WY2020 ANNUAL MONITORING SUMMARY

for

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

Prepared by:

CACHUMA OPERATION AND MAINTENANCE BOARD

FISHERIES DIVISION

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

FEBRUARY 24, 2021

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Executive Summary

The WY2020 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 2020 (WY2020, 10/1/19 – 9/30/20). 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 WY2020 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).

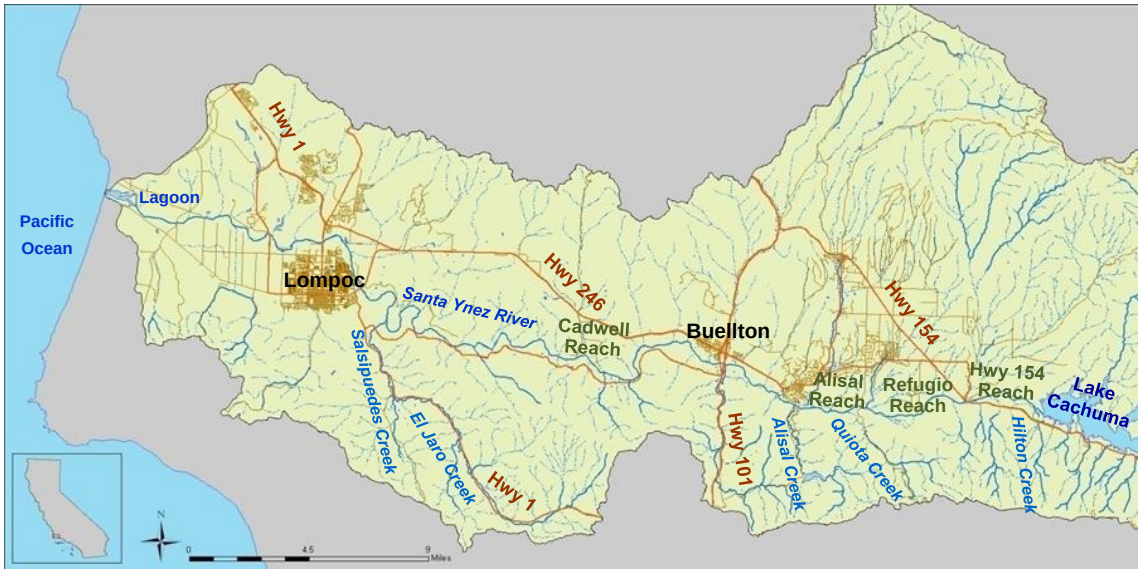

Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean west of Lompoc, showing tributary creeks and management reaches of interest for the LSYR Fish Monitoring Program.

This report summarizes data gathered since the WY2019 Annual Monitoring Summary (COMB, 2020b) and fulfills the annual 2020 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 WY2020, some deviations to the monitoring program as described in the BiOp (NMFS, 2000), Biological Assessment (BA) (USBR, 2000), LSYR Fish Management Plan (FMP) (SYRTAC, 2000) and prior Annual Monitoring Reports/Summaries were necessary, specifically in relation to water quality monitoring, redd surveys, and migrant trapping. The modifications were required due to landowner access constraints, or program evolution from acquired field knowledge. A shortened version of this report, the WY2020 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.

WY2020 was a normal (average) year (21.03 inches of precipitation measured at Bradbury Dam; long-term average, 1953-2020, is 19.91 inches) with the highest amount of rainfall occurring in December, March and April. Of the 68 year long record, this was the 27th wettest and the 42nd driest year on record and the third normal water year since the beginning of the BiOp in 2000. The driest year on record occurred in 2007 with only 7.41 inches of rain and the wettest year on record was in 1998 with 53.65 inches of rain at Bradbury Dam. The largest storm of WY2020 (6.77 inches of rain) occurred on 3/11/20 that saturated the watershed and made for excellent runoff conditions for subsequent storms. The next notable storm was on 4/6/20 that recorded 3.56 inches of rain at Bradbury Dam and generated enough runoff to open up the LSYR lagoon on 4/7/20 that remained open throughout the rest of the water year. At the beginning of the water year (10/1/19), there were 144,349 acre-feet (af) of water stored in Lake Cachuma and 135,570 af at the end of the water year (9/30/20), with peak storage on 4/25/20 at 156,960 af. BiOp required target flows of a minimum of 5 cubic feet per second (cfs) to the Highway (Hwy) 154 Bridge were maintained throughout the water year since reservoir storage was greater than 120,000 af throughout the period. Target flows to Hilton Creek of a minimum of 2 cfs were met throughout the water year through the Hilton Creek Watering System (HCWS) by gravity flow to the Upper Release Point (URP). There were 2 fish passage supplementation events (4/7/20 and 4/25/20) that followed the established program criteria for passage release both in timing and discharge quantity. There was a Water Rights (WR) 89-18 release in WY2020 that started on 8/31/20 and continued until 11/30/20 (a period of 92 days). This was a Below Narrows Account (BNA) release that discharged 10,480 af (SYRWCD) of water from Lake Cachuma to recharge downstream aquifers.

In Hilton Creek, there were 2 high streamflow events from the upper watershed on 12/25/19 and 4/6/20, the latter brought down a large quantity of streambed material from the Whittier Fire burn scar (see the WY2018 AMS for details). The first event produced a steep storm hydrograph with a rapid increase followed by an equally rapid decrease in

streamflow resulting in 1 mortality found in a high flow channel. During the subsequent April storm, stream sediments refilled most of the small and large pool habitats throughout the reaches on Reclamation property as well as continued to fill in the Long Pool. The amount of sediments moving downstream and impact to the water quality and habitats made for difficult conditions for the Hilton Creek *O. mykiss* population. There were 9 *O. mykiss* mortalities found in association with that stormflow event and most likely many fish either washed downstream or perished. Reports for these 2 stormflow events were produced and submitted to Reclamation who then provided them to NMFS.

Since the issuance of the BiOp in 2000, Reclamation, with assistance from COMB, has completed many conservation actions for the benefit of southern steelhead including: the construction and operation of the HCWS and the HCEBS; the completion of tributary passage enhancement projects on Hilton, Quiota, El Jaro, and Salsipuedes creeks; the completion of the bank stabilization and erosion control projects on El Jaro Creek; target flow releases to the LSYR mainstem and Hilton Creek; and the implementation and management of the Fish Passage Supplementation Program. COMB was involved in the planning, design, permitting, and construction of all the tributary projects (except the HCWS, HCEBS, and Cascade Chute Project in Hilton Creek) and was successful in acquiring grant funding for these projects from state and federal programs. These funds were supplemented by funding from the Cachuma Member Units which allowed for the construction of 14 fish passage projects (by the end of 2019) restoring access to the upstream reaches of key tributaries in the lower Santa Ynez River Watershed for steelhead. The total number of stream restoration and fish passage projects completed since issuance of the 2000 BiOp is 21 projects. Descriptions and photos of all habitat enhancement projects are presented in Section 4.

The following are recommendations to improve the monitoring program from WY2020 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 work closely with Reclamation on the implementation of the new Water Order WR 2019-0148 to conduct all required monitoring and reporting in a timely manner;
- Continue 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;
- Develop a gravel augmentation plan for the Hwy 154 Reach of the LSYR mainstem to provide spawning gravels to habitats with limited spawning potential due to the makeup of the stream substrate. Pattern the effort on what was successful completed in Hilton Creek on Reclamation property. Work with Reclamation on developing the plan, environmental coverage, and identifying potential funding sources.
- Continue to work with Reclamation to maximize dry season releases to Hilton Creek versus the Outlet Works to minimize lake release stream temperatures

entering the Long Pool and LSYR mainstem habitats downstream. This effort provided to be beneficial to the downstream fishery during the critical dry season rearing period.

- Work with the Santa Ynez River Conservation District on further developing their ramp-up procedures for WR 89-18 releases to enhance the successfully implemented effort started in WY2020.
- Continue to evolve the collaborative relationship with CDFW regarding fish rescue within the LSYR basin. The effort undertaken in this regard in WY2020 was exemplary and should be continued. Coordinate and prepare early as conditions warrant entering into the dry season.
- Continue to remove non-native fish species and continue to conduct basic stomach content analyses of non-native piscivorous fish whenever possible (during migrant trapping, fish rescue, and stranding surveys), specifically in habitats known to support *O. mykiss* and non-native fish;
- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin;
- Continue to 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 with scale analyses going back in time to assure all scales have been read and documented that are currently in the LSYR *O. mykiss* scale inventory, specifically looking at growth rates, evidence of life-history strategies such as fresh versus marine water rearing, signs of spawning, integration of the findings with the results of the genetic analyses, etc. in support of ongoing fisheries investigations;
- Continue working with the US Geological Survey, specifically at all LSYR basin gauges, to obtain accurate real-time measurements and to identify appropriate transect locations for stage-discharge relationships;
- Continue to maintain and develop landowner relationships in the LSYR basin to foster cooperation and gain access to reaches for all monitoring and restoration tasks; and
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WY2020 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)*

Reclamation is also required under State of California State Water Resources Control Board Order WR 2019-0148 specifically Term and Condition #27 to submit an annual report by December 31 of each water year. This report complies with that requirement.

The objective of this WY2020 Annual Monitoring Summary (AMS) is to present the monitoring data collected in Water Year 2020 (WY2020, 10/1/19-9/30/20) 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 WY2020 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 as well as WR 2019-0148 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), WY2013 Annual Monitoring Summary (COMB, 2017), WY2014 Annual Monitoring Summary (COMB, 2018a), WY2015 Annual Monitoring Summary (COMB, 2018b), WY2016 Annual Monitoring Summary (COMB, 2019a), WY2017 Annual Monitoring Summary

(COMB, 2019b), WY2018 Annual Monitoring Summary (COMB, 2020a), and WY2019 Annual Monitoring Summary (COMB, 2020b).

The data summarized in this report describe the habitat conditions and the fishery observations in the LSYR during WY2020. 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).

WY2020 was classified as a normal (average) year with 21.03 inches of precipitation recorded at Bradbury Dam (long-term average, 1953-2020, is 19.91 inches; 27th wettest year of 68 years over the period of record with WY2007 being the lowest at 7.41 inches and WY1998 being the highest at 53.65 inches. This was the 12th highest rainfall year since issuance of the 2000 BiOp, with 9 of 20 years classified as dry (WY2007, WY2013, WY2002, WY2018, WY2015, WY2014, WY2004, WY2016, WY2012, and WY2009; listed in order of severity) and only 3 years as normal (WY2000, WY2003, and WY2020). Wet years, in general, are often associated with an increase of the *O. mykiss* population due to higher stream flows, greater availability of habitat, and ocean connectivity for anadromous reproduction (Lake, 2003; COMB, 2013). However, wet years can result in high flows that create the potential for washing out redds. Following wildfires within the upper watershed, wet years also have the potential to negatively impact fish via increased transport of loosely-held burn scar sediment into downstream habitats, filling pool habitats and creating extreme short term turbidity conditions.

Migrant trapping was conducted in WY2020 and all BiOp take limits were followed. Reproduction and population status were monitored through spawner (redd) surveys and snorkel surveys.

WY2020 was a normal year following a wet year in WY2019. Entering into WY2020, the reservoir elevation at Lake Cachuma was at 74.7% capacity and well above critical drought conditions. The reservoir had over 120,000 af of water throughout the water year. The rainfall started late in November and conditions were relatively wet through the end of the calendar year with 6 storms in December. Precipitation swiftly subsided with mostly dry conditions persisting throughout the remainder of winter, until the largest storm of the year occurred on 3/11/20, with 6.77 inches of rain recorded at Bradbury Dam. Two more storms followed on 3/23/20 and 4/6/20, the second produced enough runoff to breach the sand bar at the LSYR lagoon and provide for ocean connectivity throughout the rest of the water year. No further measurable precipitation occurred for the rest of the monitoring period.

There were 2 stormflow events in Hilton Creek. The first on 12/26/20 produced a rapid increase and subsequent decrease of the storm hydrograph, creating the potential for fish strandings in high flow channels and margin habitats. One *O. mykiss* mortality was found. The second natural high flow event was associated with the large 4/6/20 storm that triggered high streamflow and sediment transport that filled in most pool habitats once again. Nine *O. mykiss* mortalities were found that either were stranded as the flows receded or might have succumbed to high turbidity. The timing of this event was unfortunate as *O. mykiss* young-of-the-year (YOY) were already coming out of the gravels at some redd sites and were vulnerable to displacement due to high streamflow. In both events, a report was prepared for Reclamation for submittal to NMFS.

The following chronology is provided for reader orientation 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:

- Reclamation released lake water to Hilton Creek through the HCWS by gravity to the URP throughout the water year.
- State water deliveries to Lake Cachuma were conducted through the CCWA by-pass pipeline. No State Water was wheeled through the Outlet Works and Penstock. Deliveries were sporadic and of short duration.
- 12/26/20 stormflow event: A short duration streamflow event resulted in one *O. mykiss* mortality.
- 4/6/20 stormflow event: This large stormflow event resulted in 9 *O. mykiss* mortalities.
- 4/7/20 - 4 /24/20: First Fish Passage Supplementation event.
- 4/25/20 – 5/13/20: Second Fish Passage Supplementation event.
- 4/25/20: Lake Cachuma reached peak volume for WY2020 at 156,960 af at a lake elevation of 740.45 feet above mean sea level.
- 8/31/20 – 11/30/20: 2020 WR 89-18 releases with a total of 10,480af released.

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 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, 2018a), 2015 (COMB, 2018b), 2016 (COMB, 2019a), 2017 (COMB, 2019b), 2018 (COMB, 2020a), and 2019 (COMB, 2020b). All reports fulfilled the annual monitoring reporting requirements set forth in the BiOp (T&C 11.1) and WR 2019-0148 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 west of 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 water quality 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). All water quality monitoring followed regulatory and industry guidelines for quality assurance and control, which are presented in Appendix B.

3. Monitoring Results

The results from the WY2020 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 (e.g., precipitation) at Bradbury Dam is equal to or less than 15 inches, a normal (average) year when rainfall is 15 inches to 22 inches, and a wet year when 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 below normal year at 26,229 af of computed inflow to Lake Cachuma.

WY2020 had 21.03 inches of rainfall at Bradbury Dam and was therefore classified as a normal year (between 15 and 22 inches) (Table 1). The long-term average (1953-2020) at the dam is 19.91 inches. There was elevated stream runoff recorded within the LSYR mainstem and tributaries in WY2020, and the mainstem flow was sufficient to breach the sand bar and open the LSYR lagoon to provide upstream migration opportunities from the ocean and the lagoon for 55 days during the migration season and 177 days during the water year (opened on 4/7/20 – remained open throughout WY2020). That total number of days can be misleading when looking at flow conditions at the USGS gauge at H Street in Lompoc. That section of the river is wide and has a sandy bottom that can be impassable for migrating fish at low flows even though the lagoon is open to the ocean. For example, recorded flows at H Street were less than 25 cfs on 4/26/20, less than 10 cfs on 5/12/20 and 0 cfs on 5/17/20 for the rest of the water year. The USGS Narrows gauge recorded an instantaneous peak flow rate of 1,710 cfs on 4/6/20. In Salsipuedes Creek, the highest recorded instantaneous peak discharge at the USGS gauging station at Jalama Road Bridge was 1,350 cfs recorded on 4/6/20. Also measured at Jalama Road Bridge was a relatively small peak early in the season on 12/25/19 of 118 cfs, followed by nothing greater than 15 cfs until the first storm in April. The USGS Solvang gauge had a maximum instantaneous flow rate of 1,470 cfs on 4/6/20. Historic minimum, maximum, and WY2020 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 12 precipitation events in WY2020 with rainfall equal to or greater than 0.1 inches at Bradbury Dam (Table 3 and Figure 1). The majority of the recorded precipitation at Bradbury Dam fell during the months of December (7.19 inches, 34.2%), March (8.13 inches, 38.7%) and April (3.58 inches, 17.0%). Spring time rain helped maintain creek baseflow and initial rearing conditions. The necessary triggers to implement the Fish Passage Supplementation Program were met and are discussed below in a separate report (2020 Fish Passage Supplementation Report). There was a BNA WR89-18 water release that began on 8/31/20 and concluded on 11/30/20 with 10,480 af released in total over 92 days.

Annual daily mean discharge hydrographs for the LSYR basin at the Narrows (USGS-11133000), Salsipuedes Creek (USGS-11132500), Solvang (Alisal Bridge) (USGS-11128500), Bradbury Dam (Reclamation), and Los Laureles (USGS-11123500) (upstream of Lake Cachuma) gauges are shown in Figure 2.

Annual hydrographs along the Santa Ynez River at Los Laureles, Solvang, Narrows and Salsipuedes Creek USGS gauges showed high spring stormflow runoff conditions throughout the basin (Figures 2 and 3). The USGS Los Laureles gauge on the Santa Ynez River mainstem upstream of Lake Cachuma recorded continuous flow from 12/22/19 through 7/19/19 with peak daily discharge observed on 3/16/20 at 301 cfs. The Hilton Creek gauge (USGS-11125605) is a low flow gauge only (less than 50 cfs) and during the 12/23/19, 3/11/20, and 4/6/20 stormflow events, stream discharge was above the recording threshold 12/25/19, 3/16/20, and 4/5/20, respectively. The peak release from Bradbury Dam (Outlet Works plus the HCWS to Hilton Creek) was approximately 65.3

cfs on 4/9/20 and 4/26/20 during Fish Passage Supplemental Releases followed by 158 cfs during the 2020 WR 89-18 release on 9/6/20. None of these discharge rates were high enough to cause any changes to the channel or banks within the LSYR mainstem. Only localized scour of small vegetation within the wetted channel was observed at a few locations.

Ocean Connectivity: The Santa Ynez River breached on 4/7/20 and remained open throughout the rest of the water year for a total of 177 days; 55 days were during the migration season (Figures 2 and 3). During the days of ocean connectivity with the Santa Ynez River, no anadromous *O. mykiss* were captured or observed during migrant trapping efforts, redd surveys, or bank surveys. Streamflow went to zero at the H Street USGS gauge on 5/17/20 and remained dry for the rest of the water year except for a short distance during a brief period of the 2020 WR 89-18 releases when the release waters reached about 100-200 feet downstream (maximum downstream extent of the release). For comparison, the long-term status of the lagoon berm is presented in Table 4.

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 was 1 storm during WY2020 migration season that met the established criteria for passage supplementation; 4/7/20. A second pulse release was initiated on 4/25/20 following the end of the first release to facilitate additional smolt movement downstream and was not related to any stormflow event. Because the passage supplementation event occurred in the February to mid-April time period, the established protocol required Reclamation to conduct automatic supplementation. There were 51 days during the migration season where flows were in excess of 25 cfs at the USGS gauging station in Solvang and the lagoon was connected to the ocean. 37 days of the 51 days (73%) were associated with the Fish Passage Supplementation Program releases. Trapping activities were conducted in the LSYR mainstem (and in Hilton Creek and Salsipuedes Creek) for all three passage supplementation events. There were 5 *O. mykiss* smolts captured in the downstream LSYR mainstem trap (LSYR-6.08) during the passage supplementation event.

Adaptive Management Actions: There were no Adaptive Management Committee (AMC) meetings during WY2020. No flow allocations were made by the AMC from the Adaptive Management Account (AMA).

Target Flows: There were no spills from Bradbury Dam in WY2020. Reservoir storage remained above 120,000 af from the start of the water year (10/1/19) through the rest of the water year (9/30/20). That reservoir storage required Reclamation to maintain 2000 BiOp target flows of a minimum of 5 cfs to the Hwy 154 Bridge and a minimum of 2 cfs to Hilton Creek. Lake Cachuma water was delivered and discharged to Hilton Creek at the URP from the HCWS by gravity flow throughout the water year.

Water Rights Releases: Water Rights releases are non-discretionary releases called for by the Santa Ynez River Water Conservation District (downstream Water Rights holders) as described in WR Order 89-18 (WR 89-18). There was a 2020 WR 89-18 BNA release that was initiated on 8/31/20 and ended on 11/30/20 that discharged 10,480 af of water from Lake Cachuma to recharge downstream aquifers. A separate report was submitted after the release by COMB to Reclamation that described the results of the monitoring effort associated with that release.

Mixing and Temperature of State Water Project Waters Released into the LSYR: Reclamation monitors downstream releases to comply with the 50% mixing criterion required by BiOp RPM 5.1 (NMFS, 2000) for release of State Water Project (SWP) water into the Santa Ynez River below Bradbury Dam. The Central Coast Water Authority (CCWA) in collaboration with Reclamation delivers SWP water to Lake Cachuma. SWP water is mixed with water releases from Lake Cachuma in the Penstock and Stilling Basin at the base of the dam. Lake Cachuma water enters Hilton Creek through the Hilton Creek water delivery systems and flows through Hilton Creek into the Long Pool. The determined point for mixing is the Long Pool that receives both water sources (Outlet Works and HCWS/HCEBS). SWP water can be delivered to Lake Cachuma through a bypass system that eliminates having to use the Penstock.

CCWA did not deliver SWP to the lake through the Penstock throughout the water year. Hence, the criterion was met for RPM 5.1 throughout WY2020 (Figures 4). On 1/4/20, CCWA completed a bypass pipeline that went over the dam for SWP discharge into the lake instead of through the Penstock 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 was the fourth year that the sensors were operational and the data are recorded by Reclamation. No SWP water was delivered to Lake Cachuma through to Penstock hence there were no issues with water temperatures from releases from the Outlet Works to the LSYR mainstem.

3.2. Water Quality Monitoring within the LSYR Basin:

Water quality parameters were monitored within the LSYR Basin during the dry season from approximately May through November to track conditions for over-summering *O. mykiss*. The critical parameters for salmonid survival, water temperature and dissolved oxygen (DO) concentrations, were recorded and are presented below.

Stream temperatures play a critical role in salmonid energy conversion by influencing the metabolic requirements for food and governing the rate of food processing as salmonids are not able to regulate their temperature physiologically (Moyle, 2002). They can compensate for thermal conditions behaviorally by adjusting activity rates and metabolic demand in adverse thermal conditions (Nielson et al., 1994). Stream and lake water temperature and DO concentrations are presented below for the LSYR mainstem and selected tributaries.

Stream water temperatures were collected at various locations within the LSYR mainstem and its tributaries of the LSYR with thermographs (recording continuously at the beginning of every hour) and dissolved oxygen concentrations with multi-parameter units (Sondes and U-26s) (Figure 5). Since 1995, a thermograph network has been deployed in the LSYR mainstem and tributaries downstream of Bradbury Dam as described in the BA (USBR, 2000), to monitor seasonal trends, diel variations, longitudinal and vertical gradients, and general temperature suitability for *O. mykiss*. Changes in channel configuration and associated pool habitats from spill events have necessitated slightly modifying the thermograph deployment regime and locations described in the BA (USBR, 2000). When presented, the two data sources (thermographs and multi-parameter units) will be discussed separately for the LSYR mainstem and tributaries.

Results of water quality monitoring are presented in all cases, but described only if the habitat contained *O. mykiss*, non-native aquatic species, or there was an observation of particular importance. Data presentations include daily minimum, average, and maximum water temperatures as well as hourly data during the highest maximum water temperatures recorded over the period at that site. Several monitoring locations were added over the years starting in WY2013 to increase the understanding of the thermal regime in various LSYR mainstem and tributary habitats as they relate to fish assemblages.

Water Temperature: During WY2020, 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 2000 Cachuma Project BiOp (see previous Annual Monitoring Reports) and were originally monitored specifically due to the presence of *O. mykiss* to evaluate seasonal

rearing conditions as it relates to temperature. Keeping legacy sites that are now sometimes absent of *O. mykiss* allows for a comparison of how habitats respond to different flow regimes and water year types over time. Other sites were selected and monitored to evaluate the longitudinal thermal gradient along the LSYR, to document the presence of cold water refuge habitats, and to monitor the rearing conditions where *O. mykiss* were present, while some previously monitored locations were discontinued due to habitat alterations (i.e., LSYR-7.3 and LSYR-9.6) or access limitations (2 sites within the Santa Ynez River Lagoon).

In addition, several monitoring locations were discontinued due to the absence of observed fish over several years (Nojoqui Creek), or a sequence of impassable barriers prohibiting access for anadromous steelhead (San Miguelito Creek). In Hilton Creek, single units were deployed at two locations; at the Upper Release Point (URP) and just upstream of the creek's confluence with the LSYR mainstem to monitor stream temperatures in the artificially watered sections of the creek on Reclamation property.

There were 30 thermograph units deployed at 15 sites on the LSYR mainstem which are listed below with the number of units in parentheses:

- Stilling Basin parapet wall (LSYR-0.01 (3));
- Downstream of Stilling Basin (LSYR-0.25 (1));
- Long Pool (LSYR-0.51 (3));
- LSYR directly downstream of Long Pool and upstream of Reclamation and Crawford-Hall property boundary (LSYR-0.68(1));
- Grimm Property upstream (LSYR-1.09 (1));
- Grimm Property downstream (LSYR-1.54 (1));
- Grimm Property pool (LSYR-1.71 (3));
- Kaufman Property Run (LSYR-2.77 (1));
- Encantado Pool (LSYR-4.95 (3));
- Mainstem Trap Site (LSYR-6.08 (1));
- Double Canopy Pool (LSYR-7.65 (2));
- Head of Beaver Pool (LSYR-8.7 (3));
- Alisal Bedrock Pool (LSYR-10.2 (3));
- Avenue of the Flags (LSYR-13.9 (1)); and
- Cadwell Pool (LSYR-22.68 (3))

In the tributaries, there were 12 thermograph units deployed at 12 sites during WY2020, 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);
    - SC-Jalama Bridge (SC-3.5); and
    - SC-upper (SC-3.8).
- El Jaro Creek (EJC, 3 sites):
    - EJC-lower (EJC-3.81);
    - EJC-Palos Colorados (EJC-5.4); and
    - EJC-Rancho San Julian (EJC-10.82).
- Los Amoles Creek – Tributary to El Jaro (LAC, 1 site):
    - LAC-Los Amoles Creek (LAC-7.0).

Again, all stream temperature monitoring locations are presented in Figure 5 with their deployment period and type in Table 5, and the observed fish species in each habitat in Table 6 for the LSYR mainstem and tributaries. Photos of each LSYR mainstem and tributary deployment location are presented in Figures 6-10 for general reference.

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

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

A 3-unit vertical array was deployed along the northeast parapet wall of the Stilling Basin from 4/29/20 through 11/19/20 (Figure 6 (a) and Figures 11-13). The units were deployed at 1-foot, 14-feet, and 28-feet. The Stilling Basin is the largest habitat on the LSYR and measures approximately 866 feet long from the spillway to the downstream riffle crest, is 482 feet wide at its midpoint, and is approximately 36 feet deep when at full capacity. In the absence of high volume water releases, the upper lens of the Stilling Basin water column heats while cooler water sinks to the bottom, particularly during the summer. Water temperatures at this location are greatly influenced by both low and high volume water releases from the Bradbury Dam Outlet Works. When water is released from the Outlet Works, it is released from the cold hypolimnion at the bottom of the lake.

Water temperatures within the Stilling Basin showed gradual seasonal warming starting at the beginning of May before rapidly cooling on 8/31/20 following the start of WR89-18 downstream releases. Surface water temperatures through August were noticeably cooler compared to previous years with surface maximum temperatures remaining less than 22 °C during the entire deployment period. Middle and bottom temperatures were correspondingly cooler at 14-feet and 28-feet below the surface. Following the initiation of WR89-18 releases, water temperatures rapidly cooled throughout the water column, essentially becoming uni-thermal and holding steady around 14 °C. No snorkel surveys were conducted in the Stilling Basin. Only adult carp were observed from the parapet wall, no other fish species were observed. While no *O. mykiss* were observed in the Stilling Basin, their presence cannot be ruled out, particularly following the WR89-18 release which provided good flow conditions to portions of lower Hilton Creek and Long Pool where numerous *O. mykiss* were observed in WY2020.

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

A single temperature unit was deployed in a 1.5 foot deep run habitat approximately 40-feet downstream of the Stilling Basin control point from 4/29/20 through 11/19/20 (Figure 6 (b) and Figure 14). Maximum water temperatures generally remained less than 23 °C during the lead up to WR89-18 downstream releases. Water temperatures showed a corresponding increase coincidental with a major heat wave in the middle of August, briefly increasing to greater than 24 °C. Overall, maximum temperatures at this site were noticeably warmer compared to the Stilling Basin due to thermal heating and releasing of the surface waters downstream of the Stilling Basin. Water temperatures decreased from a high of 22 °C to less than 15 °C following the start of WR89-18 releases. No *O. mykiss* were observed in or around this monitoring location, though their presence cannot be ruled out as cold water from the downstream releases created a linkage to the lower portions of Hilton Creek and the Long Pool where numerous YOY were observed prior to the release.

Long Pool – Pool (LSYR-0.51)

Prior to the Whittier Fire in 2017, the Long Pool habitat dimensions were approximately 100 feet wide at the widest point and 1,200 feet long with a maximum depth of over 9 feet. Since the Whittier Fire, the Long Pool has lost considerable length and depth due to excessive sedimentation input from the Hilton Creek watershed and the Whittier Fire burn scar (approximately a third of its maximum volume). Currently, the Long Pool is approximately 900 feet long and has a maximum depth of just under 6-feet. It can be fed by three water sources when there is no spill: the Outlet Works; the chute release (Chute Release Point, CRP) which is part of the HCWS that can release water directly into the Stilling Basin; and Hilton Creek proper (URP and LRP of the HCWS/HCEBS and upper natural basin creek flow). The flow from the Stilling Basin and Hilton Creek confluences in the newly formed delta upstream of the Long Pool that has been decreased in length by 300-400 feet from sediment deposition from the Whittier Fire burn scar. The HCWS and HCEBS are cooler water sources that take water at the 65 foot level in Lake Cachuma and from the bottom of the lake, respectively. Mixing of the two sources occurs in the newly formed stream channel that traverses the delta.

Over the last several years, the Long Pool has been inhabited by various invasive species that can limit *O. mykiss* colonization due to predation, competition, and degradation of water quality. This conclusion was based on visual observations of the lack of multi-year age classes within the habitat, particularly smaller 1-2 year old *O. mykiss*. As the Long Pool has decreased in depth due to siltation, there has been a change in the overall fish assemblage observed. Of note is a reduction in the numbers of both invasive species and larger size classes of *O. mykiss*.

In addition, chronic turbidity which can negatively affect salmonids was observed in both the Stilling Basin and Long Pool due to the presence of large numbers of carp, primarily in the Stilling Basin and to a lesser extent, the Long Pool. Beaver activity has also been an issue in the past; however, they are currently not present within the Hwy 154 Reach on Reclamation property.

A vertical array was deployed on 4/29/20 and removed 11/19/20 at the deepest portion of the pool habitat at 1-foot, 2.5 feet and 5.5 feet below the surface (Figure 6 (c) and Figures 15-17). Maximum surface water temperatures fluctuated from approximately 16 °C to 21.0 °C during the warmest portion of the year with minimum temperatures remaining less than 17 °C during the entire deployment period. Water temperatures at the middle and bottom monitoring locations were slightly cooler still providing good rearing conditions throughout the year. YOY *O. mykiss* were observed throughout the year at the head of the Long Pool near the Hilton Creek confluence with Long Pool. Also, several adult largemouth bass and common carp were observed and predation of *O. mykiss* cannot be ruled out.

Downstream of Long Pool (LSYR-0.68)

This single unit was deployed 300 feet downstream of the Long Pool in a shallow run habitat with a maximum depth of 2 feet from 4/29/20 to 11/19/20 (Figure 6 (d) and Figure 18). Temperatures at this location closely mimicked those collected in the Long Pool at the surface unit. Maximum water temperatures were generally less than 21 °C with minimum temperatures less than 18 °C. An optic shuttle for downloading the thermograph malfunctioned during temperature unit downloading resulted in a loss of water temperature data starting on 8/20/20 through 9/24/20. YOY *O. mykiss* were observed throughout this section of the river downstream of the Long Pool.

Grimm Property Upstream – Run (LSYR-1.09)

A single thermograph was deployed in a heavy canopy run habitat measuring approximately 100 feet long, 15 feet wide and 1.5 feet deep from 4/29/20 to 11/17/20 (Figure 6 (e) and Figure 19). This is the third year water temperature monitoring has occurred at this location. Water temperatures showed a slight warming compared to LSYR-0.68 with maximum temperatures generally less than 21 °C and minimum temperatures less than 18 °C. An optic shuttle malfunction during unit downloading resulted in a loss of data staring on 8/20/20 through 10/16/20. YOY *O. mykiss* were observed in this habitat during routine snorkel surveys in the spring.

Grimm Property Downstream – Run (LSYR-1.54)

A single thermograph was deployed in a run habitat measuring approximately 45 feet long, 15 feet wide and 1.5 feet deep from 4/29/20 to 11/17/20 (Figure 6 (f) and Figure 20). This is the third year water quality monitoring has occurred at this location. Water temperatures collected at this site showed slight warming developing 0.45 miles downstream from LSYR-1.09, most likely due to the absence of any over story canopy and several large pool habitats between the two sites that allow for thermal heating. Maximum water temperatures generally remained less than 22 °C during the warmest portion of the year. Minimum temperatures remained less than 20 °C. An optic shuttle malfunction during unit downloading resulted in a loss of data starting on 8/20/20 through 10/16/20. *O. mykiss* were observed both upstream and downstream of this location during snorkel surveys.

Grimm Property - Pool (LSYR-1.71)

A two unit vertical array was deployed for the third year in this pool habitat from 4/29/20 to 11/17/20 (Figure 7 (a) and Figures 21-22). The habitat measures approximately 200 feet long, is 35 feet wide and 6.5 feet deep. Surface and bottom temperatures were nearly identical with the surface being slightly warmer during the period of deployment prior to WR89-18 releases. Overall, maximum water temperatures remained less than 22 °C (except for 3 occasions at the surface) with minimum temperatures ranging from 18-20 °C. An optic shuttle malfunction during thermograph unit downloading resulted in a loss of data starting on 8/20/20 through 10/16/20. Many adult *O. mykiss* were observed at this location in addition to several size classes of largemouth bass during the spring snorkel survey.

Kaufman Property – Run (LSYR-2.77)

A single thermograph was deployed for the first time at this location at the head of a run habitat measuring 200 feet long, 20 feet wide, and 2 feet deep from 4/29/20 through 11/17/20. Maximum water temperatures show slight warming compared to LSYR-1.71 with temperatures ranging from 22-23 °C during the warmest portion of the year. Minimum temperatures ranged from 18-20 °C. Notable warming was observed in conjunction with a significant heat wave in the middle of August (Figure 23). An optic shuttle malfunction during thermograph unit downloading resulted in a loss of data starting on 8/20/20 through 10/16/20. Several juvenile *O. mykiss* as well as adult bass were observed in this unit during the spring snorkel surveys.

Encantado Pool – Pool (LSYR-4.95)

When full, the Encantado Pool is approximately 400 feet long, averaged 30-feet wide, and has a maximum depth of 6 feet. A vertical array was deployed in this habitat from 4/30/20 to 11/12/20. (Figure 7 (b) and Figures 24-26). Maximum surface water temperatures were the highest at this site compared to all other mainstem monitoring locations, briefly reaching greater than 26 °C during the heat wave in the middle of August. Maximum temperatures at the middle unit were generally less than 24 °C and less than 22 °C at the bottom unit. Minimum temperatures at all three sites generally fluctuated between 18-20 °C except during the mid-August heat wave. Once the WR89-18 release reached the site, maximum water temperatures dropped to less than 18 °C throughout the water column. Many adult *O. mykiss* were observed at this location during the spring snorkel surveys, as well as several size classes of largemouth bass.

WR89-18 Trap Site (also the LSYR mainstem migrant trap site) - Run (LSYR-6.08)

A single thermograph was attached to the fish trapping infrastructure from 9/1/20 through 9/17/20 to monitor water temperatures as the WR89-18 release arrived and during the first couple of weeks. The unit was placed in 3 feet of water approximately six inches from the bottom. The river bottom was dry when the traps were deployed. Water arrived at the site at 13:37 hours on 9/1/20. Maximum water temperature was in excess of 24 °C upon flow arrival and quickly decreased to less than 20 °C (Figure 27). Once the leading edge of the water passed, maximum water temperatures remained less than 20 °C for the remainder of the 16 day deployment. The mainstem trap and associated thermograph unit

were removed on 9/17/20. Only invasive warm water species were captured, no *O. mykiss* were captured or observed.

Double Canopy - Pool (LSYR-7.65)

The Double Canopy Pool is located directly upstream of the Refugio Bridge. The pool was approximately 350 feet long, 40 feet wide, and 3.0 feet deep at its deepest point when the habitat is filled and flowing. A two unit vertical array was deployed at this site from 4/30/20 to 11/12/20 due to its relatively shallow depth. With the exception of early May, maximum surface water temperatures remained less than 22 °C with minimum water temperatures less than 20 °C (Figure 7 (c) and Figures 28-29). Bottom water temperatures were notably cooler compared to the surface. *O. mykiss* were observed in this habitat during the summer snorkel surveys as well as carp, bass, and sunfish. An optic shuttle malfunction resulted in loss of data from 8/24/20 through 9/22/20.

Head of Beaver Pool (LSYR-8.7)

This habitat is located approximately ¼ mile downstream of the Quiota Creek confluence with the Santa Ynez River. The habitat is approximately 730 feet long, 50 feet wide, and 5.5 feet at the deepest point while residual pool depth is being maintained. A vertical array was deployed in this habitat from 4/30/20 to 11/12/20. Maximum surface temperatures ranged from 22 °C to 24 °C during the warmest portion of the year with minimum surface temperatures less than 19.5 °C during the entire deployment period. (Figure 7 (d) and Figures 30-32). The middle and bottom units recorded slightly lower temperatures compared to the surface making this a suitable rearing habitat. Maximum water temperature decreased to less than 20 °C coincident with the WR89-18 downstream release. No *O. mykiss* were observed at this habitat, only bass during the summer survey. One *O. mykiss* was observed in a run habitat 150 feet upstream during the spring and summer surveys showing successful rearing. Unfortunately that *O. mykiss* was found dead during the fall snorkel survey; a likely result of heron predation as a deep puncture wound was observed in the mid-body of the fish.

Alisal Bedrock Pool (LSYR-10.2)

The Alisal Bedrock Pool is a corner scour pool habitat approximately 60 feet long and 40 feet wide with a maximum depth of 9 feet. A vertical array was deployed in the habitat from 4/30/20 to 11/12/20 (Figure 7 (e) and Figures 33-35). Water temperature data at the surface and middle are nearly identical with maximum temperatures fluctuating between 23 °C to 25 °C and minimum temperatures ranging from 20 °C to 22 °C. Temperatures collected at the bottom of the habitat were notably cooler. No *O. mykiss* were observed at this habitat, only invasive warm water species.

Avenue of the Flags – Pool (LSYR-13.9)

The habitat was approximately 65 feet long and 20 feet wide at its widest point with a maximum depth of approximately 4 feet. A single unit was deployed in this habitat from 4/30/20 to 11/12/20 one foot off the bottom. Water temperatures showed more variation from the start of the deployment until the second week in June when water temperatures quickly decreased to less than 20 °C. This temperature pattern has been routinely observed at this location as surface water flow decreases to a trickle flowing into the

habitat, greater groundwater contribution lowers water temperature and the daily variation. Water temperatures quickly elevated to almost 22 °C as the leading edge of the WR89-18 water reached the site, followed by a cool down to less than 18 °C (Figure 7 (f) and Figure 36). No *O. mykiss* were observed at this location.

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 4/30/20 to 11/12/20. The surface unit was exposed to air from 5/23/20 to 7/16/20 due to declining water levels. The data showed stratified conditions developed with warmer water at the surface compared to the middle and bottom of the habitat (Figure 8 (a) and Figures 37-39). These stratified conditions persisted until WR89-18 release water reached the site. Maximum surface temperatures approached 26 °C during the mid-August heatwave before decreasing to less than 18 °C once WR89-18 water reached the site. Bottom maximum temperatures remained less than 20 °C except for a brief period when warmer water first entered the habitat. No *O. mykiss* were observed at this location in WY2020, only invasive species including largemouth bass, green sunfish, and carp.

LSYR Mainstem Longitudinal Comparisons

Longitudinal LSYR mainstem (maximum daily) water temperature at the surface thermographs for LSYR-0.01, LSYR-0.51, LSYR-0.68, LSYR-1.09, LSYR-1.54, LSYR-1.71, LSYR-4.95, LSYR-7.65, LSYR-8.7, LSYR-10.2, LSYR-13.9, and LSYR-22.68 are presented in Figure 40. Longitudinal maximum surface temperature comparison was complicated to interpret due to the variety of complex environmental variables all acting in conjunction with each other at each individual site (i.e., flow rate, riparian vegetation development/ riparian shading, ambient air temperatures, groundwater upwelling, pool stratification, etc.). In addition, the analysis only looked at a small portion of the overall habitat and does not reflect the general rearing potential throughout the water column of each of the habitats. For a more complete presentation of each specific habitat, see above.

Factors influencing surface water temperatures along the longitudinal profile presented can be: (1) thermally-warmed Stilling Basin surface water moving downstream resulting in an increase in stream temperature; (2) dry cobble bars with extensive exposure to the sun that warm the leading edge of any released waters moving downstream that can cause elevated temperatures usually over a short period of time until the full rate of the release arrives and cools the water column thereafter; and (3) the arrival of a WR 89-18 release that elevates water temperatures (associated with the aforementioned factors) for a short period (1-2 hours) followed by a drop in water temperature to favorable conditions for *O. mykiss*.

The wet spring and Hwy 154 target flows enabled river flows to persist through the entire Hwy 154 Reach through LSYR-4.95 and in some sections of the river in the Refugio Reach and Alisal Reach from approximately LSYR-7.0 to LSYR-10.5 (i.e., LSYR-7.65 and LSYR-8.7). Much of the river dried from LSYR-5.0 to LSYR-7.0 as well as portions

of the river downstream of Avenue of the Flags Bridge (LSYR-13.9) and in areas directly upstream and downstream of the Narrows.

All sites showed typical seasonal warming with an increase in ambient air temperatures and decreasing flow rates prior to WR89-18 with lower temperatures recorded at all monitoring sites once the downstream release reached each site. Of note compared to previous years was the overall cooler water temperatures recorded at most of the LSYR mainstem monitoring locations. Maximum water temperatures generally remained less than 24 °C during the warmest portion of the year, prior to WR89-18 releases reaching each site. The two exceptions to the above observation were LSYR-4.95 and LSYR-10.5 which recorded noticeably higher water temperatures compared to the other locations.

O. mykiss and Water Temperature Criteria within the LSYR Mainstem

YOY, juvenile, and adult *O. mykiss* were observed at various locations in the spring, summer and fall within the first 8.0 miles downstream of Bradbury Dam showing that habitat conditions remained favorable for rearing fish in this section (except for the dry section from about LSYR-5.0 to LSYR 6.5). The majority of the YOY were localized to areas upstream of LSYR-1.09 with most of these small fish likely originating from the successful spawning in Hilton Creek during the spring of 2020 that washed down during stormflows. Juvenile and adult *O. mykiss* were observed in larger numbers in the mainstem than have been observed in the past 10 years, with highest densities of fish observed in and around the Hwy 154 Reach specifically within the Grimm property and upstream sections of the Refugio Reach. Most of these fish inhabited deeper pool habitats where stratification and groundwater inflow contributed to lower water temperatures. Monitored water temperatures showed cooler and more favorable rearing conditions compared to previous years. Plus there were more upstream production of *O. mykiss* than in previous years that may also helped explain the greater prevalence of *O. mykiss* in both the number of habitats and overall numbers of *O. mykiss* observed in the LSYR mainstem in WY2020.

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 run habitat approximately 250 feet upstream of the delta confluence of Hilton Creek and LSYR mainstem (Long Pool). The unit was deployed near the bottom in approximately 1.5-foot of water from 4/29/20 to 11/19/20. Water temperatures remained near or less than 16 °C during the majority of the deployment period (Figure 8 (b) and Figure 41). YOY *O. mykiss* were observed throughout this area during all of WY2020. No invasive species were observed in the lower section of Hilton Creek during spring and fall snorkel surveys.

Upper Hilton Creek (HC-0.54)

A single thermograph was deployed in a pool habitat adjacent to the URP release site from 4/29/20 to 11/19/20. The instrument was placed at the bottom of a pool habitat 20 feet long and 10 feet wide with a depth of approximately 1.5 feet. Water temperatures

remained at or less than 15 °C for the majority of the deployment period (Figure 8 (c) and Figure 42). *O. mykiss* were observed inhabiting the creek at this monitoring location throughout the year indicating optimal rearing conditions. No invasive species were observed in the upper portion of Hilton Creek during spring and fall snorkel surveys.

In comparing water temperatures differences between the Upper and Lower Hilton Creek, data showed less than a 1.5 °C increase in water temperature due to thermal heating between the upper and lower monitoring sites. Splitting the release between the URP and the LRP and increasing to a higher discharge rate would help reduce the effect of thermal heating within the creek and lower LSYR mainstem water temperatures downstream within the Highway 154 Reach during the critical dry season rearing period.

Quiota Creek (QC-2.66)

A single thermograph was deployed approximately 20 feet upstream of Crossing 6 on Refugio Road from 5/1/20 through 11/5/20 (Figure 8 (d) and Figure 43). 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. Maximum water temperatures fluctuated between 20 °C and nearly 24 °C (mid-August heatwave) during the period of deployment. Minimum water temperatures generally remained below 15 °C except during the heat wave in August. Juvenile *O. mykiss* were observed rearing in this habitat. However, on 10/22/20, the pool was no longer maintaining residual pool depth and the creek was drying rapidly.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed in this habitat approximately 4.5 feet below the surface from 5/1/20 to 11/4/20. During the winter of 2017, stormflows changed the configuration of this habitat from a relatively shallow run to a pool habitat 30 feet long and 15 feet wide with a maximum depth of approximately 5 feet. This site is immediately downstream of the Salsipuedes Creek migrant trapping location.

Water temperatures showed a gradual decrease as the season progressed and flows diminished. Temperatures were warmer during the May and early June timeframe coincident with greater streamflow before decreasing to less than 20 °C during the warmest portion of the year indicating possible cooler groundwater influences (Figure 8 (e) and Figure 44). The cooler temperatures provide good rearing conditions, however, no *O. mykiss* were observed at this monitoring site, only invasive green sunfish.

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

A single thermograph was deployed in a pool habitat approximately 4 feet below the surface from 5/1/20 through 11/5/20. Reach 2 is a short bedrock section with deep pools, extends approximately 1/3 of a mile, and represents some of the best habitat for oversummer rearing *O. mykiss* within the entire Salsipuedes/El Jaro Creek watershed due to the presence of numerous bedrock formed pools. The monitored habitat is approximately 40 feet long, 15 feet wide, and 6 feet deep at its deepest point. *O. mykiss* have been routinely observed at this location when visibility permits. Spawning surveys routinely document *O. mykiss* redds in this reach of the creek. Water temperatures were warmest during the May and June timeframe compared to the rest of the year (Figure 8

(f) and Figure 45). Overall, maximum water temperatures remained between 18 °C and 22 °C during the warmest portion of the year. Two brief spikes in excess of 22 °C were recorded during the mid-August heatwave. Starting in early September, water temperatures rapidly cooled to less than 18 °C. *O. mykiss* were observed in this reach during the spring snorkel surveys in WY2020. This habitat is abundant with invasive green sunfish.

Salsipuedes Creek – Highway 1 Bridge (SC-3.0)

A single thermograph was deployed in the pool habitat approximately 4 feet below the surface, directly downstream of the Hwy 1 fish ladder from 5/1/20 through 6/1/20. On 6/1/20, the unit was relocated 200 feet downstream to a large pool habitat due to CalTrans bridge replacement construction activities. The unit was removed on 11/9/20. Highway 1 pool habitat historically was approximately 85 feet long and 18 feet wide with a maximum depth of 7 feet. This area routinely holds *O. mykiss* and many were observed in WY2020. Due to the construction project, the new deployment site was 200 feet downstream in the deepest pool on Salsipuedes Creek measuring 175 feet long and 45 feet wide with a maximum depth of 12 feet. This thermograph location is near the top of Reach 4, the second significant bedrock influenced section of the creek. Reach 4 is similar to Reach 2 in that there are numerous deep pool habitats formed in the bedrock that offer excellent oversummering opportunities for rearing *O. mykiss*. Water temperatures were relatively cool with maximum temperatures remaining less than 22 °C during the warmest portion of the season. Minimum temperatures generally ranged from 19 °C to 21 °C (Figure 9 (a) and Figure 46). *O. mykiss* were observed in both of these habitats in the spring of WY2020. Green sunfish were also observed in both habitats during spring snorkel surveys.

Salsipuedes Creek – Jalama Bridge (SC-3.5)

A single thermograph was deployed in a pool habitat approximately 4 feet below the surface, directly downstream of the Jalama Bridge fish ladder from 5/1/20 through 11/9/20. The pool was approximately 30 feet long, 18 feet wide, and 6 feet in depth. The creek upstream and downstream of this monitoring location was one of the few stretches in the creek that provided minimal flow and rearing habitat during the recent drought. This area routinely holds oversummering *O. mykiss* and *O. mykiss* were observed in this habitat as well as in upstream and downstream habitats during the spring and fall snorkel surveys in WY2020.

Maximum water temperatures ranged from around 20 °C to over 23 °C during the warmest portion of the year with minimum temperatures generally remaining less than 19 °C except during the mid-August heatwave (Figure 9 (b) and Figure 47). These temperatures provided suitable rearing conditions for *O. mykiss* present in this and the surrounding habitats. Green sunfish were also present in this habitat.

Upper Salsipuedes Creek (SC-3.8)

Upper Salsipuedes was negatively impacted by the prolonged drought which dried the creek for an extended period of time and extirpated *O. mykiss* entirely from the portion of Salsipuedes Creek upstream of its confluence with El Jaro Creek. In the years before the

drought, Upper Salsipuedes routinely held various age classes of *O. mykiss* as well as multiple spawning locations for both resident and anadromous steelhead.

A single thermograph was deployed on the bottom of the creek in a shallow run habitat 15 feet long, 4 feet wide, and approximately 0.5-foot deep from 5/1/20 through 11/10/20. No *O. mykiss* were observed at this site throughout the monitoring period although water temperatures were favorable for rearing in this section of the creek. *O. mykiss* were observed in the confluence pool habitat approximately 35 feet downstream. Maximum water temperatures remained less than 21 °C except during the mid-August and early September heatwave which increased temperatures to 23 °C for a brief period of time. Minimum temperatures remained less than 16 °C for the majority of the deployment period (Figure 9 (c) and Figure 48). YOY *O. mykiss* were observed immediately downstream in the confluence pool of Salsipuedes/El Jaro Creeks.

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

A single thermograph was deployed at the bottom of a pool habitat immediately upstream of the El Jaro/Salsipuedes Creek confluence from 5/1/20 to 11/10/20. The habitat is roughly 50 feet long and 12 feet wide with a max depth of 3.5 feet. This location routinely held rearing *O. mykiss* prior to the drought and one *O. mykiss* was observed in this habitat in the spring of WY2020. Water temperature data collected at this location was the coldest compared to the other thermographs within the watershed. Greater variation was observed in the early portion of the deployment coincident with higher streamflow entering the habitat. As the season progressed and flow decreased, stratification and cool water upwelling greatly influenced this habitat. Temperatures generally remained less than 17 °C during the warmest portion of the year (Figure 9 (d) and Figure 49). YOY *O. mykiss* were observed immediately upstream and downstream of this monitoring location during snorkel surveys in WY2020.

El Jaro Creek – Palos Colorados (EJC-5.4)

A single thermograph was deployed 0.5 feet from the bottom of a boulder-influenced pool habitat from 5/1/20 through 11/5/20. The habitat measured approximately 35 feet long, 7 feet wide and 3.5 feet deep. *O. mykiss*, including YOY, juveniles and adults have been observed sporadically in past years in and around the monitored habitat. This area is influenced by Palos Colorados Creek where there is a spring that confluences with El Jaro Creek approximately 1/8 of a mile upstream of the monitoring pool. Water from the spring allowed this area of El Jaro Creek to remain wetted throughout the drought and provided a cool pool refuge habitat for any *O. mykiss* inhabiting this area. The remainder of El Jaro Creek upstream of Palos Colorados Creek essentially dried during the spring/summer months of 2013-2016, completely extirpating *O. mykiss* from this section of the creek. No *O. mykiss* were observed in 2020. As seen in 2019, water temperatures collected at this location strongly mimic those collected at SC-2.2. Water temperatures were cooler than recorded in 2019 with maximum temperatures generally remaining less than 20 °C during the warmest portion of the year (the mid-August heatwave being the exception) (Figure 9 (e) and Figure 50). Minimum temperatures remained less than 18 °C during the majority of the deployment period.

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

O. mykiss have regularly been observed within the plunge pool, the fish ladder, and in habitats upstream of the fish ladder in past years; however, the drought has extirpated *O. mykiss* from large sections of upper El Jaro Creek including in and around the San Julian Ranch bridge as large portions of the creek did not flow in the summer of 2013, 2014, and were completely dry in 2015 and 2016. However, a single adult *O. mykiss* was observed in this habitat during the 2020 spring snorkel surveys indicating that recolonization is possible provided flow conditions persist. A thermograph was deployed in the pool habitat immediately downstream of the bridge from 5/1/20 and removed on 11/5/20. During the deployment, water temperatures generally remained less than 20 °C during the warmest portion of the year, mid-August heatwave being the exception (Figure 9 (f) and Figure 51).

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 5/1/20 through 11/5/20. The habitat is 30 feet long, 15 feet wide, and 3.0 feet deep and is located approximately 1/8 of a mile upstream from the confluence with El Jaro Creek. Los Amoles Creek has regularly held various age classes of *O. mykiss* and spawning sites have been identified in the creek over the years. Recent drought conditions have negatively impacted the creek with vast sections of Los Amoles Creek dry several hundred feet upstream of the monitoring location. It is likely *O. mykiss* have been temporarily extirpated from the upper portions of this tributary since the prolonged drought. Conversations with the land owner in 2020 indicate that the majority of the creek upstream of the monitoring location was completely dry once again.

Maximum water temperatures in the small flowing section of Los Amoles Creek were somewhat cooler compared to other monitoring stations in the watershed. Overall, maximum water temperatures remained less than or close to 19 °C for the majority of the deployment with minimum temperatures generally remaining less than 18 °C (Figure 10 and Figure 52). No *O. mykiss* were observed at this monitoring location in WY2020.

Salsipuedes Creek Longitudinal Comparisons

Longitudinal maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 53 for the thermographs at Rancho San Julian (EJC-10.82), Palos Colorados (EJC-5.4), the confluence with El Jaro/Salsipuedes Creek EJC-(3.81), Upper Salsipuedes Creek upstream of the El Jaro confluence (SC-3.80), Salsipuedes Creek at Jalama Bridge (SC-3.5), Salsipuedes Creek at Highway 1 Bridge (SC-3.0), Salsipuedes Creek in the Reach 2 Bedrock Section (SC-2.20), and lower Salsipuedes Creek (SC-0.77). Also included in the graph is the Los Amoles Creek monitoring location (LAC-7.0) which is a tributary to El Jaro Creek and approximately 2.5 miles upstream of EJC-5.4.

Overall, water temperatures collected in the Salsipuedes/El Jaro Creek watershed were noticeably cooler compared to previous years. With the exception of the early monitoring period of May through early June and again during the mid-August heatwave, maximum water temperatures remained less than 22 °C for the majority of the deployment period.

When looking at Salsipuedes Creek flow, there was more variation between the sites at flows greater than 0.5 cfs. As flows decreased, less temperature variation was observed, primarily after the middle portion of June. SC-2.2 and SC-3.5 were generally the warmest while EJC-3.81 was the coldest.

O. mykiss and Water Temperature Criteria within the Tributaries

The Salsipuedes/El Jaro Creek watershed is a dynamic system with many variables that influence water temperatures at any given time. The amount of surface flow, depth within individual habitats, groundwater upwelling, ambient air temperatures, drought, and presence/absence of riparian vegetation all influence the flow and thermal regime within individual habitats in the watershed. The recent drought caused much of the Salsipuedes/El Jaro Creek habitat to constrict down to a few fragmented and isolated flowing sections of creek. The wet water year of 2019 (33.99 inches at Rancho San Julian) and average water year of 2020 (21.0 inches at Rancho San Julian) have helped to some degree reconnect the creek system. However, there are portions of El Jaro Creek, most of Los Amoles Creek, and all of Ytias Creek that went dry in WY2020. Whether this is being exasperated by the long-term drought conditions in the past or some other draw on the groundwater supply is not clear but the watershed has not recovered entirely to pre-drought dry season condition.

Spawning surveys identified 9 separate redd sites within Salsipuedes Creek and none in El Jaro Creek. Follow up snorkel surveys noted the presence of YOY throughout the majority of Salsipuedes Creek and to a lesser extent the lower portions of El Jaro Creek with none observed in the upper part of the creek. Looking at the monitoring locations within the watershed, it is encouraging to see lower water temperatures during the critical summer period compared to previous years. Based on the data, habitat conditions improved throughout the watershed indicating there was a greater likelihood of YOY survival in the habitats they occupy.

Invasive species in the Salsipuedes/El Jaro Watershed

Various sections of primarily lower Salsipuedes Creek and to a lesser extent El Jaro Creek have been inhabited over the past several years by invasive warm water species, specifically green sunfish, largemouth bass, bullhead catfish, bullfrog, and carp. Their numbers have been low and they have generally been relegated to the lower sections of Salsipuedes Creek (downstream of Reach 2) and a few deeper habitats in and around EJC-4.0 on El Jaro Creek. Invasive fish are entering the creek at the confluence with the LSYR mainstem and traveling upstream into the creek when flows permit. Snorkel surveys conducted during WY2019 and WY2020 have yielded concerns regarding the increased numbers, wider distribution and observed high reproduction rate of green sunfish in the Salsipuedes and El Jaro creek drainage. The increased number of invasive species will be discussed in the Snorkel Survey section below.

Dissolved Oxygen and Temperature at LSYR-0.01 and LSYR-4.95: A series of Onset U-26 dissolved oxygen/temperature loggers were deployed at two locations in the LSYR to monitor water quality within the first 5 miles downstream of Bradbury Dam

during the WR 89-18 water rights releases. Each array deployment site will be discussed separately.

Stilling Basin (LSYR-0.01)

A three unit U-26 array was deployed several days ahead of the start of the WR89-18 release (8/31/20) off of the parapet wall of the Stilling Basin with the top unit one foot below the surface, the middle unit 14-foot below the surface, and the bottom unit 28-foot below the surface. Prior to the WR89-18 release, water temperatures showed a typical distribution with warmer water temperatures at the surface and cooler at the middle and bottom due to stratification. Dissolved oxygen (DO) showed a similar distribution with greater concentration of DO at the surface with decreased levels deeper in the water column (Figure 54). Prior to the WR 89-18 release, surface values were generally greater than 8 mg/L, middle values were decreased to between 6-7 mg/L and bottom values were approaching zero. Following the WR 89-18 release, the entire Stilling Basin became uni-thermal with temperatures hovering around 14 °C and DO concentrations increasing at all three units to around 10 mg/L, showing better rearing conditions throughout the water column compared to before the release.

Encantado Pool (LSYR-4.95)

The three unit array was deployed several days ahead of the WR 89-18 release at one foot below the surface, 4-foot below the surface, and 8-foot below the surface near the bottom. Prior to the release, water temperature showed a typical distribution with warmer water at the surface and cooler water at the bottom. Conversely, DO data showed nearly identical values at each of the three points in the water column with DO concentrations fluctuating between a low of 4 mg/L and a high of around 12-14 mg/L. After the WR 89-18 release arrived, the pool became uni-thermal with water temperatures remaining less than 18 °C and DO concentrations across the three units recording in excess of 8 mg/L (Figure 55).

Lake Cachuma Water Quality Profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 1/7/20, 2/11/20, 3/4/20, 4/7/20, 6/2/20, 7/7/20, 8/4/20, 9/1/20, 9/29/20, 11/3/20, 11/20/20 and 12/1/20 (Figure 56). The purpose of collecting lake profiles is to gather vertical temperature and DO concentrations to assure that the depth of the adjustable intake hose for the HCWS is set to provide optimum conditions for *O. mykiss* in Hilton Creek, at or below 18 °C as stipulated in the BiOp. Lake profiles are not obtained from the deepest part of the lake; rather, profiles are obtained near the HCWS intake to look at water quality conditions going into Hilton Creek. In 2020, lake profile measurements were taken from a boat moored up to the HCWS intake barge off the back of the boat so that the submerged monitoring equipment was not sucked into the intake. The HCWS intake has been set at an approximate depth of 65 feet below the water surface, and temperatures of the released water are typically well below 18 °C. Lake Cachuma reservoir elevation remained high in WY2020 compared to the drought period between WY2012-WY2016, so water temperatures being released into Hilton Creek remained generally below 16 °C throughout the year.

The first lake profiles of the year occurred in January and February indicating very cold and uniform reservoir temperatures from the surface down to the bottom of the lake, ranging from 12.7 °C – 12.3 °C and 12.6 °C – 11.6 °C, respectively (Figure 56). The third profile in March indicated a slight warming at the surface with cooler temperature remaining at most depths. By the middle of the spring (April), the surface temperature had reached 16.2 °C with the thermocline just beginning to form at a depth of 20 feet. The final spring profile occurred at the start of June with the surface warming to 21.8 °C and a steady thermocline developing to depth. There were three summer lake profiles conducted between July and September, each showing increasing surface temperatures over time from 23.6 °C in July to a maximum of 24.5 °C in September. All three profiles had the thermocline forming around 26 feet below the surface and extending down to approximately 53 feet in depth. Bottom temperatures during the same time frame ranged from 12.9 °C – 13.1 °C. End of September and early November profiles indicated the surface of the lake had cooled significantly, but the reservoir was still in a stratified condition. The lake profile on November 20th showed near unithermal conditions from the surface (17.0 °C) down to 20 meters (16.1 °C). The bottom temperature reading was only a few degrees cooler at 13.5 °C. The COMB-FD staff returned on 12/1/20 and found that surface (15.2 °C) and bottom (13.5 °C) temperatures were even more similar to the end of November profile, indicating near unithermal temperatures from top to bottom.

DO concentrations at the surface of the lake gradually climbed from 8.25 mg/l in January to 9.73 mg/l in March (Figure 56). Except for the bottom DO measurement, DO concentrations remained above 6.0 mg/l at all depths during the first three profiles. The profile collected in April revealed the highest surface DO concentration of the year at 11.5 mg/l. In fact, the first 60 feet of depth in April contained a DO greater than 7.0 mg/l. The amount of oxygen available at depth greatly decreased during the next profile in June. Although the surface DO concentration was 9.0 mg/l, it quickly dropped off at depth with less than 5.0 mg/l recorded from 46 feet down to the bottom of the lake. Lake Cachuma showed hypolimnetic oxygen depletion beginning during the July profile and lasting through the end of September. DO values less than 5.0 mg/l extending all the way to the bottom were observed at a depth of only 32 feet in July, 36 feet in August, and 30 feet in September. DO conditions to depth slightly improved during the two measurements in November, with anoxic (< 5.0 mg/l) conditions found at 49 and 69 feet down to the bottom on 11/3/20 and 11/20/20, respectively. The final profile taken in December had a surface DO concentration of 7.65 mg/l, with high oxygen content down to about 79 feet (7.57 mg/l) below the surface. At 82 and 85 feet below the surface, DO content began to crash with values of 3.29 mg/l and 0.48 mg/l, respectively. The remaining DO measurements towards the bottom were all anoxic with readings between 0.04 – 0.18 mg/l.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2020 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 WY2020 LSYR mainstem 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 2020 showed an increase of LSYR mainstem riparian growth since the target flows were required to be met at the Alisal Bridge (2005), approximately 10.5 miles downstream from Bradbury Dam (Figures 57-61). 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. The recent drought caused significant die off of riparian vegetation throughout the mainstem with some areas being impacted harder than other areas. The last Bradbury Dam spill event occurred in 2011. Since 2011, the region has experienced 5 consecutive years of drought and decreased flows throughout the entire watershed. The last several years (WY2017, WY2019, and WY2020) of average to above average rainfall has resulted in positive changes to the riparian vegetation with new growth observed in areas hit hard by the drought. WR 89-18 releases provide a water source for riparian plants during the latter part of the summer and the fall. In addition, there hasn't been a spill event to scour out the river channel all resulting in favorable conditions for riparian growth.

Photo documentation within Hilton Creek continues to show a maturing/drought recovering riparian zone, particularly within the reach between the URP and LRP which was initially activated in 2005 (Figures 62-63). Larger trees (willows, alders, sycamores, and cottonwoods) are replacing the smaller understory within the drainage. Salsipuedes and El Jaro Creeks showed recolonization of riparian vegetation after the 2005 flow events, the drought and two years of channel changing flow events in 2017 and 2019 (Figures 64-66). In addition, the cattle exclusionary fencing installed in lower Salsipuedes Creek (completed in WY2015) has contributed to an increase in riparian growth in those reaches where cattle no longer eat, trample and damage emerging vegetation. Large flows are important in both the LSYR mainstem and its tributaries as they clear out potential passage barriers/impediments and remove debris/silt and generally clean out potential spawning locations for mating *O. mykiss*.

3.4. Migration - Trapping

Migrant trapping activities to monitor both migrating anadromous and resident *O. mykiss* have been conducted on the Santa Ynez River and/or several of its tributaries every year since 1993. There were a few exceptions to this due to the endangered listing of steelhead (1997), and threatened listing of California red-legged frog (2000) which caused trapping delays due to scientific permitting issues during those years, and WY2013 due to a

misinterpretation of a NMFS request by Reclamation. Results from this year's migrant trapping effort remained below the 2000 BiOp established Incidental Take Statement (ITS) limits.

WY2020 was the seventh 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 at Hilton Creek and Salsipuedes Creek can be modified with a pass-through gate system that allows any fish entering the trap to move through the trap unencumbered. A 12-inch HDPE pipe approximately 15-feet long can be secured to the back of the downstream traps below the water level to provide unhindered downstream movement when activated. During the WY2020 trapping season, the HDPE pipe was installed at Hilton Creek only to stay within established take limits. It was decided that a HDPE pipe was not necessary at the Salsipuedes Creek trap and LSYR mainstem trap sites due to the low population size and limited captures for the past three years. Take was not exceeded during the WY2020 trapping season.

In WY2020, migrant traps were deployed at the same locations as during WY2019. 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 6.08 miles downstream of Bradbury Dam (LSYR-6.08). Migrant traps were installed in Hilton Creek (2/5/20 – 5/19/20) and Salsipuedes Creek (3/24/20 – 5/15/20) and at the LSYR mainstem (4/9/20 to 4/24/20) (Table 7). The reason for the late deployment at the LSYR mainstem site was due to low flows that were not favorable for fish passage. The LSYR mainstem trap was pulled early in order to provide unimpeded movement for smolts at the beginning of the second (pulse) Passage Supplementation event.

The weather pattern during WY2020 was not conducive in providing prolonged migratory conditions. A wet December 2019 with 7.19 inches of rain (34.2%) was followed by a dry January (0.48 inches) and a dry February (0.06 inches). The watershed was primed for a significant runoff event following December, particularly since January and February are typically among the wettest months during the rain year. However, that did not occur and drying conditions prevailed for the next 60 plus days. A wet March (8.13 inches, 38.2%) and April (3.58 inches, 17.0%) resulted in a large runoff event starting on 4/6/20 that opened the lagoon to the ocean for the first time of the water year on 4/7/20 (Table 3). The lagoon remained open throughout the rest of the water year but flow conditions at H Street reached zero on 5/17/20, eliminating passage opportunities

for both upstream migrating anadromous adults and downstream migrating juvenile smolts.

During WY2020, there were 51 passage days with flows greater than 25 cfs at Solvang during the migration season. There were two Passage Supplementation Releases that occurred (see 2020 Passage Supplementation Report for additional details) near the end of the migration season. The first release occurred 4/7/20-4/24/20 and created 18 passage days. The second release occurred 4/25/20-5/13/20 and created 19 passage days. When combined, both Passage Supplementation Releases accounted for 72.5% of all passage days greater than 25 cfs at Solvang during the migration season. Catch per unit effort (CPUE) for the WY2020 at the Hilton, Salsipuedes, LSYR mainstem migrant traps was 82.7%, 90.2%, and 100% efficiency, respectively (Table 8).

Nighttime fish movement is a well-documented adaptation to avoid predation during migration (Mains and Smith, 1964; Krcma and Raleigh, 1970; Meehan and Bjornn, 1991; Brege et al., 1996). Others found that elevated turbidity can also reduce predation, specifically during stormflow events, suggesting migration during the receding limb of storm hydrographs (Knutsen and Ward, 1991; Gregory and Levings, 1998). The COMB-FD staff checks each trap a minimum of 4 times per 24-hour period. Fish captures are recorded into the following time categories; 1st AM (05:00-10:00), 2nd AM (10:01-14:00), 1st PM (18:00-22:00) and 2nd PM (22:01-01:59) depending on when they were captured. WY2020 migrant trapping results suggested *O. mykiss* were more likely to move during the late night (2nd check) and early morning hours (first check) (Table 9).

With 21.03 inches of rain recorded at Bradbury Dam, WY2020 ranked just above the 2 year recurrence interval in Santa Barbara County for total rainfall amount (2-year recurrence = 18.22 inches). The nearest County rainfall station in the El Jaro/Salsipuedes Creek watershed is at Rancho San Julian (Station 389). In December 2019, Rancho San Julian recorded 7.17 inches of rain. That amount of rain recharged the watershed but did not provide any significant long-term runoff, fish passage opportunity, or reach the lagoon proper as no flow was recorded at the USGS gauging station at H Street until the mid-March storms. It was not until the 4/6/20 storm that the LSYR mainstem and its tributaries had sufficient streamflow for full ocean/lagoon connectivity for upstream and downstream fish passage. By 4/18/20, flows had decreased to less than 5 cfs indicating the small window of opportunity for any migrating adult steelhead attempting to reach Salsipuedes Creek and tributaries up the LSYR mainstem. In the LSYR, the USGS Solvang gauge during the same storms described above created maximum flows of 36.3 cfs on 12/26/20 and 1,470 cfs on 4/6/20. Two passage supplementation releases were initiated in April and are discussed below. By 5/9/20, flows in the mainstem had decreased to less than 25 cfs. Baseflows in Hilton Creek remained essentially greater than 3.0 cfs during the migration period, with peak flow events greater than 50 cfs occurring on 12/25/19, 3/16/20, 3/22/20 and 4/5/20. Migration opportunities were suitable for resident *O. mykiss* occupying areas downstream of Hilton Creek and within the Highway 154 Reach and are discussed below.

Hilton Creek Migrant Traps: Both upstream and downstream migrant traps were installed from 2/5/20 through 5/19/20 (Table 7). There were 49 upstream migrant captures ranging in size from 65 mm (2.6 inches) to 456 mm (18.0 inches) of which 4 were recaptures (Figure 67, Figure 68, and Table 10). Twenty one of the upstream migrants were classified as parr, 5 were classified as juveniles, 1 classified as a presmolt, and the remainder (22) were classified as adults. Upstream migrating fish were captured throughout the trap deployment and numbers captured were not related to any particular runoff event (Figure 69). There were 90 downstream migrating fish captured ranging in size from 64 mm (2.5 inches) to 400 mm (15.7 inches) of which 10 were recaptures. Downstream migrating fish were captured throughout the trap deployment and numbers captured did show a response to increased flow conditions following elevated flow from stormflow events, particularly after 3/24/20 (Figure 69). Thirty six of the fish were classified as parr, 36 were classified as juveniles (including smolts and presmolts) and the remainder (18) were classified as adults. Of the downstream migrating fish, 32 were classified as smolts or presmolts with 2 captured in February, 11 in March, 17 in April, and 2 in May (Figure 70). Average smolt size varied by month and the cumulative average was 141.7mm (5.6 inches). No anadromous *O. mykiss* were captured.

During the 104 days of trapping operations, both the upstream and downstream traps operated for a period of 86 days (82.7% efficiency). The traps had to be removed for a total of 18 days during 3 storm events. The catch per unit effort (CPUE) for upstream and downstream fish was 0.57 and 1.05 captures per day, respectively (Table 8). Of the 139 migrant captures, 100 (72%) occurred during the hours of darkness showing that the majority of migrating fish travel at night to reduce predation (Table 9).

Salsipuedes Creek Migrant Traps: Trapping was conducted in Salsipuedes Creek from 3/24/20 through 5/15/20 (Table 7). Only 2 upstream migrating *O. mykiss* were captured one measured 298 mm (11.7 inches) and the other measured 73 mm (2.9 inches). There was only one downstream migrating fish captured measuring 68 mm (2.7 inches). All of the migrant captures occurred following the 4/6/20 storm event (Figures 67, Figures 71-72, and Table 10).

No smolts were captured in Salsipuedes Creek in WY2020 (Figure 70). This finding illustrates the detrimental impact of the previous drought in terms of *O. mykiss* survival and smolt production within the Salsipuedes/El Jaro Creek watershed. The *O. mykiss* population in the basin is still recovering from the prolonged drought. Only 1 of the 3 migrating fish was captured during the hours of darkness (Table 9). No anadromous *O. mykiss* were captured.

During the 51 days of trapping operations, both the upstream and downstream migrant trap operated for a period of 46 days (90.2% efficiency) (Table 8). The traps had to be removed for a total of 5 days during 1 storm event. The CPUE for Salsipuedes was an anemic 0.04 captures per day for upstream and 0.02 captures per day for downstream.

Trapping results in Salsipuedes Creek illustrated the impact that the recent drought has had on the *O. mykiss* population inhabiting the watershed. Prior to the drought, wet year

types (1995, 1998, 2001, 2005, 2008, and 2011) resulted in numerous adult upstream captures and many downstream smolt captures. During the last two wet years, (WY2017 and WY2019), no upstream migrating fish have been captured and only one smolt has been captured at the Salsipuedes Creek trap site, with none captured in WY2020.

A comparison of the trapping results between Salsipuedes Creek and Hilton Creek is provided in Table 10 and discussed in Section 4.4.

LSYR Mainstem Trap: Trapping was conducted in the LSYR mainstem approximately 6.08 miles downstream from Bradbury Dam from 4/9/20 through 4/24/20 (Table 7). There were two consecutive Fish Passage Supplementation releases initiated (4/7/20 and 4/25/20), only during the first event was the trap operated. During the second event (Pulse flow release) the traps were pulled to assure no impediment to fish passage. Storm events in combination with passage supplementation releases provided 51 days of flow greater than 25 cfs at the Alisal Bridge (37 consecutive days from 4/7/20 to 5/13/20). Through the LSYR mainstem trap deployment, no upstream migrants were captured. There were 5 downstream migrating *O. mykiss* captured, all classified as smolts with an average length of 201.6 mm (7.9 inches) (Figure 70). The first smolt was captured on 4/12/20 and the last smolt was captured on 4/24/20 (Figure 73). The smallest smolt measured 169 mm (6.7 inches) and the largest measured 264 mm (10.4 inches) (Figures 74 - 75 and Table 10). Invasive warm water species captured included largemouth bass, green sunfish, bluegill, carp, bullhead catfish, and bullfrogs. The vast majority of the invasive species were captured in the downstream trap indicating they were moving downstream with elevated flows during the Passage Supplementation event.

