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CASITAS MUNICIPAL WATER DISTRICT, a California special district

SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF LOS ANGELES, DISTRICT

SANTA BARBARA CHANNELKEEPER, a California non-profit corporation, Petitioner, vs. STATE WATER RESOURCES CONTROL BOARD, et. al., Respondents. CITY OF SAN BUENA VENTURA, et. al., Cross-Complainant, vs. DUNCAN ABBOTT, an individual, et al., Cross-Defendants.	Case No. 19STCP01176 *Judge:* *Hon. William F. Highberger* Dept: 10 **DECLARATION OF CASITAS MUNICIPAL WATER DISTRICT ASSISTANT GENERAL MANAGER KELLEY DYER IN SUPPORT OF JOINT APPLICATION TO SET A HEARING DATE FOR AN INTERIM ORDER REGARDING THE PHYSICAL SOLUTION AND TO CONTINUE THE STAY UNTIL THE HEARING DATE** Date: November 13, 2024 Time: 9:00 A.M. Dept.: 10 Date Action Filed: September 19, 2014 Trial Date: Not Set

DECLARATION OF KELLEY DYER

I, Kelley Dyer, declare:

1. I am the Assistant General Manager (AGM) of Cross Defendant Casitas Municipal Water District ("Casitas"). I have served as AGM at Casitas since 2019 and am extensively familiar with Lake Casitas and all facilities operated by Casitas within the Ventura River Watershed (VRW). I have personal knowledge of the facts set forth in this declaration, and if called as a witness, could competently testify to all matters set forth herein.

2. I make this declaration in support of the Joint Application to Set a Hearing Date for an Interim Order Regarding a Physical Solution and Request to Continue the Stay Until the Hearing Date ("Joint Application") submitted by Casitas and the eight other Ventura River watershed parties ("Watershed Parties") listed in the Joint Application, and by the State Water Resources Control Board/California Department of Fish and Wildlife (collectively the "State") to extend the current stay in this action, the Ventura River Adjudication Litigation ("Litigation"), until such time as the Court hears the Watershed Parties request for an Interim Order regarding a potential physical solution, and thereafter per the terms of the Interim Order.

3. I have been appointed by the Casitas Board to serve on the Casitas Negotiating Team in connection with the mediation in this matter, and I have attended all, or nearly all mediation sessions since the mediation first started in or around May of 2022. I have also played a significant role in managing the Casitas representatives on the Watershed Parties Technical Team "Technical Team" in developing a physical solution that the mediating parties hope will result in a permanent physical solution that the Court can approve.

4. I am responsible, with Casitas' General Manager Michael Flood, for the operation of Lake Casitas, and of greater relevance here, for the operation of the Robles Diversion and Fish Passage Facility ("Robles Facility") on the Ventura River, which diverts water from the Ventura River to Lake Casitas only when there are sufficient flows in the Ventura River to meet the in-stream flow requirements previously imposed by the National Marine Fisheries Services ("NMFS") via a 2003 biological opinion (the "Biological Opinion") to protect Southern California

steelhead.

5. Attached hereto as Exhibit 1 is a true and correct copy of a paper I drafted in support of Casitas Memorandum to the Court that: (a) describes the steps that Casitas has taken to protect Southern California steelhead in the Ventura River, consistent with obligations under the Biological Opinion for the Robles Facility, and which also analyzes the significant bypasses of river flow that Casitas is already required to make to support Southern California steelhead in the Ventura River (sometimes up to 170 cubic feet per second, and nearly 20,000 acre feet per year during some years, before Casitas is authorized to divert from the Ventura River); (b) describes Casitas Water Efficiency and Allocation Program (WEAP) that has resulted in current water deliveries supplied by Casitas being approximately 50% of 1989 demands; (c) describes the annual progress reports prepared for the Robles Facility and the types of information that can be found in such reports.

6. Attached hereto as Exhibit 2 are true and correct copies of representative Robles Facility Progress reports that Casitas, per the Biological Opinion, submitted in 2008, 2010, 2012, 2019, and 2020. These reports, which are representative of different water year types, contain key information that the Watershed Parties and the State will need to consider as they develop the permanent physical solution, including: (a) in-channel passage conditions; (b) natural surface water connections; (c) river discharges when adult steelhead have migrated upstream, seasonal and diel migration behavior; (d) detail of successful reestablishment of adult steelhead to historic spawning and rearing habitat through passage at the Robles Fish Passage Facility; and (e) the cyclic nature of *O. mykiss* abundance vis-à-vis precipitation in the Ventura River Watershed..

7. Casitas is committed to the completion of the structured mediation process, and despite already bypassing substantial flows for the benefit of Southern California steelhead, is willing to increase its current obligations as provided in the proposed Interim Order to demonstrate to the Court, and to all parties, Casitas' belief that the best interests of the Watershed are best served by completing the scientific process needed to develop a credible and implementable permanent physical solution. Despite diligent effort by all parties, the structured

mediation process needs more time to properly complete. The issues the parties are seeking to solve, through credible and watershed relevant science, are very complex, and unfortunately, time consuming. We ask that Court to provide the Parties the time that is needed after considering and issuing the Interim Order the Parties will be requesting.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed this 17th day of October, 2024 at Oak View, California.

KELLEY DYER
Assistant General Manager, Casitas MWD

Exhibit “1”

EXHIBIT 1: CASITAS EFFORTS TO BE PART OF THE SOLUTION FOR SOUTHERN CALIFORNIA STEELHEAD RECOVERY IN THE VENTURA RIVER WATERSHED (VRW)

In support of the Joint Application for an Interim Order, and in order to demonstrate to the Court the significant and ongoing efforts of Casitas to develop a physical solution that will benefit the Southern California steelhead (SC steelhead) in the Ventura River while supplying water to western Ventura County in an environmentally responsible manner, the following information is provided.

Existing Instream Flows

Casitas, as well as the United States Bureau of Reclamation ("USBR"), have been active participants in the recovery of SC steelhead in the Ventura River since the federal listing of Southern California steelhead (*Oncorhynchus mykiss* or "*O. Mykiss*") in 1997, through the design, construction, and operation of a state-of-the-art fish passage facility at the Robles Diversion and Fish Passage Facility ("Robles Facility"). The Robles Facility, owned by USBR and operated by Casitas, diverts water from the Ventura River to Lake Casitas only when there are sufficient flows in the Ventura River to meet the in-stream flow requirements previously imposed by the 2003 National Marine Fisheries Service ("NMFS") Biological Opinion for the Robles Diversion and Fish Passage Facility (the "Biological Opinion"). The instream flow requirements for SC steelhead in the Biological Opinion were developed through a Technical Advisory Committee that included representatives from NMFS, USBR, and California Department of Fish and Wildlife ("CDFW"). Casitas, therefore, already abides by significant and meaningful instream flows, as discussed further below, for SC steelhead per operations under the Biological Opinion.

The Robles Facility is located on the naturally occurring "Dry Reach" of the Ventura River and there is little to no flow in the Dry Reach for most of the year[1]. Prior to diverting at the Robles Facility, a minimum flow of 20 cubic feet per second (CFS) is required in the Ventura River. Diversions rarely occur during summer and fall months due to dry conditions, and there have been some years in the recent past where Casitas has been unable to divert from the Ventura River to Lake Casitas at all—putting a significant strain on local water supply throughout the watershed. In accordance with the existing Biological Opinion, during the fish passage augmentation season (January 1 – June 30[2]), **the required minimum flow in the Ventura River at the location of the Robles Facility is 30 CFS once a defined storm event first occurs, and up to 50-170 CFS required minimum flow for 10-12 days after subsequent migratory storm events.** Therefore, Casitas already bypasses large volumes of water, and diversions only occur during high flow events and for very limited periods, as previously authorized.

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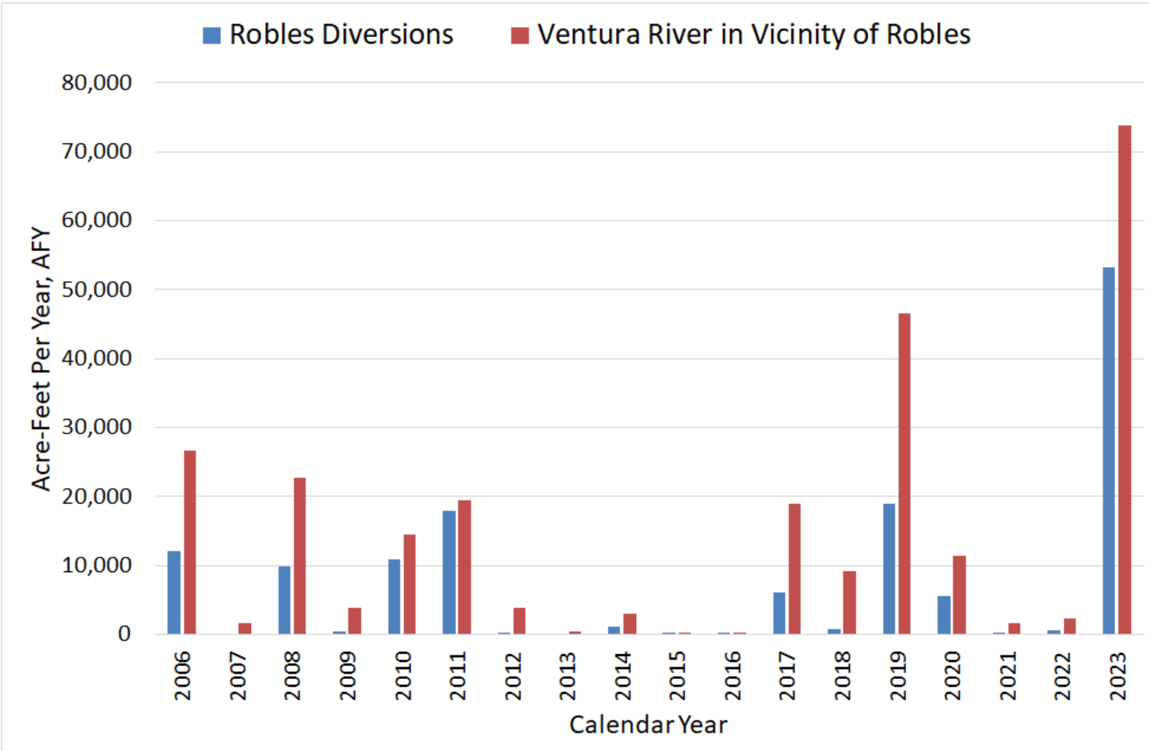
[1] In what is locally known as the Dry Reach of the Ventura River, water percolates rapidly through the highly permeable riverbed to the groundwater alluvium flowing from north to south, following the surface drainage of the Ventura River. Except during very wet rainfall years, surface water in the Dry Reach quickly disappears underground once storm flows have passed—even when surface flow is still present in other reaches of the Ventura River upstream and downstream of the Dry Reach.

[2] The greatest potential for flow in the vicinity of the Robles Facility falls between January and June each year.

About 80% of the time there is no significant surface flow in the Ventura River at the Robles Facility (Cardno-Entrix 2012[3]), and the chart below shows that diversions do not occur during dry periods (e.g. 2012-2016).



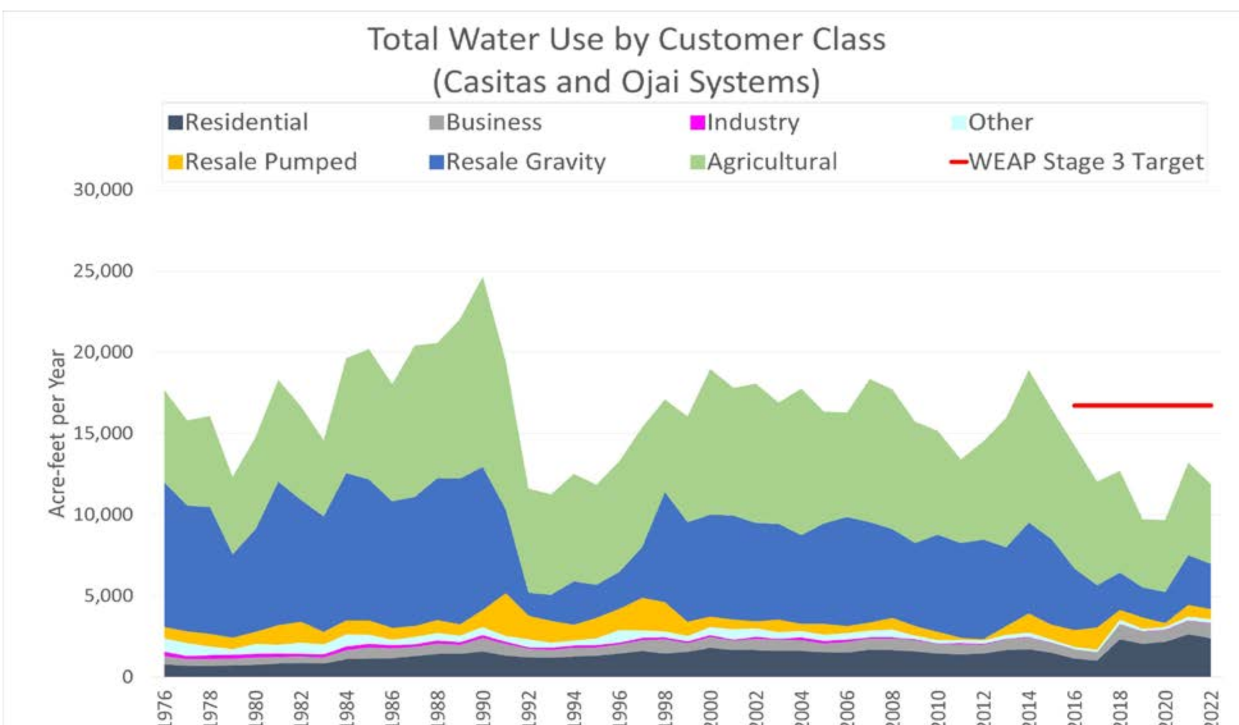
The following table shows the estimated amount of Casitas' water that remained in the Ventura River as instream flows since implementation of the NMFS Biological Opinion. After the Biological Opinion was implemented, the Ventura River Watershed experienced extremely dry conditions from 2012-2022 which allowed for little to no diversions at the Robles Facility putting further strain on Casitas' ability to provide critical water supply. Prolonged drought conditions are common in this flashy Southern California watershed where drought is immediately followed by extreme precipitation and flooding, sometimes during the same water year. Thus, as illustrated in the chart below, Casitas already bypasses substantial amounts of water by its Robles Facility to protect the SC steelhead.

Casitas Water Remaining as Instream Flows under NMFS Biological Opinion Operations for Southern CA Steelhead (Estimated based on Calendar Year 2006-2023 Operations)	
Minimum, Acre-Feet per Year	0
Maximum, Acre-Feet per Year	19,724
Average, Acre-Feet per Year	4,256

[3] Cardno-Entrix. 2012. Ventura River Watershed Protection Plan Report. Prepared for Ventura County Watershed Protection District. February 2012.

Conservation Efforts

Given the Ventura River Watershed history of extended dry periods when limited water supply is available, Casitas has implemented a longstanding conservation program which has been, and continues to be, a cornerstone policy in managing its water supplies. In 1992, the Casitas Municipal Water District adopted a series of ordinances, resolutions, and a Water Efficiency and Allocation Program (WEAP) in response to the increasing water demands and declining water in storage in Lake Casitas experienced during the 1987-1991 drought period. The collective work in 1992 was the starting point for a system of water allocation assignments and demand response criteria for Casitas customers that are based upon the level of water storage in Lake Casitas. Since 1992, there has been a significant outreach by Casitas to raise the public's awareness on the importance to conserve local water supplies, changes in the water supply and demand, regulatory compliance directives pursuant to the Endangered Species Act, and system outage events that temporarily activated Casitas' emergency response plan. The chart below demonstrates successful conservation efforts over several decades with recent water demands over 50% lower than 1989 demand levels. In the most recent drought, Casitas declared Stage 3 of its WEAP which mandated 30 percent conservation and Casitas customers saved water above and beyond this mandate. These collective conservation efforts by the community help stretch available water supplies stored in Lake Casitas. While the level of conservation achieved by Casitas customers is noteworthy and significant, demand hardening has occurred, and additional water supply cuts beyond current levels will be difficult to achieve without damaging entire industries, particularly with regard to Casitas' agricultural customers. The chart below reflects the success that Casitas has had in achieving greater water efficiency across its customer base.



Progress Reports

For the Court's consideration, Casitas is submitting a subset of its annual progress reports related to the Robles Fish Passage Facility which are prepared under the Biological Opinion. They are attached to my Declaration as Exhibit 2. Additional progress reports are available upon request. However, the progress reports are submitted because they include pertinent information demonstrating numerous *O. mykiss* life history features and responses to environmental conditions in the Ventura River Basin. Notable information submitted with the progress reports at Exhibit 2 includes:

- in-channel passage conditions,
- natural surface water connections,
- river discharges when adult SC steelhead have migrated upstream, seasonal and diel migration behavior,
- the successful reestablishment of adult SC steelhead to historic spawning and rearing habitat through passage at the Robles Fish Passage Facility, and
- the cyclic nature of *O. mykiss* abundance and precipitation in the Ventura River Watershed.

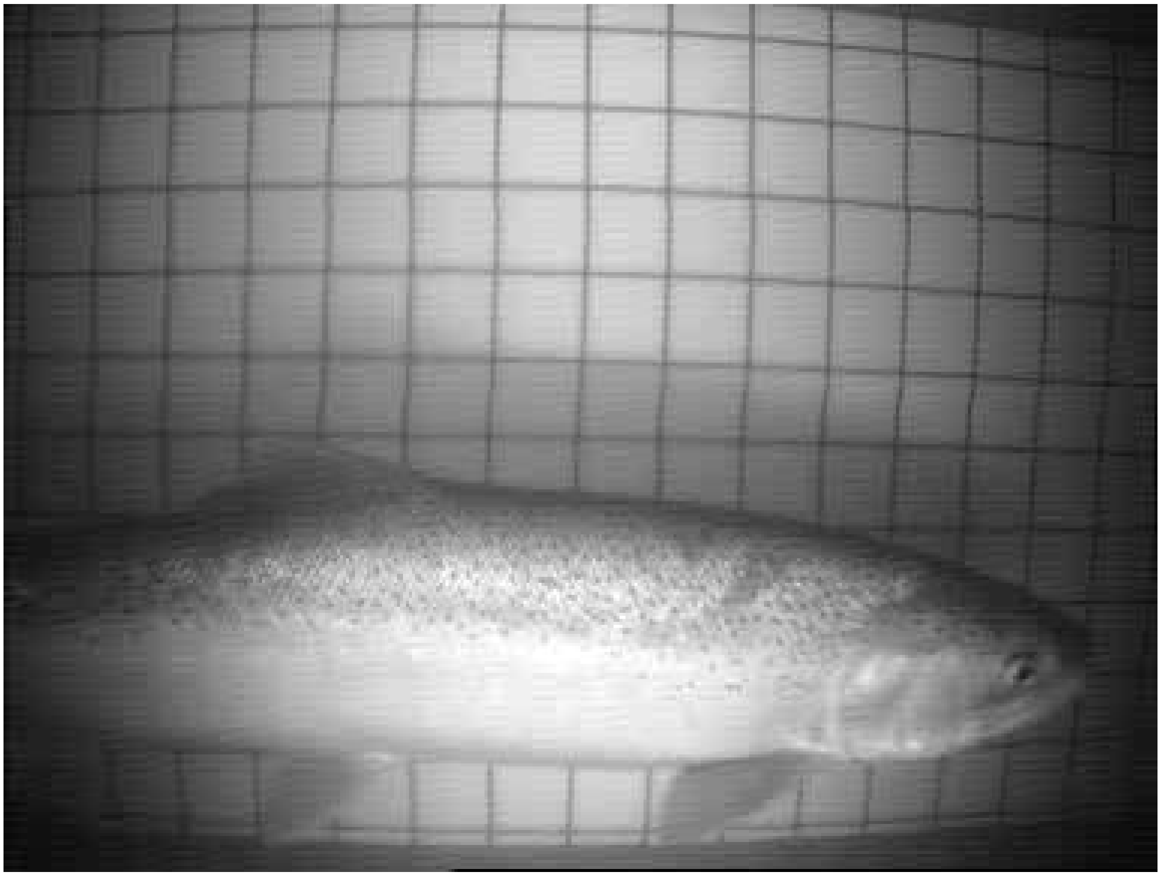
The success of the Robles Fish Passage Facility has been a collaborative effort among USBR, NMFS and CDFW. The monitoring data provided herein demonstrates passage through the facility, and the current recovery process, can result in increases in the SC steelhead numbers, which are naturally cyclical depending on hydrologic conditions in the Ventura River Watershed.

Recovery actions are complex and take considerable time and funding to plan, design, permit, build, and study outcomes. Casitas will continue efforts towards SC steelhead recovery, but doing so in a litigation setting opposed to a more collaborative mediation process has potential to frustrate the meaningful progress that has been made to date in the Ventura River.

Exhibit "2"

2008 Progress Report for the

Robles Diversion Fish Passage Facility



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1.0 EXECUTIVE SUMMARY

Casitas Municipal Water District (CMWD) is implementing the Robles Fish Passage Facility (Robles Facility) Project described in the Biological Assessment (BA) proposed by Reclamation (USBOR 2003) and analyzed in the Biological Opinion (BO) prepared by the National Marine Fisheries Service (NMFS 2003a). This 2008 Annual Progress Report of the Robles Facility, as required by the BO, is the culmination of monitoring and operational data collected during the reporting period of July 1, 2007 to June 30, 2008.

The monitoring and evaluation studies related to the Robles Facility conducted during the 2007-2008 reporting period are included in two main sections of this progress report. The fisheries monitoring section contains: upstream fish migration impediment evaluation, sandbar monitoring at the mouth of the Ventura River, fish attraction evaluation, fish passage monitoring, and downstream fish passage evaluations. The Robles Facility Operation section contains: information and data on the facility status, flow observations and control, costs associated with operation and monitoring, assessment of the effectiveness to provide fish passage, recommendations of priorities for future activities, and revisions deemed necessary to the operations.

During the 2008 migration season, six adult steelhead were detected passing upstream through the fish ladder and three of those were detected migrating back downstream, one of which was detected passing back upstream a second time.

2.0 INTRODUCTION

NOAA Fisheries listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA) of 1973. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) and represented groupings that were considered to be substantially isolated from other steelhead stocks reproductively and were an important part of the evolutionary legacy of the species. The southern California steelhead ESU included, at the time, steelhead populations from the Santa Maria River in San Luis Obispo County south to Malibu Creek in Los Angeles County. The ESU was later extended to the US/Mexican border in San Diego County in 2002 (NMFS 2003b). In a later delineating approach, NOAA Fisheries recognized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) under the ESA (NMFS 2005). The DPS policy differs from the ESU by delineating a group of organisms by “marked separation” rather than “substantial reproductive isolation”. In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated, are still part of the ESU; however, the anadromous *O. mykiss* (steelhead) are now part of a smaller subset identified as the southern California steelhead DPS.

Rainbow trout can be generally organized into four large groupings (Behnke 1992; Scott and Crossman 1973): 1) coastal rainbow trout that extend from northern Baja California to northern Alaska near the Kuskokwim River and also the Kamchatkan Peninsula of northeastern Asia, 2) redband trout of the inland Columbia and Frazer River basins, 3) redband trout of the central valley of California, and 4) trout of the Gulf of California drainages. The taxonomic group of coastal rainbow trout, *O. m. irideus*, exhibit two life history forms; anadromous and resident. The common name for the anadromous life history form is termed steelhead trout and the resident form is generally termed rainbow trout. Throughout the range of coastal rainbow trout, there is a widespread occurrence of the anadromous life history form (Behnke 1992). There are two general life history patterns exhibited by adult anadromous steelhead when they return from the ocean to spawn in fresh water. The patterns are group by either summer or winter spawning runs. There are many exceptions to this pattern, but this general characterization has been use to group steelhead spawning runs by the season in which the peak of spawning run occurs as they return from the ocean (Busby et al. 1996). Summer steelhead are generally found in river systems that drain from far inland like that of the Columbia Basin. Winter steelhead runs are typically found in the coastal areas where river systems is not as large and overall are the most abundant life history pattern within the natural range of the species (Busby et al. 1996).

3.0 MONITORING

The monitoring and evaluation studies and activities related to the modifications of the Robles Facility, as outlined in the BO (NMFS 2003a), were intended to achieve three main objectives:

I. Monitor Fish Passage Facility operations and performance.

II. Determine if the Fish Passage Facility functions and operates in such a fashion that migrating steelhead:
    a. Successfully navigate into and through the facility, and
    b. Move through the facility in good physical condition.

III. Determine if the operations at the Robles Diversion are enhancing the opportunity for:
    a. Adult steelhead to migrate upstream to the Robles Facility, and
    b. Smolts and kelts to migrate downstream through the Robles Reach.

3.1 Upstream Fish Migration Impediment Evaluation

Methods

The objective of the impediment evaluation is to assess factors that may impede steelhead's ability to migrate to the fish passage facilities (NMFS 2003a).

Selected critical passage features will be surveyed multiple times during the fish migration season to determine water depth, velocity, and channel width so that discharge can be calculated. The mainstem Ventura River was first surveyed from the mouth to the Robles Facility using standard stream survey techniques. The survey methodology used followed Moore et al. (2002) and was equivalent to a level IV survey as described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002). Selected sites will be surveyed over a range of discharges from approximately 10-100 cfs (the upper limit dependent on the ability to safely conduct the surveys). The number of repeated surveys will be dependent on the number of significant rain events, the number of selected sites, access to sites, and time constraints due to other aspects of the monitoring and evaluation program. These impediment surveys will most likely be conducted over a period of 3-4 years depending on water conditions. The selected impediment sites will be resurveyed as many times as needed to develop a statistically rigorous data set that could be used to evaluate fish passage.

Results

During 2008, the initial phase was completed by conducting physical stream surveys for the 23 km of the Ventura River from the mouth to the Robles Facility. This provided physical measurements of all habitat units so that a more objective method could be developed to select potential impediments for future monitoring. Of the 378 habitat units surveyed, a subset of 15 sites (14 units plus the sandbar) were chosen for the impediment evaluation that were representative of potential impediment throughout the 23 km reach (Appendix 1). An impediment metric was developed and calculated for all 378 habitat units. A set of initial of sites were chosen based on their impediment metric value and nature of the impediment (Appendix 2).

After discussions with the Biological Committee, NMFS and CDFG believed that this method of site selection could be missing important potential sites for monitoring. Therefore, an alternative method, separately or in conjunction with this metric, of selecting sites will be used in 2009 to determine the final sites for future impediment evaluations.

The impediment metric for each habitat unit was determined by the equation:

$$\text{Impediment Metric} = \log_{10} [(10/((\text{unit length}/\text{unit slope})*\text{unit depth}))+1]$$

The impediment metric value indicates units that have the attributes of being short, steep, and shallow. Shallow water habitat units (i.e., critical riffles) have been commonly used to study potential upstream passage impediments in other California rivers (Dettman and Kelley 1986; Bratovich and Kelley 1988; Hager 1996). By combining all three measurements (unit length, slope, and depth), the shorter, steeper, and shallower a unit is, the smaller the resulting number will be. By dividing this into 10, the smaller numbers become larger and the larger numbers become smaller relative to each other. This creates numbers that range from close to 0 to 10,000, therefore a $\log_{10}$ was needed to make the larger numbers smaller; however, 1 was first added to make all numbers > 1 because the log of a number between 0 and 1 is negative. The impediment metric values for all 378 habitat units ranged from 0.0 to 3.0, with a mean value of 0.34. Of the 378 sites, 7% (n = 26) of the units scored an impediment metric value of greater than 1.0. Of those 26 sites, 20 of the sites were located within the Robles Reach.

Discussion

The habitat surveys were completed in spring of 2008, which allowed the metric analysis to be conducted. The survey, and subsequent analysis, was done to select a subset of all possible passage impediments for further monitoring. The analysis of the habitat units was done by identifying units that were short, steep, and shallow and calculating an impediment metric. The subset was selected based on their metric score and location within the Ventura River. An effort was made to have an approximate 2 km systematic sampling plan to cover each representative reach of the river. This would allow for longitudinal differences of losing and gaining reaches of the river to be captured. Ease of site access was also taken into consideration due to the fact that the sites would potentially be survey multiple times per year during periods when the hydrograph would also be rapidly rising or falling. Of the 15 sites selected, 10 sites are located within the Robles Reach and the remaining 5 sites are located downstream of the Robles Reach. The sandbar at the mouth of the Ventura River was also included because of its unknown potential in limiting entry into the river at lower flows. Ironically, the interim rock weirs downstream of Robles scored as some of the most severe impediments to fish passage. Because of the artificial nature of the rock weirs and proximity to the Robles fish ladder, they were included in the impediment evaluation. The low-flow road crossing was also included in the evaluation for the same reasons. All step units were evaluated for passability using downstream pool depths to step height and steelhead jumping capabilities (Powers and Orsborn 1985). Over the next several years, the selected units will be resurveyed multiple times over a range of flows to determine water depths and velocities. The impediment metric was only developed to as a tool to help objectively select sites rather than subjective site selection, which is the common practice. The metric was not intended to be used for future monitoring of sites, only to aid in site selection.

To reiterate, NMFS and CDFG believed that this method of site selection could be missing important potential sites for monitoring. Therefore, an alternative method, separately or in conjunction with the metric, of selecting sites will be used in 2009 to determine the final sites for the impediment evaluation.

3.1.1 Sandbar Monitoring

Methods

The primary objective of the sandbar monitoring is to determine if the criteria for initiation of the fish passage augmentation season have been met (NMFS 2003a). During each sandbar inspection, observations and recordings were made for: date, time, status of the sandbar, general location of the mouth, tidal stage, water temperature, discharge at the Robles Facility and the USGS Foster Park gauging station, and index count of piscivorous birds.

Results

From July 27, 2007 to June 19, 2008 the mouth of the Ventura River was inspected 23 times to determine if the sandbar had been breached. Thirteen of the observations occurred during the fish passage augmentation season (January 1 to June 30) and 10 were outside of the fish passage augmentation season. The sandbar closed in August 2007 and remained closed for the next several months (Appendix 3). In mid December 2007, the sandbar was breached and the Ventura River was able to flow into the Pacific Ocean allowing fish to volitionally enter or exit the estuary. The sandbar remained open throughout the 2008 fish passage augmentation season. The river discharge during the days the sandbar was inspected at the USGS Foster Park gauge station ranged from about 0.51 to 1,080 cfs and 0.0 to 304 cfs at the Robles Facility. Prior to the sandbar closing in August of 2007, the river was exiting from the westside of the estuary, but once the sandbar was breached in December 2007, the river was exiting from the eastside of the estuary.

A total of 3,381 piscivorous birds were counted during 19 index surveys of the Ventura River estuary (Appendix 4). The bird that was observed the most were gulls at 2,709, followed by pelicans at 345, cormorants at 260, terns at 48, and egrets at 14. Kingfishers, grebes, and herons were counted less than two times during the same period. No mergansers were observed although 5 were observed the previous year (CMWD 2007).

Discussion

Since the sandbar was already breached before January 1, 2008, the fish passage augmentation season began on that date and continued through June 2008. The Ventura River, like many other California rivers, typically develops a seasonal sandbar at the mouth during the late spring or summer and is breached by higher river discharge in the late fall and winter. The sandbar closed the estuary in August 2007 and remained closed until December 2007. However, during 2006 and 2005, a sandbar did not develop at the mouth. As more data are collected on this dynamic process, a better understanding of the Ventura River estuary will begin to be developed and how this process compares with other California systems. The lagoon that forms, if a sandbar develops, can provide important rearing habitat for juvenile steelhead because of the abundant food resources available and facilitate the physiological and behavioral changes associated with steelhead smoltification (Cannata 1998).

3.2 Fish Attraction Evaluation

Methods

The objective of the fish attraction evaluation is to determine if any adult or juvenile steelhead were holding in close proximity to the fish ladder entrance during the fish passage augmentation season (NMFS 2003a). The primary area of interest was the reach immediately downstream of the Robles Facility to the low-flow road crossing. The reach also included the area downstream of the low-flow road crossing within the four rock weirs. The distance of this reach was approximately 200 m. Surveys were completed from January through June of 2008. Bank surveys were conducted by 1-2 surveyors moving in an upstream direction while wearing polarized glasses. Snorkel surveys were also conducted by 1-2 snorkelers in an upstream direction. All fish species were identified and enumerated to extent that the conditions and fish densities would allow.

Results

The reach downstream of the fish facility was surveyed on 26 separate occasions, 17 bank and 9 snorkel surveys. A cumulative total of 5,200 m were surveyed from January through June. An total of 143 fish were observed during all surveys (Appendix 5). The fish most frequently observed was the arroyo chub, *Gila orcutti*, (n = 56), followed by *O. mykiss* at 47. Also observed during the surveys were green sunfish, *Lepomis cyanellus*, (n = 23) and three-spine stickleback, *Gasterosteus aculeatus*, (n = 7). The water temperatures ranged from 9.0 °C in January to 25.0 °C in June.

Discussion

Previous surveys and studies found fish species throughout the Ventura River similar to the surveys conducted in 2008 (EDAW 1978; Moore 1980; CMWD 1988, 2006, 2007; Capelli 1997). The total count of 143 was the result of fish counted multiple times over the course of survey season. In particular, the count of 47 *O. mykiss* in the reach below the Robles Facility was the result of counting fish multiple times. The surface flow connection to the lower river was lost approximately mid-April and the first *O. mykiss* was not observed until April 18th. Undoubtedly, some *O. mykiss* were counted that ultimately migrated downstream. By June 18th, 4 *O. mykiss* were observed in the two large pools on the Ojai Valley Land Conservancy property approximately 1 km downstream of Robles. However, it seems likely that the vast majority of the 47 total *O. mykiss* counted were the result of multiple observations. The highest count of *O. mykiss* during any one survey was 13 and ranged from about 2 to 13 fish. Over the monitoring period, there was an increase of *O. mykiss* downstream of the facility. This could have been do to an inability to migrate upstream through the fish ladder because of insufficient water depth in the ladder or a preference for the cooler water in the entrance pool and a rejection of the warmer water coming from the ladder. Based on observations during the April snorkel surveys, it appeared these fish were going through the smoltfication process, i.e., vanishing parr marks, silvering of the body, and darkening of the margins of the fins. The lack of flow (3 cfs at the peak count of *O. mykiss*) in the channel most likely stopped further migration downstream (Appendix 6). Based on snorkel observations during June, it appeared these fish were beginning to revert to a resident form, i.e., lightening of the margin of the fins, coloring across lateral line, and yellowish-green coloring on the dorsal side of the body.

The total fish count was substantially lower then the previous season with 2,255 fish in 2007 to 141 in 2008, although 97% (n = 2,192) of the fish in 2007 were non-*O. mykiss* species, most of which were arroyo chub. The lower fish counts were most likely caused by the lack perennial flow, thus a lack of habitat, at and near the Robles Facility. In the summer and fall of 2007 the area around Robles was dry, while during the same time period in 2006, surface flow existed at the Facility, thus providing suitable habitat for a continued existence of the these non-*O. mykiss* fish that were counted in the subsequent year.

3.3 Fish Passage Monitoring

Methods

Fish passage monitoring within the Robles Facility is accomplished using a Vaki Riverwatcher (Riverwatcher). The Riverwatcher consists of a scanner with light diodes that send infrared light beams through the water to a receiving scanner plate. When a fish swims through the infrared beams of light, it breaks the signal and a silhouette is recorded on a computer. In addition, when a fish swims through the infrared light beams, the scanner triggers an underwater camera to record a short video clip. Only fish swimming upstream can be recorded with the Riverwatcher system because only one camera can be operated and it is located on the upstream side of the scanner. Other data recorded when the scanner is triggered are: date and time, length of the fish (from a length/height ratio), swimming speed (m/sec), and direction of the fish movement (upstream or downstream). The scanner is positioned in the center of an aluminum frame (fish crowder) covered with 1/2 inch aluminum bars, spaced 1 1/2 inches apart on center, with a resulting 1 inch spacing between the bars. The crowder directs fish that swim between the scanner plates. The crowder acts essentially as a bottleneck for the fish to swim through so they can be counted in both an up- and downstream direction. A separate standalone downstream camera was added in 2008 to verify downstream detections. The downstream camera was independent of the Riverwatcher and the video captured was stored on a digital video recorder (DVR). Two DVR’s were used with one recording for three weeks, while the other is reviewed. After the three weeks the DVR’s were exchanged and the process was repeated. However, this year the downstream camera was only installed for a limited time and continued evaluations and operational logistics are still being worked out.

Upstream detections were reviewed and classified as an adult steelhead, O. mykiss non-adult steelhead, largemouth bass, unknown fish, steelhead probable, fish probable, or not a fish. The classifications were determined by the combination of the silhouette, estimated length, and the video clip. Also, larger *O. mykiss* were measured for a variety of morphometric ratios that were compared to known steelhead and rainbow trout. The adult steelhead classification was used if the fish observed was an O. mykiss and displayed characteristics of an adult steelhead, such as black spotting on dorsal, adipose, and caudal fins, black spotting on dorsal side of body, slivery body, and larger size. O. mykiss non-adult steelhead classification was used if the fish observed was an O. mykiss but did not display the characteristics of an adult O.mykiss. Because of the difficulty in distinguishing between resident and anadromous fish of smaller sizes, no further classifications were used for O. mykiss. The fish unknown classification was used if the detection was known to be a fish, but the species identity could not be determined. The fish probable classification was used if no fish were observed in the video, but the silhouette was similar to that of a typical fish silhouette based on previous experience. The not fish probable classification was used when no fish was observed in the video and the silhouette was not similar to that of a typical fish silhouette and was most likely debris or water turbulence.

Downstream detections were classified as fish probable, steelhead probable, and not fish probable. The fish probable classification was used if the silhouette image was similar to that of a typical fish silhouette. The steelhead probable classification was used when the silhouette was similar to that of a typical fish silhouette and the estimated length was a minimum of 42 cm. The not fish probable classification was used when the silhouette did not look like a typical fish silhouette.

Results

During the 2008 fish migration season, the Riverwatcher recorded 5,592 total detections, of which 1,944 were upstream and 3,648 were downstream (Appendix 7). Of the total upstream detections, 11.6 % (n = 225) were fish and included: 6 adult confirmed steelhead, 1 adult steelhead probable, 74 O.mykiss non-adult steelhead, 81 largemouth bass, 24 fish unknown, and 39 fish probable. Of the total downstream detections, 5.4% (n = 186) were fish and included 3 adult steelhead probable and 183 fish probable.

The dates for the upstream detections occurred from January 31 through June 30 with a mean date of May 23. The 6 upstream adult steelhead passed through the facility between January 31 and February 22, with a mean date of February 7. The one upstream probable adult steelhead was detected by the Riverwatcher on April 23. The one fish that was considered a probable adult steelhead was not confirmed due to a camera malfunction. However, because of the silhouette and size recorded by the Riverwatcher, it was most likely an adult steelhead. The 74 *O. mykiss* non-adult steelhead were detected between February 2 and June 28, with a mean date of April 30. The dates for downstream detections were from February 9 through June 30 with a mean date of May 22. The three downstream probable adult steelhead were detected from February 26 to April 4 with a mean date of March 17. The downstream probable fish were detected from February 9 through June 30 with a mean date of May 28. Of the 7 adult steelhead detected migrating upstream, three were detected in daylight hours and 4 at night.

The total lengths of the upstream adult steelhead ranged from 42 cm to 65 cm with a mean of 55 cm. The one upstream probable steelhead total length was 49 cm. The total lengths of upstream migrating O. mykiss non-adult steelhead were from 12 cm to 39 cm with a mean of 30 cm. The total length of the downstream probable adult steelhead ranged from 43 cm to 49 cm with a mean of 47 cm. The downstream fish probable total lengths were from 14 cm to 48 cm with a mean of 29 cm. In addition to length and visual confirmation of adult steelhead, morphometric analysis was conducted. A conventional method is to use ratios of body measurements for comparison to remove the effects of body size so actual differences can be determined. (Strauss and Bond 1990). This was done by comparing the standard length (SL) to the ratio of eye diameter to SL in linear regression (Appendix 8). Standard length is the length from the snout to the end of the hypural plate near the end of the fleshy caudal peduncle, which is unaffected by caudal fin deformities (Anderson and Neumann 1996). Of the 6 adult steelhead detected, only 5 could be included in this analysis because the video camera malfunctioned. Data for the rainbow trout included in the analysis were from non-adult steelhead from the Ventura River and the data for the steelhead were collected from adult steelhead in Oregon. The one fish that had a total length of 32 cm was concluded to be a rainbow trout because it was smaller that a typical small adult steelhead (Shapovalov and Taft 1954).

The turbidity levels at the time of passage for the upstream adult steelhead ranged from 2 NTU to 22.5 NTU with a mean of 12 NTU. The turbidity levels for the upstream migrating O. mykiss non-adult steelhead were from 0.6 NTU to 21.2 NTU with a mean of 2 NTU. The mean turbidity for the downstream adult steelhead and fish probable was 9 NTU and 2 NTU, respectively.

The discharge at the Robles Facility at the time of upstream passage for adult steelhead ranged from 21 cfs to 129 cfs with a mean of 85 cfs. The discharge for the upstream migrating O. mykiss non-adult steelhead was from 1 cfs to 129 cfs with a mean of 22 cfs. The discharge for the downstream probable adult steelhead ranged from 32 cfs to 50 cfs with a mean of 43 cfs. The mean discharge for the downstream fish probable was 12 cfs.

Discussion

The six adult steelhead that migrated upstream past the Robles Facility relatively soon after the series of storm events in January and February of 2008. From the peak of the last and largest storm event, the travel times to Robles ranged from 4 to 26 days, with a median of 9 days and a mean of 11.

The one additional steelhead that was detected migrating upstream passed the Robles Facility occurred on April 23. At the time of the Riverwatcher detection, the upstream camera was not functioning and no image was recorded to verify the detection as an adult steelhead. Given that the estimated length was 49 cm, the fish was most likely an adult steelhead. It is unlikely that it was a new adult steelhead however, but rather one of the three that had passed downstream through the facility earlier in the season. A steelhead passed downstream three weeks prior on April 4 that had an estimated length of 49 cm. The surface water connection to the lower river was lost sometime around April 18 approximately 4.5 km downstream of the Robles Facility preventing any downstream migration. The steelhead which passed through the ladder on April 4 migrating downstream most likely made it a few kilometers downstream before having to turn around and migrated upstream again, passing back through the facility on April 23. Three probable adult steelhead passed downstream through the fish passage facility in 2008. The first downstream adult passed through the facility 26 days after the first adult steelhead passed upstream and just 4 days after the last adult passed upstream. Post-spawn adult steelhead are termed kelts; however, the spawning status of the three adult steelhead that migrated downstream through the Robles fish ladder was not known.

During the 2008 fish migration season, three adult steelhead were visually observed: two in the pool at the fish ladder entrance (on March 3 and 21). On March 21, an adult steelhead was observed just upstream of Santa Ana Blvd Bridge. It is unknown which direction this steelhead was traveling, but it was most likely migrating downstream due to the date, river discharge, and timing other detected steelhead.

The hour of detection by the Riverwatcher revealed a diel migration pattern for non-adult O. mykiss through the fish passage, in which O. mykiss are migrating downstream just before dawn then migrating back upstream just after dusk. The hour of upstream migration for O. mykiss peaked at 2000 h. There was also a peak of downstream migration for fish at 0500 h. Although it is unknown which species was migrating downstream, they are likely O. mykiss. The distance of the daily travel is unknown, it is probable the fish are remaining within the area around the facility since the number *O. mykiss* visually observed near the Robles Facility remained relatively constant for periods of time. A full listing of fish detection can be found in Appendix 9 and of steelhead adults only in Appendix 10 and 11.

Equipment Issues

There were several technical problems with the Riverwatcher during the 2008 season. On several occasions in January and February, the communication connection was lost between the Riverwatcher and the computer. The communication was generally lost for less than one day. Attempts were made to fix the problem which included: powering down the computer and restarting the system, inspection of cables and connectors, and cleaning and re-greasing of connections. Generally one of these actions would remedy the problem. Then, in April, for a period of several weeks, the video communication from the Riverwatcher to the computer was not working. The Riverwatcher continued to function as a counter, but the video communication was lost. The problem was eventually diagnosed as a faulty cable; several wires had broken off from inside a connector. The damaged cable was the likely cause of communication problems between computer and the Riverwatcher earlier in the season.

One of the two Riverwatcher lights seals failed and filled with water during the season and a replacement light was ordered and installed. In discussions with Vaki, Casitas was informed that white lights are now being offered as well as the standard red lights. Vaki stated the white lights are now the preferred light color for Riverwatcher systems. However, Vaki could not provide any scientific data of the effects of the use of red or white lights. Therefore, at this time Casitas intends to continue using the red lights until it can be determined that white lights do not interfere with migration.

The upstream camera was moved mid-season because the speed at which the upstream adult steelhead were swimming, the video system could not start soon enough to maximize the amount of time a steelhead was in the field of view. The camera was moved upstream, within in tunnel, approximately 1 foot. The effect of the new camera position was not analyzed because additional adult steelhead did not pass upstream after the modification.

The downstream camera was installed on March 11, 2008. However, within hours the “waterproof” camera filled with water and stopped operating. A replacement camera was installed on April 21, 2008. The review process was more time consuming then initially anticipated because of several technical issues related to the speed of searching video, time differences between the Riverwatcher and DVD, and field of view of the camera. The effectiveness of the downstream camera to verify detections was much less then expected because of the technical issues.

Non-fish detections remain an issue with the Riverwatcher. During storm events, leafy and woody debris remains an issue causing false detections by the Riverwatcher and blockage the crowded. Later in the season as water temperatures increased, filamentous algae caused blockage of the crowder and also caused false detection by the Riverwatcher. Water turbulence also appears to cause false detections.

The effects of turbidity on the Riverwatcher efficiency continues to be being evaluated. The current findings show the Riverwatcher begins to function below 200 NTUs. In the 150-200 NTU range, the Riverwatcher is operational, but seems to have many false detections. This is most likely caused from a combination from the suspended material in the water deflecting the light from the scanner plate and high debris. In the 30-150 NTU range, the Riverwatcher was operating, but the camera could only be used to verify detections at turbidity levels below approximately 30 NTU. The effects of turbidity on the Riverwatcher will continued to be evaluated.

3.4 Downstream Fish Passage Evaluations

Methods

There are two main objectives for the downstream fish passage evaluation. The first objective is to determine if steelhead are successfully passing through the Robles Facility. The second objective is to capture and examine steelhead smolts and kelts and determine if there are any injuries that may have been caused by downstream passage through the Robles Facility (NMFS 2003a).

A weir trap was placed and operated approximately 100 m downstream of the Robles Facility. The weir trap consisted of a live-box with an internal fyke situated near the bank. A fence was extend upstream at a 45° angle, approximately 3/4 of the way into the river channel from the live-box allowing any adult steelhead to pass upstream by the trap location (Appendix 12). The trap was planned to be operated from mid-March through June or until water temperatures exceeded a daily mean of 22°C, which could negatively impact capture fish (SYRTAC 2000). However, the trap was not installed until April after a CDFG permit was obtained.

Results

The trap was operated from April 9, 2008 to June 16, 2008. The trap generally operated from Sunday afternoon through Saturday morning. No *O. mykiss* were trapped during this time period. Although green sunfish, *Lepomis cyanellus*, (n = 1), bullfrog, *Rana catesbeiana*, (n = 3), western pond turtle, *Clemmys marmorata*, (n = 4) and red swamp crayfish, *Procambarus clarkii*, (n = 4), were trapped. Since no O. mykiss were trap, no radio tags were used to determine downstream smolt migrations. The average daily water temperature was 22°C on three of the four days prior to the trap being removed, which was the criterion for trap removal. The stream discharge ranged from 3 cfs to 27 cfs (see appendix 6, 13, and 14 for discharge data and trends during trapping period).

Discussion

The trap was installed and operational later then was expected. This delay in trapping was most likely the cause for not capturing *O. mykiss* in the trap. In May, one O.mykiss was observed immediately downstream of the trap in the weir pools. It is unknown when and how long the fish was there, but there is a possibility the fish may have avoided the trap and successful migrate downstream around the trap or may have moved downstream while the trap was removed for the weekend. Even through there were up to 10 *O. mykiss* observed in the entrance pool and numerous *O. mykiss* were passing back and forth through the fish ladder, it appeared there was a general lack of urgency to migrate downstream. This could be partly explained by the elevated water temperatures that can cause the smoltification process to stop and allow the fish to revert back to a resident form (Allan T. Scholz, Eastern Washington University, personal communication). The trap was effectively operated in flows up to 27 cfs during the 2008 migration season. However, these levels are thought to be well under the maximum operational limit of the trap. After next years trapping season, the upper limit of river flow operation will be determined, if conditions exist.

4.0 ROBLES FACILITY OPERATIONS

4.1 Facility Status

The Robles Fish Passage Facility started the 2007-2008 season in a fully functional mode. The 2007-2008 season was characterized by an average rainfall year as measured at Casitas Dam with more snow pack than normal in the watershed. Two water diversion periods occurred during the year. The first occurred between January 4 and January 11, 2008. The second diversion period began on January 24 and continued until March 31, 2008. It appeared that the snow pack remained in the mountains for a longer period of time resulting in an extended recession of the surface flows. Some surface flow continued over the measurement weir until August 2008.

The 2007 Report identified several projects to be completed during the summer and fall. The principal projects were:

- Cut rebar in spillway
- Fill in scour hole at the diffuser (entrance) box w/rock
- Remove Arundo/non native plant
- Implemement MWH recommended Improvements to the brush system.
- Repair trash grate in the entrance box
- Install raw water pump for screen cleaning
- Repair or replace auxiliary pipeline flowmeter

A brief description of each project and the project's status is listed below:

Cut Rebar in Spillway-Scour of the concrete deck in the spillway has occurred, exposing steel rebar. Rather than resurface this area with concrete at this time, the rebar was removed. At some point in the future, this area will require a concrete repair.

Fill in Scour Hole at the Diffuser (entrance) Box with Rock-A scour hole developed in the entrance pool and threatened to undermine the diffuser structure. The scour hole was filled with rock.

Removal of *Arundo donax* from the forebay and channel-This year, removal of the non native plants was accomplished by the same crews removing arundo for the County as part of the Matilija Dam removal project.

Implement some of MWH Recommended Improvements to the Brush System – MWH, a consulting firm formerly known as Montgomery Watson Harza, was hired by Casitas to make recommendations on the brush system. MWH produced a report with suggested modifications. Casitas implemented several of these improvements, including shorter, stiffer brushes, articulated (windshield wiper) brush arms and hydrofoil wings on the brush arms. The modified brush assemblies removed significantly more debris than the original design. However, the existing brush motors were unable to drive the brushes at full stage condition. Casitas intends to upgrade the brush motor drive system this summer and fall. Brush motors will be increased from 1.5 hp to 5 hp and the gear drive will be upsized to meet the requirements of the new motor. New variable frequency drives will be installed for the upsized motors. The variable frequency drives will be relocated to an enclosure near the brush motors. This should reduce the electrical interference the variable frequency drives have had on some of the instrumentation at Robles Fish Passage.

Repair the trash grate and diffuser panel in the entrance box-The winter storms of 2004-2005 damaged one of the vertical grates at the entrance/diffuser box. In the summer of 2005, Casitas staff was unable to close the entrance box gates and pump the box dry to facilitate the removal and repair of the grate. During the fall of 2006, the gates were closed sufficiently to allow the entrance box to be pumped dry. This allowed for the inspection and repair of the trash grate. Temporary repairs were made to the diffuser panels. Permanent repairs were completed in the summer of 2007 after surface flow in the river stopped. Further modifications for the diffuser panels are anticipated to allow for removal without draining the box.

Install raw water pump for screen cleaning-A raw water pump was purchase for use at the Robles Fish Passage. Unfortunately, the pump was damaged in shipping and was returned. The replacement has arrived and will be installed this summer and fall.

Repair of the auxiliary flow meter-The auxiliary flow meter was not operational by the end of the 2005-2006 season. In the fall of 2006, when the entrance box could be drained, the transducers for the auxiliary flow meter were inspected. The mounting band holding the transducers was torn loose from the pipe. The band was damaged. To protect the instrument from further damage it was removed. During the fall of 2007 while there was no surface flow in the river, a new mounting band was installed. The repaired flow meter appears to be working, however Casitas has not yet been able to verify the accuracy of the instrument.

4.2 Flow Observations and Control

The District collected flow information and verified flows where and when reasonably safe conditions existed in the Ventura River. Flow and level measurement devices are also located at various locations within the Robles Fish Passage Facility. The primary points of measuring and recording stream flows entering, flowing through and leaving the Robles Fish Passage Facility are:

- Matilija Creek at Matilija Hot Springs – located approximately 2,100 feet downstream of Matilija Dam – good rating for low to moderate flows – operated by Casitas Municipal Water District, formerly a USGS station;

- North Fork Matilija Creek – located approximately 3,000 feet upstream of its confluence with Matilija Creek – good rating for low to moderate flows – operated by the Ventura County Watershed District;
- Robles-Casitas Diversion Canal – located on the diversion canal approximately 1,300 feet downstream of the Robles Diversion Dam – trapezoidal channel with a good rating for flows up to 600 cfs;
- Ventura River near Meiners Oaks (VRNMO) – located approximately 540 feet downstream of the Robles Fish Passage spillway – concrete weir section – good rating to 70 cfs, use of equations above 70 cfs with poor ratings above 1000 cfs (no verifications at higher flows).
- Fish Ladder-A 4 path flow meter by Accusonics located near the Riverwatcher. Provides reasonable flow data in the 15 to 60 cfs range.
- Auxiliary Water Supply-An American Sigma flow meter.

All of the instruments can suffer from inaccuracies from time to time. The inaccuracies can be caused by clogging of bubbler lines, electronic creep, debris accumulating on sensors, changes to the measured cross sections, and equipment problems. As an example, the bubbler at the low flow crossing stopped providing accurate measurements early in the flow season. A new bubbler hose was required to correct the problem. For this reason, the data is verified against field measurements and observations. The information gathered from each of these locations has been reduced to the daily reporting of flows in the form of average cubic-feet per second. The spreadsheets are in Appendix 13, entitled "Ventura River Flow Assessment for the Robles Fish Passage Facility – FY 07-08" and general trends from Appendix 14).

The first surface flows came to Robles with the January rain storms. The screens remained in place for the entire year.

Five storm peaks, several of them overlapping, triggered BA/BO required supplemental flow releases.

Facility Testing

Casitas had entered into an agreement with Wood Rodgers to complete performance testing on the Robles Fish Passage Facility. Wood Rodgers primary human resource on the project left the firm. Wood Rodgers did not have anyone else on staff capable of replacing this person, so Wood Rodgers requested to be released from the contract. Casitas was unable to contract with another firm before the end of the flow season. Testing will be completed next year if there are sufficient flows for testing.

4.3 Costs Associated with Operation and Monitoring

The BA/BO specified that the District provide the costs that are associated with the activity. The following is a summary of the direct costs incurred by the District during the 2007-08 fiscal years:

- **Fisheries Monitoring**:

Salaries	$233,404
Equipment	$ 16,091
Materials	$ 22,855
Permits	$ 295
	$272,645

- **Facility Operations**:

Salaries	$ 63,823
Materials	$ 15,044
Permit	$ 471
Equipment	$ 11,898
	$ 91,236

- **Capital Improvements**:
  No capital improvement costs were incurred this year.

4.4 Assessment of the Effectiveness to Provide Fish Passage

A total of 10 adult steelhead were documented passing through the Robles Fish Passage. Six passed upstream, three downstream, and one passed back upstream a second time. This provides evidence that the fish passage facility is effective in providing fish passage for steelhead.

4.5 Recommendations Regarding the Prioritization of Future Activities

The District has completed its third season with the fish passage fully operational. Several projects have been identified to improve the functionality and reliability of the system. Other items require repairs. The summer and fall work list includes:

- Upgrading the brush drive system
- Modify the brush on the west side to match the brush on the east and make all modifications permanent.
- Adjust the notch on interim weir two.
- Install the raw water pump.
- Purchase and install small crane to facilitate brush removal.
- Removal of reeds from fish passage facility.

4.6 Recommendations on any Revisions Deemed Necessary to the Operations

Casitas recommends that the construction of the 15-weir portion of the project be put on hold at least until the Matilija Dam Removal Project is completed. Physical and numerical model studies show that the Robles Reach of the river will significantly accrete with the removal of the dam. The level of accretion would be sufficient to bury the weirs. The accretion of sediment in this reach would make the weirs unnecessary for grade control.

5.0 LITERATURE CITED

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 477-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Bratovich, P. M., and D. W. Kelley. Investigation of salmon and steelhead in Lagunitas Creek, Marin County, California. Volume 1. Migration, spawning, embryo incubation and emergence, juvenile rearing, emigration. Marin Municipal Water District. Corte Madera, California.

Busby, P. B., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. National Marine Fisheries Service. NOAA technical memorandum NMFS-NWFSC-27, August 1996.

Cannata, S. T. 1998. Observations of steelhead trout (*Oncorhynchus mykiss*), coho salmon (*O. kisutch)* and water quality pf the Navarro River estuary/lagoon, May 1996 to December 1997. Draft report, Humboldt State University Foundation. Humboldt, CA.

Capelli, M. H. 1997. Ventura River steelhead survey. Prepared for California Department of Fish and Game, Region 5.

CMWD. 1988. Ventura River fisheries monitoring program monthly report, June, 1988. Casitas Municipal Water District, Oak View, CA.

CMWD. 2006. 2006 Annual progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2007. 2007 Annual progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

Dettman, D. H., and D. W. Kelley. 1986. Assessment of the Carmel River steelhead resource, Volume 1. biological investigations. Monterey Peninsula Water Management District, Monterey, CA.

EDAW. 1978. Draft environmental impact report: Ventura River conjunctive use agreement. Casitas Municipal Water District and the City of San Buenaventura.

Hagar, J. 1996. Salinas River steelhead status and migration flow requirements. Monterey County Water Resources Agency. Salinas, California.

Moore, M. R. 1980. Factors influencing the survival of juvenile steelhead rainbow trout (Salmo gairdneri gairdneri) in the Ventura River, California. MS Thesis. Humboldt State University, Humboldt, CA.

National Marine Fisheries Service. 1997. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead. Federal Register, 50 CFR Parts 222 and 227 [Docket No. 960730210–7193–02; I.D. 050294D] RIN 0648–XX65. Vol. 62, page 43937.

National Marine Fisheries Service. 2003a. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

National Marine Fisheries Service. 2003b. Endangered and Threatened Species: Range Extension for Endangered Steelhead in Southern California. Federal Register, 50 CFR Part 224 [Docket No. 001025296-2079-02; I.D. 072600A] RIN 0648-AO05. Vol. 67 page 21586.

National Marine Fisheries Service. 2005. Endangered and Threatened Species: Request for Comment on Alternative Approach to Delineating 10 Evolutionarily Significant Units of West Coast Oncorhynchus mykiss. 50 CFR Parts 223 and 224 [Docket No. 040525161–5274–05; I.D. No. 052104F] RIN No. 0648–AR93. Vol. 70 page 67130.

Powers, P. D., and J. F. Orsborn. 1985. Analysis of barriers to upstream fish migration. Bonneville Power Administration, project No. 82-14.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa, Bulletin 184.

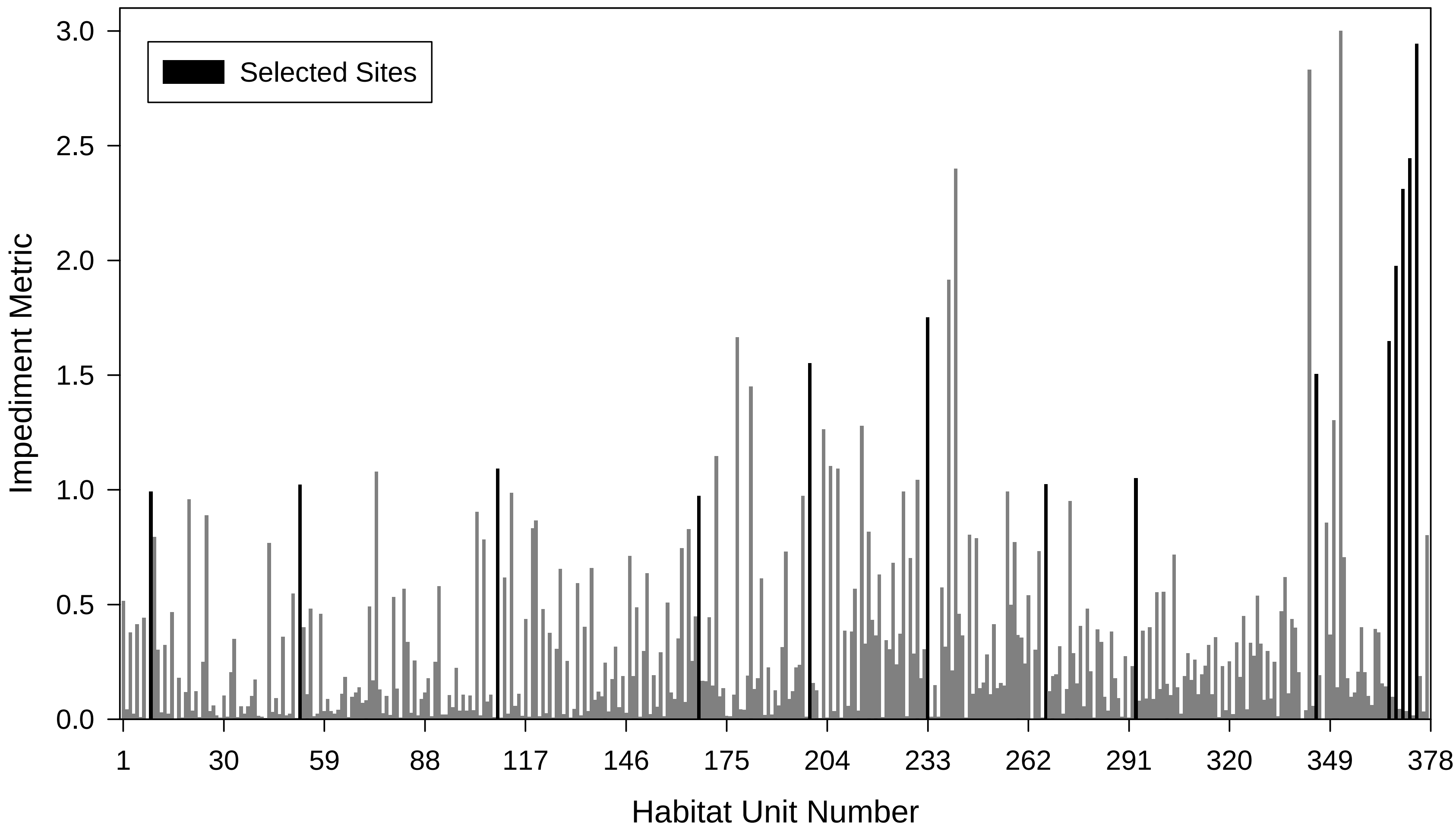
Strauss, R. E., and C. E. Bond. 1990. Taxonomic methods: In Schreck C. B. and P. B. Moyle, editors. Methods for fish biology. AFS, Bethesda, Maryland.

Shapovalov, L. and A. C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*), with special reference to Waddell Creek, California, and recommendations regarding their management. State of California Department of Fish and Game, fish bulletin No. 98.

SYRTAC (Santa Ynez River Technical Advisory Committee). 2000. Lower Santa Ynez River fish management plan. Santa Ynez River Consensus Committee, Santa Barbara, CA.

U.S. Bureau of Reclamation. 2003. Revised biological assessment for diversion operations and fish passage facilities at the Robles Diversion, Ventura River, CA. South-Central California Area Office, February 21, 2003.

6.0 APPENDIXES



Appendix 1. Impediment metric values for all surveyed habitat units from the mouth of the Ventura to the Robles Fish Facility.

Appendix 2. Impediments sites initially selected for upstream fish migration impediment evaluations.

Unit Number	Unit[1] Type	Unit Length (m)	River Kilometer	Unit Width (m)	Unit Slope (%)	Unit Depth or Step Height (m)	Discharge at time of Survey (cfs)[2]	Metric Score	Selection Criteria
0	sandbar		0.0						First potential impediment and unknown status.
9	RB	11.7	0.4	11	3.1	0.3	13	0.99	Highest IM score in 2 km reach.
52	RB	18.6	3.8	2	6.2	0.35	9.8	1.02	Highest IM score in 2 km reach.
109	RI	16.4	7.5	15	2.8	0.15	10	1.09	Highest IM score in 4 km reach and near other monitoring sites.
167	RB	22	11.0	27	3.7	0.2	9.6	0.97	2nd highest IM score and near ENTRIX (1999) site.
199	RI	10.1	13.1	10	3.5	0.1	124	1.55	Highest IM score in 2 km reach.
233	RI	8.4	14.5	36	7	0.15	42	1.75	3rd highest IM score in 2 km reach with good access.
267	CB	26.1	16.3	22	5	0.2	30	1.02	Highest IM score in 2 km reach.
293	RB	24.4	18.4	8	5	0.2	21	1.05	Highest IM score in 2 km reach.
345	CB	9.2	21.6	24	10	0.35	14	1.51	3rd highest IM score in 2 km reach and selected due to more difficult fish passage.[3]
366	SS	5.1	22.7	17	10	0.5	14	1.65	Artificial rock weir.
368	SS	4.7	22.7	15	11	0.5	14	1.98	Artificial rock weir.
370	SS	4.9	22.7	22.5	20	1.1	14	2.31	Artificial rock weir.
372	SS	3.6	22.7	21	20	0.6	14	2.45	Artificial rock weir.
374	SS	0.5	22.7	7	44	0.4	14	2.94	Road Crossing.

[1] The habitat types are: RB = rapid with protruding boulders, RI = riffle, CB = cascade over boulders, and SS = step crated by artificial structure (Moore et al. 2002).

[2] Discharge for USGS station at Foster Park or Casitas station at Robles was recoded depending on which station was most representative.

[3] The first and second highest scoring units were step-type habitats that were considered passable based on downstream pool depth, step height, step length, and steelhead jumping capabilities (Powers and Orsborn 1985).

Appendix 3. Ventura River sandbar monitoring from July 2007 to June 2008.

Date	Sandbar Breeched (Y/N)	Time (24h)	Tide Height (ft)	Tidal State	High Tide Time (24h)	High Tide Height (ft)	Low Tide Time (24h)	Low Tide Height (ft)	Temp (°C)[1]	Discharge at Foster[2] (cfs)	Discharge at Robles (cfs)	Notes
07/27/07	Y	10:00	3.58	slack	9:56	3.59	3:19	2.71	23.2	4.3	0	Open west bank
08/14/07	N	11:00	4.58	ebb	11:28	4.65	5:14	-0.30	23.1	2.6	0	If breach, open WB
09/11/07	N	11:00	4.90	ebb	11:13	5.07	16:09	1.13	20.9	2.5	0	If breach, open WB
10/16/07	N	9:00	4.16	flood	11:48	5.02	4:42	2.88	15.6	1.2	0	If breach, open WB
11/07/07	N	7:30	5.63	slack	7:24	5.64	14:14	0.26	13.9	0.72	0	If breach, open WB
11/14/07	N	10:50	5.22	ebb	10:30	5.24	18:49	0.32	14.7	0.73	0	If breach, open WB
12/11/2007	N	10:30	5.61	ebb	9:14	5.91	16:57	0.32	9.0	0.51	0	If breach, open EB
12/18/2007	N	9:00	2.09	ebb	4:12	5.00	11:12	1.30	11.6	1.2	0	If breach, open EB
12/19/2007	Y	9:00	2.43	ebb	4:54	5.55	12:12	0.38	12.8	1.4	0	Open east bank
12/26/2007	Y	9:20	6.12	flood	10:12	6.35	4:07	2.29	8.6	0.62	0	Open east bank
01/02/2008	Y	9:30	2.25	ebb	4:58	4.95	12:42	0.72	9.6	0.61	0	Open east bank
01/15/2008	Y	9:15	1.47	flood	2:13	4.80	20:05	1.71	10.5	4.9	8	Open east bank
01/29/2008	Y	11:45	1.98	flood	14:54	2.43	9:30	1.68	10.9	1080	304	Open east bank
02/20/2008	Y	9:15	5.90	ebb	8:29	6.10	15:24	-1.05	14.2	56	47	Open east bank
02/29/2008	Y	11:45	0.44	ebb	6:13	5.01	13:37	-0.39	15.8	79	59	Open east bank
03/11/2008	Y	12:20	3.26	flood	13:04	3.37	7:02	-0.03	18.0	57	49	Open east bank
03/25/2008	Y	14:47	2.51	ebb	12:30	3.11	17:24	1.84	20.5	53	43	Open east bank
04/08/2008	Y	10:25	2.81	flood	12:15	3.64	5:59	-1.03	15.8	40	28	Open east bank
04/24/2008	Y	14:30	2.67	ebb	13:47	2.70	17:02	2.52	21.0	29	20	Open east bank
05/06/2008	Y	11:10	3.72	flood	11:26	3.74	5:03	-1.66	17.9	20	13	Open east bank
05/21/2008	Y	11:24	3.08	flood	11:58	3.14	5:24	-0.56	21.1	13	4	Open east bank
06/05/2008	Y	10:00	2.24	flood	12:27	3.72	5:50	-1.82	19.4	19	3	Open east bank
06/19/2008	Y	9:55	2.70	flood	11:52	3.37	5:14	-0.66	21.1	17	0	Open east bank

[1]Main St. Bridge temperature probe at time of observation.

[2]USGS gauging station 11118500, downstream of Foster Park. Data is provisional and subject to revision.

Appendix 4. Ventura River estuary piscivorous bird survey from July 2007 through June 2008.

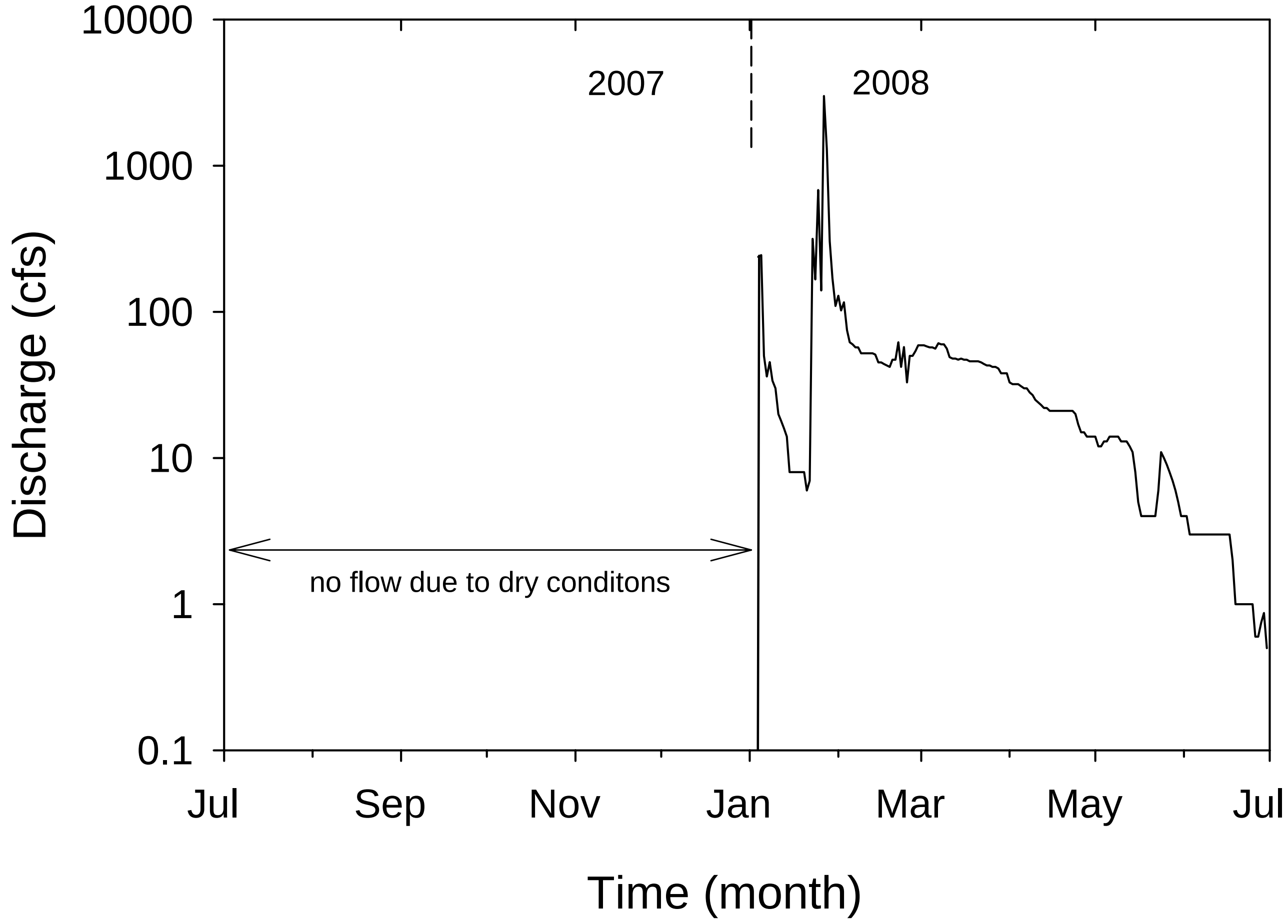
		Common Name and Quantity of Observed Birds									
Date	Time	Gulls	Pelicans	Cormorants	Terns	Egrets	Greebs	Herons	Kingfishers	Mergansers	Total
07/27/2007	10:00	44	0	4	33	0	0	0	0	0	81
08/14/2007	11:00	109	3	7	15	0	0	0	0	0	134
09/11/2007	11:00	130	0	7	0	1	0	0	0	0	138
10/16/2007	9:00	73	0	0	0	2	0	1	1	0	77
11/14/2007	10:40	147	21	18	0	0	0	0	0	0	186
12/11/2007	10:20	272	9	0	0	8	0	1	0	0	290
01/02/2008	9:30	112	2	10	0	0	0	0	0	0	124
01/15/2008	9:15	147	0	15	0	2	2	0	0	0	166
01/29/2008	11:45	267	4	9	0	1	0	0	0	0	281
02/20/2008	9:15	147	12	25	0	0	0	0	0	0	184
02/29/2008	11:45	102	0	16	0	0	0	0	0	0	118
03/11/2008	12:30	54	20	0	0	0	0	0	0	0	74
03/25/2008	14:50	327	11	6	0	0	0	0	0	0	344
04/08/2008	10:25	64	50	37	0	0	0	0	0	0	151
04/24/2008	14:30	236	0	33	0	0	0	0	0	0	269
05/06/2008	11:07	99	3	27	0	0	0	0	0	0	129
05/21/2008	11:24	137	19	28	0	0	0	0	0	0	184
06/05/2008	10:00	112	170	11	0	0	0	0	0	0	293
06/19/2008	9:45	130	21	7	0	0	0	0	0	0	158
Total		2709	345	260	48	14	2	2	1	0	3381

Appendix 5. Fish attraction evaluation downstream of Robles Fish Passage Facility

Date	Method	Location	Length (M)	Temp (°C)	Turbidity (NTU)	Discharge from Robles (cfs)	Species	Quantity
01/08/2008	Bank	Robles entrance pool to d/s most rock weir	200	9.0	48.7	45	NFO	
01/16/2008	Bank	Robles entrance pool to d/s most rock weir	200		9.12	8	NFO	
01/23/2008	Bank	Robles entrance pool to d/s most rock weir	200			316	NFO	
01/30/2008	Bank	Robles entrance pool to d/s most rock weir	200		31.1	170	NFO	
02/06/2008	Bank	Robles entrance pool to d/s most rock weir	200	9.1	7.1	60	NFO	
02/14/2008	Bank	Robles entrance pool to d/s most rock weir	200	11.3	2.06	51	NFO	
02/21/2008	Bank	Robles entrance pool to d/s most rock weir	200	12.7	1.34	47	NFO	
02/27/2008	Bank	Robles entrance pool to d/s most rock weir	200	11.0	4.13	50	NFO	
03/04/2008	Bank	Robles entrance pool to d/s most rock weir	200	11.5	2.51	57	NFO	
03/12/2008	Bank	Robles entrance pool to d/s most rock weir	200	13.3	1.91	48	NFO	
03/14/2008	Snorkel	Robles entrance pool to d/s most rock weir	200			47	NFO	
03/19/2008	Bank	Robles entrance pool to d/s most rock weir	200	12.6	4.98	46	NFO	
03/27/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	15.0		42	LMB	1
04/02/2008	Bank	Robles entrance pool to d/s most rock weir	200	14.5	0.56	32	NFO	
04/08/2008	Bank	Robles entrance pool to d/s most rock weir	200	17.0	2.32	28	NFO	
04/10/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	13.0		25	NFO	
04/18/2008	Bank	Robles entrance pool to d/s most rock weir	200	21.5	2.15	21	OMY	3
04/23/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	16.0		21	NFO	
05/08/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	16.0		14	NFO	
05/13/2008	Bank	Robles entrance pool to d/s most rock weir	200	16.0		12	OMY	2
							ARC	22
05/20/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	21.0		4	OMY	8
							UKN	2
							LMB	2
05/27/2008	Bank	Robles entrance pool to d/s most rock weir	200	15.0	0.5	8	OMY	3
06/04/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	20.5		3	OMY	13
							GSF	4
							LMB	1
							TSS	4
							ARC	10
06/12/2008	Bank	Robles entrance pool to d/s most rock weir	200	18.4	0.5	3	OMY	3
06/18/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	25.0		2	OMY	8
							LMB	2
							TSS	1
							ARC	19
							GSF	6
							UKN	1
06/24/2008	Snorkel	Robles entrance pool to d/s most rock weir	200	23.6	0.72	1	OMY	7
							LMB	1
							ARC	5
							TSS	2
							GSF	13

Fish species codes: O. mykiss = OMY, threespine stickleback = TSS, arroyo chub = ARC
green sunfish = GSF, unknown fish species: UKN, no fish observed = NFO.

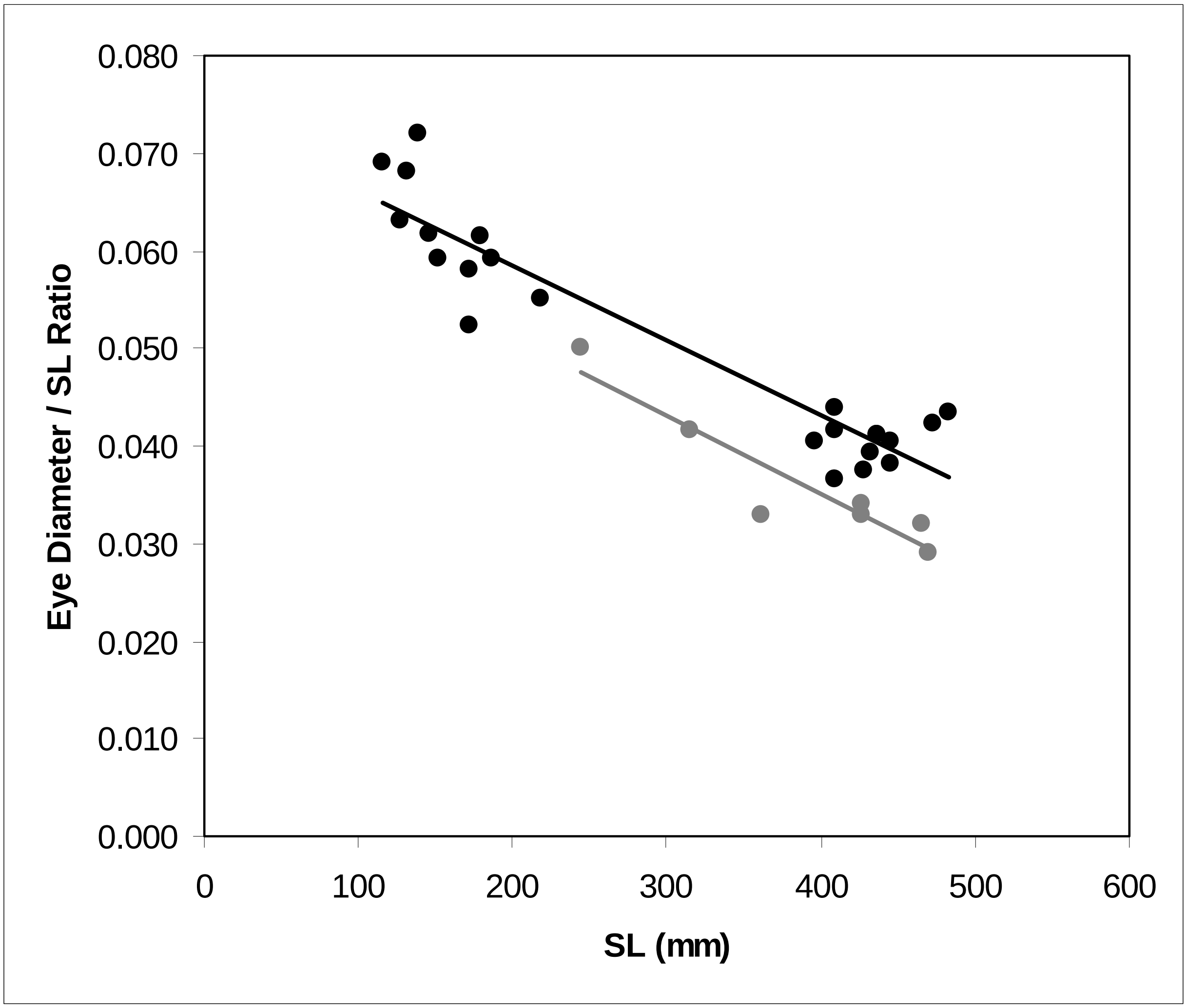
Species	Total
arroyo chub	56
O. mykiss	47
green sunfish	23
threespine stickleback	7
largemouth bass	7
unknown fish	3
Total	143



Appendix 6. Discharge (cfs) below the Robles Fish Passage Facility for the reporting period from July 1, 2007 through June 31, 2008.

Appendix 7. Summary of Vaki Riverwatcher counts at the Robles Fish Passage Facility for 2008.

	Upstream	Downstream
Adult Steelhead	6	0
Adult Steelhead, probable	1	3
O.mykiss, non-adult steelhead	74	0
Largemouth Bass	81	0
Fish, unknown	24	0
Fish, probable	39	183
Not Fish, probable	1719	3462
Total	1944	3648
Mean Date - Adult Steelhead	2/7/2008	N/A
Mean Date - Adult Steelhead, probable	4/23/2008	3/17/2008
Mean Date - O.mykiss, non-adult steelhead	4/30/2008	N/A
Mean Date - Fish, unknown	6/11/2008	N/A
Mean Date - Fish, probable	5/23/2008	5/28/2008
Mean Date - Largemouth Bass	6/15/2008	N/A
Mean Time - Adult Steelhead (24h)	14:51	N/A
Mean Time - Adult Steelhead, probable (24h)	10:42	8:58
Mean Time - O.mykiss, non-adult steelhead (24h)	15:18	N/A
Mean Time - Fish, unknown (24h)	18:06	N/A
Mean Time - Fish, probable (24h)	10:13	16:35
Mean Time - Largemouth Bass (24h)	15:21	N/A
Mean of Mean Daily Turbidity - Adult Steelhead (NTU)	12	N/A
Mean of Mean Daily Turbidity - Adult Steelhead, probable (NTU)	2	9
Mean of Mean Daily Turbidity - O.mykiss, non-adult steelhead (NTU)	2	N/A
Mean of Mean Daily Turbidity - Fish, unknown (NTU)	1	N/A
Mean of Mean Daily Turbidity - Fish, probable (NTU)	1	2
Mean of Mean Daily Turbidity - Largemouth Bass (NTU)	1	N/A
Mean of Mean Daily Temperature - Adult Steelhead (°C)	11.3	N/A
Mean of Mean Daily Temperature - Adult Steelhead, probable (°C)	16.9	14.2
Mean of Mean Daily Temperature - O.mykiss, non-adult steelhead (°C)	18.0	N/A
Mean of Mean Daily Temperature - Fish, unknown (°C)	22.3	N/A
Mean of Mean Daily Temperature - Fish, probable (°C)	20.1	20.5
Mean of Mean Daily Temperature - Largemouth Bass (°C)	22.9	N/A
Mean of Mean Daily Discharge - Adult Steelhead (cfs)	85	N/A
Mean of Mean Daily Discharge - Adult Steelhead, probable (cfs)	21	43
Mean of Mean Daily Discharge - O.mykiss, non-adult steelhead (cfs)	22	N/A
Mean of Mean Daily Discharge - Fish, unknown (cfs)	4	N/A
Mean of Mean Daily Discharge - Fish, probable (cfs)	9	12
Mean of Mean Daily Discharge - Largemouth Bass (cfs)	3	N/A
Mean Length - Adult Steelhead (cm)	55	N/A
Mean Length - Adult Steelhead, probable (cm)	49	47
Mean Length - O.mykiss, non-adult Steelhead (cm)	30	N/A
Mean Length - Largemouth Bass (cm)	40	N/A
Mean Length - Fish, unknown (cm)	28	N/A
Mean Length - Fish, probable (cm)	27	29



Appendix 8. Morphometric analysis of steelhead (n = 5) and rainbow trout (n = 2) observed passing through the Robles fish ladder (gray symbols) compared with known steelhead and rainbow trout (black symbols).

Appendix 9. Summary of Vaki Riverwatcher fish counts at the Robles Fish Passage Facility for 2008.

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
01/31/2008	13:27	10.4	22.5	110	Steelhead	54	Up
02/01/2008	2:40	10.8	21.2	129	Steelhead	64	Up
02/01/2008	4:06	10.8	21.2	129	O. mykiss	32	Up
02/02/2008	23:19	10.5	13.4	102	Steelhead	64	Up
02/07/2008	10:03	11.0	5.1	57	Steelhead	42	Up
02/09/2008	10:18	12.2	4.4	52	Fish, probable	36	Down
02/12/2008	21:24	12.8	5.7	52	Steelhead	49	Up
02/13/2008	6:51	13.0	3.9	52	Fish, probable	21	Down
02/14/2008	6:54	11.8	2	51	Fish, probable	17	Down
02/15/2008	6:42	11.3	2.7	45	Fish, probable	22	Down
02/17/2008	17:48	11.9	1.6	44	O. mykiss	22	Up
02/18/2008	6:44	12.3	1.5	43	Fish, probable	18	Down
02/18/2008	12:54	12.3	1.5	43	Fish, probable	28	Down
02/18/2008	12:55	12.3	1.5	43	O. mykiss	32	Up
02/18/2008	17:39	12.3	1.5	43	O. mykiss	17	Up
02/19/2008	6:34	12.2	1.6	42	Fish, probable	14	Down
02/19/2008	6:37	12.2	1.6	42	Fish, probable	26	Down
02/19/2008	7:58	12.2	1.6	42	Fish, unknown	34	Up
02/19/2008	9:34	12.2	1.6	42	O. mykiss	32	Up
02/19/2008	17:27	12.2	1.6	42	O. mykiss	22	Up
02/20/2008	17:43	12.6	1.6	47	O. mykiss	25	Up
02/21/2008	6:21	12.1	2.1	47	Fish, probable	17	Down
02/21/2008	17:04	12.1	2.1	47	Fish, probable	24	Down
02/22/2008	1:16	12.0	4.5	62	Fish, probable	17	Down
02/22/2008	18:16	12.0	4.5	62	Steelhead	58	Up
02/23/2008	6:23	11.2	14.1	42	Fish, probable	25	Down
02/23/2008	16:12	11.2	14.1	42	O. mykiss	22	Up
02/23/2008	16:26	11.2	14.1	42	Fish, probable	25	Down
02/26/2008	0:31	12.4	4.2	50	Steelhead, probable	48	Down
03/01/2008	11:27	13.3	2.9	59	O. mykiss	28	Up
03/02/2008	7:17	12.6	2.9	59	O. mykiss	28	Up
03/03/2008	7:13	12.4	2.9	58	O. mykiss	21	Up
03/03/2008	9:26	12.4	2.9	58	O. mykiss	25	Up
03/04/2008	8:02	12.6	2.6	57	O. mykiss	26	Up
03/05/2008	14:43	12.8	2.4	57	Fish, probable	18	Down
03/06/2008	16:22	12.7	2.2	56	Fish, probable	21	Up
03/07/2008	6:58	13.3	5.5	61	Fish, probable	21	Down
03/07/2008	7:08	13.3	5.5	61	O. mykiss	24	Up
03/07/2008	9:42	13.3	5.5	61	Fish, probable	26	Down
03/07/2008	9:49	13.3	5.5	61	O. mykiss	26	Up
03/07/2008	12:38	13.3	5.5	61	Fish, probable	18	Down
03/08/2008	8:51	13.8	4.8	60	Fish, probable	17	Down
03/08/2008	22:57	13.8	4.8	60	Fish, probable	39	Down
03/10/2008	7:43	13.9	2.7	56	Fish, probable	18	Down
03/13/2008	11:01	15.0	2.2	48	Fish, probable	18	Down
03/13/2008	11:38	15.0	2.2	48	Fish, probable	22	Down

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
03/13/2008	11:40	15.0	2.2	48	O. mykiss	24	Up
03/13/2008	15:07	15.0	2.2	48	Fish, probable	25	Down
03/13/2008	15:41	15.0	2.2	48	O. mykiss	26	Up
03/14/2008	14:17	14.7	3.7	47	O. mykiss	26	Up
03/16/2008	9:00	12.7	2.7	47	Fish, probable	26	Down
03/16/2008	9:04	12.7	2.7	47	O. mykiss	29	Up
03/19/2008	8:27	13.9	1.9	46	Fish, probable	21	Down
03/19/2008	8:31	13.9	1.9	46	O. mykiss	29	Up
03/19/2008	10:42	13.9	1.9	46	Fish, probable	15	Down
03/19/2008	12:29	13.9	1.9	46	O. mykiss	26	Up
03/19/2008	12:37	13.9	1.9	46	Fish, probable	22	Down
03/19/2008	15:51	13.9	1.9	46	O. mykiss	29	Up
03/20/2008	10:04	14.3	1.8	46	Fish, probable	29	Down
03/20/2008	10:24	14.3	1.8	46	O. mykiss	29	Up
03/20/2008	10:27	14.3	1.8	46	Fish, probable	29	Down
03/20/2008	10:34	14.3	1.8	46	O. mykiss	18	Up
03/20/2008	11:03	14.3	1.8	46	O. mykiss	25	Up
03/20/2008	11:10	14.3	1.8	46	Fish, probable	14	Up
03/20/2008	11:30	14.3	1.8	46	Fish, probable	20	Up
03/20/2008	11:46	14.3	1.8	46	Fish, probable	22	Down
03/20/2008	12:27	14.3	1.8	46	O. mykiss	32	Up
03/20/2008	12:42	14.3	1.8	46	Fish, probable	22	Down
03/21/2008	12:38	14.2	1.7	46	Steelhead, probable	43	Down
03/21/2008	15:57	14.2	1.7	46	Fish, probable	28	Down
03/22/2008	18:53	14.5	1.6	45	Fish, probable	25	Up
03/29/2008	10:11	15.2	6.4	38	O. mykiss	34	Up
03/30/2008	20:36	15.6	6.4	38	Fish, probable	18	Down
04/01/2008	7:14	14.8	6.2	33	Fish, probable	18	Down
04/01/2008	8:00	14.8	6.2	33	Fish, probable	29	Down
04/01/2008	8:34	14.8	6.2	33	O. mykiss	31	Up
04/02/2008	6:43	14.6	0.9	32	O. mykiss	12	Up
04/04/2008	13:46	16.0	0.8	32	Steelhead, probable	49	Down
04/07/2008	7:11	15.8	0.7	30	Fish, probable	25	Down
04/07/2008	7:22	15.8	0.7	30	O. mykiss	26	Up
04/19/2008	11:02	16.0	2.4	21	Fish, probable	28	Up
04/23/2008	10:42	16.9	2.3	21	Steelhead, probable	49	Up
05/03/2008	2:15	18.2	1.4	12	Fish, probable	22	Down
05/07/2008	20:14	16.6	1.1	14	Fish, probable	24	Up
05/15/2008	11:39	20.4	0.6	8	O. mykiss	22	Up
05/16/2008	2:13	21.2	0.8	5	O. mykiss	28	Up
05/16/2008	4:09	21.2	0.8	5	Fish, probable	22	Down
05/16/2008	23:08	21.2	0.8	5	O. mykiss	26	Up
05/17/2008	2:47	21.9	1.0	4	O. mykiss	26	Up
05/17/2008	12:35	21.9	1.0	4	Largemouth Bass	38	Up
05/18/2008	16:08	22.7	0.8	4	Fish, probable	36	Down
05/20/2008	5:50	21.6	0.9	4	Fish, probable	25	Down
05/20/2008	5:54	21.6	0.9	4	Fish, probable	24	Down

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
05/20/2008	6:05	21.6	0.9	4	Fish, probable	22	Down
05/20/2008	6:47	21.6	0.9	4	Fish, probable	26	Up
05/20/2008	6:55	21.6	0.9	4	Fish, probable	25	Down
05/20/2008	23:39	21.6	0.9	4	O. mykiss	36	Up
05/21/2008	4:16	20.2	1.6	4	Fish, probable	18	Down
05/21/2008	5:16	20.2	1.6	4	Fish, probable	28	Down
05/21/2008	5:42	20.2	1.6	4	Fish, probable	15	Down
05/21/2008	5:42	20.2	1.6	4	Fish, probable	24	Down
05/21/2008	6:35	20.2	1.6	4	O. mykiss	25	Up
05/21/2008	7:15	20.2	1.6	4	Fish, probable	18	Down
05/21/2008	8:17	20.2	1.6	4	Fish, probable	25	Down
05/21/2008	8:18	20.2	1.6	4	Fish, probable	25	Up
05/21/2008	8:32	20.2	1.6	4	Fish, probable	24	Down
05/21/2008	8:54	20.2	1.6	4	Fish, probable	25	Down
05/22/2008	20:12	19.3	1.2	4	Fish, unknown	25	Up
05/22/2008	20:57	19.3	1.2	4	O. mykiss	39	Up
05/23/2008	4:35	16.9	1.2	6	O. mykiss	28	Up
05/23/2008	4:43	16.9	1.2	6	Fish, probable	20	Down
05/23/2008	5:25	16.9	1.2	6	Fish, probable	26	Down
05/23/2008	20:34	16.9	1.2	6	O. mykiss	24	Up
05/23/2008	20:38	16.9	1.2	6	O. mykiss	36	Up
05/25/2008	4:35	16.4	0.9	10	Fish, probable	35	Down
05/25/2008	5:31	16.4	0.9	10	Fish, probable	26	Down
05/25/2008	6:05	16.4	0.9	10	Fish, probable	24	Up
05/25/2008	6:05	16.4	0.9	10	Fish, probable	22	Down
05/25/2008	20:48	16.4	0.9	10	Fish, probable	28	Up
05/26/2008	5:03	16.9	0.9	9	Fish, probable	26	Down
05/26/2008	12:54	16.9	0.9	9	Fish, probable	20	Up
05/26/2008	20:40	16.9	0.9	9	O. mykiss	36	Up
05/26/2008	20:51	16.9	0.9	9	O. mykiss	18	Up
05/26/2008	20:57	16.9	0.9	9	Fish, unknown	25	Up
05/27/2008	4:52	18.2	0.9	8	Fish, probable	20	Down
05/27/2008	5:19	18.2	0.9	8	Fish, probable	31	Down
05/27/2008	20:04	18.2	0.9	8	O. mykiss	38	Up
05/28/2008	4:11	18.7	0.7	7	Fish, probable	18	Down
05/28/2008	4:31	18.7	0.7	7	Fish, probable	21	Up
05/28/2008	5:10	18.7	0.7	7	Fish, probable	24	Down
05/28/2008	5:10	18.7	0.7	7	Fish, probable	36	Down
05/28/2008	20:27	18.7	0.7	7	Fish, probable	38	Up
05/29/2008	5:14	19.2	0.7	6	Fish, probable	32	Down
05/29/2008	20:05	19.2	0.7	6	O. mykiss	35	Up
05/29/2008	20:32	19.2	0.7	6	Fish, probable	25	Up
05/30/2008	5:09	19.6	1.1	5	Fish, probable	32	Down
05/30/2008	20:28	19.6	1.1	5	Fish, probable	34	Up
05/31/2008	4:21	19.8	0.5	4	Fish, probable	24	Up
05/31/2008	4:27	19.8	0.5	4	Fish, probable	24	Down
05/31/2008	4:39	19.8	0.5	4	Fish, probable	24	Up

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
05/31/2008	4:55	19.8	0.5	4	Fish, probable	25	Up
05/31/2008	5:04	19.8	0.5	4	Fish, probable	20	Down
05/31/2008	5:17	19.8	0.5	4	Fish, probable	17	Down
05/31/2008	19:58	19.8	0.5	4	Fish, probable	34	Up
05/31/2008	20:19	19.8	0.5	4	Fish, probable	26	Up
06/01/2008	5:09	20.2	0.6	4	Fish, probable	25	Down
06/01/2008	5:12	20.2	0.6	4	Fish, probable	31	Down
06/01/2008	19:45	20.2	0.6	4	O. mykiss	34	Up
06/01/2008	20:36	20.2	0.6	4	Fish, probable	26	Up
06/02/2008	4:26	20.4	0.6	4	Fish, probable	21	Down
06/02/2008	4:37	20.4	0.6	4	O. mykiss	25	Up
06/02/2008	4:45	20.4	0.6	4	O. mykiss	25	Up
06/02/2008	5:06	20.4	0.6	4	Fish, probable	25	Down
06/02/2008	5:12	20.4	0.6	4	Fish, probable	31	Down
06/02/2008	20:13	20.4	0.6	4	O. mykiss	36	Up
06/02/2008	20:32	20.4	0.6	4	Fish, probable	28	Up
06/03/2008	5:20	20.4	1.1	3	Fish, probable	28	Down
06/03/2008	19:41	20.4	1.1	3	O. mykiss	35	Up
06/03/2008	20:35	20.4	1.1	3	Fish, probable	25	Up
06/04/2008	5:08	20.4	1.3	3	Fish, probable	31	Down
06/04/2008	19:52	20.4	1.3	3	O. mykiss	36	Up
06/04/2008	20:40	20.4	1.3	3	Fish, probable	26	Up
06/05/2008	5:25	20.6	0.6	3	Fish, probable	20	Down
06/05/2008	20:22	20.6	0.6	3	O. mykiss	35	Up
06/05/2008	20:34	20.6	0.6	3	Fish, unknown	25	Up
06/06/2008	2:53	21.2	0.9	3	Fish, probable	18	Down
06/06/2008	3:16	21.2	0.9	3	Fish, unknown	28	Up
06/06/2008	5:03	21.2	0.9	3	Fish, probable	34	Down
06/06/2008	14:36	21.2	0.9	3	Largemouth Bass	26	Up
06/06/2008	16:17	21.2	0.9	3	Largemouth Bass	32	Up
06/06/2008	20:26	21.2	0.9	3	O. mykiss	32	Up
06/06/2008	20:26	21.2	0.9	3	O. mykiss	26	Up
06/07/2008	2:32	21.3	1.4	3	Fish, probable	24	Down
06/07/2008	4:55	21.3	1.4	3	Fish, probable	31	Down
06/07/2008	20:11	21.3	1.4	3	Fish, unknown	36	Up
06/07/2008	20:33	21.3	1.4	3	Fish, unknown	21	Up
06/08/2008	5:05	21.4	1.8	3	Fish, probable	32	Down
06/08/2008	5:24	21.4	1.8	3	Fish, probable	20	Down
06/08/2008	20:21	21.4	1.8	3	O. mykiss	35	Up
06/08/2008	20:46	21.4	1.8	3	Fish, unknown	28	Up
06/08/2008	22:46	21.4	1.8	3	Fish, probable	25	Up
06/09/2008	4:41	22.4	1.0	3	Fish, probable	20	Down
06/09/2008	5:06	22.4	1.0	3	Fish, probable	28	Down
06/09/2008	5:13	22.4	1.0	3	Fish, probable	24	Down
06/09/2008	20:25	22.4	1.0	3	O. mykiss	34	Up
06/09/2008	20:42	22.4	1.0	3	Fish, probable	29	Up
06/10/2008	5:14	22.1	1.4	3	Fish, probable	29	Down

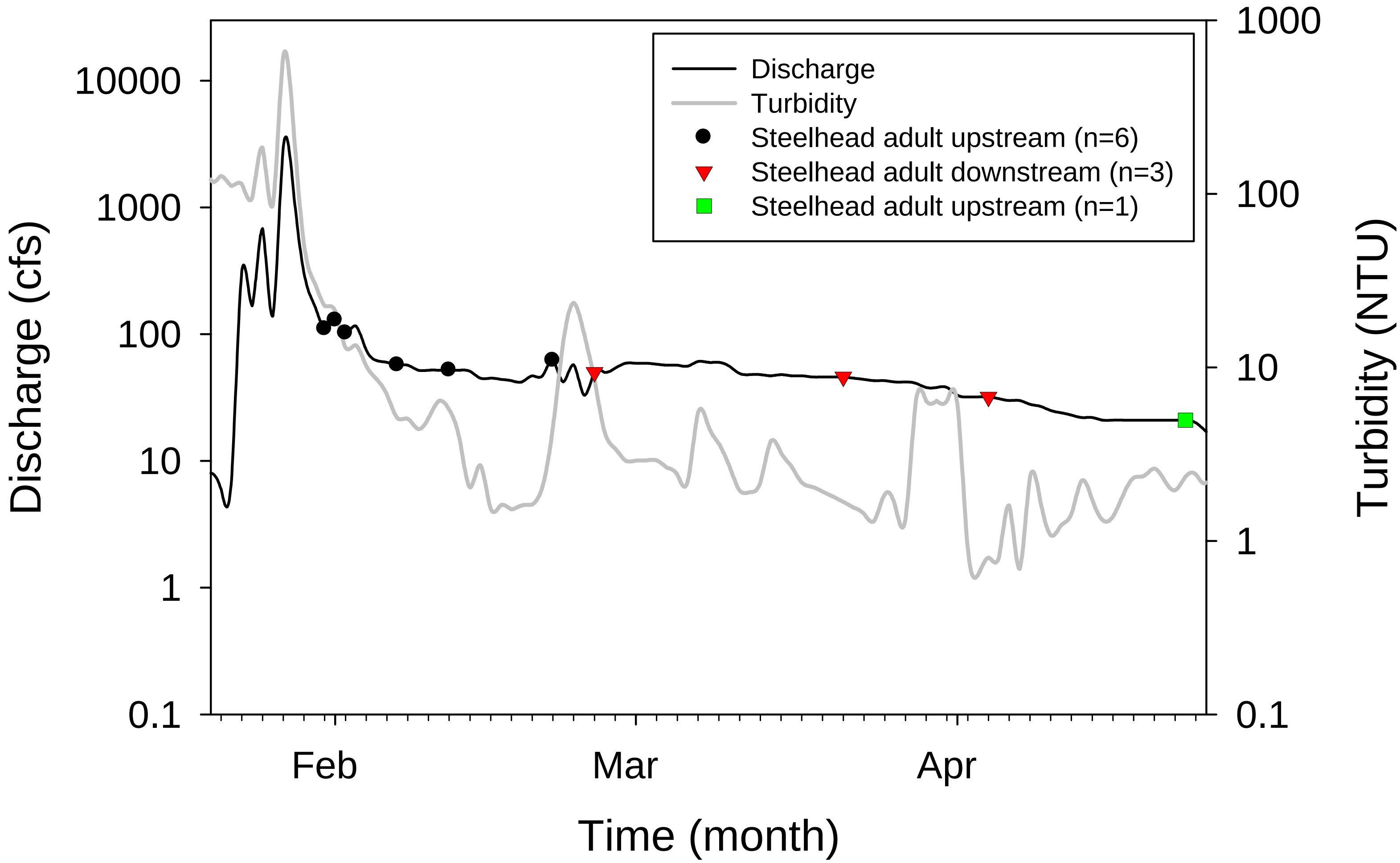
Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
06/10/2008	5:20	22.1	1.4	3	Fish, probable	21	Down
06/10/2008	20:02	22.1	1.4	3	O. mykiss	36	Up
06/10/2008	20:28	22.1	1.4	3	Fish, unknown	28	Up
06/11/2008	4:57	22.2	0.8	3	Fish, probable	31	Down
06/12/2008	20:06	21.7	0.6	3	O. mykiss	31	Up
06/12/2008	20:34	21.7	0.6	3	O. mykiss	20	Up
06/13/2008	2:29	22.3	0.6	3	Fish, probable	15	Down
06/13/2008	4:40	22.3	0.6	3	Fish, probable	24	Down
06/13/2008	15:38	22.3	0.6	3	Fish, probable	20	Down
06/13/2008	17:30	22.3	0.6	3	Fish, probable	34	Down
06/13/2008	20:52	22.3	0.6	3	O. mykiss	31	Up
06/13/2008	23:00	22.3	0.6	3	Fish, unknown	25	Up
06/14/2008	0:34	22.5	0.9	3	Fish, unknown	21	Up
06/14/2008	1:42	22.5	0.9	3	Fish, probable	21	Down
06/14/2008	4:53	22.5	0.9	3	Fish, probable	25	Down
06/14/2008	5:11	22.5	0.9	3	Fish, probable	15	Down
06/14/2008	12:31	22.5	0.9	3	Largemouth Bass	38	Up
06/14/2008	12:41	22.5	0.9	3	Largemouth Bass	38	Up
06/14/2008	12:48	22.5	0.9	3	Largemouth Bass	35	Up
06/14/2008	12:56	22.5	0.9	3	Fish, probable	40	Down
06/14/2008	12:56	22.5	0.9	3	Largemouth Bass	38	Up
06/14/2008	13:09	22.5	0.9	3	Largemouth Bass	39	Up
06/14/2008	13:18	22.5	0.9	3	Fish, probable	31	Down
06/14/2008	14:30	22.5	0.9	3	Largemouth Bass	39	Up
06/14/2008	14:43	22.5	0.9	3	Fish, unknown	43	Up
06/14/2008	14:43	22.5	0.9	3	Fish, probable	20	Down
06/14/2008	17:37	22.5	0.9	3	Largemouth Bass	34	Up
06/14/2008	17:43	22.5	0.9	3	Fish, probable	36	Down
06/14/2008	17:43	22.5	0.9	3	Largemouth Bass	42	Up
06/14/2008	17:47	22.5	0.9	3	Fish, probable	38	Down
06/14/2008	17:48	22.5	0.9	3	Largemouth Bass	39	Up
06/14/2008	18:00	22.5	0.9	3	Largemouth Bass	40	Up
06/14/2008	18:06	22.5	0.9	3	Largemouth Bass	40	Up
06/14/2008	18:12	22.5	0.9	3	Largemouth Bass	38	Up
06/14/2008	18:17	22.5	0.9	3	Fish, probable	38	Down
06/14/2008	18:22	22.5	0.9	3	Largemouth Bass	26	Up
06/14/2008	18:26	22.5	0.9	3	Fish, probable	39	Down
06/14/2008	18:30	22.5	0.9	3	Largemouth Bass	38	Up
06/14/2008	18:57	22.5	0.9	3	Largemouth Bass	38	Up
06/14/2008	19:03	22.5	0.9	3	Largemouth Bass	39	Up
06/14/2008	19:08	22.5	0.9	3	Largemouth Bass	34	Up
06/14/2008	19:25	22.5	0.9	3	Fish, probable	36	Down
06/14/2008	19:26	22.5	0.9	3	Largemouth Bass	35	Up
06/14/2008	19:27	22.5	0.9	3	Largemouth Bass	26	Up
06/14/2008	19:28	22.5	0.9	3	Fish, probable	31	Down
06/14/2008	20:39	22.5	0.9	3	O. mykiss	36	Up
06/14/2008	20:44	22.5	0.9	3	O. mykiss	28	Up

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
06/15/2008	2:16	22.6	1.2	3	Fish, probable	14	Down
06/15/2008	11:21	22.6	1.2	3	Largemouth Bass	38	Up
06/15/2008	13:19	22.6	1.2	3	Fish, probable	32	Down
06/15/2008	13:19	22.6	1.2	3	Largemouth Bass	36	Up
06/15/2008	13:26	22.6	1.2	3	Fish, probable	35	Down
06/15/2008	13:26	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	13:31	22.6	1.2	3	Largemouth Bass	40	Up
06/15/2008	13:37	22.6	1.2	3	Fish, probable	31	Down
06/15/2008	13:37	22.6	1.2	3	Largemouth Bass	38	Up
06/15/2008	13:44	22.6	1.2	3	Largemouth Bass	38	Up
06/15/2008	13:54	22.6	1.2	3	Largemouth Bass	26	Up
06/15/2008	13:54	22.6	1.2	3	Fish, probable	42	Up
06/15/2008	13:57	22.6	1.2	3	Largemouth Bass	36	Up
06/15/2008	14:02	22.6	1.2	3	Fish, probable	22	Down
06/15/2008	14:02	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	14:07	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	14:07	22.6	1.2	3	Fish, probable	26	Down
06/15/2008	14:15	22.6	1.2	3	Largemouth Bass	38	Up
06/15/2008	14:19	22.6	1.2	3	Fish, probable	38	Down
06/15/2008	14:20	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	14:21	22.6	1.2	3	Largemouth Bass	40	Up
06/15/2008	14:30	22.6	1.2	3	Largemouth Bass	42	Up
06/15/2008	14:33	22.6	1.2	3	Largemouth Bass	35	Up
06/15/2008	14:41	22.6	1.2	3	Fish, probable	35	Down
06/15/2008	14:42	22.6	1.2	3	Largemouth Bass	40	Up
06/15/2008	14:48	22.6	1.2	3	Fish, probable	36	Down
06/15/2008	14:48	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	14:53	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	14:58	22.6	1.2	3	Largemouth Bass	40	Up
06/15/2008	15:01	22.6	1.2	3	Fish, probable	42	Down
06/15/2008	15:03	22.6	1.2	3	Largemouth Bass	36	Up
06/15/2008	15:10	22.6	1.2	3	Fish, probable	36	Down
06/15/2008	15:11	22.6	1.2	3	Largemouth Bass	38	Up
06/15/2008	15:14	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	15:22	22.6	1.2	3	Fish, probable	26	Up
06/15/2008	15:23	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	15:32	22.6	1.2	3	Largemouth Bass	38	Up
06/15/2008	15:37	22.6	1.2	3	Largemouth Bass	25	Up
06/15/2008	15:42	22.6	1.2	3	Largemouth Bass	38	Up
06/15/2008	15:46	22.6	1.2	3	Largemouth Bass	40	Up
06/15/2008	15:48	22.6	1.2	3	Fish, probable	28	Down
06/15/2008	15:53	22.6	1.2	3	Largemouth Bass	34	Up
06/15/2008	15:56	22.6	1.2	3	Fish, probable	36	Down
06/15/2008	15:56	22.6	1.2	3	Largemouth Bass	40	Up
06/15/2008	16:02	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	16:07	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	16:09	22.6	1.2	3	Largemouth Bass	34	Up

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
06/15/2008	16:19	22.6	1.2	3	Fish, probable	40	Down
06/15/2008	16:19	22.6	1.2	3	Largemouth Bass	39	Up
06/15/2008	17:56	22.6	1.2	3	Fish, probable	39	Down
06/15/2008	18:04	22.6	1.2	3	Fish, probable	42	Down
06/15/2008	20:39	22.6	1.2	3	O. mykiss	25	Up
06/15/2008	20:52	22.6	1.2	3	O. mykiss	25	Up
06/15/2008	20:52	22.6	1.2	3	Fish, probable	24	Down
06/15/2008	20:55	22.6	1.2	3	O. mykiss	20	Up
06/15/2008	21:37	22.6	1.2	3	O. mykiss	36	Up
06/16/2008	4:46	23.0	1.5	3	Fish, probable	22	Down
06/16/2008	4:52	23.0	1.5	3	Fish, probable	29	Down
06/16/2008	7:35	23.0	1.5	3	Fish, probable	20	Up
06/16/2008	20:17	23.0	1.5	3	O. mykiss	25	Up
06/16/2008	20:17	23.0	1.5	3	O. mykiss	35	Up
06/16/2008	22:47	23.0	1.5	3	Fish, probable	32	Down
06/16/2008	22:55	23.0	1.5	3	Fish, probable	22	Down
06/17/2008	4:39	23.5	1.9	3	Fish, probable	18	Down
06/17/2008	4:56	23.5	1.9	3	Fish, probable	20	Down
06/17/2008	5:13	23.5	1.9	3	Fish, probable	31	Down
06/17/2008	12:07	23.5	1.9	3	O. mykiss	25	Up
06/17/2008	20:35	23.5	1.9	3	O. mykiss	25	Up
06/17/2008	20:51	23.5	1.9	3	Fish, unknown	36	Up
06/18/2008	4:50	23.7	2.3	2	Fish, probable	20	Down
06/18/2008	5:08	23.7	2.3	2	Fish, probable	29	Down
06/18/2008	12:11	23.7	2.3	2	Largemouth Bass	34	Up
06/18/2008	12:26	23.7	2.3	2	Fish, probable	36	Down
06/18/2008	12:27	23.7	2.3	2	Largemouth Bass	34	Up
06/18/2008	12:46	23.7	2.3	2	Fish, probable	36	Down
06/18/2008	12:46	23.7	2.3	2	Largemouth Bass	38	Up
06/18/2008	13:00	23.7	2.3	2	Largemouth Bass	39	Up
06/18/2008	13:17	23.7	2.3	2	Largemouth Bass	38	Up
06/18/2008	13:34	23.7	2.3	2	Fish, probable	39	Down
06/18/2008	13:36	23.7	2.3	2	Largemouth Bass	42	Up
06/18/2008	13:39	23.7	2.3	2	Fish, probable	34	Down
06/18/2008	13:41	23.7	2.3	2	Largemouth Bass	43	Up
06/18/2008	13:49	23.7	2.3	2	Largemouth Bass	38	Up
06/18/2008	13:51	23.7	2.3	2	Fish, probable	36	Down
06/18/2008	13:53	23.7	2.3	2	Largemouth Bass	40	Up
06/18/2008	13:57	23.7	2.3	2	Largemouth Bass	42	Up
06/18/2008	14:01	23.7	2.3	2	Fish, probable	34	Down
06/18/2008	14:03	23.7	2.3	2	Largemouth Bass	38	Up
06/18/2008	14:23	23.7	2.3	2	Fish, probable	28	Down
06/18/2008	14:28	23.7	2.3	2	Largemouth Bass	32	Up
06/18/2008	14:36	23.7	2.3	2	Fish, probable	29	Down
06/18/2008	14:36	23.7	2.3	2	Largemouth Bass	39	Up
06/18/2008	14:46	23.7	2.3	2	Largemouth Bass	43	Up
06/18/2008	14:51	23.7	2.3	2	Fish, probable	29	Down

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
06/18/2008	14:53	23.7	2.3	2	Largemouth Bass	43	Up
06/18/2008	15:19	23.7	2.3	2	Fish, probable	32	Down
06/18/2008	16:49	23.7	2.3	2	Largemouth Bass	43	Up
06/18/2008	16:52	23.7	2.3	2	Fish, probable	31	Down
06/18/2008	16:55	23.7	2.3	2	Largemouth Bass	40	Up
06/18/2008	17:01	23.7	2.3	2	Largemouth Bass	42	Up
06/18/2008	17:02	23.7	2.3	2	Fish, probable	35	Down
06/18/2008	17:06	23.7	2.3	2	Largemouth Bass	42	Up
06/18/2008	17:08	23.7	2.3	2	Fish, probable	39	Down
06/18/2008	17:11	23.7	2.3	2	Largemouth Bass	40	Up
06/18/2008	17:13	23.7	2.3	2	Fish, probable	40	Down
06/18/2008	17:16	23.7	2.3	2	Largemouth Bass	36	Up
06/18/2008	17:19	23.7	2.3	2	Fish, probable	38	Down
06/18/2008	17:20	23.7	2.3	2	Largemouth Bass	36	Up
06/18/2008	17:26	23.7	2.3	2	Largemouth Bass	38	Up
06/18/2008	17:30	23.7	2.3	2	Largemouth Bass	39	Up
06/18/2008	17:36	23.7	2.3	2	Largemouth Bass	42	Up
06/18/2008	17:36	23.7	2.3	2	Fish, probable	36	Down
06/18/2008	17:40	23.7	2.3	2	Largemouth Bass	38	Up
06/18/2008	20:43	23.7	2.3	2	O. mykiss	25	Up
06/18/2008	21:53	23.7	2.3	2	Fish, unknown	34	Up
06/19/2008	5:03	23.9	2.7	1	Fish, probable	15	Down
06/19/2008	5:04	23.9	2.7	1	Fish, probable	22	Down
06/19/2008	17:23	23.9	2.7	1	Fish, probable	20	Down
06/19/2008	23:04	23.9	2.7	1	Fish, probable	24	Down
06/19/2008	23:25	23.9	2.7	1	Fish, probable	21	Up
06/20/2008	4:49	25.0	3.1	1	Fish, probable	20	Down
06/20/2008	16:44	25.0	3.1	1	Fish, probable	15	Down
06/20/2008	22:48	25.0	3.1	1	Fish, probable	25	Up
06/21/2008	3:47	25.8	2.5	1	Fish, probable	25	Down
06/21/2008	15:12	25.8	2.5	1	Fish, probable	35	Down
06/21/2008	16:09	25.8	2.5	1	Fish, probable	39	Down
06/21/2008	16:19	25.8	2.5	1	Fish, probable	20	Down
06/21/2008	17:20	25.8	2.5	1	Fish, probable	26	Down
06/21/2008	18:21	25.8	2.5	1	Fish, probable	22	Down
06/21/2008	22:17	25.8	2.5	1	Fish, unknown	21	Up
06/21/2008	23:47	25.8	2.5	1	Fish, probable	22	Down
06/22/2008	17:17	25.5	1.9	1	Fish, probable	38	Down
06/23/2008	17:27	25.0	1.3	1	Fish, probable	20	Down
06/23/2008	20:52	25.0	1.3	1	Fish, unknown	21	Up
06/23/2008	21:41	25.0	1.3	1	Fish, unknown	25	Up
06/23/2008	22:12	25.0	1.3	1	Fish, unknown	11	Up
06/24/2008	4:35	24.2	1.1	1	Fish, probable	28	Down
06/24/2008	16:35	24.2	1.1	1	Fish, probable	14	Down
06/24/2008	20:57	24.2	1.1	1	Fish, unknown	24	Up
06/24/2008	22:28	24.2	1.1	1	Fish, probable	21	Down
06/24/2008	23:50	24.2	1.1	1	Fish, probable	35	Up

Date	Time (24h)	Mean Daily Temputerure (°C)	Mean Daily Turbidity (NTU)	Mean Daily Dishcharge (cfs)	Fish Species	Length (cm)	Direction
06/25/2008	4:55	23.3	1.3	1	Fish, probable	21	Down
06/25/2008	5:00	23.3	1.3	1	Fish, probable	29	Down
06/25/2008	20:42	23.3	1.3	1	Fish, probable	20	Up
06/25/2008	21:44	23.3	1.3	1	Fish, probable	18	Up
06/25/2008	23:12	23.3	1.3	1	Fish, probable	28	Up
06/26/2008	5:04	23.2	0.8	1	Fish, probable	22	Down
06/26/2008	5:16	23.2	0.8	1	Fish, probable	25	Down
06/26/2008	5:29	23.2	0.8	1	Fish, probable	31	Down
06/26/2008	16:00	23.2	0.8	1	Fish, probable	31	Down
06/26/2008	19:15	23.2	0.8	1	Fish, probable	34	Down
06/26/2008	20:35	23.2	0.8	1	O. mykiss	32	Up
06/26/2008	20:46	23.2	0.8	1	O. mykiss	25	Up
06/26/2008	21:21	23.2	0.8	1	Fish, probable	20	Up
06/27/2008	0:26	23.6	2.5	1	Fish, unknown	22	Up
06/27/2008	5:16	23.6	2.5	1	Fish, probable	28	Down
06/27/2008	16:38	23.6	2.5	1	Fish, probable	39	Down
06/27/2008	20:46	23.6	2.5	1	Fish, probable	28	Up
06/27/2008	21:35	23.6	2.5	1	O. mykiss	31	Up
06/28/2008	5:09	23.8	2.0	1	Fish, probable	25	Down
06/28/2008	5:17	23.8	2.0	1	Fish, probable	21	Down
06/28/2008	5:20	23.8	2.0	1	Fish, probable	34	Down
06/28/2008	13:40	23.8	2.0	1	Fish, probable	17	Down
06/28/2008	20:57	23.8	2.0	1	O. mykiss	36	Up
06/28/2008	21:05	23.8	2.0	1	Fish, probable	48	Down
06/29/2008	5:17	23.5	1.6	1	Fish, probable	34	Down
06/29/2008	5:18	23.5	1.6	1	Fish, probable	24	Down
06/29/2008	20:43	23.5	1.6	1	Fish, probable	25	Up
06/29/2008	21:23	23.5	1.6	1	Fish, probable	32	Up
06/30/2008	5:09	23.8	1.1	1	Fish, probable	32	Down
06/30/2008	5:18	23.8	1.1	1	Fish, probable	26	Down
06/30/2008	5:19	23.8	1.1	1	Fish, probable	24	Down
06/30/2008	15:46	23.8	1.1	1	Fish, probable	38	Down
06/30/2008	20:55	23.8	1.1	1	Fish, unknown	14	Up
06/30/2008	21:49	23.8	1.1	1	Fish, unknown	29	Up
06/30/2008	23:35	23.8	1.1	1	Fish, unknown	22	Up
06/30/2008	23:55	23.8	1.1	1	Fish, unknown	22	Up

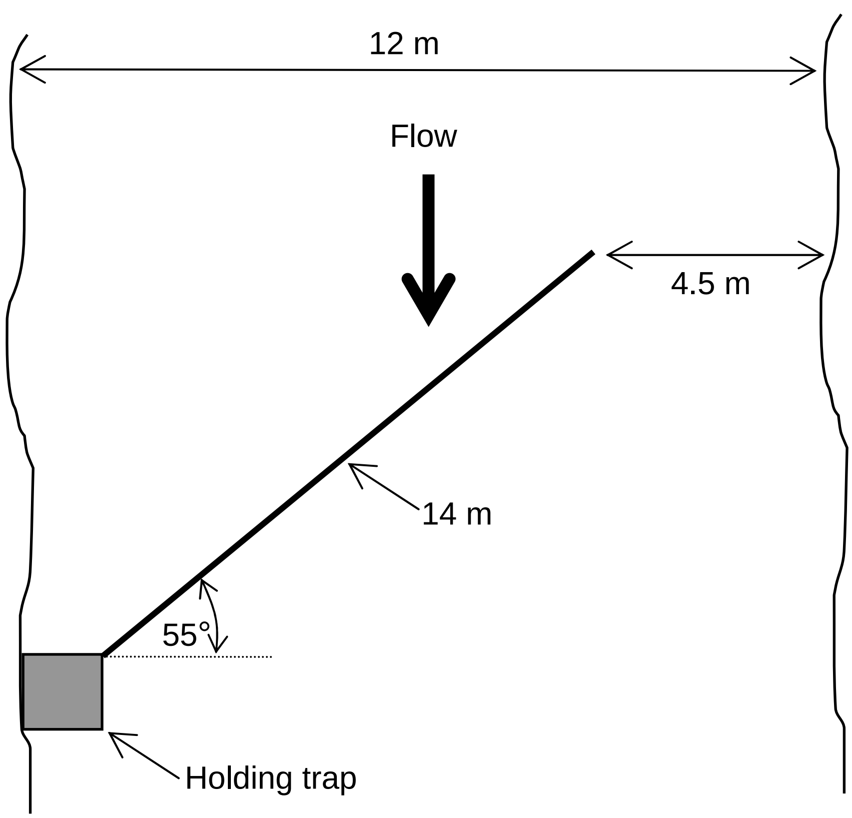


Appendix 10. Upstream and downstream adult steelhead detected by the Riverwatcher at Robles Fish Passage relative to discharge (cfs) and tubidity (NTU) from January 20, 2008 through April 25, 2008. The green box indicates an adult detected on 23-Apr that was migrating back upstream for the second time.

Appendix 11. Summary table of adult steelhead that passed up- or downstream through the Robles fish ladder during 2008. The last upstream detection on 23-Apr was assumed to be a downstream migrating fish that changed directions and went back upstream through the ladder for a second time.

Species/Life Stage	Date	Time (24h)	Direction	Ladder (cfs)	Discharge (cfs)	Days from Peak[1]	Turbidity (NTU)	Total Length (cm)
Steelhead/adult	31-Jan	13:37	Upstream	50	110	4	23	54
Steelhead/adult	01-Feb	14:40	Upstream	42	129	5	21	64
Steelhead/adult	02-Feb	23:19	Upstream	42	102	6	21	64
Steelhead/adult	07-Feb	10:03	Upstream	38	57	11	5	42
Steelhead/adult	12-Feb	21:24	Upstream	36	52	16	6	49
Steelhead/adult	22-Feb	18:16	Upstream	34	62	26	5	58
Steelhead/adult	26-Feb	0:31	Downstream	42	50	2	4	48
Steelhead/adult	21-Mar	12:38	Downstream	35	46	26	2	43
Steelhead/adult	04-Apr	13:46	Downstream	32	32	40	1	49
Steelhead/adult	23-Apr	10:42	Upstream	21	21	59	2	49

1. Peak of storm event as defined in the Robles Biological Opinion.



Appendix 12. Top view of downstream migrant smolt trap layout in the Ventura River below the Robles Fish Facility.

Appendix 13. Ventura River Flow Assessment for the Robles Fish Passage - FY 07-08.

Annual Flow Summary - FY 07-08							
	-1	-2	(1)+(2)	-3	-4	-5	(4)+(5)
	Source Stream Daily Flows			**Robles Facility Daily Flows**			
	Matilija Ck D/S Dam* (avg cfs/d)	North Fork Matilija Ck.* (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
Jul-07	5	0	5	0	0	0	0
Aug-07	4	0	4	0	0	0	0
Sep-07	3	0	3	0	0	0	0
Oct-07	1	1	1	0	0	0	0
Nov-07	1	1	2	0	0	0	0
Dec-07	1	1	2	0	0	0	0
Jan-08	271	69	340	28	226	71	297
Feb-08	131	32	163	38	60	84	144
Mar-08	67	13	80	36	49	17	66
Apr-08	27	2	29	23	23	0	23
May-08	15	2	17	9	9	0	9
Jun-08	9	2	11	2	2	0	2
Jul-08	6	2	8	0	0	0	0
Total	540	126	666	136	369	172	541

* Preliminary flow information provided by the Ventura County Watershed Protection District.

