WY2019 ANNUAL MONITORING SUMMARY

for

THE BIOLOGICAL OPINION FOR THE OPERATION AND MAINTENANCE OF THE CACHUMA PROJECT ON THE SANTA YNEZ RIVER IN SANTA BARBARA COUNTY, CALIFORNIA

Prepared by:

CACHUMA OPERATION AND MAINTENANCE BOARD

FISHERIES DIVISION

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

JANUARY 30, 2020

DISCLAIMER

The Cachuma Operation and Maintenance Board (COMB), a Joint Powers Authority under California Government Code section 6500 et seq., and its member agencies, supply this Annual Monitoring Summary ("Report"), including all of its data, summaries, figures, tables, photographs, charts, analyses, results, conclusions and recommendations, "as is," with no warranties either express or implied made regarding the accuracy, adequacy, completeness, legality, reliability or usefulness of the information in the Report. The user of the contents of the Report assumes all responsibilities on its usage and for verifying the completeness and accuracy of the Report for both critical and non-critical uses and applications. In no event will COMB or its member agencies be in any way held liable to the user or any third party who uses this Report or any derivatives, products or services arising from this Report, for any damages, whether direct, indirect, incidental, special, exemplary or consequential. This disclaimer applies to both isolated and aggregated uses of the contents of the Report.

Executive Summary

The WY2019 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 2019 (WY2019, 10/1/18 – 9/30/19). 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 WY2019 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).

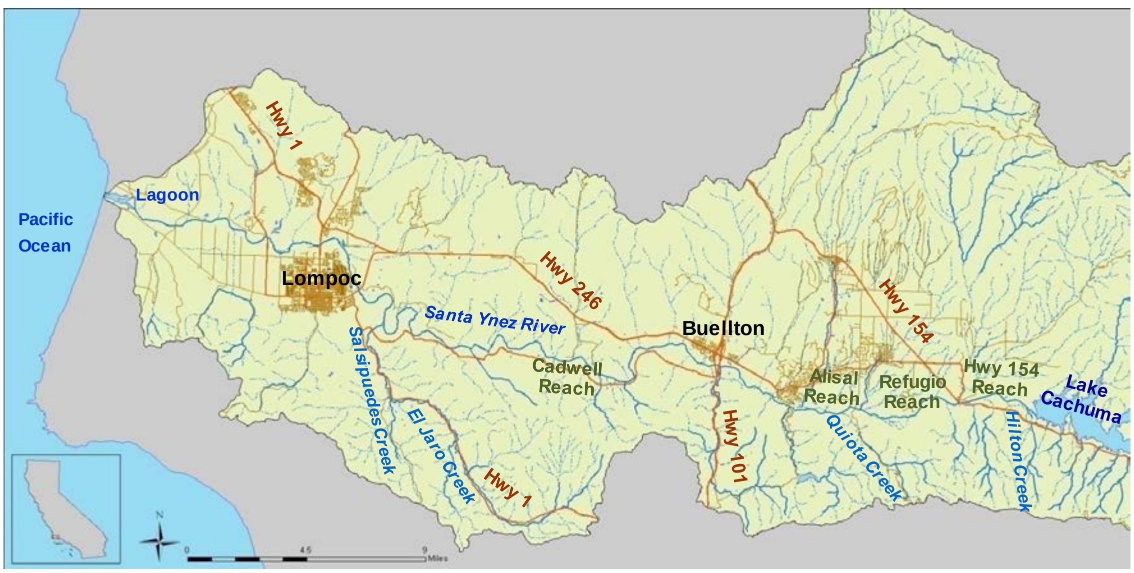


Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean west of Lompoc, showing tributary creeks and management reaches of interest for the LSYR Fish Monitoring Program.

This report summarizes data gathered since the WY2018 Annual Monitoring Summary (COMB, 2020) and fulfills the annual 2019 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 WY2019, 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, or program evolution from acquired field knowledge. A shortened version of this report, the WY2019 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 for monitoring equipment, (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.

WY2019 was a wet year (23.79 inches of precipitation measured at Bradbury Dam; long-term average, 1953-2019, is 19.89 inches) with the highest amount of rainfall occurring in January and February. This was the second wet year after 5 consecutive years of dry conditions (from 2012 to 2016, the driest year on record occurring in 2007 with only 7.41 inches of rain at Bradbury Dam). The largest storm of WY2019 (5.94 inches of rain) occurred on 1/31/19 to 2/5/19. The LSYR lagoon opened to the ocean on 1/18/19 and closed on 5/7/19 for a duration of 107 days of continuous ocean connectivity. At the beginning of the water year (10/1/18), there were 61,200 acre-feet (af) of water stored in Lake Cachuma and 144,475 af at the end of the water year (9/30/19). BiOp required target flows of a minimum of 2.5 cubic feet per second (cfs) to the Highway (Hwy) 154 Bridge were maintained until reservoir storage went above 120,000 af on 2/27/19 when target flows to the Hwy 154 Bridge went to 5 cfs throughout the rest of the water year. Target flows to Hilton Creek of a minimum of 2 cfs were met throughout the year through either the Hilton Creek Watering System (HCWS) by pumped flow or the Hilton Creek Emergency Backup System (HCEBS) by gravity flow to the Upper Release Point (URP). The only exception were 2 short-duration interruptions of flow on 10/3/18 and 12/31/18 due to power outages that shut off the HCWS pumps but were reactivated quickly; the second had 1 *O. mykiss* mortality. There were 3 fish passage supplementation events (2/6/19, 2/16/19, and 3/4/19) that followed the established program criteria for passage release both in timing and discharge quantity. There was no Water Rights (WR) 89-18 release in WY2019 which was the first time since WY2012.

In addition to the 2 short-duration interruption of flow events in Hilton Creek due to power outages, there was a high flow event from the upper watershed on 1/17/19 that brought down a large quantity of streambed material from the Whittier Fire burn scar (see the WY2018 AMS for details). The stream sediments filled in most all small and large pool habitats throughout the reaches on Reclamation property as well as filled in about a third of the Long Pool. The amount of sediments moving downstream and impact to the water quality and habitats made for difficult conditions for the Hilton Creek *O. mykiss* population. There were 3 *O. mykiss* mortalities found in association with that stormflow event and most likely many fish either washed downstream or perished. Reports for these 3 events were produced and submitted to Reclamation who then provided them to NMFS.

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 and the HCEBS; 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, HCEBS, 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 14 projects (by the end of 2019) restoring access to the upstream reaches of key tributaries in the lower Santa Ynez River Watershed for steelhead. Descriptions and photos of all habitat enhancement projects are presented in Section 4.

The following are recommendations to improve the monitoring program from WY2019 onward 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;
- Work closely with Reclamation on the implementation of the new Water Order WR 2019-0148 to conduct all required monitoring and reporting in a timely manner;
- Continue to collaborate with Reclamation on best management practices in Hilton Creek to address the potential for sediment-laden runoff from the Whittier Fire burn area;
- 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;
- Considering the success of the gravel augmentation effort in Hilton Creek in WY2018, discuss with Reclamation the possibility of a long-term program in Hilton Creek and other locations of known spawning activities that are limited in stream gravels;
- Work with the regulatory agencies to utilize the COMB Electrofishing Backpack unit and trained/certified staff whenever possible to implement fish rescue and removal of non-native fish from the LSYR basin;
- Remove non-native fish species and continue to 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;

- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin;
- Encourage Reclamation to improve and make reliable its system operation for delivering lake water to Hilton Creek;
- Continue to encourage Reclamation to gather continuous data on the water temperature discharged from the Outlet Works of Bradbury Dam to the LSYR to monitor BiOp compliance of a maximum of 18 ^{o}C of that discharge water;
- 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;
- 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;
- Continue to maintain and develop landowner relationships in the LSYR basin to foster cooperation and gain access to reaches for all monitoring and restoration tasks; and
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS and the Monte Arido Highland Biogeographic Region to improve collective knowledge, collaboration, and dissemination of information.

TABLE OF CONTENT

TABLES and FIGURES

Table 1: WY2000 to WY2019 rainfall (precipitation) at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Table 2: WY2019 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed (source: County of Santa Barbara and USBR).

Table 3: (a) Storm events greater than 0.1 inches of rainfall at Bradbury Dam with associated flow conditions (> 10 cfs) at Salsipuedes Creek (SC) and the Los Laureles (Los L) gauging stations and (b) monthly rainfall totals at Bradbury Dam during WY2019; dates reflect the starting day of the storm and not the storm duration.

Figure 1: Rainfall in WY2019 recorded at Bradbury Dam (USBR).

Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open to the ocean in WY2019.

Figure 3: USGS average daily discharge at the LSYR mainstem USGS gauging stations at Los Laureles, Bradbury Dam (USBR), Hilton Creek (USBR), Alisal Bridge (Solvang), Salsipuedes Creek, the Narrows and H Street (Lompoc) during WY2019.

Table 4: Ocean connectivity, lagoon status and number of days during the *O. mykiss* migration season from WY2001 to WY2019.

Figure 4: State Water Project (SWP) release into the LSYR regarding BiOp compliance with (a) the 50-50 mix rule showing the percentage of CCWA water being released from Bradbury Dam downstream to the Long Pool and (b) the 18 ^{o}C rule for the water temperature being released from the Outlet Works.

Figure 5: Thermograph single and vertical array deployment locations in WY2019 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 close together with overlapping symbols.

Table 5: 2019 thermograph network locations and period of record listed from upstream to downstream.

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.

Figure 6: **:** 2019 LSYR mainstem temperature unit deployment locations at: a) LSYR-0.01, b) LSYR-0.25, c) LSYR-0.51, d) LSYR-0.68, e) LSYR-1.09, f) LSYR-1.54.

Figure 19: 2019 LSYR-1.09 (Grimm Property upstream-run) bottom (1.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

Figure 20: 2019 LSYR-1.54 (Grimm Property downstream-run) bottom (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

Figure 21: 2019 LSYR-1.71 (Grimm Property pool) –surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

Figure 22: 2019 LSYR-1.71 (Grimm Property pool) middle (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

Figure 23: 2019 LSYR-1.71 (Grimm Property pool) bottom (6.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

Figure 24: 2019 LSYR 4.95 (Encantado Pool) 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 entire period of record; the surface unit data gap from 7/13/19 – 7/30/19 due to declining water levels and the array was removed from the habitat on 8/22/19 as the habitat was nearly dry

Figure 25: 2019 LSYR-4.95 (Encantado Pool) middle (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; the middle unit was exposed to air on 8/7/19 and the array was removed from the habitat on 8/22/19 as the habitat was nearly dry.

Figure 26: 2019 LSYR-4.95 (Encantado Pool) bottom (6.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; the array was removed from the habitat on 8/22/19 as the habitat was nearly dry.

Figure 27: 2019 LSYR-7.65 (Double Canopy Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

Figure 28: 2019 LSYR-7.65 (Double Canopy Pool) middle (2.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

Figure 63: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) August 2019.

Figure 64: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) August 2019.

Figure 65: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) May 2019.

Table 7: WY2019 migrant trap deployments.

Table 8: WY2019 *O. mykiss* Catch Per Unit Effort (CPUE) for each trapping location.

Table 9: Number of *O. mykiss* migrant captures, including recaptures but not young-of-the-year, associated with each trap check at each trapping location over 24-hours in WY2019.

Figure 66: Monthly *O. mykiss* smolt captured at the Hilton Creek and Salsipuedes Creek traps in WY2019 showing: (a) number captured at each site and (b) average size of smolts captured by month; trapping start and end times are listed on the graph.

Figure 67: WY2019 paired histogram of weekly upstream and downstream *O. mykiss* captures by trap site for: (a) Hilton Creek and (b) Salsipuedes Creek; the trapping season started on 1/23/19 and ended on 5/15/19.

Figure 68: WY2019 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* migrant captures.

Figure 69: WY2019 Hilton Creek *O. mykiss* migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures.

Figure 70: WY2019 Salsipuedes Creek trap length frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* captures.

Figure 71: WY2019 Salsipuedes Creek *O. mykiss* migrant captures (red dots) vs. flow for downstream migrants; no upstream migrants were captured during WY019.

Table 10: Tributary upstream and downstream *O. mykiss* migrant captures for Hilton Creek and Salsipuedes Creek in WY2019; blue lettering represents breakdown of smolts, pre-smolts, and resident trout for each size category.

Table 11: WY2019 tributary *O. mykiss* redd survey results; lengths and widths are given in feet and Salsipuedes Creek watershed includes Upper Salsipuedes, El Jaro, Ytias, and Los Amoles creeks.

Table 12: WY2019 tributary redd observations by month for each creek surveyed.

Figure 86: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

Figure 87: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2019, the last three years are shown with a wider line.

Figure 88: Hilton Creek post-storm habitat conditions showing (a) silt bar formation at head of Long Pool, (b) staff standing in the middle of the Spawning Pool in 6 inches of water (previously 6 feet deep), (c) sediment deposits within the Honeymoon Pool (previously 4 feet deep), and (d) general composition of the sand/gravel deposited from the high flow event.

Figure 89: Confluence of Hilton Creek with the LSYR mainstem showing (a-b) the formation of an extensive delta looking up towards the creek confluence from within the Long Pool (previously at least 3 feet deep), (c) looking downstream towards the center of the Long Pool within the previous pool habitat, and (d) again looking downstream towards the center of the Long Pool well after winter storms showing extensive deposition with a bobcat captured with a game camera.

Figure 90: Results from the 2019 spring snorkel survey results in Hilton Creek; reaches are shown in different colors and are numbered, observed redd sites are shown with yellow triangles.

WY2019 Annual Monitoring Summary

1. Introduction

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

> ***RPM 11:*** "Reclamation shall provide NMFS with monitoring data and reports evaluating the effects of the proposed project on steelhead." *(Page 72)*

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

The objective of this WY2019 Annual Monitoring Summary (AMS) is to present the monitoring data collected in Water Year 2019 (WY2019, 10/1/18-9/30/19) 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 WY2019 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), the WY2014 Annual Monitoring Summary (COMB, 2018a), the WY2015 Annual Monitoring Summary (COMB, 2018b), the WY2016 Annual Monitoring Summary (COMB, 2019a), the WY2017 Annual Monitoring Summary (COMB, 2019b), and the WY2018 Annual Monitoring Summary (COMB, 2020).

The data summarized in this report describe the habitat conditions and the fishery observations in the LSYR during WY2019. 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).

WY2019 was classified as a wet year with 23.79 inches of precipitation recorded at Bradbury Dam (long-term average, 1953-2019, is 19.89 inches; 20th wettest year of 66 years over the period of record with WY2007 being the lowest at 7.41 inches). This was the 7th highest rainfall year since issuance of the 2000 BiOp, with 9 of 19 years classified as dry (WY2007, WY2013, WY2002, WY2018, WY2015, WY2014, WY2004, WY2016, WY2012, and WY2009) listed in order of severity). Wet years, in general, are often associated with an increase of the *O. mykiss* population due to higher stream flows, greater availability of habitat, and ocean connectivity for anadromous reproduction (Lake, 2003; COMB, 2013). However, wet years can result in high flows that create the potential for washing out redds. Following wildfires within the upper watershed, wet years also have the potential to negatively impact fish via increased transport of loosely-held burn scar sediment into downstream habitats.

Migrant trapping was conducted in WY2019 and all BiOp take limits were followed. Reproduction and population status were monitored through spawner (redd) surveys and snorkel surveys.

WY2018 was a dry year following a wet year in WY2017. Entering into WY2019, the reservoir elevation at Lake Cachuma was at 31.7% capacity and well above critical drought conditions. The rainfall started early in the water year with 5 storms greater than 0.1 inches of rain recorded at Bradbury Dam prior to the start of the winter (12/21/18). Come January, the Santa Ynez River watershed was well wetted and primed for measureable runoff following larger storms in January and February. Prolonged rainfall in the spring to the end of May made for excellent conditions for migrating fish and spawning.

There were 2 incidents in Hilton Creek that caused a sudden drop in streamflow. The first was on 10/3/18, when a power outage occurred in association with the first storm event of the year. It happened in the early morning and Reclamation staff was able to quickly reactivate the HCWS pumps. There was no apparent impact to the Hilton Creek fisheries from the incident and a report was submitted by Reclamation to NMFS. The second incident occurred on 12/31/18, and was also associated with a power outage (not storm related) where the HCWS pumps turned off, but were quickly turned back on by Reclamation staff. One *O. mykiss* mortality was found and 3 prickly sculpin (*Cottus asper*) were rescued and relocated.

On 1/17/19, there was a sudden change in streamflow rate at Hilton Creek due to runoff associated with the storm beginning on 1/14/19 (4.72 inches recorded at Bradbury Dam from 1/14/19 to 1/17/19). Upper basin flow in Hilton Creek produced a rapid climb in the streamflow hydrograph throughout the wetted section of the creek resulting in high sediment transport and 3 *O. mykiss* mortalities found along the high flow lines of the lower reaches of the creek. The stormflow deposited large quantities of sediment and filled in most all small and large pool habitats as well as approximately a third of the Long Pool in the LSYR mainstem just downstream of the Hilton Creek confluence. The amount of sediment moving downstream and impact to the water quality and habitats made for difficult conditions for the Hilton Creek *O. mykiss* population. There was a concern that no fish survived, but a bank survey conducted well after the stormflow event suggested that some fish had survived in a few habitats (see Section 4.8 for further details).

To assist in understanding the hydrologic condition and specifically the origin of releases to Hilton Creek from Lake Cachuma, the following chronology is provided of events or milestones that directly influenced flow releases for the *O. mykiss* population downstream of Bradbury Dam (including Hilton Creek) throughout the water year:

- 10/1/18-1/31/19: The HCEBS by gravity flow to the LRP and the HCWS by pump flow to the URP provided lake water to Hilton Creek. A blocking seine was installed to prohibit fish movement into the reach upstream of the LRP until the 1/14/19 stormflow event when it was removed for the rest of the water year.
- 10/3/18: Power outage at Bradbury Dam and the HCWS pumps turned off for a brief period; there was no impact to the O. mykiss population in Hilton Creek.
- 12/31/18: Power outage at Bradbury Dam and the HCWS pumps turned off for a brief period; there was 1 *O. mykiss* mortality found in Hilton Creek.
- 2/1/19-9/30/19: Only HCEBS by gravity flow to the URP provided lake water to Hilton Creek.
- Stormflow events: Upper Hilton Creek stormflow events occurred starting on 1/14/19 and 1/31/19 with durations of approximately 4 days and 6 days, respectively that brought down a significant amount of sediment from the Whittier Fire burn scar. The first event had 3 *O. mykiss* mortalities found.
- 2/6/19-2/15/19: First Fish Passage Supplementation event.
- 2/12/19: State Water deliveries to Lake Cachuma ended for the rest of the water year. CCWA delivered State Water to the lake through the bypass piping system only and did not utilize the Penstock throughout the water year.
- 2/16/19-3/3/19: Second Fish Passage Supplementation event.
- 2/27/19: Lake storage climbed above 120,000 af triggering an increase in target flows to the Hwy 154 Bridge to 5.0 cfs.
- 3/4/19-3/21/19: Third Fish Passage Supplementation event.

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 seven Annual Monitoring Reports/Summaries completed for 2009 (USBR, 2012), 2010 (USBR, 2013), 2011 (COMB, 2013), 2012 (COMB, 2016), 2013 (COMB, 2017), 2014 (COMB, 2018a), 2015 (COMB, 2018b), 2016 (COMB, 2019a), 2017 (COMB, 2019b), and 2018 (COMB, 2020). 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 prefer water temperatures below 20°C and dissolved oxygen (DO) concentrations greater that 4 mg/L (Molony, 2001; Moyle, 2002). 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 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) concentrations 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 indicate these suggested limits may not hold true in this area as LSYR basin fish appear to have higher tolerances for warmer 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 WY2019 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 AMS/R reports, the SWRCB approach will not be used in this report, although the designation would have been an above normal year at 105,602 af of computed inflow to Lake Cachuma.

WY2019 had 23.79 inches of rainfall at Bradbury Dam and was therefore classified as a wet year (greater than 22 inches) (Table 1). The long-term average (1953-2019) at the dam is 19.89 inches. There was elevated stream runoff recorded within the LSYR mainstem and tributaries in WY2019, and the mainstem flow was sufficient to breach the sand bar and open the LSYR lagoon to provide upstream migration opportunities from the lagoon and the ocean for 107 days (opened on 1/18/19 – closed 5/7/19). That total number of days can be misleading when looking at flow conditions at the USGS gauge at H Street. That section of the river is wide and has a sandy bottom that can be impassable for migrating fish at low flows even though the lagoon is open to the ocean. For example, recorded flows at H Street were less than 25 cfs on 4/14/19, less than 10 cfs on 4/23/19 and 0 cfs on 5/14/19 for the rest of the water year. In Salsipuedes Creek, the highest recorded instantaneous peak discharge at the USGS gauging station at Jalama Bridge was 4,770 cfs recorded on 1/17/19 and 7,050 cfs recorded on 2/2/19, both associated with the 2 largest storm events of the water year. In the LSYR, the USGS Solvang gauge during the same storms had a maximum instantaneous flow rate of 704 cfs on 1/17/19 and 2,170 cfs on 2/2/19. Peak daily discharge recorded by the USGS at the Narrows on the LSYR mainstem occurred on 2/2/19 at 4,470 cfs. Historic minimum, maximum, and WY2019 rainfall data at 6 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 22 precipitation events in WY2019 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). The majority of the recorded precipitation at Bradbury Dam fell during the months of January (8.07 inches, 33.9%) and February (8.26 inches, 34.7%). There was over an inch of rainfall recorded in November, January, February, March, and May (Table 3). Spring time rain helped maintain creek baseflow and made for ideal spawning and initial rearing conditions. The necessary triggers to implement the Fish Passage Supplementation Program were met and are discussed below and in a separate report (2019 Fish Passage Supplementation Report). No WR89-18 water releases were conducted.

Annual daily mean discharge 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.

Annual hydrographs along the Santa Ynez River at Los Laureles, Solvang, Narrows and Salsipuedes Creek USGS gauges showed high winter stormflow and moderately high spring runoff conditions throughout the basin (Figures 2 and 3). The USGS Los Laureles gauge on the Santa Ynez River mainstem upstream of Lake Cachuma recorded continuous flow from 1/15/19 through 7/27/19 with peak daily discharge observed on 1/17 at 6,670 cfs (Figure 3). The Hilton Creek gauge (USGS-11125600) is a low flow gauge only (less than 50 cfs) and during 2 separate stormflow events, stream discharge was above the recording threshold on 1/17/19 and 2/2/19. The peak release from Bradbury Dam was approximately 118 cfs on 3/4/19 during Fish Passage Supplemental Releases. None of these discharge rates were high enough to cause any changes to the channel or banks within the LSYR mainstem. Only localized scour of small vegetation within the wetted channel was observed at a few locations.

Ocean Connectivity: The Santa Ynez River breached on 1/18/19 and remained open until 5/7/19 (Figures 2 and 3). There was a two day period of time when the lagoon briefly closed from 3/23/19 to 3/24/19. During the 107 days of ocean connectivity with the Santa Ynez River, no anadromous *O. mykiss* were captured or observed during migrant trapping efforts, redd surveys, or bank surveys. Streamflow went to zero at the H Street USGS on 5/14/19 and remained dry for the rest of the water year.

Since WY2006, the presence of the lagoon sandbar has been monitored daily from Ocean Park (at the lagoon, see Figure ES-1) during the wet season (November through June). From WY2001 to WY2005, the lagoon was monitored weekly and the flow at the USGS 13th Street gauge (approximately 1.2 mile upstream of the lagoon) was used to determine when the lagoon was open.

Passage Supplementation: There were 3 storms during WY2019 migration season that met the established criteria for passage supplementation; 2/6/19-2/15/19, 2/16/19-3/3/19, and 3/4/19-3/21/19. Because the 3 passage supplementation events occurred in the February to mid-April time period, the established protocol required Reclamation to conduct automatic supplementation during each event. There were 52 days during the migration season where flows were in excess of 25 cfs at the USGS gauging station in Solvang and the lagoon was connected to the ocean. 43 days of the 52 days (83%) were associated with the Fish Passage Supplementation Program releases. Trapping activities were conducted in the LSYR mainstem (and in Hilton Creek and Salsipuedes Creek) for all three passage supplementation events. No *O. mykiss* were observed in the LSYR mainstem traps during all three passage supplementation events or during the entire migration period.

Adaptive Management Actions: There were no Adaptive Management Committee (AMC) meetings during WY2019. No flow allocations were made by the AMC from the Adaptive Management Account (AMA).

Target Flows: There were no spills from Bradbury Dam in WY2019. Reservoir storage remained above 30,000 af and below 120,000 af from the start of the water year (10/1/18) through 2/26/19 at which time Reclamation maintained 2000 BiOp target flows of 2.5 cfs to the Hwy 154 Bridge and a minimum of 2 cfs to Hilton Creek. On 2/27/19, reservoir storage climbed above 120,000 af when Reclamation increased target flows to 5.0 cfs at the Hwy 154 Bridge as require in the BiOp; there was no change in minimum flow delivered to Hilton Creek throughout the water year (except during 2 short duration power outages discussed above). Lake Cachuma water was discharged to Hilton Creek at either the LRP with the HCEBS by gravity and the HCWS by pump flow to the URP from 10/1/18 through 1/31/19, then with the HCEBS by gravity flow only to the URP from 2/1/19 through the rest of the water year.

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). No downstream water rights releases were conducted in WY2019.

Mixing and Temperature of State Water Project Waters Released into 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 systems 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/HCEBS). SWP water can be delivered to Lake Cachuma through a bypass system that eliminates having to use the Penstock. CCWA did not deliver SWP to the lake through the Penstock throughout the water year. Hence, the criterion was met for RPM 5.1 throughout WY2019 (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 to the ocean.

Outlet Works release water is now being monitored for temperature to assure BiOp compliance of 18 °C or less being released to the Stilling Basin of the LSYR. SWP water can arrive to the dam at higher temperatures than 18 °C at which point it would need to be mixed with cool lake water from the bottom of the lake through the Penstock. Reclamation has installed temperature sensors in the CCWA delivery pipe and the Penstock to enable a volumetric calculation of the blended water temperature using the water temperature and the rate of flow from each source. This is the third year that the sensors were operational and the data are recorded by Reclamation. No SWP water was delivered to Lake Cachuma through to Penstock hence there were no issues with water temperatures from releases from the Outlet Works to the LSYR mainstem.

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 over-summering *O.*

mykiss. The critical parameters for salmonid survival, water temperature and dissolved oxygen (DO) concentrations, were recorded and are presented below.

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 and lake water temperature and DO concentrations are presented below for the LSYR mainstem and selected tributaries.

Stream water temperatures were collected at various locations within the 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 units (Sondes and U-26s) (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 multi-parameter units) 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 WY2019, 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 monitoring 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 the 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 habitats, 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), or a sequence of impassable barriers prohibiting access for anadromous steelhead (San Miguelito Creek). In Hilton Creek, single units were deployed at two locations; upstream of the Upper Release Point (URP) and just upstream of the creek's confluence with the LSYR mainstem to monitor stream temperatures in the watered sections of the creek.

There were 29 thermograph units deployed at 13 sites on the LSYR mainstem which are listed below with the number of units in parentheses:

- Stilling Basin parapet wall (LSYR-0.01 (3));
- Downstream of 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-0.68(1));
- Grimm Property upstream (LSYR-1.09 (1));
- Grimm Property downstream (LSYR-1.54 (1));
- Grimm Property pool (LSYR-1.71 (3));
- 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 13 thermograph unit deployed at 13 sites during WY2019, all of which were single unit deployments:

- Hilton Creek (HC, 3 sites):
  - HC-lower (HC-0.12);
  - HC-upper (HC-0.54; and
  - HC-culvert (HC-0.78);
- Quiota Creek (QC, 1 site):
  - QC-Crossing 6 (QC-2.66).
- Salsipuedes Creek (SC, 5 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); and
  - SC-upper (SC-3.8).
- El Jaro Creek (EJC, 3 sites):
  - EJC-lower (EJC-3.81, legacy site but dry);
  - 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. Photos of each LSYR mainstem and tributary deployment location are presented in Figures 6-10 for general reference.

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

Stilling Basin Parapet Wall – Pool (north) (LSYR-0.01)

A 3-unit vertical array was deployed along the northeast wall of the Stilling Basin from 5/1/19 through 11/18/19 (Figures 11-13 and Figure 6). The units were deployed at 1-foot, 14-feet, and 28-feet. 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 482 feet wide at its midpoint, and is approximately 36 feet deep when at full capacity. In the absence of high volume water releases, the upper lens of the Stilling Basin water column heats while cooler water sinks to the bottom, particularly during the summer. Water temperatures at this location are greatly influenced by both low and high volume water releases from the Bradbury Dam outlet works. When water is released from the outlet works, it is released from the cold hypolimnion at the bottom of the lake.

Water temperatures within the Stilling Basin showed typical seasonal warming starting at the end of May with a rapid cooling trend starting mid-September. During the warmest portion of the year (July-September), maximum temperatures remained greater than 22 °C with the highest temperature (> 25 °C) recorded near the end of July. Minimum remained from 20-22 °C during the warmest portion of the year. Temperatures collected at the middle and bottom locations are nearly identical showing little diel variation and remaining greater than 21 °C during the warmest portion of the year. Young of the year (YOY) *O. mykiss* were observed just downstream of the tail out of the Stilling Basin in the May timeframe. It is speculated that these YOYs were produced in Hilton Creek and moved upstream to exploit additional habitat as they grew. While no *O. mykiss* have been directly observed within the Stilling Basin, their presence cannot be ruled out. In addition, largemouth bass, green sunfish, and carp were present and observed at various times within the Stilling Basin during WY2019.

Downstream of the Stilling Basin – Run (LSYR-0.25)

A single temperature unit was deployed in a 1.5 foot deep run habitat approximately 40-feet downstream of the Stilling Basin control point from 5/1/19 through 12/3/19 (Figure 14 and Figure 6). Maximum water temperatures generally remained greater than 24 °C during the warmest portion of the year with minimum temperatures fluctuating from 19.5 °C to 21 °C during those warmer months. Of note were the differences in the Stilling Basin surface temperatures compared to this site. Overall, maximum temperatures at this site were noticeable warmer while minimum temperatures were considerably cooler during the hottest portion of the year than at the surface of the Stilling Basin. The presence of riparian canopy coupled with some amount of subsurface flow likely provides a modest cooling effect as warm surface water leaves the Stilling Basin. YOY *O. mykiss* were observed immediately upstream of this monitoring location during May. Carp, juvenile largemouth bass, and green sunfish were also observed in and around this habitat during WY2019.

Long Pool – Pool (LSYR-0.51)

Prior to the Whittier Fire in 2017, the Long Pool habitat dimensions were approximately 100 feet wide at the widest point and 1,200 feet long with a maximum depth of over 9 feet. Since the Whittier Fire, the Long Pool has lost considerable length and depth due to excessive sedimentation input from Hilton Creek and the Whittier Fire burn scar (approximately a third of its maximum volume). Currently, the Long Pool is approximately 900 feet long and has a maximum depth of just under 6-feet. It is fed by two water sources when there is no spill or release from the Outlet Works: the chute release (Chute Release Point, CRP) which is part of the HCWS that releases water directly into the Stilling Basin; and Hilton Creek proper (URP and LRP of the HCWS/HCEBS and upper natural basin creek flow). Both flow sources confluence directly into the Long Pool in two separate channels. The HCWS and HCEBS are cooler water sources that take water at the 65 foot level in Lake Cachuma and from the bottom of the lake, respectively. Mixing of the two sources occurs in the newly formed delta region that was once the head of Long Pool.

The Long Pool is inhabited by invasive species that can limit *O. mykiss* colonization due to predation, competition, 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. Beaver activity has also been an issue in the past; however, they are currently not present within the Hwy 154 Reach on Reclamation property.

A vertical array was deployed on 5/1/19 and removed 12/3/19 at the deepest portion of the pool habitat (Figures 15-17 and Figure 6). Maximum surface water temperatures fluctuated from 19.5 °C to 23.0 °C during the warmest portion of the year with minimum temperatures remaining less than 18 °C during the entire deployment period. Water temperatures at the middle and bottom monitoring locations were cooler still providing good rearing conditions throughout the year. Adult and YOY *O. mykiss* were observed throughout the year in the Long Pool near the Hilton Creek confluences with Long Pool. Also, several adult largemouth bass were observed lurking at the confluence and predation of *O. mykiss* cannot be ruled out.

Downstream of Long Pool (LSYR-0.68)

This single unit was deployed 300 feet downstream of the Long Pool in a shallow run habitat with a maximum depth of 2 feet from 5/1/19 to 11/18/19 (Figure 18 and Figure 6). Temperatures at this location closely mimicked those collected in the Long Pool at the middle unit. Maximum water temperatures were generally less than 21 °C with minimum temperatures less than 18 °C. YOY *O. mykiss* were observed throughout this section of the river downstream of the Long Pool.

Grimm Property Upstream – Run (LSYR-1.09)

A single thermograph was deployed in a heavy canopy run habitat measuring approximately 100 feet long and 15 feet wide from 5/30/19 to 11/18/19 (Figure 19 and Figure 6). The unit was deployed in 1.5 feet of water. This is the second year water temperature monitoring has occurred at this location. Water temperatures show a slight warming compared to LSYR-0.68 with maximum temperatures from 21-23 °C and minimum temperatures from 17-19 °C. YOY *O. mykiss* were observed directly upstream of this habitat during routine snorkel surveys in the spring and fall as well as several largemouth bass in the 6-9 inch size range.

Grimm Property Downstream – Run (LSYR-1.54)

A single thermograph was deployed in a run habitat measuring approximately 45 feet long and 15 feet wide from 5/30/19 to 11/18/19 (Figure 21 and Figure 6). The unit was deployed in 1.5 feet of water. This is the second year water quality monitoring has occurred at this location. Water temperatures collected at this site show rapid warming developing 0.45 miles downstream from LSYR-1.09, primarily due to the general absence of any over story canopy and several large pool habitats between the two sites. Maximum water temperatures ranged from 22 °C – 25 °C during the warmest portion of the year. Minimum temperatures remained less than 20 °C except for three brief occasions. No *O. mykiss* or invasive species were observed at this location.

Grimm Property - Pool (LSYR-1.71)

A three unit vertical array was deployed for the second year in this pool habitat from 5/30/19 to 11/18/19 (Figure 21-23 and Figure 7). The habitat measures approximately 200 feet long, is 35 feet wide and 6.5 feet deep. The warmest maximum water temperatures of all mainstem thermographs were recorded at the surface in this pool habitat. Maximum temperatures in excess of 24 °C with a high of nearly 28 °C were recorded during the warmest portion of the year. Minimum temperatures were generally greater than 19 °C. Water temperatures at the middle and bottom units were markedly cooler. No *O. mykiss* were observed at this location though several size classes of largemouth bass were observed during the fall snorkel survey.

Encantado Pool – Pool (LSYR-4.95)

When full, the Encantado Pool is approximately 400 feet long, averaged 30-feet wide, and has a maximum depth of 6 feet. A vertical array was deployed in this habitat on 5/1/19 and removed on 8/22/19 due to declining water levels (Figures 24-26 and Figure 7). This site typically holds a combination of *O. mykiss* and invasive species, especially following a wet winter and spring. However, no fish of any species were observed during snorkel surveys this year. At the time of the vertical array removal, the habitat was a small isolated puddle and nearly dry. This habitat was one of the first locations to dry out with the onset of the dry season.

Double Canopy - Pool (LSYR-7.65)

The Double Canopy Pool is located directly upstream of the Refugio Bridge. The pool was approximately 350 feet long, 40 feet wide, and 3.5 feet deep at its deepest point when the habitat is filled and flowing. A vertical array was deployed at this site from 5/1/19 to 11/5/19. Maximum surface water temperatures remained less than 22 °C for the entire deployment period with minimum surface temperatures remaining less than 20 °C (Figures 27-29 and Figure 7). The middle and bottom units recorded slightly lower temperatures compared to the surface. No *O. mykiss* were observed at this habitat. Largemouth bass, green sunfish, bluegill, and carp were observed during the spring and fall snorkel surveys.

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 5.5 feet at the deepest point while residual pool depth is being maintained. A vertical array was deployed in this habitat from 5/9/19 to 11/5/19. Maximum surface temperatures ranged from 21 °C to 24 °C during the warmest portion of the year with minimum surface temperatures less than 19 °C during the entire deployment period. (Figures 30-32 and Figure 7). The middle and bottom units recorded slightly lower temperatures compared to the surface making this a suitable rearing habitat. No *O. mykiss* or any other fish species were observed at this habitat. This is unusual due to the fact that various warm water fish species were observed in habitats approximately ¼ of a mile upstream. It is speculated that the presence of a thick and extensive mat of cattails directly within the river channel upstream was helping to limit movement of invasive fish species through this area.

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. A vertical array was deployed in the habitat from 5/13/19 to 10/24/19 (Figures 33-35 and Figure 7). The data showed that stratification developed as the dry season progressed and water flows diminished. Maximum surface temperatures were greater than 23 °C during the warmest portion of the year with minimum temperatures approaching 22 °C. The middle and bottom temperatures were significantly cooler compared to the surface. The pool was a shallow isolated puddle when the thermographs were removed. No *O. mykiss* were observed at this habitat, only invasive warm water species including largemouth bass, green sunfish, bluegill, and carp.

Avenue of the Flags – Pool (LSYR-13.9)

The habitat was approximately 65 feet long and 20 feet wide at its widest point with a maximum depth of approximately 4 feet. A single unit was deployed in this habitat from 5/9/19 to 10/24/19. Overall, water temperatures in this habitat remained relatively cool with maximum temperatures greater than 20 °C till near the end of June before rapidly decreasing coincident with decreased flow and a larger influence from subsurface flows. Minimum temperatures remained less than 20 °C during the entire deployment period making this area suitable for rearing *O. mykiss* (Figure 36 and Figure 7). No *O. mykiss* or invasive species were observed in this habitat.

Cadwell Pool (LSYR-22.68)

The pool when full is approximately 490 feet long and 32 feet wide at the maximum point with a maximum depth of approximately 15 feet. A vertical array was deployed in this habitat from 5/13/19 to 11/6/19. The data showed stratified conditions developed with warmer water at the surface compared to the middle and bottom of the habitat (Figures 37-39 and Figure 8). These stratified conditions persisted for the remainder of the monitoring period. Maximum surface temperatures varied from 21 °C to 24 °C during the warmest portion of the year. The middle unit was noticeably cooler and the bottom unit showed daily maximum and minimum temperatures remaining less than 20 °C during the entire deployment period. No *O. mykiss* were observed at this location in WY2019, only invasive species including largemouth bass, green sunfish, and carp.

LSYR Mainstem Longitudinal Comparisons

Longitudinal LSYR mainstem (maximum daily) water temperature at the surface thermographs for LSYR-0.01, LSYR-0.51, LSYR-0.68, LSYR-1.09, LSYR-1.54, LSYR-1.71, LSYR-7.65, LSYR-8.7, and LSYR-22.68 are presented in Figure 40. 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.

Factors influencing surface water temperatures along the longitudinal profile presented can be: (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*.

The wet spring enabled river flows to persist through the entire Hwy 154 Reach and in some sections of the river in the Refugio Reach and Alisal Reach from approximately LSYR-6.0 to LSYR-9.0 (i.e., LSYR-7.65 and LSYR-8.7). The remainder of the LSYR mainstem monitoring locations were wet but not maintaining residual pool habitat (i.e., LSYR-10.5, LSYR-13.9, and LSYR-22.68) or completely dried (i.e., LSYR-4.95).

All sites showed typical seasonal warming and cooling associated with ambient air temperatures and decreasing flow rates. Of note is the rapid decrease in water temperatures across the watershed near the end of September. When looking at past years, the rapid temperature decrease usually occurs sometime in October, several weeks later than what was observed in WY2019.

O. mykiss and Water Temperature Criteria within the LSYR Mainstem

YOY *O. mykiss* were observed at various locations through the fall within the first 1.09 miles downstream of Bradbury Dam showing that habitat conditions remained favorable for rearing fish in this section. Monitored water temperatures showed a rapid warming of temperature between LSYR-1.09 and LSYR-1.54. Several large and deep pool habitats were present between the two sites that act to thermally heat the water and hold large numbers of invasive warm water species. It is likely (based on observations) that the rapidly warming water and the presence of invasive species within this section of river is limiting the distribution of *O. mykiss* downstream of LSYR-1.09. Downstream of the Hwy 154 Bridge (LSYR-3.4), rearing condition deteriorated rapidly with drying portions of the LSYR mainstem and the presence of invasive species in nearly all habitats where water remained. There were several sections of the mainstem that did maintain oversummering habitats in the Refugio Reach and Alisal Reach as well as Reach 3 downstream of the Avenue of the Flags Bridge where temperature monitoring showed suitable rearing conditions for *O. mykiss*. However, the presence of invasive warm water species, many of which were successfully reproducing in those habitats, may have limited *O. mykiss* distribution through the LSYR mainstem.

Tributary Thermographs: The data from single thermograph deployments are presented by site from downstream to upstream along the creek (Figure 5 and Tables 5 and 6).

Lower Hilton Creek (HC-0.12)

A single thermograph was deployed in a riffle habitat approximately 250 feet upstream of the sand delta confluence of Hilton Creek and LSYR mainstem (Long Pool). The unit was deployed in approximately 1.5-foot of water from 5/15/19 to 11/19/19. Water temperatures remained less than 17 °C during the entire deployment period (Figure 41 and Figure 8). YOY *O. mykiss* were observed throughout this area during all of WY2019. Several green sunfish were observed upstream of this location in and around the migrant trapping location.

Upper Hilton Creek (HC-0.54)

A single thermograph was deployed in a pool habitat adjacent to the URP release site from 5/15/15 to 11/20/19. Water temperatures remained less than 14 °C during the warmest portion of the year (Figure 42 and Figure 8). *O. mykiss* were observed inhabiting the creek at this monitoring location throughout the year indicating optimal rearing conditions. No invasive species were observed in the upper portion of Hilton Creek.

In comparing water temperatures differences between the Upper and Lower Hilton Creek, data showed a 2.5 °C – 3.0 °C increase in water temperature due to thermal heating between the upper and lower monitoring sites. The observed temperature increase may have been related to the loss of a mature riparian canopy during the long standing drought when Hilton Creek releases had to be discharged to the LRP and not the URP, which caused a die off of water-loving trees (alders, cottonwoods, and willows) that prior were shading the creek and preventing thermal heating across that upper section of the creek. Splitting the release between the URP and the LRP and possibly higher discharge rates may help reduce thermal heating particularly during the critical summer rearing period.

Quiota Creek (QC-2.66)

A single thermograph was deployed approximately 20 feet upstream of Crossing 6 on Refugio Road from 5/20/19 through 10/28/19 (Figure 43 and Figure 8). The unit was placed at the bottom of a run habitat 30 feet long and 10 feet wide with a depth of approximately 2.5 feet. This site was selected because rearing *O. mykiss* have been observed over the years (up to WY2014) during routine snorkel surveys. Unlike the past years during the drought, water flow persisted in this habitat during the entire year. Maximum water temperatures exceeded 21 °C on several occasions while minimum temperatures remained less than 18 °C for nearly the entire deployment. No *O. mykiss* were observed in this habitat in WY2019 though they were observed upstream of the Quiota Creek Crossing 9 Bridge.

Lower Salsipuedes Creek (SC-0.77)

A vertical array was deployed at this habitat in WY2019; the bottom unit was deployed from 5/15/19 to 11/6/19 and the surface was deployed from 5/30/19 to 11/6/19. During the winter of 2017, stormflows changed the configuration of the habitat from a relatively shallow run with a maximum depth of 1 foot, to a pool habitat with a maximum depth of approximately 5 feet. The surface unit was added to better evaluate the water temperature conditions in deeper pool habitats in the lower section of the creek. This site is immediately downstream of the Salsipuedes Creek migrant trapping location.

Surface maximum temperatures remained greater than 22 °C until early September when they rapidly decreased (Figures 44-45 and Figure 8). Minimum temperatures remained less than 20 °C for the entire deployment. Bottom temperatures were slightly cooler at the beginning of the deployment and cooled more quickly compared to the surface. Overall, as with the surface unit, minimum water temperatures remained less than 20 °C during the entire deployment suggesting good rearing conditions. However, no *O. mykiss* were observed at this monitoring site, only invasive green sunfish.

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

A single thermograph was deployed in a pool habitat approximately 4-feet below the surface from 5/31/19 through 11/7/19. Reach 2 is a short bedrock section with deep pools, extends approximately 1/3 of a mile, and represents some of the best habitat for oversummer rearing *O. mykiss* within the entire Salsipuedes/El Jaro Creek watershed due to the presence of numerous bedrock formed pools. The monitored habitat is approximately 40 feet long, 15 feet wide, and 6 feet deep at its deepest point. *O. mykiss* have been routinely observed at this location when visibility permits. Spawning surveys routinely document *O. mykiss* redds in this reach of the creek.

Water temperatures were warmest through July with maximum temperatures approaching 26 °C on multiple occasions before rapidly cooling to less than 22 °C at the beginning of August (Figure 46 and Figure 8). These represent some of the warmest temperatures recorded in Salsipuedes Creek. Minimum temperatures remained less than 20 °C during the entire deployment period suggesting that there was a daily recovery period that provided better rearing conditions during the warm summer period. A single *O. mykiss* was observed in this habitat during the spring snorkel surveys in WY2019. This habitat is abundant with invasive green sunfish.

Salsipuedes Creek – Highway 1 Bridge (SC-3.0)

A single thermograph was deployed in the pool habitat approximately 4 feet below the surface, directly downstream of the Hwy 1 fish ladder from 5/31/19 through 11/12/19. The pool habitat is approximately 85 feet long and 18 feet wide with a maximum depth of 7 feet. This area routinely holds *O. mykiss* though none were observed in WY2019. This is the sixth 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 significant bedrock influenced section of the creek. Reach 4 is similar to Reach 2 in that there are numerous deep pool habitats formed in the bedrock that offer excellent oversummering opportunities for rearing *O. mykiss*.

Water temperatures were relatively cool compared to monitoring locations downstream with maximum temperatures hovering from 20 °C to just over 22 °C during the warmest portion of the year (Figure 47 and Figure 9). Minimum temperature remained less than 20 °C except for a brief period in early September. *O. mykiss* were observed upstream and downstream of this monitoring location in the spring and fall of WY2019. Green sunfish were also observed in this habitat during spring snorkel surveys.

Salsipuedes Creek – Jalama Bridge (SC-3.5)

A single thermograph was deployed in a pool habitat approximately 4 feet below the surface, directly downstream of the Jalama Bridge fish ladder from 5/20/19 through 11/12/19. The pool is approximately 30 feet long, 18 feet wide and 6 feet in depth. The creek upstream and downstream of this monitoring location was one of the few stretches in the creek that provided minimal flow and rearing habitat during the recent drought. This area routinely holds oversummering *O. mykiss* and *O. mykiss* were observed in this habitat as well as in upstream and downstream habitats during the spring and fall snorkel surveys in WY2019.

Maximum water temperatures ranged from around 20 °C to over 23 °C during the warmest portion of the year with minimum temperatures generally remaining less than 18 C (Figure 48 and Figure 9). These temperatures provided suitable rearing conditions for *O. mykiss* present in this and the surrounding habitats. Green sunfish were also present in this habitat.

Upper Salsipuedes Creek (SC-3.8)

Upper Salsipuedes was negatively impacted by the prolonged drought which dried the creek for an extended period of time and extirpated *O. mykiss* entirely from the portion of Salsipuedes Creek upstream of its confluence with El Jaro Creek. In the years before the drought, Upper Salsipuedes routinely held various age classes of *O. mykiss* as well as multiple spawning locations for both resident and anadromous steelhead.

A single thermograph was deployed on the bottom of the creek in a shallow run habitat 15 feet long, 4 feet wide, and approximately 0.5-foot deep from 5/31/19 through 11/14/19. No *O. mykiss* were observed at this site throughout the monitoring period although water temperatures were favorable for rearing in this section of the creek. Maximum water temperatures remained less than 22 °C and minimum temperatures remained less than 18 °C for the majority of the deployment period (Figure 49 and Figure 9). YOY *O. mykiss* were observed immediately downstream in the confluence pool of Salsipuedes/El Jaro Creeks.

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

A single thermograph was deployed at the bottom of a pool habitat immediately upstream of the El Jaro/Salsipuedes Creek confluence from 5/31/19 to 11/14/19. The habitat is roughly 50 feet long, 12 feet wide with a max depth of 2.5 feet. This location routinely held rearing *O. mykiss* prior to the drought. Water temperature data show a gradual cooling trend starting near the end of July. Prior to then, maximum water temperatures were generally from 20 °C to 24 °C (Figure 50 and Figure 9). By mid-August, maximum temperatures had declined to less than 20 °C. Minimum temperatures remained less than 20 °C during the entire deployment. YOY *O. mykiss* were observed immediately upstream and downstream of this monitoring location during snorkel surveys in WY2019.

El Jaro Creek – Palos Colorados (EJC-5.4)

A single thermograph was deployed 0.5 feet from the bottom of a boulder-influenced pool habitat from 5/31/19 through 11/14/19. The habitat measured approximately 35 feet long, 7 feet wide and 3.5 feet deep. *O. mykiss*, including YOY, juveniles and adults have been observed sporadically in past years in and around the monitored habitat. This area is influenced by Palos Colorados Creek that confluence with El Jaro Creek approximately 1/8 of a mile upstream of the monitoring pool. Water contribution into El Jaro Creek (though at extreme minimal levels) allowed this area to remain wetted throughout the drought and provided pool refuge habitat for any *O. mykiss* inhabiting this area. The remainder of El Jaro Creek upstream of Palos Colorados Creek essentially dried during the spring/summer months of 2013-2016, completely extirpating *O. mykiss* from this section of the creek at this time.

Water temperatures collected at this location strongly mimic those collected at SC-2.2 and were among the warmest recorded in El Jaro Creek. Water temperatures were warmest May through July with maximum temperatures exceeding 26 °C on several occasions before rapidly cooling to less than 22 °C by the end of July (Figure 51 and Figure 9). Minimum temperatures remained less than 19 °C during the entire deployment period. No *O. mykiss* were observed in this habitat in WY2019. The closest *O. mykiss* was observed approximately 0.5 miles downstream at the only redd site (EJC-01-032719) identified in the creek. No *O. mykiss* were observed upstream of this monitoring location during WY2019.

<u>El Jaro Creek – Rancho San Julian (EJC-10.82)</u>

O. mykiss have regularly been observed within the plunge pool, the fish ladder, and in habitats upstream of the fish ladder in past years; however, the drought has extirpated *O. mykiss* from large sections of upper El Jaro Creek including in and around the San Julian Ranch as large portions of the creek did not flow in the summer of 2013, 2014, and were completely dry in 2015 and 2016. A thermograph was deployed in the pool habitat immediately downstream of the bridge from 5/31/19 and removed on 11/14/19. During the deployment, water temperatures remained less than 20 °C for the majority of the monitoring period with minimum temperatures remaining less than 18 °C (Figure 52 and Figure 9). No *O. mykiss* were observed in this area in WY2019.

<u>Los Amoles Creek – Tributary to El Jaro – (LAC-7.0)</u>

A single thermograph was deployed 0.5 feet from the bottom of a corner scour pool habitat from 6/27/19 through 11/14/19. The reason for the late deployment compared to other monitoring sites was due to cattle ranching activities that necessitated deployment postponement. The habitat is 30 feet long, 15 feet wide, and 3.0 feet deep and is located approximately 1/8 of a mile upstream from the confluence with El Jaro Creek. Los Amoles Creek has regularly held various age classes of *O. mykiss* and spawning sites have been identified in the creek over the years. Recent drought conditions have negatively impacted the creek with vast sections of Los Amoles Creek dry several hundred feet upstream of the monitoring location. It is likely *O. mykiss* have been temporarily extirpated from the upper portions of this tributary.

Maximum water temperatures in Los Amoles Creek were somewhat cooler compared to other monitoring stations in the watershed. Overall, maximum water temperatures remained less than 19°C for the majority of the deployment with minimum temperatures generally remaining less than 17 °C (Figure 53 and Figure 10). No *O. mykiss* were observed at this monitoring location in WY2019.

<u>Salsipuedes Creek Longitudinal Comparisons</u>

Longitudinal maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 54 for the thermographs at: Rancho San Julian (EJC-10.82), Palos Colorados (EJC-5.4), the confluence with El Jaro/Salsipuedes Creek EJC-(3.81), Upper Salsipuedes Creek upstream of the El Jaro confluence (SC-3.80), 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.

WY2019 was the first year since WY2012 that El Jaro Creek at Rancho San Julian flowed for the entire year. Rainfall collected at Rancho San Julian showed that 2 of the past 3 years were wet rainfall years (WY2017 and WY2019) and have recharged the local aquifer enough to allow the creek to flow during the entire year. Flow values measured at the USGS gauging station at Salsipuedes Creek show a significantly higher value in the spring compared to previous years with a typical seasonal decrease in flow through the summer and early fall period. Flow reached the 1.0 cfs level in late July, declining to less than 0.5 cfs in the summer and fall before increasing in late November with the arrival of cooler conditions. Residual pool depth was maintained in all habitats throughout the watershed in WY2019.

Maximum daily water temperatures at thermograph sites within the watershed show a broad range of results with the warmest sites at: SC-0.77, SC-2.2, and EJC-5.4 and the coolest site at SC-3.80, EJC-10.82, and LAC-7.0 (Figure 54). Water temperatures appeared suitable for rearing *O. mykiss* at all creek monitoring stations in WY2019.

O. mykiss and Water Temperature Criteria within the Tributaries

The Salsipuedes/El Jaro Creek watershed is a dynamic system with many variables that influence water temperatures at any given time. The amount of surface flow, depth within individual habitats, groundwater upwelling, ambient air temperatures, drought, and presence/absence of riparian vegetation all influence the flow and thermal regime within individual habitats in the watershed. The recent drought caused much of the Salsipuedes/El Jaro creek habitat to constrict down to a few fragmented and isolated flowing sections of creek. There was a very real concern that if conditions deteriorated further, *O. mykiss* could potentially be extirpated from the system. Fortunately, the winter of 2019 provided excellent migration and spawning conditions that resulted in successful YOY production in portions of El Jaro Creek starting at the Palos Colorado (downstream of LSYR-5.4) downstream to Reach 2 in Salsipuedes (SC-2.2). Temperature monitoring within the watershed highlighted the variability/suitability of individual habitats. Additional flow contributions to the Salsipuedes/El Jaro Creek in the summer after a wet year greatly improved overall habitat conditions throughout the watershed showing that the majority of the habitats monitored provided suitable water temperatures for rearing *O. mykiss* through portions of El Jaro and Salsipuedes Creeks.

Invasive species in the Salsipuedes/El Jaro Watershed

Various sections of primarily lower Salsipuedes Creek and to a lesser extent El Jaro Creek have been inhabited over the past several years by invasive warm water species, specifically largemouth bass, bullhead catfish, green sunfish, bullfrog, and carp. Their numbers have been low and they have generally been relegated to the lower sections of Salsipuedes Creek (downstream of Reach 2) and a few deeper habitats in and around EJC-4.0 on El Jaro Creek. Invasive fish are entering the creek at the confluence with the LSYR mainstem and traveling upstream into the creek when flows permit. Snorkel surveys conducted during WY2019 have yielded some concerning observations and trends regarding the increased numbers and distribution of green sunfish and will be discussed in the Snorkel Survey section below. Of particular concern are the overall abundance of green sunfish throughout both watersheds and the fact that these fish appear to be reproducing at a high rate.

Lake Cachuma Water Quality Profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 3/7/19, 4/23/19, 6/4/19, 7/21/19, 8/6/19, 9/4/19, 10/8/19, 10/24/19, 11/12/19 and 12/10/19 (Figure 50). 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 into Hilton Creek. In 2019, lake profile measurements were taken from a boat moored up to the HCWS intake pipe off the back of the boat so that the submerged monitoring equipment was 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 are typically well below 18 °C. Lake Cachuma saw a marked increase in reservoir elevation in 2019, so water temperatures being released into Hilton Creek remained below 18 °C throughout the year.

The first lake profile of the year occurred in March indicating cool temperatures from the surface down to the bottom of the lake, ranging from 12.8 °C – 10.8 °C (Figure 55). The second profile in April indicated warming at all depths, but in particular the surface where temperatures had already reached 18.4 °C. The final spring profile occurred at the beginning of June with the surface warming to 20.2 °C and a steady thermocline developing to depth. There were three summer lake profiles conducted between July and September, each showing increasing surface temperatures over time from 22.9 °C in July to a maximum of 25.3 °C in September. All three profiles had the thermocline beginning to take form around 26 feet below the surface extending down to approximately 49 feet in depth. Bottom temperatures during the same time frame ranged from 12.4 °C – 12.8 °C. Reservoir cooling was apparent during the three lake profile measurements from October through November, with a surface temperature of 20.4 °C in early October and 16.8 °C in mid-November. The final lake profile in December showed a surface temperature of 14.2 °C and a bottom temperature of 13.9 °C, a difference of only 0.3 °C, indicating that the reservoir had turned over.

DO concentrations were high during the first profile in March, measuring 9.98 mg/l at the surface and 8.25 mg/l at the bottom of the lake (Figure 55). Profiles between April and July continued to show high surface DO with decreasing concentrations to depth, with bottom concentrations ranging between 1.89 mg/l in July and 5.97 mg/l in April. The lake began to show severe hypolimnetic oxygen depletion in August with DO concentrations crashing below 30 feet. In fact, instruments recorded a DO of 6.67 mg/l at 26 feet with only 0.25 mg/l at 33 feet in the month of August. Anoxic (< 1.0 mg/l) conditions continued at depth and were recorded at 33 feet in September, 49 feet in October and 66 feet in November. One indication that the lake had not completed turning over in

November was that oxygen levels remained high (8.55 mg/l) at the surface but were near zero from 66 feet and below. Typically the lake contains similar DO concentrations at all depths when the lake has finished its turnover phase. The final profile in December showed that anoxic conditions at depth had disappeared due to a lake turnover event, with a DO concentration of 7.14 mg/l at the surface and 5.55 mg/l at the bottom.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2019 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. 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 WY2019 photo points is provided in Appendix C (Table C-1)**.**

LSYR mainstem photo point locations include all bridges from the Highway 154 Bridge to the Highway 246 Robinson Bridge near Lompoc. Several other mainstem photo point locations are located on Reclamation property near Bradbury Dam within the Refugio and Alisal reaches and at the LSYR lagoon. Tributary photo points include various locations on Hilton, Quiota, Alisal, Nojoqui, Salsipuedes, El Jaro, and San Miguelito creeks (Appendix C, Table C-2).

Photo point comparison between 2005 and 2019 showed an increase of LSYR mainstem riparian growth since the target flows were required to be met at the Alisal Bridge (2005), approximately 10.5 miles downstream from Bradbury Dam (Figures 56-60). Sections of the mainstem that were nearly devoid of vegetation in 2005 now show abundant new growth with willow, sycamore, and cottonwood trees in excess of 15 feet in height. However, trees in the riparian corridor throughout the mainstem are showing signs of stress and die off from the past drought and lack of flowing water and the fact that target flows were no longer required at the Alisal Bridge due to no spill events. The last Bradbury Dam spill event occurred in 2011. Since 2011, the region has experienced 5 consecutive years of drought and decreased flows throughout the entire watershed.