During the 15 days of trapping operations, both the upstream and downstream migrant traps operated for a period of 15 days (100% efficiency) (Tables 7-8). Even though the second Passage Supplementation Release ended on 5/13/20, flow at Solvang recorded a daily flow of 23.0 cfs on 5/10/20 and flows continued to decline for the remainder of the spring.

3.5. Aging of *O. mykiss* Migrant Captures plus Mortalities

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. The rate at which fish and their scales grow depends 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 of the lagoon, size at ocean entry, how long they spent at sea, when spawning occurred, and the approximate age they returned to the river. From a fisheries management perspective, it is important to know how long a fish lives, how big a fish can grow, how many offspring a fish can have, and how often they can reproduce. These various parameters make up the life history of the fish.

COMB-FD staff collects *O. mykiss* scales during migrant trapping efforts generally from fish that are greater than 120 mm (4.7 inches), opportunistically during any required fish rescue or if a mortality is found. These scales are dried and stored in envelopes until they can be mounted on a microscope slide per fish 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 condition.

Scales were taken and analyzed on 67 of 147 total migrant captures at the 3 trap sites (Hilton Creek, LSYR Mainstem and Salsipuedes Creek) and 4 mortalities found over the reporting period. The minimum size for sampling was set at 120 mm and some fish could not be sampled or the scales were not representative enough to make a clear determination, hence why the number analyzed is less than the total number of captures. The scales from each fish were dried, placed on individual microscope slides, photographed, and analyzed by COMB-FD to make an age determination. The age range was from 0+ to 5 years old with an associated size range of 82 mm to 431 mm (Table 11). The majority of fish were 1+ in age (29 at 43%), with the second highest category of 3 (9 at 13%) and 3+ (9 at 13%) in age. Two examples of analyzed fish scales would be a 4 year old Hilton Creek upstream migrant resident *O. mykiss* at 417 mm and a 2+ year old LSYR mainstem downstream migrating smolt at 264 mm (Figure 76). Scale analysis is a valuable effort to better understand population dynamics. Further discussion of the results of scale analyses can be seen in Section 4.

3.6. Reproduction and Rearing

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

Redd Surveys: Redd (spawning) surveys are typically conducted opportunistically once a month in the LSYR mainstem (Refugio, Alisal, and Hwy 154 reaches) and bi-monthly in the tributaries (Hilton, Quiota, Salsipuedes, and El Jaro including Los Amoles and Ytias creeks) in the winter and spring within the reaches where access is permitted.

The winter of WY2020 started off with a charged watershed following the December rain totals which were in excess of 7 inches at Bradbury Dam and Rancho San Julian. Historically, January and February are typically months with significant rainfall. However, when combined in WY2020, both months accounted for only 0.54 inches of rain (2.6% of the total). Regardless, the early December rains did provide migratory opportunities for resident *O. mykiss* to move to spawning locations in Hilton, Salsipuedes, and Quiota Creeks during January, February, and March.

There were 34 redd sites documented in the tributaries in WY2020; 24 redds identified in Hilton Creek, 1 in Quiota Creek, and 9 in Salsipuedes Creek (Table 12). In Hilton, 7 redd sites were documented in January, 13 in February, and 4 in March. In Salsipuedes, 2 redd sites were identified in January, 2 in February and 5 in March. One redd site was identified in Quiota Creek in March (Table 13). All of the redd sites were created by resident *O. mykiss* based on the smaller overall size of the excavation sites. No redd sites were identified after April 2020 suggesting that the resident *O. mykiss* present in the watershed had all spawned before the large April storm event.

No spawning was documented in the LSYR mainstem in the Hwy 154 Reach and no other surveys were conducted downstream due to dry conditions January through most of March and turbid conditions in early April (Table 14). Spawning surveys started in the tributaries in January and concluded in early May.

Snorkel Surveys: Snorkel survey reaches are presented in Figure 76. Snorkel surveys in 2020 were conducted in the spring, summer, and fall within the LSYR mainstem (Figure 77 and Tables 15-17). Standard and accepted single-pass snorkel survey protocols were followed (Hankin and Reeves, 1988). Spring snorkel surveys were completed in June (with the exception of the Hwy 154 Reach and Hilton Creek which were completed in July) and were meant to record baseline conditions after the spawning season and prior to the critical summer rearing season. Specifically, spring surveys carefully locate all dry season rearing habitats for *O. mykiss* after wet season runoff and spawning as well as document the number and location of YOY produced over the spawning season and the standing crop of *O. mykiss* going into the over-summering period. Summer surveys were conducted in early October and give an indication of *O. mykiss* survival after the hottest months of the year. Fall snorkel surveys were completed in November and December and are meant to evaluate the population of *O. mykiss* that survived the dry season as they go into the following water year.

Considering that March and April were wet months, and there were 2 Passage Supplementation events during the spring, the COMB-FD staff conducted a more exhaustive spring survey from Avenue of the Flags Bridge (LSYR-13.9) down to Robinson Bridge (LSYR-36.7). More fish were observed in these reaches than in past years particularly from Sweeney Crossing (LSYR-26.7) to the Narrows (LSYR-36.0). Since these areas are not currently part of our routine snorkel survey reaches, the results and associated fish rescue/relocation efforts will be described in Section 4.7.

There was a WR 89-18 release in 2020 that started at the end of August and ran into early December. 2000 BiOp Reasonable and Prudent Measure (RPM) 6 requires snorkel surveys be conducted just prior to, during, and after the WR 89-18 release to monitor possible movement of *O. mykiss* and other species within the Hwy 154, Reach 2 (Refugio and Alisal reaches) and Reach 3 (downstream of Alisal Bridge). These snorkel surveys are 3-pass surveys and are traditionally used for the summer and fall routine snorkel surveys within the LSYR mainstem and are reported as such below. Compliance reporting for RPM 6 occurs in a separate document.

The COMB-FD staff applied the same level of effort for snorkel surveys and covered the same spatial area during the spring, summer, and fall surveys (except for 3-pass surveys required for RPM 6 snorkel surveys in specific LSYR mainstem habitats). However, factors such as turbidity, beaver activity, and lack of water influenced those objectives and diminished the spatial extent of the three surveys as conditions changed throughout the year in the LSYR mainstem and its tributaries. The COMB-FD staff continues to solicit landowner cooperation and gain access to new reaches, particularly when conducting tributary project performance evaluations within upstream tributary reaches.

Snorkel survey locations within the LSYR mainstem were predominately pool habitats where the majority of *O. mykiss* have reared in previous years during the dry season. However, in the tributaries the full suite of habitat types (pool, run, riffle, and glide) is typically snorkeled. The results of the surveys are broken out by 3-inch size classes of fish. The total number of *O. mykiss* observed during all three snorkel surveys is shown in Figure 78 with all survey dates shown in Table 15 for the LSYR mainstem and Table 18 for its tributaries.

LSYR Mainstem: LSYR mainstem snorkel surveys were conducted during the spring, summer, and fall within the Refugio, Alisal, Avenue of the Flags, and Cadwell reaches (Figure 78). The Hwy 154 Reach was surveyed in the spring and fall only.

Hwy 154 Reach

Although the Hwy 154 Reach extends from the Stilling Basin (LSYR-0.01) to the Hwy 154 Bridge (LSYR-3.2), due to access constraints and the size and poor water clarity of the Stilling Basin and the Long Pool, the only areas snorkeled were the habitats downstream of the Long Pool to the Reclamation property boundary (LSYR-0.5 to LSYR-0.7) and habitats above the Long Pool to the tail-out of the Stilling Basin (Figure 77). Snorkel survey results for the Hwy 154 Reach are shown in Figure 79 as well as Tables 16-17. See Section 4.5 for a description of newly acquired access to the Hwy 154 Reach downstream of Reclamation property. A total of 119 *O. mykiss* were observed within the Hwy 154 Reach during the spring snorkel survey in early July; all of which were observed below the Long Pool to the Reclamation property boundary. The Long Pool, the section above the Long Pool to the tail-out of the Stilling Basin, and the Stilling Basin contained poor visibility during the spring survey which prevented COMB-FD staff from counting fish in those habitats.

Of the 119 *O. mykiss* observed during the spring survey, 58 (48.7 %) fell into the 0-3 inch size category, 48 (40.3 %) were 3-6 inches, 12 (10.1 %) were 6-9 inches and 1 (0.8%) was 9-12 inches. The majority of small *O. mykiss* observed during the spring survey were likely the result of YOY produced in and spreading downstream from Hilton Creek that had been produced during the winter and spring of 2020.

No snorkel survey was conducted within the Hwy 154 Reach in the summer. The fall survey was commensurate with the post-release survey conducted just after completion of the 2020 WR 89-18 Release. A total of 65 *O. mykiss* were observed during the fall survey, 34 (52.3%) were 3-6 inches, 29 (44.6%) were 6-9 inches and 2 (3.1%) were 9-12 inches in length. Notable is the fact that no fish in the 0-3 inch size class were observed, indicating successful growth of oversummering fish in this reach. The majority (63) of fish observed within this reach were found below the Long Pool down to the Reclamation property boundary. Only 2 *O. mykiss* were observed within the relatively short section of LSYR mainstem above the Long Pool to the tail-out of the Stilling Basin.

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. Location and results are presented in Figure 77, Figure 80, and Tables 16-17. Spring snorkel surveys were conducted in May with 33 *O. mykiss* observed within the Refugio Reach. The size class breakout showed 16 (48.5 %) in the 6-9 inch range, 13 (39.4 %) in the 9-12 inch range, 3 (9.1%) in the 12-15 inch range, and 1 (3.0%) 15-18 inches.

The COMB-FD staff revisited the Refugio Reach in the summer where the same habitat units were snorkeled in the spring. A total of 25 *O. mykiss* were observed during the summer survey, of which 7 (28.0 %) were 9-12 inches, 15 (60.0 %) were 12-15 inches, and 3 (12.0 %) were 15-18 inches. The size difference of *O. mykiss* observed between the spring and summer surveys (a period of approximate 5 months) showed a noticeable increase across all size classes, although a reduction in the total number of observed fish.

Fall snorkel surveys within the Refugio Reach were conducted after the completion of the 2020 WR 89-18 Release in early December. Divers counted a total of 30 *O. mykiss*, all larger size classes of fish; 6 (20.0%) were 9-12, 19 (63.5%) were 12-15, and 5 (16.7%) were 15-18. WR 89-18 releases in the late summer and fall of WY2020 appeared to provide ample food resources for the oversummering *O. mykiss* within the Refugio Reach, indicated by the upward shift in size classes observed.

Alisal Reach

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figure 77). Snorkel survey results are presented in Figure 81 and Tables 16-17. The spring snorkel survey was conducted in late May with 4 *O. mykiss* observed within 4 separate habitat units. Of the total, there were 1 (25.0 %) within the 3-6 inch size class, 2 (50.0%) within the 6-9 inch size class, and 1 (25.0%) in the 9-12 inch range.

Divers returned in the summer where they visited the same habitats as in the spring snorkel survey. Once again, a total of 4 *O. mykiss* were observed during the summer survey, 2 (50.0%) were 9-12 inches and 2 (50.0%) were 12-15 inches.

Fall snorkel surveys within the Alisal Reach were conducted after the completion of the 2020 WR 89-18 Release in early December. A total of 2 *O. mykiss* were observed during the final fall snorkel survey, 1 at 9-12 inches and 1 at 12-15 inches.

*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) (Figure 77). Results of all snorkel surveys for this reach are presented Figure 82 and Tables 16-17. The upper half of the reach below Alisal Bridge is influenced by Buellflat, Granite, and other flood plain mining companies that have historically altered the river bottom. The bottom (or downstream) half of the Avenue of the Flags Reach consists of a mature, unaltered riparian canopy with better complexity and overhead vegetative cover.

A spring snorkel survey was conducted the first week of June with 2 *O. mykiss* measuring 9-12 inches in length being observed within 2 separate habitat units. No *O. mykiss* were observed in the summer snorkel survey.

Divers returned in early December to conduct the final fall snorkel survey, corresponding with the completion of the 2020 WR 89-18 Release. No *O. mykiss* were observed during the final fall snorkel survey.

Cadwell Reach

The LSYR mainstem downstream of the Avenue of Flags Bridge is mostly comprised of private property that has been subdivided into sub-reaches (i.e., going downstream: Sanford, Cadwell, Cargasacchi, etc.) where the COMB-FD staff has been granted access. Since WY2011, The Cadwell sub-reach (LSYR-22.0-23.0) has been used as permanent monitoring location for both snorkel surveys and water quality monitoring (LSYR-22.68) (Figure 77). Results for all 2020 snorkel surveys are presented in Tables 16-17.

The Cadwell sub-reach contains one large bedrock pool approximately 18 feet in depth with several smaller pools located further upstream that can provide rearing habitat during wet years as has been observed. No *O. mykiss* were observed within this reach during the spring, summer or fall snorkel survey.

Tributaries: Tributary snorkel surveys were conducted in the spring and fall in 2020 at all of the long-term monitoring locations within Hilton, Quiota, Salsipuedes, and El Jaro creeks. The location and results are presented in Figure 77-78, Tables 18-20, and Figures 83-87. Summer snorkel surveys were not conducted in the tributaries as agreed to by NMFS through Reclamation last year due to concerns of adverse impacts on the fishery by divers in refuge habitats during the time of the year when water quality conditions are often the most stressful for *O. mykiss*. In addition, summer snorkel surveys within the tributaries are often problematic due to poor visibility and decreased water levels.

Hilton Creek

Hilton Creek snorkel 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 77). 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 along a relatively short stretch that contains a relatively high density of *O. mykiss*, all habitats within Hilton Creek are snorkeled and have been since the installation of the HCWS in 2001.

During WY2020, target flows into Hilton Creek were sustained above the 2 cfs minimum throughout the dry season as set forth in the 2000 BiOp (NMFS, 2000). Reclamation kept the HCWS activated via gravity flow to the URP and kept that configuration for the duration of the calendar year.

The spring snorkel survey within Hilton Creek was once again intentionally delayed until July so that the many YOY that had been produced in the spring could grow and occupy habitats where divers could count them (Table 18). Oftentimes recently produced YOY are found only along the slow moving and shallow stream margins, which end up being undercounted by instream divers. A total of 968 *O. mykiss* were observed within Hilton Creek during the spring snorkel survey (Figure 83 and Tables 19-20). Of the 968 fish observed, 598 (61.8 %) were within the 0-3 inch size class and another 314 (32.4 %) were within the 3-6 inch size class. The *O. mykiss* in these two smaller size classes were predominantly produced during the winter and spring spawning season within Hilton Creek. The remaining number and size classes observed were 50 (5.2%) in the 6-9 inch size class and 6 (0.6%) in the 9-12 inch size class. No *O. mykiss* over 12 inches in length was observed in Hilton Creek during the spring survey.

No summer Hilton Creek snorkel surveys were conducted in WY2020. Fall snorkel surveys were conducted over several days on 11/2/20 – 11/3/20 and during WR 89-18 Release flow ramp down on 11/12. A total of 553 *O. mykiss* were observed; 194 at 0-3 inches (35%), 297 at 3-6 inches (54%), 56 at 6-9 inches (10%), and 6 at 9-12 inches (1%) (Figure 82 and Tables 19-20). The biggest reduction in fish numbers between the spring and the fall snorkel count occurred within Reach 1 (lower part of Hilton Creek) where WR 89-18 Release flows had inundated the creek between August and the end of November. The juvenile *O. mykiss* that had been residing in that area likely moved out of the area during the peak of the water release which was over 150 cfs. A noticeable shift in size class was observed from the spring to the fall survey, with 61.8% 0-3 inch size fish observed in the spring and 35% 0-3 inch fish observed in the fall. A similar upward size shift occurred in the 3-6 inch size class, with 32.4% and 54% of the total being observed in the spring and the fall, respectively. Once again, no *O. mykiss* over 12 inches in length were observed in the fall survey.

Quiota Creek

A historic section of Quiota Creek, located between Crossing 5 and Crossing 7, typically contains perennial flow and has been routinely snorkeled. The location and results of all snorkel surveys are presented in Figures 77-78, Figure 84 and Tables 19-20. With heavy spring rains in March and April, Quiota Creek had steady baseflow with clear visibility during the initial spring snorkel survey in mid-June. The relatively short, historic section of Quiota Creek contained 3 *O. mykiss* in spring; 1 at 3-6 inches in length and 2 at 6-9 inches in length. These fish were found just downstream and upstream of Crossing 6 in two separate habitat units. No summer Quiota Creek snorkel survey was conducted in WY2020. COMB-FD staff revisited Quiota Creek in the fall and found less wetted habitat between Crossing 5 and Crossing 7. Only 2 isolated (barely wetted) pools remained between Crossing 5 and Crossing 6, with only a trickle of flow observed between Crossing 6 and Crossing 8. No *O. mykiss* were observed during the fall snorkel survey.

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 from

Santa Rosa Bridge (on Santa Rosa Road) upstream to the Jalama Road Bridge, a distance of approximately 2.85 stream miles (Figure 77). Reach 5 extends upstream from Jalama Road Bridge to the confluence of El Jaro Creek, a distance of approximately 0.45 miles. Reach 5 has been a historic monitoring location because of its reliable water clarity and flow, as well as the regular presence of *O. mykiss*.

Above average spring rains in 2020 manifested solid baseflow conditions throughout the Salsipuedes Creek watershed during the spring snorkel survey in late May and early June (Figures 85-86 and Tables 19-20). Spring snorkel surveys within Reaches 1 through 4 had a total *O. mykiss* count of 321; 180 (56.1%) 0-3 inches, 117 (36.4%) 3-6 inches, 13 (4.0%) 6-9 inches, 8 (2.5%) 9-12 inches, 2 (0.6%) 12-15 inches, and 1 (0.1%) 15-18 inches. Notable is the fact that divers observed YOY throughout all of the reaches, starting from near the confluence of lower Salsipuedes Creek with the LSYR mainstem all the way to the top of Reach 4 (SC-3.5). This was an indication of successful spawning in multiple locations and spring flow conditions allowing recently hatched juveniles to spread out within the drainage. Reach 5 was also snorkeled in late May and early June that had a total of 83 *O. mykiss* observed; 21 (25.3%) were 0-3 inches, 40 (48.2%) were 3-6 inches, 16 (19.3%) were 6-9 inches, 4 (4.8%) were 9-12 inches, and 2 (2.4%) were 12-15 inches. Nearly three quarters of the total fish observed were juveniles, indicating successful spawning and emergence in this upper reach of Salsipuedes Creek.

As mentioned above, summer surveys were not conducted within the tributaries in 2020. Divers returned to Salsipuedes Creek in the fall (11/4/20 – 11/9/20) and snorkeled all reaches, but encountered poor visibility throughout the watershed. A total of 30 *O. mykiss* were observed in Reaches 1-4, 93% (28) which were in the 3-6 inch size class. This significant reduction in numbers from the spring is attributable to poor visibility. Divers noted underwater visibility of 2-3 feet in most locations, many of which were deep pool habitats where divers couldn't detect the bottom.

The fall survey within Reach 5 of Salsipuedes contained slightly better visibility than downstream reaches, however, only a total of 20 *O. mykiss* were observed. Of the 20 fish observed, 14 (70%) were 3-6 inches, 5 (25%) were 6-9 inches, and 1 (5%) was 9-12 inches in length. Divers noted fair visibility within this reach, which likely resulted in a lower count than what was actually present within the creek.

El Jaro Creek

A 0.40 mile long section of El Jaro Creek, just upstream of its confluence with Salsipuedes Creek, is typically surveyed by the COMB-FD staff each year. Location and snorkel survey results are presented in Figure 77, Figure 87 and Tables 19-20. Divers snorkeled El Jaro Creek in early June and encountered good flow conditions and water clarity during the survey. A total of 23 *O. mykiss* were counted; 13 (56.5%) were 0-3 inches, 5 (21.7%) were 3-6 inches, and 5 (21.7%) were 6-9 inches. The juvenile YOY *O. mykiss* observed were spread out along the survey reach, similar to what was observed downstream in Salsipuedes Creek.

Summer surveys were not conducted within the tributaries in 2020. Divers returned in early November (11/10/20) and found a limited amount of wetted habitat within the reach. Only a few habitats were deep enough to snorkel with several stretches of the creek completely dry. Of the 7 total habitats snorkeled, no *O. mykiss* were observed but divers noted poor visibility complicating the ability to accurately conduct a fish count.

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. Results are presented in Figures 88-89. Fish species that inhabit Lake Cachuma are often found throughout the LSYR mainstem downstream of the lake. Typically, the most numerous species observed during snorkel surveys include largemouth bass (*Micropterus salmoides*), three sunfish species including bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and redear sunfish (*Lepomis microlophus*), common carp (*Cyprinus carpio*), and two catfish species, specifically the black bullhead (*Ameriurus melas*) and the channel catfish (*Ictalurus punctatus*). It is thought that these fish travel downstream during spill events from the lake to the lower river via the Bradbury Dam spillway (not the Penstock due to high pressure and small aperture release valves), take up residency in the Stilling Basin or habitats downstream and reproduce as conditions allow. Bass, sunfish and catfish are known predators of *O. mykiss*, particularly the younger life stages. Carp and catfish can stir up the bottom of the substrate and greatly reduce water clarity. Historically, warm-water species were not observed in any of the three tributary drainages (Salsipuedes, Quiota, and Hilton creeks) that the COMB-FD staff monitors. However, snorkel survey results within Salsipuedes Creek and El Jaro Creek did contain warm-water fish in 2020. Divers did not encounter any warm-water species occupying Hilton Creek during the annual spring or fall snorkel surveys.

LSYR mainstem

Largemouth Bass: Spring observations of largemouth bass within the LSYR mainstem in 2020 remained relatively low compared to past years (Figure 88). This could still be considered a result from the Stilling Basin de-watering and non-native fish removal that occurred in July of 2017; the Stilling Basin is a known source population for largemouth bass residing in the LSYR mainstem. With no spill at Bradbury Dam in the winter and spring of 2020, target flows were only to the Hwy 154 Bridge (LSYR-3.2). This meant no steady streamflow down to Alisal Bridge (LSYR-10.5) where residual pool depths could be maintained. As a result, some of the habitats within the Refugio Reach and Alisal Reach were either desiccated or much smaller in size by the time spring snorkel surveys were conducted in late May.

The total number of largemouth bass observed in the spring within the Refugio Reach and Alisal Reach was 51 and 13, respectively. Bass observations in the summer decreased within the Refugio Reach with only 9 being observed. The number of bass remained fairly constant within the Alisal Reach during the summer with 14 being observed.

Fall snorkel surveys were conducted after the completion of the 2020 WR 89-18 Release when flows were dropping in early December. Bass numbers continued to decline during

the final survey with 11 observed in the Refugio Reach and none observed in the Alisal Reach. With very cold water temperatures in December at the time of the survey, it's possible that largemouth bass were hiding in cover (reeds, aquatic vegetation, stream margins with warmer temperatures) and not within standard viewing lanes.

Sunfish Species: There are several types of sunfish species (green, red-ear, and bluegill) found within the LSYR mainstem, most of which are especially difficult to distinguish at smaller size classes. The COMB-FD staff attempted to categorize the different species of sunfish during snorkel surveys when possible, but all three species were grouped into a single category when reported.

Low numbers of sunfish were counted in the spring within the management reaches of the LSYR mainstem in 2020 (Figure 88). Divers counted 14 sunfish within the Refugio Reach and 7 sunfish in the Alisal Reach in the spring. The summer survey only found 1 sunfish occupying the Refugio Reach with none seen in the Alisal Reach. No sunfish were observed in either reach in the final fall survey. As mentioned above, very cold water temperatures at the time of the survey may have pushed warm-water species to seek cover or warmer margin habitat and were not easily detectable to divers.

Catfish Species: Two types of catfish are found within the LSYR mainstem, bullhead and channel catfish. Catfish are easier to differentiate (compared to sunfish) based on their tail morphology (forked = channel, flat = bullhead), but they are lumped into a single catfish category for the purposes of this report. In 2020, no catfish were observed during the spring, summer, or fall snorkel surveys within the LSYR mainstem management reaches (Figure 89).

Carp: Carp continue to be abundant within the Hwy 154 Reach, in particular, the Stilling Basin (LSYR-0.01) and to a lesser extent the Long Pool (LSYR-0.51). This is based on consistent, above water, surface observations while conducting other fisheries or oak tree related tasks on Reclamation property below the reservoir. However, poor water clarity within these two large habitat units continued throughout 2020 and divers were unable to accurately assess the fish assemblages there, hence no official counts were conducted.

Carp totals within the Refugio Reach and Alisal Reach of the LSYR mainstem during the spring were 25 and 12, respectively (Figure 89). The number of carp seen in Refugio and Alisal Reaches during the summer was 13 and 28, respectively. An uptick in carp observations occurred during the final fall snorkel survey with 20 observed in the Refugio Reach and 38 observed in the Alisal Reach.

Salsipuedes Creek

COMB-FD staff counted a total of 1,783 green sunfish within Reaches 1 through 4 during the annual spring survey (245 0-3 inches, 1,309 3-6 inches, 226 6-9 inches, and 3 9-12 inches). This is an astounding 78% increase from the same survey reach conducted in 2019 when there were 393 total sunfish observed. Green sunfish were found in high numbers throughout all of the reaches surveyed with the greatest concentrations in Reach 1 (1,159 total or 65% of the total). Reach 2 saw the second highest total with 378 counted

(21% of the total). Reach 3 and 4 green sunfish totals were 166 (9%) and 80 (5%), respectively. Unfortunately the upward trend in green sunfish numbers continues to suggest their population is expanding within the drainage. During the spring survey, divers observed numerous green sunfish redds with spawning adults actively protecting their nests. Every effort was made to smother (by hand) every nest that was encountered by divers to decrease juvenile survivorship. Additional warm-water species were encountered, including 9 bluegill (4 at 3-6 inches and 5 at 6-9 inches), 2 largemouth bass (1 at 3-6 inches and 1 at 6-9 inches), and 17 bullhead catfish (14 at 3-6 inches, 2 at 9-12 inches and 1 at 12-15 inches). The fall snorkel survey within Reaches 1 through 4 occurred in mid-November and divers were met with difficult viewing conditions along the majority of the creek. A total of 94 green sunfish were observed; 49 0-3 inches, 34 3-6 inches, 8 6-9 inches, and 3 9-12 inches. In addition, 3 largemouth bass (2 at 3-6 inches and 1 at 6-9) and 3 bullhead catfish (2 at 0-3 inches and 1 at 6-9 inches)

The green sunfish total within Reach 5 of Salsipuedes Creek during the spring survey was 102 individuals (26 at 0-3 inches, 63 at 3-6 inches, and 13 at 6-9 inches). Bullhead catfish were also present within Reach 5 with 12 3-6 inch fish observed and 1 adult at 9-12 inches. Divers returned in mid-November to conduct the fall snorkel survey within Reach 5 and only observed a single green sunfish measuring 6-9 inches. As mentioned above, the water clarity during the fall survey was not optimal for underwater viewing and total fish observations were down across the board (*O. mykiss* and other species).

El Jaro Creek

The 0.40 mile regular survey reach of El Jaro Creek also contained warm-water species during the annual spring snorkel survey with 143 green sunfish observed. This is an 83% increase in total green sunfish observed across the same reach since the spring of 2019. Three size classes of sunfish were recorded: 53 measuring 0-3 inches, 76 measuring 3-6 inches, and 14 measuring 6-9 inches. No other warm-water species were observed during the survey. The mid-November (fall) snorkel survey within the same El Jaro reach was challenged by the lack of water and turbid conditions. No warm-water fish were observed during the fall snorkel survey.

Hilton Creek

No warm water non-native fish were observed in Hilton Creek during the spring snorkel survey. The fall snorkel survey was conducted in early November with no warm-water observed. This marked the first season in several years that non-native fish were absent from Hilton Creek.

3.7. 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 WY2020, COMB-FD completed 2 tributary projects. The first replaced a dilapidated single lane bridge on top of a damaged low flow concrete

crossing of S. Refugio Road over Quiota Creek with a 54 foot bottomless arched culvert bridge at Crossing 8. The project was successfully completed on 1/8/20 and now provides full juvenile and adult fish passage across all determined fish passage flows. The second project addressed erosion problems to the south of the Quiota Creek Crossing 8 Project in two small tributaries. The project installed a small settling basin in two intermittent drainages that historically conveyed fine sediments to Quiota Creek, installed a culvert under a ranch road to reduce the erosion potential, planted ten native Coast Live oak trees in close proximity to each of the settling basins for reforestation, and seeded/mulched all disturbed areas within the project footprint. Project construction took two weeks and was successfully completed on 9/28/20. The project will be monitored for the next couple of years to document the success of the restoration effort to improve water quality in Quiota Creek.

Post-project monitoring continued at all 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.

3.8 Additional Investigations

Genetic Analysis: Tissue samples from all of the migrant captures during WY2020 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. In addition, the vast majority of the fish sampled during trapping activities indicate that these fish are genetic descendants of native coastal steelhead. Very little introgression with hatchery raised trout has been observed in samples collected in the LSYR basin.

Beaver Activity: The North American Beaver (*Castor canadensis*) according to all peer reviewed scientific literature was introduced into the Santa Ynez River system in the late 1940s (Hensley, 1946; Baker and Hill, 2003; CDFG, 2005). The presence of this species in the 1940s was initially scattered and isolated in a few areas within the LSYR mainstem.

Over time and with the increased amount of flow in the river since 2000 as a result of the target flow requirements of the 2000 BiOp, the number and spatial distribution of beavers and their dams have increased substantially throughout the LSYR mainstem. Once Lake Cachuma surcharged for the first time and the long-term target flows were initiated in 2005, beaver dams have been observed in the wetted reaches during the dry season from the Bradbury Dam to the Narrows as well as portions of the LSYR mainstem downstream of the Lompoc Waste Water Treatment Plant upstream of the Santa Ynez River lagoon. In addition, beavers now have successfully inhabited the Salsipuedes/El Jaro Creek watershed though their numbers and distribution were reduced during the 2012-2016 drought. Well established beaver dams can be of sufficient strength and breadth to remain

in place during stormflows, and create passage impediments and/or barriers for migrating fish during low to moderate flows.

Beaver dams and the associated ponds often change riffles and runs into pools that can lead to greater thermal heating of stream water, can fragment habitat and inhibit movement of juvenile and adult fish species, increase siltation, change benthic macroinvertebrate assemblages, and increase ideal pool habitat for invasive aquatic species (i.e., bass, sunfish, catfish, and carp). Beaver regularly build their dams at the control points of pool habitats, a prime spawning location for *O. mykiss* and have been observed to reduce spawning locations/opportunities during normal and drier years in the El Jaro/Salsipuedes Creek watershed. 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.

During November and December of 2019 and January of 2020, the COMB-FD staff completed the LSYR mainstem beaver dam survey from Bradbury Dam (LSYR-0.0) to downstream of the Narrows where the river goes dry out on the Lompoc plain downstream of the Salsipuedes Creek confluence with the LSYR mainstem (approximately LSYR-34.4), except within the Hwy 154 Reach on the San Lucas Ranch (due to lack of access). The survey also looked at the wetted section of the river downstream of the Lompoc Waste Water Treatment Plant (approximately LSYR-42.0) to the 13th Street Bridge on Vandenberg Airforce Base and the start of the lagoon. All of Salsipuedes Creek and a significant portion of El Jaro Creek are also surveyed for beaver dams.

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. All beaver dams are typically built at pool control points (i.e., tail out of pool habitats). Barrier dams were large in height resulting in minimal depth downstream to allow fish to jump over the dams. Barrier dams spanned the river channel with no flanking flows around the dam. Impediment dams were generally smaller in height, had greater depths at their downstream side and/or were flanked by flow along one or both channel margins which would allow fish to swim around the impediment. Passable dams were all small in height with deeper habitats immediately downstream of the dam with some measure of flanking occurring, or in some cases were in the process of being built and small in stature.

Since WY2010, the number of beaver dams has fluctuated over the monitoring period with distribution increasing during wet year types and decreasing during the drought years (Figure 90 and Table 21). 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 until this year.

The results from this year's beaver dam survey showed an increase LSYR mainstem beaver dams from 45 in WY2019 to 58 in WY2020 and is the most dams recorded since 2017 (Figure 89, Table 20). Of the 58 beaver dams identified, 43 were active and 15 were non-active relic dams. Of the active dams, 35 were considered barriers to fish migration, 5 were classified as impediments and 18 were classified as passable at the current flow rate. No beaver dams were observed in the Hwy 154 Reach. There were 6 active dam in the Refugio Reach and 3 active dams in the Alisal Reach. The majority of the dams (34) were located downstream of the Avenue of the Flags Bridge in Reach 3 of the LSYR mainstem. The lower most active dam in the Santa Ynez River watershed was located immediately downstream of the Floradale Bridge in Lompoc and downstream of the City's river discharge point for their waste water treatment plant.

For the first time since 2017, active beaver dams (2) were observed on Salsipuedes Creek/El Jaro Creek watershed, specifically in the lower sections of Salsipuedes Creek. While the long-term drought caused a reduction in wetted habitat reducing the number and distribution of beavers (especially in the Salsipuedes/El Jaro Creek watershed), wetted habitat conditions have improved overall due to increased rainfall (e.g., 2017 and 2019) and WR89-18 releases (e.g., 2017, 2018, and 2020). Since WY2015 active dams in Reach 3 of the LSYR mainstem have increased from 4 to 38 observed in WY2019 and 34 observed in WY2020. As a consequence, beavers have begun to expand their range by spreading out in the LSYR mainstem and back into Salsipuedes Creek to exploit the unoccupied habitats within the watershed.

Until a beaver management plan is developed and implemented, beavers will continue to impact endangered steelhead through dam building activities, especially in dry and average years. Biologists have observed during both dry and average rain year types that active beaver dams can act as partial or complete barriers to migrating anadromous and resident *O. mykiss* from moving between habitats to suitable spawning grounds and finding mating partners. With climate change already influencing weather patterns and shifting rainfall to later in the year, beaver dams will continue to have the potential to influence spawning and recruitment of *O. mykiss* within the LSYR basin.

4. Discussion

The Discussion section provides (4.1) additional historical context for the WY2020 results presented above specifically since the issuance of the 2000 BiOp, (4.2-4.13)

discussion as needed on specific topics of interest or concern, and (4.14) the status of last year's Annual Monitoring Summary recommendations. Summaries of the LSYR Fisheries Monitoring Program (Annual Monitoring Reports/Summaries) have been compiled for 1993-1997 (SYRCC and SYRTAC, 1997),1993-2004 (AMC, 2008), 2005-2008 (USBR, 2011), 2009 (USBR, 2012), 2010 (USBR, 2013), 2011 (COMB, 2013), 2012 (COMB, 2016), 2013 (COMB, 2017), 2014 (COMB, 2018a), 2015 (COMB, 2018b), 2016 (COMB, 2019a), 2017 (COMB, 2019b), 2018 (COMB, 2020a), and 2019 (COMB, 2020b).

4.1. Water Year Type since WY2000

The monthly rainfall (Table 22), monthly average runoff at Solvang and the Narrows (Table 23), and water year type with the years that Lake Cachuma spilled (Table 1 and Figure 91) are presented from WY2000-WY2020. Since WY2000, there have been 6 spill events, 8 wet years, 3 normal (average) years, and 10 dry years.

4.2. WY2020 – An Unusual Water Year

WY2020 was the third normal water year (defined as 15 to 22 inches of rainfall recorded at Bradbury Dam) since issuance of the 2000 BiOp but was particularly unusual with two distinct periods of rainfall (December and then late March through early April) with little rainfall before, between, or after. The wet season started off at the end of November with a sequence of storms towards the end of December that generated short-lived full basin streamflow at a low to moderate magnitude. A warm and dry January and February triggered tributary spawning resulting in a record breaking number of redds observed in Hilton Creek. Just as YOYs were emerging from the gravels toward the end of March, the area received a couple of larger storms that re-saturated the watersheds throughout the LSYR basin, breached the LSYR lagoon, and generated significant runoff associated with the 4/6/20 storm. The storm caused sediment movement throughout Hilton Creek (including from the Whittier Fire burn scar) that washed out most spawning production (redds and YOYs). Several YOY mortalities were found in lower Hilton Creek during the receding limb of the storm hydrograph (a report was provided to Reclamation, which submitted it to NMFS). Sediment movement from the Whittier Fire burn scar once again filled in all pool habitats with upslope sediments, further decreasing the size and depth of the Long Pool. Further sediment deposition was observed on the Hilton Creek / Long Pool delta. Two Passage Supplementation events were conducted on the back end of that storm to extend the opportunity for fish passage to and from the ocean. Ocean connectivity continued for fish passage throughout the rest of the migration season. The dry season set in thereafter and there were no more storms for the remainder of the water year.

4.3. Hilton Creek and Long Pool Sediment Deposition from the Whittier Fire

The Whittier Fire in WY2017 completely burned the upper half of the Hilton Creek watershed. That combined with the significant runoff events in WY2019 generated significant bedload transport and channel changing conditions within the drainage. All pool habitats were filled in with sediments and a large delta formed at the creek's confluence with the LSYR mainstem and specifically out into the Long Pool. Although turbid conditions and heavy silt loads were observed in WY2018, it was not until the

above average rainfall in WY2019 that the Whittier Fire burn scar truly impacted the lower reaches of Hilton Creek on Reclamation property.

At the end of the runoff season in WY2019 and through three quarters of the wet season in WY2020 (a normal rainfall year), Hilton Creek pool habitats on Reclamation property were showing signs of scouring and recovery of pool extent and depth. The 4/6/20 storm was of sufficient magnitude to liberate upstream sediments and transport them downstream where they were deposited once again in those pool habitats and in the headwaters of the Long Pool (Figures 92 and 93). There were no further storms in the water year hence pool scour was minimal leaving limited deep pool refuge habitats throughout the lower sections of the creek. Since the Whittier Fire, the Long Pool has lost approximately 400 feet in length and 3-4 feet in depth at the deepest point. The newly formed and extensive delta deposits caused spreading of stream discharge from both Hilton Creek and any releases from the dam resulting in poorly defined shallow braided channels and optimum conditions for riparian plant growth. The 2020 WR 89-18 releases with maximum flows of approximately 150 cfs helped to induce channel scour and redefined a single thread channel across the newly formed delta that is now more suitable for fish passage and rearing up into Hilton Creek and to some degree up towards the Stilling Basin.

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

Salsipuedes Creek and Hilton Creek are very different tributaries in terms of their size (Salsipuedes is an order of magnitude larger than Hilton), hydrology (rainfall and flow patterns, hydrologic regime, and artificial watering system), land use (chaparral, agriculture, and cattle ranching), and biology (*O. mykiss* migration and population characteristics). Both creeks have hydrologic regimes typical of a Mediterranean-type climate with flashy streams and high inter/intra-year runoff variability. The watershed area for Salsipuedes Creek is larger than that of Hilton Creek and at times can receive more rainfall during any given storm event due to its westerly location. Typically, smaller watersheds like Hilton Creek can have sharper recessional storm hydrographs; however, Hilton Creek has an artificially sustained baseflow greater than 2 cfs year round from Lake Cachuma water deliveries, whereas in the upper reaches of Salsipuedes Creek and its largest tributary, El Jaro Creek, baseflows typically approach 0.05 cfs during the dry season. Out-migrant *O. mykiss* smolts in both creeks have been documented to attempt to migrate to the ocean/lagoon when flow opportunities present themselves, hence not always at the same time. Travel distance from the confluence of each creek with the LSYR mainstem to the ocean is approximately 15 river miles for Salsipuedes Creek and 49 river miles for Hilton Creek fish.

The *O. mykiss* populations between the two creeks exhibit differences in upstream and downstream migration timing, spawning time, rearing habitat, and over-summering characteristics (i.e., water quality, flow, and habitat complexity). Hilton Creek normally has good habitat quality (refuge pools with structure and a mature riparian canopy) but has limited stream length. The Salsipuedes Creek system has extensive stream mileage but only fair habitat quality due to low dry season baseflows, limited pool habitat with acceptable water quality for over-summering, a predominance of fine sediment substrate,

and high water temperatures in the lower portion of the creek (AMC, 2009). One result of these differences is earlier resident *O. mykiss* upstream migration in Hilton Creek due to greater availability of water in the LSYR mainstem immediately below the dam where resident *O. mykiss* have been documented to oversummer. Hilton Creek also has a longer migration time for smolts to make it to the ocean given the additional distance and the numerous beaver dams they must negotiate. Smolts may be inclined to linger in areas within the Highway 154 Reach as favorable conditions near the dam can diminish some environmental cues for out migration (for example low water temperatures and continuous baseflow generally less than 4 cfs). Returning ocean run adults also have a much longer travel distance to Hilton Creek compared to Salsipuedes Creek.

Regardless of the differences in the watersheds described above, the drought of WY2012-WY2016 has negatively impacted both watersheds, but Salsipuedes to a much greater extent as recent trapping trend data indicate with low numbers of observed *O. mykiss*. Since the end of the drought, the LSYR watershed has experienced 2 wet years (WY2017 and WY2019), one dry year (WY2018), and one normal (average) year (WY2020) (Figure 91). Starting in WY2017, Hilton Creek has shown an increase in the numbers of both upstream migrants captured (1 in WY2017 and 49 in WY2020) and downstream migrants (4 in WY2017 and 90 in WY2020) (Table 24). The number of smolt (including pre-smolt) captured leaving the creek has also increased from 2 in WY2017 to 32 in WY2020. The ability to keep *O. mykiss* alive in Hilton Creek during the extended drought (trickle tank flow for example) was instrumental in keeping a viable seed population alive to repopulate Hilton Creek, the Highway 154 Reach, and locations further downstream. The fact that smolts were being captured leaving the creek every year since the drought shows that the *O. mykiss* that survived in Hilton Creek possessed the anadromous genes that encourage smolting behavior under the right environmental conditions. It also illustrates the importance of keeping the HCWS/HCEBS functional and reliable while expanding upon its operational capacity to assist recovery efforts of the species.

The contrast between Salsipuedes Creek and Hilton Creek is stark. Since WY2017, only 2 upstream migrating *O. mykiss* were captured during Salsipuedes Creek trapping efforts. Both of those fish were captured in WY2020 and were classified as residents. Similarly, downstream captures have also decreased with none captured in WY2017, 3 in WY2018, 2 in WY2019, and 1 in WY2020. Of the downstream migrants captured during those years, only 3 of those fish were classified as smolts with no smolts captured in WY2020 (Table 25). For comparison, there were 177 smolts captured in WY2011 which was a wet year with excellent ocean connectivity. These numbers illustrate the negative impact the drought has had on the *O. mykiss* population within the El Jaro/Salsipuedes watershed and the slow *O. mykiss* population recovery when compared to Hilton Creek.

4.5 Hwy 154 Reach – Access and New Findings

The Hwy 154 Reach of the LSYR runs from Bradbury Dam to the Highway 154 Bridge (LSYR-0.0 to LSYR-3.4). Historically, fish surveys of this reach have been limited to a small area immediately downstream of Bradbury Dam on Reclamation property (LSYR-0.0 to LSYR-0.70). The remainder of the Hwy 154 Reach (LSYR-0.70 to LSYR-3.4) has

been off limits due to property access constraints. COMB biologists have speculated that optimal rearing conditions do exist in the section downstream of Reclamation property from aerial imagery that shows the presence of numerous deep pool habitats and from scale analyses of fish captured in the Hilton Creek migrant trap that show rapid growth of large resident fish that may be over summering downstream of Reclamation property. The 2000 BiOp required LSYR mainstem and Hilton Creek target flows that have provided cool water to this section of the river in support of the fishery during those years when there was sufficient lake storage. Starting in WY2018, COMB-FD gained access to portions of the Hwy 154 Reach from LSYR-1.09 to LSYR-1.71 with further access obtained in WY2020 from LSYR-1.71 to LSYR-2.77. Access into these previously restricted areas has provided an opportunity to verify previous assumptions while evaluating instream habitats with respect to water quality and the presence of *O. mykiss* and any other aquatic species.

Water temperature data collected from various thermograph deployment locations (LSYR-1.09, LSYR-1.54, and LSYR-1.71 since WY2018 and LSYR-2.77 since WY2020) indicated that releases from Bradbury Dam provide cool water and good rearing conditions down into that area of the Hwy 154 Reach, especially in the deeper pool habitats that are scattered throughout. Refuge habitats are large and often have poor water clarity making snorkel surveying challenging. Although snorkeled several times in WY2018, no *O. mykiss* were observed due to turbid water conditions. In the Spring of WY2019, 19 YOY were observed upstream of LSYR-1.09 in a run habitat. These fish likely originated from Hilton Creek due to the poor spawning conditions in the Hwy 154 Reach (specifically embedded substrate and the lack of suitable spawning gravels). No other *O. mykiss* were observed in WY2019 due to turbid conditions.

Beginning in WY2020, snorkel surveys were conducted from LSYR-2.77 upstream to LSYR-1.09. Many deep pools and deep glide habitats are present within this region as well as a relatively intact riparian corridor that provided shade and abundant terrestrial food sources. During the spring snorkel survey, water clarity was good, allowing for the observation of 122 *O. mykiss* that were inhabiting run, glide, and pool habitats; specifically 18 (14.8%) were 3-6 inches, 62 (50.8%) were 6-9 inches, 30 (24.6%) were 9-12 inches, 11 (9.0%) were 12-15 inches, and 1 (0.8%) was 15-18 inches. Most of the fish observed were greater than 6 inches in length with the majority within the 6-9 inch and 9-12 inch size category, with 12 greater than 12-inches in length. The fish appeared robust and were observed actively feeding at several locations with the greatest abundance observed in deeper pool and deeper glide habitats. During the fall snorkel survey under WR 89-18 equilibrium flows (approximately 30 cfs), the visibility was fair and there was a possibility of missing fish particularly in the deeper habitats where *O. mykiss* were observed during the spring survey. Divers did observe a total of 39 *O. mykiss*; specifically 11 (28.2%) were 3-6 inches, 19 (48.7%) were 6-9 inches, 7 (18.0%) were 9-12 inches, and 2 (5.1%) were 12-15 inches. Again, the lower total may be a result of less water clarity.

Spawning surveys conducted in WY2020 in Hilton Creek resulted in 24 spawning sites documented. Upstream migrant captures showed that 19 fish between 12-18 inches in

length (resident *O. mykiss* since the lagoon and ocean connectivity to the LSYR mainstem did not occur until after the redds were documented) moved upstream to spawn in the creek. It is likely these fish originated from within the Hwy 154 Reach and specifically the area downstream of the Long Pool which has lost considerable depth and length due to Whitter Fire sediment inputs making it less of a potential refuge habitat.

Putting these observations into a broader perspective, the long standing drought from WY2012 through WY2016 saw the Hwy 154 Reach dry up completely at the end of that period except for a small amount of water that remained in the Stilling Basin. Reclamation was able to maintain trickle flow in Hilton Creek that was insufficient to reach the LSYR mainstem but sustained the Hilton Creek fishery. The only *O. mykiss* within the LSYR downstream of Bradbury Dam were those that were surviving in Hilton Creek under trickle flow. The remaining small *O. mykiss* population (57 fish total) observed in Hilton Creek during the summer snorkel survey of 2016 provided the seed population that is currently resurging in the Hwy 154 Reach.

From 2016 to 2020, the watershed has experienced 2 dry years, 2 wet years, and 1 average year. Since 2016, Hilton Creek has shown a remarkable increase in the number of migrants captured, the number of redds identified, and the number of *O. mykiss* observed during snorkel surveys. Based on the last 5 years of trend data, there has been a steady increase in the number of spawning sites observed in Hilton Creek (2 in 2016 to 24 in 2020) and a corresponding increase in the number and size of upstream migrants captured during the spawning migration season (8 in 2016 and 49 in 2020) (see Section 4.4 for further details of migrant trapping trends). It could be argued that Hilton Creek provided the refuge and spawning grounds while the Hwy 154 Reach provided larger habitats for greater fish growth and abundance, and larger fish with greater fecundity since the end of the extreme drought ending in 2016.

In summary, the Hwy 154 Reach is an important management reach for survival of the *O. mykiss* population due to its close proximity to Bradbury Dam releases (Hilton Creek and the Outlet Works) and cooler water temperatures that are more suited for rearing and oversummering conditions. The current resurgence of the *O. mykiss* population downstream of the dam can most likely be attributed to the combination of those 2 reaches. Given the extent of target flows, the recently observed quality of the habitat, and lack of suitable spawning gravels within the Hwy 154 Reach, consideration should be given to conducting gravel augmentation within certain habitats of the Hwy 154 Reach to provide additional locations for fish to spawn to help boost the *O. mykiss* population in this section of the river. The short-term gravel augmentation effort in Hilton Creek in WY2018 and WY2019 was very successful and relatively inexpensive to implement.

4.6. Reproduction Success in Hilton, Quiota, and Salsipuedes/El Jaro Creeks

The winter of WY2020 started off with a sequence of storms in December that produced in excess of 7 inches of rain at Bradbury Dam and Rancho San Julian (located in upper El Jaro Creek basin) that charged up the watersheds sufficiently for decent runoff. However, January and February, which historically are the wettest months of the year, combined to account for only 0.54 inches of rain (2.6% of the annual total). The December rains did

provide migratory opportunities for resident *O. mykiss* to move to spawning locations in Hilton, Salsipuedes, and Quiota Creeks during January, February, and March. April storms provided excellent migration opportunities throughout the lower basin with full ocean connectivity starting on 4/7/20 through the rest of the migration season.

Redd (spawner) surveys began in January and continued through April. Redds were observed during the months of January, February, and March. There were 24 redd sites identified in Hilton Creek (7 in January, 13 in February, and 4 in March), 1 redd in Quiota Creek (March), and 9 redds in Salsipuedes Creek (2 in January, 2 in February and 5 in March). No redds were identified following the 4/6/20 storm event. Spawning was highly successful with many YOYs observed, the first being in Hilton Creek on 3/25/20. YOY take refuge in margin habitat upon emerging from the gravels as those locations provide slower flow velocities and allow the fish to grow in a relatively stable location before moving into faster water with better food availability. The timing of the large stormflow event on 4/6/20 impacted those recently emerged YOYs. For example, in Hilton Creek streamflow increased from approximately 3 cfs to over 50 cfs and the YOYs were displaced or became vulnerable during rapid flow reduction of the falling limb of the storm hydrograph. Bank surveys following the high flow event resulted in the discovery of 9 mortalities along the high flow line of Hilton Creek, ranging in size from 28 mm (1.1 inches) to 82 mm (3.2 inches). An event report was provided to Reclamation which was submitted to NMFS. Subsequent bank surveys noted an absence of YOYs in the margin habitats compared to before the storm. Whether these fish perished from the exposure to the turbulent/turbid water, were displaced to suboptimal habitats that went dry as flows receded, or were washed downstream to other suitable habitats (or all of the above) is unknown as well as the total number of lost YOYs. In addition, surveyors noted that all of the past spawning sites identified during January, February, and March were unrecognizable (i.e., all of the pits and depressions caused from spawning activity were covered with new gravel) after the 4/6/20 storm event. The fact that no additional spawning sites were observed after the April storm event suggests that all resident adult fish capable of spawning did so during the first three months of 2020, particularly during the unseasonably warm and dry January through February period.

Spawning opportunities in Quiota Creek were limited due to the anemic rainfall and limited flow during January through the early part of March. On 3/3/20, there were three separate marginal spawning locations being utilized by resident fish. Due to the lack of flow, the fish were forced to use sub-optimal locations (i.e., locations with limited suitable gravel but in deeper habitats with minimal flow). One of the sites was defined sufficiently to collect information while the other two sites were noted and were evaluated at a later date. Following the 4/6/20 storm event, no additional redd sites were observed and no YOY were observed throughout the entire creek during 2020.

Spawning in Salsipuedes Creek was first documented in late January with the majority of spawning observed during early March. The early April storm event recorded flows in excess of 1,400 cfs (USGS Salsipuedes Creek gauging station). With these high magnitude stromflows, biologists were concerned that newly emerging YOY would experience the same negative impacts as was observed in Hilton Creek. Subsequent redd

surveys resulted in the first YOY being observed on 4/17/20 in an area well downstream of any documented redd site. While it is likely some YOY perished before they could emerge from the gravels it was encouraging to observe that some were able to survive after being displaced downstream.

The 2020 spring snorkel surveys in Hilton Creek documented 598 *O. mykiss* within the 0-3 inch size category (all YOY) and 314 within the 3-6 inch size category (most were YOYs on the low end of the range); indicating that the high flow event did not displace or kill all the emerging fish from the creek. The total number of YOYs observed from 24 redds in 2020 was quite low compared to in 2019 with 8 documented redds and over 2,000 YOY observed during the spring snorkel survey, suggesting there was a significant loss/displacement of YOYs following the 4/6/20 storm event.

Similarly, there were 9 redds identified in Salsipuedes Creek and none observed in El Jaro Creek in 2020. Spring snorkel surveys recorded over 201 YOY in various habitats in Salsipuedes Creek indicating that the high flow event did not displace or wipeout all of the newly emerged YOYs from the creek and instead, distributed them to many locations downstream from where redds were observed. Instead of many YOY localized in a few habitats adjacent to redd sites (as has been observed in the past), these YOY observations occurred over a broad linear distance downstream suggesting they were displaced and moved downstream of their emergence sites by high flows and moderate baseflows lasting through the spring. While no redds were recorded in El Jaro Creek, there were 13 YOY observed in the creek suggesting that some level of spawning did take place.

4.7 Spawning Success within the Narrows and Salsipuedes Creek Confluence Reaches followed by Fish Rescue and Relocation: Due to late season rainfall, higher than usual late spring runoff, and 2 Passage Supplementation events in WY2020, the COMB-FD conducted a springtime exploratory snorkel survey in the lower LSYR mainstem from Buellton to the Lompoc plain. The snorkel surveys led to a collaborative effort with CDFW to conduct fish rescue and relocate threatened *O. mykiss*.

Snorkel Surveys: From 5/26/20 through 6/9/20, multiple teams conducted snorkel surveys throughout the lower river to determine whether or not *O. mykiss* were occupying these reaches of the river and if they were in peril. A total of 82 habitat units were surveyed between the Avenue of the Flags Bridge (LSYR-13.9) and Robinson Bridge (LSYR-36.7). Based on the long distance surveyed, the number of fish observed, and the life stage (0+ to over 1+ aged fish) of *O. mykiss* observed, the following discussion was broken out into 2 distinct reaches.

Avenue of the Flags Bridge (LSYR-13.9) down to Sweeney Road Crossing (LSYR-26.7)

This section of the LSYR mainstem has been historically broken out by sub-reaches where access has been granted by landowners (i.e., Ryan, Sanford, Dorian, Cadwell, Cargasacchi, and Baer) where the COMB-FD staff has been granted access. Several habitats with these sub-reaches are long standing WR 89-18 RPM 6 monitoring sites. The initial spring snorkel survey was conducted in early June where COMB-FD staff snorkeled 36 habits and only observed one *O. mykiss* measuring 9-12 inches in a pool habitat in the Baer property sub-reach. Divers returned in the summer as part of the

"during-release" phase of the 2020 WR 89-18 Release and no *O. mykiss* were observed within the 5 designated RPM 6 habitat units below the Avenue of the Flags Bridge.

Sweeney Road Crossing (LSYR-26.7) down to Robinson Bridge (LSYR-36.7)

In late May, prior to the standard seasonal drying of this lower section of LSYR mainstem above and below the Salsipuedes Creek confluence, the COMB-FD staff snorkel surveyed 46 habitats. This section of the river is not part of routine snorkel surveys or WR 89-18 RPM 6 monitoring, hence this was an exploratory effort given favorable late season runoff and migration conditions.

A total of 56 *O. mykiss* within 21 habitat units were observed; 23 *O. mykiss* below the Salsipuedes Creek confluence and 33 *O. mykiss* above the Salsipuedes Creek confluence. The majority of the 56 total fish observed were within the 0-3 inch (32) and 3-6 inch (21) size classes, indicating successful *O. mykiss* spawning and rearing during the WY2020 migration season. The remaining size class and number of *O. mykiss* observed were 6-9 inch (2) and 9-12 inches (1). Surveyors noted several beaver dams upstream and downstream of the Salsipuedes Creek confluence, the largest active dam located at LSYR-29.3 being just upstream of the upstream most observed *O. mykiss* in the area. Despite moderate flows generated from natural runoff and Passage Supplementation events in the spring, it appeared as though that large beaver dam may have limited upstream migration resulting in spawning just downstream of the beaver dam. This condition and circumstance was observed once before along this section of the LSYR mainstem during WY2012 with 155 *O. mykiss* observed, most being YOYs.

The origin of the mating pairs of adult *O. mykiss* in this section of the LSYR mainstem is unknown. Possibilities include fish migrating downstream from Hilton Creek or the Hwy 154 Reach, Quiota Creek, Salsipuedes Creek where they turned and went upstream, or anadromous fish from the LSYR lagoon or the ocean. Beaver dams that block movement or diminishing streamflow that prevent movement through critical riffle habitat may have inhibited upstream migration or other factors (i.e., increased photo period, stream temperature increase) may have queued any fish residing in that area to spawn before reaching more favorable upstream spawning locations.

Fish Rescue and Relocation: Due to the presence of *O. mykiss* and the observation of drying conditions in late spring, and with the coordination and approval of NMFS and CDFW, a fish rescue team was assembled and led by CDFW and staffed by COMB-FD and members of the Pacific States Marine Fisheries Commission (PSMFC), referred to as the Fish Rescue Team. NMFS provided the environmental coverage to CDFW for this successful collaborative effort that may need to be repeated over time. A report detailing those efforts was prepared and submitted by CDFW to NMFS in September (CDFW, 2020). The Fish Rescue Team used several backpack electrofishing units, dip nets and seines to capture fish which were then placed in buckets with aerators and kept cool while being transported to upstream stable rearing habitats where they were released unharmed.

Narrows Reach above and below Salsipuedes Creek

Fish rescue and relocation efforts were conducted over 5 separate days within this reach between 6/24/20 and 7/28/20. A total of 17 *O. mykiss* were successfully removed and relocated from the Narrows Reach to a series of large pool habitats just downstream of Jalama Bridge in Salsipuedes Creek (SC-3.5). *O. mykiss* captured ranged in size between 76 and 130 mm (fork length), indicating fish were likely 0+ or 1+ years in age and adults had moved elsewhere after spawning.

Upper Refugio Reach

The COMB-FD staff routinely snorkels the Refugio Reach between LSYR-4.7 (upstream of Encantado Pool) and LSYR-7.8 (Refugio Bridge) as part of their standard spring, summer, and fall monitoring efforts. The spring snorkel survey on 5/21/20 revealed several large pool habitats containing *O. mykiss* towards the upper end of the Refugio Reach. By the end of June, several of these habitat units had shrunk in size and contained poor water quality conditions with large amounts of surface algae. An abundance of algae is an indication of potentially anoxic conditions at depth, especially during the overnight hours.

The Fish Rescue Team attempted to electrofish several of these units on 7/1/20, but was unsuccessful in catching any *O. mykiss* due to the depth and extent of the habitat. COMB-FD personnel observed a rapid decline in water level in this reach on 7/31/20 and the Fish Rescue Team quickly assembled to conduct a rescue attempt that afternoon. One unit in particular, the Corner Scour Pool (LSYR-5.9) required immediate rescue due to extensive algae, diminishing pool depth and spatial extent, and degrading water quality conditions. It is unclear whether changes in atmospheric conditions, water diversions, groundwater pumping, or a combination of factors resulted in the drop in streamflow and water quality condition. The Fish Rescue Team was successful in removing 8 adult *O. mykiss*, ranging in size from 212 mm to 311 mm, with no juvenile fish observed. After careful consideration, CDFW and COMB-FD opted to release the rescued *O. mykiss* into several large pool habitats in Hilton Creek located near the URP (HC-0.54). The release location had optimal water quality conditions (low water temperature and high dissolved oxygen), cover, and depth which presented best opportunity for survival and disbursement. No other *O. mykiss* were observed in that habitat or the pool habitat just upstream (the Sycamore Pool, LSYR-5.8).

The rapidly changing conditions for *O. mykiss* survival in the Upper Refugio Reach and the Narrows Reach suggest the need for the Fish Rescue Team to be organized well in advance and be at the ready as conditions warrant entering into the dry season.

4.8 Trends in Migrant Trapping since WY2001

Trend analyses of migrant captures can provide insights into the dynamics of *O. mykiss* population within the LSYR basin. The migrant trapping effort has been complicated by a long-term drought (WY2012-WY2016). Additionally, COMB-FD believes that there is need for a modification to the Incidental Take Statement (ITS) (numbers well above the current take limits of 110 juveniles and 150 adults) that is reflective of the general increase of the basin population since the issuance of the 2000 BiOp. The *O. mykiss*

population was trending upward within the Hwy 154 Reach of the LSYR mainstem, Hilton Creek, Quiota Creek, and Salsipuedes/El Jaro Creek until the onset of the drought in WY2012 where the observed number of fish decreased annually through WY2016. WY2017 was the low point and thereafter began an increase in the population that has continued through the current water year (WY2020). Although annually the number of captured juvenile *O. mykiss* throughout the LSYR basin at all trapping locations was over the 2000 BiOp established juvenile take limit (and at or below the adult take limit) from WY2001 through WY2011, NMFS required enforcement of the ITS limits from WY2012 onward. This resulted in implementing a truncated trapping plan that did not fully capture all migrants throughout the migration season (January – May). The annual Migrant Trapping Plan prioritizes capture of upstream migrating anadromous fish and downstream migrating smolts. Since WY2012, take limits have not been exceeded for juveniles and adults (Figure 94).

From WY2001 to WY2020, the maximum number of migrant *O. mykiss* captures across all trapping locations was in WY2007 with 665 captured and a minimum of 5 in WY2017 that reflected the basin wide impact of the long-standing drought (Table 26). Anadromous fish captured over that time had a high in WY2008 of 16 with the next highest of 9 in WY2011 (one being a recapture at Hilton Creek that was initially observed in Salsipuedes Creek) (Table 27). Since the issuance of the 2000 BiOp, there have been 7 years with 1 or more anadromous steelhead observed (WY2001, WY2003, WY2005, WY2006, WY2008, WY2009, WY2010, and WY2011). Only during 2 years have anadromous steelhead been observed in Hilton Creek (WY2009 and WY2011) most likely from the WY2005 and WY2006 cohorts. The number of returning anadromous adults has not been great since monitoring began, but WY2008 and WY2011 were slight signs of the potential viability of the LSYR watershed for maintaining the southern California steelhead population. An increase in the number of anadromous returns during those 2 years was also observed in other watersheds where monitoring has taken place across the Monte Arido Highlands Biogeographic Population Group (NMFS, 2012; Dagit et al., 2020). Smolt captures had a maximum of 445 in WY2006 and a low of 2 in WY2017, again reflective of the impact of the drought (Table 28). Salsipuedes Creek use to produce the most number of smolts across the LSYR basin until the drought when all smolt observations rapidly decreased, but Hilton Creek continued to produce smolts albeit at a lower number then its peak in WY2006 (Figure 95). The high number of the out migrating smolts within WY2006 cohort was most likely associated with the higher number of returning anadromous steelhead in WY2008. A similar pattern was observed with the WY2009 and WY2010 smolt cohort and the higher number of anadromous steelhead returns observed in WY2011 (Figure 96). The WY2011 anadromous steelhead may have had less time in the ocean (or lagoon) hence a possible reason for the overall smaller size observed that year than in WY2008 that had larger anadromous fish observed (Figure 97).

The total migrant *O. mykiss* captures of larger fish, defined as equal to or greater than 400 mm, over the same time period followed a similar trend as discussed above with a maximum total observed in WY2008, then a rapid decline during the extended drought taking the totals down to zero in WY2015, and a slow resurgence starting in WY2018

onward (Figure 98). Tracking the abundance of larger fish is important due to the higher fecundity rate of larger verse smaller spawning fish.

4.9. Genetic Findings in WY2019 and Before

All *O. mykiss* tissue samples taken during the migrant trapping effort are sent to Dr. Carlos Garza of the NOAA Southwest Science Center at UC Santa Cruz (Center) for genetic analyses. Genetic analysis of captured *O. mykiss* is a 2000 BiOp compliance measure (RPM 11). A small tissue sample is carefully taken from each captured fish larger than 120 mm (fork length) from the upper lobe of the caudal fin. Each sample is dried, stored in clearly labeled envelopes, and sent to the Center once the migrant trapping effort has concluded for the year. Results can lag the Water Year they were sampled in by 1 to 2 years due to the backlog and other priorities at the Center. WY2020 samples have been submitted to the Center and the results are forthcoming. The genetics lab at the Center is constantly evolving its analytic approach for DNA extraction and since 2014 uses novel single-nucleotide polymorphism (SNP) markers to evaluate whether sampled fish are derived from coastal steelhead lineage or rainbow trout introductions (Clemento and Garza, 2020). The panel of markers allows for a more robust analysis than prior methods, genetic assignment of individuals, and assessment of each individual if they carry the alleles associated with the anadromous life history strategy through chromosome Omy05 (Pearse et al., 2019). Results are added to the west coast genetic database on coastal steelhead and common planted hatchery fish.

The *O. mykiss* population in southern California and specifically in the Santa Ynez River watershed has been well documented and continues to be studied (Clemento et al., 2009; Alagona et al., 2012). Water storage, withdrawal, and conveyance projects, which include three major dams, have curtailed the habitat and range of steelhead within the Santa Ynez River watershed. Other anthropogenic impacts include low flow concrete stream crossings and road culverts that may pose some level of fish passage impediment and loss of riparian corridor vegetation due to land development. However, genetic analyses demonstrate that steelhead continue to live in the LSYR watershed below Bradbury Dam, the keystone migration barrier in this NMFS determined Core 1 watershed with little genetic introgression from introduced hatchery fish (NMFS, 2012).

The results from the WY2019 sampled fish, most *O. mykiss* sampled assigned to their natal stream (94.3%), i.e., Hilton Creek, Quiota Creek, and Salsipuedes Creek, with little influx of inter-basin or out of basin migrants, or introgression of hatchery fish (Clemento and Garza, 2020). Hatchery fish can be of concern when considering the effective population size of native fish and importance of genetic diversity. There was some detection of out of basin steelhead suggesting some gene flow from straying fish. Historically, most analyzed fish from the Santa Ynez River basin identified to the coastal steelhead lineage.

The low genetic introgression and no pure hatchery fish identification was surprising given the number of planted hatchery fish in Lake Cachuma annually and over the years but consistent with past genetic analyses. There was no assignment of fish to upper basin fish above Bradbury Dam suggesting minimal connectivity between below and above

dam *O. mykiss* populations. That result is not surprising considering 2011 was the last time Bradbury Dam spilled. There was a relatively high frequency of the anadromous association (0.77) of all sampled fish at the OmyO5 marker with higher association of the resident life history from the Quiota Creek fish. The method does not guarantee anadromy, rather only strongly influences the probability that an individual carries the anadromous gene.

Conclusions from Garza-Clemento and Anderson-Garza suggest the following (Garza and Clemento, 2008; Anderson and Garza, 2009). The two primary steelhead (below barrier to anadromy) populations in the basin, Salsipuedes and Hilton creeks are temporally stable and genetically differentiated. Estimates of effective population size in the two populations indicate values of ~25-50 which is consistent with census size estimates and the generally accepted ration of effective to census size for salmonids. In addition, Hilton and, in particular, Salsipuedes Creek population samples were dominated by sibling groups in some years, which can confound inference if undetected. The Santa Ynez River basin has maintained the spatial genetic structure observed in most other coastal steelhead populations, with significant genetic differences between the four primary populations sampled: Salsipuedes, Juncal (upper basin), Santa Cruz (upper basin), and Hilton creeks. In spite of this differentiation, which is moderate, analysis that combined these data with other *O. mykiss* populations in the region demonstrate unambiguously that all 4 of these populations are primarily of coastal steelhead ancestry, indicating that the *O. mykiss* populations above dams are descended from steelhead present historically. With respect to hatchery fish, few hatchery fish were present below Bradbury Dam, a signal of introgression and reproduction was essentially absent from all Santa Ynez River populations. This indicates that hatchery trout are different enough in life history and physiology that they do not successfully reproduce with naturally spawning fish, although they may have other detrimental ecological effects through competition and predation. In addition, all currently stocked *O. mykiss* at Lake Cachuma are triploid, rendering them sterile.

The collected tissue and scale samples from all the anadromous fish captured since WY2001 provide valuable information of the genetic assignment (watershed of origin plus score or confidence) (tissues) and age (scales) of each fish (Table 29). Many fish assigned to their natal streams (22 of 32, with 2 that failed genotyping or had no record) while other migrants assigned to out of basin coastal watersheds (10 of 32) such as from San Luis Obispo area streams, Big Sur streams, tributaries of the Salinas River, and Sespe Creek, a tributary of the Santa Clara River. Origin diversity suggests the plasticity of the species to spawn opportunistically. Out of basin migrant fish (strays) provide needed diversity to the gene pool for the LSYR *O. mykiss* population that can be dominated by siblings. Most fish spent 1 to 3 years in the fresh and then 1 to 4 years in the salt water (ocean or lagoon) before migrating upstream to spawn. It is speculated that the variance on the number of years spent where (fresh vs salt) depends on multiple factors such as rainfall year type (streamflow), ocean/lagoon connectivity, duration of migration opportunity, time of the year with migration flows, and water/habitat quality.

Genetic analysis of tissue samples from migrant captured *O. mykiss* is a highly valuable effort and should be continued.

4.10. Aging *O. mykiss* through Scales Analyses

Further discussion of the results of scale analyses of WY2020 fish (from Section 3.5) is provided below as well as the results of scales from WY2019 and some interesting findings from comparisons across water years.

WY2020 Scales: Two fish were of particular interest in the scales of the *O. mykiss* analyzed in WY2020. There was a 296 mm *O. mykiss* capture at the Salsipuedes Creek trap on 4/16/20 that appeared to be from the LSYR lagoon. The scale analysis showed a change in habitat with rapid growth there after that would not have occurred in the creek or LSYR mainstem due to lack of food supply (Figure 99). The fish was determined to be a 2 year old fish having lived one year in the creek and one year in the lagoon (1F/1S). It is possible that the fish could have come from the ocean as the lagoon was breached on 4/7/20 but unlikely due to its small relative size.

The second fish of particular interest was a 365 mm LSYR mainstem mortality found in a run habitat on 12/3/20 just upstream of the Head of Beaver Pool (LSYR-8.7) (Figure 99). The fish appeared to be 3+ years old. This fish was seen alive and healthy in this same run habitat during the spring and summer survey but was found dead during the fall survey. The fish appeared to have perished due to a bird strike on its side and hadn't been dead for more than a day or so prior to being found. The pattern of laid down circuli suggest an increase in the growth rate going into its third year most likely due to a habitat change from a creek with limited food supply to the LSYR mainstem with more food supply.

WY2019 Scale: Scales were taken and analyzed on 22 of 39 total migrant captures at 2 trap sites (Hilton Creek and Salsipuedes Creek, there were no LSYR mainstem captures) and 6 mortalities found over the WY2019 reporting period. Minimum fish size for tissue sampling was again set at 120 mm and some fish could not be sampled or the scales were not legible. The age range was from 0+ to 4+ years old with a size range of 54 mm to 447 mm (Table 30). Scales were read from 28 fish of which the highest totals were for 3 and 3+ year old fish at 7 and 7, respectively (25% each of the total).

During the tail-end of the recent long standing drought, delivered flows to Hilton Creek were via trickle flow in WY2016. In WY2017, a combination of trickle flow and various low flow release scenarios were provided to the LRP through the HCWS/HCEBS. The majority of readable scales from larger (3 year old) *O. mykiss* sampled in WY2019 indicate 2 years of slow growth precisely when Hilton Creek flows were minimal in WY2016 and WY2017 (Figures 100-102). Those low flow conditions in Hilton Creek likely produced fewer food resources and less habitat space for optimal growth, indicated by the truncated growth patterns on the inner portion of those scales where the circuli were tightly spaced. With the return of higher annual flow rates, the fish began to grow faster based on scale observations.

Genetics and Scale Matches: As discussed in Section 4.9 above, genetic sampling of captured *O. mykiss* during migrant trapping operations has provided some rare opportunities to study growth rate of both the resident and anadromous life history forms over a specific period of time. Genetic sampling over multiple years, specifically in Hilton Creek, has provided multiple examples of the same fish being captured 2 to 3 times (1-3 years between captures) with associated scale samples collected and analyzed for growth and age determination in relation to each date of capture.

Scales start to form when a fish is about an inch long and in general scale growth is proportional to fish growth. As the scale grows, circuli (ridges) form on the edge. Circuli make a concentric pattern over the course of a year that is related to environmental and growth conditions (i.e., food availability, water temperature, etc.). During months when fish eat less and growth slows down or ceases (typically the winter), the circuli are crowded together (termed annuli formation). When feeding and growth resume (typically in spring), new circuli form that are spaced further apart. Annuli (true year marks) are characterized by crowded closely spaced ridges at both sides of the scale. Unusual events may cause false annuli to form on scales. Examples are extreme water temperatures, injury, or any other stress that causes growth to stop for a period of time during the normal growing season.

The examples discussed below are from resident fish scale samples of genetic matches collected during the WY2007 through WY2010 trapping season. Optimal growth rates are dependent on local conditions to provide good water quality and abundant food sources for rearing fish as was the case during those water years.

On 3/26/07, a 192 mm smolt (HD-83) was captured leaving Hilton Creek and was aged as a 2+ fish. That same fish was captured on 4/6/08 (HU-156 resident female) and measured 309 mm (aged at 3 years). This fish grew 117 mm (4.6 inches) in 370 days or approximately 3.16 mm (0.12 inches) per day (Figure 103). The fact that this fish was classified as a smolt in WY2007 then came back to spawn in WY2008 proves that *O. mykiss* will residualize back to a resident life history form if they are unable to make it to the ocean once they have undergone smoltification. It also demonstrates that residualized *O. mykiss* carry the anadromous gene and will pass that gene down to successive generations provided successful spawning occurs.

On 3/28/07, a 122 mm resident parr (young *O. mykiss* distinguished by dark rounded patches evenly spaced along its sides) (HD-96) was captured leaving Hilton Creek and was aged as a 1+ fish (Figure 104). That same fish was captured on 1/15/08 (HU-31 resident female) and measured 237 mm (aged as a 2 year fish). This fish grew 115 mm (4.5 inches) in 288 days or approximately 2.5 mm (0.1 inch) per day.

One fish was captured three times and had scale samples collected during each capture. On 3/31/07, a 135 mm resident parr (HD-128) was captured leaving Hilton Creek and was aged at 1 year (Figure 105). This fish was captured again on 3/9/08 (HU-129 resident female) and measured 265mm (aged at 2+ years). This fish grew 130 mm (5.1 inches) in 288 days or 2.2 mm (0.09 inches) per day. This fish was captured a third time on 2/15/10

(HD-44 resident female-aged at 4 years), measured 345 mm and grew an additional 88 mm (3.1 inches) between March of 2008 and February of 2010. In total, the fish grew 8.3 inches in 696 days and spawned at least twice due to check marks observed on the scales.

On 3/24/07, a 150 mm smolt (HD-68) was captured leaving Hilton Creek and was aged as a 1/1+ fish (Figure 106). That same fish was captured on 1/24/09 (HD-20 resident male) and measured 380 mm (aged at 3+ years). This fish grew 230 mm (9.1 inches) in 661 days or 2.9 mm (0.11 inches) per day. This fish is another example of a smolt that was heading downstream and residualized back to the resident life history form.

