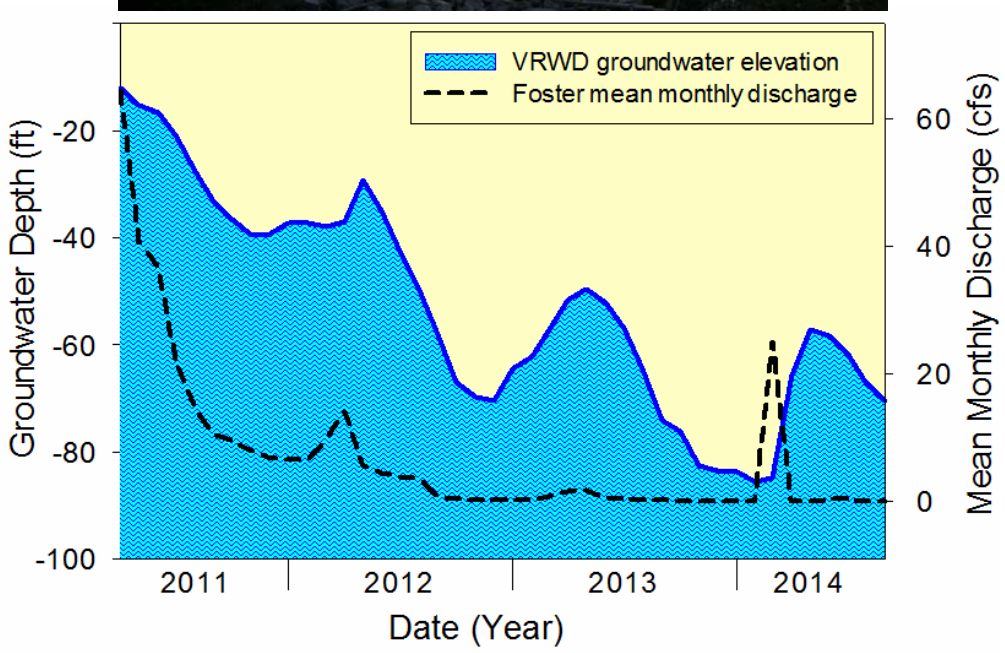
2014 Robles Fish Passage Facility Progress Report



Ventura River channel going subsurface at Foster Park in 2012 for the first time in several years (top) Mean monthly discharge at Foster Park (USGS) and groundwater elevation near HWY 150 bridge (VRWD) since April 2011 (bottom). Three consecutive years of below average precipitation have resulted in groundwater depletion in the Ventura River basin and limited surface connection to only 72 hours during the 2014 fish passage 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 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 2014 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 2013 to 30 June 2014.

The monitoring and evaluation studies related to the Robles Fish Facility conducted during the 2013-2014 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.

Even though a March 2014 storm was the first significant storm to occurred in 3 years (March 2011), little precipitation occurred during the 2014 migration season and river flows were too low to collect data for most aspects of the monitoring and evaluation program. The sandbar at the mouth of the Ventura River was closed for a substantial period of time during the reporting period and provided little opportunity for volitional steelhead passage except for a brief period after the 01 March 2014 storm. Only one *O. mykiss* was detected moving downstream of the Robles Fish Facility during the fish migration period of 2014. During the post-storm fish attraction, likely only 3 *O. mykiss* were documented migrating through the Robles Fish Facility in 2014.

2.0 GENERAL 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 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, 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" 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.

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 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 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).

Monitoring and Research of the 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 Ventura River while maintaining suitable condition 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. It is recommended that all aspects of the monitoring and evaluation for the Robles Fish Facility be continued during 2015. Due to the variable water conditions and insufficient numbers 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.

3.0 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 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 of the potential for low-river flows to impede upstream fish migration in the Robles Reach, it 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 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. Impediment surveys will likely be conducted over a number of 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 below the Robles Fish Facility. 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 (CDFW), and Scott Lewis (CMWD). Mike Gibson (CMWD) and hydrologists Bob Hughes (CDFW) 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) study 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 a previous progress report (CMWD 2011).

Results

During 2014, only one rain event occurred that created two BO-defined storm events (peak of primary event occurred on 01 March 2014). During the brief time there was surface flow, 11 transects were completed at the 7 sites for the Upstream Fish Migration Impediment Evaluation. Resulting data were analyzed by modeling discharge from the Robles Fish Facility and water depth at each site for several passage criteria that resulted in numerous adult steelhead passage criteria discharges. Precipitation in the Ventura River basin ranged from approximately 30-50% of normal for the 2014 water year. A total of 14.8 inches of precipitation was measured in Matilija Canyon (Ventura County site 207c), of that annual total, about 80% occurred during the one storm event. If the March rain event had not occurred, the 2014 WY would have been the lowest for the 147-year period of record at this site. Daily mean discharge from the Robles Fish Facility ranged from 0 to 425 cfs.

The 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 (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 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 the new site selections were made (i.e., 11 January 2012), insufficient flows were available to make final site selection or transect placements. During 2012, and 2013, the lack of precipitation, and subsequent insufficient surface flow, did not allow for confirmation of these sites. This was done 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.

Site 10, located downstream of Casitas Springs, was only surveyed one time during the brief period that surface water was available. During the one survey, the discharge at Robles was 83 cfs, but no depths at the site were greater than 0.6 ft in depth. A second survey was attempted at a Robles discharge of 56 cfs; however, the site had no surface flow (Appendix 3). No further analysis was possible.

Site 3-2 was surveyed two times at discharges at Robles ranging from 82 to 171 cfs. The addition of 2014 survey data to the Site 3-2 regression produced estimates of 120 and 259 cfs using the Thompson passage criteria (Appendix 4, see dashed regression lines). The resulting minimum discharges required to meet the three other criteria were even higher discharges ranging from 413 to 544 cfs. Due to the outlier nature of the

2014 results at Site 3-2, the resulting minimum passage discharge to meet Thompson criteria remained unchanged from 2011 results (Appendix 10 and 11).

Site 4 was surveyed one time during 2014, which was conducted at a Robles discharge of 79 cfs. Although considered an outlier, the 2014 survey did not substantially change the site regression and was therefore added to the previous data set and analyses were revised. The resulting minimum discharges required to meet the Thompson criteria were 70 and 53 cfs (Appendix 5). The resulting minimum discharges required to meet the three other criteria ranged from 42 to 80 cfs (Appendix 11).

Site 5-2 was surveyed one time during 2014; Robles discharge was 77 cfs at the time of the survey. The addition of 2014 survey data to the Site 5-2 regression produced implausible results using the Thompson passage criteria (Appendix 6, see dashed regression lines), which were 196 and 279 cfs. The resulting minimum discharges required to meet the three other criteria resulted in even higher discharges ranging from 671 to 970 cfs. Due to the 2014 results at Site 5-2, the resulting minimum passage discharge to meet Thompson criteria remained unchanged from 2011 results (Appendix 10 and 11).

Site 6-2, which is located about 1.3 km upstream from Santa Ana bridge, was surveyed one time at a Robles discharge of 77 cfs (Appendix 7). The addition of 2014 survey data to the Site 6-2 regression produced implausible results using the Thompson passage criteria (Appendix 7, see dashed regression lines), which were 91 and -62 cfs. The resulting minimum discharges required to meet the three other criteria resulted in even higher discharges ranging from -56 to 703 cfs. Due to the 2014 results at Site 6-2, the resulting minimum passage discharge to meet Thompson criteria remained unchanged from 2011 results (Appendix 10 and 11).

Site 9, located upstream of Hwy 150, was surveyed four times at Robles discharges ranging from 32 to 78 cfs. The regression equations and statistics for the three criteria models were plausible and produced results similar to other sites (Appendix 8 and 10).

The resulting minimum discharges required to meet the Thompson criteria were 45 and 33 cfs (Appendix 11). The resulting minimum discharges required to meet the three other criteria ranged from 28 to 65 cfs.

Site 7 was surveyed one time during 2014 at Robles discharge of 80 cfs. The 2014 survey did not substantially change the site regression and was therefore added to the previous data set and analyses were revised (Appendix 9). The resulting minimum discharges required to meet the Thompson criteria were 53 and 25 cfs, and the resulting minimum discharges required to meet the three other criteria ranged from 14 to 27 cfs (Appendix 11).

Photos of the potential impediment sites at a Robles discharge of about 80 cfs can be found in Appendix 12a-h for reference. The regression equations and statistics for the four passage criteria using the Robles discharge are in Appendix 10. The calculated minimum discharges to meet the four passage criteria using the Robles discharge are in Appendix 11.

Discussion

The March 2014 storm event produced two BO-defined peak flows and provided the first notable surface flow downstream of the Robles Fish Facility in 3 years. However, given that the lack of normal precipitation over this preceding time period, the resulting surface flows were transient and produced significant outliers to existing impediment models at four of the seven impediment sites. These outliers strongly influenced the linear regression, so much that their inclusion inverted the regression line and yielded implausible discharge results (i.e., inverse relation between discharge and upstream fish passage conditions) and(or) statistically insignificant results. For example, at Site 5-2, the 2014 data inclusion increased the previous results from 55 cfs to 279 cfs. For two of the sites, sites 4 and 7, the 2014 data were included since their influence was not as strong (i.e., the models were not effected in the same manner as at the other sites). Given the short duration of the surface flows and data collection need at the new sites

and missing target discharges, only sites 3-2 and 9 had multiple surveys conducted; all other sites only had one survey completed. Of the two new sites, Site 9 had four surveys completed and the resulting analysis produce a calculated Thompson criteria discharge of 45 cfs, which is only 5 cfs less than the proposed 50 cfs of the BO. The underlining explanation for the nature of the 2014 data is likely the substantial river channel infiltration rate and lack of tributary contributions during an exceptional drought. This result may have been different if the surveys are completed during a more normal year. This effect appeared to increase with distance downstream from the Robles Fish Facility. In fact, even at discharge of 56 cfs at Robles, Site 10 was dry. Given the outlier nature of results for much of the 2014 data, additional data will be needed at similar discharges during a wetter year to better understand the effects of the drought on impediment water depths (see Appendix 13 for completed transects a specific Robles Fish Facility discharges).

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 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. The sandbar was closed on 02 January 2014 and its status was monitored once every two weeks through March and only monthly through June since no surface flow was present at the Robles Fish Facility. Outside of the fish passage augmentation season the sandbar was monitored at least monthly.

Results

During the reporting period, July 2013 through June 2014, 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 2014) and seven were outside of the fish passage augmentation season. The sandbar was open only 17% of the time during the fish passage augmentation season (Appendix 14). At the beginning of the fish passage augmentation season, the sandbar was closed and no volitional passage into the estuary could occur. Only during two inspections was the sandbar open (end of February and middle of March), and the sandbar was closed for the remainder of the 2014 fish passage augmentation season. During the three of the inspections when the sandbar was closed, there was evidence (i.e., wet sand on the lagoon side of the sandbar) that intermittent saltwater intrusions occurred and overtopped the sandbar. However, these overtoppings were not sufficient to erode the sandbar enough to cause water to exit the lagoon. This occurred for 18% of the closed sandbar observations. When the sandbar opened as a result of the only 2014 storm, the period was brief and the sandbar reformed. On the days the sandbar was inspected during the reporting period, the mean daily discharge at the USGS

Foster Park gage station ranged from approximately < 1 to 3 cfs and 0 to 38 cfs at the Robles Fish Facility. When the sandbar was open, the river was observed exiting 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.

The tendency for the sandbar to remain open in all but very dry years is likely due to a few 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, 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 conditions 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. The three consecutive years of below-normal precipitation (about 50-60% of average) have created conditions at the mouth of the Ventura River causing the sandbar to be closed for the majority of the time

during the monitoring period. This has occurred even though some surface water has continued to flow into the lagoon. Furthermore, the amount of time the sandbar was closed over the last two years was the greatest since monitoring began in 2005.