Photo documentation within Hilton Creek continues to show a maturing/drought recovering riparian zone, particularly within the reach between the URP and LRP which was initially activated in 2005 (Figures 61-62). Larger trees (willows, alders, sycamores, and cottonwoods) are replacing the smaller understory within the drainage. Salsipuedes and El Jaro Creeks show recolonization of riparian vegetation after the 2005 flow events, the drought and two years of channel changing flow events in 2017 and 2019 (Figures 63-65). In addition, the cattle exclusionary fencing installed in lower Salsipuedes Creek (completed in WY2015) has contributed to an increase in riparian growth in those reaches where cattle no longer eat, trample and damage emerging vegetation. 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 mating *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 (1997), and threatened listing of California red-legged frog (2000) 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 remained below the BiOp established Incidental Take Statement (ITS) limits.

WY2019 was the sixth 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 ITS, even though juvenile take had been exceeded multiple times since 2000 and was reported to NMFS. In 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 migration 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 WY2019 trapping season, the HDPE pipe was deployed to the site but not installed as it was not needed given that the total number of juveniles captured did not approach the established take limits. Take was not exceeded during the 2019 trapping season.

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 LSYR mainstem (SC-0.7); and (3) in the LSYR mainstem LSYR 7.3 miles downstream of Bradbury Dam (LSYR-7.3). In WY2019, migrant traps were installed in Hilton Creek and Salsipuedes Creek at their usual locations from 1/23/19 to 5/15/19 and at the LSYR mainstem site (LSYR 7.3) from 2/7/19 to 3/27/19 (Table 7). The reason for the early removal at the LSYR mainstem site was due to low flows that were not favorable for fish passage, particularly with the last Passage Supplementation event ending the week prior on 3/21/19.

WY2019 represented a wet year with 23.79 inches of rain recorded at Bradbury dam. There were 22 storms with rainfall amounts greater than 0.1 inches with the first storm in early October 2018 and the last storm in late May 2019. The majority of the rain (68.7%) fell during January (8.07 inches) and February (8.26 inches) (Table 3). The wet year provided migration opportunities for *O. mykiss* throughout the LSYR basin although the LSYR at Solvang saw fewer days compared to areas further downstream. For example, the lagoon was open for a period of 107 days, while Solvang registered only 52 days of flow greater than 25 cfs from 2/2/19 through 3/23/19. Catch per unit effort (CPUE) for the WY2019 at the Hilton, Salsipuedes, LSYR mainstem migrant traps was 88%, 74%, and 88% efficiency, respectively (Table 8).

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 9).

WY2019 ranked just below the 5 year recurrence interval in Santa Barbara County for total rainfall amount. Streamflow conditions at the USGS Salsipuedes Creek gauge responded quickly to the large winter storms with peak flows of 4,770 cfs recorded 1/17/19 and 7,050 cfs recorded 2/2/19. These streamflow events were of sufficient magnitude to alter their channels and deepened habitats throughout the watershed and provide excellent migration opportunities for *O. mykiss* once the flows receded. In the LSYR, the USGS Solvang gauge during the same storms described above created maximum flows of 704 cfs on 1/17/19 and 2,170 cfs on 2/2/19. Three passage supplementation releases were initiated in the February and March which are discussed below. By 3/24/19, flows in the mainstem had decreased to less than 25 cfs. Base flows in Hilton Creek remained essentially greater than 4.0 cfs during the migration period, with peak flow events greater than 20 cfs occurring on 1/17/19, 2/3/19, 2/14/19 and 3/6/19. The USGS gauge on Hilton Creek is only capable of recording flows less than 50 cfs. During the storms of 1/17/19, 2/3/19, and 2/14/19, the Hilton Creek gauge stopped collecting flow data for several hours on each day indicating that flow conditions were greater than 50 cfs. Personal observations during the peak storm events suggest that flows in the creek were in excess of several hundred cfs and were of high enough magnitude to alter the channel in many locations and deposit an impressive amount of woody debris along upslope areas. The streamflow during the January and February storm events were greater than normal due to the impacts from the Whittier Fire which burned a large portion of the upper Hilton Creek watershed in 2017. The resulting sediment laden flows altered the channel by filling in most small and large pool habitats but did spread optimal size spawning gravel throughout the creek after several peak flows had flushed the system, which provided excellent spawning opportunities for migrating *O. mykiss*.

Hilton Creek Migrant Traps: Both upstream and downstream migrant traps were installed from 1/23/19 through 5/15/19 (Table 7). There were 20 upstream migrants ranging in size from 113 mm (4.4 inches) to 420 mm (16.5 inches) of which 4 were recaptures (Figures 67-69, Table 10). Six of the upstream migrants were classified as juveniles and the remainder (14) as adults. There were 17 downstream migrating fish captured ranging in size from 98 mm (3.8 inches) to 447 mm (17. 6 inches) of which 2 were recaptures (Figures 67-69). Twelve of the fish were classified as juveniles and the remainder (5) as adults. Of the downstream migrating fish, only 4 were classified as smolts with 1 captured in January, 2 in March, and one in April (Figure 66). No anadromous *O. mykiss* were captured.

During the 112 days of trapping operations, both the upstream and downstream traps operated for a period of 98 days (88% efficiency). The traps had to be removed for a total of 14 days during 5 storm events. The catch per unit effort (CPUE) for upstream and downstream fish was 0.2 and 0.17 captures per day, respectively (Table 8). Of the 37 migrant captures, 34 (92%) occurred during the hours of darkness showing that the majority of migrating fish travel at night to reduce predation (Table 9). No anadromous *O. mykiss* were captured.

Salsipuedes Creek Migrant Traps: Trapping was conducted in Salsipuedes Creek from 1/23/19 through 5/15/19 (Table 7). No upstream migrating *O. mykiss* were captured which is the second occurrence (WY2017) during a wet year since trapping operations were started in 1995. There were only two downstream migrating fish captured measuring 181 mm (7.1 inches) and 299 mm (11.8 inches) (Figures 67, 70-71, Table 10). Of the downstream migrants, 1 was classified as a pre-smolt and was captured in late January, the other as a resident that was captured in early May (Figure 66). Both of the downstream migrants were captured during the hours of darkness (Table 9). No anadromous *O. mykiss* were captured.

During the 112 days of trapping operations, both the upstream and downstream migrant trap operated for a period of 83 days (74% efficiency). The traps had to be removed for a total of 29 days during 5 storm events (Table 8). The CPUE for Salsipuedes was an anemic 0.02 captures per day.

Trapping results in Salsipuedes Creek illustrate the impact that the recent drought has had on the *O. mykiss* population inhabiting the watershed. Prior to the drought, wet year types (1995, 1998, 2001, 2005, 2008, and 2011) resulted in numerous adult upstream captures and many downstream smolt captures. During the last two wet years, (WY2017 and WY2019), no upstream migrating fish have been captured and only one smolt have been captured at the Salsipuedes Creek trap site.

A comparison of the trapping results between Salsipuedes Creek and Hilton Creek is provided in Table 10 and discussed in Section 4.2.

LSYR Mainstem Trap: Trapping was conducted in the mainstem approximately 7.3 miles downstream from Bradbury Dam from 2/7/19 through 3/27/19. There were three consecutive Fish Passage Supplementation releases initiated during LSYR mainstem trapping operations (2/6/19, 2/16/19, and 3/4/19). Storm events in combination with passage supplementation releases provided 52 days of flow greater than 25 cfs at the Alisal Bridge (50 consecutive days from 2/2/19 – 3/23/19). Through the LSYR mainstem trap deployment, no upstream or downstream migrating *O. mykiss* were captured, only invasive warm water species including largemouth bass, green sunfish, bluegill, catfish, and bullfrogs. The vast majority of the invasive species were captured in the downstream trap indicating they were moving with elevated flows during each Passage Supplementation event.

During the 50 days of trapping operations, both the upstream and downstream migrant traps operated for a period of 44 days (88% efficiency) (Tables 7-8). The traps had to be removed for a total of 6 days during 2 storm events. Despite WY2019 being a wet year and having 3 consecutive passage supplementation releases, flows measured at the USGS gauging station at Solvang decreased to less than 25 cfs on 3/24/19. River discharge was below 25 cfs 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, Alisal, and Hwy 154 reaches) and bi-monthly in the tributaries (Hilton, Quiota, Salsipuedes, and El Jaro [including Los Amoles and Ytias creeks]) in the winter and spring within the reaches where access is permitted. The winter of WY2019 provided optimal migration flows and spawning opportunities throughout the lower watershed and tributaries. No spawning was documented in the mainstem in the Hwy 154 Reach and no other surveys were conducted downstream due to turbid conditions (Table 13). Spawning surveys started in the tributaries in late February and concluded in early May.

Survey conditions were problematic during January and February due to several large storm events that created high flow and turbid conditions for an extended period of time. Between January and February, nearly 16.5 inches of rain was recorded at Bradbury Dam. There were 11 redd sites documented in the tributaries in WY2019; 8 redds identified in Hilton Creek, 2 in Quiota Creek, and 1 in El Jaro Creek. Seven of the redd sites were identified in March (6 in Hilton Creek) and 4 in April (2 in Hilton Creek and 2 in Quiota Creek) (Table 11 and Table 12). No redd sites were identified in Salsipuedes Creek. All of the redd sites appear to have been created by resident *O. mykiss* based on the smaller overall size of the excavation sites.

Spawning was highly successful with YOYs first observed in Hilton Creek on 4/3/19 and in Quiota Creek on 4/18/19. One redd site was identified in El Jaro Creek in late March and YOYs from that spawning location were verified during the spring snorkel surveys. Hilton Creek showed the highest success rate with over 2,000 YOY observed during the spring snorkel surveys. Quiota Creek contained nearly 200 YOY during the spring survey. While no spawning sites were observed in Salsipuedes Creek, there were 149 YOY observed throughout Salsipuedes Creek and 23 observed in El Jaro Creek indicating that some level of spawning did take place though the specific redd sites were not identified. The redd site identified in El Jaro Creek was originally listed as a potential redd and later changed to a verified redd as YOY were observed immediately downstream of that location. No *O. mykiss* were observed upstream of this location.

Snorkel Surveys: Survey reaches are described in Figure 72. Snorkel surveys in WY2019 were conducted towards the end of the spring, summer, and fall within the LSYR mainstem (Figure 73 and Tables 14-16). Standard and accepted single-pass snorkel survey protocols were followed (Hankin and Reeves, 1988). Spring snorkel surveys were completed in June (with the exception of Hilton Creek which was 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 over the spawning season, as well as the standing crop of *O. mykiss* going into the over-summering period. Summer surveys were conducted in the LSYR mainstem in September. Fall LSYR mainstem snorkel surveys were conducted in November and December. Fall surveys are meant to evaluate the population of over-summering *O. mykiss* going into the following water year.

The COMB-FD staff applied the same level of effort for each of the 3 snorkel 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 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* have reared in previous years during the dry season. However, in the tributaries the full suite of habitat types (pool, run, riffle, and glide) is typically 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 73 with all survey dates shown in Table 14 for the LSYR mainstem and Table 17 for its tributaries.

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 72). 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 downstream of the Long Pool to the Reclamation property boundary (LSYR-0.5 to LSYR-0.7) and habitats above the Long Pool to the tail-out of the Stilling Basin. Snorkel survey results for the Hwy 154 Reach are shown in Figure 73, Panel a as well as Tables 15-16. A total of 154 *O. mykiss* were observed within the Hwy 154 Reach during the spring snorkel survey in June; 131 below the Long Pool to the Reclamation property boundary and 23 above the Long Pool to the tail-out of the Stilling Basin. Poor visibility within the Long Pool and Stilling Basin prevented COMB-FD staff from counting fish in those habitats. All of the *O. mykiss* observed during the spring count were likely YOYs that had been produced in Hilton Creek and had spread out above and below the confluence of Hilton Creek and the LSYR mainstem. Of the 154 *O. mykiss* observed, 107 (69%) fell into the 0-3 inch size category and 47 (31%) fell into the 3-6 inch size category. Surveyors noted that nearly all of the 3-6 inch fish observed were just over 3 inches in length, further indicating that they were YOYs that had been produced in the winter and spring of 2019.

Divers snorkeled the Hwy 154 Reach again in September (summer survey) and counted a total of 192 *O. mykiss*. Of the 192 fish observed, 190 were counted below the Long Pool to the Reclamation property boundary with only 2 observed between the reach of the Long Pool to the tail-out of the Stilling Basin. A shift to higher size classes was observed in the summer indicating solid growth during the first few months of the oversummering period within the Hwy 154 Reach. Only 3 *O. mykiss* in the 0-3 inch size class were observed, with 147 (77% of the total) falling into the 3-6 inch size category. Further substantiating the notion of steady growth were the 42 *O. mykiss* counted in the 6-9 inch category during the summer survey. There were no *O. mykiss* over 6 inches during the initial spring survey in the Hwy 154 Reach.

Divers returned to the Hwy 154 Reach in the fall to complete another survey but were met with very poor water clarity in early and late November. Visibility above and below the Long Pool where surveyors had conducted spring and summer counts was estimated to be less than 1 foot during a site visit on 11/18/19 and again on 11/29/19. The likely culprit of the poor water clarity was a lake turnover event within Lake Cachuma, which was in the process of completion in mid-November. Approximately half of the downstream releases at the time were being delivered from the bottom of the reservoir through the Outlet Works. Divers returned on 12/12/19 and found fair visibility within the Hwy 154 Reach, enough clarity to justify a snorkel survey. A total of 55 *O. mykiss* were observed in this final fall survey with 1 measuring 0-3 inches, 50 measuring 3-6 inches and 4 measuring 6-9 inches.

<u>*Refugio Reach*</u>

The Refugio Reach ranges from the Hwy 154 Bridge (LSYR-3.2) downstream to Refugio Bridge (LSYR-7.8); however, the section of river between LSYR-3.2 to LSYR-4.9 is not snorkeled due to access limitations (Figure 73). Spring snorkel surveys were conducted in June with no *O. mykiss* observed within the Refugio Reach. COMB-FD staff conducted the summer survey in September and found many of the units had gone dry or was barely wetted (particularly in the upper section of the Refugio Reach). Once again no *O. mykiss* was observed. The final survey in the fall occurred in November with similar results. It should be noted that flow targets in WY2019 were set to the Hwy 154 Bridge (LSYR-3.2) and not Alisal Bridge (LSYR-10.5), hence the observation of drying habitats within the Refugio Reach during the summer and fall surveys.

Alisal Reach

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figure 73). Spring snorkel surveys were conducted in June and while the entire reach was still flowing with good visibility for divers, no *O. mykiss* were observed in the entire reach. Summer and fall surveys were conducted in September and November, respectively, with many of the habitats dry or barely wetted during both surveys. No *O. mykiss* were observed during the summer and fall snorkel surveys.

Avenue of the Flags Reach

The Avenue of the Flags Reach is located from Alisal Bridge (LSYR-10.5) down to the Avenue of the Flags Bridge (LSYR-13.9) (Figure 73). The river towards the upper half of the reach has noticeably changed by anthropogenic means, insofar as where Buellflat, Granite and other flood plain mining companies have been historically altering the river bottom. The downstream half of the reach consists of a mature, unaltered riparian canopy. The COMB-FD staff conducted a spring snorkel survey in the Avenue of the Flags Reach in June with no *O. mykiss* observed. Surveyors noted flowing and clear conditions throughout the Avenue of the Flag Reach during the spring snorkel survey. No *O. mykiss* were observed within the Avenue of the Flags Reach during the summer (September) and fall (November) snorkel surveys. Much of the reach had gone dry so personnel focused on areas still containing surface water and clear enough visibility for fish observations.

Cadwell Reach

The LSYR 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 in WY2011 (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 survey activities and water quality monitoring (Figure 55 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 3 WY2019 surveys and like other locations further upstream, the majority of the reach was drying out with residual pool depth not being maintained during the summer and fall snorkel surveys.

Tributaries: Tributary snorkel surveys were conducted in the spring and fall in WY2019 at all of the long-term monitoring locations within Hilton, Quiota, Salsipuedes, and El Jaro creeks (Figure 73 and Tables 17-19). Summer snorkel surveys within the tributaries were not conducted. Just prior to the summer snorkel season, COMB, Reclamation and NMFS communicated and agreed to temporarily discontinue summer snorkel surveys within the tributaries. The rationale being that summer surveys are typically conducted during the time when water quality conditions are often the most stressful to *O. mykiss*, and divers could potentially cause increased stress levels when pushing through these habitats. In addition, summer snorkel surveys within the tributaries are often problematic due to poor visibilities and decreased water levels.

Hilton Creek

Hilton Creek surveys are conducted on Reclamation property from the confluence of the LSYR upstream to the Reclamation property boundary, which is approximately 100 feet above the URP of the HCWS and a total distance of approximately 3,000 feet (Figure 72 Panel a). Hilton Creek is divided into 6 reaches, separated by geomorphic breaks in creek and channel morphology. Since Hilton Creek is supplemented with year-round flow from the lake along a relatively short stretch that contains a relatively high density of *O. mykiss*, all habitats within Hilton Creek are snorkeled and have been since the installation of the HCWS in 2001.

During the WY2019, target flows into Hilton Creek were sustained above the 2 cfs minimum throughout the dry season as set forth in the 2000 BiOp (NMFS, 2000). Reclamation kept the HCEBS activated via gravity flow from the bottom of the reservoir to the LRP with HCWS pumped flow to the URP from the start of the water year until 1/31/19 when the HCWS pumps were turned off and the lake elevation was sufficient to provide HCEBS gravity flow to the URP throughout the rest of the WY2019. Reclamation switched over to the HCWS via gravity feed to the URP on 10/30/19 and kept that configuration for the remainder of the calendar year.

The spring snorkel survey within Hilton Creek was intentionally delayed until late July so that the many YOY that had been produced in the spring could grow and occupy habitats where divers could achieve an accurate count and not endanger them by walking along the margins (Table 17). Even in June, COMB-FD staff observed hundreds of newly emerged *O. mykiss* within Hilton Creek in shallow, marginal habitats that could not be counted while diving. A total of 2,153 *O. mykiss* were observed within Hilton Creek during the spring snorkel survey (Figure 73-74 and Tables 18-19). This was by far the highest spring *O. mykiss* total count within the drainage since WY2008 (spring count of 2,210, a spill year that also had large, anadromous adults migrate and reproduce in the system). Of the 2,153 fish observed in the spring of WY2019, 1,612 (75%) were within the 0-3 inch size class and another 520 (24%) were within the 3-6 inch size class. The *O. mykiss* in these two smaller size classes were undoubtedly produced during this successful winter and spring spawning season within Hilton Creek. Rounding out the remaining size classes, 11 (6-9 inches), 7 (9-12 inches), 1 (12-15 inches) and 2 (15-18 inches) fish were also observed.

No summer tributary snorkel surveys were conducted in WY2019, an action that was discussed with Reclamation and NMFS. Divers returned to Hilton Creek and conducted the final fall snorkel survey in November. A total of 1,497 *O. mykiss* were observed (Figure 73-74 and Tables 18-19). Of the 1,497 fish observed, 569 (38%) were within the 0-3 inch size class and 896 (60%) were within the 3-6 inch size class. This represented a significant upward shift in size class compared to the spring survey in July. In addition to the smaller two size classes, 31 (6-9 inches) and 1 (9-12 inches) *O. mykiss* was observed.

Quiota Creek

A historic section of Quiota Creek, located between Crossing 5 and Crossing 7, typically contains perennial flow and habitat of which staff routinely snorkels (Figure 73 and Tables 18-19). With WY2019 being a wet year, divers found continuous flow and clear visibility in that reach during the spring snorkel survey. Unfortunately, no *O. mykiss* were observed within the historic section of Quiota Creek. Divers returned in November for the fall snorkel survey and found few habitats to snorkel as most had already gone dry during the summer months. Once again, no *O. mykiss* were observed during the fall survey in the traditionally snorkeled habitats. O. mykiss were observed in the upper tributary and 2 adults were discovered in the refuge pool below the Quiota Creek Crossing 8 Project dewatering effort that were safely relocated into the upper tributary.

Salsipuedes Creek

Lower Salsipuedes Creek contains five reaches that the COMB-FD staff separates by fluvial geomorphic changes in the stream channel. Reaches 1 through 4 are located between Santa Rosa Bridge (on Santa Rosa Road) upstream to the Jalama Road Bridge, a distance of approximately 2.85 stream miles (Figure 72). Reach 5 extends upstream from Jalama Road Bridge to the confluence of El Jaro Creek, a distance of approximately 0.45 miles. Reach 5 has been a historic monitoring location because of its reliable water clarity and flow, as well as the regular presence of *O. mykiss*.

With WY2019 being an above average rainfall season, flow and water clarity conditions were optimal during the initial June spring snorkel survey in Salsipuedes Creek (Figure 73, Figures 75-76 and Tables 18-19). Spring surveys within Reaches 1 through 4 revealed at total of 67 *O. mykiss*, with 42 (0-3 inch) and 19 (3-6 inch) juveniles observed. The notable observation being that the juveniles observed were well spread out amongst the upper mile and a half of the survey reach, with no discernable location where they had originated or emerged from. Since baseflows remained high in the spring as the result of a big rainfall season (33.99” of rain at Rancho San Julian), juvenile *O. mykiss* were likely able to move freely and occupy more habitats within the reach. The larger size classes of fish observed in the spring only had a few individuals: 2 (6-9 inches), 3 (12-15 inches) and 1 (15-18 inches).

Summer surveys were not conducted as mentioned above, but divers returned to Salsipuedes in November to complete the fall survey. A total of 29 *O. mykiss* were observed within Reaches 1 through 4 (Figure 75 and Tables 18-19). Divers noted that visibility within several sections of the creek limited viewing opportunities, which likely led to the lower totals observed compared to the spring survey. Of the 29 fish observed, none were recorded as being 0-3 inches in length with 23 (79%) falling into the 3-6 inch category. This confirmed a strong oversummering growth period for the YOY produced in the winter and spring. The remaining number and size classes observed in the fall were the following: 5 (6-9 inches) and 1 (15-18 inches).

Spring and fall surveys were conducted within Reach 5 of Salsipuedes Creek in June and November, respectively. The total number of *O. mykiss* observed in the spring was 82; the dominant size class being 0-3 inches with 73 (89%) fish counted (Figures 76 and

Tables 18-19). Surveyors also counted 3 (3-6 inches), 4 (6-9 inches), 1 (9-12 inches) and 1 (12-15 inches) *O. mykiss* during the spring survey. Just as what was observed in the lower reaches of Salsipuedes, the juvenile *O. mykiss* observed within Reach 5 were well spread out and occupying many different habitats in the spring. COMB-FD divers returned to Reach 5 in November and counted 22 *O. mykiss*, none of which were 0-3 inches (just as observed in the lower reaches). Of the 22 total, 18 (82%) were 3-6 inches, with 1 6-9 inch and 3 9-12 inch fish.

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 each year (Figure 77, Tables 18-19). Divers arrived in late June to conduct spring snorkel surveys and encountered good flow conditions and water clarity during the survey. A total of 23 *O. mykiss* were encountered, all of which were YOYs in the 0-3 inch size class. No summer dive survey was conducted, commensurate with the decision to forego summer tributary surveys in WY2019. The fall survey conducted in November showed low oversummering survival with only 1 juvenile 3-6 inch *O. mykiss* observed.

Other Fish Species Observed: All warm-water non-native fish species in the LSYR mainstem are counted during routine snorkel surveys conducted in the spring, summer, and fall (Figures 78-79). 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. Historically, warm-water species are 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, Salsipuedes Creek and El Jaro Creek did contain warm-water fish in WY2019.

Hilton Creek

Divers during the spring snorkel survey in Hilton Creek found several green sunfish in Reach 1 at and just above the Hilton Creek migrant trap site. A total of 4 sunfish were counted, 3 measuring 3-6 inches and 1 measuring 6-9 inches. When COMB-FD returned to conduct the fall survey, only 1 green sunfish measuring 3-6 inches was observed in Reach 1. No other non-native fish species were observed further upstream.

Salsipuedes Creek

In the spring survey within Reaches 1 through 4, COMB-FD staff counted 393 green sunfish (39 0-3 inches, 325 3-6 inches, and 29 6-9 inches). The boost in green sunfish numbers and range of size classes observed suggests that their population is expanding within the drainage. During the spring survey, divers observed many green sunfish redds with fish actively protecting their nests. An effort was made to disturb (by hand) every sunfish nest that was encountered to help decrease survivorship. Over 70 sunfish nests were observed distributed throughout the creek. Surveyors also observed 1 largemouth bass measuring 3-6 inches and another measuring 9-12 inches. In the middle of Reach 4, staff found 3 carp adults measuring 12-18 inches in a single pool habitat. In Reach 5 of Salsipuedes Creek, divers counted an additional 9 green sunfish all measuring 3-6 inches.

Personnel returned in the fall and observed a total of 886 green sunfish within Reaches 1 through 4 (273 0-3 inches, 143 3-6 inches, 26 6-9 inches, and 1 9-12 inches). The notable increase in green sunfish numbers were in the smallest size class, indicating successful spawning and emergence after the spring snorkel count. This was despite the effort in the spring to disturb all sunfish nests that were seen while diving. Other warm-water species observed during the fall survey included 9 largemouth bass measuring 6-9 inches and 65 juvenile bullhead catfish measuring 0-3 inches (all seen in one large pool habitat within Reach 1). The fall survey within Reach 5 contained 12 green sunfish, 4 measuring 3-6 inches and 8 measuring 6-9 inches.

El Jaro Creek

The 0.40 mile regular survey reach of El Jaro Creek also contained warm-water species in the spring with 24 green sunfish observed. Three size classes of sunfish were recorded: 3 measuring 0-3 inches, 7 measuring 3-6 inches, and 14 measuring 6-9 inches. In addition to the sunfish observed, divers found a single bullhead catfish measuring 9-12 inches in a large pool habitat approximately 300 yards upstream of the confluence with Salsipuedes Creek. The follow up survey in November (fall survey) contained a total of 23 green sunfish in the two larger size classes: 21 measuring 3-6 inches and 2 measuring 6-9. The bullhead catfish that was seen in the spring was not observed in the fall.

LSYR mainstem

Largemouth Bass: Largemouth bass were observed within the LSYR mainstem in WY2019 in somewhat lower numbers compared to recent years (Figure 78 Panel a). This could, in some measure, be due to the Stilling Basin de-watering and non-native fish removal activities that occurred in July of 2017; the Stilling Basin being a known seed population source for largemouth bass occupying the LSYR mainstem. In addition, target flows were set to the Hwy 154 Bridge (LSYR-3.2) in WY2019 and not further downstream to Alisal Bridge (LSYR-10.5). This led to the drying and desiccation of many management reach habitats within the Refugio and Alisal Reaches. The total number of largemouth bass observed in the spring within the Refugio and Alisal Reaches was 15 and 22, respectively. Largemouth bass observations in the summer slightly increased with 29 observed in the Refugio Reach and 33 observed in the Alisal Reach. The final fall survey in the Refugio Reach saw a greater total of 49, while the Alisal Reach stayed more consistent with a total of 34 largemouth bass.

Sunfish Species: There are multiple sunfish species (green, red-ear, and bluegill) inhabiting the LSYR mainstem, which can be especially difficult to distinguish in juvenile form. Although the COMB-FD staff differentiates between them during routine snorkel surveys when possible, all three species are lumped into a single sunfish category for the purposes of this report. Relatively low numbers of sunfish were observed within the management reaches of the LSYR mainstem in WY2019 (Figure 78 Panel b). The spring, summer and fall sunfish total within the Refugio Reach was 18, 88, and 48, respectively. The same survey periods for the Alisal Reach totaled 13, 3, and 2 sunfish, respectively.

Catfish Species: There are two species of catfish present in the LSYR mainstem, bullhead and channel catfish. 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 WY2019, no catfish were observed during any of the spring, summer, and fall surveys within the LSYR mainstem (Figure 79 Panel a).

Carp: The number of carp observed within the Refugio Reach of the LSYR mainstem remained low throughout the year. None were observed in the spring, with 8 and 17 recorded by divers in the summer and fall, respectively (Figure 79 Panel b). When divers began assessing the Alisal Reach in the spring, they came across a single run habitat containing hundreds of juvenile carp measuring 0-3 inches. Just a short distance upstream, divers encountered 2 adult carp holding in a pool habitat which were the likely spawning pair that had produced all the juvenile carp seen just downstream. In total, 397 carp were counted in the Alisal Reach during the spring survey, approximately 350 of which were the juveniles mentioned above. Three months later during the summer survey, a total of 439 carp were counted in the Alisal Reach. The majority of which were the same school of juvenile carp which had grown to the 3-6 inch size class. The final fall survey in November saw a massive die-off of carp within the Alisal Reach. The habitat containing all the juvenile carp observed during the spring and summer had just de-watered prior to the fall survey. The carcasses of many of the juvenile carp were still present in the muddy remnants of the habitat, most showing continued signs of growth (6-7 inches) at the time of their demise. As a result, only 11 carp in total were counted in the final survey within the Alisal Reach.

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 WY2019, 1 tributary project was conducted at Quiota Creek Crossing 8 (construction started on 9/30/19 and was completed by the end of the calendar year). Compliance monitoring was conducted throughout the project. All of the completed projects along Quiota Creek removed a fish passage barrier and replaced it with a bridge that allowed complete juvenile and adult fish passage across all determined fish passage flows.

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, mulching), and photo documentation were all conducted in accordance with the post-project monitoring requirements at each location.

3.7. Additional Investigations

Scale Analysis: *O. mykiss* have fish scales (cycloid scales) that grow out of the skin and protect the body. They add rings (circuli) to their scales as they grow, depending upon food availability, water quality, and environmental stressors. Seasonal variations in conditions create annuli, which can be used to estimate the age of the fish. Other information that can be estimated from scale analysis include growth rate, when an individual migrated to the ocean, size at ocean entry, how long they spent at sea, when spawning occurred, and the approximate age they returned to the river.

COMB-FD staff collects eligible *O. mykiss* scales during migrant trapping efforts. These scales are stored in envelopes and transferred to microscope slides and added to the *O. mykiss* scale library at the COMB-FD office for analysis as time permits. The scale library is a valuable resource for documenting patterns in migration, growth rate, spawning, and environmental stress.

Genetic Analysis: Tissue samples from all of the migrant captures during WY2019 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 peer reviewed scientific literature was introduced into the Santa Ynez River system in the late 1940s (Hensley, 1946; Baker and Hill, 2003; CDFG, 2005). The presence of this species in the 1940s was initially scattered and isolated in a few areas within the LSYR mainstem.

Over time and with the increased amount of flow in the river since 2000 as a result of the target flow requirements of the 2000 BiOp, the number and spatial distribution of beavers and their dams have increased substantially throughout the LSYR mainstem. Once Lake Cachuma surcharged for the first time and the long-term target flows were initiated in 2005, beaver dams have been observed in the wetted reaches during the dry season from the Bradbury Dam to the Narrows as well as portions of the LSYR mainstem downstream of the Lompoc Waste Water Treatment Plant upstream of the Santa Ynez River lagoon. In addition, beavers now have successfully inhabited the Salsipuedes/El Jaro Creek watershed though their numbers and distribution were significantly reduced by the drought. Well established beaver dams can be of sufficient strength and breadth to remain in place during stormflows, and create passage impediments and/or barriers for migrating fish during low to moderate flows.

Beaver dams and the associated ponds often change riffles and runs into pools that can lead to greater thermal heating of stream water, can fragment habitat and inhibit movement of juvenile and adult fish species, increase siltation, change benthic macroinvertebrate assemblages, and increase ideal pool habitat for invasive aquatic species (i.e., bass, sunfish, catfish, and carp). Beaver regularly build their dams at the control points of pool habitats, a prime spawning location for *O. mykiss* and have been observed to reduce spawning locations/opportunities during “normal” and drier years. Also, beaver dams can affect operational flows of the Fish Passage Supplementation Program, target flow releases, and downstream water right releases. As a result of increased beaver activity in the watershed, an additional monitoring element has been added to the Fisheries Program to track the number, extent (size), and distribution (location) of beaver dams within the LSYR mainstem and tributaries below Bradbury Dam. Beaver dam abundance is a simple way to annually track the beaver population and spatial distribution within the LSYR basin. This survey is conducted each year prior to the steelhead migration season.

Over a couple of weeks in December 2018 and January 2019, the COMB-FD staff completed the LSYR mainstem beaver dam survey from Bradbury Dam (LSYR-0.0) to downstream of the Narrows where the river goes dry out on the Lompoc plain downstream of the Salsipuedes Creek confluence with the LSYR mainstem (approximately LSYR-34.4), except within the Hwy 154 Reach on the San Lucas Ranch (due to lack of access). The survey also looked at the wetted section of the river downstream of the Lompoc Waste Water Treatment Plant (approximately LSYR-42.0) to the 13th Street Bridge on Vandenberg Airforce Base and the start of the lagoon.

Dams were classified as barriers, impediments, or passable utilizing CDFW passage criteria. In order for migrating *O. mykiss* to pass over barriers, CDFW criteria states that 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 pool control points (i.e., tail out of pool habitat) 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 dams were all small in height with deeper habitats immediately downstream of the dam with some measure of flanking occurring, or in some cases were in the process of being built and small in stature.

Since WY2010, the number of beaver dams has fluctuated over the monitoring period with distribution increasing during wet year types and decreasing during the drought years (Table 20). In 2011, Bradbury Dam spilled, removing many beaver dams and killing an indeterminate number of individual beavers 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 2011. The highest total of dams identified in the mainstem (132) occurred in WY2013 and tributaries (36) occurred in WY2014. Since then, the number has gone down most likely due to impacts from the prolonged drought.

LSYR mainstem beaver dams identified in WY2019 (45) represent a slight reduction in the number of dams observed compared to the previous year and is tied for the fewest number of beaver dams documented (WY2016) since the surveys began (Figure 80, Table 20). Of the 45 beaver dams identified, 42 were active and three were non-active relic dams. Of the active dams, 41 were considered barriers to fish migration at the current flow rate and 4 were considered passable. No beaver dams were observed in the Hwy 154 Reach. There were 2 active dams and 1 non-active dam in the Refugio Reach and 2 active dams in the Alisal Reach. The majority of the dams (40) were located downstream of the Avenue of the Flags Bridge in Reach 3 of the LSYR mainstem. The lower most active dam in the Santa Ynez River watershed was located immediately downstream of the Floradale Bridge in Lompoc.

For the third straight year (2017-2019), there were no active beaver dams observed within the entire Salsipuedes/El Jaro Creek watersheds. The long-term drought and significant reduction of wetted habitat likely caused the die-off of beavers. The last active dam was documented in El Jaro Creek in 2016. High stormflows during WY2019 (in excess of 7,000 cfs recorded by the USGS at the Jalama Road Bridge) removed all evidence of relic beaver dams throughout both creeks and allowed unimpeded movement of migrating and spawning fish during WY2019. Since active dams are present at various locations throughout the LSYR mainstem, it is likely that beaver populations will expand and exploit additional habitats when favorable flow conditions are present and it is likely they will move back into the Salsipuedes/El Jaro Creek watershed in future years.

4. Discussion

This section provides (4.1) additional historical context for the WY2019 results presented above, specifically since the issuance of the 2000 BiOp, (4.2-4.9) discussion as needed on specific topics of interest or concern, and (4.10) the status of last year's Annual Monitoring Summary 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), 2014 (COMB, 2018a), 2015 (COMB, 2018b), 2016 (COMB, 2019a), 2017 (COMB, 2019b), and 2018 (COMB, 2020).

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 (Table 1 and Figure 81) are presented since WY2000.

4.2. Comparison of Salsipuedes Creek and Hilton Creek Migrant Trapping Results

Salsipuedes Creek and Hilton Creek are very different tributaries in terms of their size (Salsipuedes is an order of magnitude larger than Hilton), hydrology (rainfall and flow patterns, hydrologic regime, and artificial watering system), 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 can receive more rainfall during any given rainfall event due to its westerly location. Typically, smaller watersheds like Hilton Creek can have sharper recessional storm hydrographs; however, Hilton Creek has an artificially sustained baseflow greater than 2 cfs year round, whereas in the upper reaches of Salsipuedes Creek and its largest tributary, El Jaro Creek, baseflows typically approach 0.5 cfs during the dry season. Out-migrant *O. mykiss* smolts in both creeks attempt to migrate to the ocean/lagoon when flow opportunities present themselves.

The *O. mykiss* populations between the two creeks exhibit differences in upstream and downstream migration timing, spawning time, rearing habitat, and over-summering characteristics (i.e., water quality, flow, and habitat complexity). Hilton Creek has good habitat quality (refuge pools with structure and a mature riparian canopy) and flows into the Long Pool just downstream of the confluence with the LSYR mainstem, but has limited stream length. The Salsipuedes Creek system has extensive stream mileage but only fair habitat quality due to low dry season flows, limited pool habitat with acceptable water quality for over-summering, a predominance of fine sediment substrate, and high water temperatures in the lower portion of the creek (AMC, 2009). One result of these differences is earlier resident *O. mykiss* upstream migration in Hilton Creek due to greater availability of water in the mainstem immediately below the dam where resident *O. mykiss* have been documented to oversummer. Hilton Creek also has a longer migration time for smolts to make it to the ocean given the additional distance, and a potentially longer smolting period due to favorable water quality conditions near the dam which can diminish some environmental cues for out migration (for example low water temperature and continuous baseflow greater than 2 cfs). Returning ocean run adults also have a longer travel distance to Hilton Creek than Salsipuedes Creek.

Regardless of the differences in the watersheds described above, the drought of WY2012-WY2016 has negatively impacted both watersheds. Based on migration numbers alone in WY2019, Hilton Creek has fared far better than Salsipuedes/El Jaro Creek. During the last three years, only three smolts have been captured leaving Salsipuedes Creek, compared to 23 leaving Hilton Creek. Upstream migration numbers show an even starker contrast with 27 fish captured moving upstream in Hilton Creek compared to zero moving upstream in Salsipuedes Creek (Table 23-24). The last time an upstream migrating resident *O. mykiss* was captured in Salsipuedes was WY2014 and WY2011 for an anadromous *O. mykiss*.

4.3. Tributary Passage Enhancement Projects

By the end of calendar year 2019, 17 tributary passage enhancement projects had been completed within the LSYR basin: Salsipuedes Creek Highway 1 Bridge Fish Ladder, the bank stabilization (Demonstration) project on El Jaro Creek, 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), Quiota Creek Crossing 0A, Quiota Creek Crossing 4, Quiota Creek Crossing 5, Quiota Creek Crossing 9, and Quiota Creek Crossing 8 as well as the HCWS and HCEBS which supplies water year round to Hilton Creek from Lake Cachuma (Tables 25-26 and Figures 82-86). All documented anthropogenic passage impediments within the Salsipuedes/El Jaro Creek watershed have now been removed, allowing for full adult and juvenile *O. mykiss* passage throughout the stream. 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.

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 61-62). 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 86) and releases from the URP provided for extensive riparian vegetation growth that has shaded and cooled the stream water. Channel changes and the redistribution of optimal sized spawning gravels throughout Hilton Creek, coupled with activation of the URP during WY2019 has greatly enhanced instream rearing conditions throughout the creek. In fact, maximum water temperatures collected in Lower Hilton Creek this year represent some of the lowest water temperatures observed since 1998 (Figure 87).

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 potential 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.

The cattle exclusionary fencing project was completed on Rancho Salsipuedes on the lower reaches of Salsipuedes Creek in the winter of 2014. The project continued to be a success in WY2019 as cattle have been excluded from the stream corridor, except for a couple of short duration break-ins .

4.4. Water Hyacinth Discovery and Removal

Water hyacinth 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, specifically in the Sacramento-San Joaquin River

Delta where it has heavily impacted the river ecology and fisheries (Villamagna and Murphy, 2010). 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. The infestation extended approximately 1.2 miles downstream and was contained by COMB-FD staff over the course of 3 years within that section of the river channel. Staff surveyed that section of river in WY2019 (last known occurrence was 12/8/16) and did not observe any water hyacinth. This has become a routine field monitoring activity.

4.5. Hilton Creek Water Quality Effects from the Whittier Fire

The combination of the Whittier Fire burn scar in the upslope areas of the Hilton Creek watershed, coupled with significant runoff in WY2019 from several large storm events in January and February, generated significant bedload transport and channel changing conditions within the drainage. Although observations of turbid conditions and heavy silt loads occurred in WY2018, it wasn't until the above average rainfall in WY2019 that the Whittier Fire burn scar truly impacted the basin. A series of 3 storms impacted the Hilton Creek drainage between 1/12/19 and 1/17/19, with the third storm event of sufficient magnitude to transport large quantities of upper basin sediment down into the watered section of Hilton Creek on Reclamation property that filled most all pool habitats with sand and gravel, including a large portion of the Long Pool.

COMB-FD staff was on site each day during the storm series to conduct fish rescues as needed, removed equipment and provided information to Reclamation. A total of 3 *O. mykiss* mortalities were found in lower Hilton Creek, which had likely succumbed to excessive suspended sediment, bedload transport, turbidity and high flow conditions. While walking the creek channel it became apparent that the substrate and habitat conditions (particularly pool depths) had changed significantly from these high flow events. Pool habitats were mostly filled in with very little depth (Spawning Pool, Honeymoon Pool, etc.), and what once was a streambed of large, course material was now full of loose silt, sand, and gravel (Figure 88).

Several other storm events, including another large event between 1/31/19 and 2/4/19 continued to transport upslope material from the Whittier Fire burn scar into and through Hilton Creek. This large flow event and several small subsequent flow events continued to move material into and out of Hilton Creek, resulting in less and less fines and transitioning into larger streambed material (gravels) suitable for spawning. Although the filled in pool habitats within Hilton Creek remained mostly filled in, the upstream (or head) portions of the pools began to scour, beginning the process of scouring out the large amount of material that had been deposited and recovering some pool habitat. Lake water discharges were provided to Hilton Creek via the HCEBS/HCWS systems throughout WY2019 at a minimum of 2 cfs even though upper basin background flows had ceased in late May.

4.6. Long Pool Filling in with Sediment from the Whittier Fire

The large amount of sediment that transited Hilton Creek from the Whitter Fire burn scar ended up in the Long Pool of the LSYR mainstem (Figure 89). The COMB-FD was on

site during each of the large flow events to document flow and habitat conditions, conduct fish rescues as needed, and to provide timely information to Reclamation. While personnel were focused on Hilton Creek during the initial high flow events, subsequent observations within the Long Pool revealed a significant filling of this large and long-standing pool habitat from Hilton Creek material depositing as a delta well out into and across the Long Pool. The extensive deposits rendered the Long Pool significantly shallower towards the upper third of that long habitat and with approximately a third less volume over the entire habitat. Personnel could then walk the upper 200 feet of the Long Pool near the confluence in what once was not a wadeable section of the pool.
In the late spring when background flows had diminished within Hilton Creek, personnel went to deploy the regular thermograph array within the middle and deepest section of the Long Pool. It became immediately apparent that a significant loss of depth had occurred across the entire bottom of the pool. Typically the thermograph array sits within the maximum depth region of the pool (to take advantage of any stratification), strapped to a cable running the width of the pool at its deepest transect. Prior to the Whittier Fire and subsequent debris flows realized in WY2018 and WY2019, this section of the pool was typically 9 feet in depth. When deploying the thermograph array in the spring of WY2019, the approximate depth had decreased to 5.5 feet. This amounted to approximately 3.5 feet of deposited materials from Hilton Creek during the runoff season. In that middle section, the consistency of the substrate was soft and muddy, with no hard bottom across the entire transect. Most of the gravels deposited at or near the confluence of Hilton Creek with the mainstem.

In the absence of a spill event, the Long Pool is likely to remain in a shallower state. Any short-term (1-3 years) high flow events from Hilton Creek could bring more sediment from the Whittier Fire burn scar and previously deposited sediment in the wetted section of Hilton Creek as they scour out over time. Given that the settled material at the bottom of the Long Pool is mainly comprised of fines, any spill event from Bradbury Dam would likely flush the pool and assist in regaining the lost depth. Whether or not the Long Pool in a deepened or shallower condition is beneficial for *O. mykiss* is under question, particularly in this temperature controlled reach below Bradbury Dam where consistent cold water is being released. Although stratification can be critical to the oversummering survival of *O. mykiss* further downstream in the basin where water temperatures often reach or exceed lethal limits, it may not be as critical in the relatively cool reach below the reservoir. Deep pools in the Hwy 154 Reach may harbor and attract more invasive species, whereas shallower pools with greater flow velocity may promote *O. mykiss* growth from better benthic productivity and reduced competition/predation.

4.7. Gravel Augmentation in Hilton Creek

In collaboration with NMFS, Reclamation proposed to conduct a short-term, 2 year gravel augmentation effort within Hilton Creek starting in 2018 and ending in 2019. All gravel augmentation, monitoring, and reporting was implemented by the COMB-FD. During this second year augmentation effort, a total of 6 gravel treatment sites were pre-selected for augmentation and all gravel had been placed at those locations by 11/28/18 well before the spawning season. Unlike WY2018 where storm hydrographs recorded peak flows of less than 50 cfs and did not mobilize augmented gravels during that year, WY2019 had several large flow events during January and February that produced channel changing flows, high turbidity, and significant bedload transport. As predicted in the Whitter Fire BAER report, Hilton Creek was impacted during storm events on 1/14/19, 1/31/19, and 2/13/19 that moved a large amount of sediment and woody debris through the creek, filled in many pool habitats, and caused degraded water quality conditions during the first portion of the spawning season. Bank observations suggested that the bedload movement redistributed, replaced, or covered all of the gravel that was augmented in the creek in November of 2018.

Heavy rainfall began in early January and continued through mid-February. Conditions were difficult for surveyors to conduct spawning surveys within Hilton Creek during January, particularly with high and turbid flows throughout the month making observation difficult. Suspended sediments and elevated turbidity from the Whittier Fire burn scar continued through mid-February, with the first official spawning survey conducted on 2/26/19.

Several spawning surveys had occurred before the first redd site within Hilton Creek was observed on 3/18/19. A total of 6 spawning sites were observed on this date, with one additional redd observed on a follow up survey on 3/20/19. One additional redd site was found on 4/8/19 which brought the Hilton Creek total to 8 redds sites observed in WY2019. Three of the 8 redd sites occurred in the locations where November, 2018 gravel augmentation had occurred. However, the storms in January and February caused significant bedload movement which likely replaced or covered over the augmented gravel. Natural upslope gravel was distributed throughout Hilton Creek which allowed *O. mykiss* to utilize a larger extent of the creek for spawning due to the presence of newly deposited upper basin gravels.

Spawning was highly successful in WY2019. In total, there were 2,153 *O. mykiss* observed during the spring snorkel survey with the majority (99%) of the fish in the 0-3 inch and 3-6 inch size categories (i.e., mostly 2019 YOYs). The high spawning success in 2019 suggests that the large quantity of spawning gravel in the creek system is having a positive influence on the *O. mykiss* population within the creek. Future years with average to above average rainfall will continue to mobilize and redistribute gravel from both upslope areas and along the stream margins in the short-term until those areas become revegetated and stabilized.

4.8. Reproduction Success in Hilton Creek, Quiota Creek and Salsipuedes/El Jaro Creek

The above average rainfall season in WY2019 provided background flows and ample spawning opportunities within all of the major LSYR tributaries below Bradbury Dam. Although no large anadromous *O. mykiss* were captured during the migrant trapping operation or observed during spawning or snorkel surveys, a total of 11 redds were observed within Hilton (8), Quiota (2) and El Jaro Creek (1). All of the observed redds in WY2019 were presumably constructed by resident *O. mykiss* within the basin.
Spring snorkel surveys were conducted in June (Hilton Creek was completed in July to allow time for late fry emergence) are meant to record baseline conditions after the

spawning season and prior to the critical summer rearing season. They are designed to document the number and location of YOYs produced over the spawning season, as well as the standing crop of *O. mykiss* going into the over-summering period.
LSYR mainstem spring counts revealed no evidence of spawning or recruitment within the management reaches (Refugio/Alisal) and downstream through Reach 3 (Avenue of the Flags) and beyond. However, personnel surveying the Hwy 154 Reach on Reclamation property counted 154 *O. mykiss* in June with 107 YOY in the 0-3 inch size class and 47 YOY in the 3-6 inch size class. These fish were likely produced within Hilton Creek and traveled the short distance downstream into the Hwy 154 Reach within the LSYR mainstem. They then occupied habitats above and below the Long Pool (LSYR-0.5) where divers counted them during the June survey.

The spring survey (actual survey start date was 7/24/19) conducted within Hilton Creek was intentionally started late to allow the YOYs produced to fully emerge and occupy habitats deep enough for underwater observation. A total of 2,153 *O. mykiss* were observed, of which 75% of the total were fish 0-3 inches in length and 24% of the total were fish 3-6 in length. The remaining totals and size classes were as follows: 11 (6-9), 7 (9-12), 1 (12-15) and 2 (15-18). This was the highest *O. mykiss* count within Hilton Creek since WY2008 (a spill year with the most anadromous fish captured). Although a moderate number of redds (8) were observed in Hilton Creek in WY2019 (for comparison 17 redds observed in WY2014, 9 in WY2015, and 8 in WY2018), the number of YOYs produced in WY2019 far exceeded those years in which an equal or greater number of redds were observed in that same year. Plus redds and YOYs were observed throughout the creek and not exclusively associated with the deeper refuge and historic spawning sites (Figure 90). There were YOYs even observed down on the newly created delta in the upper third of the Long Pool that was filled in during winter stormflow events. The higher number of fish produced in WY2019 could be attributed to the availability of natural spawning gravel and recruitment from upstream sources during winter and spring storms.

4.9. Update on the Lake Cachuma Oak Tree Mitigation Project

The annual oak tree inventory was completed in March of 2019 with an objective to determine the status and success rate of the trees planted since the beginning of the program with 10 years of plantings. At the end of the 2019 planting season, 4,721 oak trees have been planted and 3,741 are alive and thriving (78.5% survival rate). The number of mitigation trees still to be planted stood at 980 trees (mitigation number minus total alive trees). There were 300 oak trees planted during FY18/19 at Lake Cachuma County Park that are referenced as Year 10 trees. The lessons learned by the COMB-FD staff from seven years of conducting the Oak Tree Program have been put into practice and are recommended for future work. These lessons include annual mulching, deer cage maintenance, exposing buried gopher wire baskets, planting trees above ground, and planting larger trees.

4.10. Status of WY2018 Annual Monitoring Summary Recommendations:

The following is a status report (i.e., completed, ongoing, no longer applicable, or should carry forward to next year) for all the recommendations listed in the WY2018 Annual Monitoring Summary 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 to collaborate with Reclamation on best management practices in Hilton Creek to address the potential for sediment-laden runoff from the Whittier Fire burn area;
  - Status: This recommendation is being followed and is ongoing.

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

- Conduct gravel augmentation as soon as possible in the fall well in advance of the spawning season;
  - Status: This recommendation was completed.

- Considering the success of the gravel augmentation effort in Hilton Creek in 2018, discuss with Reclamation the possibility of a long-term program in Hilton Creek and other locations of known spawning activities that are limited in stream gravels;
  - Status: This recommendation has not been addressed and should be a recommendation for next year.

- Obtain an Electrofishing Backpack unit and get the necessary professional training to be certified in its use;
  - Status: This recommendation is being completed.

- Encourage Reclamation to improve and make reliable its system operation for delivering lake water to Hilton Creek;
  - Status: This recommendation is being followed and is ongoing.

- Continue to encourage Reclamation to gather continuous data on the water temperature discharged from the Outlet Works of Bradbury Dam to the LSYR to monitor BiOp compliance of a maximum of 18 ^{o}C of that discharge water;
  - 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;
    - Status: This recommendation is being followed and is ongoing.

- 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.

- Remove non-native fish species and continue to 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;
    - Status: This recommendation is being followed and is ongoing.

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

- Continue to maintain and develop landowner relationships in the LSYR basin to foster cooperation and gain access to reaches for all monitoring and restoration tasks;
    - Status: This recommendation is being followed and is ongoing.

- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin; and
    - Status: This continues to be a good recommendation and has not been addressed.

- 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: Collaborative relationships continue to be developed between COMB-FD staff and fisheries biologists working on the Ventura River, Santa Clara River, Carpinteria Creek, Topanga Creek, and Malibu Creek.

5. Conclusions and Recommendations

WY2019 was the second wet year since the drought that started in WY2012. Bradbury Dam recorded 23.79 inches of rain with the highest rainfall occurring in January and February with springtime rains continuing until late May. Lake Cachuma did not spill but it did go from 31.7% to 74.7% of capacity from the beginning to the end of the water year. The highest lake level of the water year was recorded on 5/28/19 at 80.9% of capacity. A minimum of 2 cfs was delivered to Hilton Creek at the URP and target flows to the Hwy 154 Bridge were met. The lagoon did breach providing ocean connectivity but no anadromous fish were observed entering or within the Santa Ynez River basin.

There were 11 redds documented across the LSYR basin, none in the mainstem and 11 in the tributaries. Spring, summer, and fall snorkel surveys showed a high level of spawning success with many YOYs observed in Hilton, Quiota and Salsipuedes/El Jaro creeks. The uptick of *O. mykiss* was particularly noticed in Hilton Creek with a 2 order of magnitude increase; most all were YOY. There was ample fish passage potential for migrating fish but no anadromous fish were observed even with 3 fish passage supplementation events.

Monitoring tributary and LSYR mainstem *O. mykiss* populations has resulted in observations that fluctuate by water year type, instream flows, spawning success, and oversummer rearing 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 WY2018 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 from WY2019 onward:

- 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;
- Work closely with Reclamation on the implementation of the new Water Order WR 2019-0148 to conduct all required monitoring and reporting in a timely manner;
- Continue to collaborate with Reclamation on best management practices in Hilton Creek to address the potential for sediment-laden runoff from the Whittier Fire burn area;
- 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;
- Considering the success of the gravel augmentation effort in Hilton Creek in WY2018, discuss with Reclamation the possibility of a long-term program in Hilton Creek and other locations of known spawning activities that are limited in stream gravels;
- Work with the regulatory agencies to utilize the COMB Electrofishing Backpack unit and trained/certified staff whenever possible to implement fish rescue and removal of non-native fish from the LSYR basin;

- Remove non-native fish species and continue to 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;
- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin, particularly in light of the new flow requirements required by the State Board;
- Encourage Reclamation to improve and make reliable its system operation for delivering lake water to Hilton Creek;
- Continue to encourage Reclamation to gather continuous data on the water temperature discharged from the Outlet Works of Bradbury Dam to the LSYR to monitor BiOp compliance of a maximum of 18 ^{o}C of that discharge water;
- 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 and management efforts;
- Continue working with the US Geological Survey, specifically at all LSYR basin gauges, to obtain accurate real-time flow measurements;
- Continue to maintain and develop landowner relationships in the LSYR basin to foster cooperation and gain access to reaches for all monitoring and restoration tasks; and
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS and the Monte Arido Highland Biogeographic Region to improve collective knowledge, collaboration, and dissemination of information.

6. References

AMC, 2008. Upper Basin Study - Habitat Synthesis. Adaptive Management Committee (AMC).

AMC, 2009. Summary and analysis of annual fishery monitoring in the Lower Santa Ynez River, 1993-2004. Prepared for the National Marine Fisheries Service by the Santa Ynez River Adaptive Management Committee (AMC).

Baker, B. W. and E. P. Hill, 2003. Beaver (*Castor canadensis*), The Johns Hopkins University Press, Baltimore, Maryland, USA.

Brege, B. A., R. F. Absolon and R. J. Graves, 1996. Seasonal and diel passage of juvenile salmonids at John Day Dam on the Columbia River. North American Journal of Fisheries Management, 16 (3): 659-665.

CDFG, 2005. M112 American Beaver (*Castor canadensis*). California Wildlife Habitat Relationships (CWHR) System Version 8.1, California Department of Fish and Game, California Interagency Wildlife Task Group, Sacramento, CA.

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

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

COMB, 2017. 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, 2018a. WY2014 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division. Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

COMB, 2018b. WY2015 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division. Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

COMB, 2019a. WY2016 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division. Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

COMB, 2019b. WY2017 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division

Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

COMB, 2020. WY2018 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division. Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

DeVries, P., 2013a. Evaluation of water temperature and dissolved oxygen impacts of water rights releases and habitat flows on steelhead trout in the Santa Ynez River. R2 Resource Consultants, Inc.

DeVries, P., 2013b. Identification of water temperature and dissolved oxygen criteria applicable to assessing effects of water rights and habitat flow releases on steelhead trout in the Santa Ynez River. R2 Resource Consultants, Inc.

Dolloff, C. A., D. G. Hankin and G. H. Reeves, 1993. Basinwide estimation of habitat and fish populations in streams. U.S. Forest Service, Southeastern Forest Experiment Station, Asheville, North Carolina.

Gregory, R. S. and C. D. Levings, 1998. Turbidity reduces predation on migrating juvenile pacific salmon. Transactions of the American Fisheries Society, 127: 275-285.

Hankin, D. G. and G. H. Reeves, 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences, 45: 834-844.

Hensley, A. L., 1946. A progress report on beaver management in California. California Fish and Game, 32 (2): 87-99.

Knutsen, C. J. and D. L. Ward, 1991. Behavior of juvenile salmonids migrating through the Willamette River near Portland, Oregon. Oregon Department of Fish and Wildlife, Portland, Oregon, 1-16.

Krcma, R. R. and R. F. Raleigh, 1970. Migration of juvenile salmon and trout into Brownlee Reservoir 1962-1965. Fishery Bulletin, 68: 203-217.

Lake, P. S., 2003. Ecological effects of perturbation by drought in flowing waterings. Freshwater Biology, 48: 1161-1172.

Mains, E. M. and J. M. Smith, 1964. The distribution, size, time and current preferences of seaward migrant chinook salmon in the Columbia and Snake rivers. Fisheries Research Papers, Washington Department of Fisheries, 2: 5-43.

Matthews, K. and N. Berg, 1997. Rainbow trout responses to water temperature and dissolved oxygen stress in two southern Californa stream pools. Journal of Fish Biology, 50: 40-67.

Meehan, W. R. and T. C. Bjornn, 1991. Salmonid distributions and life histories. Influences of forest and rangeland management on salmonid fishes and their habitats, American Fisheries Society Special Publication. 19**:** 47-82.

Molony, B., 2001. Environmental requirements and tolerances of rainbow trout (Oncorhynchus mykiss)
and brown trout (Salmo trutta) with special reference to Western Australia: a review. 130.

Moyle, P. B., 2002. Inland fishes of California, revised and expanded, University of California Press, Berkeley, CA.

Nielson, L. J., E. T. Lisle and V. Ozaki, 1994. Thermally stratified pools and their use by steelhead in northern California streams. Transactions of the American Fisheries Society, 123: 613-626.

NMFS, 1997. Code of Federal Regulations, listing of Southern Steelhead 62 FR 43937, National Marine Fisheries Service.

NMFS, 2000. Cachuma Project Biological Opinion, U.S. Bureau of Reclamation operation and maintenance of the Cachuma Project on the Santa Ynez River in Santa Barbara County, California. National Marine Fisheries Service, Southwest Region.

