WY2021 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

MARCH 1, 2022

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Executive Summary

The WY2021 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 2021 (WY2021, 10/1/20 – 9/30/21). 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 WY2021 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).

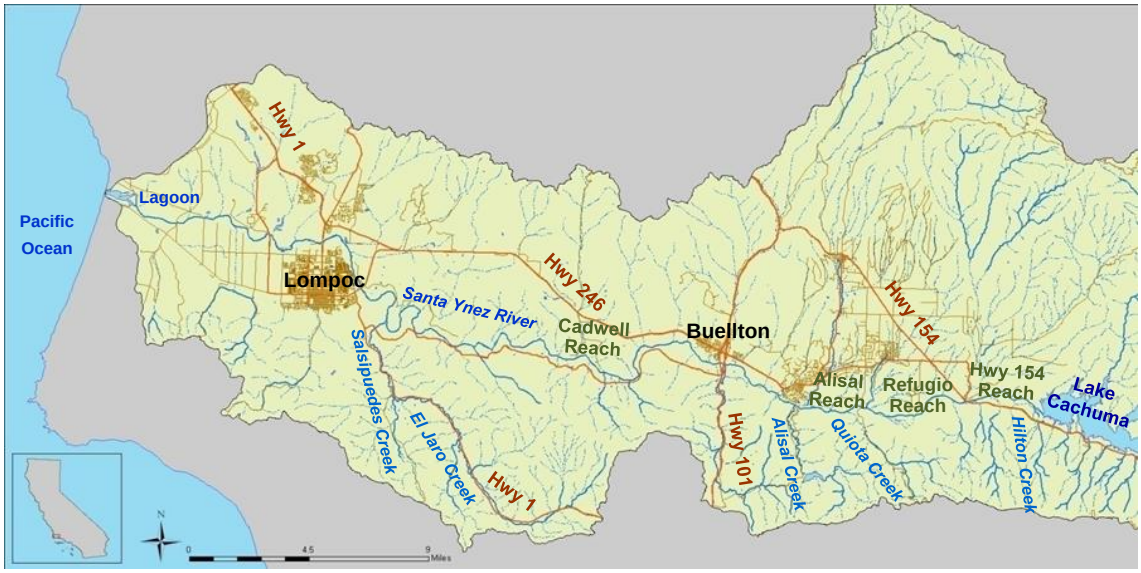

Figure ES-1: LSYR from Bradbury Dam and Lake Cachuma to the Pacific Ocean west of Lompoc, showing tributary creeks and management reaches of interest for the LSYR Fish Monitoring Program.

This report summarizes data gathered since the WY2020 Annual Monitoring Summary (COMB, 2021) and fulfills the annual 2021 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 WY2021, 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, a very dry water year, or program evolution from acquired field knowledge. A shortened version of this report, the WY2021 Annual Monitoring Report (AMR), is prepared by COMB-FD and provided by Reclamation to NMFS for compliance reporting established in the 2000 BiOp and Water Rights Order (WRO) 2019-0148.

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.

WY2021 was a dry year (11.84 inches of precipitation recorded at Bradbury Dam; long-term average, 1953-2021, is 19.79 inches) with the highest amount of rainfall occurring in December and January (10.39 inches). Of the 69 year long record, this was the 53rd wettest and the 18th driest year on record and the 11th driest water year since the beginning of the BiOp in 2000 (3 normal and 8 wet years). 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 WY2021 (8.38 inches of rain) occurred on 1/23/21 that moved the watershed towards saturation but dried thereafter with only 2 small storms (0.79 inches on 3/10/21 and 0.18 inches on 3/15/21) throughout the rest of the water year. The lagoon was open to the ocean from the previous water year but closed on 12/7/20, then reopened on 1/28/21 in association with the large rainfall event, then closed on 3/10/21, and has been closed since. At the beginning of the water year (10/1/21), there were 135,402 acre-feet (af) of water stored in Lake Cachuma and 95,720 af at the end of the water year (9/30/21), with peak storage at the beginning and minimum storage at the end of the water year. BiOp required target flows to the Highway (Hwy) 154 Bridge were maintained throughout the water year at a minimum of 5 cubic feet per second (cfs) until 3/31/21 when the lake storage dropped below 120,000 af when target flows decreased to a minimum of 2.5 cfs. Target flows to Hilton Creek were provided to the Upper Release Point (URP) and Lower Release Point (LRP) by gravity flow from either the Hilton Creek Watering System (HCWS), the Hilton Creek Emergency Backup System (HCEBS), or both. The required 2000 BiOp Hilton Creek target flows of a minimum of 2 cfs were met until approximately 7/20/21 due to the drop of lake elevation (head) but remained above 1.3 cfs throughout the rest of the water year. NMFS was informed by Reclamation in July and concurred given the concerns of going to the HCWS pumps with the potential of power failure and interruption of flow to the creek. There were 10 PG&E power outages during WY2021 (10 in Calendar Year 2021) that would have made continuous HCWS pump operation difficult.

On 6/8/21, Reclamation activated the HCEBS to Hilton Creek to provide gravity flow to the LRP and the URP. The HCWS continued to provide gravity flows to the creek with the two systems working in parallel. As the lake level dropped, the HCWS contribution diminished as the HCEBS contribution increased, although the net delivery to the creek slowly decreased with the drop in lake elevation. The parallel deliveries continued to operate until approximately the second half of July when the lake level dropped below the HCWS limit for gravity flow into the system (approximately at 719 ft).

During the migrant trapping effort, 205 *O. mykiss* were captured (187 at Hilton Creek and 18 at Salsipuedes Creek; the LSYR mainstem trap was not operated due to low flow conditions). There were 28 smolts observed at Hilton Creek and 15 at Salsipuedes Creek going downstream. Sixty-six redds were observed (48 in Hilton Creek, seven in Salsipuedes Creek, four in El Jaro Creek, three in the LSYR Refugio Reach, and two in the LSYR Narrows Reach). That was the highest number of redds documented in Hilton Creek since monitoring began. The two redds in the Narrows Reach were identified as anadromous redds which were the first documented spawning of an anadromous *O. mykiss* since WY2011.

There was a Water Rights (WR) 89-18 release in WY2021 that started on 8/2/21 and continued until 10/22/21 (a period of 81 days). This was an Above Narrows Account (ANA) release of 4,649 af from Lake Cachuma by SYRWCD to recharge downstream aquifers.

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 which were Reclamation projects) 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 15 fish passage projects restoring access to the upstream reaches of key tributaries in the lower Santa Ynez River Watershed for steelhead. The total number of stream restoration, fish passage, and flow enhancement projects completed since issuance of the 2000 BiOp is 22 projects, with the most recent completed this water year at Quiota Creek Crossing 8, the South Side Erosion Control and Reforestation Project. Descriptions and photos of all habitat enhancement projects are presented in Section 4.

The following are recommendations to improve the monitoring program from WY2021 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), BiOp (NMFS, 2000), and Order Water Rights (WR) 2019-0148 (SWRCB, 2019) 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;
- Incorporate the Narrows Reach into routine monitoring efforts specifically redd surveys, snorkel surveys, and water quality.
- Continue to support Reclamation upon their request of information needed for their Reconsultation process with NMFS, in particular efforts to increase the ITS limits for both juvenile and adult *O. mykiss* to best cover the current and future population size.
- Continue to work closely with Reclamation on the implementation of the new 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;
- Work with Onset to improve functionality and reliability of their Hobo Shuttles for thermograph data downloads.
- 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 maximize support of the downstream fishery and minimize lake release stream temperatures entering the Long Pool and LSYR mainstem habitats downstream.
- Work with the Santa Ynez River Conservation District on further developing their ramp-up and ramp-down procedures for WR 89-18 releases to enhance the successful implementation of the release that was started in WY2020.
- Continue to evolve the collaborative relationship with CDFW regarding fish rescue within the LSYR basin. The effort was started in WY2020 it has been exemplary, and should be continued. Coordinate and prepare early as conditions warrant entering into the dry season.
- Initiate a PIT tag monitoring effort in the LSYR basin to trap current and future CDFW tagged fish. This will require obtaining the equipment and conducting the required monitoring effort.
- Continue to remove non-native fish species and 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;
- Investigate with Reclamation Stilling Basin management specifically 1) a Stilling Basin bypass pipeline system to provide target flow releases without the potential for thermal heating and warm water fish species movement downstream; 2) limiting *O. mykiss* access to the Stilling Basin, 3) establishing a small road for access to the Stilling Basin, and 4) dewatering of the Stilling Basin for non-native fish removal; and
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WY2021 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 WY2021 Annual Monitoring Summary (AMS) is to present the monitoring data collected in Water Year 2021 (WY2021, 10/1/20-9/30/21) 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) watershed below Bradbury Dam throughout WY2021 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), WY2019 Annual Monitoring Summary (COMB, 2020b), and WY2020 Annual Monitoring Summary (COMB, 2021).

The data summarized in this report describe the habitat conditions and the fishery observations in the LSYR during WY2021. 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 to provide seasonal continuity of life-cycle observation and *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).

WY2021 was classified as a dry year with 11.84 inches of precipitation recorded at Bradbury Dam (long-term average, 1953-2021, is 19.79 inches; 18th driest year of 69 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 9th driest rainfall year since issuance of the 2000 BiOp, with 11 of 22 years classified as dry (WY2007, WY2013, WY2002, WY2018, WY2015, WY2014, WY2004, WY2016, WY2021, WY2012, and WY2009; listed in order of severity), only 3 years as normal (WY2003, WY2020, and WY2000; listed in order of magnitude), and the rest were wet years (WY2008. WY2019, WY2010, WY2006, WY2017, WY2011, WY2001, and WY2005; listed in order of magnitude). Wet years 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 watersheds, 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 WY2021 and all BiOp take limits were followed. Reproduction and population status were monitored through spawner (redd) surveys and snorkel surveys.

WY2021 was a dry year following a normal year in WY2020. Entering into WY2021, the reservoir elevation at Lake Cachuma was at 70.0% capacity (135,402 af) and well above critical drought conditions. The reservoir had over 120,000 af of water at the beginning of the water year but fell below that threshold level on 3/31/21 casing a reduction in target flows to the Hwy 154 Bridge from 5.0 cfs to 2.5 cfs. There were only 5 storm events greater than 0.1 inches of rain recorded at Bradbury Dam; one small storm occurred during early November, a moderate storm in late December that created no stormflow, a

major storm in late January, and 2 small storms in mid-March. Essentially no rain fell on the basin after mid-March and dry conditions persisted for the remainder of the water year. The highest instantaneous flow recorded at H Street in Lompoc was 1,920 cfs on 1/28/21, which was sufficient to breach the LSYR lagoon and provide for ocean connectivity, but then river flows decreased to less than 10 cfs on 2/25/21 (29 days) and continued to decrease reaching zero flow on 3/26/21. Any anadromous steelhead entering the Santa Ynez watershed from the ocean or lagoon had a small window of opportunity in late January through late February when flow conditions were conducive to movement in and out of the LSYR basin.

The only stormflow event that generated flows that created upper basin flows in Hilton was the large January storm. Flows greater than 50 cfs were recorded in Hilton Creek on 1/28/21 before quickly decreasing 5.0 cfs a few days later. There was little to no upper basin flows throughout the rest of the water year.

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 (10/1/20 – 6/7/21), HCWS and HCEBS by gravity to URP and LRP (6/8/21 – 3rd week of July), and then HCEBS only by gravity to URP and LRP (from the end of July through the rest of the calendar year, the exact date of the end of HCWS gravity flow could not be determined).
- 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 until 9/30/21 when they have been more consistent.
- 10/1/20: Lake Cachuma at peak volume for WY2021 at 135,402 af at a lake elevation of 731.94 feet above mean sea level. The low point during WY2021 for the lake volume was 9/30/21 at 95,720 af (713.48 ft).
- 8/2/21 – 10/22/21: 2021 WR 89-18 releases with a total of 4,649 af 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 and the WR 2019-0148. 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 12 Annual Monitoring Reports/Summaries completed for WY2009 (USBR, 2012), WY2010 (USBR, 2013), WY2011 (COMB, 2013), WY2012 (COMB, 2016), WY2013 (COMB, 2017), WY2014 (COMB, 2018a), WY2015 (COMB, 2018b), WY2016 (COMB, 2019a), WY2017 (COMB, 2019b), WY2018 (COMB, 2020a), WY2019 (COMB, 2020b), WY2020 (COMB, 2021). 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 and north of Point Conception. 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, there is river connectivity with the LSYR lagoon, and the tributaries begin flowing. This typically occurs sometime after the first couple of major storms of the 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 than 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 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 WY2021 monitoring effort are organized by (1) hydrologic condition, (2) water quality, (3) habitat quality, (4) migration of *O. mykiss*, (5) Aging of *O. mykiss* migrant captures, (6) reproduction and rearing, (7) tributary enhancements project monitoring, and (8) 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 critically dry year with only 3,556 af of computed inflow to Lake Cachuma.

WY2021 had 11.84 inches of rainfall recorded at Bradbury Dam and was therefore classified as a dry year (less than 15 inches) (Table 1). The long-term average (1953-2021) at the dam is 19.79 inches. With only 11.84 inches of rain recorded at Bradbury Dam, WY2021 ranked well below the 2-year recurrence interval in Santa Barbara County for total rainfall amount (2-year recurrence = 18.10 inches). There was elevated stream runoff recorded within the LSYR mainstem and tributaries in WY2021 in association with the 1/23/21 storm only. The streamflow from the 1/23/21 storm was sufficient to breach the LSYR lagoon but then diminished from there on throughout the water year. The LSYR lagoon closed on 3/10/21 (85 days over the water year and only 30 days during the migration season). Peak instantaneous flow at H Street in Lompoc was 1,920 cfs on 1/28/21 (USGS) but river flows decreased to less than 10 cfs on 2/25/21 (29 days) and continued to decrease to zero on 3/26/21. At H Street, 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 showed passable conditions starting on 1/28/21 with flows peaking on 1/29/21 then decreasing to less than 25 cfs on 2/14/21 and zero by 3/26/21.

While the lagoon remained open after 2/14/21, anadromous *O. mykiss* entering from the ocean only had a small 17-day window of opportunity to move past H Street while flows were in excess of 25 cfs. The USGS Narrows gauge recorded an instantaneous peak flow rate of 2,170 cfs on 1/28/21 (daily average 1,010 cfs). Narrows flows had decreased to less than 25 cfs on 2/22/21. In Salsipuedes Creek, the highest recorded instantaneous peak discharge at the USGS gauging station at Jalama Road Bridge was 1,800 cfs recorded on 1/28/21 (daily average 897 cfs). The USGS Solvang gauge had a maximum instantaneous flow rate of 347 cfs on 1/29/21 (daily average 200 cfs). Rainfall from the January storm was focused on the western portion of the Santa Ynez River watershed (Salsipuedes Creek watershed) and not in the mid- to upper-watershed towards the east. Historic minimum, maximum, and WY2021 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 5 precipitation events in WY2021 with rainfall equal to or greater than 0.1 inches at Bradbury (Table 3 and Figure 1). The majority of the recorded precipitation at Bradbury Dam fell during the months of December (2.00 inches 16.9%) and January (8.39 inches, 70.9%) combining for 87.8% of the total rainfall for the year. While some of the triggers for the Fish Passage Supplementation Program were met (i.e., cumulative flow greater than 1000 af and ocean connectivity), the lack of any meaningful rainfall after the large January event and throughout the springtime eliminated the possibility of conducting Fish Passage Supplementation as flow conditions throughout the watershed

quickly attenuated following that late January storm. There was an ANA WR 89-18 water release that began on 8/2/21 and concluded on 10/22/21 with 4,649 af released in total over 81 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 anemic 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 1/28/21 through 2/26/21 with peak daily discharge of 40.6 cfs observed on 1/28/21. Flows at Los Laureles decreased to zero on 2/27/21 and did not flow again for the remainder of the year.

The Hilton Creek gauge (USGS-11125605) is a low flow gauge only (less than 50 cfs) and during the 1/28/21 stormflow event, stream discharge was above the recording threshold. The peak release from Bradbury Dam (Outlet Works plus the HCWS to Hilton Creek) was approximately 93.4 cfs on 8/8/21 during the 2021 WR 89-18 release. None of these discharge rates were high enough to cause any changes to the channel or banks within the LSYR mainstem.

Ocean Connectivity: The Santa Ynez River lagoon was open to the ocean from 4/4/20 until 12/7/20 when it closed. The sand berm was the breached on 1/28/21 in association with the largest storm of the year (1/23/21) that focused in on the lower watershed specifically the Salsipuedes Creek drainage. Ocean connectivity during the migration season was maintained for only 30 when the lagoon closed on 3/10/21. There were several days when the lagoon was temporarily closed between when it opened (1/28/21) and closed (3/10/21) for the rest of the migration season. Those 30 days did provide sufficient opportunity for anadromous fish to move into the Santa Ynez River basin from the ocean or lagoon as documented by the CDFW DIDSON near the Lompoc Airport and redd surveys in the Narrows Reach which are further detailed below. Streamflow went to zero at the H Street USGS gauge on 3/26/21 and remained dry for the rest of the water year. The USGS gauge at the Narrows went to less than 25 cfs on 2/22/21 suggesting that the migration opportunity for anadromous fish was short. 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 routinely 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.

Fish Passage Supplementation: No Fish Passage Supplementation occurred during WY2021. The criteria were not met even though the January storm did saturate the

watershed and created ocean connectivity but was not supplemented due to being the first storm in January. No storms thereafter were of sufficient magnitude to meet the criteria to supplement.

Adaptive Management Actions: There were no Adaptive Management Committee (AMC) meetings during WY2021. No flow allocations were made by the AMC from the Adaptive Management Account (AMA).

Target Flows: There were no spills from Bradbury Dam in WY2021. Reservoir storage remained above 120,000 af from the start of the water year (10/1/19) through 3/31/21 when it dropped below that threshold and BiOp (2000) target flows at the Hwy 154 Bridge went from 5.0 cfs to 2.5 cfs throughout the rest of the water year. Documenting Hwy 154 Bridge target flow compliance cannot be done at that specific location due to the channel configuration and landowner access limitations. Reclamation established a low-flow river discharge monitoring location approximately 1 mile downstream of the bridge where access is available. Reclamation takes a discharge measurement approximately once a month and COMB-FD once a week plus maintains a pressure transducer which takes a stage measurement once every 15 minutes. The objective is to maintain a river discharge at that monitoring location of 5.0 cfs if the lake storage is above 120,000 af (10/1/20 – 3/30/21) or 2.5 cfs or greater if the lake storage is below 120,000 af (3/31/21 – 9/30/21) to meet required target flows at the Hwy 154 Bridge upstream for WY2021. Based on the measurements at the monitoring location one mile downstream of the bridge, target flows were met by Reclamation for WY2021 except for a brief period in July when discharge measured approximately 2 cfs.

The required BiOp (2000) target flows for Hilton Creek on Reclamation property is a minimum of 2 cfs. Target flows to Hilton Creek were provided to the Upper Release Point (URP) and Lower Release Point (LRP) by gravity flow from either the Hilton Creek Watering System (HCWS), the Hilton Creek Emergency Backup System (HCEBS), or both. A minimum of 2 cfs by gravity flow were met until approximately 7/20/21 due to the drop of lake elevation (head) but remained above 1.5 cfs throughout the rest of the water year. NMFS was informed by Reclamation and concurred given the concerns of going to the HCWS pumps with the potential of power failure and interruption of flow to the creek. For reference, there were 10 PG&E power outages at Bradbury Dam during WY2021 that would have made continuous HCWS pump operations difficult.

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 2021 WR 89-18 ANA release that was initiated on 8/2/21 and ended on 10/22/21 that discharged 4,649 af of water from Lake Cachuma to recharge downstream aquifers over 81 days. A separate report was submitted after the release by COMB-FD to Reclamation that described the results of the monitoring effort associated with the release. Reclamation submitted that report to NMFS on 1/28/22.

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 (Outlet Works). 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 is delivered to Hilton Creek through the HCWS and/or HCEBS delivery systems and flows through Hilton Creek into the LSYR mainstem just upstream of 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 goes up and over the dam and eliminates having to use the Penstock (Outlet Works).

CCWA did not deliver SWP to the lake through the Penstock (Outlet Works) throughout the water year. Hence, the criterion was met for RPM 5.1 throughout WY2021 (Figures 4). All SWP deliveries to Lake Cachuma went through the bypass 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 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 fifth 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 (Figure 4). Reclamation does not routinely record water temperatures going through the Penstock when there is no SWP water being delivered through the Outlet Works. Hence, monthly lake profile data from the bottom were used as a surrogate since the profile is taken near the intake to the Penstock at the bottom of the lake.

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 with thermographs (recording continuously at the beginning of every hour) and dissolved oxygen concentrations with multi-parameter units (Sondes and U-26s). 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 warmest portion of the year (July through September). 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, specifically *O. mykiss*.

Water Temperature: During WY2021, 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 (Figure 5 and 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 31 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));
- LSYR Mainstem (WR 89-18) Trap Site (LSYR-6.08 (1));
- Double Canopy Pool (LSYR-7.65 (3));
- Head of Beaver Pool (LSYR-8.7 (3));
- Alisal Bedrock Pool (LSYR-10.2 (3));
- Avenue of the Flags (LSYR-13.9 (1)); and
- Cadwell Pool (LSYR-22.68 (3))

In the tributaries, there were 12 thermograph units deployed at 12 sites which are listed below, 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. There were problems with the optic shuttle for downloading thermograph data for units at several locations in the LSYR mainstem with no data recorded after 8/24/21. Occurrences are stated in the figure captions.

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 4/5/21 through 8/24/21 (Figure 6 (a) and Figures 11-13). An optic shuttle malfunction resulted in no data collected after 8/24/21. 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 causing a rapid decrease in water temperatures.

Water temperatures within the Stilling Basin showed gradual seasonal warming starting in April before rapidly cooling on 8/2/21 following the start of WR 89-18 downstream releases. The thermal warming is most pronounced at the surface unit and diminishing going to depth with stratification. A brief temperature spike greater than 22°C occurred on 5/12/21 on the surface only in association with a Reclamation valve replacement operation at the Outlet Works; no releases for approximate 8 hours during which time Stilling Basin water was pumped downstream to match the release rate, (USBR, 2021). This was followed by seasonal warming through June and early July. Maximum temperatures generally remained less than 22 °C for the entire deployment. Following the start of WR 89-18 releases, water temperatures decreased to less than 16°C followed by gradual warming through the later portion of August. Middle and bottom temperatures showed essentially the same trends and that the thermocline was established below 14-feet in depth.

No snorkel surveys were conducted in the Stilling Basin. Only adult carp and largemouth bass 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 WR 89-18 release, which provided cool water and a migration

corridor to the Stilling Basin from portions of lower Hilton Creek and Long Pool where numerous *O. mykiss* were observed in WY2021.

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 tailwater control point from 4/5/21 through 8/24/21 (Figure 6 (b) and Figure 14). Maximum water temperatures generally remained less than 23 ℃ during the lead up to WR 89-18 downstream releases. Overall, maximum temperatures at this site were near identical through the summer and slightly warmer compared to the Stilling Basin surface unit. Water temperatures decreased from a high of 22 ℃ to less than 16 ℃ following the start of WR 89-18 releases. *O. mykiss* were observed in and around this monitoring location during spring and fall snorkel surveys. It is likely some *O. mykiss* moved into the Stilling Basin as cold water from 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 (2017), the Long Pool has lost considerable length and depth due to extensive sedimentation input from the Hilton Creek watershed specifically from the Whittier Fire that burned the upper third of the watershed. Currently, the Long Pool is approximately 900 feet long and has a maximum depth of just under 5.5-feet (Figure 6 (c) and Figures 15-17). 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). Typically, water sources originate from the Outlet Works and Hilton Creek with mixing of the two sources occurring in the newly formed stream channel that traverses the delta. Though the Long Pool's overall length has decreased by 300-400 feet due to sedimentation, the length of Hilton Creek and where it confluences with the Long Pool has increased and appears to be a net benefit to rearing *O. mykiss* based on snorkel and redd survey data collected since 2017.

Over the last several decades, 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*. 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 though no carp were observed in Long Pool in WY2021. Beaver activity has also been an issue in the past; however, they are currently not present within the Hwy 154 Reach on Reclamation property. 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 significant reduction in the

numbers of both invasive species and an increase in numbers of multi-age size classes of *O. mykiss* (see snorkel survey section).

A vertical array was deployed on 4/5/21 and removed 8/25/21 at the deepest portion of the pool habitat at 1-foot, 2.5 feet and 5.5 feet below the surface. Maximum surface water temperatures fluctuated from approximately 16 ℃ in April and August (WR 89-18 release) to greater than 24.0 ℃ in late June and early July during a heatwave. Overall, minimum temperatures remaining less than 18.2 ℃ during the entire deployment period. Maximum temperatures show a several day duration spike at the beginning of July that was likely due to the fact that the surface unit was only a few inches below the water surface instead of the usual 1-foot below the surface. This resulted in slightly higher temperatures recorded compared to other sites. Maximum water temperatures at the middle unit closely mimicked those collected at the Stilling Basin bottom unit. Long Pool bottom temperatures generally remained at or slightly less than 18℃ during the entire deployment, especially following the initiation of the WR 89-18 release. Water quality conditions observed in Long Pool during WY2021 were favorable to rearing *O. mykiss* as evident by the observation of 77 multi-age class *O. mykiss* in the fall snorkel survey.

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 4/5/21 to 8/24/21 (Figure 6 (d) and Figure 18). Temperatures at this location were slightly cooler compared to surface units upstream with maximum temperatures remaining less than 22℃ and minimum temperatures remaining less than 18℃ for the entire deployment period, particularly following the start of the WR 89-18 releases. Adult, juvenile, and YOY *O. mykiss* were observed throughout this section of the river downstream of the Long Pool indicating good available rearing conditions throughout the year.

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 5/24/21 to 11/16/21 (Figure 6 (e) and Figure 19). This is the fourth year water temperature monitoring has occurred at this location. Water temperatures were nearly identical compared to LSYR-0.68 with maximum temperatures less than 22 ℃ and minimum temperatures less than 19 ℃ during a late June/early July heatwave. Rapid cooling was observed following the start of the WR-89-18 downstream releases. YOY, juvenile, and adult *O. mykiss* were observed throughout this area during spring and fall snorkel surveys.

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 5/24/21 to 11/16/21 (Figure 6 (f) and Figure 20). This is the fourth year water quality monitoring has occurred at this location. Water temperatures collected at this site showed slight warming during the early July heatwave, but otherwise, water temperatures were nearly identical to those collected at LSYR-1.09. Maximum water temperatures generally remained less than 22 ℃ during the warmest portion of the year (the early July heatwave being the exception). Minimum temperatures

remained less than 20 °C. The warming is most likely due to the absence of over story canopy and the presence of several large pool habitats between the two sites that allow for thermal heating, particularly during lower flow releases. Many YOY *O. mykiss* were observed both upstream and downstream of this location during spring snorkel surveys. Overall, *O. mykiss* numbers decreased during the fall snorkel surveys as the fish grew and moved to occupy deeper habitats or were displaced and moved to other habitats during the WR 89-18 releases. Water temperatures decreased significantly following the start of the downstream water rights releases.

Grimm Property - Pool (LSYR-1.71)

A three unit vertical array was deployed for the fourth year in this pool habitat from 5/24/21 to 11/16/21 (Figure 7 (a) and Figures 21-23). The habitat measures approximately 200 feet long, is 35 feet wide, and 6.5 feet deep. Surface water temperatures were nearly identical to those collected at LSYR-1.54 with the same corresponding spike associated with the early July heatwave. Middle and bottom temperatures were slightly cooler with bottom maximum temperatures generally less than 21 ℃ and minimum temperatures less than 20 ℃. YOY, juvenile, and adult *O. mykiss* were observed in this habitat during spring snorkel surveys with fewer numbers observed in the fall as the fish moved, were displace, or may have been predated upon. In addition, several size classes of largemouth bass were also observed in the spring, summer, and fall. Water temperatures showed a rapid decline following the start of WR 89-18 downstream releases, which provided cool water conditions after August and allowed a migratory pathway both upstream and downstream of this habitat.

Kaufman Property – Run (LSYR-2.77)

A single thermograph was deployed for the second time at this location at the head of a run habitat measuring 200 feet long, 20 feet wide, and 2 feet deep from 5/24/21 through 11/16/21. Maximum water temperatures were very similar compared to the Grimm property thermographs upstream with temperatures ranging from 22-23 ℃ during June and early July. Maximum temperatures gradually decreased after early July followed by a rapid decrease following the start of WR 89-18 downstream releases. Minimum temperatures were less than 20 ℃ during the entire deployment (Figure 24). Juvenile and adult *O. mykiss* were observed in this habitat during spring and fall snorkel surveys as well as several adult largemouth bass during the summer and fall 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 8 feet when residual pool depth is being maintained. A vertical array was deployed in this habitat from 4/5/21 to 8/25/21. (Figure 7 (b) and Figures 25-27). Maximum surface water temperatures were among the highest along the LSYR mainstem monitoring locations, exceeding 27°C during the middle portion of June through early July. Coincidently during this timeframe was a rapid decrease in flow with the river going dry upstream and downstream of this habitat when residual pool depth was lost. Middle maximum temperature exceeded 24 °C before decreasing in early July at roughly the same time as flow stopped with minimum temperatures mostly remaining less than 20 °C during the entire deployment. Bottom temperatures were the most notable

at this location due to the presence of nine relatively large adult *O. mykiss* inhabiting this section of the pool when inflow ceased. Overall, water temperatures collected at the bottom closely mimicked those collected at the bottom of the Grimm Pool (LSYR-1.71) with maximum temperatures remaining less than 21 °C prior to WR 89-18 releases when minimum temperatures went less than 19 °C.

Adult *O. mykiss* successfully oversummered in this habitat as bottom pool temperatures provided refuge habitat during the warmest portion of the summer. WR 89-18 flow reached this monitoring location on 8/3/21 and showed a brief and slight increase in water temperature, likely caused by water flowing over a hot and dry channel before reaching the habitat. Once the flow reached the habitat general cooling was recorded while higher flow rates were being maintained. As the higher flow rates were decreased, there was a corresponding increase in water temperatures, but still cooler when compared to water temperatures before the release with bottom temperatures decreasing further. Of note was an increase in the *O. mykiss* observed prior to and after WR 89-18 water reached the site. Fall snorkel surveys observed six new juvenile *O. mykiss* (taking the total to 15 *O. mykiss*) that appeared to have moved into the habitat after WR 89-18 release reached the site showing fish movement into that refuge habitat during the downstream water rights release. The fish likely originated from upstream habitats in the Highway 154 or upper Refugio reach as the river channel was dry both upstream and downstream of the Encantado Pool prior to the release. Invasive warm water species were also observed in this habitat during snorkel surveys, primarily adult and juvenile largemouth bass and sunfish.

LSYR Mainstem (WR 89-18) Trap Site - Run (LSYR-6.08)

A single thermograph was attached to the trapping infrastructure from 8/2/21 through 8/26/21 to monitor water temperatures during trapping operations of the WR 89-18 release. The unit was attached to the trap infrastructure (A-frame) approximately 1-foot from the bottom of the river. Water arrived at the site on 8/5/21 sometime between 19:00 and 20:00 hours (the unit was recording every hour). Maximum water temperatures were lowest during the highest flow rates and generally remained less than 22°C except for the first day after water arrived at the site when maximum temperatures reached 23°C (Figure 28). Maximum water temperatures trended lower for over a week after the water rights front arrived then trended higher to a maximum temperature of 26°C. The unit was removed when the traps were removed. This increase in temperature corresponds to a reduction of releases at Bradbury, showing that thermal control were slightly maintained at SYR-6.08 at higher flow rates. Minimum temperatures generally remained at or less than 18°C. A downstream juvenile (85 mm, 3.3 inch) *O. mykiss* was captured in the downstream trap during the morning hours on 8/12/21 when water temperatures were approximately 17 °C. The *O. mykiss* was collected, placed in an aerated 5-gallon bucket, and successfully relocated to a pool habitat in Hilton Creek as per established protocol. Numerous warm water invasive species were captured during trapping operations (i.e., largemouth bass, sunfish species, adult bullfrogs, and bullhead catfish).

Of note were two juvenile *O. mykiss* rescued from a drying pool habitat (previously dry prior to WR 89-18 releases) during post-release/stranding surveys approximately 200

yards downstream of the LSYR mainstem trapping location on 10/27/21. Finding *O. mykiss* in this habitat was a complete surprise given past observations and suggests that *O. mykiss* may move downstream during a WR 89-18 releases in Reach 2a and did so sometime after the trap was removed on 8/26/21. Moving upstream from downstream habitats was unlikely due to their size, a sequence of large beaver dams just downstream that would have impeded upstream movement and no *O. mykiss* observed within and downstream of those beaver dam complexes. A report was provided to Reclamation, which was submitted to NMFS by Reclamation on 1/28/22 with the 2021 WR 89-18 RPM 6 Report.

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. There is a significant beaver dam in the habitat directly upstream and at the bottom of the Double Canopy pool (150 feet upstream of the Refugio Bridge) (Figure 7 (c)). A three-unit vertical array was deployed at this site from 4/5/21 to 7/14/21 (Figures 29-31). Unfortunately, members of the general public went to great lengths to remove the cabled thermograph array and the tree branch it was attached to and stole the units. The theft was discovered on 8/24/21. Snorkel and bank surveys were conducted in an attempt to locate the units but were unsuccessful and the units remain missing. Data collected through the monitoring period show that the Double Canopy habitat recorded some of coolest water temperatures compared to all LSYR mainstem locations during the same timeframe. Maximum temperatures at the surface and middle units were essentially identical and remained below 21 °C while minimum temperatures were less than 19 °C. Bottom maximum temperatures remained less than 20 °C during the entire deployment. Though the data is not available, it is likely (compared to thermograph monitoring locations upstream and downstream) that water temperatures decreased further or essentially remained the same once the WR 89-18 release reached the site. Two adult *O. mykiss* were observed in this habitat during summer and fall snorkel surveys showing successful oversummering at LSYR-7.65 during WY2021. Numerous adult largemouth bass, sunfish species, and carp were also observed during snorkel surveys.

Head of Beaver Pool (LSYR-8.7)

This habitat is located approximately ¼ mile downstream of the Quiota Creek confluence with the LSYR mainstem. 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 period (Figure 7 (d) and Figures 32-34). A vertical array was deployed in this habitat from 4/5/21 to 8/25/21. Maximum surface temperatures ranged from 22.5 °C during the warmest portion of the year with minimum surface temperatures around 18 °C or less during most of the deployment. The middle and bottom units recorded lower temperatures compared to the surface making this a suitable rearing habitat. Unfortunately, no *O. mykiss* were observed in this unit during spring and fall snorkel surveys. WR 89-18 water reached this site on 8/6/21 that was noted primarily at the middle and bottom locations which recorded a corresponding 1+ °C increase in maximum water temperature and <1 °C decrease in

minimum temperatures. No invasive warm water species were observed in this habitat during the spring and fall snorkel surveys.

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 4/6/21 to 8/25/21 (Figure 7 (e) and Figures 35-37). Prior to WR 89-18 water reaching the site on 8/7/21, maximum water temperatures exceeded 26 °C during the July timeframe. Once the release reached the site, the surface unit recorded the largest temperature spike (29 °C) compared to all other LSYR mainstem monitoring locations. Once release water reached the site there was a corresponding rapid reduction of maximum temperatures from 29 °C to 21 °C followed by a slight warming trend before the data stream stops. Minimum surface water temperatures were less than 22 °C prior to the release and decreased to 18 °C once the water reached the site. Both the middle and bottom units did not record a temperature spike and instead showed a corresponding decrease in temperature of several degrees. Though no *O. mykiss* were observed in the habitat, bottom water temperature conditions compared to upstream monitoring locations with *O. mykiss* present indicated that rearing temperatures were favorable to *O. mykiss*. Bottom temperatures prior to the release hovered around 21 °C and decreased to approximately 19 °C once release water reached the site. Invasive warm water species observed included largemouth bass, sunfish species, and carp.

Avenue of the Flags – Pool (LSYR-13.9)

The habitat was approximately 65 feet long and 20 feet wide at its widest point with a maximum depth of approximately 4 feet. A single unit was deployed in this habitat from 4/6/21 to 8/25/21 one foot off the bottom (Figure 7 (f) and Figure 38). Water temperatures started off cool at this location with maximum temperatures less than 18 °C at the beginning of April, reaching a maximum of 20 °C in mid-July. As surface flow diminished, daily variation was essentially absent at this monitoring location until WR 89-18 water reached the site due to greater contribution of cool groundwater compared to surface flow. Once the release waters reached the site, there was a corresponding 4 °C increase in maximum temperature (to 22.5 °C) and a 1 °C increase in minimum temperature (to 19 °C). Minimum temperatures remained less than 20 °C and maximum temperatures remained less than 22.5 °C for the rest of the deployment. 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 4/6/21 to 8/25/21 (Figure 8 (a) and Figures 39-41). The Cadwell pool remained relatively cool throughout the deployment period. Surface and middle thermographs recorded essentially the same water temperatures with maximum temperature remaining less than 21 °C and minimum temperatures less than 20 °C. Bottom temperatures showed little variation, remaining less than 20 °C throughout the monitoring period. No *O. mykiss* were observed in this habitat, only invasive species including largemouth bass, sunfish species, and carp.

LSYR Mainstem Longitudinal Comparisons

Longitudinal LSYR mainstem (maximum daily) water temperature at the surface thermographs for LSYR-0.01, LSYR-0.25, LSYR-0.51, LSYR-0.68, LSYR-1.09, LSYR-1.54, LSYR-1.71, LSYR-2.77, LSYR-4.95, LSYR-7.65, LSYR-8.7, LSYR-10.2, LSYR-13.9, and LSYR-22.68 including USGS flows at Hilton Creek and Alisal Bridge in Solvang are presented in Figure 42. Longitudinal maximum surface temperature comparison is complicated to interpret due to the variety of complex environmental variables all acting in conjunction with each other at each individual site (i.e., flow rate, riparian vegetation development / riparian shading, ambient air temperatures, groundwater upwelling, pool stratification, etc.). In addition, the analysis only looks at the surface water temperature at all sites and does not look at bottom temperatures in pool habitats with vertical arrays (i.e., LSYR-0.01, LSYR-0.51, LSYR-1.71, LSYR-4.95, LSYR-7.65, LSYR-8.7, LSYR-10.2, and LSYR-22.68). Surface maximum temperatures, particularly in pool habitats does not reflect the general rearing potential throughout the water column of each habitat. For example, *O. mykiss* observed in pool habitats at LSYR-0.51, LSYR-1.71, LSYR-4.95 and LSYR-7.65 with elevated surface water temperatures do not inhabit fish survival and rearing specifically during the warmest portion of the year. Those fish are observed almost exclusively near the bottom or mid-water column of the habitats where cooler water quality conditions persisted due to stratification and/or groundwater upwelling. For a more complete presentation of each specific habitat, see above.

Factors influencing surface water temperatures along the longitudinal profile include: (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*.

WY2021 was a dry year type with no measurable rain after mid-March. The Hwy 154 target flows enabled flow to persist through the entire Hwy 154 Reach and portions of the upper Refugio Reach through late June. By July, portions of the Refugio Reach and Alisal Reach had completely dried, specifically approximately 0.5 miles upstream of LSYR-4.95 and from LSYR-5.0 to LSYR-7.0 as well as sections of the Alisal Reach upstream of LSYR-10.2 and in areas 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 WR 89-18 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.

Overall, maximum daily water temperatures generally increased going downstream and remained less than 24 ℃ during the warmest portion of the year prior to WR 89-18

releases reaching each site. The two exceptions to the above observation were LSYR-4.95 and LSYR-10.2 which recorded noticeably higher surface 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 7.0), particularly in deeper pool habitats based on recorded water temperatures. The majority of the *O. mykiss* were in the Hwy 154 Reach and areas upstream of Encantado Pool (LSYR-4.95), with a few juveniles and adults scattered as far downstream as LSYR-7.8. Most of the YOYs observed upstream of LSYR-2.77 likely originated from successful spawning in Hilton Creek (48 redds documented) and localized areas within the Hwy 154 Reach where some suitable spawning habitats were available. Of note were the snorkel observations of numerous large adults in deeper pool habitats in the Hwy 154 Reach which likely points to the potential for another abundant spawning year in Hilton Creek during the spawning season of WY2022. Snorkel survey results recorded more juvenile and adult *O. mykiss* than over 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 (see snorkel survey results). Most of these fish inhabited deeper pool habitats where stratification and groundwater inflow contributed to lower water temperatures in the summer and early fall before general ambient temperatures began to decrease with the days getting shorter and the drop off of evapotranspiration. Monitored water temperatures showed cooler and more favorable rearing conditions compared to previous years possibly due to the timing and operation of the WR 89-18 releases. Plus there were more upstream production of *O. mykiss* than in previous years that may also have 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 WY2021.

Tributary Thermographs: The data from single thermograph deployments are presented by site from downstream to upstream along each creek (Figure 5 and Tables 5 and 6). Optic shuttle problems continued for downloading thermograph data for units deployed in Hilton and Quiota creeks and some locations in Salsipuedes Creek with no data recorded after 8/24/21. Occurrences are stated in the figure captions.

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 4/5/21 to 8/24/21. Maximum water temperatures remained near or less than 17 °C during the entire period of deployment (Figure 8 (b) and Figure 43). YOY and juvenile *O. mykiss* were observed throughout this section of the creek during all of WY2021. 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 4/5/21 to 8/24/21. 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 less than 15 °C for the entire deployment period (Figure 8 (c) and Figure 44). *O. mykiss* were observed inhabiting the creek at this monitoring location throughout the year indicating optimal rearing conditions though numbers declined as flows to the creek at the URP decreased and the potential for heron predation increased. 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 from thermal heating between the upper and lower monitoring sites. The cool water releases coupled with the intact riparian canopy contributed to the continued low water temperatures readings from the URP downstream. Increasing the discharge rate to the URP would likely reduce bird predation by providing greater depth and cover to rearing *O. mykiss* in this upper section of the creek. Further discussion of lake water releases to Hilton Creek are provided in Section 4.

Quiota Creek (QC-2.66)

A single thermograph was deployed approximately 35 feet upstream of Crossing 6 on Refugio Road from 4/5/21 through 8/17/21 (Figure 8 (d) and Figure 45). The unit was placed at the bottom of a pool habitat 30 feet long and 10 feet wide with a depth of approximately 2.75 feet. Maximum water temperatures fluctuated between 16 °C and 22 °C during the period of deployment. Declining water levels required the removal of the thermograph unit on 8/17/21 as the pool habitat was decreasing and residual pool depth was no longer being maintained. YOY *O. mykiss* were observed rearing in this habitat prior to it drying out.

Lower Salsipuedes Creek (SC-0.77)

A single thermograph was deployed in this habitat approximately 4.5 feet below the surface from 4/12/21 to 11/10/21. An optic shuttle malfunction resulted in a loss of data between 8/24/21 through 9/29/21. The thermograph was moved 40 feet upstream to a similar habitat from the previous year's deployment due to the difficulty in reaching the old deployment site (too deep). The habitat measured approximately 40 feet long, 15 feet wide with a maximum depth of 5.0 feet (Figure 8 (e) and Figure 46). Water temperatures showed relatively stable water temperatures during the period of deployment with maximum temperatures at or slightly above 20 °C during the entire period of deployment. Minimum temperatures remained less than 19 °C indicating that rearing temperatures were suitable for *O. mykiss* throughout the year at this location. No *O. mykiss* were observed in this habitat though *O. mykiss* were observed in habitats directly upstream during WY2021 snorkel surveys. Invasive green sunfish were observed throughout this section of the creek.

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

A single thermograph was deployed in a pool habitat approximately 4 feet below the surface from 4/12/21 through 11/10/21 within Reach 2. This 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 9-10 feet deep at its deepest point (Figure 8 (f) and Figure 47). *O. mykiss* have been routinely observed at this location when visibility permits. Spawning surveys routinely document *O. mykiss* redds in this reach of the creek. Water temperatures showed typical seasonal warming, peaking in June through early August with maximum temperatures between 21-22 °C and minimum temperatures between 19-21 °C during the warmest portion of the year. Starting in August, water temperatures showed a slow decline followed by a rapid decline by early September. *O. mykiss* were observed throughout Reach 2 during spring and fall snorkel surveys in WY2021. In the last 4-5 years, this habitat along with much of the creek has been populated by numerous invasive green sunfish.

Salsipuedes Creek – Highway 1 Bridge (SC-3.0)

A single thermograph was deployed in the pool habitat approximately 6 feet below the surface, directly downstream of the Hwy 1 fish ladder from 4/12/21 through 11/10/21. On 6/1/20, the unit was relocated 200 feet downstream from its original location to a large pool habitat due to CalTrans bridge replacement construction activities. The new deployment site was in the deepest pool on Salsipuedes Creek measuring 175 feet long and 45 feet wide with a maximum depth of approximately 14 feet (Figure 9 (a) and Figure 48). 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 17 °C to 20 °C. While no *O. mykiss* were observed in the pool habitat due to turbid conditions, *O. mykiss* were observed immediately upstream and downstream of this habitat which suggested they were likely rearing in the deeper sections of this large pool habitat. Green sunfish were also observed this habitat during spring and fall 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 4/12/21 through 11/10/21. The pool was approximately 30 feet long, 18 feet wide, and 6 feet in depth (Figure 9 (b) and Figure 49). 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 has held oversummering *O. mykiss* and YOY, juvenile, and adult *O. mykiss* were observed in this habitat as well as in upstream and downstream habitats during the spring and fall snorkel surveys in WY2021. Maximum water temperatures ranged from around 18 °C to over 22 °C during the warmest portion of the year with minimum temperatures generally remaining less than 20

°C. These temperatures provided suitable rearing conditions for *O. mykiss* present in this and the surrounding habitats. Green sunfish adults and juveniles were observed in this habitat during the spring and fall snorkel surveys.

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, 3 feet wide, and approximately 0.5-foot deep from 4/14/21 through 8/1/21 (Figure 9 (c) and Figure 50). Due to the dry year type with essentially no spring rain in 2021, Lower Salsipuedes was dry on 8/1/21. 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 when water was present. *O. mykiss* were observed in the confluence pool habitat approximately 35 feet downstream. Maximum water temperatures remained less than 21 °C during the entire deployment period. Minimum temperatures remained less than 17 °C for the entirety of the deployment period). YOY *O. mykiss* were observed immediately downstream in the confluence pool of Salsipuedes/El Jaro Creeks during spring snorkel surveys.

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

A single thermograph was deployed at the bottom of a pool habitat immediately upstream of the El Jaro/Salsipuedes Creek confluence from 4/14/21 to 8/23/21. The habitat is roughly 50 feet long and 12 feet wide with a max depth of 1.5 feet (Figure 9 (d) and Figure 51). This location routinely held rearing *O. mykiss* prior to the drought and numerous YOYs were observed during the spring snorkel surveys in this habitat and in multiple other upstream habitats. Water temperature data collected at this location were generally cooler compared to the other thermographs within the watershed. Maximum water temperatures generally remained less than 20 °C during the deployment with minimum temperatures less than 17 °C. As the season progressed, flow within the lower section of El Jaro Creek completely ceased leaving small isolated shallow pool habitats. By 8/23/21, the thermograph was removed as the deployment habitat was dry. Fall snorkel surveys noted several YOY occupying isolated habitats upstream of the Salsipuedes/El Jaro creek confluence.

El Jaro Creek – Palos Colorados (EJC-5.4)

A single thermograph was deployed 0.5 feet from the bottom of a boulder-influenced pool habitat from 4/12/21 through 11/15/21. The habitat measured approximately 35 feet long, 7 feet wide and 3.5 feet deep (Figure 9 (e) and Figure 52). *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, extirpating *O. mykiss* from this section of the creek. No *O. mykiss* were observed in 2021 though several juvenile *O. mykiss* were observed in a pool habitat approximately 300 feet downstream. Water temperatures showed an increased daily variation during the early portion of the deployment period. During the warmest portion of the year, maximum water temperatures remained less than 21 °C and minimum temperatures less than 20 °C indicating good potential rearing habitat when fish were present. Upstream of Palos Colorados Creek, large portions of El Jaro Creek dried during 2021.

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. 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 was possible with sufficient streamflow. Unfortunately, this habitat and large portions of Upper El Jaro Creek again dried out in WY2021. A thermograph was deployed in the pool habitat immediately downstream of the bridge from 4/12/21 and removed on 8/11/21 due to drying conditions (Figure 9 (f) and Figure 53). During the deployment, water temperatures showed a steady increase coincident with seasonal warming, reaching a maximum of 24 °C near the end of the deployment. Minimum temperatures remained less than 20 °C when water was present. No *O. mykiss* or warm water species were observed in this habitat during snorkel surveys.

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

A single thermograph was deployed 0.5 feet from the bottom of a corner scour pool habitat from 4/12/21 through 11/15/21. 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 (Figure 10 and Figure 54). 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 drying 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 landowner in 2020 and 2021 indicated that the majority of the creek upstream of the monitoring location was completely dry once again in WY2021. Maximum water temperatures in the small flowing section of Los Amoles Creek were cooler compared to other monitoring stations in the watershed. Overall, maximum water temperatures remained less than 22 °C for the majority of the deployment with minimum temperatures generally remaining less than 19 °C. No *O. mykiss* were observed at this monitoring location in WY2021 though water temperatures remain favorable.

Salsipuedes Creek Longitudinal Comparisons

Longitudinal maximum daily water temperatures for Salsipuedes Creek and El Jaro Creek are shown in Figure 55 for the thermographs at Rancho San Julian (EJC-10.82), Palos Colorados (EJC-5.4), Los Amoles Creek (LAC-7.0), 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 was 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. Drying conditions required the removal of thermographs at SC-3.81, EJC-3.8, and EJC 10.82. For the remaining thermographs, water temperatures collected in the Salsipuedes/El Jaro Creek watershed were noticeably cooler compared to previous years with the majority of maximum water temperatures remaining at or less than 22 °C during the entire year. When looking at Salsipuedes Creek flow, there was more 24-hour temperature variation between the sites at flows greater than 0.5 cfs (primarily during the May through June period). As flows decreased, less 24-hour temperature variations were recorded.

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. Unfortunately, the dry water year of 2021 (11.84 inches) again caused significant restriction in habitat extent, specifically in Lower Salsipuedes Creek downstream of Santa Rosa Bridge (dry) and portions of El Jaro Creek upstream of the Upper Salsipuedes confluence to Rancho San Julian (dry). As seen in WY2020, most of Los Amoles Creek, and all of Ytias Creek went dry in WY2021. Whether this was caused by the long-term drought conditions in the past or some other draw on the groundwater supply was not clear but the watershed have not entirely recovered to pre-drought dry season condition.

Spawning surveys identified seven separate redd sites within Salsipuedes Creek and four in El Jaro Creek. Follow up snorkel surveys noted the presence of YOY in large numbers from SC-3.81 downstream to SC-3.0, with moderate numbers observed downstream of SC-2.2. Moderate numbers of YOY were also observed in a portion of El Jaro Creek around EJC-4.0 (upstream of Cross Creek Ranch) and directly upstream of the confluence with Salsipuedes Creek before that section of the creek dried as well. Concentrations of YOY were closely associated to the proximity of spawning sites identified in March and April of 2021. 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, water quality 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 by invasive warm water species over the past several years, specifically green sunfish, largemouth bass, bullhead catfish, bullfrog, and carp. Their numbers have been low and they have generally been limited 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, WY2020, and WY2021 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-4.95: A single Onset U-26 dissolved oxygen/temperature logger was deployed to monitor water quality within the first 5 miles downstream of Bradbury Dam prior to and immediately following the WR 89-18 water rights releases.

Encantado Pool (LSYR-4.95)

A single U-26 temperature/dissolved oxygen unit was deployed in the mid-water column of the Encantado Pool from 7/13/21 – 8/25/21 to monitor water quality conditions for the *O. mykiss* present in the habitat prior to and immediately following WR 89-18 releases (release started on 8/2/21). Release water reached the site on 8/5/21 at approximately 16:00 hours. Two weeks prior to the release inflow and outflow to the habitat had ceased creating an isolated pool habitat inhabited by approximately nine adult *O. mykiss* and numerous largemouth bass of various sizes. Prior to the release water temperatures showed little 24-hour variation, ranging from 18°C - 21°C. Dissolved oxygen showed a wide variation ranging from a high of around 11.0 mg/L to a low of nearly 1.0 mg/L. Several days prior to the release water reaching the site, there was a slight improvement in dissolved oxygen concentrations (Figure 56). Once the water reached the site there was a slight increase in water temperature which is not unexpected as the water was flowing through a hot, dry river channel during the heat of the day before reaching the habitat. Once the water started to mix within the habitat, there was a general cooling to less than 18 °C followed by gradual warming through the end of the deployment. Dissolved oxygen concentration decreased from 6.45 mg/L at 16:00 hours to about 2.09 mg/L at 0:00 hours (most likely was due to mixing of stratified low DO waters towards to bottom) before gradually rising again. While dissolved oxygen concentrations regularly dipped into values that are considered stressful to rearing *O. mykiss* during portions of the instrument deployment, the short duration of the exposure did not appear to cause a long-term negative impact as the same fish were present in the habitat following the end of the releases in November. In addition, there were six juvenile *O. mykiss* observed following the release indicating that these fish moved into the habitat during the downstream water rights release.

Lake Cachuma Water Quality Profiles: Water quality profiles were collected at Bradbury Dam near the intake for the HCWS on 1/12/21, 2/2/21, 3/2/21, 4/7/21, 5/4/21, 6/1/21, 7/6/21, 8/3/21, 9/7/21, 10/5/21, 11/2/21, 11/23/21 and 12/7/21 (Figure 57). 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 which is close to the deepest part of the lake. In 2021, 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 the thermocline and 18 °C. Lake Cachuma reservoir remained over 50% capacity through WY2021 (except for a short period at the end of the water year) compared to the drought period between WY2012-WY2016 when it was well below 50%, so water temperatures being released into Hilton Creek at both release points (URP and LRP) remained generally below 15 °C throughout the year.

The first three lake profiles of the year between January and March indicated very cold and uniform reservoir temperatures from the surface down to the bottom of the lake, ranging from 11.5 °C – 12.9 °C (Figure 57). The third profile in March had warming surface waters at 16.0 °C with temperatures below at 13.0 °C starting at a depth of 52 feet. By April, the surface temperature had reached 19.3 °C with the thermocline just beginning to form at a depth of 30 feet. The final spring profile occurred at the start of June with the surface warming to 20.5 °C and a steady thermocline developing to depth. There were three summer lake profiles conducted between July and September, each with high surface temperatures ranging from 23.4 °C in July to a maximum of 24.1 °C in August. Summer profiles indicated that the thermocline formed between 30-36 feet below the surface and extended down to approximately 54 feet in depth. Bottom temperatures during the same time frame were steady and ranged from 13.5 °C – 13.8 °C. By October the surface of the lake had cooled, but the reservoir was still in a stratified condition. The two lake profiles in November showed much cooler conditions near the surface (17.1 °C – 17.7 °C) but the lake was still in a stratified condition. The final lake profile of the season was taken on 12/7/21 with near unithermal conditions from the surface (15.4 °C) down to the bottom (14.3 °C) of the lake, suggesting that a slow lake turnover was still in process. The observed late season lake turnover was unusual as historically the lake turns over between late October and middle of November.

DO concentrations at the surface of the lake gradually climbed from 8.51 mg/l in January to 9.35 mg/l in March (Figure 57). DO concentrations remained above 6.0 mg/l at all depths during the first three months of the year. Profiles collected in April and May continued to show elevated surface DO concentrations with all DO measurements remaining over 5.0 mg/l even at the bottom of the lake. Anoxic conditions at depth began to appear in June with DO dropping below 5.0 mg/l at 50 feet below the surface. By July,

anoxic conditions started at 33 feet below the surface and the DO plunged to less than 1.0 mg/l towards the bottom of the lake. Profiles from August through October confirmed elevated DO ranging between 7.5 mg/l – 8.1 mg/l from the surface down to approximately 33 feet in depth. Anoxic conditions persisted into the fall with severe hypolimnetic oxygen depletion found at greater depths. Lake profiles in November showed elevated DO pushing further to depth with anoxic conditions occurring 62-66 feet below the surface. The final profile taken in December indicated a more uniform oxygen concentration from the surface (7.3 mg/l) down to 75 feet below the surface (6.7 mg/l). Anoxic conditions were still present at the bottom 7 meters of the profile, evidence that full lake turnover had not occurred yet.

3.3. Habitat Quality within the LSYR Basin

Habitat quality monitoring during WY2021 within the LSYR Basin was conducted 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 WY2021 LSYR mainstem photo points is provided in Appendix C (Figure C-1 and 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 LSYR 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, Figure C-1 and Table C-2).

Photo point comparison between 2005 and 2021 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 58-62). Sections of the LSYR mainstem that were nearly devoid of vegetation in 2005 now show abundant new growth with willow, sycamore, and cottonwood trees in excess of 30 feet in height in many locations. The recent drought caused significant die off of riparian vegetation throughout the LSYR 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 with WY2021 being the most recent dry year. 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, the absence of spill events for the past 10 years has contributed to increased riparian encroachment creating more complex and shaded habitats.

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 63-64). 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 65-67). 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. Exceptions to trapping include 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 no trapping in WY2013 due to a misinterpretation of a NMFS incidental take request by Reclamation. Results from this year's migrant trapping effort remained below the 2000 BiOp established Incidental Take Statement (ITS) limits due to modified trapping operations that truncate migrate trapping efforts.

WY2021 was the eighth 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 has been started in February (instead of January) to reduce numbers captured and to stay within the ITS. The trapping effort focuses on upstream migrating adults early in the season followed by a focus on out migrating smolts (often juveniles) during the second half of the migration season. Trapping typically ends before the completion of the smolting run as juvenile ITS numbers are usually reached by early April and does not reflect actual total numbers of outmigrating smolts leaving both Hilton and Salsipuedes Creek watersheds. 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 is secured to the back of the downstream traps below the water level to provide unhindered downstream movement when activated/open.

During the WY2021 trapping season, the HDPE pipe was installed at Hilton Creek only to stay within established take limits as the juvenile population was significantly greater compared to Salsipuedes Creek. It was decided that a HDPE pipe was not necessary at

the Salsipuedes Creek trap site due to the low population size and limited captures the past four years. Juvenile and adult take limits were not exceeded during the WY2021 trapping season.

In WY2021, migrant traps were deployed in Hilton and Salsipuedes Creeks. LYSR mainstem traps were not deployed due to low flow conditions, the lack of spring rains, and no Passage Supplementation Releases. Two sets of paired upstream and downstream migrant traps were deployed at: (1) lower Hilton Creek (tributary farthest from the ocean) 0.14 miles upstream from the confluence with the mainstem LSYR (HC-0.14) and (2) lower Salsipuedes Creek (tributary closest to ocean) 0.7 miles upstream of the confluence with the LSYR mainstem (SC-0.7).

Migrant traps were installed in Hilton Creek (2/1/21 – 4/6/21) and Salsipuedes Creek (2/1/21 – 4/6/21) (Table 7). The downstream Hilton Creek trap pass through system was activated on two separate occasions (3/16/21 – 3/22/21 and 3/25/21 – 3/30/21) to reduce the likelihood of juvenile take being met and allowed for continued migrant trapping activities in both creeks.

As in WY2020, the weather pattern during WY2021 was not conducive in providing prolonged migratory conditions. Rainfall was inconsistent and sporadic with only two storm events of any significance influencing the watershed, both early in the year. The first storm was a moderate storm that impacted the area in late December and dropped 1.99 inches of rain (16.9% of the yearly total). The 2000-2021 average of rainfall in December is 16.6%, which is roughly the average for the past 21 years. At the end of January 2021, an atmospheric rain event hit the watershed during a nine-day period, dropping 8.38 inches of rain (70.9% of the yearly total). By comparison, from 2000-2021, average January rainfall is 24.4% and average rainfall from the combined months of January through March is 62.8%. The January storm generated high magnitude, short duration flows throughout the watershed, opening the lagoon and providing a small window of opportunity for upstream and downstream migration. Rainfall in February (0.1 inches; 0.8 % of yearly total) and March (1.02 inches; 8.6 % of yearly total) was minimal and accounted for only 9.4% of the yearly total rainfall (Table 3). Because of the lack of spring rains, upstream and downstream migration opportunities quickly dwindled with flows at H Street dropping to less than 25 cfs after only 17 days (1/28/21 – 2/13/21).

During WY2021, there were seven passage days (1/28/21 – 2/3/21) with flows greater than 25 cfs at Solvang during the migration season, all from runoff from the late January storm. Flows continued to decrease in the absence of spring rains and by 5/15/21, flows at Solvang were zero. No Passage Supplementation Releases occurred due to not meeting the established criteria. Catch per unit effort (CPUE) for WY2021 at the Hilton Creek upstream and downstream migrant trap, and Salsipuedes Creek (upstream and downstream) traps were 1.32, 1.87, and 0.28 (100%, 83%, and 100% efficiency), respectively (Table 8). The downstream trap at Hilton Creek was taken out of service on two separate occasions in March in order to stay within the allotted take limit. It is unknown how many smolts exited Hilton Creek during the 11 days the downstream trap

was open and smolts were still being captured in April when the traps had to be removed due to reaching the established take limit for juveniles.

Nighttime fish movement is a well-documented survival 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. WY2021 migrant trapping results suggested *O. mykiss* in general were more likely to move during the late night (2nd check) and early morning hours (1st check) (Table 9).

During the migration/trapping season, baseflows in Hilton Creek were maintained right around 5.0 cfs (range 4.87 - 5.46 cfs) except for a brief increase in January when flows exceeded 50 cfs coincident with the 1/23/21 storm event with upper basin flows. Streamflow in excess of 5.0 cfs provided nearly unimpeded movement of adult and juvenile fish in the Hilton Creek system. By contrast, flows in Salsipuedes Creek generally remained less than 1.0 cfs prior to the late January storm event. Following that event, streamflows quickly dropped from a daily average of 897 cfs on 1/28/21 to less than 5.0 cfs on 2/4/21. Flows continued to drop and by 4/6/21 (trap removal), flows had decreased to 1.82 cfs. In the LSYR, the USGS Solvang gauge recorded flows in excess of 25 cfs for only a 7-day period from 1/28/21 – 2/3/21 before steadily decreasing and reaching zero flow on 5/15/21. The lagoon opened to the ocean on 1/28/21 but the USGS H Street gauge on the Lompoc Airport went to zero on 3/26/21 which suggested limited anadromous migration. The storm track for that January storm was more focused on the western watershed and not the mid or eastern watershed which further limited upstream migration much beyond the Salsipuedes Creek confluence.

Hilton Creek Migrant Traps: Both upstream and downstream migrant traps were installed from 2/1/21 through 4/6/21 (Table 7). There were 86 upstream migrant captures ranging in size from 84 mm (3.3 inches) to 430 mm (16.9 inches) of which 5 were recaptures (Figure 68, Figure 69, and Table 10). Fifteen of the upstream migrants were classified as parr, 19 were classified as juveniles (<254 mm (10 inches)), one classified as a pre-smolt, and the remainder (52) were classified as adults (>= 254 mm (10 inches)). Upstream migrating fish were captured throughout the trap deployment after the high flow event in late January (Figure 70). There were 101 downstream migrating fish captured ranging in size from 85 mm (3.3 inches) to 425 mm (16.7 inches) of which 21 were recaptures. Downstream migrating fish were captured throughout the trap deployment with no spring storm to generate any additional flow cues following the late January storm event. Thirteen of the fish were classified as parr, 12 were classified as juveniles (no juveniles classified as smolts or pre-smolts), 28 classified as smolts or pre-smolts, and the remainder (48) were classified as adults. Of the 101 downstream migrating fish, 14 were classified as smolts and 14 classified as pre-smolts (27.7%) with

six captured in February, 11 in March, and 11 in April (Figure 71). Average smolt size varied slightly by month (range 170.0 mm - 161.5 mm) with a cumulative average of 164.2 mm (6.5 inches) (Table 10). No anadromous *O. mykiss* were captured or observed.

During the 65 days of trapping operations, both the upstream and downstream traps operated for a period of 65 and 54 days respectively (100% and 83% efficiency). The downstream trap had to be opened for a total of 11 days during the end of the trapping season to stay within the allotted juvenile take limit. The catch per unit effort (CPUE) for upstream and downstream fish was 1.32 and 1.87 captures per day, respectively (Table 8). Of the 187 migrant captures, 126 (67%) 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 2/1/21 through 4/6/21 (Table 7). Only one upstream migrating *O. mykiss* was captured on 2/11/21 measuring 153 mm (6.0 inches). There were 17 downstream migrating fish captured ranging in size from 109 mm (4.3 inches) to 237 mm (9.3 inches) (Figures 68, Figures 72-73, and Table 10). The majority (15) of the downstream migrating *O. mykiss* captured were identified as smolts (5) or pre-smolts (10) (Figure 71). The *O. mykiss* population is still recovering from the prolonged drought that started in 2012. For example, in 2011 there were 177 smolt and pre-smolts captured in Salsipuedes. Since 2011, the smolt total from 2021 represents the highest smolt capture total in the past 10 years and illustrates the challenges the Salsipuedes Creek *O. mykiss* population is experiencing during this current drought cycle and how dependent this population is on average to above average rainfall years. No smolts were captured from 2015-2017, or 2020, with only 2 smolts captured in 2018 and one in 2019. Sixteen of the 18 fish captured at the Salsipuedes trap in WY2021 were captured during the hours of darkness (89%) and is similar to what was observed in Hilton Creek (67%) (Table 9).

During the 65 days of trapping operations, both the upstream and downstream migrant trap operated during the entire period (100% efficiency) (Table 8). The absence of any spring storms precluded trap removal for potential high flow events. The CPUE for Salsipuedes was an anemic 0.02 captures per day for upstream captures and 0.26 captures per day for downstream captures.

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: No trapping was conducted in the LSYR mainstem during the 2021 migration season due to low water conditions.

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

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 carcass or mortality are 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 collected and analyzed on 132 of 205 upstream and downstream migrants captured at Hilton and Salsipuedes Creeks, plus five carcasses found in Hilton Creek (3), Quiota Creek (1), and El Jaro Creek (1). Captured fish less than 120 mm were not sampled or recaptured fish, and some fish that were greater than 120 mm had scales that were not clear enough to make an age 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+ years (76 mm El Jaro Creek carcass) to 4+ years (425 mm Hilton Creek downstream migrant, HD-12), with the Quiota Creek carcass aged at 4+ years (Table 11). The majority of fish were 1+ in age (35 at 27%) and 2+ in age (50 at 38%), with the next highest category at 3 and 3+ in age (16 at 12% each).

Two examples of analyzed fish scales would be a 4+ year old Hilton Creek downstream migrant resident *O. mykiss* at 425 mm and a 2+ year old Hilton Creek upstream migrating resident at 286 mm (Figure 74). The larger fish indicated 2 years of slower, consistent growth followed by accelerated growth in year 3. The smaller fish showed slow growth in year 1 followed by rapid growth during its second year. 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 and fall). The results are presented below.

Redd Surveys: Redd (spawning) surveys are typically conducted opportunistically once a month in the LSYR mainstem (Highway 154, Refugio, Alisal, and Narrows 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 WY2021 started with very little rainfall within the LSYR watershed with no rain recorded in October and only 0.31 inches recorded in November. Rainfall and

subsequent runoff is important in several ways to migrating and spawning *O. mykiss*. Besides providing a pathway for movement, the first rains of the season are necessary to remove leaf debris, accumulated silt and other allochthonous material from spawning beds to make them accessible and usable for spawning fish. The late December rainfall was the first significant storm of the season and dropped nearly 2-inches of rain on the watershed. That storm event generated a maximum flow of 4.31 cfs on 12/28/20 at the Salsipuedes USGS gauge (2.9 cfs daily average) and was not enough flow to clear debris from spawning areas as flows swiftly decreased to less than 0.75 cfs by 12/30/20. Flows did not increase again until the late January storm event and was of sufficient magnitude to clear spawning beds and allow a sufficient flow pathway for spawning fish.

There were 61 redd sites documented in the tributaries in WY2021 (Table 12); 48 redds identified in Hilton Creek, two in Quiota Creek, seven in Salsipuedes Creek and four in El Jaro Creek (Tables 12 and 13). In Hilton, five redd sites were documented in January, 23 in February, 18 in March and four in April. In Salsipuedes, four redd sites were identified in March and three in April. In El Jaro Creek, one redd was identified in February and three in March. Two redds site were identified in Quiota Creek in April, but were very small in size. All of the redd sites were created by resident *O. mykiss* based on the smaller overall size of the excavation sites compared to anadromous redd sites. No redd sites were identified after April as flow conditions had deteriorated to the point where movement between habitats was prohibited. Redd sites identified in Hilton Creek represent the highest count in total redds observed compared to any previous year and suggested rearing flows provided throughout the Hwy 154 Reach were sufficient for good oversummering conditions for resident adult fish to survive, migrate, and spawn upstream the following season. In Quiota Creek, a couple spawning locations were documented but were extremely small in dimension compared to other creeks. In fact, surveyors collected video of a small resident adult female (approximately 4.5 inches) building a redd site. This video represents the smallest adult fish observed spawning in the LSYR basin. Young-of-the-year (YOY) *O. mykiss* were first observed in Hilton Creek on 3/8/21 and in Salsipuedes Creek on 4/13/21. By the end of April, Hilton Creek was literally teeming with newly hatched *O. mykiss*.

