WY2018 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

Spawning *O. mykiss* on augmented gravel, Hilton Creek

Prepared by:

CACHUMA OPERATION AND MAINTENANCE BOARD

FISHERIES DIVISION

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

JANUARY 29, 2020

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Executive Summary

The WY2018 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 2018 (WY2018, 10/1/17 – 9/30/18). Although the report was finalized in 2019, the monitoring data are from WY2018. 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 WY2018 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).

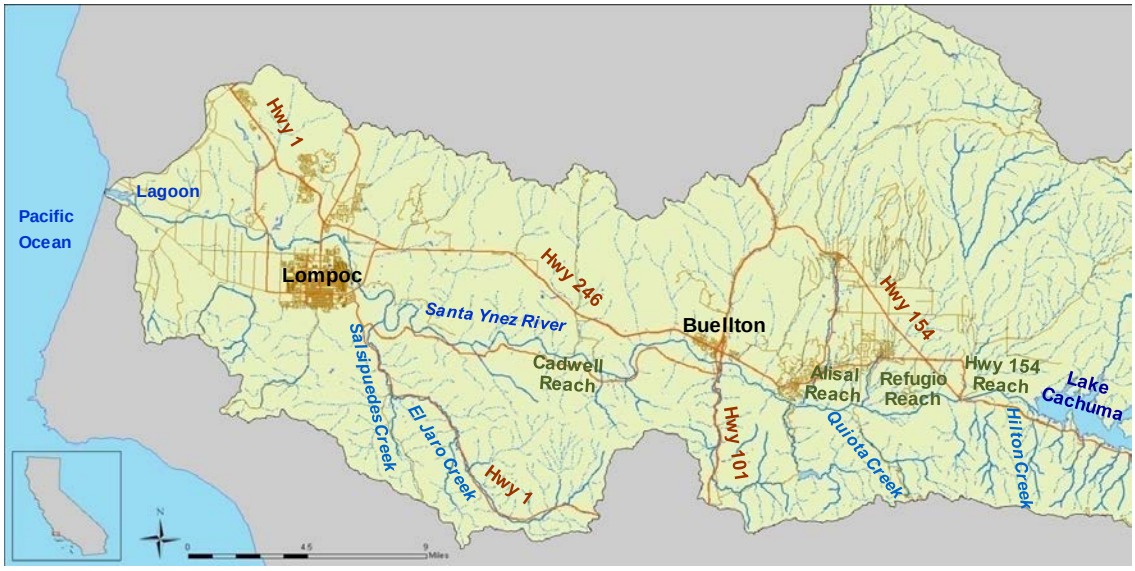

Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean west of Lompoc, showing tributary creeks and management reaches of interest for the LSYR Fish Monitoring Program.

This report summarizes data gathered since the WY2017 Annual Monitoring Summary (COMB, 2019b) and fulfills the annual 2018 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 WY2018, some deviations to the monitoring program as described in the BiOp (NMFS, 2000), Biological Assessment (BA) (USBR, 2000), LSYR Fish Management Plan (FMP) (SYRTAC, 2000) and prior Annual Monitoring Reports/Summaries were necessary, specifically in relation to water quality monitoring, redd surveys, and migrant trapping. The modifications were required due to landowner access constraints, drought-related (specifically reaching critical drought) conditions, or program evolution from acquired field knowledge. A shortened version of this report, the WY2018 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.

WY2018 was a dry year (9.32 inches of precipitation measured at Bradbury Dam; long-term average, 1953-2018, is 19.83 inches) with the highest amount of rainfall occurring in January and March. This was the sixth driest year on record (the driest year on record occurring in 2007 with only 7.41 inches of rain at Bradbury Dam). The largest storm of WY2018 (3.32 inches of rain) occurred on 1/8/18, followed by the 3/21/18 storm (2.72 inches of rain). The LSYR lagoon was closed all water year. At the beginning of the water year (10/1/17), there were 82,580 acre-feet (af) of water stored in Lake Cachuma and only 61,273 af at the end of the water year (9/30/18). BiOp required target flows of a minimum of 2.5 cubic feet per second (cfs) to the Highway (Hwy) 154 Bridge were maintained throughout the water year. Target flows to Hilton Creek of a minimum of 2 cfs were only partially met due to deliveries being conducted through the Hilton Creek Emergency Backup System (HCEBS) by gravity flow which was directly linked to the lake elevation. A minimum of 1.5 cfs was delivered to Hilton Creek throughout the year, all being released at the Lower Release Point (LRP) up until 8/1/18 when the Hilton Creek Watering System (HCWS) pumps were operated through the rest of the water year. There was no fish passage supplementation due a dry year and not meeting the established criteria. A Water Rights (WR) 89-18 release was conducted from 8/6/18 until 9/11/18 during which 8,054 af of water were released over a period of 37 days.

There was one event in Hilton Creek where there was a rapid increase then decrease in streamflow due to upper basin flow that resulted in a high sediment load from the Whittier Fire burn scar that started on 1/8/18. There were 13 *O. mykiss* mortalities found and a report was provided by Reclamation to NMFS that described the event.
Stream water quality data (temperature and dissolved oxygen concentration) are presented for the LSYR mainstem below Bradbury Dam and its tributaries where *O. mykiss* historically have been observed. Given the complexity of the dataset, details are

summarized in the Monitoring Results Section (3.2) only when there were observations of note, such as the presence of native and non-native fish species.

Since the issuance of the BiOp in 2000, Reclamation, with assistance from COMB, has completed many conservation actions for the benefit of southern steelhead including: the construction and operation of the HCWS 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 13 projects (by the end of 2018) 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. Plans have moved forward for the completion of another fish passage project on Quiota Creek for Crossing 8, which will be built in WY2019.

The following are recommendations to improve the monitoring program from WY2018 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;
- 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;
- Conduct gravel augmentation as soon as possible in the fall well in advance of the spawning season;
- 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;
- Obtain an Electrofishing Backpack unit and get the necessary professional training to be certified in its use;
- 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 efforts to remove fish passage impediments within the LSYR basin as listed in the proposed actions of the BiOp, utilizing grant funding wherever possible;
- 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;
- 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;
- 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;
- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin; and
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS and the Monte Arido Highland Biogeographic Region to improve collective knowledge, collaboration, and dissemination of information.

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Figure 67: 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 68: 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 69: 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 70: 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 71: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

Figure 72: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2018, the last three years are shown with a wider line.

Figure 72: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2018, the last three years are shown with a wider line.

Figure 74: Found *O. mykiss* mortalities associated with the 1/8/18 stormflow event (a-d) all located in the lower reaches of Hilton Creek and at the upper limits of the high flow event.

WY2018 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 WY2018 Annual Monitoring Summary (AMS) is to present the monitoring data collected in Water Year 2018 (WY2018, 10/1/17-9/30/18) 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 WY2018 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, 2018c), the WY2015 Annual Monitoring Summary (COMB, 2018d), the WY2016 Annual Monitoring Summary (COMB, 2019a); and the WY2017 Annual Monitoring Summary (COMB, 2019b).

The data summarized in this report describe the habitat conditions and the fishery observations in the LSYR during WY2018. 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).

WY2018 was classified as a dry year with 9.32 inches of precipitation recorded at Bradbury Dam (long-term average, 1953-2018, is 19.83 inches; 6th driest year on record with WY2007 being the lowest at 7.41 inches). This was the 4th driest rainfall year since issuance of the 2000 BiOp, with 10 of 18 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.

Migrant trapping was conducted in WY2018 and all BiOp take limits were followed. Reproduction and population status was monitored through spawner (redd) surveys and snorkel surveys.

WY2017 was a wet year and the first wet year after 5 years of a long-standing drought which enabled the reservoir to recover storage and end critical drought conditions. Although WY2018 was a dry year, there was sufficient rainfall and lake inflow to stay well above critical drought conditions. There was no measureable rainfall in the late fall and it wasn't until the second week of January when a large storm hit the area and produced short duration upper basin streamflow. Hilton Creek experienced flashy streamflow conditions with a discharge peak of approximately 40 cfs that brought with it high sediment load from the Whittier burn scar. The entire creek on Reclamation property was blanketed with fine sediments. Upper basin flow quickly diminished with a short recessional limb to the storm hydrograph. There were 13 *O. mykiss* mortalities found associated with this event and a report was prepared and provided to NMFS (COMB, 2018a). The only other large storm of the year occurred on 3/21/18 and did not produce much upper basin flow and there were no associated incidents with the Hilton Creek *O. mykiss* population.

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:

- 10/1/17-7/31/18: Only HCEBS gravity flow to the LRP was provided to Hilton Creek.

- 8/1/18-8/9/18: In addition to HCEBS gravity flow to the LRP, the pumps on the HCWS were turned on to deliver water to the Upper Release Point (URP). A blocking sein was installed to prohibit fish movement into the reach upstream of the LRP.
- 9/10/18-9/30/18: Only the HCWS by pump flow delivered water to the URP of Hilton Creek and the HCEBS was put in standby mode in the case of an unplanned shutoff of the HCWS.
- Stormflow events: Upper Hilton Creek stormflow events occurred starting on 1/8/18, 3/2/18, and 3/21/18 with durations of approximately 3 days, 1 day, and 7 days, respectively.
- Stormflow event on 1/8/18: This rainfall event was strong enough to produce upper basin runoff that was laden with sediment from the Whittier Fire burn area. A total of 13 *O. mykiss* mortalities were found associated with this event.
- State Water deliveries to Lake Cachuma: CCWA delivered State Water to the lake through the bypass piping system except from 8/22/18-8/29/18 when they were in the Penstock. Otherwise they were in the bypass pipeline or not delivering at all to the lake.
- 8/6/18-9/11/18: The WR 89-18 release occurred.

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 eight Annual Monitoring Reports/Summaries completed for 2009 (USBR, 2012), 2010 (USBR, 2013), 2011 (COMB, 2013), 2012 (COMB, 2016), 2013 (COMB, 2017), 2014 (COMB, 2018c), 2015 (COMB, 2018d), 2016 (COMB, 2019a), and 2017 (COMB, 2019b). 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 adhered to regulatory and industry guidelines for quality assurance and control, which are presented in Appendix B.

3. Monitoring Results

The results from the WY2018 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 a dry year at 4,576.1 af of computed inflow to Lake Cachuma.

WY2018 had 9.32 inches of rainfall at Bradbury Dam and was therefore classified as a dry year (less than 15 inches) (Table 1). The long-term average (1953-2018) at the dam was 19.83 inches. There were only two significant storms during the water year on 1/8/18 and 3/21/18 that produced 3.32 inches and 2.72 inches of rainfall at Bradbury Dam, respectively. There was not sufficient LSYR mainstem and tributary streamflow to breach the sand bar and open the LSYR lagoon throughout the water year. In Salsipuedes Creek, the highest recorded flow (instantaneous peak discharge) at the USGS station at Jalama Bridge in WY2018 was 160 cfs on 3/22/18. Historic minimum, maximum, and WY2018 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 9 precipitation events in WY2018 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). Recorded precipitation at Bradbury Dam was 9.32 inches in WY2018, with the majority of rain falling in January (3.75 inches) and March (4.85 inches). The necessary triggers to implement a passage supplementation event were not met in WY2018. In addition, a WR 89-18 Water Rights release was conducted during the summer from 8/6/18 to 9/11/18.

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. To note, the Hilton Creek gauge (USGS-11125600) is a low flow gauge only (less than 50 cfs). The WR 89-18 release is visible from August through September.

Peak daily mean discharge recorded by the USGS at the Narrows on the LSYR mainstem and Salsipuedes gauges occurred on 3/22/18 at 73.8 cfs and 31.4 cfs (stormflow), respectively. Peak daily discharge at the Solvang gauge of the LSYR mainstem during the migration season was 36.6 cfs on 3/22/18 (peak WR 89-18 release was 170 cfs on 8/19/18). The USGS Los Laureles gauge on the Santa Ynez River mainstem upstream of Lake Cachuma recorded flow from 3/22/18 through 6/20/18 with peak daily discharge observed on 3/22/18 at 66.3 cfs. The Hilton Creek Gauge recorded flow throughout the water year with stormflow starting on 1/8/18 (Figure 3). The peak release from Bradbury Dam was approximately 182.6 cfs on 8/10/18 during the onset of the 2018 WR 89-18 Release. None of these discharge rates were high enough to cause any changes to the channel or banks within the LSYR. Only localized scour of small vegetation within the wetted channel was observed at a few locations.

Annual hydrographs along the Santa Ynez River at Los Laureles, Solvang, Narrows and Salsipuedes Creek gauges showed low spring runoff conditions throughout the basin (Figures 2 and 3). Baseflows (daily mean discharge) within Hilton Creek were between 1.5 cfs and 2.0 cfs prior to the start of WR 89-18 releases. The *O. mykiss* population in Hilton Creek survived throughout the Water Year but conditions were not ideal during the 1/8/18 stormflow event.

Instantaneous peak discharges across the Santa Ynez River basin occurred on 3/22/18 with values recorded at the Narrows, Salsipuedes, and Los Laureles USGS gauges of 213 cfs, 160 cfs, and 261 cfs, respectively. Peak values at Solvang were associated with the WR 89-18 release (184 cfs recorded on 8/19/18). No localized scour of vegetation within the wetted channel was observed.

Ocean Connectivity: The Santa Ynez River lagoon was not breached throughout the water year (Figures 2 and 3). As a result, no anadromous *O. mykiss* were observed during migrant trapping efforts, redd surveys, or bank observations. Streamflow at the H Street

USGS gauge was observed in the late fall in association with the 2017 WR 89-18 releases and the 3/21/18 storm that produced a couple days of recorded flow mostly below 10 cfs.

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

Passage Supplementation: There were no passage supplementation events in WY2018. The minimum criteria per BiOp RPM 3 were not met for passage supplementation.

Adaptive Management Actions: There were no Adaptive Management Committee (AMC) meetings during WY2018 and no flow allocations were made by the AMC from the Adaptive Management Account (AMA).

Target Flows: There were no spills from Bradbury Dam in WY2018, and reservoir storage remained under 120,000 AF, so long-term BiOp established target flows of 2.5 cfs were maintained at the Hwy 154 Bridge under these conditions. Target flows to Hilton Creek of a minimum of 2 cfs were only partially met due to deliveries being conducted through the Hilton Creek Emergency Backup System (HCEBS) by gravity flow which is directly dependent on the head elevation in Lake Cachuma. A minimum of 1.5 cfs was delivered to Hilton Creek at the Lower Release Point (LRP) until the lake elevation rose sufficiently towards the end of December to resume minimum target flow discharges of 2 cfs (Figure 3). Starting in August, Reclamation operated both the HCEBS by gravity to the LRP and the HCWS by pump to the URP in preparation for WR 89-18 releases for a week then turned off the HCEBS and kept it in standby mode in case the HCWS turned off. That configuration continued throughout the rest of the water year (see Section 4 for further details).

Water Rights Releases: Water Rights releases are non-discretionary releases called for by the Santa Ynez River Water Conservation District (downstream Water Rights holders) as described in WR Order 89-18 (WR 89-18). In WY2018, these releases began on 8/6/18 and ended on 9/11/18, with a total release amount of 8,054 af over 37 days (Figure 2). This was a Below Narrows Account (BNA) release that reached just downstream of the Robinson Bridge in Lompoc but did not go past the H Street Bridge. Monitoring for fish movement and water quality was conducted by the COMB-FD staff as stipulated in the BiOp RPM 6 and the 2018 Study Plan (monitoring plan for WR 89-18 releases) (USBR, 2018). Snorkel surveys during the releases indicated *O. mykiss* were not encouraged to move downstream of Alisal Bridge throughout the WR 89-18 release. No fish were found stranded during the release or after ramp-down of the release. These findings were consistent with previous monitoring efforts during prior WR 89-18 releases. Further details of the 2018 WR 89-18 release are provided in the RPM 6 Monitoring Report submitted by Reclamation to NMFS (USBR, 2019).

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. The criterion was met for RPM 5.1 throughout WY2018 (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 second year that the sensors were operational and the data were recorded by Reclamation from 8/9/18 to 8/29/18 once a day at approximately 8:00 AM when the Penstock was being used by CCWA (Figure 4b). Temperatures exceeded 17 °C after 8/23/18. Once temperatures approached 18 °C, Reclamation switched CCWA deliveries back to the bypass system for the rest of the water year at which point temperature monitoring ended.

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 WY2018, 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). Several mainstem legacy sites were not monitored during WY2018 due to the site being dry prior to downstream water right releases with much of the LSYR drying soon after releases were stopped. Sites not monitored during WY2018 include: downstream of the Stilling Basin (LSYR-0.25) and Encantado Pool (LSYR-4.95).

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 21 thermograph units (normally 24) deployed at 9 sites (normally 10) on the LSYR mainstem which are listed below with the number of units in parentheses:

- Stilling Basin parapet wall (LSYR-0.01 (3));
- 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));
- Double Canopy Pool (LSYR-7.65 (3));
- Head of Beaver Pool (LSYR-8.7 (3)); and
- Cadwell Pool (LSYR-22.68 (3))

In the tributaries, there were 12 thermograph units deployed at 12 sites during WY2018, all of which were single unit deployments:

- Hilton Creek (HC, 2 sites):
    - HC-lower (HC-0.12); and
    - HC-upper (HC-0.54).
- 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.

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

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

A 3-unit vertical array was deployed along the northeast wall of the Stilling Basin from 5/2/18 through 12/6/18 (Figures 6-8). 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.

Stilling Basin water temperatures, particularly at the surface, show gradual seasonal warming prior to the start of WR89-18 releases on 8/7/18. Surface water temperatures warmed to over 26 °C before falling to less than 15 °C once the downstream releases started. Temperatures at the middle and bottom locations showed nearly identical values, generally remaining around 23 °C before decreasing to less than 15 °C during the downstream releases. Following the releases, surface waters quickly warmed while the middle and bottom monitoring locations essentially remained less than 20 °C for the remainder of the deployment period. The surface unit was out of the water from 10/8/18 – 10/31/18 due to declining water levels following the stop of WR89-18 downstream releases. No *O. mykiss* were observed in this habitat although carp were plentiful.

Long Pool (LSYR-0.51)

The Long Pool is approximately 100 feet wide at the widest point and 1,200 feet long with a maximum depth of over 9 feet. It is fed by two water sources when there is no spill or release from the outlet works; the chute release which is part of the HCWS that releases water directly into the Stilling Basin and Hilton Creek proper (URP and LRP of the HCWS and upper natural basin creek flow) both flow sources confluence directly into the Long Pool in two separate channels. The HCWS is a cooler water source that takes water at the approximate 65 foot level in Lake Cachuma. Mixing of the two sources occurs within the first 200 feet of the Long Pool and well upstream of the thermograph vertical array location. *O. mykiss* are routinely observed rearing in this habitat when water visibility permits.

The thermograph vertical array was deployed on 5/2/18 and removed on 12/6/18 at the deepest point of the pool at 9 feet (Figure 9 – Figure 11,). Debris load and silty runoff following storm events from the Whittier Fire burn scar the last two years has added a tremendous amount of material through Hilton Creek and into the Long Pool filling in approximately ¼ of the pool and decreasing the maximum depth from 9 feet to 6 feet at its deepest point, specifically during the 1/8/18 stormflow event.

Gradual seasonal warming was observed in the Long Pool with maximum surface temperatures reaching 24 °C in mid-July before declining sharply to near 14 °C following initiation of WR89-18 downstream water rights releases. Minimum temperatures remained less than 19 °C during the entire deployment time. Temperatures at the middle

unit remained less than 19 °C during the entire deployment except for a brief time when the leading edge of the water rights release pushed warm water out of the Stilling Basin and raised the temperature over 21 °C before rapidly falling. Temperatures at the bottom did not show much of a change from minimum to maximum, remaining less than 18 °C during the deployment. It is suspected that the bottom unit was partially submerged in silty substrate that provided ambient insulation and did not record the range of temperatures normally observed at the bottom unit at this monitoring location.

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 5/2/18 to 12/6/18 (Figure 12). Temperatures at this location closely mimicked those collected in the Long Pool. Maximum water temperatures were less than 23 °C and dropped to less than 21 °C following the start of WR89-18 releases. No *O. mykiss* were observed at this habitat.

Grimm Property Upstream – Run (LSYR-1.09)

A single thermograph was deployed in a heavy canopy covered run habitat measuring approximately 100 feet long and 15 feet wide from 5/14/18 to 12/10/18 (Figure 13). The unit was deployed in 1.5 feet of water. This is the first year water temperature monitoring has occurred at this location. Maximum water temperatures at the time of deployment hovered around 20 °C and showed typical seasonal warming and reached a seasonal high of around 25 °C after the middle of July. Following the release of WR89-18 water, maximum temperatures quickly dropped to 16 °C and remained less than 21 °C during the entire deployment. No *O. mykiss* were observed at this site.

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 5/14/18 to 12/10/18 (Figure 14). The unit was deployed in 1.5 feet of water. This is the first time water quality monitoring has occurred at this location. Maximum water temperatures at this site recorded some of the warmest water temperatures in the LSYR mainstem during the monitoring period. Maximum water temperatures exceeded 28 °C several times in July while minimum temperatures remained less than 22 °C. Following the start of WR89-18 releases, there was a rapid drop in maximum temperatures to less than 17 °C. Once the releases were halted, rapid warming was observed to occur through September. No *O. mykiss* were observed at this location.

Grimm Property Pool (LSYR-1.71)

A three unit vertical array was deployed for the first time in this pool habitat from 5/14/18 to 12/10/18 (Figure 15 – Figure 17). 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. Prior to the start of WR89-18 releases, maximum water temperatures exceeded 29 °C during several days in July. The middle and bottom units recorded similar warm temperatures with the bottom unit remaining greater than 22 °C prior to downstream water right releases.

Following the release, all three sites essentially mimicked each other showing near uni-thermal conditions until the releases stopped and allowed stratification to develop again.

Double Canopy Pool (LSYR-7.65)

The Double Canopy Pool is located directly upstream of the Refugio Bridge. The pool was approximately 350 feet long, 40 feet wide, and 4.5 feet deep at its deepest point when the habitat is filled with water. A vertical array was deployed at this site from 5/15/18 to 7/9/18. The thermographs were removed by members of the general public sometime after July 9 and were not recovered. The short deployment shows seasonal stratification developing in the pool habitat with surface maximum temperatures warming to near 24 ℃ and bottom temperatures remaining less than 21 (Figure 18 – Figure 20). The thermographs at this site were stolen by members of the public and the units were not replaced during WY2018. No *O. mykiss* were observed at this habitat in WY2018.

Head of Beaver Pool (LSYR-8.7)

This habitat is located approximately ¼ mile downstream of the Quiota Creek confluence with the Santa Ynez River. The habitat is approximately 730 feet long, 50 feet wide, and 7.1 feet at the deepest point while residual pool depth is being maintained. A vertical array was deployed in this habitat from 5/18/18 – 7/10/18 (Figure 21 – Figure 23). Following the deployment of the thermographs, the habitat rapidly dried out prior to WR89-18 releases. In fact, the surface unit was exposed to air on 5/29/18 and the middle unit was exposed to air on 6/18/18. When the habitat was visited on 7/10/18, there was only a small isolated puddle remaining and the thermographs were removed. The vertical array was not redeployed for WR89-18 releases. No *O. mykiss* were observed at this habitat in WY2018.

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 5/15/18 to 12/6/18. The data show stratified conditions developed with warmer water at the surface compared to the bottom of the habitat (Figure 24 - Figure 26). These stratified conditions persisted until the WR89-18 releases reached that habitat causing the water to become essentially uni-thermal from surface to the bottom during the water rights release. Of note in the data set is how water temperatures responded at the bottom of the habitat once WR89-18 releases reached the site. There was a nearly 4 ℃ increase in maximum water temperatures and an approximately 3 ℃ variation between maximum and minimum temperatures. Prior to and after the releases, there was a less than 1 ℃ variation between maximum and minimum temperatures. No *O. mykiss* were observed at this location in WY2018.

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 27. Other legacy sites were not included due a dry habitat prior to the WR 89-18 releases. 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*.

Even through the previous year was considered a wet year (25.48 inches), the dry rainy season of 2018 (9.32 inches) illustrated the impact of the previous 5 years of drought can have on the LSYR mainstem habitats, causing dry conditions to develop during the onset of spring into summer. Zero flow was measured at Solvang starting 2/10/18 through 3/21/18 and flowed briefly at low levels until 4/11/18 and remained dry until WR89-18 release water reached the site on 8/9/18 (Figure 27). Prior to WR89-18 releases, observations showed warming conditions typical of seasonal warming at all the monitoring locations with the warmest locations being the run unit at LSYR-1.54 and the pool surface unit at LSYR-1.71.

Rapid cooling coincident with cold WR89-18 release water was recorded through the Highway 154 Reach followed by gradual warming as the release rate was reduced and eventually halted.

O. mykiss and Water Temperature Criteria within the LSYR Mainstem

Five of the last 6 years have seen drought conditions and the significant contraction of available oversummering rearing habitat throughout the mainstem and all of the tributaries within the lower watershed. The wet water year classification of WY2017 did little to alleviate the impacts of the previous 5 years of drought with dry conditions developing during the spring of WY2018 in the LSYR mainstem and its tributaries following. No *O. mykiss* were observed in the mainstem during WY2018 and many of the habitats were inhabited by one or more species of largemouth bass, sunfish, and carp prior to drying out over the summer and the arrival of the WR 89-18 releases.

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 100 feet upstream of the confluence with the LSYR mainstem in approximately 1 foot of water from 4/30/18 to 12/6/18. Water temperatures in the lower section of the creek remained well below 18 °C before showing a spike in temperatures to near 19 °C coincident with WR89-18 releases which inundated the monitoring site and raised temperatures (Figure 28). Overall, maximum water temperatures remained less than 20 °C during the entire deployment period. While no *O. mykiss* were observed at this location, *O. mykiss* were observed inhabiting the creek upstream of the monitoring location.

Upper Hilton Creek (HC-0.54)

A single thermograph was deployed immediately downstream of the URP in a shallow run habitat from 11/2/18 – 12/7/18. The URP was turned off for the majority of the year and the thermograph was not deployed until water flow to the URP was started. Water temperatures remained less than 18 °C during most of the deployment period (Figure 29). While no *O. mykiss* were observed at this location, *O. mykiss* were observed inhabiting the creek downstream of the LRP.

Quiota Creek (QC-2.66)

A single thermograph was deployed approximately 20 feet upstream of Crossing 6 on Refugio Road from 4/30/18 through 7/9/18. 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 until WY2014) during routine snorkel surveys. The thermograph was removed on 7/9/18 due to the habitat going dry (Figure 30). Overall, maximum water temperatures reached just over 20 °C during several times in late May and early July before the unit was removed. Minimum temperatures remained less than 18 °C during the entire deployment. No *O. mykiss* were observed at this location in 2018.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed on the bottom of the creek from 4/30/18 through 12/6/18. During the winter of 2017, storm flows 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. This site is also immediately downstream of the Salsipuedes Creek trapping location. The habitat configuration change has resulted in a positive improvement in water temperature conditions during the summer as observed in 2017 and 2018. This is likely due to the increase in depth which allows for thermal stratification and potential groundwater contributions to the habitat. Due to the increase in habitat depth, it is recommended a vertical array to better monitor the thermal condition along the vertical profile.

Water temperatures during the deployment showed little seasonal variation during the critical summer months. Overall, maximum water temperatures remained less than 19 °C during the entire monitoring period with generally less than 1 °C variation over a 24-hour period (Figure 31). Seasonal cooling was observed to start in early September. The long term data set (1995 to present) has shown this monitoring location to be one of the

warmest in the watershed and a departure from previous years (1995-2016). This site recorded some of the coldest water temperatures in the watershed. No *O. mykiss* were observed at this monitoring site.

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

A single thermograph was deployed in a pool habitat approximately 4-feet below the surface from 4/30/18 through 12/10/18. Temperature monitoring has been conducted at this location since 2013 in order to better understand the water temperature regime in this reach and throughout the watershed. It has been particularly important in identifying creek sections with remaining flow and adequate *O. mykiss* rearing conditions during the prolonged drought (2012 to the 2018, with the exception of 2017). Reach 2 is a short bedrock section with deep pools, extends approximately 1/3 of a mile, and during the drought represents some of the best and only remaining viable habitat for rearing *O. mykiss* within the entire Salsipuedes/El Jaro creek watershed due to the presence of numerous bedrock formed pools. The monitored habitat is approximately 40 feet long, 15 feet wide, and 6-feet deep at its deepest point. *O. mykiss* 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 showed a similar seasonal pattern compared with the Lower Salsipuedes monitoring location though with slightly elevated temperatures (Figure 32). The water temperature regime during the deployment period showed typical seasonal warming in the spring and summer followed by a general cooling trend beginning early August which is a month earlier than past seasonal cooling. Maximum water temperatures in excess of 20 °C were recorded from mid-June to late August. Maximum temperatures just over 23 °C were recorded near the end of July. Minimum temperatures closely followed maximum temperatures with the 24-hour variation less than 1-2 °C during the entire deployment period. *O. mykiss* were observed at this location during the summer of WY2018.

Salsipuedes Creek – Highway 1 Bridge (SC-3.0)

A single thermograph was deployed in the pool habitat approximately 4-feet below the surface, directly downstream of the Hwy 1 fish ladder from 4/30/18 through 12/6/18. 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 WY2018 due to turbid conditions. A thermograph has been deployed at this location since WY2013 and was done so to better understand the temperature regime throughout the creek, particularly in reaches that may be holding 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 is numerous deep pool habitats formed in the bedrock that offer excellent oversummering opportunities for rearing *O. mykiss*. No *O. mykiss* were observed at this location during WY2018.

Water temperatures mimicked those that were recorded downstream at SC-2.20, though slightly warmer in comparison. Data show gradual warming in the spring followed by

rapid warming starting in late June and extending through late July with maximum temperatures exceeding 24 °C on two separate occasions in July (Figure 33). Minimum temperatures were in excess of 20 °C during that timeframe. The 24-hour variation was greatest during the warmest period with fluctuations of 2.0-3.0 °C. Minimum temperatures remained below 20 °C from May through late June and from mid-September through December.

Salsipuedes Creek – Jalama Bridge (SC-3.5)

A single thermograph was deployed in a pool habitat approximately 4-feet below the surface, directly downstream of the Jalama Bridge fish ladder from 4/30/18 through 12/6/18. The pool is approximately 30 feet long, 18 feet wide and 6 feet in depth. This area routinely holds oversummering *O. mykiss* and *O. mykiss* were observed in this habitat during snorkel surveys and bank observations in WY2018.

Water temperature data collected at this site remained relatively cool throughout the deployment period showing adequate rearing conditions for oversummering *O. mykiss*. Maximum temperatures remained less than 22 °C except for a few days at the beginning of July (Figure 34). Minimum temperatures remained less than 20 °C for the entire deployment and less than 18 °C except for a several week period from early July through early September. Upper Salsipuedes and the confluence area between Salsipuedes and El Jaro creeks were dry on 7/10/18 onward.

Upper Salsipuedes Creek (SC-3.8)

Since the beginning of water quality monitoring of this creek in the mid-1990s, Upper Salsipuedes Creek has been one of the most important reaches in the lower tributary system due to its optimal rearing conditions for *O. mykiss*. For three consecutive years from 2014 to 2016, and again in 2018, it dried at the confluence where the thermograph was placed. Past snorkel and redd surveys have documented many different age classes of *O. mykiss* in addition to large redd excavations that most likely were from anadromous steelhead. However, the recent drought has extirpated *O. mykiss* from this portion of Salsipuedes Creek and none were observed in WY2018. Because of the current low population, recolonization of *O. mykiss* into Upper Salsipuedes Creek may take many years.

A single thermograph was deployed in a shallow run habitat 30 feet upstream of the confluence with El Jaro Creek from 4/30/18 to 7/9/18. The monitoring location was observed to be dry on 7/10/18 during a routine site visit for instrument downloading. Upon looking at the data, it appeared that the creek went dry the day before on 7/9/18. Maximum water temperatures fluctuated greatly during the deployment, ranging from below 16 °C to over 21 °C within a short period during May (Figure 35). Minimum temperatures remained less than 16 °C except for one day in late June. Again, no *O. mykiss* were observed at this location.

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 4/30/18 to 7/9/18. The habitat is

roughly 50 feet long, 12 feet wide with a max depth of 3.5 feet. This location routinely held rearing *O. mykiss* prior to the drought. This area, along with Upper Salsipuedes Creek, dried during the summer in the previous 3 years (2014-2016 and again in 2018).

This monitoring location was one of the coldest in the entire watershed. Overall, water temperatures remained less than 18 °C during the entire deployment period (Figure 36). The 24-hour variation was less than 1 °C. The habitat was rapidly drying and not maintaining residual pool depth when the site was visited on 7/10/18 for instrument downloading. The unit was nearly exposed to air and removed from the site at that time. Again, no *O. mykiss* were observed at this site.

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 4/30/18 through 12/6/18. The habitat measured approximately 35 feet long, 7 feet wide and 3.5 feet deep. A thermograph has been deployed in this section of the creek since 2013 and was done to better understand potential oversummering rearing habitat for *O. mykiss* in El Jaro Creek. *O. mykiss*, including young of the year, juveniles and adults have been observed sporadically within this area over the past several years. This area is influenced by Palos Colorados Creek that 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) has allowed this area to remain wetted throughout the drought and provided pool refuge habitat for any rearing *O. mykiss* inhabiting this area.

Water temperatures at this location recorded some of the coolest temperatures during the deployment period with little 24-hour variation. Temperatures generally remained less than 20 °C except for a short period of time from mid-July to early August when they were slightly warmer (Figure 37). Minimum temperatures remained less than 20 °C during the deployment period. No *O. mykiss* were observed in this area in WY2018.

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

O. mykiss have regularly been observed within the plunge pool and 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, 2017 and 2018 and was completely dry in 2015 and 2016. A thermograph was deployed in the pool habitat immediately downstream of the bridge from 4/30/18 and removed on 7/10/18 due to the pool habitat drying out.

During the deployment, water temperatures showed typical seasonal warming with maximum and minimum temperatures exceeding 20 °C briefly in late May and again in late June and early July (Figure 38). The habitat was an isolated shallow pool when the site was visited on 7/10/18 and the thermograph was removed. No *O. mykiss* were observed in this area in WY2018.

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

A single thermograph was deployed 0.5 feet from the bottom of a corner scour pool habitat from 5/15/18 through 12/6/18. The habitat is 30 feet long, 15 feet wide, and 3.0 feet deep and is located approximately 1/8 of a mile upstream from the confluence with El Jaro Creek. Los Amoles Creek has regularly held various age classes of *O. mykiss* and spawning sites have been identified in the creek over the years. Drought conditions have negatively impacted water flow through most of the creek with vast sections of Los Amoles Creek dry several hundred feet upstream of the monitoring location. An unnamed spring enters the creek approximately 150 yards upstream of the monitoring locations and provides the sole source of water for that section of the creek.

Water temperatures show typical seasonal warming starting in the spring and continuing into the summer. Maximum temperatures generally remained less than 22 °C except for a several day period in mid-August when they exceeded 23 °C (Figure 39). Minimum temperatures remained less than 20 °C during the entire deployment period. The 24-hour variation was greatest during the warmest period and extending into mid-September when variation was within the 2.5-3.0 °C range. No *O. mykiss* were observed at this monitoring location in WY2018.

Salsipuedes Creek Longitudinal Comparisons

Longitudinal maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 40 for the thermographs at Rancho San Julian (EJC-10.82), 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-2.2), 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.

The entire watershed is still exhibiting the impacts of the long-term drought. For example, while WY2017 was considered a wet year with 34.64 inches of rain recorded at Rancho San Julian, the thermograph monitoring location at Rancho San Julian was observed to be dry on 8/21/18, an observation that has only been observed during the past few years of this recent drought (personal communication with ranch manager Jim Poett). In 2018, there was 11.73 inches of rain recorded at Ranch San Julian (dry year) and this site was essentially dry by the middle of July 2018, along with Upper Salsipuedes Creek and El Jaro Creek at the confluence with Salsipuedes.

The maximum flow rate measured at the USGS gauging station in Salsipuedes occurred on 3/22/18 following a storm event that increased flows to 157 cfs. This was the single largest flow event for the entire year. Following that event, flows quickly declined in the creek and by 3/26/18, flows had dropped to less than 1.0 cfs. Flows continued to decline during the spring and summer and by 6/4/18, recorded flow was 0.1 cfs and by 7/10/18, flows had declined further to 0.04 cfs and remained low for the remainder of the year.

Maximum daily water temperatures at all thermograph sites within the watershed show a broad range of results with the warmest sites at LAC-7.0 and SC-3.0 to the coldest sites at EJC-5.4 and SC-0.77 (Figure 40). Water temperatures appeared suitable for rearing *O. mykiss* at all creek monitoring locations in WY2018.

O. mykiss and Water Temperature Criteria within the Tributaries

The Salsipuedes/El Jaro Creek watershed is a dynamic system with many variables that influence water temperatures at any given time. The amount of surface flow, groundwater upwelling, ambient air temperatures, and presence/absence of riparian vegetation all influence the thermal regime within individual habitats in the watershed. In addition to the above listed variables, the previous years of drought conditions have caused a significant negative impact to all tributary habitats throughout the watershed. The previous four years in particular have seen the majority of El Jaro and Upper Salsipuedes Creek dry causing a large reduction in available habitat for oversummering and rearing fish. The recent dry year following on the heels of a wet year showed all indications of continuing persistent drought conditions with large sections of El Jaro and Salsipuedes Creek drying out again.

In WY2017 additional flow contributions to the creek in the summer from the wet winter 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. In WY2018, flow conditions more closely resembled those that were observed in WY2015 and WY2016. Overall, rearing conditions appeared to be suitable for *O. mykiss* in habitats that retained water during 2018.

Lake Cachuma Water Quality Profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 4/10/18, 6/21/18, 8/20/18, 10/10/18, 11/1/18, 11/2/18, 11/6/18, and 12/21/18 (Figure 41). The purpose of collecting lake profiles is to gather vertical temperature and DO concentrations to assure that the depth of the adjustable intake hose for the HCWS is set to provide optimum conditions for *O. mykiss* in Hilton Creek, at or below 18 °C as stipulated in the BiOp. Lake profiles are not obtained from the deepest part of the lake; rather, profiles are obtained near the HCWS intake to look at water quality conditions going to Hilton Creek. In 2018, lake profile measurements were taken from a boat moored up to the HCWS intake barge, but off the back of the boat so that the submerged monitoring equipment was not sucked into the intake. Reservoir elevation remained high enough in WY2018 to provide release temperatures under 18 °C throughout most of the year. However, temperatures exceeded 18 °C during the months of September through November as a result of the HCWS intake snorkel getting kinked and sitting at less than the design depth of 65 feet and above the thermocline.

The first profile of the year was measured in April with typical springtime warming evident within the first 10 feet, ranging from 17.6 °C – 17.5 °C (Figure 41). Summertime profiles in late June and August showed an increase in temperatures at all depths, with surface temperatures of 21.4 °C and 24.4 °C and bottom temperatures of 13.8 °C and 14.1

°C, respectively. Thermocline depths during those profiles ranged from 26-43 feet. Cooler weather coupled with a shorter photoperiod resulted in cooler reservoir temperatures during the October lake profile. The surface temperature had dropped approximately 4 °C from the August profile, with a recorded surface value of 20.2 °C. Multiple lake profiles were called for and carried out in early November due to warmer than normal temperatures being observed within Hilton Creek. Three profiles were conducted between 11/1/18, 11/2/18, and 11/6/18 with similar surface temperatures ranging between 18.0 °C - 19°C. The epilimnion (warm surface zone) generally extended down to 53 feet, ranging from 17.9 °C – 18.3 °C, where temperatures quickly cooled in the thermocline and beyond. Temperatures at 65 feet (the presumed HCWS intake take) during the same three lake profiles ranged between 14.9 °C – 15.1 °C. Using the lake profile results, and then matching them up with COMB-FD thermographs and USGS gauging station temperatures in Hilton Creek near the LRP indicated that the HCWS intake barge was higher in the water column during this time frame and above the thermocline. The final lake profile in December showed unithermal conditions to depth with a surface temperature of 13.7 °C and a bottom temperature of 13.6 °C suggesting that the lake had turned over.

Surface DO concentrations ranged between 7.92 mg/l – 9.72 mg/l during all profiles taken in WY2018 (Figure 41). DO concentrations remained above 7 mg/l within the top 26 feet of the water column throughout the year. Anoxic conditions at depth were observed from June through November with less than 3 mg/l recorded below 60 feet. The final profile in December showed relatively uniform DO conditions ranging from 8.76 mg/l at the surface to 7.21 mg/l at the bottom of the reservoir after the lake had turned over. Note that DO concentration in the lake significantly increases when delivered to Hilton Creek at the URP and LRP due to the diffuser box and engineered rock cascade at HCWS outlets.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2018 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 WY2018 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 2018 shows 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 42-46). 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 20 feet in height. However, trees in the riparian corridor throughout the LSYR mainstem are showing signs of stress and die off from the ongoing drought and lack of flowing water and the fact that target flows were no longer required at the Alisal Bridge. The last Bradbury Dam spill event occurred in 2011. Since 2011, the region has been experienced nearly 7 consecutive years of drought resulting in decreased flows and constricting habitat throughout the entire watershed.

Photo documentation within Hilton Creek continues to show a maturing riparian zone, particularly within the reach between the URP and LRP which was initially activated in 2005 (Figures 47-48). Larger trees (willows, alders, sycamores, and cottonwoods) are replacing the smaller understory within the drainage. Drought conditions have negatively impacted the riparian corridor upstream of the LRP in particular. Salsipuedes and El Jaro Creeks showed rapid recolonization of riparian vegetation in WY2018 due to consecutive years of below average rainfall and an absence of channel changing flow events (Figures 49-51). Large flows are important in both the mainstem and tributaries as they clear out potential passage barriers/impediments and remove debris/silt and generally clean out potential 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.

WY2018 was the fifth 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 WY2018 trapping season,

the HDPE pipe was deployed as proposed, but was not needed as the total number of juveniles captured did not approach the established take limits. Take was not exceeded during the 2018 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 WY2018, migrant traps were installed in Hilton Creek from 3/5/18 to 4/27/18 and in Salsipuedes Creek from 3/23/18 to 3/30/18 (Table 7). The reason for the early removal on Salsipuedes was due to extremely low flows following the only significant storm event of the year. By 3/30/18, flows in Salsipuedes Creek had decreased to approximately 0.6 cfs, preventing any upstream or downstream migrating fish from negotiating critical riffle habitats.

WY2018 was a dry year with only 9 storms that produced rainfall greater than 0.1 inches recorded at Bradbury Dam. The dry year provided little to no migration opportunities for *O. mykiss* throughout the LSYR basin and its tributaries. The Hilton Creek and Salsipuedes Creek migrant traps were operated continuously from 3/5/18 to 4/27/18, at which point flows were too low for fish passage with 2 brief periods when the traps needed to be removed at Hilton Creek due to the potential for high streamflow (Table 7). The LSYR mainstem traps were not operated due to limited fish passage potential with only one brief period of flow above 25 cfs at Solvang (determined critical riffle flow) during the migration season. Total catch per unit effort (CPUE) for WY2018 was 0.51 at Hilton Creek was 90% efficiency and 0.43 at Salsipuedes Creek (100% efficiency) (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).

Hilton Creek Migrant Traps: Both upstream and downstream migrant traps were installed from 3/6/18 through 4/27/18. Migrant traps are typically deployed in the January-February timeframe, but were not deployed until early March due to low rainfall and streamflow resulting in poor migration conditions. There were 6 upstream migrating *O. mykiss* captured during the deployment with the smallest measuring 132 mm (5.2 inches) and the largest measuring 459 mm (18.1 inches) (Figures 52-54 and Table 10). There were 18 downstream migrating fish captured with the smallest measuring 132 mm (5.2 inches) and the largest measuring 265 mm (10.4 inches). Of those 18 downstream

migrants, 17 exhibited smolting characteristics with nearly twice as many fish captured in April as were captured in March. Average smolt size shows that fish captured in March were slightly smaller than those captured in April. The majority of the fish captured in the creek were classified as juveniles.

The flows in Hilton Creek spiked briefly at less than 17 cfs (from the Hilton Creek USGS gauge) and remained between 2.5-6.0 cfs during the entire migration period, illustrating the overall poor migration opportunities for any upstream or downstream migrating fish within the Santa Ynez River mainstem. The majority of the fish were captured following the peak flow event that occurred on 3/21/18 and were all classified as resident fish (Figure 55).

The 2018 trapping season was 52 days long with the traps being operational for 47 of those days (90% trapping efficiency) (Tables 7-8). The traps were removed for several days on 3/10/18 and 3/20/18 due to storm conditions and anticipation of elevated flows (Table 7). The combined Catch per Unit Effort (CPUE) was 0.51 captures per day with 0.13 and 0.38 captures per day for upstream and downstream fish respectively.