July-07 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Forebay Avg. Depth (ft)	Robles Facility Daily Flows: Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	5	1	6	0.01	0	0	0	0
2	5	0	5	0.01	0	0	0	0
3	5	0	5	0.01	0	0	0	0
4	5	0	5	0.01	0	0	0	0
5	5	0	5	0.01	0	0	0	0
6	5	0	5	0.01	0	0	0	0
7	5	0	5	0.01	0	0	0	0
8	5	0	5	0.01	0	0	0	0
9	5	0	5	0.01	0	0	0	0
10	5	1	6	0.01	0	0	0	0
11	5	1	6	0.01	0	0	0	0
12	5	1	6	0.01	0	0	0	0
13	5	1	6	0.01	0	0	0	0
14	5	1	6	0.01	0	0	0	0
15	5	1	6	0.01	0	0	0	0
16	5	1	6	0.00	0	0	0	0
17	5	1	6	0.01	0	0	0	0
18	5	1	6	0.01	0	0	0	0
19	5	1	6	0.01	0	0	0	0
20	5	0	5	0.01	0	0	0	0
21	5	0	5	0.01	0	0	0	0
22	5	0	5	0.01	0	0	0	0
23	5	0	5	0.01	0	0	0	0
24	5	0	5	0.01	0	0	0	0
25	5	0	5	0.01	0	0	0	0
26	5	0	5	0.01	0	0	0	0
27	5	0	5	0.01	0	0	0	0
28	5	0	5	0.01	0	0	0	0
29	5	0	5	0.01	0	0	0	0
30	5	0	5	0.01	0	0	0	0
31	5	0	5	0.01	0	0	0	0
Monthly Avg	5	0	5	0	0	0	0	0

August-07 **Average Daily Flow FY 07-08**

	Source Stream Daily Flows					Robles Facility Daily Flows			
Date	Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)		Forebay Avg. Depth (ft)	Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	5	0	5		0.01	0	0	0	0
2	5	0	5		0.01	0	0	0	0
3	5	0	5		0.07	0	0	0	0
4	5	0	5		0.18	0	0	0	0
5	5	0	5		0.16	0	0	0	0
6	5	0	5		0.14	0	0	0	0
7	5	0	5		0.11	0	0	0	0
8	5	0	5		0.09	0	0	0	0
9	5	0	5		0.07	0	0	0	0
10	5	0	5		0.04	0	0	0	0
11	5	0	5		0.00	0	0	0	0
12	5	0	5		0.00	0	0	0	0
13	5	0	5		0.00	0	0	0	0
14	5	0	5		0.00	0	0	0	0
15	5	0	5		0.00	0	0	0	0
16	4	0	4		0.00	0	0	0	0
17	4	0	4		0.01	0	0	0	0
18	3	0	3		0.00	0	0	0	0
19	3	0	3		0.00	0	0	0	0
20	3	0	3		0.00	0	0	0	0
21	3	0	3		0.00	0	0	0	0
22	3	0	3		0.00	0	0	0	0
23	3	0	3		0.00	0	0	0	0
24	3	0	3		0.00	0	0	0	0
25	3	0	3		0.00	0	0	0	0
26	3	0	3		0.00	0	0	0	0
27	3	0	3		0.00	0	0	0	0
28	3	0	3		0.00	0	0	0	0
29	3	0	3		0.01	0	0	0	0
30	3	0	3		0.01	0	0	0	0
31	3	0	3		0.01	0	0	0	0
Monthly Avg	4	0	4		0	0	0	0	0

September-07 **Average Daily Flow FY 07-08**

	Source Stream Daily Flows				Robles Facility Daily Flows			
Date	Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Forebay Avg. Depth (ft)	Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	3	0	3	0.01	0	0	0	0
2	3	0	3	0.02	0	0	0	0
3	3	0	3	0.01	0	0	0	0
4	3	0	3	0.00	0	0	0	0
5	3	0	3	0.01	0	0	0	0
6	3	0	3	0.01	0	0	0	0
7	3	0	3	0.01	0	0	0	0
8	3	0	3	0.00	0	0	0	0
9	3	0	3	0.01	0	0	0	0
10	3	0	3	0.01	0	0	0	0
11	3	0	3	0.01	0	0	0	0
12	3	0	3	0.01	0	0	0	0
13	3	0	3	0.00	0	0	0	0
14	3	0	3	0.00	0	0	0	0
15	3	0	3	0.00	0	0	0	0
16	3	0	3	0.00	0	0	0	0
17	3	0	3	0.00	0	0	0	0
18	3	1	4	0.01	0	0	0	0
19	3	1	4	0.02	0	0	0	0
20	3	1	4	0.01	0	0	0	0
21	3	1	4	0.02	0	0	0	0
22	3	1	4	0.02	0	0	0	0
23	3	1	4	0.01	0	0	0	0
24	3	1	4	0.01	0	0	0	0
25	3	1	4	0.02	0	0	0	0
26	3	1	4	0.01	0	0	0	0
27	3	1	4	0.01	0	0	0	0
28	3	1	4	0.02	0	0	0	0
29	3	1	4	0.01	0	0	0	0
30	3	1	4	0.02	0	0	0	0
Monthly Avg	3	0	3	0	0	0	0	0

October-07 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows			Robles Facility Daily Flows				
	Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Forebay Avg. Depth (ft)	Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	1	1	2	0.01	0	0	0	0
2	1	1	2	0.02	0	0	0	0
3	1	1	1	0.01	0	0	0	0
4	1	1	1	0.01	0	0	0	0
5	1	1	1	0.02	0	0	0	0
6	1	1	1	0.02	0	0	0	0
7	1	1	1	0.01	0	0	0	0
8	1	1	1	0.01	0	0	0	0
9	1	1	1	0.01	0	0	0	0
10	1	1	1	0.01	0	0	0	0
11	1	1	1	0.02	0	0	0	0
12	1	1	1	0.02	0	0	0	0
13	1	1	2	0.02	0	0	0	0
14	1	1	2	0.02	0	0	0	0
15	1	1	1	0.01	0	0	0	0
16	1	1	1	0.01	0	0	0	0
17	1	1	1	0.02	0	0	0	0
18	1	1	1	0.01	0	0	0	0
19	1	1	1	0.01	0	0	0	0
20	1	1	1	0.02	0	0	0	0
21	1	1	1	0.02	0	0	0	0
22	1	1	1	0.02	0	0	0	0
23	1	1	1	0.02	0	0	0	0
24	1	1	1	0.02	0	0	0	0
25	1	1	1	0.01	0	0	0	0
26	1	1	1	0.01	0	0	0	0
27	0	1	1	0.03	0	0	0	0
28	0	1	1	0.02	0	0	0	0
29	0	1	1	0.02	0	0	0	0
30	0	1	1	0.01	0	0	0	0
31	0	1	1	0.02	0	0	0	0
Monthly Avg	1	1	1	0	0	0	0	0

November-07 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Forebay Avg. Depth (ft)	Robles Facility Daily Flows: Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	0	1	1	0.01	0	0	0	0
2	0	1	1	0.02	0	0	0	0
3	1	1	1	0.02	0	0	0	0
4	0	1	1	0.01	0	0	0	0
5	1	1	1	0.01	0	0	0	0
6	0	1	1	0.02	0	0	0	0
7	1	1	1	0.01	0	0	0	0
8	0	1	1	0.02	0	0	0	0
9	0	1	1	0.02	0	0	0	0
10	0	1	1	0.02	0	0	0	0
11	0	1	1	0.03	0	0	0	0
12	1	1	1	0.02	0	0	0	0
13	1	1	1	0.02	0	0	0	0
14	1	1	1	0.02	0	0	0	0
15	1	1	1	0.02	0	0	0	0
16	0	1	1	0.01	0	0	0	0
17	0	1	1	0.02	0	0	0	0
18	0	1	1	0.02	0	0	0	0
19	0	1	1	0.02	0	0	0	0
20	1	1	1	0.02	0	0	0	0
21	0	1	1	0.01	0	0	0	0
22	0	1	1	0.02	0	0	0	0
23	0	1	1	0.02	0	0	0	0
24	0	1	1	0.02	0	0	0	0
25	0	1	1	0.02	0	0	0	0
26	0	1	1	0.01	0	0	0	0
27	1	1	1	0.02	0	0	0	0
28	1	1	1	0.03	0	0	0	0
29	1	1	1	0.01	0	0	0	0
30	1	1	1	0.02	0	0	0	0
Monthly Avg	1	1	1	0	0	0	0	0

December-07 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Robles Facility Daily Flows: Forebay Avg. Depth (ft)	Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	1	1	1	0.02	0	0	0	0
2	1	1	1	0.02	0	0	0	0
3	1	1	1	0.01	0	0	0	0
4	1	1	1	0.01	0	0	0	0
5	1	1	1	0.01	0	0	0	0
6	1	1	1	0.02	0	0	0	0
7	1	1	2	0.09	0	0	0	0
8	1	1	2	0.09	0	0	0	0
9	1	1	2	0.07	0	0	0	0
10	1	1	2	0.06	0	0	0	0
11	1	1	2	0.04	0	0	0	0
12	1	1	2	0.01	0	0	0	0
13	1	1	2	0.01	0	0	0	0
14	1	1	2	0.01	0	0	0	0
15	1	1	2	0.01	0	0	0	0
16	1	1	2	0.01	0	0	0	0
17	1	1	2	0.01	0	0	0	0
18	2	4	5	0.18	0	0	0	0
19	1	5	6	0.48	0	0	0	0
20	1	2	3	0.70	0	0	0	0
21	1	2	3	0.39	0	0	0	0
22	1	2	2	0.32	0	0	0	0
23	1	1	2	0.25	0	0	0	0
24	1	1	2	0.20	0	0	0	0
25	1	1	2	0.16	0	0	0	0
26	1	1	2	0.18	0	0	0	0
27	1	1	2	0.16	0	0	0	0
28	1	1	2	0.17	0	0	0	0
29	1	1	2	0.16	0	0	0	0
30	1	1	3	0.16	0	0	0	0
31	1	1	3	0.17	0	0	0	0
Monthly Avg	1	1	2	0	0	0	0	0

January-08 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Forebay Avg. Depth (ft)	Robles Facility Daily Flows: Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	1	1	3	0.2	0	0	0	0
2	2	1	3	0.2	0	0	0	0
3	2	1	3	0.4	0	0	0	0
4	160	130	290	2.0	34	238	8	247
5	282	68	350	6.2	50	245	32	277
6	74	21	95	7.1	40	50	31	81
7	58	19	77	8.1	36	36	29	65
8	64	13	77	8.1	50	45	20	65
9	52	10	62	8.2	50	34	19	52
10	33	8	41	8.2	30	30	7	37
11	17	7	24	7.3	20	20	2	22
12	15	6	21	4.7	18	18	0	18
13	15	5	20	3.9	16	16	0	16
14	12	4	16	3.6	14	14	0	14
15	6	4	10	3.3	8	8	0	8
16	6	4	10	2.2	8	8	0	8
17	6	4	10	2.1	8	8	0	8
18	6	4	10	1.9	8	8	0	8
19	6	4	10	2.0	8	8	0	8
20	6	4	10	1.9	8	8	0	8
21	6	4	9	1.8	6	6	0	6
22	7	4	11	1.9	7	7	0	7
23	289	82	371	2.0	50	316	0	316
24	271	87	358	6.5	50	167	137	304
25	944	261	1205	8.1	50	682	342	1024
26	494	117	611	8.0	50	140	440	580
27	2950	538	3488	8.3	50	3000	200	3200
28	1420	379	1799	6.7	50	1300	200	1500
29	566	159	725	7.7	50	304	310	614
30	360	112	472	7.8	50	170	235	405
31	270	86	356	8.2	50	110	194	304
Monthly Avg	271	69	340	5	28	226	71	297

(light grey) Bubbler non-operational, flow calculated by visual inspection @ weir & based on Matilija Data
(dark grey) No data point, value averaged from adjacent data points

February-08 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Robles Facility Daily Flows: Forebay Avg. Depth (ft)	Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	225	70	295	8.4	42	129	125	254
2	200	60	260	8.3	42	102	120	222
3	211	76	287	8.1	42	116	125	241
4	187	48	235	8.2	42	75	125	200
5	151	43	194	8.0	42	62	92	154
6	136	39	175	7.6	40	60	92	152
7	126	36	162	7.4	38	57	78	135
8	127	33	160	7.3	36	57	68	125
9	124	31	155	7.3	36	52	73	125
10	117	29	146	7.2	36	52	72	124
11	112	27	139	7.2	36	52	67	119
12	108	25	133	7.1	36	52	62	114
13	106	24	130	7.1	35	52	58	110
14	104	23	127	7.1	35	51	57	108
15	93	21	114	7.1	36	45	57	102
16	85	20	105	7.0	36	45	52	97
17	81	20	101	6.8	36	44	47	91
18	77	19	96	6.7	25	43	42	85
19	73	19	92	6.5	35	42	36	78
20	75	19	94	6.6	34	47	32	79
21	76	18	94	6.7	34	47	34	81
22	93	22	115	6.6	34	62	35	97
23	85	20	105	7.1	34	42	51	93
24	268	56	324	6.8	34	57	218	275
25	205	37	242	7.9	33	33	173	206
26	161	29	190	8.4	42	50	112	162
27	141	26	167	8.3	42	50	93	143
28	129	24	153	8.1	42	54	73	127
29	120	22	142	8.0	42	59	62	121
Monthly Avg	131	32	163	7	38	60	84	144

(shaded) Bubbler non-operational, flow calculated by visual inspection @ weir & based on Matilija Data

March-08 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)		Forebay Avg. Depth (ft)	Robles Facility Daily Flows: Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	114	21	135		7.9	40	59	56	115
2	109	20	129		7.8	40	59	52	111
3	102	19	121		7.7	40	58	45	103
4	97	18	115		7.6	40	57	39	96
5	93	17	110		7.6	39	57	35	92
6	87	17	104		7.5	38	56	31	87
7	84	16	100		7.4	37	61	24	85
8	81	15	96		7.3	37	60	21	81
9	78	15	93		7.3	37	60	18	78
10	74	14	88		7.3	36	56	18	74
11	72	14	86		7.3	36	49	21	70
12	70	14	84		7.2	36	48	20	68
13	68	13	81		7.2	36	48	18	66
14	66	13	79		7.2	36	47	17	64
15	66	13	79		7.2	36	48	16	64
16	66	12	78		7.2	36	47	15	62
17	61	12	73		7.1	36	47	12	59
18	60	11	71		7.0	35	46	11	57
19	58	11	69		7.0	35	46	10	56
20	57	11	68		7.0	35	46	9	55
21	54	10	64		6.9	35	46	7	53
22	52	10	62		6.8	35	45	6	51
23	51	10	61		6.8	35	44	5	49
24	50	10	60		6.8	35	43	5	48
25	48	9	57		6.7	35	43	4	47
26	47	9	56		6.6	34	42	4	46
27	47	9	56		6.6	34	42	3	45
28	43	9	52		6.6	34	41	2	43
29	41	9	50		6.5	34	38	2	40
30	41	9	50		6.5	34	38	1	39
31	40	9	49		6.5	33	38	1	39
Monthly Avg	67	13	80		7	36	49	17	66

April-08 **Average Daily Flow FY 07-08**

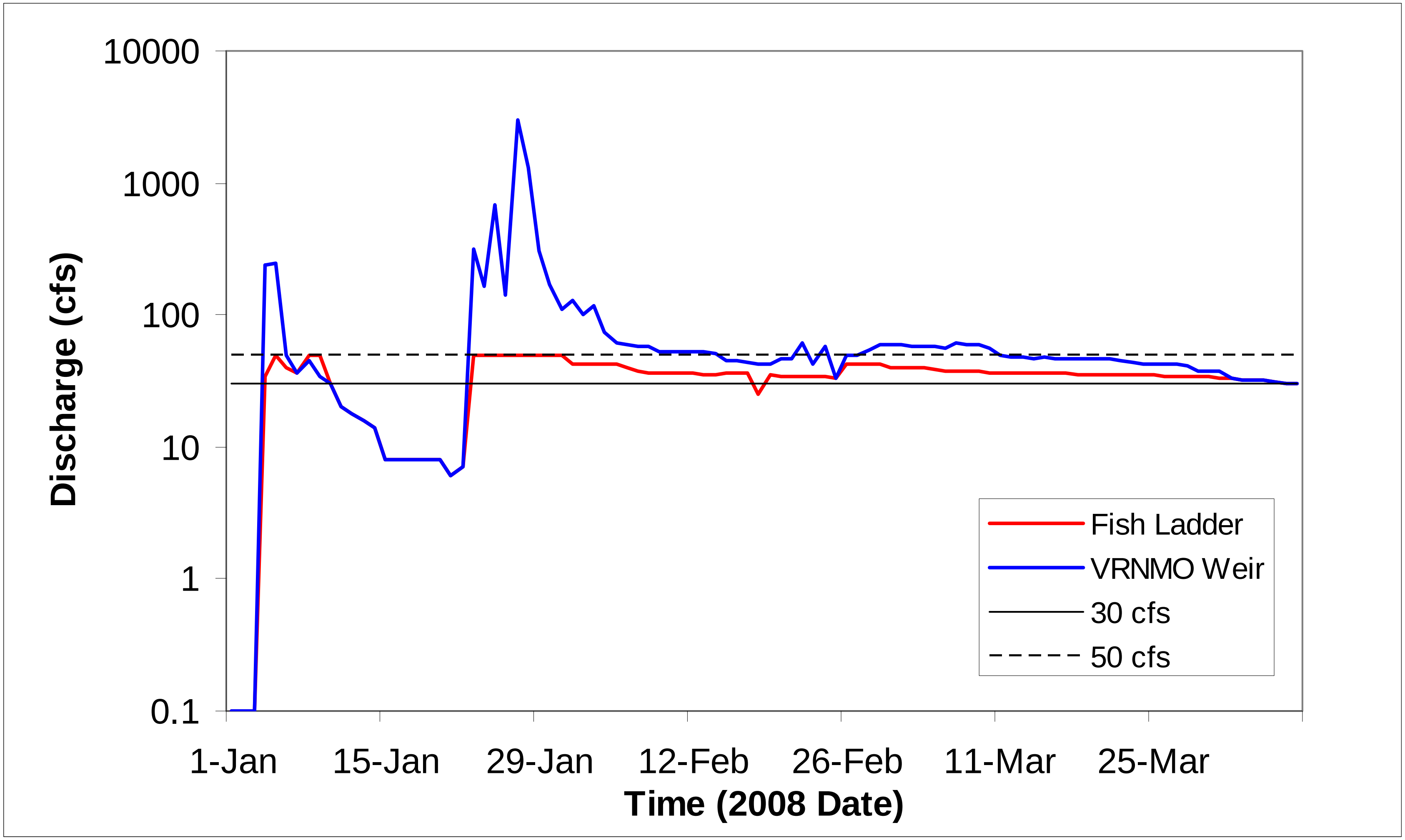
Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)	Forebay Avg. Depth (ft)	Robles Facility Daily Flows: Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	39	2	41	6	33	33	1	34
2	39	2	41	6	32	32	0	32
3	38	2	40	6	32	32	1	33
4	36	2	38	6	32	32	0	32
5	36	2	38	6	31	31	0	31
6	35	2	37	6	30	30	0	30
7	34	2	36	6	30	30	0	30
8	34	2	36	6	28	28	0	28
9	32	2	34	6	27	27	0	27
10	31	2	33	6	25	25	0	25
11	30	2	32	6	24	24	0	24
12	28	2	30	6	23	23	0	23
13	25	2	27	6	22	22	0	22
14	25	2	27	5	22	22	0	22
15	25	2	27	5	21	21	0	21
16	24	2	26	5	21	21	0	21
17	24	2	26	5	21	21	0	21
18	23	2	25	5	21	21	0	21
19	23	2	25	5	21	21	0	21
20	24	2	26	5	21	21	0	21
21	23	2	25	5	21	21	0	21
22	23	2	25	5	21	21	0	21
23	22	2	24	5	21	21	0	21
24	21	2	23	5	20	20	0	20
25	20	2	22	5	17	17	0	17
26	19	2	21	5	15	15	0	15
27	18	2	20	5	15	15	0	15
28	17	2	19	4	14	14	0	14
29	17	2	19	4	14	14	0	14
30	17	2	19	4	14	14	0	14
Monthly Avg	27	2	29	5	23	23	0	23

May-08 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)		Robles Facility Daily Flows: Forebay Avg. Depth (ft)	Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	17	2	19		3.2	14	14	0	14
2	17	2	19		3.3	12	12	0	12
3	16	2	18		3.8	12	12	0	12
4	17	2	19		3.7	13	13	0	13
5	17	2	19		3.5	13	13	0	13
6	18	2	20		3.5	14	14	0	14
7	18	2	20		3.5	14	14	0	14
8	18	2	20		3.5	14	14	0	14
9	17	2	19		3.5	14	14	0	14
10	17	2	19		3.5	13	13	0	13
11	17	2	19		3.6	13	13	0	13
12	17	2	19		3.4	13	13	0	13
13	16	2	18		3.3	12	12	0	12
14	15	2	17		3.2	11	11	0	11
15	14	2	16		3.1	8	8	0	8
16	13	2	15		2.8	5	5	0	5
17	13	2	15		2.7	4	4	0	4
18	12	2	14		2.6	4	4	0	4
19	12	2	14		2.5	4	4	0	4
20	11	2	13		2.4	4	4	0	4
21	12	2	14		2.5	4	4	0	4
22	11	2	13		2.3	4	4	0	4
23	14	2	16		2.7	6	6	0	6
24	15	2	17		3.1	11	11	0	11
25	14	2	16		3.0	10	10	0	10
26	14	2	16		2.9	9	9	0	9
27	14	2	16		2.8	8	8	0	8
28	13	2	15		2.7	7	7	0	7
29	12	2	14		2.6	6	6	0	6
30	12	2	14		2.5	5	5	0	5
31	11	2	13		2.5	4	4	0	4
Monthly Avg	15	2	17		3	9	9	0	9

June-08 **Average Daily Flow FY 07-08**

Date	Source Stream Daily Flows: Matilija Ck D/S Dam (avg cfs/d)	North Fork Matilija Ck. * (avg cfs/d)	Sum of Creek Flows (avg cfs/d)		Forebay Avg. Depth (ft)	Robles Facility Daily Flows: Fishway Ladder (avg cfs/d)	VRNMO Weir (avg cfs/d)	Diversion Canal (avg cfs/d)	Total Inflow (avg cfs/d)
1	11	2	13		2.42	4	4	0	4
2	11	2	13		2.37	4	4	0	4
3	10	2	12		2.32	3	3	0	3
4	11	2	13		2.28	3	3	0	3
5	10	2	12		2.17	3	3	0	3
6	10	2	12		2.01	3	3	0	3
7	10	2	12		2.06	3	3	0	3
8	10	2	12		2.13	3	3	0	3
9	10	2	12		2.09	3	3	0	3
10	10	2	12		2.08	3	3	0	3
11	10	2	12		2.07	3	3	0	3
12	10	2	12		2.09	3	3	0	3
13	10	2	12		2.07	3	3	0	3
14	10	2	12		1.99	3	3	0	3
15	11	2	13		1.92	3	3	0	3
16	11	2	13		2.01	3	3	0	3
17	11	2	13		1.98	3	3	0	3
18	9	2	11		1.90	2	2	0	2
19	7	2	8		1.37	1	1	0	1
20	7	2	8		1.33	1	1	0	1
21	7	2	8		1.31	1	1	0	1
22	7	2	8		1.34	1	1	0	1
23	7	2	8		1.30	1	1	0	1
24	7	2	9		1.22	1	1	0	1
25	7	2	9		1.40	1	1	0	1
26	7	2	9		1.41	1	1	0	1
27	7	2	9		1.39	1	1	0	1
28	7	2	9		1.42	1	1	0	1
29	7	2	9		1.45	1	1	0	1
30	7	2	9		1.36	1	1	0	1
Monthly Avg	9	2	11		2	2	2	0	2



Appendix 14. Graph of discharge below the Robles Facility and through the fish ladder during the period of storm events for 2008.

2010 Robles Fish Passage Facility

Progress Report

Casitas Municipal Water District
1055 Ventura Avenue
Oak View, California 93022

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1.0 EXECUTIVE SUMMARY

Casitas Municipal Water District (CMWD) is implementing the Robles Fish Passage Facility Project (Robles Fish Facility) described in the Biological Assessment (BA) proposed by Bureau of Reclamation (USBOR 2003). The BA was later analyzed in the Biological Opinion (BO) prepared by the National Marine Fisheries Service (NMFS 2003a). This 2010 Robles Fish Passage Facility Progress Report, as described by the BO, is the culmination of monitoring, evaluation, and operational data collected during the reporting period of 01 July 2009 to 30 June 2010.

The monitoring and evaluation studies related to the Robles Fish Facility conducted during the 2009-2010 reporting period are included in two main sections of this progress report. The Fisheries Monitoring and Evaluation section contains: upstream fish migration impediment evaluation, sandbar monitoring at the mouth of the Ventura River, fish attraction evaluation, fish passage monitoring, downstream fish passage evaluations, and downstream fish migration through the Robles Reach. The Facility Operation section contains: information and data on the facility status, flow observations and control, costs associated with operation and monitoring, assessment of the effectiveness to provide fish passage, recommendations of priorities for future activities, and revisions deemed necessary to the operations.

A total of 48 transects at seven monitoring sites were completed for the upstream fish migration impediment evaluation in 2010. The sandbar at the mouth of the Ventura River was only closed for short periods during mid September and was open for potential volitional steelhead passage during the remainder of the reporting period. A total of 147 *O. mykiss* juveniles were counted in the area upstream and downstream of the Robles Fish Facility during the fish attraction evaluations in 2010. This number represents multiple counts of some *O. mykiss* due to smolting rates and migration behavior. During the fish passage monitoring evaluations, 54 *O. mykiss* were detected migrating upstream through the Robles Fish Facility in 2010. Five *O. mykiss* smolts were captured migrating downstream below the Robles Fish Facility.

2.0 INTRODUCTION

NOAA Fisheries listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA) of 1973. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) that were considered to be substantially isolated from other steelhead stocks reproductively and were an important part of the evolutionary legacy of the species. The southern California steelhead ESU included, at that time, steelhead populations from the Santa Maria River in San Luis Obispo County south to Malibu Creek in Los Angeles County. The ESU was later extended to the US/Mexican border in San Diego County during 2002 (NMFS 2003b). In a later delineating approach, NOAA Fisheries recognized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) as described under the ESA (NMFS 2005). The DPS policy differs from the ESU by delineating a group of organisms by "marked separation" rather than "substantial reproductive isolation". In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated, are still part of the ESU; however, the anadromous *O. mykiss* (i.e., steelhead) are now part of a smaller subset identified as the southern California steelhead DPS.

Rainbow trout can be generally organized into four large groupings (Behnke 1992; Scott and Crossman 1973): 1) coastal rainbow trout that extend from northern Baja California to northern Alaska near the Kuskokwim River and also the Kamchatkan Peninsula of northeastern Asia, 2) redband trout of the inland Columbia and Frazer River basins, 3) redband trout of the central valley of California, and 4) trout of the Gulf of California drainages. The taxonomic group of coastal rainbow trout, *O. m. irideus*, exhibit two life history forms; anadromous and resident. The common name for the anadromous life history form is termed steelhead trout and the resident form is generally termed rainbow trout. Throughout the range of coastal rainbow trout, there is a widespread occurrence of the anadromous life history form (Behnke 1992). There are two general life history patterns exhibited by adult anadromous steelhead when they return from the ocean to spawn in fresh water. The patterns are grouped by either summer or winter spawning runs. There are many exceptions to this pattern, but this general characterization has been used to group steelhead spawning runs by the season in which the peak occurs as they return from the ocean (Busby et al. 1996). Summer steelhead are generally found in river systems that drain from farther inland, such as the Columbia River basin. Winter steelhead runs are typically found in the coastal systems where the river systems are not as large. The winter steelhead life history pattern is the most abundant anadromous life history within the natural range of the species (Busby et al. 1996).

3.0 FISHERIES MONITORING AND EVALUATION

The monitoring and evaluation studies and activities related to the modification of the Robles Facility, as outlined in the BO (NMFS 2003a), were intended to achieve three main objectives:

I. Monitor Fish Passage Facility operations and performance.
II. Determine if the Fish Passage Facility functions and operates in such a fashion that migrating steelhead:
   a. Successfully navigate into and through the facility, and
   b. Move through the facility in good physical condition.
III. Determine if the operations at the Robles Diversion are enhancing the opportunity for:
   a. Adult steelhead to migrate upstream to the Robles Facility, and
   b. Smolts and kelts to migrate downstream through the Robles Reach.

5-year Reevaluation of Initial Evaluation and Monitoring Activities

As described in the BO, a 5-year reevaluation of the initial fish flow operations would be conducted to determine if monitoring and evaluations have been completed (NMFS

2003a). The initiation of the 5-year period began in 2006, which was the first year the Robles Fish Facility was fully operational. This would necessitate a reevaluation after the 2010 fish passage season. Through the Cooperative Decision Making Process, the Robles Biological Committee would review each of the specific monitoring and evaluations and determine if they have addressed the original objectives and could be discontinued or if additional study would be needed. It is recommended that all aspects of the monitoring and evaluation for the Robles Fish Facility be continued at this time. Because of the variable water conditions and insufficient number of adult and juvenile steelhead, the objectives of the monitoring and evaluation program have not yet been accomplished. Beginning in 2011, each aspect of the program will be evaluated to determine if sufficient information exist to complete the objectives.

3.1 Upstream Fish Migration Impediment Evaluation

Introduction

The ability of adult steelhead to swim upstream can be impeded during the migration season at times of low-river flow (NMFS 2003a). Evaluations at shallow water habitat units (i.e., critical riffles) have been commonly used as a method to determine if impediments exist for adult and juvenile steelhead in California rivers (Dettman and Kelley 1986; Bratovich and Kelley 1988; Hager 1996). The Robles Reach, which extends downstream from the Robles Fish Facility approximately 6.5 km (NMFS 2003a) to just upstream of the San Ana Boulevard bridge (Appendix 1), is a wide alluvial section of the Ventura River that is composed of active wash deposits of unconsolidated silt, sand, gravel, and boulders (Tan and Jones 2006). Due to this type of channel morphology and geology, alluvial channels like the Robles Reach have high infiltration rates that cause channel surface flow to rapidly recede and cease shortly after storm events (Cooke et al. 1992).

An initial assessment of potential passage impediments in relation to river discharge was completed by ENTRIX (1999). The physical characteristics of seven potential impediments were evaluated using the Thompson (1972) passage criteria. The Thompson (1972) passage criteria for adult steelhead at critical riffles is a water depth of 0.6 ft for 25% of the total transect width and a continuous portion equal to 10% of the total transect width. The potential impediments were also evaluated using a criteria of 0.5 ft and 0.6 ft depth for 25% of the total width and a total of 8 ft width for both depths. The resulting discharge required was estimated to be between 40 and 65 cfs. There have been several modifications to the Thompson passage criteria by other researchers; Dettman and Kelly (1986) on the Carmel River used a depth of 0.6 ft over a 5 ft continuous section, a criteria of 0.6 ft depth over an 8 ft section was used on the Santa Ynez River (SYRTAC 2000), and Harrison et al. (2006) used a criteria of 0.6 ft depth over a 10 ft section on the Santa Clara River. Thompson's (1972) depth criterion of 0.6 ft was not based on actual migration observations and was not evaluated. It has been observed that adult salmonids can successfully move through shallower riffles than the 0.6 ft criterion (Mosley 1982). The final evaluation of potential impediments will use one of the aforementioned criteria or a yet to be determined criteria that will be developed by the Biological Committee through the Cooperative Decision Making Process as described in the BO.

The objective of the impediment evaluation is to assess factors that may impede steelhead's ability to migrate to the fish passage facilities (NMFS 2003a). Because of the potential for low-river flows to impede upstream fish migration, the Robles Reach will be the primary focus of the impediment evaluations (NMFS 2003a).

Methods

Selected channel features that may pose an impediment to upstream passage were surveyed multiple times during the fish migration season (January through June) to measure water depth, velocity, and channel width along a transect at each site. The selected sites were surveyed over a range of discharges from approximately 20-100 cfs (the upper limit was dependent on the ability to safely conduct the surveys), which was correlated with discharge at the Robles Fish Facility. The number of repeated surveys was dependent on the number and duration of significant rain events, rate of hydrograph recession, and time constraints due to other aspects of the monitoring and evaluation program. The impediment surveys will most likely be conducted over a period of 3-4 years given the natural variation of water conditions. The selected impediment sites will be resurveyed as many times as needed to develop a statistically rigorous data set to evaluate fish passage in relation to Robles Fish Facility discharge.

During the initial phase, the Ventura River was surveyed from the mouth to the Robles Fish Facility (23 km) using standard stream survey techniques and was completed in 2008 (CMWD 2008). This provided physical measurements of all habitat units for the selection process. The survey methodology followed Moore et al. (2002) and was equivalent to a level IV survey as described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002).

Over the course of three meetings and one conference call between 24 January and 18 June of 2009, the Biological Committee (BC) for the Robles Fish Facility completed an impediment site selection process that culminated in the selection of eight sites that would be monitored for the impediment evaluation. The BC reviewed physical parameters of the 376 habitat units surveyed and general river characteristics that included: unit type, length, width, water depth, slope, longitudinal location (river km), step height on step units, discharge at Foster Park and the Robles Fish Facility at the time of the surveys, and a river profile for the 23 km of the Ventura River surveyed. Upon completing an initial assessment of this data, a list of potential sites was developed that the BC visited in the field on 27 May 2009 to determine if monitoring was warranted. This data and field assessment included regular BC members Mike Kinsey (BOR), Stan Glowacki (NMFS), Mary Larson (CDFG), and Scott Lewis (CMWD). Hydrologists Bob Hughes (CDFG) and David Crowder (NMFS) were also involved in this assessment and selection process. At the completion of the habitat survey, 379 units were identified. Changes were due to incorrect unit numbering, separating out the Foster Park weir, resurveying several areas so that the correct primary channel was followed, and elimination of several step units that did not warrant separation. Because of these changes, there was a net loss of three units to the survey. This resulted in a change to the unit ID numbers from what the BC reviewed and selected; however, the actual units did not change.

An attempt was made to locate and determine the current status of the ENTRIX (1999) sites during 2009. Because there had been numerous bed-mobilizing runoff events after the study was completed, the present status of the sites was unknown and needed to be determined. Based on the site descriptions in the ENTRIX (1999) study report, field surveys were conducted to locate and describe the existing channel conditions at the original site locations.

2009 Results

Due to the important nature of the selected sites and original ENTRIX evaluations, selected portions of the 2009 results have been included to provide context, background, and comparisons for the 2010 results.

Of the 376 habitat units surveyed, a subset of eight sites (7 units plus the sandbar) were selected by the BC for the impediment evaluation that were thought to be representative of potential impediments throughout the 23 km reach (Appendix 2). Three riffles, two rapids, and two cascades were selected. The sandbar at the mouth was also selected since it is the first potential impediment to adult steelhead entering the Ventura River and is highly variable in nature due to shifting sands, tidal state, wave action, and river discharge. The mean length and slope of the selected sites were approximately 20 m and 5%, respectively. Substrate of the selected sites was composed of cobbles and boulders and represented 87% of the total area. The sandbar was not surveyed due to its variable nature.

A baseline set of photos was taken of each site after the final selection was completed to provide a method for determining qualitative changes over time. However, this first set of photos was not able to fully reveal site characteristics due to the heavy vegetation growth that has occurred because the last significant discharge event in January 2008 (CMWD 2008). The vegetation growth has occurred primarily in areas that tend to have longer periods of flowing surface water, which is primarily in the mainstem Ventura River downstream of the Robles Reach. After the next significant discharge event removes this vegetation, and subsequent impediment surveys are completed, it will be easier to view and document the impediment sites.

Of the seven sites originally identified by ENTRIX (1999), only four sites were able to be relocated with any degree of certainty. Of those four sites, all are no longer in the primary low-flow channel. Sites 1-3 were originally located between the Robles Fish Facility and the Hwy 150 bridge. The river channel in the general area where these sites were located has migrated naturally due to bed-mobilizing runoff events (primarily during a 2005 flood event) since the study was completed. The area where sites 1-3 were located may indeed still be within the river channel, but because of GPS field measurement errors (Larry Wise, ENTRIX, personal communication), their exact locations and status could not be determined. Even if those three sites are still within the river channel, there could have been longitudinal migration of the channel features over the last 10 years. Site 4 was originally located just upstream of the Hwy 150 bridge. The channel since then, based on photos from 2003, has migrated laterally approximately 20 m towards the left bank (looking upstream) caused from natural channel meandering. Site 5 was originally located just downstream of Santa Ana Blvd bridge. Based on photos from 2003, the channel has moved latterly approximately 30 m from the right bank towards left bank. This could be partly due to channel modifications that were made by CalTrans near the bridge in recent years (Mary Larson, CDFG, personal communication). Sites 6 and 7 were both originally located near the community of Casitas Springs. Site 6 was located behind the Arroyo Trailer Park and site 7 was located approximately 200 yards downstream (ENTRIX 1999). Again based on aerial photos of this area prior to the 2005 flood event, the river channel was located considerably closer to the left bank than it is presently. The main low-flow river channel is now located on the right bank against the levee that protects Casitas Springs from high water runoff events. This represents approximately a 30 m shift to the right bank for site 6 and a 50 m shift for site 7. The main low-flow channel at sites 6 and 7 appears to have switched between preexisting channels and was not the result of natural meandering over the last 10 years. Of the four original sites that could be relocated, all would be inundated at higher flows; however, because low-flow river conditions are the focus of the upstream fish impediment evaluation (NMFS 2003a), new sites were needed for future evaluations.

2010 Results

During 2010, a total of 48 water depth transects were completed at Robles discharges that ranged from 25 to 100 cfs. Because several passage criteria have been commonly used to evaluate potential passage impediments, analysis of the 2010 transect data was evaluated with four different criteria.

Site 2 was surveyed four times at Robles discharges ranging from 21 to 64 cfs. In general, Site 2 produced poor linear correlations. In order to evaluate Site 2 at the different passage criteria, the regression was forced through the origin to produce plausible results (Appendix 3). The resulting minimum discharges required to meet the four criteria ranged from 5 to 37 cfs. Site 3 was surveyed five times with discharges at Robles ranging from 21 to 82 cfs and produced similar results as Site 2. Site 3 regression was also forced through the origin in order to produce plausible results (Appendix 4). The resulting minimum discharges required to meet the four criteria ranged from 32 to 85 cfs. Site 4 was surveyed seven times with Robles discharges ranging from 21 to 100 cfs; standard linear regression was used (Appendix 5). The resulting minimum discharges required to meet the four criteria ranged from 46 to 74 cfs. Surface water at Site 5 was initially thought to be confined to one channel at lower flow, however, a secondary channel was used once surface water reached the site. To evaluate this condition, the secondary channel was also surveyed in the same manner as other sites. Site 5-1, the original site, was surveyed eight times with discharges at Robles ranging from 21 to 100 cfs and both standard and origin forced regression were conducted (Appendix 6). The evaluation method did not produced plausible results because the resulting minimum discharges required to meet the four criteria ranged from 431 to 3,289 cfs. Site 5-2, the secondary channel, was surveyed five times and at Robles discharges ranging from 23 to 64 cfs and standard linear regression was conducted (Appendix 7). The resulting minimum discharges required to meet the four criteria ranged from 52 to 138 cfs. Site 6 was surveyed eight times at Robles discharges ranging from 23 to 100 cfs and standard linear regression was conducted (Appendix 8). The resulting minimum discharges required to meet the four criteria ranged from 25 to 68 cfs. Site 7 was surveyed seven times at Robles discharges ranging from 31 to 100 cfs and both standard and origin-forced linear regression was conducted (Appendix 9). The resulting minimum discharges required to meet the four criteria ranged from 17 to 70 cfs. Site 8 was surveyed seven times at Robles discharges ranging from 21 to 100 cfs and both standard and origin forced linear regression was conducted (Appendix 10). The resulting minimum discharges required to meet the four criteria ranged from 19 to 26 cfs. Photos of the potential impediment sites at a Robles discharge of 30 or 40 cfs are in Appendix 11a-h for reference. The regression equations and statistics for the four passage criteria are in Appendix 12. The calculated minimum discharges to meet the four passage criteria are in Appendix 13.

In addition to the above analysis, a set of linear regressions were developed for the same impediment sites evaluating the Thompson criteria against individual site discharge estimates instead of Robles discharge (Appendix 29a-g). For regressions that did not produce plausible results, as some did in the previous analysis, no regressions were forced through the origin for this analysis. This resulted in some regressions that were not accurate descriptions of the relation intended to be modeled. For example, two of the sites produced an inverse relation between discharge and passage conditions (i.e., an increase in discharge resulted in a decrease in passage conditions). Additionally, resulting equations had y-intercepts that were larger than expected (Appendix 30a-b).

Discussion

The survey and analytical methods used to evaluate the potential impediments in the Ventura River appear to be able to produce reasonable estimates of minimum discharge needed for adult steelhead passage. The intent of evaluating the impediments using the aforementioned criteria was simply to validate the methods and determine if similar results could be obtained as that of those by ENTRIX (1999) on the Ventura River.

ENTRIX (1999) used the criteria developed by Thompson (1972) for adult steelhead at critical riffles, which is a water depth of 0.6 ft for 25% of the total transect width and a continuous portion equal to 10% of the width. ENTRIX also evaluated the critical riffles using a modification that would produce a water depth of 0.6 ft over a continuous width of 8 ft. The transect that required the highest minimum discharge to meet the two criteria was used to determine the discharge needed for adult steelhead passage, which was a range of 40-65 cfs. It appears that during the development of the initial minimum flows for the Robles Biological Opinion, NMFS averaged these two numbers to come up the initial minimum flow of 50 cfs (NMFS 2003a). By applying this same criteria and flow selection method to data collected during 2010, a minimum discharge of 70 cfs was estimated. However, as stated by Thompson (1972), the selected sites should be averaged to determine the final minimum discharge estimate. This would result in a minimum discharge estimate of 27-60 cfs for the four criteria. Of the adult passing through the Robles Fish Facility to date, the deepest body depth has been 0.41 ft. If this depth was used instead of the 0.6 ft, the resulting discharge would be even less. Sites 2, 3, and 5 were not included in this estimate because of the lack of plausible estimates and poor statistical results they produced. The discharge estimates by ENTRIX (1999) were generally lower than those produced by field measurements during 2010. There appears to be several possible reasons for the differences that could include: (1) ENTRIX used a modeling approach that was based on data collected from a dry channel. At the time of site selection and survey, any potential side channels were not evident and therefore all of the modeling would have assumed the flowing water would have passed only through the primary channel. (2) Several of the sites surveyed during 2010 included areas that developed secondary and even tertiary channels. These sites were also selected when there was no surface water flowing and led to the same potential error. However, the field surveys during 2010 revealed that as the discharge increased, surface water began to flow in the side channels resulting in higher discharge estimates. Lastly, (3) vegetation at the lower river sites caused surface channel water to spread out into shallow areas that resulted in higher estimates. Field measurements, like that during 2010, would be able to detect these types of changes that modeling could not. The vegetation in the lower river is likely due to the rising ground water downstream of the Robles Reach and inflow from San Antonio Creek that provides perennial water for vegetation establishment and growth.

The additional analysis of site discharge to Thompson criteria produced results that were not plausible for some sites. The inverse relations, negative discharge, and statistically insignificant results could have been due to several reasons. The previously mentioned possible causes would still be applicable for this analysis. Additional data would likely improve some of the regression models. However, it seems that the Thompson method and criteria has limitations that could be exceeded at channel and basin scales.

Regardless of the passage criteria ultimately used, the survey and analytical methods used to evaluate the potential impediments appeared to produce reasonable estimates of minimum discharge needed for adult steelhead passage. Several of the lower river sites should be replaced with new sites that would produce usable estimates for future evaluations.

3.1.1 Sandbar Monitoring

Introduction

The Ventura River, like many other California rivers, typically develops a seasonal sandbar at the mouth during the late spring or summer that is breached by higher river flows in the late fall or winter. If a sandbar does develop, which occurs more often during dry years, the resulting lagoon can provide important rearing habitat for steelhead juveniles because of the abundant food resources available that can facilitate the physiological and behavioral changes associated with smoltification (Cannata 1998) and can also enhance marine survival (Bond et al. 2008).

The primary objective of the sandbar monitoring is to determine if the criteria for initiation of the fish passage augmentation season have been met (NMFS 2003a). As stipulated in the BO, the fish passage augmentation season will extend from 01 January through 30 June of each year and will commence after the sandbar has been breached at least once during the current year's fish flow operations season. During the fish passage augmentation season, several Robles Fish Facility operation criteria must also be implemented (see NMFS 2003a for a complete list of operational criteria).

Methods

During each sandbar inspection, observations and recordings were made that included: date, time, status of the sandbar, general location of the mouth, tidal stage, water temperature, discharge at the Robles Fish Facility and the USGS Foster Park gauge station, and an index count of piscivorous birds. Because the sandbar was open at the first of the year, its status was monitored once every two weeks for the remainder of the fish passage season. During the remainder of the year, the sandbar was monitored at least monthly.

Results

During the reporting period, July 2009 through June 2010, the mouth of the Ventura River was inspected 21 times to determine if the sandbar was open or closed. Thirteen of the observations occurred during the fish passage augmentation season (01 January to 30 June) and eight were outside of the fish passage augmentation season. The sandbar was only closed during the September observation; however, this closure was brief in nature because it only occurred during low tides. During high tides, the surface water was reaching the Pacific Ocean (Appendix 14). In mid December of 2009, the sandbar was open and the Ventura River was able to flow into the Pacific Ocean allowing fish to volitionally enter or exit the estuary. On 04 January 2010, the sandbar was also open, which officially initiated the beginning of the fish passage augmentation season. The sandbar was open for the remainder of the 2010 fish passage augmentation season. On the days the sandbar was inspected, the river discharge at the USGS Foster Park gauge station ranged from approximately 2 to 67 cfs and 0 to 44 cfs at the Robles Fish Facility. The river was observed exiting primarily from the west side of the estuary during the reporting period.

A total of 3,881 piscivorous birds were counted during 18 index surveys of the Ventura River estuary (Appendix 15). Gulls represented approximately 70% of the bird observations at 2,737, followed by terns at 447, cormorants at 351, and pelicans at 296. Egrets, grebes, herons, mergansers, and kingfishers were each counted at total of less than 24 times during the same period.

Discussion

The sandbar at the mouth of the Ventura River tends to remain open during average and above average precipitation years and is closed more often during years with few significant rain events (Lewis et al. 2010). During 2005 and 2006, the sandbar remained open and did not close until April of 2007 after an extended period of low precipitation (Appendix 16). During 2008, the sandbar was only closed during October and November and reopened in December. During the period that the sandbar was closed in December of 2007, the lagoon had a surface area of 4.7 ha. During an open period in August of 2008, the estuary had a surface area of 2.8 ha, which represents an approximately 70% increase in surface area during periods when the sandbar was closed (Lewis et al. 2010). The status of the sandbar indicates changes in the estuary/lagoon that may help determine potential juvenile steelhead rearing conditions.

3.2 Fish Attraction Evaluation

Introduction

River discharge has been shown to be one of several key environmental factors initiating and facilitating steelhead and other salmonid adult and juvenile migrations in natural fluvial environments (Shapovalov and Taft 1954; Banks 1969; Spina et al. 2005). As adults and juveniles approach fish passage facilities, sufficient discharge and water velocities become even more important to ensure successful passage through any facility (Clay 1995; Beeman and Maule 2001).

The entrance of the fish ladder at the Robles Fish Facility is located approximately 20 m downstream of the spillway gates and is where fish migrating upstream enter and where fish migrating downstream exit. The downstream end of the ladder is adjacent to a large pool (entrance pool) that was scoured out and maintained by high discharges through the spillway gates. Maximum discharge at the exit of the ladder is 170 cfs (50 cfs through the entire ladder and an additional 120 cfs can be supplemented at the lower end of the ladder). The distance from the entrance pool downstream to the lower most interim rock weir is approximately 200 m. This reach includes all four rock weirs and the facility's low flow road crossing, which is also the weir used to measure discharge for the Robles Fish Facility. The habitat unit types that could be used by migrants in this reach includes the four pools created by the weirs, a glide created by the low flow road crossing, a riffle, and the entrance pool.

The objective of the fish attraction evaluation is to determine if adult or juvenile steelhead were holding immediately downstream of the Robles Fish Facility during the fish passage augmentation season (NMFS 2003a).

Methods

The fish attraction surveys were conducted on a weekly basis during the fish passage season from January through June of 2010. The particular survey methodology used was determined based on water visibility, river discharge, and expected steelhead life history stage present at the time of the survey. From January through March, which is when the vast majority of adults are expected to be migrating upstream (Shapovalov and Taft 1954), bank surveys were the predominant method used. Beginning in March through the remainder of the fish passage season, snorkel surveys were the predominant method used, which is when steelhead smolts are expected to migrate downstream (Shapovalov and Taft 1954; Spina et al. 2005). Bank surveys were conducted by one or two surveyors in an upstream direction. The surveyors wore polarized sunglasses to reduce water surface reflection. Snorkel surveys were conducted by one or two surveyors in an upstream direction. All fish species were identified and enumerated to the greatest extent possible that the river conditions and fish densities allowed at the time of the surveys. Lengths of each *O. mykiss* were estimated to the nearest cm if only a few individuals were present. At times of greater abundance, *O. mykiss* were grouped and assigned to the nearest length (cm) category. In order to collect additional information that may help determine *O. mykiss* upstream and downstream movements through the Robles Fish Facility, an upstream study reach was added in 2009. The upstream study reach included observations in the screenbay of the facility and the area immediately upstream of the low-flow fish exit in the forebay. The total distance of this upstream reach was approximately 140 m.

Results

A total of 147 *O. mykiss* were counted from January through June of 2010 in the 340 m study reach (Appendix 17). One large 58 cm *O. mykiss* was observed during the fish attraction surveys. A total of 8,160 m were surveyed by either bank or snorkel methodologies during the 6-month period. The water temperatures during the study period ranged from 10 °C in January to 25 °C in June and turbidity was less than 11 NTUs. *O. mykiss* were first observed in March and peaked in late April and early May at 20 fish (Appendix 18). After peaking, *O. mykiss* counts declined at the end of May and ranged from 2 to 6 *O. mykiss* through the end of June 2010. The discharge at the Robles Fish Facility ranged from about 0 to 588 cfs. During the period that *O. mykiss* counts began to increase, the discharge was generally receding.

The 200 m reach downstream of the fish facility was surveyed on 24 separate occasions, 6 bank and 18 snorkel surveys. A cumulative total of 4,800 m were surveyed from January through June. A total of 53 *O. mykiss* were observed downstream of the Robles Fish Facility (Appendix 19). The peak count for the downstream reach was 9 *O. mykiss*, which declined to about 3 *O. mykiss* for the remainder of the study period.

The 140 m reach upstream was surveyed on 24 separate occasions, 6 bank and 18 snorkel surveys. A cumulative total of 3,360 m were surveyed from January through June. A total of 94 *O. mykiss* were observed in the upstream reach. Observations of *O. mykiss* upstream of the Robles Fish Facility were somewhat similar to downstream counts. The general pattern of increasing counts in early March and receding to lower levels in late May was similar for both upstream and downstream counts, but the upstream counts peaked about 3 weeks earlier (Appendix 19). The peak count for the upstream reach was 16 *O. mykiss*, which declined to about 3 *O. mykiss* for the remainder of the season.

An additional fish attraction survey method was conducted in 2010. This entailed surveying three times per day for five consecutive days following a BO-defined storm event after a Secchi depth of 1 m was reached in the entrance pool. These surveys were conducted for the three storm events and no adult steelhead were observed. Only bank surveys were conducted because the turbidity was too high to conduct snorkel surveys.

<u>*Discussion*</u>

The total count of 147 *O. mykiss* in the upstream and downstream reaches was in all likelihood the result of repeated counts of *O. mykiss* over the course of the survey season. Because the surveys were conducted weekly, some *O. mykiss* likely remained in the 340 m reach for more than one week and were counted at least one additional time; most likely several times. Without tracking individual *O. mykiss* (e.g., mark/recapture, telemetry, or other tagging studies), the time spent by *O. mykiss* in close proximity to the Robles Fish Facility cannot be determined by observations alone. It is clear, however, that *O. mykiss* are migrating from the upper Ventura Basin and passing through the Robles Fish Facility successfully and continuing downstream.

From observational counts alone, the ability to interpret the fine-scale migration behavior of the *O. mykiss* near the Robles Fish Facility is limited. The abundance trends were similar for upstream and downstream observations (Appendix 19). The three-week earlier increase of upstream counts may indicate a downstream migration of *O. mykiss*. The decreased counts for both the upstream and downstream reaches in mid May indicates that they were obviously moving downstream and upstream out of the study reaches. Some of the *O. mykiss* in the upstream reach most likely migrated back upstream as water temperature increased above 22 °C. Even though the snorkel counts in the downstream reach were less than 5 *O. mykiss* later in the season, there were at least 38. This was evident after a rescue of *O. mykiss* was conducted in late August. The reason for the difference is that turbidity and the difficulty of snorkeling a pool up to 4.5 m (15 ft) deep can cause the counts to be underestimated. Additionally, on two occasions, snorkeling inside of the fish ladder (i.e., the entrance box) revealed as many as 30-40 *O. mykiss*; this alone could have accounted for the difference. The *O. mykiss* may be residing inside the lower portion of the ladder during the day and moving back out at night.

O. mykiss tended to accumulate in the entrance pool at the outlet of the fish ladder. This is likely due to several reasons, acting alone or together, that resulted in this accumulation. As discharge decreased, *O. mykiss* could have had difficultly moving back upstream through the ladder. During these periods, discharge can be as little as 2-5 cfs and the facility operational design criterion for functional fish passage was estimated to be a minimum of 10 cfs (CMWD et al. 2002). Additionally, water temperature related effects could have played a role. As discharge recedes, the surface water temperature increases. When given a choice between the cooler water of the thermally stratified entrance pool (4.5 m deep) and the warmer water discharged from the ladder, *O. mykiss* most likely preferred to stay in the entrance pool. During late August, surface water in the entrance pool was approximately 26 °C and 19 °C near the bottom (Lewis et al. 2010). At that same time, the dissolved oxygen remained about 8-9 mg/L from the surface to the bottom. *O. mykiss* are known to use thermally stratified pools as a means to escape warmer surface water temperatures (Matthews et al. 1994). However, deep pools can develop low concentrations of DO at times of the year, and depending on their hydraulic connection to subsurface flows, *O. mykiss* may face a tradeoff between warmer surface water and low DO in the cooler water of deep pools (Matthews and Berg 1997). Given that the DO throughout the water column in late May was within the range acceptable to *O. mykiss*, they did not face this tradeoff between low DO and high temperatures. Thus, fish could have been restricted to the deeper water of the entrance pool by a thermal blockage and unable or unwilling to move through it. This effect was likely only exacerbated with receding river discharges.

There was a surface water connection to the lower Ventura River for 16 weeks, from late January to early May (Lewis et al. 2010). The surface water connection to the lower Ventura River was lost near the time when the peak counts occurred at the

Robles Fish Facility. The majority of the steelhead smolts likely had an opportunity to migrate downstream and enter the ocean, but a significant portion did not.

Based on qualitative observations during the snorkel surveys, it appeared that most of the *O. mykiss* were progressing through smoltfication. The onset of smoltification can be identified by vanishing parr marks, silvering of the body, and darkening of the margins of the fins among other characteristics (Chrisp and Bjornn 1978; Hasler and Scholz 1983; Quinn 2005; Spina et al. 2005). During the survey period, 93% of the *O. mykiss* observed were categorized into five classifications that included parr, three transitional phases (T-1, T-2, and T-3), and full smolts following the methods of Hasler and Scholz (1983). This classification method has been used successfully for smolting steelhead (Allen Scholz, Eastern Washington University, personal communication). Of the classified *O. mykiss*, 35% were T-2 stage, 51% were stage T-3, and 3% full smolts (Lewis et al. 2010). With a total of 89% of *O. mykiss* in mid to late smoltification stages, it would indicate that a downstream smolt migration behavior was the likely reason for their occurrence in the fish attraction study reach. Based on snorkel observations during June, it appeared the remaining *O. mykiss* were beginning to revert to a resident form (i.e., lightening of the margin of the fins, coloring across lateral line, and reappearance of parr marks). During this period of smolt reversal, the mean water temperature during snorkel observations was measured at 22 °C, which exceeded the temperature limit of smolt regulating enzymes and hormones (Allen Scholz, Eastern Washington University, personal communication) and could explain the residualization observations.

The total number of *O. mykiss* observed during 2010 was substantially less than in 2009. During same period in 2009, 807 *O. mykiss* juveniles were counted as compared to the 147 during 2010 (CMWD 2009). The dramatic decrease was most likely because no adult steelhead were able to migrate upstream in 2009. The observed *O. mykiss* were likely a combination of 2+ smolts from the 2008 steelhead brood and resident rainbow trout produced progeny that smolted and migrated downstream in attempt to reach the ocean. However, the downstream counts peaked earlier than the upstream counts suggesting a general movement of *O. mykiss* from downstream areas.

3.3 Fish Passage Monitoring

Introduction

Monitoring of migratory fish moving through fish passage facilities has been conducted using many different methods that include: visual counting, trapping and hand counting, continuous video recording, PIT tagging, radio telemetry, and acoustical telemetry. In each fish passage application, the particular physical and biological conditions (e.g., variable discharge, turbidity, debris, size of facility, and number of fish) usually dictate which method would be most effective. New technologies have been employed to improve fish passage monitoring in turbid conditions specifically. One such monitoring device is the Vaki Riverwatcher® (Riverwatcher). The Riverwatcher has the capability to operate in greater turbidity than more traditional monitoring equipment. Because of this advertised capability, the Riverwatcher was selected to be used in the Robles Fish Facility by the Technical Advisory Group.

The primary objective of fish passage monitoring is to provide an index of upstream adults and downstream kelts migrating through the Robles Fish Facility (NMFS 2003a). The Riverwatcher was advertised to detect fish down to a fish body depth of about 40 mm (Vaki 2003) and it was not known how well it would work for smolt-sized fish given the debris load in the Ventura River (NMFS 2003a).

Methods

Upstream and downstream migrating fish were monitored passing through the Robles Fish Facility using the Riverwatcher. The Riverwatcher is located in the fish bypass channel, which is the channel between the fish ladder and fish screens. The Riverwatcher consists of two scanner plates with light diodes that transmit beams of infrared light through the water to a corresponding receiver plate. When a fish swims (or debris drifts) through the infrared light beams, it breaks the light signal and a silhouette of the fish is recorded on a computer. Other data recorded when the Riverwatcher scanner is triggered are: date and time, total length (TL) of the fish (from a length/height ratio), swimming speed (m/sec), and direction of the fish movement (upstream or downstream). In addition, the scanner triggers an underwater camera to record a 10-second video clip (25 frames/sec). Only fish swimming upstream can be recorded in the Riverwatcher computer system because it was only designed for one camera, and that camera is on the upstream side of the scanner. An additional two cameras were installed in 2008-09 so that video of downstream fish could be captured on a digital video recorder (DVR). Both downstream cameras are located upstream of the Riverwatcher scanners in an aluminum tunnel along with the upstream Riverwatcher camera. The downstream digital cameras recorded continuously at 12 frames/sec and captured about 2-3 weeks of data until the DVR data storage drive was full (each week of data required approximately 4 h to review). These two downstream cameras are independent of the Riverwatcher and have to be reviewed separately for downstream detections. Once the DVR memory is full, it is exchanged with a second DVR and the data are reviewed before the DVRs have to be exchanged again.

The Riverwatcher scanner and cameras are positioned at the bottom of an aluminum frame covered with 1/2 inch aluminum bars, spaced 1 1/2 inches on center resulting in 1 inch spacing between the bars (crowder), which directs the fish to swim between the scanner plates. The crowder can be raised and lowered in guide slots of the fish bypass channel with the aid of an A-frame hoist for cleaning or repair. The Riverwatcher is usually operated during the entire flow augmentation season as long as sufficient water elevations in the fish bypass are present and debris and turbidity are low enough so that the crowder will not be damaged and the Riverwatcher will function.
The Riverwatcher was operated continuously from mid December 2009 through June 2010 during the reporting period. During this time, the crowder was removed from the fish bypass channel and cleaned or inspected 90 times. During times of higher debris, the cleaning and inspections occurred multiple times per day, and at times of low debris,

cleaning and inspections occurred only once every 2-3 days. The crowder was removed for cleaning for a combined total of approximately 8 h during the operation period.

Prior to 2010, each upstream and downstream Riverwatcher detection was reviewed and classified as an adult steelhead, *O. mykiss* non-adult steelhead, other species if identifiable, unknown fish, fish probable, or false detection (see Appendix 20 for detection classification flow chart). At the request of NMFS, this classification system was modified during the review process for this report (see Appendix 31 for Biological Committee discussions). All confirmed *O. mykiss* were classified solely as *O. mykiss*. The classifications were determined by using a combination of the silhouette images, estimated lengths, and video clips. In addition, if larger adult sized *O. mykiss* were detected and useful video clip was recorded, a measurement of eye diameter and standard length (SL) were estimated from the video clip to calculate morphometric ratios that were compared to known steelhead and rainbow trout. A commonly used method is to develop ratios of body measurements for comparison to remove the effects of body size so actual differences can be determined (Strauss and Bond 1990). This was done by comparing SL to the ratio of eye diameter in linear regression. Standard length is the length from the snout to the end of the hypural plate near the end of the fleshy caudal peduncle, which is unaffected by caudal fin deformities (Anderson and Neumann 1996). Previous to 2010, the adult steelhead classification was used if the fish observed was an *O. mykiss* and displayed the typical characteristics of an anadromous adult steelhead, such as black spotting on dorsal, adipose, and caudal fins, black spotting on dorsal side of body, slivery body, vertical edge to caudal fin, ≥ 38 cm TL (Shapovalov and Taft 1954), and had an eye diameter/SL ratio ≤ 0.045 (CMWD 2008). This new classification method likely included juvenile resident, smolts, adult resident, and adult anadromous *O. mykiss* migrating throughout the basin. Conceivably, after more data are collected from the downstream trapping component of the monitoring and evaluation, or from other Ventura River basin research projects, a more detailed classification of Riverwatcher detections could be used again. The fish unknown classification was used if the detection was identified to be a fish based on video evidence, but the species identity could not be determined due to high turbidity or the fish not swimming through the camera field of view. The fish probable classification was used if no fish was observed in the video, but the silhouette was similar to that of a typical fish silhouette based on previous experience. Even with reasonably good video coverage, smaller fish were still able to pass through the Riverwatcher undetected by the video cameras. This can occur if the fish swim very close, high, or low to the cameras. In addition, this can happen if an upstream fish swims through the scanners then stops before entering the video field of view. High turbidity can also obscure the video detection and identification of fish. The false detection classification was used when no fish was observed in the video and the silhouette was not similar to that of a typical fish silhouette based on previous experience. Because false detections tended to occur frequently during higher discharges when turbidity and debris were also high, it was likely that most false detections were caused by debris, high turbidity, and water turbulence. When turbidity exceeds about 100 NTUs, hundreds of false detections per hour can occur and not until turbidity falls below about 30 NTUs is the Riverwatcher fully operational (Table 1).

Table 1. Riverwatcher operational status over a range of water turbidity (NTUs).

Turbidity (NTU)	Riverwatcher status
> 200	Not operational
100-200	Many false detections
30-100	Scanner operational, but unable to confirm with video
< 30	Video grid detectable
0-30	Riverwatcher fully operational

Results

During the 2010 fish migration season, the Riverwatcher recorded 2,831 total detections, of which 879 were upstream and 1,952 were downstream (Appendix 21). Of the total upstream detections, 7% (n = 58) were determined to be fish (excluding largemouth bass) and included 54 *O. mykiss* and 5 probable fish. Of the total downstream detections, 2% (n = 42) were determined to be fish (excluding largemouth bass) and included 39 *O. mykiss* and 3 probable fish.

The one large *O. mykiss* (58 cm TL) passed upstream through the ladder on 20 March 2010 at 0550 h at a discharge of 36 cfs. The mean daily temperature was 15 °C and the turbidity was 1 NTU. It passed downstream through the fish ladder between 29 March and 14 April without being detected. This could have occurred during times the Riverwatcher and fish crowder were removed for cleaning (total time about 3 h) or during a 12 h period that had high turbidity and the crowder was also removed. It could have also escaped detection if it was swimming tail first downstream at a velocity too slow for the Riverwatcher to detect. At the time it first passed upstream, it drifted downstream and was not detected by the Riverwatcher, it was not until that downstream DVR was reviewed that this type of error was detected (Table 2).

Table 2. Date and location of all seven confirmed sightings of the 58 cm *O. mykiss* observed during 2010 migration season.

Date (2010)	Time (h)	Location	Method	Direction
20 March	0550	Robles fish ladder	Riverwatcher	Upstream
20 March	0551	Robles fish ladder	Underwater video	Downstream
20 March	0555	Robles fish ladder	Riverwatcher	Upstream
30 March[1]	NA	North Fork Matilija Cr.	Snorkeling	NA
14 April	1343	Ventura R. @ OVLC pool	Snorkeling	NA
15 April	0955	Ventura R. @ OVLC pool	Snorkeling	NA
20 April	1050	Weir pool #3 DS of Robles	Snorkeling	NA

[1]Stoecker 2010

The mean date for the upstream migrating *O. mykiss* was 02 May and 14 May 2010 for the downstream migrating *O. mykiss* (Appendix 21). During the migration season, there was a general increase of fish detections for both upstream and downstream (Appendix 22).

The time of upstream detections occurred essentially at all times of the day, but the modal time was 1500 h (Appendix 23). The majority of downstream detections ranged from about 03:00 h to 09:00 h. Of the *O. mykiss* migrating downstream, 77% were detected in the morning from 0100-0900 h.

The mean total lengths for upstream and downstream *O. mykiss* were estimated to be 34 and 32 cm, respectively (Appendix 21). Upstream and downstream *O. mykiss* lengths overall ranged from 20 to 58 cm (Appendix 24). The software program that operates the Riverwatcher estimates the TL of a fish detection based on a ratio of height to length (Vaki 2003). This ratio can be changed depending on available data for the target species. Based on morphometric measurements of *O. mykiss* mortalities over the last several years, an *O. mykiss* height to TL ratio was estimated to be 5.1 for fish ranging from about 10 to 28 cm. During a validation and calibration pilot study, it was estimated that the Riverwatcher was underestimating the fish heights by about 10 mm. A correction was added to the TL to height ratio to calibrate it to the known fish heights. This calibrated ratio was used to estimate the TL of Riverwatcher detections from January through June of 2010. However, the resulting TL estimates appeared to be over estimated when compared to known *O. mykiss* lengths that were measured in 2009. It was decided that a more accurate method would be to use a regression model to convert Riverwatcher estimated fish heights to lengths. Again, from the morphometric measurements, a sigmoid regression was conducted to develop a model for converting the Riverwatcher fish heights to total lengths ($TL = 687.68 / (1 + \exp(-(D - 50.78)/23.97)) / 10$, $p < 0.0001$, $r^2 = 0.99$, $n = 59$, D = body depth). This regression model will continue to be improved upon as more data becomes available. In general, the Riverwatcher was inefficient at detecting smolt-sized fish passing upstream or downstream and underestimated the size of fish that it did detect.

The physical river conditions of temperature, turbidity, and discharge at the time of passage were similar for upstream and downstream migrating *O. mykiss* and other fish classifications (Appendix 21). The mean water temperature for upstream migrating *O. mykiss* was approximately 18 °C and was 18.5 °C for downstream *O. mykiss*. The mean turbidity levels at the time of passage for upstream and downstream *O. mykiss* non-adult steelhead was about 4 NTU. The mean turbidity at the time of the false detections in both upstream and downstream directions was approximately 50-60 NTU. The discharge at the Robles Fish Facility at the time of upstream passage for *O. mykiss* was a mean of 23 cfs and 19 cfs for downstream migrating *O. mykiss*. Like turbidity, the periods of false detections coincided with times of higher discharge. For a list of all fish detections, see Appendix 25. The total time the Riverwatcher was not operational because of high turbidity was 5.5 days.

Discussion

Approximately 2,800 false detections occurred and were likely due to the greater river discharges, associated turbidity and debris, and settings of the Riverwatcher to detect smaller fish. In addition, the Riverwatcher and crowder were left in the ladder for longer periods at high turbidity. This was done to increase the chance of detecting any adult steelhead migrating during those times of higher turbidity. Given that the Riverwatcher is recommended to be set at a minimum of no less than 40 mm (Vaki 2003), it appears that overestimation of fish passage was likely given that all false detections could not be identified and eliminated. For the 2010 season, the minimum height was set at 28 mm so that large numbers of false detections could be eliminated while still attempting to detect steelhead smolts. The height was determined to be similar to some of the smallest steelhead smolts that might be expected to emigrating downstream through the Robles Fish Facility based on available data from the Ventura Basin. The height of 28 mm corresponds to 146 mm TL and 139 mm FL. *O. mykiss* mortalities found and measured during the course of ongoing field monitoring efforts, and subsequently turned over to NMFS, were all larger than 146 mm TL. The estimated fish detection rate from the validation pilot study and the comparison of snorkel counts to Riverwatcher detections both indicate that as much as 78-88% of smolt sized *O. mykiss* are not able to be detected by the Riverwatcher. During the 2009 validation pilot study, larger sized fish (i.e., height > 60 mm) appeared to be detected nearly 100% of the time. This height is equal to about 300 mm TL and is larger than what would be expected to be migrating downstream through the Riverwatcher. Before a detection rate correction could be applied to downstream detections, more data would need to be collected on detection efficiency. The highly variable results from the pilot study were not sufficient to develop a correction factor with enough confidence. Like the detection efficiency, the Riverwatcher estimated fish heights were also highly variable and the true error could not be determined. The data collected to date would indicate that the Riverwatcher is not able to sufficiently monitor steelhead smolt emigration, and given the manufacture's operational recommendations, these results should not be surprising. However, additional Riverwatcher validation/calibration tests will be conducted during 2011 in an attempt to further identify the operation limitations of the Riverwatcher.

From general observations over the last several years, and supported by observations during the 2009 validation pilot study, *O. mykiss* juveniles do not move through the fish crowder and Riverwatcher quickly. *O. mykiss* tend to swim downstream and back upstream repeatedly before ultimately moving in one direction. This lack of aggressive and rapid directional movement is supported by observations during the fish attraction monitoring. *O. mykiss* juveniles were observed holding in general areas for extended periods of time before either moving downstream or back upstream, which is commonly found in all salmonid smolts (Quinn 2005). During the fish attraction surveys, of the *O. mykiss* that were categorized into smolt transformation stages, all stages were present. Because the smolt migration rate is positively correlated with the smoltification process (Quinn 2005), some holding and lack of aggressive downstream migration would be expected.

The detection of *O. mykiss* passage by the Riverwatcher did not show the same diel migration pattern through the Robles Fish Facility as in 2009 where *O. mykiss* primarily passed downstream just before dawn then passed back upstream just before and after dusk. The downstream pattern was similar; however, the upstream *O. mykiss* were migrating throughout the day and night. The reasons are not clear at this time for the differences. The early morning movement of downstream migrating smolts is common among steelhead throughout its range (Dauble et al. 1989). However, monitoring upstream movements of smolts has not been studied specifically and little available data exists to make comparisons. Most smolt monitoring studies do not have volitional passage with passive monitoring like that used at the Robles Fish Facility. Therefore, the opportunity to examine upstream movements is not usually available. The distance of daily migrations were unknown; however, it is likely the fish remained within, or near, the Robles Fish Facility before continuing their downstream migration.

As previously discussed, the Riverwatcher's ability to accurately estimate fish lengths is an area that will need more work to fully determine its usefulness in monitoring smolt-sized *O. mykiss*. However, the use of the regression model to estimate TL from the Riverwatcher's estimate of height produced reasonable results. The mean TL of *O. mykiss* detections was larger than what others have documented for steelhead smolts in central and southern California. Shapovalov and Taft (1954) estimated a mean FL for 2+ and 3+ age smolts at approximately 17 cm. Spina et al. (2005) also measured a mean smolt FL of approximately 17 cm. This difference could be due to several reasons. The error associated with the Riverwatcher estimates could be one possible cause. In addition, the regression model used does appear to result in an over estimate when compared to video estimates. Regardless, the Ventura River smolts are indeed larger and this is probably due to faster growth rates in the warmer water as compared to the more northern basins. Age of the migrants might also explain the differences observed; however, no scales of *O. mykiss* were collected for aging.

As mentioned above, the combination of the Riverwatcher error and body depth to TL over estimation, likely resulted in the *O. mykiss* being smaller than reported. There appears to have been many larger resident *O. mykiss* spawning in the basin during 2010 (Lewis et al. 2010), which likely accounted for detection of larger *O. mykiss* in the 30-45 cm range. Shapovalov and Taft (1954) document adult steelhead in the 38-40 cm range, but given that scales have not been collected and analyzed for Ventura River *O. mykiss* in this size range, their life history form could not be conclusively determined and therefore some of the larger *O. mykiss* documented could have been adult anadromous steelhead. However, the 58 cm *O. mykiss* detected was in all likelihood an adult anadromous steelhead.

3.4 Downstream Fish Passage Evaluations

Introduction

Passage evaluations of migrating salmonid through fish passage facilities have been conducted throughout the western United States for many years. Methods to determine if a facility is operating as designed and not causing harm to the intended fish species vary. Early work typically entailed trapping and tagging fish before entering a facility and recapturing them after exiting. Trapping and visual inspections for injuries, PIT tagging, radio telemetry, and acoustical telemetry has been conducted extensively as well.

There are two objectives for the downstream fish passage evaluation. The first objective is to determine if steelhead are successfully passing through the Robles Fish Facility. The second objective is to capture and examine steelhead smolts and kelts and determine if there are any injuries that may have been caused by downstream passage through the Robles Facility (NMFS 2003a).

Methods

A weir trap was placed and operated approximately 100 m downstream of the Robles Fish Facility. The weir trap consisted of a live-box (120 cm on all three sides) with an internal fyke and the trap was situated in the center of the river channel and thalweg. The live-box internal frame was constructed out of PVC pipe and covered with plastic fencing with 1.9-cm diagonal openings. A plastic fence (3-cm openings) supported by T-bar fence posts was extended upstream on both sides of the live-box at 30° angles into the river channel and ended near each bank leaving gaps of approximate 1 m so adult steelhead could pass upstream by the trap location (Appendix 26). Two-meter deflector wings positioned approximately 14 m upstream of the trap were also used to guide shore-orientated smolts toward the thalweg. Because the vast majority of downstream steelhead migrants were expected to be captured from mid-March through mid-June (Shapovalov and Taft 1954; Dettman and Kelley 1986), the trap was planned to be operated from mid-March through June or until water temperatures exceeded a daily mean of 22°C, which could negatively impact captured fish (SYRTAC 2000).

The trap was intended to be operated only at lower river flows when it would be effective at capturing downstream migrants. The upper limit of river flow operation will be determined after successive seasons. Because base-flow conditions are more likely to be used for downstream passage by steelhead (NMFS 2003a), a weir trap was chosen as the method for this evaluation rather than a rotary screw trap. After assessing representative hydrographs from previous years, evaluating potential screw trap sites, and the potential for capturing downstream migrants with a screw trap at the higher discharges, a screw trap was determined to be much less effective at gathering the data needed to address the objectives of the downstream passage evaluation.

When the trap was operational, it was checked twice per day (in the morning and late afternoon). The trap generally operated from Sunday afternoon through Saturday morning. Data collected included: fork length (mm), weight (g), and a subsample of scale and tissue samples for aging and genetic analysis. Fish that were to be handled were put into an aerated container with a solution of tricaine methanesulfonate (MS-222) and Stress Coat®. The anesthesia MS-222 is registered by the US Food and Drug Administration for use with food fish (Summerfelt and Smith 1990). The level of anesthesia needed is generally stage 2-4, which is a deep sedation to a total loss of equilibrium (Summerfelt and Smith 1990). To achieve a short induction time of 3-4 minutes, as recommended by Summerfelt and Smith (1990), a concentration of 60-100 mg/L of MS-222 was used. This concentration allows for a recovery time of less than 5 minutes (Summerfelt and Smith 1990), but from previous experience, anesthetized steelhead smolts will most likely recover in less than 3 minutes. Stress Coat® is a synthetic slime coating that replaces the naturally secreted protective slime that is lost during capture and handing of fish. Stress Coat was added to both the anesthetizing and recovery containers at the manufacture's recommended concentration of 0.25 ml/L.

Scale loss was assessed by examining captured fish and estimating scale loss over three zones on each side of the fish. The three zones were: 1) the caudal zone that included the area above and below the lateral line from the caudal fin to the posterior end of the dorsal fin, 2) the dorsal zone that included the area anterior of the caudal zone to the operculum and above the lateral line, and 3) the ventral zone that included the area anterior of the caudal zone to the operculum and below the lateral line (Marine and Gorman 2005). The percentage of scale loss in each zone was estimated and then weighted by each zone's area proportional to the total area of all six zones. Summing of the resulting weighted scale loss yielded the total area of each fish with scale loss. Any physical injury was noted and categorized among the fins, skin, eyes, and head. Within each anatomical category, there are 2-3 types of injuries that could be documented. In general, the scale loss and physical injury methods followed those of Marine and Gorman (2005) and McNabb et al. (1998). Only one weir trap will be used initially to determine if there are any significant physical injuries or scale loss occurring. If significant scale loss or physical injuries are occurring, and the Robles Biological Committee deems it necessary, then a second trap will be installed and operated upstream of the Robles Fish Facility. If an upstream trap is operated in the future, steelhead will be captured, marked, and released before they enter the Robles Fish Facility and then recaptured in a trap downstream of the facility to determine if the injuries were the result of passage through the facility.

Prior to the operation of the downstream weir trap, an annual fish handling training class was conducted with seasonal fisheries technicians and full-time biologists. This training class was conducted with hatchery rainbow trout and all techniques and procedures were practiced until the fisheries personnel were fully proficient with each. Additional, annual training and review occurred with all other aspects of the monitoring and evaluation program so personnel are proficient at each task that they may be assigned to conduct.

Results

The weir trap was operated from 16 March through 07 May 2010 when the mean daily water temperatures exceeded 22 °C. A total of 5 smolts were captured with the first two being captured on 18 March; three were then captured on 25 March. The mean FL was 187 mm and mean weight was 69 g. The smolts all appeared to be undergoing smoltification; one was a T-2, three were T-3, and one was a full smolt. The mean water temperature was 15.8 °C during the 53-day trapping period and 13.9 °C on the two days smolts were captured. The stream discharge ranged from 24 to 44 cfs during the trapping period and was a mean of 33 cfs at the time the 5 smolts were captured. The *O. mykiss* smolts were not tagged with radio transmitters. It was anticipated that more would be trapped and tagged; however, no other smolts were captured. Four of the five smolts showed signs of descaling and one did not. Using the descaling assessment methods described, the descaling ranged from 1.9% to 9.6% with a mean of 6.1%. Four of the smolts had small but noticeable skin damage to the head region.

Discussion

The first objective of the downstream fish passage evaluation is to determine if steelhead are successfully passing downstream through the Robles Fish Facility (NMFS 2003a). If determined using downstream trapping data alone, this objective cannot be fully evaluated with the limited data collected to date. However, from the fish attraction data alone, it is clear that *O. mykiss* juvenile are successfully navigating downstream through the Robles Fish Facility during the expected steelhead smolt migration period (Shapovalov and Taft 1954; Dettman and Kelley 1986; Spina et al. 2005).

The second objective of downstream fish passage evaluation is to capture and examine steelhead smolts and kelts and determine if there are any injuries that may be caused by passing downstream through the Robles Fish Facility (NMFS 2003a). Also, like the first objective, this could not be fully evaluated due to a lack of data. The five *O. mykiss* smolts captured in the trap had a mean descaling of 4.9%. It is not known how much of this could have been due to passage downstream through the Robles Fish Facility or the trapping and handling procedures. A pilot test will be conducted in 2011 with hatchery fish to help determine how much descaling might occur during trapping and handling of fish. Additionally, a literature research will be conducted to determine what other researchers have estimated for steelhead smolts passing through fish facilities versus trapping and handling.

3.5 Downstream Fish Migration through the Robles Reach

Introduction

When the number of fish to be physically handled in a study is of concern, such as with an endangered species, the method of radio telemetry can be a useful method over others like extensive trapping (Hockersmith et al. 2000). Telemetry migration information of steelhead smolts in the Ventura River would allow for the determination of survival, travel time and rates through select reaches, migration relative to river discharge, habitat use, and passage success through critical riffles. By tracking the fish until the batteries die, it is anticipated that downstream migration can be monitored all the way to the Ventura River estuary/lagoon, which could provide important data on estuary rearing and emigration behavior.

The purpose of the downstream migration evaluation is to determine how successfully smolts are migrating through the Robles Reach (NMFS 2003). Because of the limited number of steelhead smolts most likely passing downstream through the facility at this time, a pilot study using radio telemetry will be used for evaluations.

Methods

During the estimated smolt migration period of mid-March through mid-June, up to 15 steelhead smolts captured in the weir trap downstream of the Robles Fish Facility were to be tagged with radio transmitters and released downstream of the weir trap. Only steelhead smolts that exhibit steelhead smolt characteristics and in good physical condition were to be tagged. The smolting characteristics include: increased skin reflectance, larger heads, slimmer bodies, longer caudal peduncle, loss of parr marks, and darker margin of the dorsal fin (Beeman et al. 1995; Haner et al. 1995; Ando et al. 2005). These characteristics have been used in southern California to identify steelhead smolts migrating downstream (Spina et al. 2005).

The radio transmitters intended be used were manufactured by Advanced Telemetry Systems (ATS) and had transmitter radio frequencies ranging from 149.000 to 150.999 MHz, a pulse rate of 30 per minute, and a pulse width of 18 ms. Each tag had a unique radio frequency so that individual fish, if needed, could be tracked during their downstream migration. The transmitters weighed 0.85 g and had an expected operational life of about 48 days. The dimensions of ATS tags (model number F1435) were 14 mm long with a diameter of 7 mm. The ratio of tag weight to steelhead weight in the air will be less than 5%, which will ensure that physiological stress will be minimized (Jepsen et al. 2001) and swimming performance will not be altered (Brown et al. 1999). Based on the expected sizes of captured smolts; estimated from steelhead smolts captured in the Santa Clara River (ENTRIX 2000), the maximum tag-to-weight ratio will be closer to approximately 3%. The steelhead were anesthetized with a solution of MS-222 and placed on a water and Stress Coat® soaked foam pad ventral side up and the tags were gastrically inserted (Adams et al. 1998). The tag was lubricated with food-grade glycerin to prevent abrasion (Adams et al. 1998; Hockersmith et al. 2000) and gently inserted through the mouth and into the stomach using a rigid small-diameter tube. The fish were allowed to fully recover to assure they are behaving normally before they were released downstream for migration tracking; typical recovery occurs in approximately 3 minutes. The estimated time for tagging and recovery were based on previous radio telemetry studies with steelhead smolts (Lewis 2001, 2002, and 2003).

After tagging and recovery, the steelhead were released downstream of the weir trap. Tagged steelhead were located on a daily basis as they migrate downstream for the first week after release and then at least weekly until the batteries die, the fish was lost, the fish entered the ocean, was found dead, or the tag was regurgitated. Mobile tracking was done using an ATS radio telemetry receiver (model R2100) and 3-element Yagi antennae. Initial broad scanning was accomplished from locations at higher elevations accessed by a vehicle driven on roads near the Ventura River. Once a general location of a tagged steelhead was found, the final location was determined on foot. This method can yield locations of ± 10 m (Lewis 2001). All determined locations were recorded on a map and datasheet. Every reasonable effort was made to determine the ultimate final location of each radio tagged steelhead and if any mortality occurred, the cause of the mortality was determined if possible. It is estimated, that at the most, one tag would be lost due to regurgitation during the study period; Hockersmith et al. (2000) measured a short-term regurgitation rate of 1.3% using the gastric method, Adams et al. (1998) measured a regurgitation rate of 4.2%, and Jepson et al. (2001) measured a 5.0% regurgitation rate. Beyond the 30-40 day period, the regurgitation rate typically increases dramatically.

Using the method of radio telemetry to monitor migration through the Robles Reach will provide more usable information while using fewer fish to gather that information; compared to using an additional weir trap at the downstream end of the Robles Reach. It is estimated that no more than one steelhead mortality will occur due to the method and this initial sample size. Hockersmith et al. (2000) measured a mortality rate of 2.4% using the gastric method. Gastric implanted fish also have similar survival rates, overall health, and similar physiological stress as fish with surgically implanted radio or PIT tags (Adams et al. 1998; Hockersmith et al. 2000; Jepsen et al. 2001).

Results

As stated before, the five smolts captured were not radio tagged. It was anticipated that more smolts would have been captured during the normal migration period and most of the tagging would have occurred then. However, the five smolts were captured at the first part of the migration period and no additional smolts were captured.

4.0 ROBLES FACILITY OPERATIONS

4.1 Facility Status

The Robles Fish Passage Facility started the 2009-2010 season in a fully functional mode. The 2009-2010 season was characterized by a slightly above average rainfall year as measured at Casitas Dam. 31.13 inches of rain were measured at Casitas Dam. The average rainfall at the dam is 24.06 inches. Three peak flows, as defined by the BA/BO occurred during the year. Two water diversion periods occurred during the year. The diversions occurred from January 18 through March 31, 2010 and from April 12 through April 29, 2010. The diversion periods included water that was downloaded from Lake Matilija. Some surface flow continued over the measurement weir until late August 2010. The surface flow through the Robles Reach stopped in briefly during a hot period in late August but resume briefly once cooler temperatures returned.

The 2009 Report identified several projects to be completed during the summer and fall. The principal projects were:

- Adjust the notch on interim weir two.
- Removal of reeds from fish passage facility.
- Install additional limit switches on the brush system
- Replace the brush cables

A brief description of each project and the project's status is listed below:

Adjust the notch on interim weir two -The agencies had previously requested some adjustments to the low flow notch in weir number to facilitate easier fish passage. Adult fish have moved past this weir in previously years. Casitas personnel attempted to place an additional rock in the notch to remove a "whoopee" flow that would occur. The rock addition removed the "whoppee" but created a higher notch sill. While adult steelhead were able to pass over the weir, the passage could be made easier with some additional modifications. Casitas will make some additional modifications this summer and fall to weirs 2 and 3 to further improve fish passage.

Removal of reeds from fish passage facility –The silt and reeds were removed from the fish passage facility and the screens were cleaned.

Install additional limit switches on the brush system-Additional limit switches were added to the brush control system. However, the mechanical limit switches continued to be unreliable. Casitas has purchased optical switches to replace the limit switches. The optical switches will be installed this summer and fall.

Replace the brush cables-The drive cables were replaced.

4.2 Flow Observations and Control

Casitas collected flow information and verified flows where and when reasonably safe conditions existed in the Ventura River. Flow and level measurement devices are also located at various locations within the Robles Fish Passage Facility. The primary points of measuring and recording stream flows entering, flowing through and leaving the Robles Fish Passage Facility are:

- Matilija Creek at Matilija Hot Springs – located approximately 2,100 feet downstream of Matilija Dam – good rating for low to moderate flows – operated by Casitas Municipal Water District, formerly a USGS station;
- Matilija Dam Stage Bubbler-Located at the dam, this gage provides the lake elevation. Under high flows, the dam acts as a weir. This is the primary flow measurement location under high flows and to determine if a peak has occurred.
- North Fork Matilija Creek – located approximately 3,000 feet upstream of its confluence with Matilija Creek – good rating for low to moderate flows – operated by the Ventura County Watershed District;
- Robles-Casitas Diversion Canal – located on the diversion canal approximately 1,300 feet downstream of the Robles Diversion Dam – trapezoidal channel with a good rating for flows up to 600 cfs;

- Ventura River near Meiners Oaks (VRNMO) – located approximately 540 feet downstream of the Robles Fish Passage spillway – concrete weir section – good rating to 70 cfs, use of equations above 70 cfs with poor ratings above 1000 cfs (no verifications at higher flows).
- Fish Ladder-A 4 path flow meter by Accusonics located near the Riverwatcher. This flow meter has not been accurate since the installation of the replacement Vaki shroud. Turbulence from the shroud is believed to be the cause of the inaccurate measurements. The transducer will be relocated this summer in the hopes of obtaining better measurements.
- Auxiliary Water Supply-An American Sigma flow meter. This meter did not function during this period. The problem is believed to be that the transducer mounting hardware has failed. Casitas will complete the inspection and hopefully, the repair of this instrument.

All of the instruments can suffer from inaccuracies from time to time. The inaccuracies can be caused by clogging of bubbler lines, electronic creep, debris accumulating on sensors, changes to the measured cross sections, and equipment problems. For this reason, the data is verified against field measurements and observations. The information gathered from each of these locations has been reduced to the daily reporting of flows in the form of average cubic-feet per second. The spreadsheets are in Appendix 27, entitled "Ventura River Flow Assessment for the Robles Fish Passage Facility – FY 09-10" and general trends can be found in Appendix 28.

Three storm peaks occurred this year that triggered BA/BO required supplemental flow releases. The peaks occurred on January 18, January 21and on February 5, 2010. The April rain storm did not produce a peak as defined by the BA/BO. The fish screens remained in place for the entire year.

Facility Testing

Casitas has entered into an agreement with HydroScientific West to complete the first phase of the hydraulic testing. Performance testing was begun on January 25th and 26th. Casitas augmented the flows with water that was downloaded from Lake Matilija. Unfortunately, the flows did not remain at sufficient levels to complete the screen testing.

4.3 Costs Associated with Operation and Monitoring

The BA/BO specified that the District provide the costs that are associated with the activity. The following is a summary of the direct costs incurred by the District during the 2009-10 fiscal years:

- **Fisheries Monitoring**:

Salaries & Benefits	$262,032
Equipment/Material	$ 57,539
	$319,571

- **Facility Operations**:

Salaries & Benefits	$74,002
Equipment/Materials	$13,639
Outside Contracts	$22,915
Utilities	$ 3,397
Permit	$ 1,050
	$115,003

- **Capital Improvements**: No capital improvements were made during this fiscal year.

4.4 Assessment of the Effectiveness to Provide Fish Passage

Performance testing of the Fish Passage began on January 25. Work on the performance testing was halted on January 26 because of inadequate surface flows.

Flows were augmented on January 25 and 26 with flow from Lake Matilija. Hydro Scientific West performed the testing.

One large 58 cm *O. mykiss* was recorded swimming through the facility demonstrating that the facility is capable of providing fish passage for adult steelhead.

4.5 Recommendations Regarding the Prioritization of Future Activities

The District has completed its fifth season with the fish passage fully operational. Several projects have been identified to improve the functionality and reliability of the system. Other items require repairs. The summer and fall work list includes:

- Adjust interim weir two and three to improve fish passage.
- Replace the mechanical limit switches with optical switches on the brush system.
- Repair or replace the auxiliary water flow meter.
- Relocate the fish passage flow meter to minimize turbulence from the Vaki shroud.
- Update and improve the automated controls for the facility.

4.6 Recommendations on any Revisions Deemed Necessary to the Operations

Casitas continues to recommends that the construction of the 15-weir portion of the project be put on hold at least until the Matilija Dam Removal Project is completed. Preliminary plans for the High Flow Sediment Bypass and High Flow Fish Passage require this area to be graded to new elevations. The existing temporary weir system has proven to be passable by adult O Mykiss.

5.0 LITERATURE CITED

Adams, N. S., D. W. Rondorf, S. D. Evans, and J. E. Kelly. 1998. Effects of surgically and gastrically implanted radio transmitters on growth and feeding behavior of juvenile Chinook salmon. Transaction of the American Fisheries Society, 127:128-136.

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 477-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Ando, D., T. Kitamura, and S. Mizuno. 2005. Quantitative analysis of body silvering during smoltification is masu salmon using chromameter. North American Journal of Aquaculture, 67:160-166.

Banks, J. W. 1969. A review of the literature on the upstream migration of adult salmonids. Journal of Fish Biology, 1:85-136.

Beeman, J. W., and A. G. Maule. 2001. Residence time and diel passage distribution of radio-tagged juvenile spring Chinook salmon and steelhead in a gatewell and fish collection channel of a Columbia River dam. North American Journal of Fisheries Management, 21:455-463.

Beeman, J. W., D. W. Rondorf, M. E. Tilson, and D. A. Venditti. 1995. A nonlethal measure of smolt status of juvenile steelhead based on body morphology. Transactions of the American Fisheries Society 124:764-769.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Bond, M. H., A. A. Hayes, G. V. Hanson, and R. B. MacFarlane. 2008. Marine survival of steelhead (*Oncorhynchus mykiss*) enhanced by a seasonally closed estuary. Canadian Journal of Fisheries and Aquatic Sciences, 65: 2242-2252.

Bratovich, P. M., and D. W. Kelley. Investigation of salmon and steelhead in Lagunitas Creek, Marin County, California. Volume 1. Migration, spawning, embryo incubation and emergence, juvenile rearing, emigration. Marin Municipal Water District. Corte Madera, California.

Brown, R. S., S. J. Cooke, W. G. Anderson, and R. S. McKinley. 1999. Evidence to challenge the “2% rule” for biotelemetry. North American Journal of Fisheries Management, 19:867-871.

Busby, P. B., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. National Marine Fisheries Service. NOAA technical memorandum NMFS-NWFSC-27, August 1996.

Cannata, S. T. 1998. Observations of steelhead trout (*Oncorhynchus mykiss*), coho salmon (*O. kisutch)* and water quality pf the Navarro River estuary/lagoon, May 1996 to December 1997. Draft report, Humboldt State University Foundation. Humboldt, CA.

Chrisp, E. Y., and T. C. Bjornn. 1978. parr-smolt transformations and seaward migration of wild and hatchery steelhead trout in Idaho. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow, Idaho. Final project report F-49-R.

Clay, H. C. 1995. Design of fishways and other fish facilities, 2nd edition. CRC Press, Inc., Boca Raton, FL.

Cooke, R. U., A. Warren, and A. S. Goudie. 1992. Desert geomorphology. UCL Press, London.

CMWD. 2005. 2005 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2006. 2006 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2007. 2007 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2008. 2008 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD, Wood Rogers, and ENTRIX Inc. 2002. Preliminary draft technical memorandum of operation constraint assessment of the Robles Fish Passage Facility. Prepared for US Bureau of Reclamation.

Dauble, D. D., T. L. Page, and W. Hanf. 1989. Spatial distribution of juvenile salmonids in the Hanford Reach, Columbia River. Fishery Bulletin, 87:775-790.

Dettman, D. H., and D. W. Kelley. 1986. Assessment of the Carmel River steelhead resource, Volume 1. biological investigations. Monterey Peninsula Water Management District, Monterey, CA.

ENTRIX. 1999. Evaluations of natural passage barriers on the Ventura River downstream of Robles Diversion. ENTRIX, Walnut Creek, CA.

ENTRIX. 2000. Results of fish passage monitoring at the Vern Freeman diversion facility Santa Clara River, 1994-1998. ENTRIX, Walnut Creek, CA.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 2002. California salmonid stream habitat restoration manual, Volume I, 3rd edition. California Department of Fish and Game. Inland Fisheries Division, Sacramento, CA.

Hagar, J. 1996. Salinas River steelhead status and migration flow requirements. Monterey County Water Resources Agency. Salinas, California.

Haner, P. V., J. C. Faler, R. M. Schrock, D. W. Rondorf, and A. G. Maule. 1995. Skin reflectance as a nonlethal measure of smoltification for juvenile salmonids. North American Journal of Fisheries Management, 15:814-822.

Hockersmith, E. E., W. D. Muir, S. G. Smith, B. P. Sandford, N. S. Adams, J. M. Plumb, R. W. Perry, and D. W. Rondorf. 2000. Comparative performance of sham radio-tagged and PIT-tagged juvenile salmon. US Army Corps of Engineers, Walla Walla District.

Harrison, L. R., E. A. Keller, E. Kelley, and L. A. K. Mertes. 2006. Minimum flow requirements for southern steelhead passage on the lower Santa Clara River, CA. University of California, Santa Barbara.

Hasler, A. D., and A. T. Scholz. 1983. Olfactory imprinting and homing is salmon. Springer-Verlag, New York.

Jepsen, N., L. E. Davis, C. B. Schreck, and B. Siddens. 2001. The physiological response of Chinook salmon smolts to two methods of radio-tagging. Transactions of the American Fisheries Society 130:495-500.

Lewis, S. D. 2001. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2000. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2002. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2001. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2003. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2002. Portland General Electric. Portland, Oregon.

Lewis, S. D. M. W. Gibson J. L. Switzer. 2010. Ventura River basin *Oncorhynchus mykiss irideus* monitoring, evaluation, and research: 2010 annual program report. Casitas Municipal Water District, Oak View, California.

Marine, K. R., and M. Gorman. 2005. Monitoring and evaluation for the A-Canal fish screen and bypass facility; scale loss and physical injury test, 2005. Bureau of Reclamation, Klamath Falls, OR.

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

Matthews, K. R., N. H. Berg, D. L. Azuma, and T. R. Lambert. 1994. Cool water formation and trout habitat use in a deep pool in the Sierra Nevada, California. Transactions of the American Fisheries Society, 123:549-564.

McNabb, C. D., C. R. Liston, and S. M. Borthwick. 1998. In-plant biological evaluation of the Rd Bluff Research Pumping Plant on the Sacramento River in Northern California: 1995 and 1996. Red Bluff Research Pumping Plant Report Se4arries, volume 3. US Bureau of Reclamation, Denver, CO.

Moore. K., K. Jones, and J. Dambacher. 2002. Methods for stream habitat surveys, Version 12.1. Oregon Department of Fish and Wildlife, Aquatic Inventories Project, Natural Production Program, Corvallis, OR.

Mosley, M. P. 1982. Critical depths for passage in braided river, Canterbury, New Zealand. New Zealand Journal of Marine and Freshwater Research, Vol. 16:351-357.

National Marine Fisheries Service. 1997. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead. Federal Register, 50 CFR Parts 222 and 227 [Docket No. 960730210–7193–02; I.D. 050294D] RIN 0648–XX65. Vol. 62, page 43937.

National Marine Fisheries Service. 2003a. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

National Marine Fisheries Service. 2003b. Endangered and Threatened Species: Range Extension for Endangered Steelhead in Southern California. Federal Register, 50 CFR Part 224 [Docket No. 001025296-2079-02; I.D. 072600A] RIN 0648-AO05. Vol. 67 page 21586.

National Marine Fisheries Service. 2005. Endangered and Threatened Species: Request for Comment on Alternative Approach to Delineating 10 Evolutionarily Significant Units of West Coast Oncorhynchus mykiss. 50 CFR Parts 223 and 224 [Docket No. 040525161–5274–05; I.D. No. 052104F] RIN No. 0648–AR93. Vol. 70 page 67130.

National Marine Fisheries Service. 2009. Letter addressed to Scott Lewis (Casitas Municipal Water District) addressing the downstream fish passage evaluation. Letter dated 28 April 2009, SWR/2002/1871:SCG.

Quinn, T, H. 2005. The behavior and ecology of pacific salmon and trout. American Fisheries Society, Bethesda, Maryland.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa, Bulletin 184.

Shapovalov, L. and A. C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*), with special reference to Waddell Creek, California, and recommendations regarding their management. State of California Department of Fish and Game, fish bulletin No. 98.

Spina, A. P., M. A. Allen, and M. Clarke. 2005. Downstream migration, rearing abundance, and pool habitat associations of juvenile steelhead in the lower main stem of a south-central California stream. North American Journal of Fisheries Management, 25:919-930.

Stoecker, M. 2010. North Fork Matilija Creek adult steelhead below Ojai Quarry barriers. Letter sent on 30 March 2010 about adult steelhead observations, 5 p.

Strauss, R. E., and C. E. Bond. 1990. Taxonomic methods: In Schreck C. B. and P. B. Moyle, editors. Methods for fish biology. AFS, Bethesda, Maryland.

Summerfelt, R. C., and L. S. Smith. 1990. Anesthesia, surgery, and related techniques. Pages 213-272 in C. B. Schreck and P. B. Moyle, editors. Methods for Fish Biology. American Fisheries Society, Bethesda, Maryland.

SYRTAC (Santa Ynez River Technical Advisory Committee). 1999. Adult steelhead passage flow analysis for the Santa Ynez River. Santa Ynez River Consensus Committee, Santa Barbara, CA.

SYRTAC (Santa Ynez River Technical Advisory Committee). 2000. Lower Santa Ynez River fish management plan. Santa Ynez River Consensus Committee, Santa Barbara, CA.

Tan, S. S., and T. A. Jones. 2006. Geologic map of the Matilija 7.5' quadrangle Ventura County, California: a digital database. Version 1.0, Los Angeles, CA.

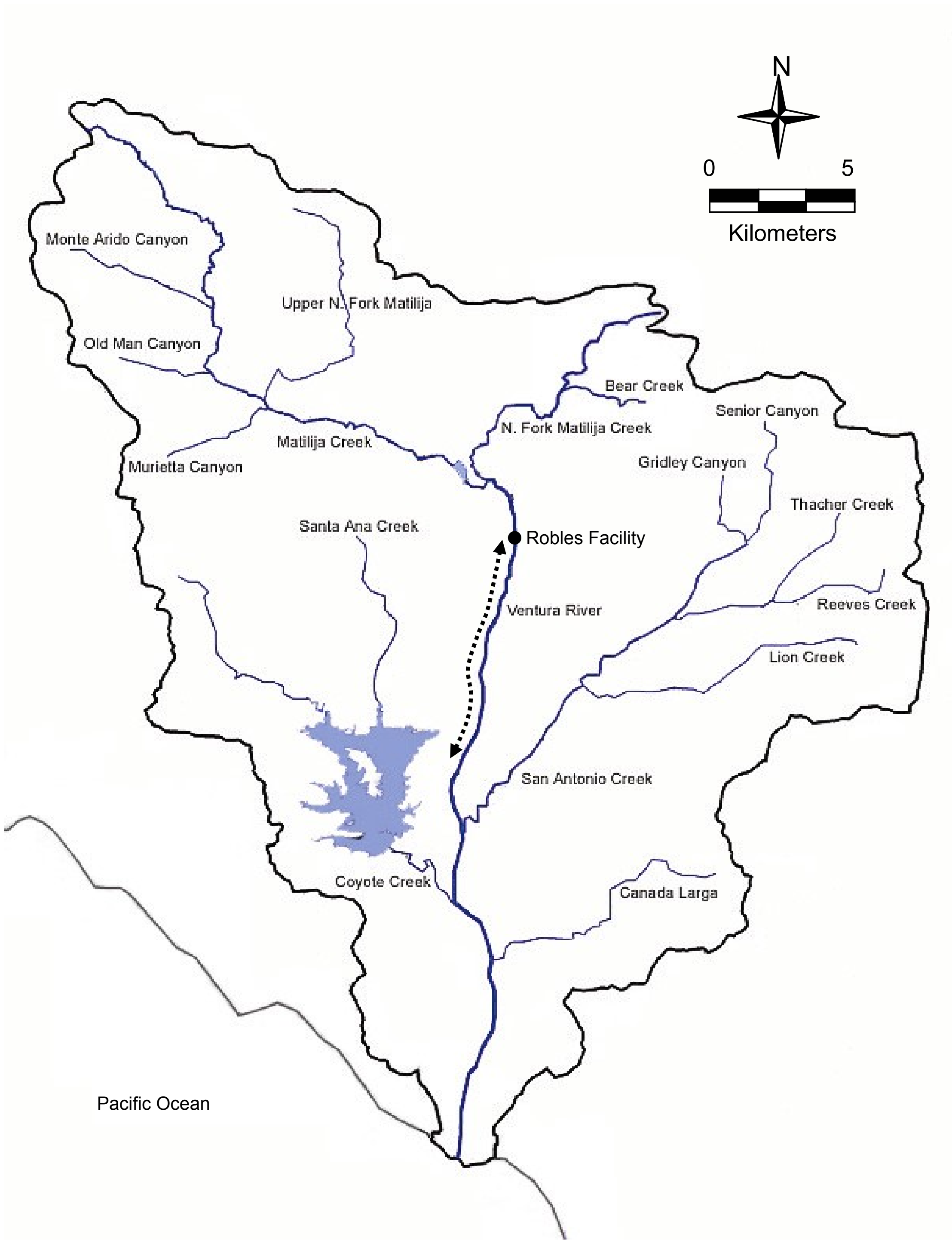
Thompson, K. 1972. Determining stream flows for fish life. Pacific Northwest River Basins Commission, instream flow requirements workshop. Portland, Oregon. Proceedings: 31-50.

U.S. Bureau of Reclamation. 2003. Revised biological assessment for diversion operations and fish passage facilities at the Robles Diversion, Ventura River, CA. South-Central California Area Office, February 21, 2003.

Vaki. 2003. User manual for Riverwatcher. Vaki Aquaculture Systems Ltd., Iceland.

Wagner, H. H., R. L. Wallace, and H. J. Campbell. 1963. The seaward migration and return of hatchery-reared steelhead trout, *Salmo gairdneri* Richardson, in the Alsea River, Oregon. Transactions of the American Fisheries Society, 92(3):202-210.

6.0 APPENDIXES



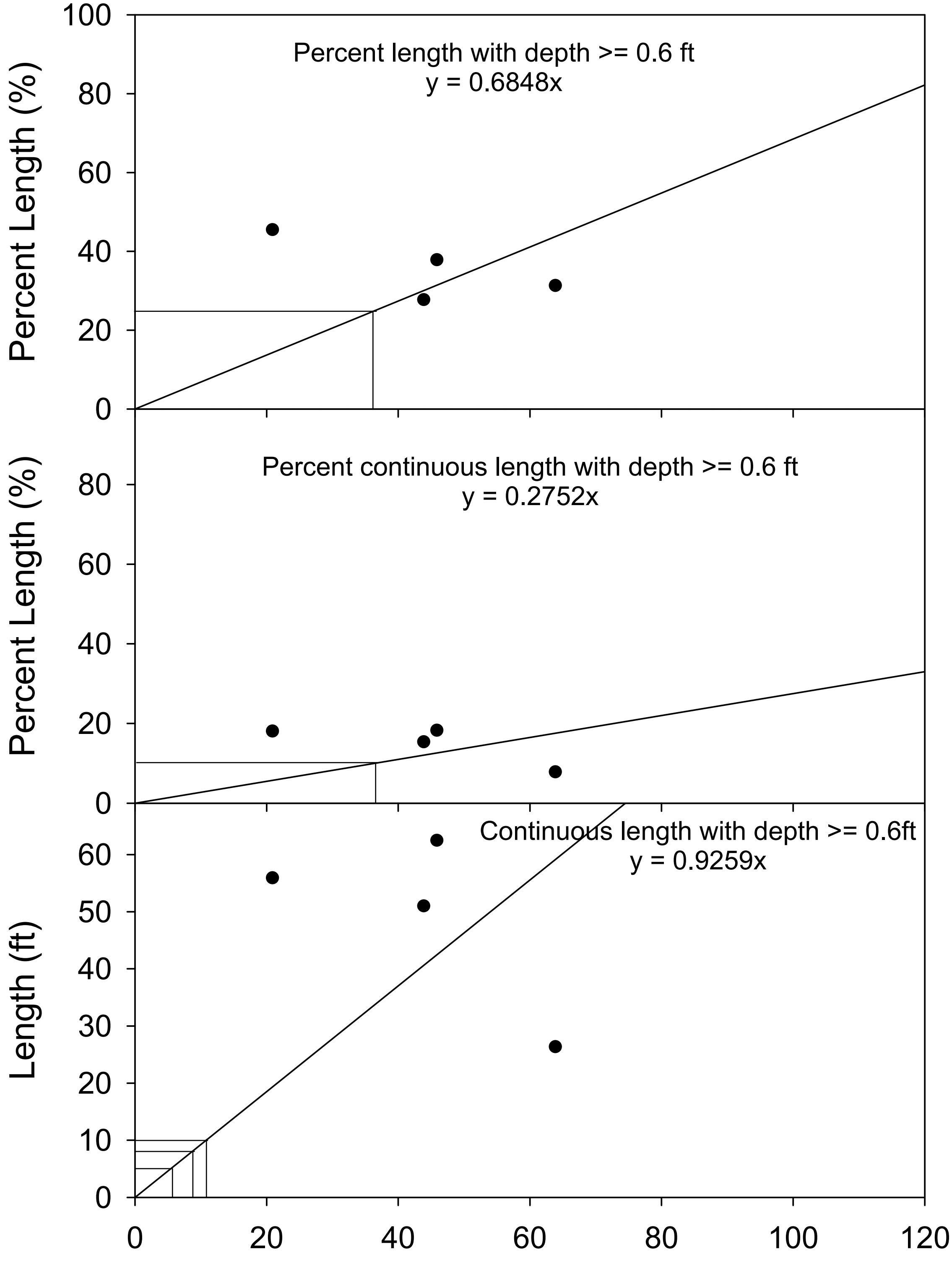
Appendix 1. Basin map of the Ventura River. The Robles Fish Passage Facility is identified by the black dot and the Robles Reach is identified by the dashed line downstream of the Robles Facility.

Appendix 2. Summary data of impediment sites selected for upstream fish migration impediment evaluations.

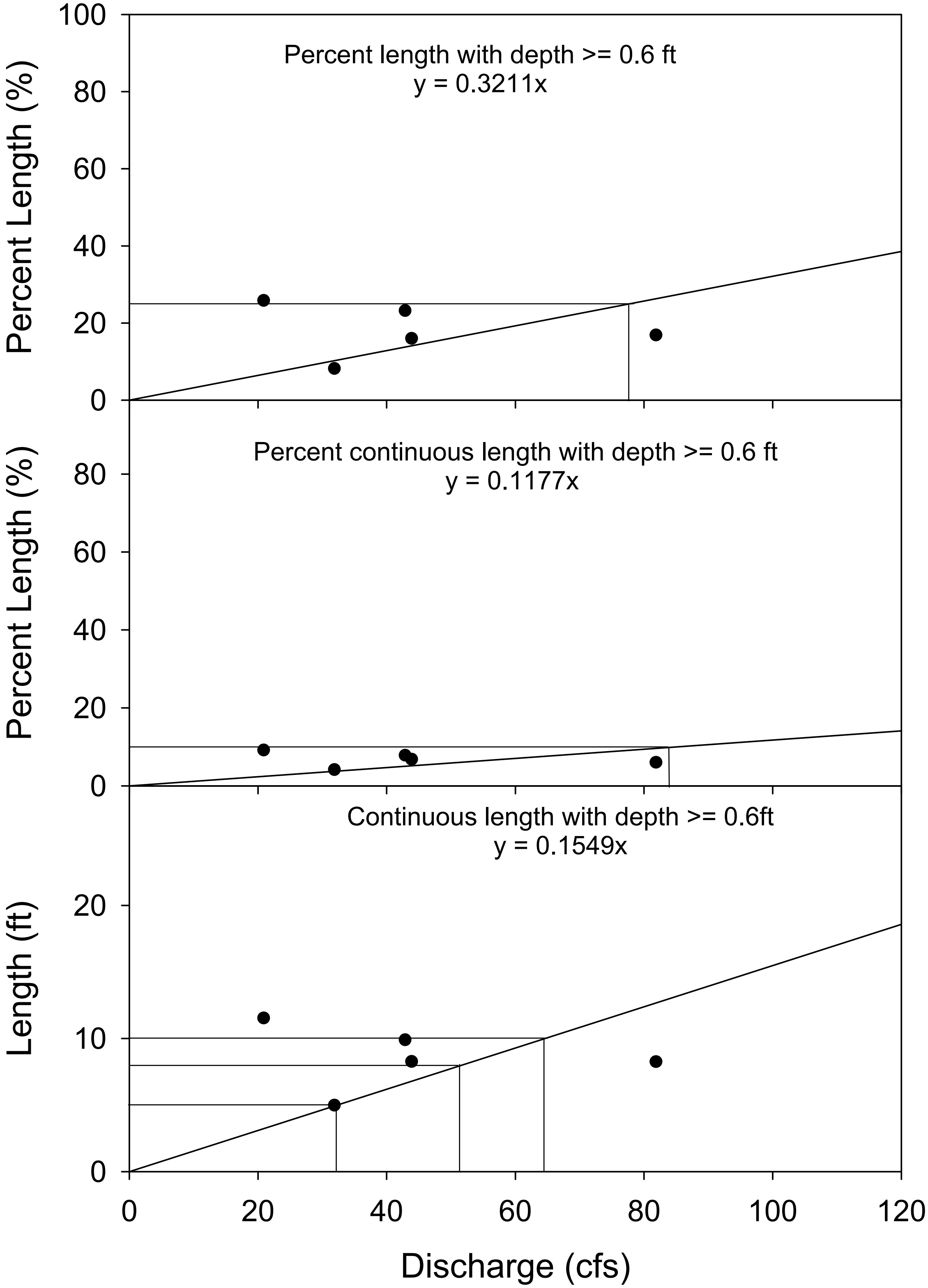
Site	Latitude (N)	Longitude (W)	km	Habitat Type[a]	Site Description	Length (m)	Slope (%)	Percent Substrate[b] SO	SD	GR	CB	BD	BR	Active Channel Width (m)
1			0		River mouth				100					
2	34°20'27"	119°17'53"	7.5	RI	Near treatment plant	16.4	2.8	10	10	15	45	20	0	31.3
3	34°22'07"	119°18'34"	11	RB	Near Casitas Springs at end of levy	22.0	3.7	10	5	10	65	10	0	27.0
4	34°23'05"	119°18'36"	13	RI	0.5 km upstream of San Antonio Cr. confluence	23.8	5.0	0	0	0	15	85	0	27.9
5	34°23'46"	119°18'33"	15	RI	0.4 km downstream of Santa Ana Blvd. bridge	8.4	7.0	0	5	5	45	45	0	50.6
6	34°24'39"	119°18'06"	17	CB	1.4 km upstream of Santa Ana Blvd. bridge	26.1	5.0	0	0	0	65	35	0	33.8
7	34°26'04"	119°18'00"	19	RB	1.1 km upstream of Hwy 150 bridge	31.6	2.0	5	0	10	40	45	0	65.9
8	34°12'15"	119°17'36"	22	CB	1.2 km downstream of Robles Fish Facility	9.2	10.0	0	0	10	45	45	0	32.4

[a]The habitat types are: RB = rapid with protruding boulders, RI = riffle, and CB = cascade over boulders.

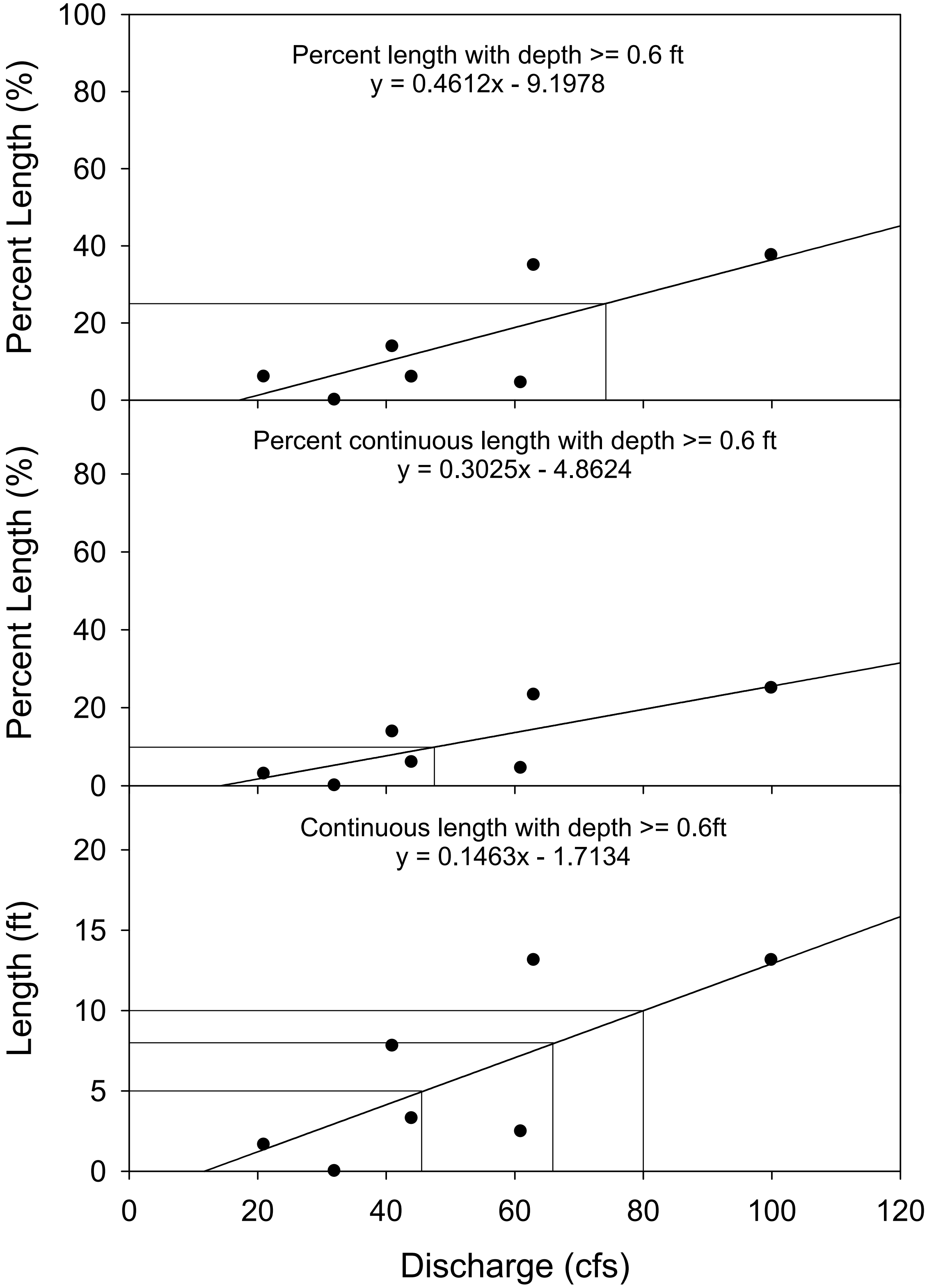
[b]The substrate types are: SO = silt and organics, SD = sand, GR = gravel, CB = cobble, BD = boulders, and BR = bedrock.



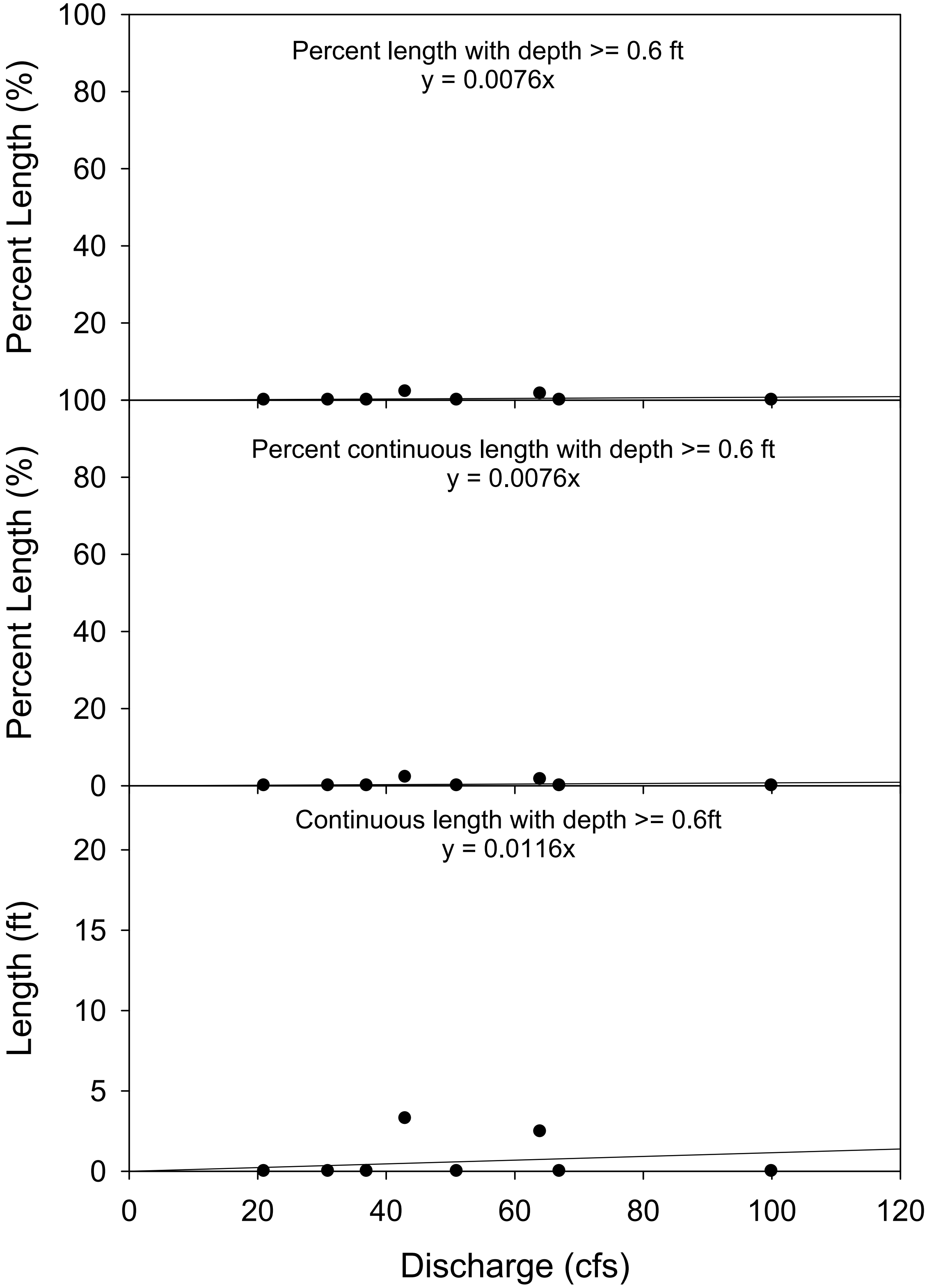
Appendix 3. Relation between Robles discharge and water depth at site 2 downstream of the wastewater treatment plant and resulting discharge for various passage criteria.



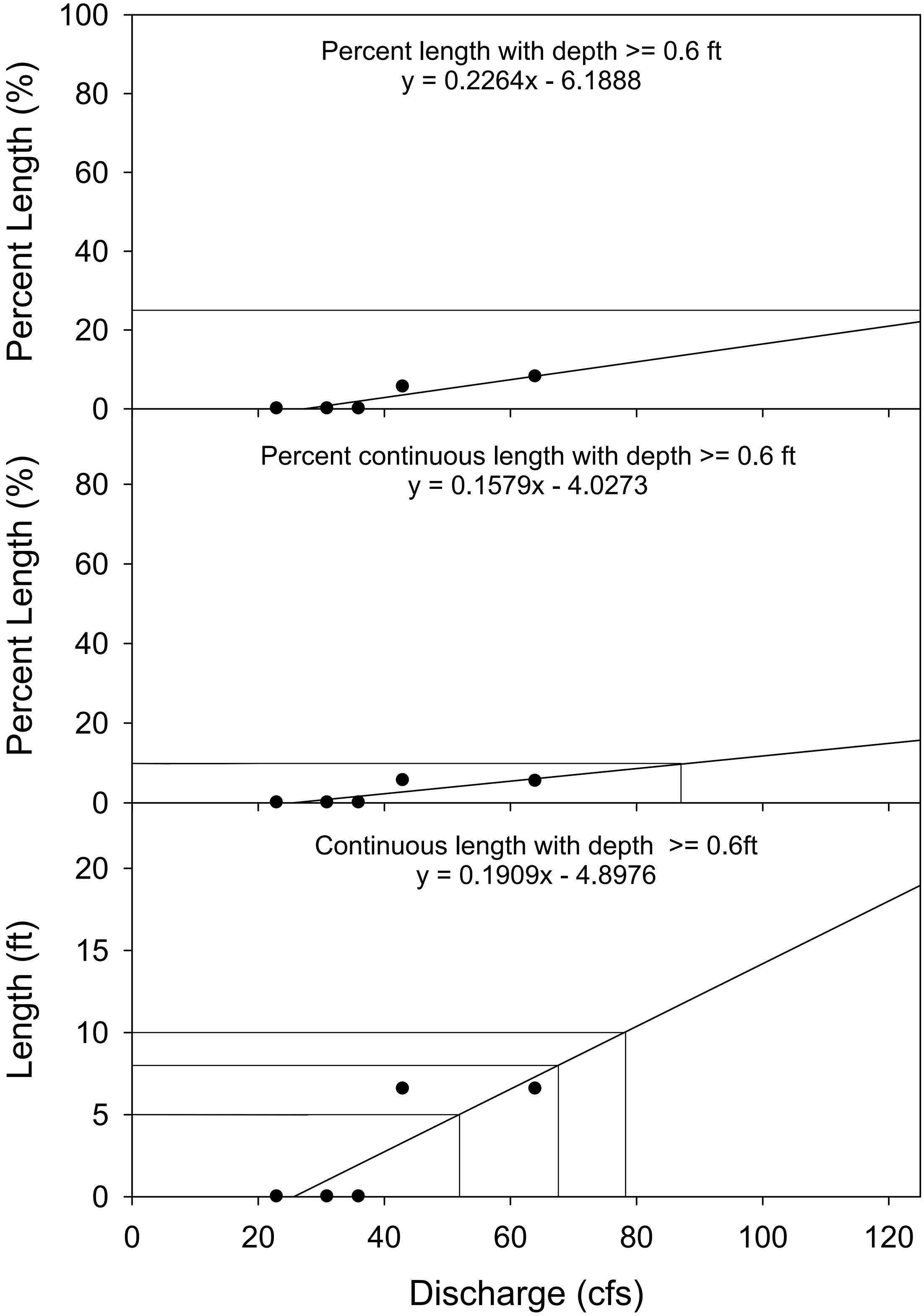
Appendix 4. Relation between Robles discharge and water depth at site 3 near Casitas Springs and resulting discharge for various passage criteria.



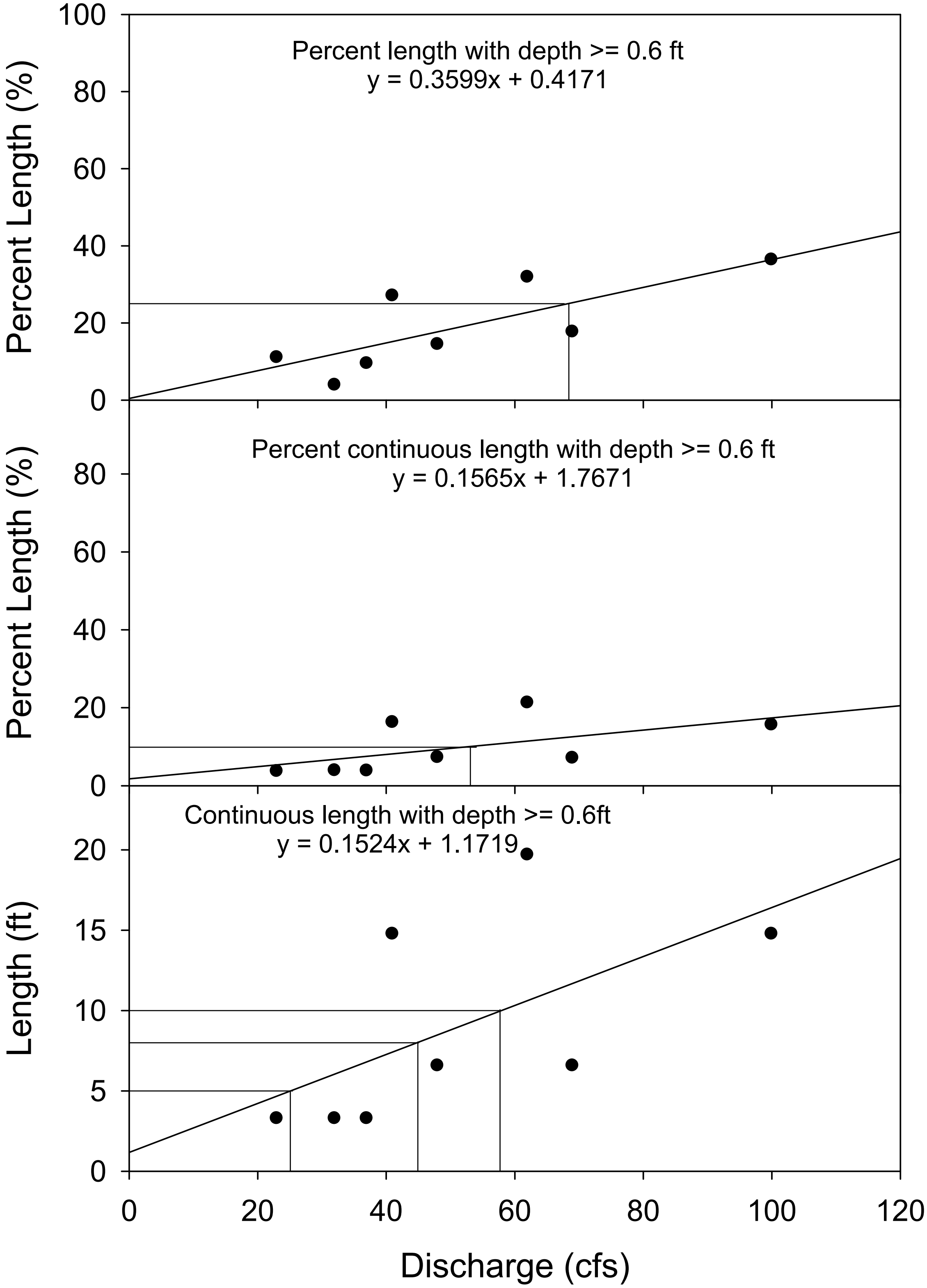
Appendix 5. Relation between Robles discharge and water depth at site 4 upstream of San Antonio Creek and resulting discharge for various passage criteria.