There were five redd sites documented in the LSYR mainstem; three in the Refugio Reach around LSYR-4.9 to LSYR-4.97 and two very large redd sites considered to be anadromous steelhead documented in the Narrows Reach (LSYR-32.79) (Tables 12 through 14). The three redds in the Refugio Reach were identified 2/9/21 with the first YOY observed near redd site 3 (Ref-03-020921) on 4/1/21. The two redd sites identified in the Narrows Reach were observed on 3/16/21 and 3/23/21 and were in close proximity to each other (approximately 1.23 miles upstream of the Salsipuedes Creek confluence). These redds were considered anadromous steelhead redds based on the significantly larger size of the excavations compared to resident *O. mykiss* redd sites with both measuring 9.5 feet long (pit length plus tailspill length) and greater than 2 feet wide. CDFW with their DIDSON camera deployed in the LSYR mainstem near the Lompoc Airport did document several large fish entering the system in January and February after the 1/23/21 storm. Those redds are the first documented anadromous steelhead redd sites identified in the LSYR in the past 10 years. When those redds were identified, flows were

in excess of approximately 13.0 cfs (Narrows flow minus Salsipuedes Creek flow). One month later (4/16/21) the flow had decreased to 3.1 cfs and the water was warming. By this time, flow had decreased to the point that both redds egg deposition areas were exposed to air. A thermograph was deployed immediately upstream of both redds on 4/29/21. Results of the monitoring show that the average water temperature (4/29/21 – 5/13/21) immediately upstream of the redd sites was 17.6°C. Bjornn defines optimum temperatures for salmon and steelhead egg incubation as 4.4°C – 14.4°C (Bjornn, 1991). Results of the monitoring showed that low flow, coupled with the lack of spring rainfall heated the water in the lower river greater than optimal egg incubation temperatures required by steelhead. Only two YOY were observed from these two spawning sites. No other YOY or adult steelhead were observed in that lower section of the river and it was likely that no YOYs survived as the entire area went dry by late May.

Additional observations include the presence of a significant beaver dam approximately 0.9 miles upstream of the two identified anadromous redd sites. This beaver dam was intact following the high flow event in late January with no flanking flow and no pool habitat at its downstream extent to allow *O. mykiss* an opportunity to navigate past the dam. As a result, it appeared that the anadromous *O. mykiss* were forced to spawn in sub-optimal habitat.

Snorkel Surveys: Snorkel surveys in 2021 were conducted in the spring, summer, and fall within the LSYR mainstem (Figure 75 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 some of the tributaries which were completed in late June and early 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 September and gave an indication of *O. mykiss* survival after the hottest months of the year. Fall snorkel surveys were completed between October 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.

February through May was incredibly dry in WY2021 with a total of 1.14 inches of rain recorded at Bradbury Dam. Drying conditions in the spring manifested the need for earlier spring surveys in the LSYR mainstem. Several exploratory surveys were conducted downstream of the standard management reaches from Sweeney Crossing (LSYR-26.7) to the Narrows (LSYR-36.0). The results of these exploratory snorkel surveys and associated fish rescue/relocation efforts are described in Section 4.8.

There was a WR 89-18 ANA release in 2021 that started on 8/2/21 and ran until 10/22/21. 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 some of 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 76 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 Hwy 154, Refugio, Alisal, Avenue of the Flags, and Cadwell reaches (Figure 76).

Hwy 154 Reach

The Hwy 154 Reach extends from the Stilling Basin (LSYR-0.01) to the Hwy 154 Bridge (LSYR-3.2) (Figure 75); due to continuous poor water clarity the Stilling Basin was not snorkeled. The Long Pool water clarity was sufficient enough to count fish only during the fall snorkel survey with a team of four divers. Snorkel survey results for the Hwy 154 Reach are shown in Figure 77 as well as Tables 16-17.

Divers conducted the spring snorkel survey within the Hwy 154 Reach in May and counted a total of 407 *O. mykiss*; 388 of which were observed below the Long Pool to the Reclamation property boundary and 19 which were observed above the Long Pool to the tail-out of the Stilling Basin. The Long Pool and the Stilling Basin contained poor visibility during the spring survey which prevented COMB-FD staff from enumerating fish in those large pool habitats. Of the 407 *O. mykiss* observed during the spring survey, 333 (81.8%) fell into the 0-3 inch size category, 24 (5.9%) were 3-6 inches, 30 (7.4%) were 6-9 inches, 13 (3.2%) were 9-12 inches, 5 (1.2%) were 12-15 inches and 2 (0.5%) were 15-18 inches. With so many YOY in the 0-3 inch size class observed, it was likely these fish were produced in the winter and spring in Hilton Creek and traversed through the Long Pool downstream into the Hwy 154 Reach.

The timing of the 2021 WR 89-18 Release necessitated snorkel surveys in the Hwy 154 Reach in late July to satisfy pre-release RPM 6 snorkel survey requirements. This survey was used here as a surrogate for the regular summer Hwy 154 Reach surveys. Divers revisited the same habitat units as was observed 2 months earlier (spring survey) and counted a total of 420 *O. mykiss*; 217 (51.7%) were 0-3 inches, 158 (37.6%) were 3-6 inches, 37 (8.8%) were 6-9 inches, and 8 (1.9%) were 9-12 inches.

The fall survey was commensurate with the post-release survey conducted just after completion of the 2021 WR 89-18 Release in mid-November. A total of 248 *O. mykiss* were observed in the Hwy 154 Reach; 120 (48.4%) were 3-6 inches, 111 (44.8%) were 6-9 inches, 16 (6.5%) were 9-12, and 1 (0.4%) was 15-18 inches. Of particular note was the absence of any *O. mykiss* under 3 inches in length, indicating quick oversummering growth of any YOYs rearing in this reach. The long-duration WR 89-18 Release (August through October) likely allowed ample rearing space, good water quality conditions and an abundance of food resources for *O. mykiss* below Bradbury Dam.

Improved visibility late in the year within the Long Pool (LSYR-0.51) allowed a team of four divers to conduct a fall snorkel survey. Since the Long Pool was unable to be snorkeled in the spring and the summer, fish numbers are not comparable over time in WY2021; hence *O. mykiss* totals for this single habitat unit were not included in the Hwy 154 totals above. A total of 77 *O. mykiss* were observed; 7 (9.1%) at 3-6 inches, 33 (42.9%) at 6-9 inches, 30 (39.0%) at 9-12 inches, and 7 (9.1%) at 12-15 inches. Only 1 non-native largemouth bass measuring18-21 inches was observed by divers. A good portion of the Long Pool remained filled in with silt (Whittier Fire runoff from Hilton Creek) in WY2021, rendering the pool approximately half the depth and size compared to previous seasons. Shallower depths and a muddy substrate likely contributed to the absence of warm-water species and may have prevented successful reproduction of invasive species during the oversummering period.

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 75, Figure 78, and Tables 16-17. Spring snorkel surveys were conducted in April and May with 102 *O. mykiss* observed within the Refugio Reach. The size class breakout were as follows; 82 (80.4%) 0-3 inches, 1 (1.0%) 3-6 inches, 4 (3.9%) 6-9 inches, 9 (8.8%) 9-12 inches, 3 (2.9%) 12-15 inches, 2 (2.0%) 15-18 inches, and 1 (1.0%) 18-21 inches. The majority of 0-3 inch *O. mykiss* observed were YOY that were thought to have been produced by observed spring LSYR mainstem redd sites above and below the Encantado Pool (LSYR-4.95) in the Refugio Reach.

COMB-FD personnel conducted the summer snorkel survey in the Refugio Reach corresponding with the during-release phase of RPM 6 WR 89-18 Release requirements. Surveyors snorkeled the same habitat units in the summer as were snorkeled during the spring time-frame. A total of 10 *O. mykiss* were observed; 2 (20%) were 9-12 inches, 3 (30%) were 12-15 inches, 3 (30%) were 15-18 inches, and 2 (20%) were 18-21 inches. Of

note was that no smaller *O. mykiss* were observed during this summer survey, likely the result of habitats drying and losing connection with adjacent habitats prior to WR 89-18 Release flow arrival and this survey.

Divers returned for the fall survey (post-release RPM 6 surveys) in late October and early November. A total of 18 *O. mykiss* were observed; 8 (44.4%) were 6-9 inches, 4 (22.2%) were 9-12 inches, 5 (27.8%) were 12-15 inches, and 1 (5.6%) was 18-21 inches. The 8 smaller 6-9 inch *O. mykiss* were observed in 2 habitats, 6 of which were located in the Encantado Pool (LSYR-4.95) and 2 were located in an isolated pool just above the Lower Gainey Crossing (LSYR-6.4). The 2 *O. mykiss* in the isolated pool were discovered, seined, and relocated during stranding surveys as part of post-release RPM 6 requirements. These fish were relocated to the LSYR mainstem just below the Hilton Creek confluence.

Alisal Reach

The Alisal Reach extends from Refugio Bridge (LSYR-7.8) downstream to the Alisal Bridge (LSYR-10.5) (Figure 75). Snorkel survey results are presented in Figure 79 and Tables 16-17. The spring snorkel survey was conducted in late April through May with 3 *O. mykiss* observed within 3 separate habitat units. Of the total, there were 1 (33.3 %) within the 9-12 inch size class and 2 (66.7%) within the 15-18 inch size class.

Divers returned in the summer (during-release RPM 6 surveys) where they visited the same habitats as in the spring snorkel survey. Only 1 *O. mykiss* was observed during the summer survey falling into the 18-21 inch size class.

Fall snorkel surveys within the Alisal Reach were conducted after the completion of the 2021 WR 89-18 Release in early November. The same *O. mykiss* that was observed in the summer was observed during this final fall survey within the same habitat unit. This single fish had been residing in a deep pool habitat located approximately 150 yards below Refugio Bridge (LSYR-7.8) during all three snorkel surveys.

*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 75). Results of all snorkel surveys for this reach are presented Figure 80 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.

Spring snorkel surveys in 29 separate habitat units were conducted from late April through the end of May in the Avenue of the Flags Reach. No *O. mykiss* were observed. Ten designated RPM 6 habitat units were snorkeled in the summer and the fall with no *O. mykiss* observed.

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 75). Results for all 2021 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 surveys.

Tributaries: Tributary snorkel surveys were conducted in the spring and fall in 2021 at all of the long-term monitoring locations within Hilton, Quiota, Salsipuedes, and El Jaro creeks. The location and results are presented in Figure 75, Tables 18-20, and Figures 81-85. Summer snorkel surveys were not conducted in the tributaries this year 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 75). 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 WY2021, target flows into Hilton Creek were not able to be sustained above the 2 cfs minimum throughout the dry season as set forth in the 2000 BiOp (NMFS, 2000) due to the low lake elevation and gravity flow through the HCWS/HCEBS. Because of concerns of losing power at Bradbury Dam (10 power outages occurred in WY2021) and the HCWS pumping system shutting down, the decision was made to deliver water to Hilton Creek through the HCWS/HCEBS via gravity instead of the HCWS via pumped flow. This alternative flow delivery, with inherent flow capacity limitations, was thoroughly vetted between Reclamation and NMFS. Because of flow limitations through the two delivery systems, there were several periods in WY2021 when cumulative flows dropped below the minimum 2 cfs criteria. As the lake level dropped over the summer, proportionally less lake water was delivered by the HCWS and more from the HCEBS by gravity until approximately the end of July when all delivered water came from the HCEBS by gravity. Reclamation kept gravity flow to the URP with some flow released at

LRP which was maintained throughout the calendar year at a flow rate associated with the lake elevation.

COMB-FD staff typically waits to conduct the spring snorkel survey within Hilton Creek until early July to allow YOY to grow and occupy habitats deep enough to snorkel and observe (Table 18). A total of 1,725 *O. mykiss* were observed within Hilton Creek during the spring snorkel survey (Tables 19-20 and Figure 81). Of the fish observed, 1,313 (76.1%) were 0-3 inches, 360 (20.9%) were 3-6 inches, 48 (2.8%) were 6-9 inches, and 4 (0.2%) were 9-12 inches. The two smaller size classes of observed *O. mykiss* were likely produced during the winter and spring spawning season when a total of 48 redd sites were documented by COMB-FD staff in Hilton Creek. The lack of bigger (>12 inch) *O. mykiss* during the spring survey is indicative of Whittier Fire sediment/material still filling in most of the deeper pool refuge habitats within Hilton Creek.

No summer Hilton Creek snorkel surveys were conducted in WY2021. Fall snorkel survey was conducted in mid-October. A total of 757 *O. mykiss* were observed; 313 (41.3%) at 0-3 inches, 403 (53.2%) at 3-6 inches, 37 (4.9%) at 6-9 inches, and 4 (0.5%) at 9-12 inches (Tables 19-20 and Figure 81). Reach 1 of Hilton Creek saw the biggest reduction in fish numbers where WR 89-18 Release flows had inundated the creek between August and the end of October. Reach 1 *O. mykiss* totals in the spring compared to the fall were 776 and 222, respectively. Despite lower flows (~2 cfs) being released into Hilton Creek during the oversummering season, a shift upwards in size class was observed from the spring to the fall survey. YOY (0-3 inches) accounted for 76.1% of the *O. mykiss* total in the spring and 41.3% in the fall, indicating a healthy food supply and growing environment between the two survey periods. The larger size classes of *O. mykiss* inhabiting Hilton Creek remained relatively static with the same number (4) of 9-12 inch fish observed during both surveys.

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 Figure 75, Tables 19-20 and Figure 82. In a dry or below average rainfall season, Quiota Creek has one of the highest surface water retraction and habitat loss rates observed in the Santa Ynez River basin. Surveyors conducted a spring snorkel survey and observed 22 *O. mykiss* in the 0-3 inch (YOY) size class and 2 *O. mykiss* measuring 6-9 inches, indicating at least some successful spawning in this middle section of the drainage. When surveyors returned for the fall snorkel survey at the end of September, no *O. mykiss* were observed. Only a few small, barely wetted habitats remained within this regularly monitored reach of Quiota Creek.

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 75). 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*.

Although WY2021 was classified as a dry year with below average rainfall, divers encountered flowing and mostly clear water quality conditions within the drainage during the spring survey (except for several stretches that had beaver activity). The spring snorkel survey in Reach 1 through 4 occurred in mid-June (Tables 19-20 and Figures 83-84 and). A total of 790 *O. mykiss* were observed; 730 (92.4%) at 0-3 inches, 40 (5.1%) at 3-6 inches, 11 (1.4%) at 6-9 inches, and 9 (1.1%) at 9-12 inches. With over 92% the *O. mykiss* observed as YOY and in all reaches, successful spawning throughout the drainage was evident during the annual spring count. Reach 5 was snorkeled soon after completion of the lower reaches and a total of 769 *O. mykiss* were observed: 655 (85.2%) at 0-3 inches, 87 (11.3%) at 3-6 inches, 7 (0.9%) at 6-9 inches, 17 (2.2%) at 9-12 inches, and 3 (0.4%) at 12-15 inches. Results of this survey further illustrated the high spawning success rate *O. mykiss* had within the basin in WY2021, despite the low rainfall and runoff conditions in the winter and spring. The wide range of size classes observed in Reach 5, including 20 fish over 9 inches in length indicated that adult, post-spawn fish were residing in this reach as baseflow dropped out in the spring.

Summer surveys were not conducted in the Salsipuedes Creek drainage in WY2021. COMB-FD staff returned to Salsipuedes Creek in the fall and snorkeled all reaches, but did encounter poor visibility in more stretches of the creek compared to the spring survey. Much lower baseflow coupled with increased beaver activity resulted in only fair diving conditions, particularly in deeper pool habitats where *O. mykiss* were difficult to detect. A total of 270 *O. mykiss* were observed in Reach 1 through 4 in the fall; 116 (%) at 0-3 inches, 134 (43.0%) at 3-6 inches, 16 (49.6%) at 6-9 inches, and 4 (1.5%) at 9-12 inches. Although the drop in numbers from the spring to the fall are likely due to habitat retraction and natural attrition, poor visibility in some locations account for the overall lower number of fish observed.

The fall survey within Reach 5 of Salsipuedes Creek showed a similar percentage drop-off in *O. mykiss* numbers compared to the spring survey. With that being said, even at extremely low flow conditions (some habitats nearly de-watered) and poor visibility within the deeper pool habitats, a total of 197 *O. mykiss* were observed in the fall. Of the 197 fish observed, 127 (64.5%) were 0-3 inches, 60 (30.5%) were 3-6 inches, and 10 (5.1%) were 6-9 inches. This was by far the highest fall count (standing crop) of *O. mykiss* observed since WY2012.

El Jaro Creek

El Jaro Creek is the main tributary to Salsipuedes 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 75, Tables 19-20, and Figure 85. Divers snorkeled El Jaro Creek in late June and encountered good flow conditions and water clarity during the survey. Divers counted a total of 244 *O. mykiss* in this relatively short reach with 199 (81.6%) at 0-3 inches, 43 (17.6%) at 3-6 inches, 1 (0.4%) at 6-9 inches, and 1 (0.4%) at 9-12 inches. The majority

of the YOYs observed were found in the first half of the survey reach, indicating successful fry emergence upstream of the Salsipuedes Creek confluence.

Summer surveys were not conducted within the tributaries in 2021. Divers returned to El Jaro Creek in the fall (October) and anticipated finding very few *O. mykiss* due to the fact that the majority of the reach had already gone dry several months prior. On 8/23/21 COMB-FD personnel was conducting routine tributary thermograph downloading and discovered most of El Jaro Creek had already gone dry. The El Jaro Creek thermograph was pulled for the season due that habitat unit being barely wetted. Despite only a few habitats remaining in the fall visit, personnel found several units still holding *O. mykiss*. A total of 29 fish had survived; 6 (20.7%) at 0-3 inches, 22 (75.9%) at 3-6 inches, and 1 (3.4%) at 6-9 inches.

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 86-87. 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 (*Ictalurus punctatus*) catfish. 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 2021. Divers did not encounter any warm-water species occupying Hilton Creek during the annual spring or fall snorkel surveys.

LSYR mainstem

Largemouth Bass: The largemouth bass population within the LSYR mainstem was a bit higher in WY2021 compared to recent years (Figure 86). The Stilling Basin de-watering and non-native fish removal effort is now 5 years removed (July of 2017); the Stilling Basin is a known source population for largemouth bass residing in the LSYR mainstem.

The total number of largemouth bass observed in the spring within the Refugio Reach and Alisal Reach was 29 and 64, respectively. Bass observations in the summer increased within the Refugio Reach to 68 and decreased within the Alisal Reach to 50. Fall snorkel surveys contained 54 bass in the Refugio Reach and 46 bass in the Alisal Reach. It should be noted that although divers enumerate all warm-water species encountered, much of the

focus is dedicated to accurately counting and sizing *O. mykiss* when snorkeling, hence slight discrepancies from one survey to the next can be expected.

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.

When comparing recent survey years, slightly higher numbers of sunfish were observed in the spring within the management reaches of the LSYR mainstem in WY2021 (Figure 86). COMB-FD staff counted 45 and 11 sunfish in the Refugio and Alisal Reaches during the spring survey, respectively. Summer sunfish totals were 29 in the Refugio Reach and 15 in the Alisal Reach. Numbers declined in the final fall survey with only 14 observed in the Refugio Reach and none observed in the Alisal Reach.

Catfish Species: The two types of catfish found in the LYSR mainstem are easier to differentiate (compared to sunfish) based on their tail morphology (forked for channel and flat for bullhead), but they are lumped into a single catfish category for the purposes of this report. In 2021, no catfish were observed during the spring, summer, or fall snorkel surveys within the LSYR mainstem management reaches (Figure 87).

Carp: Carp continue to be abundant within the Hwy 154 Reach, in particular within the Stilling Basin (LSYR-0.01). COMB-FD staff observed dozens of adult carp on the surface of the Stilling Basin on every site visit throughout the oversummering season, chiefly milling around the HCEBS piping system on both sides of the pool. Several carp were observed from the bank at the head of the Long Pool while downloading thermographs in the spring, but divers didn't encounter carp during the one and only Long Pool snorkel survey in the fall.

Carp totals in the Refugio Reach and Alisal Reach of the LSYR mainstem during the spring were 16 and 133, respectively (Figure 87). One particular pool habitat (LSYR-10.0) in the Alisal Reach contained 70 of the 133 carp observed in the spring, located approximately 0.5 mile upstream of Alisal Bridge. Divers returned to the management reaches in the summer and counted 10 carp in the Refugio Reach and 98 carp in the Alisal Reach. The final fall survey saw an increase of carp in the Refugio Reach totaling 74 (50 of which were juvenile 0-3 inch carp seined out of a single pool habitat during stranding surveys), while the Alisal Reach remained somewhat steady with 122 carp being observed.

Salsipuedes Creek

COMB-FD staff counted a total of 1,361 green sunfish within Reaches 1 through 4 during the annual spring survey (655 0-3 inches, 495 3-6 inches, 203 6-9 inches, and 8 9-12 inches). This was a 24% decrease in sunfish numbers observed in the spring of 2020 which totaled 1,783. Green sunfish were found throughout all the lower reaches of Salsipuedes Creek; however, Reach 1 contained 72.6% (988) of the total. The proximity

of the LSYR mainstem where warm-water species are likely originating and elevated water temperatures in lower part of the Salsipuedes drainage supports this observation. In the spring survey divers encountered numerous green sunfish redds with spawning adults and staff smothered (by hand) all nests that were encountered to help decrease juvenile survivorship. Other spring warm-water species included 3 bluegill between 6-9 inches, 5 bullhead catfish between 9-12 inches, and 1 adult carp.

The final fall survey in Reaches 1 through 4 occurred in late September and early October and a total of 937 green sunfish were observed; 519 at 0-3 inches, 364 at 3-6 inches, 49 at 6-9 inches and 5 at 9-12 inches. In addition, 885 bullhead catfish fry (~850 in one habitat and 35 in another), 3 bullhead catfish between 9-12 inches and 1 largemouth bass between 6-9 inches was observed.

Since *O. mykiss* are tracked separately within the historic section of Reach 5 of Salsipuedes Creek, warm-water species are treated in the same fashion for the purposes of this report. The green sunfish total within Reach 5 in the spring was 72; 4 at 0-3 inches, 48 at 3-6 inches and 20 at 6-9 inches. All other warm-water fish observed came from a single pool habitat containing 3 bullhead catfish at 6-9 inches and 1 bullhead catfish measuring 12-15 inches. Divers returned in the fall and observed 111 green sunfish within Reach 5; 89 at 0-3 inches, 14 at 3-6 inches, 7 at 6-9 inches, and 1 at 9-12 inches. A single adult bullhead catfish measuring 9-12 inches was observed in a drying pool habitat located just downstream of the Salsipuedes and El Jaro Creek confluence.

El Jaro Creek

The 0.40 mile regular survey reach of El Jaro Creek (just upstream of its confluence with Salsipuedes Creek) also contained warm-water species during the annual spring snorkel survey with 83 green sunfish observed. This was a 62% decrease in green sunfish numbers from the previous spring snorkel survey in 2020. Three size classes of sunfish were observed: 12 measuring 0-3 inches, 37 measuring 3-6 inches, and 34 measuring 6-9 inches. Three bullhead catfish (2 at 6-9 inches and 1 at 12-15 inches) were observed in a single pool habitat. The fall (October) survey showed 41 green sunfish; 9 were 0-3 inches, 22 were 3-6 inches, 7 were 6-9 inches, and 3 were 9-12 inches.

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 mid-October with no warm-water species observed. This marked the second season in a row that non-native fish were not observed in 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 or other aquatic species 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. COMB-FD did not conduct any tributary enhancement projects in WY2021.

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, vegetation maintenance (watering, weeding, mulching, etc.), 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 WY2021 were sent to Dr. Carlos Garza of NOAA Southwest Science Center at UC Santa Cruz. A total of 169 *O. mykiss* tissue samples were sent to the NMFS Southwest Fisheries Science Center for WY2021 mostly from the migrant trapping efforts; 78 Hilton Creek upstream captures, 69 Hilton Creek downstream captures, 14 Salsipuedes Creek downstream captures, 2 LSYR mainstem fish rescue captures, and 6 sampled carcasses that were found in various locations throughout the previous year. 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. A LSYR mainstem fish and a Hilton Creek fish were partly assigned to Quiota Creek, and one Hilton Creek fish was partly assigned to Arroyo Grande Creek in San Luis Obispo County. Very little introgression with hatchery raised trout has been observed in samples collected this year and during past years in the LSYR basin. The single *O. mykiss* carcass sample collected from a dead fish found on the HCWS intake barge (located on Lake Cachuma) was verified as a hatchery fish. This supports the effectiveness and efficacy of the genetic sampling and analyses as this fish was the only sample in the lot anticipated to be of hatchery origin.

Beaver Activity: 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 habitats and inhibit movement of juvenile and adult *O. mykiss* during the spawning season, increase siltation, change benthic macroinvertebrate assemblages, and create favorable 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 as well as the LSYR mainstem. 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, typically from November through January.

During December of 2020 and January of 2021, 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). A small section of the Hwy 154 Reach on the San Lucas Ranch was not surveyed due to lack of access (LSYR-0.68 to LSYR-4.0). 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 Air Force 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) and hence create an immediate barrier to movement as no pool habitat exists downstream of a beaver dam to allow fish to jump over. 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.

The results of WY2021 beaver dam surveys showed an increase in the number of LSYR mainstem beaver dams identified compared to the previous year. There were 58 mainstem beaver dams documented in WY2020 and 80 identified in WY2021 (22 dam increase) and is the most dams recorded since WY2015 (Figure 88, Table 21). Of the 80 mainstem dams identified, 52 were classified as barriers, 9 as impediments, and 19 as passable at the survey flow rate, with 73 of the 80 dams determined to be active. There were two dams in the Refugio Reach, 11 in the Alisal Reach, and 60 in Reach 3 (Alisal Bridge downstream to the Narrows). The lowermost active dam in the LSYR watershed was located immediately downstream of the Narrows USGS gauging station. No beaver dams were identified downstream of the Floradale Bridge (Wastewater Treatment Plant) or around 13th Street (Vandenberg Air Force Base).

Active beaver dams in the Salsipuedes/El Jaro watershed increased from two in WY2020 to 11 in WY2021. The increase represents the highest number of dams identified in the watershed since WY2015 and is a cause for concern. While the long-term drought caused a reduction in wetted habitat reducing the number and distribution of beaver dams from WY2014 to WY2019 (36 to zero dams), the trend appears to be reversing as two of the

last three years were relatively wet, creating more favorable habitat conditions for beavers. For example, WY2021 was considered a dry year with 11.84 inches of rain, WY2019 was considered a wet year (23.79 inches of rain) and WY2020 was considered an average year with 21.03 inches of rain. It appears likely that beavers inhabiting the LSYR mainstem migrated into the Salsipuedes Creek watershed sometime during the fall of WY2020. Flowing conditions were present in excess of 10 cfs at the Salsipuedes/LSYR mainstem confluence through early December 2020 due to WR 89-18 BNA releases. This pathway would have provided opportunities for beavers to move into Salsipuedes Creek watershed. No beaver activity was observed in the Quiota Creek or Hilton Creek watersheds.

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, (4.2-4.16) discussion as needed on specific topics of interest or concern, and (4.17) 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), 2019 (COMB, 2020b), and 2020 (COMB, 2021).

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 89) are presented from WY2000-WY2021. Since WY2000, there have been 6 spill events, 8 wet years, 3 normal (average) years, and 11 dry years.

4.2. WY2021 – An Unusually Dry Water Year

WY2021 was the eleventh dry water year (defined as < 15 inches of rainfall recorded at Bradbury Dam) since issuance of the 2000 BiOp but was particularly severe with only one large rainfall event in January and only two minor storms thereafter and very little upper basin flow. Storms tended to concentrate more on the western end of the Santa Ynez River watershed, sufficient enough to create enough flow from the Salsipuedes Creek drainage to breach the lagoon and have ocean (and lagoon) connectivity for 30 days (1/28/21 – 3/9/21). Large fish, most likely anadromous *O. mykiss*, were documented during that time period by CDFW with their DIDSON video camera deployed near the Lompoc Airport entering the basin from either the ocean or lagoon but were not recorded at COMB-FD's trap or CDFW's DIDSON at Salsipuedes Creek. Those fish appeared to have moved upstream past the Salsipuedes Creek confluence but were blocked a short distance beyond by beaver dams and then spawned in a less than ideal location (see further descriptions in Section 4.8 below). The lack of spring rains resulted in a long dry season although summer temperatures were generally mild with few prolonged heat waves. Habitat loss from streams drying up was particularly evident in sections of

Quiota, Salsipuedes, El Jaro, Los Amoles, and Ytias creeks. The LSYR basin *O. mykiss* population benefited from 1) the WR 89-18 releases in the LSYR mainstem and 2) early rainfall in WY2022, specifically in the tributaries.

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

The Whittier Fire in WY2017 completely burned the upper third of the Hilton Creek watershed. That combined with the significant runoff events in WY2019 generated significant bed load 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 where half the depth and a third of the length of that habitat were filled in. 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, through three quarters of the wet season in WY2020 (a normal rainfall year), and in January of WY2021, Hilton Creek pool habitats on Reclamation property continue to be full of deposited sediment with very small scour pockets at the start of the habitat. Deposited upstream gravel bars are still being scoured during higher flow events and translating down into the watered section of Hilton Creek resulting in approximately a net neutral situation between degradation and aggregation in pool habitats (Figures 90 and 91). There continues to be an abundance of great spawning gravels in the creek but very limited amount of pool refuge habitat for rearing and oversummering, particularly for larger size classes of *O. mykiss*. This will be an ongoing issue until the upper watershed vegetation recovers and depositional bars get locked in with riparian corridor plant growth. Furthering the loss of habitat extent was the reduction of HCWS/HCEBS releases to the creek in WY2021 that were delivered to the creek only by gravity flow and consistently reduced as the lake level dropped through the dry season. Reach 5 of Hilton Creek (URP to the LRP) with stream discharges from the URP went from well above 2 cfs in the spring to approximately 0.5 cfs by the end of WY2021 and going into WY2022. Results from the spring to fall snorkel showed a drop in population with a reduction in habitat extent in the wetted section of the creek over and above historical attrition observed through the dry season. Numerous observations of herons positioned in the diminishing pool habitat suggest predation was a contributor to the population decrease.

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, which was the case in WY2021. 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 that provides a higher sustainable flow rate and cooler water temperatures. The Salsipuedes/El Jaro watershed has significantly higher winter flows due to the larger watershed with baseflows typically approaching 0.05 cfs during the dry season with extensive areas completely drying out during the drought. 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 with the Hilton Creek smolt run starting earlier and lasting longer into the spring compared with Salsipuedes Creek. 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 excellent habitat quality (refuge pools with structure and a mature riparian canopy) but has limited stream length. Many of the Hilton Creek refuge pools have since and continue to be filled in due to siltation from the Whittier Fire and as of 2021, pool habitats have not reformed. The Salsipuedes Creek system has extensive stream mileage but only fair habitat quality due to low dry season baseflows, a predominance of fine sediment substrate, a greater prevalence of invasive species (mainly green sunfish) and sometimes high water temperatures in portions of the lower creek (AMC, 2009; COMB, 2021). 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 (Highway 154 Reach). 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 Hwy 154 Reach as favorable conditions near the dam can diminish some environmental cues for out migration especially later in the year as flows decrease and water temperatures increase. This phenomena has been observed during tissue/scale analyses of smolts captured moving downstream but then are recaptured the following year as adults migrating into Hilton Creek to spawn but appeared to have not made it to the lagoon or ocean. Using scale analyses, Hilton Creek fish tend to grow larger faster than Salsipuedes Creek fish due to favorable year round conditions and as a result may out migrate as smolts at an earlier age (Figure 92). Returning ocean run adults also have a much longer travel distance to Hilton Creek compared to Salsipuedes Creek and must navigate a significant number of barrier beaver dams.

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* during trapping operations. Since the end of five consecutive dry years (drought), the LSYR watershed has experienced 2 wet years (WY2017 and WY2019), two dry years (WY2018 and WY2021), and one normal (average) year (WY2020) (Figure 89). The

spring and fall snorkel surveys suggest that the *O. mykiss* population in Salsipuedes Creek is rebounding although the dry season survival rate was low due to low baseflows and drying up habitats.

Starting in WY2017, Hilton Creek has shown an increase in the numbers of both upstream migrants captured (one in WY2017, 49 in WY2020, and 86 in WY2021) and downstream migrants (4 in WY2017, 90 in WY2020, and 101 in WY2021) (Table 24). The number of smolt (including pre-smolt) captured leaving the creek has also increased from two in WY2017 to 32 in WY2020 with a slight decline to 28 in WY2021. The first smolt was captured on 2/6/21 and the last was captured on 4/6/21 (the last day of trapping due to reaching the ITS take limit). 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. This positive trend will most likely continue into WY2022 based on the number of adults observed in the Hwy 154 Reach in the last fall snorkel survey in 2021. The fact that smolts were being captured leaving the creek every year since the drought showed that the *O. mykiss* population 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 and reliability to assist recovery efforts of the species.

The contrast between Salsipuedes Creek and Hilton Creek is stark. Since WY2017, only three upstream migrating *O. mykiss* were captured during Salsipuedes Creek trapping efforts (only one in WY2021 at 153 mm [6 inches]). These three fish were classified as residents. Similarly, downstream captures have also decreased (prior to WY2021) with none captured in WY2017, three in WY2018, two in WY2019, and one in WY2020. Of the downstream migrants captured during those years, only three of those fish were classified as smolts with no smolts captured in WY2020 (Table 25). WY2021 showed the largest increase in downstream migrants (primarily smolts) with 17 downstream migrants, 15 identified as smolts or pre-smolts. The first Salsipuedes Creek smolt was captured on 2/1/21 and the last was captured on 3/30/21. Based on H Street flows, it is unlikely any smolts from either Hilton or Salsipuedes creeks made it to the lagoon as flows at H Street were less than 5.0 cfs on 3/2/21 and had reached zero flow by 3/27/21. 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 Creek watershed and the slower *O. mykiss* population recovery when compared to Hilton Creek.

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

There were 5 precipitation events in WY2021 with rainfall equal to or greater than 0.1 inches at Bradbury. The majority of the recorded precipitation at Bradbury Dam fell during the months of December (2.00 inches, 16.9% of annual total) and January (8.39 inches, 70.9% of annual total) combining for 87.8% of the total rainfall for the year. Rainfall essentially stopped in February with only two small storms in March and no

significant storms in April. The late January storm created decent runoff conditions to allow for movement into spawning grounds

Redd (spawner) surveys began in January and continued through April. Redds were observed during the months of January, February, March, and April for a total of 66 redds found through the LSYR basin (48 in Hilton Creek, two in Quiota Creek, seven in Salsipuedes Creek, four in El Jaro Creek and none in Los Amoles or Ytias Creek). The 48 redds identified in Hilton Creek represent the highest yearly total of redds observed in the creek since monitoring started in the 1990s; 24 redds were observed in WY2020 which at the time was a high total. Due to extensive quantities of suitable spawning gravels resulting from the Whittier Fire, redds were observed in many places not seen prior particularly in Reach 5 (LRP to URP) and between the Hilton Creek confluence and the Long Pool associated with the newly formed and extensive delta (Figures 90 and 91). Also, there were several areas with superimposed redds (i.e., Spawning Pool and just upstream of the Ford Crossing (Figure 93). Unlike WY2020, no late season storms impacted the numerous spawning locations across the basin to disturb redd sites or displace newly hatched YOYs. Spawning was highly successful with many YOYs observed, the first being in Hilton Creek on 3/8/21. YOYs 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. YOY emergence and concentrations in lower HC were extremely dense, prompting greater downstream dispersal into the Hwy 154 Reach downstream of the Long Pool and why our snorkel survey counts were high of that age class of fish. Diminishing flows in Hilton Creek through the spring and summer also contributed to downstream dispersal into the Long Pool and Hwy 154 Reach.

Spawning opportunities in Quiota Creek were limited primarily due to low flow in the later portion of the spring and sparse gravel beds for suitable spawning resulting in fish being forced to use sub-optimal locations. On 4/12/21 surveyors noted several areas where small resident adults (sub 5-inches) were attempting to spawn. These were the smallest observed spawning fish on record in the entire LSYR watershed. In fact, observations showed how little material a small spawning fish could excavate, especially considering the substrate these small fish were attempting to move. That being said, successful spawning did take place and YOYs were observed in the late May timeframe, mostly in the upper reaches of the creek.

Spawning in Salsipuedes Creek was documented March and April and in El Jaro Creek in February and March. Subsequent redd surveys resulted in the first YOYs being observed on 4/13/21 downstream of a previously identified redd site.

4.6. Recovery of the *O. mykiss* Population in Hilton Creek and the Hwy 154 Reach

Between the drought that occurred between WY2012-WY2016 and impacts from the Whittier Fire and subsequent sediment deposition in WY2017-WY2021, the *O. mykiss* population and associated stream habitat (filled in refuge pools and sediment load) has been in a state of recovery the past few years including WY2021. Although the sediment load from the fire is diminishing with upper basin and riparian corridor vegetation

growth, much of the deeper pool habitats within Hilton Creek remain gravel filled and shallow through WY2021 (Figure 92). The lack of deep water may be precluding larger *O. mykiss* from oversummering within Hilton Creek, as reflected by the absence of larger size classes of fish observed during snorkel surveys the past several years. The larger fish appear to be oversummering in the Hwy 154 Reach and entering Hilton Creek to spawn then returning downstream after spawning. No redds were observed in the Hwy 154 Reach. The abundance of new gravel from the upper basin specifically from the burn scar area has enhanced the spawning material and opportunity for *O. mykiss* to successfully reproduce.

Migrant trapping in Hilton Creek occurred from 2/1/21 through 4/6/21 and resulted in 86 upstream and 101 downstream *O. mykiss*. Trapping ceased due to nearing the total allowable take limits set forth by NMFS in the 2000 BiOp. A total of 100 adult and 87 juvenile *O. mykiss* were captured in the Hilton Creek traps. As a comparison, a total of 19 and 40 adult *O. mykiss* were captured in Hilton Creek in WY2019 and WY2020, respectively. WY2021 Hilton Creek trapping results indicated a healthy run of upstream resident adults (52), which was also verified by the record number of redds (48) observed in Hilton Creek during the spawning season and provides evidence that ample and appropriately sized spawning material (gravel) were present.

The spring snorkel survey in Hilton Creek was conducted in early July to allow the recently produced YOY time to grow and occupy deeper habitats for divers to count. A total of 1,725 *O. mykiss* were observed; 1,313 (or 76.1%) were recently produced YOY measuring 0-3 inches. The number of spring YOYs observed was one of the highest totals ever observed within Hilton Creek, indicating successful emergence from the numerous redds observed earlier in the year. The fall snorkel survey found a total of 757 *O. mykiss*, 313 were 0-3 inch and 403 were 3-6 inches, suggesting rapid growth and downstream migration, possibly associated with shrinking habitats from diminishing HCWS/HCEBS deliveries by gravity as discussed above.

Divers conducted a spring snorkel survey in the Hwy 154 Reach downstream of Hilton Creek and the Long Pool (LSYR-0.51) in late May and observed 407 *O. mykiss*. Of the total, 333 (or 81.8%) were YOYs (0-3 inch). This was yet another indication of the successful spawning, emergence, and downstream dispersal of fish produced in Hilton Creek in the winter and spring. In late July, divers conducted the summer survey and counted 420 *O. mykiss*, 217 of which still fell in the 0-3 inch size class. Fall snorkel surveys found a total of 248 *O. mykiss*, none were 0-3 inches and 120 were 3-6 inches, again indicating rapid growth, dispersal and attrition. The combination of Hilton Creek and Hwy 154 Reach target flows, available spawning gravels and rearing habitats in Hilton Creek oversummering habitats within the Hwy 154 Reach have made for a very successful and dynamic fishery.

4.7. Target Flow Compliance to Hilton Creek and the Hwy 154 Bridge

Target flow compliance as set forth in the 2000 BiOp has been challenging in WY2021 as described above. Target flows for the Hwy 154 Bridge have been 2.5 cfs throughout the water year. Since flow measurements can't be taken at the Bridge, a substitute

location approximately 1 mile downstream has been used where COMB-FD take a river discharge measure once a week plus maintains a pressure transducer to document stream stage between flow measurements.

Monitoring for the required 2000 BiOp and WR 2019-0148 target flows are conducted by USGS and USBR for Hilton Creek, and COMB-FD and USBR for the LSYR at the Hwy 154 Bridge. Documenting target flow compliance at the Highway 154 Bridge (2.5 cfs) cannot be done at that specific location due to the channel configuration and landowner access limitations. USBR established a low-flow river discharge monitoring location approximately 1 mile downstream of the Highway154 Bridge where access is available. USBR has been taking a discharge measurement approximately once a month and the COMB-FD staff are taking a discharge measurement once a week as well as maintaining a pressure transducer at that location to record river stage every 15 minutes to enable development of a rating curve (stage vs discharge) (Figure 94). This is part of a compliance measure within WR 2019-0148, specifically the Plan required in Term 18 and Term 25. The objective is to maintain a river discharge at that monitoring location of 2.5 cfs or greater (at the current lake elevation) which follows Reclamations established operational protocols for meeting required target flows at the Highway 154 Bridge upstream. The objective was challenging to meet at all times in June and July due to many factors influencing streamflow between the release point at Bradbury Dam and the monitoring location (i.e., weather changes, varying riparian corridor vegetation and substrate composition, land use practices, alluvial groundwater extraction, etc.). USBR has been operating within acceptable discharge parameters to meet Highway 154 Bridge target flows throughout the year, although difficult in June and July and often times at higher flow rates than is required to assure continuous compliance. The Hwy 154 Reach and upper Refugio Reach fishery has certainly benefitted from any additional flow releases.

The 2000 BiOp and WR 2019-0148 target flows to Hilton Creek are a minimum of 2 cfs. That minimum flow rate was met from the start of the water year up until the middle of July when the rate dropped below 2 cfs and has steadily declined due to the drop in lake level to the current condition of approximately 1.3 cfs by HCEBS gravity flow to the URP and LRP. Reclamation is reluctant to run any level of pumps to deliver water to the creek given past operational issues and recent power outages at Bradbury Dam. There were 10 PG&E power outages at the dam in WY2021 (10/20/20, 11/18/20, 1/1/21, 1/18/21, 5/28/21, 6/11//21, 7/14/21, 7/26/21, 8/11/21, and 9/28/21); 10 in Calendar Year 2021 (1/1/21, 1/18/21, 5/28/21, 6/11/21, 7/14/21, 7/26/21, 8/11/21, 9/28/21, 10/18/21, and 12/17/21). USBR has discussed the situation with NMFS and it was agreed to continue with gravity flow instead of going to pumps which have proven multiple times to be problematic in sustaining the Hilton Creek fishery. There has been sufficient discharge at the URP to sustain the fishery from there to the LRP as well as down to the confluence of the creek with the LSYR mainstem. The habitat extent (pool area and depth) has diminished with dropping releases to the creek which has manifested in an associated declining *O. mykiss* population in the creek.

USBR measures releases to Hilton Creek with their pipeline Mag meters and the USGS takes physical stream discharge measurements periodically to create and calibrate their developed rating curve that integrates stream stage (recorded every 15 minutes) and measurement discharge. The two have not been in agreement since the third week in July, USBR being less than USGS (Figure 95). During July, the flow measurement location for Hilton Creek transitioned from the HCWS mag meter to the HCEBS mag meter which showed a discrepancy from one to the other. The HCEBS mag meter appears to be under-registering the flow to Hilton Creek compared to the flow measurements by the USGS.

4.8. WY2021 LSYR Mainstem *O. mykiss* Observations/Rescues

Due to sufficient January rainfall and stream runoff, ocean connectivity was establish for enough time for anadromous fish to enter the LSYR basin as well as fish to move within Reach 1 (Hwy 154 Reach) and Reach 2 (Refugio and Alisal reaches). Spring streamflow was extremely limited, which quickly isolated certain habitats and stranded *O. mykiss* within the LSYR mainstem, specifically the Narrows Reach (USGS Narrows gauge to Sweeney Crossing) and the Refugio Read (Refugio Bridge to Hwy 154 Bridge). Fish rescues and relocations were conducted within each reach in collaboration with CDFW and their concurrence with NMFS (the Fish Rescue Team).

Narrows Reach

In WY2021, COMB-FD conducted exploratory spawning surveys in the Narrows Reach of the LSYR mainstem due to ocean connectivity and CDFW's observations of anadromous fish moving into the basin in January and February through their DIDSON camera near the Lompoc Airport. During those spawner surveys, COMB-FD discovered 2 large steelhead redds both measuring 9.5 feet in length (pit and tail-spill) approximately 1 mile upstream of the Salsipuedes Creek confluence. The first redd was discovered on 3/16/21 with a subsequent (new) redd discovered 80 feet upstream on 3/23/21 (Figure 96). The LSYR mainstem flow rate at the Narrows gauge (which includes discharge from Salsipuedes Creek) was approximately 19 cfs and 16 cfs when the 2 redds were discovered, respectively. Large and active beaver dams were observed approximately 0.9 mile upstream of the redd sites that likely prevented upstream migration of any mainstem migrating *O. mykiss* at the time of redd construction.

CDFW installed and maintained a DIDSON video camera near the Lompoc Airport and just downstream of the H Street USGS gauge. During the DIDSON deployment period (10 days of footage in late January through early February), they recorded 13 large fish, 5 of which most likely were adult anadromous steelhead (CDFW, 2021). At this deployment, it was difficult to identify fish by species with the large camera window length and low footage quality. During this migration window, the USGS H Street gauge ranged from 267 to 57 cfs. Given the timing, it was likely that some of those anadromous fish created the 2 redds and spawned upstream of the Salsipuedes Creek confluence as observed by COMB-FD staff. No *O. mykiss* (resident or anadromous) were observed by CDFW at their Salsipuedes Creek DIDSON site (60 days of footage).

COMB-FD staff visited redd sites weekly after the initial redd observations in March; downloading adjacent water quality equipment, noting flow conditions and checking for

fry emergence from the redds. On 4/29/21, a team of two divers snorkeled all remaining wetted habitats 1,000 feet upstream and 1,000 feet downstream of the redd locations. Divers found 2 YOY just downstream of the lowermost Narrows redd with only stagnant surface water barely maintaining at this redd and the narrow run downstream. The original upper redd site (80 feet upstream) was completely exposed to the air with no water remaining on the tail-spill. In addition to the YOY observed, divers observed 5 *O. mykiss* (4 between 6-9 inches and 1 between 9-12 inches) in a pool habitat approximately 860 feet downstream of the YOY observations.

Flow and water quality conditions were carefully monitored in the Narrows Reach in April and May. Reduced flow and poor water quality (low DO in particular), prompted coordination by the resource agencies (CDFW and NMFS) to conduct a fish rescue operation on 5/15/21. The Fish Rescue Team (CDFW and COMB-FD) attempted to seine (and e-fish the shallower areas) and capture the 5 observed *O. mykiss* from that pool (Figure 97). Several attempts were made with the seine but the habitat remained too deep and too complex to be successful with the seine or potential use of the e-fisher.

That same day the team scouted additional habitats downstream in need of potential fish rescue. A deep and narrow pool habitat located just downstream (34.589357, -120.408858) was electrofished and two *O. mykiss* were successfully removed from that drying habitat (Figure 96). Those fish measured 213 mm and 242 mm. Both *O. mykiss* were quickly transported to Salsipuedes Creek at Jalama Bridge (SC-3.5) where they were measured, photographed, fin clipped for genetics analyses, PIT tagged by CDFW, and released in good condition. COMB-FD staff revisited the release site and several hundred yards downstream over the next couple of days looking for any mortalities with none found.

COMB-FD staff revisited the area several times but no further fish rescue efforts were conducted within the Narrows Reach as the large habitat with 5 *O. mykiss* remained too extensive to effectively conduct a fish rescue while smaller habitats dried out. This was the third year (WY2021, WY2020, and WY2012) that COMB-FD staff has observed spawning in that area suggesting that this reach needs to be added to the routine annual monitoring for redd and snorkel surveys, as well as working with CDFW and NMFS to facilitate fish rescue and relocation.

Refugio Reach

While conducting spawning surveys in the Refugio Reach of the LSYR mainstem, COMB-FD personnel observed and recorded 3 redds on 2/9/21 above and below the Encantado Pool (LSYR-4.95). Total redd lengths ranged between 2.7 – 3.5 feet, indicative of resident adult *O. mykiss* spawners and not anadromous fish from the ocean or lagoon. For reference, 19 adult *O. mykiss* (9-18 inches) were observed in the Encantado Pool during the fall snorkel survey in December, 2020. The redds observed in the Refugio Reach in February were likely the result of fish that had successfully oversummered in the pool located in between the spawning sites.

Spring snorkel surveys in the Refugio Reach in late April/May revealed 81 YOY *O. mykiss* in the 0-3 inch size class, presumably the progeny of the redds mentioned above. The bulk of the YOYs in the Refugio Reach were observed at the head of the Encantado Pool and just downstream of the Encantado Pool and Meadow Lark Crossing (LSYR-5.0), in close proximity to the two redd sites. Unfortunately, the majority of the YOYs likely perished as both locations dried prior to arrival of the WR 89-18 releases.

The extent of surface water in the dry gap of the Refugio Reach continued to retreat in the spring. As the COMB-FD monitored this reach closely, coupled with spring snorkel survey results, staff was able to predict if and when any *O. mykiss* rescues would be necessary. An example was the Sycamore Pool (LSYR-5.8) that is located in the upper portion of the dry gap and was rapidly losing residual pool depth. CDFW and COMB-FD personnel conducted a fish rescue at the Sycamore Pool on 5/8/21. A total of 10 *O. mykiss* ranging in size between 56-322 mm were successfully electrofished, measured, photographed, fin clipped, transported, PIT tagged (9 total), and released just downstream of the Long Pool (LSYR-0.7) within the LSYR mainstem (Figure 98). All fish were released in good condition into a deep run habitat that was sustained throughout the summer with cool, oxygenated releases from Bradbury Dam. Fish releases from Bradbury Dam were sustained through target flows and WR 89-18 Releases throughout the remainder of the calendar year. Background flows in Hilton Creek began in mid-December of WY2021 with several large storm events impacting the basin.

4.9. Trends in Migrant Trapping since WY2001

Trend analyses of migrant captures through the longstanding trapping effort can provide insights into the dynamics of the *O. mykiss* population within the LSYR basin. The migrant trapping results have been complicated by a long-term drought (WY2012-WY2016) and the limited amount of take provided by the 2000 Incidental Take Statement (ITS), specifically only 110 juveniles and 150 adults. Since the issuance of the 2000 BiOp, it has been evident that those take limits (specifically for juveniles) are insufficient for the size of the *O. mykiss* population within the LSYR basin and as a result of the multiple tributary and LSYR mainstem enhancement projects in support of the fishery. As of WY2012, the ITS limits were adhered to resulting in a truncated trapping effort and incomplete dataset for each migration season. None the less, valuable insights can be gained by conducting a trend analyses from the migrant trapping effort.

The LSYR basin *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. Nearly the entire LSYR dried in WY2016 with only the Stilling Basin, Hilton Creek, and small portions of Quiota and Salsipuedes Creek remaining wetted. WY2017 was the low point and thereafter began an increase in the population that has continued through the current water year (WY2021). 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 (February – April) that did not fully capture the environmental conditions and subsequent population response throughout the migration season (January – May); a crucial metric when managing endangered species. The annual Migrant Trapping Plans prioritize first capture of upstream migrating resident/anadromous adults and second downstream migrating juvenile/smolts. Unfortunately the current Migrant Trapping Plan misses the start of the adult migration season and the end of the smolting run hence captures do not accurately reflect actual population totals and dynamics but is the best that can be done given the imposed ITS limits. Since WY2012, take limits have not been exceeded for juveniles and adults (Figure 99), with take limits typically being met and trapping ending by early April.

From WY2001 to WY2021, 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-term drought (Table 26). Anadromous fish captured over that time had a high in WY2008 of 16 with the next highest of nine in WY2011 (one being a recapture at Hilton Creek that was initially captured in Salsipuedes Creek) (Tables 27 and 28). Since the issuance of the 2000 BiOp, there have been 7 years with one or more anadromous steelhead observed, primarily in Salsipuedes Creek (WY2001, WY2003, WY2005, WY2006, WY2008, WY2009, WY2010, and WY2011). Only during 2 years have anadromous steelhead been observed in Hilton Creek (WY2008 and WY2011), most likely from the WY2005/WY2006 and WY2008 (all spill years) cohorts. The number of returning anadromous adults has been low since monitoring began, but WY2008 and WY2011 (wet years) 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). Unfortunately, the drought and inconsistent rain years after WY2016 have hampered a positive overall population response within the LSYR watershed. In Hilton Creek, the number of resident adults migrating upstream to spawn have shown a positive trend with a low of one captured in WY2017 (most likely due to the long-term drought plus Whittier Fire impacts) and a high of 86 captured in WY2021 that resulted in the construction of 48 individual redd sites, the highest yearly total recorded in the creek. Smolt captures had a maximum of 445 in WY2006 at all trapping locations (Hilton Creek [213], Salsipuedes Creek [218], and the mainstem [14]) and a low of two in WY2017, again reflective of the impact of the drought (Table 29). Downstream migrants in Hilton Creek have also shown an encouraging population response since WY2016 with a low of four captured in WY2017 (two smolts) and a high of 101 captured in WY2021 (28 smolts). Downstream migrants, especially smolts, are likely undercounted due to the truncated trapping season so the number of smolts moving downstream in WY2021 (and possibly other truncated trapping seasons) is likely higher (Figure 100). Smolt captures in Hilton Creek are on the rise since the low numbers observed after the effects of the Whittier Fire and drought.

Before the drought, Salsipuedes Creek routinely produced the most smolts compared to all trapping sites and is highly correlated to the amount of rainfall received in the watershed. This behavior is not observed in Hilton Creek due to the artificial flow from

Lake Cachuma and the low water temperature regime from reservoir releases to the creek that is not reflected in the rest of the LSYR watershed. For example, wet and average year types produced the most number of smolts in Salsipuedes Creek whereas during dry year types, the number of smolts captured was significantly reduced (WY2002, WY2004, WY2007, and WY2009) highlighting the importance of environmental ques in relation to the smolt migration in this watershed. Since WY2016, the effects of the drought to the smolt population in Salsipuedes is most pronounced and a stark reminder of long-term drought impacts to the overall population in the creek. Since WY2016, there were only three smolts captured leaving Salsipuedes Creek (two in WY2018 and one in WY2019). Smolt captures in WY2021 showed encouraging results with 15 captured and represents the highest smolt total since WY2011 (Figure 101).

The last years that anadromous steelhead were captured in the LSYR were in WY2008 and WY2011 in Salsipuedes and Hilton Creeks with several fish captured between 480-701 mm (19-27.5 inches) including a few smaller fish that were speculated to have originated from the lagoon based on their general appearance (robust with silvery coloration) (Figure 102).

The total number of large *O. mykiss* fish captures, defined as equal to or greater than 400 mm (15.7 inches) follows a similar trend as discussed above with the highest total observed in WY2008 (prior to the drought) (Figure 103). No fish larger than 400 mm have been captured in Salsipuedes Creek since WY2011. In Hilton Creek, only two large migrants were captured in WY2014 with none captured in WY2012, WY2015, WY2016, and WY2017. There was a steady uptick in larger fish captured in the creek since WY2018 with one captured in WY2018, three in WY2019, eight captured in WY2020, and three captured in WY2021. Given the increased population size inhabiting the Hwy 154 Reach, it is likely that more larger fish will be captured in WY2022 than the previous few years. Tracking the abundance of larger fish is an important metric due to the higher fecundity rate of larger versus smaller spawning fish. This also reflects the positive results of Highway 154 Bridge target flows that have been enhancing the rearing habitats within the Hwy 154 Reach, particularly for larger fish.

4.10. Aging WY2018 *O. mykiss* through Scales Analyses

Scales were taken and analyzed on 17 of 27 total migrant captures at 2 trap sites (Hilton Creek and Salsipuedes Creek, there were no LSYR mainstem captures) over the WY2018 reporting period. Minimum fish size for tissue sampling was again set at 120 mm and some fish could not be sampled due to their size or the scales were not legible. The age range was from 0+ to 1+ years old with a size range of 132 mm to 210 mm (Table 30). Scales were read from 17 fish of which near all were 1+ year old fish. Scale analyses are valuable and insightful regarding growth patterns, environmental changes, and differences between one stream and another. For example, Hilton Creek with continuous favorable rearing conditions from lake releases result in rapid and consistent growth (Figure 104). It is common to see smolt out-migration in Hilton Creek after just one (1+) age (Figure 105).

The total number of fish captured and fish size (and age) in WY2018 was an indication of the toll the long stranding drought had on the LSYR *O. mykiss* tributary populations. In fact, the largest fish captured in WY2018 was only 265 mm (10.4 inches). It should be noted that scales were not obtained from that particular fish, due to having imbedded scales.

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

In 2021, there was an ANA WR 89-18 release with a maximum release rate of 92 cfs that extended down to several miles upstream of the Narrows Reach. Below Narrows Account (BNA) releases are conducted typically at a higher release rate as exemplified in 2020 when the maximum release rate was 150 cfs and extended out into the Lompoc Plain. Prior to the start of the 2021 WR 89-18 ANA release on 8/2/21, the total dam release rate was 12 cfs (Hilton Creek and Outlet Works combined). Starting on 8/3/21, the release was ramped up to 22 cfs, and was gradually ramped up to 92 cfs on 8/8/21. This resulted in a gradual cooling of the Stilling Basin waters which translated to monitoring locations immediately downstream and resulted in no observed water temperature spike as recorded during previous years of a rapid start of the release that pushed thermally heated Stilling Basin water downstream at onset of the WR 89-18 releases (Figure 106). Water temperatures gradually cooled over the five day period and on 8/8/21 unithermal conditions were observed with a maximum temperature of approximately 16 °C; the lowest recorded water temperature across all monitoring locations. As flow release rates decreased, water temperatures slowly increased with the Long Pool surface monitoring location showing the largest increase in temperature with a maximum in excess of 21 °C. The monitoring location downstream of Long Pool (LSYR-0.68) remained less than 18 °C during the remainder of the deployment period.

4.12. LSYR Beaver Dams

History: The North American Beaver (*Castor canadensis*) according to scientific literature was introduced into the Santa Ynez River and have sustained active populations in the watershed since the late 1940's (Hensley, 1946; Baker and Hill, 2003; CDFG, 2005; Richmond, 2021). In the mid 1990's, their distribution within the lower watershed was spotty, localized to areas downstream of Buellton with a few scattered dams in the Salsipuedes Creek watershed. From 1995 to 2011, the hydrological regime was in a wetter cycle and the lake spilled on average about every three years (1995, 1998, 2001, 2005, 2006, 2008, and 2011) creating migration opportunities throughout the lower watershed (AMC, 2009). In addition, prior to 2005 when summer target flows were implemented for rearing *O. mykiss*, the river was managed much differently. Prior to the listing of the endangered Southern California steelhead in 1997, the river was largely used as a water delivery corridor to quickly and efficiently recharge the various groundwater basins both upstream and downstream of the Narrows. Once natural flows ceased from the tributaries (typically April-June), no releases occurred from Bradbury Dam unless a WR89-18 downstream water rights release was called for to recharge the groundwater basins, usually every three years or so. This resulted in large sections of the LSYR mainstem going dry with the riparian corridor vegetation largely absent from the associated floodplain, particularly in the Alisal, Refugio, and Avenue Reaches as well as

large sections of the river in Reach 3 downstream of Buellton (LSYR-13.9) to the Narrows (LSYR-36.0).

Since 2005, Hilton Creek releases and target flows were required to improve summertime *O. mykiss* rearing conditions in the LSYR mainstem in the year of and year after a spill when *O. mykiss* were present in the Refugio and Alisal reaches. Target flows are required to the Highway 154 Bridge (Hwy 154 Reach) for all other years until Lake Cachuma storage drops below 30,000 af. This coupled with consecutive downstream water rights releases during the drought has provided water in the river during June through September that has resulted in an explosion of riparian corridor vegetation growth (willows, cottonwoods, sycamores, mulefat, etc.) and in some places the surrounding floodplain due to the additional water. An average of 6,719 af of water (range 2,468 to 13,333 af) has been provided to the LSYR mainstem each year target flows were required during the summertime period (June-September) (Table 31). This has translated to more surface water down into Reach 3 downstream of Buellton due to groundwater flow that emerges and creates surface streamflow at various locations due to basin geology that forces groundwater to the surface. The increase in surface water in the LYSR mainstem has increased the extent of suitable conditions for beavers as well as the lack of Lake Cachuma spill that can cause channel changing and clearing events.

Over time and with the increased amount of flow in the river since 2005 as a result of the target flow requirements of the 2000 BiOp and WR 2019-0148, the number and spatial distribution of beavers and their dams have increased substantially throughout the LSYR mainstem and select tributaries. 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 colonized the Salsipuedes/El Jaro Creek watershed despite their numbers and distribution being 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 - Documentation and Potential Migration Barriers: Beaver dams have been observed to act as migration barriers on the LSYR especially during low to moderate flows, forcing *O. mykiss* to spawn in suboptimal locations, as they are unable to negotiate past large well-established dams. This was evident in WY2021 when two large anadromous steelhead redds were identified 1.5 miles upstream of the Salsipuedes Creek confluence and 0.9 miles downstream of a significant beaver dam. The steelhead spawned in the only area available that consequently went dry before most of the eggs hatched. Without the presence of beaver dams (80 recorded in the LYSR mainstem in WY2021), it is likely those fish could have moved up through the Management Reaches to Hilton Creek where optimal spawning and rearing habitat were available. Barrier beaver dams are forcing anadromous steelhead to spawn in sub-optimal locations that are

prone to drying before fry can emerge and navigate to refuge and rearing habitats, especially in the lower river, as illustrated in WY2021 within the Narrows Reach.

WY2021 is the first year since WY2011 that anadromous steelhead redds were identified in the LSYR and their entry into the LSYR basin was documented most likely by CDFW's DIDSON video camera. Looking at the USGS Narrows and H Street flows, it appeared like that anadromous steelhead had a small window of opportunity to enter the watershed following the late January storm before decreasing flow began to impede movement. At H Street, flows in excess of 25 cfs were present for only 17 days (1/28/21 – 2/13/21) and were present for 26 days at the Narrows (1/27/21 – 2/21/21). It is estimated that about 45 cfs (25 cfs at Solvang) is the minimum flow rate needed to allow for steelhead to pass through critical riffles (SYRTAC, 1999). For a point of reference, the steelhead redds were found approximately three miles upstream of the Narrows USGS gauging station. The closest barrier beaver dam is located approximately 0.9 miles upstream from both steelhead redd sites. Upon inspection of the beaver dam following the discovery of the steelhead redds, it was clear that the dam was a complete barrier to any upstream migrating fish due to the absence of a jump pool below the beaver dam, the height of the dam (2.7 feet) and no observable flow paths to enable fish to swim through the dam. In order for an *O. mykiss* to make the jump according to CDFW fish passage criteria, there needed to be a pool in excess of 4.05 feet in depth. At no point between the time the fish entered the system and the steelhead redds were discovered could an anadromous *O. mykiss* successfully pass over or around this one beaver barrier.

From 2005 to 2010, COMB-FD biologists noted an increase in the number of beaver dams observed in the Management Reaches (Alisal, Refugio, and Hwy 154 reaches), which called into question the efficacy of conducting Fish Passage Supplementation Releases and how successful the releases were regarding anadromous steelhead and outmigrating smolt passage with many LYSR mainstem beaver dams of varying size. In order to evaluate the number and distribution of beaver dams in the LSYR and to better understand movement challenges by *O. mykiss* in regards to Fish Passage releases from Bradbury Dam, yearly beaver dam surveys have been conducted along the entire LSYR and the Salsipuedes/El Jaro watershed since 2010. Prior to the 2012-2016 drought, regular spill events acted to remove beaver dams or provide enough flanking flows to allow for both upstream and downstream *O. mykiss* passage as evident in anadromous steelhead captures in both Hilton and Salsipuedes Creeks. While the drought did contribute to a significant reduction in both the number and geographic distribution of beavers, there has been a noticeable uptick in the number and distribution of beaver dams since 2016 (Figure 88 and Table 21). The fewest number of LSYR mainstem dams identified was in 2016 with 45 dams documented. That number has increased to 80 in WY2021. Beaver dams in the tributaries declined to 0 in WY2019 then increased to 11 in WY2021.

Beaver Activities Transforming the Riparian Corridor: Beavers are classified as ecosystem engineers by changing their habitat to suit their needs (Jones et al., 1997). In the absence of significant spill and/or stormflow events during the past 10 years to remove beaver dams, the overall beaver population and associated dams/pools have

increased and contributed to a transformation of the riparian corridor throughout the LSYR watershed where beavers have been active. In the past, biologists have been able to negotiate pathways through the LSYR riparian corridor while conducting the beaver dam survey. That was not the case in the WY2021 survey. Spatial distribution of dams has changed over time from scattered individual impoundments to contiguous complexes or impoundments along extensive sections of the river. What was once a relatively confined channel (especially in Reach 3) has transformed into a marsh/reed/willow forest that in many places has extended well out into the floodplain and widened the riparian vegetation corridor. The dense vegetation can obscure or eliminate the active channel with no apparent migration pathway available for upstream and downstream migrating *O. mykiss*. Any new channel with flowing water has the potential for beaver dam building that with time further extends the inundation zone and expansion of vegetation contributing to additional suitable habitat and food sources for beavers. Reed and willow growth in their present state have a high resilience to disturbance, slowing water velocities and reducing erosional characteristics of high flow events and creating obscure migratory pathways in the absence of higher stormflows (Naiman et al., 1994). The extensive ponding and marsh habitat has also reduced and in some locations eliminated all spawning habitat. Introduced species, such as the American beaver into the Santa Ynez River watershed, can extensively alter the historical ecosystem and negatively disrupt the balance of sustainability for native flora and fauna (Richmond et al., 2021). These beaver complexes often attract and favor non-native species (i.e., Centrarchids vs. *O. mykiss*, bull frogs vs. red-legged frogs, arundo donax, tamarisk, etc.). The LSYR basin is no stranger to these invasive non-native species. Until a beaver management plan is developed and implemented, beavers will continue to impact endangered steelhead through dam building activities that impede passage, especially in dry and average years, and favor non-native species competition. With climate change already influencing weather patterns and shifting rainfall to later in the year, beaver dams will continue to have the potential to negatively influence spawning and recruitment of *O. mykiss* within the LSYR basin in the foreseeable future.

4.13. 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 32). Many of the fish passage projects, but not all, were listed in the 2000 BiOp (Tables 33-34 and Figures 107-112). 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 Santa Barbara 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 (concrete low flow crossing to fully spanning bridge) 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).

The South Side Erosion Control and Reforestation Project was an enhancement to the completed Quiota Creek Crossing 8 Project by addressing observed erosion problems to the south in two small tributaries. The project was successfully completed at the end of September in WY2020 (Figure 111). Two small settling basins were constructed in each of the two 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 (*Quercus agrifolia*) were planted in close proximity to each of the settling basins for reforestation (totaling 20 trees), and all disturbed areas were seeded/mulched within the project footprint. Each basin allows for slowing of the streamflow so that sediments can settle out during high flow events when the tributaries are running that results in reduced sediment delivery to the perennial channel of Quiota Creek.

The two settling basins also act as infiltration basins to elevate the local groundwater table. Sediment capture and groundwater infiltration are benefits to all aquatic organisms within the drainage, particularly to *O. mykiss* and California red-legged frogs (*R. draytonii*) by providing improved water quality and clarity during critical life stages and sustaining baseflow further into the dry season. The basins also help to alleviate overland erosion and potential damage to the newly installed Crossing 8 Bridge and stream banks by slowing and channelizing the flow around that project area from the two subject tributaries. The ranch road drain improves the drainage of S. Refugio Road by directing flow away from the road and into an improved unnamed tributary that acts as a conveyance channel. The objective of the revegetation effort was to enhance erosion control measures and habitat development in areas that historically only contained grasses and weeds. Once established, the oak trees will lock in the surrounding soils, provide shade, and allow for successional vegetative processes to begin. Both planting areas were fenced off to prohibit impacts from cattle grazing. All elements of this project and specifically the reforestation efforts will provide habitat for a variety of amphibian, mammal, and bird populations over time. All planted oak trees are now included in the project proponent's maintenance efforts for the Quiota Creek Crossing 8 Project.

The deliveries from the HCWS/HCEBS have 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 63-64). 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 113). Channel changes and the redistribution of optimal sized spawning gravels throughout Hilton Creek from the Whittier Fire, coupled with continuous Lake Cachuma water deliveries to the URP since WY2019, and gravel augmentation (2017-2018) have greatly enhanced instream spawning and 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 that continue to stabilize the creek. Also, 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 WY2021 as cattle have been excluded from the stream corridor, except for a couple of short duration break-ins. Prolific riparian growth has transformed this section of the creek providing greater complexity of instream habitats, additional cover in refuge habitats, and more favorable *O. mykiss* rearing conditions.

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.

4.14. Hilton Creek Tank Re-wrapping, Shade Cloth Enhancement, and Flushing

Four 5,000 gallon water tanks with a low-flow delivery system were installed in 2016 by USBR on a plateau next to the LRP on Hilton Creek (Figure 114). The objective of the project was to provide *O. mykiss* in Hilton Creek with water during critical drought conditions in WY2016/2017 as well as a backup water supply during any flow interruptions or emergencies. These tanks were wrapped with insulation blankets that were held in place by a plastic wrap with the objective of keeping the water in the tanks cool when not in use and a hoop structure was built over the top of all tanks to provide shading specifically for hot and sunny days. Over time the plastic wrap disintegrated and the insulation blankets came off the tanks. The COMB-FD collaborated with USBR to reposition the insulation blankets and secure them in place. Some of the shade cloth had come off which was also repaired and improved. The plastic wrap and surrounding areas were cleaned up and returned to as-built standards. Once completed, the tanks were slowly drained to Hilton Creek overnight on 9/8/21 and then refreshed with new cool lake water from the Outlet Works on 9/9/21.

4.15. 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 WY2021 during beaver dam surveys and did not observe any water hyacinth (last known occurrence was 12/8/16). This has become a routine field monitoring activity during beaver dam surveys.