Overall, of the 24 fish captured migrating upstream and downstream, 22 (92%) were captured during the first and second PM trap check showing that the majority of the fish movement occurred during the hours of darkness (Table 9).

Salsipuedes Creek Migrant Traps: Trapping was conducted in Salsipuedes Creek for a limited period of time from 3/23/18 through 3/30/18. The absence of any meaningful storms and associated runoff events through the end of March created poor migration opportunities for upstream and downstream migrating *O. mykiss* with flow rates so low fish could not adequately negotiate critical riffles throughout the creek. No upstream migrating *O. mykiss* were captured. There were three downstream *O. mykiss* captured on 3/23/18 with the smallest measuring 117 mm (4.6 inches) and the largest measuring 210 mm (8.3 inches) (Figures 52-53 and Figure 56). Two of the 3 fish were classified as smolts.

Flows in Salsipuedes Creek remained less than 1.0 cfs for the majority of the migration season. The largest flow event occurred on 3/22/18 with a brief instantaneous flow peak of 160 cfs which rapidly decreased to less than 1.0 cfs within a matter of a few days (Figure 57).

The trapping season at Salsipuedes was only 7 days long due to extremely low water flow conditions from lack of storm events. Traps were only able to be operated for a short period of time following the storm event on 3/21/18 when there was enough streamflow for fish movement (Table 7). The combined 7-day CPUE was 0.43 captures per day with 100% trapping efficiency (Table 8). All three of the downstream migrating *O. mykiss* were captured during the hours of darkness (Table 9).

When comparing the trapping results since 1995, it is evident that the drought has caused significant attrition to the overall population of *O. mykiss* inhabiting the watershed and

has prevented access by anadromous adults since WY2011, except during WY2017 (a wet year with the lagoon upon to the ocean for over 50 days). 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: No trapping was conducted at the LSYR mainstem trapping location in WY2018. Flows greater than 25 cfs only occurred once at Solvang during the migration season for a brief period of time with rapid recessions to less than 5 cfs shortly after stormflow resulting in minimal passage opportunities.

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 previous 6 years of drought (excluding 2017) have been detrimental to spawning opportunities for resident *O. mykiss* throughout the watershed. Constricting habitats, beaver dams, and ponds that restrict water movement and submerge potential spawning grounds, and low flows essentially eliminated longitudinal *O. mykiss* movement within the LSYR mainstem and tributaries as fish could not navigate past critical riffles during those years. While flow conditions were greatly improved in 2017 compared to the previous 5 years in allowing fish to navigate critical riffles and locate mates, the low number of redd sites observed during the spawning surveys underscores the overall low population levels of adult *O. mykiss* inhabiting the Salsipuedes/El Jaro creek watershed this year.

Survey results are presented for the tributaries in Tables 11-12. Redd surveys within the LSYR and tributaries began in early January and ended in April. WY2018 was classified as a dry year which presented few opportunities for stormflow to allow unimpeded migration passage throughout the tributaries and the LSYR mainstem. Redds identified in Hilton Creek correspond directly to a Gravel Augmentation Project that placed spawning gravels at areas where spawning would most likely occur (see Section 4.6). Of the 5 gravel augmentation treatment sites, three had fish spawning on them within a matter of days to weeks after placement. In total, 8 redds were identified in Hilton Creek with young of the year being first observed on 4/7/18.

Spawning identified in Salsipuedes Creek was closely associated with pool refuge habitat in the primary areas that continue to hold water during the drought. There were four redd sites identified in Salsipuedes Creek in WY2018. When conducting redd surveys on 3/12/19, surveyors discovered a resident adult carcass between two redd sites in Reach 3. It did not appear this fish was successful in spawning as no young of the year were observed near these particular sites. Young of the year were first observed in Salsipuedes

Creek on 4/17/18 and were associated with spawning activity downstream of Jalama Bridge.

Redd surveys conducted in Quiota Creek resulted in 2 redd sites being documented in the upper reaches of the creek well above Crossing 9 (the upstream limit of our routine snorkel surveys). Both spawning sites were located in sub-optimal locations but the resident *O. mykiss* were using the best available material and locations based on the limited flow conditions. Young of the year were first observed in the creek on 5/2/18 and were associated with both documented redd sites.

There were no redds or evidence of spawning identified in the LSYR mainstem during WY2018 within Reclamation property immediately downstream of the Long Pool or in the management reaches downstream (Table 13). Spawning surveys were not conducted in either the Refugio Reach or Alisal Reach due to low or dry river conditions during the spawning season although bank surveys were conducted.

Snorkel Surveys: Snorkel surveys in WY2018 were conducted in the spring, summer, and fall within the LSYR mainstem (Figures 58- 59 and Table 14). Standard and accepted single-pass snorkel survey protocols were followed (Hankin and Reeves, 1988). Spring snorkel surveys were completed in June (except for a section of Reach 3 which was conducted as a pre WR 89-18 Release survey in August) 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 young of the year produced, 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, commensurate with the during-release phase of the WR 89-18 Release. Fall LSYR mainstem snorkel surveys were followed soon after the summer survey due to the need for post-release surveys of the WR 89-18 Release. Fall surveys are meant to evaluate the population of over-summering *O. mykiss* going into the following water year.

The COMB-FD staff applied the same level of effort for each of the three surveys and covered the same spatial area during the spring, summer, and fall. However, factors such as turbidity, beaver activity, and lack of water 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* reared 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 59 with all survey dates shown in Table 14 and Table 17 for the LSYR mainstem and 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 58). Spring surveys carefully located 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. Oftentimes summertime Water Rights Releases (WR 89-18) are conducted during the middle of the dry season along the LSYR mainstem. Since COMB-FD conducts pre-, during- and post-release surveys for a WR 89-18 release as part of compliance for the 2000 BiOp, Reasonable and Prudent Measure 6, 2000 BiOp (NMFS, 2000), these surveys are used conjunctively as part of routine monitoring activities. The start time and duration of a specific WR 89-18 Release dictates when pre-, during- and post-release snorkel surveys are conducted. In WY2018, during and post-release WR 89-18 Release snorkel surveys were used as a surrogate for the regular summer and fall snorkel surveys along the mainstem.

Hwy 154 Reach

Although the Hwy 154 Reach extends from the Stilling Basin (LSYR-0.0) to the Hwy 154 Bridge (LSYR-3.2), due to access constraints and the size and poor clarity of the Stilling Basin and the Long Pool, the only areas snorkeled were the habitats below the Long Pool to the Reclamation property boundary (LSYR-0.5 to LSYR-0.7). Hwy 154 Reach surveys in the spring were not conducted due to heavy siltation and poor water clarity. However, pre and post WR 89-18 Release surveys were conducted. Snorkel survey results for the Hwy 154 Reach are shown in Figures 58-59 and Tables 15 and 16. No *O. mykiss* were observed in the reach below the Long Pool to the Reclamation property boundary during either survey (LSYR-0.5 to LSYR-0.7).

As stated, a WR 89-18 release was conducted in WY2018, which called for pre- and post-release surveys within the Hwy 154 Reach. Divers snorkeled the Hwy 154 Reach in August and September and no *O. mykiss* were observed.

Refugio Reach

The Refugio Reach ranges from the Hwy 154 Bridge (LSYR-3.2) downstream to Refugio Bridge (LSYR-7.8); however, the section of river between LSYR-3.2 to LSYR-4.9 is not snorkeled due to access limitations (Figures 58-59). Spring snorkel surveys were conducted in late June, although most habitats were dry during the time of the survey. Summer and fall snorkel surveys were conducted in relation to the timing of the 2018 WR 89-18 Release, as well as the predetermined number and location of habitats snorkeled. A total of 9 wetted habitats were snorkeled during the spring survey and a total of 7 habitats were snorkeled in relation to the WR 89-18 Release (Table 15 and 16). No *O. mykiss* were observed within any of the spring, summer, and fall snorkel surveys within the Refugio Reach in WY2018.

Alisal Reach

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figures 58-59). Spring snorkel surveys were conducted in late June. Summer and fall snorkel surveys were conducted in relation to the timing of the

2018 WR 89-18 Release, as well as the predetermined number and location of habitats snorkeled. A total of 9 wetted habitat units were snorkeled during the spring survey and a total of 7 habitats were snorkeled in relation to the WR 89-18 Release (Table 15 and 16). No *O. mykiss* were observed within any of the spring, summer, and fall snorkel surveys within the Refugio Reach in WY2018.

*Avenue of the Flags Reac*h

The Avenue of the Flags Reach is located from Alisal Bridge (LSYR-10.5) down to the Avenue of the Flags Bridge (LSYR-13.9) (Figures 58-59 and Table 15 and 16). The river towards the upper half of the reach has noticeably been changed by anthropogenic means, insofar as where Buellflat, Granite, and other mining companies have been altering the riparian channel. The downstream half of the reach consists of a mature, unaltered riparian canopy. The COMB-FD staff conducted a pre-release or late spring snorkel survey in the Avenue of the Flags Reach in August with no *O. mykiss* observed within the last remaining wetted habitat located underneath the Hwy 101 Bridge. All remaining habitats within the Avenue of the Flags Reach were dry during the initial spring surveys. With WR 89-18 Release flows making it down past the Avenue of the Flags Reach in the summer, staff conducted surveys in the summer (during-release) and fall (post-release). A total of 9 habitat units were surveyed, comprised of 5 pools and 4 runs. No *O. mykiss* were observed within the Avenue of the Flags Reach during the summer and fall snorkel surveys.

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. Snorkel surveys are focused on the Cadwell Reach for both snorkel surveys and water quality monitoring (Figures 58-59 and Tables 15-16). The Cadwell Property (LSYR-22.0-23.0) contains one large bedrock pool approximately 16 feet in depth with several smaller pools located further upstream that can provide rearing habitat during wet years as has been observed. No *O. mykiss* were observed within the reach during any of the three WR 89-18 Release surveys and like other locations further upstream, the majority of the reach was drying out with residual pool depth not being maintained prior to the WR 89-18 Release in the summer.

Tributaries: Tributary snorkel surveys were conducted in the spring, summer, and fall in WY2018 at most of the long-term monitoring locations within Hilton, Quiota, Salsipuedes, and El Jaro creeks (Figure 58 and Tables 17-19). With low rainfall and associated streamflow observed and early drying conditions in WY2018, snorkeling opportunities were limited due to decreased surface flows and poor visibility.

Hilton Creek

Hilton Creek surveys are conducted on Reclamation property from the confluence of the LSYR mainstem 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 58 and Table 17). 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 Lake Cachuma through 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.

In WY2018, flows into Hilton Creek were being provided by the HCEBS from the bottom by gravity from 10/1/18 through 7/31/18, then both the HCEBS by gravity and the HCWS by pump from 8/1/18 through 8/9/18, and for the rest of the water year it was HCWS by pump to the URP only. COMB-FD staff regularly visited Hilton Creek during the spring and summer and found poor water clarity throughout the drainage during every site visit. During a late September site visit to Hilton Creek to download thermographs, biologists observed a sudden (deemed fair) improvement in water clarity. This prompted an immediate snorkel survey on 10/1/18, particularly since poor visibility had prevented surveying in the spring and summer. The COMB-FD staff snorkeled from the confluence of Hilton Creek/LSYR to the LRP and observed a total of 49 *O. mykiss*. Of the 49 fish observed 33 (67.3%) were 3-6 inch fish, 11 (22.4%) were 6-9 inch fish, 4 (8.2%) 9-12 inch fish, and 1 (2.0%) were 12-15 inch fish (Figure 60 and Tables 18 and 19). Surveyors noted that the fair visibility (2-4 feet) observed during this fall survey likely undercounted (estimated at 10-15%) the total number of *O. mykiss* occupying the drainage.

Quiota Creek

A historic section of Quiota Creek, located between Crossing 5 to Crossing 9, typically contains perennial flow and habitat of which staff routinely snorkels (Figure 59 and Tables 18-19). WY2018 was a dry year with limited flow conditions throughout the drainage. Spring snorkel surveys were conducted on 6/27/18 with no *O. mykiss* observed. By mid-July, the majority of this historic snorkel reach was dry. COMB-FD staff attempted summer and fall snorkel surveys but only a few barely wetted habitats remained with no *O. mykiss* observed from the banks.

Salsipuedes Creek

Lower Salsipuedes Creek contains five reaches that the COMB-FD staff separates by fluvial geomorphic changes in the stream channel. Reaches 1 through 4 are located between the Santa Rosa Bridge (on Santa Rosa Road) upstream to the Jalama Road Bridge, a distance of approximately 2.85 stream miles (Figure 58). 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, presence of *O. mykiss*, and relatively easy access. With WY2018 being dry, flow conditions and water clarity made for poor snorkeling conditions and reduced counts (Figure 58 and Table 18 and 19).

Spring surveys within Reaches 1 through 4 were completed between 5/29/18-5/31/18. Only 8 *O. mykiss* were observed during the survey; 3 (37.5%) 0-3 inch fish, 4 (50.0%) 6-9 inch fish, and 1 (12.5%) 9-12 inch fish (Figure 61). The 3 smallest *O. mykiss* observed were young of the year indicating at least some successful spawning and emergence had occurred. The spring survey within Reach 5 had a higher concentration of *O. mykiss* compared to the lower reaches. A total of 21 fish were observed, all within and just below

the Jalama Bridge fish ladder project; 17 (81.0%) 0-3 inch fish, 3 (14.3%) 9-12 inch fish and 1 (4.8%) 12-15 inch fish. The majority of *O. mykiss* observed were young of the year indicting successful spawning and emergence had occurred within Reach 5.

Divers returned to conduct a summer survey within Reaches 1 through 4 but poor visibility throughout the drainage prevented snorkeling. Staff also attempted to snorkel Reach 5 but poor visibility negated that survey as well.

On 10/16/18 and 10/18/18, divers attempted a fall snorkel survey within Reaches 1 through 4 but only a small portion of Reach 2 was clear enough for underwater viewing (Figure 62). Two larger *O. mykiss* adults were observed in the same pool habitat in Reach 2, 1 measuring 12-15 inches and the other measuring 15-18 inches. This particular pool habitat consisted of bedrock substrate, had significant depth (6 feet), and was well aerated from a small waterfall (2 feet in height) at the head of the unit.

On 10/18/18, divers conducted a fall survey within Reach 5 (Figure 62). A total of 28 *O. mykiss* were observed; 21 (75.0%) 3-6 inch fish, 3 (10.7%) 6-9 inch fish, 2 (7.1%) 9-12 inch fish, 1 (3.6%) 12-15 inch fish and 1 (3.6%) inch fish. All of the fish observed were either residing in or just downstream of the Jalama Bridge fish ladder.

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 in the spring, summer, and fall of each year (Figure 58, Tables 17-19). Divers arrived in late May to conduct spring snorkel surveys but residual pool depth was hardly being maintained and visibility was already fair. Although conditions were favorable enough for observation, no *O. mykiss* were observed. Most of lower El Jaro Creek near the confluence with Salsipuedes Creek was dry by August; hence no snorkel surveys (i.e., summer and fall surveys) were conducted for the remainder of the year.

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 (Figure 58). 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 event 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 were 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 WY2018.

Hilton Creek

As previously mentioned, no spring or summer snorkel surveys were conducted within Hilton Creek due to poor visibility. During the fall survey, the COMB-FD staff observed 4 green sunfish; 3 (0-3 inch) and 1 (3-6 inch) within Reach 1 in lower Hilton Creek near the confluence with the LSYR mainstem. Prior to WY2015, it was uncommon to observe any non-native fish species in Hilton Creek.

Salsipuedes Creek

In the spring survey of Salsipuedes Creek within Reaches 1 through 4, COMB-FD staff counted 622 green sunfish; 407 (0-3 inch), 184 (3-6 inch) and 31 (6-9 inch). No warm-water species were observed within Reach 5 of Salsipuedes Creek in the spring. In the fall survey where divers were only able to enumerate fish within Reach 2, a total of 1,036 green sunfish were observed. The size class breakout of green sunfish were as follows; 830 (0-3 inch), 185 (3-6 inch) and 21 (6-9 inch). Concerning was the number of large, potentially sexually mature size classes of green sunfish observed at the end of the season.

El Jaro Creek

The single snorkel survey conducted in the spring within El Jaro Creek in WY2018 contained several warm-water species. Divers counted 5 green sunfish; 2 (3-6 inch) and 3 (3-6 inch). In addition, divers observed 2 adult carp (12-15 inches) in a glide habitat within the creek. Other than an occasional carp caught in the migratory fish traps (located near the LSYR mainstem confluence), this was the first time COMB-FD staff had observed carp oversummering and located this far upstream within the Salsipuedes/El Jaro Creek drainage.

LSYR mainstem

Largemouth Bass: Largemouth bass were observed in moderate numbers in the spring and the summer within the LSYR mainstem in WY2018 (Figure 63). Spring snorkel surveys within the Refugio and Alisal reaches resulted in 69 largemouth bass and 33 largemouth bass being observed within each reach, respectively. Coincident with WR 89-18 releases, largemouth bass observations slightly decreased during the summer with 45 observed in Refugio Reach and 1 observed in the Alisal Reach. An increase in largemouth bass numbers came during the fall snorkel survey with 1,316 observed in the Refugio Reach. Approximately 1,200 of the 1,316 observed were attributed to one particular habitat where divers found 3 schools of recently hatched largemouth bass fry. Personnel counted a total of 61 largemouth bass within the Alisal Reach during the fall survey.

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. During the spring survey within the Refugio and Alisal reaches, a total of 11 and 29 sunfish were observed, respectively (Figure 63). In the summer (or during WR 89-18 Release) survey, only 3 sunfish were observed in the Refugio Reach and only 2 sunfish were observed within the Alisal Reach. The fall (post WR 89-18 Release) survey resulted in an increase in sunfish observations within the Refugio Reach with 25 fish observed. Sunfish numbers remained low within the Alisal Reach during the final fall survey with 3 fish observed.

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 WY2018, no catfish were observed during any of the spring, summer and fall surveys within the LSYR mainstem (Figure 64). This marked the seventh consecutive year (since WY2012) that no catfish were observed within the LSYR mainstem during snorkel surveys, indicating that successful catfish reproduction is limited within the LSYR.

Carp: A total of 29 carp were observed within the Refugio Reach and 20 carp were observed within the Alisal Reach during the initial spring survey (Figure 64). The summer snorkel survey (commensurate with the during-release survey of the WR 89-18 Release) had a significant decrease in carp observations with 2 in the Refugio Reach and none observed within the Alisal Reach. Increased flows during WR 89-18 Releases allows fish to occupy and move to different habitats before settling back into their original locations, which could explain why surveyors often see less fish during these higher flow surveys. In the final fall survey, COMB-FD staff observed 27 carp within the Refugio Reach and 17 carp 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 WY2018, 2 tributary projects were conducted at Quiota Creek Crossing 5 and Crossing 9. Compliance monitoring was conducted throughout these projects. 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 WY2018 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 BO, the number and spatial distribution of beavers and their dams have increased substantially throughout the LSYR mainstem. Once Lake Cachuma surcharged for the first time and the long-term target 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 successfully inhabit the Salsipuedes/El Jaro Creek watershed. Well established beaver dams can be of sufficient strength and breadth to remain in place during stormflows, and may create passage impediments and/or barriers for migrating 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 dryer 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 several day period in December 2017 through February 2018, the COMB-FD staff completed the LSYR mainstem beaver dam survey from the 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 gone down then up and down over the monitoring period (Figure 65 and 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.

Mainstem dams identified in WY2018 (47) represent a noticeable decrease in the number of dams observed during the previous year (66). Of the 47 dams identified, 37 were active with 29 of those considered to be a barrier to fish passage, 4 classified at impediments, and 14 considered passable (Figure 65, Table 20). No beaver dams were observed in the Highway 154 Reach. There were 3 active and 3 non-active dams in the

Alisal Reach, 2 active and non-active dams in the Refugio Reach and one inactive dam in the Avenue of the Flags Reach. The majority of beaver dams (36) were located downstream of the Avenue of the Flags Bridge in Reach 3 of the mainstem. The lower most active dam was located immediately downstream of the Floradale Bridge in Lompoc.

There were 2 beaver dams identified in the Salsipuedes/El Jaro watershed; both in Salsipuedes Creek with none observed in El Jaro Creek. Both dams were inactive and considered relic dams. It appears that the extended drought conditions have effectively removed beavers from the entire Salsipuedes/El Jaro Creek watershed as no active dams have been identified in the past two years. Since active dams are present in the LSYR mainstem, it is likely that beavers will continue to move and exploit additional habitats when favorable flow conditions are present and it is possible 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 WY2018 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, 2018c), 2015 (COMB, 2018d), 2016 (COMB, 2019a), and 2017 (COMB, 2019b).

4.1. Water Year Type since WY2000

The rainfall (Table 21), runoff (Table 22), and water year type with the years that Lake Cachuma spilled (Figure 65) are presented since WY2000.

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

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

The *O. mykiss* population between the two creeks exhibit differences in 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 and can have sparse spawning gravel. The Salsipuedes Creek system has extensive stream mileage but only fair habitat quality due to low dry season flows, limited pool habitat for over-summering, a predominance of fine sediment substrate, and high water temperatures in the lower portion of the creek (AMC, 2009). The result is earlier resident *O. mykiss* upstream migration in Hilton Creek due to greater availability of water in the mainstem immediately below the dam where resident *O. mykiss* have been documented to oversummer, a longer migration time by smolts to make it the ocean due to differences in distance, and a potentially longer smolt migration time 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), and later steelhead arrival in Hilton Creek due to its greater distance from the ocean.

Regardless of the differences in the watersheds described above, the prolonged drought has negatively impacted both watersheds as evident by the low migrant captures in Hilton Creek (24) and Salsipuedes Creek (3) in 2018 (Table 10). Though smolts were captured in each creek, it is unlikely any of them made it to the ocean based on the low flow conditions throughout the mainstem and that the lagoon was closed during the migration season.

4.3. Tributary Passage Enhancement Projects

By the end of WY2018, 16 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, and Quiota Creek Crossing 9 as well as the HCWS and HCEBS which supplies water year round to Hilton Creek from Lake Cachuma (Tables 23-24 and Figures 67-70). 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. Hilton Creek and Quiota Creek continue to have a few anthropogenic passage impediments that are being addressed as time and funding become available.

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 47-48). 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 71) and releases from the URP provided for extensive riparian vegetation growth that has shaded and cooled the stream water. Due to critical drought conditions and no releases from the URP, though, the larger riparian trees between the URP and the LRP that need continuous water (i.e., alders and cottonwoods) have been stressed or have died, which has resulted in some thermal heating in that upper reach (Figure 72).

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 WY2018 as cattle have been excluded from the stream corridor.

4.4. Water Hyacinth Discovery and Removal

Invasive water hyacinth (*Eichhornia crassipes*) was first discovered in the LSYR during beaver dam surveys in December 2013 approximately 2 miles downstream of the Avenue of the Flags Bridge in Buellton. 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 WY2018 (last known occurrence was 12/8/16) and did not observe any water hyacinth. This has become a routine field monitoring activity.

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. In California, the weed has caused severe ecological impacts in the Sacramento-San Joaquin River Delta by: 1) destroying biodiversity, 2) depleting oxygen and reducing water quality, 3) providing breeding grounds for pests and other vectors, and 4) generally blocking waterways, hampering agriculture, fisheries, recreation, and hydropower (Villamagna and Murphy, 2010) .

4.5. HCWS and HCEBS Testing and the Effects on Flow Delivery to Hilton Creek

Reclamation performed multiple tests of the HCWS and HCEBS to make delivery modifications, repairs to the system, check functionality, and improve the systems. The HCEBS was operated on gravity flow for all of the water year until the start of WR 89-18 Releases. On 8/1/18, the HCWS pump was turned on in addition to the HCEBS prior to WR 89-18 Releases (8/1/18), creating a temporary spike in flows to Hilton Creek for

several days. On 8/9/18, the HCEBS was shut off and deliveries to the creek were only from HCWS pumps for the remainder of the water year

4.6. 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. All gravel augmentation, monitoring and reporting was implemented by the COMB-FD. A total of 5 gravel treatment sites were pre-selected for augmentation and all gravel had been placed at those locations by 1/30/18, prior to any spawning activities (Figure 73). Redd (spawning) surveys began soon after gravel augmentation had been completed and continued throughout the spawning season. Spawning occurred at an augmentation site less than 6 days following augmentation efforts. Three of the 5 gravel augmentation sites in Hilton Creek contained *O. mykiss* redds in 2018. Of the 8 total redds observed between February and May, 7 (or 87.5%) were associated with gravel augmentation sites. The only exception was an early spawning site that occurred just downstream of the LRP and prohibited gravel augmentation in that area. The overall results from this first year of gravel augmentation within the watered section of Hilton Creek suggest that the effort was beneficial towards achieving the objective of improving spawning habitat for the Hilton Creek *O. mykiss* population. A report was prepared and submitted to NMFS by Reclamation (COMB, 2018b).

4.7. January 8, 2018 Stormflow Event in Hilton Creek

In the summer of WY2017, the Whittier Fire burned approximately 18,430 acres in the Santa Ynez Mountains south of Lake Cachuma, including a portion of the Hilton Creek watershed. Approximately the upper 41% (819 acres) of the Hilton Creek drainage burned. On 1/8/18, a large rain-storm impacted the Hilton Creek watershed. The high intensity rainfall that fell on recently burned and bare hillsides produced an ash laden and high turbidity stormflow event that entered Hilton Creek and produced a peak discharge of approximately 40 cfs on 1/9/18. The COMB-FD arrived at Hilton Creek on the afternoon of 1/9/18 to evaluate the condition of the creek after peak flows had diminished. The flow rate at the time of the visit was 6.29 cfs according to the USGS gauge and water quality conditions appeared poor with high turbidity observed throughout the creek.

The following day (1/10/18), members of the COMB-FD team returned to inspect the creek for any fish mortalities that may have been caused by the poor water quality. Seven dead *O. mykiss* were discovered, and on the following day (1/11/18) when the creek was thoroughly inspected by COMB-FD staff, six additional *O. mykiss* mortalities were found (Figure 74). In addition to the *O. mykiss* mortalities, one prickly sculpin (*Cottus asper*) mortality was discovered. Many of the deceased fish were found along the high water mark mixed in with leaf litter and fine allochthonous sediment laden materials. Based on the location and condition of the carcasses when found, those fish likely perished early on during the high flow event and floated downstream to be deposited along the high water mark.

The 13 recovered *O. mykiss* mortalities ranged in size from 101 – 250 mm (3.9 – 9.8 inches). Reclamation and NMFS were notified immediately of all found mortalities. COMB-FD followed NMFS protocols by measuring, photographing, and collecting tissue and scale samples from each mortality. Sampled fish were then individually bagged, labeled and stored appropriately for later retrieval by NMFS.

Stream water clarity in Hilton Creek improved by 1/10/18 as upper basin silt laden runoff quickly decreased and lost connection upstream of the Hilton Creek LRP. Water being released from the LRP was a vast improvement in water quality compared to the high turbidity ash laden streamflow observed during the storm event. Hilton Creek was inspected again on 1/16/18 to determine if any *O. mykiss* were present. Surveyors carefully looked at several known *O. mykiss* habitats and discovered three separate locations where fish were actively feeding. Additional observations noted that a significant amount of silty material was deposited on the stream bottom from the high flow mark downward, especially where water velocities were slow. Upstream of the LRP and URP, the silt deposits were abundant with much of the creek channel covered with a thick, heavy layer of mud.

4.8. Update on the Lake Cachuma Oak Tree Mitigation Project

The annual oak tree inventory was completed in April 2018 with an objective to determine the status and success rate of the trees planted since the beginning of the program with 9 years of plantings. At that time, 4,414 oak trees had been planted and 3,674 were alive which is a survival rate of 82.2%. More trees need to be planted to meet the mitigation target. There were no oak trees planted in Fiscal Year 17/18 due to a drought year and poor conditions for planting. However, 124 trees planted by Reclamation dam tenders from approximately 2001 to 2010 were incorporated into the program and those trees are now part of the routine maintenance program. Those trees are located near the Bradbury Dam Tenders Office and the dam overlook just to the east. Lessons learned by the COMB-FD staff from six 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.

4.9. Summary of the Results from Tissue Samples

At the end of the WY2016 Trapping Season, 109 samples were sent to the NOAA Southwest Fisheries Science Center (SFSC) at UC Santa Cruz for analysis and to be incorporated into the state-wide database for *O. mykiss*. In the winter and spring of 2016, there were 94 tissues collected from *O. mykiss* during the migrant trapping program within Hilton Creek. In addition, a total of 11 *O. mykiss* mortalities were found and sampled in upper Hilton Creek as a result of the transfer of flows from the URP to the LRP. Four additional *O. mykiss* samples were collected, 2 from the Stilling Basin trapping operation conducted during the 2016 WR 89-18 Release and 2 from mortalities (likely osprey kills) found between the Stilling Basin and the Long Pool. Results from the SFSC showed that 105 of the 109 analyzed samples assigned to the Santa Ynez River, primarily Hilton Creek. Anadromous alleles continued to dominate this particular batch of samples. Of particular interest were the results from the 2 samples collected from

mortalities between the Stilling Basin and the Long Pool. When these samples were initially collected, surveyors noted that both fish were missing their heads and that one of the fish contained a Floy fish tag on its dorsal fin. This tag indicated that it was a hatchery fish that had been planted within Lake Cachuma. One possible explanation for finding these two mortalities (within very close proximity) was that an osprey had captured them, flown downstream below the dam to perch and then ate the heads of the fish (discarding the remaining carcass below). This is a common osprey feeding behavior that is well documented. Genetic results from these two *O. mykiss* supported the observation by clearly assigning one of the fish to a hatchery origin, while the other fish assigned to a hatchery hybrid.

In 2017, 8 tissue samples collected and submitted to the SFSC for analysis. In the winter and spring of 2017, there were 5 tissues samples collected from *O. mykiss* during the migrant trapping program within Hilton Creek. One additional sample was collected from a resident adult in Salsipuedes Creek. Two samples came from *O. mykiss* mortalities during a Reclamation transfer of flow deliveries to Hilton Creek from the URP to the LRP. Genetic results indicated that one of the 8 samples failed genotyping completely, while 4 of the remaining 7 samples were assigned to the Santa Ynez River mainstem. Interestingly, one of the samples (the only Hilton Creek upstream migrant fish captured in 2017) was assigned to the Salinas River system. Anadromous alleles once again dominated this set of samples.

In 2018, 35 tissue samples were collected and submitted to the SFSC for analysis. In the winter and spring of 2018 in association with the migrant trapping program, there were 19 tissues samples from Hilton Creek and 2 from Salsipuedes Creek. In addition, a total of 13 *O. mykiss* mortalities were found and sampled as a result of debris/ash flow (post Whittier Fire) from the large storm event on 1/8/18. One additional sample was collected from a mortality which was a spawned-out female resident *O. mykiss* within Salsipuedes Creek. Genetic results from samples collected in 2018 have not yet been received.

4.10. Status of WY2017 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 WY2017 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.

- 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.

- Work with Reclamation and NMFS to develop a gravel augmentation program for Hilton Creek for spawning fish, given the long standing observation of a gravel starved system;
    - Status: This recommendation was implemented this year for a 2-year program. The results of the first year are presented in Section 4.6. The results of the second year of the program will be presented in next year's AMS.

- Encourage Reclamation to improve its system operation for delivering lake water to Hilton Creek with one or a combination of the HCWS, HCEBS, Hilton Creek Water Tanks, and Stilling Basin submersible pumps to provide continuous flow to Hilton Creek without interruption;
    - 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 with 1 fish passage project scheduled for the fall of 2019.

- 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 additional time should be dedicated to scale analyses and comparison to the trapping results.

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

- 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 work closely with the Santa Ynez River Water Conservation District during WR 89-18 releases to conduct trapping to monitor *O. mykiss* movement and remove non-native fish moving with the release and out of the Stilling Basin at the very beginning of the release;
    - 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

WY2018 was the sixth dry year of the last 7 years with only 9.32 inches of rainfall recorded at Bradbury Dam. Lake Cachuma did not spill and it went from 42.7% to 31.7% of capacity from the beginning of the water year to the end, respectively. The height of the lake was sufficient to implement BiOp required target flow to Hilton Creek and the Highway 154 Bridge. The lagoon did not breach and there was no ocean connectivity throughout the water year. Migration opportunities were extremely limited across the Santa Ynez River basin.

Limited spawning was observed with only 14 redds documented across the entire LSYR basin. Spring, summer, and fall snorkel surveys did not record many *O. mykiss* in the basin, which provided further evidence of the toll on the basin's *O. mykiss* population from the previous 5 years of drought and very low flow conditions. The passage potential for migrating fish and dry season rearing water quality conditions during WY2018 continue to be influenced by depleted groundwater storage resulting in rapid decay of stormflow hydrographs and limited baseflow conditions between storms and during the

following dry season. Several years of wet conditions are needed for the basin to fully recover and sustain streamflow over extended periods of time.

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 WY2017 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 WY2018 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;
- 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;
- Conduct gravel augmentation as soon as possible in the fall well in advance of the spawning season;
- 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;
- Obtain an Electrofishing Backpack unit and get the necessary professional training to be certified in its use;
- 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 efforts to remove fish passage impediments within the LSYR basin as listed in the proposed actions of the BiOp, utilizing grant funding wherever possible;
- 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;

- 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;
- 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;
- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin; and
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS and the Monte Arido Highland Biogeographic Region to improve collective knowledge, collaboration, and dissemination of information.

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3. Monitoring Results

Table 1: WY2000 to WY2018 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	61,107	691.17	No	Yes
2016	11.45	Dry	No	0	32,989	669.66	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

* Bradbury Dam rainfall (Cachuma) period of record = 66 years (1953-2018) with an average rainfall of 19.83 inches.

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

Table 2: WY2018 and historic rainfall data for six meteorological stations in the Santa Ynez River Watershed (source: County of Santa Barbara and USBR).

Location	Station	Initial Year	Period of Record	Long-term Average	Minimum Rainfall		Maximum Rainfall		Rainfall (WY2018)
	(#)	(date)	(years)	(in)	(in)	(WY)	(in)	(WY)	(in)
Lompoc	439	1955	64	14.49	5.31	2007	34.42	1983	8.59
Buellton	233	1955	64	16.62	5.87	2014	41.56	1998	8.12
Solvang	393	1965	54	18.27	6.47	2007	43.87	1998	8.57
Santa Ynez	218	1951	68	15.69	6.58	2007	36.36	1998	8.27
Cachuma*	USBR	1953	66	19.83	7.33	2007	53.37	1998	9.32
Gibraltar	230	1920	99	26.21	8.50	2013	73.12	1998	11.70
Jameson	232	1926	93	28.68	8.50	2007	79.52	1969	13.18

* 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 WY2018; 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	1/4/2018	0.38	No	No
2	1/8/2018	3.32	No	No
3	2/27/2018	0.11	No	No
4	3/2/2018	0.83	No	No
5	3/11/2018	0.71	No	No
6	3/13/2018	0.49	No	No
7	3/17/2018	0.10	No	No
8	3/21/2018	2.72	Yes	Yes
9	5/2/2018	0.4	No	No

(b)

Month	Rainfall (in.)
Oct-17	0.00
Nov-17	0.07
Dec-17	0.00
Jan-18	3.75
Feb-18	0.16
Mar-18	4.85
Apr-18	0.09
May-18	0.40
Jun-18	0.00
Jul-18	0.00
Aug-18	0.00
Sep-18	0.00
Total:	**9.32**

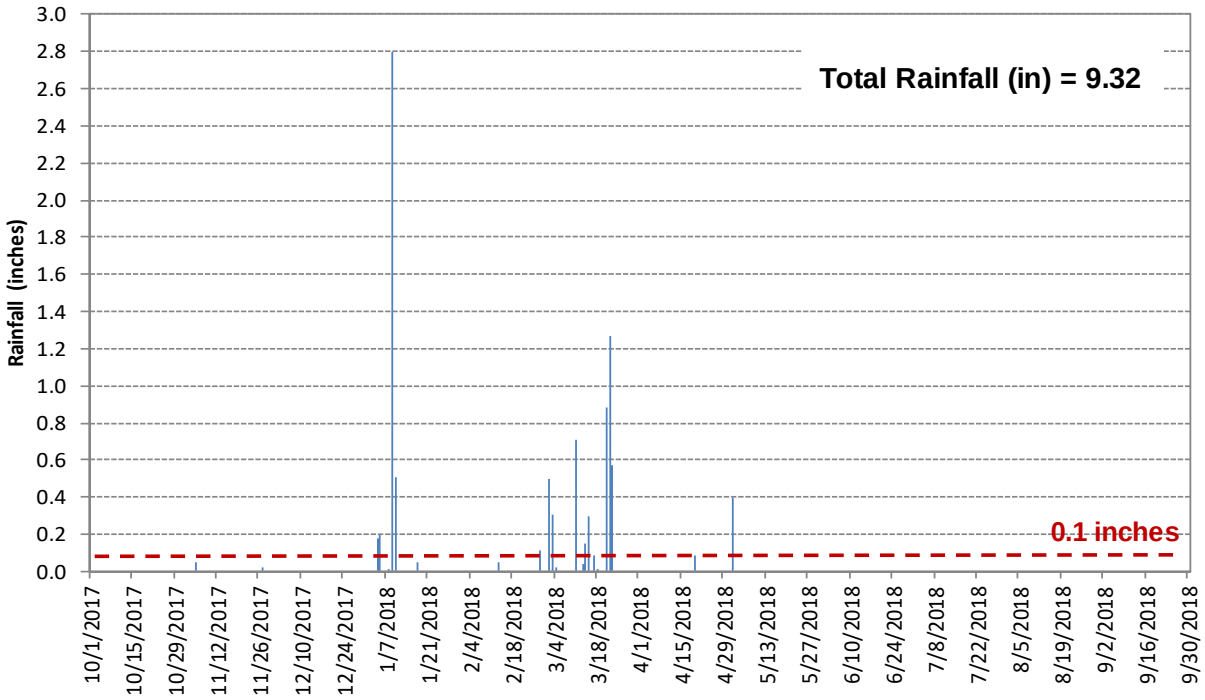


Figure 1: WY2018 rainfall recorded at Bradbury Dam (USBR).

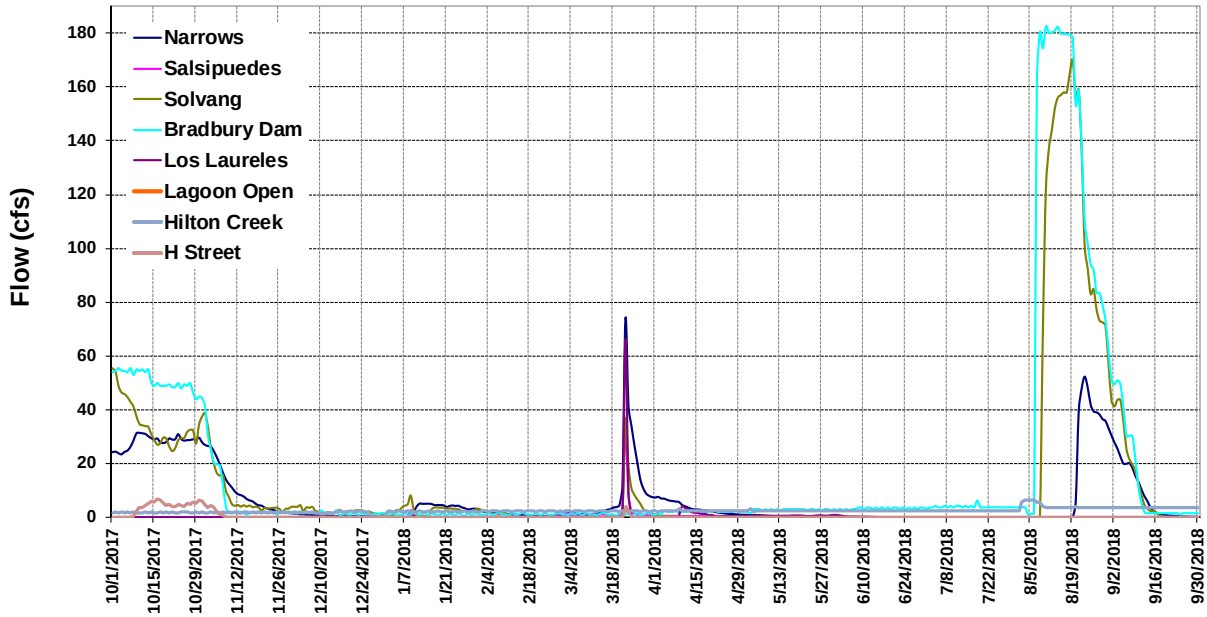


Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open to the ocean in WY2018.

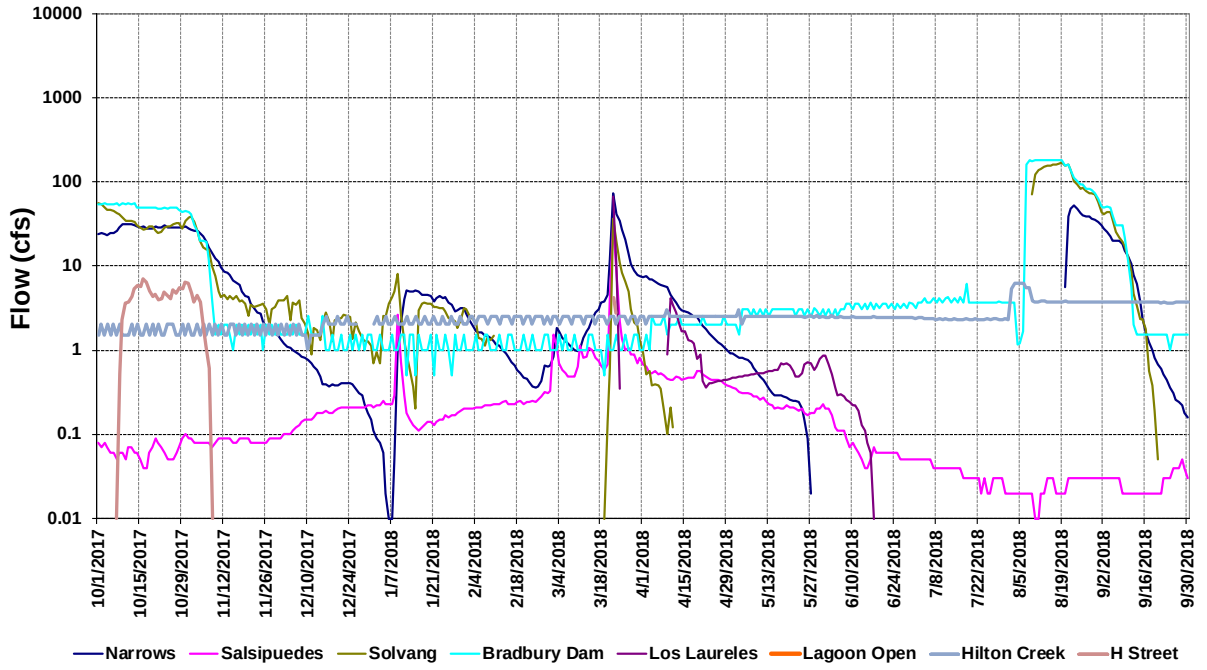


Figure 3: USGS average daily discharge at the LSYR mainstem USGS gauging stations at Los Laureles, Bradbury Dam (USBR), Hilton Creek (USBR), Alisal Bridge (Solvang), Salsipuedes Creek, the Narrows and H Street (Lompoc) during WY2018.

Table 4: Ocean connectivity, lagoon status and number of days during the *O. mykiss* migration season from WY2001 to WY2018.

Water Year	Year Type	Ocean Connectivity	Lagoon Status			# of Days Open in Migration Season*
			Open	Closed	# of Days	
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	Yes	2/7/17	4/4/17	57	57
2018	Dry	No	-	-	0	0

*Migration Season is January through May.