4. 11 Water Quality Impacts from the Stilling Basin from the Leading Edge of the WR 89-18 Releases

It has been observed that the leading edge of a WR 89-18 release causes a rapid rise in stream water temperature followed by a decline and unithermal conditions to depth. The apparent spike in stream water temperature is a concern for the LSYR mainstem *O. mykiss* population downstream of the dam. The observations have been documented just downstream of the Stilling Basin, within the Long Pool, downstream of the Long Pool, and at several locations within the Refugio Reach (Rach 2a). The cause of the spike is most likely from the release waters pushing out thermally heated surface water from the Stilling Basin and leading edge release waters being heated up while initially flooding river cobbles that were previously dry and exposed to the sun.

Releases into the LSYR mainstem occur at two locations: 1) the Outlet Works which takes water from the bottom of the lake (lower hypolimnion) where the water is the coldest and discharges into the Stilling Basin and 2) from the HCWS which takes water from approximately 65 feet below the surface and below the thermocline (upper hypolimnetic) and is released at URP and/or the LRP into Hilton Creek. Releases at each location fluctuate depending on the time of year and target flow requirements but are *generally* less than 5 cfs at each release point outside of a WR 89-18 release. Cold water releases into Hilton Creek from the URP warm only 1-2°C as they travel to the confluence with the LSYR mainstem (a distance of approximately 3,000 feet) primarily due to the thick riparian canopy which shades the creek channel from solar radiation. Conversely, the Stilling Basin is the largest pool habitat on the LSYR mainstem (outside of the lagoon) measuring roughly 866 feet long, 482 feet wide at its midpoint and approximately 36-feet deep at its deepest point (when at full capacity) and is completely exposed to the sun. During the hot summer months, thermal stratification develops annually. Surface waters have been observed to be greater than 25°C and can extend down 8-12 feet into the water column. Low flow, cold water releases from the Outlet Works into the Stilling Basin quickly warm on the surface. This warm surface water translates downstream over the tail water control and stream water temperatures are recorded directly downstream of the Stilling Basin (LSYR-0.25), within the Long Pool (LSYR-0.51), and downstream of the Long Pool (LSYR-0.66). These waters are in contrast to Hilton Creek (Upper HC [HC-0.54] and Lower HC [HC-0.12]) with recorded cooler water temperatures. The two sources mix in the Long Pool. Figure 107 shows the difference in water temperature from each source before and during a WR 89-18 release, specifically Stilling Basin releases (cold from the bottom of the lake) and Hilton Creek

(warmer but below the thermocline) and the slight warming from the URP to the confluence in Hilton Creek.

Outlet Works discharge rates during WR 89-18 releases historically start at greater than 150 cfs with no ramp-up (i.e., 5 cfs to 150+ cfs) (Figure 109). Water temperatures data have shown that releases do not initially mix in the Stilling Basin but instead act to push a slug of warm stratified surface water downstream first before any mixing occurs. This results in a noticeable temperature spike between 2 – 5 °C immediately downstream of Bradbury Dam (LSYR-0.25) and into the Long Pool (LSYR-0.51) lasting between 45 minutes to 1 hour before mixing occurs in each habitat and stream water temperatures cool and go uni-thermal to depth (Figures 109 and 110). This generally occurs within approximately 2 hours and reaches equilibrium within the first 8 to 14 hours following the maximum recorded temperature. At the onset of a WR 89-18 release, the *O. mykiss* population is subject to this temperature spike over a very short period of time prior to cooling compared to the normal diel cycle. The effect of thermally warmed water from the Stilling Basin diminishes going downstream but the release waters are subject to further warming as the leading edge floods dry warm river cobles.

In 2020, NMFS requested that the WR89-18 release be ramped up to 150 cfs over the course of 2 days with the objective of discouraging *O. mykiss* movement during the initial release pulse. No fish were observed moving during the initial pulse of the release at the LSYR mainstem trap location (LSYR-6.08) in 2020. An added benefit to this operational change of a 2 day ramp-up was more time for mixing resulting in less thermal heating of stream waters downstream compared to previous years (Figure 111). The temperature spike was small and the period of time to equilibrium was less compared to other years (e.g., 2018, 2014, and 2013). Based on data collected in 2020 and the operation conducted, consideration should be given to continuing with a ramp-up procedure, possibly over a longer period of time, and possibly starting the release at a different time than 8:00 AM (possibly middle of the night) to address heating of the leading edge as it floods warm dry river cobbles. Timing the leading edge to go across the dry gap (approximately LSYR-5.4 to LSYR-6.3) at night could reduce the potential thermal heating and negative impacts to endangered *O mykiss* from WR 89-18 releases downstream of the dam.

4.12. Tributary Fish Passage Enhancement and Stream Restoration Projects

By the end of calendar year 2020, 15 tributary fish passage enhancement and 6 stream restoration projects for a total of 21 projects have been completed within the LSYR basin in support of the LSYR basin O. mykiss population (Table 31). Many of the fish passage projects, but not all, were listed in the 2000 BiOp (Tables 32-33 and Figures 112-117). All documented anthropogenic passage impediments within the Salsipuedes/El Jaro Creek and Quiota Creek (except for Crossing 0B which is a partial migration barrier that has been mandated by the District Attorney to be removed) 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 these fish passage facilities, and in cases where fish ladders were installed, fish often use the ladders for refuge and oversummering habitats.

The Fish Passage Enhancement Project at Quiota Creek Crossing 8 was successfully completed at the very end of 2019 and was the final stream crossing project on S. Refugio Road. This marks a significant accomplishment and milestone that started in WY2007 with the development of a Watershed Plan to remove all known fish passage impediments along Quiota Creek (CCRB, 2009). It was the most difficult project to design due to its configuration and to obtain funding required authoring 4 grants before funding was secured. The magnitude of the effort warranted being selected for the cover photo on this year's Annual Monitoring Summary for the accomplishment and the beauty of the project.

The HCWS/HCEBS 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 62-63). In 2005, completion of the Hilton Creek Cascade Chute Project doubled the available habitat for *O. mykiss* in the watered section of Hilton Creek and releases from the URP provided for extensive riparian vegetation growth that has shaded and cooled the stream water (Figure 118). Channel changes and the redistribution of optimal sized spawning gravels throughout Hilton Creek, coupled with continuous Lake Cachuma water deliveries to the URP since WY2019 and gravel augmentation (2017-2018) have greatly enhanced instream rearing conditions throughout the creek.

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 WY2020 as cattle have been excluded from the stream corridor, except for a couple of short duration break-ins.

The South Side Erosion Control and Reforestation Project at Crossing 8 was successfully completed at the end of September in WY2020. This project enhanced the just completed Fish Passage Improvement at Quiota Creek Crossing 8 Project by addressing erosion problems to the south in two small tributaries. Small settling basins were installed in each of the 2 intermittent drainages to reduce sediment delivery to Quiota Creek, a culvert was installed under the ranch road to reduce the erosion potential, ten native Coast Live oak trees were planted in close proximity to each of the settling basins for reforestation, and all disturbed areas were seeded/mulched within the project footprint. Benefits of the project will be documented once the rainy season returns.

4.13. Water Hyacinth Discovery and Removal

Water hyacinth is native to the Amazon Basin in South America and has emerged as a major weed in more than 50 countries in the tropical and subtropical regions of the world with profuse and profound impacts, specifically in the Sacramento-San Joaquin River Delta where it has heavily impacted the river ecology and fisheries (Villamagna and Murphy, 2010). Invasive water hyacinth (*Eichhornia crassipes*) was first discovered in the LSYR during beaver dam surveys in December 2013 approximately 2 miles downstream of the Avenue of the Flags Bridge in Buellton. The infestation extended approximately 1.2 miles downstream and was contained by COMB-FD staff over the course of 3 years within that section of the river channel. Staff surveyed that section of river in WY2020 and did not observe any water hyacinth (last known occurrence was 12/8/16). This has become a routine field monitoring activity.

4.14. Update on the Lake Cachuma Oak Tree Mitigation Project

The annual oak tree inventory was completed in February of 2020 with an objective to determine the status and success rate of the trees planted since the beginning of the program with 11 years of plantings. At the end of the 2020 planting season, 5,025 oak trees have been planted and 4,092 are alive and thriving (80.5% survival rate). The number of mitigation trees still to be planted stood at 629 trees (mitigation number minus total alive trees). There were 311 at Lake Cachuma County Park that are referenced as Year 11 trees. The lessons learned by the COMB-FD staff from 8 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.

4.15. Status of WY2019 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 WY2019 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.

- Work closely with Reclamation on the implementation of the new Water Order WR 2019-0148 to conduct all required monitoring and reporting in a timely manner;
    - Status: This recommendation is being followed and is ongoing.

- Continue to collaborate with Reclamation on best management practices in Hilton Creek to address the potential for sediment-laden runoff from the Whittier Fire burn area;
    - Status: This recommendation is being followed and is ongoing.

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

- Considering the success of the gravel augmentation effort in Hilton Creek in WY2018, discuss with Reclamation the possibility of a long-term program in Hilton Creek and other locations of known spawning activities that are limited in stream gravels;
    - Status: Several discussions have been had with Reclamation on continuing the gravel augmentation effort. At the moment, it is being discussed through the Reconsultation process between Reclamation and NMFS.

- Work with the regulatory agencies to utilize the COMB Electrofishing Backpack unit and trained/certified staff whenever possible to implement fish rescue and removal of non-native fish from the LSYR basin;
    - Status: This recommendation is being followed and is ongoing. The unit has been used multiple times in collaboration with NMFS and CDFW.

- Remove non-native fish species and continue to conduct basic stomach content analyses of non-native piscivorous fish whenever possible (during migrant trapping, fish rescue, and stranding surveys), specifically in habitats known to support *O. mykiss* and non-native fish;
    - Status: This recommendation is being followed and is ongoing.

- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin;
    - Status: This continues to be a good recommendation and is being considered in the Reconsultation effort between Reclamation and NMFS.

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

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

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

- Continue working with the US Geological Survey, specifically at all LSYR basin gauges, to obtain accurate real-time measurements and to identify appropriate transect locations for stage-discharge relationships;
    - Status: This recommendation is being followed and is ongoing.

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

- 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

WY2020 was the third year since the drought that started in WY2012. Bradbury Dam recorded 21.03 inches of rain with the highest rainfall occurring in December, March and April. Lake Cachuma did not spill but did reach 81.2% of capacity on 4/25/20 at 156,960 af (740.45 ft in elevation). A minimum of 2 cfs was delivered to Hilton Creek at the URP and target flows to the Hwy 154 Bridge were met. The lagoon breached late in the season on 4/7/20 and remained open for the rest of the water year. No anadromous fish were observed entering or within the Santa Ynez River basin.

There were 34 redds documented across the LSYR basin, none in the LSYR mainstem as all were in the tributaries. Spring, summer, and fall snorkel surveys showed an elevated level of spawning success with many YOYs observed in Hilton, Quiota and Salsipuedes/El Jaro creeks. The number of observed YOYs was not as high as during WY2019, most likely due to the large stormflow event associated with the 4/6/20 storm that washed out many YOYs and redds. There was ample fish passage potential for migrating fish but no anadromous fish were observed even with 2 fish passage supplementation events.

Monitoring tributary and LSYR mainstem *O. mykiss* populations has resulted in observations that fluctuate by water year type, instream flows, spawning success, and oversummer rearing conditions. The continuation of the long-term monitoring program within the LSYR basin is essential for tracking population trends, particularly as restoration efforts are completed and adaptive management actions are realized. Collaboration with other local monitoring programs within the Southern California Steelhead DPS and Monte Arido Highland Biogeographical Region is desirable to better understand population viability and restoration potential at a regional scale.

Recommendations to Improve the Monitoring Program: Based on observations and gained knowledge, the following suggestions (consistent with WY2019 AMS 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 WY2020 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 work closely with Reclamation on the implementation of the new Water Order WR 2019-0148 to conduct all required monitoring and reporting in a timely manner;
- Continue 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;
- Develop a gravel augmentation plan for the Hwy 154 Reach of the LSYR mainstem to provide spawning gravels to habitats with limited spawning potential due to the makeup of the stream substrate. Pattern the effort on what was successful completed in Hilton Creek on Reclamation property. Work with Reclamation on developing the plan, environmental coverage, and identifying potential funding sources.
- Continue to work with Reclamation to maximize dry season releases to Hilton Creek versus the Outlet Works to minimize lake release stream temperatures entering the Long Pool and LSYR mainstem habitats downstream. This effort provided to be beneficial to the downstream fishery during the critical dry season rearing period.
- Work with the Santa Ynez River Conservation District on further developing their ramp-up procedures for WR 89-18 releases to enhance the successfully implemented effort started in WY2020.
- Continue to evolve the collaborative relationship with CDFW regarding fish rescue within the LSYR basin. The effort undertaken in this regard in WY2020 was exemplary and should be continued. Coordinate and prepare early as conditions warrant entering into the dry season.
- Continue to remove non-native fish species and continue to conduct basic stomach content analyses of non-native piscivorous fish whenever possible (during migrant trapping, fish rescue, and stranding surveys), specifically in habitats known to support *O. mykiss* and non-native fish;
- Develop a Beaver Management Plan and an Invasive Species Management Plan for the LSYR basin;
- Continue to 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 with scale analyses going back in time to assure all scales have been read and documented that are currently in the LSYR *O. mykiss* scale inventory,

specifically looking at growth rates, evidence of life-history strategies such as fresh versus marine water rearing, signs of spawning, integration of the findings with the results of the genetic analyses, etc. in support of ongoing fisheries investigations;

- Continue working with the US Geological Survey, specifically at all LSYR basin gauges, to obtain accurate real-time measurements and to identify appropriate transect locations for stage-discharge relationships;
- Continue to maintain and develop landowner relationships in the LSYR basin to foster cooperation and gain access to reaches for all monitoring and restoration tasks; and
- Continue working with other *O. mykiss* monitoring programs within the Southern California Steelhead DPS and the Monte Arido Highland Biogeographic Region to improve collective knowledge, collaboration, and dissemination of information.

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3. Monitoring Results

Table 1: WY2000 to WY2020 rainfall (precipitation) at Bradbury Dam, reservoir conditions, passage supplementation, and water rights releases.

Water Year	Rainfall Bradbury* (in)	Year Type**	Spill	# of Spill Days	Reservoir Condition Storage (max) (af)	Reservoir Condition Elevation (max) (ft)	Passage Supplementation	Water Right Release
2000	21.50	Normal	Yes	26	192,948	750.83	No	Yes
2001	31.80	Wet	Yes	131	194,519	751.34	No	No
2002	8.80	Dry	No	0	173,308	744.99	No	Yes
2003	19.80	Normal	No	0	130,784	728.39	No	No
2004	10.60	Dry	No	0	115,342	721.47	No	Yes
2005	44.41	Wet	Yes	131	197,649	753.11	No	No
2006	24.50	Wet	Yes	54	197,775	753.15	Yes	No
2007	7.40	Dry	No	0	180,115	747.35	No	Yes
2008	22.59	Wet	Yes	53	196,365	752.70	No	No
2009	13.66	Dry	No	0	168,902	743.81	No	No
2010	23.92	Wet	No	0	178,075	747.05	Yes	Yes
2011	31.09	Wet	Yes	53	195,763	753.06	No	No
2012	12.69	Dry	No	0	180,986	748.06	No	No
2013	7.57	Dry	No	0	142,970	733.92	No	Yes
2014	9.96	Dry	No	0	91,681	710.00	No	Yes
2015	9.38	Dry	No	0	60,992	691.09	No	Yes
2016	11.45	Dry	No	0	32,900	669.57	No	Yes
2017	25.48	Wet	No	0	99,152	715.25	No	Yes
2018	9.32	Dry	No	0	82,580	706.27	No	Yes
2019	23.79	Wet	No	0	156,374	740.23	Yes	No
2020	21.03	Normal	No	0	156,960	740.45	Yes	Yes

* Bradbury Dam rainfall (Cachuma) period of record = 68 years (1953-2020) with an average rainfall of 19.91 inches.

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

Table 2: WY2020 and historic precipitation data for six meteorological stations in the Santa Ynez River Watershed (source: County of Santa Barbara and USBR).

Location	Station	Initial Year	Period of Record	Long-term Average	Minimum Rainfall		Maximum Rainfall		Rainfall (WY2020)
	(#)	(date)	(years)	(in)	(in)	(WY)	(in)	(WY)	(in)
Lompoc	439	1955	65	14.56	5.31	2007	34.42	1983	12.97
Buellton	233	1955	65	16.64	5.87	2014	41.56	1998	15.43
Solvang	393	1965	55	18.31	6.47	2007	43.87	1998	16.69
Santa Ynez	218	1951	69	15.74	6.58	2007	36.36	1998	15.13
Cachuma*	USBR	1953	68	19.91	7.33	2007	53.37	1998	21.03
Gibraltar	230	1920	100	26.28	8.50	2013	73.12	1998	24.51
Jameson	232	1926	94	28.69	8.50	2007	79.52	1969	22.89

* 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 WY2020; 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	11/27/2019	1.47	No	No
2	12/1/2020	0.76	No	No
3	12/3/2019	1.19	No	No
4	12/7/2019	0.56	No	No
5	12/23/2019	2.41	No	No
6	12/26/2020	1.75	No	No
7	12/30/2020	0.50	No	No
8	1/17/2020	0.43	No	No
9	3/2/2020	0.16	No	No
10	3/11/2020	6.77	No	No
11	3/23/2020	1.16	Yes	Yes
12	4/6/2020	3.56	Yes	Yes

(b)

Month	Rainfall (in.)	%
Oct-19	0.00	0.0
Nov-19	1.52	7.2
Dec-19	7.19	34.2
Jan-20	0.48	2.3
Feb-20	0.06	0.3
Mar-20	8.13	38.7
Apr-20	3.58	17.0
May-20	0.07	0.3
June-20	0.00	0.0
July-20	0.00	0.0
Aug-20	0.00	0.0
Sept-20	0.00	0.0
Total:	**21.03**	100

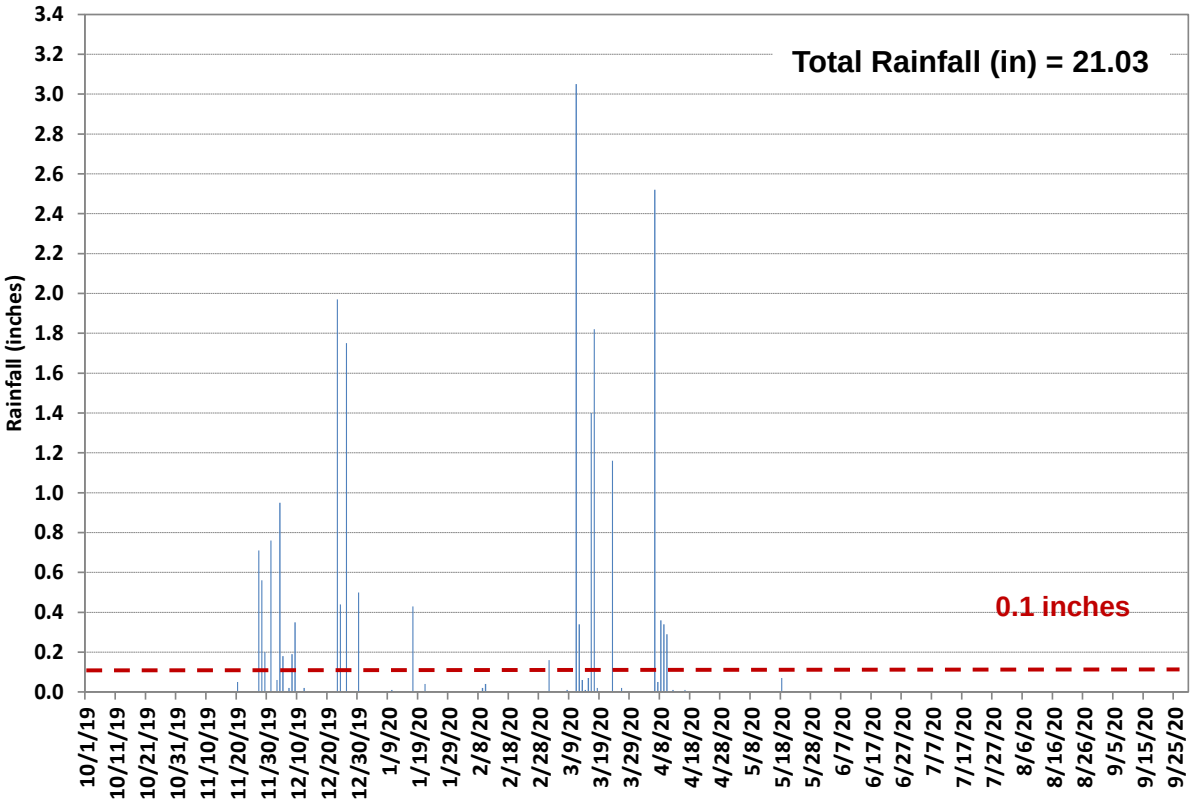


Figure 1: Rainfall in WY2020 recorded at Bradbury Dam (USBR).

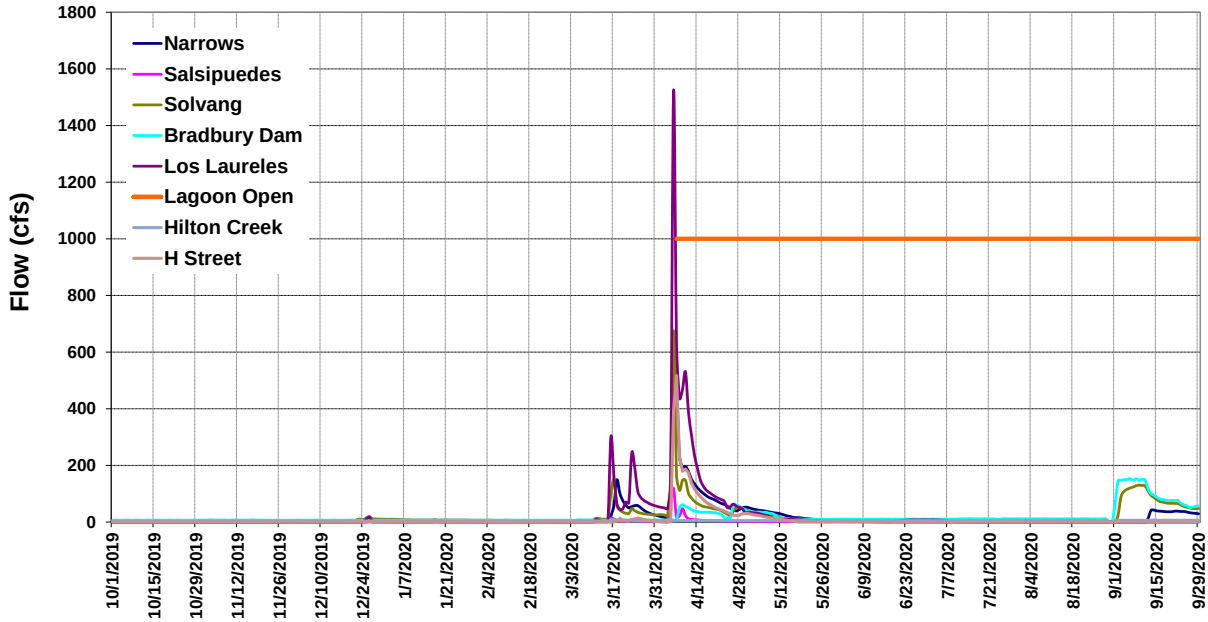


Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open to the ocean in WY2020.

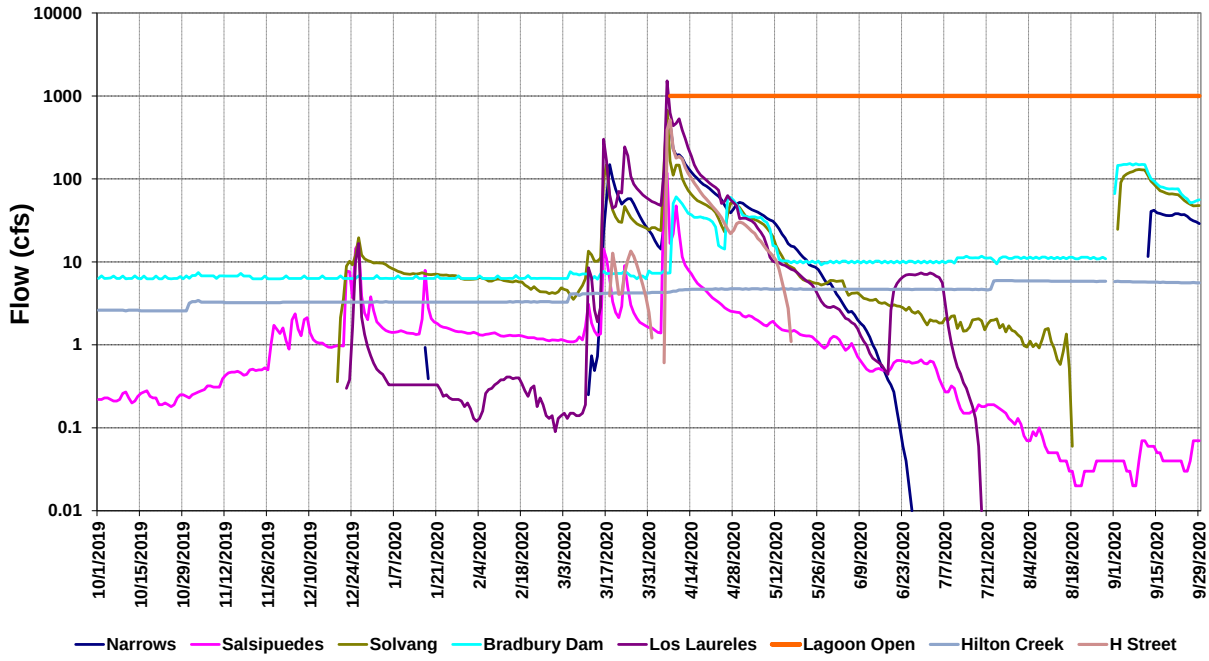


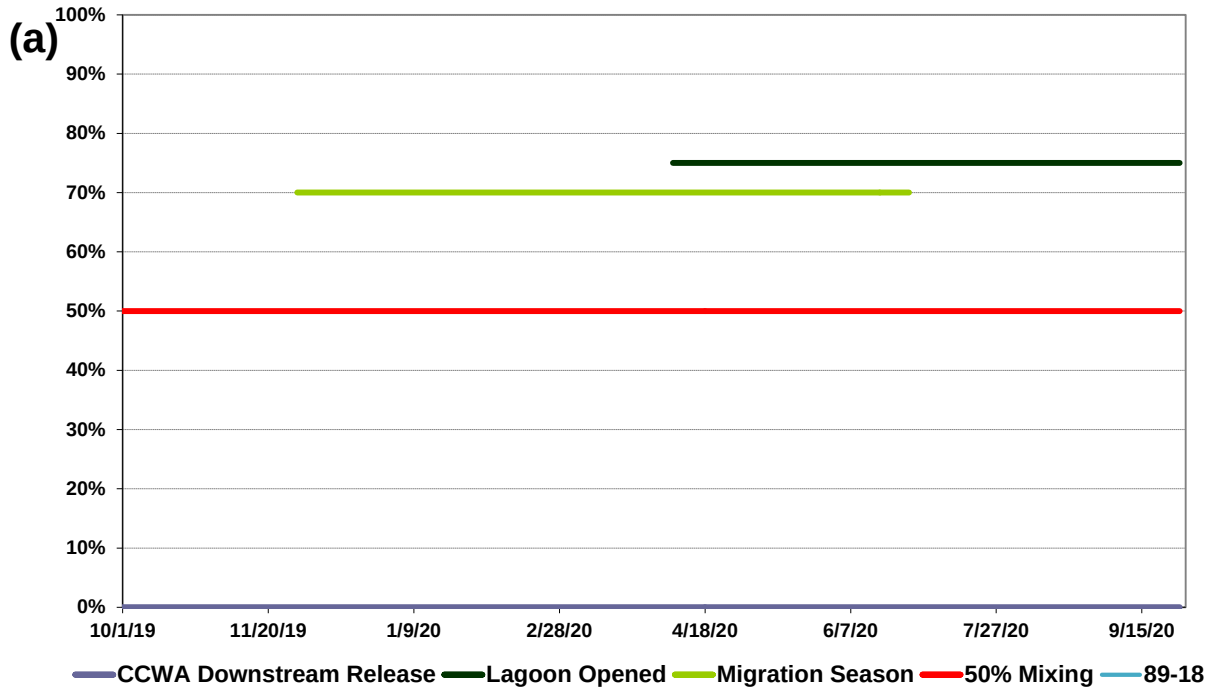
Figure 3: USGS average daily discharge at the LSYR mainstem USGS gauging stations at Los Laureles, Bradbury Dam (USBR), Hilton Creek (USBR), Alisal Bridge (Solvang), Salsipuedes Creek, the Narrows and H Street (Lompoc) during WY2020.

Table 4: Ocean connectivity, lagoon status and number of days during the *O. mykiss* migration season from WY2001 to WY2020.

Water Year	Year Type	Ocean Connectivity	Lagoon Status			# of Days Open in Migration Season*
			Open	Closed	# of Days	
2001	Wet	Yes	1/11/01	6/5/01	146	141
2002	Dry	No	-	-	0	0
2003	Normal	Yes	12/20/02	5/19/03	151	139
2004	Dry	Yes	2/26/04	3/22/04	26	26
2005	Wet	Yes	12/27/04	7/21/05	207	151
2006	Wet	Yes	3/1/06	-	214	92
2007	Dry	Yes	-	11/21/06	52	0
2008	Wet	Yes	1/6/08	5/19/08	135	135
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**	80	33
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
2019	Wet	Yes	1/18/19	5/6/19	107	107
2020	Normal	Yes	4/7/20	-	177	55

*Migration Season is January through May.

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



(b)

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

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

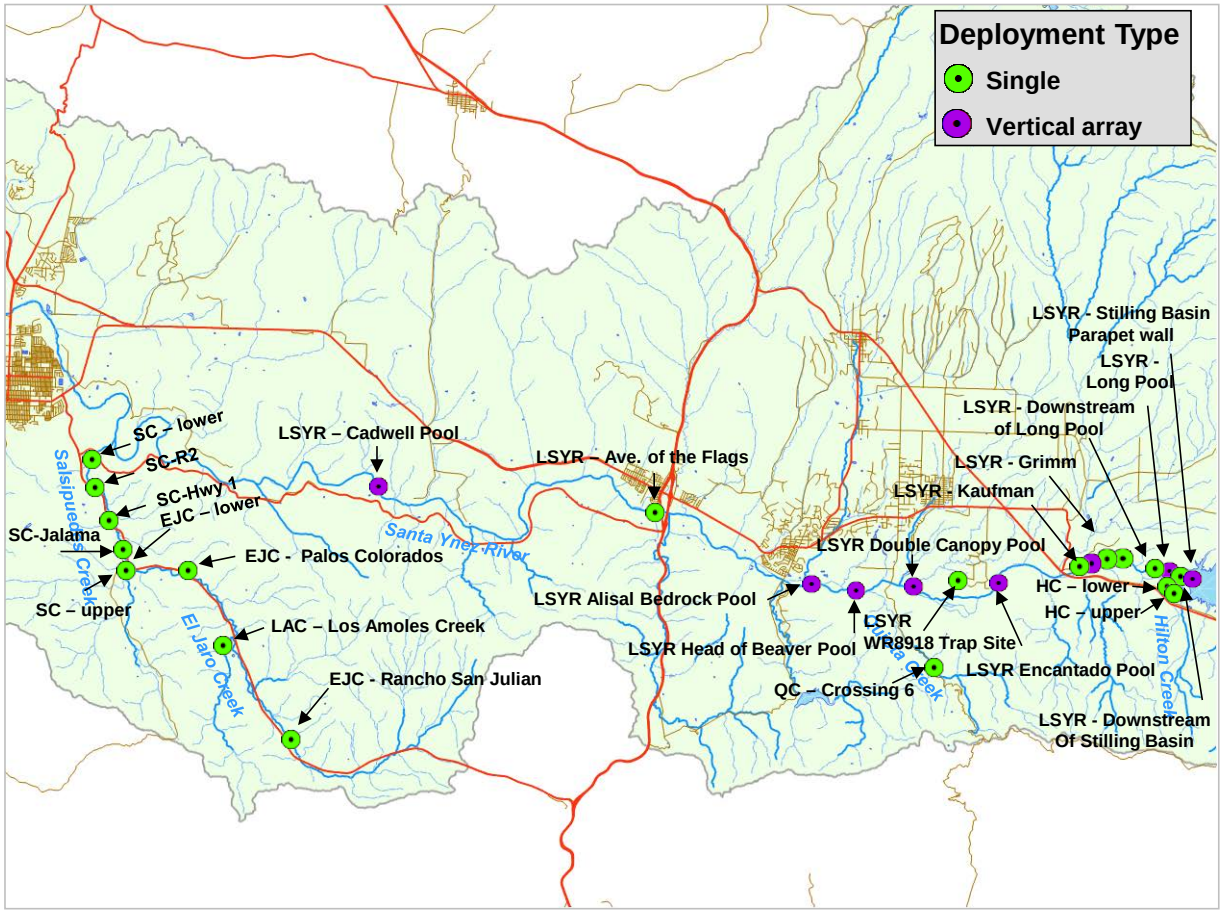


Figure 5: Thermograph single and vertical array deployment locations in WY2020 within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are close together with overlapping symbols.

Table 5: 2020 thermograph network locations and period of record listed from upstream to downstream.

	Location Name	Stream ID	Type	Latitude	Longitude	Deployment Date	Retrieval Date	Period of Record (Days)
Mainstem	LSYR - Stilling Basin Wall	LSYR-0.01	Vertical Array	34.585472	-119.98316	4/29/2020	11/19/2020	200
	LSYR - D/s of Stilling Basin	LSYR-0.25	Single	34.586502	-119.985333	4/29/2020	11/19/2020	200
	LSYR - Long Pool	LSYR-0.51	Vertical Array	34.588545	-119.987998	4/29/2020	11/19/2020	200
	LSYR - D/s of Long Pool	LSYR-0.68	Single	34.590550	-119.991317	4/29/2020	11/19/2020	200
	LSYR-Grimm Property-Upstream	LSYR-1.09	Single	34.590097	-119.999322	4/29/2020	11/17/2020	198
	LSYR-Grimm Property-Downstream	LSYR-1.54	Single	34.59423	-120.00537	4/29/2020	11/17/2020	198
	LSYR-Grimm Property Pool	LSYR-1.71	Vertical Array	34.594533	-120.008004	4/29/2020	11/17/2020	198
	LSYR-Kaufman Property Pool	LSYR-2.77	Single	34.589631	-120.025523	4/29/2020	11/17/2020	198
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	34.583817	-120.058500	4/30/2020	11/12/2020	192
	LSYR - WR89-18 Trap Site	LSYR-6.08	Single	34.579611	-120.077804	9/1/2020	9/17/2020	16
	LSYR - Double Canopy	LSYR-7.65	Vertical Array	34.583998	-120.096764	4/30/2020	11/12/2020	192
	LSYR - Head of Beaver	LSYR-8.7	Vertical Array	34.581116	-120.114454	4/30/2020	11/12/2020	192
	LSYR - Alisal Bedrock Pool	LSYR-10.2	Vertical Array	34.583267	-120.141369	4/30/2020	11/12/2020	192
	LSYR - Avenue of the Flags	LSYR-13.9	Single	34.606734	-120.195150	4/30/2020	11/12/2020	192
	LSYR - Cadwell Pool	LSYR-22.68	Vertical Array	34.610143	-120.306920	4/30/2020	11/12/2020	192
Tributaries	Hilton Creek (HC)-lower	HC-0.12	Single	34.587132	-119.986255	4/29/2020	11/19/2020	200
	HC at URP	HC-0.54	Single	34.581522	-119.982846	4/29/2020	11/19/2020	200
	Quiota Creek (QC)-Crossing 6	QC-2.66	Single	34.559525	-120.084834	5/1/2020	11/5/2020	184
	Salsipuedes Creek (SC)-lower-Reach 1	SC-0.77	Single	34.620473	-120.423552	5/1/2020	11/4/2020	183
	SC-Reach 2-Bedrock Section	SC-2.2	Single	34.61168	-120.42191	5/1/2020	11/5/2020	184
	SC-Reach 4-Hwy 1 Bridge	SC-3.0	Single	34.597429	-120.413034	5/1/2020	11/9/2020	188
	SC-Reach 5-Jalama Bridge	SC-3.5	Single	34.589551	-120.408944	5/1/2020	11/9/2020	188
	SC-upper at El Jaro confluence	SC-3.8	Single	34.583953	-120.408199	5/1/2020	11/10/2020	189
	El Jaro Creek (EJC)-Lower-Confluence	EJC-3.81	Single	34.584167	-120.407983	5/1/2020	11/10/2020	189
	EJC-Palos Colorados	EJC-5.4	Single	34.574767	-120.371795	5/1/2020	11/5/2020	184
	EJC-Rancho San Julian Bridge	EJC-10.82	Single	34.530013	-120.342545	5/1/2020	11/5/2020	184
	Los Amoles Creek (LAC)-Creek Crossing	LAC-7.0	Single	34.558216	-120.369581	5/1/2020	11/5/2020	184

*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-0.01	n/s	n/s	n/s
		Downstream of Stilling Basin	LSYR-0.25	n/s	n/s	
		Long Pool	LSYR-0.51	n/s	n/s	n/s
		Downstream of Long Pool	LSYR-0.68	O, B	n/s	O
		LSYR-Grimm Property Upstream	LSYR-1.09	O	n/s	
		LSYR-Grim Property Downstream	LSYR-1.54	O	n/s	
		LSYR-Grimm Property Pool	LSYR-1.71	O, B	n/s	O
		LSYR-Kaufman Property Run	LSYR-2.77	O, B	n/s	O
Reach 2	Refugio	Encantado	LSYR-4.95	O, B	O, B, S	O, B
		Double Canopy Pool	LSYR-7.65	B, S, C	O, B, C	B, C
		Head of Beaver Pool	LSYR-8.7		B	
		Bedrock Pool	LSYR-10.2	C	B	C
Reach 3	Ave. of the Flags	Ave. of the Flags (HWY 101)	LSYR-13.9	B, C		
	Cadwell	Cadwell Pool	LSYR-22.68	B, S, C	B, C	B, C
Tributaries:						
Hilton	Upper Hilton	Hilton Creek URP Pool	HC-0.12	O	n/s	O
	Lower Hilton	Lower Hilton Creek near Conf.	HC-0.54	O	n/s	O
Quiota	Crossing 6	Crossing 6 Pool	QC-2.66	O	n/s	
Salsipuedes	Reach 1	Salsipuedes Creek at Trap Site	SC-0.77	O, B, S, C	n/s	S
	Reach 2	Salsipuedes Creek Reach 2 Bedrock Section	SC-2.2	O	n/s	S
	Reach 4	Salsipuedes Creek at Highway 1 Bridge	SC-3.0	O	n/s	
	Reach 5	Salsipuedes Creek at Jalama Bridge	SC-3.5	O	n/s	O, S
	Upper Salsipuedes	Salsipuedes Creek upstream of El Jaro Conf.	SC-3.8		n/s	
El Jaro	Lower El Jaro	El Jaro upstream of Conf. with Salsipuedes	EJC-3.81	O, S	n/s	
	Palos Colorados	Palos Colorados Pool	EJC-5.4		n/s	
	Rancho San Julian	EL Jaro at Rancho San Julian Bridge	EJC-10.82	O	n/s	
Los Amoles	Lower Los Amoles	Lower Los Amoles Creek Crossing	LAC-7.0		n/s	

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

n/s - not snorkeled due to turbidity.

Figure 6: 2020 LSYR mainstem temperature unit deployment locations at: a) LSYR-0.01, b) LSYR-0.25, c) LSYR-0.51, d) LSYR-0.68, e) LSYR-1.09, f) LSYR-1.54.

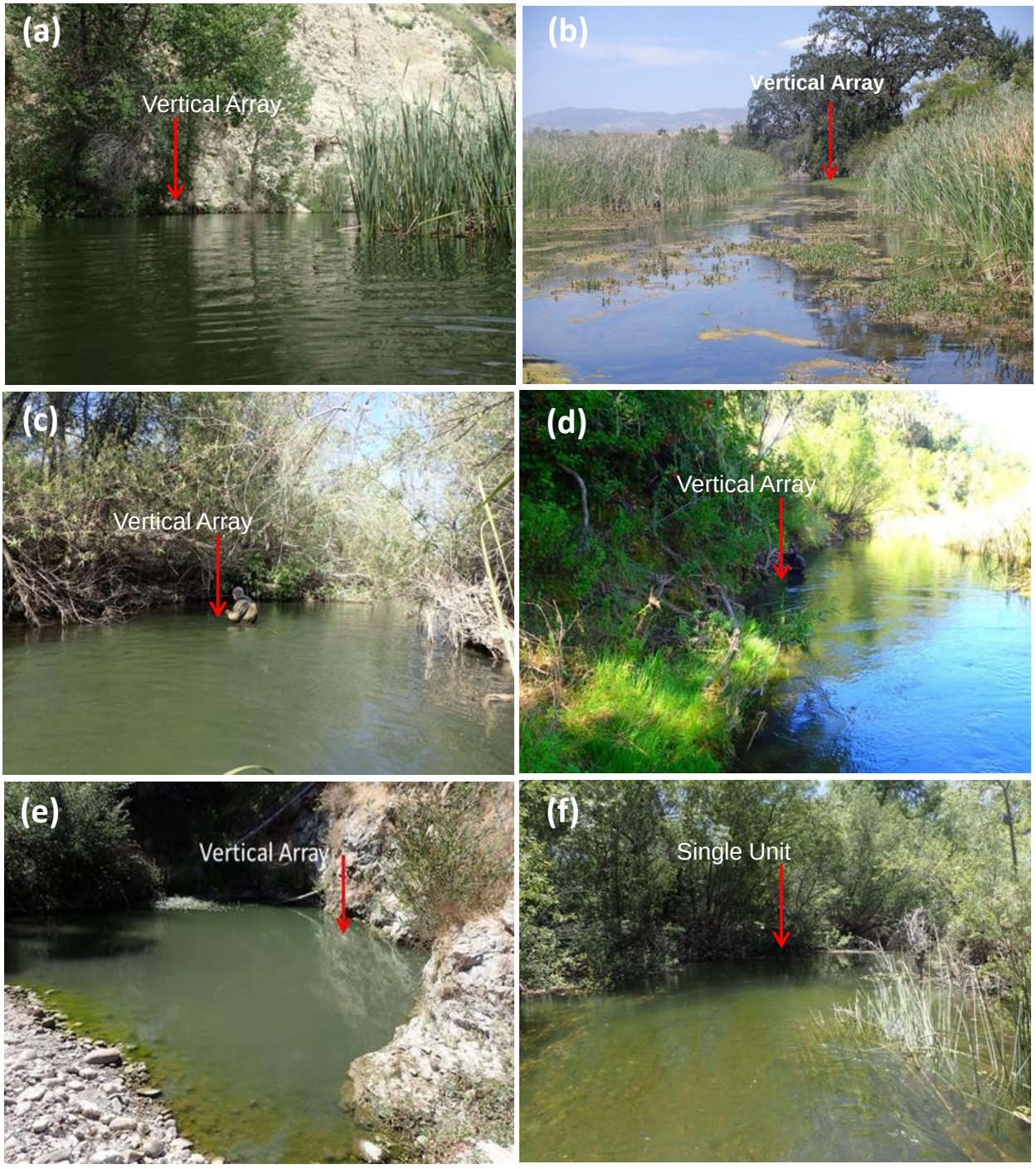


Figure 7: 2020 LSYR mainstem temperature unit deployment locations at: a) LSYR-1.71, b) LSYR-4.95, c) LSYR-7.65, d) LSYR-8.7, e) LSYR-10.2, f) LSYR-13.9.

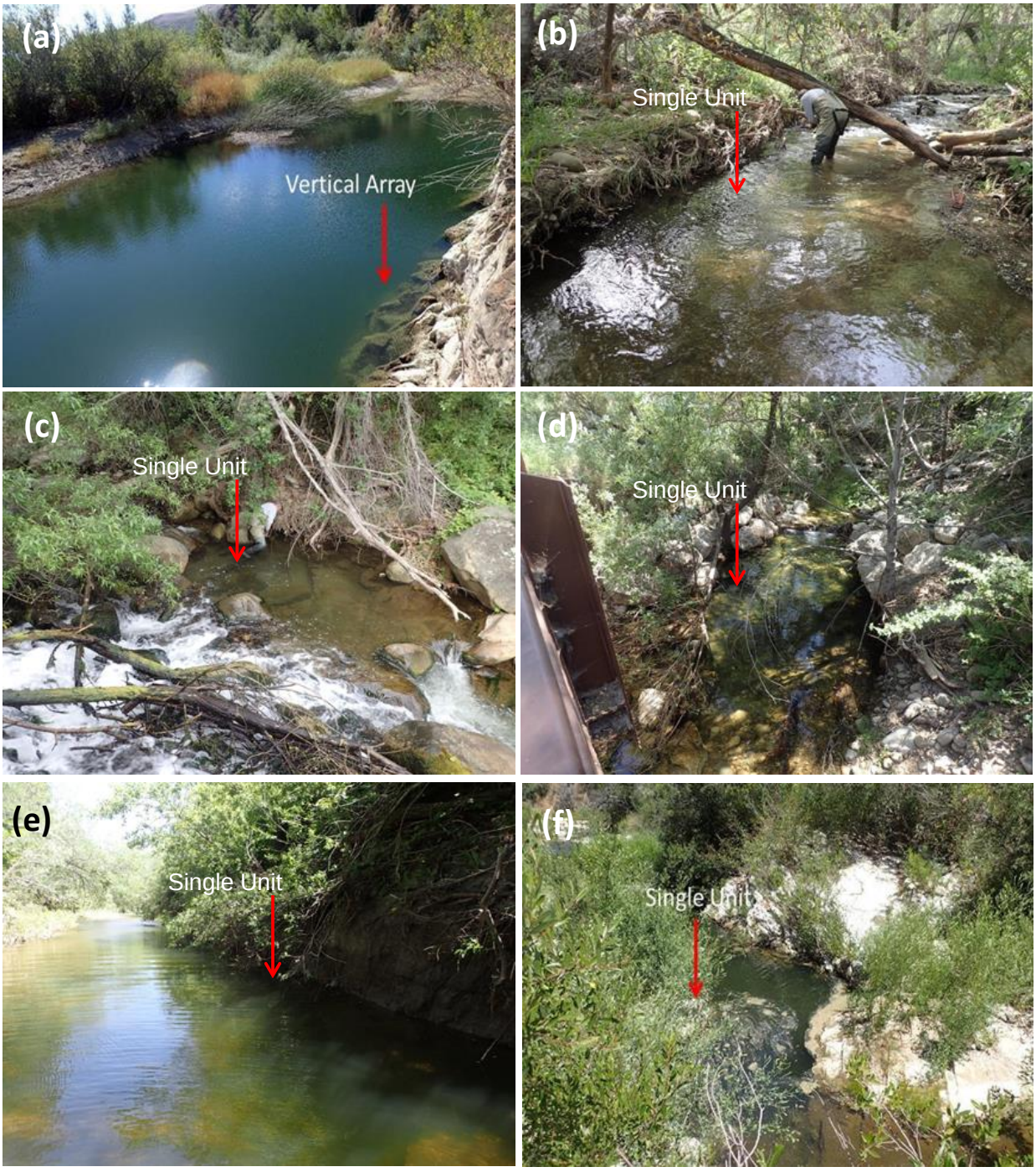


Figure 8: 2020 LSYR mainstem temperature unit deployment location at: a) LSYR-22.68 and tributary deployment locations at: b) HC-0.12, c) HC-0.54, d) QC-2.66, e) SC-0.77 and, f) SC-2.2.

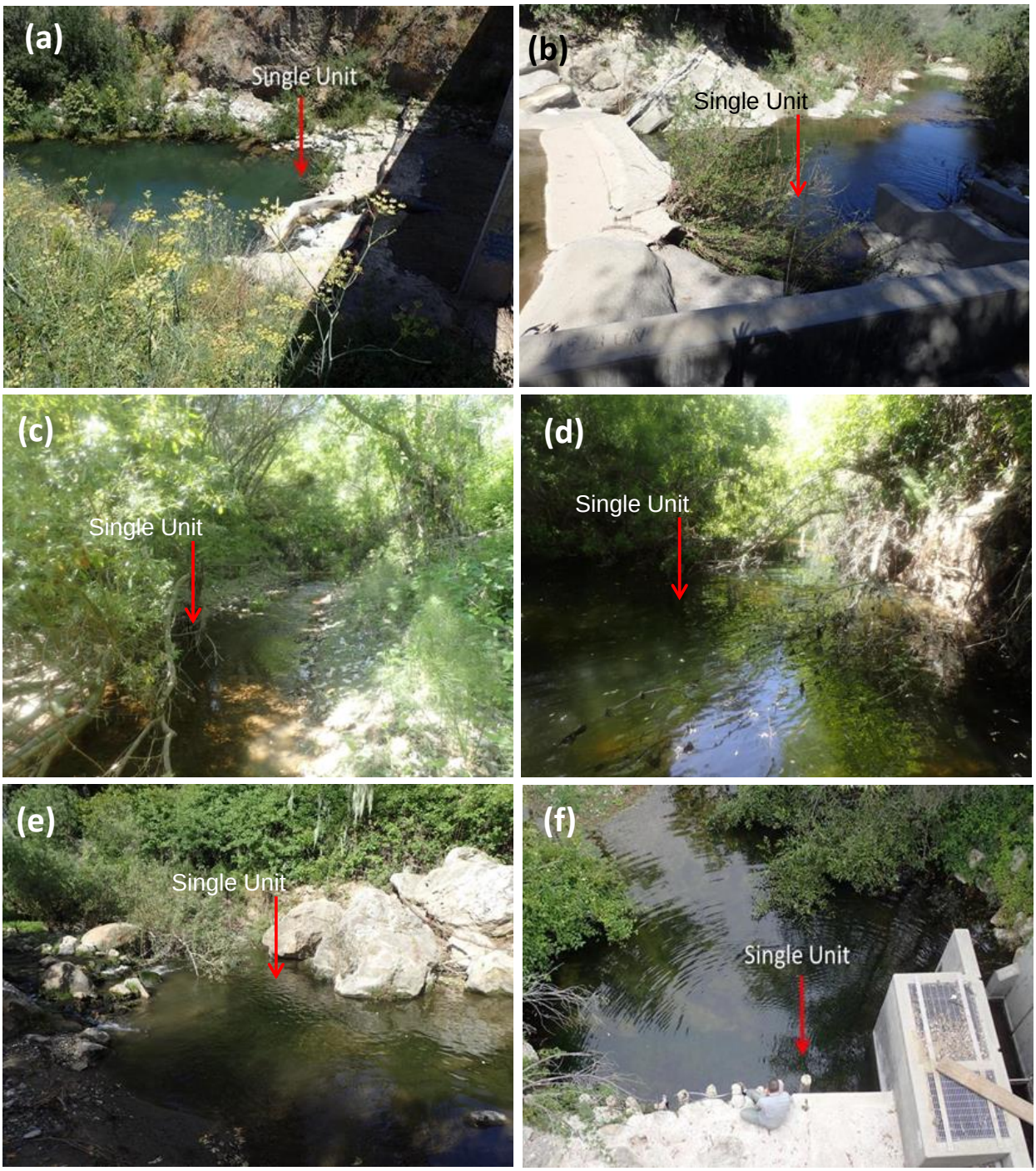


Figure 9: 2020 Tributary thermograph deployment locations at: a) SC-3.0, b) SC-3.5, c) SC-3.8, d) EJC-3.81, e) EJC-5.4, and f) EJC-10.82.

Figure 10: 2020 Tributary temperature unit deployment location at: a) LAC-7.0.

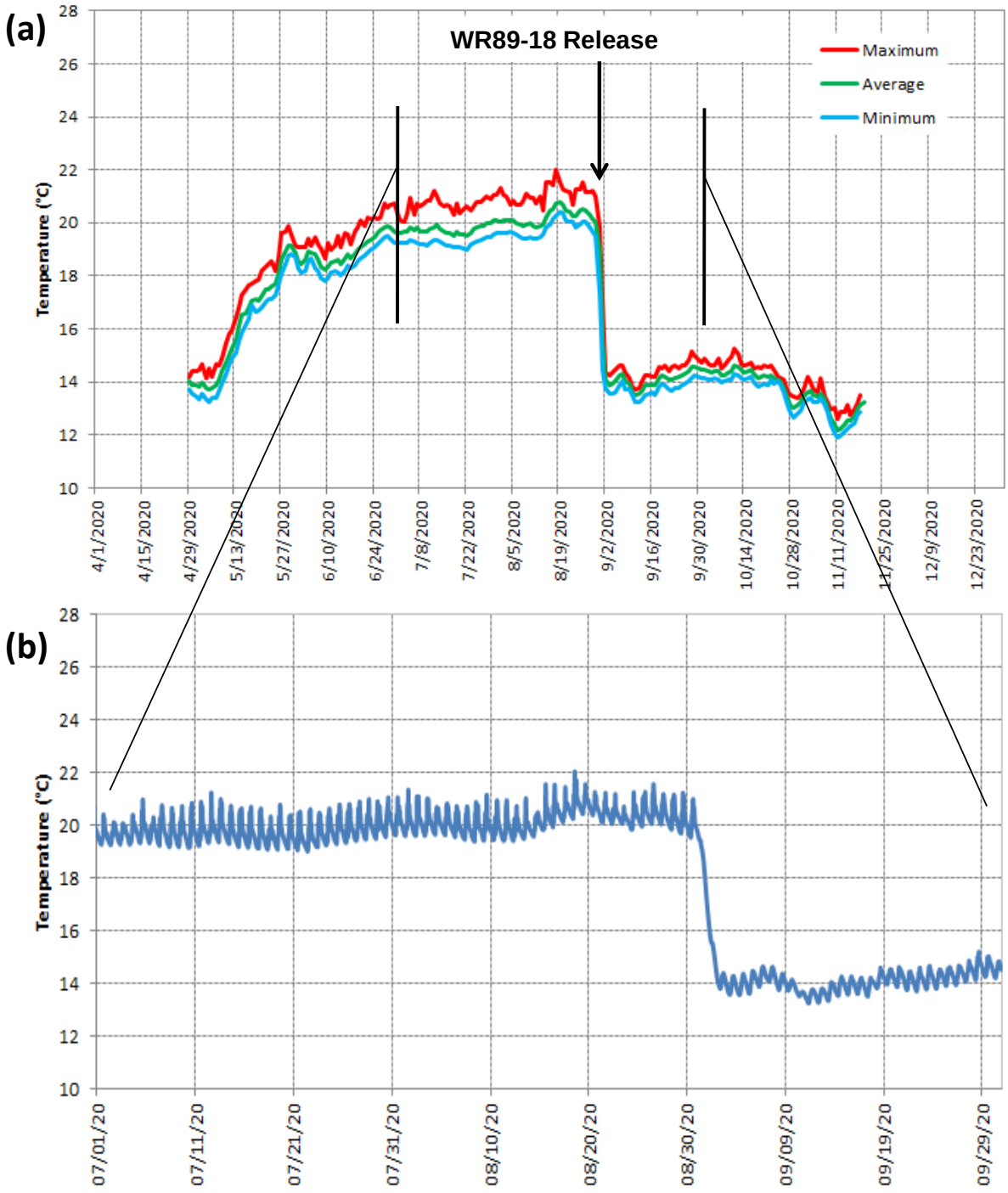


Figure 11: 2020 LSYR-0.01 (Stilling Basin parapet wall) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/20 – 10/1/20.

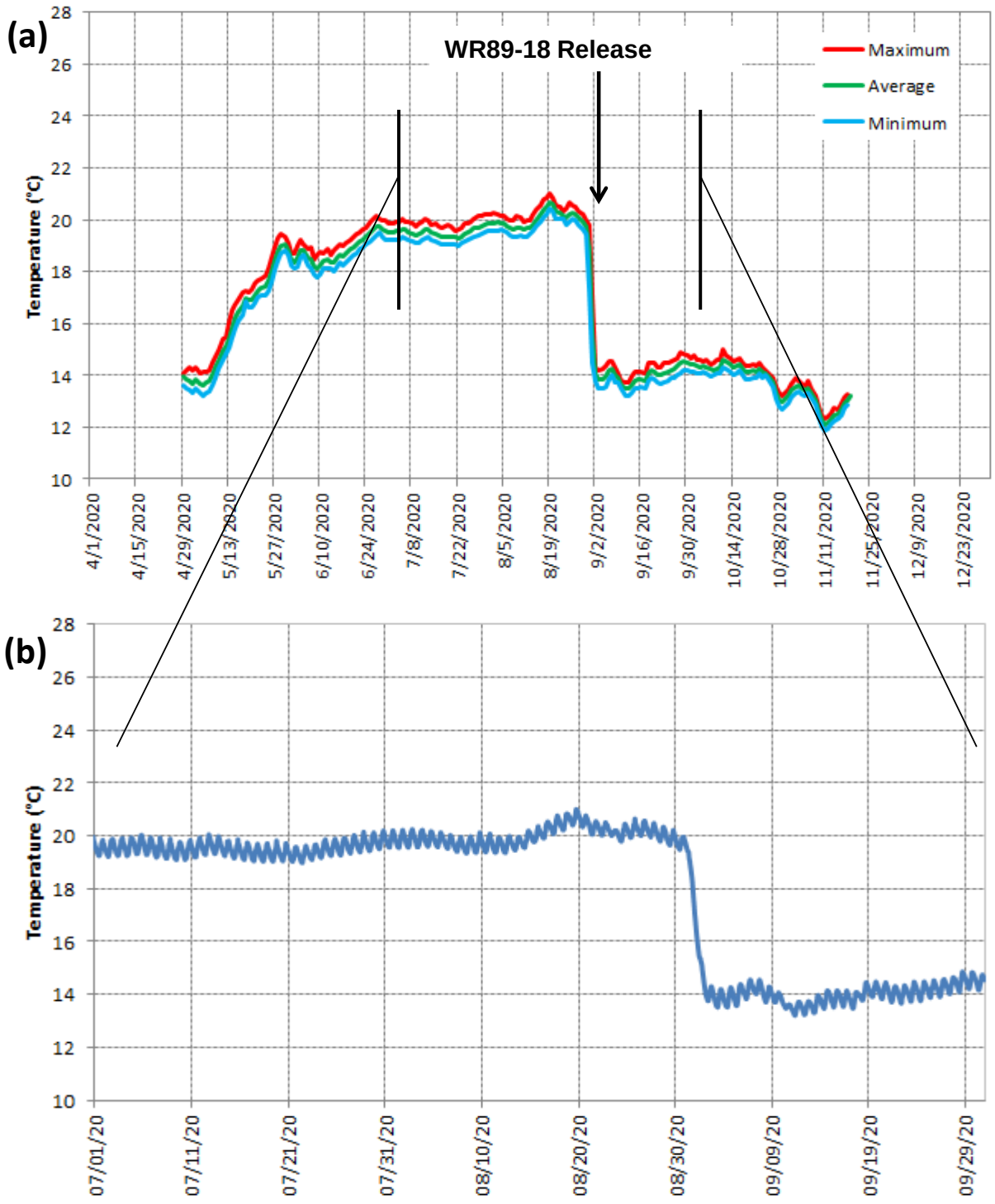


Figure 12: 2020 LSYR-0.01 (Stilling Basin parapet wall) middle (14 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/20 – 10/1/20.

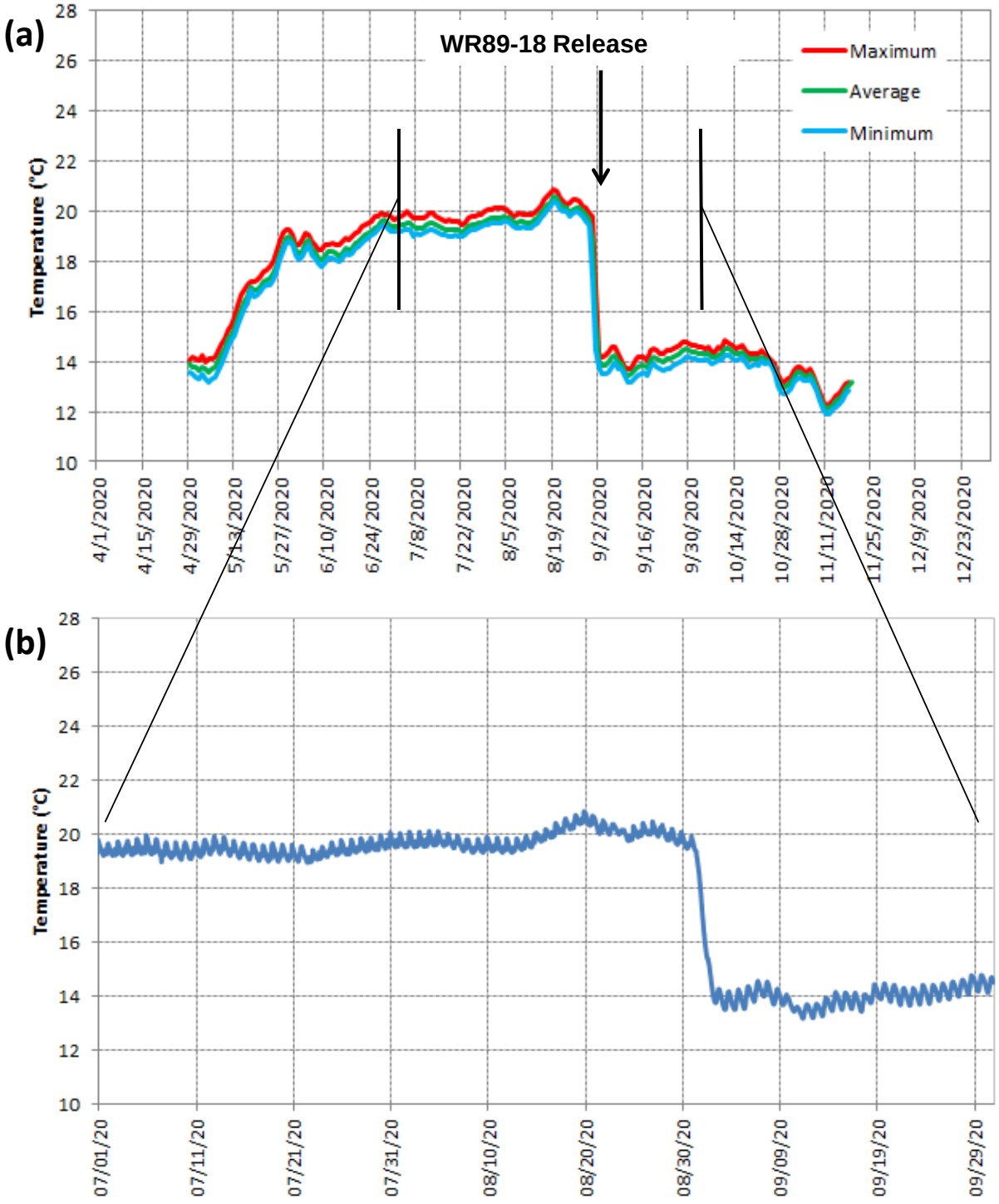


Figure 13: 2020 LSYR-0.01 (Stilling Basin parapet wall) bottom (28 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/20 – 10/1//20.

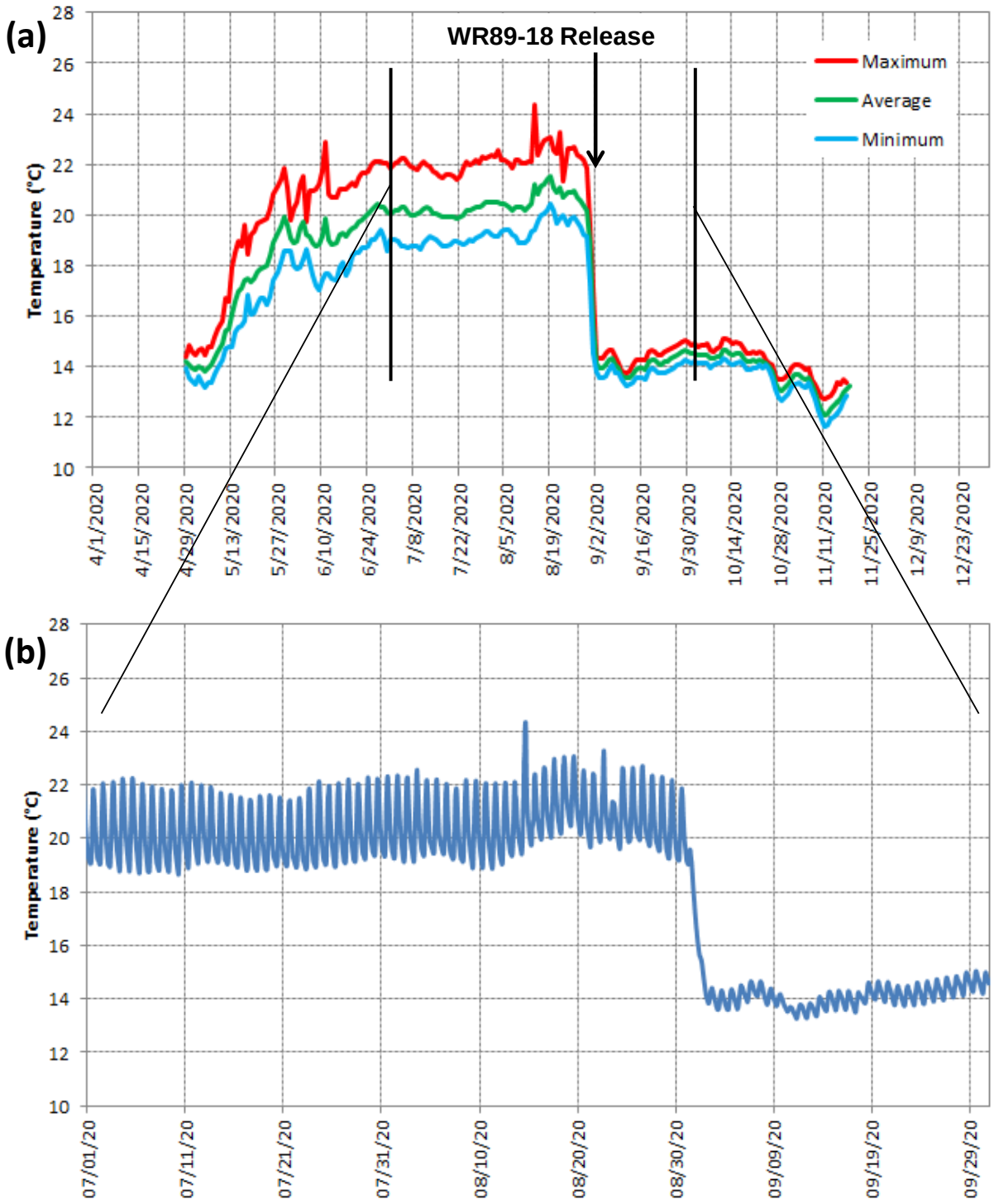


Figure 14: 2020 LSYR-0.25 (Downstream of Stilling Basin) bottom (1.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period of 7/1/20 – 10/1/20.

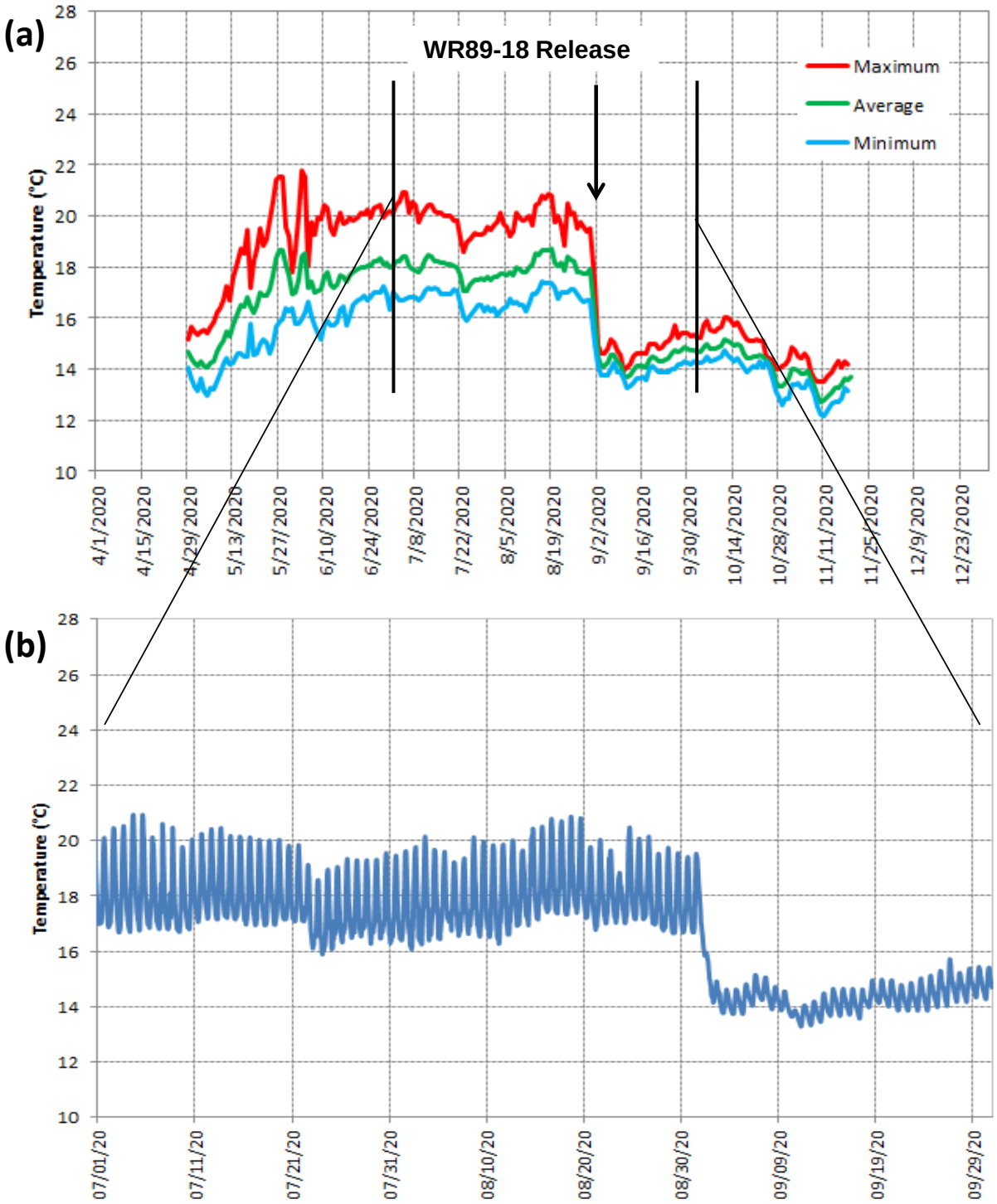


Figure 15: 2020 LSYR-0.51 (Long Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum values for the entire period of deployment and (b) hourly data from 7/1/20 – 10/1/20; the Long Pool depth decreased over 3-feet due to storm flow siltation from the Whittier Fire.

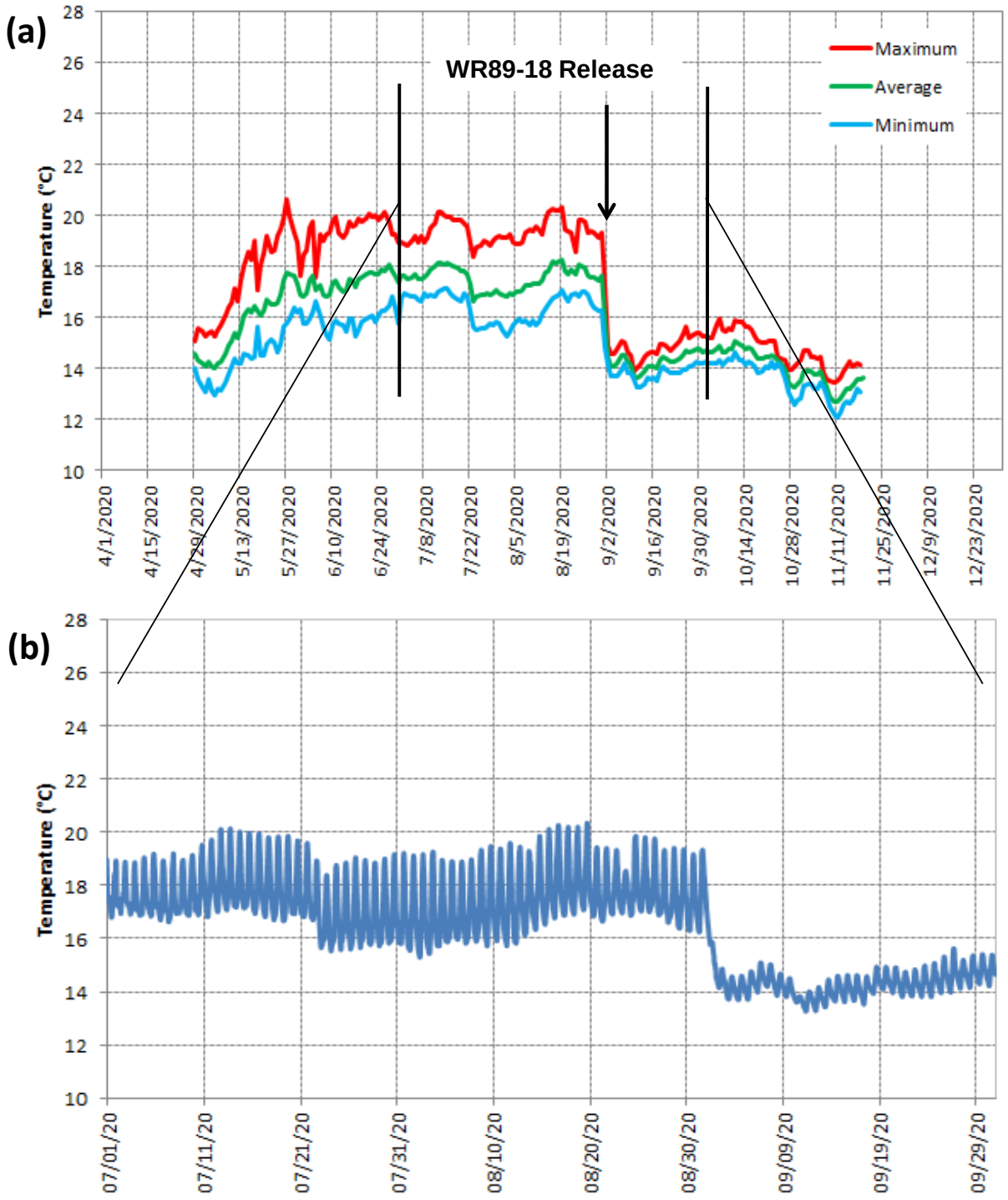


Figure 16: 2020 LSYR-0.51 (Long Pool) middle (2.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/20 – 10/1/20 the Long Pool depth decreased over 3-feet due to storm flow siltation from the Whittier Fire.