4.16. Update on the Lake Cachuma Oak Tree Mitigation Project

The annual oak tree inventory was completed on 4/8/21 with an objective to determine the status and success rate of the trees planted since the beginning of the program with 12 years of plantings. At the end of the 2021 planting season, 5,350 oak trees have been planted and 4,341 are alive and thriving (an 80.28 % survival rate). The number of mitigation trees still to be planted is 380 trees (mitigation number minus total alive trees) (Figure 115). Staff is on target to complete the remaining planting during WY2022.

There were 325 trees planted at Lake Cachuma County Park that are referenced as Year 12 trees. We have found that trees planted inside Cachuma County Park as opposed to outside the park have a higher success rate due to easier access for maintenance, less brush that would otherwise provide habitat for herbivores that eat oak trees (e.g. woodrats, rabbits, etc.), a water source inside the park to ease the process of filling the water truck and trailer, and clean mulch piles on site that can be utilized as needed. The lessons learned by the COMB-FD staff from 9 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 when planting new trees, and planting larger trees.

4.17. Status of WY2020 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.

- 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;
    - 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.

- 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 successfully completed in Hilton Creek on Reclamation property. Work with Reclamation on developing the plan, environmental coverage, and identifying potential funding sources.

- 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.

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

- 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.
    - This recommendation is being followed, has produced positive results in support of the LSYR mainstem fishery, and is ongoing.

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

- 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;
    - 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.

- Continue to 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 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;
    - Status: This recommendation is being followed, progress is being made, and the effort 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: This recommendation is being followed and is ongoing.

5. Conclusions and Recommendations

WY2021 was the 11th dry year since the 2000 BiOp was issued. Bradbury Dam recorded only 11.84 inches of rain with the highest rainfall occurring in December and January. Lake Cachuma did not spill and the highest lake level was on the first day of the water year (10/1/20) at 731.94 ft above mean sea level (135,402 af, or 70.0% of capacity). A minimum of 1.3 cfs was delivered to Hilton Creek at the URP and LRP, and target flows to the Hwy 154 Bridge were met. The lagoon was open to the ocean for only a short period of time during the *O. mykiss* migration season (1/28/21 – 3/9/21) and remained closed for the rest of the water year. After review of the CDFW DIDSON data on the LSYR near the Lompoc Airport, their staff observed 13 large fish, 5 appeared to be anadromous *O. mykiss*, January and February. Some of those fish may have created the two anadromous redds documented by COMB-FD in the LSYR mainstem just upstream of the Salsipuedes Creek.

There were 66 redds documented across the LSYR basin with the majority observed in Hilton Creek (48), Salsipuedes Creek (7), El Jaro Creek (4), and two in Quiota Creek. There were five redds documented in the LSYR mainstem; three immediately upstream and downstream of LSYR-4.95 and two in the Narrows Reach approximately 1.0 mile upstream of the Salsipuedes Creek confluence that were presumed to be constructed by anadromous steelhead based on the large size of the excavation. 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 higher than WY2020, most likely due to extensive spawning gravels in Hilton

Creek and no stormflow beyond the third week in January that could have washed out redds. There were no Fish Passage Supplementation Events in WY2021.

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 WY2020 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 WY2022 onward:

- Continue to implement the monitoring program described in the revised BA (USBR, 2000), BiOp (NMFS, 2000), and Order Water Rights (WR) 2019-0148 (SWRCB, 2019) 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;
- Incorporate the Narrows Reach into routine monitoring efforts specifically redd surveys, snorkel surveys, and water quality.
- Continue to support Reclamation upon their request of information needed for their Reconsultation process with NMFS, in particular efforts to increase the ITS limits for both juvenile and adult *O. mykiss* to best cover the current and future population size.
- Continue to work closely with Reclamation on the implementation of the new 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;
- Work with Onset to improve functionality and reliability of their Hobo Shuttles for thermograph data downloads.
- 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 successfully 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 maximize support of the downstream fishery and minimize lake release stream temperatures entering the Long Pool and LSYR mainstem habitats downstream.

- Work with the Santa Ynez River Conservation District on further developing their ramp-up and ramp-down procedures for WR 89-18 releases to enhance the successful implementation of the release that was started in WY2020.
- Continue to evolve the collaborative relationship with CDFW regarding fish rescue within the LSYR basin. The effort was started in WY2020 and continued in WY2021 and has been exemplary and should be continued. Coordinate and prepare early as conditions warrant entering into the dry season.
- Initiate a PIT tag monitoring effort in the LSYR basin to trap current and future CDFW tagged fish. This will require obtaining the equipment and conducting the required monitoring effort.
- Continue to remove non-native fish species and 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;
- Investigate with Reclamation Stilling Basin management specifically 1) a Stilling Basin bypass pipeline system to provide target flow releases without the potential for thermal heating and warm water fish species movement downstream; 2) limiting *O. mykiss* access to the Stilling Basin, 3) establishing a small road for access to the Stilling Basin, and 4) dewatering of the Stilling Basin for non-native fish removal; 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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Results
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3. Monitoring Results

Table 1: WY2000 to WY2021 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
2021	11.84	Dry	No	0	135,402	731.94	No	Yes

* Bradbury Dam rainfall (Cachuma) period of record = 69 years (1953-2021) with an average rainfall of 19.79 inches.

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

Table 2: WY2021 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 (WY2021)
	(#)	(date)	(years)	(in)	(in)	(WY)	(in)	(WY)	(in)
Lompoc	439	1955	67	14.50	5.31	2007	34.42	1983	10.78
Buellton	233	1955	67	16.52	5.87	2014	41.56	1998	8.57
Solvang	393	1965	57	18.13	6.47	2007	43.87	1998	9.31
Santa Ynez	218	1951	71	15.64	6.58	2007	36.36	1998	8.35
Cachuma*	USBR	1953	69	19.79	7.33	2007	53.37	1998	11.84
Gibraltar	230	1920	102	28.48	8.50	2013	73.12	1998	10.65
Jameson	232	1926	96	28.48	8.50	2007	79.52	1969	8.46

* 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 WY2021; 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	11/7/2020	0.30	No	No
2	12/27/2020	1.99	No	No
3	1/23/2021	8.38	Yes	Yes
4	3/10/2021	0.79	No	No
5	3/15/2021	0.18	No	No

(b)

Month	Rainfall (in.)	%
Oct-20	0.00	0.0
Nov-20	0.31	2.6
Dec-20	2.00	16.9
Jan-21	8.39	70.9
Feb-21	0.10	0.8
Mar-21	1.02	8.6
Apr-21	0.02	0.2
May-21	0.00	0.0
June-21	0.00	0.0
July-21	0.00	0.0
Aug-21	0.00	0.0
Sept-21	0.00	0.0
Total:	**11.84**	100

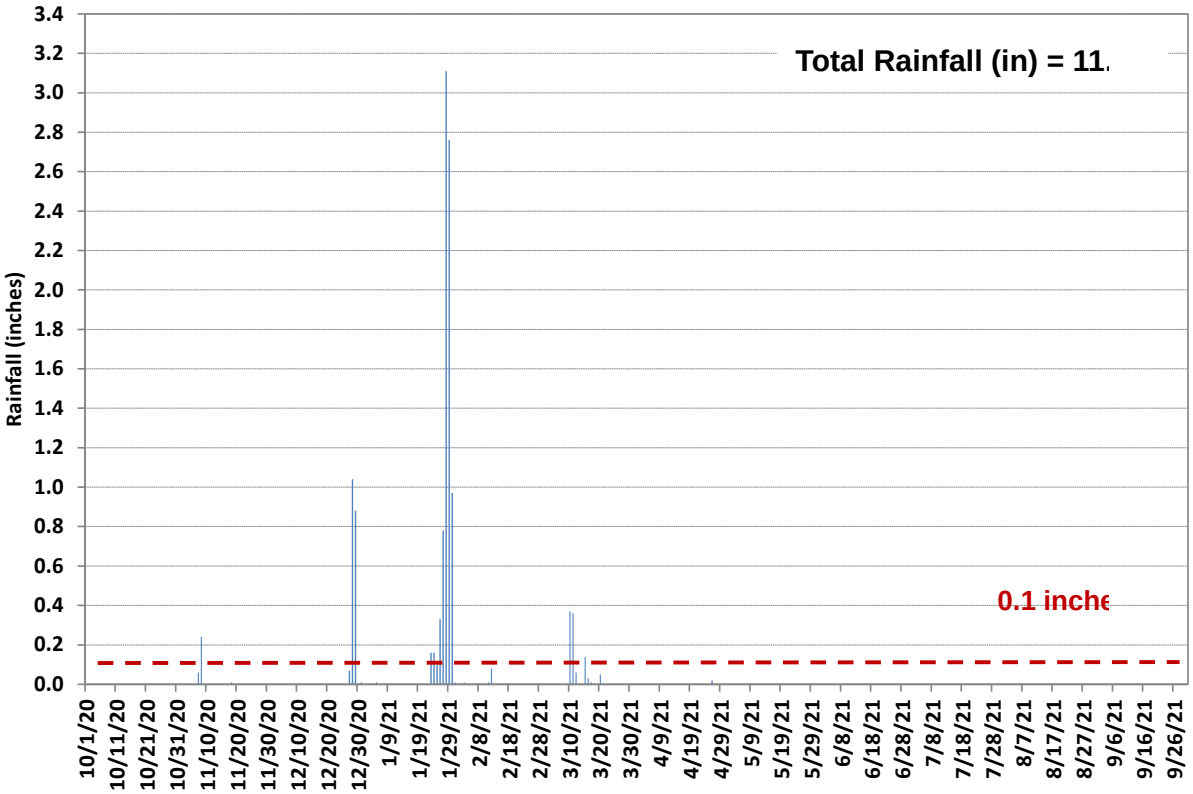

Figure 1: Rainfall in WY2021 recorded at Bradbury Dam (USBR).

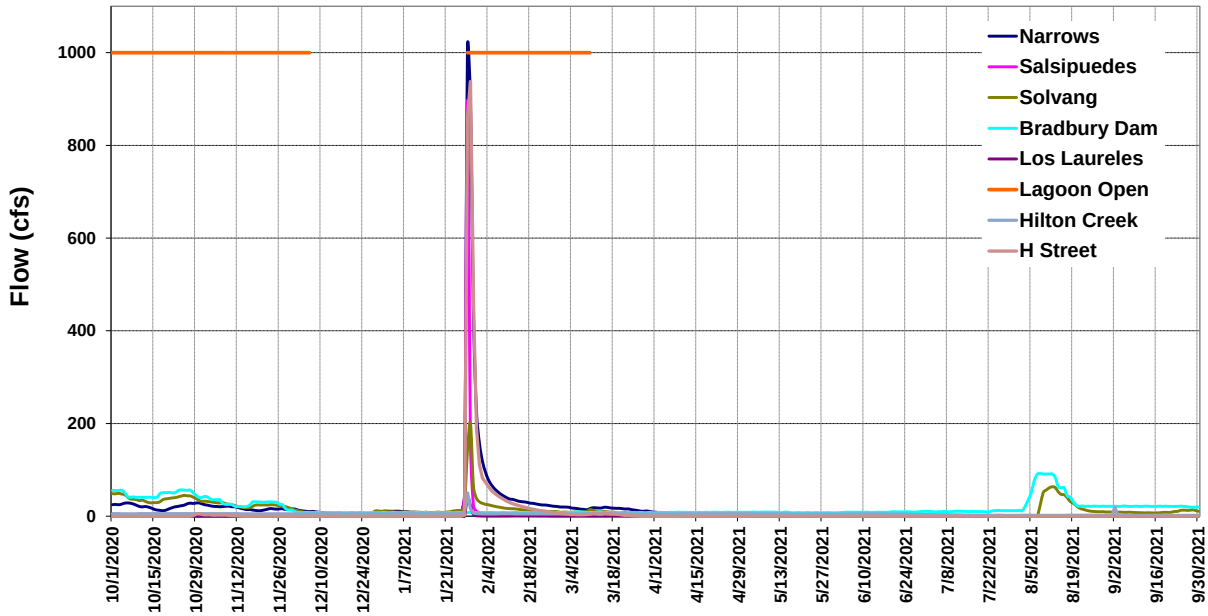

Figure 2: Santa Ynez River discharge and the period when the Santa Ynez River lagoon was open to the ocean in WY2021.

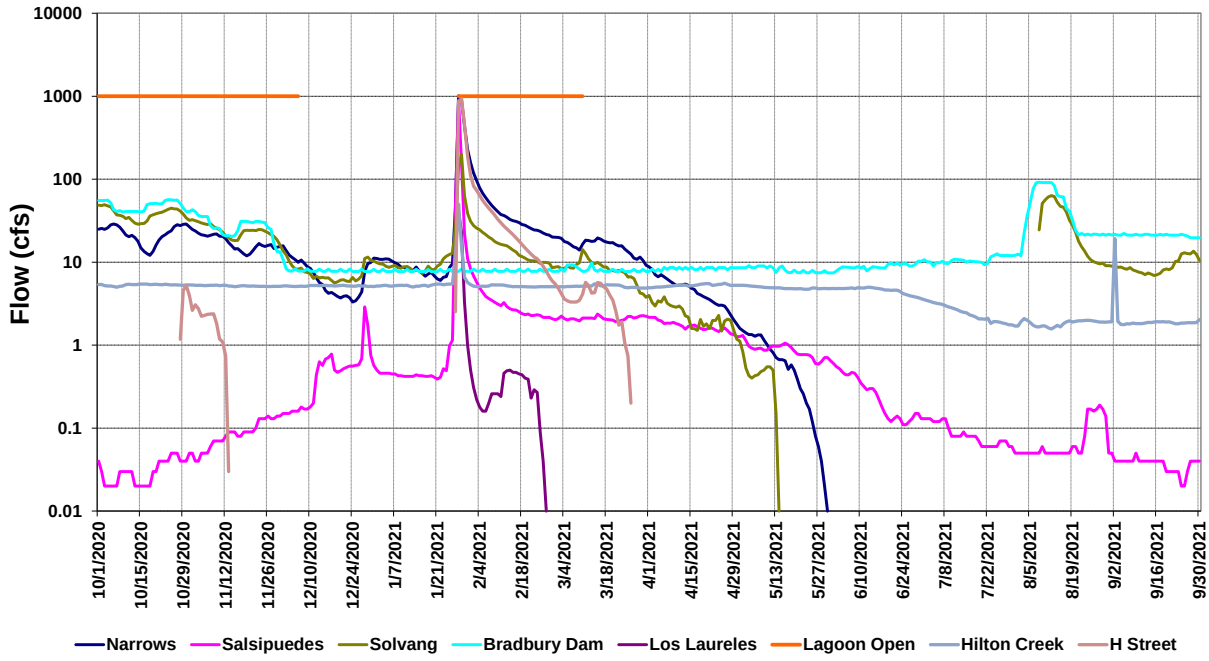

Figure 3: USGS average daily discharge at the LSYR mainstem USGS gauging stations at Los Laureles, Bradbury Dam (USBR), Hilton Creek (USBR), Alisal Bridge (Solvang), Salsipuedes Creek, the Narrows and H Street (Lompoc) during WY2021.

Table 4: Ocean connectivity, lagoon status and number of days during the *O. mykiss* migration season from WY2001 to WY2021.

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	12/20/10	-	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
2021**	Dry	Yes	-	12/7/20	55	0
			1/28/21	3/10/21	30	30

*Migration Season is January through May.

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

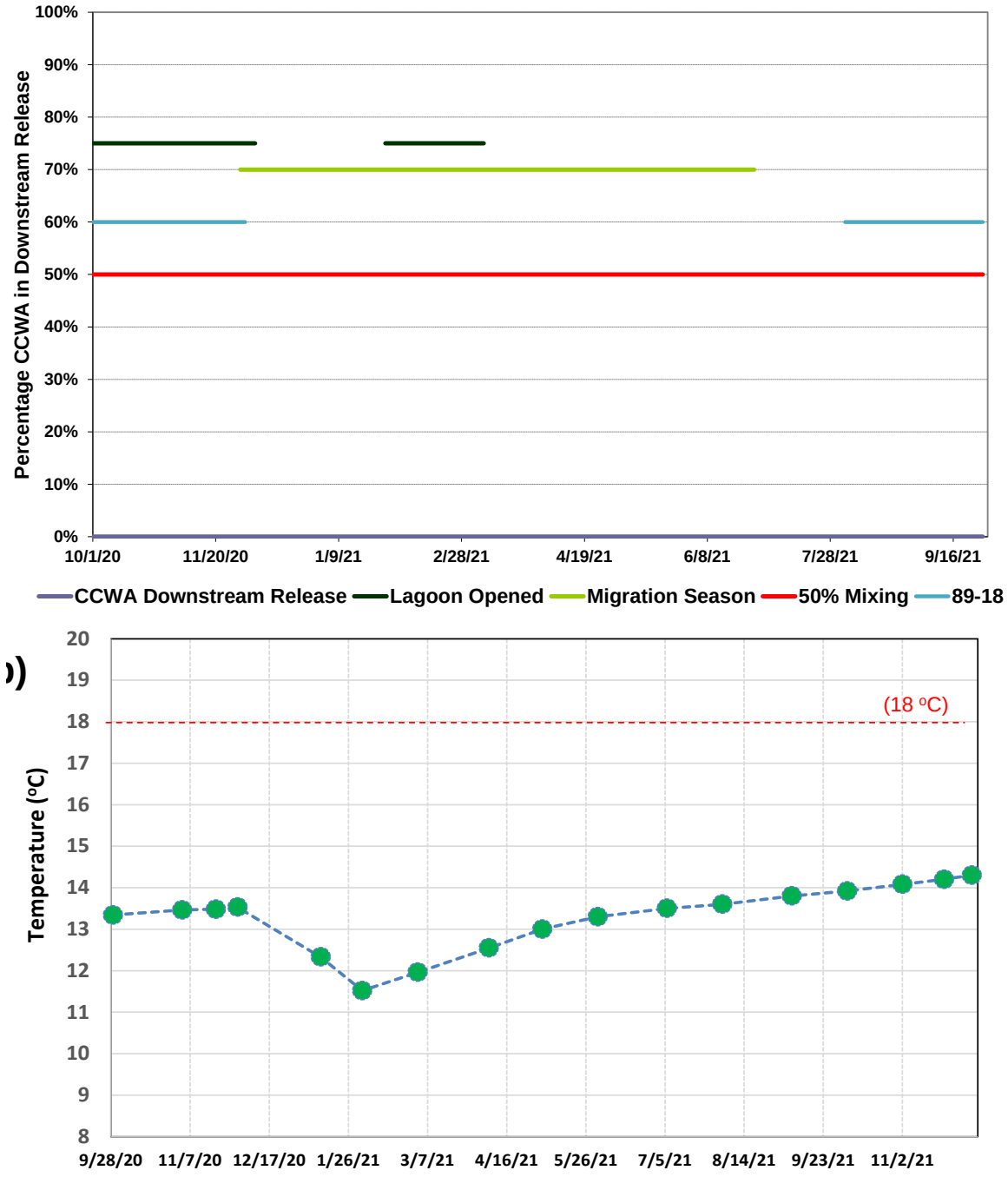

Figure 4: State Water Project (SWP) release into the LSYR regarding BiOp compliance with (a) the 50-50 mix rule showing the percentage of CCWA water being released from Bradbury Dam downstream to the Long Pool and (b) the 18 °C rule for the water temperature being released from the Outlet Works; there were no SWP deliveries through the Bradbury Dam Outlet Works (penstock) in WY2021 hence bottom lake profile data were used for this graph.

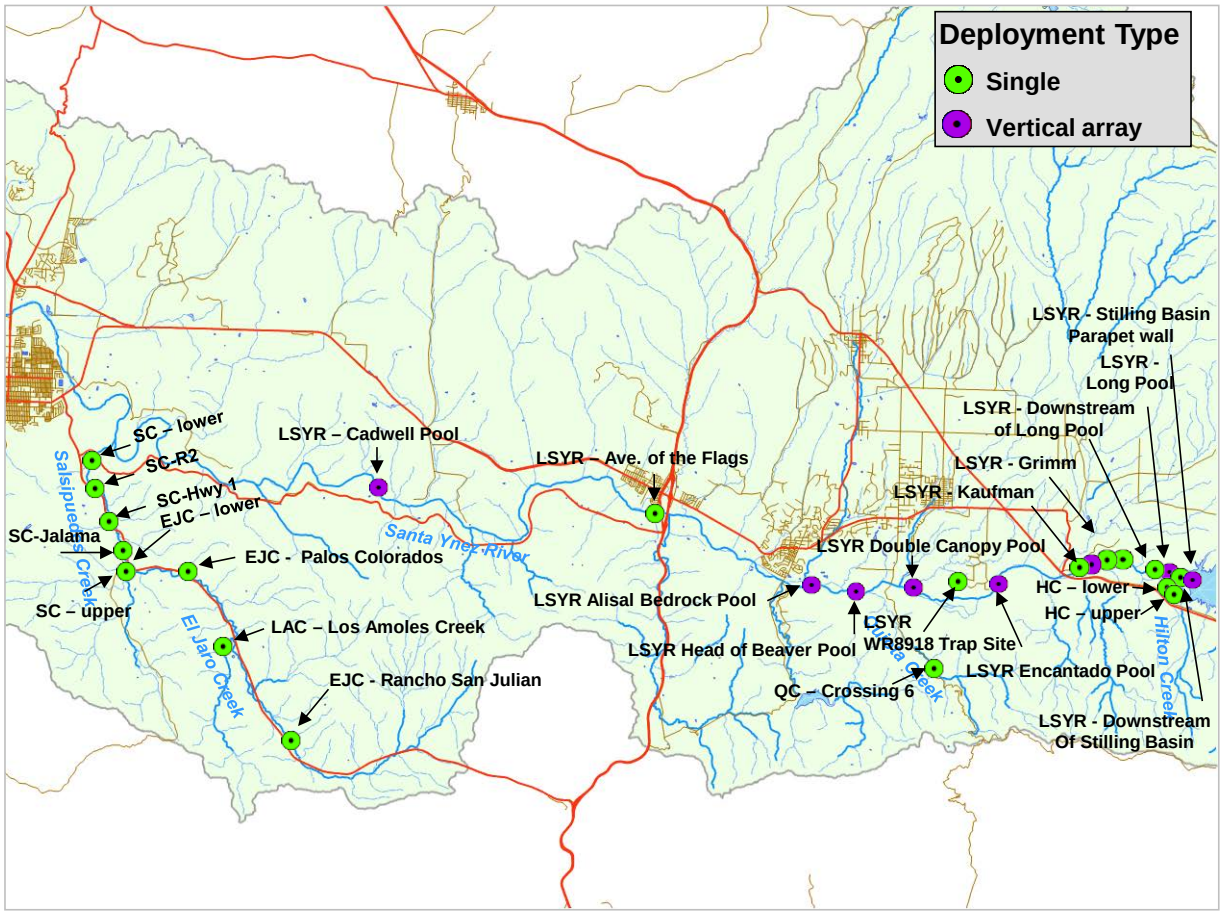

Figure 5: Thermograph single and vertical array deployment locations in WY2021 within the LSYR and its tributaries (HC – Hilton Creek, QC – Quiota Creek, SC – Salsipuedes Creek, and EJC – El Jaro Creek); the El Jaro Creek site and upper Salsipuedes Creek sites are close together with overlapping symbols.

Table 5: 2021 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)	# of units (#)
Mainstem	LSYR - Stilling Basin Wall	LSYR-0.01	Vertical Array	34.585472	-119.98316	4/5/2021	8/24/2021	139	3
	LSYR - D/s of Stilling Basin	LSYR-0.25	Single	34.586502	-119.985333	4/5/2021	8/24/2021	139	1
	LSYR - Long Pool	LSYR-0.51	Vertical Array	34.588545	-119.987998	4/5/2021	8/24/2021	139	3
	LSYR - D/s of Long Pool	LSYR-0.68	Single	34.590550	-119.991317	4/5/2021	8/24/2021	139	1
	LSYR-Grimm Property-Upstream	LSYR-1.09	Single	34.590097	-119.999322	5/24/2021	11/16/2021	172	1
	LSYR-Grimm Property-Downstream	LSYR-1.54	Single	34.59423	-120.00537	5/24/2021	11/16/2021	172	1
	LSYR-Grimm Property Pool	LSYR-1.71	Vertical Array	34.594533	-120.008004	5/24/2021	11/16/2021	172	3
	LSYR-Kaufman Property Pool	LSYR-2.77	Single	34.589631	-120.025523	5/24/2021	11/16/2021	172	1
	LSYR - Encantado Pool	LSYR-4.95	Vertical Array	34.583817	-120.058500	4/5/2021	8/25/2021	140	3
	LSYR - Mainstem (WR 89-18) Trap Site	LSYR-6.08	Single	34.579611	-120.077804	8/2/2021	8/26/2021	24	1
	LSYR - Double Canopy	LSYR-7.65	Vertical Array	34.583998	-120.096764	4/5/2021	7/14/2021	99	3
	LSYR - Head of Beaver	LSYR-8.7	Vertical Array	34.581116	-120.114454	4/6/2021	8/25/2021	139	3
	LSYR - Alisal Bedrock Pool	LSYR-10.2	Vertical Array	34.583267	-120.141369	4/6/2021	8/25/2021	139	3
	LSYR - Avenue of the Flags	LSYR-13.9	Single	34.606734	-120.195150	4/6/2021	8/25/2021	139	1
	LSYR - Cadwell Pool	LSYR-22.68	Vertical Array	34.610143	-120.306920	4/6/2021	8/25/2021	139	3
Tributaries	Hilton Creek (HC)-lower	HC-0.12	Single	34.587132	-119.986255	4/5/2021	8/24/2021	139	1
	HC at URP	HC-0.54	Single	34.581522	-119.982846	4/5/2021	8/24/2021	139	1
	Quiota Creek (QC)-Crossing 6	QC-2.66	Single	34.559525	-120.084834	4/5/2021	8/17/2021	132	1
	Salsipuedes Creek (SC)-lower-Reach 1	SC-0.77	Single	34.620473	-120.423552	4/12/2021	11/10/2021	208	1
	SC-Reach 2-Bedrock Section	SC-2.2	Single	34.61168	-120.42191	4/12/2021	11/10/2021	208	1
	SC-Reach 4-Hwy 1 Bridge	SC-3.0	Single	34.597429	-120.413034	4/12/2021	11/10/2021	208	1
	SC-Reach 5-Jalama Bridge	SC-3.5	Single	34.589551	-120.408944	4/12/2021	11/10/2021	208	1
	SC-upper at El Jaro confluence	SC-3.8	Single	34.583953	-120.408199	4/12/2021	8/24/2021	132	1
	El Jaro Creek (EJC)-Lower-Confluence	EJC-3.81	Single	34.584167	-120.407983	4/12/2021	8/24/2021	132	1
	EJC-Palos Colorados	EJC-5.4	Single	34.574767	-120.371795	4/12/2021	11/15/2021	213	1
	EJC-Rancho San Julian Bridge	EJC-10.82	Single	34.530013	-120.342545	4/12/2021	8/17/2021	125	1
	Los Amoles Creek (LAC)-Creek Crossing	LAC-7.0	Single	34.558216	-120.369581	4/12/2021	11/15/2021	213	1
*Stream distance for El Jaro Creek (a tributary of Salsipuedes Creek) are to the confluence with the LSYR mainstem.									43

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	B, C	n/s	B,C
		Downstream of Stilling Basin	LSYR-0.25	O, B	O	O
		Long Pool	LSYR-0.51	O, B, C	O, B, C	O, B
		Downstream of Long Pool	LSYR-0.68	O	O, B	O
		LSYR-Grimm Property Upstream	LSYR-1.09	O	O	O
		LSYR-Grim Property Downstream	LSYR-1.54	O	O	O
		LSYR-Grimm Property Pool	LSYR-1.71	O, B	O, B	O, B
		LSYR-Kaufman Property Run	LSYR-2.77		O, B	O, B
Reach 2	Refugio	Encantado	LSYR-4.95	O, B	O, B	O, B, S
		Double Canopy Pool	LSYR-7.65	O, B, C	O, B, S, C	O, B, C
	Alisal	Head of Beaver Pool	LSYR-8.7		B, S	
		Bedrock Pool	LSYR-10.2	B, C	B, S, C	B, C
Reach 3	Ave. of the Flags	Ave. of the Flags (HWY 101)	LSYR-13.9			
	Cadwell	Cadwell Pool	LSYR-22.68	B, S, 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	n/s
Salsipuedes	Reach 1	Salsipuedes Creek at Trap Site	SC-0.77	S	n/s	S
	Reach 2	Salsipuedes Creek Reach 2 Bedrock Section	SC-2.2	O, S	n/s	S
	Reach 4	Salsipuedes Creek at Highway 1 Bridge	SC-3.0	O, S	n/s	O
	Reach 5	Salsipuedes Creek at Jalama Bridge	SC-3.5	O, S	n/s	O, S
	Upper Salsipuedes	Salsipuedes Creek upstream of El Jaro Conf.	SC-3.8		n/s	n/s
El Jaro	Lower El Jaro	El Jaro upstream of Conf. with Salsipuedes	EJC-3.81		n/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		n/s	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: 2021 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, and (f) LSYR-1.54.

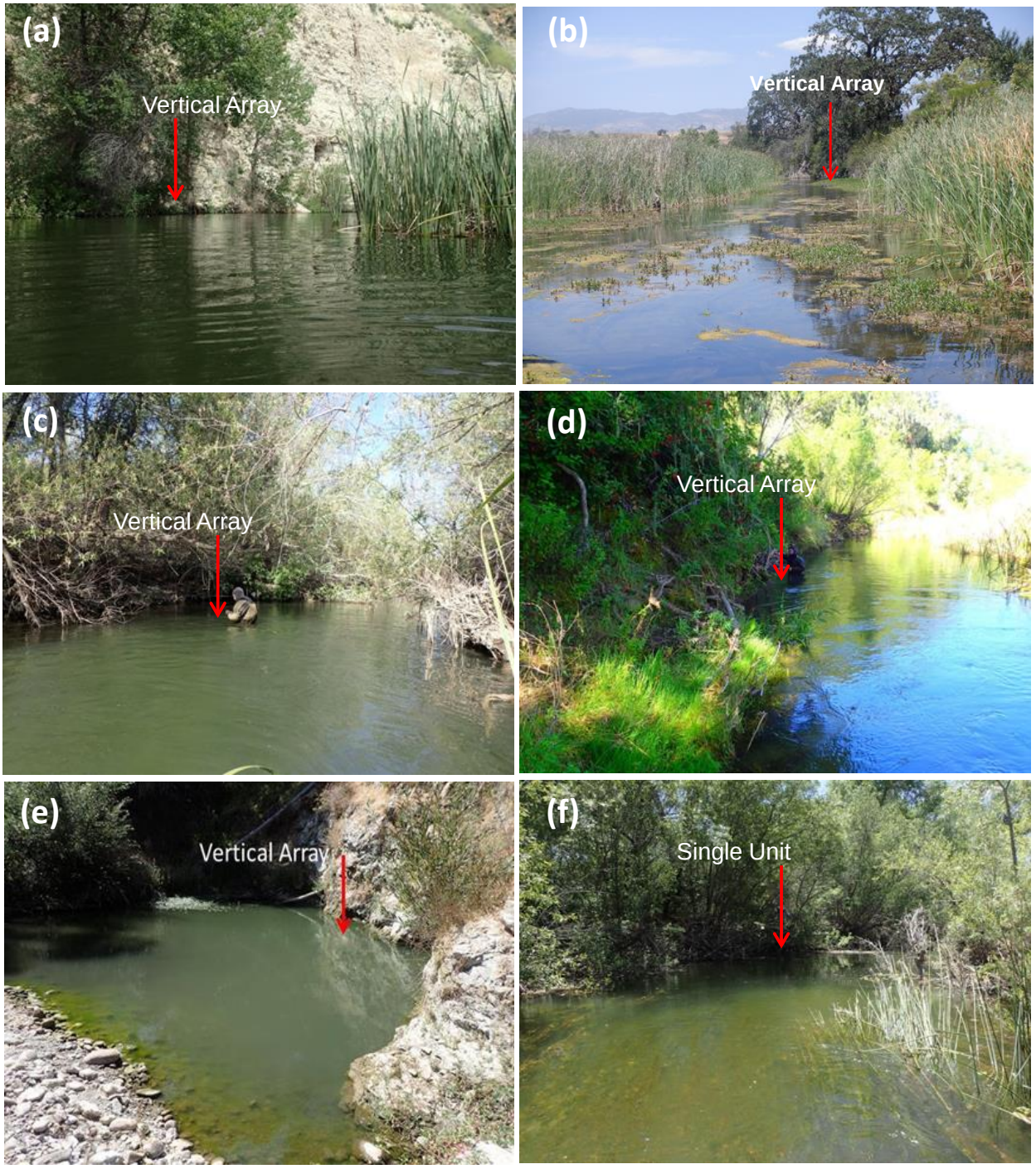

Figure 7: 2021 LSYR mainstem temperature unit deployment locations at: (a) LSYR-1.71, (b) LSYR-4.95, (c) LSYR-7.65, (d) LSYR-8.7, (e) LSYR-10.2, and (f) LSYR-13.9.

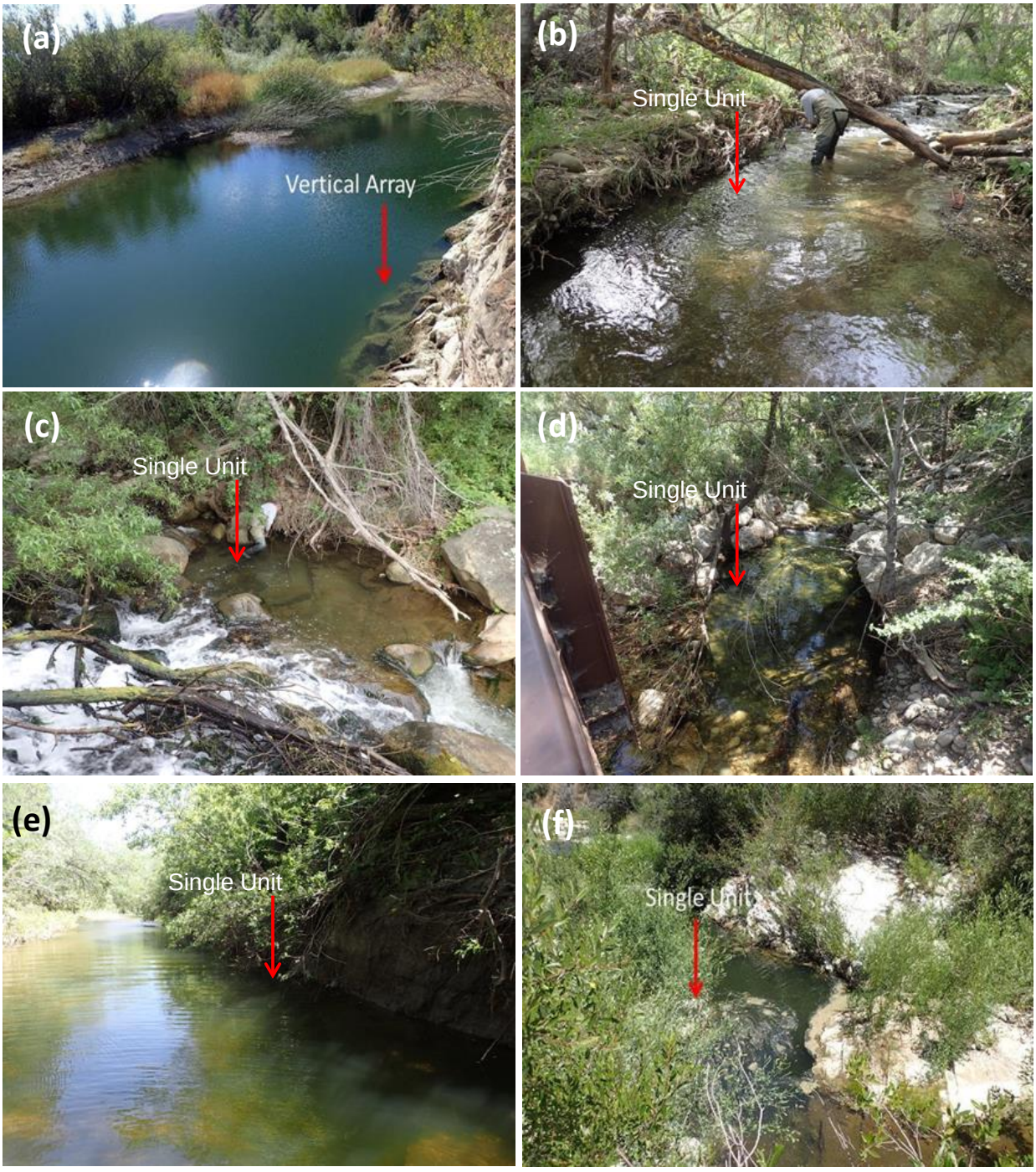

Figure 8: 2021 LSYR mainstem temperature unit deployment location at: (a) LSYR-22.68 and tributary deployment locations at: (b) HC-0.12, (c) HC-0.54, (d) QC-2.66, (e) SC-0.77, and (f) SC-2.2.

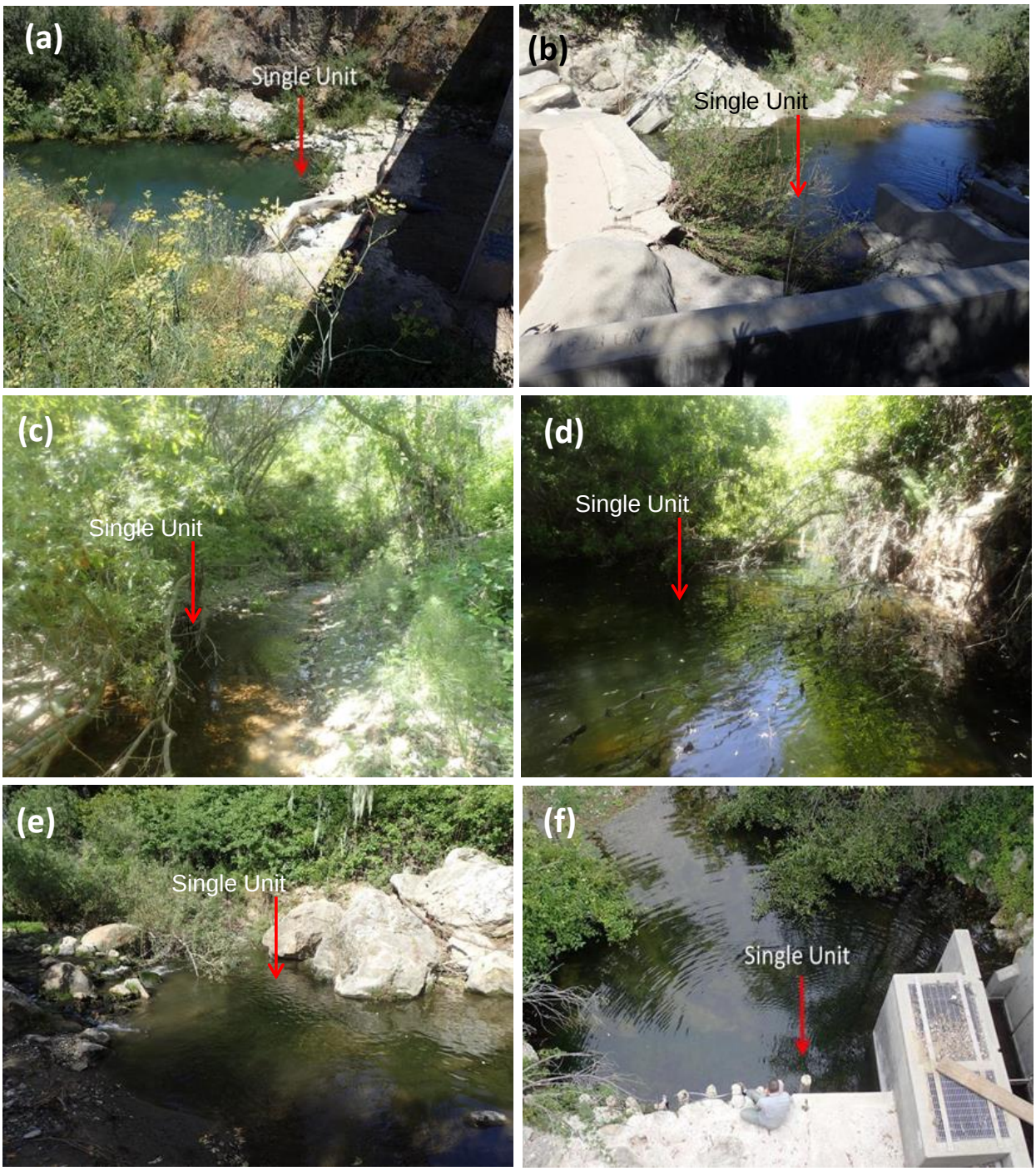

Figure 9: 2021 Tributary thermograph deployment locations at: (a) SC-3.0, (b) SC-3.5, (c) SC-3.8, (d) EJC-3.81, (e) EJC-5.4, and (f) EJC-10.82.

Figure 10: 2021 Tributary temperature unit deployment location at: a) LAC-7.0.

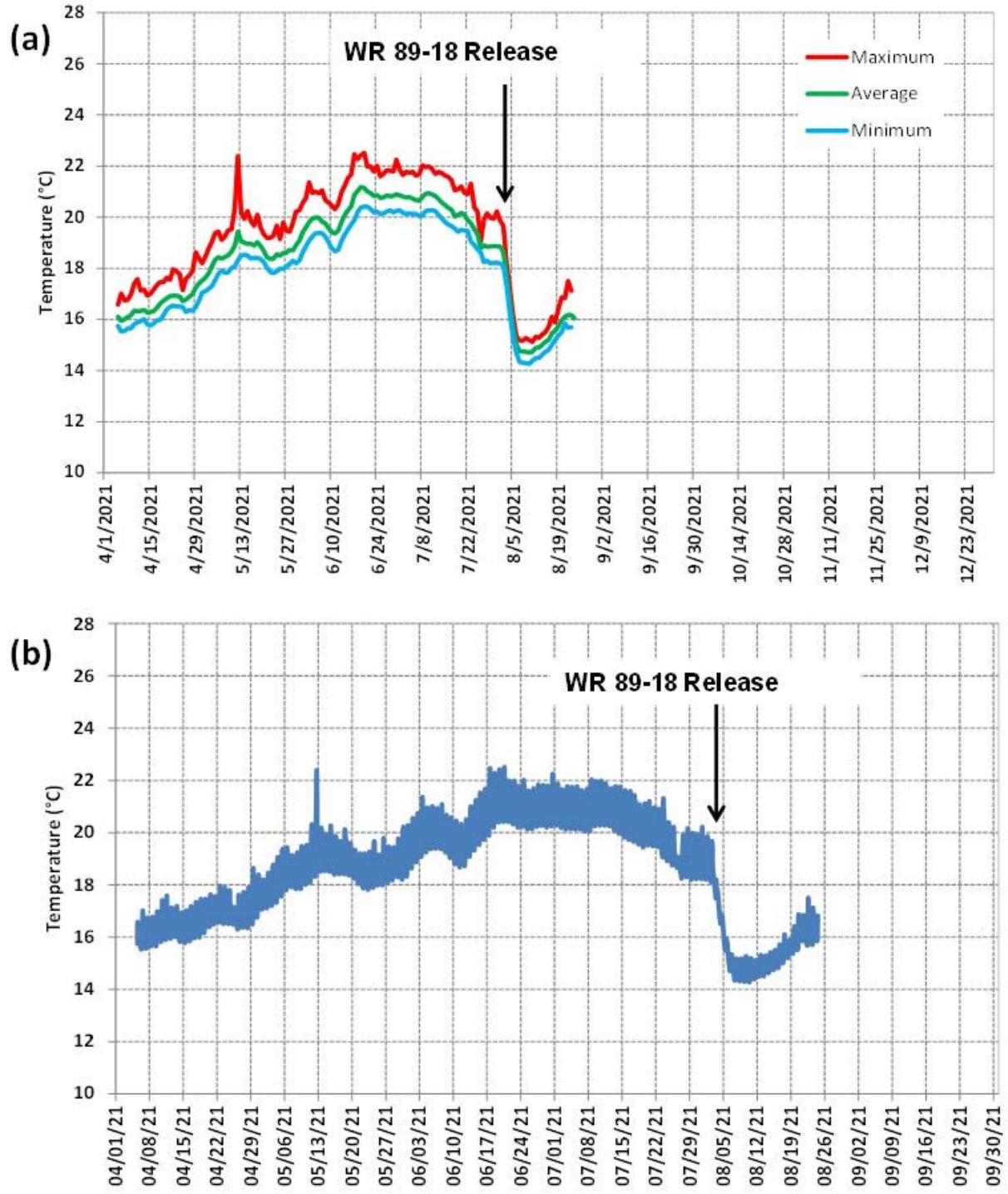

Figure 11: 2021 LSYR-0.01 (Stilling Basin parapet wall) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data were collected after 8/25/21.

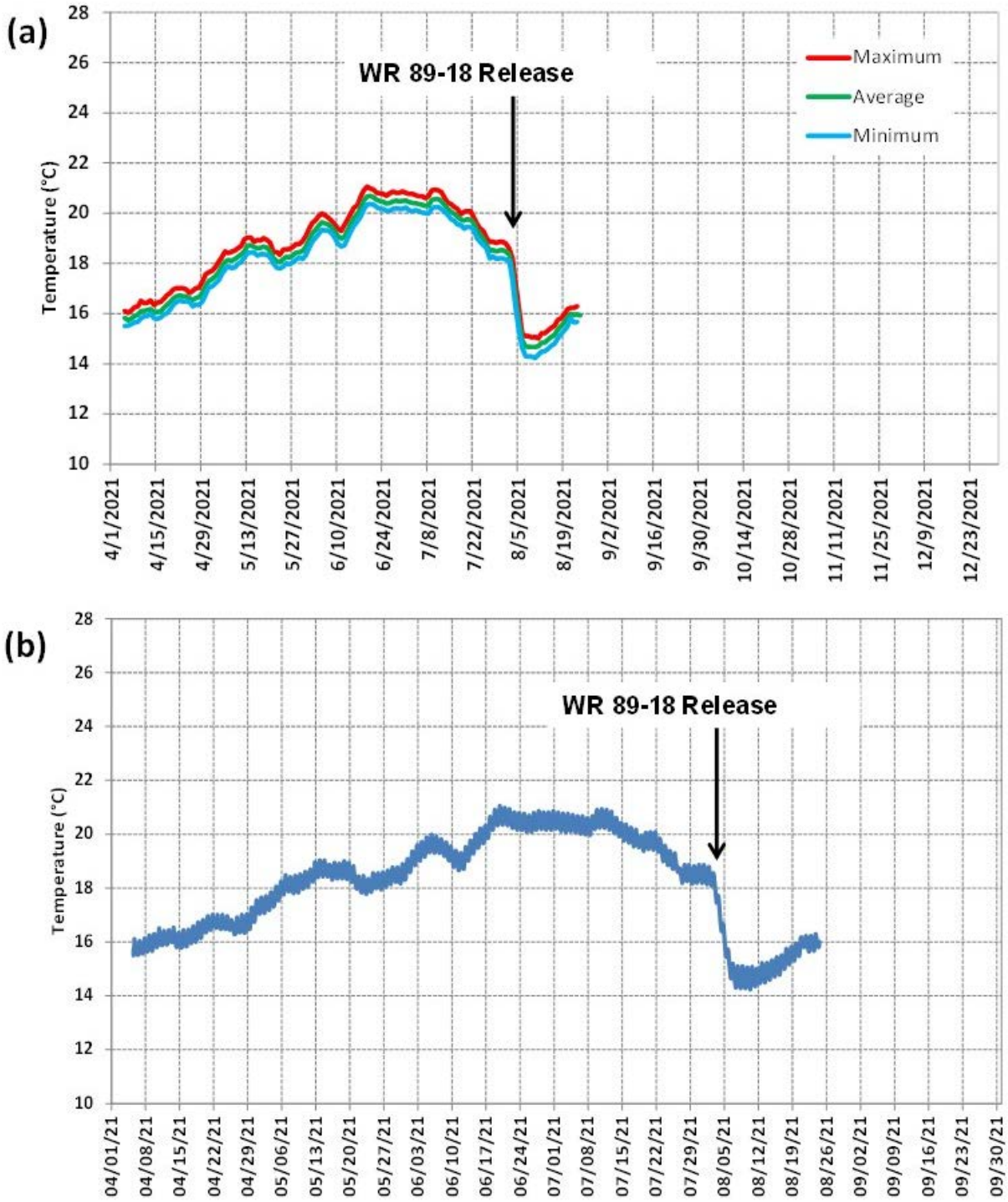

Figure 12: 2021 LSYR-0.01 (Stilling Basin parapet wall) middle (14 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

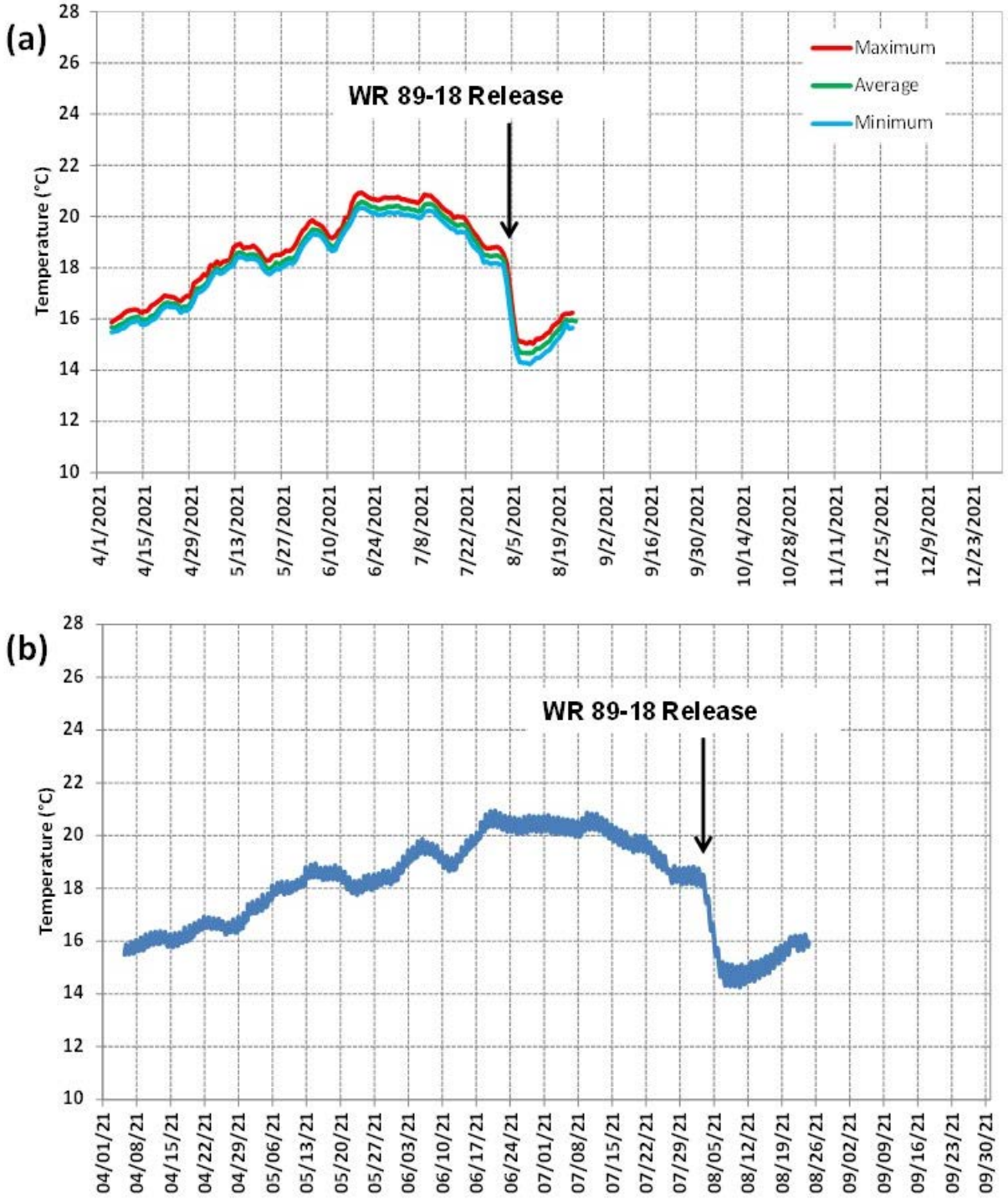

Figure 13: 2021 LSYR-0.01 (Stilling Basin parapet wall) bottom (28 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

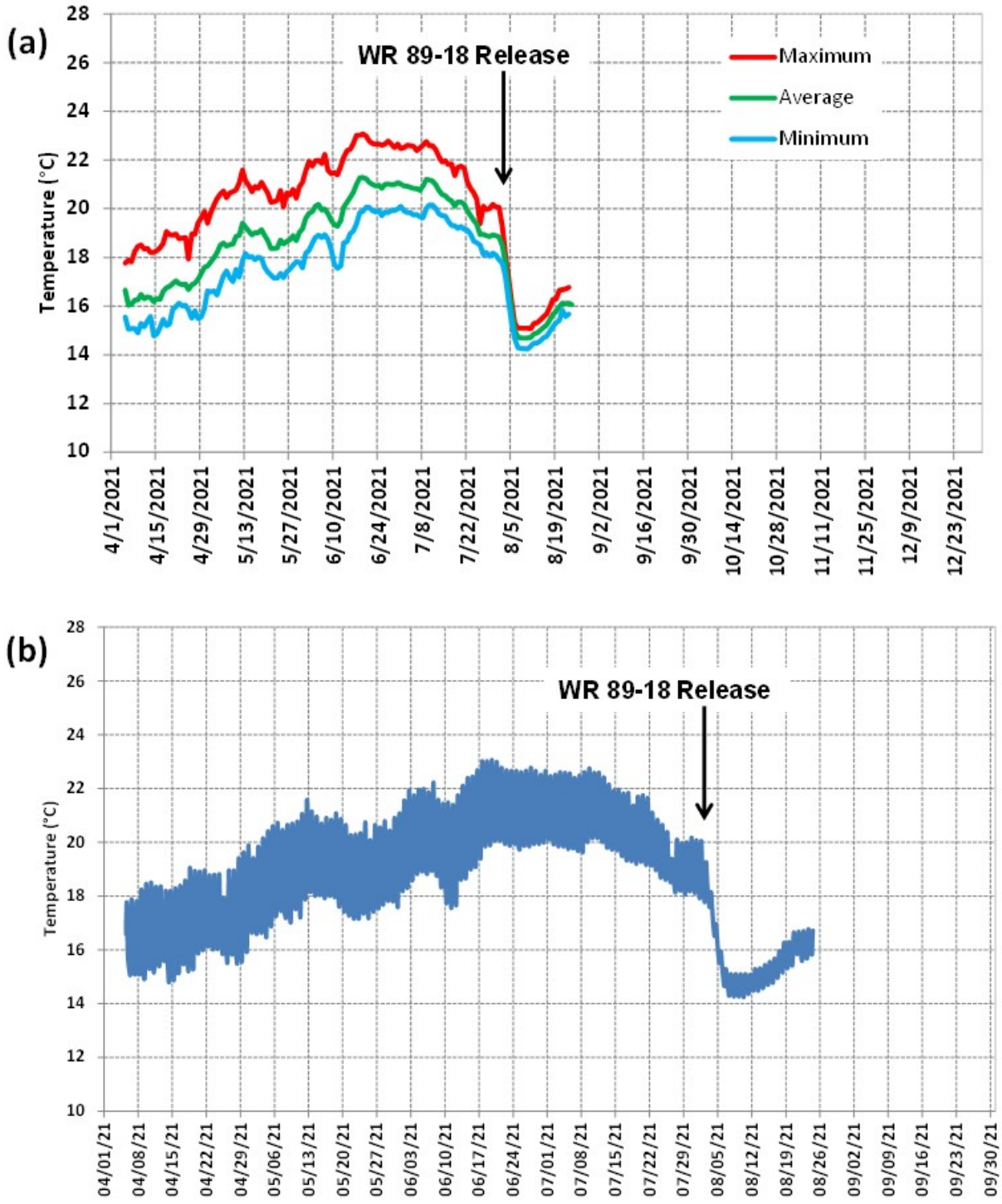

Figure 14: 2021 LSYR-0.25 (Downstream of Stilling Basin) bottom (1.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

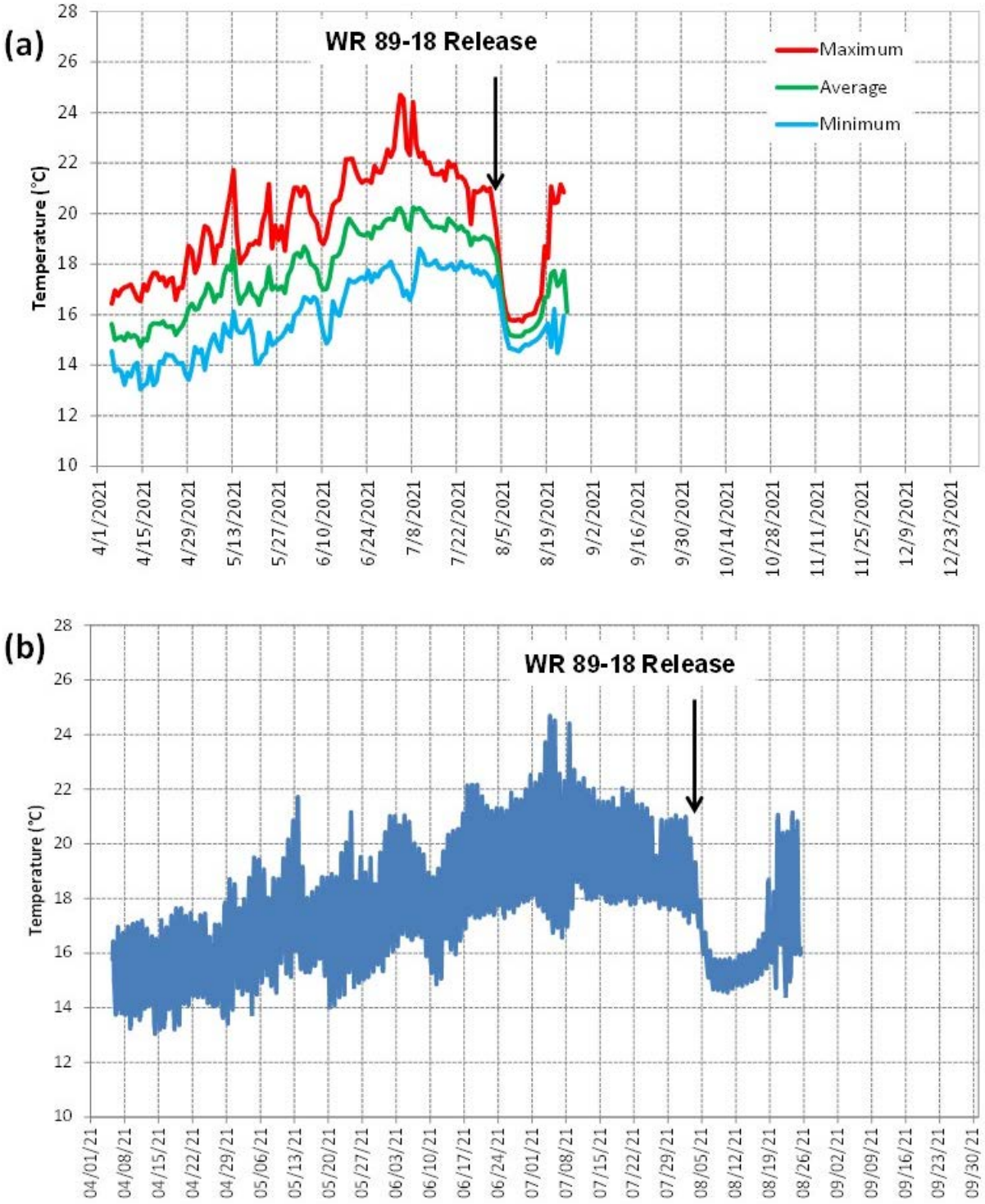

Figure 15: 2021 LSYR-0.51 (Long Pool) surface (1.0 foot) thermograph for (a) daily maximum, average, and minimum values for the entire period of deployment and (b) hourly data for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

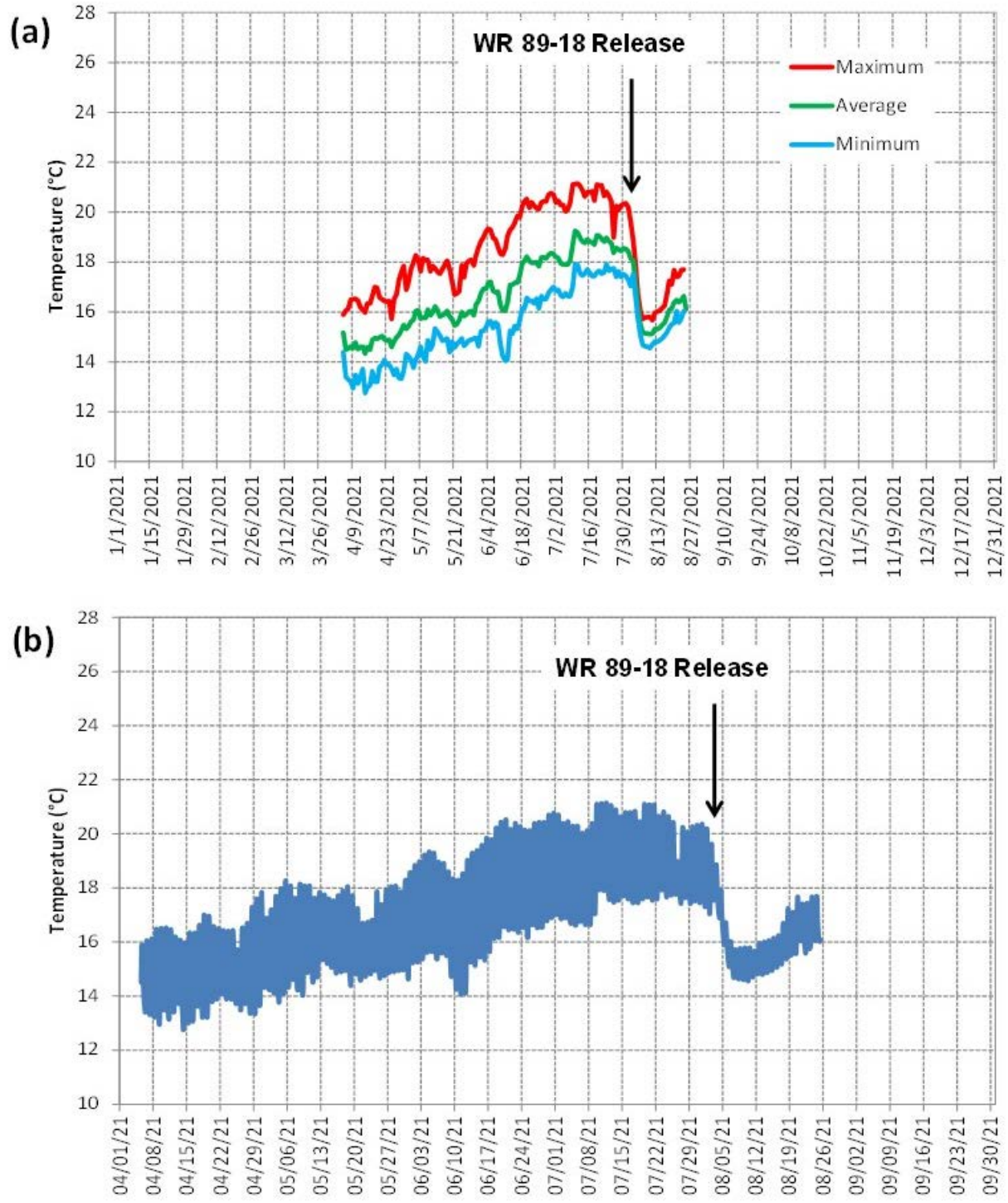

Figure 16: 2021 LSYR-0.51 (Long Pool) middle (2.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

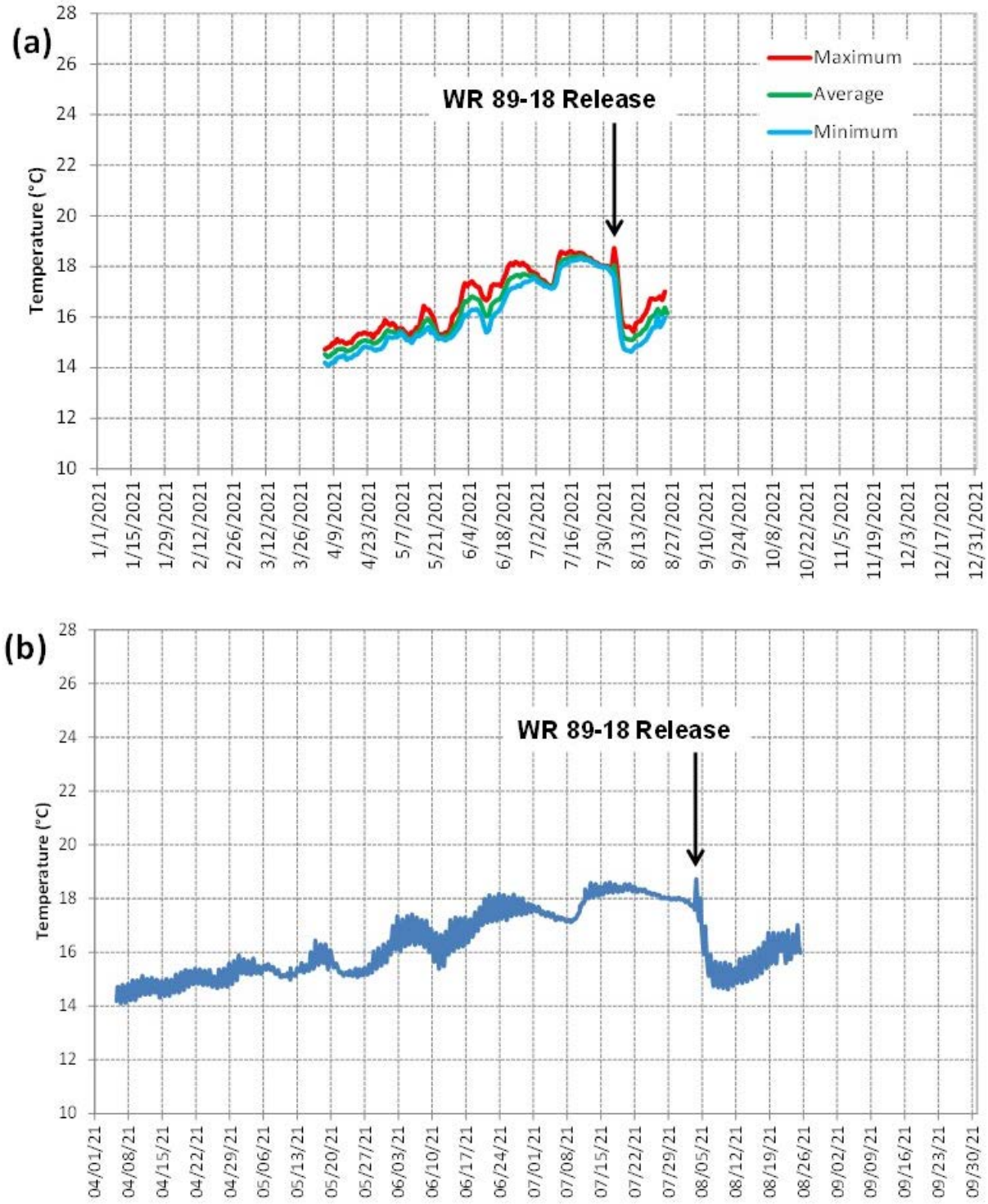

Figure 17: 2021 LSYR-0.51 (Long Pool) bottom (5.5 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

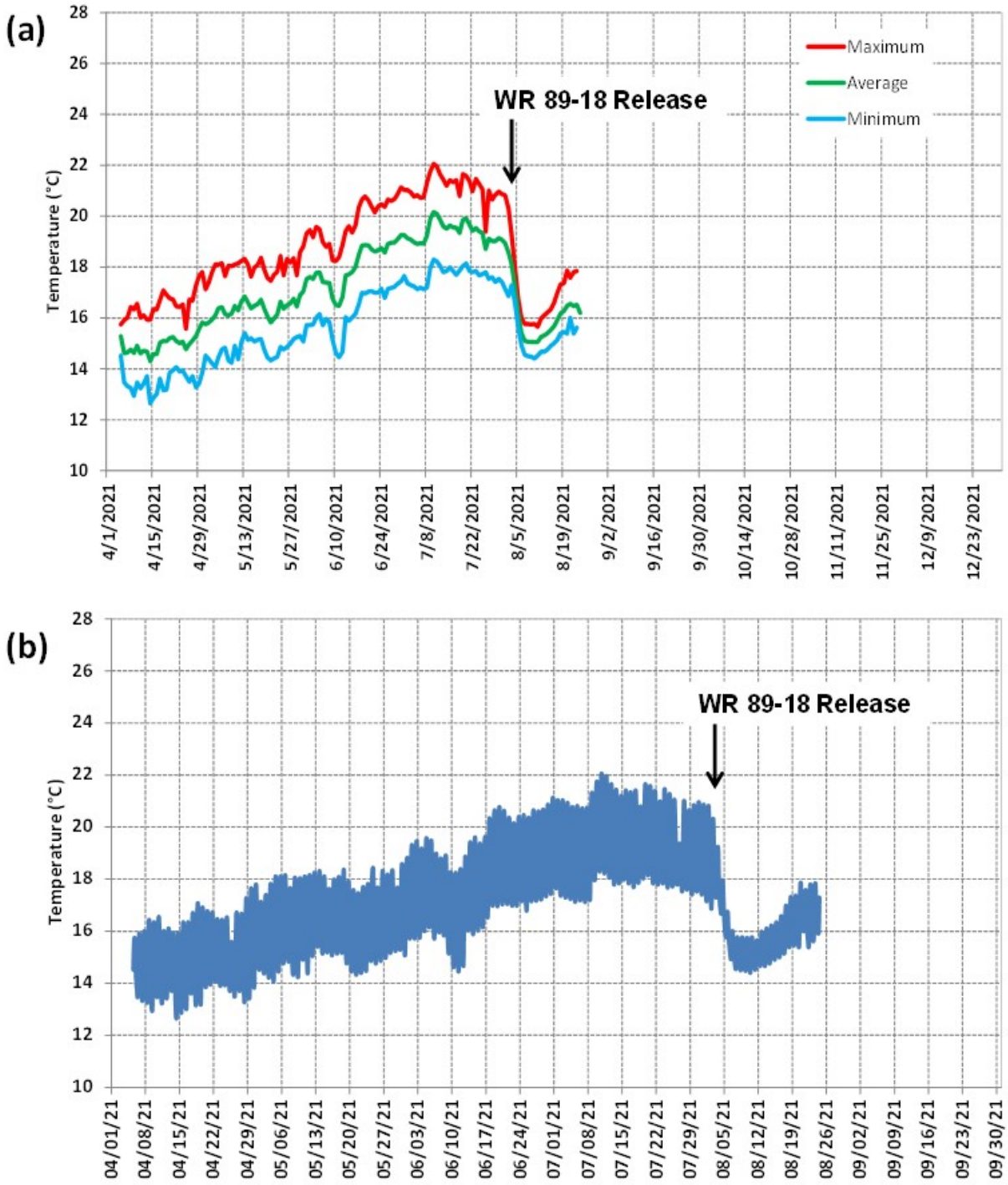

Figure 18: 2021 Reclamation property boundary at LSYR-0.68 (downstream of the Long Pool) bottom (2 feet) thermograph for (a) daily maximum, average, and minimum values and (b) hourly data for the period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