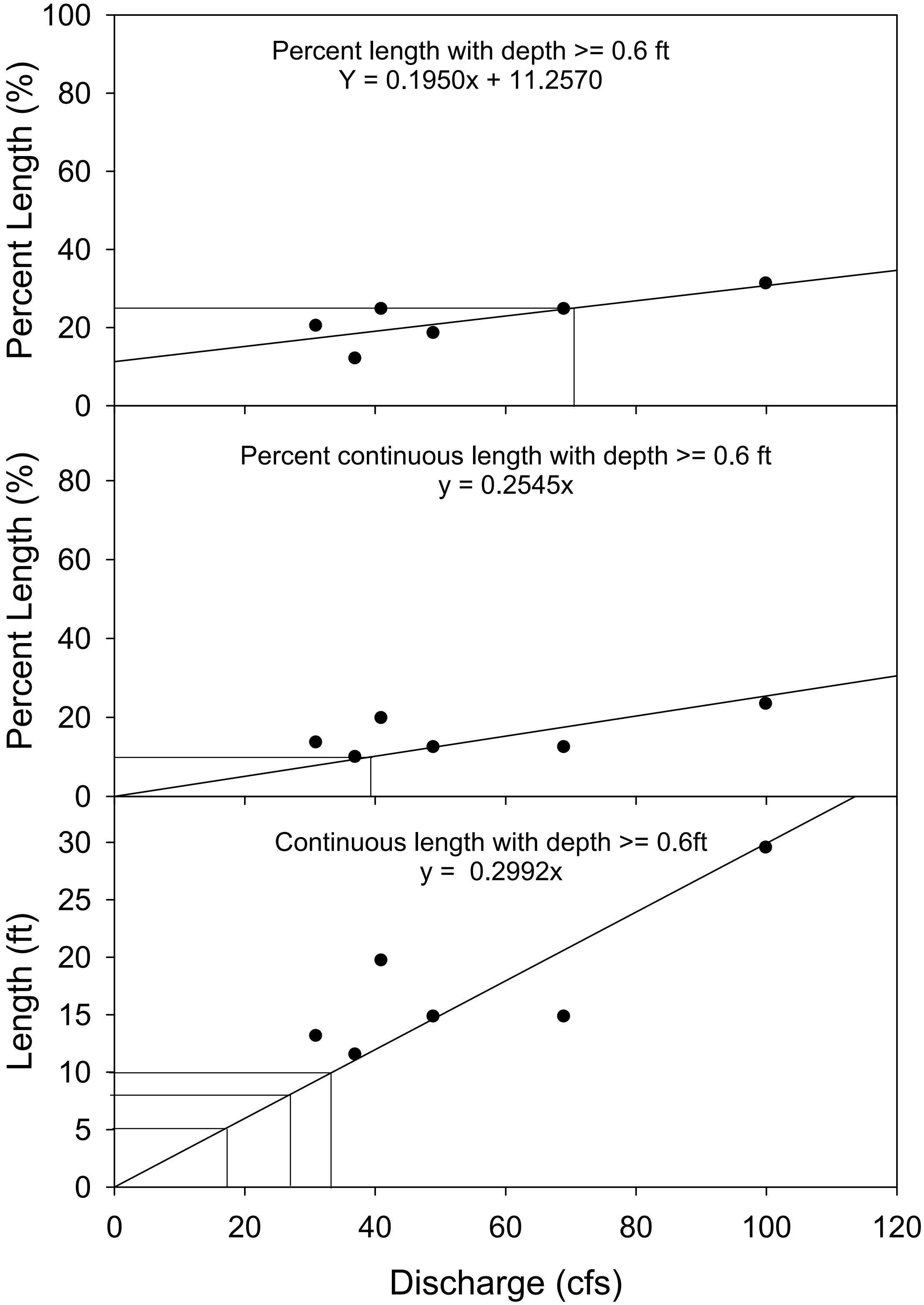
Appendix 6. Relation between Robles discharge and water depth at site 5-1 downstream of Santa Ana bridge and resulting discharge for various passage criteria.



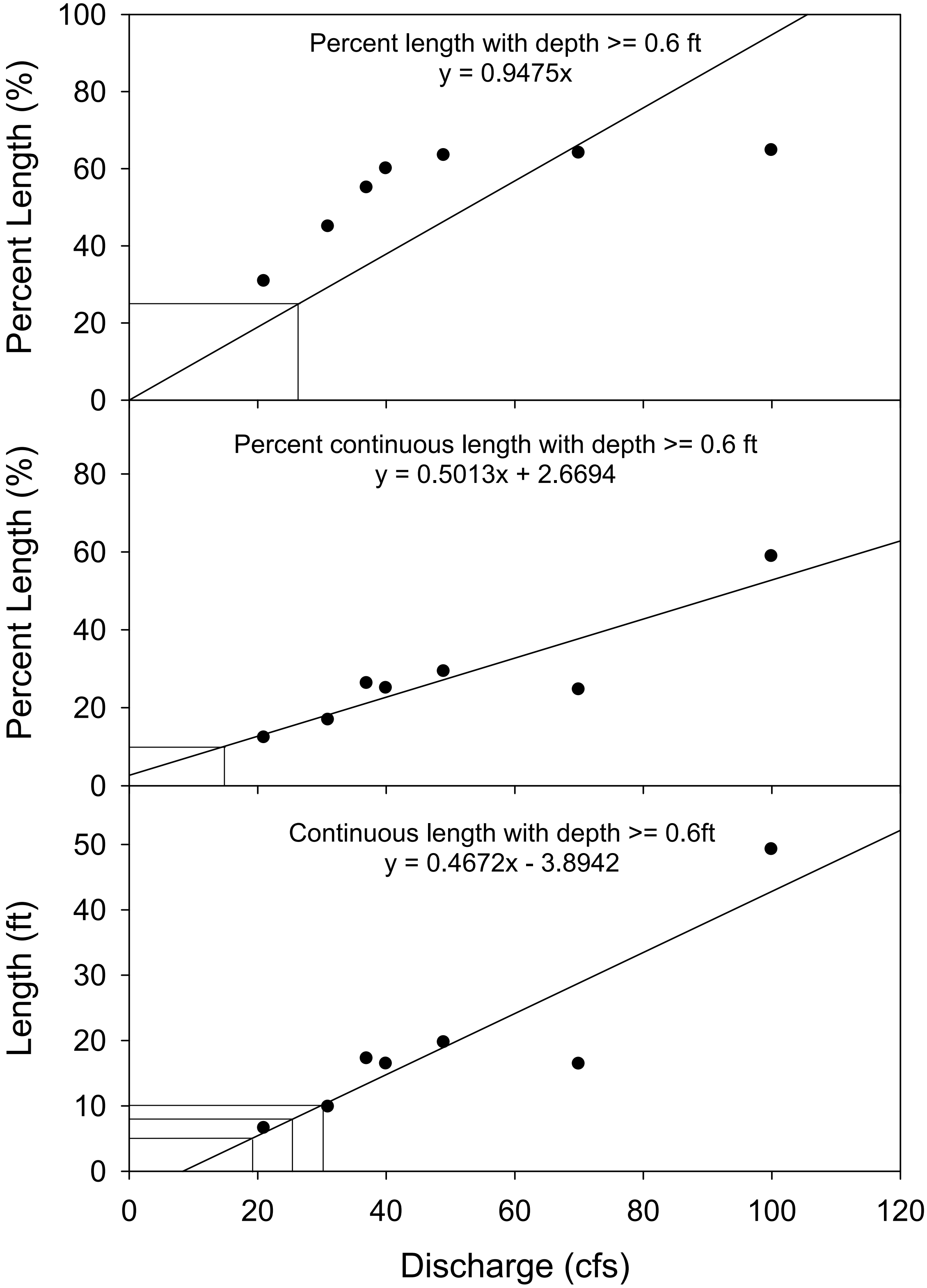
Appendix 7. Relation between Robles discharge and water depth at site 5-2 downstream of Santa Ana bridge and resulting discharge for various passage criteria.



Appendix 8. Relation between Robles discharge and water depth at site 6 upstream of Santa Ana bridge and resulting discharge for various passage criteria.



Appendix 9. Relation between Robles discharge and water depth at site 7 upstream of Hwy 150 bridge and resulting discharge for various passage criteria.



Appendix 10. Relation between Robles discharge and water depth at site 8 downstream of the Robles Fish Facility and resulting discharge for various passage criteria.

A.

B.

C.

D.

Appendix 10a. Photos of impediment site number 2 on February 2, 2010 during 40 cfs discharge releases from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.


A.


B.


C.


D.

Appendix 10b. Photos of impediment site number 3 on February 22, 2010 during 30 cfs discharge release from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.


A.


B.


C.


D.

Appendix 10c. Photos of impediment site number 4 on February 22, 2010 during 30 cfs discharge release from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.


A.


B.


C.


D.

Appendix 10d. Photos of potential impediment site number 5-1 on February 04, 2010 during 30 cfs discharge release from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.


A.


B.


C.


D.

Appendix 10e. Photos of potential impediment site number 5-2 on February 04, 2010 during 30 cfs discharge release from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.


A.


B.


C.


D.

Appendix 10f. Photos of impediment site number 6 on February 22, 2010 during 30 cfs discharge release from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.


A.


B.


C.


D.

Appendix 10g. Photos of impediment site number 7 on February 04, 2010 during 30 cfs discharge release from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.


A.


B.


C.


D.

Appendix 10h. Photos of impediment site number 8 on February 04, 2010 during 30 cfs discharge release from Robles fish facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.

Appendix 12. Regression equations and statistics of the four passage criteria evaluated at potential impediment sites.

	% Total Length (ft) with Depth ≥ 0.6 ft			% Continuous Length (ft) with Depth ≥ 0.6 ft			Continuous length (ft) with depth ≥ 0.6 ft		
Site	Equation	R^2	P-Value	Equation	R^2	P-Value	Equation	R^2	P-Value
2	y = 0.6848x	N/A[a]	N/A[a]	y = 0.2752x	N/A[a]	N/A[a]	y = 0.9259x	N/A[a]	N/A[a]
3	y = 0.3211x	N/A[a]	N/A[a]	y = 0.1177x	N/A[a]	N/A[a]	y = 0.1549x	N/A[a]	N/A[a]
4	y = 0.4612x - 9.1978	0.61	0.04	y = 0.3025x - 4.8624	0.61	0.04	y = 0.1593x - 2.3217	0.57	0.05
5-1	y = 0.0076x	N/A[a]	N/A[a]	y = 0.0076x	N/A[a]	N/A[a]	y = 0.0116x	N/A[a]	N/A[a]
5-2	y = 0.2264x - 6.1888	0.84	0.03	y = 0.1579x - 4.0273	0.67	0.09	y = 0.1909x - 4.8976	0.68	0.08
6	y = 0.3599x + 0.4171	0.59	0.03	y = 0.1565x + 1.7671	0.32	0.14	y = 0.1524x + 1.1719	0.34	0.13
7	y = 0.1950x + 11.2570	0.60	0.07	y = 0.2545x	N/A[a]	N/A[a]	y = 0.2992x	N/A[a]	N/A[a]
8	y = 0.9475x	N/A[a]	N/A[a]	Y = 0.5013x + 2.6694	0.82	0.01	y = 0.4672x -3.8942	0.82	0.01

[a]Regression statistics are not applicable if forced through the origin.

Appendix 13. Calculated discharge (cfs) required from Robles facility to meet various adult passage criteria.

Site	25% Total length with depth ≥ 0.6 ft[a]	10% Continuous length with depth ≥ 0.6 ft[a]	Minimum discharge to meet Thompson criteria[a]	10ft Continuous length with depth ≥ 0.6 ft[b]	8ft Continuous length with depth ≥ 0.6 ft[c]	5ft Continuous length with depth ≥ 0.6 ft[d]
2	37	36	37	11	9	5
3	78	85	85	65	52	32
4	74	49	74	77	65	46
5-1	3,289	1,316	3,289	862	690	431
5-2	138	89	138	78	68	52
6	68	53	68	58	45	25
7	70	39	70	33	27	17
8	26	15	26	30	25	19
Mean (all sites)	473	210	474	152	122	78
Mean (4,6,7,8)	60	39	60	50	40	27

[a]Thompson (1972).
[b]Harrison et al. (2006).
[c]Santa Ynez River Technical Advisory Committee (2000).
[d]Dettman and Kelly (1986).

Appendix 14. Ventura River sandbar monitoring data from July 2009 through June 2010.

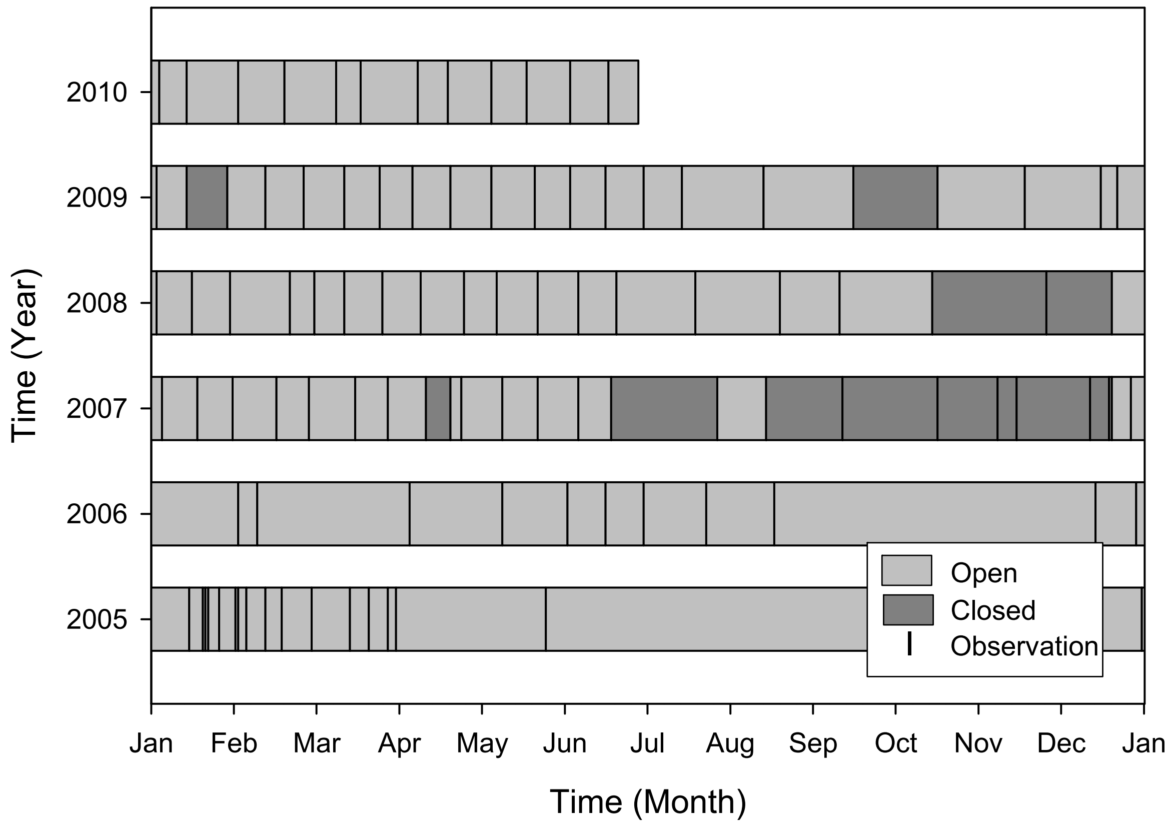
					High Tide		Low Tide					
Date	Sandbar Breeched (Y/N)	Time (24h)	Tide Height (ft)	Tidal State	Time (24h)	Height (ft)	Time (24h)	Height (ft)	Temp (°C)[a]	Discharge at Foster (cfs)[b]	Discharge at Robles (cfs)	Notes
07/14/2009	Y	12:50	3.8	flood	15:09	4.6	08:09	1.4	19.7	3.9	0	Open on east bank
08/13/2009	Y	14:50	5.1	slack	15:01	5.1	07:23	2.4	20.9	3.0	0	Open on east bank
09/15/2009	N[c]	13:10	1.9	ebb	19:29	6.1	13:33	1.9	21.3	2.9	0	If breach, open on EB
10/16/2009	Y	08:40	6.0	slack	08:34	6.0	15:05	0.0	21.1	3.3	4	Open on east bank
11/17/2009	Y	09:15	6.2	ebb	08:34	6.4	16:02	-0.7	13.4	2.4	0	Open on east bank
12/15/2009	Y	14:00	-0.4	ebb	07:47	6.2	15:18	-0.9	12.6	5.8	23	Open on west bank
12/21/2009	Y	11:15	4.6	slack	11:12	4.6	18:43	0.4	12.6	4.2	12	Open on west bank
12/30/2009	Y	12:40	0.2	ebb	07:22	6.8	14:55	-1.5	11.6	4.2	8	Open on west bank
01/04/2010	Y	09:00	4.0	flood	11:24	5.4	05:36	1.7	10.6	3.8	5	Open on west bank
01/14/2010	Y	10:30	4.5	ebb	08:15	5.9	15:35	-0.8	13.6	4.4	4	Open on west bank
02/02/2010	Y	14:11	3.2	ebb	12:11	4.0	18:17	0.7	15.1	50.0	39	Open on west bank
02/19/2010	Y	12:30	2.9	ebb	12:07	2.9	17:32	1.6	16.5	55.0	35	Open on west bank
03/10/2010	Y	11:30	0.5	ebb	05:56	4.6	13:11	-0.1	14.6	67.0	50	Open on west bank
03/19/2010	Y	14:25	0.6	ebb	12:21	3.2	17:33	1.6	19.1	40-50[d]	36	Open on west bank
04/09/2010	Y	09:17	3.4	ebb	07:11	4.2	13:49	0.4	19.3	37.0	31	Open on west bank
04/20/2010	Y	14:10	2.3	flood	17:54	3.5	10:42	-0.1	16.7	40.0	31	Open on west bank
05/06/2010	Y	12:20	0.9	flood	05:16	3.8	11:22	0.7	18.6	30.0	26	Open on west bank
05/19/2010	Y	15:00	3.6	flood	16:00	3.8	08:55	-0.3	17.9	24.0	20	Open on west bank
06/04/2010	Y	13:45	2.8	flood	16:59	4.1	09:52	1.0	18.5	17.0	7	Open on west bank
06/18/2010	Y	14:45	4.5	flood	16:49	5.2	09:57	0.9	18.8	15.0	4	Open on west bank
06/29/2010	Y	14:35	3.4	ebb	13:28	3.9	18:30	2.5	20.5	14.0	3	Open on west bank

[a]Main St. bridge temperature logger at time of observation, approximately 800 m upstream of estuary/lagoon.
[b]USGS gauging station number 11118500, downstream of Foster Park.
[c]Sandbar was closed at low tide and open during some high tides.
[d]Data missing from Foster Park USGS web site. Range represents the nearest provisional data.

Appendix 15. Ventura River estuary piscivorous bird survey data from July 2009 through June 2010.

		Common Name and Quantity of Observed Birds									
Date	Time	Pelican	Gull	Cormorant	Merganser	Egret	Tern	Grebe	Heron	Kingfisher	Total
07/14/2009	12:50	3	152	27	0	1	9	0	1	0	193
08/13/2009	14:50	19	315	42	0	2	12	0	0	0	390
09/15/2009	13:10	0	37	18	0	0	9	0	2	0	66
10/16/2009	08:45	0	21	9	0	3	3	0	0	0	36
11/17/2009	09:30	0	187	34	3	1	0	1	0	0	226
12/15/2009	14:15	0	59	36	0	0	0	1	1	0	97
01/14/2010	10:15	4	62	17	0	0	0	0	0	0	83
02/02/2010	14:11	0 (1)	53 (250)	12 (2)	0	2	0	0	1	1	69 (253)
02/19/2010	12:30	0 (8)	10 (150)	20 (4)	7	1	0	0	1	0	39 (162)
03/10/2010	11:30	0 (22)	19 (400)	18	0	0	0	0	0	0	37 (422)
03/19/2010	14:25	20 (45)	17 (200)	0 (9)	0	0	0	0	1	0	38 (254)
04/09/2010	09:20	12	31 (2)	13	2	0	0	0	0	0	58 (2)
04/20/2010	13:50	0 (89)	1 (250)	0 (15)	0	11	375 (11)	0	1	0	388 (365)
05/06/2010	12:10	0 (61)	0 (150)	1 (27)	0	0	0 (11)	0	1	0	2 (249)
05/19/2010	15:00	0 (12)	0 (200)	0 (35)	0	1	0	0	1	0	2 (247)
06/04/2010	13:40	0	0 (88)	0 (2)	0	2	0 (17)	0	1	0	3 (107)
06/18/2010	14:40	0	6 (7)	0	0	0	0	0	0	0	6 (7)
06/29/2010	14:25	0	0 (70)	10	0	0	0	0	0	0	10 (70)
Total		58 (238)	970 (1767)	257 (94)	12	24	408 (39)	2	11	1	1,743 (2,138)

Normal observation point on east bank of estuary, counts within parentheses denotes observations on west bank at river mouth.



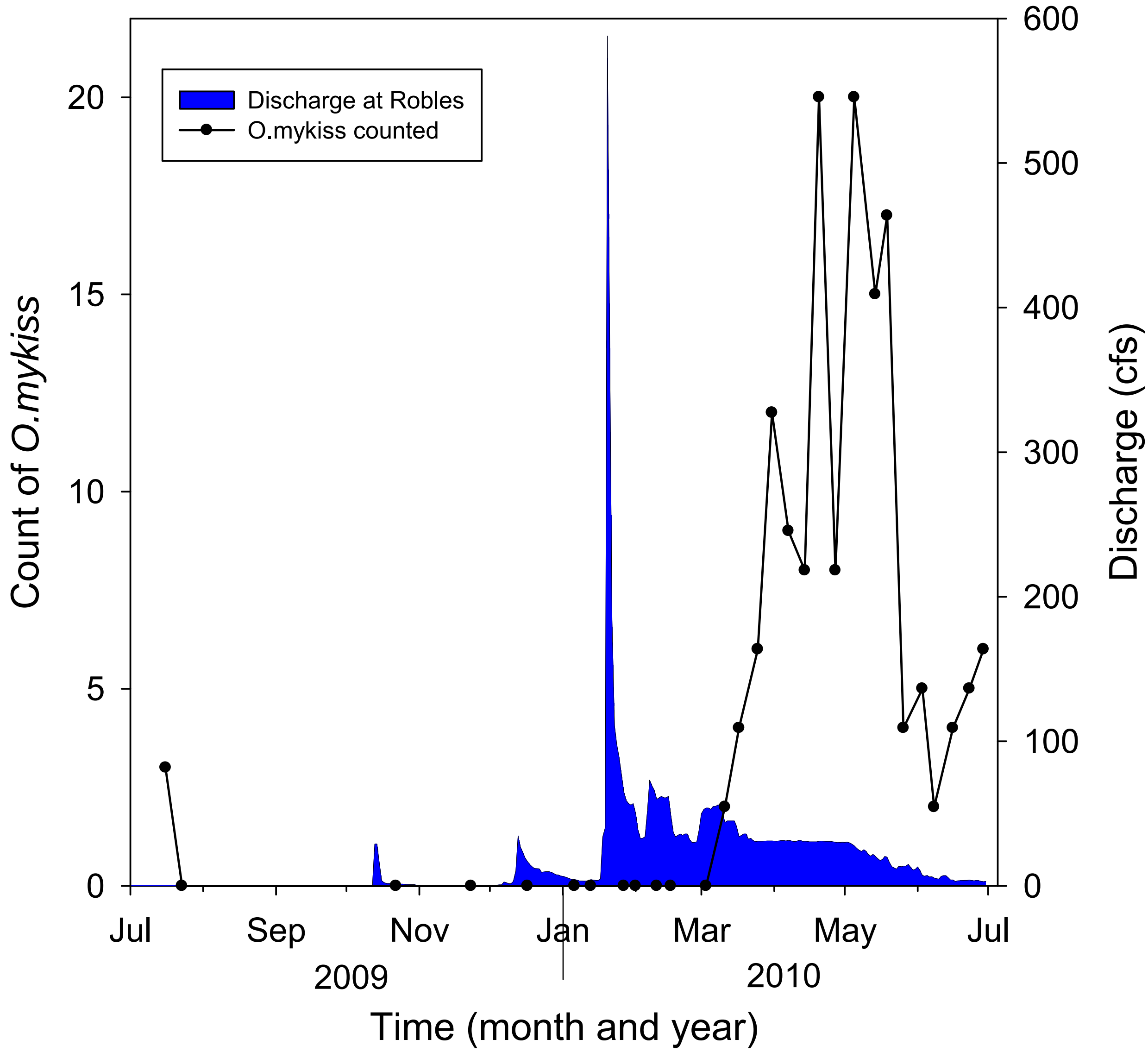
Appendix 16. Sandbar status at the mouth of the Ventura River from 2005 through June of 2010. Each observation is indicated by vertical lines and the sandbar status was assumed to remain the same until the next observation (Lewis et al. 2010).

Appendix 17. Fish attraction counts of *O. mykiss* in close proximity to the Robles Fish Facility from January through June of 2010.

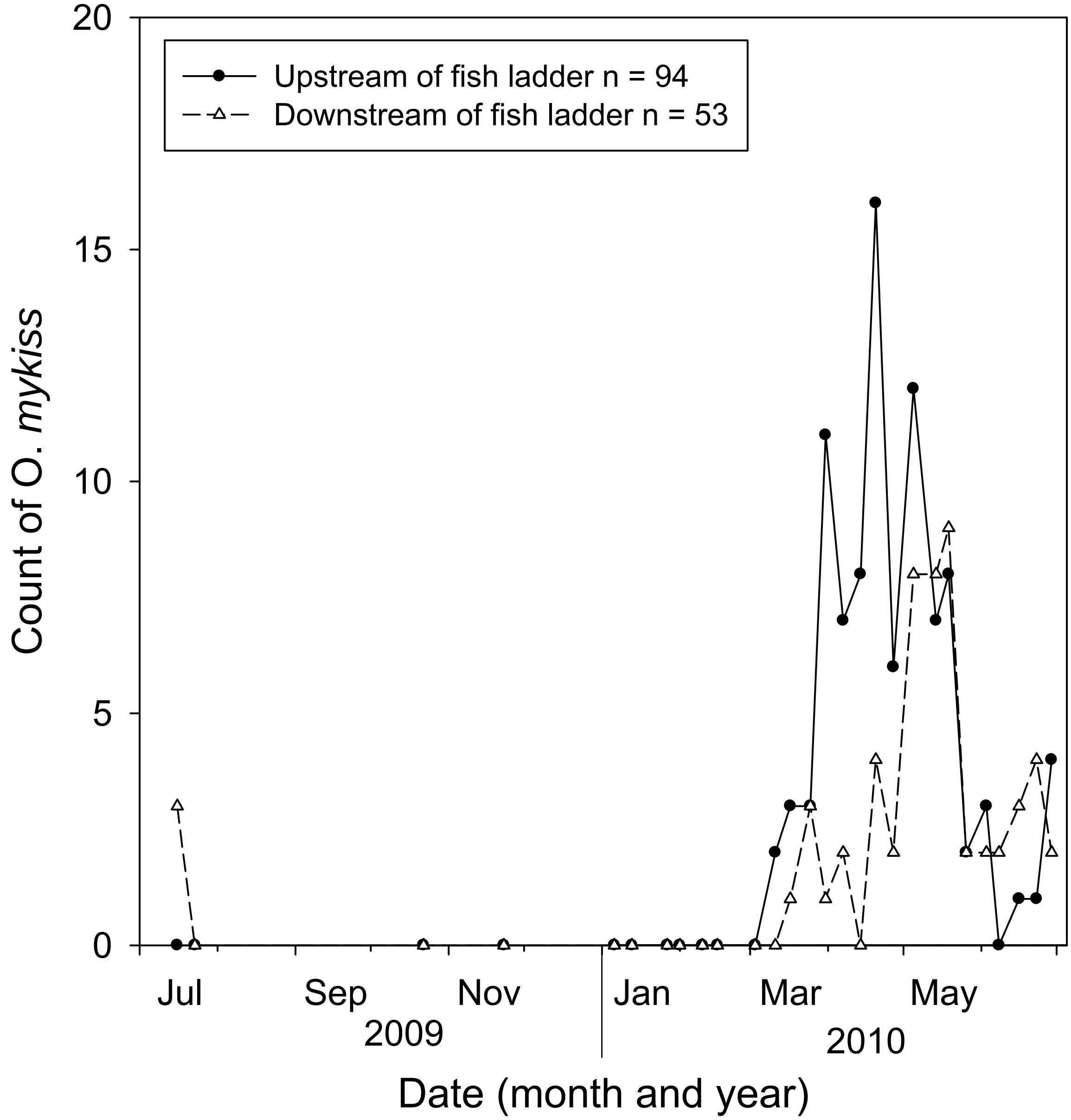
Date	Method	Direction	Length (m)	Temp (°C)	Turbidity (NTU)	Robles Discharge (CFS)	Species[a]	Count
6-Jan-2010	BANK	Downstream	200	10.5	1	4	NFO	0
6-Jan-2010	BANK	Upstream	140	11.5	2	4	NFO	0
13-Jan-2010	SNORKEL	Downstream	200	13.5	2	4	NFO	0
13-Jan-2010	SNORKEL	Upstream	140	15.3	2	4	NFO	0
27-Jan-2010	BANK	Downstream	200	10.0	11	65	NFO	0
27-Jan-2010	BANK	Upstream	140	10.0	11	65	NFO	0
1-Feb-2010	BANK	Downstream	200	10.0	3	50	NFO	0
1-Feb-2010	BANK	Upstream	140	10.0	3	50	NFO	0
10-Feb-2010	BANK	Downstream	200	12.5	7	60	NFO	0
10-Feb-2010	BANK	Upstream	140	12.5	7	60	NFO	0
16-Feb-2010	SNORKEL	Downstream	200	14.8	2	49	NFO	0
16-Feb-2010	SNORKEL	Upstream	140	15.4	2	49	NFO	0
3-Mar-2010	BANK	Downstream	200	11.8	2	54	NFO	0
3-Mar-2010	BANK	Upstream	140	11.8	2	54	NFO	0
11-Mar-2010	BANK	Downstream	200	14.2	1	44	NFO	0
11-Mar-2010	BANK	Upstream	140	14.2	1	44	OMY	2
17-Mar-2010	SNORKEL	Downstream	200	16.7	1	34	OMY	1
17-Mar-2010	SNORKEL	Upstream	140	16.7	1	34	OMY	3
25-Mar-2010	SNORKEL	Downstream	200	13.8	1	31	OMY	3
25-Mar-2010	SNORKEL	Upstream	140	13.8	1	31	OMY	3
31-Mar-2010	SNORKEL	Downstream	200	18.0	4	31	OMY	1
31-Mar-2010	SNORKEL	Upstream	140	18.0	4	31	OMY	11
7-Apr-2010	SNORKEL	Downstream	200	18.0	1	32	OMY	2
7-Apr-2010	SNORKEL	Upstream	140	18.0	1	32	OMY	7
14-Apr-2010	SNORKEL	Downstream	200	17.4	1	31	NFO	0
14-Apr-2010	SNORKEL	Upstream	140	18.6	1	31	OMY	8
20-Apr-2010	SNORKEL	Downstream	200	15.0	1	31	OMY	4
20-Apr-2010	SNORKEL	Upstream	140	15.0	1	31	OMY	16
27-Apr-2010	SNORKEL	Downstream	200	16.9	1	30	OMY	2
27-Apr-2010	SNORKEL	Upstream	140	17.1	2	30	OMY	6
5-May-2010	SNORKEL	Downstream	200	15.0	2	28	OMY	8
5-May-2010	SNORKEL	Upstream	140	15.0	2	28	OMY	12
14-May-2010	SNORKEL	Downstream	200	17.0	2	21	OMY	8
14-May-2010	SNORKEL	Upstream	140	17.0	2	21	OMY	7
19-May-2010	SNORKEL	Downstream	200	17.6	3	20	OMY	9
19-May-2010	SNORKEL	Upstream	140	17.0	2	20	OMY	8
26-May-2010	SNORKEL	Downstream	200	21.4	2	14	OMY	2
26-May-2010	SNORKEL	Upstream	140	22.7	6	14	OMY	2
3-Jun-2010	SNORKEL	Downstream	200	22.8	5	7	OMY	2
3-Jun-2010	SNORKEL	Upstream	140	22.8	5	7	OMY	3
8-Jun-2010	SNORKEL	Downstream	200	23.2	3	6	OMY	2
8-Jun-2010	SNORKEL	Upstream	140	25.9	6	6	NFO	0
16-Jun-2010	SNORKEL	Downstream	200	18.9	2	4	OMY	3
16-Jun-2010	SNORKEL	Upstream	140	18.90	7	4	OMY	1

23-Jun-2010	SNORKEL	Downstream	200	20.30	2	4	OMY	4
23-Jun-2010	SNORKEL	Upstream	140	21.40	3	4	OMY	1
29-Jun-2010	SNORKEL	Downstream	200	20.00	3	3	OMY	2
29-Jun-2010	SNORKEL	Upstream	140	20.90	3	3	OMY	4
		Upstream	3,360				Upstream	94
		Downstream	4,800				Downstream	53
		Total	8,160				Total	147

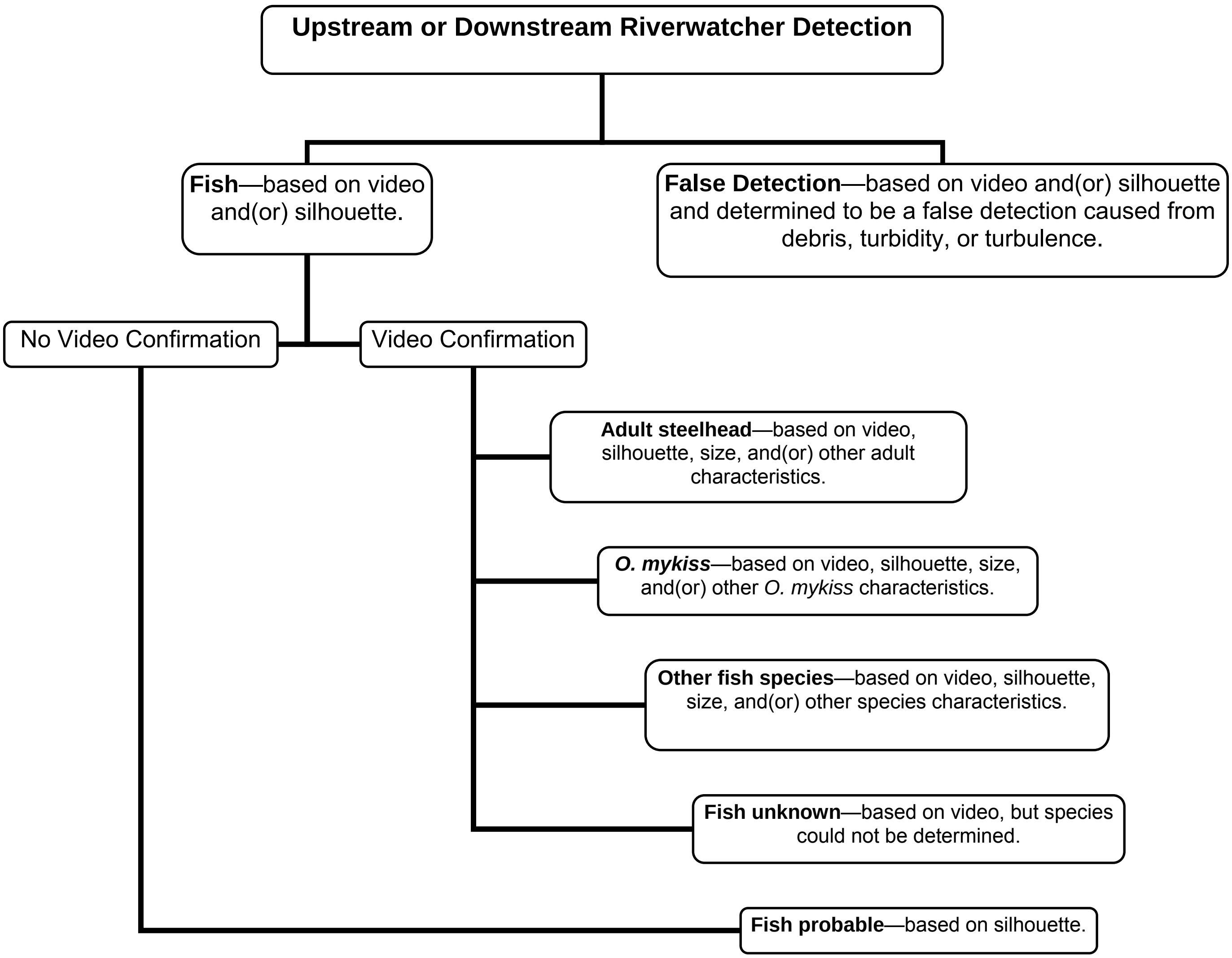
[a]OMY = *O. mykiss* and NFO = no fish observed.



Appendix 18. Total count of *O. mykiss* observed during fish attraction surveys during the reporting year from July 2009 through June 2010 and discharge from the Robles Facility.



Appendix 19. Count of *O. mykiss* observed during fish attraction surveys upstream and downstream of the Robles Fish Facility during the reporting year from July 2008 through June 2009.

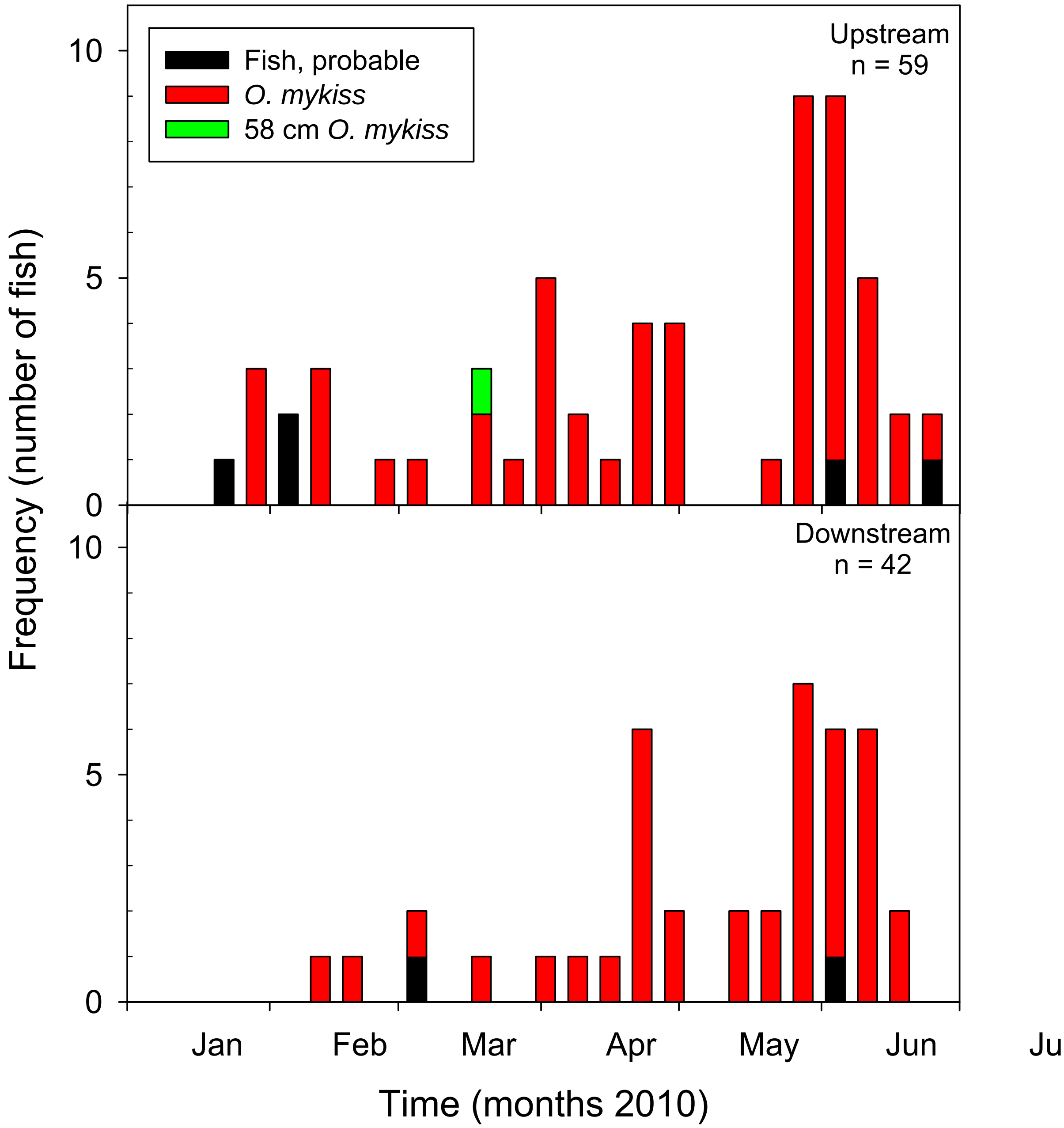


Appendix 20. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections. For the 2010 report, adult steelhead were not classified and instead included in the *O. mykiss* category.

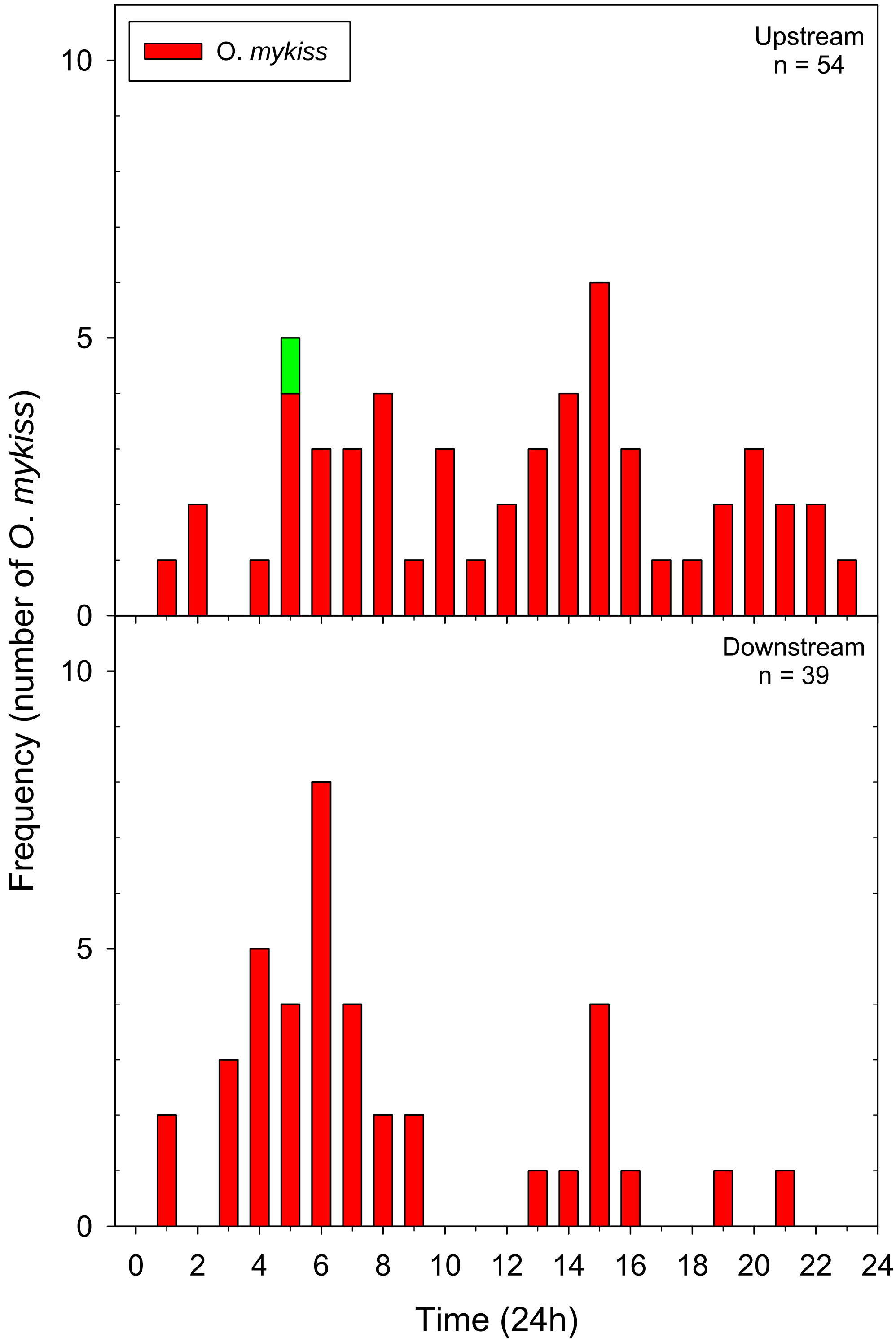
Appendix 21. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* from January through June of 2010.

	Upstream	Downstream
58 cm O. *mykiss*	1	1[a]
Other *O. mykiss*	53	39
Fish, probable	5	3
False detections	820	1,910
Total	879	1,952
Date-58 cm O. *mykiss*	20-Mar-10	
Mean date- Other *O. mykiss*	2-May-10	14-May-10
Mean date-fish, probable	27-Mar-10	14-May-10
Time-58 cm O. *mykiss* (24h)	5:50	
Mean time- Other *O. mykiss* (24h)	12:45	8:19
Mean time-fish, probable (24h)	11:10	11:02
Length -58 cm O. *mykiss* (cm)	58.0	
Mean length- Other *O. mykiss* (cm)	34.3	32.3
Mean length-fish, probable (cm)	31.0	38.5
Daily temperature-58 cm O. *mykiss* (°C)	15.3	
Mean daily temperature- Other *O. mykiss* (°C)	18.0	18.5
Mean daily temperature-fish, probable (°C)	15.2	18.4
Daily turbidity-58 cm O. *mykiss* (NTU)	1	
Mean daily turbidity- Other *O. mykiss* (NTU)	4	4
Mean daily turbidity-fish, probable (NTU)	27	3
Mean daily turbidity-false detections (NTU)	57	47
Daily discharge-58 cm O. *mykiss* (cfs)	36.0	
Mean daily discharge- Other *O. mykiss* (cfs)	22.5	18.8
Mean daily discharge-fish, probable (cfs)	46.8	18.3
Mean daily discharge-false detections (cfs)	23.9	19.4

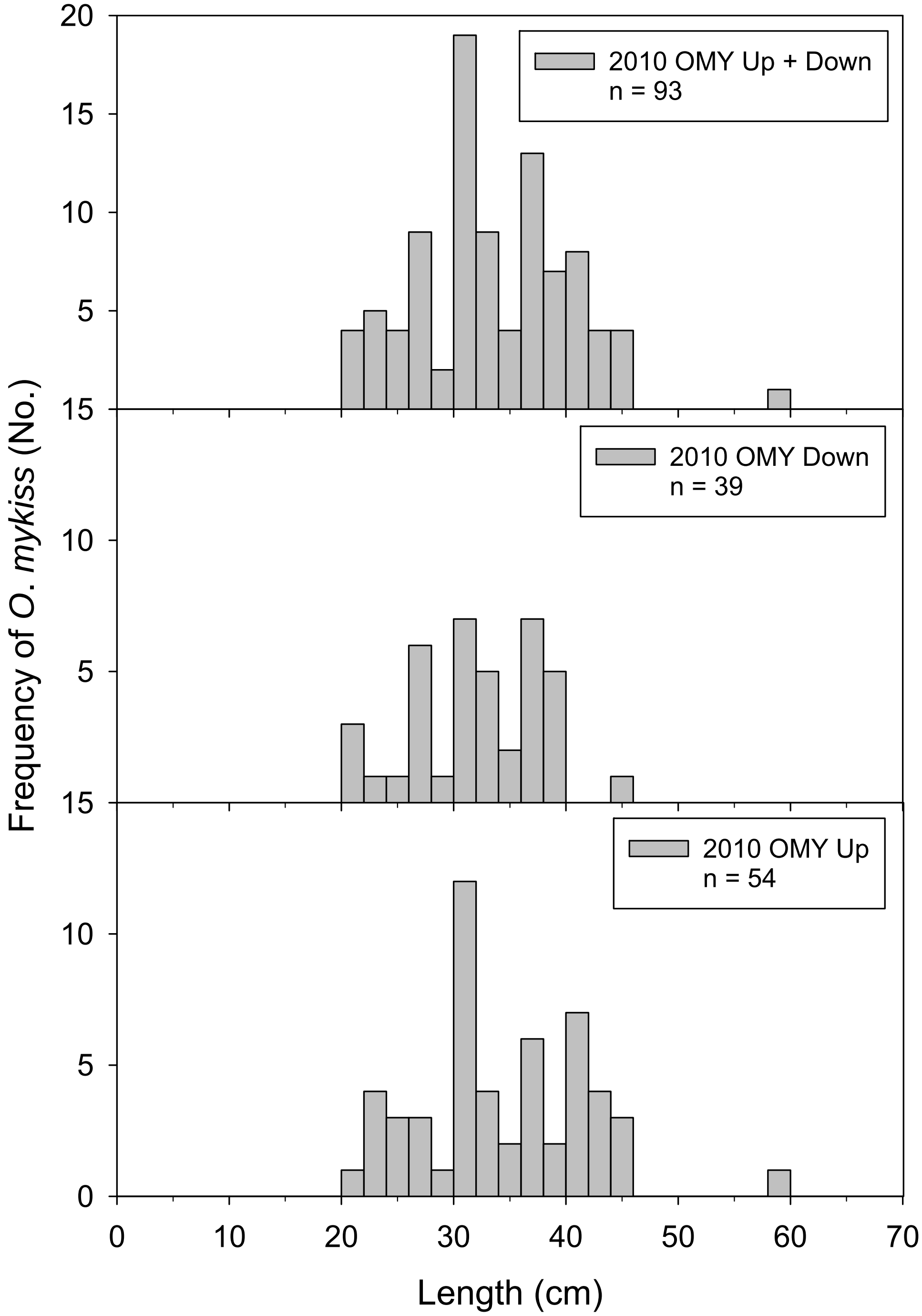
[a]The 58 cm *O. mykiss* was not detected passing downstream through the ladder; however, it was observed on two snorkeling surveys downstream of the ladder.



Appendix 22. Weekly Riverwatcher upstream and downstream detections classified as *O. mykiss* and fish probable from January through June of 2010.



Appendix 23. Time (24h) of *O. mykiss* passage through the Riverwatcher in upstream and downstream directions from January through June of 2010. The 58 cm *O. mykiss* is identified by the green bar.



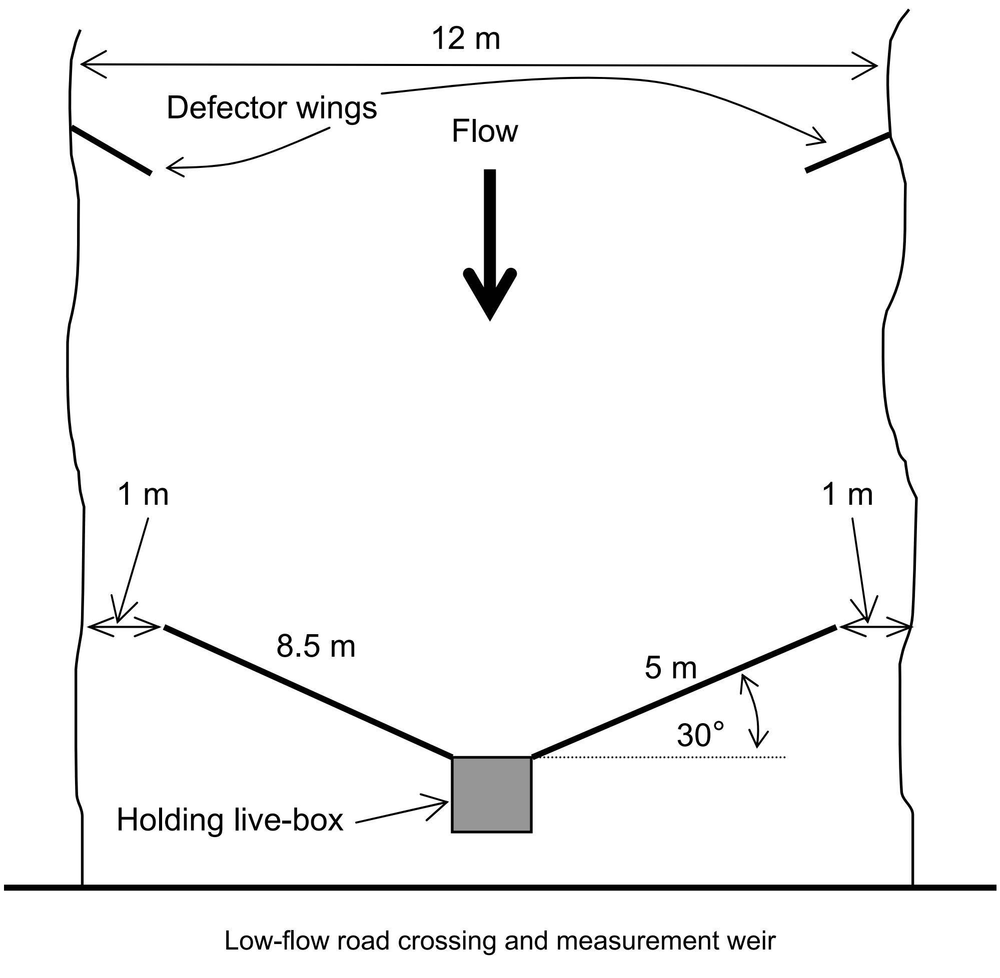
Appendix 24. Length frequency distribution of *O. mykiss* detected passing through the Riverwatcher from January through June of 2010.

Appendix 25. Date, time, TL, direction, discharge, turbidity, and temperature at time of all upstream and downstream Riverwatcher detections that were determined to be fish.

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature(°C)
24-Jan-2010	10:05	Fish Probable	20	Up	98	37	9.63
29-Jan-2010	15:40	O. mykiss	32	Up	39	6	11.60
30-Jan-2010	13:45	O. mykiss	25	Up	39	5	11.48
4-Feb-2010	15:57	O. mykiss	42	Up	33	5	12.15
6-Feb-2010	17:06	Fish Probable	25	Up	52	58	11.53
7-Feb-2010	10:18	Fish Probable	34	Up	73	32	11.05
14-Feb-2010	8:32	O. mykiss	41	Up	61	4	12.20
14-Feb-2010	13:48	O. mykiss	39	Down	61	4	12.20
15-Feb-2010	8:38	O. mykiss	27	Up	62	3	12.35
17-Feb-2010	13:33	O. mykiss	39	Up	37	2	13.28
21-Feb-2010	4:02	O. mykiss	37	Down	35	2	12.58
2-Mar-2010	10:16	O. mykiss	37	Up	53	2	13.38
8-Mar-2010	3:15	O. mykiss	20	Down	56	1	9.43
11-Mar-2010	8:31	O. mykiss	30	Up	44	2	11.48
11-Mar-2010	12:12	Fish Probable	35	Down	44	2	11.48
19-Mar-2010	7:03	O. mykiss	34	Up	36	2	15.23
20-Mar-2010	5:50	O. mykiss	58	Up	36	1	15.28
23-Mar-2010	1:41	O. mykiss	34	Down	31	3	15.48
24-Mar-2010	10:53	O. mykiss	27	Up	31	1	15.63
27-Mar-2010	22:29	O. mykiss	23	Up	31	1	15.63
4-Apr-2010	16:24	O. mykiss	30	Up	31	1	14.83
7-Apr-2010	11:07	O. mykiss	30	Up	32	1	16.20
7-Apr-2010	19:09	O. mykiss	22	Down	32	1	16.20
8-Apr-2010	16:40	O. mykiss	23	Up	31	1	16.93
8-Apr-2010	17:11	O. mykiss	22	Up	31	1	16.93
8-Apr-2010	22:10	O. mykiss	37	Up	31	1	16.93
9-Apr-2010	4:00	O. mykiss	23	Down	31	1	17.23
11-Apr-2010	19:54	O. mykiss	32	Up	31	35	16.20
13-Apr-2010	7:30	O. mykiss	27	Up	31	10	13.68
20-Apr-2010	19:13	O. mykiss	41	Up	31	1	15.60
21-Apr-2010	6:48	O. mykiss	32	Down	31	2	14.60
25-Apr-2010	3:55	O. mykiss	46	Down	31	2	16.80
27-Apr-2010	6:43	O. mykiss	27	Down	30	2	16.30
27-Apr-2010	8:38	O. mykiss	30	Down	30	2	16.30
28-Apr-2010	6:22	O. mykiss	32	Up	30	2	17.30
28-Apr-2010	8:46	O. mykiss	35	Up	30	2	17.30
28-Apr-2010	9:19	O. mykiss	34	Down	30	2	17.30
28-Apr-2010	9:34	O. mykiss	37	Up	30	2	17.30
28-Apr-2010	9:35	O. mykiss	34	Down	30	2	17.30
28-Apr-2010	10:28	O. mykiss	28	Up	30	2	17.30
29-Apr-2010	1:15	O. mykiss	28	Down	30	1	16.20
30-Apr-2010	6:45	O. mykiss	27	Down	30	1	16.20
30-Apr-2010	7:24	O. mykiss	27	Down	30	1	16.20

30-Apr-2010	7:45	O. mykiss	34	Up	30	1	16.20
30-Apr-2010	12:45	O. mykiss	30	Up	30	1	16.20
30-Apr-2010	21:14	Bullfrog	30	Down	30	1	16.20
2-May-2010	14:55	O. mykiss	35	Up	30	1	17.70
5-May-2010	13:08	O. mykiss	25	Up	28	2	18.90
16-May-2010	7:46	O. mykiss	30	Down	18	3	19.50
18-May-2010	6:44	O. mykiss	37	Down	21	3	17.70
25-May-2010	6:22	O. mykiss	27	Down	13	4	17.80
26-May-2010	6:09	O. mykiss	39	Down	14	5	18.80
26-May-2010	6:17	O. mykiss	30	Up	14	5	18.80
30-May-2010	12:29	O. mykiss	39	Up	11	5	19.80
30-May-2010	14:33	O. mykiss	34	Up	11	5	19.80
30-May-2010	14:33	O. mykiss	30	Down	11	5	19.80
30-May-2010	14:39	O. mykiss	30	Up	11	5	19.80
30-May-2010	15:19	O. mykiss	32	Down	11	5	19.80
30-May-2010	15:20	O. mykiss	37	Up	11	5	19.80
30-May-2010	15:33	O. mykiss	25	Down	11	5	19.80
30-May-2010	15:54	O. mykiss	32	Up	11	5	19.80
31-May-2010	2:04	O. mykiss	23	Up	12	6	20.30
1-Jun-2010	7:36	O. mykiss	35	Down	13	5	19.50
1-Jun-2010	16:12	O. mykiss	34	Down	13	5	19.50
1-Jun-2010	18:02	O. mykiss	41	Up	13	5	19.50
3-Jun-2010	5:54	O. mykiss	27	Down	7	5	20.60
3-Jun-2010	6:35	O. mykiss	37	Up	7	5	20.60
3-Jun-2010	15:08	O. mykiss	32	Down	7	5	20.60
3-Jun-2010	15:30	O. mykiss	32	Up	7	5	20.60
4-Jun-2010	4:56	O. mykiss	32	Up	7	5	21.60
4-Jun-2010	15:29	O. mykiss	34	Up	7	5	21.60
4-Jun-2010	15:42	O. mykiss	30	Down	7	5	21.60
4-Jun-2010	16:52	Fish Probable	30	Up	7	5	21.60
4-Jun-2010	16:52	Fish Probable	32	Down	7	5	21.60
4-Jun-2010	16:56	O. mykiss	25	Up	7	5	21.60
4-Jun-2010	21:02	O. mykiss	22	Down	7	5	21.60
6-Jun-2010	5:24	O. mykiss	41	Up	6	5	22.50
6-Jun-2010	7:04	O. mykiss	37	Down	6	5	22.50
6-Jun-2010	14:42	O. mykiss	23	Up	6	5	22.50
7-Jun-2010	5:47	O. mykiss	42	Up	6	5	22.20
7-Jun-2010	8:29	O. mykiss	39	Down	6	5	22.20
9-Jun-2010	5:59	O. mykiss	41	Up	5	4	21.20
9-Jun-2010	6:58	O. mykiss	37	Down	5	4	21.20
10-Jun-2010	20:28	O. mykiss	41	Up	5	5	20.50
11-Jun-2010	6:04	O. mykiss	27	Down	7	4	20.70
11-Jun-2010	21:12	O. mykiss	44	Up	7	4	20.70
12-Jun-2010	5:44	O. mykiss	37	Down	7	5	20.80
12-Jun-2010	20:58	O. mykiss	37	Up	7	5	20.80
13-Jun-2010	3:55	O. mykiss	37	Down	7	7	21.30
13-Jun-2010	5:27	O. mykiss	44	Up	7	7	21.30
13-Jun-2010	5:51	O. mykiss	35	Down	7	7	21.30
13-Jun-2010	20:32	O. mykiss	43	Up	7	7	21.30
14-Jun-2010	5:45	O. mykiss	39	Down	6	5	22.10

14-Jun-2010	23:07	O. mykiss	42	Up	6	5	22.10
16-Jun-2010	4:39	O. mykiss	37	Down	4	5	21.20
18-Jun-2010	2:19	O. mykiss	41	Up	4	4	21.30
19-Jun-2010	4:46	O. mykiss	34	Down	4	3	21.40
21-Jun-2010	21:00	O. mykiss	40	Up	4	4	21.40
22-Jun-2010	4:49	O. mykiss	39	Down	4	3	21.40
27-Jun-2010	1:33	Fish Probable	46	Up	4	3	22.20
27-Jun-2010	1:39	O. mykiss	46	Up	4	3	22.20
27-Jun-2010	4:03	Fish Probable	49	Down	4	3	22.20



Appendix 26. Top view of downstream migrant smolt trap layout in the Ventura River below the Robles Fish Facility.

Appendix 27. Annual Flow Summary - Robles Fish Passage Facility
Water Year 2009 - 2010

	* (1)	* (2)	(1)+(2)		** (3)	(4)	(5)	*** (4)+(5)
	Source Stream Daily Flows				**Robles Facility Daily Flows**			
	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck.* (cfsd)	Sum of Creek Flows (cfsd)		Fishway Ladder (cfsd)	VRNMO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)
Jul-09	89	16	105		0	0	0	0
Aug-09	61	16	76		0	0	0	0
Sep-09	56	72	72		0	0	0	0
Oct-09	69	121	191		0	0	0	0
Nov-09	116	40	156		1	1	0	1
Dec-09	193	118	310		289	289	3	292
Jan-10	2778	933	3711		593	1961	1745	3706
Feb-10	1815	507	2322		965	1276	985	2261
Mar-10	1400	334	1734		976	1287	345	1632
Apr-10	781	265	1046		925	925	186	1110
May-10	462	141	603		609	609	0	609
Jun-10	235	76	311		158	158	0	158
Total	8055	2636	10635		4516	6505	3264	9769

* Preliminary flow information provided by the Ventura County Watershed Protection District. North Fork Data is estimated. To be confirmed by VCWPD. Refer to the Operations section of the Report to determine operational reasons for flow variances.

** Flow in the Fish Passage was too low to be measured by the Accusonics Flowmeter. Flow needs to be greater than 15 CFS for reasonable flow measurements.

*** This does not account for any flow being expelled from the spillway gates

Ventura River Flow Assessment
Water Year 2009 - 2010

Jul-09	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	Field Measurement: Matilija Creek (cfsd)	VRNMO (cfsd)
1	5	1	5	0.8	0	0	0	0	0		
2	4	1	4	0.8	0	0	0	0	0		
3	4	1	4	0.8	0	0	0	0	0		
4	4	1	4	0.8	0	0	0	0	0		
5	4	1	4	0.8	0	0	0	0	0		
6	4	1	4	0.4	0	0	0	0	0		
7	3	1	3	0.4	0	0	0	0	0	2.61	
8	3	1	3	0.4	0	0	0	0	0		
9	3	1	3	0.3	0	0	0	0	0		
10	3	1	3	0.3	0	0	0	0	0		
11	3	1	3	0.3	0	0	0	0	0		
12	3	1	3	0.2	0	0	0	0	0		
13	3	1	3	0.2	0	0	0	0	0		
14	3	1	3	0.2	0	0	0	0	0		
15	3	1	3	0.2	0	0	0	0	0		
16	3	1	3	0.2	0	0	0	0	0		
17	3	1	3	0.2	0	0	0	0	0		
18	3	1	3	0.2	0	0	0	0	0		
19	3	1	3	0.1	0	0	0	0	0		
20	3	1	3	1.1	0	0	0	0	0		
21	3	1	3	0.1	0	0	0	0	0		
22	3	1	3	0.1	0	0	0	0	0		
23	3	1	3	0.0	0	0	0	0	0		
24	3	1	3	0.0	0	0	0	0	0		
25	3	1	3	0.0	0	0	0	0	0		
26	3	1	3	0.0	0	0	0	0	0		
27	3	1	3	0.0	0	0	0	0	0		
28	3	1	3	0.0	0	0	0	0	0		
29	3	1	3	0.0	0	0	0	0	0		
30	3	1	3	0.0	0	0	0	0	0		
31	3	1	3	0.0	0	0	0	0	0		
Totals	89	16	105		0	0	0	0	0		

Water Year 2009 - 2010

	Source Stream Daily Flows				Robles Facility Daily Flows					Field Measurement -	
Aug-09	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	Matilija Creek (cfsd)	VRNMO (cfsd)
1	3	1	3	0.0	0	0	0	0	0		
2	3	1	3	0.0	0	0	0	0	0		
3	3	1	3	0.0	0	0	0	0	0		
4	3	1	3	0.0	0	0	0	0	0		
5	3	1	3	0.0	0	0	0	0	0		
6	3	1	3	0.0	0	0	0	0	0		
7	3	1	3	0.0	0	0	0	0	0		
8	3	1	3	0.0	0	0	0	0	0		
9	3	1	3	0.0	0	0	0	0	0		
10	3	1	3	0.0	0	0	0	0	0		
11	3	1	3	0.0	0	0	0	0	0		
12	3	1	3	0.0	0	0	0	0	0		
13	2	1	2	0.0	0	0	0	0	0		
14	2	1	2	0.0	0	0	0	0	0		
15	2	1	2	0.0	0	0	0	0	0		
16	1	1	2	0.0	0	0	0	0	0		
17	1	1	2	0.0	0	0	0	0	0		
18	1	1	2	0.0	0	0	0	0	0		
19	1	1	2	0.0	0	0	0	0	0		
20	1	1	2	0.0	0	0	0	0	0		
21	2	1	2	0.0	0	0	0	0	0		
22	2	1	2	0.0	0	0	0	0	0		
23	2	1	2	0.0	0	0	0	0	0		
24	2	1	2	0.0	0	0	0	0	0		
25	2	1	2	0.0	0	0	0	0	0		
26	2	1	2	0.0	0	0	0	0	0		
27	2	1	2	0.0	0	0	0	0	0		
28	2	1	2	0.0	0	0	0	0	0		
29	2	1	2	0.0	0	0	0	0	0		
30	2	1	2	0.0	0	0	0	0	0		
31	2	1	2	0.0	0	0	0	0	0		

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Sep-09	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) Source Stream Daily Flows: North Fork Matilija Ck. (cfsd)	(1)+(2) Source Stream Daily Flows: Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) Robles Facility Daily Flows: VRNMO Weir (cfsd)	(5) Robles Facility Daily Flows: Diversion Canal (cfsd)	(4)+(5) Robles Facility Daily Flows: Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	- Field Measurement: Matilija Creek (cfsd)	Field Measurement: VRNMO (cfsd)
1	2	1	3	0.0	0	0	0	0	0		
2	2	1	2	0.0	0	0	0	0	0		
3	1	1	2	0.0	0	0	0	0	0		
4	1	1	2	0.0	0	0	0	0	0		
5	1	1	2	0.0	0	0	0	0	0		
6	2	1	3	0.0	0	0	0	0	0		
7	4	1	5	0.0	0	0	0	0	0		
8	3	1	4	0.0	0	0	0	0	0		
9	2	1	3	0.0	0	0	0	0	0		
10	2	1	3	0.0	0	0	0	0	0		
11	2	1	3	0.0	0	0	0	0	0		
12	2	1	3	0.0	0	0	0	0	0		
13	2	1	3	0.0	0	0	0	0	0		
14	2	1	3	0.0	0	0	0	0	0		
15	2	1	3	0.0	0	0	0	0	0		
16	2	1	3	0.0	0	0	0	0	0		
17	2	1	2	0.0	0	0	0	0	0		
18	1	1	2	0.0	0	0	0	0	0		
19	1	1	2	0.0	0	0	0	0	0		
20	1	1	2	0.0	0	0	0	0	0		
21	1	1	2	0.0	0	0	0	0	0		
22	1	1	2	0.0	0	0	0	0	0		
23	1	1	2	0.0	0	0	0	0	0		
24	2	1	2	0.0	0	0	0	0	0		
25	2	1	2	0.0	0	0	0	0	0		
26	2	1	2	0.0	0	0	0	0	0		
27	2	1	2	0.0	0	0	0	0	0		
28	1	1	2	0.0	0	0	0	0	0		
29	1	1	2	0.0	0	0	0	0	0		
30	1	1	2	0.0	0	0	0	0	0		
Totals	56	16	72		0	0	0	0	0		

Oct-09	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	Matilija Creek (cfsd)	VRNMO (cfsd)
	Source Stream Daily Flows				Robles Facility Daily Flows					- Field Measurement	
1	0	0	1	0.0	0	0	0	0	0		
2	0	0	1	0.0	0	0	0	0	0		
3	0	0	1	0.0	0	0	0	0	0		
4	1	0	1	0.0	0	0	0	0	0		
5	1	0	1	0.0	0	0	0	0	0		
6	1	0	1	0.0	0	0	0	0	0		
7	1	0	1	0.0	0	0	0	0	0		
8	1	0	1	0.0	0	0	0	0	0		
9	1	0	1	0.0	0	0	0	0	0		
10	1	0	1	0.0	0	0	0	0	0		
11	1	0	1	0.0	0	0	0	0	0		
12	1	0	1	0.0	0	0	0	0	0		
13	2	24	26	0.3	29	29	0	29	0		
14	3	55	58	2.6	29	29	4	33	7		
15	2	7	10	2.1	15	15	0	15	0		
16	4	5	8	1.2	4	4	0	4	0		
17	4	3	7	1.0	2	2	0	2	0		
18	4	3	6	0.9	2	2	0	2	0		
19	4	2	6	0.9	2	2	0	2	0		
20	4	2	6	1.0	2	2	0	2	0		
21	4	2	5	9.2	2	2	0	2	0		
22	4	2	5	0.9	2	2	0	2	0		
23	4	2	5	0.9	1	1	0	1	0		
24	4	2	5	0.9	1	1	0	1	0		
25	4	1	5	0.9	1	1	0	1	0		
26	4	1	5	0.8	1	1	0	1	0		
27	4	1	5	0.9	1	1	0	1	0		
28	4	1	5	0.8	1	1	0	1	0		
29	4	1	5	0.8	1	1	0	1	0		
30	4	1	5	0.8	1	1	0	1	0		
31	4	1	5	0.7	0	0	0	0	0		
Totals	69	121	191		97	97	4	101	7		

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Nov-09	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	- Field Measurement: Matilija Creek (cfsd)	VRNMO (cfsd)
1	4	1	5	0.7	0	0	0	0	0		
2	4	1	5	0.7	0	0	0	0	0		
3	4	1	5	0.6	0	0	0	0	0		
4	4	1	5	0.7	0	0	0	0	0		
5	4	1	5	0.8	0	0	0	0	0		
6	4	1	5	0.8	0	0	0	0	0		
7	4	1	5	0.8	0	0	0	0	0		
8	4	1	5	0.8	0	0	0	0	0		
9	4	1	5	0.8	0	0	0	0	0		
10	4	1	5	0.8	0	0	0	0	0		
11	4	1	5	0.7	0	0	0	0	0		
12	4	1	5	0.6	0	0	0	0	0		
13	4	1	5	0.7	0	0	0	0	0		
14	4	1	5	0.7	0	0	0	0	0		
15	4	1	5	0.8	0	0	0	0	0		
16	4	1	5	0.8	0	0	0	0	0		
17	4	1	5	0.8	0	0	0	0	0		
18	4	1	5	0.8	0	0	0	0	0		
19	4	1	5	0.7	0	0	0	0	0		
20	4	1	5	0.7	0	0	0	0	0		
21	4	1	5	0.7	0	0	0	0	0		
22	4	1	5	0.7	0	0	0	0	0		
23	4	1	5	0.7	0	0	0	0	0		
24	4	1	5	0.7	0	0	0	0	0		
25	4	1	5	0.6	0	0	0	0	0		
26	4	1	5	0.8	0	0	0	0	0		
27	4	1	5	0.8	0	0	0	0	0		
28	4	1	5	0.8	0	0	0	0	0		
29	4	1	5	0.8	1	1	0	1	0		
30	4	1	5	0.8	0	0	0	0	0		
Totals	116	40	156		1	1	0	1	0		

Dec-09	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)		Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)		(5) X 1.98 Robles Diversion (AF)		- Field Measurement Matilija Creek (cfsd)	VRNMO (cfsd)
	Source Stream Daily Flows					Robles Facility Daily Flows								
1	4	1	5		0.7	0	0	0	0		0			
2	4	1	5		0.8	0	0	0	0		0			
3	4	1	5		0.8	1	1	0	1		0			
4	4	1	5		0.8	1	1	0	1		0			
5	4	1	5		0.9	1	1	0	1		0			
6	4	1	5		0.9	1	1	0	1		0			
7	4	3	7		1.2	3	3	0	3		0			
8	4	2	6		1.0	2	2	0	2		0			
9	4	2	6		1.0	2	2	0	2		0			
10	4	2	6		1.0	2	2	0	2		0			
11	4	3	7		1.3	3	3	0	3		0			
12	5	16	21		2.2	11	11	0	11		0			
13	6	17	23		5.1	35	35	3	38		6			
14	12	7	19		3.4	27	27	0	27		0			
15	10	5	15		2.9	23	23	0	23		0			
16	9	5	14		2.5	19	19	0	19		0			
17	9	4	13		2.3	17	17	0	17		0			
18	8	3	12		2.2	15	15	0	15		0			
19	8	3	11		2.1	13	13	0	13		0			
20	8	3	11		2.0	12	12	0	12		0			
21	8	3	11		2.0	12	12	0	12		0			
22	8	3	11		2.0	12	12	0	12		0			
23	7	3	10		1.9	9	9	0	9		0			
24	7	3	11		2.1	10	10	0	10		0			
25	7	3	10		2.1	10	10	0	10		0			
26	7	3	10		2.1	10	10	0	10		0			
27	7	3	10		2.1	10	10	0	10		0			
28	7	3	10		2.1	9	9	0	9		0			
29	6	3	9		2.0	8	8	0	8		0			
30	6	3	9		2.0	8	8	0	8		0			
31	6	3	9		2.0	7	7	0	7		0			
Totals	193	118	310			289	289	3	292		6			

Jan-10	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	Field Measurement: Matilija Creek (cfsd)	VRNMO (cfsd)
1	6	3	9	2.0	7	7	0	7	0		
2	5	3	9	2.0	6	6	0	6	0		
3	5	3	8	1.9	6	6	0	6	0		
4	5	3	8	1.9	5	5	0	5	0		
5	5	3	8	1.8	4	4	0	4	0		
6	5	3	8	1.8	4	4	0	4	0		
7	5	3	8	1.7	4	4	0	4	0		
8	5	3	8	1.6	3	3	0	3	0		
9	5	3	8	1.6	3	3	0	3	0		
10	5	3	7	1.5	3	3	0	3	0		
11	5	3	7	1.6	3	3	0	3	0		
12	5	3	7	1.6	4	4	0	4	0		
13	5	3	8	1.8	4	4	0	4	0		
14	5	3	7	1.7	4	4	0	4	0		
15	4	3	7	1.7	4	4	0	4	0		
16	4	3	7	1.7	4	4	0	4	0		
17	5	3	8	1.8	5	5	0	5	0		
18	163	90	253	4.4	34	34	86	120	170		
19	123	50	173	6.8	40	40	129	169	255		
20	367	174	541	7.8	36	588	213	801	422		
21	657	199	856	7.7	36	372	405	777	802		
22	415	130	545	8.0	41	184	383	567	759		
23	194	66	260	7.6	37	111	149	260	295		
24	129	45	174	7.5	36	98	72	170	143		
25	149	31	180	7.5	35	89	85	174	168		
26	169	23	192	7.6	36	77	112	189	222		
27	94	19	113	7.6	37	65	47	112	93		
28	72	17	89	8.0	37	59	26	85	52		
29	59	15	74	8.1	39	57	17	74	34		
30	52	13	65	8.1	39	56	11	67	21		
31	52	12	64	8.1	38	57	9	66	18		
Totals	2778	933	3711		593	1961	1745	3706	3455		

Ventura River Flow Assessment
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Feb-10	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	- Field Measurement: Matilija Creek (cfsd)	VRNMO (cfsd)
1	47	11	58	7.8	36	50	11	61	22		
2	41	11	52	6.1	33	39	15	54	29		
3	39	10	49	5.1	33	33	19	52	38		
4	38	10	48	5.1	33	33	13	46	26		
5	39	53	92	5.2	34	34	38	72	74		
6	153	50	203	7.5	36	52	153	205	302		
7	136	32	168	7.5	36	73	90	163	177		
8	105	25	130	7.5	36	69	58	127	114		
9	98	23	121	7.5	35	66	54	120	107		
10	88	21	109	7.5	35	60	45	105	89		
11	77	18	95	7.6	36	61	32	93	63		
12	71	16	87	7.6	37	62	24	86	48		
13	66	15	81	7.5	36	61	19	80	38		
14	61	14	75	7.5	36	61	14	75	29		
15	57	13	70	7.5	36	62	11	73	21		
16	53	13	66	7.1	32	49	18	67	36		
17	50	11	61	5.8	34	37	25	62	50		
18	44	11	55	5.1	34	34	20	54	40		
19	46	11	57	5.2	35	35	21	56	42		
20	46	11	57	5.2	36	36	20	56	40		
21	43	10	53	5.2	35	35	18	53	36		
22	41	10	51	5.2	36	36	15	51	29		
23	40	9	49	5.2	36	36	13	49	25		
24	40	9	49	5.3	32	32	13	45	26		
25	38	9	47	5.3	30	30	11	41	22		
26	36	9	45	5.3	30	30	9	39	19		
27	114	44	158	5.4	31	31	120	151	238		
28	108	28	136	6.8	36	39	86	125	171		
Totals	1815	507	2322		965	1276	985	2261	1950		

Mar-10	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	- Field Measurement: Matilija Creek (cfsd)	VRNMO (cfsd)
1	80	19	99	8.0	37	50	40	90	78		
2	71	16	87	8.0	37	53	28	81	55		
3	66	15	81	8.0	36	54	19	73	38		
4	62	14	76	8.1	34	54	15	69	30		
5	57	13	70	8.1	34	53	10	63	21		
6	56	13	69	8.1	36	55	10	65	20		
7	56	15	71	8.1	36	55	11	66	22		
8	50	13	63	8.0	33	56	6	62	12		
9	48	12	60	8.1	34	56	4	60	7		
10	46	12	58	7.4	32	50	10	60	19		
11	44	11	55	6.8	27	44	8	52	16		
12	42	11	53	6.8	26	45	6	51	11		
13	41	11	52	6.7	25	45	4	49	8		
14	39	10	49	6.7	25	45	2	47	4		
15	38	10	48	6.5	26	45	1	46	2		
16	36	10	46	6.1	26	41	4	45	7		
17	35	10	45	5.0	32	34	7	41	14		
18	34	10	44	5.0	32	35	5	40	11		
19	33	9	42	5.0	32	36	4	40	8		
20	32	9	41	5.0	32	36	3	39	6		
21	31	9	40	5.1	32	32	2	35	5		
22	44	9	53	5.1	33	33	11	44	22		
23	49	9	58	4.3	31	31	22	53	43		
24	49	8	57	3.9	31	31	22	53	44		
25	47	8	55	3.9	31	31	21	52	42		
26	42	8	50	3.9	31	31	17	48	34		
27	41	8	49	3.9	31	31	15	46	30		
28	41	8	49	3.8	31	31	15	46	30		
29	37	8	45	3.8	31	31	12	44	25		
30	29	8	37	3.7	31	31	7	38	14		
31	24	8	32	3.8	31	31	3	34	7		
Totals	1400	334	1734		976	1287	345	1632	684		

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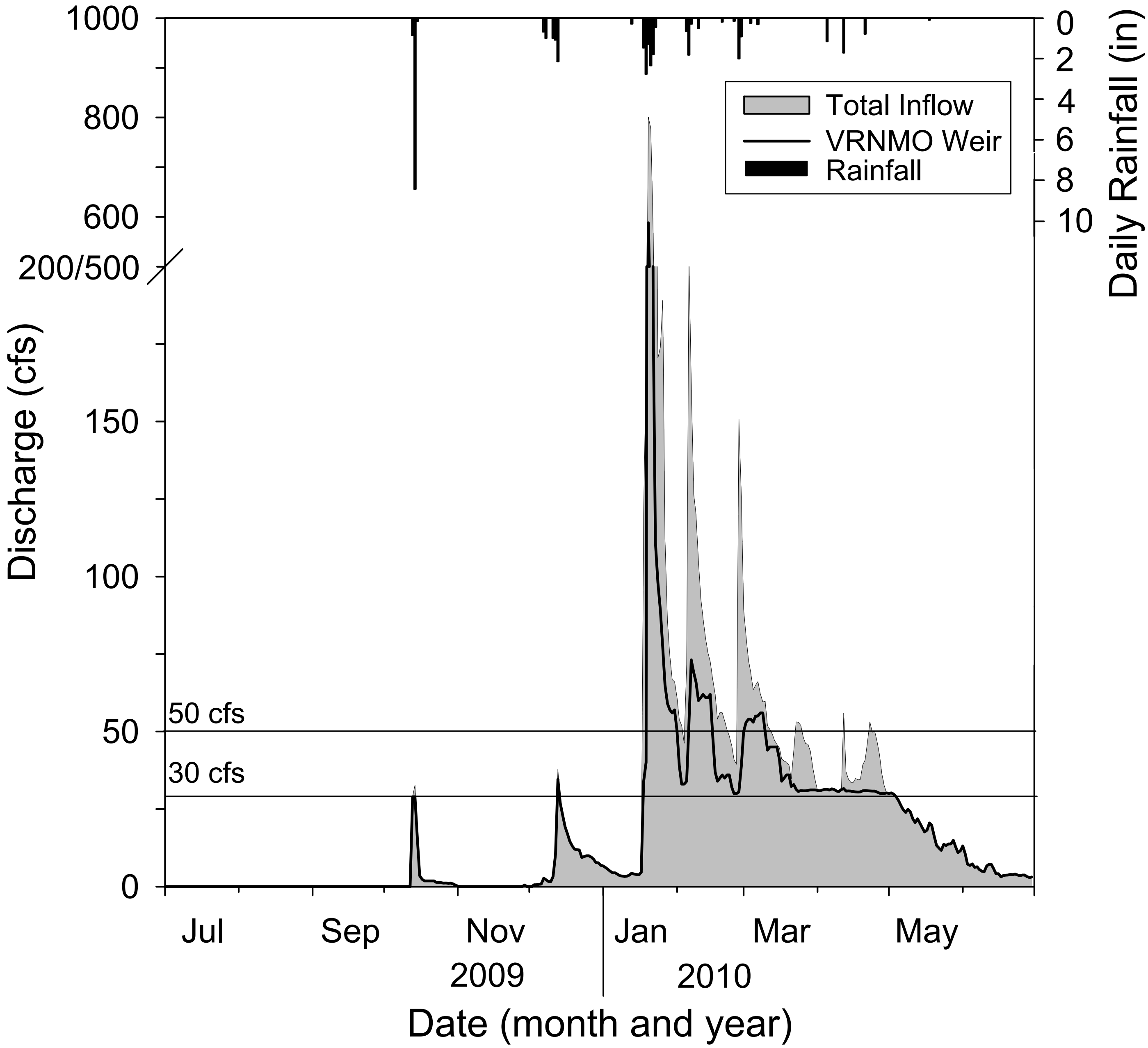
Apr-10	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	- Field Measurement Matilija Creek (cfsd)	VRNMO (cfsd)
	Source Stream Daily Flows				Robles Facility Daily Flows						
1	22	8	30	3.7	31	31	0	31	0		
2	22	8	30	3.7	31	31	0	31	0		
3	22	8	30	3.7	31	31	0	31	0		
4	22	8	30	3.8	31	31	0	31	0		
5	23	9	32	3.9	31	31	0	31	0		
6	22	8	30	3.8	31	31	0	31	0		
7	22	8	30	3.9	32	32	0	32	0		
8	21	7	28	3.9	31	31	0	31	0		
9	21	7	28	3.6	31	31	0	31	0		
10	21	7	28	3.6	31	31	0	31	0		
11	21	14	35	3.8	31	31	0	31	0		
12	21	27	48	4.1	32	32	24	56	48		
13	21	12	33	3.7	31	31	6	37	12		
14	21	10	31	3.7	31	31	4	35	7		
15	21	9	30	3.8	31	31	3	34	6		
16	23	9	32	3.8	31	31	3	34	6		
17	25	8	33	3.8	31	31	4	35	8		
18	25	8	33	3.8	30	30	4	34	8		
19	25	8	33	3.8	31	31	4	35	8		
20	28	10	38	3.9	31	31	8	39	16		
21	31	9	40	4.0	31	31	10	41	20		
22	40	8	48	4.0	31	31	16	47	32		
23	43	8	51	4.0	31	31	22	53	44		
24	40	8	48	4.0	31	31	19	50	38		
25	40	7	47	4.0	31	31	19	50	38		
26	36	7	43	3.9	30	30	16	47	33		
27	31	7	38	3.8	30	30	13	43	25		
28	26	7	33	3.7	30	30	7	36	13		
29	23	6	29	3.7	30	30	3	33	5		
30	22	6	28	3.8	30	30	0	30	0		
Totals	781	265	1046		925	925	186	1110	367		

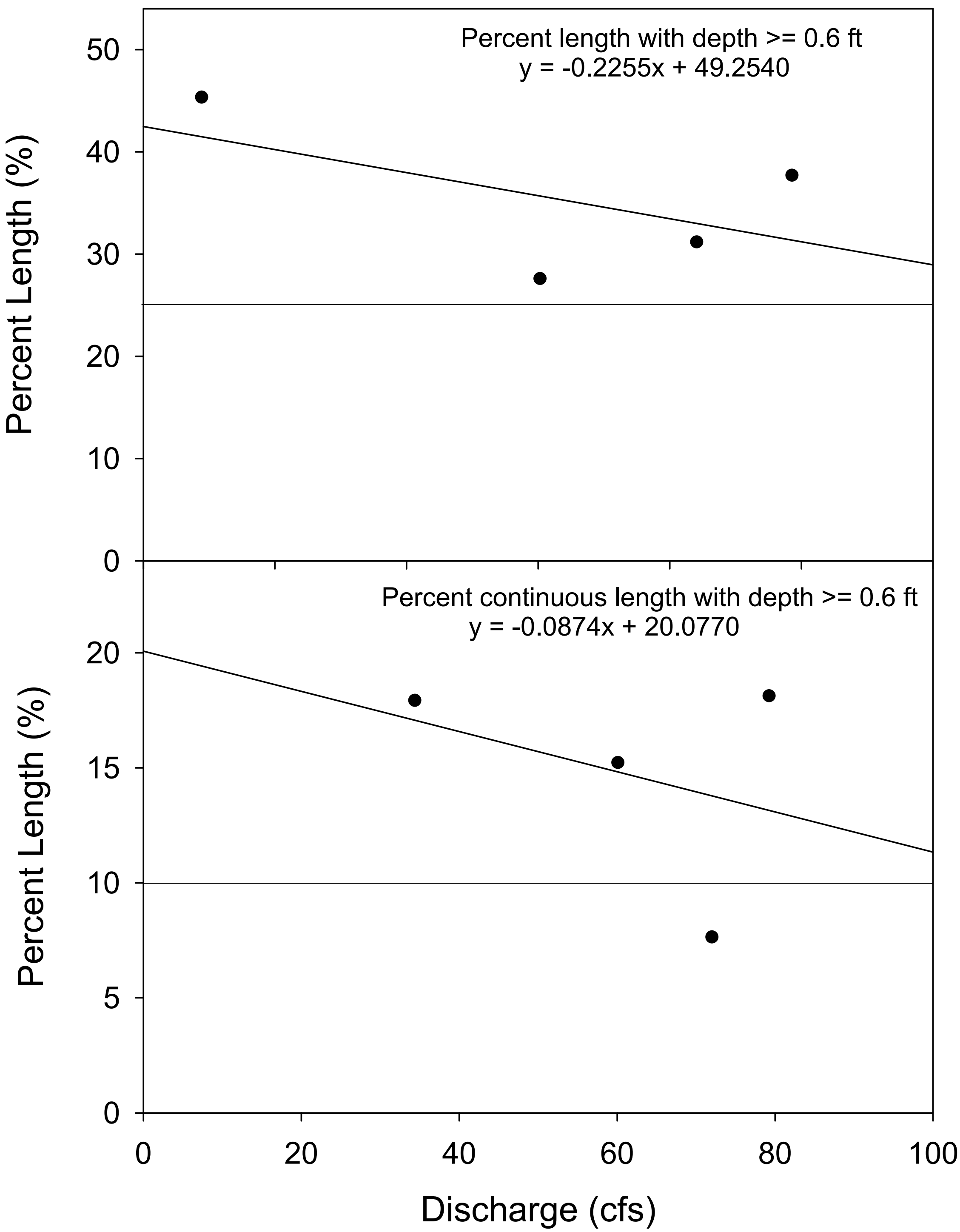
May-10	(1) Source Stream Daily Flows Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)		Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)		(5) X 1.98 Robles Diversion (AF)		- Field Measurement Matilija Creek (cfsd)	VRNMO (cfsd)
1	22	6	28		3.8	30	30	0	30		0			
2	22	6	28		3.9	30	30	0	30		0			
3	22	6	28		3.7	30	30	0	30		0			
4	20	6	26		3.5	29	29	0	29		0			
5	19	6	25		3.3	28	28	0	28		0			
6	17	5	22		3.1	26	26	0	26		0			
7	16	5	21		2.9	25	25	0	25		0			
8	16	5	21		2.9	24	24	0	24		0			
9	16	5	21		3.0	25	25	0	25		0			
10	16	5	21		2.9	24	24	0	24		0			
11	16	5	21		2.7	22	22	0	22		0			
12	15	5	20		2.6	21	21	0	21		0			
13	15	5	20		2.8	22	22	0	22		0			
14	15	5	20		2.7	21	21	0	21		0			
15	14	4	18		2.5	19	19	0	19		0			
16	14	4	18		2.5	18	18	0	18		0			
17	14	4	18		2.5	18	18	0	18		0			
18	14	5	19		2.7	21	21	0	21		0			
19	14	4	18		2.7	20	20	0	20		0			
20	13	4	17		2.4	16	16	0	16		0			
21	12	4	16		2.2	13	13	0	13		0			
22	12	4	16		2.2	12	12	0	12		0			
23	12	4	16		2.1	12	12	0	12		0			
24	12	4	16		2.2	14	14	0	14		0			
25	12	4	16		2.2	13	13	0	13		0			
26	12	4	16		2.3	14	14	0	14		0			
27	12	4	16		2.3	14	14	0	14		0			
28	12	4	16		2.3	15	15	0	15		0			
29	12	3	15		2.3	13	13	0	13		0			
30	12	3	15		2.1	11	11	0	11		0			
31	12	3	15		2.1	12	12	0	12		0			
Totals	462	141	603			609	609	0	609		0			

Water Year 2009 - 2010

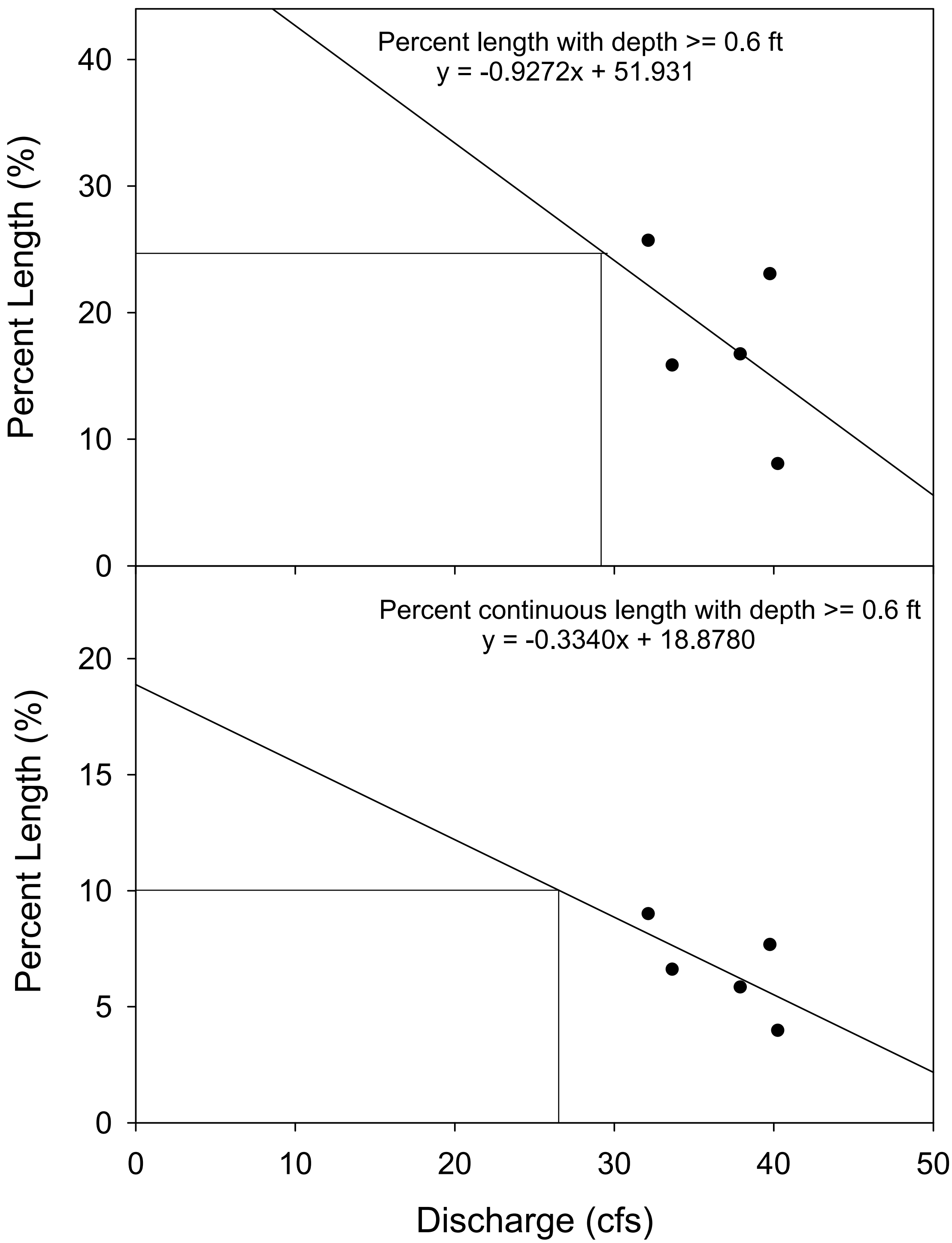
Jun-10	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) Source Stream Daily Flows: North Fork Matilija Ck. (cfsd)	(1)+(2) Source Stream Daily Flows: Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) Robles Facility Daily Flows: VRNMO Weir (cfsd)	(5) Robles Facility Daily Flows: Diversion Canal (cfsd)	(4)+(5) Robles Facility Daily Flows: Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)	- Field Measurement: Matilija Creek (cfsd)	Field Measurement: VRNMO (cfsd)
1	12	3	15	2.2	13	13	0	13	0		
2	10	3	13	2.1	11	11		11	0		
3	9	3	12	1.9	7	7		7	0		
4	9	3	12	1.9	7	7		7	0		
5	10	3	12	1.9	7	7		7	0		
6	10	3	12	1.8	6	6		6	0		
7	7	3	9	1.8	6	6		6	0		
8	7	3	10	1.8	6	6		6	0		
9	7	3	9	1.8	5	5		5	0		
10	7	3	10	1.8	5	5		5	0		
11	7	3	10	1.9	7	7		7	0		
12	7	3	10	1.9	7	7		7	0		
13	7	3	10	1.9	7	7		7	0		
14	7	3	10	1.8	6	6		6	0		
15	7	3	10	1.7	4	4		4	0		
16	7	3	10	1.6	4	4		4	0		
17	7	3	10	1.5	3	3		3	0		
18	8	2	11	1.5	4	4		4	0		
19	9	2	11	1.6	4	4		4	0		
20	9	2	11	1.6	4	4		4	0		
21	9	2	11	1.7	4	4		4	0		
22	9	2	11	1.6	4	4		4	0		
23	9	2	12	1.7	4	4		4	0		
24	9	2	12	1.6	4	4		4	0		
25	9	2	12	1.6	4	4		4	0		
26	6	2	8	1.6	4	4		4	0		
27	5	2	7	1.6	4	4		4	0		
28	5	2	7	1.5	3	3		3	0		
29	5	2	7	1.4	3	3		3	0		
30	5	2	7	1.5	3	3		3	0		
Totals	235	76	311		158	158	0	158	0		



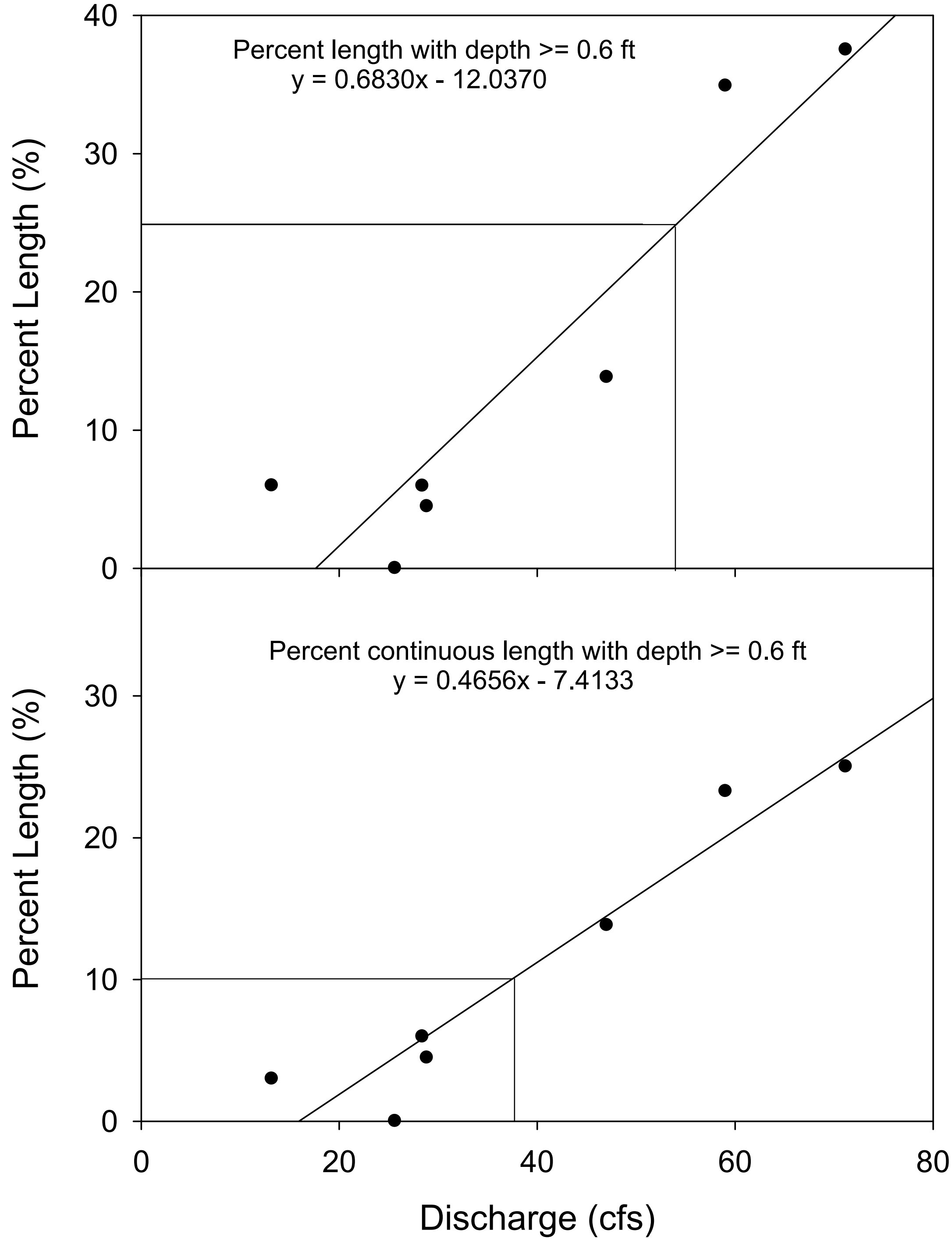
Appendix 28. Total inflow to Robles Fish Passage Facility, discharge downstream at measurement weir, and precipitation during the reporting period.



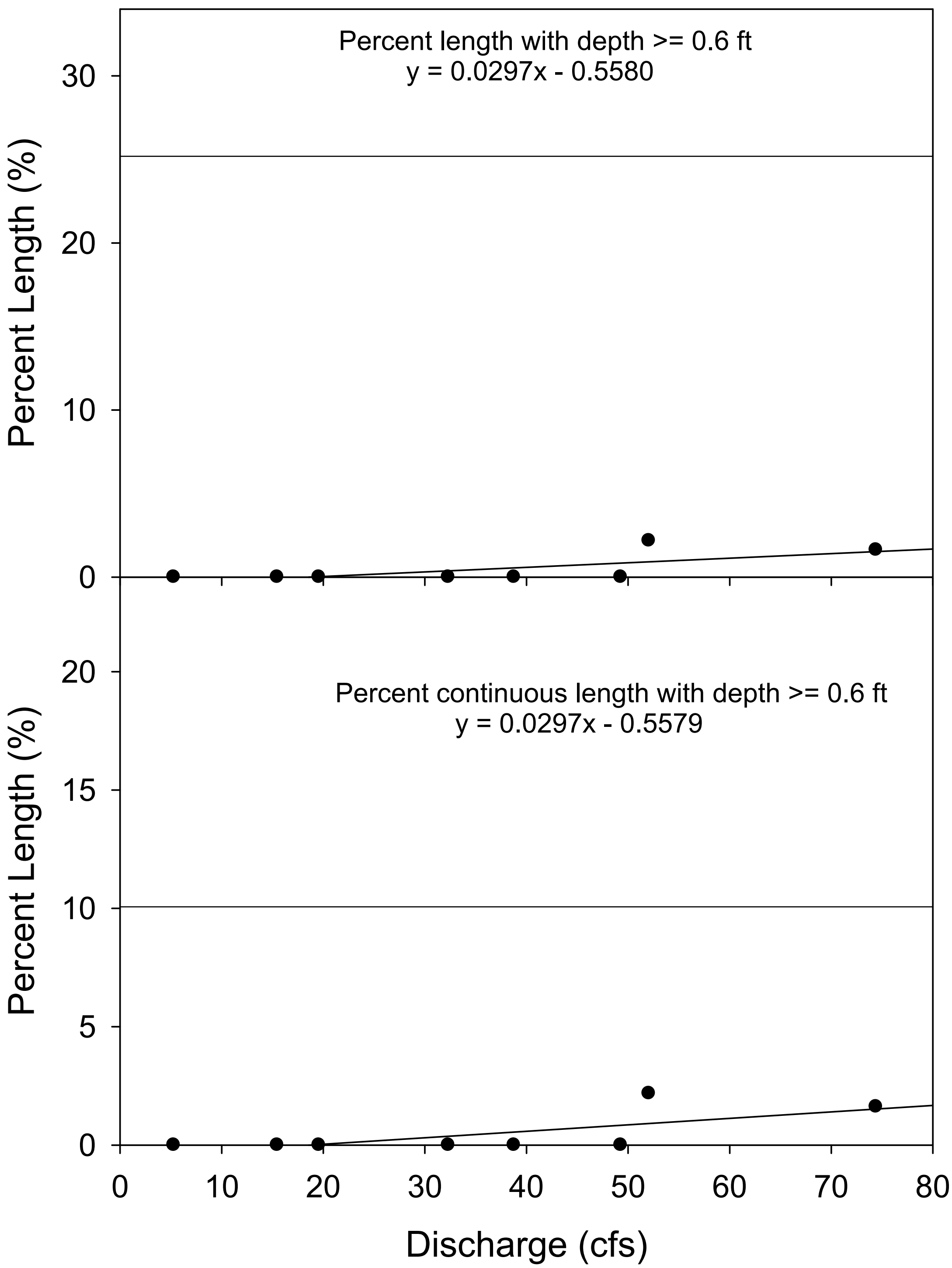
Appendix 29a. Relation between site discharge and water depth at site 2 downstream of the wastewater treatment plant and resulting discharge for Thompson passage criteria.



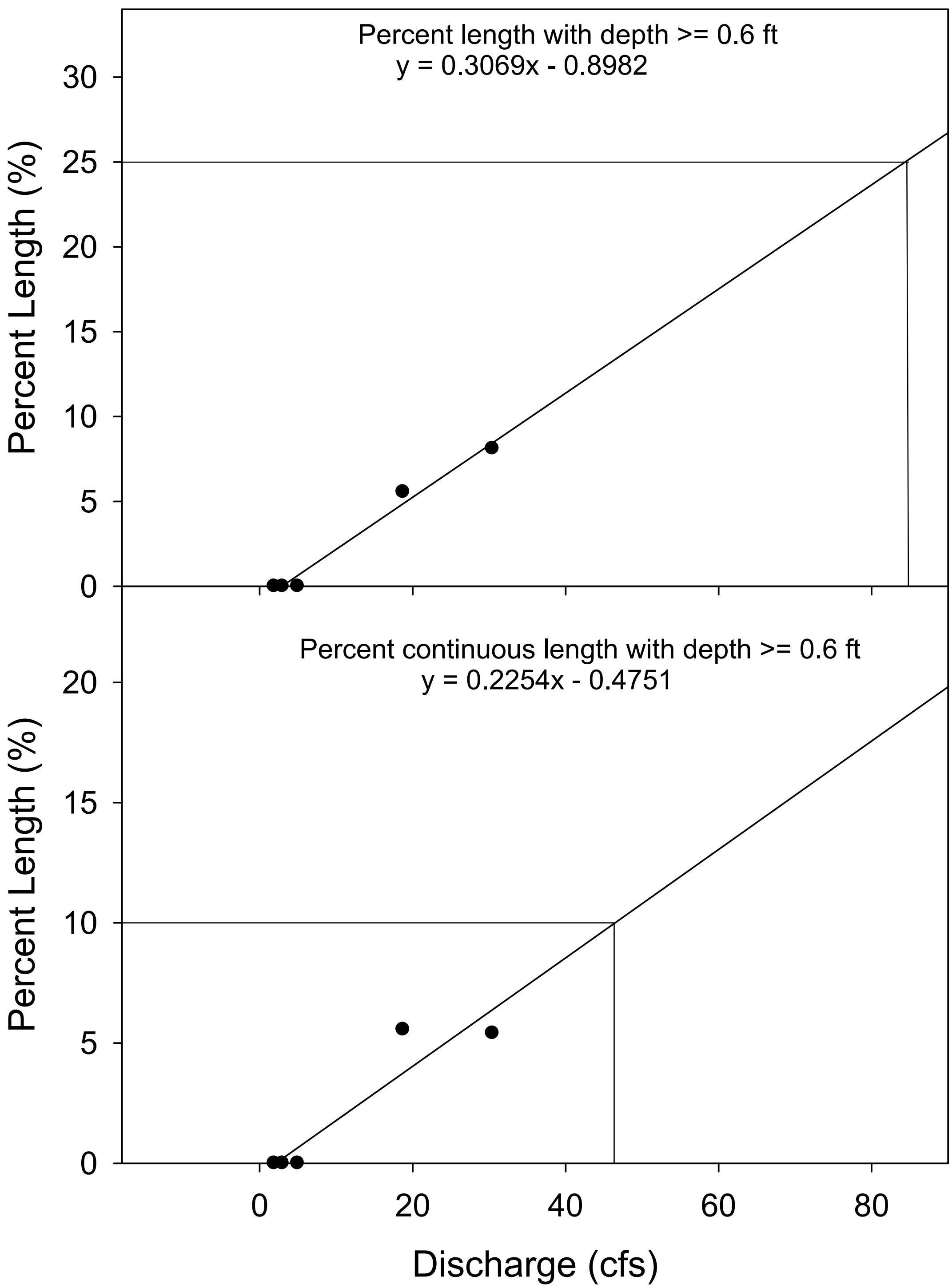
Appendix 29b. Relation between site discharge and water depth at site 3 near Casitas Springs and resulting discharge for Thompson passage criteria.



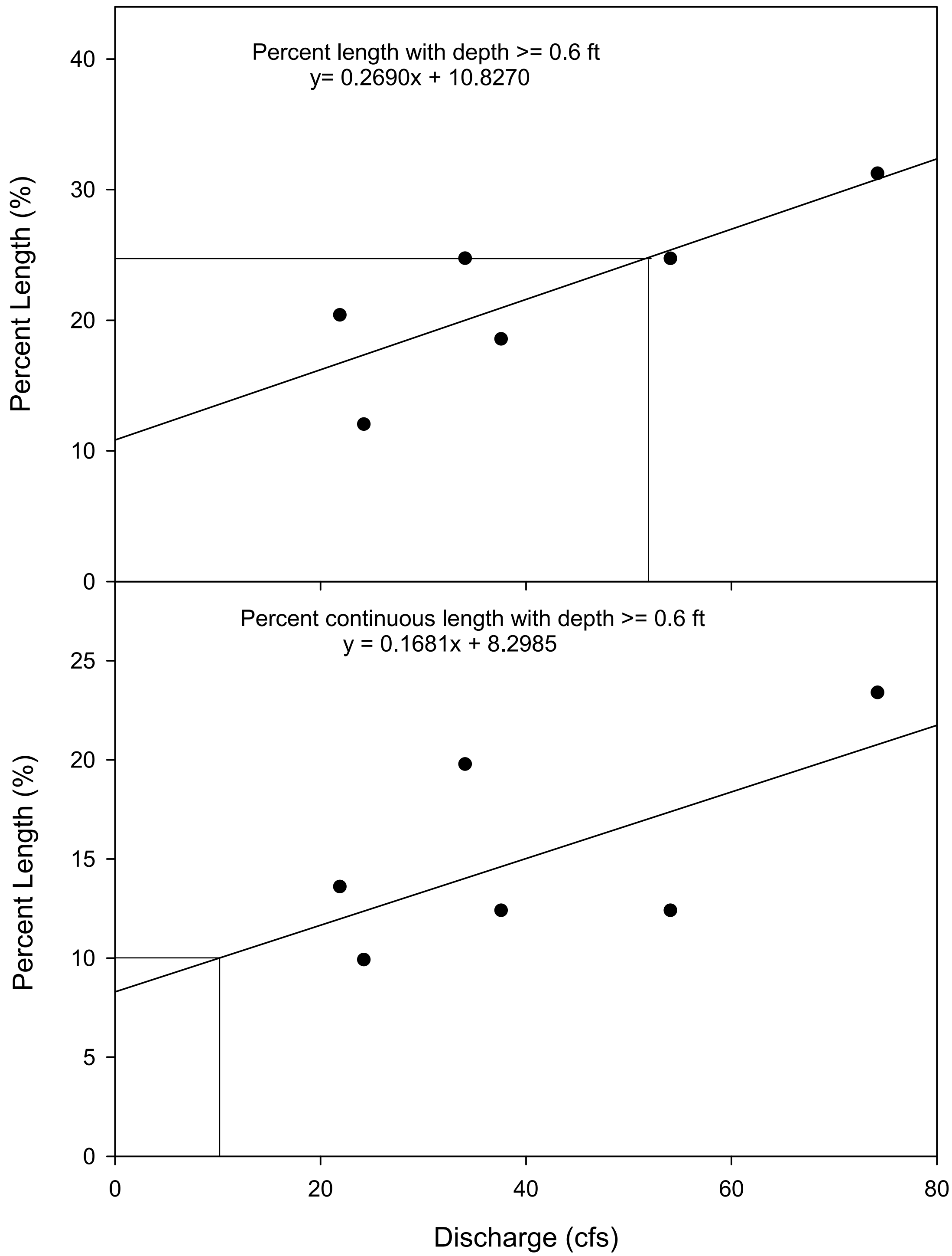
Appendix 29c. Relation between site discharge and water depth at site 4 upstream of San Antonio Creek and resulting discharge for Thompson passage criteria.



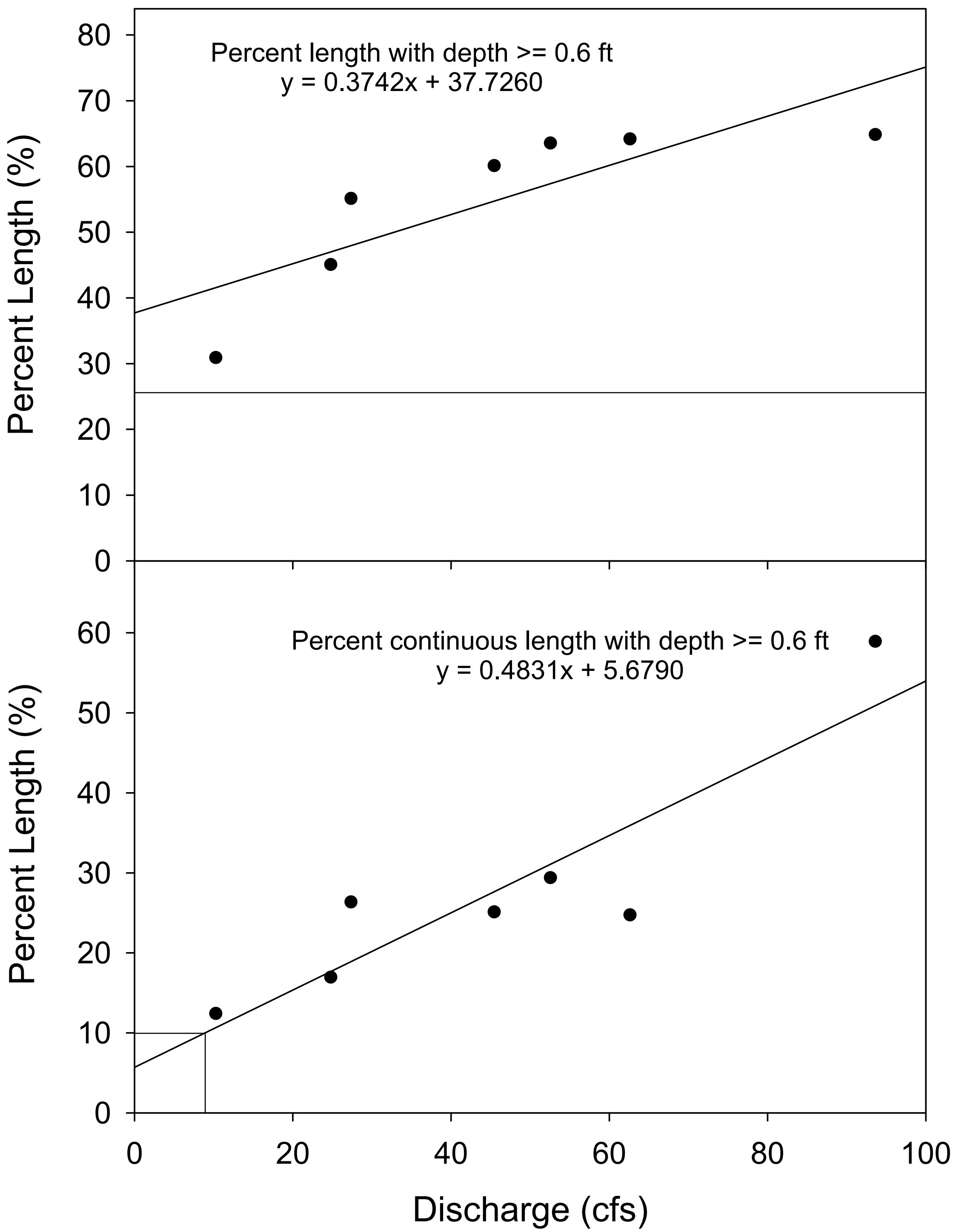
Appendix 29d. Relation between site discharge and water depth at site 5-1 downstream of Santa Ana bridge and resulting discharge for Thompson passage criteria.



Appendix 29e. Relation between site discharge and water depth at site 5-2 downstream of Santa Ana bridge and resulting discharge for Thompson passage criteria.



Appendix 29f. Relation between site discharge and water depth at site 7 upstream of Hwy 150 bridge and resulting discharge for Thompson passage criteria.



Appendix 29g. Relation between site discharge and water depth at site 8 downstream of the Robles Fish Facility and resulting discharge for Thompson passage criteria.

Appendix 30a. Regression equations and statistics for impediment site discharge evaluated using the Thompson (1972) passage criteria.

	% Total length with depth ≥ 0.6 ft			% Continuous length with depth ≥ 0.6 ft		
Site	Equation	R^2	P-value	Equation	R^2	P-value
2	y = -0.2255x + 49.2540	0.32	0.43	y = -0.0874x + 20.0770	0.12	0.65
3	y = -0.9272x + 51.931	0.24	0.40	y = -0.3340x + 18.8780	0.42	0.24
4	y = 0.6830x - 12.0370	0.85	0.00	y = 0.4656x - 7.4133	0.91	0.00
5-1	y = 0.0297x - 0.5580	0.46	0.06	y = 0.0297x - 0.5579	0.46	0.06
5-2	y = 0.3069x - 0.8982	0.98	0.00	y = 0.2254x - 0.4751	0.87	0.02
6	y = 0.4363x + 0.9446	0.74	0.01	y = 0.2329x + 0.2143	0.60	0.02
7	y = 0.2690x + 10.8270	0.67	0.05	y = 0.1681x + 8.2985	0.42	0.17
8	y = 0.3742x + 37.7260	0.68	0.02	y = 0.4831x + 5.6790	0.81	0.01

Appendix 30b. Calculated discharge (cfs) required at each impediment site to meet Thompson (1972) passage criteria.

Site	25% Total length with depth ≥ 0.6 ft	10% Continuous length with depth ≥ 0.6 ft	Minimum discharge to meet Thompson criteria
2	108	115	115
3	29	27	29
4	54	37	54
5-1	861	355	861
5-2	84	46	84
6	55	42	55
7	53	10	53
8	-34	9	9

Appendix 31. Correspondences among Biological Committee participants regarding the 2010 progress report and 2011 study plan.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

SWR/2002/1871: RAB

February 3, 2011

Ned Gruenhagen
Bureau of Reclamation
South-Central California Area Office
1243 N Street
Fresno, CA 93721-1813

Dear Mr. Gruenhagen:

NOAA's National Marine Fisheries Service (NMFS) and California Department of Fish and Game (CDFG) conferenced on Feb 1, 2011, to discuss the Casitas Municipal Water District (Casitas) monitoring activities related to the modification of the Robles Fish Facility, as outlined in the 2003 Robles biological opinion. The specific purpose of the meeting was to provide agency recommendations that address the 2011 upstream fish migration impediment evaluation changes proposed by Casitas on December 1, 2010, at the Robles Biological Committee Meeting. Listed below are NMFS and CDFG's collective recommendations for inclusion in the 2011 Monitoring and Evaluation Study Plan.

Robles Reach Definition
In accordance with the definition presented in the 2011 Monitoring and Evaluation Study Plan, the Robles Reach should consistently be defined as the reach extending downstream to the confluence of San Antonio Creek. The Robles Reach measures approximately 11 river kilometers.

Impediment Monitoring Site Selection
The 2011 monitoring should continue at all 7 sites identified in Appendix 13 (Casitas 2010). In addition to the collection of transect depths, we recommend that site-specific discharge measurements are recorded during each site visit. Site-specific flow information is necessary to accurately develop the relationship between stream flow and the stream width meeting the minimum depth criterion. It is also necessary to evaluate the relationship between water releases from the Robles facility and the corresponding flow conditions observed at the individual sites. The relationship between discharge at Robles and depths at the monitoring transects (provided in Appendices 3-10 of Casitas, 2010) is characterized by a high degree of scatter and lack of a clear trend at a number of the transects. This may be due to the issue that the discharge at Robles may not be representative of the streamflow at the study sites, due to gains and losses to groundwater. Ideally, a sufficient number of flow measurements may be obtainable in a single field season to develop a better correlation between flow at specific critical riffle monitoring sites and flow at

the Robles Diversion Facility. On a year-to-year basis, all relevant data gathered during the previous year would be reviewed, evaluated, and ultimately recommended to continue or discontinue through the Cooperative Decision Making Process as stated in the Robles biological opinion. In regard to site 5, the primary channel should be selected for measurement based on the expectation that a migrating steelhead will ascend the channel braid that carries the bulk of the flow.

Sandbar Impediment Monitoring

NMFS and CDFG agree with Casitas that impediment monitoring at Site 1 in Appendix 2 (Casitas 2010) is no longer necessary, but recommend that a single site be selected just upstream of the Highway 150 bridge as a replacement monitoring site that is consistent with site 4 identified by ENTRIX (1999). NMFS and CDFG Robles Biological Committee members (Mary Larson and Rick Bush) would like to accompany Casitas in the field for identification of this site.

Thompson Method (1972) Criteria

Thompson (1972) passage criteria for adult steelhead should be applied to the Ventura River at critical riffles including a water depth of 0.6-ft for 25% of the total transect width and a continuous portion equal to 10% of the width. NMFS previously commented on the limitations of the Thompson method used in the ENTRIX (1999) study, and the questionable modifications made to its criteria (i.e., 0.5-ft depth) for application to the Ventura River (NMFS 2003). The resulting minimum discharge should be equal to the critical-riffle measurement that presents the greatest passage difficulty, not by averaging results from all measurement sites. The results obtained from applying the 5-ft continuous length criterion should not be included in the 2011 data summary or analysis.

NMFS and CDFG greatly appreciate the opportunity to provide technical assistance to the District to ensure that the Robles Facility functions as analyzed in the March 31, 2003, biological opinion. Please contact Rick Bush at (562) 980-3562 to coordinate a field visit for site selection replacement of Site 1, or if you have any questions.

Sincerely,

for Rodney R. McInnis
Regional Administrator

cc: Scott Lewis, Casitas Municipal Water District
Mary Larson, California Department of Fish and Game
Bob Hughes, California Department of Fish and Game
Roger Root, U.S. Fish and Wildlife Service
Administrative file#: 151422SWR2002PR6168

Literature Cited

Casitas 2010. 2010 Robles Fish Passage Facility progress report. Casitas Municipal Water District, Oak View, CA.

ENTRIX, Inc.1999. Evaluation of natural passage barriers on the Ventura River downstream of the Robles Diversion. Prepared for Borcalli and Associates. December 2, 1999.

National Marine Fisheries Service. 2003. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

Thompson, Ken. 1972. Determining stream flows for fish life. Proceedings from the Pacific Northwest River Basins Commission - Instream Flow Requirements Workshop. March 15-16, 1972.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

2002/1871: RAB

March 22, 2011

Ned Gruenhagen
Bureau of Reclamation
South-Central California Area Office
1243 N Street
Fresno, CA 93721-1813

Dear Mr. Gruenhagen:

NOAA's National Marine Fisheries Service (NMFS) is contacting the Bureau of Reclamation (Reclamation) regarding the December 1, 2010, Robles Biological Committee (Committee) meeting for the Robles Diversion Fish Passage Facility (Facility). The Committee members in attendance included Ned Gruenhagen of Reclamation; Mike Gibson, Neil Cole, Scott Lewis of Casitas Municipal Water District; Mary Larson of California Department of Fish and Game (CDFG) and Rick Bush and Stan Glowacki of NMFS. Since the December 1, 2010, meeting, the Committee participated in a conference call with NMFS (Lee Harrison) and CDFG (Bob Hughes) hydrologists on February 1, 2011, to further refine the 2011 impediment evaluation monitoring. Please reference our letter of February 3, 2011, for our recommendations on this specific element of the Robles biological opinion (NMFS 2003) monitoring. A site visit was conducted on March 1, 2011, which allowed the new Committee members (Ned Gruenhagen and Rick Bush) to visit the seven 2010 impediment monitoring sites that have been re-proposed for monitoring in 2011. The attachment to this letter summarizes the meeting discussions pertaining to the 2010 Annual Report, and concludes with NMFS recommendations for the 2011 Monitoring and Evaluation Plan.

Please contact Rick Bush at (562) 980-3562 if you have any questions regarding the summary or if you would like additional information.

Sincerely,

Robert S. Hoffman
for
Penny Ruvelas
Southern California Area Office Supervisor
for Protected Resources

cc: Scott Lewis, Casitas Municipal Water District
Roger Root, U.S. Fish and Wildlife Service
Mary Larson, California Department of Fish and Game
Administrative file#: 151422SWR2002PR6168

NOAA's National Marine Fisheries Service' (NMFS) Summary of the Meeting Discussions Pertaining to the 2010 Annual Report for Operation of the Robles Diversion Fish Passage Facility

March 14, 2011

The following is a summary of the meeting discussions pertaining to the 2010 Annual Report (Report), and concludes with NMFS recommendations for the 2011 Monitoring and Evaluation Plan (Plan). This summary is based on discussion during the December 1, 2010, Robles Biological Committee (Committee) meeting for the Robles Diversion Fish Passage Facility (Facility). Additionally, this summary references discussion since the December 1, 2010, committee meeting, including a conference call with NMFS and CDFG on February 1, 2011, to further refine the 2011 impediment evaluation monitoring (see NMFS' letter of February 3, 2011, for specific recommendations on impediment evaluation monitoring), and a site visit on March 1, 2011, which allowed the new committee members (Ned Gruenhagen and Rick Bush) to visit the seven 2010 impediment monitoring sites that have been re-proposed for monitoring in 2011.