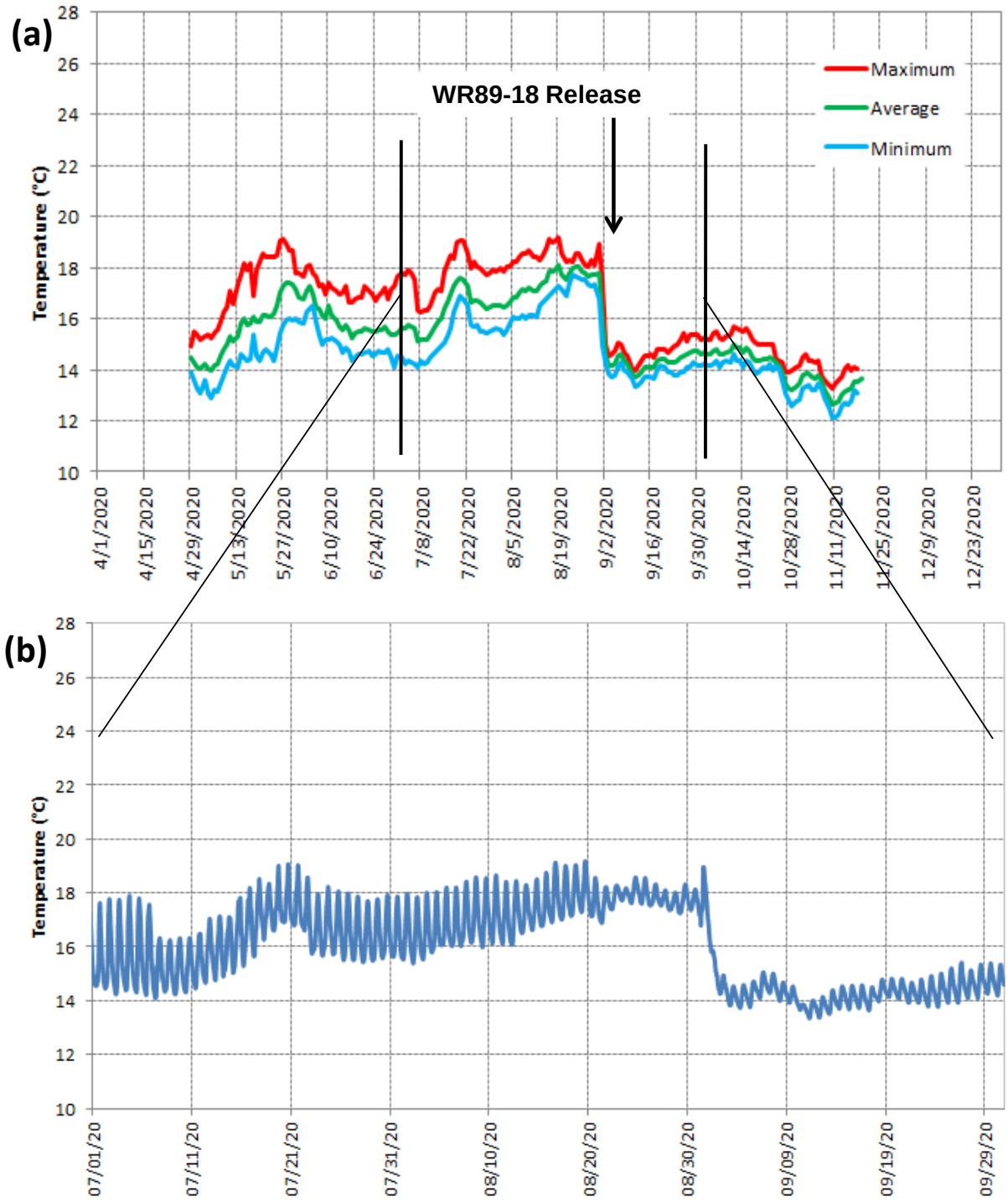


Figure 17: 2020 LSYR-0.51 (Long Pool) bottom (5.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/20 – 10/1/20; the Long Pool depth decreased over 3 feet due to storm flow siltation from the Whittier Fire.

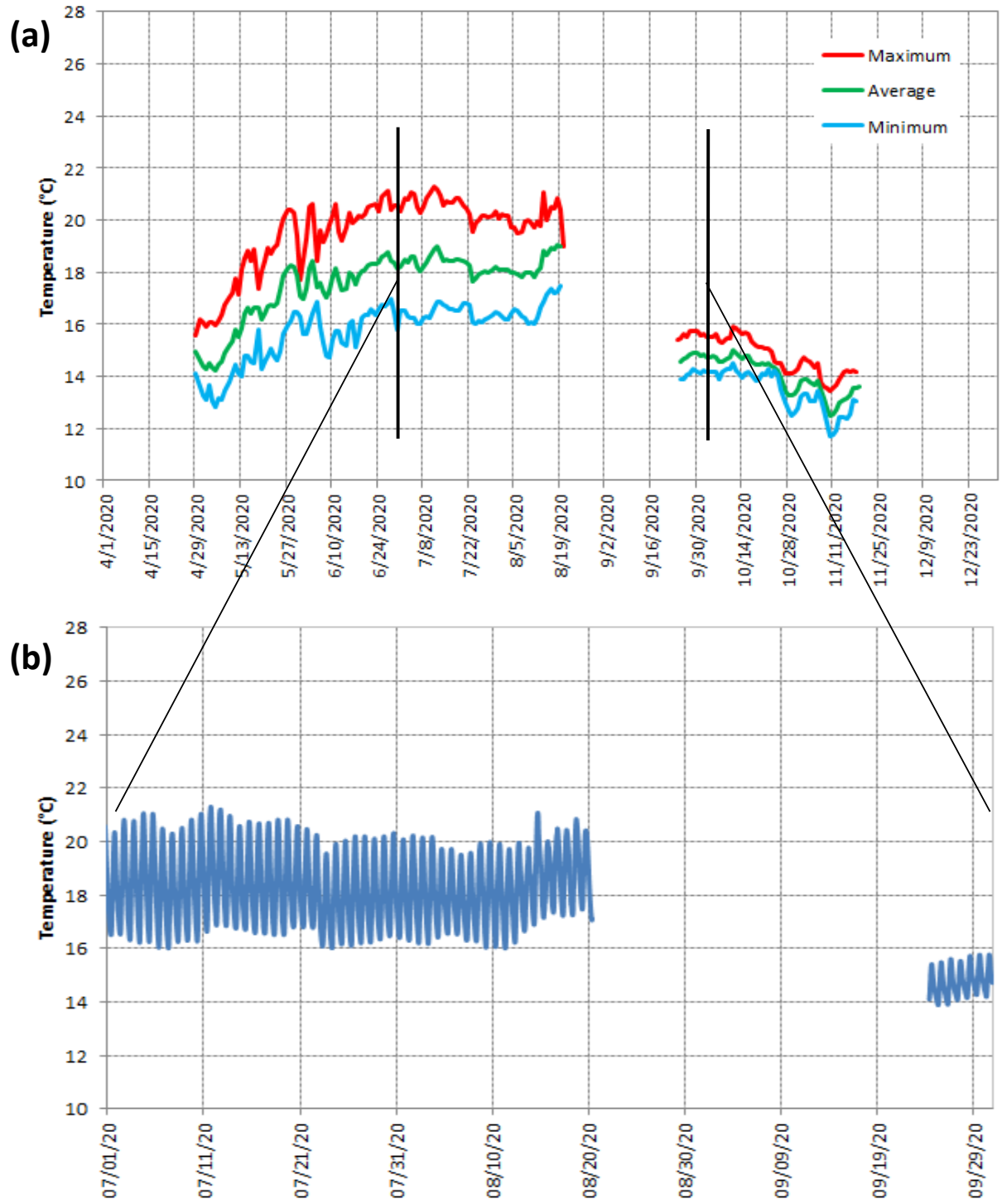


Figure 18: 2020 Reclamation property boundary at LSYR 0.68 (downstream of the Long Pool) bottom (2 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data from 7/1/20 – 10/1/20; optic shuttle malfunction resulted in loss of data from 8/20/20 through 9/24/20.

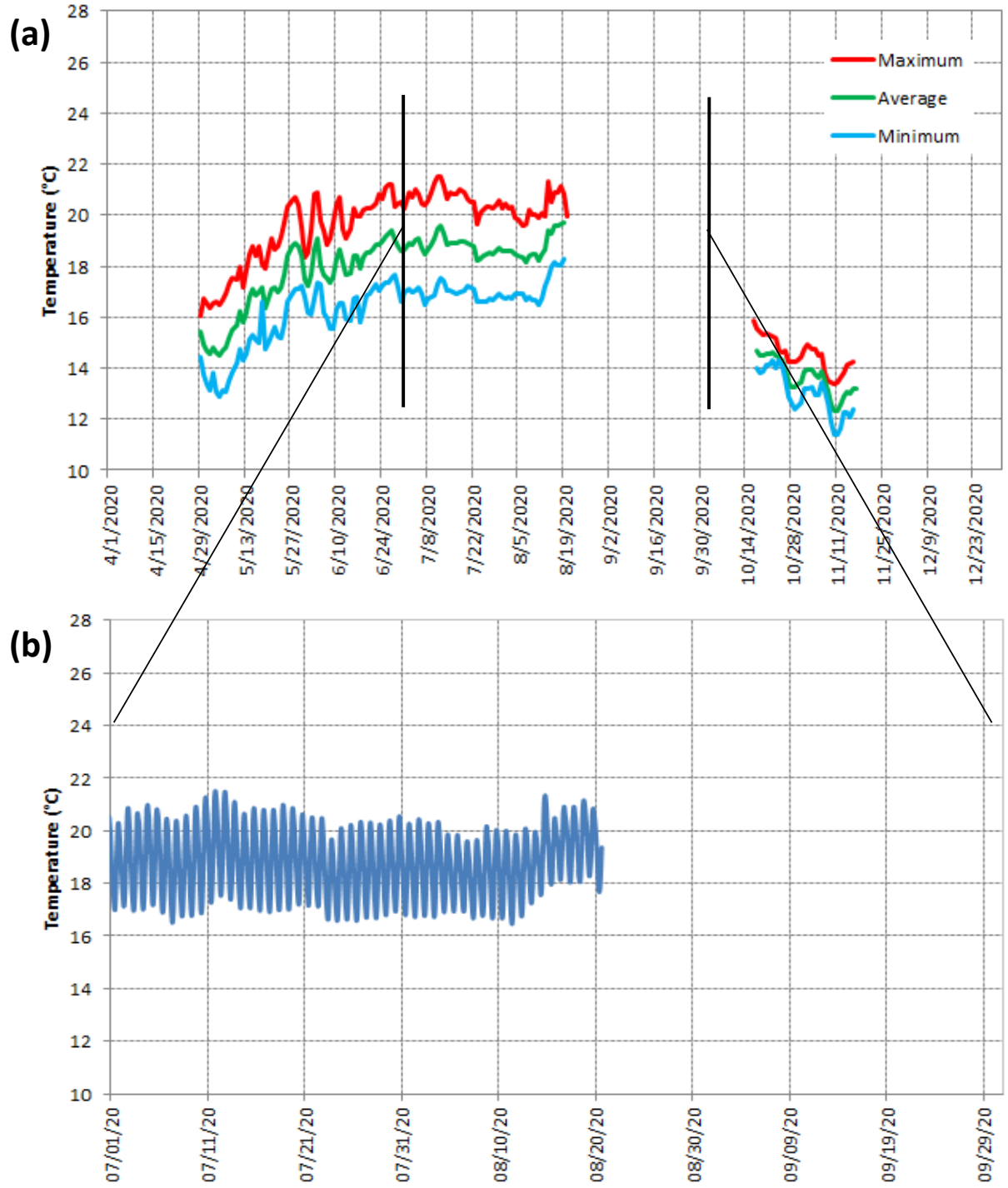


Figure 19: 2020 LSYR-1.09 (Grimm Property upstream-run) bottom (1.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20; optic shuttle malfunction resulted in a loss of data between 8/20/20 and 10/16/20.

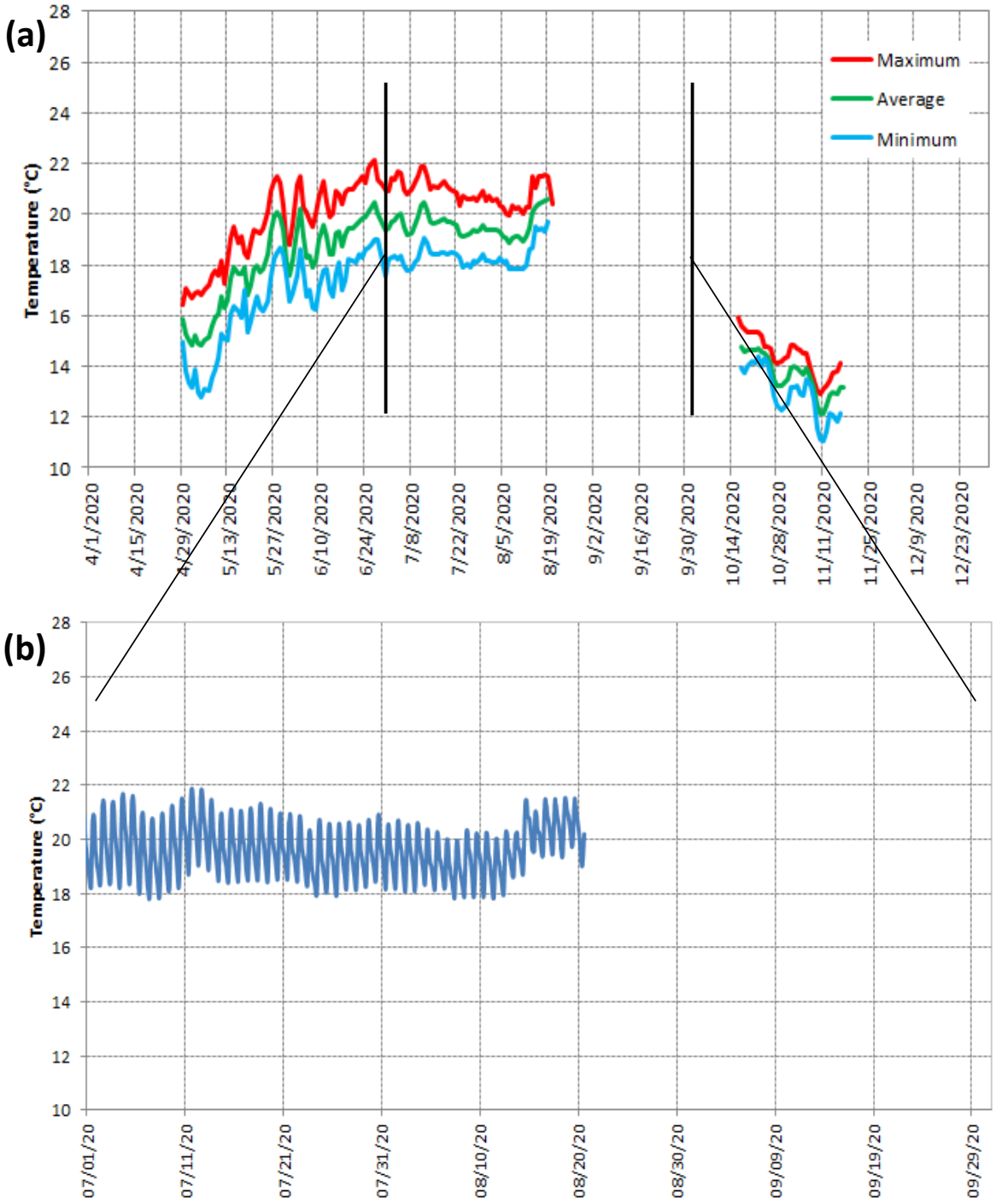


Figure 20: 2020 LSYR-1.54 (Grimm Property downstream-run) bottom (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20; optic shuttle malfunction resulted in a loss of data between 8/20/20 and 10/16/20.

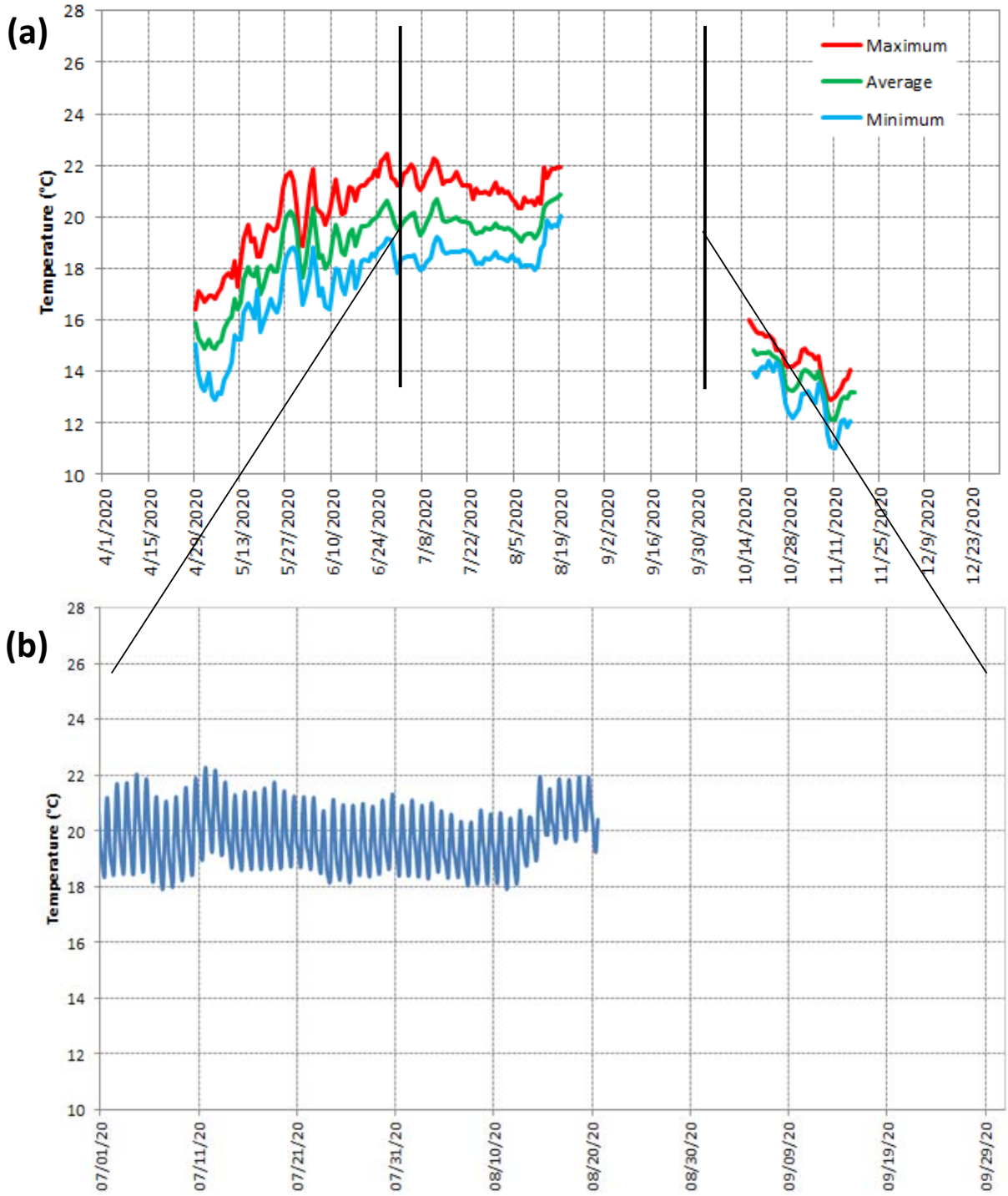


Figure 21: 2020 LSYR-1.71 (Grimm Property pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20: optic shuttle malfunction resulted in a loss of data between 8/20/20 and 10/16/20.

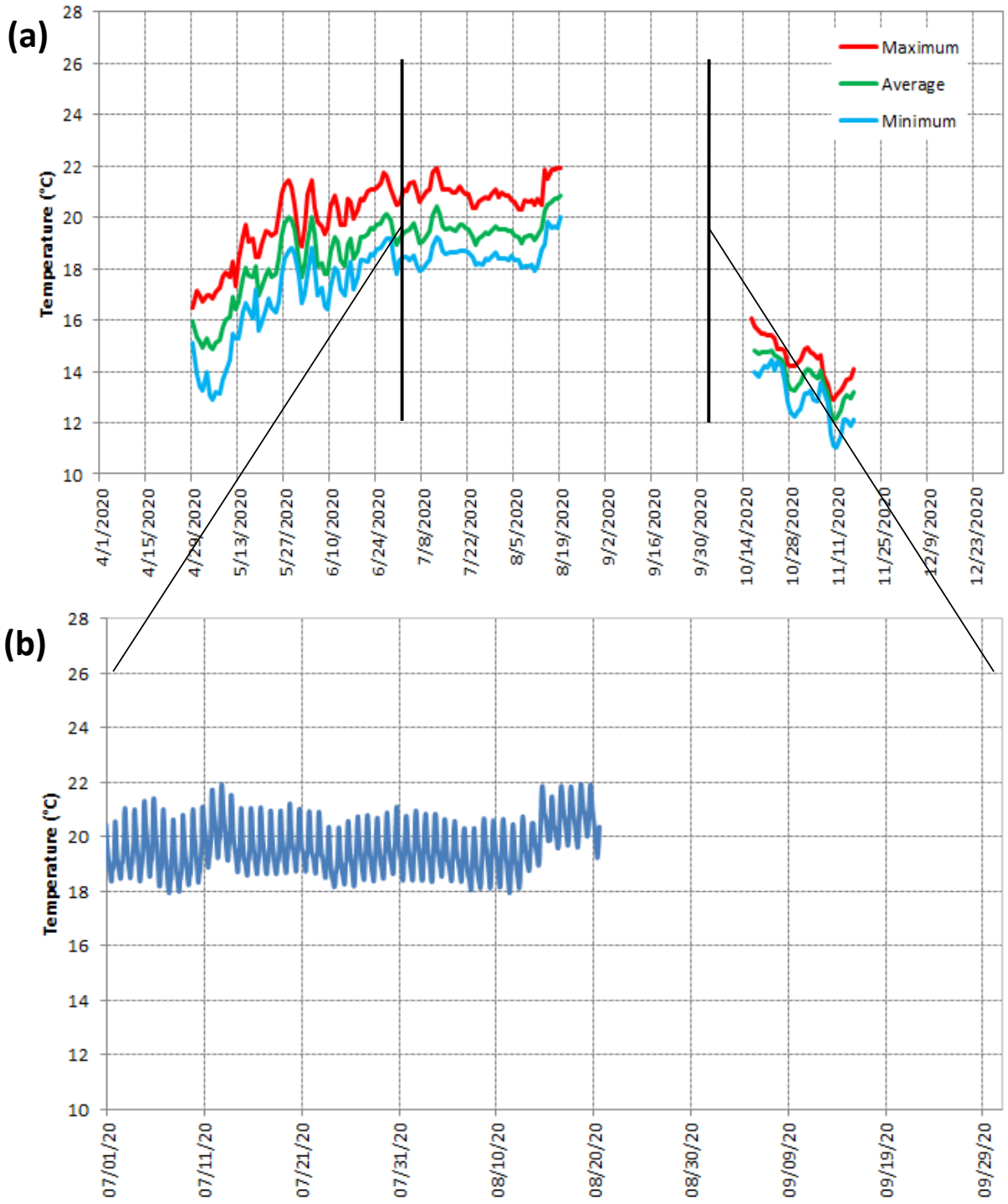


Figure 22: 2020 LSYR-1.71 (Grimm Property pool) bottom (6.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20; optic shuttle malfunction resulted in a loss of data between 8/20/20 and 10/16/20.

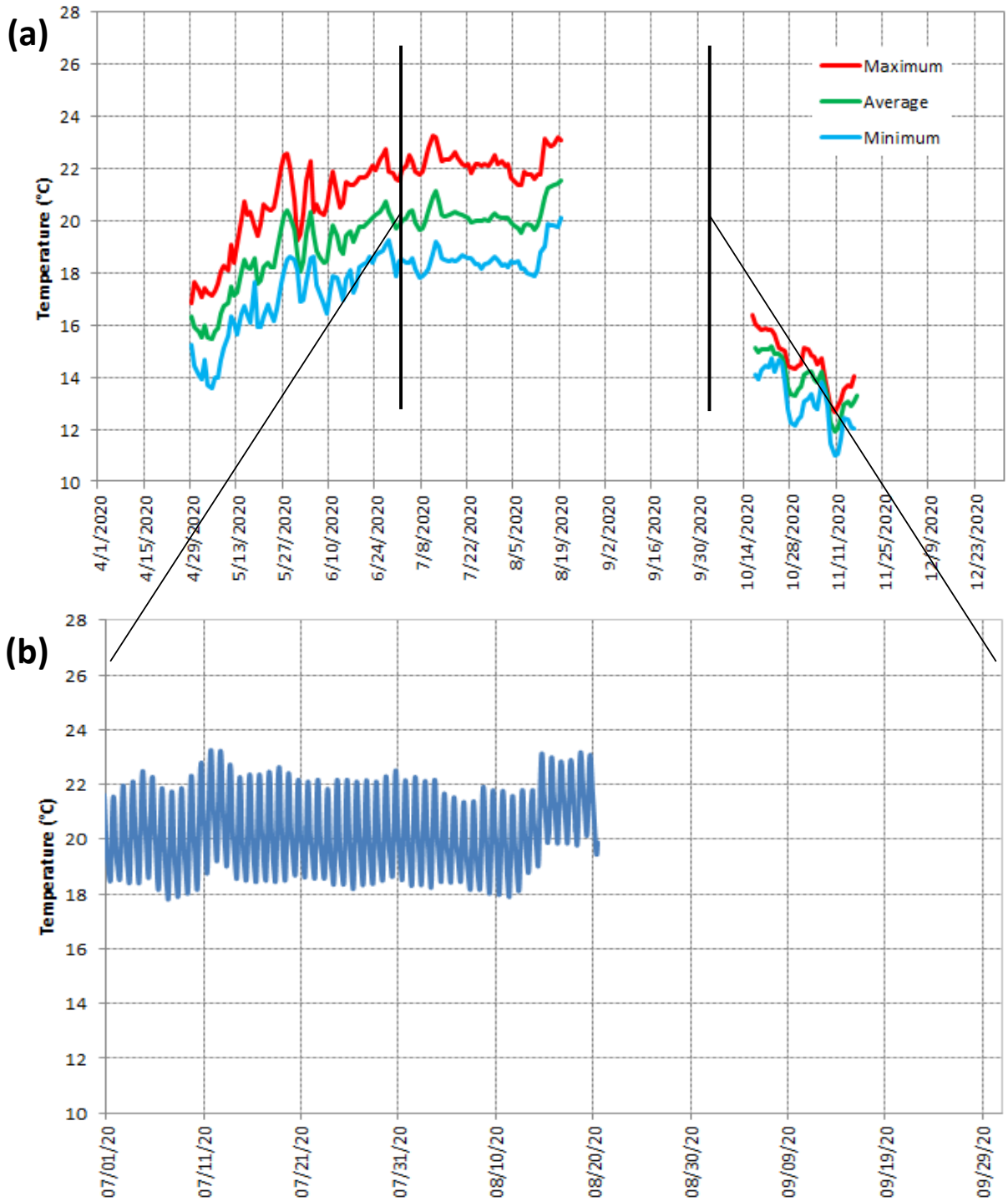


Figure 23: 2020 LSYR-2.77 (Kaufman run) bottom (1.0-feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20; optic shuttle malfunction resulted in a loss of data between 8/20/20 and 10/16/20.

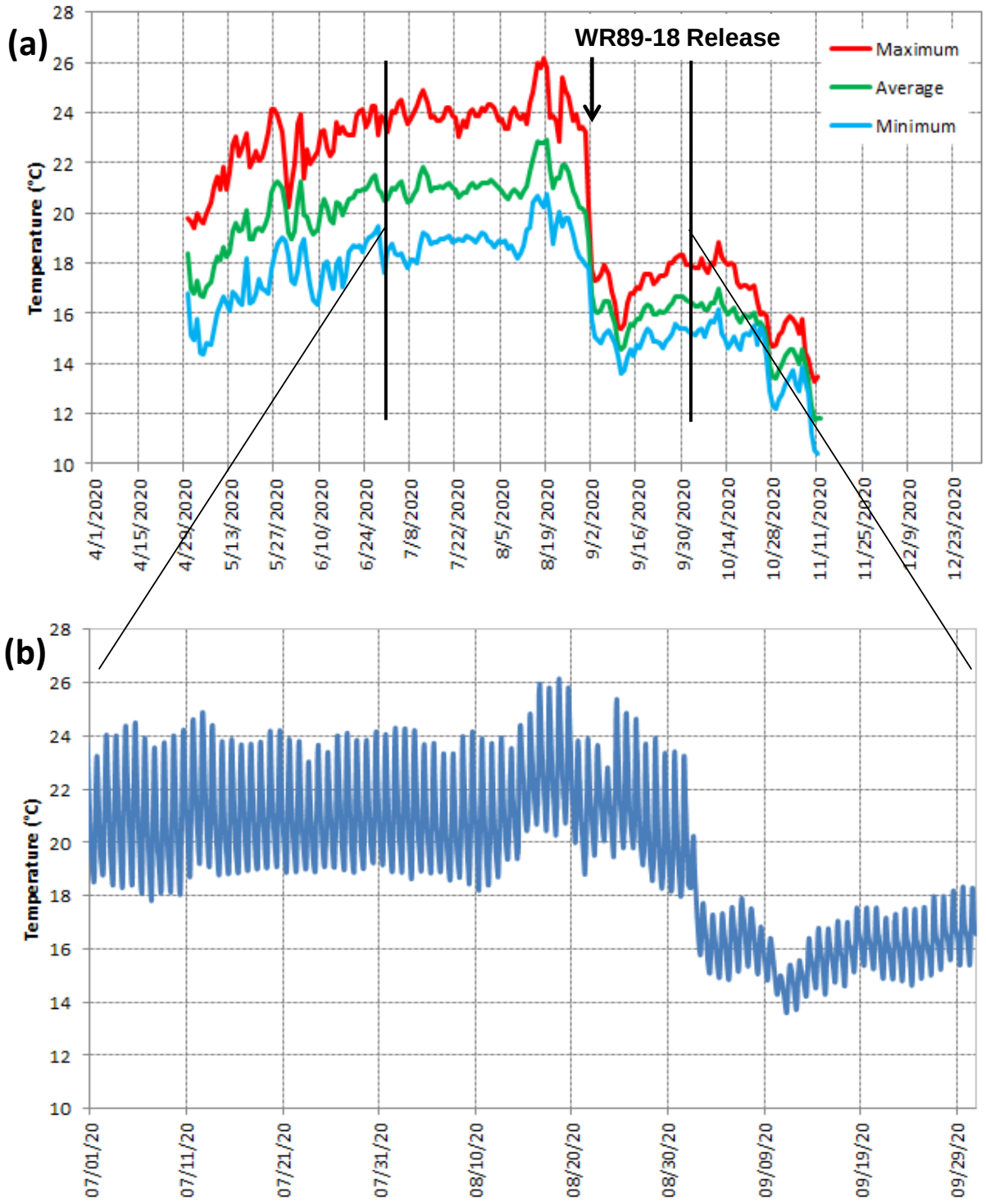


Figure 24: 2020 LSYR 4.95 (Encantado Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

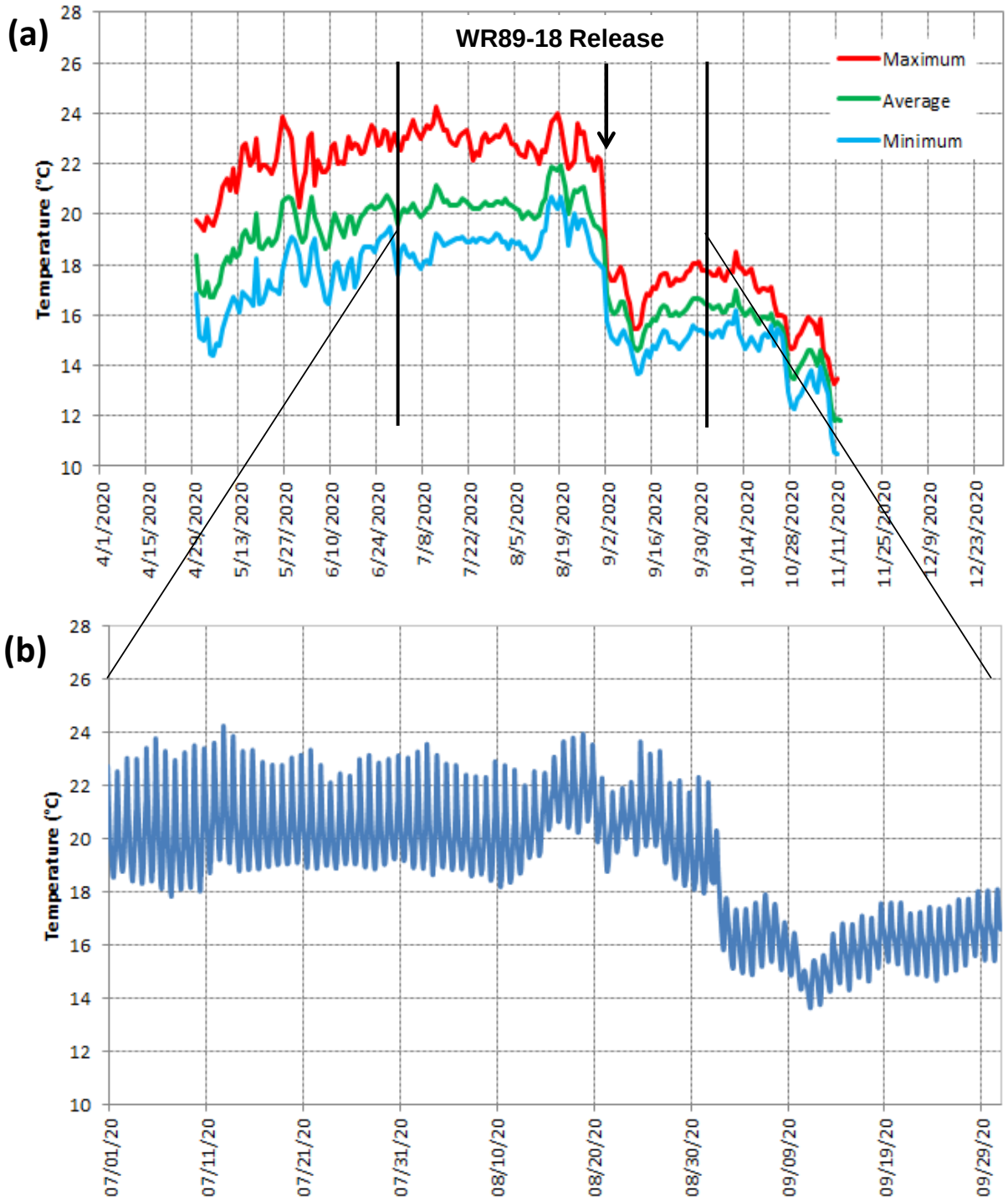


Figure 25: 2020 LSYR-4.95 (Encantado Pool) middle (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

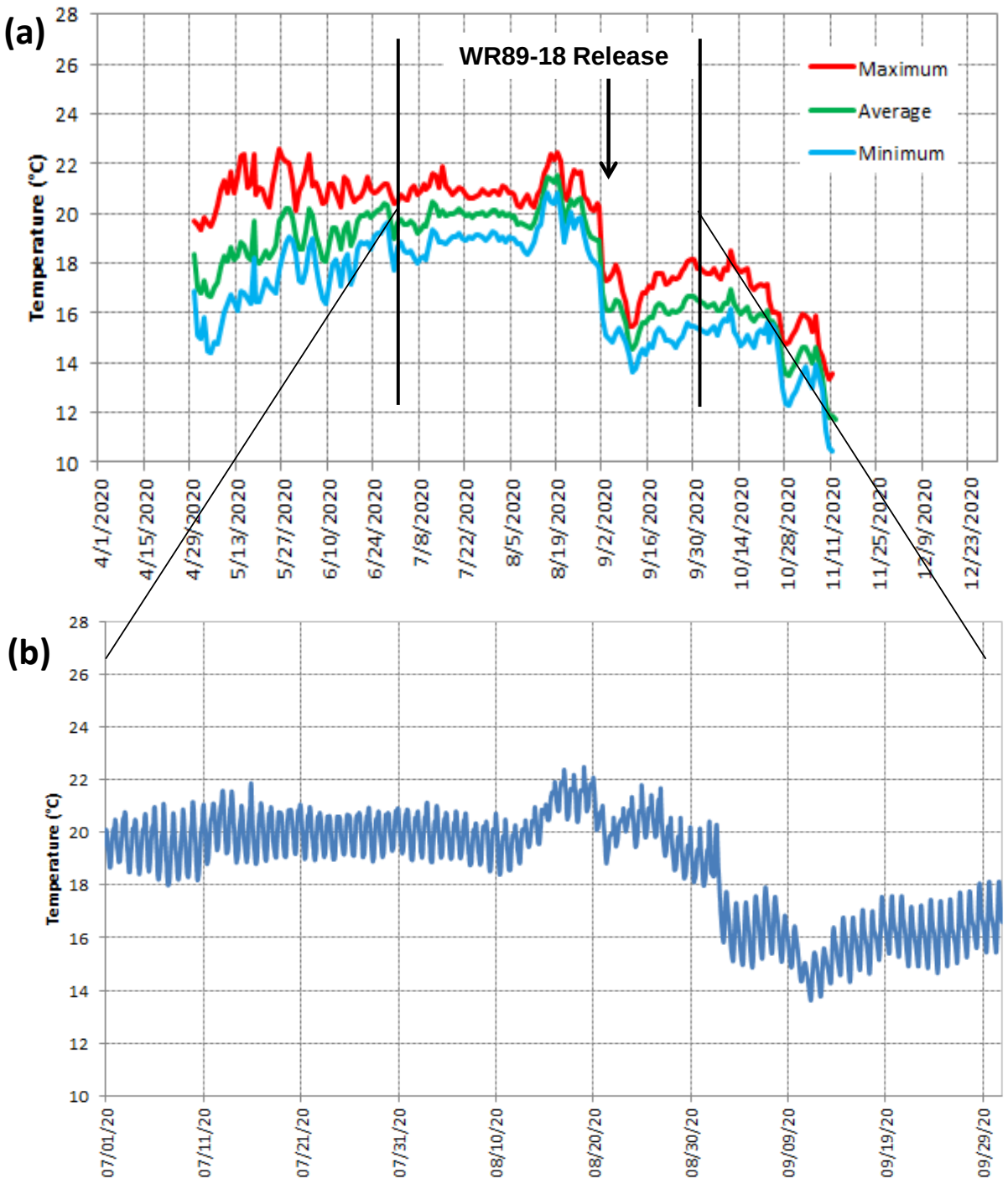


Figure 26: 2020 LSYR-4.95 (Encantado Pool) bottom (8.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

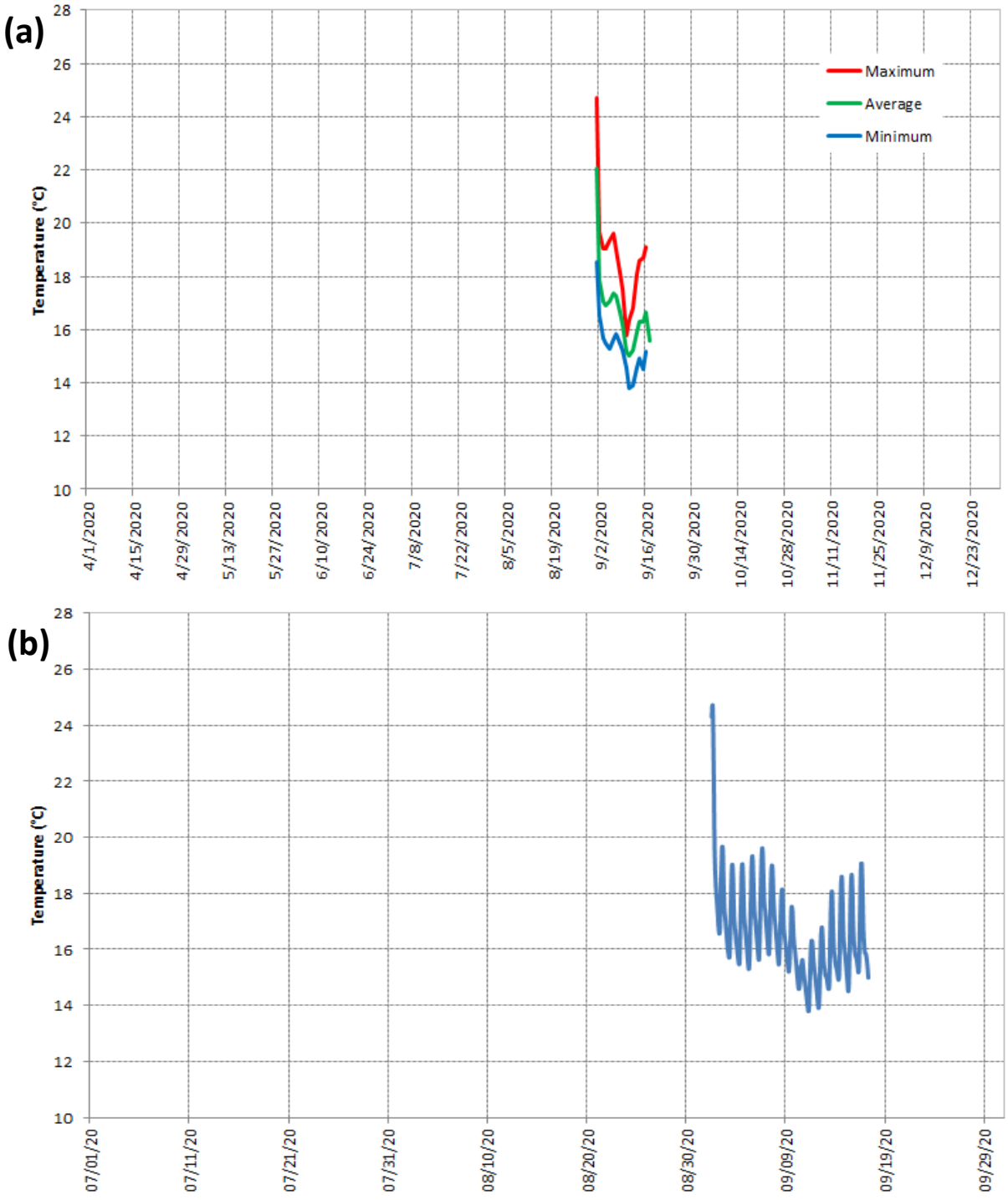


Figure 27: 2020 LSYR-6.08 (Mainstem Trap Site) bottom (3.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; unit deployed to monitor water temperature conditions during trapping of the WR89-18 release.

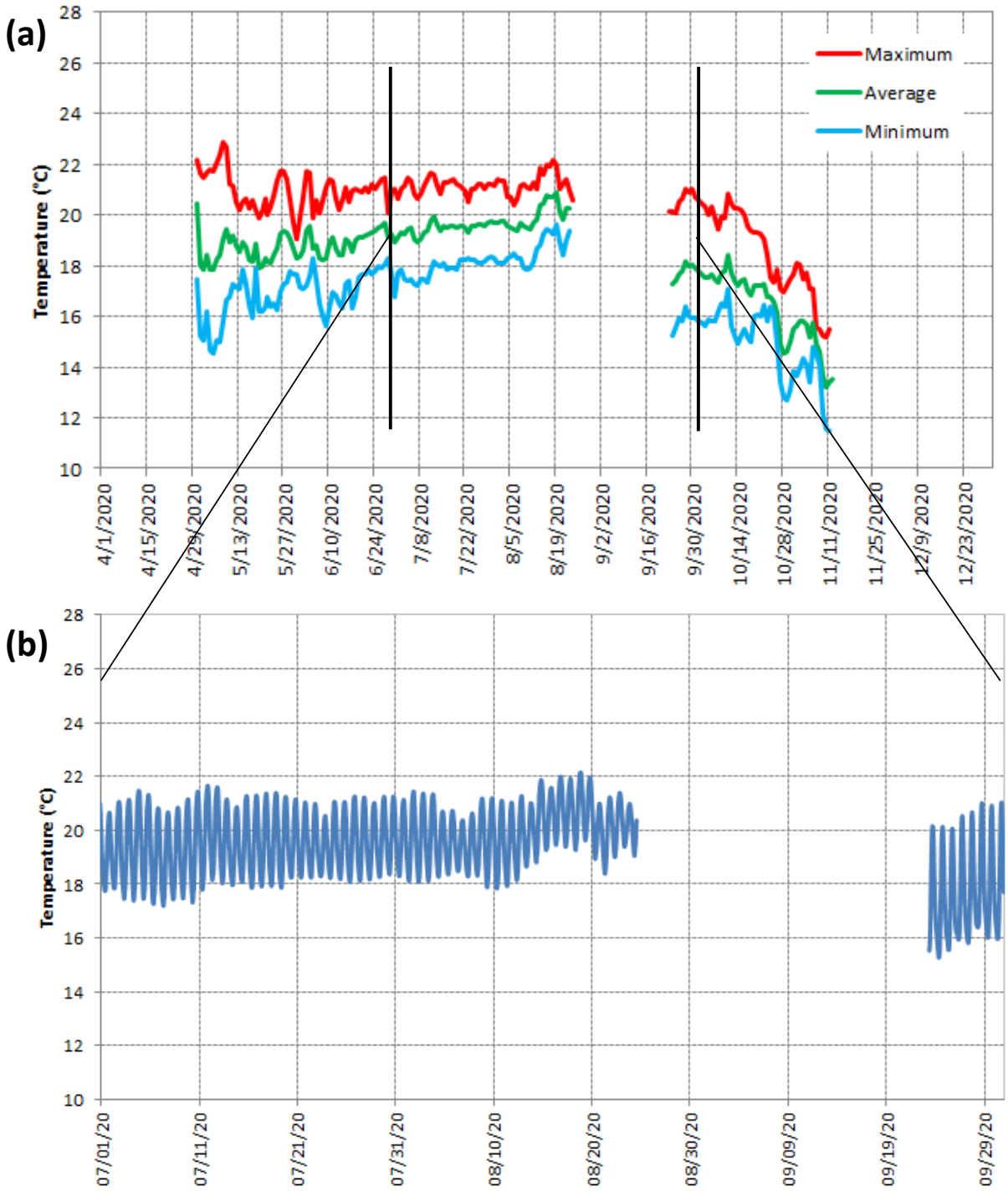


Figure 28: 2020 LSYR-7.65 (Double Canopy Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20; optic shuttle malfunction resulted in loss of data from 8/24/20 to 9/22/20.

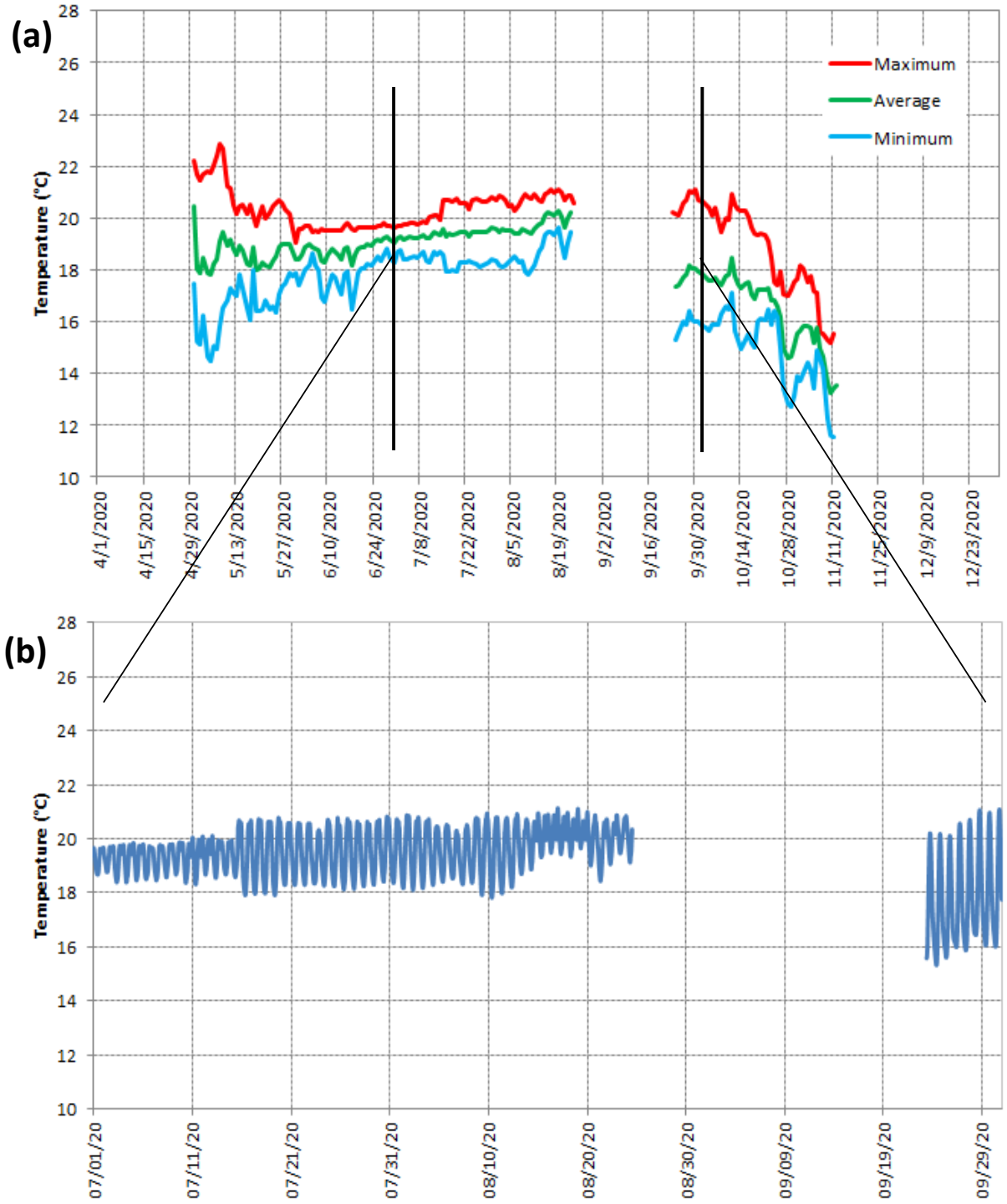


Figure 29: 2020 LSYR-7.65 (Double Canopy Pool) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 - 10/1/20; optic shuttle malfunction resulted in loss of data from 8/24/20 to 9/22/20.

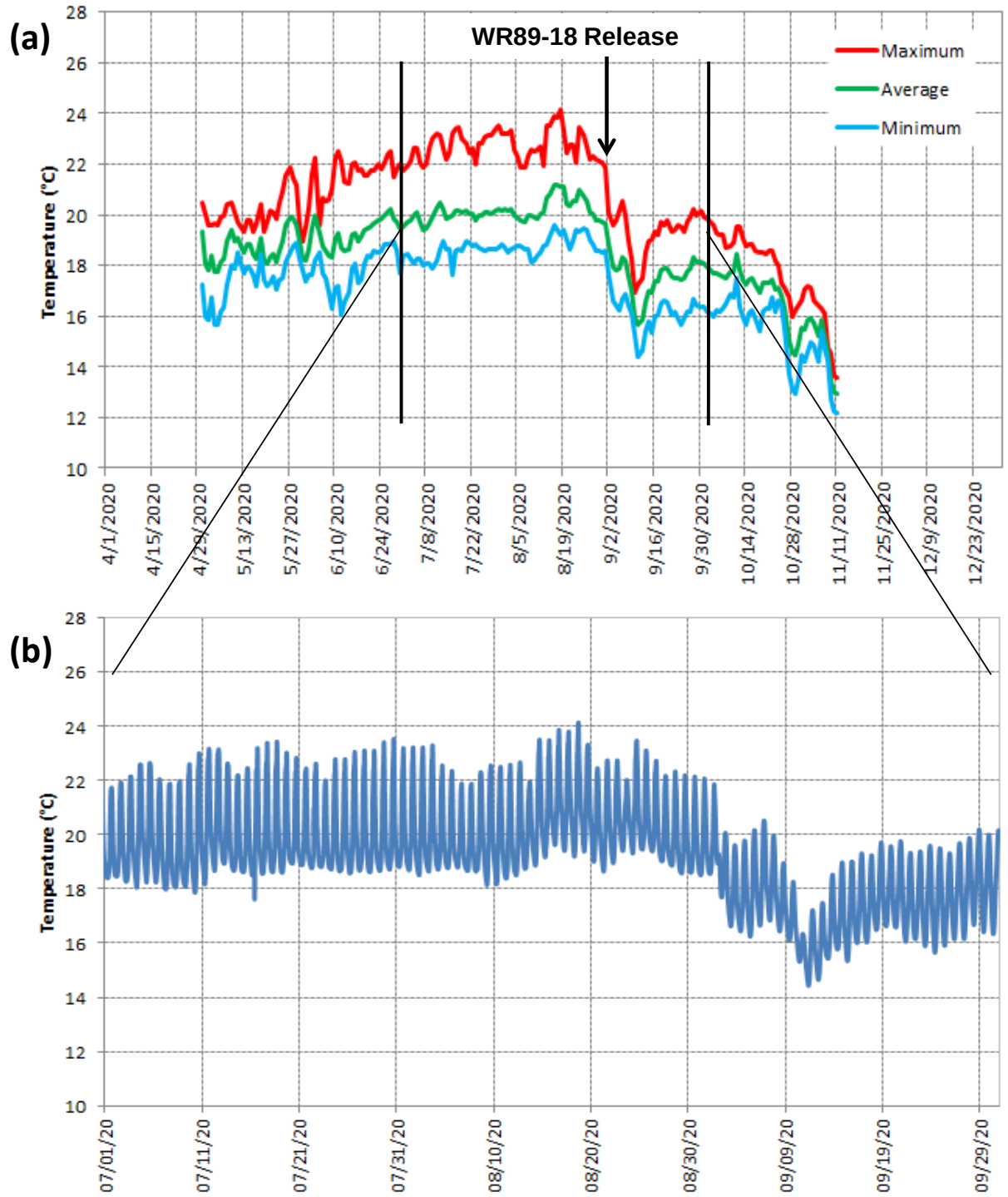


Figure 30: 2020 LSYR-8.7 (Head of Beaver Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 - 10/1/20.

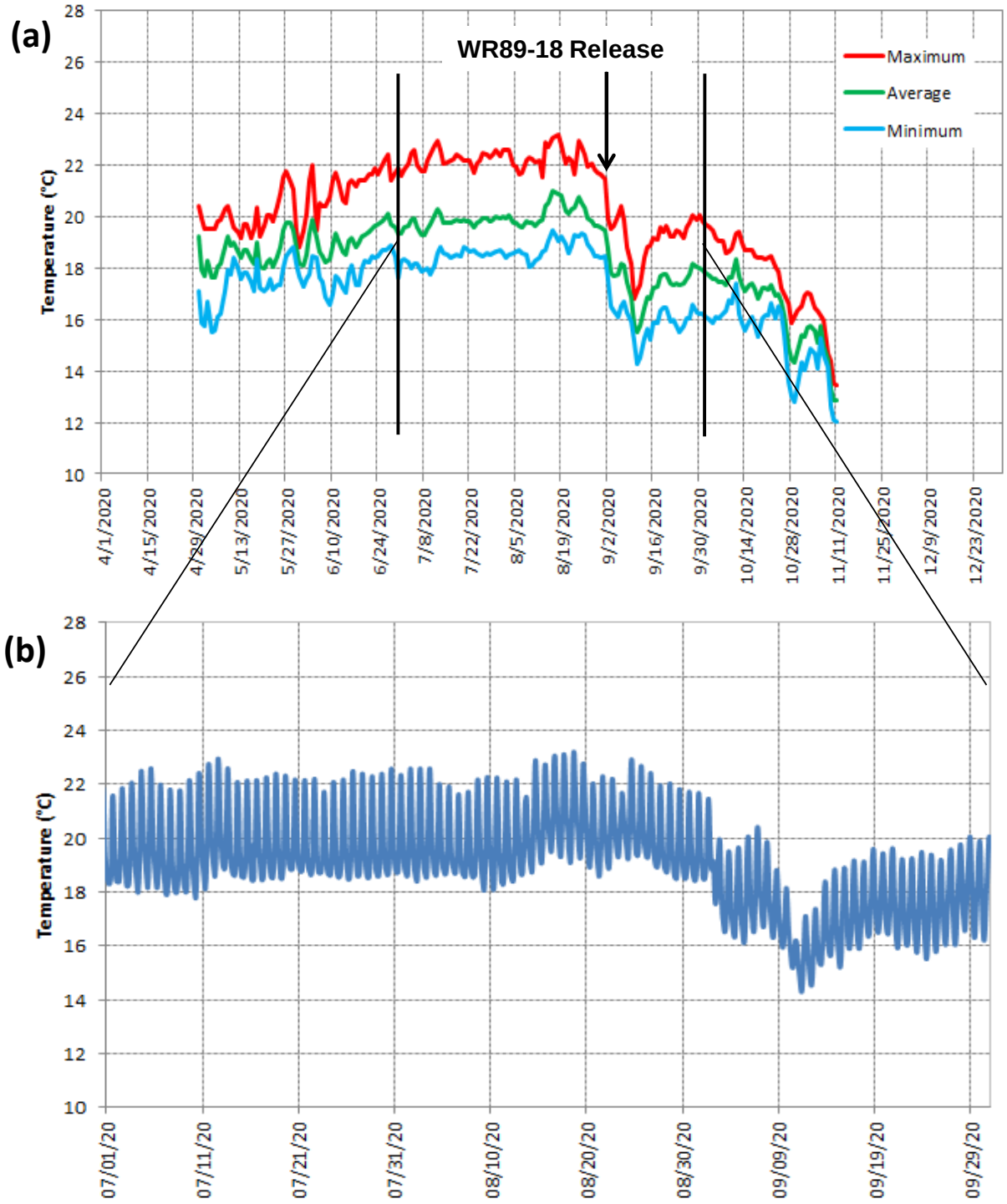


Figure 31: 2020 LSYR-8.7 (Head of Beaver Pool) middle (2.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 - 10/1/20.

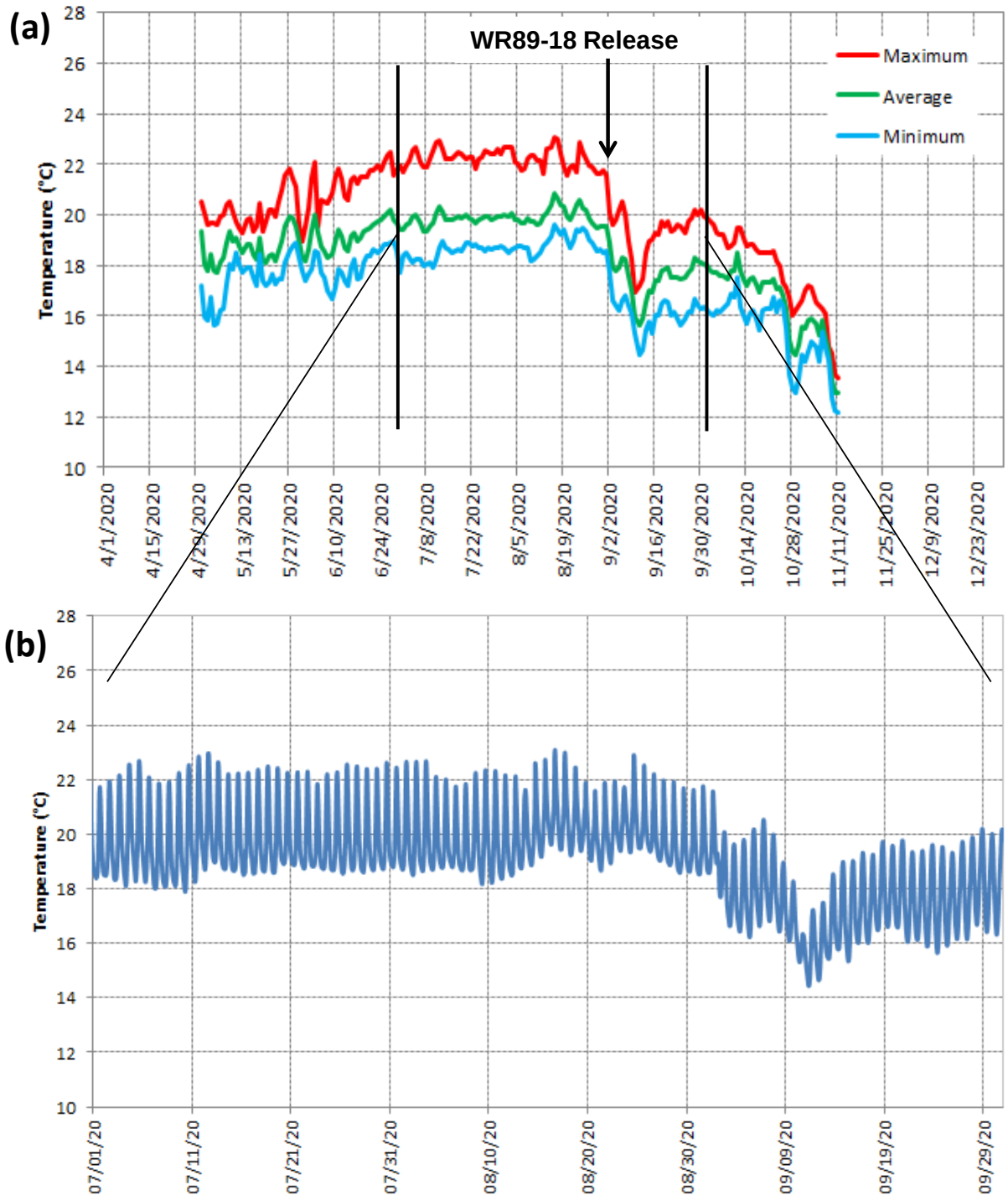


Figure 32: 2020 LSYR-8.7 (Head of Beaver Pool) bottom (5.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

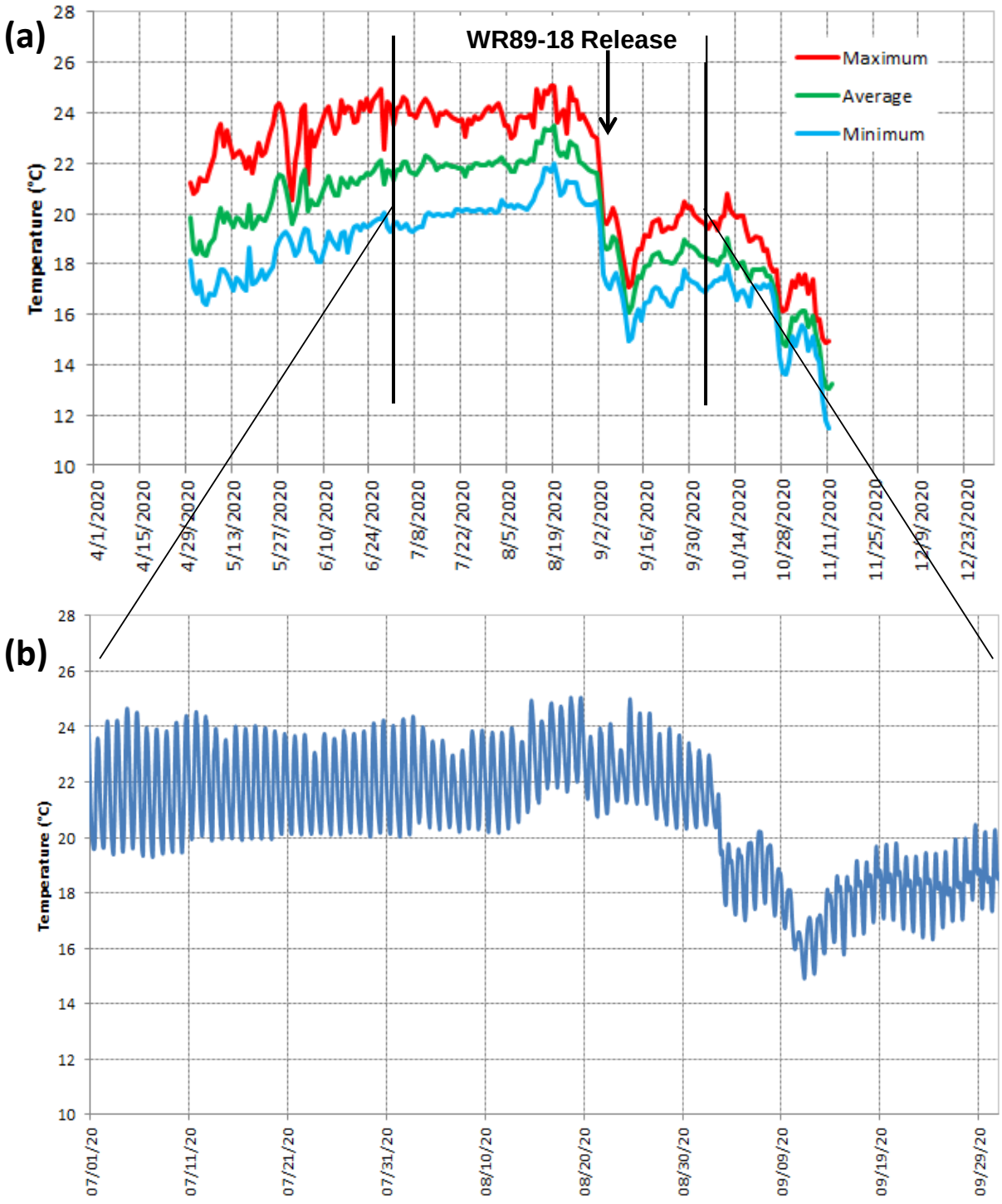


Figure 33: 2020 LSYR-10.2 (Bedrock Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

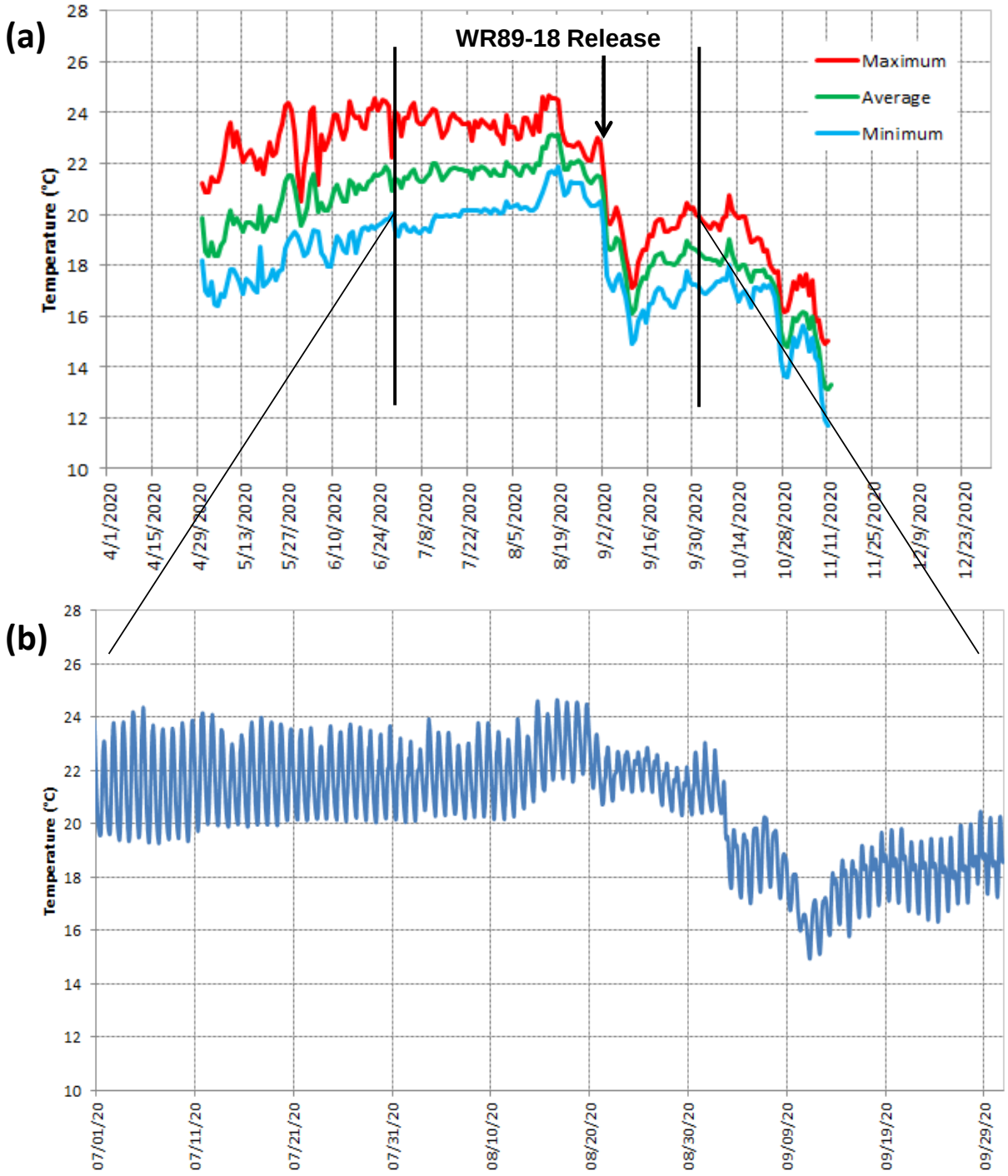


Figure 34: 2020 LSYR-10.2 (Bedrock Pool) middle (4.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

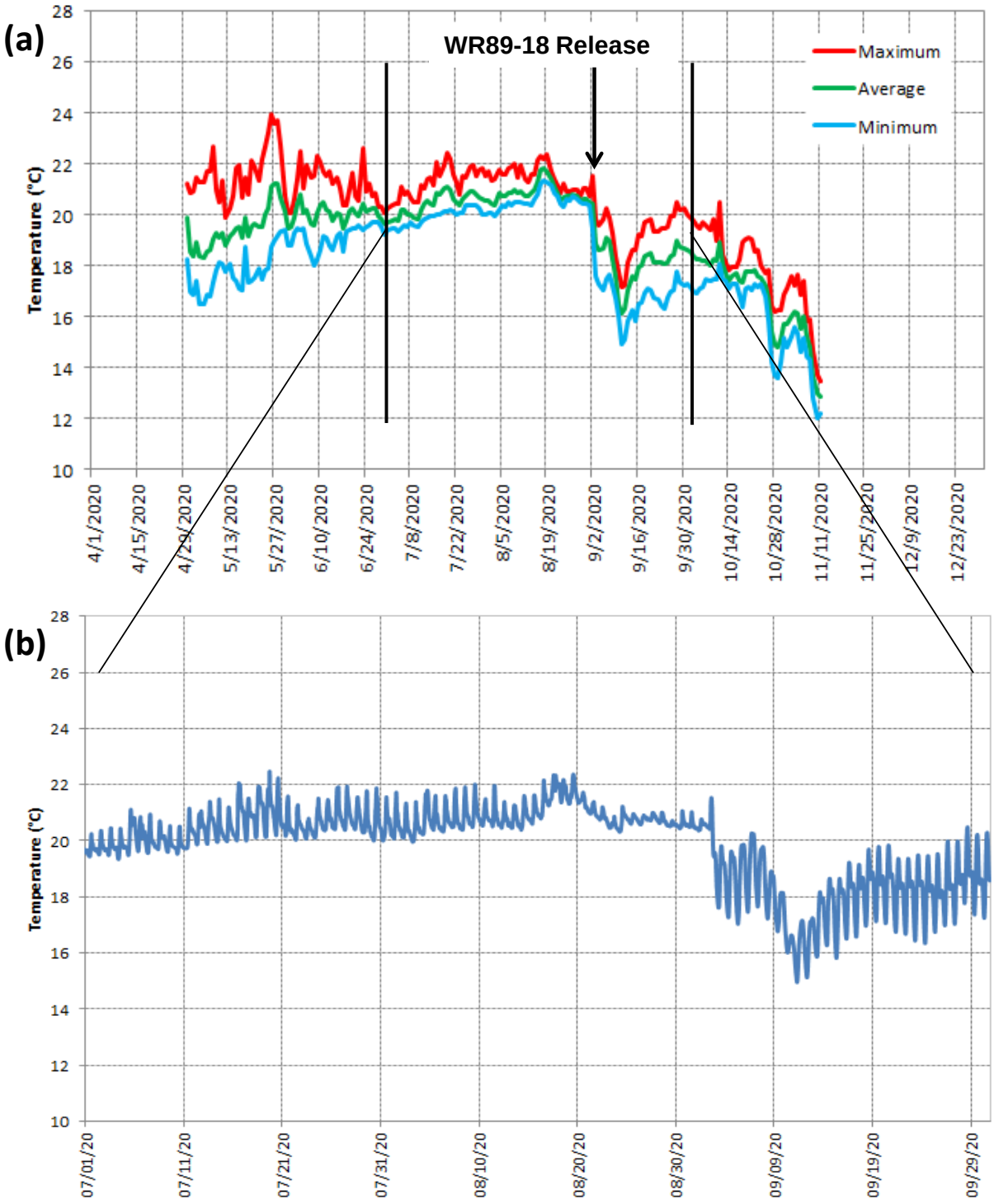


Figure 35: 2020 LSYR-10.2 (Bedrock Pool) bottom (9.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

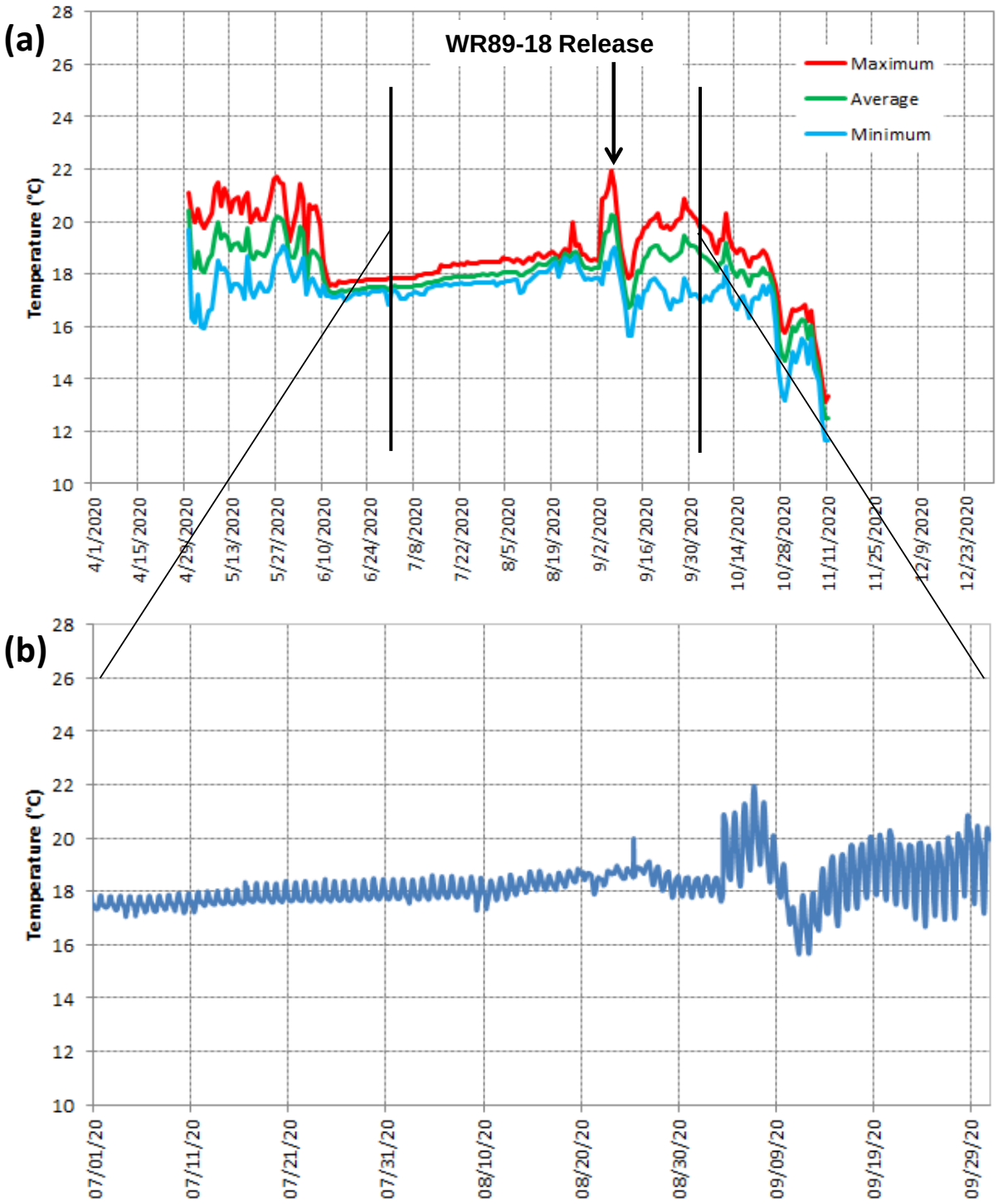


Figure 36: 2020 LSYR-13.9 (Avenue of the Flags) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

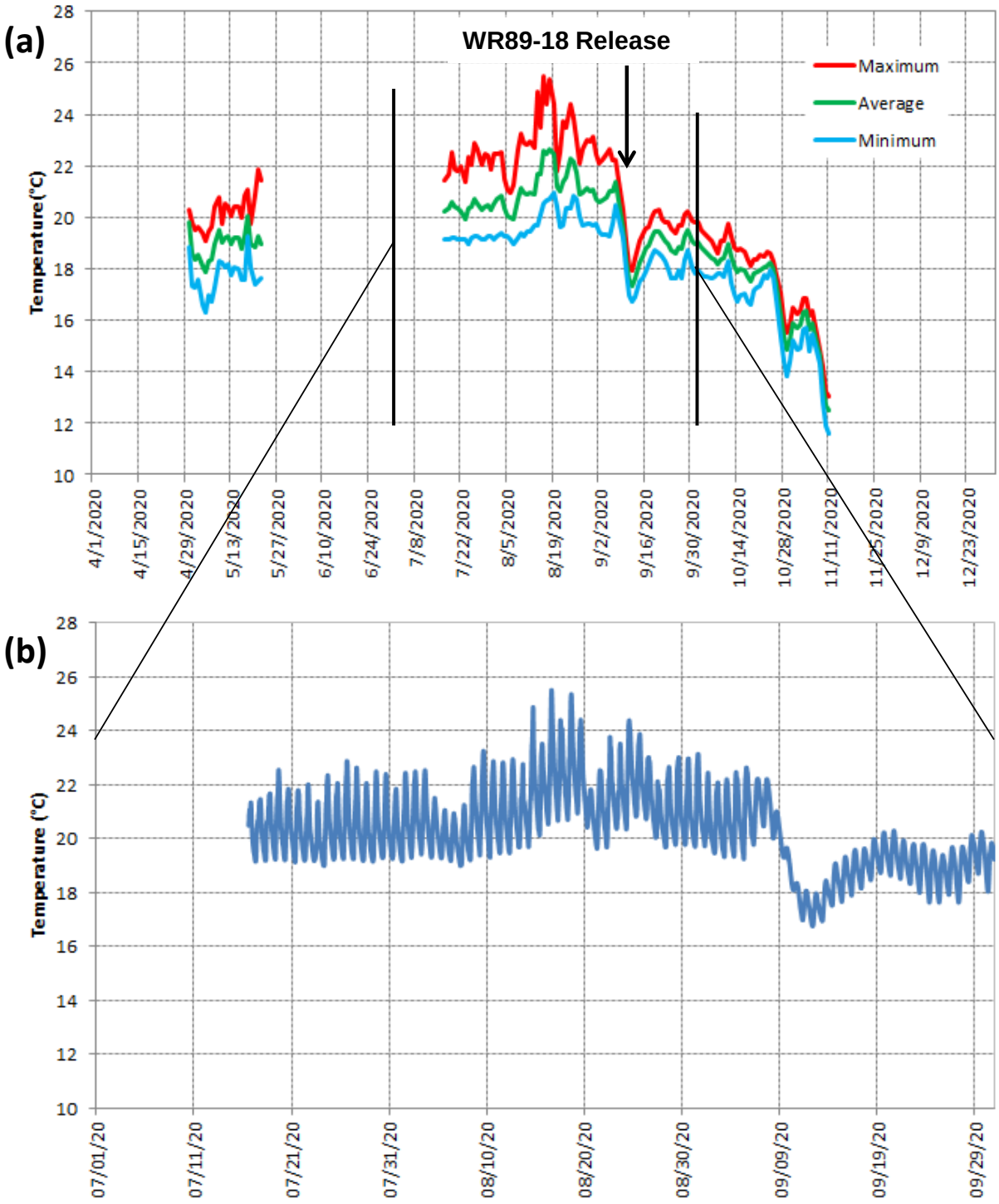


Figure 37: 2020 LSYR-22.68 (Cadwell Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20; the surface unit was out of the water from 5/23/20 – 7/16/20 due to declining water levels.