4.0 EVALUATE FISH MOVEMENT THROUGH THE PASSAGE FACULTY

4.1 Water Velocity and Depth Validation Evaluation

Due to the quickly receding post-storm hydrograph, sufficient flows were not available and no performance testing could be completed during the 2013-2014 season.

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 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 facility (i.e., two-way passage facility). 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 171 cfs (50 cfs through the entire ladder and an additional 121 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 from 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

Three separate methods were employed to determine the presence of *O. mykiss* for the Fish Attraction Evaluation. 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 attraction surveys were conducted during the fish passage season from January through April of 2014 if water was present. The March storm created surface flows and allowed surveys to be competed for approximately 2 months. This method has been used since 2007. 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. Since the March storm increased turbidity making snorkel surveys less effective, bank surveys were conducted until turbidity decreased and then snorkel surveys were conducted. 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. If *O. mykiss* were present, lengths of each were estimated to the nearest cm if only a few individuals

(generally < 10) when 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 the March storm. This consisted of daily surveys during the 12-day augmentation period. Beginning the day after a BO-defined peak event, a Secchi visibility was measured in the entrance pool to determine when survey could begin. Bank surveys were conducted while 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 the March storm and ramp-down period. After the storm event occurred, a video camera was installed at the entrance of the fish ladder during the 12-day ramp down period. The video camera was mounted on a bracket adjacent to the fish ladder entrance and it was lowered into place to provide monitoring following the storm event. The camera was installed on 02 March and removed on 19 March 2014. The camera was positioned near the bottom of the entrance where adult steelhead are more likely to be migrating. The camera was angled to capture as much of the lower portion of the entrance as the field of view could provide while still allowing for identification of any adult steelhead.

Results

1) A total of 7 surveys were completed during the weekly surveys and no *O. mykiss* were observed (Appendix 15). During the 2-month period, a total of 1,550 m were surveyed by either bank or snorkel methods. The water temperatures during the study period ranged from 14 °C in March to 21 °C in May and turbidity was less than 34 NTUs

when the surveys were conducted. The discharge at the Robles Fish Facility ranged from 0 to 38 cfs at the time of the surveys. Flowing water remained in the upper portions of the survey reach (<1 cfs) even though no flow was passing over the weir at times before the entire survey reach went dry.

2) A total of 12 post-storm fish attraction surveys were completed. No *O. mykiss* were observed during the post-storm surveys (Appendix 16). The post-storm snorkel surveys were not initiated until a Secchi visibility of about 1 m was available, which occurred 6 days after the peak. As an approximate reference, a Secchi visibility of 1 m equates about to the surveyor's feet not being visible while floating on the surface during the snorkel survey.

3) The post-storm underwater video monitoring was conducted for a total of 12 days commencing on the first day after the peak. The DVR malfunctioned for several days from 04 to 07 March and no video was recorded. However, it was not until 08 March that visibility improved enough for observations. After review of the video, 7 *O. mykiss* observations occurred during the 12-day period. Observations were made on 11 and 12 March 2014, 10 and 11 days past the peak of the storm. The first *O. mykiss* (downstream at 12:30 h and upstream at 12:34 h) was estimated to be 20 cm TL. At the time of the observations, discharge was 18 cfs, temperature was 14.4 C, and turbidity was 5.68 NTUs. The second *O. mykiss* (TL = 25-30 cm) was observed at 14:50 h moving downstream, upstream 20 seconds later, and finally upstream at 14:54 h. At the time of the observations, discharge was 18 cfs, temperature was 14.8 C, and turbidity was 6.6 NTUs. The final observation set for *O. mykiss* was documented on 12 March 2014. There were two individual observations within 7 minutes of each other. Both observations were moving upstream. Due to turbidity, light back scatter, and lack of light penetration at the camera depth, video review was not sufficient to detect fish until the 08 March 2014 at a turbidity of 9 NTUs. Discharge at various times for all Fish Attraction Evaluation methods can be found in Appendix 17.

Discussion

Because consecutive *O. mykiss* observations were made within minutes or seconds of each other, limited coverage of the camera, and turbidity limitations, the total number of unique individuals was likely not the total of seven observations. More likely, only 4 *O. mykiss* at the most and as few as two were observed moving through the entrance gate. Due to little precipitation throughout the migration season, and previous 2 years, a surface water connection to the lower Ventura River only occurred for about 72 hours after the 01 March 2014 storm peak. The *O. mykiss* that were detected on the post-storm video were observed 10 and 11 days past the peak and moving downstream and upstream. These observations were approximately 7-8 days after a surface water connection was lost. However, this loss of surface flow occurred downstream of the San Antonio Creek confluence and may have allowed the *O. mykiss* to come from San Antonio Creek as well as from upstream of the Robles Fish Facility.

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. 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 occurring as they passage downstream through the Robles Fish Facility (NMFS 2003a).

Methods

Due to low precipitation and quickly receding discharge after the 01 March storm, trapping was not conducted during 2014 and no data were collected for the Downstream Passage Evaluation. For a full description of evaluation methods, see CMWD (2014).

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 2003). 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.

Due to low precipitation and quickly receding discharge after the 01 March storm, trapping was not conducted during 2014 and no data were collected for the

Downstream Fish Migration through the Robles Reach evaluation. For a full description of evaluation methods, see CMWD (2014).

6.0 LONG-TERM MONITIORNG COMPONENTS

6.1 Monitoring Robles Facility Operations

6.1.1 Facility Status

The Robles Fish Passage Facility started the 2013-2014 season in a fully functional mode. The 2013-2014 season was characterized by a below average rainfall year as measured at Casitas Dam. Only 9.8 inches of rain were measured at Casitas Dam. The average rainfall at the dam is 24.06 inches. This was the third year in a row with below average rainfall.

No water was downloaded from Lake Matilija to Robles and no valves were operated at Matilija Dam.

The 2013 Report identified several projects to be completed during the summer and fall. The principal projects were:

- Adjust interim weir three.
- 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:

Adjust interim weir three to improve fish passage-This work was completed before January 2014.

Modify the differential level sensors at the fish ladder entrance to individually read water levels-Casitas is continuing to work with the instrumentation engineer to record the fish ladder entrance pool level. This is not a Biological Opinion requirement.

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;
  A second gaging station at this location is operated by the County.
- 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 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 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 2013-14 season but the readings were very volatile. It appears that the Vaki shroud is still influencing the readings at this location. Casitas has purchased a Sontek IQ Plus to measure flow in the fish passage.

- 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. This meter read "zero" even though there were flows in the pipe. This meter will be left in place and the back-up transducer will be used in the future. Casitas has also purchased a Sontek IQ Pipe to obtain flow measurements in the auxiliary water supply.

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 18). The mean daily Robles Fish Facility discharge and corresponding turbidity and temperature measurements for the entire Fish Passage Season are presented in Appendix 19. Also included are the mean hourly flow data for the three days preceding the peak and for the twelve days following the peak (Appendix 20).

The measurement weir remained dry (no flow) until February 27, 2014. Low flow continued over the weir until April 29, 2014. Two BO-defined peak flow events occurred during the Fish Flow Operations Season (Appendix 35). The first peak was 450 cfs and occurred on February 28, 2014 at approximately 7:20 p.m. The second peak occurred on March 1, 2014 at approximately 4:00 p.m. The Ventura River had surface flow continuity between Robles and the ocean briefly from March 1st to March 4th, 2014.

Water diversions occurred over a 4-day period beginning early in the morning of February 28 until the morning of March 3. Following BO guidelines, the initial downstream flow release for the February 28, 2014 storm peak was 171 cfs, which began on March 1, 2014. The following storm peak on March 1, 2014 met the BO

definition as a separate “initial storm event” requiring initiation of a second 12-day ramp down schedule with an initial downstream flow release of 74 cfs, which began on March 2, 2014. Due to the quickly receding natural hydrograph and difficulties with fine control of the auxiliary water supply system, diversions ceased and all inflow was released downstream after 08:50 am on March 3, 2014. At this point, the weir was reading 83 cfs. The natural hydrograph receded below the augmentation release requirement of 68 cfs at 22:00 and remained below for the remainder of the 12-day window. When augmentation releases were scheduled to cease on March 13, 2014, inflow into the facility was 16 cfs.

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 of the direct costs incurred by the District during the 2013-14 fiscal year:

- **Fisheries Monitoring**:

Salaries & Benefits	$373,234
Equipment/Material	$ 46,061
	$419,295

- **Facility Operations**:

Salaries & Benefits	$ 43,522
Equipment/Materials	$ 24,017
Outside Contracts	$ 1052
Utilities	$ 2331
Permit	$ 551
	$71,473

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

6.1.4 Water Velocity and Depth Validation Evaluation

Casitas 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 25, 2011.

Because of inadequate flows, no additional performance testing was completed during the 2013-2014 season. Casitas priorities for 2014-2015 season include completing flow measurements in the spillway-entrance box channel (per NMFS request) and completing flow measurements at the auxiliary water screen in the entrance box. Both of these measurements require flows of 671 CFS for a minimum of 24 hours to complete.

Additionally, Casitas has purchased a Hach (Marsh-McBirney) FH 950 flow meter to assist in obtaining flow measurements in the fish ladder under the criteria specified in the Performance Evaluation Program. These measurements can be completed under moderate flow conditions.

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 eighth season with the Robles Fish 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 for 2014 included:

- Modify the differential level sensors at the fish ladder entrance to individually read water levels.

- Install Sontek IQ flow measurement devices in the fish passage and the auxiliary flow pipe.

6.1.6 Recommendations Deemed Necessary to the Operations

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 portion of the Matilija Dam Removal Project require this area to be graded to new elevations. The existing temporary weir system has proven to be passable by adult *O. mykiss*.

Casitas will be submitting to USBR a recommendation for modification to the diffuser panels behind the fish screens and at the auxiliary flow exit.

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 an index of the number of upstream adults and downstream kelts migrating through the Robles Fish Facility (NMFS 2003a). The Riverwatcher has the ability to detect smolt-sized steelhead, but it's recommended for fish body depths ≥ 40 mm by the manufacturer (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). 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 Riverwatcher detections). 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 27 February 2014 to 07 May 2014 of the reporting period. During this time, the crowder was removed from the fish bypass channel and cleaned or inspected 20 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 crowder was removed for cleaning for a combined total of approximately 4 h during the operation period. The Riverwatcher was operated a total of 67 days, which was 96% of the time the Riverwatcher could have possibly been operated during the fish augmentation period. There were no technical problems with the Riverwatcher during the entire 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 7 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 morphological 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 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. 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 third video camera was added for the 2014 season 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), which about half 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 detection from suspended solid are not typical, but poor camera visibility does not allow for video confirmation. Once the turbidity falls below about 25-30 NTUs, turbidity does not limit the Riverwatcher's capability for detecting and confirming detections (Table 1).

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

Approximate Turbidity (NTUs)	Riverwatcher status
> 200	Not functional
100-200	Many false scanner detections
30-100	Scanner operational, but unable to confirm with video
< 30	Scanner operational, grid detectable for video confirmation

Results

During the 2014 fish migration season, the Riverwatcher recorded 1,017 total detections, of which 379 were upstream and 638 were downstream (Appendix 9). A total of 1,005 detections were determined to be false detections from debris, high turbidity, turbulence, or air bubbles. Of the total detections, only 1 *O. mykiss* was confirmed through video. The length of the *O. mykiss* was 30 cm. The date for the upstream migrating *O. mykiss* was 10 March 2014 at 17:24 h (Appendix 22). The mean water temperature recorded when the *O. mykiss* was detected was approximately 15 °C. The mean turbidity levels at the time of passage was about 8 NTU. The discharge from the Robles Fish Facility at the time of passage was 20.0 cfs.