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

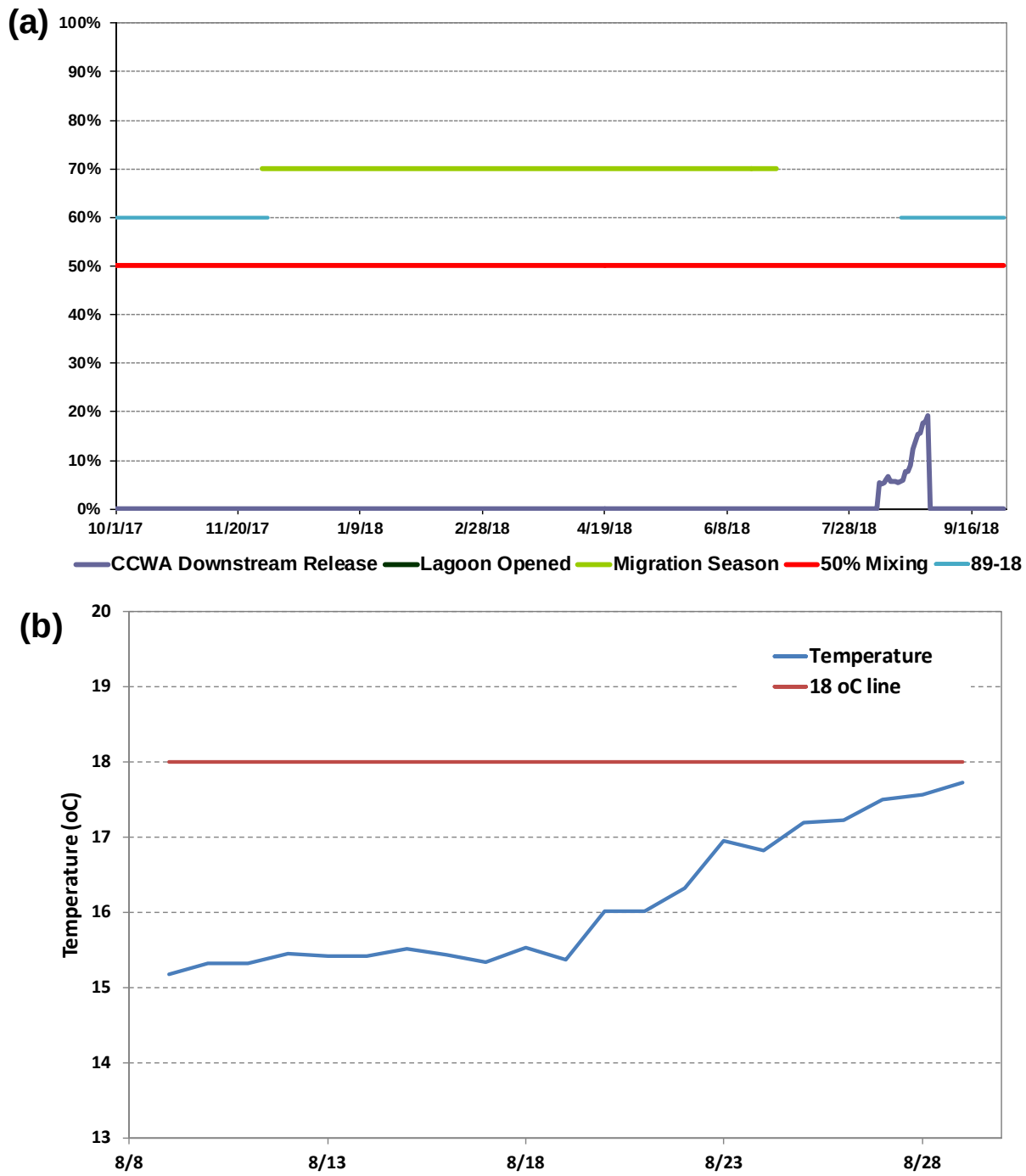


Figure 4: State Water Project (SWP) release into the LSYR regarding BiOp compliance with (a) the 50-50 mix rule showing the percentage of CCWA water being released from Bradbury Dam downstream to the Long Pool and (b) the 18 ^{o}C rule for the water temperature being released from the Outlet Works.

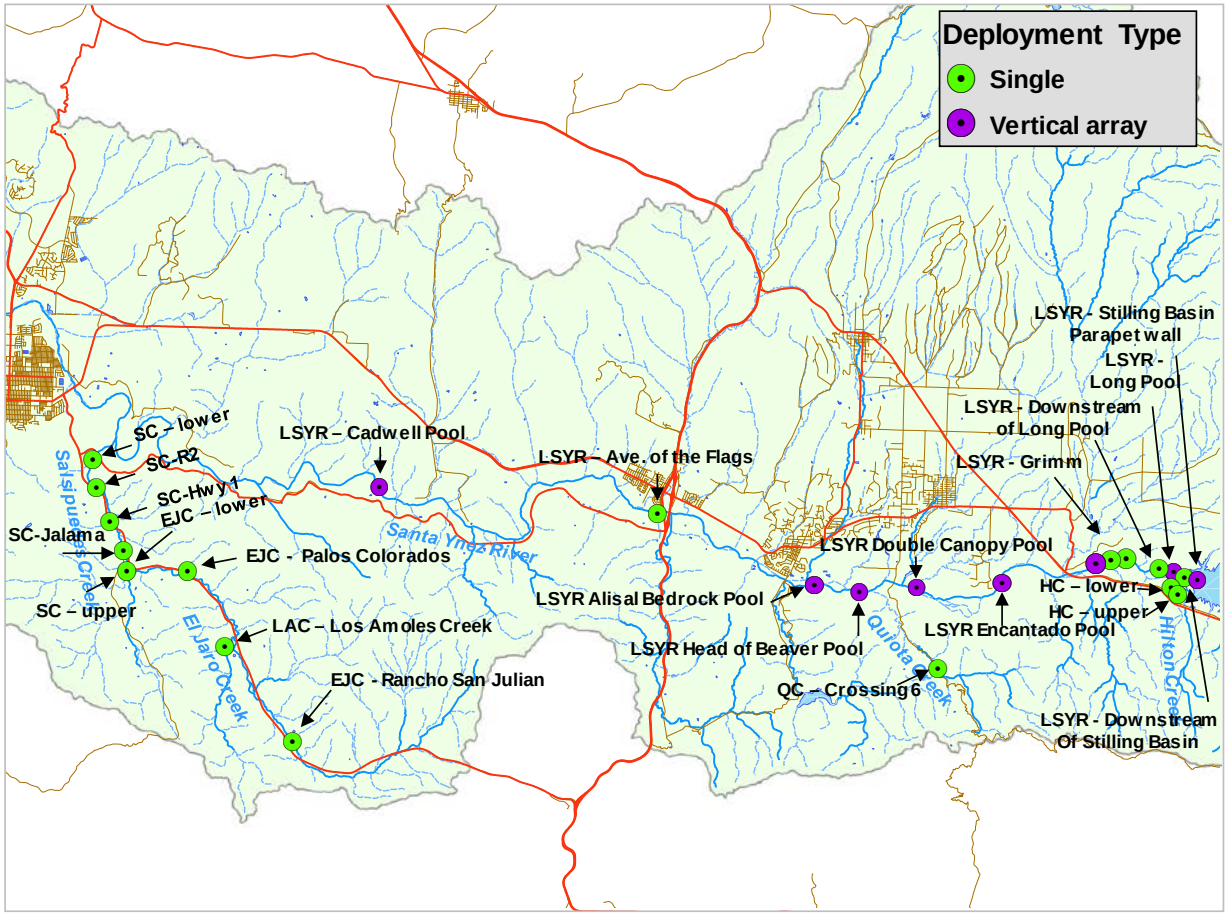


Figure 5: Thermograph single and vertical array deployment locations in WY2018 within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are close together with overlapping symbols.

Table 5: 2018 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	5/2/18	12/6/2018	214
	LSYR - D/s of Stilling Basin	LSYR-0.25	Single	Not deployed - Habitat dry prior to WR89-18		
	LSYR - Long Pool	LSYR-0.51	Vertical Array	5/2/18	12/6/2018	214
	LSYR - D/s of Long Pool	LSYR-0.68	Single	5/2/18	12/6/2018	214
	LSYR-Grimm Property-Upstream	LSYR-1.09	Single	5/14/18	12/10/2018	206
	LSYR-Grimm Property-Downstream	LSYR-1.54	Single	5/14/18	12/10/2018	206
	LSYR-Grimm Property Pool	LSYR-1.71	Vertical Array	5/14/18	12/10/2018	206
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	Not deployed - Habitat dry prior to WR89-18		
	LSYR - Double Canopy	LSYR-7.65	Vertical Array	5/15/2018	7/9/2018	54
	LSYR - Head of Beaver	LSYR-8.7	Vertical Array	5/18/2018	7/10/2018	52
	LSYR - Alisal Bedrock Pool	LSYR-10.2	Vertical Array	Not deployed - Habitat dry prior to WR89-18		
	LSYR - Avenue of the Flags	LSYR-13.9	Single	Not deployed - Habitat dry prior to WR89-19		
	LSYR - Cadwell Pool	LSYR-22.68	Vertical Array	5/15/2018	12/6/2018	201
Tributaries	Hilton Creek (HC)-lower	HC-0.12	Single	4/30/2018	12/6/2018	216
	HC-upper (URP)	HC-0.54	Single	11/2/2018	12/7/2018	35
	Quiota Creek (QC)-Crossing 6	QC-2.66	Single	4/30/2018	7/9/2018	69
	Salsipuedes Creek (SC)-lower-Reach 1	SC-0.77	Single	4/30/2018	12/6/2018	216
	SC-Reach 2-Bedrock Section	SC-2.2	Single	4/30/2018	12/10/2018	220
	SC-Reach 4-Hwy 1 Bridge	SC-3.0	Single	4/30/2018	12/6/2018	216
	SC-Reach 5-Jalama Bridge	SC-3.5	Single	4/30/2018	12/6/2018	216
	SC-upper at El Jaro confluence	SC-3.8	Single	4/30/2018	7/9/2018	69
	El Jaro Creek (EJC)-Lower-Confluence	EJC-3.81	Single	4/30/2018	7/9/2018	69
	EJC-Palos Colorados	EJC-5.4	Single	4/30/2018	12/6/2018	216
	EJC-Rancho San Julian Bridge	EJC-10.82	Single	4/30/2018	7/10/2018	70
	Los Amoles Creek (LAC)-Creek Crossing	LAC-7.0	Single	5/15/2018	12/6/2018	201

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

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

ns - not snorkeled due to turbidity.

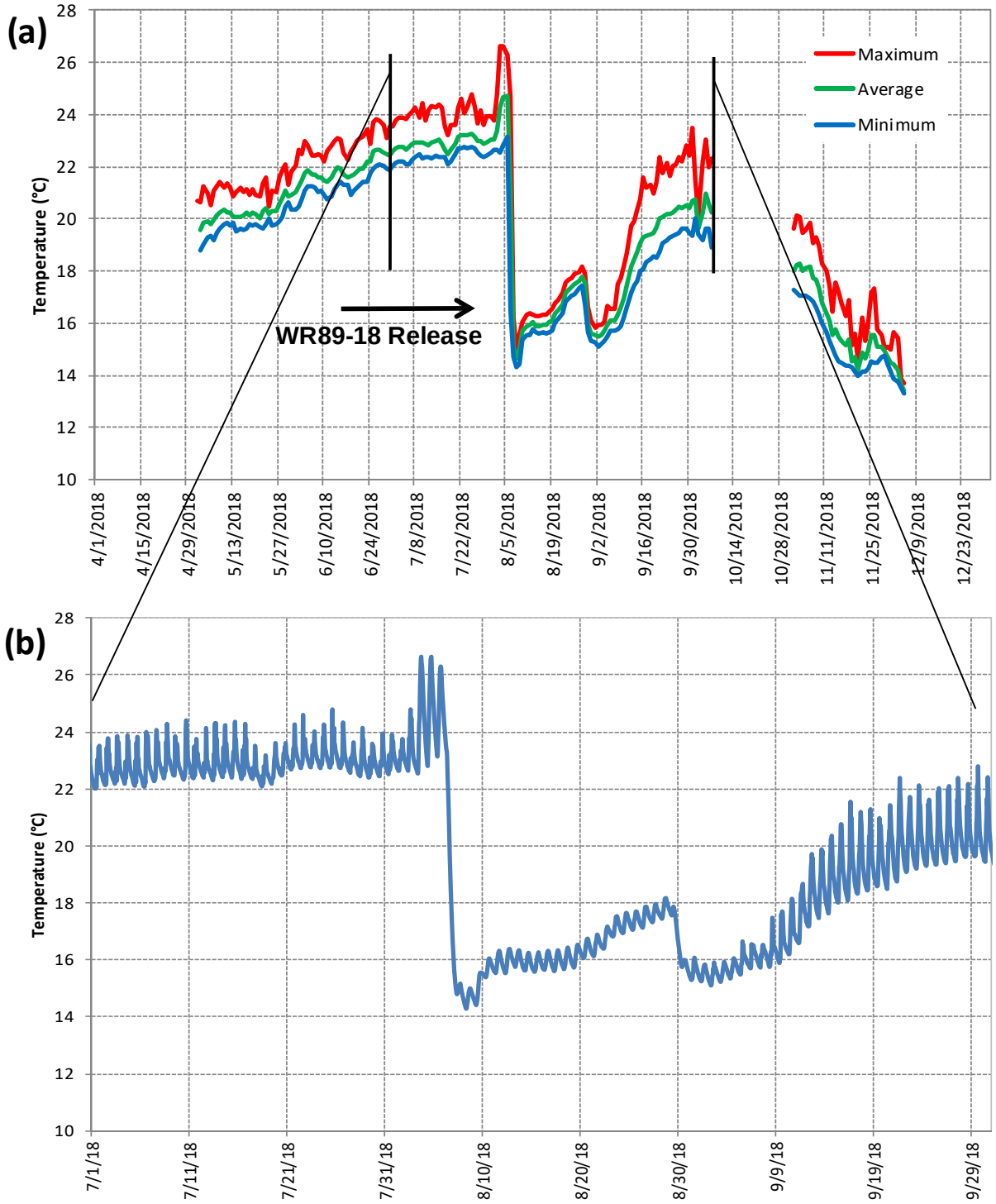


Figure 6: 2018 LSYR-0.01 (Stilling Basin parapet wall) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/18 - 10/1/18; surface unit was exposed to air from 10/8/18 - 10/31/18 due to declining water levels in the Stilling Basin and WR89-18 releases began on 8/6/18.

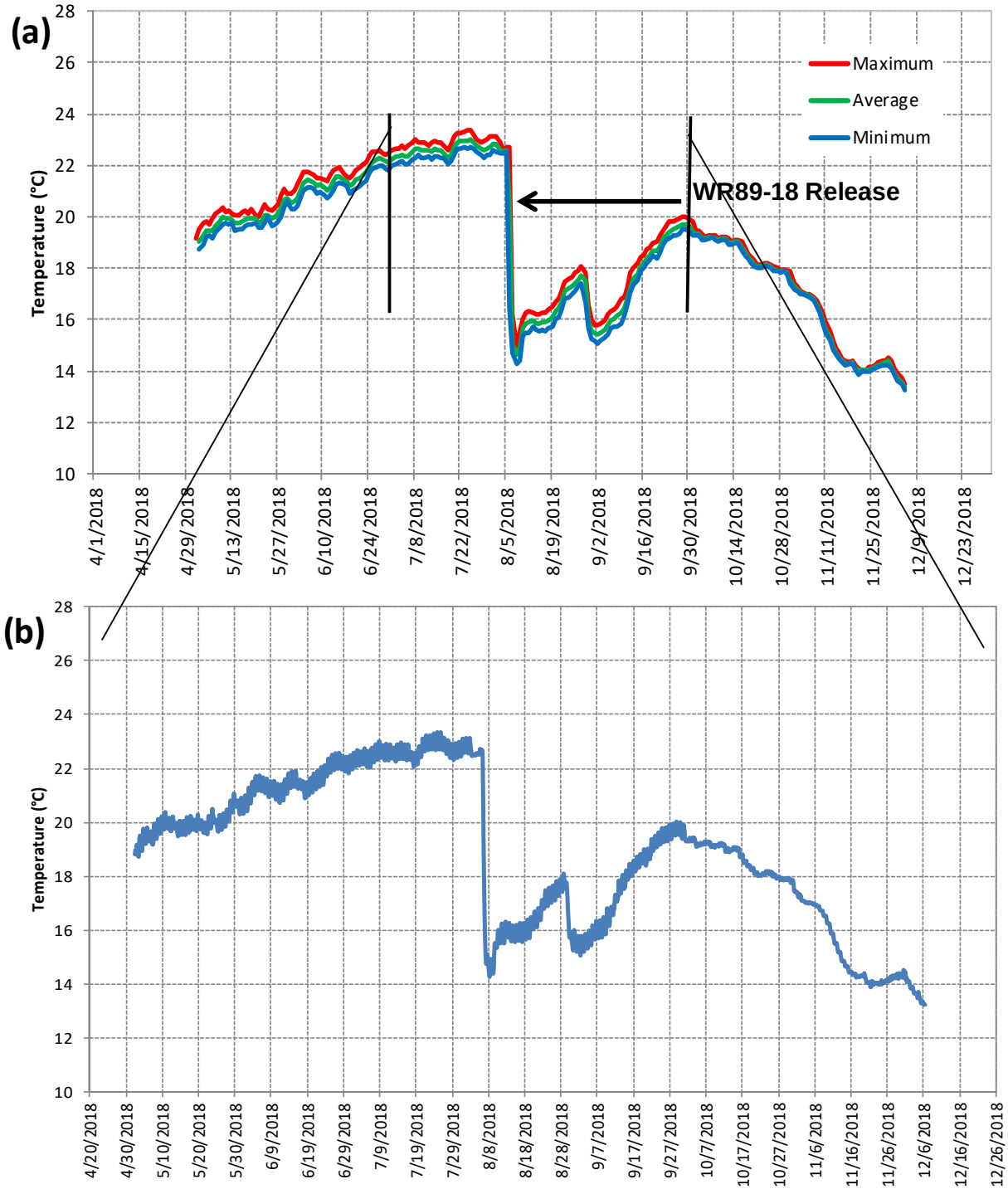


Figure 7: 2018 LSYR-0.01 (Stilling Basin parapet wall) middle (14 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/18 - 10/1/18; WR89-18 releases started on 8/6/18.

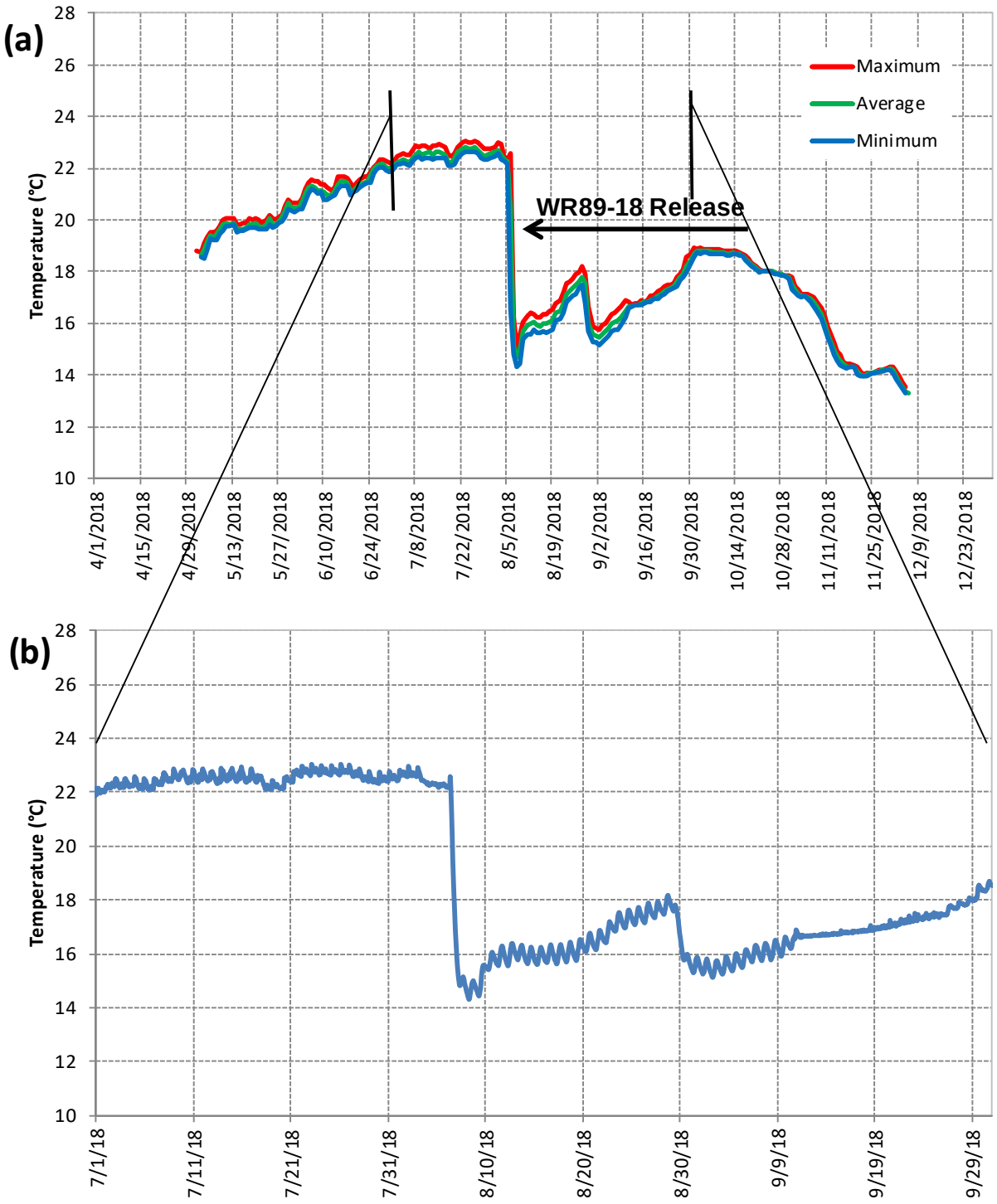


Figure 8: 2018 LSYR-0.01 (Stilling Basin parapet wall) bottom (28 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/18 - 10/1/18; WR89-18 releases started on 8/6/18.

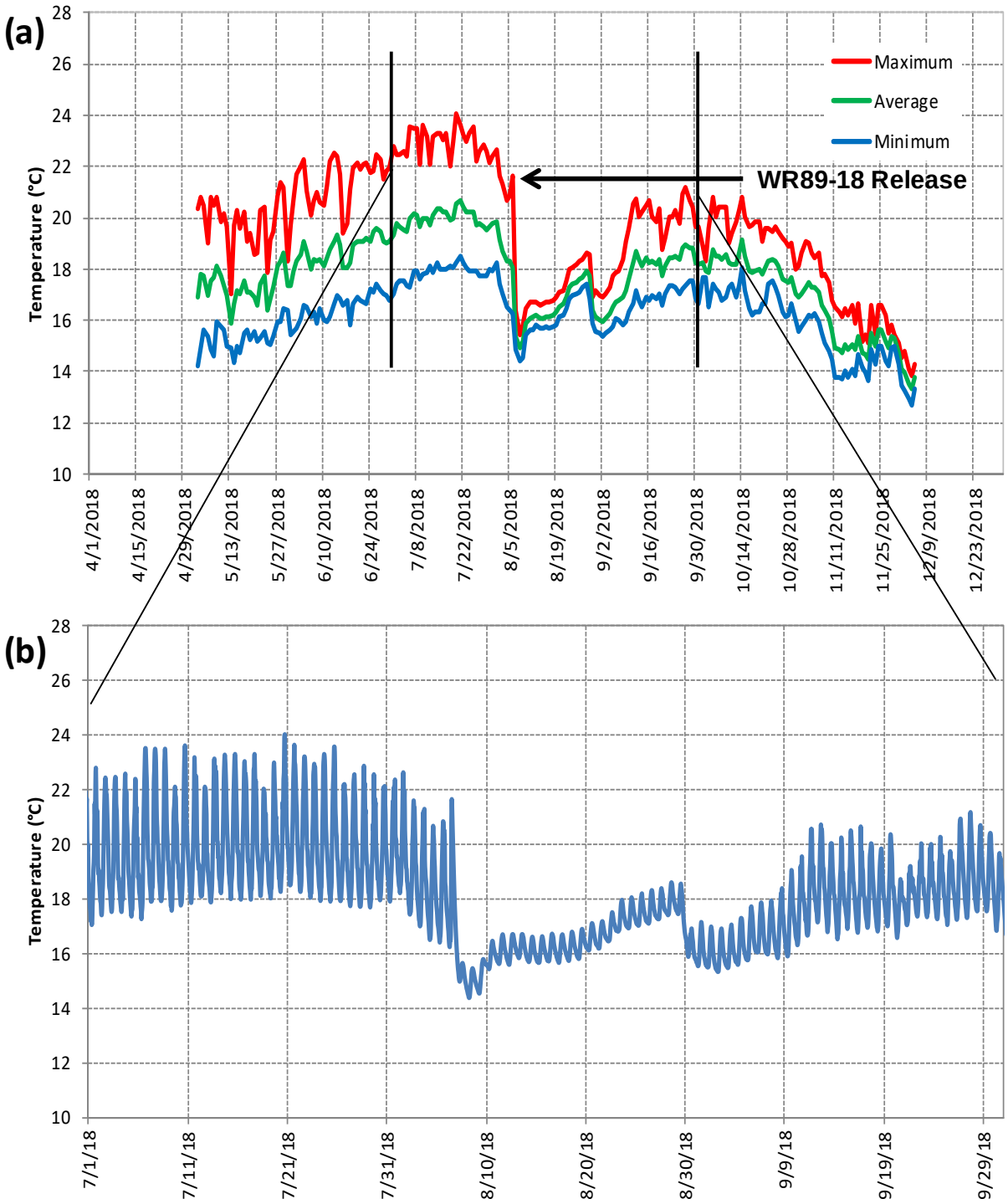


Figure 9: 2018 LSYR-0.51 (Long Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum values for the entire period of deployment and (b) hourly data from 7/1/18 - 10/1/18.

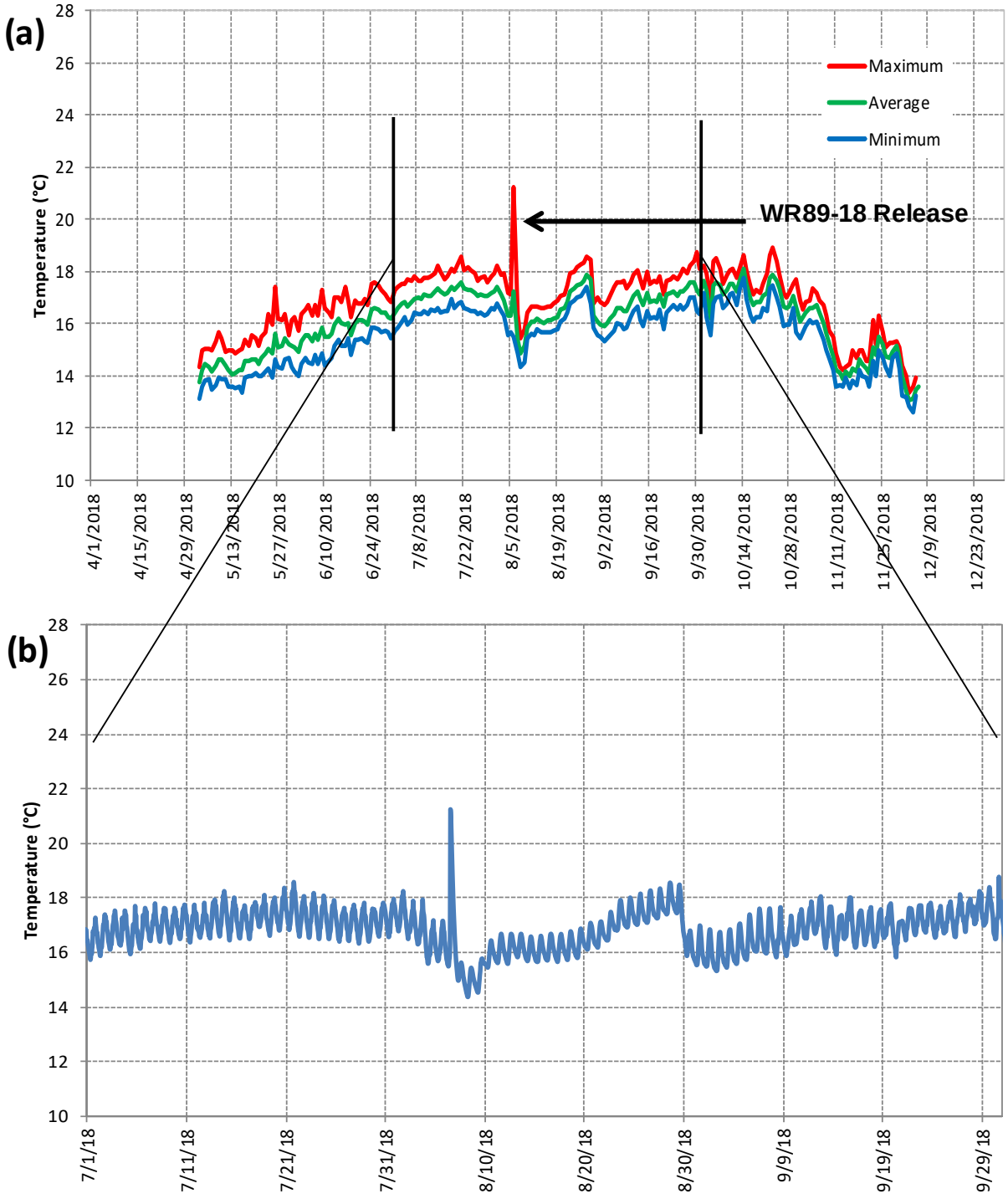


Figure 10: 2018 LSYR-0.51 (Long Pool) middle (3.0 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/18 - 10/1/18.

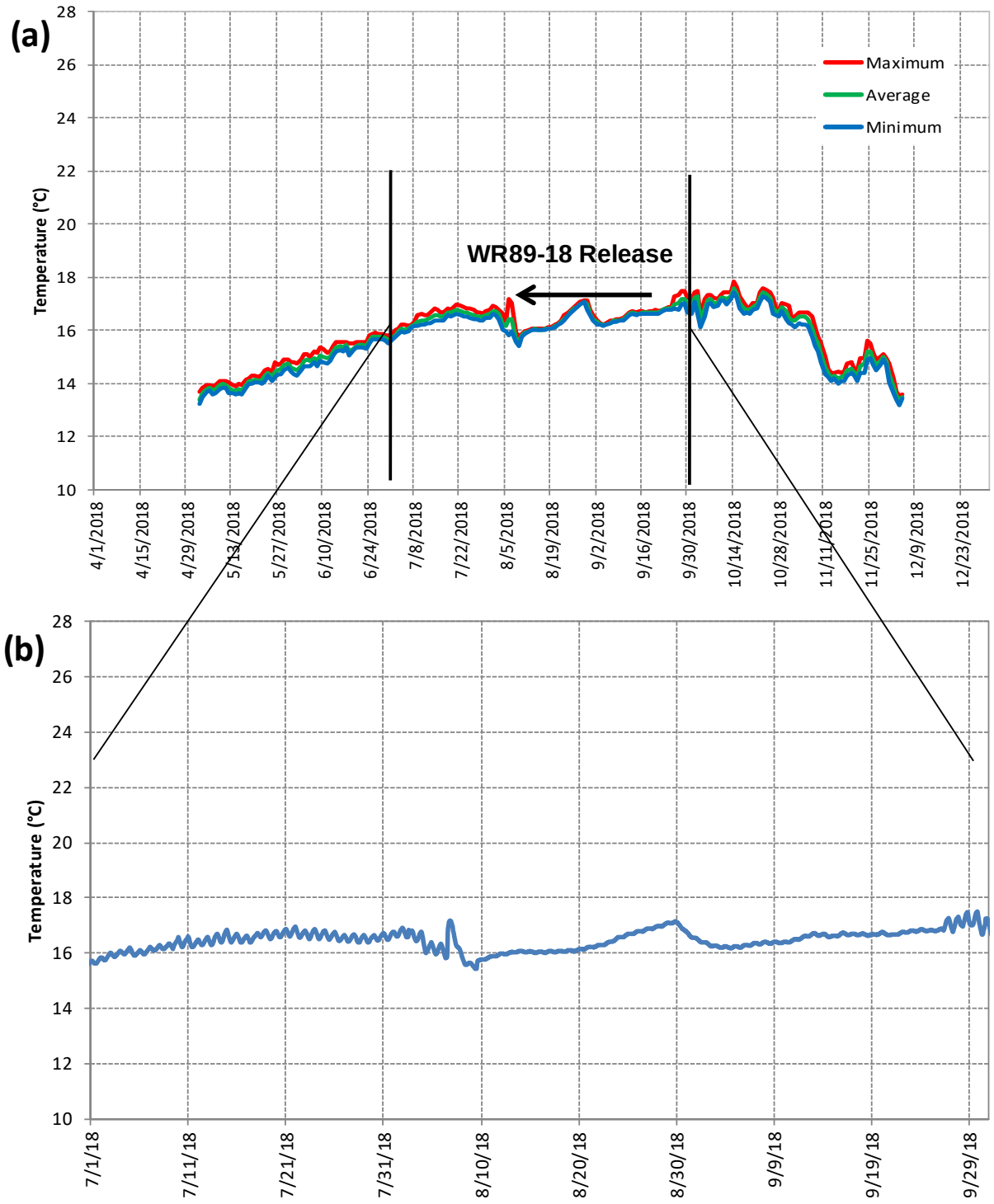


Figure 11: 2018 LSYR-0.51 (Long Pool) bottom (6 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/18 - 10/1/18.

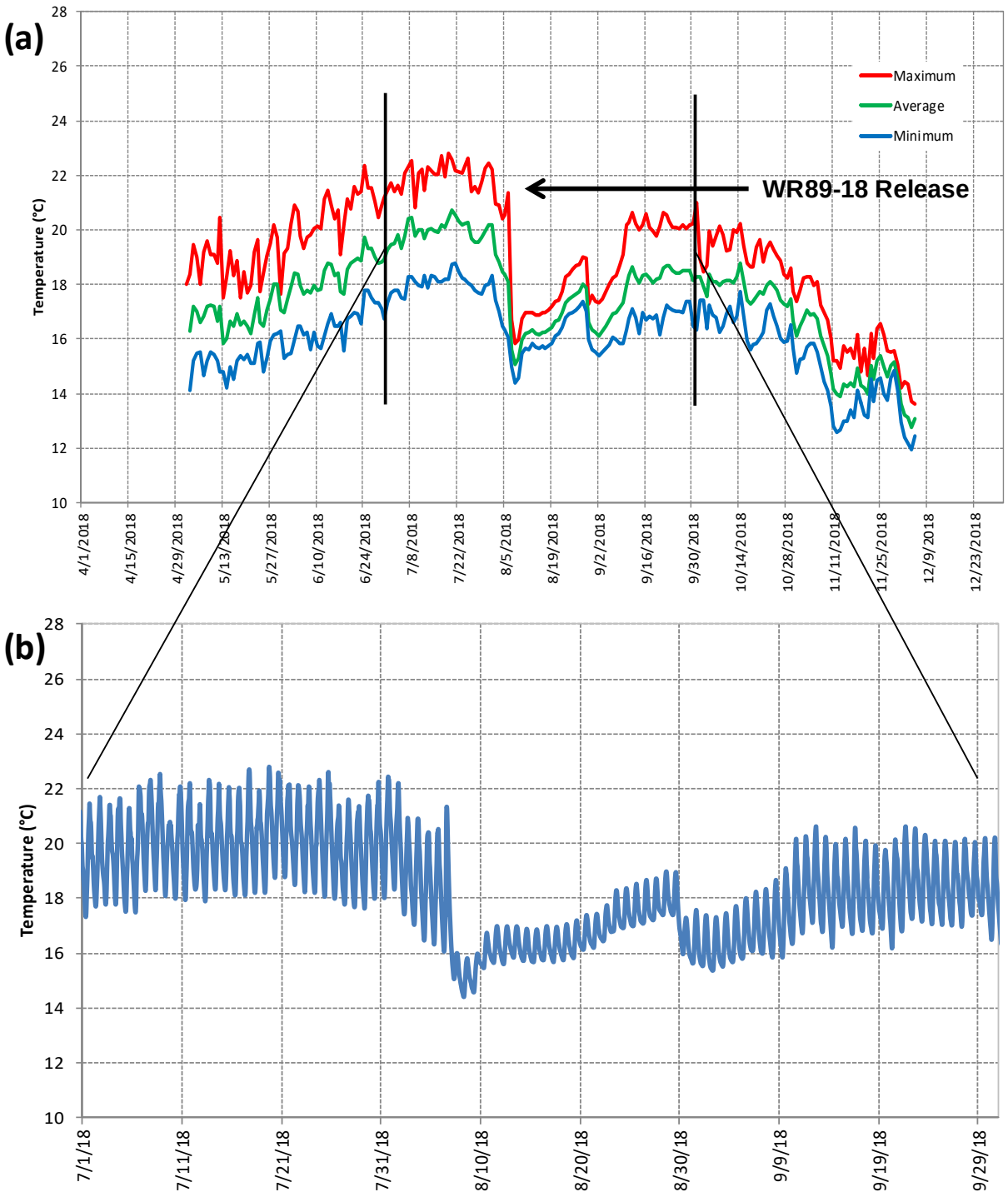


Figure 12: 2018 Reclamation property boundary at LSYR 0.68 (downstream of the Long Pool) bottom (2 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/18 - 10/1/18.

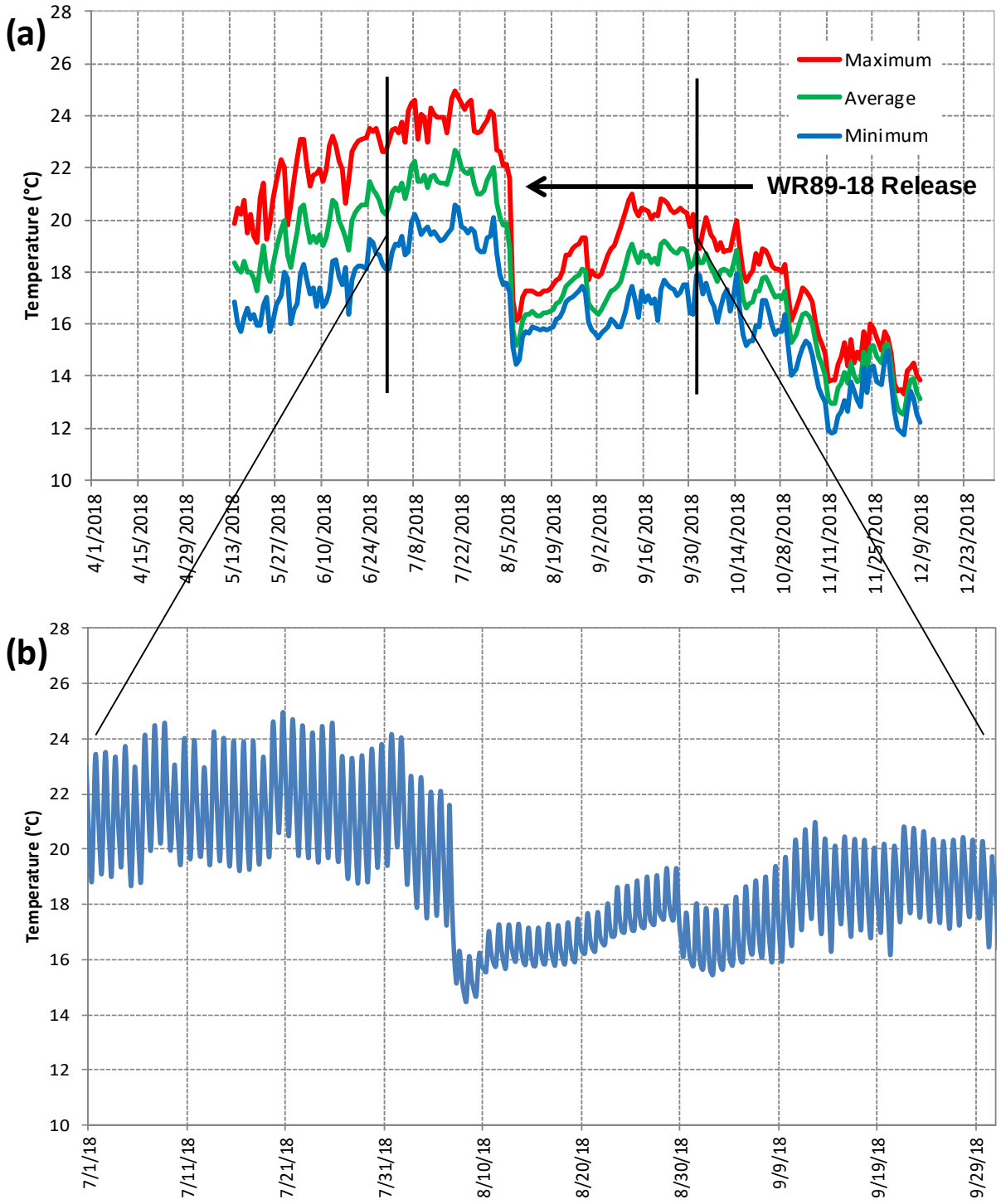


Figure 13: 2018 LSYR-1.09 (Grimm Property upstream-run) bottom (1.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

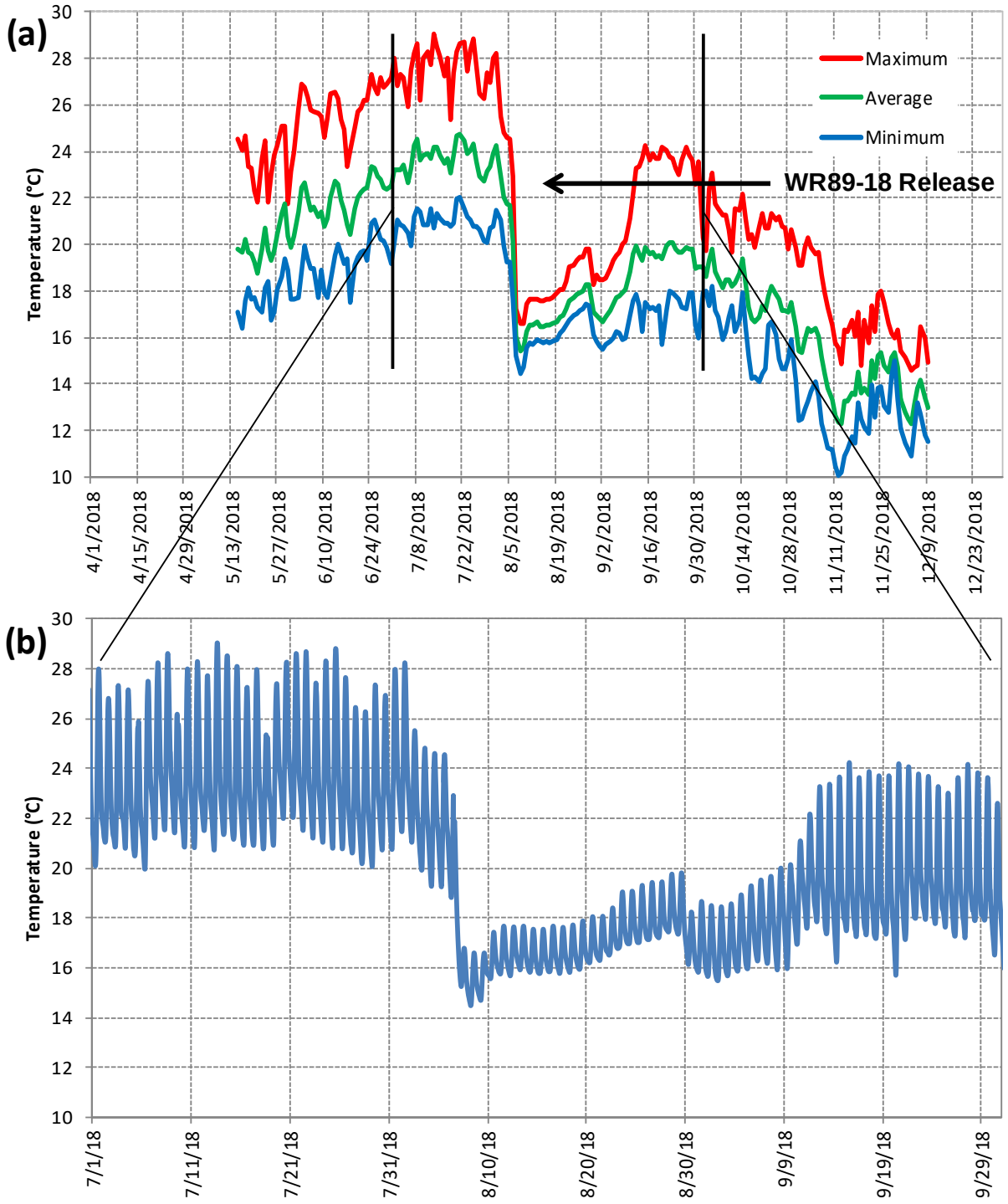


Figure 14: 2018 LSYR-1.54 (Grimm Property downstream-run) bottom (1.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