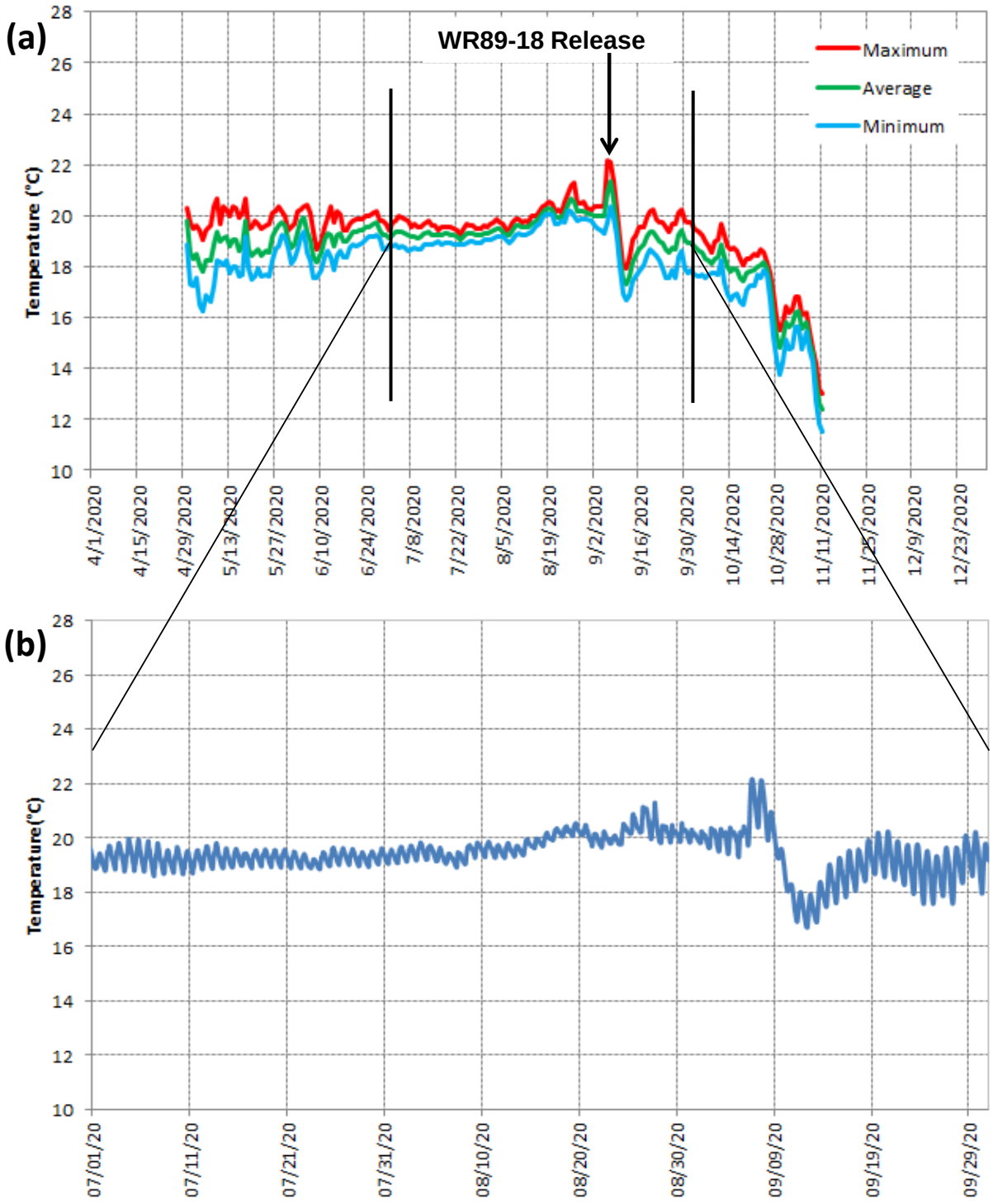


Figure 38: 2020 LSYR-22.68 (Cadwell Pool) middle (7.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

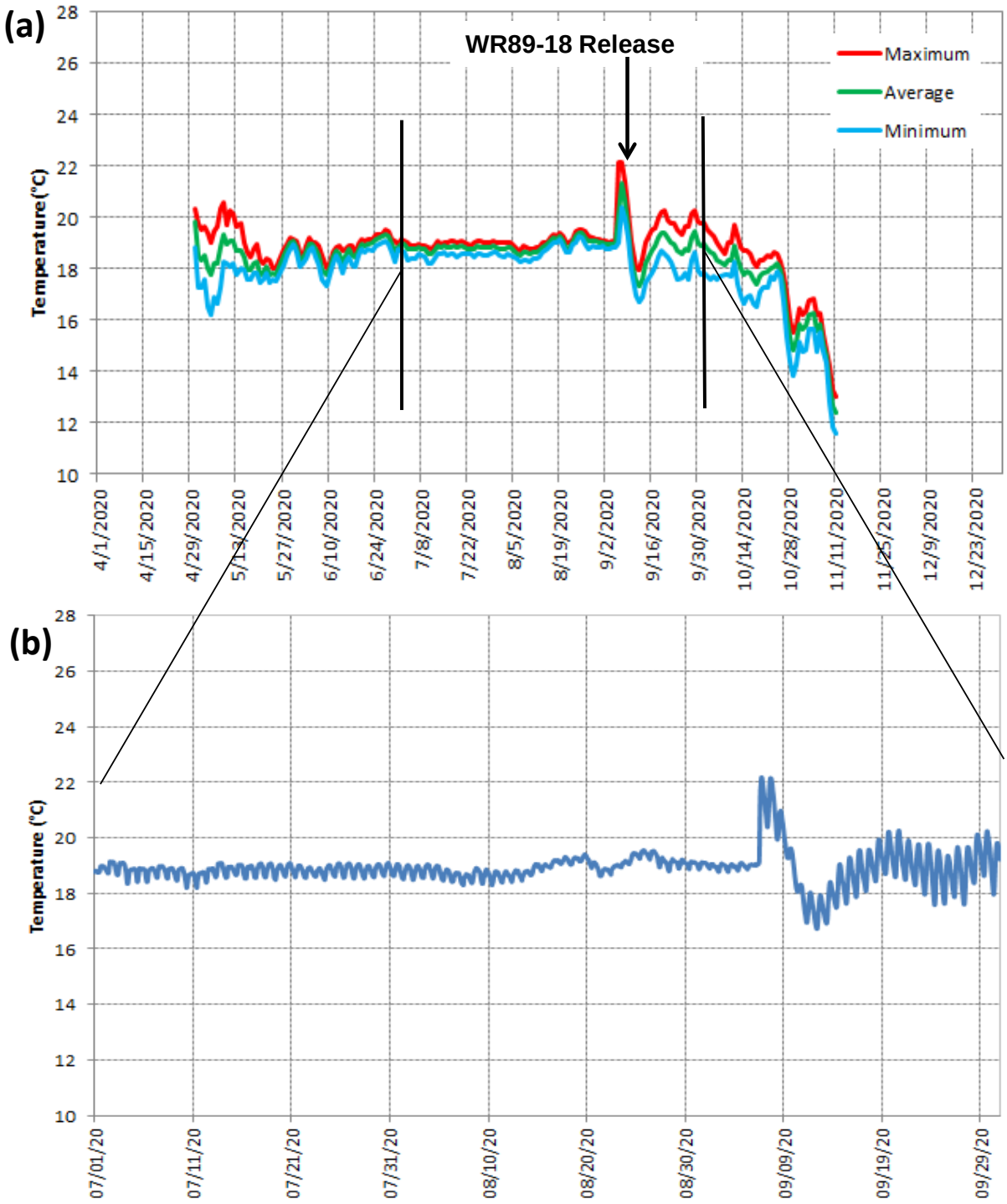


Figure 39: 2020 LSYR-22.68 (Cadwell Pool) bottom (14.0 feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

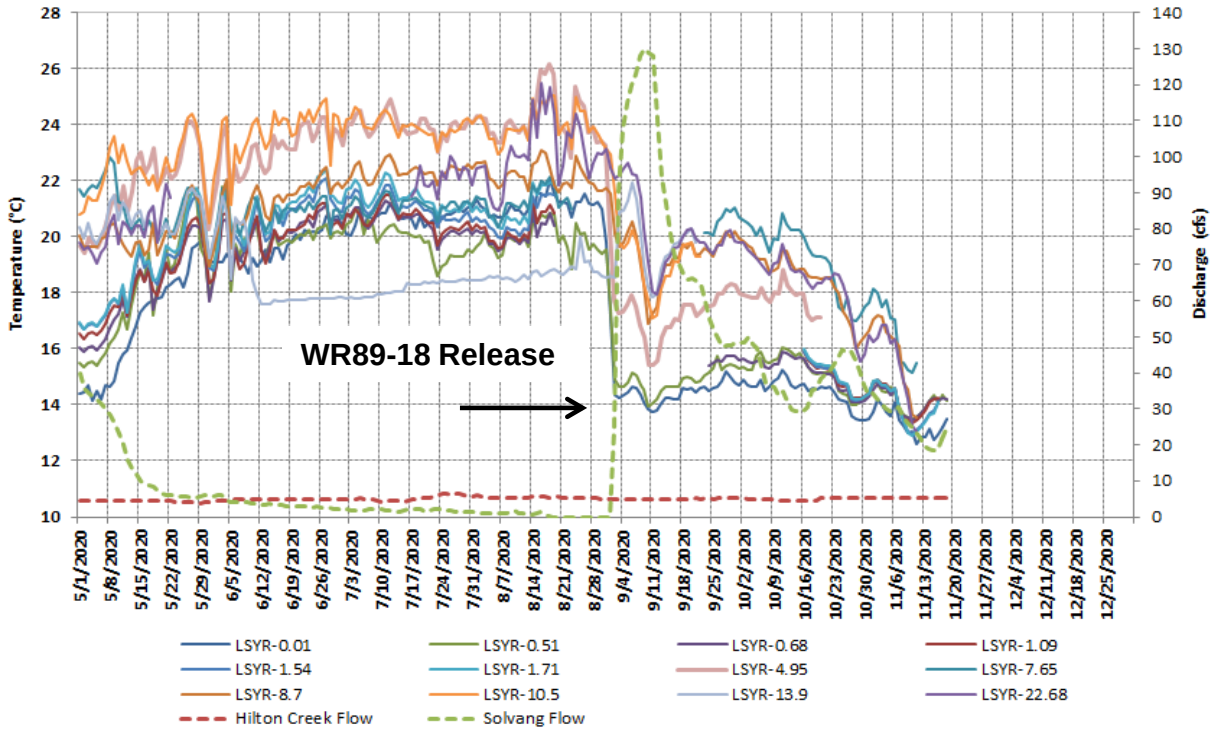


Figure 40: 2020 Longitudinal maximum surface water temperatures at: LSYR-0.01 (parapet wall), LSYR-0.51 (Long Pool), LSYR-0.68 (downstream of Long Pool), LSYR-1.09 (Grimm u/s), LSYR-1.54 (Grimm d/s), LSYR-1.71 (Grimm Pool), LSYR-4.95 (Encantado Pool), LSYR-7.65 (Double Canopy), LSYR-8.7 (Head of Beaver), LSYR-10.5 (Alisal Bedrock Pool), LSYR-13.9 (Avenue of the Flags), and LSYR-22.68 (Cadwell Pool) with daily flow (discharge) at the Hilton Creek and Solvang (at the Alisal Bridge) USGS gauges.

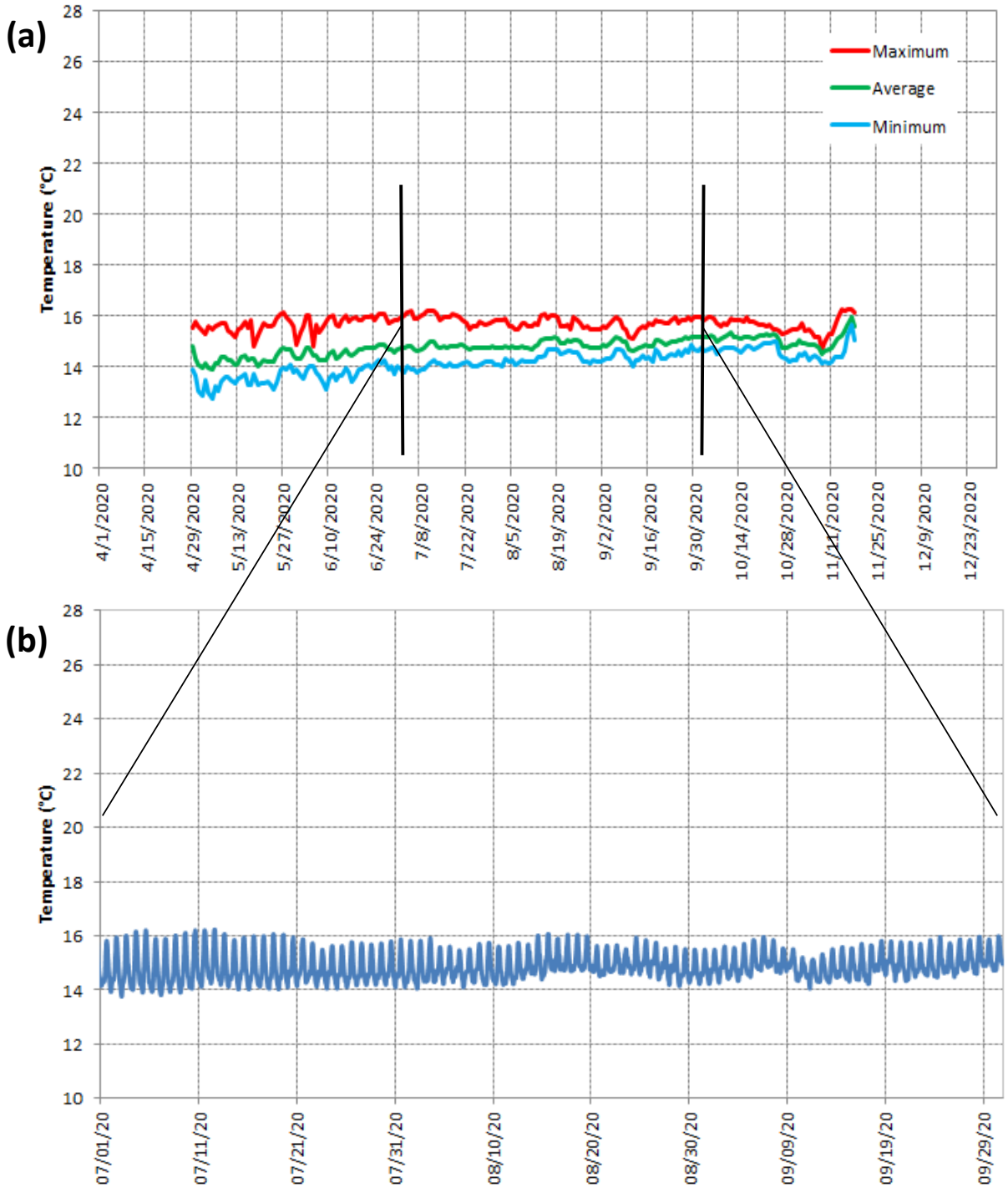


Figure 41: 2020 Lower Hilton Creek (HC-0.12) bottom (1.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/1/20 – 10/1/20.

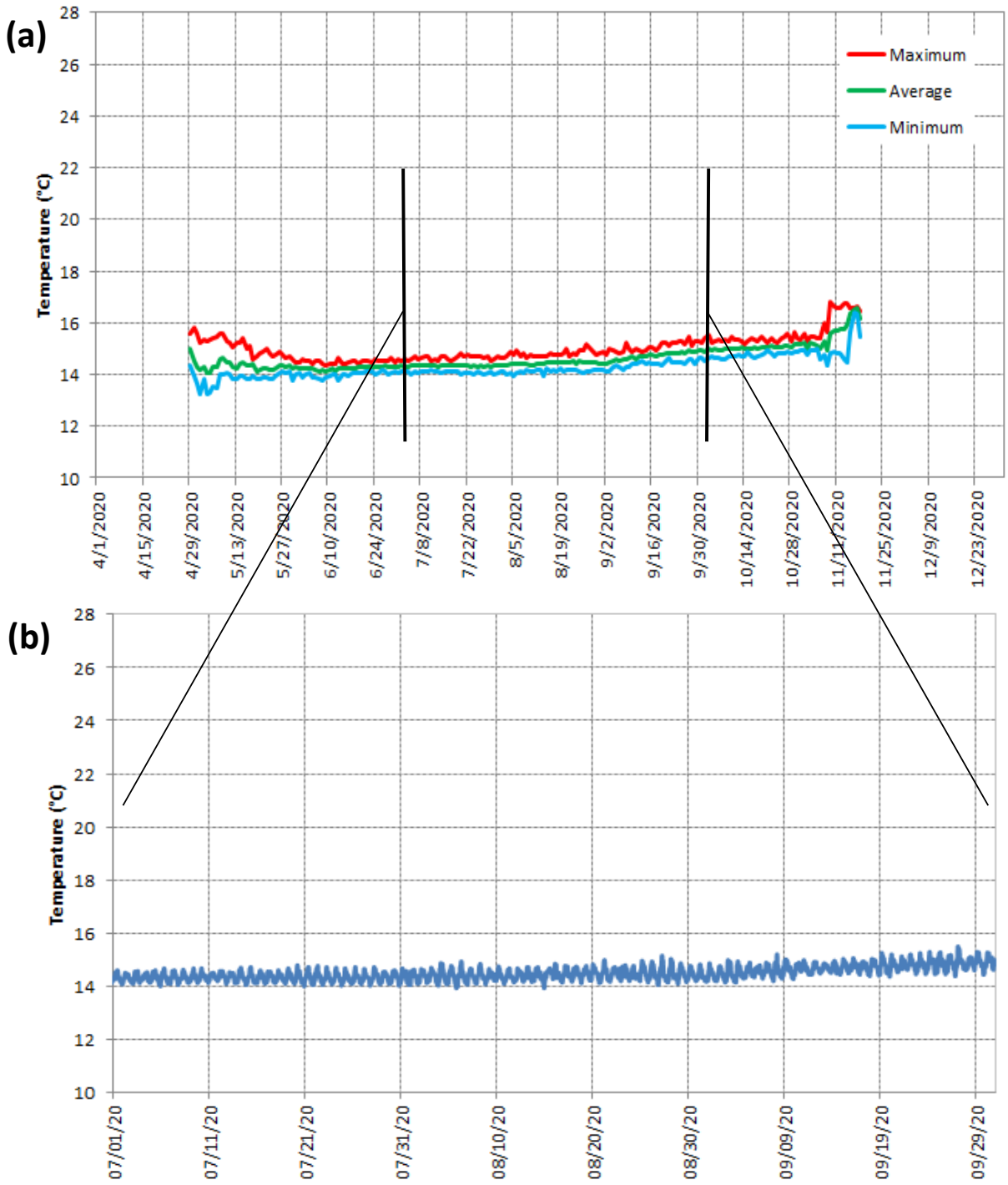


Figure 42: 2020 Hilton Creek at the Upper Release Point (HC-0.54) bottom (2.5 feet) water temperatures for: (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

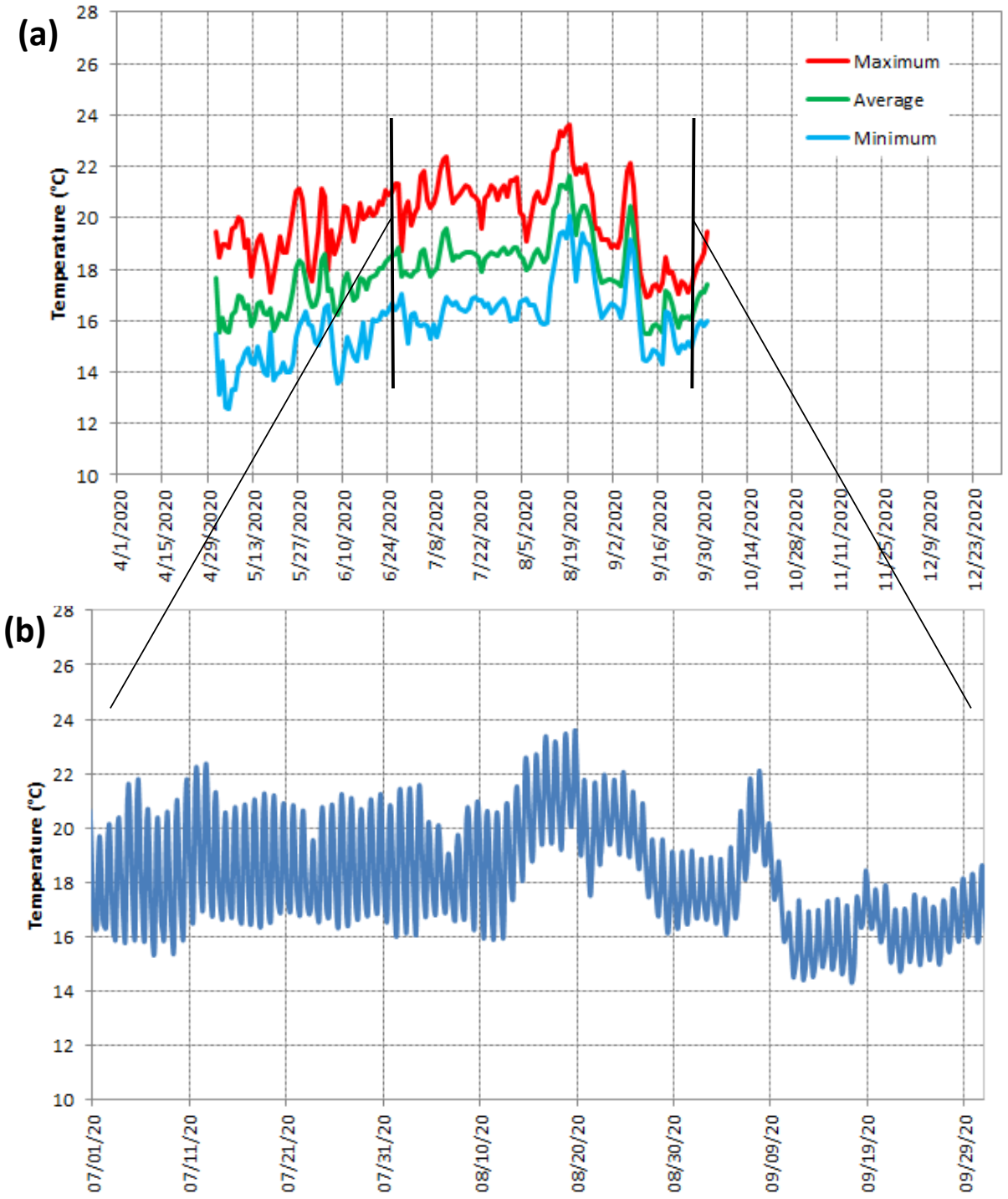


Figure 43: 2020 Quiota Creek (QC-2.66) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data from 7/1/20 – 10/1/20.

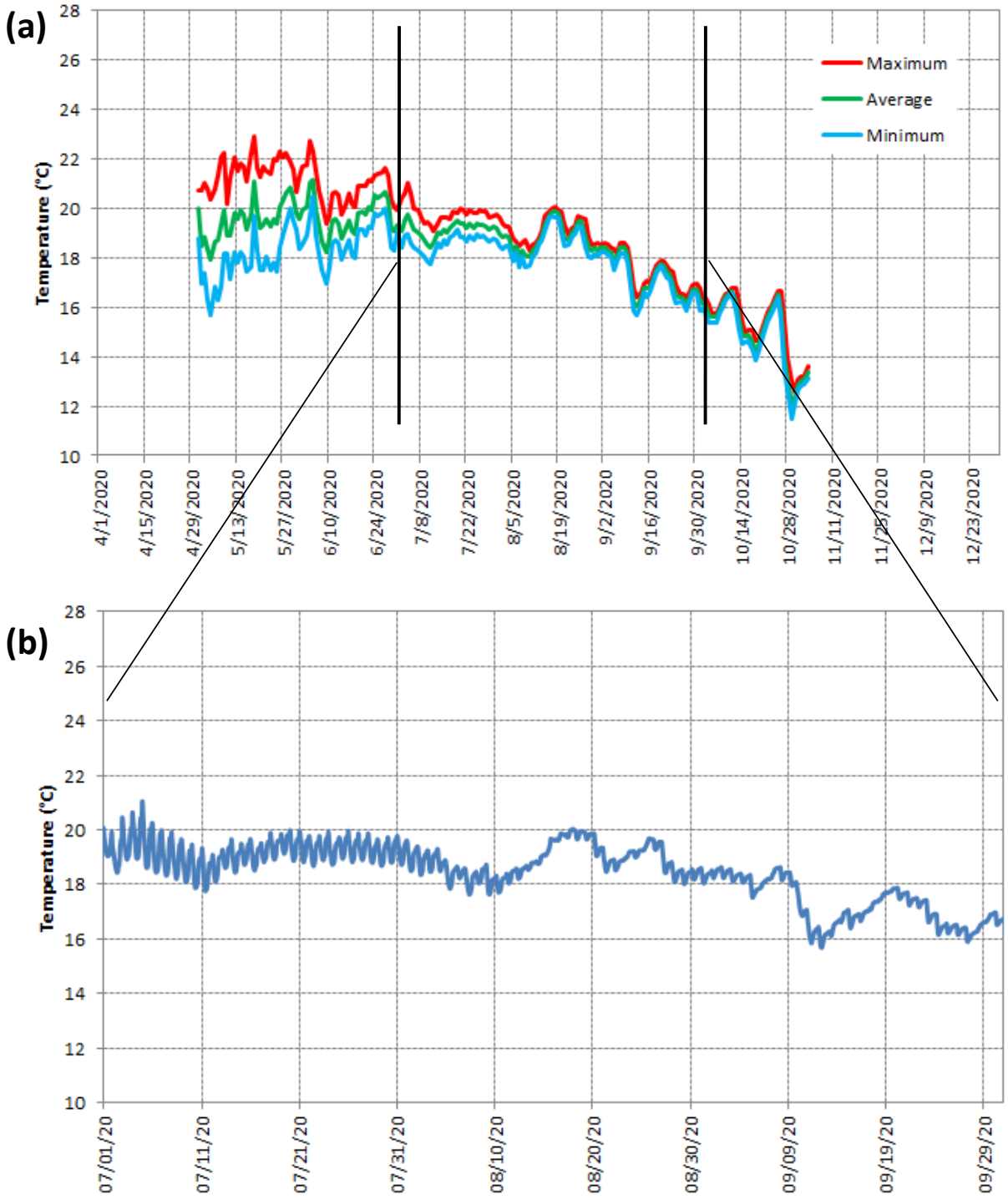


Figure 44: 2020 SC-0.77 bottom (5.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

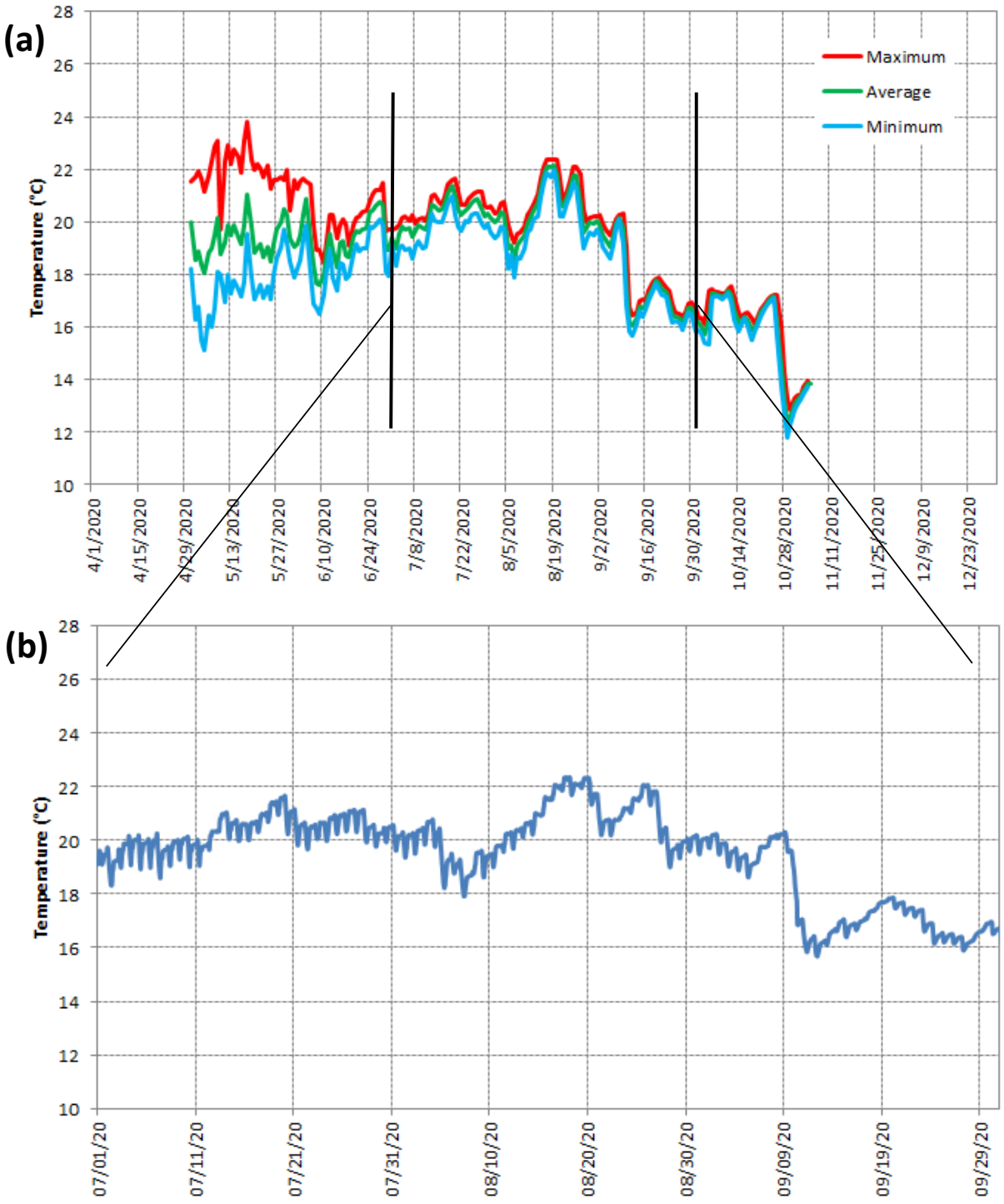


Figure 45: 2020 SC-2.20 (Reach 2 Bedrock Section) bottom (4.0 feet) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period from 7/1/20 – 10/1/20.

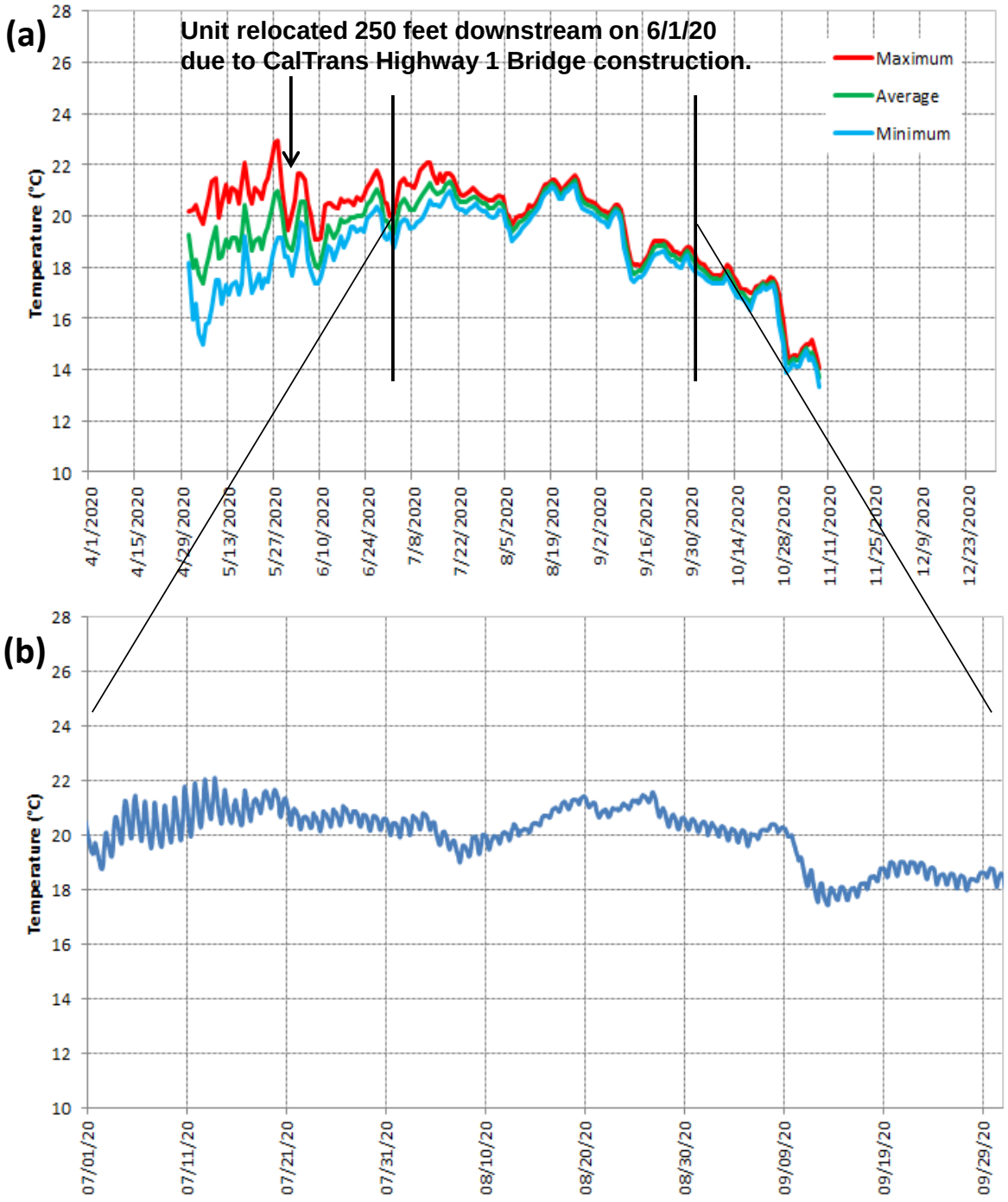


Figure 46: 2020 SC-3.0 (Highway 1 Bridge Pool Habitat) bottom (4.5 feet) water temperature for (a) maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/20 – 10/1/20.

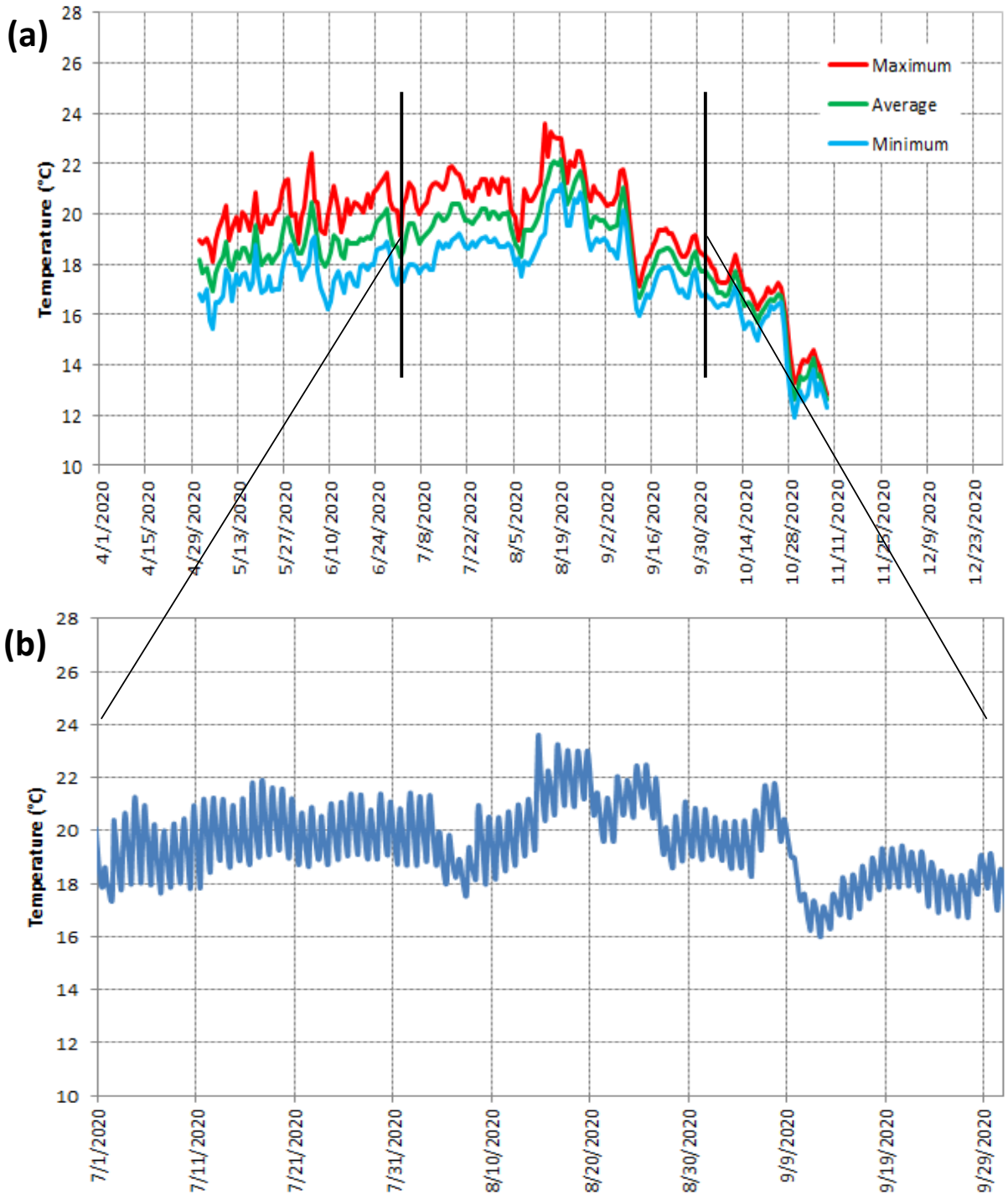


Figure 47: 2020 SC-3.5 (Jalama Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/20 – 10/1/20.

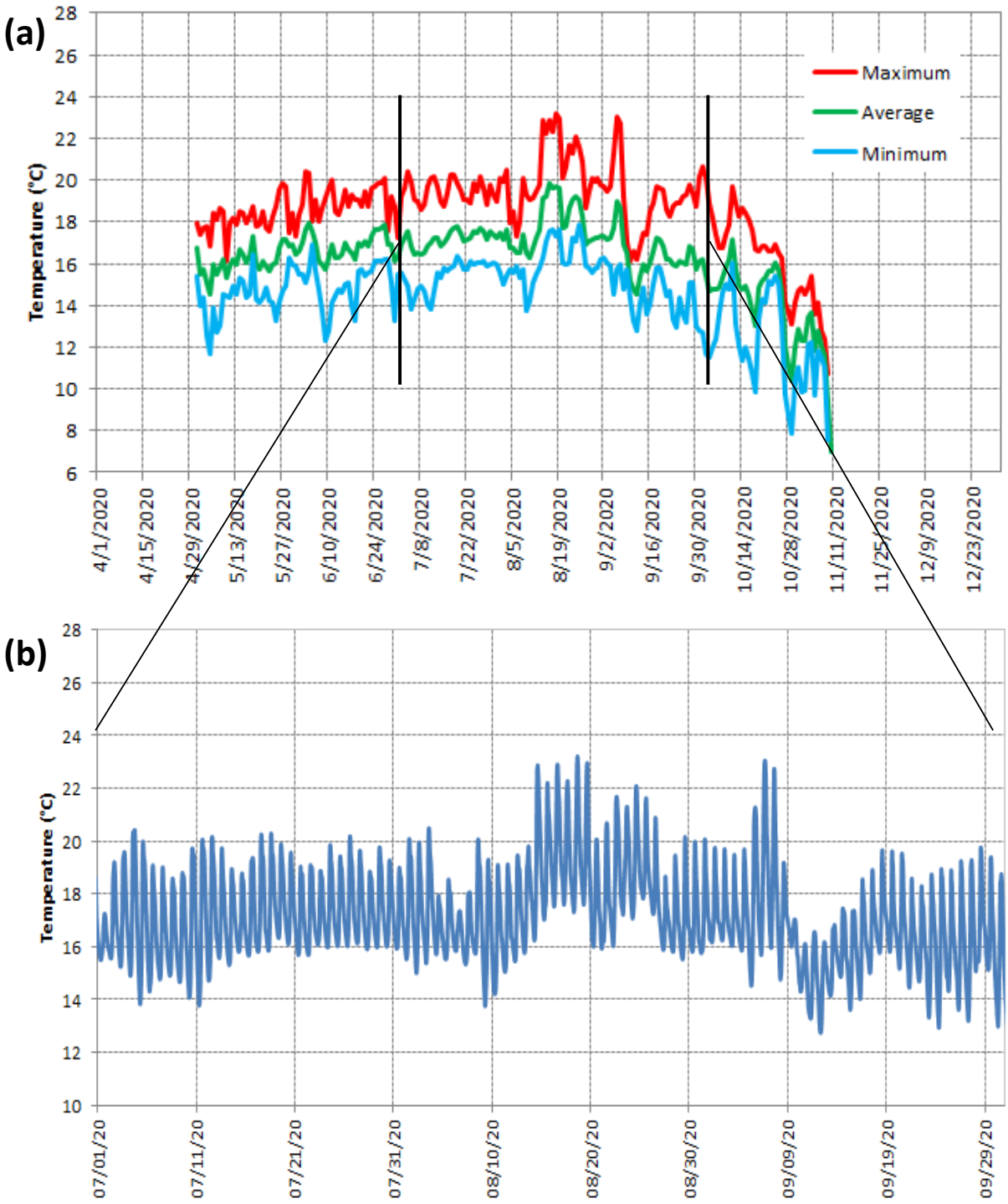


Figure 48: 2020 SC-3.80 Upper Salsipuedes Creek (0.5 feet) water temperatures for (a) daily maximum, average and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

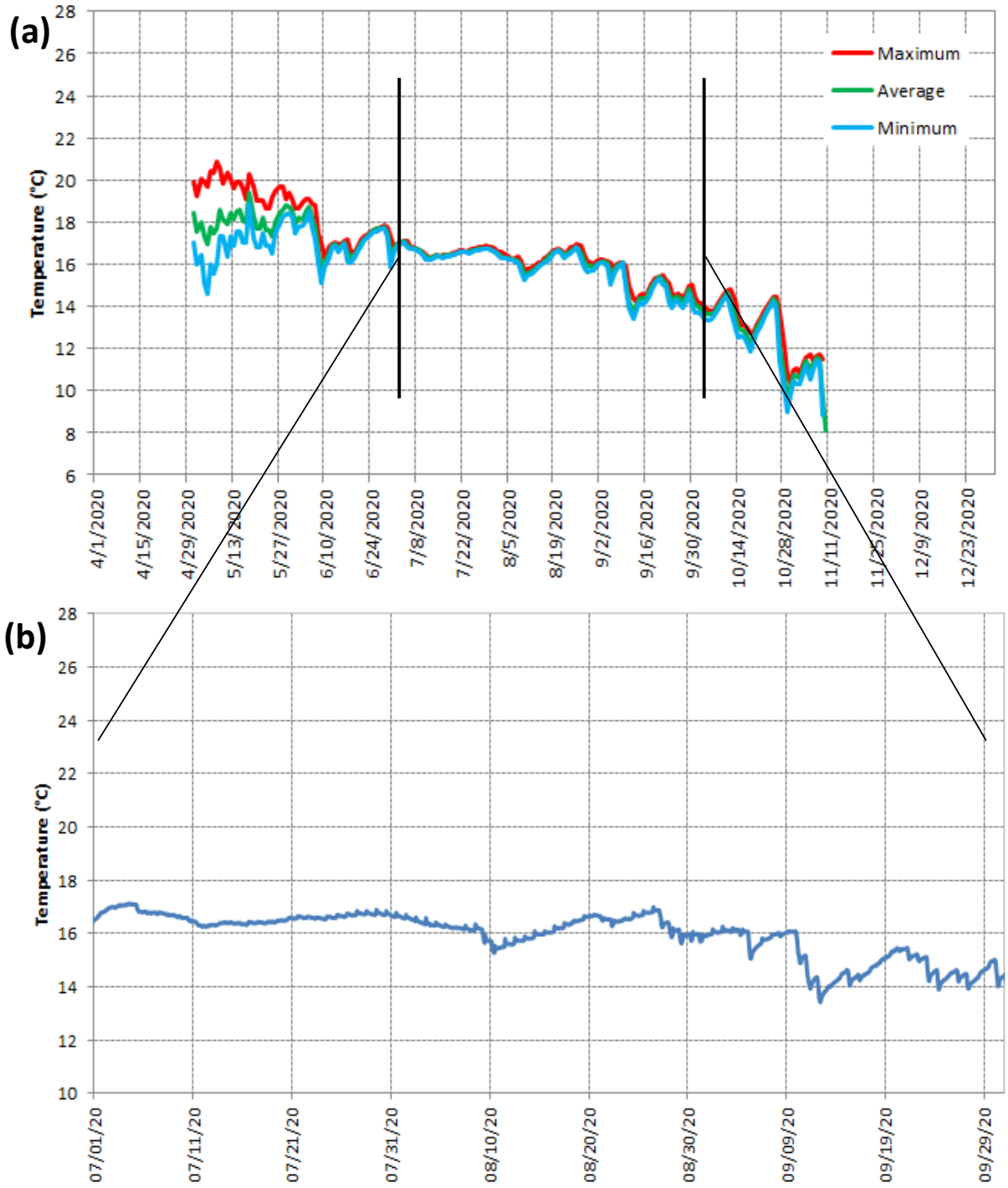


Figure 49: 2020 EJC-3.81 directly upstream of the Upper Salsipuedes Creek confluence – bottom (3.0 - feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

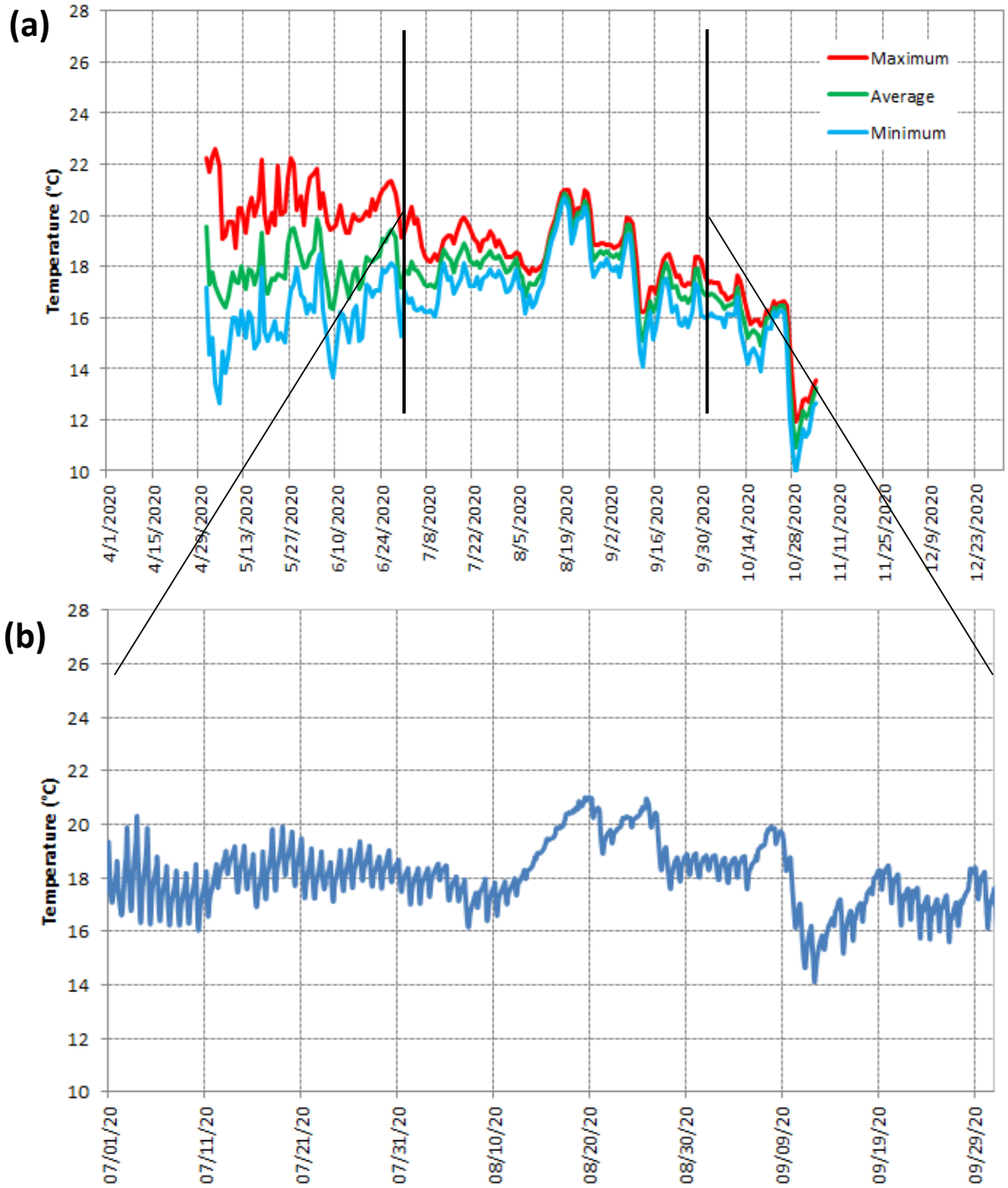


Figure 50: 2020 EJC-5.4 (Palos Colorados Pool Habitat) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/20 – 10/1/20.

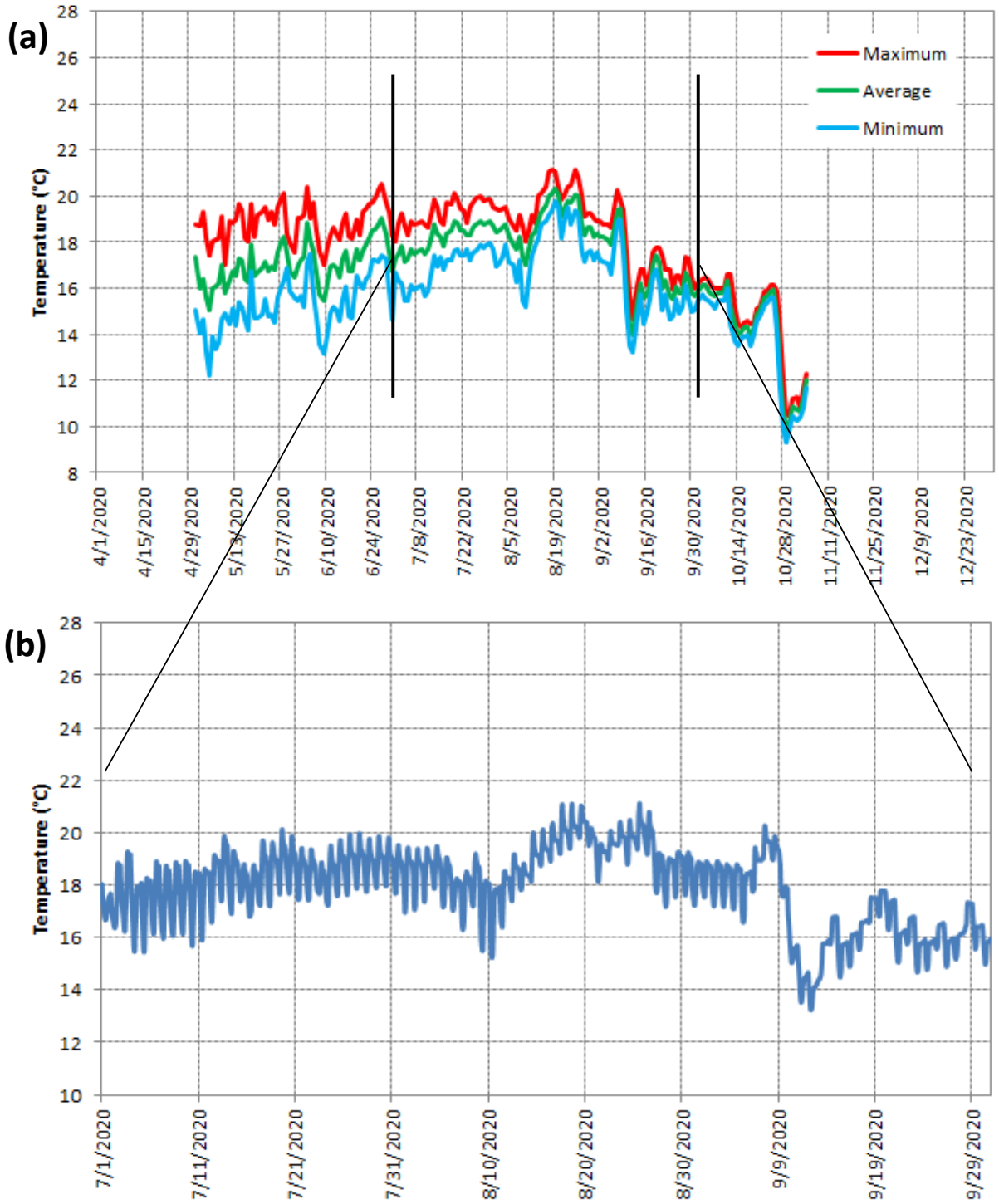


Figure 51: 2020 EJC-10.82 water temperature at Rancho San Julian Fish Ladder bottom (3.5-feet) for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/20 – 10/1/20.

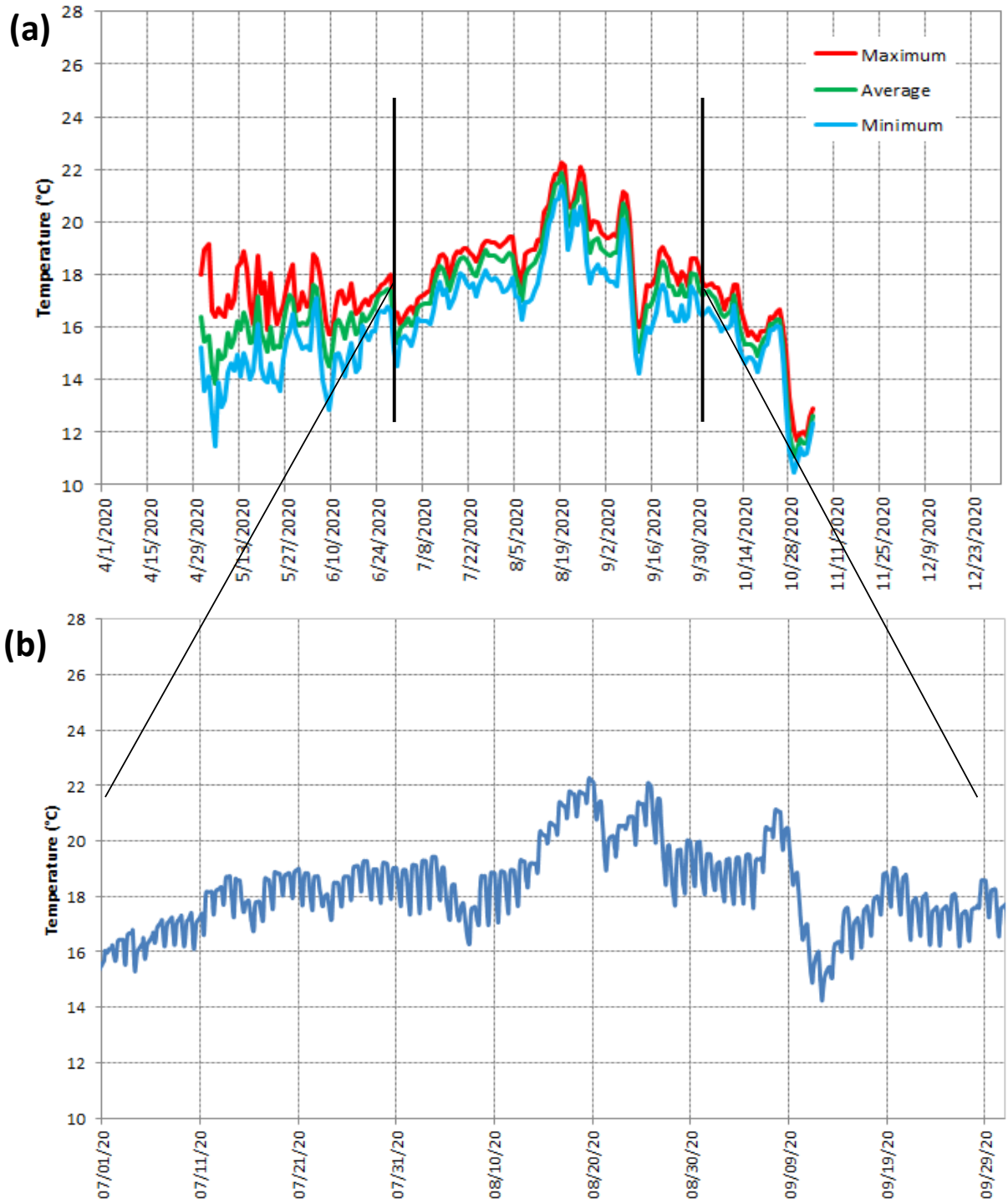


Figure 52: 2020 LAC-7.0 (Los Amoles Creek at Ford Crossing) bottom (2.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/20 – 10/1/20.

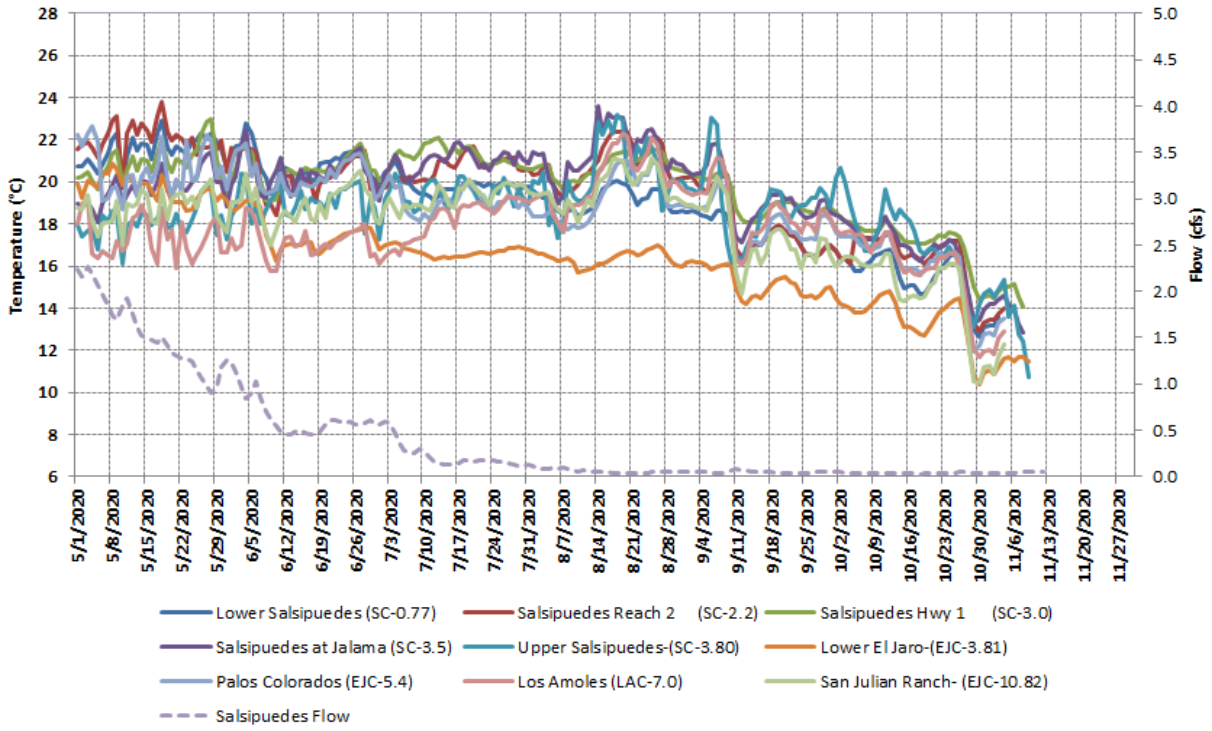


Figure 53: 2020 longitudinal surface daily maximum at 9 tributary locations within Salsipuedes/El Jaro watershed and flow at the USGS gauging station at Salsipuedes Creek.

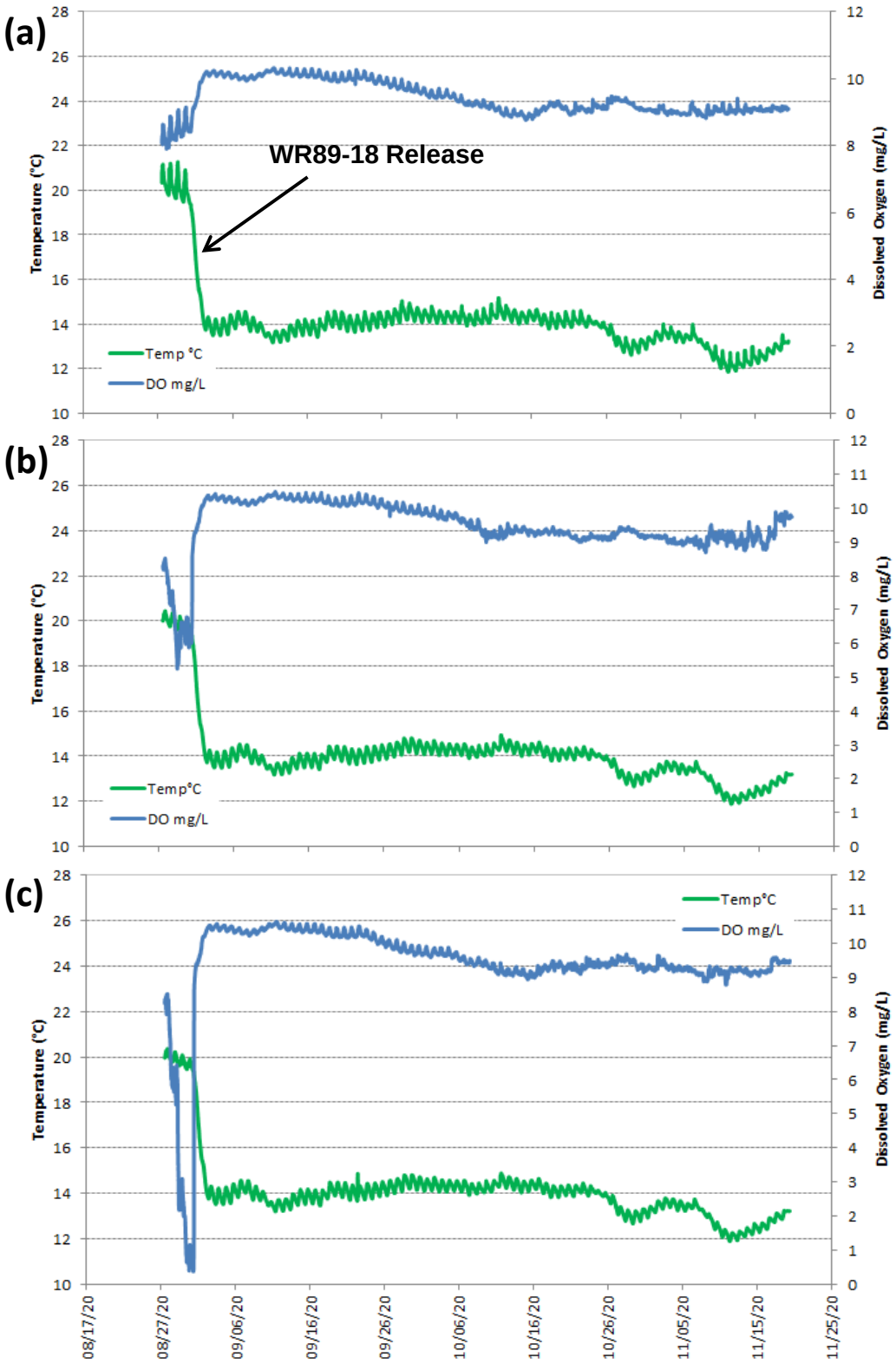


Figure 54: 2020 Temperature and dissolved oxygen at LSYR-0.01 at: a) 1-foot below the surface, b) 14-foot below the surface and c) 28-foot below the surface; WR89-18 releases started on 8/31/20.

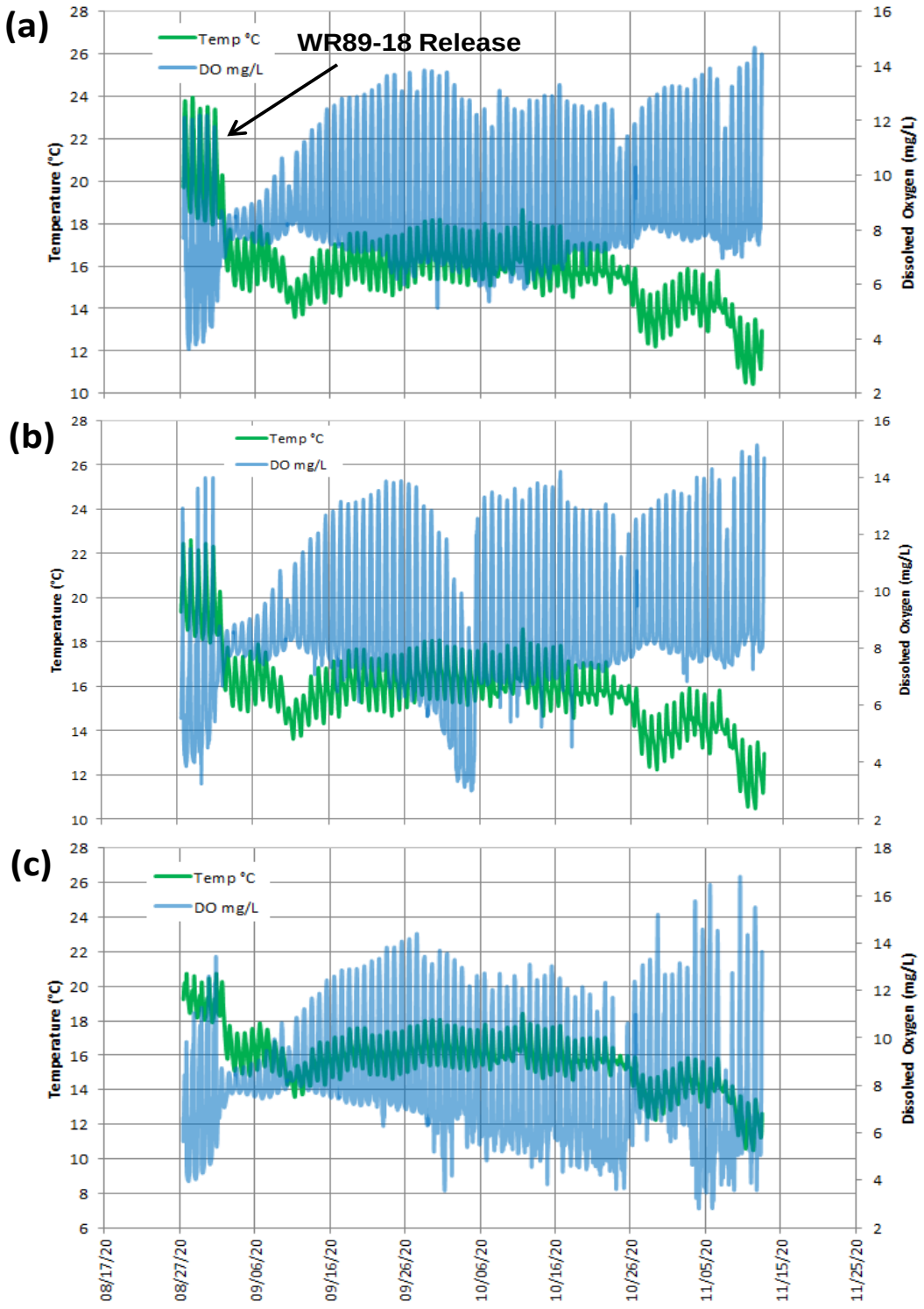


Figure 55: 2020 Temperature and dissolved oxygen at LSYR-4.95 at: a) 1-foot below the surface, b) 4-foot below the surface and c) 8-foot below the surface: WR89-18 releases started on 8/31/20.