NMFS, 2012. Final Southern California Steelhead Recovery Plan. National Marine Fisheries Service.

NOAA, 2005. Endangered and threatened species: designation of critical habitat for seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California. Federal Register 70FR52488 - 52627, Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), http://www.nwr.noaa.gov/Publications/FR-Notices/2005/loader.cfm?csModule=security/getfile&pageid=33713.

SWRCB, 2011. Cachuma Project final environmental impact report on consideration of modifications to the U.S. Bureau of Reclamation's Water Rights Permits 11308 and 11310 (Applications 11331 and 11332) to protect public trust values and downstream Water Rights on the Santa Ynez River below Bradbury Dam (Final EIR). State Water Resources Control Board (SWRCB).

SYRCC and SYRTAC, 1997. Synthesis and analysis of information collected on the fishery resources and habitat conditions of the Lower Santa Ynez River: 1993-1996. Prepared in compliance with Provision 2.C of the 1996 Memorandum of Understanding for cooperation in research and fish maintenance - Santa Ynez River, Santa Ynez River Consensus Committee and Santa Ynez River Technical Advisory Committee.

SYRTAC, 2000. Lower Santa Ynez River Fish Management Plan. Santa Ynez River Technical Advisory Committee, prepared for the Santa Ynez River Consensus Committee, Santa Barbara, CA.

USBR, 1999. Biological assessment for Cachuma Project operations and the Lower Santa Ynez River. Prepared for the National Marine Fisheries Service, U.S. Bureau of Reclamation (USBR), Fresno, CA.

USBR, 2000. Revised Section 3 (Proposed Project) of the Biological Assessment for Cachuma Project Operations and the Lower Santa Ynez River. Prepared for the National Marine Fisheries Service, U.S. Bureau of Reclamation, Fresno, CA.

USBR, 2011. 2008 Annual monitoring report and trend analysis for 2005-2008. Prepared for the National Marine Fisheries Service by the Cachuma Operation and Maintenance Board for USBR, U.S. Bureau of Reclamation.

USBR, 2012. 2009 Annual monitoring report and trend analysis. Prepared for the National Marine Fisheries Service by the Cachuma Operation and Maintenance Board for USBR, U.S. Bureau of Reclamation.

USBR, 2013. 2010 Annual monitoring report and trend analysis. Prepared for the National Marine Fisheries Service by the Cachuma Operation and Maintenance Board for USBR, U. S. Bureau of Reclamation (USBR).

Villamagna, A. and B. Murphy, 2010. Ecological and socio-economic impacts of invasive water hyacinth (Eichhornia crassipes). Freshwater Biology.

WY2019 Annual Monitoring Summary
Results
Figures and Tables

3. Monitoring Results

Table 1: WY2000 to WY2019 rainfall (precipitation) at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Water Year	Rainfall Bradbury* (in)	Year Type**	Spill	# of Spill Days	Reservoir Condition Storage (max) (af)	Reservoir Condition Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.50	Normal	Yes	26	192,948	750.83	No	Yes
2001	31.80	Wet	Yes	131	194,519	751.34	No	No
2002	8.80	Dry	No	0	173,308	744.99	No	Yes
2003	19.80	Normal	No	0	130,784	728.39	No	No
2004	10.60	Dry	No	0	115,342	721.47	No	Yes
2005	44.41	Wet	Yes	131	197,649	753.11	No	No
2006	24.50	Wet	Yes	54	197,775	753.15	Yes	No
2007	7.40	Dry	No	0	180,115	747.35	No	Yes
2008	22.59	Wet	Yes	53	196,365	752.70	No	No
2009	13.66	Dry	No	0	168,902	743.81	No	No
2010	23.92	Wet	No	0	178,075	747.05	Yes	Yes
2011	31.09	Wet	Yes	53	195,763	753.06	No	No
2012	12.69	Dry	No	0	180,986	748.06	No	No
2013	7.57	Dry	No	0	142,970	733.92	No	Yes
2014	9.96	Dry	No	0	91,681	710.00	No	Yes
2015	9.38	Dry	No	0	60,992	691.09	No	Yes
2016	11.45	Dry	No	0	32,900	669.57	No	Yes
2017	25.48	Wet	No	0	99,152	715.25	No	Yes
2018	9.32	Dry	No	0	82,580	706.27	No	Yes
2019	23.78	Wet	No	0	156,374	740.23	Yes	No

* Bradbury Dam rainfall (Cachuma) period of record = 67 years (1953-2019) with an average rainfall of 19.89 inches.

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

Table 2: WY2019 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 (WY2019) (in)
Lompoc	439	1955	65	14.58	5.31	2007	34.42	1983	20.44
Buellton	233	1955	65	16.66	5.87	2014	41.56	1998	19.22
Solvang	393	1965	55	18.31	6.47	2007	43.87	1998	20.81
Santa Ynez	218	1951	69	15.75	6.58	2007	36.36	1998	20.07
Cachuma*	USBR	1953	67	19.89	7.33	2007	53.37	1998	23.79
Gibraltar	230	1920	100	26.30	8.50	2013	73.12	1998	34.8
Jameson	232	1926	94	28.75	8.50	2007	79.52	1969	35.18

* Bradbury Dam USBR rainfall.

Table 3: (a) Storm events greater than 0.1 inches of rainfall at Bradbury Dam with associated flow conditions (> 10 cfs) at Salsipuedes Creek (SC) and the Los Laureles (Los L) gauging stations and (b) monthly rainfall totals at Bradbury Dam during WY2019; dates reflect the starting day of the storm and not the storm duration.

(a)

#	Date	Rainfall (in.)	SC 10 cfs	Los L 10 cfs
1	10/3/2018	0.17	No	No
2	11/22/2018	0.28	No	No
3	11/29/2018	1.58	No	No
4	12/5/2018	0.26	No	No
5	12/17/2018	0.17	No	No
6	12/25/2018	0.19	No	No
7	1/6/2019	1.29	No	No
8	1/10/2019	0.22	Yes	No
9	1/12/2019	1.10	Yes	Yes
10	1/14/2019	4.72	Yes	No
11	1/31/2019	5.94	Yes	Yes
12	2/9/2019	0.62	Yes	Yes
13	2/13/2019	2.15	Yes	Yes
14	2/21/2019	0.11	Yes	Yes
15	2/27/2019	0.14	Yes	Yes
16	3/2/2019	0.91	Yes	Yes
17	3/6/2019	1.56	Yes	Yes
18	3/20/2019	0.56	Yes	Yes
19	5/11/2019	0.21	Yes	Yes
20	5/16/2019	0.41	Yes	Yes
21	5/19/2019	0.77	Yes	Yes
22	5/26/2019	0.15	Yes	Yes

(b)

Month	Rainfall (in.)
Oct-18	0.17
Nov-18	1.86
Dec-18	0.68
Jan-19	8.07
Feb-19	8.26
Mar-19	3.06
Apr-19	0.11
May-19	1.57
June-19	0.00
July-19	0.00
Aug-19	0.00
Sept-19	0.01
Total:	**23.79**

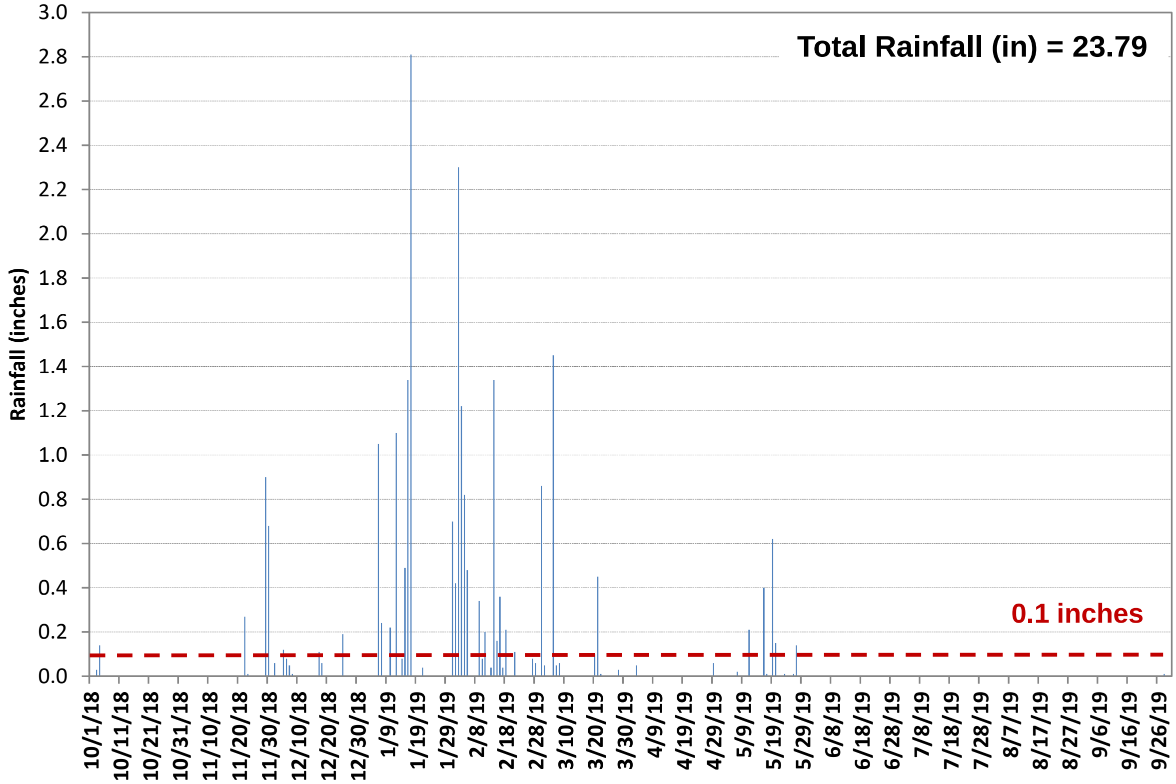


Figure 1: Rainfall in WY2019 recorded at Bradbury Dam (USBR).

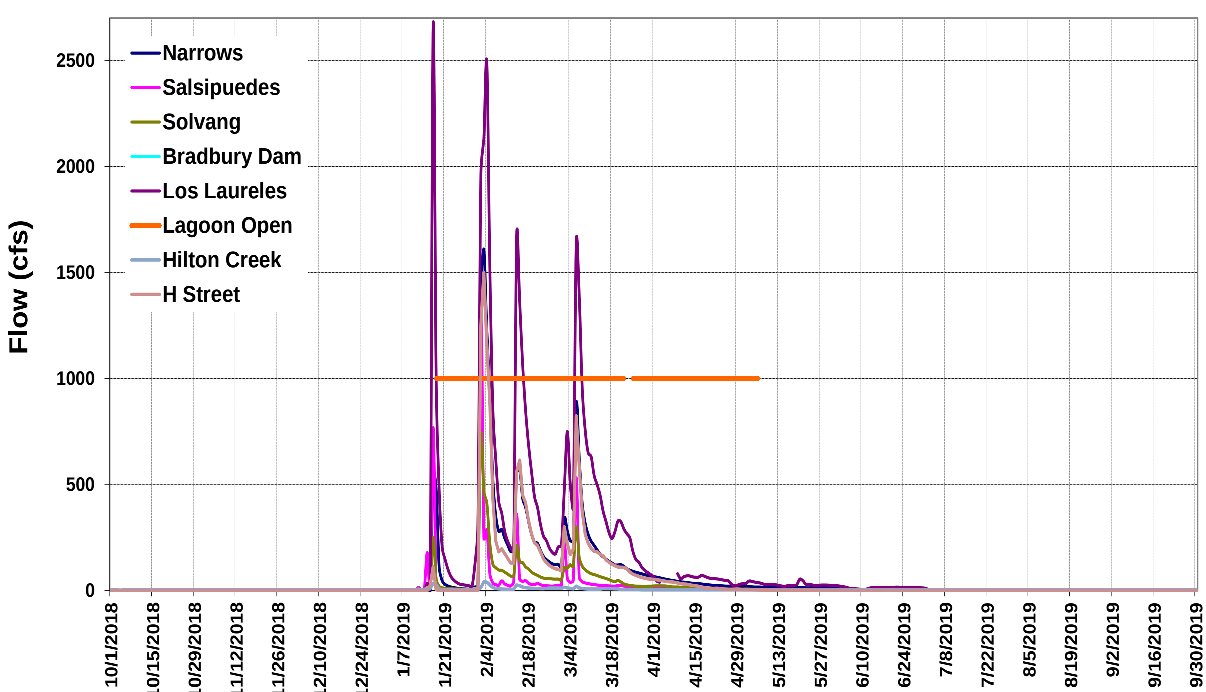


Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open to the ocean in WY2019.

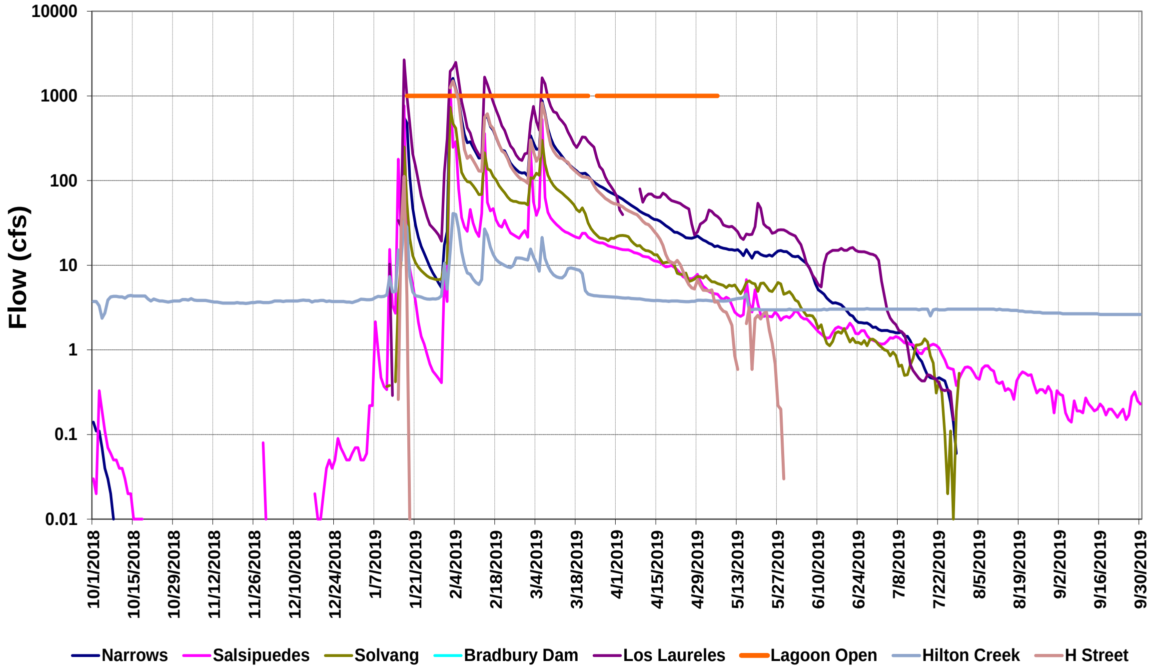


Figure 3: USGS average daily discharge at the LSYR mainstem USGS gauging stations at Los Laureles, Bradbury Dam (USBR), Hilton Creek (USBR), Alisal Bridge (Solvang), Salsipuedes Creek, the Narrows and H Street (Lompoc) during WY2019.

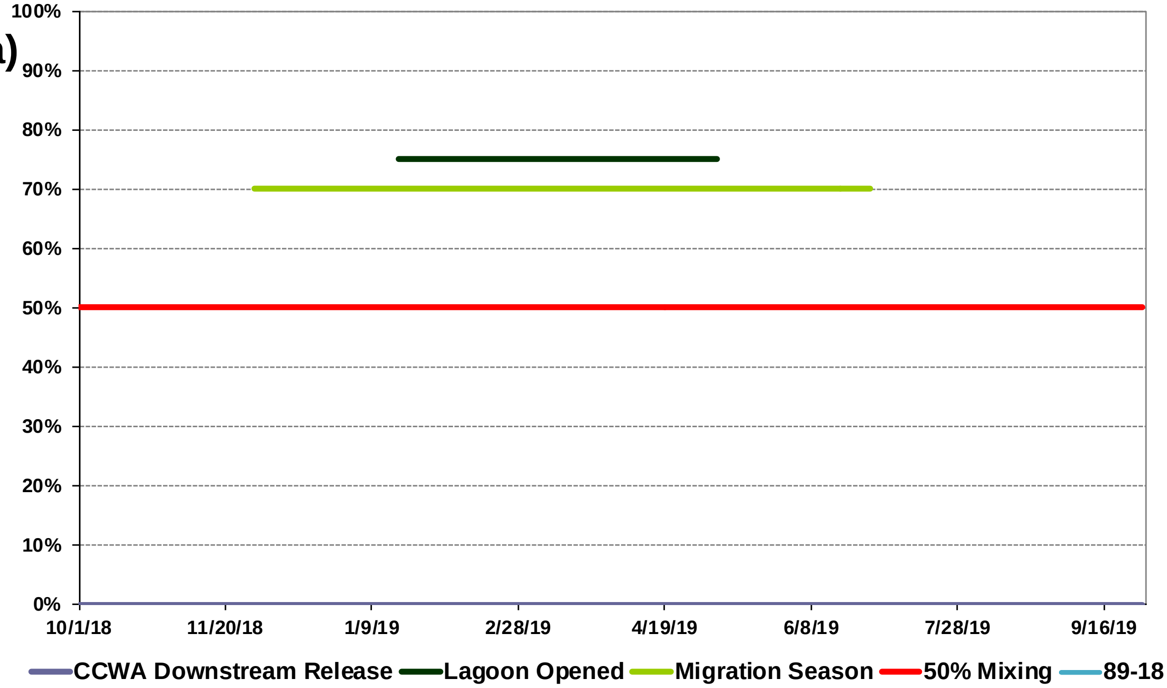
Table 4: Ocean connectivity, lagoon status and number of days during the *O. mykiss* migration season from WY2001 to WY2019.

Water Year	Year Type	Ocean Connectivity	Lagoon Status Open	Closed	# of Days	# of Days Open in Migration Season*
2001	Wet	Yes	1/22/01	5/10/01	109	109
2002	Dry	No	-	-	0	0
2003	Normal	Yes	12/21/02	5/9/03	150	140
2004	Dry	Yes	2/26/04	3/22/04	26	26
2005	Wet	Yes	12/28/04	5/20/05	144	141
2006	Wet	Yes	1/3/06	-	271	151
2007	Dry	Yes	-	11/22/06	52	0
2008	Wet	Yes	1/6/08	5/19/08	134	134
2009	Dry	Yes	2/16/09	3/17/09	30	30
2010	Wet	Yes	1/19/10	5/6/10	107	107
2011	Wet	Yes	12/20/12	-	285	151
2012	Dry	Yes	-	5/17/12**	86	34
2013	Dry	No	-	-	0	0
2014	Dry	No	-	-	0	0
2015	Dry	No	-	-	0	0
2016	Dry	No	-	-	0	0
2017	Wet	?	-	-	0	0
2018	Dry	No	-	-	0	0
2019	Wet	Yes	1/18/19	5/7/19	107	107

*Migration Season is January through May.

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

(a)



(b)

CCWA was not using the Penstock for SWP deliveries to Lake Cachuma throughout the water year.

Figure 4: State Water Project (SWP) release into the LSYR regarding BiOp compliance with (a) the 50-50 mix rule showing the percentage of CCWA water being released from Bradbury Dam downstream to the Long Pool and (b) the 18 ^{o}C rule for the water temperature being released from the Outlet Works.

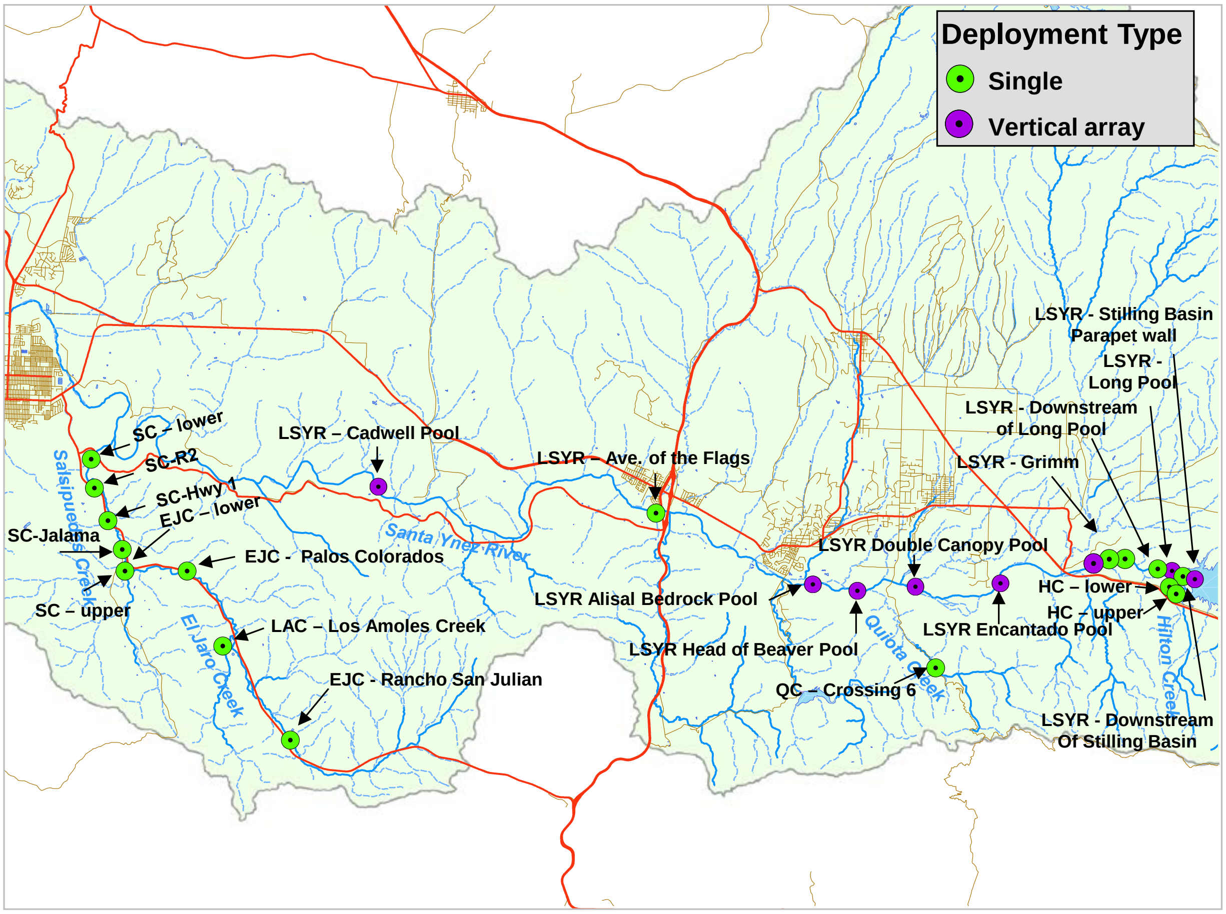


Figure 5: Thermograph single and vertical array deployment locations in WY2019 within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are close together with overlapping symbols.

Table 5: 2019 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 Wall	LSYR-0.01	Vertical Array	5/1/19	11/18/2019	197
	LSYR - D/s of Stilling Basin	LSYR-0.25	Single	5/1/19	12/3/19	212
	LSYR - Long Pool	LSYR-0.51	Vertical Array	5/1/19	12/3/2019	212
	LSYR - D/s of Long Pool	LSYR-0.68	Single	5/1/19	11/18/2019	197
	LSYR-Grimm Property-Upstream	LSYR-1.09	Single	5/30/19	11/18/2019	168
	LSYR-Grimm Property-Downstream	LSYR-1.54	Single	5/30/19	11/18/2019	168
	LSYR-Grimm Property Pool	LSYR-1.71	Vertical Array	5/30/19	11/18/2019	168
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	5/1/2019	8/22/2019	111
	LSYR - Double Canopy	LSYR-7.65	Vertical Array	5/1/2019	11/5/2019	184
	LSYR - Head of Beaver	LSYR-8.7	Vertical Array	5/9/2019	11/5/2019	176
	LSYR - Alisal Bedrock Pool	LSYR-10.2	Vertical Array	5/13/2019	10/24/2019	161
	LSYR - Avenue of the Flags	LSYR-13.9	Single	5/9/2019	10/24/2019	165
	LSYR - Cadwell Pool	LSYR-22.68	Vertical Array	5/13/2019	11/6/2019	173
Tributaries	Hilton Creek (HC)-lower	HC-0.12	Single	5/15/2019	11/19/2019	184
	HC at URP	HC-0.54	Single	5/15/2019	11/20/2019	185
	Quiota Creek (QC)-Crossing 6	QC-2.66	Single	5/20/2019	10/28/2019	158
	Salsipuedes Creek (SC)-lower-Reach 1	SC-0.77	Double	5/15/2019	11/6/2019	171
	SC-Reach 2-Bedrock Section	SC-2.2	Single	5/31/2019	11/7/2019	157
	SC-Reach 4-Hwy 1 Bridge	SC-3.0	Single	5/31/2019	11/12/2019	162
	SC-Reach 5-Jalama Bridge	SC-3.5	Single	5/20/2019	11/12/2019	172
	SC-upper at El Jaro confluence	SC-3.8	Single	5/31/2019	11/14/2019	164
	El Jaro Creek (EJC)-Lower-Confluence	EJC-3.81	Single	5/31/2019	11/14/2019	164
	EJC-Palos Colorados	EJC-5.4	Single	5/31/2019	11/14/2019	164
	EJC-Rancho San Julian Bridge	EJC-10.82	Single	5/31/2019	11/14/2019	164
	Los Amoles Creek (LAC)-Creek Crossing	LAC-7.0	Single	6/27/2019	11/14/2019	137

*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, S, C	C	C
		Long Pool	LSYR-0.51	NS	NS	NS
		Downstream of Long Pool	LSYR-0.62	O, B	O, B, S	NS
Reach 2	Refugio	Encantado	LSYR-4.95			
		Corner Scour	LSYR-5.9	S		
		Double Canopy Pool	LSYR-7.65	B	B, C	B, S, C
	Alisal	Car Pool	LSYR-7.8	B, C	B	B
		Quiota Confluence Pool	LSYR-8.2		S, C	
		Head of Beaver Pool	LSYR-8.7			
		Rip-Rap Pool	LSYR-10.49	B, C	ns	
Reach 3	Ave. of the Flags	Ave. of the Flags (HWY 101)	LSYR-13.9			
	State Pipeline	Canoe Pool	LSYR-16.66	B, S, C	B, C	B, S, C
	Cadwell	Cadwell Pool	LSYR-22.68	B, C	B, S, C	B, C
Tributaries:						
Hilton	Reaches 1-5			O, S	NS	O, S
Quiota	Crossings 1-9				NS	
	Upstream of Crossing 9			O	NS	O
Salsipuedes	Reaches 1-4			O, B, S, C	NS	O, B, S, Ca
	Reach 5			O, S	NS	O, S
El Jaro	Upstream of Confluence			O, S, Ca	NS	O, S

* O - *O. mykiss*, B - bass, S - sunfish, C - carp, Ca - catfish, blank means zero observed.

ns - not snorkeled due to turbidity.

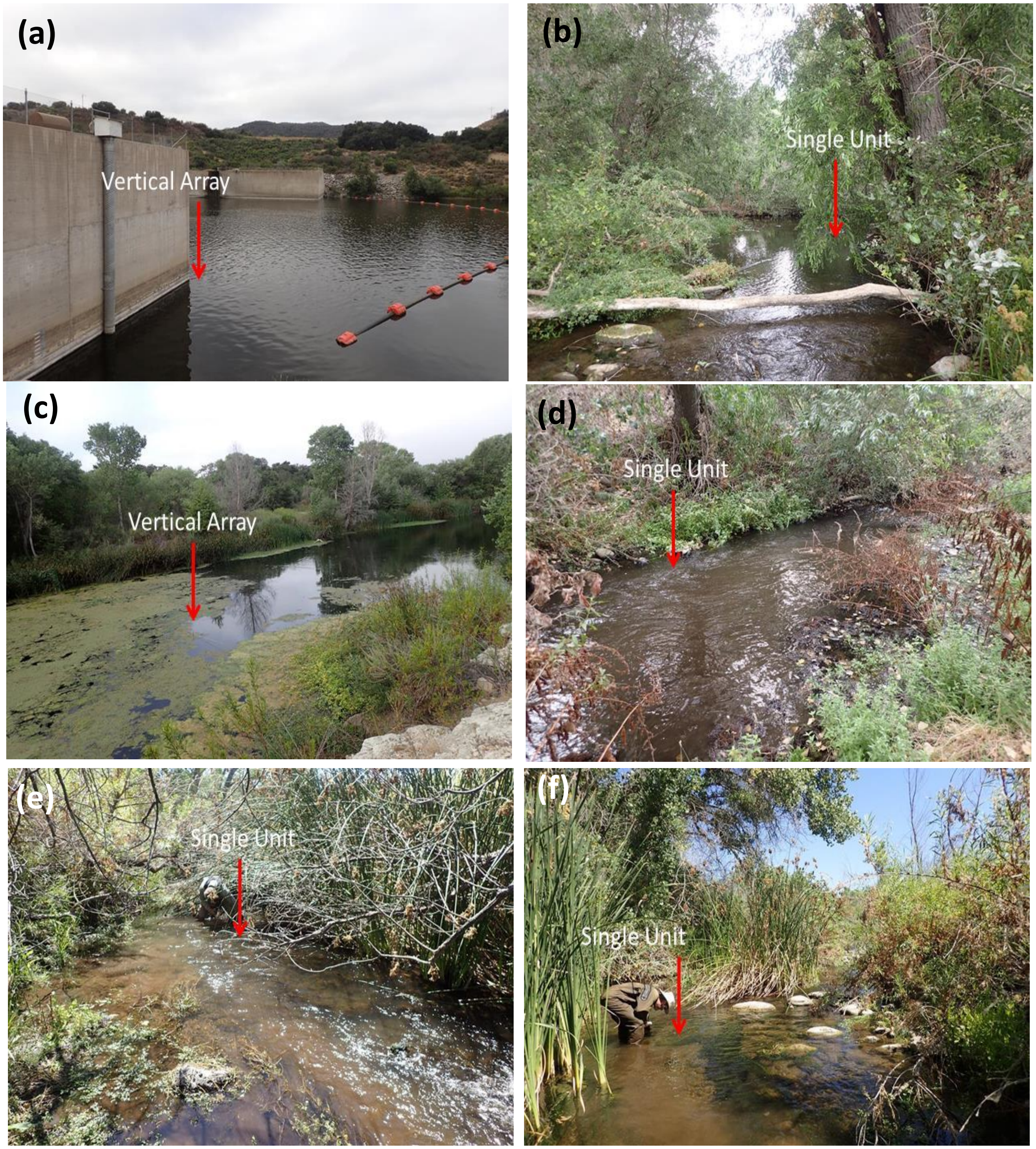


Figure 6: **:** 2019 LSYR mainstem temperature unit deployment locations at: a) LSYR-0.01, b) LSYR-0.25, c) LSYR-0.51, d) LSYR-0.68, e) LSYR-1.09, f) LSYR-1.54.

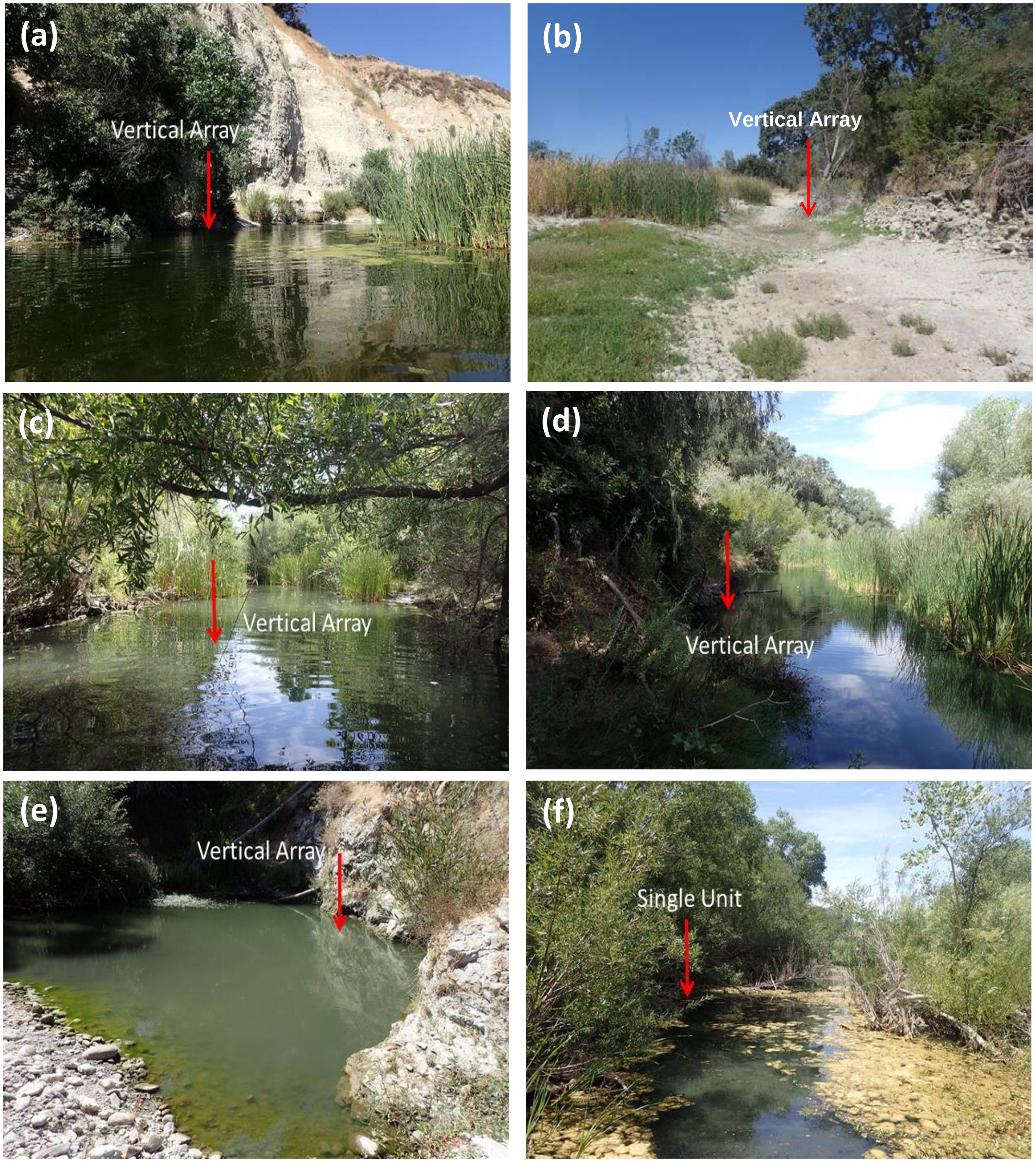


Figure 7: 2019 LSYR mainstem temperature unit deployment locations at: a) LSYR-1.71, b) LSYR-4.95 (dry), c) LSYR-7.65, d) LSYR-8.7, e) LSYR-10.2, f) LSYR-13.9.

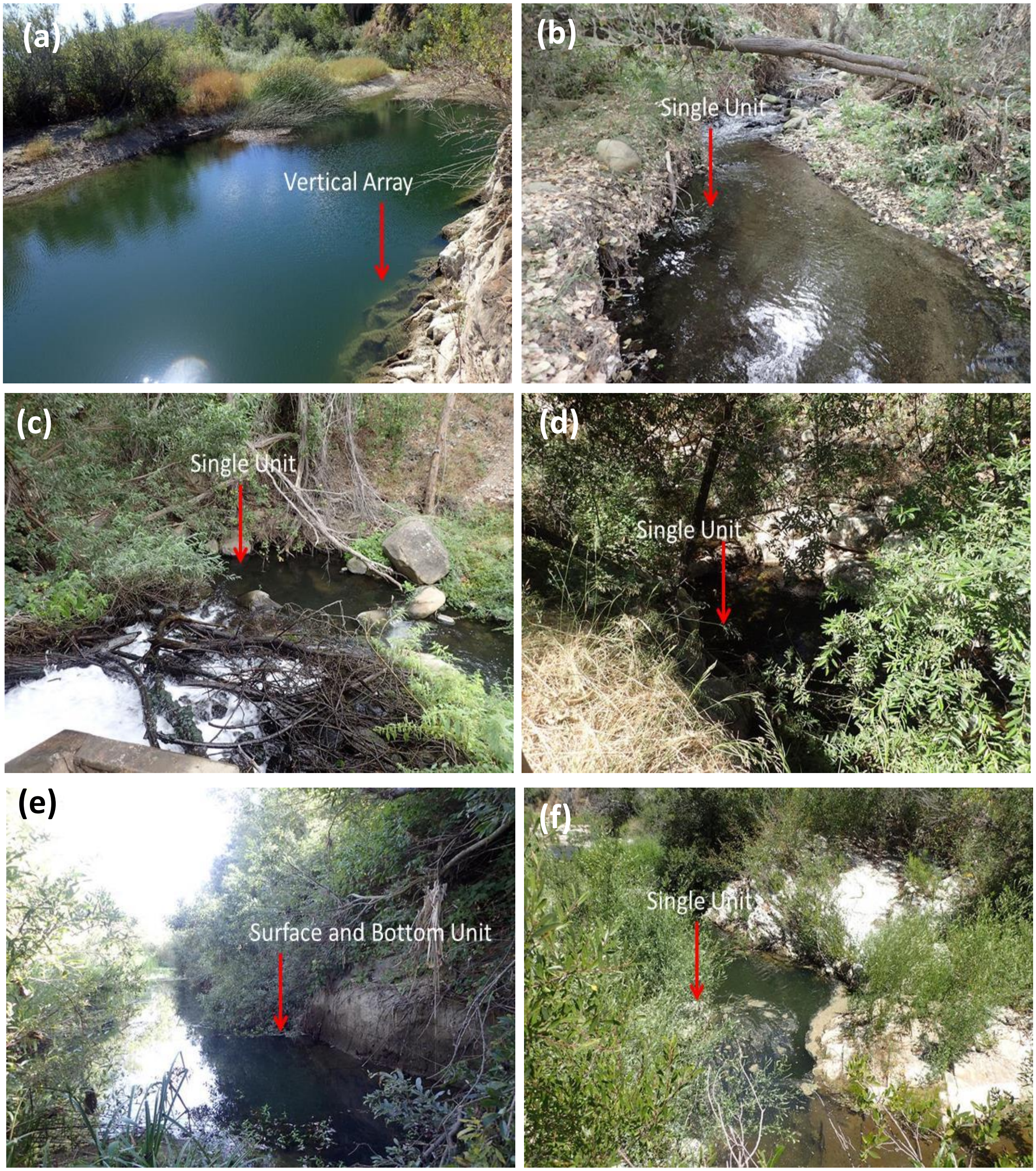


Figure 8: 2019 LSYR mainstem temperature unit deployment location at: a) LSYR-22.68 and tributary deployment locations at: b) HC-0.12, c) HC-0.54, d) QC-2.66, e) SC-0.77 and, f) SC-2.2.

Figure 9: 2019 Tributary thermograph deployment locations at: a) SC-3.0, b) SC-3.5, c) SC-3.8, d) EJC-3.81, e) EJC-5.4, and f) EJC-10.82.

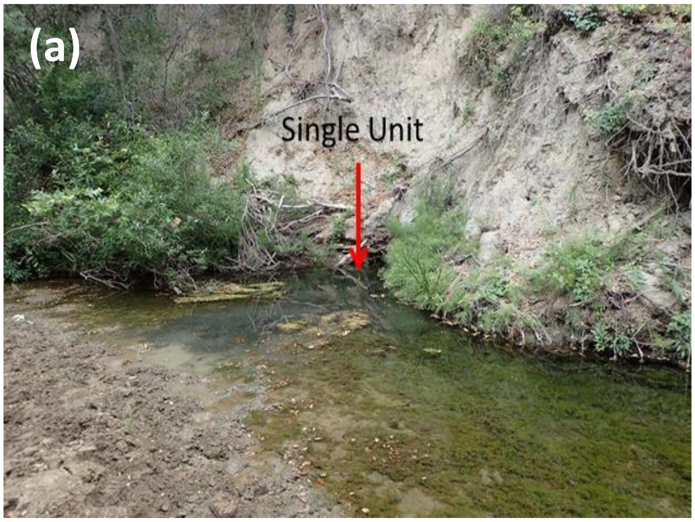


Figure 10: 2019 Tributary temperature unit deployment location at: a) LAC-7.0.

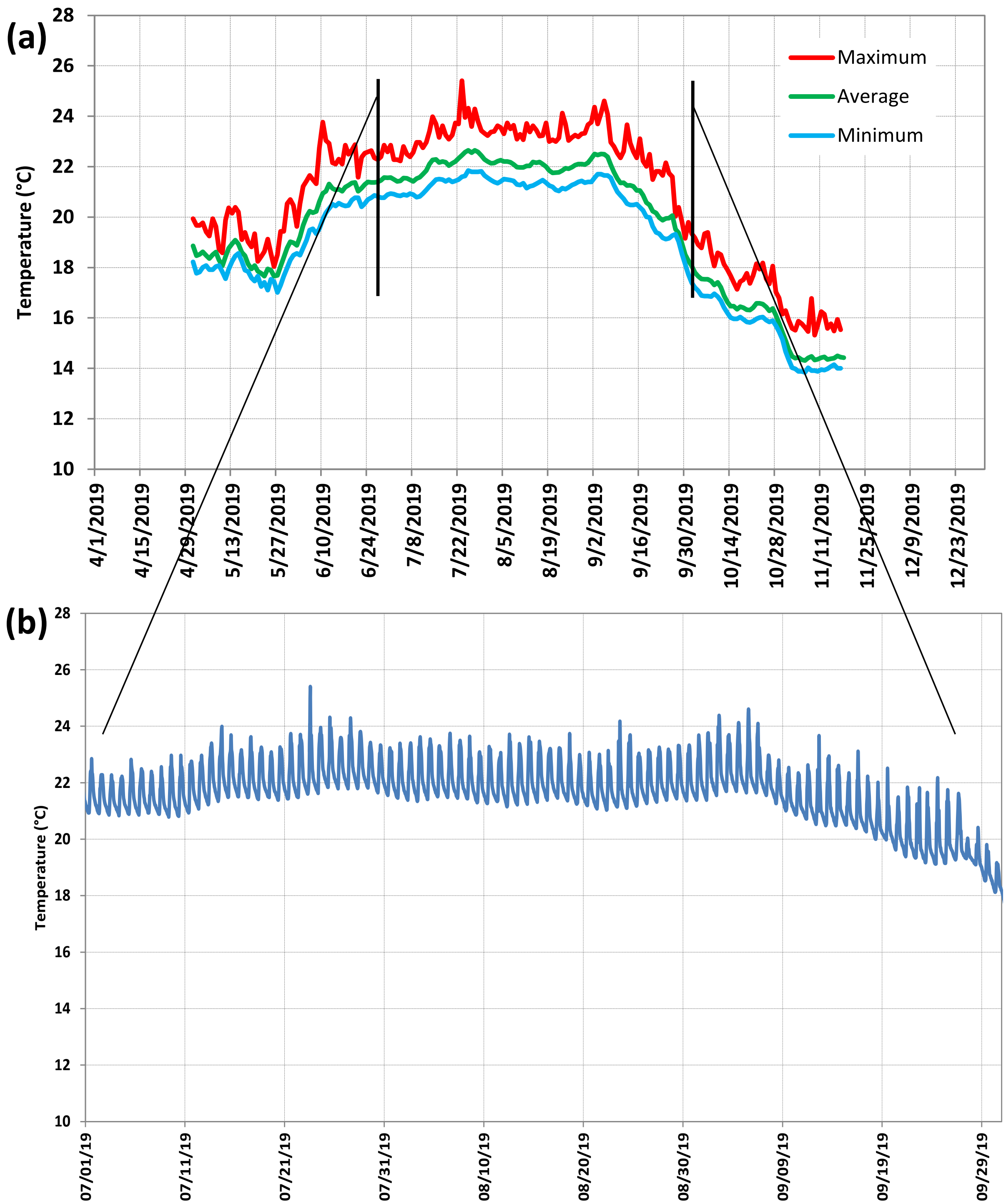


Figure 11: 2019 LSYR-0.01 (Stilling Basin parapet wall) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/19 - 10/1/19.

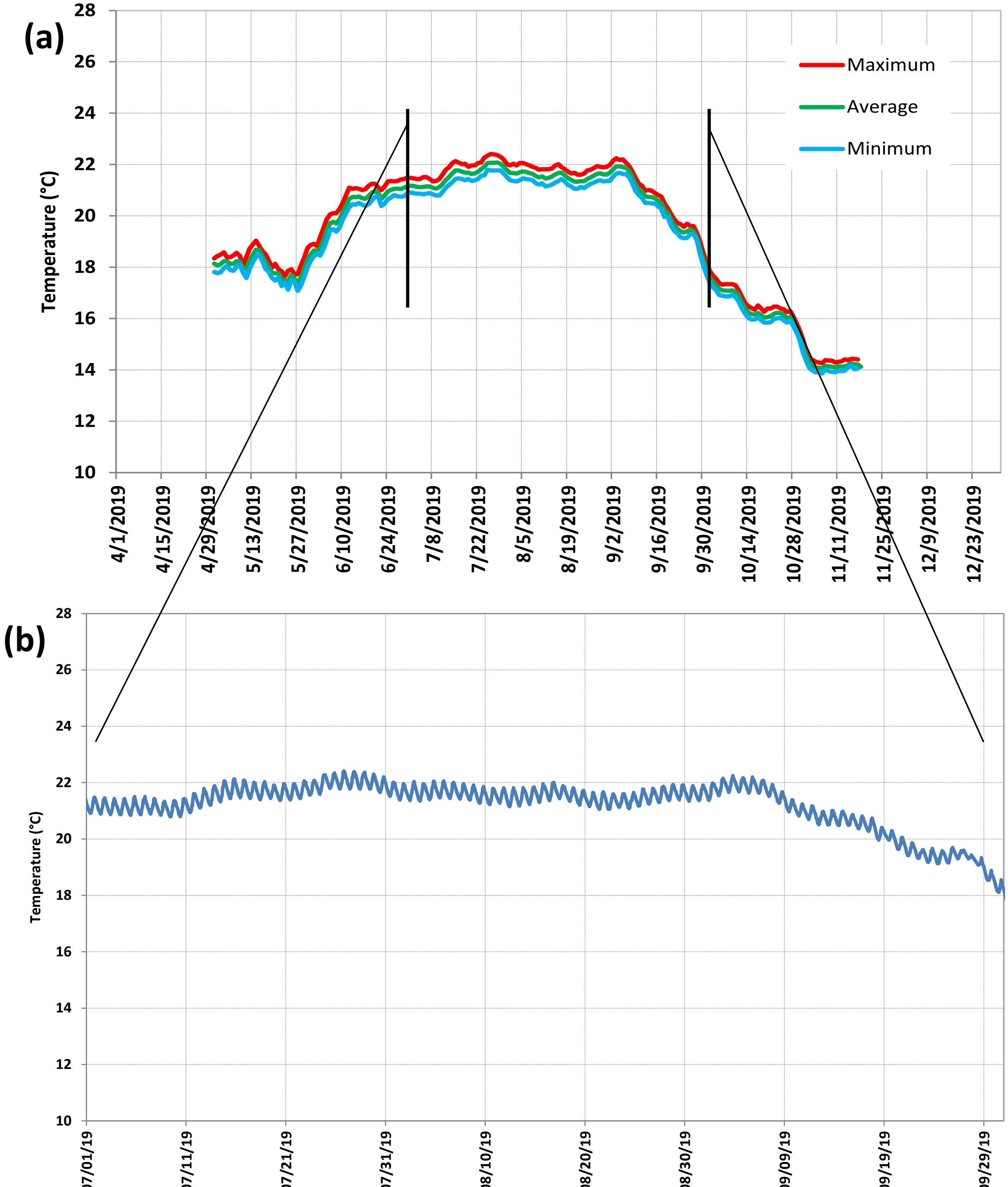


Figure 12: 2019 LSYR-0.01 (Stilling Basin parapet wall) middle (14 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/19 - 10/1/19.

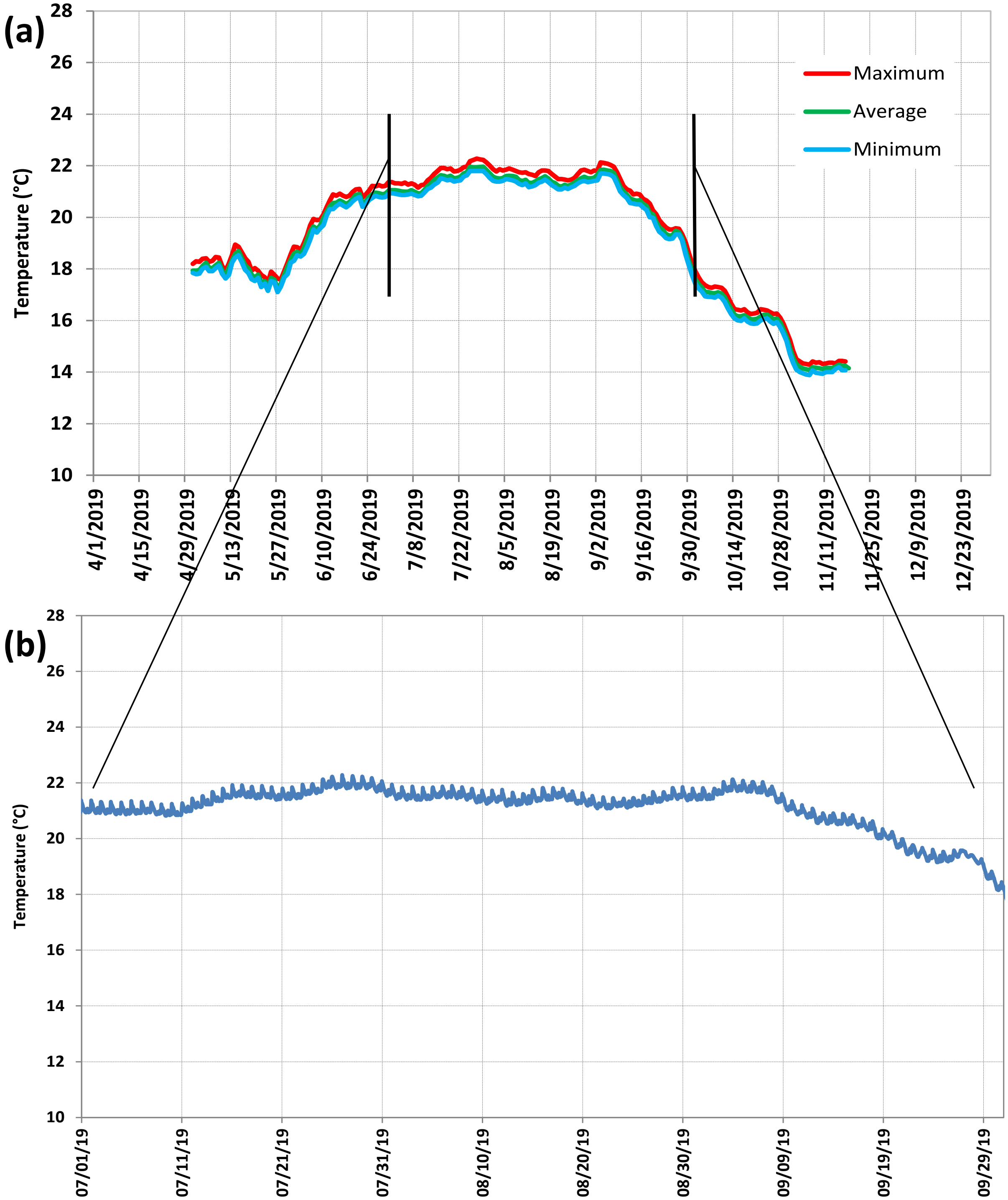


Figure 13: 2019 LSYR-0.01 (Stilling Basin parapet wall) bottom (28 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/19 - 10/1/19.

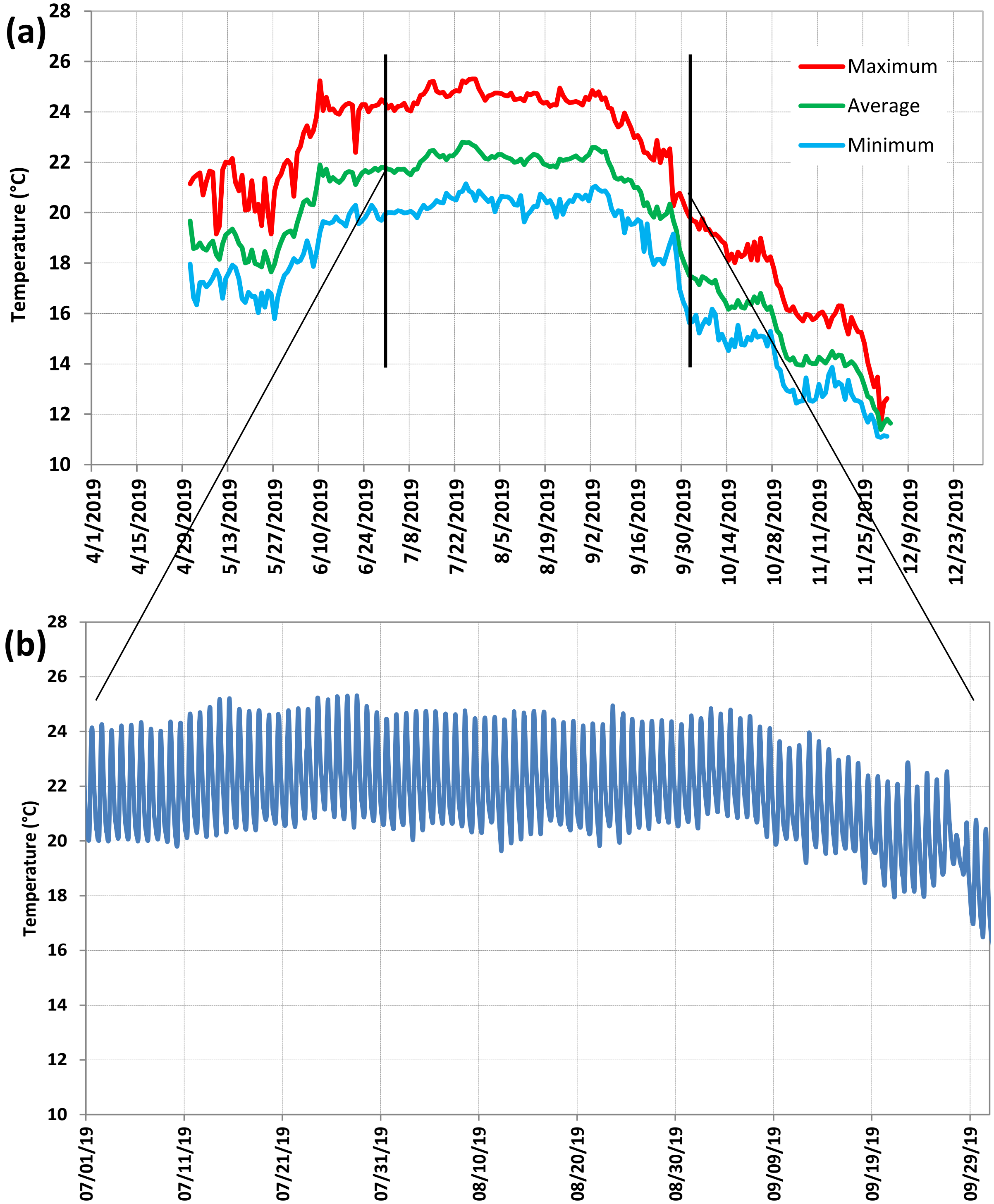


Figure 14: 2019 LSYR-0.25 (Downstream of Stilling Basin) bottom (1.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/19 - 10/1/19.

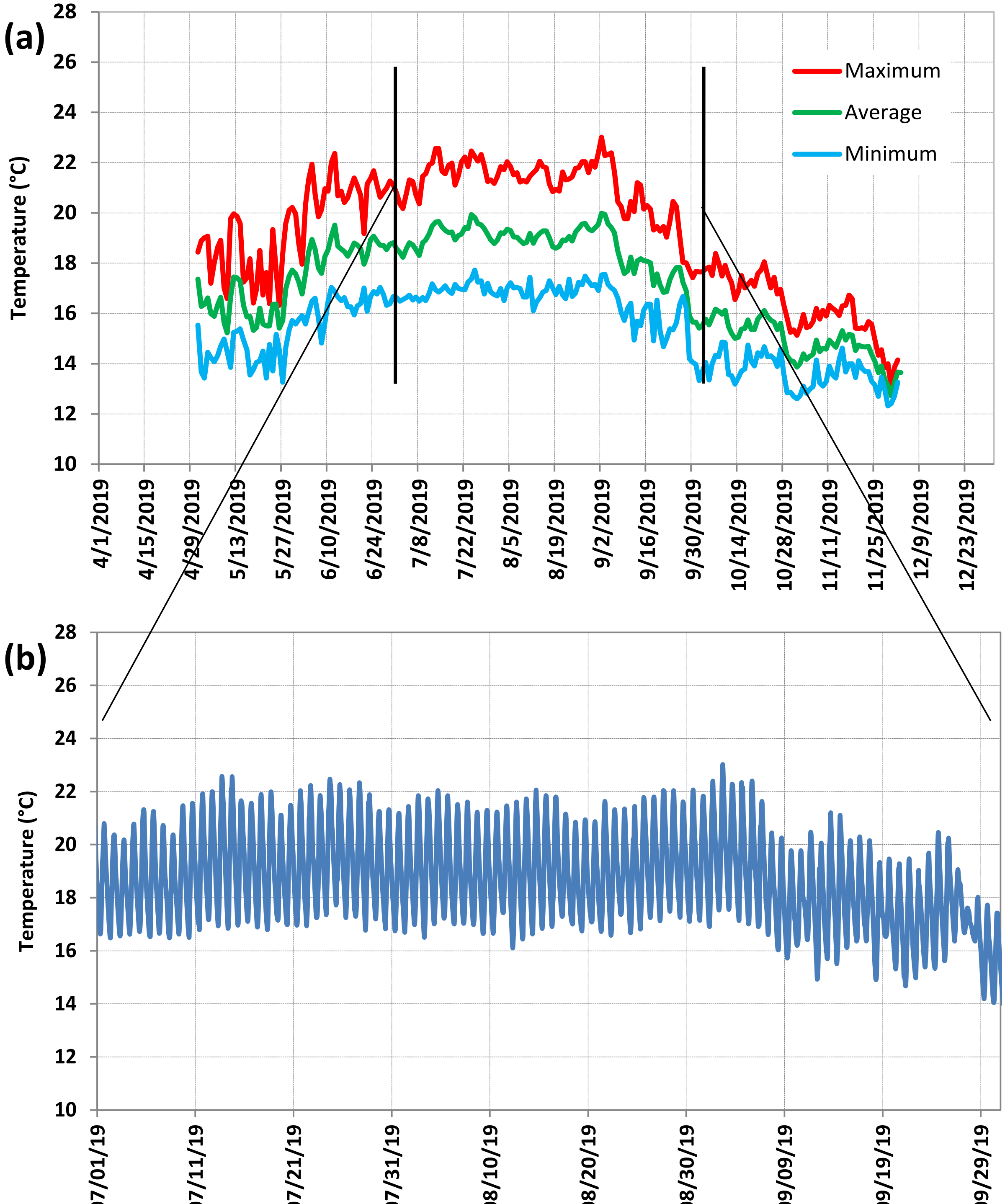


Figure 15: 2019 LSYR-0.51 (Long Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum values for the entire period of deployment and (b) hourly data from 7/1/19 - 10/1/19; the Long Pool depth decreased over 3feet due to storm flow siltation from the Whittier Fire.