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 (one diode is 5 mm in diameter). 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-value < 0.0001, $R^2 = 0.99$, n = 59, D = body depth). This regression model will continue to be refined as more data become available.

Discussion

There were an estimated 1,005 false detections recorded by the Riverwatcher. Many were likely due to debris, low-flow surface turbulence, and settings of the Riverwatcher to detect smaller fish. The results from the third camera directed at the Riverwatcher scanner plates provides confidence that these are the likely causes of the false detections. This number of false detections was greater than 2013. Given the higher flow conditions from the one storm event in 2014, the greater number of false detections are to be expected. For the 2014 season, the minimum 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. *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 for smolts 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 reliable correction factor. Like the detection efficiency, the fish heights estimated by the Riverwatcher 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. The results of all other Riverwatcher validation/calibration will be provided in a stand-alone report and distributed to the Biological Committee prior to 2015.

From observations made over the last several years, and those made during the two validation pilot studies, *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. The *O. mykiss* that was detected and confirmed in the Riverwatcher was likely not the same *O. mykiss* observed in the

post-storm video Fish Attraction Evaluation. Even though the times of observations were within about 24 h, the lengths were estimated to be 10 cm different (Appendix 23). As have been determined previously, fish are able to elude detection through the Riverwatcher and crowder, and it is assumed fish passed through the entrance gate with out being detected.

7.0 ADDITIONAL BIOLOGICAL AND ENVIRONMENTAL MONITIORNG STUDIES

7.1 *O. mykiss Presence/Absence Surveys*

Methods

In addition to the fish attraction monitoring, *O. mykiss* presence/absence 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 surveys were done in an attempt 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. Additionally, juvenile *O. mykiss* (smolts and residents) were documented to determine 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 identified 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 and 2014. Due to the exceptional drought in its third year, the peak numbers of *O. mykiss* have dropped substantially (Appendix 25). Only 14 *O. mykiss* were counted during the peak for 2014, this was a drop from 54 in 2013 (Appendix 25).

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 in the upper portions of the basin. Nineteen 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. 1961). During 2008, the spawning index sites selected were initially distributed broadly within the basin to capture general spawning locations and timing. These same sites were used in 2014 and better sites added if observed. Three additional longer reaches were included in 2014; these were added in 2011 to incorporate previously surveyed discrete sites. Four additional sites were added to capture quality spawning areas. This initial information was 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. 1961; 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, only 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

Since spawning surveys were initiated in 2008, numbers increased from only 3 redds to a high of 165 redds in 2012. Over the last 2 years, as the current drought intensified, the available habitat diminished, causing dramatic losses to the adult and juvenile *O. mykiss* populations resulting in significantly lower redd counts. In 2014, the total redd count was only 8 redds (Appendix 28). The median spawning date from 2008 through 2013 was 02 March (Appendix 29).

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 30). Water temperatures are recorded at 12 locations throughout the Ventura River basin. The locations include the Ventura River mouth 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 record: 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 are monitored if sufficient water was present. Given the current drought, many of the monitoring sites were dry.

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 monitoring 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 relative 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 current drought, conditions have remained somewhat consistent (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 documents beginning at the end of 2007. Like the sandbar monitoring, clear patterns have become apparent. During normal precipitation years, there are typically surface flows during the fish passage season throughout the length of the Ventura River mainstem. Even during normal years, the Robles Reach goes dry shortly after storms occur. However, beginning with the current drought, the Robles Reach has been dry for extensive periods of time, even extending downstream of the San Antonio Creek confluence (Appendix 32).

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 34). The sites are re-visited twice per year, during March and September. 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 the 2005 channel clearing storm.

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 present. If this pilot study is successful, it may be expanded and developed into a more quantitative monitoring tool. This is the same system that was used at the fish ladder entrance during post-storm observations.

7.8 *Stranding Surveys*

After the 01 March 2014 storm event, the Robles Reach was surveyed during the course of other data collection projects (i.e., impediment transect, surface flow monitoring, and spawning surveys) to determine if any adult steelhead might have been stranded by the storm flows. No steelhead were observed.

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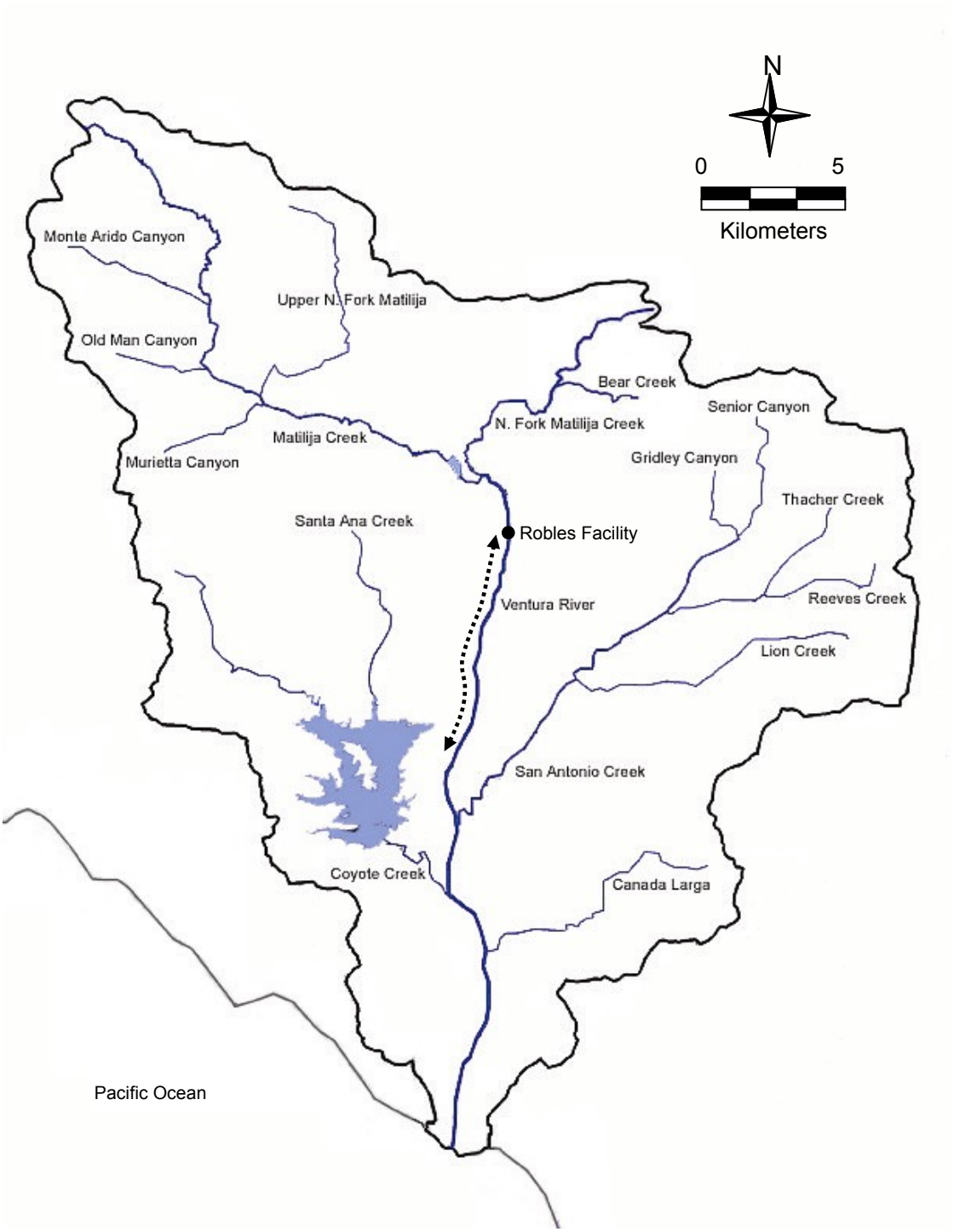
9.0 APPENDIXES

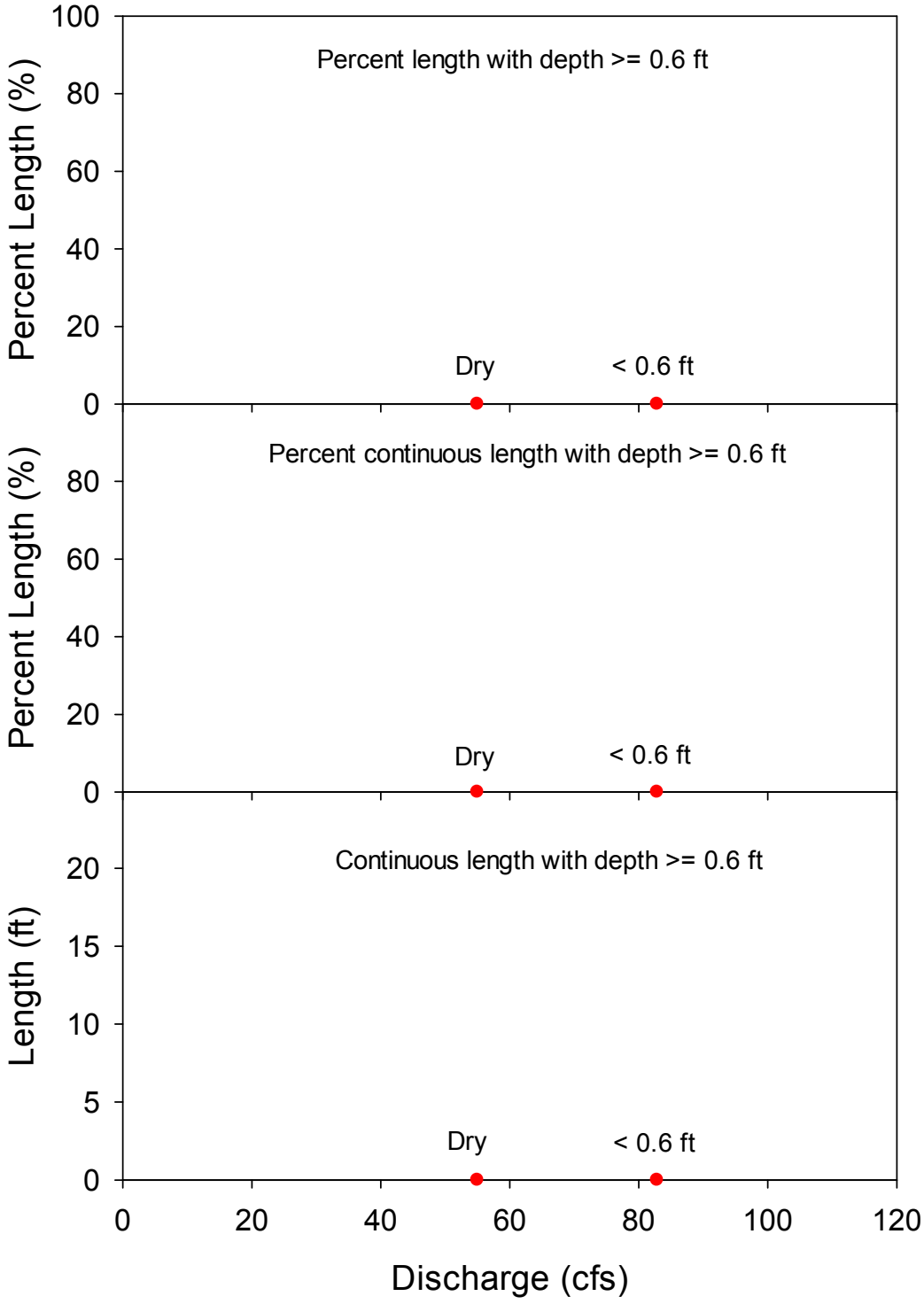


Appendix 1. Basin map of the Ventura River. The Robles Fish Passage Facility is identified by the black dot and the Robles Reach is identified by the dashed line downstream of the Robles Facility.