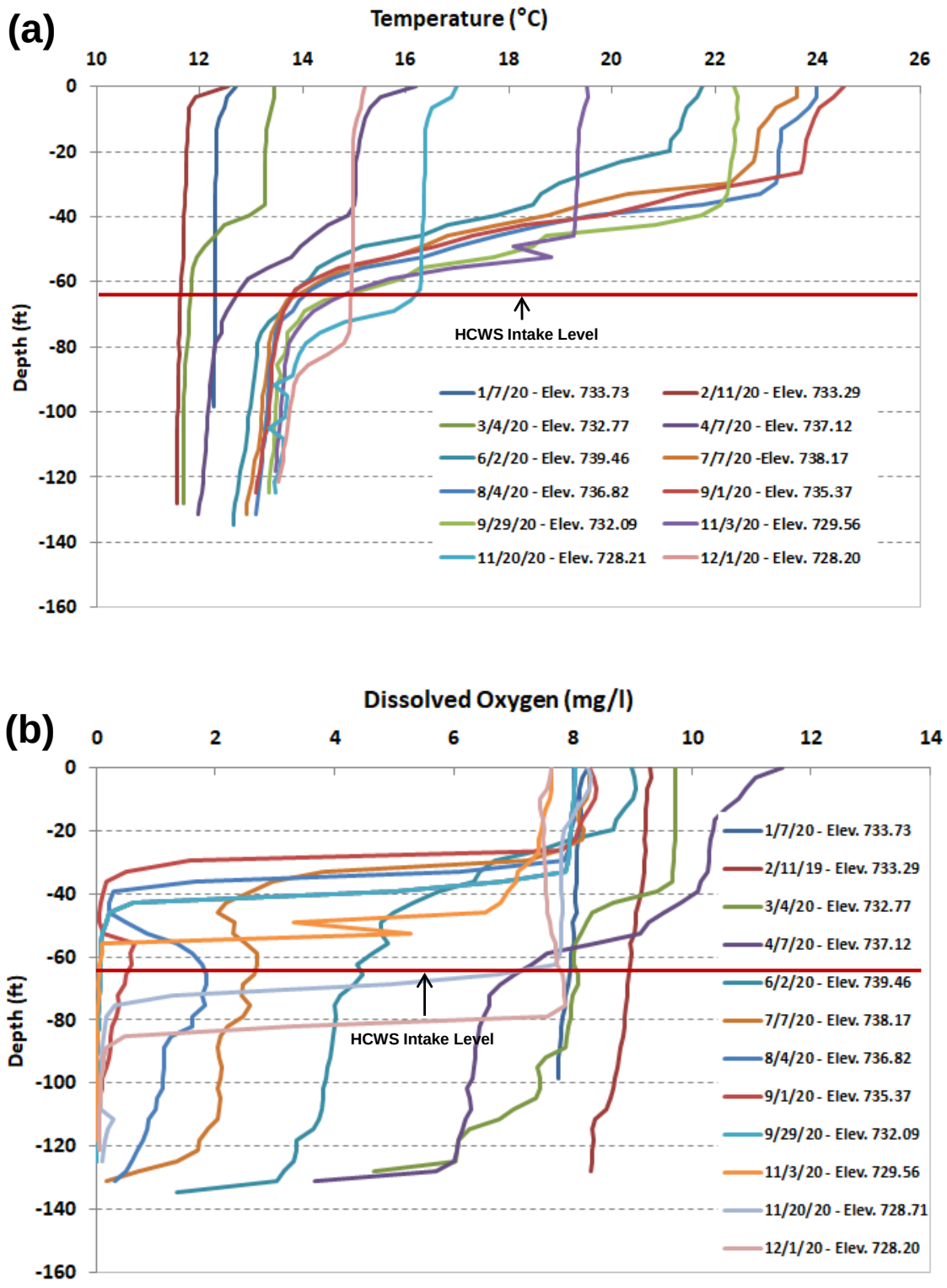


Figure 56: Lake Cachuma 2020 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS; the target depth of HCWS intake hose is 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

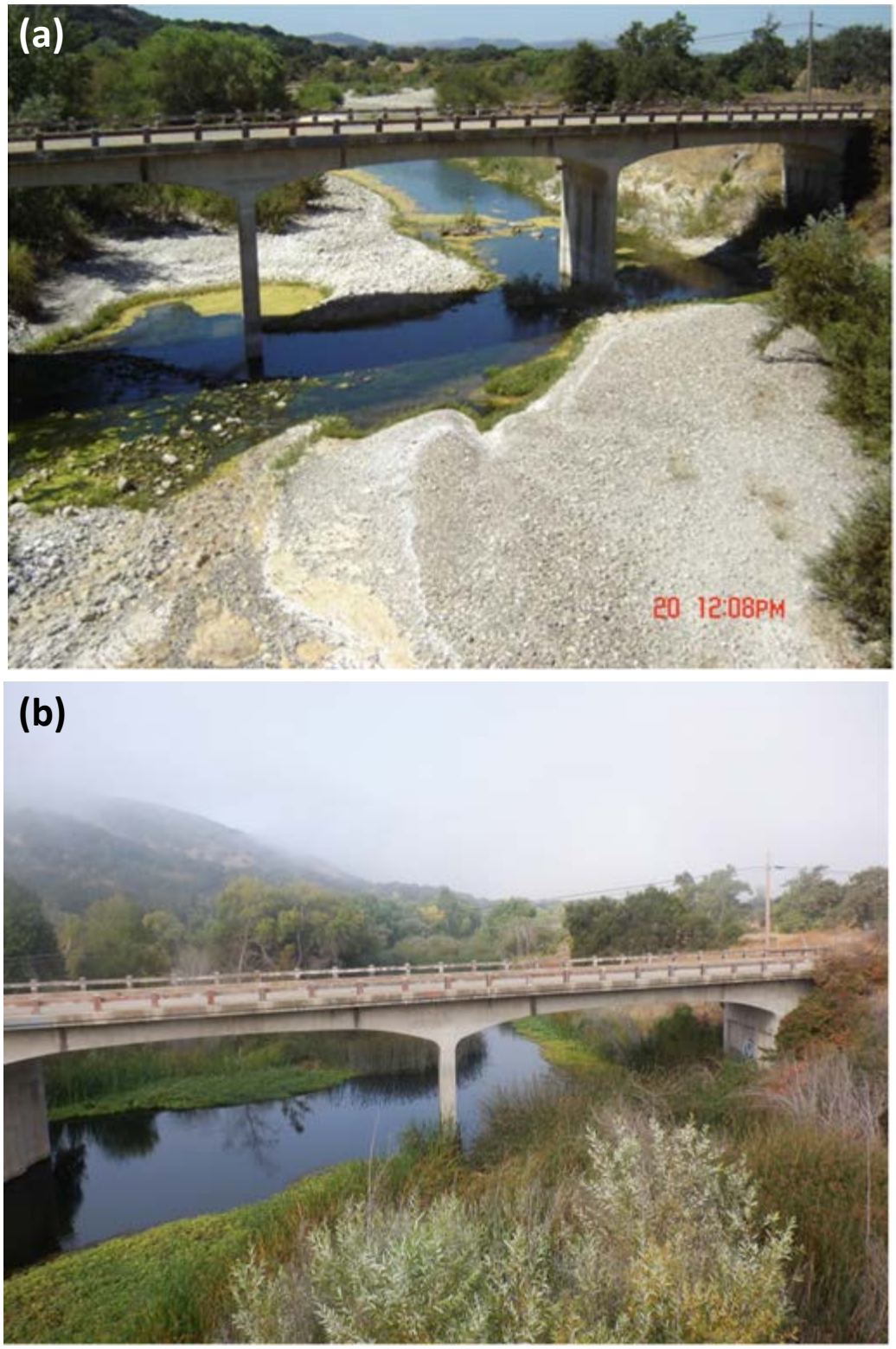


Figure 57: Photo points (M-6) collected at Highway 154 Bridge looking downstream in (a) September 2005 and (b) September 2020.

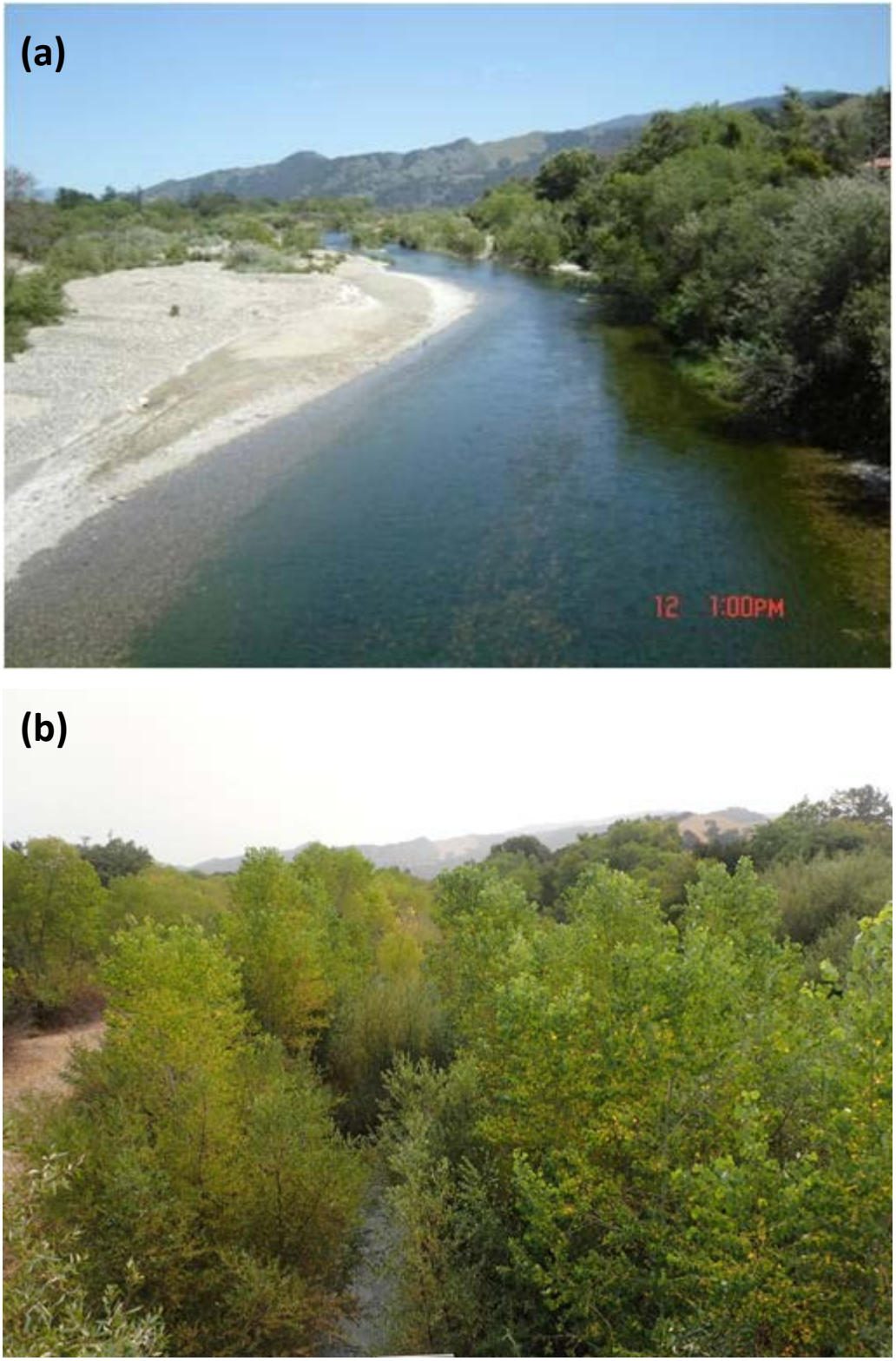


Figure 58: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) September 2020.

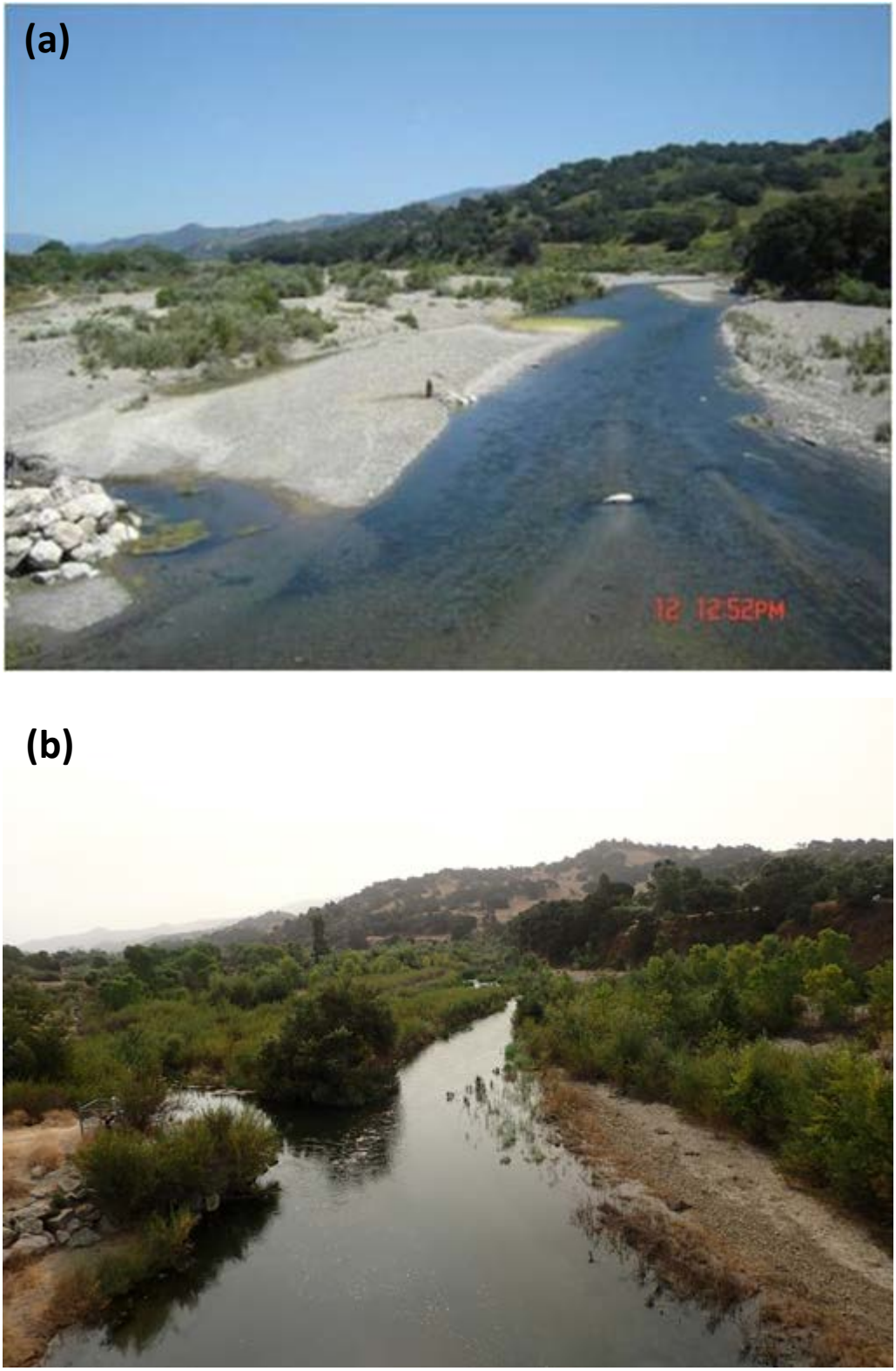


Figure 59: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) September 2020.

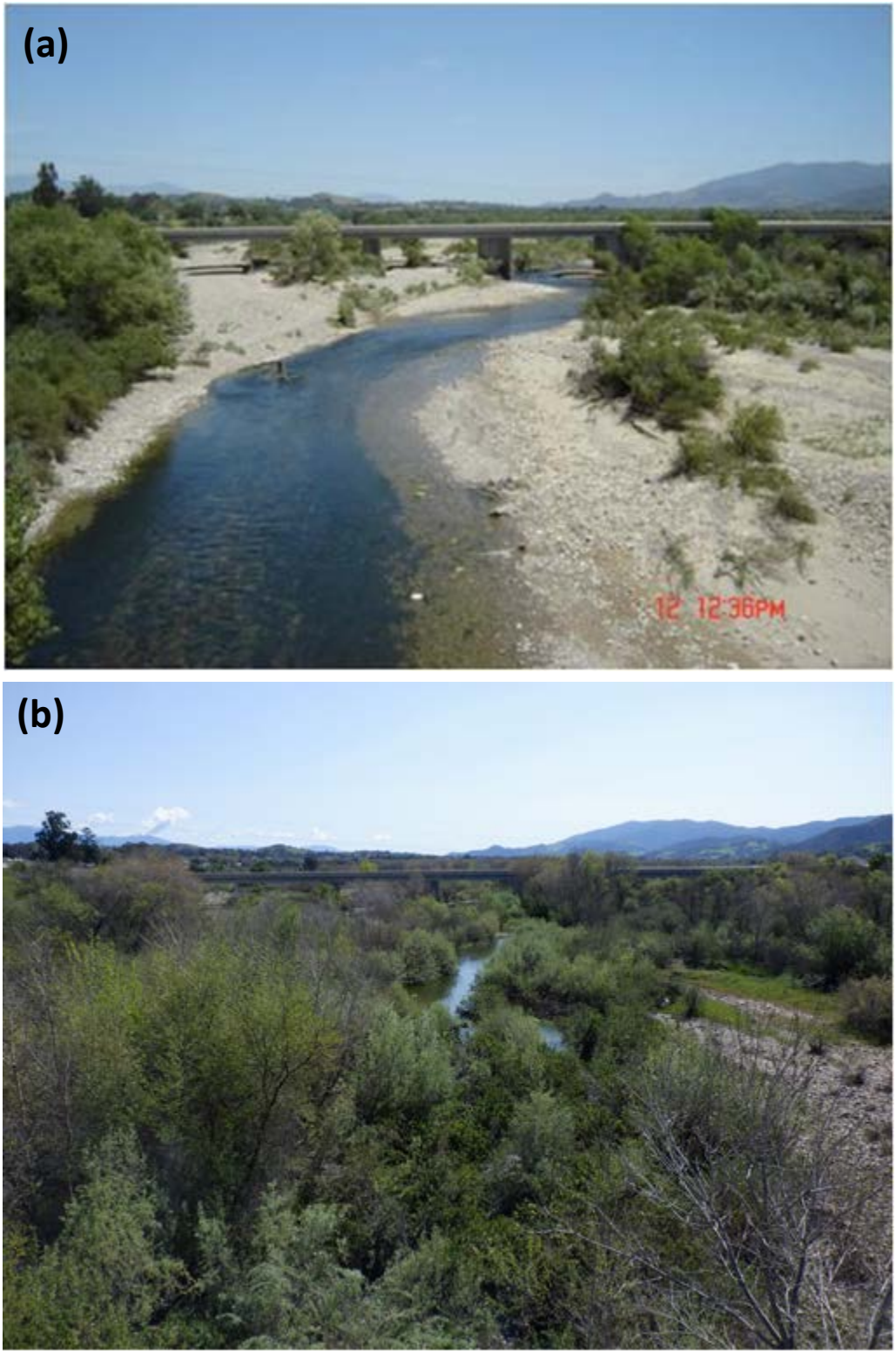


Figure 60: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) March 2020.

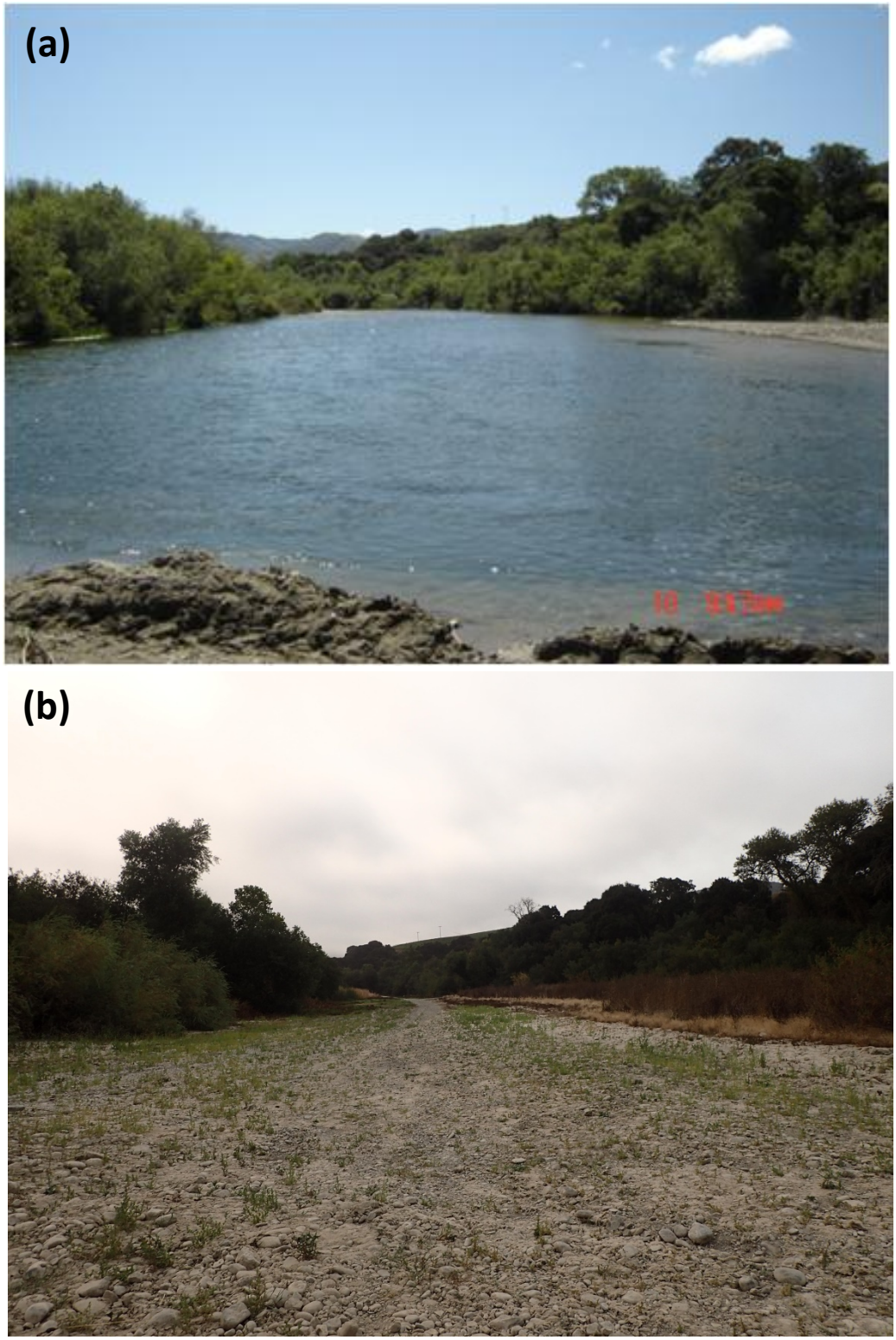


Figure 61: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) September 2020.

Figure 62: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) September 2020.

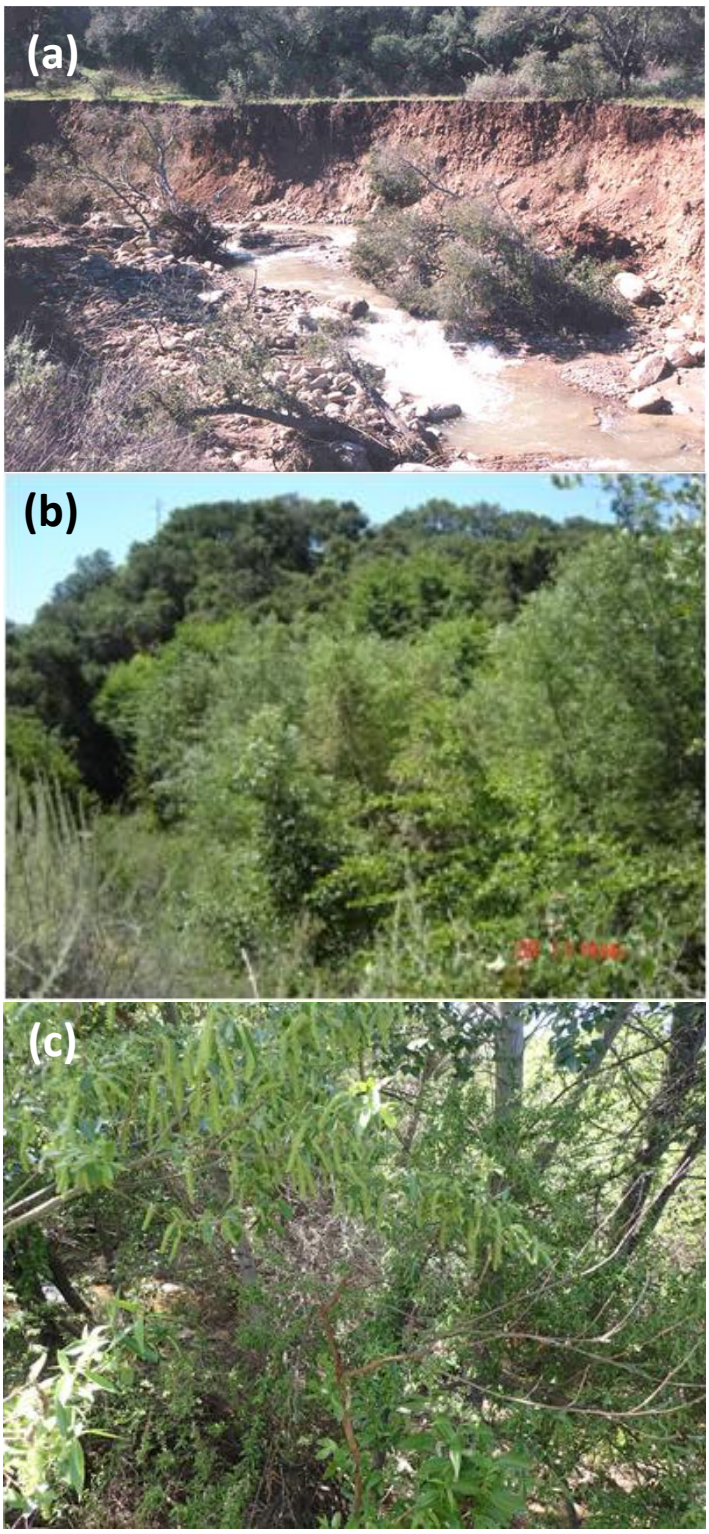


Figure 63: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) September 2020; the creek is nearly invisible now from this vantage point.

Figure 64: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) September 2020.

Figure 65: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) September 2020 (during Caltrans bridge replacement project).

Figure 66: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) September 2020.

3.4 Migrant Trapping

Table 7: WY2020 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	2/5/2020	5/19/2020	3/9/2020	3/12/2020	3		
			3/14/2020	3/24/2020	10		
			4/5/2020	4/10/2020	5		
	Total:	104		**Total:**	18	86	83%
Salsipuedes	3/24/2020	5/15/2020	4/5/2020	4/10/2020	5		
	Total:	51		**Total:**	5	46	90%
Mainstem	4/9/2020	4/24/2020					
	Total:	15		**Total:**	0	15	100%

Table 8: WY2020 *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	49	90	86	104	82.7	0.57	1.05	1.62	4.5	4.3
Salsipuedes	2	1	46	51	90.2	0.04	0.02	0.07	5.1	1.6
Mainstem	0	5	15	15	100.0	0.00	0.33	0.33	39.1	25.7

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 WY2020.

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	19	11	7	12	49
	Downstream	32	9	12	37	90
	Total:	51	20	19	49	139
Salsipuedes	Upstream	0	1	1	0	2
	Downstream	0	1	0	0	1
	Total:	0	2	1	0	3
Mainstem	Upstream	0	0	0	0	0
	Downstream	0	1	0	4	5
	Total:	0	1	0	4	5

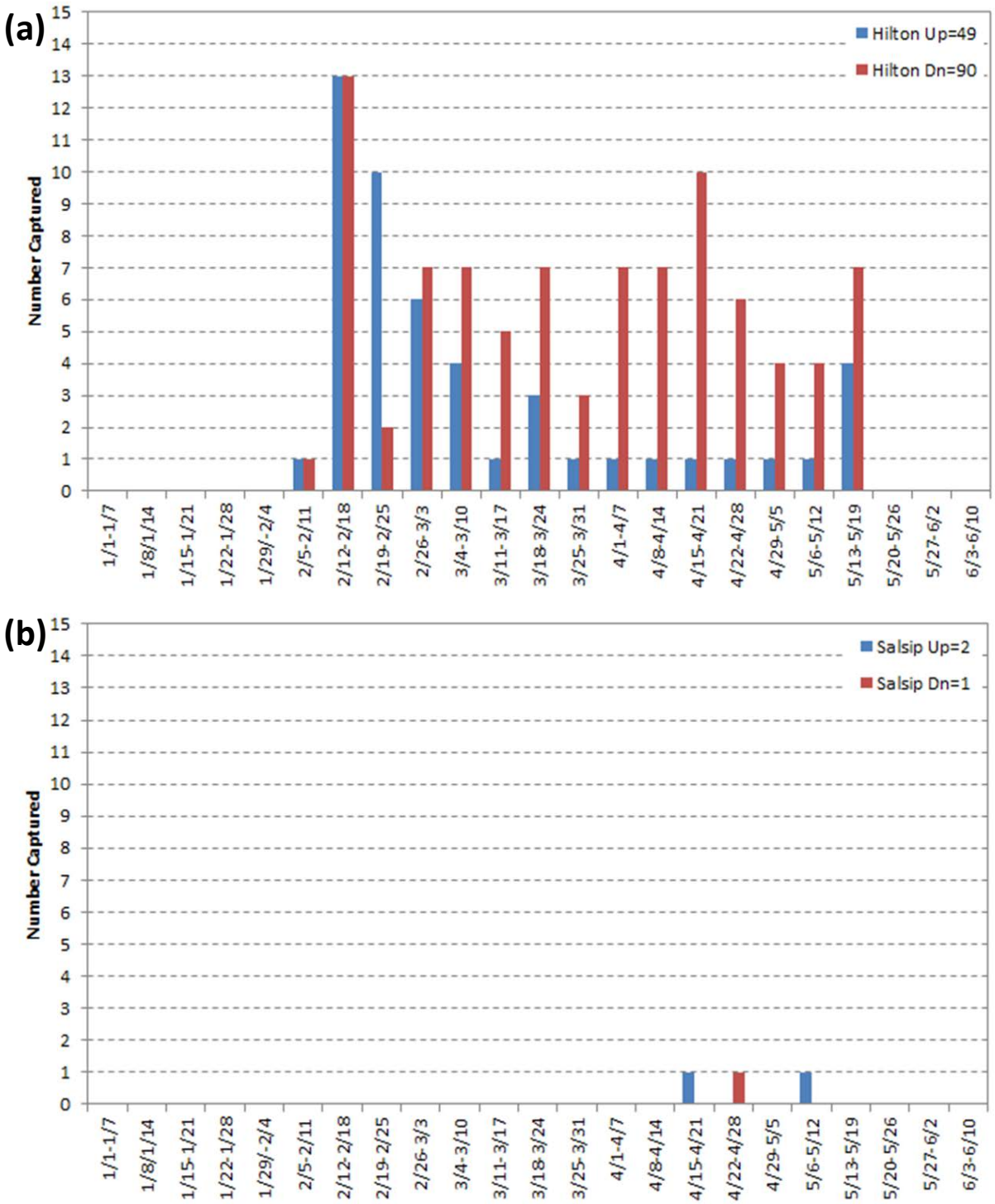


Figure 67: WY2020 paired histogram of weekly upstream and downstream *O. mykiss* captures by trap site for: (a) Hilton Creek and (b) Salsipuedes Creek.

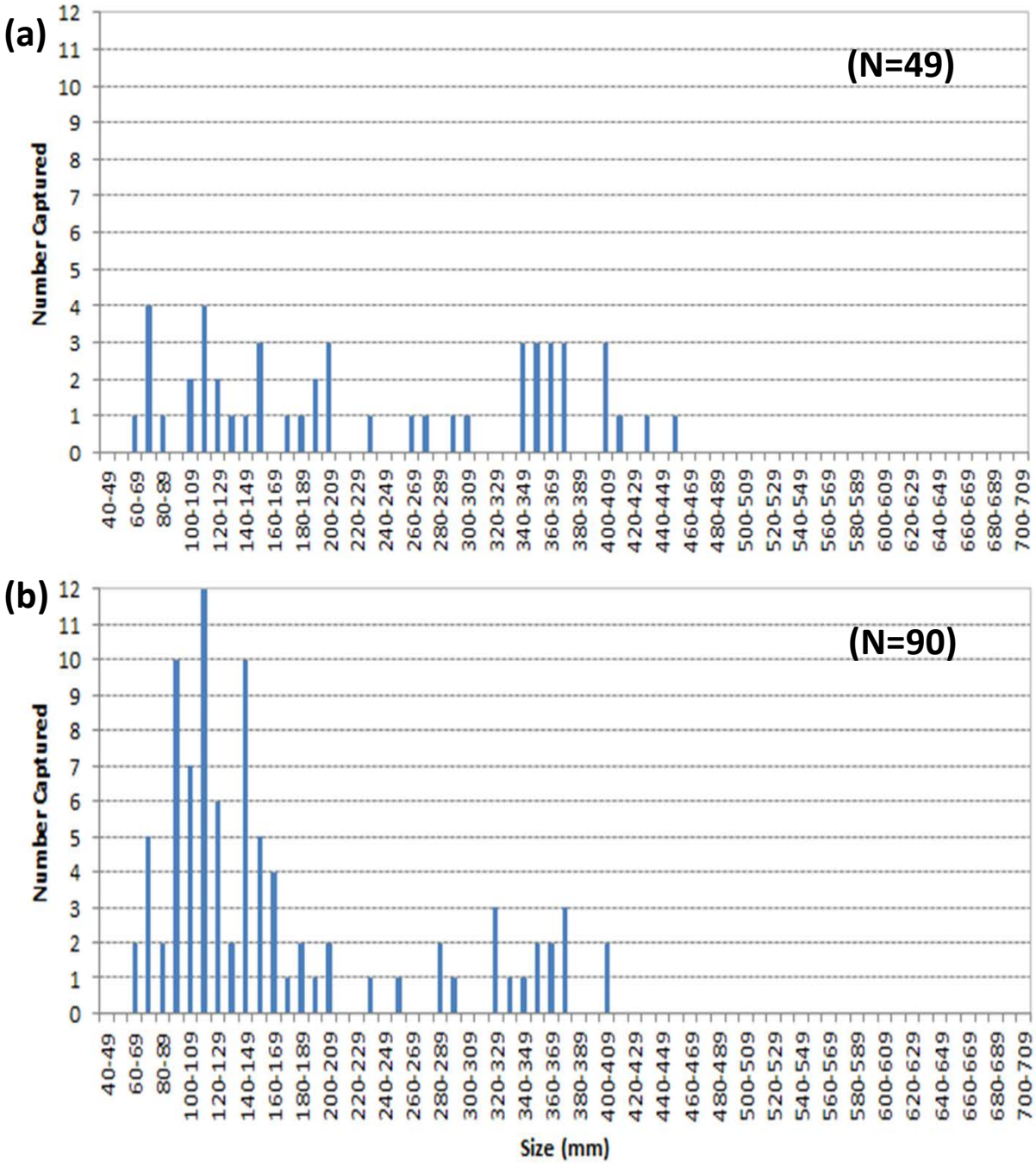


Figure 68: WY2020 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* migrant captures.

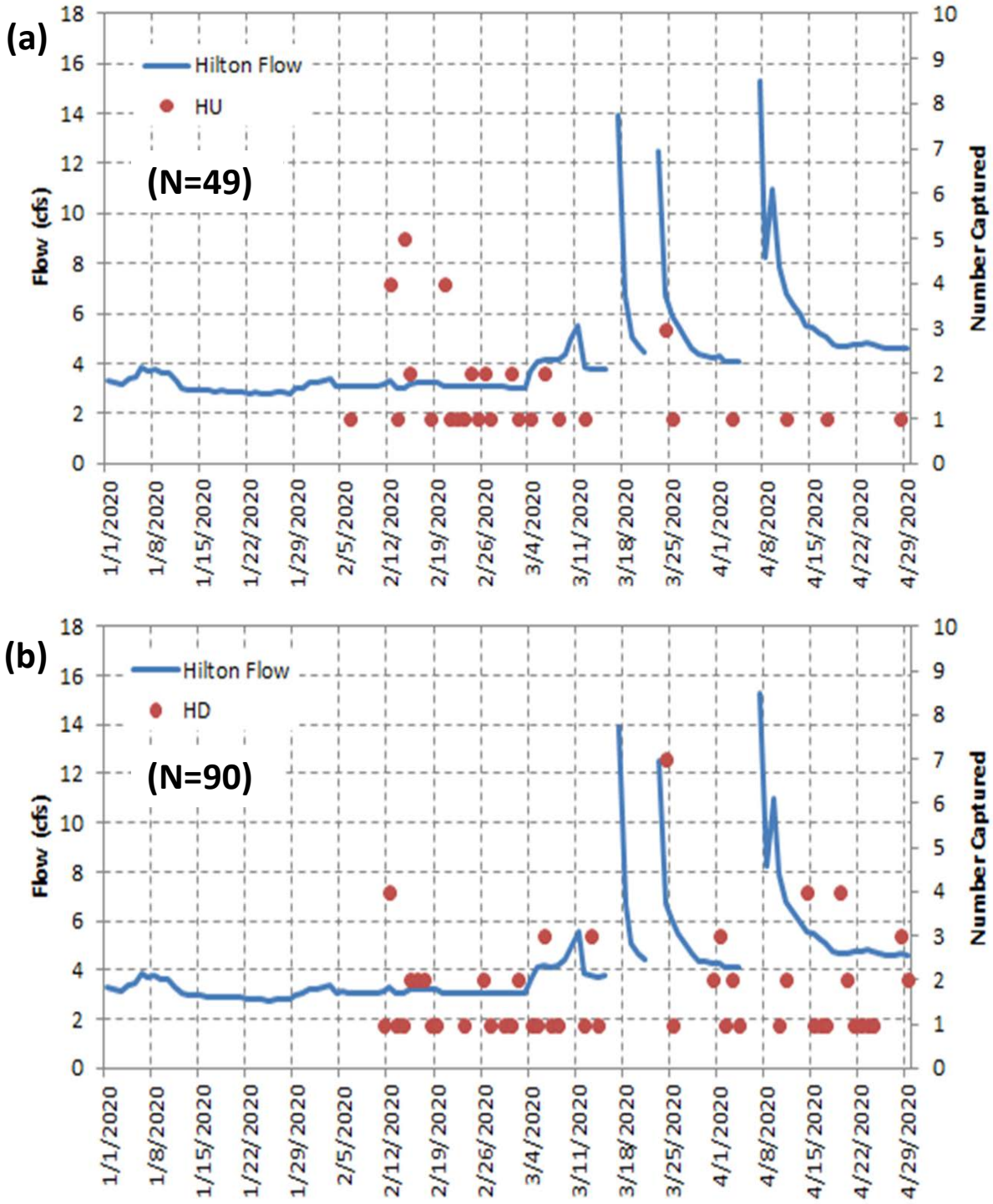


Figure 69: WY2020 Hilton Creek *O. mykiss* migrant captures (red dots) vs. flow: (a) upstream migrant captures and (b) downstream migrant captures.

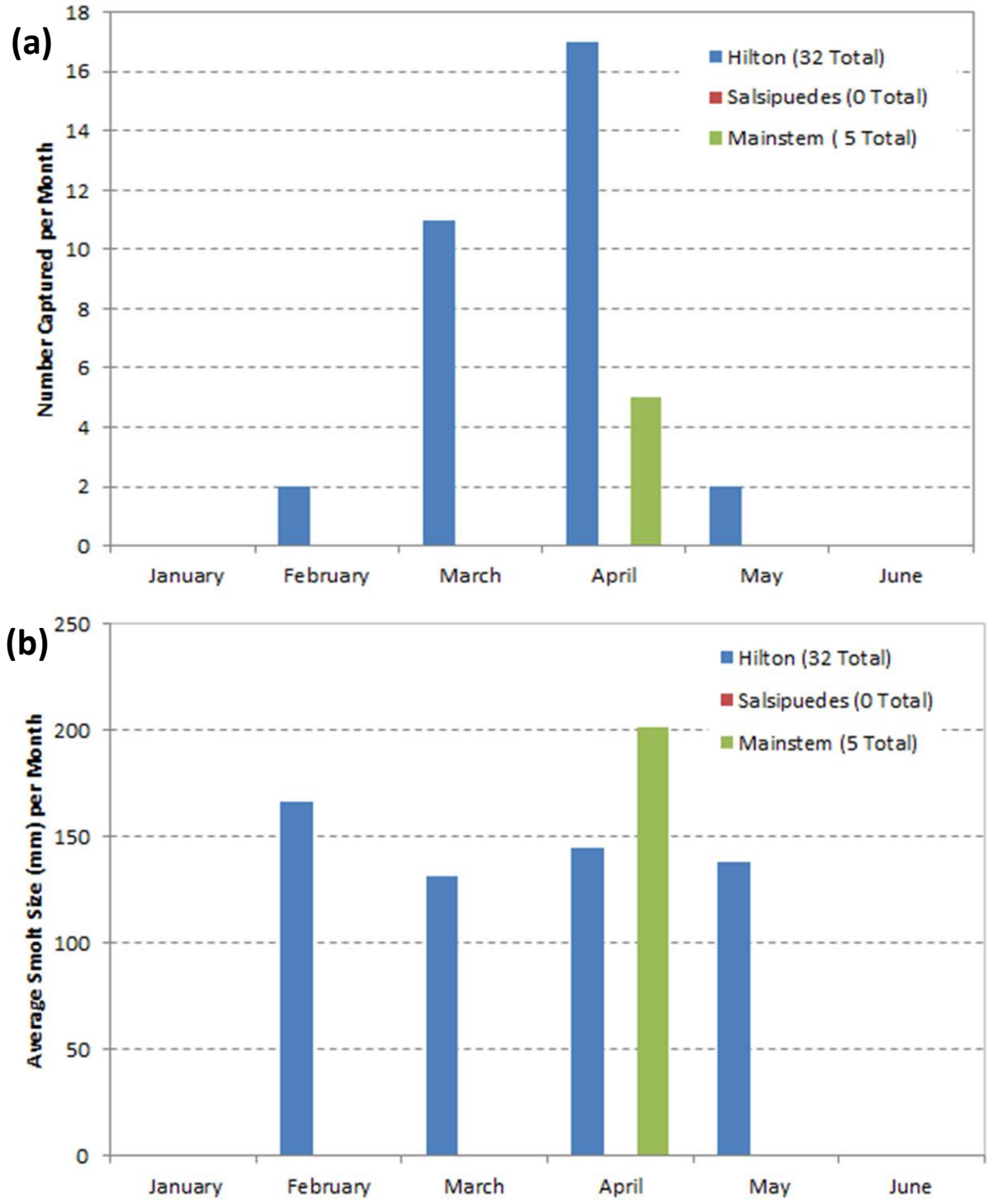


Figure 70: Monthly *O. mykiss* smolt captured at the Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps in WY2020 showing: (a) number of molts captured and (b) average size of smolts captured at each site by month.

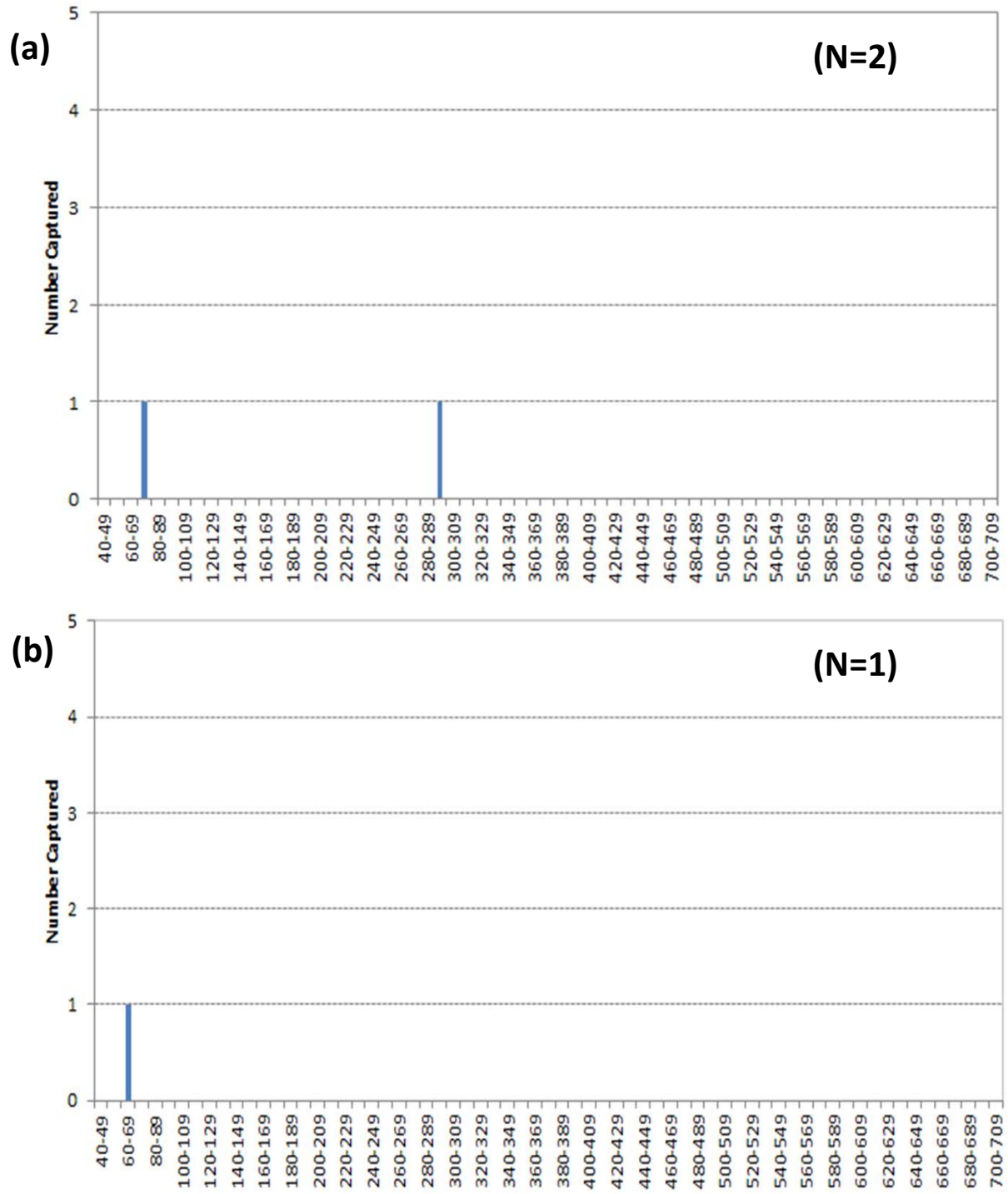


Figure 71: WY2020 Salsipuedes Creek trap length frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* captures.

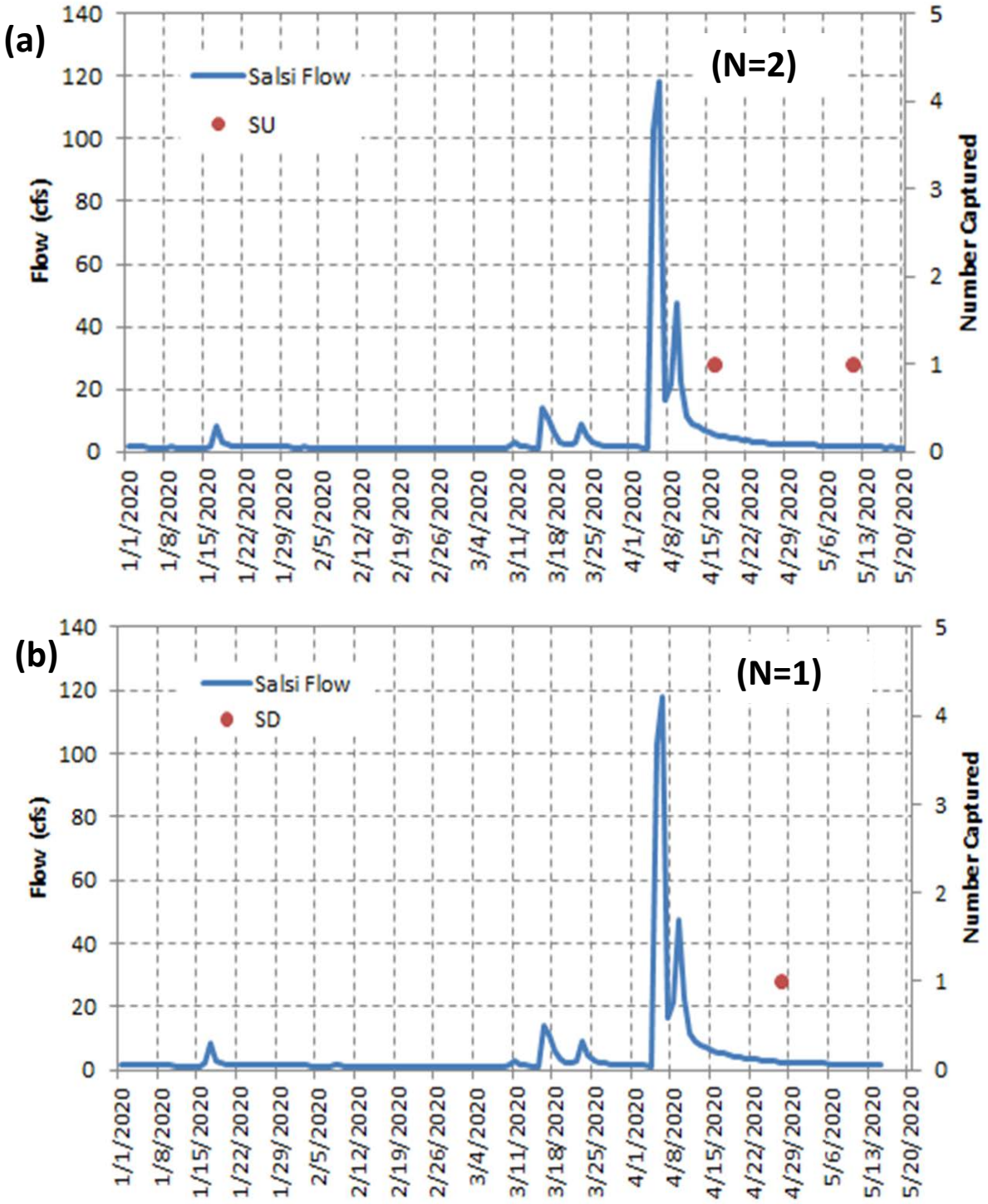


Figure 72: WY2020 Salsipuedes Creek *O. mykiss* migrant captures (red dots) vs. flow for (a) upstream migrants and (b) downstream migrants.

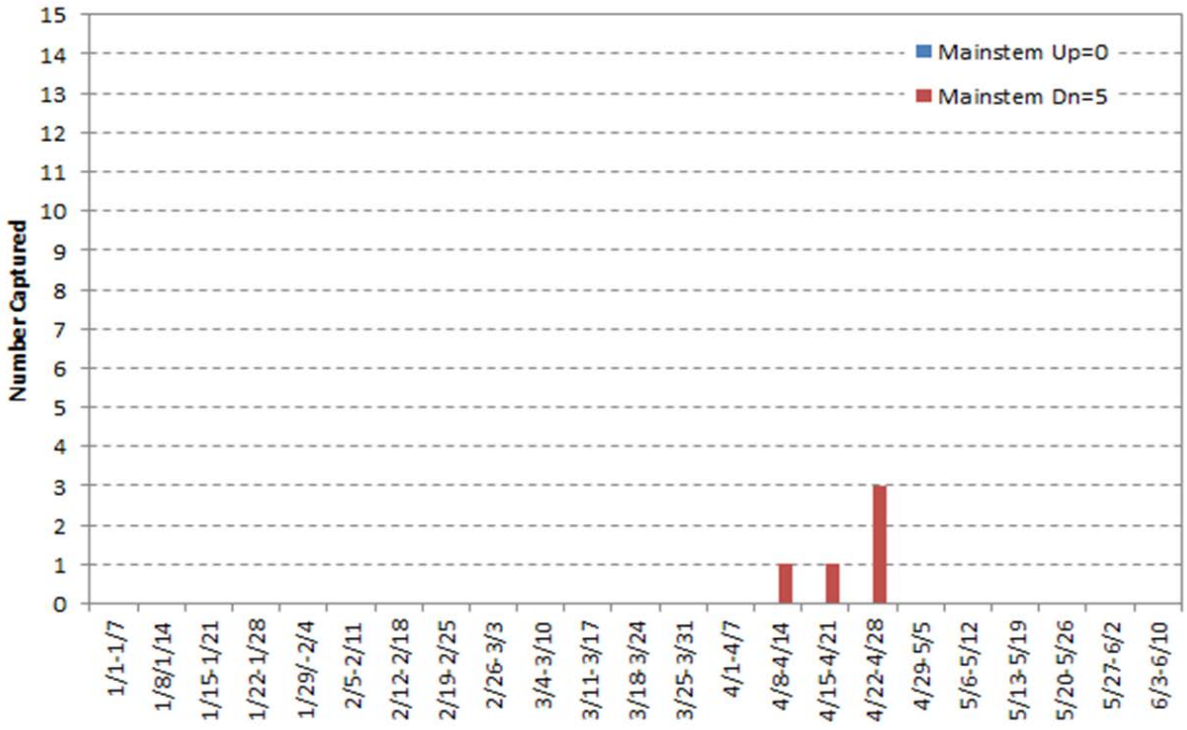


Figure 73: WY2020 paired histogram of weekly upstream and downstream *O. mykiss* captures by trap site for the Santa Ynez River mainstem at LSYR-6.08; no upstream migrants were captured in the mainstem in 2020.

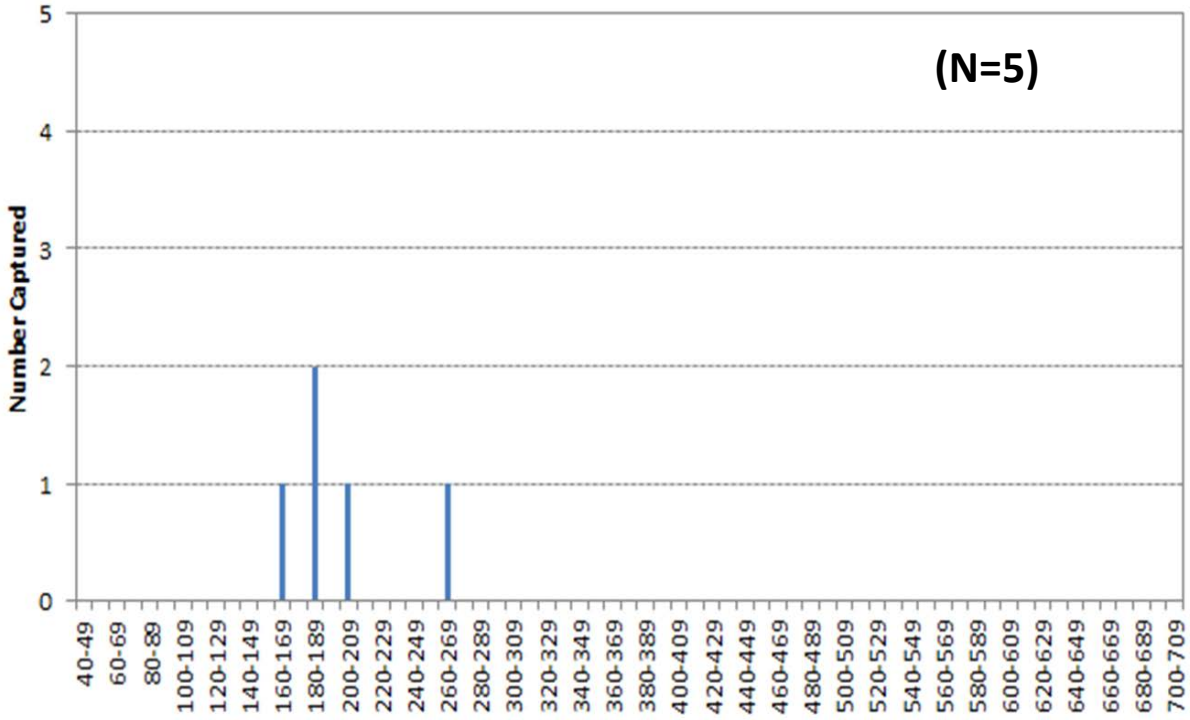


Figure 74: WY2020 Lower Santa Ynez mainstem trap length frequency histogram in 10-millimeter intervals for downstream migrants; no upstream migrants were captured in 2020.

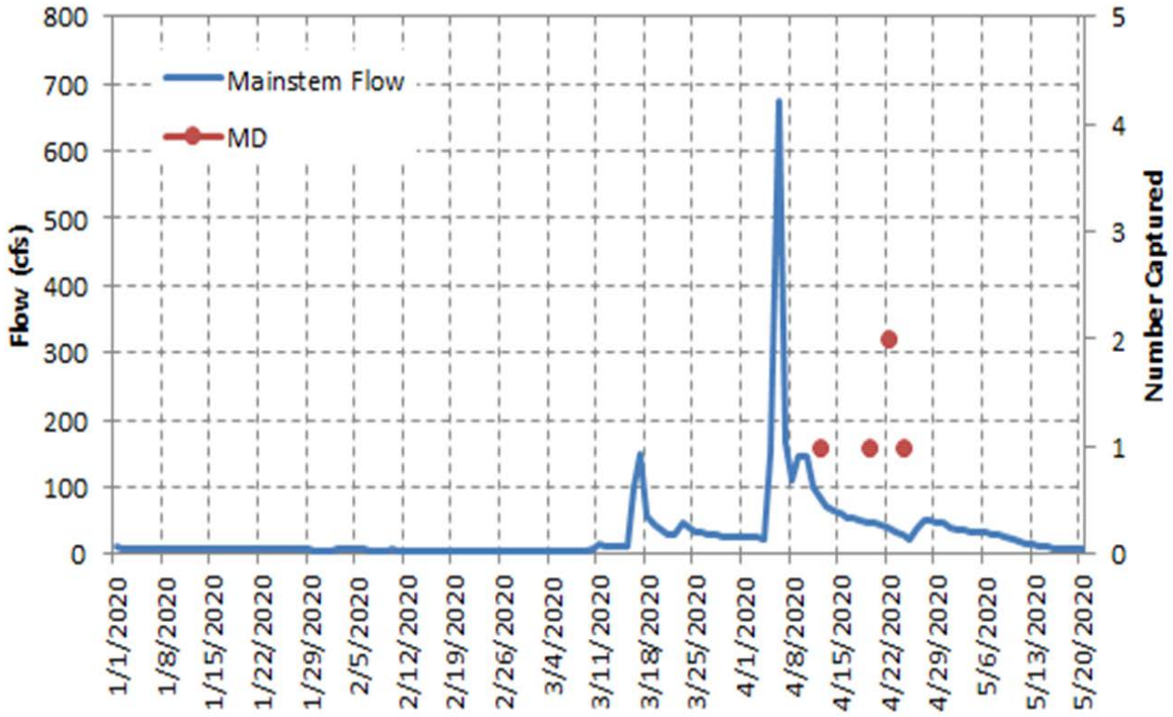


Figure 75: WY2020 Lower Santa Ynez River mainstem trap at LSYR-6.08 *O. mykiss* migrant captures (red dots) vs. flow for downstream migrants; no upstream migrants were captured in 2020.

Table 10: Tributary upstream and downstream *O. mykiss* migrant captures for Hilton Creek and Salsipuedes Creek and the Santa Ynez River mainstem in WY2020; 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
6	400-449	0
13	300-399	0
7	200-299	1
17	100-199	0
6	<99	1
49	**Total**	**2**
	Downstream Traps	
0	>700	0
0	650-699	0
0	600-649	0
0	550-599	0
0	500-549	0
0	450-499	0
2	400-449	0
12	300-399	0
7	200-299	0
1	*Smolts*	*0*
0	*Pre-Smolt*	*0*
6	*Res*	*0*
50	100-199	0
11	*Smolts*	*0*
18	*Pre-Smolt*	*0*
19	*Res*	*0*
19	<99	1
0	*Smolts*	*0*
2	*Pre-Smolt*	*0*
17	*Res*	*1*
90	**Total**	**1**

Size	Mainstem Captures
(mm)	(#)
Upstream Trap	
>700	0
650-699	0
600-649	0
550-599	0
500-549	0
450-499	0
400-449	0
300-399	0
200-299	0
100-199	0
<99	0
Total	**0**
Downstream Trap	
>700	0
650-699	0
600-649	0
550-599	0
500-549	0
450-499	0
400-449	0
300-399	0
200-299	2
Smolts	*2*
Pre-Smolt	*0*
Res	*0*
100-199	3
Smolts	*3*
Pre-Smolt	*0*
Res	*0*
<99	0
Smolts	*0*
Pre-Smolt	*0*
Res	*0*
Total	**5**

Table 11: The results of scale analyses of *O. mykiss* migrant captures and mortalities found over the monitoring period aggregated by 10 mm size classes.

		Age:									
Size (mm)	**Amount**	**0+**	**1**	**1+**	**2**	**2+**	**3**	**3+**	**4**	**4+**	**5**
<120	*			1							
120-129	****	1		3							
130-139	***			3							
140-149	******			6							
150-159	********	1	1	5							
160-169	****			4							
170-179	*			1							
180-189	****		1	2		1					
190-199	**		1	1							
200-209	****			3	1						
210-219											
220-229											
230-239	*				1						
240-249											
250-259	**					1		1			
260-269	**				1	1					
270-279	*				1						
280-289	**				1			1			
290-299	**				2						
300-309	*						1				
310-319											
320-329	***					1	1	1			
330-339	*							1			
340-349	*						1				
350-359	**						2				
360-369	****						1	3			
370-379	***						2	1			
380-389											
390-399											
400-409	****						1	1	1		1
410-419	*								1		
420-429											
430-439	*								1		
Total:	**67**	**2**	**3**	**29**	**7**	**4**	**9**	**9**	**3**	**0**	**1**

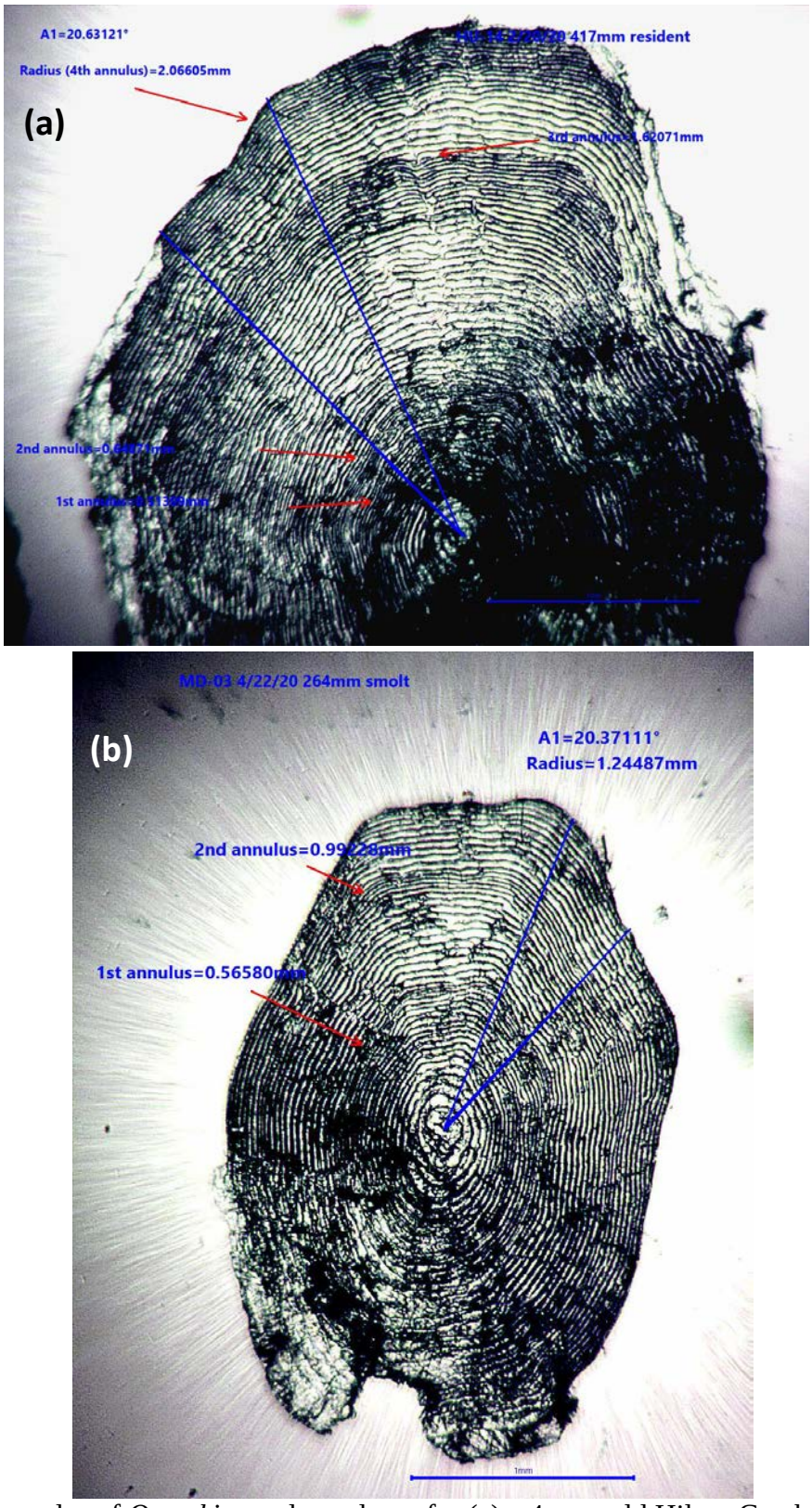


Figure 76: Examples of *O. mykiss* scale analyses for (a) a 4 year old Hilton Creek 417 mm upstream migrating resident fish and (b) and a 2+ year old LSYR mainstem 264 mm downstream migrating smolt.

Table 12: WY2020 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 Creek	1/14/2020	1	2.1	0.9
	1/14/2020	2	2.6	1.0
	1/27/2020	3	2.9	1.2
	1/27/2020	4	3.8	1.6
	1/27/2020	5	3.6	2.4
	1/27/2020	6	3.8	1.7
	1/27/2020	7	4.6	2.0
	2/4/2020	8	5.4	1.7
	2/12/2020	9	2.9	1.3
	2/12/2020	10	3.4	1.4
	2/12/2020	11	2.9	1.6
	2/12/2020	12	3.0	1.4
	2/12/2020	13	3.5	1.4
	2/20/2020	14	3.6	1.7
	2/26/2020	15	3.9	1.5
	2/26/2020	16	3.4	1.9
	2/26/2020	17	4.3	2.1
	2/26/2020	18	4.2	1.8
	2/26/2020	19	3.3	1.4
	2/27/2020	20	2.2	1.4
	3/3/2020	21	2.8	1.3
	3/5/2020	22	4.8	2.6
	3/13/2020	23	3.2	1.5
	3/13/2020	24	2.7	1.4
Salsipuedes Creek	1/29/2020	25	3.6	1.8
	1/29/2020	26	3.3	1.6
	2/28/2020	27	3.1	1.7
	2/28/2020	28	3.9	1.3
	3/2/2020	29	3.3	1.4
	3/2/2020	30	4.1	1.6
	3/2/2020	31	2.7	1.4
	3/2/2020	32	3.4	1.4
	3/2/2020	33	3.4	1.7
Quiota Creek	3/3/2020	34	1.6	0.8
* Pit length plus tailspill length.				
** Average of pit width and tailspill widths.				

Table 13: WY2020 tributary redd observations by month for each creek surveyed.

	January	February	March	April	May	Total
Hilton Ck	7	13	4	0	n/s	24
Quiota Ck	0	0	1	0	n/s	1
Salsipuedes Ck	2	2	5	0	n/s	9
El Jaro Ck	0	0	0	0	n/s	0
Los Amoles CK	0	0	0	n/s	n/s	0
Ytias Ck	n/s	n/s	n/s	n/s	n/s	n/s
					Total:	**34**
n/s - not surveyed due to trubid conditions or low water level.						

Table 14: WY2020 LSYR mainstem redd survey results within the management reaches (Refugio and Alisal reaches) by month.

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

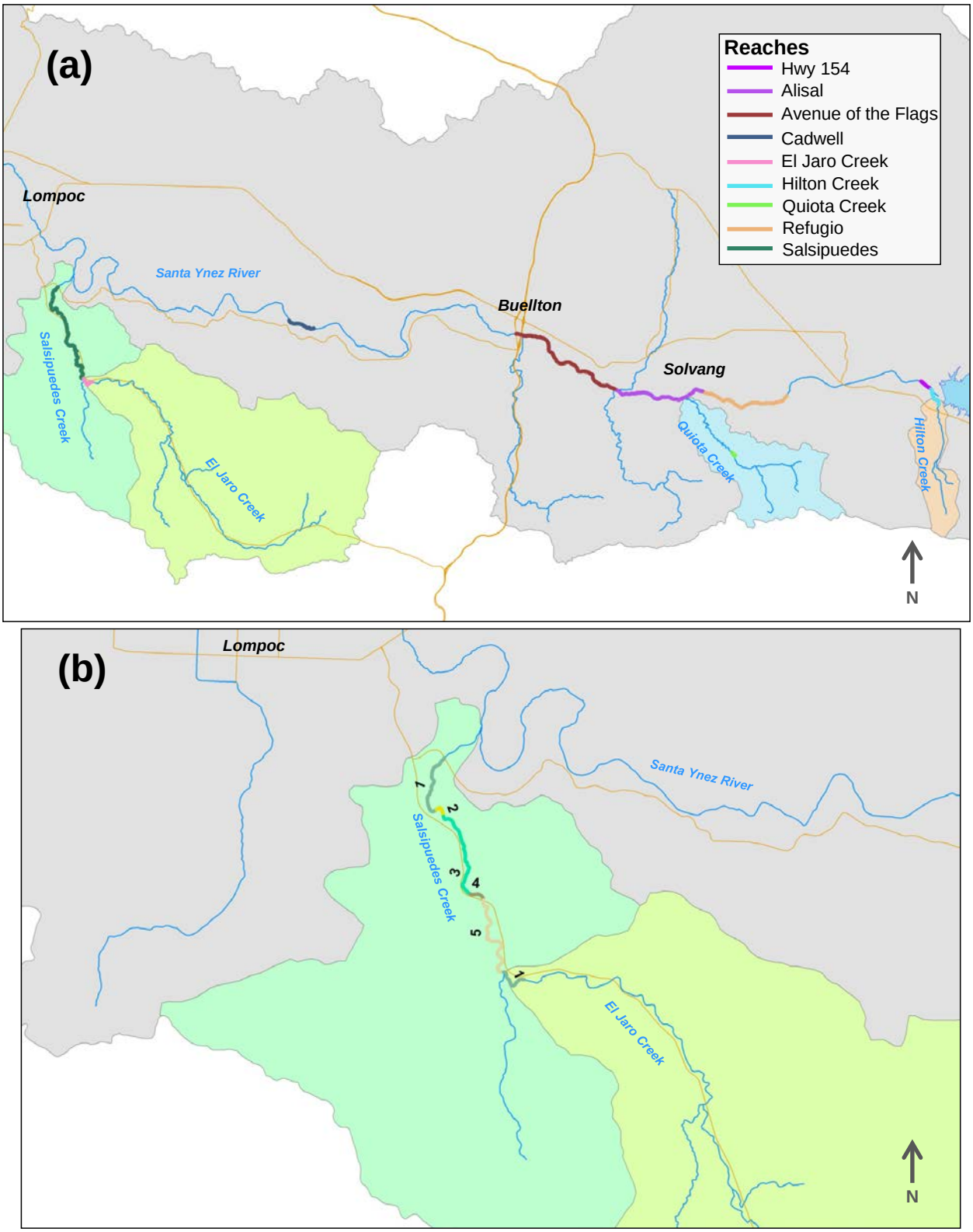


Figure 77: Stream reaches snorkel surveyed in 2020 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

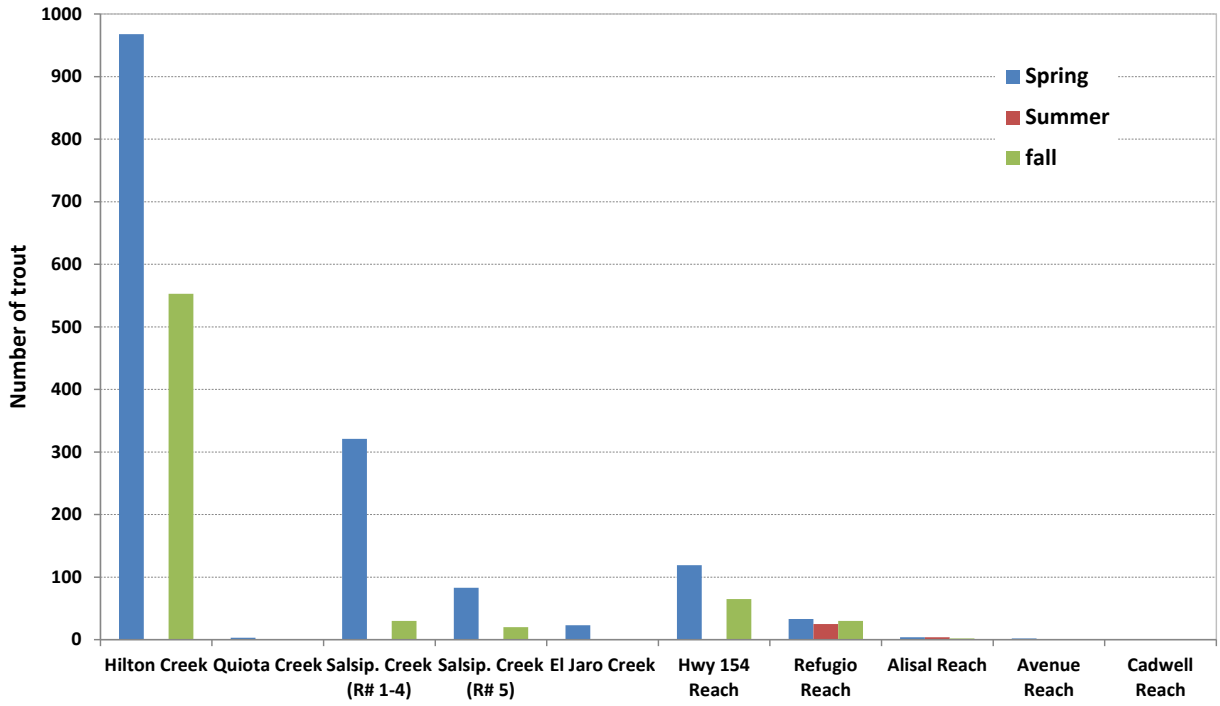


Figure 78: 2020 LSYR *O. mykiss* observed during spring, summer, and fall snorkel surveys.

Table 15: 2020 LSYR mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	7/6/2020
(LSYR-0.2 to LSYR-0.7)	Summer	n/s
	Fall	12/3/2020
Refugio Reach	Spring	5/20/20 - 5/21/20
(LSYR-4.9 to LSYR-7.8)	Summer	10/9/20 - 10/14/20
	Fall	12/2/2020
Alisal Reach	Spring	5/22/20 & 5/26/20
(LSYR-7.8 to LSYR-10.5)	Summer	10/8/20 & 10/9/20
	Fall	12/2/2020
Avenue Reach	Spring	6/1/20 - 6/4/20
(LSYR-10.5 to LSYR-13.9)	Summer	10/7/20 & 10/8/20
	Fall	12/3/20 -12/7/20
Reach 3 Downstream of Avenue	Spring	5/26/20 - 6/9/20
(LSYR-13.9 to LSYR-25.0)	Summer	10/6/2020
	Fall	12/7/20 - 12/8/20
*n/s - not surveyed.		

Table 16: LSYR mainstem spring, summer, and fall snorkel survey results in 2020 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	119	n/s	65	0.26
Refugio Reach	33	25	30	2.95
Alisal Reach	4	4	2	2.80
Avenue of the Flags Reach	2	0	0	3.4
Cadwell Reach	0	0	0	0.3
n/s - not surveyed.				

Table 17: LSYR mainstem spring, summer, and fall snorkel survey results in 2020 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	58	48	12	1						119
	Refugio			16	13	3	1				33
	Alisal		1	2	1						4
	Avenue				2						2
	Cadwell										0
Summer	Hwy 154										n/s
	Refugio				7	15	3				25
	Alisal				2	2					4
	Avenue										0
	Cadwell										0
Fall	Hwy 154		34	29	2						65
	Refugio				6	19	5				30
	Alisal				1	1					2
	Avenue										0
	Cadwell										0
n/s - not surveyed.											