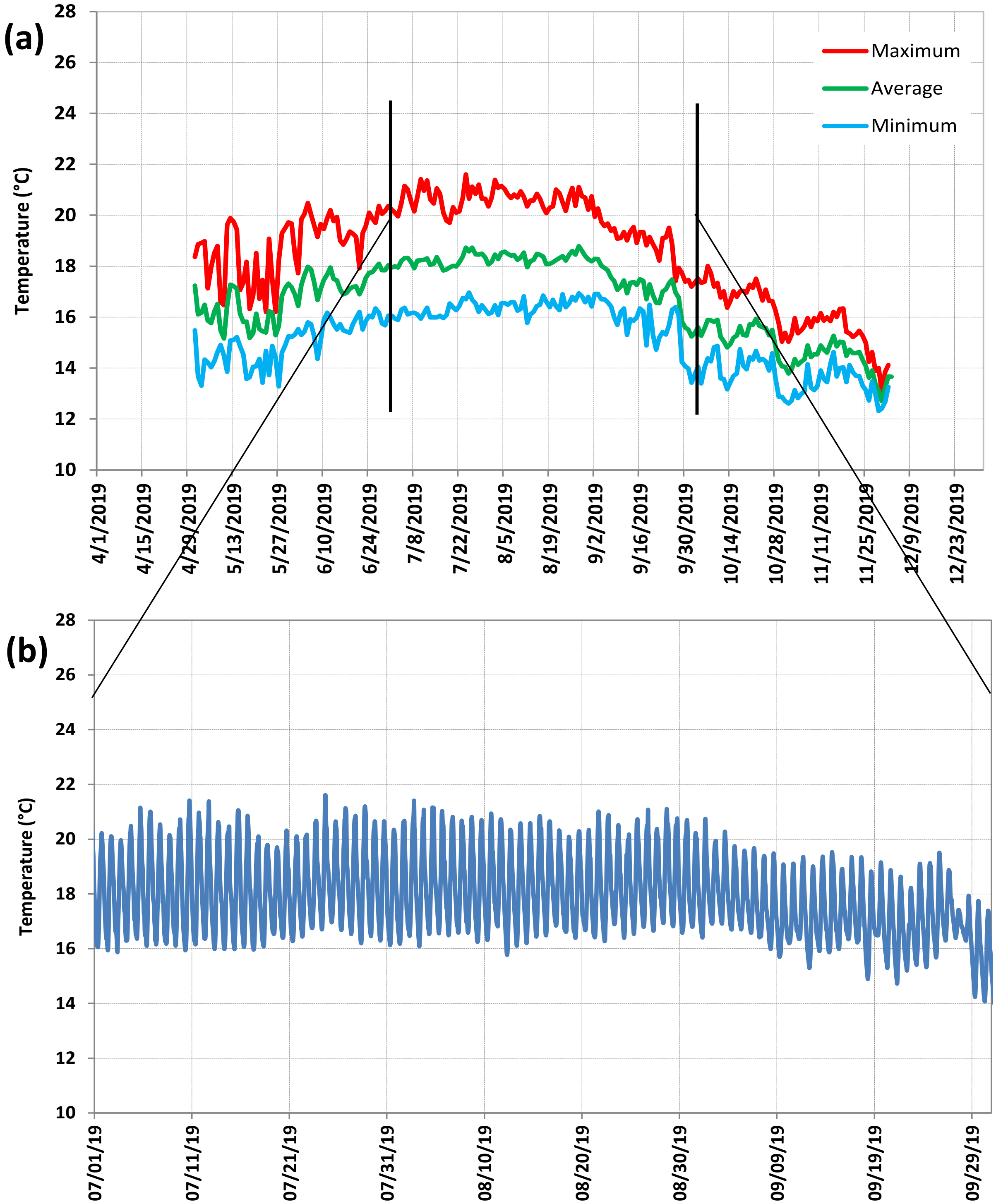


Figure 16: 2019 LSYR-0.51 (Long Pool) middle (2.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/19 - 10/1/19 the Long Pool depth decreased over 3-feet due to storm flow siltation from the Whittier Fire.

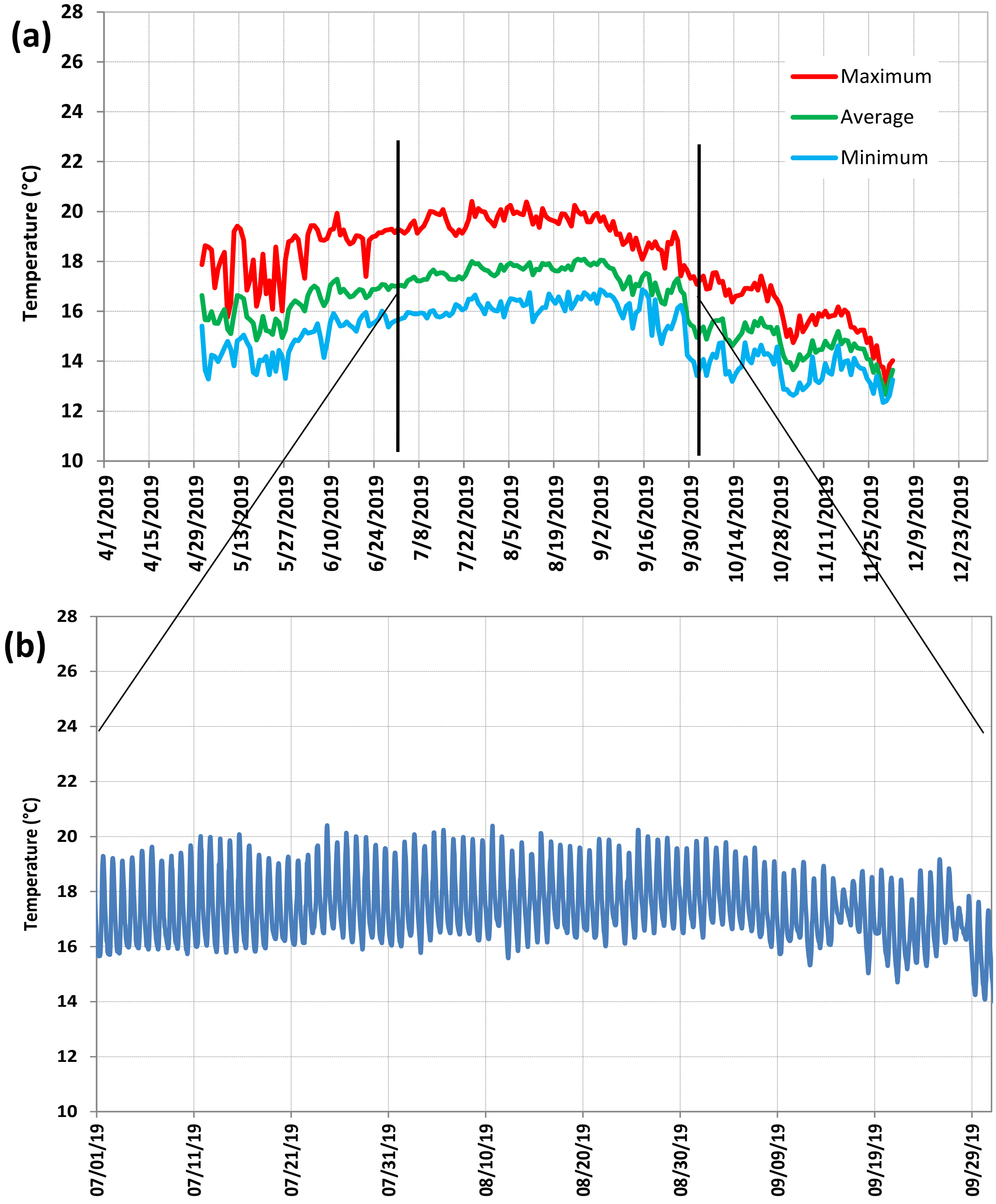


Figure 17: 2019 LSYR-0.51 (Long Pool) bottom (6 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/19 - 10/1/19; the Long Pool depth decreased over 3 feet due to storm flow siltation from the Whittier Fire.

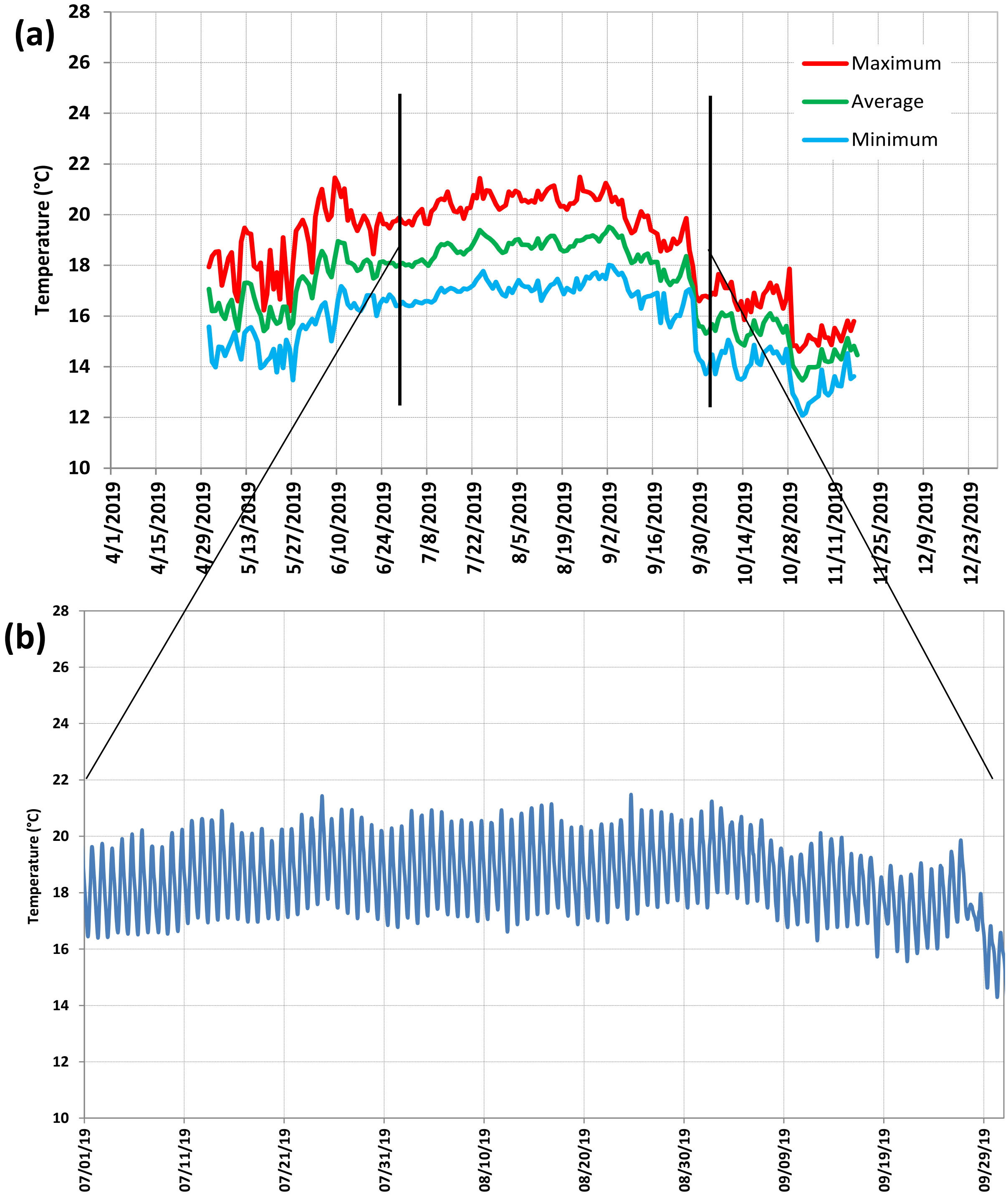


Figure 18: 2019 Reclamation property boundary at LSYR 0.68 (downstream of the Long Pool) bottom (2 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/19 - 10/1/19.

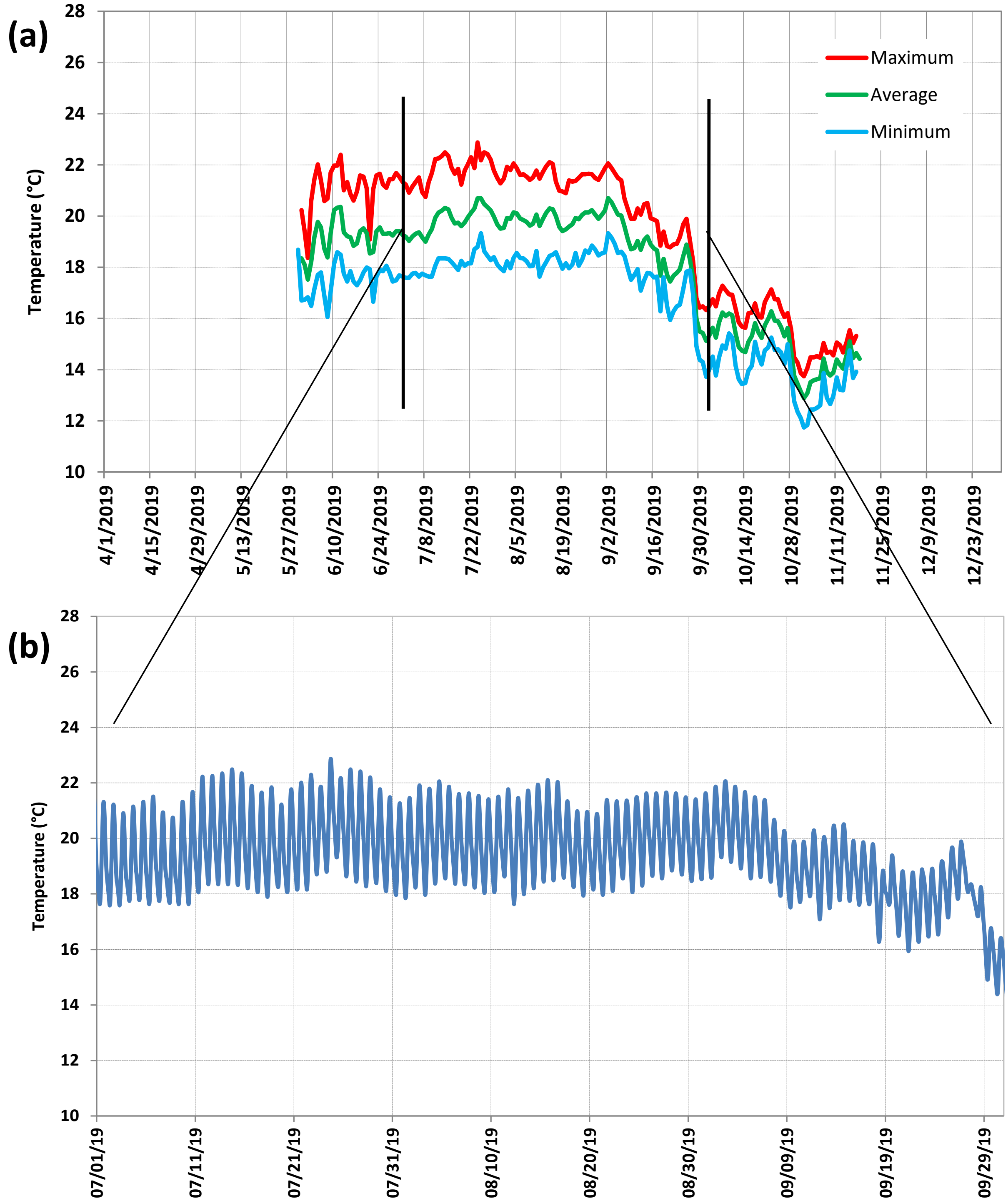


Figure 19: 2019 LSYR-1.09 (Grimm Property upstream-run) bottom (1.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

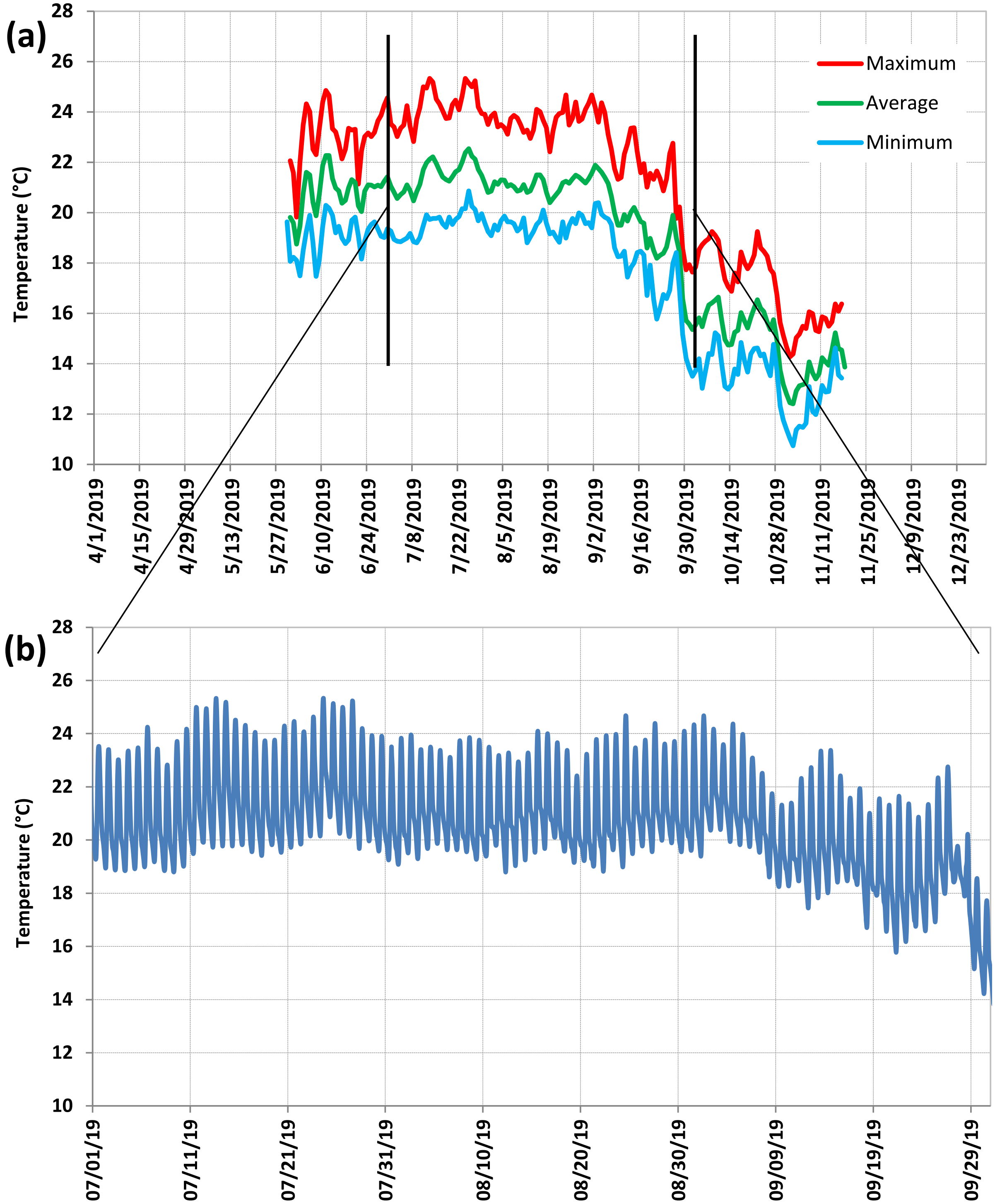


Figure 20: 2019 LSYR-1.54 (Grimm Property downstream-run) bottom (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

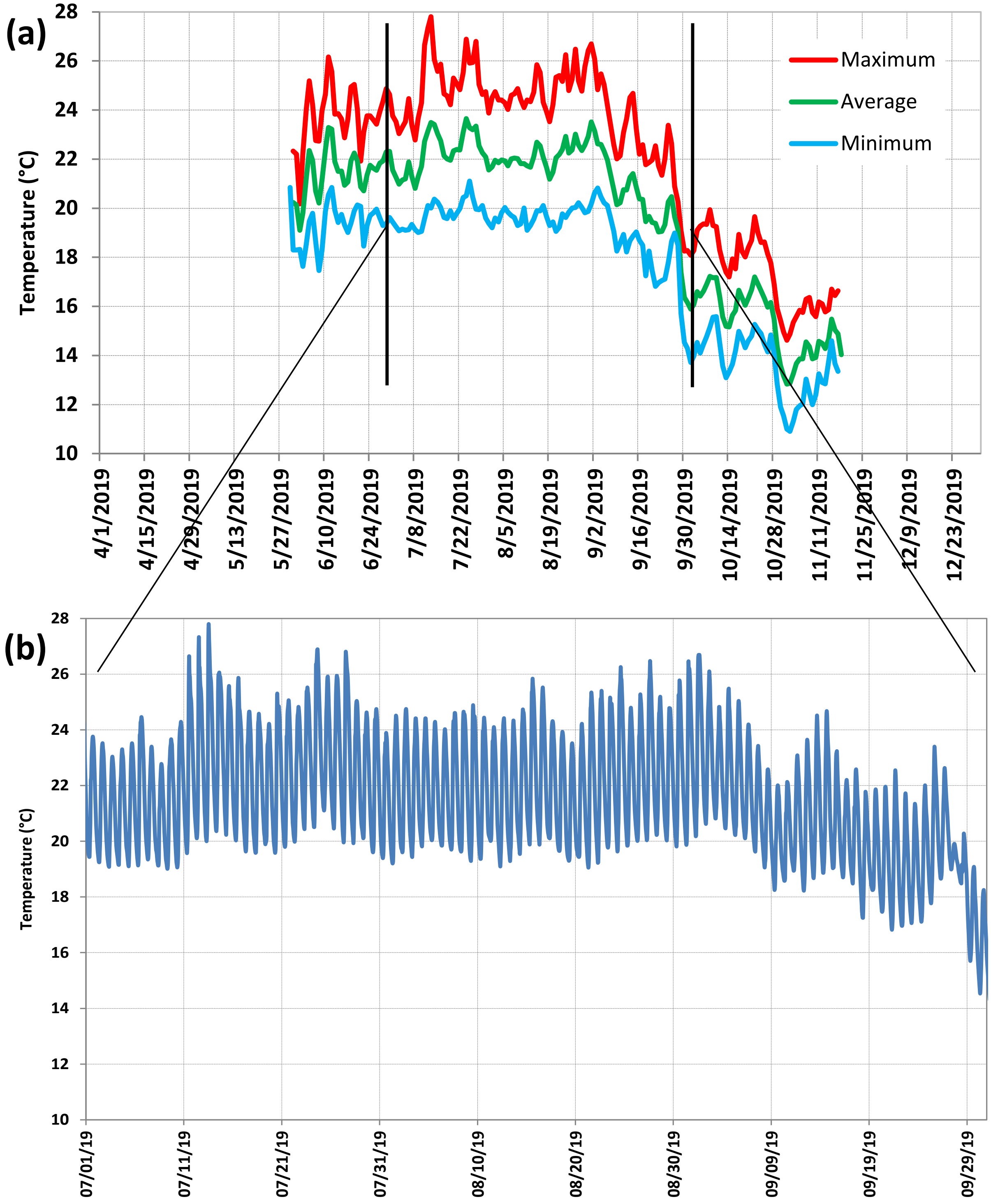


Figure 21: 2019 LSYR-1.71 (Grimm Property pool) –surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

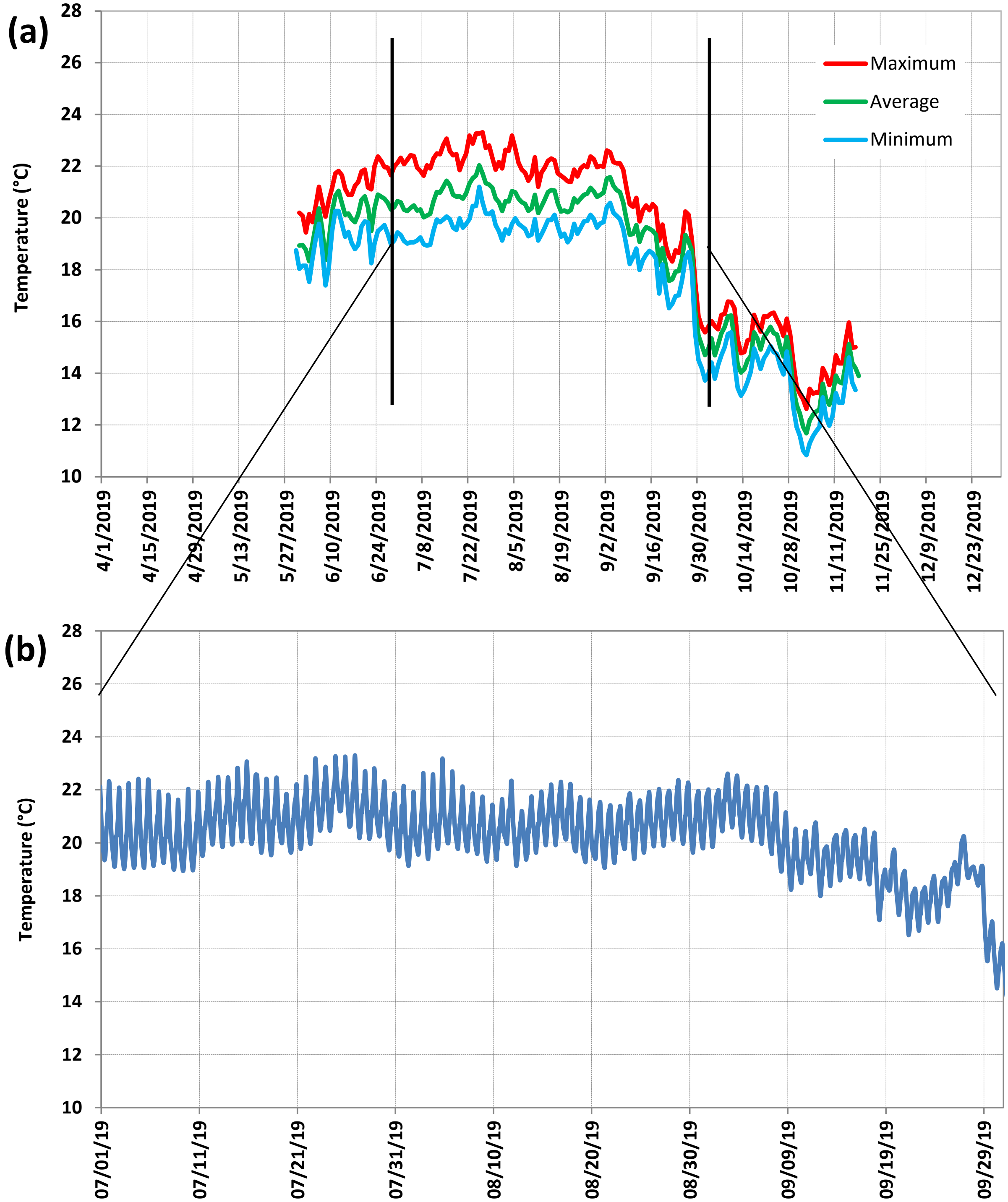


Figure 22: 2019 LSYR-1.71 (Grimm Property pool) middle (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

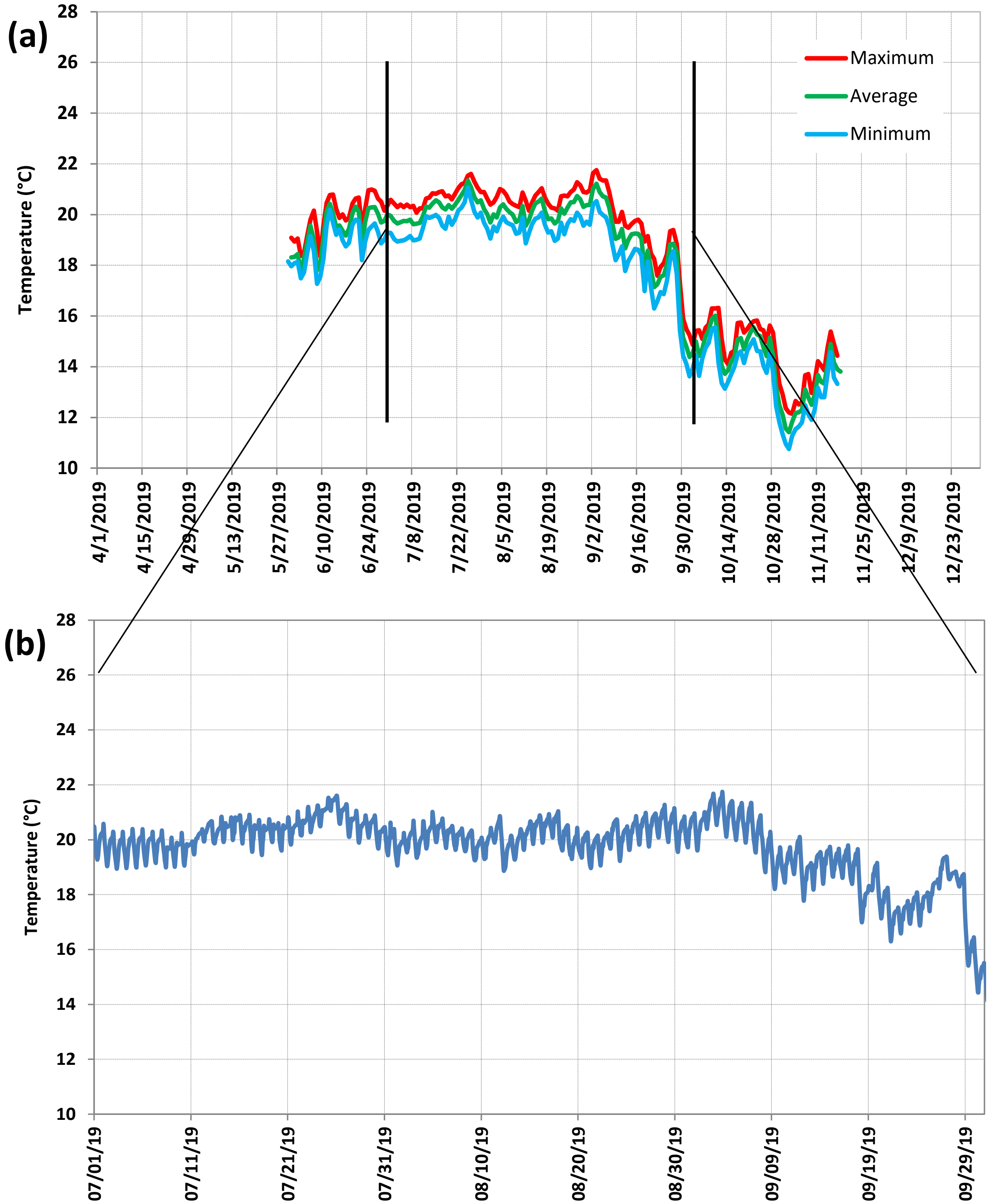


Figure 23: 2019 LSYR-1.71 (Grimm Property pool) bottom (6.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

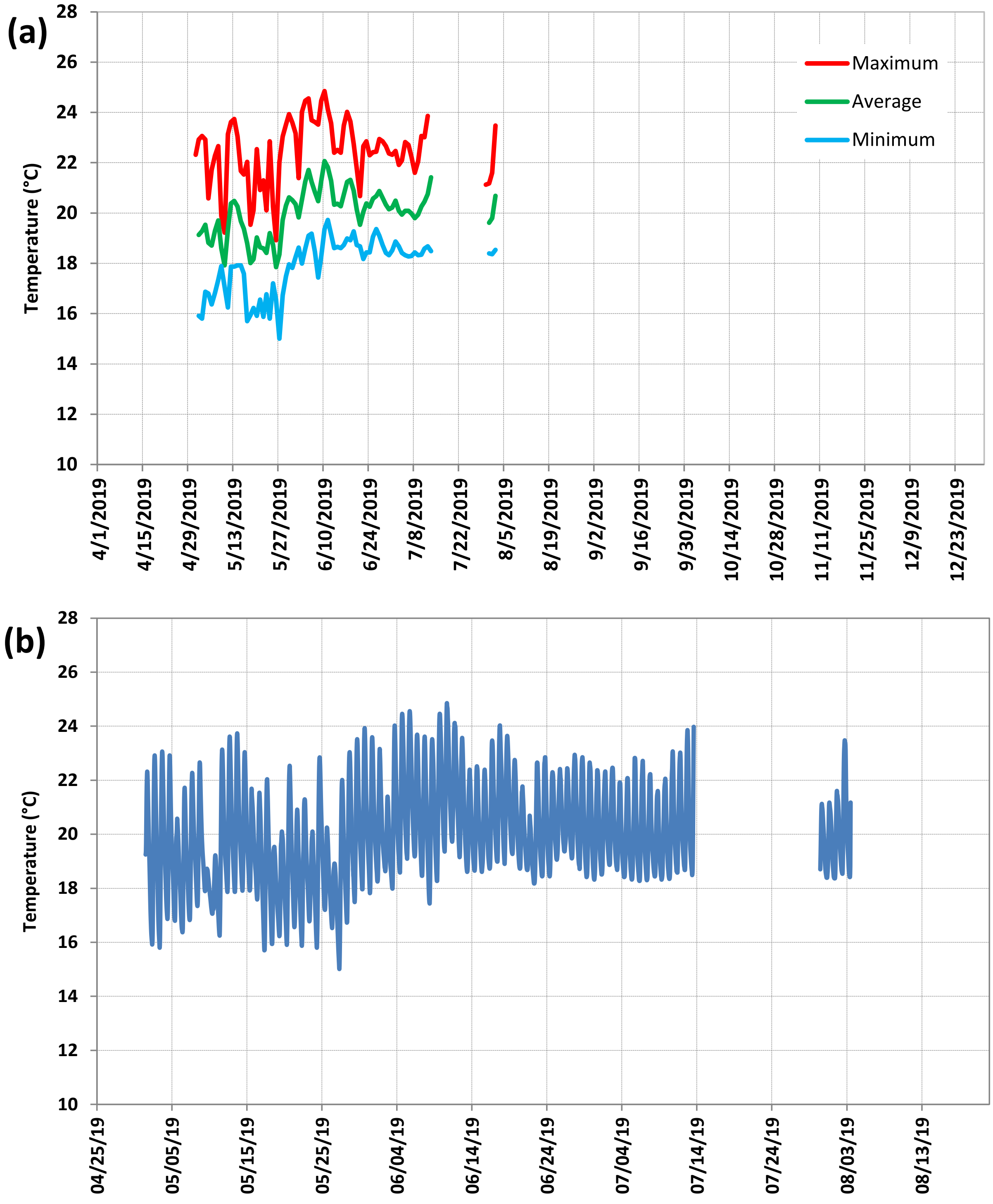


Figure 24: 2019 LSYR 4.95 (Encantado Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; the surface unit data gap from 7/13/19 – 7/30/19 due to declining water levels and the array was removed from the habitat on 8/22/19 as the habitat was nearly dry

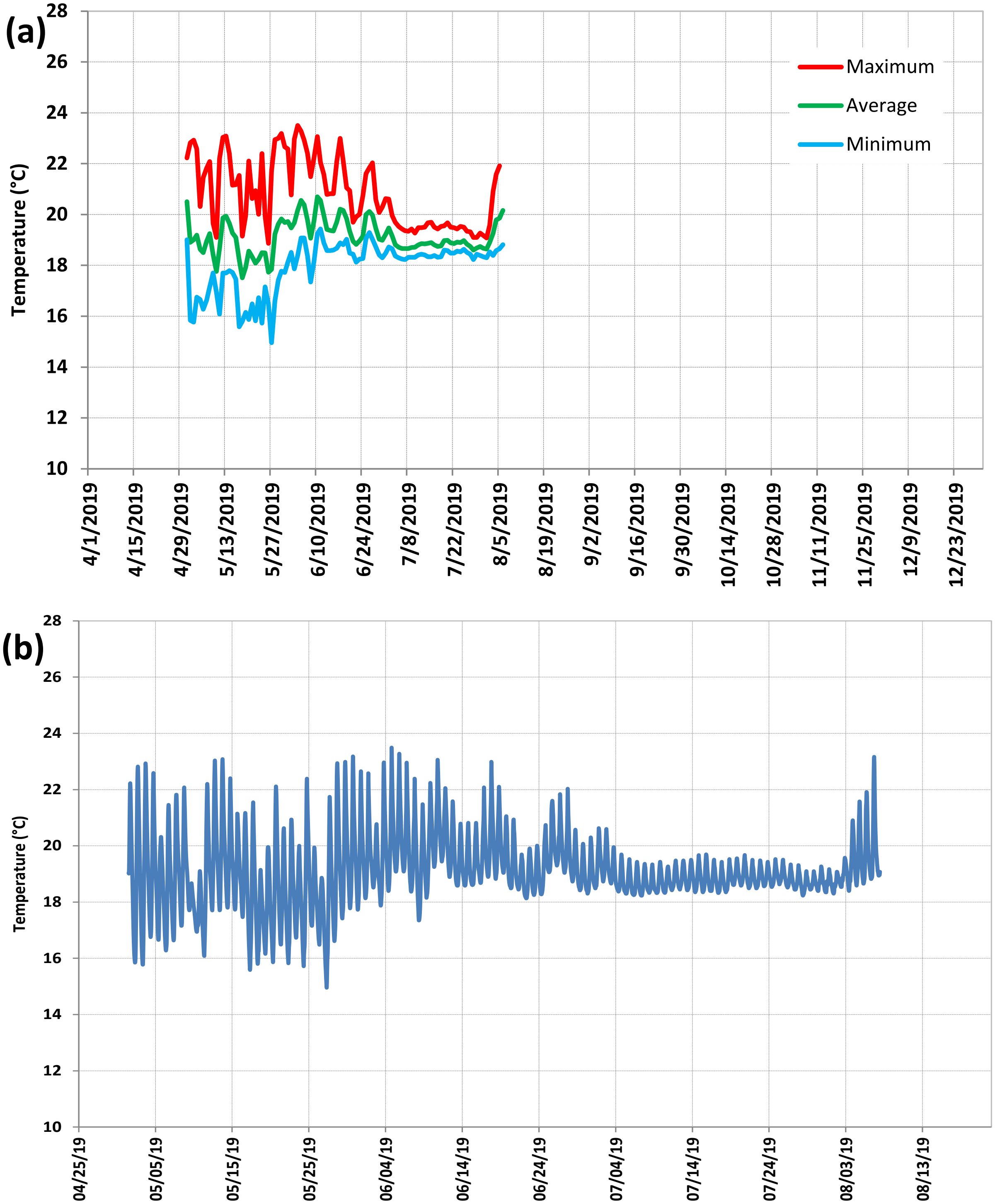


Figure 25: 2019 LSYR-4.95 (Encantado Pool) middle (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; the middle unit was exposed to air on 8/7/19 and the array was removed from the habitat on 8/22/19 as the habitat was nearly dry.

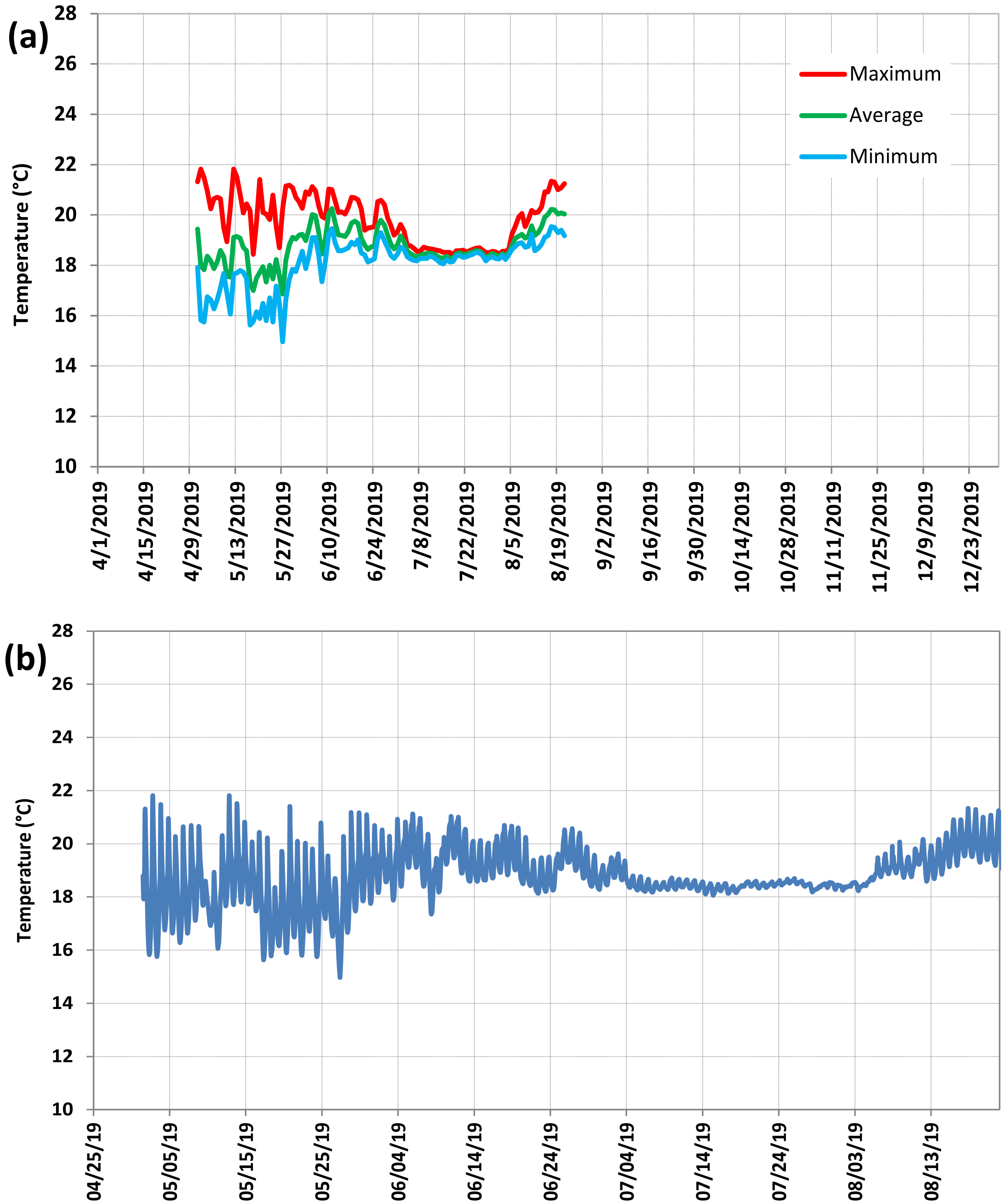


Figure 26: 2019 LSYR-4.95 (Encantado Pool) bottom (6.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; the array was removed from the habitat on 8/22/19 as the habitat was nearly dry.

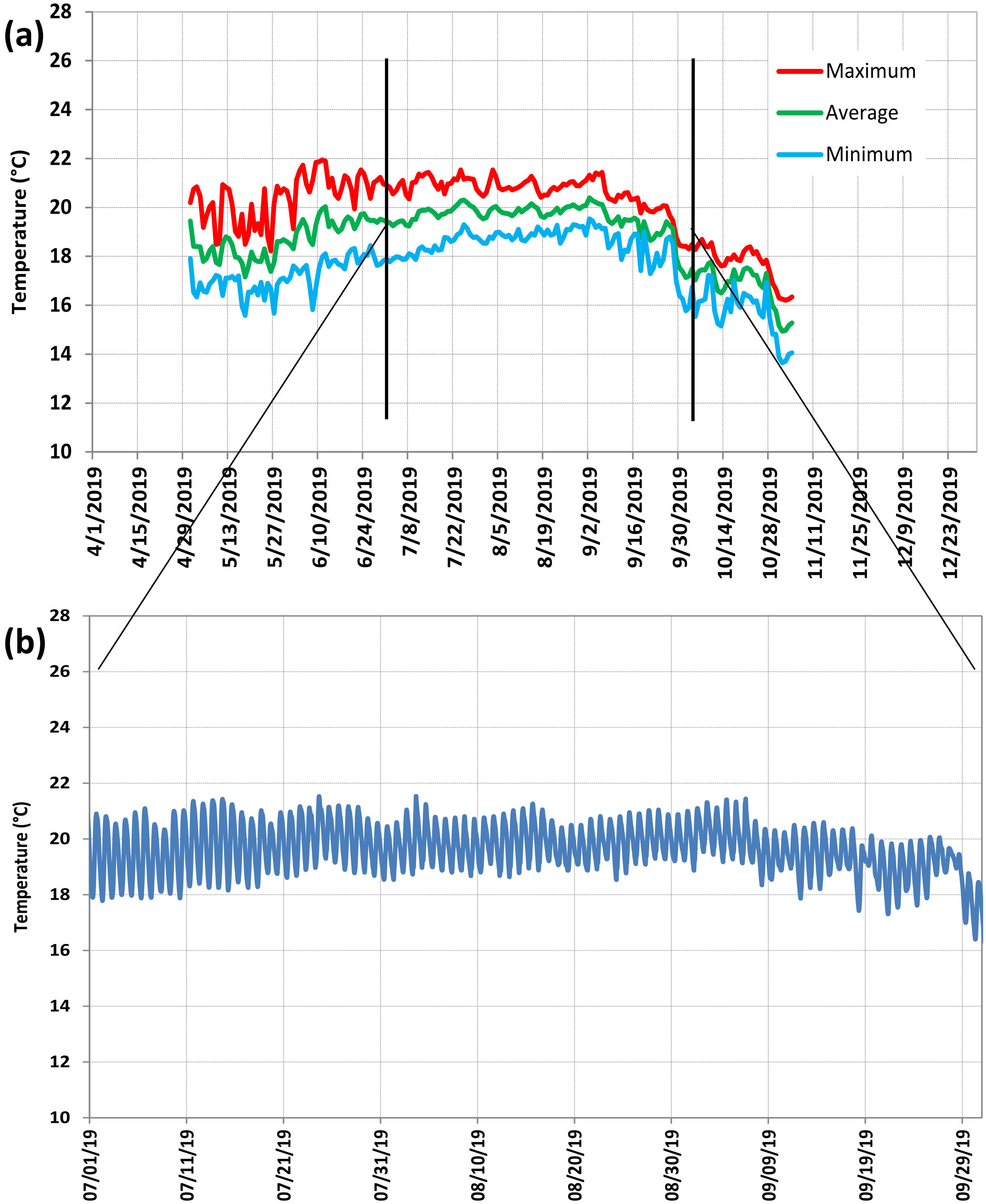


Figure 27: 2019 LSYR-7.65 (Double Canopy Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

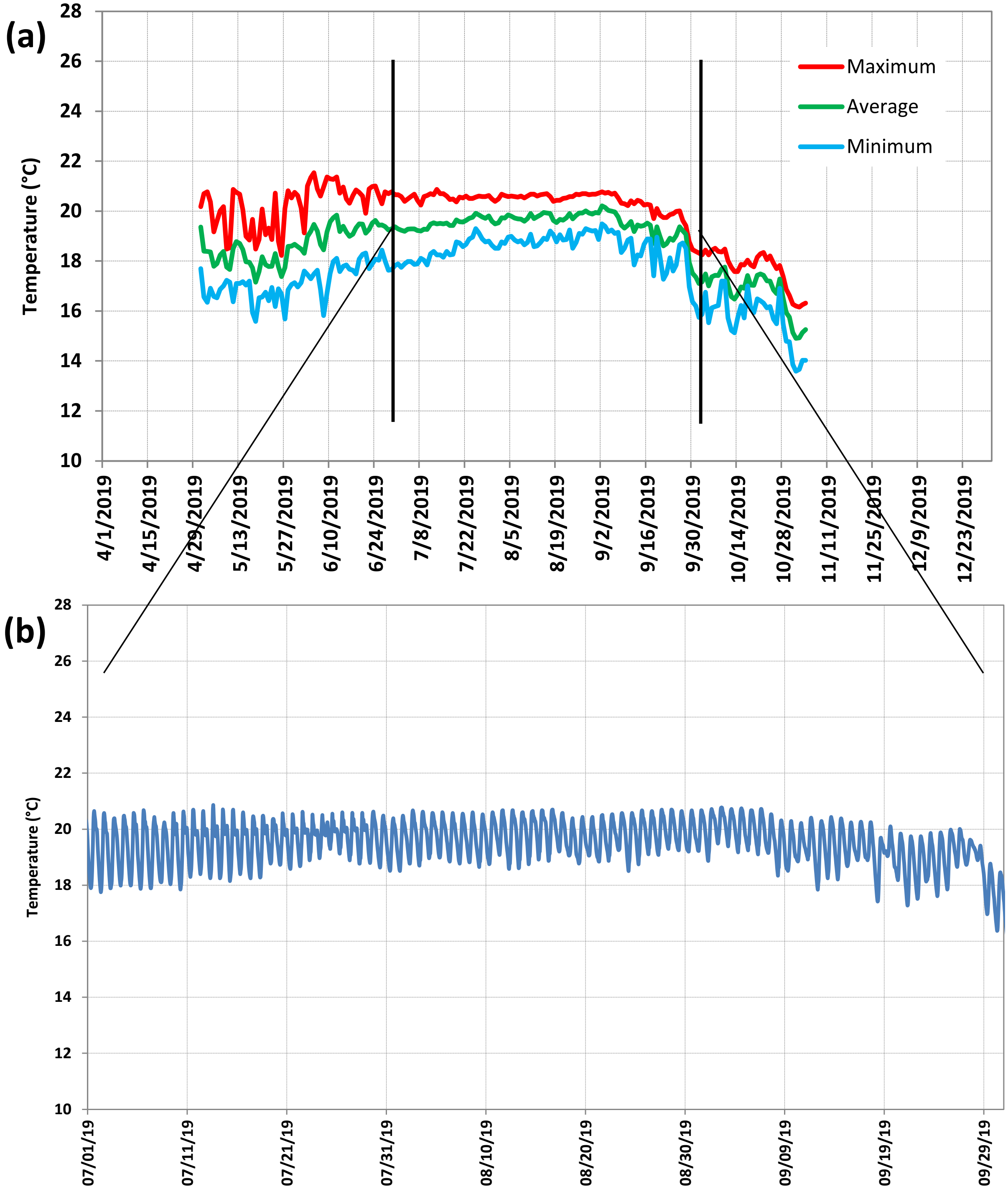


Figure 28: 2019 LSYR-7.65 (Double Canopy Pool) middle (2.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

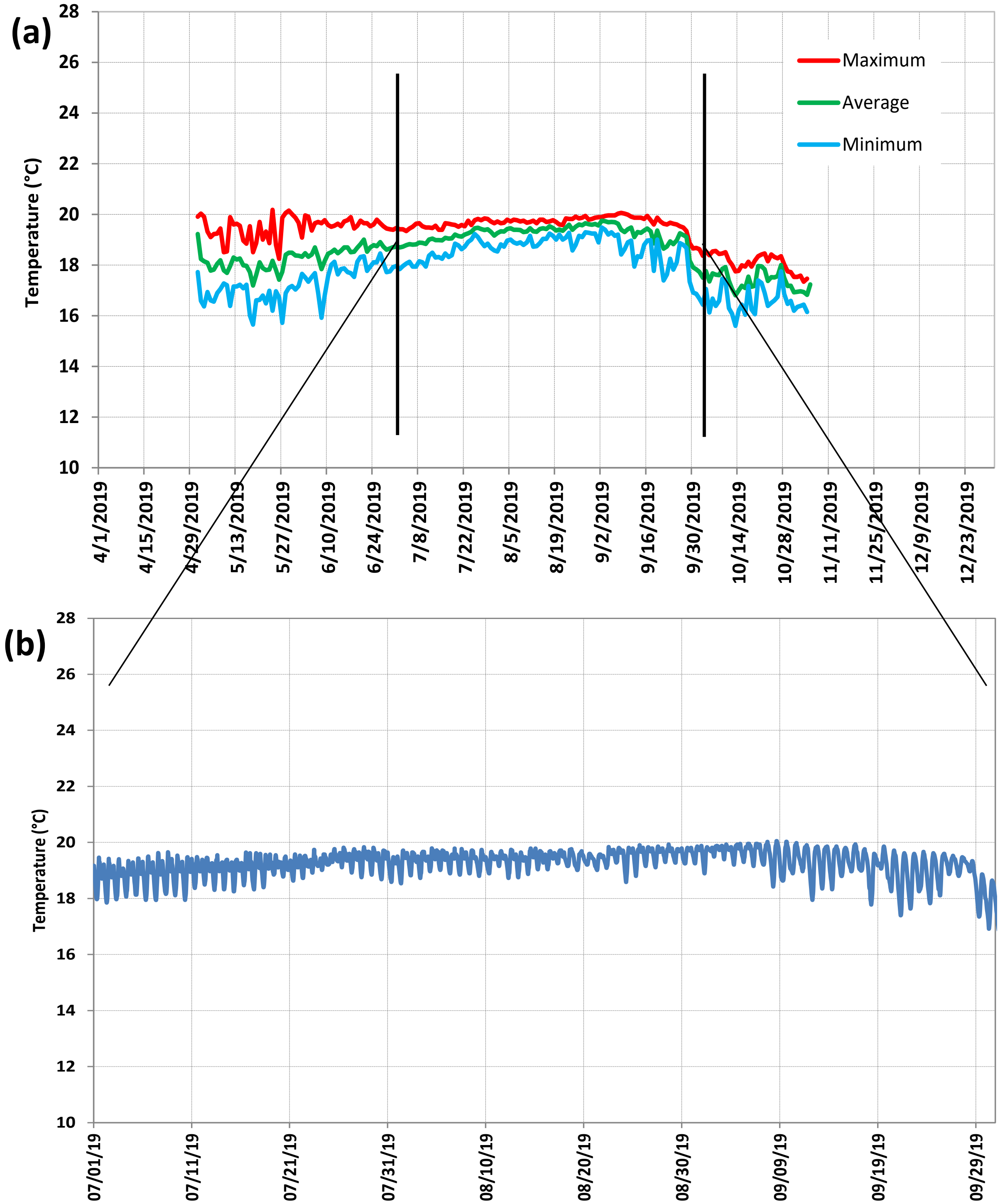


Figure 29: 2019 LSYR-7.65 (Double Canopy Pool) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

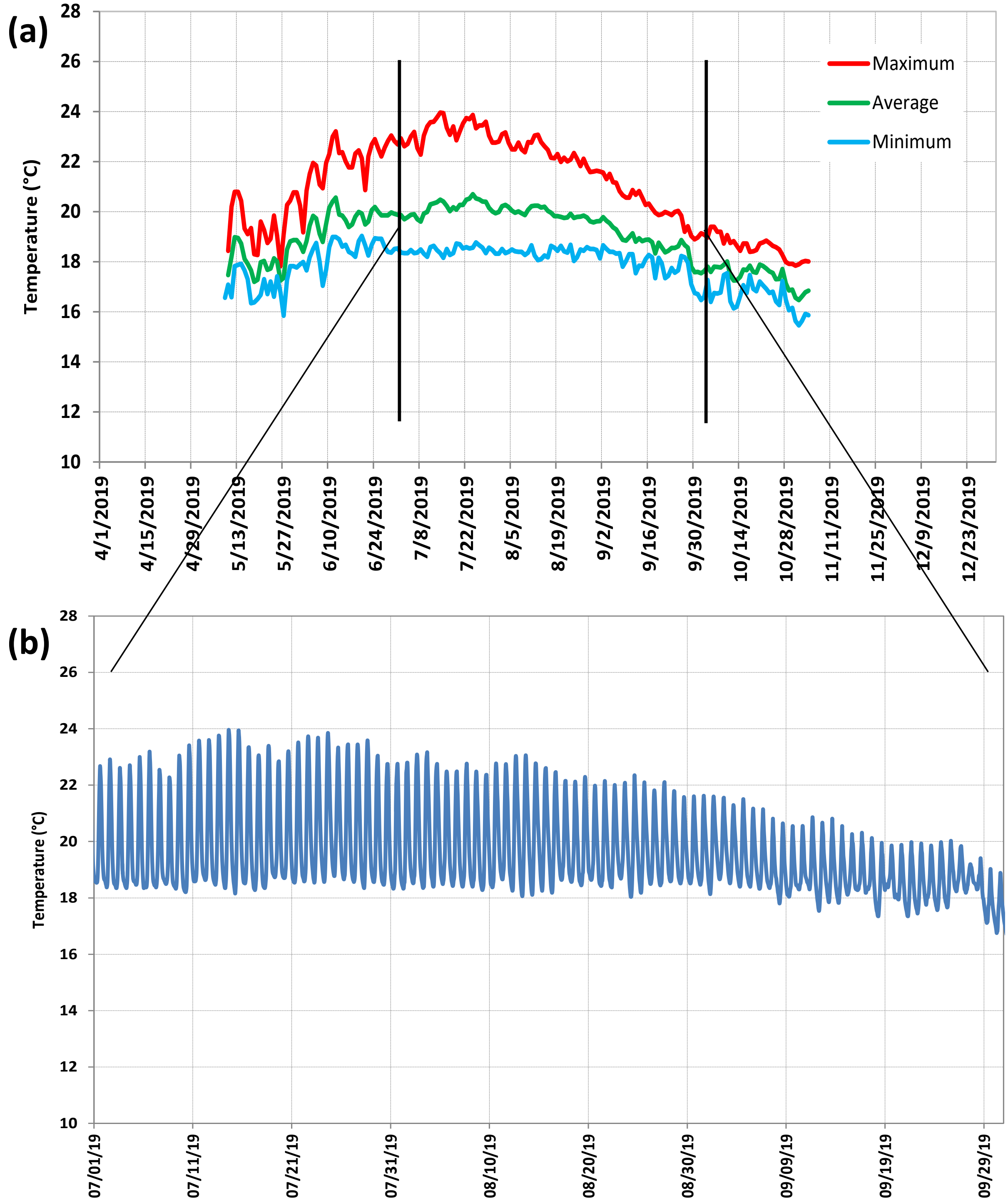


Figure 30: 2019 LSYR-8.7 (Head of Beaver Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

