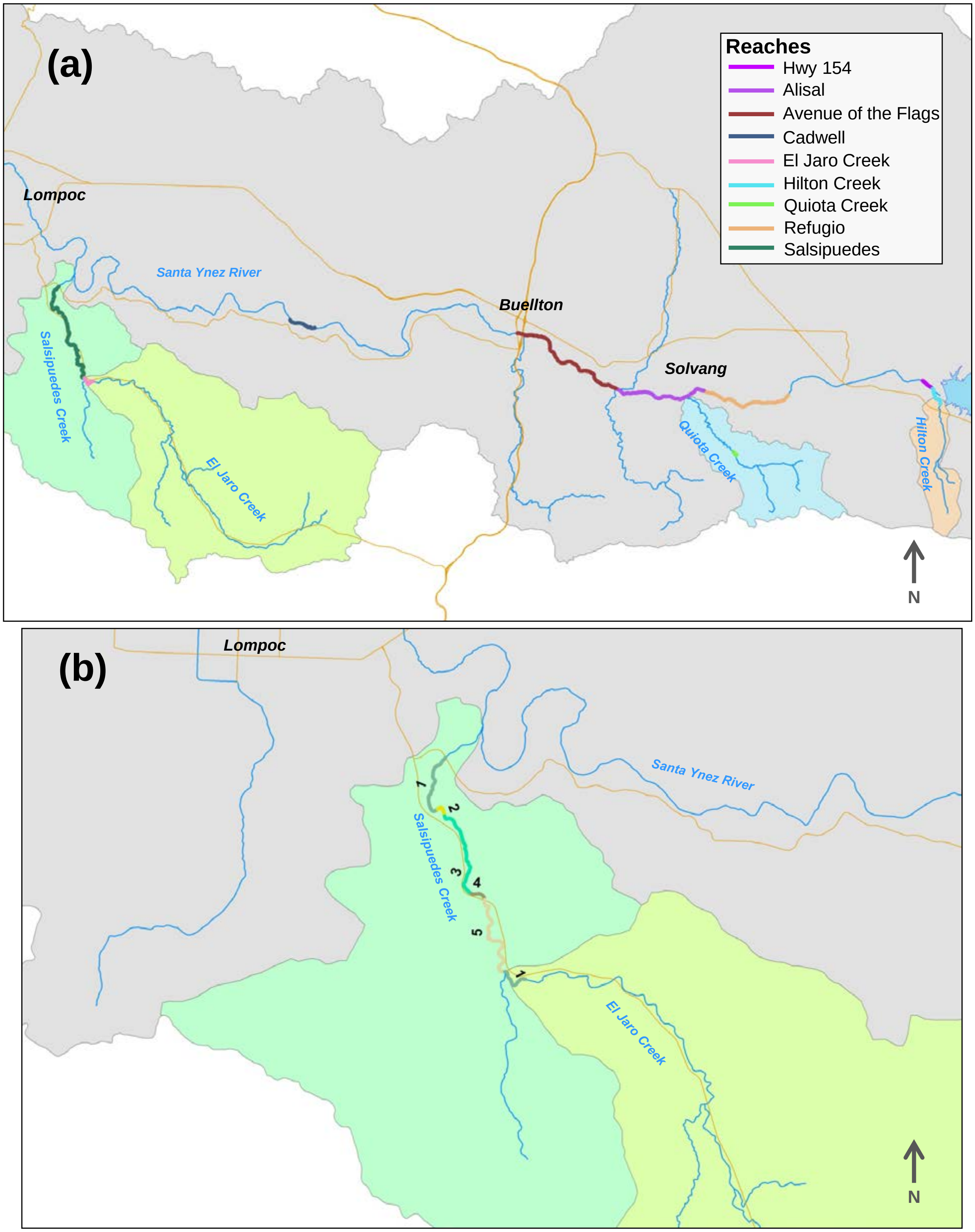


Figure 59: Stream reaches snorkel surveyed in WY2015 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

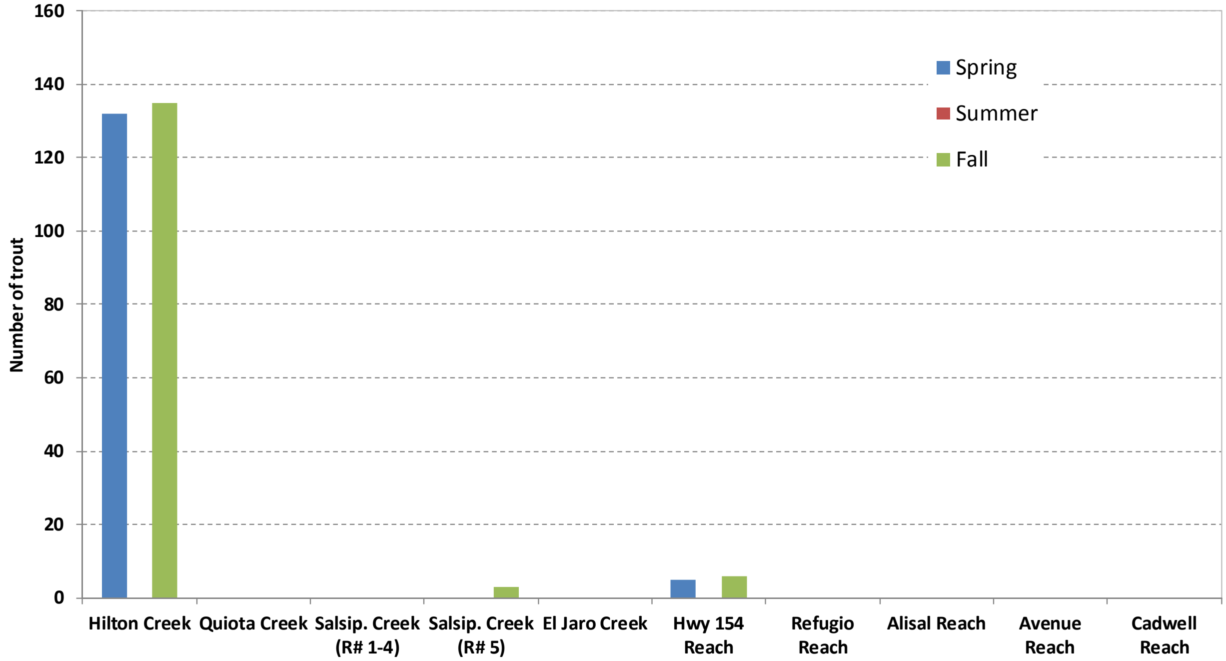


Figure 60: 2015 LSYR steelhead/rainbow trout observed during spring, summer and fall snorkel surveys.

Table 14: 2015 LSYR mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	7/29/2015
(LSYR-0.2 to LSYR-0.7)	Summer	n/s
	Fall	10/7/2015
Refugio Reach	Spring	7/29/2015
(LSYR-4.9 to LSYR-7.8)	Summer	9/14/2015-9/15/15
	Fall	9/30/15-10/1/15
Alisal Reach	Spring	7/28/2015-7/29/2015
(LSYR-7.8 to LSYR-10.5)	Summer	9/15/2015-9/16/15
	Fall	10/1/2015 & 10/5/15
Avenue Reach	Spring	7/28/2015
(LSYR-10.5 to LSYR-13.9)	Summer	9/16/15-9/17/15
	Fall	10/5/15-10/6/15
Reach 3 Downstream of Avenue	Spring	7/28/2015
(LSYR-13.9 to LSYR-25.0)	Summer	9/21/2015
	Fall	10/7/2015
*n/s = no survey		

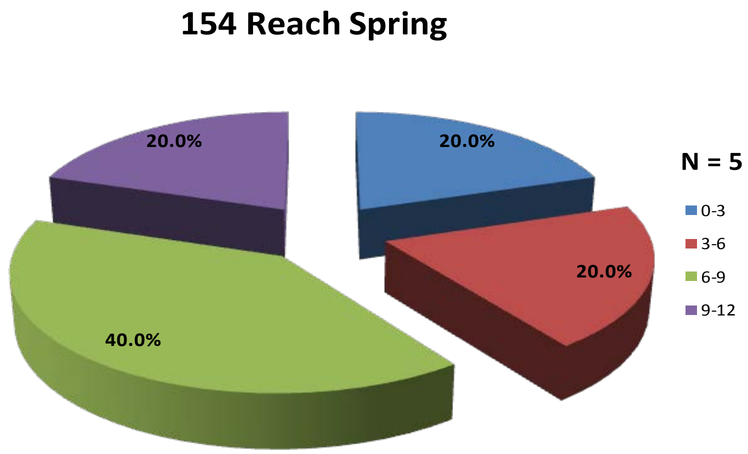
Table 15: LSYR mainstem spring, summer, and fall snorkel survey results in 2015 with the miles surveyed; the level of effort was the same for each snorkel survey.