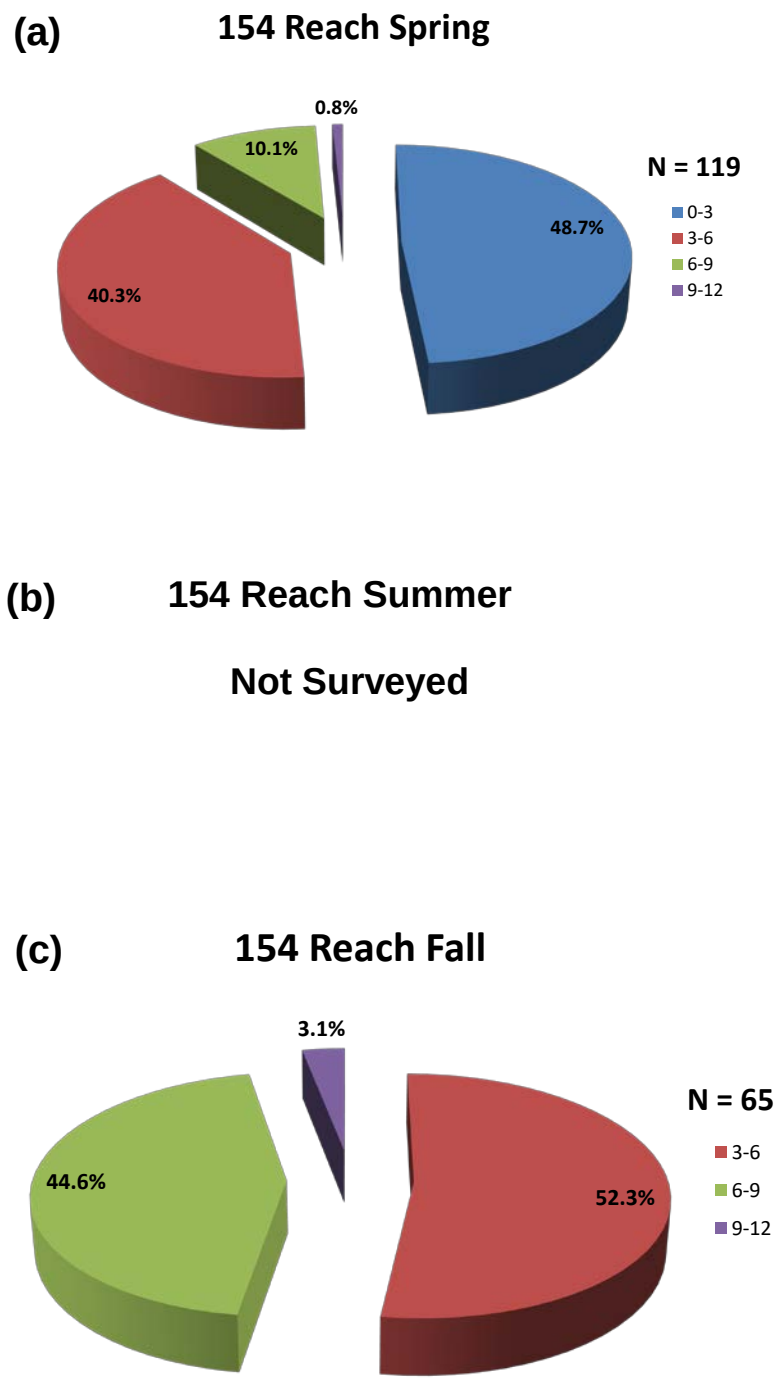


Figure 79: 2020 LSYR Mainstem Highway 154 Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, and (b) fall.

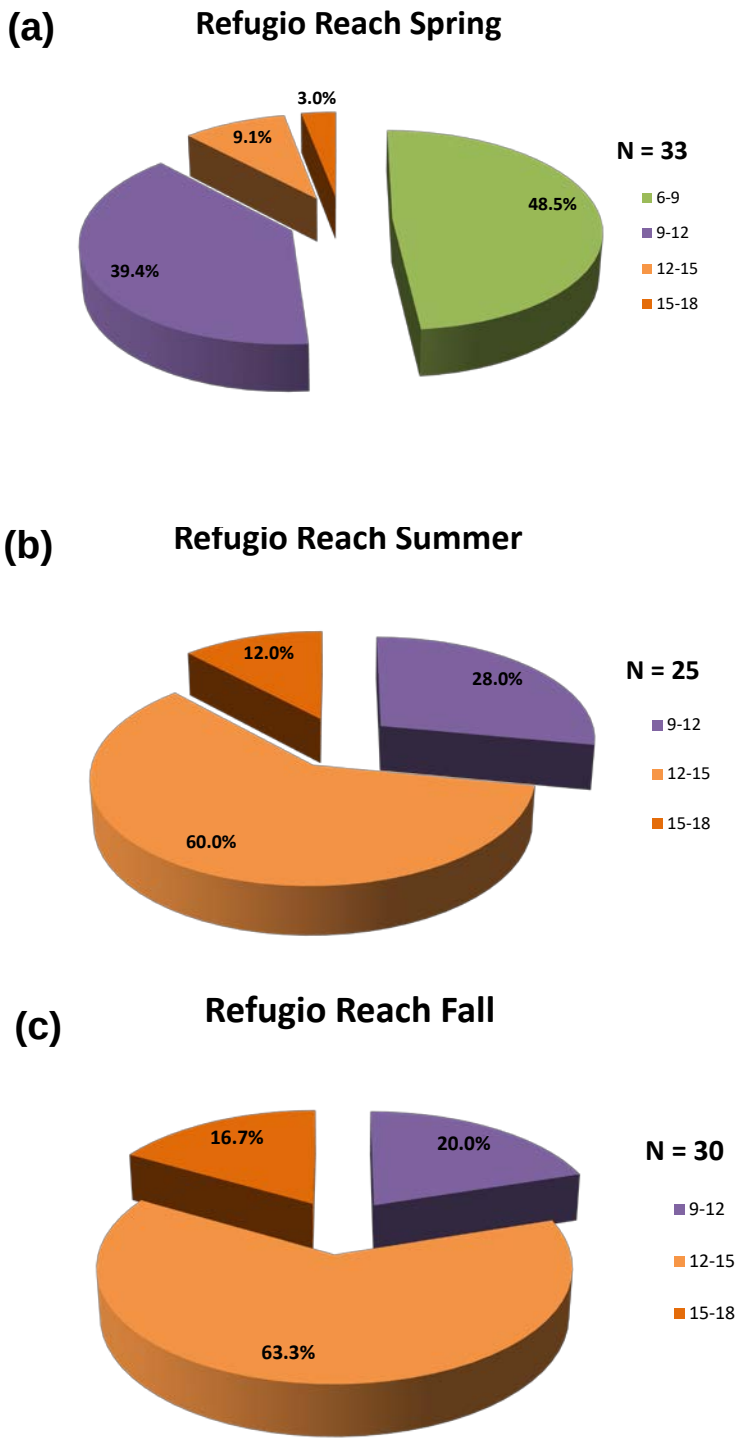


Figure 80: 2020 LSYR Mainstem Refugio Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, (b) summer, and (c) fall.

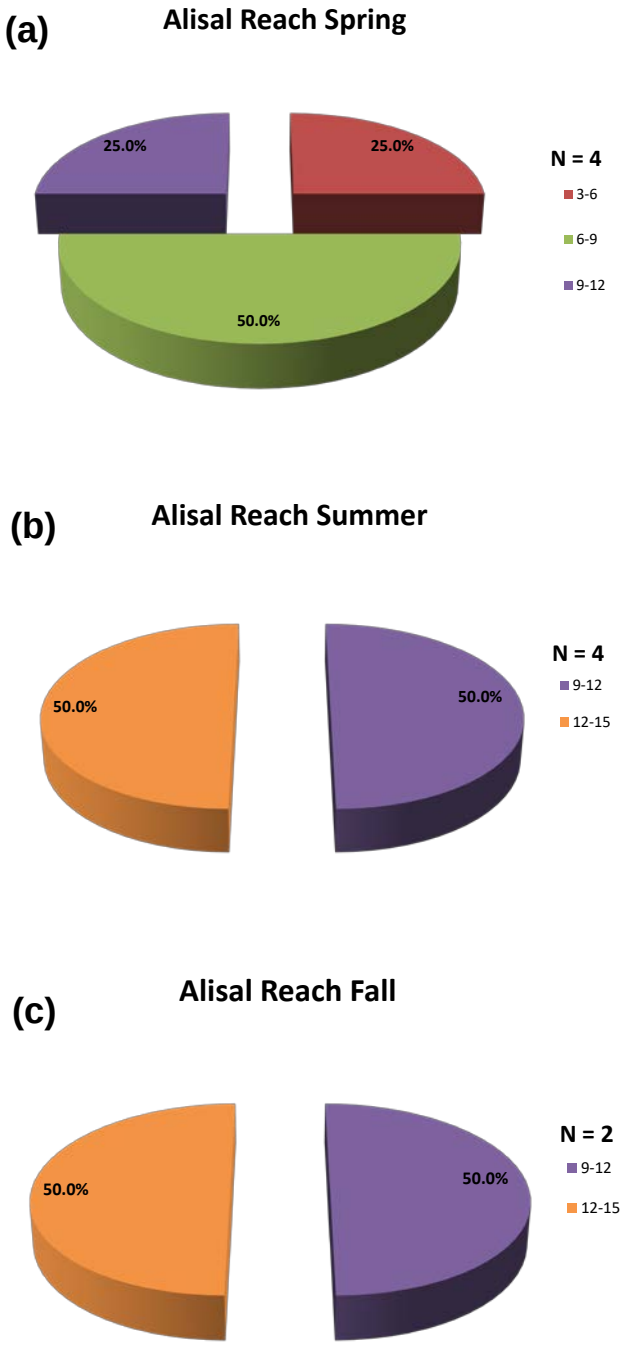
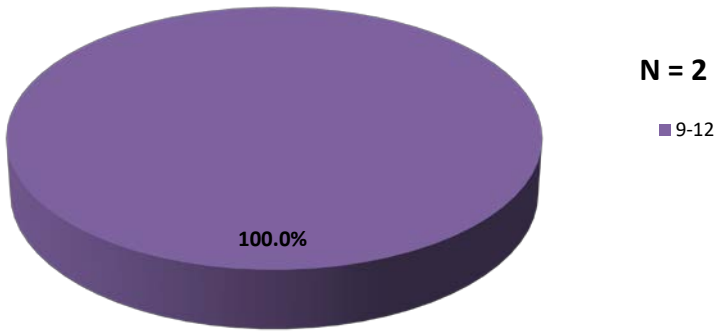


Figure 81: 2020 LSYR Mainstem Alisal Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, (b) summer, and (c) fall.

(a) **Avenue Reach Spring**



(b) **Avenue Reach Summer**

No *O. mykiss* observed

(c) **Avenue Reach Fall**

No *O. mykiss* observed

Figure 82: 2020 LSYR Mainstem Avenue of the Flags Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, (b) summer, and (c) fall.

Table 18: 2020 tributary snorkel survey schedule; no summer surveys were conducted in 2020.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	7/8/20 - 7/9/20
(HC-0.0 to HC-0.54)	Summer	n/s
	Fall	11/2/20 - 11/3/20
Quiota Creek	Spring	6/11/20 & 6/15/20
(QC-2.58 to QC-2.73)	Summer	n/s
	Fall	11/4/2020
Salsipuedes Creek	Spring	5/27/20 - 6/4/20
(Reach 1-4)	Summer	n/s
	Fall	11/4/20-11/5/20 & 11/9/20
Salsipuedes Creek	Spring	5/28/20 & 6/2/20
(Reach 5)	Summer	n/s
	Fall	11/9/20 - 11/10/20
El Jaro Creek	Spring	6/2/20
(ELC-0.0 to ELC-0.4)	Summer	n/s
	Fall	11/10/20

*n/s - not surveyed.

Table 19: *O. mykiss* observed and miles surveyed during all tributary snorkel surveys in 2020; 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	382	n/s	191	0.133
Reach 2	152	n/s	73	0.050
Reach 3	69	n/s	11	0.040
Reach 4	79	n/s	44	0.075
Reach 5	285	n/s	234	0.242
Reach 6	1	n/s	0	0.014
Total:	***968***	***n/s***	***553***	***0.554***
Quiota Creek	3	n/s	0	0.11
Salsipuedes Creek (Reach 1-4)	321	n/s	30	2.85
Salsipuedes Creek (Reach 5)	83	n/s	20	0.45
El Jaro Creek	23	n/s	0	0.35

n/s - not surveyed.

Table 20: 2020 tributary spring 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	598	314	50	6						968
	Quiota		1	2							3
	Salsipuedes (R 1-4)	180	117	13	8	2	1				321
	Salsipuedes (R-5)	21	40	16	4	2					83
	El Jaro	13	5	5							23
Summer	Hilton										n/s
	Quiota										n/s
	Salsipuedes (R 1-4)										n/s
	Salsipuedes (R-5)										n/s
	El Jaro										n/s
Fall	Hilton	194	297	56	6						553
	Quiota										0
	Salsipuedes (R 1-4)	1	28	1							30
	Salsipuedes (R-5)		14	5	1						20
	El Jaro										0

n/s - not surveyed.

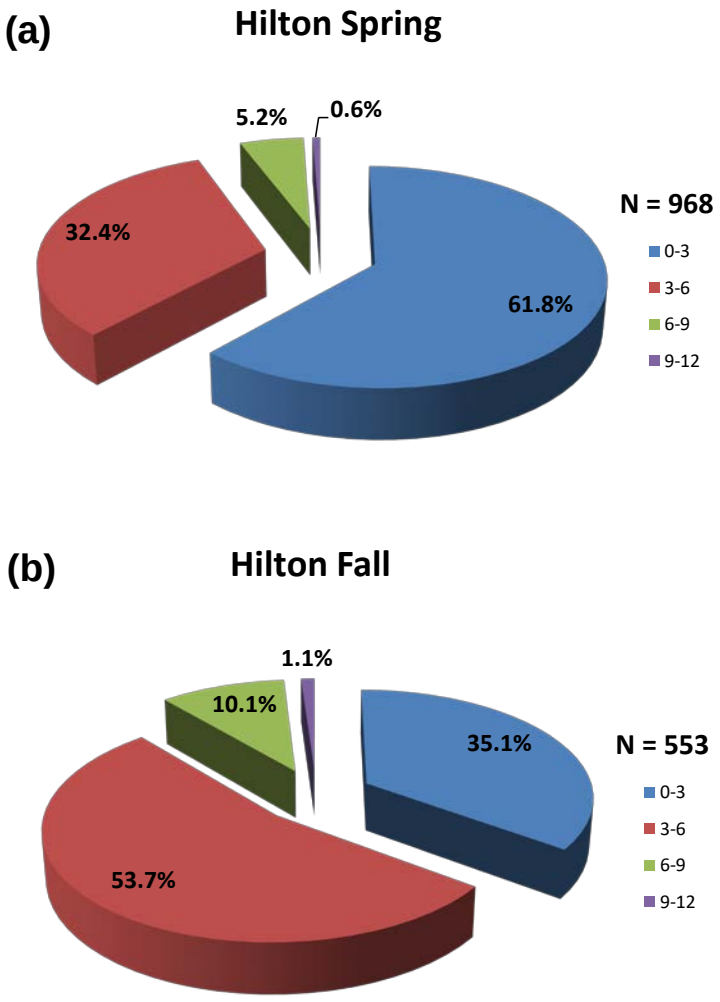


Figure 83: 2020 Hilton Creek snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, and (b) fall.

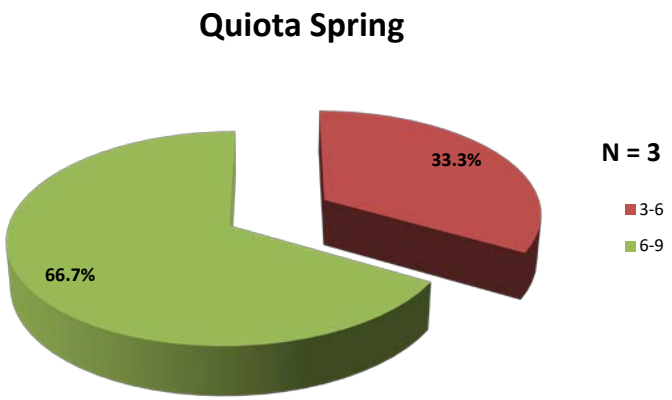


Figure 84: 2020 Quiota Creek snorkel survey results of *O. mykiss* proportioned by size class in inches; no *O. mykiss* were observed during the fall snorkel survey.

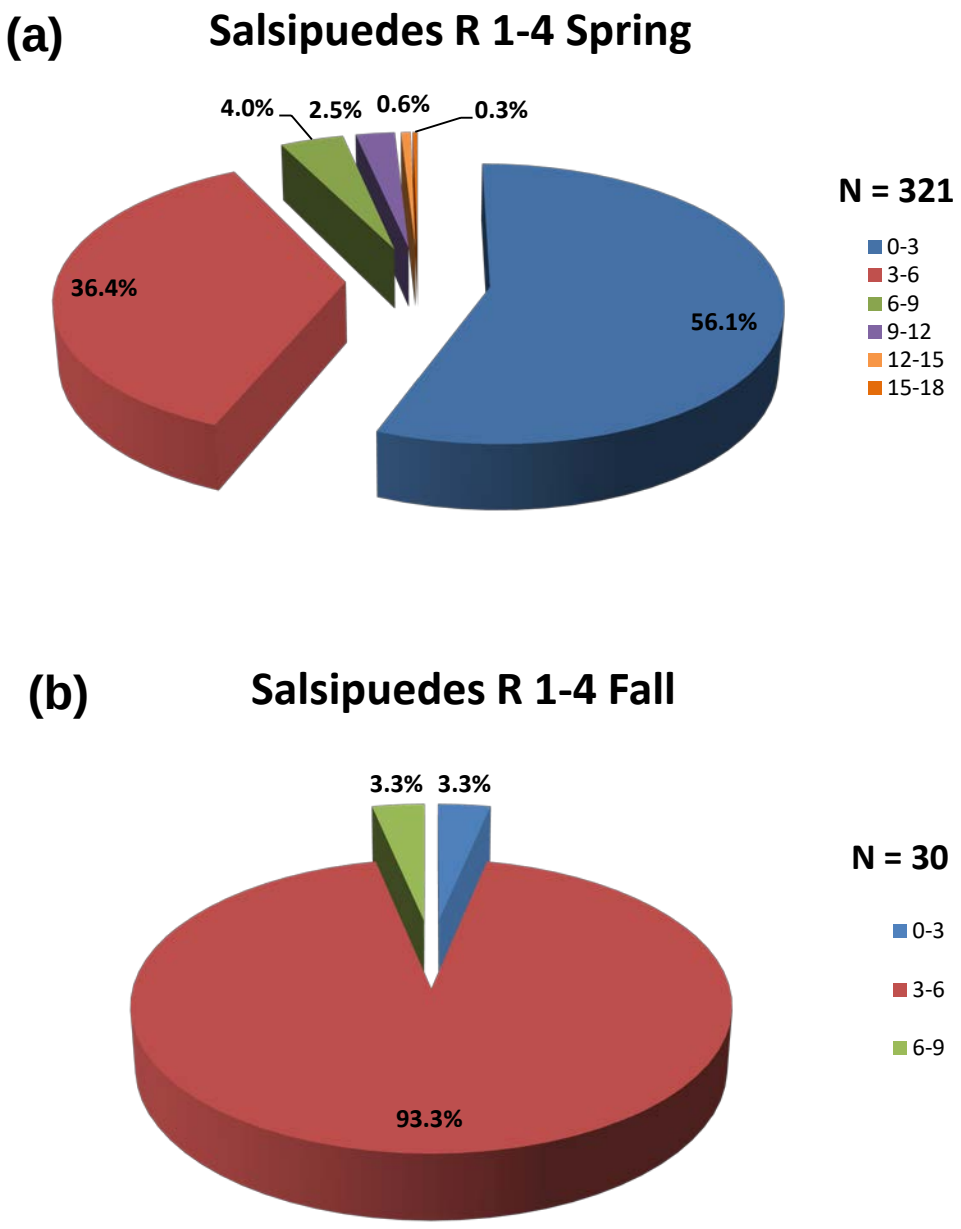


Figure 85: 2020 Salsipuedes Creek Reaches 1-4 snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, and (b) fall.

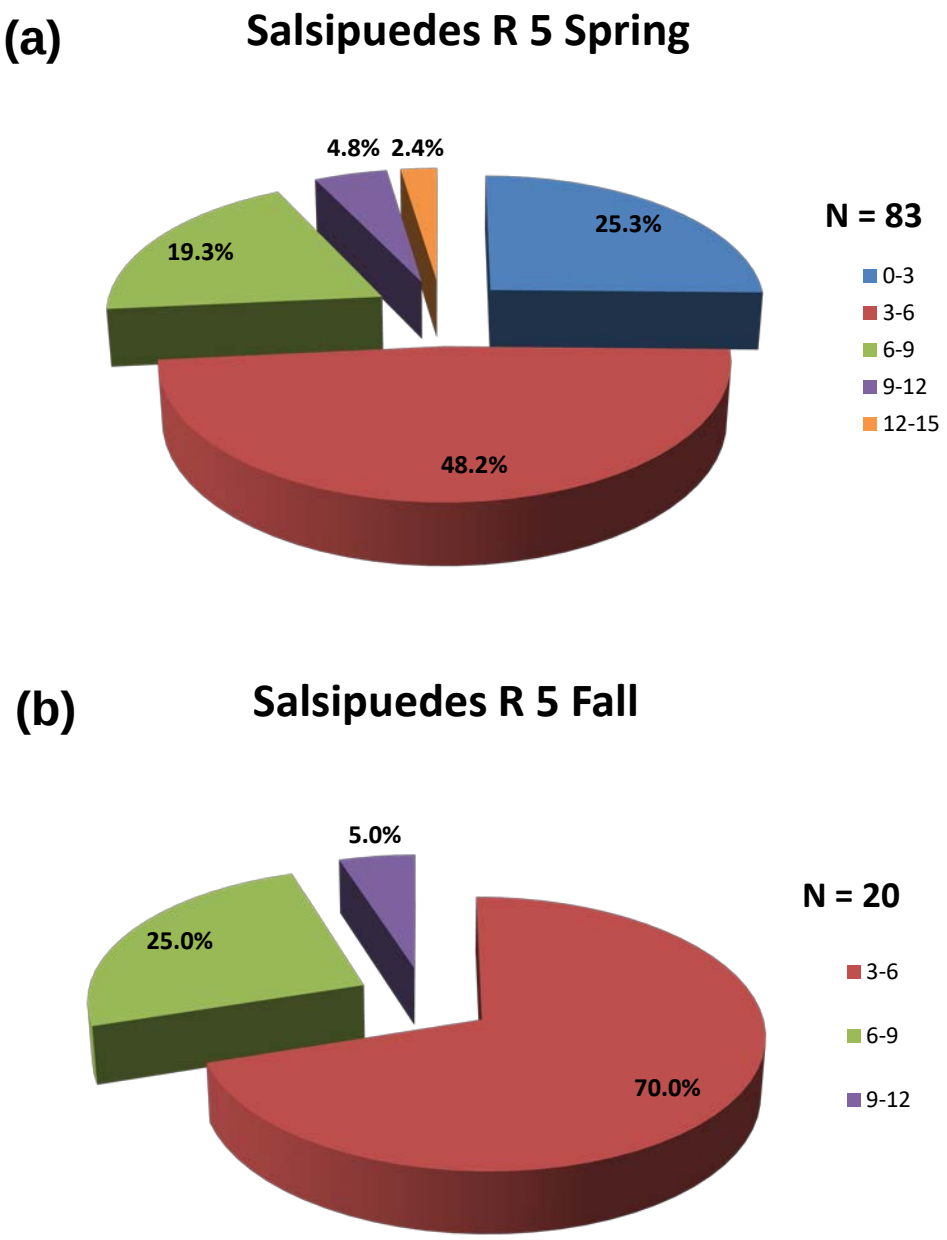


Figure 86: 2020 Salsipuedes Creek Reach 5 snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, and (b) fall.

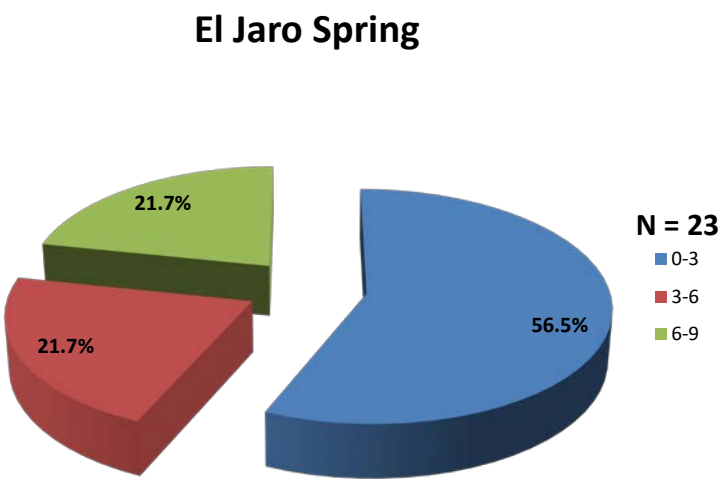


Figure 87: 2020 El Jaro Creek snorkel survey results of *O. mykiss* proportioned by size class in inches. No *O. mykiss* were observed during the fall snorkel survey.

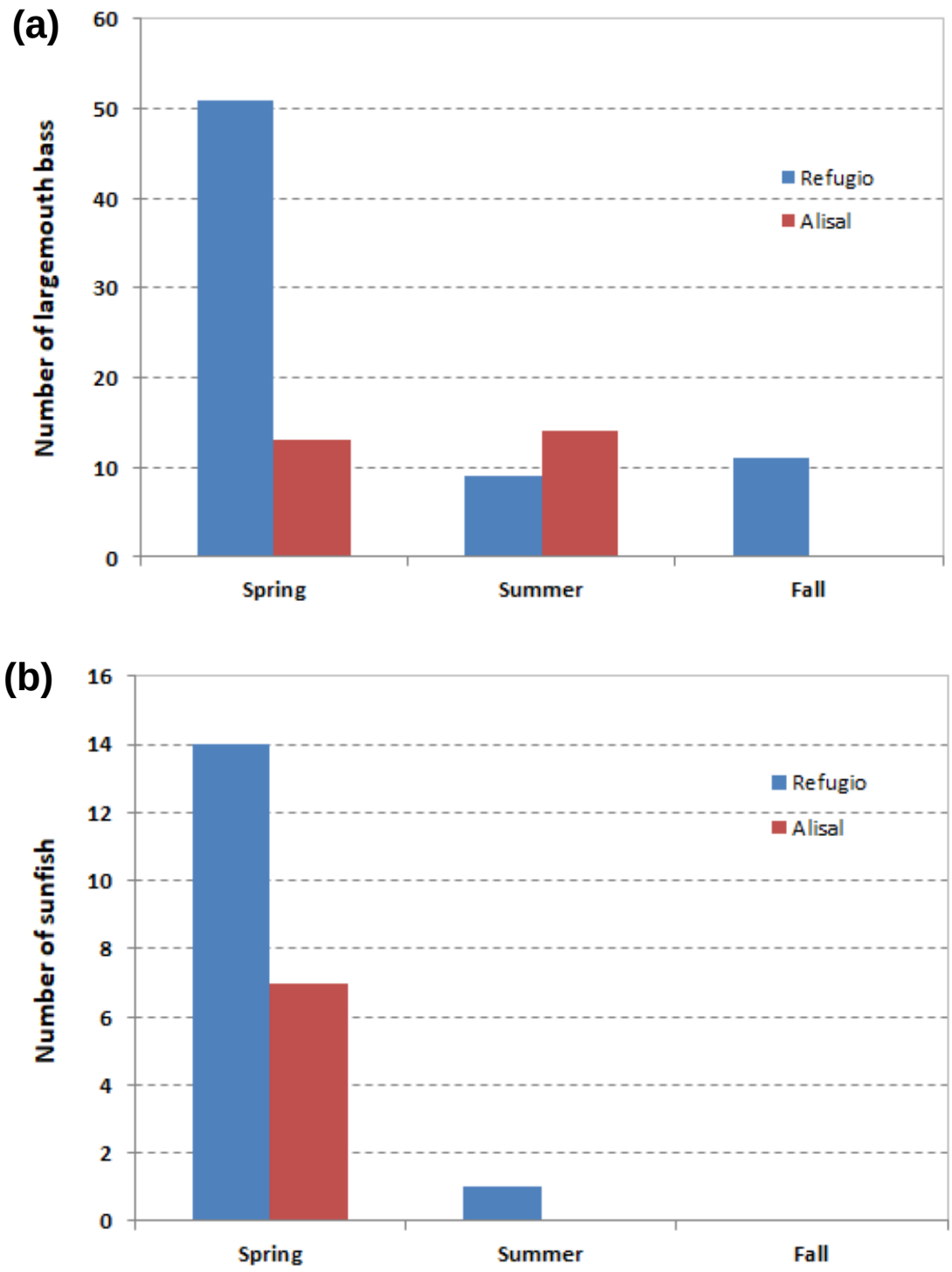


Figure 88: Count of warm water predators, (a) largemouth bass and (b) sunfish, observed in Refugio and Alisal reaches during the spring, summer and fall snorkel surveys in 2020.

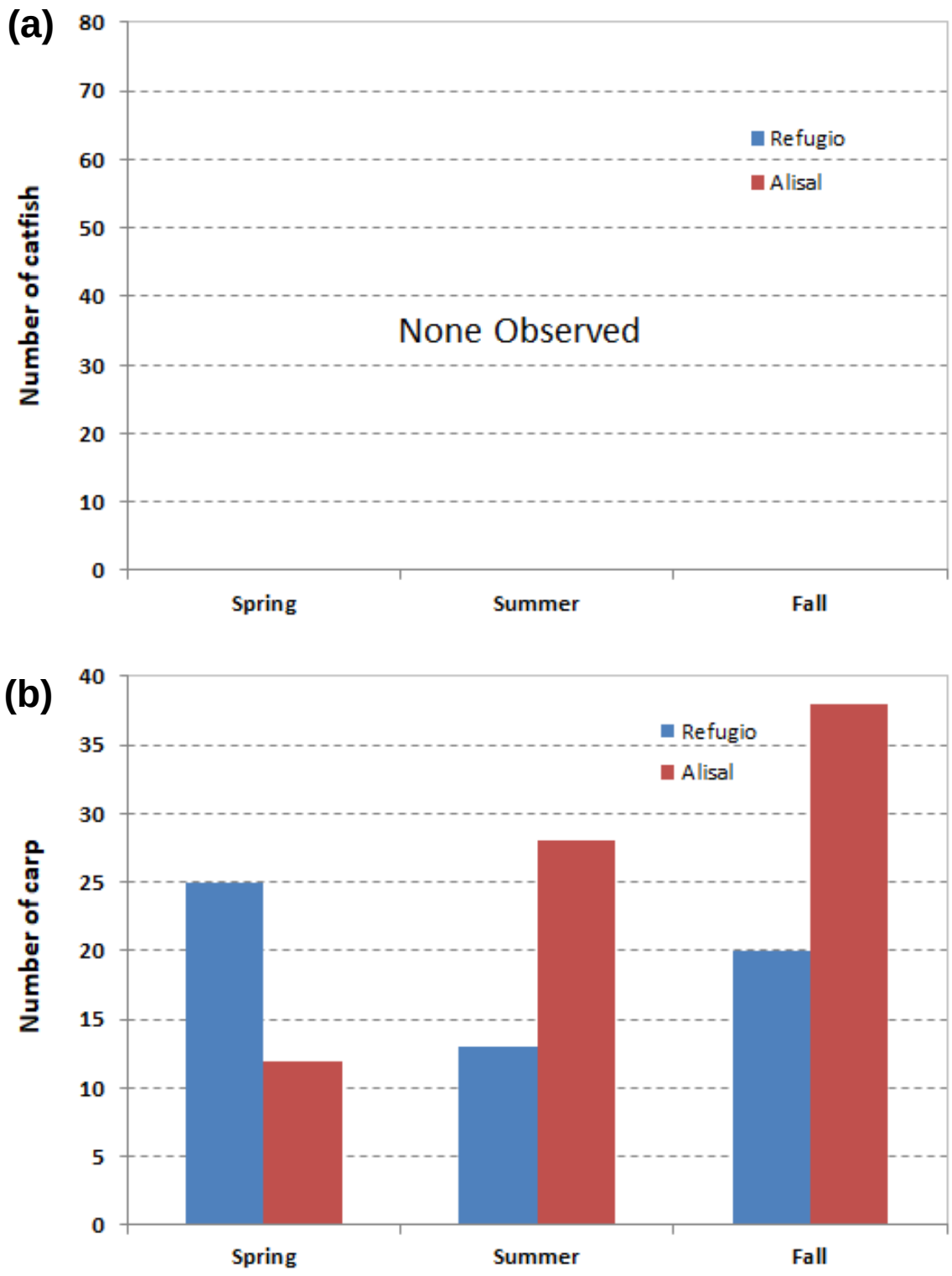
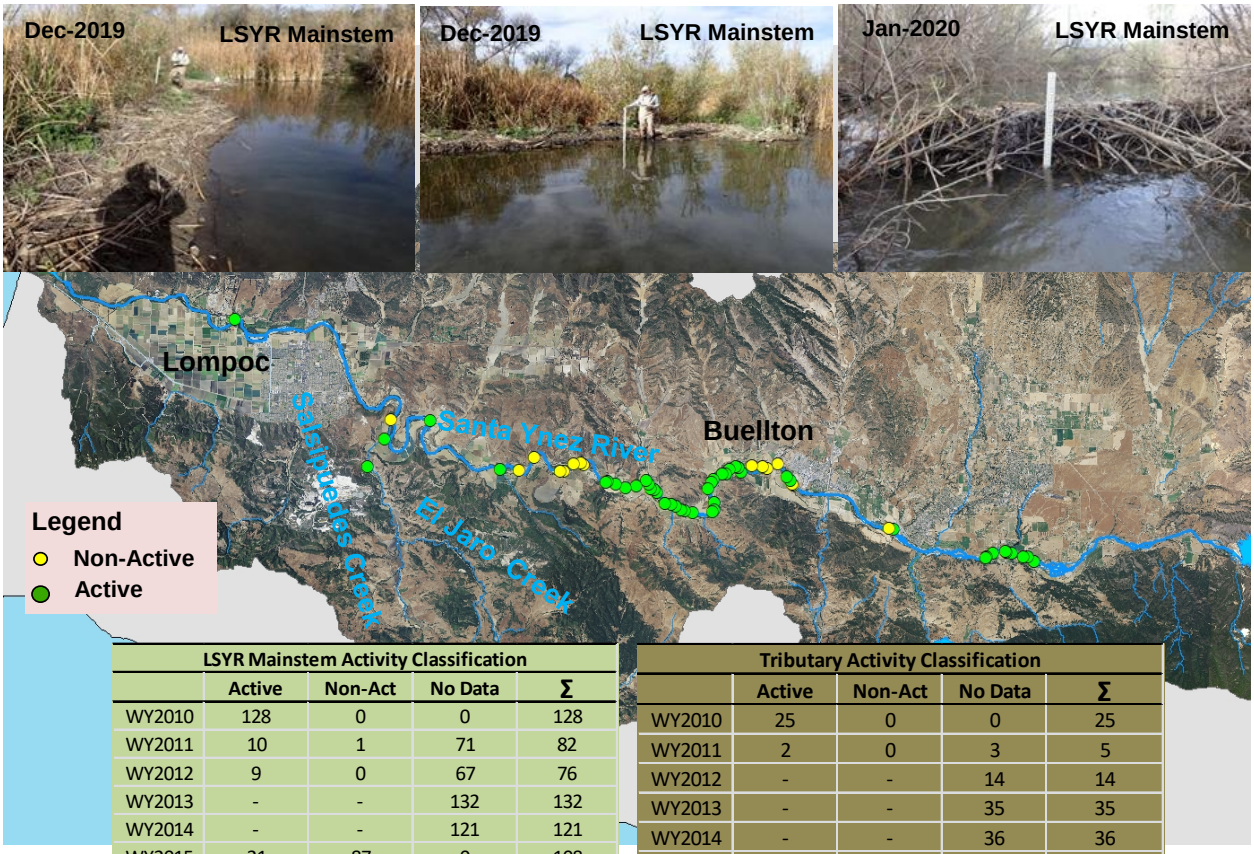


Figure 89: Count of warm water predators, (a) catfish and (b) carp, observed in Refugio and Alisal reaches during the spring, summer and fall snorkel surveys in 2020.



LSYR Mainstem Activity Classification				
	Active	Non-Act	No Data	Σ
WY2010	128	0	0	128
WY2011	10	1	71	82
WY2012	9	0	67	76
WY2013	-	-	132	132
WY2014	-	-	121	121
WY2015	21	87	0	108
WY2016	16	29	0	45
WY2017*	14	52	0	66
WY2018	37	10	0	47
WY2019	42	3	0	45
WY2020	43	15	0	58

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

Tributary Activity Classification				
	Active	Non-Act	No Data	Σ
WY2010	25	0	0	25
WY2011	2	0	3	5
WY2012	-	-	14	14
WY2013	-	-	35	35
WY2014	-	-	36	36
WY2015	6	15	0	21
WY2016	1	7	0	8
WY2017	0	8	0	8
WY2018	0	2	0	2
WY2019	0	0	0	0
WY2020	2	0	0	2

- Indicates limited attribute data taken at each dam site.

Figure 90: Spatial extent of beaver dams from the WY2020 survey within the LSYR drainage where 58 dams (43 active) were observed in the mainstem and two dams observed in the Salsipuedes/El Jaro Creek watershed.

Table 21: Annual count of 2010-2020 beaver dams in the LSYR mainstem and Salsipuedes/El Jaro watershed broken out by dam 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
WY2019	7	24	12	2	0	45	0	0	0	0	0	0
WY2020	13	30	13	2	0	58	1	1	0	0	0	2
* There are 76 mainstem beaver dams in 2012, two were not measured												

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Table 22: Monthly rainfall totals at Bradbury Dam from WY2000-WY2020.

Month	Water Years:																				
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Oct	0.0	2.64	0.62	0.0	0.0	6.38	0.48	0.16	0.34	0.15	2.2	2.24	0.47	0.12	0.34	0.0	0.30	1.13	0.00	0.17	0.00
Nov	1.62	0.0	3.27	2.5	1.20	0.33	1.64	0.20	0.06	3.39	0.0	1.42	2.82	1.34	1.14	0.87	0.73	1.21	0.07	1.86	1.52
Dec	0.0	0.09	2.66	6.73	2.03	13.25	0.73	1.59	2.39	2.46	3.00	9.48	0.35	2.95	0.18	5.88	1.12	1.92	0.00	0.68	7.19
Jan	1.94	8.40	0.87	0.06	0.32	10.30	7.82	1.30	16.6	0.65	10.34	1.84	1.58	1.75	0.02	0.82	4.03	8.81	3.75	8.07	0.48
Feb	10.37	5.71	0.24	3.56	6.52	9.22	3.06	3.03	2.33	5.70	4.92	3.36	0.43	0.40	4.11	0.51	1.65	10.61	0.16	8.26	0.06
Mar	2.76	13.44	0.79	2.40	0.48	3.08	4.31	0.15	0.46	0.85	0.26	11.9	3.63	0.80	3.52	0.08	3.01	0.83	4.85	3.06	8.13
Apr	4.73	1.35	0.13	2.15	0.0	1.27	4.89	0.81	0.06	0.19	3.15	0.14	3.21	0.19	0.65	0.36	0.0	0.20	0.09	0.11	3.58
May	0.01	0.06	0.12	2.33	0.0	0.51	1.56	0.0	0.38	0.0	0.05	0.42	0.02	0.02	0.0	0.26	0.0	0.32	0.40	1.57	0.07
Jun	0.04	0.0	0.0	0.02	0.0	0.04	0.0	0.0	0.0	0.16	0.0	0.34	0.0	0.0	0.0	0.42	0.0	0.00	0.00	0.00	0.00
Jul	0.0	0.06	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.0	0.00	0.00	0.00	0.00
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
Sep	0.0	0.0	0.08	0.0	0.0	0.03	0.0	0.17	0.0	0.08	0.0	0.0	0.18	0.0	0.0	0.15	0.0	0.45	0.00	0.01	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***	***23.79***	**21.03**

Table 23: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2020 (yellow indicates still not available on the USGS website).

Month	WY2001		WY2002		WY2003		WY2004		WY2005		WY2006	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	n/d	20.6	n/d	2.06	23.3	18.8	0	0	31.1	29.4	6.05	9.41
Nov	n/d	14.8	n/d	12.3	8.11	15.2	0	0	6.35	14.2	6.94	16
Dec	n/d	14.9	n/d	25.2	22.3	55.5	0	0.02	293.2	478.5	10.7	20.1
Jan	37.3	75.3	n/d	24.6	10.7	26.7	1.6	1.54	2556	2765	40	79.4
Feb	n/d	321	n/d	21.6	12.7	27	8.96	38.4	2296	2555	12.2	28
Mar	n/d	3378	n/d	13.4	24	70.2	4.25	12.4	776.6	929.3	51.2	86.1
Apr	n/d	207.3	n/d	3.93	14.9	22.3	0.295	1.46	206.8	300.8	1317	1053
May	n/d	57.5	n/d	1.44	9.83	19.5	0	0.10	104.3	150.7	131.9	139.6
Jun	n/d	13.6	n/d	0.515	1.64	3.97	0	0	13.8	32.7	20.1	26.5
Jul	n/d	5.08	n/d	0.09	0.01	0.64	53.2	3.69	9.15	14	7.83	4.76
Aug	n/d	2.53	64.8	24.2	0	0.11	59.4	30.9	6.35	2.86	4.69	0.98
Sep	n/d	2.15	37.2	28.9	0	0	39.3	24	6.02	4.15	5.7	1

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

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

Month	WY2019		WY2020	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	0	0.017	0	0
Nov	0	0	0	0
Dec	0	0	3.88	0.135
Jan	14.4	61.7	7.48	0.043
Feb	139.9	414.5	5.39	0
Mar	68.7	208	22.8	28.9
Apr	13.3	35.7	87	114.4
May	5.79	14.6	15.7	22.2
Jun	1.91	5.21	3.42	
Jul	0.653	0.875	1.8	
Aug	0	0	0.527	
Sep	0	0	77.5	

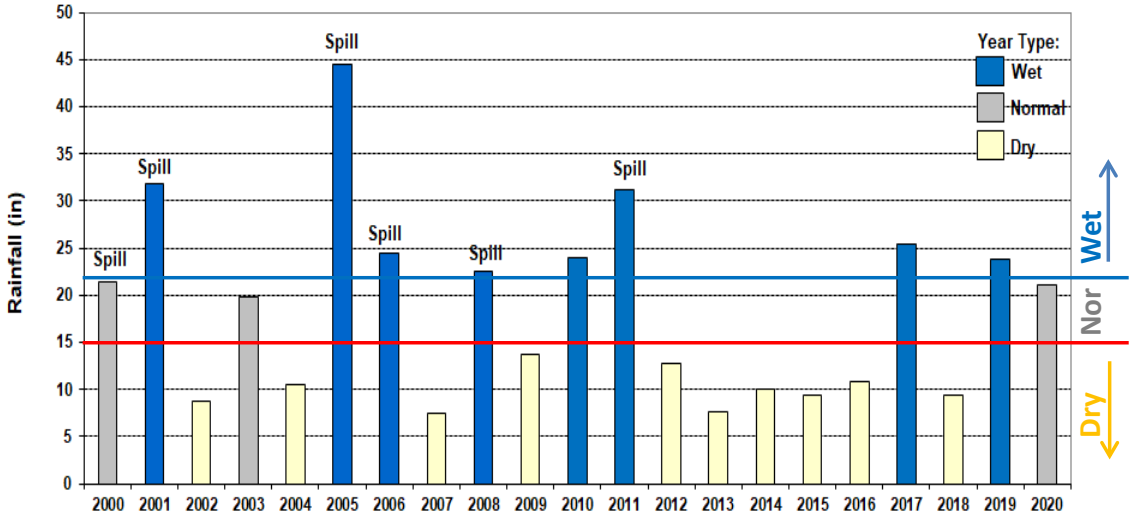

Figure 91: Water year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

Figure 92: Hilton Creek post-storm habitat conditions showing (a) sediment deposition in the (a) Spawning Pool (1/18/19) and (b) Honeymoon Pool just upstream (1/22/19), and

limited scour leading into WY2021 at (c) the Spawning Pool (11/16/20) and (d) Honeymoon Pool (11/16/20)

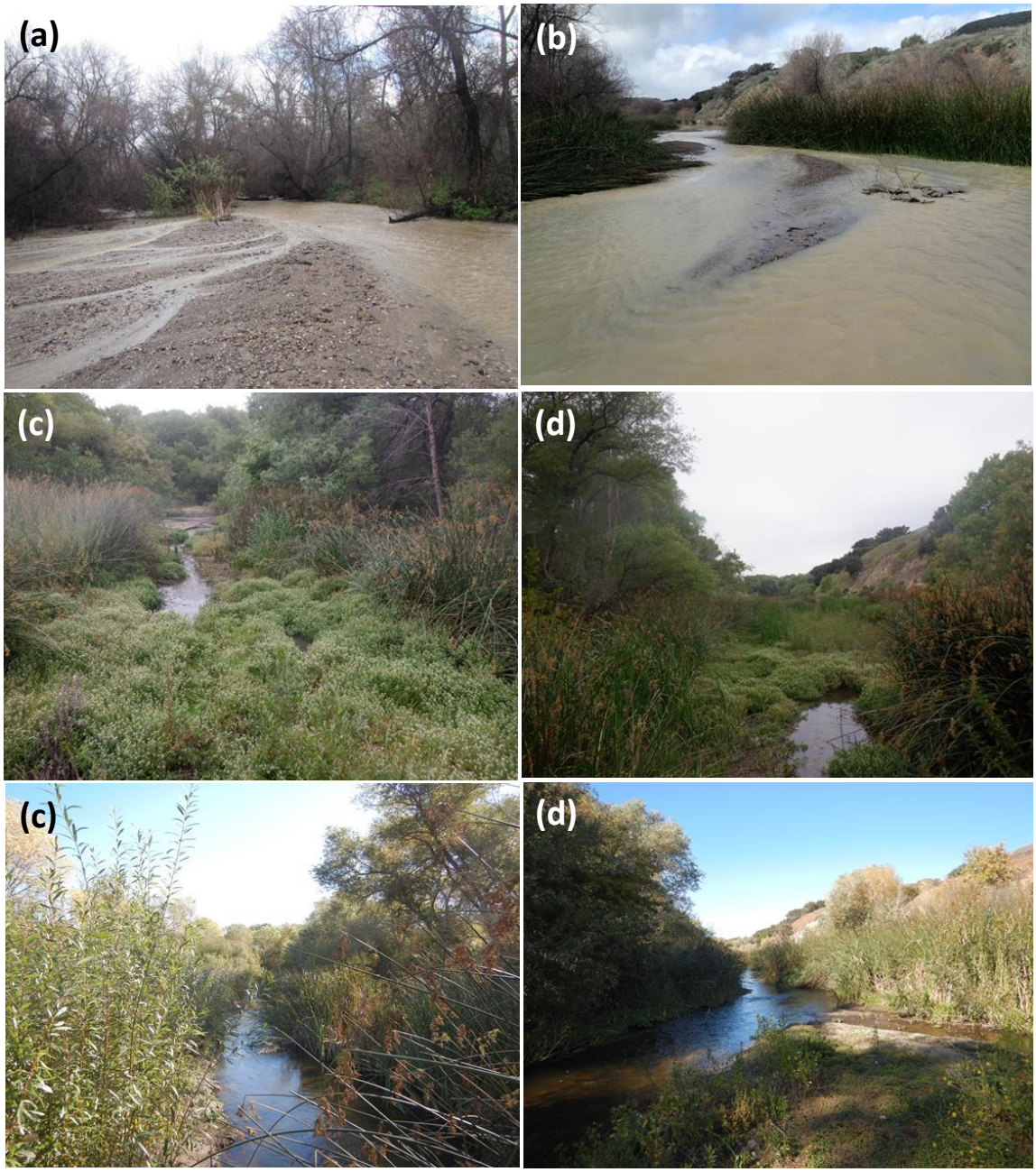

Figure 93: Delta formation at head of Long Pool along the LSYR mainstem looking (a) up towards the Hilton Creek confluence on 2/4/19 and (b) down towards the Long Pool on 2/5/19, and from the same vantage point (c+d) prior to 2020 WR 89-18on 5/29/20, and (e+f) at the end of the 2020 WR 89-18 on 11/16/20 showing a newly defined channel.

Table 24: WY2001-WY2020 Hilton Creek upstream and downstream *O. mykiss* captures.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	*WY2012	*WY2013	*WY2014	*WY2015	*WY2016	*WY2017	WY2018	WY2019	WY2020
	Hilton Creek																			
	Upstream																			
>700	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	0	0	0	0	0	0
650-699	0	0	0	0	0	0	0	4	0	0	0	0	n/d	0	0	0	0	0	0	0
600-649	0	0	0	0	0	0	0	0	1	0	0	0	n/d	0	0	0	0	0	0	0
550-599	0	0	0	0	0	1	0	2	0	0	0	0	n/d	0	0	0	0	0	0	0
500-549	1	0	1	0	2	2	0	2	1	0	0	0	n/d	0	0	0	0	0	0	0
450-499	3	0	0	6	8	9	0	13	1	2	0	0	n/d	0	0	0	0	0	0	0
400-449	5	0	9	11	9	21	2	6	2	1	11	0	n/d	1	0	0	0	1	1	6
300-399	2	0	10	24	10	31	11	31	27	11	6	12	n/d	24	7	1	0	0	8	13
200-299	2	0	2	8	7	10	4	22	29	39	11	12	n/d	12	11	5	0	0	9	7
101-199	11	38	14	27	4	18	15	63	33	39	34	17	n/d	9	6	1	1	5	2	17
<100	1	1	0	12	1	17	11	29	24	15	23	4	n/d	0	0	1	0	0	0	6
Total	**25**	**39**	**36**	**88**	**41**	**109**	**43**	**172**	**118**	**107**	**85**	**45**	**n/d**	**46**	**24**	**8**	**1**	**6**	**20**	**49**
	Downstream																			
>700	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	0	0	0	0	0	0
650-699	0	0	0	0	0	0	0	2	0	0	0	0	n/d	0	0	0	0	0	0	0
600-649	0	0	0	0	0	0	0	1	0	0	0	0	n/d	0	0	0	0	0	0	0
550-599	0	0	0	0	0	0	0	2	1	0	0	0	n/d	0	0	0	0	0	0	0
500-549	1	0	1	1	2	3	0	1	0	0	0	0	n/d	0	0	0	0	0	0	0
450-499	2	0	1	2	0	5	0	15	1	2	2	0	n/d	0	0	0	0	0	0	0
400-449	5	0	3	9	5	6	4	12	0	3	7	0	n/d	1	0	0	0	0	2	2
300-399	2	0	2	7	3	20	16	28	24	9	10	1	n/d	5	7	0	0	0	1	12
200-299	0	5	1	5	2	15	9	18	26	38	22	14	n/d	6	35	3	0	4	5	7
Smolts	0	4	0	3	1	11	7	4	7	1	4	6	n/d	1	11	2	0	3	1	1
Pre-Smolt	0	0	0	1	0	0	0	2	0	1	0	1	n/d	1	3	1	0	1	0	0
Res	0	1	1	1	1	4	2	12	19	36	18	7	n/d	4	21	0	0	0	4	6
101-199	22	45	12	46	6	47	369	178	218	84	82	99	n/d	64	68	91	4	14	8	50
Smolts	2	19	3	28	6	33	96	59	73	41	37	17	n/d	16	30	54	0	7	1	11
Pre-Smolt	0	5	0	2	0	5	42	21	36	4	16	48	n/d	27	23	32	2	6	2	18
Res	21	21	9	16	0	9	231	98	109	39	29	34	n/d	21	15	5	2	1	5	19
<100	1	7	0	16	2	173	200	47	34	15	16	15	n/d	2	0	1	0	0	1	19
Smolts	0	0	0	1	0	1	0	0	0	0	0	0	n/d	0	0	0	0	0	0	0
Pre-Smolt	0	0	0	0	1	163	0	1	0	0	2	0	n/d	1	0	1	0	0	0	2
Res	1	7	0	15	1	9	200	46	34	15	14	15	n/d	1	0	0	0	0	1	17
Total	**33**	**57**	**20**	**86**	**20**	**269**	**598**	**304**	**304**	**151**	**139**	**129**	**n/d**	**78**	**110**	**95**	**4**	**18**	**17**	**90**
	*Abbreviated trapping season due to NOAA take issues																			

Table 25: WY2001-WY2020 Salsipuedes Creek upstream and downstream *O. mykiss* captures.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	*WY2012	*WY2013	*WY2014	*WY2015	*WY2016	*WY2017	WY2018	WY2019	WY2020
	Salsipuedes Creek																			
	Upstream																			
>700	0	0	0	0	0	0	0	1	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
650-699	1	0	1	0	1	0	0	2	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
600-649	0	0	0	0	0	0	0	3	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
550-599	1	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
500-549	0	0	0	0	0	1	0	0	0	0	3	0	n/d	0	n/d	n/d	0	0	0	0
450-499	2	0	0	0	0	0	0	0	0	0	2	0	n/d	0	n/d	n/d	0	0	0	0
400-449	1	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
300-399	7	3	0	1	0	6	0	0	0	0	1	2	n/d	0	n/d	n/d	0	0	0	0
200-299	9	3	3	11	0	6	2	7	1	4	7	1	n/d	1	n/d	n/d	0	0	0	1
101-199	10	8	22	9	0	4	5	2	9	2	22	0	n/d	2	n/d	n/d	0	0	0	0
<100	0	0	3	0	0	1	0	3	3	0	5	0	n/d	0	n/d	n/d	0	0	0	1
Total	**31**	**14**	**29**	**21**	**1**	**18**	**7**	**18**	**13**	**6**	**40**	**3**	**n/d**	**3**	**n/d**	**n/d**	**0**	**0**	**0**	**2**
	Downstream																			
>700	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
650-699	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
600-649	1	0	0	0	0	0	0	0	0	1	0	0	n/d	0	n/d	n/d	0	0	0	0
550-599	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
500-549	1	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
450-499	3	0	0	0	0	0	0	1	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
400-449	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
300-399	6	0	0	1	0	4	1	1	0	0	3	0	n/d	0	n/d	n/d	0	0	0	0
200-299	21	2	2	2	9	19	3	13	2	20	13	0	n/d	1	n/d	n/d	0	1	1	0
Smolts	8	1	2	0	9	10	0	9	1	18	2	0	n/d	1	n/d	n/d	0	0	0	0
Pre-Smolt	0	0	0	1	0	2	0	1	0	0	1	0	n/d	0	n/d	n/d	0	0	0	0
Res	13	1	0	2	0	7	3	3	1	2	10	0	n/d	0	n/d	n/d	0	0	1	0
101-199	144	4	98	20	46	193	12	41	60	50	160	10	n/d	9	n/d	n/d	0	2	1	0
Smolts	124	3	55	9	45	135	1	31	16	48	100	1	n/d	3	n/d	n/d	0	0	0	0
Pre-Smolt	2	0	21	2	1	50	1	10	13	1	57	7	n/d	6	n/d	n/d	0	2	1	0
Res	18	1	22	9	0	8	10	0	31	1	3	2	n/d	0	n/d	n/d	0	0	0	0
<100	1	0	11	20	0	24	1	6	111	2	24	12	n/d	0	n/d	n/d	0	0	0	1
Smolts	0	0	0	5	0	4	0	0	0	0	0	0	n/d	0	n/d	n/d	0	0	0	0
Pre-Smolt	0	0	5	3	0	17	0	0	2	0	17	0	n/d	0	n/d	n/d	0	0	0	0
Res	1	0	6	12	0	3	1	6	109	2	7	12	n/d	0	n/d	n/d	0	0	0	1
Total	**177**	**6**	**111**	**43**	**55**	**240**	**17**	**62**	**173**	**73**	**200**	**22**	**n/d**	**10**	**n/d**	**n/d**	**0**	**3**	**2**	**1**
	*Abbreviated trapping season due to NOAA take issues																			

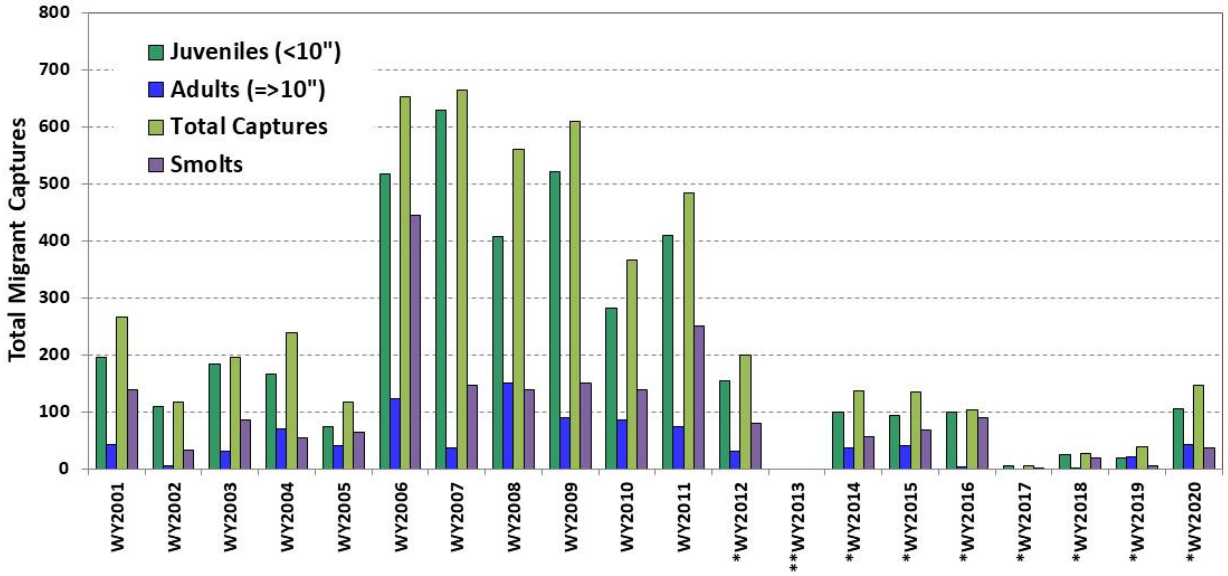

Figure 94: Number of migrant juveniles, adults, smolts and total migrant captures from WY2001 through WY2020.

Table 26: Total number of migrant captures at all 3 trapping locations from WY2001 through WY2020.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	WY2012*	WY2013**	WY2014*	WY2015*	WY2016*	WY2017*	WY2018*	WY2019*	WY2020*
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Wet	Dry	Wet	Normal
Hilton	58	96	56	174	61	378	641	476	422	258	224	174	0	124	134	103	5	24	37	139
Mainstem	nd	nd	nd	nd	nd	17	nd	5	2	30	20	0	0	0	0	0	0	0	0	5
Salsipuedes	208	20	140	64	56	258	24	80	186	79	240	25	0	13	0	0	0	3	2	3
Total Captured:	**266**	**116**	**196**	**238**	**117**	**653**	**665**	**561**	**610**	**367**	**484**	**199**	**0**	**137**	**134**	**103**	**5**	**27**	**39**	**147**
* Abbreviated trapping season due to NOAA take limits enforced.																				
** No trapping conducted.																				

Table 27: The water years with observed returning anadromous steelhead since monitoring began in WY1994 at the migrant traps at Salsipuedes Creek, Hilton Creek, and the LSYR mainstem.

Location	WY1997	WY1998	WY1999	WY2001	WY2003	WY2005	WY2006	WY2008	WY2009	WY2010	WY2011**
Salsipuedes Creek	2	1	3	4	1	1	1	7		1	8
Hilton Creek								7	1		1
LSYR Mainstem*								2			
Total:	**2**	**1**	**3**	**4**	**1**	**1**	**1**	**16**	**1**	**1**	**9**
* LSYR Mainstem trap was first installed in WY2006.											
** The Hilton Creek anadromos fish was a recapture first observed in Salsipuedes Creek.											

Table 28: Total number of smolt captures at all 3 trapping locations from WY2001 through WY2020.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	WY2012*	WY2013**	WY2014*	WY2015*	WY2016*	WY2017*	WY2018*	WY2019*	WY2020*
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Wet	Dry	Wet	Normal
Hilton	4	28	3	35	8	213	145	87	116	47	59	72	0	46	67	90	2	17	4	32
Mainstem	-	-	-	-	-	14	-	1	2	25	14	0	0	0	0	0	0	0	0	5
Salsipuedes	135	4	83	20	55	218	2	51	32	67	177	8	0	10	0	0	0	2	1	0
Total:	139	32	86	55	63	445	147	139	150	139	250	80	0	56	67	90	2	19	5	37
* Abbreviated trapping season due to NOAA take limits enforced.																				
** No trapping conducted.																				

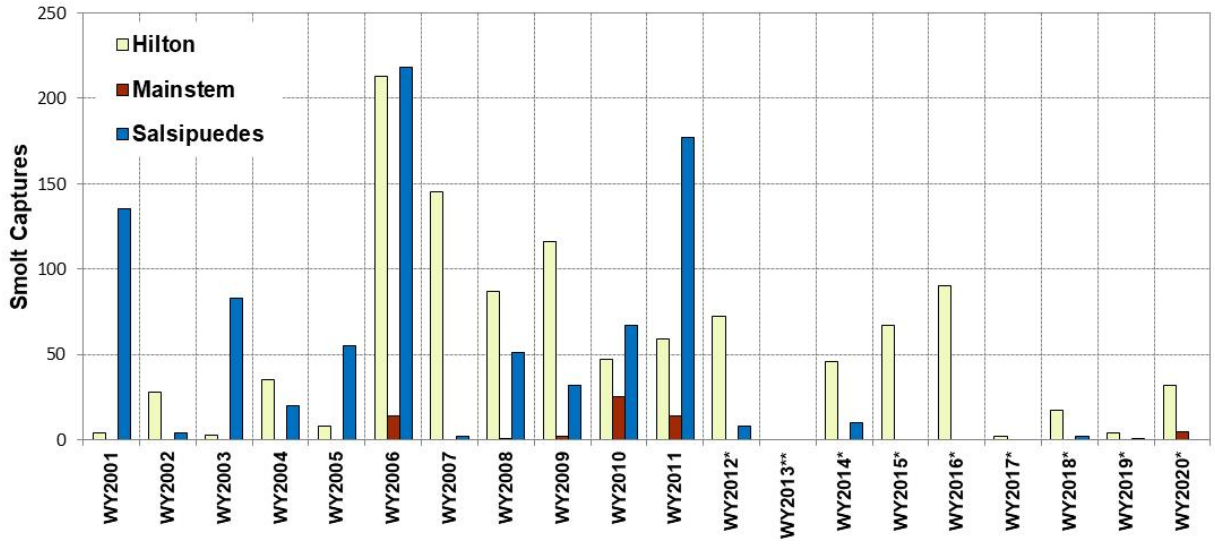

Figure 95: Number of smolt captured at all 3 trapping locations from WY2001 through WY2020.

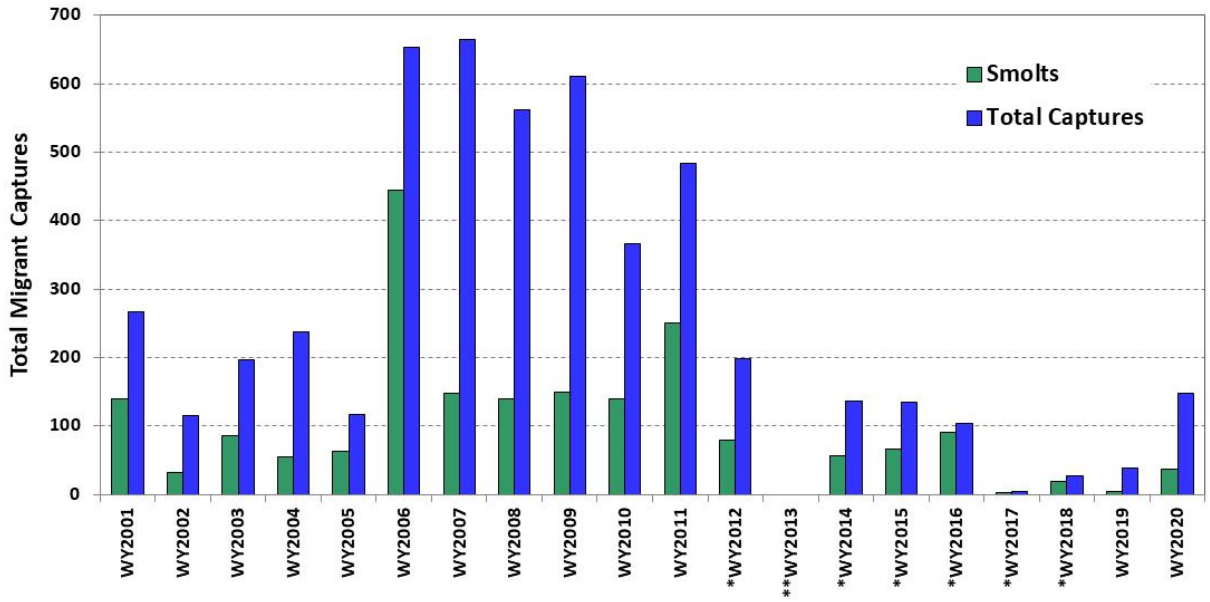

Figure 96: Total number of migrant and smolt captures from WY2001 through WY2020.

WY2008 Adult Steelhead

Salsipuedes Creek Upstream
701 mm = 27.6 Inches
2/5/08
***Largest Steelhead Captured**

Hilton Creek Upstream
659 mm = 26.0 Inches
2/7/08
***1st Steelhead In Hilton Creek**

WY2008 Adult Steelhead Captures					
#	#	Location	Direction	Size (mm)	Date
1	1	Salsipuedes	US	640	2/4
2	2	Salsipuedes	US	701	2/5
3	3	Salsipuedes	DS	496	2/7
4	4	Salsipuedes	US	635	2/17
5	5	Salsipuedes	US	663	3/25
6	6	Salsipuedes	US	675	3/29
7	1	Mainstem	US	678	2/10
8	2	Mainstem	US	600	3/18
9	1	Hilton	US	659	2/7
10	2	Hilton	DS	578	2/11
11	3	Hilton	US	691	2/16
12	4	Hilton	US	510	2/26
13	5	Hilton	DS	617	3/4
14	6	Hilton	US	563	3/5
15	7	Hilton	US	660	3/7
16	8	Hilton	US	688	3/23

WY2011 Adult Steelhead

Salsipuedes Creek Upstream
528 mm = 20.8 Inches
3/5/11

Salsipuedes Creek Upstream
315 mm = 12.4 Inches
1/24/11

WY2011 Adult Steelhead Captures					
#	#	Location	Direction	Size (mm)	Date
1	1	Salsipuedes	US	315*	1/24
2	2	Salsipuedes	US	528	3/5
3	3	Salsipuedes	US	481	3/11
4	4	Salsipuedes	US	490	4/2
5	5	Salsipuedes	US	458	4/8
6	6	Salsipuedes	US	507	4/10
7	7	Salsipuedes	US	298*	5/6
8	8	Salsipuedes	US	242*	5/6
9	1	Hilton	US	481**	4/1
* Lagoon Steelhead.					
** Recaptured Steelhead from Salsipuedes Creek 3/11.					

Figure 97: WY2008 and WY2011 anadromous (adult) steelhead captures with the LSYR basin.

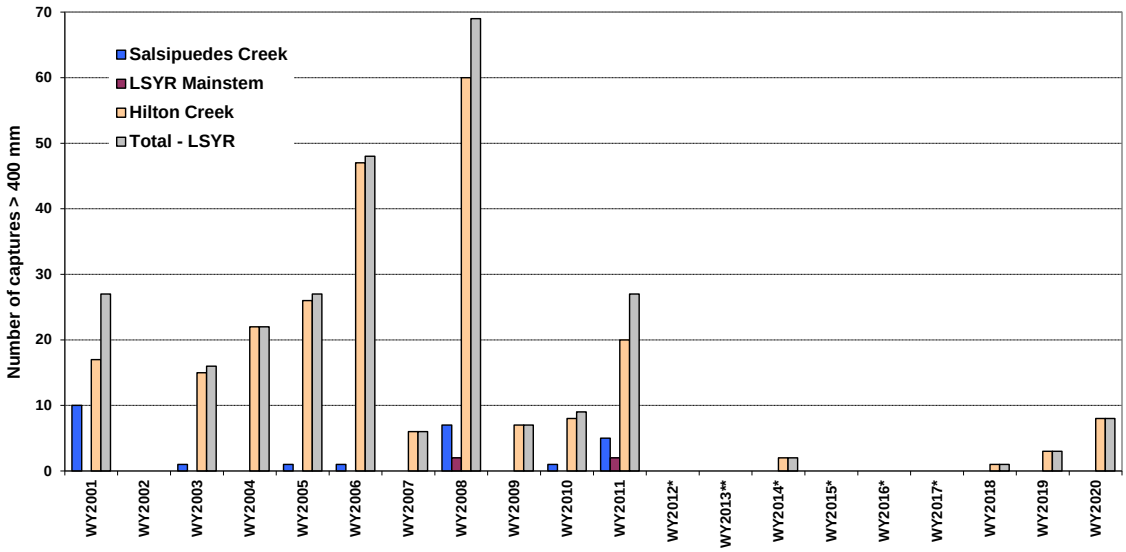

Figure 98: Migrant *O. mykiss* captures equal to or larger than 400 mm (15.7 inches) observed at the 3 trap sites from WY2001 through WY2020; the LSYR Mainstem trap was first installed in WY2006 and was not deployed in WY2007, WY2012, WY2013, WY2014 and WY2015 due to low flow conditions.

Table 29: Genetics and scale aging results from all anadromous fish captures since WY2001 showing the Assignment, Score or confidence (%), watershed of origin, and age (genetics source: NOAA Southwest Science Center).

Fish #	Date	Time	Size (mm)	Size (in)	Sex	Type	Assignment	Score (%)	Watershed	Age (scales)*
SU-04	3/20/2001	0:05	560	22.0	F	Steelhead	failed genotyping	-	-	2.2
SU-11	3/23/2001	19:35	650	25.6	~	Steelhead	no record	-	-	2.3
SD-48	3/25/2001	23:00	625	24.6	F	Steelhead	Salsipuedes	95.383	Salsipuedes Creek (SYR)	ns
SD-149	4/22/2001	12:27	547	21.5	M	Steelhead	Salsipuedes	100	Salsipuedes Creek (SYR)	2.2
SU-17	3/20/2003	22:15	686	27.0	F	Steelhead	Salsipuedes	100	Salsipuedes Creek (SYR)	2.3
SU-01	4/12/2005	23:00	675	26.6	M	Steelhead	SLTjeraB	99.48	Tassajera Creek (Sta. Margarita C, Salinas R)	ns
SU-10	4/15/2006	22:09	515	20.3	F	Steelhead	SCLionB	98.874	Lion Canyon Creek (Sespe C, Santa Clara R)	ns
HU-74	2/7/2008	0:46	659	25.9	F	Steelhead	SLSAntA (AGLBerB)	55.30% (32.66%)	San Antonio River (Salinas R)	ns
HU-100	2/16/2008	6:14	691	27.2	F	Steelhead	SLTjaraB (Quiota)	88.11% (8.46%)	Tassajara Creek (Arroyo Seco, Salinas R)	2.3
HU-119	3/5/2008	6:01	563	22.2	F	Steelhead	Hilton	100%	Hilton Creek (SYR)	5
HU-123	3/7/2008	0:00	660	26.0	F	Steelhead	SLTjaraB	99.10%	Tassajara Creek (Arroyo Seco, Salinas R)	2.3
HU-142	3/23/2008	23:58	688	27.1	F	Steelhead	Hilton (AGMainB)	90.25% (9.34%)	Hilton Creek (SYR)	2.3
HD-109	2/11/2008	6:47	578	22.8	F	Steelhead	Hilton	99.91%	Hilton Creek (SYR)	ns
HD-147	3/4/2008	23:34	617	24.3	F	Steelhead	Hilton	100.00%	Hilton Creek (SYR)	ns
SU-03	2/4/2008	20:58	640	25.2	F	Steelhead	AGLopzA (AGMainB)	74.59% (25.33%)	Arroyo Grande Creek (SLO)	2.2+
SU-04	2/5/2008	7:53	701	27.6	F	Steelhead	AGLopzA (Hilton)	56.19% (43.73%)	Arroyo Grande Creek (SLO)	2.2
SU-08	2/17/2008	7:38	635	25.0	F	Steelhead	Salsipuedes	100.00%	Salsipuedes Creek (SYR)	2.3
SU-11	3/25/2008	21:36	663	26.1	F	Steelhead	Salsipuedes	99.82	Salsipuedes Creek (SYR)	2.3+
SU-12	3/29/2008	9:00	675	26.6	F	Steelhead	Salsipuedes	96.43	Salsipuedes Creek (SYR)	1.3
SU-14	4/14/2008	8:43	608	23.9	F	Steelhead	Salsipuedes	99.86%	Salsipuedes Creek (SYR)	2.3
SD-06	2/7/2008	22:47	496	19.5	F	Steelhead-Lagoon	Salsipuedes	98.33%	Salsipuedes Creek (SYR)	1.4
MU-01	2/10/2008	11:22	678	26.7	F	Steelhead	AGMainB (AGLopzA)	70.04% (24.80%)	Arroyo Grande Creek (SLO)	ns
MU-02	3/18/2008	7:13	600	23.6	F	Steelhead	Quiota	99.99%	Quiota Creek (SYR)	2.2
HU-89	3/22/2009	23:23	605	23.8	F	Steelhead	Hilton	97.22	Hilton Creek (SYR)	1.2.2**
SD-23	3/5/2010	6:18	634	25.0	F	Steelhead	Salsipuedes	100	Salsipuedes Creek (SYR)	ns
SU-05	1/24/2011	18:46	315	12.4	~	Steelhead	Salsipuedes	78.53	Salsipuedes Creek (SYR)	1.2+
SU-24	3/5/2011	1:01	528	20.8	F	Steelhead	Salsipuedes	98.33	Salsipuedes Creek (SYR)	3.2
SU-29	3/11/2011	6:28	481	18.9	M	Steelhead	Quiota (Hilton)	47.14% (39.87%)	Quiota Creek (SYR)	2.1
HUR-06	4/1/2011	20:40	482	18.9	M	Steelhead	Quiota (Hilton)	47.14% (39.87%)	Quiota Creek (SYR)***	2.1
SU-31	4/2/2011	0:05	510	20.1	F	Steelhead	Salsipuedes	99.34	Salsipuedes Creek (SYR)	2.1+
SU-33	4/8/2011	8:25	485	19.1	M	Steelhead	BigMont	94.193 (5.78%)	Big Mountain Creek (Big Sur)	2.1
SU-35	4/10/2011	6:26	507	20.0	M	Steelhead	BigMont	99.44% (0.48%)	Big Mountain Creek (Big Sur)	3.1
SU-36	5/6/2011	6:40	298	11.7	~	Steelhead-Lagoon	Salsipuedes	99.604	Salsipuedes Creek (SYR)	1.1
SU-37	5/6/2011	13:10	242	9.5	M	Steelhead-Lagoon	Salsipuedes (BigMont)	57.87% (39.72%)	Salsipuedes Creek (SYR)	1.1

* Age: F - years in fresh . S - years in salt/lagoon water; ns - no scales taken.