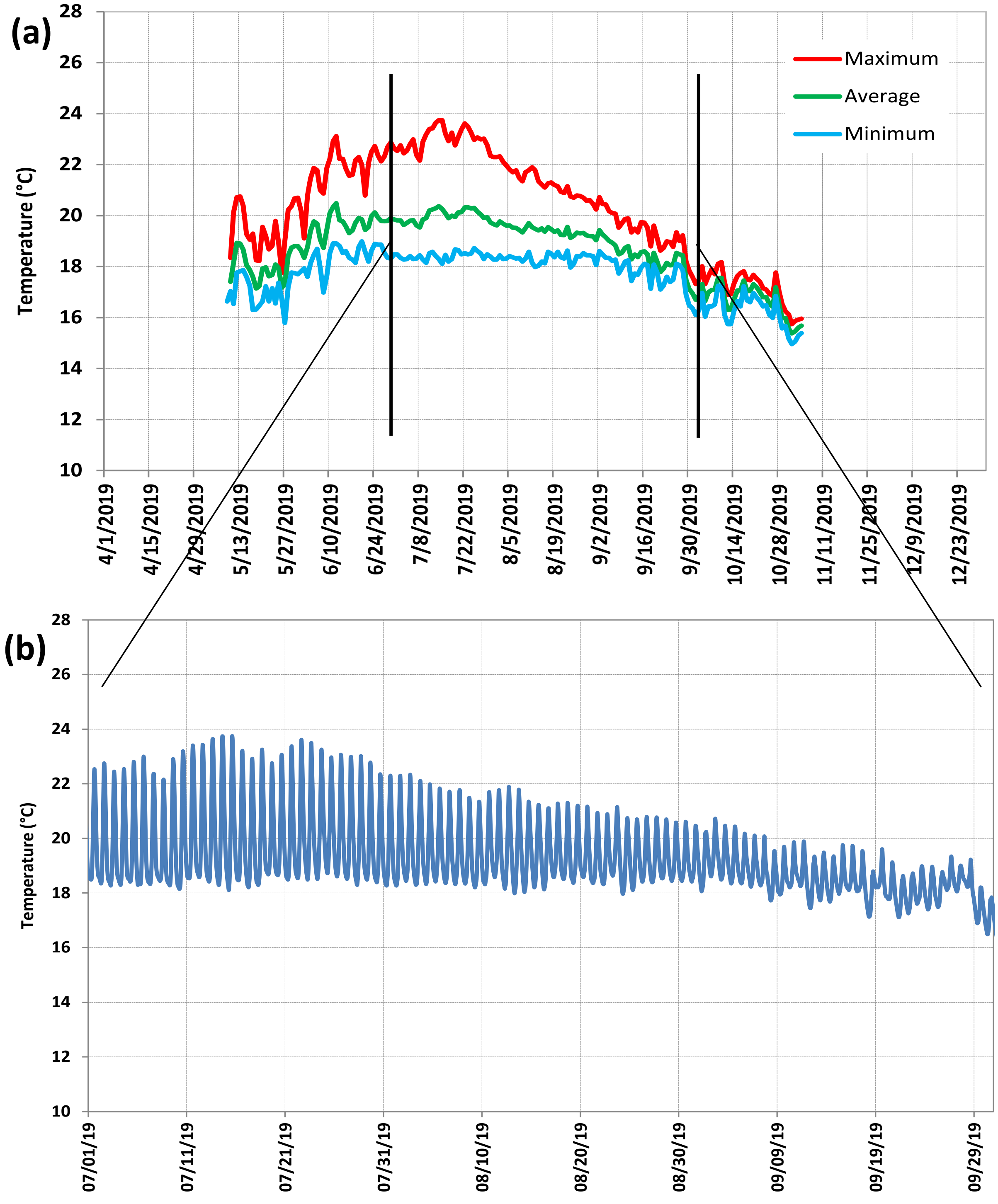


Figure 31: 2019 LSYR-8.7 (Head of Beaver Pool) middle (2.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

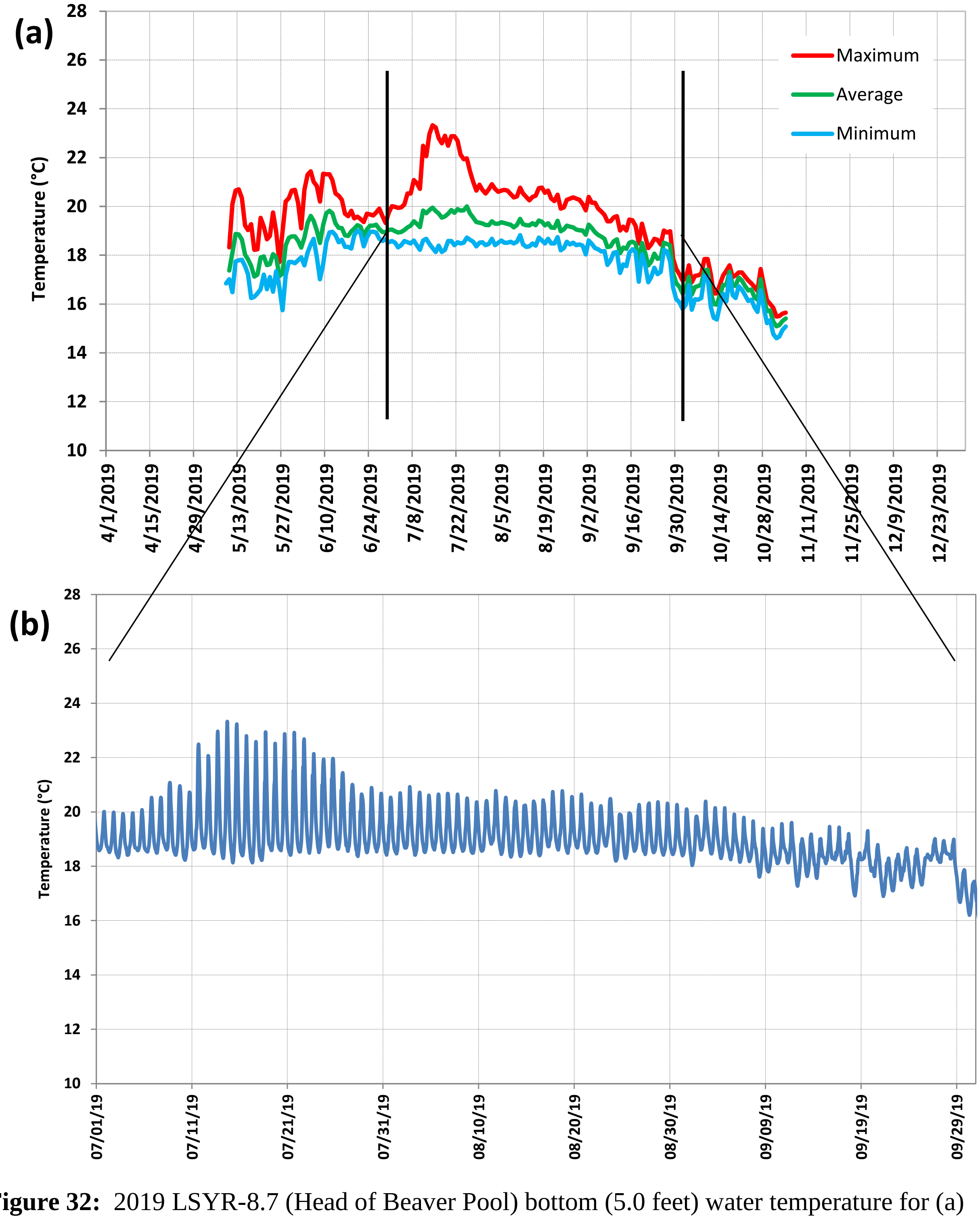


Figure 32: 2019 LSYR-8.7 (Head of Beaver Pool) bottom (5.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

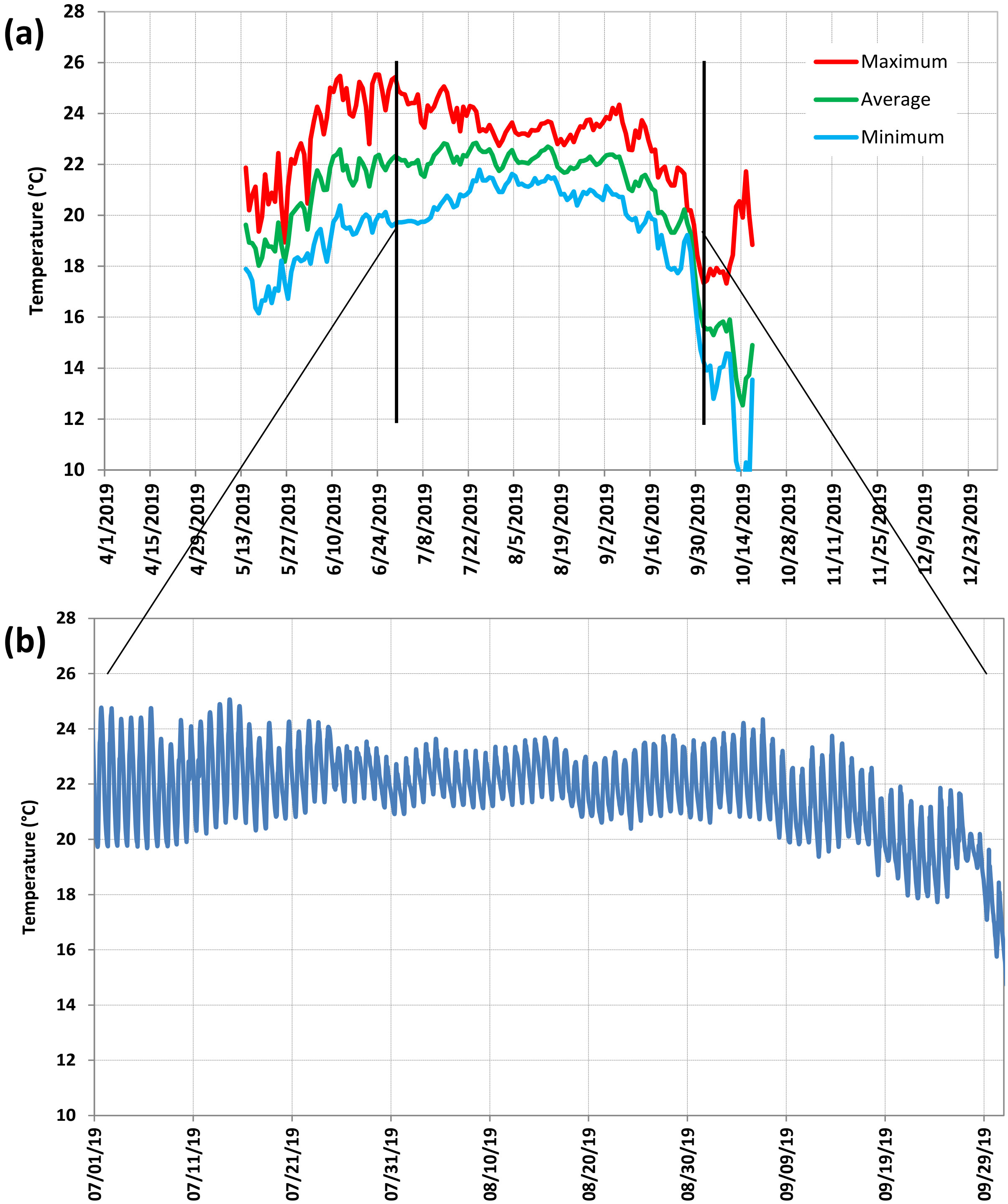


Figure 33: 2019 LSYR-10.5 surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19; the surface unit was out of the water from 10/18/19 due to drying conditions.

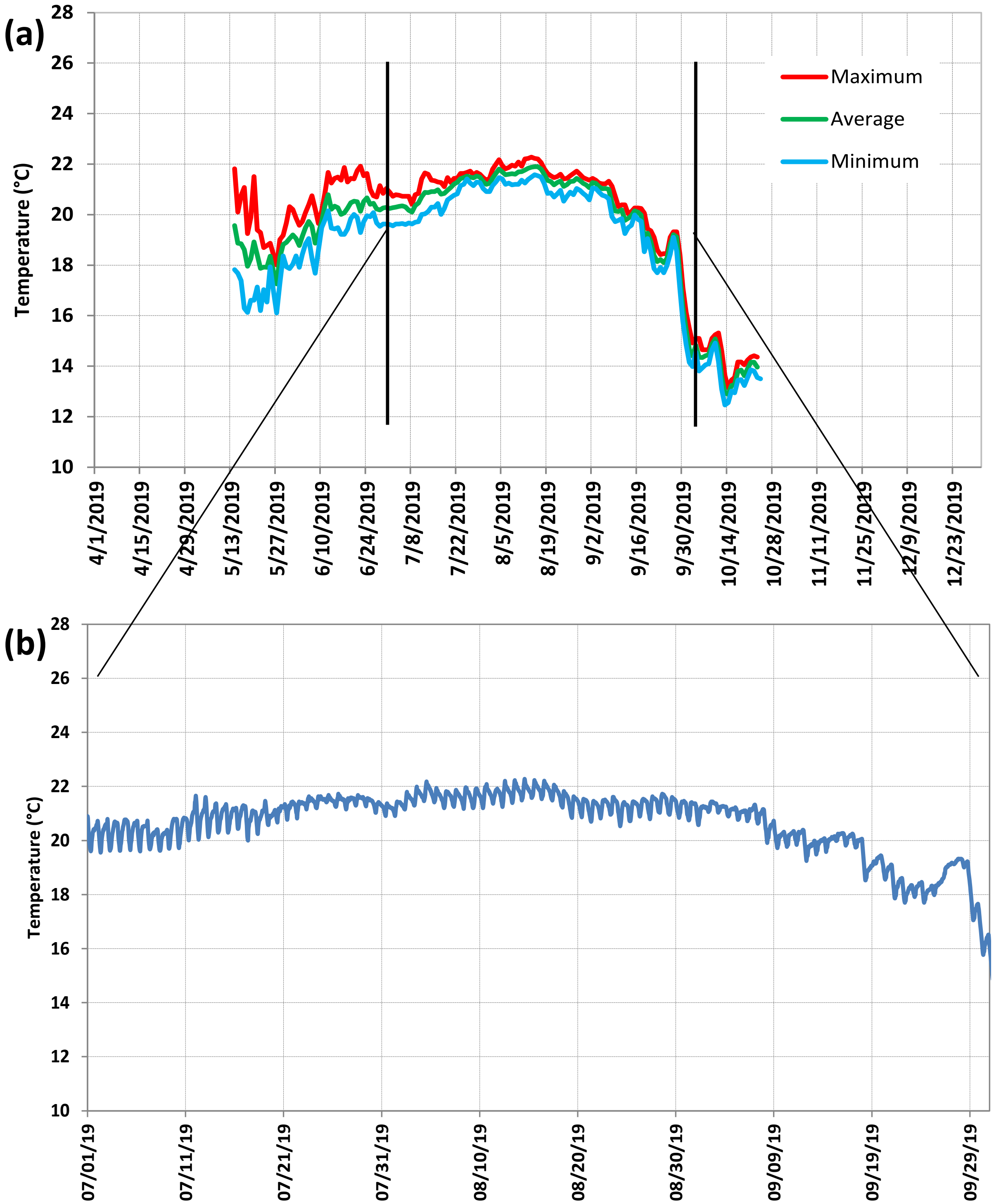


Figure 34: 2019 LSYR-10.5 middle (4.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

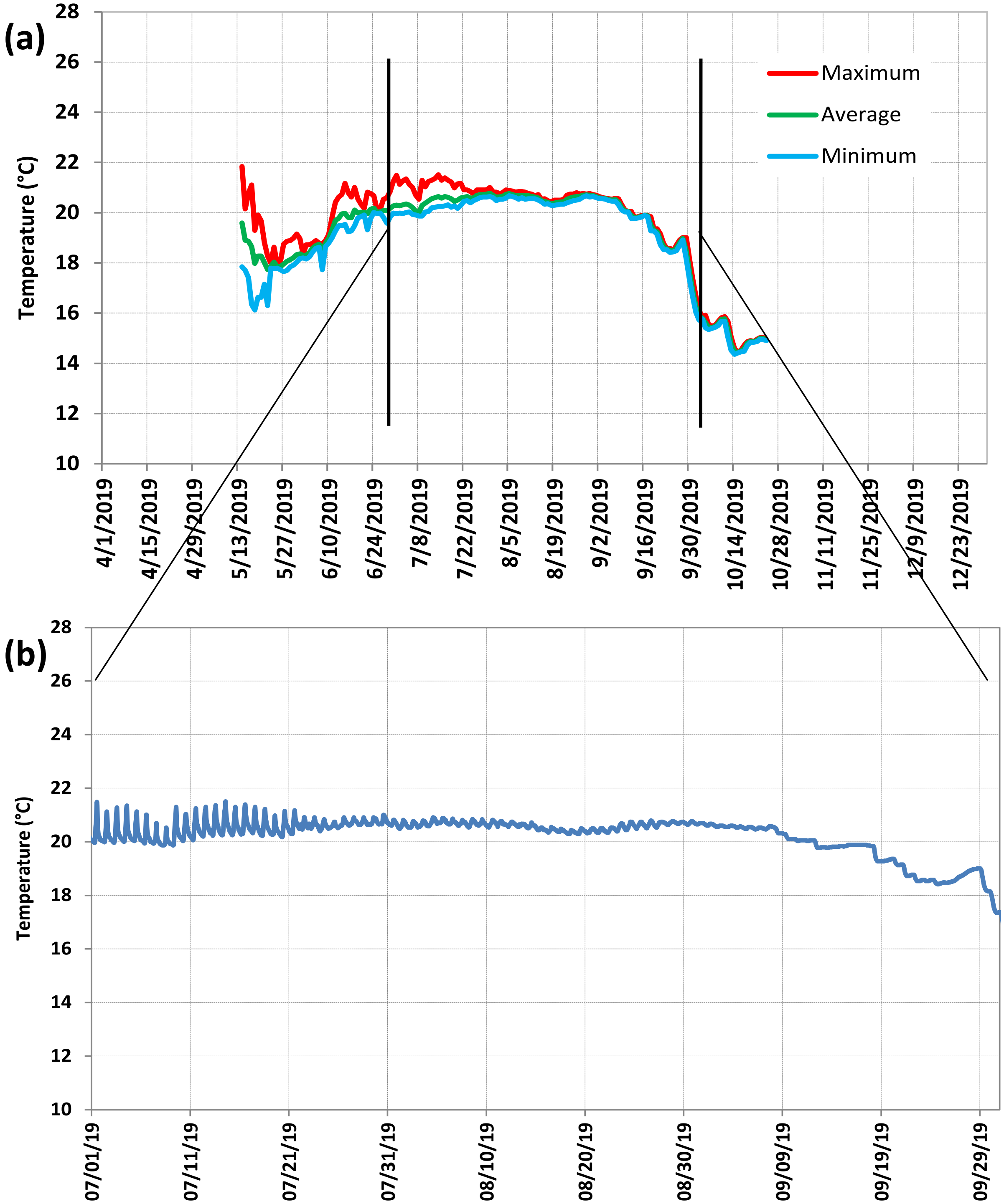


Figure 35: 2019 LSYR-10.5 bottom (9.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

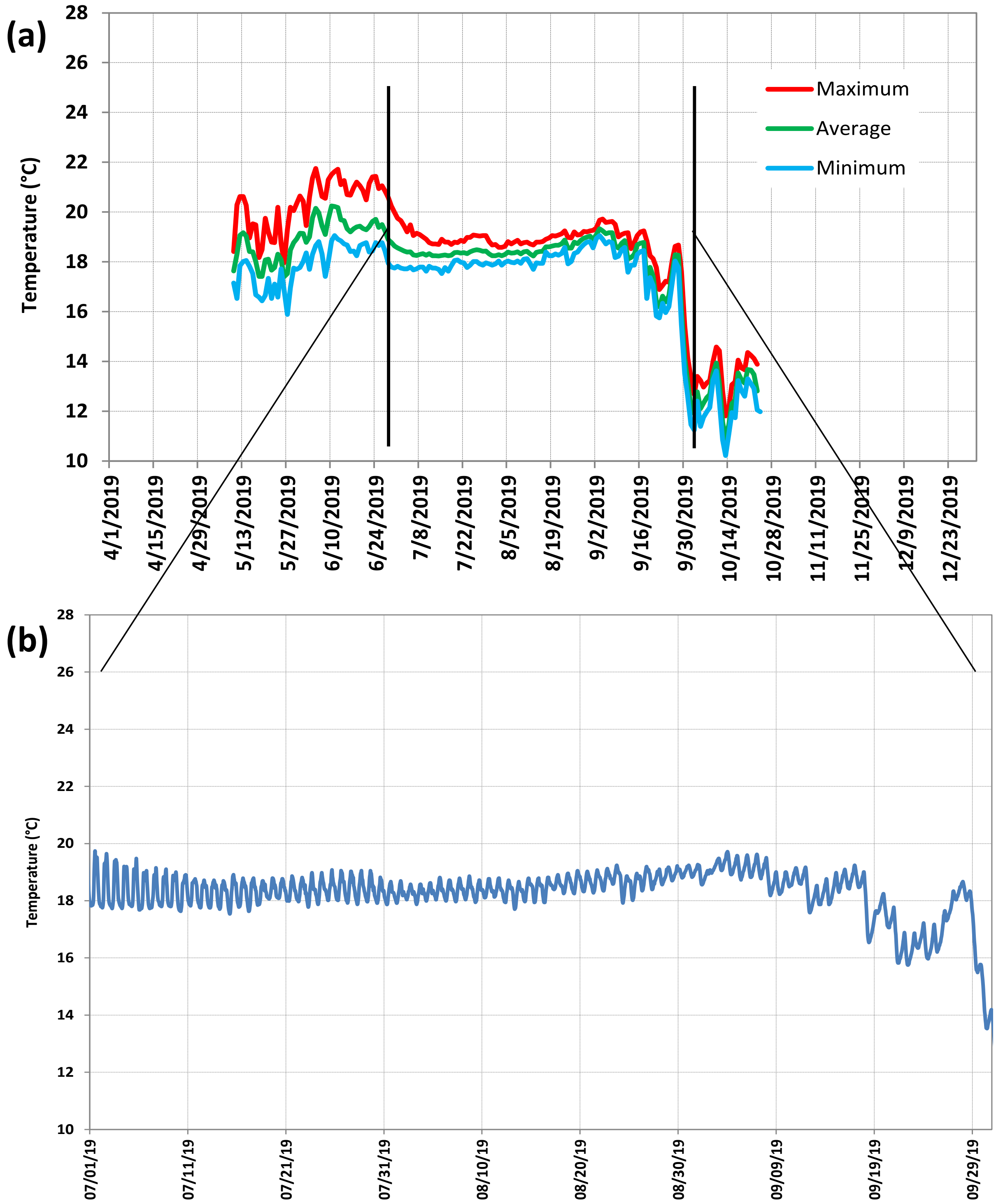


Figure 36: 2019 LSYR-13.9 bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

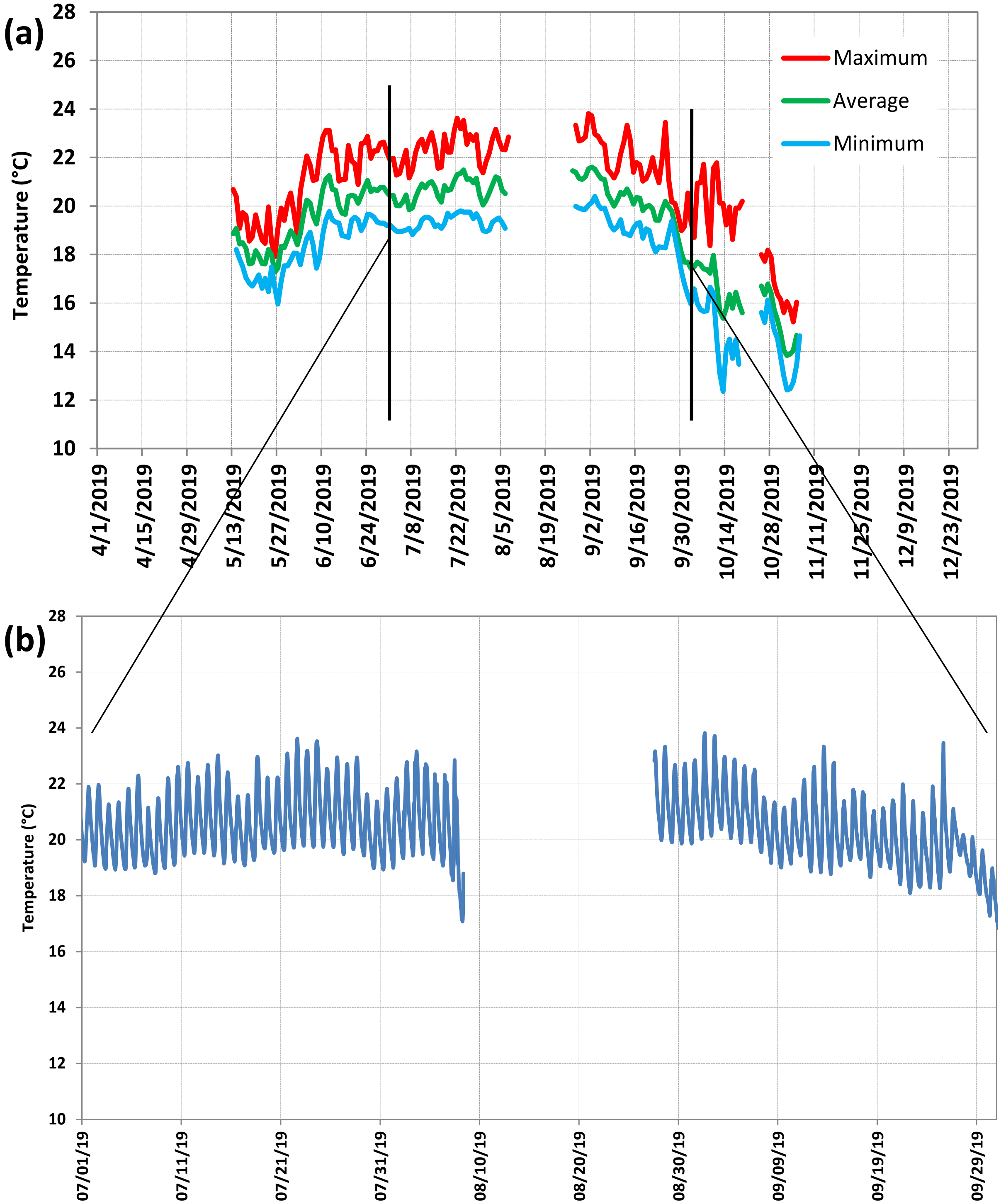


Figure 37: 2019 LSYR-22.68 (Cadwell Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19; the surface unit was out of the water from 8/8/19 - 8/27/19 and 10/17/19 - 10/24/19 due to declining water levels.

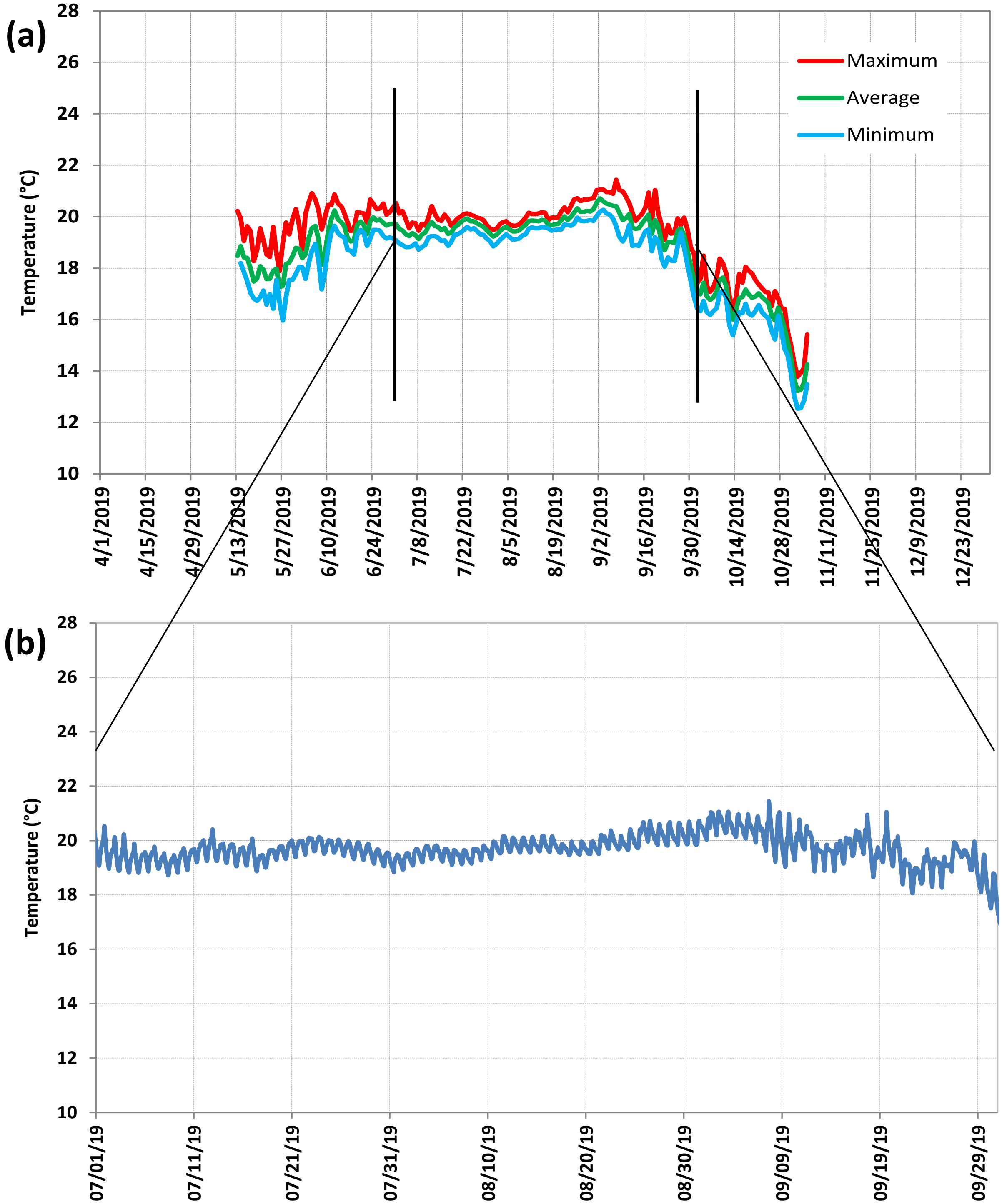


Figure 38: 2019 LSYR-22.68 (Cadwell Pool) middle (7.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

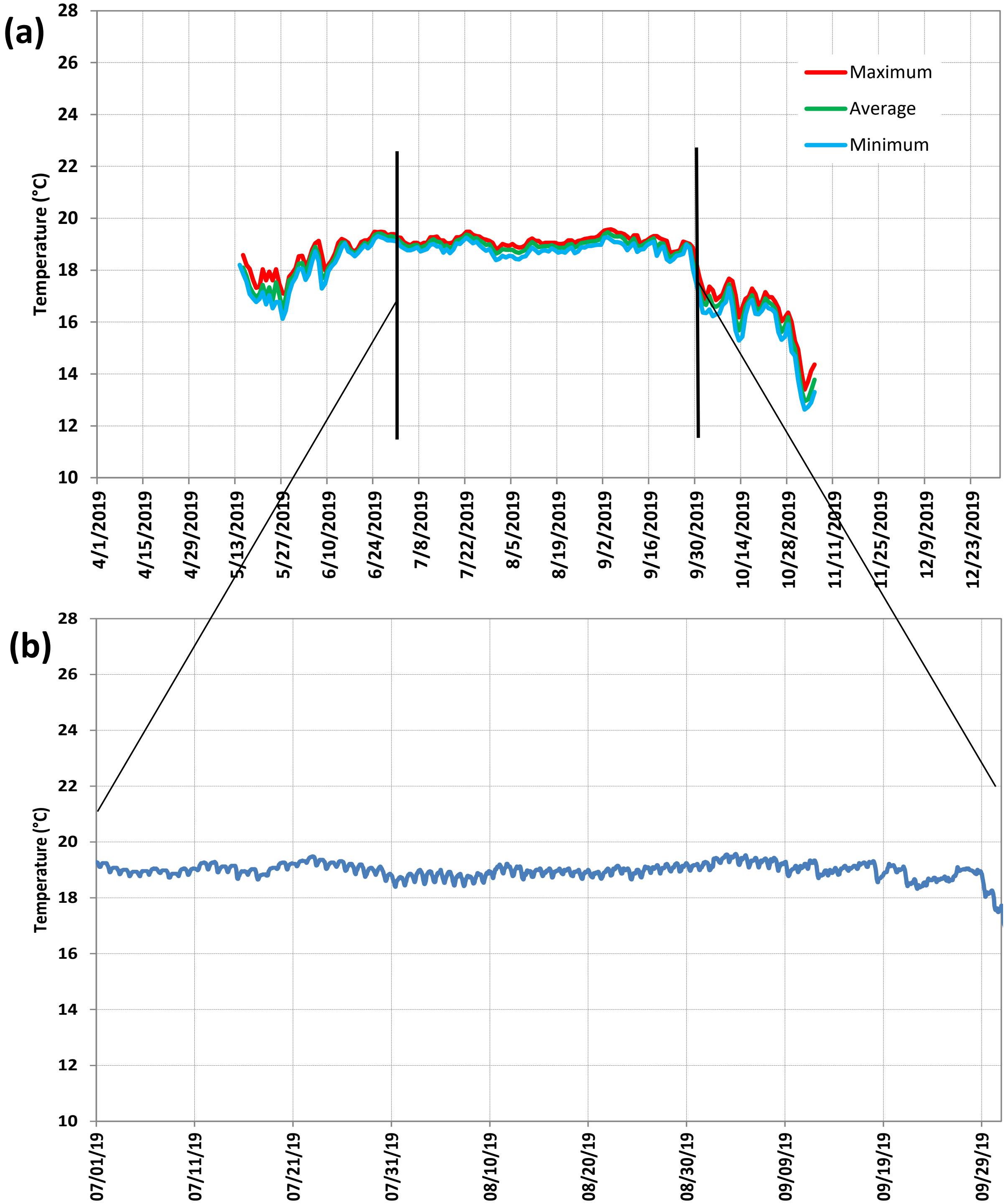


Figure 39: 2019 LSYR-22.68 (Cadwell Pool) bottom (14.0 feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/19 - 10/1/19.

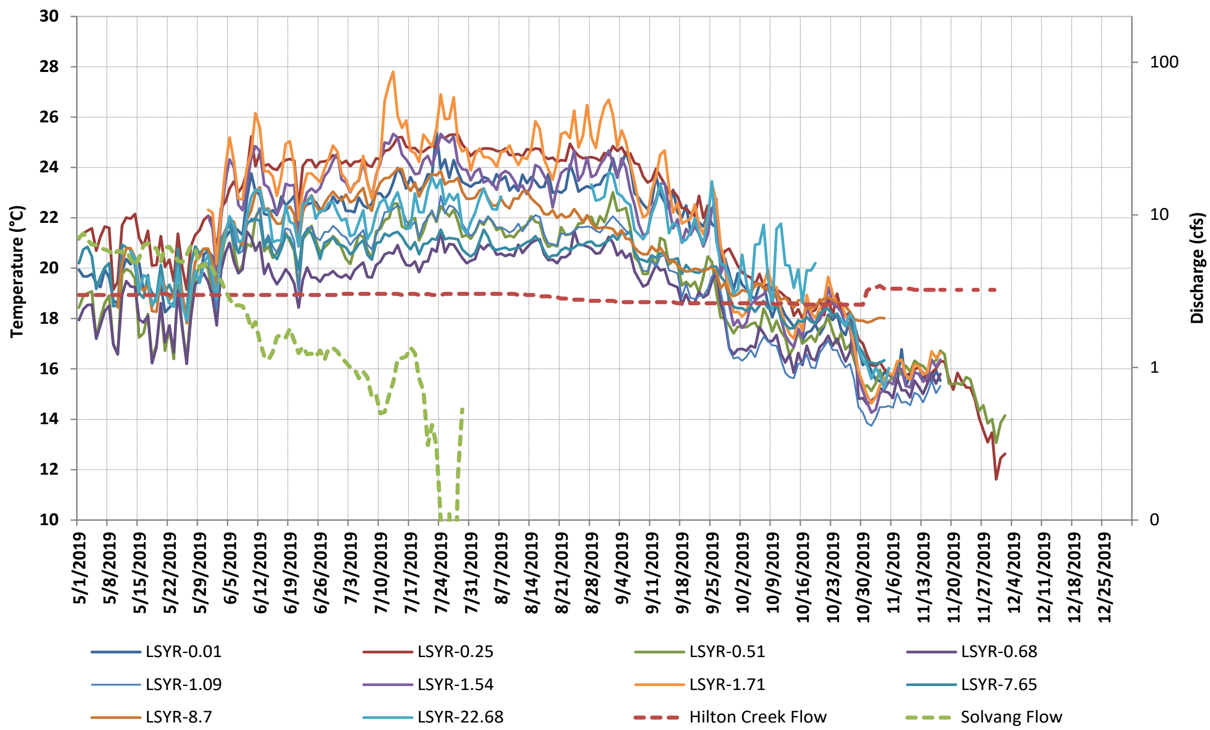


Figure 40: 2019 Longitudinal maximum surface water temperatures at: LSYR-0.01 (parapet wall), LSYR-0.51 (Long Pool), LSYR-0.68 (downstream of Long Pool), LSYR-1.09 (Grimm u/s), LSYR-1.54 (Grimm d/s), LSYR-1.71 (Grimm Pool), LSYR-7.65 (Double Canopy), LSYR-8.7 (Head of Beaver), and LSYR-22.68 (Cadwell Pool) with daily flow (discharge) at the Hilton Creek and Solvang (at the Alisal Bridge) USGS gauges.

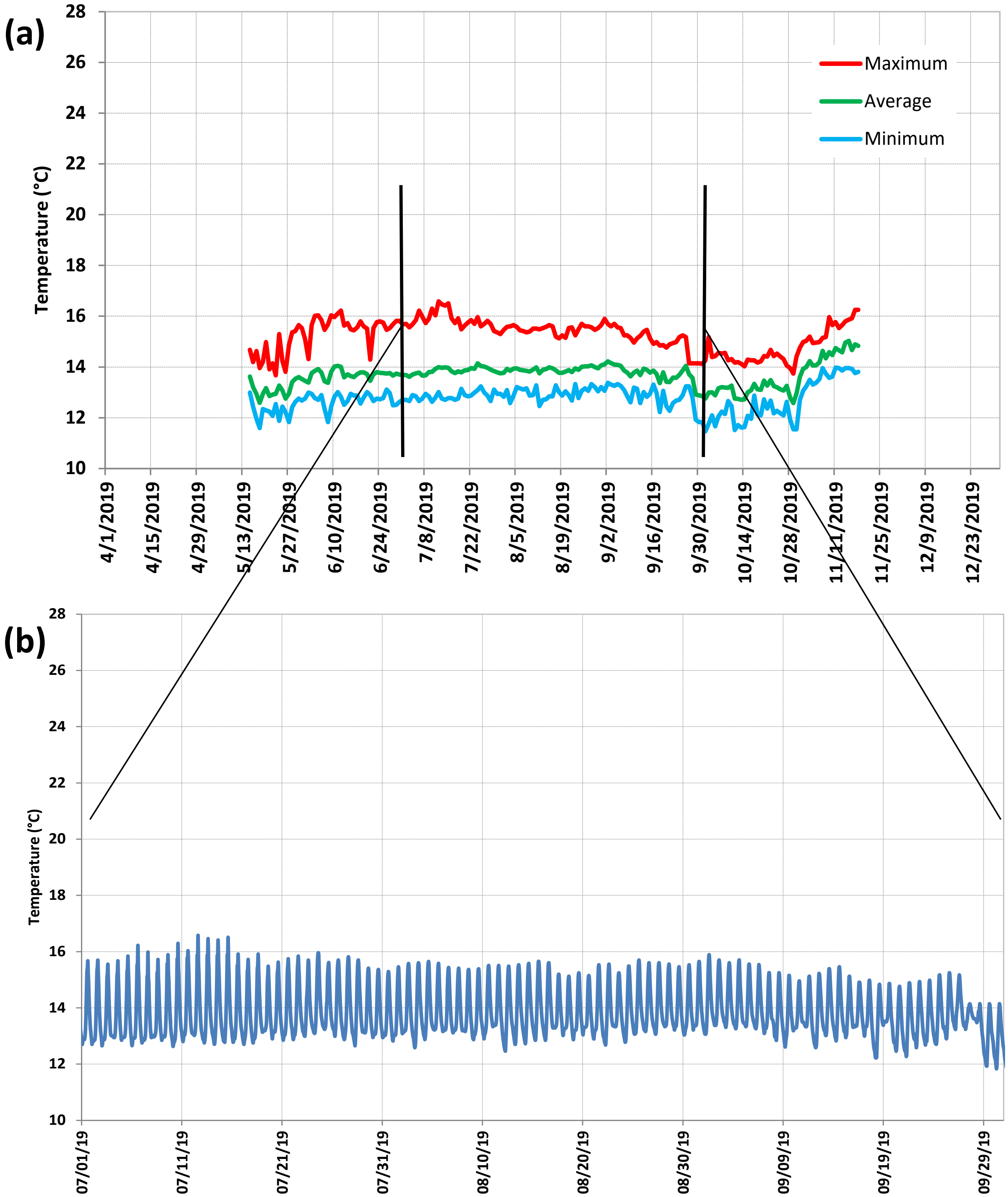


Figure 41: 2019 Lower Hilton Creek (HC-0.12) bottom (1.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/1/19 - 10/1/19.

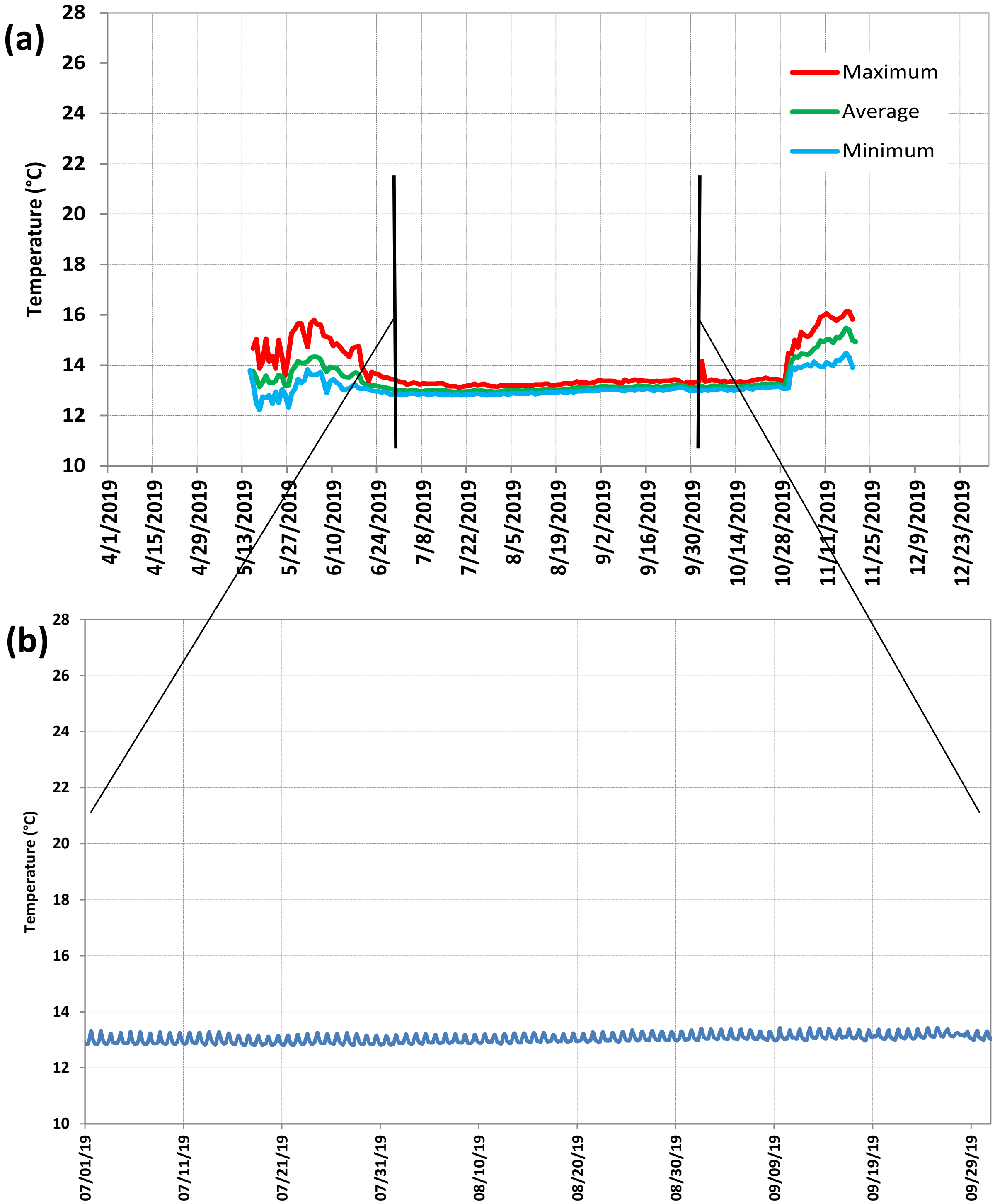


Figure 42: 2019 Hilton Creek at the Upper Release Point (HC-0.54) bottom (2.5 feet) water temperatures for: (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

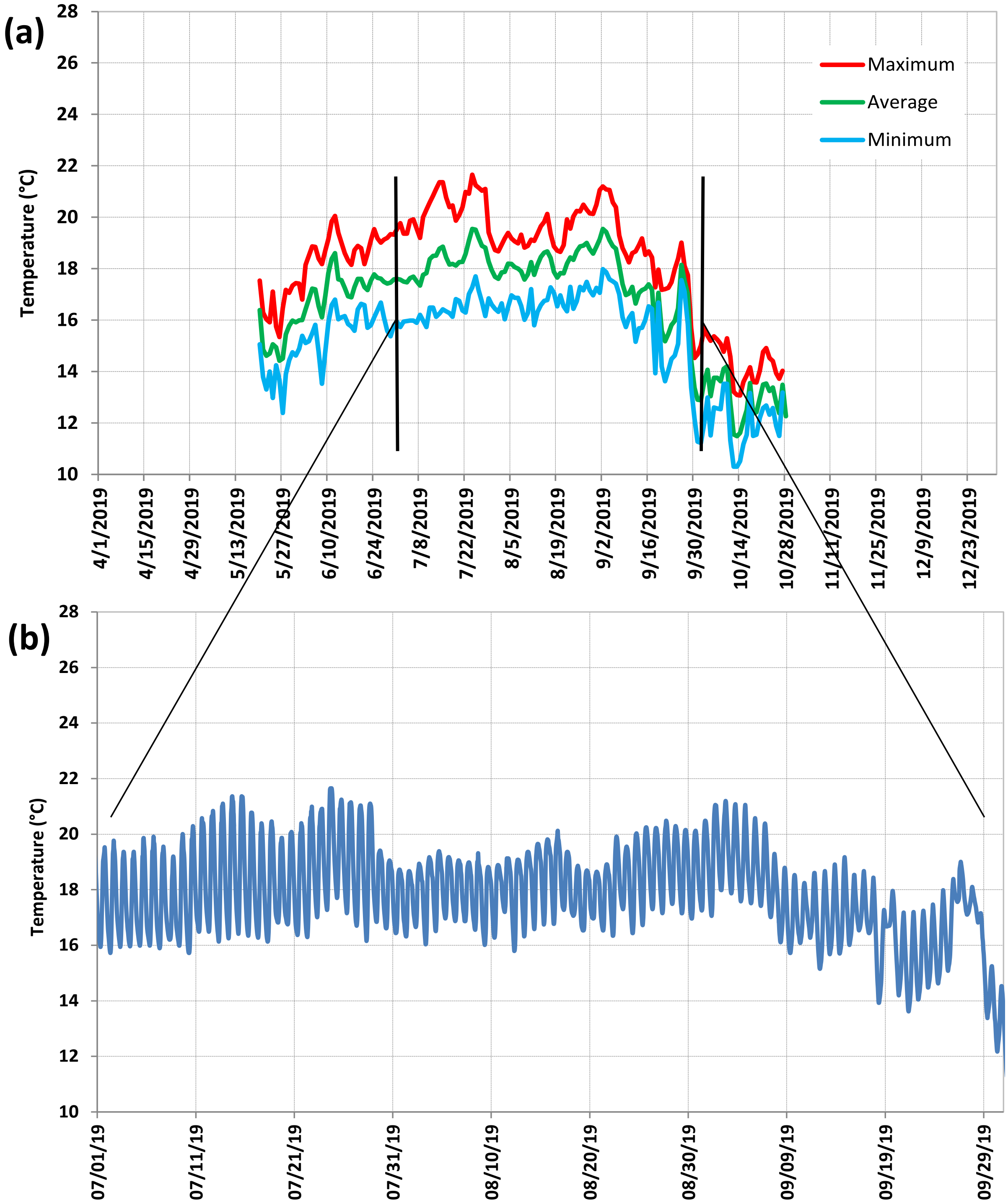


Figure 43: 2019 Quiota Creek (QC-2.66) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/1/19 - 10/1/19.

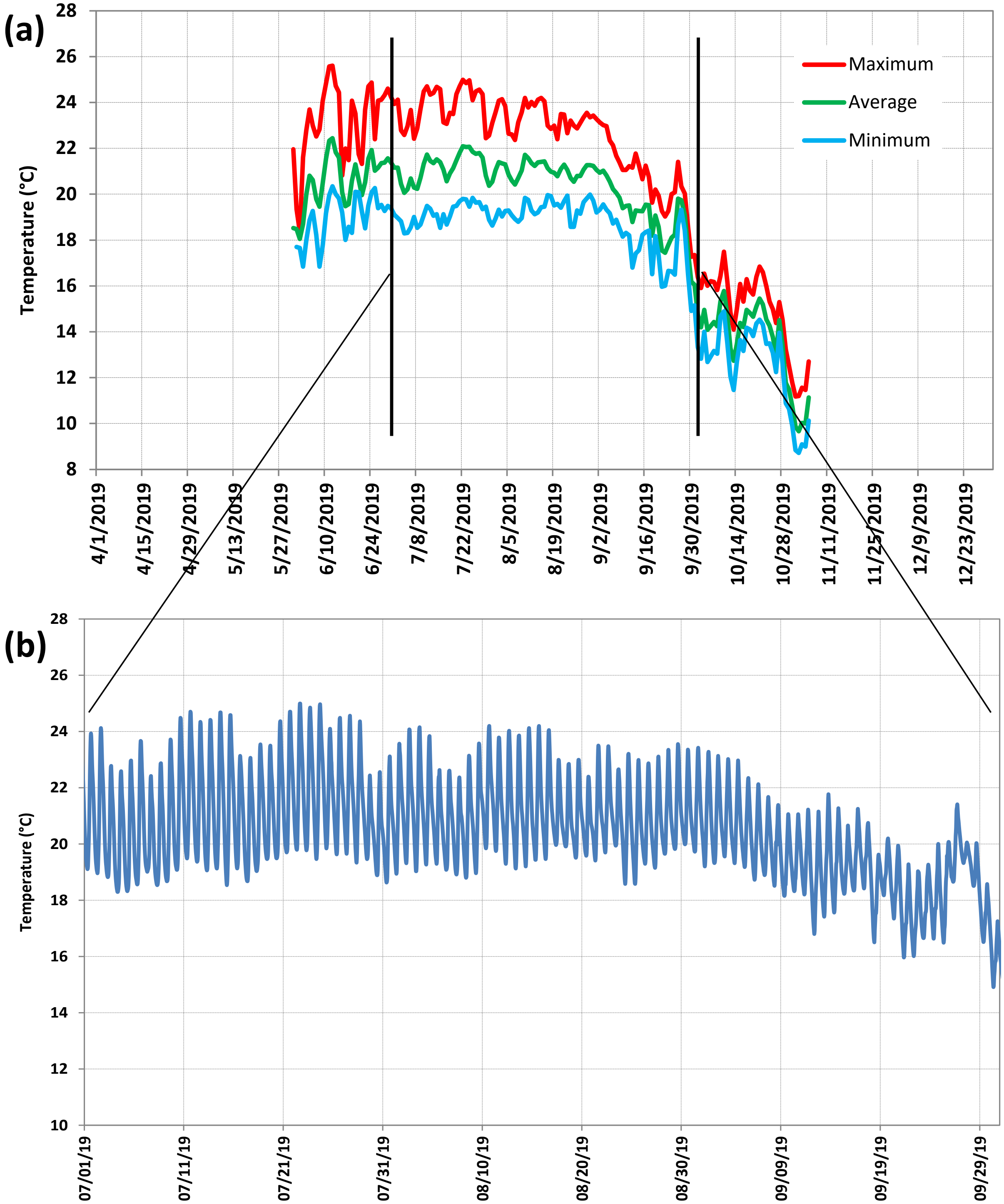


Figure 44: 2019 SC-0.77 surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

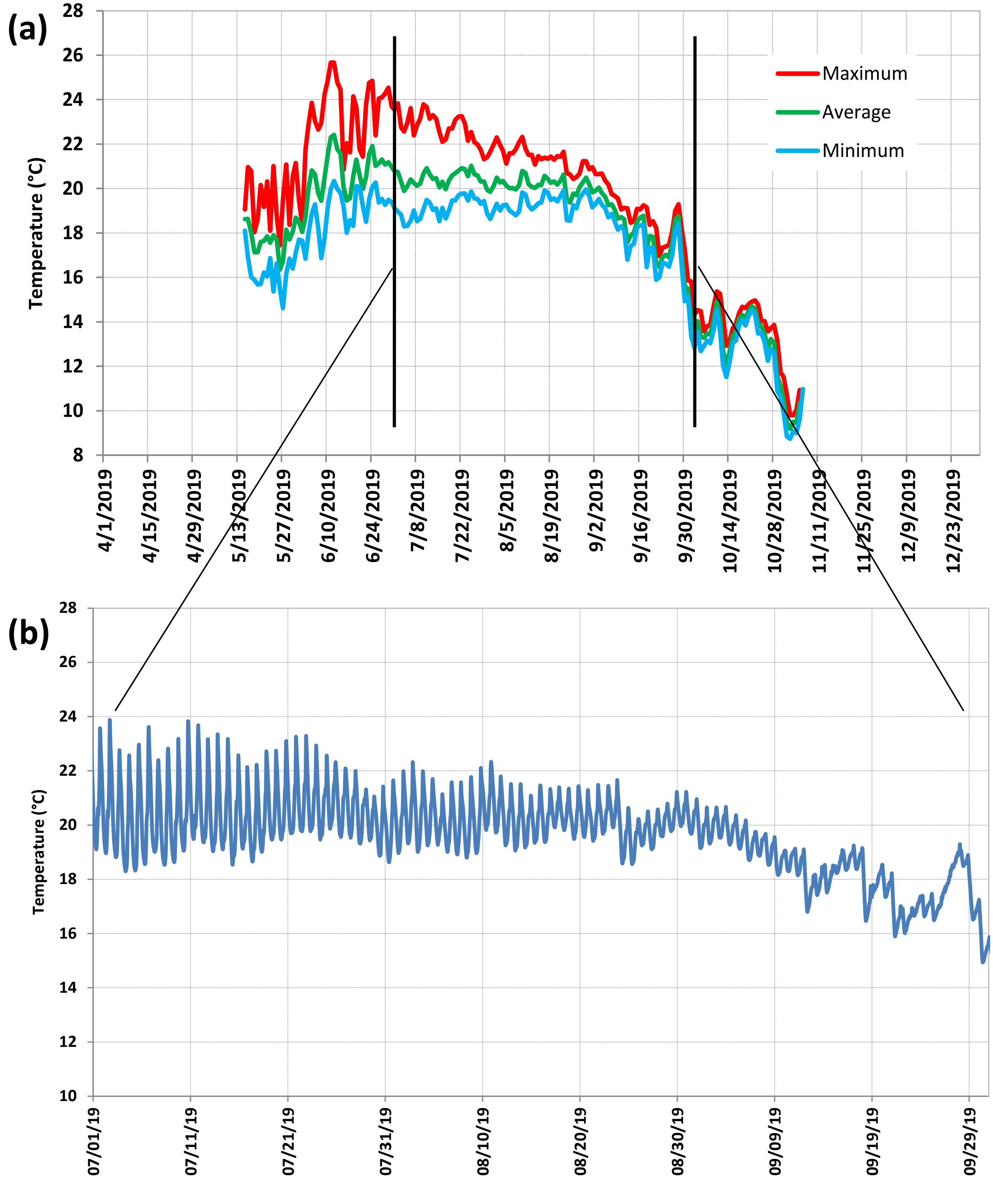


Figure 45: 2019 Lower Salsipuedes Creek (SC-0.77) bottom (5.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/1/19 - 10/1/19.

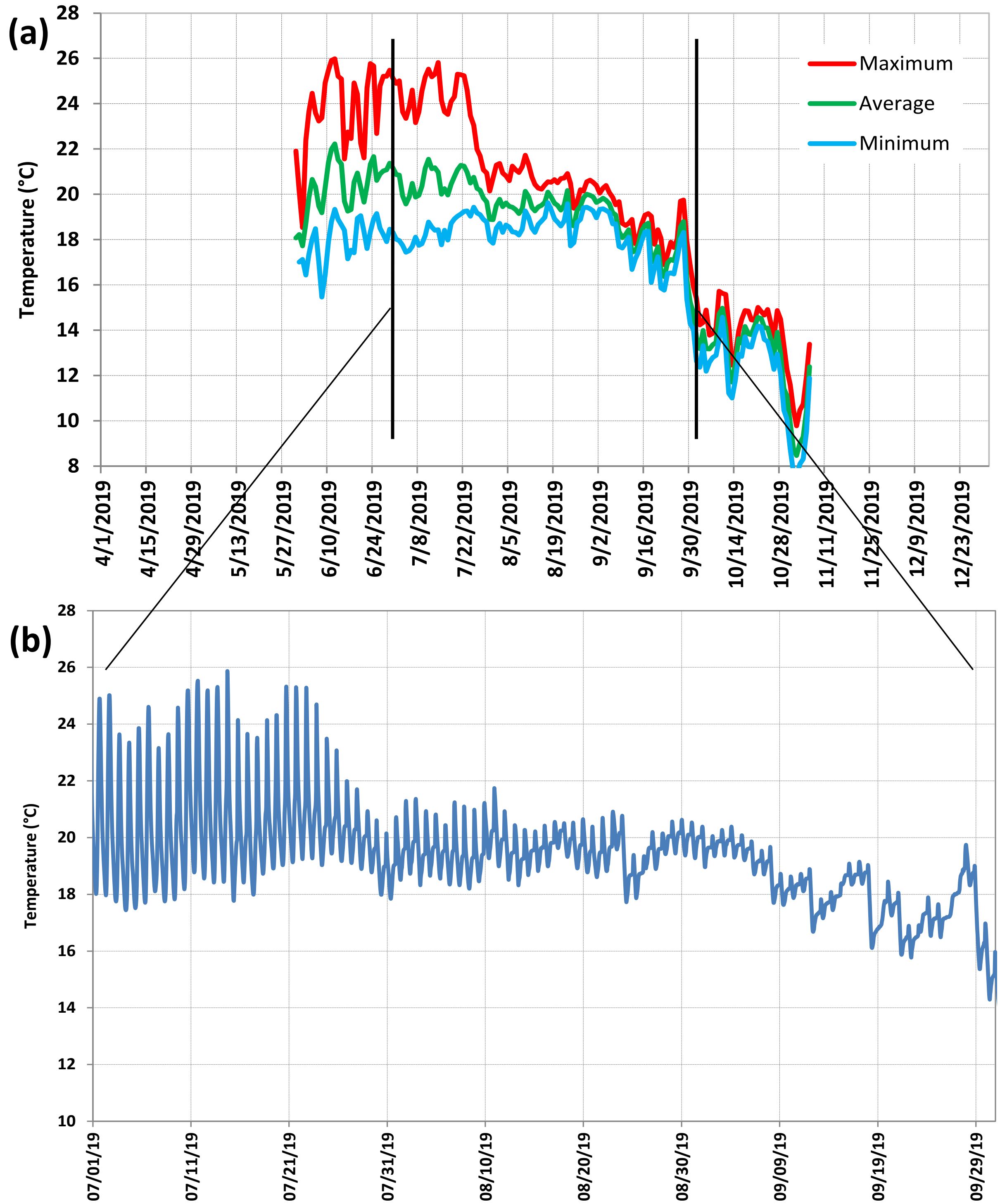


Figure 46: 2019 SC-2.20 (Reach 2 Bedrock Section) bottom (4.0 feet) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period from 7/1/19 - 10/1/19.