Mainstem	Spring (# of trout)	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hwy 154 Reach	5	n/s	6	0.26
Refugio Reach	0	0	0	2.95
Alisal Reach	0	0	0	2.80
Avenue of the Flags Reach	0	0	0	3.4
Cadwell Reach	0	0	0	0.3

Table 16: LSYR mainstem spring, summer, and fall snorkel survey results in 2015 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	1	1	2	1						5
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0
Summer	Hwy 154										
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0
Fall	Hwy 154			5	1						6
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0

(a)



(b)

No Survey

(c)

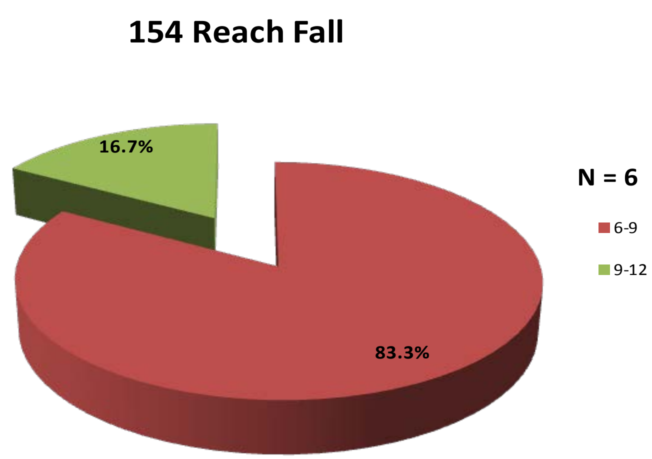


Figure 61: 2015 Hwy 154 Reach fall snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a) **Refugio Reach Spring**

None observed

(b) **Refugio Reach Summer**

None observed

(c) **Refugio Reach Fall**

None observed

Figure 62: 2015 Refugio Reach snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a) **Alisal Reach Spring**

None observed

(b) **Alisal Reach Summer**

None observed

(c) **Alisal Reach Fall**

None observed

Figure 63: 2015 Alisal Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a) **Avenue Reach Spring**

None observed

(b) **Avenue Reach Summer**

None observed

(c) **Avenue Reach Fall**

None observed

Figure 64: 2015 Avenue Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a) **Cadwell Reach Spring**

None observed

(b) **Cadwell Reach Summer**

None observed

(c) **Cadwell Reach Fall**

None observed

Figure 65: 2015 Cadwell Reach snorkel survey size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

Table 17: 2015 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	7/8/2015
(HC-0.0 to HC-0.54)	Summer	n/s*
	Fall	10/22/2015*
Quiota Creek	Spring	6/15/2015
(QC-2.58 to QC-2.73)	Summer	n/s
	Fall	n/s
Salsipuedes Creek	Spring	n/s
(Reach 5)	Summer	n/s
	Fall	11/5/2015
El Jaro Creek	Spring	n/s
(ELC-0.0 to ELC-0.4)	Summer	n/s
	Fall	n/s
*n/s = no survey, turbid conditions or dry		
*Poor visibility		

Table 18: WY2015 *O. mykiss* observed and miles surveyed during all tributary snorkel surveys; the level of effort was the same for each survey.

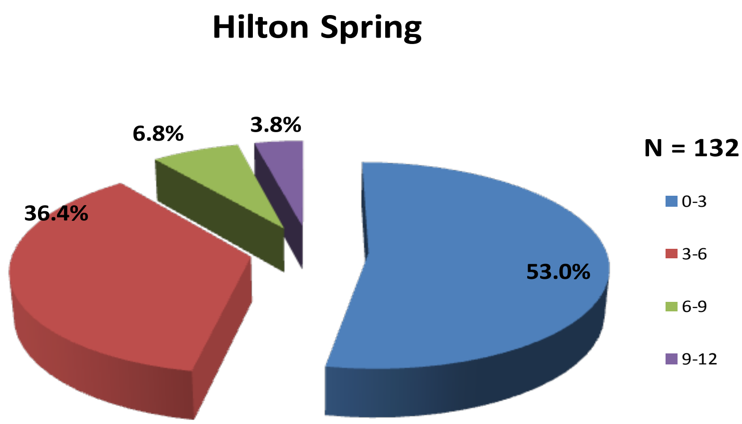
Tributaries	Spring (# of trout)*	Summer (# of trout)	Fall (# of trout)	Survey Distance (miles)
Hilton Creek				
Reach 1	32		56	0.133
Reach 2	23		40	0.050
Reach 3	19		11	0.040
Reach 4	14		28	0.075
Reach 5	44		n/a	0.242
Reach 6				0.014
Total:	***132***	***n/s****	***135***	***0.554***
Quiota Creek	0	0	0	0.11
Salsipuedes Creek (Reach 1-4)	n/s	n/s	n/s	2.85
Salsipuedes Creek (Reach 5)	n/s	n/s	3	0.45
El Jaro Creek	n/s	n/s	n/s	0.35
n/s = no survey, turbid conditions				
*Poor visibility				

Table 19: WY2015 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	70	48	9	5						132
	Quiota										0
	Salsipuedes (R 1-4)	n/s									0
	Salsipuedes (R-5)	n/s									
	El Jaro	n/s									
Summer	Hilton	n/s									
	Quiota	n/s									
	Salsipuedes (R 1-4)	n/s									
	Salsipuedes (R-5)	n/s									
	El Jaro	n/s									
Fall	Hilton	36	73	22	4						135
	Quiota	n/s									
	Salsipuedes (R 1-4)	n/s									
	Salsipuedes (R-5)		2		1						3
	El Jaro	n/s									

n/s = no survey, turbid conditions or dry

(a)



(b)

Hilton Summer

N/A – poor visibility

(c)

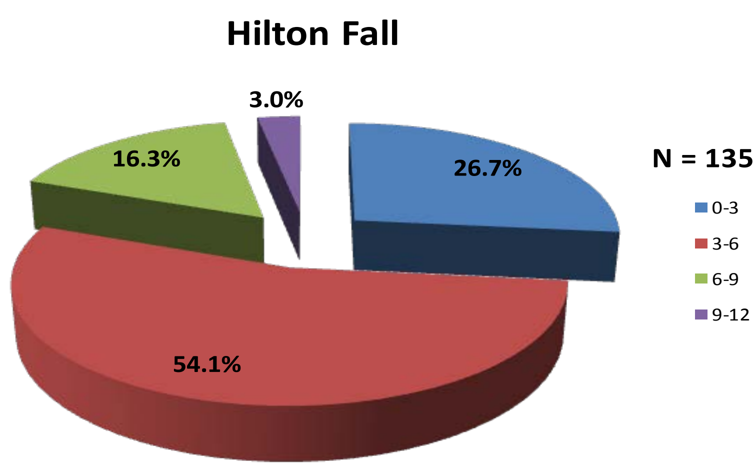


Figure 66: WY2015 Hilton Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a) Quiota Spring

N = 0

No Fish Observed

(b) Quiota Summer

N/A – few wetted habitats remaining and poor visibility

(c) Quiota Fall

N/A – Entire reach dry with only a few wetted habitats

Figure 67: WY2015 Quiota Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

(a) **Salsipuedes R #1-4 Spring**

N/A – poor visibility

(b) **Salsipuedes R #1-4 Summer**

N/A – poor visibility

(c) **Salsipuedes R #1-4 Fall**

N/A – poor visibility

Figure 68: WY2015 Salsipuedes Creek reaches 1-4 snorkel survey with size classes (range) of fish observed in inches; (a) spring, and (b) summer.