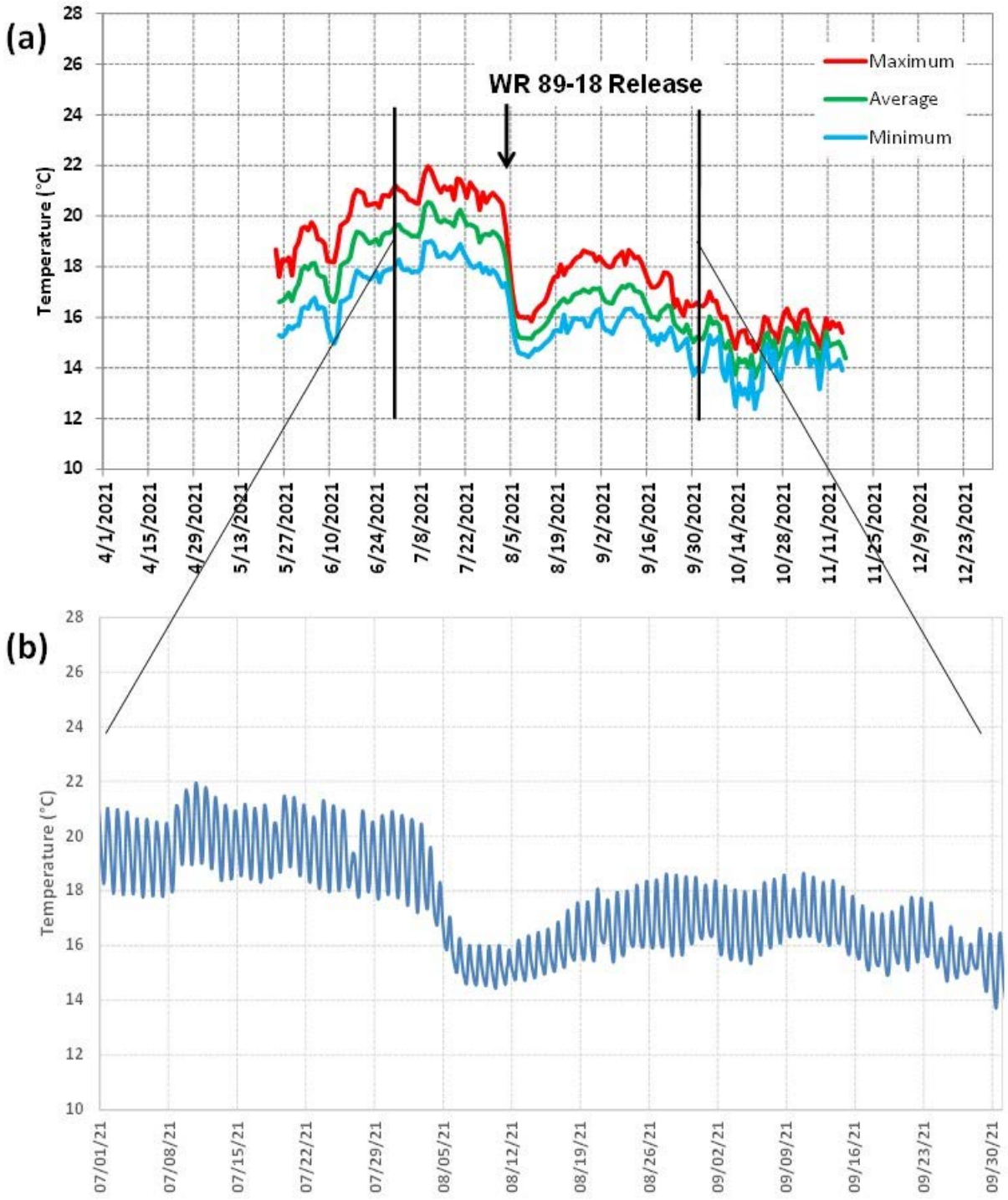

Figure 19: 2021 LSYR-1.09 (Grimm Property upstream-run) bottom (1.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

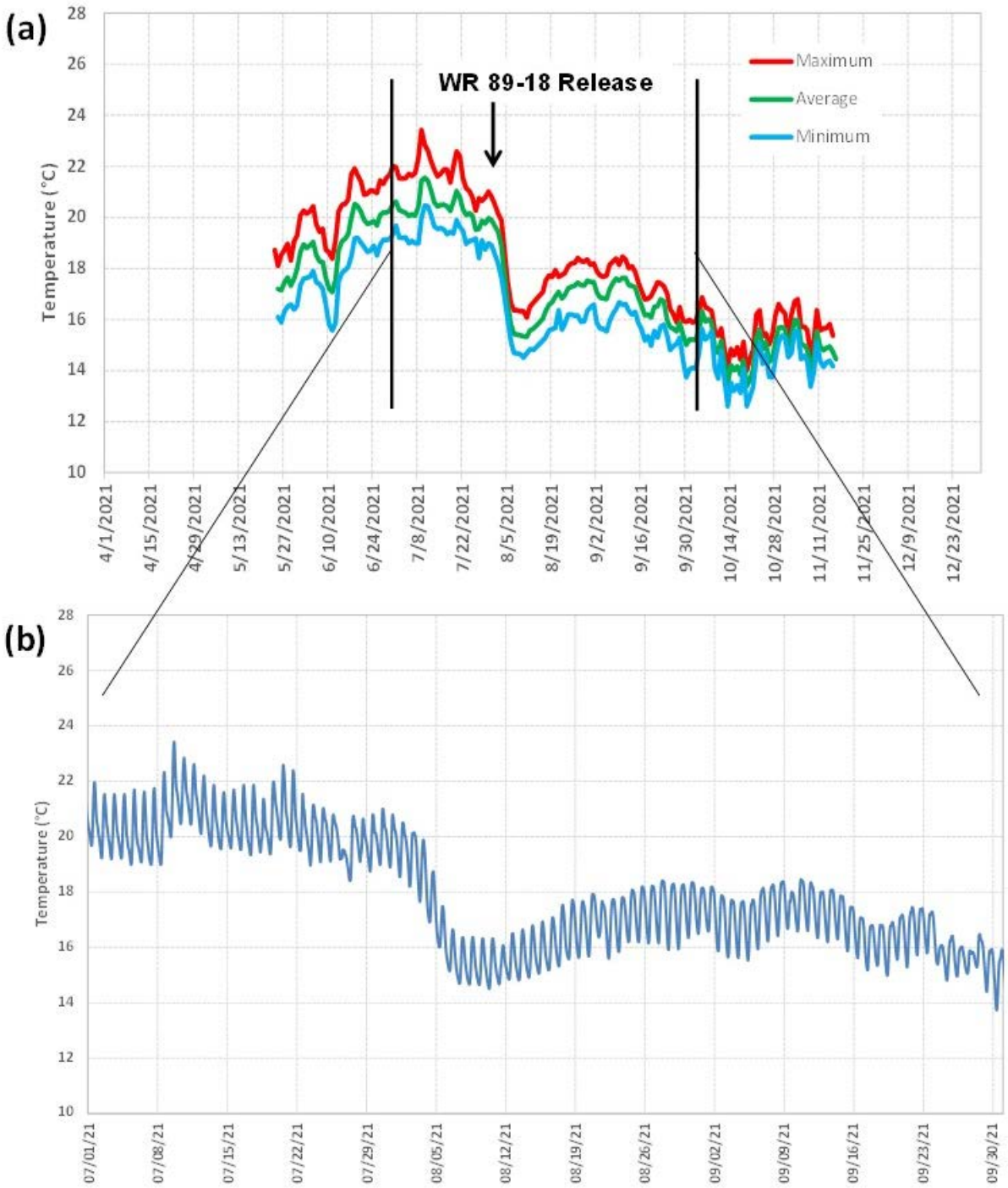

Figure 20: 2021 LSYR-1.54 (Grimm Property downstream-run) bottom (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

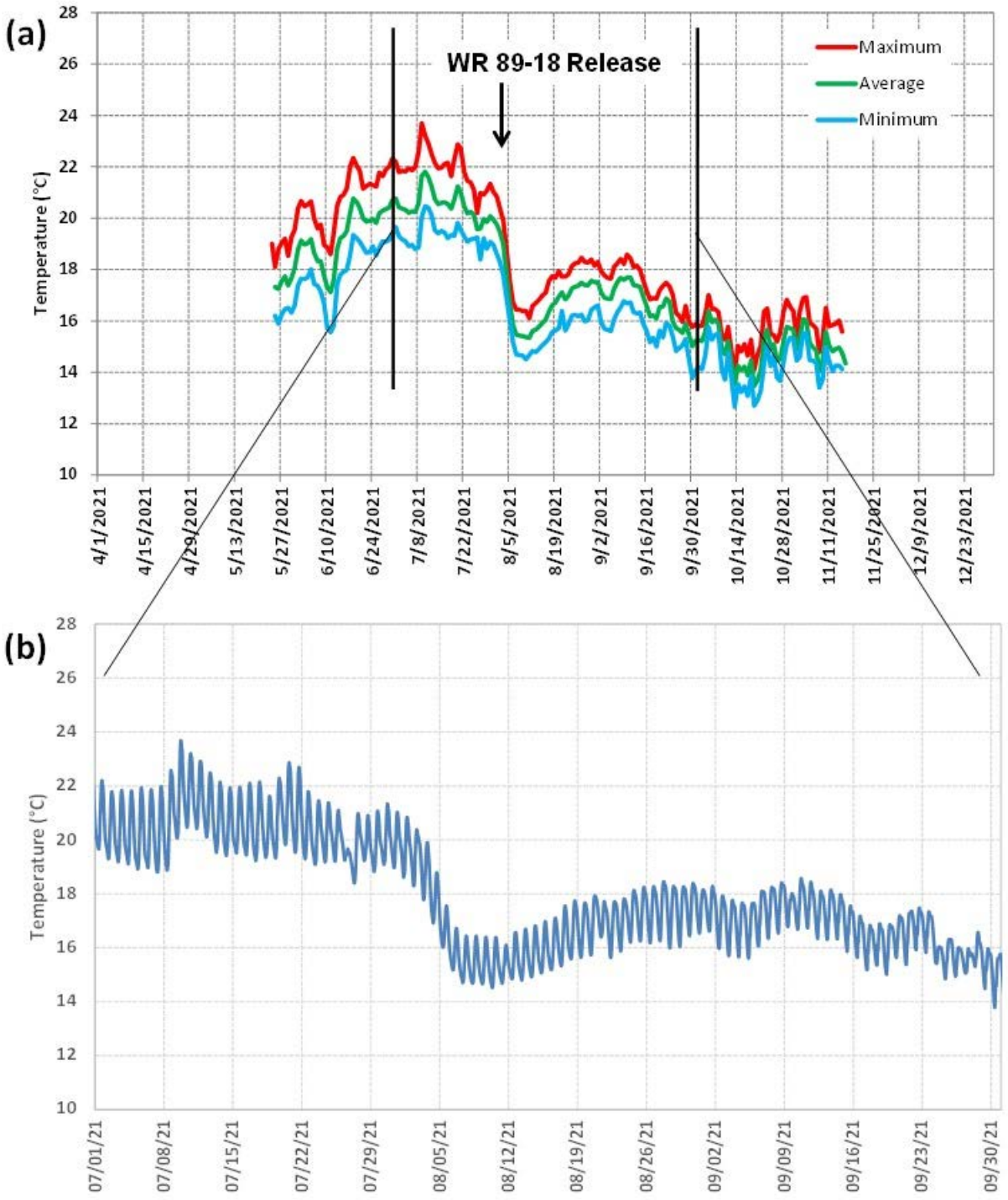

Figure 21: 2021 LSYR-1.71 (Grimm Property pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

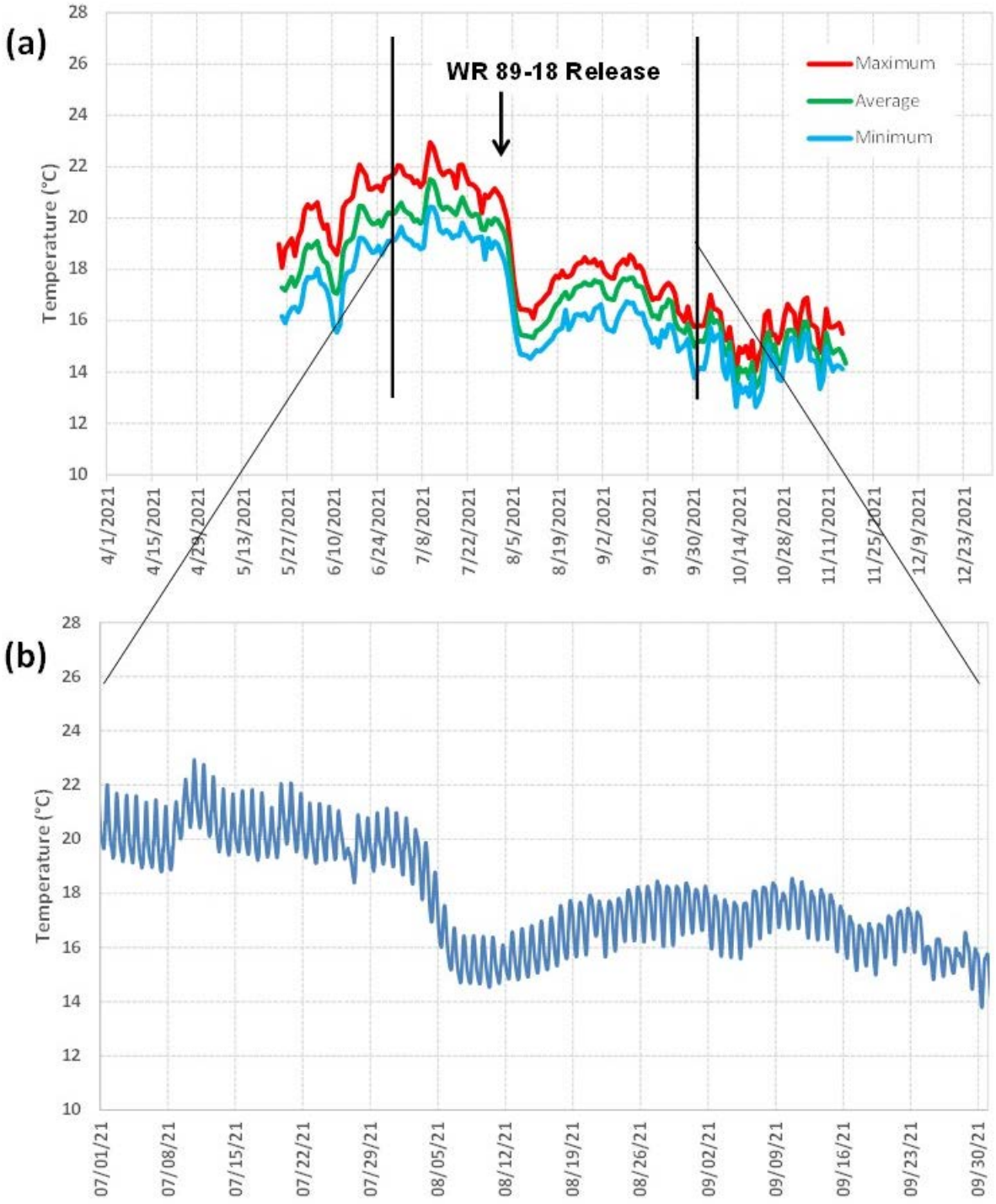

Figure 22: 2021 LSYR-1.71 (Grimm Property pool) middle (3.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

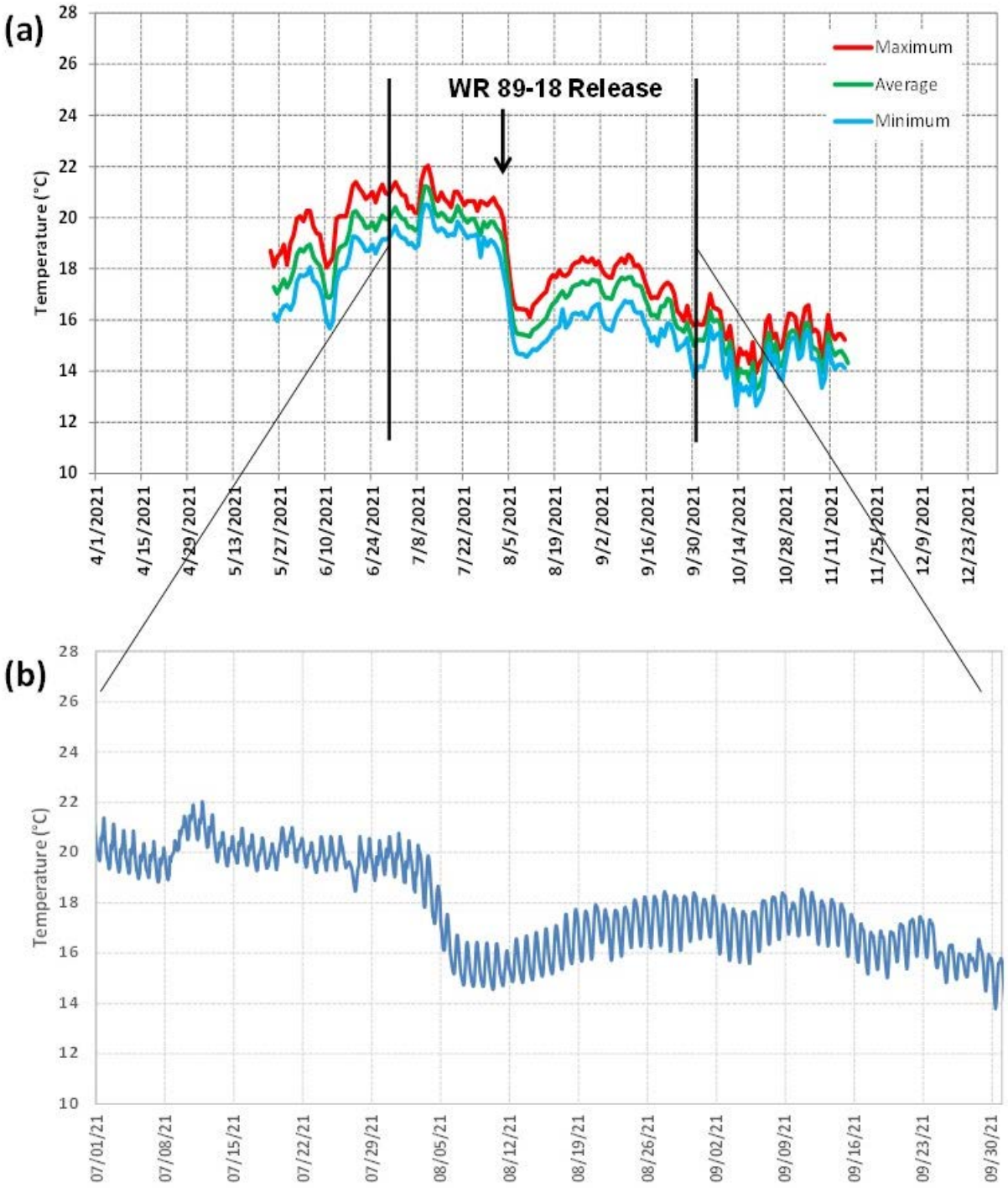

Figure 23: 2021 LSYR-1.71 (Grimm Property pool) bottom (6.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

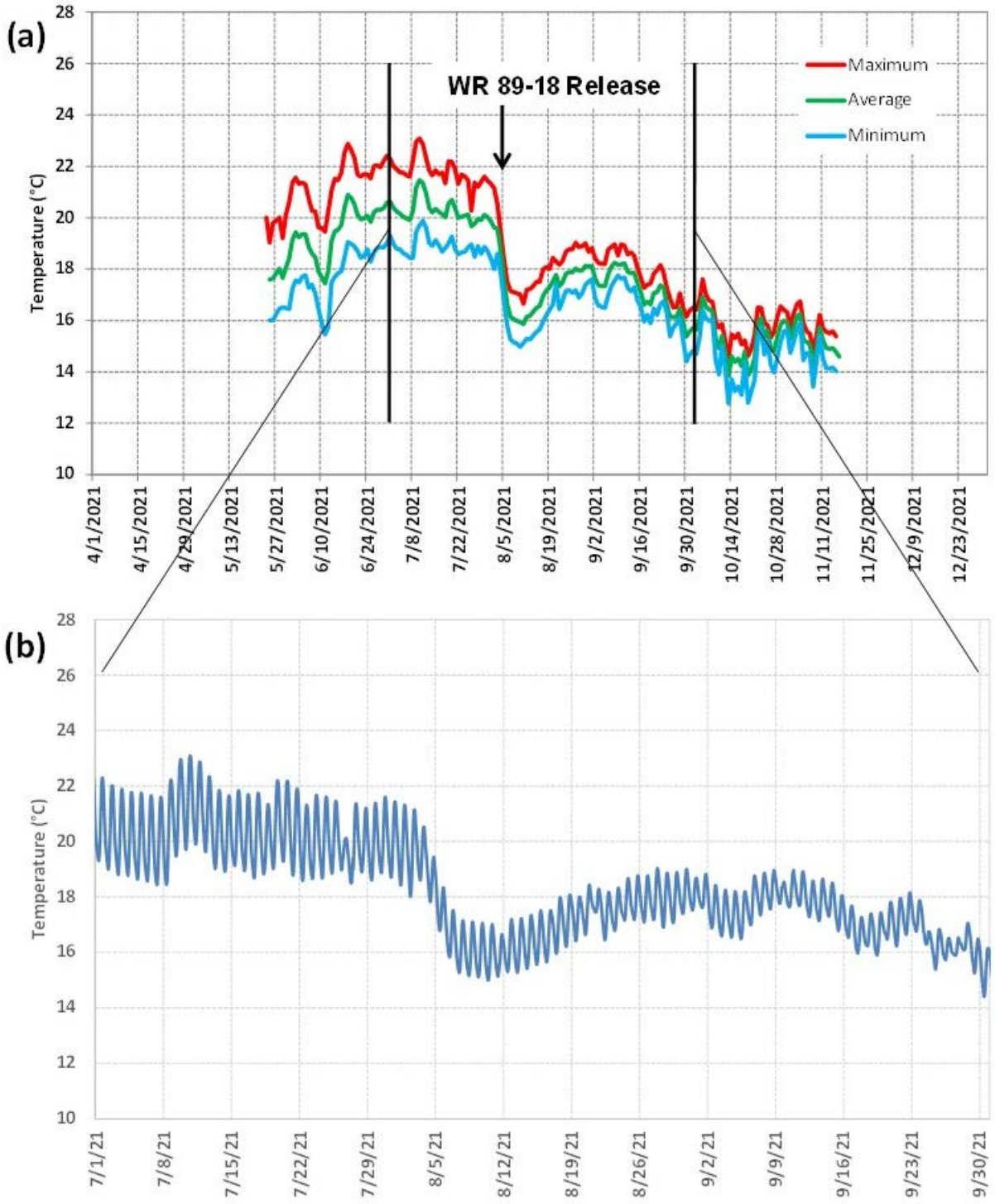

Figure 24: 2021 LSYR-2.77 (Kaufman run) bottom (1.0-feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements from 7/1/20 – 10/1/20.

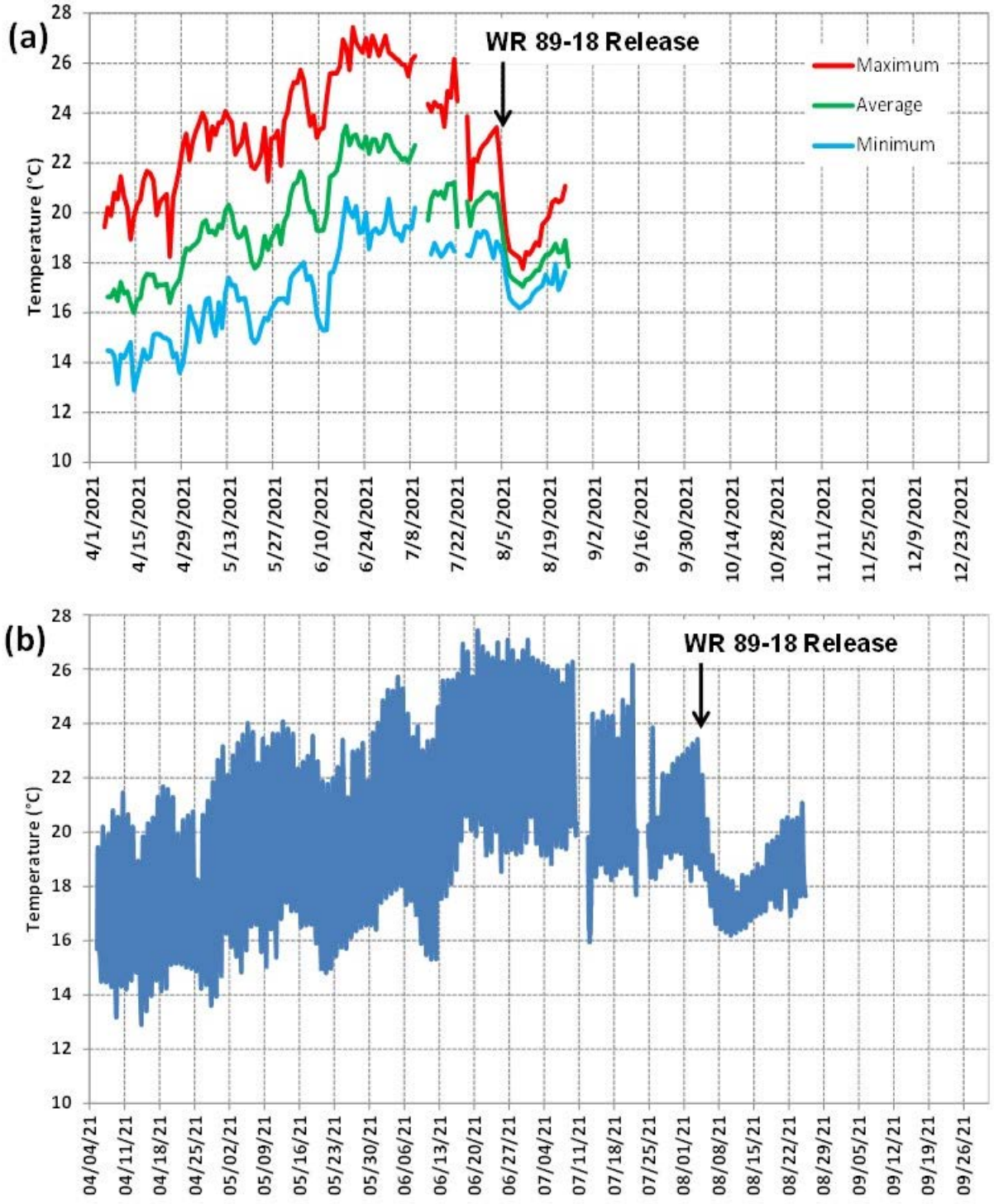

Figure 25: 2021 LSYR 4.95 (Encantado Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record. Optic shuttle malfunction resulted in loss of data after 8/25/21; the WR89-18 water reached the site on 8/3/21.

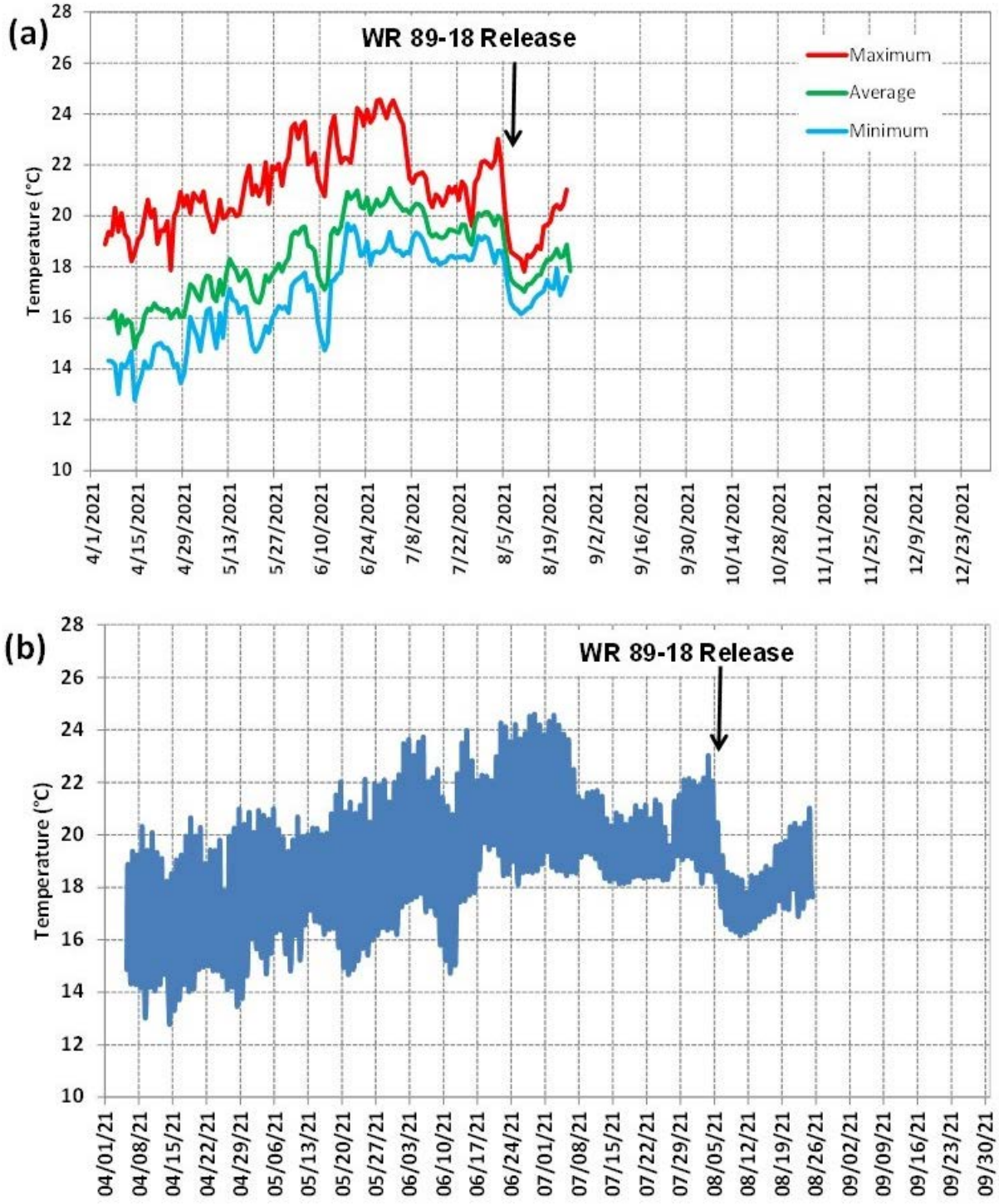

Figure 26: 2021 LSYR-4.95 (Encantado Pool) middle (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record. Optic shuttle malfunction resulted in loss of data after 8/25/21; the WR89-18 water reached the site on 8/3/21.

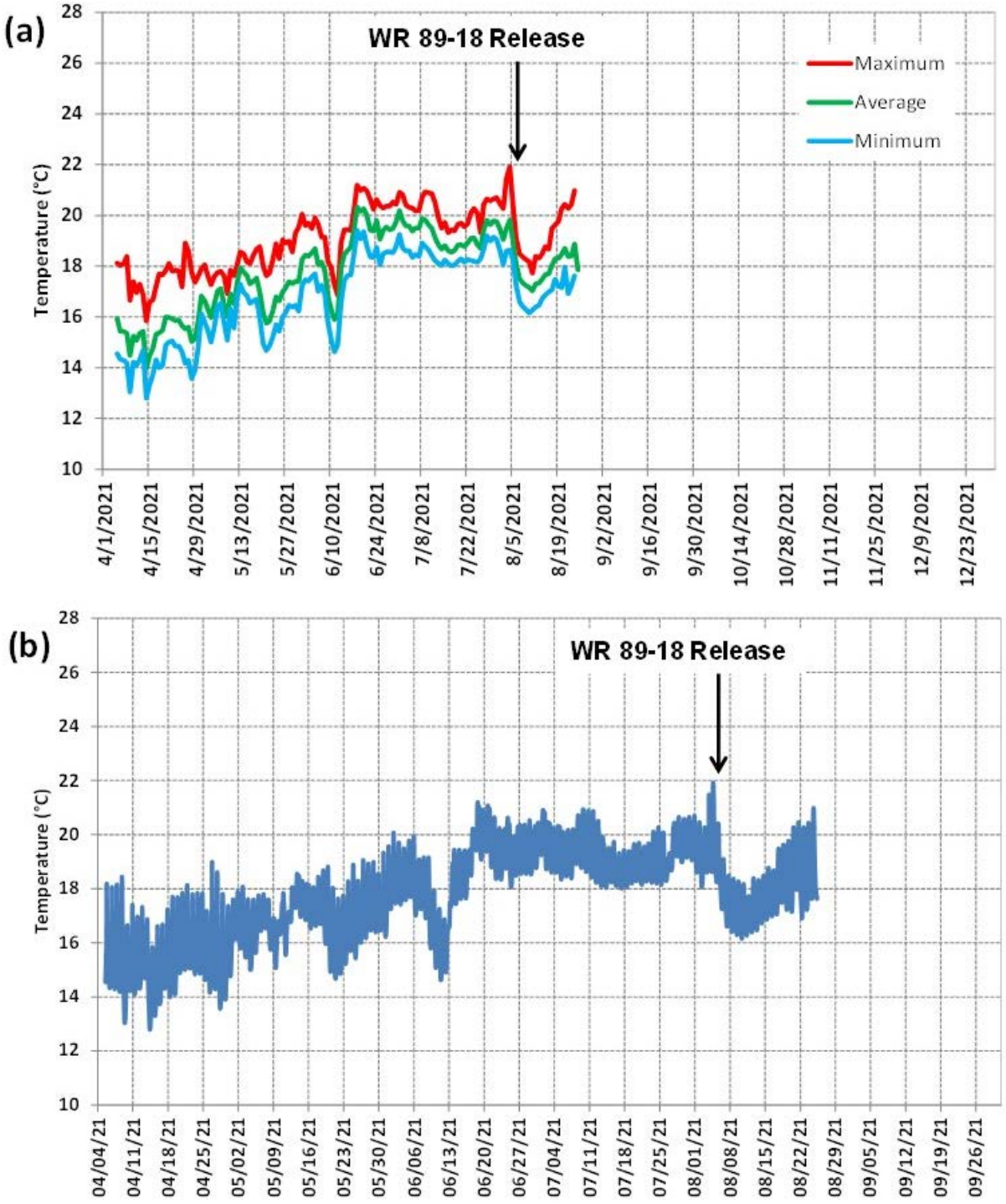

Figure 27: 2021 LSYR-4.95 (Encantado Pool) bottom (8.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record. Optic shuttle malfunction resulted in loss of data after 8/25/21; the WR89-18 water reached the site on 8/3/21.

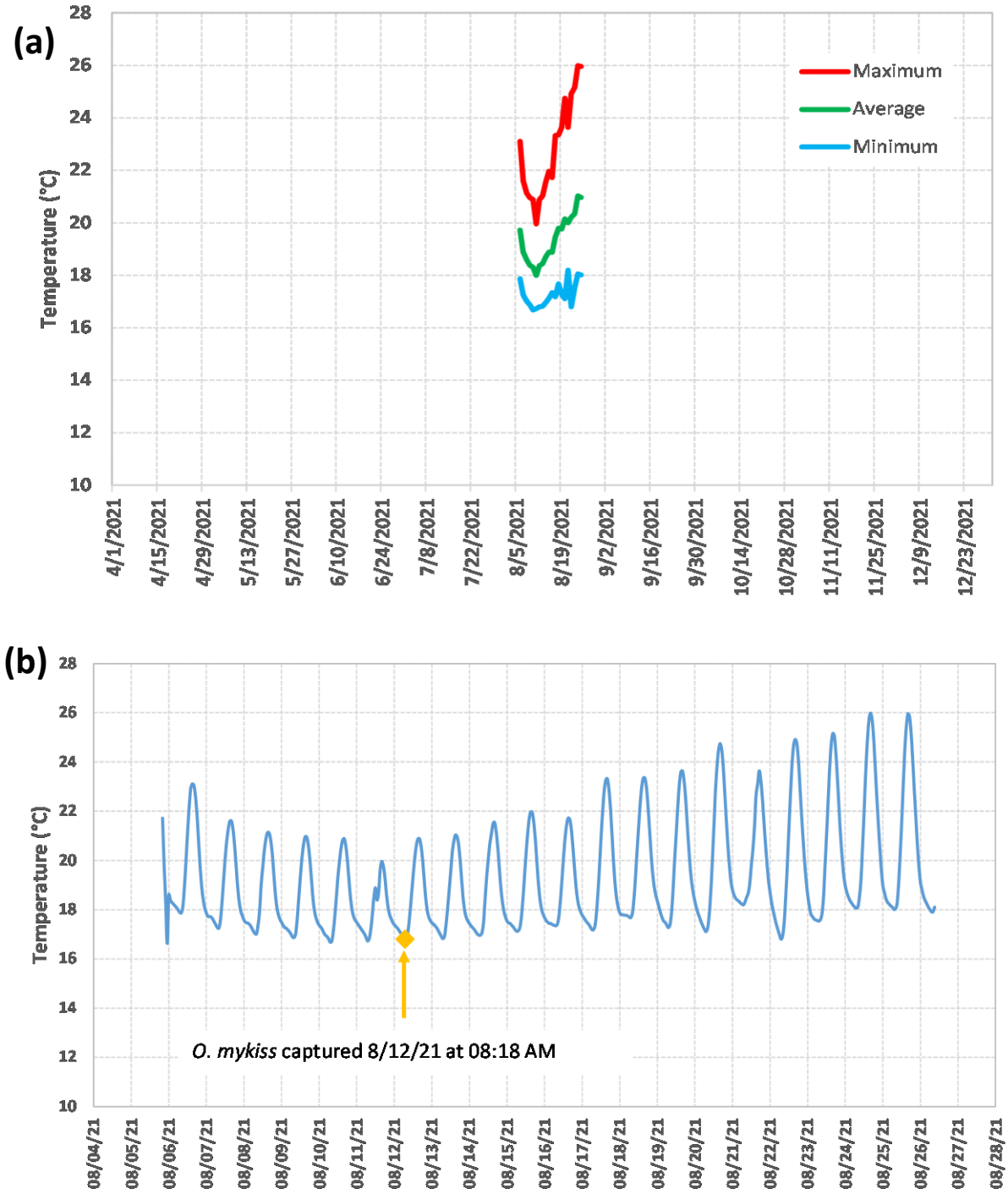

Figure 28: 2021 LSYR-6.08 (Mainstem Trap Site) bottom (3.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; unit deployed to monitor water temperature conditions during trapping of the WR89-18 release; one 88 mm (3.5 inch) *O. mykiss* was captured moving downstream on 8/12/21.

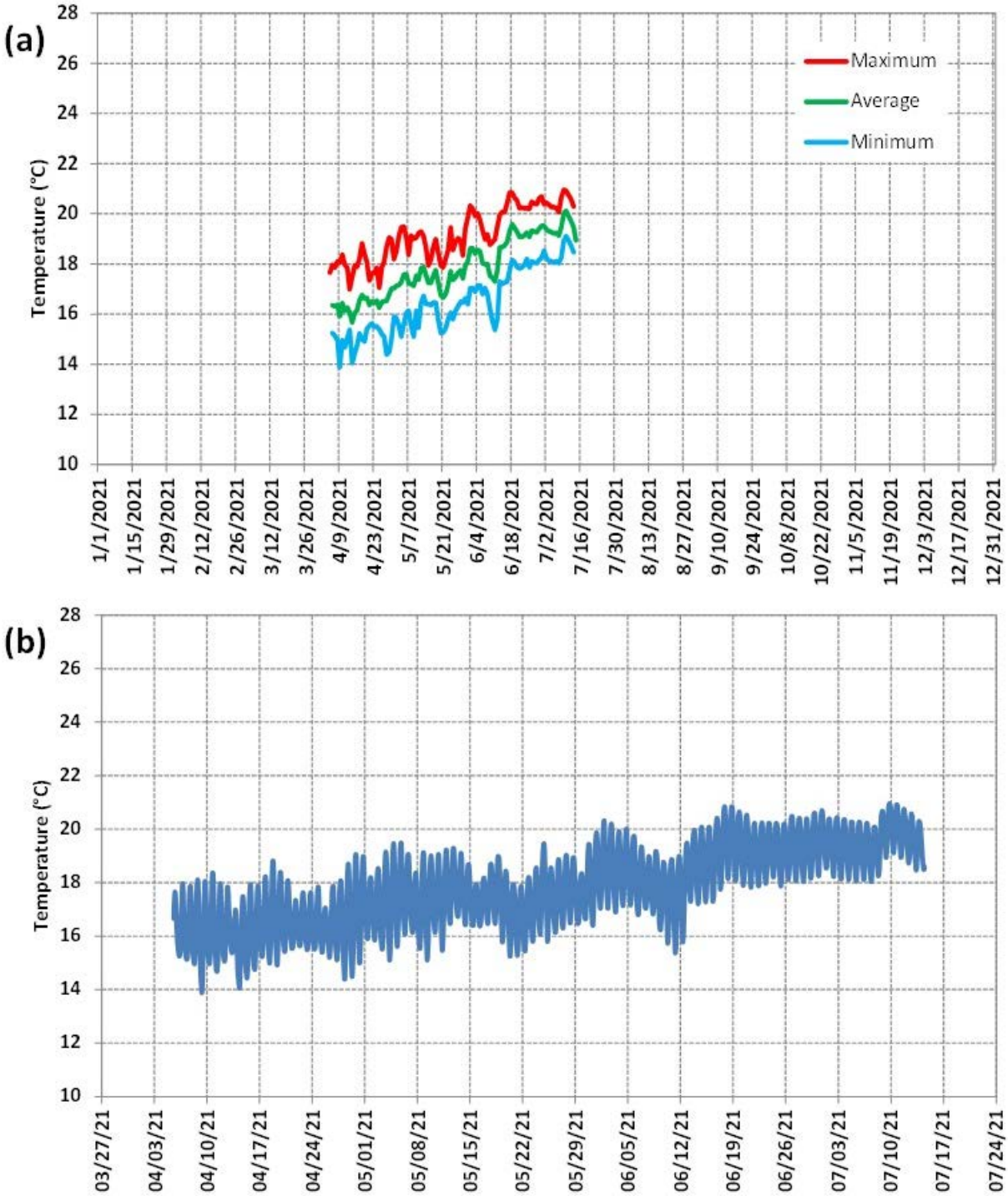

Figure 29: 2021 LSYR-7.65 (Double Canopy Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; the units were stolen by members of the general public sometime between 7/14/21 and 8/24/21.

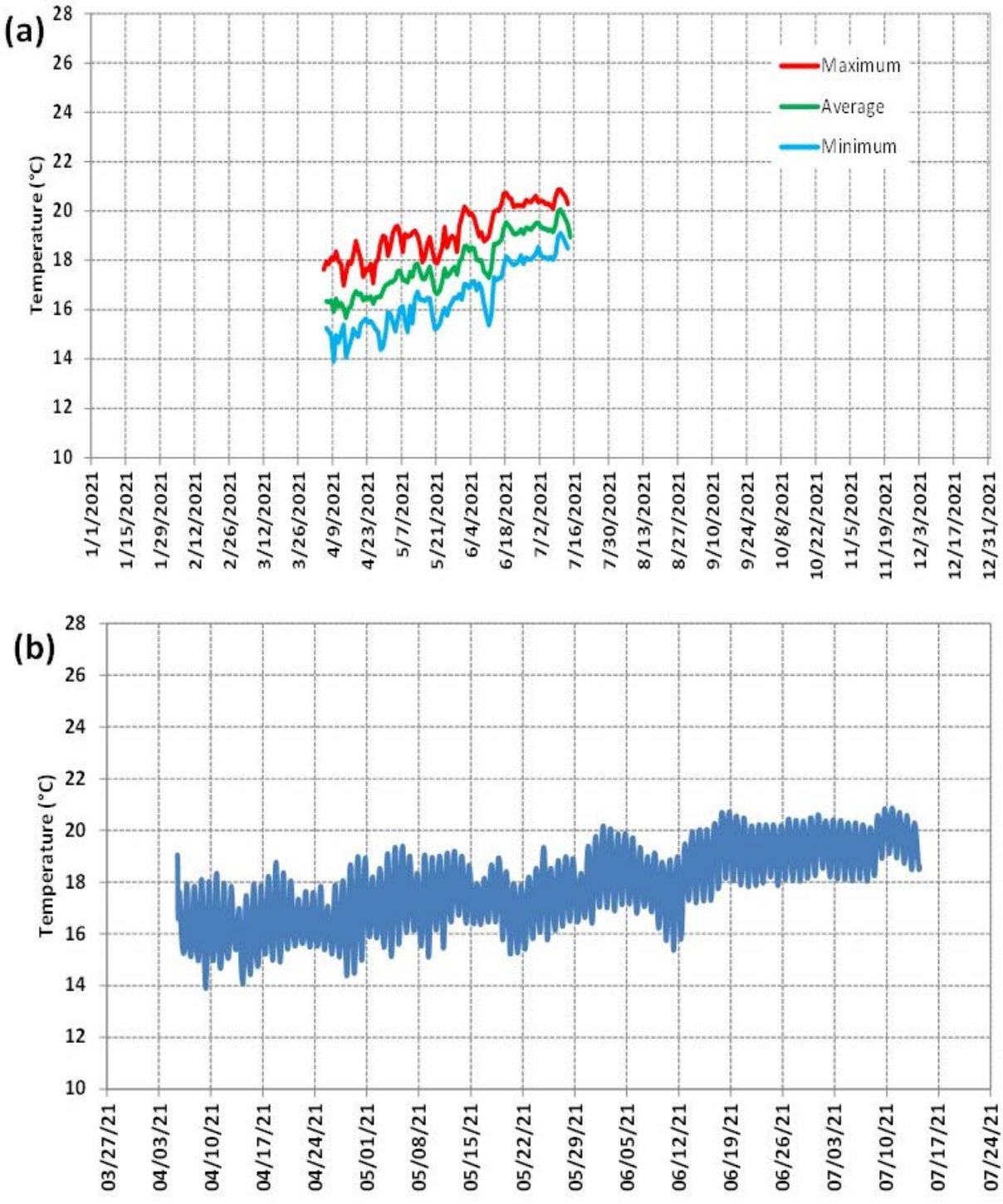

Figure 30: 2021 LSYR-7.65 (Double Canopy Pool) middle (2.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; the units were stolen by members of the general public sometime between 7/14/21 and 8/24/21.

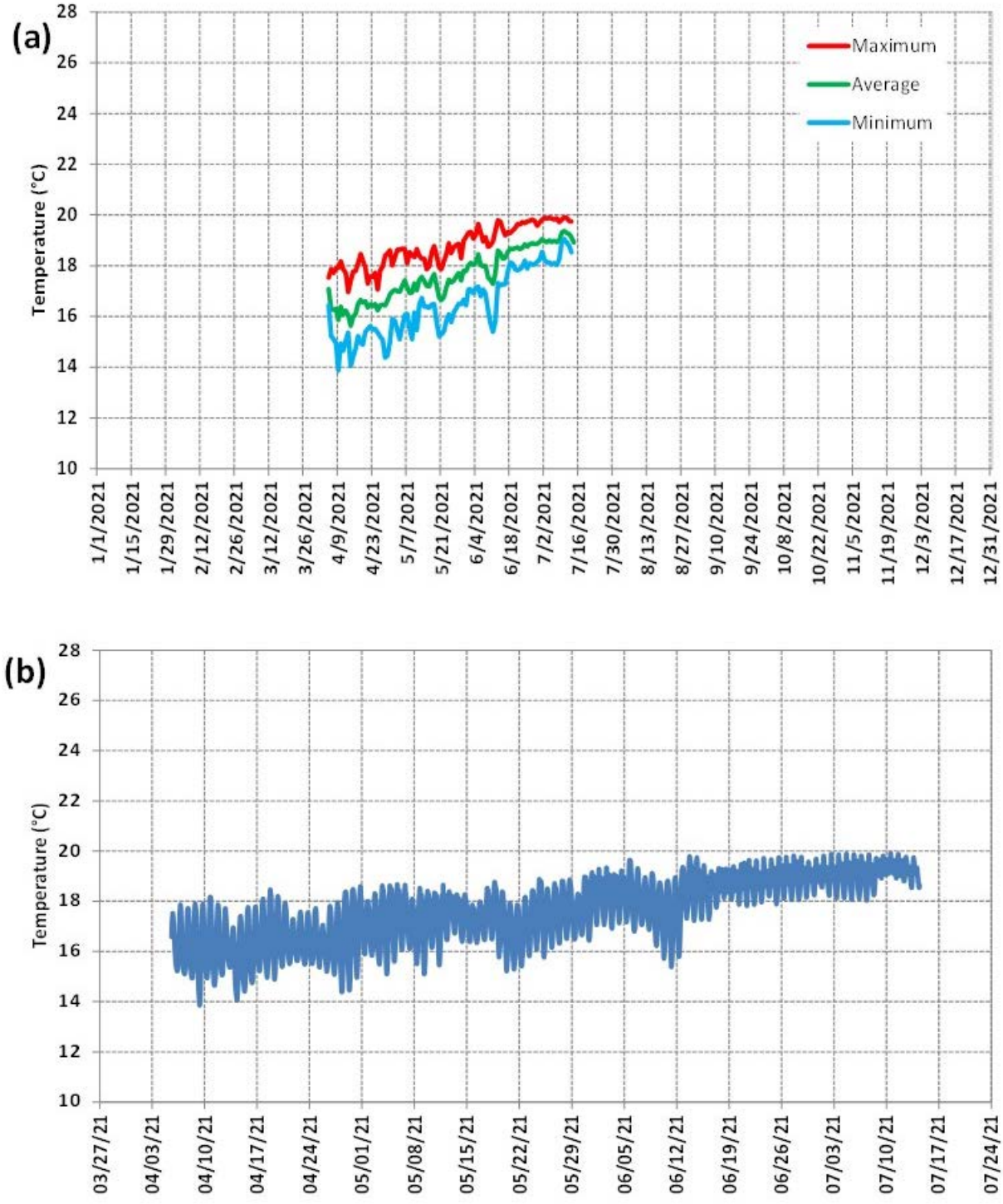

Figure 31: 2021 LSYR-7.65 (Double Canopy Pool) bottom (3.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; the units were stolen by members of the general public sometime between 7/14/21 and 8/24/21.

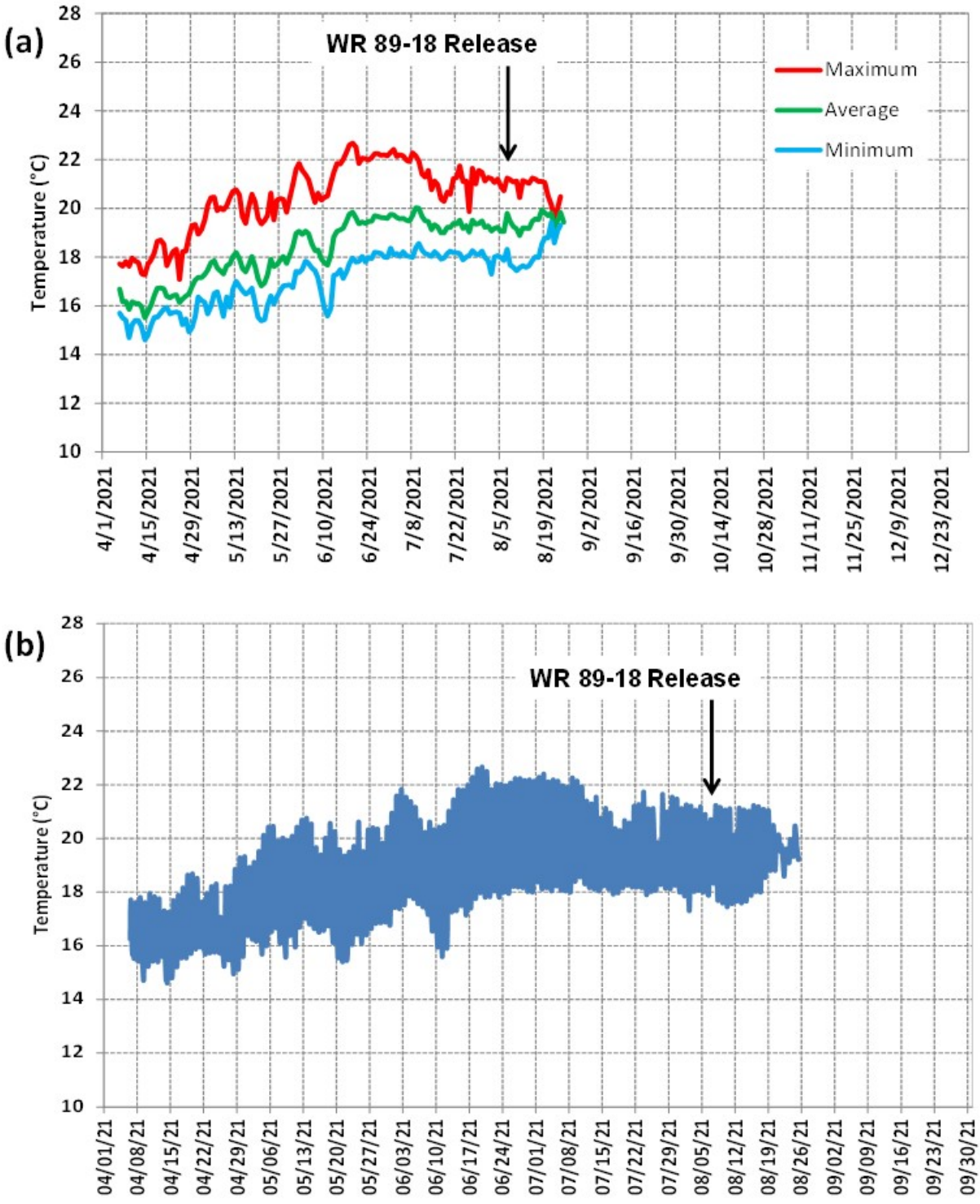

Figure 32: 2021 LSYR-8.7 (Head of Beaver Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in a loss of data after 8/25/21.

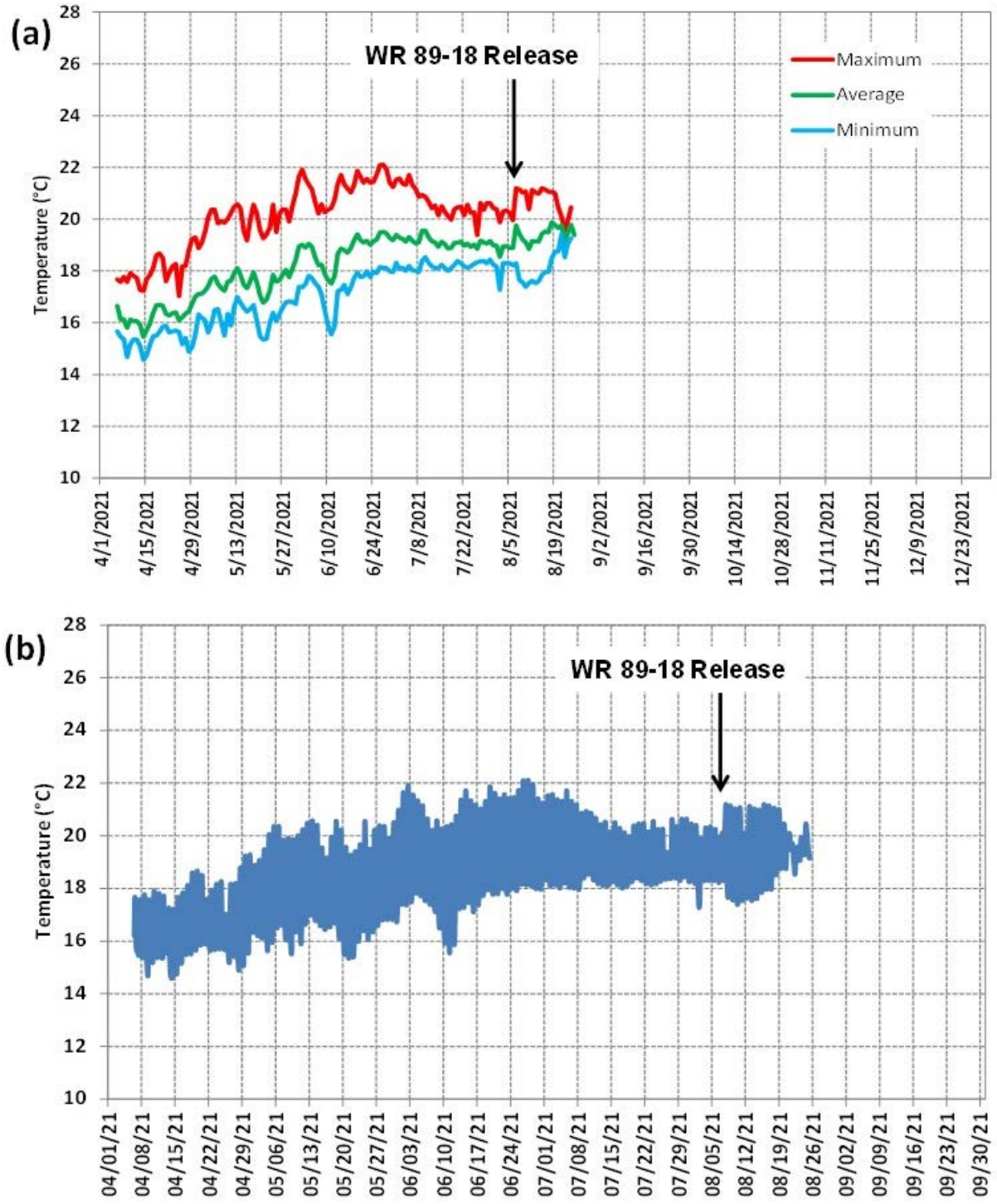

Figure 33: 2021 LSYR-8.7 (Head of Beaver Pool) middle (2.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in a loss of data after 8/25/21.

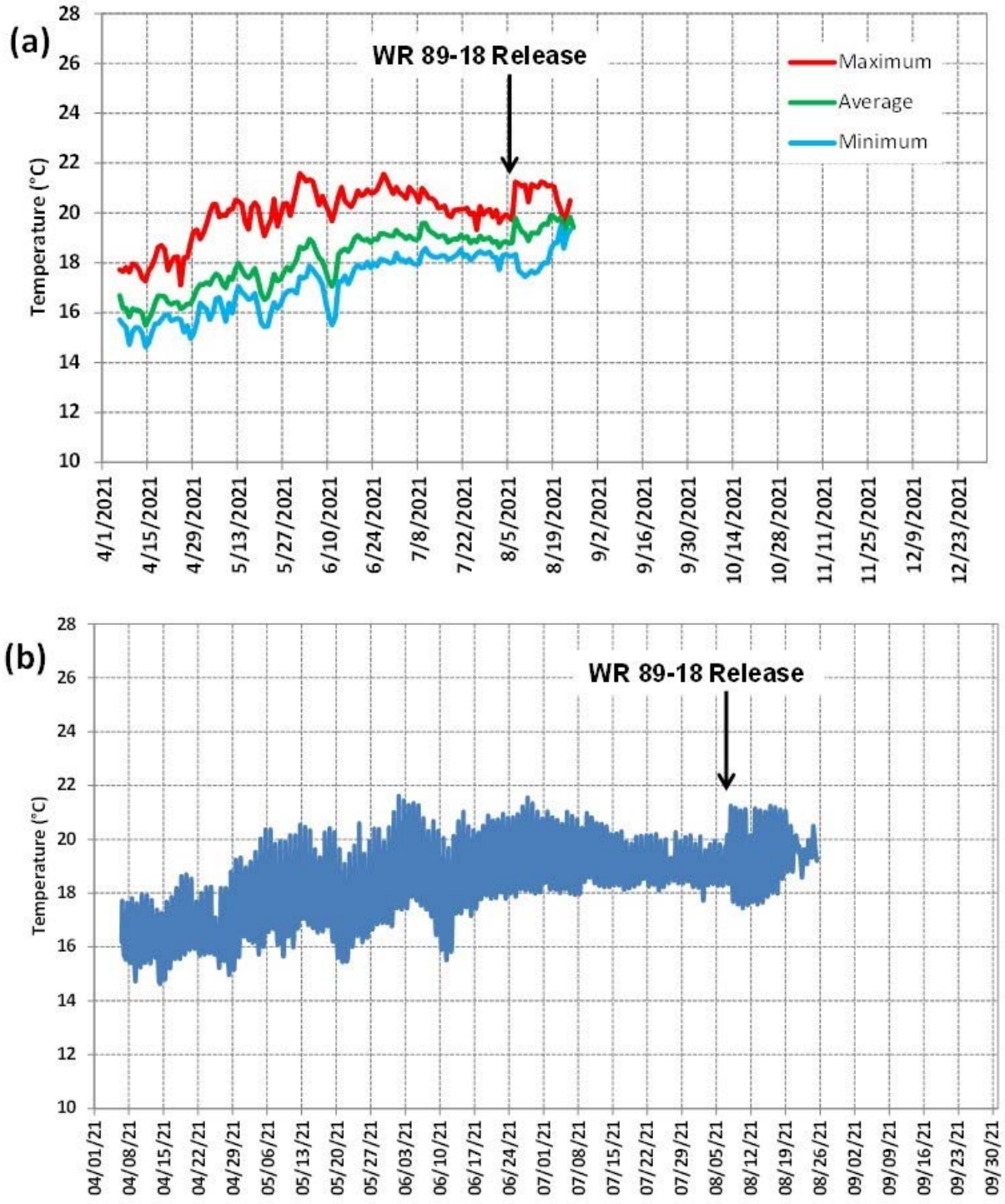

Figure 34: 2021 LSYR-8.7 (Head of Beaver Pool) bottom (5.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in a loss of data after 8/25/21.

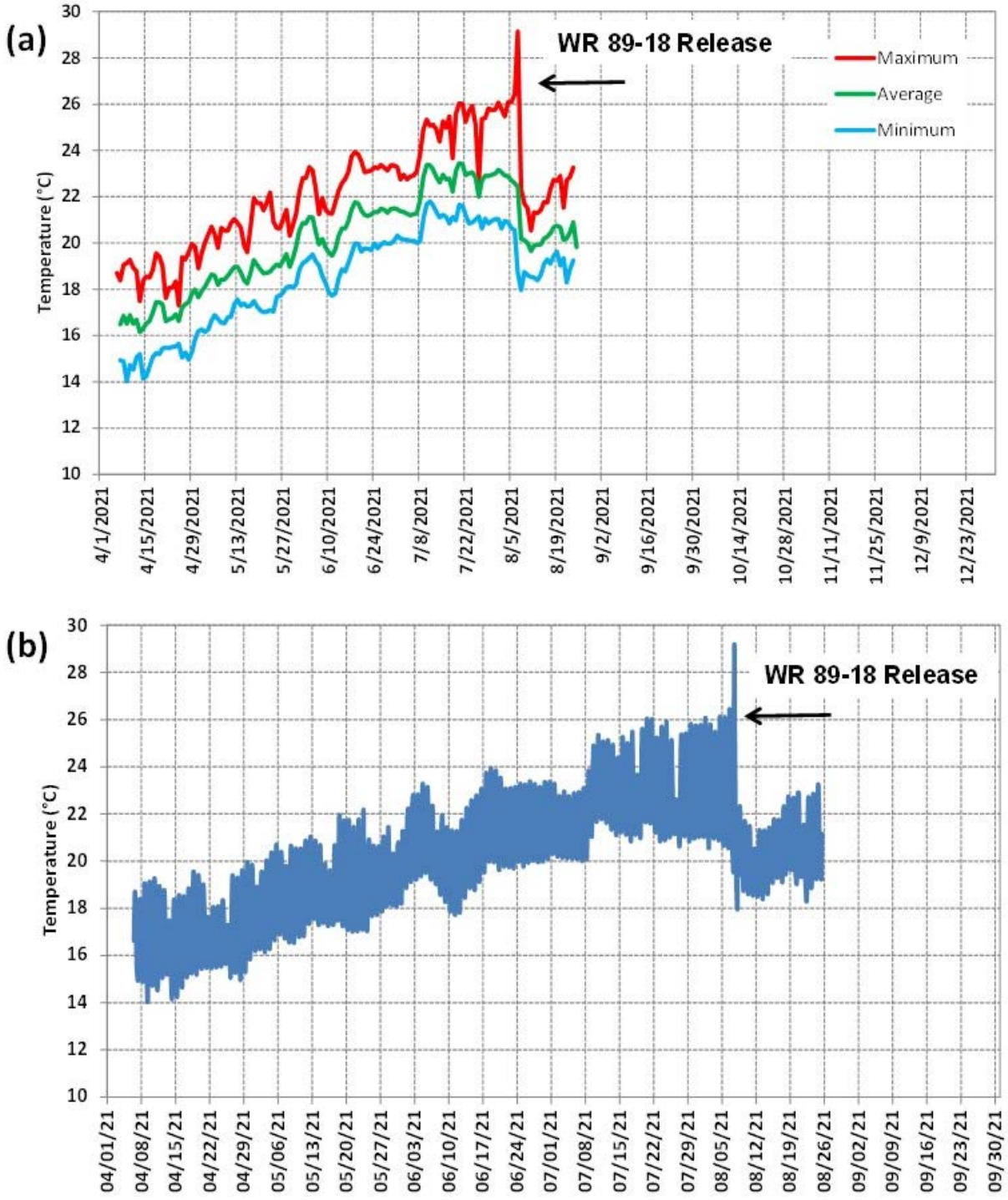

Figure 35: 2021 LSYR-10.2 (Bedrock Pool) surface (1.0-foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in a loss of data after 8/25/21.

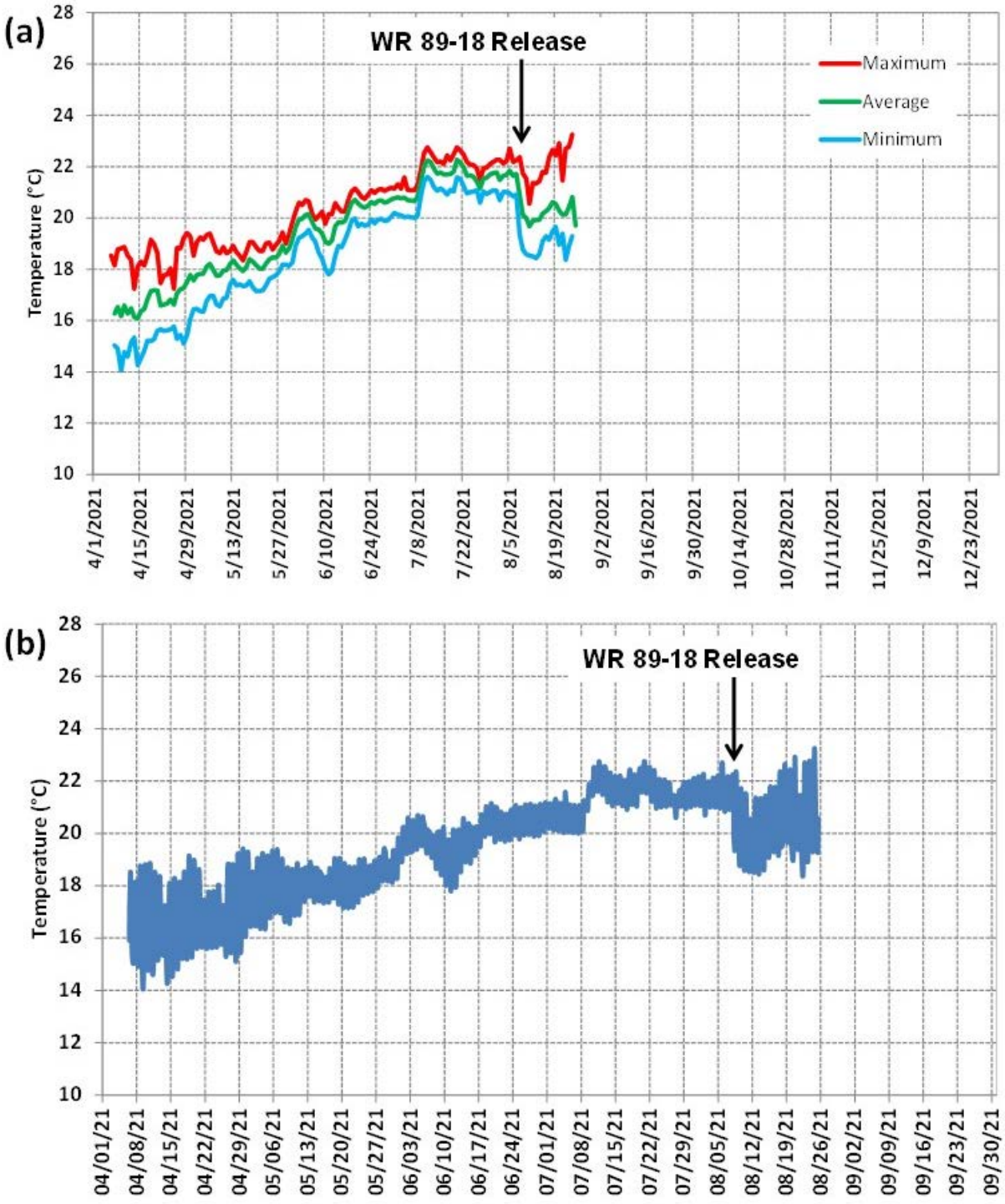

Figure 36: 2021 LSYR-10.2 (Bedrock Pool) middle (4.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in a loss of data after 8/25/21.