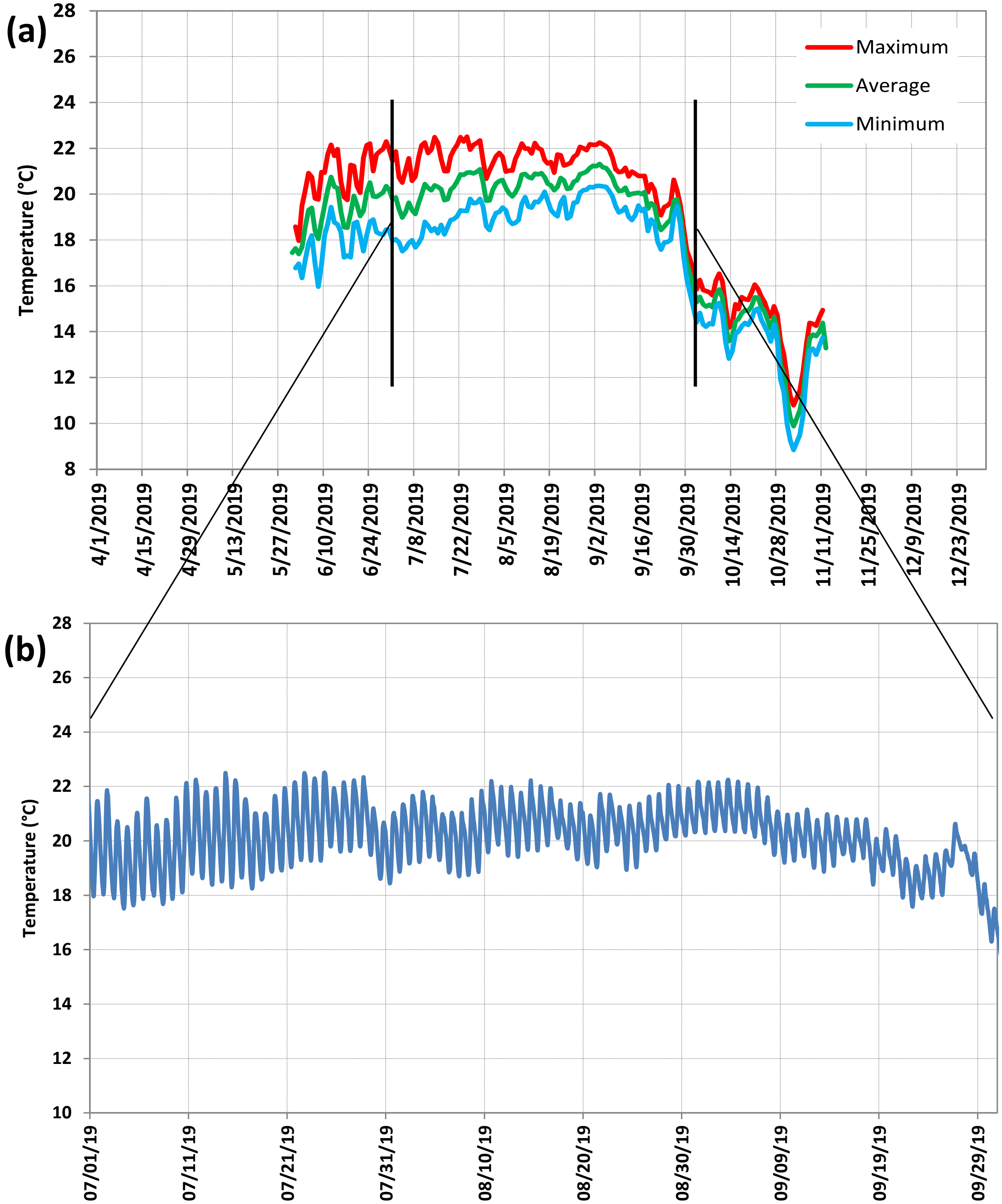


Figure 47: 2019 SC-3.0 (Highway 1 Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/19 - 10/1/19.

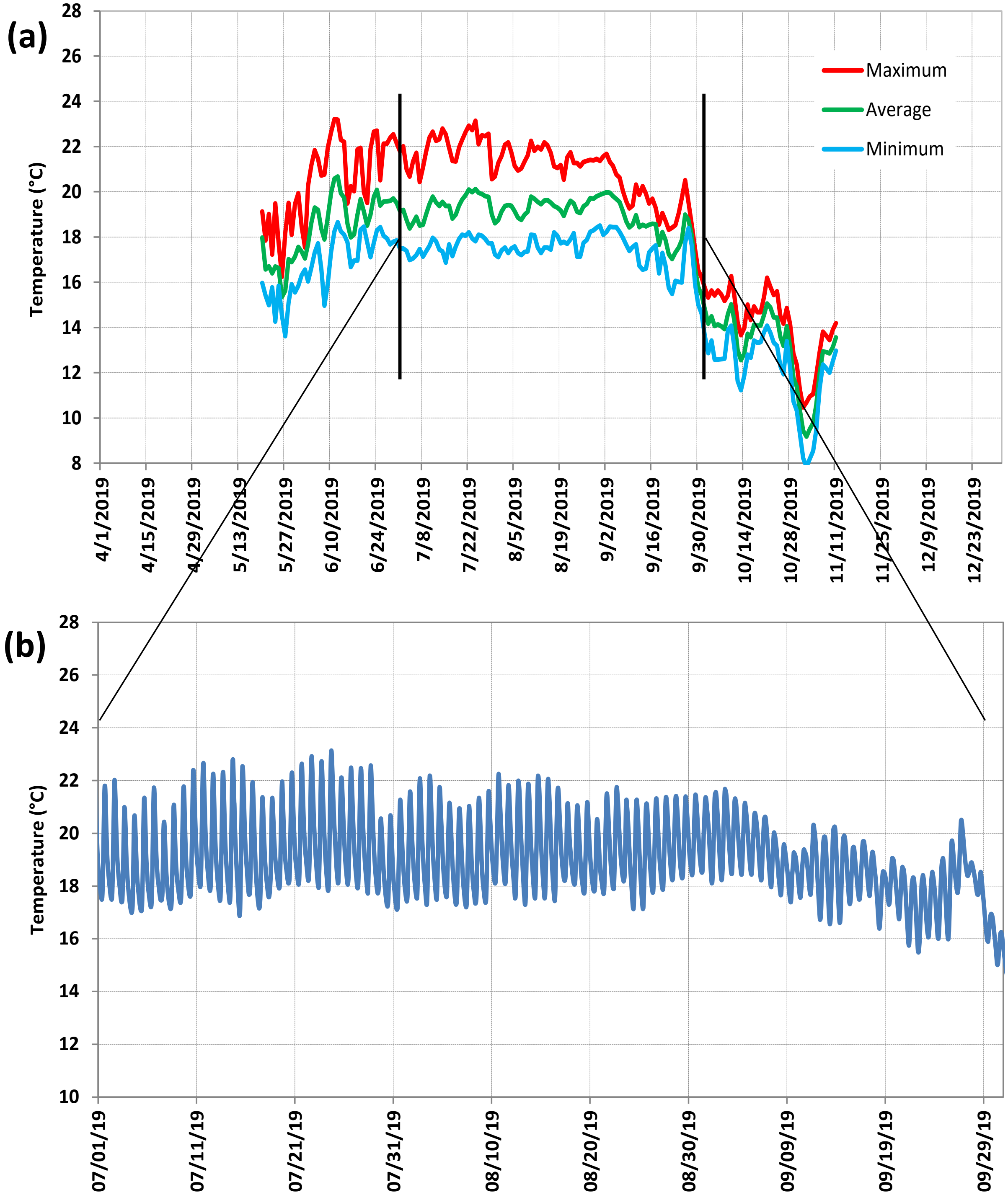


Figure 48: 2019 SC-3.5 (Jalama Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/19 - 10/1/19.

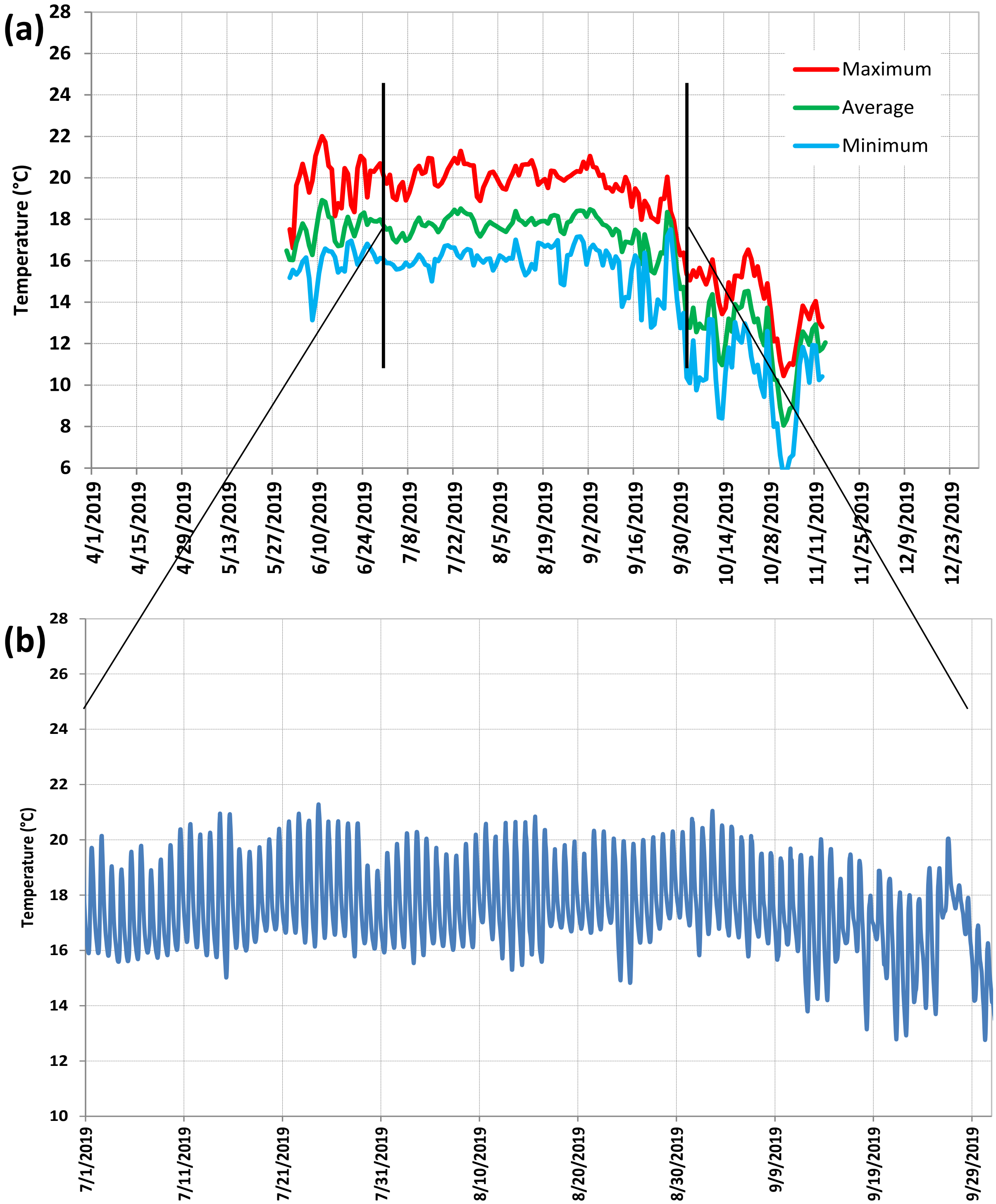


Figure 49: 2019 SC-3.8 Upper Salsipuedes Creek (0.5 feet) water temperatures for (a) daily maximum, average and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

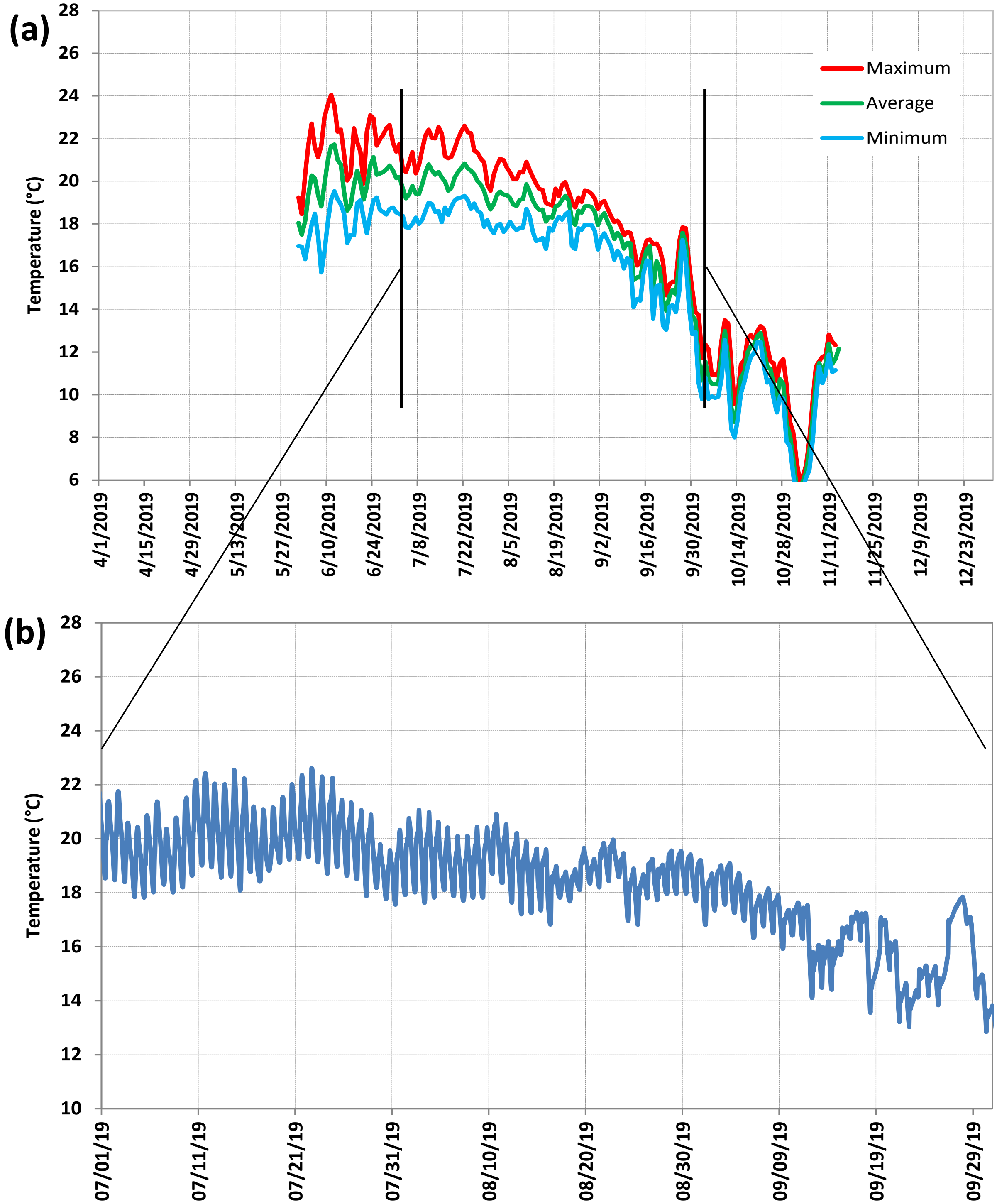


Figure 50: 2018 EJC-3.81 directly upstream of the Upper Salsipuedes Creek confluence bottom (2.5 - feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

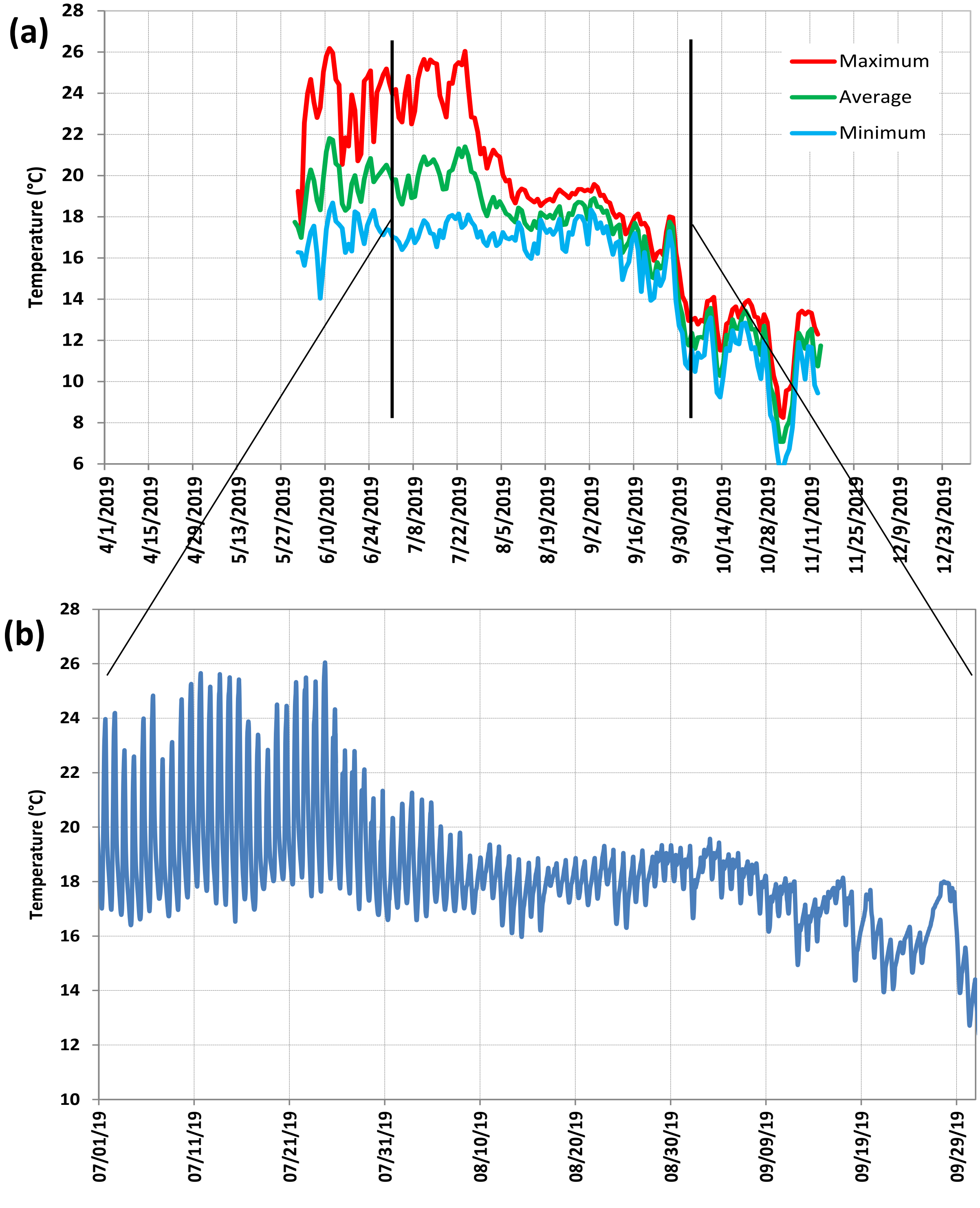


Figure 51: 2019 EJC-5.4 (Palos Colorados Pool Habitat) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/19 - 10/1/19.

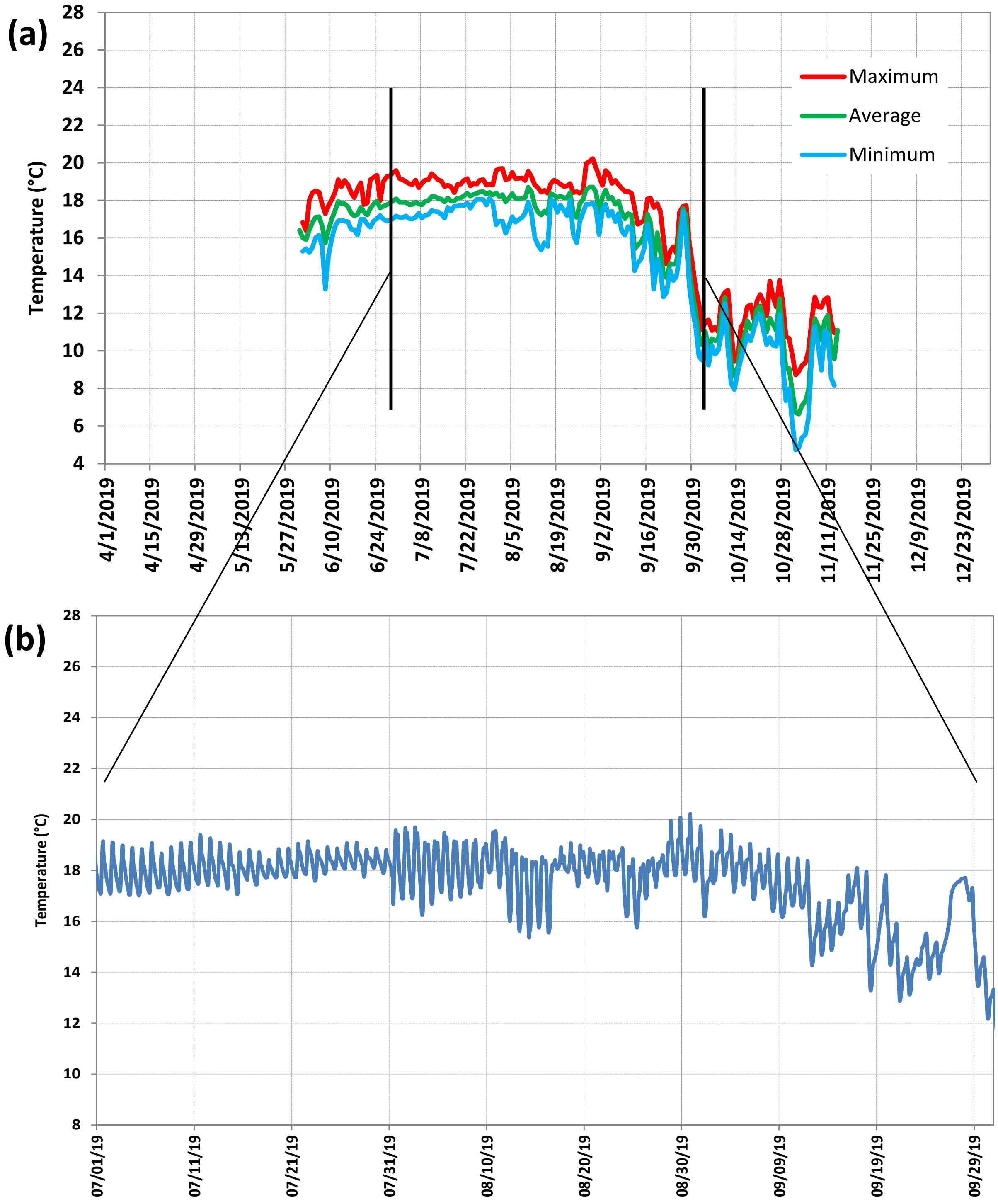


Figure 52: 2019 EJC-10.82 water temperature at Rancho San Julian Fish Ladder bottom (3.5 feet) for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/19 - 10/1/19.

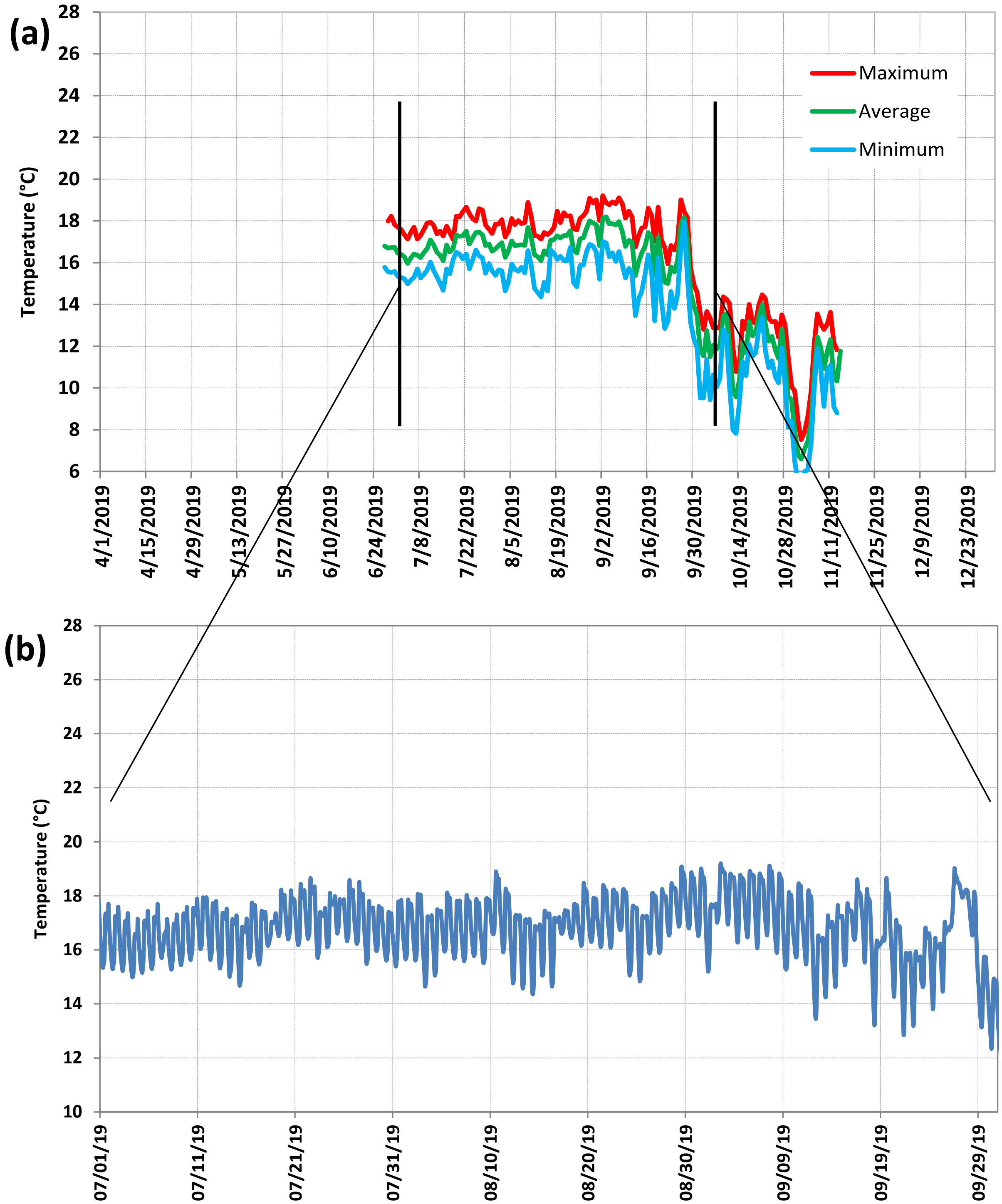


Figure 53: 2019 LAC-7.0 (Los Amoles Creek at Ford Crossing) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/19 - 10/1/19.

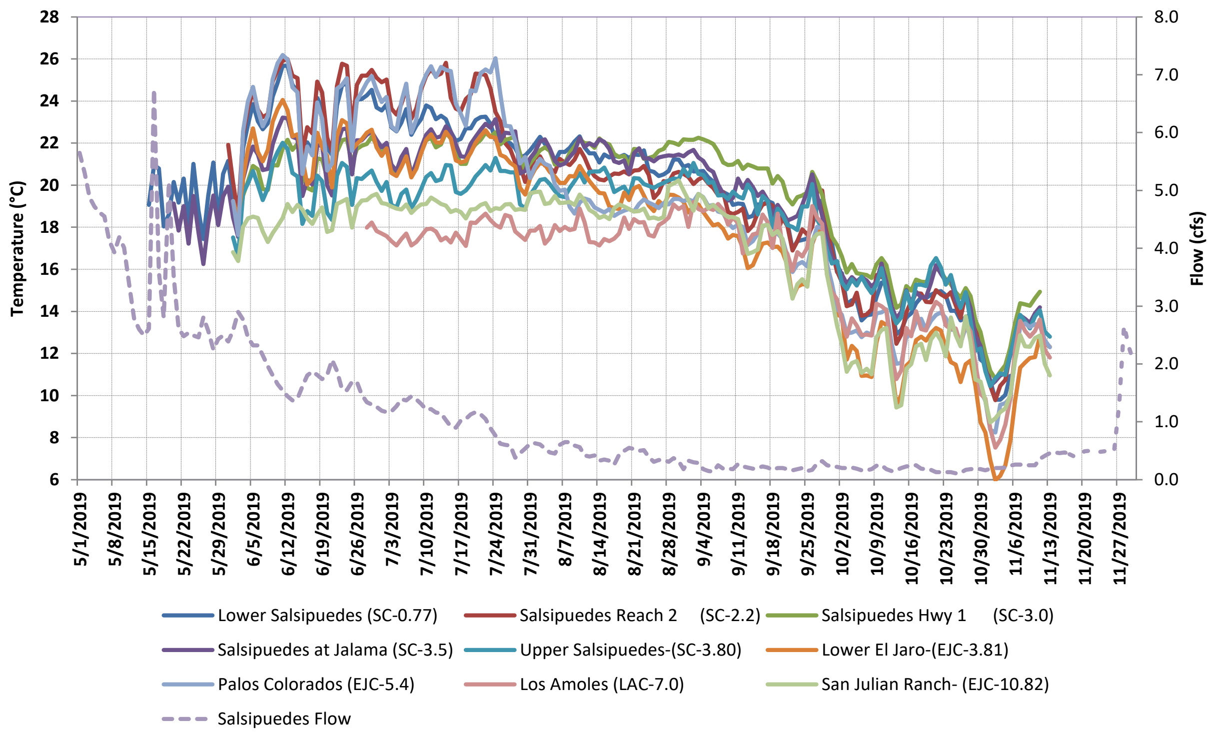


Figure 54: 2019 Longitudinal maximum daily water temperatures within the Salsipuedes Creek watershed which included El Jaro Creek at Rancho San Julian, (EJC-10.82), at Palos Colorados (EJC-5.4), at lower El Jaro Creek (EJC-3.81), at upper Salsipuedes Creek (SC-3.8), at Jalama Bridge (SC-3.5), at Highway 1 (SC-3.0), at Bedrock Section (SC-2.2), and at lower Salsipuedes Creek (SC-0.77) versus flow (cfs) at the USGS gauging station at Salsipuedes Creek.

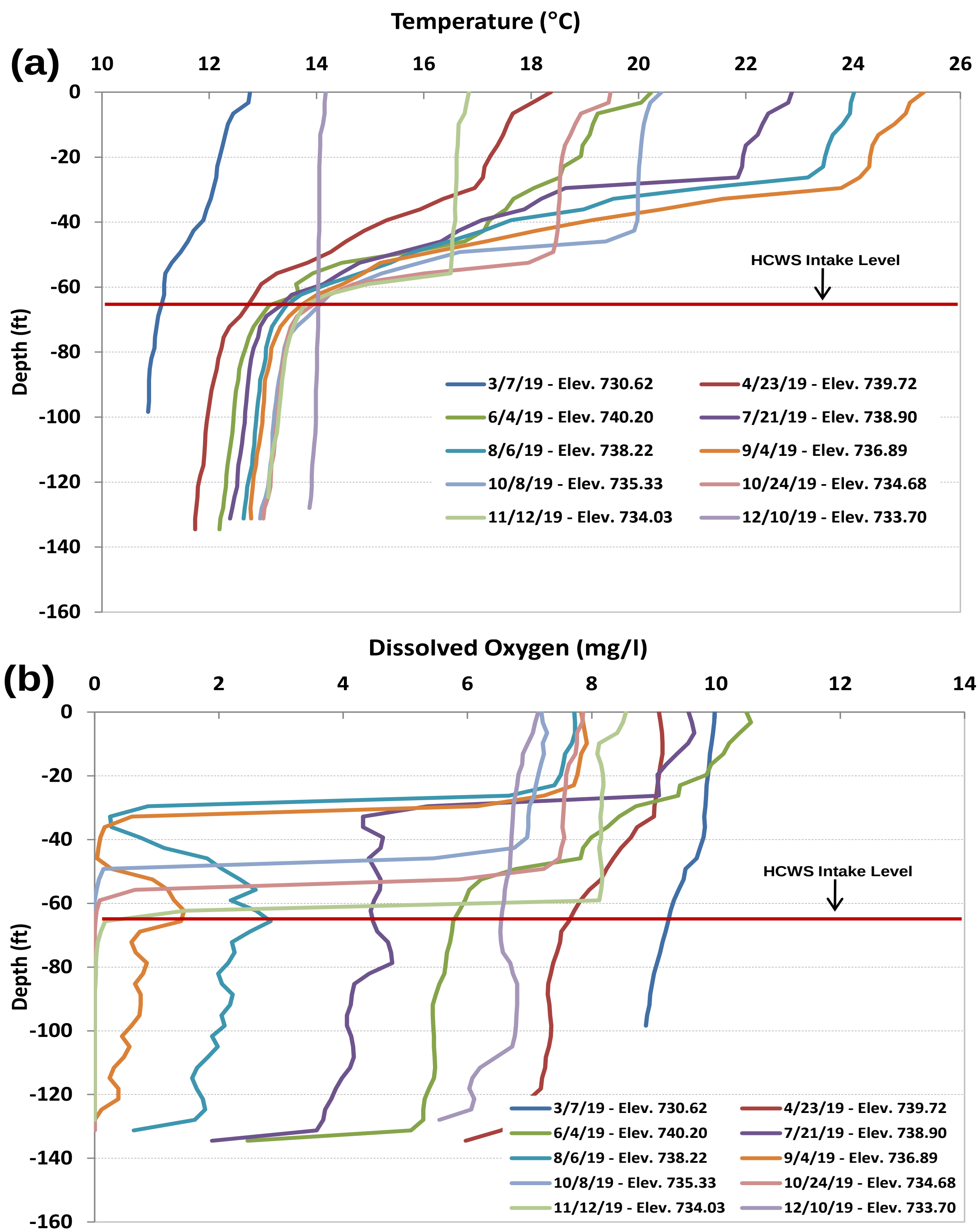


Figure 55: Lake Cachuma 2019 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS; the target depth of HCWS intake hose is 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

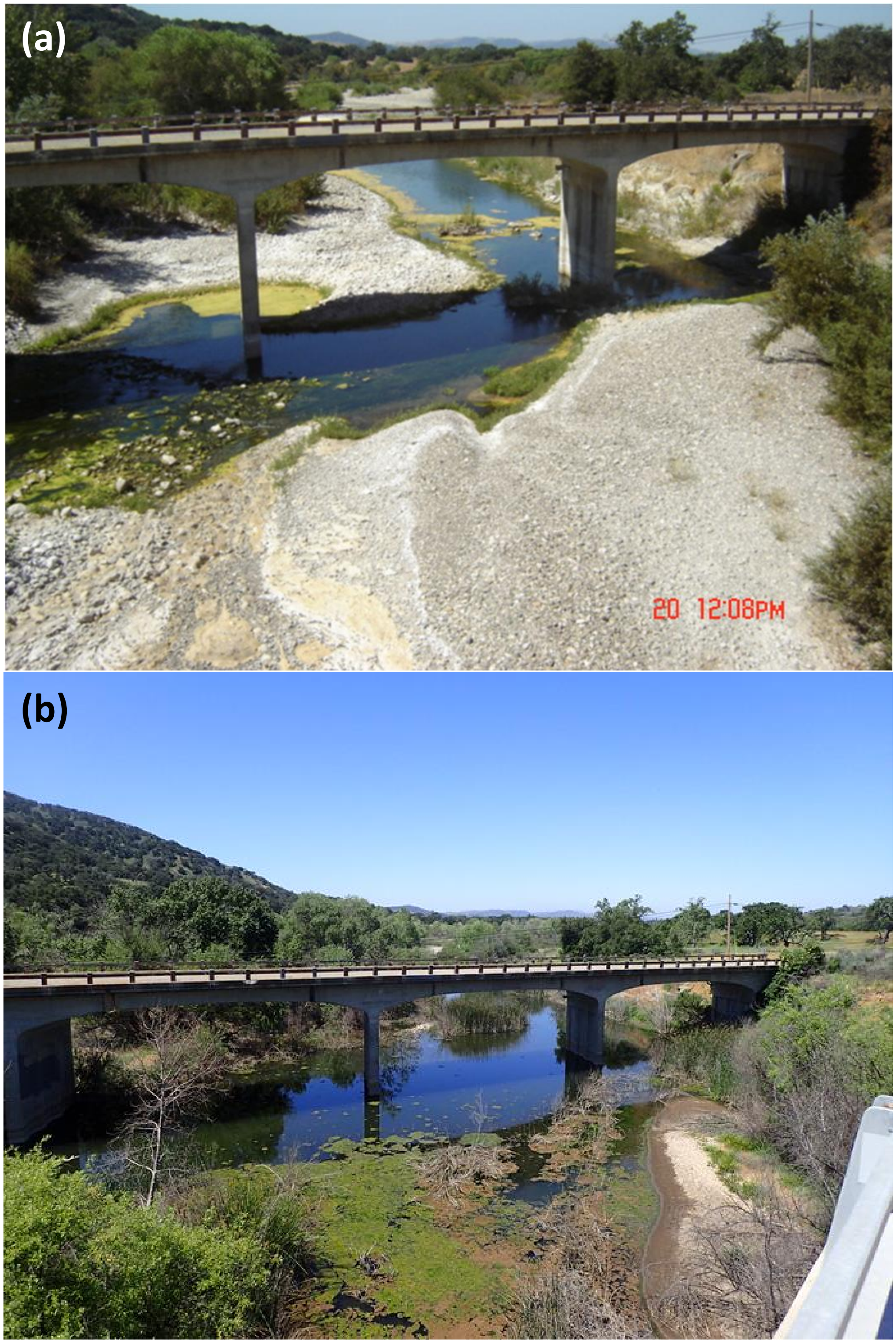


Figure 56: Photo points (M-6) collected at Highway 154 Bridge looking downstream in (a) September 2005 and (b) April 2019.

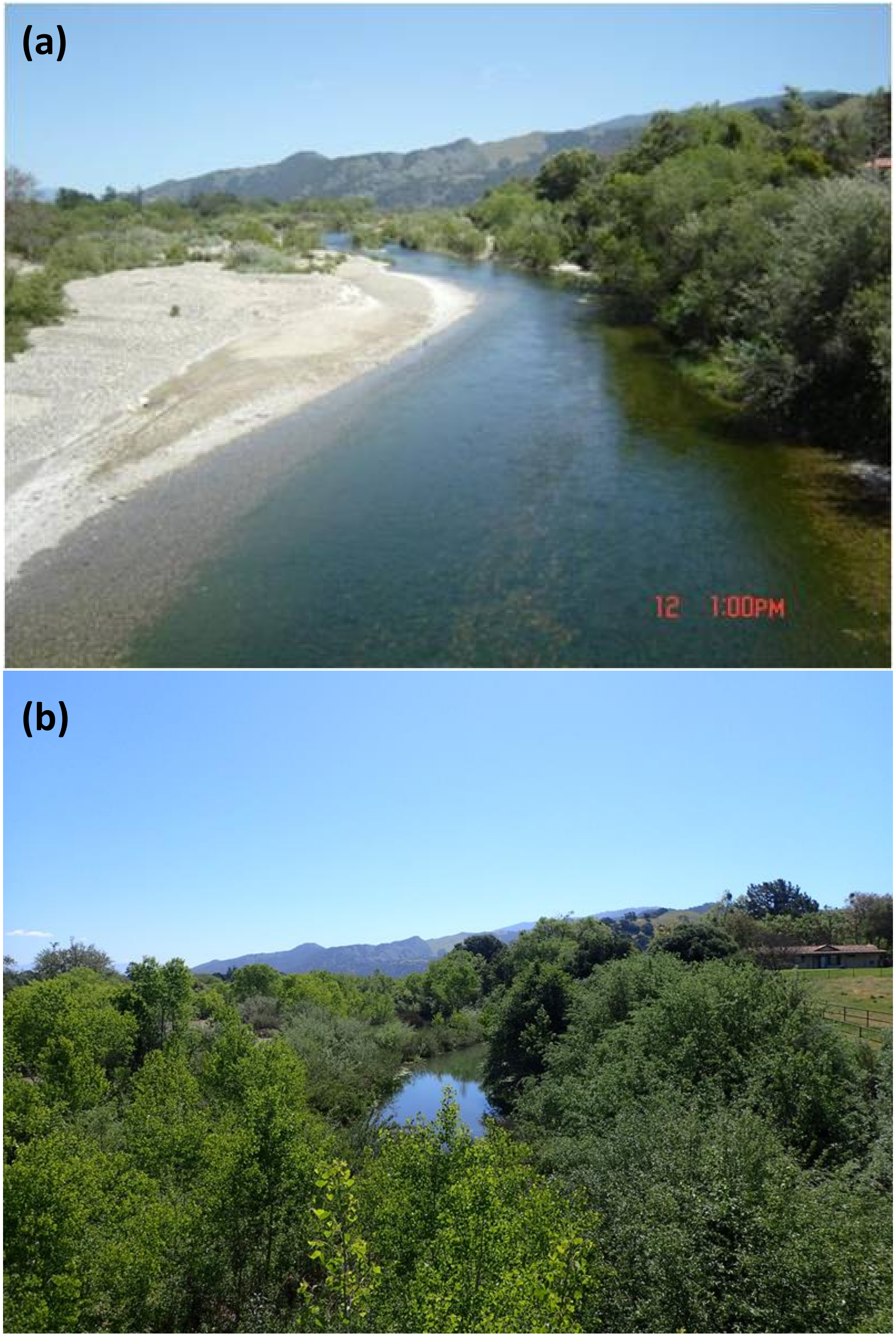


Figure 57: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) April 2019.

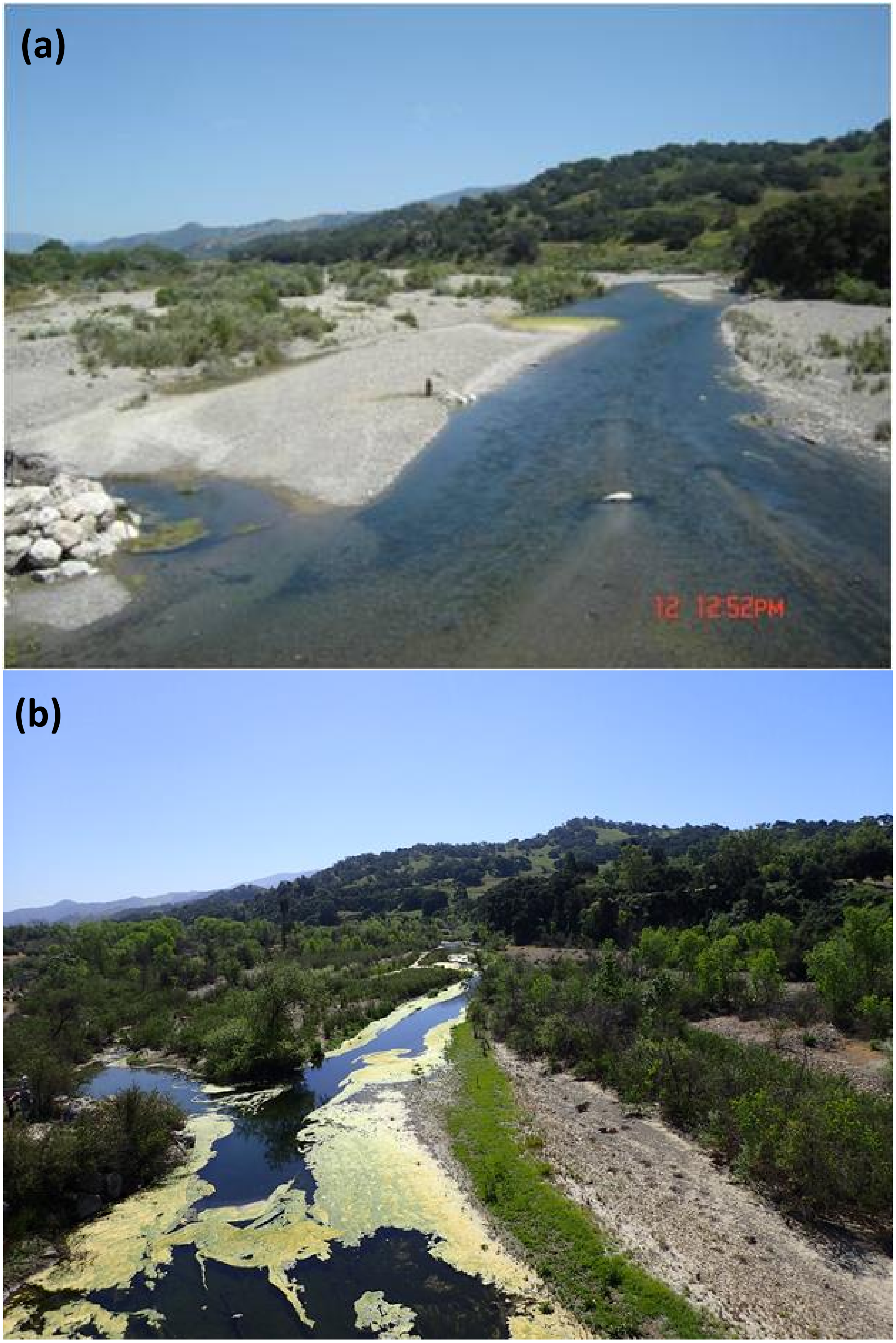


Figure 58: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) April 2019.

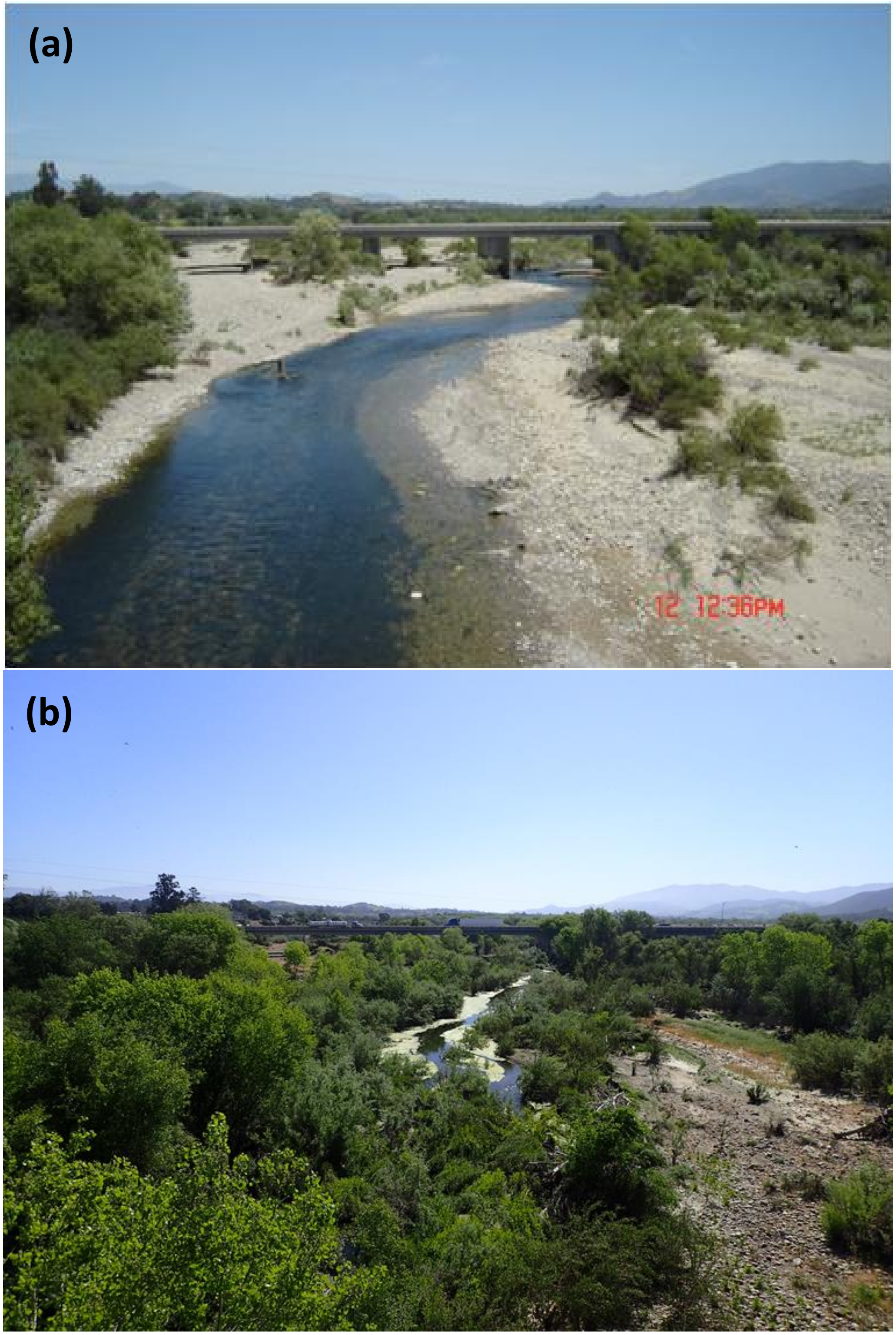


Figure 59: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) April 2019.

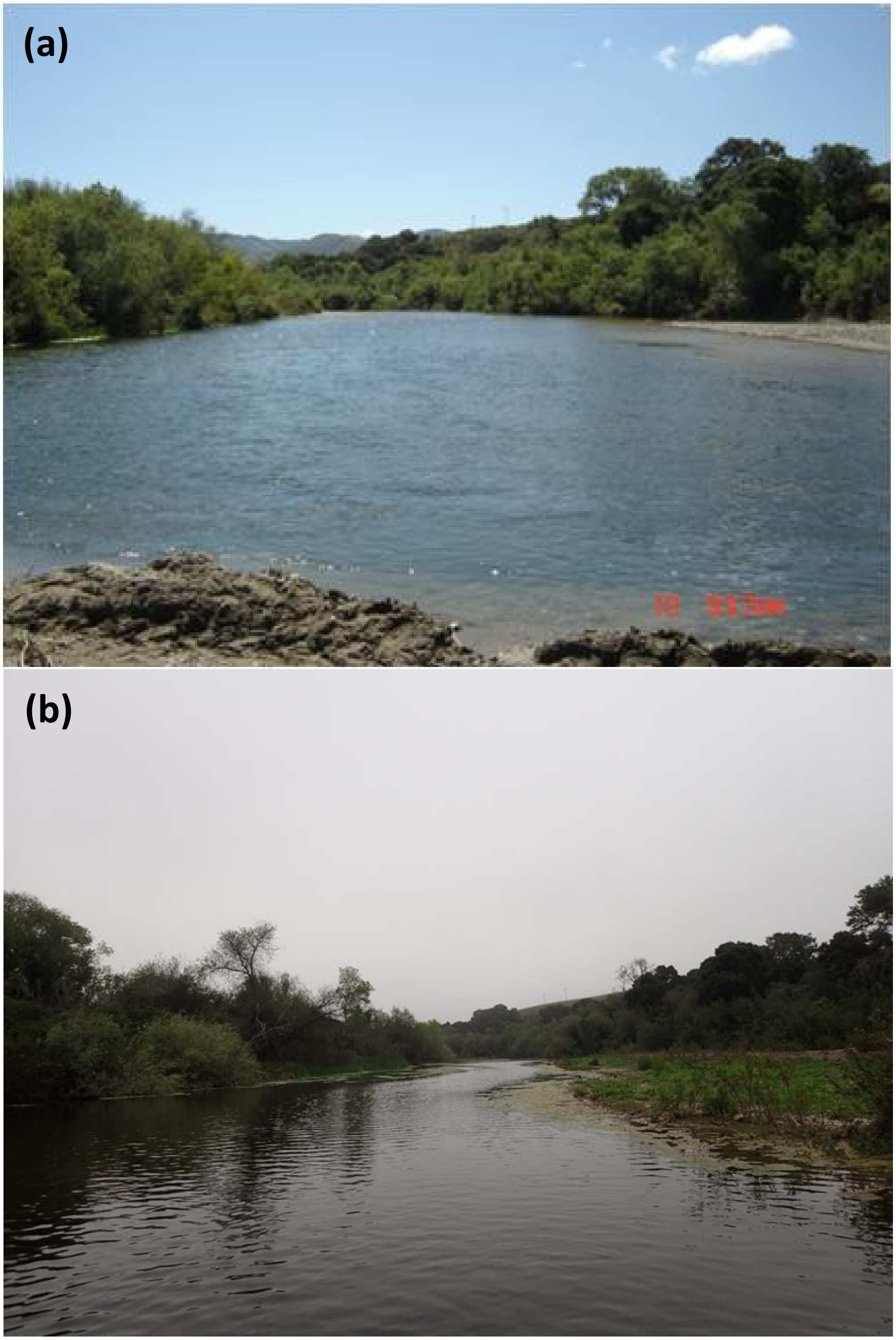


Figure 60: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) April 2019.

Figure 61: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) August 2019.

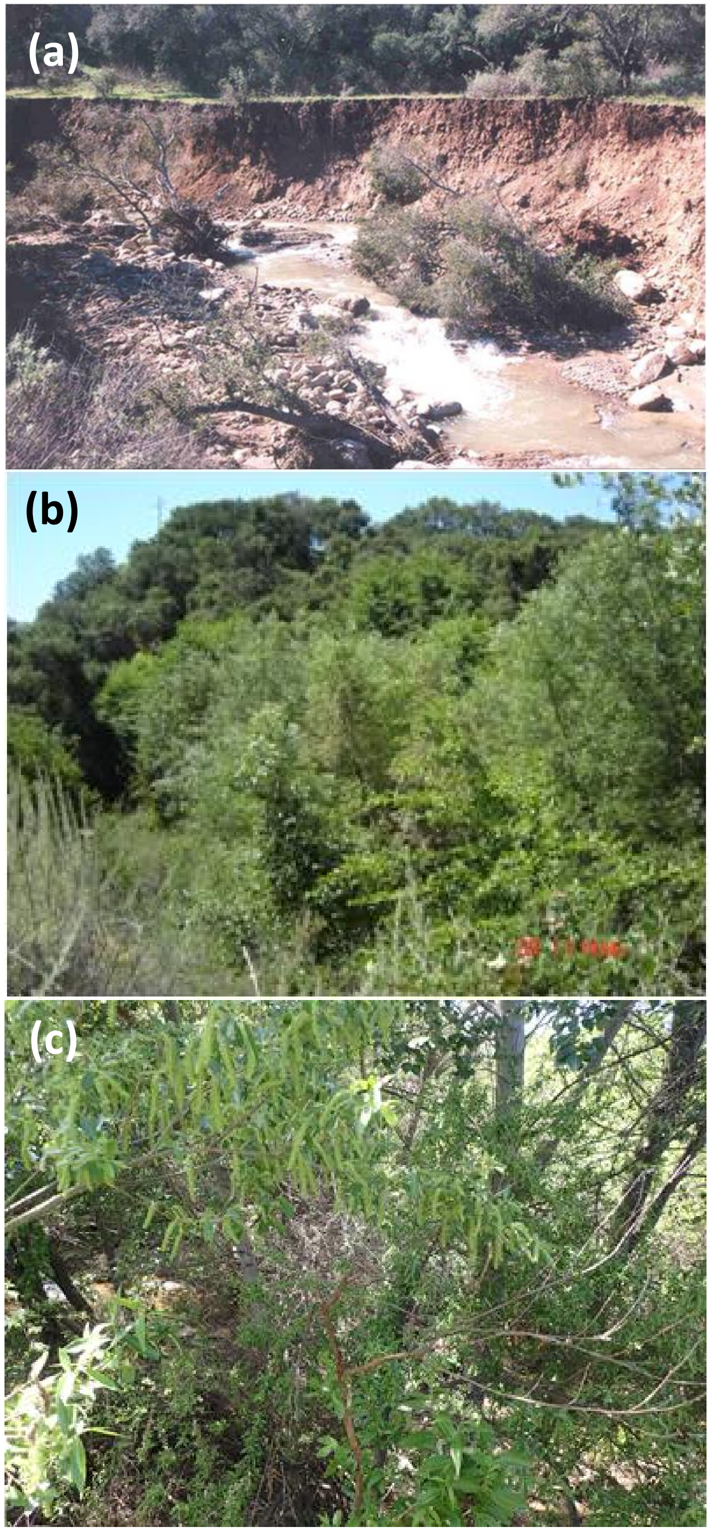


Figure 62: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) April 2019; the creek is nearly invisible now from this vantage point.