Salsipuedes R #5 Spring

(a)

N/A – poor visibility

Salsipuedes R #5 Summer

(b)

N/A – poor visibility

(c)

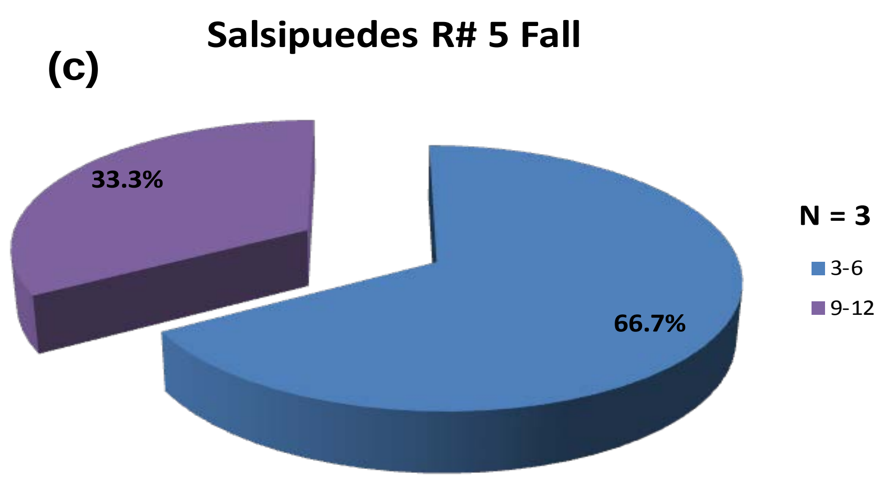


Figure 69: WY2015 Salsipuedes Creek Reach 5 survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.

El Jaro Spring

(a)

N/A – poor visibility

El Jaro #1-4 Summer

(b)

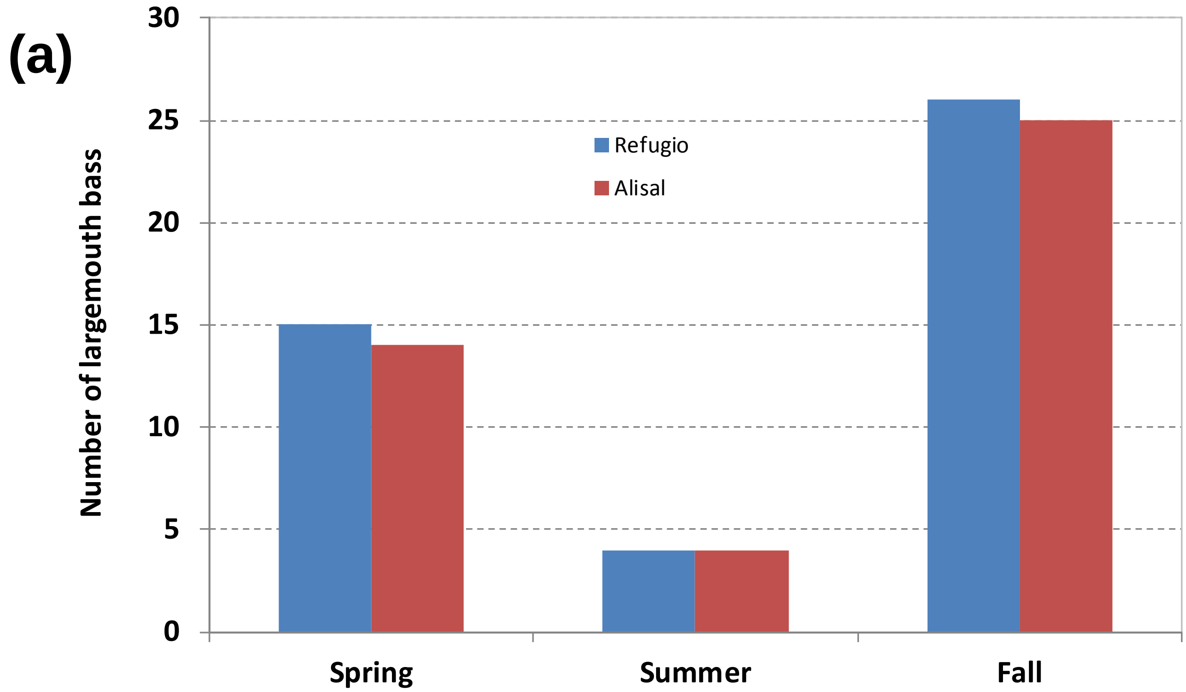
N/A – poor visibility

El Jaro #1-4 Fall

(c)

N/A – poor visibility

Figure 70: WY2015 El Jaro Creek snorkel survey with size classes (range) of fish observed in inches; (a) spring, (b) summer, and (c) fall.



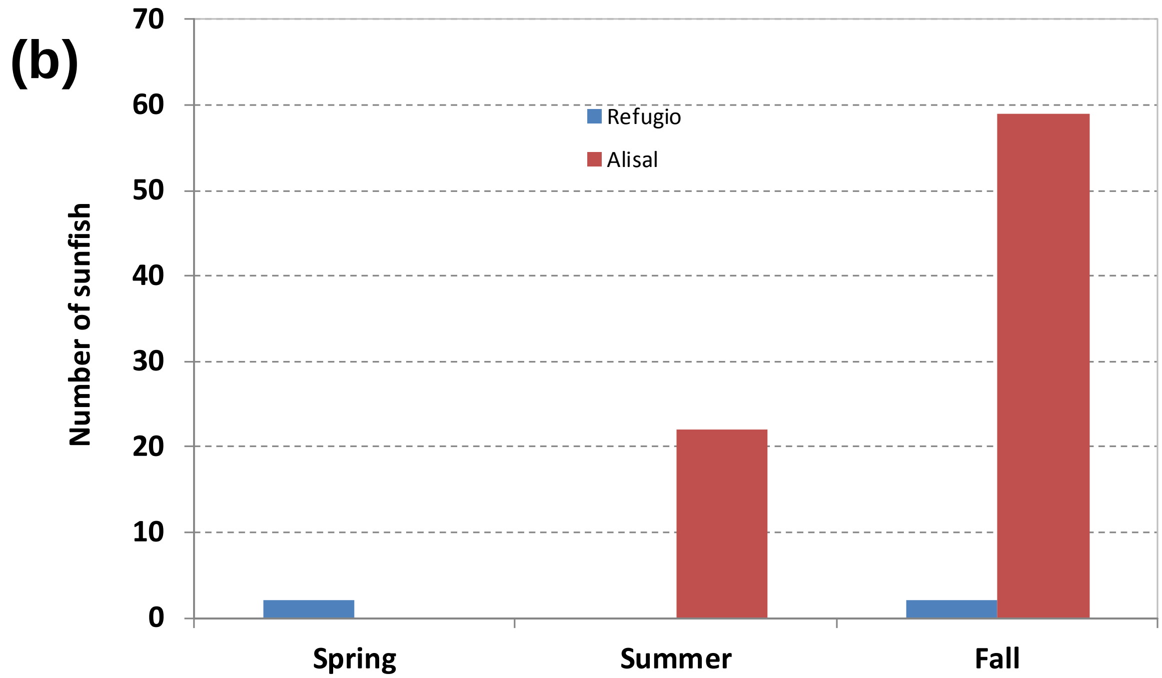
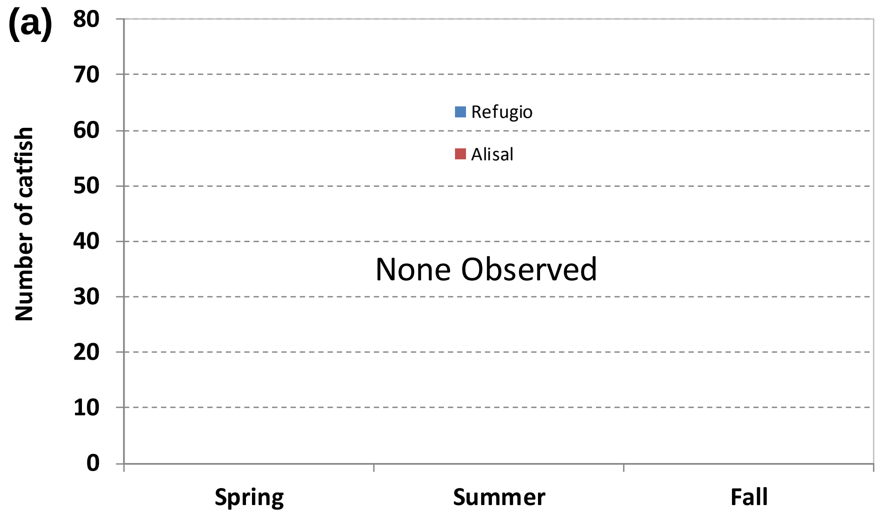