2010 Annual Report and Biological Meeting Summary

The central topics discussed during the Committee meeting include the upstream steelhead impediment evaluation in the Ventura River, fish attraction evaluation, upstream adult monitoring results and downstream smolt trapping.

Upstream steelhead impediment evaluation. — The 2010 monitoring season was the first year Casitas was able to collect a sufficient amount of impediment evaluation data at the 8 sites (i.e., critical riffles) selected by the Committee in 2009. A total of 48 water depth transect measurements were completed at Robles discharges that ranged from 25 to 100-cfs. The relationship between Robles discharge and water depth was plotted at the 7 riverine sites (sandbar results omitted). The transects that required the highest minimum discharge to meet the two Thompson criteria to determine the discharge needed for adult steelhead passage ranged from 79 - 123 cfs (Appendix 13, Site 5-1 excluded). In 2011, Casitas indicated they will measure site-specific discharge (at the selected monitoring sites) for the impediment evaluation monitoring. Casitas proposed the following site changes, 1) discontinue site 1 from evaluations, 2) move sites 2, 3, 4 upstream into the Robles Reach, and 3) move site 5 upstream near Santa Ana bridge. A Committee conference call was proposed with NMFS and CDFG hydrologist participation to discuss these changes in greater detail. The product of these meetings formed the recommendations that were conveyed to Casitas in the letter of February 3, 2011.

Fish attraction evaluation. — Fish attraction surveys in the 200-m reach downstream of the Facility were conducted on a weekly basis during the fish passage augmentation season from January through June 2010. Bank surveyors counted 1 adult steelhead, and snorkel surveyors enumerated a total of 53 juvenile *O. mykiss*. A total of 94 *O. mykiss* were observed in the 140-m reach upstream of the Facility (monitoring component added by Casitas in 2009). Following 2010 storm events, bank surveys were conducted three times per day when turbidity allowed per Committee recommendations. These surveys were conducted for three storm events and no adults were observed. Additional fish attraction survey modifications were discussed during the meeting that will be reiterated in the Monitoring Recommendation section of this letter.

Upstream adult monitoring results.— Casitas reported one 'adult' steelhead (estimated at 58-cm) observation in 2010, which passed through the Robles fish ladder on March 20, 2010. The Vaki Riverwatcher apparatus also documented 44 *O. mykiss* (and fish probable) ≥ 30-cm , of which 17 *O. mykiss* (and fish probable) were greater than 40-cm passing thru the Robles fish ladder during the steelhead migration and spawning season. The Report speculates that these fish are resident *O. mykiss* and hence their exclusion from the upstream adult steelhead count. In response to NMFS and CDFG disagreement over this anadromous versus resident life form uncertainty and unsubstantiated size cut-off of 40-cm, Casitas agreed to rewrite this section of the Report (Page 25-30) and submit a draft to the Committee using language that acknowledges that these adult *O. mykiss* may be adult steelhead. Casitas also agreed to provide a detailed data summary of the time the 58-cm adult steelhead spent in the Robles Facility from the time of initial observation until final upstream passage occurred (including any fall-backs). The third adult monitoring deliverable that NMFS requested at the meeting is the continuous Robles fish ladder turbidity record (i.e., raw data) from January 1 through June 30, 2010.

Downstream smolt trapping.— A modified fence weir trap was operated from March 16, 2010, through May 7, 2010, in the glide habitat immediately upstream of the Facility low-flow vehicle crossing. The trap wings that extend upstream to guide fish into the holding box stop short of the low-flow channel banks (approximately 1-meter) to allow for unimpeded adult steelhead passage. A total of five smolts were captured, and four of the smolts showed signs of descaling and skin damage to the head region. All fish were captured in the first week of trap operation. Casitas proposed to conduct their 2011 downstream fish passage evaluation in the same location as 2010. NMFS commented on the lack of suitable river noise (i.e., turbulence) and approach velocity in this reach, and questioned if there is a more appropriate trapping location that will produce better results. Casitas biologists indicated they feel they have situated the trap in the best possible location and that they are trapping effectively.

Similar to 2010, Casitas proposed to radio tag up to 15 steelhead smolts captured in the weir trap downstream of the Robles facility for the purpose of evaluating smolt migration from Robles to the estuary. Casitas has acquired fifteen ATS radio tags (~1-gram each) suitable for tagging *O. mykiss* weighing a minimum of 20-grams (tag weight will not exceed 5% fish weight). In addition to the 2010 tagging objectives, this year Casitas has requested to release eight of the radio tagged fish at a point on the mainstem Ventura River upstream of the Facility (e.g., Camino Cielo bridge) for the purpose of evaluating if the Fish Passage Facility functions and operates such that migrating smolts move through the facility in good physical condition (NMFS 2003). Casitas also asked the Committee for guidance on, 1) whether trapping should be discontinued if the Ventura River loses a surface connection downstream of the Facility, and 2) if both trap wings can be extended the entire distance to the river banks.

NMFS 2011 Monitoring Recommendations

Since the purpose of the Biological Committee is to serve an advisory role, NMFS requests that the schedule outlined in the NMFS (2003) biological opinion be adhered to in order to allow sufficient time for Committee review prior to the start of the monitoring activities. The opinion states that the Committee will meet annually each summer to review monitoring data from the preceding season's monitoring studies. Reclamation will submit the draft Plan to the Committee for review on or before October 1 of each year. The Committee will have 1 month to review the Plan and submit recommended changes to Casitas. In addition to the annual Plan, Reclamation will prepare the annual progress Report. A draft Report will be provided by September 1 and the final will be completed by November 1.

With respect to the 2011 Plan, NMFS recommends the following monitoring activities to address the three main objectives outlined in the NMFS (2003) biological opinion:

1. Temporarily install an underwater video camera in the entrance pool focused on the open fish ladder entrance to conduct continuous *Fish Attraction Evaluation Monitoring* for the duration of all storm events (as defined in the biological opinion) and ramp down period (i.e., 12-days or less, unless overlapping storm events occur). Casitas agreed to write up this protocol at meeting.

2. Until sufficient scale and/or otolith analyses become available for reliably distinguishing juvenile and adult steelhead in the Ventura River, report all *Upstream Adult Monitoring* results such that *O. mykiss* ≥38-cm are classified as "adult steelhead" as defined in the 2011 Plan. Report all *O. mykiss* <38 to 20-cm as "adult *O. mykiss*", instead of "*O. mykiss* non-adult steelhead"; based on NMFS observations of 20-cm *O. mykiss* routinely spawning in the Ventura River watershed upstream of the Facility.

3. Report individual smolt fork length, weight and smolt index in *Downstream Fish Passage Evaluation* results instead of mean values.

4. Exclude Vaki Riverwatcher results and discussion for smolt emigration from Report Section 3.3 until the operating limits of the Riverwatcher are determined.

5. In regards to *Downstream Smolt Trapping*, NMFS agrees that tagged smolts should be released upstream of the Facility to assess if fish downstream migrants are successfully navigating through the facility and to evaluate fish damaged incurred during passage through the Facility. NMFS recommends PIT tags instead of radio tags be used for this specific monitoring activity for the following reasons: a) a larger percentage of the smolts could be tagged throughout the entire migration period which would provide better weir trap efficiency estimates (page 20, NMFS 2003), b) a greater size range of downstream migrants (74mm or larger) could be evaluated (Tatara 2009), and c) long-term survival estimates of salmonids tagged with gastrically implanted radio tags is lower relative to PIT-tagged fish (Hockersmith et al. 2000). Trapping from mid-March through June (or until water temperatures exceed a daily mean of 22° C) is acceptable regardless of the loss of a Ventura River surface connection downstream of the Facility.

6. In regards to *Downstream Fish Migration through the Robles Reach*, a pilot study using radio telemetry is agreeable with NMFS as long as a Ventura River surface connection with a depth of 0.5-feet is maintained for juvenile *O. mykiss* passage (Evans and Johnston 1980). If the mortality rate of radio tagged fish exceeds 2.4% (Hockersmith et al. 2000), NMFS should be contacted immediately and tagging activities should cease.

7. In the event the fence weir trap wings are extended the entire distance to both river banks, Casitas will need to modify the trap to allow for upstream passage of adult *O. mykiss*. The new trap modification will need to be approved by NMFS prior to operation.

Literature Cited

Evans, W.A. and B. Johnston. 1980. Fish migration and fish passage. USDA Forest Service, EM-7100-l2. Washinqton, D.C. 63 pp.

Hockersmith, E. E., W. D. Muir, S. G. Smith, B. P. Sandford, N. S. Adams, J. M. Plumb, R. W. Perry, and D. W. Rondorf. 2000. Comparative Performance of Sham Radio-Tagged and PIT-Tagged Juvenile Salmon. Report prepared for U.S. Army Corps of Engineers, Walla Walla District Contract W66QKZ91521282. December 2000. 36pp.

National Marine Fisheries Service. 2003. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

Tatara, C. P. 2009. Size at Implantation Affects Growth of Juvenile Steelhead Implanted with 12-mm Passive Integrated Transponders. North American Journal of Fisheries Management, 29 (2), 417 – 422.

April 29th, 2011

Ned Gruenhagen
Bureau of Reclamation
South-Central California Area Office
1243 N Street
Fresno, CA 93721

Dear Ned,

This letter is in response to the NMFS and CDFG recommendation letter: SWR/2002/1871:RAB dated February 3rd of 2011 and NMFS' recommendation letter 2002/1871:RAB dated March 22nd of 2011. There are several issues related to the Robles Fish Passage Facility monitoring and evaluation studies that need to be addressed. Casitas' response regarding these issues has been included in this letter. In addition, there appears to be several instances where what was discussed in previous Biological Committee (BC) meetings was not characterized correctly by NMFS and CDFG. I have identified these below. It would seem a meeting of the Robles Biological Committee would be the most efficient manner to resolve these issues. Given that the issues are relevant to all future monitoring, and that this monitoring year is near the end, an expanded BC meeting could be conducted during the normal review process in the fall of 2011 to accommodate such a discussion. If BC committee members wish to do so, we could begin initial discussion sooner.

In reference to the NMFS letter dated February 3rd, 2011, pertaining to upstream fish migration impediment evaluations, below is Casitas' response to the four topics that comments and recommendations were provided.

Robles Reach Definition

The Robles Biological Opinion (BO) defines the Robles Reach as the 4 miles downstream of the Robles Fish Passage Facility (NMFS 2003; page 48); the downstream end of the reach is located upstream of Santa Ana Blvd Bridge. In an attempt to provide a convenient reference point to the Robles Reach, the confluence of San Antonio Creek was selected in the draft 2011 study plan (Lewis and Gibson 2011). This was not done to change the scope of the monitoring and evaluations required in the BO, but merely for identification convenience. Because the downstream end of the Robles Reach is located approximately 0.85 miles upstream of Santa Ana Blvd Bridge, perhaps the bridge would have been a better reference point to select. Because BO-required upstream and downstream fish passage monitoring and evaluation activities are clearly tied to the Robles Reach, further reference to the Robles Reach should be in agreement with the BO. As stated in the BO (NMFS 2003), "Conditions in this reach

1

[Robles Reach] have the greatest potential for low flows to impede upstream fish passage." The Robles Reach is a wide alluvial section of the Ventura River that is composed of active wash deposits of unconsolidated silt, sand, gravel, and boulders (Tan and Jones 2006). Due to this channel morphology and geology, alluvial channels like the Robles Reach have high infiltration rates that cause channel surface flow to rapidly recede and cease shortly after storm events (Cooke et al. 1992). Extending the downstream end of the Robles Reach to the confluence with San Antonio Creek would change the scope of BO monitoring and evaluations. The hydrology of Ventura River as it approaches San Antonio Creek is significantly different from the BO-defined Robles Reach. In fact, emerging groundwater makes the Ventura River perennial during most years in this area while the Robles Reach experiences annual dry channel conditions.

Impediment Monitoring Site Selection

As stated in the Casitas email to BC members dated March 4th, the impediment sites will continue to be monitored with some changes due to the March 20th high flows.

Site 2—The March 20th high flows changed site 2 substantially. It no longer appears to be a potential impediment. Three new channels were created through the site. A new site should be selected in the Robles Reach to replace this site. We are not currently monitoring this site.

Site 3—The high flows caused significant scour at the upstream end of where the two channels split. This has changed the primary channel to the left (looking upstream). Now there is approximately 80% of the flow in this new primary channel. After determining this, a new impediment site was selected (see Photo 1) on March 27th and monitoring began on March 28th. Casitas reasoned that a new site needed to be selected immediately to take advantage of post-storm flows rather than going through a likely long Biological Committee selection process and lose a data collection opportunity. Data detailing the new site and 2011 summaries will be included in the 2011 progress report for review by the BC.

Site 4—Some change occurred at this site, but not enough to require monitoring changes; monitoring has continued.

Site 5—The primary channel has now moved to the left channel. High flows scoured the old secondary channel and now approximately 60-70% of the flow is now in this new primary channel. Monitoring has continued, but now only in the new primary channel.

Site 6—Significant change occurred at site 6. A new channel was cut on the left side very near where the transect was located. Monitoring has continued, but the transect line was moved upstream approximately 20 ft to include the new channel.

Site 7—Little change occurred at this site and monitoring has continued.

Site 8—Little change occurred at this site and monitoring has continued.

Site-Specific Discharge Measurements

As normal procedure, during all impediment transect measurements, water velocity is also recorded so that discharge can be calculated. However, because site conditions (i.e., passage channels with certain water depths) are assumed to be the critical measurement to correlate with discharge from the Robles Fish Facility, it was believed that modeling directly between Robles discharge and site depth (Model 1) would include other sources of variability. By simply separating Model 1 into different models (i.e., site discharge and site depth, then Robles discharge and site discharge) does nothing to improve the analysis. The two models will each have less variability than Model 1, but only because the variability from Model 1 has been partitioned between two models; this is simply an unnecessary step and does not improve the current method. To test just that conclusion, the method as was discussed on the conference call on January 19th with BC regular members and NMFS and CDFG hydrologists and recommended in the February 3rd NMFS/CDFG letter, was applied to selected impediment sites. Sites 4, 6, 7, and 8 provided the best data sets to reanalyze because they showed good correlation with only one year of data collection. A site discharge and site depth model (Model 2) was first developed for each site, then a criteria of 10 ft width with 0.6 ft depth (Harrison et al 2006) was applied to estimate the site discharge needed to meet this criteria. A Robles discharge and site discharge model (Model 3) was then developed. The resulting estimated discharge from Model 2 was then run through Model 3 to estimate the Robles discharge needed for the site discharge to meet the criteria. This method was then applied to all four sites and the resulting Robles discharge for each site, using both methods, were compared (Table 1). The mean difference between the two model methods was 2.8 cfs. The greatest difference was for Site 4, where 6 cfs more was needed to meet criteria using Model 1; however, the overall differences between the two methods were relatively small.

Table 1. Discharge (cfs) from Robles Needed to Meet a 10 ft Width @ 0.6 ft Depth Criteria.

Site	Model 1 (cfs)	Model 2+3 (cfs)	Difference (cfs)
4	77	71	6
6	58	53	5
7	33	34	-1
8	30	29	1
		Mean	2.8

Casitas agrees that comparing site discharge with Robles discharge provides information about basin-scale hydrology; however, this is not necessary if the steelhead passage conditions at a potential impediment site are the primary interest. It is not clear to Casitas how understanding the general hydrology patterns will help directly determine the passage conditions at any particular impediment site in the Ventura River. The Robles BO operation criteria, related to fish passage augmentation flows, are controlled at the Robles Fish Facility. This is the only location where flows can be manipulated and therefore correlating back to this location directly, using a method as described for

Model 1, is the most direct approach. It's clear that the farther downstream a site is from Robles, non-project related factors such as losing and gaining reaches, urban drains, tributaries, ground water pumping, and effluent, increase the variability of any model developed. For these reasons, Casitas believes that the current method agreed to by the BC members in 2009 continues to be the best method and should be applied to sites in the Robles Reach.

Data Variability

Regarding the "high degree of scatter" of the first year of data in appendices 3-10, after further review of the data, it was determined that many of the Robles discharges used in the correlation were incorrect. This was because the mean daily discharges were used and no adjustment for hydraulic lag-time was included. During days when a post-storm ramp-down occurred, discharge changes normally occurred at 1200 h. Therefore, the mean discharge for a ramp-down day was the average of the two discharge numbers. In addition, depending on what time of the day an impediment site was measured and how far downstream from Robles it was, the discharge from Robles that resulted in the site conditions at the time of the measurement was at times incorrect. To correct this problem, the measurement time for all impediments was determined, and accounting for the distance downstream of Robles, a back calculation was done to determine what the discharge was at Robles. Based on observed changes in discharge measured at Robles after a change was made at Matilija Dam, a hydraulic travel time of 2.0 km/hr was estimated and used for making these corrections. Of the 48 total impediment measurements, 40 were corrected using this method. The corrections ranged from 1 to 14 cfs and the mean difference was 2.5 cfs; however, 7 measurements had a difference of 10-14 cfs. This corrected Robles discharge data resulted in a moderate improvement in the analyses. The final 2010 progress report will included all of these corrections and all future analyses will used this more accurate method of estimating Robles discharge at downstream sites. In addition, the hydraulic lag-time of the Robles Reach will continue to be updated and improved as data becomes available.

Primary Channel Selection

Casitas agrees that the primary channel should be selected for monitoring and will implement that recommendation as it applies to the Upstream Fish Migration Impediment Evaluation.

Sandbar Impediment Monitoring

The hydraulic conditions of the Ventura River as it passes over its sandbar are variable to say the least. Seasonal, tidal, and the aforementioned basin factors control the site conditions. For example, during one low-tide sampling event, the discharge at Robles was only 3 cfs while over 40% of the sandbar had measured depths greater than 0.6 ft deep. During subsequent high tides, the water over the sandbar at times was so deep that it was not even safe to enter and measure depths. For these reasons, it was clear that the sandbar did not represent a potential impediment to upstream migrating steelhead and ultimately why it was recommended for elimination as a monitoring site. However, given that there are already seven sites, Casitas does not see the need for a replacement site in the Robles Reach (also see justification below in *NMFS' Modified Thompson Criteria*).

Thompson Method (1972) Criteria

Passage Criteria

Based on the first sentence in paragraph 3 on page 2 of NMFS and CDFG's February 3rd letter, it appears they are recommending that the Thompson (1972) criteria be used to evaluate potential passage impediments—**Casitas respectfully requests BOR to confirm this with NMFS and CDFG?** Previously, NMFS and CDFG have been reluctant to discuss which passage criteria they would ultimately recommend. However, during the January 19th BC conference call, NMFS and CDFG representatives suggested that a draft review document (SWRCB 2008) would be used for recommending passage criteria—**Casitas respectfully requests BOR to confirm with NMFS and CDFG that they are no longer recommending the criteria in the SWRCB (2008) document?** The SWRCB document was sent via email to Casitas by CDFG, therefore clarification is needed. It is difficult to analyze the impediment data without a clear criteria to apply. The application of several passage criteria in the draft 2010 progress report was done to simply show the range of possible results using previously used criteria. The questions related to criteria selection are important to Casitas as we move through the BO evaluation process. Casitas also has concerns about the limitations of the Thompson (1972) criteria, as well as other potential criteria, and how applicable they are to the Ventura River and believes an objective discussion is warranted. Casitas would like to have direct discussions with BOR, NMFS, and CDFG related to final criteria selection through the Cooperative Decision Making Process. We believe final criteria selection will expedite the evaluation process by providing a clear framework for all future impediment analyses.

ENTRIX Study

It appears that NMFS and CDFG may not clearly understand the results of the ENTRIX (1999) study, not only in their recent letter, but in previous letters and discussions as well. Because of this, Casitas felt a brief discussion of the study would be beneficial for clarification and future discussions related to the study and subject.

ENTRIX (1999) used the criteria developed by Thompson (1972) for adult steelhead at critical riffles, which is a water depth greater than or equal to 0.6 ft for 25% of a total transect width and a continuous portion equal to 10% of the width. ENTRIX also evaluated the critical riffles using a modification of a 0.6 ft water depth over a continuous width of 8 ft. The transect that required the highest minimum discharge to meet the two criteria were used to determine the discharge needed for adult steelhead passage, which ranged between 40-65 cfs. In paragraph 3 on page 2 of the February 3rd letter, NMFS and CDFG questioned ENTRIX's modifications to the Thompson criteria. First, the 0.5 ft depth criterion modification was conducted and included in the final report; however, the results were not included in the final minimum flow conclusions. Additionally, the 40 cfs was the result of the 8 ft wide modification and the 65 cfs was the result of the 25% width, both at 0.6 ft of depth (ENTRIX 1999). It appears that during the development of the initial minimum flows for the Robles BO, NMFS may have averaged these two numbers to come up the initial minimum discharge of 50 cfs (NMFS 2003). However, it's not entirely clear to Casitas how NMFS decided on this flow rate.

NMFS' Modified Thompson Criteria

The 3rd sentence of paragraph 3 on page 2 of NMFS and CDFG's February 3rd letter, appears to be recommending a modified Thompson criteria be used for Robles BO impediment evaluations that does not average all impediments for a final flow determination. The Thompson (1972) method clearly states that "The results averaged from all transects is the minimum flow we have recommended for passage." Casitas feels that in a geomorphically variable river channel like the Ventura River, averaging the impediments would be more representative of likely potential impediments over a longer period of time. Basing future minimum discharge on a single transient channel feature seems to lack understanding of the dynamic nature of the fluvial process. As the March high-flow event clearly demonstrated, basing all future Robles operations on one site that might not exists in the near future, is questionable. However, if NMFS and CDFG are only interested in the most restrictive site, Casitas sees little need to evaluate all seven potential impediment sites. Several sites could be eliminated because it is evident, even with one year of data, that they are not as restrictive as others. Casitas believes that monitoring several sites best represents potential Ventura River passage impediments. Furthermore, if all seven sites are to be monitored, then the mean discharge should be calculated and used to determine minimum passage discharge from Robles.

5 ft Width at 0.6 ft Depth Criteria

As stated during the conference call on January 19th, Casitas would review the citation used for the 5 ft width at 0.6 ft depth criteria in Appendix 13 and make any changes necessary for the final report. In the text of the progress report, the proper citations were applied and the two citations were unintentionally switched in the table. The table will be corrected for the final report. More importantly however, it appears that NMFS and CDFG were implying that passage criteria that have not been applied in previous evaluations should not be used on the Ventura River and suppressed from the progress report, which seems irrational. If a new criterion or method is used, simple logic and justification for its use is all that is needed for inclusion into this type of report. It should be obvious, but all new criteria or methods were used for a first time initially.

In reference to the NMFS' letter dated March 22nd, 2011, pertaining to comments for the draft 2010 progress report and 2011 study plan, below is Casitas' response to the topics for which you provided comments and recommendations.

2010 Annual Report and Biological Meeting Summary

Upstream Steelhead Impediment Evaluation—Regarding sites 2, 3, 4, and 5, Casitas continues to believe that relocation for the previously describe reasons (at the December BC meeting and subsequent meetings) is still warranted. Also, see Casitas' response in previous sections above.

Fish Attraction Evaluation—See below in response # 1.

Upstream Adult Monitoring Results—Casitas agreed to rewrite this section of the draft progress report to incorporate NMFS and CDFG's level of uncertainty and submit that section before finalization. Casitas agreed to include a table of dates, times, and locations of the one adult steelhead observed migrating through the Robles Fish Facility in 2010. Casitas also agreed to include the percentage of time the Riverwatcher was not operation due to high turbidity, but not produce the raw turbidity data. It's not clear to Casitas if NMFS wants the raw turbidity data sent to them, or include it on a graph or table in the final progress report. **Casitas respectfully requests BOR to confirm with NMFS on this recommendation?**

Downstream Smolt Trapping—Yes, NMFS did suggest that the current trap location was not producing sufficient capture rates. However, as stated at the December BC meeting, there have not been a sufficient number of downstream migrating smolts when the trap was in and operational to come to that conclusion. During the first year (2009) of trap operation at the current location, NMFS requested that Casitas remove the trap due to loss of a surface water connection in the Robles Reach. This was before the peak count of *O. mykiss* in the area even occurred. During 2010, the total of potential downstream migrating smolts was substantially less, yet 5 smolts were still captured. During the review process for the draft 2011 progress report, we will have the opportunity to more thoroughly discuss the results of the trapping at this location.

Regarding the release location of the radio-tagged smolts, it is not accurate for NMFS to portray the proposal of an upstream release location entirely as Casitas'. Initially, the BC had discussions during 2009 about improving our understanding of downstream smolt passage through the facility. It was at that time discussions about releasing some of the tagged smolts upstream of the facility to gain information on these topics of interest initially occurred. Also at that time, BOR discussed funding additional telemetry equipment to allow a fixed station to be placed near the Robles Fish Facility. During the December 2010 BC meeting, we again discussed this topic collectively and all members contributed to the development of the modification. Therefore, to suggest that this was a Casitas request is not acknowledging NMFS and CDFG's involvement.

NMFS 2011 Monitoring Recommendations

Regarding draft report submittal, review, and finalization process, discussions at the 2009 BC meeting included a request by Casitas to change the submittal date of the draft progress report to October 1st along with the study plan. NMFS indicated at the meeting that if BOR would send NMFS a letter requesting the change, NMFS would likely accommodate that request. Due to changing BOR and NMFS representatives, apparently this is has "fallen through the cracks". More time is needed by Casitas to compete the annual data summaries, analyses, and draft report preparation. June 30th is the end of the BO described monitoring year, this provides only two months for preparation before September 1st, while providing BC members one month for review. Casitas would like to again discuss adjusting the draft submittal date with BOR, NMFS, and CDFG.

1) Casitas did not agree to underwater video camera monitoring as NMFS suggested. During the meeting, a discussion occurred related to the one adult steelhead observed during 2010 in the Fish Attraction study reach downstream of the facility. From that discussion, Casitas agreed to temporally install an underwater camera at the fish ladder entrance if an adult was again observed in the downstream study reach. The camera would remain in place for 7 days or until the adult was observed passing through the Riverwatcher. In addition, Casitas agreed to conduct fish attraction bank surveys two times per day if an adult steelhead was observed, again for 7 days or until it passes through the Riverwatcher. This would allow information to be gained as to how long an adult steelhead might hold downstream of the ladder before passing upstream.

2) It appears that there is some disagreement about what an adult steelhead fundamentally is. To Casitas' knowledge, an adult steelhead is only an *O. mykiss* that has entered the marine environment, matured, and returned to freshwater to spawn. Excluding half-pounders and other less prevalent life history patterns, this seems to be the clear definition of an adult steelhead in the literature. Casitas clearly stated in the draft 2010 Progress report that there was evidence of extensive resident *O. mykiss* spawning in the Ventura River basin during 2009 and 2010 and was not suggesting that *O. mykiss* in the 20-45 cm range were not mature/adult *O. mykiss*. Casitas was simply saying that due to the preponderance of evidence, they were most likely resident *O. mykiss* and not anadromous steelhead. For NMFS to suggest that "Until sufficient scale and/or otolith analyses become available..." that all *O. mykiss* larger than 38 cm should be classified as adult steelhead is contradictory with available evidence. On the Santa Ynez, for example, of the 16 adult steelhead captured in traps, the smallest adult was 49.6 cm (Scott Volan, Cachuma Operation & Maintenance Board, personal communication). NMFS must remember that Casitas' classification using the 38 cm threshold also includes other components (see draft 2011 study plan excerpt below). It seems clear that steelhead progeny will remain in the Ventura River, mature, and spawn as residents. Perhaps through more discussion among the BC members, an agreeable classification could be developed by all members through the Cooperative Decision Making Process.

Each upstream and downstream Riverwatcher detection will be reviewed and classified as an adult steelhead, *O. mykiss* non-adult steelhead, other species if fish are identifiable, fish unknown, fish probable, or false detection (Figure 3). The classifications will be determined by using the combination of silhouette images, estimated lengths, and video clips. In addition, if larger adult sized *O. mykiss* are detected, a measurement of eye diameter and standard length (SL) will be estimated from the video clip to calculate morphometric ratios that will be compared to known steelhead and rainbow trout. A commonly used method is to develop ratios of body measurements for comparison so that the effects of body size can be removed and actual differences can be determined (Strauss and Bond 1990). This will be accomplished by comparing SL to the ratio of eye diameter and SL in linear regression. Standard length is the length from the snout to the end of the hypural plate near the end of the fleshy caudal peduncle, which is unaffected by caudal fin deformities (Anderson and Neumann 1996). The adult steelhead classification will be used if the fish observed is an *O. mykiss* and displays the typical characteristics of an adult steelhead, such as black spotting on dorsal, adipose, and caudal fins, black spotting on dorsal side of body, slivery body, vertical posterior edge to caudal fin, ≥ 38 cm TL (Shapovalov and Taft 1954), and has an eye diameter/SL ratio ≤ 0.045 (CMWD 2008). *O. mykiss* non-adult steelhead classification will be used if the fish observed is an *O. mykiss* and displays the characteristics of a resident *O. mykiss*: lobed caudal fins and darker color. Because of the difficulty in distinguishing between resident and anadromous *O. mykiss* of smaller sizes, no further classifications will be used for *O. mykiss*. Even though many, if not most, of the *O. mykiss* documented are likely to be smolting, the uncertainty remains. Conceivably, after more data has been collected from the downstream trapping component of the monitoring and evaluation, a more detailed classification of Riverwatcher detections can be made in the future. (see draft 2011 study plan for citations)

3) Casitas will report individual smolt lengths, weights, and smolt index in future reports as NMFS has recommended.

4) NMFS' recommendation to completely eliminate any data and discussion related to downstream Riverwatcher detections seems illogical and unsubstantiated. The working limitations of the Riverwatcher have been evaluated and described in previous reports. As time permits, additional evaluations will be conducted to better understand the full limitations of the technology. However, Casitas has been clear about the uncertainty of the data recorded by the Riverwatcher, which is part of the scientific process, and simply suppressing it is unwarranted. All BC participants must remember that the Riverwatcher manufacturer did not design the equipment to be used for detecting smaller fish, in this case downstream migrating smolts.

5) Also see comments in *Downstream Smolt Trapping* section above. Casitas agrees that PIT-tagged smolts released upstream of the Robles Fish Facility would provide useful data to evaluate Robles downstream passage. However, the resolution of information would be much better using radio telemetry methods. With PIT tagging, only the travel time from the release point to the PIT tag antenna in the crowder and from the crowder to the smolt trap could be determined. Using telemetry, a fine-scale migration behavior could be developed. For clarification, radio-tagged smolts released upstream were not intended to be used for determining any Robles Fish Facility passage injuries. Regarding NMFS' reasons for recommending PIT tagging over telemetry: a) Casitas agrees that a larger percentage of smolts could be tagged and used for the evaluation. However, as stated by Casitas previously, the trap efficiency is

not necessary to conduct the related studies. Trap efficiencies are used for determining total smolt emigration and that is not the objective of the evaluations. b) Casitas agrees that smaller *O. mykiss* could be tagged using PIT tags; however, parr-sized *O. mykiss* have not been observed migrating downstream through the Robles Fish Facility during the last five years of evaluations. c) Casitas agrees that the long-term survival of PIT-tagged fish is much better; however, the passage of smolts through this proposed study reach would likely be rapid and well with in the acceptable range. Regardless of our exact agreement about the usefulness of the two methods, Casitas will agree to PIT tagging the smolts and releasing them upstream as previously discussed. Casitas also agrees to continue smolt trapping regardless of a surface water connection through the Robles Reach. However, this seems contrary to NMFS' # 6 recommendation.

6) Casitas agrees to continue radio tagging downstream migrating smolts to determine the Robles Reach passage behaviors. The exact method for applying the 0.5 ft criterion NMFS cited in their letter could not be located through a standard literature research. If NMFS could send Casitas an electronic copy if available, it would be greatly appreciated.

7) If needed, Casitas will agree to extend the smolt trap wings to each bank and make accommodations for upstream passage of *O. mykiss*.

Casitas is committed to conducting the monitoring and evaluation of the Robles Facility as specified in the Biological Opinion and participating in the Cooperative Decision Making Process to further improve aspects of studies as needed. If BOR, NMFS, or CDFG would like to discuss any of these issues further, please contact me at your convenience.

Respectfully,

Scott Lewis

Scott Lewis

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Literature Cited

Cooke, R. U., A. Warren, and A. S. Goudie. 1992. Desert geomorphology. UCL Press, London.

ENTRIX. 1999. Evaluations of natural passage barriers on the Ventura River downstream of Robles Diversion. Entrix, Walnut Creek, CA.

Harrison, L. R., E. A. Keller, E. Kelley, and L. A. K. Mertes. 2006. Minimum flow requirements for southern steelhead passage on the lower Santa Clara River, CA. University of California, Santa Barbara.

Lewis, S. D. and M. W. Gibson 2011. 2011 monitoring and evaluation study plan for the Robles Fish Passage Facility and related studies (draft). Casitas Municipal Water District, Oak View, CA.

National Marine Fisheries Service. 2003. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

State Water Resources Control Board (SWRCB). 2008. Protectiveness of draft guideline alternatives. Appendix G, Approach for assessing effects of policy element alternatives on upstream passage and spawning habitat availability *in* North coast instream flow policy: scientific basin and development of alternatives protecting anadromous salmonids. California State Water Resources Control Board, Sacramento, California.

Tan, S. S., and T. A. Jones. 2006. Geologic map of the Matilija 7.5' quadrangle Ventura County, California: a digital database. Version 1.0, Los Angeles, CA.

Thompson, K. 1972. Determining stream flows for fish life. Pacific Northwest River Basins Commission, instream flow requirements workshop. Portland, Oregon. Proceedings: 31-50.

Photo 1. Photo of new site 3 looking downstream. Water is moving from right to left and across the transverse riffle/rapid. The yellow line represents approximate location of transect.

UNITED STATES DEPARTMENT OF COMMERCE
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NATIONAL MARINE FISHERIES SERVICE
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2002/11871: RAB

JUN 22 2011

Ned Gruenhagen
Bureau of Reclamation
South-Central California Area Office
1243 N Street
Fresno, CA 93721-1813

Dear Mr. Gruenhagen:

NOAA's National Marine Fisheries Service (NMFS) is contacting the Bureau of Reclamation (Reclamation) regarding the draft 2010 Robles Fish Passage Facility Progress Report (Report). Scott Lewis of Casitas Municipal Water District (Casitas) redistributed the draft Report to the Biological Committee (Committee) members on May 23, 2011, for review. NMFS has completed our review of the document. Although NMFS is pleased to find that several of the concerns expressed in NMFS' letter of Mar 22, 2011, have been adequately addressed, the draft Report continues to contain information that requires revision and clarification. In this context, the attachment to this letter describes NMFS' specific remaining concerns with the draft Report and includes recommendations for revision. Once NMFS' comments have been addressed and the recommended revisions incorporated, the revised draft Report should be submitted to NMFS for further review.

Please contact Rick Bush at (562) 980-3562 if you have a question regarding the summary or if you would like additional information.

Sincerely,

Penny Ruvelas
Southern California Area Office Supervisor
for Protected Resources

cc: Scott Lewis, Casitas Municipal Water District
Roger Root, U.S. Fish and Wildlife Service
Mary Larson, California Department of Fish and Game
Administrative file#: 151422SWR2002PR6168

NOAA's National Marine Fisheries Service' (NMFS) Comments on the 2010 Draft Annual Report for Operation of the Robles Diversion Fish Passage Facility

June 16, 2011

The following is a summary of the draft 2010 Annual Report (Report). This summary is based on discussion during the December 1, 2010, Robles Biological Committee (Committee) meeting for the Robles Diversion Fish Passage Facility (Facility), and the May 23, 2011, draft Report revisions. Additionally, this summary references Casitas Municipal Water District (Casitas) letter received by NMFS on May 9, 2011.

NMFS experienced difficulty in comparing the draft Report to the older version because the changes Casitas made to the original document are not shown on the new draft. NMFS was asked to confine our review to pages 25-30 for changes made to the document; however, numerous sections in the Report were found to contain changes to the data figures presented without any justification for the changes. NMFS disagrees with Casitas that the Report is ready to be finalized. NMFS would like to see a working draft document detailing all of the May 23, 2011, edits that were made to the original, and our comments below incorporated before finalizing the document. NMFS has organized our comments below according to the order that the information is presented in the draft Report.

1. The description of the Robles Reach has changed in the latest document. The description of the Robles Reach in the previous Report indicated the reach extends 10-km downstream of the Facility. In the latest Report, the Robles Reach is now defined as extending 6.5-km (p. 6) downstream of the Facility. Regardless of how the Robles Reach is defined (addressed in our February 3, 2011 letter), NMFS continues to recommend that the critical riffle monitoring should continue to occur at the 7 sites that were previously selected by the biological committee using the Cooperative Decision Making Process described in the biological opinion (NMFS 2003). Since the selected impediment sites will be surveyed over a period of 3 to 4 years given the natural variation of water conditions (p. 8), continuing to relocate the sites and extend the duration of this monitoring element is illogical.
2. Based on our review of Mosley (1982), this paper does not provide any analytical data that support the statement made in the Report (p. 7) that adult steelhead successfully navigate through riffles measuring less than 0.6-ft deep. The author simply comments that he has observed jetboats and trout passing riffles of about 0.1-m deep. Mosley concludes by stating that empirical data for minimum passage depths must be more rigorously evaluated.
3. The resulting minimum discharge estimate has apparently changed from 43-62 cfs to 27-60 cfs in the latest version of the document (p.13) without any explanation for the reduced figures. Clarification is needed as to why 4 criteria are being referenced when a comparison is being made to the Entrix (1999) results that were calculated using the Thompson (1972) methodology of 0.6-ft at 25% width, and 0.6-ft over a continuous width of 8-ft.
4. In regard to the Vaki Riverwatcher (Vaki) discussion (p. 24), the statement, *"Even though many, if not most, of the O. mykiss documented were likely smolting"*, is uncorroborated information that should be excluded from the report. Unlike smolt trap captures that are visually categorized using a smolt index, the Vaki apparatus is unable to perform a reliable

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assessment to determine whether fish are "smolting". As noted on the same page, *"after more data have been collected from the downstream trapping component ... a more detailed classification of Riverwatcher detections can be made."* NMFS recommends including a comparison table in the Report of daily smolt trap captures and Vaki detections of suspected smolts to allow the reader to make a direct comparison of the efficacy of the Vaki technology for documenting outmigrating smolt.

5. Casitas cites Shapavolov and Taft (1954) as justification for their adult steelhead size classification (p. 24), but close inspection of Shapavolov and Taft does not support Casitas' rationale. According to Shapavolov and Taft, in practically all cases sea-run fish are more than 300-mm in [fork] length and juveniles, stream fish, and resident fish are less than 300-mm in length. Shapavolov and Taft summarized 9-years of data to determine that the **mean size of Age-2** (1-yr stream/1-yr ocean) returning adult steelhead captured in Waddell Creek was 38-cm for males, and 40-cm for females. Therefore, many of the age-2 steelhead were smaller than 38-cm. The average 2-year old adult measured <38-cm for two of the study years. NOAA-NWFSC Tech Memo-27 suggests that southern California steelhead adults are likely spawning as 2-year-olds (1/1) in our region due to rapid freshwater growth rates (Busby et al. 1996). NOAA Fisheries biologists have determined that there is almost no overlap in the size distributions of anadromous adult steelhead (typically >35-cm) and *O. mykiss* that have not gone to sea (<25-cm) in central California coastal streams (Hayes et al. 2004, Pearse et al. 2009). Therefore, NMFS reiterates that the current methodology used by Casitas to document returning adult steelhead migrating through the Robles fish ladder does not accurately reflect the best available science.

6. The Fish Passage Monitoring results section (p. 26) still indicates with certainty that only one "*adult steelhead*", and 53 *O. mykiss* "*non-adult steelhead*" passed upstream through the Robles Facility fish ladder in 2010. The Vaki data presented in Appendix 25 suggest that many (44 > 30-cm, of which 17 ≥ 40-cm) of the fish classified as "*non-adult steelhead*" would likely be classified as adult steelhead based on the 9-years of scale analysis presented in Shapavolov and Taft (1954). NMFS requests that Reclamation correct this discrepancy, or provide the "preponderance of evidence" that was referenced in the Casitas May 9, 2011, letter used to ascertain that these fish were resident fish instead of anadromous steelhead.

7. NMFS recommended that Casitas rewrite Section 3.3 Fish Passage Monitoring (p. 25-30) to clarify the uncertainty that exists in regards to Casitas' exclusion of possible adult steelhead from their data summary. However, no changes were made to the discussion section (p. 30 - 31) that summarizes Casitas' biased explanation of the data. Specifically, Casitas classified 44 upstream migrating adult *O. mykiss* measuring 30 - 46cm as *"not considered to be adult steelhead"*, which contradicts the best available science using scale analysis that indicates fish in this size range are often adult steelhead (Shapavolov and Taft 1954, Hayes et al. 2004, Pearse at al. 2009). In arriving at this conclusion, Casitas appears to rely upon circular logic, citing a separate Ventura River report authored by their in-house biologists that hypothesized that most of the spawning that occurred in the watershed in 2010 was credited to resident *O. mykiss*. No biological data was analyzed by Casitas (e.g., scales, DNA) because no datum is presented that would support this inference. By excluding all 44 of these fish from the anadromous steelhead spawning population, Casitas makes the assumption that age-2 steelhead do not spawn in the Ventura River. This assumption directly contradicts NMFS' assessment (which led to the listing of the species) that age-2 steelhead likely contribute

more in the southern California Distinct Population Segment than they do in northern populations (Busby et al. 1996).

8. Casitas also referenced the length-frequency data (p. 79) to base their exclusion of any potential age-2 adult steelhead from their Vaki detections. NMFS cautions that a single data point (i.e., 58-cm) on a length-frequency distribution does not reveal a bimodal distribution. NMFS reminds Reclamation that the Vaki failed to detect the downstream passage of that same 58-cm steelhead. Failure to randomly detect all adult fish using the Vaki system creates a biased length-frequency distribution of limited usefulness. Because larger fish are more powerful swimmers than smaller fish, which imparts the ability to migrate during periods when river discharge and turbidity concentrations are exceedingly elevated, the possibility exists that additional adults could have passed the Facility undetected. As described in the Report, the total time the Vaki was not operational because of high turbidity was 5.5 days, plus another 8-hrs when the system was removed from the fishway for cleaning.
9. Review of the Ventura River Flow Assessment in Appendix 27 (p. 83) indicates that the Ventura River experienced two threshold storm events in 2010 that required Casitas to augment streamflow downstream of the Facility for steelhead passage (NMFS 2003). Therefore, Casitas operation of the Facility provided steelhead with approximately 22 passage days when flow released downstream of Robles was ≥ 50-cfs. Assuming that the Vaki was non-operational for six of the days coinciding with the highest flow (i.e., highest turbidity and debris load), the Vaki may have been operable a little under 75-percent of the time when Casitas was augmenting flow for steelhead passage. Further review of Appendix 27 indicates that the highest flow recorded in the fish ladder was 41-cfs, and averaged approximately 36-cfs during the flow augmentation period. NMFS is interested to know why the entire 50-cfs augmentation flow was not routed through the fish ladder in 2010 as it was during the 2011 "fish flow operations" season?

Literature Cited

ENTRIX. 1999. Evaluations of natural passage barriers on the Ventura River downstream of Robles Diversion. ENTRIX, Walnut Creek, CA.

Hayes, S. A., M. H. Bond, C. V. Hanson and R. B. MacFarlane. 2004. Interactions between endangered wild and hatchery salmonids: can the pitfalls of artificial propagation be avoided in small coastal streams? Journal of Fish Biology: 65 (Supplement A), 101–121.

Mosley, M. P. 1982. Critical depths for passage in braided river, Canterbury, New Zealand. New Zealand Journal of Marine and Freshwater Research, Vol.16:351-357.

NMFS. 2003. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

Busby, P. B., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-27: 261pp.

Pearse, D. E., S. A. Hayes, M. H. Bond, C. V. Hanson, E. C. Anderson, R. B. Mac Farlane, and J. C. Garza. 2009. Over the Falls? Rapid Evolution of Ecotypic Differentiation in Steelhead/ Rainbow Trout (*Oncorhynchus mykiss*). Journal of Heredity: 100 (5): 515–525.

Shapovalov, L., and A. C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*). California Department of Fish and Game, Fish Bulletin 98: 375pp.

Thompson, K. 1972. Determining stream flows for fish life. Pacific Northwest River Basins Commission, Instream Flow Requirements Workshop Proceedings: 31-50. Vancouver, WA.

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11 August 2011

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Dear Ned,

This letter is a response to the NMFS recommendation letter: 2002/11871:RAB dated June 22rd of 2011, which was pertaining to the 2010 progress report for the Robles Fish Facility. There were numerous issues related to the Robles Fish Passage Facility monitoring and evaluation studies that NMFS commented on in their letter that need to be addressed. Casitas' response regarding these issues has been included in this letter.

In generally, NMFS appears to have spent little time reading, or did not understand, the Casitas letter dated April 29th, 2011. Many of NMFS' recommendations or requested clarifications appeared to be addressed in the Casitas April 29th letter. Therefore, where appropriate, the pertinent sections of that letter were reproduced in this letter. NMFS included several new comments on topics that they had previously reviewed in the first draft of the progress report, but did not provided comments for at that time. NMFS also included comments or recommendations that altered what they have previously stated. This indecisive approach by NMFS has caused the finalization process of the 2010 report to be drawn-out. For example, at the December 2010 BC meeting, NMFS asked for wording to be added that would indicate the uncertainty they have with the classification of larger *O. mykiss* as resident instead of anadromous in the draft progress report. In their letter from March 22nd, 2010, they instead asked that *O. mykiss* ≥ 38 cm be classified as adult steelhead. Finally, in their June 22nd letter, NMFS changed this to all *O. mykiss* ≥ 30 cm. The effect of this ever-shrinking adult size limit is to cause an inflation of the true adult steelhead population in the Ventura River. It seems ironic that during the steelhead recovery process, NMFS always decided on the precautionary approach that would result in the largest number of steelhead needed for the DPS to be considered "recovered." However, NMFS is now desiring an adult estimate in the Ventura River that would be the most optimistic that results in the largest number by using an overly inclusive size limit and rigid interpretation.

NMFS made numerous references to the "best available science" in their June 22nd letter. However, it appears that these references are based exclusively on two small and neighboring creeks of central California outside of the local DPS. To suggest that this represents the "best available science" is a rather bold statement considering its limited scope. The basins of Scott and Waddell creeks of Santa Cruz County are each only about 10% in area of the Ventura River basin. They are also situated in the cooler climate of the central coast of California. It would appear that more appropriate and relevant comparisons to the Ventura River could be made with steelhead data derived from local DPS systems such as the Santa Ynez River, Santa Clara River, Topanga Creek, and even the Ventura River.

Many of the issues NMFS has indicated could have likely been resolved with a simple phone call between NMFS and Casitas, instead of the lengthy and inefficient back and forth letter correspondence. As stated before, a meeting of the Robles Biological Committee would be the most efficient manner to resolve many of these issues. Given that the issues are relevant to all future monitoring and evaluations, and that this monitoring year has ended, an expanded BC meeting could be conducted during the normal review process in the fall of 2011 to accommodate such discussions. If BC members wish to do so, initial discussions could begin sooner.

NMFS stated they "experienced difficulty" in comparing the most recent draft with the earlier one. In previous years, the BC has not produced a "track-changes" type of document. If NMFS wishes to see the changes, perhaps they could simply do a "compare documents" in Adobe Acrobat. NMFS stated there were changes in the second draft that were not justified. It's not clear to Casitas which unjustified changes NMFS is referring to, but if they could clarify this, we would be happy to address them. NMFS also stated that Casitas asked them to "confine" their review to pages 25-30 of the most recent report draft. Casitas did send the email below referencing those pages in the attached second draft. However, it was only those pages that NMFS and CDFG specifically asked to review at the December BC meeting.

> Attached is the revised Robles 2010 progress report. It is essentially ready to be finalized in my opinion. Mary had requested a review of pages 25-30 regarding the language used in identifying anadromous/resident/adult fish. Please let me know as soon as you can regarding those pages so I can finalize it and send it to BOR.

Casitas' response to NMFS' June 22nd letter is detailed below. There were nine topics outlined in the NMFS letter and were followed here. The bold general topic headings were added for clarification.

1. Robles Reach Definition and Impediment Evaluations

Robles Reach Definition—The reason for the Robles Reach definition change from the first draft to the second was clearly explained in the April 29th Casitas letter sent to BOR and copied to NMFS and CDFG (note that this letter was inadvertently dated 2010 when distributed). NMFS is requesting a change to the description of the Robles Reach from what they originally identified in their own Biological Opinion for the Robles Fish Facility (NMFS 2003). Casitas verbally discussed this briefly at the December 1st, 2010, BC meeting, a follow-up conference call on January 19th, 2011, with BC regular members and NMFS and CDFG hydrologists, and finally in writing in the April 29th letter. Casitas has made it clear as to why we feel the original Robles Reach description in the BO should be used to guide relevant aspects of the monitoring and evaluations. If NMFS could provide their rational for wanting to change their Robles Reach definition from the BO, it may facilitate the resolution of this issue. I have included the text related to the Robles Reach from the April 29th letter below for reference.

> The Robles Biological Opinion (BO) defines the Robles Reach as the 4 miles downstream of the Robles Fish Passage Facility (NMFS 2003; page 48); the downstream end of the reach is located upstream of Santa Ana Blvd Bridge. In an attempt to provide a convenient reference point to the Robles Reach, the confluence of San Antonio Creek was selected in the draft 2011 study plan (Lewis and Gibson 2011). This was not done to change the scope of the monitoring and evaluations required in the BO, but merely for identification convenience. Because the downstream end of the Robles Reach is located approximately 0.85 miles upstream of Santa Ana Blvd Bridge, perhaps the bridge would have been a better reference point to select. Because BO-required upstream and downstream fish passage monitoring and evaluation activities are clearly tied to the Robles Reach, further reference to the Robles Reach should be in agreement with the BO. As stated in the BO (NMFS 2003), "Conditions in this reach [Robles Reach] have the greatest potential for low flows to impede upstream fish passage." The Robles Reach is a wide alluvial section of the Ventura River that is composed of active wash deposits of unconsolidated silt, sand, gravel, and boulders (Tan and Jones 2006). Due to this channel morphology and geology, alluvial channels like the Robles Reach have high infiltration rates that cause channel surface flow to rapidly recede and cease shortly after storm events (Cooke et al. 1992). Extending the downstream end of the Robles Reach to the confluence with San Antonio Creek would change the scope of BO monitoring and evaluations. The hydrology of Ventura River as it approaches San Antonio Creek is significantly different from the BO-defined Robles Reach. In fact, emerging groundwater makes the Ventura River perennial during most years in this area while the Robles Reach experiences annual dry channel conditions.

Impediment Evaluations—The comments NMFS provided in the June 22nd letter only pertain to the 2011 study plan (i.e., they still recommend monitoring at the original sites 2-8). Regarding those sites, Casitas presented a description of changes resulting from the March 2011 high flows. Only two sites changed sufficiently to necessitate a relocation of the monitoring. NMFS stated in their June 22nd letter that they think it is "illogical" to relocated a site. Casitas disagrees with this statement and suggests that it is indeed logical to adapt to changing channel conditions as needed. It seems unscientific to continue to monitor a site that is no longer an impediment or is no longer even the primary channel. In NMFS' February 3rd, 2011, letter, they even stated that "the primary channel should be selected for measurement" and Casitas agreed. Therefore, it appears that NMFS is confused about their previous comments/recommendations and the information contained in Casitas' April 29th letter. Casitas will continue to work with BOR and NMFS to resolve any impediment evaluation issues. I have included the text related to impediment site changes from the April 29th letter below for reference.

As stated in the Casitas email to BC members dated March 4th, the impediment sites will continue to be monitored with some changes due to the March 20th high flows.

Site 2—The March 20th high flows changed site 2 substantially. It no longer appears to be a potential impediment. Three new channels were created through the site. A new site should be selected in the Robles Reach to replace this site. We are not currently monitoring this site.

Site 3—The high flows caused significant scour at the upstream end of where the two channels split. This has changed the primary channel to the left (looking upstream). Now there is approximately 80% of the flow in this new primary channel. After determining this, a new impediment site was selected (see Photo 1) on March 27th and monitoring began on March 28th. Casitas reasoned that a new site needed to be selected immediately to take advantage of post-storm flows rather than going through a likely long Biological Committee selection process and lose a data collection opportunity. Data detailing the new site and 2011 summaries will be included in the 2011 progress report for review by the BC.

Site 4—Some change occurred at this site, but not enough to require monitoring changes; monitoring has continued.

Site 5—The primary channel has now moved to the left channel. High flows scoured the old secondary channel and now approximately 60-70% of the flow is now in this new primary channel. Monitoring has continued, but now only in the new primary channel.

Site 6—Significant change occurred at site 6. A new channel was cut on the left side very near where the transect was located. Monitoring has continued, but the transect line was moved upstream approximately 20 ft to include the new channel.

Site 7—Little change occurred at this site and monitoring has continued.

Site 8—Little change occurred at this site and monitoring has continued.

2. Mosley Paper on Critical Depths

The use of the Mosley (1982) paper, as cited on page 7 of the progress report, was an acceptable usage. Contrary to NMFS' contention, the statement made on page 7 of the progress report was supported by the citation and its usage. The statement made in the progress report was, "It has been observed that adult salmonids can successfully move through shallower riffles than the 0.6 ft criterion (Mosley 1982)." This statement was made in context of the Thompson's (1972) criteria lacking validation with actually fish migration observations. Mosley (1982) simply stated:

> ...the writer recently observed, in side channels of the Ashley and Ahuriri Rivers...trout over 40 cm long passing up riffles with lengths of over 20 m, depths over the length of the riffles of about 0.1 m [0.33 ft], discharges less than 1 $m^3 s^{-1}$ [35 cfs], and with many cobbles exposed to the air.

This general description appeared to be very similar to biological and environmental conditions of the Ventura Basin and was appropriately used in that context. NMFS appears to be implying that any reference to adult salmonids passing upstream through water less than 0.6 ft deep can only be done if derived from "analytical data" and not general observations. If NMFS' approach is to question any suggestion that steelhead can swim upstream in water < 0.6 ft deep, then they should also question the lack of "analytical data" to support any minimum depth criteria use of adult passage. As Casitas has stated previously, we are not aware of any research that has quantified what constitutes a steelhead impediment based on actual fish passage measurements/observations and, again, if NMFS is aware of known quantified impediments, Casitas would appreciate a reference to such work. After spending a great deal of time in the field conducting habitat surveys, spawning surveys, radio telemetry, snorkel surveys, and even recreational steelhead fishing, I have personally observed steelhead and other adult salmonids swimming upstream through riffles much less than 0.6 ft. I did not cite my own personal observations in this case because I considered the Mosley (1982) citation more appropriate.

3. Minimum Discharge Estimates

Data Corrections—The rationale for the data corrections was clearly explained in the April 29th letter sent to NMFS and was as follows:

> *Data Variability*
>
> Regarding the "high degree of scatter" of the first year of data in appendices 3-10, after further review of the data, it was determined that many of the Robles discharges used in the correlation were incorrect. This was because the mean daily discharges were used and no adjustment for hydraulic lag-time was included. During days when a post-storm ramp-down occurred, discharge changes normally occurred at 1200 h. Therefore, the mean discharge for a ramp-down day was the average of the two discharge numbers. In addition, depending on what time of the day an impediment site was measured and how far downstream from Robles it was, the discharge from Robles that resulted in the site conditions at the time of the measurement was at times incorrect. To correct this problem, the measurement time for all impediments was determined, and accounting for the distance downstream of Robles, a back calculation was done to determine what the discharge was at Robles. Based on observed changes in discharge measured at Robles after a change was made at Matilija Dam, a hydraulic travel time of 2.0 km/hr was estimated and used for making these corrections. Of the 48 total impediment measurements, 40 were corrected using this method. The corrections ranged from 1 to 14 cfs and the mean difference was 2.5 cfs; however, 7 measurements had a difference of 10-14 cfs. This corrected Robles discharge data resulted in a moderate improvement in the analyses. The final 2010 progress report will included all of these corrections and all future analyses will used this more accurate method of estimating Robles discharge at downstream sites. In addition, the hydraulic lag-time of the Robles Reach will continue to be updated and improved as data becomes available.

Passage Criteria—It's not entirely apparent to Casitas what clarification in the progress report that NMFS is asking for. However, if NMFS is referring to the statement,

> ...as stated by Thompson (1972), the selected sites should be averaged to determine the final minimum discharge estimate. This would result in a minimum discharge estimate of 27-60 cfs for the four criteria.

then this was simply applying the Thompson (1972) method of averaging the resulting discharge estimates from each site to determine the final minimum flow estimate for each of the four criteria used in the comparison (see appendix 13 of the progress report). If NMFS is referring to the statement below,

> ENTRIX (1999) used the criteria developed by Thompson (1972) for adult steelhead at critical riffles, which is a water depth of 0.6 ft for 25% of the total transect width and a continuous portion equal to 10% of the width. ENTRIX also evaluated the critical riffles using a modification that would produce a water depth of 0.6 ft over a continuous width of 8 ft. The transect that required the highest minimum discharge to meet the two criteria was used to determine the discharge needed for adult steelhead passage, which was a range of 40-65 cfs. It appears that during the development of the initial minimum flows for the Robles Biological Opinion, NMFS averaged these two numbers to come up the initial minimum flow of 50 cfs (NMFS 2003a). By applying this same criteria and flow selection method to data collected during 2010, a minimum discharge of 70 cfs was estimated.

then this was done simply to use similar analysis methods to ENTRIX (1999) so that resulting discharge estimates with the 2010 data could be compared with the ENTRIX (1999) results. Regardless, Casitas would be happy to clarify this in the final report.

4. Vaki Riverwatcher

NMFS' viewpoint that the statement in the progress report of "...many, if not most, of the *O. mykiss* documented were likely smolting..." was uncorroborated and should be excluded from the report is unjustified. Based on observations from the fish attraction evaluations, on page 21 of the progress report, a summary of *O. mykiss* smolt stage totaled 89% in mid to late states.

> With a total of 89% of *O. mykiss* in mid to late smoltification stages, it would indicate that a downstream smolt migration behavior was the likely reason for their occurrence in the fish attraction study reach.

This clearly supports the statement of "...many, if not most, of the *O. mykiss* documented were likely smolting..." This statement was made in the methods section of Fish Passage Monitoring and was simply referring to the results in the previous section of Fish Attraction Evaluation. It's unclear how NMFS could misinterpret this statement as being derived from Vaki Riverwatcher data since it was made in the methods section and not in the results or discussion sections. Casitas would be happy to clarify this in the final copy.

5. Size of Adult Anadromous Steelhead and Resident Rainbow Trout

Given the variation of steelhead life history traits (e.g., run timing, spawning, emergence, growth rates, freshwater residents, smolt migration timing, and saltwater residence—just to name a few), its difficult to understand why NMFS seems to believe that an inflexible classification system is available to distinguish anadromous adults from resident adults without the add of scales or otoliths. Casitas believes that life history variations of steelhead and resident rainbow trout necessitate a flexible approach that may vary from year to year. This was the primary reason for the classification of the numerous larger *O. mykiss* as "non-adult steelhead" during 2010.

Lower Size Limit of Adult Steelhead

With respect NMFS' contention that the citation of Shapovalov and Taft (1954) does not support Casitas' use of use of 38 cm TL for adult steelhead, it was intended to provide at least some logical lower limit on the size of adult steelhead that may be detected in the Ventura River. NMFS failed to notice that Shapovalov and Taft (1954) used FL while the use of the 38 cm limit was TL. The difference between the two measurements is approximately 1 cm for fish close to this size range. Therefore, the more appropriate number to compare with Shapovalov and Taft (1954) would be 37 cm. Unfortunately, Shapovalov and Taft (1954) did not include a frequency distribution of each year or total lengths they measured. So for NMFS to suggest that "many" of the 1/1 steelhead adults were < 38 cm cannot be confirmed. In addition, NMFS did not specify their definition of "many" so their contention is a bit vague considering the specificity of their assertion. Regardless, a more objective approach would be a simple calculation of Shapovalov and Taft's (1954) standard deviation (SD) for the annual means to get some idea of the underline distribution. This was done and resulted in a SD = 1.3 cm, which can be applied to the total mean of 39.1 cm from page 130 of Shapovalov and Taft (1954). Two SDs would include approximately 95% of all means if the distribution was approximately normal. The distribution was remarkably normal and passed a normality test (P > 0.20, KS Dist. = 0.17, Kolmogorov-Smirnov test of normality). Two SDs below the mean resulted in a lower limit of 36.5 cm. This is only 0.5 cm less than the 38 cm TL (37 FL) that was used in the progress report. It seems NMFS is overreaching, to say the least, by suggesting that the 38 TL limit was not supported by Shapovalov and Taft (1954). Furthermore, one of the two Shapovalov and Taft study years that NMFS referred to as having a mean FL < 38 cm actually had only one steelhead (1936-37 at 37.5 cm), which would have had a TL of approximately 38 cm. While Shapovalov and Taft's research on steelhead was seminal and extensive, it was completed almost 70 years ago in the central coast of California, which clearly has a different climate and hydrology than the Ventura Basin. Therefore, NMFS must use caution when making comparisons to the Ventura River.

NMFS' reinterpretation of their own document (NOAA Tech Memo NMFS-NWFSC-27) appears to misrepresent the meaning of what Busby et al. (1996) stated to support their assertion in the June 22nd letter. In NMFS' letter, they state "...Tech Memo-27 suggests that southern California steelhead adults are likely spawning as 2-year-olds (1/1) in our region due to rapid freshwater growth rates (Busby et al. 1996)." By contrasting this with what Busby et al. (1996) actually stated, the reader is left with a very different impression as to the likely proportion of the DPS anadromous adults that spawn as one or two salts. The excerpt below is from Busby et al. (1996) on page 26.

> Central and southern California steelhead appear to spend less time in the ocean, and they are dominated by 3-year-old (2/1) spawner. Complete life history data for southern

> California steelhead are lacking: however, it appears that it is common for these fish to smolt in 1 year (CDFG 1995). If they only have one ocean year, as neighboring populations to the north do, then adults may be spawning as 2-year-olds (1/1) in this region.

Furthermore, NMFS' reference to other works to support for their contention is questionable. NMFS states in their July 22nd letter:

> NOAA Fisheries biologist have determined that there is almost no overlap in the size distributions of anadromous adult steelhead (typically >35-cm) and *O. mykiss* that have not gone to sea (<25-cm) in central California coastal stream (Hayes et al. 2004, Pearse et al. 2009).

On page 105 of Hayes et al. (2004), it was stated that "…the number of anadromous (typically >40 cm) and resident fish (typically <25 cm)…" In fact, upon further examination of Figure 6 in Hayes et al. (2004), approximately 98.6% of the adults were ≥ 37 cm FL. Additionally, the citation of Pearse et al. (2009) by NMFS was flawed. Pearse et al. (2009) was a genetic study and only cited Hayes et al. (2004) in their method section but changed the lower limit from 40 cm to 35 cm. Pearse et al. (2009) states: "There is almost no overlap in the size distributions of anadromous adults (typically >35 cm) and fish that have not gone to sea (<25 cm) Hayes et al. (2004)." It's not clear why the change of the wording was done since Sean Hayes was a coauthor of Pearse et al. (2009); however, his statement that anadromous steelhead typically are greater than 40 cm was clear in Hayes et al. (2004).

Finally, as noted in Casitas April 29th letter sent to NMFS, there are other more applicably reference streams which could be compared to the Ventura River. "On the Santa Ynez, for example, of the 16 adult steelhead captured in traps [during 2008], the smallest adult was 49.6 cm (Scott Volan, Cachuma Operation & Maintenance Board, personal communication)." Even current data yielded similar results; through March 2011, the smallest adult steelhead captured was 48 cm.

Upper Size Limit of Resident Rainbow Trout

NMFS again relied on Hayes et al. (2004) and Pearse et al. (2009) as justification for their speculation that the upper limit for resident rainbow trout would be 25 cm in the Ventura River. The misuse of the Pearse et al. (2009) citation has already been addressed above. In regards to Hayes et al. (2004), the growth rate in Scott Creek is slower than what has been found in more southern streams. In addition, the maximum attainable size of resident rainbow trout is smaller. When more applicable data are reviewed, it's clear that small central coastal California streams are not the best available reference locations to use when trying to make extrapolations to the Ventura River. In Topanga Creek, Stillwater Sciences et al. (2010) documented *O. mykiss* between 35 cm and 60 cm FL that they presumed to be resident adults. In the Santa Ynez River, large resident rainbow trout have been document, in many cases are larger than some anadromous adult steelhead, that were in the 40-50 cm range (Scott Volan, Cachuma Operation & Maintenance Board, personal communication).

6. Classification of *O. mykiss* Riverwatcher Detections as Non-Adult Steelhead

Upon further review of the December BC committee notes, NMFS' March 22nd letter, and the previous two drafts of the 2010 progress report, the level of uncertainty as to the life history form of the *O. mykiss* that the Riverwatcher detected ≥ 30 cm was not sufficiently incorporated into the most recent draft to NMFS' satisfaction. Casitas will make that correction and incorporate additional text to indicate that level of uncertainty as recommended in NMFS' March 22nd letter. However, in NMFS' June 22nd letter, they are now recommending not just an acknowledgement of uncertainty in the *O. mykiss* classification, but reclassification to inflate the estimated number of anadromous adults.

The classification of one of the detected *O. mykiss* passing upstream through the Riverwatcher in 2010 as the only adult steelhead was done in an attempt to interpret available data (past and present), observations, and literature in a logical manner to determine the most likely correct classification. It is clear that overlapping lengths between life history stages of different life history forms (and even changing life history forms) make any consistent separation difficult. NMFS' most recent suggestion in their June 22nd letter that an additional 44 *O. mykiss* (≥ 30 cm) passing upstream should be reclassified as adult steelhead appears to dramatically inflate the estimated number of anadromous adult steelhead passing upstream through the Robles Fish Facility. The "non-adult steelhead" classification was used to address the uncertainty in the detections of *O. mykiss* by the Riverwatcher and not an attempt to classify the detections into parr, smolt, resident juvenile, or resident adult fish. Casitas made it clear that as more data becomes available, changes to increase the classification resolution could be made. As stated in the most recent draft:

> Conceivably, after more data are collected from the downstream trapping component of the monitoring and evaluation, or from other Ventura River basin research projects, a more detailed classification of Riverwatcher detections can be made.

Below is a generalized discussion of Casitas' rationale for not classifying the larger *O. mykiss* as adult anadromous steelhead. In addition, the specific number of 44 fish that NMFS has now suggested be reclassified is discussed relative to the potential error.

1. The Riverwatcher overestimates TL, as Casitas has pointed out several times, and therefore many of the larger fish are smaller than estimated. Even after attempting corrections and body depth to TL conversion, this overestimate seems likely. In addition, there appears to be large variability in Riverwatcher body depth estimates. One way to learn about the error and variability is to compare Riverwatcher estimated lengths to known fish lengths. This was reported on by Casitas in earlier progress reports and we have indicated that additional tests and verifications will be done. In relation to the actual fish in question during 2010, only 5 smolts were captured in the downstream smolt trap, which did not provide a sufficient sample for comparison to the Riverwatcher. However, during the rescue of *O. mykiss* from the receding entrance pool at the Robles Fish Facility by NMFS and CDFG (with Casitas assistance) during September of 2010, 38 *O. mykiss* were captured and moved downstream to a perennial reach of the river. *O. mykiss* FL were measured and the largest was about 38 cm.

Compared to Riverwatcher estimated lengths of known *O. mykiss*, the largest was approximately 46 cm TL; this yields a difference of approximately 7 cm. If the 44 fish ≥ 30 cm that NMFS thinks should be classified as adult steelhead were 7 cm shorter, than only 24 would have been ≥ 30 cm. In addition, that difference would also make virtually all of the larger *O. mykiss* detected by the Riverwatcher below the original 38 cm limit.

2. There appears to have been many larger resident *O. mykiss* spawning in the basin during 2010 (Lewis and Gibson 2010), which is a more plausible explanation for the larger fish detected and not the result of additional adult steelhead. The 2010 basin spawning estimate for steelhead accessible areas was 164 spawners (which represented an 865% increase over the estimated 17 spawners in 2009); however, it was concluded that the vast majority of the redds were created by resident *O. mykiss* due to redd length and other characteristics (Lewis and Gibson 2010). Approximately 90% of the redds observed during 2010 were located in San Antonio Creek (Lewis and Gibson 2010), which is downstream of the Robles Fish Facility. These resident *O. mykiss* appear to be the progeny of adult steelhead that spawned during 2008. A large portion of that 2008 year class likely did not complete the smoltification process and migrate to the ocean. They instead residualized, matured, and spawned in significant numbers beginning in 2010. As part of a basin-wide *O. mykiss* snorkel monitoring program, Casitas collects length estimates at comparable locations. At one location, in lower San Antonio Creek, the growth of some individuals from the 2008 cohort began to approach 30 cm after about 16 months of growth (Figure 1). It is therefore plausible that some portion of this 2008 cohort remained in the basin and continued to grow and represented fish in the 30-40 cm range detected migrating upstream through the Robles Fish Facility during 2010.

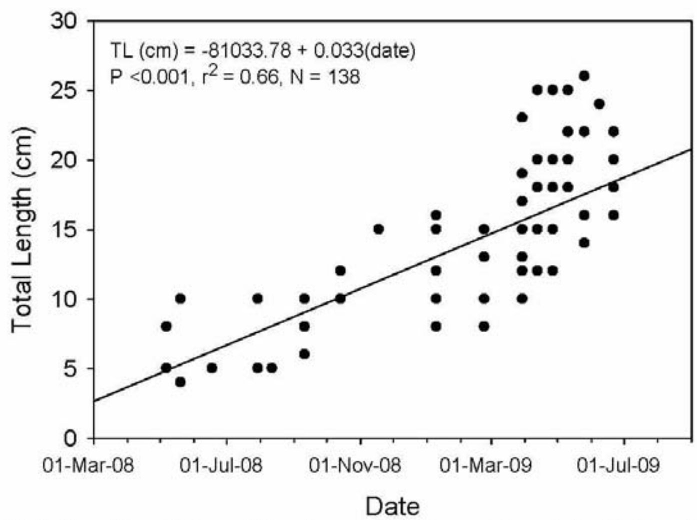

Figure 1. Total lengths of *O. mykiss* observed in lower San Antonio Creek. Each datum point represents from one to several length estimates.

3. Casitas stated in the progress report that "In addition, the length frequency distribution did not clearly indicate that the grouping of fish up to 45 cm included other anadromous adults." What was intended by this was that the Appendix 24 frequency distribution from 20 to 46 cm did not clearly indicate a modal peak that could represent some underlying distribution representing a relatively large grouping of adult steelhead as proposed by NMFS.

4. Of the *O. mykiss* in question by NMFS, most (30 of the 44) were detected after the period when adult steelhead would be expected to be migrating upstream given the precipitation pattern during 2010. In addition, this was later than adult steelhead have been observed migration upstream in the Ventura River (CMWD 2008). Furthermore, 24 of the fish in question by NMFS were detected passing upstream through the Robles Fish Facility 21-53 days past the time when a surface water connection was lost in the Robles Reach (Figure 2). This type of migration behavior would be difficult to attribute to adult steelhead. In addition, the total number of *O. mykiss* detected by the Riverwatcher can be misleading. As it has been pointed out before, it appears that the fish are moving upstream and downstream through the Robles Fish Facility on a daily basis. This would exaggerate any estimate of *O. mykiss* moving in either direction. It's anticipated the PIT tagging effort started in 2011 will develop data to better understand this behavior.

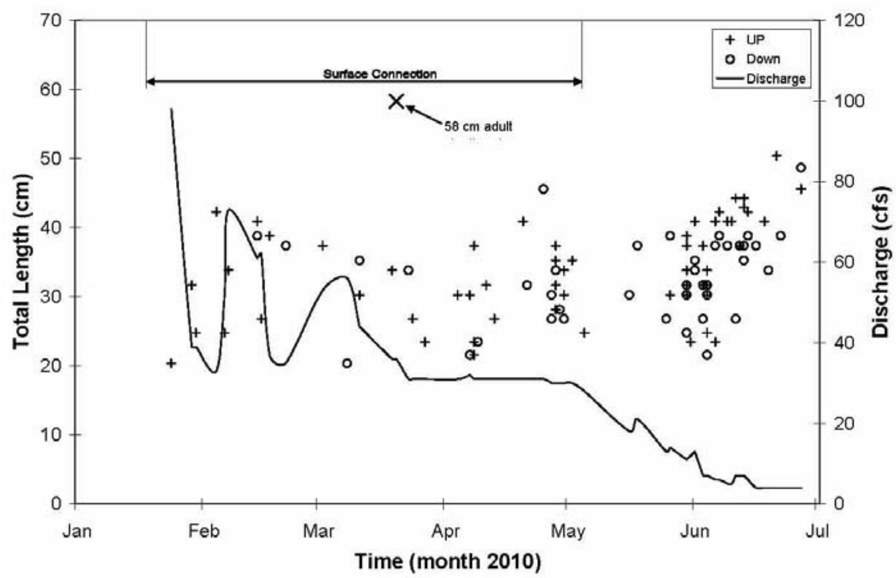

Figure 2. Time and total lengths of Riverwatcher detected *O. mykiss* during 2010 migration season with discharge downstream of Robles Fish Facility. (+) = upstream fish and (o) = downstream fish. The period when there was a surface water connection in the Robles Reach is indicated by the arrowed horizontal line.

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5. If the 44 fish in question were to be reclassified as adult steelhead, the estimated number of adult steelhead passing upstream through the Robles Fish Facility would increase dramatically from 1 to 45 adults. Given that no other surrounding basins experience such an increase that we are aware of, reclassification would result in a drastically inaccurate estimate of the true number of adult steelhead during 2010. The rational for this type of regional pattern association is based on the 2008 run year. During that year, there were six adult steelhead detected passing through the Robles Fish Facility; this represented a large increase over previous years. That same year, the surrounding regional basins also experienced relatively large increases in adult steelhead observations, which suggested a correlation of freshwater and/or ocean survival among the regional basins. This pattern should not be too surprising since there are similar geologic, climatic, hydrologic, and near shore oceanic conditions among the basins.

6. If the 44 fish in question were to be reclassified as adult steelhead, then logic would dictate that there would have been a relatively large smolt emigration during 2009 from the Ventura River (unless NMFS is suggesting that they would all be strays) to produce that many returning adults. The data that Casitas has collected would not suggest that. If a smolt to adult survival ratio (SAR) were applied to the 44 fish, an approximate number of emigrating smolts needed could be estimated. From the literature, the SARs for steelhead range widely. For winter steelhead populations along the west coast, SARs from as little of 1% up to 10% can be found. Obviously many factors play into the survival rate that vary from year to year; however, a few hypothetical examples can be developed. A SAR of 1% and 10% would require an emigration of 4,400 and 440 smolts, respectively. If a more likely SAR in the range of 2.5% were used, 1,760 smolts would have emigrated from the Ventura River. Adult steelhead in the size range of the fish in question would in all likelihood have to be 1/1 (i.e., one year in the freshwater and one year in saltwater). The number of smolts attempting to migrate downstream did appear to be substantially higher in 2009; however, due to the lack of precipitation, the surface water connection in the Robles Reach was lost before any appreciable number could have migrated downstream (CMWD 2009).

7. NMFS suggested in their June 22nd letter that the 44 fish in question were likely 1/1 adult steelhead. They cited Busby et al. (1996) and Shapovalov and Taft (1954) as justification. The irregular use of the Busby et al. (1996) citation has already been addressed in section "5. Size of Adult Anadromous Steelhead and Resident Rainbow Trout." Shapovalov and Taft (1954) did document 1/1 life history patterns, which Casitas thinks are likely to occur in the Ventura River as well; however, the percentage in their study was only 4.7%. For NMFS to suggest that the 1/1 percentage for the 2010 run year was 97.7% seems extremely unlikely and unsubstantiated. Casitas is not aware of any data from regional basins, or any other steelhead population, that would indicate such a radical life history shift. Considering that during 2008 there were 6 adult steelhead larger than 49 cm detected passing upstream through the Robles Fish Facility, a change of that magnitude seems very unlikely only two years later.

7. Rewrite of Section 3.3, Circular Logic, and 1/1 Life Histories

Regarding the rewrite of section 3.3 in the progress report, this has been addressed in section "6. Classification of *O. mykiss* Riverwatcher Detections as Non-Adult Steelhead." Concerning NMFS' claim of "circular logic" by Casitas, we were simply using the most current available data to make our determination. Moreover, it would seem hypocritical for NMFS to suggest that the use or citation of ones own data or reports would be considered "circular logic." Regarding the NMFS statement that Casitas assumed that no 1/1 steelhead spawn in the Ventura River, this is simply an inaccurate assumption by NMFS.

8. Length Frequency Interpretation and Undetected Adult Steelhead

The length frequency interpretation issue was clarified in section 6.3 above. NMFS misunderstood what was stated in the progress report. No reference to the 58 cm adult was intended as they have assumed in their June 22^{nd} letter. NMFS should review the report and section 6.3 above for clarification.

With regards to NMFS' suggestion that some unknown but significant number of adult steelhead could have passed upstream without being detected, it is simply unsupported speculation. The 58 cm adult in 2010, that was not detected moving downstream occurred because it moved very slow backwards through the Riverwatcher scanners, which is outside of the Riverwatcher detection capabilities. Casitas believes the circumstances of this occurrence were abnormal and the likelihood of not detecting an upstream migrating adult steelhead is very low. In fact, that same steelhead was detected both times it passed upstream through the Riverwatcher.

The suggestion by NMFS that because adult steelhead are large fish that they will migrate upstream during times of high turbidity is baseless. As discussed in previous progress reports, the Riverwatcher operates up to about 100 NTUs; the video is simply not able to capture an image until the turbidity decreases to about 30 NTUs. For example, during 2008 there were 6 adult steelhead detected passing upstream. The turbidity during the period steelhead passed upstream ranged from 5 to 23 NTUs ($\bar{x}$ = 13.5, 95% CI = 9.4) and the number of days past the peak discharge ranged from 4 to 26 days. The conditions when the crowder is usually removed from the fish bypass coincided with times that there is very high discharge and turbidity. This is usually just before the peak discharge and within 24-48 hours after the peak. The crowder is usually reinstalled before the turbidity drops below the 100 NTU upper limit so any fish that may pass during higher turbidity (100-30 NTUs) could be detected. However, no fish have been detected to date. Casitas is not aware of any literature that would indicate that steelhead migrate upstream in turbidity greater than about 40 NTUs. NMFS should provide more credible evidence than just the chain-of-reasoning in their June 22^{nd} letter that "…larger fish are more powerful swimmers…which imparts the ability to migrate during periods when river discharge and turbidity…are exceeding elevated…" to suggest that the probability of not detecting adult steelhead at higher turbidity (> 100 NTUs) is anything but exceedingly remote. The total of 8 hours that the crowder was removed for cleaning was a more likely time when an adult steelhead could have passed upstream without being detection; however, given that the 8 hours only represented about 0.2% of the total time the crowder could have been installed would indicate the probability was very small.

9. Flow Assessment

There were actually three BO defined storm peaks that required supplemental flow releases and not two as NMFS stated in their June 22nd letter. Therefore, the Riverwatcher was operational approximately 85% of the time there were releases downstream ≥ 50 cfs. However, NMFS is assuming that adult steelhead are only able to migrated upstream when the discharge is ≥ 50 cfs. This does not reflect the available data available from the Ventura River. For example, during 2010, the 58 cm adult steelhead was detected passing upstream when the discharge was 36 cfs. Ironically, most of the fish in question by NMFS were actually detected passing upstream when the discharge was < 30 cfs (Figure 2).

Regarding the ladder flow discrepancy between 2010 and 2011, the flow estimates of the ladder have not been accurate since the instillation of the new fish crowder. The new crowder creates a head difference greater than the original crowder did. The flow transducers upstream of the crowder need to be moved upstream far enough out of the new crowder's influence. This is planned to be completed in the late summer or fall during the annual maintenance period. This error was corrected in the flow data that was sent to NMFS for 2011.

Casitas is committed to conducting the monitoring and evaluation of the Robles Facility as specified in the Biological Opinion and participating in the Cooperative Decision Making Process to further improve aspects of studies as needed. If BOR, NMFS, or CDFG would like to discuss any of these issues further, please contact me at your convenience.

Respectfully,

Scott Lewis

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Literature Cited

Cooke, R. U., A. Warren, and A. S. Goudie. 1992. Desert geomorphology. UCL Press, London.

CMWD. 2008. 2008 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2009. 2009 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

ENTRIX. 1999. Evaluations of natural passage barriers on the Ventura River downstream of Robles Diversion. Entrix, Walnut Creek, CA.

Harrison, L. R., E. A. Keller, E. Kelley, and L. A. K. Mertes. 2006. Minimum flow requirements for southern steelhead passage on the lower Santa Clara River, CA. University of California, Santa Barbara.

Hayes, S. A., M. H. Bond, C. V. Hanson, and R. B. MacFarlane. Interaction between endangered wild and hatchery salmonids: can the pitfalls of artificial propagation be avoided in small coastal streams? Journal of Fish Biology, 65(Supplement A):101-121.

Lewis, S. D. and M. W. Gibson 2010. Coastal steelhead and rainbow trout (*Oncorhynchus mykiss irideus*) spawning surveys and population estimates in the Ventura River Basin, California. Casitas Municipal Water District, Oak View, CA.

Lewis, S. D. and M. W. Gibson 2011. 2011 monitoring and evaluation study plan for the Robles Fish Passage Facility and related studies (draft). Casitas Municipal Water District, Oak View, CA.

National Marine Fisheries Service. 2003. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

Pearse, D. E., S. A. Hayes, M. H. Bond, D. V. Hanson, E. D. Anderson, R. B. MacFarlane, and J. C. Garza. Over the falls? Rapid evolution of ecotypic differentiation in steelhead/rainbow trout (*Oncorhynchus mykiss*). Journal of Heredity, 100(5):515-525.

State Water Resources Control Board (SWRCB). 2008. Protectiveness of draft guideline alternatives. Appendix G, Approach for assessing effects of policy element alternatives on upstream passage and spawning habitat availability *in* North coast instream flow policy: scientific basin and development of alternatives protecting anadromous salmonids. California State Water Resources Control Board, Sacramento, California.

Stillwater Sciences, R. Dagit, and J. C. Garza. 2010. Lifecycle monitoring of *O. mykiss* in Topanga Creek, California. Prepared for California Department of Fish and Game Contract No. P0750021.

Tan, S. S., and T. A. Jones. 2006. Geologic map of the Matilija 7.5' quadrangle Ventura County, California: a digital database. Version 1.0, Los Angeles, CA.

Thompson, K. 1972. Determining stream flows for fish life. Pacific Northwest River Basins Commission, instream flow requirements workshop. Portland, Oregon. Proceedings: 31-50.

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2002/11871: RAB

September 29, 2011

Ned Gruenhagen
Bureau of Reclamation
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Dear Mr. Gruenhagen:

NOAA's National Marine Fisheries Service (NMFS) is contacting the Bureau of Reclamation (Reclamation) in regards to our letters of February 3, 2011, March 22, 2011, and June 22, 2011, and Biological Committee conference call on September 26, 2011. NMFS has reviewed Casitas Municipal Water District's (Casitas) monitoring and evaluation activities associated with the operation of the Robles Fish Passage Facility (Facility) targeted at improving endangered steelhead (*Oncorhynchus mykiss*) passage conditions in the Ventura River. NMFS has dedicated a significant amount of time providing recommendations to improve the efficacy of these monitoring and evaluation activities.

Based on the framework of the Cooperative Decision Making Process described in the Robles Biological Opinion, it is NMFS' role as a member of the Biological Committee to provide technical guidance to the Management Committee. Reclamation serves as Chair of the Management Committee, and is required to make final decisions regarding Robles Operation (including monitoring and evaluation activities) based on the information and recommendations provided from the Biological Committee. In this context, the goals of this letter are to reiterate NMFS' recommendations discussed during the call on September 26, 2011, to ensure the Facility monitoring is conducted in accordance with the Biological Opinion, and clear up any remaining Biological Committee misunderstandings that were not discussed during the conference call due to time limitations. NMFS requests that Reclamation review the recommendations provided in this current letter and previous correspondences and advise Casitas to 1) monitor the upstream steelhead impediment evaluation sites selected by the Biological Committee (including changes described in NMFS' letters), and 2) report all *O. mykiss* estimated length and migration direction and avoid speculation as to which *O. mykiss* should be classified as adults. NMFS would like to be copied on the letter from Reclamation that provides this guidance to Casitas.

1. Upstream Steelhead Impediment Evaluation

NMFS and CDFG have provided clear, consistent guidance on monitoring the same sites identified, and collectively agreed upon, by the Biological Committee in 2009 (excluding site 1). Because the sites were selected by the Biological Committee using the Cooperative Decision Making Process, any modifications to impediment evaluation sites must be conducted using the same process. Casitas made some in-season modifications to the 2011 impediment evaluation sites due to a March 2011 high-flow event without consulting with the Biological Committee. At its upcoming meeting, the Biological Committee will review these changes and the data collected and coordinate a site visit to make recommendations for the 2012 Monitoring Plan.

Rationale for Monitoring All Ventura River Impediments Downstream of Robles.— **NMFS recommends that impediment evaluations continue to occur at impediments identified throughout the Ventura River downstream of the Facility.** The rationale for NMFS' recommendation is provided in the Biological Opinion. Starting on page 2 of the Biological Opinion, NMFS defines the area affected by the proposed action as including the entire 26-km of mainstem Ventura River to the Pacific Ocean. On page 17 of the Biological Opinion, NMFS states that the proposed evaluation and monitoring activities have been developed to determine if the operations at the Robles Diversion are enhancing the opportunity for steelhead to migrate upstream to the Facility. Monitoring sites downstream of the Robles reach is necessary to determine if sufficient instream flows exist in the Ventura River from the river mouth upstream to the Facility during the fish passage augmentation season when Casitas is diverting streamflow.

Site 5 Primary Flow Channel Recommendation.— NMFS recommended conducting transect measurements at site 5 in the primary channel based on the assumption that steelhead would likely ascend the channel that carries the bulk of the flow. NMFS is not confused about our previous recommendation as was recently suggested, but rather NMFS is attempting to work cooperatively with Casitas at Site 5 to find an agreeable solution to continue monitoring at the selected site in light of the fact that the channel characteristics suggest it may create an impediment. Since one year of flow measurements have been collected at the site 5 primary channel, it is logical and appropriate to continue the duration of the monitoring effort at this site to capture the natural variation of water conditions that exist. To further the collaborative process of assessing the difficulty of monitoring at this site, NMFS visited site 5 on March 1, 2011, with Casitas and Reclamation and determined our recommendation to collect measurements in the primary flow channel was supported by the conditions observed (~50 cfs). **In the event one of the other impediment evaluation sites develops a braided channel, NMFS recommends Reclamation advise Casitas to take measurements in both channels as conducted in 2010 at site 5 and present all measurement data for both channels as Casitas did in the Draft 2010 Annual Report for Biological Committee review.**

Data Variability and Site Specific Discharge.—To improve the Biological Committee's ability to evaluate and interpret future impediment monitoring results, NMFS and CDFG recommended measuring Ventura River discharge at each impediment evaluation site in our February 3, 2011 letter. During our March 1, 2011, site visit, NMFS learned it is Casitas' standard procedure to measure water velocity during all impediment transect measurements. **NMFS reiterates our recommendation that Reclamation advise Casitas to provide the site specific discharge measurements collected at impediment evaluation sites 2 – 8 in the 2010 and future Annual Reports.** NMFS believes excluding this information from Biological Committee review handicaps the Cooperative Decision Making Process in determining if the operations at the Robles Diversion are enhancing the opportunity for steelhead to migrate upstream to the Facility.

Impediment Site Evaluation Upstream of the Highway 150 Bridge.—The Biological Opinion states that all potential impediments to upstream fish migration shall be identified and monitored closely during the fish migration season to better understand fish passage limitations at these individual sites. **NMFS reiterates our recommendation that Reclamation advise Casitas to monitor an impediment site ~ 200-meter upstream of Highway 150 bridge** (see February 3, 2011, letter). Casitas reasoned that monitoring was occurring at seven sites and that an eighth site was not needed. Further review indicates that Casitas' impediment monitoring occurred only at six sites in 2011. NMFS does not support reducing the overall number of monitoring sites. Observations of intermittent streamflow were made by NMFS staff in 2011 on the Ventura River while conducting surveys about 200-meters upstream of Highway 150. These dry channel observations are significant because they were noted repeatedly during the steelhead migration and spawning season, and completely block all fish passage at this point in the river. Based on corresponding Robles discharge data (i.e., downstream releases) at the time of the observations, it appears that the mainstem Ventura River channel at this site can be dry when passage is deemed sufficient at other impediment monitoring sites. The functional effect of averaging the results of all the impediment sites lessens the severity of the true impediments that exist downstream of the Facility. Because the focus of the impediment evaluation is to identify a flow regime that allows for steelhead migration upstream to the Facility, evaluation of results for each individual site allow for identification of the necessary flows that afford unimpeded passage conditions throughout the entire 24-km reach of the Ventura River below the Facility.

ENTRIX 1999 Study Comparison.—ENTRIX (1999) completed a steelhead passage assessment of all low flow barriers observed in the 24-km reach of the Ventura River downstream of the Facility. The purpose of the assessment was to determine the most restrictive transects for fish passage and incorporate the corresponding minimum streamflow information for steelhead passage into the Robles Fish Passage Facility Biological Assessment. To determine the necessary streamflow, eleven transects at seven sites were evaluated using the Thompson (1972) method. The ENTRIX results indicate that the minimum flow allowing steelhead to migrate upstream lies in the range of 40 to 65 cfs. ENTRIX's recommendation is based on the minimum flow required for steelhead passage at the most restrictive sites, using the Thompson Criteria for the upper end of the flow recommendation (i.e., 65-cfs) and the 8-foot width criteria at 0.6-ft depth for the lower end of the range (i.e., 40-cfs). Applying the ENTRIX criteria to the Casitas data in the revised draft 2010 Report indicates that the minimum flow allowing steelhead to migrate upstream ranges from 68 to 138-cfs.

NMFS understands that river channel characteristics change over time (hence the reason to monitor numerous impediments over a period of years), but it is interesting to compare ENTRIX's most restrictive sites for steelhead passage to Casitas' 2010 results. ENTRIX determined their site located downstream of the Arroyo Mobile Home Park, and just upstream of Highway 150 bridge required the highest discharge for passage. Casitas' impediment site 3 is also located downstream of the Arroyo Mobile Home Park and was determined to be the second most restrictive passage site in 2010. A relatively short distance (~250-m) separates the second most restrictive impediment sites determined by both steelhead passage assessments on the Ventura River (Figure 1). NMFS recently learned that site 3 was replaced with a new impediment site due to site changes. ENTRIX's most restrictive site was located upstream of Highway 150 (Thompson method). Despite recommendations made by NMFS and CDFG, Casitas has ignored Biological Committee input and the Cooperative Decision Making Process by deciding not to monitor this location. In addition to monitoring at all sites selected by the Biological Committee, **NMFS recommends that Reclamation advise Casitas to evaluate the minimum discharge required for steelhead passage by focusing only on the site that creates the greatest passage difficulty as recommended by other studies (Reinfelds et al. 2010, Reiser et al 2006, ENTRIX 1999).**

2. Adult Steelhead Classification

Visual scale analysis of numerous cohorts across a wide age range can provide a foundation for differentiating age and attributing temporal growth periodicity between life stages. Using scale growth patterns to differentiate estuarine/marine growth from riverine growth can be achieved, but uncertainty exists without validation of the results. The fact that there is the potential for size range overlap between the co-occuring life forms further complicates correct classification. Chemical analysis of calcified structures can provide a reliable method to differentiate fish growth in fresh and saltwater (Campana and Thorrold 2001), but the method requires lethal sampling. Therefore, NMFS does not believe it is possible to distinguish adult steelhead from resident *O. mykiss* in anadromous stream reaches with any level of certainty using the methods described in Casitas' study plan, nor is it necessary to make such distinctions to fulfill the purpose of the Biological Opinion monitoring. **NMFS recommends that Reclamation advise Casitas to avoid speculation and eliminate the inconsistent classification of adult steelhead in the Annual Report and Monitoring Plan.** Instead of classifying individual *O. mykiss* as "adult steelhead" versus "*O. mykiss* non-adult steelhead" without the necessary data (i.e., otolith, scale analysis, DNA) to support the life history determination, simply document all *O. mykiss* estimated total lengths for upstream and downstream migrants.

Is *NMFS attempting to artificially inflate the steelhead population in the Ventura River by recommending an overly inclusive size limit for adult steelhead?*—NMFS reassures Reclamation that this claim is inaccurate. During the 2010 Biological Committee meeting on December 1, 2010, Reclamation asked for clarification on how other researchers differentiate adult steelhead based on size. In our March 22, 2011, letter summarizing the Biological Committee meeting, NMFS cited what we believe to be the best available science (see discussion below) based on published peer-reviewed studies. In response to Casitas' reference of NMFS using the Robles ladder counts to evaluate recovery of the Southern California steelhead Distinct Population

Segment (DPS), NMFS notes that the Robles Biological Opinion monitoring is defined as "effectiveness monitoring" (Boughton 2010). The effectiveness monitoring for the Robles Biological Opinion is designed to evaluate the Facility operation criteria, not evaluate the condition of the DPS population as a whole to judge its status toward recovery.

Is NMFS reference to the best available science limited in scope and outside the local DPS?— NMFS is required to rely on the best available scientific information to make well-informed decisions. Casitas' suggestion to utilize findings from scientific studies that are conducted within the Southern California steelhead DPS is agreeable with NMFS, but we are not limited to considering only studies conducted within the DPS. Unfortunately, very few published and peer-reviewed scientific studies documenting basic steelhead life history characteristics at the southern extent of the species range exist. In such cases, NMFS is required to then look to other best available information to inform its analyses and determinations. Casitas has questioned NMFS' reference to recent scientific studies conducted in central California coastal watersheds due to differences in geography and watershed size. NMFS notes numerous references in Casitas' 2010 Annual Report and 2011 Monitoring Plan demonstrate reliance on studies conducted in these same central California rivers, observations made in the Southern hemisphere and watersheds (Topanga Creek, 19-mi^2) that are about half the size of those cited by NMFS in central California (Scott Creek, 39- mi^2).

Casitas concluded that that there appears to have been many larger resident *O. mykiss* spawning in the Ventura River during 2010 (Lewis and Gibson 2010). Review of Lewis and Gibson (2010) indicates that a wide size range of redds were observed ranging in length from 0.35 to 2.03-m. Lewis and Gibson compared the Ventura River results to mean rainbow trout redd lengths and other characteristics measured on the Deshutes River in northern Oregon (Zimmerman and Reeves 2000), and concluded the vast majority of the Ventura River redds were constructed by resident fish. While NMFS does not disagree that resident *O. mykiss* may contribute to steelhead production in the Ventura River watershed, we find Casitas' comparison to a hydrologically different inland watershed in the Pacific Northwest to lack regional support for their conclusion. On the Santa Ynez River, Reclamation (2011) reported that the Cachuma Operation and Maintenance Board (COMB) uses a 0.91-m length criteria to differentiate anadromous steelhead redds from smaller resident *O. mykiss* spawning nests. While Lewis and Gibson (2010) did not report individual redd lengths, we see that their observed mean redd length of 0.97-m exceeds the COMB steelhead criteria. Unlike the Ventura, the Deschutes River is well known for its stability of flow, which is more uniform than any other river of its size (Zimmerman and Reeves 2000). Flows in the study area are regulated by dams and ranged from 4060 to 6320-cfs (Zimmerman and Reeves 2000), which contribute to a world-class tailrace fishery for native "redband" rainbow trout that range from 25 to 50-cm (ODFW website). NMFS agrees that physical redd characteristics are difficult to analyze with other comparative studies in southern California and warns that Casitas should exercise caution in drawing conclusions on these data.

In summary, NMFS recommends that Reclamation advise Casitas to 1) monitor the same impediment evaluation sites selected by the Biological Committee in 2009 (exchanging site near Highway 150 for Sandbar), and 2) report all *O. mykiss* length and migration direction in the Annual Reports and avoid speculation as to which *O. mykiss* should be classified as adults. The Monitoring and Evaluation component of the Incidental Take Statement (ITS) is mandatory for continued application of the section 7 (o)(2) exemption. If Reclamation fails to assume and implement the terms and conditions or fails to require Casitas to adhere to the terms and conditions of the ITS, the Robles Facility protective coverage of section 7 may lapse. Please contact Rick Bush at (562) 980-3562 to discuss the recommendations contained in this letter.

Sincerely,

Penny Ruvelas
Southern California Area Office Supervisor
for Protected Resources

cc: Scott Lewis, Casitas Municipal Water District
Mary Larson, California Department of Fish and Game
Roger Root, U.S. Fish and Wildlife Service
Administrative file#: 151422SWR2002PR6168

Literature Cited

Boughton, D. A. 2010. Some Research Questions On Recovery of Steelhead On the South-Central and Southern California Coast. NOAA Tech. Memo. NMFS-SWFSC 467.

Campana, S. E. and S. R. Thorrold. 2001. Otoliths, increments, and elements: keys to a comprehensive understanding of fish populations? Can. J. Fish. Aquat. Sci. 58: 30–38.

ENTRIX. 1999. Evaluation of Natural Passage Barriers on the Ventura River Downstream Of Robles Diversion. Prepared for Borcalli and Associates, December 2, 1999.

Reclamation. 2011. Cachuma Project 2008 Annual Monitoring Report and Trend Analysis for 2005-2008. Prepared for National Marine Fisheries Service, June 23, 2011.

Reinfelds, I., M. Lincoln-Smith, T. Haeusler, D. Ryan, and I. Growns. 2010. Hyraulic Assessment of Environmental Flow Regimes to Facilitate Fish Passage Through Natural Riffles: Shoalhaven River Below Tallowa Dam, NSW. River Res. Applic. 26: 589-604.

Reiser, D. W., C. Huang, S. Beck, M. Gagner and E. Jeanes. 2006. Defining Flow Windows for Upstream Passage of Adult Anadromous Salmonids at Cascades and Falls. TAFS, 135:668-679.

Zimmerman, C. E. and Reeves, G. H. 2000. Population structure of sympatric anadromous and nonanadromous *O. mykiss*: evidence from spawning surveys and otolith microchemistry. Canadian Journal of Fisheries and Aquatic Sciences 57:2152–2162.

Figure 1. Upper green arrow represents the approximate location of ENTRIX's (1999) Site 7 located about 200-m downstream of Arroyo Mobile Home Park. Lower green arrow represents Casitas' Site 3. Both sites are bordered by Casitas Springs Levee on East bank, and located at similar channel features.

2012 Robles Fish Passage Facility
Progress Report

Ventura River channel in the Robles Reach downstream of Hwy 150 during March of 2012. Due to low precipitation, the river channel was dry throughout the steelhead migration season.

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1.0 EXECUTIVE SUMMARY

Casitas Municipal Water District (CMWD) is implementing the Robles Fish Passage Facility Project (Robles Fish Facility) described in the Biological Assessment (BA) proposed by Bureau of Reclamation (USBOR 2003). The affects of the Robles Fish Facility were analyzed in the Biological Opinion (BO) prepared by the National Marine Fisheries Service (NMFS 2003a). This 2012 Robles Fish Passage Facility Progress Report, as described by the BO, is the culmination of monitoring, evaluation, and operational data collected during the reporting period of 01 July 2011 to 30 June 2012.

The monitoring and evaluation studies related to the Robles Fish Facility conducted during the 2011-2012 reporting period are included in two main sections of this progress report. The Fisheries Monitoring and Evaluation section includes: upstream fish migration impediment evaluation, sandbar monitoring at the mouth of the Ventura River, fish attraction evaluation, fish passage monitoring, downstream fish passage evaluations, and downstream fish migration through the Robles Reach. The Facility Operation section includes: information and data on the facility status, flow observations and control, costs associated with operation and monitoring, assessment of the effectiveness to provide fish passage, recommendations of priorities for future activities, and revisions deemed necessary to the operations.

Because little precipitation occurred during the migration season, the resulting low river flows did not make it possible to collect data and evaluate potential impediments to upstream fish migration during 2012. The sandbar at the mouth of the Ventura River was closed only for short periods during December 2011 and January 2012 and was open for potential volitional steelhead passage during the remainder of the reporting period. A total of 378 *Oncorhynchus mykiss* were counted in the area upstream and downstream of the Robles Fish Facility during the fish attraction evaluations in 2012. This number likely represents multiple counts of some *O. mykiss* due to smolting rates and migration behavior. During the fish passage monitoring, 659 *O. mykiss* were detected migrating through the Robles Fish Facility in 2012.

2.0 INTRODUCTION

NOAA Fisheries listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA, 16 U.S.C. § 1531 et. seq.) of 1973, as amended. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) that were considered to be substantially isolated from other steelhead stocks reproductively and were an important part of the evolutionary legacy of the species. The southern California steelhead ESU included, at that time, steelhead populations from the Santa Maria River in San Luis Obispo County south to Malibu Creek in Los Angeles County. The ESU was later extended to the US/Mexican border in San Diego County during 2002 (NMFS 2003b). In a later delineating approach, NOAA Fisheries recognized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) as described under the ESA (NMFS 2005). The DPS policy differs from the ESU by delineating a group of organisms by "marked separation" rather than "substantial reproductive isolation". In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated, are still part of the ESU; however, the anadromous *O. mykiss* (i.e., steelhead) are now part of a smaller subset identified as the southern California steelhead DPS.

Rainbow trout (*O. mykiss*) can be generally organized into four large groupings (Behnke 1992; Scott and Crossman 1973): 1) coastal rainbow trout that extend from northern Baja California to northern Alaska near the Kuskokwim River and also the Kamchatkan Peninsula of northeastern Asia, 2) redband trout of the inland Columbia and Frazer River basins, 3) redband trout of the central valley of California, and 4) trout of the Gulf of California drainages. The taxonomic group of coastal rainbow trout, *O. m. irideus*, exhibit two life history forms; anadromous and resident. The common name for the anadromous life history form is termed steelhead trout and the resident form is generally termed rainbow trout. Throughout the range of coastal rainbow trout, there is a widespread occurrence of the anadromous life history form (Behnke 1992). There are two general life history patterns exhibited by adult anadromous steelhead when they return from the ocean to spawn in fresh water. The patterns are grouped by either summer or winter spawning runs. There are many exceptions to this pattern, but this general characterization has been used to group steelhead spawning runs by the season in which the peak occurs as they return from the ocean (Busby et al. 1996). Summer steelhead are generally found in river systems that drain from farther inland, such as the Columbia River basin. Winter steelhead runs are typically found in the coastal systems where the river systems are not as large. The winter steelhead life history pattern is the most abundant anadromous life history within the natural range of the species (Busby et al. 1996).

3.0 FISHERIES MONITORING AND EVALUATION

The monitoring and evaluation studies and activities related to the modification of the Robles Facility, as outlined in the BO (NMFS 2003a), were intended to achieve three main objectives:

I. Monitor Fish Passage Facility operations and performance.

II. Determine if the Fish Passage Facility functions and operates in such a fashion that migrating steelhead:

    a. Successfully navigate into and through the facility, and
    b. Move through the facility in good physical condition.

III. Determine if the operations at the Robles Diversion are enhancing the opportunity for:

    a. Adult steelhead to migrate upstream to the Robles Facility, and
    b. Smolts and kelts to migrate downstream through the Robles Reach.

5-year Reevaluation of Initial Evaluation and Monitoring Activities

As described in the BO, a 5-year reevaluation of the initial fish flow operations would be conducted to determine if monitoring and evaluations have been completed (NMFS 2003a). The initiation of the 5-year period began in 2006, which was the first year the Robles Fish Facility was fully operational. An annual and ongoing reevaluation began after the 2010 fish passage season. Through the Cooperative Decision Making Process, the Robles Biological Committee will review each of the specific evaluations and determine if the original objectives have been addressed and could be discontinued or if additional study would be needed. It is recommended that all aspects of the monitoring and evaluation for the Robles Fish Facility be continued during 2013. Due to the variable water conditions and insufficient number of adult and juvenile steelhead, the objectives of the monitoring and evaluation program have not been accomplished. Each aspect of the monitoring and evaluation will be evaluated annually to determine if sufficient information exist to complete each objective.

3.1 Upstream Fish Migration Impediment Evaluation

Introduction

The ability of adult steelhead to swim upstream can be impeded during the migration season at times of low-river flow (NMFS 2003a). Evaluations at shallow water habitat units (i.e., critical riffles) have been commonly used as a method to determine if impediments exist for adult and juvenile steelhead in California rivers (Dettman and Kelley 1986; Bratovich and Kelley 1988; Hager 1996). The Robles Reach, which extends downstream from the Robles Fish Facility approximately 6.5 km (NMFS 2003a) to just upstream of the Santa Ana Boulevard bridge (Appendix 1), is a wide alluvial section of the Ventura River that is composed of active wash deposits of unconsolidated silt, sand, gravel, and boulders (Tan and Jones 2006). Due to this type of channel morphology and geology, alluvial channels like the Robles Reach have high infiltration rates that cause channel surface flow to rapidly recede and cease shortly after storm events (Cooke et al. 1992).

An initial assessment of potential passage impediments in relation to river discharge was completed by ENTRIX (1999). The physical characteristics of seven potential impediments were evaluated using the Thompson (1972) passage criteria. The Thompson (1972) passage criteria for adult steelhead at critical riffles is a water depth of 0.6 ft for 25% of the total transect width and a continuous portion equal to 10% of the total transect width. ENTRIX (1999) also evaluated the potential impediments using a criteria of 0.5 ft and 0.6 ft depth for 25% of the total width and a total of 8 ft width for both depths. The resulting discharge required was estimated to be between 40 and 65 cfs. There have been several modifications to the Thompson passage criteria by other researchers; Dettman and Kelly (1986) on the Carmel River used a depth of 0.6 ft over a 5 ft continuous section, a criteria of 0.6 ft depth over an 8 ft section was used on the Santa Ynez River (SYRTAC 2000), and Harrison et al. (2006) used a criteria of 0.6 ft depth over a 10 ft section on the Santa Clara River. Thompson's (1972) depth criterion of 0.6 ft was not based on actual migration observations and was never validated as a minimum condition for passage. It has been observed that adult salmonids can successfully move through shallower riffles than the 0.6 ft criterion (Mosley 1982).

The objective of the impediment evaluation is to assess factors that may impede steelhead's ability to migrate to the Robles Fish Facility (NMFS 2003a). Because of the potential for low-river flows to impede upstream fish migration, the Robles Reach will be the primary focus of the impediment evaluations (NMFS 2003a).

Methods

Selected channel features that may pose an impediment to upstream passage were to be surveyed multiple times during the fish migration season (January through June) to measure water depth, velocity, and channel width along a transect at each site. The selected sites were planned to be surveyed over a range of discharges from approximately 30-100 cfs (the upper limit is dependent on the ability to safely conduct the surveys), which is correlated with discharge at the Robles Fish Facility. The number of repeated surveys has been dependent on the number and duration of significant rain events, rate of hydrograph recession, and time constraints due to other aspects of the monitoring and evaluation program. The impediment surveys will most likely be conducted over a period of 3-4 years given the natural variation of water conditions. The selected impediment sites will be resurveyed as many times as needed to develop a statistically rigorous data set to evaluate fish passage in relation to Robles Fish Facility discharge.

During the initial phase, the Ventura River was surveyed from the mouth to the Robles Fish Facility (23 km) using standard stream survey techniques and was completed in 2008 (CMWD 2008). This provided physical measurements of all habitat units for the selection process. The survey methodology followed Moore et al. (2002) and was equivalent to a level IV survey as described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002).

Over the course of three meetings and one conference call between 24 January and 18 June of 2009, the Biological Committee (BC) for the Robles Fish Facility completed an impediment site selection process that culminated in the original selection of eight sites that would be monitored for the impediment evaluation. The BC reviewed physical parameters of the 379 habitat units surveyed and general river characteristics that included: unit type, length, width, water depth, slope, longitudinal location (river km), step height on step units, discharge at Foster Park and the Robles Fish Facility at the time of the surveys, and a river profile for the 23 km of the Ventura River surveyed. Upon completing an initial assessment of this data, a list of potential sites was developed that the BC visited in the field on 27 May 2009 to determine if monitoring was warranted. This data and field assessment included regular BC members Mike Kinsey (BOR), Stan Glowacki (NMFS), Mary Larson (CDFG), and Scott Lewis (CMWD). Mike Gibson (CMWD) and hydrologists Bob Hughes (CDFG) and David Crowder (NMFS) were also involved in this assessment and selection process.

ENTRIX Site Assessments

An effort was made to locate and determine the status of the ENTRIX (1999) sites during 2009. Because there had been numerous bed-mobilizing runoff events after the study was completed, the status of the sites was unknown and needed to be determined. Based on the site descriptions in the ENTRIX (1999) study report, field surveys were conducted to locate and describe the existing channel conditions at the original site locations. Of the seven sites originally identified by ENTRIX (1999), only four sites were located with any degree of certainty. Of those four sites, all were no longer in the primary low-flow channel. A more detailed description of the ENTRIX sites can be found in the previous progress report (CMWD 2011).

Results

During 2012, dry conditions prevented data collection for the Upstream Fish Migration Impediment Evaluation. Precipitation in the Ventura Basin was 50-60% of normal for the 2012 water year. Discharge from the Robles Fish Facility ranged from 0 to 26 cfs. There were three small rain events from mid March to mid April, 2012, however, they were not sufficient to create the discharge needed to conduct the impediment evaluations.

The moderately sized flow event that peaked on 20 March 2011 at approximately 20,000 cfs at the USGS Foster Park gage station, a recurrence interval of about 6 years, significantly altered some impediments sites that necessitated modifications to the monitoring. See CMWD (2011) for a detailed description of the high-flow caused site alterations. A Biological Committee (BC) field trip on 11 January 2012 was conducted to review alterations that occurred and select replacement sites for ones that no longer appeared to be impediments. Regular BC members Ned Gruenhagen (BOR), Rick Bush (NMFS), Mary Larson (CDFG), and Scott Lewis (CMWD) participated in this review and site-selection process; Mike Gibson (CMWD) and hydrologist Bob Hughes (CDFG) were also involved in this assessment and selection process.

Based on this field review, Site 2 was no longer considered a potential impediment. Site 10 and was identified as a replacement site during the January field trip. Site 8, which was originally selected during dry conditions, was not considered as restrictive as other potential sites after evaluating data collected during 2010 and 2011. Consequently, Site 8 was replaced with Site 9 during the January field trip. The complete list of impediment sites that the BC visited and determined to be satisfactory for monitoring during the 2012 season can be found in Appendix 2. However, at the time the new site selections were made (i.e., 11 January 2012), insufficient flows were available to make final site selection or transect placements. As soon as sufficient flows are available, members of the BC will visit sites 9 and 10. If, after further evaluations with sufficient flows, Site 10 does not appear to be adequate, then Site 8 will continue to be monitored.

Discussion

Flows have been inadequate to be able to identify all replacement sampling sites, and this task will be accomplished as conditions permit.

3.1.1 Sandbar Monitoring

Introduction

The Ventura River, like many other California rivers, frequently develops a seasonal sandbar at the mouth during the late spring or summer that is breached by higher river flows in the late fall or winter. If a sandbar does develop, which occurs more often during dry years, the resulting lagoon can provide important rearing habitat for steelhead juveniles because of the abundant food resources available that can facilitate the physiological and behavioral changes associated with smoltification (Cannata 1998) and can also enhance marine survival (Bond et al. 2008).

The primary objective of the sandbar monitoring is to determine if the criteria for initiation of the fish passage augmentation season have been met (NMFS 2003a). As stipulated in the BO, the fish passage augmentation season will extend from 01 January through 30 June of each year and will commence after the sandbar has been breached at least once during the current year's fish flow operations season. During the fish passage augmentation season, several Robles Fish Facility operation criteria must also be implemented (see NMFS 2003a for a complete list of operational criteria).

Methods

During each sandbar inspection, observations and recordings were made that included: date, time, status of the sandbar, general location of the mouth, tidal stage, water temperature, and discharge at the Robles Fish Facility and the USGS Foster Park gage station. Because the sandbar was open on 01 January 2012, its status was monitored once every two weeks for the remainder of the fish passage season. During the remainder of the year, the sandbar was monitored at least monthly.

Results

During the reporting period, July 2011 through June 2012, the mouth of the Ventura River was inspected 19 times to determine if the sandbar was open or closed. Twelve of the observations occurred during the fish passage augmentation season (01 January to 30 June 2012) and seven were outside of the fish passage augmentation season. The sandbar was closed during a December and January observation; however, these closures were brief in nature because they only occurred during low tides. During high tides, the surface water was reaching the Pacific Ocean (Appendix 3). At the end of December of 2011, the sandbar was open and the Ventura River was flowing into the Pacific Ocean, which allowed fish to volitionally enter or exit the estuary. On 03 January 2012, the sandbar was also open, which officially initiated the beginning of the fish passage augmentation season. Except for the brief closure in January, the sandbar was open for the remainder of the 2012 fish passage augmentation season. On the days the sandbar was inspected during the reporting period, the discharge at the USGS Foster Park gage station ranged from approximately 5 to 25 cfs and 0 to 26 cfs at the Robles Fish Facility. The river was observed exiting primarily from the center of the estuary during the reporting period.

Discussion

The sandbar at the mouth of the Ventura River tends to remain open during average and above average precipitation years and can close at times during years with few significant rain events (Lewis et al. 2010). During 2005 and 2006, the sandbar remained open and did not close until April of 2007 after an extended period of low precipitation (Appendix 4). During 2008, the sandbar was only closed during October and November and reopened in December. During the period that the sandbar was closed in December of 2007, the lagoon had a surface area of 4.7 ha. During an open period in August of 2008, the estuary had a surface area of 2.8 ha, which represents an approximately 70% increase in surface area during periods when the sandbar was closed (Lewis et al. 2010).

The tendency for the sandbar to remain open in all but very dry years is likely due to a few factors. Although the mid reach of the Ventura River goes dry every year, subsurface water continues to flow and eventually begins to resurface just upstream of the confluence with San Antonio Creek and continues to increase slightly proceeding downstream. Additionally, treated effluent water from the Ojai Valley Sanitary District at rkm 7.5 increases the river discharge by approximately 3 cfs. Finally, tributary flow from San Antonio Creek also adds to the Ventura River through a surface or subsurface connection throughout the year. These factors contribute to the water quantity at the mouth of the Ventura River to keep the sandbar from fully forming and therefore closing the outlet during most years. The status of the sandbar indicates changes in the estuary/lagoon that may help determine potential entry and exit condition for adult and juvenile steelhead. It appears that passage conditions remain suitable during most seasons when steelhead are likely migrating. However, lagoon conditions optimal for juvenile rearing (i.e., when a sandbar closes and results in an estuary forming a deeper freshwater lagoon; Bond et al. 2008), appear to have been limited during the study period beginning in 2005.

3.2 Fish Attraction Evaluation

Introduction

River discharge has been shown to be one of several key environmental factors initiating and facilitating steelhead and other salmonid adult and juvenile migrations in natural fluvial environments (Shapovalov and Taft 1954; Banks 1969; Spina et al. 2005). As adults and juveniles approach fish passage facilities, sufficient discharge and water velocities become even more important to ensure successful passage through any facility (Clay 1995; Beeman and Maule 2001).

The entrance of the fish ladder at the Robles Fish Facility is located approximately 20 m downstream of the spillway gates and is where fish migrating upstream enter and where fish migrating downstream exit. The downstream end of the ladder is adjacent to a large pool (entrance pool) that was scoured out and has been maintained by high discharges through the spillway gates. The ladder was designed for a maximum discharge at the exit of 170 cfs (50 cfs through the entire ladder and an additional 120 cfs can be supplemented at the lower end of the ladder). The distance downstream from the entrance pool to the lower most interim rock weir is approximately 200 m. This reach includes all four rock weirs and the facility's low-flow road crossing, which is also the weir used to measure discharge for the Robles Fish Facility. The habitat unit types that can be used by migrants in this reach include the four pools created by the weirs, a glide created by the low flow road crossing, a riffle, and the entrance pool.

The objective of the fish attraction evaluation is to determine if adult or juvenile steelhead are holding immediately downstream of the Robles Fish Facility during the fish passage augmentation season (NMFS 2003a).

Methods

Fish attraction surveys were conducted on a weekly basis during the fish passage season from January through June of 2012. The particular survey methodology used was determined based on water visibility, river discharge, and expected steelhead life history stage present at the time of the survey. From January through March 2012, which is when the vast majority of adults were expected to be migrating upstream (Shapovalov and Taft 1954), bank surveys were the predominant method used. Beginning in March, and through the remainder of the fish passage season, snorkel surveys were the predominant method used. This coincides with the approximate period of time when steelhead smolts are expected to migrate downstream (Shapovalov and Taft 1954; Spina et al. 2005). Bank surveys were conducted by one or two surveyors in an upstream direction. The surveyors wore polarized sunglasses to reduce water-surface reflection. Snorkel surveys were conducted by one or two surveyors in an upstream direction. All fish species were identified and enumerated to the greatest extent possible permitted by the ambient river conditions and fish densities at the time of each survey. Lengths of each *O. mykiss* were estimated to the nearest cm if only a few individuals (generally < 5-10) were present. At times of greater *O. mykiss* abundance, they were grouped and assigned to the nearest length (cm) category. In order to collect additional information that may help determine *O. mykiss* upstream and downstream movements through the Robles Fish Facility, an upstream study reach was added for surveying in 2009. The upstream study reach included observations in the screenbay of the facility and the area immediately upstream of the low-flow fish exit in the forebay. The total distance of this upstream reach was approximately 140 m.

If a BO-defined storm event would have occurred during 2012, video-camera monitoring would have been conducted using a camera positioned at the fish ladder entrance to determine when adult steelhead enter the ladder during the 10 or 12-day ramp down period. However, due to the lack of significant precipitation, the video camera was not installed during 2012 because no BO-defined storm events occurred.

Results

A total of 378 *O. mykiss* were counted from January through June of 2012 in the entire 340 m study reach (Appendix 5), which covered the upstream and downstream reaches. During the 6-month period, a total of 8,500 m were surveyed by either bank or snorkel methods. The water temperatures during the study period ranged from 8 °C in January to 25 °C in June and turbidity was less than 6 NTUs when the surveys were conducted. *O. mykiss* were observed throughout the survey period and numbers peaked in mid February at 36. The number of *O. mykiss* counted declined to only 2 by early April, but rebounded to 28 by mid May before declining again at the end of the study period (Appendix 6). The discharge at the Robles Fish Facility ranged from 0 to 20 cfs at the time of the surveys (water remained in the upper portions of the survey reach even though no flow was passing over the weir). There was no significant correlation between the number of *O. mykiss* observed and river discharge during the study period (p-value = 0.33, r^2 = 0.04, n = 25, linear regression).

The 200 m reach downstream of the fish facility was surveyed on 25 separate occasions, 13 bank and 12 snorkel surveys. A cumulative total of 5,000 m were surveyed from January through June 2012. A total of 148 *O. mykiss* were observed downstream of the Robles Fish Facility (Appendix 7). The peak count for the downstream reach was 22 *O. mykiss* in early to mid May. There was an earlier peak in mid February at 19 *O. mykiss*. There was no significant correlation between the number of *O. mykiss* observed downstream of the Robles Fish Facility and river discharge during the study period (p-value = 0.64, r^2 = 0.01, n = 25, linear regression).

The 140 m reach upstream of the facility was surveyed on 25 separate occasions, 13 bank and 12 snorkel surveys. A cumulative total of 3,500 m were surveyed from January through June 2012. A total of 230 *O. mykiss* were observed in the upstream reach. Observations of *O. mykiss* upstream of the Robles Fish Facility were generally higher early during the study period and decreased after April (Appendix 7). There was no significant correlation between the number of *O. mykiss* observed upstream and river discharge during the study period (p-value = 0.28, r^2 = 0.05, n = 25, linear regression).

Discussion

The total count of 378 *O. mykiss* from the upstream and downstream reaches likely included repeated counts of the same *O. mykiss* over the study period. Because the surveys were conducted weekly, some *O. mykiss* likely remained in the 340 m reach for more than one week and were counted at least one additional time. Without tracking individual *O. mykiss* (e.g., mark/recapture, telemetry, or other tagging studies), the time spent by individual *O. mykiss* in close proximity to the Robles Fish Facility cannot be determined by observation methods alone.

From observational counts alone, the ability to interpret the fine-scale migration behavior of the *O. mykiss* near the Robles Fish Facility is limited. Abundance trends for upstream and downstream observations were different from previous sampling years. The counts were initially higher at the beginning of the study period in January. This was likely due to better water conditions that allowed *O. mykiss* to continue to rear in the study area. In previous years, as river flows decreased, counts of *O. mykiss* also decreased due to upstream or downstream movement (CMWD 2010). In dry years, the surveyed habitat will eventually become dry. In June 2012 at the end of the study period, flow ceased over the Robles measurement weir and a fish rescue was conducted by CDFG on 28 June 2012. A second fish rescue was conducted by CDFG and NMFS on 11 July 2012, and within a few days, the entire study area both upstream and downstream of the Robles Fish Facility was completely dry.

The count of *O. mykiss* in the study reach at the beginning of the study period was higher than in previous years. This may be explained by two causes. First, discharge was sufficient during the dry season in 2011 for *O. mykiss* to remain and rear in the study reach, and second, there was a relatively large number of resident *O. mykiss* that remained in the study reach during 2011 to be counted beginning in January of 2012

(CMWD 2011). During many years, like 2012, the entire reach dries up and typical is re-watered the following winter. *O. mykiss* will then move downstream into the study reach as they begin the smoltfication process or disperse into new rearing and foraging habitat.

Because little precipitation occurred during the migration season, a surface water connection to the lower Ventura River existed for only about 3 hours during the study period. This brief connection occurred on 13 April 2012 during a small rain event that produced the third and final discharge peak during the migration season (Appendix 6). Not only was the surface connection very brief, but the quantity and quality of water for downstream passage was limited. At the time of the surface connection, the discharge was visually estimated at approximately 5 cfs from the Hwy 150 bridge. The short duration and minimal flow of the surface connection were likely insufficient to allow an appreciable number of smolts to migrate downstream through the Robles Reach to the lower Ventura River.

Despite the lack of higher flows, some downstream movement may have occurred related to changing flows. During late February, there was a substantial decrease in the number of *O. mykiss* observed in the study reach downstream of the Robles Fish Facility (Appendix 7). In late March, there was also a decrease of the *O. mykiss* observations in the upstream study reach. However, during the late April and early May, the count of *O. mykiss* dramatically increased in the reach downstream of the Robles Fish Facility. The apparent downstream movement could partially be explained by normal behavior expected during the smolt migration period, as well as movement initiated by the first two small peaks of stream discharge. The increased downstream counts during late April and early May could have been due to upstream movements back into the study reach from the Robles Reach, which was drying at that time. This seems plausible because 1) the total number of *O. mykiss* that moved out of the study reaches was similar to the number that moved into the lower study reach, 2) the increase coincided with receding surface flows, which would have forced any *O. mykiss* to move upstream as well, and 3) this type of upstream movement after an initial downstream movement was documented with at least two radio tagged *O. mykiss* smolts during 2011 (CMWD 2011).

The onset of smoltification can be identified by vanishing parr marks, silvering of the body, and darkening of the margins of the fins among other characteristics (Chrisp and Bjornn 1978; Hasler and Scholz 1983; Quinn 2005; Spina et al. 2005). Based on qualitative observations during the snorkel surveys, it appeared that very few of the *O. mykiss* were going through the smoltfication process. During the survey period, 92 *O. mykiss* (24% of all *O. mykiss* observed) were categorized into six classifications that included parr, three transitional phases (T-1, T-2, and T-3), and full smolt following the methods of Hasler and Scholz (1983). Also, larger *O. mykiss* not classified in one of the previous categories were classified as residents. This method has been used successfully to classify smolting steelhead (Allen Scholz, Eastern Washington University, personal communication). Only 13.6% of *O. mykiss* classified were in early to late smoltification stages (T-1 to full smolt). During 2011, this same grouping of early to late stages composed 80% of all *O. mykiss* classified and no T-3 or full smolt *O. mykiss* were observed (CMWD 2011). This same lack of smolting *O. mykiss* was documented elsewhere in the Ventura River basin during 2012. At several snorkel monitoring sites in the lower mainstem Ventura River and lower San Antonio Creek, the percentage of early to late stage smolts (excluding parr) was about 47% and 11% for 2011 and 2012, respectively (CMWD, unpublished data).

The smaller percentage of smolting *O. mykiss* in the Ventura River basin during 2012 was likely due to several reasons. There were two significant rain events during 2011 that produced considerable runoff (about 3,000 and 20,000 cfs at Foster Park) and contributed to base flows between peak and post flows. During 2012, this did not occur because only three small rain events produced peaks in mean daily flow; the largest was only 26 cfs at the Robles Fish Facility and 42 cfs at Foster Park. Water temperature did not appear to be a significant environmental variable to explain differences in smolting for 2012 (Appendix 13). The mean daily water temperature did not appear to be significantly different between 2011 and 2012 from January through

April. However, the mean daily water temperature for May and June of 2012 ranged from about 2.5 to 5.0 °C warmer than 2011 near the Robles Fish Facility.

3.3 Fish Passage Monitoring

Introduction

Monitoring of migratory fish moving through fish passage facilities has been conducted using many different methods that include: visual counting, trapping and hand counting, continuous video recording, PIT tagging, radio telemetry, and acoustical telemetry. In each fish passage application, the particular physical and biological conditions (e.g., variable discharge, turbidity, debris, size of facility, and number of fish) usually dictate which method would be most effective. New technologies have been employed to improve fish passage monitoring in turbid conditions specifically. One such monitoring device is the Vaki Riverwatcher® (Riverwatcher). The Riverwatcher has the capability to operate in greater turbidity than more traditional monitoring equipment. Because of this advertised capability, the Riverwatcher was selected to be used in the Robles Fish Facility by the Technical Advisory Group.

The primary objective of fish passage monitoring is to provide an index of the number of upstream adults and downstream kelts migrating through the Robles Fish Facility (NMFS 2003a). The Riverwatcher was advertised to detect fish down to a fish body depth of about 40 mm (Vaki 2003) and it was not known how well it would work at detecting smolt-sized fish given the debris load of the Ventura River (NMFS 2003a).