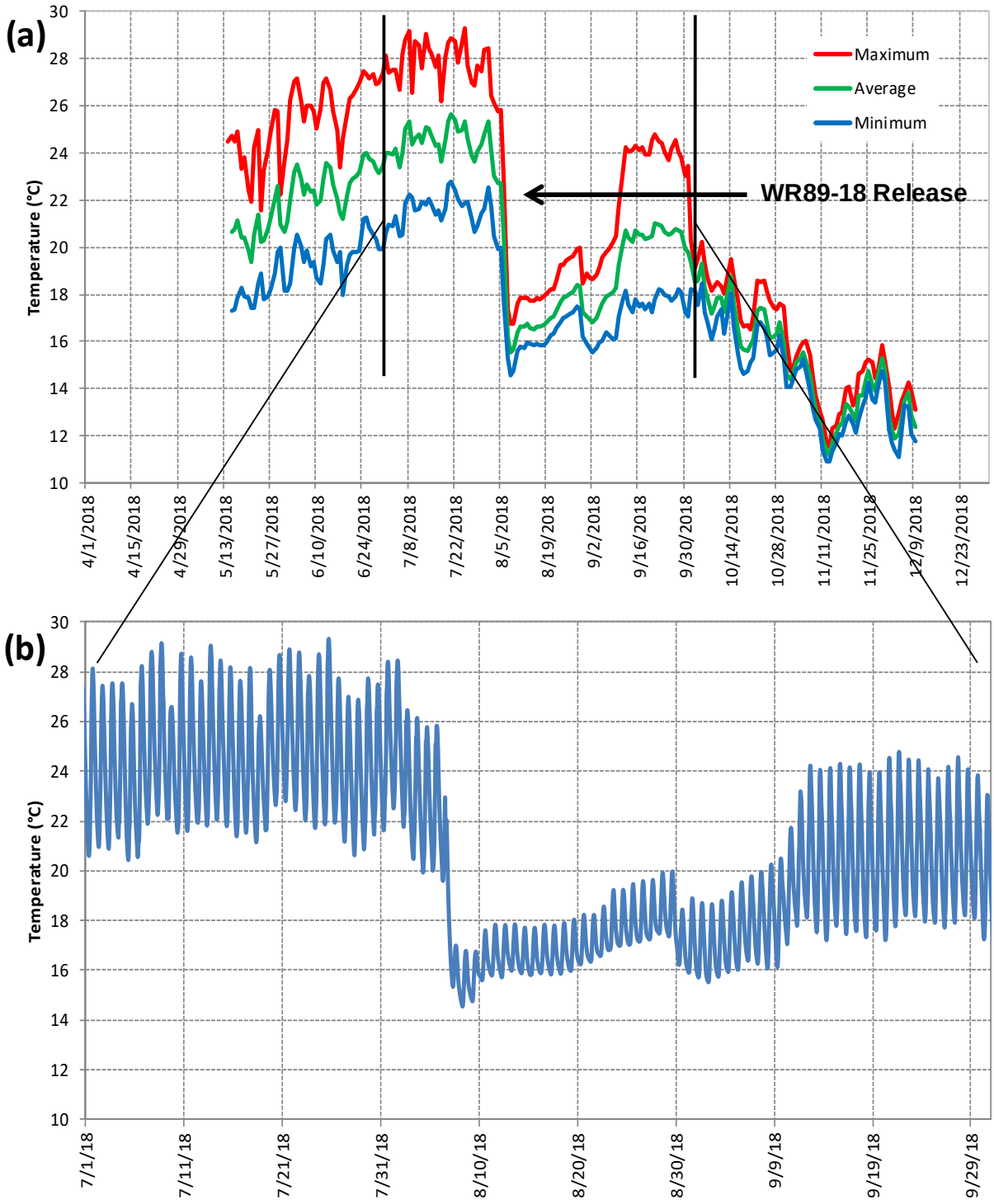


Figure 15: 2018 LSYR-1.71 (Grimm Property pool) surface (1.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

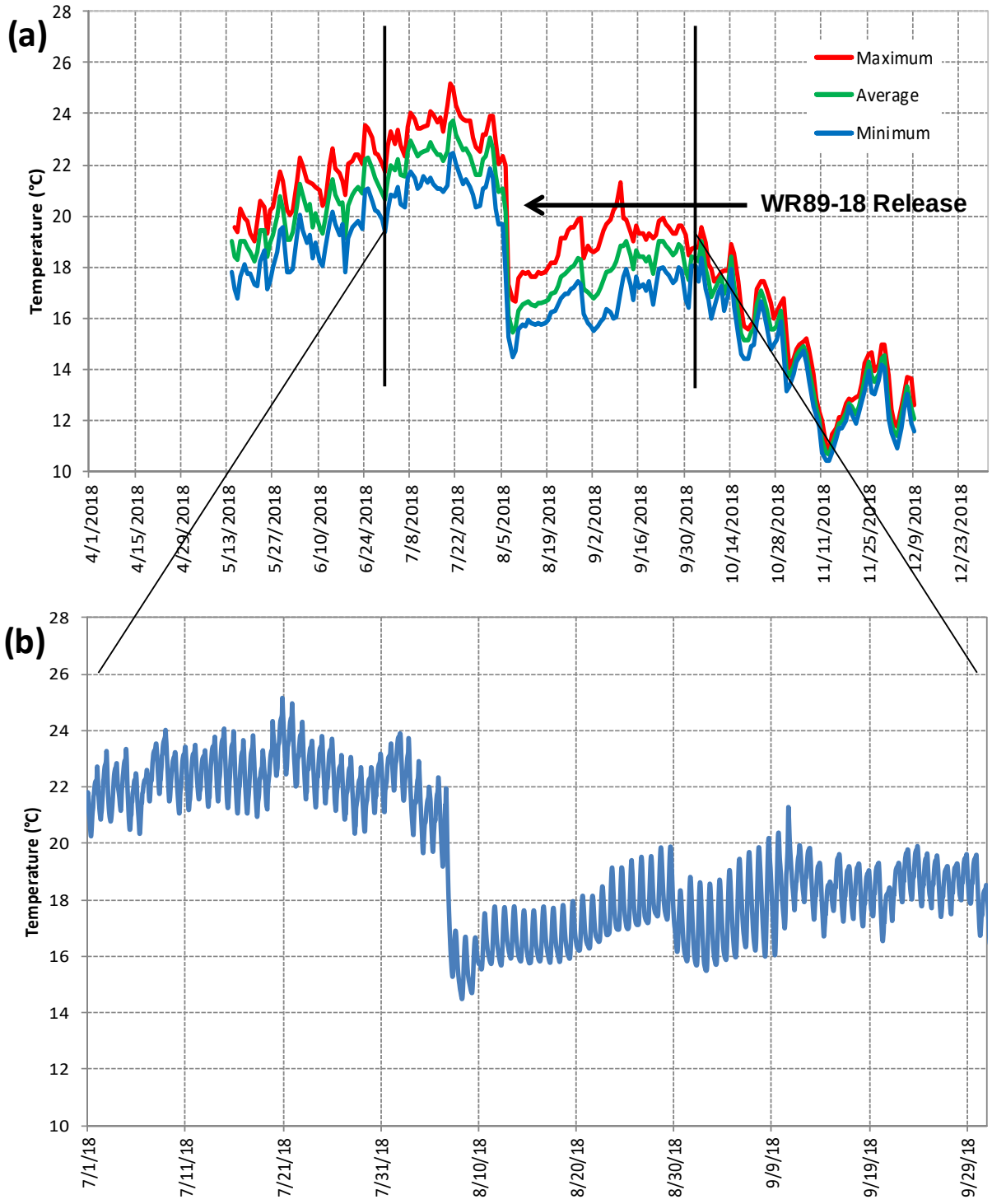


Figure 16: 2018 LSYR-1.71 (Grimm Property pool) middle (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

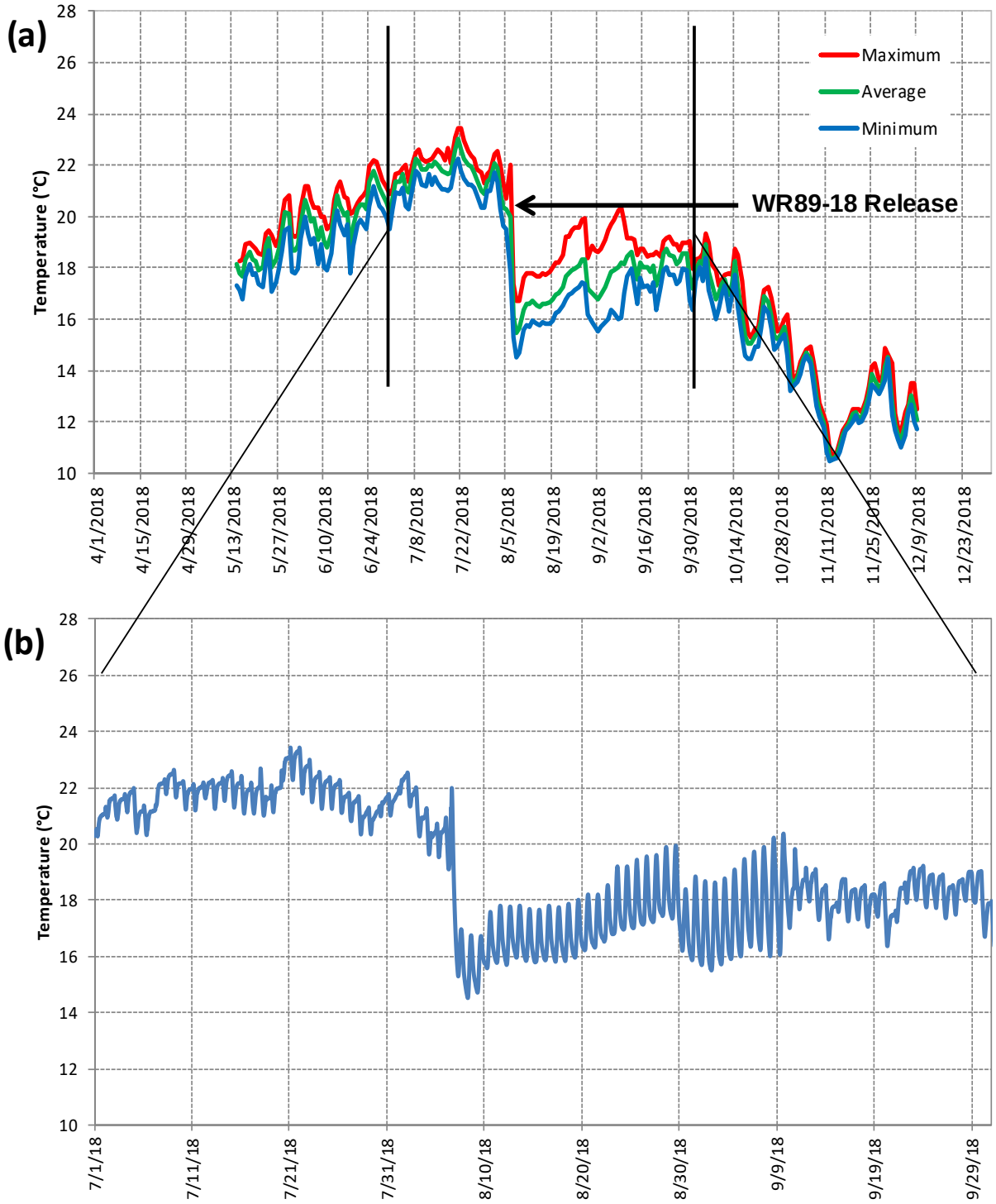


Figure 17: 2018 LSYR-1.71 (Grimm Property pool) bottom (6.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

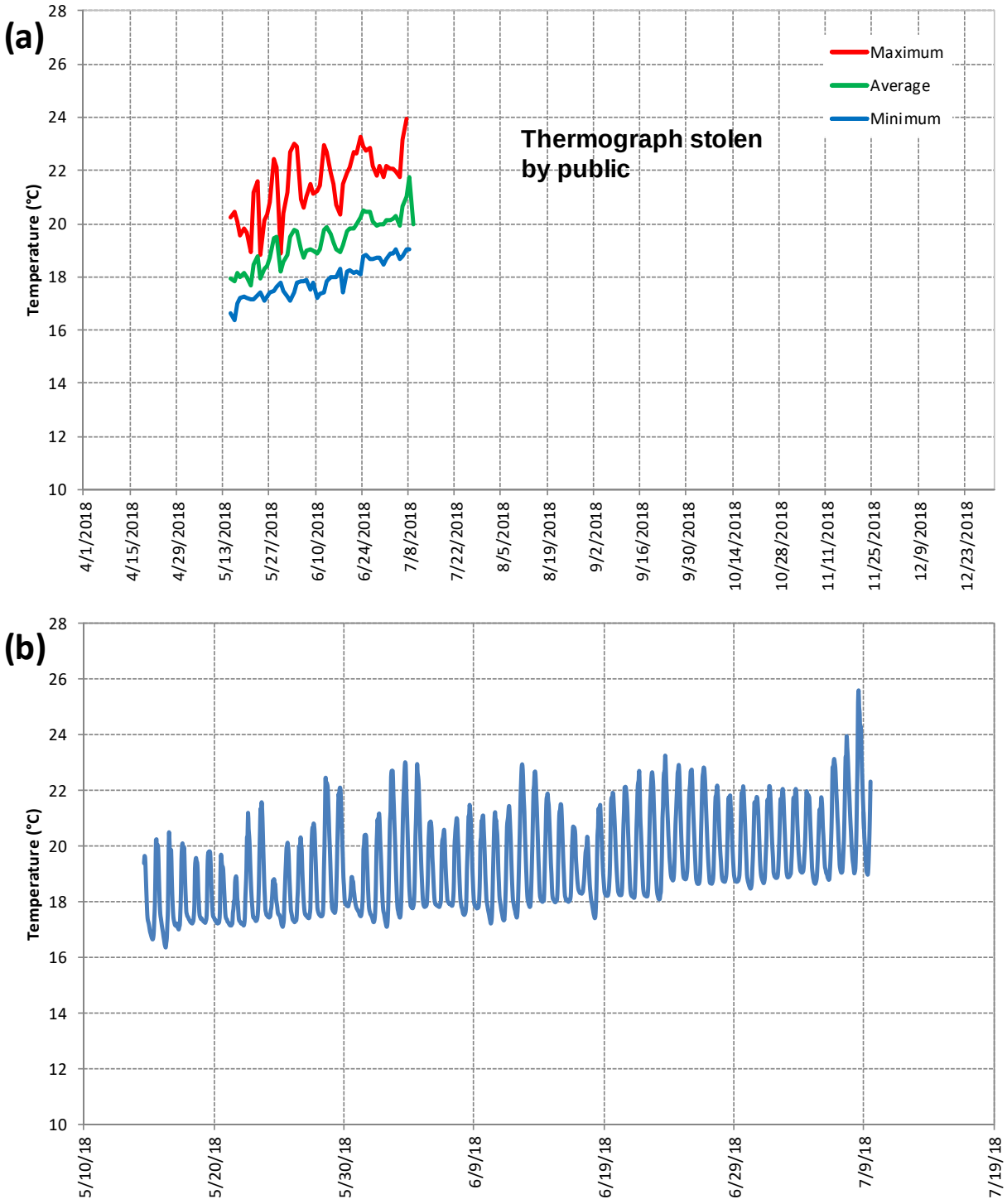


Figure 18: 2018 LSYR-7.65 (Double Canopy Pool) surface (1.0 foot) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record.

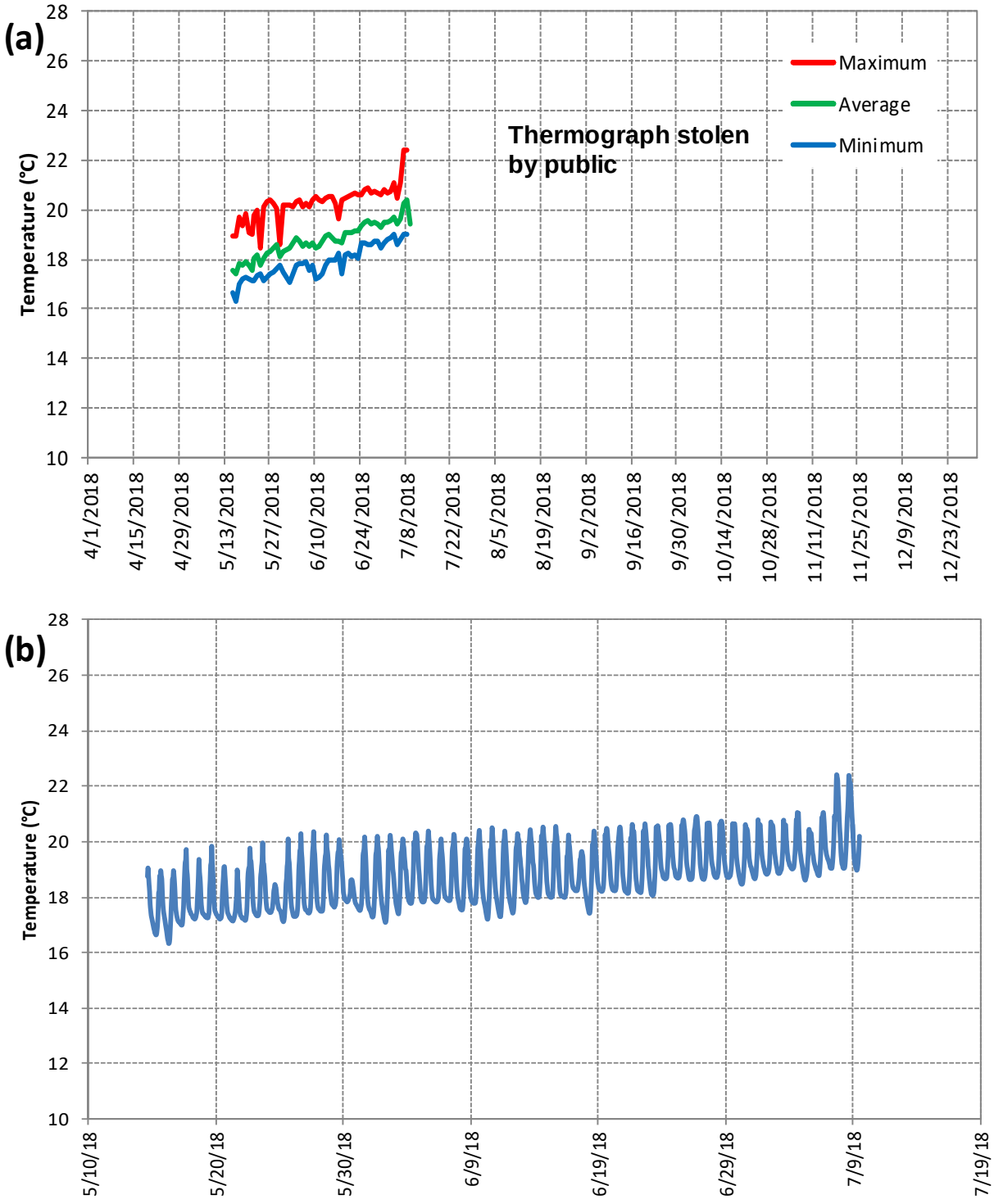


Figure 19: 2018 LSYR-7.65 (Double Canopy Pool) middle (2.0 feet) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record.

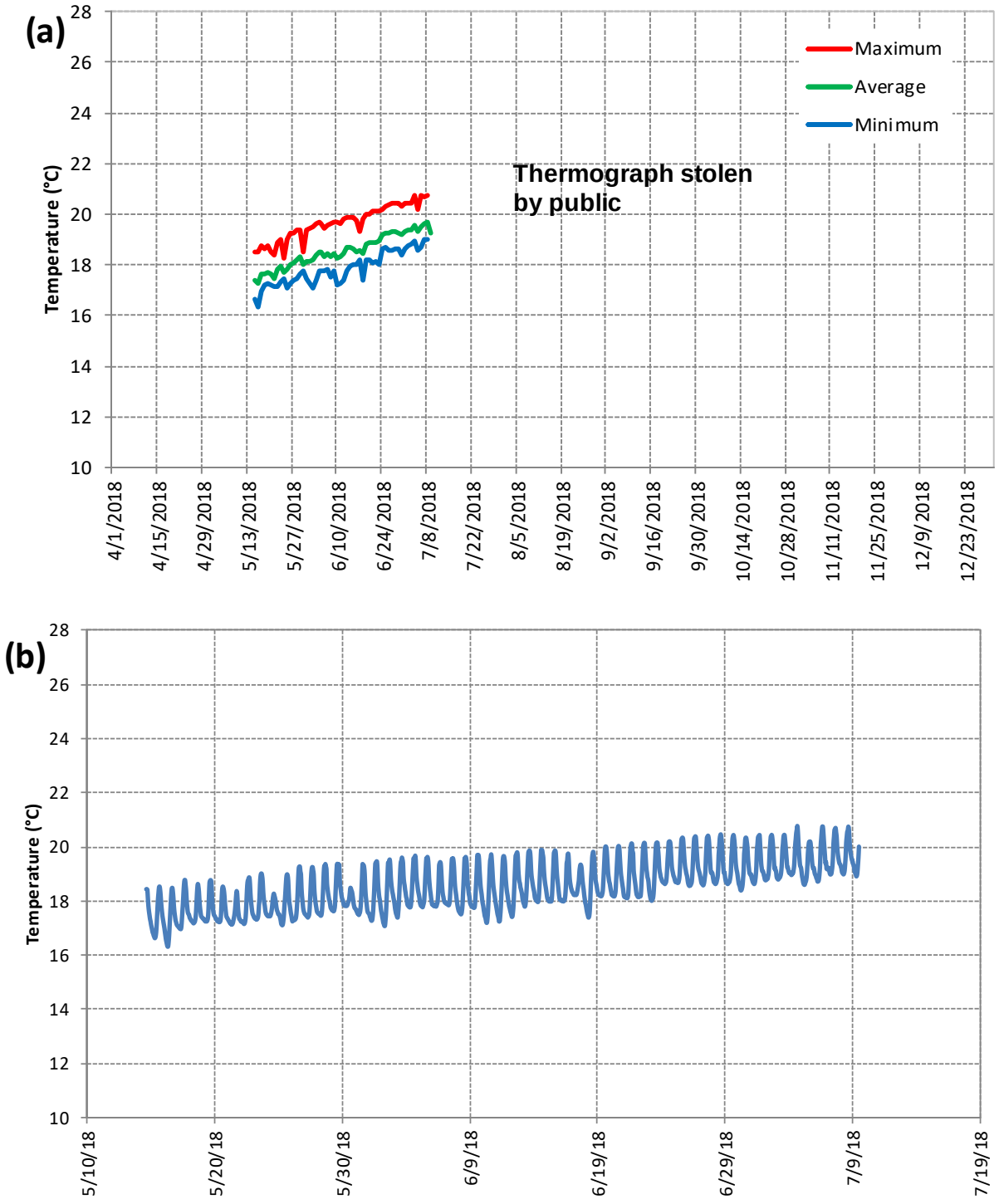


Figure 20: 2018 LSYR-7.65 (Double Canopy Pool) bottom (3.0 feet) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record.

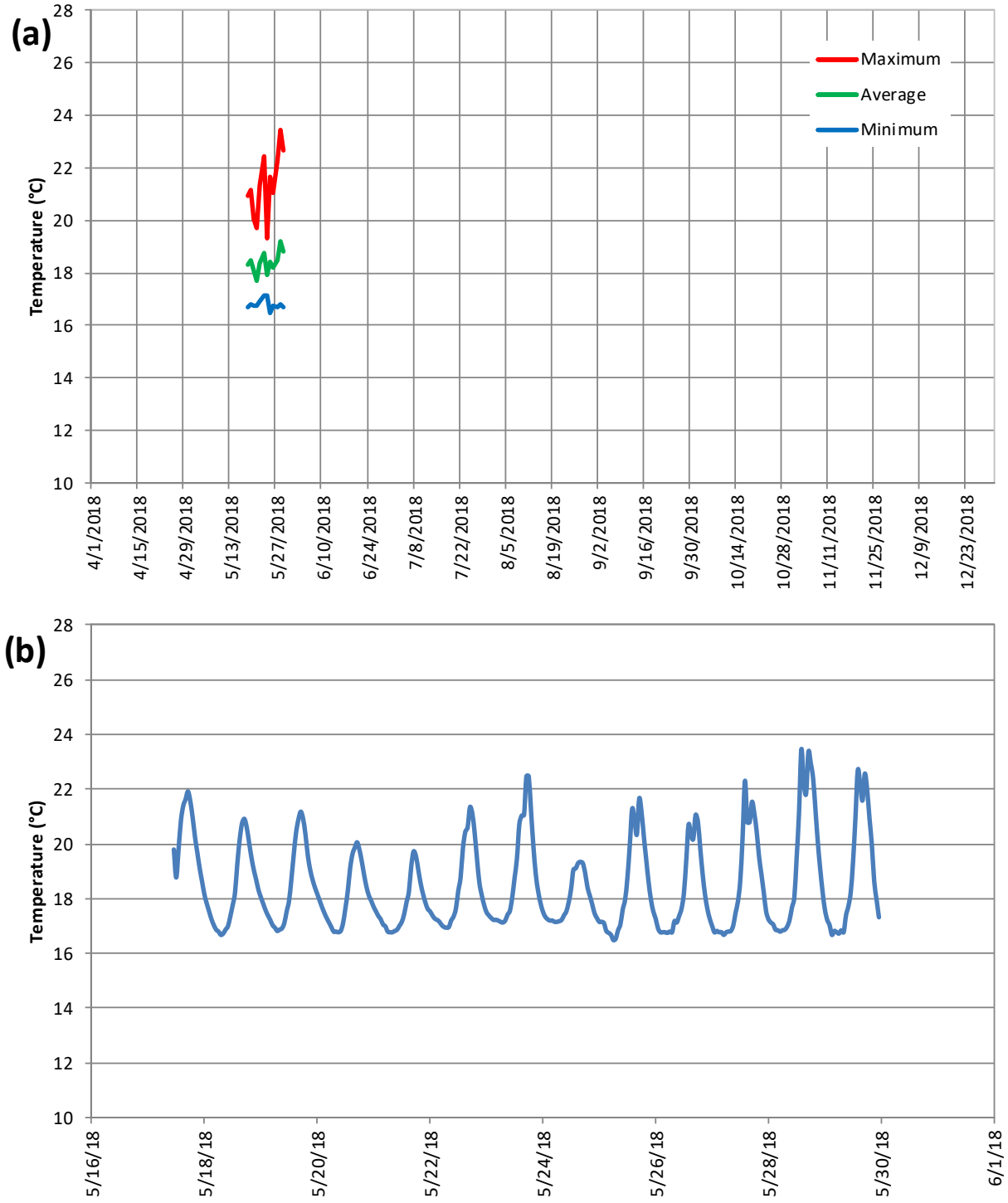


Figure 21: 2018 LSYR-8.7 (Head of Beaver Pool) surface (1.0 foot) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the period of record.

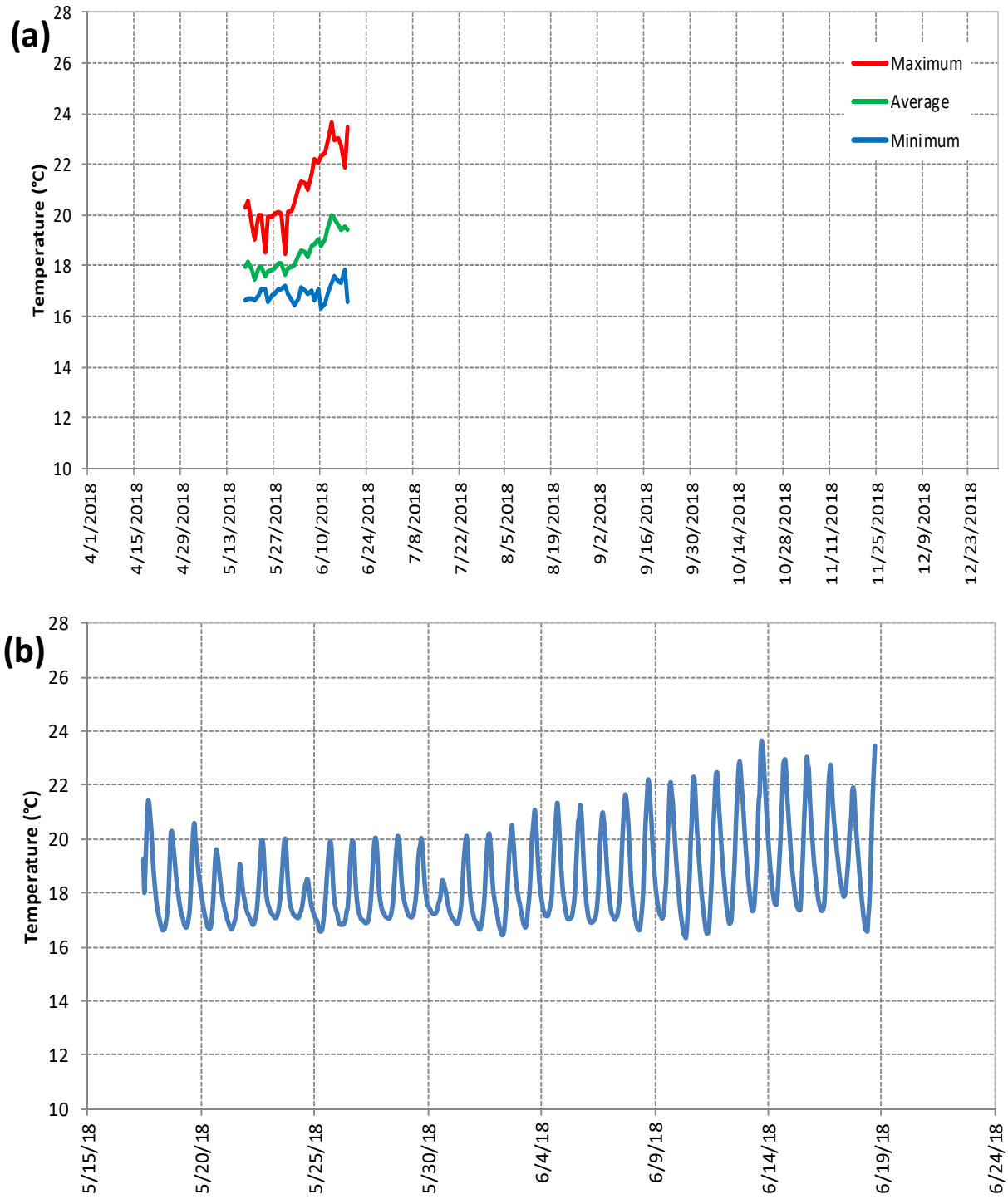


Figure 22: 2018 LSYR-8.7 (Head of Beaver Pool) middle (2.5 feet) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the period of record.

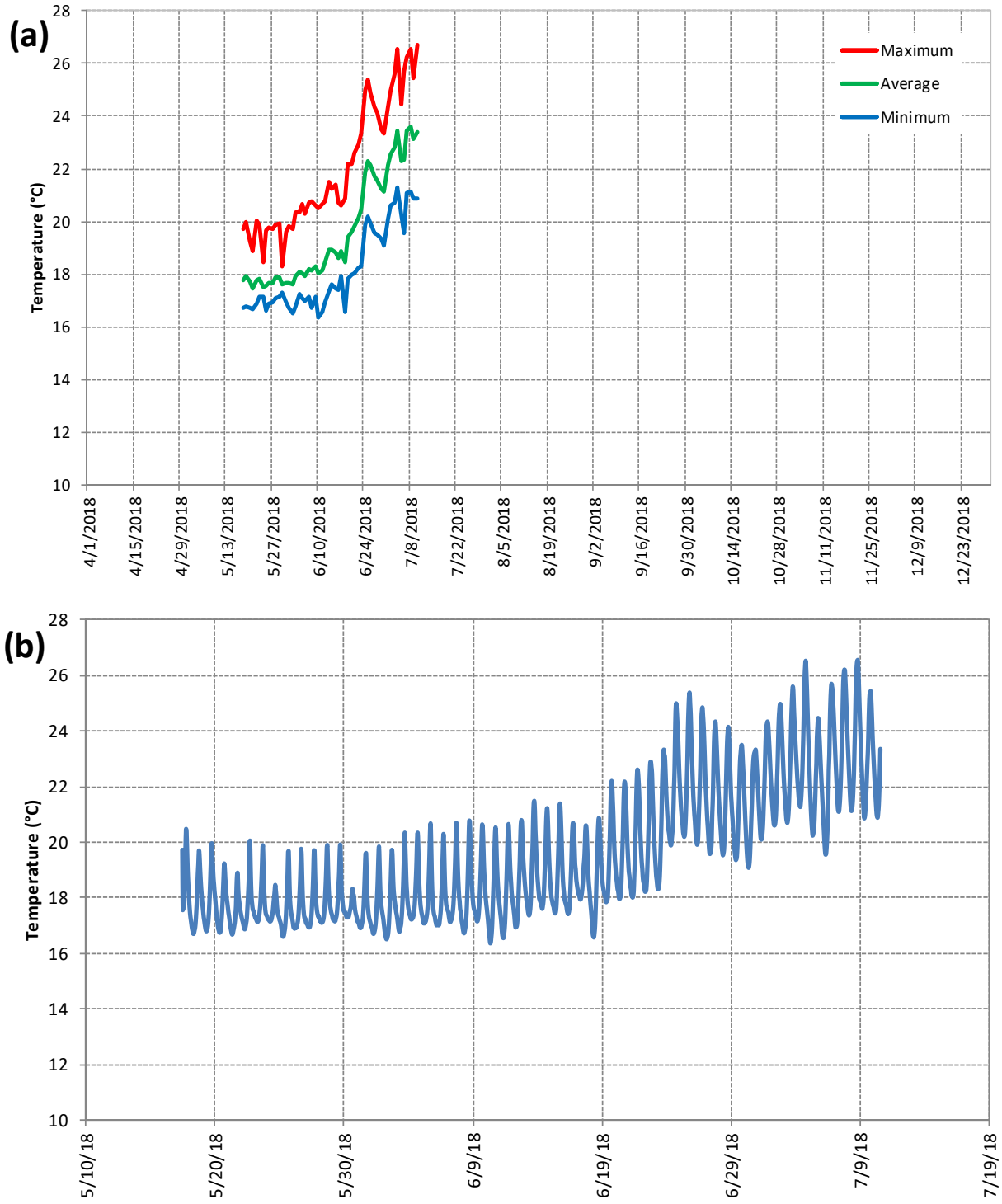


Figure 23: 2018 LSYR-8.7 (Head of Beaver Pool) bottom (5.0 feet) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the period of record.

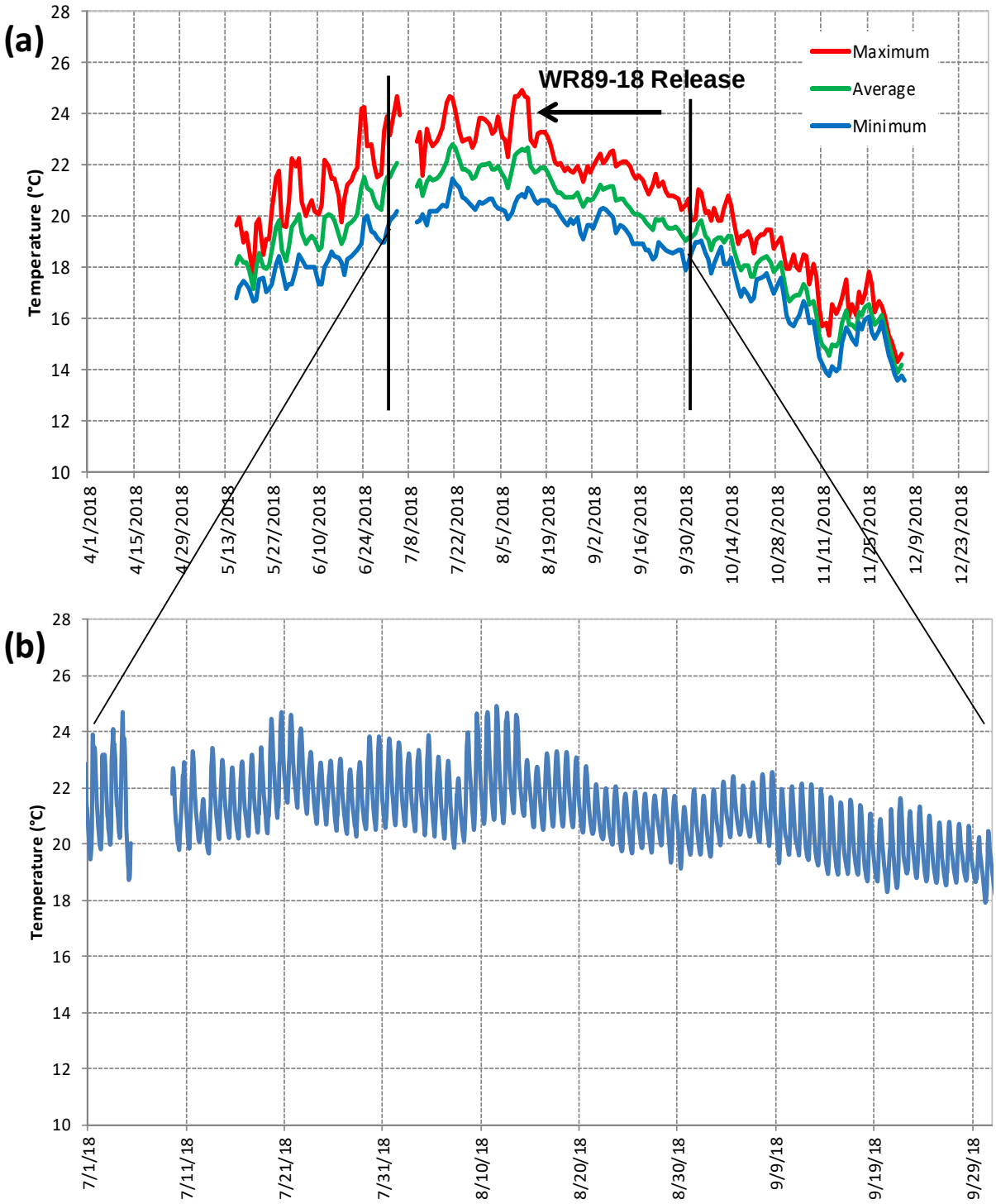


Figure 24: 2018 LSYR-22.68 (Cadwell Pool) surface (1.0 foot) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

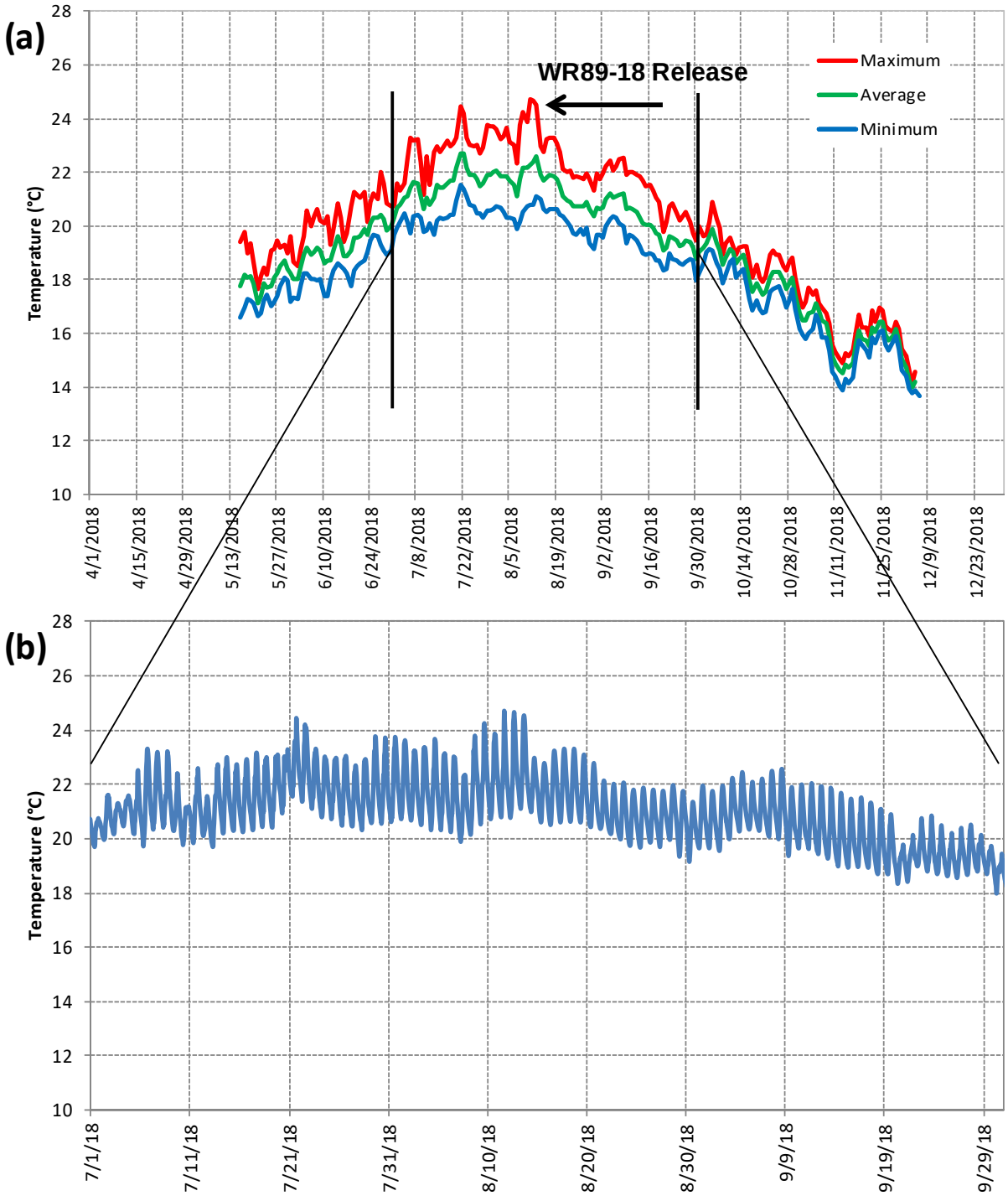


Figure 25: 2018 LSYR-22.68 (Cadwell Pool) middle (7.0 feet) water temperature for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

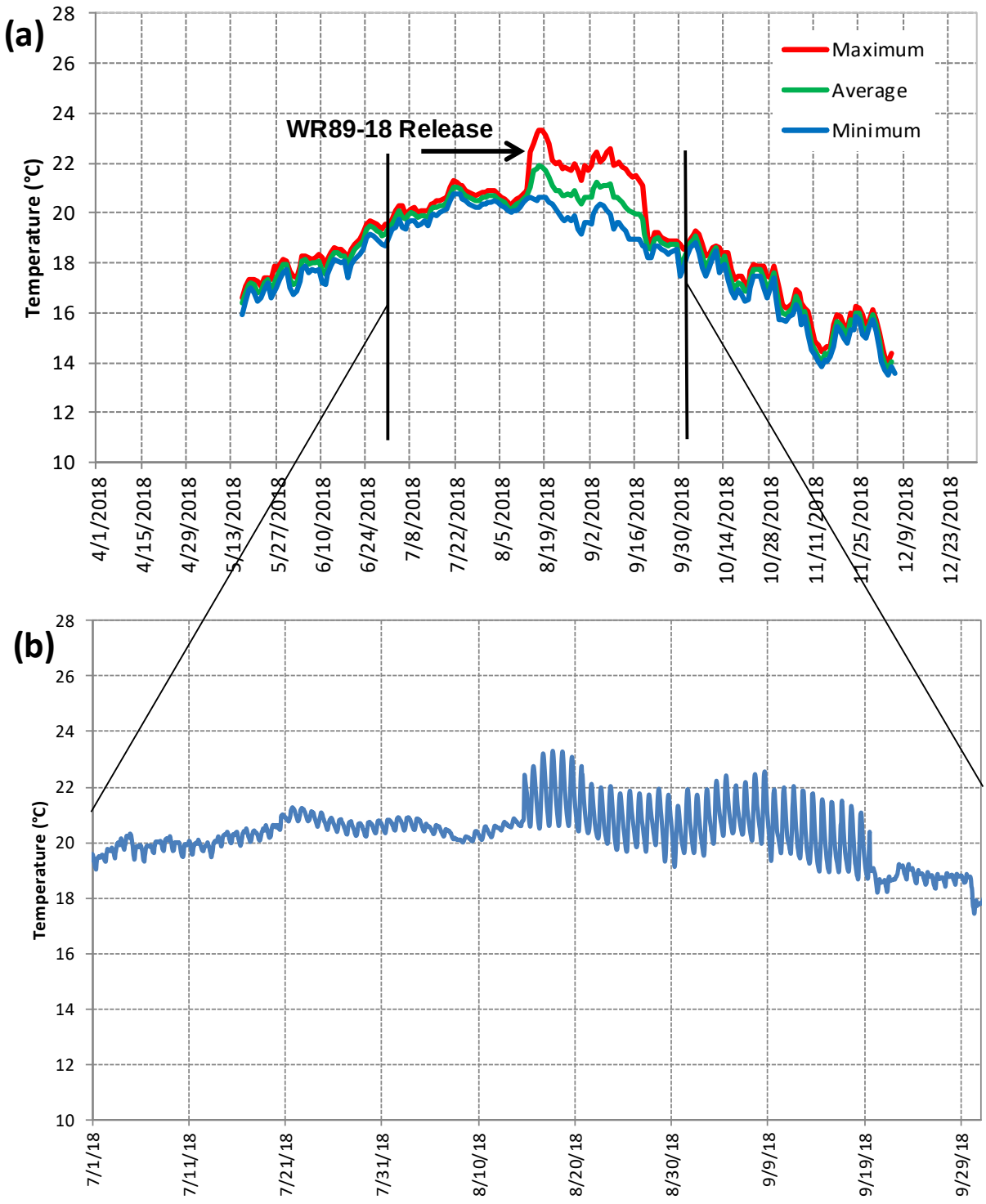


Figure 26: 2018 LSYR-22.68 (Cadwell Pool) bottom (14.0 feet) water temperatures for a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/18 - 10/1/18.