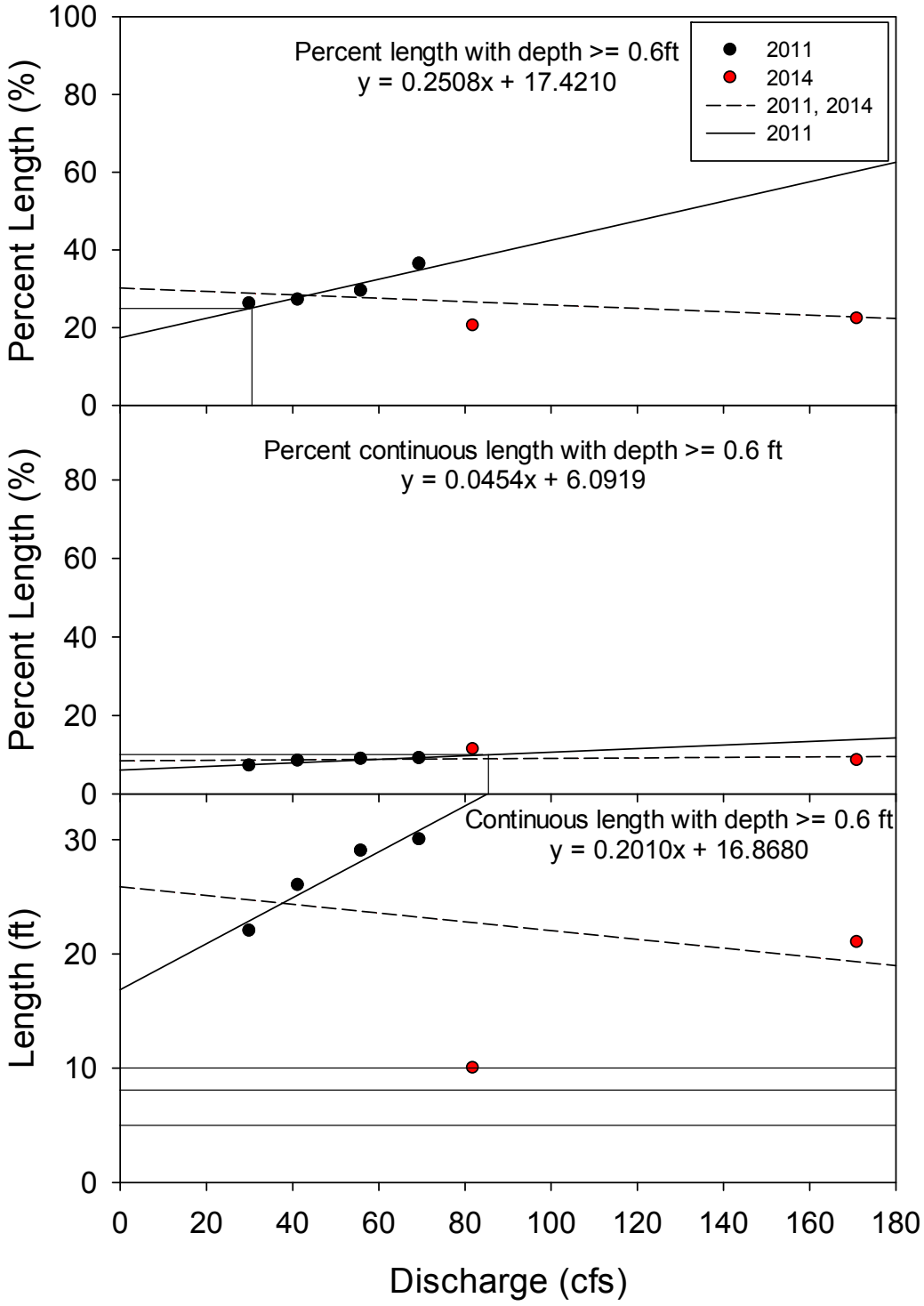
Appendix 2. Summary data of impediment sites selected for upstream fish migration impediment evaluations.

Site No.	Latitude (N)	Longitude (W)	km	Habitat Type[a]	Site Description	Length (m)	Slope (%)	Percent Substrate[b]						Active Channel Width (m)
								SO	SD	GR	CB	BD	BR	
10	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
6-2	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

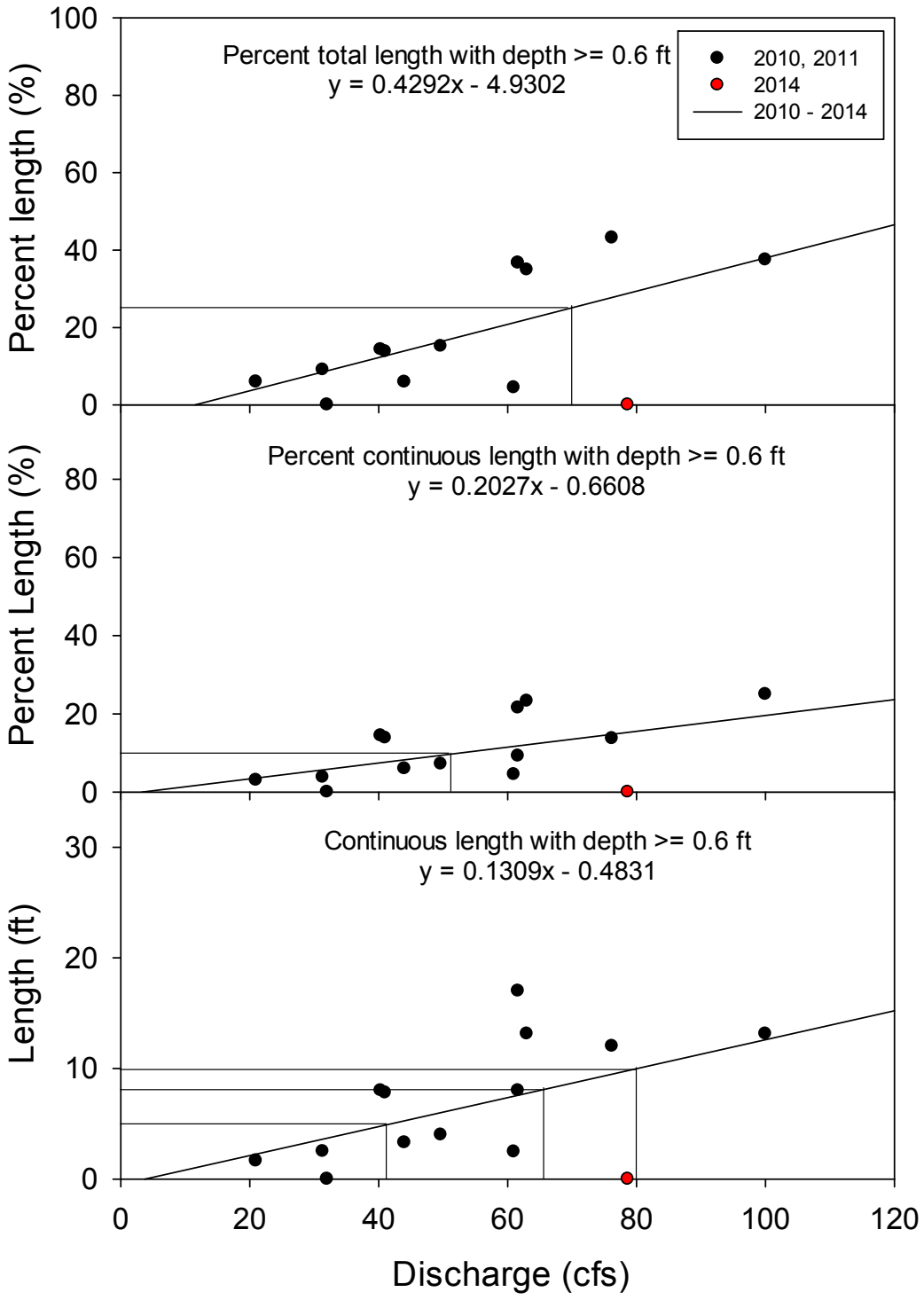
[a]The habitat types are: RB = rapid with protruding boulders, RI = riffle, and CB = cascade over boulders.
[b]The substrate types are: SO = silt and organics, SD = sand, GR = gravel, CB = cobble, BD = boulders, and BR = bedrock.



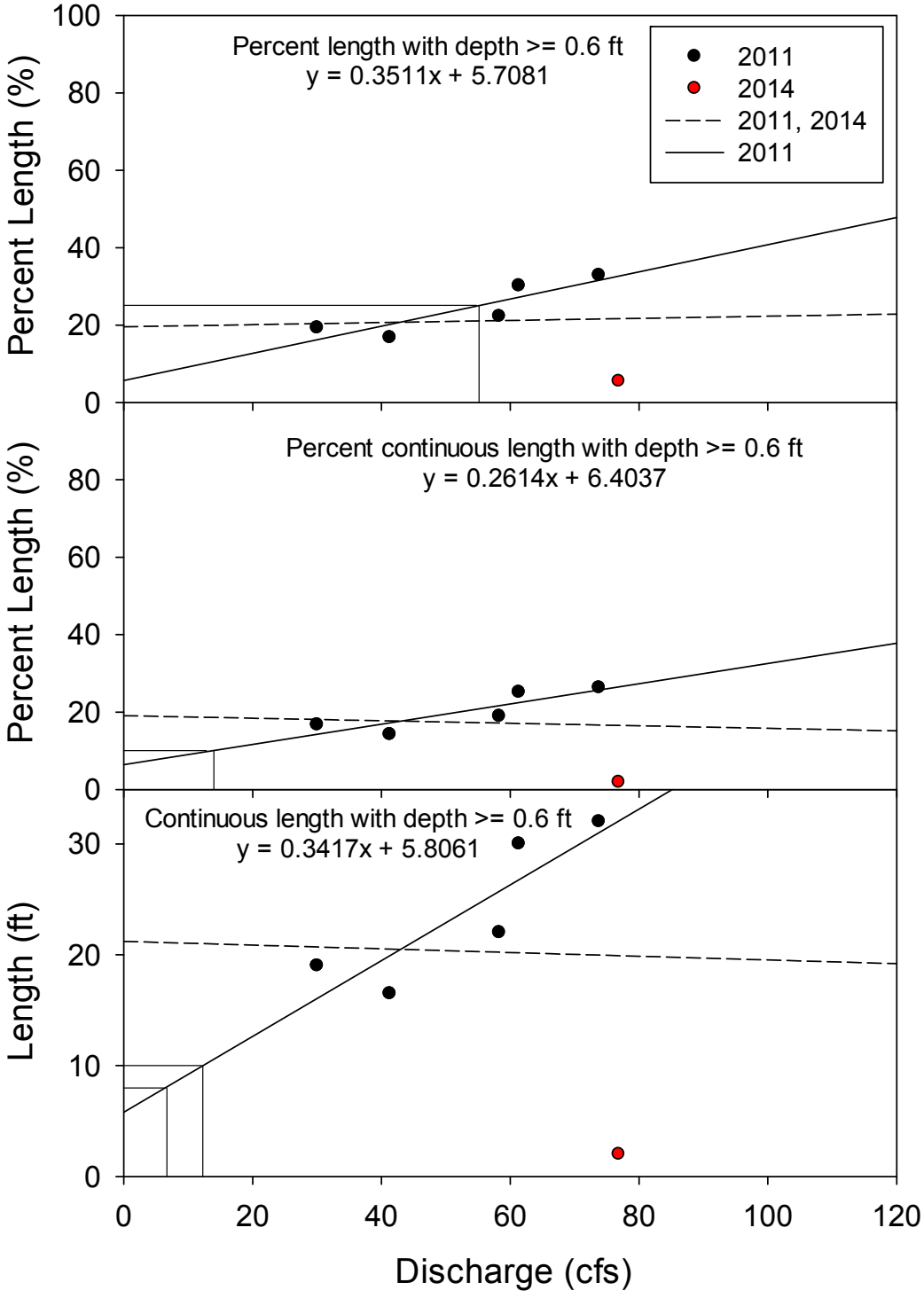
Appendix 3. Relation between Robles discharge and water depth at Site 10 downstream of Casitas Springs during 2014.