Methods

Fish migrating upstream and downstream through the Robles Fish Facility were monitored using the Riverwatcher. The Riverwatcher is located in the fish bypass channel, which is the channel between the fish ladder and fish screens. The Riverwatcher consists of two scanner plates with light diodes that transmit beams of infrared light through the water to a corresponding receiver plate. When a fish swims (or debris drifts) through the infrared light beams, it breaks the light signal and a digital silhouette of the fish is recorded on a computer. Other data recorded when the Riverwatcher scanner is triggered are: date and time, total length (TL) of the fish (from a length/height ratio), swimming speed (m/sec), and direction of the fish movement (upstream or downstream). In addition, the scanner triggers an underwater camera to record a 10-second video clip (25 frames/sec). Only fish swimming upstream can be recorded in the Riverwatcher computer video system because it was designed for one camera, and that camera was placed on the upstream side of the scanner. An additional two cameras were installed in 2008-09 so that video of fish moving downstream could be captured on a digital video recorder (DVR). Both downstream cameras are located upstream of the Riverwatcher scanners in an aluminum tunnel along with the upstream Riverwatcher camera. The downstream digital cameras recorded continuously at 12 frames/sec and captured about 4-5 weeks of data until the DVR data storage drive was full (each week of data required approximately 4 h to review). These two downstream cameras are independent of the Riverwatcher system and have to be reviewed separately for downstream detections. Once the DVR memory is full, it is exchanged with a second DVR and the data are reviewed before the DVRs have to be exchanged again.

The Riverwatcher scanner and cameras are positioned at the bottom of an aluminum frame (crowder) covered with 1/2 inch aluminum bars, spaced 1 1/2 inches on center resulting in 1-inch spacing between the bars, which directs the fish to swim between the scanner plates. The crowder can be raised and lowered in guide slots of the fish bypass channel with the aid of an A-frame hoist for cleaning or repair. The Riverwatcher is usually operated during the entire flow augmentation season as long as sufficient water elevations in the fish bypass are present and debris and turbidity are low enough so that the crowder will not be damaged and the Riverwatcher will function. The Riverwatcher was operated from 04 January 2012 to 11 June 2012 of the reporting period. During this time, the crowder was removed from the fish bypass channel and cleaned or inspected 26 times. Typically, during times of higher debris, the cleaning and inspections occur multiple times per day, and at times of low debris, cleaning and inspections occur only once every 2-3 days. The lack of storm flows during 2012 reduced the need for frequent crowder cleaning. The crowder was removed for cleaning for a combined total of approximately 7 h during the operation period, which represented 0.2% of the time the Riverwatcher could have possibly been operated if there were no operational limitations. The Riverwatcher was operated a total of 143 days, which was 89.4% of the time the Riverwatcher could have possibly been operated. A complete Riverwatcher malfunction occurred at the end of April. After extensive troubleshooting was attempted by the manufacture, the complete Riverwatcher unit was shipped to the manufacture in Iceland for repairs. A replacement Riverwatcher was loaned to CMWD by FishBio for the remainder of the season. The total time from initial malfunction to Riverwatcher replacement was 2 weeks, during which time no passage data was collected, this represented 9% of the total time the Riverwatcher could have operated.

Prior to 2010, each upstream and downstream Riverwatcher detection was reviewed and classified as an adult steelhead, *O. mykiss* non-adult steelhead, other species if identifiable, unknown fish, fish probable, or false detection (see Appendix 25 for detection classification flow chart). At the request of NMFS, this classification system was modified during the review process of the 2010 progress report. All confirmed *O. mykiss* were classified solely as *O. mykiss*. The classifications were determined by using a combination of the silhouette images, estimated lengths, and video clips. In addition, if larger adult sized *O. mykiss* were detected and a useful video clip was recorded, measurements of eye diameter and standard length (SL) were estimated from the video clip to calculate morphometric ratios that were compared to known steelhead and rainbow trout. A commonly used method is to develop ratios of body measurements for comparison to remove the effects of body size so actual differences can be determined (Strauss and Bond 1990). This was done by comparing SL to the ratio of eye diameter in linear regression. Standard length is the length from the snout to the end of the hypural plate near the end of the fleshy caudal peduncle, which is unaffected by caudal fin deformities (Anderson and Neumann 1996). Previous to 2010, the adult steelhead classification was used if the fish observed was an *O. mykiss* and displayed the typical characteristics of an anadromous adult steelhead, such as black spotting on dorsal, adipose, and caudal fins, black spotting on dorsal side of body, silvery body, vertical edge to caudal fin, ≥ 38 cm TL (Shapovalov and Taft 1954), and had an eye diameter/SL ratio ≤ 0.045 (CMWD 2008). The new classification method could have included juvenile resident, smolts, adult resident, and adult anadromous *O. mykiss* migrating throughout the basin. Conceivably, after more data are collected from the downstream trapping component of the monitoring and evaluation, or from other Ventura River basin research projects, a more thorough classification system of Riverwatcher detections could be used. The "fish unknown" classification was used if the detection was identified to be a fish based on video evidence, but further classification could not be determined due to high turbidity or an insufficient amount of the fish captured on the video clip. The "fish probable" classification was used if no fish was observed in the video, but the silhouette was similar to that of a typical fish silhouette where a video clip was available. Even with reasonably good video coverage, smaller fish were still able to pass through the Riverwatcher undetected by the video cameras. This occurs if fish swim very close, high, or low relative to the cameras. In addition, this can happen if a fish swims upstream through the scanners but stops before entering the video field of view. High turbidity can also obscure the video detection and identification of fish. The "false detection" classification was used when no fish was observed in the video and the silhouette was not similar to that of a typical fish silhouette. Because false detections tended to occur frequently during higher discharges, when turbidity and debris also were high, it was likely that most false detections were caused by debris, high turbidity, and water turbulence. When turbidity exceeds about 100 NTUs, hundreds of false detections can occur per hour and not until turbidity falls below about 30 NTUs is the Riverwatcher fully operational (Table 1).

Table 1. Riverwatcher operational status over a range of water turbidity (NTUs).

Turbidity (NTU)	Riverwatcher status
> 200	Not operational
100-200	Many false detections
30-100	Scanner operational, but unable to confirm with video
< 30	Video grid detectable
0-30	Riverwatcher fully operational

Results

During the 2012 fish migration season, the Riverwatcher recorded 3,168 total detections, of which 1,386 were upstream and 1,782 were downstream (Appendix 9). Of the total upstream detections, 36% (n = 501) were determined to be fish and included: 396 *O. mykiss*, 32 “fish probable”, 57 unknown fish, and 16 non *O. mykiss*. Of the total downstream detections, 19% (n = 344) were determined to be fish and included: 263 *O. mykiss*, 64 “fish probable”, 11 unknown fish, and 6 non *O. mykiss*. The mean date for the upstream migrating *O. mykiss* was 12 March and 27 February 2012 for the downstream migrating *O. mykiss* (Appendix 9). During the migration season, there was a bi-modal distribution of detections for both upstream and downstream detections, one during February and a second during May (Appendix 10).

Detections occurred essentially at all times of the day for both upstream and downstream. However, the upstream detections peaked between 17:00 h to 21:00 h (Appendix 11). The peak of downstream detections was more pronounced and occurred between about 06:00 h and 07:00 h.

The mean total lengths for upstream and downstream migrating *O. mykiss* was estimated to be 31 cm and 29 cm, respectively (Appendix 9). Overall lengths of upstream and downstream migrating *O. mykiss* ranged from 15 cm to 50 cm (Appendix 12). The software program that operates the Riverwatcher estimates the TL of a fish detection based on a ratio of height to length (Vaki 2003). This ratio can be changed depending on available data for the target species. Based on morphometric measurements of *O. mykiss* mortalities over the last several years, an *O. mykiss* height to TL ratio was estimated to be 5.1:1 for fish ranging from about 10 to 28 cm. During a validation and calibration pilot study, it was estimated that the Riverwatcher was underestimating the test fish heights by about 10 mm. A correction was added to the TL to height ratio to calibrate it to the known fish heights. This correction was used to estimate the TL of Riverwatcher detections from January through June of 2010. However, the resulting TL estimates appeared to be over estimated when compared to known *O. mykiss* lengths that were measured in 2009. It was decided that a more accurate method would be to use a regression model to convert Riverwatcher estimated fish heights to lengths. Again, from the morphometric measurements, a sigmoid regression was conducted to develop a best-fit model for converting the Riverwatcher fish heights to total lengths ($TL = 687.68 / (1 + \exp(-(D - 50.78)/23.97)) / 10$, $p\text{-value} < 0.0001$, $R^2 = 0.99$, $n = 59$, D = body depth). This regression model will continue to be refined as more data becomes available.

The physical river conditions of temperature, turbidity, and discharge at the time of passage were similar for upstream and downstream migrating *O. mykiss* and other fish classifications (Appendix 9). The mean water temperature recorded during the time *O. mykiss* were migrating upstream was approximately 14 °C and was 13 °C for downstream migrants. The mean turbidity levels at the time of passage for upstream and downstream *O. mykiss* was about 5-6 NTUs. The mean turbidity at the time of the false detections in both upstream and downstream directions was approximately 17-25 NTUs. The discharge from the Robles Fish Facility at the time of upstream passage for *O. mykiss* was a mean of 10 cfs and 11 cfs for downstream *O. mykiss*. Like turbidity, the periods of false detections coincided with higher discharge. For a list of all fish detections, see Appendix 13. The total time the Riverwatcher was not operational because of high turbidity was 48 hours, which represented 1.2% of the time the Riverwatcher could have been operated if no operational limitations existed.

Discussion

Approximately 2,323 false detections were recorded and were likely due to greater river discharges, the associated turbidity and debris, low-water surface turbulence, and settings of the Riverwatcher to detect smaller fish. In addition, to increase the chance of detecting any adult steelhead, the Riverwatcher and crowder were left in the ladder for longer periods at high turbidity. Because the Riverwatcher is recommended to be set at a minimum of no less than 40 mm (Vaki 2003), an overestimation of fish passage was likely, since all false detections could not be identified and eliminated. For the 2012 season, the minimum height was set at 28 mm so that a large number of false detections could be eliminated while still attempting to detect steelhead smolts. Based on available data from the Ventura Basin, a height of 28 mm was determined to be similar to some of the smallest steelhead smolts expected to emigrate downstream through the Robles Fish Facility. This height corresponds to 146 mm TL and 139 mm FL. *O. mykiss* mortalities found and measured during the course of ongoing field monitoring efforts (subsequently turned over to NMFS) were all larger than 146 mm TL. The estimated fish detection rate from the validation pilot study and the comparison of snorkel counts to Riverwatcher detections both indicate that 78-88% of smolt sized *O. mykiss* are not detected by the Riverwatcher. During the 2009 validation pilot study, larger sized fish (i.e., height > 60 mm) appeared to be detected nearly 100% of the time. This height is equal to about 300 mm TL and is larger than what would be expected to be migrating downstream through the Riverwatcher. Before a detection rate correction could be applied to downstream detections, more data would need to be collected on detection efficiency. The highly variable results from the pilot study were not sufficient to develop a correction factor with enough confidence. Like the detection efficiency, the Riverwatcher estimated fish heights were also highly variable and the true error could not be determined. The data collected to date indicates that the Riverwatcher is unable to reliably detect emigrating steelhead smolts; given the manufacture's operational recommendations, these results should not be surprising. Additional Riverwatcher validation/calibration tests were conducted during the summer of 2011 in an attempt to further identify the operation limitations of the Riverwatcher. It was anticipated that these results in addition to all other Riverwatcher validation/calibration results would be reported on in this 2012 progress report, however that review and summary could not be completed in time. The review will be completed as soon as possible and distributed to the Biological Committee as a stand-alone report, or be incorporated into the 2013 progress report.

From general observations over the last several years, and those made during the 2009 validation pilot study, *O. mykiss* juveniles do not move through the fish crowder and Riverwatcher quickly. *O. mykiss* tend to swim downstream and back upstream repeatedly before ultimately moving in one direction. This lack of uniform and rapid directional movement is also supported by observations during fish attraction monitoring where *O. mykiss* have been observed repeatedly swimming in and out of the fish ladder on both the upstream and downstream ends. Also, *O. mykiss* that appeared to be the same fish (based on video and length estimates) have been observed on video swimming back and forth through the fish crowder. *O. mykiss* juveniles were observed holding in areas for extended periods of time before either moving downstream or back upstream, which is commonly found in all salmonid smolts (Quinn 2005). All smolt transformation stages of *O. mykiss* were observed during the fish attraction surveys. Because the smolt migration rate is positively correlated with the smoltification process (Quinn 2005), some holding and lack of rapid downstream migration would be expected for *O. mykiss* in early to mid stages of smolting.

O. mykiss passage through the Robles Fish Facility and recorded by the Riverwatcher showed a similar diel migration pattern to that in 2009. *O. mykiss* primarily passed downstream through the ladder just before dawn and then passed back upstream just before and after dusk. The reasons for the timing of these movements are unknown. However, early morning movement of downstream migrating smolts is common among steelhead throughout its range (Dauble et al. 1989). Monitoring upstream movements of smolts has not been studied specifically and little available data exists to make comparisons. Most smolt monitoring studies do not have volitional passage with passive monitoring like that used at the Robles Fish Facility. Therefore, the opportunity to examine upstream movements is usually not available. The distance of the daily migrations are not known.

As previously discussed, the Riverwatcher's inability to accurately estimate lengths will need more work to fully determine its usefulness for monitoring smolt-sized *O. mykiss*. However, the use of the regression model to estimate TL from the Riverwatcher's estimate of fish height produced plausible results. The mean TL of *O. mykiss* detections by the Riverwatcher was larger than what others have documented for steelhead smolts in central and southern California. Shapovalov and Taft (1954) estimated a mean FL for 2+ and 3+ age smolts at approximately 17 cm. Spina et al. (2005) also measured a mean smolt FL of approximately 17 cm. The difference could have been due to several factors. First, the differences could be due to the error associated with the Riverwatcher estimates. Second, the regression model appears to over-estimate lengths when compared to video estimates. Third, many *O. mykiss* may have residualized from 2011, and their continued growth could have produced larger resident *O. mykiss*. Regardless of the actual cause, the Ventura River smolts are indeed larger and this may be due to faster growth rates in the warmer water as compared to the more northern basins. The age of migrants might also explain the differences observed; however, no scales of *O. mykiss* were collected for aging.

3.4 Downstream Fish Passage Evaluations

Introduction

Passage evaluations of salmonids migrating through fish passage facilities have been conducted throughout the western United States for many years. Methods to determine if a facility is operating as designed and not causing harm to the intended fish species vary. Early work typically entailed trapping and tagging fish before entering a facility and recapturing them after exiting. Trapping and visual inspections for injuries, PIT tagging, radio telemetry, and acoustical telemetry has been conducted extensively as well.

There are two objectives for the downstream fish passage evaluation. The first objective is to determine if downstream migrants are successfully passing through the Robles Fish Facility. The second objective is to capture and examine steelhead smolts and kelts and determine if injuries are caused by downstream passage through the Robles Facility (NMFS 2003a).

Methods

Due to low precipitation and discharge, trapping was not conducted during 2012 and no data were collected for the Downstream Passage Evaluation. For a full description of evaluation methods, see CMWD (2011).

During 2011, descaling and snout injuries were documented on captured smolts. The potential biological significance of the descaling was unknown; therefore, a literature review was conducted to evaluated available information and develop a basis for comparison. In addition, a "handling test" was conducted with hatchery *O. mykiss* to study the effects of handling on descaling and snout injuries.

Results

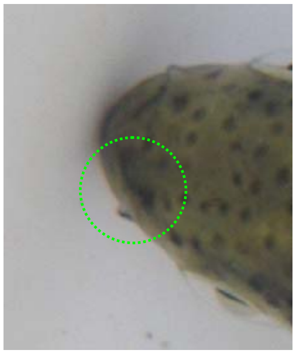
The literature on descaling rates was reviewed and the results varied across different measurement methods, criteria, capture methods, and other study designs (Appendix 14). Five methods were used to quantify descaling. Early work used a 2- or 3-category descaling classification of total descaling (Wunderlich and Dilley 1986; Dilley and Wunderlich 1992). These methods grouped examined fish into 2 or 3 categories of total descaling and reported the percentage of total fish in each category. For example, Wunderlich and Dilley (1986) used 3 categories that represented low (<10%), moderate (10-50%), and high (>50%) descaling and observed 12.5%, 6%, and 2.1% of the captured steelhead smolts with descaling in the respective categories.

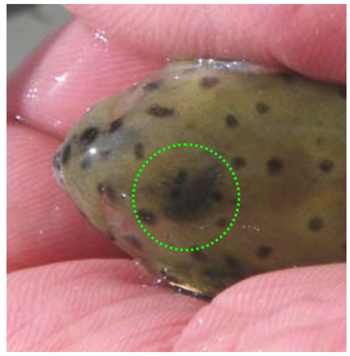
Most of the current descaling work uses a simple criterion to determine if a smolt is descaled or not; it is essentially a 1-category method. This method only records smolt descaling if it exceeds 20% on one side of the smolt (i.e., 10% of total body surface). This method is used extensively in the Columbia River basin and apparently exclusively at Columbia River and Snake River dams. The method was developed originally during the 1980s to evaluate passage facility effects and its use has continued to present. The method is used by the Pacific States Marine Fisheries Commission (PSMFC 2001) and the Fish Passage Center (i.e., the state, federal, and tribal fisheries agencies that collect and submit data to the center). The Fish Passage Center is a technical center that collects, analyzes, and distributes passage data for 11 mainstem Columbia dams and five Snake River dams. This also includes six large up-river trapping stations where test fish are captured and released for dam evaluations (www.fpc.org). The descaling rate of steelhead smolts using the 20% criterion ranged from about 2% up to 7% of the fish. The mean descaling rate of the reviewed literature (n = 6) was about 4% for approximately 190,000 steelhead smolts. This is the mean number that met the 20% descaling criteria, not the mean total surface area descaled on all fish.

The 20% descaling method divides each side of a smolt into 5 zones, if at least two of the zones on one side of a smolt has at least 50% descaling (i.e., 20% descaling for one side of the smolt), then the smolt is considered descaled. This represents a total descaling of 10% for the entire smolt. The method used for the Robles Fish Facility monitoring and evaluation estimates total descaling and does not categorize it to more accurately document any descaling. Scale loss is assessed by examining captured fish and estimating scale loss over three zones on each side of the fish. The three zones are: 1) the caudal zone that includes the area above and below the lateral line from the caudal fin to the posterior end of the dorsal fin, 2) the dorsal zone that includes the area anterior of the caudal zone to the operculum and above the lateral line, and 3) the ventral zone that includes the area anterior of the caudal zone to the operculum and below the lateral line (Marine and Gorman 2005). The percentage of scale loss in each zone is estimated and then weighted by each zone's area proportional to the total area of all six zones. Summing the resulting weighted scale loss yields the total area of each fish with scale loss.

The handling tests with hatchery *O. mykiss* were intended to address both descaling and snout injuries. However, during initial trials, no descaling differences could be detected after 10 hatchery *O. mykiss* were handled and were confined to the trap box overnight, it became evident that descaling from handling and trapping using hatchery fish would not be representative of wild steelhead smolts. The hatchery *O. mykiss* were from resident brood stocks and therefore were not smolting. When salmonid smolts undergo the parr-smolt transformation, they become more susceptible to scales loss. This susceptibility is likely tied to the hormonal changes that regulate the onset of physiological changes and the smolting process. During the smolting process, a subcutaneous layer of guanine crystals is deposited, which gives smolts their slivery color, and may cause scales to more easily be dislodged. The remainder of the handling tests were conducted to address the snout injuries.

The most common physical injuries for smolts captured during 2011 were small but noticeable areas of skin damage to the snout on 22 (88%) *O. mykiss* captured (Figure 1a). The location of the skin damage on the top of the snout suggested that it might have been the result of “nosing” into the plastic mesh to avoid capture while in the trap; this behavior was also observed while smolts were being removed from the trap. To examine this as the source of injury, six hatchery *O. mykiss* were anesthetized using standard methods (CMWD 2011). The fish were forcibly “nosed” into the plastic mesh by hand and were moved side-to-side to mimic a swimming behavior for 6 sec. The resulting snout injury was similar on all six test fish to what had been observed during 2011 (Figure 1b). The same test was repeated, but with a small piece of smooth knot-less ¼ inch netting covering the plastic mesh. It was anticipated that the netting would not allow the snout to extend into the plastic mesh and prevent the injury. The six tested fish did not have the same extent of snout injury when the netting was in place (Figure 1c).


a.


b.


c.

Figure 1. Photos of (a) snout injury from a 2011 smolt, (b) replicated injury with hatchery *O. mykiss*, and (c) uninjured snout of hatchery *O. mykiss* after netting installation. Dashed green circle indicates area of injury.

<u>Discussion</u>

Smolts undergo a variety of challenges during their migration to the ocean. The dermis and epidermis layers, which includes the scales, provides some protection from natural environmental conditions such as hydraulic and physical impediments, predators, and parasites and pathogens (Zydlewski et al. 2009). Descaling can be caused from natural sources as well as anthropogenic ones (Zydlewski et al. 2009). When injuries occur to the dermal layers, smolts' ability to respond to the many environmental challenges may be diminished, and therefore their eventual survival as well (Zydlewski et al. 2009; Hostetter et al. 2011).

The use of descaling as an index to determine if smolts are injured as they pass downstream through a fish passage facility is a common practice (Axel et al. 2011; Mensik et al. 2006). Therefore, descaling was selected to determine if smolt injuries have been caused by the Robles Fish Facility (CMWD 2011). Descaling was first studied in the field at the Robles Fish Facility in 2011. This was the first year with sufficient water, available smolts, and an operational trap (CMWD 2011). In 2011, only 25 smolts were captured downstream of the Robles Fish Facility in the smolt trap, but all 25 smolts showed signs of descaling. However, the total descaling ranged from 0.8% to 9.3% with a mean of 3.4%.

The predominate descaling method and criterion used in the reviewed literature was the 5-zone method with a 20% criterion. This has been used throughout the Columbia Basin. Apparently, the significance of descaling less than 10% of total fish surface are was not deemed important enough to quantify. However, comparisons with Robles Fish Facility during 2011 can be made using this same criterion. As stated before, the descaling rate from six of the studies using this method ranged from about 2% to 7%. The descaling rate for the Robles Fish Facility using the 20% criterion would have been 0.0% (i.e., none of the 25 smolts captured had descaling that occurred over more than 20% on one side or 10% total). Few studies reported their findings as descaling as a percentage of total area. While some researchers obviously must have recorded the total amount of descaling, it was categorized for presentation in their subsequent reports. Only Hawkes et al. (1991) reported total descaling rate. Their estimated mean total descaling was 8.7% for 26,000 steelhead smolts examined. Using this same total method, the Robles Fish Facility had a mean descaling of 3.4%. There were two of the reviewed reports that had lower descaling rates than the Robles Fish Facility. Wunderlich and Dilley (1986) used a 3-category method and presumably, even though it was not reported as such, had 77% of examined smolts with no descaling. This assumes that small amounts of descaling was documented. Using a 5-zone method and a 16% criterion, Neitzel et al. (1990) reported a descaling rate of 0.3%. Applying a 16% criterion to the Robles Fish Facility would have yielded a 4.0% descaling rate. In both of these cases, the reported descaling appeared to be very low.

There are some difficulties in comparing the Robles Fish Facility descaling rates to available literature. There are differences due to flow, smoltification levels, natural background descaling levels, testing procedures, passage facility differences, trap type, handling protocol, and descaling measurement and analysis methods. In the case of the Robles Fish Facility, there were four sources of potential descaling (Appendix 14), and yet the level of descaling was one of the lowest among the literature reviewed. Given that there were several potential sources of descaling, the level is considered low by current standards. How much of the descaling was due to each potential source alone could not be determined. Descaling from trapping and handling was not partitioned out in the studies reviewed.

Perhaps the more fundamental question, and biologically significant, is not descaling itself, but the effects of descaling and the ultimate survival and performance of smolts. Few studies have assessed the actual result of descaling on future survival (Zydlewski et al. 2010; Hostetter et al. 2011). Two reviewed studies focused directly at evaluating this fundamental question. Zydlewski et al. (2010) tested the osmoregulatory ability of descaled Atlantic salmon smolts. They manually descaled smolts to meet the 20% criteria and conducted salt-water challenges to measure the physiological response. They concluded that after 3 days, descaled fish did not differ from control smolts in their ability to osmoregulate and this was likely due to epithelial repair during the intervening 3 days (Zydlewski et al. 2010). In a field study to examine the effects of descaling, and other external smolt conditions, Hostetter et al. (2011) PIT tagged steelhead smolts and determined several external conditions that were compared to survival. Descaling was classified into <5%, 5-20%, and >20% categories. They concluded that as descaling increased, the odds of survival decreased. Steelhead with >20% descaling had a 1.6 times lower chance of survival over a distance of 354 km than steelhead with <5% descaling. Even though they documented a decrease in survival over a distance of 119 km for the 5-20% descaled group, the difference was small and they concluded that any change is survival for all steelhead smolts with <20% descaling was likely not biologically significant (Hostetter et al. 2011).

Although survivorship was not examined in relation to descaling for individual smolts in our studies, based on the reviewed literature, the measured Robles Fish Facility total descaling rate of 3.4% likely had no significant effect on smolt survival. Moreover, given the initially estimated mean migration rate of about 2 km/day from the 2011 radio tagging study, any descaling would have enough time (10.6 days) to be repaired prior to entering the ocean environment. Even the fastest documented smolt (6 km/day) would have had time (3.8 days) for epithelial repair.

The initial results from the snout injury test seemed to confirm the hypothesis that the injuries were caused from “nosing” into the plastic mesh. After establishing that the tests with netting covering the plastic mesh did not produce the same injury in an experimental situation, it was concluded that the snout injuries might be reduced or eliminated in the field by lining the inside of the trap with smoother netting material (1/4-inch holes). Even though the percentage of smolts with this injury was high, the extent (i.e., size) of the injury was always small relative the surface are of the smolts. The injuries were generally about 2 mm x 10 mm and corresponded to the shape and dimensions of the plastic mesh. The injuries were not skin abrasions, but contusions and the epidermis was not broken. Given the relatively detailed level of examinations of *O. mykiss* captured in the weir trap, small injuries that would likely go unnoticed during other studies have been observed.

Given the literature reviewed, tests performed, and observations made, the most reasonable course of action would be to continue the monitoring and evaluations as conducted during 2011 with the netting modifications to the weir trap. Only one weir trap was used initially to determine if there are any significant physical injuries or scale loss occurring. If significant scale loss or physical injuries are shown to likely be due to the Robles Fish Facility, and the Robles Biological Committee deems it necessary, a second trap would be installed and operated upstream of the Robles Fish Facility. To determine if any injuries were the result of passage through the facility, steelhead smolts would be captured, marked, and released upstream of the Robles Fish Facility and recaptured downstream of the facility to measure any differences. The additional stress incurred by additional trapping and tagging of smolts would not justify the use of a second weir trap at this time.

3.5 Downstream Fish Migration through the Robles Reach

Introduction

When the number of fish physically handled in a study is of concern, such as with an endangered species, radio telemetry can be a useful method over others like extensive trapping (Hockersmith et al. 2000). Telemetry migration information of steelhead smolts in the Ventura River would allow for the determination of survival, travel time and rates through select reaches, migration relative to river discharge, habitat use, and passage success through critical riffles. By tracking the tagged fish until the batteries die, it is anticipated that downstream migration can be monitored all the way to the Ventura River estuary/lagoon and could provide important data on estuary rearing and emigration behavior.

The purpose of the downstream migration evaluation is to determine how successfully smolts are migrating through the Robles Reach (NMFS 2003). Because of the limited number of steelhead smolts most likely passing downstream through the facility, a pilot study using radio telemetry was used for evaluations.

Due to low precipitation, trapping was not conducted during 2012 and no data was collected for the Downstream Fish Migration through the Robles Reach. For a full description of evaluation methods, see CMWD (2011).

4.0 ROBLES FACILITY OPERATIONS

4.1 Facility Status

The Robles Fish Passage Facility started the 2011-2012 season in a fully functional mode, with the Fish Ladder Flow meter requiring verification after being relocated. The 2011-2012 season was characterized by a below average rainfall year as measured at Casitas Dam; 15.06 inches of rain were measured at Casitas Dam. The average rainfall at the dam is 24.06 inches. No peak flow events as defined by the BA/BO occurred during the Fish Flow Operations Season. Water diversions were limited to several hours on two occasions. No water was downloaded (i.e., released) from Lake Matilija. Lake Matilija remained in spill condition the entire year. The measurement weir stopped flowing in June and the entrance pool stopped having surface water in July.

The 2011 Report identified several projects to be completed during the summer and fall. The projects were:

- Modify the diffuser panel in the auxiliary water system.
- Complete the relocation of the fish passage flow meter to minimize turbulence from the Vaki shroud.
- Adjust interim weir three if flow stops in the weir section of the river.
- Modify the differential level sensors at the fish ladder entrance to individually read water levels.

A brief description of each project and the project's status is listed below:

Modify the diffuser panel in the auxiliary water system-Casitas received authorization from USBR and NMFS to complete this work in August and will complete the initial repairs planned prior to the start of the passage season.

Complete the relocation of the fish passage flow meter to minimize turbulence from the Vaki shroud-Work on this item was completed. The fish passage flow meter appeared to provide more consistent readings in its new location. However, the readings appear to be high when compared to the weir readings. Adjustments are being made during the summer and fall of 2012.

Adjust interim weir three to improve fish passage-This work was not accomplished because surface flows remained at the weirs throughout the year. This work is expected to be completed during the summer and fall of 2012.

Modify the differential level sensors at the fish ladder entrance to individually read water levels-Casitas is working with an instrumentation engineer to determine if this can be accomplished with the existing equipment.

4.2 Flow Observations and Control

Flow and level measurement devices are located at various locations within the Robles Fish Passage Facility. The primary points of measuring and recording stream flows entering, flowing through, and leaving the Robles Fish Passage Facility are:

- Matilija Creek at Matilija Hot Springs – located approximately 2,100 feet downstream of Matilija Dam – good rating for low to moderate flows – operated by Casitas Municipal Water District, formerly a USGS station;
- Matilija Dam Stage Bubbler-Located at the dam, this gage provides the lake elevation. Under high flows, the dam acts as a weir. This is the primary flow measurement location under high flows and to determine if a peak has occurred.
- North Fork Matilija Creek – located approximately 3,000 feet upstream of its confluence with Matilija Creek – good rating for low to moderate flows – operated by the Ventura County Watershed District;
- Robles-Casitas Diversion Canal – located on the diversion canal approximately 1,300 feet downstream of the Robles headworks – trapezoidal channel with a good rating for flows up to 600 cfs;
- Ventura River near Meiners Oaks (VRNMO) – located approximately 540 feet downstream of the Robles Fish Passage spillway – concrete weir section – good rating to 70 cfs, use of equations above 70 cfs with poor ratings above 1000 cfs (no verifications at higher flows). **This is the most reliable flow measurement for the fish passage and downstream releases with a 50 year plus history.** This site was formerly a USGS site.
- Fish Ladder-A 4 path flow meter by Accusonics located near the Riverwatcher. This flow meter has not been accurate since the installation of the replacement

Vaki shroud. **This flow measurement device was functional during the 2011-12 season but the readings were not verified.**

- Auxiliary Water Supply-An American Sigma flow meter. This meter has not provided reliable readings. Troubleshooting the problem is problematic because of infrequent flows necessitating the use of the auxiliary (attraction flow) flow system and because NMFS interpretation of the BO does not allow the system to be dewatered for inspections. The problem is believed to be “sloshing” in the pipe. Casitas received approval to implement the proposed solution and will complete initial modifications by the start of the fish passage season. This recommended solution was discussed in the 2011 Operations Report and at the annual 2011 Biological Committee meeting.

All of the instruments can suffer from inaccuracies from time to time. The inaccuracies can be caused by clogging of bubbler lines, electronic creep, debris accumulating on sensors, changes to the measured cross sections, human interactions, and equipment problems. For this reason, the data is verified against field measurements and observations. The information gathered from each of these locations has been reduced to the daily reporting of flows in the form of average cubic-feet per second. The spreadsheets are in Appendix 15. The monthly flow summaries could not be completed in time for this draft report due to upstream gage data availability. Therefore, Appendix 15 is incomplete and provisional in this draft; it will be completed for the final report.

The fish screens remained in place for the entire year.

No storm peaks occurred this year that triggered BA/BO required supplemental flow releases (Appendix 16). The river had minimal surface flow continuity through the Robles Reach for a few hours on April 13. Surface flow at no time met the adult steelhead passage requirements. This is the second season since Robles Fish Passage was completed that flows have been sufficient for adult steelhead to migrate up or downstream and the third season when no BO-defined peak occurred.

Delays in the Robles operation system has been suggested as a cause for peak flows to be overstated. Overstating peak flows could occur when the forebay builds and the over shot adjusts. A reasonable analogy for this situation is that of filling a hinged bucket with a spigot from a hose. Flow from the spigot is analogous to flow for the fish ladder. At some point, the bucket fills sufficiently that it tips on the hinge and releases water. The bucket tipping is analogous to the overshot gate. The flow from the bucket is measured at the spigot (weir flow) and the water spilling over the edge (canal flow). When the bucket first tips, there is greater flow out of the bucket than the amount of water supplied through the spigot by the hose. Provided the bucket is held steady, at some point, the flow from the spigot and the flow going over the edge of the bucket equals the flow provided by the hose. To determine if this differential was a significant issue at Robles, the peak flows since 2005 were reviewed along with the flow chart from April 13, 2012. Below is a table for all of the peaks since the Robles Fish Passage Facility became operational in 2006.

YEAR	Date	Peak Flow (cfs)
2006	1/2	3500
	2/28	3070
	3/28	1447
	4/4	5427
2007	No Peaks	
2008	1/4	2000
	1/23	769
	1/25	1700
	1/27	5000
	2/24	250
2009	No Peaks	
2010	1/18	1400
	2/5	585
	2/27	160
2011	2/18	214
	2/27 (Overlap)	270
	3/21	5200
2012	No Peaks	

Based on the flow chart for April 13, 2012, the increased flow associated with the system delays are about 10 cfs. This amount of flow would not have changed the peak determination for any of the above peaks. The system delays are insignificant based on this data.

4.3 Costs Associated with Operation and Monitoring

The BA/BO specified that the District provide the costs that are associated with the activity. The following is a summary of the direct costs incurred by the District during the 2011-12 fiscal years:

- **Fisheries Monitoring**:

Salaries & Benefits	$314,744
Equipment/Material	$ 49,083
	$363,827

- **Facility Operations**:

Salaries & Benefits	$ 64,192
Equipment/Materials	$ 3715
Outside Contracts	$ 0
Utilities	$ 2314
Permit	$ 0
	$ 70,221

- **Capital Improvements**:

  No capital improvements were made during this fiscal year.

4.4 Assessment of the Effectiveness to Provide Fish Passage

Casitas has entered into an agreement with HydroScientific West to complete the first phase of the performance (hydraulic) testing. Performance testing of the fish screen was completed March 24 and 25, 2011. The report for the fish screen portion of the testing will be provided under a separate cover once completed.

4.5 Recommendations Regarding the Prioritization of Future Activities

The District has completed its seventh season with the fish passage facility operational. Several projects have been identified to improve the functionality and reliability of the system. Other items require repairs. The summer and fall work list includes:

- Modify the diffuser panel in the auxiliary water system.
- Re-calibrate the transit time flow meter in the fish passage.
- Adjust interim weir three if flow stops in the weir section of the river.
- Modify the differential level sensors at the fish ladder entrance to individually read water levels.

4.6 Recommendations on any Revisions Deemed Necessary to the Operations

Casitas is recommending that the fish screen diffuser panels be replaced. The current diffuser panels are two super-imposed perforated plates with ¼” holes at 3/8” staggered centers. Casitas is proposing to replace the perforated plates with ½” diameter holes on 11/16” staggered centers perforated plates. The fewer but larger holes should reduce clogging of the diffuser panels.

Casitas has proposed modifying the diffuser panel on the auxiliary water. This diffuser appears to be restricting the flow in the auxiliary water system.

Casitas continues to recommend that the construction of the 15-weir portion of the project be put on hold at least until the Matilija Dam Removal Project is completed. Preliminary plans for the High Flow Sediment Bypass and High Flow Fish Passage require this area to be graded to new elevations. The existing temporary weir system has proven to be passable by adult *O. mykiss*.

5.0 LITERATURE CITED AND BIBLIOGRAPHY

Adams, N. S., D. W. Rondorf, S. D. Evans, and J. E. Kelly. 1998. Effects of surgically and gastrically implanted radio transmitters on growth and feeding behavior of juvenile Chinook salmon. Transaction of the American Fisheries Society, 127:128-136.

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 477-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Ando, D., T. Kitamura, and S. Mizuno. 2005. Quantitative analysis of body silvering during smoltification is masu salmon using chromameter. North American Journal of Aquaculture, 67:160-166.

Axel, G. A., M. H. Gessel, E. E. Hockersmith, M. Nesbit, and B. P. Sandford. 2011. Evaluation of juvenile salmonid condition (descaling) under different turbine operating conditions at McNary Dam, 2010. National Marine Fisheries Service, Fish Ecology Division. U.S. Army Corps of Engineers. Walla Walla, Washington.

Banks, J. W. 1969. A review of the literature on the upstream migration of adult salmonids. Journal of Fish Biology, 1:85-136.

Beeman, J. W., and A. G. Maule. 2001. Residence time and diel passage distribution of radio-tagged juvenile spring Chinook salmon and steelhead in a gatewell and fish collection channel of a Columbia River dam. North American Journal of Fisheries Management, 21:455-463.

Beeman, J. W., D. W. Rondorf, M. E. Tilson, and D. A. Venditti. 1995. A nonlethal measure of smolt status of juvenile steelhead based on body morphology. Transactions of the American Fisheries Society 124:764-769.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Bond, M. H., A. A. Hayes, G. V. Hanson, and R. B. MacFarlane. 2008. Marine survival of steelhead (*Oncorhynchus mykiss*) enhanced by a seasonally closed estuary. Canadian Journal of Fisheries and Aquatic Sciences, 65: 2242-2252.

Bratovich, P. M., and D. W. Kelley. Investigation of salmon and steelhead in Lagunitas Creek, Marin County, California. Volume 1. Migration, spawning, embryo incubation and emergence, juvenile rearing, emigration. Marin Municipal Water District. Corte Madera, California.

Brown, R. S., S. J. Cooke, W. G. Anderson, and R. S. McKinley. 1999. Evidence to challenge the “2% rule” for biotelemetry. North American Journal of Fisheries Management, 19:867-871.

Busby, P. B., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. National Marine Fisheries Service. NOAA technical memorandum NMFS-NWFSC-27, August 1996.

Cannata, S. T. 1998. Observations of steelhead trout (*Oncorhynchus mykiss*), coho salmon (*O. kisutch)* and water quality pf the Navarro River estuary/lagoon, May 1996 to December 1997. Draft report, Humboldt State University Foundation. Humboldt, CA.

Chrisp, E. Y., and T. C. Bjornn. 1978. parr-smolt transformations and seaward migration of wild and hatchery steelhead trout in Idaho. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow, Idaho. Final project report F-49-R.

Clay, H. C. 1995. Design of fishways and other fish facilities, 2nd edition. CRC Press, Inc., Boca Raton, FL.

Cooke, R. U., A. Warren, and A. S. Goudie. 1992. Desert geomorphology. UCL Press, London.

CMWD. 2005. 2005 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2006. 2006 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2007. 2007 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2008. 2008 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2009. 2009 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2010. 2010 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD, Wood Rogers, and ENTRIX Inc. 2002. Preliminary draft technical memorandum of operation constraint assessment of the Robles Fish Passage Facility. Prepared for US Bureau of Reclamation.

Dauble, D. D., T. L. Page, and W. Hanf. 1989. Spatial distribution of juvenile salmonids in the Hanford Reach, Columbia River. Fishery Bulletin, 87:775-790.

Dettman, D. H., and D. W. Kelley. 1986. Assessment of the Carmel River steelhead resource, Volume 1. biological investigations. Monterey Peninsula Water Management District, Monterey, CA.

Dilley, S., R. Wunderlich. 1992. Juvenile anadromous fish passage at Howard Hanson Project, Green River, Washington, 1991. U.S. Fish and Wildlife Service, Western Washington Fishery Resource Office, Olympia, Washington.

ENTRIX. 1999. Evaluations of natural passage barriers on the Ventura River downstream of Robles Diversion. ENTRIX, Walnut Creek, CA.

ENTRIX. 2000. Results of fish passage monitoring at the Vern Freeman diversion facility Santa Clara River, 1994-1998. ENTRIX, Walnut Creek, CA.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 2002. California salmonid stream habitat restoration manual, Volume I, 3rd edition. California Department of Fish and Game. Inland Fisheries Division, Sacramento, CA.

Gessel, M. H., J. G. Williams, D. A. Brege, R. F. Krcma., and D. R. Chambers. 1991. Juvenile salmonid guidance at the Bonneville Dam Second Powerhouse, Columbia River, 1983-1989. North American Journal of Fisheries Management, 11:400-412.

Hagar, J. 1996. Salinas River steelhead status and migration flow requirements. Monterey County Water Resources Agency. Salinas, California.

Haner, P. V., J. C. Faler, R. M. Schrock, D. W. Rondorf, and A. G. Maule. 1995. Skin reflectance as a nonlethal measure of smoltification for juvenile salmonids. North American Journal of Fisheries Management, 15:814-822.

Hockersmith, E. E., W. D. Muir, S. G. Smith, B. P. Sandford, N. S. Adams, J. M. Plumb, R. W. Perry, and D. W. Rondorf. 2000. Comparative performance of sham radio-tagged and PIT-tagged juvenile salmon. US Army Corps of Engineers, Walla Walla District.

Harrison, L. R., E. A. Keller, E. Kelley, and L. A. K. Mertes. 2006. Minimum flow requirements for southern steelhead passage on the lower Santa Clara River, CA. University of California, Santa Barbara.

Hasler, A. D., and A. T. Scholz. 1983. Olfactory imprinting and homing is salmon. Springer-Verlag, New York.

Hawkes, L. A., R. C. Johnsen, W. W. Smith, R. D. Martinson, W. A. Hevlin, and R. F. Absolon. 1991. Monitoring of downstream salmon and steelhead at federal hydroelectric facilities. National Marine Fisheries Service, Northwest Region. BPA Project No. 84-14.

Hostetter, N. J., A. F. Evans, D. D. Roby, K. Collis, M. Hawbecker, B. P. Sandford, D. E. Thompson, and F. J. Loge. 2011. Relationship of external fish condition to pathogen prevalence and out-migration survival in juvenile steelhead. Transactions of the American Fisheries Society 140:1158-1171.

Jepsen, N., L. E. Davis, C. B. Schreck, and B. Siddens. 2001. The physiological response of Chinook salmon smolts to two methods of radio-tagging. Transactions of the American Fisheries Society 130:495-500.

Leopold, L. B., M. G. Wolman, and J. P. Miller. Fluvial processes in geomorphology. W. H. Freeman and Company, San Francisco.

Lewis, S. D. 2001. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2000. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2002. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2001. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2003. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2002. Portland General Electric. Portland, Oregon.

Lewis, S. D. M. W. Gibson J. L. Switzer. 2010. Ventura River basin *Oncorhynchus mykiss irideus* monitoring, evaluation, and research: 2010 annual program report. Casitas Municipal Water District, Oak View, California.

Marine, K. R., and M. Gorman. 2005. Monitoring and evaluation for the A-Canal fish screen and bypass facility; scale loss and physical injury test, 2005. Bureau of Reclamation, Klamath Falls, OR.

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

Matthews, K. R., N. H. Berg, D. L. Azuma, and T. R. Lambert. 1994. Cool water formation and trout habitat use in a deep pool in the Sierra Nevada, California. Transactions of the American Fisheries Society, 123:549-564.

McNabb, C. D., C. R. Liston, and S. M. Borthwick. 1998. In-plant biological evaluation of the Rd Bluff Research Pumping Plant on the Sacramento River in Northern California: 1995 and 1996. Red Bluff Research Pumping Plant Report Se4arries, volume 3. US Bureau of Reclamation, Denver, CO.

Mensik, F., S. Rapp, D. Ross, and C. Morrill. 2006. Lower Granite Dam smolt monitoring program. Washington State Department of Fish and Wildlife. Bonneville Power Administration, project No. 1987-127-00. Portland, Oregon.

Moore. K., K. Jones, and J. Dambacher. 2002. Methods for stream habitat surveys, Version 12.1. Oregon Department of Fish and Wildlife, Aquatic Inventories Project, Natural Production Program, Corvallis, OR.

Mosley, M. P. 1982. Critical depths for passage in braided river, Canterbury, New Zealand. New Zealand Journal of Marine and Freshwater Research, Vol. 16:351-357.

National Marine Fisheries Service. 1997. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead. Federal Register, 50 CFR Parts 222 and 227 [Docket No. 960730210–7193–02; I.D. 050294D] RIN 0648–XX65. Vol. 62, page 43937.

National Marine Fisheries Service. 2003a. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

National Marine Fisheries Service. 2003b. Endangered and Threatened Species: Range Extension for Endangered Steelhead in Southern California. Federal Register, 50 CFR Part 224 [Docket No. 001025296-2079-02; I.D. 072600A] RIN 0648-AO05. Vol. 67 page 21586.

National Marine Fisheries Service. 2005. Endangered and Threatened Species: Request for Comment on Alternative Approach to Delineating 10 Evolutionarily Significant Units of West Coast Oncorhynchus mykiss. 50 CFR Parts 223 and 224 [Docket No. 040525161–5274–05; I.D. No. 052104F] RIN No. 0648–AR93. Vol. 70 page 67130.

National Marine Fisheries Service. 2009. Letter addressed to Scott Lewis (Casitas Municipal Water District) addressing the downstream fish passage evaluation. Letter dated 28 April 2009, SWR/2002/1871:SCG.

Neitzel, D. A., C. S. Abernethy, and G. A. Martenson. A fisheries evaluation of the Westside Ditch and Town Canal fish screening facilities, spring 1990. Pacific Northwest Laboratory. Bonneville Power Administration, Project No. 85-62. Portland, Oregon.

Pacific States Marine Fisheries Commission. 2001. Smolt handling guide. Pacific States Marine Fisheries Commission. Portland, Oregon.

Quinn, T, H. 2005. The behavior and ecology of pacific salmon and trout. American Fisheries Society, Bethesda, Maryland.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa, Bulletin 184.

Shapovalov, L. and A. C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*), with special reference to Waddell Creek, California, and recommendations regarding their management. State of California Department of Fish and Game, fish bulletin No. 98.

Spina, A. P., M. A. Allen, and M. Clarke. 2005. Downstream migration, rearing abundance, and pool habitat associations of juvenile steelhead in the lower main stem of a south-central California stream. North American Journal of Fisheries Management, 25:919-930.

Stoecker, M. 2010. North Fork Matilija Creek adult steelhead below Ojai Quarry barriers. Letter sent on 30 March 2010 about adult steelhead observations, 5 p.

Strauss, R. E., and C. E. Bond. 1990. Taxonomic methods: In Schreck C. B. and P. B. Moyle, editors. Methods for fish biology. AFS, Bethesda, Maryland.

Summerfelt, R. C., and L. S. Smith. 1990. Anesthesia, surgery, and related techniques. Pages 213-272 in C. B. Schreck and P. B. Moyle, editors. Methods for Fish Biology. American Fisheries Society, Bethesda, Maryland.

SYRTAC (Santa Ynez River Technical Advisory Committee). 1999. Adult steelhead passage flow analysis for the Santa Ynez River. Santa Ynez River Consensus Committee, Santa Barbara, CA.

SYRTAC (Santa Ynez River Technical Advisory Committee). 2000. Lower Santa Ynez River fish management plan. Santa Ynez River Consensus Committee, Santa Barbara, CA.

Tan, S. S., and T. A. Jones. 2006. Geologic map of the Matilija 7.5' quadrangle Ventura County, California: a digital database. Version 1.0, Los Angeles, CA.

Thompson, K. 1972. Determining stream flows for fish life. Pacific Northwest River Basins Commission, instream flow requirements workshop. Portland, Oregon. Proceedings: 31-50.

U.S. Bureau of Reclamation. 2003. Revised biological assessment for diversion operations and fish passage facilities at the Robles Diversion, Ventura River, CA. South-Central California Area Office, February 21, 2003.

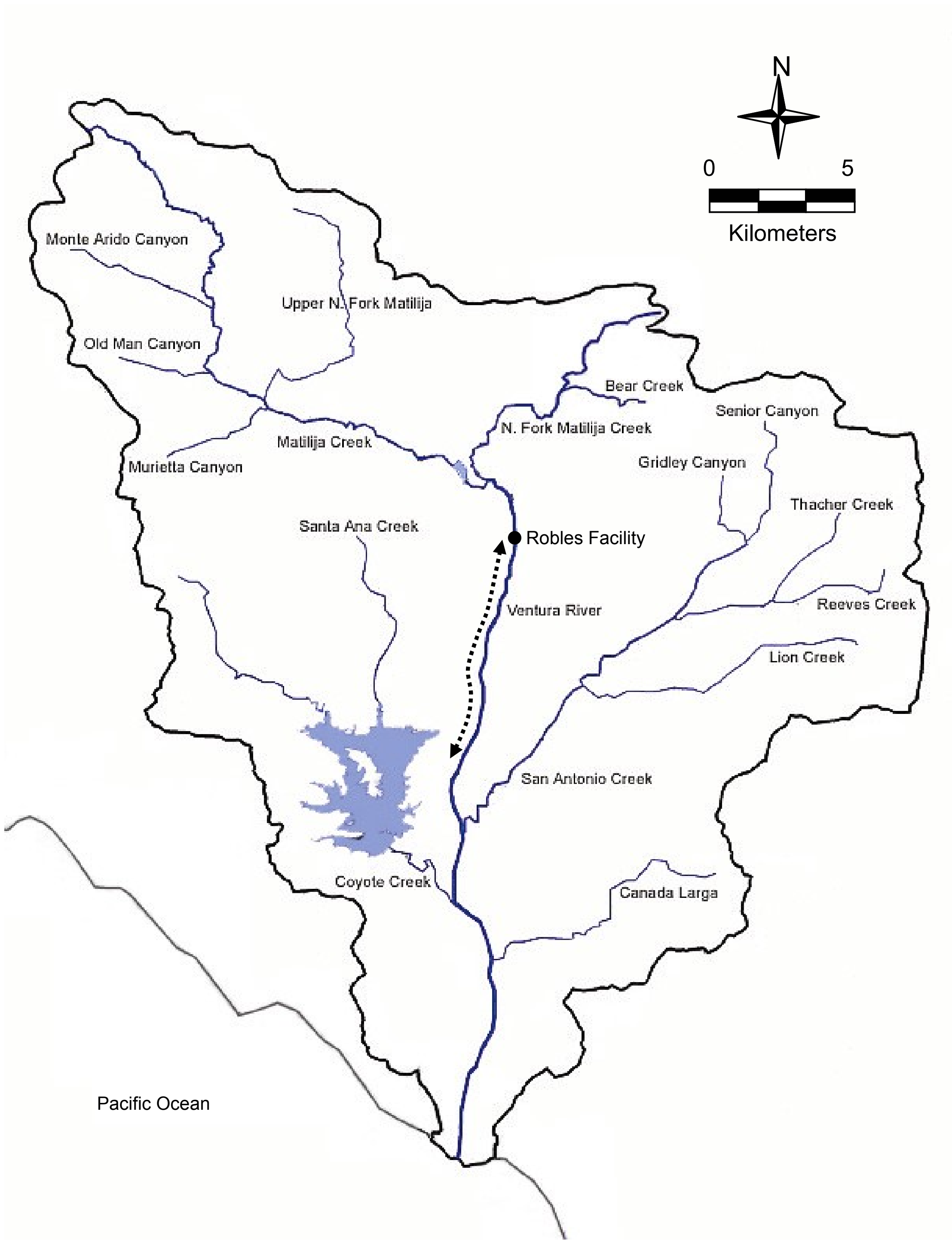
Vaki. 2003. User manual for Riverwatcher. Vaki Aquaculture Systems Ltd., Iceland.

Wagner, H. H., R. L. Wallace, and H. J. Campbell. 1963. The seaward migration and return of hatchery-reared steelhead trout, *Salmo gairdneri* Richardson, in the Alsea River, Oregon. Transactions of the American Fisheries Society, 92(3):202-210.

Wunderlich, R. C., and S. J. Dilley. 1986. Field tests of data collection procedures for the Elwha salmonid survival model. U.S. Fish and Wildlife Service, Fisheries Assistance Office, Olympia, Washington.

Zydlewski, J., G. Zydlewski, and G. R. Danner. 2010. Descaling injury impairs the osmoregulatory ability of Atlantic salmon smolts entering seawater. Transactions of the American Fisheries Society 138:129-136.

6.0 APPENDIXES



Appendix 1. Basin map of the Ventura River. The Robles Fish Passage Facility is identified by the black dot and the Robles Reach is identified by the dashed line downstream of the Robles Facility.

Appendix 2. Summary data of impediments sites selected for upstream fish migration impediment evaluations selected or assessed by the Biological Committee during January 2012.

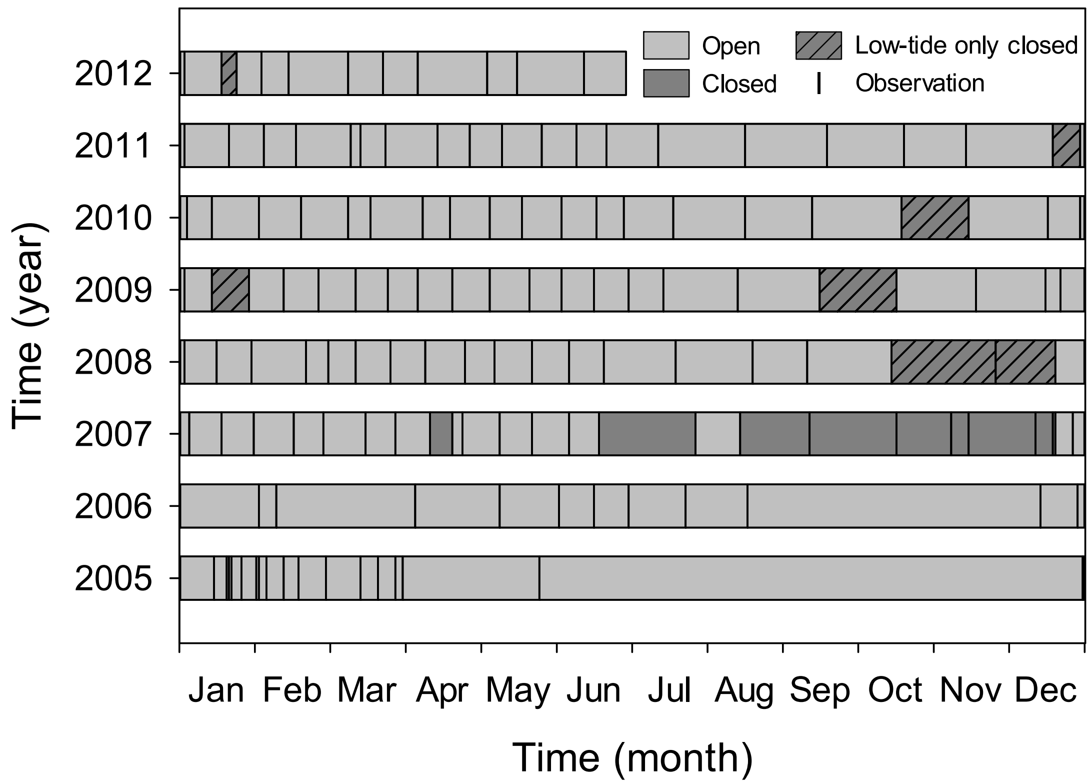
Site No.	Latitude (N)	Longitude (W)	km	Habitat Type[a]	Site Description	Length (m)	Slope (%)	Percent Substrate[b] SO	SD	GR	CB	BD	BR	Active Channel Width (m)
10[c]	34.365265°	119.311082°	11	RI	Near Casitas Springs at bottom of levy					TBD[d]				
3-2	34.373789°	119.308417°	12	RB	Near Casitas Springs at top of levy	22.0	3.7	10	5	10	65	10	0	27.0
4	34.384743°	119.310030°	14	RI	0.5 km upstream of San Antonio Cr. confluence	23.8	5.0	0	0	0	15	85	0	27.9
5-2	34.396095°	119.309537°	15	RI	0.4 km downstream of Santa Ana Blvd. bridge	8.4	7.0	0	5	5	45	45	0	50.6
6-1	34.411318°	119.301491°	17	CB	1.4 km upstream of Santa Ana Blvd. bridge	26.1	5.0	0	0	0	65	35	0	33.8
9	34.426708°	119.301831°	19	RB	0.2 km upstream of Hwy 150 bridge					TBD[d]				
7	34.438184°	119.299528°	20	RB	1.1 km upstream of Hwy 150 bridge	31.6	2.0	5	0	10	40	45	0	65.9
8[e]	34.454189°	119.293143°	22	CB	1.2 km downstream of Robles Fish Facility	9.2	10.0	0	0	10	45	45	0	32.4

[a]The habitat types are: RB = rapid with protruding boulders, RI = riffle, and CB = cascade over boulders.
[b]The substrate types are: SO = silt and organics, SD = sand, GR = gravel, CB = cobble, BD = boulders, and BR = bedrock.
[c]Site 10 was selected to replace Site 2.
[d]Insufficient discharge prevented site characterization during 2012.
[e]Site 8 will only be monitored if Site 10 is determined to be unsuitable after sufficient flows have occurred.

Appendix 3. Ventura River sandbar monitoring data from July 2011 through June 2012.

					High Tide		Low Tide				
Date	Sandbar Breeched (Y/N)	Time (24h)	Tide Height (ft)	Tidal State	Time (24h)	Height (ft)	Time (24h)	Height (ft)	Mean Daily Discharge at Foster[a] (cfs)	Mean Daily Discharge at Robles (cfs)	Notes
07/13/2011	Y	14:16	2.2	slack	9:49	3.9	14:33	2.1	25.0	19	Open in center
08/17/2011	Y	09:15	3.1	flood	12:09	4.8	05:55	0.9	19.0	5	Open in center
09/19/2011	Y	14:30	4.6	slack	13:51	4.6	22:38	1.3	9.7	2	Open in center
10/20/2011	Y	13:30	3.8	flood	16:13	4.5	10:48	3.2	9.3	0	Open in center
11/14/2011	Y	16:15	0.7	ebb	10:10	5.6	17:55	0.1	7.9	14	Open in center
12/19/2011	N[b]	15:45	2.8	flood	17:19	3.2	11:34	0.8	6.2	10	If breached, center
12/30/2011	Y	11:45	3.6	flood	12:48	3.7	07:34	2.3	7.9	10	Open in center
01/03/2012	Y	12:00	0.8	ebb	05:01	4.9	12:44	0.7	7.0	10	Open in center
01/18/2012	N[b]	09:45	1.3	ebb	04:48	5.5	12:26	-0.3	5.4	9	If breached, center
01/24/2012	Y	11:15	4.9	ebb	09:29	5.9	16:26	-0.9	8.2	10	Open in center
02/03/2012	Y	13:45	-0.1	slack	00:14	3.3	13:31	-0.1	6.8	10	Open in center
02/14/2012	Y	09:38	0.6	slack	01:55	5.1	09:42	0.6	6.7	10	Open in center
03/09/2012	Y	14:02	1.1	ebb	09:44	5.2	15:55	-0.1	5.8	7	Open in west-center
03/23/2012	Y	10:20	4.3	flood	10:40	4.3	04:42	0.2	9.5	13	Open in west-center
04/06/2012	Y	14:35	0.7	ebb	09:53	4.9	15:46	0.3	14.0	14	Open in west-center
05/04/2012	Y	15:05	0.9	flood	20:34	6.3	14:34	0.8	7.8	16	Open in west-center
05/16/2012	Y	09:00	3.4	ebb	07:53	3.6	13:26	1.3	4.9	11	Open in west-center
06/12/2012	Y	13:55	2.7	flood	17:10	3.2	11:01	1.4	5.1	2	Open in center
06/29/2012	Y	14:00	2.8	flood	18:26	6.1	11:47	1.9	4.8	0	Open in center

[a]USGS gauging station number 11118500, downstream of Foster Park.
[b]Sandbar was closed at low tide and open during some high tides.

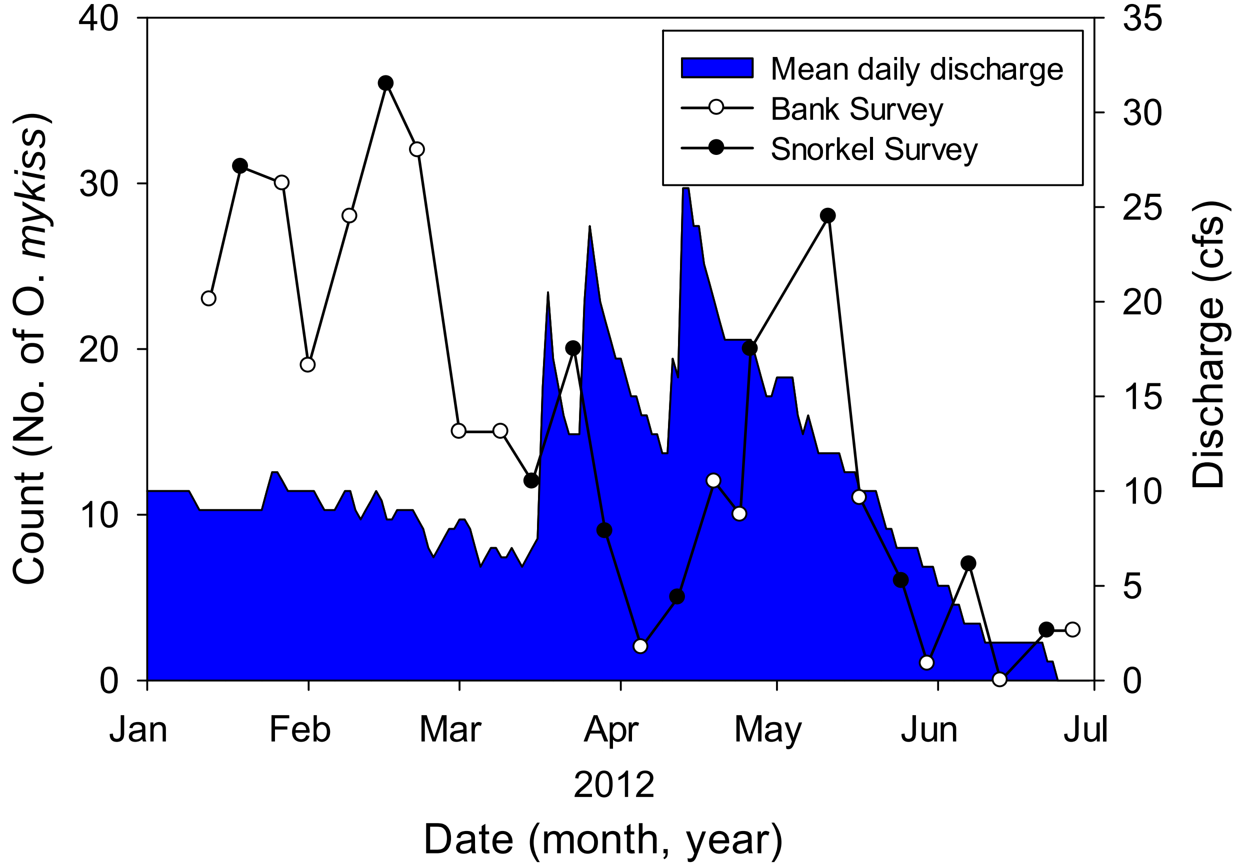


Appendix 4. Sandbar status at the mouth of the Ventura River from 2005 through June of 2012. Each observation is indicated by vertical lines and the sandbar status was assumed to remain the same until the next observation.

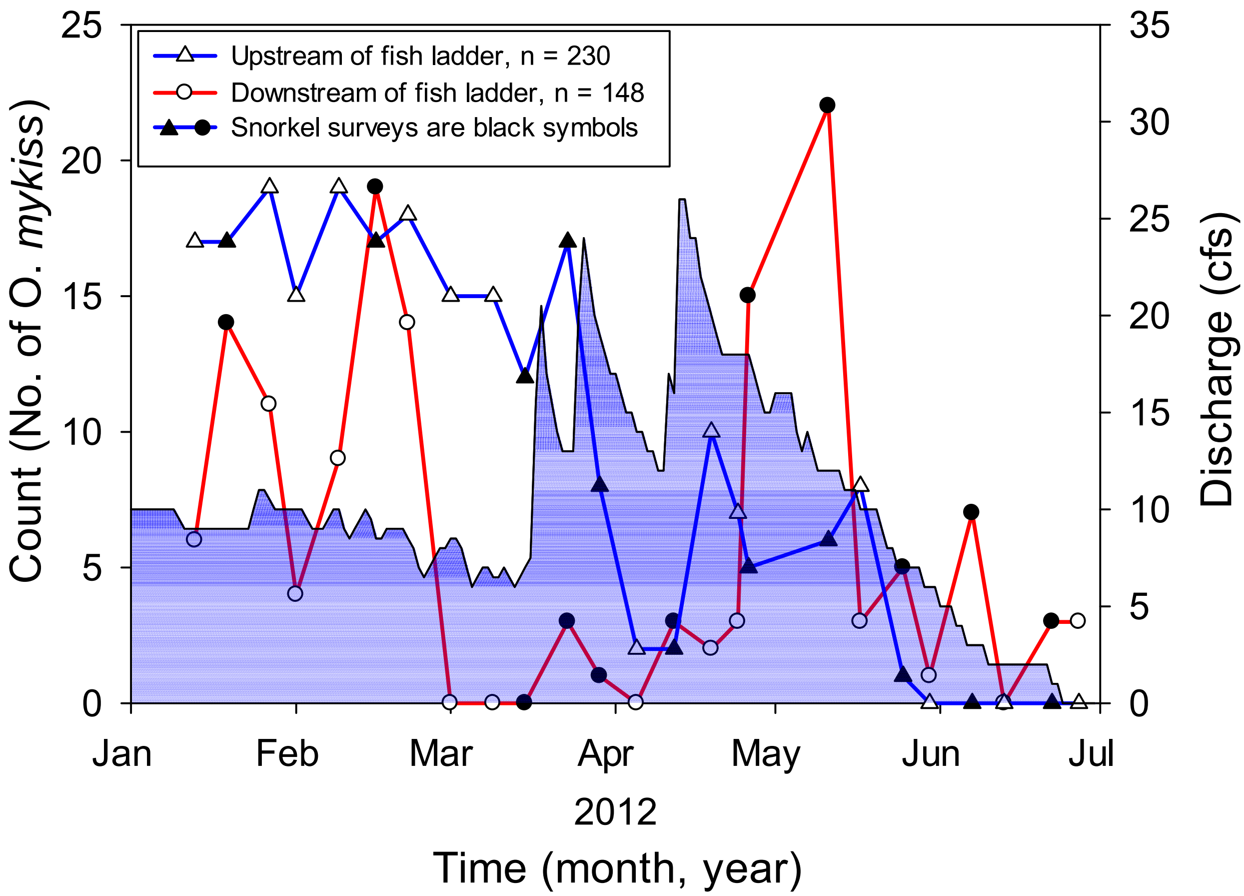
Appendix 5. Fish attraction counts at the Robles Fish Facility, January-June of 2012.

Date	Method	Direction	Length (m)	Temp. (°C)	Turbidity (NTU)	Robles Discharge (CFS)	Species[a]	Count
01/13/2012	Bank	Downstream	200	8	1	9	OMY	6
01/13/2012	Bank	Upstream	140	8	1	9	OMY	17
01/19/2012	Snorkel	Downstream	200	12	0	9	OMY	14
01/19/2012	Snorkel	Upstream	140	12	0	9	OMY	17
01/27/2012	Bank	Downstream	200	12	1	11	OMY	11
01/27/2012	Bank	Upstream	140	12	1	11	OMY	19
02/01/2012	Bank	Downstream	200	11	1	10	OMY	4
02/01/2012	Bank	Upstream	140	11	1	10	OMY	15
02/09/2012	Bank	Downstream	200	11	1	10	OMY	9
02/09/2012	Bank	Upstream	140	11	1	10	OMY	19
02/16/2012	Snorkel	Downstream	200	11	1	9	OMY	19
02/16/2012	Snorkel	Upstream	140	11	1	9	OMY	17
02/22/2012	Bank	Downstream	200	15	1	9	OMY	14
02/22/2012	Bank	Upstream	140	15	1	9	OMY	18
03/01/2012	Bank	Downstream	200	11	1	9	NFO	0
03/01/2012	Bank	Upstream	140	11	1	9	OMY	15
03/09/2012	Bank	Downstream	200	19	1	7	NFO	0
03/09/2012	Bank	Upstream	140	19	1	7	OMY	15
03/15/2012	Snorkel	Downstream	200	15	6	7	NFO	0
03/15/2012	Snorkel	Upstream	140	15	6	7	OMY	12
03/23/2012	Snorkel	Downstream	200	13	3	13	OMY	3
03/23/2012	Snorkel	Upstream	140	13	3	13	OMY	17
03/29/2012	Snorkel	Downstream	200	16	1	19	OMY	1
03/29/2012	Snorkel	Upstream	140	16	1	19	OMY	8
04/05/2012	Bank	Downstream	200	12	1	14	NFO	0
04/05/2012	Bank	Upstream	140	12	1	14	OMY	2
04/12/2012	Snorkel	Downstream	200	14	2	16	OMY	3
04/12/2012	Snorkel	Upstream	140	14	2	16	OMY	2
04/19/2012	Bank	Downstream	200	17	4	20	OMY	2
04/19/2012	Bank	Upstream	140	17	4	20	OMY	10
04/24/2012	Bank	Downstream	200	15	5	18	OMY	3
04/24/2012	Bank	Upstream	140	15	5	18	OMY	7
04/26/2012	Snorkel	Downstream	200	16	1	18	OMY	15
04/26/2012	Snorkel	Upstream	140	16	1	18	OMY	5
05/11/2012	Snorkel	Downstream	200	19	2	12	OMY	22
05/11/2012	Snorkel	Upstream	140	19	2	12	OMY	6
05/17/2012	Bank	Downstream	200	19	2	10	OMY	3
05/17/2012	Bank	Upstream	140	19	2	10	OMY	8
05/25/2012	Snorkel	Downstream	200	18	2	7	OMY	5
05/25/2012	Snorkel	Upstream	140	18	2	7	OMY	1
05/30/2012	Bank	Downstream	200	24	4	6	OMY	1
05/30/2012	Bank	Upstream	140	24	4	6	NFO	0
06/07/2012	Snorkel	Downstream	200	20	2	3	OMY	7
06/07/2012	Snorkel	Upstream	140	20	2	3	NFO	0
06/13/2012	Bank	Downstream	200	23	2	2	NFO	0
06/13/2012	Bank	Upstream	140	23	2	2	NFO	0
06/22/2012	Snorkel	Downstream	200	21	2	1	OMY	3
06/22/2012	Snorkel	Upstream	140	21	2	1	NFO	0
06/28/2012	Snorkel	Downstream	200	25	1	0	OMY	3
06/28/2012	Snorkel	Upstream	140	25	1	0	NFO	0
		Upstream	3,500				Upstream	230
		Downstream	5,000				Downstream	148
		Total	8,500				Total	378

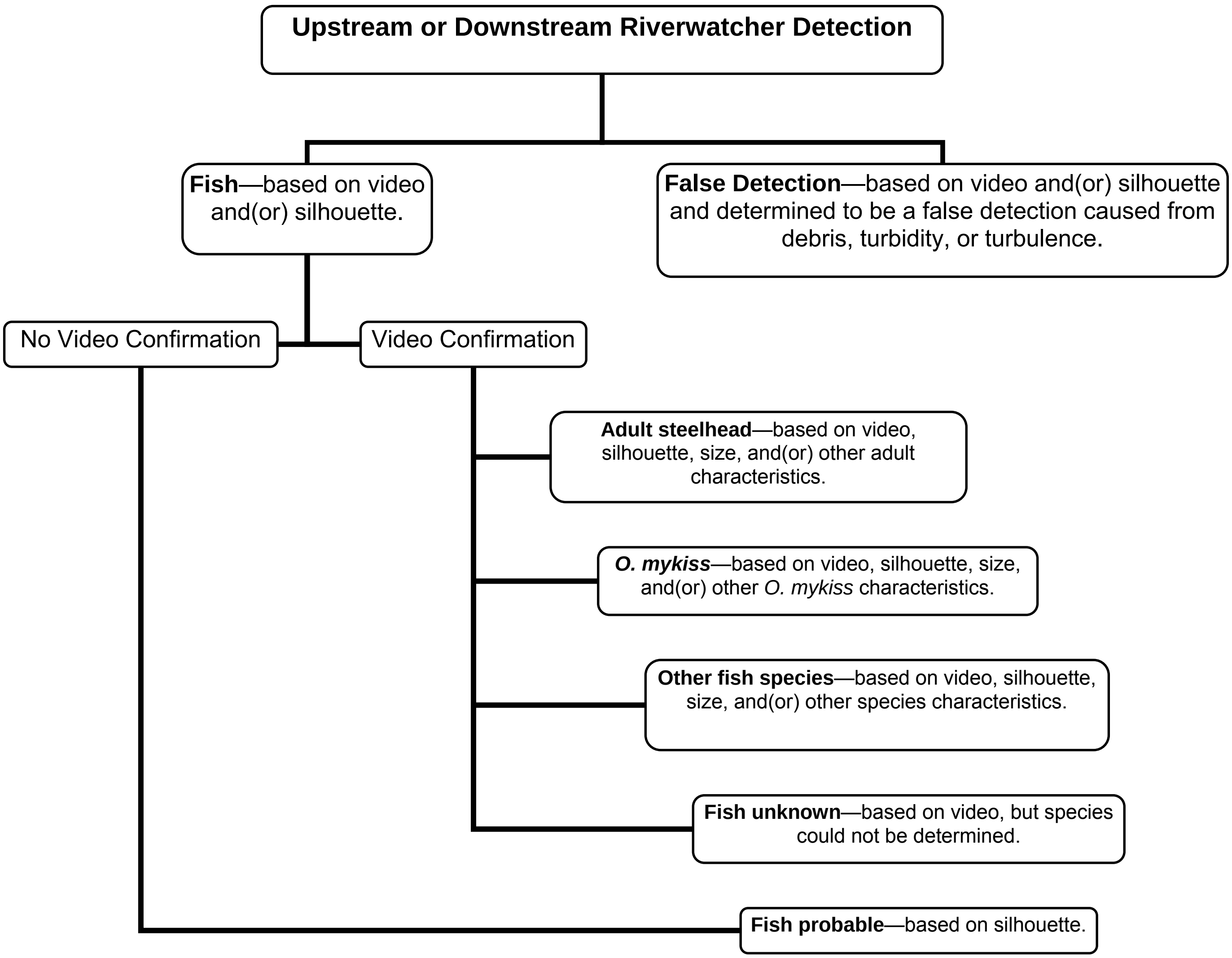
[a]OMY = *O. mykiss* and NFO = no fish observed.



Appendix 6. Total count of *O. mykiss* observed during fish attraction surveys during the fish passage season from January through June 2012 and discharge from the Robles Facility.



Appendix 7. Count of *O. mykiss* observed during fish attraction surveys upstream and downstream of the Robles Fish Facility during the fish passage season from January through June 2012.

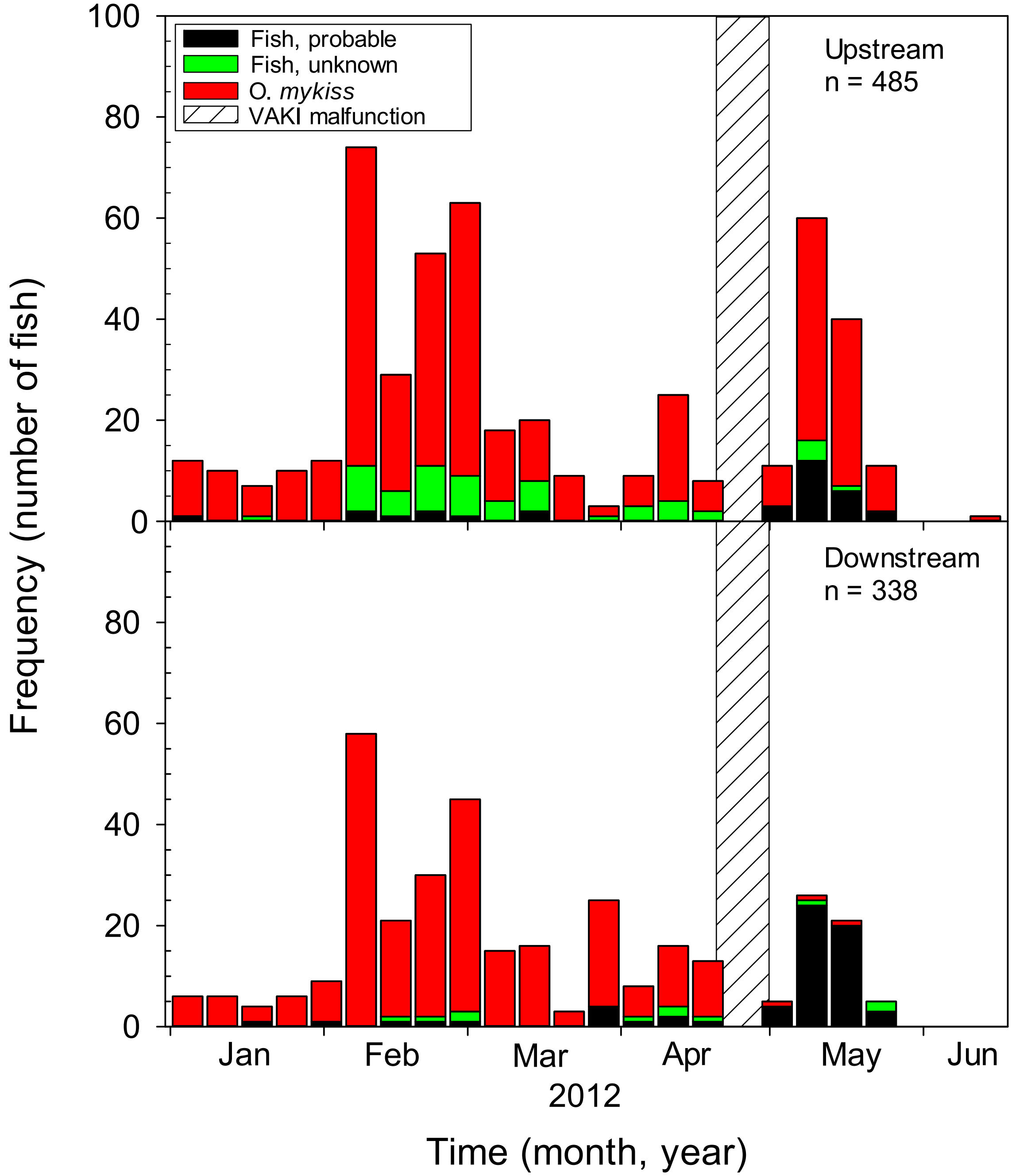


Appendix 8. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections.

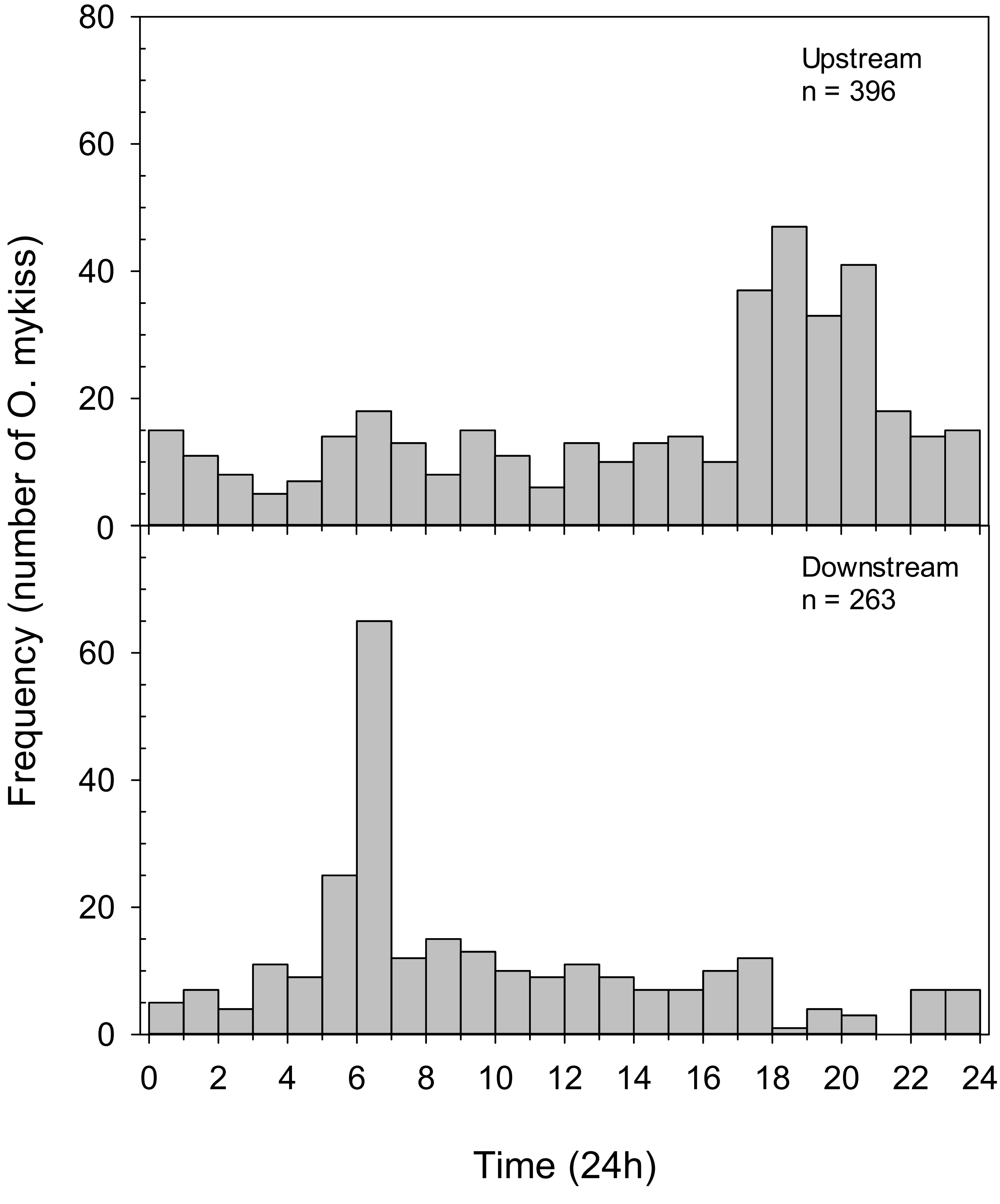
Appendix 9. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* from January through June of 2012.

	Upstream	Downstream
O. *mykiss*	396	263
Fish, non O. *mykiss*[a]	16	6
Fish, unknown	57	11
Fish, probable	32	64
False detections	885	1,438
Total	1,386	1,782
Mean date - O. *mykiss*	12-Mar	27-Feb
Mean date - fish, non O. *mykiss*	11-Mar	5-Mar
Mean date - fish, unknown	9-Mar	3-Apr
Mean date - fish, probable	17-Apr	29-Apr
Mean time - O. *mykiss* (24h)	14:23	9:37
Mean time - fish, non O. *mykiss* (24h)	16:30	13:10
Mean time - fish, unknown (24h)	11:35	13:05
Mean time - fish, probable (24h)	13:35	9:37
Mean length - O. *mykiss* (cm)	31	29
Mean length - fish, non O. *mykiss* (cm)	45	49
Mean length - fish, unknown (cm)	29	29
Mean length - fish, probable (cm)	30	26
Mean daily temperature - O. *mykiss* (°C)	14.4	12.9
Mean daily temperature - fish, non O. *mykiss* (°C)	13.6	13.0
Mean daily temperature - fish, unknown (°C)	13.8	15.9
Mean daily temperature - fish, probable (°C)	17.8	18.4
Mean daily turbidity - O. *mykiss* (NTU)	5	6
Mean daily turbidity - fish, non O. *mykiss* (NTU)	6	4
Mean daily turbidity - fish, probable (NTU)	3	3
Mean daily turbidity - fish, unknown (NTU)	5	4
Mean daily turbidity - false detections (NTU)	17	25
Mean daily discharge - O. *mykiss* (cfs)	10.3	10.7
Mean daily discharge - fish, non O. *mykiss* (cfs)	12.6	9.4
Mean daily discharge - fish, probable (cfs)	11.0	12.6
Mean daily discharge - fish, unknown (cfs)	10.2	12.3
Mean daily discharge - false detections (cfs)	14.8	15.0

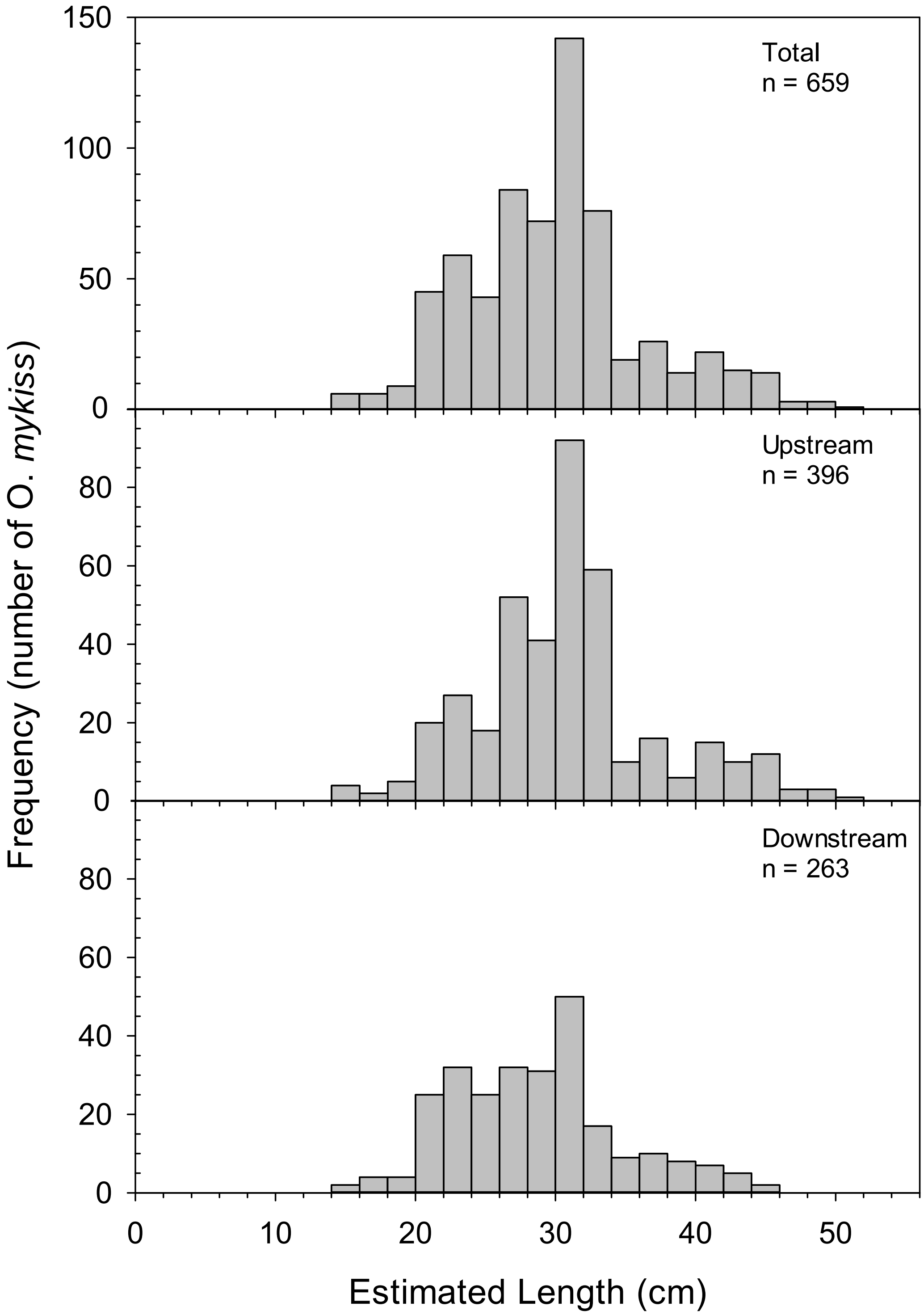
[a]Fish, non O. mykiss includes 1 sunfish (up) and 21 largemouth bass



Appendix 10. Weekly Riverwatcher upstream and downstream detections classified as *O. mykiss*, fish probable, and fish unknown from January through June of 2012.



Appendix 11. Time (24h) of *O. mykiss,* fish probable, and fish unknown passage through the Riverwatcher in upstream and downstream directions from January through June of 2012.



Appendix 12. Length frequency distribution of *O. mykiss* detected passing through the Riverwatcher from January through June of 2012.

Appendix 13. Date, time, TL, direction, discharge, turbidity, and temperature at time of all upstream and downstream Riverwatcher detections that were determined to be fish.

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
4-Jan-2012	12:23	Fish Probable	28	Up	10	4	11.8
4-Jan-2012	22:24	O. mykiss	32	Up	10	4	11.8
4-Jan-2012	22:38	O. mykiss	41	Up	10	4	11.8
4-Jan-2012	22:38	O. mykiss	34	Down	10	4	11.8
5-Jan-2012	0:26	O. mykiss	41	Up	10	4	12.0
5-Jan-2012	0:37	O. mykiss	34	Down	10	4	12.0
5-Jan-2012	10:22	O. mykiss	34	Up	10	4	12.0
5-Jan-2012	12:43	O. mykiss	30	Up	10	4	12.0
6-Jan-2012	1:42	O. mykiss	34	Up	10	4	11.8
6-Jan-2012	2:55	O. mykiss	32	Up	10	4	11.8
6-Jan-2012	17:52	O. mykiss	27	Up	10	4	11.8
6-Jan-2012	19:54	O. mykiss	41	Up	10	4	11.8
7-Jan-2012	6:08	O. mykiss	28	Down	10	4	10.9
7-Jan-2012	6:35	O. mykiss	44	Down	10	4	10.9
7-Jan-2012	6:45	O. mykiss	23	Down	10	4	10.9
7-Jan-2012	15:36	O. mykiss	20	Down	10	4	10.9
7-Jan-2012	15:36	O. mykiss	30	Up	10	4	10.9
7-Jan-2012	19:29	O. mykiss	44	Up	10	4	10.9
8-Jan-2012	1:43	O. mykiss	27	Up	10	4	10.4
8-Jan-2012	6:50	O. mykiss	23	Down	10	4	10.4
8-Jan-2012	6:55	O. mykiss	32	Up	10	4	10.4
8-Jan-2012	17:31	O. mykiss	37	Down	10	4	10.4
8-Jan-2012	17:34	O. mykiss	25	Up	10	4	10.4
9-Jan-2012	3:33	O. mykiss	22	Up	10	4	10.3
9-Jan-2012	4:23	O. mykiss	41	Up	10	4	10.3
9-Jan-2012	6:56	O. mykiss	22	Down	10	4	10.3
9-Jan-2012	20:34	O. mykiss	44	Up	10	4	10.3
10-Jan-2012	6:15	O. mykiss	41	Down	10	4	10.6
11-Jan-2012	8:51	O. mykiss	19	Up	9	4	10.4
12-Jan-2012	19:48	O. mykiss	20	Up	9	4	10.9
13-Jan-2012	7:03	O. mykiss	23	Down	9	4	10.2
13-Jan-2012	7:04	O. mykiss	32	Up	9	4	10.2
14-Jan-2012	6:51	O. mykiss	23	Down	9	4	9.3
14-Jan-2012	6:58	O. mykiss	28	Up	9	4	9.3
15-Jan-2012	8:28	O. mykiss	23	Down	9	4	9.7
15-Jan-2012	8:28	O. mykiss	27	Up	9	4	9.7
15-Jan-2012	21:01	O. mykiss	19	Up	9	4	9.7
16-Jan-2012	0:28	O. mykiss	32	Up	9	4	10.3
16-Jan-2012	5:52	O. mykiss	23	Down	9	4	10.3
17-Jan-2012	8:28	O. mykiss	23	Down	9	4	9.1
17-Jan-2012	8:34	Fish Unknown	25	Up	9	4	9.1
17-Jan-2012	8:35	Fish Probable	27	Down	9	4	9.1
20-Jan-2012	23:42	O. mykiss	30	Up	9	4	10.2
21-Jan-2012	13:00	O. mykiss	28	Up	9	5	11.7
21-Jan-2012	17:31	O. mykiss	27	Up	9	5	11.7
22-Jan-2012	7:12	O. mykiss	30	Down	9	5	10.7
22-Jan-2012	9:43	O. mykiss	34	Up	9	5	10.7
22-Jan-2012	16:20	O. mykiss	32	Up	9	5	10.7
22-Jan-2012	17:59	O. mykiss	25	Up	9	5	10.7
23-Jan-2012	2:24	O. mykiss	28	Up	9	4	11.2

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
23-Jan-2012	6:18	O. mykiss	22	Down	9	4	11.2
23-Jan-2012	21:27	O. mykiss	27	Up	9	4	11.2
24-Jan-2012	6:47	O. mykiss	25	Down	10	4	11.4
24-Jan-2012	11:55	O. mykiss	25	Up	10	4	11.4
25-Jan-2012	20:10	O. mykiss	25	Up	11	4	12.0
26-Jan-2012	16:41	Largemouth Bass	39	Up	11	4	12.9
26-Jan-2012	17:50	O. mykiss	23	Up	11	4	12.9
27-Jan-2012	14:52	O. mykiss	34	Down	11	4	13.2
27-Jan-2012	23:24	O. mykiss	42	Up	11	4	13.2
28-Jan-2012	6:50	O. mykiss	40	Down	10	4	11.9
28-Jan-2012	6:57	O. mykiss	19	Down	10	4	11.9
28-Jan-2012	15:39	O. mykiss	25	Up	10	4	11.9
30-Jan-2012	1:49	O. mykiss	23	Up	10	4	11.0
30-Jan-2012	6:06	O. mykiss	28	Down	10	4	11.0
30-Jan-2012	6:36	Fish Probable	17	Down	10	4	11.0
31-Jan-2012	6:02	O. mykiss	32	Down	10	4	11.4
31-Jan-2012	16:22	Largemouth Bass	50	Up	10	4	11.4
31-Jan-2012	17:53	O. mykiss	27	Up	10	4	11.4
31-Jan-2012	18:31	O. mykiss	28	Up	10	4	11.4
1-Feb-2012	1:47	O. mykiss	32	Up	10	4	12.1
1-Feb-2012	6:05	O. mykiss	30	Down	10	4	12.1
1-Feb-2012	17:55	O. mykiss	30	Up	10	4	12.1
1-Feb-2012	20:55	O. mykiss	28	Up	10	4	12.1
2-Feb-2012	5:56	O. mykiss	30	Down	10	4	11.9
2-Feb-2012	6:09	O. mykiss	34	Down	10	4	11.9
2-Feb-2012	18:17	O. mykiss	30	Up	10	4	11.9
3-Feb-2012	3:57	O. mykiss	30	Down	10	5	11.5
3-Feb-2012	6:14	O. mykiss	23	Down	10	5	11.5
3-Feb-2012	17:43	O. mykiss	30	Up	10	5	11.5
3-Feb-2012	18:00	O. mykiss	19	Up	10	5	11.5
3-Feb-2012	23:11	O. mykiss	23	Up	10	5	11.5
4-Feb-2012	0:03	O. mykiss	28	Up	9	5	10.9
4-Feb-2012	17:55	O. mykiss	27	Up	9	5	10.9
4-Feb-2012	22:36	O. mykiss	17	Down	9	5	10.9
5-Feb-2012	0:19	O. mykiss	27	Up	9	6	11.1
5-Feb-2012	0:23	O. mykiss	28	Up	9	6	11.1
5-Feb-2012	0:32	O. mykiss	34	Up	9	6	11.1
5-Feb-2012	1:50	O. mykiss	28	Down	9	6	11.1
5-Feb-2012	2:52	O. mykiss	29	Up	9	6	11.1
5-Feb-2012	5:18	O. mykiss	20	Down	9	6	11.1
5-Feb-2012	6:12	O. mykiss	32	Down	9	6	11.1
5-Feb-2012	18:03	O. mykiss	30	Up	9	6	11.1
5-Feb-2012	18:14	O. mykiss	20	Up	9	6	11.1
5-Feb-2012	23:41	O. mykiss	28	Up	9	6	11.1
6-Feb-2012	1:55	O. mykiss	30	Up	9	5	10.9
6-Feb-2012	5:17	O. mykiss	25	Down	9	5	10.9
6-Feb-2012	6:22	O. mykiss	23	Down	9	5	10.9
6-Feb-2012	19:08	O. mykiss	30	Up	9	5	10.9
6-Feb-2012	19:12	O. mykiss	27	Up	9	5	10.9
7-Feb-2012	6:37	O. mykiss	23	Down	10	4	11.5
7-Feb-2012	17:00	O. mykiss	15	Up	10	4	11.5
7-Feb-2012	19:45	O. mykiss	28	Up	10	4	11.5
7-Feb-2012	20:19	O. mykiss	27	Down	10	4	11.5

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
7-Feb-2012	20:21	O. mykiss	32	Up	10	4	11.5
7-Feb-2012	22:22	O. mykiss	17	Up	10	4	11.5
7-Feb-2012	23:59	O. mykiss	23	Down	10	4	11.5
8-Feb-2012	0:14	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	4:02	O. mykiss	23	Down	10	4	12.3
8-Feb-2012	6:14	O. mykiss	28	Down	10	4	12.3
8-Feb-2012	8:52	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	8:53	O. mykiss	34	Up	10	4	12.3
8-Feb-2012	8:58	O. mykiss	30	Down	10	4	12.3
8-Feb-2012	8:58	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	9:12	O. mykiss	25	Down	10	4	12.3
8-Feb-2012	9:12	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	9:13	O. mykiss	35	Up	10	4	12.3
8-Feb-2012	9:13	O. mykiss	34	Up	10	4	12.3
8-Feb-2012	11:53	O. mykiss	25	Down	10	4	12.3
8-Feb-2012	11:53	O. mykiss	25	Up	10	4	12.3
8-Feb-2012	11:55	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	12:04	O. mykiss	27	Up	10	4	12.3
8-Feb-2012	12:13	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	12:15	O. mykiss	22	Up	10	4	12.3
8-Feb-2012	12:19	O. mykiss	30	Down	10	4	12.3
8-Feb-2012	12:26	O. mykiss	37	Up	10	4	12.3
8-Feb-2012	12:51	O. mykiss	25	Down	10	4	12.3
8-Feb-2012	13:13	O. mykiss	23	Up	10	4	12.3
8-Feb-2012	13:20	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	14:02	O. mykiss	27	Up	10	4	12.3
8-Feb-2012	14:08	O. mykiss	28	Down	10	4	12.3
8-Feb-2012	14:55	Fish Probable	23	Up	10	4	12.3
8-Feb-2012	22:27	O. mykiss	34	Down	10	4	12.3
8-Feb-2012	22:32	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	23:49	O. mykiss	27	Down	10	4	12.3
9-Feb-2012	0:04	Fish Unknown	30	Up	10	4	12.8
9-Feb-2012	0:17	O. mykiss	32	Up	10	4	12.8
9-Feb-2012	5:38	O. mykiss	27	Down	10	4	12.8
9-Feb-2012	5:40	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	6:48	O. mykiss	28	Down	10	4	12.8
9-Feb-2012	6:48	O. mykiss	30	Down	10	4	12.8
9-Feb-2012	6:52	O. mykiss	37	Up	10	4	12.8
9-Feb-2012	6:52	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	7:03	O. mykiss	23	Down	10	4	12.8
9-Feb-2012	8:26	O. mykiss	27	Down	10	4	12.8
9-Feb-2012	8:41	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	8:46	O. mykiss	25	Down	10	4	12.8
9-Feb-2012	9:01	Fish Unknown	32	Up	10	4	12.8
9-Feb-2012	9:06	O. mykiss	30	Down	10	4	12.8
9-Feb-2012	9:22	O. mykiss	32	Up	10	4	12.8
9-Feb-2012	18:08	O. mykiss	30	Up	10	4	12.8
9-Feb-2012	18:17	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	19:49	O. mykiss	25	Down	10	4	12.8
9-Feb-2012	19:55	O. mykiss	28	Up	10	4	12.8
9-Feb-2012	20:40	O. mykiss	34	Down	10	4	12.8
9-Feb-2012	20:42	O. mykiss	30	Up	10	4	12.8
9-Feb-2012	20:53	O. mykiss	30	Up	10	4	12.8

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
10-Feb-2012	1:04	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	1:14	Fish Probable	34	Up	9	4	13.0
10-Feb-2012	5:33	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	5:55	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	6:27	O. mykiss	23	Down	9	4	13.0
10-Feb-2012	6:27	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	6:32	O. mykiss	22	Down	9	4	13.0
10-Feb-2012	9:18	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	9:28	O. mykiss	25	Down	9	4	13.0
10-Feb-2012	9:45	O. mykiss	32	Up	9	4	13.0
10-Feb-2012	9:48	O. mykiss	25	Down	9	4	13.0
10-Feb-2012	9:48	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	9:50	O. mykiss	32	Down	9	4	13.0
10-Feb-2012	9:50	O. mykiss	32	Up	9	4	13.0
10-Feb-2012	9:56	O. mykiss	27	Down	9	4	13.0
10-Feb-2012	10:01	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	10:03	O. mykiss	23	Down	9	4	13.0
10-Feb-2012	10:03	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	10:39	O. mykiss	27	Down	9	4	13.0
10-Feb-2012	10:39	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	12:26	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	12:33	Fish Unknown	27	Up	9	4	13.0
10-Feb-2012	12:37	O. mykiss	23	Down	9	4	13.0
10-Feb-2012	12:50	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	12:53	O. mykiss	27	Up	9	4	13.0
10-Feb-2012	12:57	O. mykiss	30	Down	9	4	13.0
10-Feb-2012	13:08	Fish Unknown	32	Up	9	4	13.0
10-Feb-2012	13:16	O. mykiss	32	Down	9	4	13.0
10-Feb-2012	13:17	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	13:19	O. mykiss	32	Down	9	4	13.0
10-Feb-2012	13:56	O. mykiss	23	Up	9	4	13.0
10-Feb-2012	14:05	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	14:14	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	14:18	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	14:19	O. mykiss	23	Up	9	4	13.0
10-Feb-2012	14:29	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	14:36	O. mykiss	25	Down	9	4	13.0
10-Feb-2012	16:20	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	16:20	O. mykiss	32	Up	9	4	13.0
10-Feb-2012	17:00	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	17:10	O. mykiss	27	Up	9	4	13.0
10-Feb-2012	18:14	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	19:08	O. mykiss	30	Down	9	4	13.0
10-Feb-2012	19:16	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	22:33	O. mykiss	28	Down	9	4	13.0
11-Feb-2012	1:01	O. mykiss	28	Down	9	4	12.8
11-Feb-2012	1:03	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	3:21	O. mykiss	30	Down	9	4	12.8
11-Feb-2012	5:54	O. mykiss	30	Down	9	4	12.8
11-Feb-2012	8:57	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	10:11	O. mykiss	32	Down	9	4	12.8
11-Feb-2012	10:14	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	11:19	O. mykiss	27	Down	9	4	12.8

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
11-Feb-2012	15:08	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	16:16	O. mykiss	32	Down	9	4	12.8
11-Feb-2012	16:20	Fish Unknown	30	Up	9	4	12.8
11-Feb-2012	17:39	O. mykiss	27	Up	9	4	12.8
11-Feb-2012	17:49	O. mykiss	23	Up	9	4	12.8
11-Feb-2012	18:12	O. mykiss	25	Up	9	4	12.8
11-Feb-2012	18:48	O. mykiss	20	Up	9	4	12.8
12-Feb-2012	1:19	O. mykiss	30	Down	9	4	12.2
12-Feb-2012	1:21	Fish Unknown	30	Up	9	4	12.2
12-Feb-2012	4:39	Fish Unknown	34	Up	9	4	12.2
12-Feb-2012	6:44	O. mykiss	30	Down	9	4	12.2
12-Feb-2012	10:12	Fish Unknown	23	Up	9	4	12.2
12-Feb-2012	10:24	O. mykiss	30	Down	9	4	12.2
12-Feb-2012	12:19	O. mykiss	32	Up	9	4	12.2
12-Feb-2012	12:31	O. mykiss	28	Down	9	4	12.2
12-Feb-2012	15:51	O. mykiss	27	Up	9	4	12.2
12-Feb-2012	16:48	Largemouth Bass	41	Up	9	4	12.2
12-Feb-2012	17:25	O. mykiss	22	Up	9	4	12.2
12-Feb-2012	18:15	O. mykiss	27	Up	9	4	12.2
12-Feb-2012	18:20	O. mykiss	32	Up	9	4	12.2
12-Feb-2012	19:54	O. mykiss	28	Up	9	4	12.2
13-Feb-2012	1:05	O. mykiss	27	Up	10	4	12.3
13-Feb-2012	5:20	O. mykiss	30	Down	10	4	12.3
13-Feb-2012	6:38	O. mykiss	22	Down	10	4	12.3
13-Feb-2012	6:38	O. mykiss	28	Down	10	4	12.3
13-Feb-2012	6:42	O. mykiss	28	Down	10	4	12.3
13-Feb-2012	14:36	O. mykiss	27	Up	10	4	12.3
15-Feb-2012	3:50	O. mykiss	20	Down	10	4	10.7
15-Feb-2012	17:30	O. mykiss	28	Up	10	4	10.7
15-Feb-2012	18:40	O. mykiss	28	Up	10	4	10.7
15-Feb-2012	21:53	O. mykiss	37	Up	10	4	10.7
16-Feb-2012	2:55	O. mykiss	30	Down	9	4	10.7
16-Feb-2012	3:00	Fish Probable	23	Up	9	4	10.7
16-Feb-2012	4:40	O. mykiss	30	Down	9	4	10.7
16-Feb-2012	5:03	O. mykiss	34	Down	9	4	10.7
16-Feb-2012	5:21	O. mykiss	23	Down	9	4	10.7
16-Feb-2012	17:42	O. mykiss	30	Up	9	4	10.7
16-Feb-2012	17:56	O. mykiss	30	Up	9	4	10.7
16-Feb-2012	18:11	O. mykiss	27	Up	9	4	10.7
16-Feb-2012	18:40	O. mykiss	32	Up	9	4	10.7
16-Feb-2012	21:32	O. mykiss	28	Up	9	4	10.7
17-Feb-2012	4:22	O. mykiss	34	Down	9	4	11.0
17-Feb-2012	4:23	Fish Probable	23	Down	9	4	11.0
17-Feb-2012	6:20	O. mykiss	23	Down	9	4	11.0
17-Feb-2012	15:20	O. mykiss	34	Up	9	4	11.0
17-Feb-2012	16:52	O. mykiss	27	Down	9	4	11.0
17-Feb-2012	16:56	O. mykiss	28	Up	9	4	11.0
17-Feb-2012	17:01	O. mykiss	28	Down	9	4	11.0
17-Feb-2012	17:02	Fish Unknown	32	Up	9	4	11.0
17-Feb-2012	17:10	O. mykiss	30	Down	9	4	11.0
17-Feb-2012	17:12	Fish Unknown	28	Up	9	4	11.0
17-Feb-2012	17:36	O. mykiss	30	Up	9	4	11.0
17-Feb-2012	18:24	O. mykiss	28	Up	9	4	11.0

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
18-Feb-2012	6:12	O. mykiss	23	Down	9	4	11.6
18-Feb-2012	6:24	Fish Unknown	30	Down	9	4	11.6
18-Feb-2012	17:06	O. mykiss	34	Up	9	4	11.6
18-Feb-2012	17:24	Largemouth Bass	34	Up	9	4	11.6
18-Feb-2012	18:06	O. mykiss	32	Up	9	4	11.6
18-Feb-2012	21:46	O. mykiss	44	Up	9	4	11.6
19-Feb-2012	5:07	O. mykiss	30	Down	9	4	12.0
19-Feb-2012	5:07	O. mykiss	38	Down	9	4	12.0
19-Feb-2012	5:26	O. mykiss	37	Up	9	4	12.0
19-Feb-2012	6:06	O. mykiss	32	Down	9	4	12.0
19-Feb-2012	6:38	Largemouth Bass	50	Down	9	4	12.0
19-Feb-2012	8:10	O. mykiss	40	Down	9	4	12.0
19-Feb-2012	15:31	O. mykiss	27	Up	9	4	12.0
19-Feb-2012	15:41	Fish Unknown	30	Up	9	4	12.0
19-Feb-2012	16:05	O. mykiss	44	Up	9	4	12.0
19-Feb-2012	16:17	Fish Unknown	34	Up	9	4	12.0
19-Feb-2012	16:23	O. mykiss	28	Down	9	4	12.0
19-Feb-2012	16:32	Fish Unknown	32	Up	9	4	12.0
19-Feb-2012	16:56	Largemouth Bass	49	Up	9	4	12.0
19-Feb-2012	17:16	O. mykiss	27	Down	9	4	12.0
19-Feb-2012	17:19	Fish Unknown	32	Up	9	4	12.0
19-Feb-2012	17:23	O. mykiss	28	Up	9	4	12.0
19-Feb-2012	18:08	O. mykiss	22	Up	9	4	12.0
19-Feb-2012	18:50	O. mykiss	32	Up	9	4	12.0
20-Feb-2012	6:22	O. mykiss	27	Down	9	4	11.2
20-Feb-2012	6:40	O. mykiss	37	Down	9	4	11.2
20-Feb-2012	14:09	Largemouth Bass	50	Down	9	4	11.2
20-Feb-2012	14:10	Largemouth Bass	42	Up	9	4	11.2
20-Feb-2012	14:28	Largemouth Bass	49	Down	9	4	11.2
20-Feb-2012	14:29	Largemouth Bass	50	Up	9	4	11.2
20-Feb-2012	14:38	Largemouth Bass	44	Down	9	4	11.2
20-Feb-2012	15:46	O. mykiss	46	Up	9	4	11.2
20-Feb-2012	17:27	O. mykiss	32	Up	9	4	11.2
20-Feb-2012	17:28	Fish Probable	41	Down	9	4	11.2
20-Feb-2012	17:30	O. mykiss	41	Up	9	4	11.2
20-Feb-2012	18:51	O. mykiss	27	Up	9	4	11.2
21-Feb-2012	5:23	O. mykiss	30	Down	9	4	11.8
21-Feb-2012	6:43	O. mykiss	35	Down	9	4	11.8
21-Feb-2012	8:00	O. mykiss	28	Up	9	4	11.8
21-Feb-2012	13:34	O. mykiss	37	Up	9	4	11.8
21-Feb-2012	14:13	O. mykiss	28	Down	9	4	11.8
21-Feb-2012	17:30	O. mykiss	34	Up	9	4	11.8
21-Feb-2012	18:03	O. mykiss	20	Up	9	4	11.8
21-Feb-2012	18:06	O. mykiss	41	Up	9	4	11.8
21-Feb-2012	19:20	O. mykiss	27	Up	9	4	11.8
21-Feb-2012	21:58	O. mykiss	37	Up	9	4	11.8
22-Feb-2012	1:05	O. mykiss	37	Down	9	5	13.1
22-Feb-2012	6:23	O. mykiss	34	Down	9	5	13.1
22-Feb-2012	17:28	O. mykiss	30	Up	9	5	13.1
22-Feb-2012	18:06	O. mykiss	27	Up	9	5	13.1
22-Feb-2012	18:24	O. mykiss	23	Up	9	5	13.1
23-Feb-2012	0:08	O. mykiss	43	Up	8	5	13.7
23-Feb-2012	0:55	O. mykiss	27	Down	8	5	13.7

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
23-Feb-2012	2:44	O. mykiss	34	Down	8	5	13.7
23-Feb-2012	2:45	O. mykiss	34	Down	8	5	13.7
23-Feb-2012	2:47	O. mykiss	41	Up	8	5	13.7
23-Feb-2012	3:00	O. mykiss	41	Down	8	5	13.7
23-Feb-2012	3:07	O. mykiss	37	Up	8	5	13.7
23-Feb-2012	6:35	O. mykiss	37	Down	8	5	13.7
23-Feb-2012	7:41	O. mykiss	34	Up	8	5	13.7
23-Feb-2012	11:42	Fish Unknown	23	Up	8	5	13.7
23-Feb-2012	11:50	Fish Unknown	23	Up	8	5	13.7
23-Feb-2012	12:22	Fish Unknown	32	Up	8	5	13.7
23-Feb-2012	16:29	O. mykiss	23	Up	8	5	13.7
23-Feb-2012	18:51	O. mykiss	46	Up	8	5	13.7
23-Feb-2012	18:53	O. mykiss	32	Up	8	5	13.7
23-Feb-2012	19:19	O. mykiss	44	Up	8	5	13.7
23-Feb-2012	19:51	O. mykiss	27	Up	8	5	13.7
23-Feb-2012	22:12	O. mykiss	37	Down	8	5	13.7
23-Feb-2012	22:12	O. mykiss	39	Up	8	5	13.7
24-Feb-2012	0:30	O. mykiss	47	Up	7	5	14.1
24-Feb-2012	0:40	O. mykiss	44	Up	7	5	14.1
24-Feb-2012	5:55	O. mykiss	22	Down	7	5	14.1
24-Feb-2012	6:22	O. mykiss	41	Down	7	5	14.1
24-Feb-2012	7:41	O. mykiss	30	Down	7	5	14.1
24-Feb-2012	14:18	O. mykiss	32	Up	7	5	14.1
24-Feb-2012	14:34	Fish Unknown	32	Up	7	5	14.1
24-Feb-2012	14:36	O. mykiss	28	Up	7	5	14.1
24-Feb-2012	14:43	O. mykiss	27	Up	7	5	14.1
24-Feb-2012	14:58	Fish Unknown	27	Down	7	5	14.1
24-Feb-2012	15:32	O. mykiss	44	Up	7	5	14.1
24-Feb-2012	16:45	Fish Probable	44	Up	7	5	14.1
24-Feb-2012	19:11	Fish Probable	34	Up	7	5	14.1
25-Feb-2012	3:41	O. mykiss	39	Down	7	5	14.6
25-Feb-2012	3:47	O. mykiss	39	Up	7	5	14.6
25-Feb-2012	6:08	O. mykiss	42	Down	7	5	14.6
25-Feb-2012	9:25	O. mykiss	35	Down	7	5	14.6
25-Feb-2012	10:52	O. mykiss	32	Up	7	5	14.6
25-Feb-2012	14:57	O. mykiss	34	Up	7	5	14.6
25-Feb-2012	16:43	O. mykiss	25	Down	7	5	14.6
25-Feb-2012	16:43	O. mykiss	30	Up	7	5	14.6
25-Feb-2012	17:06	O. mykiss	27	Down	7	5	14.6
25-Feb-2012	17:06	O. mykiss	30	Up	7	5	14.6
25-Feb-2012	19:09	O. mykiss	49	Up	7	5	14.6
25-Feb-2012	20:59	Fish Unknown	41	Up	7	5	14.6
25-Feb-2012	23:57	O. mykiss	42	Down	7	5	14.6
26-Feb-2012	2:10	O. mykiss	41	Up	7	5	12.5
26-Feb-2012	2:27	O. mykiss	39	Down	7	5	12.5
26-Feb-2012	2:32	O. mykiss	41	Up	7	5	12.5
26-Feb-2012	3:45	O. mykiss	35	Down	7	5	12.5
26-Feb-2012	6:13	Fish Unknown	27	Down	7	5	12.5
26-Feb-2012	6:32	O. mykiss	25	Down	7	5	12.5
26-Feb-2012	16:38	Fish Probable	30	Up	7	5	12.5
26-Feb-2012	18:45	O. mykiss	30	Up	7	5	12.5
26-Feb-2012	20:19	O. mykiss	30	Up	7	5	12.5
26-Feb-2012	20:29	O. mykiss	34	Up	7	5	12.5

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
27-Feb-2012	4:51	O. mykiss	17	Down	8	4	12.0
27-Feb-2012	6:37	O. mykiss	34	Down	8	4	12.0
27-Feb-2012	18:26	O. mykiss	25	Up	8	4	12.0
27-Feb-2012	18:49	O. mykiss	22	Up	8	4	12.0
27-Feb-2012	19:27	O. mykiss	23	Up	8	4	12.0
27-Feb-2012	21:33	O. mykiss	27	Up	8	4	12.0
28-Feb-2012	5:29	O. mykiss	28	Down	8	4	11.0
28-Feb-2012	5:49	O. mykiss	23	Up	8	4	11.0
28-Feb-2012	6:03	O. mykiss	30	Down	8	4	11.0
28-Feb-2012	6:03	O. mykiss	30	Down	8	4	11.0
28-Feb-2012	15:25	O. mykiss	41	Up	8	4	11.0
28-Feb-2012	20:12	O. mykiss	20	Up	8	4	11.0
29-Feb-2012	1:40	O. mykiss	27	Down	8	4	11.4
29-Feb-2012	1:47	O. mykiss	32	Up	8	4	11.4
29-Feb-2012	4:28	Fish Unknown	30	Up	8	4	11.4
29-Feb-2012	4:28	Fish Probable	20	Down	8	4	11.4
29-Feb-2012	4:52	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	4:59	O. mykiss	42	Down	8	4	11.4
29-Feb-2012	5:03	O. mykiss	35	Down	8	4	11.4
29-Feb-2012	6:14	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	15:22	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	15:22	O. mykiss	20	Up	8	4	11.4
29-Feb-2012	15:25	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	15:29	O. mykiss	25	Up	8	4	11.4
29-Feb-2012	15:29	O. mykiss	17	Down	8	4	11.4
29-Feb-2012	15:44	O. mykiss	27	Up	8	4	11.4
29-Feb-2012	16:12	O. mykiss	19	Down	8	4	11.4
29-Feb-2012	17:39	O. mykiss	30	Up	8	4	11.4
29-Feb-2012	17:39	O. mykiss	27	Up	8	4	11.4
29-Feb-2012	18:16	O. mykiss	30	Up	8	4	11.4
29-Feb-2012	19:20	O. mykiss	41	Up	8	4	11.4
1-Mar-2012	3:35	O. mykiss	25	Down	9	4	12.2
1-Mar-2012	5:02	O. mykiss	28	Down	9	4	12.2
1-Mar-2012	6:15	O. mykiss	27	Down	9	4	12.2
1-Mar-2012	6:36	O. mykiss	39	Down	9	4	12.2
1-Mar-2012	6:37	O. mykiss	35	Up	9	4	12.2
1-Mar-2012	6:37	O. mykiss	25	Up	9	4	12.2
1-Mar-2012	6:44	O. mykiss	37	Down	9	4	12.2
1-Mar-2012	7:20	Fish Unknown	34	Up	9	4	12.2
1-Mar-2012	7:47	O. mykiss	35	Up	9	4	12.2
1-Mar-2012	7:55	O. mykiss	28	Down	9	4	12.2
1-Mar-2012	7:56	O. mykiss	28	Up	9	4	12.2
1-Mar-2012	7:57	O. mykiss	27	Up	9	4	12.2
1-Mar-2012	8:39	O. mykiss	28	Down	9	4	12.2
1-Mar-2012	9:25	O. mykiss	19	Up	9	4	12.2
1-Mar-2012	9:30	O. mykiss	25	Down	9	4	12.2
1-Mar-2012	10:01	O. mykiss	30	Up	9	4	12.2
1-Mar-2012	10:02	O. mykiss	23	Down	9	4	12.2
1-Mar-2012	10:05	O. mykiss	28	Up	9	4	12.2
1-Mar-2012	10:11	Fish Unknown	27	Up	9	4	12.2
1-Mar-2012	10:16	Fish Unknown	28	Up	9	4	12.2
1-Mar-2012	10:33	O. mykiss	27	Down	9	4	12.2
1-Mar-2012	17:46	O. mykiss	37	Up	9	4	12.2

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
1-Mar-2012	17:48	Largemouth Bass	44	Up	9	4	12.2
1-Mar-2012	18:05	O. mykiss	35	Up	9	4	12.2
1-Mar-2012	18:47	O. mykiss	30	Up	9	4	12.2
1-Mar-2012	22:12	O. mykiss	27	Up	9	4	12.2
1-Mar-2012	23:05	O. mykiss	41	Down	9	4	12.2
1-Mar-2012	23:06	O. mykiss	22	Up	9	4	12.2
1-Mar-2012	23:06	O. mykiss	44	Up	9	4	12.2
1-Mar-2012	23:46	O. mykiss	27	Up	9	4	12.2
2-Mar-2012	0:51	O. mykiss	35	Down	9	4	12.5
2-Mar-2012	0:52	O. mykiss	44	Up	9	4	12.5
2-Mar-2012	6:09	O. mykiss	22	Down	9	4	12.5
2-Mar-2012	6:10	O. mykiss	39	Down	9	4	12.5
2-Mar-2012	6:19	O. mykiss	42	Up	9	4	12.5
2-Mar-2012	6:24	O. mykiss	22	Down	9	4	12.5
2-Mar-2012	6:24	O. mykiss	35	Down	9	4	12.5
2-Mar-2012	6:37	O. mykiss	34	Up	9	4	12.5
2-Mar-2012	6:41	O. mykiss	27	Up	9	4	12.5
2-Mar-2012	9:26	O. mykiss	28	Down	9	4	12.5
2-Mar-2012	9:27	O. mykiss	42	Up	9	4	12.5
2-Mar-2012	10:08	Fish Unknown	27	Up	9	4	12.5
2-Mar-2012	11:40	O. mykiss	15	Down	9	4	12.5
2-Mar-2012	11:44	O. mykiss	44	Up	9	4	12.5
2-Mar-2012	12:47	O. mykiss	37	Down	9	4	12.5
2-Mar-2012	13:56	Largemouth Bass	49	Down	9	4	12.5
2-Mar-2012	14:12	O. mykiss	25	Up	9	4	12.5
2-Mar-2012	15:59	Fish Unknown	34	Up	9	4	12.5
2-Mar-2012	16:13	O. mykiss	23	Up	9	4	12.5
2-Mar-2012	16:44	Fish Unknown	32	Down	9	4	12.5
2-Mar-2012	16:46	O. mykiss	30	Up	9	4	12.5
2-Mar-2012	17:18	O. mykiss	27	Down	9	4	12.5
2-Mar-2012	17:19	O. mykiss	30	Up	9	4	12.5
2-Mar-2012	17:27	O. mykiss	30	Down	9	4	12.5
2-Mar-2012	17:28	Fish Unknown	34	Up	9	4	12.5
2-Mar-2012	17:42	O. mykiss	23	Down	9	4	12.5
2-Mar-2012	19:52	O. mykiss	42	Up	9	4	12.5
2-Mar-2012	20:42	Fish Unknown	20	Up	9	4	12.5
2-Mar-2012	21:03	O. mykiss	23	Up	9	4	12.5
3-Mar-2012	1:59	O. mykiss	42	Up	8	6	13.0
3-Mar-2012	5:14	O. mykiss	30	Down	8	6	13.0
3-Mar-2012	5:48	O. mykiss	39	Down	8	6	13.0
3-Mar-2012	6:08	O. mykiss	41	Down	8	6	13.0
3-Mar-2012	17:37	O. mykiss	28	Up	8	6	13.0
3-Mar-2012	18:35	O. mykiss	34	Up	8	6	13.0
3-Mar-2012	21:37	O. mykiss	34	Up	8	6	13.0
3-Mar-2012	21:53	O. mykiss	32	Up	8	6	13.0
3-Mar-2012	23:46	O. mykiss	35	Up	8	6	13.0
3-Mar-2012	23:46	O. mykiss	34	UP	8	6	13.0
4-Mar-2012	5:37	O. mykiss	22	Down	7	5	13.9
4-Mar-2012	5:57	O. mykiss	27	Down	7	5	13.9
4-Mar-2012	6:24	O. mykiss	34	Down	7	5	13.9
4-Mar-2012	9:25	O. mykiss	23	Up	7	5	13.9
4-Mar-2012	17:01	O. mykiss	28	Up	7	5	13.9
4-Mar-2012	18:03	O. mykiss	23	Up	7	5	13.9

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
4-Mar-2012	18:30	O. mykiss	27	Up	7	5	13.9
4-Mar-2012	22:16	O. mykiss	42	Up	7	5	13.9
4-Mar-2012	22:44	Fish Unknown	20	Up	7	5	13.9
5-Mar-2012	3:16	O. mykiss	34	Up	6	4	14.5
5-Mar-2012	5:44	O. mykiss	30	Down	6	4	14.5
5-Mar-2012	5:54	O. mykiss	20	Down	6	4	14.5
5-Mar-2012	5:57	Fish Unknown	25	Up	6	4	14.5
5-Mar-2012	6:02	O. mykiss	23	Down	6	4	14.5
5-Mar-2012	6:40	O. mykiss	35	Down	6	4	14.5
9-Mar-2012	16:15	Fish Unknown	25	Up	7	4	13.3
9-Mar-2012	18:48	O. mykiss	23	Up	7	4	13.3
9-Mar-2012	19:57	O. mykiss	30	Up	7	4	13.3
9-Mar-2012	22:21	O. mykiss	23	Down	7	4	13.3
9-Mar-2012	22:22	O. mykiss	22	Up	7	4	13.3
10-Mar-2012	1:14	O. mykiss	41	Up	7	4	14.0
10-Mar-2012	1:46	O. mykiss	32	Down	7	4	14.0
10-Mar-2012	1:56	O. mykiss	35	Up	7	4	14.0
10-Mar-2012	4:06	O. mykiss	30	Down	7	4	14.0
10-Mar-2012	5:54	Fish Unknown	23	Up	7	4	14.0
10-Mar-2012	10:12	O. mykiss	32	Down	7	4	14.0
10-Mar-2012	10:12	O. mykiss	41	Up	7	4	14.0
10-Mar-2012	13:07	O. mykiss	27	Down	7	4	14.0
10-Mar-2012	13:07	O. mykiss	25	Up	7	4	14.0
10-Mar-2012	13:12	O. mykiss	22	Down	7	4	14.0
10-Mar-2012	17:30	O. mykiss	41	Down	7	4	14.0
10-Mar-2012	17:31	O. mykiss	17	Up	7	4	14.0
10-Mar-2012	18:00	O. mykiss	23	Down	7	4	14.0
11-Mar-2012	3:13	O. mykiss	30	Down	7	4	13.7
11-Mar-2012	4:01	Fish Unknown	23	Up	7	4	13.7
11-Mar-2012	11:18	Fish Unknown	20	Up	7	4	13.7
11-Mar-2012	12:20	O. mykiss	23	Up	7	4	13.7
11-Mar-2012	13:46	O. mykiss	25	Down	7	4	13.7
11-Mar-2012	13:46	O. mykiss	23	Up	7	4	13.7
11-Mar-2012	13:47	O. mykiss	22	Up	7	4	13.7
11-Mar-2012	17:40	Fish Unknown	25	Up	7	4	13.7
11-Mar-2012	17:57	O. mykiss	50	Up	7	4	13.7
11-Mar-2012	18:05	Fish Unknown	27	Up	7	4	13.7
11-Mar-2012	21:02	O. mykiss	19	Up	7	4	13.7
11-Mar-2012	23:01	O. mykiss	27	Up	7	4	13.7
11-Mar-2012	23:39	O. mykiss	34	Down	7	4	13.7
12-Mar-2012	3:07	O. mykiss	20	Down	7	4	13.9
12-Mar-2012	3:07	O. mykiss	42	Down	7	4	13.9
12-Mar-2012	3:35	O. mykiss	47	Up	7	4	13.9
12-Mar-2012	3:51	O. mykiss	25	Down	7	4	13.9
12-Mar-2012	4:49	O. mykiss	25	Down	7	4	13.9
12-Mar-2012	6:11	O. mykiss	35	Down	7	4	13.9
12-Mar-2012	10:59	Fish Unknown	27	Up	7	4	13.9
12-Mar-2012	11:19	O. mykiss	19	Down	7	4	13.9
12-Mar-2012	11:23	O. mykiss	20	Up	7	4	13.9
12-Mar-2012	14:10	O. mykiss	34	Up	7	4	13.9
12-Mar-2012	14:16	O. mykiss	37	Down	7	4	13.9
12-Mar-2012	18:36	O. mykiss	27	Up	7	4	13.9
13-Mar-2012	5:26	O. mykiss	22	Down	6	4	12.9