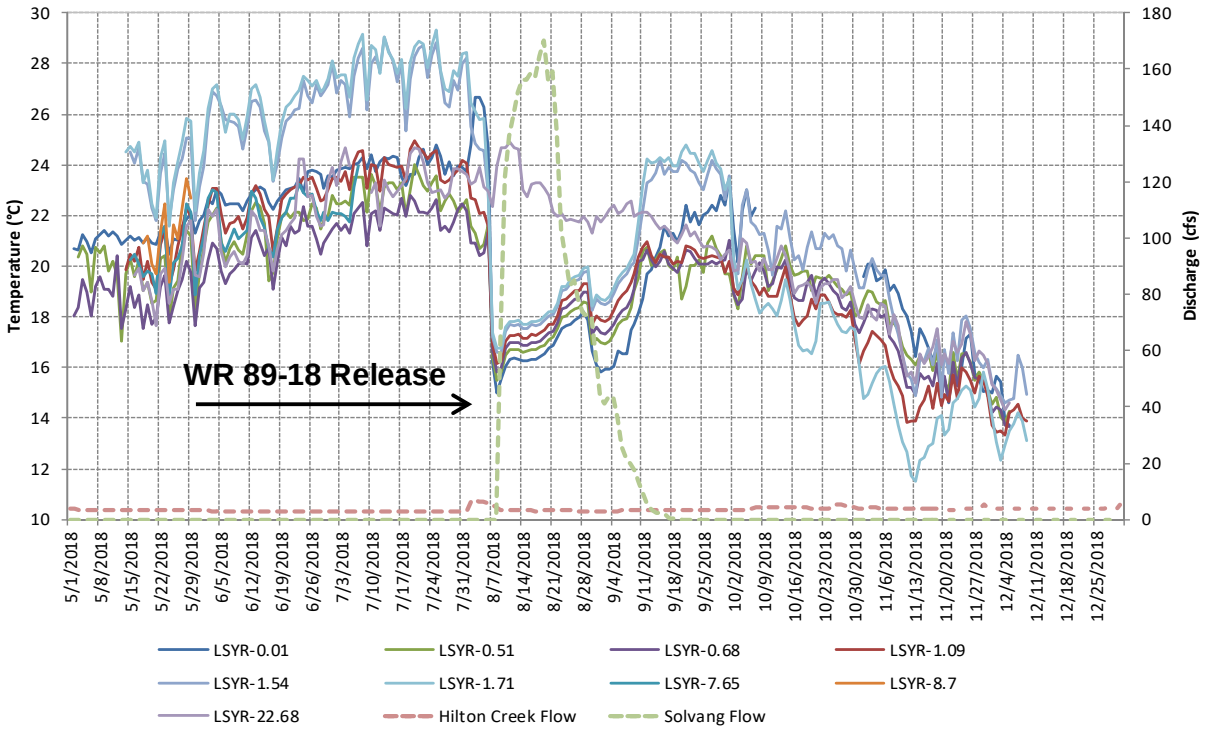


Figure 27: 2018 Longitudinal maximum surface water temperatures at: LSYR-0.01 (parapet wall), LSYR-0.51 (Long Pool), LSYR-0.68 (downstream of Long Pool), LSYR-1.09 (Grimm u/s), LSYR-1.54 (Grimm d/s), LSYR-1.71 (Grimm Pool), LSYR-7.65 (Double Canopy), LSYR-8.7 (Head of Beaver), and LSYR-22.68 (Cadwell Pool) with daily flow (discharge) at the Hilton Creek and Solvang (at the Alisal Bridge) USGS gauges; no water quality monitoring was conducted at LSYR-0.25, LSYR-4.95, LSYR-10.5, and LSYR13.9 because the river was dry at those locations prior to WR89-18 releases.

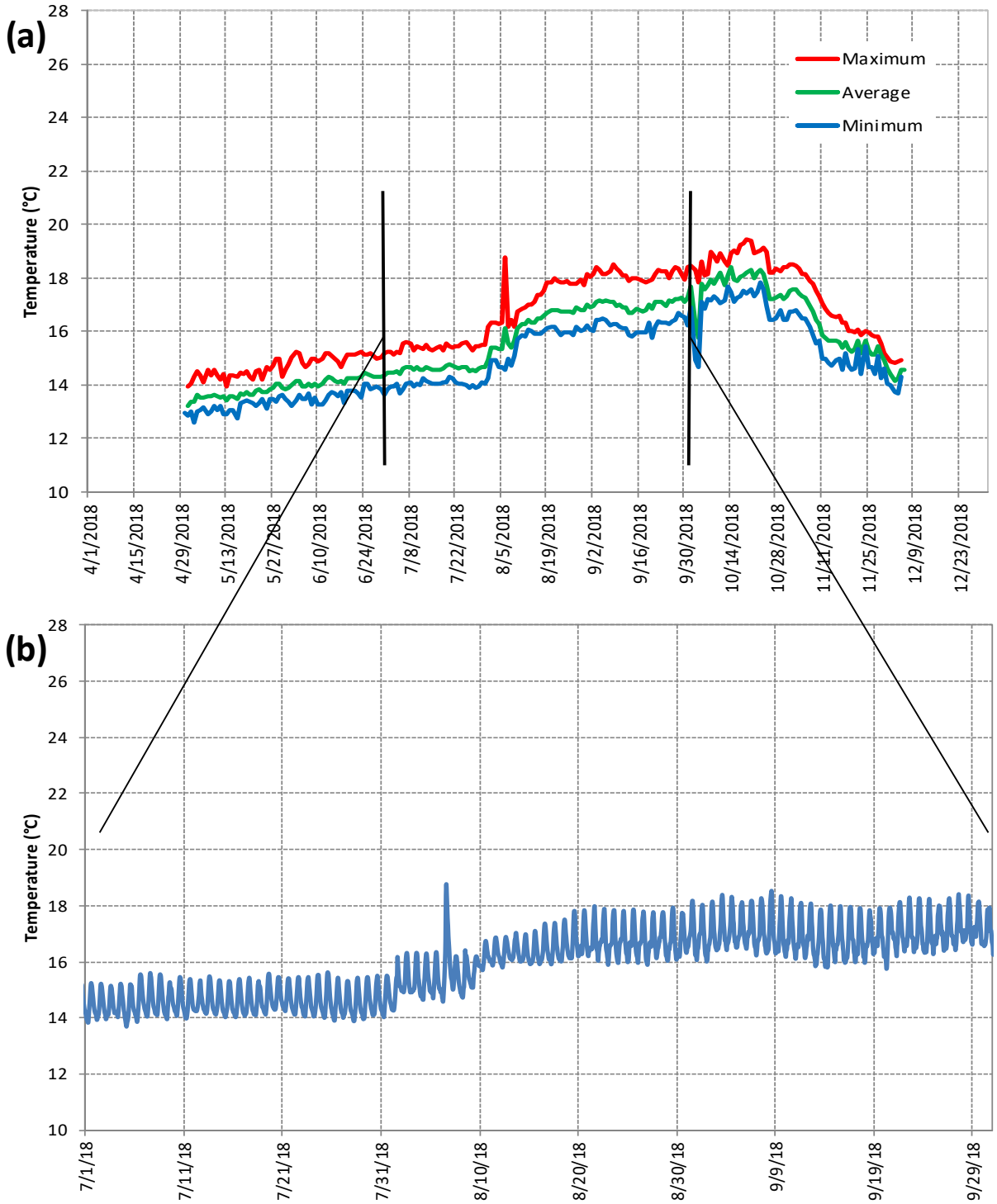


Figure 28: 2018 Lower Hilton Creek (HC-0.12) bottom (0.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/1/18 - 10/1/18.

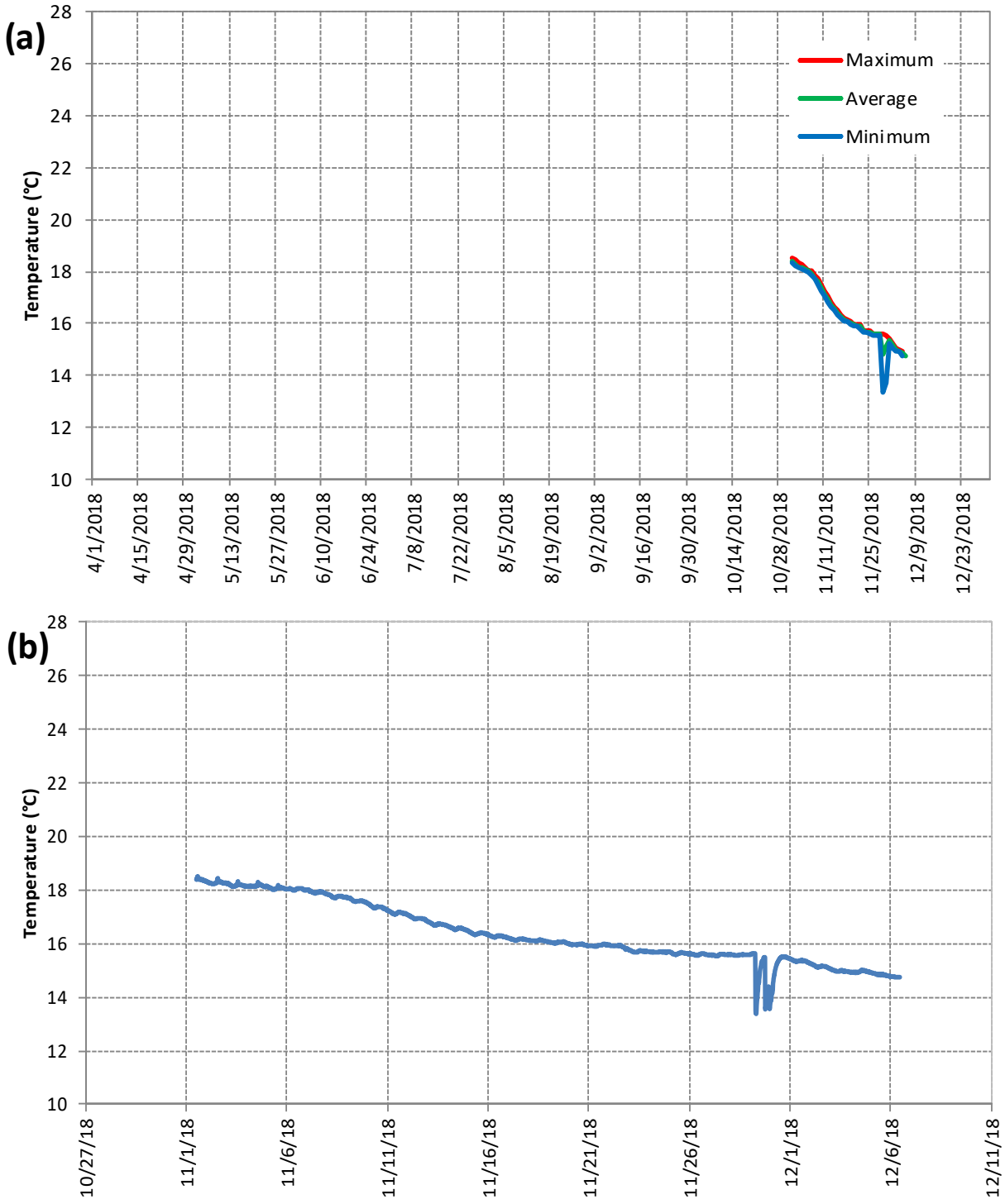


Figure 29: 2018 Hilton Creek at the Upper Release Point (HC-0.54) bottom (2.5 feet) water temperatures for: (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of deployment.

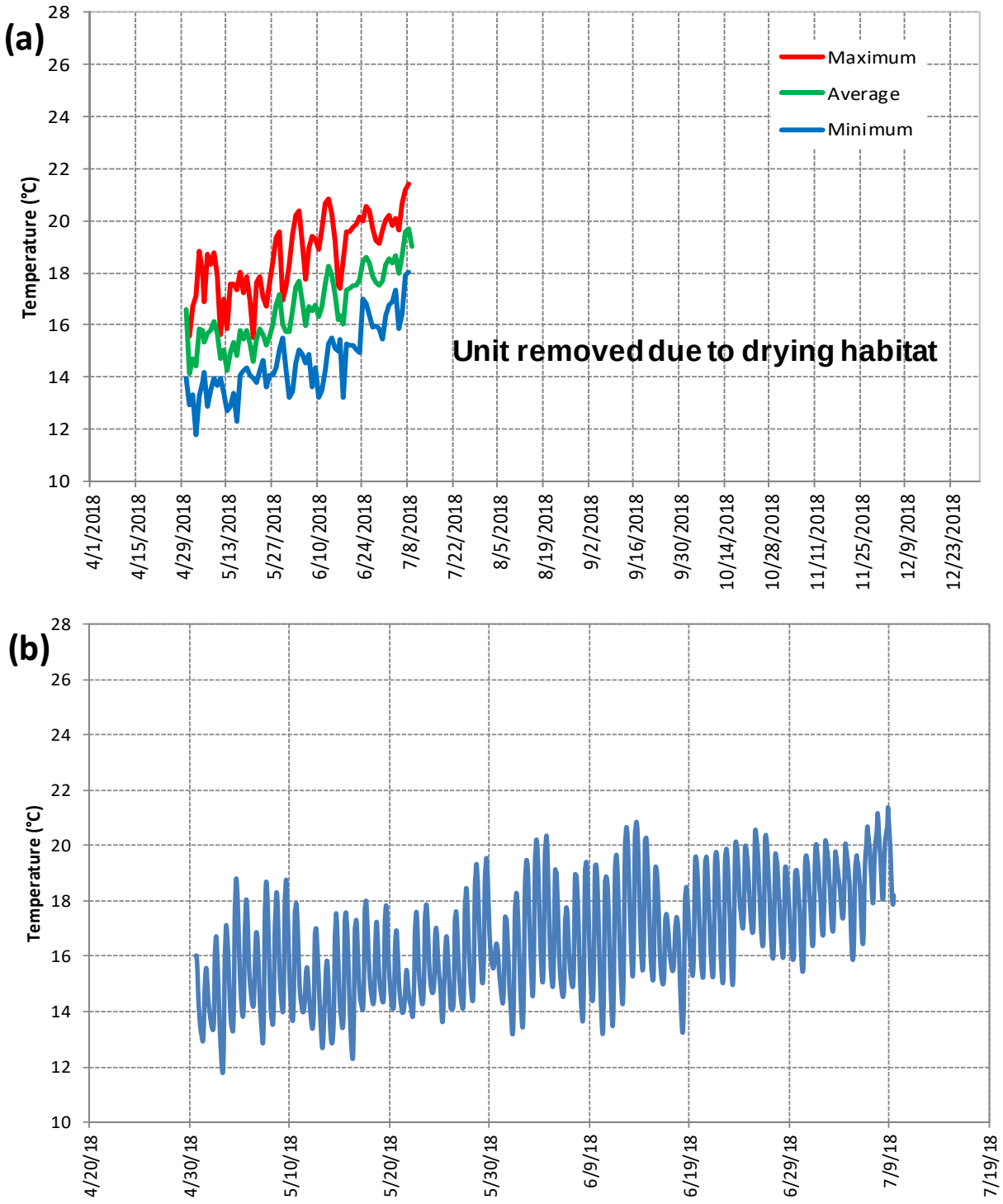


Figure 30: 2018 Quiota Creek (QC-2.66) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the entire period of deployment; unit removed due to drying habitat.

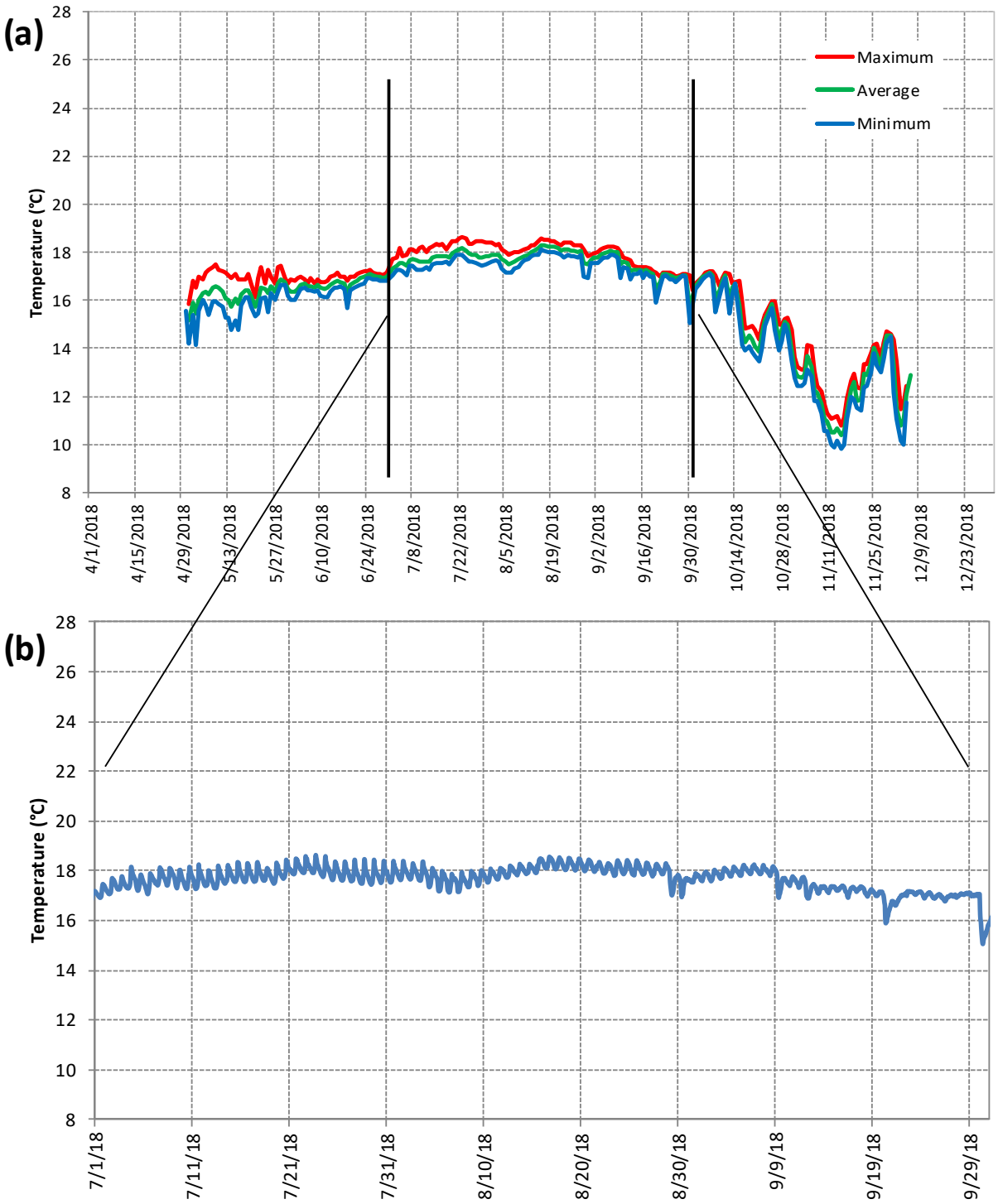


Figure 31: 2018 Lower Salsipuedes Creek (SC-0.77) bottom (5.0 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/1/18 - 10/1/18.

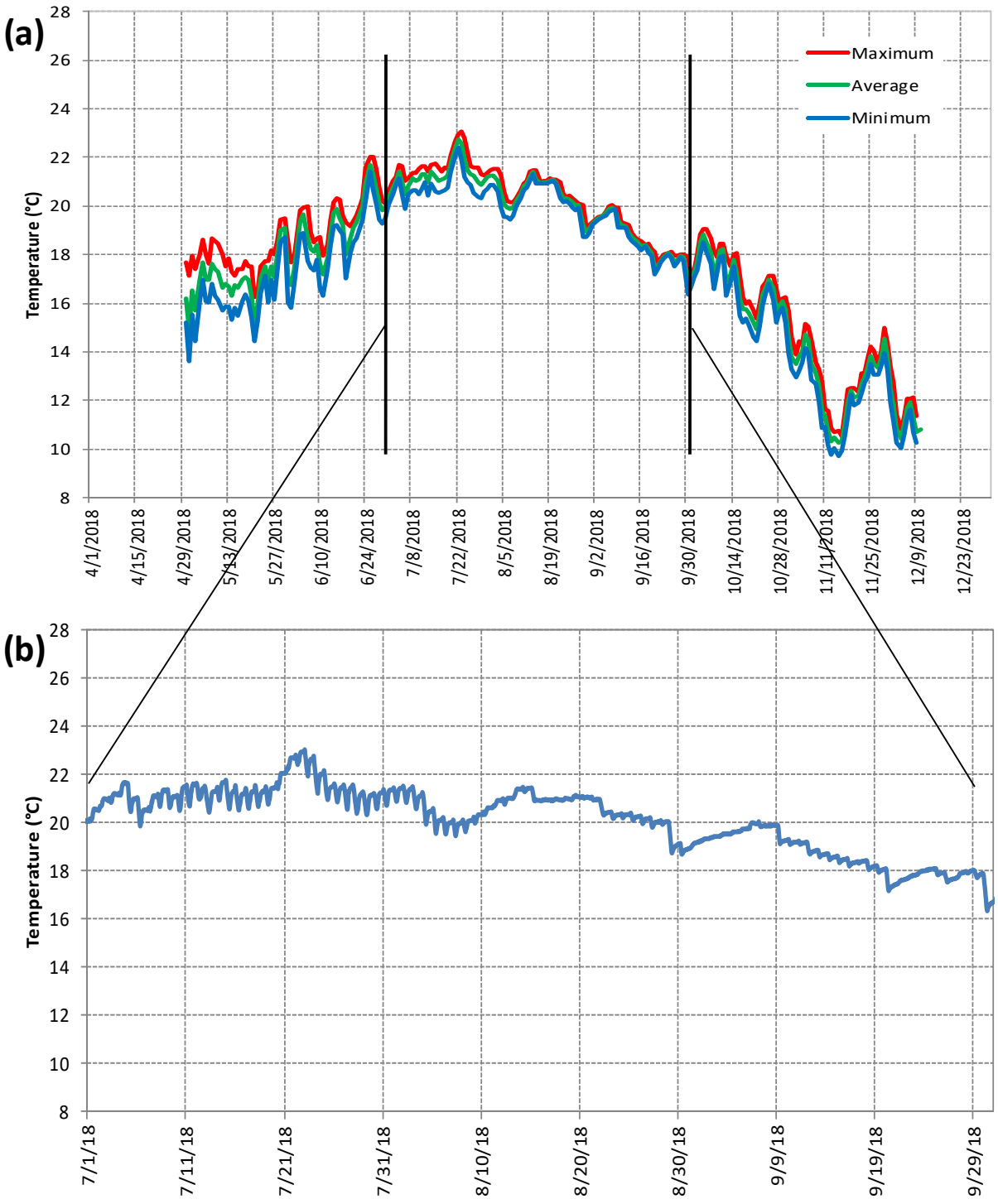


Figure 32: 2018 SC-2.20 (Reach 2 Bedrock Section) bottom (4.0 feet) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period from 7/1/18 - 10/1/18.

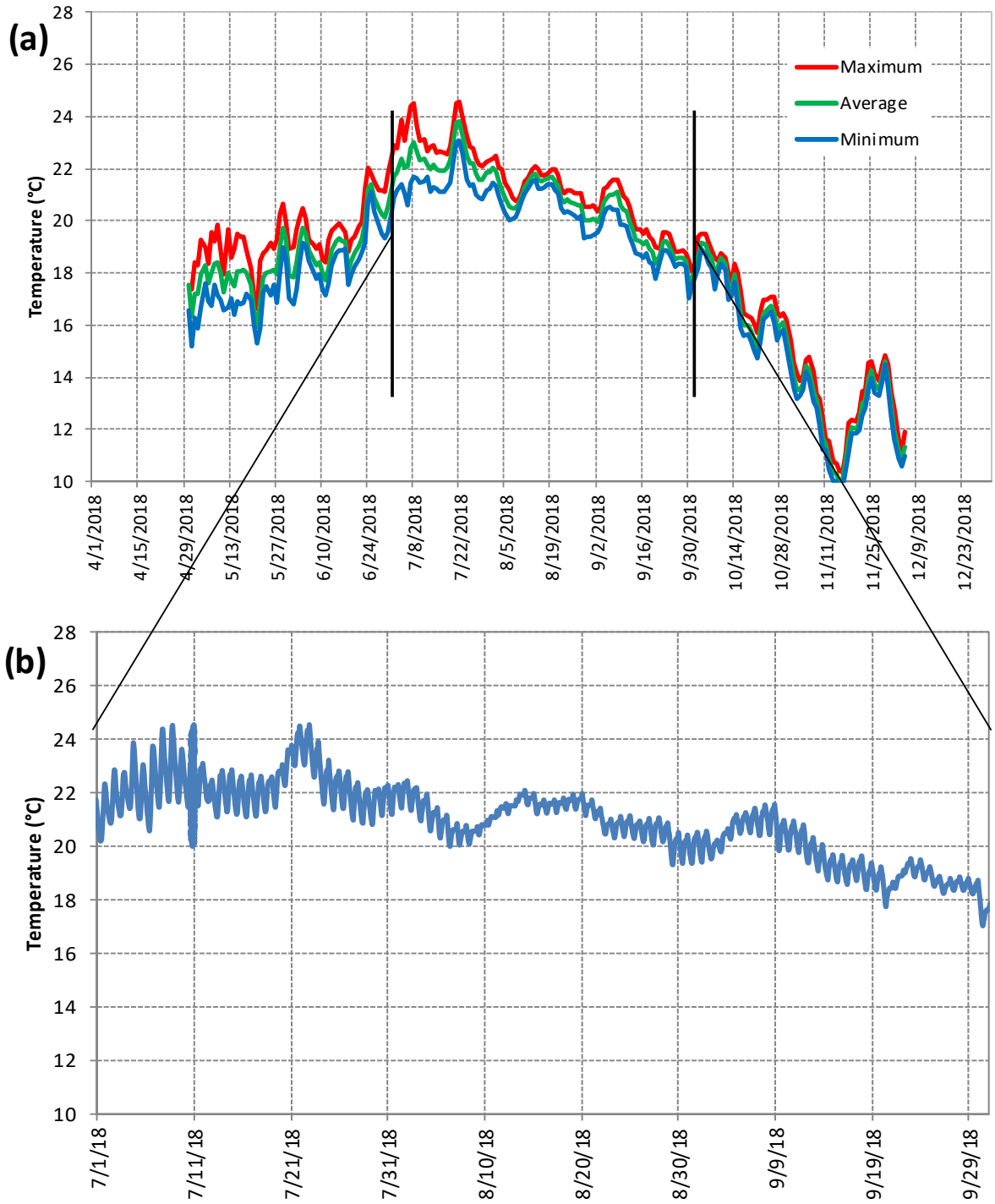


Figure 33: 2018 SC-3.0 (Highway 1 Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/18 - 10/1/18.

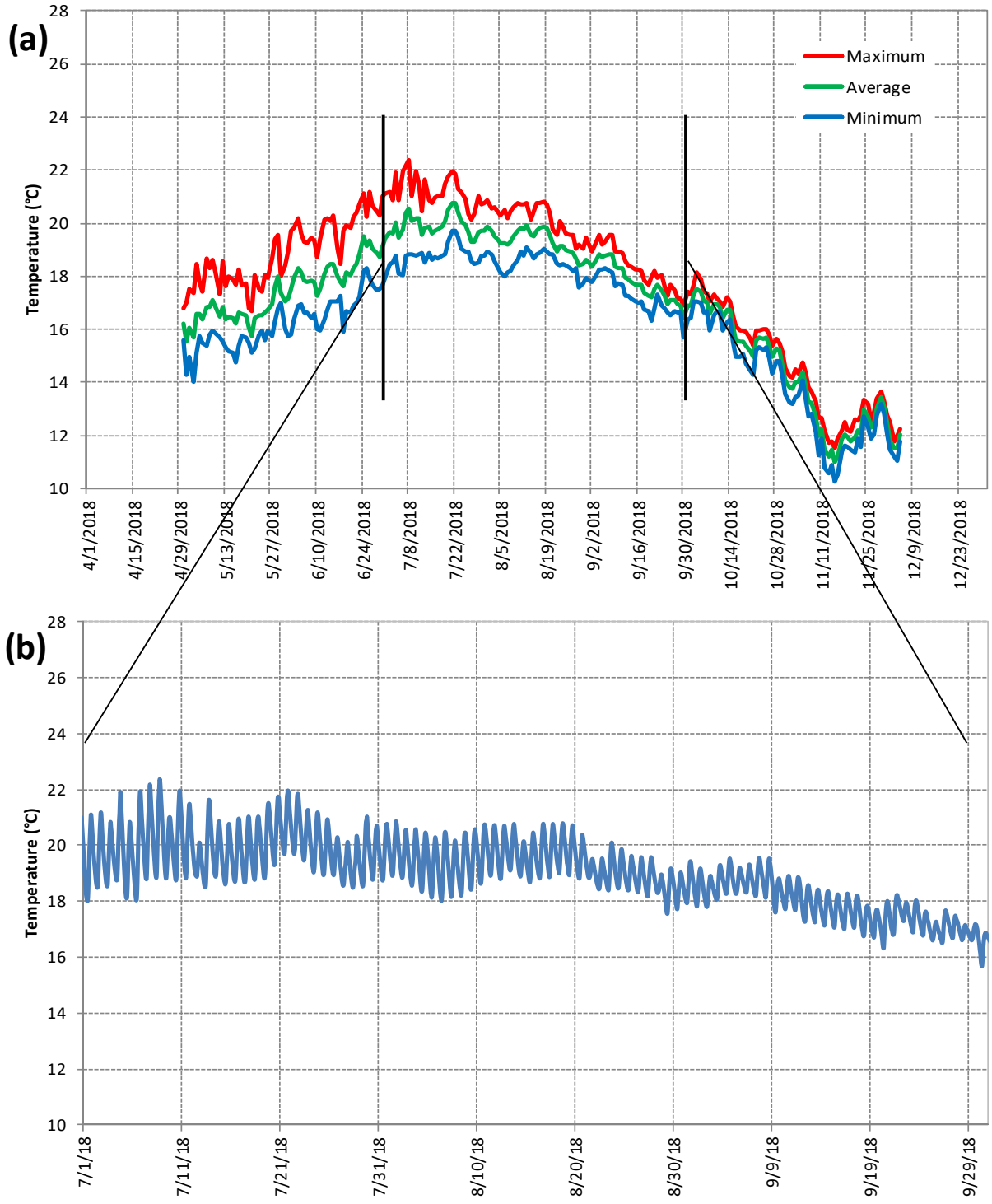


Figure 34: 2018 SC-3.5 (Jalama Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/18 - 10/1/18.

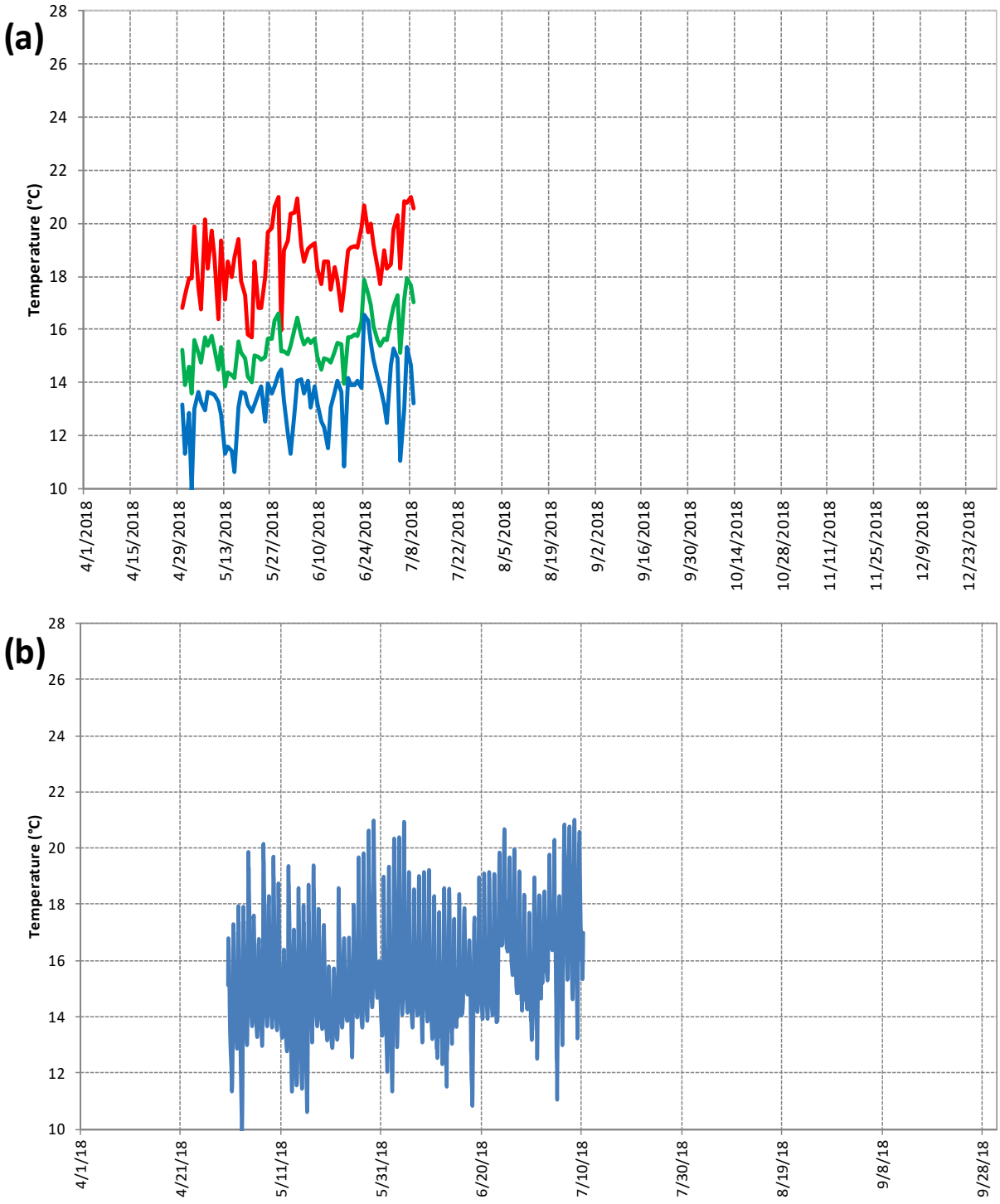


Figure 35: 2018 SC-3.8 Upper Salsipuedes Creek (0.5 feet) water temperatures for (a) daily maximum, average and minimum for the entire period of deployment and (b) hourly measurements for the period of record.

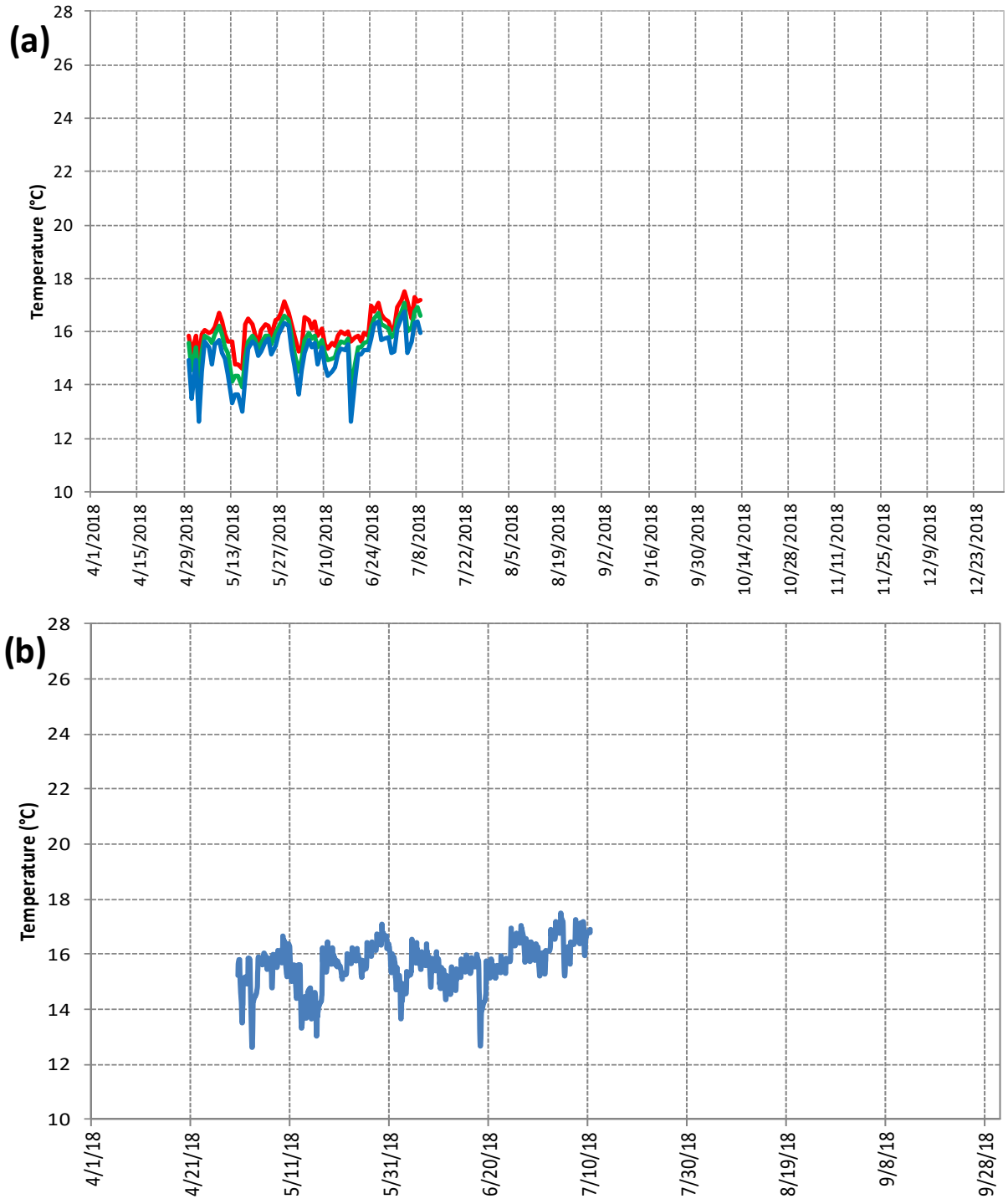


Figure 36: 2018 EJC-3.81 – Directly upstream of the Upper Salsipuedes Creek confluence – bottom (3.5 feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of record; on 7/10/18, the unit was removed because residual pool habitat was not being maintained and the pool was drying out.

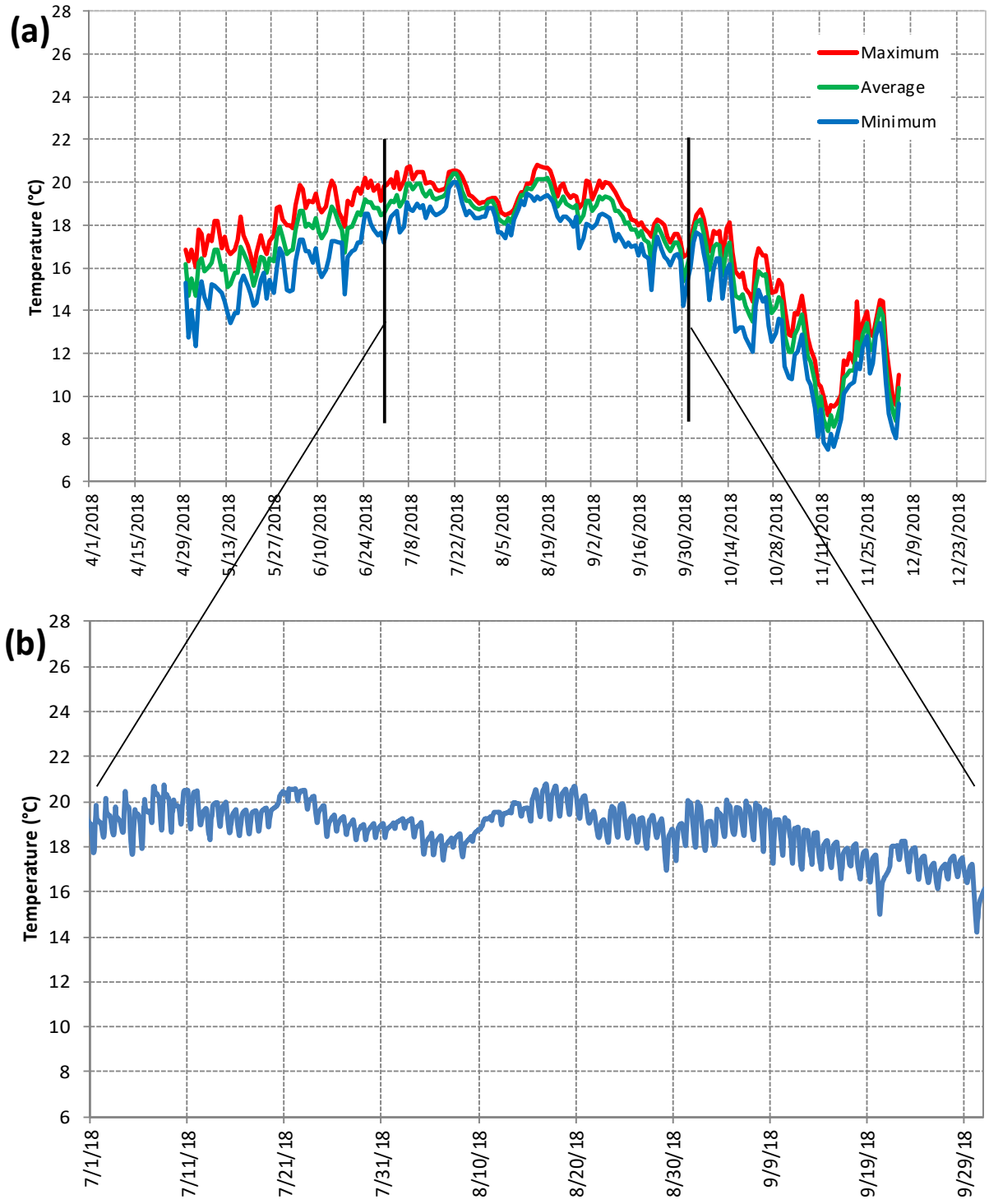


Figure 37: 2018 EJC-5.4 (Palos Colorados Pool Habitat) bottom (3.0-feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/18 - 10/1/18.

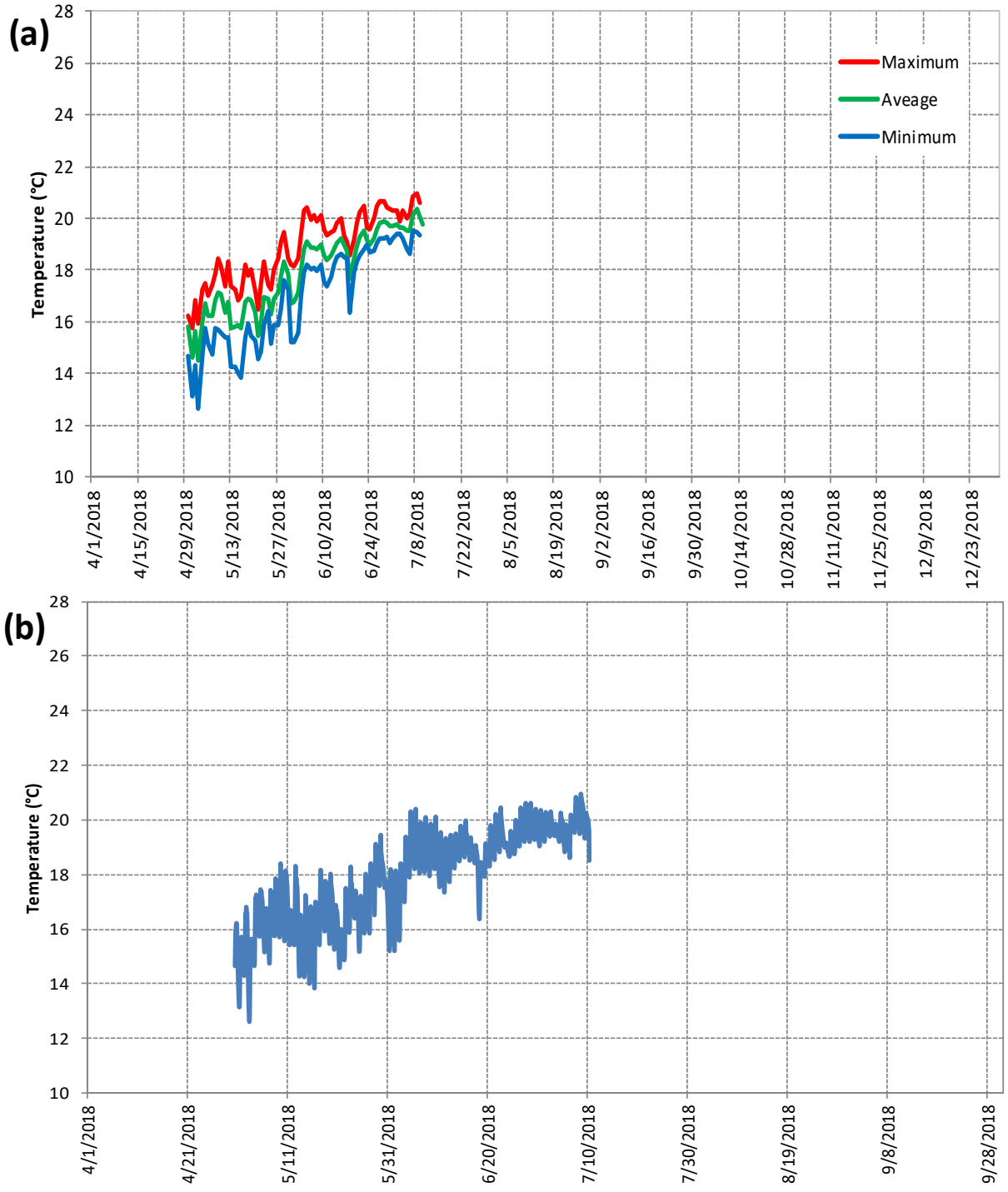


Figure 38: 2018 EJC-10.82 – water temperature at Rancho San Julian Fish Ladder bottom (3.5 feet) for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of deployment.