Figure 71: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2015 within the Refugio and Alisal reaches: (a) largemouth bass and (b) sunfish.



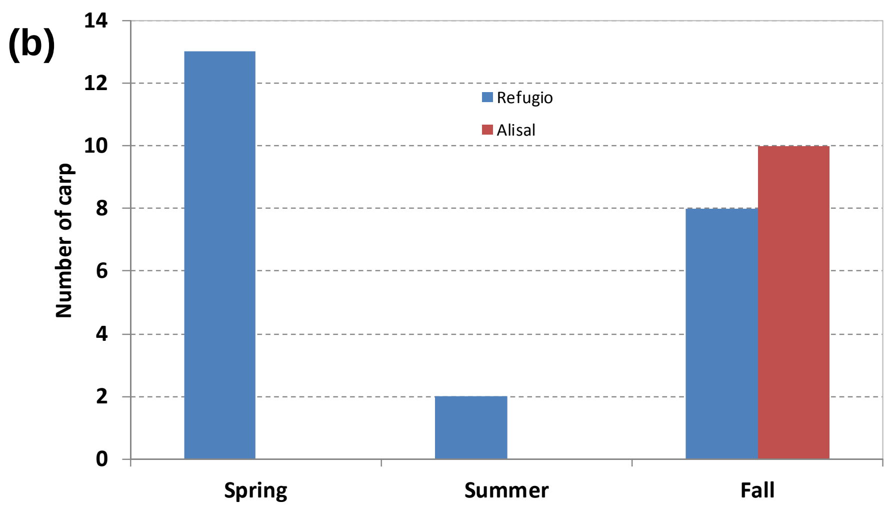
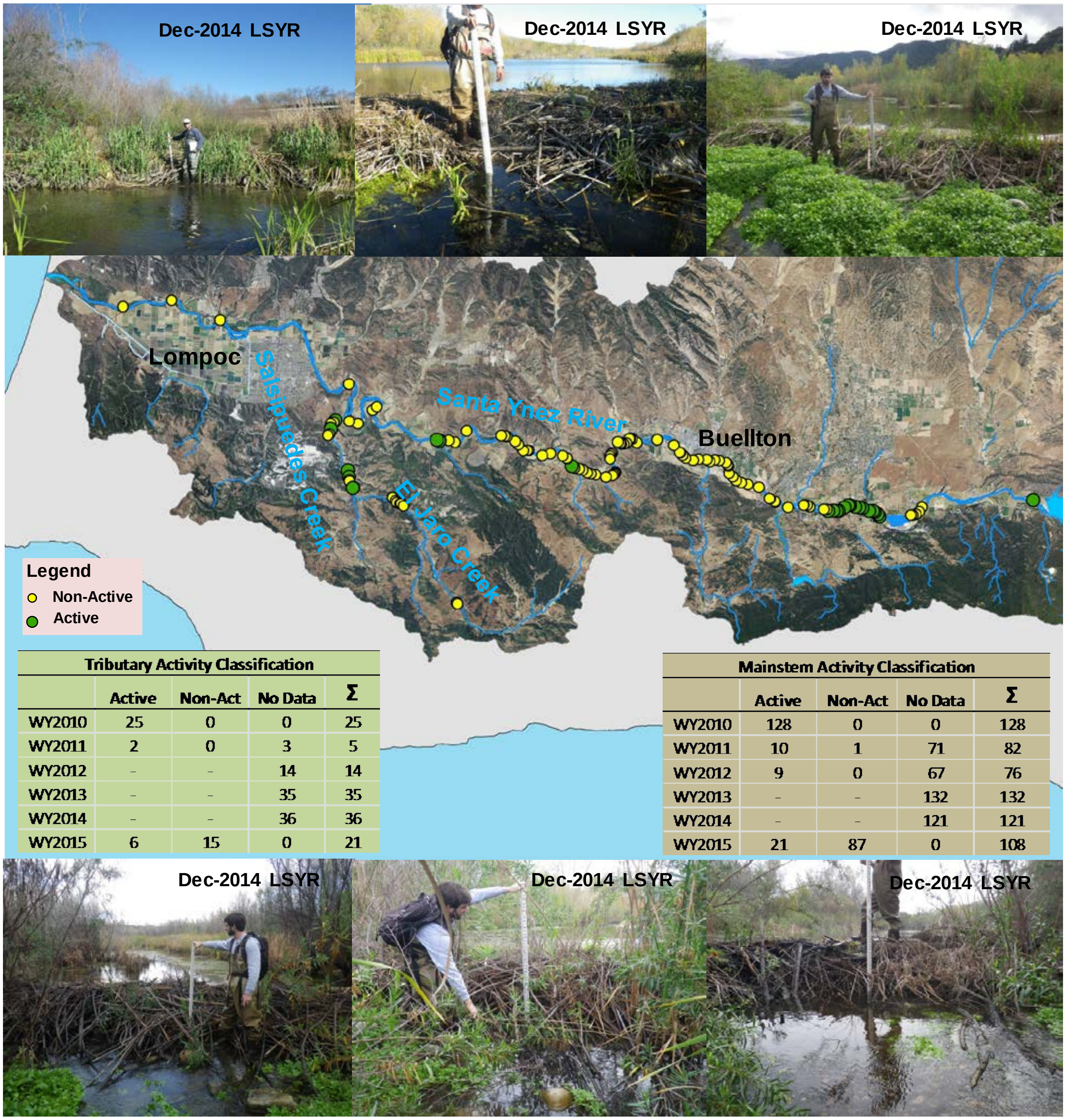


Figure 72: Observed warm water predators during the spring, summer and fall snorkel surveys in WY2015 within the Refugio and Alisal reaches: (a) catfish, and (b) carp.

Table 20: 2010-2015 beaver dams in the LSYR mainstem and Salsipuedes/El Jaro watershed 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
2010	3	65	40	17	3	128	0	17	5	3	0	25
2011	5	34	31	10	2	82	3	1	1	0	0	5
2012*	9	38	23	4	0	74	5	6	3	0	0	14
2013	23	75	27	7	0	132	8	23	4	0	0	35
2014	21	48	36	15	1	121	10	24	2	0	0	36
2015	19	52	32	5	0	108	9	10	2	0	0	21

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



Tributary Activity Classification

	Active	Non-Act	No Data	Σ
WY2010	25	0	0	25
WY2011	2	0	3	5
WY2012	-	-	14	14
WY2013	-	-	35	35
WY2014	-	-	36	36
WY2015	6	15	0	21

Mainstem Activity Classification

	Active	Non-Act	No Data	Σ
WY2010	128	0	0	128
WY2011	10	1	71	82
WY2012	9	0	67	76
WY2013	-	-	132	132
WY2014	-	-	121	121
WY2015	21	87	0	108

Figure 73: Spatial extent of beaver dams from the 2015 survey within the LSYR mainstem and its tributaries.

4. Discussion

Table 21: Monthly rainfall totals at Bradbury Dam from WY2000-WY2015.