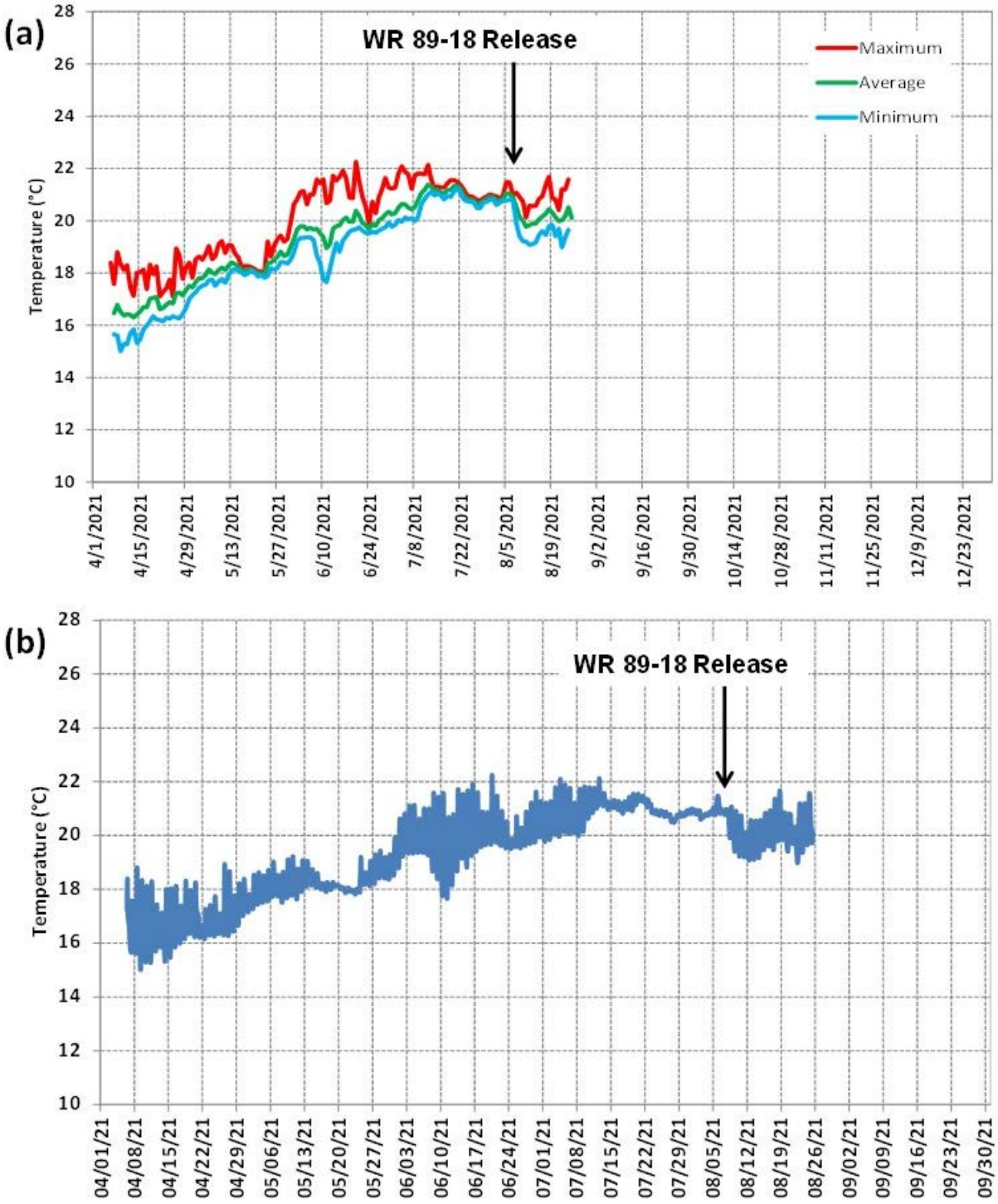

Figure 37: 2021 LSYR-10.2 (Bedrock Pool) bottom (9.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in a loss of data after 8/25/21.

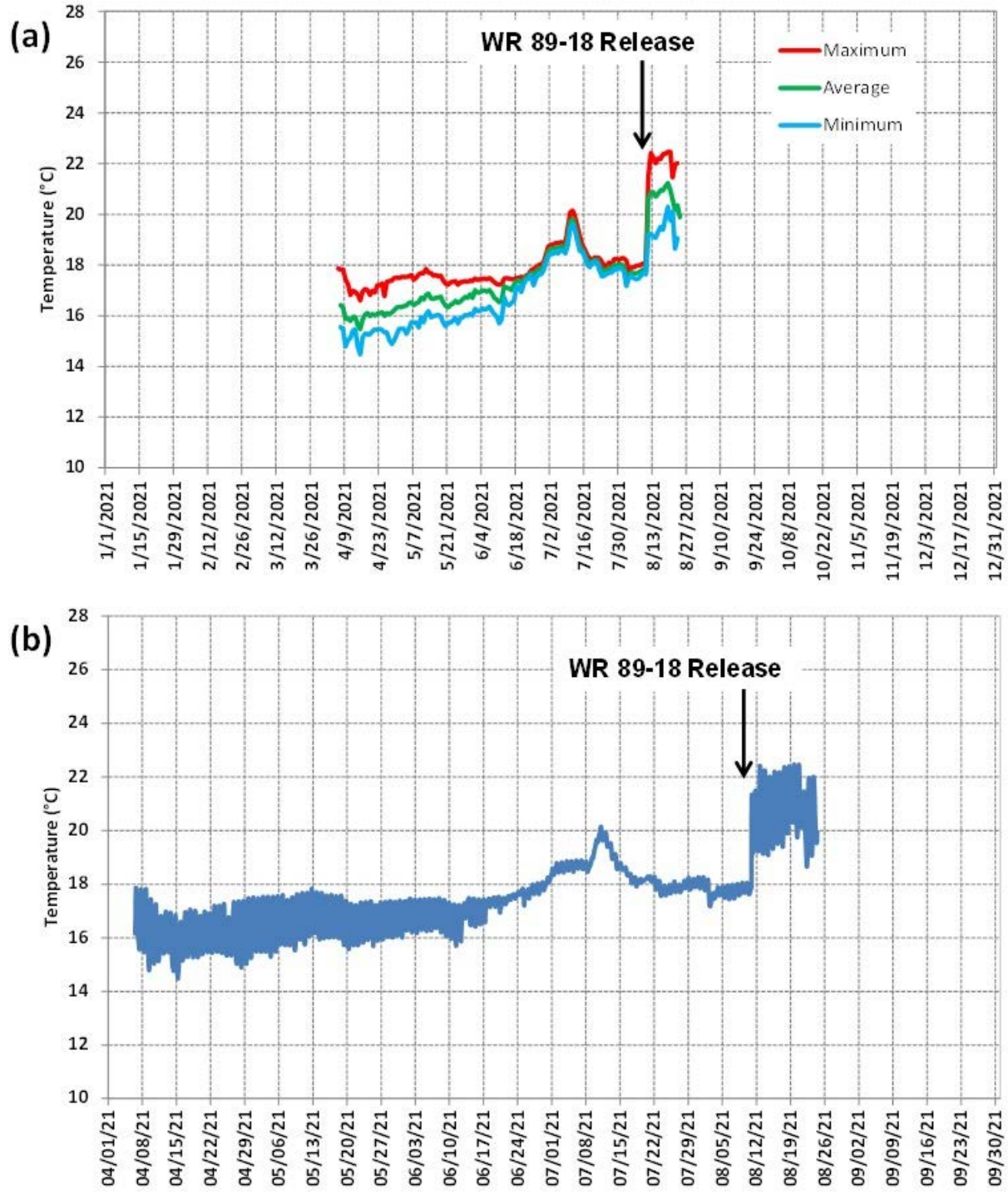

Figure 38: 2021 LSYR-13.9 (Avenue of the Flags) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in a loss of data after 8/25/21.

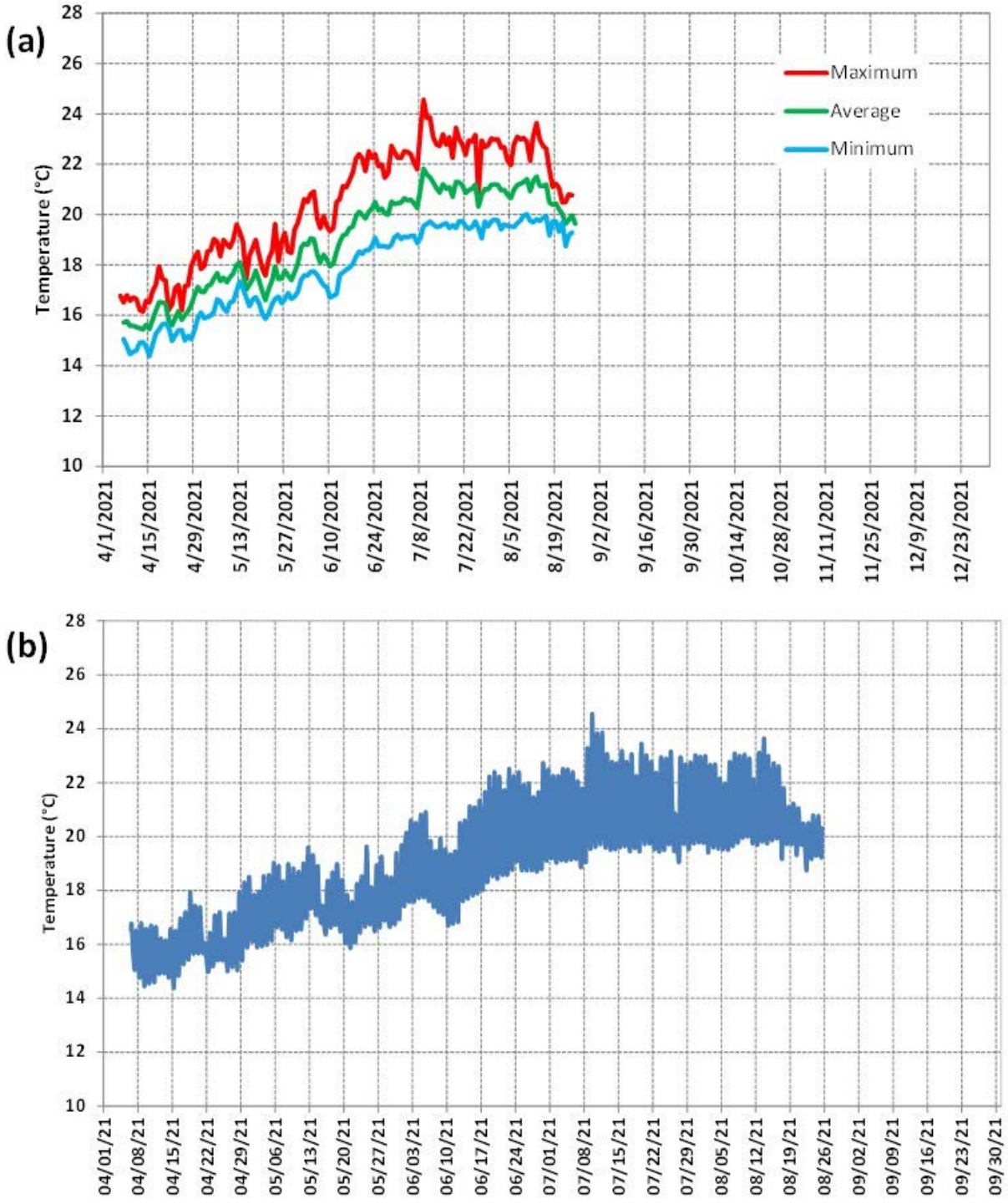

Figure 39: 2021 LSYR-22.68 (Cadwell Pool) surface (1.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

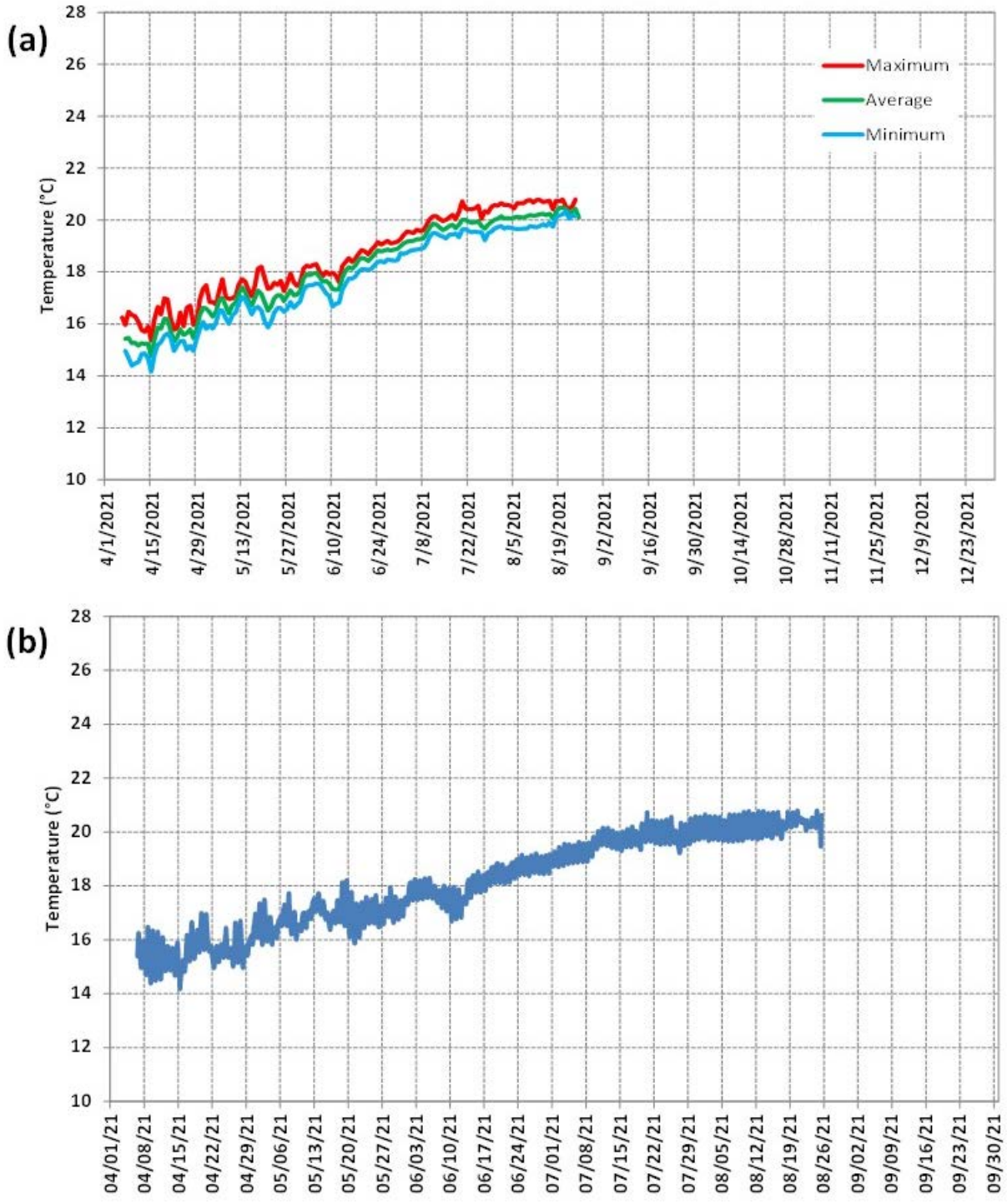

Figure 40: 2021 LSYR-22.68 (Cadwell Pool) middle (7.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

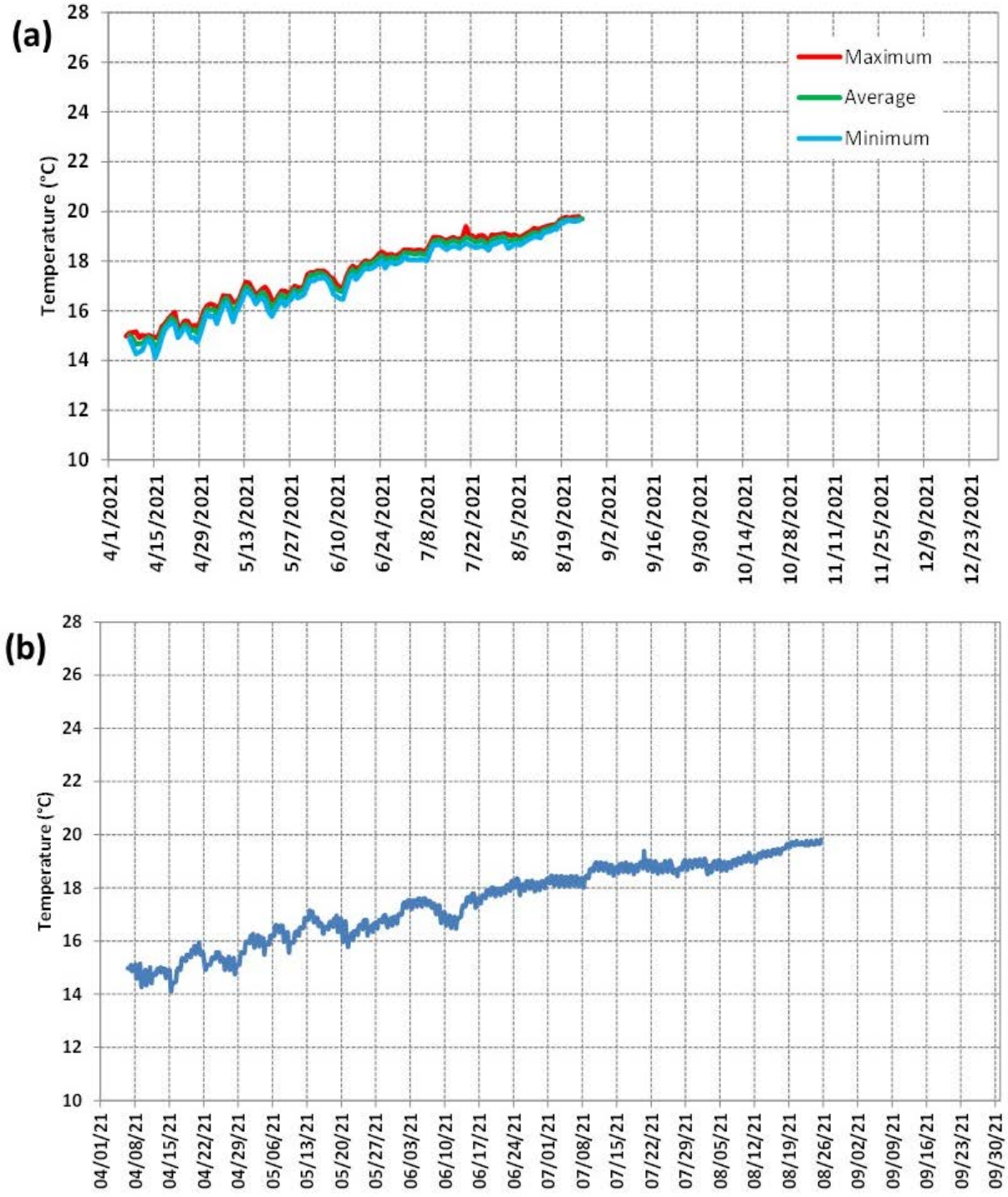

Figure 41: 2021 LSYR-22.68 (Cadwell Pool) bottom (14.0 feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of record and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/25/21.

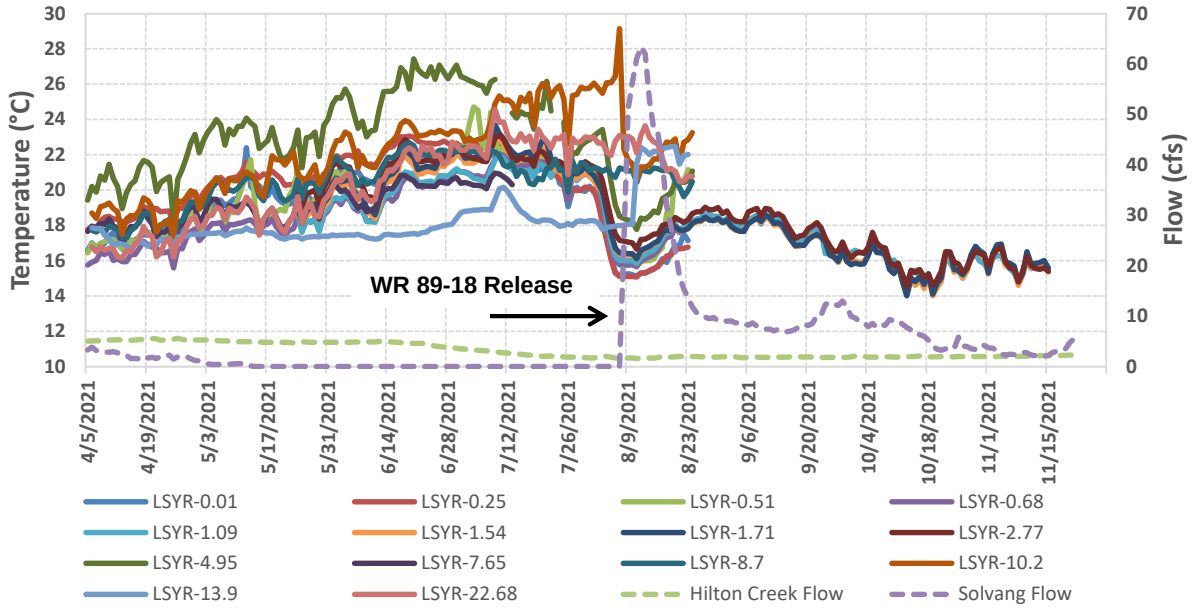

Figure 42: 2021 Longitudinal maximum daily surface water temperatures at: LSYR-0.01 (parapet wall), LSYR-0.25 (downstream of Stilling Basin), LSYR-0.51 (Long Pool), LSYR-0.68 (downstream of Long Pool), LSYR-1.09 (Grimm u/s), LSYR-1.54 (Grimm d/s), LSYR-1.71 (Grimm Pool), LSYR-2.77 (Kauffman), LSYR-4.95 (Encantado Pool), LSYR-7.65 (Double Canopy), LSYR-8.7 (Head of Beaver), LSYR-10.2 (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.

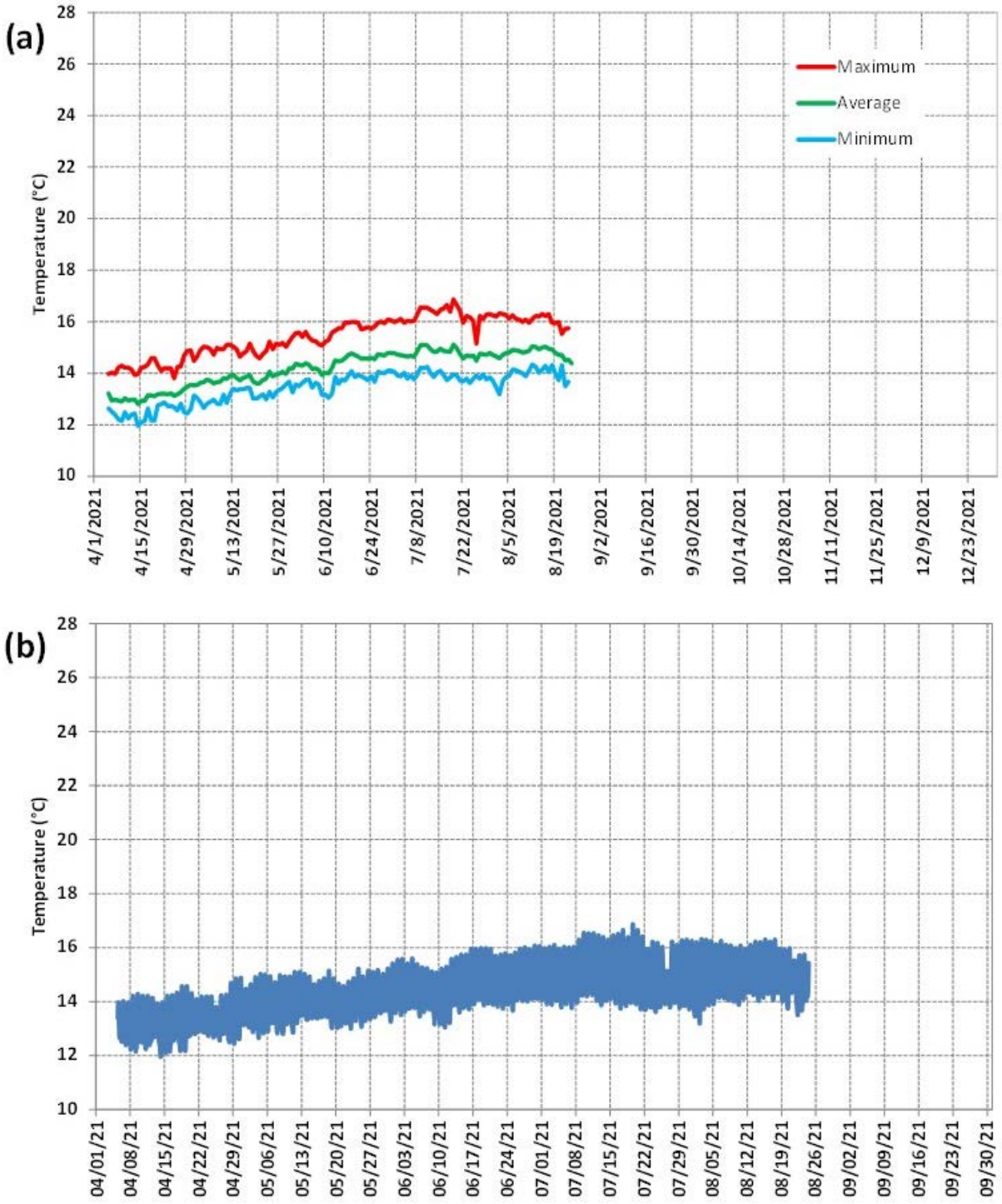

Figure 43: 2021 Lower Hilton Creek (HC-0.12) bottom (1.5 feet) thermograph for (a) daily maximum, average, and minimum daily values and (b) hourly data for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/24/21.

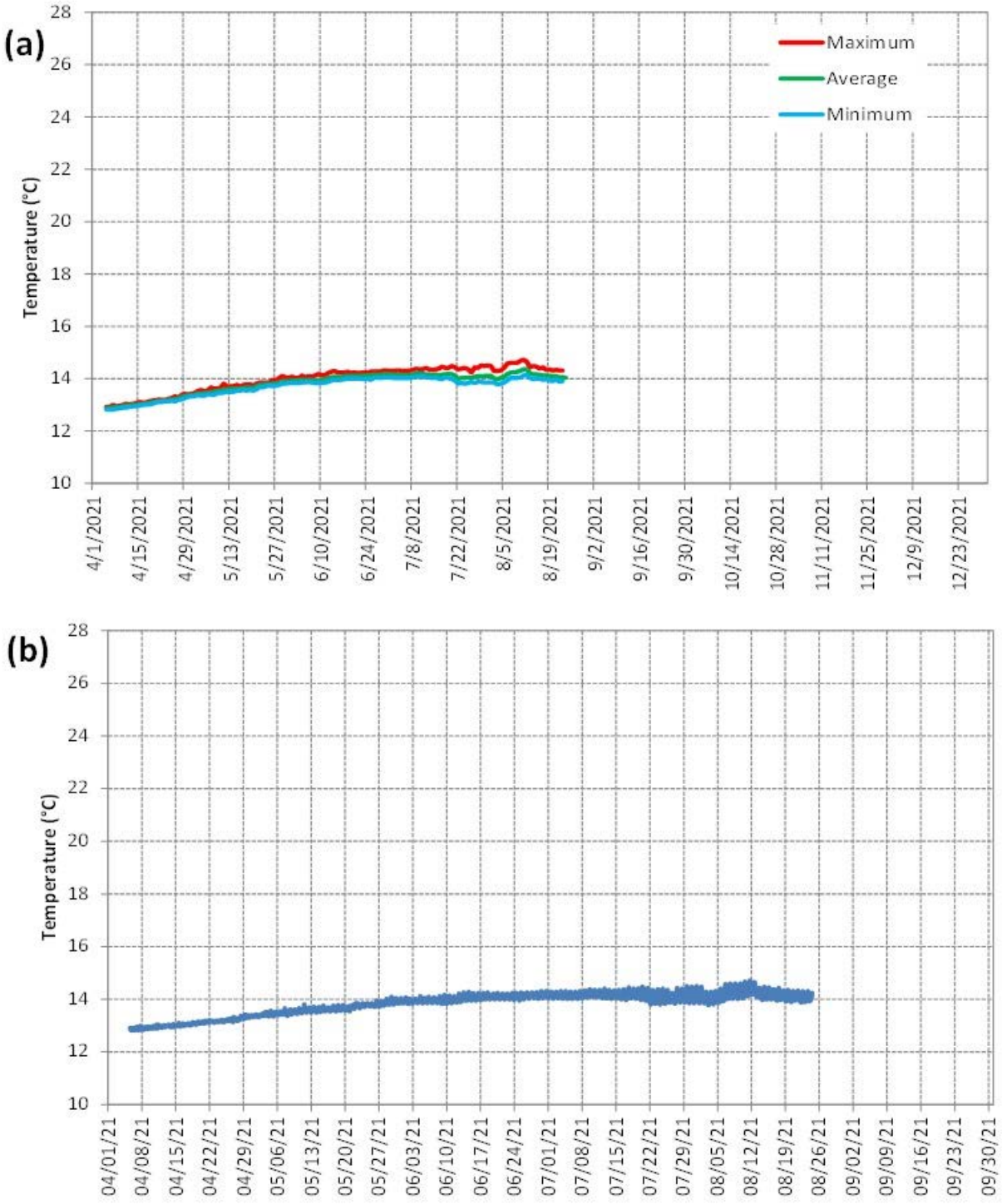

Figure 44: 2021 Hilton Creek at the Upper Release Point (HC-0.54) bottom (2.5 feet) water temperatures for: (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record; optic shuttle malfunction resulted in no data collected after 8/24/21.

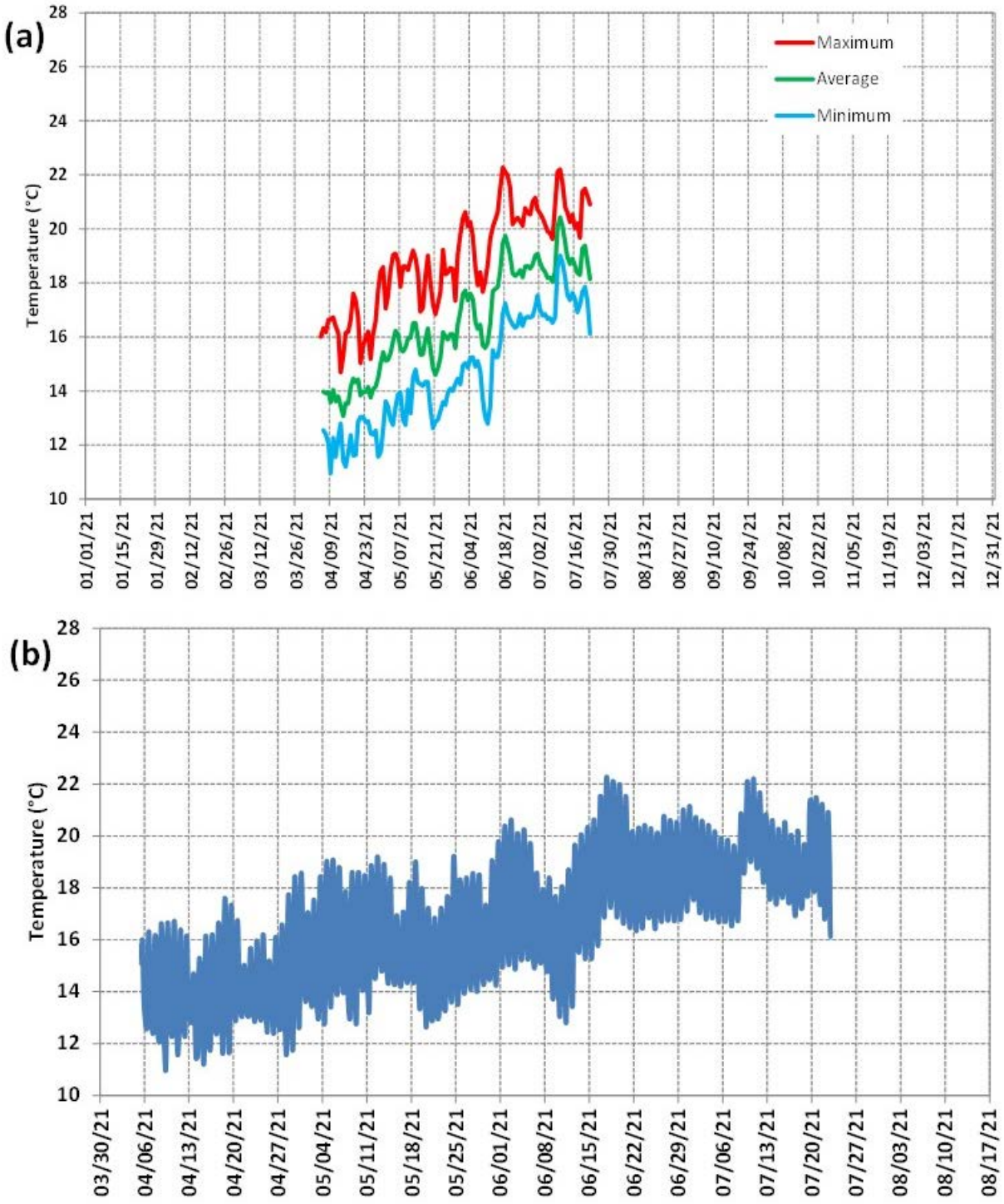

Figure 45: 2021 Quiota Creek (QC-2.66) bottom (2.5 feet) thermograph for (a) daily maximum, average, and minimum daily values for the entire period of record and (b) hourly data for the entire period of record 4/5/21 – 7/22/21; the habitat was nearly dry when the thermograph was removed.

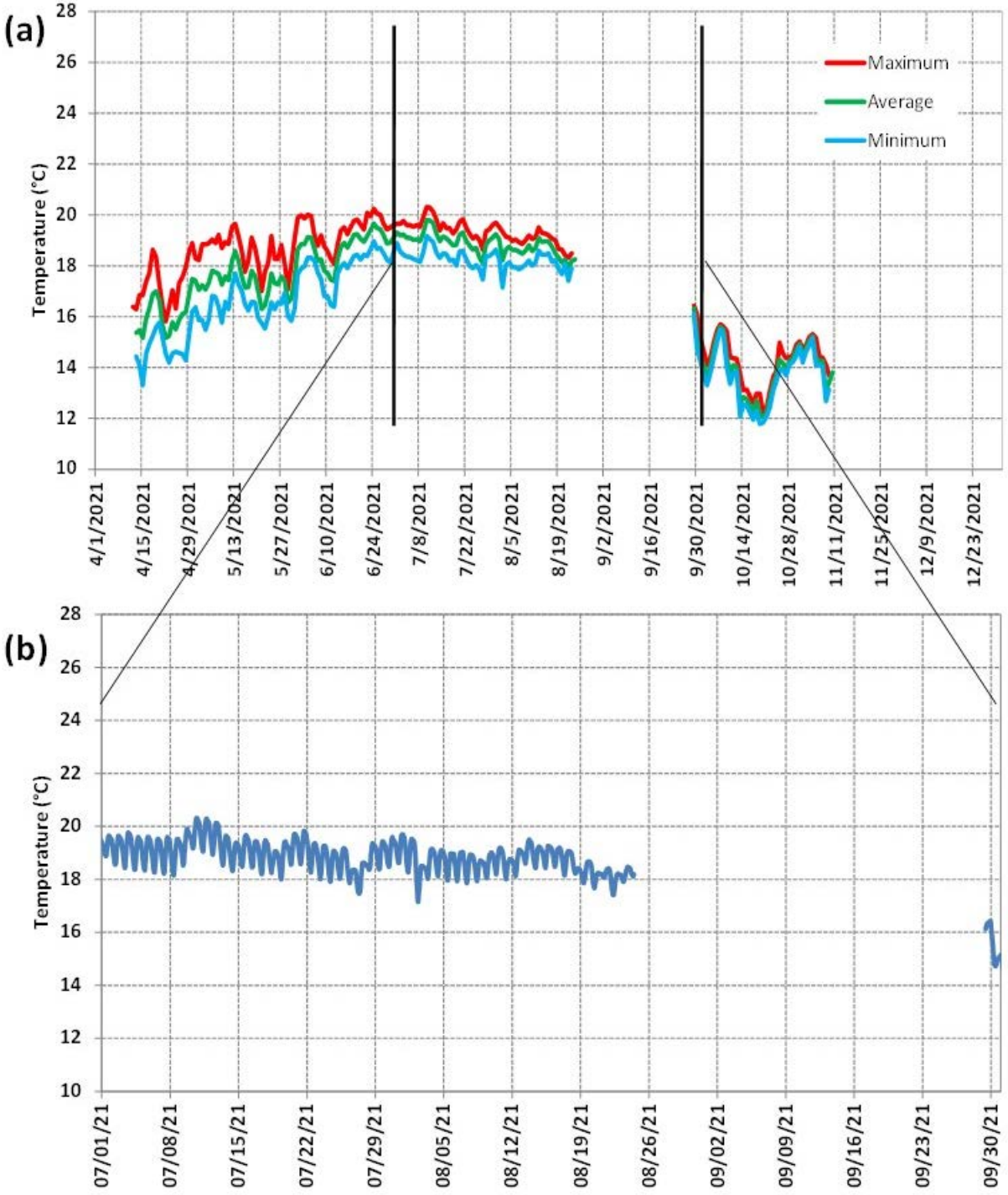

Figure 46: 2021 SC-0.77 bottom (5.0 foot) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements from 7/1/21 – 10/1/21; optic shuttle malfunction resulted in no data collected from 8/25/21 to 9/29/21.

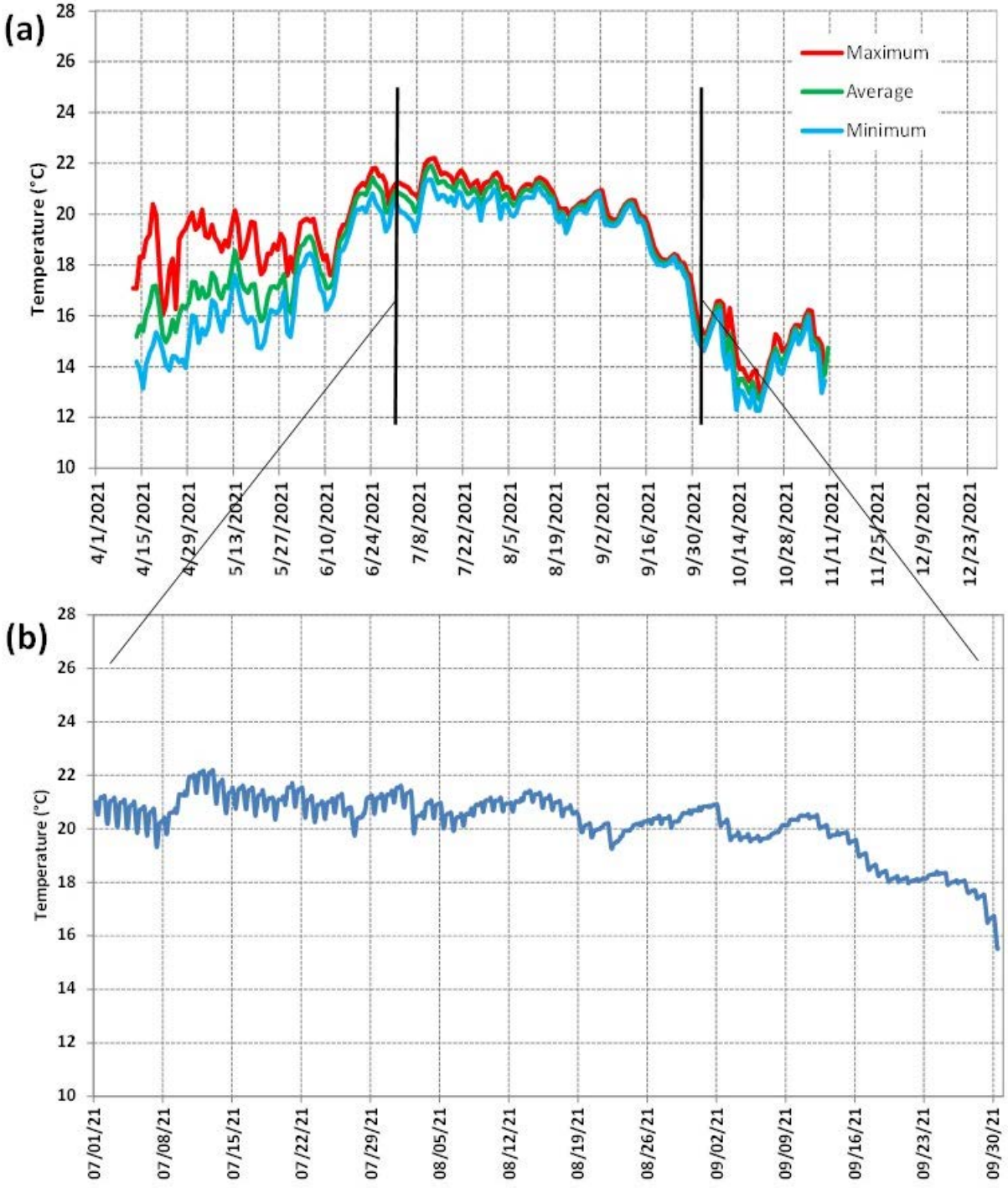

Figure 47: 2021 SC-2.20 (Reach 2 Bedrock Section) middle (4.0 feet) water temperatures for (a) daily maximum, average, and minimum temperatures for the entire period of deployment and (b) hourly measurements for the period from 7/1/21 – 10/1/21.

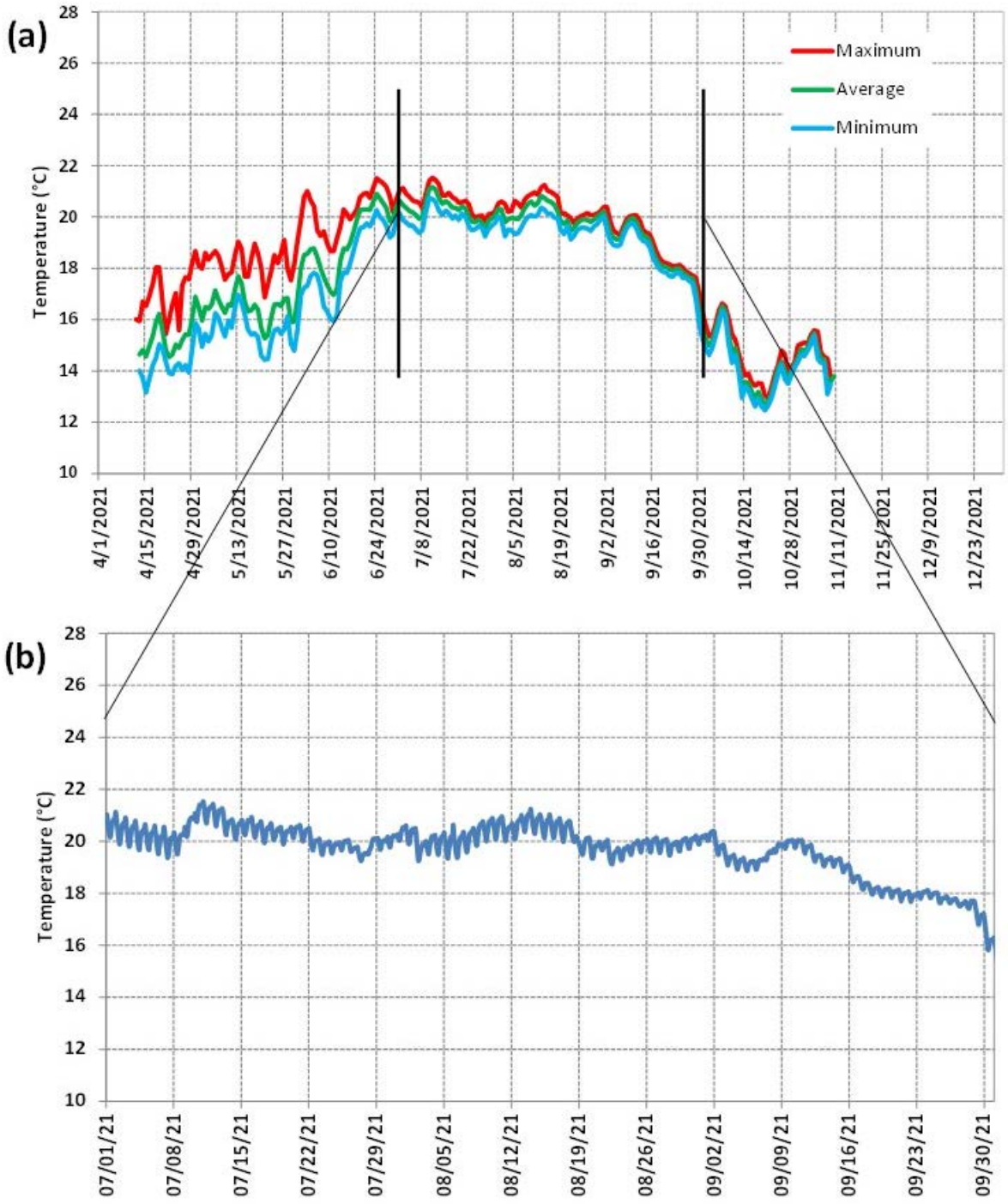

Figure 48: 2021 SC-3.0 (Highway 1 Bridge Pool Habitat) middle (6 feet) water temperature for (a) maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/21 – 10/1/21.

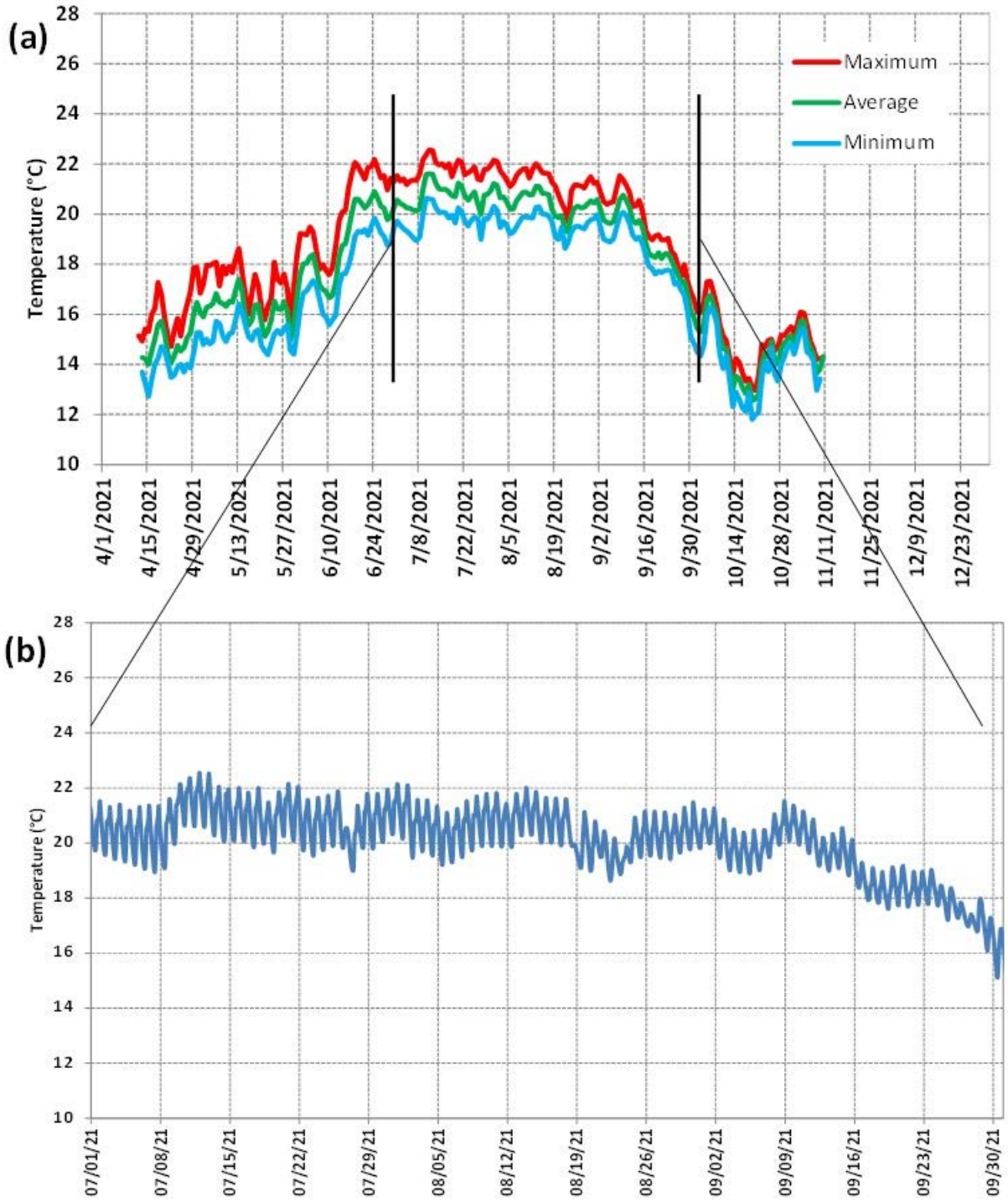

Figure 49: 2021 SC-3.5 (Jalama Bridge Pool Habitat) bottom (4.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/21 – 10/1/21.

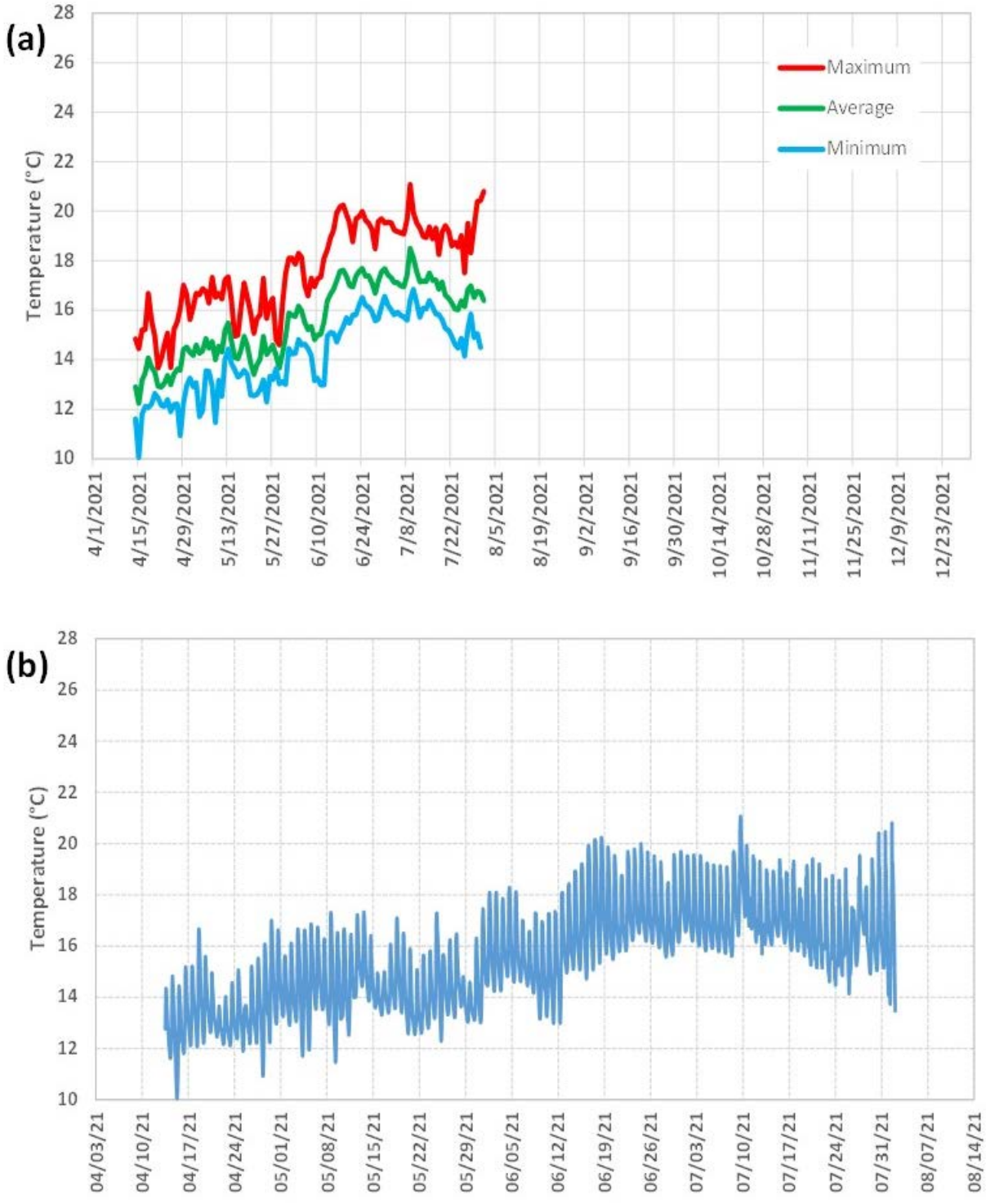

Figure 50: 2021 SC-3.80 Upper Salsipuedes Creek (0.5 feet) water temperatures for (a) daily maximum, average and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record 4/14/21 – 8/1/21 (creek was dry on 8/1/21).

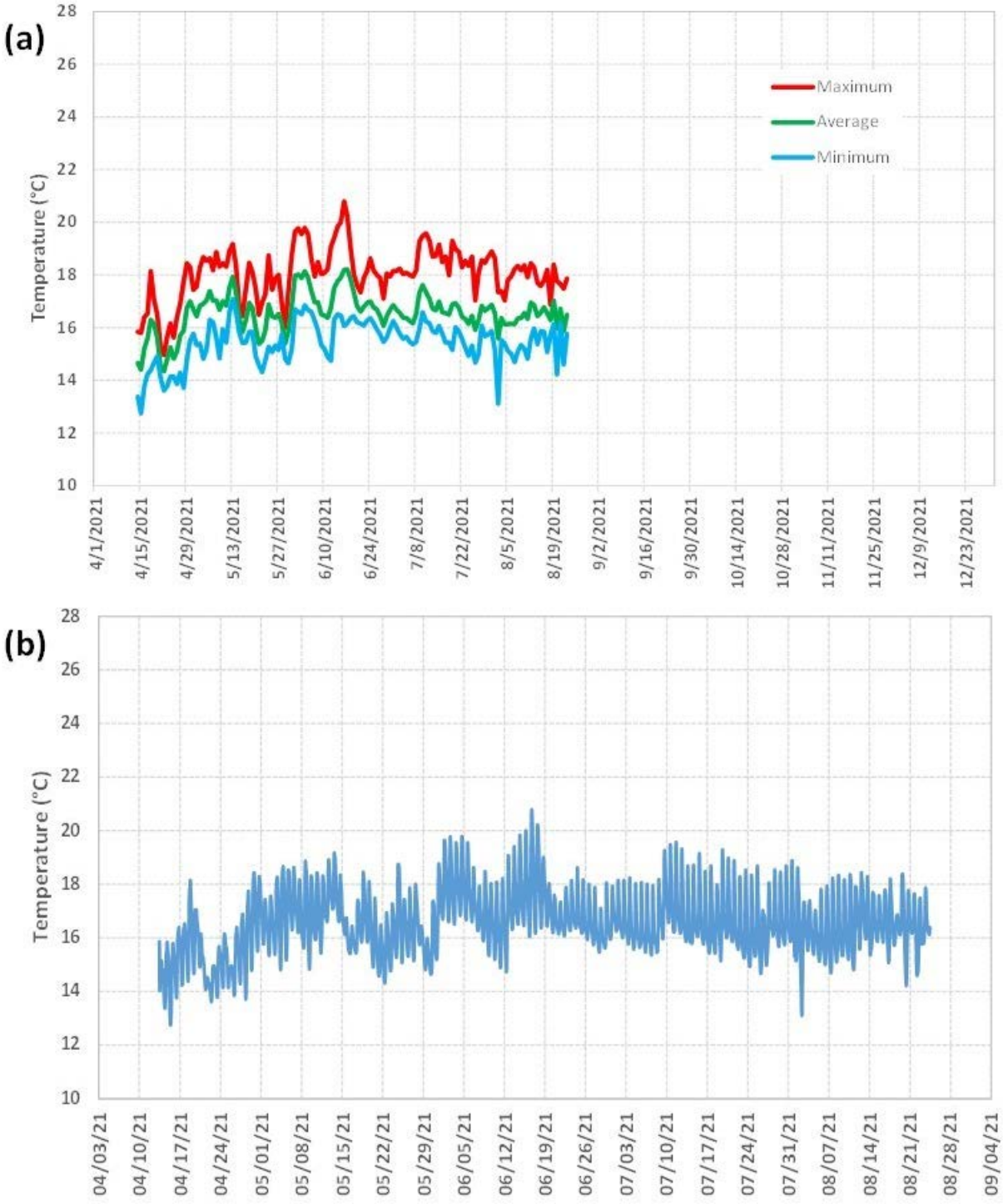

Figure 51: 2021 EJC-3.81 directly upstream of the Upper Salsipuedes Creek confluence – bottom (3.0 -feet) water temperatures for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of record (4/14/21 – 8/23/21); only a small isolated puddle remained of the drying habitat.

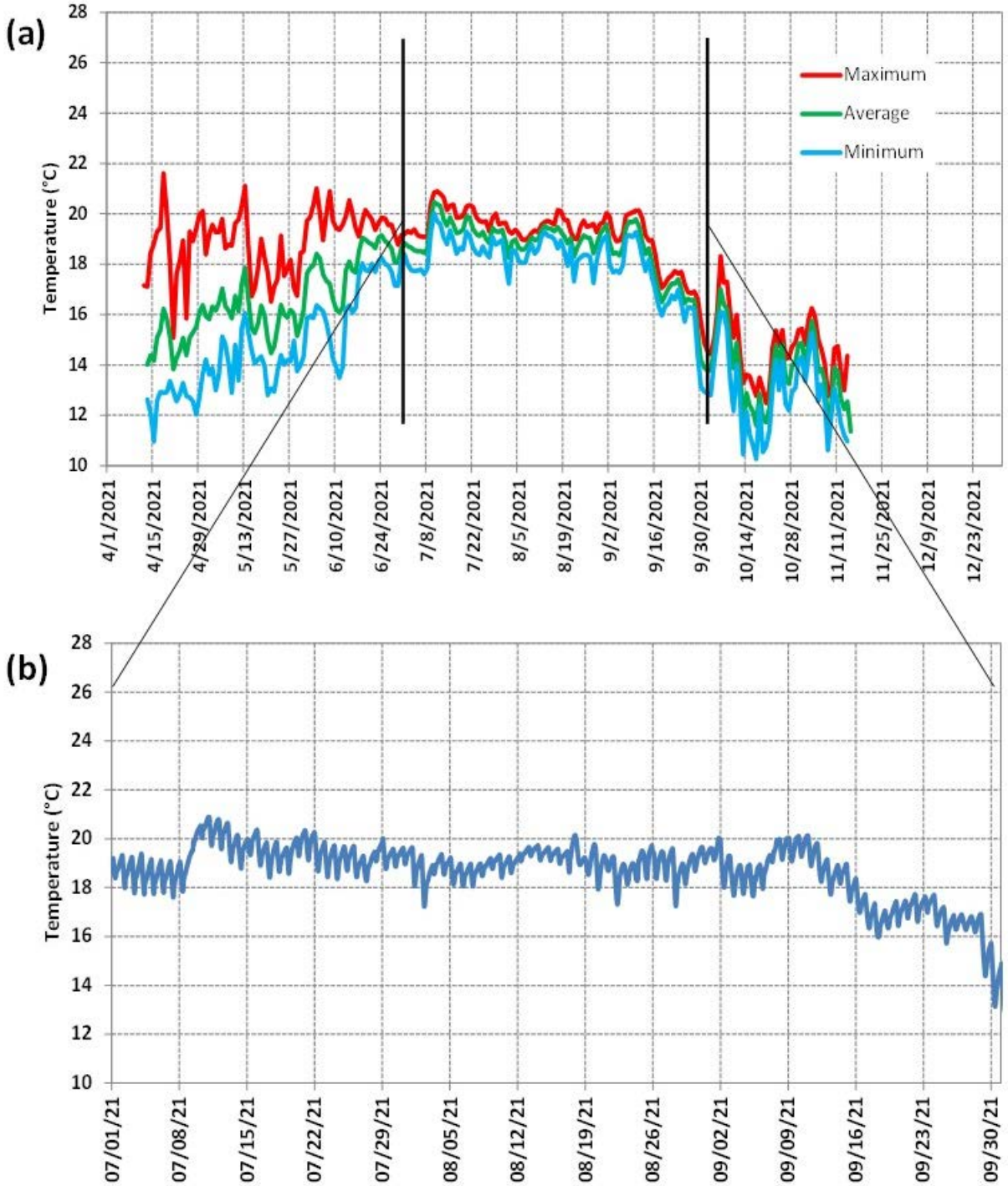

Figure 52: 2021 EJC-5.4 (Palos Colorados Pool Habitat) bottom (3.0 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/20 – 10/1/20.

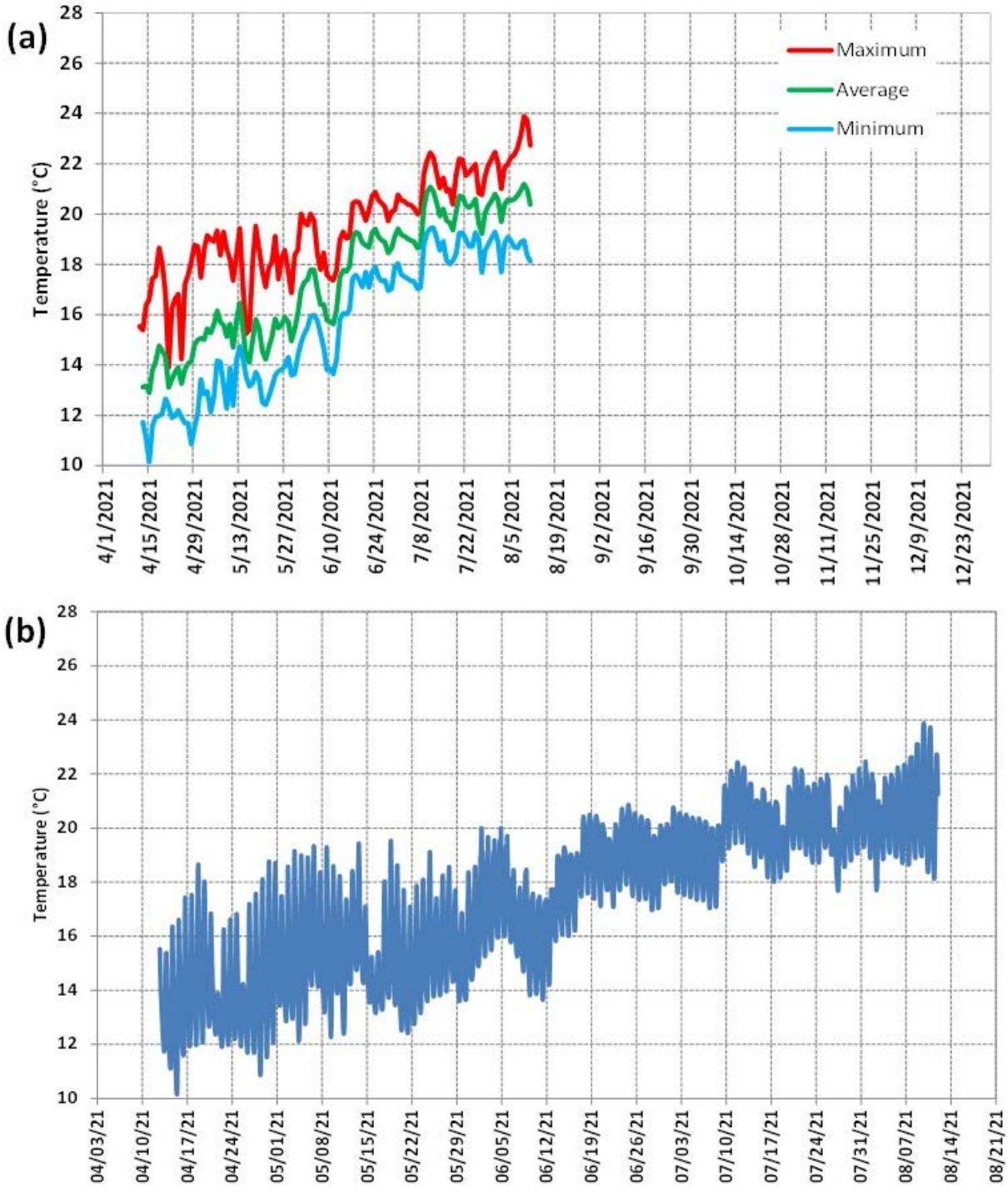

Figure 53: 2021 EJC-10.82 water temperature at Rancho San Julian Fish Ladder bottom (3.5-feet) for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the entire period of deployment 4/12/21 – 8/17/21. Unit removed from drying and isolated habitat.

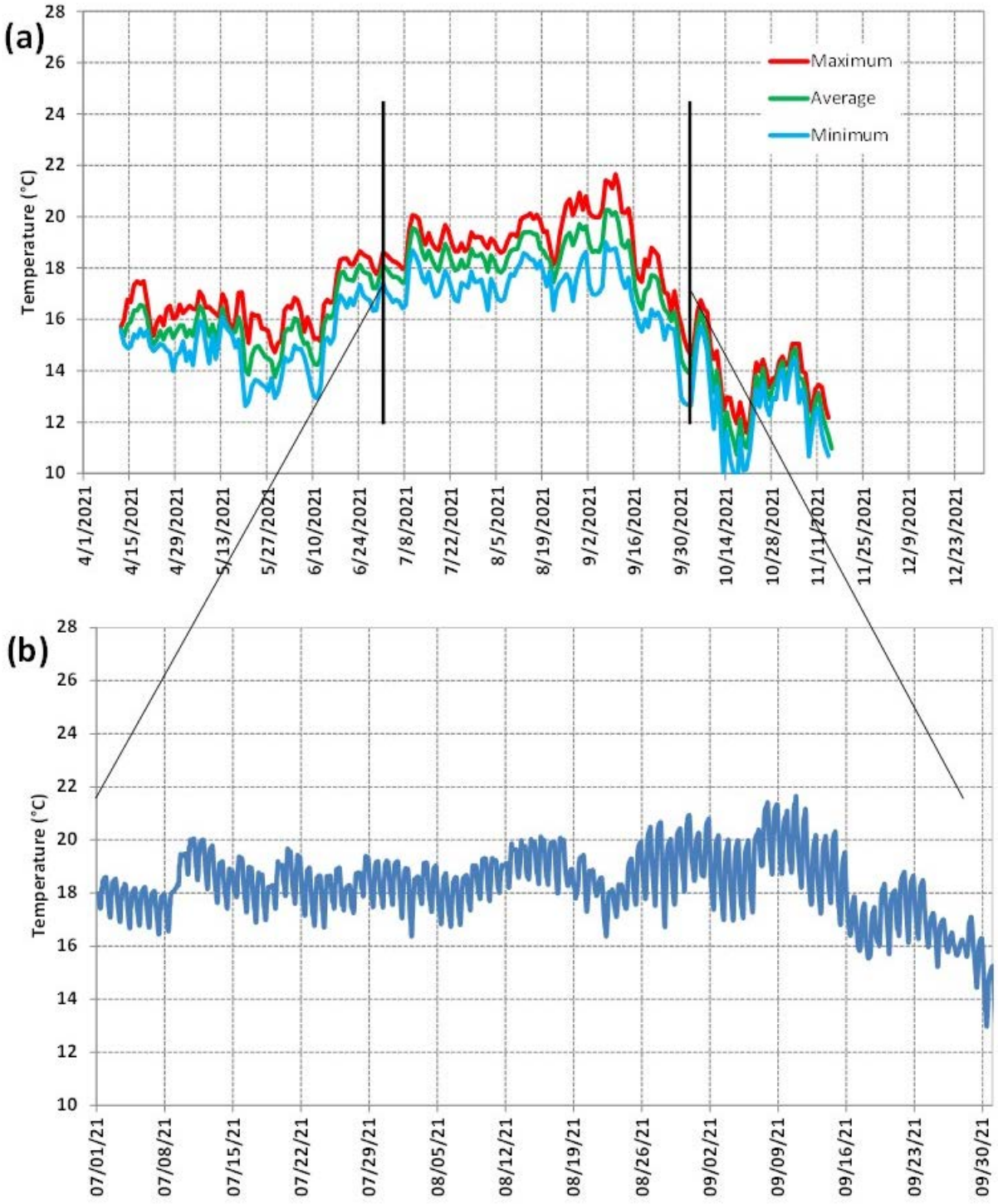

Figure 54: 2021 LAC-7.0 (Los Amoles Creek at Ford Crossing) bottom (2.5 feet) water temperature for (a) daily maximum, average, and minimum for the entire period of deployment and (b) hourly measurements for the period from 7/1/20 – 10/1/20.