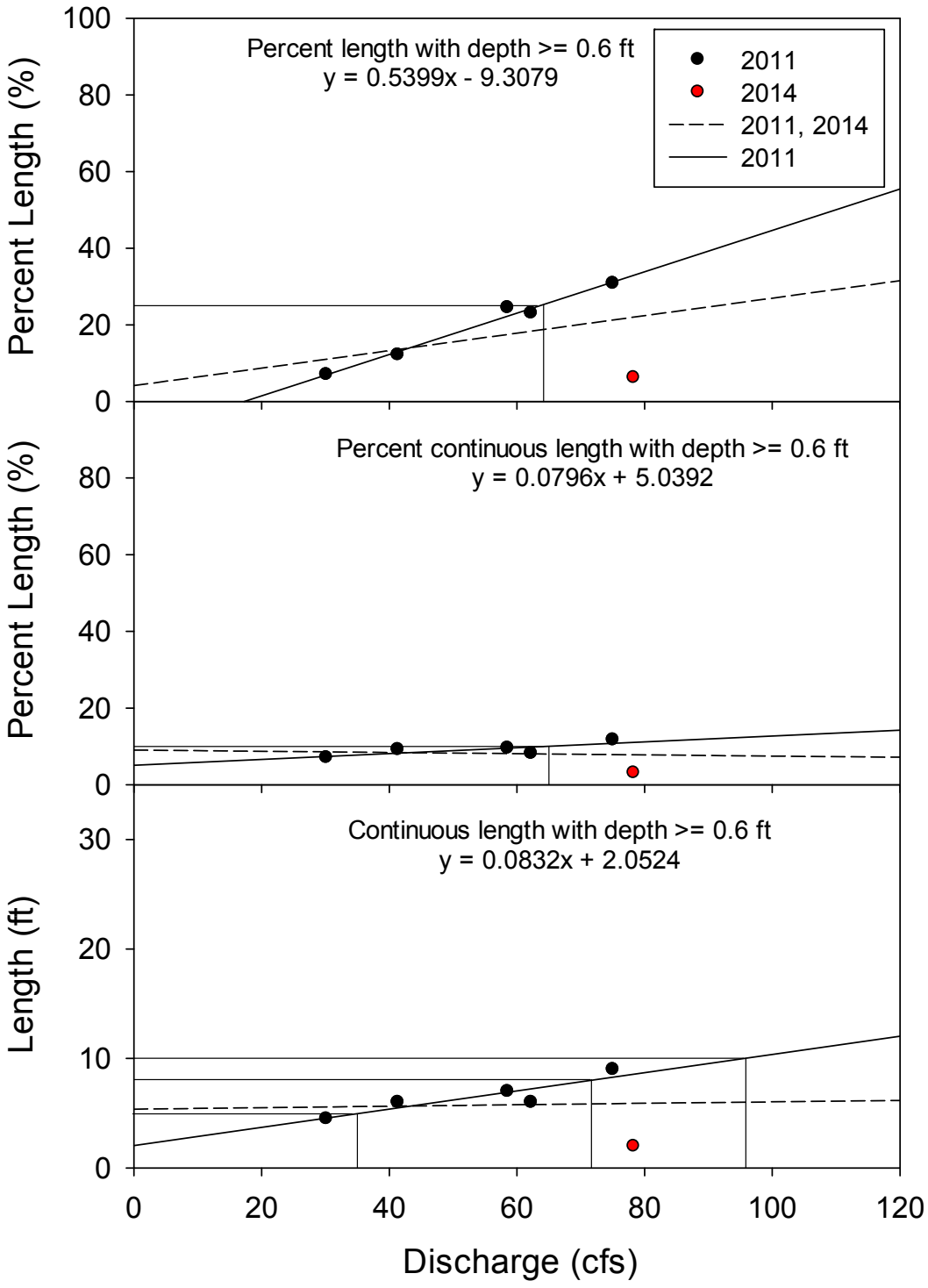
Appendix 4. Relation between Robles discharge and water depth at Site 3-2 near Casitas Springs and resulting discharge for various passage criteria.



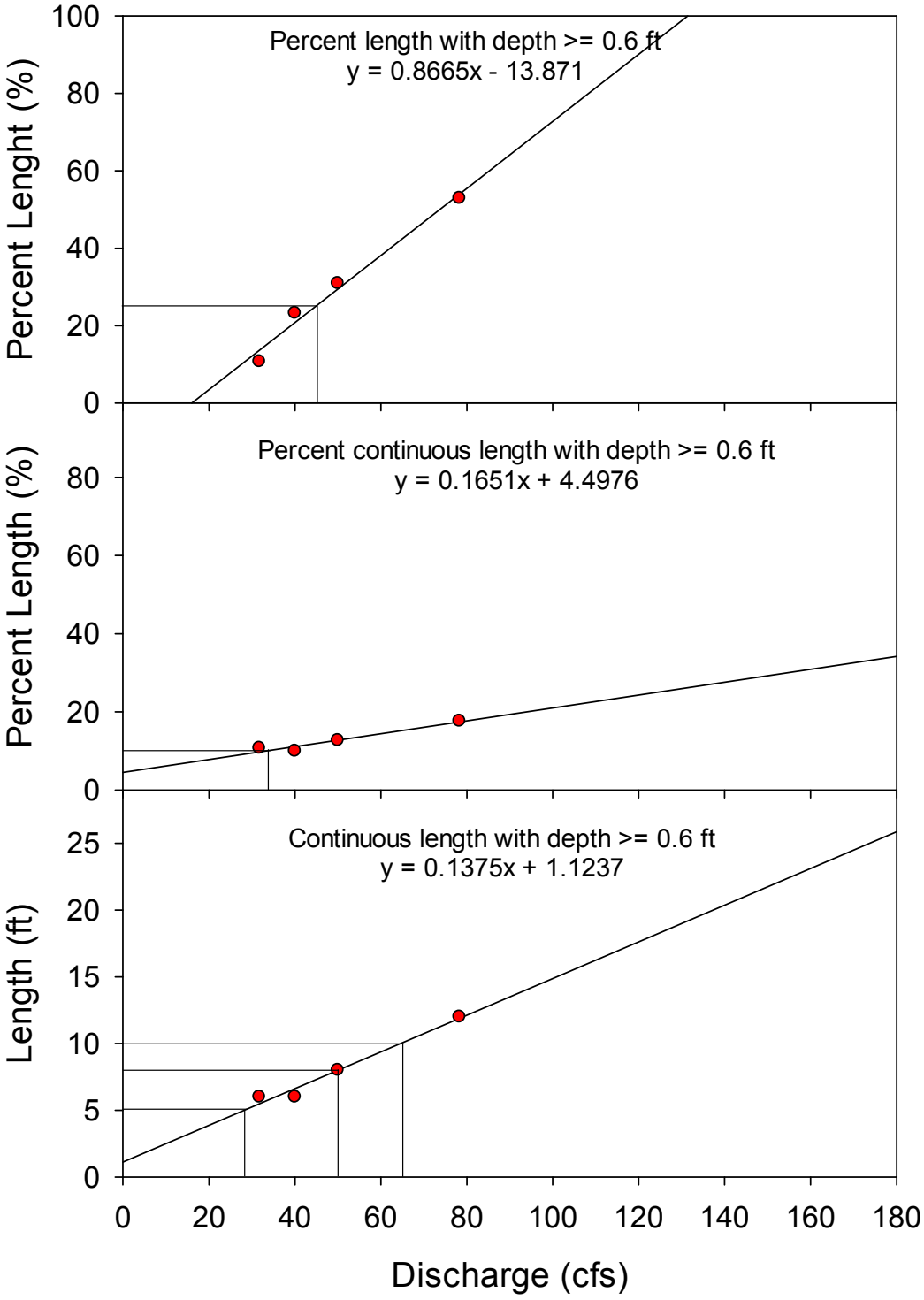
Appendix 5. Relation between Robles discharge and water depth at Site 4 upstream of San Antonio Creek and resulting discharge for various passage criteria.



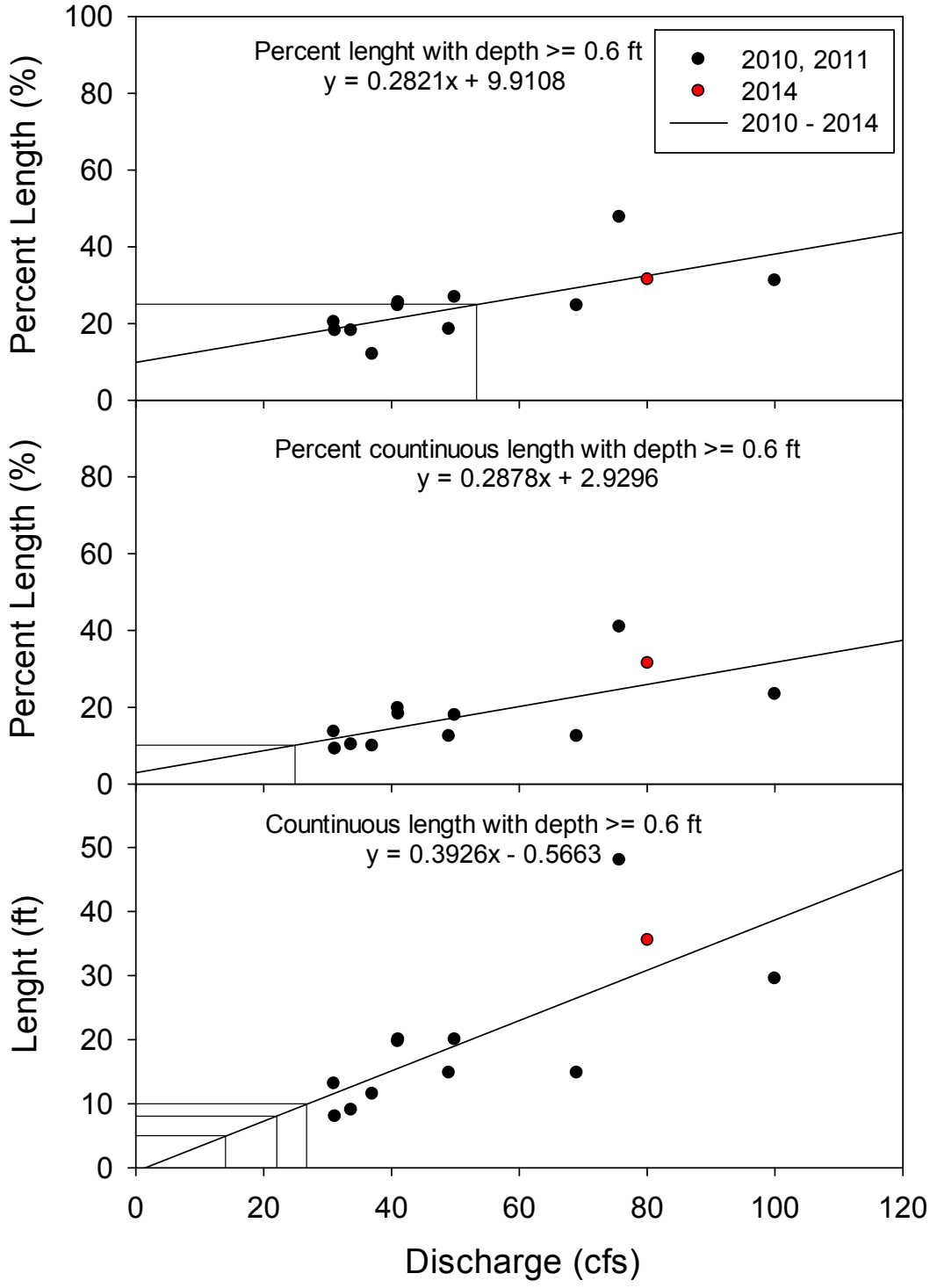
Appendix 6. Relation between Robles discharge and water depth at Site 5-2 downstream of Santa Ana bridge and resulting discharge for various passage criteria.