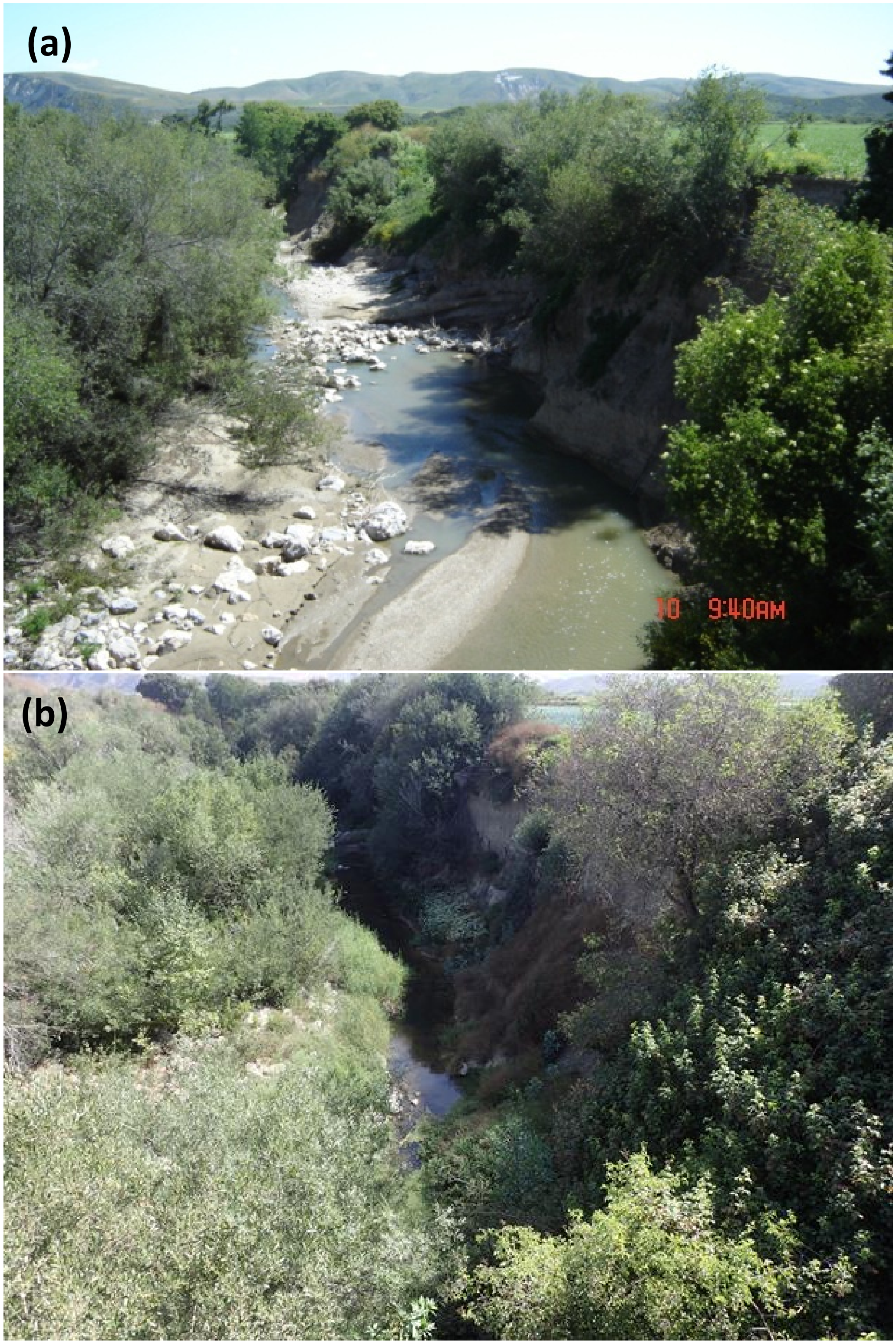


Figure 63: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) August 2019.

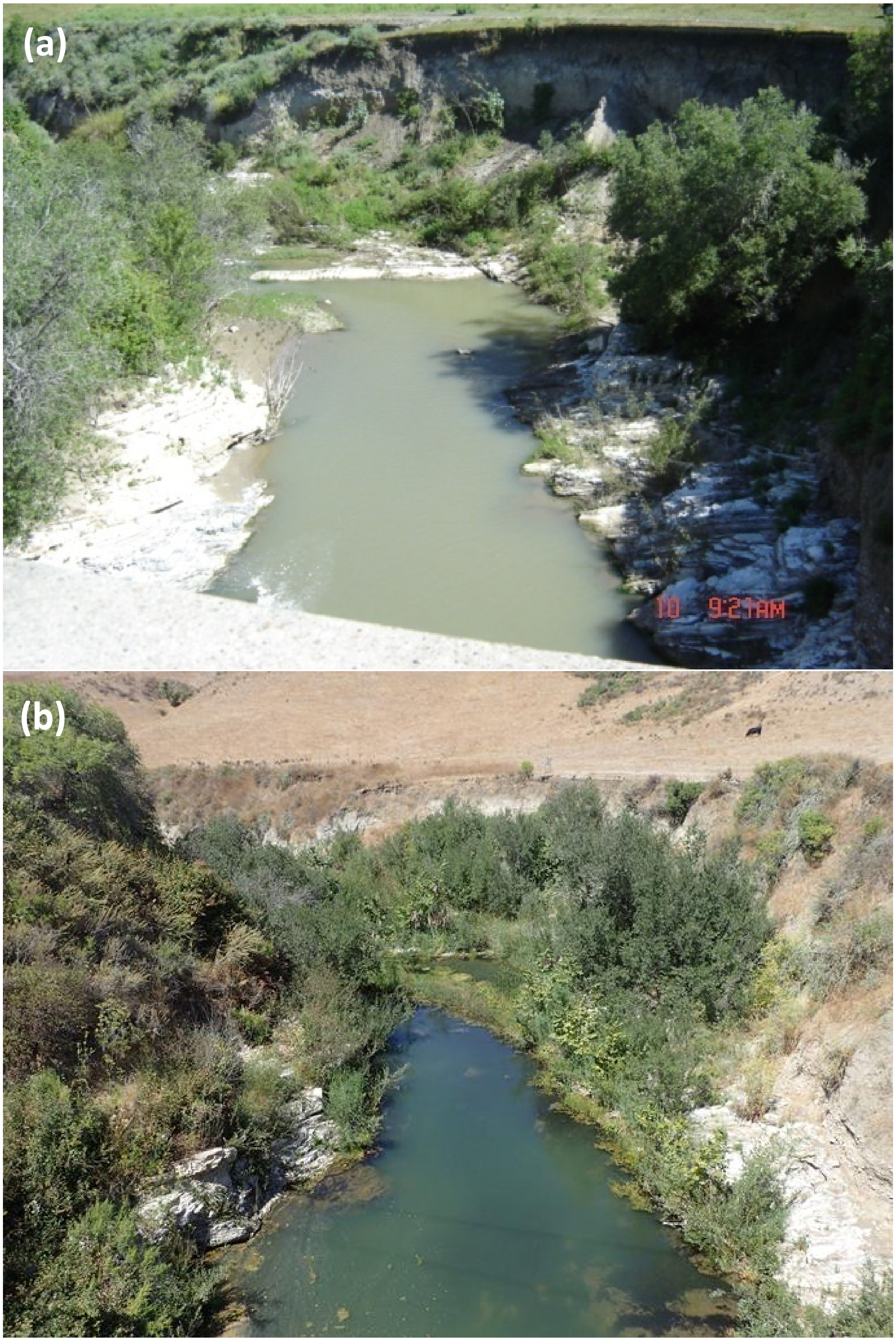


Figure 64: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) August 2019.

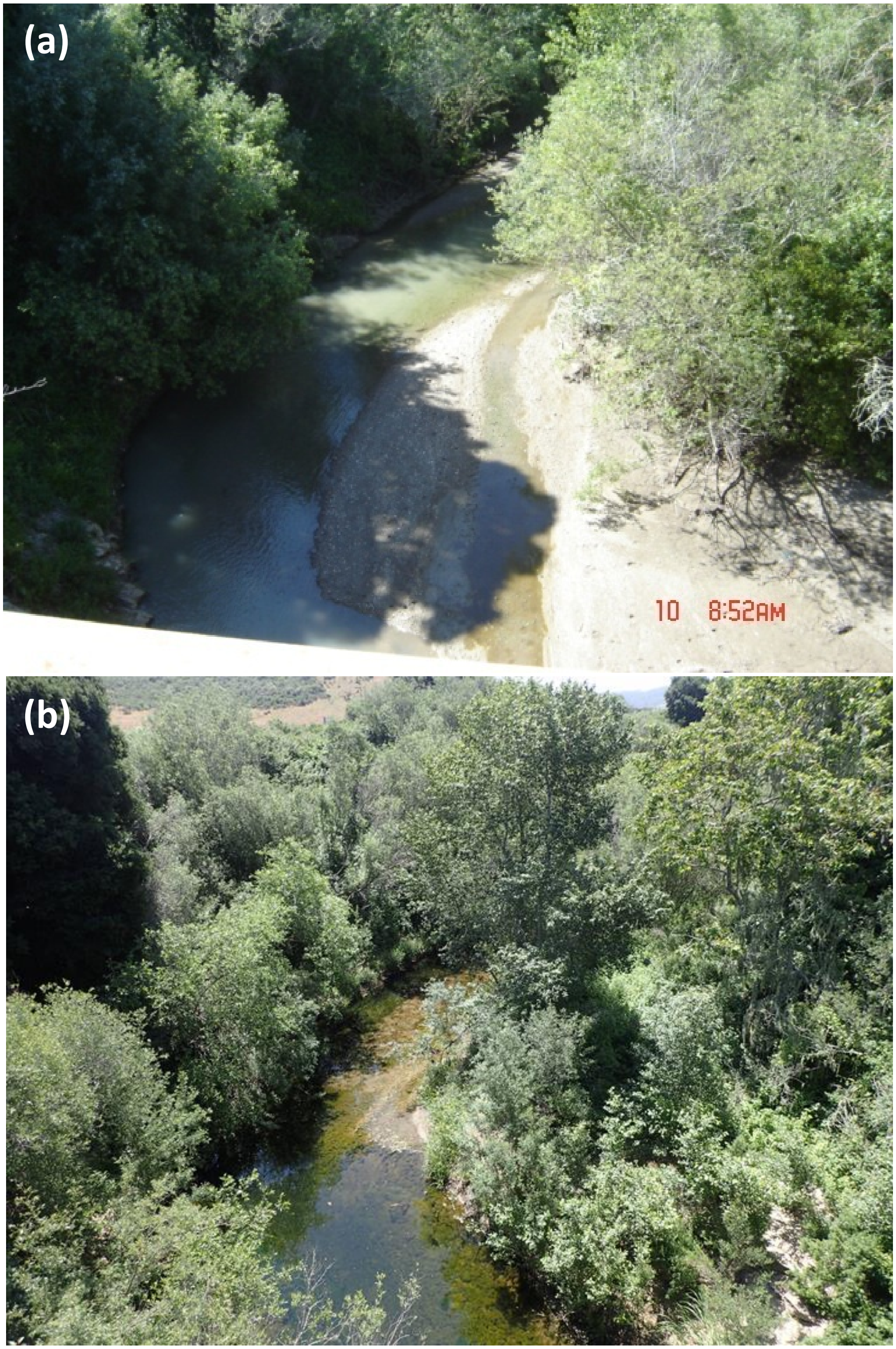


Figure 65: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) May 2019.

3.4 Migrant Trapping

Table 7: WY2019 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 Trap	1/23/2019	5/15/2019	1/31/2019	2/6/2019	6		
			2/8/2019	2/9/2019	1		
			2/13/2019	2/16/2019	3		
			3/1/2019	3/3/2019	2		
			3/5/2019	3/7/2019	2		
	Total:	112		**Total:**	14	98	88%
Salsipuedes	1/23/2019	5/15/2019	1/31/2019	2/6/2019	6		
			2/8/2019	2/11/2019	3		
			2/13/2019	2/19/2019	6		
			2/26/2019	3/8/2019	12		
			3/19/2019	3/21/2019	2		
	Total:	112		**Total:**	29	83	74%
Mainstem	2/7/2019	3/27/2019	2/13/2019	2/16/2019	3		
			3/5/2019	3/8/2019	3		
	Total:	50		**Total:**	6	44	88%

Table 8: WY2019 *O. mykiss* 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	20	17	98	112	87.5	0.20	0.17	0.38	7.6	4.3
Salsipuedes	0	2	83	112	74.1	0.00	0.02	0.02	43.4	15.5
Mainstem	0	0	44	50	88.0	0.00	0.00	0.00	46.2	21.9

Table 9: Number of *O. mykiss* migrant captures, including recaptures but not young-of-the-year, associated with each trap check at each trapping location over 24-hours in WY2019.

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	6	3	5	6		20
	Downstream	3	0	7	7		17
	Total:	9	3	12	13		37
Salsipuedes	Upstream	0	0	0	0		0
	Downstream	0	0	1	1		2
	Total:	0	0	1	1		2

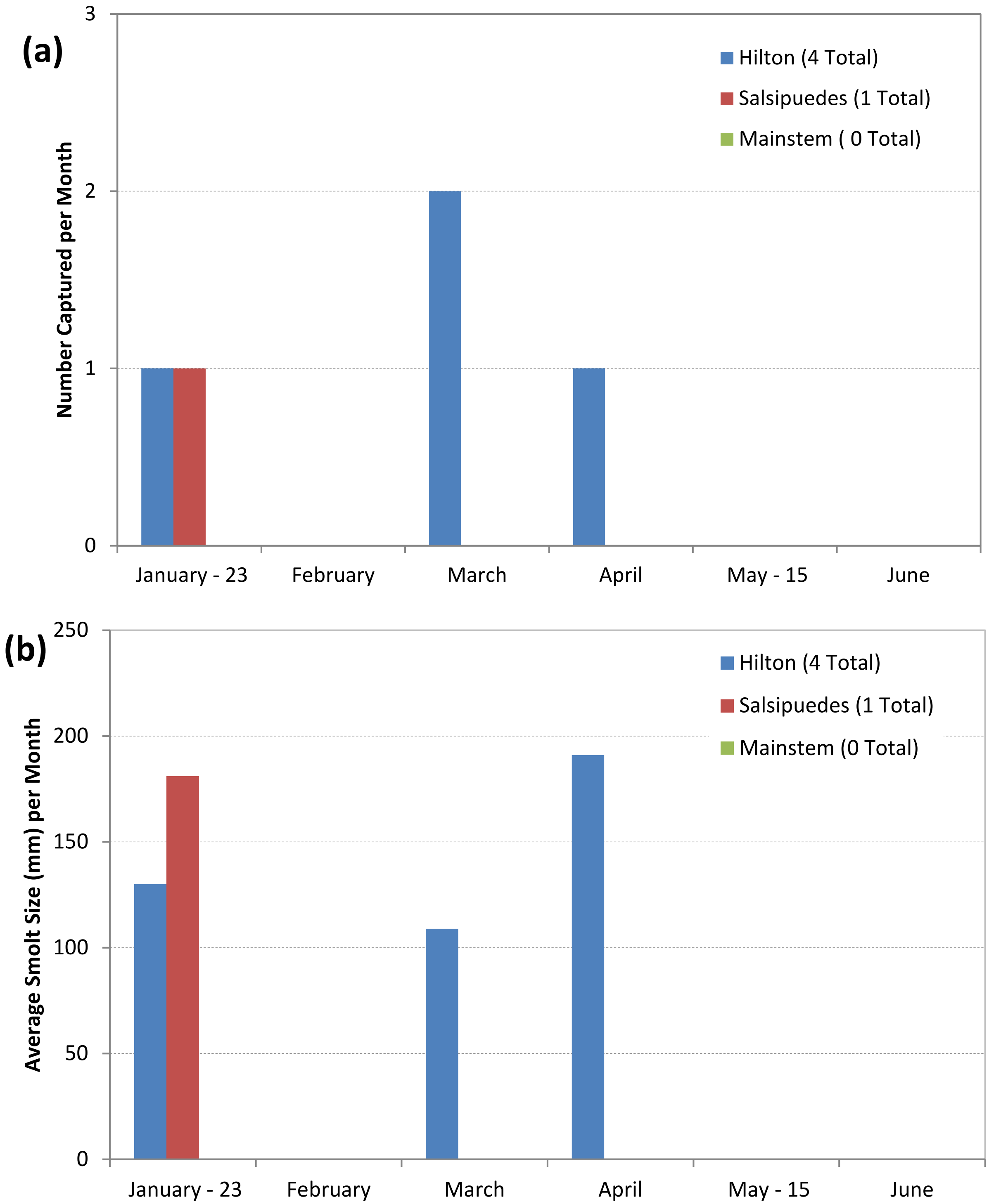


Figure 66: Monthly *O. mykiss* smolt captured at the Hilton Creek and Salsipuedes Creek traps in WY2019 showing: (a) number captured at each site and (b) average size of smolts captured by month; trapping start and end times are listed on the graph.

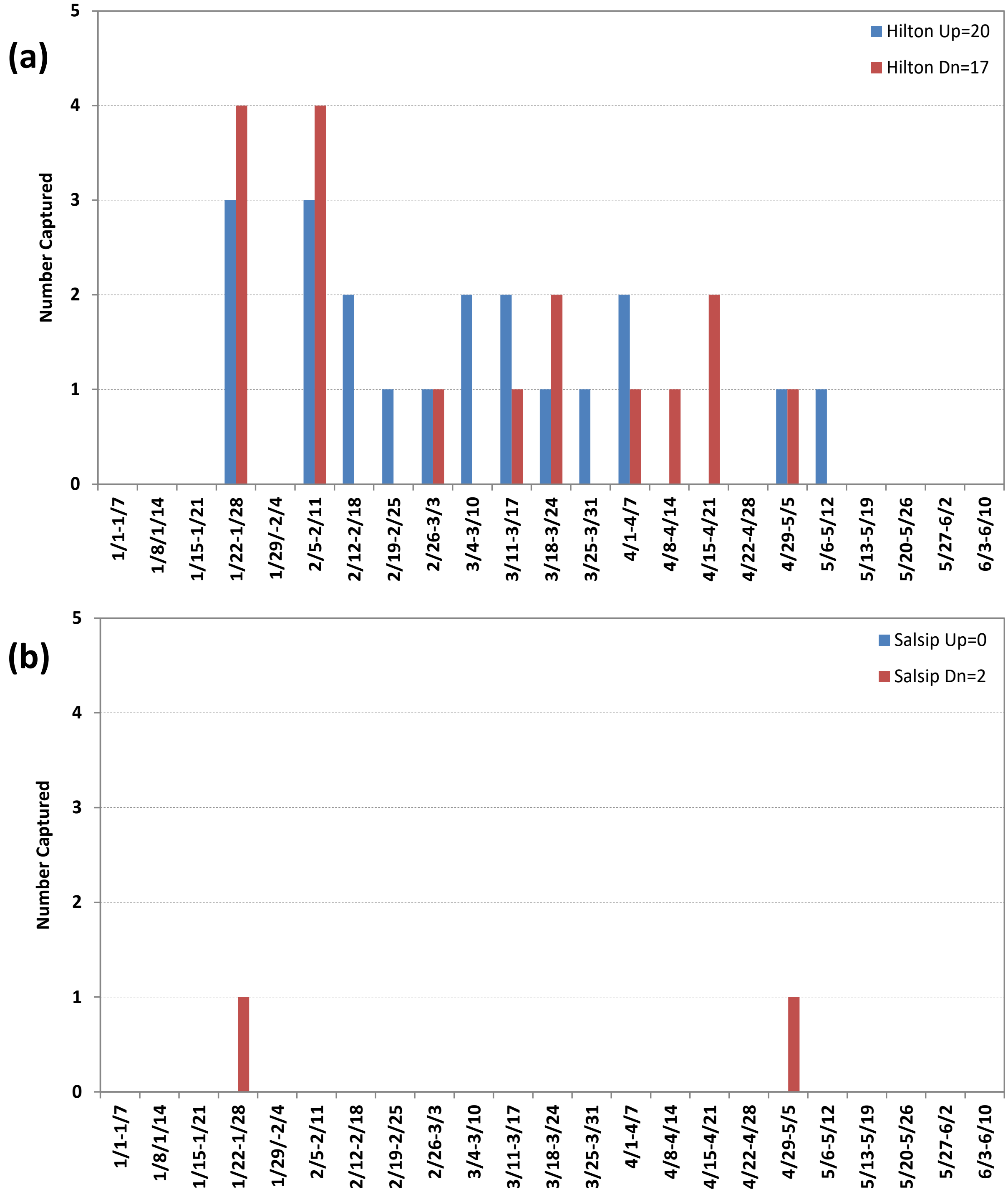


Figure 67: WY2019 paired histogram of weekly upstream and downstream *O. mykiss* captures by trap site for: (a) Hilton Creek and (b) Salsipuedes Creek; the trapping season started on 1/23/19 and ended on 5/15/19.

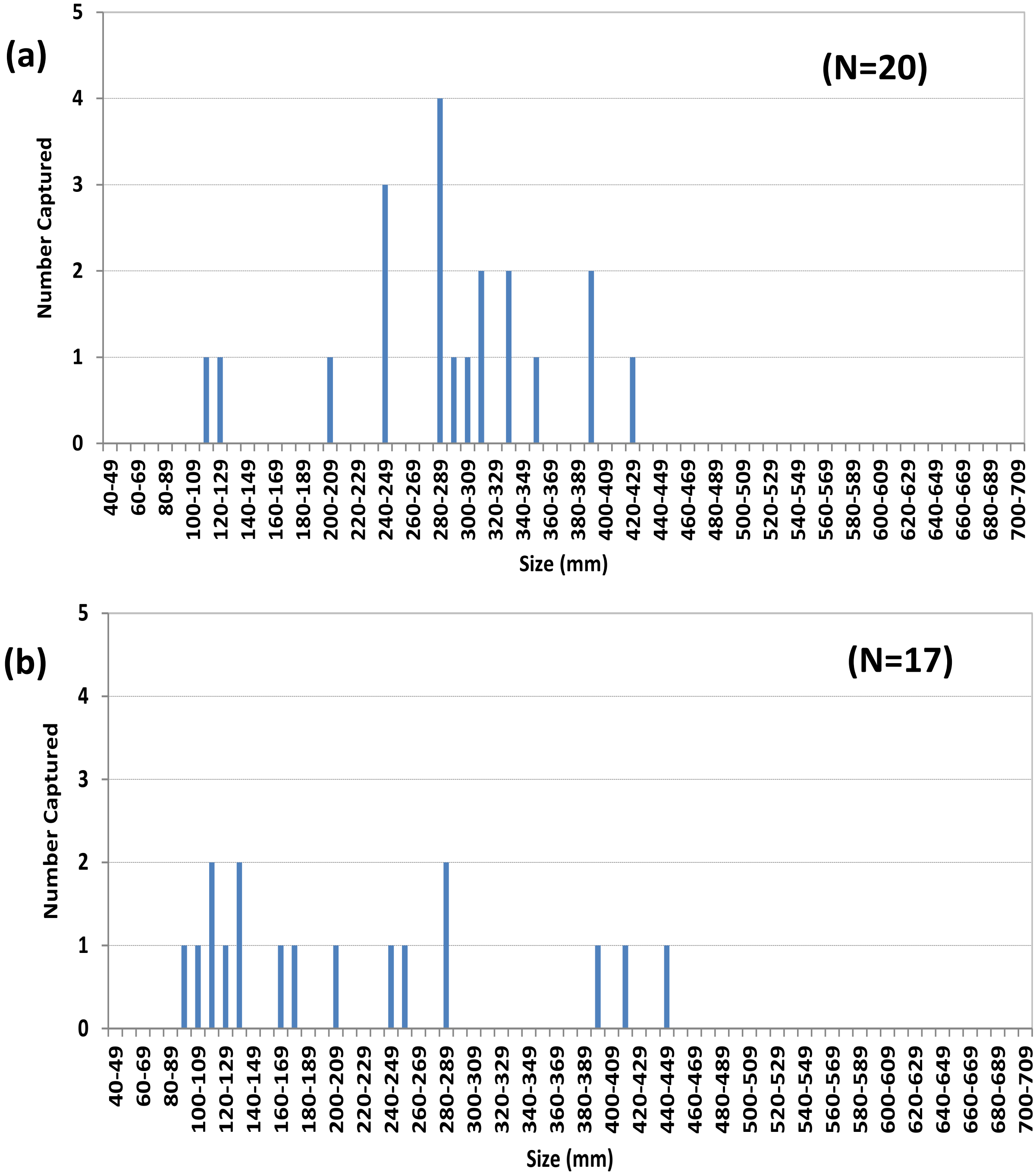


Figure 68: WY2019 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* migrant captures.

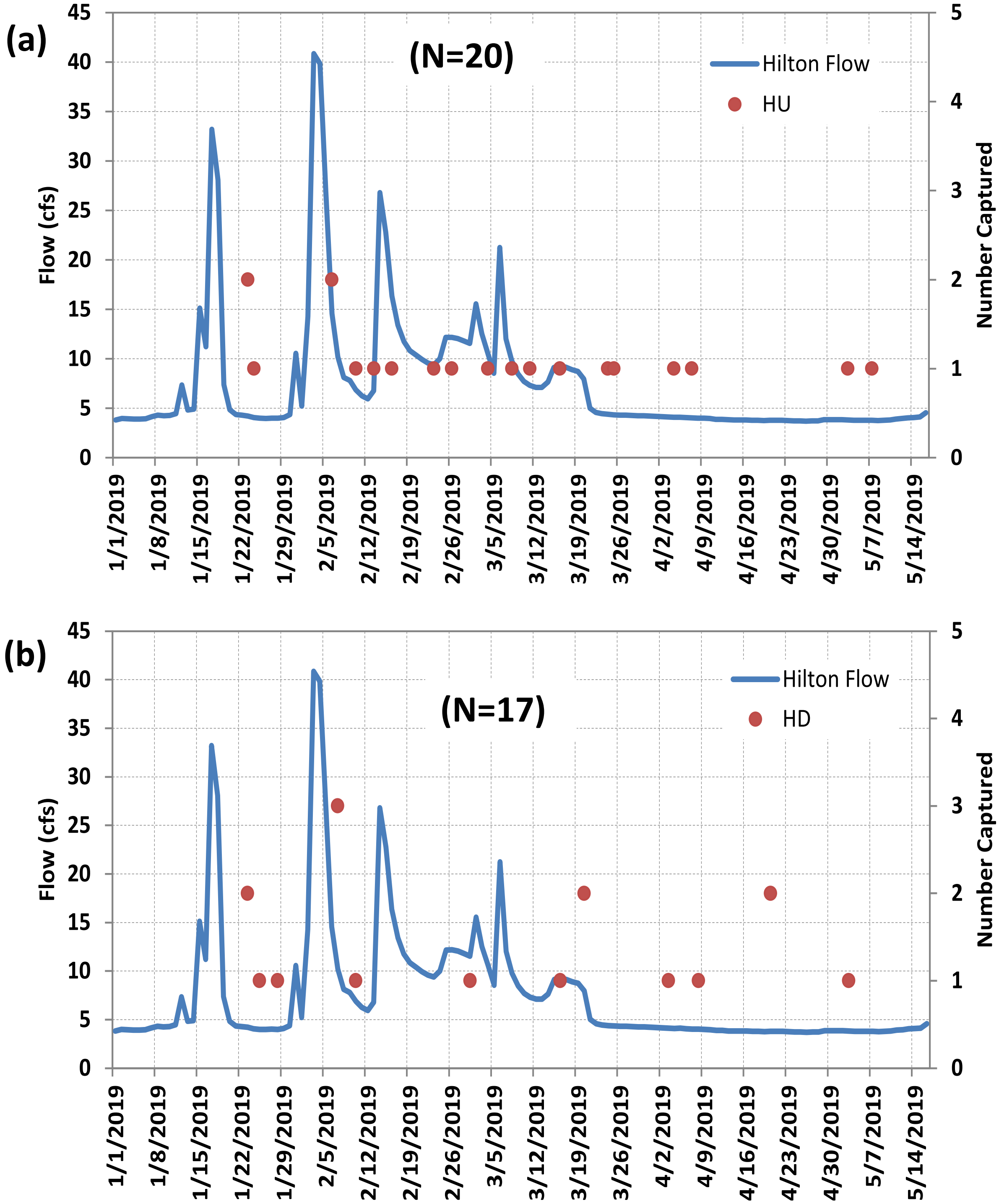


Figure 69: WY2019 Hilton Creek *O. mykiss* migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures.

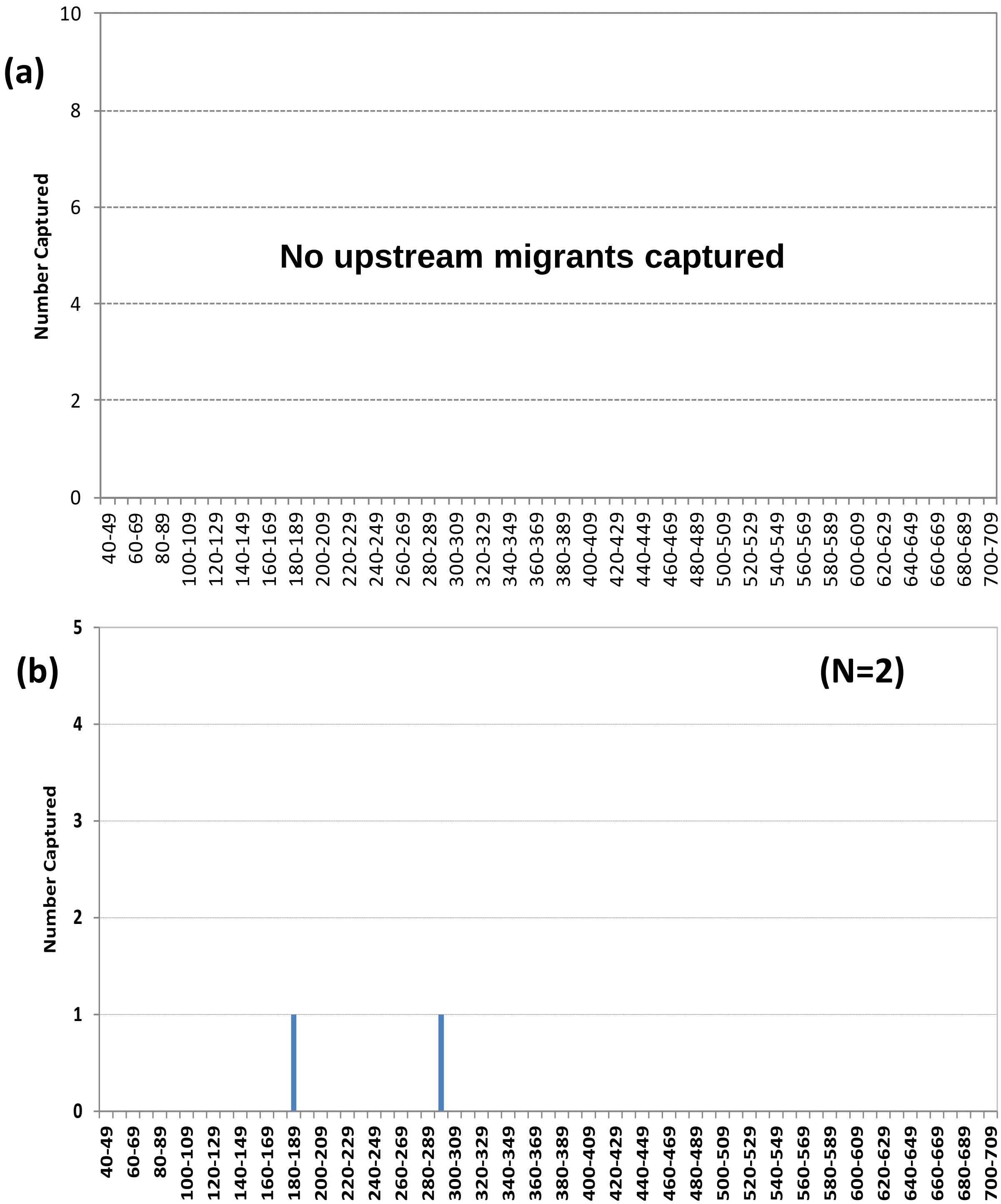


Figure 70: WY2019 Salsipuedes Creek trap length frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* captures.

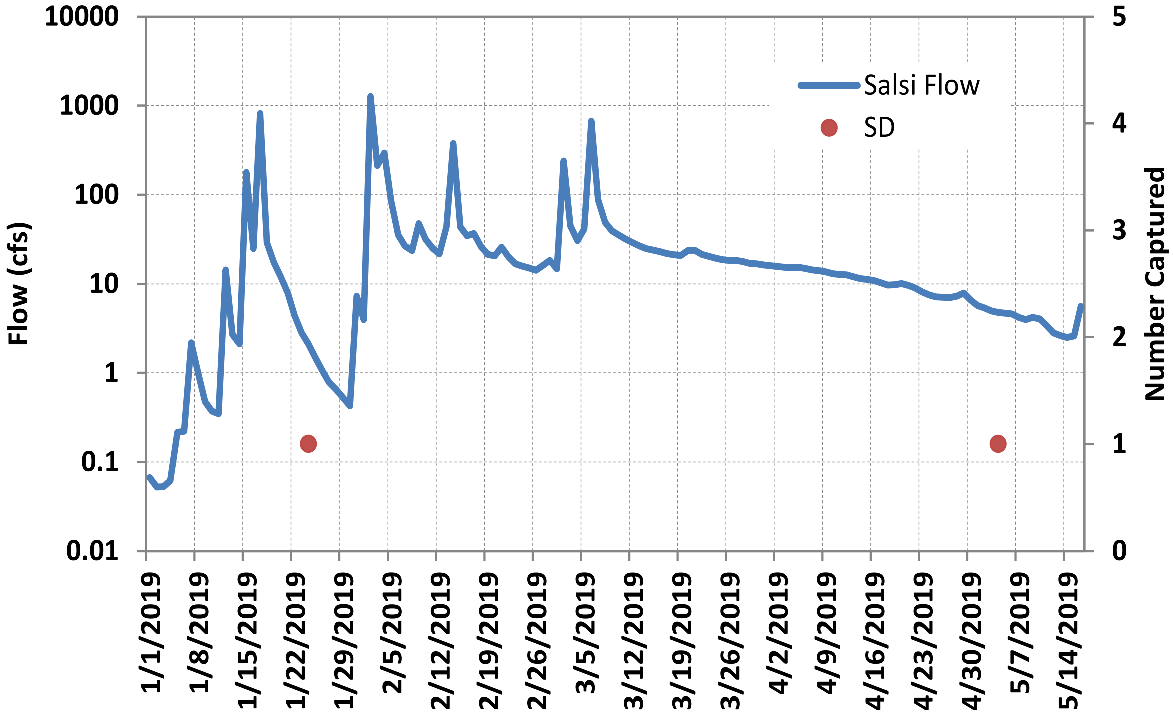


Figure 71: WY2019 Salsipuedes Creek *O. mykiss* migrant captures (red dots) vs. flow for downstream migrants; no upstream migrants were captured during WY019.

Table 10: Tributary upstream and downstream *O. mykiss* migrant captures for Hilton Creek and Salsipuedes Creek in WY2019; 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
0		650-699		0
0		600-649		0
0		550-599		0
0		500-549		0
0		450-499		0
1		400-449		0
8		300-399		0
9		200-299		0
2		100-199		0
0		<99		0
20		**Total**		**0**
		Downstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
0		550-599		0
0		500-549		0
0		450-499		0
2		400-449		0
1		300-399		0
5		200-299		1
	1	***Smolts***	***0***	
	0	***Pre-Smolt***	***0***	
	4	***Res***	***1***	
8		100-199		1
	1	***Smolts***	***0***	
	2	***Pre-Smolt***	***1***	
	5	***Res***	***0***	
1		<99		0
	0	***Smolts***	***0***	
	0	***Pre-Smolt***	***0***	
	1	***Res***	***0***	
17		**Total**		**2**

Table 11: WY2019 tributary *O. mykiss* redd survey results; lengths and widths are given in feet and Salsipuedes Creek watershed includes Upper Salsipuedes, El Jaro, Ytias, and Los Amoles creeks.

Location	Date	Redd #	Length*	Width**
Tributary Redds				
Hilton Ck	3/18/2019	1	3.4	1.4
	3/18/2019	2	3.2	1.0
	3/18/2019	3	2.7	1.5
	3/18/2019	4	4.3	2.0
	3/18/2019	5	2.6	1.1
	3/20/2019	6	3	1.7
	4/8/2019	7	3.4	2.1
	4/18/2019	8	4.2	1.4
El Jaro	3/27/2019	9	2.9	1.4
Quiota Ck	4/3/2019	10	2.1	1.1
	4/3/2019	11	1.6	0.9
* Pit length plus tailspill length.				
** Average of pit width and tailspill widths.				

Table 12: WY2019 tributary redd observations by month for each creek surveyed.

	January	February	March	April	May	Total
Hilton Ck	n/s	n/s	6	2	n/s	8
Quiota Ck	n/s	n/s	0	2	n/s	2
Salsipuedes Ck	n/s	n/s	0	0	n/s	0
El Jaro Ck	n/s	n/s	1	0	n/s	1
Los Amoles CK	n/s	n/s	0	0	n/s	0
Ytias Ck	n/s	n/s	0	0	n/s	0
					Total:	**11**
n/s - not surveyed due to trubid conditions or low water level.						

Table 13: WY2019 LSYR mainstem redd survey results within the management reaches (Refugio and Alisal reaches) by month.

	January	February	March	April	May	Total
Highway 154	n/s	0	0	0	n/s	0
Refugio Reach	n/s	n/s	n/s	n/s	n/s	-
Alisal Reach	n/s	n/s	n/s	n/s	n/s	-
					Total:	**0**
n/s - not surveyed due to trubid conditions or low water level.						

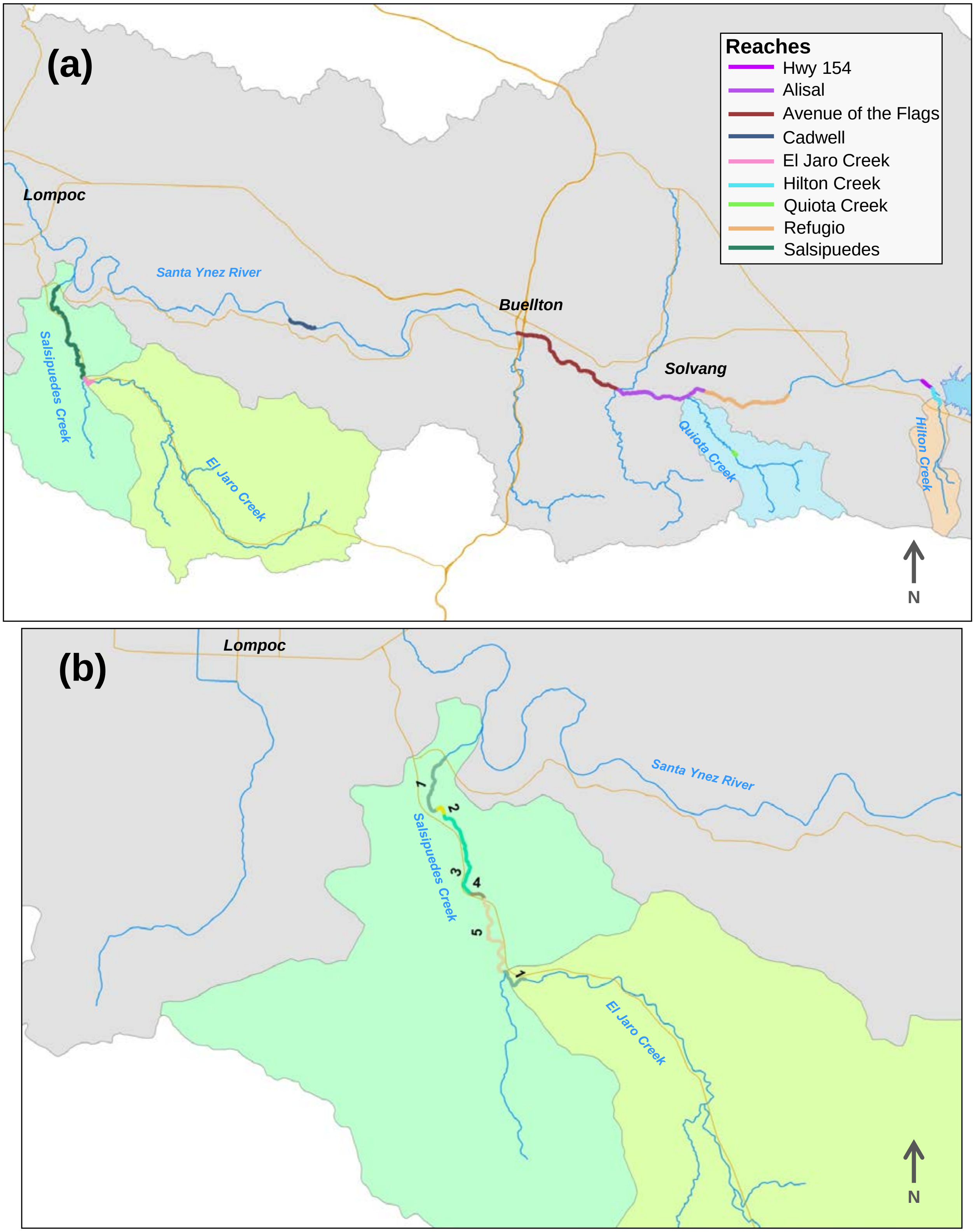


Figure 72: Stream reaches snorkel surveyed in 2019 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

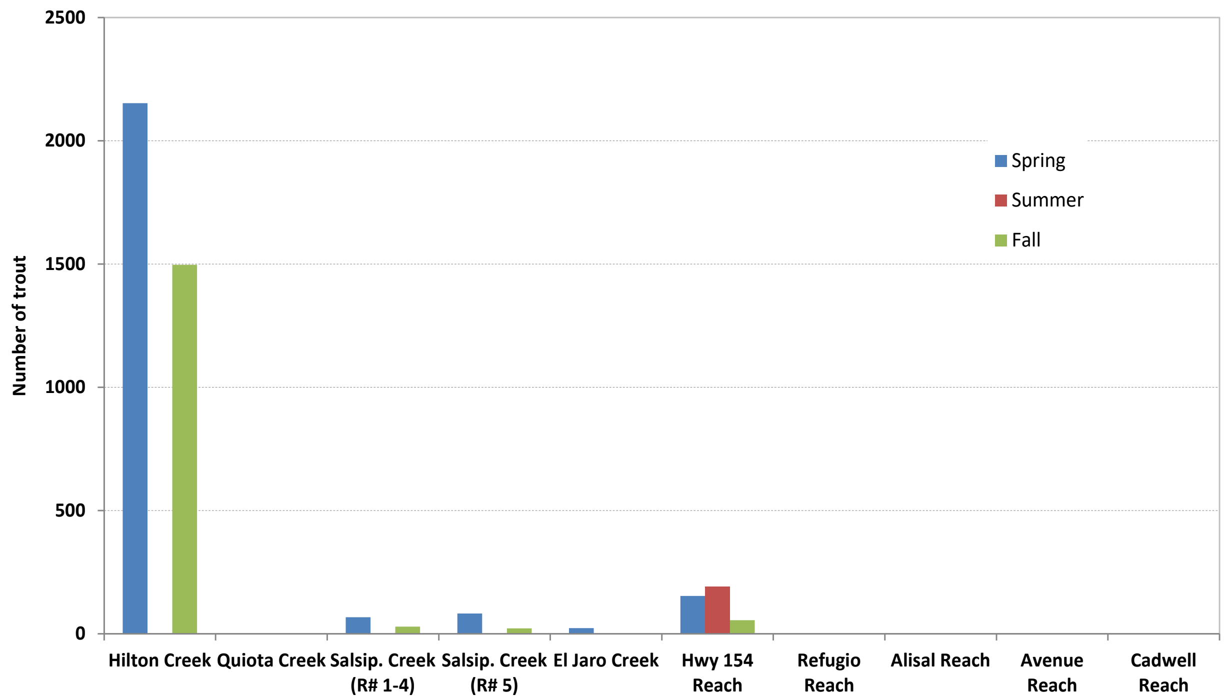


Figure 73: 2019 LSYR *O. mykiss* observed during spring, summer and fall snorkel surveys.

Table 14: 2019 LSYR mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	6/18/2019
(LSYR-0.2 to LSYR-0.7)	Summer	9/17/2019
	Fall	12/12/2019
Refugio Reach	Spring	6/13/2019
(LSYR-4.9 to LSYR-7.8)	Summer	9/11/2019
	Fall	11/5/2019
Alisal Reach	Spring	6/11/19 - 6/12/19
(LSYR-7.8 to LSYR-10.5)	Summer	9/10/19 - 9/11/19
	Fall	11/5/2019
Avenue Reach	Spring	6/7/19 & 6/11/19
(LSYR-10.5 to LSYR-13.9)	Summer	9/9/19 - 9/10/19
	Fall	11/6/2019
Reach 3 Downstream of Avenue	Spring	6/3/2019
(LSYR-13.9 to LSYR-25.0)	Summer	9/9/2019
	Fall	11/6/2019

Table 15: LSYR mainstem spring, summer, and fall snorkel survey results in 2019 with the miles surveyed; the level of effort was the same for each snorkel survey.

LSYR Mainstem	Spring (# of *O. mykiss*)	Summer (# of *O. mykiss*)	Fall (# of *O. mykiss*)	Survey Distance (miles)
Hwy 154 Reach	154	192	55	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 2019 broken out by three inch size classes.

Survey	Reach	Size Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hwy 154	107	47								154
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0
Summer	Hwy 154	3	147	42							192
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0
Fall	Hwy 154	1	50	4							55
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0

Table 17: 2019 tributary snorkel survey schedule; no summer surveys were conducted in 2019.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	7/24/19 - 7/31/19
(HC-0.0 to HC-0.54)	Summer	
	Fall	11/19/19 - 11/20/19
Quiota Creek	Spring	6/18/2019
(QC-2.58 to QC-2.73)	Summer	
	Fall	11/11/2019
Salsipuedes Creek	Spring	6/3/19, 6/20/19, 6/24/19 - 6/26/19
(Reach 1-4)	Summer	
	Fall	11/6/19 - 11/12/19
Salsipuedes Creek	Spring	6/26/19 - 6/27/19
(Reach 5)	Summer	
	Fall	11/14/2019
El Jaro Creek	Spring	6/27/2019
(ELC-0.0 to ELC-0.4)	Summer	
	Fall	11/14/2019

Table 18: *O. mykiss* observed and miles surveyed during all tributary snorkel surveys in 2019; the level of effort was the same for each survey.

Tributaries	Spring (# of *O. mykiss*)*	Summer (# of *O. mykiss*)	Fall (# of *O. mykiss*)	Survey Distance (miles)
Hilton Creek				
Reach 1	757	n/s	375	0.133
Reach 2	329	n/s	165	0.050
Reach 3	228	n/s	175	0.040
Reach 4	312	n/s	225	0.075
Reach 5	515	n/s	557	0.242
Reach 6	12	n/s	0	0.014
Total:	***2153***	***n/s***	***1497***	***0.554***
Quiota Creek	0	n/s	0	0.11
Salsipuedes Creek (Reach 1-4)	67	n/s	29	2.85
Salsipuedes Creek (Reach 5)	82	n/s	22	0.45
El Jaro Creek	23	n/s	1	0.35
n/s - not surveyed due to turbid conditions or low water level.				

Table 19: 2019 tributary spring, summer , and fall snorkel survey results broken out by three-inch size classes.

Survey	Reach	Size Class (inches)									Total
		0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	
Spring	Hilton	1612	520	11	7	1	2				2153
	Quiota										0
	Salsipuedes (R 1-4)	42	19	2		3	1				67
	Salsipuedes (R-5)	73	3	4	1	1					82
	El Jaro	23									23
Summer	Hilton										n/s
	Quiota										n/s
	Salsipuedes (R 1-4)										n/s
	Salsipuedes (R-5)										n/s
	El Jaro										n/s
Fall	Hilton	569	896	31	1						1497
	Quiota										0
	Salsipuedes (R 1-4)		23	5			1				29
	Salsipuedes (R-5)	0	18	1	3						22
	El Jaro		1								1
n/s - no surveyed due to turbid conditions or low water level.											

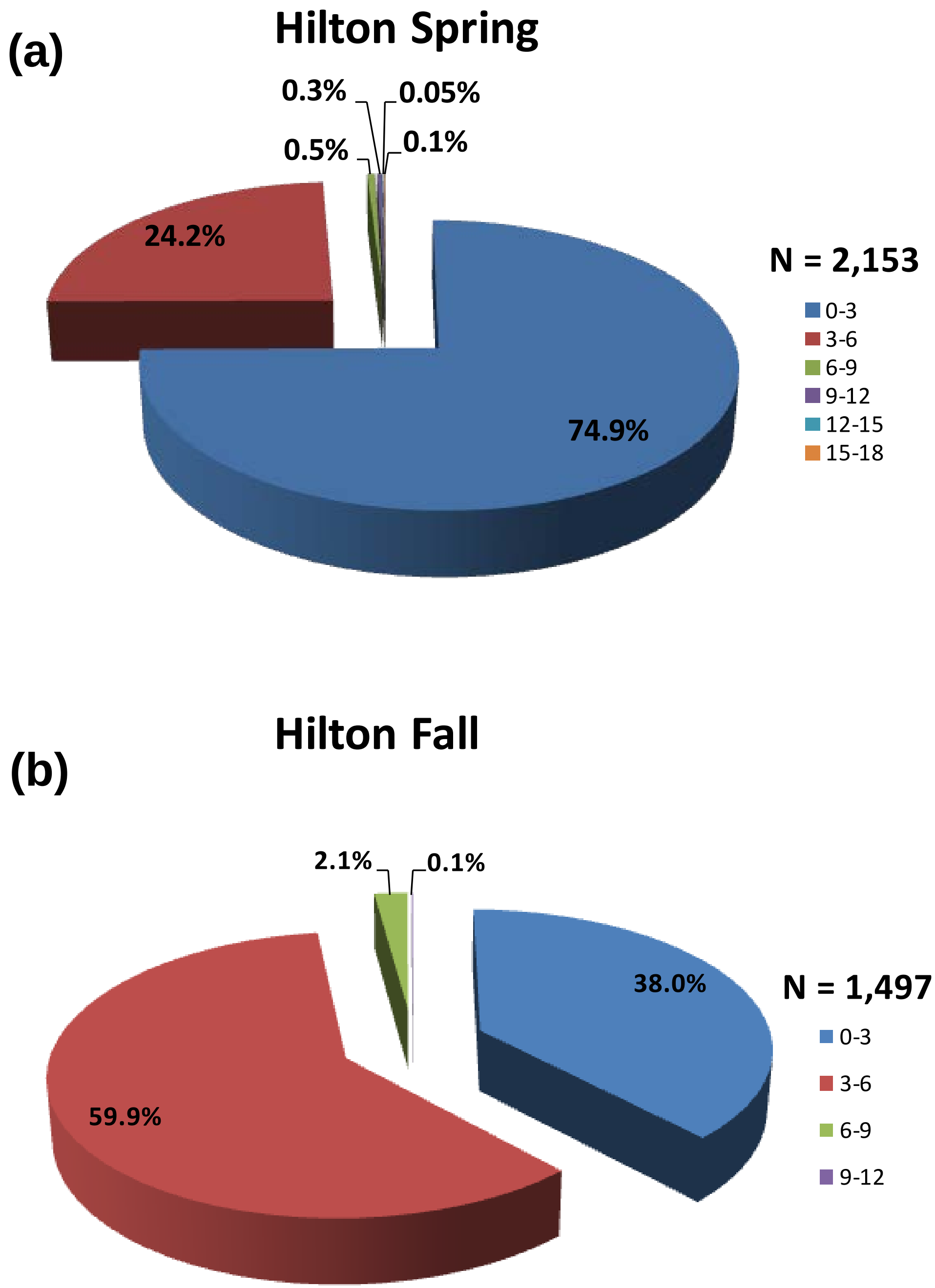


Figure 74: 2019 Hilton Creek snorkel survey results of *O. mykiss* proportioned by size class in inches.

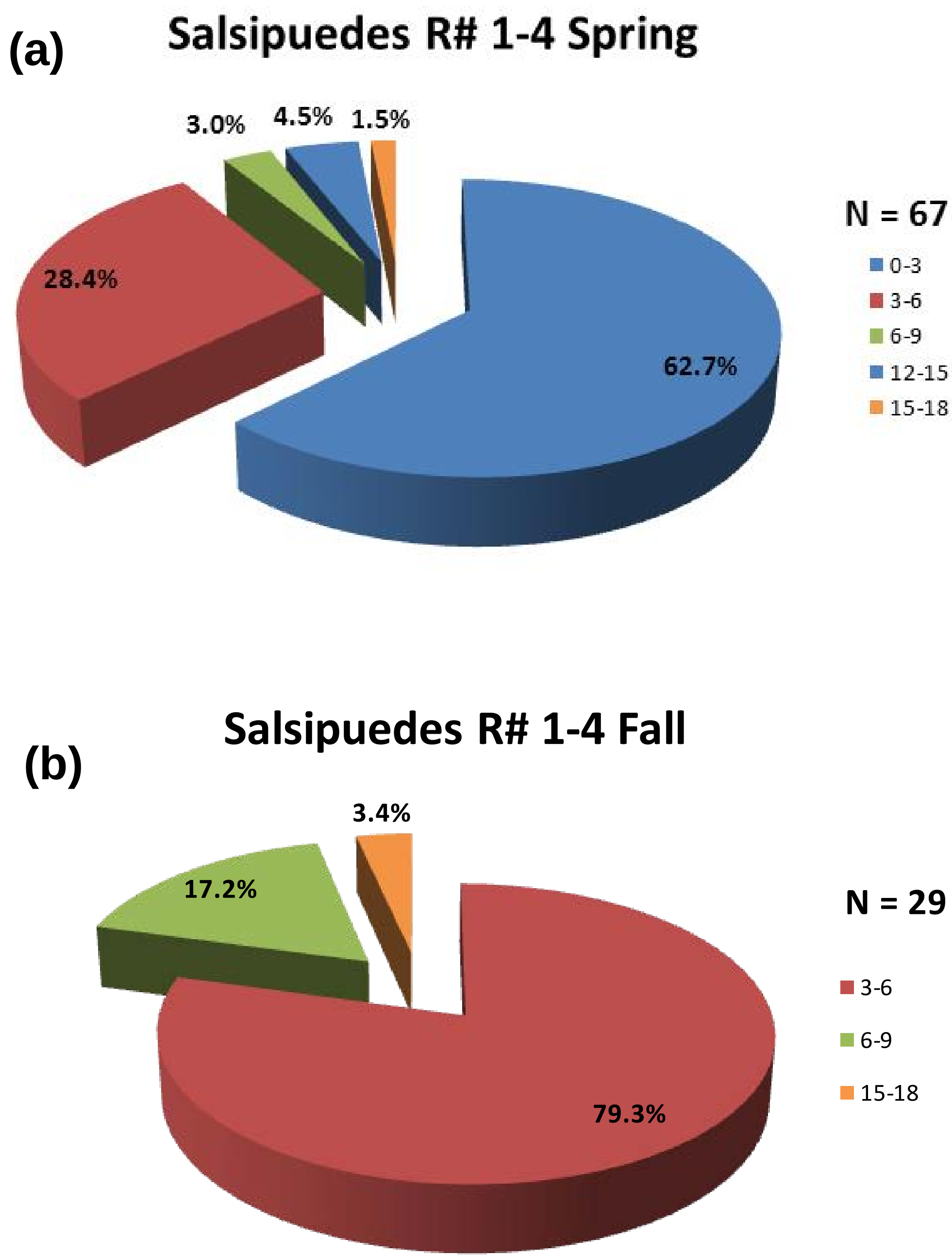


Figure 75: 2019 Salsipuedes Creek Reaches 1-4 snorkel survey results of *O. mykiss* proportioned by size class in inches.

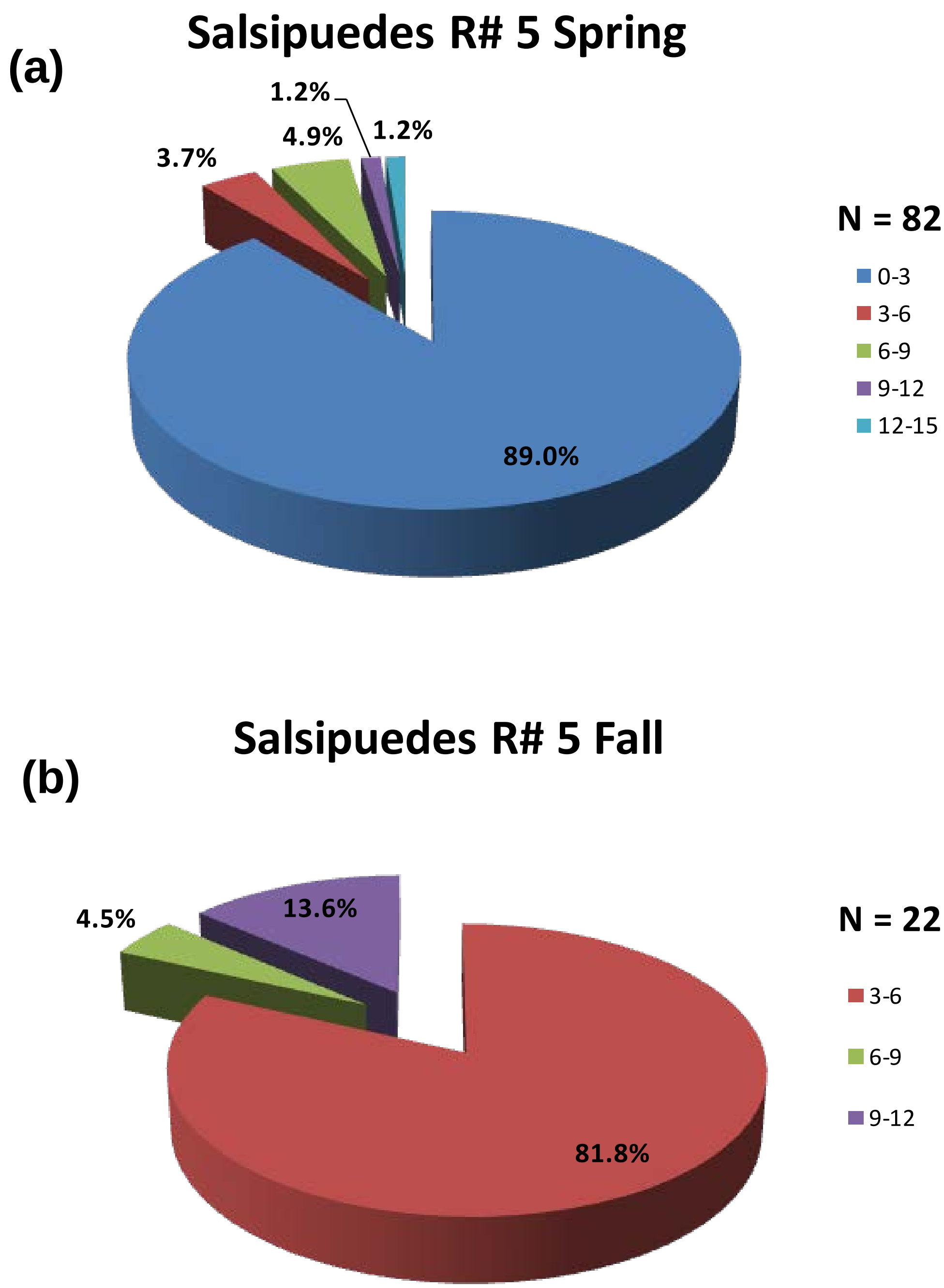


Figure 76: 2019 Salsipuedes Creek Reach 5 snorkel survey results of *O. mykiss* proportioned by size class in inches.