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
16-Mar-2012	11:10	Fish Probable	28	Up	8	4	13.7
16-Mar-2012	11:35	O. mykiss	20	Down	8	4	13.7
16-Mar-2012	11:53	O. mykiss	35	Down	8	4	13.7
16-Mar-2012	15:27	O. mykiss	25	Down	8	4	13.7
16-Mar-2012	15:50	Fish Probable	30	Up	8	4	13.7
16-Mar-2012	15:56	O. mykiss	27	Down	8	4	13.7
16-Mar-2012	16:38	O. mykiss	30	Down	8	4	13.7
16-Mar-2012	16:44	Fish Unknown	27	Up	8	4	13.7
16-Mar-2012	18:43	O. mykiss	28	Up	8	4	13.7
16-Mar-2012	22:38	O. mykiss	41	Up	8	4	13.7
19-Mar-2012	10:47	O. mykiss	44	Down	17	12	12.2
19-Mar-2012	15:36	O. mykiss	32	Up	17	12	12.2
20-Mar-2012	15:02	Largemouth Bass	46	Up	16	8	12.7
20-Mar-2012	16:02	O. mykiss	42	Down	16	8	12.7
21-Mar-2012	9:00	O. mykiss	47	Up	14	16	14.1
21-Mar-2012	12:45	O. mykiss	39	Up	14	16	14.1
21-Mar-2012	19:21	O. mykiss	42	Up	14	16	14.1
22-Mar-2012	4:57	O. mykiss	42	Down	13	18	15.2
22-Mar-2012	5:00	O. mykiss	49	Up	13	18	15.2
22-Mar-2012	12:58	O. mykiss	42	Up	13	18	15.2
22-Mar-2012	15:00	O. mykiss	49	Up	13	18	15.2
22-Mar-2012	19:17	Largemouth Bass	50	Up	13	18	15.2
23-Mar-2012	0:40	O. mykiss	42	Up	13	15	14.4
24-Mar-2012	22:44	O. mykiss	23	Up	13	7	14.1
26-Mar-2012	16:11	Largemouth Bass	30	Up	24	18	12.5
27-Mar-2012	7:35	O. mykiss	22	Down	22	5	13.3
27-Mar-2012	13:37	O. mykiss	25	Down	22	5	13.3
27-Mar-2012	14:48	Largemouth Bass	42	Up	22	5	13.3
27-Mar-2012	15:40	O. mykiss	22	Down	22	5	13.3
27-Mar-2012	16:13	O. mykiss	23	Down	22	5	13.3
27-Mar-2012	16:23	O. mykiss	28	Up	22	5	13.3
27-Mar-2012	17:19	O. mykiss	25	Down	22	5	13.3
27-Mar-2012	23:26	O. mykiss	15	Down	22	5	13.3
27-Mar-2012	23:27	O. mykiss	15	Up	22	5	13.3
27-Mar-2012	23:27	Fish Probable	17	Down	22	5	13.3
27-Mar-2012	23:27	Fish Probable	17	Down	22	5	13.3
27-Mar-2012	23:29	Fish Probable	16	Down	22	5	13.3
28-Mar-2012	13:36	O. mykiss	23	Down	20	5	13.5
28-Mar-2012	16:25	O. mykiss	25	Down	20	5	13.5
29-Mar-2012	14:47	O. mykiss	17	Down	19	6	14.8
30-Mar-2012	0:49	O. mykiss	27	Down	18	5	15.1
30-Mar-2012	5:54	O. mykiss	34	Down	18	5	15.1
30-Mar-2012	7:30	O. mykiss	20	Down	18	5	15.1
30-Mar-2012	8:32	O. mykiss	25	Down	18	5	15.1
30-Mar-2012	8:38	O. mykiss	22	Down	18	5	15.1
30-Mar-2012	8:51	O. mykiss	23	Down	18	5	15.1
30-Mar-2012	9:19	O. mykiss	32	Down	18	5	15.1
30-Mar-2012	16:31	O. mykiss	34	Down	18	5	15.1
31-Mar-2012	3:51	Fish Unknown	28	Up	17	5	14.1
31-Mar-2012	8:14	O. mykiss	23	Down	17	5	14.1
31-Mar-2012	9:09	O. mykiss	22	Down	17	5	14.1
31-Mar-2012	11:49	O. mykiss	22	Down	17	5	14.1
31-Mar-2012	23:36	Fish Probable	23	Down	17	5	14.1

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
31-Mar-2012	23:41	O. mykiss	22	Down	17	5	14.1
1-Apr-2012	0:12	Fish Unknown	17	Up	17	5	13.7
1-Apr-2012	7:34	O. mykiss	28	Down	17	5	13.7
1-Apr-2012	12:29	O. mykiss	30	Up	17	5	13.7
1-Apr-2012	20:12	O. mykiss	32	Up	17	5	13.7
2-Apr-2012	6:33	O. mykiss	20	Down	16	4	13.6
3-Apr-2012	6:34	O. mykiss	28	Down	15	4	14.9
3-Apr-2012	15:32	Largemouth Bass	60	Up	15	4	14.9
4-Apr-2012	0:32	Fish Probable	27	Down	15	4	15.8
4-Apr-2012	0:32	Fish Unknown	23	Up	15	4	15.8
4-Apr-2012	6:51	Fish Unknown	23	Down	15	4	15.8
5-Apr-2012	0:15	O. mykiss	23	Down	14	4	14.7
5-Apr-2012	7:04	O. mykiss	23	UP	14	4	14.7
5-Apr-2012	8:31	O. mykiss	25	Up	14	4	14.7
5-Apr-2012	8:43	O. mykiss	27	Down	14	4	14.7
5-Apr-2012	8:46	O. mykiss	25	Down	14	4	14.7
6-Apr-2012	7:01	O. mykiss	25	Up	14	4	14.2
7-Apr-2012	8:52	Fish Unknown	22	Up	13	5	14.8
7-Apr-2012	20:18	O. mykiss	27	Up	13	5	14.8
8-Apr-2012	7:58	O. mykiss	27	Down	13	5	15.4
8-Apr-2012	16:10	Largemouth Bass	53	Up	13	5	15.4
8-Apr-2012	22:21	O. mykiss	27	Up	13	5	15.4
9-Apr-2012	19:07	Fish Unknown	27	Up	12	5	15.7
10-Apr-2012	7:21	O. mykiss	25	Down	12	4	15.6
10-Apr-2012	7:26	O. mykiss	22	Up	12	4	15.6
10-Apr-2012	9:21	O. mykiss	30	Up	12	4	15.6
10-Apr-2012	11:38	O. mykiss	27	Down	12	4	15.6
10-Apr-2012	19:44	O. mykiss	23	Up	12	4	15.6
10-Apr-2012	20:41	O. mykiss	28	Up	12	4	15.6
11-Apr-2012	0:14	O. mykiss	23	Up	17	5	14.8
11-Apr-2012	2:38	O. mykiss	22	Up	17	5	14.8
11-Apr-2012	4:47	O. mykiss	25	Up	17	5	14.8
11-Apr-2012	6:31	O. mykiss	37	Down	17	5	14.8
11-Apr-2012	6:42	O. mykiss	39	Up	17	5	14.8
11-Apr-2012	7:14	Fish Probable	35	Down	17	5	14.8
11-Apr-2012	7:42	O. mykiss	28	Up	17	5	14.8
11-Apr-2012	7:43	Fish Probable	27	Down	17	5	14.8
11-Apr-2012	8:26	O. mykiss	30	Up	17	5	14.8
11-Apr-2012	8:54	O. mykiss	27	Down	17	5	14.8
11-Apr-2012	9:19	Fish Unknown	32	Down	17	5	14.8
11-Apr-2012	10:35	O. mykiss	27	Up	17	5	14.8
11-Apr-2012	12:07	O. mykiss	23	Down	17	5	14.8
11-Apr-2012	18:04	Fish Unknown	27	Up	17	5	14.8
11-Apr-2012	18:05	Fish Unknown	28	Down	17	5	14.8
11-Apr-2012	18:15	O. mykiss	30	Up	17	5	14.8
11-Apr-2012	19:27	O. mykiss	23	Up	17	5	14.8
12-Apr-2012	6:54	O. mykiss	23	Down	16	6	13.6
12-Apr-2012	7:15	O. mykiss	28	Down	16	6	13.6
12-Apr-2012	7:48	O. mykiss	32	Up	16	6	13.6
12-Apr-2012	10:11	O. mykiss	27	Up	16	6	13.6
12-Apr-2012	18:39	Fish Unknown	25	Up	16	6	13.6
12-Apr-2012	19:36	O. mykiss	32	Up	16	6	13.6
12-Apr-2012	20:28	O. mykiss	16	Up	16	6	13.6

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
12-Apr-2012	20:28	O. mykiss	27	Up	16	6	13.6
13-Apr-2012	6:59	O. mykiss	27	Down	26	309	12.2
14-Apr-2012	11:56	Fish Unknown	32	Up	26	70	12.7
14-Apr-2012	12:54	O. mykiss	28	Down	26	70	12.7
14-Apr-2012	13:54	O. mykiss	22	Down	26	70	12.7
14-Apr-2012	19:42	O. mykiss	19	Down	26	70	12.7
14-Apr-2012	19:44	O. mykiss	23	Up	26	70	12.7
14-Apr-2012	21:17	O. mykiss	25	Up	26	70	12.7
15-Apr-2012	4:42	O. mykiss	20	Up	24	10	14.0
15-Apr-2012	6:16	O. mykiss	34	Down	24	10	14.0
15-Apr-2012	6:31	O. mykiss	34	Up	24	10	14.0
15-Apr-2012	10:17	O. mykiss	37	Down	24	10	14.0
15-Apr-2012	19:11	O. mykiss	23	Down	24	10	14.0
15-Apr-2012	22:07	O. mykiss	30	Down	24	10	14.0
16-Apr-2012	6:49	O. mykiss	32	Down	24	5	15.1
16-Apr-2012	9:21	O. mykiss	16	Up	24	5	15.1
16-Apr-2012	20:06	O. mykiss	32	Down	24	5	15.1
16-Apr-2012	21:26	O. mykiss	32	Up	24	5	15.1
17-Apr-2012	6:01	O. mykiss	28	Down	22	5	16.5
17-Apr-2012	6:51	Fish Probable	28	Down	22	5	16.5
17-Apr-2012	7:37	O. mykiss	22	Up	22	5	16.5
17-Apr-2012	10:24	O. mykiss	27	Down	22	5	16.5
17-Apr-2012	19:17	Fish Unknown	28	Down	22	5	16.5
17-Apr-2012	19:33	Fish Unknown	32	Up	22	5	16.5
18-Apr-2012	6:09	O. mykiss	27	Down	21	6	17.3
18-Apr-2012	6:09	Fish Unknown	28	Up	21	6	17.3
18-Apr-2012	7:34	O. mykiss	30	Down	21	6	17.3
18-Apr-2012	7:47	O. mykiss	27	Up	21	6	17.3
18-Apr-2012	9:20	O. mykiss	25	Down	21	6	17.3
1-May-2012	17:28	Fish Probable	37	Up	16	2	17.2
2-May-2012	12:37	O. mykiss	30	Down	16	2	16.4
2-May-2012	12:58	Fish Probable	30	Up	16	2	16.4
4-May-2012	18:26	O. mykiss	30	Up	16	3	17.3
4-May-2012	19:02	O. mykiss	34	Up	16	3	17.3
4-May-2012	19:09	Fish Probable	30	Down	16	3	17.3
4-May-2012	19:31	Fish Probable	34	Up	16	3	17.3
4-May-2012	20:17	O. mykiss	30	Up	16	3	17.3
5-May-2012	5:39	Fish Probable	20	Down	14	3	17.9
5-May-2012	6:06	Fish Probable	27	Down	14	3	17.9
5-May-2012	6:34	Fish Probable	32	Down	14	3	17.9
5-May-2012	10:33	O. mykiss	34	Up	14	3	17.9
5-May-2012	11:13	O. mykiss	34	Up	14	3	17.9
5-May-2012	17:20	O. mykiss	30	Up	14	3	17.9
5-May-2012	20:11	O. mykiss	25	Up	14	3	17.9
5-May-2012	21:00	O. mykiss	32	Up	14	3	17.9
6-May-2012	5:53	Fish Probable	30	Down	13	3	18.5
6-May-2012	6:01	Fish Probable	30	Down	13	3	18.5
6-May-2012	6:12	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:13	Fish Probable	28	Down	13	3	18.5
6-May-2012	6:15	Fish Probable	28	Down	13	3	18.5
6-May-2012	6:15	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:26	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:28	Fish Probable	30	Down	13	3	18.5

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
6-May-2012	6:43	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:44	Fish Probable	32	Down	13	3	18.5
6-May-2012	15:59	O. mykiss	30	Up	13	3	18.5
6-May-2012	19:28	O. mykiss	34	Up	13	3	18.5
6-May-2012	20:15	O. mykiss	28	Up	13	3	18.5
6-May-2012	23:30	O. mykiss	37	Up	13	3	18.5
7-May-2012	5:41	Fish Probable	25	Down	14	3	19.3
7-May-2012	6:04	O. mykiss	37	Up	14	3	19.3
7-May-2012	6:13	Fish Probable	25	Down	14	3	19.3
7-May-2012	6:26	Fish Probable	32	Down	14	3	19.3
7-May-2012	13:50	O. mykiss	35	Up	14	3	19.3
7-May-2012	18:03	O. mykiss	37	Up	14	3	19.3
7-May-2012	18:07	O. mykiss	34	Up	14	3	19.3
7-May-2012	20:09	O. mykiss	27	Up	14	3	19.3
7-May-2012	20:14	Fish Unknown	34	Up	14	3	19.3
8-May-2012	1:12	Fish Unknown	41	Up	13	3	19.6
8-May-2012	1:38	Fish Probable	30	Up	13	3	19.6
8-May-2012	1:58	Fish Probable	41	Up	13	3	19.6
8-May-2012	1:58	Fish Probable	30	Up	13	3	19.6
8-May-2012	1:59	Fish Unknown	39	Up	13	3	19.6
8-May-2012	2:10	Fish Probable	22	Up	13	3	19.6
8-May-2012	2:15	O. mykiss	39	Up	13	3	19.6
8-May-2012	2:21	Fish Probable	22	Down	13	3	19.6
8-May-2012	2:27	Fish Probable	41	Up	13	3	19.6
8-May-2012	4:14	O. mykiss	27	Up	13	3	19.6
8-May-2012	4:39	O. mykiss	41	Up	13	3	19.6
8-May-2012	5:35	Fish Probable	20	Up	13	3	19.6
8-May-2012	5:55	Fish Probable	23	Up	13	3	19.6
8-May-2012	12:05	Fish Unknown	34	Up	13	3	19.6
8-May-2012	17:12	Fish Unknown	28	Down	13	3	19.6
8-May-2012	17:22	Largemouth Bass	42	Up	13	3	19.6
8-May-2012	18:07	Fish Probable	34	Up	13	3	19.6
8-May-2012	19:05	O. mykiss	34	Up	13	3	19.6
8-May-2012	19:58	O. mykiss	32	Up	13	3	19.6
9-May-2012	1:00	O. mykiss	39	Up	12	3	20.2
9-May-2012	3:57	Fish Probable	23	Down	12	3	20.2
9-May-2012	4:14	O. mykiss	35	Up	12	3	20.2
9-May-2012	5:13	Fish Probable	22	Down	12	3	20.2
9-May-2012	5:56	Fish Probable	23	Up	12	3	20.2
9-May-2012	6:09	Fish Probable	22	Down	12	3	20.2
9-May-2012	15:16	Largemouth Bass	49	Down	12	3	20.2
9-May-2012	18:13	O. mykiss	34	Up	12	3	20.2
9-May-2012	18:54	Sunfish	39	Up	12	3	20.2
9-May-2012	19:02	O. mykiss	34	Up	12	3	20.2
9-May-2012	19:14	O. mykiss	30	Up	12	3	20.2
9-May-2012	20:09	Fish Probable	27	Up	12	3	20.2
9-May-2012	20:09	Fish Probable	25	Down	12	3	20.2
9-May-2012	20:11	Fish Probable	32	Up	12	3	20.2
9-May-2012	20:12	O. mykiss	30	Up	12	3	20.2
9-May-2012	20:14	O. mykiss	28	Up	12	3	20.2
10-May-2012	5:21	Fish Probable	27	Down	12	3	20.4
10-May-2012	5:45	O. mykiss	34	Up	12	3	20.4
10-May-2012	5:55	Fish Probable	27	Down	12	3	20.4

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
10-May-2012	12:24	O. mykiss	27	Up	12	3	20.4
10-May-2012	18:17	O. mykiss	30	Up	12	3	20.4
10-May-2012	18:28	O. mykiss	35	Up	12	3	20.4
10-May-2012	20:08	O. mykiss	28	Up	12	3	20.4
11-May-2012	5:11	Fish Probable	27	Down	12	3	20.0
11-May-2012	5:39	O. mykiss	28	Up	12	3	20.0
11-May-2012	5:42	Fish Probable	28	Down	12	3	20.0
11-May-2012	6:15	Fish Probable	23	Down	12	3	20.0
11-May-2012	6:19	Fish Probable	23	Down	12	3	20.0
11-May-2012	17:16	O. mykiss	34	Up	12	3	20.0
11-May-2012	17:46	O. mykiss	28	Down	12	3	20.0
11-May-2012	17:52	O. mykiss	37	Up	12	3	20.0
11-May-2012	19:04	O. mykiss	37	Up	12	3	20.0
11-May-2012	20:05	O. mykiss	32	Up	12	3	20.0
11-May-2012	20:26	O. mykiss	34	Up	12	3	20.0
11-May-2012	20:54	O. mykiss	27	Up	12	3	20.0
11-May-2012	20:57	Fish Probable	22	Up	12	3	20.0
11-May-2012	20:57	Fish Probable	20	Down	12	3	20.0
11-May-2012	20:59	O. mykiss	28	Up	12	3	20.0
12-May-2012	5:16	Fish Probable	22	Down	12	3	19.9
12-May-2012	6:53	Fish Probable	23	Down	12	3	19.9
12-May-2012	18:24	O. mykiss	34	Up	12	3	19.9
12-May-2012	19:01	O. mykiss	34	Up	12	3	19.9
12-May-2012	19:35	O. mykiss	34	Up	12	3	19.9
12-May-2012	20:30	O. mykiss	34	Up	12	3	19.9
12-May-2012	20:35	O. mykiss	32	Up	12	3	19.9
12-May-2012	20:36	Fish Probable	32	Down	12	3	19.9
12-May-2012	20:40	O. mykiss	34	Up	12	3	19.9
13-May-2012	5:18	Fish Probable	32	Down	12	3	20.0
13-May-2012	5:36	Fish Probable	23	Down	12	3	20.0
13-May-2012	5:40	Fish Probable	28	Down	12	3	20.0
13-May-2012	5:47	Fish Probable	28	Down	12	3	20.0
13-May-2012	9:11	O. mykiss	34	Up	12	3	20.0
13-May-2012	9:14	Fish Probable	35	Down	12	3	20.0
13-May-2012	12:22	O. mykiss	30	Up	12	3	20.0
13-May-2012	17:26	O. mykiss	32	Up	12	3	20.0
13-May-2012	18:54	O. mykiss	25	Up	12	3	20.0
13-May-2012	20:22	Fish Probable	28	Up	12	3	20.0
13-May-2012	20:22	Fish Probable	23	Down	12	3	20.0
13-May-2012	20:23	O. mykiss	28	Up	12	3	20.0
13-May-2012	20:34	O. mykiss	28	Up	12	3	20.0
13-May-2012	20:37	O. mykiss	27	Up	12	3	20.0
13-May-2012	22:52	O. mykiss	35	Up	12	3	20.0
14-May-2012	5:02	Fish Probable	20	Down	11	3	20.1
14-May-2012	5:12	Fish Probable	37	Down	11	3	20.1
14-May-2012	5:32	O. mykiss	30	Up	11	3	20.1
14-May-2012	6:02	O. mykiss	27	Up	11	3	20.1
14-May-2012	7:14	O. mykiss	34	Up	11	3	20.1
14-May-2012	11:20	O. mykiss	30	Up	11	3	20.1
14-May-2012	20:25	Fish Probable	34	Up	11	3	20.1
14-May-2012	20:25	Fish Probable	27	Down	11	3	20.1
14-May-2012	20:27	O. mykiss	30	Up	11	3	20.1
15-May-2012	5:35	O. mykiss	34	Up	11	2	20.0

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
15-May-2012	5:55	Fish Probable	23	Down	11	2	20.0
15-May-2012	6:23	O. mykiss	30	Up	11	2	20.0
15-May-2012	6:25	Fish Probable	30	Down	11	2	20.0
15-May-2012	19:54	Fish Probable	27	Up	11	2	20.0
15-May-2012	20:22	O. mykiss	34	Up	11	2	20.0
15-May-2012	21:28	O. mykiss	34	Up	11	2	20.0
15-May-2012	21:28	Fish Probable	23	Down	11	2	20.0
15-May-2012	21:32	O. mykiss	27	Up	11	2	20.0
16-May-2012	5:49	O. mykiss	30	Up	11	2	21.2
16-May-2012	13:38	O. mykiss	27	Down	11	2	21.2
16-May-2012	19:56	O. mykiss	30	Up	11	2	21.2
16-May-2012	22:24	O. mykiss	27	Up	11	2	21.2
16-May-2012	22:29	O. mykiss	23	Up	11	2	21.2
17-May-2012	14:54	Fish Probable	20	Down	10	2	21.5
17-May-2012	20:39	O. mykiss	23	Up	10	2	21.5
17-May-2012	20:42	Fish Probable	23	Up	10	2	21.5
17-May-2012	20:42	Fish Probable	27	Down	10	2	21.5
17-May-2012	20:44	O. mykiss	34	Up	10	2	21.5
17-May-2012	20:56	Fish Probable	22	Up	10	2	21.5
17-May-2012	20:57	O. mykiss	30	Up	10	2	21.5
18-May-2012	5:17	Fish Probable	20	Down	10	2	20.6
18-May-2012	6:34	Fish Probable	27	Down	10	2	20.6
18-May-2012	19:49	O. mykiss	34	Up	10	2	20.6
18-May-2012	20:54	O. mykiss	23	Up	10	2	20.6
18-May-2012	21:39	O. mykiss	20	Up	10	2	20.6
18-May-2012	23:05	Fish Probable	41	Up	10	2	20.6
18-May-2012	23:06	Fish Probable	27	Down	10	2	20.6
18-May-2012	23:08	O. mykiss	34	Up	10	2	20.6
18-May-2012	23:08	Fish Probable	30	Down	10	2	20.6
18-May-2012	23:23	O. mykiss	37	Up	10	2	20.6
19-May-2012	4:57	Fish Probable	23	Down	10	3	20.4
19-May-2012	5:45	Fish Probable	34	Down	10	3	20.4
19-May-2012	5:47	O. mykiss	27	Up	10	3	20.4
19-May-2012	9:35	Fish Unknown	27	Up	10	3	20.4
19-May-2012	20:36	O. mykiss	37	Up	10	3	20.4
19-May-2012	23:07	O. mykiss	28	Up	10	3	20.4
20-May-2012	5:38	O. mykiss	30	Up	10	3	21.3
20-May-2012	6:14	Fish Probable	27	Down	10	3	21.3
20-May-2012	6:49	Fish Probable	27	Down	10	3	21.3
20-May-2012	14:04	Fish Unknown	34	Down	10	3	21.3
20-May-2012	14:53	Fish Unknown	28	Down	10	3	21.3
20-May-2012	14:57	O. mykiss	27	Up	10	3	21.3
20-May-2012	20:38	O. mykiss	32	Up	10	3	21.3
20-May-2012	21:22	O. mykiss	34	Up	10	3	21.3
21-May-2012	0:08	O. mykiss	34	Up	9	3	21.8
21-May-2012	5:13	Fish Probable	23	Down	9	3	21.8
21-May-2012	5:38	O. mykiss	34	Up	9	3	21.8
21-May-2012	5:54	O. mykiss	32	Up	9	3	21.8
21-May-2012	20:37	Fish Probable	34	Up	9	3	21.8
21-May-2012	20:40	O. mykiss	27	Up	9	3	21.8
22-May-2012	20:55	O. mykiss	37	Up	8	3	22.2
25-May-2012	20:54	Fish Probable	27	Up	7	3	20.4
10-Jun-2012	4:54	O. mykiss	34	Up	2	4	21.5

Appendix 14. Descaling references, species, criteria, source of descaling, and amount of descaling for comparison to measured descaling from Robles Fish Facility monitoring and evaluations during 2011.

			Source of Descaling							
Citation	Species	Descaling Method or Criteria	Natural	Test Fish Transport	Passage Facility	Trap	Handling	Percent Descaled	Mean Total Descaling	Sample Size
Wunderlich and Dilley 1986	Steelhead	3 categories[a]	X	X		Floating net trap	X	L/M/H 12.5/6/2.1		91
Dilley and Wunderlich 1992	Chinook	2 categories[b]	X			Scoop trap	X	P/D 20/17		59
	Coho	2 categories[b]	X			Scoop trap	X	P/D 18/5		104
Hawkes et al. 1991	Steelhead	% of total	X		Dam facility	Facility trap	X		8.7	26,000
Neitzel et al. 1990	Steelhead	16%[c]	X	X	Drum screens	Fyke net	X	0.3		341
Mensik et al. 2006	Steelhead (wild)	20%[d]	X		Dam facility	Facility trap	X	2.2		10,786
	Steelhead (hatchery)	20%	X		Dam facility	Facility trap	X	3.2		32,192
Axel et al. 2011	Steelhead	16%	X		Dam facility	Facility trap	X	7.3		1,155
Fish Passage Center[e]	Steelhead	20%	X		Dam facility	Facility trap	X	2.1		73,091
Fish Passage Center[e]	Steelhead	20%	X			Scoop trap	X	6.9		19,746
Fish Passage Center[e]	Steelhead	20%	X			Screw trap	X	4.9		27,120
Hostetter et al. 2011	Steelhead	3 categories[f]	X		Dam facility	Facility trap	X	</5-20/> 66/30/4		22,451
CMWD 2011	Steelhead	% of total	X		V-screen and ladder	Weir fence trap	X	0.0[g]	3.4	25

[a]Descaling was L = low at <10%, M = moderate from 10-50%, and H = high at >50%.
[b]Descaling was P = partial at 3-16% and D = descaled at >16%.
[c]Criterion for 16% was if any two of five zones on one side of a smolt had at least 40% descaling. This would equal a total descaling of 8%.
[d]Criterion for 20% was based on any two of five zones on one side of a smolt had at least 50% descaling. This is a total descaling of 10%.
[e]Data was acquired from the Fish Passage Center data base for the 2009-2012 smolt migration years (www.fpc.org).
[f]Descaling was categorized into <5%, 5-20%, and >20%.
[g]Percentage was standardized to be comparable to the 20% criterion.

Appendix 15. Monthly flow summary for Robles Fish Facility, water year 2011-2012.

Ventura River Flow Assessment
Water Year 2011 - 2012

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Jul-11	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	12	3	15	2.8	24	24	0	24	0
2	12	3	15	2.7	23	23	0	23	0
3	11	3	14	2.7	22	22	0	22	0
4	11	3	14	2.6	22	22	0	22	0
5	11	3	14	2.5	19	19	0	19	0
6	10	3	13	2.5	19	19	0	19	0
7	10	3	13	2.7	21	21	0	21	0
8	10	3	13	2.7	21	21	0	21	0
9	10	3	13	2.6	21	21	0	21	0
10	10	3	13	2.7	22	22	0	22	0
11	10	3	13	2.7	22	22	0	22	0
12	10	3	13	2.8	22	22	0	22	0
13	11	3	14	2.7	22	22	0	22	0
14	11	3	14	2.9	24	24	0	24	0
15	11	3	14	3.1	26	26	0	26	0
16	11	3	14	3.0	24	24	0	24	0
17	11	2	13	2.9	23	23	0	23	0
18	10	2	12	2.6	21	21	0	21	0
19	9	2	12	2.4	17	17	0	17	0
20	9	2	11	2.3	15	15	0	15	0
21	9	2	11	2.3	15	15	0	15	0
22	9	2	11	2.4	17	17	0	17	0
23	9	2	11	2.4	17	17	0	17	0
24	9	2	11	2.3	15	15	0	15	0
25	8	2	10	2.1	11	11	0	11	0
26	8	2	10	3.0	10	10	0	10	0
27	8	2	10	2.0	10	10	0	10	0
28	8	2	10	2.0	10	10	0	10	0
29	8	2	10	1.9	7	7	0	7	0
30	8	2	10	2.0	10	10	0	10	0
31	8	2	10	1.9	7	7	0	7	0
Totals	301	77	379		558	558	0	558	0

(pink) The computer had a power failure. No data collected assume 10 CFS
(gray) Tubing partially plugged values adjusted

Ventura River Flow Assessment
Water Year 2011 - 2012

Aug-11	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	7	2	9	1.9	7	7	0	7	0
2	7	2	9	1.8	5	5	0	5	0
3	7	2	8	1.7	4	4	0	4	0
4	7	2	8	1.8	5	5	0	5	0
5	7	2	8	1.7	4	4	0	4	0
6	7	2	8	1.7	4	4	0	4	0
7	7	2	8	1.7	4	4	0	4	0
8	7	2	8	1.6	4	4	0	4	0
9	7	2	8	1.6	4	4	0	4	0
10	7	2	8	1.6	4	4	0	4	0
11	7	1	9	1.7	4	4	0	4	0
12	7	2	9	1.7	4	4	0	4	0
13	7	1	9	1.7	4	4	0	4	0
14	7	1	8	1.7	4	4	0	4	0
15	7	1	8	1.6	4	4	0	4	0
16	7	1	8	1.5	3	3	0	3	0
17	7	1	8	1.5	3	3	0	3	0
18	6	1	8	1.4	3	3	0	3	0
19	6	1	8	1.5	3	3	0	3	0
20	7	1	8	1.5	7	7	0	7	0
21	7	1	8	1.7	7	7	0	7	0
22	7	1	8	1.0	6	6	0	6	0
23	7	1	8	0.1	5	5	0	5	0
24	6	1	7	0.2	5	5	0	5	0
25	6	1	7	0.2	4	4	0	4	0
26	6	1	7	0.2	4	4	0	4	0
27	6	1	7	0.2	4	4	0	4	0
28	6	1	7	0.2	3	3	0	3	0
29	5	1	7	0.1	3	3	0	3	0
30	5	1	7	0.1	2	2	0	2	0
31	5	1	7	0.1	4	4	0	4	0
Totals	202	42	245		130	130	0	130	0

(Shaded) Tubing partially plugged values adjusted

Ventura River Flow Assessment
Water Year 2011 - 2012

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
Sep-11	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck. (cfsd)	Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	Fishway Ladder (cfsd)	VRNMO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)	Robles Diversion (AF)
1	5	1	7	0	4	4	0	4	0
2	5	1	6	0	3	3	0	3	0
3	5	1	6	0	2	2	0	2	0
4	5	1	6	0	2	2	0	2	0
5	5	1	6	0	2	2	0	2	0
6	5	1	6	0	1	1	0	1	0
7	5	1	6	0	1	1	0	1	0
8	5	1	6	0	0	0	0	0	0
9	5	1	7	0	0	0	0	0	0
10	5	1	6	0	0	0	0	0	0
11	6	1	7	0	2	2	0	2	0
12	6	1	7	0	3	3	0	3	0
13	6	1	7	0	2	2	0	2	0
14	6	1	7	0	2	2	0	2	0
15	6	1	7	0	2	2	0	2	0
16	6	1	7	0	2	2	0	2	0
17	6	1	7	0	2	2	0	2	0
18	6	1	7	0	2	2	0	2	0
19	5	1	6	0	2	2	0	2	0
20	5	1	6	0	2	2	0	2	0
21	5	1	6	0	2	2	0	2	0
22	5	1	6	0	3	3	0	3	0
23	5	1	6	0	2	2	0	2	0
24	5	1	6	0	3	3	0	3	0
25	5	1	6	0	4	4	0	4	0
26	5	1	7	0	4	4	0	4	0
27	5	1	6	0	3	3	0	3	0
28	5	1	6	0	2	2	0	2	0
29	5	1	6	0	2	2	0	2	0
30	5	1	6	1	2	2	0	2	0
Totals	155	37	192		64	64	0	64	0

Ventura River Flow Assessment Water Year 2011 - 2012									
	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
Oct-11	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck. (cfsd)	Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	Fishway Ladder (cfsd)	VRNMO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)	Robles Diversion (AF)
1	4	1	5	1	3	3	0	3	0
2	4	1	5	1	3	3	0	3	0
3	4	1	5	1	2	2	0	2	0
4	4	1	5	1	3	3	0	3	0
5	8	2	10	2	10	10	0	10	0
6	6	1	7	1	10	10	0	10	0
7	5	1	6	1	7	7	0	7	0
8	5	1	6	1	7	7	0	7	0
9	5	1	6	1	7	7	0	7	0
10	5	1	6	1	6	6	0	6	0
11	5	1	6	1	6	6	0	6	0
12	4	1	5	1	6	6	0	6	0
13	4	1	5	1	5	5	0	5	0
14	4	1	5	1	5	5	0	5	0
15	4	1	5	1	6	6	0	6	0
16	4	1	5	1	6	6	0	6	0
17	4	1	5	1	5	5	0	5	0
18	4	1	5	1	4	4	0	4	0
19	4	1	5	1	3	3	0	3	0
20	4	1	5	1	0	0	0	0	0
21	4	1	5	1	0	0	0	0	0
22	4	1	5	1	0	0	0	0	0
23	4	1	5	1	0	0	0	0	0
24	4	1	5	1	0	0	0	0	0
25	4	1	5	1	0	0	0	0	0
26	4	1	5	1	0	0	0	0	0
27	4	1	5	1	0	0	0	0	0
28	4	1	5	1	0	0	0	0	0
29	4	1	5	1	0	0	0	0	0
30	4	1	5	1	0	0	0	0	0
31	4	1	5	1.0	0	0	0	0	0
Totals	135	34	168		102	102	0	102	0

Ventura River Flow Assessment Water Year 2011 - 2012									
	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
Nov-11	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck. (cfsd)	Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	Fishway Ladder (cfsd)	VRNMO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)	Robles Diversion (AF)
1	4	1	5	1.0	0	0	0	0	0
2	4	1	5	1.0	0	0	0	0	0
3	4	1	5	1.0	0	0	0	0	0
4	5	1	6	1.1	0	0	0	0	0
5	5	1	6	1.1	0	0	0	0	0
6	5	2	7	1.2	0	0	0	0	0
7	5	1	7	1.2	0	0	0	0	0
8	5	1	7	1.1	0	0	0	0	0
9	6	1	7	1.2	0	0	0	0	0
10	5	1	7	1.2	0	0	0	0	0
11	5	1	7	1.2	15	15	0	15	0
12	8	2	10	1.6	20	20	0	20	0
13	7	2	8	1.4	18	18	0	18	0
14	6	2	8	1.3	14	14	0	14	0
15	6	2	8	1.3	10	10	0	10	0
16	6	2	8	1.4	10	10	0	10	0
17	6	2	8	1.4	10	10	0	10	0
18	6	2	8	1.3	10	10	0	10	0
19	6	2	8	1.3	10	10	0	10	0
20	11	3	14	2.0	10	10	0	10	0
21	10	2	12	2.2	10	10	0	10	0
22	9	2	11	1.8	10	10	0	10	0
23	9	2	11	1.7	10	10	0	10	0
24	9	2	10	1.7	10	10	0	10	0
25	9	2	10	1.6	10	10	0	10	0
26	8	2	10	1.6	10	10	0	10	0
27	8	2	9	1.6	10	10	0	10	0
28	8	2	10	1.5	10	10	0	10	0
29	8	2	10	1.4	10	10	0	10	0
30	9	2	11	1.6	10	10	0	10	0
Totals	204	47	251		226	226	0	226	0

Ventura River Flow Assessment Water Year 2011 - 2012									
	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
Dec-11	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck. (cfsd)	Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	Fishway Ladder (cfsd)	VRNMO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)	Robles Diversion (AF)
1	8	2	10	1.6	10	10	0	10	0
2	8	2	9	1.5	10	10	0	10	0
3	7	2	9	1.5	10	10	0	10	0
4	7	2	9	1.5	10	10	0	10	0
5	7	2	9	1.4	10	10	0	10	0
6	7	2	9	1.4	10	10	0	10	0
7	7	2	9	1.5	10	10	0	10	0
8	7	2	9	1.5	10	10	0	10	0
9	7	2	9	1.5	10	10	0	10	0
10	7	2	8	1.5	10	10	0	10	0
11	7	2	8	1.5	10	10	0	10	0
12	7	2	9	1.6	10	10	0	10	0
13	7	2	9	1.6	10	10	0	10	0
14	7	2	9	1.5	10	10	0	10	0
15	7	2	9	1.6	10	10	0	10	0
16	8	2	9	1.5	10	10	0	10	0
17	7	2	9	1.5	10	10	0	10	0
18	7	2	9	1.5	10	10	0	10	0
19	7	2	9	1.5	10	10	0	10	0
20	7	2	9	1.5	10	10	0	10	0
21	7	2	9	1.6	10	10	0	10	0
22	7	2	9	1.5	10	10	0	10	0
23	7	2	8	1.5	10	10	0	10	0
24	7	2	8	1.5	10	10	0	10	0
25	7	2	8	1.5	10	10	0	10	0
26	7	2	8	1.5	10	10	0	10	0
27	7	2	8	1.5	10	10	0	10	0
28	7	2	8	1.5	10	10	0	10	0
29	7	2	8	1.5	10	10	0	10	0
30	6	2	8	1.4	10	10	0	10	0
31	6	2	8	1.4	10	10	0	10	0
Totals	217	52	269		310	310	0	310	0

Ventura River Flow Assessment
Water Year 2011 - 2012

Jan-12	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	6	2	8	1.4	10	10	0	10	0
2	6	2	8	1.4	10	10	0	10	0
3	6	2	8	1.4	10	10	0	10	0
4	6	2	8	1.6	10	10	0	10	0
5	6	2	8	1.6	10	10	0	10	0
6	6	2	8	1.6	10	10	0	10	0
7	6	2	8	1.7	10	10	0	10	0
8	6	2	8	1.6	10	10	0	10	0
9	6	2	8	1.6	10	10	0	10	0
10	6	2	8	1.6	10	10	0	10	0
11	6	2	8	1.7	9	9	0	9	0
12	6	2	8	1.7	9	9	0	9	0
13	6	2	8	1.7	9	9	0	9	0
14	6	2	8	1.7	9	9	0	9	0
15	6	2	8	1.8	9	9	0	9	0
16	6	2	8	1.7	9	9	0	9	0
17	6	2	8	1.8	9	9	0	9	0
18	6	2	8	1.8	9	9	0	9	0
19	6	2	8	1.7	9	9	0	9	0
20	6	2	8	1.7	9	9	0	9	0
21	7	2	9	1.9	9	9	0	9	0
22	6	2	7	2.0	9	9	0	9	0
23	7	2	9	2.0	9	9	0	9	0
24	6	2	8	2.0	10	10	0	10	0
25	6	2	7	1.9	11	11	0	11	0
26	6	2	7	1.9	11	11	0	11	0
27	5	2	7	1.9	11	11	0	11	0
28	5	2	7	1.8	10	10	0	10	0
29	5	2	7	1.8	10	10	0	10	0
30	5	2	7	1.8	10	10	0	10	0
31	5	2	7	1.8	10	10	0	10	0
Totals	184	51	235		299	299	0	299	0

Ventura River Flow Assessment
Water Year 2011 - 2012

Feb-12	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	5	2	7	1.8	10	10	0	10	0
2	5	2	7	1.8	10	10	0	10	0
3	5	2	6	1.7	10	10	0	10	0
4	5	1	6	1.6	9	9	0	9	0
5	5	1	6	1.6	9	9	0	9	0
6	5	2	6	1.6	9	9	0	9	0
7	5	2	6	1.6	10	10	0	10	0
8	5	1	6	1.7	10	10	0	10	0
9	5	1	6	1.7	10	10	0	10	0
10	5	1	6	1.6	9	9	0	9	0
11	5	1	6	1.6	9	9	0	9	0
12	5	1	6	1.7	9	9	0	9	0
13	5	1	6	1.8	10	10	0	10	0
14	5	2	6	1.7	10	10	0	10	0
15	5	1	6	1.7	10	10	0	10	0
16	5	1	6	1.6	9	9	0	9	0
17	5	1	6	1.6	9	9	0	9	0
18	5	1	6	1.6	9	9	0	9	0
19	5	1	6	1.6	9	9	0	9	0
20	5	1	6	1.6	9	9	0	9	0
21	5	1	6	1.6	9	9	0	9	0
22	5	1	6	1.6	9	9	0	9	0
23	4	1	6	1.5	8	8	0	8	0
24	4	1	5	1.4	7	7	0	7	0
25	4	1	6	1.4	7	7	0	7	0
26	4	1	5	1.4	7	7	0	7	0
27	4	1	5	1.5	8	8	0	8	0
28	4	1	6	1.5	8	8	0	8	0
29	4	1	6	1.5	8	8	0	8	0
Totals	130	40	169		255	247	0	247	0

Ventura River Flow Assessment Water Year 2011 - 2012										
	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Mar-12	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	5	1	6	1.6	9	9	0	9	0
2	4	1	5	1.6	9	9	0	9	0
3	4	1	5	1.5	8	8	0	8	0
4	4	1	5	1.4	7	7	0	7	0
5	4	1	5	1.3	6	6	0	6	0
6	4	1	5	1.3	7	7	0	7	0
7	4	1	5	1.4	7	7	0	7	0
8	4	1	5	1.4	7	7	0	7	0
9	4	1	5	1.4	7	7	0	7	0
10	4	1	5	1.4	7	7	0	7	0
11	4	1	5	1.4	7	7	0	7	0
12	4	1	5	1.3	7	7	0	7	0
13	4	1	5	1.3	6	6	0	6	0
14	4	1	5	1.3	7	7	0	7	0
15	4	1	5	1.4	7	7	0	7	0
16	4	1	5	1.5	8	8	0	8	0
17	21	15	36	2.5	16	16	3	19	6
18	13	15	28	3.1	21	21	3	24	6
19	10	14	24	2.7	17	17	0	17	0
20	9	7	17	2.4	16	16	0	16	0
21	8	2	9		14	14	0	14	0
22	8	2	9		13	13	0	13	0
23	7	2	9		13	13	0	13	0
24	7	2	9		13	13	0	13	0
25	14	8	22		20	20	0	20	0
26	17	8	25		24	24	0	24	0
27	13	4	17		22	22	0	22	0
28	11	3	14		20	20	0	20	0
29	11	3	14		19	19	0	19	0
30	10	2	12		18	18	0	18	0
31	10	2	12		17	17	0	17	0
Totals	230	105	335		374	374	6	380	12
	Data loss due to computer failure								

Ventura River Flow Assessment
Water Year 2011 - 2012

Apr-12	(1) Source Stream Daily Flows: Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows: Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
1	9	2	12		17	17	0	17	0
2	8	2	10		16	16	0	16	0
3	8	2	10		15	15	0	15	0
4	8	2	9		15	15	0	15	0
5	7	2	9		14	14	0	14	0
6	7	2	8		14	14	0	14	0
7	6	2	8		13	13	0	13	0
8	6	2	8		13	13	0	13	0
9	6	2	7		12	12	0	12	0
10	6	2	7		12	12	0	12	0
11	9	3	12		17	17	0	17	0
12	8	2	10		16	16	0	16	0
13	22	46	68		26	26	27	53	53
14	24	60	84		26	26	11	37	22
15	17	59	76		24	24	0	24	0
16	14	26	40		24	24	0	24	0
17	12	3	15		22	22	0	22	0
18	11	3	14		21	21	0	21	0
19	11	2	13		20	20	0	20	0
20	10	2	12		19	19	0	19	0
21	9	2	11		18	18	0	18	0
22	9	2	11		18	18	0	18	0
23	9	2	11		18	18	0	18	0
24	9	2	11		18	18	0	18	0
25	8	2	10		18	18	0	18	0
26	9	2	11		18	18	0	18	0
27	8	2	10		17	17	0	17	0
28	7	2	9		16	16	0	16	0
29	7	2	9		15	15	0	15	0
30	7	2	8		15	15		15	0
Totals	289	243	532		527	527	38	565	75

(shaded) Data loss due to computer failure

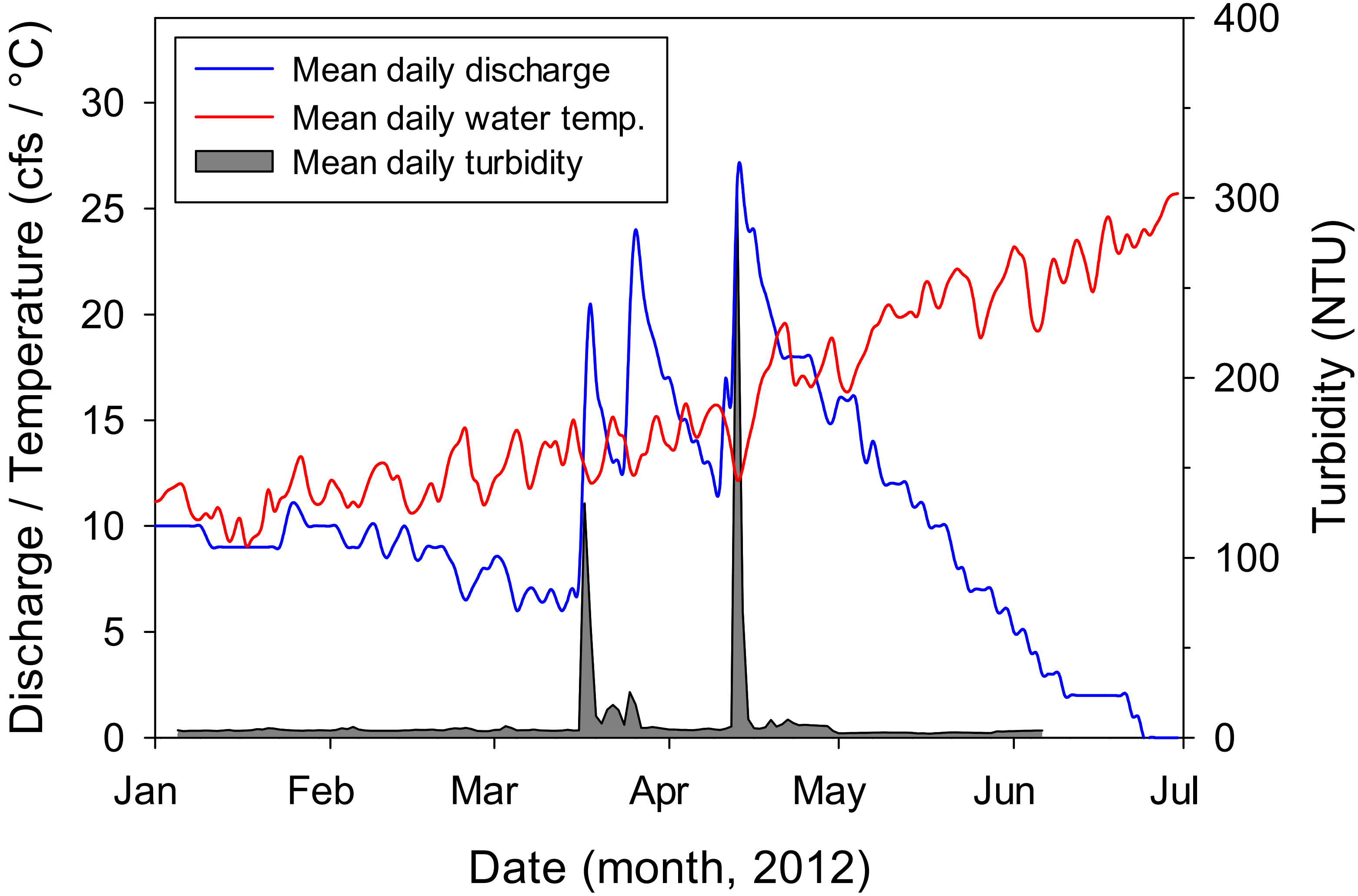
Ventura River Flow Assessment
Water Year 2011 - 2012

May-12	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	7	2	9		16	16	0	16	0
2	7	2	9		16	16	0	16	0
3	7	2	9		16	16	0	16	0
4	7	2	8		16	16	0	16	0
5	7	2	8		14	14	0	14	0
6	6	2	8		13	13	0	13	0
7	6	1	7		14	14	0	14	0
8	5	1	7		13	13	0	13	0
9	5	1	6		12	12	0	12	0
10	5	1	6		12	12	0	12	0
11	5	1	6		12	12	0	12	0
12	5	1	6		12	12	0	12	0
13	5	1	6		12	12	0	12	0
14	5	1	6		11	11	0	11	0
15	5	1	6		11	11	0	11	0
16	4	1	6		11	11	0	11	0
17	4	1	5		10	10	0	10	0
18	4	1	5		10	10	0	10	0
19	4	1	5		10	10	0	10	0
20	4	1	5		10	10	0	10	0
21	4	1	4		9	9	0	9	0
22	3	1	4		8	8	0	8	0
23	3	1	4		8	8	0	8	0
24	3	1	4		7	7	0	7	0
25	3	1	4		7	7	0	7	0
26	3	1	4		7	7	0	7	0
27	3	1	4		7	7	0	7	0
28	3	1	4		7	7	0	7	0
29	3	1	3		6	6	0	6	0
30	3	1	3		6	6	0	6	0
31	3	1			6	6	0	6	0
Totals	137	38	171		329	329	0	329	0

(shaded) Data loss due to computer failure

Ventura River Flow Assessment
Water Year 2011 - 2012

Jul-12	(1) Source Stream Daily Flows Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)		Forebay Avg. Depth (ft)	(3) Robles Facility Daily Flows Fishway Ladder (cfsd)	(4) VRN MO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)		(5) X 1.98 Robles Diversion (AF)
1	1.4	0.0	1.4		0.5	0	0	0	0		0
2	1.4	0.5	1.9		0.5	0	0	0	0		0
3	1.5	0.5	2.0		0.4	0	0	0	0		0
4	1.4	0.5	1.9		0.5	0	0	0	0		0
5	1.4	0.5	1.9		0.4	0	0	0	0		0
6	1.3	0.5	1.8		0.5	0	0	0	0		0
7	1.3	0.5	1.8		0.3	0	0	0	0		0
8	1.2	0.4	1.6		0.2	0	0	0	0		0
9	1.0	0.4	1.4		0.2	0	0	0	0		0
10	1.0	0.4	1.4		0.2	0	0	0	0		0
11	1.1	0.4	1.5		0.2	0	0	0	0		0
12	1.1	0.4	1.5		0.2	0	0	0	0		0
13	1.1	0.4	1.5		0.2	0	0	0	0		0
14	1.0	0.4	1.4		0.2	0	0	0	0		0
15	1.0	0.4	1.4		0.2	0	0	0	0		0
16	1.0	0.4	1.4		0.2	0	0	0	0		0
17	1.0	0.5	1.5		0.2	0	0	0	0		0
18	1.0	0.5	1.5		0.1	0	0	0	0		0
19	1.1	0.4	1.5		0.1	0	0	0	0		0
20	1.0	0.4	1.4		0.1	0	0	0	0		0
21	1.0	0.4	1.3		0.1	0	0	0	0		0
22	1.0	0.4	1.4		0.1	0	0	0	0		0
23	1.0	0.4	1.4		0.1	0	0	0	0		0
24	1.1	0.4	1.5		0.1	0	0	0	0		0
25	1.0	0.4	1.4		0.1	0	0	0	0		0
26	0.9	0.4	1.3		0.1	0	0	0	0		0
27	0.9	0.4	1.3		0.1	0	0	0	0		0
28	0.8	0.4	1.2		0.1	0	0	0	0		0
29	0.8	0.4	1.2		0.1	0	0	0	0		0
30	0.8	0.4	1.2		0.1	0	0	0	0		0
31	0.8	0.4	1.2		0.1	0	0	0	0		0
Totals	33	13	46			0	0	0	0		0



Appendix 16. Mean daily discharge, water temperature, and turbidity from the Robles Fish Facility during the fish passage season.

2019 Robles Fish Passage Facility
Progress Report

Storms during 2019 transported extensive Thomas Fire sediment downstream from the upper Ventura River basin. Sediment was transported into the Robles forebay until full, which then moved into the Robles Fish Passage Facility. Top left photo is aerial of Robles Facility showing sediment accumulation in forebay, top right is sediment removal process from screenbay, bottom left is sediment that filled in entrance pool (channel on left bank remained open because of fish ladder flows), and bottom right is showing sediment-filled channel upstream of the measurement weir.

Casitas Municipal Water District
1055 Ventura Avenue
Oak View, California 93022

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1.0 EXECUTIVE SUMMARY

Casitas Municipal Water District (CMWD) is implementing the Robles Fish Passage Facility Project (Robles Fish Facility) described in the Proposed Action of the Bureau of Reclamation's Biological Assessment (BA); (USBOR 2003). The effects of the Robles Fish Facility were analyzed in the Biological Opinion (BO) prepared by the National Marine Fisheries Service (NMFS 2003a). This 2019 Robles Fish Passage Facility Progress Report, as described by the BO, is the culmination of monitoring, evaluation, and operational data collected during the reporting period of 01 July 2018 to 30 June 2019.

The monitoring and evaluation studies related to the Robles Fish Facility conducted during the 2018-2019 reporting period are included in two main sections of this progress report. The Fisheries Monitoring and Evaluation section includes: upstream fish migration, impediment evaluation, sandbar monitoring at the mouth of the Ventura River, fish attraction evaluation, fish passage monitoring, downstream fish passage evaluations, and downstream fish migration through the Robles Reach. The Facility Operation section includes: information and data on the facility status, flow observations and control, costs associated with operation and monitoring, assessment of the effectiveness to provide fish passage, recommendations of priorities for future activities, and revisions deemed necessary to the operations.

Above normal precipitation occurred in the Ventura River Basin during the 2019 fish passage season. Nine BO-defined storm events occurred and allowed data collection for the monitoring and evaluations of the Robles Fish Facility. The sandbar at the mouth of the Ventura River was open for the entire fish migration season and provided opportunity for steelhead passage through the lower mainstem Ventura River. No *Oncorhynchus mykiss* were detected passing through the Robles Fish Facility during the fish migration period of 2019.

2.0 GENERAL INTRODUCTION

The National Marine Fisheries Service (NMFS) listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA, 16 U.S.C. § 1531 et. seq.) of 1973, as amended. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) that were considered to be substantially reproductively isolated from other steelhead stocks and were an important part of the evolutionary legacy of the species. The southern California steelhead ESU included, at that time, steelhead populations from the Santa Maria River in San Luis Obispo County south to Malibu Creek in Los Angeles County. The ESU was later extended to the US/Mexican border in San Diego County during 2002 (NMFS 2003b). In a later delineating approach, NMFS categorized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) as described under the ESA (NMFS 2005). The DPS policy differs from the ESU by delineating a group of organisms by "marked separation" rather than "substantial reproductive isolation" as originally listed. In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated, are still part of the ESU; however, the anadromous *O. mykiss* (i.e., steelhead) are now part of a smaller subset identified as the southern California steelhead DPS. Anadromous *O. mykiss* in the southern California DPS exhibit a winter-run life-history pattern during their spawning migrations; see life history discussion below.

Rainbow trout (*O. mykiss*) can be generally organized into four large groupings (Behnke 1992; Scott and Crossman 1973): 1) coastal rainbow trout that extend from northern Baja California to northern Alaska near the Kuskokwim River and also the Kamchatkan Peninsula of northeastern Asia, 2) redband trout of the inland Columbia and Frazer River basins, 3) redband trout of the central valley of California, and 4) trout of the Gulf of California drainages. The taxonomic group of coastal rainbow trout, *O. m. irideus*, exhibit two life history forms; anadromous and resident. The common name for the anadromous life history form is “steelhead trout” and the resident form are “rainbow trout”. Throughout the range of coastal rainbow trout, the anadromous life history form is widespread (Behnke 1992). There are two general life-history patterns exhibited by adult anadromous steelhead when they return from the ocean to spawn in fresh water. The patterns are grouped by either summer or winter spawning runs. There are many exceptions to this pattern, but this general characterization has been used to group steelhead runs by the season in which the peak spawning occurs as they return from the ocean (Busby et al. 1996). Summer steelhead are generally found in river systems that drain from farther inland, such as the Columbia River basin. Winter-run steelhead are typically found in the coastal systems where river systems are smaller. The winter-run pattern is the more common of the two anadromous life histories within the natural range of the species (Busby et al. 1996).

Monitoring and Research of the Robles Diversion and Fish Passage Facility

As stated in the BO (NMFS 2003a), the “Modifications to the Robles Diversion Facility and associated operation criteria have been targeted at improving fish passage conditions within the Robles Reach of the Ventura River while maintaining suitable conditions through the Fish Passage Facility.” The monitoring and evaluation studies and activities related to the modification of the Robles Facility, as outlined in the BO (NMFS 2003a), were intended to achieve three main objectives:

I. Monitor Fish Passage Facility operations and performance.

II. Determine if the Fish Passage Facility functions and operates in such a fashion that migrating steelhead:
    a. Successfully navigate into and through the facility, and
    b. Move through the facility in good physical condition.

III. Determine if the operations at the Robles Diversion are enhancing the opportunity for:
    a. Adult steelhead to migrate upstream to the Robles Facility, and
    b. Smolts and kelts to migrate downstream through the Robles Reach.

<u>5-year Reevaluation of Initial Evaluation and Monitoring Activities</u>

As described in the BO, a 5-year reevaluation of the initial fish flow operations would be conducted to determine if monitoring and evaluations have been completed (NMFS 2003a). The initiation of the 5-year period began in 2006, which was the first year the Robles Fish Facility was fully operational. An annual and ongoing reevaluation began after the 2010 fish passage season. Through the Cooperative Decision Making Process, the Robles Biological Committee will review annually each of the specific evaluations and determine if the original objectives have been addressed and could be discontinued or if additional study would be needed. Due to the variable water conditions and insufficient numbers of adult and juvenile steelhead, all objectives of the monitoring and evaluation program have not yet been accomplished. This was exacerbated by the historic 5-year exceptional drought affecting much of California, and particularly the southern coast of California including the Ventura River Basin. After the 2017 season, the drought in Ventura River basin had diminished to a moderate level, and continued into 2018 and 2019. Each aspect of the monitoring and evaluation program will be assessed annually to determine if sufficient information has been collected to complete each objective. While significant progress has been made, it is recommended that several aspects of the monitoring and evaluation for the Robles Fish Facility be continued during 2020. Sufficient data have been collected for the upstream fish migration impediment evaluation to begin finalizing the results for incorporation into the long-term fish flow operations.

3.0 UPSTREAM FISH MIGRATION IMPEDIMENT EVALUATION

<u>Introduction</u>

The ability of adult steelhead to swim upstream can be impeded during migration at times of low-river flow (NMFS 2003a). Evaluations at shallow water habitat units (i.e., critical riffles) have been commonly used as a method to determine if impediments exist for adult and juvenile steelhead in California rivers (Dettman and Kelley 1986; Bratovich and Kelley 1988; Hagar 1996). The Robles Reach, which extends downstream from the Robles Fish Facility approximately 6.5 km (NMFS 2003a) to just upstream of the Santa Ana Boulevard bridge (Appendix 1), is a wide alluvial section of the Ventura River that is composed of active wash deposits of unconsolidated silt, sand, gravel, and boulders (Tan and Jones 2006). Due to this type of channel morphology and geology, alluvial channels like the Robles Reach have high infiltration rates that cause channel surface flow to rapidly recede and cease shortly after storm events (Cooke et al. 1992).

An initial assessment of potential passage impediments in relation to river discharge was completed by ENTRIX (1999). The physical characteristics of seven potential impediments were evaluated using the Thompson (1972) passage criteria. The Thompson (1972) passage criteria for adult steelhead at critical riffles is a water depth of 0.6 ft for 25% of the total transect width and a continuous portion equal to 10% of the total transect width. ENTRIX (1999) also evaluated the potential impediments using criteria of 0.5 ft and 0.6 ft depth for 25% of the total width and a total width of 8 ft for both depths. The resulting discharge required to meet critical criteria was estimated to be between 40 and 65 cfs. There have been several modifications to the Thompson passage criteria by other researchers; Dettman and Kelly (1986) on the Carmel River used a depth of 0.6 ft over a 5 ft continuous section, a criteria of 0.6 ft depth over an 8-ft section was used on the Santa Ynez River (SYRTAC 2000), and Harrison et al. (2006) used a criteria of 0.6 ft depth over a 10-ft section on the Santa Clara River. Thompson's (1972) depth criterion of 0.6 ft was not based on actual migration observations and was never validated as a minimum condition for passage. It has been observed that adult salmonids can successfully move through riffles shallower than the 0.6 ft criterion (Mosley 1982).

The objective of the impediment evaluation is to assess factors that may impede steelhead's ability to migrate to the Robles Fish Facility (NMFS 2003a). Because low-river flows have the potential to impede upstream fish migration in the Robles Reach, characterizing the effect of flows on critical riffles in this reach will be the primary focus of the impediment evaluations (NMFS 2003a).

Methods

Selected channel features that may pose an impediment to upstream passage were surveyed multiple times during the fish migration season (January through June) to measure water depth, velocity, and channel width along a transect at each site. The selected sites were planned to be surveyed over a range of discharges from approximately 30-171 cfs (the upper limit is dependent on the ability to safely conduct the surveys), which was correlated with discharge at the Robles Fish Facility. The number of repeated surveys has depended on the number and duration of significant rain events, rate of hydrograph recession, and time constraints due to other aspects of the monitoring and evaluation program. Impediment surveys have been conducted over a number of years given the natural variation of water conditions. The selected impediment sites (Appendix 2) were resurveyed multiple times to develop a statistically rigorous data set, given the natural variability, to evaluate fish passage in relation to Robles Fish Facility discharge.

Site Selection Process

During the initial phase, the Ventura River was surveyed from the mouth to the Robles Fish Facility (23 km) using standard stream survey techniques and was completed in 2008 (CMWD 2008). This provided physical measurements of all habitat units for the selection process. The survey methodology followed Moore et al. (2002) and was equivalent to a level IV survey as described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002).

Over the course of three meetings and one conference call between 24 January and 18 June of 2009, the Biological Committee (BC) for the Robles Fish Facility completed an impediment site selection process that culminated in the original selection of eight sites that would be monitored for the impediment evaluation. The BC reviewed physical parameters of the 379 habitat units surveyed and general river characteristics that included: unit type, length, width, water depth, slope, longitudinal location (river km), step height on step units, discharge at Foster Park and the Robles Fish Facility at the time of the surveys, and a river profile for the 23 km of the Ventura River below the Robles Fish Facility. Upon completion of initial assessment of the data, a list of potential sites was developed that the BC visited in the field on 27 May 2009 to determine if monitoring was warranted. This data and field assessment included regular BC members (at the time of the assessment) Mike Kinsey (BOR), Stan Glowacki (NMFS), Mary Larson (CDFW), and Scott Lewis (CMWD). Mike Gibson (CMWD), hydrologists Bob Hughes (CDFW), and David Crowder (NMFS) also participated in this assessment and selection process.

A flow event that peaked on 20 March 2011 at approximately 20,000 cfs at the USGS Foster Park gage station, a recurrence interval of about 6 years, significantly altered some impediments sites that necessitated modifications to the monitoring. See CMWD (2011) for a detailed description of the high-flow caused site alterations. A Biological Committee (BC) field assessment on 11 January 2012 was conducted to review alterations that occurred and select replacement sites for ones that no longer appeared to be impediments. Regular BC members (at the time of the assessment) Ned Gruenhagen (BOR), Rick Bush (NMFS), Mary Larson (CDFW), and Scott Lewis (CMWD) participated in this review and site-selection process; Mike Gibson (CMWD) and hydrologist Bob Hughes (CDFW) were also involved in this assessment and selection process. Based on this field review, Site 2 was no longer considered a potential impediment. Site 10 was identified as a replacement site during the January field trip. Site 8, which was originally selected during dry conditions, was not considered as restrictive as other potential sites after evaluating data collected during 2010 and 2011. Consequently, Site 8 was replaced with Site 9 during the January 2010 field trip. The complete list of current impediment sites that the BC visited and determined to be satisfactory for monitoring during the 2012 season can be found in Appendix 2. However, at the time new site selections were made (i.e., 11 January 2012), insufficient flows were available to make final site selection or transect placements. Until March of 2014, the lack of precipitation and subsequent insufficient surface flow, did not allow for confirmation of these new sites. This confirmation was completed after the March 2014 storm provided the first notable surface flows in 3 years and allowed available members of the BC to visit sites 9 and 10 on 03 March 2014. The confirmation was conducted by Scott Lewis (CMWD), Dana McCanne (CDFW), and Mike Gibson (CMWD).

ENTRIX Study Site Assessments

An effort was made to locate and determine the status of the ENTRIX (1999) study sites during 2009. Because there were numerous bed-mobilizing runoff events after the study was completed, the current status of all study sites was unknown. Based on the site descriptions in the ENTRIX (1999) study report, field surveys were conducted to locate and describe the existing channel conditions at the original site locations. Of the 7 sites originally identified by ENTRIX (1999), only 4 sites were located with any degree of certainty. Of those 4 sites, all were no longer in the primary low-flow channel. A more detailed description of the ENTRIX sites can be found in a previous progress report (CMWD 2011).

Results

During the reporting period for 2019, nine BO-defined storm events occurred. During the periods after the storms, a total of 9 water depth transects were completed. The 9 transects were focused on Robles discharges were data have not been collected to improve modeling results (Appendix 3). Highly dynamic flows that quickly receded limited the time for measurements and the discharges that data could be collected during the nine BO-defined storms.

Due to the number of storms, difficulties associated with sediment deposition, and staff workloads, final flow data was not available at the time of draft report and will be distributed at the annual BC meeting. Data will be analyzed by modeling discharge from the Robles Fish Facility and water depth at each site for the five passage criteria. This will produced five criteria discharges to provide the current status of data collection for each impediment site. Given that 6 seasons of data have been collected over a range of discharges through 2019, all impediment sites will be pooled individually across all years for this initial step of final analyses. Pooling the data broadly characterized the full range of data collected at the different impediment sites across a range of hydrologic conditions. All previous impediments will be included for this initial analysis.

Discussion

Exploratory data analyses are needed to determine the most appropriate and informative methods for analyzing the data, including data pooling, data transformations, other model explorations, outlier determinations, and final model ranking and selection. This process will proceed on a parallel track within the BC, culminating in a recommendation to the Management Committee based on the BC's interpretation of the results.

3.1 *Sandbar Monitoring*

Introduction

The Ventura River, like many other California rivers, frequently develops a seasonal sandbar at the mouth during the late spring or summer that is breached by higher river flows in the late fall or winter. If a sandbar develops, which occurs more often during dry years, the resulting lagoon can provide important rearing habitat for steelhead juveniles because of the abundant food resources available. Additionally, this can facilitate the physiological and behavioral changes associated with smoltification (Cannata 1998) and also enhance marine survival (Bond et al. 2008).
The primary objective of the sandbar monitoring is to determine if the criteria for initiation of the fish passage augmentation season have been met (NMFS 2003a). As stipulated in the BO, the fish passage augmentation season will extend from 01 January through 30 June of each year and will commence after the sandbar has been breached at least once during the current year's fish flow operations season. During the fish

passage augmentation season, several Robles Fish Facility operation criteria must also be implemented (see NMFS 2003a for a complete list of operational criteria).

Methods

During each sandbar inspection, observations and recordings were made that included: date, time, status of the sandbar, general location of the mouth, tidal stage, water temperature, and discharge at the Robles Fish Facility and the USGS Foster Park gage station. The sandbar was open on 01 January 2019 and its status was monitored once every two weeks through June. Outside of the fish passage augmentation season the sandbar was monitored at least monthly.

Results

During the reporting period, July 2018 through June 2019, the mouth of the Ventura River was inspected 18 times to determine if the sandbar was open or closed. There were 11 observations that occurred during the fish passage augmentation season (January through June 2019) and 7 observations outside of the season. The sandbar was open on 01 January 2019 through 20 June 2019 for volitional fish passage (Appendix 16). On the days the sandbar was inspected during the reporting period, the mean daily discharge at the USGS Foster Park gage station and the Robles Fish Facility ranged from approximately 0.2 to 201 cfs and 0.7 to 66 cfs, respectively. When the sandbar was open, the river was observed exiting from both the east and west sides of the estuary simultaneously during the reporting period.

Discussion

The sandbar at the mouth of the Ventura River tends to remain open during average and above average precipitation years and closes only during years with few significant rain events. This typical pattern where the sandbar remains open during the fish passage season is illustrated from 2006 to 2018 (Appendix 17). This pattern commonly includes a period, during the summer and fall, when the sandbar is closed. A single low precipitation year can produce a longer period of closure, as occurred in 2007, 2012, and 2016. Consecutive dry years may cause a closure to persist into the fish passage season, only opening during short periods following rain events, such as in 2013 through 2015.

The tendency of the sandbar to remain open during the fish passage season, in all but very dry years, is likely due to a several factors. Although the middle reach of the Ventura River goes dry every year, during most years subsurface water continues to flow and eventually begins to resurface just upstream of the confluence with San Antonio Creek and continues to increase slightly proceeding downstream. Additionally, tributary flow from San Antonio Creek also adds to the Ventura River through a surface or subsurface connection throughout the year. Finally, treated effluent water from the Ojai Valley Sanitary District at rkm 7.5 increases the river discharge by approximately 3 cfs. Together, these hydrologic features contributed water to the Ventura River and likely prevent the sandbar from fully forming and therefore remaining open during most fish passage seasons, which is approximately 77% of the time.

The status of the sandbar indicates changes in the estuary/lagoon that may help determine potential entry and exit conditions for adult steelhead and juvenile *O. mykiss*, respectively. It appears that passage conditions remain suitable during most seasons when steelhead are typically migrating. However, lagoon conditions optimal for juvenile rearing (i.e., when a sandbar closes and causes an estuary to form into a deeper freshwater lagoon; Bond et al. 2008), appear to have been limited during years with potential smolt recruitment for the study period beginning in 2006.

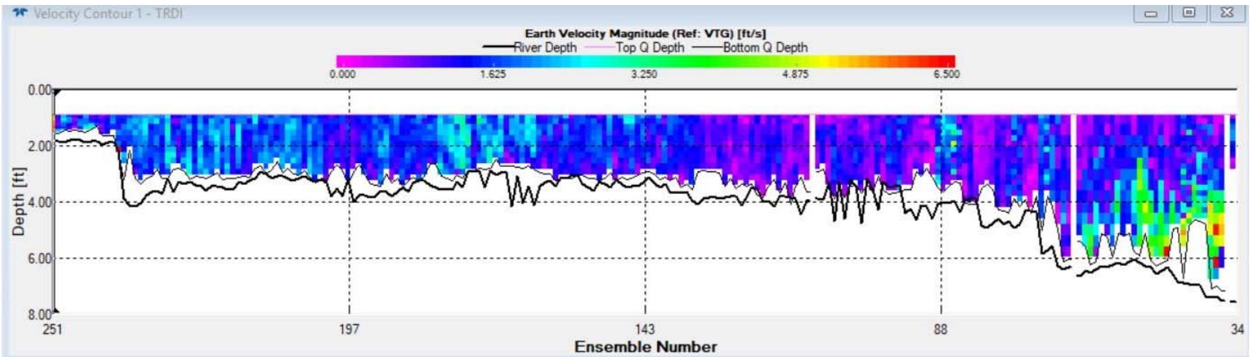
4.0 EVALUATE FISH MOVEMENT THROUGH THE PASSAGE FACILITY

4.1 *Water Velocity and Depth Validation Evaluation*

Sufficient flows into the Robles Fish Facility occurred during the 2018-2019 season for performance testing and evaluation; however, extensive sedimentation and project operation issues limited data collection opportunities.

Fish ladder entrance gate #4 water velocities were measured at 72 cfs and 50 cfs; gate #5 only at 50 cfs. The remaining fishway entrance gate performance testing objective was to measure water velocities at 171 cfs (i.e., two gates open, 50 cfs from the fish ladder, and 121 cfs from the auxiliary water supply). However, it was decided to collect a set of measurements at the available 72 cfs since the larger discharge was not available at the time. The 72 cfs was close the theoretical maximum discharge of 75 cfs that can be passed through one gate before a second gate has to be opened. This same discharge was measured through gate #5 in 2018. Gate #4, is typically the second gate operated once release flows exceed 75 cfs. Due to the sedimentation issues in 2019, gate #4 was frequently operated at release < 75 cfs to assist in maintaining a suitable fish passage channel near the fish ladder entrance area (see cover photo).

Initial velocity measurements were collected for the high-flow objectives. However, due to high turbidity, damaged measurement equipment, substantial sedimentation, and quickly receding storm hydrographs no high-flow objectives were completed. Due to the past logistical issues of getting a consultant and needed acoustical equipment on site during previous storms, Casitas purchased an acoustic Doppler current profiler (ADCP) by Teledyne and began testing in the entrance pool at low flow during 2018; the 2019 fish passage season was the first opportunity to collected data. A tether line, with a drop line for the ADCP River Cat trimaran, was installed prior to any BO-defined storm events in 2019. The tether line was snapped by large debris during the peak of first storm in January 2019. After reinstalling the tether line, velocity profiles were collected during spillway discharge of 400 cfs and fish ladder at 50 cfs. Entrance pool velocity profiles were targeted for three spill conditions with a fish ladder release of 171 cfs. Inflow and release discharges were not adequate for the full 171 cfs at the time of measurement, and canal diversions were reduced for about an hour in an effort to collect at least some initial data and practice deployment methods. Below is a screen shot from ADCP software for one of the velocity profile transects. Even at a fish ladder flow of 50 cfs, water velocities were higher near the fish ladder exit (profile is looking downstream and higher velocities from fish ladder are on the right side). A full report of the Water Velocity and Depth Validation Evaluation will be completed once data collection has been completed for all tasks the BC determines necessary.



4.2 *Fish Attraction Evaluation*

<u>Introduction</u>

River discharge has been shown to be one of several key environmental factors initiating and facilitating steelhead, and other salmonids, adult and juvenile migrations in natural fluvial environments (Shapovalov and Taft 1954; Banks 1969; Spina et al. 2005). As adults and juveniles approach fish passage facilities, suitable discharge and water velocities become even more important to ensure successful passage through any facility (Clay 1995; Beeman and Maule 2001).

The entrance of the fish ladder at the Robles Fish Facility is located approximately 20 m downstream of the spillway gates and where fish migrating upstream enter and downstream migrating fish exit the facility (i.e., two-way passage facility). The downstream end of the ladder is adjacent to a large pool (entrance pool). The ladder exit was designed for a maximum discharge at the exit of 171 cfs (50 cfs through the entire ladder and an additional 121 cfs that can be supplemented at the lower end of the ladder). The distance downstream from the entrance pool to the lower most rock weir is approximately 200 m. This reach includes all four rock weirs and the facility's discharge measurement weir, which also functions as a low-flow road crossing. The habitat types that can be used by migrants in this reach include the four pools created by the weirs, a glide created by the discharge measurement weir, a riffle, and the entrance pool.

The objective of the fish attraction evaluation is to determine if adult or juvenile steelhead are holding immediately downstream of the Robles Fish Facility during the fish passage augmentation season (NMFS 2003a).

Methods

Three separate methods were employed to determine the presence of *O. mykiss* for the Fish Attraction Evaluation to encompass a range of spatial and temporal scales. The methods used included: 1) Weekly bank/snorkel survey during the fish passage season, 2) post-storm bank/snorkel surveys in the entrance pool during the BO-defined ramp-down period, and 3) post-storm underwater video monitoring at the fish ladder entrance during the ramp-down period.

1) Weekly bank/snorkel fish attraction surveys, a methodology used since 2007, were conducted during the fish passage season from January through June of 2019 when water was present. During 2019, the 9 BO-defined storms created significant surface flows and allowed surveys to be completed for 6 months. The particular survey methodology used (i.e., bank or snorkel) was determined based on water visibility, river discharge, expected steelhead life history stage present at the time of the survey, and safety of surveyors. A combination of bank and snorkel surveys were conducted during the 6-month period. Bank surveys were conducted by one or two surveyors in an upstream direction. The surveyors wore polarized sunglasses to reduce water-surface reflection. Snorkel surveys were conducted by one or two surveyors in an upstream direction. When present, fish species were identified and enumerated to the greatest

extent possible permitted by the ambient river conditions and fish densities at the time of each survey. If *O. mykiss* were present, lengths of each fish was estimated to the nearest cm if only a few individuals (generally <10) were present. In order to collect additional information that may help determine *O. mykiss* upstream and downstream movements through the Robles Fish Facility, an upstream study reach was added in 2009. The upstream study reach included observations in the screenbay of the facility and the area immediately upstream of the low-flow fish exit in the forebay. The total distance of this upstream reach was approximately 140 m.

2) Post-storm bank/snorkel surveys were conducted in the entrance pool during the ramp-down period for all BO-defined storms. This consisted of daily surveys during the 10-12 day augmentation period after a storm event. Beginning the day after a BO-defined peak event, a Secchi depth was measured in the entrance pool to determine when surveys could begin. Bank surveys were conducted when visibility was poor and snorkel surveys were conducted after visibility increased (> 1.0 m Secchi), assuming this would allow *O. mykiss* to be observed.

3) The post-storm underwater video monitoring was conducted after a BO-defined storm and during the ramp-down period. After the storm event occurred, video cameras were installed at the entrance of the fish ladder. The video cameras were mounted on a bracket adjacent to the fish ladder entrance and lowered into place to provide monitoring following the storm event. The cameras recorded the entire 10-12 day ramp-down period to a digital video recorder (DVR) and reviewed at a later date.

<u>*Results*</u>

1) A total of 46 surveys (38 bank and 8 snorkel) were completed during the weekly surveys and no *O. mykiss* were observed (Appendix 18). During the 6-month period, a total of 7,820 m were surveyed by either bank or snorkel methods. Water temperatures during the study period ranged from 9.0 °C to 20.2 °C and turbidity ranged from 4 to

1,230 NTUs when the surveys were conducted. The mean daily discharge at the Robles Fish Facility ranged from 7 to 900 cfs at the time of the surveys.

2) There were 9 BO-defined storm events in 2019. A total of 52 surveys were conducted for the post-storm fish attraction surveys and no *O. mykiss* were observed (Appendix 19). Water temperatures during the study period ranged from approximately 10 °C to 15 °C and turbidity ranged from 17 to 10,000 NTUs when the surveys were conducted. The mean daily discharge at the Robles Fish Facility ranged from 32 to 2,700 cfs at the time of the surveys. While not part of the post-storm fish attraction surveys, an adult steelhead was observed on 07 March in the entrance pool while adjustment were being made to the fish ladder entrance gate. Only the head of the steelhead was observed (due to the high turbidity) at the surface of the water and it did not appeared to be alive. A technical memorandum detailing the observation was distributed to the BC.

3) Post-storm underwater video monitoring could not be conducted during the 9 BO-defined storm events. Turbidities were too high for the camera to operate in during the 10-12 period of any release downstream. However, during the last storm of the year, turbidity was less than earlier storms and the video system was installed to verify past efforts. The turbidity near the end of the release was approximately 20 NTUs and no useable video could be collected. The sedimentation prevented the video system from reaching the bottom of the sampling area. The guide strut used to lower and raise the system was also damaged. Once the release was completed, the video system could not be removed. Repairs will need to be made prior to the 2020 fish passage season.

4.3 *Downstream Fish Passage Evaluation*

<u>Introduction</u>

Passage evaluations of salmonids migrating through fish passage facilities have been conducted throughout the western United States for many years (Odeh 2000). Methods to determine if a facility is operating as designed and not causing harm to the intended fish species vary. Early work typically entailed trapping and tagging fish before entering a facility and recapturing them after exiting. Trapping and visual inspections for injuries, PIT tagging, radio telemetry, and acoustical telemetry have been conducted extensively as well.

There are two objectives for the downstream fish passage evaluation. The first objective is to determine if downstream migrants are successfully passing through the Robles Fish Facility. The second objective is to capture and examine steelhead smolts and kelts and determine if injuries are occurring as they pass downstream through the Robles Fish Facility (NMFS 2003a).

Methods

For a full description of evaluation methods, see section 5.0.

Results

No *O. mykiss* were captured during trapping operations and therefore no evaluations for the Downstream Passage Evaluation were conducted. The trap was operated a total of 93 days from 11 March 2019 (77 cfs) through 12 June 2019 (18 cfs) and was removed when mean daily temperatures exceeded 22 °C. Sedimentation also created operational challenges for trapping in 2019. The previous year's trap site was too shallow because of sediment fill that the trap had to be located upstream approximately 4 m. In addition, to maintain suitable flow patterns for effective trap operation, the trap was orientated more to the left channel (looking upstream) due to sedimentation in the right channel reducing flow. Frequent sediment removal by hand was needed over the course of the trapping period as upstream sediment continued to move downstream into the trap and wings.

5.0 DOWNSTREAM FISH MIGRATION THROUGH THE ROBLES REACH

Introduction

When the number of fish physically handled in a study is of concern, such as with an endangered species, radio telemetry can be a useful method over others like extensive trapping (Hockersmith et al. 2000). Telemetry migration information of steelhead smolts in the Ventura River would allow for the determination of survival, travel time and rates through select reaches, migration relative to river discharge, habitat use, and passage success through critical riffles. By tracking the tagged fish until the batteries die, it is anticipated that downstream migration can be monitored all the way to the Ventura River estuary/lagoon and could provide important data on estuary rearing and emigration behavior.

The purpose of the downstream migration evaluation is to determine how successful smolts are at migrating through the Robles Reach (NMFS 2003a). Because of the limited number of steelhead smolts likely passing downstream through the facility, a NMFS approved pilot study using radio telemetry was used for evaluations.

Methods

A weir trap was placed and operated approximately 40 m downstream of the Robles Fish Facility. The weir trap consisted of a live-box (120 cm for all three dimensions) with an internal fyke. The trap was situated in the center of the river channel and thalweg. The live-box internal frame was constructed of PVC pipe and covered with plastic fencing with 1.9-cm diagonal openings. A plastic fence (3-cm openings) supported by T-bar fence posts was extended upstream on both sides of the live-box at 30° angles into the river channel. There was a 1-m gap on the right and left bank so any adult steelhead could bypass the trap location and move upstream. The left bank passage was created because the trap wing orientation in 2019 may have made only a right-bank passage gap difficult to find for adult steelhead. Because the vast majority of downstream steelhead migrants were expected to be captured from mid-March through mid-June (Shapovalov and Taft 1954; Dettman and Kelley 1986), the trap was intended to be operated from mid-March through June 2019 or until water temperatures exceeded a daily mean of 22 °C, which could negatively impact captured fish (SYRTAC 2000), or the surface water connection was lost in the mainstem of the Ventura River. For a full description of evaluation methods, see the 2019 CMWD monitoring and evaluation study plan (Lewis et al. 2019).

Results

No *O. mykiss* were captured during the 2019 trapping operations. The trap was operated for 93 days from 11 March to 12 June 2019. The trap was only removed for sediment removal that usually took approximately 2-3 hours. The surface flow in the Robles Reach remained connection throughout the trapping period. Trapping was discontinued when the water temperature exceeded a daily mean of 22 °C.

6.0 LONG-TERM MONITORING COMPONENTS

6.1 *Monitoring Robles Facility Operations*

6.1.1 Facility Status

The Robles Fish Passage Facility started the 2018-2019 season in a fully functional mode. The 2018-2019 season was characterized by above average rainfall year as measured at Matilija Canyon. The 62.45 inches of rain measured at Matilija Canyon during the 2018-2019 water year was 182% of the average annual rainfall. Once the CDPM was approve for implantation, one download and only 2 days of a modified release were completed since Lake Casitas exceeded the CDPM volume of 100,000 af. The estimated download was only about 80-100 af. The Matilija water elevation did not drop as far as anticipated due to what appeared to be debris blocking the intake structure on the upstream side of the dam. However, an underwater or acoustical survey would likely be needed to confirm this. Previous reports identified several projects to be completed or reported on current status. The principal projects were:

- Install repaired Sontek IQ Pipe flow meter in the auxiliary water supply pipe. The flow meters had numerous communication issues during 2019 that need to be resolved before the 2020 season. Sediment accumulated in the fishway also created errors.
- Install level sensors at the fish ladder entrance to read water levels in the entrance pool. This item was not successfully completed due to sensor and SCATA limitations. It will remain an item to explore further by a qualified SCATA technician. CMDW is currently working with a contractor to examine this and other modifications to the SCATA.
- Install new diffuser perforated plate for the fish screens and the auxiliary water supply. During the 9 BO-defined storms in 2019, the new diffuser perforated panels did not become obstructed with debris as before and appear at this time to have solved the issue. They were opportunistically cleaned once while the facility was shut down for sediment removal and only low levels of debris was present. They will continue to be monitored during future storms.

6.1.2 Flow Observations and Control

Flow and level measurement devices are located at various locations within the Robles Fish Passage Facility. The primary points of measuring and recording stream flows entering, flowing through, and leaving the Robles Fish Passage Facility are:

- Matilija Creek at Matilija Hot Springs – located approximately 2,100 feet downstream of Matilija Dam – good rating for low to moderate flows – operated by Casitas Municipal Water District, formerly a USGS station; CMWD will be investigating the cost to have this gage data accessible from Robles for future use. A second gaging station at this location is operated by the County but has not been working for several years.

- Matilija Dam Stage Bubbler-Located at the dam, this gage provides the lake elevation. Under high flows, the dam acts as a weir. This is one of the primary flow measurement locations to determine if a peak has occurred. It was determined during the download that the bubbler line does not extend down into the dam forebay deep enough for monitoring of downloads. Ventura County was made aware of this situation as well of the debris issue at the inlet.
- North Fork Matilija Creek – located approximately 3,000 feet upstream of its confluence with Matilija Creek – good rating for low to moderate flows – operated by the Ventura County Watershed District;
- Robles-Casitas Diversion Canal – located on the diversion canal approximately 1,300 feet downstream of the Robles headworks – trapezoidal channel with a good rating for flows up to 600 cfs;
- Ventura River near Meiners Oaks (VRNMO or Measurement Weir) – located approximately 540 feet downstream of the Robles Fish Passage spillway – concrete weir section – good rating to 100 cfs, use of equations above 100 cfs with no verifications at higher flows above 1000 cfs. This is the most reliable flow measurement for the fish passage and downstream releases with a 50-year plus history. This site was formerly a USGS site.
- Fish Ladder- A Sontek IQ Plus has been added to this location to measure flow in the fish passage operation and was nominal with ongoing assessment.
- Auxiliary Water Supply- A Sontek IQ Pipe has been installed to obtain flow measurements in the auxiliary water supply and was nominal with ongoing assessment.

All of the instruments can suffer from inaccuracies from time to time. The inaccuracies can be caused by clogging of bubbler lines, electronic creep, debris accumulating on sensors, changes to the measured cross sections, human interactions and equipment problems. For this reason, the data is verified against field measurements and observations. The information gathered from each of these locations has been reduced to the mean daily flows in cfs (Appendix 20). The mean daily Robles Fish Facility discharge and corresponding turbidity and temperature measurements for the entire

Fish Passage Season are presented in Appendix 21. The weir bubbler data collector was operational during all BO-defined peaks.

Surface flow over the measurement weir was present throughout the reporting period. Nine BO-defined peak flow events occurred during the 2018-19 fish passage season. The first peak occurred on January 15, 2019 and the last was on March 7th. The largest peak for the season at about 12,000 cfs on February 2nd. Flow assessment worksheets for each of the 9 BO-defined storms are included at the end of this progress report. Substantial sedimentation occurred in the Robles forebay, which eventually began to move into the screenbay area. The sedimentation necessitated two facility shutdowns and removal of the sediment, one in February and one in March. Each cleanout resulted in approximately 1,000 yrd^3 of estimate. The facility was shut down and all water was spilled downstream for approximately 5 days in total. The USBOR consulted with NMFS for each of the two facility shutdowns and cleanouts. Summary reports will be distributed at the BC annual meeting.

6.1.3 Costs Associated with Operation and Monitoring

The BA/BO specified that the District provide the costs that are associated with the activity. The following is a summary estimate of the direct costs incurred by the District during the 2018-19 fiscal year:

- **Fisheries Monitoring**:

Salaries & Benefits	$ 443,936
Equipment/Material	$ 53,861

- **Facility Operations**:

Salaries & Benefits	$ 84,971
Equipment/Materials	$ 22,645
Utilities	$ 4,323
Permit	$ 1,225

- **Capital Improvements**:

Prototype eval. devel. and design	$ 137,886
Forebay cleanout devel.	$ 30,055
Screenbay cleanouts	$ 115,267

6.1.4 Water Velocity and Depth Validation Evaluation

Velocity tests were taken in the fish passage facility during the 2018-19 season as report above. The 9 BO-defined storm hydrographs receded too quickly to collect velocity data on tasks that required larger flows. All performance testing will be completed in general accordance with the NMFS approved Performance Evaluation Program and Biological Committee recommendations.

6.1.5 Recommendations Regarding the Prioritization of Future Activities

The District has completed its thirteenth season with the Robles Fish Facility operational. An assessment of the current fish screens and cleaning system was initiated to determine if modifications can be made to improve fish passage and diversion operations. A prototype evaluation plan was completed and distributed to the BC for review. The goal is to implement the evaluation plan for the 2020 fish passage season.

6.1.6 Recommendations Deemed Necessary to the Operations

Forebay sedimentation caused significant operational issues and the sediment needs to be removed for diversions and fish passage. Casitas continues to recommend that the construction of the 15-weir project be put on hold until the Matilija Dam Removal Project is completed. Plans for the High Flow Sediment Bypass and High Flow Fish Passage portion of the Matilija Dam Removal Project require this area to be graded to new elevations. To facilitate operation of Matilija Dam during CDPM downloads, the dam bubbler should be extended so remote and accurate monitoring can occur. Performance testing should remain a high priority to verify facility operations as designed.

6.2 *Fish Passage Monitoring*

Introduction

Monitoring of migratory fish moving through fish passage facilities has been conducted using many different methods that include: visual counting, trapping and hand counting, continuous video recording, PIT tagging, radio telemetry, and acoustical telemetry. In each fish passage application, the particular physical and biological conditions (e.g., variable discharge, turbidity, debris, size of facility, and number of fish) usually dictate which method would be most effective. New technologies have been employed to improve fish passage monitoring in turbid conditions specifically. One such monitoring device is the Vaki Riverwatcher® (Riverwatcher). The Riverwatcher has the capability to operate in greater turbidity than more traditional monitoring equipment. Because of this advertised capability, the Riverwatcher was selected to be used in the Robles Fish Facility by the Technical Advisory Group during original facility design.

The primary objective of fish passage monitoring is to provide a long-term index of upstream adults and downstream kelts migrating through the Robles Fish Facility (NMFS 2003a). Although the Riverwatcher has the ability to detect smolt-sized steelhead, the manufacturer recommends it for monitoring fish with body depths ≥ 40 mm (Vaki 2003). Consequently, it was not known how well it would work at detecting smolt-sized fish given the debris load of the Ventura River (NMFS 2003a).

Methods

Fish migrating upstream and downstream through the Robles Fish Facility were monitored using the Riverwatcher. The Riverwatcher is located in the fish bypass channel, which is the channel between the fish ladder and fish screens. The Riverwatcher consists of two scanner plates with light diodes that transmit beams of infrared light through the water to a corresponding receiver plate. When a fish swims (or debris drifts) through the infrared light beams, it breaks the light signal and a digital silhouette of the fish is recorded on a computer. Other data recorded when the Riverwatcher scanner is triggered are: date and time, total length (TL) of the fish (from a length/height ratio), swimming speed (m/sec), and direction of the fish movement (upstream or downstream). In addition, the scanner triggers an underwater camera to record a 10-second video clip (25 frames/sec).

The Riverwatcher was experiencing technical issues of malfunctioning video during the 2015 monitoring season. In the fall of 2015 the Riverwatcher was sent to Vaki for servicing. Through diagnostic testing, Vaki concluded no repairs were necessary and did not experience any issues with malfunctioning video. Vaki stated recent improvements to the Riverwatcher system could be integrated into older systems, and recommended upgrading the Robles Riverwatcher. This recommendation was discussed and approved by BC members at the 2015 committee meeting. The primary upgrade was changing from an analog camera to a digital camera. In conjunction with updated software, the camera now records video for both upstream and downstream detections. Additional upgrades to the Riverwatcher included: white and infrared lights, cabling, multiplexor, and power supply. To improve video detection of fish, an additional camera was installed and is located upstream of the Riverwatcher scanners in an aluminum tunnel below the Riverwatcher camera. A second DVR camera is located above the Riverwatcher and pointed at the scanner plates. These two DVR cameras are independent of the Riverwatcher system and have to be reviewed separately for detections. The digital cameras recorded continuously at 12 frames/sec and capture about 5 weeks of data until the DVR data storage drive is full. Once the DVR memory is full, it can be exchanged with a second DVR and data can be reviewed.

The Riverwatcher scanner and cameras are positioned at the bottom of an aluminum frame (crowder) covered with 1/2 inch aluminum bars, spaced 1 1/2 inches on center resulting in 1-inch spacing between the bars, which directs the fish to swim between the scanner plates. The crowder can be raised and lowered in guide slots of the fish bypass channel with the aid of an A-frame hoist for cleaning or repair. The Riverwatcher is usually operated during the entire flow augmentation season as long as sufficient water elevations in the fish bypass are present and debris and turbidity are low enough so that the crowder will not be damaged and the Riverwatcher will function.

Typically, during times of higher debris, the cleaning and inspections occur multiple times per day, and at times of lower debris, cleaning and inspections occur only once every 2-3 days. At times of very low flow (< 1-2 cfs), the crowder may only be cleaned once per week.

Prior to 2010, each upstream and downstream Riverwatcher detection was reviewed and classified as either: an adult steelhead, *O. mykiss* non-adult steelhead, other species if identifiable, unknown fish, fish probable, or false detection (see Appendix 22 for detection classification flow chart). At the request of NMFS, this classification system was modified during the review process of the 2010 progress report. It is NMFS' belief that supporting data do not exist to distinguish between the resident and anadromous forms of steelhead. All confirmed *O. mykiss* were classified solely as *O. mykiss*. The classifications were determined by using a combination of the silhouette images, estimated lengths, and video clips. In addition, if larger adult sized *O. mykiss* were detected and a useful video clip was recorded, measurements of eye diameter and standard length (SL) were estimated from the video clip to calculate morphometric ratios that were compared to known steelhead and rainbow trout.

A commonly used morphological method to discriminate differences is to develop ratios of body measurements for comparison to remove the effects of body size (Strauss and Bond 1990). This is done by comparing SL to the ratio of eye diameter in linear regression. Standard length is the length from the snout to the end of the hypural plate near the end of the fleshy caudal peduncle, which is unaffected by caudal fin deformities (Anderson and Neumann 1996).

Before 2010, the adult steelhead classification was used if the fish observed was an *O. mykiss* and displayed the typical characteristics of an anadromous adult steelhead, such as black spotting on dorsal, adipose, and caudal fins, black spotting on dorsal side of body, silvery body, vertical edge to caudal fin, ≥ 38 cm TL (Shapovalov and Taft 1954), and had an eye diameter/SL ratio ≤ 0.045 (CMWD 2008). The new classification method may include juvenile resident, smolts, adult resident, and adult anadromous *O. mykiss* migrating throughout the basin. Conceivably, after more data are collected from the downstream trapping component, or from other Ventura River basin research projects, a more thorough classification system of Riverwatcher detections could be used again.

The "fish unknown" classification was used if a detection was identified to be a fish based on video evidence, but further classification could not be determined due to high turbidity or an inadequate amount of the fish captured within the camera's field of view. The "fish probable" classification was used if no fish was observed in the video, but the silhouette was similar to that of a typical fish silhouette confirmed by video evidence. Even with reasonably good video coverage, smaller fish are still able to pass through the Riverwatcher undetected by the video cameras. This occurs if fish swim very close, high, or low relative to the cameras. In addition, this can happen if a fish swims upstream through the scanners but stops before entering the video field of view. High turbidity can also obscure the video detection and identification of fish. The "false detection" classification was used when no fish was observed in the video and the silhouette was not similar to that of a typical fish silhouette. Because false detections tended to occur frequently during higher discharges, when turbidity and debris also were high, it was likely that most false detections during these periods are caused by debris, high turbidity, and water turbulence. A second video camera is directed at the Riverwatcher scanner plates to help determine the cause of many of the false detections. After reviewing selected times where many assumed false detections occurred, it was concluded that debris, air bubbles, and turbulence were indeed the source of the detections. During low-flow periods (<10 cfs), 99.9% of the time the Riverwatcher was operating, surface water turbulence was likely the cause of most false detections. When turbidity exceeds about 100 NTUs, hundreds of false detections can occur per hour due to high concentration of suspended solids breaking the infrared beams of the scanner plates. When turbidity is less than about 100 NTUs, false detections from suspended solids are not as frequent, but poor camera visibility does not always allow for video confirmation, depending on how close to the camera that a fish swims during passage. Once the turbidity falls below about 25-30 NTUs, turbidity does not limit the Riverwatcher's capability for detecting and confirming fish (Table 1). In spring 2016, the Riverwatcher was tested in an above-ground pool with wooden fish silhouettes at varying water turbidities. This was intended to simulate natural stream conditions to provide further resolution of the operational capabilities of the Riverwatcher (Lewis et al. 2016).

Table 1. Riverwatcher general operational status for ranges of water turbidity (NTUs).

Approximate Turbidity (NTUs)	Riverwatcher status
> 200	Not functional
100-200	Many false scanner detections, not fully functional
30-100	Scanner functional, but unable to confirm with video
< 30	Scanner functional, grid detectable for video confirmation

A standardization test for the Riverwatcher was developed using wooden silhouettes of a typical smolt and adult steelhead. To confirm the Riverwatcher is functioning correctly, this test was conducted before the Riverwatcher was operated during the 2016 fish passage season. A more detailed description of this test can be found in Lewis et al. (2016).

Results and Discussion

The Riverwatcher was operated from 06 January 2019 through 30 June 2019 of the reporting period. However, due to the high turbidities, the Riverwatcher could not operate for 49 days. During this fish passage season, the crowder was removed from the fish bypass channel and cleaned or inspected approximately 100 times. The crowder was removed during the two facility shutdowns for a total of 5 days. During the 2019 fish migration season, the Riverwatcher did not detect *O. mykiss* passing through the Robles Fish Facility (Appendix 23). False detections were recorded by the Riverwatcher, of which 950 were upstream and 2,199 were downstream.

The 3,149 false detections recorded by the Riverwatcher were assumed to be caused from turbidity, debris, turbulence, air bubbles, and settings of the Riverwatcher to detect smaller fish. The review of the second DVR camera directed at the Riverwatcher scanner plates provides confidence that these are the likely cause of false detections. None of the detections produced silhouettes that appeared to be fish based on previous experience operating the Riverwatcher. In the event that one of these silhouettes could have been caused by a fish, all detection video clips created by the Riverwatcher were reviewed and no fish were observed. For the 2019 season, the minimum threshold height remained at 28 mm so that a large number of false detections could be eliminated while still attempting to detect steelhead smolts. Based on available data from the Ventura Basin, a height of 28 mm was determined to be similar to some of the smallest steelhead smolts expected to emigrate downstream through the Robles Fish Facility. This height corresponds to 146 mm TL and 139 mm FL. The estimated fish detection rate from a Riverwatcher verification study indicated that up to 93% of smolt sized *O. mykiss* will not be detected by the Riverwatcher (Lewis et al. 2016). Additionally, it was concluded that larger-sized fish (i.e., height > 80 mm) appeared to be detected nearly 100% of the time. This height is equal to about 475 mm TL. Shapovalov and Taft's (1954) 9-year study documented only 4% of the total number of adult steelhead were smaller than 475 mm. Therefore, the number of small adult steelhead that may not be detected would likely be low. However, the vast majority of adult steelhead would be detected.

7.0 ADDITIONAL BIOLOGICAL AND ENVIRONMENTAL MONITORING STUDIES

7.1 *O. mykiss Presence/Absence Surveys*

Methods

In addition to the fish attraction monitoring, *O. mykiss* relative abundance index surveys were conducted in the Ventura River mainstem between the Robles Fish Facility and the Ventura River mouth and San Antonio Creek. Surveys were conducted upstream of the Robles Fish Facility in Matilija and North Fork Matilija creeks. These additional sites were surveyed using both bank and snorkeling methods (depending on water conditions and expected life history stage) but were conducted primarily after storm events for adults and during the rest of the year for smolts, parr, and fry. Methods to estimate fish size and numbers were the same as those used in the fish attraction evaluation. A total of 14 sites were monitored and both pool and riffle habitat at each site were included (Appendix 24). These additional areas were surveyed to determine if adult steelhead were entering the Ventura River, migrating upstream, holding and spawning, and if they were successfully passing through the Robles Fish Facility. Also, juvenile *O. mykiss* (smolts and residents) were surveyed to learn spatial and temporal patterns.

The sites were initially selected based on ease of access, coverage of basin, and presumed chance of detecting *O. mykiss*. However, after all habitat surveys were completed, site selection was also based on quantitative measurements identifying high-quality habitats used for *O. mykiss* juvenile rearing and adult holding.

Results

Peak snorkel counts within each year have generally been between 350 and 400 *O. mykiss* until 2013. Due to the exceptional 5-year drought, the peak numbers of *O. mykiss* have dropped substantially (Appendix 25). No *O. mykiss* were observed during the reporting period.

7.2 *O. mykiss Index Spawning Surveys*

Methods

Spawning surveys were conducted throughout the Ventura Basin that is accessible to adult steelhead and only resident rainbow upstream of Matilija Dam. A total of 21 index sites or reaches were subjectively selected (Appendix 26) with small to medium size gravel that are suitable for steelhead spawning (Shapovalov and Taft 1954; Orcutt et al. 1968). During 2008, the spawning index sites selected were initially distributed broadly within the basin to capture general spawning locations and timing. Since 2008, longer reaches have been added to incorporate and replace previously surveyed discrete sites to accommodate for spawning gravel redistribution after storm events. Additional sites have been added to capture quality spawning habitat and to be more representative of each surveyed sub-basin. This initial information will used to establish long-term index sites to capture population trends. The spawning surveys were conducted biweekly from January through June, or until no further spawning was observed, and observations were made at sites to identify and count *O. mykiss* redds; redds were identified by typical characteristics (Orcutt et al. 1968; Chapman 1988). Once a redd was identified, physical measurements similar to those recorded by Zimmerman and Reeves (2000) were collected to characterize the redd. The physical measurements were only recorded during the first three years because it was felt sufficient data was collected to characterize redds. Currently, larger redds (likely anadromous) have all measurements collected. Pit and tailspill lengths were measured from the upstream end to the downstream end of each, respectively. Redd width was measured at the widest point of the tailspill (Appendix 27). Water depth was measured at four locations: in the pit, adjacent to the pit, upstream of the pit, and at the tailspill. The surface median (D_{50}) and maximum substrate size of each redd tailspill was estimated. All adjacent measurements were taken on the thalweg side of each redd. Photos and GPS locations were also recorded for all redds identified. This information will help determine steelhead spawning habitat selection characteristics.

Results

Spawning surveys started in 2008, numbers initially increased from only 3 redds to a high of 165 redds in 2012. Over the last 5 years, as the current drought intensified or was sustain, the available habitat diminished, and there have been corresponding losses to the adult and juvenile *O. mykiss* populations with significantly lower redd counts. In 2019, no redds were observed in the index areas (Appendix 28).

7.3 *Ambient Water Quality Monitoring*

In order to fully evaluate several aspects of the monitoring and evaluation program, water quality data is collected throughout the Ventura River basin (Appendix 29). Water temperatures are recorded at 12 locations throughout the Ventura River basin. The locations include the Ventura River estuary and mainstem, Coyote Creek, San Antonio Creek, North Fork Matilija Creek, and Matilija Creek upstream and downstream of Matilija Dam. The loggers record at 30-min intervals. Monthly grab samples are also collected at the same locations with a multiprobe that measures: dissolved oxygen, pH, conductivity, salinity, TDS, and temperature. A monthly water quality profile is also collected in the estuary/lagoon. The profiles are collected at approximately the mid-point of the estuary/lagoon and at least four depths are recorded. A continuous turbidity probe is also installed in the Robles Fish Facility near the Riverwatcher. It records water turbidity at 1-hr intervals when the bypass is operational. Turbidity measurements are also collected at several sites upstream, downstream, and within the Robles Fish Facility to ensure the continuous probe is located in a position that will be representative of the turbidity in the Ventura River. All locations were monitored if sufficient water was present. A weather station has been installed at the Robles Fish Facility to collect various atmospheric data including rainfall, temperature, pressure, wind, humidity, and dew point (Appendix 30).

7.4 *Estuary/Lagoon Monitoring*

The sandbar is monitored during the fish passage season to determine if it is open. If open, Robles Fish Facility operating criteria must be met per the BO. Outside of the passage season, monitoring has been conducted and expanded to better understand the nature of the Ventura River sandbar and how it may affect fish passage year round, and also potential rearing capacity. The estuary/lagoon has been monitored monthly for water depth as part of the water quality monitoring. In addition, the surface area has been measured every 6 months. Together, these physical measurements can provide some general index of rearing capacity of the Ventura River estuary/lagoon over time.

From 2008 through 2011, which were wetter years, the sandbar status and estuary/lagoon depth and size varied with conditions. However, since the beginning of the drought in 2012, conditions have remained somewhat uniform (Appendix 31).

7.5 *Surface Flow Monitoring*

The Ventura River, like most rivers in southern California, have significant reaches that lose surface flow during most years after storm flows recede. To quantify this natural pattern, surface flows have been observed and documented beginning at the end of 2007. Like the sandbar monitoring, clear patterns have become apparent. During normal precipitation years, there are typically surface flows throughout the length of the Ventura River mainstem during the fish passage season. Even during years of normal precipitation, the Robles Reach goes dry shortly after storms occur. However, beginning with the drought, the Robles Reach has been dry for extensive periods of time, even extending downstream of the San Antonio Creek confluence. This dry pattern was reduced significantly due to the precipitation and runoff during 2017 monitoring period. During 2019, precipitation was about 180% of average and surface flow continued longer in time and farther downstream than typical (Appendix 32). This may be caused from the effects of the Thomas Fire. One, a significant amount of sediment, after the January storm, was deposited within the stream channels upstream of Robles that could have provided water storage capacity and extended the low-flow hydrograph. Two, fine sediment from the January storm deposited fine sediment downstream of Riverwatcher that filled interstitial spaces between channel surface substrate and reduced infiltration and extending the distance of surface flows. Three, a decrease in evapotranspiration post fire also increased basin flows.

7.6 *Photographic Index Sites*

Photographic index sites were established throughout the Ventura River basin in 2007 to monitor general changes of the stream channel morphology, water conditions, and riparian zones. There are a total of 14 sites where an upstream and downstream photo are taken (Appendix 33). The sites were re-visited twice during the reporting period, in September 2018 and March 2019. As a representation of the general patterns within the mainstem of the Ventura River, Appendix 34 shows the general trend that has been observed of increasing riparian and within channel vegetation over time since 2012.

7.7 *Underwater Video Monitoring*

As time allowed, a pilot study of an underwater video monitoring system was continued to determine if remote monitoring for adults or smolts is feasible within the Ventura River or tributaries. The monitoring system was placed at selected locations when water conditions were suitable to record fish rearing, holding, or migrating. The system consisted of an underwater video camera attached to a DVR that can record for 6-8 hours at a time. The system was powered by a 12 volt DC battery so the system could be placed anywhere within the basin. The video was reviewed to determine presence or absence and relative numbers of steelhead. If this pilot study is successful, it may be expanded and developed into a more quantitative monitoring tool. This system also was used at the fish ladder entrance during post-storm observations. Underwater video monitoring was not conducted during the 2019 fish passage season.

7.8 *Stranding Surveys*

Stranding surveys were conducted during the reporting period as part of other monitoring and evaluations (i.e., impediment, snorkel, and spawning surveys) and no stranded *O. mykiss* were observed.

8.0 LITERATURE CITED AND BIBLIOGRAPHY

Adams, N. S., D. W. Rondorf, S. D. Evans, and J. E. Kelly. 1998. Effects of surgically and gastrically implanted radio transmitters on growth and feeding behavior of juvenile Chinook salmon. Transaction of the American Fisheries Society, 127:128-136.

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 477-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Ando, D., T. Kitamura, and S. Mizuno. 2005. Quantitative analysis of body silvering during smoltification is masu salmon using chromameter. North American Journal of Aquaculture, 67:160-166.

Banks, J. W. 1969. A review of the literature on the upstream migration of adult salmonids. Journal of Fish Biology, 1:85-136.

Beeman, J. W., and A. G. Maule. 2001. Residence time and diel passage distribution of radio-tagged juvenile spring Chinook salmon and steelhead in a gatewell and fish collection channel of a Columbia River dam. North American Journal of Fisheries Management, 21:455-463.

Beeman, J. W., D. W. Rondorf, M. E. Tilson, and D. A. Venditti. 1995. A nonlethal measure of smolt status of juvenile steelhead based on body morphology. Transactions of the American Fisheries Society 124:764-769.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Bond, M. H., A. A. Hayes, G. V. Hanson, and R. B. MacFarlane. 2008. Marine survival of steelhead (*Oncorhynchus mykiss*) enhanced by a seasonally closed estuary. Canadian Journal of Fisheries and Aquatic Sciences, 65: 2242-2252.

Bratovich, P. M., and D. W. Kelley. 1988. Investigation of salmon and steelhead in Lagunitas Creek, Marin County, California. Volume 1. Migration, spawning, embryo incubation and emergence, juvenile rearing, emigration. Marin Municipal Water District. Corte Madera, California.

Brown, R. S., S. J. Cooke, W. G. Anderson, and R. S. McKinley.1999. Evidence to challenge the “2% rule” for biotelemetry. North American Journal of Fisheries Management, 19:867-871.

Busby, P. B., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. National Marine Fisheries Service. NOAA technical memorandum NMFS-NWFSC-27, August 1996.

Cannata, S. T. 1998. Observations of steelhead trout (*Oncorhynchus mykiss*), coho salmon (*O. kisutch)* and water quality of the Navarro River estuary/lagoon, May 1996 to December 1997. Draft report, Humboldt State University Foundation. Humboldt, CA.

Chapman, D. W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117(1):1-21.

Chrisp, E. Y., and T. C. Bjornn.1978. parr-smolt transformations and seaward migration of wild and hatchery steelhead trout in Idaho. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow, Idaho. Final project report F-49-R.

Clay, H. C. 1995. Design of fishways and other fish facilities, 2nd edition. CRC Press, Inc., Boca Raton, FL.

Cooke, R. U., A. Warren, and A. S. Goudie.1992. Desert geomorphology. UCL Press, London.

CMWD. 2005. 2005 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2006. 2006 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2007. 2007 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2008. 2008 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2009. 2009 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2010. 2010 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2011. 2011 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD, Wood Rogers, and ENTRIX Inc. 2002. Preliminary draft technical memorandum of operation constraint assessment of the Robles Fish Passage Facility. Prepared for US Bureau of Reclamation.

Dauble, D. D., T. L. Page, and W. Hanf.1989. Spatial distribution of juvenile salmonids in the Hanford Reach, Columbia River. Fishery Bulletin, 87:775-790.

Dettman, D. H., and D. W. Kelley.1986. Assessment of the Carmel River steelhead resource, Volume 1.biological investigations. Monterey Peninsula Water Management District, Monterey, CA.

ENTRIX.1999. Evaluations of natural passage barriers on the Ventura River downstream of Robles Diversion. ENTRIX, Walnut Creek, CA.

ENTRIX. 2000. Results of fish passage monitoring at the Vern Freeman diversion facility Santa Clara River, 1994-1998. ENTRIX, Walnut Creek, CA.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 2002. California salmonid stream habitat restoration manual, Volume I, 3rd edition. California Department of Fish and Game. Inland Fisheries Division, Sacramento, CA.

Hagar, J. 1996. Salinas River steelhead status and migration flow requirements. Monterey County Water Resources Agency. Salinas, California.

Haner, P. V., J. C. Faler, R. M. Schrock, D. W. Rondorf, and A. G. Maule. 1995. Skin reflectance as a nonlethal measure of smoltification for juvenile salmonids. North American Journal of Fisheries Management, 15:814-822.

Hockersmith, E. E., W. D. Muir, S. G. Smith, B. P. Sandford, N. S. Adams, J. M. Plumb, R. W. Perry, and D. W. Rondorf. 2000. Comparative performance of sham radio-tagged and PIT-tagged juvenile salmon.US Army Corps of Engineers, Walla Walla District.

Harrison, L. R., E. A. Keller, E. Kelley, and L. A. K. Mertes. 2006. Minimum flow requirements for southern steelhead passage on the lower Santa Clara River, CA. University of California, Santa Barbara.

Hasler, A. D., and A. T. Scholz. 1983. Olfactory imprinting and homing is salmon. Springer-Verlag, New York.

Jepsen, N., L. E. Davis, C. B. Schreck, and B. Siddens. 2001. The physiological response of Chinook salmon smolts to two methods of radio-tagging. Transactions of the American Fisheries Society 130:495-500.

Leopold, L. B., M. G. Wolman, and J. P. Miller. Fluvial processes in geomorphology. W. H. Freeman and Company, San Francisco.

Lewis, S. D. 2001. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2000. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2002. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2001. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2003. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2002. Portland General Electric. Portland, Oregon.

Lewis, S. D., M. W. Gibson, J. L. Switzer, and A. L. Bonsignori. 2016. DRAFT—Verification testing of the Robles Fish Facility Vaki Riverwatcher. Casitas Municipal Water District, Oak View, California.

Lewis, S. D., M. W. Gibson, and J. L. Switzer. 2015. 2016 monitoring and evaluation study plan for the Robles Fish Passage Facility and related studies. Casitas Municipal Water District, Oak View, California.

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

Matthews, K. R., N. H. Berg, D. L. Azuma, and T. R. Lambert. 1994. Cool water formation and trout habitat use in a deep pool in the Sierra Nevada, California. Transactions of the American Fisheries Society, 123:549-564.

Moore. K., K. Jones, and J. Dambacher.2002. Methods for stream habitat surveys, Version 12.1.Oregon Department of Fish and Wildlife, Aquatic Inventories Project, Natural Production Program, Corvallis, OR.

Mosley, M. P. 1982. Critical depths for passage in braided river, Canterbury, New Zealand. New Zealand Journal of Marine and Freshwater Research, Vol. 16:351-357.

National Marine Fisheries Service.1997. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead. Federal Register, 50 CFR Parts 222 and 227 [Docket No. 960730210–7193–02; I.D. 050294D] RIN 0648–XX65. Vol. 62, page 43937.

National Marine Fisheries Service. 2003a. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

National Marine Fisheries Service. 2003b. Endangered and Threatened Species: Range Extension for Endangered Steelhead in Southern California. Federal Register, 50 CFR Part 224 [Docket No. 001025296-2079-02; I.D. 072600A] RIN 0648-AO05. Vol. 67 page 21586.

National Marine Fisheries Service. 2005. Endangered and Threatened Species: Request for Comment on Alternative Approach to Delineating 10 Evolutionarily Significant Units of West Coast Oncorhynchus mykiss. 50 CFR Parts 223 and 224 [Docket No. 040525161–5274–05; I.D. No. 052104F] RIN No. 0648–AR93. Vol. 70 page 67130.

National Marine Fisheries Service. 2009. Letter addressed to Scott Lewis (Casitas Municipal Water District) addressing the downstream fish passage evaluation. Letter dated 28 April 2009, SWR/2002/1871:SCG.

Orcutt, D. R., B. R. Pulliam, and A. Arp. 1968. Characteristics of steelhead trout redds in Idaho streams. Bureau of Commercial Fisheries, Boise, Idaho.

Odeh, M. 2000. Advances in fish passage technology: engineering design and biological evaluation. American Fisheries Society, Bethesda, Maryland.

Quinn, T, H. 2005. The behavior and ecology of pacific salmon and trout. American Fisheries Society, Bethesda, Maryland.

Scott, W. B. and E. J. Crossman.1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa, Bulletin 184.

Shapovalov, L. and A. C. Taft.1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*), with special reference to Waddell Creek, California, and recommendations regarding their management. State of California Department of Fish and Game, fish bulletin No. 98.

Spina, A. P., M. A. Allen, and M. Clarke.2005. Downstream migration, rearing abundance, and pool habitat associations of juvenile steelhead in the lower main stem of a south-central California stream. North American Journal of Fisheries Management, 25:919-930.

Stoecker, M. 2010. North Fork Matilija Creek adult steelhead below Ojai Quarry barriers. Letter sent on 30 March 2010 about adult steelhead observations, 5 p.

Strauss, R. E., and C. E. Bond.1990. Taxonomic methods: In Schreck C. B. and P. B. Moyle, editors. Methods for fish biology. AFS, Bethesda, Maryland.

Summerfelt, R. C., and L. S. Smith.1990. Anesthesia, surgery, and related techniques. Pages 213-272 in C. B. Schreck and P. B. Moyle, editors. Methods for Fish Biology. American Fisheries Society, Bethesda, Maryland.

SYRTAC (Santa Ynez River Technical Advisory Committee). 1999. Adult steelhead passage flow analysis for the Santa Ynez River. Santa Ynez River Consensus Committee, Santa Barbara, CA.

SYRTAC (Santa Ynez River Technical Advisory Committee).2000. Lower Santa Ynez River fish management plan. Santa Ynez River Consensus Committee, Santa Barbara, CA.

Tan, S. S., and T. A. Jones.2006. Geologic map of the Matilija 7.5' quadrangle Ventura County, California: a digital database. Version 1.0, Los Angeles, CA.

Thompson, K. 1972. Determining stream flows for fish life. Pacific Northwest River Basins Commission, instream flow requirements workshop. Portland, Oregon. Proceedings: 31-50.

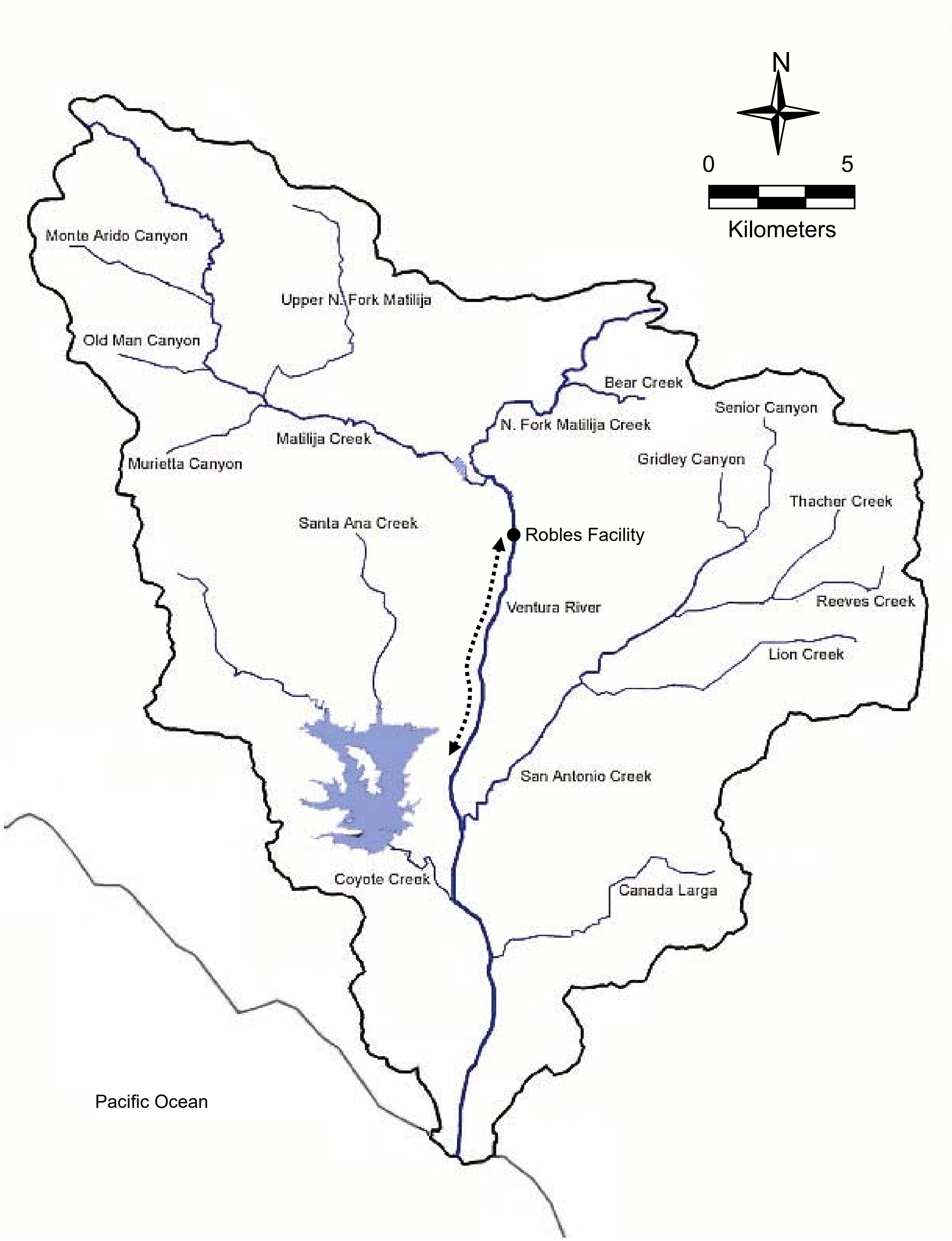
U.S. Bureau of Reclamation. 2003. Revised biological assessment for diversion operations and fish passage facilities at the Robles Diversion, Ventura River, CA. South-Central California Area Office, February 21, 2003.

Vaki.2003. User manual for Riverwatcher. Vaki Aquaculture Systems Ltd., Iceland.

Wagner, H. H., R. L. Wallace, and H. J. Campbell.1963. The seaward migration and return of hatchery-reared steelhead trout, *Salmo gairdneri* Richardson, in the Alsea River, Oregon. Transactions of the American Fisheries Society, 92(3):202-210.

Zimmerman, C. E., and G. H. Reeves. 2000. Population structure of sympatric anadromous and nonanadromous *Oncorhynchus mykiss*: evidence from spawning survey and otolith microchemistry. Canadian Journal of Fisheries and Aquatic Sciences, 57:2152-2162.

9.0 APPENDICES



Appendix 1. Basin map of the Ventura River. The Robles Fish Passage Facility is identified by the black dot and the Robles Reach is identified by the dashed line downstream of the Robles Facility.

Appendix 2. Summary data of current impediment sites for upstream fish migration impediment evaluations.

Site No.	Latitude (N)	Longitude (W)	km	Habitat Type[a]	Site Description	Length (m)	Slope (%)	Percent Substrate[b] SO	SD	GR	CB	BD	BR	Active Channel Width (m)
10-2	34.365265°	119.311082°	11	RI	Near Casitas Springs at bottom of levy	38.2	1.0	0	0	10	70	20	0	44.5
3-2	34.373789°	119.308417°	12	RB	Near Casitas Springs at top of levy	22.0	3.7	10	5	10	65	10	0	27.0
4	34.384743°	119.310030°	14	RI	0.5 km upstream of San Antonio Cr. confluence	23.8	5.0	0	0	0	15	85	0	27.9
5-2	34.396095°	119.309537°	15	RI	0.4 km downstream of Santa Ana Blvd. bridge	8.4	7.0	0	5	5	45	45	0	50.6
6-5	34.411318°	119.301491°	17	CB	1.4 km upstream of Santa Ana Blvd. bridge	26.1	5.0	0	0	0	65	35	0	33.8
9	34.426708°	119.301831°	19	RI	0.2 km upstream of Hwy 150 bridge	67.9	1.5	0	0	0	30	70	0	32.4
7	34.438184°	119.299528°	20	RB	1.1 km upstream of Hwy 150 bridge	31.6	2.0	5	0	10	40	45	0	65.9

[a]The habitat types are: RB = rapid with protruding boulders, RI = riffle, and CB = cascade over boulders.
[b]The substrate types are: SO = silt and organics, SD = sand, GR = gravel, CB = cobble, BD = boulders, and BR = bedrock.

Appendix 3. Completed transects through 2019 at impediment sites for ramp-down target discharges from the Robles Fish Facility.

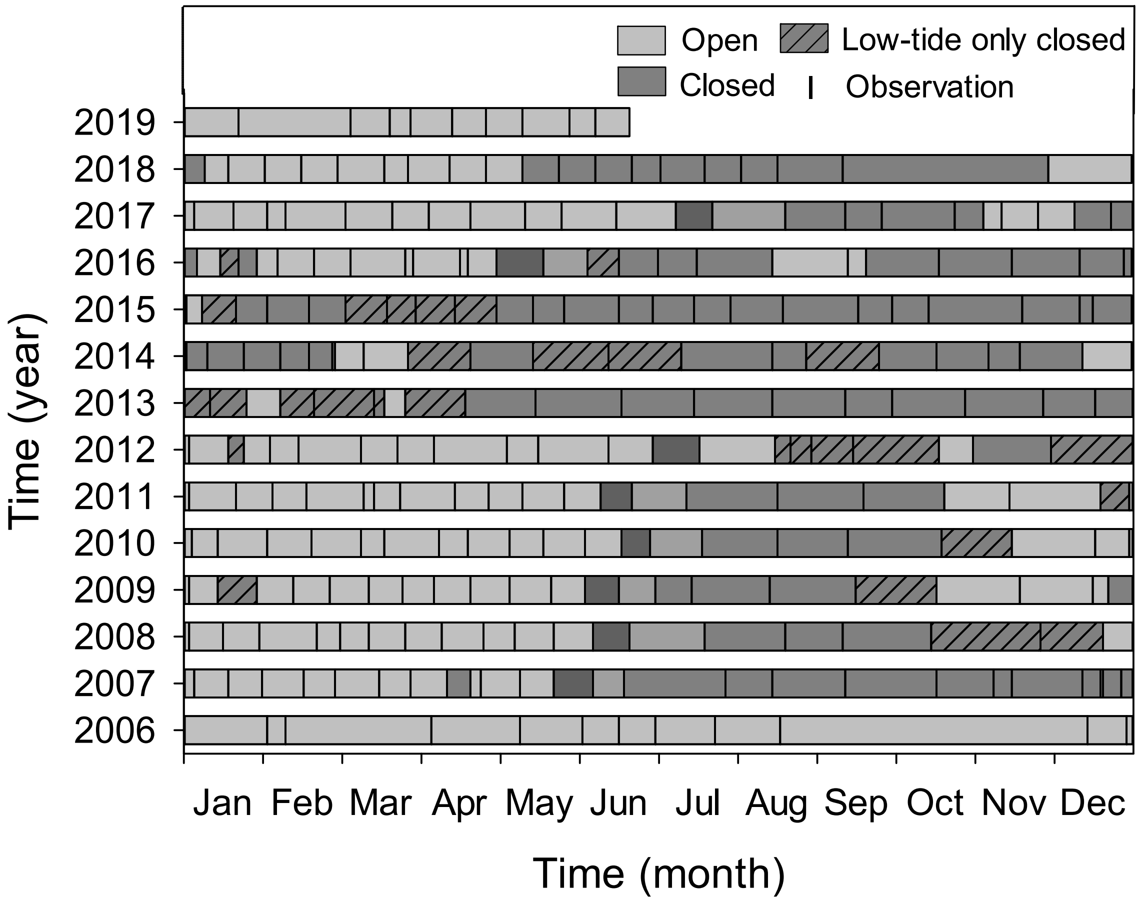
Robles Discharge (cfs)	Impediment Sites								
	3-2	4	5-2	6-2 6-3	6-4 6-5	7	9	10	10-2
171	x		x	x, x			x	x	
100	x	x	x			x	x	x	x
82	x, x	x	x		x	x, x	x, x	x	x
74	x	x	x, x	x, x	x	x	x		x
68	x		x		x	x	x		x
62	x	x, x, x, x	x	x		x	x	x	x
56	x		x	x	x	x	x	dry	x
50	x	x	x	x, x	x	x, x	x	x, x	x
40	x	x, x, x	x, x	x	x	x, x, x	x, x, x	x	x
30	x	x, x	x, x	x	x, x	x, x, x	x, x, x	x, x	x
20	x	x	x		x	x	x		x

Completed transects rounded to nearest Robles discharge (e.g., the four transects measured at Site 4 at 62 cfs ranged from 61-63 cfs) based on mean 2.6 rkm/h lag time and averaging hourly discharge of released water from Robles. Colors correspond to year of survey: x = 2010, x = 2011, x = 2014, x = 2017, x = 2018, and x = 2019 (shaded gray for accent).