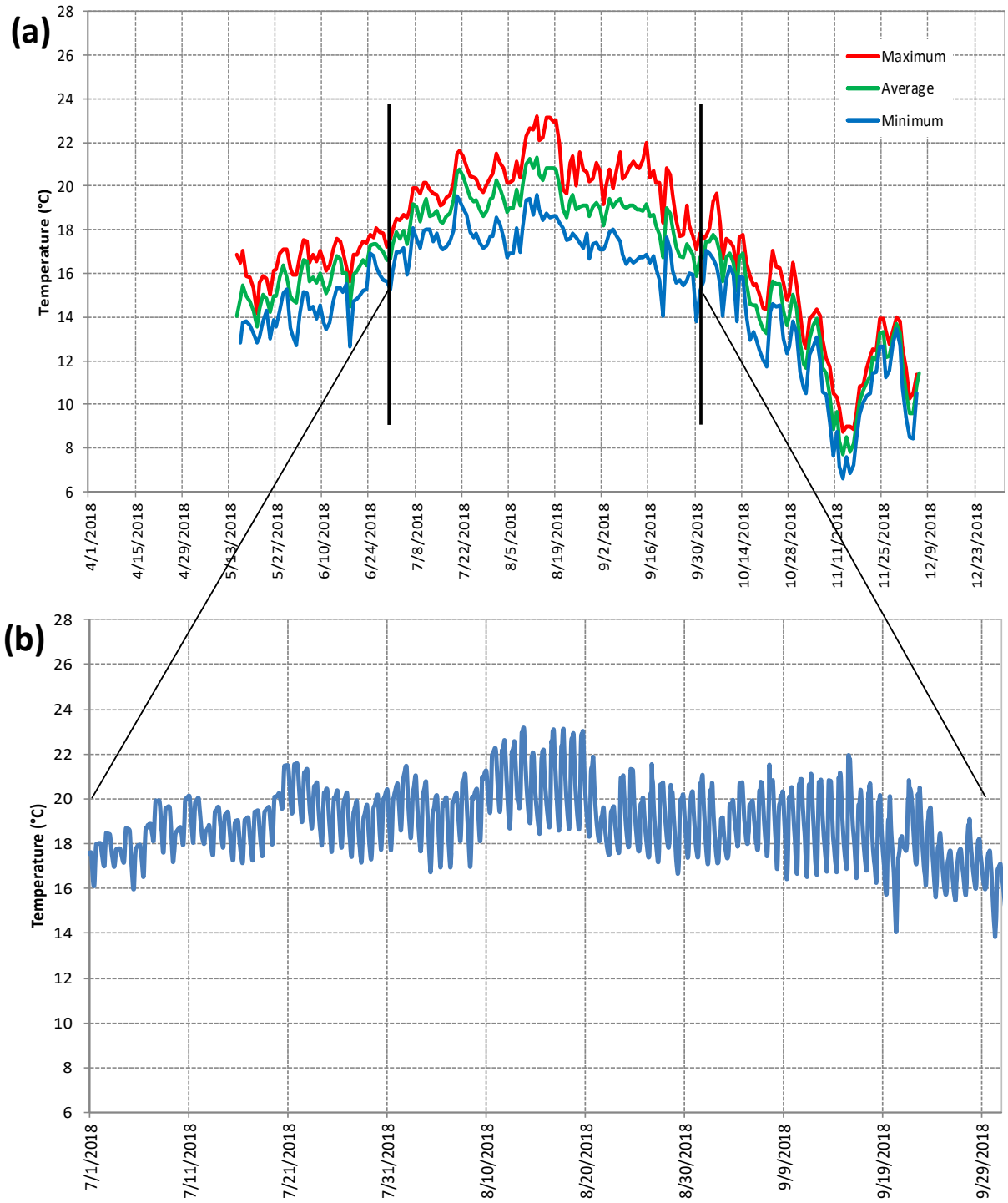


Figure 39: 2018 LAC-7.0 (Los Amoles Creek at Ford Crossing) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/18 - 10/1/18.

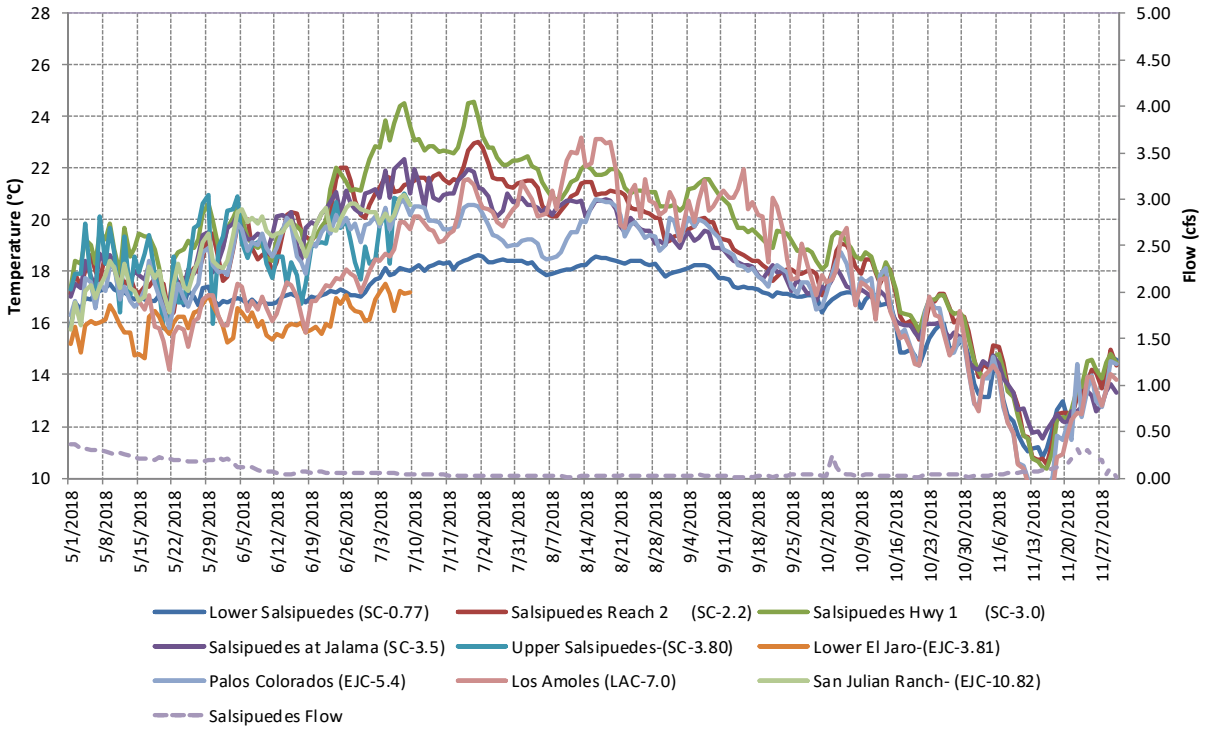


Figure 40: 2018 Longitudinal maximum daily water temperatures within the Salsipuedes Creek watershed which included El Jaro Creek at Rancho San Julian (dry on 7/10) (EJC-10.82), at Palos Colorados (EJC-5.4), at lower El Jaro Creek (dry on 7/10) (EJC-3.81), at upper Salsipuedes Creek (dry on 7/10) (SC-3.8), 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.

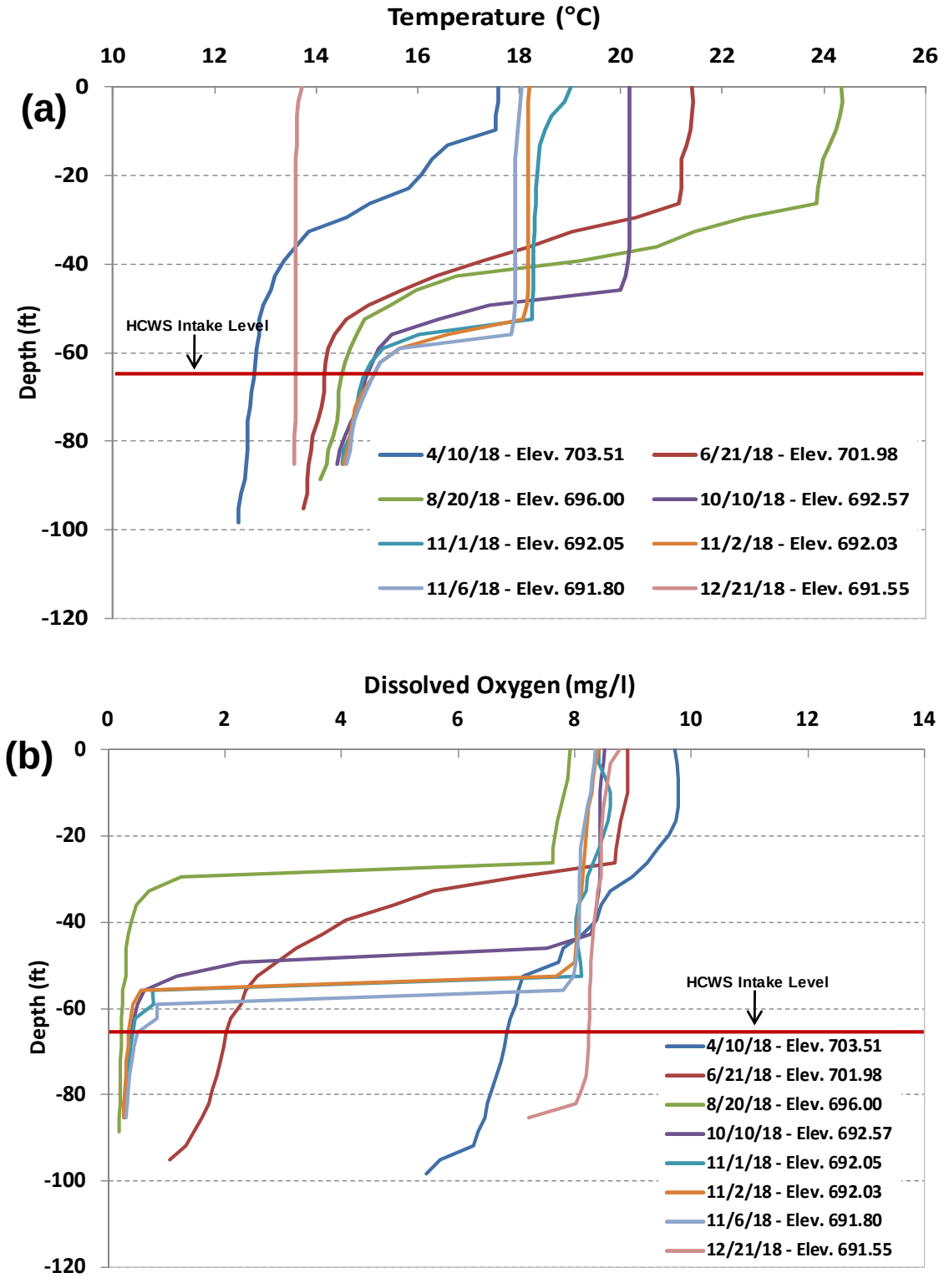


Figure 41: Lake Cachuma 2018 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS; the target depth of HCWS intake hose is 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

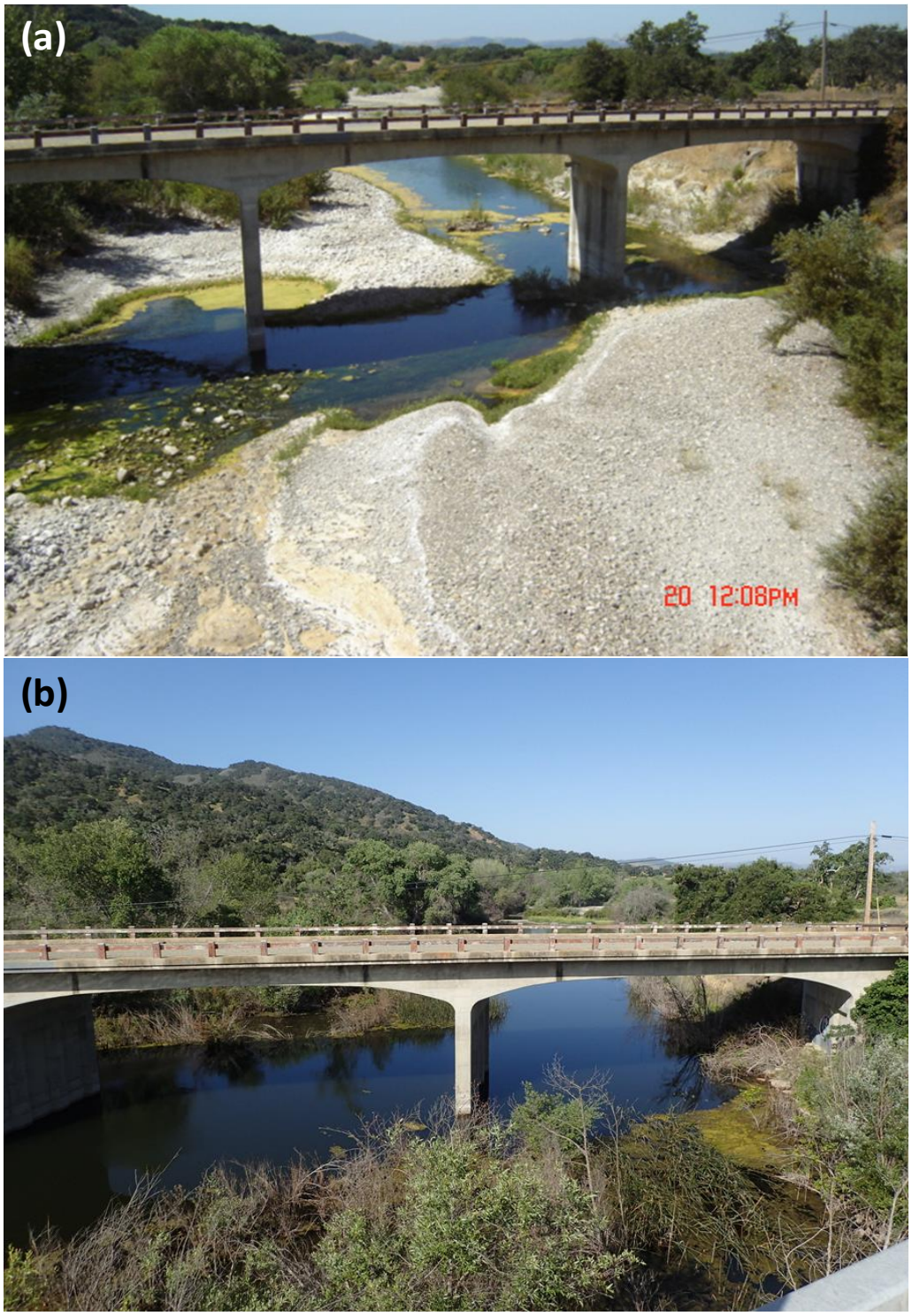


Figure 42: Photo points (M-6) collected at Highway 154 Bridge looking downstream in (a) September 2005 and (b) May 2018.

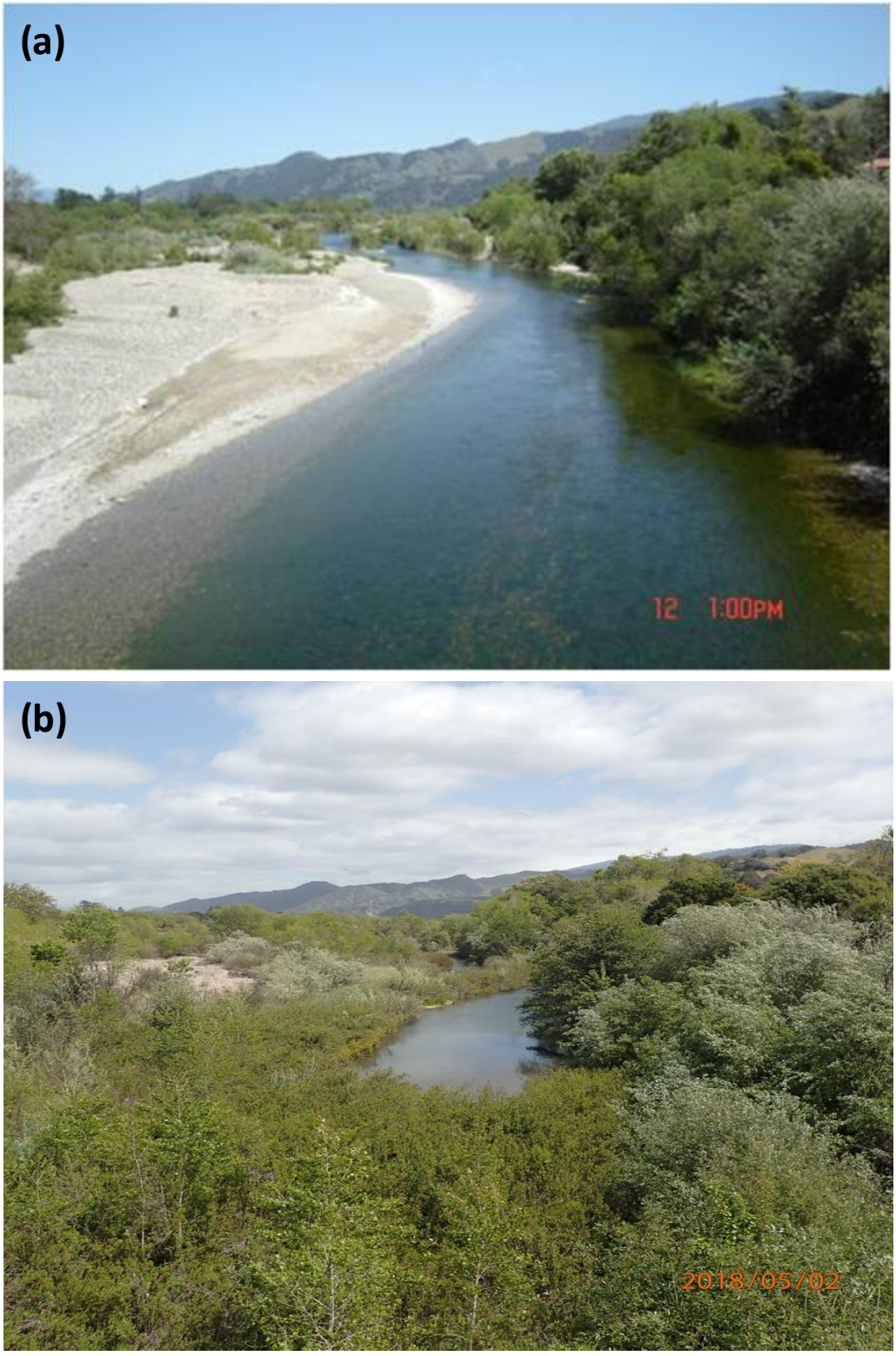


Figure 43: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) May 2018.

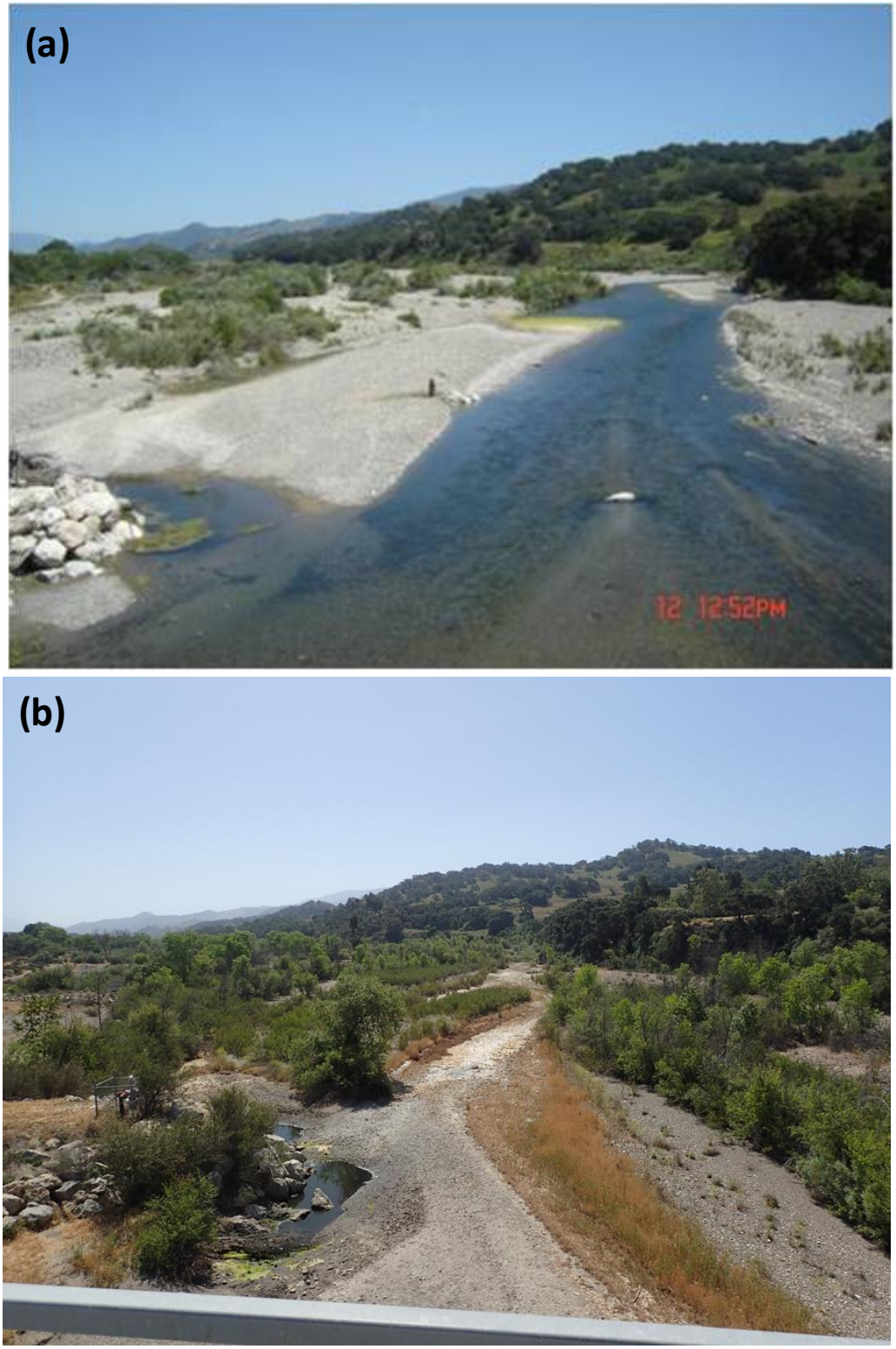


Figure 44: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) May 2018.

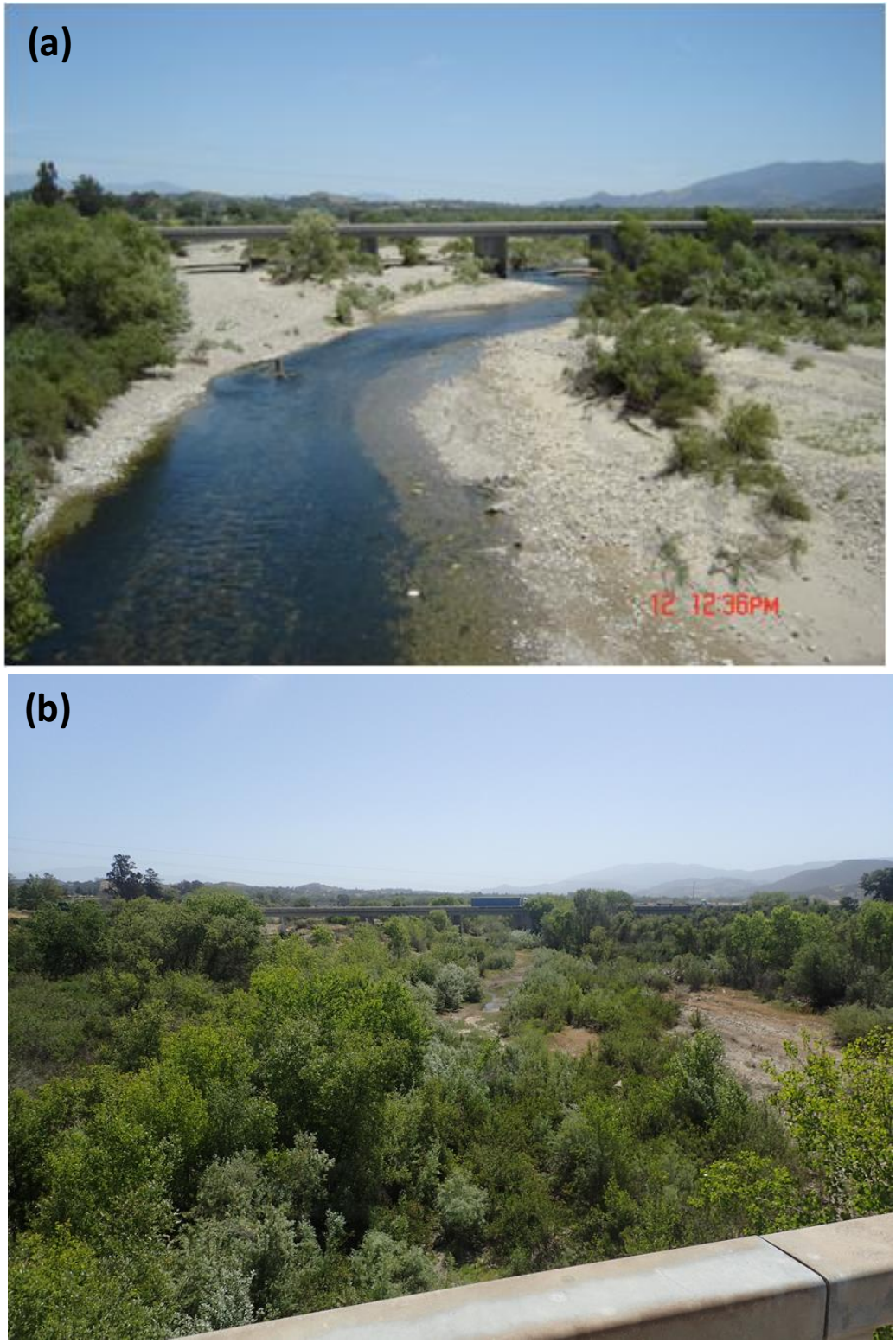


Figure 45: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) May 2018.

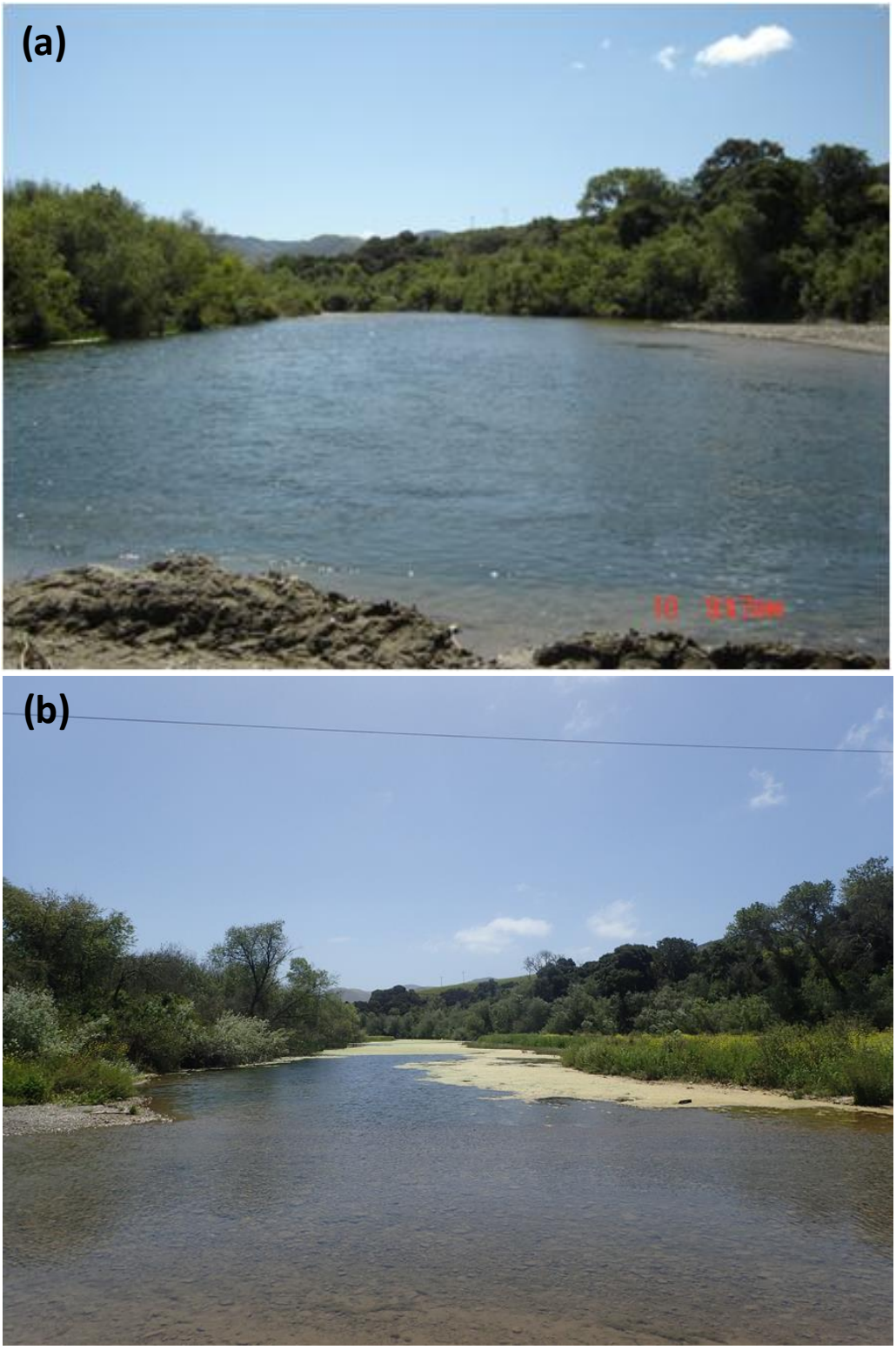


Figure 46: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) May 2018.

Figure 47: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) May 2018.

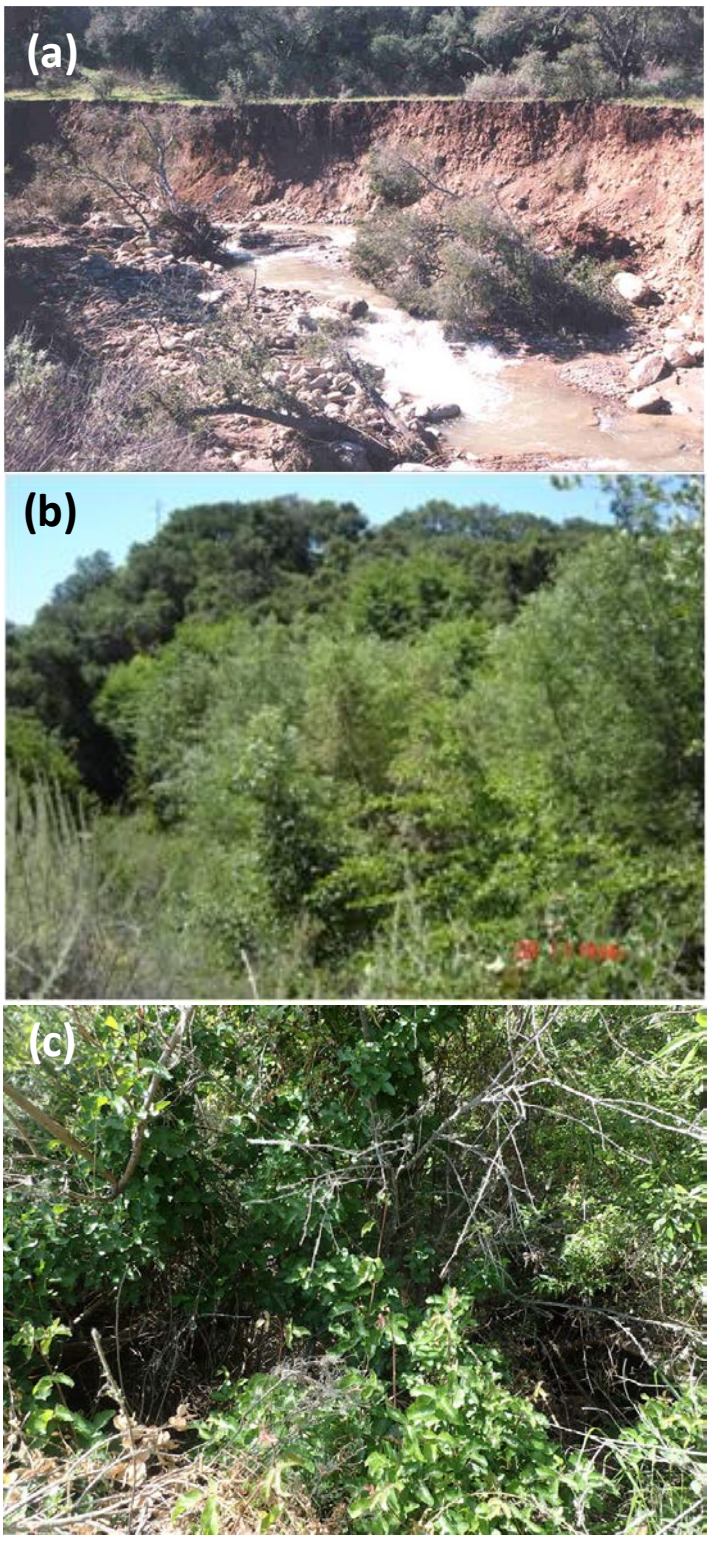


Figure 48: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) May 2018. The creek is nearly invisible now from this vantage point.

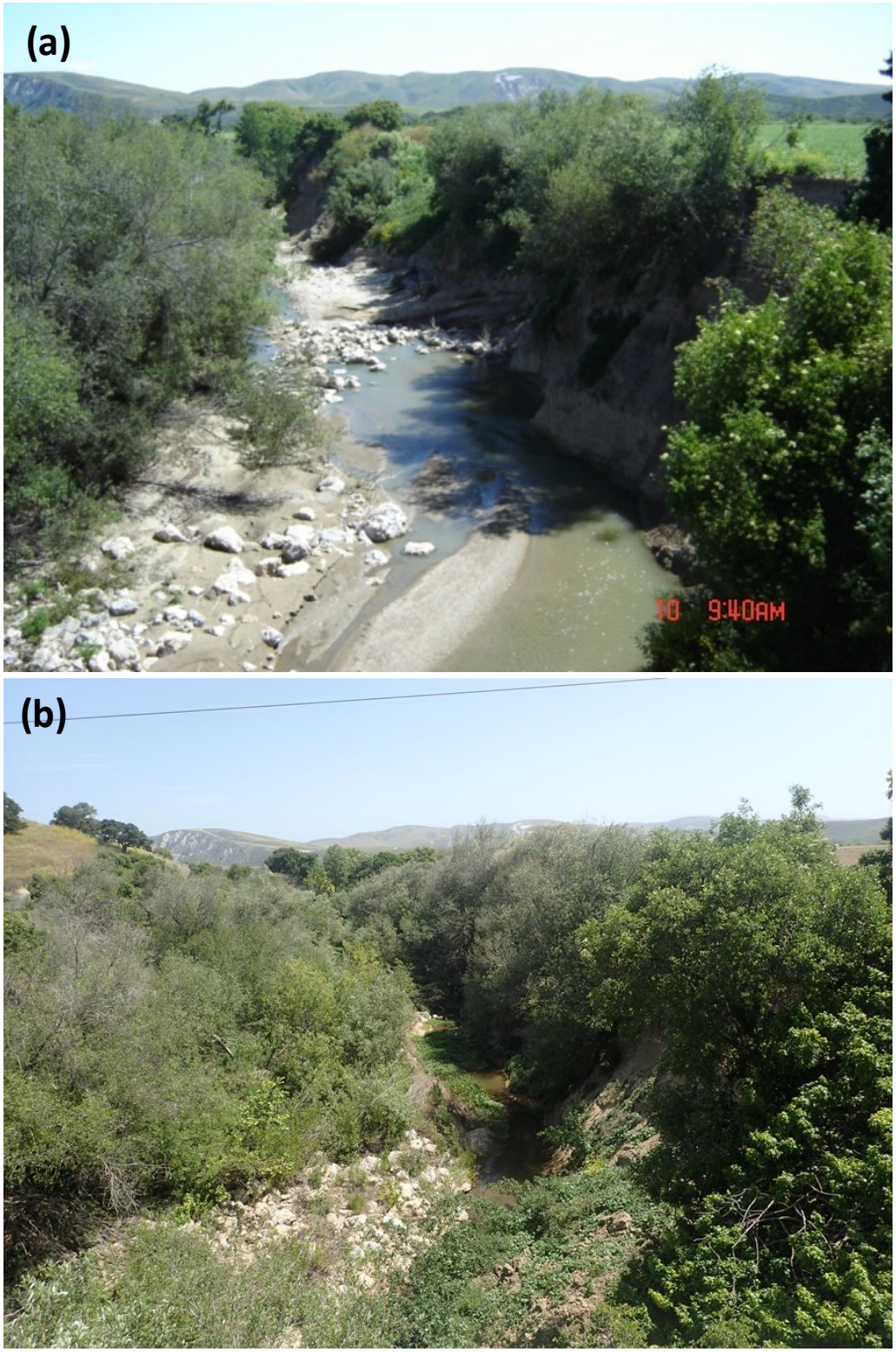


Figure 49: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) May 2018.

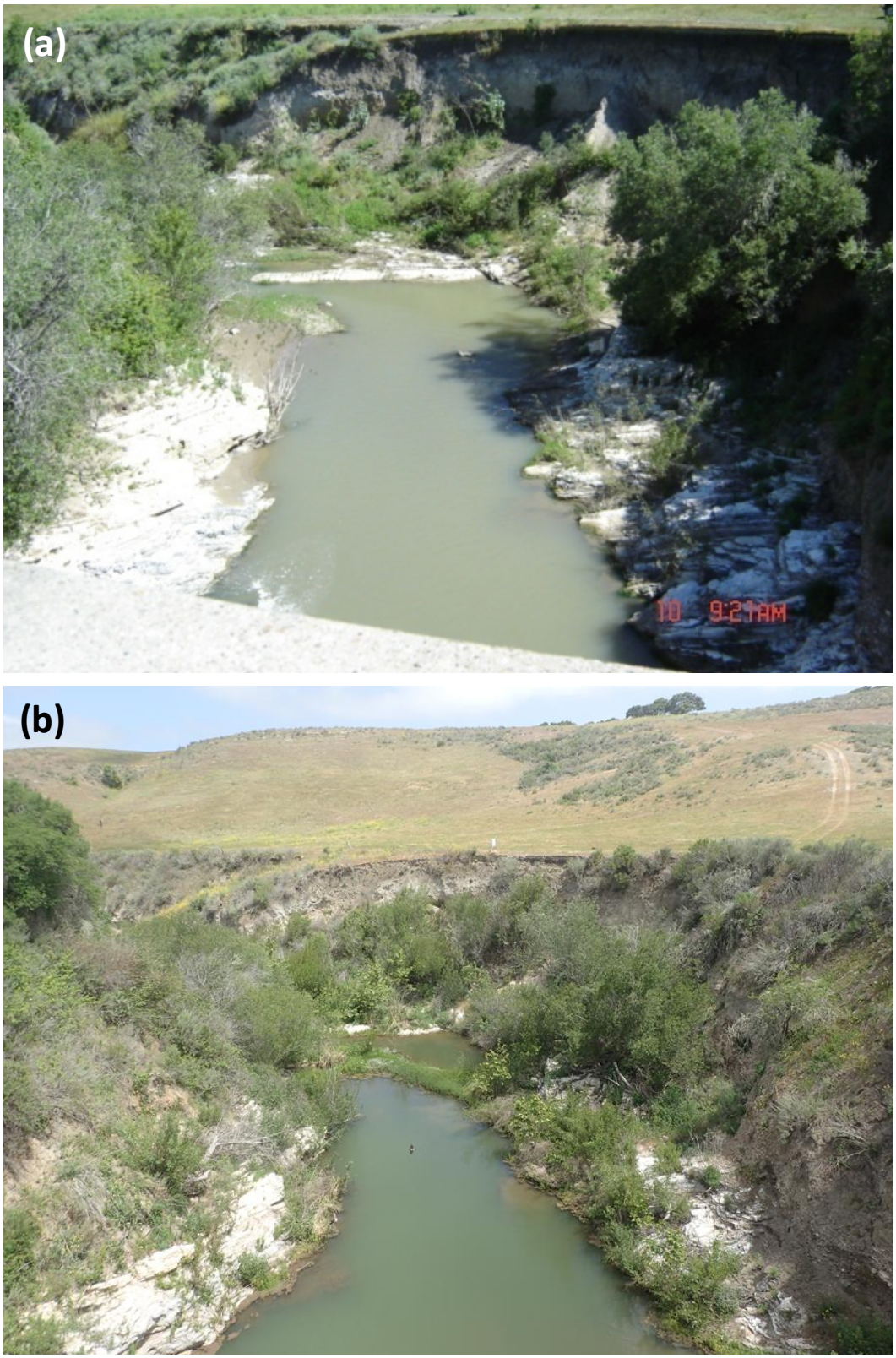


Figure 50: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) May 2018.