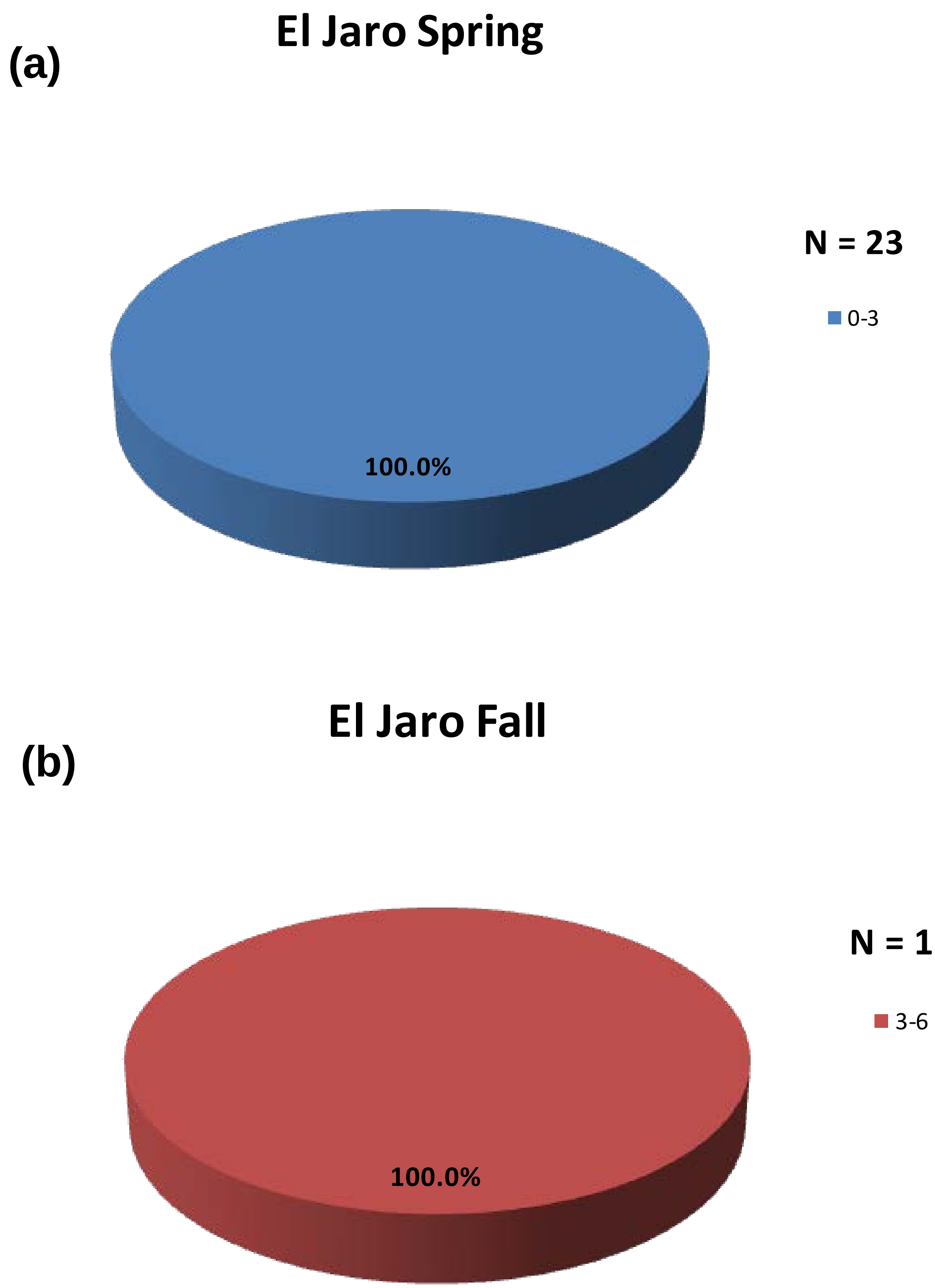


Figure 77: 2019 El Jaro Creek snorkel survey results of *O. mykiss* proportioned by size class in inches.

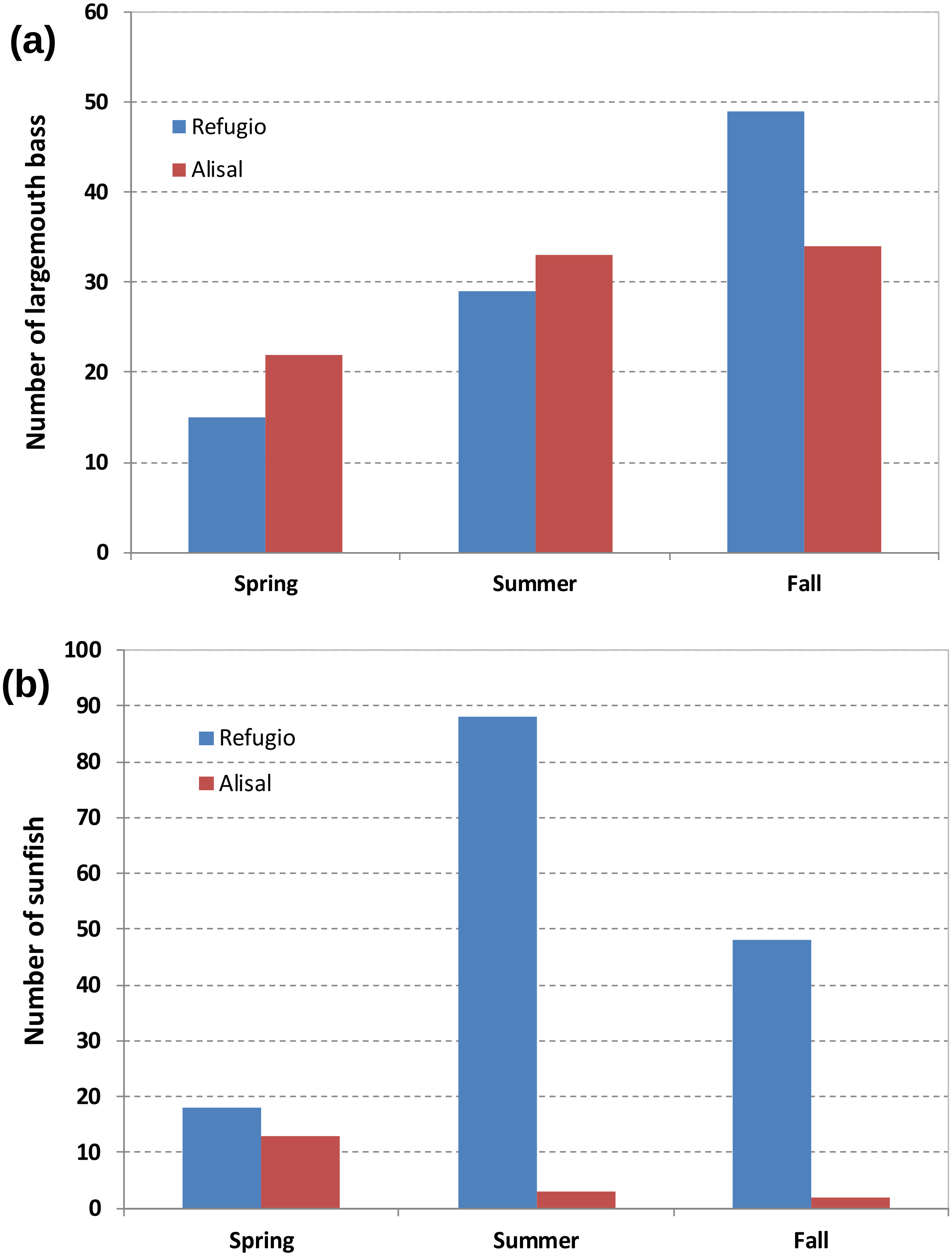


Figure 78: Count of warm water predators, (a) largemouth bass and (b) sunfish, observed in Refugio and Alisal reaches during the spring, summer and fall snorkel surveys in 2019.

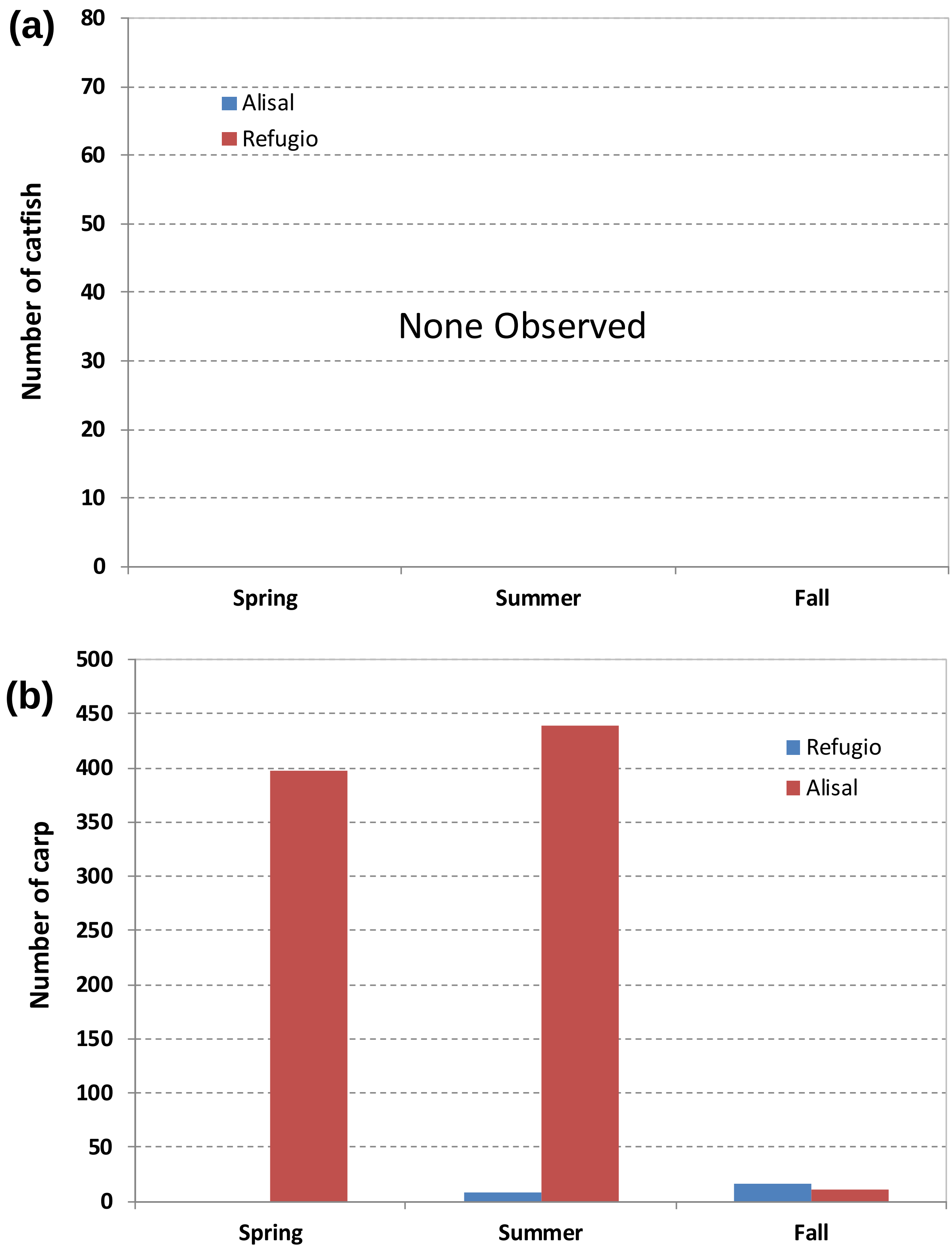
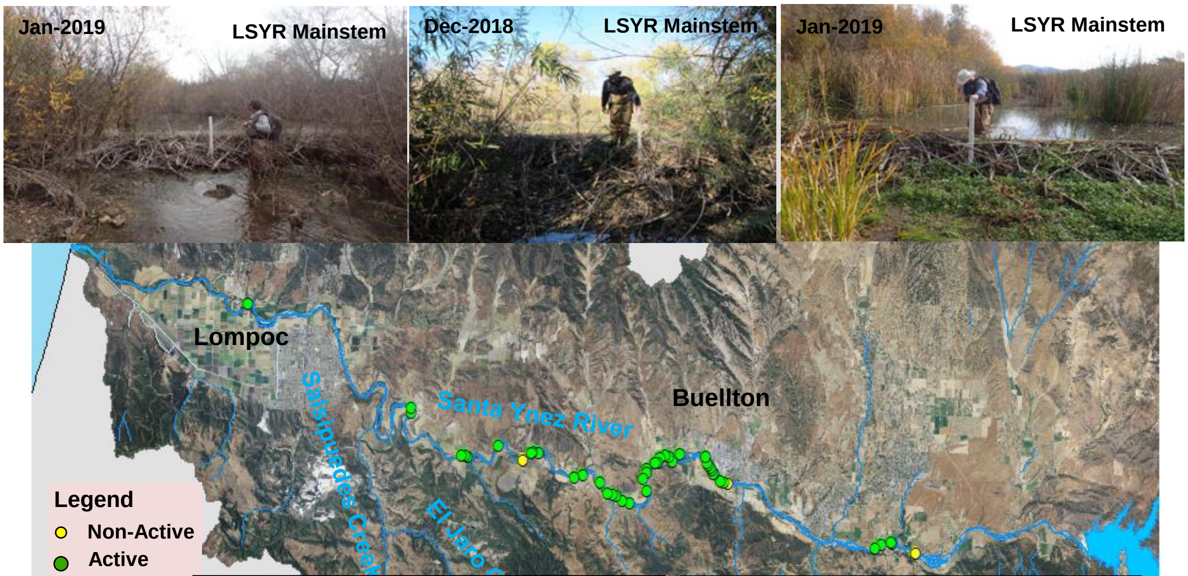


Figure 79: Count of warm water predators, (a) catfish and (b) carp, observed in Refugio and Alisal reaches during the spring, summer and fall snorkel surveys in 2019.



LSYR Mainstem Activity Classification				
	Active	Non-Active	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
WY2016	16	29	0	45
WY2017*	14	52	0	66
WY2018	37	10	0	47
WY2019	42	3	0	45

* Additional reaches surveyed from previous year.
- Indicates limited attribute data taken at each dam site.

Tributary Activity Classification				
	Active	Non-Active	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
WY2016	1	7	0	8
WY2017	0	8	0	8
WY2018	0	2	0	2
WY2019	0	0	0	0

- Indicates limited attribute data taken at each dam site.

Figure 80: Spatial extent of beaver dams from the WY2019 survey within the LSYR drainage where 45 dams (42 active) were observed in the mainstem and zero dams observed in the Salsipuedes/El Jaro Creek watershed.

Table 20: Annual count of 2010-2019 beaver dams in the LSYR mainstem and Salsipuedes/El Jaro watershed broken out by dam height.

	LYSR Mainstem Beaver Dams						Tributary Beaver Dams					
Height Year	0.0-1.0 (ft)	1.1-2.0 (ft)	2.1-3.0 (ft)	3.1-4.0 (ft)	> 4.0 (ft)	Σ	0.0-1.0 (ft)	1.1-2.0 (ft)	2.1-3.0 (ft)	3.1-4.0 (ft)	> 4.0 (ft)	Σ
WY2010	3	65	40	17	3	128	0	17	5	3	0	25
WY2011	5	34	31	10	2	82	3	1	1	0	0	5
WY2012*	9	38	23	4	0	74	5	6	3	0	0	14
WY2013	23	75	27	7	0	132	8	23	4	0	0	35
WY2014	21	48	36	15	1	121	10	24	2	0	0	36
WY2015	19	52	32	4	1	108	9	10	2	0	0	21
WY2016	7	21	14	3	0	45	1	6	1	0	0	8
WY2017	8	29	28	1	0	66	1	5	2	0	0	8
WY2018	13	24	9	1	0	47	2	0	0	0	0	2
WY2019	7	24	12	2	0	45	0	0	0	0	0	0

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

WY2019 Annual Monitoring Summary
Discussion
Figures and Tables

4. Discussion

Table 21: Monthly rainfall totals at Bradbury Dam from WY2000-WY2019.

Month	Water Years:																			
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
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	0.30	1.13	0.00	0.17
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	0.73	1.21	0.07	1.86
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	1.12	1.92	0.00	0.68
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	4.03	8.81	3.75	8.07
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	1.65	10.61	0.16	8.26
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	3.01	0.83	4.85	3.06
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	0	0.20	0.09	0.11
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	0	0.32	0.40	1.57
Jun	0.04	0	0	0.02	0	0.04	0	0	0	0.16	0	0.34	0	0	0	0.42	0	0	0	0
Jul	0	0.06	0	0.01	0	0	0	0	0	0	0	0.00	0	0	0	0.03	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0.03	0	0.00	0	0	0	0	0	0	0	0
Sept	0	0	0.08	0	0	0.03	0	0.17	0	0.08	0	0.00	0.18	0	0	0.15	0	0.45	0	0
Totals:	***21.47***	***31.75***	***8.78***	***19.76***	***10.55***	***44.41***	***24.49***	***7.41***	***22.59***	***13.66***	***23.92***	***31.09***	***12.69***	***7.57***	***9.96***	***9.38***	***10.84***	***25.48***	***9.32***	***23.78***

Table 22: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2019 (yellow indicates still not available on the USGS website).

Month	WY2001		WY2002		WY2003		WY2004		WY2005		WY2006	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	n/d	20.6	n/d	2.06	23.3	18.8	0	0	31.1	29.4	6.05	9.41
Nov	n/d	14.8	n/d	12.3	8.11	15.2	0	0	6.35	14.2	6.94	16
Dec	n/d	14.9	n/d	25.2	22.3	55.5	0	0.02	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	0.10	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	0.09	0.01	0.64	53.2	3.69	9.15	14	7.83	4.76
Aug	n/d	2.53	64.8	24.2	0	0.11	59.4	30.9	6.35	2.86	4.69	0.98
Sep	n/d	2.15	37.2	28.9	0	0	39.3	24	6.02	4.15	5.7	1

Month	WY2007		WY2008		WY2009		WY2010		WY2011		WY2012	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	0	0	0	0	0	0	0	0	0	0	7.59	4.28
Nov	0	0	0	0	0	0	0	0	0	0	8.33	11.1
Dec	0	0	0	0	0	0	0	0	0	0	7.91	14.6
Jan	0	0	0	0	0	0	0	0	0	0	7.97	16.9
Feb	0	0	0	0	0	0	0	0	0	0	7.46	14.1
Mar	0	0	0	0	0	0	0	0	0	0	6.01	11.7
Apr	0	0	0	0	0	0	0	0	0	0	8.82	14.7
May	0	0	0	0	0	0	0	0	0	0	5.56	5.53
Jun	0	0	0	0	0	0	0	0	0	0	4.73	0.52
Jul	0	0	0	0	0	0	0	0	0	0	4.58	0.03
Aug	0	0	0	0	0	0	0	0	0	0	4.88	0
Sep	0	0	0	0	0	0	0	0	0	0	6.60	0

Month	WY2013		WY2014		WY2015		WY2016		WY2017		WY2018	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	4.5	0	42.6	28.8	13.2	0	0.65	0	0.002	0	35	28.2
Nov	2.7	0	22.7	17.1	5.21	0	0	0	0.01	0	8.63	9.67
Dec	5.8	0	8.9	8.1	7.1	0	0	0	0.069	0	2.28	0.586
Jan	6.3	0	4.3	2.2	5.1	0	0.22	0	12.4	29.9	2.63	2.9
Feb	6	3.6	6	3.6	4	0	2.14	0	193.2	432.4	0.649	1
Mar	4.8	4.5	10.6	12.3	1.5	0	2.39	0	12.7	50.5	3.09	9.5
Apr	1.7	0.54	3	1.8	0	0	0.09	0	2.98	9.83	0.138	3.5
May	0	0	0	0	0	0	0	0	0.2	1.99	0	0.38
Jun	0	0	0	0	0	0	0	0	0	0.66	0	0
Jul	51	3	0	0	0	0	54.8	0	0	0	0	0
Aug	59.1	27	0	0	79	0	69.4	34.8	28.9	0	88.8	15
Sep	47.9	28	2.7	0	42	0.77	0.67	2.86	74.1	37.2	10.9	8.4

Month	WY2019	
	Solvang (cfs)	Narrows (cfs)
Oct	0	
Nov	0	
Dec	0	
Jan	14.4	
Feb	139.9	
Mar	68.7	
Apr	13.3	
May	5.79	
Jun	1.91	
Jul		
Aug		
Sep		

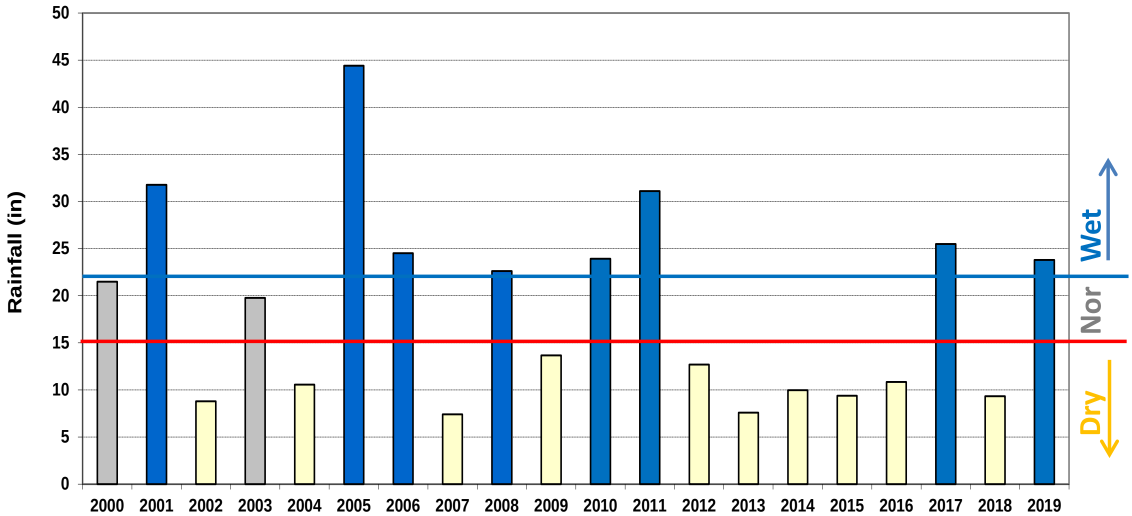


Figure 81: Water year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 23: WY2001-WY2019 Hilton Creek upstream and downstream *O. mykiss* captures.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	*WY2012	*WY2013	*WY2014	*WY2015	*WY2016	*WY2017	WY2018	WY2019
	Hilton Creek																		
	Upstream																		
>700	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	0	0	0	0	0
650-699	0	0	0	0	0	0	0	4	0	0	0	0	n/d	0	0	0	0	0	0
600-649	0	0	0	0	0	0	0	0	1	0	0	0	n/d	0	0	0	0	0	0
550-599	0	0	0	0	0	1	0	2	0	0	0	0	n/d	0	0	0	0	0	0
500-549	1	0	1	0	2	2	0	2	1	0	0	0	n/d	0	0	0	0	0	0
450-499	3	0	0	6	8	9	0	13	1	2	0	0	n/d	0	0	0	0	0	0
400-449	5	0	9	11	9	21	2	6	2	1	11	0	n/d	1	0	0	0	1	1
300-399	2	0	10	24	10	31	11	31	27	11	6	12	n/d	24	7	1	0	0	8
200-299	2	0	2	8	7	10	4	22	29	39	11	12	n/d	12	11	5	0	0	9
101-199	11	38	14	27	4	18	15	63	33	39	34	17	n/d	9	6	1	1	5	2
<100	1	1	0	12	1	17	11	29	24	15	23	4	n/d	0	0	1	0	0	0
Total	**25**	**39**	**36**	**88**	**41**	**109**	**43**	**172**	**118**	**107**	**85**	**45**	**n/d**	**46**	**24**	**8**	**1**	**6**	**20**
	Downstream																		
>700	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	0	0	0	0	0
650-699	0	0	0	0	0	0	0	2	0	0	0	0	n/d	0	0	0	0	0	0
600-649	0	0	0	0	0	0	0	1	0	0	0	0	n/d	0	0	0	0	0	0
550-599	0	0	0	0	0	0	0	2	1	0	0	0	n/d	0	0	0	0	0	0
500-549	1	0	1	1	2	3	0	1	0	0	0	0	n/d	0	0	0	0	0	0
450-499	2	0	1	2	0	5	0	15	1	2	2	0	n/d	0	0	0	0	0	0
400-449	5	0	3	9	5	6	4	12	0	3	7	0	n/d	1	0	0	0	0	2
300-399	2	0	2	7	3	20	16	28	24	9	10	1	n/d	5	7	0	0	0	1
200-299	0	5	1	5	2	15	9	18	26	38	22	14	n/d	6	35	3	0	4	5
Smolts	0	4	0	3	1	11	7	4	7	1	4	6	n/d	1	11	2	0	3	1
Pre-Smolt	0	0	0	1	0	0	0	2	0	1	0	1	n/d	1	3	1	0	1	0
Res	0	1	1	1	1	4	2	12	19	36	18	7	n/d	4	21	0	0	0	4
101-199	22	45	12	46	6	47	369	178	218	84	82	99	n/d	64	68	91	4	14	8
Smolts	2	19	3	28	6	33	96	59	73	41	37	17	n/d	16	30	54	0	7	1
Pre-Smolt	0	5	0	2	0	5	42	21	36	4	16	48	n/d	27	23	32	2	6	2
Res	21	21	9	16	0	9	231	98	109	39	29	34	n/d	21	15	5	2	1	5
<100	1	7	0	16	2	173	200	47	34	15	16	15	n/d	2	0	1	0	0	1
Smolts	0	0	0	1	0	1	0	0	0	0	0	0	n/d	0	0	0	0	0	0
Pre-Smolt	0	0	0	0	1	163	0	1	0	0	2	0	n/d	1	0	1	0	0	0
Res	1	7	0	15	1	9	200	46	34	15	14	15	n/d	1	0	0	0	0	1
Total	**33**	**57**	**20**	**86**	**20**	**269**	**598**	**304**	**304**	**151**	**139**	**129**	**n/d**	**78**	**110**	**95**	**4**	**18**	**17**
	*Abbreviated trapping season due to NOAA take issues																		

Table 24: WY2001-WY2019 Salsipuedes Creek upstream and downstream *O. mykiss* captures.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	*WY2012	*WY2013	*WY2014	*WY2015	*WY2016	*WY2017	WY2018	WY2019
	Salsipuedes Creek																		
	Upstream																		
>700	0	0	0	0	0	0	0	1	0	0	0	0	n/d	0	n/d	n/d	0	0	0
650-699	1	0	1	0	1	0	0	2	0	0	0	0	n/d	0	n/d	n/d	0	0	0
600-649	0	0	0	0	0	0	0	3	0	0	0	0	n/d	0	n/d	n/d	0	0	0
550-599	1	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
500-549	0	0	0	0	0	1	0	0	0	0	3	0	n/d	0	n/d	n/d	0	0	0
450-499	2	0	0	0	0	0	0	0	0	0	2	0	n/d	0	n/d	n/d	0	0	0
400-449	1	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
300-399	7	3	0	1	0	6	0	0	0	0	1	2	n/d	0	n/d	n/d	0	0	0
200-299	9	3	3	11	0	6	2	7	1	4	7	1	n/d	1	n/d	n/d	0	0	0
101-199	10	8	22	9	0	4	5	2	9	2	22	0	n/d	2	n/d	n/d	0	0	0
<100	0	0	3	0	0	1	0	3	3	0	5	0	n/d	0	n/d	n/d	0	0	0
Total	**31**	**14**	**29**	**21**	**1**	**18**	**7**	**18**	**13**	**6**	**40**	**3**	**n/d**	**3**	**n/d**	**n/d**	**0**	**0**	**0**
	Downstream																		
>700	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
650-699	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
600-649	1	0	0	0	0	0	0	0	0	1	0	0	n/d	0	n/d	n/d	0	0	0
550-599	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
500-549	1	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
450-499	3	0	0	0	0	0	0	1	0	0	0	0	n/d	0	n/d	n/d	0	0	0
400-449	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
300-399	6	0	0	1	0	4	1	1	0	0	3	0	n/d	0	n/d	n/d	0	0	0
200-299	21	2	2	2	9	19	3	13	2	20	13	0	n/d	1	n/d	n/d	0	1	1
Smolts	8	1	2	0	9	10	0	9	1	18	2	0	n/d	1	n/d	n/d	0	0	0
Pre-Smolt	0	0	0	1	0	2	0	1	0	0	1	0	n/d	0	n/d	n/d	0	0	0
Res	13	1	0	2	0	7	3	3	1	2	10	0	n/d	0	n/d	n/d	0	0	1
101-199	144	4	98	20	46	193	12	41	60	50	160	10	n/d	9	n/d	n/d	0	2	1
Smolts	124	3	55	9	45	135	1	31	16	48	100	1	n/d	3	n/d	n/d	0	0	0
Pre-Smolt	2	0	21	2	1	50	1	10	13	1	57	7	n/d	6	n/d	n/d	0	2	1
Res	18	1	22	9	0	8	10	0	31	1	3	2	n/d	0	n/d	n/d	0	0	0
<100	1	0	11	20	0	24	1	6	111	2	24	12	n/d	0	n/d	n/d	0	0	0
Smolts	0	0	0	5	0	4	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0
Pre-Smolt	0	0	5	3	0	17	0	0	2	0	17	0	n/d	0	n/d	n/d	0	0	0
Res	1	0	6	12	0	3	1	6	109	2	7	12	n/d	0	n/d	n/d	0	0	0
Total	**177**	**6**	**111**	**43**	**55**	**240**	**17**	**62**	**173**	**73**	**200**	**22**	**n/d**	**10**	**n/d**	**n/d**	**0**	**3**	2
	*Abbreviated trapping season due to drought and NOAA take issues																		

Table 25: 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	BiOp Expected Completion Date	Current Status (as of December 2018)
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	Completed (2018)
Quiota Creek Crossing 7	2003	Completed (2012)
Quiota Creek Crossing 9	2003	Completed (2018)
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 or funded:	***9***	
Projects suggested to be removed:	***2***	
1. Project proposed for removal from the BiOp.		

Table 26: 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 2018)
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	Construction (2019)[1]
Total:	**7**
Projects completed:	***5***
Projects remaining:	***2***
1. Grant funding has been secured.	

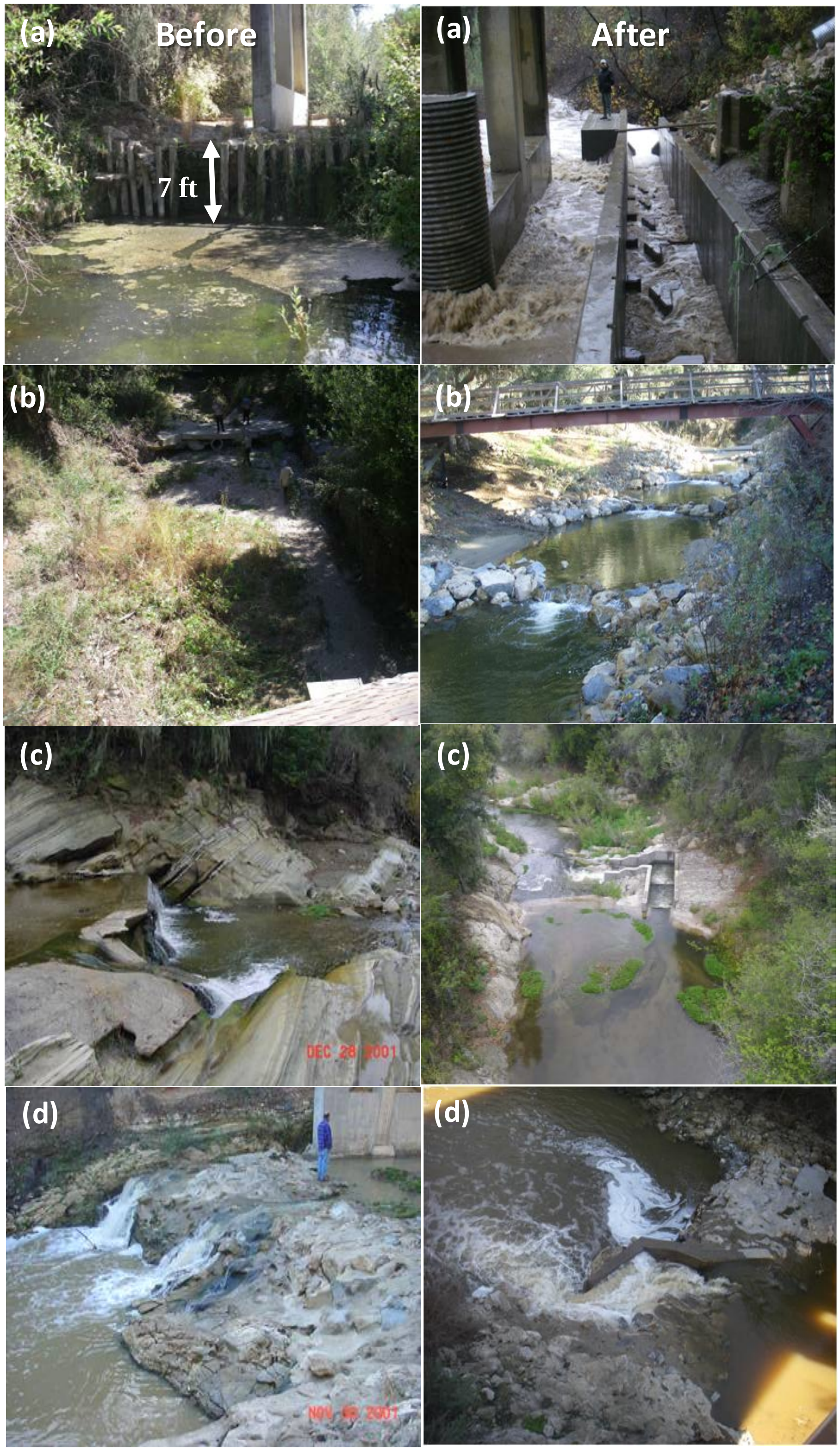


Figure 82: Fish passage and habitat restoration at: at (a) Rancho San Julian Bridge on El Jaro Creek (2008), (b) Cross Creek Ranch on El Jaro Creek (2009), (c) Jalama Road Bridge on Salsipuedes Creek (2004), and (d) Highway 1 Bridge on Salsipuedes Creek (2002).

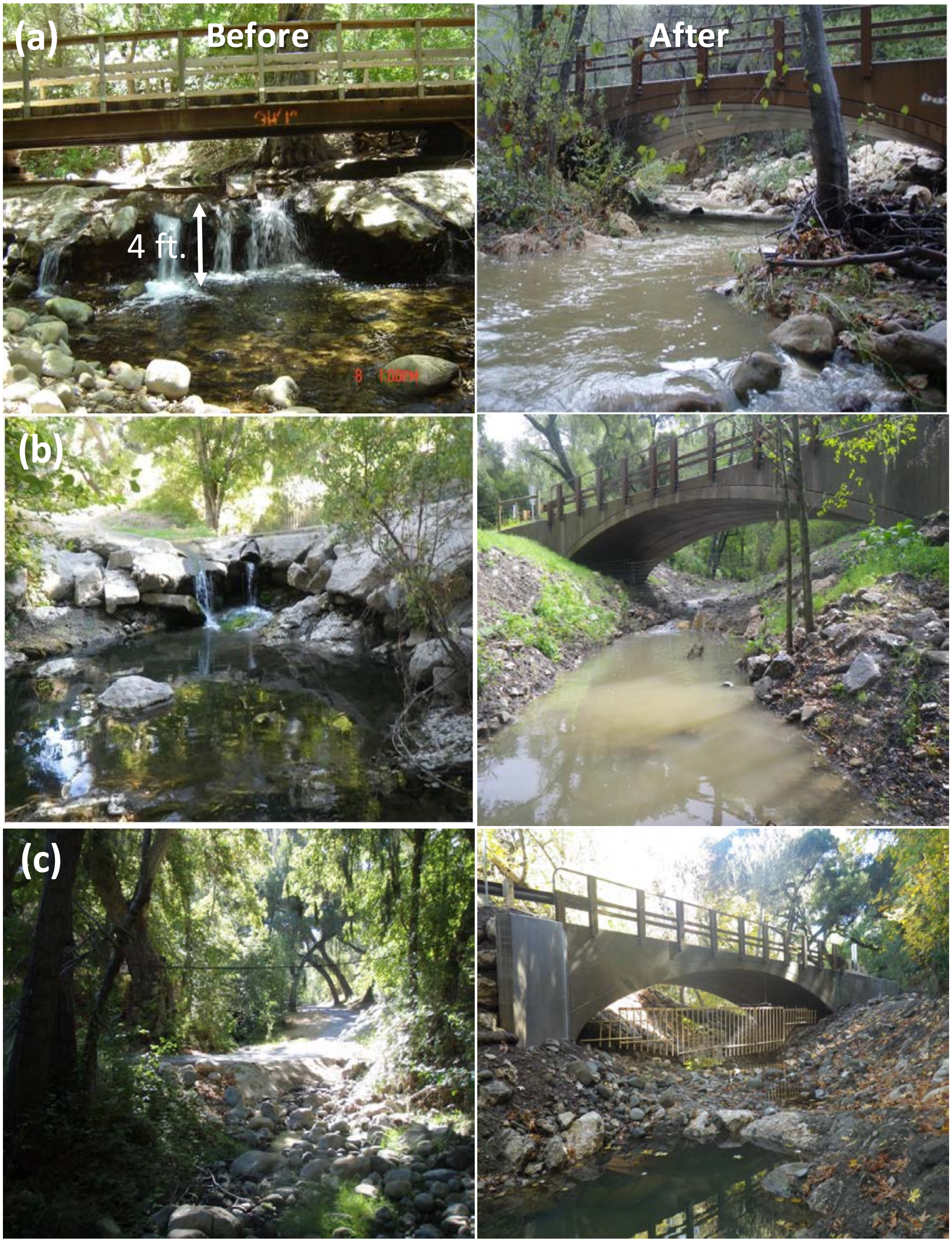


Figure 83: Fish passage and habitat restoration at a) Quiota Creek Crossing 6 (2008), (b) Quiota Creek Crossing 2 (2011), and Quiota Creek Crossing 7 (2013).

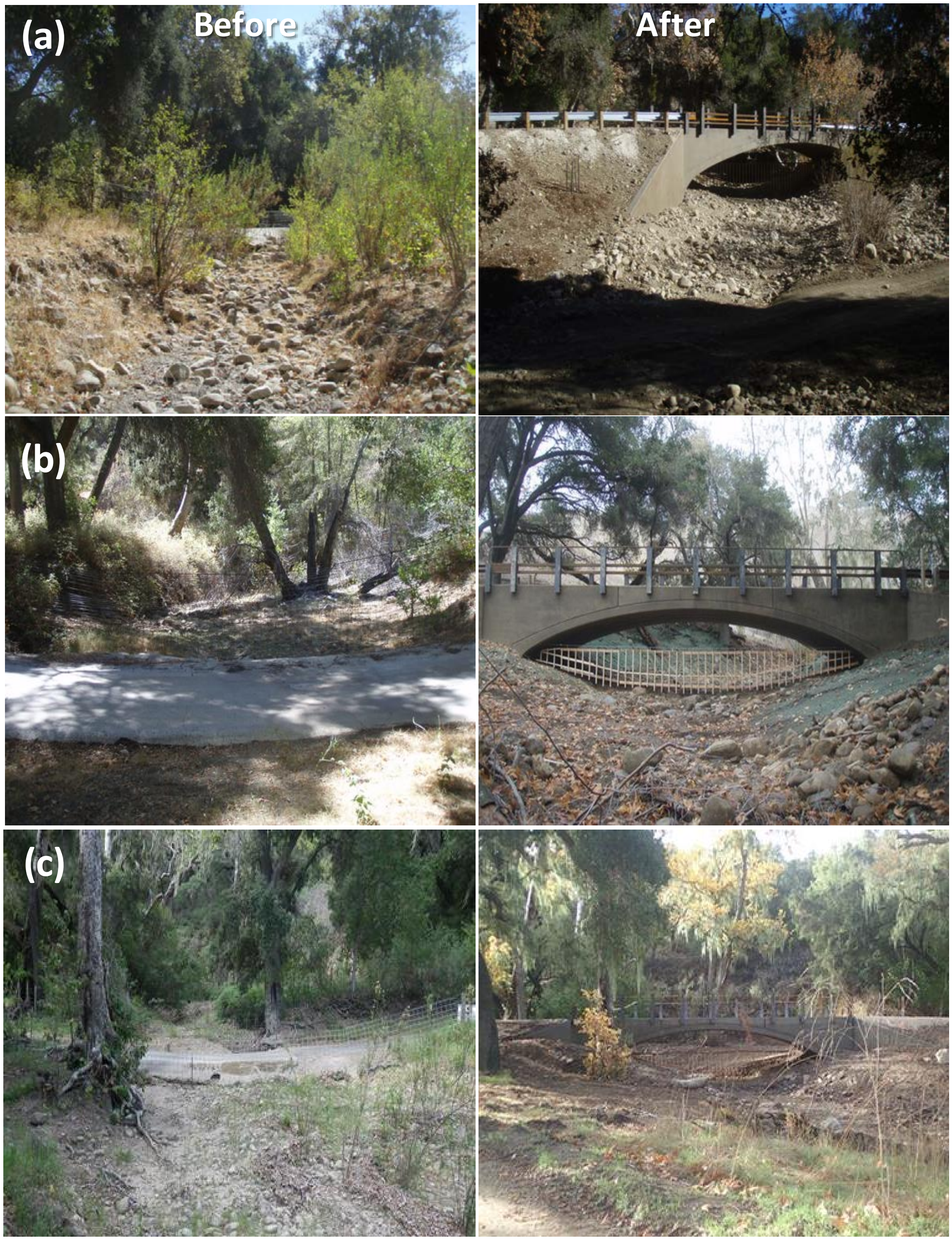


Figure 84: Fish passage and habitat restoration at (a) Quiota Creek Crossing 1 (in 2014), (b) Quiota Creek Crossing 3 (in 2015), and (c) Quiota Creek Crossing 4 (in 2016).

Figure 85: Fish passage and habitat restoration at (a) Quiota Creek Crossing 0A (in 2016), (b) Quiota Creek Crossing 5 (in 2018), and (c) Quiota Creek Crossing 9 (in 2018).

Figure 86: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

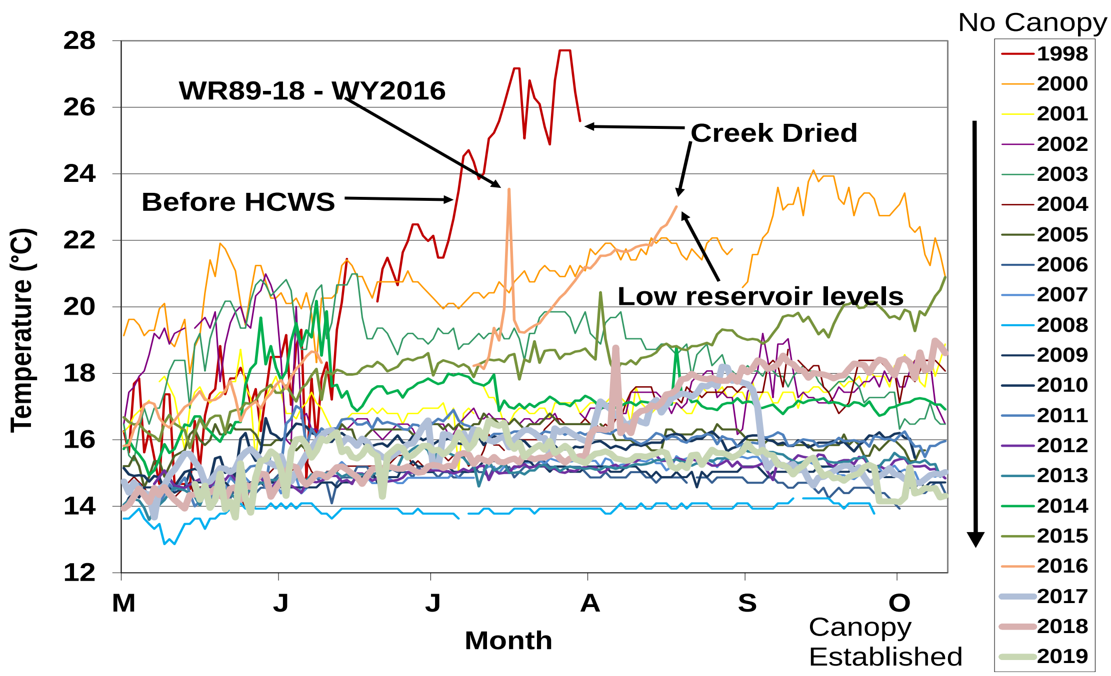


Figure 87: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2019, the last three years are shown with a wider line.

Figure 88: Hilton Creek post-storm habitat conditions showing (a) silt bar formation at head of Long Pool, (b) staff standing in the middle of the Spawning Pool in 6 inches of water (previously 6 feet deep), (c) sediment deposits within the Honeymoon Pool (previously 4 feet deep), and (d) general composition of the sand/gravel deposited from the high flow event.

Figure 89: Confluence of Hilton Creek with the LSYR mainstem showing (a-b) the formation of an extensive delta looking up towards the creek confluence from within the Long Pool (previously at least 3 feet deep), (c) looking downstream towards the center of the Long Pool within the previous pool habitat, and (d) again looking downstream towards the center of the Long Pool well after winter storms showing extensive deposition with a bobcat captured with a game camera.

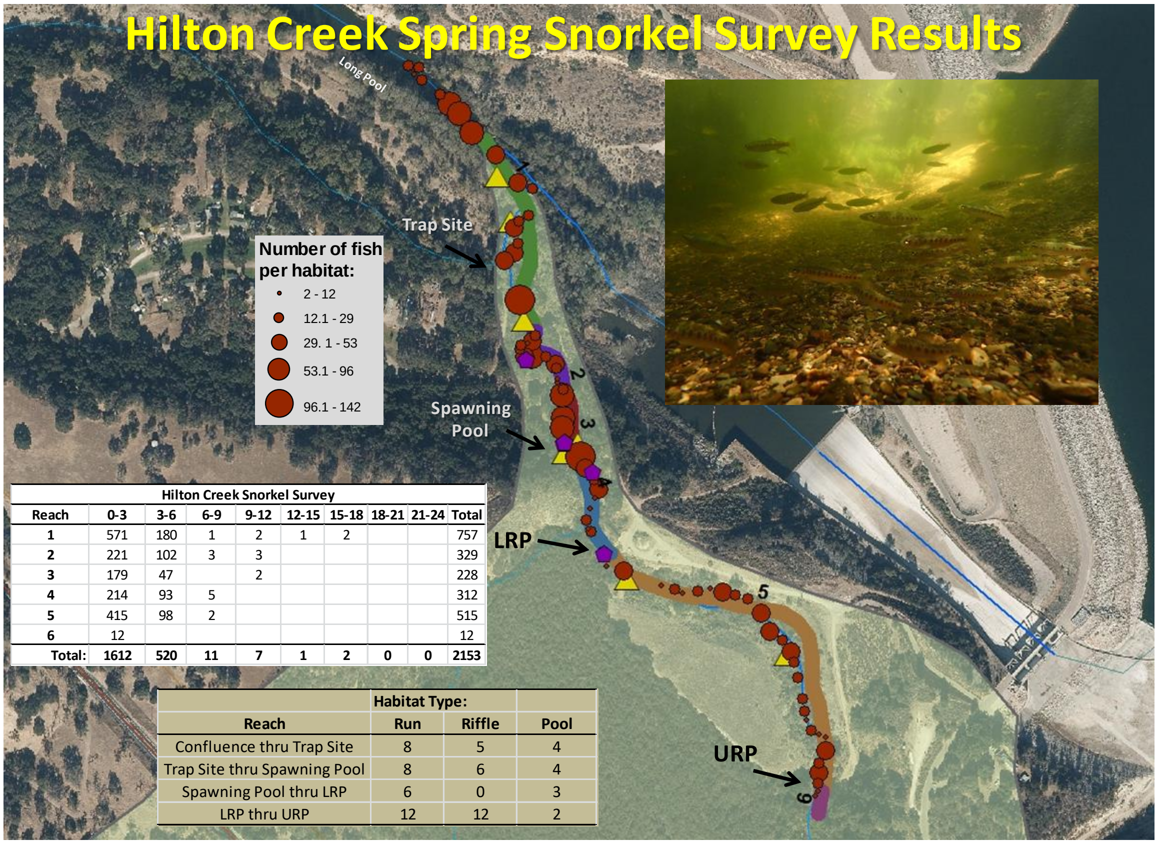


Figure 90: Results from the 2019 spring snorkel survey results in Hilton Creek; reaches are shown in different colors and are numbered, observed redd sites are shown with yellow triangles.

WY2019 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

COMB-FD: COMB Fisheries Division (previously 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 Operation and Maintenance Board – Fisheries Division (COMB-FD)staff 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 COMB-FD 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 2002-2019 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 WY2019 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.

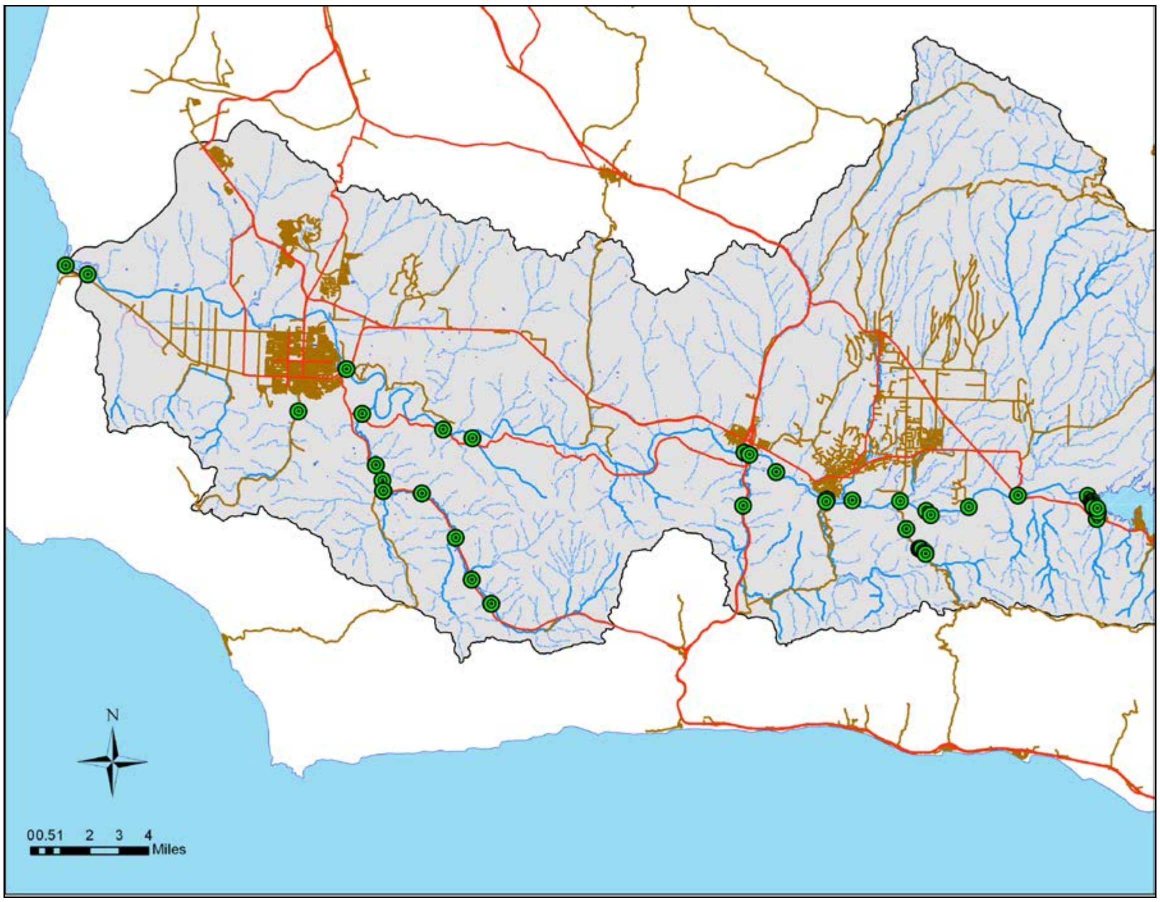


Figure C-1: WY2019 photo point locations.

Table C-1: WY2019 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	October 2018	April 2019	May 2019	August 2019	September 2019
M1	Lower Hilton Creek, photo d/s at ford crossing	X	X		X	
M2a	Bluffs overlooking long pool, photo u/s	X			X	
M2b	Bluffs overlooking long pool, photo d/s	X				
M3	Highway 154 culvert on Hilton Creek, photo u/s					
M4	Highway 154 culvert on Hilton Creek, photo d/s					
M5	Highway 154 Bridge, photo u/s	X	X		X	
M6	Highway 154 Bridge, photo d/s	X	X		X	
M7	Meadowlark crossing, photo u/s	X		X	X	
M8	Meadowlark crossing, photo d/s	X		X	X	
M9	Lower Gainey crossing, beaver dam, photo u/s			X		
M10	Lower Gainey crossing, beaver dam, photo d/s			X		
M11a	Lower Gainey crossing, photo u/s			X	X	
M11b	Lower Gainey crossing, photo d/s			X	X	
M12	Refugio Bridge, photo u/s		X		X	
M13	Refugio Bridge, photo d/s		X		X	
M14	Alisal Bridge, photo u/s	X	X		X	
M15	Alisal Bridge, photo d/s		X		X	
M17	Mid-Alisal Reach, photo u/s					X
M18	Mid-Alisal Reach, photo d/s					X
M19	Avenue of the Flags Bridge, photo u/s	X	X		X	
M20	Avenue of the Flags Bridge, photo d/s	X	X		X	
M21	Sweeney Road crossing, photo u/s	X	X		X	
M22	Sweeney Road crossing, photo d/s	X	X		X	
M23	Highway 246 (Robinson) Bridge, photo u/s		X		X	
M24	Highway 246 (Robinson) Bridge, photo d/s		X		X	
M25	LSYR Lagoon on railroad bridge, photo u/s		X		X	
M26	LSYR Lagoon on railroad bridge, photo d/s		X		X	
M27	LSYR at 35th St. Bridge, photo d/s		X		X	
M28	LSYR at 35th St. Bridge, photo u/s		X		X	
M29	LSYR Lagoon upper reach, photo d/s					
M30	LSYR Lagoon upper reach, photo u/s					
M31	Slick Gardener, looking across towards highway		X		X	
M32	Slick Gardener, looking d/s through culvert	X	X		X	
M33	Slick Gardener, looking u/s through culvert	X	X		X	
	Floradale Br-u/s	X	X		X	
	Floradale Br-d/s	X	X		X	

Table C-2: WY2019 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	October 2018	April 2019	May 2019	August 2019
T1	Hilton trap site, photo u/s	X			X
T2	Hilton start Reach #2, pt site, photo d/s	X	X		X
T3	Hilton at ridge trail, photo d/s	X	X		X
T4	Hilton at ridge trail, photo u/s	X	X		X
T5	Hilton at telephone pole, photo d/s				
T6	Hilton at telephone pole, photo u/s	X	X		
T7	Hilton at tail of spawning pool, photo u/s	X	X		X
T8	Hilton impediment/tributary, photo d/s	X			X
T9	Hilton impediment/tributary, photo u/s	X			X
T10	Hilton just u/s of URP, photo d/s	X	X		X
T11	Hilton road above URP, photo d/s	X	X		X
T12	Hilton road above URP, photo u/s	X	X		X
T14	Hilton from hard rock toe, photo d/s	X	X		X
T15	Hilton from hard rock toe, photo u/s	X	X		X
TX1a	Quiota Creek at 1st crossing, photo u/s		X		X
TX1b	Quiota Creek at 1st crossing, photo d/s		X		X
TX2a	Quiota Creek at 2nd crossing, photo u/s		X		X
TX2b	Quiota Creek at 2nd crossing, photo d/s		X		X
TX3a	Quiota Creek at 3rd crossing, photo u/s		X		X
TX3b	Quiota Creek at 3rd crossing, photo d/s		X		X
TX4a	Quiota Creek at 4th crossing, photo u/s		X		X
TX4b	Quiota Creek at 4th crossing, photo d/s		X		X
T16	Quiota Creek at 5th crossing, photo d/s		X		X
T17	Quiota Creek at 5th crossing, photo u/s		X		X
T18	Quiota Creek at 6th crossing, photo d/s		X		X
T19	Quiota Creek at 6th crossing, photo u/s		X		X
T20	Quiota Creek at 7th crossing, photo d/s		X		X
T21	Quiota Creek at 7th crossing, photo u/s		X		X
T22	Quiota Creek below 1st crossing, photo d/s		X		X
T23	Alisal Creek from Alisal Bridge, photo u/s		X		X
T24a	Alisal Creek from Alisal Bridge, photo u/s		X		X
T24b	Alisal Creek from Alisal Bridge, photo d/s		X		X
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s				X
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s				X
T27	Nojoqui/LSYR confluence, photo u/s				X
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s		X		X
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s		X		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	X
T42a	Salsipuedes Creek at Jalama Bridge, photo u/s			X	X
T42b	Pool at Jalama Bridge			X	X
T43	El Jaro/Upper Salsipuedes confluence, photo u/s				X
T44	Upper Salsipuedes/El Jaro confluence, photo u/s				X
T45	Upper Salsipuedes/El Jaro confluence, photo d/s				X
T48	El Jaro Creek above El Jaro confluence, photo u/s				X
T49	El Jaro Creek above El Jaro confluence, photo d/s				
T52	Ytias Creek Bridge, photo d/s			X	X
T53	Ytias Creek Bridge, photo u/s			X	X
T54	El Jaro Creek 1st Hwy 1 Bridge, photo d/s			X	X
T55	El Jaro Creek 1st Hwy 1 Bridge, photo u/s			X	X
T56	El Jaro Creek 2nd Hwy 1 Bridge, photo d/s			X	X
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s			X	X
T58	El Jaro Creek 3rd Hwy 1 Bridge, photo d/s			X	X
T59	El Jaro Creek 3rd Hwy 1 Bridge, photo u/s			X	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	X
T63	Rancho San Julian Bridge, photo u/s			X	X

D. List of Supplemental Reports Created During WY2019

- WY2016 Annual Monitoring Summary (COMB, 2019c).
- WY2017 Annual Monitoring Summary (COMB, 2019d).
- WY2018 Annual Monitoring Summary (COMB, 2020).
- WY2019 Migrant Trapping Plan (January, 2019).
- Incident Report, October 3, 2018 Power Outage (COMB, 2018).
- Incident Report, December 31, 2018 Power Outage (COMB, 2019b).
- Storm Flow Event Related Fish Mortalities in Hilton Creek (COMB, 2019a).
- 2018 WR 89-18 Release Monitoring Report for RPM 6 (USBR, 2019).

E. Appendices References

COMB, 2018. Interruption of Flow to Hilton Creek on 10/3/18, Event Report. Cachuma Operation and Maintenance Board, Fisheries Division.

COMB, 2019a. Hilton Creek January Storm Events Report. Cachuma Operation and Maintenance Board, Fisheries Division.

COMB, 2019b. Interruption of Flow to Hilton Creek, Incident Report. Cachuma Operation and Maintenance Board, Fisheries Division.

COMB, 2019c. WY2016 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division. Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

COMB, 2019d. WY2017 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division
Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

COMB, 2020. WY2018 Annual Monitoring Summary, Prepared by the Cachuma Operation and Maintenance Board (COMB), Fisheries Division. Prepared to be consistent with requirements set forth in the 2000 Cachuma Project Biological Opinion.

USBR, 2019. 2000 Cachuma Biological Opinion Reasonable and Prudent Measure 6 Monitoring Report Submittal on 2018 State Water Right 89-18 Releases - Cachuma Project. United States Bureau of Reclamation (USBR), prepared in collaboration with the Cachuma Operation and Maintenance Board Fisheries Division.