Appendix 7. Relation between Robles discharge and water depth at Site 6-2 upstream of Santa Ana bridge and resulting discharge for various passage criteria.



Appendix 8. Relation between Robles discharge and water depth at Site 9 upstream of Hwy 150 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. Regression equations and statistics of the four passage criteria using the Robles discharge evaluated at potential impediment sites.

	% Total Length with Depth ≥ 0.6 ft			% Continuous Length 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
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3-2	y = 0.2508x + 17.4210	0.87	0.07	y = 0.0454x + 6.0919	0.83	0.09	y = 0.2010x + 16.8680	0.92	0.04
4	y = 0.4292x - 4.9302	0.43	0.28	y = 0.2027x - 0.6608	0.26	0.05	y = 0.1309x - 0.4831	0.26	0.06
5-2	y = 0.3511x + 5.7081	0.76	0.05	y = 0.2614x + 6.4037	0.73	0.06	y = 0.3417x + 5.8061	0.75	0.06
6-2	y = 0.5399x - 9.3079	0.98	< 0.01	y = 0.0764x + 5.0392	0.62	0.11	y = 0.0832x + 2.0524	0.79	0.04
9	y = 0.8665x - 13.871	0.98	< 0.01	y = 0.1651x + 4.4976	0.93	0.033	y = 0.1375x + 1.1237	0.97	0.01
7	y = 0.2821x + 9.9108	0.48	< 0.01	y = 0.2878x + 2.9296	0.45	0.016	y = 0.3926x - 0.5663	0.56	< 0.01

Appendix 11. Calculated discharge (cfs) required from the Robles Fish 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]
10	N/A	N/A	N/A	N/A	N/A	N/A
3-2	30	86	86	-34	-44	-59
4	70	53	70	80	65	42
5-2	55	14	55	12	6	-2
6-2	64	65	65	96	71	35
9	45	33	45	65	50	28
7	53	25	53	27	22	14

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

A.

B.

C.

D.

Appendix 12a. Photos of Site 10 impediment on 03 March 2014 during 83 cfs discharge release from Robles Fish Facility, looking: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.

A.

B.

C.

D.

Appendix 12b. Photos of Site 3-2 impediment on 03 March 2014 during 82 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 12c. Photos of Site 4 impediment on 03 March 2014 during 79 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 12d. Photos of Site 5-2 impediment on 03 March 2014 during 77 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 12e. Photos of Site 6-2 impediment on 03 March 2014 during 78 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 12f. Photos of Site 9 impediment on 03 March 2014 during 78 cfs discharge release from Robles Fish Facility, looking: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to right bank.

A.

B.

C.

D.

Appendix 12g. Photos of Site 7 impediment on 03 March 2014 during 80 cfs discharge release from Robles Fish Facility, looking from: (A) downstream, (B) upstream, (C) right to left bank, and (D) left to

Appendix 13. Completed transects at impediment sites for ramp down target discharges from the Robles Fish Facility through 2014.

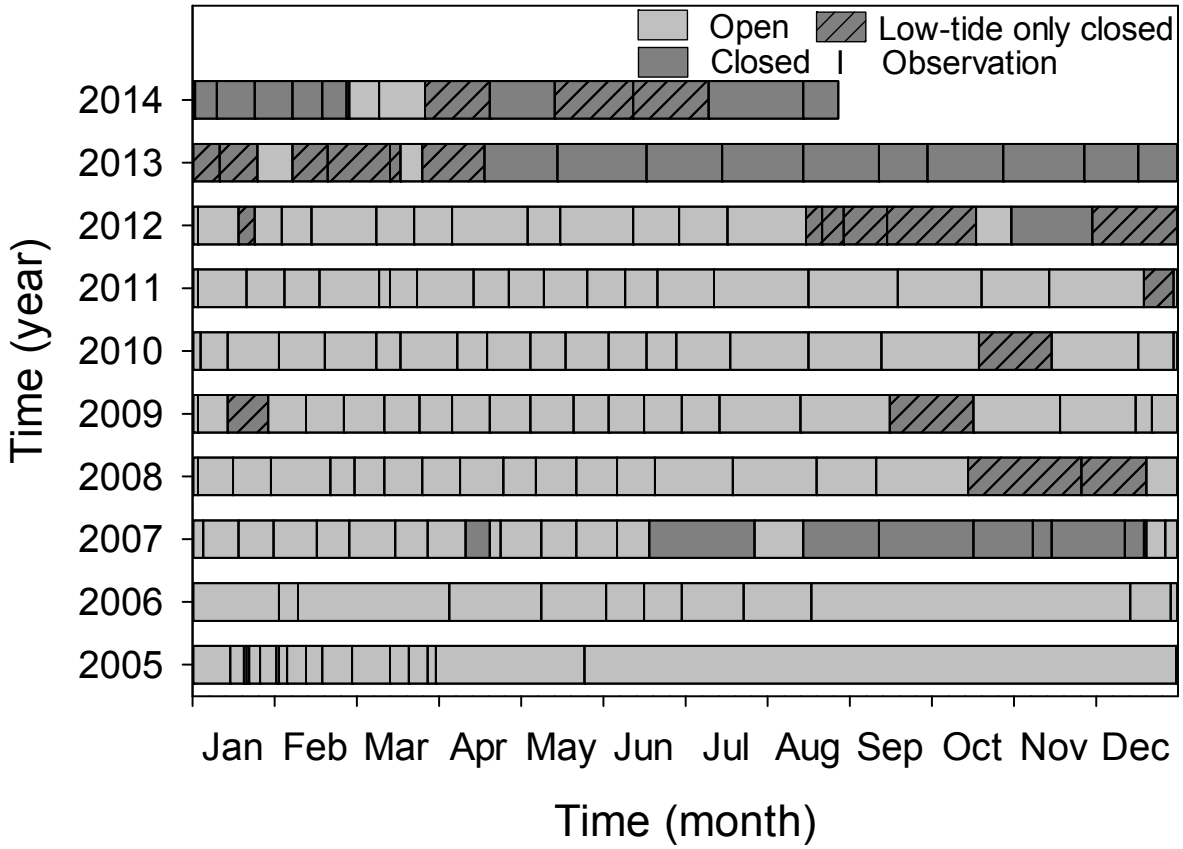
Robles Discharge (cfs)	Impediment Sites						
	3-2	4	5-2	6-2	7	9	10
171	x						
100		x			x		
82	x	x			x	x	x
74		x	x, x	x, x	x		
68	x				x		
62		x, x, x, x	x	x			
56	x		x	x			x
50		x	x		x, x	x	
40	x	x, x, x	x, x	x	x, x, x	x	
30	x	x, x	x	x	x, x, x	x	
20		x					

Completed transects rounded to nearest Robles discharge based on a 2 rkm/hr lag time and averaging hourly discharge of released water. Colors correspond to year of survey: x = 2010 x = 2011 x = 2014.

Appendix 14. Ventura River sandbar monitoring data from July 2013 through June 2014.

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
07/16/2013	N	9:18	2.21	ebb	5:51	2.92	10:33	2.06	0.4	0	If breached, center
08/15/2013	N	9:30	2.58	ebb	6:02	3.07	10:13	2.54	0.3	0	If breached, center
09/12/2013	N	10:19	3.10	flood	15:17	5.14	8:30	2.78	0.2	0	If breached, center
09/30/2013	N	10:00	3.69	ebb	7:55	4.41	13:36	2.03	0.1	0	If breached, center
10/28/2013	N	10:00	3.16	ebb	6:41	4.30	12:35	2.42	0.1	0	If breached, center
11/27/2013	N	8:40	3.02	ebb	5:06	4.73	11:49	1.68	0	0	If breached, center
12/17/2013	N	10:50	4.51	ebb	8:31	5.98	15:52	-0.59	0	0	If breached, center
01/02/2014	N	9:15	6.84	slack	9:16	6.84	3:10	1.48	0	0	If breached, center
01/10/2014	N	9:10	2.56	ebb	5:14	5.29	12:43	0.29	0	0	If breached, center
01/24/2014	N	9:15	1.47	ebb	2:59	4.58	10:38	1.24	0	0	If breached, center
02/07/2014	N	9:05	1.45	ebb	3:32	4.65	11:20	0.76	0	0	If breached, center
02/18/2014	N	9:45	3.93	flood	10:51	4.21	5:06	1.12	0	0	If breached, center
02/27/2014	N	7:20	6.14	slack	7:28	6.15	1:25	1.02	0	3.2	If breached, center
02/28/2014	Y	9:50	5.25	ebb	8:15	6.18	14:58	-1.20	2.8	37.6	Open in center
03/11/2014	Y	14:40	0.20	flood	20:33	3.74	14:10	0.14	0.4	18.8	Open in center
03/28/2014	N[b]	8:45	5.35	ebb	8:21	5.41	14:51	-0.59	0	11.0	If breached, center
04/21/2014	N	9:30	0.25	ebb	3:12	4.27	10:20	0.10	0	< 0.1	If breached, center
05/15/2014	N[b]	9:35	3.28	flood	11:06	3.89	4:52	-1.03	< 0.1	0	If breached, center
06/13/2014	N[b]	10:13	3.82	flood	10:59	3.99	4:40	-1.36	0.1	0	If breached, center

[a]USGS gauging station number 11118500, downstream of Foster Park.
[b]Sandbar was closed at low tide, but intermittent saltwater sandbar overtopping intrusions occurred during some high tides.



Appendix 15. Sandbar status at the mouth of the Ventura River from 2005 through August of 2014. Each observation is indicated by vertical lines and the sandbar status was assumed to remain the same until the next observation.

Appendix 15. Weekly fish attraction counts at the Robles Fish Facility during 2014.

Date	Method	Direction	Length (m)	Temp. (°C)	Turbidity (NTU)	Robles Discharge (cfs)	Species[a]	Count
03/05/2014[b]	Bank	Downstream	120	14.1	33.8	37.5	NFO	0
03/05/2014	Bank	Upstream	140	14.1	33.8	37.5	NFO	0
03/11/2014	Bank	Downstream	200	14.8	6.6	18.8	NFO	0
03/11/2014	Bank	Upstream	140	14.8	6.6	18.8	NFO	0
03/17/2014[b]	Bank	Downstream	120	16.2	1.7	14.1	NFO	0
03/17/2014	Bank	Upstream	140	16.2	1.7	14.1	NFO	0
03/26/2014	Snorkel	Downstream	200	16.0	1.0	8.4	NFO	0
03/26/2014	Snorkel	Upstream	140	16.0	1.0	8.4	NFO	0
04/10/2014	Snorkel	Downstream	200	18.0	2.0	4.0	NFO	0
04/10/2014	Snorkel	Upstream	140	18.0	2.0	4.0	NFO	0
04/23/2014[c]	Snorkel	Downstream	35	17.0	2.0	3.7	NFO	0
04/23/2014[c]	Snorkel	Upstream	140	17.0	2.0	3.7	NFO	0
05/01/2014[c]	Snorkel	Downstream	10	21.0	4.0	0.0	NFO	0
05/01/2014[c]	Snorkel	Upstream	140	21.0	4.0	0.0	NFO	0
		Upstream	570				Upstream	0
		Downstream	980				Downstream	0
		Total	1,550				Total	0

[a]OMY = *O. mykiss* and NFO = no fish observed.
[b]Glide habitat unit not surveyed.
[c]Partial survey due to dry habitat unit.