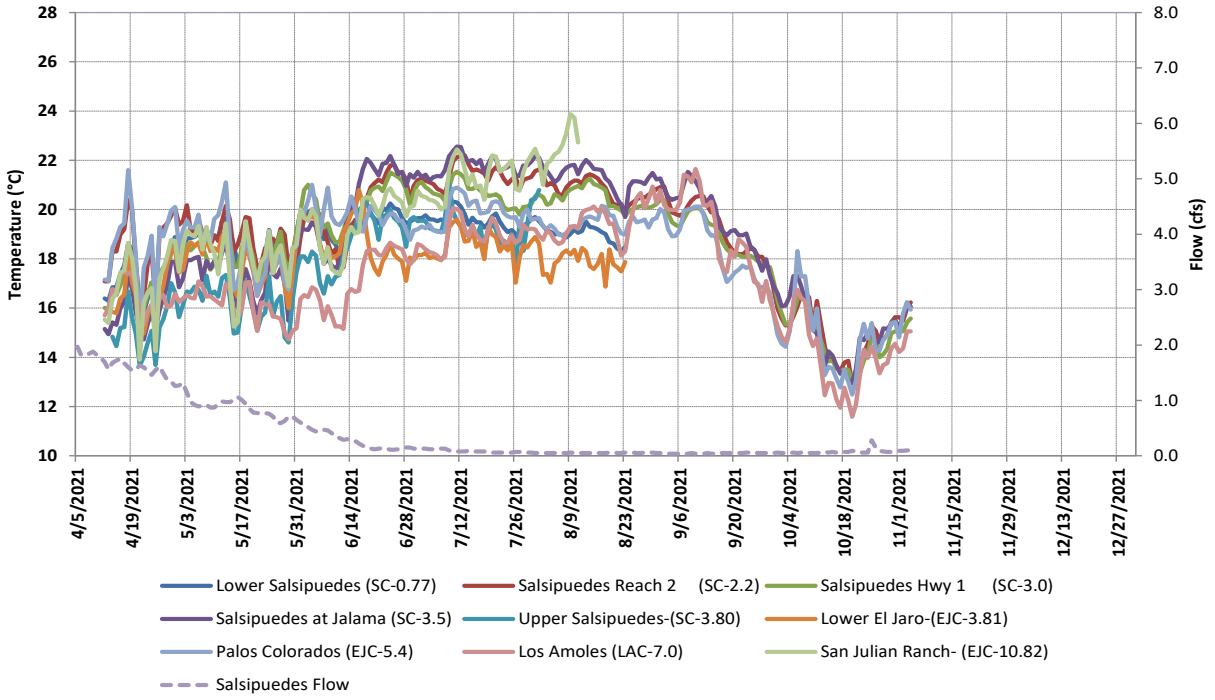

Figure 55: 2021 longitudinal surface daily maximum at 9 tributary locations within Salsipuedes/El Jaro watershed and flow at the USGS gauging station at Salsipuedes Creek.

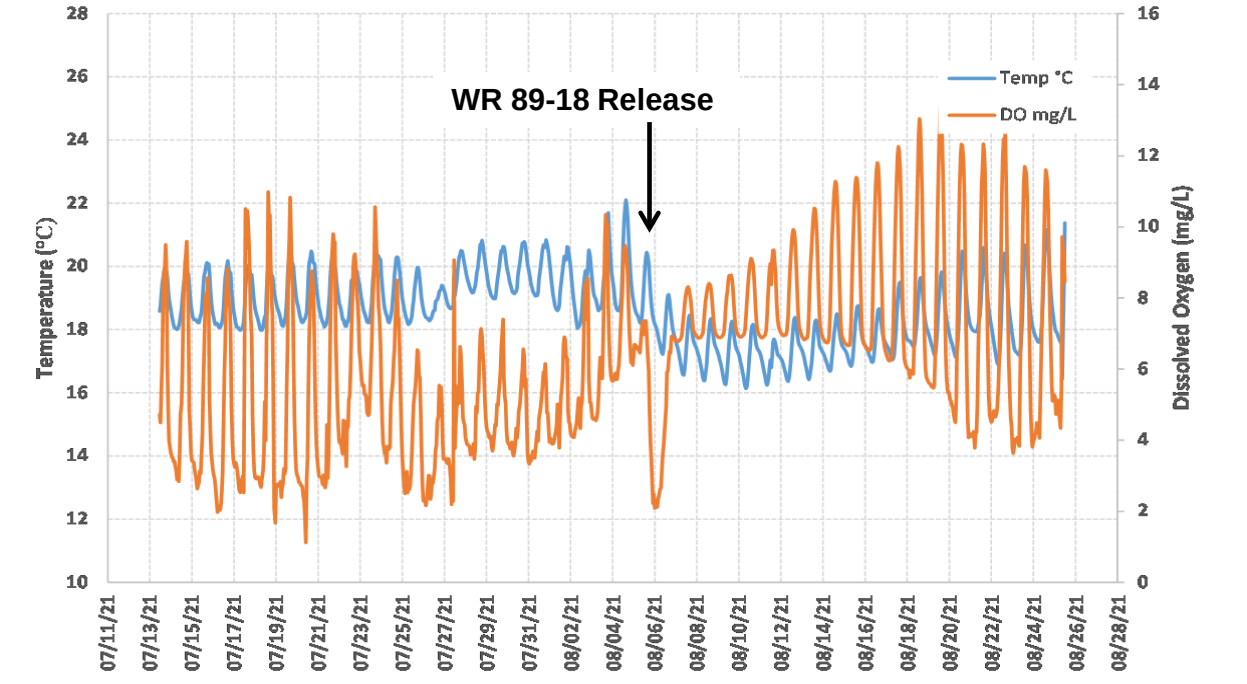

Figure 56: Temperature and dissolved oxygen at LSYR-4.95 4-feet below the surface (mid-water) from 7/13/21-8/25/21; 1.32water from the WR 89-18 release reached the site on 8/5/21 at approximately 16:00 hours.

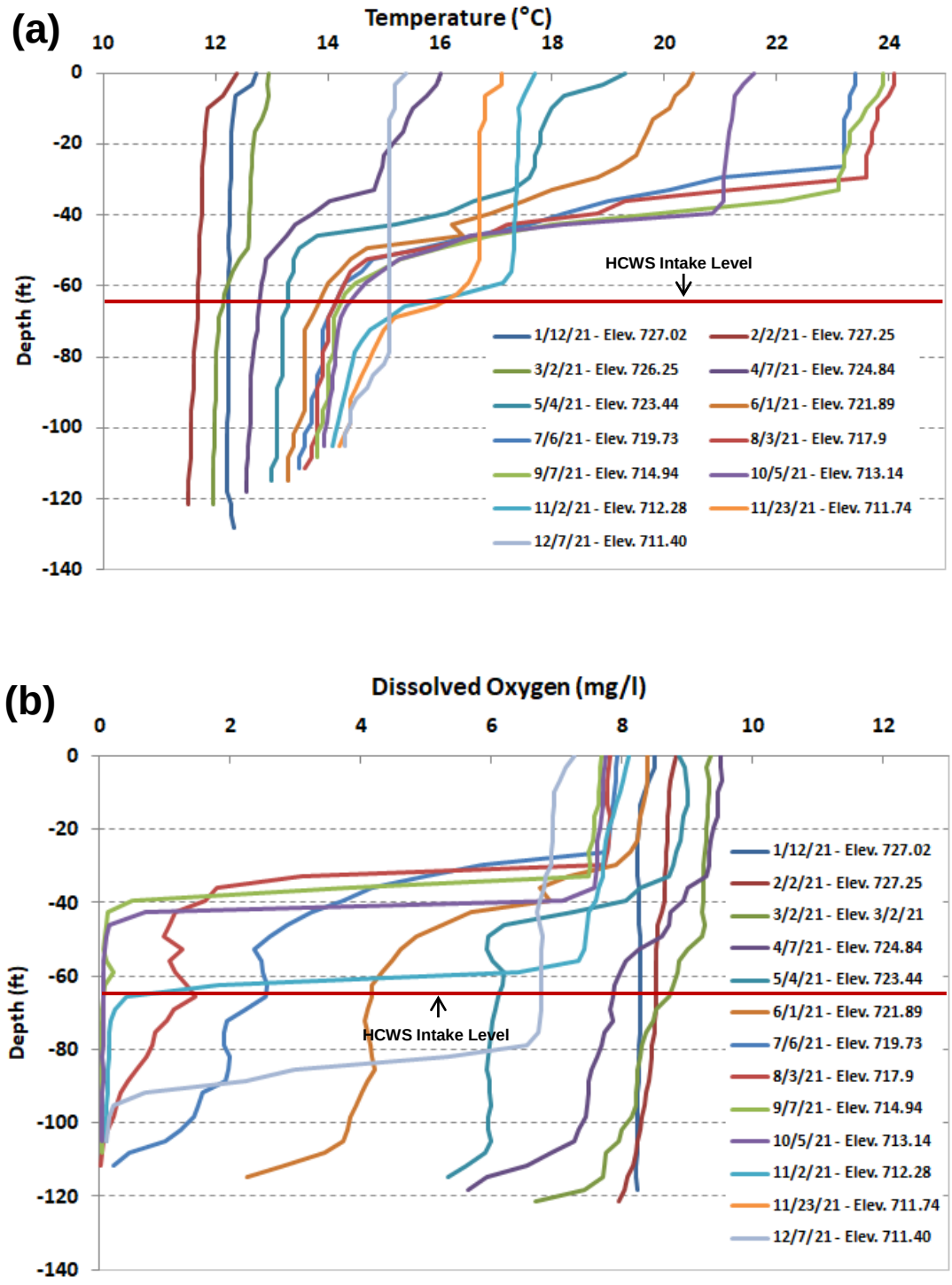

Figure 57: Lake Cachuma 2021 water quality profiles for (a) temperature and (b) dissolved oxygen concentrations at the intake barge for the HCWS; the target depth of HCWS intake hose is 65 feet of depth throughout the monitoring period.

3.3. Habitat Quality within the LYSR Basin

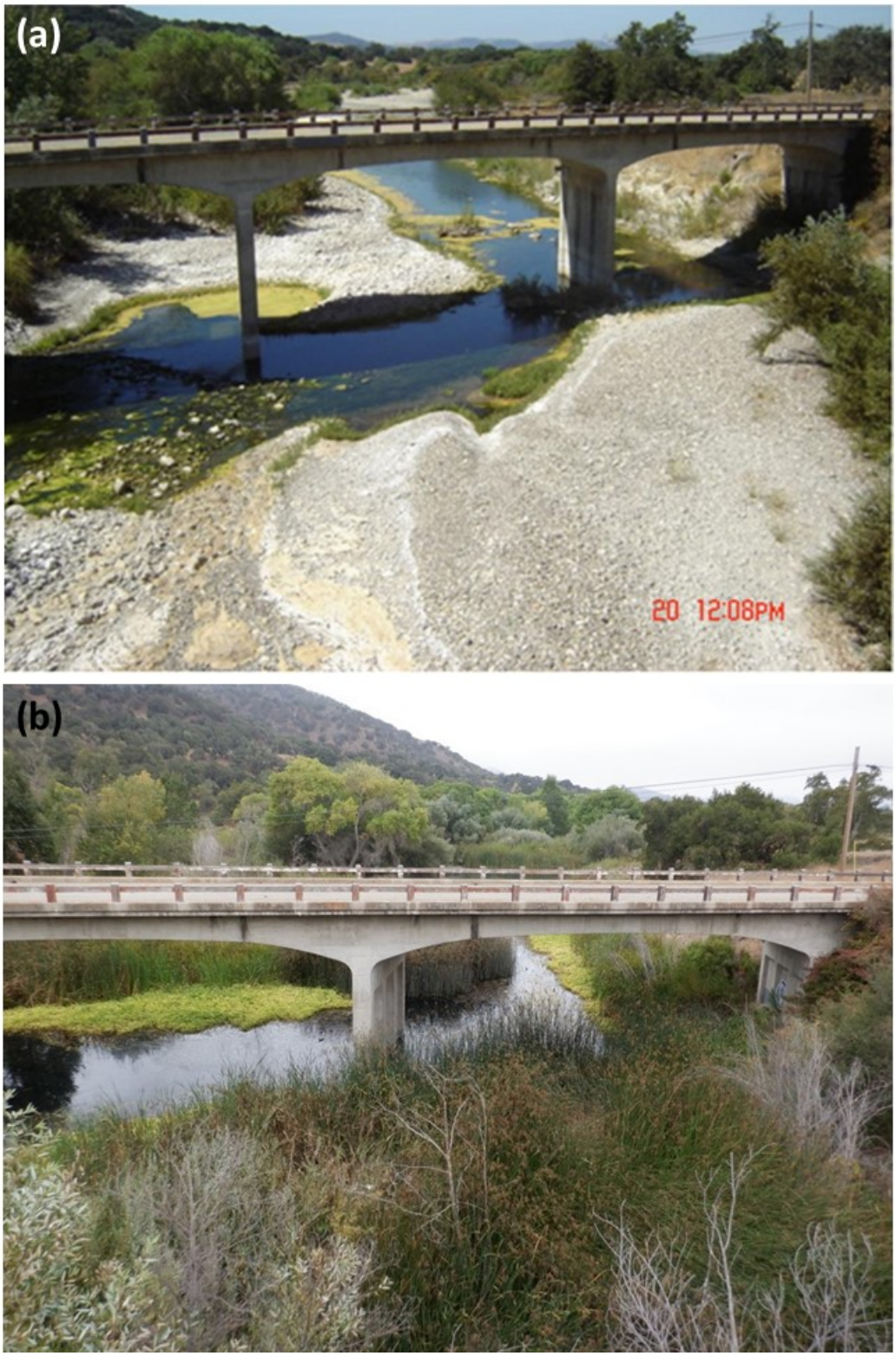

Figure 58: Photo points (M-6) collected at Highway 154 Bridge looking downstream in (a) September 2005 and (b) September 2021.

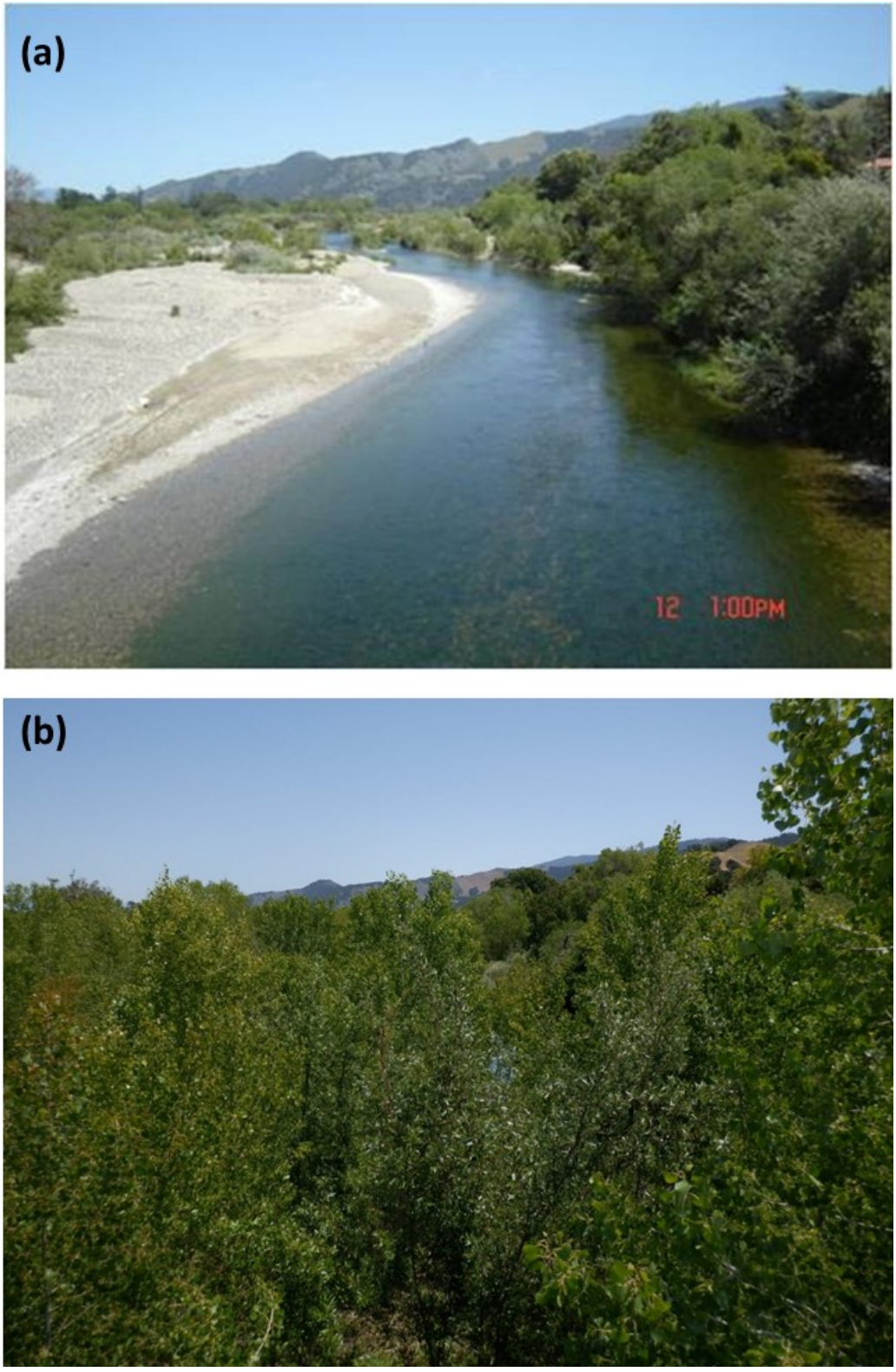

Figure 59: Photo point (M-12) collected at Refugio Bridge looking upstream in (a) May 2005, and (b) September 2021.

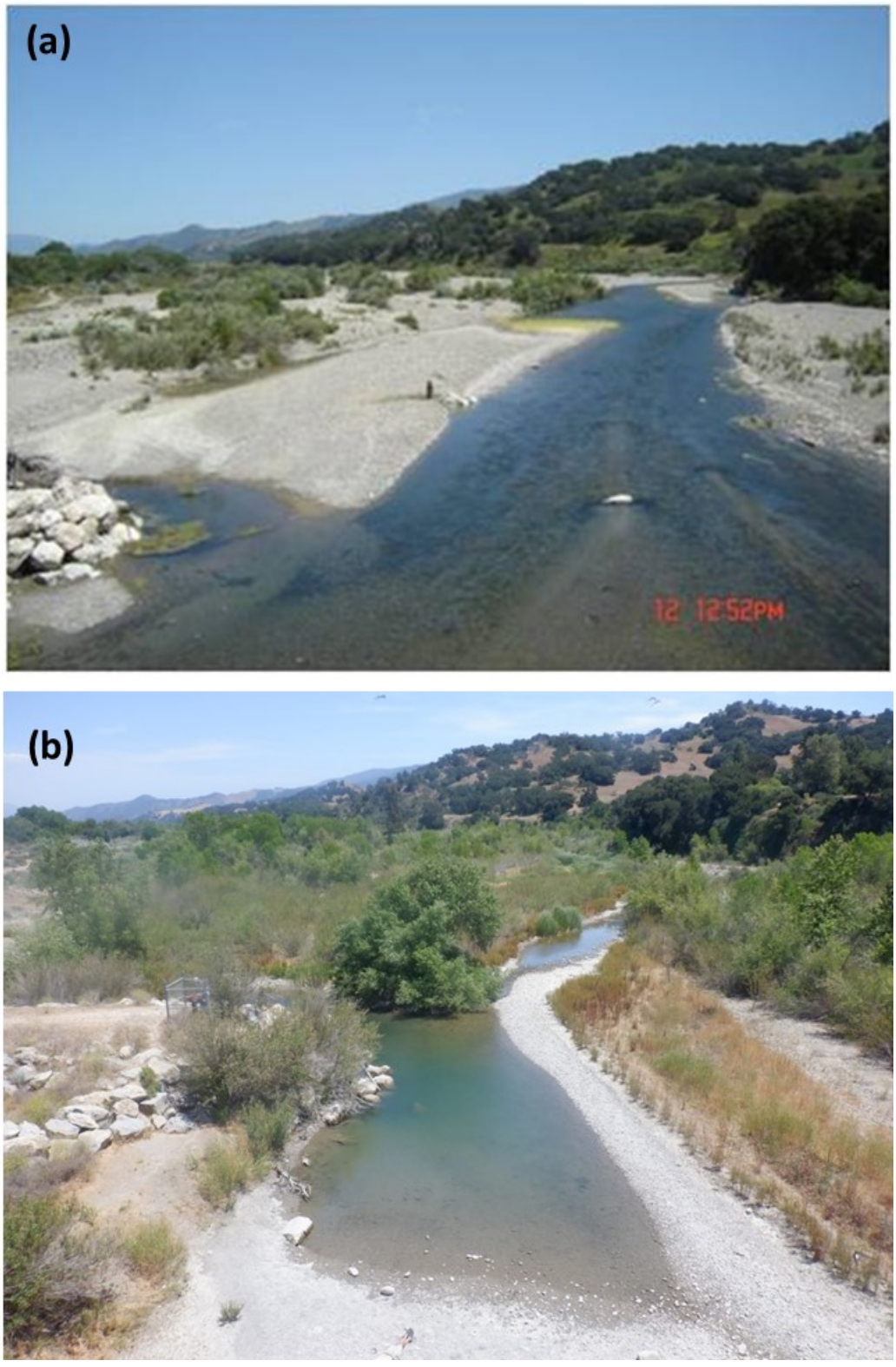

Figure 60: Photo point (M-14) collected at Alisal Bridge looking upstream in a) May 2005, and b) June 2021.

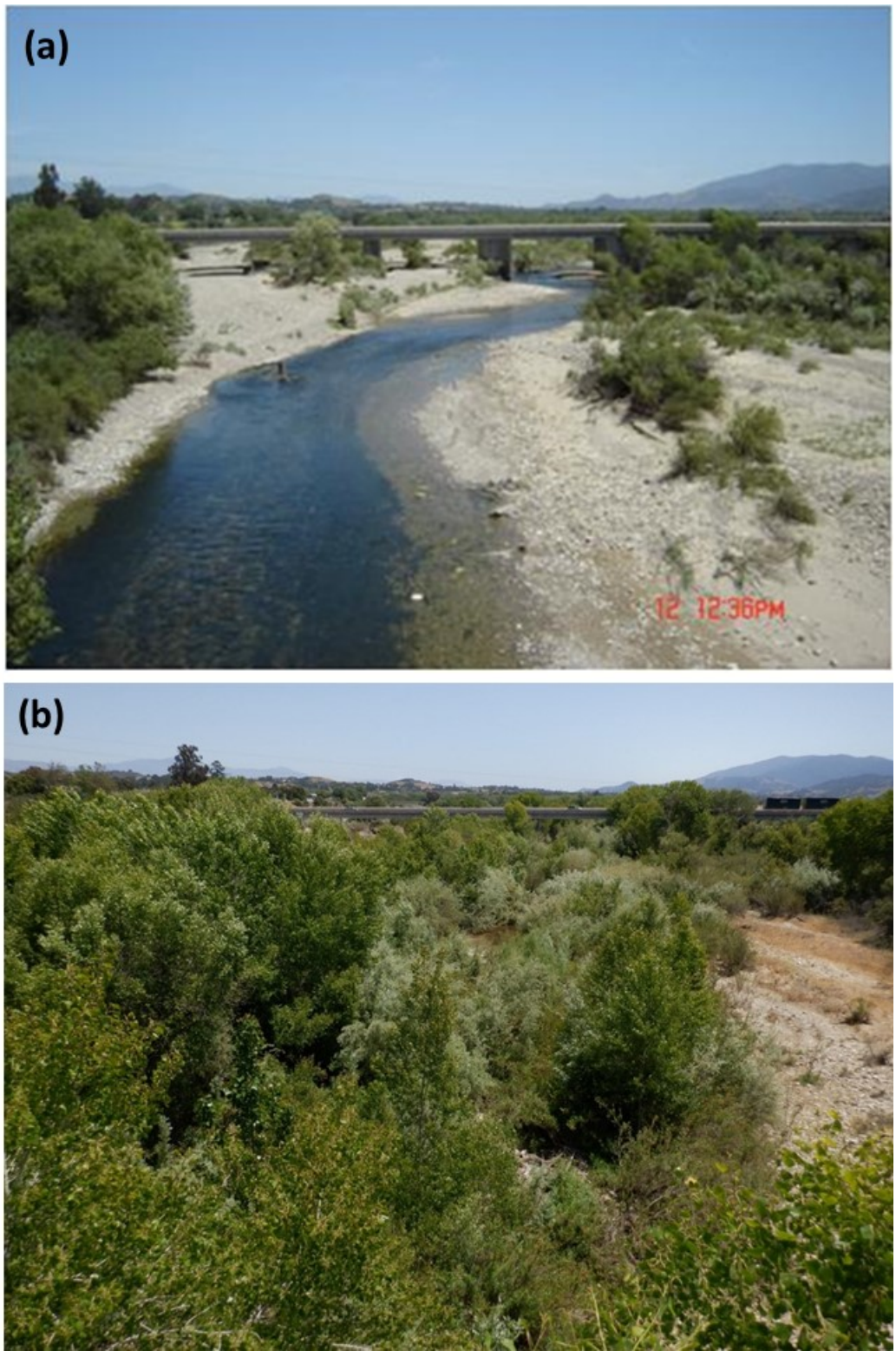

Figure 61: Photo point (M-19) collected at Avenue of the Flags Bridge looking upstream in (a) May 2005, and (b) May 2021.

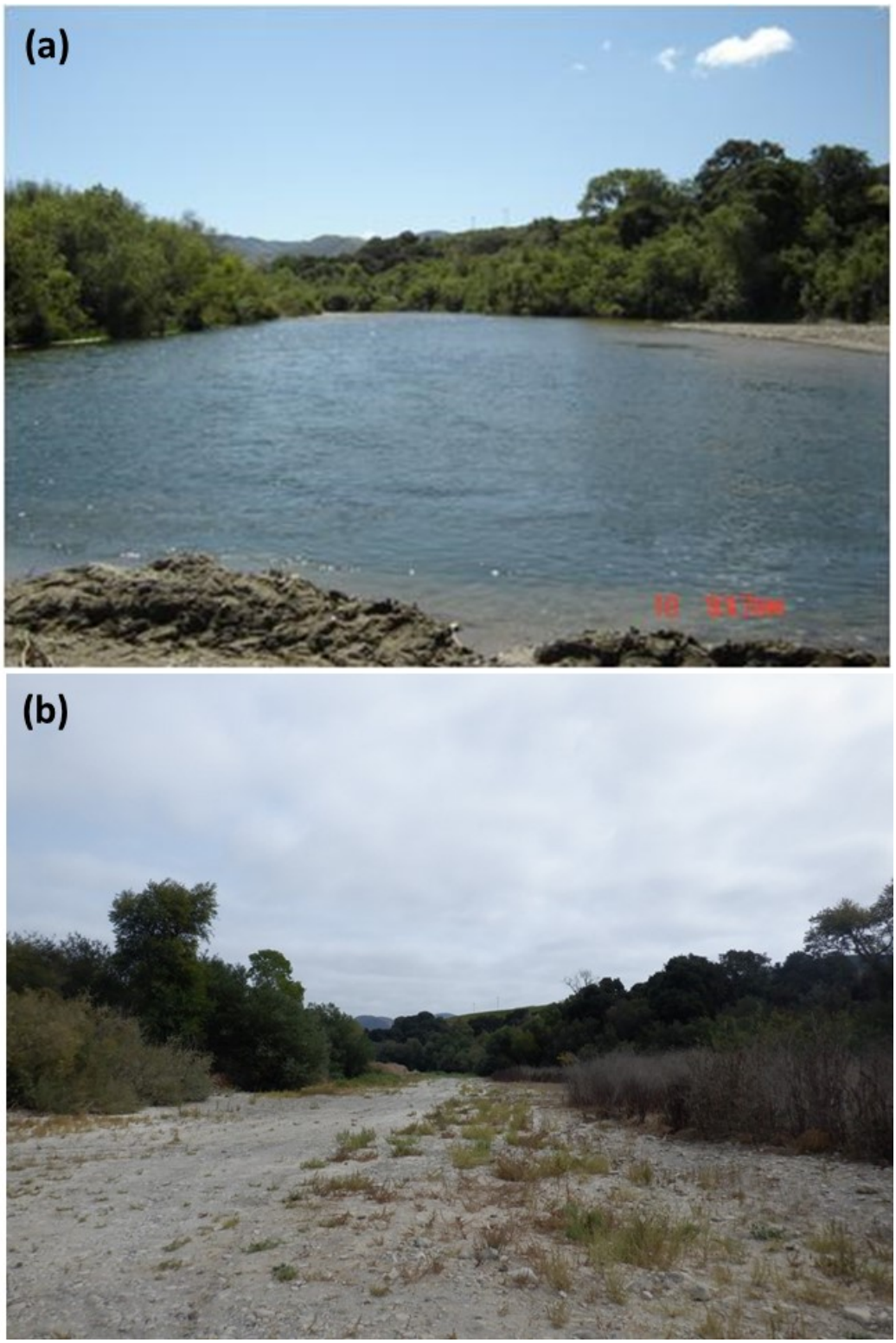

Figure 62: Photo point (M-21) collected at Sweeney Road Crossing looking upstream in (a) May 2005, and (b) September 2021.

Figure 63: Photo point (T-1) collected at Hilton Creek looking upstream towards the trap site on (a) May 2005, and (b) September 2021.

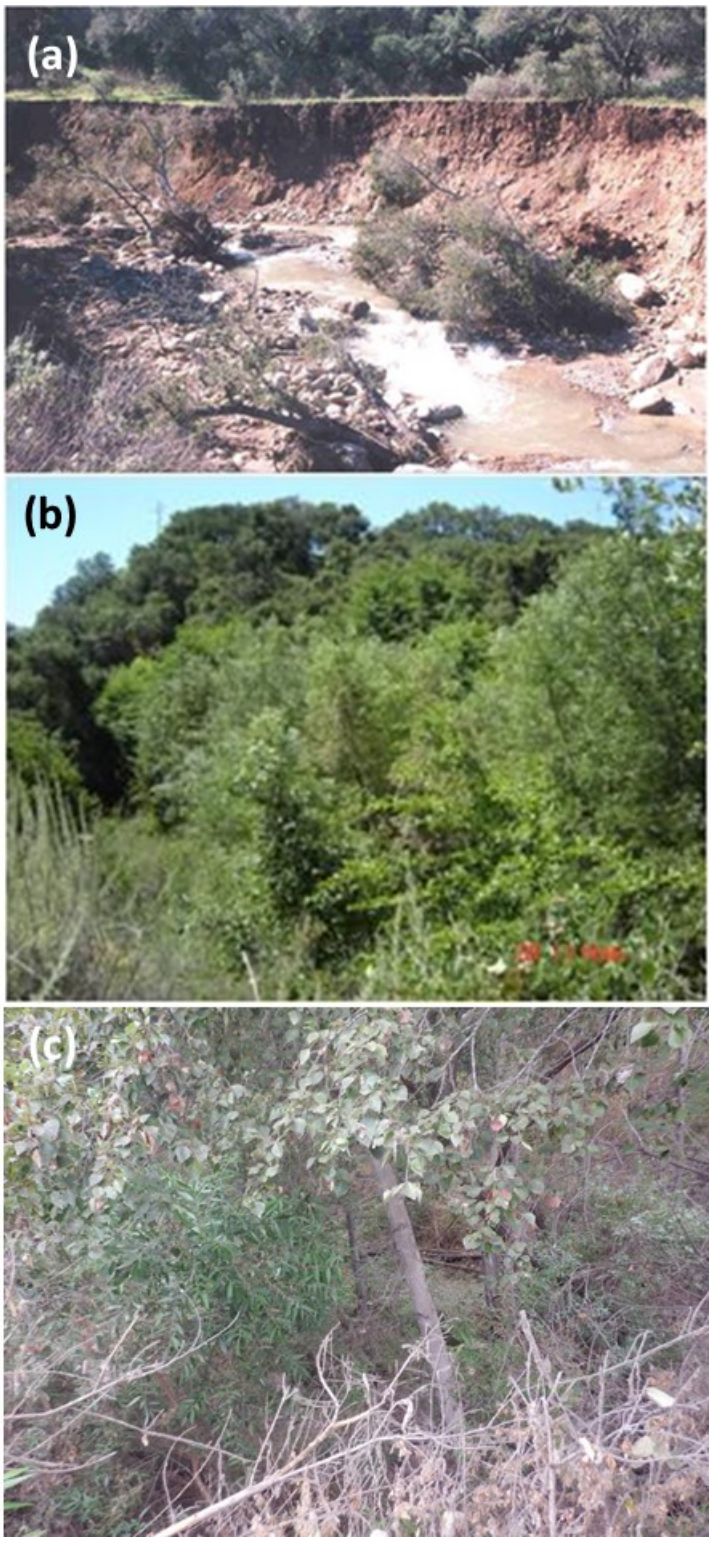

Figure 64: Photo point (T-6) collected at the Hilton Creek ridge trail looking upstream in (a) March 1999, (b) May 2005, and (c) September 2021; the creek is nearly invisible now from this vantage point.

Figure 65: Photo point (T-28) collected at Salsipuedes Creek at Santa Rosa Bridge in (a) May 2005 and (b) September 2021.

Figure 66: Photo point (T-39) collected at Salsipuedes Creek at Hwy 1 Bridge in May 2005 and (b) September 2021 (Post CalTrans Hwy 1 Bridge Replacement Project).

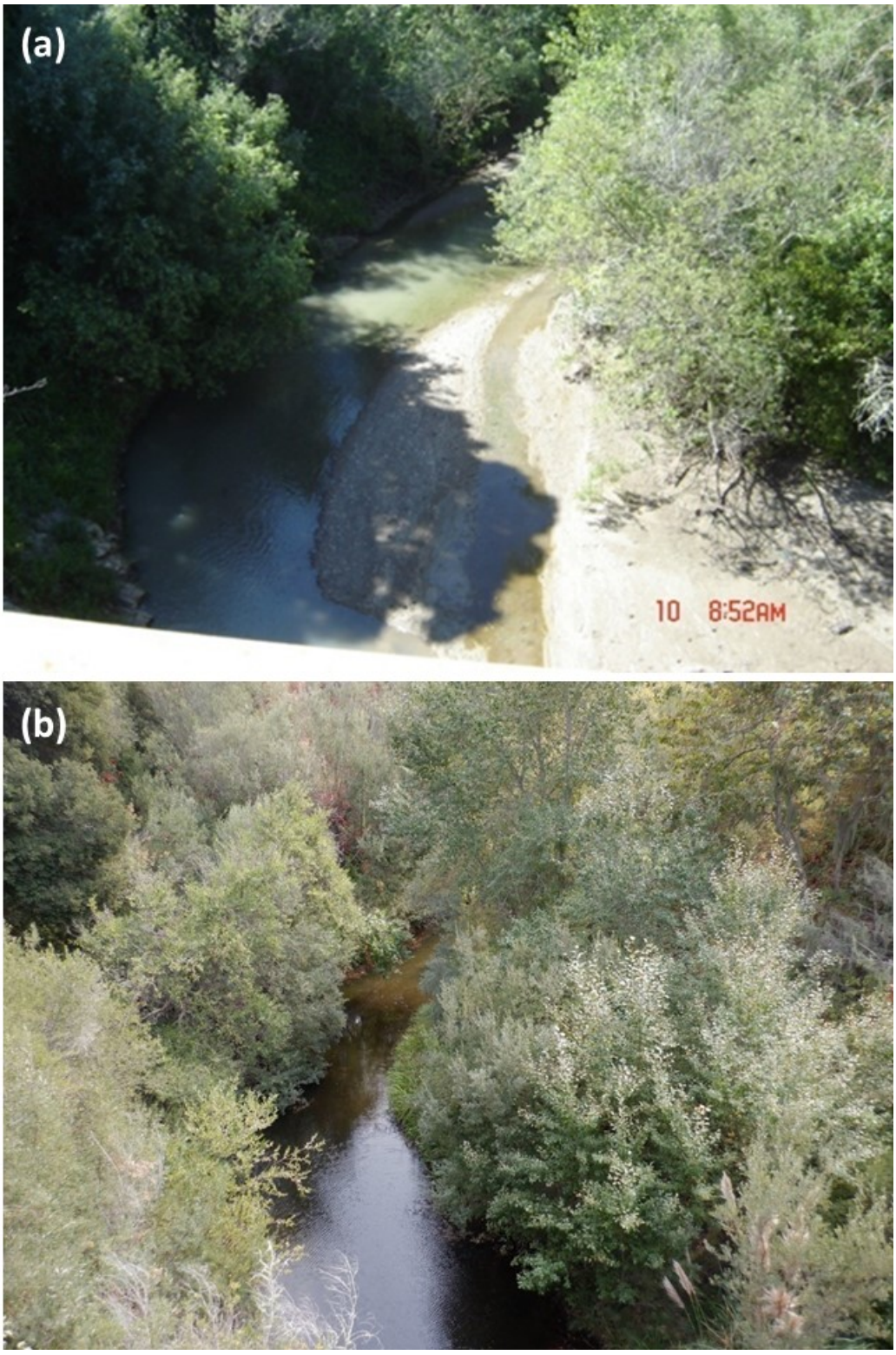

Figure 67: Photo point (T-42) collected at Salsipuedes Creek at Jalama Road Bridge in May 2005 and (b) September 2021.

3.4 Migrant Trapping

Table 7: WY2021 migrant trap deployments.

Location	Date Traps Deployed	Date Trap Removed	Date Traps Removed (take limit)	Date Traps Installed (take limit)	# of Days Not Trapping	Functional Trapping Days	Functional Trapping %
	(dates)	(dates)	(dates)	(dates)	(days)	(days)	(days)
Hilton u/s Trap	2/1/2021	4/6/2021					
	Total:	65		**Total:**	0	65	100%
Hilton d/s Trap	2/1/2021	4/6/21	3/16/2021	3/22/2021	6		
			3/25/2021	3/30/2021	5		
	Total:	65			11	54	83%
Salsipuedes	2/1/2021	4/6/2021					
	Total:	65		**Total:**	0	65	100%
Mainstem	No trapping conducted						
	Total:			**Total:**	0	0	

Table 8: WY2021 *O. mykiss* Catch Per Unit Effort (CPUE) for each trapping location.

Location	Upstream Captures	Downstream Captures	Functional Trap Days	Trap Season	Trapping Effeciency	CPUE Upstream	CPUE Downstream	CPUE (Total)	Avg Flow	Median Flow
	(#)	(#)	(days)	(days)	(%)	(Captures/day)	(Captures/day)	(Captures/day)	(cfs)	(cfs)
Hilton UP	86	~	65	65	100.0	1.32	~	1.32	6.3	5.0
Hilton DN	~	101	54	65	0.83	~	1.87	1.87	6.1	5.1
Salsipuedes	1	17	65	65	100.0	0.02	0.26	0.28	17.5	2.2

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 WY2021.

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	28	9	11	38	86
	Downstream	9	4	37	51	101
	Total:	37	13	48	89	187
Salsipuedes	Upstream	0	0	1	0	1
	Downstream	5	1	0	11	17
	Total:	5	1	1	11	18
Mainstem	Upstream	0	0	0	0	0
	Downstream	0	0	0	0	0
	Total:	0	0	0	0	0

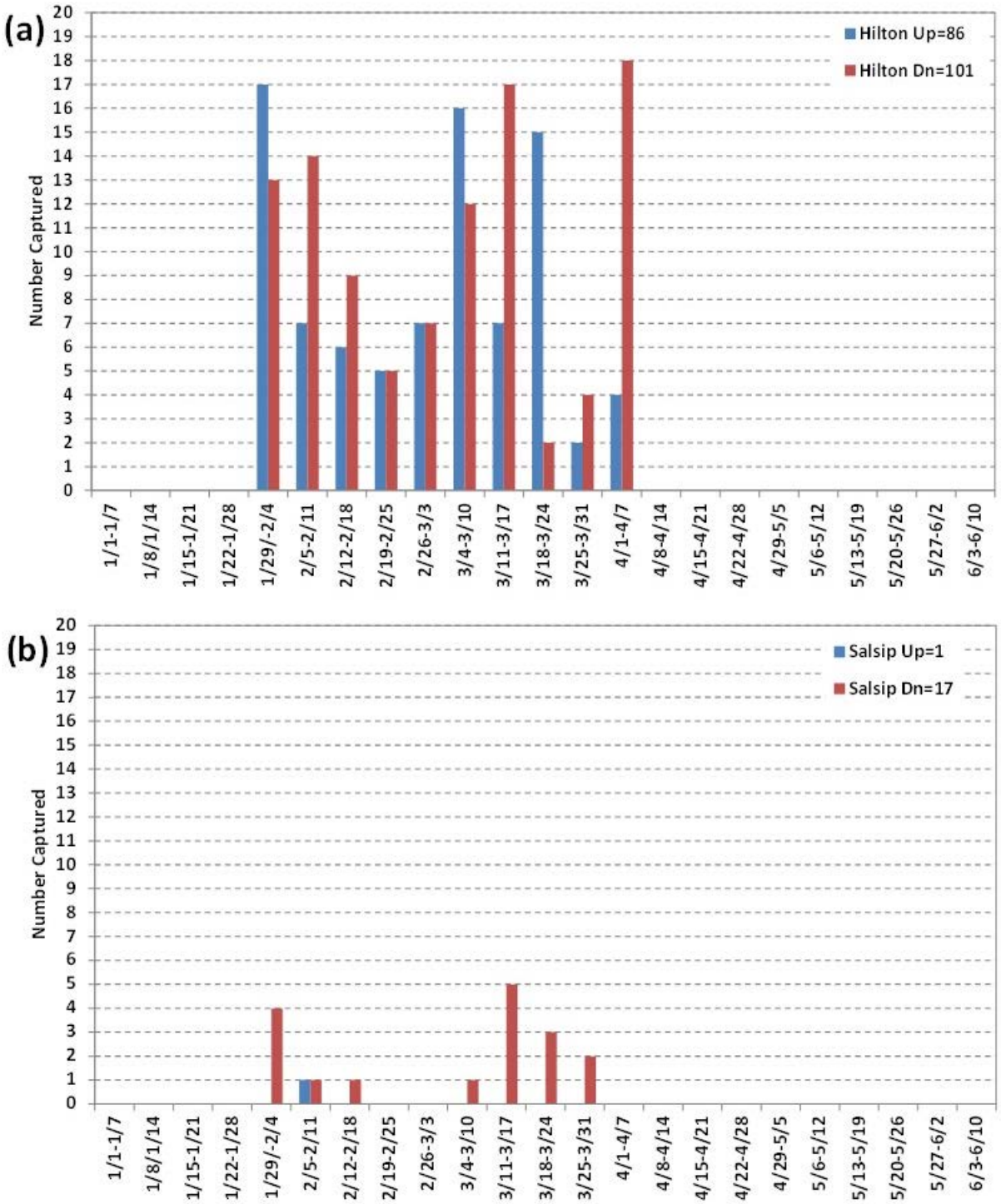

Figure 68: WY2021 paired histogram of weekly upstream and downstream *O. mykiss* captures by trap site for (a) Hilton Creek and (b) Salsipuedes Creek.

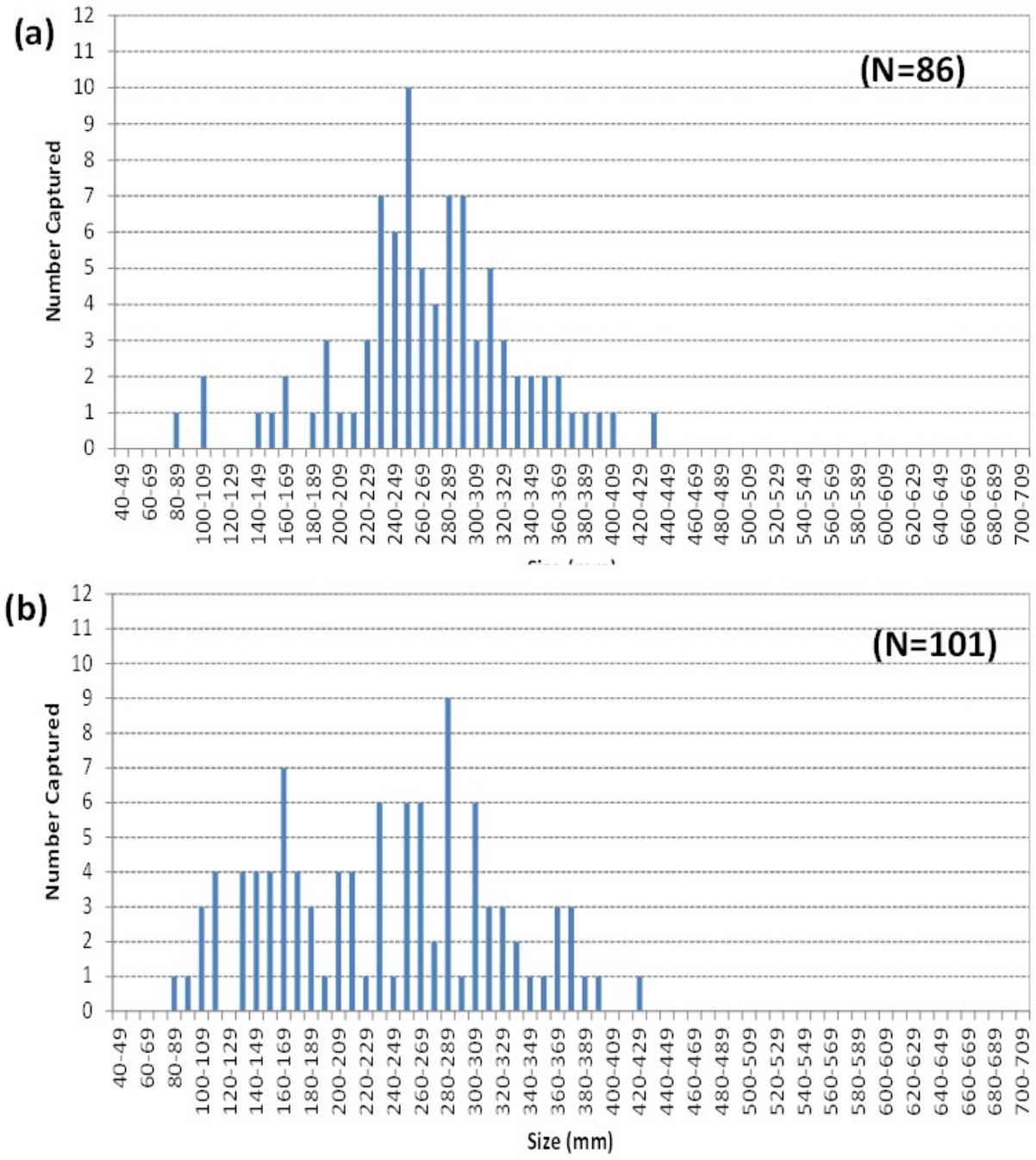

Figure 69: WY2021 Hilton Creek trap length-frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* migrant captures.

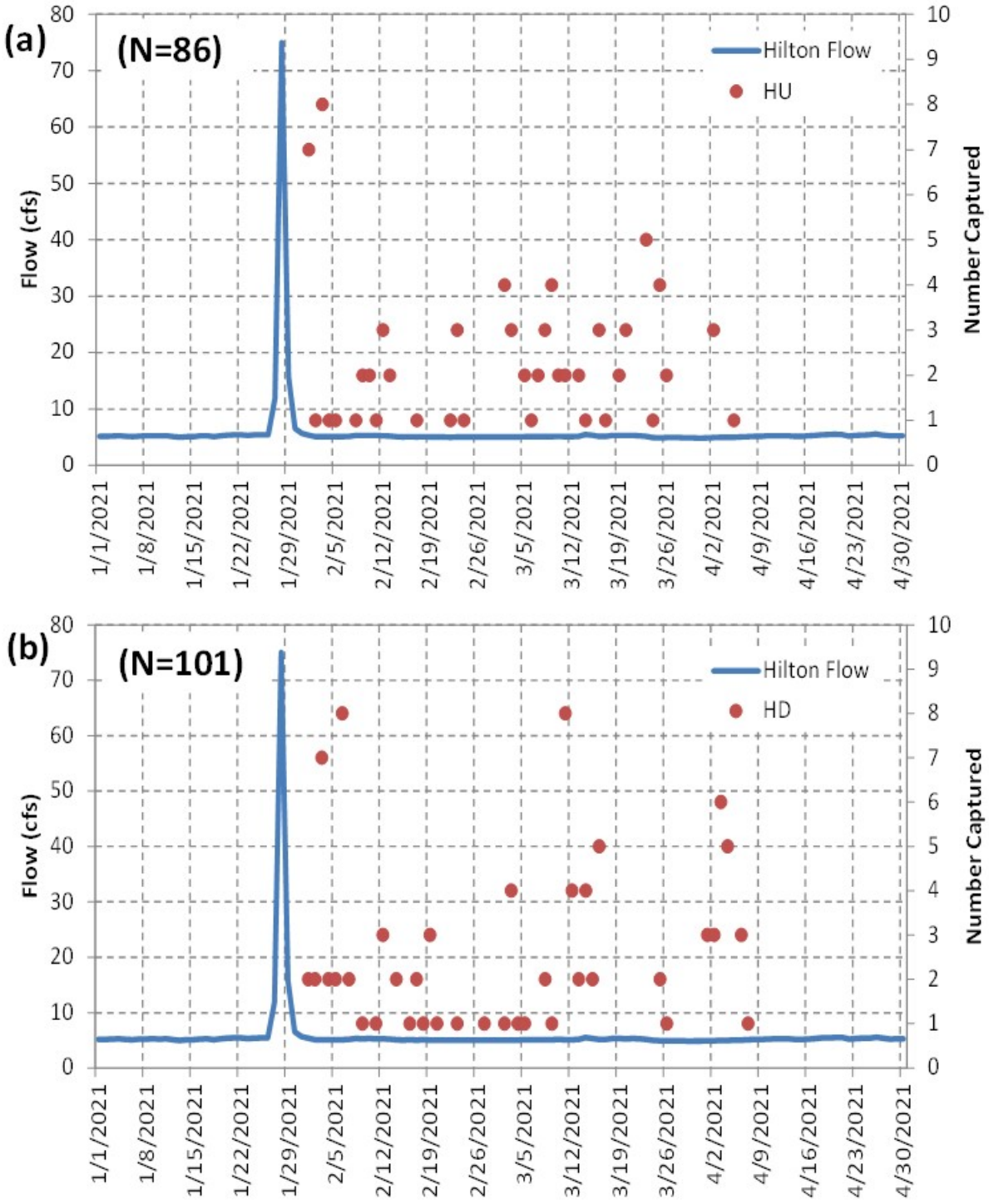

Figure 70: WY2021 Hilton Creek *O. mykiss* migrant captures (red dots) vs. flow for (a) upstream migrant captures and (b) downstream migrant captures.

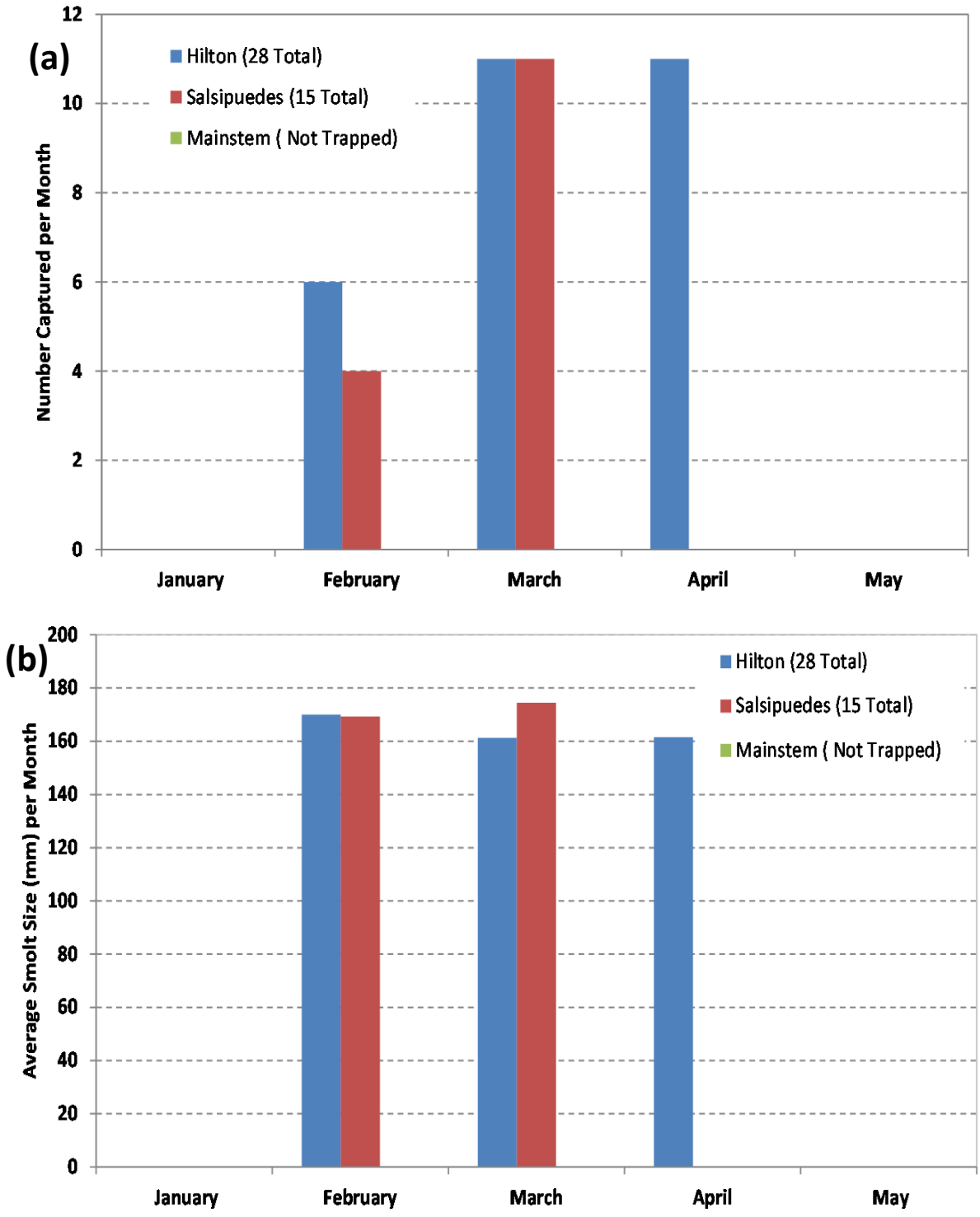

Figure 71: Monthly *O. mykiss* smolts captured at the Hilton Creek, Salsipuedes Creek, and LSYR mainstem traps in WY2021 showing: (a) number of smolts captured and (b) average size of smolts captured at each site by month.

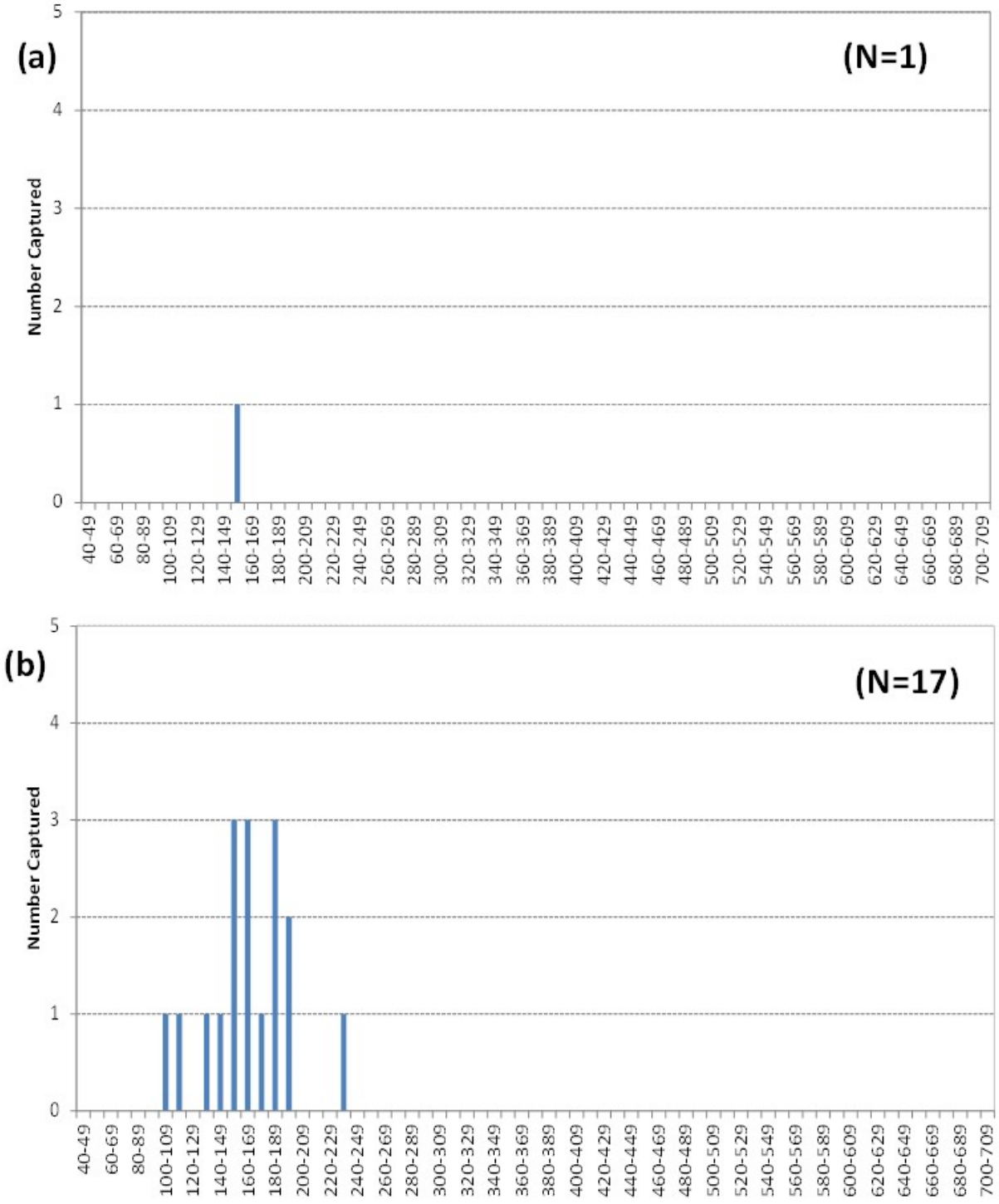

Figure 72: WY2021 Salsipuedes Creek trap length frequency histogram in 10-millimeter intervals for (a) upstream and (b) downstream *O. mykiss* captures.

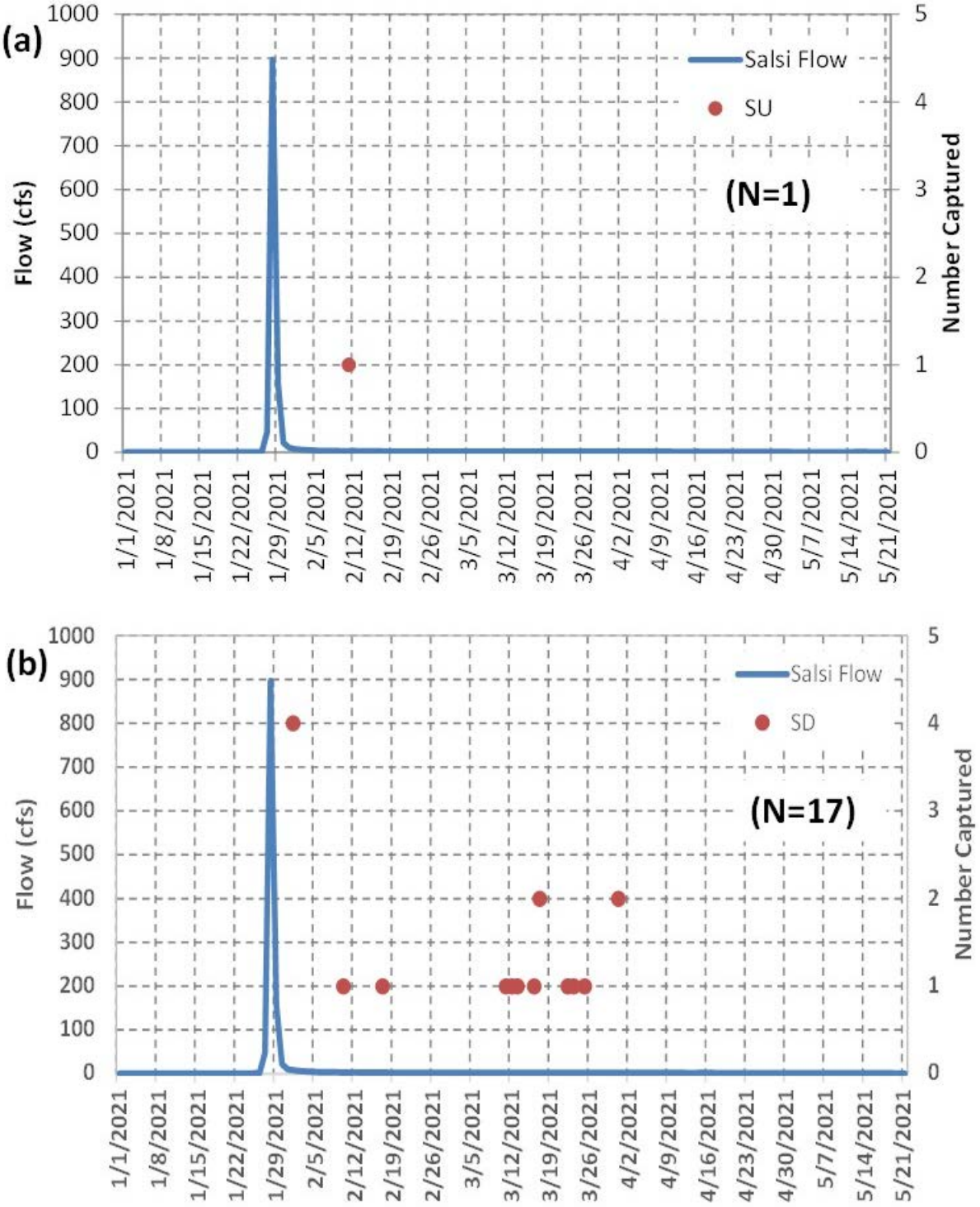

Figure 73: WY2021 Salsipuedes Creek *O. mykiss* migrant captures (red dots) vs. flow for (a) upstream migrants and (b) downstream migrants.

Table 10: Tributary upstream and downstream *O. mykiss* migrant captures for Hilton Creek and Salsipuedes Creek and the Santa Ynez River mainstem in WY2021; 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
2		400-449		0
22		300-399		0
51		200-299		0
10		100-199		1
1		<99		0
86		**Total**		**1**
		Downstream Traps		
0		>700		0
0		650-699		0
0		600-649		0
0		550-599		0
0		500-549		0
0		450-499		0
1		400-449		0
24		300-399		0
40		200-299		1
	2	***Smolts***	***0***	
	1	***Pre-Smolt***	***1***	
	37	***Res***	***0***	
34		100-199		16
	12	***Smolts***	***10***	
	13	***Pre-Smolt***	***5***	
	9	***Res***	***1***	
2		<99		0
	0	***Smolts***	***0***	
	0	***Pre-Smolt***	***0***	
	2	***Res***	***0***	
101		**Total**		**17**

Table 11: The results of WY2021 scale analyses of *O. mykiss* migrant captures and carcasses 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											
130-139	***			3							
140-149	*****			5							
150-159	*******			7							
160-169	**********			10							
170-179	******			6							
180-189	*******			3	1	3					
190-199	****			1	3						
200-209	****				1	3					
210-219	****				2	2					
220-229	****					4					
230-239	*********					8		1			
240-249	*****					5					
250-259	**********					6	3	1			
260-269	********				1	5	2				
270-279	****					2		1		1	
280-289	********					7		1			
290-299	****					2	1	1			
300-309	*******					3	2	2			
310-319	********						3	5			
320-329	****						2	2			
330-339	***						2	1			
340-349											
350-359	*						1				
360-369	*								1		
370-379											
380-389	**							1	1		
390-399	**								2		
400-409											
410-419											
420-429	*									1	
Total:	**132**	**1**	**0**	**35**	**8**	**50**	**16**	**16**	**4**	**2**	**0**

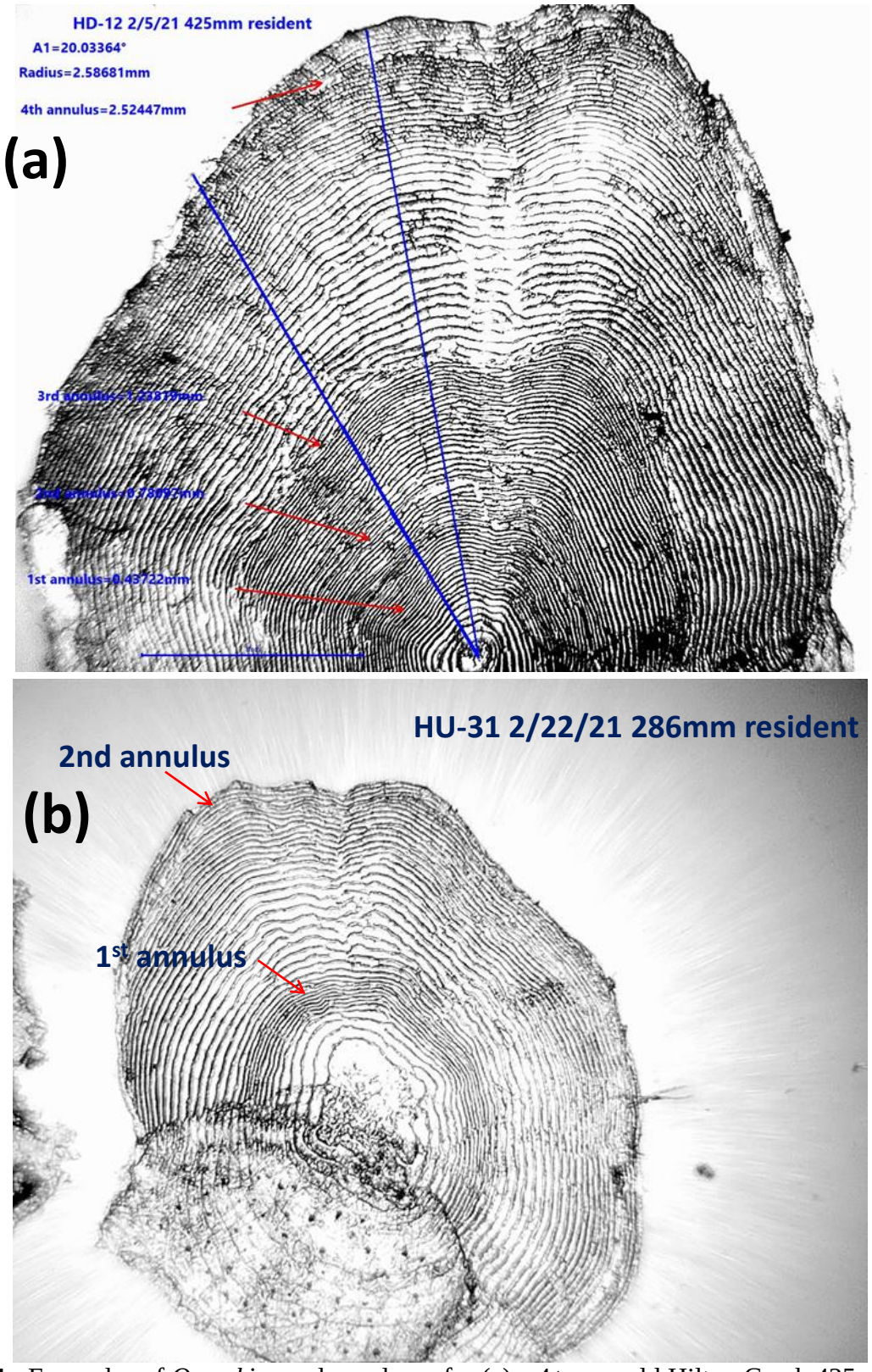

Figure 74: Examples of *O. mykiss* scale analyses for (a) a 4+ year old Hilton Creek 425 mm downstream migrating resident fish, and (b) and a 2+ year old Hilton Creek 286 mm upstream migrating resident fish.