Month	Water Years:															
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
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	0.00
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	0.87
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	5.88
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	0.82
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	0.51
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	0.08
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	0.36
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	0.26
Jun	0.04	0	0	0.02	0	0.04	0	0	0	0.16	0	0.34	0	0	0	0.42
Jul	0	0.06	0	0.01	0	0	0	0	0	0	0	0.00	0	0	0	0.03
Aug	0	0	0	0	0	0	0	0	0	0.03	0	0.00	0	0	0	0.00
Sept	0	0	0.08	0	0	0.03	0	0.17	0	0.08	0	0.00	0.18	0	0	0.15
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***	***9.38***

Table 22: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2015.

Month	WY2001 Solvang (cfs)	WY2001 Narrows (cfs)	WY2002 Solvang (cfs)	WY2002 Narrows (cfs)	WY2003 Solvang (cfs)	WY2003 Narrows (cfs)	WY2004 Solvang (cfs)	WY2004 Narrows (cfs)	WY2005 Solvang (cfs)	WY2005 Narrows (cfs)	WY2006 Solvang (cfs)	WY2006 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 Solvang (cfs)	WY2007 Narrows (cfs)	WY2008 Solvang (cfs)	WY2008 Narrows (cfs)	WY2009 Solvang (cfs)	WY2009 Narrows (cfs)	WY2010 Solvang (cfs)	WY2010 Narrows (cfs)	WY2011 Solvang (cfs)	WY2011 Narrows (cfs)	WY2012 Solvang (cfs)	WY2012 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 Solvang (cfs)	WY2013 Narrows (cfs)	WY2014 Solvang (cfs)	WY2014 Narrows (cfs)	WY2015 Solvang (cfs)	WY2015 Narrows (cfs)
Oct	4.5	0	42.6	28.8	13.2	0
Nov	2.7	0	22.7	17.1	5.21	0
Dec	5.8	0	8.9	8.1	7.1	0
Jan	6.3	0	4.3	2.2	5.1	0
Feb	6	3.6	6	3.6	4	0
Mar	4.8	4.5	10.6	12.3	1.5	0
Apr	1.7	0.54	3	1.8	0	0
May	0	0	0	0	0	0
Jun	0	0	0	0	0	0
Jul	51	3	0	0	0	0
Aug	59.1	27	0	0	79	0
Sep	47.9	28	2.7	0	42	0.77

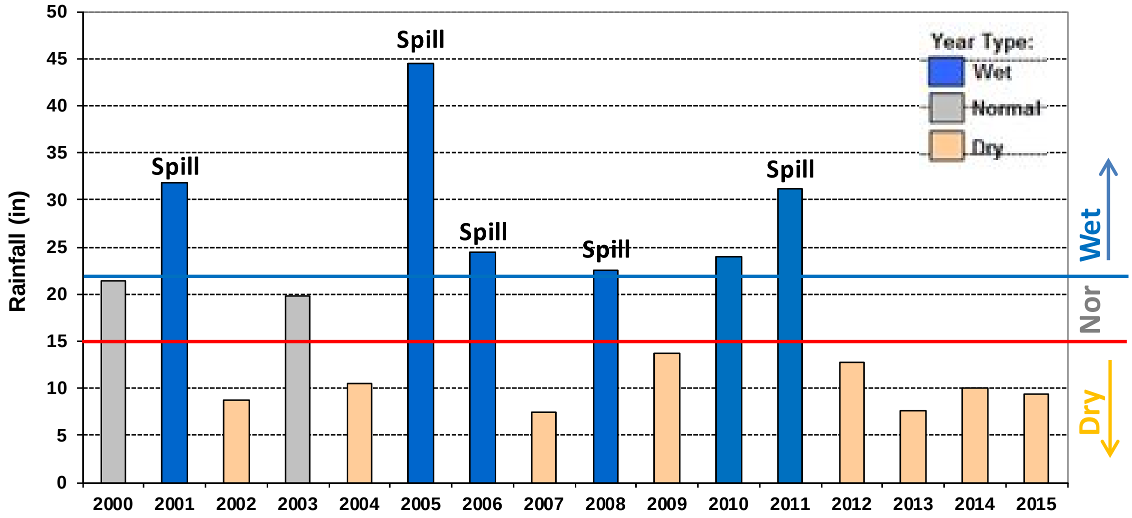


Figure 74: Water year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 23: Biological Opinion (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.

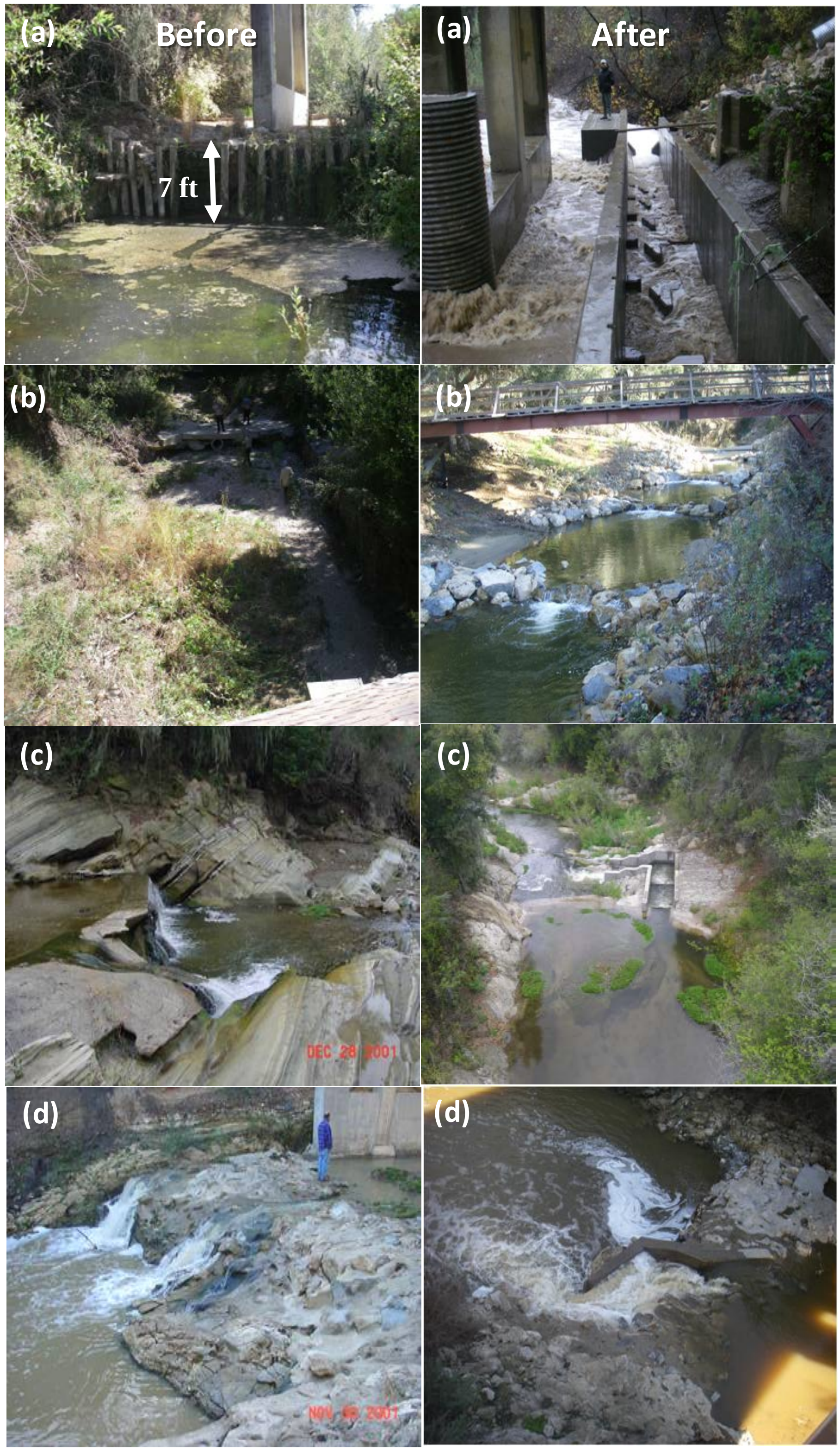


Figure 75: Fish passage and habitat restoration at: at (a) Rancho San Julian Bridge on El Jaro Creek (2008), (b) Cross Creek Ranch on El Jaro Creek (2009), (c) Jalama Road Bridge on Salsipuedes Creek (2004), and (d) Highway 1 Bridge on Salsipuedes Creek (2002).