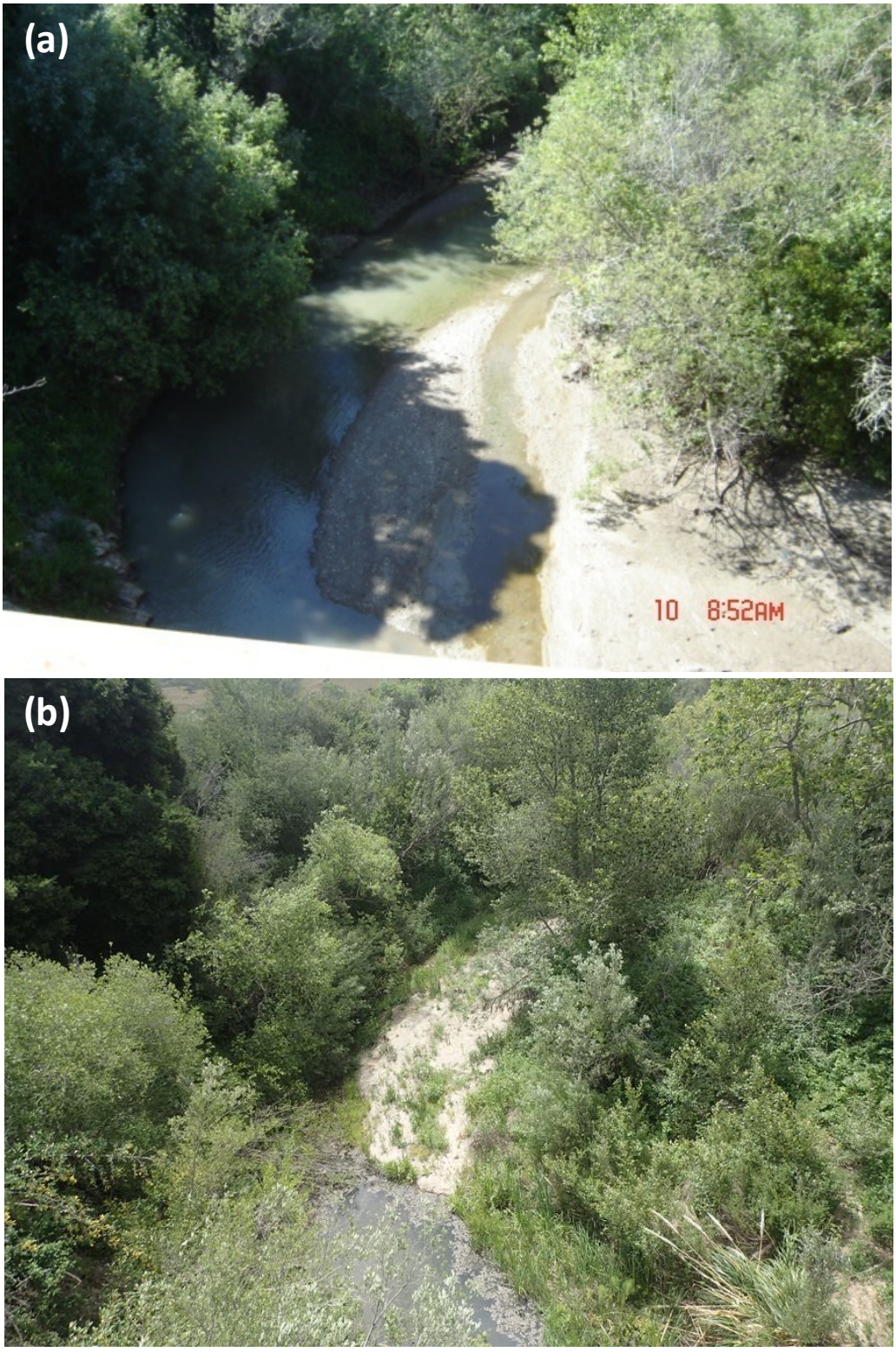


Figure 51: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) May 2018.

3.4 Migrant Trapping

Table 7: WY2018 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	3/5/2018	4/27/2018	3/10/2018	3/12/2018	2		
			3/20/2018	3/23/2018	3		
	Total:	52		**Total:**	5	47	90%
Salsipuedes	3/23/2018	3/30/2018			0		
	Total:	7		**Total:**	0	7	100%
Mainstem	No trapping conducted						
	Total:			**Total:**	0		

Table 8: WY2018 *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	6	18	47	52	90%	0.13	0.38	0.51	6.3	5.9
Salsipuedes	0	3	7	7	100%	0.00	0.43	0.43	2.0	3.4
Mainstem	No Trapping Conducted		~	~	~	~	~	~		

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 WY2018.

Location	Trap	Trap Check				Total
		1st AM (05:00-10:00)	2nd AM (10:01-14:00)	1st PM (18:00-22:00)	2nd PM (22:01-01:59)	
Hilton	Upstream	1	0	2	3	6
	Downstream	1	0	3	14	18
	Total:	2	0	5	17	24
Salsipuedes	Upstream	0	0	0	0	0
	Downstream	0	0	1	2	3
	Total:	0	0	1	2	3

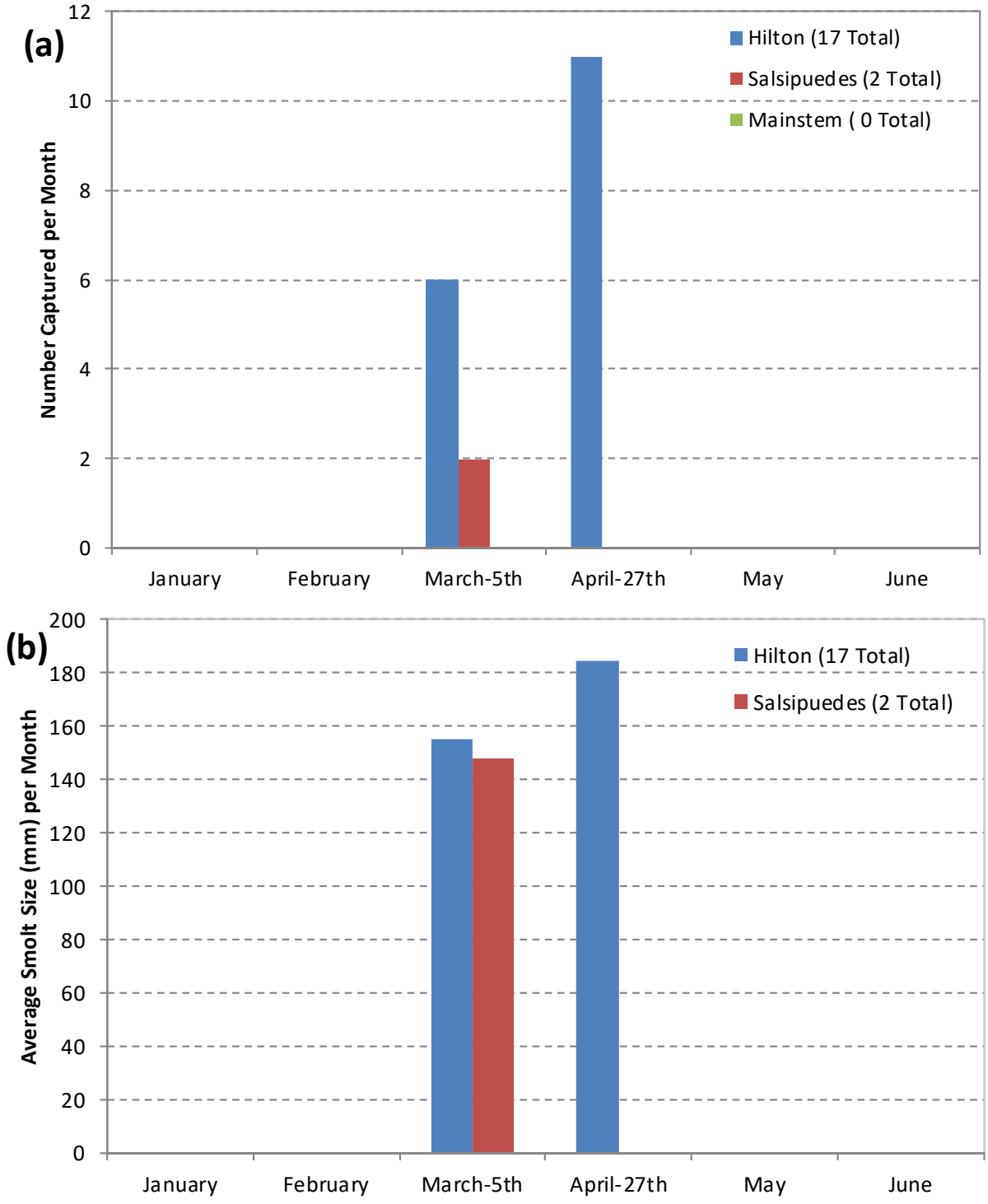


Figure 52: Monthly *O. mykiss* smolt captured at the Hilton Creek and Salsipuedes Creek traps in WY2018 showing: (a) number captured at each site and (b) average size of smolts captured by month. Trapping start and end times are listed on the graph.

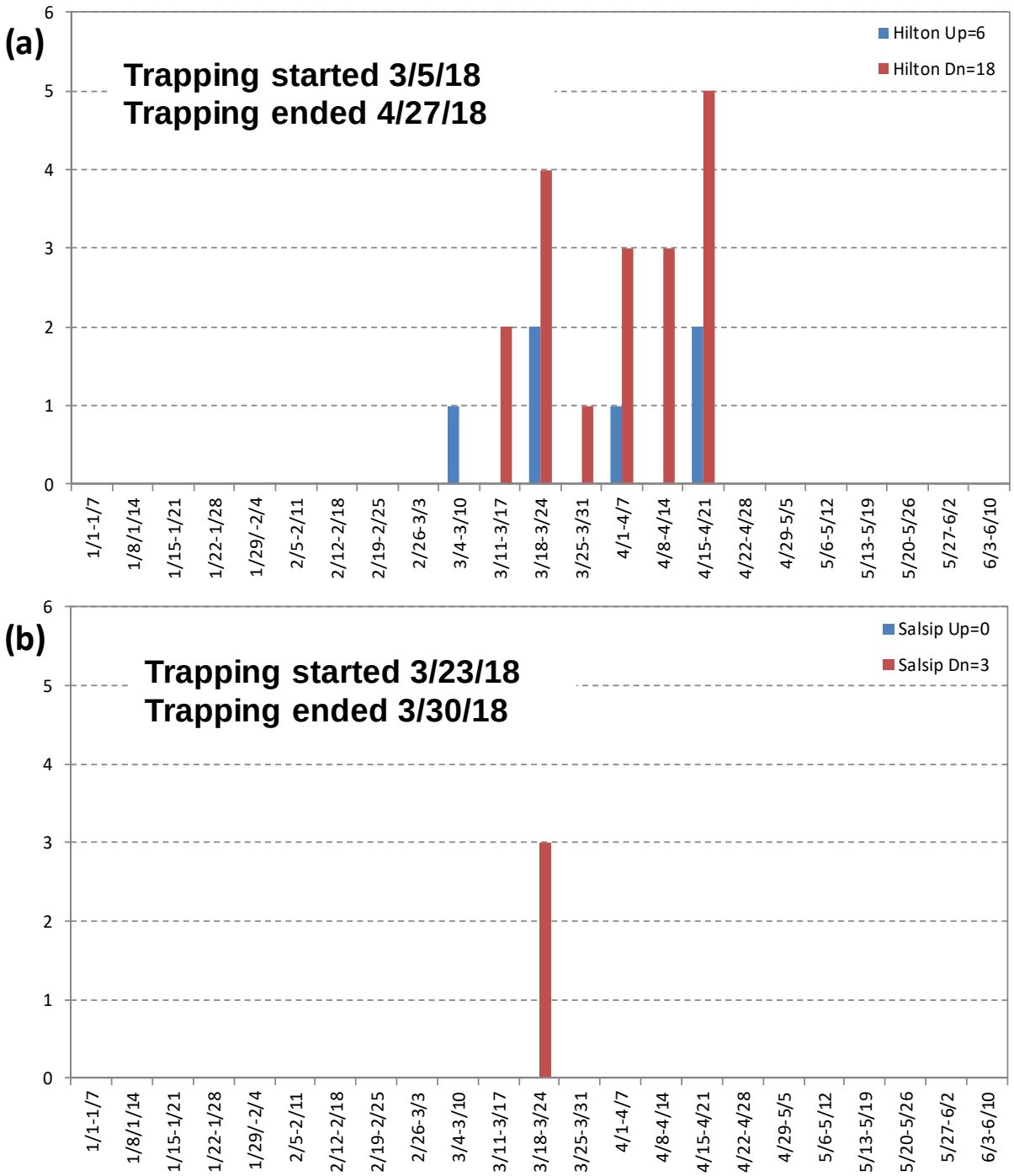


Figure 53: WY2018 paired histogram of weekly upstream and downstream *O. mykiss* captures by trap site for: (a) Hilton Creek and (b) Salsipuedes Creek. The trapping season was shortened due to inadequate flow conditions during the migration season.

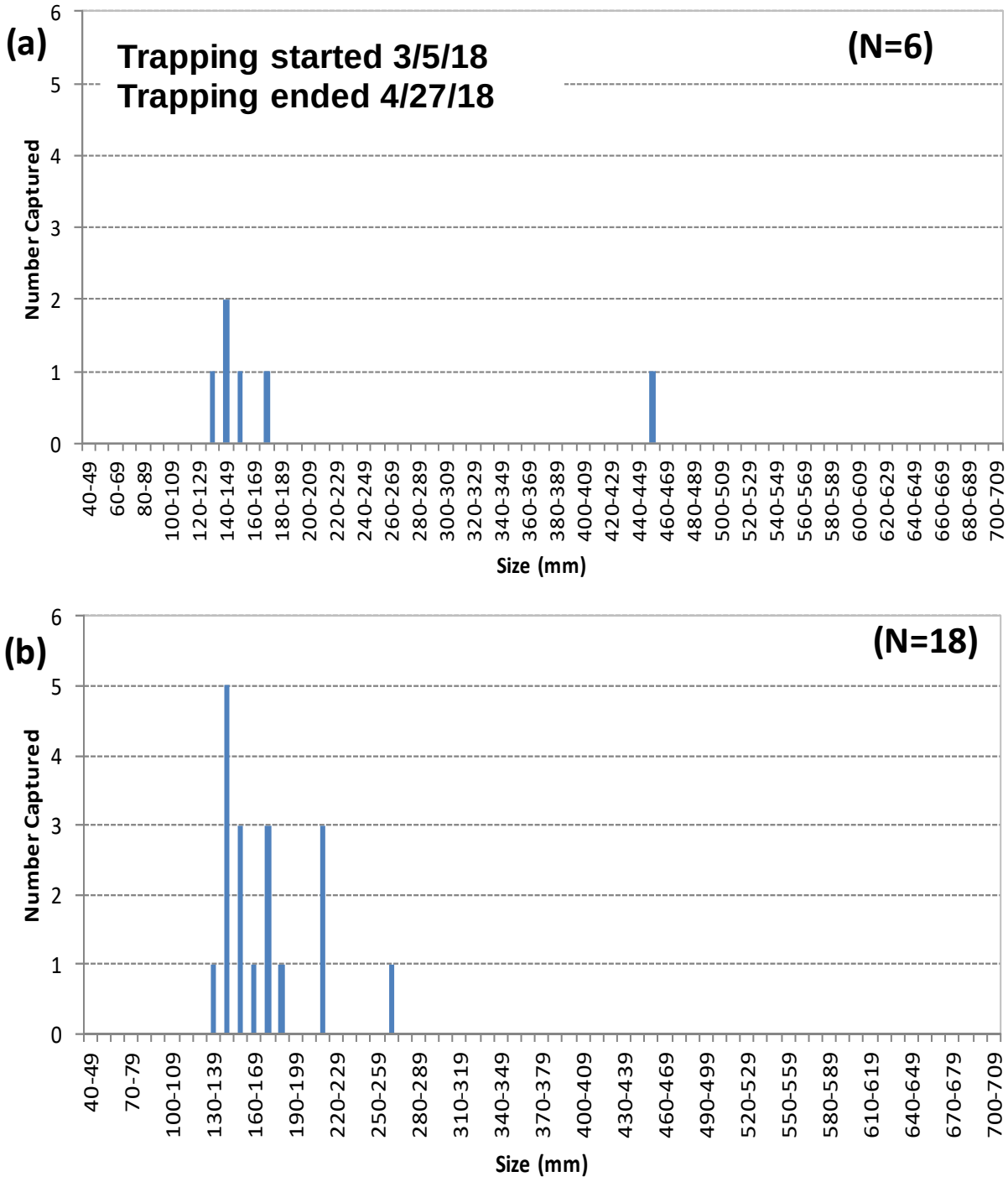


Figure 54: WY2018 Hilton Creek *O. mykiss* trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream migrant captures.

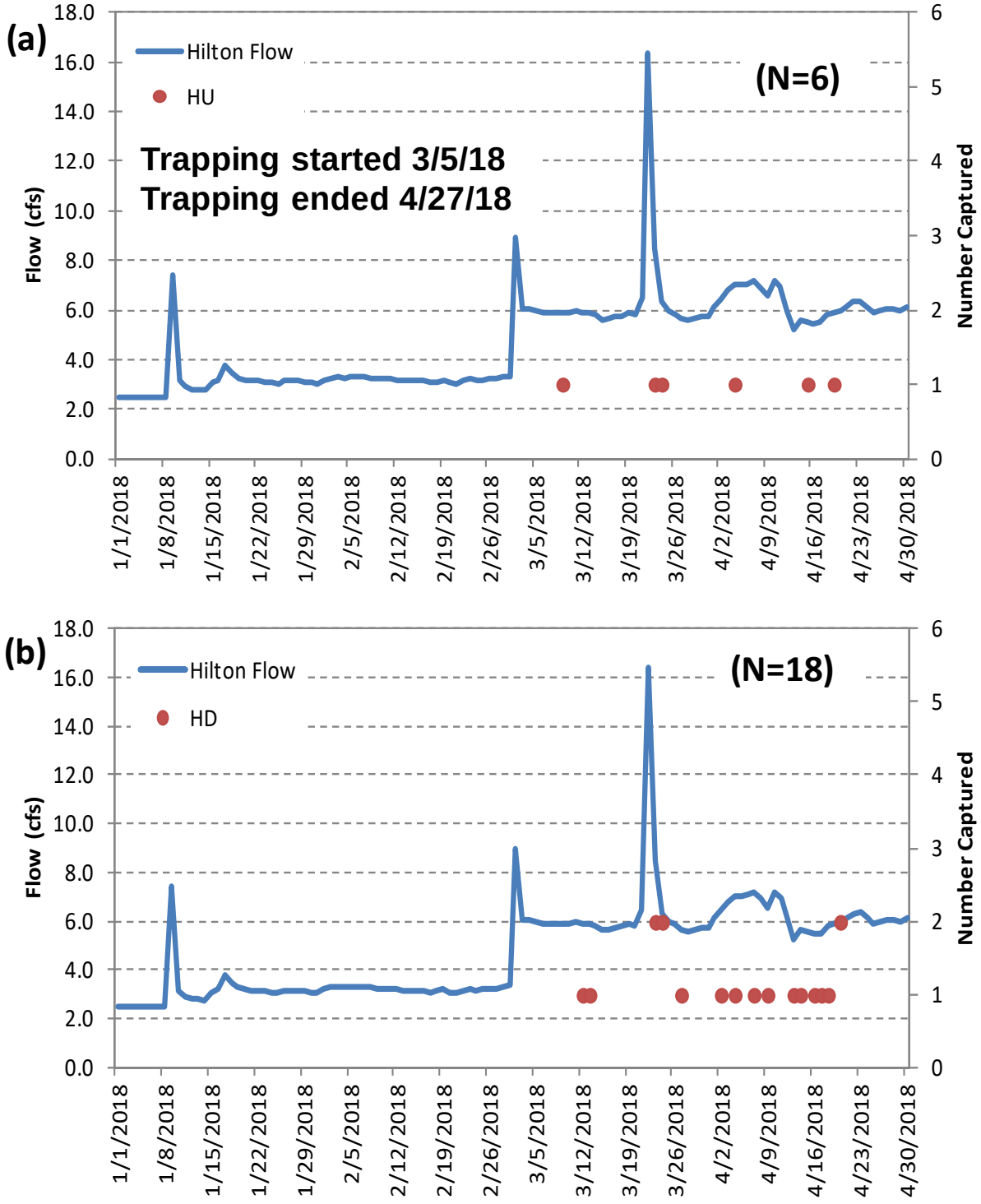


Figure 55: WY2018 Hilton Creek *O. mykiss* migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures.

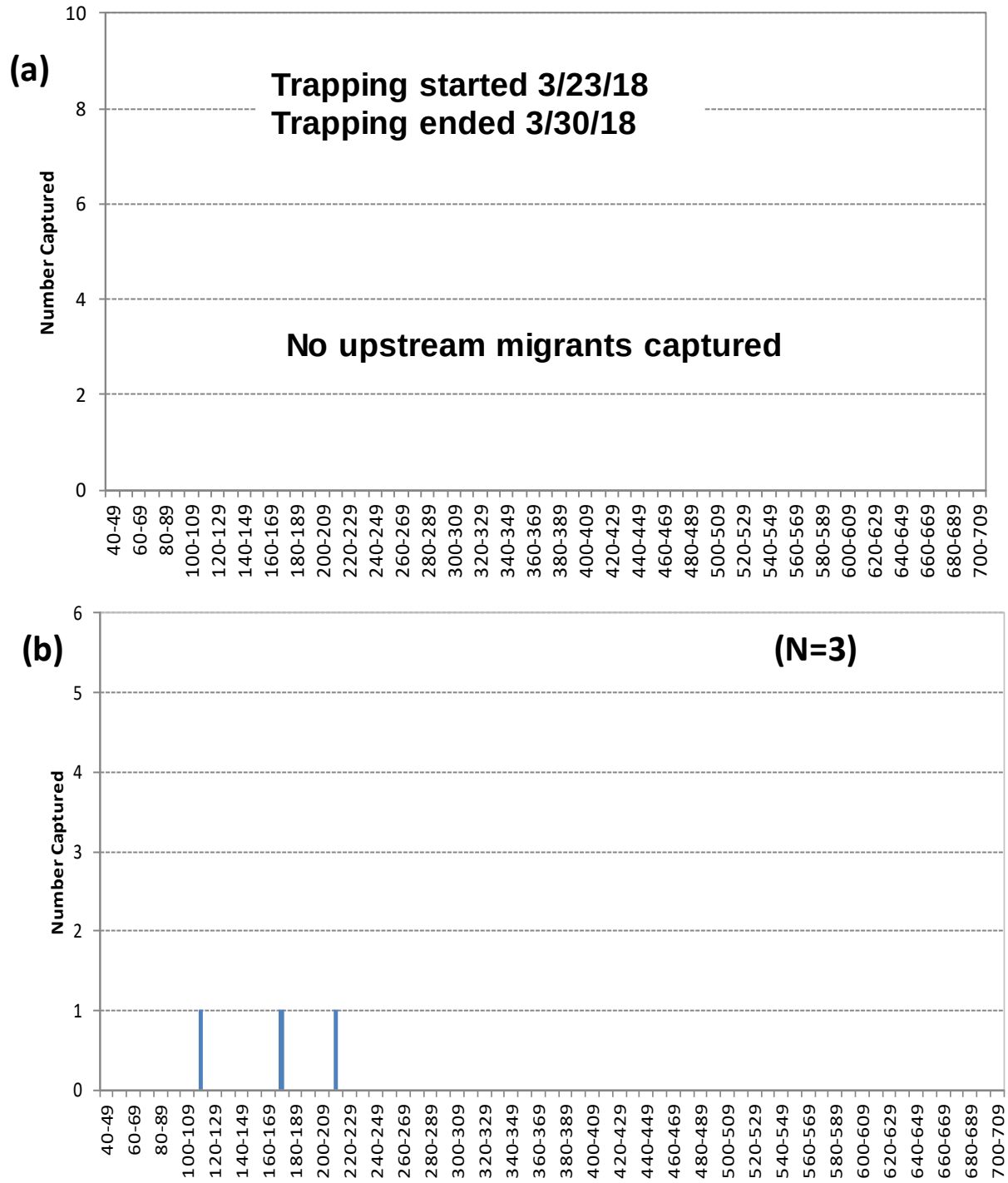


Figure 56: WY2018 Salsipuedes Creek *O. mykiss* trap length frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream captures.

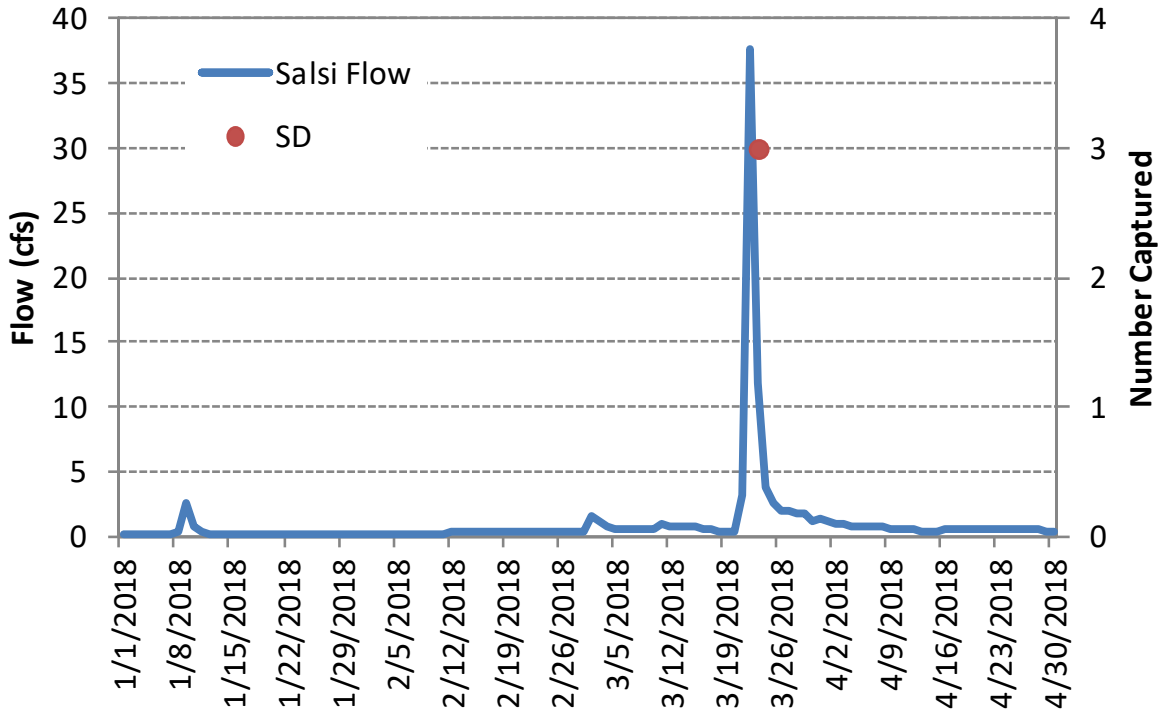


Figure 57: WY2018 Salsipuedes Creek *O. mykiss* migrant captures (red dots) vs. flow for downstream migrants. No upstream migrants were captured during 2018.

Table 10: Tributary upstream and downstream *O. mykiss* migrant captures for Hilton Creek and Salsipuedes Creek in WY2018. 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
0		300-399		0
0		200-299		0
5		100-199		0
0		<99		0
6		**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
0		400-449		0
0		300-399		0
4		200-299		1
	3	***Smolts***	***0***	
	1	***Pre-Smolt***	***0***	
	0	***Res***	***1***	
14		100-199		2
	7	***Smolts***	***0***	
	6	***Pre-Smolt***	***2***	
	1	***Res***	***0***	
0		<99		0
	0	***Smolts***	***0***	
	0	***Pre-Smolt***	***0***	
	0	***Res***	***0***	
18		**Total**		**3**

Table 11: WY2018 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	1/8/2018	1	4.80	1.8
	1/22/2018	2	5.90	1.7
	2/5/2018	3	2.70	1.4
	2/12/2018	4	2.60	1.0
	2/26/2018	5	3.50	1.4
	2/26/2018	6	2.50	1.0
	3/19/2018	7	2.60	1.2
	3/19/2018	8	2.90	1.3
Quiota Creek	3/8/2018	9	2.2	1.1
	3/8/2018	10	2.3	1.0
Salsipuedes Ck	2/12/2018	11	2.90	1.0
	2/27/2018	12	2.80	1.1
	3/8/2018	13	4.10	1.4
	3/12/2018	14	4.10	1.5
*Pit length plus tailspill length.				
**Average of pit width and tailspill widths.				

Table 12: WY2018 tributary *O. mykiss* redd observations by month for each creek surveyed.

	January	February	March	April	May	Total
Hilton Ck	2	4	2	n/s	n/s	8
Quiota Ck	0	0	2	n/s	n/s	2
Salsipuedes Ck	0	2	2	n/s	n/s	4
El Jaro Ck	n/s	0	0	n/s	n/s	0
Los Amoles CK	n/s	0 (dry)	0	n/s	n/s	0
Ytias Ck	n/s	0 (dry)	0 (dry)	n/s	n/s	0
					Total:	**14**
n/s - not surveyed due to turbid conditions or low water level.						

Table 13: WY2018 LSYR mainstem *O. mykiss* redd survey results within the management reaches (Refugio and Alisal reaches) by month.

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

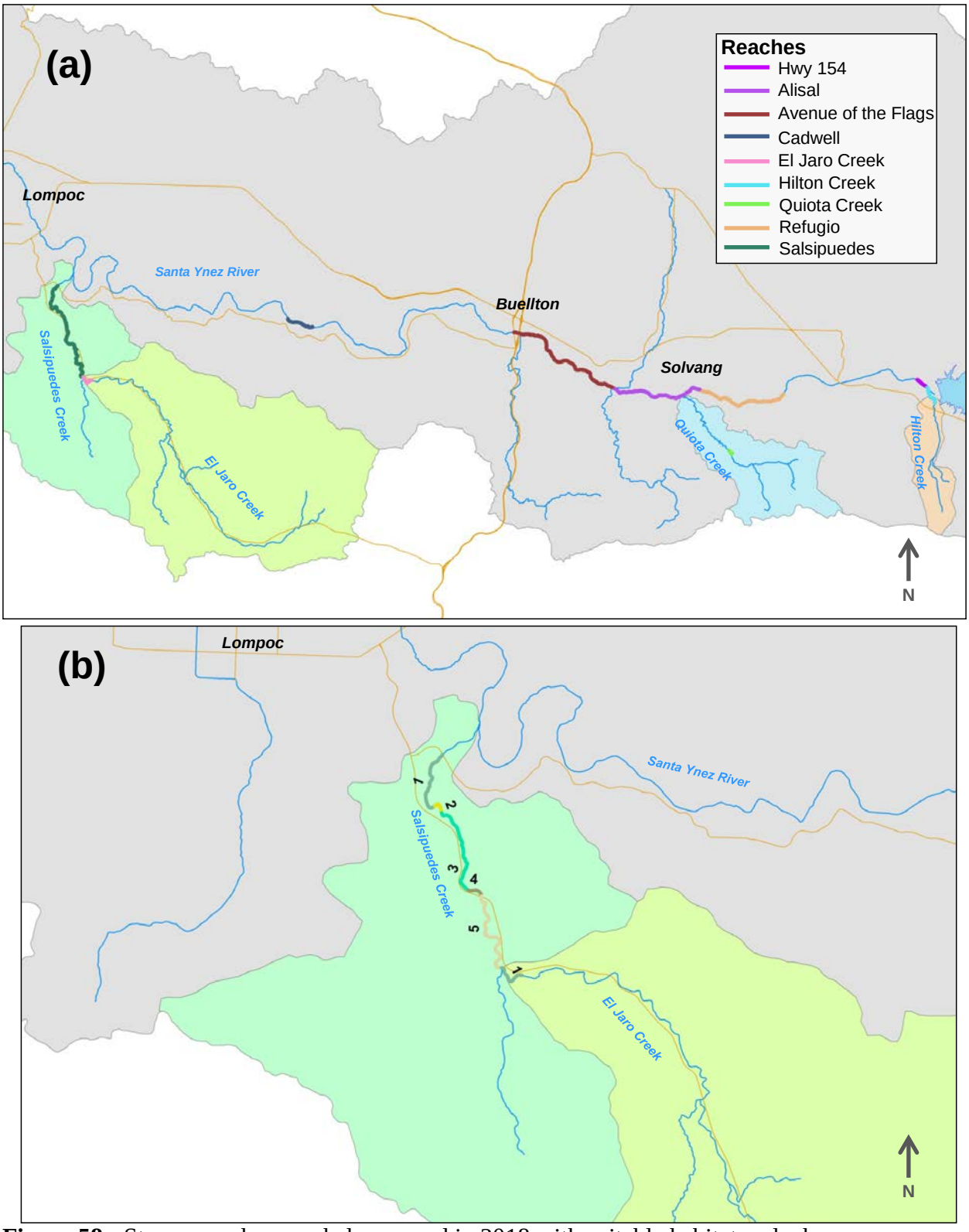


Figure 58: Stream reaches snorkel surveyed in 2018 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

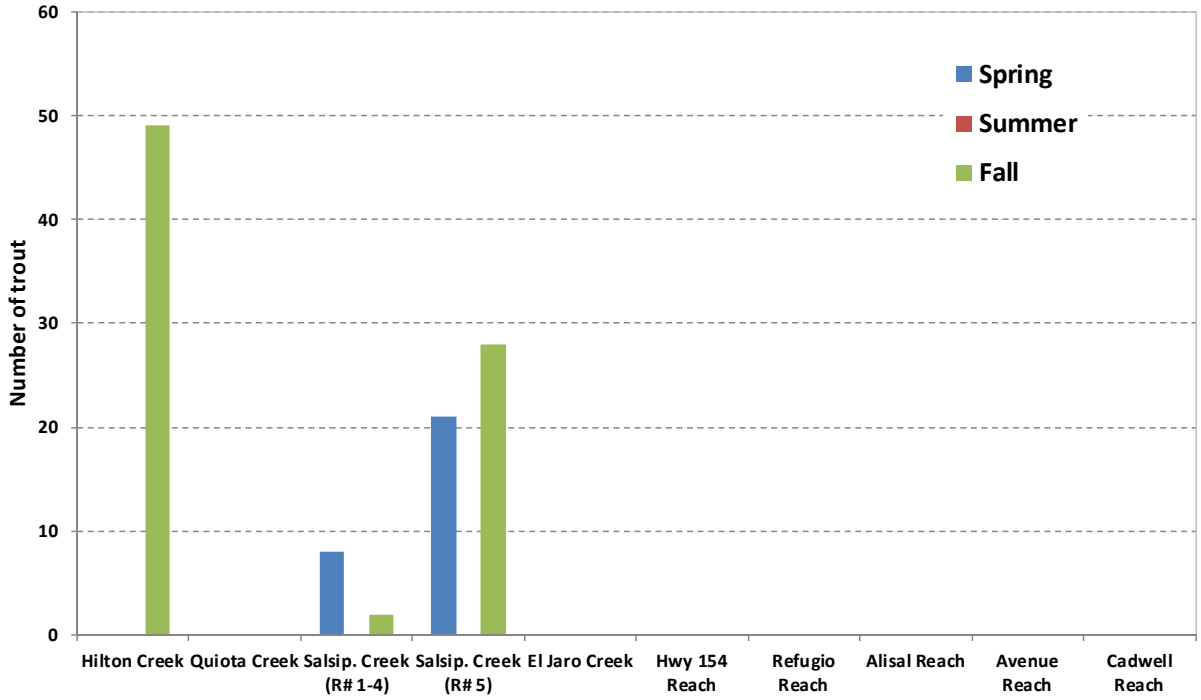


Figure 59: 2018 LSYR *O. mykiss* observed during spring, summer and fall snorkel surveys.

Table 14: 2018 LSYR mainstem snorkel survey schedule.

LSYR Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	n/s
(LSYR-0.2 to LSYR-0.7)	Summer	n/s
	Fall	9/13/2018
Refugio Reach	Spring	6/27/2018
(LSYR-4.9 to LSYR-7.8)	Summer	8/30/18 & 9/5/18
	Fall	9/14/18 & 9/17/18
Alisal Reach	Spring	6/26/2018
(LSYR-7.8 to LSYR-10.5)	Summer	9/5/18 - 9/6/18
	Fall	9/17/18 - 9/18/18
Avenue Reach	Spring	8/8/2018
(LSYR-10.5 to LSYR-13.9)	Summer	9/6/18 - 9/7/18
	Fall	9/18/18 - 9/19/18
Reach 3 Downstream of Avenue	Spring	5/16/18 (narrows)
(LSYR-13.9 to LSYR-25.0)	Summer	9/10/2018
	Fall	9/20/2018
n/s - not surveyed due to turbid conditions or low water level.		

Table 15: LSYR mainstem spring, summer, and fall snorkel survey results in 2018 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	n/s	n/s	0	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
n/s - not surveyed due to turbid conditions or low water level.				

Table 16: LSYR mainstem spring, summer, and fall snorkel survey results in 2018 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										0
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0
Summer	Hwy 154										n/s
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0
Fall	Hwy 154										0
	Refugio										0
	Alisal										0
	Avenue										0
	Cadwell										0
n/s - not surveyed due to turbid conditions or low water level.											

Table 17: 2018 tributary snorkel survey schedule.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	n/s
(HC-0.0 to HC-0.54)	Summer	n/s
	Fall	10/1/2018
Quiota Creek	Spring	6/27/2018
(QC-2.58 to QC-2.73)	Summer	n/s
	Fall	n/s
Salsipuedes Creek	Spring	5/29/18 & 5/31/18
(Reach 1-4)	Summer	n/s
	Fall	10/16/18 & 10/18/18
Salsipuedes Creek	Spring	5/29/18 & 5/30/18
(Reach 5)	Summer	n/s
	Fall	10/18/2018
El Jaro Creek	Spring	5/30/2018
(ELC-0.0 to ELC-0.4)	Summer	n/s
	Fall	10/18/2018
n/s - not surveyed due to turbid conditions or low water level.		

Table 18: *O. mykiss* observed and miles surveyed during all tributary snorkel surveys in 2018; 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	n/s	n/s	16	0.133
Reach 2	n/s	n/s	12	0.050
Reach 3	n/s	n/s	5	0.040
Reach 4	n/s	n/s	16	0.075
Reach 5	n/s	n/s	0	0.242
Reach 6	n/s	n/s	n/s	0.014
Total:	***n/s***	***n/s***	***49***	***0.554***
Quiota Creek	0	n/s	n/s	0.11
Salsipuedes Creek (Reach 1-4)	8	n/s	2	2.85
Salsipuedes Creek (Reach 5)	21	n/s	28	0.45
El Jaro Creek	0	n/s	0	0.35
n/s - not surveyed due to turbid conditions or low water level.				

Table 19: 2018 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										n/s
	Quiota										0
	Salsipuedes (R 1-4)	3		4		1					8
	Salsipuedes (R-5)	17			3	1					21
	El Jaro										0
Summer	Hilton										n/s
	Quiota										0
	Salsipuedes (R 1-4)										n/s
	Salsipuedes (R-5)										n/s
	El Jaro										n/s
Fall	Hilton		23	18	5	2	1				49
	Quiota										0
	Salsipuedes (R 1-4)					1	1				2
	Salsipuedes (R-5)		21	3	2	1	1				28
	El Jaro										0
n/s - not surveyed due to turbid conditions or low water level.											

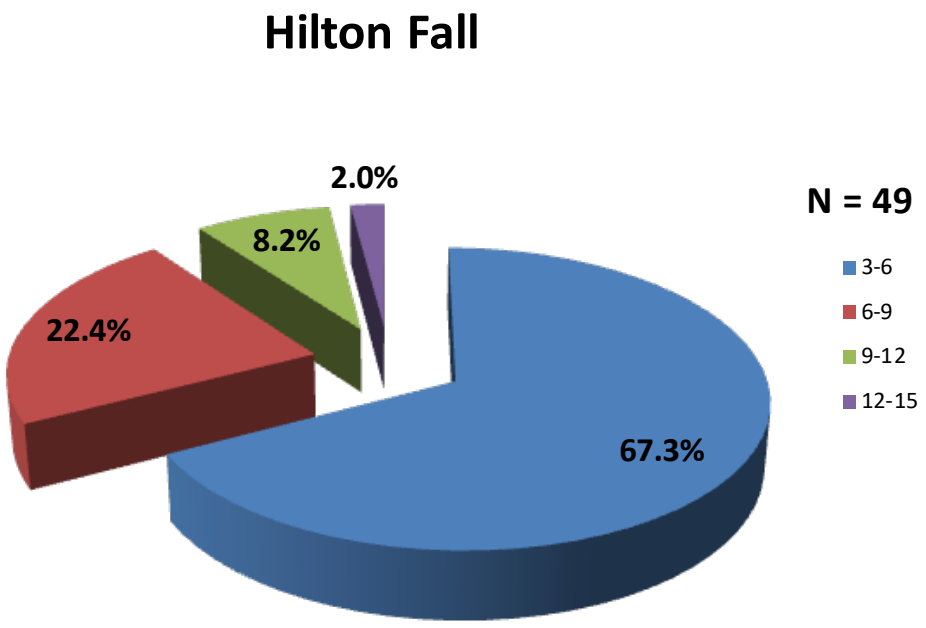


Figure 60: 2018 Hilton Creek snorkel survey results of *O. mykiss* proportioned by size class in inches.

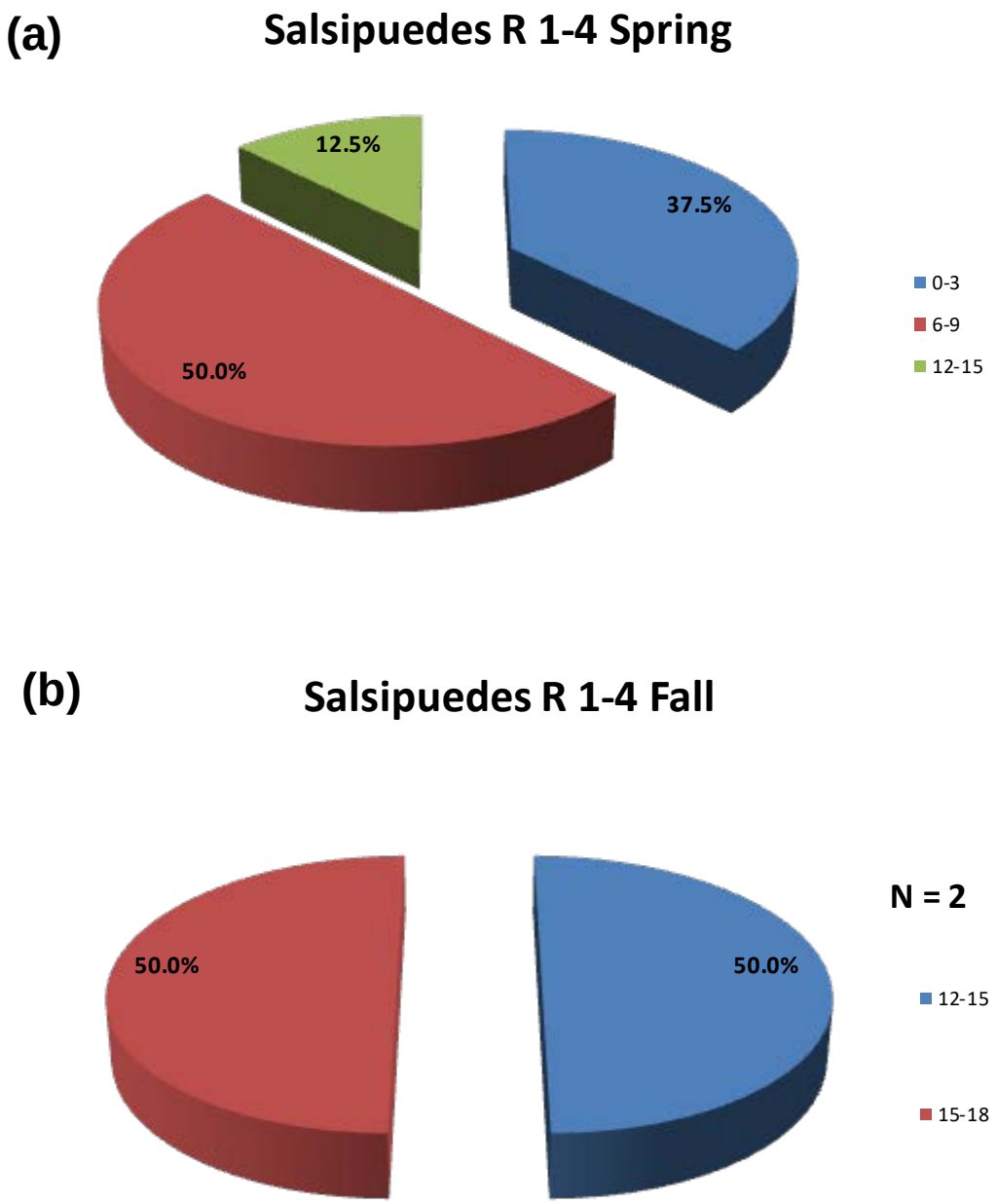


Figure 61: 2018 Salsipuedes Creek Reaches 1-4 snorkel survey results of *O. mykiss* proportioned by size class in inches.