Table 12: WY2021 *O. mykiss* redd survey results for the tributaries and LYSR mainstem; 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**
Hilton Creek	1/14/2021	1	2.7	1.1
	1/14/2021	2	3.9	1.1
	1/21/2021	3	3.8	1.3
	1/21/2021	4	2.7	1.2
	1/21/2021	5	4.7	2.1
	2/2/2021	6	3.5	1.7
	2/3/2021	7	2.8	1.2
	2/3/2021	8	4.2	1.7
	2/3/2021	9	3.9	1.8
	2/3/2021	10	2.7	1.5
	2/17/2021	11	3.1	1.2
	2/17/2021	12	5.6	2.2
	2/17/2021	13	3.8	1.7
	2/17/2021	14	4.5	2.3
	2/17/2021	15	4.2	1.9
	2/17/2021	16	5.3	2.6
	2/17/2021	17	2.6	1.9
	2/17/2021	18	2.6	1.4
	2/17/2021	19	2.4	1.2
	2/17/2021	20	2.9	1.2
	2/17/2021	21	3.7	2.4
	2/17/2021	22	4.8	2.4
	2/17/2021	23	3.1	1.5
	2/17/2021	24	4.5	2.0
	2/17/2021	25	3.9	1.9
	2/17/2021	26	4.1	1.3
	2/17/2021	27	3.8	1.8
	2/17/2021	28	2.7	1.5
	3/8/2021	29	2.6	1.1
	3/8/2021	30	3.6	1.4
	3/8/2021	31	3.5	1.8
	3/8/2021	32	3.5	1.7
	3/8/2021	33	2.2	1.5
	3/8/2021	34	2.3	1.0
	3/8/2021	35	3.1	1.3
	3/8/2021	36	2.5	1.1
	3/8/2021	37	3.4	1.7
	3/22/2021	38	3.1	1.4
	3/22/2021	39	3.8	2.1
	3/22/2021	40	3.7	1.7
	3/22/2021	41	4.1	2.0
	3/22/2021	42	4.3	1.9
	3/22/2021	43	2.6	1.1
	3/24/2021	44	3.0	1.6
	3/24/2021	45	4.1	2.1
	3/24/2021	46	3.1	1.5
	4/14/2021	47	2.6	1.1
	4/14/2021	48	3.5	1.6
Salsipuedes Creek	3/30/2021	49	2.4	0.9
	3/30/2021	50	3.8	1.4
	3/30/2021	51	2.2	0.9
	3/30/2021	52	4.8	2.2
	4/13/2021	53	3.6	1.6
	4/13/2021	54	2.9	1.4
	4/13/2021	55	6.3	2.9
El Jaro Creek	2/11/2021	56	2.7	1.2
	3/4/2021	57	5.0	2.7
	3/4/2021	58	5.6	2.2
	3/4/2021	59	2.7	1.2
Quiota Creek	4/19/2021	60	1.4	0.8
	4/19/2021	61	1.8	1.2
LSYR Refugio Reach	2/9/2021	62	3.4	1.3
	2/9/2021	63	2.7	1.2
	2/9/2021	64	3.5	1.0
LSYR Narrows Reach	3/16/2021	65	9.5	2.6
	3/23/2021	66	9.5	2.2

* Pit length plus tailspill length.

** Average of pit width and tailspill widths.

Table 13: WY2021 tributary redd observations by month for each creek surveyed.

	January	February	March	April	May	Total
Hilton Ck	5	23	18	2	n/s	48
Quiota Ck	0	0	0	2	n/s	2
Salsipuedes Ck	0	0	4	3	n/s	7
El Jaro Ck	0	1	3	0	n/s	4
Los Amoles CK	n/s	0	0	0	n/s	0
Ytias Ck	n/s	n/s	n/s	n/s	n/s	n/s
					Total:	**61**
n/s - not surveyed due to trubid conditions or low water level.						

Table 14: WY2021 LSYR mainstem redd survey results within the management reaches (Refugio and Alisal reaches) by month.

	January	February	March	April	May	Total
Highway 154	0	0	0	0	0	0
Refugio Reach	n/s	n/s	3	0	0	3
Alisal Reach	n/s	n/s	n/s	n/s	n/s	n/s
Narrows Reach	n/s	n/s	2	0	0	2
					Total:	**5**
n/s - not surveyed due to trubid conditions or low water level.						

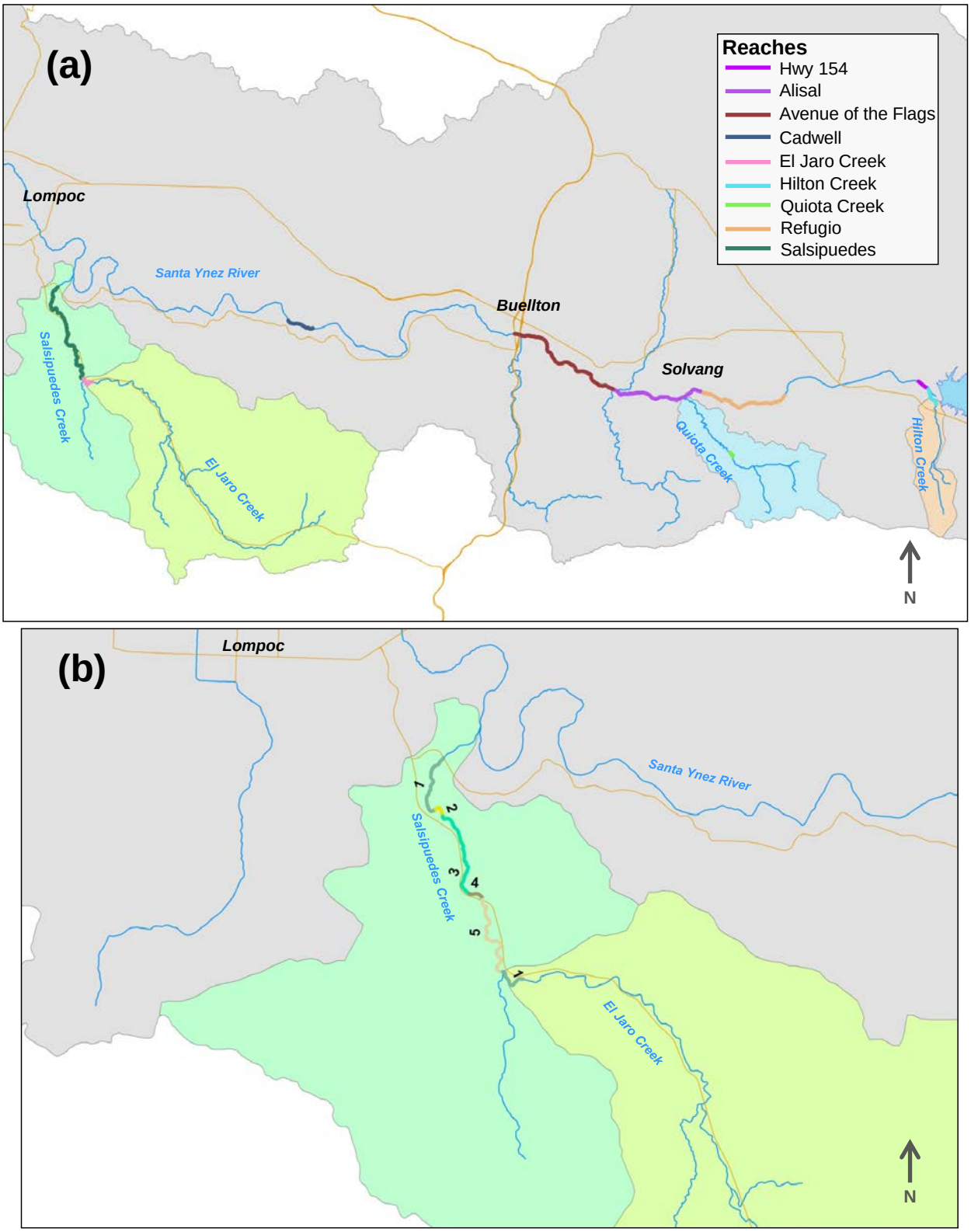

Figure 75: Stream reaches snorkel surveyed in 2021 with suitable habitat and where access was granted within the (a) LSYR mainstem and its tributaries, and (b) Salsipuedes Creek.

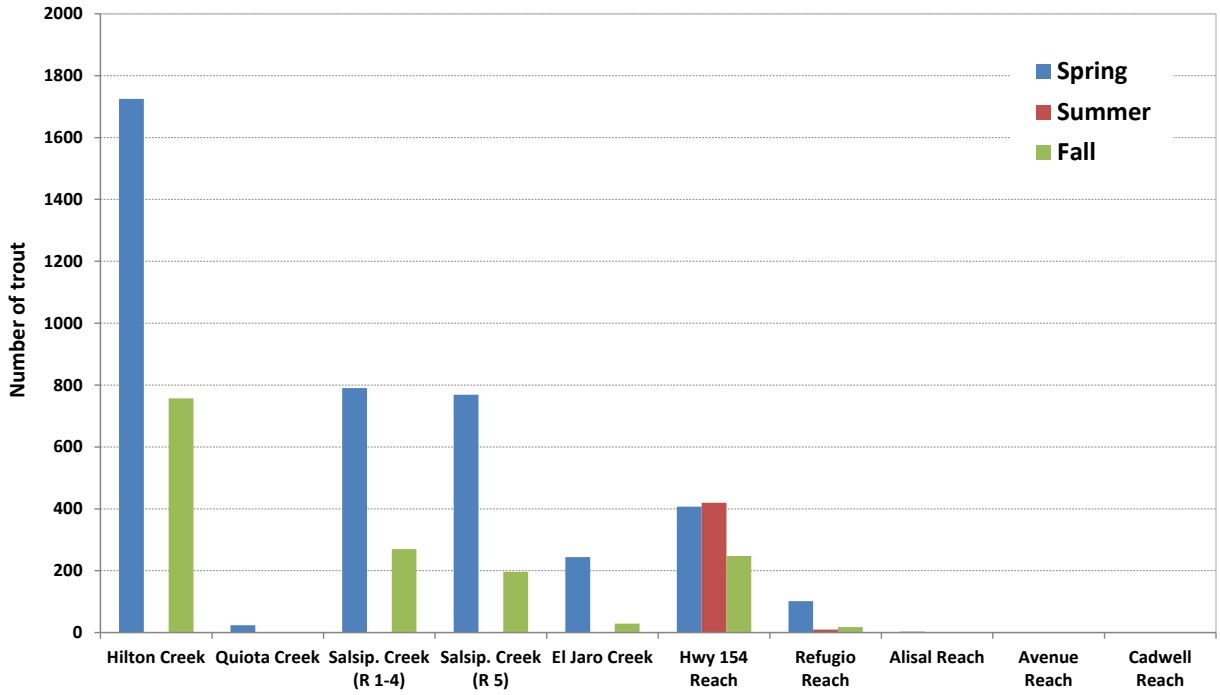

Figure 76: 2021 LSYR *O. mykiss* observed during spring, summer, and fall snorkel surveys.

Table 15: 2021 LSYR mainstem snorkel survey schedule.

Mainstem/Stream Miles	Season	Survey Date
Hwy 154 Reach	Spring	5/13/21 - 5/27/21
(LSYR-0.2 to LSYR-0.7)	Summer	7/28/2021
	Fall	11/15/21 - 11/17/21
Refugio Reach	Spring	4/27/21 - 5/19/21
(LSYR-4.9 to LSYR-7.8)	Summer	9/1/21 - 9/2/21
	Fall	10/27/21 - 11/1/21
Alisal Reach	Spring	4/22/21 - 5/27/21
(LSYR-7.8 to LSYR-10.5)	Summer	9/8/21 - 9/9/21
	Fall	11/1/21 - 11/2/21
Avenue Reach	Spring	4/22/21 - 6/2/21
(LSYR-10.5 to LSYR-13.9)	Summer	9/10/21 & 9/13/21
	Fall	11/8/21 - 11/10/21
Reach 3 Downstream of Avenue	Spring	5/4/21 - 6/1/21
(LSYR-13.9 to LSYR-25.0)	Summer	9/13/21 - 9/14/21
	Fall	11/10/21 & 11/15/21

Table 16: LSYR mainstem spring, summer, and fall snorkel survey results in 2021 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	407	420	248	0.26
Refugio Reach	102	10	18	2.95
Alisal Reach	3	1	1	2.80
Avenue of the Flags Reach	0	0	0	3.4
Cadwell Reach	0	0	0	0.3

Table 17: LSYR mainstem spring, summer, and fall snorkel survey results in 2021 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	333	24	30	13	5	2				407
	Refugio	82	1	4	9	3	2	1			102
	Alisal				1		2				3
	Avenue										0
	Cadwell										0
Summer	Hwy 154	217	158	37	8						420
	Refugio				2	3	3	2			10
	Alisal							1			1
	Avenue										0
	Cadwell										0
Fall	Hwy 154		120	111	16		1				248
	Refugio			8	4	5		1			18
	Alisal						1				1
	Avenue										0
	Cadwell										0

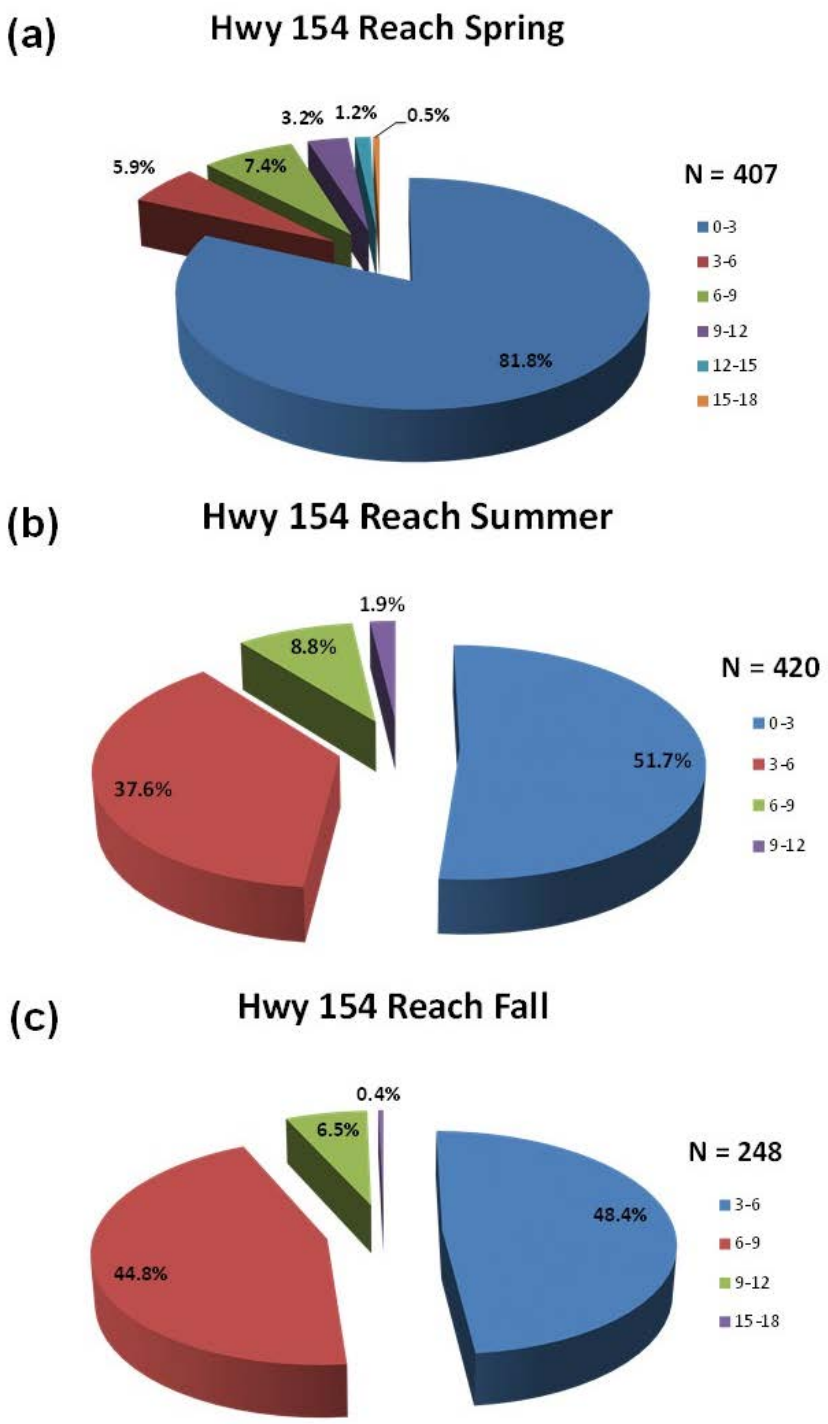

Figure 77: 2021 LSYR mainstem Hwy 154 Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, (b) summer, and (c) fall.

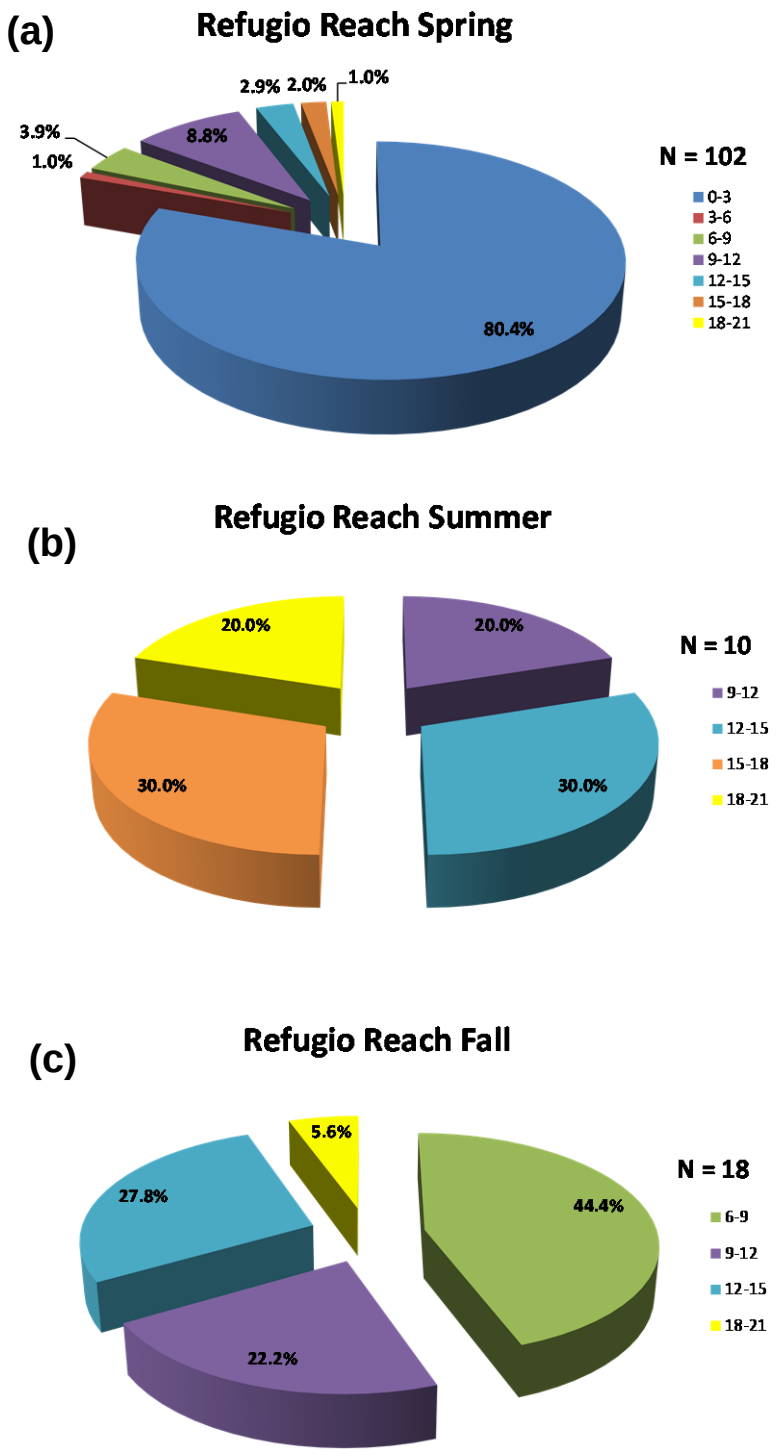

Figure 78: 2021 LSYR mainstem Refugio Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, (b) summer, and (c) fall.

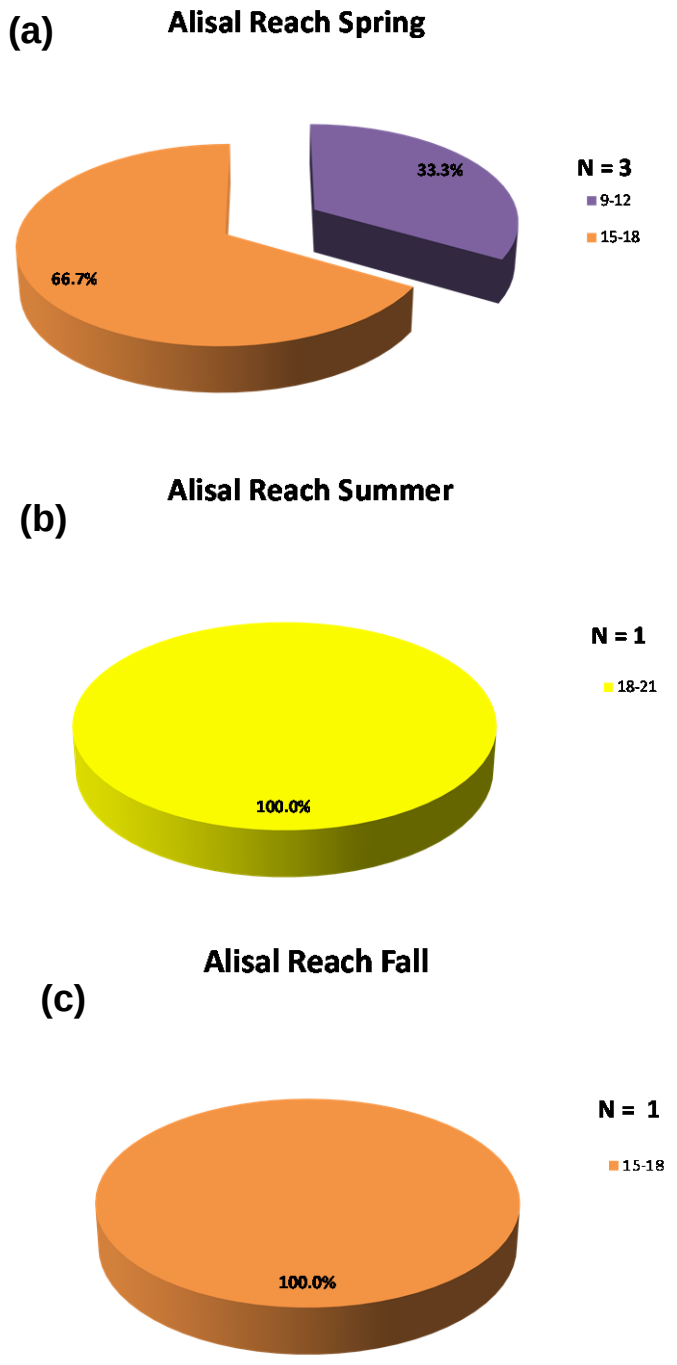

Figure 79: 2021 LSYR mainstem Alisal Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, (b) summer, and (c) fall.

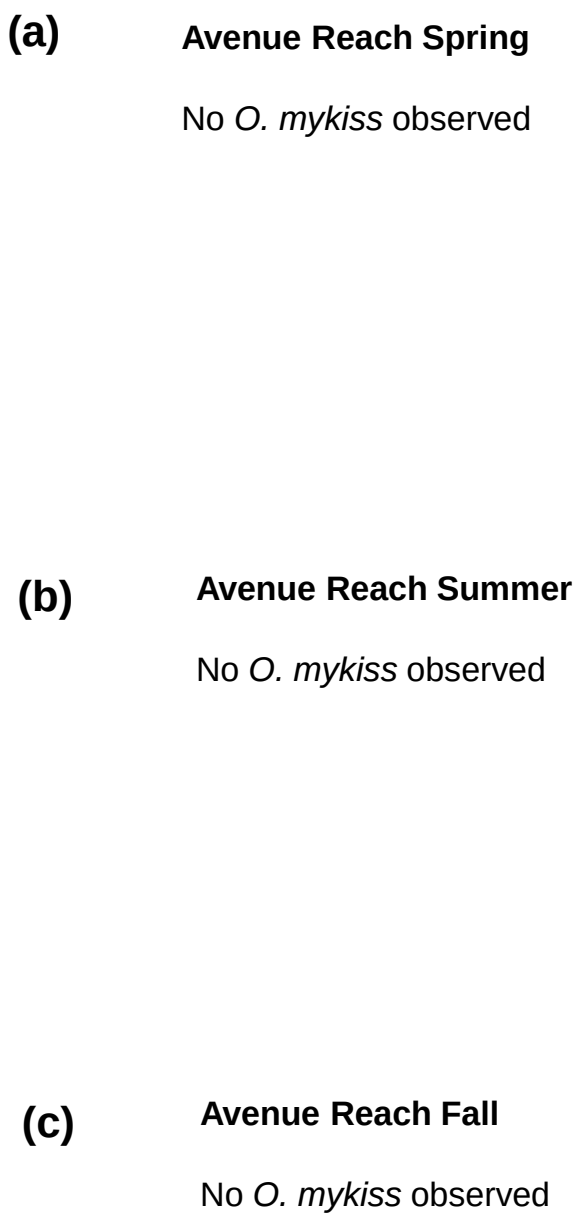

Figure 80: 2021 LSYR mainstem Avenue of the Flags Reach snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, (b) summer, and (c) fall.

Table 18: 2021 tributary snorkel survey schedule; no summer surveys were conducted in 2020.

Tributaries/Stream Miles	Season	Survey Date
Hilton Creek	Spring	7/9/21- 7/12/21
(HC-0.0 to HC-0.54)	Summer	n/s
	Fall	10/13/21 - 10/14/21
Quiota Creek	Spring	7/1/2021
(QC-2.58 to QC-2.73)	Summer	n/s
	Fall	9/28/2021
Salsipuedes Creek	Spring	6/15/21 - 6/22/21
(Reach 1-4)	Summer	n/s
	Fall	9/29/21 - 10/5/21
Salsipuedes Creek	Spring	6/22/21 - 6/23/21
(Reach 5)	Summer	n/s
	Fall	10/5/21 & 10/21/21
El Jaro Creek	Spring	6/23/21
(ELC-0.0 to ELC-0.4)	Summer	n/s
	Fall	10/21/21
*n/s - not surveyed.		

Table 19: *O. mykiss* observed and miles surveyed during all tributary snorkel surveys in 2021; 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	776		222	0.133
Reach 2	203		110	0.050
Reach 3	105		70	0.040
Reach 4	203		104	0.075
Reach 5	438		251	0.242
Reach 6	0		0	0.014
Total:	***1725***		***757***	***0.554***
Quiota Creek	24		0	0.11
Salsipuedes Creek (Reach 1-4)	790		270	2.85
Salsipuedes Creek (Reach 5)	769		197	0.45
El Jaro Creek	244		29	0.35

Table 20: 2021 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	1313	360	48	4						1725
	Quiota	22		2							24
	Salsipuedes (R 1-4)	730	40	11	9						790
	Salsipuedes (R-5)	655	87	7	17	3					769
	El Jaro	199	43	1	1						244
Summer	Hilton										n/s
	Quiota										n/s
	Salsipuedes (R 1-4)										n/s
	Salsipuedes (R-5)										n/s
	El Jaro										n/s
Fall	Hilton	313	403	37	4						757
	Quiota										0
	Salsipuedes (R 1-4)	116	134	16	4						270
	Salsipuedes (R-5)	127	60	10							197
	El Jaro	6	22	1							29

n/s - not surveyed.

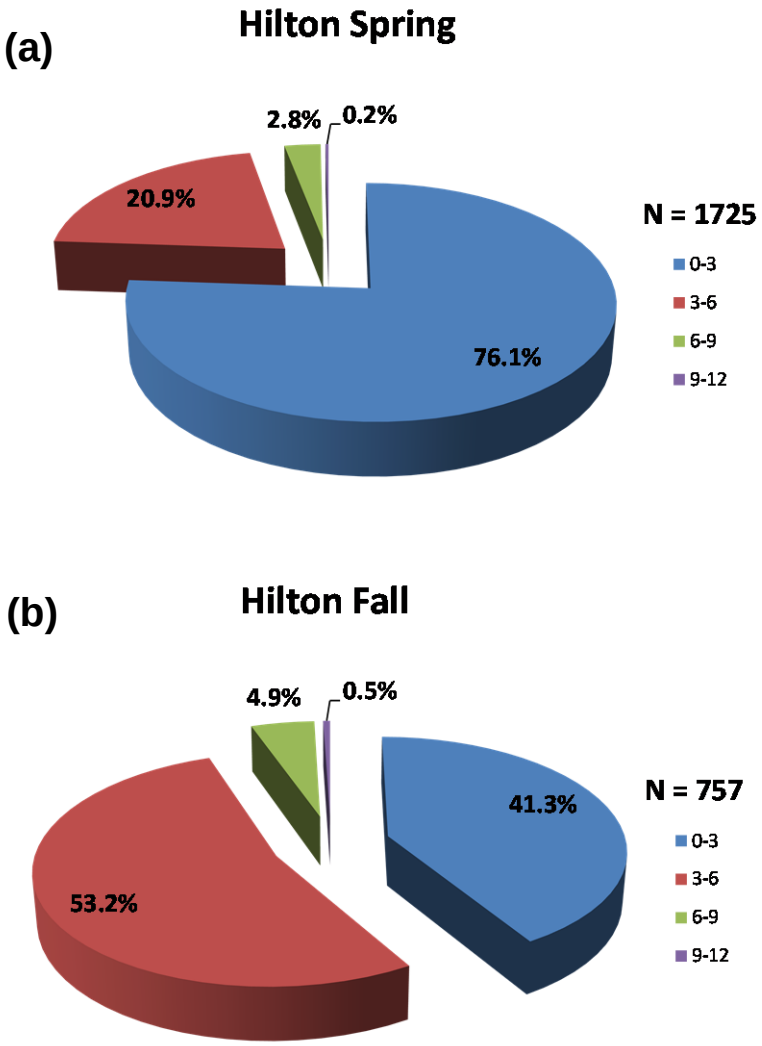

Figure 81: 2021 Hilton Creek snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, and (b) fall.

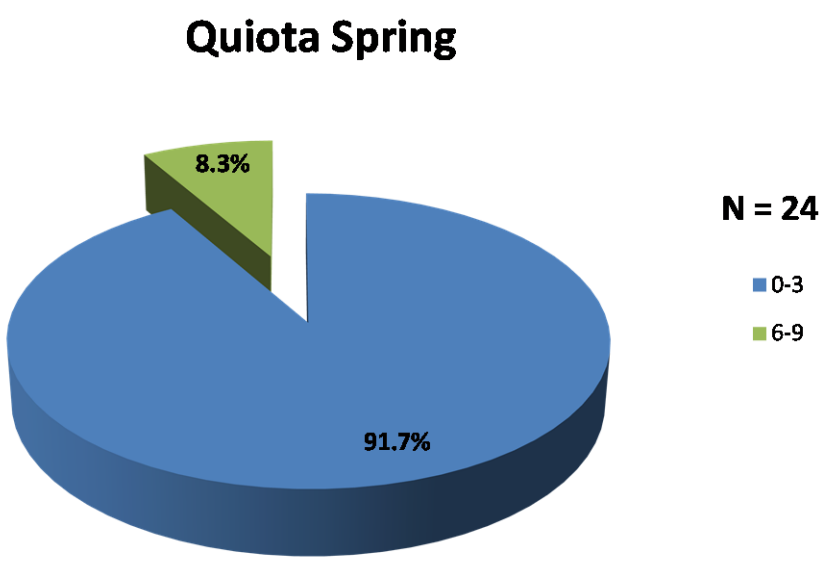

Figure 82: 2021 Quiota Creek snorkel survey results of *O. mykiss* proportioned by size class in inches; no *O. mykiss* were observed during the fall snorkel survey.

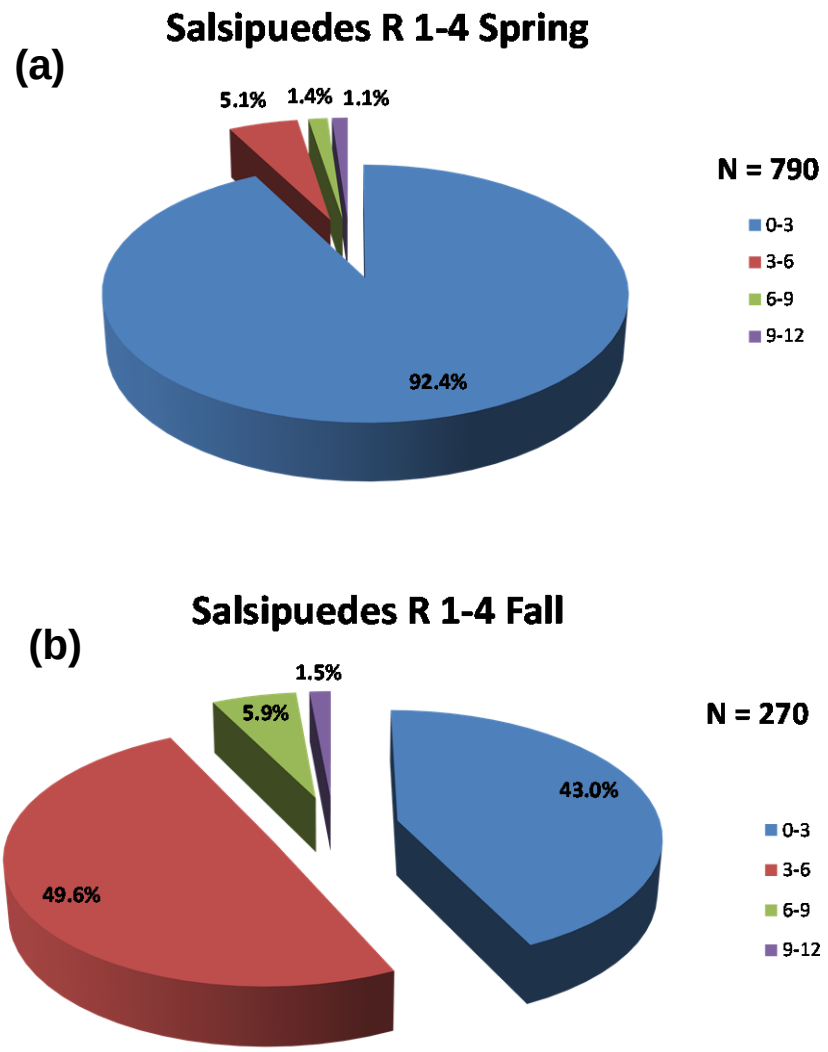

Figure 83: 2021 Salsipuedes Creek Reaches 1-4 snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, and (b) fall.

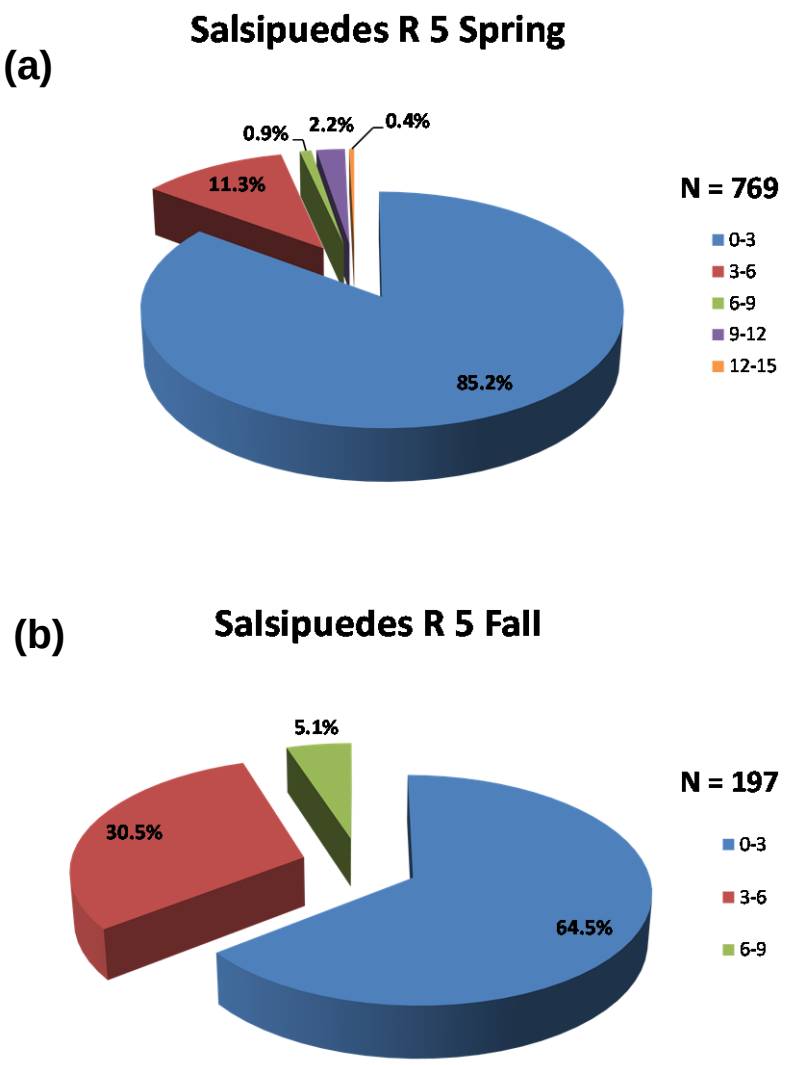

Figure 84: 2021 Salsipuedes Creek Reach 5 snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring, and (b) fall.

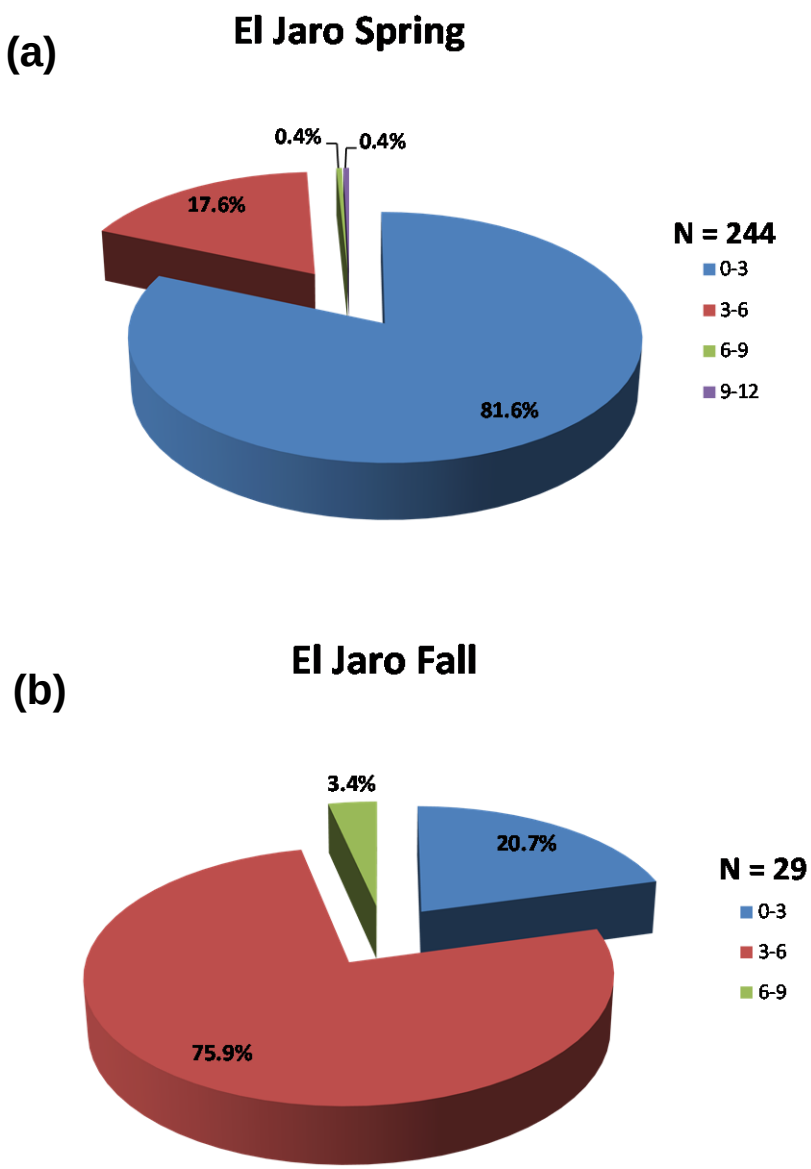

Figure 85: 2021 El Jaro Creek snorkel survey results of *O. mykiss* proportioned by size class in inches in the (a) spring and (b) fall.

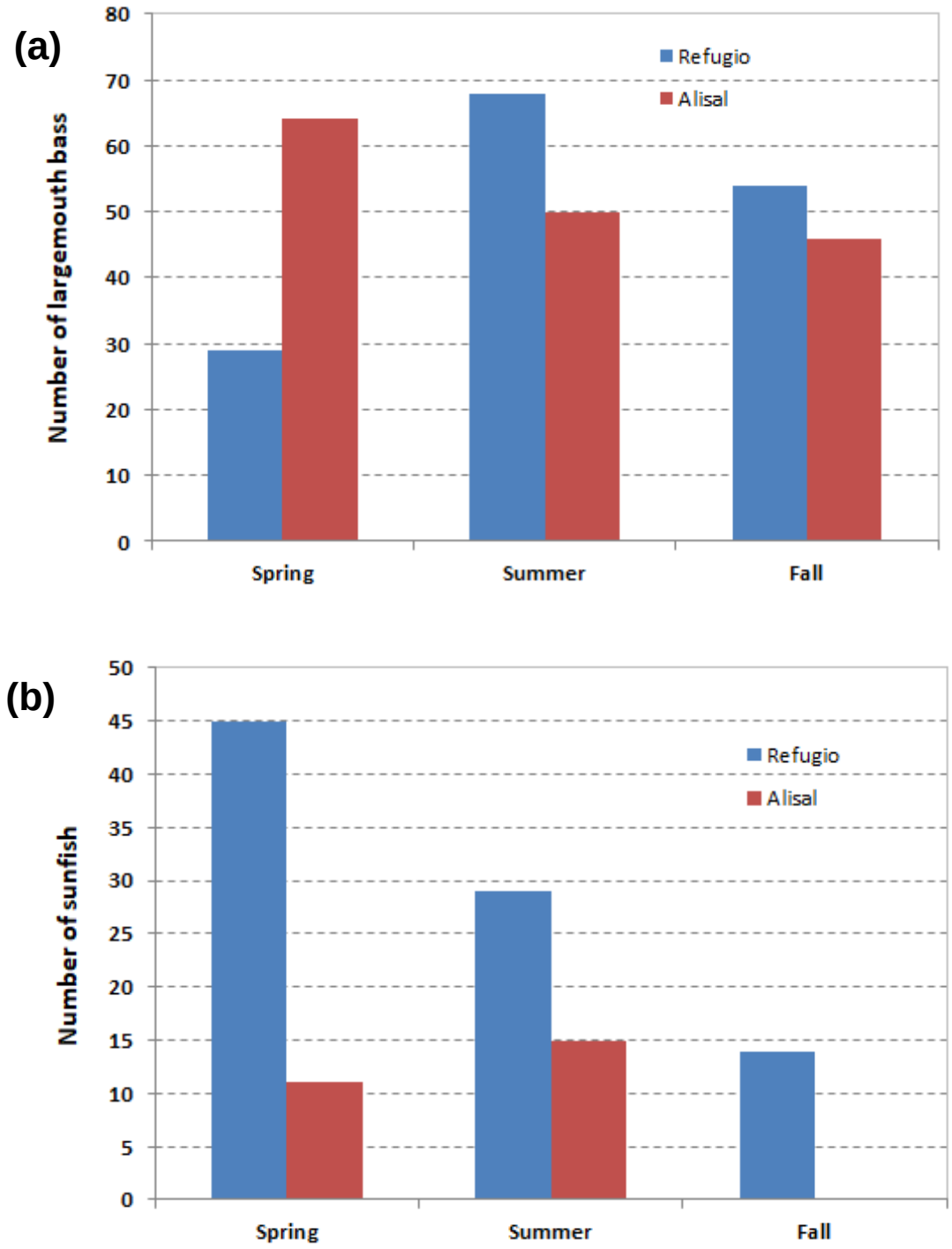

Figure 86: Count of warm water predators, (a) largemouth bass and (b) sunfish, observed in Refugio and Alisal reaches during the spring, summer, and fall snorkel surveys in 2021.

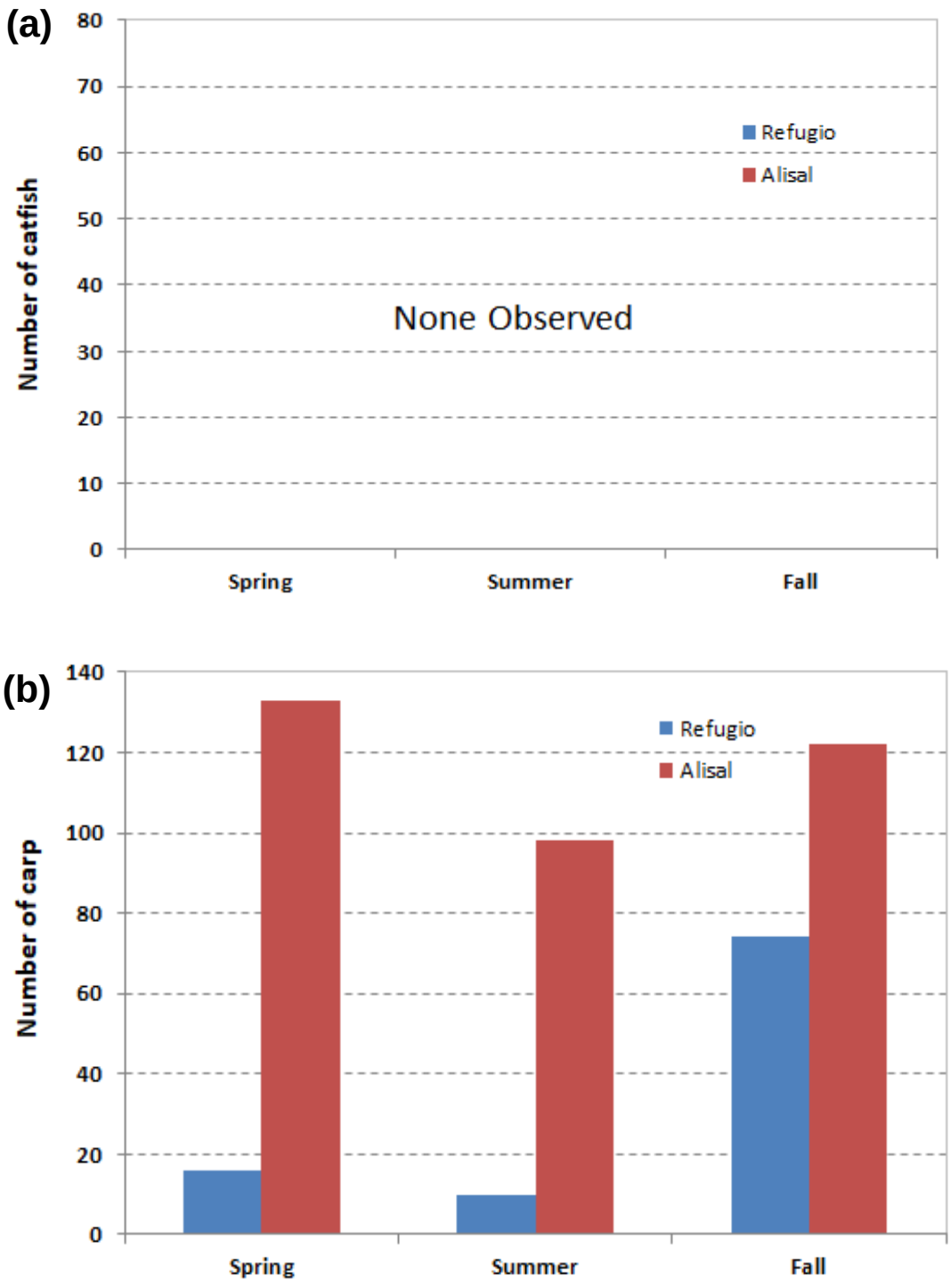

Figure 87: Count of warm water predators, (a) catfish and (b) carp, observed in Refugio and Alisal reaches during the spring, summer, and fall snorkel surveys in 2021.

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
WY2021	73	7	0	80

*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
WY2021	11	0	0	11

-Indicates limited attribute data taken at each dam site.

Figure 88: Spatial extent of beaver dams from the WY2021 survey within the LSYR drainage where 80 dams (73 active) were observed in the mainstem and two dams observed in the Salsipuedes/El Jaro Creek watershed.

Table 21: Annual count of WY2010 - WY2021 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
WY2021	10	31	35	4	0	80	6	4	1	0	0	11
* 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-WY2021.

Month	Water Years:																					
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
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	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	0.31
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	2.00
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	8.39
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	0.10
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	1.02
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	0.02
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	0.00
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	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	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	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	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**	**11.84**

Table 23: Monthly average stream discharge at the USGS Solvang and Narrows gauges during WY2001-WY2021 (yellow indicates still not available on the USGS website as of 10/12/21).

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		WY2021	
	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)	Solvang (cfs)	Narrows (cfs)
Oct	0	0.017	0	0	38.5	22.4
Nov	0	0	0	0	24	17.5
Dec	0	0	3.88	0.135	7.82	7.92
Jan	14.4	61.7	7.48	0.043	22.8	91.6
Feb	139.9	414.5	5.39	0	15.8	45.2
Mar	68.7	208	22.8	28.9	8.1	15.9
Apr	13.3	35.7	87	114.4	2.37	4.73
May	5.79	14.6	15.7	22.2	0.224	0.676
Jun	1.91	5.21	3.42	1.13	0	0
Jul	0.653	0.875	1.8	0	0	0
Aug	0	0	0.527	0	22.6	0
Sep	0	0	77.5	20.9	9.07	0

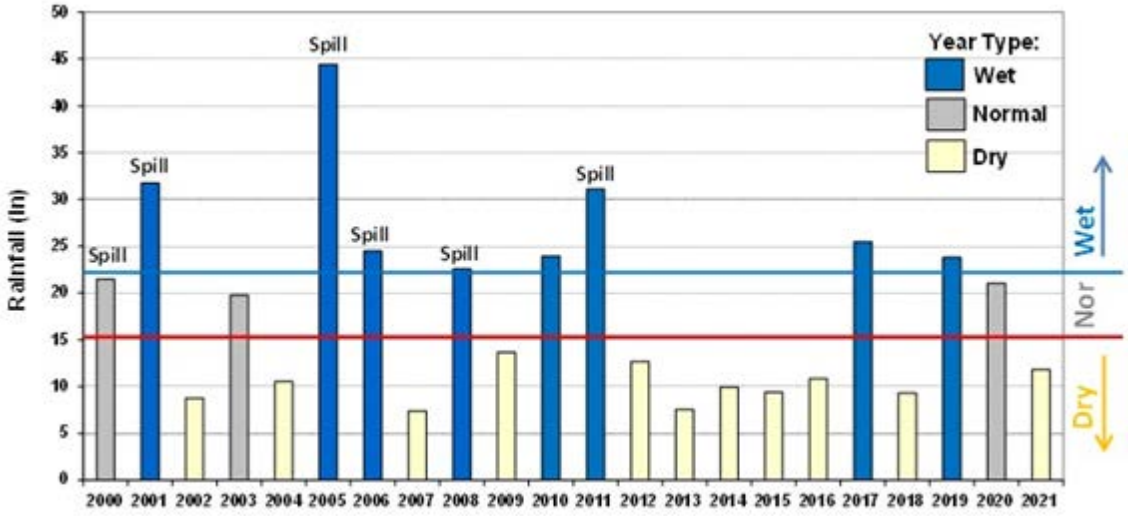

Figure 89: Water year type (wet, normal and dry) and spill years since the issuance of the BO in 2000. Year types are defined as Dry (< 15 inches), Normal (15 to 22 inches) and Wet (> 22 inches) at Bradbury Dam.

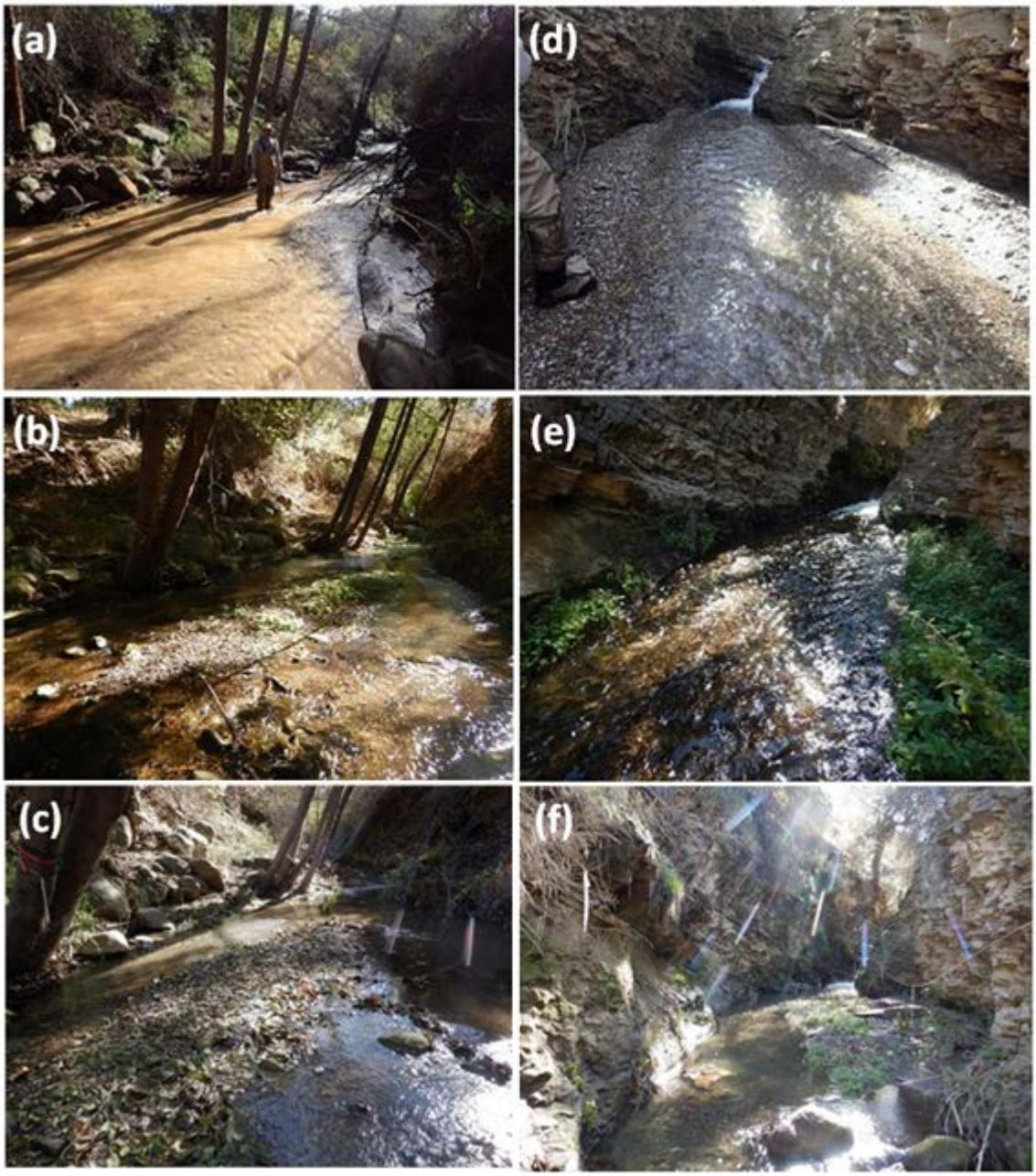

Figure 90: Hilton Creek post-storm habitat conditions showing sediment deposition in the Spawning Pool on (a) 1/18/19, (b) 11/16/20, and (c) 12/3/21; and in the Honeymoon Pool just upstream on (d) 1/22/19, (e) 11/16/20, and (f) 12/3/21.

Figure 91: Delta formation at head of Long Pool along the LSYR mainstem looking up towards the Hilton Creek confluence on (a) 2/4/19, (b) 5/29/20, and (12/3/21; and looking downstream towards the Long Pool on (d) 2/5/19, (e) 11/16/20, and (f) 12/3/21 showing a newly defined and evolving channel.

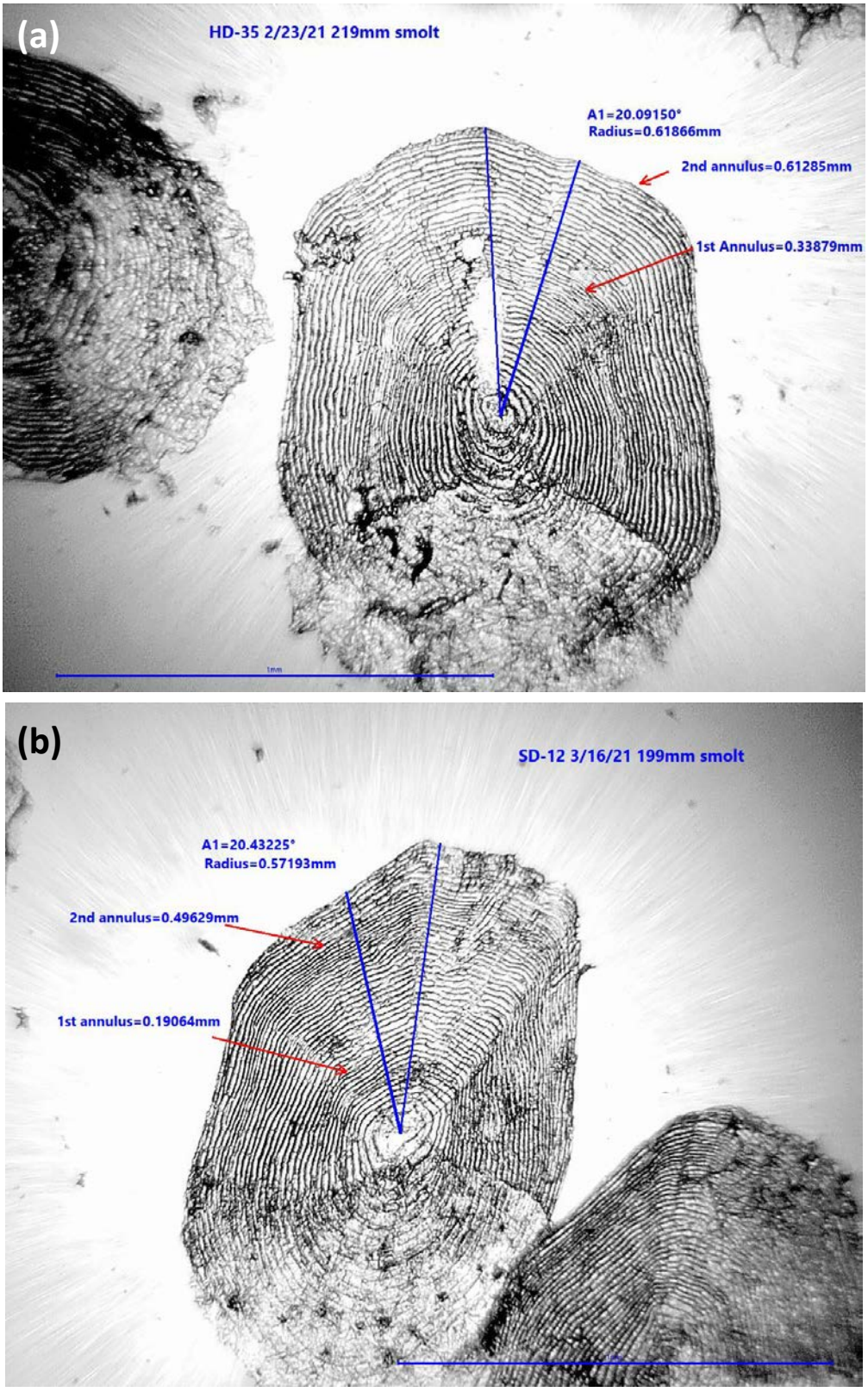

Figure 92: Smolt comparison between Hilton Creek and Salsipuedes Creek in WY2021 showing (a) HC-35 219 mm smolt aged at 2 years and a (b) SC-12 199 mm smolt aged at 2+ years.

Table 24: WY2001-WY2021 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	*WY2021
	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	0
650-699	0	0	0	0	0	0	0	4	0	0	0	0	n/d	0	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	0
550-599	0	0	0	0	0	1	0	2	0	0	0	0	n/d	0	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	0
450-499	3	0	0	6	8	9	0	13	1	2	0	0	n/d	0	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	2
300-399	2	0	10	24	10	31	11	31	27	11	6	12	n/d	24	7	1	0	0	8	13	22
200-299	2	0	2	8	7	10	4	22	29	39	11	12	n/d	12	11	5	0	0	9	7	51
101-199	11	38	14	27	4	18	15	63	33	39	34	17	n/d	9	6	1	1	5	2	17	10
<100	1	1	0	12	1	17	11	29	24	15	23	4	n/d	0	0	1	0	0	0	6	1
Total	**25**	**39**	**36**	**88**	**41**	**109**	**43**	**172**	**118**	**107**	**85**	**45**	**n/d**	**46**	**24**	**8**	**1**	**6**	**20**	**49**	**86**
	Downstream																				
>700	0	0	0	0	0	0	0	0	0	0	0	0	n/d	0	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	0
600-649	0	0	0	0	0	0	0	1	0	0	0	0	n/d	0	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	0
500-549	1	0	1	1	2	3	0	1	0	0	0	0	n/d	0	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	0
400-449	5	0	3	9	5	6	4	12	0	3	7	0	n/d	1	0	0	0	0	2	2	1
300-399	2	0	2	7	3	20	16	28	24	9	10	1	n/d	5	7	0	0	0	1	12	24
200-299	0	5	1	5	2	15	9	18	26	38	22	14	n/d	6	35	3	0	4	5	7	40
Smolts	0	4	0	3	1	11	7	4	7	1	4	6	n/d	1	11	2	0	3	1	1	2
Pre-Smolt	0	0	0	1	0	0	0	2	0	1	0	1	n/d	1	3	1	0	1	0	0	1
Res	0	1	1	1	1	4	2	12	19	36	18	7	n/d	4	21	0	0	0	4	6	37
101-199	22	45	12	46	6	47	369	178	218	84	82	99	n/d	64	68	91	4	14	8	50	34
Smolts	2	19	3	28	6	33	96	59	73	41	37	17	n/d	16	30	54	0	7	1	11	12
Pre-Smolt	0	5	0	2	0	5	42	21	36	4	16	48	n/d	27	23	32	2	6	2	18	13
Res	21	21	9	16	0	9	231	98	109	39	29	34	n/d	21	15	5	2	1	5	19	9
<100	1	7	0	16	2	173	200	47	34	15	16	15	n/d	2	0	1	0	0	1	19	2
Smolts	0	0	0	1	0	1	0	0	0	0	0	0	n/d	0	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	0
Res	1	7	0	15	1	9	200	46	34	15	14	15	n/d	1	0	0	0	0	1	17	2
Total	**33**	**57**	**20**	**86**	**20**	**269**	**598**	**304**	**304**	**151**	**139**	**129**	**n/d**	**78**	**110**	**95**	**4**	**18**	**17**	**90**	**101**
	*Abbreviated trapping season due to NOAA take issues																				

Table 25: WY2001-WY2021 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	*WY2021
	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	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	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	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	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	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	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	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	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	0
101-199	10	8	22	9	0	4	5	2	9	2	22	0	n/d	2	n/d	n/d	0	0	0	0	1
<100	0	0	3	0	0	1	0	3	3	0	5	0	n/d	0	n/d	n/d	0	0	0	1	0
Total	**31**	**14**	**29**	**21**	**1**	**18**	**7**	**18**	**13**	**6**	**40**	**3**	**n/d**	**3**	**n/d**	**n/d**	**0**	**0**	**0**	**2**	**1**
	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	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	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	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	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	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	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	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	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	1
Smolts	8	1	2	0	9	10	0	9	1	18	2	0	n/d	1	n/d	n/d	0	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	1
Res	13	1	0	2	0	7	3	3	1	2	10	0	n/d	0	n/d	n/d	0	0	1	0	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	16
Smolts	124	3	55	9	45	135	1	31	16	48	100	1	n/d	3	n/d	n/d	0	0	0	0	10
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	5
Res	18	1	22	9	0	8	10	0	31	1	3	2	n/d	0	n/d	n/d	0	0	0	0	1
<100	1	0	11	20	0	24	1	6	111	2	24	12	n/d	0	n/d	n/d	0	0	0	1	0
Smolts	0	0	0	5	0	4	0	0	0	0	0	0	n/d	0	n/d	n/d	0	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	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	0
Total	**177**	**6**	**111**	**43**	**55**	**240**	**17**	**62**	**173**	**73**	**200**	**22**	**n/d**	**10**	**n/d**	**n/d**	**0**	**3**	**2**	**1**	**17**
	*Abbreviated trapping season due to NOAA take issues																				

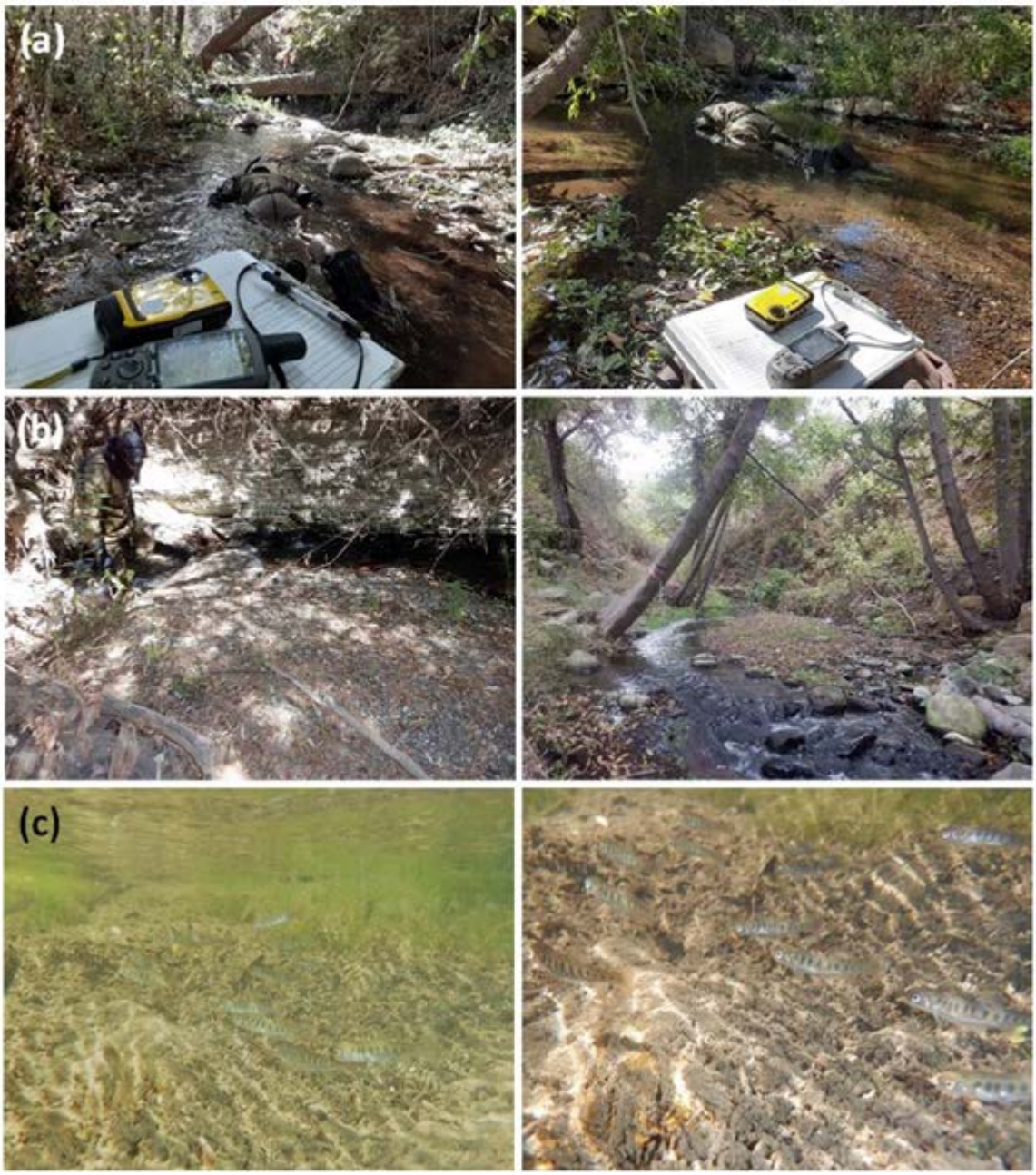

Figure 93: Photographs showing (a + b) snorkel surveying in Hilton Creek with extensive gravel deposition and (c) YOYs

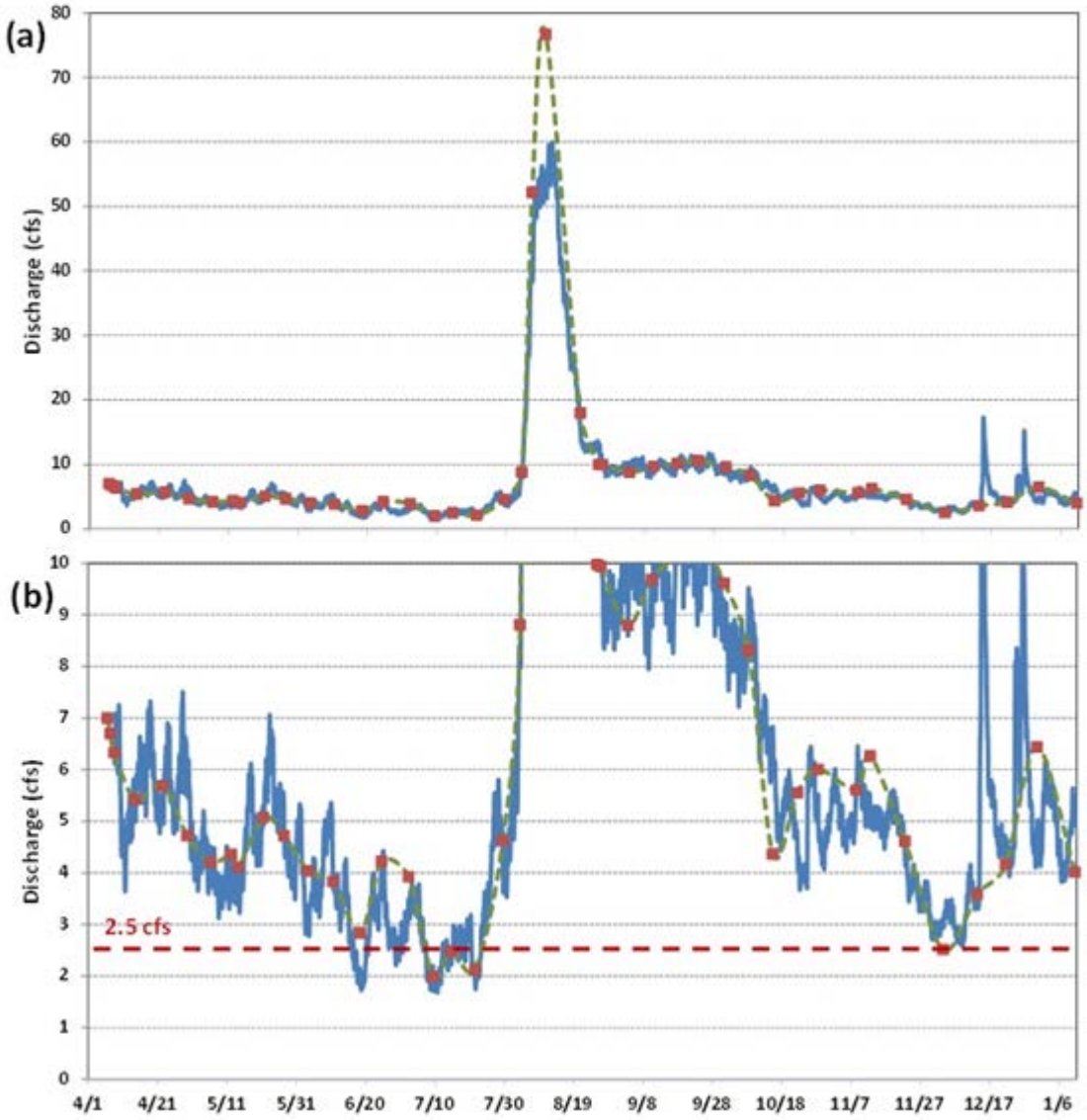

Figure 94: Results from target flow (2.5 cfs) compliance for the Highway 154 Bridge showing (a) measured discharge (points) and (b) modeled discharge (blue curve) using 15-minute pressure transducer data and a developed rating curve (source: COMB-FD).