** 1.2.2: 1F.2S.2F.

*** SU-29: This Salsipuedes Creek fish was later recaptured in Hilton Creek (HUR-06), both marked in tan.

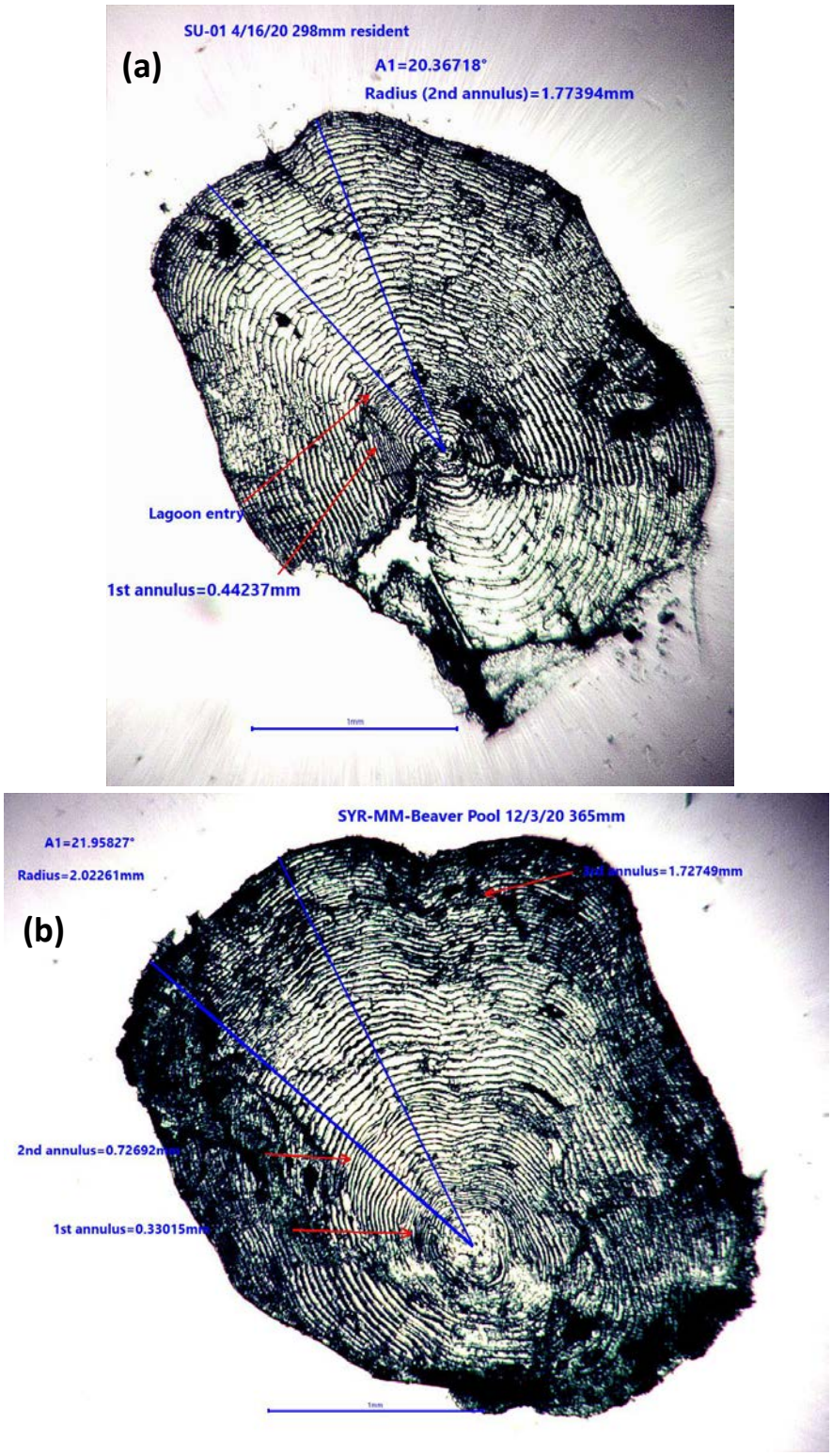

Figure 99: Scale analyses of (a) a upstream Salsipuedes Creek migrating fish captured on 4/16/20 and (b) a LSYR mainstem mortality found on 12/3/20.

Table 30: The results of scale analyses of *O. mykiss* migrant captures and mortalities found over the monitoring period aggregated by 10 mm size classes in 2019.

		Age:								
Size (mm)	**Amount**	**0+**	**1**	**1+**	**2**	**2+**	**3**	**3+**	**4**	**4+**
<120	***	1	2							
120-129										
130-139	*	1								
140-149										
150-159	*			1						
160-169	*			1						
170-179	*					1				
180-189	*				1					
190-199										
200-209	**					1	1			
210-219										
220-229										
230-239	*							1		
240-249	**						1	1		
250-259	*						1			
260-269										
270-279										
280-289	****					1	2	1		
290-299	*					1				
300-309	*					1				
310-319	**						2			
320-329										
330-339	*							1		
340-349										
350-359	*							1		
360-369										
370-379										
380-389										
390-399	**							1		1
400-409										
410-419										
420-429	*								1	
430-439										
440-449	*							1		
Total:	**28**	**2**	**2**	**2**	**1**	**5**	**7**	**7**	**1**	**1**

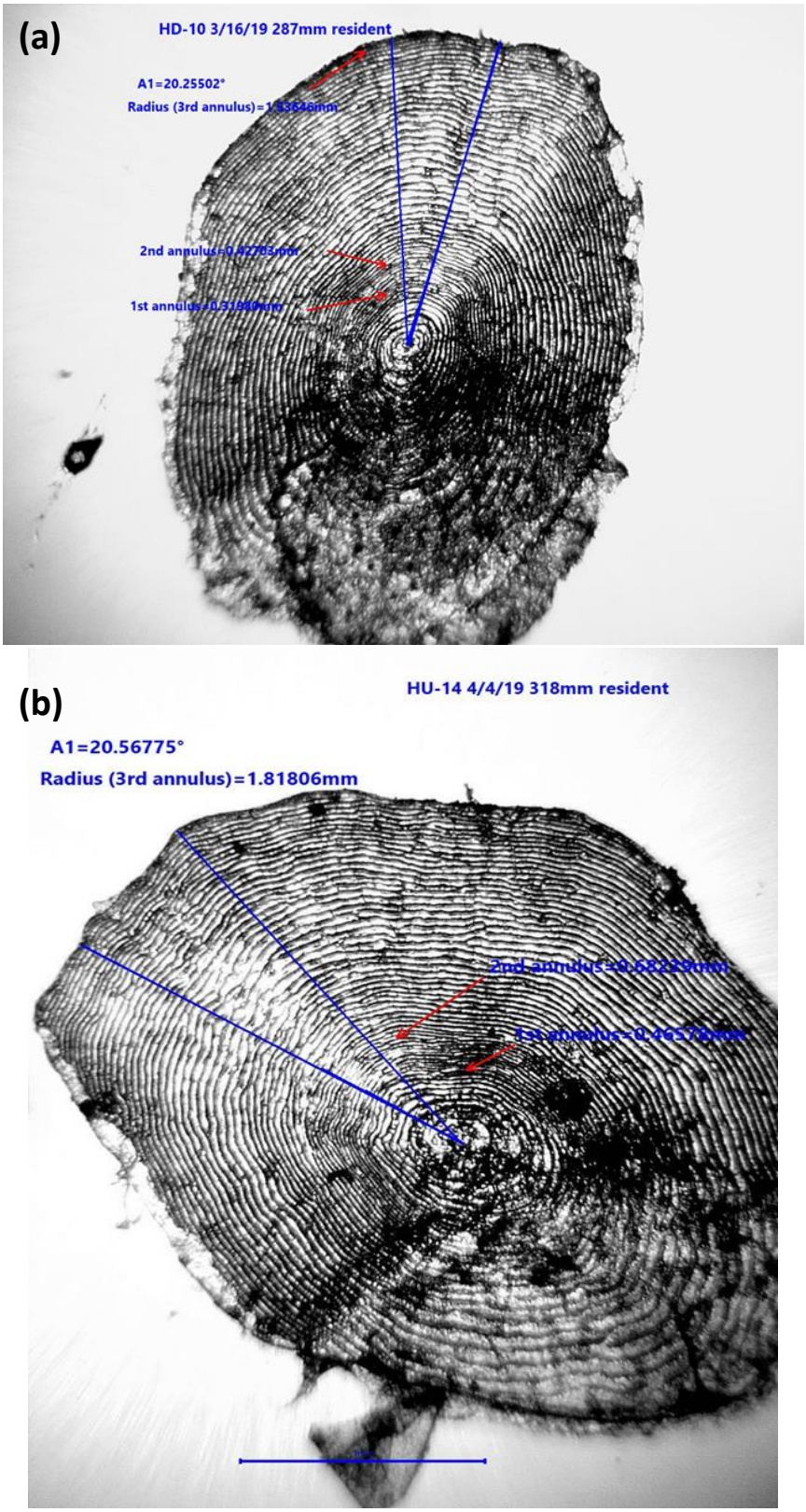

Figure 100: WY2019 *O. mykiss* scales from Hilton Creek showing a change in growth rate after the drought for (a) a 287 mm 3 year old resident fish and (b) a 318 mm 3 year old resident fish.

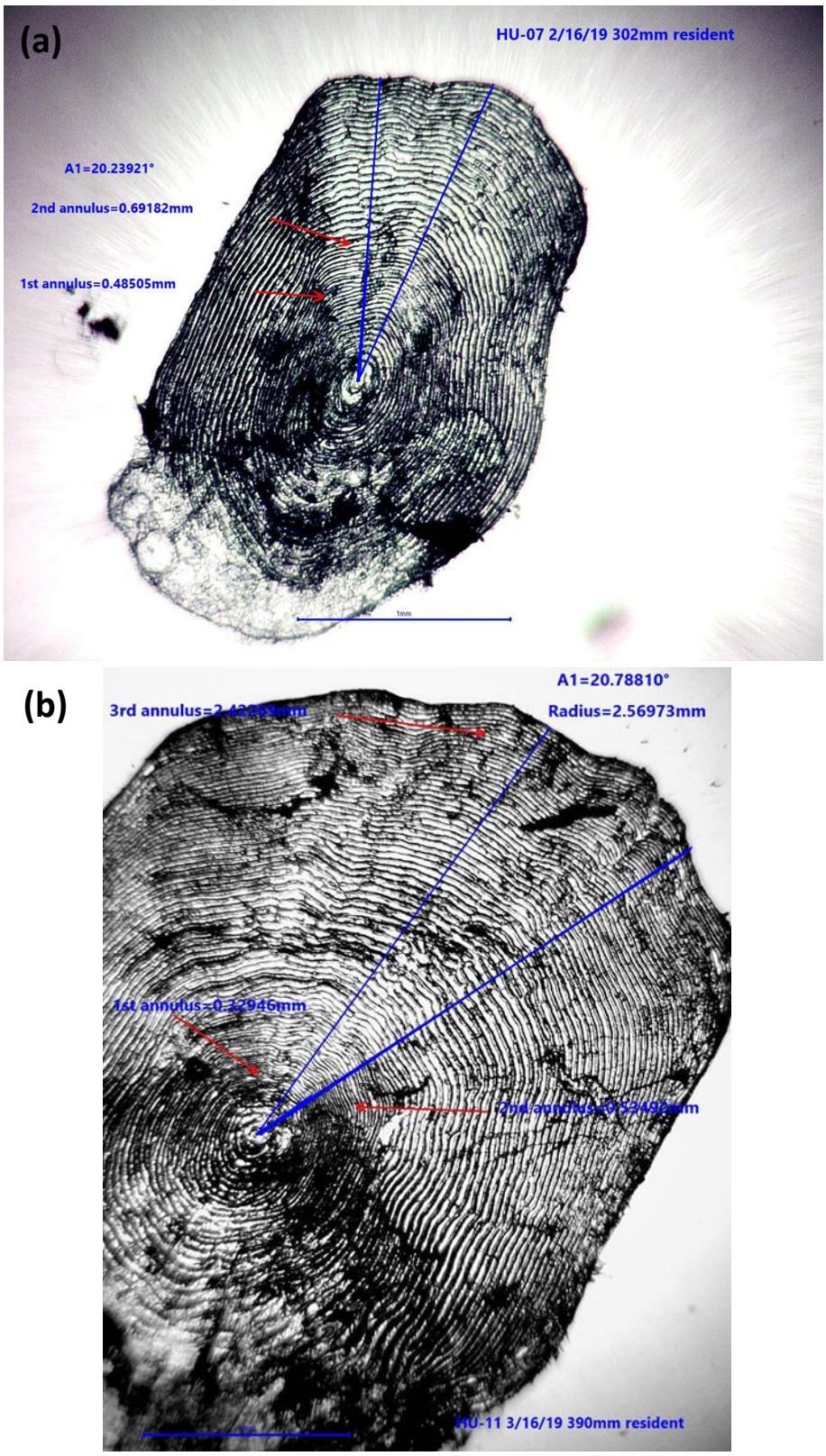

Figure 101: WY2019 *O. mykiss* scales from Hilton Creek showing a change in growth rate after the drought for (a) a 302 mm 2+ year old resident fish and (b) a 390 mm 3+ year old resident fish.

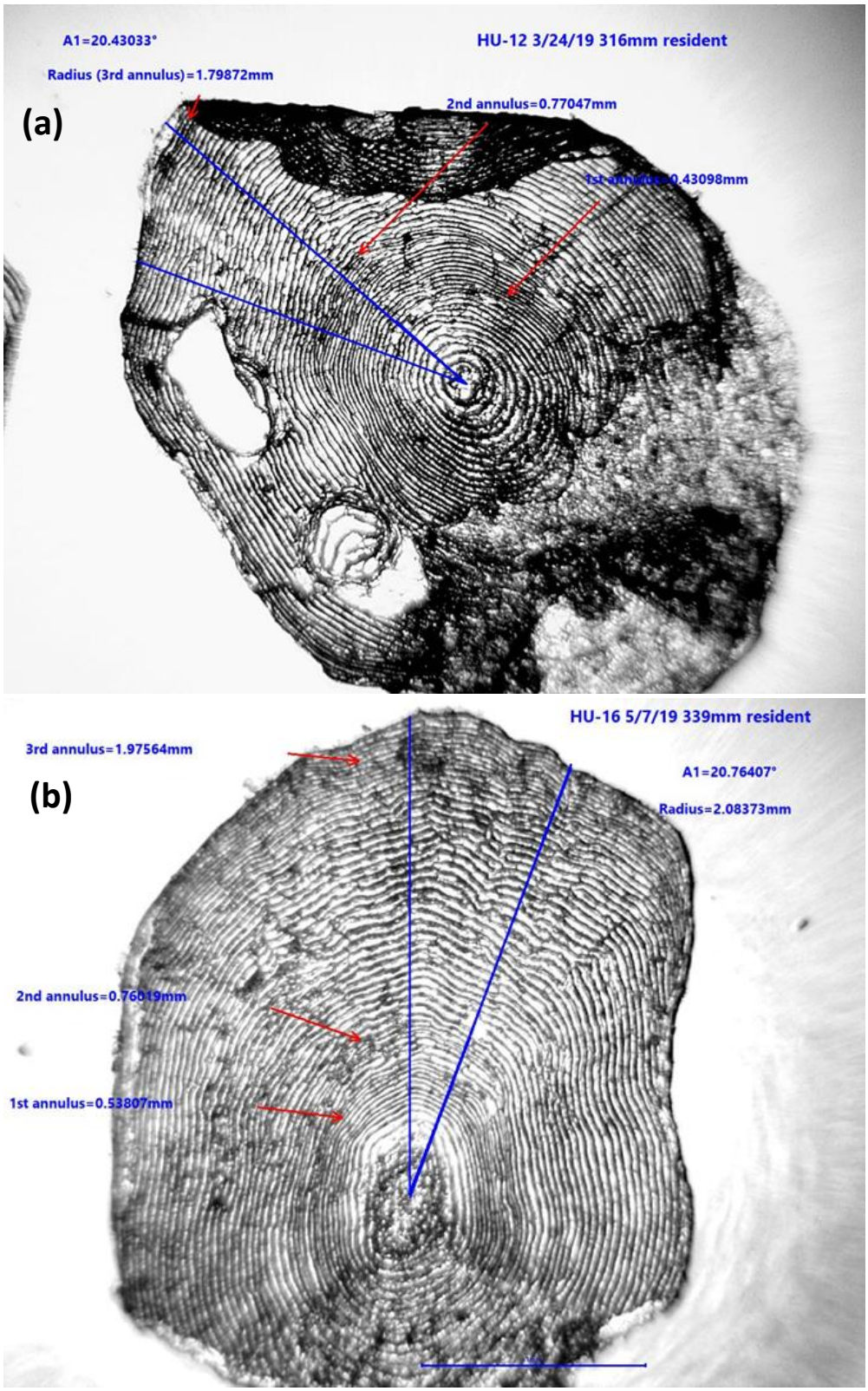

Figure 102: WY2019 *O. mykiss* scales from Hilton Creek showing a change in growth rate after the drought for (a) a 316 mm 3 year old resident fish and (b) a 339 mm 3+ year old resident fish.

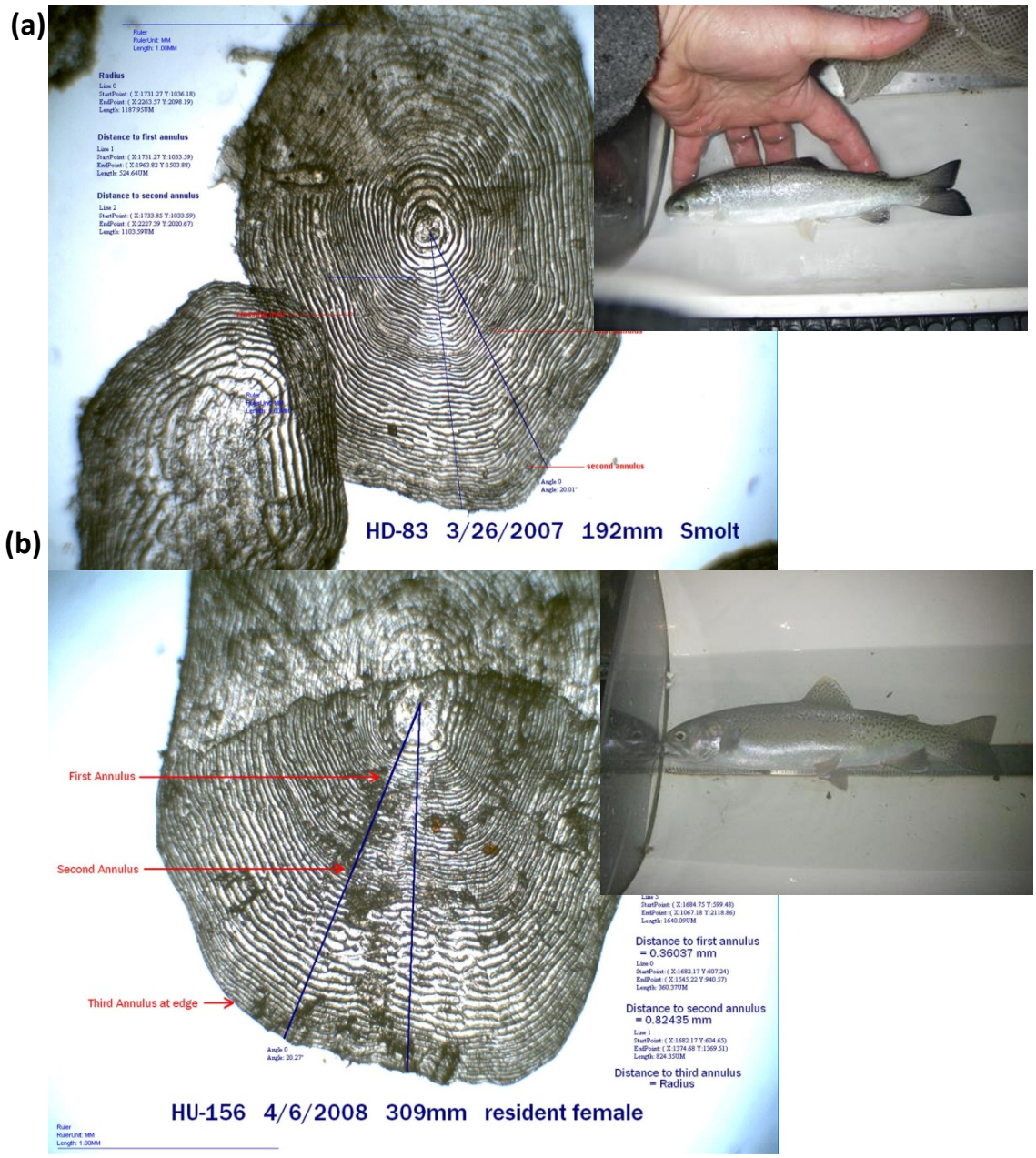

Figure 103: Scale analysis of genetic match of a) HD-83 captured on 3/26/07 (aged at 2+ years) and b) HU-156 captured on 4/6/08 (aged at 3 years). This fish grew 117 mm (4.6 inches in 370 days.

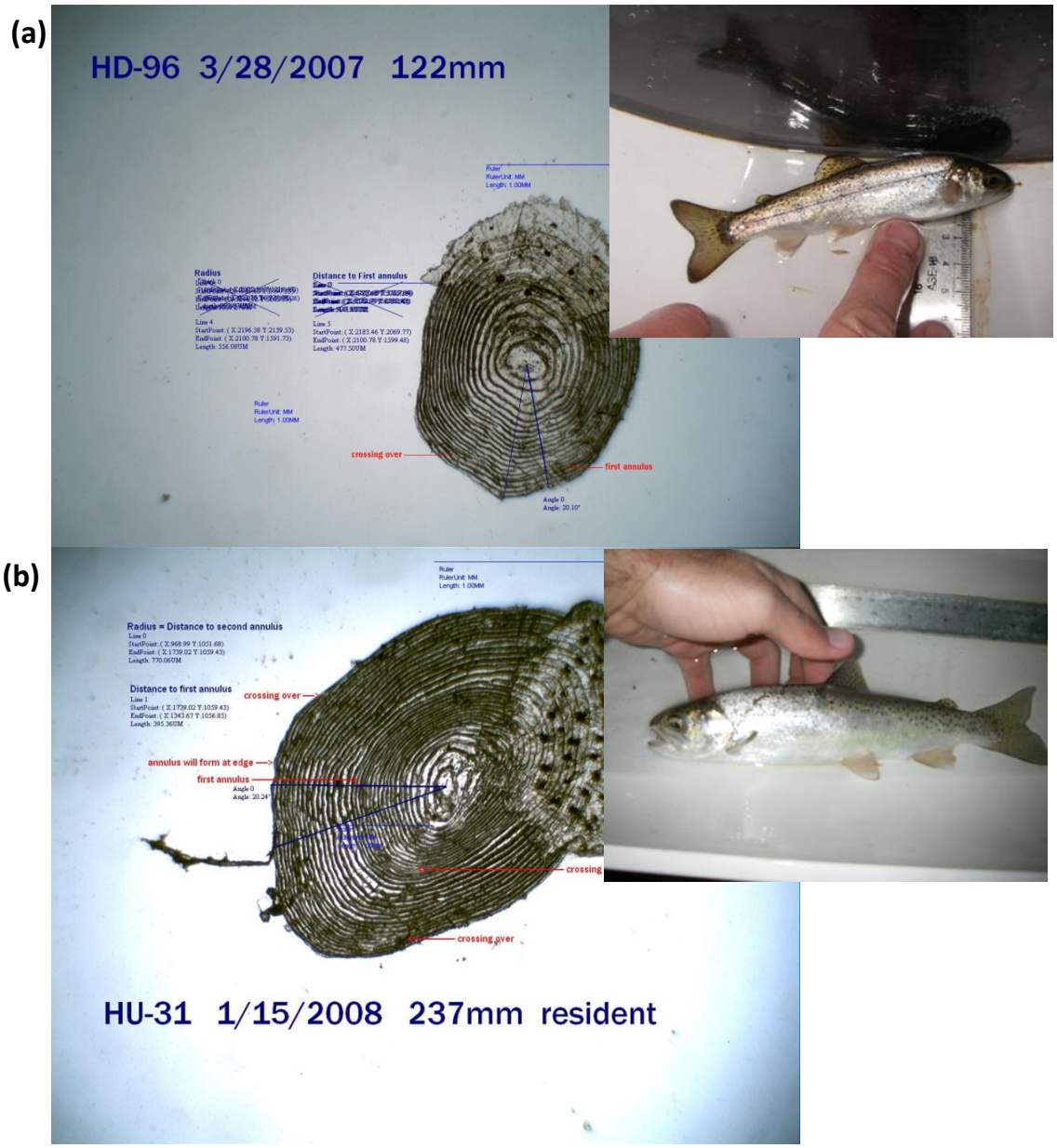

Figure 104: Scale analysis of genetic match of a) HD-96 captured on 3/8/07 (aged at 1+ years) and b) HU-31 captured on 1/15/08 (aged at 2 years). This fish grew 115mm (4.5 inches in 288 days.

Figure 105: Scale analysis and genetic match of a) HD-128 captured on 3/31/07 (aged at 1 year), b) HU-129 captured on 3/9/08 (aged at 2+ years), and c) HD-44 captured on 2/15/10 (aged at 4 years). This fish grew 130mm (5.1 inches) between the first and second capture (288 days) and 80mm (3.1 inches) between the second and third capture with a total of 8.3 inches of growth in 696 days.

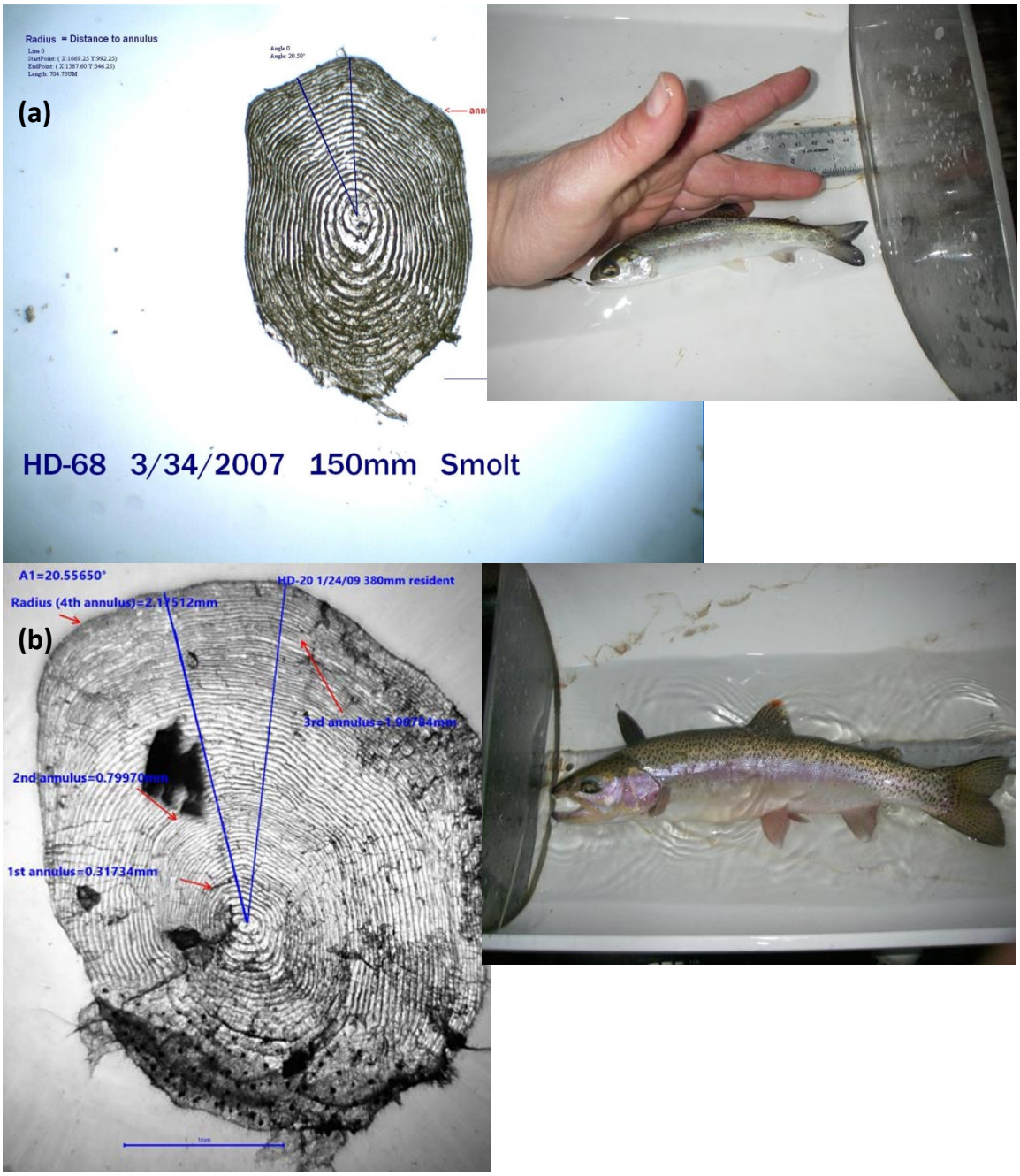

Figure 106: Scale analysis of genetic match of a) HD-68 captured on 3/24/07 (aged at 1/1+ year) and b) HD-20 captured on 1/24/09 (aged at 3+ years). This fish grew 230mm (9.1 inches in 661 days).

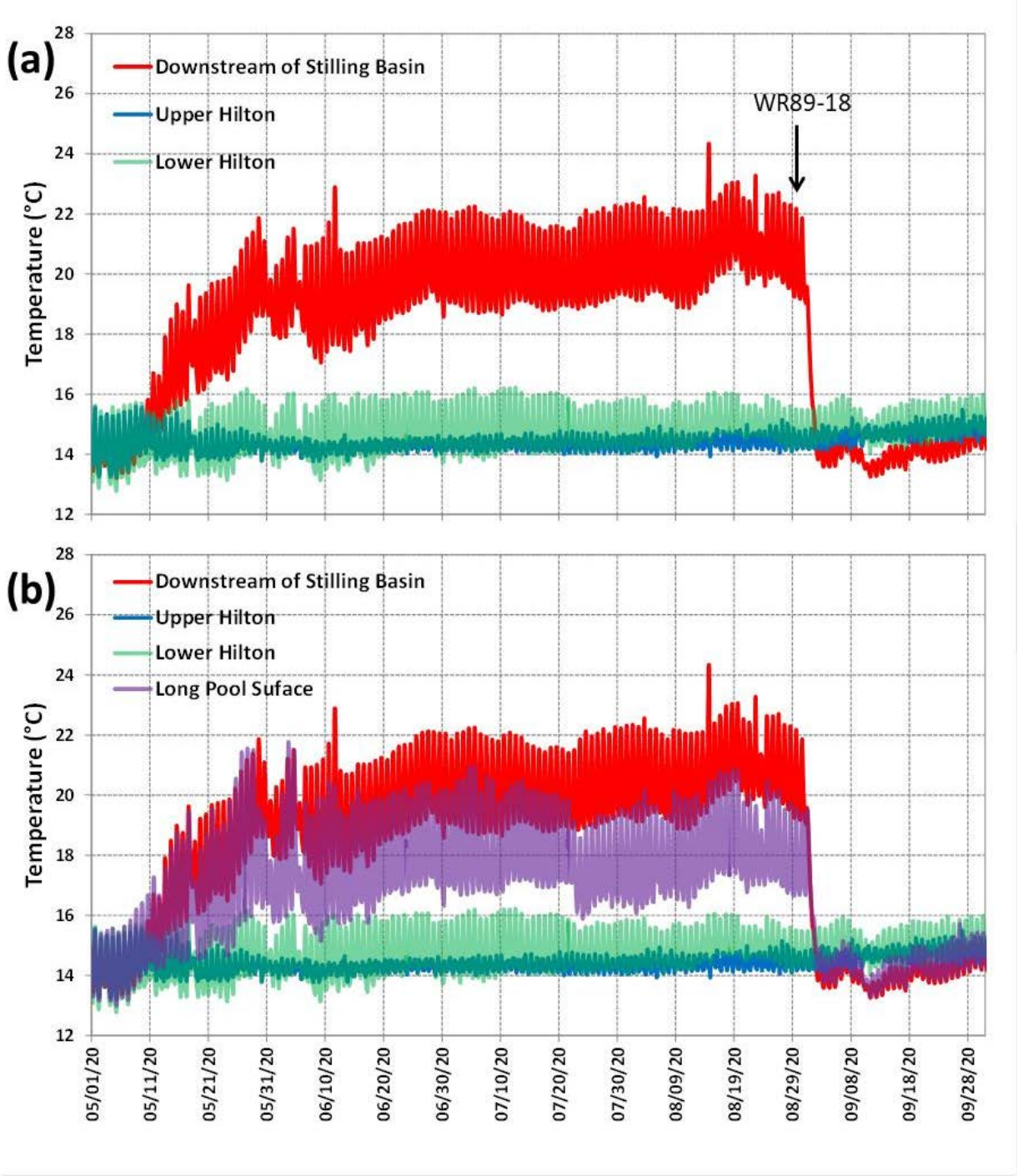

Figure 107: Recorded stream temperatures (a) downstream of the Stilling Basin (LSYR-0.25), upper Hilton Creek (HC-0.54), and lower Hilton Creek (HC-0.12), and (b) with Long Pool (LSYR-5.1) data inserted.

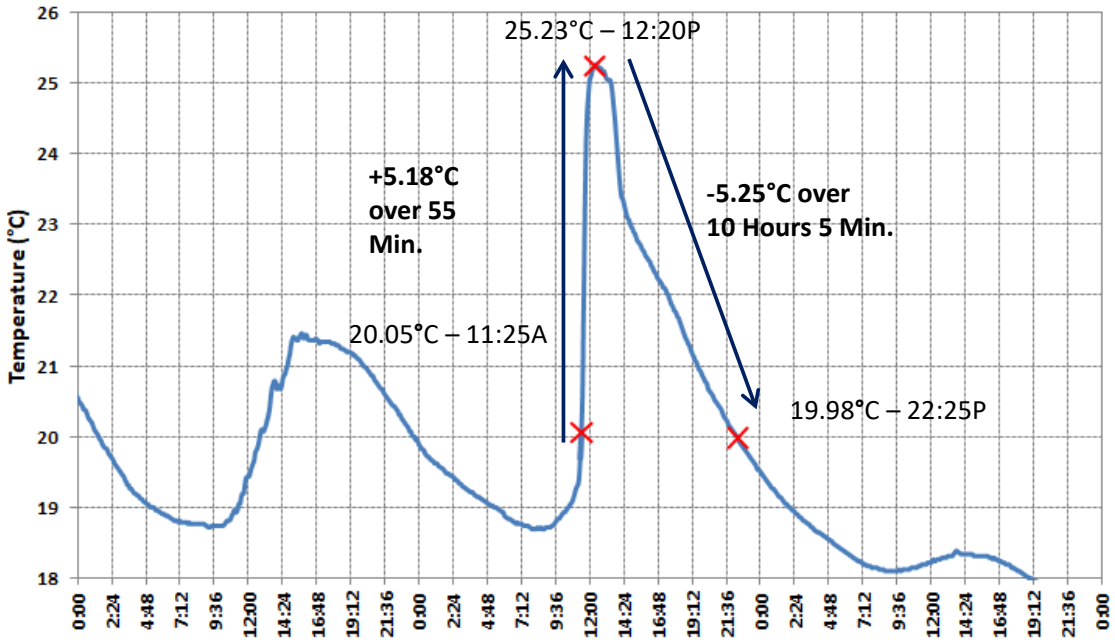

Figure 108: Recorded stream temperatures downstream of the Stilling Basing (LSYR-0.25) at the beginning of the WY2015 WR 89-18 release.

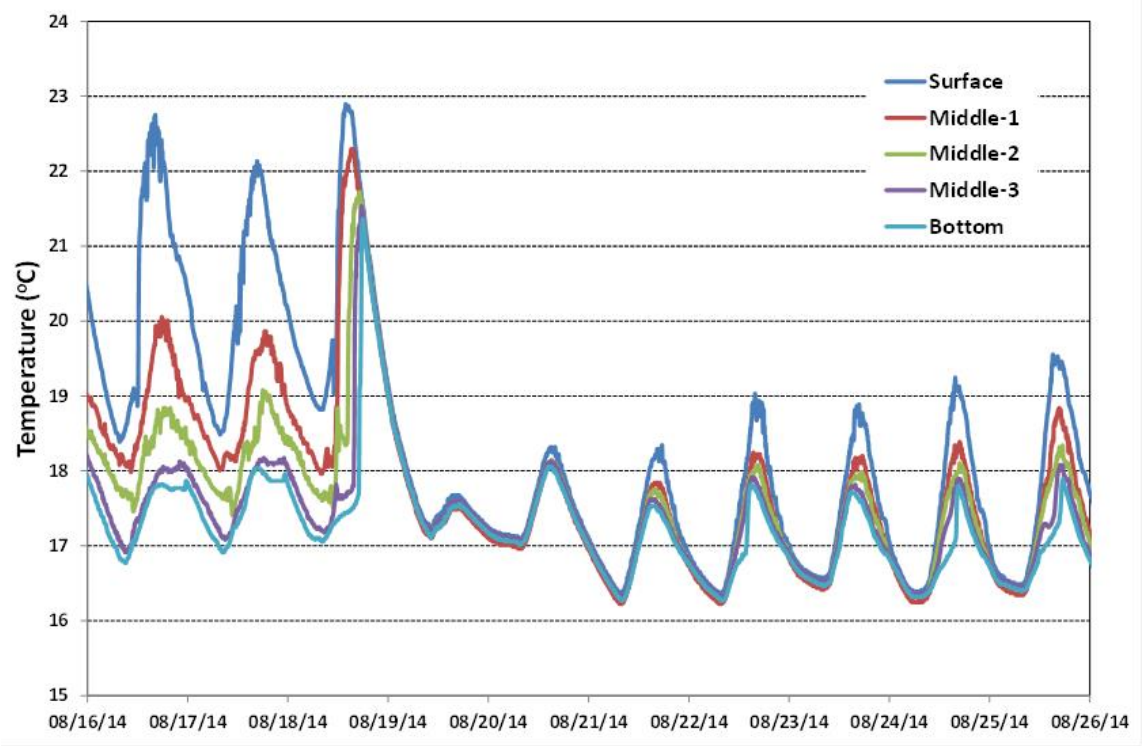

Figure 109: Recorded stream temperatures within the Long Pool (LSYR-0.51) at the beginning of the WY2014 WR 89-18 release from profile data with evenly distributed units going to depth.

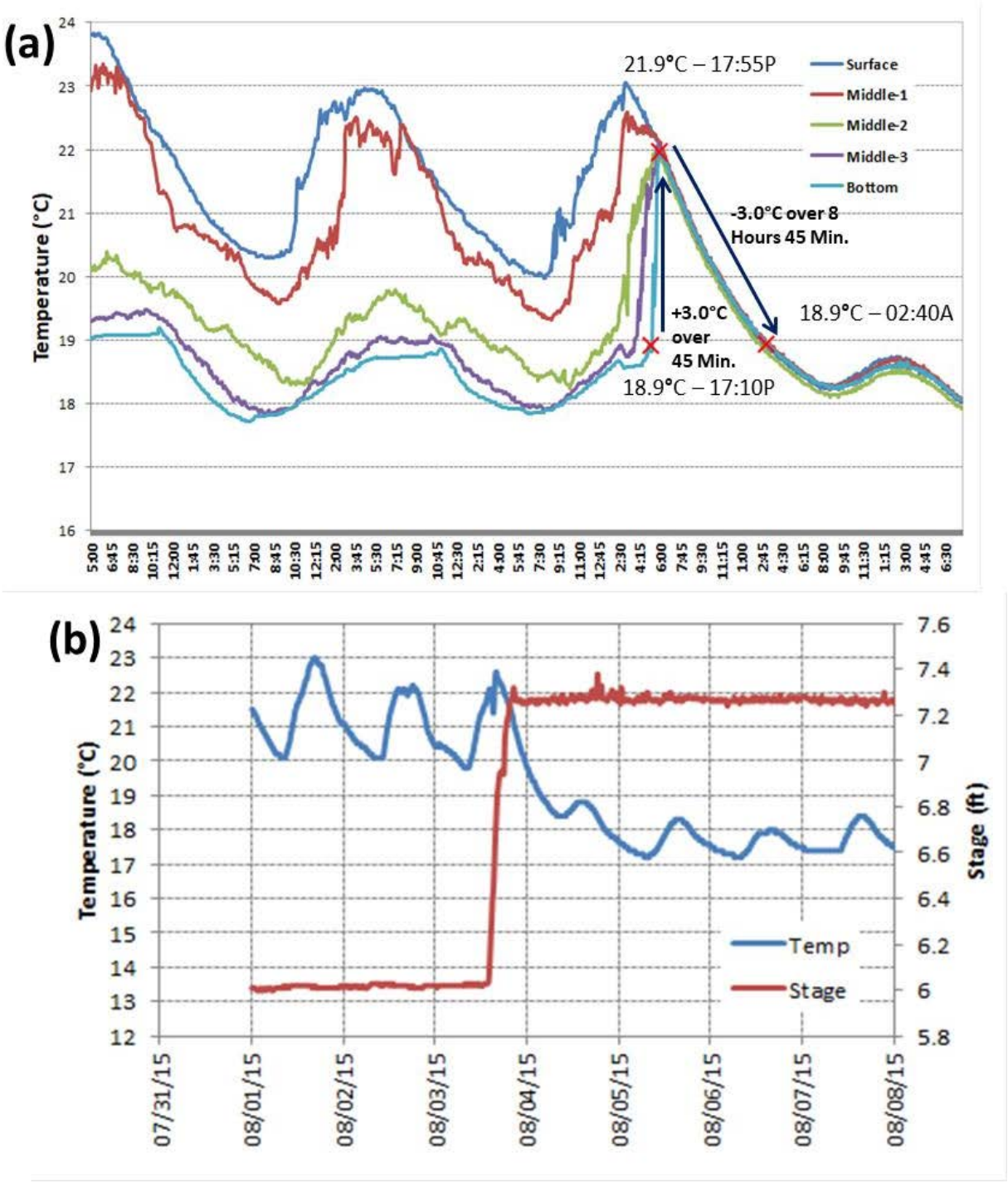

Figure 110: Recorded stream temperatures within the (a) Long Pool (LSYR-0.51) and (b) USGS gauge just downstream of the Long Pool at the beginning of the 2015 WR 89-18 release.

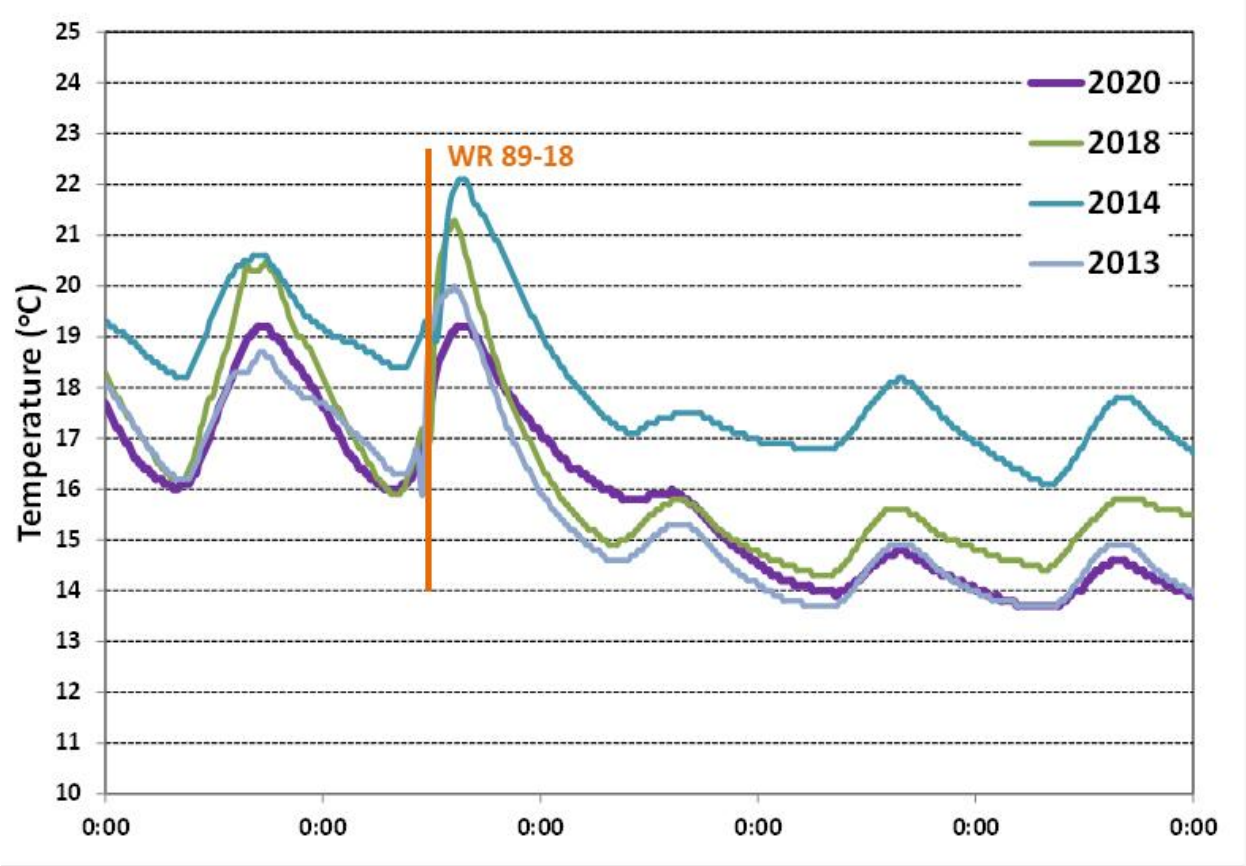

Figure 111: Comparison of stream water temperatures before, during and after the arrival of the WR 89-18 release recorded at the USGS gauge just downstream of the Long Pool from the 2020, 2018, 2014 and 2013; all releases started at 8:00 AM.

Table 31: Fish passage enhancement and stream restoration projects successfully completed within the LSYR watershed since 2000.

#	Project	Drainage	Category*	Timeline
1	Hilton Creek Watering System / Emergency Backup System	Hilton	SR	2000/2015
2	Hwy 1 Bridge Fish Ladder	Salsipuedes	FP	2002
3	Streambank and Side Channel Restoration	El Jaro	SR	2003
4	Jalama Bridge Fish Ladder	Salsipuedes	FP	2004
5	Bradbury Dam Flashboard Installation (Surcharge)	Santa Ynez River	SR	2004
6	Cascade Chute	Hilton	FP	2005
7	Crossing 6 48-ft Bottomless Arched Culvert	Quiota	FP	2008
8	Rancho San Julian Fish Ladder	El Jaro	FP	2008
9	Cross Creek Ranch Fish Passage Improvement	El Jaro	FP	2009
10	Crossing 2 60-ft Bottomless Arched Culvert	Quiota	FP	2011
11	Crossing 7 60-ft Bottomless Arched Culvert	Quiota	FP	2012
12	Crossing 1 60-ft Bottomless Arched Culvert	Quiota	FP	2013
13	Cattle Exclusionary Fencing	Salsipuedes	SR	2014
14	Crossing 3 53-ft Bottomless Arched Culvert	Quiota	FP	2015
15	Crossing 0A 55-ft Bottomless Arched Culvert	Quiota	FP	2015
16	Crossing 4 54-ft Bottomless Arched Culvert	Quiota	FP	2016
17	Crossing 5 58-ft Bottomless Arched Culvert	Quiota	FP	2018
18	Crossing 9 60-ft Bottomless Arched Culvert	Quiota	FP	2018
19	Hilton Creek Gravel Augmentation	Hilton	SR	2018/2019
20	Crossing 8 54-ft Bottomless Arched Culvert	Quiota	FP	2019
21	South Side Erosion Control and Reforestation at Crossing 8	Quiota	SR	2020

*Category: Fish Passage (FP) and Stream Restoration (SR).

Table 32: 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 220)
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 33: 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 2020)
Jalama Road Bridge on Salsipuedes Creek	Completed (2004)
San Julian Ranch on El Jaro Creek	Completed (2008)
Quiota Creek Crossing 0A	Completed (2015)
Quiota Creek Crossing 0B	In design
Quiota Creek Crossing 2	Completed (2011)
Quiota Creek Crossing 6	Completed (2008)
Quiota Creek Crossing 8	Construction (2019)
Total:	**7**
Projects completed:	***6***
Projects remaining:	***1***

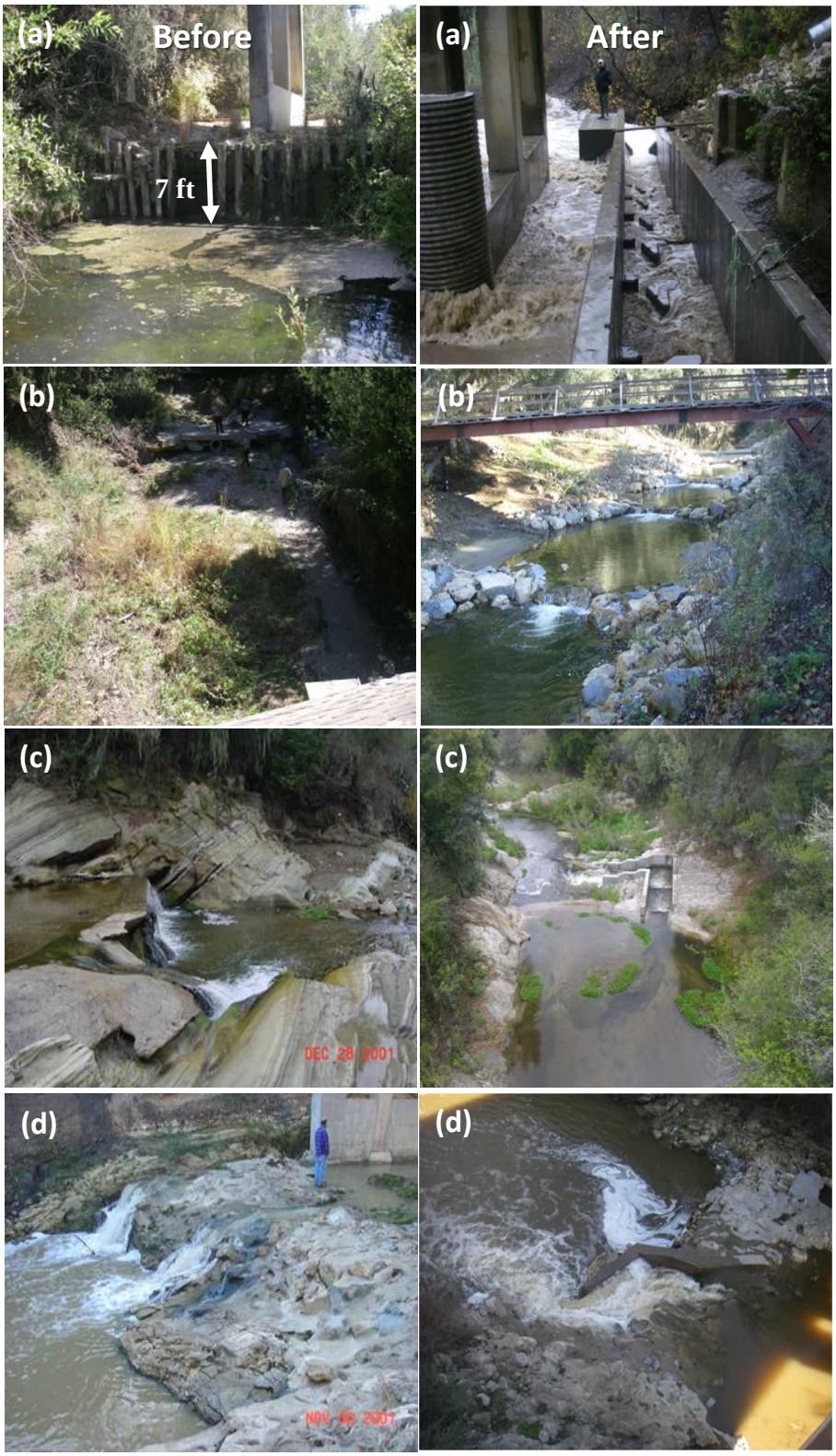

Figure 112: Fish passage and habitat restoration at: at (a) Rancho San Julian Bridge on El Jaro Creek (2008), (b) Cross Creek Ranch on El Jaro Creek (2009), (c) Jalama Road Bridge on Salsipuedes Creek (2004), and (d) Highway 1 Bridge on Salsipuedes Creek (2002).

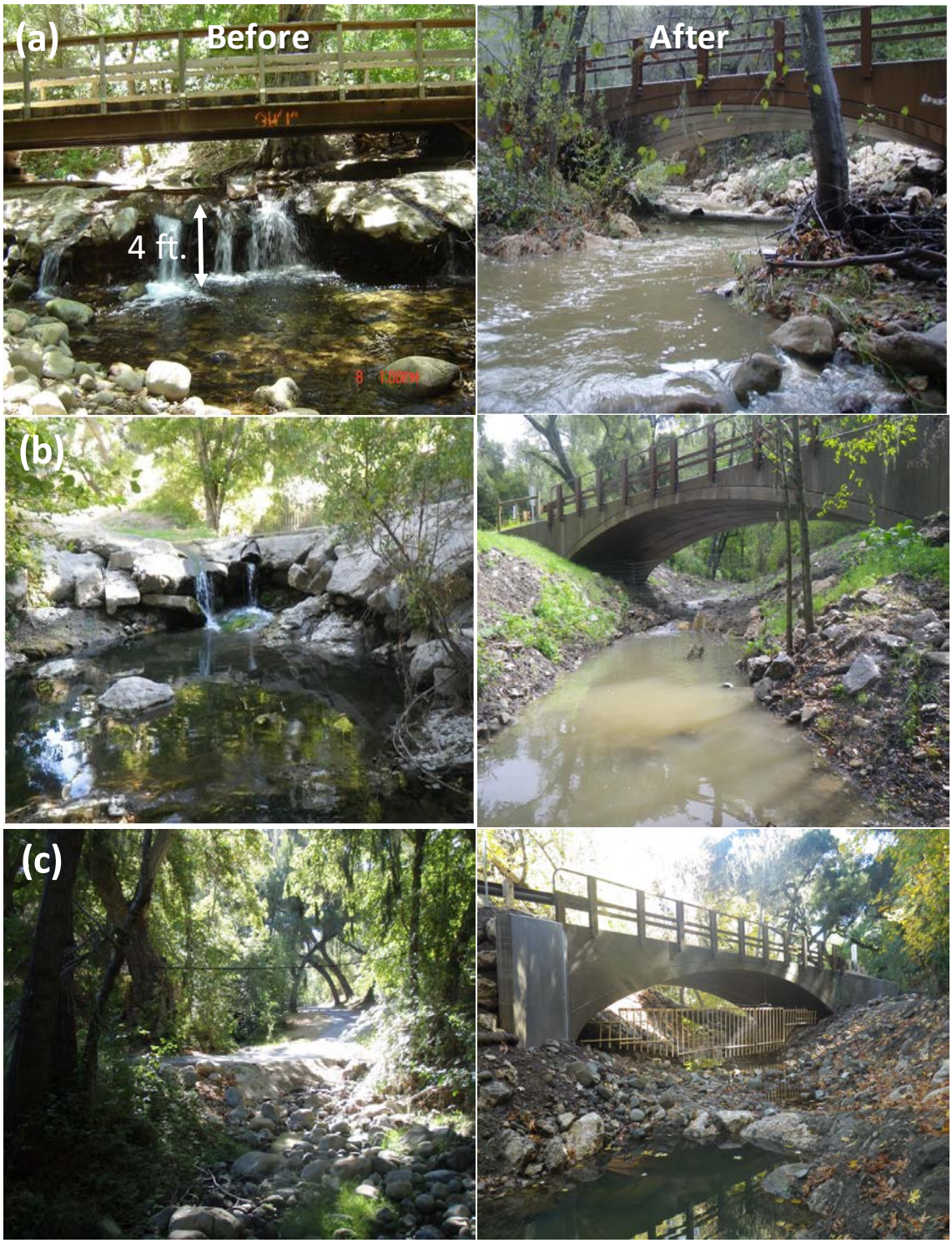

Figure 113: Fish passage and habitat restoration at a) Quiota Creek Crossing 6 (2008), (b) Quiota Creek Crossing 2 (2011), and Quiota Creek Crossing 7 (2012).

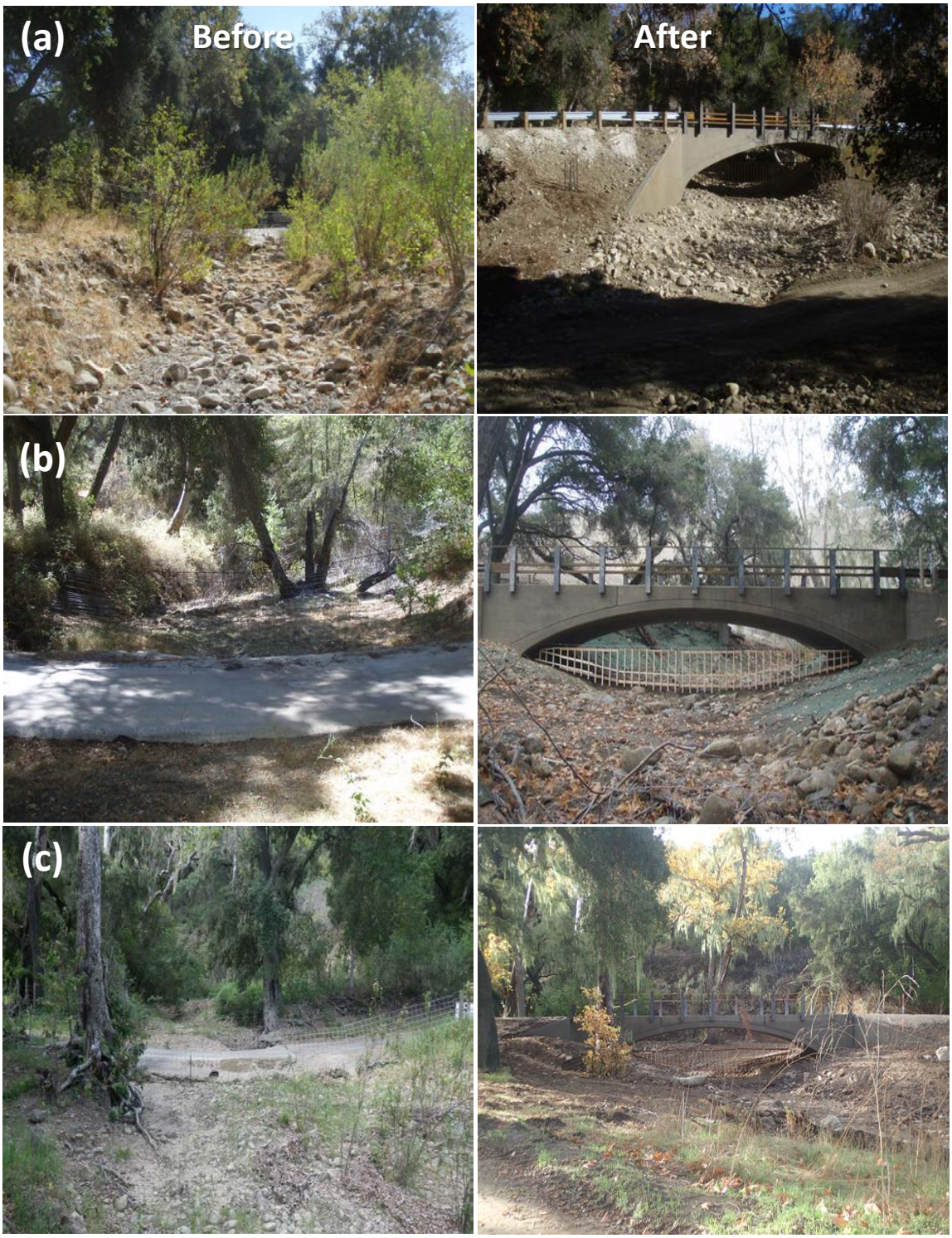

Figure 114: Fish passage and habitat restoration at (a) Quiota Creek Crossing 1 (2013), (b) Quiota Creek Crossing 3 (2015), and (c) Quiota Creek Crossing 4 (2016).

Figure 115: Fish passage and habitat restoration at (a) Quiota Creek Crossing 0A (2015), (b) Quiota Creek Crossing 5 (2018), and (c) Quiota Creek Crossing 9 (2018).

Figure 116: Fish passage and habitat restoration at Quiota Creek Crossing 8 completed in 2019.

Figure 117: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

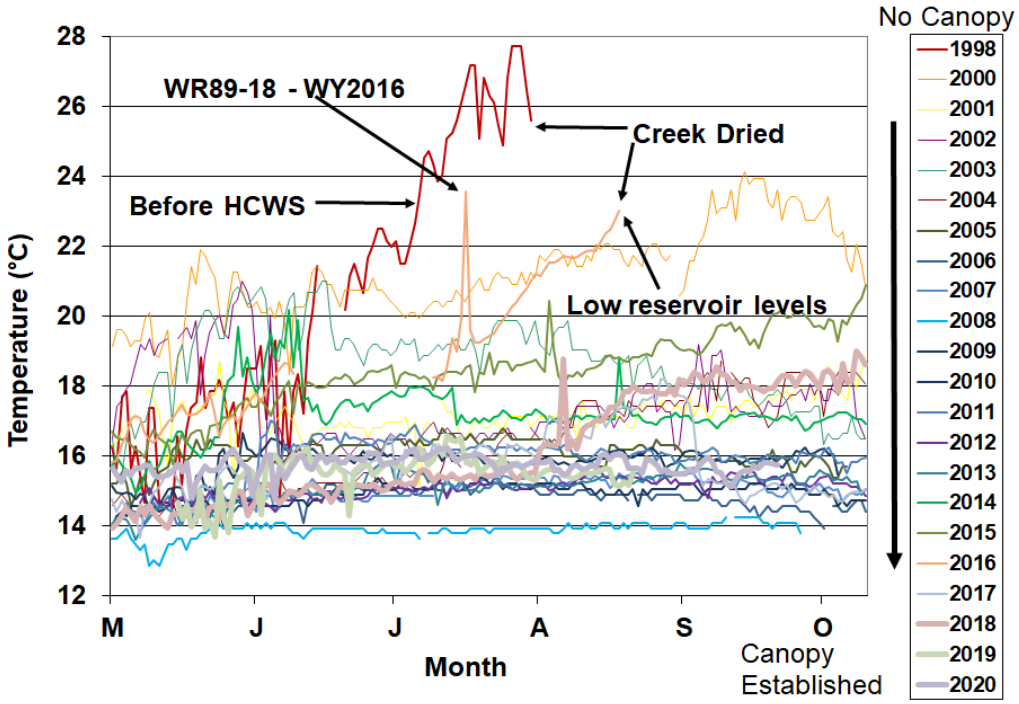

Figure 118: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2020, the last three years are shown with a wider line.

WY2020 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
Parr: Young *O. mykiss* distinguished by dark rounded patches evenly spaced along its sides

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	Monthly	Monthly when in use	At a minimum, water saturated air, according to manufacturer's instructions.
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	SonTek FlowTracker2	When in use	When in use	Software driven calibration
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
SonTek FlowTracker2	Stream Velocity	ft/sec	0.003	±0.0003	± 1% of measured velocity
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
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.

Acoustic Doppler Velocimeter

Flows are measured using a SonTek FlowTracker 2 handheld Acoustic Doppler Velocimeter, an engineer's measuring tape and a top setting rod. This unit is a software driven instrument that includes real time plot of point data and QC parameters for each measurement thereby increasing accuracy and minimizing data handling. A minimum of 15 transects are established across and measurements collected in each transect cell. Surveyors keep a constant eye on the 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 enters the values into the handheld unit to determine discharge.

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 2002-2020 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 WY2020 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.

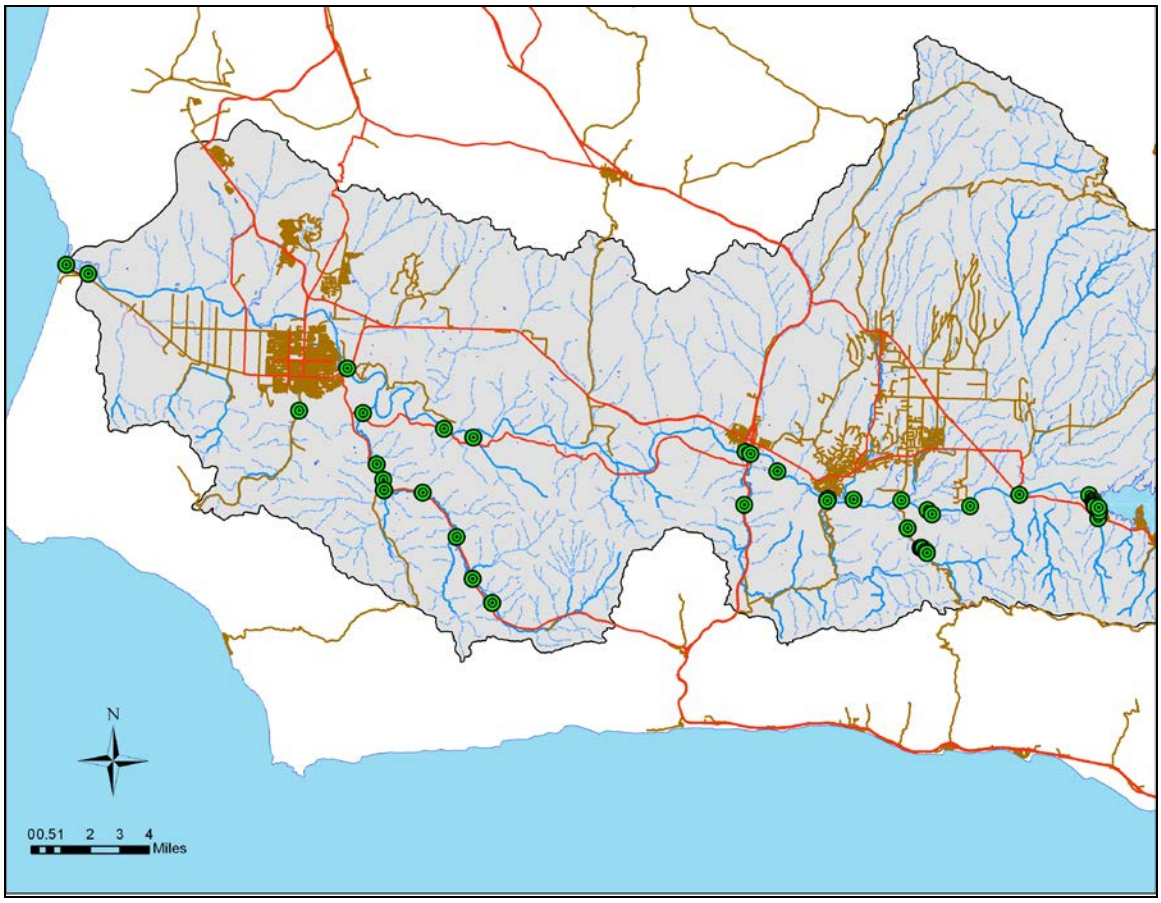

Figure C-1: WY2020 photo point locations.

Table C-1: WY2020 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	November 2019	March 2020	Sept 2020
M1	Lower Hilton Creek, photo d/s at ford crossing			X
M2a	Bluffs overlooking long pool, photo u/s		X	X
M2b	Bluffs overlooking long pool, photo d/s		X	X
M3	Highway 154 culvert on Hilton Creek, photo u/s			
M4	Highway 154 culvert on Hilton Creek, photo d/s			
M5	Highway 154 Bridge, photo u/s		X	X
M6	Highway 154 Bridge, photo d/s		X	X
M7	Meadowlark crossing, photo u/s		X	X
M8	Meadowlark crossing, photo d/s		X	X
M9	Lower Gainey crossing, beaver dam, photo u/s			
M10	Lower Gainey crossing, beaver dam, photo d/s			
M11a	Lower Gainey crossing, photo u/s			
M11b	Lower Gainey crossing, photo d/s			
M12	Refugio Bridge, photo u/s		X	X
M13	Refugio Bridge, photo d/s		X	X
M14	Alisal Bridge, photo u/s		X	X
M15	Alisal Bridge, photo d/s		X	X
M17	Mid-Alisal Reach, photo u/s	X		
M18	Mid-Alisal Reach, photo d/s	X		
M19	Avenue of the Flags Bridge, photo u/s		X	X
M20	Avenue of the Flags Bridge, photo d/s		X	X
M21	Sweeney Road crossing, photo u/s		X	X
M22	Sweeney Road crossing, photo d/s		X	X
M23	Highway 246 (Robinson) Bridge, photo u/s		X	X
M24	Highway 246 (Robinson) Bridge, photo d/s		X	X
M25	LSYR Lagoon on railroad bridge, photo u/s			X
M26	LSYR Lagoon on railroad bridge, photo d/s			X
M27	LSYR at 35th St. Bridge, photo d/s			X
M28	LSYR at 35th St. Bridge, photo u/s			X
M29	LSYR Lagoon upper reach, photo d/s			
M30	LSYR Lagoon upper reach, photo u/s			
M31	Slick Gardener, looking across towards highway		X	X
M32	Slick Gardener, looking d/s through culvert		X	X
M33	Slick Gardener, looking u/s through culvert		X	X
	Floradale Br-u/s			X
	Floradale Br-d/s			X

Table C-2: WY2020 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	November 2019	March 2020	Sept 2020
T1	Hilton trap site, photo u/s		X	X
T2	Hilton start Reach #2, pt site, photo d/s		X	X
T3	Hilton at ridge trail, photo d/s		X	X
T4	Hilton at ridge trail, photo u/s		X	X
T5	Hilton at telephone pole, photo d/s			
T6	Hilton at telephone pole, photo u/s			X
T7	Hilton at tail of spawning pool, photo u/s		X	X
T8	Hilton impediment/tributary, photo d/s		X	X
T9	Hilton impediment/tributary, photo u/s		X	X
T10	Hilton just u/s of URP, photo d/s		X	X
T11	Hilton road above URP, photo d/s		X	X
T12	Hilton road above URP, photo u/s		X	X
T14	Hilton from hard rock toe, photo d/s			X
T15	Hilton from hard rock toe, photo u/s			
TX1a	Quiota Creek at 1st crossing, photo u/s		X	X
TX1b	Quiota Creek at 1st crossing, photo d/s		X	X
TX2a	Quiota Creek at 2nd crossing, photo u/s		X	X
TX2b	Quiota Creek at 2nd crossing, photo d/s		X	X
TX3a	Quiota Creek at 3rd crossing, photo u/s		X	X
TX3b	Quiota Creek at 3rd crossing, photo d/s		X	X
TX4a	Quiota Creek at 4th crossing, photo u/s		X	X
TX4b	Quiota Creek at 4th crossing, photo d/s		X	X
T16	Quiota Creek at 5th crossing, photo d/s		X	X
T17	Quiota Creek at 5th crossing, photo u/s		X	X
T18	Quiota Creek at 6th crossing, photo d/s		X	X
T19	Quiota Creek at 6th crossing, photo u/s		X	X
T20	Quiota Creek at 7th crossing, photo d/s		X	X
T21	Quiota Creek at 7th crossing, photo u/s		X	X
T22	Quiota Creek below 1st crossing, photo d/s			X
T23	Alisal Creek from Alisal Bridge, photo u/s		X	X
T24a	Alisal Creek from Alisal Bridge, photo u/s		X	X
T24b	Alisal Creek from Alisal Bridge, photo d/s		X	X
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s			
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s			
T27	Nojoqui/LSYR confluence, photo u/s			
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s		X	X
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s		X	X
T38-New	Salsipuedes Creek at Hwy 1 looking u/s from bluff			X
T39	Salsipuedes Creek at Hwy 1 Bridge, photo d/s		X	X
T40	Salsipuedes Creek at Hwy 1 Bridge, photo u/s		X	X
T41	Salsipuedes Creek at Jalama Bridge, photo d/s		X	X
T42a	Salsipuedes Creek at Jalama Bridge, photo u/s		X	X
T42b	Pool at Jalama Bridge		X	X
T43	El Jaro/Upper Salsipuedes confluence, photo u/s			
T44	Upper Salsipuedes/El Jaro confluence, photo u/s			X
T45	Upper Salsipuedes/El Jaro confluence, photo d/s			X
T48	El Jaro Creek above El Jaro confluence, photo u/s			
T49	El Jaro Creek above El Jaro confluence, photo d/s			
T52	Ytias Creek Bridge, photo d/s		X	X
T53	Ytias Creek Bridge, photo u/s		X	X
T54	El Jaro Creek 1st Hwy 1 Bridge, photo d/s		X	X
T55	El Jaro Creek 1st Hwy 1 Bridge, photo u/s		X	X
T56	El Jaro Creek 2nd Hwy 1 Bridge, photo d/s		X	X
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s		X	X
T58	El Jaro Creek 3rd Hwy 1 Bridge, photo d/s		X	X
T59	El Jaro Creek 3rd Hwy 1 Bridge, photo u/s		X	X
T60	San Miguelito Creek at crossing, photo d/s			
T61	San Miguelito Creek at Stillman, photo u/s			
T62	Rancho San Julian Bridge, photo d/s		X	X
T63	Rancho San Julian Bridge, photo u/s		X	X

D. List of Supplemental Reports Created During WY2020

- WY2019 Annual Monitoring Summary (COMB, 2020f).
- WY2020 Annual Monitoring Report (COMB, 2020g).
- WY2020 Migrant Trapping Plan (COMB, 2020h).
- 12/25/19 Hilton Creek Stormflow Event Report (COMB, 2020b).
- WY2020 Fish Passage Supplementation Program Report (COMB, 2020e).
- 4/6/20 Hilton Creek Stormflow Event Report (COMB, 2020a).
- End of Project Compliance Report, Fish Passage Improvement at Crossing 8, Quiota Creek (COMB, 2020c).
- End of Project Compliance Report, South Side Erosion Control and Reforestation Project at Quiota Creek Crossing 8 (COMB, 2020d).
- Occurrences of Steelhead Trout (*Oncorhynchus mykiss*) in southern California, 1994-2018 (Dagit et al., 2020).

E. Appendices References

COMB, 2020a. 4/6/20 Hilton Creek Stormflow Event Report. Cachuma Operation and Maintenance Board (COMB).

COMB, 2020b. 12/25/19 Hilton Creek Stormflow Event Report. Cachuma Operation and Maintenance Board (COMB).

COMB, 2020c. End of Project Compliance Report, Fish Passage Improvement at Crossing 8, Quiota Creek. Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2020d. End of Project Compliance Report, South Side Eroion Control and Reforestation Proejct at Quiota Creek Crossing 8. Cachuma Operation and Maintenance Board (COMB) Fisheries Division.

COMB, 2020e. Report on the WY2020 Fish Passage Supplementation Program. Cachuma Operation and Maintenance Board (COMB) Fisheries Division.

COMB, 2020f. WY2019 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, 2020g. WY2020 Annual Monitoring Report. Cachuma Operation and Maintenance Board (COMB) Fisheries Division.

COMB, 2020h. WY2020 Migrant Trapping Plan. Prepared in collaboration with United States Bureau of Recalamation, Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

Dagit, R., M. T. Booth, M. Gomez, T. Hovey, S. Howard, S. D. Lewis, S. Jacobson, M. Larson, D. McCanne and T. H. Robinson, 2020. Occurrences of Steelhead Trout (*Onchorynchus mykiss*) in southern California, 1994-2018. California Fish and Wildlife Journal, 106 (1): 39-58.