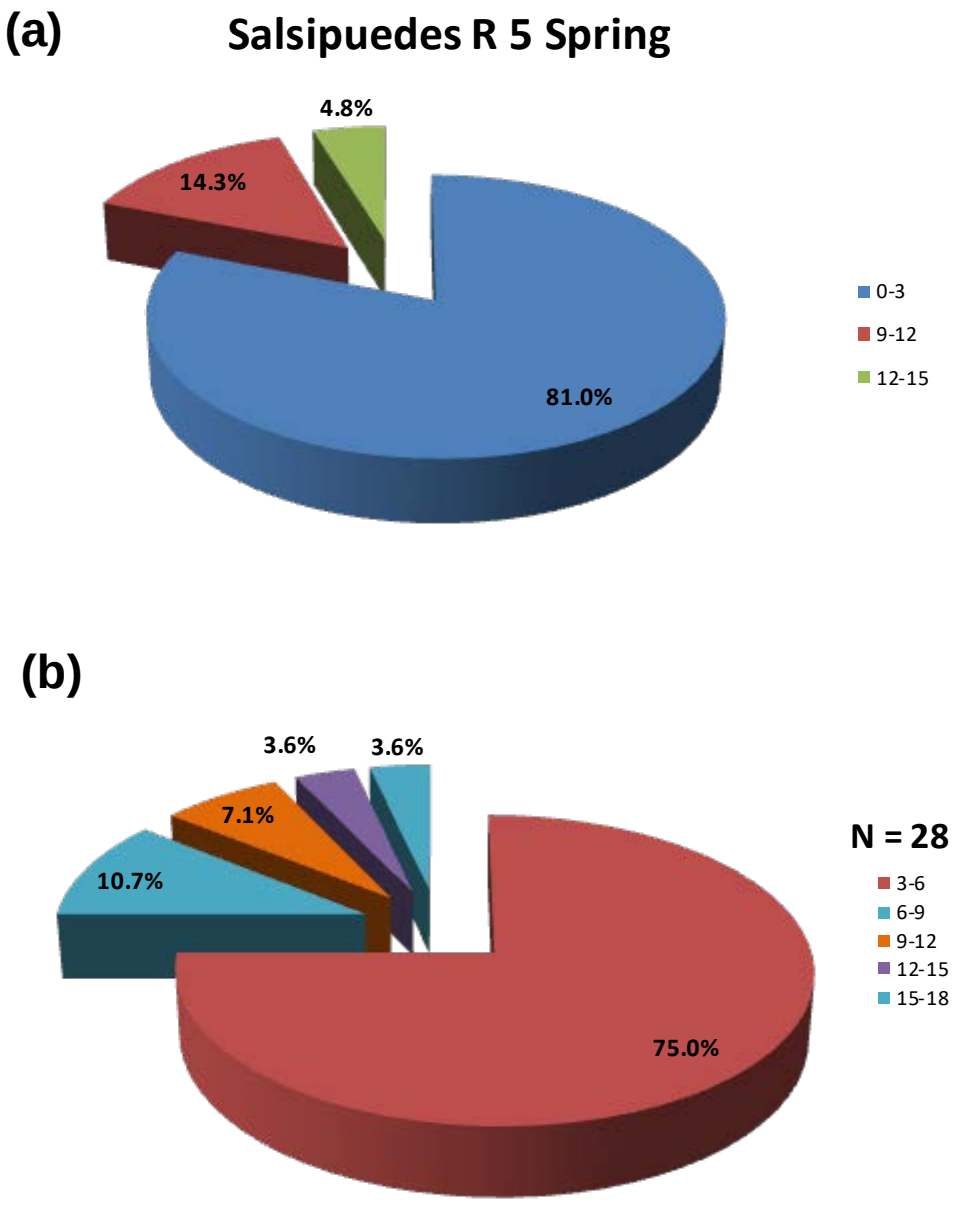


Figure 62: 2018 Salsipuedes Creek Reach 5 snorkel survey results of *O. mykiss* proportioned by size class in inches.

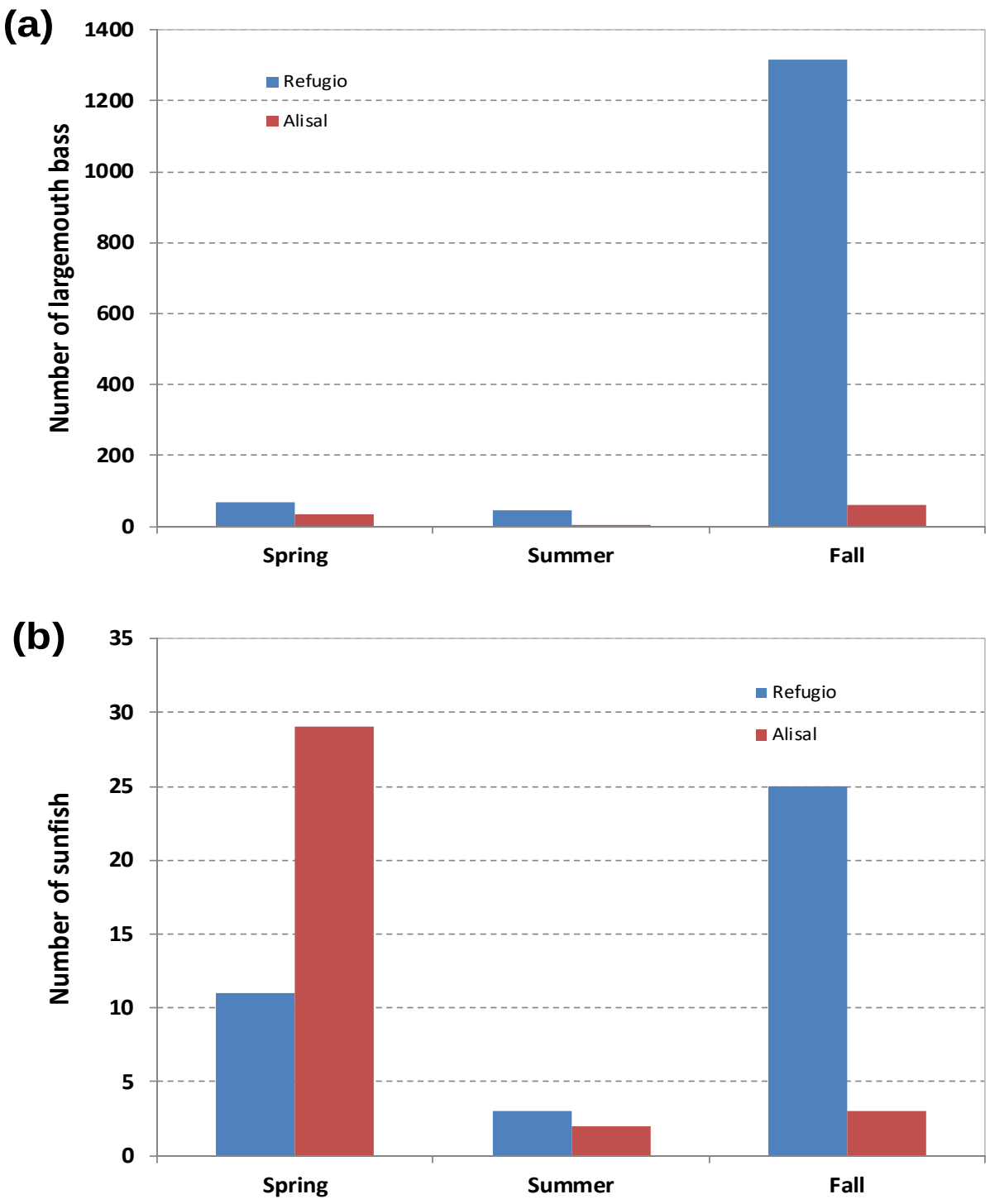


Figure 63: Observed warm water predators during the spring, summer, and fall snorkel surveys in 2018 within the Refugio and Alisal reaches: (a) largemouth bass and (b) sunfish.

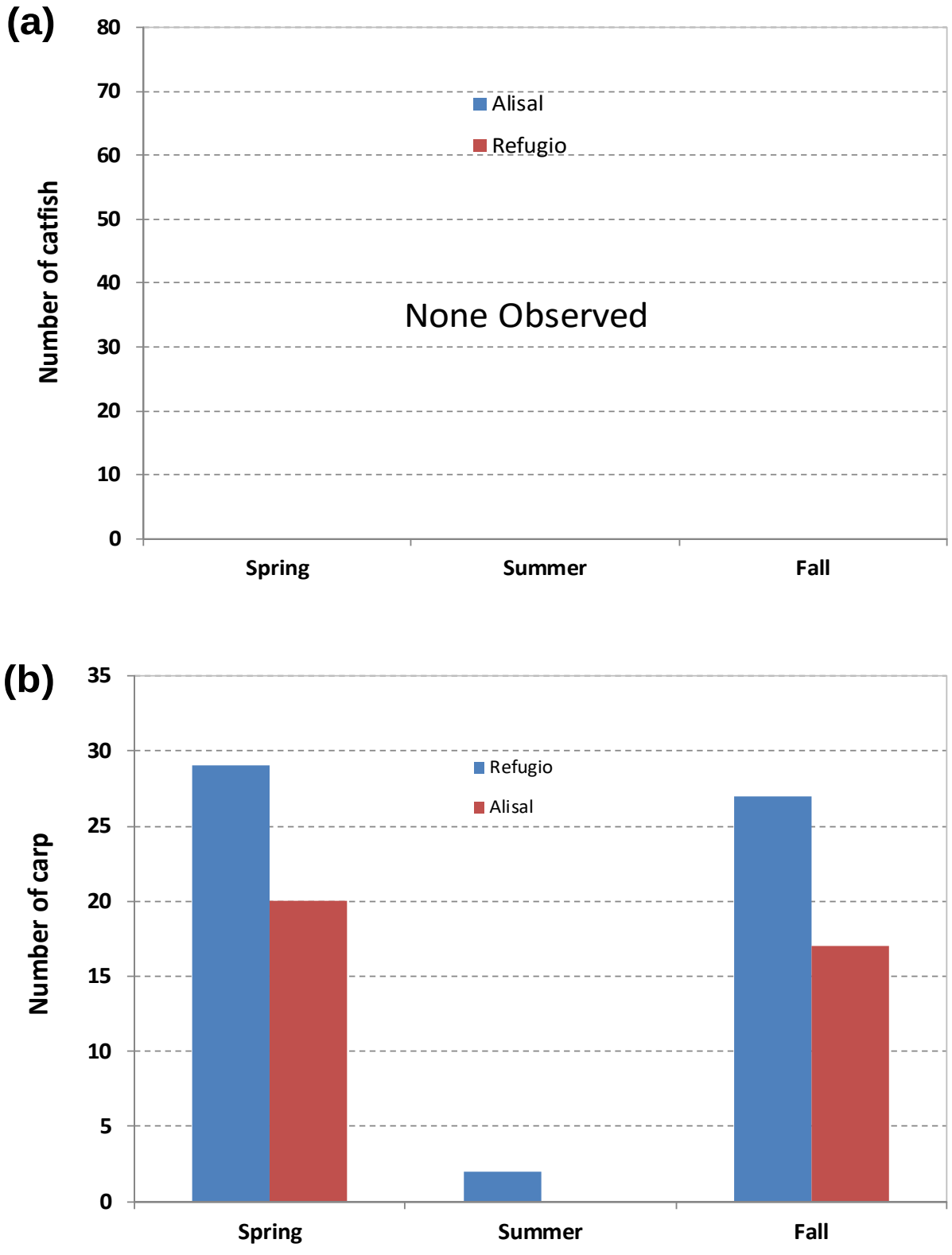
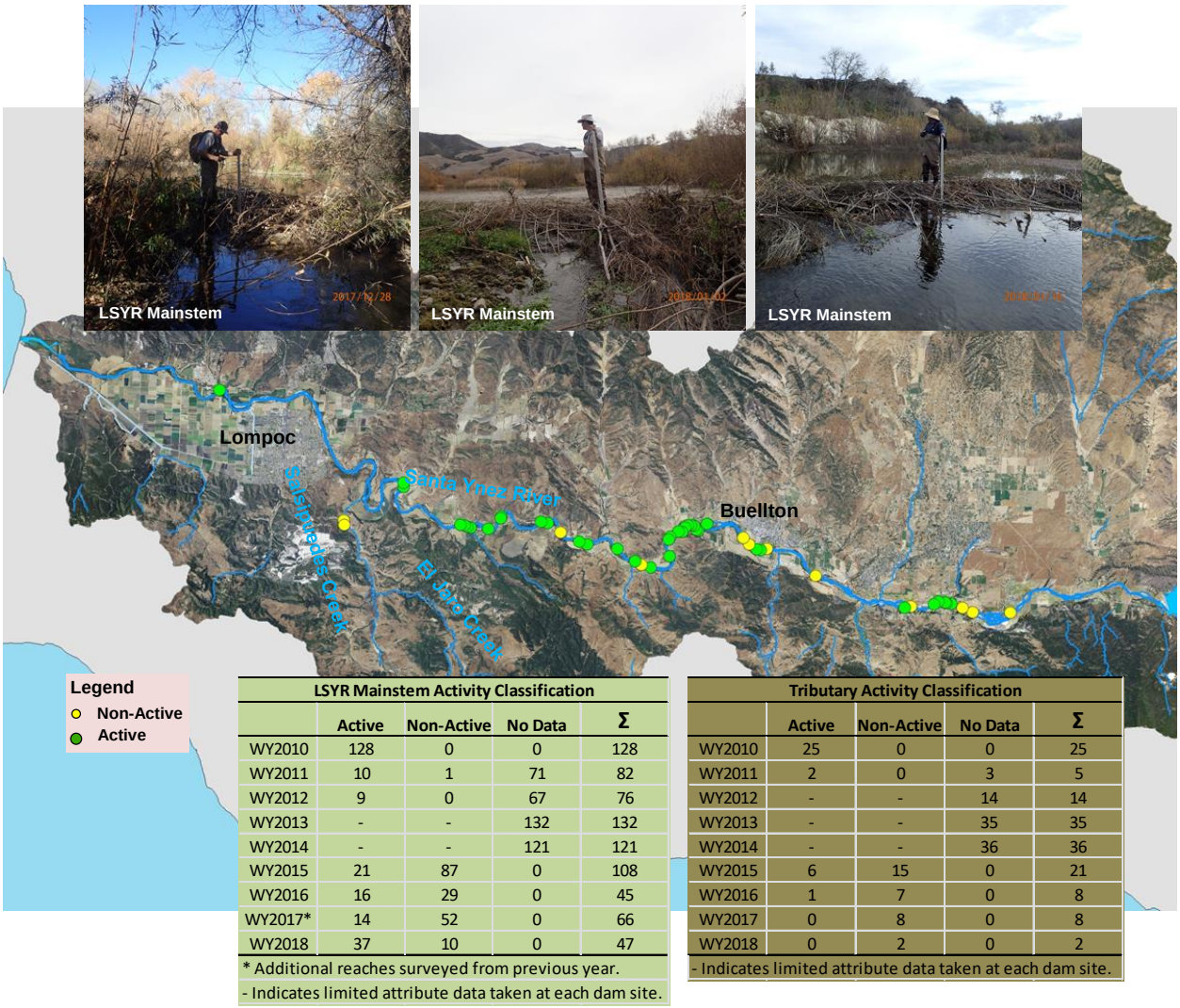


Figure 64: Observed warm water predators during the spring, summer and fall snorkel surveys in 2018 within the Refugio and Alisal reaches: (a) catfish, and (b) carp.



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

* 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

- Indicates limited attribute data taken at each dam site.

Figure 65: Spatial extent of beaver dams from the WY2018 survey within the LSYR drainage where 47 dams (37 active) were observed in the mainstem and 2 dams (0 active) observed in the Salsipuedes Creek watershed.

Table 20: 2010-2018 beaver dams in the LSYR and Salsipuedes/El Jaro watershed broken out by height.

	LSYR 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

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

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Table 21: Monthly rainfall totals at Bradbury Dam from WY2000-WY2018.

Month	Water Years:																		
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
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
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
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
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
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
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
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
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
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
Jul	0	0.06	0	0.01	0	0	0	0	0	0	0	0.00	0	0	0	0.03	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
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	0.00
Totals:	***21.47***	***31.75***	***8.78***	***19.76***	***10.55***	***44.41***	***24.49***	***7.41***	***22.59***	***13.66***	***23.92***	***31.09***	***12.69***	***7.57***	***9.96***	***9.38***	***10.84***	***25.48***	***9.32***

Table 22: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2018.

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	7.3	0.998	25	17.5	2.97	0	6.8	0	19.8	18.3	7.59	4.28
Nov	5.8	0.996	7.36	8.54	5.8	0	1.6	0	6.94	12.8	8.33	11.1
Dec	7.74	9.98	6.61	13.2	7.01	1.02	6.9	0	53.1	203.3	7.91	14.6
Jan	9.37	15.3	265	496.3	6.14	5.11	73.0	184	27.6	85.8	7.97	16.9
Feb	10.4	18.6	401.1	490.1	17.7	33.4	72.0	181	24	100.3	7.46	14.1
Mar	8.82	10.7	93.9	158.4	12.1	18.6	26.0	68	1441	1267	6.01	11.7
Apr	4.52	1.43	8.46	18.9	4.39	5.23	35.0	51	321.5	422	8.82	14.7
May	1.47	0.475	6.3	6.77	5.05	0.648	6.1	13	39.0	70.8	5.56	5.53
Jun	1.93	0.13	5.05	2.49	7.08	0.275	1.3	1.8	13.9	29.4	4.73	0.52
Jul	35.8	1.39	7.09	0.42	3.51	0	0.4	0.5	9.28	10.7	4.58	0.03
Aug	55.2	30.8	3.68	0.069	3.72	0	53.0	22	7.8	3.05	4.88	0
Sep	31.0	23.4	3.76	0	4.08	0	30.0	19	8.5	2.22	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

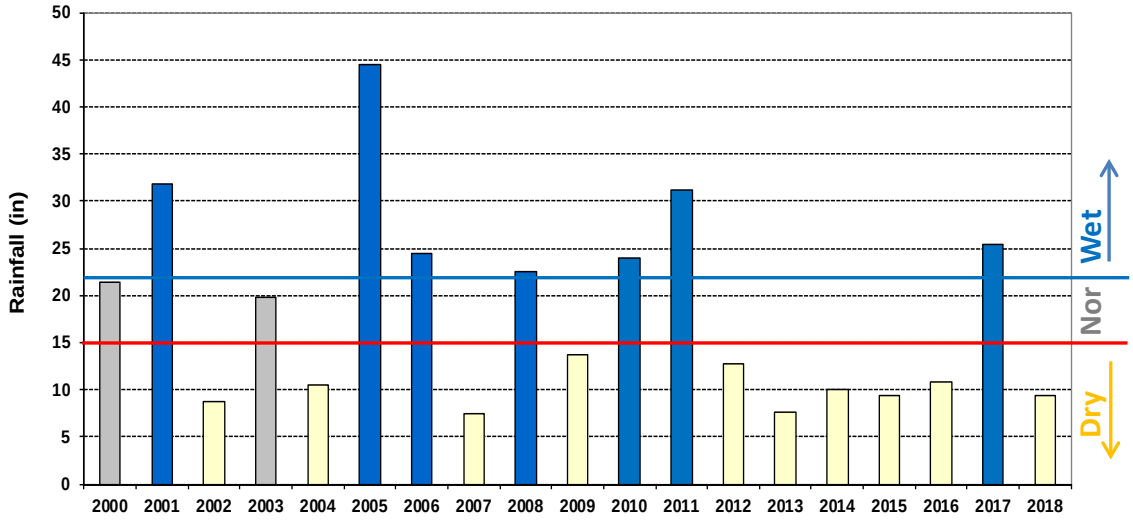

Figure 66: Water year type (wet, normal and dry) and spill years since the issuance of the BiOp in 2000; year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Table 23: BiOp tributary project inventory with the completion date specified in the BiOp and their status to date; completed projects are listed by calendar year.

Tributary Projects	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 24: Non-BiOp tributary projects already completed or proposed with their status to date; completed projects are listed by calendar year.

Tributary Projects	Current Status (as of December 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.	

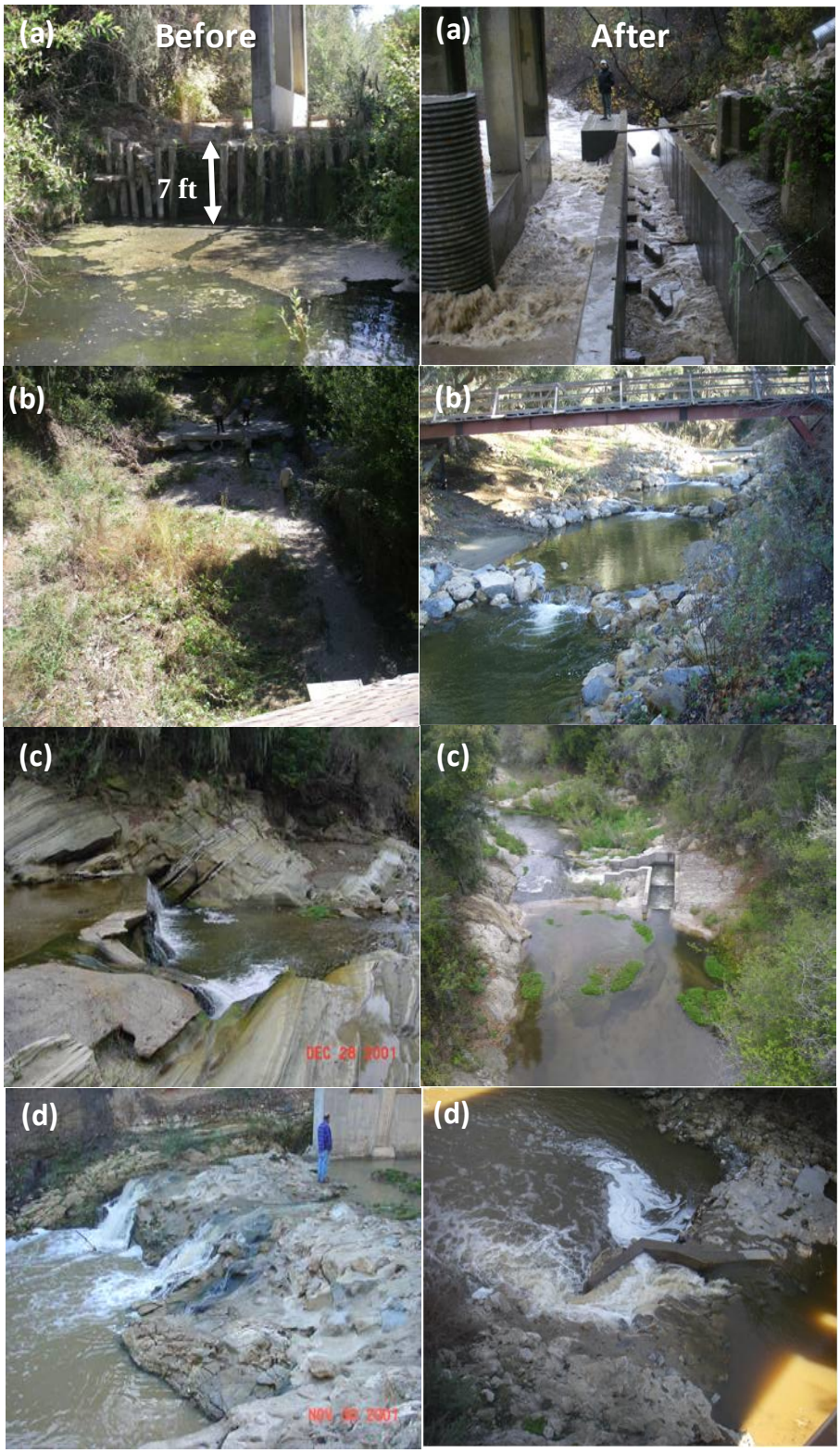

Figure 67: Fish passage and habitat restoration at: at (a) Rancho San Julian Bridge on El Jaro Creek (2008), (b) Cross Creek Ranch on El Jaro Creek (2009), (c) Jalama Road Bridge on Salsipuedes Creek (2004), and (d) Highway 1 Bridge on Salsipuedes Creek (2002).

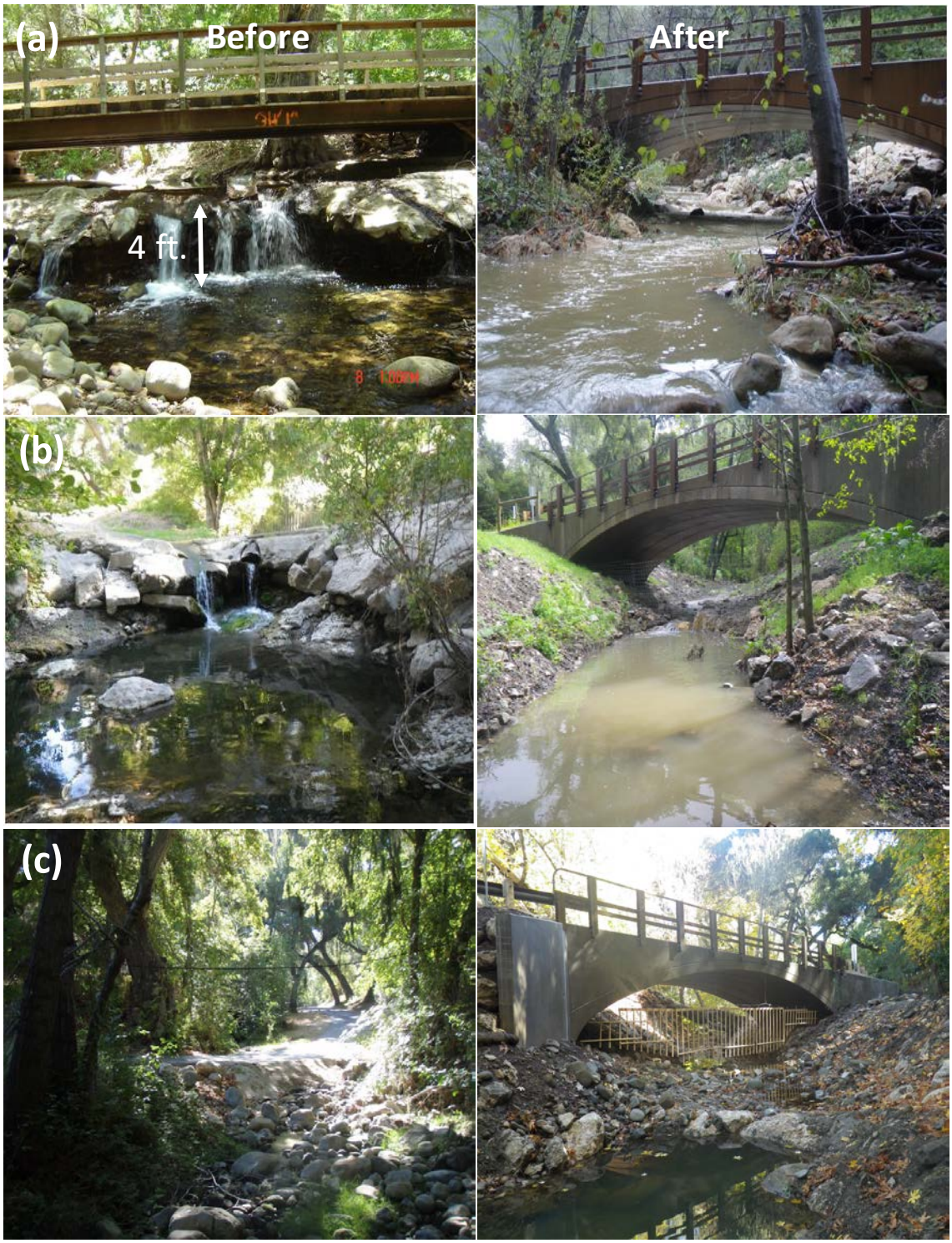

Figure 68: Fish passage and habitat restoration at a) Quiota Creek Crossing 6 (2008), (b) Quiota Creek Crossing 2 (2011), and Quiota Creek Crossing 7 (2013).

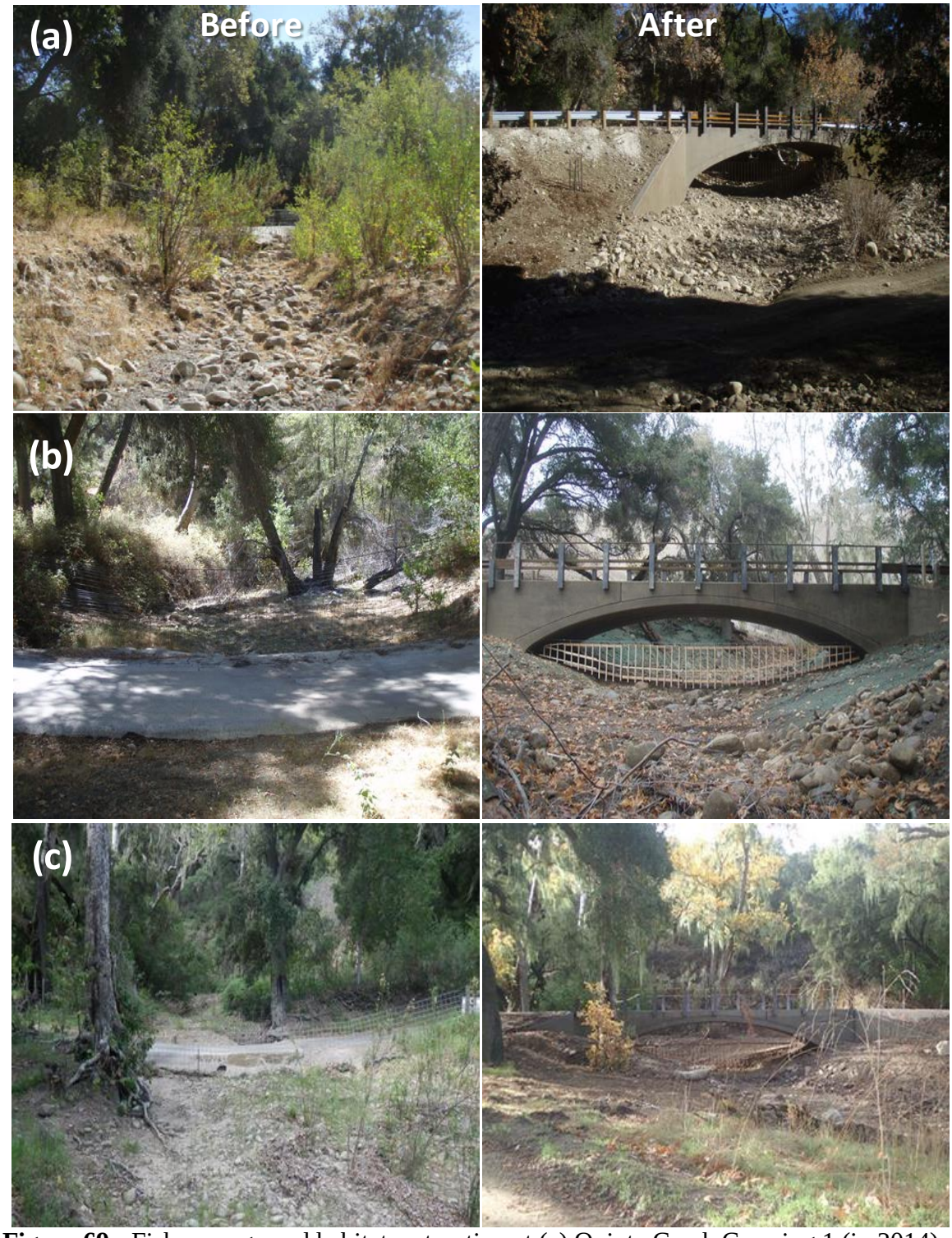

Figure 69: Fish passage and habitat restoration at (a) Quiota Creek Crossing 1 (in 2014), (b) Quiota Creek Crossing 3 (in 2015), and (c) Quiota Creek Crossing 4 (in 2016).

Figure 70: 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 71: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

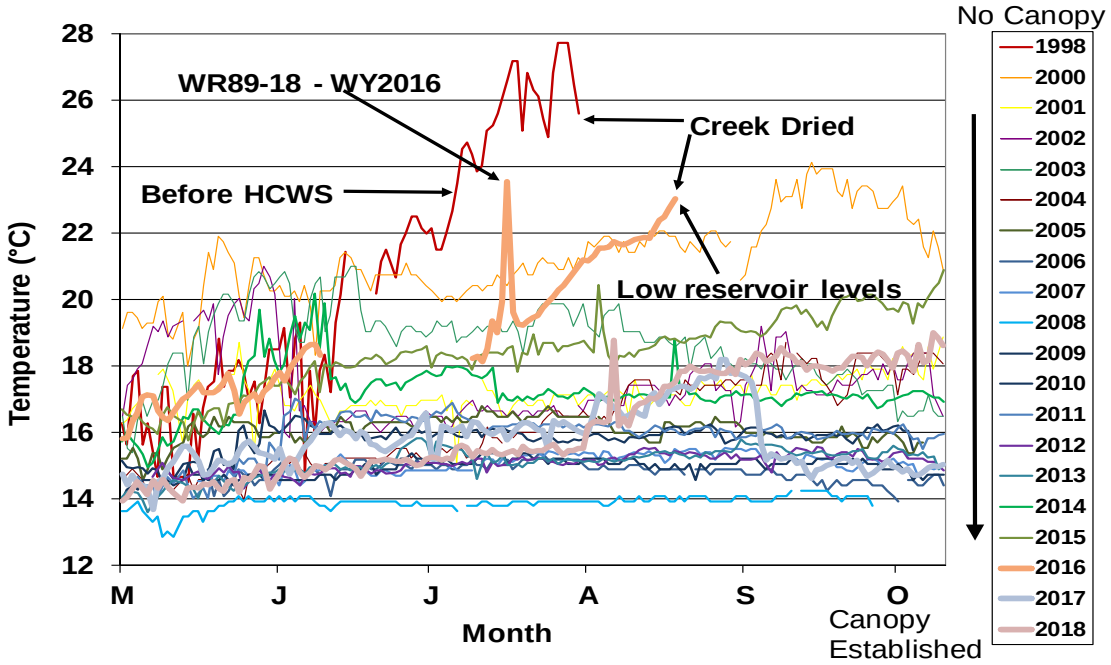

Figure 72: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2018, the last three years are shown with a wider line.

Figure 73: Gravel augmentation in Hilton Creek at the Spawning Pool (a) loading washed gravel into 5-gallon buckets and (b-d) hand placing gravels at the tailout of the habitat.

Figure 74: Found *O. mykiss* mortalities associated with the 1/8/18 stormflow event.(a-d) all located in the lower reaches of Hilton Creek and at the upper limits of the high flow event.

WY2018 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 2002-2018 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 WY2018 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.

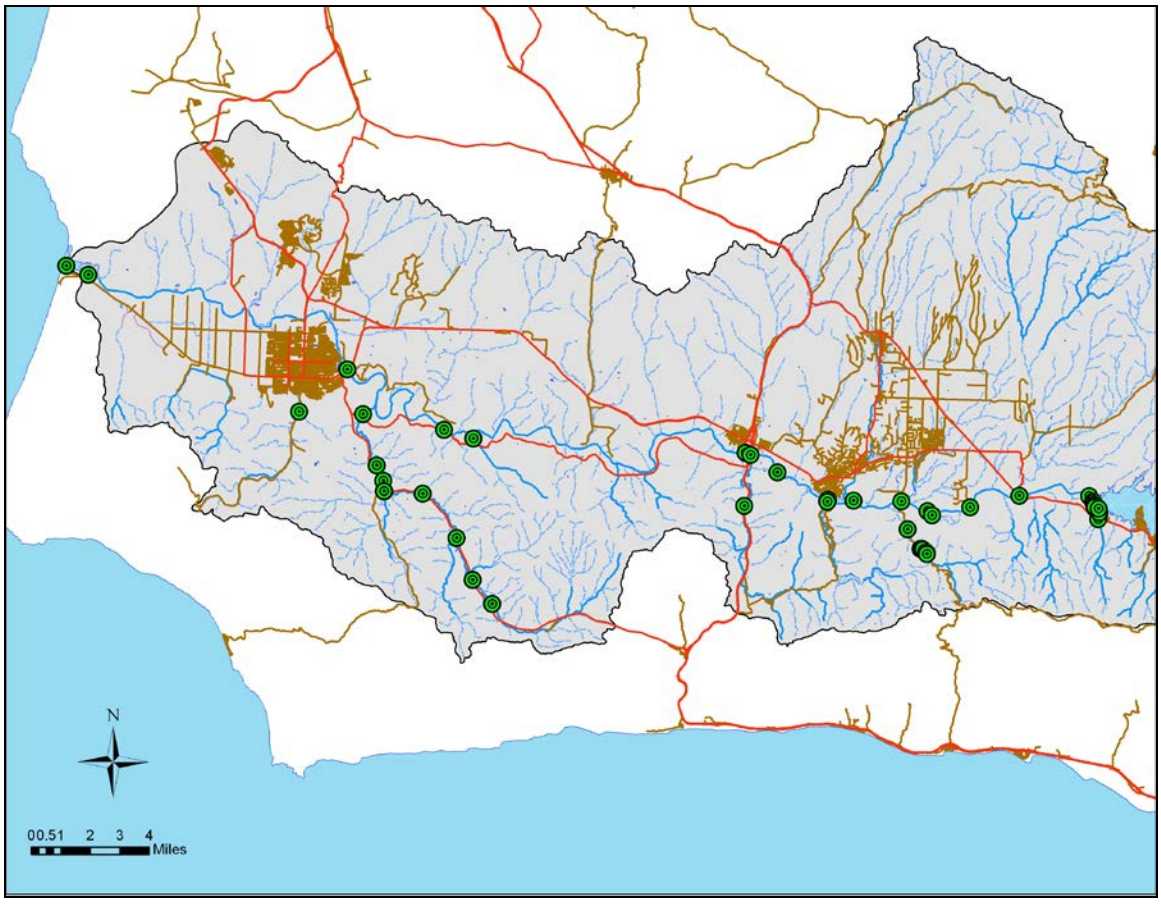

Figure C-1: WY2018 photo point locations.

Table C-1: WY2018 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	May-2018	Sept-2018	Oct-2019
M1	Lower Hilton Creek, photo d/s at ford crossing	5/14		10/4
M2a	Bluffs overlooking long pool, photo u/s	5/2		10/4
M2b	Bluffs overlooking long pool, photo d/s	5/2		10/4
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	5/10		10/10
M6	Highway 154 Bridge, photo d/s	5/10		10/10
M7	Meadowlark crossing, photo u/s	5/10		10/1
M8	Meadowlark crossing, photo d/s	5/10		10/1
M9	Lower Gainey crossing, beaver dam, photo u/s	5/10		
M10	Lower Gainey crossing, beaver dam, photo d/s	5/10		
M11a	Lower Gainey crossing, photo u/s	5/10		
M11b	Lower Gainey crossing, photo d/s	5/10		
M12	Refugio Bridge, photo u/s	5/2	9/27	
M13	Refugio Bridge, photo d/s	5/2	9/27	
M14	Alisal Bridge, photo u/s	5/10	9/27	
M15	Alisal Bridge, photo d/s	5/10	9/27	
M17	Mid-Alisal Reach, photo u/s	6/26		10/4
M18	Mid-Alisal Reach, photo d/s	6/26		10/4
M19	Avenue of the Flags Bridge, photo u/s	5/10	9/27	
M20	Avenue of the Flags Bridge, photo d/s	5/10	9/27	
M21	Sweeney Road crossing, photo u/s	5/10		
M22	Sweeney Road crossing, photo d/s	5/10		
M23	Highway 246 (Robinson) Bridge, photo u/s	5/10	9/27	
M24	Highway 246 (Robinson) Bridge, photo d/s	5/10	9/27	
M25	LSYR Lagoon on railroad bridge, photo u/s	5/21	9/27	
M26	LSYR Lagoon on railroad bridge, photo d/s	5/21	9/27	
M27	LSYR at 35th St. Bridge, photo d/s	5/21	9/27	
M28	LSYR at 35th St. Bridge, photo u/s	5/21	9/27	
M29	LSYR Lagoon upper reach, photo d/s	n/a	n/a	n/a
M30	LSYR Lagoon upper reach, photo u/s	n/a	n/a	n/a
M31	Slick Gardener, looking across towards highway	5/10		
M32	Slick Gardener, looking d/s through culvert	5/10	9/27	
M33	Slick Gardener, looking u/s through culvert	5/10	9/27	
	Floradale Br-u/s	5/21		
	Floradale Br-d/s	5/21		

Table C-2: WY2018 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	May-2018	Sept-2018	Oct-2019
T1	Hilton trap site, photo u/s	5/14		10/4
T2	Hilton start Reach #2, pt site, photo d/s	5/14		10/4
T3	Hilton at ridge trail, photo d/s	5/14		10/4
T4	Hilton at ridge trail, photo u/s	5/14		10/4
T5	Hilton at telephone pole, photo d/s	5/14		10/4
T6	Hilton at telephone pole, photo u/s	5/14		10/4
T7	Hilton at tail of spawning pool, photo u/s	5/14		10/4
T8	Hilton impediment/tributary, photo d/s	5/14		10/4
T9	Hilton impediment/tributary, photo u/s	5/14		10/4
T10	Hilton just u/s of URP, photo d/s	5/14		10/4
T11	Hilton road above URP, photo d/s	5/14		10/4
T12	Hilton road above URP, photo u/s	5/14		10/4
T14	Hilton from hard rock toe, photo d/s	5/14		10/4
T15	Hilton from hard rock toe, photo u/s	5/14		10/4
TX1a	Quiota Creek at 1st crossing, photo u/s	5/2	9/27	
TX1b	Quiota Creek at 1st crossing, photo d/s	5/2	9/27	
TX2a	Quiota Creek at 2nd crossing, photo u/s	5/2	9/27	
TX2b	Quiota Creek at 2nd crossing, photo d/s	5/2	9/27	
TX3a	Quiota Creek at 3rd crossing, photo u/s	5/2	9/27	
TX3b	Quiota Creek at 3rd crossing, photo d/s	5/2	9/27	
TX4a	Quiota Creek at 4th crossing, photo u/s	5/2	9/27	
TX4b	Quiota Creek at 4th crossing, photo d/s	5/2	9/27	
T16	Quiota Creek at 5th crossing, photo d/s	5/2		
T17	Quiota Creek at 5th crossing, photo u/s	5/2		
T18	Quiota Creek at 6th crossing, photo d/s	5/2		
T19	Quiota Creek at 6th crossing, photo u/s	5/2		
T20	Quiota Creek at 7th crossing, photo d/s	5/2		
T21	Quiota Creek at 7th crossing, photo u/s	5/2		
T22	Quiota Creek below 1st crossing, photo d/s	5/2		
T23	Alisal Creek from Alisal Bridge, photo u/s	5/10	9/27	
T24a	Alisal Creek from Alisal Bridge, photo u/s	5/10	9/27	
T24b	Alisal Creek from Alisal Bridge, photo d/s	5/10	9/27	
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s			
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s			
T27	Nojoqui/LSYR confluence, photo u/s			
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s	5/10	9/27	
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s	5/10	9/27	
T39	Salsipuedes Creek at Hwy 1 Bridge, photo d/s	5/10	9/27	
T40	Salsipuedes Creek at Hwy 1 Bridge, photo u/s	5/10	9/27	
T41	Salsipuedes Creek at Jalama Bridge, photo d/s	5/10	9/27	
T42a	Salsipuedes Creek at Jalama Bridge, photo u/s	5/10	9/27	
T42b	Pool at Jalama Bridge	5/10	9/27	
T43	El Jaro/Upper Salsipuedes confluence, photo u/s			
T44	Upper Salsipuedes/El Jaro confluence, photo u/s			
T45	Upper Salsipuedes/El Jaro confluence, photo d/s			
T48	El Jaro Creek above El Jaro confluence, photo u/s			
T49	El Jaro Creek above El Jaro confluence, photo d/s			
T52	Ytias Creek Bridge, photo d/s	5/10		
T53	Ytias Creek Bridge, photo u/s	5/10		
T54	El Jaro Creek 1st Hwy 1 Bridge, photo d/s	5/10	9/27	
T55	El Jaro Creek 1st Hwy 1 Bridge, photo u/s	5/10	9/27	
T56	El Jaro Creek 2nd Hwy 1 Bridge, photo d/s	5/10	9/27	
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s	5/10	9/27	
T58	El Jaro Creek 3rd Hwy 1 Bridge, photo d/s		9/27	
T59	El Jaro Creek 3rd Hwy 1 Bridge, photo u/s		9/27	
T60	San Miguelito Creek at crossing, photo d/s	5/21		
T61	San Miguelito Creek at Stillman, photo u/s	5/21		
T62	Rancho San Julian Bridge, photo d/s	5/10		
T63	Rancho San Julian Bridge, photo u/s	5/10		

D. List of Supplemental Reports Created During WY2018

- WY2014 Annual Monitoring Summary (COMB, 2018b).
- WY2015 Annual Monitoring Summary (COMB, 2018c).
- WY2016 Annual Monitoring Summary (COMB, 2019c)
- Quiota Creek Crossing 5 End of Project Report (COMB, 2019a).
- Quiota Creek Crossing 9 End of Project Report (COMB, 2019b)
- CDFW-FRGP Grant Proposal for Quiota Creek Crossing 8 Project (April, 2018).
- WY2018 Migrant Trapping Plan (January, 2018).
- Event Report, January 8, 2018 Storm Flow Related Fish Mortalities in Hilton Creek (COMB, 2018a)
- 2018 WR 89-18 Release Study Plan (July, 2018).
- 2018 WR 89-18 Release Monitoring Report for RPM 6 (USBR, 2019).

E. Appendices References

COMB, 2018a. Event Report, January 8-10, 2018 Storm Flow Related Fish Mortalities in Hilton Creek. Prepared by COMB-FD for USBR that was submitted to NMFS, Cachuma Operation and Maintenance Board, Fisheries Division.

COMB, 2018b. 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, 2018c. 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. End of Project Compliance Report, Fish Passage Improvement on Crossing 5, Quiota Creek. Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2019b. End of Project Compliance Report, Fish Passage Improvement on Crossing 9, Quiota Creek. Cachuma Operation and Maintenance Board (COMB), 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.

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.