Appendix 16. Post-storm Fish attraction counts of O. mykiss at the Robles Fish Facility for the 01 March 2014 storm event.

Date	Time	Method	Location	Temp (°C)[a]	Turbidity (NTU)[a]	Secchi Depth (m)[a]	Robles Discharge (cfs)[a]	Species[b]	Count
03/02/2014	09:40	Bank	Entrance Pool	11.6	307	0.19	169	NFO	0
03/03/2014	09:45	Bank	Entrance Pool	10.0	102	0.19	81	NFO	0
03/04/2014	10:35	Bank	Entrance Pool	11.2	109	0.34	51	NFO	0
03/05/2014	09:00	Bank	Entrance Pool	11.0	34	0.47	39	NFO	0
03/06/2014	10:30	Bank	Entrance Pool	13.0	28	0.84	31	NFO	0
03/07/2014	14:00	Snorkel	Entrance Pool	14.8	12	1.16	27	NFO	0
03/08/2014	09:50	Snorkel	Entrance Pool	11.2	9	1.38	24	NFO	0
03/09/2014	10:15	Snorkel	Entrance Pool	12.2	9	1.41	21	NFO	0
03/10/2014	10:00	Snorkel	Entrance Pool	11.0	7	2.20	20	NFO	0
03/11/2014	11:15	Snorkel	Entrance Pool	12.0	5.6	2.08	18	NFO	0
03/12/2014	09:30	Snorkel	Entrance Pool	11.0	7	2.59	17	NFO	0
03/13/2014	09:20	Snorkel	Entrance Pool	10.2	6	3.30	17	NFO	0

[a]Environmental conditions at time of survey.
[b]OMY = *O. mykiss* and NFO = no fish observed.

Appendix 17. Discrete discharges at the Robles Fish Facility during specific dates and times for the fish attraction surveys.

			Flow Routed Through Robles Facility			
Date	Time	Inflow[a] (cfs)	Fishway Flow[b] (cfs)	Auxiliarly Water Supply[b] (cfs)	Spill[b] (cfs)	Diversion (cfs)
03/02/2014	9:40	214	29	24	115	45
03/02/2014	10:00	208	30	24	112	42
03/03/2014	9:45	79	43	36	0	0
03/04/2014	10:35	51	29	22	0	0
03/05/2014	9:00	39	27	12	0	0
03/06/2014	10:30	30	30	0	0	0
03/07/2014	14:00	25	25	0	0	0
03/08/2014	9:50	24	24	0	0	0
03/09/2014	10:15	21	21	0	0	0
03/10/2014	10:00	20	20	0	0	0
03/11/2014	10:20	18	18	0	0	0
03/11/2014	11:15	18	18	0	0	0
03/11/2014	12:30	18	18	0	0	0
03/12/2014	9:30	17	17	0	0	0
03/13/2014	9:20	17	17	0	0	0
03/17/2014	13:55	13	13	0	0	0
03/26/2014	11:25	12	12	0	0	0
04/10/2014	11:30	6	6	0	0	0
04/23/2014	11:05	2	2	0	0	0
05/01/2014	10:05	0	0	0	0	0

[a]Inflow calculated as VRNMO weir discharge plus diversion.

[b]Due to malfunctioning flow meters, flows routed through facility were estimated using regressions based on weir discharge and level sensor readings.

Ventura River Flow Assessment
Water Year 2013 – 2014

Appendix 18. Monthly flow summary for Robles Fish Facility, water year 2013-2014.

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Jul-13	D/S Dam	Matilija Ck.	Flows	Flow Release	Ladder	Weir	Canal	Inflow
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	0.2	0.3	0.5	20	0	0	0	0
2	0.2	0.3	0.5	20	0	0	0	0
3	0.2	0.3	0.5	20	0	0	0	0
4	0.2	0.3	0.5	20	0	0	0	0
5	0.2	0.3	0.5	20	0	0	0	0
6	0.2	0.3	0.5	20	0	0	0	0
7	0.2	0.3	0.5	20	0	0	0	0
8	0.2	0.3	0.5	20	0	0	0	0
9	0.2	0.3	0.4	20	0	0	0	0
10	0.1	0.3	0.4	20	0	0	0	0
11	0.2	0.3	0.4	20	0	0	0	0
12	0.2	0.3	0.5	20	0	0	0	0
13	0.2	0.3	0.5	20	0	0	0	0
14	0.2	0.3	0.4	20	0	0	0	0
15	0.2	0.3	0.4	20	0	0	0	0
16	0.2	0.3	0.4	20	0	0	0	0
17	0.1	0.3	0.4	20	0	0	0	0
18	0.1	0.3	0.4	20	0	0	0	0
19	0.1	0.3	0.4	20	0	0	0	0
20	0.1	0.3	0.4	20	0	0	0	0
21	0.1	0.3	0.4	20	0	0	0	0
22	0.1	0.3	0.4	20	0	0	0	0
23	0.1	0.3	0.4	20	0	0	0	0
24	0.1	0.3	0.4	20	0	0	0	0
25	0.1	0.3	0.4	20	0	0	0	0
26	0.1	0.3	0.4	20	0	0	0	0
27	0.1	0.3	0.4	20	0	0	0	0
28	0.1	0.3	0.4	20	0	0	0	0
29	0.2	0.3	0.4	20	0	0	0	0
30	0.2	0.2	0.4	20	0	0	0	0
31	0.2	0.2	0.4	20	0	0	0	0
Totals	5	8	13	620	0	0	0	0
	CMWD bubbler lined clogged. Data obtained from VCWPD.							

Aug-13	(1) Source Stream Mean Daily Flows: Matilija Ck D/S Dam (cfs)	(2) Source Stream Mean Daily Flows: North Fork Matilija Ck. (cfs)	(1) + (2) Source Stream Mean Daily Flows: Sum of Creek Flows (cfs)	BO Required Flow Release (cfs)	(3) Robles Facility Mean Daily Flows: Fishway Ladder (cfs)	(4) Robles Facility Mean Daily Flows: VRNMO Weir (cfs)	(5) Robles Facility Mean Daily Flows: Diversion Canal (cfs)	(4) + (5) Robles Facility Mean Daily Flows: Total Inflow (cfs)
1	0.2	0.2	0.4	20	0	0	0	0
2	0.2	0.2	0.4	20	0	0	0	0
3	0.1	0.2	0.4	20	0	0	0	0
4	0.1	0.2	0.4	20	0	0	0	0
5	0.1	0.2	0.4	20	0	0	0	0
6	0.1	0.2	0.4	20	0	0	0	0
7	0.1	0.2	0.4	20	0	0	0	0
8	0.1	0.2	0.4	20	0	0	0	0
9	0.1	0.2	0.4	20	0	0	0	0
10	0.2	0.2	0.4	20	0	0	0	0
11	0.2	0.2	0.4	20	0	0	0	0
12	0.2	0.2	0.4	20	0	0	0	0
13	0.2	0.2	0.4	20	0	0	0	0
14	0.1	0.2	0.4	20	0	0	0	0
15	0.2	0.2	0.4	20	0	0	0	0
16	0.2	0.2	0.4	20	0	0	0	0
17	0.2	0.2	0.4	20	0	0	0	0
18	0.2	0.2	0.4	20	0	0	0	0
19	0.2	0.2	0.4	20	0	0	0	0
20	0.2	0.2	0.4	20	0	0	0	0
21	0.2	0.2	0.4	20	0	0	0	0
22	0.2	0.2	0.4	20	0	0	0	0
23	0.2	0.2	0.4	20	0	0	0	0
24	0.3	0.2	0.5	20	0	0	0	0
25	0.3	0.2	0.5	20	0	0	0	0
26	0.2	0.2	0.4	20	0	0	0	0
27	0.3	0.2	0.4	20	0	0	0	0
28	0.2	0.2	0.4	20	0	0	0	0
29	0.2	0.2	0.4	20	0	0	0	0
30	0.2	0.2	0.4	20	0	0	0	0
31	0.2	0.2	0.3	20	0	0	0	0
Totals	5	7	12	620	0	0	0	0

CMWD bubbler lined clogged. Data obtained from VCWPD.

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Sep-13	D/S Dam	Matilija Ck.	Flows	Flow Release	Ladder	Weir	Canal	Inflow
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	0.2	0.2	0.4	20	0	0	0	0
2	0.2	0.2	0.4	20	0	0	0	0
3	0.1	0.2	0.3	20	0	0	0	0
4	0.1	0.2	0.3	20	0	0	0	0
5	0.1	0.2	0.3	20	0	0	0	0
6	0.1	0.2	0.3	20	0	0	0	0
7	0.1	0.2	0.3	20	0	0	0	0
8	0.1	0.2	0.3	20	0	0	0	0
9	0.1	0.2	0.4	20	0	0	0	0
10	0.1	0.2	0.4	20	0	0	0	0
11	0.2	0.2	0.4	20	0	0	0	0
12	0.2	0.2	0.4	20	0	0	0	0
13	0.1	0.2	0.4	20	0	0	0	0
14	0.2	0.2	0.4	20	0	0	0	0
15	0.2	0.2	0.4	20	0	0	0	0
16	0.2	0.2	0.4	20	0	0	0	0
17	0.2	0.2	0.4	20	0	0	0	0
18	0.2	0.2	0.4	20	0	0	0	0
19	0.2	0.2	0.4	20	0	0	0	0
20	0.2	0.2	0.4	20	0	0	0	0
21	0.2	0.2	0.4	20	0	0	0	0
22	0.2	0.3	0.4	20	0	0	0	0
23	0.2	0.3	0.4	20	0	0	0	0
24	0.2	0.3	0.4	20	0	0	0	0
25	0.2	0.3	0.4	20	0	0	0	0
26	0.2	0.3	0.4	20	0	0	0	0
27	0.2	0.3	0.4	20	0	0	0	0
28	0.2	0.3	0.4	20	0	0	0	0
29	0.2	0.3	0.4	20	0	0	0	0
30	0.2	0.3	0.4	20	0	0	0	0
Totals	5	7	11	600	0	0	0	0
	CMWD bubbler lined clogged. Data obtained from VCWPD.							

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Nov-13	D/S Dam	Matilija Ck.	Flows	Flow Release	Ladder	Weir	Canal	Inflow
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	0.2	0.5	0.7	20	0	0.0	0	0
2	0.2	0.5	0.7	20	0	0.0	0	0
3	0.2	0.5	0.7	20	0	0.0	0	0
4	0.2	0.5	0.7	20	0	0.0	0	0
5	0.2	0.5	0.7	20	0	0.0	0	0
6	0.2	0.5	0.7	20	0	0.0	0	0
7	0.2	0.5	0.7	20	0	0.0	0	0
8	0.2	0.5	0.7	20	0	0.0	0	0
9	0.2	0.5	0.7	20	0	0.0	0	0
10	0.3	0.5	0.8	20	0	0.0	0	0
11	0.3	0.5	0.8	20	0	0.0	0	0
12	0.3	0.5	0.8	20	0	0.0	0	0
13	0.3	0.5	0.8	20	0	0.0	0	0
14	0.3	0.5	0.8	20	0	0.0	0	0
15	0.3	0.5	0.8	20	0	0.0	0	0
16	0.3	0.5	0.8	20	0	0.0	0	0
17	0.3	0.5	0.8	20	0	0.0	0	0
18	0.3	0.6	0.8	20	0	0.0	0	0
19	0.3	0.6	0.8	20	0	0.0	0	0
20	0.3	0.6	0.8	20	0	0.0	0	0
21	0.5	0.6	1.1	20	0	0.0	0	0
22	0.6	0.6	1.1	20	0	0.0	0	0
23	0.4	0.5	1.0	20	0	0.0	0	0
24	0.5	0.5	1.0	20	0	0.0	0	0
25	0.5	0.5	1.0	20	0	0.0	0	0
26	0.6	0.5	1.1	20	0	0.0	0	0
27	1.2	0.5	1.7	20	0	0.0	0	0
28	1.3	0.6	1.9	20	0	0.0	0	0
29	1.0	0.6	1.6	20	0	0.0	0	0
30	0.8	0.6	1.5	20	0	0.0	0	0
Totals	12	16	28	600	0	0	0	0

CMWD bubbler lined clogged. Data obtained from VCWPD.