Appendix 16. Ventura River sandbar monitoring data from July 2018 through June 2019.

Date	Sandbar Breached (Y/N)	Time (24h)	Tide Height (ft)	Tidal State	High Tide Time (24h)	High Tide Height (ft)	Low Tide Time (24h)	Low Tide Height (ft)	Mean Daily Discharge at Foster[a] (cfs)	Mean Daily Discharge at Robles (cfs)	Notes
07/03/2018	N	13:30	3.57	flood	14:40	3.78	7:47	0.35	0.73	4.0	Estuary closed
07/20/2018	N	11:30	1.70	flood	17:17	5.13	10:29	1.53	0.79	2.0	Estuary closed
08/03/2018	N	9:30	1.60	flood	14:58	4.50	8:10	1.39	0.15	0.7	Estuary closed
08/17/2018	N	10:30	2.29	flood	15:20	4.88	8:37	1.75	0.64	0.4	Estuary closed
09/11/2018	N	10:30	5.36	flood	11:16	5.57	5:08	-0.07	0.53	0.5	Estuary closed
11/29/2018	Y	12:00	3.98	flood	14:05	4.60	8:41	2.82	3.71	19.0	Estuary open west bank
12/31/2018	Y	11:30	0.71	ebb	5:17	5.42	12:21	0.55	2.45	8.0	Estuary open west bank
01/01/2019	Y	10:00	2.34	ebb	5:59	5.07	13:12	0.00	2.45	7.0	Estuary open west bank
01/22/2019	Y	12:30	3.81	ebb	9:35	6.74	16:47	-1.63	83.00	61.0	Open, both banks
03/05/2019	Y	14:48	-0.33	ebb	8:58	5.23	15:42	-0.27	201.00	66.0	Open, both banks
03/20/2019	Y	8:16	5.38	flood	9:33	6.04	3:34	0.32	102.00	31.0	Open, both banks
03/28/2019	Y	14:06	0.97	flood	19:25	3.33	12:05	0.40	77.20	34.0	Open, both banks
04/13/2019	Y	10:45	0.16	ebb	4:17	4.53	12:06	-0.20	44.00	34.0	Estuary open east bank
04/26/2019	Y	9:07	0.98	ebb	2:52	3.92	11:05	0.46	35.60	35.0	Open, both banks
05/10/2018	Y	14:14	2.90	flood	16:35	3.37	9:09	0.24	33.10	28.0	Open, both banks
05/28/2019	Y	13:08	0.99	flood	19:02	4.54	12:23	0.92	28.50	31.0	Open, both banks
06/07/2019	Y	11:42	2.21	flood	14:41	3.67	7:44	-0.79	20.90	21.0	Open, both banks
06/20/2019	Y	8:50	0.62	flood	13:22	3.57	6:40	-0.45	14.00	18.0	Open, both banks

[a]USGS gauging station number 11118500, downstream of Foster Park.



Appendix 17. Sandbar status at the mouth of the Ventura River from 2006 through July of 2019. Each observation is indicated by vertical lines and the sandbar status was assumed to remain unchanged until the next observation.

Appendix 18. Weekly fish attraction counts at the Robles Fish Facility during 2019.

Date	Method	Direction	Length (m)	Temp (°C)	Turbidity (NTU)	Robles Discharge (CFS)	Species[a]	Count
1/4/2019	Bank	Downstream	200	N/A[d]	4	7	NFO	0
1/10/2019	Bank	Upstream	140	N/A[d]	4	7	NFO	0
1/10/2019	Bank	Downstream	200	9	52	12	NFO	0
1/16/2019	Bank	Upstream	140	9	52	12	NFO	0
1/16/2019	Bank	Downstream	200	N/A[d]	470	42	NFO	0
01/22/2019	Bank	Upstream	140	N/A[d]	470	42	NFO	0
01/22/2019	Bank	Downstream	200	N/A[d]	1230	61	NFO	0
01/30/2019	Bank	Upstream	140	N/A[d]	1230	61[c]	NFO	0
01/30/2019	Bank	Downstream	200	N/A[d]	915	32	NFO	0
02/05/2019	Bank	Upstream	140	N/A[d]	915	32	NFO	0
02/05/2019	Bank	Downstream	200	N/A[d]	915	900[b]	NFO	0
02/11/2019	Bank	Upstream	140	N/A[d]	915	900[b]	NFO	0
02/11/2019	Bank	Downstream	200	N/A[d]	158	67[c]	NFO	0
02/13/2019	Bank	Upstream	140	N/A[d]	158	67[c]	NFO	0
02/13/2019	Bank	Downstream	200	N/A[d]	139	56[c]	NFO	0
02/22/2019	Bank	Upstream	140	N/A[d]	139	56[c]	NFO	0
02/22/2019	Bank	Downstream	200	N/A[d]	177	50[c]	NFO	0
02/28/2019	Bank	Upstream	140	N/A[d]	177	50[c]	NFO	0
02/28/2019	Bank	Downstream	200	14	283	33	NFO	0
03/05/2019	Bank	Upstream	140	14	283	33	NFO	0
03/05/2019	Bank	Downstream	200	N/A[d]	908	66	NFO	0
03/13/2019	Bank	Upstream	140	N/A[d]	908	66	NFO	0
03/13/2019	Bank	Downstream	200	11	37.5	67	NFO	0
03/21/2019	Bank	Upstream	140	11	37.5	67	NFO	0
03/21/2019	Bank	Downstream	200	12	10.4	31	NFO	0
03/27/2019	Bank	Upstream	140	12	10.4	31	NFO	0
03/27/2019	Snorkel	Downstream	200	13	5.6	33[c]	NFO	0
04/04/2019	Snorkel	Upstream	140	13	5.6	33[c]	NFO	0
04/04/2019	Bank	Downstream	200	15	6.06	33[c]	NFO	0
04/09/2019	Bank	Upstream	140	15	6.06	33[c]	NFO	0
04/09/2019	Snorkel	Downstream	200	16	7.4	35[c]	NFO	0
04/10/2019	Snorkel	Upstream	140	16	7.4	35[c]	NFO	0
04/10/2019	Bank	Downstream	200	14	8.39	35[c]	NFO	0
04/19/2019	Bank	Upstream	140	14	8.39	35[c]	NFO	0
04/19/2019	Bank	Downstream	200	20.2	5.18	35[c]	NFO	0
05/17/2019	Bank	Upstream	140	20.2	5.18	35[c]	NFO	0
05/17/2019	Bank	Downstream	200	18.6	1.77	30	NFO	0
05/30/2019	Bank	Upstream	140	18.6	1.77	30	NFO	0
05/30/2019	Snorkel	Downstream	200	19	1.59	30	NFO	0
06/05/2019	Snorkel	Upstream	140	19	1.59	30	NFO	0
06/05/2019	Bank	Downstream	200	17.2	1.18	27	NFO	0
06/13/2019	Bank	Upstream	140	17.2	1.18	27	NFO	0
06/13/2019	Bank	Downstream	200	19.4	5.7	18	NFO	0
06/27/2019	Bank	Upstream	140	19.4	5.7	18	NFO	0
06/27/2019	Snorkel	Downstream	200	19	7.57	17	NFO	0
		Upstream	3,220 m				Upstream	0
		Downstream	4,600 m				Downstream	0
		Total	7,820 m				Total	0

[a]OMY = *O. mykiss* and NFO = no fish observed.
[b] Weir impacted by sediment/periods of spill exceeded accuracy of rating table, discharge estimated.
[c] VRNMO Weir impacted by sediment, discharge estimated. [d] Equipment damaged in storm, data lost.

Appendix 19. Post-storm fish attraction counts of *O. mykiss* at the Robles Fish Facility for 2019 Storm Events.

Date	Time	Method	Location	Temp (°C)[a]	Turbidity (NTU)[a]	Robles Discharge (CFS)[a]	Species[b]	Count
01/16/2019	15:58	Bank	Entrance Pool	N/A[e]	687	42	NFO	0
01/17/2019	12:30	Bank	Entrance Pool	N/A[e]	10,104	2,700[c]	NFO	0
01/18/2019	13:30	Bank	Entrance Pool	N/A[e]	520	82[d]	NFO	0
01/19/2019	12:00	Bank	Entrance Pool	N/A[e]	982	80[d]	NFO	0
01/20/2019	9:30	Bank	Entrance Pool	N/A[e]	1,057	74[d]	NFO	0
01/21/2019	11:30	Bank	Entrance Pool	N/A[e]	1,149	69[d]	NFO	0
01/22/2019	10:23	Bank	Entrance Pool	N/A[e]	1,230	61[d]	NFO	0
01/23/2019	10:03	Bank	Entrance Pool	N/A[e]	1,000	56[d]	NFO	0
01/24/2019	11:02	Bank	Entrance Pool	N/A[e]	1,492	53[d]	NFO	0
01/25/2019	14:00	Bank	Entrance Pool	N/A[e]	945	51[d]	NFO	0
01/26/2019	15:40	Bank	Entrance Pool	N/A[e]	1,028	52	NFO	0
01/27/2019	9:15	Bank	Entrance Pool	N/A[e]	1,084	49	NFO	0
01/28/2019	11:05	Bank	Entrance Pool	N/A[e]	1,170	44	NFO	0
01/29/2019	11:15	Bank	Entrance Pool	N/A[e]	1,042	36	NFO	0
02/01/2019	14:15	Bank	Entrance Pool	N/A[e]	885	39	NFO	0
02/03/2019	11:00	Bank	Entrance Pool	N/A[e]	3,756	2,300[c]	NFO	0
02/04/2019	14:40	Bank	Entrance Pool	N/A[e]	2,696	1,700[c]	NFO	0
02/05/2019	15:40	Bank	Entrance Pool	N/A[e]	915	900[c]	NFO	0
02/06/2019	11:00	Bank	Entrance Pool	N/A[e]	818	2,110[c]	NFO	0
02/07/2019	16:00	Bank	Entrance Pool	N/A[e]	847	600[c]	NFO	0
02/08/2019	7:10	Bank	Entrance Pool	N/A[e]	511	600[c]	NFO	0
02/09/2019	12:30	Bank	Entrance Pool	N/A[e]	470	700[c]	NFO	0
02/10/2019	15:38	Bank	Entrance Pool	N/A[e]	320	400[c]	NFO	0
02/11/2019	11:30	Bank	Entrance Pool	N/A[e]	192	67[d]	NFO	0
02/12/2019	11:40	Bank	Entrance Pool	N/A[e]	157	59[d]	NFO	0
02/13/2019	15:16	Bank	Entrance Pool	N/A[e]	137	56[d]	NFO	0
02/14/2019	13:45	Bank	Entrance Pool	N/A[e]	8,544	2,000[c]	NFO	0
02/15/2019	13:00	Bank	Entrance Pool	N/A[e]	812	200[c]	NFO	0
02/16/2019	9:15	Bank	Entrance Pool	N/A[e]	617	78[d]	NFO	0
02/17/2019	12:02	Bank	Entrance Pool	N/A[e]	354	67[d]	NFO	0
02/18/2019	10:15	Bank	Entrance Pool	N/A[e]	281	60[d]	NFO	0
02/19/2019	11:26	Bank	Entrance Pool	N/A[e]	200	56[d]	NFO	0
02/20/2019	15:11	Bank	Entrance Pool	N/A[e]	138	49[d]	NFO	0
02/21/2019	11:45	Bank	Entrance Pool	10.82	124	50[d]	NFO	0
02/22/2019	12:50	Bank	Entrance Pool	N/A[e]	202	50[d]	NFO	0
02/23/2019	12:00	Bank	Entrance Pool	N/A[e]	76	43[d]	NFO	0
02/24/2019	11:50	Bank	Entrance Pool	11.6	55	32[d]	NFO	0
03/03/2019	13:01	Bank	Entrance Pool	N/A[e]	470	57	NFO	0

Appendix 19 cont.

Date	Time	Method	Location	Temp (°C)[a]	Turbidity (NTU)[a]	Robles Discharge (CFS)[a]	Species[b]	Count
03/04/2019	14:00	Bank	Entrance Pool	N/A[e]	170	76	NFO	0
03/05/2019	10:30	Bank	Entrance Pool	N/A[e]	926	66	NFO	0
03/06/2019	14:20	Bank	Entrance Pool	N/A[e]	999	430	NFO	0
03/08/2019	10:15	Bank	Entrance Pool	N/A[e]	230	89	NFO	0
03/09/2019	10:30	Bank	Entrance Pool	N/A[e]	162	82	NFO	0
03/10/2019	11:11	Bank	Entrance Pool	N/A[e]	106	83	NFO	0
03/11/2019	9:00	Bank	Entrance Pool	10	83	77	NFO	0
03/12/2019	10:58	Bank	Entrance Pool	N/A[e]	49	77	NFO	0
03/13/2019	10:00	Bank	Entrance Pool	10.8	38	67	NFO	0
03/14/2019	12:15	Bank	Entrance Pool	N/A[e]	33	62	NFO	0
03/15/2019	13:40	Bank	Entrance Pool	N/A[e]	29	55	NFO	0
03/16/2019	9:47	Bank	Entrance Pool	N/A[e]	26	49	NFO	0
03/17/2019	9:15	Bank	Entrance Pool	12.2	22	42	NFO	0
03/18/2019	11:40	Bank	Entrance Pool	15	17	32	NFO	0

[a]Environmental conditions at time of survey.
[b]OMY = *O. mykiss* and NFO = no fish observed.
[c] Weir impacted by sediment/periods of spill exceeded accuracy of rating table, discharge estimated.
[d] VRNMO Weir impacted by sediment, discharge estimated.
[e] Equipment damaged in storm, data lost

Appendix 20. Monthly flow summary for Robles Fish Facility, reporting year 2018-2019.

Annual Flow Summary - Robles Fish Passage Facility
BO reporting period 2018 - 2019

	*				**			
	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)
	Source Stream Daily Flows				Robles Facility Daily Flows			
	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck.* (cfsd)	Sum of Creek Flows (cfsd)		Fishway Ladder (cfsd)	VRNMO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)
Jul-18	67	50	118		76	62	0	62
Aug-18	53	32	85		35	18	0	18
Sep-18	43	143	143		30	15	0	15
Oct-18	45	472	517		1	1	0	1
Nov-18	281	447	728		76	70	71	140
Dec-18	336	465	801		218	273	25	298
Jan-19	2866	1284	4150		856	3848	884	4732
Feb-19	7909	2304	10213		1049	12936	4290	17226
Mar-19	4595	1143	5738		1220	2036	4093	6129
Apr-19	1397	336	1733		1020	1020	768	1788
May-19	780	292	1071		1038.044	905.009	397	1302
Jun-19	417	287	705		636.206	602.727	0	603
Total	18790	7254	26001		6255	21784	10529	32313

* Preliminary flow information provided by the Ventura County Watershed Protection District. North Fork Data is estimated. To be confirmed by VCWPD. Refer to the Operations section of the Report to

** Sontek-IQ became operational in November of 2014.

Ventura River Flow Assessment
Reporting Year 2018 -2019

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				**Robles Facility Mean Daily Flows**			
Jul-18	Matilija Ck D/S Dam* (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	*3*	*3*	6	20	3	4	0	4
2	*3*	*3*	6	20	3	4	0	4
3	*3*	*3*	5	20	3	4	0	4
4	*3*	*2*	5	20	3	4	0	4
5	*3*	*2*	5	20	3	4	0	4
6	*3*	*2*	5	20	3	3	0	3
7	*3*	*2*	5	20	3	3	0	3
8	*3*	*2*	5	20	3	3	0	3
9	*3*	*2*	5	20	3	3	0	3
10	*3*	*2*	4	20	2	1	0	1
11	*2*	*2*	4	20	2	1	0	1
12	*2*	*2*	4	20	3	2	0	2
13	*2*	*2*	4	20	2	1	0	1
14	*2*	*2*	4	20	2	1	0	1
15	*2*	*1*	4	20	3	2	0	2
16	*2*	*1*	3	20	3	4	0	4
17	*2*	*1*	3	20	3	2	0	2
18	*2*	*1*	3	20	3	2	0	2
19	*2*	*1*	3	20	3	2	0	2
20	*2*	*1*	3	20	3	2	0	2
21	*2*	*1*	3	20	3	1	0	1
22	*2*	*1*	3	20	3	2	0	2
23	*2*	*1*	3	20	2	1	0	1
24	*2*	*1*	3	20	2	1	0	1
25	*2*	*1*	3	20	1	0.7	0	1
26	*2*	*1*	3	20	1	0.7	0	1
27	*2*	*1*	3	20	1	0.8	0	1
28	*2*	*1*	3	20	2	0.9	0	1
29	*2*	*1*	3	20	2	1	0	1
30	*2*	*1*	3	20	2	0.9	0	1
31	*2*	*1*	3	20	2	0.8	0	1
Totals	67	50	118	620	76	62	0	62

*Flow data from Matilija Ck and North Fork Malija Ck are preliminary and subject to change (VCWPD). *Discharge Estimated*

Ventura River Flow Assessment
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	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
Aug-18	Matilija Ck D/S Dam (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	*2*	*1*	3	20	2	0.7	0	1
2	*2*	*1*	3	20	2	0.7	0	1
3	*2*	*1*	3	20	2	0.7	0	1
4	*2*	*1*	3	20	2	0.7	0	1
5	*2*	*1*	3	20	2	0.7	0	1
6	*2*	*1*	3	20	2	0.6	0	1
7	*2*	*1*	3	20	2	0.4	0	0.4
8	*2*	*1*	3	20	1	0.4	0	0.4
9	*2*	*1*	3	20	0.6	0.4	0	0.4
10	*2*	*1*	3	20	0.4	0.5	0	0.5
11	*2*	*1*	3	20	0.3	0.5	0	0.5
12	*2*	*1*	3	20	0.4	0.5	0	0.5
13	*2*	*1*	3	20	0.4	0.5	0	0.5
14	*2*	*1*	3	20	0.4	0.5	0	0.5
15	*2*	*1*	3	20	0.5	0.5	0	0.5
16	2	*1*	3	20	0.4	0.5	0	0.5
17	2	*1*	3	20	0.4	0.4	0	0.4
18	2	*1*	3	20	0.5	0.5	0	1
19	2	*1*	3	20	1	0.6	0	1
20	2	*1*	3	20	0.5	0.5	0	1
21	2	*1*	3	20	0.5	0.5	0	1
22	2	*1*	3	20	0.7	0.6	0	1
23	2	*1*	3	20	0.6	0.5	0	1
24	2	*1*	3	20	1	0.6	0	1
25	3	*1*	3	20	2	1	0	1
26	2	*1*	3	20	2	0.8	0	1
27	2	*1*	3	20	2	0.7	0	1
28	2	*1*	3	20	2	0.7	0	1
29	2	*1*	3	20	2	0.7	0	1
30	2	*1*	3	20	1	0.6	0	1
31	2	*0.9*	3	20	1	0.6	0	1
Totals	53	32	85	620	35	18	0	18

*Flow data from Matilija Ck and North Fork Malija Ck are preliminary and subject to change (VCWPD). *Discharge Estimated*

Ventura River Flow Assessment
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Sep-18	(1) Matilija Ck D/S Dam* (cfs)	(2) North Fork Matilija Ck.* (cfs)	(1) + (2) Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	(3) Fishway Ladder (cfs)	(4) VRNMO Weir (cfs)	(5) Diversion Canal (cfs)	(4) + (5) Total Inflow (cfs)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
1	2	0.9	2	20	1	0.6	0	1
2	2	0.9	2	20	1	0.6	0	1
3	2	0.9	3	20	1	0.7	0	1
4	2	0.9	3	20	2	0.8	0	1
5	2	0.9	3	20	2	0.7	0	1
6	2	0.9	3	20	2	0.8	0	1
7	2	0.9	3	20	2	0.7	0	1
8	2	0.9	3	20	1	0.6	0	1
9	1	0.9	2	20	1	0.5	0	1
10	1	0.9	2	20	1	0.5	0	1
11	1	0.9	2	20	1	0.5	0	1
12	2	0.9	2	20	1	0.6	0	1
13	2	0.9	2	20	1	0.6	0	1
14	1	0.9	2	20	1	0.6	0	1
15	1	0.9	2	20	0.9	0.5	0	1
16	1	0.9	2	20	0.8	0.4	0	0.4
17	1	0.9	2	20	0.7	0.3	0	0.3
18	1	0.9	2	20	0.6	0.3	0	0.3
19	1	0.9	2	20	0.6	0.3	0	0.3
20	1	0.9	2	20	0.8	0.3	0	0.3
21	1	0.9	2	20	0.6	0.3	0	0.3
22	1	0.9	2	20	0.6	0.3	0	0.3
23	1	0.9	2	20	0.9	0.4	0	0.4
24	1	0.9	2	20	0.9	0.4	0	0.4
25	1	13	14	20	0.9	0.4	0	0.4
26	2	13	15	20	1	0.5	0	0.5
27	1	13	14	20	0.9	0.4	0	0.4
28	1	13	14	20	1	0.4	0	0.4
29	1	13	14	20	1	0.5	0	0.5
30	1	13	14	20	1	0.5	0	0.5
Totals	43	100	143	600	30	15	0	15

*Flow data from Matilija Ck and North Fork Malija Ck are preliminary and subject to change (VCWPD). *Discharge Estimated*

Ventura River Flow Assessment
Reporting Year 2018 -2019

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				**Robles Facility Mean Daily Flows**			
Oct-18	Matilija Ck D/S Dam* (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	1	13	14	20	1	0.5	0	1
2	1	13	14	20	1	0.6	0	1
3	1	13	14	20	1	0.6	0	1
4	2	14	16	20	2	0.7	0	1
5	2	14	16	20	2	1	0	1
6	2	14	16	20	2	0.8	0	1
7	1	14	15	20	2	0.7	0	1
8	1	14	15	20	1	0.6	0	1
9	2	15	17	20	2	0.7	0	1
10	2	15	17	20	2	0.8	0	1
11	2	15	17	20	2	0.8	0	1
12	2	15	17	20	1	0.7	0	1
13	2	15	17	20	2	0.9	0	1
14	2	15	17	20	2	0.9	0	1
15	2	15	17	20	1	0.7	0	1
16	1	15	16	20	0.9	0.5	0	1
17	1	15	16	20	0.9	0.5	0	0.5
18	1	16	17	20	0.9	0.5	0	0.5
19	1	16	17	20	1	0.5	0	1
20	1	16	17	20	1	0.5	0	0.5
21	1	16	17	20	1	0.5	0	1
22	2	16	18	20	2	0.9	0	1
23	2	16	18	20	1	0.7	0	1
24	2	16	18	20	1	0.6	0	1
25	1	16	17	20	1	0.6	0	1
26	1	16	17	20	0.6	0.4	0	0.4
27	1	17	18	20	0.8	0.5	0	1
28	1	17	18	20	1	0.6	0	1
29	1	17	18	20	1	0.6	0	1
30	2	17	19	20	2	1	0	1
31	1	16	17	20	1	0.7	0	1
Totals	45	472	517	620	41	21	0	21

*Flow data from Matilija Creek and North Fork Malija Creek are preliminary and subject to change (VCWPD).

Ventura River Flow Assessment
Reporting Year 2018 -2019

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
Nov-18	Matilija Ck D/S Dam** (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	1	16	17	20	0.5	0.4	0	0.4
2	1	16	17	20	0.5	0.1	0	0.1
3	2	16	18	20	0.8	0.2	0	0.2
4	1	16	17	20	2	1	0	1
5	1	16	17	20	0.6	0.5	0	0.5
6	1	16	17	20	0.9	0.5	0	1
7	2	16	18	20	1	0.6	0	1
8	2	16	18	20	1	0.7	0	1
9	1	15	16	20	0.4	0.4	0	0.4
10		15	15	20	0.5	0.5	0	0.5
11		15	15	20	1	0.7	0	1
12		14	14	20	2	1.5	0	1
13		14	14	20	0.8	0.6	0	1
14		14	14	20	0.8	0.5	0	1
15		14	14	20	1	0.7	0	1
16		14	14	20	1	0.9	0	1
17		14	14	20	2	1	0	1
18		15	15	20	2	1	0	1
19		15	15	20	2	1	0	1
20		15	15	20	2	1	0	1
21	5	15	20	20	2	1	0	1
22	8	14	22	20	5	7	0	7
23	6	14	20	20	3	4	0	4
24	7	14	21	20	2	1	0	1
25	7	15	22	20	2	1	0	1
26	7	15	22	20	2	1	0	1
27	8	14	22	20	2	1	0	1
28	7	14	21	20	3	2	0	2
29	178	16	194	20	17	19	65	84
30	38	14	52	20	15	17	6	23
Totals	281	447	728	600	76	70	71	140

*Flow data from Matilija Creek and North Fork Malija Creek are preliminary and subject to change (VCWPD).

**Flow data from 11/10/19 to 11/20/19 not available from VCWPD at this time. CMWD bubbler repaired 11/21/19

Ventura River Flow Assessment
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	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
Dec-18	Matilija Ck D/S Dam (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	16	14	30	20	9	11	0	11
2	13	14	27	20	7	10	0	10
3	11	14	25	20	6	8	0	8
4	11	14	25	20	6	8	0	8
5	16	14	30	20	7	9	0	9
6	88	16	104	20	20	18	25	43
7	26	15	41	20	14	16	0.1	16
8	18	15	33	20	9	12	0	12
9	14	15	29	20	8	11	0	11
10	13	15	28	20	8	10	0	10
11	10	15	25	20	7	9	0	9
12	8	15	23	20	7	9	0	9
13	6	15	21	20	6	9	0	9
14	5	15	20	20	6	8	0	8
15	5	15	20	20	6	8	0	8
16	5	15	20	20	6	8	0	8
17	6	15	21	20	6	8	0	8
18	7	15	22	20	6	8	0	8
19	6	15	21	20	6	8	0	8
20	5	15	20	20	6	8	0	8
21	5	15	20	20	6	8	0	8
22	5	15	20	20	6	8	0	8
23	5	15	20	20	6	8	0	8
24	4	15	19	20	6	7	0	7
25	4	15	19	20	5	7	0	7
26	4	15	19	20	5	7	0	7
27	4	15	19	20	5	6	0	6
28	5	16	21	20	6	7	0	7
29	4	16	20	20	5	6	0	6
30	5	16	21	20	6	7	0	7
31	5	16	21	20	7	8	0	8
Totals	336	465	801	620	218	273	25	298

*Flow data from Matilija Creek and North Fork Malija Creek are preliminary and subject to change (VCWPD).

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	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
Jan-19	Matilija Ck D/S Dam (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow** (cfs)
1	4	16	20	20	5	7	0	7
2	4	16	20	20	6	7	0	7
3	4	16	20	20	6	7	0	7
4	4	16	20	20	6	7	0	7
5	10	16	26	20	9	10	0	10
6	12	16	28	20	16	17	0	17
7	33	16	49	20	24	22	11	33
8	9	16	25	20	13	15	0	15
9	8	16	24	20	10	13	0	13
10	7	16	23	20	10	12	0	12
11	7	16	23	20	9	11	0	11
12	54	18	72	20	22	21	29	51
13	20	16	36	20	21	20	6	26
14	44	16	60	20	23	21	17	39
15	216	44	260	20	28	124	117	241
16	176	37	213	50	39	42	152	194
17	1353	*576*	1929	50	31	2700	144	2844
18	225	*46*	271	82	40	82	218	300
19	111	31	142	74	44	80	62	143
20	81	30	111	68	43	74	26	101
21	65	32	97	62	43	69	13	82
22	56	35	91	56	43	61	9	70
23	48	35	83	56	44	56	7	63
24	43	27	70	50	45	53	4	56
25	39	21	60	50	48	51	1	52
26	35	21	56	50	46	52	0	52
27	33	20	53	50	43	49	0	49
28	31	21	52	40	40	44	2	46
29	29	21	50	30	36	36	6	42
30	27	21	48	30	31	32	8	40
31	76	40	116	30	31	52	50	102
Totals	2866	1284	4150	1128	856	3848	884	4732

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD). *Noted by VCWPD as estimated.*

**Total Inflow does not include flow bypassing facility via overtopping cut-off wall.

Fishway flow meter malfunction. Discharge estimated.

Weir heavily impacted by sediment or periods of spill exceeded reliable accuracy of rating table, discharge estimate

Peak flow met BO definition of potential migration event.

Represents change on date dictated by storm flow augmentation ramp-down schedule.

VRNMO Weir impacted by sediment. Discharge estimated.

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Feb-19	(1) Matilija Ck D/S Dam (cfs)	(2) North Fork Matilija Ck.* (cfs)	(1) + (2) Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	(3) Fishway Ladder (cfs)	(4) VRNMO Weir (cfs)	(5) Diversion Canal (cfs)	(4) + (5) Total Inflow** (cfs)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
1	38	44	82	50	43	39	13	52
2	1245	406	1651	50	36	2500	115	2615
3	770	301	1071	50	35	2300	225	2525
4	683	*263*	946	50	44	1700	331	2031
5	429	*95*	524	50	41	900	292	1192
6	285	*65*	350	171	50	210	293	503
7	216	*57*	273	100	14	600	68	668
8	177	*47*	224	82	0	600	0	600
9	161	*40*	201	74	0	700	0	700
10	143	*33*	176	68	24	400	56	456
11	126	*29*	155	62	50	67	97	164
12	113	*25*	138	56	49	59	85	144
13	117	*25*	142	56	48	56	94	150
14	743	258	1001	50	43	2000	276	2276
15	478	*121*	599	100	46	200	410	610
16	326	*78*	404	74	45	78	298	376
17	282	*56*	338	61	48	67	246	313
18	218	*45*	263	54	49	60	204	264
19	194	*40*	234	50	49	56	172	228
20	175	*35*	210	50	49	49	158	207
21	153	*34*	187	50	50	50	139	188
22	140	*32*	172	50	50	50	119	169
23	131	*31*	162	40	43	43	110	153
24	120	*30*	150	30	32	32	106	139
25	112	*29*	141	30	27	27	101	128
26	106	*29*	135	30	27	27	93	120
27	110	*28*	138	30	30	32	90	123
28	119	*28*	147	30	27	33	100	133
Totals	7909	2304	10213	1648	1049	12936	4290	17226

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD). *Noted by VCWPD as estimated.*

**Total Inflow does not include flow bypassing facility via overtopping cut-off wall.

- Fishway flow meter malfunction. Discharge estimated.
- Weir heavily impacted by sediment or periods of spill exceeded reliable accuracy of rating table, discharge estimate
- Peak flow met BO definition of potential migration event.
- Represents change on date dictated by storm flow augmentation ramp-down schedule.
- VRNMO Weir impacted by sediment. Discharge estimated.

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	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
Mar-19	Matilija Ck D/S Dam (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow** (cfs)
1	94	*30*	124	30	29	34	80	114
2	218	*33*	251	30	37	48	245	293
3	172	*35*	207	68	43	57	173	230
4	191	*45*	236	62	49	76	158	233
5	145	*72*	217	56	50	66	115	181
6	396	*140*	536	56	47	430	354	784
7	329	*107*	436	90	49	102	387	489
8	265	*76*	341	70	48	89	280	369
9	232	*58*	290	82	49	82	228	310
10	212	*50*	262	74	49	83	194	276
11	187	*44*	231	68	46	77	170	248
12	170	*38*	208	62	46	77	147	224
13	157	*35*	192	56	48	67	134	200
14	150	*31*	181	56	49	62	121	183
15	140	28	168	50	50	55	115	170
16	130	27	157	50	50	49	110	159
17	123	26	149	40	43	42	108	150
18	117	25	142	30	32	32	108	140
19	112	23	135	30	37	36	99	135
20	113	23	136	30	35	31	103	134
21	105	*22*	127	30	34	31	94	125
22	99	*21*	120	30	33	31	85	116
23	95	*20*	115	30	33	31	82	113
24	91	*19*	110	30	33	31	76	107
25	87	*18*	105	30	11	83	23	106
26	85	*18*	103	30	19	66	31	97
27	82	*17*	99	30	34	33	63	96
28	78	*17*	95	30	34	34	58	92
29	75	*16*	91	30	34	34	55	89
30	73	*15*	88	30	34	34	51	85
31	70	*14*	84	30	34	34	48	82
Totals	4595	1143	5738	1420	1220	2036	4093	6129

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD). *Noted by VCWPD as estimated.*

**Total Inflow does not include flow bypassing facility via overtopping cut-off wall.

Fishway flow meter malfunction. Discharge estimated.

Weir heavily impacted by sediment or periods of spill exceeded reliable accuracy of rating table, discharge estimatec

Peak flow met BO definition of potential migration event.

Represents change on date dictated by storm flow augmentation ramp-down schedule.

VRNMO Weir impacted by sediment. Discharge estimated.

Ventura River Flow Assessment
Reporting Year 2018 -2019

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				**Robles Facility Mean Daily Flows**			
Apr-19	Matilija Ck D/S Dam (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	67	*14*	81	30	34	34	46	80
2	65	*14*	79	30	34	34	45	79
3	64	*13*	77	30	34	34	44	78
4	62	*13*	75	30	33	33	42	75
5	60	*13*	73	30	33	33	40	73
6	58	*13*	71	30	33	33	37	70
7	56	*12*	68	30	34	34	34	68
8	54	*12*	66	30	35	35	31	65
9	53	*12*	65	30	35	35	30	65
10	51	*12*	63	30	35	35	32	66
11	49	*11*	60	30	34	34	31	65
12	47	*11*	58	30	34	34	29	63
13	46	*11*	57	30	34	34	26	60
14	43	*11*	54	30	35	35	23	58
15	41	*11*	52	30	34	34	23	57
16	41	*11*	52	30	34	34	23	57
17	41	*11*	52	30	33	33	21	55
18	40	*11*	51	30	34	34	19	53
19	41	*10*	51	30	35	35	18	52
20	43	*10*	53	30	34	34	20	54
21	42	*10*	52	30	34	34	18	52
22	41	*10*	51	30	34	34	17	50
23	40	*10*	50	30	35	35	14	49
24	38	*10*	48	30	34	34	14	48
25	35	*10*	45	30	34	34	13	47
26	35	*10*	45	30	35	35	13	47
27	35	*10*	45	30	34	34	15	49
28	36	*10*	46	30	34	34	15	49
29	37	*10*	47	30	34	34	17	50
30	37	*10*	47	30	33	33	19	52
Totals	1397	336	1733	900	1020	1020	768	1788

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD). *Noted by VCWPD as estimated.*

Fishway flow meter malfunction. Discharge estimated.

VRNMO Weir impacted by sediment. Discharge estimated.

Ventura River Flow Assessment
Reporting Year 2018 -2019

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
May-19	Matilija Ck D/S Dam (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	35	*10*	44	30	33	33	14	48
2	30	*10*	40	30	34	34	12	46
3	29	*10*	39	30	33	33	11	44
4	29	9	38	30	33	33	10	44
5	29	9	38	30	34	34	10	44
6	30	10	40	30	34	31	12	43
7	29	10	39	30	33	29	14	43
8	29	10	38	30	33	28	15	43
9	28	10	37	30	33	28	14	42
10	28	10	38	30	33	28	15	43
11	27	9	36	30	33	27	14	41
12	25	9	35	30	34	27	13	39
13	25	9	34	30	34	27	10	38
14	24	9	33	30	34	27	8	35
15	23	9	33	30	34	27	9	36
16	35	11	46	30	34	29	35	64
17	23	10	33	30	34	30	10	39
18	22	10	31	30	34	28	11	39
19	32	10	42	30	33	26	41	67
20	24	10	34	30	34	27	25	52
21	21	9	31	30	34	28	15	43
22	21	9	30	30	34	28	11	39
23	22	9	31	30	34	27	13	40
24	21	9	30	30	33	27	14	41
25	20	9	29	30	34	28	9	36
26	22	9	31	30	34	30	9	39
27	22	9	31	30	34	28	15	43
28	21	9	30	30	34	31	5	36
29	19	9	28	30	33	31	0	31
30	17	9	26	30	33	30	2	32
31	17	9	26	30	30	31	0	31
Totals	780	292	1071	930	1038	905	397	1302

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD). *Noted by VCWPD as estimated.*

Fishway flow meter malfunction. Discharge estimated.

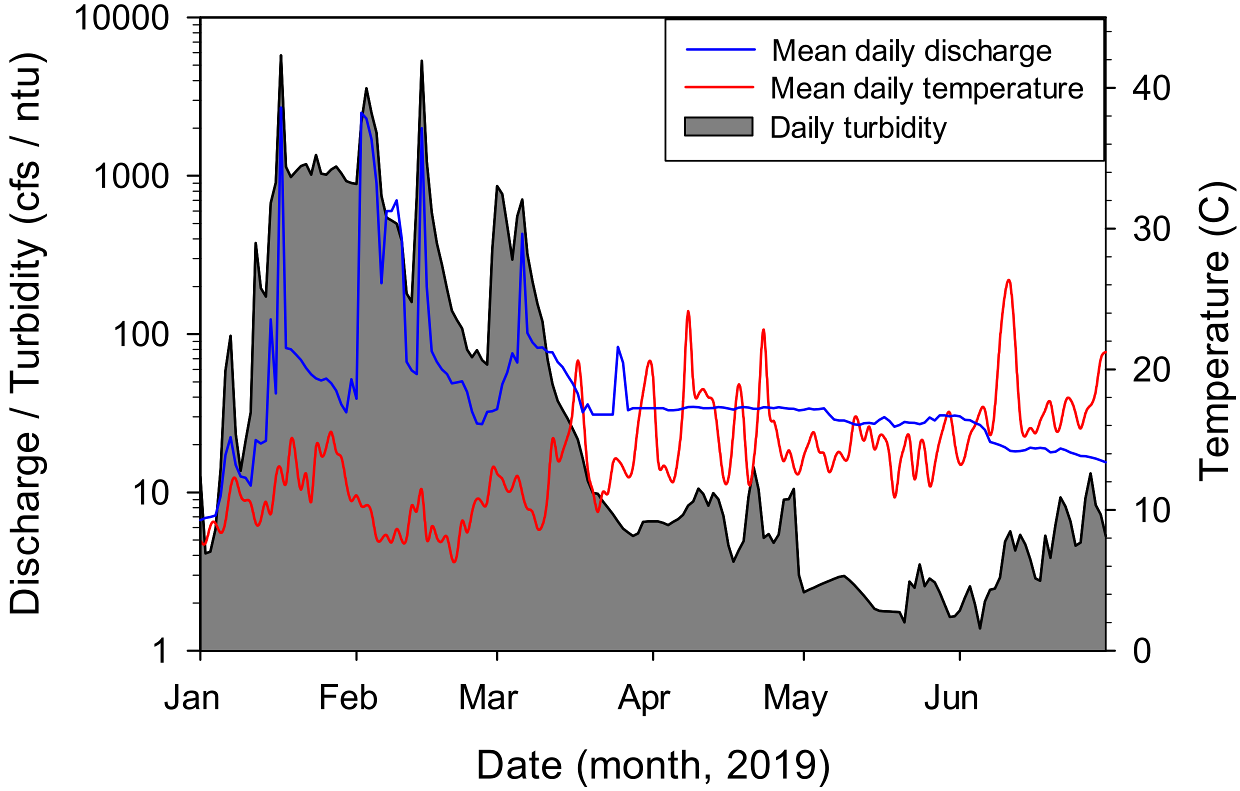
VRNMO Weir impacted by sediment. Discharge estimated.

Ventura River Flow Assessment
Reporting Year 2018 -2019

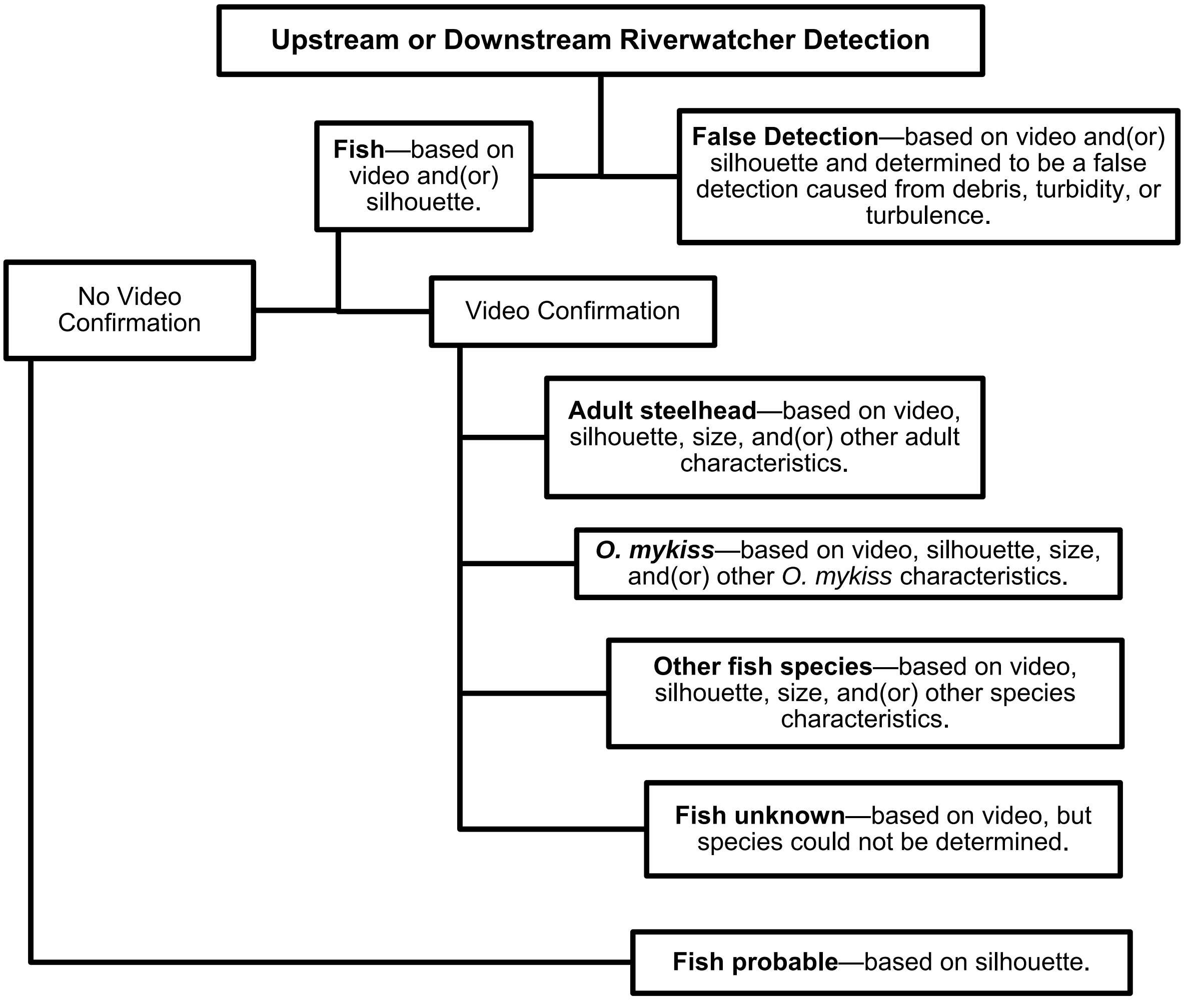
	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				**Robles Facility Mean Daily Flows**			
Jun-19	Matilija Ck D/S Dam (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	18	9	27	30	29	30	0	30
2	18	9	28	30	31	29	0	29
3	18	9	28	30	31	29	0.3	29
4	17	10	27	30	29	27	0	27
5	16	10	26	30	27	27	0	27
6	15	10	25	30	26	25	0	25
7	15	9	25	30	25	21	0	21
8	15	9	24	30	24	20	0	20
9	14	9	24	30	22	20	0	20
10	13	9	23	30	21	19	0	19
11	13	9	22	30	19	18	0	18
12	12	9	22	30	19	18	0	18
13	13	9	22	30	19	18	0	18
14	13	9	23	30	19	18	0	18
15	14	9	23	30	20	19	0	19
16	14	9	23	30	20	19	0	19
17	14	9	23	30	20	19	0	19
18	13	10	23	30	20	19	0	19
19	13	10	23	30	18	18	0	18
20	13	10	23	30	18	18	0	18
21	14	10	24	30	19	19	0	19
22	14	10	23	30	19	19	0	19
23	13	10	23	30	19	18	0	18
24	13	10	22	30	18	17	0	17
25	13	10	23	30	18	17	0	17
26	13	10	23	30	18	17	0	17
27	12	10	22	30	18	17	0	17
28	12	10	22	30	17	16	0	16
29	11	10	21	30	16	16	0	16
30	11	10	21	30	16	15	0	15
Totals	417	287	705	900	636	603	0.3	603

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD). *Noted by VCWPD as estimated.*

Fishway flow meter malfunction. Discharge estimated.



Appendix 21. Mean daily discharge, water temperature, and turbidity at the Robles Fish Facility during the 2019 fish passage season.



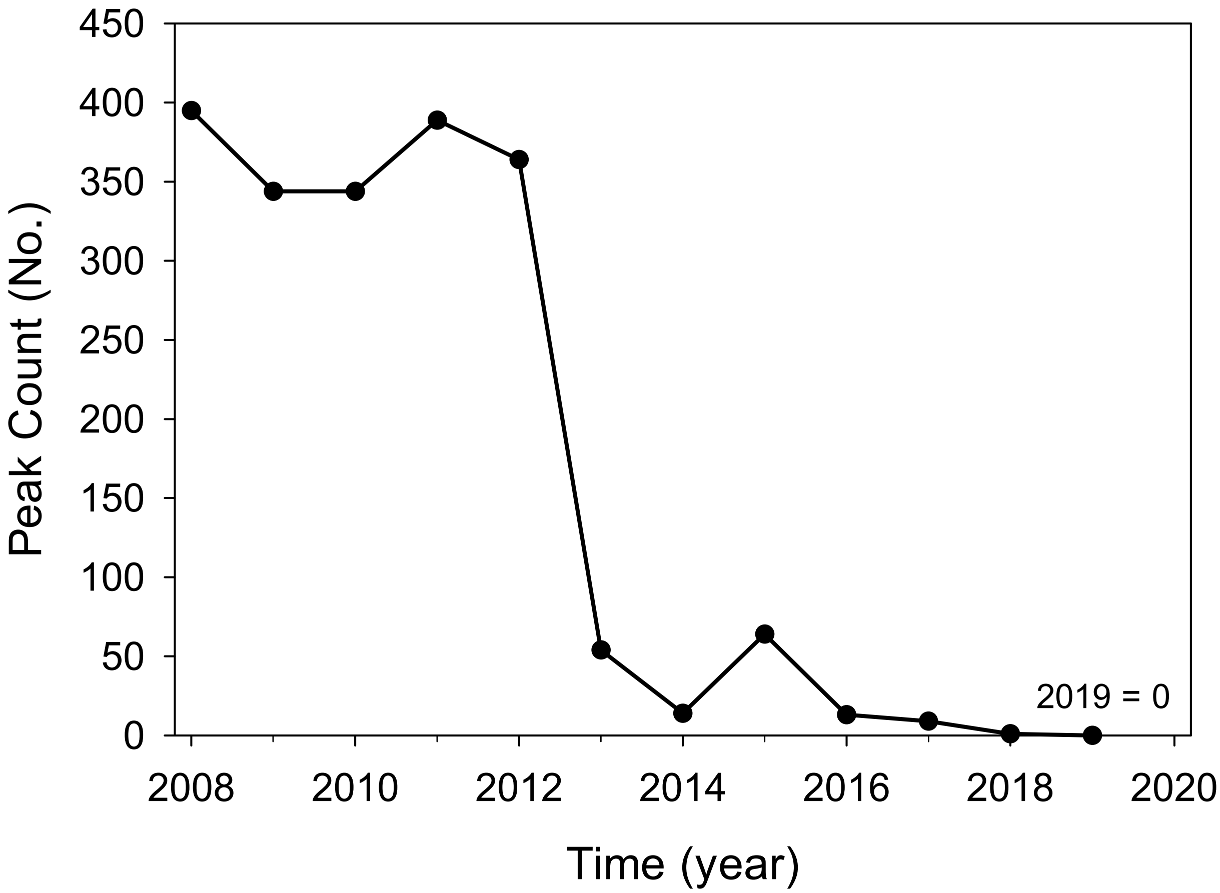
Appendix 22. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections.

Appendix 23. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* for the 2019 fish passage season.

	Upstream	Downstream
O. mykiss	0	0
Fish, non *O. mykiss*	0	0
Fish, unknown	0	0
Fish, probable	0	0
False detections	950	2,199
Total	950	2,199
Mean date - *O. mykiss*	n/a	n/a
Mean date - fish, non *O. mykiss*	n/a	n/a
Mean date - fish, unknown	n/a	n/a
Mean date - fish, probable	n/a	n/a
Mean time - *O. mykiss* (24h)	n/a	n/a
Mean time - fish, non *O. mykiss* (24h)	n/a	n/a
Mean time - fish, unknown (24h)	n/a	n/a
Mean time - fish, probable (24h)	n/a	n/a
Mean length - *O. mykiss* (cm)	n/a	n/a
Mean length - fish, non *O. mykiss* (cm)	n/a	n/a
Mean length - fish, unknown (cm)	n/a	n/a
Mean length - fish, probable (cm)	n/a	n/a
Mean daily temperature - *O. mykiss* (°C)	n/a	n/a
Mean daily temperature - fish, non *O. mykiss* (°C)	n/a	n/a
Mean daily temperature - fish, unknown (°C)	n/a	n/a
Mean daily temperature - fish, probable (°C)	n/a	n/a
Mean daily turbidity - *O. mykiss* (NTU)	n/a	n/a
Mean daily turbidity - fish, non *O. mykiss* (NTU)	n/a	n/a
Mean daily turbidity - fish, unknown (NTU)	n/a	n/a
Mean daily turbidity - fish, probable (NTU)	n/a	n/a
Mean daily turbidity - false detections (NTU)	70	69
Mean daily discharge - *O. mykiss* (cfs)	n/a	n/a
Mean daily discharge - fish, non O. *mykiss* (cfs)	n/a	n/a
Mean daily discharge - fish, unknown (cfs)	n/a	n/a
Mean daily discharge - fish, probable (cfs)	n/a	n/a
Mean daily discharge - false detections (cfs)	34	33

Appendix 24. *O. mykiss* relative abundance survey index sites in the Ventura Basin.

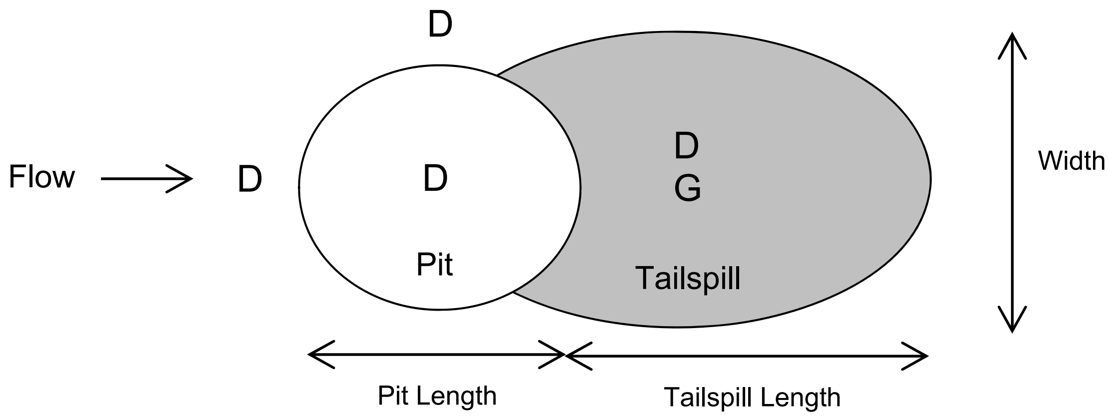
Site No.	Location	River km	Site	Lat.	Long.	Length (m)	Width (m)
1	Ventura River	0.9	Main Street pool	34.28126	-119.30887	25.1	10.0
		0.9	Main Street riffle	34.28164	-119.30893	34.0	8.0
2	Ventura River	9.4	Foster Park pool 1	34.35236	-119.30790	25.0	15.4
		10.0	Foster Park pool 2	34.35508	-119.30988	46.0	16.0
		9.7	Foster Park riffle	34.35308	-119.30877	45.0	11.0
3	Ventura River	13.0	San Antonio conf. pool 1	34.38042	-119.30752	33.0	22.0
		13.0	San Antonio conf. riffle	34.38011	-119.30755	42.0	14.0
		12.9	San Antonio conf. pool 2	34.37969	-119.30781	50.0	10.0
4	Ventura River	18.8	Hwy 150 pool 1	34.42643	-119.30220	43.3	14.0
		18.8	150 pool 2	34.42689	-119.30123	49.5	9.0
		18.7	Hwy 150 riffle	34.42576	-119.30258	43.6	11.0
5	Ventura River	22.1	Land Cons. pool 1	34.45342	-119.29314	50.1	19.1
		22.2	Land Cons. pool 2	34.45448	-119.29293	48.6	15.1
		22.1	Land Cons. Riffle	34.45411	-119.29315	44.6	18.8
6	Ventura River	23.2	Robles weir pools	34.46306	-119.29058	58.7	19.0
		23.3	Robles glide	34.46368	-119.29065	78.3	17.3
		23.4	Robles entrance pool	34.46446	-119.29058	39.8	21.8
		23.4	Fish ladder entrance box	34.46460	-119.29062	15.0	3.0
		23.5	Robles screenbay	34.46451	-119.29133	42.2	13.5
		23.5	Robles forebay	34.46503	-119.29053	33.0	17.2
7	San Antonio Cr.	0.2	Lower San Antonio pool 1	34.38088	-119.30542	16.0	6.0
		0.2	Lower San Antonio riffle	34.38098	-119.30711	20.2	3.5
		0.4	Lower San Antonio pool 2	34.38103	-119.30657	40.0	6.0
8	San Antonio Cr.	9.4	Upper San Antonio riffle	34.43268	-119.25090	25.0	5.0
		9.5	Upper San Antonio pool	34.43241	-119.25095	19.8	5.5
9	NF Matilija Cr.	0.1	Lower NF pool 1	34.48508	-119.30105	7.3	13.3
		0.1	Lower NF pool 2	34.48533	-119.30138	7.9	10.9
		0.2	Lower NF riffle	34.48523	-119.30198	17.8	8.0
10	NF Matilija Cr.	6.6	Upper NF pool	34.50956	-119.27520	29.0	9.0
		6.6	Upper NF riffle	34.50933	-119.27528	33.1	7.5
11	Matilija Cr.	0.3	Lower Matilija pool	34.48282	-119.30170	21.1	24.7
		0.3	Lower Matilija riffle	34.48302	-119.30154	15.9	8.0
12	Matilija Cr.	2.1	Upper Matilija pool	34.49190	-119.31599	89.4	13.7
		2.1	Upper Matilija riffle	34.49233	-119.31704	51.0	9.0
14	San Antonio Cr.	4.3	Fraser St. pool	34.40276	-119.28169	12.8	13.8
		4.4	Fraser St. riffle	34.40291	-119.28157	30.8	5.9
15	Ventura River	8.5	Bedrock pool	34.34539	-119.29931	50.0	17.0
		8.5	Bedrock pool riffle	34.34569	-119.29958	37.0	6.0



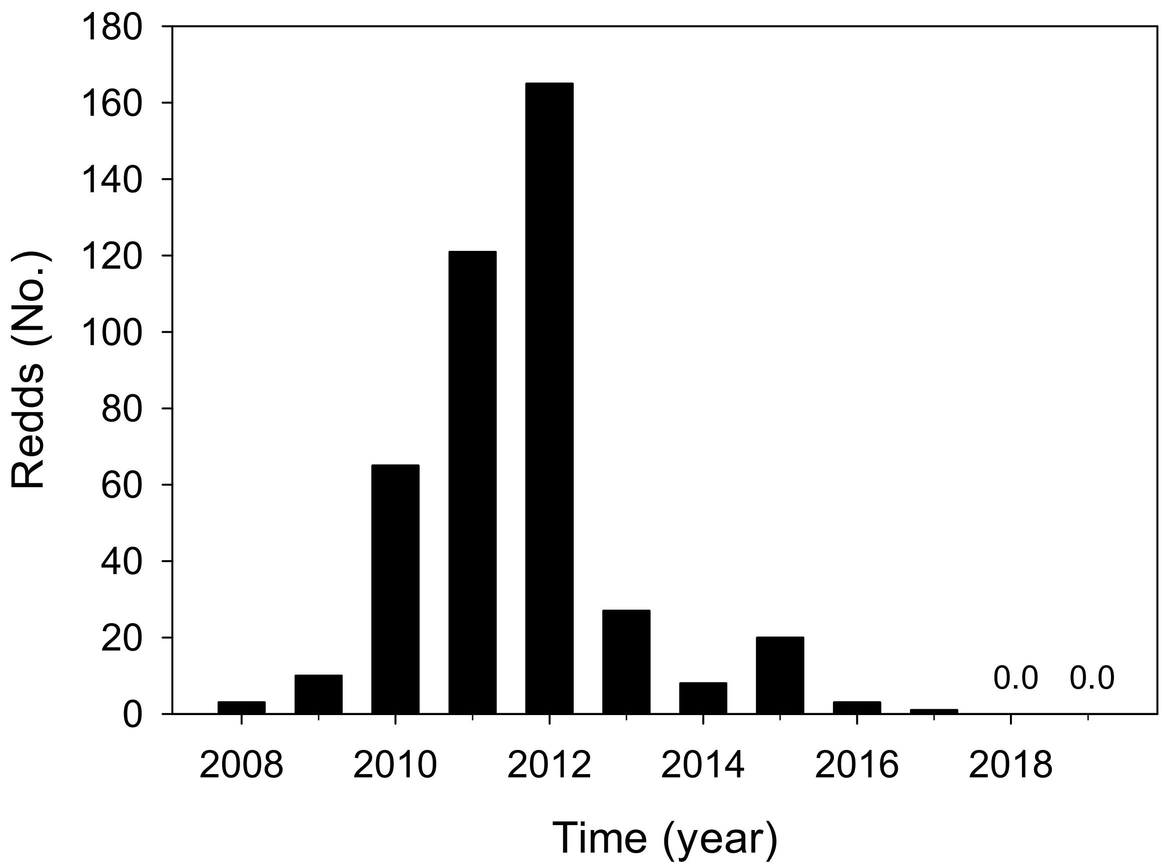
Appendix 25. Peak snorkel counts of *O. mykiss* during the period 2008-2019 at survey index sites in the Ventura Basin.

Appendix 26. *O. mykiss* spawning index sites in the Ventura Basin.

Site No.	Unit	Location	River km	Description	Lat.	Long.	Length (m)	Width (m)	Spawning Area (m^2)
24	1	Ventura River	0.8	Main St. Bridge	34.28085	-119.30862	220.0	10.0	2,200
2	1	Ventura River	7.9	Near Treatment Plant	34.34030	-119.29782	90.0	18.0	1,620
	2		8.1	Near Treatment Plant	34.34208	-119.29849	39.0	20.0	780
4	1	Ventura River	15.5	Near Santa Ana Blvd bridge	34.39950	-119.30853	26.7	8.0	214
5	1	Ventura River	18.7	Upstream of Hwy 150	34.42641	-119.30227	18.0	10.0	180
6	1	Ventura River	22.1	Land Conservancy pool tailout	34.45334	-119.29309	18.1	19.5	353
	2		22.2	Land Conservancy pool tailout	34.45445	-119.29298	16.3	14.7	240
7	1	Ventura River	23.3	Robles-1st weir pool	34.46334	-119.29061	15.4	23.9	368
	2		23.4	Robles tailout of entrance pool	34.46436	-119.29045	18.2	21.9	399
8	2	Ventura River	24.3	Upstream of Robles	34.46504	-119.29032	6.2	15.4	95
	3		23.4	Upstream of Robles forebay	34.46504	-119.29032	80.0	6.0	480
12	1	NF Matilija Cr.	0.7	Lower NF Matilija Cr.	34.48825	-119.30525	41.0	9.0	369
13	1	NF Matilija Cr.	6.6	Downstream of Wheeler Gorge	34.50911	-119.27501	23.0	8.0	184
	2		6.6	Downstream of Wheeler Gorge	34.50960	-119.27528	22.3	8.0	178
14	1	Matilija Cr.	1.9	Lake Matilija delta	34.49000	-119.31446	26.2	14.6	383
	2		2.1	Upstream of Lake Matilija	34.49198	-119.31645	15.0	10.0	150
	3		2.2	Upstream of Lake Matilija	34.49209	-119.31661	315	9.0	2,835
15	1	Matilija Cr.	8.4	End of Matilija Road	34.50456	-119.37449	20.0	19.0	380
17	1	Ventura River	9.3	DS of Foster to US reach	34.35069	-119.30463	1750	11.0	19,250
18	1	Ventura River	12.3	Casitas Springs	34.37354	-119.30877	60	12.0	960
	2		12.7	Casitas Springs	34.37712	-119.30721	230	9.0	2070
19	1	San Antonio Cr.	0.0	Mouth to end of Old Cr. Rd. reach	34.38030	-119.30738	2160	8.0	17,280
20	1	San Antonio Cr.	4.2	DS to US of Frasier St.	34.40197	-119.28237	180	8.0	1,440
21	1	San Antonio Cr.	7.8	Camp Comfort reach	34.42493	-119.26110	690	5.0	3,450
22	1	San Antonio Cr.	9.5	Upper San Antonio Cr. reach	34.43269	-119.25087	640	5.0	3,200
23	1	NF Matilija Cr.	0.1	Lower NF Matilija Cr.	34.48520	-119.30118	120	6.0	720
25	1	NF Matilija Cr.	4.1	Near Wheeler's Springs Reach	34.50826	-119.28955	300	4.5	1,350
26	1	NF Matilija Cr.	1.0	Downstream of NF gage bridge	34.49049	-119.30586	302	4.3	1,299
27	1	Matilija Cr.	5.7	Upstream Matilja hot springs	34.50030	-119.34993	105	8.0	840
								Total =	63,266



Appendix 27. Diagram of *O. mykiss* redds measurements. (D) = locations of depth measurements and (G) = location of gravel substrate sampling.



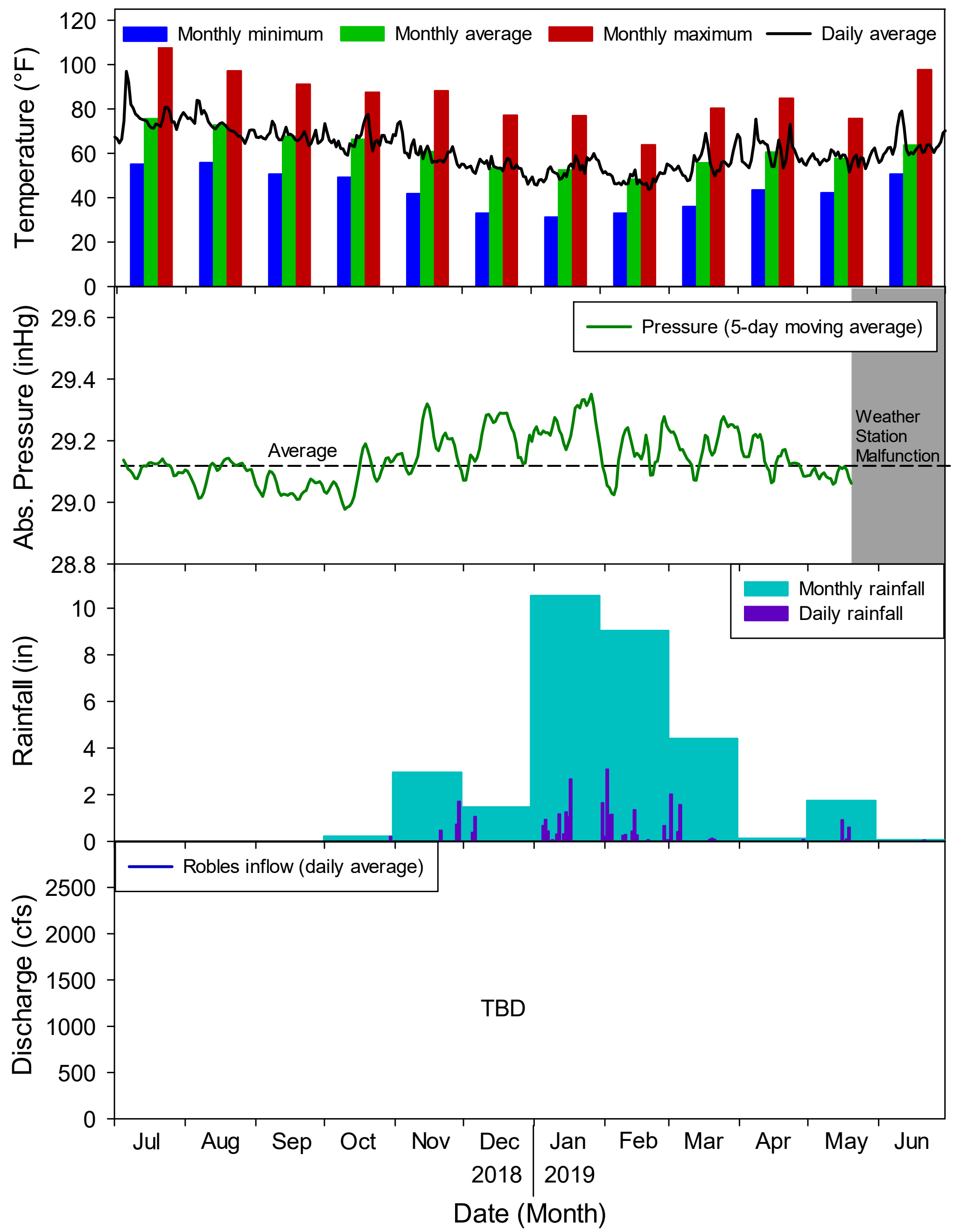
Appendix 28. Total number of *O. mykiss* redds counted at index spawning sites from 2008 through 2019 spawning years.

Appendix 29. Water quality monitoring sites and sampling summary.

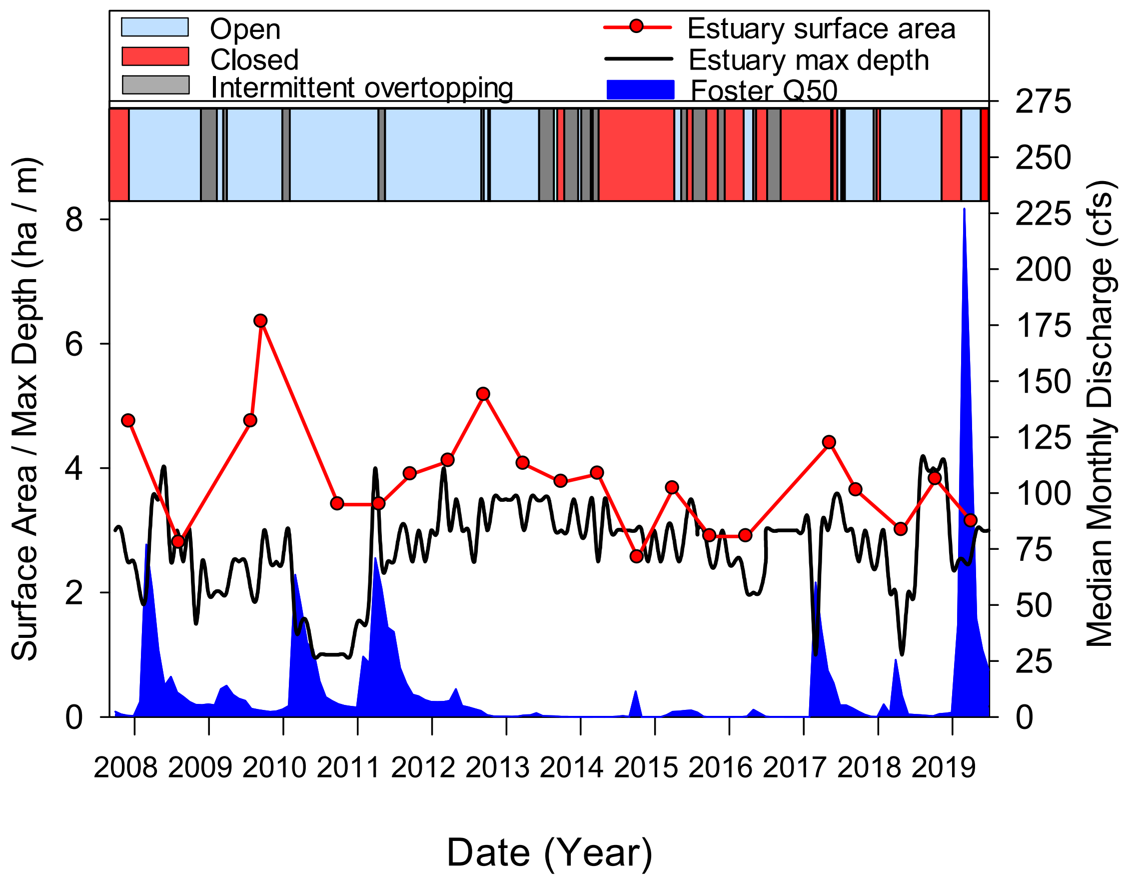
Site Number	Site Description	Site Location[a]	Sampling Method[b]	Sampling Type[c]	Frequency
1	Estuary	V 0.3 km	Multiparameter	Grab profile	Monthly
2	Main St. Bridge	V 1.0 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
3	Foster Park	V 9.7 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
4	Santa Ana Blvd Bridge	V 15.5 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
5	Hwy 150 Bridge	V 18.7 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
6	Robles Dam	V 23.5 km	Temperature Multiparameter Turbidity Weather	Continuous Grab Continuous Continuous	30 min Monthly Hourly 30 min
7	North Fork Matilija	N 1.3 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
8	Below Matilija Dam	M 1.0 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
9	Above Matilija Dam	M 2.1 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
10	Middle Matilija	M 8.5 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
11	Lower San Antonio	S 0.3 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
12	Middle San Antonio	S 9.5 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
13	Lower Coyote	C 0.4 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
14	Fraser St.	S 4.4 km	Temperature	Continuous	30 min

[a]Site location is identified by the river system and kilometers from its confluence. C = Coyote Creek, M = Matilija Creek, N = North Fork Matilija Creek, S = San Antonio Creek, V = Ventura River.

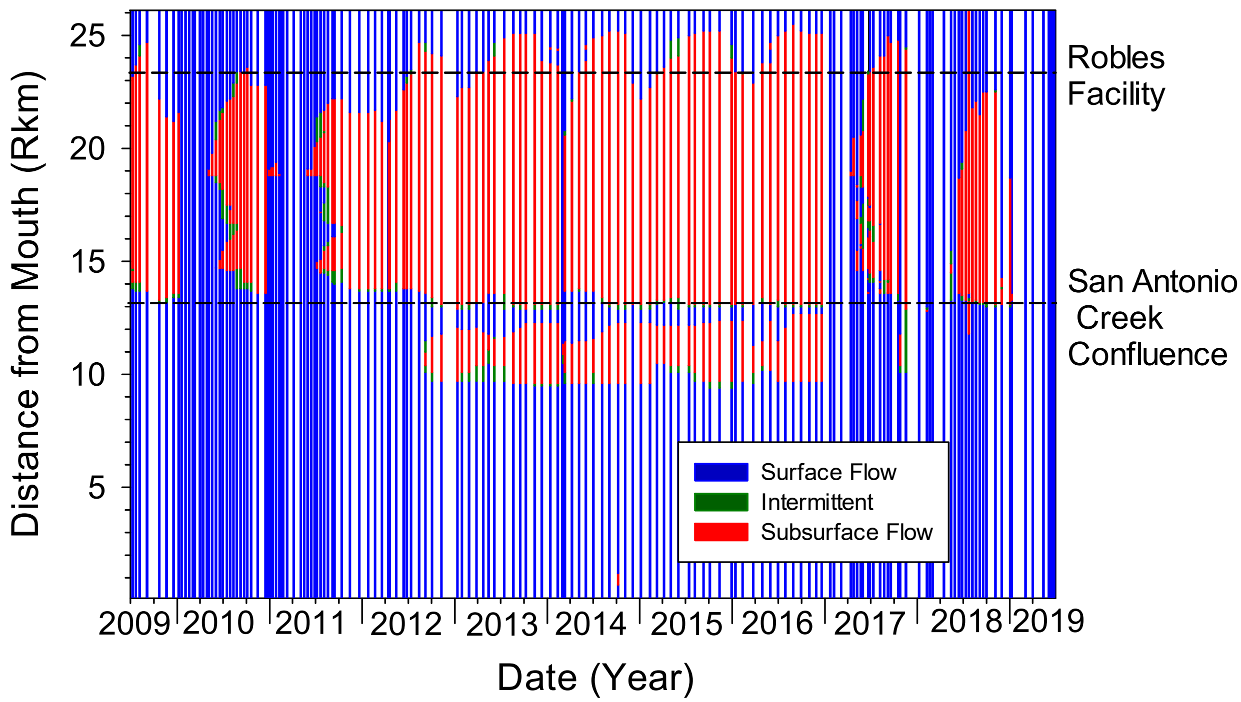
[b]Temperature data were collected using programmable loggers. Multiparameter water quality probe was use to collected water quality data including: temperature, dissolved oxygen, conductivity, salinity, pH, turbidity (separate meter). Turbidity data was collected using a programmable logger.



Appendix 30. Summary of weather and discharge data from the Robles Fish Facility for the reporting period.



Appendix 31. Ventura River estuary/lagoon water depth, surface area, sandbar status, and discharge at Foster Park from 2008 to 2019.

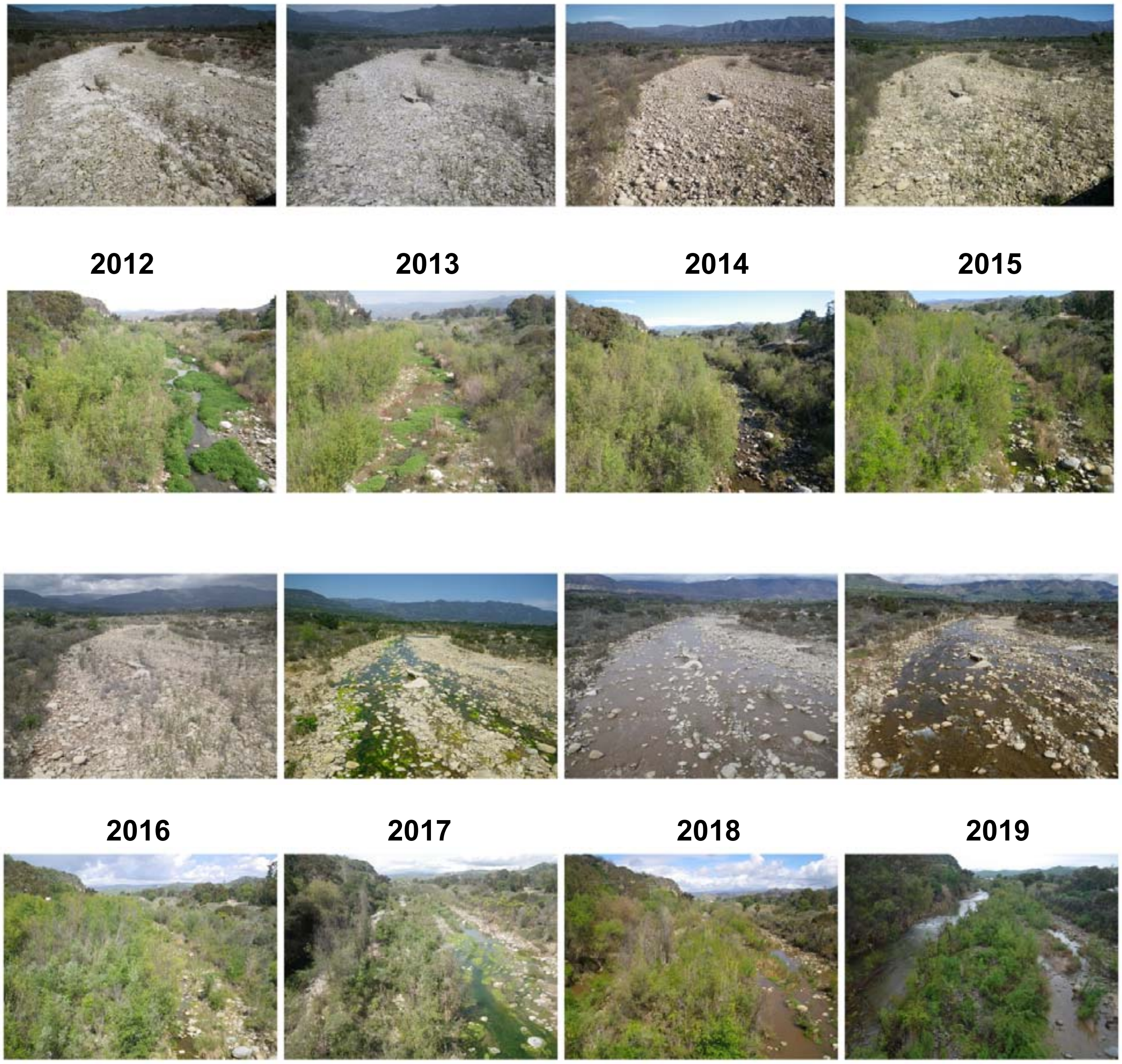


Appendix 32. Ventura River channel surface flow monitoring from 2008 to 2019.

Appendix 33. Photographic monitoring sites within the Ventura River basin.

Site Number	Site Description	Site Location[a]	Photo Direction	Frequency
1	Train bridge in estuary, east bank	V 0.3 km	Downstream	Biannual
2	Train bridge in estuary, west bank	V 0.3 km	Upstream Downstream	Biannual
3	Main Street Bridge	V 1.0 km	Upstream Downstream	Biannual
4	Shell Road Bridge	V 5.2 km	Upstream Downstream	Biannual
5	Casitas Vista Road Bridge (Foster Park)	V 9.7 km	Upstream Downstream	Biannual
6	Santa Ana Boulevard Bridge	V 15.5 km	Upstream Downstream	Biannual
7	Highway 150 Bridge	V 18.7 km	Upstream Downstream	Biannual
8	Robles Fish Passage Facility	V 23.5 km	Downstream	Biannual
9	Camino Cielo Road Bridge	V 25.7 km	Upstream Downstream	Biannual
10	Highway 33 Bridge at NF Matilija USGS Gauging Station	N 1.3 km	Upstream Downstream	Biannual
11	End of North Matilija Road	M 8.5 km	Upstream Downstream	Biannual
12	Highway 33 Bridge near Old Creek Road	S 0.3 km	Upstream Downstream	Biannual
13	Creek Road near Creek Lane	S 9.5 km	Upstream Downstream	Biannual
14	Santa Ana Road Bridge	C 0.4 km	Upstream Downstream	Biannual

[a]Site location is identified by the river or tributary system and kilometers from its confluence. C = Coyote Creek, M = Matilija Creek, N = North Fork Matilija Creek, S = San Antonio Creek, V = Ventura River.



Appendix 34. Multiple year photo comparison of ephemeral and perennial reaches of the Ventura River. Photo series row A and row C are looking upstream from Hwy 150 bridge. Photo series row B and row D are looking upstream from the bridge near the Shell Rd exit off Hwy 33.

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65K AF)

Date: 1-16-19 Time: 9:00 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	CFS
Robles	1-15-19	7:12	775
North Fork Matilija Creek	↓	7:59	183-35= 148
Matlija Creek above Resivor		3:15	580
Matlija Dam		7:35	1334-249= 1085
Matilija Creek at Hot Springs	↓		

BO Defined Storm Event: (Y)/ N
BO Defined Overlapping Event: Y /(N)

Current Flow Conditions cfs

North Fork Matilija Creek	9:00	57-35=22
Matlija Creek above Resivor	7:30	64-15=49
Matlija Dam	7:20	447-249=198
Matilija Creek at Hot Springs		
Robles Canal		109
Robles Weir		28
Total Robles In Flow		137

Date Matilija Resevior Filled ≈2011
Count of Days: >30

CDPM Method:
- ☐ <30 days - M4 - Modifed Overlapping Release
- ☐ ≥30 days - M9 - Matilija Download with Intial Release
- ☒ Standard release

Day	Date	Robles Release	M9 - Matilija Download: Robles Inflow Canal	Robles Inflow Weir	Matilija Inflow	Matilija Outflow	Matilija Elevation
1	1-16	50					
2	1-17						
3	1-18						
4	1-19						
5	1-20						
6	1-21						
7	1-22						
8	1-23						
9	1-24	↓					
10	1-25	50					
11	1-26	40					
12	1-27	30					
13							
14							
15							
16							
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65K AF)

Date: 1-18-19 Time: 11:04 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	CFS
Robles	1-17-19	6:22	≈9,100-10K
North Fork Matilija Creek	↓	6:39	2363-35=2328
Matlija Creek above Resivor		4:30	4398 +
Matlija Dam		7:20	7022-249=6773
Matilija Creek at Hot Springs			↓ 9,101

BO Defined Storm Event: (Y) / N
BO Defined Overlapping Event: Y / (N)

Current Flow Conditions cfs

	time	cfs
North Fork Matilija Creek	9:19	892*
Matlija Creek above Resivor	11:04	0*
Matlija Dam	10:55	425-249=176
Matilija Creek at Hot Springs		
Robles Canal	11:04	217
Robles Weir	11:04	54
Total Robles In Flow		271

Date Matilija Resevior Filled ≈2011
Count of Days: >730

CDPM Method:
- ☐ <30 days - M4 - Modifed Overlapping Release
- ☐ ≥30 days - M9 - Matilija Download with Intial Release
- ☒ Standard release

Day	Date	Robles Release	M9 - Matilija Download: Robles Inflow Canal	Robles Inflow Weir	Matilija Inflow	Matilija Outflow	Matilija Elevation
1	1-18	82					
2	1-19	74					
3	1-20	68					
4	1-21	62					
5	1-22	56					
6	1-23	56					
7	1-24	50					
8	1-25	50					
9	1-26	50					
10	1-27	50					
11	1-28	40					
12	1-29	30					
13							
14							
15							
16							
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 2-1-19 Time: 9:30 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	cfs	
Robles	1-31-19	14:15	≈(274-378)	
North Fork Matilija Cr	↓	12:04	133-35= 98	98
Matlija Cr above Reservoir		13:00	213*	+
Matlija Dam		13:40	469-91=378	378
Matilija Cr at Hot Springs				↓ (213-476) cfs

BO Defined Storm Event: (Y)/ N
BO Defined Overlapping Event: Y /(N)

Current Flow Conditions

	time	cfs
North Fork Matilija Cr	8:00	89-46=43
Matlija Cr above Reservoir	9:15	38
Matlija Dam	9:10	119-91=28
Matilija Cr at Hot Springs		
Robles Canal		20
Robles Weir		30
Total Robles In Flow		50

* many errors

Date Matilija Reservior Filled: ≈2011
Count of Days: >30

CDPM Method:
- [ ] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [x] Standard Release

			M9 - Matilija Download				
		Robles	Robles Inflow		Matilija	Matilija	Matilija
Day	Date	Release	Canal	Weir	Inflow	Outflow	Elevation
1	2-1	50					
2	2-2	40 → new Storm on 2-2-19					
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 2-2-19 Time: 18:00 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	cfs	
Robles	2-2-19	10:45	≈ 12-14k	
North Fork Matilija Cr	↓	10:14	2738-46=2692	2692
Matlija Cr above Reservoir	↓	10:00	5222	+
Matlija Dam	↓	10:35	9138-91=9047	9047
Matilija Cr at Hot Springs				↓ 11,739

BO Defined Storm Event: (Y)/ N
BO Defined Overlapping Event: Y /(N)

Current Flow Conditions

	time	cfs
North Fork Matilija Cr		
Matlija Cr above Reservoir		
Matlija Dam		
Matilija Cr at Hot Springs		
Robles Canal		
Robles Weir		
Total Robles In Flow		

Date Matilija Reservior Filled: ≈ 2011
Count of Days: >30

CDPM Method:

- [ ] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [x] Standard Release

Day	Date	Robles Release	M9 - Matilija Download: Robles Inflow Canal	Robles Inflow Weir	Matilija Inflow	Matilija Outflow	Matilija Elevation
1	2-3-19	[crossed out]	2nd initial storm peak				
2		↓					
3							
4							
5							
6							
7							
8							
9							
10							
11							
12		↓					
13							
14							
15							
16							
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 2-4-19 Time: ________ Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	cfs	
Robles	2-3-19	6:32	3511+263=3774	
North Fork Matilija Cr	↓	6:00	698-46=643	643
Matlija Cr above Reservoir		8:30	48*	+
Matlija Dam	↓	7:40	1790-91=1699	1699
Matilija Cr at Hot Springs				↓
				2342

BO Defined Storm Event: (Y)/ N
BO Defined Overlapping Event: Y / (N)

Current Flow Conditions

	time	cfs	
North Fork Matilija Cr		682-46=636	636
Matlija Cr above Reservoir	6:00	10*	+
Matlija Dam		1945-91=1854	1854
Matilija Cr at Hot Springs			↓
Robles Canal			2490
Robles Weir			
Total Robles In Flow			

* Many errors

Date Matilija Reservior Filled: ≈2011
Count of Days: > 30

CDPM Method:

- [ ] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [x] Standard Release

Day	Date	Robles Release	M9 - Matilija Download: Robles Inflow Canal	Robles Inflow Weir	Matilija Inflow	Matilija Outflow	Matilija Elevation
1	2-4	—	3rd initial storm				
2	2-5	|					
3	2-6	|					
4	2-7	|					
5	2-8	|					
6	2-9	|					
7	2-10	|					
8	2-11	|					
9	2-12	|					
10	2-13	|					
11	2-14	|					
12	2-15	⊥					
13							
14							
15							
16							
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 2-5-19 Time: 9:00 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	cfs	
Robles	2-4-19	9:15	3532+292=3824	
North Fork Matilija Cr		8:34	682-46=636	636
Matlija Cr above Reservoir		8:45	48*	+
Matlija Dam		9:30	1980-91=1889	1889
Matilija Cr at Hot Springs				↓
				2525

BO Defined Storm Event: (Y) / N
BO Defined Overlapping Event: Y / (N)

Current Flow Conditions

	time	cfs
North Fork Matilija Cr	9:00	408-46=362*
Matlija Cr above Reservoir	9:00	11*
Matlija Dam	9:00	844-91=753
Matilija Cr at Hot Springs		
Robles Canal		0
Robles Weir		2123
Total Robles In Flow		2123

* many errors

Date Matilija Reservior Filled: ≈ 2011
Count of Days: >30

CDPM Method:

- [ ] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [x] Standard Release w/NMFS additional release to match shut down time. per phone conversation on 2-6-19 @ 5:15pm and e-mail to BOR @ 6:55pm. with and by Rick Bush.

Day	Date	Robles Release	Robles Inflow Canal	Robles Inflow Weir	M9 - Matilija Download Matilija Inflow	Matilija Outflow	Matilija Elevation
1	2-5	>671	0	2123			
2	2-6	171					
3	2-7	100	Shut down to remove sediment				
4	2-8	82	//				
5	2-9	74	//				
6	2-10	68	Started up and release				
7	2-11	62					
8	2-12	56					
9	2-13	56					
10	2-14	50					
11	2-15	50					
12	2-16	50	added 50cfs release days for shutdown per NMFS (days 11–13)				
13	2-17	50					
14	2-18	40					
15	2-19	30					
16	2-20						
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 2-15-19 Time: 8:43 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	cfs	
North Fork Matilija Cr	2-14-19	9:49	1969	1969
Matlija Cr above Reservoir	↓	9:15	4194 - 11 = 4183	
Matlija Dam	↓	10:25	3611 - NA = 3611	3611
Matilija Cr at Hot Springs	↓			↓
Total Robles Inflow	↓	10:46	7000 weir x cutoff	5580

BO Defined Storm Event: (Y)/ N
BO Defined Overlapping Event: (Y)/ N

Santa Ana Br 8,500 @ 11:20
Foster 6,400 @ 11:30
San Antonio 850 @ 12:00

Current Flow Conditions

	time	cfs
North Fork Matilija Cr	8:00	230
Matlija Cr above Reservoir	7:15	335
Matlija Dam	8:20	744
Matilija Cr at Hot Springs		
Robles Canal	8:43	486
Robles Weir	8:49	49
Total Robles Inflow		535

Date Matilija Reservior Filled: ~2011
Count of Days: >30

CDPM Method:

- [ ] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [ ] Standard Release
- [x] Back-to-Back Release

			M9 - Matilija Download				
		Robles	Robles Inflow		Matilija	Matilija	Matilija
Day	Date	Release	Canal	Weir	Inflow	Outflow	Elevation
1	2-15	100					
2	2-16	74					
3	2-17	61					
4	2-18	54					
5	2-19	50					
6	2-20	50					
7	2-21	50					
8	2-22	50					
9	2-23	40					
10	2-24	30					
11							
12							
13							
14							
15							
16							
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 3-3-19 Time: 8:53 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	cfs
North Fork Matilija Cr	3-2-19	NA	214*
Matlija Cr above Reservoir	↓	9:15	316
Matlija Dam	↓	10:20	599
Matilija Cr at Hot Springs	↓		
Total Robles Inflow	↓	11:50	429

BO Defined Storm Event: (Y)/ N
BO Defined Overlapping Event: Y /(N)

Current Flow Conditions

	time	cfs
North Fork Matilija Cr	NA	214*
Matlija Cr above Reservoir	7:30	163
Matlija Dam	8:25	394
Matilija Cr at Hot Springs		
Robles Canal	8:53	188
Robles Weir	8:53	34
Total Robles Inflow		222

* errors

Date Matilija Reservior Filled: X 2011
Count of Days: >30

CDPM Method:

- [ ] <30 days - M4 - Modifed Overlapping Release
- [x] ≥30 days - M9 - Matilija Download with Intial Release
- [ ] Standard Release
- [ ] Back-to-Back Release

Day	Date	Robles Release	M9 - Matilija Download: Robles Inflow Canal	Robles Inflow Weir	Matilija Inflow	Matilija Outflow	Matilija Elevation
1	3-3	68					
2	3-4	62					
3	3-5	56					
4	3-6	56					
5	3-7	50					
6	3-8	50					
7	3-9	50					
8	3-10	50					
9	3-11	50					
10	3-12	50					
11	3-13	40					
12	3-14	30					
13							
14							
15							
16							
17							
18							

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 3-7-19 Time: 8:30 Prepared by: Scott Lewis

Storm Peak Conditions

	date	time	cfs
North Fork Matilija Cr	3-6-19	5:45	431
Matlija Cr above Reservoir	↓	6:00	711
Matlija Dam	↓	11:40	859
Matilija Cr at Hot Springs	↓		
Total Robles Inflow	↓		2186

BO Defined Storm Event: (Y) / N
BO Defined Overlapping Event: Y / (N)

Foster 2953 @ 7:00
Santa Ana 1127 @ 8:30
San Antonio 989 @ 6:15

Current Flow Conditions

	time	cfs
North Fork Matilija Cr	8:00	216*
Matlija Cr above Reservoir	8:30	286
Matlija Dam	8:00	637
Matilija Cr at Hot Springs		
Robles Canal	8:00	432
Robles Weir	8:00	62
Total Robles Inflow		494

*errors

Date Matilija Reservior Filled: 3-6-19
Count of Days: 1

CDPM Method:

- [X] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [X] Standard Release
- [ ] Back-to-Back Release

			M9 - Matilija Download				
Day	Date	Robles Release	~~Robles Inflow~~ ~~Canal~~	Weir	Matilija Inflow	Matilija Outflow	Matilija Elevation
1	3-7	90					
2	3-8	70					
3	3-9	~~55~~	82	changed to standard release per NMFS + BOR			
4	3-10	~~55~~	74	emails on Mar-8th			
5	3-11	~~50~~	68				
6	3-12	~~50~~	62				
7	3-13	~~50~~	56				
8	3-14	~~50~~	56				
9	3-15	~~50~~	50				
10	3-16	~~40~~	50				
11	3-17	~~30~~	40				
12	3-18		30				
13							
14							
15							
16							
17							
18							

2020 Robles Fish Passage Facility Progress Report

During 2020, a prototype evaluation study was initiated at the Robles Fish Passage Facility to compare several fish screen cleaning modifications. One prototype is a horizontal orientation wedge-wire fish screen that is being installation in the top photo. Matilija Reservoir was fully drained by Ventura County due to seismic and safety concerns and revealed the extensive sedimentation in the bottom photo.

Casitas Municipal Water District
1055 Ventura Avenue
Oak View, California 93022

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1.0 EXECUTIVE SUMMARY

Casitas Municipal Water District (CMWD) is implementing the Robles Fish Passage Facility Project (Robles Fish Facility) described in the Proposed Action of the Bureau of Reclamation's Biological Assessment (BA); (USBOR 2003). The effects of the Robles Fish Facility were analyzed in the Biological Opinion (BO) prepared by the National Marine Fisheries Service (NMFS 2003a). This 2020 Robles Fish Passage Facility Progress Report, as described by the BO, is the culmination of monitoring, evaluation, and operational data collected during the reporting period of 01 July 2019 to 30 June 2020.

The monitoring and evaluation studies related to the Robles Fish Facility conducted during the 2019-2020 reporting period are included in two main sections of this progress report. The Fisheries Monitoring and Evaluation section includes: upstream fish migration, impediment evaluation, sandbar monitoring at the mouth of the Ventura River, fish attraction evaluation, fish passage monitoring, downstream fish passage evaluations, and downstream fish migration through the Robles Reach. The Facility Operation section includes: information and data on the facility status, flow observations and control, costs associated with operation and monitoring, assessment of the effectiveness to provide fish passage, recommendations of priorities for future activities, and revisions deemed necessary to the operations.

Below normal precipitation occurred in the Ventura River Basin during the 2020 fish passage season. Three BO-defined storm events occurred and allowed data collection for the monitoring and evaluations of the Robles Fish Facility. The sandbar at the mouth of the Ventura River was open for the entire fish migration season and provided opportunity for steelhead passage through the lower mainstem Ventura River. No *Oncorhynchus mykiss* were detected passing through the Robles Fish Facility during the fish migration period of 2020.

2.0 GENERAL INTRODUCTION

The National Marine Fisheries Service (NMFS) listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA, 16 U.S.C. § 1531 et. seq.) of 1973, as amended. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) that were considered to be substantially reproductively isolated from other steelhead stocks and were an important part of the evolutionary legacy of the species. The southern California steelhead ESU included, at that time, steelhead populations from the Santa Maria River in San Luis Obispo County south to Malibu Creek in Los Angeles County. The ESU was later extended to the US/Mexican border in San Diego County during 2002 (NMFS 2003b). In a later delineating approach, NMFS categorized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) as described under the ESA (NMFS 2005). The DPS policy differs from the ESU by delineating a group of organisms by “marked separation” rather than “substantial reproductive isolation” as originally listed. In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated, are still part of the ESU; however, the anadromous *O. mykiss* (i.e., steelhead) are now part of a smaller subset identified as the southern California steelhead DPS. Anadromous *O. mykiss* in the southern California DPS exhibit a winter-run life-history pattern during their spawning migrations; see life history discussion below.

Rainbow trout (*O. mykiss*) can be generally organized into four large groupings (Behnke 1992; Scott and Crossman 1973): 1) coastal rainbow trout that extend from northern Baja California to northern Alaska near the Kuskokwim River and also the Kamchatkan Peninsula of northeastern Asia, 2) redband trout of the inland Columbia and Frazer River basins, 3) redband trout of the central valley of California, and 4) trout of the Gulf of California drainages. The taxonomic group of coastal rainbow trout, *O. m. irideus*, exhibit two life history forms; anadromous and resident. The common name for the anadromous life history form is “steelhead trout” and the resident form are “rainbow trout”. Throughout the range of coastal rainbow trout, the anadromous life history form is widespread (Behnke 1992). There are two general life-history patterns exhibited by adult anadromous steelhead when they return from the ocean to spawn in fresh water. The patterns are grouped by either summer or winter spawning runs. There are many exceptions to this pattern, but this general characterization has been used to group steelhead runs by the season in which the peak spawning occurs as they return from the ocean (Busby et al. 1996). Summer steelhead are generally found in river systems that drain from farther inland, such as the Columbia River basin. Winter-run steelhead are typically found in the coastal systems where river systems are smaller. The winter-run pattern is the more common of the two anadromous life histories within the natural range of the species (Busby et al. 1996).

Monitoring and Research of the Robles Diversion and Fish Passage Facility

As stated in the BO (NMFS 2003a), the “Modifications to the Robles Diversion Facility and associated operation criteria have been targeted at improving fish passage conditions within the Robles Reach of the Ventura River while maintaining suitable conditions through the Fish Passage Facility.” The monitoring and evaluation studies and activities related to the modification of the Robles Facility, as outlined in the BO (NMFS 2003a), were intended to achieve three main objectives:

I. Monitor Fish Passage Facility operations and performance.

II. Determine if the Fish Passage Facility functions and operates in such a fashion that migrating steelhead:
   - a. Successfully navigate into and through the facility, and
   - b. Move through the facility in good physical condition.

III. Determine if the operations at the Robles Diversion are enhancing the opportunity for:
   - a. Adult steelhead to migrate upstream to the Robles Facility, and
   - b. Smolts and kelts to migrate downstream through the Robles Reach.

5-year Reevaluation of Initial Evaluation and Monitoring Activities

As described in the BO, a 5-year reevaluation of the initial fish flow operations would be conducted to determine if monitoring and evaluations have been completed (NMFS 2003a). The initiation of the 5-year period began in 2006, which was the first year the Robles Fish Facility was fully operational. An annual and ongoing reevaluation began after the 2010 fish passage season. Through the Cooperative Decision Making Process, the Robles Biological Committee will review annually each of the specific evaluations and determine if the original objectives have been addressed and could be discontinued or if additional study would be needed. Due to the variable water conditions and insufficient numbers of adult and juvenile steelhead, all objectives of the monitoring and evaluation program have not yet been accomplished. This was exacerbated by the historic 5-year exceptional drought affecting much of California, and in particular, the southern coast of California that includes the Ventura River Basin. After the 2017 season, the drought in Ventura River basin had diminished to a moderate level, and continued into 2018 and 2019. Since March 2019, the Ventura Basin has been out of drought conditions. Each aspect of the monitoring and evaluation program will be assessed annually to determine if sufficient information has been collected to complete each objective. While significant progress has been made, it is recommended that several aspects of the monitoring and evaluation for the Robles Fish Facility be continued during 2021. Sufficient data have been collected for the upstream fish migration impediment evaluation to begin data analysis and finalizing the results for incorporation into the long-term fish flow operations.

3.0 UPSTREAM FISH MIGRATION IMPEDIMENT EVALUATION

Introduction

The ability of adult steelhead to swim upstream can be impeded during migration at times of low-river flow (NMFS 2003a). Evaluations at shallow water habitat units (i.e., critical riffles) have been commonly used as a method to determine if impediments exist for adult and juvenile steelhead in California rivers (Dettman and Kelley 1986; Bratovich and Kelley 1988; Hagar 1996). The Robles Reach, which extends downstream from the Robles Fish Facility approximately 6.5 km (NMFS 2003a) to just upstream of the Santa Ana Boulevard bridge (Appendix 1), is a wide alluvial section of the Ventura River that is composed of active wash deposits of unconsolidated silt, sand, gravel, and boulders (Tan and Jones 2006). Because of this morphology and geology, alluvial channels like the Robles Reach have high infiltration rates and cause surface flow to rapidly recede and cease relatively quickly after storm events (Cooke et al. 1992).

An initial assessment of Ventura River potential passage impediments in relation to river discharge was completed by ENTRIX (1999). The physical characteristics of seven potential impediments were evaluated using the Thompson (1972) passage criteria. The Thompson (1972) passage criteria for adult steelhead at critical riffles is a water depth of 0.6 ft for 25% of the total transect width and a continuous portion equal to 10% of the total transect width. ENTRIX (1999) also evaluated the potential impediments using criteria of 0.5 ft and 0.6 ft depth for 25% of the total width and a total width of 8 ft for both depths. The resulting discharge required to meet critical criteria was estimated to be between 40 and 65 cfs. There have been several modifications to the Thompson passage criteria by other researchers; Dettman and Kelly (1986) on the Carmel River used a depth of 0.6 ft over a 5 ft continuous section, a criteria of 0.6 ft depth over an 8-ft section was used on the Santa Ynez River (SYRTAC 2000), and Harrison et al. (2006) used a criteria of 0.6 ft depth over a 10-ft section on the Santa Clara River. Thompson's (1972) depth criterion of 0.6 ft was not based on actual migration observations and never validated as a minimum condition for passage. Adult salmonids have been observed passing through riffles shallower than the 0.6 ft criterion (Mosley 1982).

The objective of the impediment evaluation is to assess factors that may impede steelhead migrating upstream to the Robles Fish Facility (NMFS 2003a). Because low-river flows have the potential to impede upstream fish migration in the Robles Reach, characterizing the effect of flows on critical riffles in this reach will be the primary focus of the impediment evaluations (NMFS 2003a).

<u>Methods</u>

Selected channel features that may pose an impediment to upstream passage have been surveyed multiple times during the fish migration season (January through June) to measure water depth, velocity, and channel width along a transect at each site. The selected sites were planned to be surveyed over a range of discharges from approximately 30-171 cfs (the upper limit is dependent on the ability to safely conduct the surveys), which was correlated with discharge at the Robles Fish Facility. The number of repeated surveys has depended on the number and duration of significant rain events, rate of hydrograph recession, previously surveys, and time constraints due to other aspects of the monitoring and evaluation program. Impediment surveys have been conducted over a number of years given the natural variation of water conditions. The currently selected impediment sites (Appendix 2) were resurveyed multiple times to develop a statistically rigorous data set, given the natural variability, to evaluate fish passage in relation to Robles Fish Facility discharge.

Site Selection Process

During the initial phase, the Ventura River was surveyed from the mouth to the Robles Fish Facility (23 km) using standard stream survey techniques and was completed in 2008 (CMWD 2008). This provided physical measurements of all habitat units for the selection process. The survey methodology followed Moore et al. (2002) and was equivalent to a level IV survey as described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002).

Over the course of three meetings and one conference call between 24 January and 18 June of 2009, the Biological Committee (BC) for the Robles Fish Facility completed an impediment site selection process that culminated in the original selection of eight sites that would be monitored for the impediment evaluation. The BC reviewed physical parameters of the 379 habitat units surveyed and general river characteristics that included: unit type, length, width, water depth, slope, longitudinal location (river km), step height on step units, discharge at Foster Park and the Robles Fish Facility at the time of the surveys, and a river profile for the 23 km of the Ventura River below the Robles Fish Facility. Upon completion of initial assessment of the data, a list of potential sites was developed that the BC visited in the field on 27 May 2009 to determine if monitoring was warranted. This data and field assessment included regular BC members (at the time of the assessment) Mike Kinsey (BOR), Stan Glowacki (NMFS), Mary Larson (CDFW), and Scott Lewis (CMWD). Mike Gibson (CMWD), hydrologists Bob Hughes (CDFW), and David Crowder (NMFS) also participated in this assessment and selection process.

A flow event that peaked on 20 March 2011 at approximately 20,000 cfs at the USGS Foster Park gage station, a recurrence interval of about 6 years, significantly altered some impediments sites that necessitated modifications to the monitoring. See CMWD (2011) for a detailed description of the high-flow caused site alterations. A Biological Committee (BC) field assessment on 11 January 2012 was conducted to review alterations that occurred and select replacement sites for ones that no longer appeared to be impediments. Regular BC members (at the time of the assessment) Ned Gruenhagen (BOR), Rick Bush (NMFS), Mary Larson (CDFW), and Scott Lewis (CMWD) participated in this review and site-selection process; Mike Gibson (CMWD) and hydrologist Bob Hughes (CDFW) were also involved in this assessment and selection process. Based on this field review, Site 2 was no longer considered a potential impediment. Site 10 was identified as a replacement site during the January field trip. Site 8, which was originally selected during dry conditions, was not considered as restrictive as other potential sites after evaluating data collected during 2010 and 2011. Consequently, Site 8 was replaced with Site 9 during the January 2010 field trip. The complete list of current impediment sites that the BC visited and determined to be satisfactory for monitoring during the 2012 season can be found in Appendix 2. However, at the time new site selections were made (i.e., 11 January 2012), insufficient flows were available to make final site selection or transect placements. Until March of 2014, the lack of precipitation and subsequent insufficient surface flow, did not allow for confirmation of these new sites. This confirmation was completed after the March 2014 storm provided the first notable surface flows in 3 years and allowed available members of the BC to visit sites 9 and 10 on 03 March 2014. The confirmation was conducted by Scott Lewis (CMWD), Dana McCanne (CDFW), and Mike Gibson (CMWD).

ENTRIX Study Site Assessments

An effort was made to locate and determine the status of the ENTRIX (1999) study sites during 2009. Because there were numerous bed-mobilizing runoff events after the study was completed, the current status of all study sites was unknown. Based on the site descriptions in the ENTRIX (1999) study report, field surveys were conducted to locate and describe the existing channel conditions at the original site locations. Of the 7 sites originally identified by ENTRIX (1999), only 4 sites were located with any degree of certainty. Of those 4 sites, all were no longer in the primary low-flow channel. A more detailed description of the ENTRIX sites can be found in a previous progress report (CMWD 2011).

Results

During the reporting period for 2020, three BO-defined storm events occurred. The BO-required downstream flow releases for these three storms were less than the targeted priority discharges for the remaining impediment study sites (see Appendix 2). The targeted discharges were generally > 100 cfs and the 2020 BO flow releases were < 100 cfs. Therefore, no water depth transects were conducted during the 2020 fish passage season.

Discussion

The pooled data sampled from the population of sites identified as “critical riffles” will be evaluated to inform recommendations on flows to facility fish passage. This includes data collected over 6 seasons and a range of discharges. All impediment sites will be pooled individually across all years for this initial step of final analyses. Pooling the data broadly characterized the full range of data collected at the different impediment sites across a range of hydrologic conditions. All previous impediments will be included for this initial analysis.

Exploratory data analyses are needed to determine the most appropriate and informative methods for analyzing the data, including data pooling, any needed data transformations, other model explorations, outlier determinations, and final model ranking and selection. This process will proceed on a parallel track within the BC, culminating in a recommendation to the Management Committee based on the BC's interpretation of the results.

3.1 *Sandbar Monitoring*

Introduction

The Ventura River, like many other California rivers, frequently develops a seasonal sandbar at the mouth during the late spring or summer that is breached by higher river flows in the late fall or winter. If a sandbar develops, which occurs more often during dry years, the resulting lagoon can provide important rearing habitat for steelhead juveniles because of the abundant food resources available. Additionally, this can facilitate the physiological and behavioral changes associated with smoltification (Cannata 1998) and also enhance marine survival (Bond et al. 2008).

The primary objective of the sandbar monitoring is to determine if the criteria for initiation of the fish passage augmentation season have been met (NMFS 2003a). As stipulated in the BO, the fish passage augmentation season will extend from 01 January through 30 June of each year and will commence after the sandbar has been breached at least once during the current year's fish flow operations season. During the fish passage augmentation season, several Robles Fish Facility operation criteria must also be implemented (see NMFS 2003a for a complete list of operational criteria).

Methods

During each sandbar inspection, observations and recordings were made that included: date, time, status of the sandbar, general location of the mouth, tidal stage, water temperature, and discharge at the Robles Fish Facility and the USGS Foster Park gage station. The sandbar was open on 01 January 2020 and its status was monitored once every two weeks through June. Outside of the fish passage augmentation season the sandbar was monitored at least monthly.

Results

During the reporting period, July 2019 through June 2020, the mouth of the Ventura River was inspected 24 times to determine if the sandbar was open or closed. There were 13 observations that occurred during the fish passage augmentation season (January through June 2020) and 11 observations outside of the season. The sandbar was open on 01 January 2020 through 30 June 2020 for volitional fish passage (Appendix 16). On the days the sandbar was inspected during the reporting period, the mean daily discharge at the USGS Foster Park gage station and the Robles Fish Facility ranged from approximately 5 to 110 cfs and 3 to 57 cfs, respectively. The sandbar was open during the entire reporting period and the river was observed exiting only from the east side of the estuary.

Discussion

The sandbar at the mouth of the Ventura River tends to remain open during average and above average precipitation years and closes only during years with few significant rain events. This typical pattern where the sandbar remains open during the fish passage season is illustrated for most years (Appendix 17). This pattern commonly includes a period, during the summer and fall, when the sandbar is closed. A single low precipitation year can produce longer periods of closure (e.g., 2007, 2012, and 2016).

Consecutive dry years may cause a closure to persist into the fish passage season, only opening during short periods following rain events (e.g., 2013-2015).

The tendency of the sandbar to remain open during the fish passage season, in all but very dry years, is likely due to a several factors. Although the middle reach of the Ventura River goes dry every year, during most years subsurface water continues to flow and eventually begins to resurface just upstream of the confluence with San Antonio Creek and continues to increase slightly proceeding downstream. Additionally, tributary flow from San Antonio Creek also adds to the Ventura River through a surface or subsurface connection throughout the year. Finally, treated effluent water from the Ojai Valley Sanitary District at rkm 7.5 increases the river discharge by approximately 3 cfs. Continued lower evapotranspiration caused by the Thomas Fire and above average rainfall in 2019 have combined to produce longer periods of surface/subsurface flow and contributed to keeping the sandbar open. Together, these hydrologic features and effects have contributed water to the Ventura River and likely prevent the sandbar from fully forming. Consequently, the sandbar has remained open during most fish passage seasons, which has been approximately 80% of the time.

The status of the sandbar indicates changes in the estuary/lagoon that may help determine potential entry and exit conditions for adult steelhead and juvenile *O. mykiss*, respectively. It appears that passage conditions remain suitable during most seasons when steelhead are typically migrating. However, lagoon conditions optimal for juvenile rearing (i.e., when a sandbar closes and causes an estuary to form into a deeper freshwater lagoon; Bond et al. 2008), appear to have been limited during years with potential smolt recruitment for the study period beginning in 2006.

4.0 EVALUATE FISH MOVEMENT THROUGH THE PASSAGE FACILITY

4.1 *Water Velocity and Depth Validation Evaluation*

Sufficient flows into the Robles Fish Facility occurred during the 2020 fish passage season for performance testing and evaluation. However, extensive sedimentation and quickly receding storm hydrographs limited data collection opportunities. Water velocity data were collected for all 15 slots of the fish ladder at 50 cfs. This was conducted once it was determined that earlier measurements did not meet the testing criteria. The present completion status of performance testing objectives can be found in Table 1 below.

Table 1. Performance testing objectives and status of completion and remaining priorities.

Component	Complete? Yes or No	Flow Required	Required Flow duration	Anticipated completion	Comments	Completed By	Priority-Flows 30-50 cfs	Priority Flows 700 cfs +
Screens	Yes	671 cfs in channel				Consultant		
Diversion Flume	Yes							
Fishway Vertical Slots	Yes	25-35 cfs in Fishway **(34 cfs)**	24 hours	Flows permitting		Casitas		
	Yes	50 cfs in fishway **(50 cfs)**	24 hours	Flows permitting		Casitas		
	No	50 cfs in fishway + 121 cfs in Auxiliary Pipe	24 hours	After 121 cfs is achieved through the Auxiliary Pipe	River must flow at 2000 cfs for 24 hours to accomplish this task	Casitas		7
Fishway Entrance Gates	Yes	25-35 cfs in Fishway **(#5 @ 34 cfs)**	24 hours	Flows permitting		Casitas		
	Yes	50 cfs in fishway **(#5 @ 44 and 50 cfs, #4 @ 50 cfs)**	24 hours	Flows permitting		Casitas		
	No	50 cfs in fishway + 121 cfs in Auxiliary Pipe **(#5 @ 72 cfs, #4 @ 72 cfs)**	24 hours	After 121 cfs is achieved through the Auxiliary Pipe	River must flow at 2000 cfs for 24 hours to accomplish this task	Casitas		3
Auxiliary Water	No	121 CFS in Aux Pipe	24 hours	After 121 cfs is achieved through the Auxiliary Pipe	River must flow at 2000 cfs for 24 hours to accomplish this task	Casitas		4
Entrance Pool	No	400-600 cfs in spillway **(400 cfs spill and 50 cfs ladder method testing)**	8 hours	After 121 cfs is achieved through the Auxiliary Pipe		Casitas		1
	No	1200-1500 cfs in spillway	8 hours	After 121 cfs is achieved through the Auxiliary Pipe		Casitas		2
	No	2500-3500 cfs in spillway	8 hours	After 121 cfs is achieved through the Auxiliary Pipe		Casitas		6
Interim Rock Weirs	Yes	20 cfs	4 hours			Casitas		
	Yes	30-40 cfs	4 hours			Casitas		
	Yes	50 cfs	4 hours			Casitas		
Fish Guidance System	No	671 cfs in channel	4 hours			Casitas		8
Forebay	No	1000-2000 cfs	4 hours			Casitas		5
High Flow Fish Exit	Yes	150-200 cfs in channel	4 hours		HF has a continuous read flow meter	Casitas		
	No	600-700 cfs in channel	4 hours			Casitas		9
Low Flow Fish Exit	Yes	20-40 cfs **(26 cfs)**	2 hours			Casitas		

4.2 *Fish Attraction Evaluation*

Introduction

River discharge has been shown to be one of several key environmental factors initiating and facilitating steelhead, and other salmonids, adult and juvenile migrations in natural fluvial environments (Shapovalov and Taft 1954; Banks 1969; Spina et al. 2005). As adults and juveniles approach fish passage facilities, suitable discharge and water velocities are needed to ensure successful passage (Clay 1995; Beeman and Maule 2001).

The entrance of the fish ladder at the Robles Fish Facility is located approximately 20 m downstream of the spillway gates and is where fish migrating upstream enter and downstream migrating fish exit the facility (i.e., two-way passage facility). The downstream end of the ladder is adjacent to a large pool (entrance pool). The ladder was designed for a maximum discharge at the entrance of 171 cfs (50 cfs through the entire ladder and an additional 121 cfs supplemented at the lower end of the ladder). The reach downstream of the fish ladder entrance is composed of habitats that steelhead may use during migrations. The distance downstream from the entrance pool to the lower most rock weir is approximately 200 m. This reach includes all four rock weirs and the facility’s discharge measurement weir, which also functions as a low-flow road crossing. The habitat types that can be used by migrants in this reach include the four pools created by the weirs, a glide created by the discharge measurement weir, a riffle, and the entrance pool.

The objective of the fish attraction evaluation is to determine if adult or juvenile steelhead are holding immediately downstream of the Robles Fish Facility during the fish passage augmentation season (NMFS 2003a).

Methods

Three separate methods were employed to determine the presence of *O. mykiss* for the Fish Attraction Evaluation to encompass a range of spatial and temporal scales. The methods used included: 1) Weekly bank/snorkel survey during the fish passage season, 2) post-storm bank/snorkel surveys in the entrance pool during the BO-defined ramp-down period, and 3) post-storm underwater video monitoring at the fish ladder entrance during the ramp-down period.

1) Weekly bank/snorkel fish attraction surveys, a methodology used since 2007, were conducted during the fish passage season from January through June of 2020 when water was present. During 2020, the 3 BO-defined storms created significant surface flows and allowed surveys to be completed for 6 months. The particular survey methodology used (i.e., bank or snorkel) was determined based on water visibility, river discharge, expected steelhead life history stage present at the time of the survey, and safety of surveyors. A combination of bank and snorkel surveys were conducted during the 6-month period. Bank surveys were conducted by one or two surveyors in an upstream direction. The surveyors wore polarized sunglasses to reduce water-surface reflection. Snorkel surveys were conducted by one or two surveyors in an upstream direction. When present, fish species are identified and enumerated to the greatest extent possible permitted by the ambient river conditions and fish densities at the time of each survey. If *O. mykiss* were present, lengths of each fish was estimated to the nearest cm if only a few individuals (generally <10) were present. In order to collect additional information that may help determine *O. mykiss* upstream and downstream movements through the Robles Fish Facility, an upstream study reach was added in 2009. The upstream study reach included observations in the screenbay of the facility and the area immediately upstream of the low-flow fish exit in the forebay. The total distance of this upstream reach was approximately 140 m.

2) Post-storm bank/snorkel surveys were conducted in the entrance pool during the ramp-down period for all BO-defined storms. This consisted of daily surveys during the

10-12 day augmentation period after a storm event. Beginning the day after a BO-defined peak event, a Secchi depth was measured in the entrance pool to determine when surveys could begin. Bank surveys were conducted when visibility was poor and snorkel surveys were conducted after visibility increased (> 1.0 m Secchi), assuming this would allow *O. mykiss* to be observed.

3) The post-storm underwater video monitoring was conducted after a BO-defined storm and during the ramp-down period. After the storm event occurred, video cameras were installed at the entrance of the fish ladder. The video cameras were mounted on a bracket adjacent to the fish ladder entrance and lowered into place to provide monitoring following the storm event. The cameras recorded the entire 10-12 day ramp-down period to a digital video recorder (DVR) and reviewed at a later date.

Results

1) A total of 22 surveys (15 bank and 7 snorkel) were completed during the weekly surveys and no *O. mykiss* were observed (Appendix 18). During the 6-month period, a total of 7,680 m were surveyed by either bank or snorkel methods. Water temperatures during the study period ranged from 5.0 °C to 21.0 °C and turbidity ranged from 1.3 to 23 NTUs when the surveys were conducted. The mean daily discharge at the Robles Fish Facility ranged from 7 to 45 cfs at the time of the surveys.

2) There were 3 BO-defined storm events in 2020. A total of 29 surveys were conducted for the post-storm fish attraction surveys and no *O. mykiss* were observed (Appendix 19). Water temperatures during the study period ranged from approximately 7 °C to 20 °C and turbidity ranged from 12 to 380 NTUs when the surveys were conducted. The mean daily discharge at the Robles Fish Facility ranged from 22 to 69 cfs at the time of the surveys.

3) Post-storm underwater video monitoring was conducted during the 3 BO-defined storm events. Turbidities were too high for the camera to operate effectively and no useable video could be collected.

4.3 *Downstream Fish Passage Evaluation*

Introduction

Passage evaluations of salmonids migrating through fish passage facilities have been conducted throughout the western United States for many years (Odeh 2000). Methods to determine if a facility is operating as designed and not causing harm to the intended fish species vary. Early work typically entailed trapping and tagging fish before entering a facility and recapturing them after exiting. Trapping and visual inspections for injuries, PIT tagging, radio telemetry, and acoustical telemetry have been conducted extensively as well.

There are two objectives for the downstream fish passage evaluation. The first objective is to determine if downstream migrants are successfully passing through the Robles Fish Facility. The second objective is to capture and examine steelhead smolts and kelts to determine if injuries are occurring as they pass downstream through the Robles Fish Passage Facility (NMFS 2003a).

Methods

For a full description of evaluation methods, see section 5.0.

Results

No evaluations for the Downstream Passage Evaluation were conducted during 2020. The trap was not installed due to logistical and operational limitations due to the COVID-19 pandemic. It was decided during early March 2020 that installation, operation, and maintenance of the trap continuously for 3-4 months could not be done effectively.

5.0 DOWNSTREAM FISH MIGRATION THROUGH THE ROBLES REACH

Introduction

When the number of fish physically handled in a study is of concern, such as with an endangered species, radio telemetry can be a useful method over others like extensive trapping (Hockersmith et al. 2000). Telemetry migration information of steelhead smolts in the Ventura River would allow for the determination of survival, travel time and rates through select reaches, migration relative to river discharge, habitat use, and passage success through critical riffles. By tracking the tagged fish until the batteries die, it is anticipated that downstream migration can be monitored all the way to the Ventura River estuary/lagoon, where important data on estuary rearing and emigration behavior.

The purpose of the downstream migration evaluation is to determine how successful smolts are at migrating through the Robles Reach (NMFS 2003a). Because of the limited number of steelhead smolts likely passing downstream through the facility, a NMFS approved pilot study using radio telemetry was used for evaluations.

Methods

A weir trap was to be placed and operated approximately 40 m downstream of the Robles Fish Facility. The weir trap consists of a live-box (120 cm for all three dimensions) with an internal fyke. The trap was to be situated in the center of the river channel and thalweg. The live-box internal frame is constructed of PVC pipe and covered with plastic fencing with 1.9-cm diagonal openings. A plastic fence (3-cm openings) supported by T-bar fence posts was to be extended upstream on both sides of the live-box at 30° angles into the river channel. A 1-m gap on the right and left banks was designed so any adult steelhead could bypass the trap location and move upstream. Because the vast majority of downstream steelhead migrants were expected to be captured from mid-March through mid-June (Shapovalov and Taft 1954; Dettman and Kelley 1986), the trap was intended to be operated from mid-March through June

2020 or until water temperatures exceeded a daily mean of 22 °C, which could negatively impact captured fish (SYRTAC 2000), or the surface water connection was lost in the mainstem of the Ventura River. For a full description of evaluation methods, see the 2020 CMWD monitoring and evaluation study plan (Lewis and Gibson 2020).

Results

As noted previously, the trap was not installed and operated during 2020 and therefore no *O. mykiss* were captured during the 2020.

6.0 LONG-TERM MONITORING COMPONENTS

6.1 *Monitoring Robles Facility Operations*

6.1.1 Facility Status

The 2019-2020 season was a below average rainfall year as measured at Matilija Canyon. The 29.93 inches of rain measured at the Matilija Canyon Ventura County station during the 2019-2020 water year was 88% of the average annual rainfall.

Previous annual reports had identified several projects to be completed or reported on as to their current status. The principal projects were:

- Install repaired Sontek IQ Pipe flow meter in the auxiliary water supply pipe. The flow meters had numerous communication issues during 2019 that need to be resolved before the 2020 season; however, water levels did not recede enough to access the supply pipe for repairs. A new Sontek flow meter was installed in the fishway in 2020.

- Level and flow sensors repair or replacement. Install level sensors at the fish ladder entrance to read water levels in the entrance pool. In previous years this item was not successfully completed due to presumed sensor and SCADA limitations. However, CMWD contracted with a SCADA technician during late

2019 and early 2020 that was able to use the existing level sensors to record this data. Additionally, the technician was able to provide numerous updated monitoring and control modifications to the Robles SCADA system. These included: ability to monitor the entrance pool elevation directly, auxiliary and fishway gate levels displayed on SCADA PC screen, and backup fishway flow calculation from elevation. Additionally, many of the primary monitoring and controls can now be tracked or adjusted from the CMWD office without being on-site and provides more accurate operations. The forebay ultrasonic level sensor was replace with a radar level sensor after a malfunction. The malfunction caused the spill gates to open when it was not needed. This lowered the forebay water level from about 3 ft to 1 ft. It is assumed the original sensors are reaching their working life limit and will be replaced with radar sensors as budget allows.

- New diffuser perforated plate for the fish screens and the auxiliary water supply. During the 9 BO-defined storms in 2019 and three during 2020, the new diffuser perforated panels did not become obstructed with debris as before and appear at this time to have solved the issue. Further evaluations will be needed with the auxiliary panels to fully understand their effect they in that application. They were opportunistically cleaned once while the facility was shut down for sediment removal and only low levels of debris was present. They will continue to be monitored during future storms.

- Prototype Evaluation of screen clean modifications. Two horizontal fish screens were installed during the reporting period (one on each side of the V-screen). This, along with several other modifications were intended to be installed for the full evaluation. A screen back-wash system was not installed do to expected chance of significant rain and cost of system. Double brush arm screen cleaners were to be installed on the west-side of the V-screen, but they were not ready before or during the season. Installation of all components is ongoing for the 2021 season except the backwash system, which was removed from the 2020-21 budget for CMWD financial limitations.

- Forebay sediment removal. Sediment in the Robles forebay was removed and placed downstream of the cut-off wall during November of 2019. The total removed was approximately 35,000 yd^3. A remaining 15,000-20,000 yd^3 not removed due to budget constraints will be removed once funds are available.

6.1.2 Flow Observations and Control

Flow and level measurement devices are located at various locations within the Robles Fish Passage Facility. The primary points of measuring and recording stream flows entering, flowing through, and leaving the Robles Fish Passage Facility are:

- Matilija Creek at Matilija Hot Springs – located approximately 2,100 feet downstream of Matilija Dam – good rating for low to moderate flows – operated by Casitas Municipal Water District, formerly a USGS station; CMWD will be investigating the cost to have this gage data accessible from Robles for future use. A second gaging station at this location is operated by the County but has not been working for several years.
- Matilija Dam Stage Bubbler-Located at the dam, this gage provides the lake elevation. Under high flows, the dam acts as a weir. This is one of the primary flow measurement locations and to determine if a peak has occurred. It was determined during the 2019 download that the bubbler line does not extend down into the dam forebay deep enough for monitoring of downloads. Ventura County was made aware of this situation as well of the debris issue at the inlet.
- North Fork Matilija Creek – located approximately 3,000 feet upstream of its confluence with Matilija Creek – good rating for low to moderate flows – operated by the Ventura County Watershed District;
- Robles-Casitas Diversion Canal – located on the diversion canal approximately 1,300 feet downstream of the Robles headworks – trapezoidal channel with a good rating for flows up to 600 cfs;
- Ventura River near Meiners Oaks (VRNMO or Measurement Weir) – located approximately 540 feet downstream of the Robles Fish Passage spillway –

concrete weir section – good rating to 100 cfs, use of equations above 100 cfs with no verifications at higher flows above 1000 cfs. This is the most reliable flow measurement for the fish passage and downstream releases with a 50-year plus history. This site was formerly a USGS site.

- Fish Ladder- A Sontek IQ Plus has been added to this location to measure flow in the fish passage operation. It operated nominally with ongoing assessment.
- Auxiliary Water Supply- A Sontek IQ Pipe has been installed to obtain flow measurements in the auxiliary water supply and was nominal with ongoing assessment.