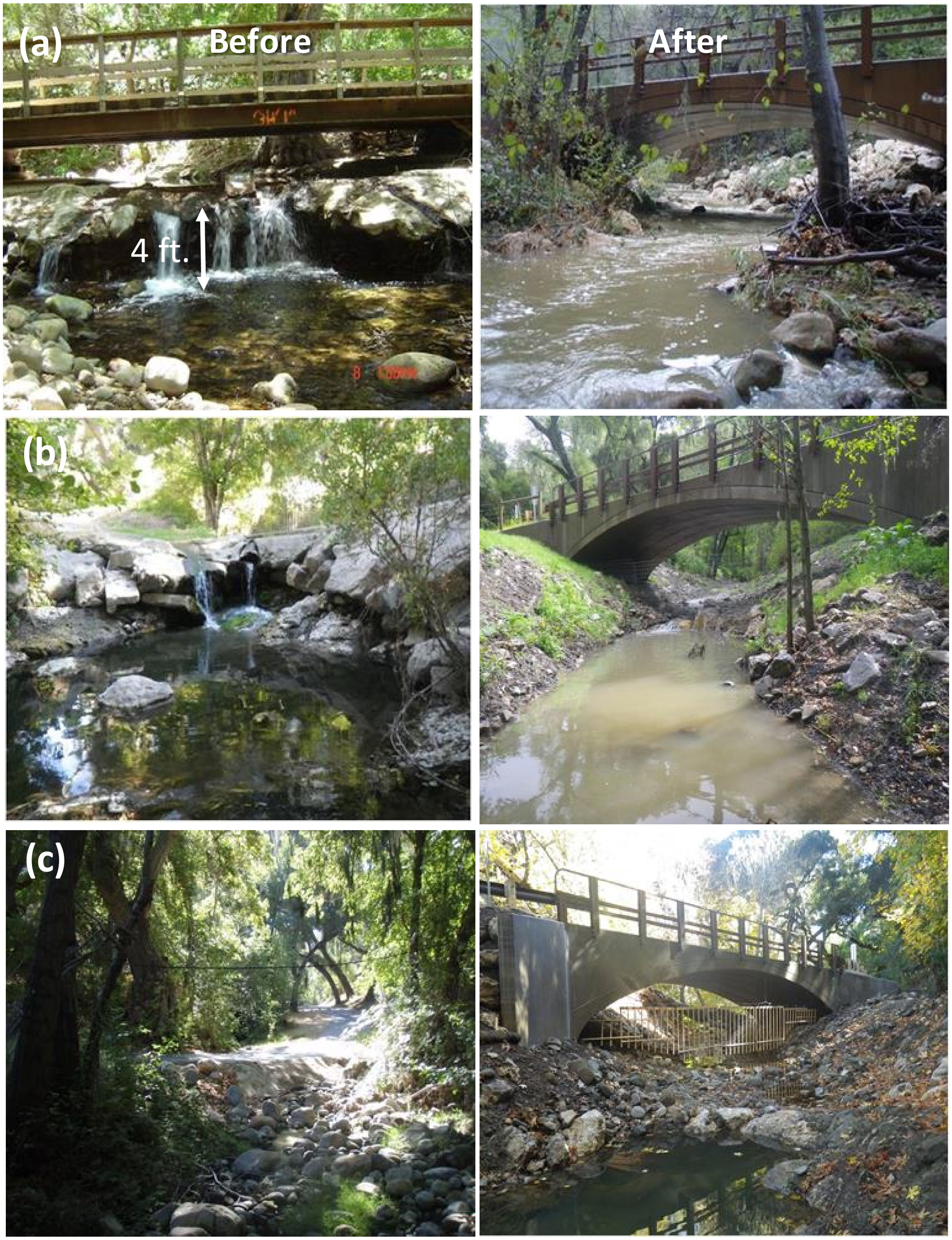


Figure 76: Fish passage and habitat restoration at a) Quiota Creek Crossing 6 (2008), (b) Quiota Creek Crossing 2 (2011), and Quiota Creek Crossing 7 (2013).

Figure 77: Fish passage and habitat restoration at (a) Quiota Creek Crossing 1 (in 2014) and (b) Quiota Creek Crossing 3 (in 2015).

Figure 78: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

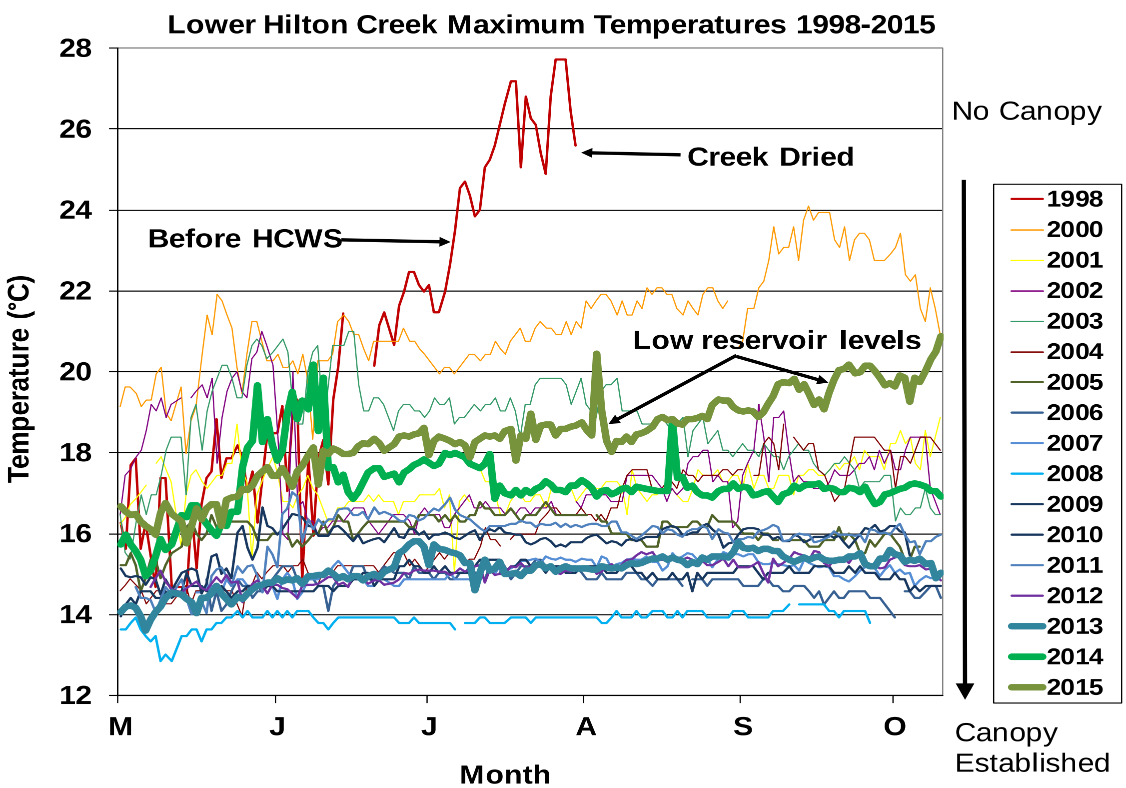


Figure 79: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2015, the last three years are shown with a wider curve.