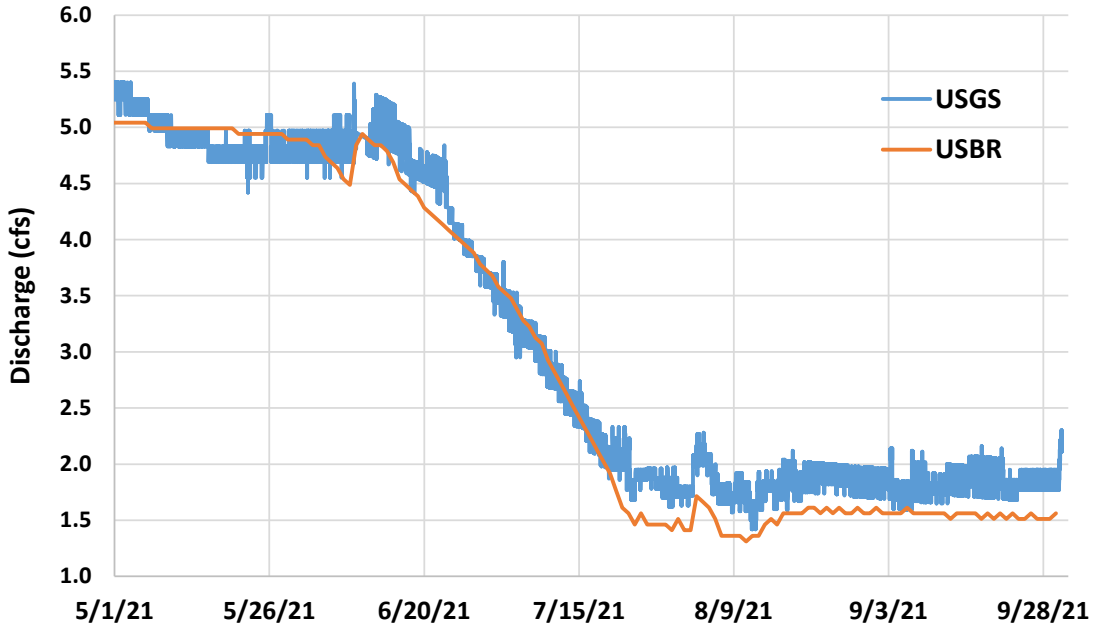

Figure 95: Recorded Hilton Creek discharge from USBR (source: USBR Operations Reports) and USGS (source: online USGS data) at their monitoring site just downstream of the LRP.

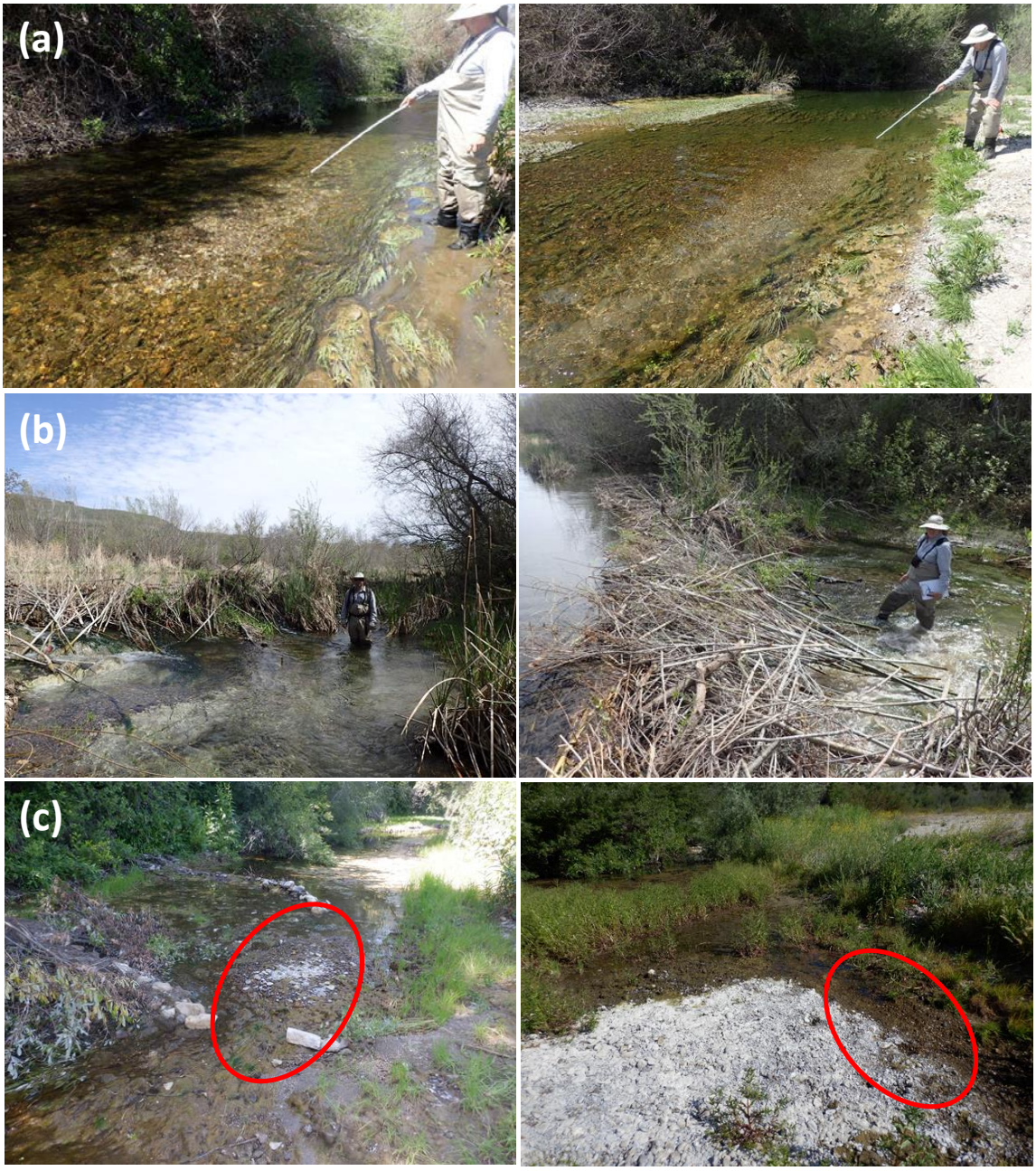

Figure 96: Paired photographs showing (a) the two anadromous redd sites upon observation, (b) the beaver dam 0.9 miles upstream of the redd sides, and (c) the two de-watered redds as flows diminished.

Figure 97: The large pool habitat with 5 observed O. mykiss within the Narrows Reach where the Fish Rescue Team attempted a rescue by seining and e-fishing in the shallower areas, specifically (a) where the fish were located, (b) taking water quality, and (c + d) seining and e-fishing.

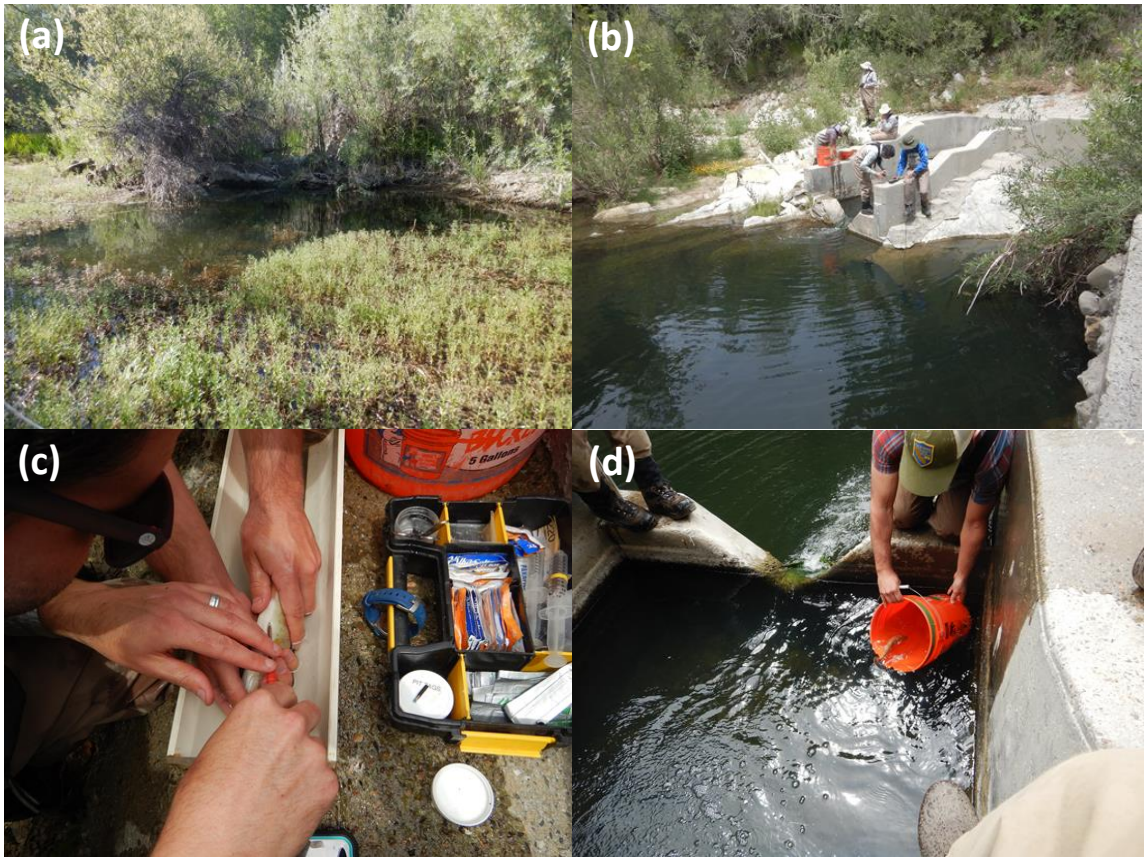

Figure 98: The second fish rescue site within the Narrows Reach showing (a) the location of the rescued fish under the overhanging willow tree, (b) the release point of the captured fish at the Jalama Road Bridge fish ladder, (c) CDFW PIT tagging captured fish, and (d) the release of the tagged fish in the downstream pool of the fish ladder.

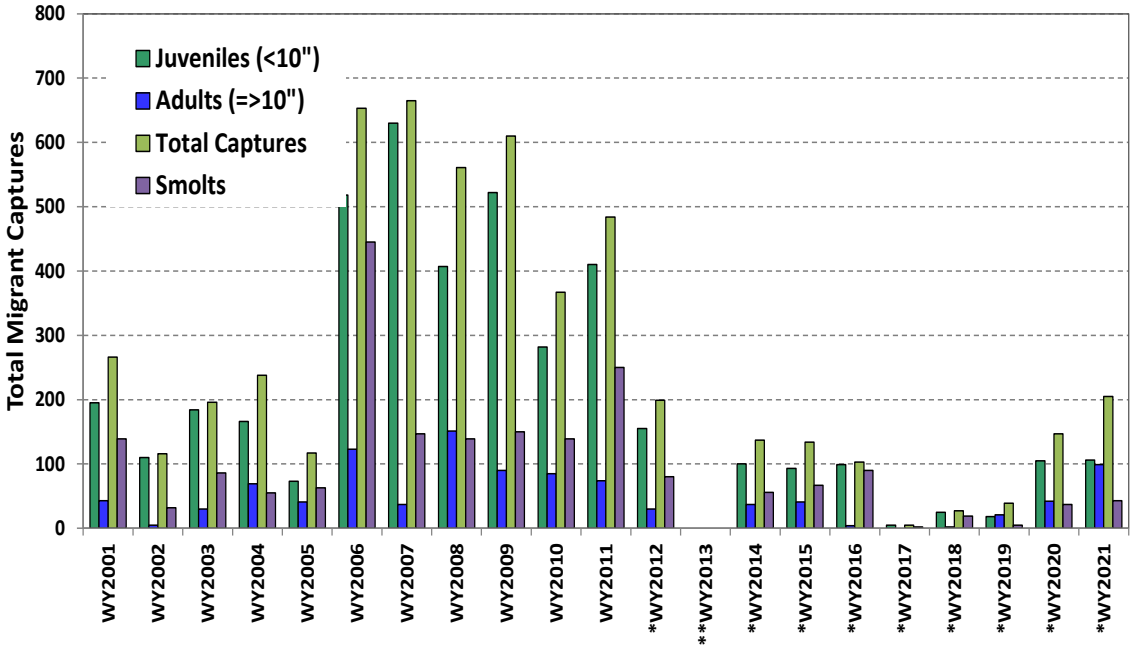

Figure 99: Number of migrant juveniles, adults, smolts, and total migrant captures from WY2001 through WY2021.

Table 26: Total number of migrant captures at all 3 trapping locations from WY2001 through WY2021.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	WY2012*	WY2013**	WY2014*	WY2015*	WY2016*	WY2017*	WY2018*	WY2019*	WY2020*	WY2021*	Total
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Wet	Dry	Wet	Normal	Dry	
Hilton	58	96	56	174	61	378	641	476	422	258	224	174	0	124	134	103	5	24	37	139	187	3771
Mainstem	nd	nd	nd	nd	nd	17	nd	5	2	30	20	0	0	0	0	0	0	0	0	5	nd	79
Salsipuedes	208	20	140	64	56	258	24	80	186	79	240	25	0	13	0	0	0	3	2	3	18	1419
Total Captured:	**266**	**116**	**196**	**238**	**117**	**653**	**665**	**561**	**610**	**367**	**484**	**199**	**0**	**137**	**134**	**103**	**5**	**27**	**39**	**147**	**205**	**5269**
* 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. No anadromous steelhead observed since 2011.

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: 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.

Table 29: Total number of smolt captures at all 3 trapping locations from WY2001 through WY2021.

	WY2001	WY2002	WY2003	WY2004	WY2005	WY2006	WY2007	WY2008	WY2009	WY2010	WY2011	WY2012*	WY2013**	WY2014*	WY2015*	WY2016*	WY2017*	WY2018*	WY2019*	WY2020*	WY2021*
Year Type:	Wet	Dry	Normal	Dry	Wet	Wet	Dry	Wet	Dry	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Wet	Dry	Wet	Normal	Dry
Hilton	4	28	3	35	8	213	145	87	116	47	59	72	0	46	67	90	2	17	4	32	28
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	15
Total:	139	32	86	55	63	445	147	139	150	139	250	80	0	56	67	90	2	19	5	37	43
																				Total=	**2044**

* Abbreviated trapping season due to NOAA take limits enforced.

** No trapping conducted.

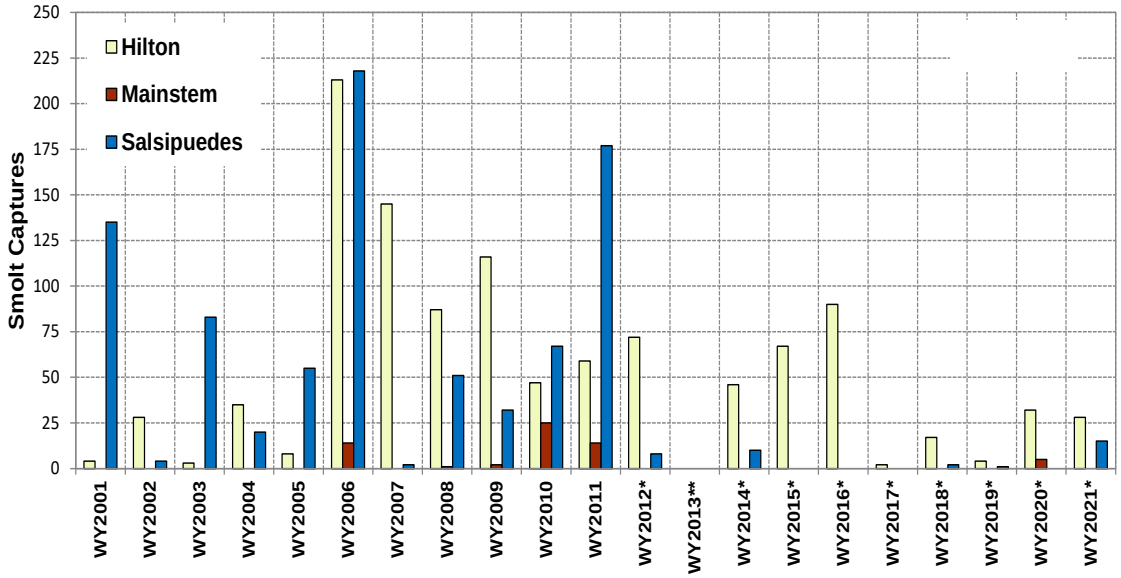

Figure 100: Number of smolt captured at all 3 trapping locations from WY2001 through WY2021.

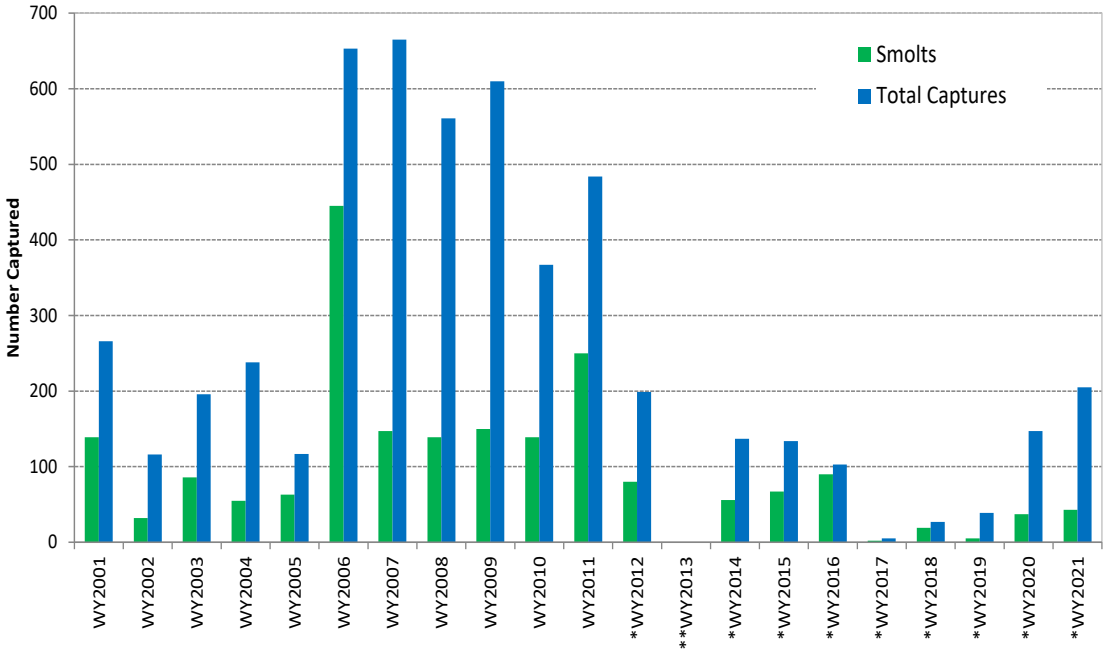

Figure 101: Total number of migrant and smolt captures from WY2001 through WY2021.

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

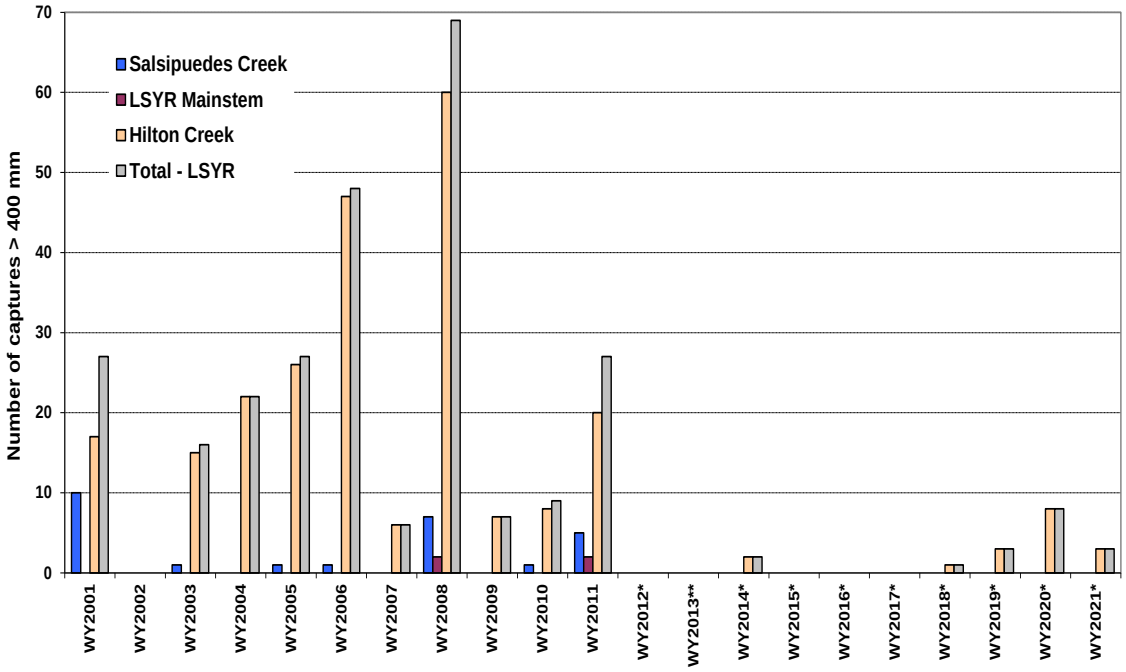

Figure 103: Migrant *O. mykiss* captures equal to or larger than 400 mm (15.7 inches) observed at the 3 trap sites from WY2001 through WY2021; the LSYR Mainstem trap was first installed in WY2006 and was not deployed in WY2007, WY2012, WY2013, WY2014, WY2015, and WY2021 due to low flow conditions.

Table 30: The results of WY2018 scale analyses of *O. mykiss* migrant captures found over the monitoring period aggregated by 10 mm size classes.

		Age:								
Size (mm)	**Amount**	**0+**	**1**	**1+**	**2**	**2+**	**3**	**3+**	**4**	**4+**
<120										
120-129										
130-139	**			2						
140-149	*****			5						
150-159	****			4						
160-169	*			1						
170-179	**			2						
180-189										
190-199										
200-209										
210-219	***			3						
220-229										
230-239										
Total:	**17**	**0**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**0**

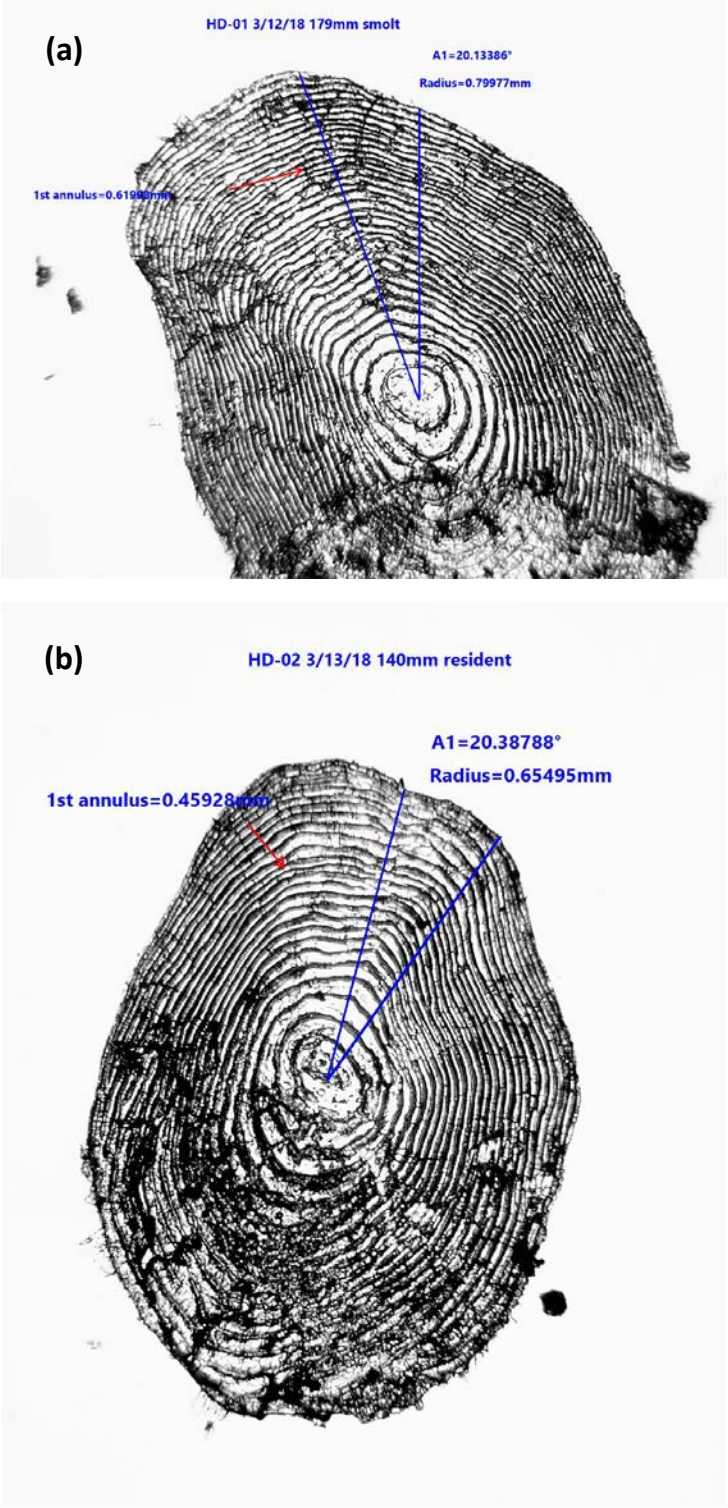

Figure 104: Two WY2018 Hilton Creek 1+ fish showing rapid and consistent growth that make annulus identification a challenge; (a) HD-01 179 mm and (b) HD-02 140 mm fish.

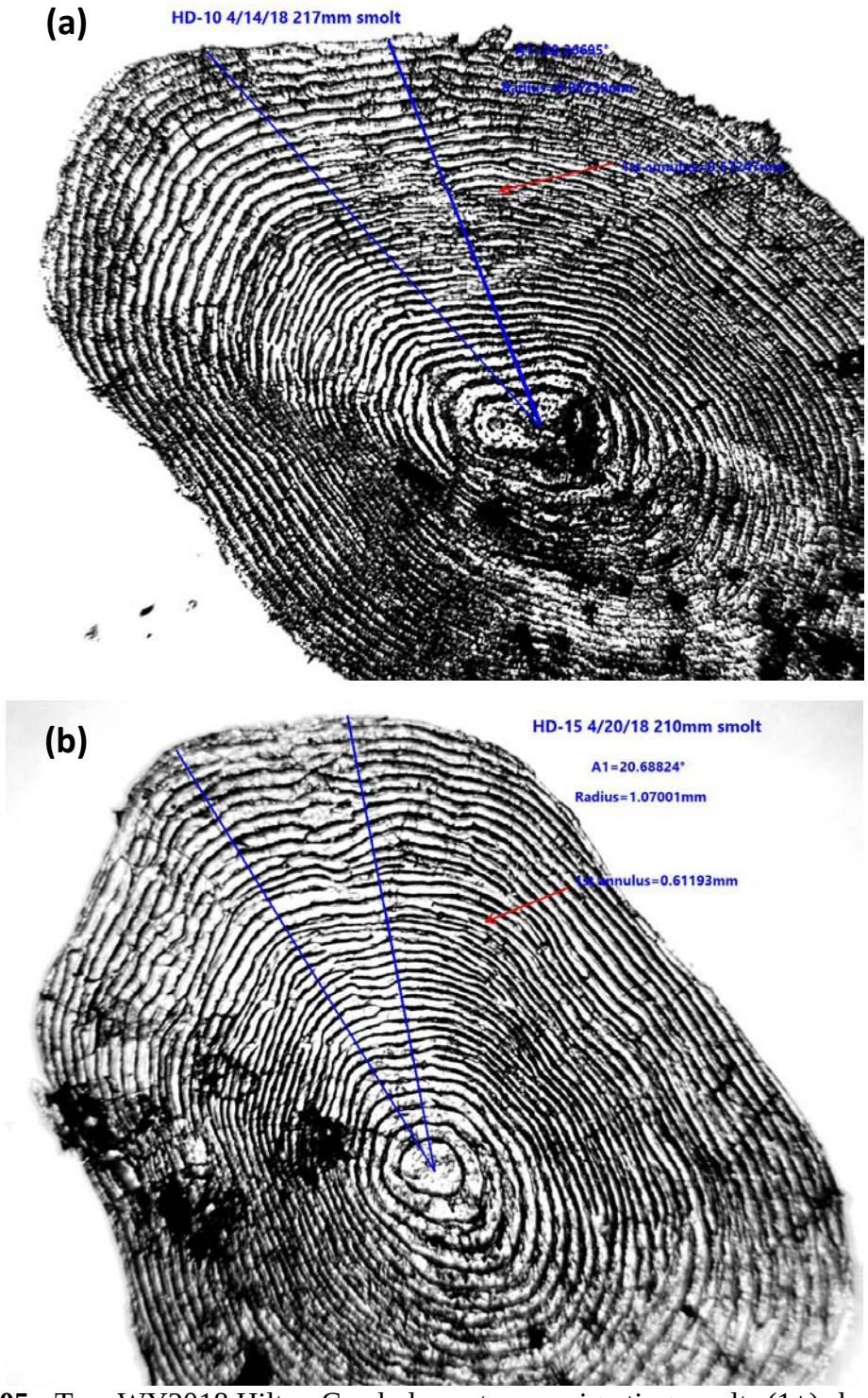

Figure 105: Two WY2018 Hilton Creek downstream migrating smolts (1+) showing similar growth pattern and annulus location; (a) HD-10 217 mm and (b) HD-15 210 mm fish.

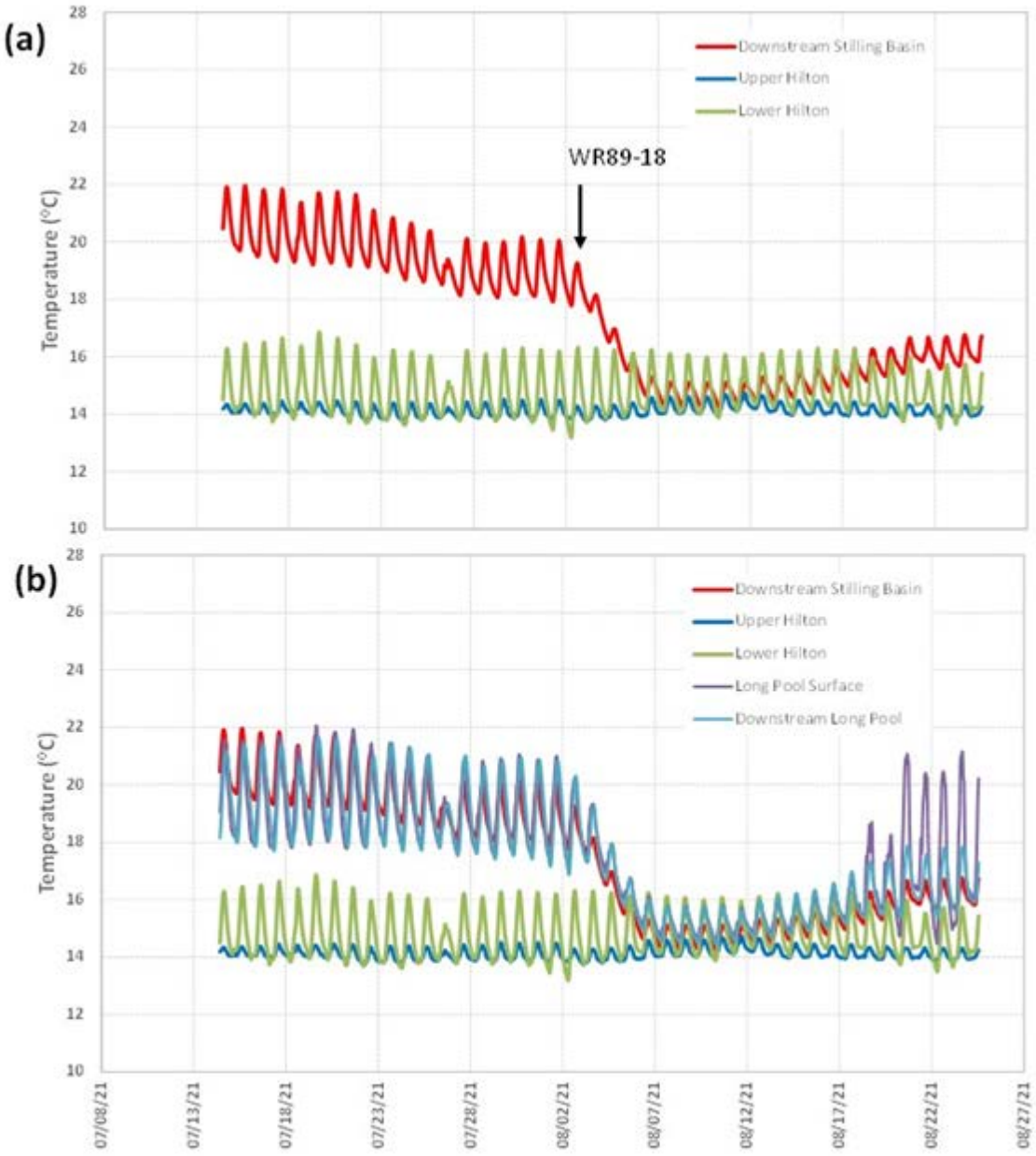

Figure 106: Recorded stream temperatures before, during and after the start of the 2021 WR 89-18 release (a) downstream of the Stilling Basin (LSYR-0.25), upper Hilton Creek (HC-0.54), and lower Hilton Creek (HC-0.12), and (b) with Long Pool (LSYR-0.51) and downstream of Long Pool (LSYR-0.68) showing no temperature spike across all habitats.

Table 31: Total Lake Cachuma releases since 2005 to the LSYR mainstem (Outlet Works and Hilton Creek) during the summer months (June-September) in acre-feet.

Year (af):																
2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
2468	2744	11233	4169	4491	8210	3149	3803	13333	3606	11148	11789	9155	8222	3663	7807	5240

Table 32: 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 33: 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 34: 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***

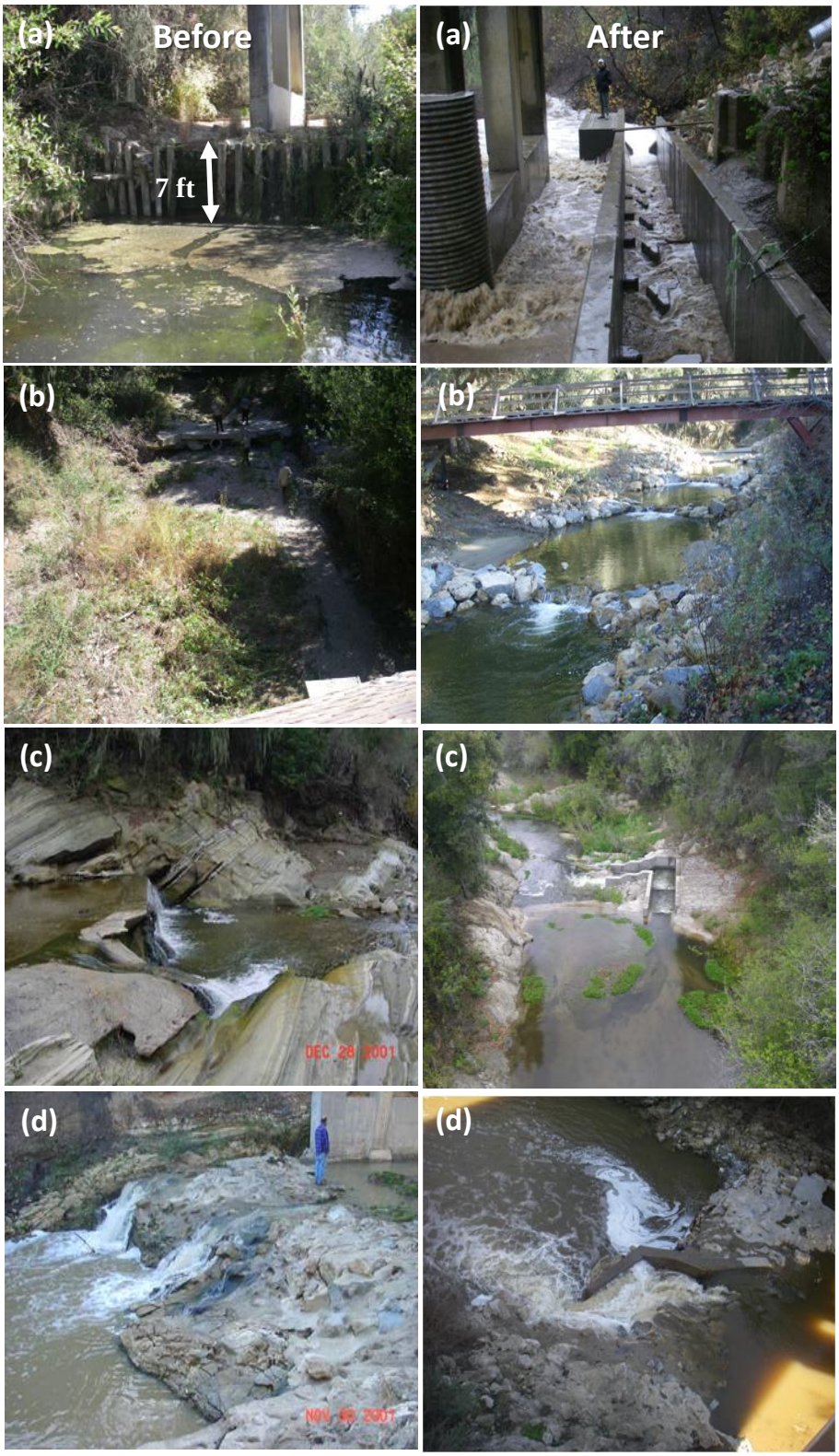

Figure 107: Fish passage and habitat restoration at: at (a) Rancho San Julian Bridge on El Jaro Creek (2008), (b) Cross Creek Ranch on El Jaro Creek (2009), (c) Jalama Road Bridge on Salsipuedes Creek (2004), and (d) Highway 1 Bridge on Salsipuedes Creek (2002).

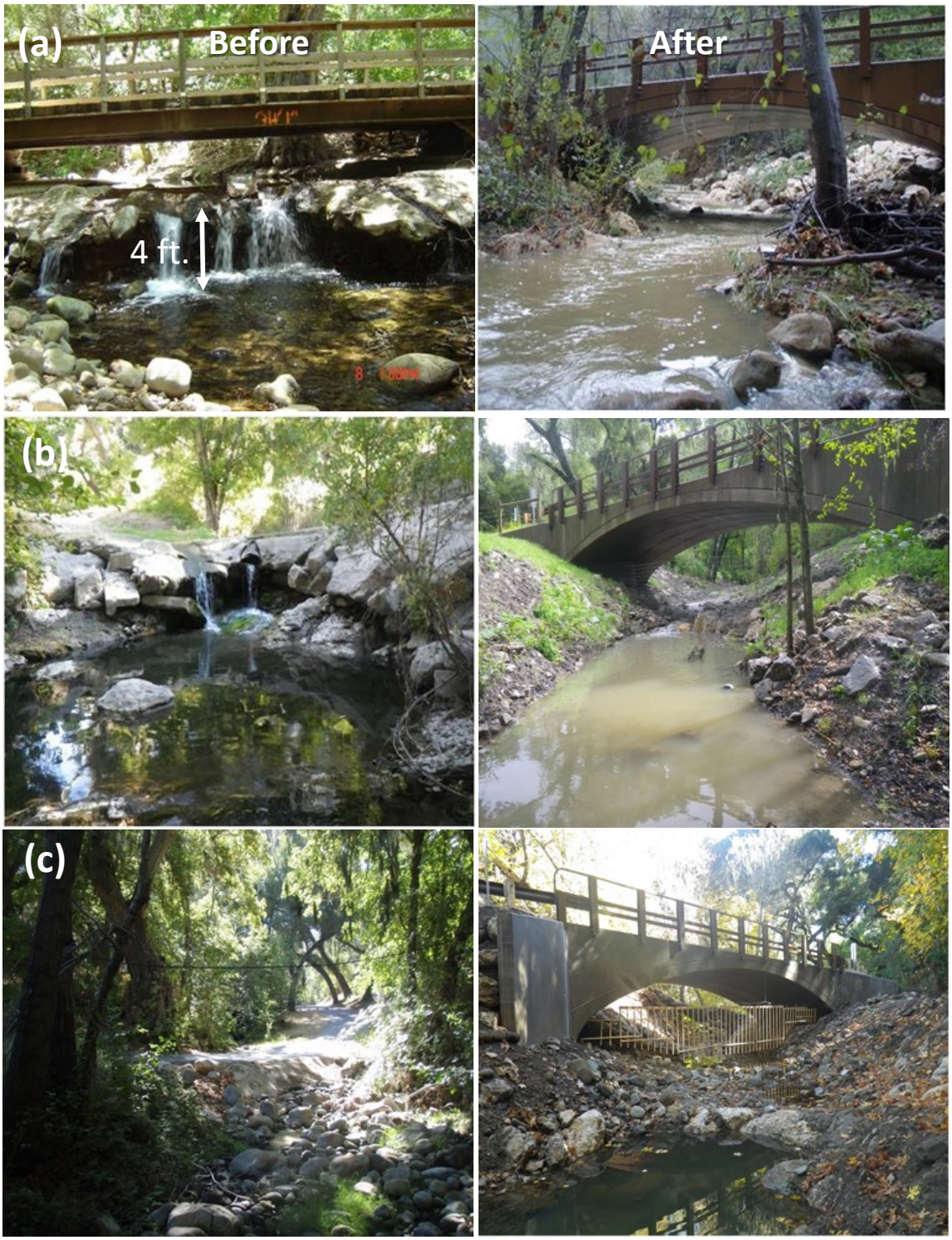

Figure 108: Fish passage and habitat restoration at a) Quiota Creek Crossing 6 (2008), (b) Quiota Creek Crossing 2 (2011), and Quiota Creek Crossing 7 (2012).

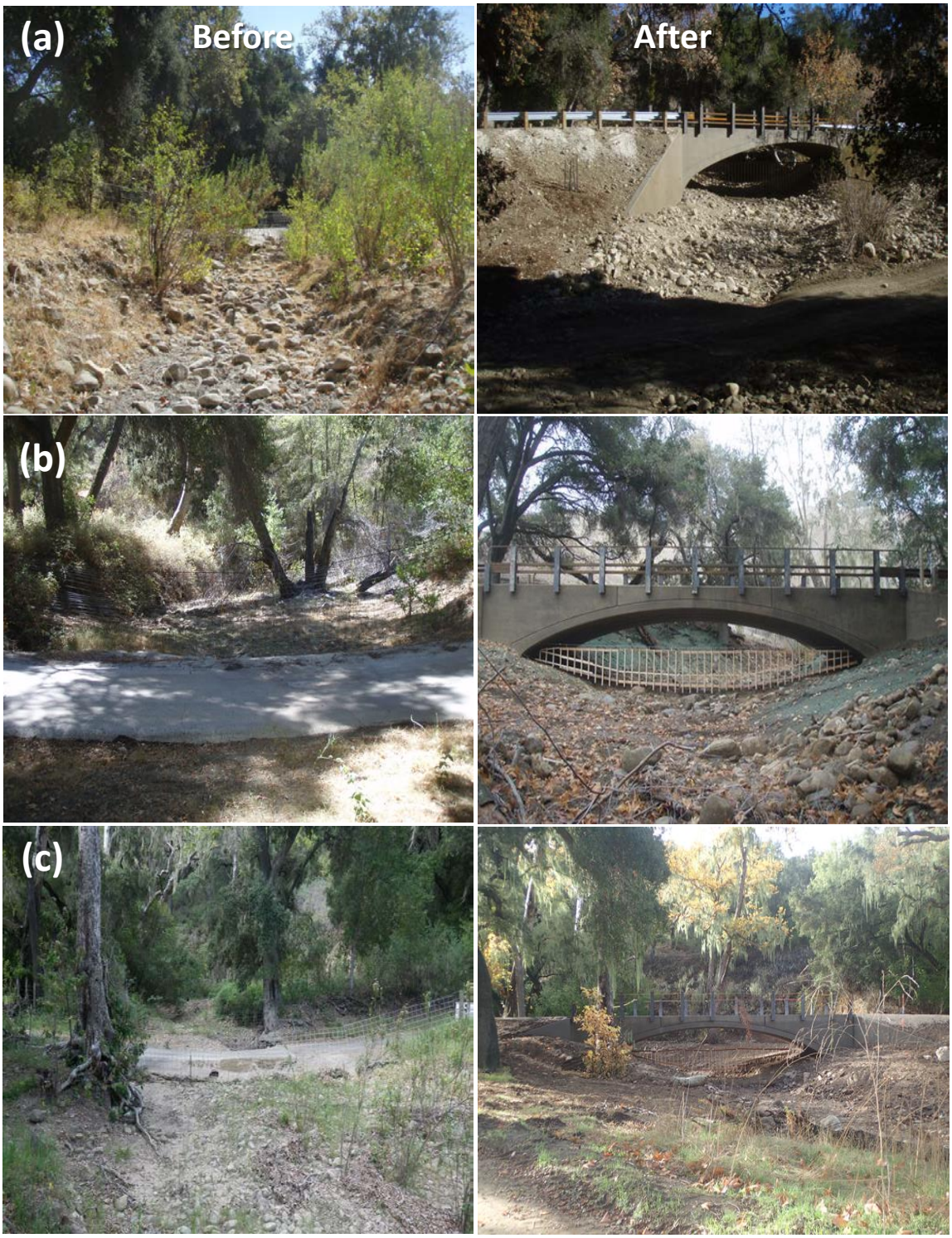

Figure 109: Fish passage and habitat restoration at (a) Quiota Creek Crossing 1 (2013), (b) Quiota Creek Crossing 3 (2015), and (c) Quiota Creek Crossing 4 (2016).

Figure 110: 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 111: Fish passage and habitat restoration at (a) Quiota Creek Crossing 8 completed in 2019 and (b) South Side Erosion Control and Reforestation Project at Crossing 8 (completed in 2020).

Figure 112: Fish passage and habitat restoration at Hilton Creek at the Cascade Chute Project that was completed in 2005.

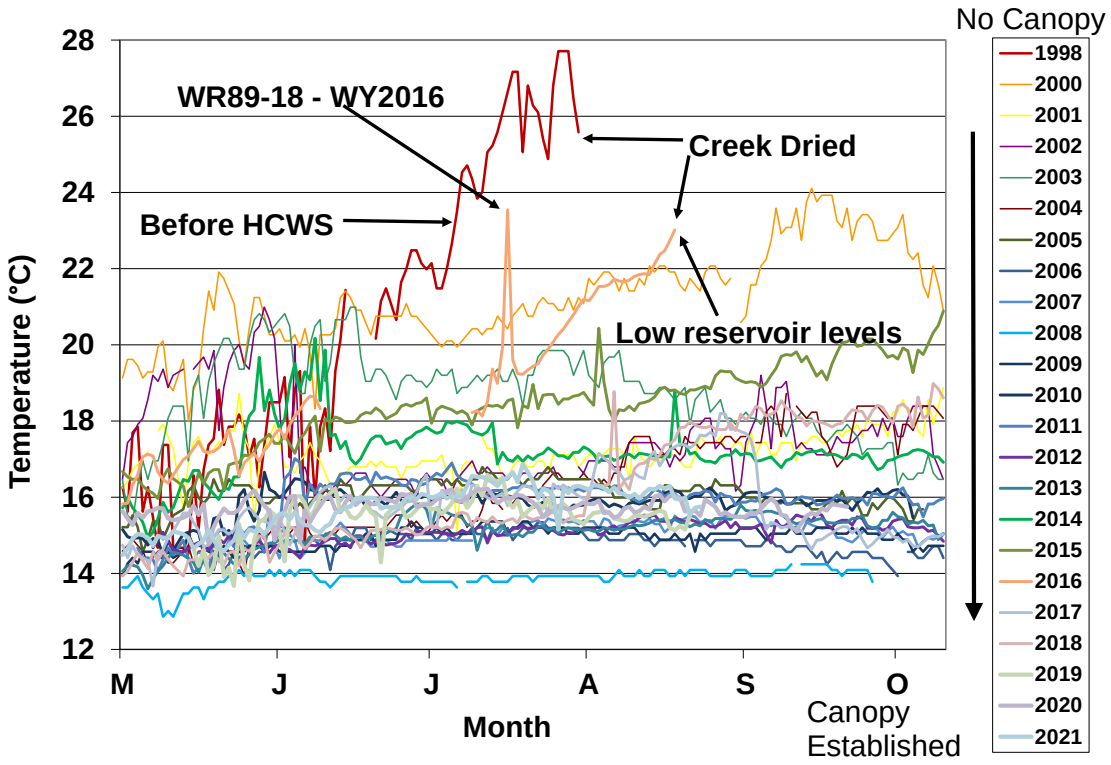

Figure 113: Lower Hilton Creek thermograph maximum water temperature data from 1998 to 2020, the last three years are shown with a wider line.

Figure 114: Hilton Creek water tanks (a+b) before and (c+d) after COMB-FD repairs.

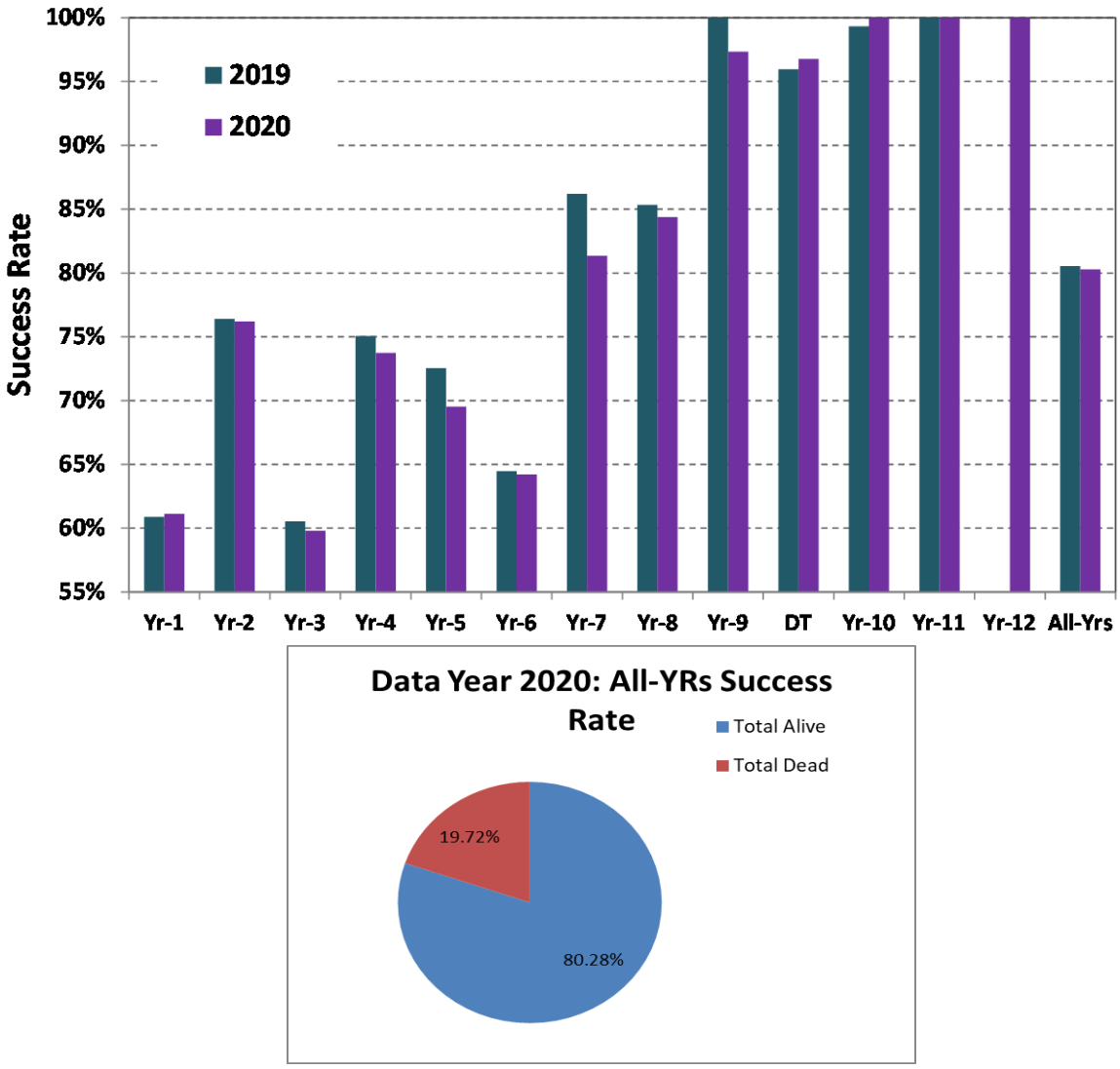

Figure 115: Success rate (a) comparison for all planting year classes plus total from 2019 to 2020 and (b) a detail of the survival rate in 2020; the 2021 inventory is currently in process.

WY2021 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
Doppler: A sonar situation wherein the target is moving toward the transducer
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

PG&E: Pacific Gas and Electric Company

PIT: Passive Integrated Transponder

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 to collect instream habitat data on the LSYR mainstem and tributaries. Water quality equipment is generally used from the spring (May-June) through the fall (October-November). Flow meters are used throughout the year to gather spot flow information, particularly during periods of stormflow in the winter and spring, as well as during the summertime period to monitor whether target flows are being met within the LSYR mainstem. The calibration procedures and timing for water quality and flow meter equipment can be found in Table A-1 (Calibration). The parameters and specifications of each instrument are listed in Table A-2 (instrument calibration, parameters and specifications). All meters on the multi-parameter Sondes are calibrated by the manufacturer or COMB-FD following manufacturer protocols.

Table B-1: Calibration procedures for thermographs, sonde probes, and flow meters.

Parameter	Instrument	Calibration Frequency	Timing	Standard or Calibration Instrument Used
Temperature	Thermograph	Annually	Spring	Water/ice bath to assure factory specifications and comparability between units.
Dissolved Oxygen	YSI -6920 (650 MDS) - DO meter ONSET -U26 DO Data Logger YSI-ProSolo	Monthly	Monthly when in use	At a minimum, water saturated air, according to manufacturer's instructions. ONSET logger sensor good for 6 months, then replaced.
pH	YSI -6920 (650 MDS) - pH meter	Monthly	Monthly when in use	pH buffer 7.0 and 10.0
Conductivity	YSI -6920 (650 MDS) - Conductivity meter YSI-ProSolo	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 - Flow Tracker 2	Not required	~	Not required
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 Flow Tracker2	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 ProSolo Temperature/Dissolved Oxygen/Conductivity Probe	Temperature	°C	0.1	±0.1	± 0.2 °C
	Dissolved Oxygen	mg/l	0.1	±0.1	0 to 20 mg/L:± 0.1 mg/l or ± 1%, whichever is greater 20 to 50 mg/L: ± 8% of reading
	Conductivity	m/S/cm	0.1	±0.1	0 to 100 mS/cm: ±0.5% of reading or .001 mS/cm, whichever is greater 100 to 200 mS/cm: ± 1% of reading
	Salinity		.01 ppt	±0.1	± 1.0% of reading or ±0.1 ppt whichever is greater
ONSET U-26 Dissolved Oxygen Data Logger	Dissolved Oxygen	mg/l	0 to 20 mg/l	0.02	0.2 mg/l up to 8 mg/l, 0.5 mg/l from 8 to 20 mg/l
	Temperature	°C	-5 to 40	0.02	0.2
U-22 Temperature Logger	Temperature	°C	-40 to 70 °C	±0.02 at 25 °C	±0.21 from 0 to 50 °C
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

Hobo 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 cable (one foot below the surface), and the bottom unit deployed at the bottom. Precautionary measures are always taken to hide the thermographs from the public, especially in places with high volume traffic. 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.

YSI 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 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.

YSI ProSolo Temperature/Dissolved Oxygen/Conductivity Probe

The YSI ProSolo is a handheld water quality probe that is used to collect spot measurement during routine monitoring activities to assess site-specific conditions. The instrument has the capability of logging a single or interval data points depending on the field requirement at the time. The unit has been used to collect water temperature and dissolved oxygen readings at individual *O. mykiss* spawning sites as well as site specific conductivity readings when conducting fish rescue operations in conjunction with California Department of Fish and Wildlife.

SonTek 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 Doppler field by getting caught on the probe. Once each transect is measured, the FlowTracker calculates the transect width, depth, and velocity to determine overall 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 and evaluate 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 cable (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 manually 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.

Solinst 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 various vertical array locations, specific fish passage projects when applicable, 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/corroborate 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 instrument 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

Thermograph deployment in the mainstem and tributaries is done in such a way as to minimize visibility of the units to prevent tampering/vandalism by the public. This methodology has largely succeeded over the many years of monitoring in the lower river. Since 1995, there have only been three instances of tampering, all of them in and around the Refugio Bridge location (LSYR-7.65). In WY2021, a 3-unit vertical array was attached to a large overhanging tree branch (6-inch diameter) in the deepest portion of the habitat and well out of view. The thermograph array was attached to a ¼ inch cable that was in turn securely attached to the tree branch. Sometime between 7/14/21 (date of last download) and 8/24/21 (date of attempted download) members of the public went to great lengths to break the tree branch and steal the thermographs. Snorkel and bank surveys were conducted in an attempt to locate the units but were unsuccessful and the units are considered lost. No data was collected after 7/14/21 at LSYR-7.65.

An Optic Shuttle malfunction caused by an interruption of power (dislodged battery) to the Optic Shuttle resulted in a loss of data after 8/24/21 at: LSYR-0.1, LSYR, 0.25, LSYR-0.51, LSYR-0.68, LSYR-4.95, LSYR-8.7, LSYR-10.2, LSYR-13.9, LSYR-22.68, HC-0.12 and HC-0.54. Thermographs deployed from LSYR-1.09 through LSYR-2.77 were not impacted by the malfunction, nor were the majority of thermographs deployed in the Salsipuedes/El Jaro watershed (SC-0.78 being the sole exception). Though the data stream of most mainstem thermographs stopped at 8/24/21, they were still able to capture water quality during and immediately after the WR89-18 release water reached each monitoring location.

Thermograph data transferred to the Optic Shuttle in the field are downloaded to the HOBOWare 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 input 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 (or the end of deployment) or during the downloads while the unit is out of the water. The other situation causing anomalous 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 2002-2005 in the spring, summer, and fall. After 2005 and continuing through 2021, photo points were scaled down and taken at irregular intervals, typically during April through September. All photo points taken in WY2021 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 some locations had become so overgrown with vegetation to make yearly evaluation impractical, river course changes, or were no longer showing any visible change.

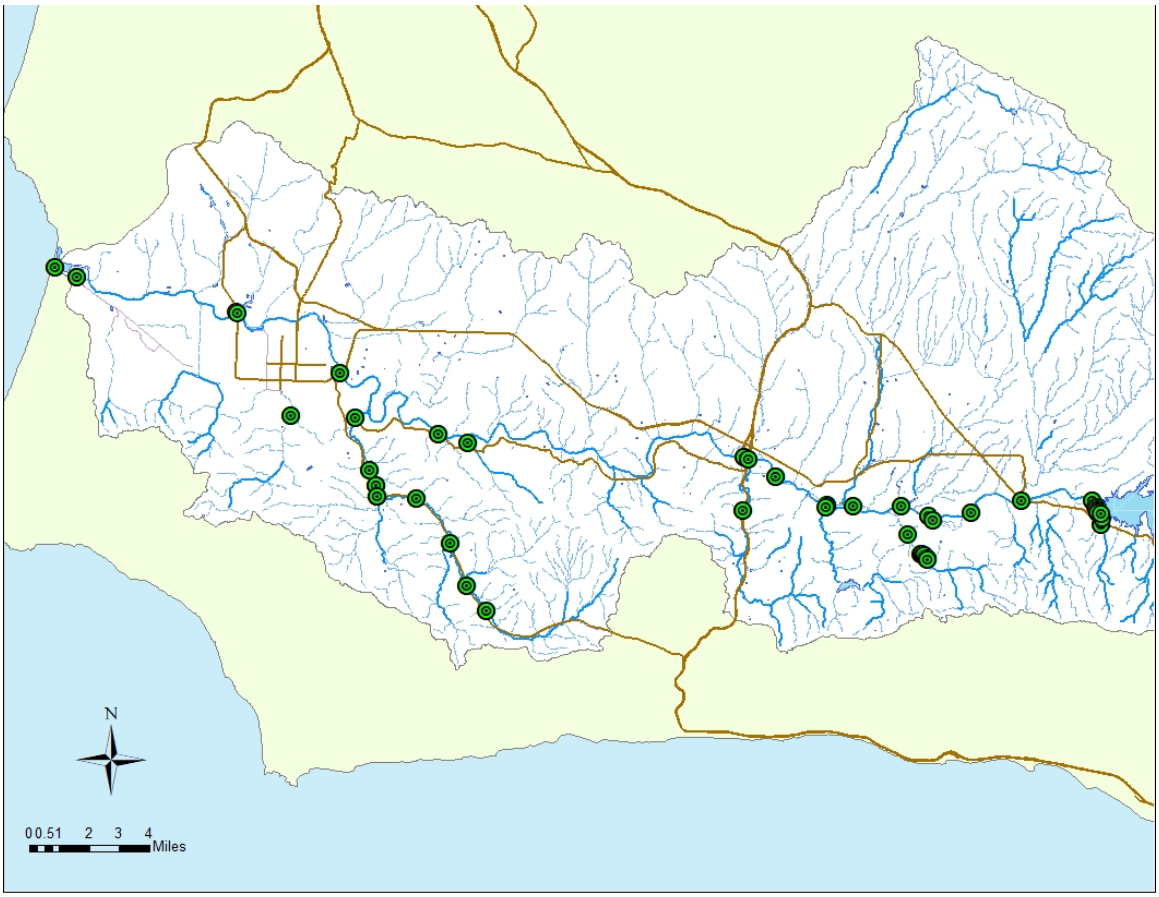

Figure C-1: WY2021 photo point locations.

Table C-1: WY2021 photo points on the LSYR mainstem. "X's" denote photos taken, downstream (d/s) and upstream (u/s).

LSYR Mainstem Photo Point ID	Location/Description	May 2021	June 2021	Sept 2021
M1	Lower Hilton Creek, photo d/s at ford crossing		X	X
M2a	Bluffs overlooking long pool, photo u/s			X
M2b	Bluffs overlooking long pool, photo d/s			X
M3	Highway 154 culvert on Hilton Creek, photo u/s			
M4	Highway 154 culvert on Hilton Creek, photo d/s			
M5	Highway 154 Bridge, photo u/s			X
M6	Highway 154 Bridge, photo d/s		X	X
M7	Meadowlark crossing, photo u/s			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
M22	Sweeney Road crossing, photo d/s			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
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		X
	Floradale Br-d/s	X		X

Table C-2: WY2021 photo points on the LSYR tributaries. "X's" denote photos taken.

Tributary Photo Point ID	Location/Description	May 2021	June 2021	Sept 2021
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			X
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
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			X
TX1a	Quiota Creek at 1st crossing, photo u/s	X		X
TX1b	Quiota Creek at 1st crossing, photo d/s	X		X
TX2a	Quiota Creek at 2nd crossing, photo u/s	X		X
TX2b	Quiota Creek at 2nd crossing, photo d/s	X		X
TX3a	Quiota Creek at 3rd crossing, photo u/s	X		X
TX3b	Quiota Creek at 3rd crossing, photo d/s	X		X
TX4a	Quiota Creek at 4th crossing, photo u/s	X		X
TX4b	Quiota Creek at 4th crossing, photo d/s	X		X
T16	Quiota Creek at 5th crossing, photo d/s	X		X
T17	Quiota Creek at 5th crossing, photo u/s	X		X
T18	Quiota Creek at 6th crossing, photo d/s	X		X
T19	Quiota Creek at 6th crossing, photo u/s	X		X
T20	Quiota Creek at 7th crossing, photo d/s	X		X
T21	Quiota Creek at 7th crossing, photo u/s	X		X
T22	Quiota Creek below 1st crossing, photo d/s	X		X
T23	Alisal Creek from Alisal Bridge, photo u/s		X	X
T24a	Alisal Creek from Alisal Bridge, photo u/s		X	X
T24b	Alisal Creek from Alisal Bridge, photo d/s		X	X
T25	Nojoqui Creek at 4th Hwy 101 Bridge, photo u/s			
T26	Nojoqui Creek at 4th Hwy 101 Bridge, photo d/s			
T27	Nojoqui/LSYR confluence, photo u/s		X	X
T28	Salsipuedes Creek at Santa Rosa Bridge, photo u/s	X		X
T29	Salsipuedes Creek at Santa Rosa Bridge, photo d/s	X		X
T38-New	Salsipuedes Creek at Hwy 1 looking u/s from bluff	X		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			
T45	Upper Salsipuedes/El Jaro confluence, photo d/s			
T48	El Jaro Creek above El Jaro confluence, photo u/s			
T49	El Jaro Creek above El Jaro confluence, photo d/s			
T52	Ytias Creek Bridge, photo d/s	X		X
T53	Ytias Creek Bridge, photo u/s	X		X
T54	El Jaro Creek 1st Hwy 1 Bridge, photo d/s	X		X
T55	El Jaro Creek 1st Hwy 1 Bridge, photo u/s	X		X
T56	El Jaro Creek 2nd Hwy 1 Bridge, photo d/s	X		X
T57	El Jaro Creek 2nd Hwy 1 Bridge, photo u/s	X		X
T58	El Jaro Creek 3rd Hwy 1 Bridge, photo d/s	X		X
T59	El Jaro Creek 3rd Hwy 1 Bridge, photo u/s	X		X
T60	San Miguelito Creek at crossing, photo d/s	X		X
T61	San Miguelito Creek at Stillman, photo u/s	X		X
T62	Rancho San Julian Bridge, photo d/s	X		X
T63	Rancho San Julian Bridge, photo u/s	X		X

D. List of Supplemental Reports Created During WY2021

- WY2020 Annual Monitoring Report (COMB, 2020b).
- WY2021 Migrant Trapping Plan (COMB, 2020c).
- 6/8/21 Hilton Creek Emergency Backup System Activation on Gravity Event Report (COMB, 2021a).
- End of Project Compliance Report, South Side Erosion Control and Reforestation Project at Quiota Creek Crossing 8 (COMB, 2020a).
- Occurrences of Steelhead Trout (*Oncorhynchus mykiss*) in southern California, 1994-2018 (Dagit et al., 2020).
- RPM 6 Ramp-Down Stranding Event Report (COMB, 2021b).

E. Appendices References

COMB, 2020a. 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, 2020b. WY2020 Annual Monitoring Report. Cachuma Operation and Maintenance Board (COMB) Fisheries Division.

COMB, 2020c. WY2021 Migrant Trapping Plan. Prepared in collaboration with United States Bureau of Recalamation, Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2021a. Hilton Creek Emergency Backup System Activation on Gravity Event Report. Cachuma Operation and Maintenance Board (COMB), Fisheries Division.

COMB, 2021b. RPM 6 Ramp-Down Stranding Event Report. Compliance Report, 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.