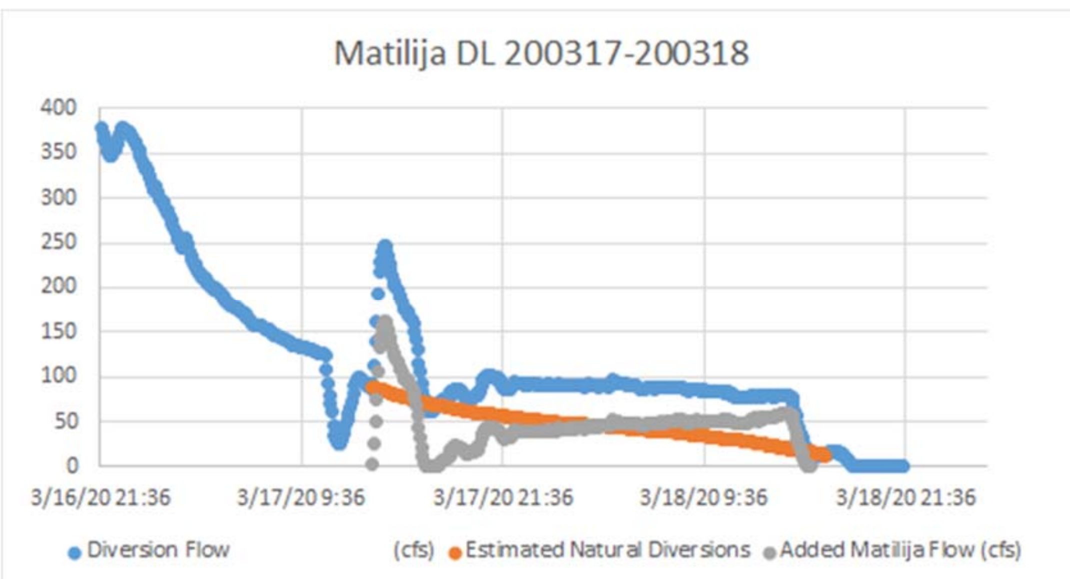
All of the instruments can suffer from inaccuracies from time to time. The inaccuracies can be caused by clogging of bubbler lines, electronic creep, debris accumulating on sensors, changes to the measured cross sections, human interactions and equipment problems. For this reason, the data is verified against field measurements and observations. The information gathered from each of these locations has been reduced to the mean daily flows in cfs (Appendix 20). The mean daily Robles Fish Facility discharge and corresponding turbidity and temperature measurements for the entire Fish Passage Season are presented in Appendix 21. The weir bubbler data collector was operational during all BO-defined peaks.

Surface flow over the measurement weir was present throughout the reporting period. Three BO-defined peak flow events occurred during the 2020 fish passage season. The first peak occurred on 17 March 2020 and the last was on 7 April. The largest peak for the season at about 3,300 cfs on 7 April. Flow assessment worksheets for each of the 3 BO-defined storms are included at the end of this progress report.

Additional sedimentation in the Robles forebay did not appear to occur during 2020. A sediment survey will have to be conducted to fully evaluate the sedimentation from the 2020 season. The lack of further forebay sedimentation also benefited the fish screens and brushes during the three storms. No sediment-related issue occurred in the screenbay during 2020.

Critical Drought Protection Measures—One CDPM download was completed during 2020, after the 17 March storm event, and was estimated at 102 af (see figure below). The estimated 102 af was determined by accounting for the expected natural recession rate during the period of the download and subtracting it from the actual diversions. The of 102 af download for 2020 is essentially the same as the 2019 download of 101 af. These download estimates support a conclusion that the Matilija Reservoir volume is less than previously thought.

A limited acoustical survey of Matilija Dam reservoir was conducted by Ventura County in 2019. The survey estimated a capacity of 144 af and is slightly higher, but generally consistent with the lower download volume estimates during 2019 and 2020. In addition, Ventura County drained Matilija Dam reservoir in July 2020 due to seismic and safety concerns. The drained reservoir visually revealed how significant the continued sedimentation has become (see cover photo).



The download for 2020 was determined by subtracting the estimated natural diversions (orange line) from the actual diversions (blue line) to estimate the additional diversions for the period of the download (gray line).

6.1.3 Costs Associated with Operation and Monitoring

The BA/BO specified that the District provide the costs that are associated with the activity. The following is a summary estimate of the direct costs incurred by the District during the 2019-20 fiscal year:

- **Fisheries Monitoring**:

Salaries & Benefits	$	520,659
Equipment/Material	$	68,982

- **Facility Operations**:

Salaries & Benefits	$	14,261
Equipment/Materials	$	13,599
Outside Contracts	$	3,285
Utilities	$	4,354
Permit	$	623

- **Capital Improvements**:

Forebay Restoration	$	1,266,225
Prototype Design/Support	$	217,452
Prototype Equip/MTL	$	552,514

6.1.4 Water Velocity and Depth Validation Evaluation

Water velocity data were collected in the fish passage facility during the 2019-20 season as reported above. The 3 BO-defined storm hydrographs receded too quickly to collect velocity data on tasks that required larger flows. As indicated in section 4.1, only the fish ladder 15 vertical slots were measured at 50 cfs during 2020. All performance testing will be completed in general accordance with the NMFS approved Performance Evaluation Program and Biological Committee recommendations.

6.1.5 Recommendations Regarding the Prioritization of Future Activities

The District has completed its 15th season with the Robles Fish Facility operational. An assessment of the current fish screens and cleaning system was initiated to determine if modifications can be made to improve fish passage and diversion operations. A prototype evaluation plan was completed and distributed to the BC for review during 2019 and implementation of the evaluation plan was ongoing for the 2020 fish passage season.

6.1.6 Recommendations Deemed Necessary to the Operations

Forebay sedimentation caused significant operational issues during 2019 and much of the sediment was removed during 2019, however the remaining sediment will need to be removed once the forebay goes dry and budgetary funds become available. Casitas continues to recommend that the construction of the 15-weir project be put on hold until the Matilija Dam Removal Project is completed. Plans for the High Flow Sediment Bypass and High Flow Fish Passage portion of the Matilija Dam Removal Project require this area to be graded to new elevations.

6.2 *Fish Passage Monitoring*

Introduction

Monitoring of migratory fish moving through fish passage facilities has been conducted using many different methods that include: visual counting, trapping and hand counting, continuous video recording, PIT tagging, radio telemetry, and acoustical telemetry. In each fish passage application, the particular physical and biological conditions (e.g., variable discharge, turbidity, debris, size of facility, and number of fish) usually dictate which method would be most effective. New technologies have been employed to improve fish passage monitoring in turbid conditions specifically. One such monitoring device is the Vaki Riverwatcher® (Riverwatcher). The Riverwatcher has the capability to operate in greater turbidity than more traditional monitoring equipment. Because of this advertised capability, the Riverwatcher was selected to be used in the Robles Fish Facility by the Technical Advisory Group during original facility design.

The primary objective of fish passage monitoring is to provide a long-term index of upstream adults and downstream kelts migrating through the Robles Fish Facility (NMFS 2003a). Although the Riverwatcher has the ability to detect smolt-sized steelhead, the manufacturer recommends it for monitoring fish with body depths ≥ 40 mm (Vaki 2003). Consequently, it was not known how well it would work at detecting smolt-sized fish given the debris load of the Ventura River (NMFS 2003a).

Methods

Fish migrating upstream and downstream through the Robles Fish Facility were monitored using the Riverwatcher. The Riverwatcher is located in the fish bypass channel, which is the channel between the fish ladder and fish screens. The Riverwatcher consists of two scanner plates with light diodes that transmit beams of infrared light through the water to a corresponding receiver plate. When a fish swims (or debris drifts) through the infrared light beams, it breaks the light signal and a digital silhouette of the fish is recorded on a computer. Other data recorded when the Riverwatcher scanner is triggered are: date and time, total length (TL) of the fish (from a length/height ratio), swimming speed (m/sec), and direction of the fish movement (upstream or downstream). In addition, the scanner triggers an underwater camera to record a 10-second video clip (25 frames/sec).

The Riverwatcher was experiencing technical issues of malfunctioning video during the 2015 monitoring season. In the fall of 2015 the Riverwatcher was sent to Vaki for servicing. Through diagnostic testing, Vaki concluded no repairs were necessary and did not experience any issues with malfunctioning video. Vaki stated recent improvements to the Riverwatcher system could be integrated into older systems, and recommended upgrading the Robles Riverwatcher. This recommendation was discussed and approved by BC members at the 2015 committee meeting. The primary upgrade was changing from an analog camera to a digital camera. In conjunction with updated software, the camera now records video for both upstream and downstream detections. Additional upgrades to the Riverwatcher included: white and infrared lights, cabling, multiplexor, and power supply. To improve video detection of fish, an additional camera was installed and is located upstream of the Riverwatcher scanners in an aluminum tunnel below the Riverwatcher camera. A second DVR camera is located above the Riverwatcher and pointed at the scanner plates. These two DVR cameras are independent of the Riverwatcher system and have to be reviewed separately for detections. The digital cameras recorded continuously at 12 frames/sec and capture about 5 weeks of data until the DVR data storage drive is full. Once the DVR memory is full, it can be exchanged with a second DVR and data can be reviewed.

The Riverwatcher scanner and cameras are positioned at the bottom of an aluminum frame (crowder) covered with 1/2 inch aluminum bars, spaced 1 1/2 inches on center resulting in 1-inch spacing between the bars, which directs the fish to swim between the scanner plates. The crowder can be raised and lowered in guide slots of the fish bypass channel with the aid of an A-frame hoist for cleaning or repair. The Riverwatcher is usually operated during the entire flow augmentation season as long as sufficient water elevations in the fish bypass are present and debris and turbidity are low enough so that the crowder will not be damaged and the Riverwatcher will function.

Typically, during times of higher debris, the cleaning and inspections occur multiple times per day, and at times of lower debris, cleaning and inspections occur only once every 2-3 days. At times of very low flow (< 1-2 cfs), the crowder may only be cleaned once per week.

Prior to 2010, each upstream and downstream Riverwatcher detection was reviewed and classified as either: an adult steelhead, *O. mykiss* non-adult steelhead, other species if identifiable, unknown fish, fish probable, or false detection (see Appendix 22 for detection classification flow chart). At the request of NMFS, this classification system was modified during the review process of the 2010 progress report. It is NMFS' belief that supporting data do not exist to distinguish between the resident and anadromous forms of steelhead. All confirmed *O. mykiss* were classified solely as *O. mykiss*. The classifications were determined by using a combination of the silhouette images, estimated lengths, and video clips. In addition, if larger adult sized *O. mykiss* were detected and a useful video clip was recorded, measurements of eye diameter and standard length (SL) were estimated from the video clip to calculate morphometric ratios that were compared to known steelhead and rainbow trout.

A commonly used morphological method to discriminate differences is to develop ratios of body measurements for comparison to remove the effects of body size (Strauss and Bond 1990). This is done by comparing SL to the ratio of eye diameter in linear regression. Standard length is the length from the snout to the end of the hypural plate near the end of the fleshy caudal peduncle, which is unaffected by caudal fin deformities (Anderson and Neumann 1996).

Before 2010, the adult steelhead classification was used if the fish observed was an *O. mykiss* and displayed the typical characteristics of an anadromous adult steelhead, such as black spotting on dorsal, adipose, and caudal fins, black spotting on dorsal side of body, silvery body, vertical edge to caudal fin, ≥ 38 cm TL (Shapovalov and Taft 1954), and had an eye diameter/SL ratio ≤ 0.045 (CMWD 2008). The new classification method may include juvenile resident, smolts, adult resident, and adult anadromous *O. mykiss* migrating throughout the basin. Conceivably, after more data are collected from the downstream trapping component, or from other Ventura River basin research projects, a more thorough classification system of Riverwatcher detections could be used again.

The “fish unknown” classification was used if a detection was identified to be a fish based on video evidence, but further classification could not be determined due to high turbidity or an inadequate amount of the fish captured within the camera’s field of view. The “fish probable” classification was used if no fish was observed in the video, but the silhouette was similar to that of a typical fish silhouette confirmed by video evidence. Even with reasonably good video coverage, smaller fish are still able to pass through the Riverwatcher undetected by the video cameras. This occurs if fish swim very close, high, or low relative to the cameras. In addition, this can happen if a fish swims upstream through the scanners but stops before entering the video field of view. High turbidity can also obscure the video detection and identification of fish. The “false detection” classification was used when no fish was observed in the video and the silhouette was not similar to that of a typical fish silhouette. Because false detections tended to occur frequently during higher discharges, when turbidity and debris also were high, it was likely that most false detections during these periods are caused by debris, high turbidity, and water turbulence. A second video camera is directed at the Riverwatcher scanner plates to help determine the cause of many of the false detections. After reviewing selected times where many assumed false detections occurred, it was concluded that debris, air bubbles, and turbulence were indeed the source of the detections. During low-flow periods (<10 cfs), 99.9% of the time the Riverwatcher was operating, surface water turbulence was likely the cause of most false detections. When turbidity exceeds about 100 NTUs, hundreds of false detections can occur per hour due to high concentration of suspended solids breaking the infrared beams of the scanner plates. When turbidity is less than about 100 NTUs, false detections from suspended solids are not as frequent, but poor camera visibility does not always allow for video confirmation, depending on how close to the camera that a fish swims during passage. Once the turbidity falls below about 25-30 NTUs, turbidity does not limit the Riverwatcher’s capability for detecting and confirming fish (Table 1). In spring 2016, the Riverwatcher was tested in an above-ground pool with wooden fish silhouettes at varying water turbidities. This was intended to simulate natural stream conditions to provide further resolution of the operational capabilities of the Riverwatcher (Lewis et al. 2016).

Table 1. Riverwatcher general operational status for ranges of water turbidity (NTUs).

Approximate Turbidity (NTUs)	Riverwatcher status
> 200	Not functional
100-200	Many false scanner detections, not fully functional
30-100	Scanner functional, but unable to confirm with video
< 30	Scanner functional, grid detectable for video confirmation

A standardization test for the Riverwatcher was developed using wooden silhouettes of a typical smolt and adult steelhead. To confirm the Riverwatcher is functioning correctly, this test was conducted before the Riverwatcher was operated during the 2016 fish passage season. A more detailed description of this test can be found in Lewis et al. (2016).

Results and Discussion

The Riverwatcher was operated from 01 January 2020 through 30 June 2020 of the reporting period. However, due to the high turbidities, the Riverwatcher was not operated for 4 days. During this fish passage season, the crowder was removed from the fish bypass channel and cleaned or inspected approximately 63 times. During the 2020 fish migration season, the Riverwatcher did not detect *O. mykiss* passing through the Robles Fish Facility (Appendix 23). False detections were recorded by the Riverwatcher, of which 627 were upstream and 1,027 were downstream. There were a total of 39 non-*O. mykiss* detected passing upstream or downstream through the Riverwatcher and were warm water exotic fish Largemouth Bass or sunfish.

The 1,654 false detections recorded by the Riverwatcher were assumed to be caused from turbidity, debris, turbulence, air bubbles, and settings of the Riverwatcher to detect smaller fish. The review of the second DVR camera directed at the Riverwatcher scanner plates provides confidence that these are the likely cause of false detections. None of the detections produced silhouettes that appeared to be fish based on previous experience operating the Riverwatcher. In the event that one of these silhouettes could have been caused by a fish, all detection video clips created by the Riverwatcher were reviewed and no fish were observed. For the 2020 season, the minimum threshold height remained at 28 mm so that a large number of false detections could be eliminated while still attempting to detect steelhead smolts. Based on available data from the Ventura Basin, a height of 28 mm was determined to be similar to some of the smallest steelhead smolts expected to emigrate downstream through the Robles Fish Facility. This height corresponds to 146 mm TL and 139 mm FL. The estimated fish detection rate from a Riverwatcher verification study indicated that up to 93% of smolt sized *O. mykiss* will not be detected by the Riverwatcher (Lewis et al. 2016). Additionally, it was concluded that larger-sized fish (i.e., height > 80 mm) appeared to be detected nearly 100% of the time. This height is equal to about 475 mm TL. Shapovalov and Taft's (1954) 9-year study documented only 4% of the total number of adult steelhead were smaller than 475 mm. Therefore, the number of small adult steelhead that may not be detected would likely be low. However, the vast majority of adult steelhead would be detected.

7.0 ADDITIONAL BIOLOGICAL AND ENVIRONMENTAL MONITORING STUDIES

7.1 *O. mykiss Presence/Absence Surveys*

Methods

In addition to the fish attraction monitoring, *O. mykiss* relative abundance index surveys were conducted in the Ventura River mainstem between the Robles Fish Facility and the Ventura River mouth and San Antonio Creek. Surveys were conducted upstream of the Robles Fish Facility in Matilija and North Fork Matilija creeks. These additional sites were surveyed using both bank and snorkeling methods (depending on water conditions and expected life history stage) but were conducted primarily after storm events for adults and during the rest of the year for smolts, parr, and fry. Methods to estimate fish size and numbers were the same as those used in the fish attraction evaluation. A total of 14 sites were monitored and both pool and riffle habitat at each site were included (Appendix 24). These additional areas were surveyed to determine if adult steelhead were entering the Ventura River, migrating upstream, holding and spawning, and if they were successfully passing through the Robles Fish Facility. Also, juvenile *O. mykiss* (smolts and residents) were surveyed to learn spatial and temporal patterns.

The sites were initially selected based on ease of access, coverage of basin, and presumed chance of detecting *O. mykiss*. However, after all habitat surveys were completed, site selection was also based on quantitative measurements identifying high-quality habitats used for *O. mykiss* juvenile rearing and adult holding.

Results

Peak snorkel counts within each year have generally been between 350 and 400 *O. mykiss* until 2013. Due to the exceptional 5-year drought, the peak numbers of *O. mykiss* have dropped substantially (Appendix 25). No *O. mykiss* were observed during the reporting period.

7.2 *O. mykiss Index Spawning Surveys*

Methods

Spawning surveys were conducted throughout the Ventura Basin that is accessible to adult steelhead and only resident rainbow upstream of Matilija Dam. A total of 21 index sites or reaches were subjectively selected (Appendix 26) with small to medium size gravel that are suitable for steelhead spawning (Shapovalov and Taft 1954; Orcutt et al. 1968). During 2008, the spawning index sites selected were initially distributed broadly within the basin to capture general spawning locations and timing. Since 2008, longer reaches have been added to incorporate and replace previously surveyed discrete sites to accommodate for spawning gravel redistribution after storm events. Additional sites have been added to capture quality spawning habitat and to be more representative of each surveyed sub-basin. This initial information will used to establish long-term index sites to capture population trends. The spawning surveys were conducted biweekly from January through June, or until no further spawning was observed, and observations were made at sites to identify and count *O. mykiss* redds; redds were identified by typical characteristics (Orcutt et al. 1968; Chapman 1988). Once a redd was identified, physical measurements similar to those recorded by Zimmerman and Reeves (2000) were collected to characterize the redd. The physical measurements were only recorded during the first three years because it was felt sufficient data was collected to characterize redds. Currently, larger redds (likely anadromous) have all measurements collected. Pit and tailspill lengths were measured from the upstream end to the downstream end of each, respectively. Redd width was measured at the widest point of the tailspill (Appendix 27). Water depth was measured at four locations: in the pit, adjacent to the pit, upstream of the pit, and at the tailspill. The surface median (D_{50}) and maximum substrate size of each redd tailspill was estimated. All adjacent measurements were taken on the thalweg side of each redd. Photos and GPS locations were also recorded for all redds identified. This information will help determine steelhead spawning habitat selection characteristics.

<u>Results</u>

Spawning surveys started in 2008, numbers initially increased from only 3 redds to a high of 165 redds in 2012. Over the last 5 years, as the current drought intensified or was sustain, the available habitat diminished, and there have been corresponding losses to the adult and juvenile *O. mykiss* populations with significantly lower redd counts. In 2020, no redds were observed in the index areas (Appendix 28).

7.3 *Ambient Water Quality Monitoring*

In order to fully evaluate several aspects of the monitoring and evaluation program, water quality data is collected throughout the Ventura River basin (Appendix 29). Water temperatures are recorded at 12 locations throughout the Ventura River basin. The locations include the Ventura River estuary and mainstem, Coyote Creek, San Antonio Creek, North Fork Matilija Creek, and Matilija Creek upstream and downstream of Matilija Dam. The loggers record at 30-min intervals. Monthly grab samples are also collected at the same locations with a multiprobe that measures: dissolved oxygen, pH, conductivity, salinity, TDS, and temperature. A monthly water quality profile is also collected in the estuary/lagoon. The profiles are collected at approximately the mid-point of the estuary/lagoon and at least four depths are recorded. A continuous turbidity probe is also installed in the Robles Fish Facility near the Riverwatcher. It records water turbidity at 1-hr intervals when the bypass is operational. Turbidity measurements are also collected at several sites upstream, downstream, and within the Robles Fish Facility to ensure the continuous probe is located in a position that will be representative of the turbidity in the Ventura River. All locations were monitored if sufficient water was present. A weather station has been installed at the Robles Fish Facility to collect various atmospheric data including rainfall, temperature, pressure, wind, humidity, and dew point (Appendix 30).

7.4 *Estuary/Lagoon Monitoring*

The sandbar is monitored during the fish passage season to determine if it is open. If open, Robles Fish Facility operating criteria must be met per the BO. Outside of the passage season, monitoring has been conducted and expanded to better understand the nature of the Ventura River sandbar and how it may affect fish passage year round, and also potential rearing capacity. The estuary/lagoon has been monitored monthly for water depth as part of the water quality monitoring. In addition, the surface area has been measured every 6 months. However, the spring 2020 survey was not conducted because of COVID-19 protocol issues with having two people in one kayak. Together, these physical measurements can provide some general index of rearing capacity of the Ventura River estuary/lagoon over time. From 2008 through 2011, which were wetter years, the sandbar status and estuary/lagoon depth and size varied with conditions. However, since the beginning of the drought in 2012, conditions have remained somewhat uniform (Appendix 31).

7.5 *Surface Flow Monitoring*

The Ventura River, like most rivers in southern California, have significant reaches that lose surface flow during most years after storm flows recede. To quantify this natural pattern, surface flows have been observed and documented beginning at the end of 2007. Like the sandbar monitoring, clear patterns have become apparent. During normal precipitation years, there are typically surface flows throughout the length of the

Ventura River mainstem during the fish passage season. Even during years of normal precipitation, the Robles Reach goes dry shortly after storms occur. However, beginning with the drought, the Robles Reach has been dry for extensive periods of time, even extending downstream of the San Antonio Creek confluence. This dry pattern was reduced significantly due to the precipitation and runoff during 2017 monitoring period. During 2020, precipitation was about 88% of average and surface flow continued longer in time and farther downstream than typical (Appendix 32). The Thomas Fire effects are likely continuing to modify the basin flows, but also the much higher than average flow of 2019 contributed to base flows.

7.6 *Photographic Index Sites*

Photographic index sites were established throughout the Ventura River basin in 2007 to monitor general changes of the stream channel morphology, water conditions, and riparian zones. There are a total of 14 sites where an upstream and downstream photo are taken (Appendix 33). The sites were re-visited twice during the reporting period, in September 2019 and March 2020. As a representation of the general patterns within the mainstem of the Ventura River, Appendix 34 shows the general trend that has been observed of increasing riparian and within channel vegetation over time since 2013.

7.7 *Underwater Video Monitoring*

As time allowed, a pilot study of an underwater video monitoring system was continued to determine if remote monitoring for adults or smolts is feasible within the Ventura River or tributaries. The monitoring system was placed at selected locations when water conditions were suitable to record fish rearing, holding, or migrating. The system consisted of an underwater video camera attached to a DVR that can record for 6-8 hours at a time. The system was powered by a 12 volt DC battery so the system could be placed anywhere within the basin. The video was reviewed to determine presence or absence and relative numbers of steelhead. If this pilot study is successful, it may be expanded and developed into a more quantitative monitoring tool. This system also was used at the fish ladder entrance during post-storm observations. Underwater video monitoring was not conducted during the 2020 fish passage season.

7.8 *Stranding Surveys*

Stranding surveys were conducted during the reporting period as part of other monitoring and evaluations (i.e., impediment, snorkel, and spawning surveys) and no stranded *O. mykiss* were observed.

8.0 LITERATURE CITED AND BIBLIOGRAPHY

Adams, N. S., D. W. Rondorf, S. D. Evans, and J. E. Kelly. 1998. Effects of surgically and gastrically implanted radio transmitters on growth and feeding behavior of juvenile Chinook salmon. Transaction of the American Fisheries Society, 127:128-136.

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 477-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Ando, D., T. Kitamura, and S. Mizuno. 2005. Quantitative analysis of body silvering during smoltification is masu salmon using chromameter. North American Journal of Aquaculture, 67:160-166.

Banks, J. W. 1969. A review of the literature on the upstream migration of adult salmonids. Journal of Fish Biology, 1:85-136.

Beeman, J. W., and A. G. Maule. 2001. Residence time and diel passage distribution of radio-tagged juvenile spring Chinook salmon and steelhead in a gatewell and fish collection channel of a Columbia River dam. North American Journal of Fisheries Management, 21:455-463.

Beeman, J. W., D. W. Rondorf, M. E. Tilson, and D. A. Venditti. 1995. A nonlethal measure of smolt status of juvenile steelhead based on body morphology. Transactions of the American Fisheries Society 124:764-769.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Bond, M. H., A. A. Hayes, G. V. Hanson, and R. B. MacFarlane. 2008. Marine survival of steelhead (*Oncorhynchus mykiss*) enhanced by a seasonally closed estuary. Canadian Journal of Fisheries and Aquatic Sciences, 65: 2242-2252.

Bratovich, P. M., and D. W. Kelley. 1988. Investigation of salmon and steelhead in Lagunitas Creek, Marin County, California. Volume 1. Migration, spawning, embryo incubation and emergence, juvenile rearing, emigration. Marin Municipal Water District. Corte Madera, California.

Brown, R. S., S. J. Cooke, W. G. Anderson, and R. S. McKinley.1999. Evidence to challenge the “2% rule” for biotelemetry. North American Journal of Fisheries Management, 19:867-871.

Busby, P. B., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. National Marine Fisheries Service. NOAA technical memorandum NMFS-NWFSC-27, August 1996.

Cannata, S. T. 1998. Observations of steelhead trout (*Oncorhynchus mykiss*), coho salmon (*O. kisutch)* and water quality of the Navarro River estuary/lagoon, May 1996 to December 1997. Draft report, Humboldt State University Foundation. Humboldt, CA.

Chapman, D. W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117(1):1-21.

Chrisp, E. Y., and T. C. Bjornn. 1978. Parr-smolt transformations and seaward migration of wild and hatchery steelhead trout in Idaho. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow, Idaho. Final project report F-49-R.

Clay, H. C. 1995. Design of fishways and other fish facilities, 2nd edition. CRC Press, Inc., Boca Raton, FL.

Cooke, R. U., A. Warren, and A. S. Goudie.1992. Desert geomorphology. UCL Press, London.

CMWD. 2005. 2005 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2006. 2006 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2007. 2007 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2008. 2008 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2009. 2009 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2010. 2010 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD. 2011. 2011 progress report for the Robles Diversion Fish Passage Facility. Casitas Municipal Water District, Oak View, CA.

CMWD, Wood Rogers, and ENTRIX Inc. 2002. Preliminary draft technical memorandum of operation constraint assessment of the Robles Fish Passage Facility. Prepared for US Bureau of Reclamation.

Dauble, D. D., T. L. Page, and W. Hanf.1989. Spatial distribution of juvenile salmonids in the Hanford Reach, Columbia River. Fishery Bulletin, 87:775-790.

Dettman, D. H., and D. W. Kelley.1986. Assessment of the Carmel River steelhead resource, Volume 1.biological investigations. Monterey Peninsula Water Management District, Monterey, CA.

ENTRIX.1999. Evaluations of natural passage barriers on the Ventura River downstream of Robles Diversion. ENTRIX, Walnut Creek, CA.

ENTRIX. 2000. Results of fish passage monitoring at the Vern Freeman diversion facility Santa Clara River, 1994-1998. ENTRIX, Walnut Creek, CA.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 2002. California salmonid stream habitat restoration manual, Volume I, 3rd edition. California Department of Fish and Game. Inland Fisheries Division, Sacramento, CA.

Hagar, J. 1996. Salinas River steelhead status and migration flow requirements. Monterey County Water Resources Agency. Salinas, California.

Haner, P. V., J. C. Faler, R. M. Schrock, D. W. Rondorf, and A. G. Maule. 1995. Skin reflectance as a nonlethal measure of smoltification for juvenile salmonids. North American Journal of Fisheries Management, 15:814-822.

Hockersmith, E. E., W. D. Muir, S. G. Smith, B. P. Sandford, N. S. Adams, J. M. Plumb, R. W. Perry, and D. W. Rondorf. 2000. Comparative performance of sham radio-tagged and PIT-tagged juvenile salmon.US Army Corps of Engineers, Walla Walla District.

Harrison, L. R., E. A. Keller, E. Kelley, and L. A. K. Mertes. 2006. Minimum flow requirements for southern steelhead passage on the lower Santa Clara River, CA. University of California, Santa Barbara.

Hasler, A. D., and A. T. Scholz. 1983. Olfactory imprinting and homing is salmon. Springer-Verlag, New York.

Jepsen, N., L. E. Davis, C. B. Schreck, and B. Siddens. 2001. The physiological response of Chinook salmon smolts to two methods of radio-tagging. Transactions of the American Fisheries Society 130:495-500.

Leopold, L. B., M. G. Wolman, and J. P. Miller. Fluvial processes in geomorphology. W. H. Freeman and Company, San Francisco.

Lewis, S. D. 2001. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2000. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2002. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2001. Portland General Electric. Portland, Oregon.

Lewis, S. D. 2003. Movements of hatchery steelhead smolts in Lake Billy Chinook and Squaw Creek during 2002. Portland General Electric. Portland, Oregon.

Lewis, S. D., M. W. Gibson, J. L. Switzer, and A. L. Bonsignori. 2016. DRAFT—Verification testing of the Robles Fish Facility Vaki Riverwatcher. Casitas Municipal Water District, Oak View, California.

Lewis, S. D., M. W. Gibson, and J. L. Switzer. 2015. 2016 monitoring and evaluation study plan for the Robles Fish Passage Facility and related studies. Casitas Municipal Water District, Oak View, California.

Lewis, S. D., and M. W. Gibson. 2020. 2020 monitoring and evaluation study plan for the Robles Fish Passage Facility and related studies. Casitas Municipal Water District, Oak View, California.

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

Matthews, K. R., N. H. Berg, D. L. Azuma, and T. R. Lambert. 1994. Cool water formation and trout habitat use in a deep pool in the Sierra Nevada, California. Transactions of the American Fisheries Society, 123:549-564.

Moore, K., K. Jones, and J. Dambacher.2002. Methods for stream habitat surveys, Version 12.1.Oregon Department of Fish and Wildlife, Aquatic Inventories Project, Natural Production Program, Corvallis, OR.

Mosley, M. P. 1982. Critical depths for passage in braided river, Canterbury, New Zealand. New Zealand Journal of Marine and Freshwater Research, Vol. 16:351-357.

National Marine Fisheries Service. 1997. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead. Federal Register, 50 CFR Parts 222 and 227 [Docket No. 960730210–7193–02; I.D. 050294D] RIN 0648–XX65. Vol. 62, page 43937.

National Marine Fisheries Service. 2003a. Biological opinion for the Robles diversion fish passage facility, Ventura River, CA. Protected Resource Division, Southwest Region, March 31, 2003.

National Marine Fisheries Service. 2003b. Endangered and Threatened Species: Range Extension for Endangered Steelhead in Southern California. Federal Register, 50 CFR Part 224 [Docket No. 001025296-2079-02; I.D. 072600A] RIN 0648-AO05. Vol. 67 page 21586.

National Marine Fisheries Service. 2005. Endangered and Threatened Species: Request for Comment on Alternative Approach to Delineating 10 Evolutionarily Significant Units of West Coast Oncorhynchus mykiss. 50 CFR Parts 223 and 224 [Docket No. 040525161–5274–05; I.D. No. 052104F] RIN No. 0648–AR93. Vol. 70 page 67130.

National Marine Fisheries Service. 2009. Letter addressed to Scott Lewis (Casitas Municipal Water District) addressing the downstream fish passage evaluation. Letter dated 28 April 2009, SWR/2002/1871:SCG.

Orcutt, D. R., B. R. Pulliam, and A. Arp. 1968. Characteristics of steelhead trout redds in Idaho streams. Bureau of Commercial Fisheries, Boise, Idaho.

Odeh, M. 2000. Advances in fish passage technology: engineering design and biological evaluation. American Fisheries Society, Bethesda, Maryland.

Quinn, T, H. 2005. The behavior and ecology of pacific salmon and trout. American Fisheries Society, Bethesda, Maryland.

Scott, W. B. and E. J. Crossman.1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa, Bulletin 184.

Shapovalov, L. and A. C. Taft.1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*), with special reference to Waddell Creek, California, and recommendations regarding their management. State of California Department of Fish and Game, fish bulletin No. 98.

Spina, A. P., M. A. Allen, and M. Clarke.2005. Downstream migration, rearing abundance, and pool habitat associations of juvenile steelhead in the lower main stem of a south-central California stream. North American Journal of Fisheries Management, 25:919-930.

Stoecker, M. 2010. North Fork Matilija Creek adult steelhead below Ojai Quarry barriers. Letter sent on 30 March 2010 about adult steelhead observations, 5 p.

Strauss, R. E., and C. E. Bond.1990. Taxonomic methods: In Schreck C. B. and P. B. Moyle, editors. Methods for fish biology. AFS, Bethesda, Maryland.

Summerfelt, R. C., and L. S. Smith.1990. Anesthesia, surgery, and related techniques. Pages 213-272 in C. B. Schreck and P. B. Moyle, editors. Methods for Fish Biology. American Fisheries Society, Bethesda, Maryland.

SYRTAC (Santa Ynez River Technical Advisory Committee). 1999. Adult steelhead passage flow analysis for the Santa Ynez River. Santa Ynez River Consensus Committee, Santa Barbara, CA.

SYRTAC (Santa Ynez River Technical Advisory Committee).2000. Lower Santa Ynez River fish management plan. Santa Ynez River Consensus Committee, Santa Barbara, CA.

Tan, S. S., and T. A. Jones.2006. Geologic map of the Matilija 7.5' quadrangle Ventura County, California: a digital database. Version 1.0, Los Angeles, CA.

Thompson, K. 1972. Determining stream flows for fish life. Pacific Northwest River Basins Commission, instream flow requirements workshop. Portland, Oregon. Proceedings: 31-50.

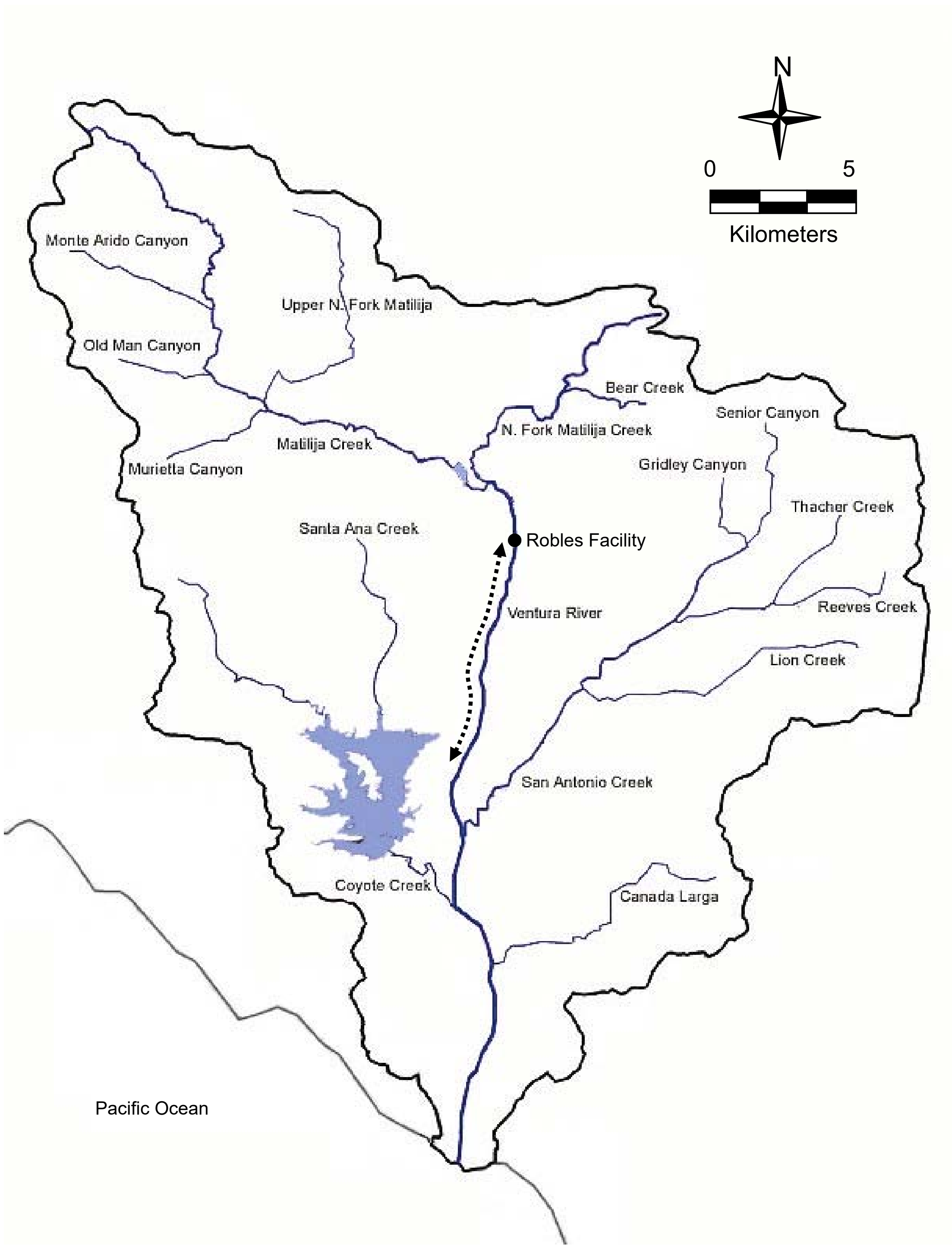
U.S. Bureau of Reclamation. 2003. Revised biological assessment for diversion operations and fish passage facilities at the Robles Diversion, Ventura River, CA. South-Central California Area Office, February 21, 2003.

Vaki.2003. User manual for Riverwatcher. Vaki Aquaculture Systems Ltd., Iceland.

Wagner, H. H., R. L. Wallace, and H. J. Campbell.1963. The seaward migration and return of hatchery-reared steelhead trout, *Salmo gairdneri* Richardson, in the Alsea River, Oregon. Transactions of the American Fisheries Society, 92(3):202-210.

Zimmerman, C. E., and G. H. Reeves. 2000. Population structure of sympatric anadromous and nonanadromous *Oncorhynchus mykiss*: evidence from spawning survey and otolith microchemistry. Canadian Journal of Fisheries and Aquatic Sciences, 57:2152-2162.

9.0 APPENDICES



Appendix 1. Basin map of the Ventura River. The Robles Fish Passage Facility is identified by the black dot and the Robles Reach is identified by the dashed line downstream of the Robles Facility.

Appendix 2. Summary data of current impediment sites for upstream fish migration impediment evaluations.

Site No.	Latitude (N)	Longitude (W)	km	Habitat Type[a]	Site Description	Length (m)	Slope (%)	Percent Substrate[b] SO	SD	GR	CB	BD	BR	Active Channel Width (m)
10-2	34.365265°	119.311082°	11	RI	Near Casitas Springs at bottom of levy	38.2	1.0	0	0	10	70	20	0	44.5
3-2	34.373789°	119.308417°	12	RB	Near Casitas Springs at top of levy	22.0	3.7	10	5	10	65	10	0	27.0
4	34.384743°	119.310030°	14	RI	0.5 km upstream of San Antonio Cr. confluence	23.8	5.0	0	0	0	15	85	0	27.9
5-2	34.396095°	119.309537°	15	RI	0.4 km downstream of Santa Ana Blvd. bridge	8.4	7.0	0	5	5	45	45	0	50.6
6-5	34.411318°	119.301491°	17	CB	1.4 km upstream of Santa Ana Blvd. bridge	26.1	5.0	0	0	0	65	35	0	33.8
9	34.426708°	119.301831°	19	RI	0.2 km upstream of Hwy 150 bridge	67.9	1.5	0	0	0	30	70	0	32.4
7	34.438184°	119.299528°	20	RB	1.1 km upstream of Hwy 150 bridge	31.6	2.0	5	0	10	40	45	0	65.9

[a]The habitat types are: RB = rapid with protruding boulders, RI = riffle, and CB = cascade over boulders.
[b]The substrate types are: SO = silt and organics, SD = sand, GR = gravel, CB = cobble, BD = boulders, and BR = bedrock.

Appendix 3. Completed transects through 2020 at impediment sites for ramp-down target discharges from the Robles Fish Facility.

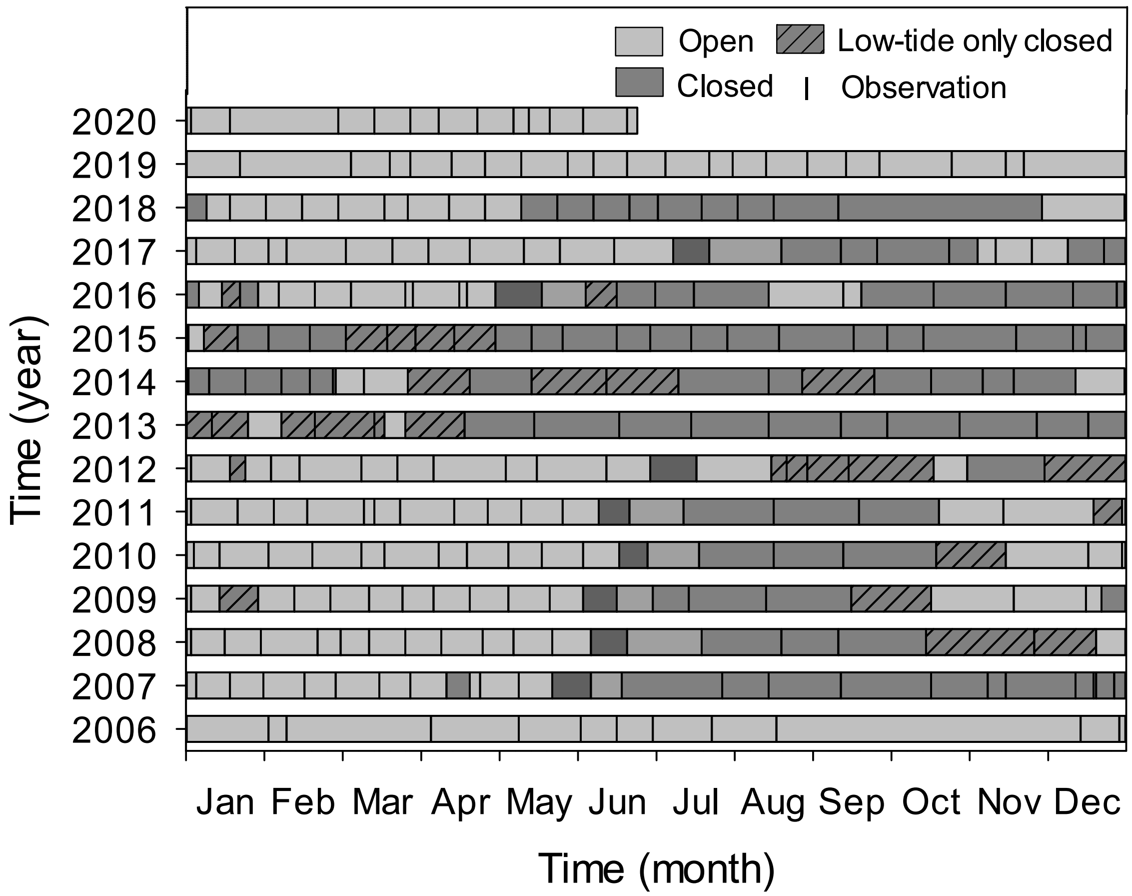
Robles Discharge (cfs)	Impediment Sites								
	3-2	**4**	**5-2**	**6-2 6-3**	**6-4 6-5**	**7**	**9**	**10**	**10-2**
171	x		x	x, x			x	x	
100	x	x	x			x	x	x	x
82	x, x	x	x		x	x, x	x, x	x	x
74	x	x	x, x	x, x	x	x	x		x
68	x		x		x	x	x		x
62	x	x, x, x, x	x	x		x	x	x	x
56	x		x	x	x	x	x	dry	x
50	x	x	x	x, x	x	x, x	x	x, x	x
40	x	x, x, x	x, x	x	x	x, x, x	x, x, x	x	x
30	x	x, x	x, x	x	x, x	x, x, x	x, x, x	x, x	x
20	x	x	x		x	x	x		x

Completed transects rounded to nearest Robles discharge (e.g., the four transects measured at Site 4 at 62 cfs ranged from 61-63 cfs) based on mean 2.6 rkm/h lag time and averaging hourly discharge of released water from Robles. Colors correspond to year of survey: x = 2010, x = 2011, x = 2014, x = 2017, x = 2018, and x = 2019. Sites 4, 6-2 through 6-5, and 10 were alter by storm flows and data have not been collected since last year identified.

Appendix 16. Ventura River sandbar monitoring data from July 2019 through June 2020.

					High Tide		Low Tide				
Date	Sandbar Breached (Y/N)	Time (24h)	Tide Height (ft)	Tidal State	Time (24h)	Height (ft)	Time (24h)	Height (ft)	Mean Daily Discharge at Foster[a] (cfs)	Mean Daily Discharge at Robles (cfs)	Notes
7/5/2019	Y	10:00	1.86	flood	13:06	4.09	6:32	-1.19	17.1	15.0	Open, east bank
7/22/2019	Y	13:20	3.80	flood	14:30	4.02	7:46	0.78	14.6	15.0	Open, east bank
7/31/2019	Y	13:00	2.90	ebb	15:20	1.86	10:23	4.17	11.2	11.0	Open, east bank
8/13/2019	Y	12:23	3.18	slack	10:25	4.15	15:30	2.09	11.8	9.0	Open, east bank
8/29/2019	Y	15:30	1.38	slack	21:17	6.86	15:15	1.36	8.68	6.0	Open, east bank
9/13/2019	Y	12:20	3.61	slack	10:06	4.69	15:49	1.48	7.25	3.0	Open, east bank
9/26/2019	Y	10:30	4.15	ebb	8:43	4.99	14:23	1.29	7.38	3.0	Open, east bank
10/24/2019	Y	9:30	4.25	slack	7:39	5.07	13:32	1.47	5.9	6.0	Open, east bank
11/14/2019	Y	13:30	2.27	ebb	9:23	6.01	16:45	-0.26	5.04	8.0	Open, east bank
11/21/2019	Y	10:30	2.03	ebb	5:30	4.95	11:34	1.81	4.62	8.0	Open, east bank
12/31/2019	Y	14:47	3.55	ebb	13:37	3.69	16:19	2.84	27.3	36.0	Open, east bank
1/2/2020	Y	10:10	2.67	flood	14:08	3.22	9:30	2.64	22.8	30.0	Open, east bank
1/17/2020	Y	11:25	1.87	flood	15:12	3.30	9:47	1.48	22.6	21.0	Open, east bank
2/28/2020	Y	12:15	3.39	ebb	11:42	3.44	17:44	1.33	10.7	9.0	Open, east bank
3/13/2020	Y	15:44	2.72	ebb	13:12	3.85	18:54	1.12	14.3	26.0	Open, east bank
3/27/2020	Y	14:45	2.49	ebb	11:54	3.66	17:34	1.35	34.5	41.0	Open, east bank
4/7/2020	Y	15:30	-0.41	slack	9:35	5.53	15:53	-0.47	109	57.0	Open, east bank
4/22/2020	Y	13:20	2.20	ebb	10:02	4.16	15:49	0.93	26.6	29.0	Open, east bank
5/6/2020	Y	14:05	0.90	ebb	9:31	4.68	15:16	0.47	27.3	28.0	Open, east bank
5/12/2020	Y	14:30	3.03	flood	16:19	3.43	8:54	-0.27	35	31.0	Open, east bank
5/20/2020	Y	12:25	2.28	ebb	9:18	3.73	14:41	1.39	25.9	27.0	Open, east bank
6/2/2020	Y	12:15	1.08	ebb	7:38	4.02	13:21	0.78	18.9	23.0	Open, east bank
6/19/2020	Y	13:42	2.25	ebb	9:56	3.46	14:33	2.14	14.7	17.0	Open, east bank
6/23/2020	Y	12:45	3.56	slack	12:49	3.57	6:08	-0.91	13.5	15.0	Open, east bank

[a]USGS gauging station number 11118500, downstream of Foster Park.



Appendix 17. Sandbar status at the mouth of the Ventura River from 2006 through July of 2020. Each observation is indicated by a vertical line and the sandbar status was assumed to remain unchanged until the next observation.

Appendix 18. Weekly fish attraction counts at the Robles Fish Facility during 2020.

Date	Method	Direction	Length (m)	Temp (°C)	Turbidity (NTU)	Robles Discharge (cfs)	Species[a]	Count
1/2/2020	Snorkel	Downstream	200	13.0	10.0	36	NFO	0
1/2/2020	Snorkel	Upstream	140	13.0	10.0	36	NFO	0
1/7/2020	Bank	Downstream	200	10.0	4.4	22	NFO	0
1/7/2020	Bank	Upstream	140	10.0	4.4	22	NFO	0
1/16/2020	Bank	Downstream	200	8.0	4.0	18	NFO	0
1/16/2020	Bank	Upstream	140	8.0	4.0	18	NFO	0
1/24/2020	Bank	Downstream	200	11.0	3.0	17	NFO	0
1/24/2020	Bank	Upstream	140	11.0	3.0	17	NFO	0
1/28/2020	Snorkel	Downstream	200	11.0	1.3	16	NFO	0
1/28/2020	Snorkel	Upstream	140	11.0	1.3	16	NFO	0
2/4/2020	Bank	Downstream	200	5.0	3.3	14	NFO	0
2/4/2020	Bank	Upstream	140	5.0	3.3	14	NFO	0
2/10/2020	Bank	Downstream	200	9.2	3.6	11	NFO	0
2/10/2020	Bank	Upstream	140	9.2	3.6	11	NFO	0
2/18/2020	Bank	Downstream	200	6.8	2.5	11	NFO	0
2/18/2020	Bank	Upstream	140	6.8	2.5	11	NFO	0
2/25/2020	Snorkel	Downstream	200	15.0	1.6	11	NFO	0
2/25/2020	Snorkel	Upstream	140	15.0	1.6	11	NFO	0
3/6/2020	Bank	Downstream	200	16.8	5.8	7	NFO	0
3/6/2020	Bank	Upstream	140	16.8	5.8	7	NFO	0
3/13/2020	Bank	Downstream	200	12.4	10.0	26	NFO	0
3/13/2020	Bank	Upstream	140	12.4	10.0	26	NFO	0
3/25/2020	Bank	Downstream	200	12.2	23.0	39	NFO	0
3/25/2020	Bank	Upstream	140	12.2	23.0	39	NFO	0
4/2/2020	Bank	Downstream	200	18.2	22.4	27	NFO	0
4/2/2020	Bank	Upstream	140	18.2	22.4	27	NFO	0
4/15/2020	Bank	Downstream	200	13.0	13.6	45	NFO	0
4/15/2020	Bank	Upstream	140	13.0	13.6	45	NFO	0
4/21/2020	Bank	Downstream	200	13.8	3.4	29	NFO	0
4/21/2020	Bank	Upstream	140	13.8	3.4	29	NFO	0
4/27/2020	Snorkel	Downstream	200	19.0	2.5	30	NFO	0
4/27/2020	Snorkel	Upstream	140	19.0	2.5	30	NFO	0
4/29/2020	Bank	Downstream	200	19.0	2.4	30	NFO	0
4/29/2020	Bank	Upstream	140	19.0	2.4	30	NFO	0
5/4/2020	Bank	Downstream	200	17.0	1.5	28	NFO	0
5/4/2020	Bank	Upstream	140	17.0	1.5	28	NFO	0
5/19/2020	Snorkel	Downstream	200	17.0	1.9	28	NFO	0
5/19/2020	Snorkel	Upstream	140	17.0	1.9	28	NFO	0
5/27/2020	Bank	Downstream	200	20.3	8.9	23	NFO	0
5/27/2020	Bank	Upstream	140	20.3	8.9	23	NFO	0
6/1/2020	Snorkel	Downstream	200	17.0	11.4	22	NFO	0
6/1/2020	Snorkel	Upstream	140	17.0	11.4	22	NFO	0
6/10/2020	Bank	Downstream	200	18.0	7.0	15	NFO	0
6/10/2020	Bank	Upstream	140	18.0	7.0	15	NFO	0
6/17/2020	Snorkel	Downstream	200	21.0	1.3	14	NFO	0
		Upstream	3,080 m				Upstream	0
		Downstream	4,600 m				Downstream	0
		Total	7,680 m				Total	0

[a]OMY = *O. mykiss* and NFO = no fish observed.

Appendix 19. Post-storm fish attraction counts of *O. mykiss* at the Robles Fish Facility for 2020 Storm Events.

Date	Time	Method	Location	Temp (°C)[a]	Turbidity (NTU)[a]	Robles Discharge (CFS)[a]	Species[b]	Count
3/17/2020	10:00	Bank	Entrance Pool	6.6	379.2	35	NFO	0
3/18/2020	11:00	Bank	Entrance Pool	10.1	102.1	40	NFO	0
3/19/2020	10:00	Bank	Entrance Pool	9.3	120.9	36	NFO	0
3/20/2020	12:00	Bank	Entrance Pool	11.9	71.3	26	NFO	0
3/21/2020	11:15	Bank	Entrance Pool	13.6	36.5	23	NFO	0
3/22/2020	11:00	Bank	Entrance Pool	14.6	49.7	22	NFO	0
3/23/2020	11:00	Bank	Entrance Pool	12.5	248.5	24	NFO	0
3/24/2020	11:00	Bank	Entrance Pool	14.1	247.3	32	NFO	0
3/25/2020	11:30	Bank	Entrance Pool	12.8	21.5	39	NFO	0
3/26/2020	10:00	Bank	Entrance Pool	11.2	15.3	41	NFO	0
3/27/2020	11:00	Bank	Entrance Pool	10.9	12.7	41	NFO	0
3/28/2020	11:00	Bank	Entrance Pool	11.4	11.8	42	NFO	0
3/29/2020	11:00	Bank	Entrance Pool	12.7	13.3	40	NFO	0
3/30/2020	10:00	Bank	Entrance Pool	12.3	29.6	35	NFO	0
3/31/2020	11:15	Bank	Entrance Pool	13.9	29.7	28	NFO	0
4/1/2020	11:30	Bank	Entrance Pool	15.6	21.1	25	NFO	0
4/2/2020	11:30	Bank	Entrance Pool	16.0	21.3	27	NFO	0
4/7/2020	11:00	Bank	Entrance Pool	8.6	148.0	57	NFO	0
4/8/2020	11:00	Bank	Entrance Pool	10.7	56.8	69	NFO	0
4/9/2020	11:15	Bank	Entrance Pool	8.6	49.0	62	NFO	0
4/10/2020	11:00	Bank	Entrance Pool	12.1	64.3	57	NFO	0
4/11/2020	11:45	Bank	Entrance Pool	20.0	45.6	53	NFO	0
4/12/2020	11:45	Bank	Entrance Pool	13.7	26.0	50	NFO	0
4/13/2020	12:00	Bank	Entrance Pool	16.0	19.2	47	NFO	0
4/14/2020	11:45	Bank	Entrance Pool	15.9	20.9	45	NFO	0
4/15/2020	11:45	Bank	Entrance Pool	19.7	13.1	45	NFO	0
4/16/2020	11:45	Bank	Entrance Pool	17.8	16.1	45	NFO	0
4/17/2020	11:00	Bank	Entrance Pool	16.6	18.9	40	NFO	0
4/18/2020	11:00	Bank	Entrance Pool	15.8	13.1	32	NFO	0
3/17/2020	10:00	Bank	Entrance Pool	6.6	379.2	35	NFO	0
3/18/2020	11:00	Bank	Entrance Pool	10.1	102.1	40	NFO	0
3/19/2020	10:00	Bank	Entrance Pool	9.3	120.9	36	NFO	0
3/20/2020	12:00	Bank	Entrance Pool	11.9	71.3	26	NFO	0
3/21/2020	11:15	Bank	Entrance Pool	13.6	36.5	23	NFO	0
3/22/2020	11:00	Bank	Entrance Pool	14.6	49.7	22	NFO	0
3/23/2020	11:00	Bank	Entrance Pool	12.5	248.5	24	NFO	0
3/24/2020	11:00	Bank	Entrance Pool	14.1	247.3	32	NFO	0
3/25/2020	11:30	Bank	Entrance Pool	12.8	21.5	39	NFO	0

[a]Environmental conditions at time of survey.
[b]OMY = *O. mykiss* and NFO = no fish observed.

Appendix 20. Monthly flow summary for Robles Fish Facility, reporting year 2019-2020. Canal diversion is reported in af and not in cfs, this will be corrected in the next draft.

Ventura River Flow Assessment
Reporting Year 2019 -2020

	(1)	(2)	(1) + (2)		B.O. Required Flow Release (cfs)	(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows					**Robles Facility Mean Daily Flows**			
Jul-19	Matilija Ck D/S Dam* (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)			Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	40	9	49		20	16	15	0	15
2	30	7	37		20	15	15	0	15
3	13	5	18		20	15	15	0	15
4	13	5	18		20	15	15	0	15
5	12	5	17		20	15	15	0	15
6	12	5	17		20	15	16	0	16
7	12	5	17		20	16	16	0	16
8	12	6	18		20	16	16	0	16
9	12	6	18		20	16	16	0	16
10	12	5	17		20	15	16	0	16
11	12	5	17		20	15	16	0	16
12	12	5	17		20	15	15	0	15
13	11	5	16		20	15	16	0	16
14	11	4	15		20	15	15	0	15
15	11	4	15		20	14	15	0	15
16	11	4	15		20	14	15	0	15
17	11	4	15		20	14	15	0	15
18	11	4	15		20	14	15	0	15
19	11	4	15		20	14	16	0	16
20	11	4	15		20	14	16	0	16
21	10	4	14		20	15	15	0	15
22	10	4	14		20	14	15	0	15
23	10	4	14		20	14	15	0	15
24	10	3	13		20	14	14	0	14
25	10	4	13		20	13	14	0	14
26	10	4	13		20	13	14	0	14
27	10	3	13		20	13	13	0	13
28	10	3	13		20	13	13	0	13
29	9	3	13		20	12	13	0	13
30	9	3	13		20	12	12	0	12
31	9	3	13		20	11	11	0	11
Totals	387	138	525		620	445	461	0	461

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
VRNMO Weir impacted by sediment. Discharge estimated.

Ventura River Flow Assessment
Reporting Year 2019 -2020

Aug-19	(1) Matilija Ck D/S Dam * (cfs)	(2) North Fork Matilija Ck.* (cfs)	(1) + (2) Sum of Creek Flows (cfs)		B.O. Required Flow Release (cfs)	(3) Fishway Ladder (cfs)	(4) VRNMO Weir (cfs)	(5) Diversion Canal (cfs)	(4) + (5) Total Inflow (cfs)
	Source Stream Mean Daily Flows					**Robles Facility Mean Daily Flows**			
1	9	3	12		20	11	11	0	11
2	9	3	12		20	11	11	0	11
3	9	3	12		20	12	12	0	12
4	9	3	12		20	12	12	0	12
5	9	3	12		20	11	11	0	11
6	8	3	12		20	10	10	0	10
7	8	3	12		20	10	10	0	10
8	8	3	12		20	9	9	0	9
9	8	3	11		20	9	9	0	9
10	8	3	11		20	9	9	0	9
11	8	3	11		20	9	9	0	9
12	8	3	10		20	9	9	0	9
13	8	3	10		20	9	9	0	9
14	7	3	10		20	8	8	0	8
15	7	3	10		20	8	8	0	8
16	7	3	10		20	8	8	0	8
17	7	3	10		20	8	8	0	8
18	7	3	10		20	8	8	0	8
19	7	3	9		20	8	8	0	8
20	7	3	9		20	8	8	0	8
21	7	3	9		20	7	7	0	7
22	6	3	9		20	7	7	0	7
23	6	3	9		20	7	7	0	7
24	6	3	9		20	7	7	0	7
25	6	3	9		20	7	7	0	7
26	6	3	9		20	6	6	0	6
27	6	3	8		20	6	6	0	6
28	6	3	8		20	6	6	0	6
29	6	3	8		20	6	6	0	6
30	6	3	8		20	6	6	0	6
31	6	3	8		20	5	5	0	5
Totals	224	88	311		620	258	258	0	258

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
VRNMO Weir impacted by sediment. Discharge estimated.

Ventura River Flow Assessment
Reporting Year 2019 -2020

	(1)	(2)	(1) + (2)		ired Flow Re	(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows					**Robles Facility Mean Daily Flows**			
Sep-19	Ck D/S Da	Fork Matilija Ck	of Creek Flows			way Ladder	VRNMO W	rsion Canal	Total Inflow (cfs)
1	6	3	8		20	5	5	0	5
2	6	3	8		20	5	5	0	5
3	6	3	8		20	5	5	0	5
4	6	3	8		20	5	5	0	5
5	6	3	8		20	5	5	0	5
6	6	3	8		20	4	4	0	4
7	6	3	8		20	4	4	0	4
8	6	3	8		20	4	4	0	4
9	6	3	8		20	4	4	0	4
10	6	3	8		20	4	4	0	4
11	6	3	8		20	5	5	0	5
12	6	3	8		20	4	4	0	4
13	6	3	8		20	3	3	0	3
14	6	3	8		20	3	3	0	3
15	6	3	8		20	4	4	0	4
16	6	3	8		20	4	4	0	4
17	6	3	8		20	4	4	0	4
18	6	3	8		20	3	3	0	3
19	6	3	9		20	3	3	0	3
20	6	3	9		20	3	3	0	3
21	6	3	9		20	4	4	0	4
22	6	3	9		20	4	4	0	4
23	6	3	9		20	3	3	0	3
24	6	3	9		20	3	3	0	3
25	6	4	9		20	3	3	0	3
26	6	4	9		20	3	3	0	3
27	6	4	9		20	4	4	0	4
28	6	4	9		20	5	5	0	5
29	6	4	9		20	4	4	0	4
30	6	4	10		20	4	4	0	4
Totals	169	88	257	0	600	123	123	0	123

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
VRNMO Weir impacted by sediment. Discharge estimated.

Ventura River Flow Assessment
Reporting Year 2019 -2020

	(1)	(2)	(1) + (2)			(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				B.O.	**Robles Facility Mean Daily Flows**			
	Matilija Ck	North Fork	Sum of Creek		Required	Fishway	VRNMO	Diversion	Total Inflow
Oct-19	D/S Dam*	Matilija Ck.*	Flows		Flow Release	Ladder	Weir	Canal	(cfs)
1	M	M	TBD		20	4	4	0	4
2	M	M	TBD		20	4	4	0	4
3	M	M	TBD		20	4	4	0	4
4	M	M	TBD		20	4	4	0	4
5	M	M	TBD		20	3	3	0	3
6	M	M	TBD		20	3	3	0	3
7	M	M	TBD		20	3	3	0	3
8	M	M	TBD		20	3	3	0	3
9	M	M	TBD		20	3	3	0	3
10	M	M	TBD		20	3	3	0	3
11	M	M	TBD		20	3	3	0	3
12	M	M	TBD		20	3	3	0	3
13	M	M	TBD		20	3	3	0	3
14	M	M	TBD		20	3	3	0	3
15	M	M	TBD		20	3	3	0	3
16	M	M	TBD		20	3	3	0	3
17	M	M	TBD		20	3	3	0	3
18	M	M	TBD		20	3	3	0	3
19	M	M	TBD		20	3	3	0	3
20	M	M	TBD		20	3	3	0	3
21	M	M	TBD		20	3	3	0	3
22	M	M	TBD		20	2	2	0	2
23	M	M	TBD		20	2	2	0	2
24	M	M	TBD		20	2	2	0	2
25	M	M	TBD		20	2	2	0	2
26	M	M	TBD		20	2	2	0	2
27	M	M	TBD		20	3	3	0	3
28	M	M	TBD		20	3	3	0	3
29	M	M	TBD		20	3	3	0	3
30	M	M	TBD		20	3	3	0	3
31	M	M	TBD		20	3	3	0	3
Totals	0	0	0		620	92	92	0	92

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined
VRNMO Weir impacted by sediment. Discharge estimated.

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	(1)	(2)	(1) + (2)	ired Flow Re	(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				Robles Facility Mean Daily Flows			
Nov-19	Matilija Ck D/S Dam* (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)		Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	M	M	TBD	20	3	3	0	3
2	M	M	TBD	20	3	3	0	3
3	M	M	TBD	20	3	3	0	3
4	M	M	TBD	20	3	3	0	3
5	M	M	TBD	20	3	3	0	3
6	M	M	TBD	20	3	3	0	3
7	M	M	TBD	20	3	3	0	3
8	M	M	TBD	20	3	3	0	3
9	M	M	TBD	20	3	3	0	3
10	M	M	TBD	20	3	3	0	3
11	M	M	TBD	20	3	3	0	3
12	M	M	TBD	20	3	3	0	3
13	M	M	TBD	20	3	3	0	3
14	M	M	TBD	20	3	3	0	3
15	M	M	TBD	20	3	3	0	3
16	M	M	TBD	20	3	3	0	3
17	M	M	TBD	20	3	3	0	3
18	M	M	TBD	20	3	3	0	3
19	M	M	TBD	20	3	3	0	3
20	M	M	TBD	20	3	3	0	3
21	M	M	TBD	20	3	3	0	3
22	M	M	TBD	20	3	3	0	3
23	M	M	TBD	20	3	3	0	3
24	M	M	TBD	20	3	3	0	3
25	M	M	TBD	20	3	3	0	3
26	M	M	TBD	20	2	2	0	2
27	M	M	TBD	20	7	7	0	7
28	M	M	TBD	20	14	11	0	11
29	M	M	TBD	20	13	16	0	16
30	M	M	TBD	20	9	13	0	13
Totals	0	0	0	600	120	124	0	124

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined
VRNMO Weir impacted by sediment. Discharge estimated.

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Dec-19	(1)	(2)	(1) + (2)		ired Flow Re	(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows					**Robles Facility Mean Daily Flows**			
	Matilija Ck D/S Dam * (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)			Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	M	M	TBD		20	11	15	0	15
2	M	M	TBD		20	8	13	0	13
3	M	M	TBD		20	8	12	0	12
4	M	M	TBD		20	22	26	0	26
5	M	M	TBD		20	24	30	0	30
6	M	M	TBD		20	17	23	96	120
7	M	M	TBD		20	25	30	17	46
8	M	M	TBD		20	26	32	0	32
9	M	M	TBD		20	24	30	7	37
10	M	M	TBD		20	20	26	35	61
11	M	M	TBD		20	17	24	8	32
12	M	M	TBD		20	16	22	0	22
13	M	M	TBD		20	14	18	0	18
14	M	M	TBD		20	14	16	0	16
15	M	M	TBD		20	13	15	0	15
16	M	M	TBD		20	12	16	0	16
17	M	M	TBD		20	12	16	0	16
18	M	M	TBD		20	12	15	0	15
19	M	M	TBD		20	11	15	0	15
20	M	M	TBD		20	11	14	0	14
21	M	M	TBD		20	11	14	0	14
22	M	M	TBD		20	14	16	0	16
23	M	M	TBD		20	25	23	0	23
24	M	M	TBD		20	25	22	8	30
25	M	M	TBD		20	25	22	93	115
26	M	M	TBD		20	28	81	26	107
27	M	M	TBD		20	25	27	12	38
28	M	M	TBD		20	21	36	149	185
29	M	M	TBD		20	17	42	70	113
30	M	M	TBD		20	16	39	21	60
31	M	M	TBD		20	14	36	0	36
Totals	0	0	0		620	537	766	543	1308

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined

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	(1)	(2)	(1) + (2)		ed Flow R	(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows					**Robles Facility Mean Daily Flows**			
Jan-20	Matilija Ck D/S Dam * (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)			Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	M	M	TBD		20	12	34	0	34
2	M	M	TBD		20	11	30	0	30
3	M	M	TBD		20	10	25	0	25
4	M	M	TBD		20	10	24	0	24
5	M	M	TBD		20	9	23	0	23
6	M	M	TBD		20	9	22	0	22
7	M	M	TBD		20	9	22	0	22
8	M	M	TBD		20	9	21	0	21
9	M	M	TBD		20	9	21	0	21
10	M	M	TBD		20	9	20	0	20
11	M	M	TBD		20	9	20	0	20
12	M	M	TBD		20	9	20	0	20
13	M	M	TBD		20	8	20	0	20
14	M	M	TBD		20	7	19	0	19
15	M	M	TBD		20	7	19	0	19
16	M	M	TBD		20	12	18	0	18
17	M	M	TBD		20	20	21	0	21
18	M	M	TBD		20	17	18	0	18
19	M	M	TBD		20	16	18	0	18
20	M	M	TBD		20	16	18	0	18
21	M	M	TBD		20	17	18	0	18
22	M	M	TBD		20	16	17	0	17
23	M	M	TBD		20	16	17	0	17
24	M	M	TBD		20	15	17	0	17
25	M	M	TBD		20	15	16	0	16
26	M	M	TBD		20	15	16	0	16
27	M	M	TBD		20	15	16	0	16
28	M	M	TBD		20	14	16	0	16
29	M	M	TBD		20	14	24	0	24
30	M	M	TBD		20	14	14	0	14
31	M	M	TBD		20	14	15	0	15
Totals	0	0	0		620	382	619	0	619

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined

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Feb-20	(1) Matilija Ck D/S Dam * (cfs)	(2) North Fork Matilija Ck.* (cfs)	(1) + (2) Sum of Creek Flows (cfs)		ed Flow R	(3) Fishway Ladder (cfs)	(4) VRNMO Weir (cfs)	(5) Diversion Canal (cfs)	(4) + (5) Total Inflow (cfs)
	Source Stream Mean Daily Flows					Robles Facility Mean Daily Flows			
1	M	M	TBD		20	13	14	0	14
2	M	M	TBD		20	13	14	0	14
3	M	M	TBD		20	13	14	0	14
4	M	M	TBD		20	13	14	0	14
5	M	M	TBD		20	13	15	0	15
6	M	M	TBD		20	13	15	0	15
7	M	M	TBD		20	13	13	0	13
8	M	M	TBD		20	13	11	0	11
9	M	M	TBD		20	13	11	0	11
10	M	M	TBD		20	12	11	0	11
11	M	M	TBD		20	12	11	0	11
12	M	M	TBD		20	12	11	0	11
13	M	M	TBD		20	12	11	0	11
14	M	M	TBD		20	12	11	0	11
15	M	M	TBD		20	12	11	0	11
16	M	M	TBD		20	12	11	0	11
17	M	M	TBD		20	12	11	0	11
18	M	M	TBD		20	11	11	0	11
19	M	M	TBD		20	9	11	0	11
20	M	M	TBD		20	8	10	0	10
21	M	M	TBD		20	11	11	0	11
22	M	M	TBD		20	12	12	0	12
23	M	M	TBD		20	12	12	0	12
24	M	M	TBD		20	12	11	0	11
25	M	M	TBD		20	11	11	0	11
26	M	M	TBD		20	10	10	0	10
27	M	M	TBD		20	10	10	0	10
28	M	M	TBD		20	10	9	0	9
29	M	M	TBD		20	10	9	0	9
Totals	0	0	0		580	337	337	0	337

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined

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	(1)	(2)	(1) + (2)		ired Flow Re	(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows					**Robles Facility Mean Daily Flows**			
Mar-20	Matilija Ck D/S Dam * (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)			Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	M	M	TBD		20	10	9	0	9
2	M	M	TBD		20	10	9	0	9
3	M	M	TBD		20	10	8	0	8
4	M	M	TBD		20	10	8	0	8
5	M	M	TBD		20	10	7	0	7
6	M	M	TBD		20	9	7	0	7
7	M	M	TBD		20	10	7	0	7
8	M	M	TBD		20	11	8	0	8
9	M	M	TBD		20	10	7	0	7
10	M	M	TBD		20	11	8	0	8
11	M	M	TBD		20	22	21	0	21
12	M	M	TBD		20	21	31	3	34
13	M	M	TBD		20	19	26	27	53
14	M	M	TBD		20	17	14	0	14
15	M	M	TBD		20	17	14	0	14
16	M	M	TBD		20	27	276	207	482
17	M	M	TBD		50	41	35	292	327
18	M	M	TBD		50	52	40	112	152
19	M	M	TBD		50	40	36	4	40
20	M	M	TBD		50	34	26	24	50
21	M	M	TBD		50	30	23	21	43
22	M	M	TBD		50	29	22	3	25
23	M	M	TBD		50	32	24	263	287
24	M	M	TBD		50	42	32	94	126
25	M	M	TBD		50	51	39	47	87
26	M	M	TBD		50	51	41	33	74
27	M	M	TBD		50	52	41	18	59
28	M	M	TBD		50	52	42	7	49
29	M	M	TBD		50	51	40	1	42
30	M	M	TBD		50	44	35	6	40
31	M	M	TBD		50	35	28	14	43
Totals	0	0	0		1070	860	963	1175	2138

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined
Represents change on date dictated by storm flow augmentation ramp-down schedule. Peak flow met BO definition of potential migration event.

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Apr-20	(1) Source Stream Mean Daily Flows: Matilija Ck D/S Dam * (cfs)	(2) North Fork Matilija Ck.* (cfs)	(1) + (2) Sum of Creek Flows (cfs)		B.O. Required Flow Release (cfs)	(3) Robles Facility Mean Daily Flows: Fishway Ladder (cfs)	(4) VRNMO Weir (cfs)	(5) Diversion Canal (cfs)	(4) + (5) Total Inflow (cfs)
1	M	M	TBD		40	32	25	14	39
2	M	M	TBD		30	32	27	12	38
3	M	M	TBD		30	33	26	8	34
4	M	M	TBD		30	32	25	8	33
5	M	M	TBD		30	34	27	18	45
6	M	M	TBD		30	40	754	671	1425
7	M	M	TBD		82	46	57	407	464
8	M	M	TBD		74	53	69	236	305
9	M	M	TBD		68	50	62	310	372
10	M	M	TBD		62	49	57	315	371
11	M	M	TBD		56	51	53	269	321
12	M	M	TBD		56	52	50	223	272
13	M	M	TBD		50	53	47	184	231
14	M	M	TBD		50	53	45	152	197
15	M	M	TBD		50	54	45	125	170
16	M	M	TBD		50	55	45	112	157
17	M	M	TBD		40	48	40	113	153
18	M	M	TBD		30	37	32	117	148
19	M	M	TBD		30	35	28	115	143
20	M	M	TBD		30	36	28	105	133
21	M	M	TBD		30	36	29	92	121
22	M	M	TBD		30	36	29	82	111
23	M	M	TBD		30	36	29	73	102
24	M	M	TBD		30	37	30	64	95
25	M	M	TBD		30	38	30	58	88
26	M	M	TBD		30	40	30	52	82
27	M	M	TBD		30	40	30	47	77
28	M	M	TBD		30	41	31	42	72
29	M	M	TBD		30	39	30	40	71
30	M	M	TBD		30	40	30	38	69
Totals	0	0	0		1218	1256	1840	4101	5940

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined
Represents change on date dictated by storm flow augmentation ramp-down schedule. Peak flow met BO definition of potential migration event.
Fishway flow meter malfunction. Discharge estimated.
Weir heavily impacted by sediment or periods of spill exceeded reliable accuracy of rating table, discharge estimated.

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May-20	(1) Source Stream Mean Daily Flows: Matilija Ck D/S Dam * (cfs)	(2) North Fork Matilija Ck.* (cfs)	(1) + (2) Sum of Creek Flows (cfs)	B.O. Required Flow Release (cfs)	(3) Robles Facility Mean Daily Flows: Fishway Ladder (cfs)	(4) VRNMO Weir (cfs)	(5) Diversion Canal (cfs)	(4) + (5) Total Inflow (cfs)
1	M	M	TBD	30	40	29	33	61
2	M	M	TBD	30	43	29	29	58
3	M	M	TBD	30	44	29	27	55
4	M	M	TBD	30	43	28	21	49
5	M	M	TBD	30	42	28	17	45
6	M	M	TBD	30	40	28	15	44
7	M	M	TBD	30	41	29	11	40
8	M	M	TBD	30	45	28	10	38
9	M	M	TBD	30	45	28	10	38
10	M	M	TBD	30	46	27	11	38
11	M	M	TBD	30	41	29	10	39
12	M	M	TBD	30	45	31	2	32
13	M	M	TBD	30	43	30	3	33
14	M	M	TBD	30	43	30	2	32
15	M	M	TBD	30	42	29	1	29
16	M	M	TBD	30	41	28	0	28
17	M	M	TBD	30	40	28	0	28
18	M	M	TBD	30	36	27	2	29
19	M	M	TBD	30	41	28	0	28
20	M	M	TBD	30	38	27	0	27
21	M	M	TBD	30	33	25	0	25
22	M	M	TBD	30	35	24	0	24
23	M	M	TBD	30	37	24	0	24
24	M	M	TBD	30	38	23	0	23
25	M	M	TBD	30	36	24	0	24
26	M	M	TBD	30	33	23	0	23
27	M	M	TBD	30	31	23	0	23
28	M	M	TBD	30	32	22	0	22
29	M	M	TBD	30	32	22	0	22
30	M	M	TBD	30	34	23	0	23
31	M	M	TBD	30	31	23	0	23
Totals	0	0	0	930	1211	824	202	1025

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined
Fishway flow meter malfunction. Discharge estimated.

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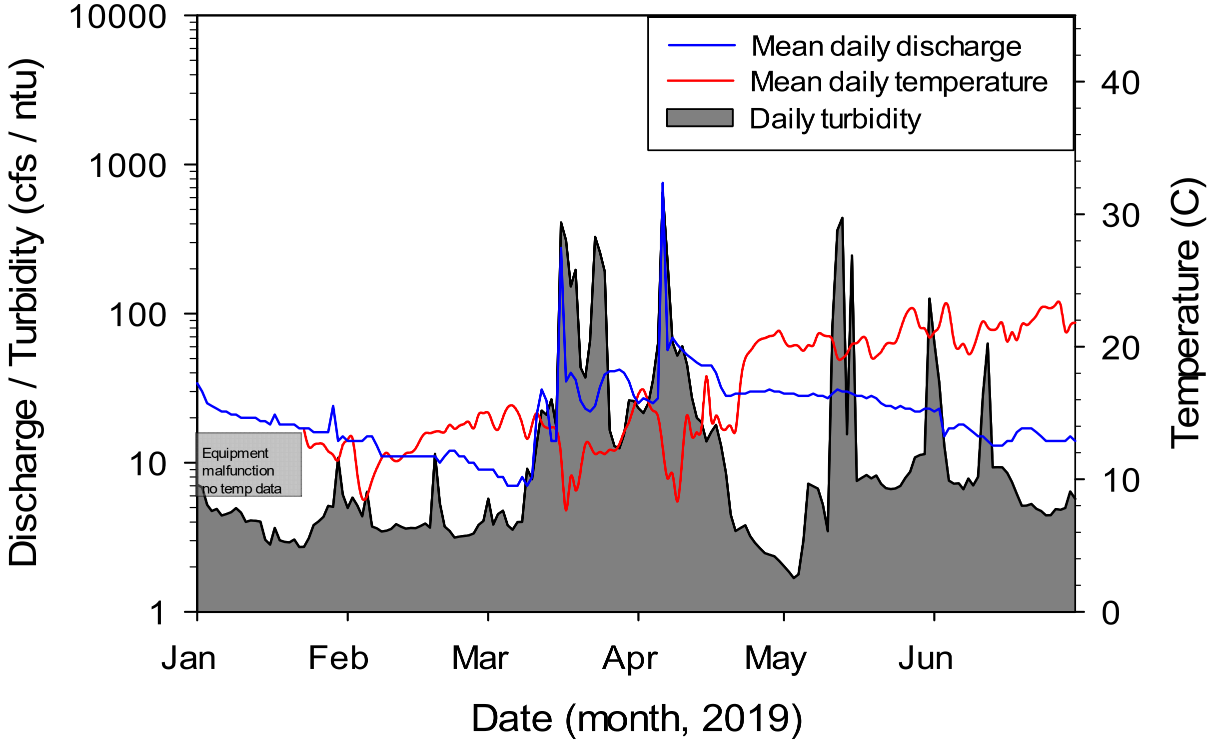
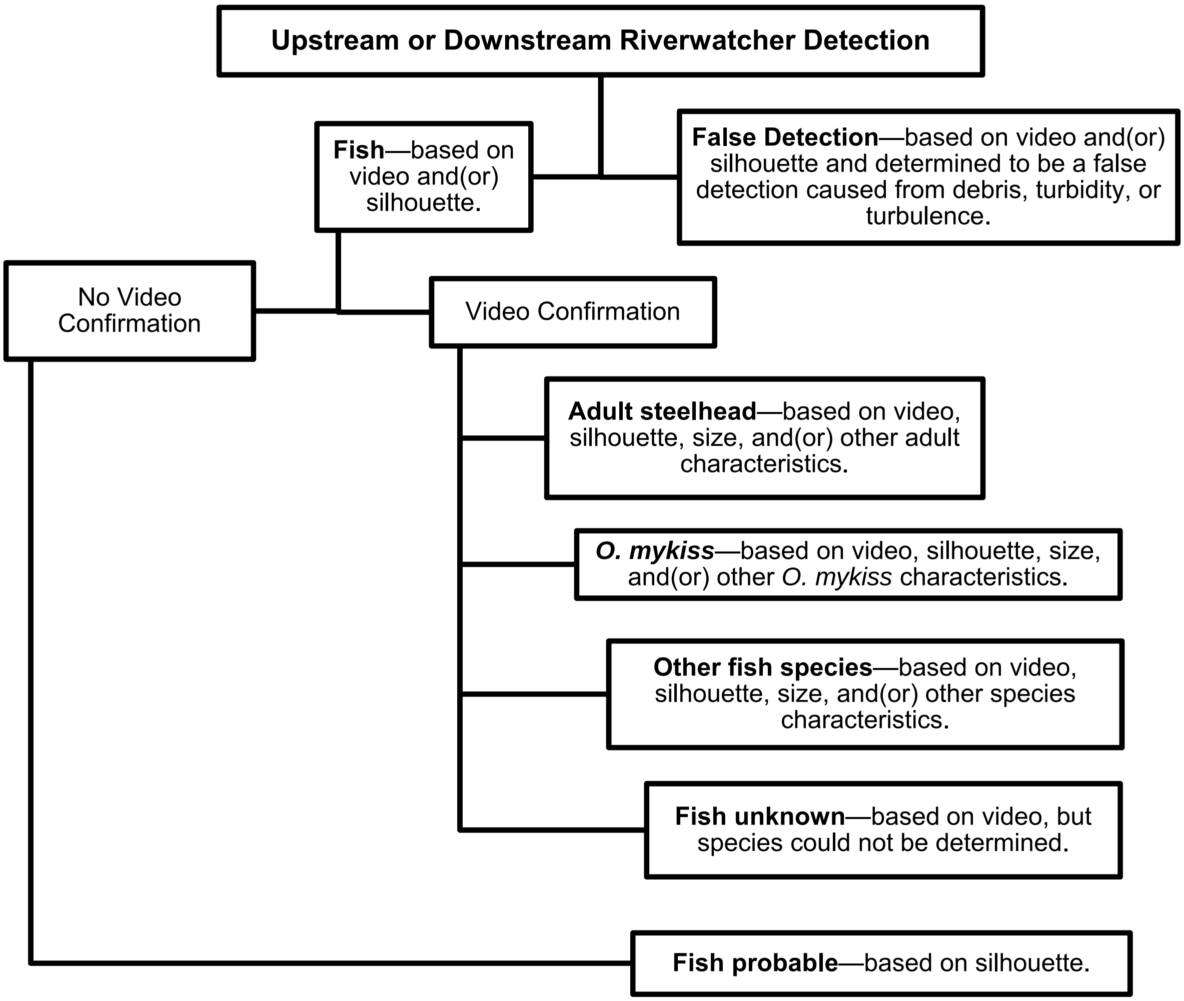
Jun-20	(1)	(2)	(1) + (2)	B.O. Required Flow Release (cfs)	(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows				**Robles Facility Mean Daily Flows**			
	Matilija Ck D/S Dam * (cfs)	North Fork Matilija Ck.* (cfs)	Sum of Creek Flows (cfs)		Fishway Ladder (cfs)	VRNMO Weir (cfs)	Diversion Canal (cfs)	Total Inflow (cfs)
1	M	M	TBD	30	30	22	0	22
2	M	M	TBD	30	27	23	0	23
3	M	M	TBD	30	8	15	0	15
4	M	M	TBD	30	25	17	0	17
5	M	M	TBD	30	25	17	0	17
6	M	M	TBD	30	26	18	0	18
7	M	M	TBD	30	24	18	0	18
8	M	M	TBD	30	24	17	0	17
9	M	M	TBD	30	26	16	0	16
10	M	M	TBD	30	26	15	0	15
11	M	M	TBD	30	26	15	0	15
12	M	M	TBD	30	22	14	0	14
13	M	M	TBD	30	17	13	0	13
14	M	M	TBD	30	17	13	0	13
15	M	M	TBD	30	19	13	0	13
16	M	M	TBD	30	17	14	0	14
17	M	M	TBD	30	19	14	0	14
18	M	M	TBD	30	16	16	0	16
19	M	M	TBD	30	16	17	0	17
20	M	M	TBD	30	19	17	0	17
21	M	M	TBD	30	17	17	0	17
22	M	M	TBD	30	19	16	0	16
23	M	M	TBD	30	19	15	0	15
24	M	M	TBD	30	14	14	0	14
25	M	M	TBD	30	16	14	0	14
26	M	M	TBD	30	18	14	0	14
27	M	M	TBD	30	17	14	0	14
28	M	M	TBD	30	18	14	0	14
29	M	M	TBD	30	19	15	0	15
30	M	M	TBD	30	17	14	0	14
Totals	0	0	0	900	602	473	0	473

*Flow data from Matilija Ck and North Fork Matilija Ck are preliminary and subject to change (VCWPD). Discharge Estimated
M=Missing
TBD=To be determined
Fishway flow meter malfunction. Discharge estimated.



Appendix 21. Mean daily discharge, water temperature, and turbidity at the Robles Fish Facility during the 2020 fish passage season.



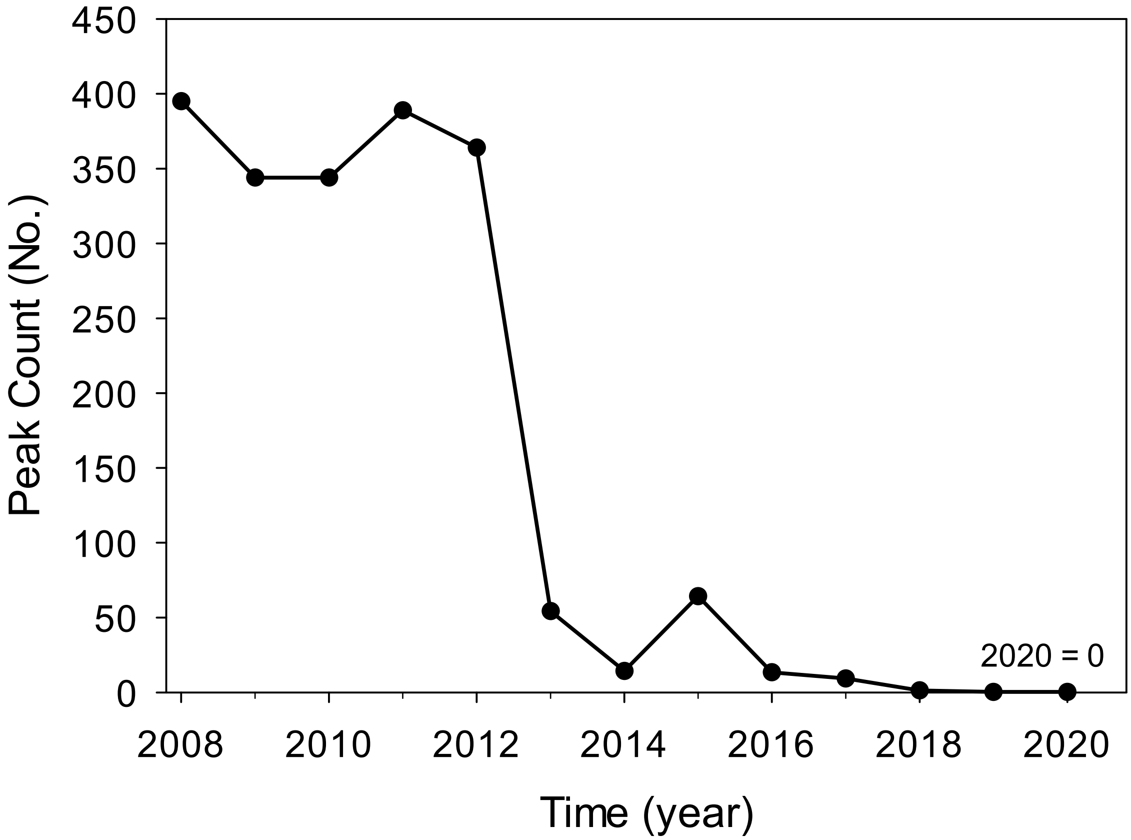
Appendix 22. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections.

Appendix 23. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* for the 2020 fish passage season.

	Upstream	Downstream
O. mykiss	0	0
Fish, non *O. mykiss*	24	15
Fish, unknown	0	0
Fish, probable	0	0
False detections	627	1,027
Total	654	1,052
Mean date - *O. mykiss*	n/a	n/a
Mean date - fish, non *O. mykiss*	5/16/20	4/17/20
Mean date - fish, unknown	n/a	n/a
Mean date - fish, probable	5/13/20	4/13/20
Mean time - *O. mykiss* (24h)	n/a	n/a
Mean time - fish, non *O. mykiss* (24h)	02:57	07:39
Mean time - fish, unknown (24h)	n/a	n/a
Mean time - fish, probable (24h)	08:42	23:15
Mean length - *O. mykiss* (cm)	n/a	n/a
Mean length - fish, non *O. mykiss* (cm)	20.4	18.6
Mean length - fish, unknown (cm)	n/a	n/a
Mean length - fish, probable (cm)	36.3	34
Mean daily temperature - *O. mykiss* (°C)	n/a	n/a
Mean daily temperature - fish, non *O. mykiss* (°C)	18.7	20.6
Mean daily temperature - fish, unknown (°C)	n/a	n/a
Mean daily temperature - fish, probable (°C)	20.9	10.9
Mean daily turbidity - *O. mykiss* (NTU)	n/a	n/a
Mean daily turbidity - fish, non *O. mykiss* (NTU)	9.6	6.0
Mean daily turbidity - fish, unknown (NTU)	n/a	n/a
Mean daily turbidity - fish, probable (NTU)	22.7	50.6
Mean daily turbidity - false detections (NTU)	82.5	90.7
Mean daily discharge - *O. mykiss* (cfs)	n/a	n/a
Mean daily discharge - fish, non O. *mykiss* (cfs)	22.7	30.2
Mean daily discharge - fish, unknown (cfs)	n/a	n/a
Mean daily discharge - fish, probable (cfs)	24.7	52.9
Mean daily discharge - false detections (cfs)	42.3	44.7

Appendix 24. *O. mykiss* relative abundance survey index sites in the Ventura Basin.

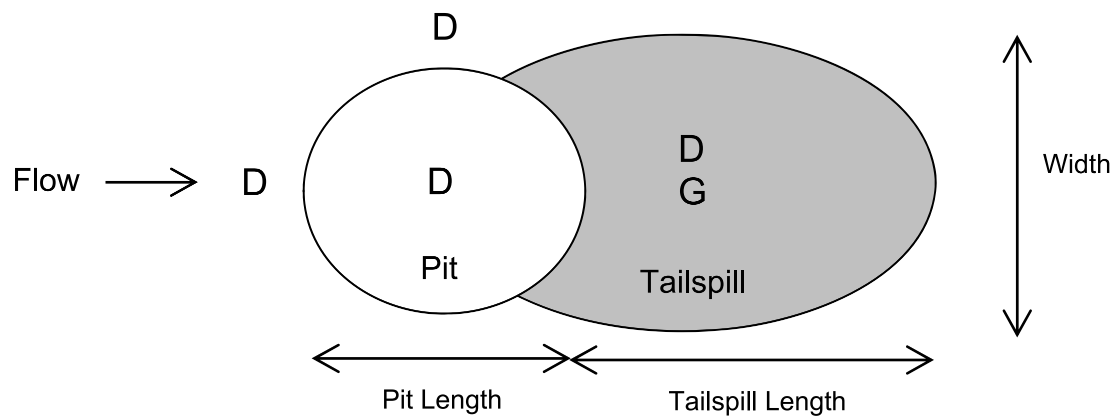
Site No.	Location	River km	Site	Lat.	Long.	Length (m)	Width (m)
1	Ventura River	0.9	Main Street pool	34.28126	-119.30887	25.1	10.0
		0.9	Main Street riffle	34.28164	-119.30893	34.0	8.0
2	Ventura River	9.4	Foster Park pool 1	34.35236	-119.30790	25.0	15.4
		10.0	Foster Park pool 2	34.35508	-119.30988	46.0	16.0
		9.7	Foster Park riffle	34.35308	-119.30877	45.0	11.0
3	Ventura River	13.0	San Antonio conf. pool 1	34.38042	-119.30752	33.0	22.0
		13.0	San Antonio conf. riffle	34.38011	-119.30755	42.0	14.0
		12.9	San Antonio conf. pool 2	34.37969	-119.30781	50.0	10.0
4	Ventura River	18.8	Hwy 150 pool 1	34.42643	-119.30220	43.3	14.0
		18.8	150 pool 2	34.42689	-119.30123	49.5	9.0
		18.7	Hwy 150 riffle	34.42576	-119.30258	43.6	11.0
5	Ventura River	22.1	Land Cons. pool 1	34.45342	-119.29314	50.1	19.1
		22.2	Land Cons. pool 2	34.45448	-119.29293	48.6	15.1
		22.1	Land Cons. Riffle	34.45411	-119.29315	44.6	18.8
6	Ventura River	23.2	Robles weir pools	34.46306	-119.29058	58.7	19.0
		23.3	Robles glide	34.46368	-119.29065	78.3	17.3
		23.4	Robles entrance pool	34.46446	-119.29058	39.8	21.8
		23.4	Fish ladder entrance box	34.46460	-119.29062	15.0	3.0
		23.5	Robles screenbay	34.46451	-119.29133	42.2	13.5
		23.5	Robles forebay	34.46503	-119.29053	33.0	17.2
7	San Antonio Cr.	0.2	Lower San Antonio pool 1	34.38088	-119.30542	16.0	6.0
		0.2	Lower San Antonio riffle	34.38098	-119.30711	20.2	3.5
		0.4	Lower San Antonio pool 2	34.38103	-119.30657	40.0	6.0
8	San Antonio Cr.	9.4	Upper San Antonio riffle	34.43268	-119.25090	25.0	5.0
		9.5	Upper San Antonio pool	34.43241	-119.25095	19.8	5.5
9	NF Matilija Cr.	0.1	Lower NF pool 1	34.48508	-119.30105	7.3	13.3
		0.1	Lower NF pool 2	34.48533	-119.30138	7.9	10.9
		0.2	Lower NF riffle	34.48523	-119.30198	17.8	8.0
10	NF Matilija Cr.	6.6	Upper NF pool	34.50956	-119.27520	29.0	9.0
		6.6	Upper NF riffle	34.50933	-119.27528	33.1	7.5
11	Matilija Cr.	0.3	Lower Matilija pool	34.48282	-119.30170	21.1	24.7
		0.3	Lower Matilija riffle	34.48302	-119.30154	15.9	8.0
12	Matilija Cr.	2.1	Upper Matilija pool	34.49190	-119.31599	89.4	13.7
		2.1	Upper Matilija riffle	34.49233	-119.31704	51.0	9.0
14	San Antonio Cr.	4.3	Fraser St. pool	34.40276	-119.28169	12.8	13.8
		4.4	Fraser St. riffle	34.40291	-119.28157	30.8	5.9
15	Ventura River	8.5	Bedrock pool	34.34539	-119.29931	50.0	17.0
		8.5	Bedrock pool riffle	34.34569	-119.29958	37.0	6.0



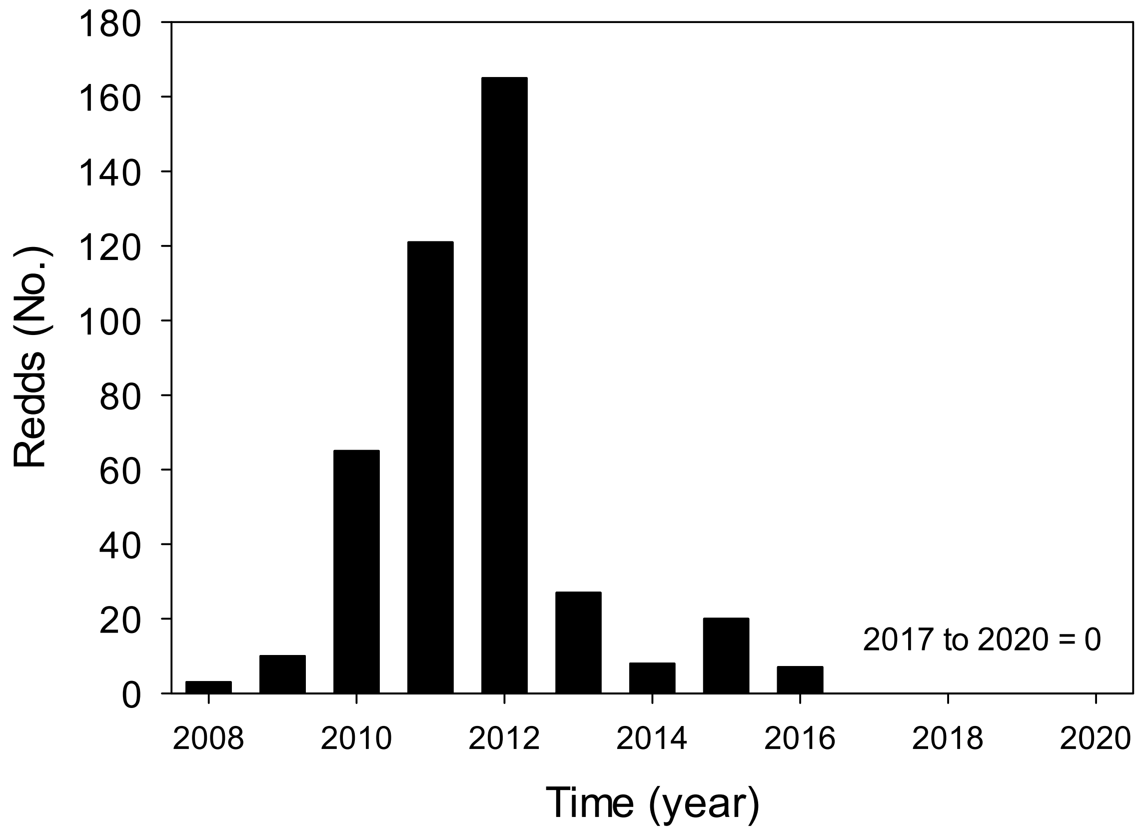
Appendix 25. Peak snorkel counts of *O. mykiss* during the period 2008-2020 at survey index sites in the Ventura Basin.

Appendix 26. *O. mykiss* spawning index sites in the Ventura Basin.

Site No.	Unit	Location	River km	Description	Lat.	Long.	Length (m)	Width (m)	Spawning Area (m^2)
24	1	Ventura River	0.8	Main St. Bridge	34.28085	-119.30862	220.0	10.0	2,200
2	1	Ventura River	7.9	Near Treatment Plant	34.34030	-119.29782	90.0	18.0	1,620
	2		8.1	Near Treatment Plant	34.34208	-119.29849	39.0	20.0	780
4	1	Ventura River	15.5	Near Santa Ana Blvd bridge	34.39950	-119.30853	26.7	8.0	214
5	1	Ventura River	18.7	Upstream of Hwy 150	34.42641	-119.30227	18.0	10.0	180
6	1	Ventura River	22.1	Land Conservancy pool tailout	34.45334	-119.29309	18.1	19.5	353
	2		22.2	Land Conservancy pool tailout	34.45445	-119.29298	16.3	14.7	240
7	1	Ventura River	23.3	Robles-1st weir pool	34.46334	-119.29061	15.4	23.9	368
	2		23.4	Robles tailout of entrance pool	34.46436	-119.29045	18.2	21.9	399
8	2	Ventura River	24.3	Upstream of Robles	34.46504	-119.29032	6.2	15.4	95
	3		23.4	Upstream of Robles forebay	34.46504	-119.29032	80.0	6.0	480
12	1	NF Matilija Cr.	0.7	Lower NF Matilija Cr.	34.48825	-119.30525	41.0	9.0	369
13	1	NF Matilija Cr.	6.6	Downstream of Wheeler Gorge	34.50911	-119.27501	23.0	8.0	184
	2		6.6	Downstream of Wheeler Gorge	34.50960	-119.27528	22.3	8.0	178
14	1	Matilija Cr.	1.9	Lake Matilija delta	34.49000	-119.31446	26.2	14.6	383
	2		2.1	Upstream of Lake Matilija	34.49198	-119.31645	15.0	10.0	150
	3		2.2	Upstream of Lake Matilija	34.49209	-119.31661	315	9.0	2,835
15	1	Matilija Cr.	8.4	End of Matilija Road	34.50456	-119.37449	20.0	19.0	380
17	1	Ventura River	9.3	DS of Foster to US reach	34.35069	-119.30463	1750	11.0	19,250
18	1	Ventura River	12.3	Casitas Springs	34.37354	-119.30877	60	12.0	960
	2		12.7	Casitas Springs	34.37712	-119.30721	230	9.0	2070
19	1	San Antonio Cr.	0.0	Mouth to end of Old Cr. Rd. reach	34.38030	-119.30738	2160	8.0	17,280
20	1	San Antonio Cr.	4.2	DS to US of Frasier St.	34.40197	-119.28237	180	8.0	1,440
21	1	San Antonio Cr.	7.8	Camp Comfort reach	34.42493	-119.26110	690	5.0	3,450
22	1	San Antonio Cr.	9.5	Upper San Antonio Cr. reach	34.43269	-119.25087	640	5.0	3,200
23	1	NF Matilija Cr.	0.1	Lower NF Matilija Cr.	34.48520	-119.30118	120	6.0	720
25	1	NF Matilija Cr.	4.1	Near Wheeler's Springs Reach	34.50826	-119.28955	300	4.5	1,350
26	1	NF Matilija Cr.	1.0	Downstream of NF gage bridge	34.49049	-119.30586	302	4.3	1,299
27	1	Matilija Cr.	5.7	Upstream Matilja hot springs	34.50030	-119.34993	105	8.0	840
									Total = 63,266



Appendix 27. Diagram of *O. mykiss* redds measurements. (D) = locations of depth measurements and (G) = location of gravel substrate sampling.



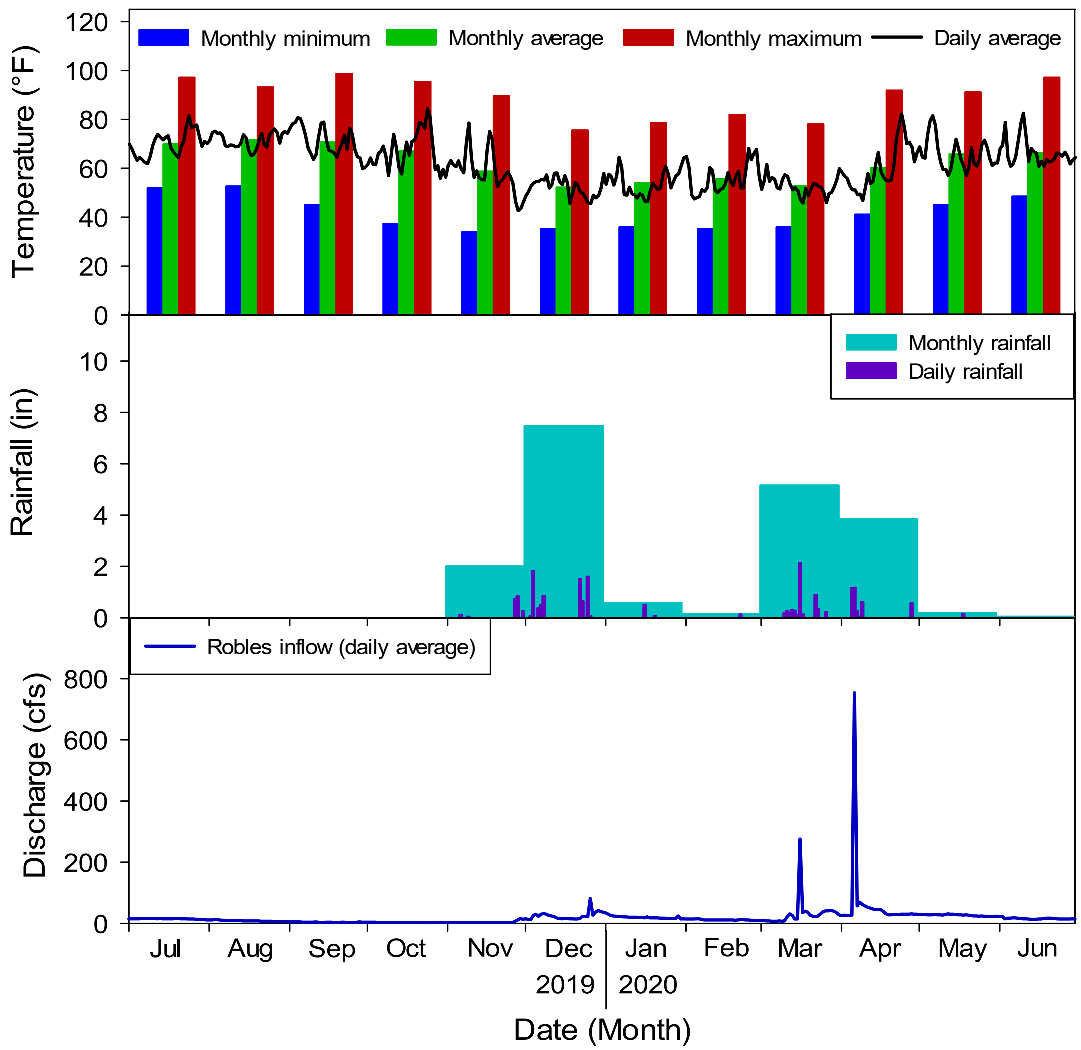
Appendix 28. Total number of *O. mykiss* redds counted at index spawning sites from 2008 through 2020 spawning years.

Appendix 29. Water quality monitoring sites and sampling summary.

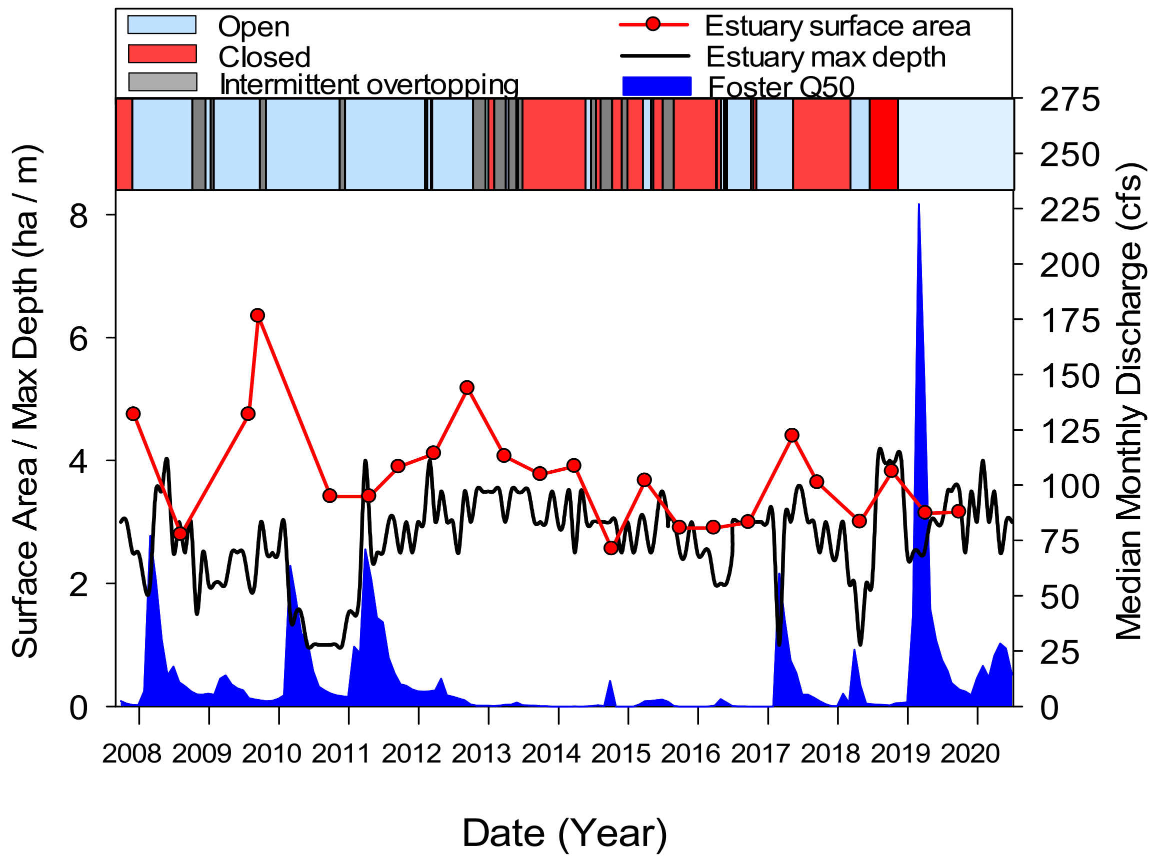
Site Number	Site Description	Site Location[a]	Sampling Method[b]	Sampling Type[c]	Frequency
1	Estuary	V 0.3 km	Multiparameter	Grab profile	Monthly
2	Main St. Bridge	V 1.0 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
3	Foster Park	V 9.7 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
4	Santa Ana Blvd Bridge	V 15.5 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
5	Hwy 150 Bridge	V 18.7 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
6	Robles Dam	V 23.5 km	Temperature Multiparameter Turbidity Weather	Continuous Grab Continuous Continuous	30 min Monthly Hourly 30 min
7	North Fork Matilija	N 1.3 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
8	Below Matilija Dam	M 1.0 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
9	Above Matilija Dam	M 2.1 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
10	Middle Matilija	M 8.5 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
11	Lower San Antonio	S 0.3 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
12	Middle San Antonio	S 9.5 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
13	Lower Coyote	C 0.4 km	Temperature Multiparameter	Continuous Grab	30 min Monthly
14	Fraser St.	S 4.4 km	Temperature	Continuous	30 min

[a]Site location is identified by the river system and kilometers from its confluence. C = Coyote Creek, M = Matilija Creek, N = North Fork Matilija Creek, S = San Antonio Creek, V = Ventura River.

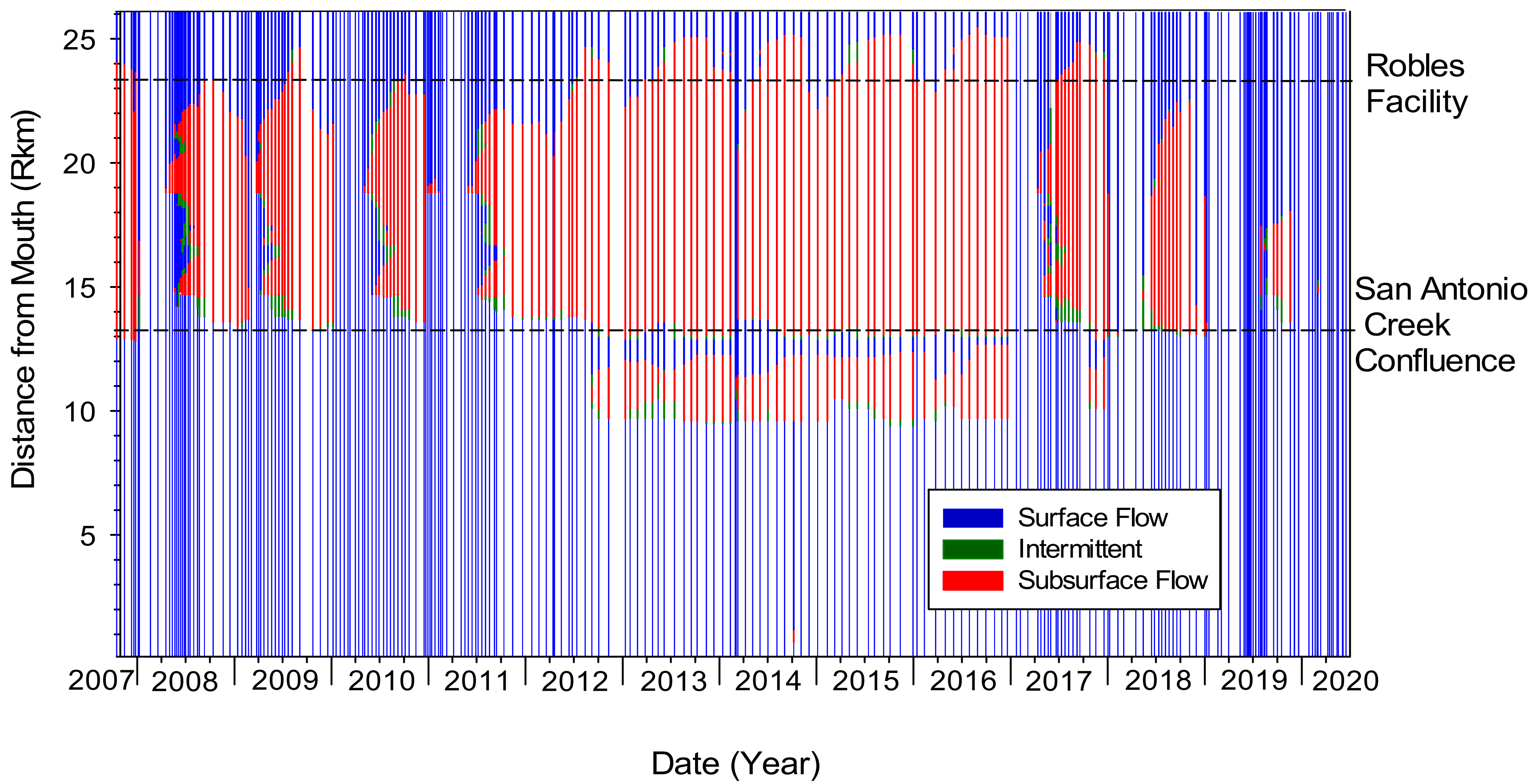
[b]Temperature data were collected using programmable loggers. Multiparameter water quality probe was use to collected water quality data including: temperature, dissolved oxygen, conductivity, salinity, pH, turbidity (separate meter). Turbidity data was collected using a programmable logger.



Appendix 30. Summary of weather and discharge data from the Robles Fish Facility for the reporting period.



Appendix 31. Ventura River estuary/lagoon water depth, surface area, sandbar status, and discharge at Foster Park from 2008 to 2020.

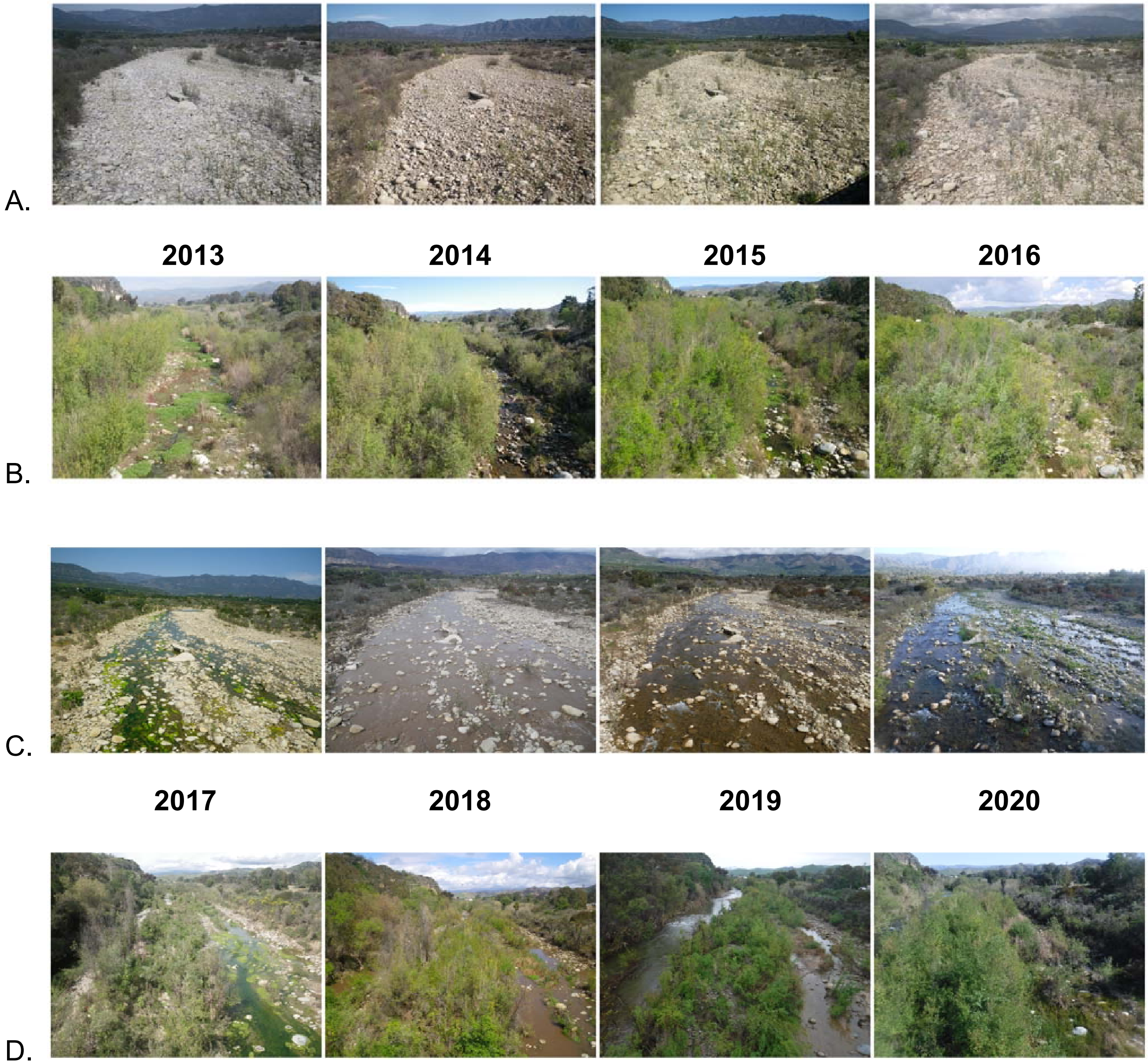


Appendix 32. Ventura River channel surface flow monitoring from 2008 to 2020.

Appendix 33. Photographic monitoring sites within the Ventura River basin.

Site Number	Site Description	Site Location[a]	Photo Direction	Frequency
1	Train bridge in estuary, east bank	V 0.3 km	Downstream	Biannual
2	Train bridge in estuary, west bank	V 0.3 km	Upstream Downstream	Biannual
3	Main Street Bridge	V 1.0 km	Upstream Downstream	Biannual
4	Shell Road Bridge	V 5.2 km	Upstream Downstream	Biannual
5	Casitas Vista Road Bridge (Foster Park)	V 9.7 km	Upstream Downstream	Biannual
6	Santa Ana Boulevard Bridge	V 15.5 km	Upstream Downstream	Biannual
7	Highway 150 Bridge	V 18.7 km	Upstream Downstream	Biannual
8	Robles Fish Passage Facility	V 23.5 km	Downstream	Biannual
9	Camino Cielo Road Bridge	V 25.7 km	Upstream Downstream	Biannual
10	Highway 33 Bridge at NF Matilija USGS Gauging Station	N 1.3 km	Upstream Downstream	Biannual
11	End of North Matilija Road	M 8.5 km	Upstream Downstream	Biannual
12	Highway 33 Bridge near Old Creek Road	S 0.3 km	Upstream Downstream	Biannual
13	Creek Road near Creek Lane	S 9.5 km	Upstream Downstream	Biannual
14	Santa Ana Road Bridge	C 0.4 km	Upstream Downstream	Biannual

[a]Site location is identified by the river or tributary system and kilometers from its confluence. C = Coyote Creek, M = Matilija Creek, N = North Fork Matilija Creek, S = San Antonio Creek, V = Ventura River.



Appendix 34. Multiple year photo comparison of ephemeral and perennial reaches of the Ventura River. Photo series row A and row C are looking upstream from Hwy 150 bridge. Photo series row B and row D are looking upstream from the bridge near the Shell Rd exit off Hwy 33.

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 3-17-20 Time: 9:00 Prepared by: Scott Lewis

Storm Peak Discharge	date	time	cfs
North Fork Matilija Cr	3-16	16:29	452
Matlija Cr above dam	↓	12:45	280
Matlija Dam		16:25	1,640
Matilija Cr at Hot Spr.		16:25	1213
Robles Canal			
Robles Weir		17:54	1,640
Total Robles Inflow		17:54	1,640

BO Defined Storm Event: (Y) / N
BO Defined Overlapping Event: Y / (N)

Santa Ana Br. 2,134 @ 17:15
Foster 2,246 @ 17:45
San Antonio 324 @ 17:00

Current Discharge (Day 1 after peak)	time	cfs
North Fork Matilija Cr	8:59	54
Matlija Cr above Reservoir	8:30	12
Matlija Dam	8:25	384
Matilija Cr at Hot Springs	8:25	167
Robles Canal	9:06	135
Robles Weir	9:06	27
Total Robles Inflow	9:06	162

Lake Casitas volume 99,485 af @ 7:55

Date Matilija Reservoir Filled: 2019
Count of Days: >30

CDPM Method:
- [ ] <30 days - M4 - Modifed Overlapping Release
- [x] ≥30 days - M9 - Matilija Download with Intial Release
- [ ] Standard Release
- [ ] Back-to-Back Release

			M9 - Matilija Download				
		Robles	Robles Inflow		Matilija	Matilija	Matilija
Day	Date	Release	Canal	Weir	Inflow	Outflow	Elevation
1	3-17	50					
2	3-18	50					
3	3-19	50					
4	3-20	50					
5	3-21	50					
6	3-22	50					
7	3-23	50					
8	3-24	50					
9	3-25	50					
10	3-26	50					
11	3-27	40					
12	3-28	30					
13							
14							
15							
16							
17							
18							

Comments:

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 3-24-20 Time: 08:00 Prepared by: Scott Lewis

Storm Peak Discharge

	date	time	cfs
North Fork Matilija Cr	3-23-20	01:49	123
Matlija Cr above dam	↓	00:35	119 VC / 288 USGS
Matlija Dam	↓	02:45	503
Matilija Cr at Hot Spr.	↓	03:20	367
Robles Canal	↓	03:40	302
Robles Weir	↓	03:40	30
Total Robles Inflow			332

BO Defined Storm Event: (Y) / N
BO Defined Overlapping Event: (Y) / N

Santa Ana Br. 26 @ 2:45
Foster 32 @ 5:45
San Antonio 20 @ 9:00

Current Discharge (Day 1 after peak)

	time	cfs
North Fork Matilija Cr	7:00	34
Matlija Cr above Reservoir	7:40	9 VC / 80 USGS
Matlija Dam	7:15	249
Matilija Cr at Hot Springs	7:00	142
Robles Canal	8:00	66
Robles Weir	8:00	35
Total Robles Inflow	8:00	101

Date Matilija Reservior Filled: 3-23-20
Count of Days: 1

CDPM Method:

- [ ] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [ ] Standard Release
- [x] Back-to-Back Release

			M9 - Matilija Download				
		Robles	Robles Inflow		Matilija	Matilija	Matilija
Day	Date	Release	Canal	Weir	Inflow	Outflow	Elevation
1	3-24	50					
2	3-25	↓					
3	3-26	↓					
4	3-27	↓					
5	3-28	↓					
6	3-29	↓					
7	3-30	↓					
8	3-31	50					
9	4-1	40					
10	4-2	30					
11							
12							
13							
14							
15							
16							
17							
18							

Comments:

Flow Assessment at Robles Diversion and Fish Passage Facility
Critical Drought Protection Measures (Stage 3-4, 100k - 65k af)

Date: 4-7-20 Time: 9:45 Prepared by: Scott Lewis

Storm Peak Discharge	date	time	cfs
North Fork Matilija Cr	4-6	2:19	912
Matlija Cr above dam	↓	2:15	390 VC/500 USGS
Matlija Dam	↓	4:10	2051
Matilija Cr at Hot Spr.	↓	4:25	1,731
Robles Canal	↓	3:50	0
Robles Weir	↓	3:50	3331
Total Robles Inflow	↓	3:50	3,331
BO Defined Storm Event:	(Y)/ N		
BO Defined Overlapping Event:	Y /(N)		

Current Discharge (Day 1 after peak)	time	cfs
North Fork Matilija Cr	10:04	92
Matlija Cr above Reservoir	9:45	40 VC/* USGS
Matlija Dam	10:05	480
Matilija Cr at Hot Springs	9:35	247
Robles Canal	9:45	227
Robles Weir	9:45	34
Total Robles Inflow	9:45	261

* equip. malf. or error

Date Matilija Reservior Filled: 3-23-20
Count of Days: 15

CDPM Method:
- [ ] <30 days - M4 - Modifed Overlapping Release
- [ ] ≥30 days - M9 - Matilija Download with Intial Release
- [x] Standard Release
- [ ] Back-to-Back Release

			M9 - Matilija Download				
		Robles	Robles Inflow		Matilija	Matilija	Matilija
Day	Date	Release	Canal	Weir	Inflow	Outflow	Elevation
1	4-7	82					
2	4-8	74					
3	4-9	68					
4	4-10	62					
5	4-11	56					
6	4-12	56					
7	4-13	50					
8	4-14	50					
9	4-15	50					
10	4-16	50					
11	4-17	40					
12	4-18	30					
13							
14							
15							
16							
17							
18							

Comments:

PROOF OF SERVICE

Santa Barbara Channelkeeper v. State Water Resources Control Board, et al.
and related cross-action
Los Angeles County Superior Court
Case No. 19STCP01176

STATE OF CALIFORNIA, COUNTY OF ORANGE

I am employed by the law office of Rutan & Tucker, LLP in the County of Orange, State of California. I am over the age of 18 and not a party to the within action. My business address is 18575 Jamboree Road, 9th Floor, Irvine, California 92612. My electronic notification address is mmartinez@rutan.com.

On October 17, 2024, I served on the interested parties in said action the within:

DECLARATION OF CASITAS MUNICIPAL WATER DISTRICT ASSISTANT GENERAL MANAGER KELLEY DYER IN SUPPORT OF JOINT APPLICATION TO SET A HEARING DATE FOR AN INTERIM ORDER REGARDING THE PHYSICAL SOLUTION AND TO CONTINUE THE STAY UNTIL THE HEARING DATE

as stated below:

☒ (Via E-Service to **File & ServeXpress**) I affected electronic service by submitting an electronic version of the document(s) to **File & ServeXpress, LLC**, through the user interface at https://secure.fileandservexpress.com, which caused the document(s) to be sent by electronic transmission to the person(s) at the electronic service address(es) listed.

Executed on October 17, 2024, at Irvine, California.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Marisol Martinez	/s/ *Marisol Martinez*
(Type or print name)	(Signature)