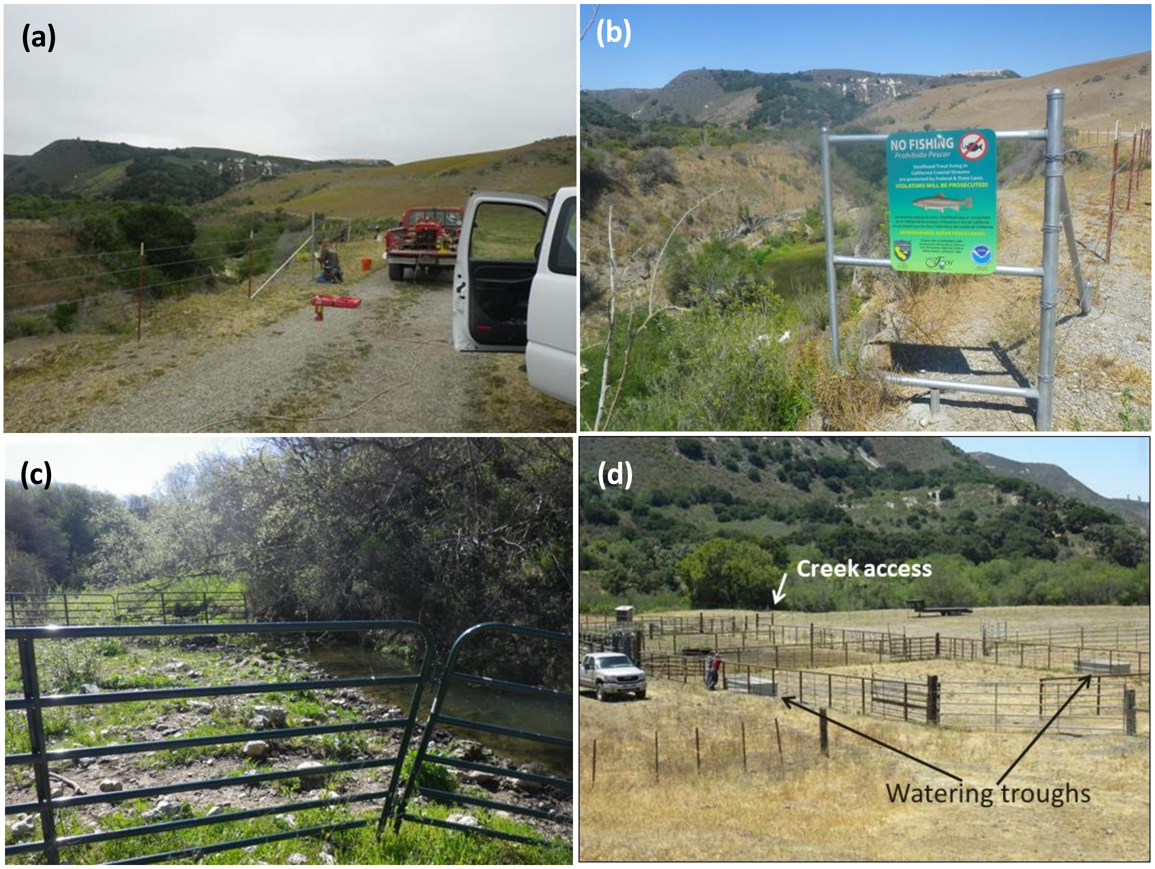


Figure 80: Salsipuedes Creek Cattle Exclusionary Fencing Project; (a) installation of the fencing, (b) signage on the fencing after installation, (c) cattle watering corridor showing cattle impacts to the stream within and not outside of the corridor, and (d) off-channel watering troughs.

Figure 81: Salsipuedes Creek Cattle Exclusionary Fencing Project; photos at the upstream boundary of the project area showing reeds and grasses growing in the creek corridor where there were none in the past due to cattle activities prior to the project in WY2013.

Figure 82: Location of water hyacinth infestation area downstream of Buellton.

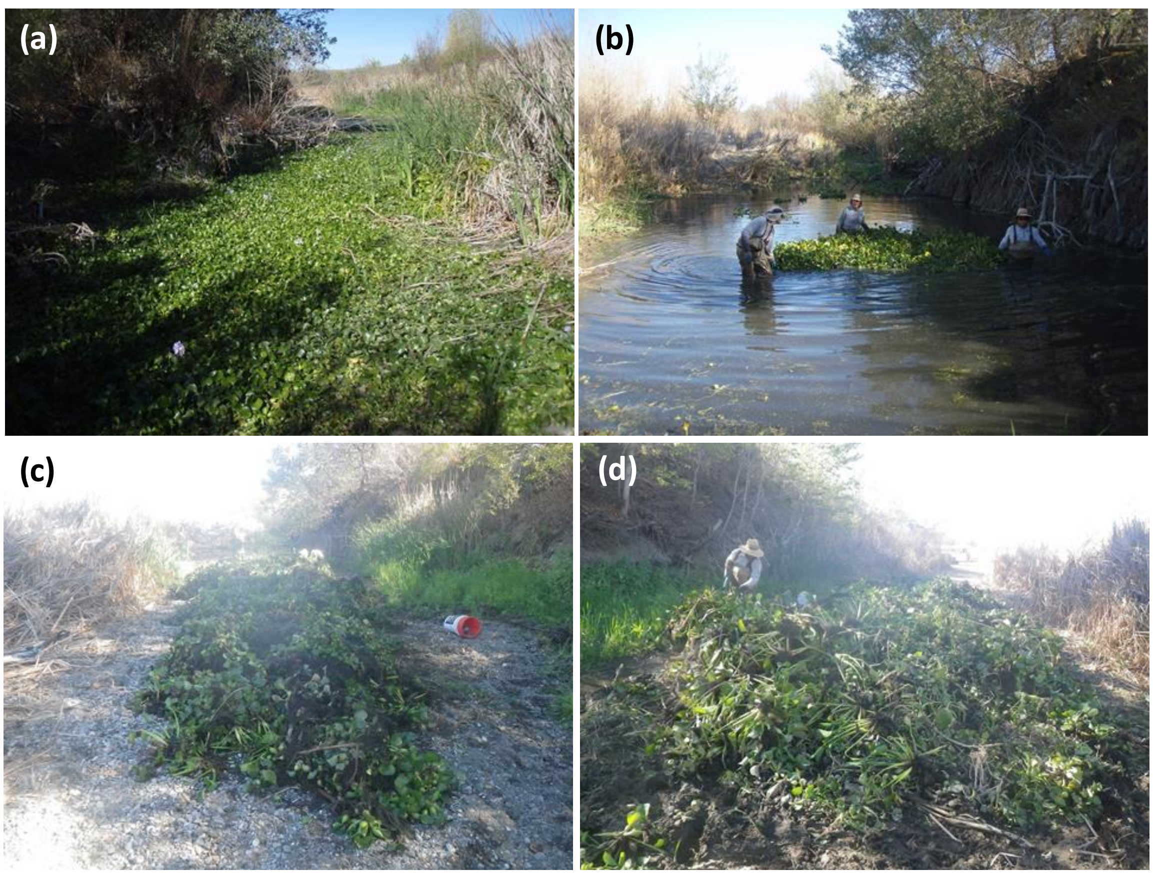


Figure 83: COMB-FD crew removing water hyacinth from: a) the upper infestation pool in October 2015, b) using ropes to tow a large patch to shore, and c-d) stockpiling water hyacinth on the shore for later excavator pick up.

Figure 84: California Conservation Corp assistance in December 2015 showing: a) bagging of water hyacinth near shore, b-c) gathering and bagging on the far shore of a large pool habitat, and d) stockpiling of bags to be spread later into an agriculture field.

WY2015 Annual Monitoring Summary
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 downloaded, 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. 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 cubic 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 recreational visitors 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 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 2002-2015 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 WY2015 are listed in Tables C-1 and C-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.

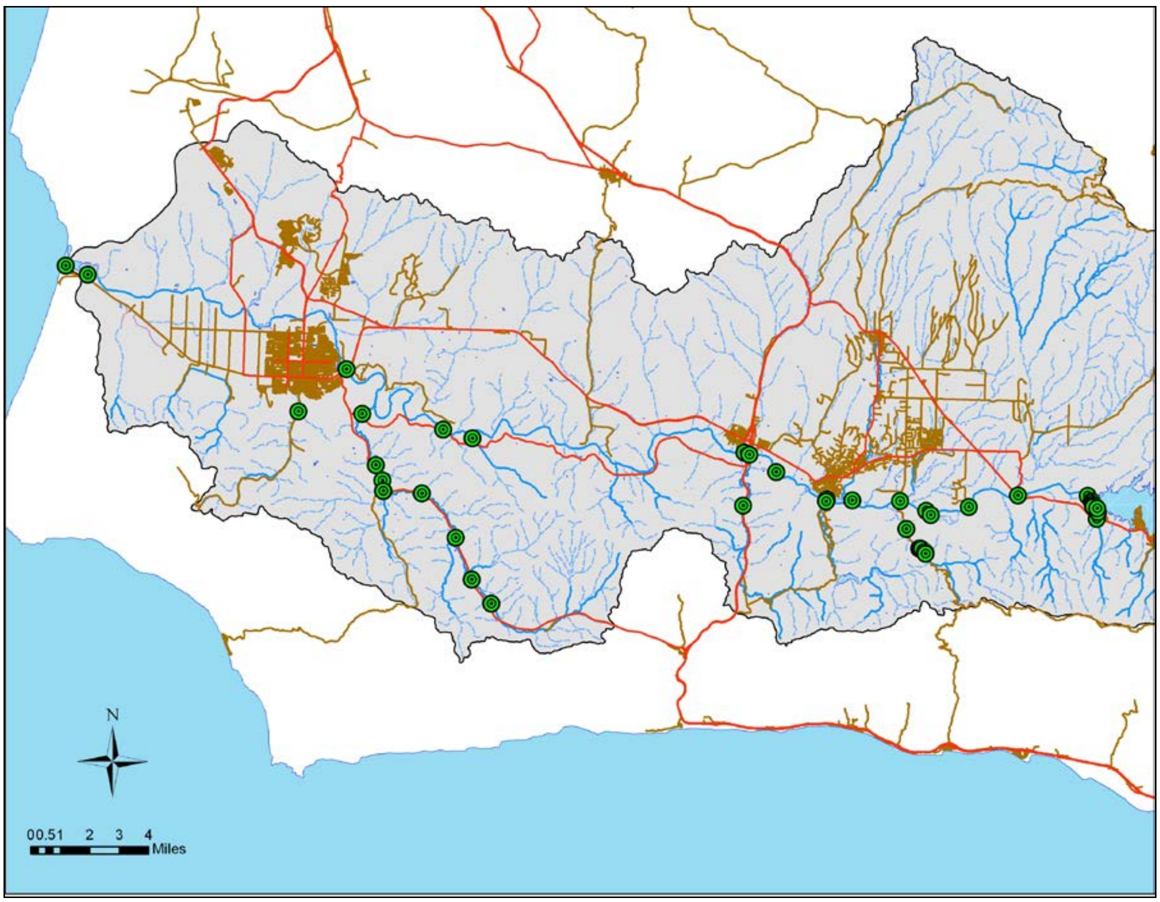


Figure C-1: WY2015 photo point locations.

Table C-1: WY2015 photo points on the LSYR mainstem. "X's" denote photos taken, downstream (d/s) and upstream (u/s).

LSYR Mainstem Photo Point ID	Location/Description	6/15/15	7/1/15
M1	Lower Hilton Creek, photo d/s at ford crossing		X
M2a	Bluffs overlooking long pool, photo u/s	X	
M2b	Bluffs overlooking long pool, photo d/s	X	
M3	Highway 154 culvert on Hilton Creek, photo u/s		
M4	Highway 154 culvert on Hilton Creek, photo d/s		
M5	Highway 154 Bridge, photo u/s	X	
M6	Highway 154 Bridge, photo d/s	X	
M7	Meadowlark crossing, photo u/s	X	
M8	Meadowlark crossing, photo d/s	X	
M9	Lower Gainey crossing, beaver dam, photo u/s		
M10	Lower Gainey crossing, beaver dam, photo d/s		
M11a	Lower Gainey crossing, photo u/s	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	X	
M30	LSYR Lagoon upper reach, photo u/s	X	
M31	Slick Gardener, looking across towards highway	X	
M32	Slick Gardener, looking d/s through culvert	X	
M33	Slick Gardener, looking u/s through culvert	X	

Table C-2: WY2015 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	6/15/15	7/1/15
T1	Hilton trap site, photo u/s		X
T2	Hilton start Reach #2, pt site, photo d/s		X
T3	Hilton at ridge trail, photo d/s	X	
T4	Hilton at ridge trail, photo u/s	X	
T5	Hilton at telephone pole, photo d/s	X	
T6	Hilton at telephone pole, photo u/s	X	
T7	Hilton at tail of spawning pool, photo u/s	X	
T8	Hilton impediment/tributary, photo d/s	X	
T9	Hilton impediment/tributary, photo u/s	X	
T10	Hilton just u/s of URP, photo d/s	X	
T11	Hilton road above URP, photo d/s	X	
T12	Hilton road above URP, photo u/s	X	
T14	Hilton from hard rock toe, photo d/s	X	
T15	Hilton from hard rock toe, photo u/s	X	
TX1a	Quiota Creek at 1st crossing, photo u/s	X	
TX1b	Quiota Creek at 1st crossing, photo d/s	X	
TX2a	Quiota Creek at 2nd crossing, photo u/s	X	
TX2b	Quiota Creek at 2nd crossing, photo d/s	X	
TX3a	Quiota Creek at 3rd crossing, photo u/s	X	
TX3b	Quiota Creek at 3rd crossing, photo d/s	X	
TX4a	Quiota Creek at 4th crossing, photo u/s	X	
TX4b	Quiota Creek at 4th crossing, photo d/s	X	
T16	Quiota Creek at 5th crossing, photo d/s	X	
T17	Quiota Creek at 5th crossing, photo u/s	X	
T18	Quiota Creek at 6th crossing, photo d/s	X	
T19	Quiota Creek at 6th crossing, photo u/s	X	
T20	Quiota Creek at 7th crossing, photo d/s	X	
T21	Quiota Creek at 7th crossing, photo u/s	X	
T22	Quiota Creek below 1st crossing, photo d/s	X	
T23	Alisal Creek from Alisal Bridge, photo u/s	X	
T24a	Alisal Creek from Alisal Bridge, photo u/s	X	
T24b	Alisal Creek from Alisal Bridge, photo d/s	X	
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s	X	
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s		
T27	Nojoqui/LSYR confluence, photo u/s		
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s		
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	
T42a	Salsipuedes Creek at Jalama Bridge, photo u/s	X	
T42b	Pool at Jalama Bridge	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	X	
T63	Rancho San Julian Bridge, photo u/s	X	

D. List of Supplemental Reports Created During WY2015

- WY2012 Annual Monitoring Summary with Trend Analyses (COMB, 2016a).
- WY2013 Annual Monitoring Report with Trend Analysis (COMB, 2017).
- WY2014 Annual Monitoring Summary (COMB, 2018)
- Quiota Creek Crossing 3 End of Project Report (COMB, 2016b).
- CDFW-FRGP Grant Proposal for Quiota Creek Crossing 0A Project.
- CDFW-FRGP Grant Proposal for Quiota Creek Crossing 4 Project.
- 2015 WR 89-18 Release Study Plan.
- 2015 WR 89-18 Release Monitoring Report for RPM 6.
- WY2015 Migrant Trapping Plan.
- HC Incident Reports (10/22/14, 10/29/14, 12/11/14, 1/14/15, and 4/4/15)

E. References

COMB, 2016a. 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, 2016b. End of Project Compliance Report, Fish Passage Improvement on Crossing 3, Quiota Creek. Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2017. WY2013 Annual Monitoring Summary and Trend Analysis. Prepared to be consistent with requireemnts set forth in the 2000 Cachuma Project Biological Opinion, Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2018. WY2014 Annual Monitoring Summary Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division. Prepared to be consistent with requireemnts set forth in the 2000 Cachuma Project Biological Opinion.