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Dec-13	D/S Dam (cfs)	Matilija Ck. (cfs)	Flows (cfs)	Flow Release (cfs)	Ladder (cfs)	Weir (cfs)	Canal (cfs)	Inflow (cfs)
1	0.8	0.6	1.4	20	0	0.0	0	0
2	0.7	0.6	1.3	20	0	0.0	0	0
3	0.8	0.6	1.4	20	0	0.0	0	0
4	0.8	0.6	1.4	20	0	0.0	0	0
5	0.7	0.6	1.3	20	0	0.0	0	0
6	0.7	0.7	1.4	20	0	0.0	0	0
7	0.9	0.7	1.6	20	0	0.0	0	0
8	1.1	0.7	1.8	20	0	0.0	0	0
9	1.1	0.7	1.8	20	0	0.0	0	0
10	0.9	0.7	1.6	20	0	0.0	0	0
11	0.9	0.7	1.6	20	0	0.0	0	0
12	0.9	0.7	1.6	20	0	0.0	0	0
13	0.9	0.7	1.6	20	0	0.0	0	0
14	1.0	0.7	1.7	20	0	0.0	0	0
15	1.0	0.7	1.6	20	0	0.0	0	0
16	1.0	0.7	1.7	20	0	0.0	0	0
17	1.0	0.7	1.7	20	0	0.0	0	0
18	1.6	0.7	2.3	20	0	0.0	0	0
19	1.8	0.7	2.5	20	0	0.0	0	0
20	2.1	0.8	2.8	20	0	0.0	0	0
21	2.1	0.7	2.8	20	0	0.0	0	0
22	2.1	0.7	2.8	20	0	0.0	0	0
23	2.3	0.7	2.9	20	0	0.0	0	0
24	2.0	0.6	2.7	20	0	0.0	0	0
25	1.8	0.6	2.5	20	0	0.0	0	0
26	1.8	0.6	2.4	20	0	0.0	0	0
27	1.8	0.6	2.4	20	0	0.0	0	0
28	1.8	0.6	2.5	20	0	0.0	0	0
29	2.0	0.6	2.6	20	0	0.0	0	0
30	1.8	0.6	2.4	20	0	0.0	0	0
31	1.1	0.6	1.7	20	0	0.0	0	0
Totals	41	21	62	620	0	0	0	0
	CMWD bubbler lined clogged. Data obtained from VCWPD.							

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Jan-14	D/S Dam (cfs)	Matilija Ck. (cfs)	Flows (cfs)	Flow Release (cfs)	Ladder (cfs)	Weir (cfs)	Canal (cfs)	Inflow (cfs)
1	1.2	0.6	1.8	20	0	0.0	0	0
2	1.2	0.6	1.8	20	0	0.0	0	0
3	1.3	0.6	1.9	20	0	0.0	0	0
4	1.4	0.6	2.0	20	0	0.0	0	0
5	1.5	0.6	2.1	20	0	0.0	0	0
6	1.5	0.6	2.1	20	0	0.0	0	0
7	1.4	0.6	2.0	20	0	0.0	0	0
8	1.4	0.6	2.1	20	0	0.0	0	0
9	1.6	0.6	2.2	20	0	0.0	0	0
10	1.9	0.6	2.5	20	0	0.0	0	0
11	1.6	0.6	2.2	20	0	0.0	0	0
12	1.6	0.6	2.2	20	0	0.0	0	0
13	1.4	0.6	2.0	20	0	0.0	0	0
14	1.4	0.6	2.0	20	0	0.0	0	0
15	1.4	0.6	2.0	20	0	0.0	0	0
16	1.4	0.6	2.0	20	0	0.0	0	0
17	1.5	0.6	2.1	20	0	0.0	0	0
18	1.5	0.6	2.1	20	0	0.0	0	0
19	1.5	0.6	2.1	20	0	0.0	0	0
20	1.6	0.6	2.2	20	0	0.0	0	0
21	1.6	0.6	2.2	20	0	0.0	0	0
22	1.6	0.6	2.2	20	0	0.0	0	0
23	1.6	0.6	2.2	20	0	0.0	0	0
24	1.6	0.6	2.2	20	0	0.0	0	0
25	1.6	0.6	2.2	20	0	0.0	0	0
26	1.7	0.6	2.3	20	0	0.0	0	0
27	1.8	0.6	2.4	20	0	0.0	0	0
28	1.8	0.6	2.3	20	0	0.0	0	0
29	1.8	0.6	2.3	20	0	0.0	0	0
30	1.8	0.6	2.4	20	0	0.0	0	0
31	2.0	0.6	2.5	20	0	0.0	0	0
Totals	48	18	67	620	0	0	0	0

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Feb-14	D/S Dam (cfs)	Matilija Ck. (cfs)	Flows (cfs)	Flow Release (cfs)	Ladder (cfs)	Weir (cfs)	Canal (cfs)	Inflow (cfs)
1	1.9	0.5	2.4	20	0	0.0	0	0
2	1.9	0.5	2.4	20	0	0.0	0	0
3	2.0	0.6	2.5	20	0	0.0	0	0
4	1.9	0.6	2.4	20	0	0.0	0	0
5	1.9	0.6	2.4	20	0	0.0	0	0
6	2.0	0.6	2.6	20	0	0.0	0	0
7	2.1	0.6	2.7	20	0	0.0	0	0
8	2.1	0.6	2.7	20	0	0.0	0	0
9	2.1	0.6	2.7	20	0	0.0	0	0
10	2.3	0.5	2.8	20	0	0.0	0	0
11	2.1	0.5	2.6	20	0	0.0	0	0
12	2.1	0.5	2.6	20	0	0.0	0	0
13	2.1	0.5	2.6	20	0	0.0	0	0
14	2.2	0.5	2.7	20	0	0.0	0	0
15	2.2	0.5	2.6	20	0	0.0	0	0
16	2.3	0.5	2.7	20	0	0.0	0	0
17	2.3	0.5	2.8	20	0	0.0	0	0
18	2.1	0.5	2.6	20	0	0.0	0	0
19	2.1	0.5	2.6	20	0	0.0	0	0
20	2.1	0.5	2.6	20	0	0.0	0	0
21	2.0	0.5	2.5	20	0	0.0	0	0
22	2.0	0.5	2.5	20	0	0.0	0	0
23	2.1	0.5	2.6	20	0	0.0	0	0
24	2.0	0.5	2.5	20	0	0.0	0	0
25	1.8	0.5	2.3	20	0	0.0	0	0
26	2.2	0.7	2.8	20	0	0.0	0	0
27	7.7	3.0	11	20	3	3.2	0	3
28	124	114	238	20	22	38	155	193
Totals	186	130	316	560	26	41	155	196

Weir discharge and calculated inflow underestimated due to spill releases exceeding rating table

Peak flow met BO definition of potential migration event

Mar-14	(1) Source Stream Mean Daily Flows: Matilija Ck D/S Dam (cfs)	(2) Source Stream Mean Daily Flows: North Fork Matilija Ck. (cfs)	(1) + (2) Source Stream Mean Daily Flows: Sum of Creek Flows (cfs)	BO Required Flow Release (cfs)	(3) Robles Facility Mean Daily Flows: Fishway Ladder (cfs)	(4) Robles Facility Mean Daily Flows: VRNMO Weir (cfs)	(5) Robles Facility Mean Daily Flows: Diversion Canal (cfs)	(4) + (5) Robles Facility Mean Daily Flows: Total Inflow (cfs)
1	443	265	708	171	43	425	233	658
2	175	49	224	74	42	124	91	215
3	79	16	95	68	41	76	4	81
4	50	8.1	58	56	30	50	0	50
5	34	5.7	40	56	29	37	0	37
6	27	4.2	31	50	32	32	0	32
7	22	3.3	25	50	27	27	0	27
8	20	3.0	23	50	24	24	0	24
9	17	2.6	20	50	21	21	0	21
10	16	2.5	19	50	20	20	0	20
11	13	2.2	15	50	18	19	0	19
12	12	2.0	14	40	17	17	0	17
13	12	1.9	14	30	17	17	0	17
14	11	1.8	13	30	16	16	0	16
15	10	1.7	12	30	15	15	0	15
16	10	1.6	11	30	15	15	0	15
17	10	1.5	12	30	14	14	0	14
18	9.1	1.5	11	30	13	13	0	13
19	8.9	1.5	10	30	13	13	0	13
20	8.9	1.4	10	30	13	13	0	13
21	9.0	1.4	10	30	13	13	0	13
22	9.1	1.5	11	30	13	13	0	13
23	9.0	1.5	11	30	13	13	0	13
24	9.0	1.4	10	30	13	13	0	13
25	8.6	1.4	10	30	12	12	0	12
26	8.4	1.4	10	30	12	12	0	12
27	8.3	1.5	10	30	11	11	0	11
28	8.0	1.7	10	30	11	11	0	11
29	8.0	1.6	10	30	10	10	0	10
30	8.1	1.6	10	30	10	10	0	10
31	8.1	1.5	10	30	10	10	0	10
Totals	1082	393	1475	1335	588	1117	328	1445

Represents change on date dictated by storm flow augmentation ramp-down schedule

Weir discharge and calculated inflow underestimated due to spill releases exceeding rating table

Peak flow met BO definition of potential migration event

	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Apr-14	D/S Dam	Matilija Ck.	Flows	Flow Release	Ladder	Weir	Canal	Inflow
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	7.6	1.7	9.3	30	12	12	0	12
2	5.7	1.7	7.4	30	12	12	0	12
3	5.3	1.6	6.9	30	11	11	0	11
4	5.1	1.5	6.6	30	11	11	0	11
5	5.3	1.5	6.8	30	10	10	0	10
6	4.3	1.4	5.7	30	9	8.9	0	9
7	4.4	1.4	5.8	30	8	8.2	0	8
8	4.2	1.3	5.5	30	7	7.4	0	7
9	4.1	1.3	5.4	30	7	6.7	0	7
10	4.0	1.3	5.3	30	5	5.5	0	5
11	4.0	1.3	5.3	30	4	4.2	0	4
12	4.1	1.3	5.4	30	5	5.0	0	5
13	4.3	1.3	5.6	30	7	7.0	0	7
14	4.2	1.3	5.5	30	6	6.2	0	6
15	4.0	1.2	5.2	30	5	4.7	0	5
16	3.9	1.2	5.1	30	4	4.0	0	4
17	3.9	1.2	5.1	30	4	4.3	0	4
18	4.0	1.2	5.2	30	4	4.5	0	4
19	3.9	1.2	5.1	30	3	3.1	0	3
20	3.8	1.2	5.0	30	1	0.8	0	1
21	3.7	1.1	4.8	30	0	0.0	0	0
22	3.8	1.1	4.9	30	1	0.8	0	1
23	3.6	1.1	4.7	30	1	0.9	0	1
24	3.4	1.1	4.5	30	0	0.2	0	0
25	3.5	1.1	4.6	30	0	0.0	0	0
26	3.9	1.1	5.0	30	1	1.2	0	1
27	3.6	1.1	4.7	30	0	0.0	0	0
28	3.7	1.1	4.8	30	0	0.0	0	0
29	3.3	1.0	4.3	30	0	0.0	0	0
30	3.2	1.0	4.2	30	0	0.0	0	0
Totals	126	38	164	900	139	139	0	139

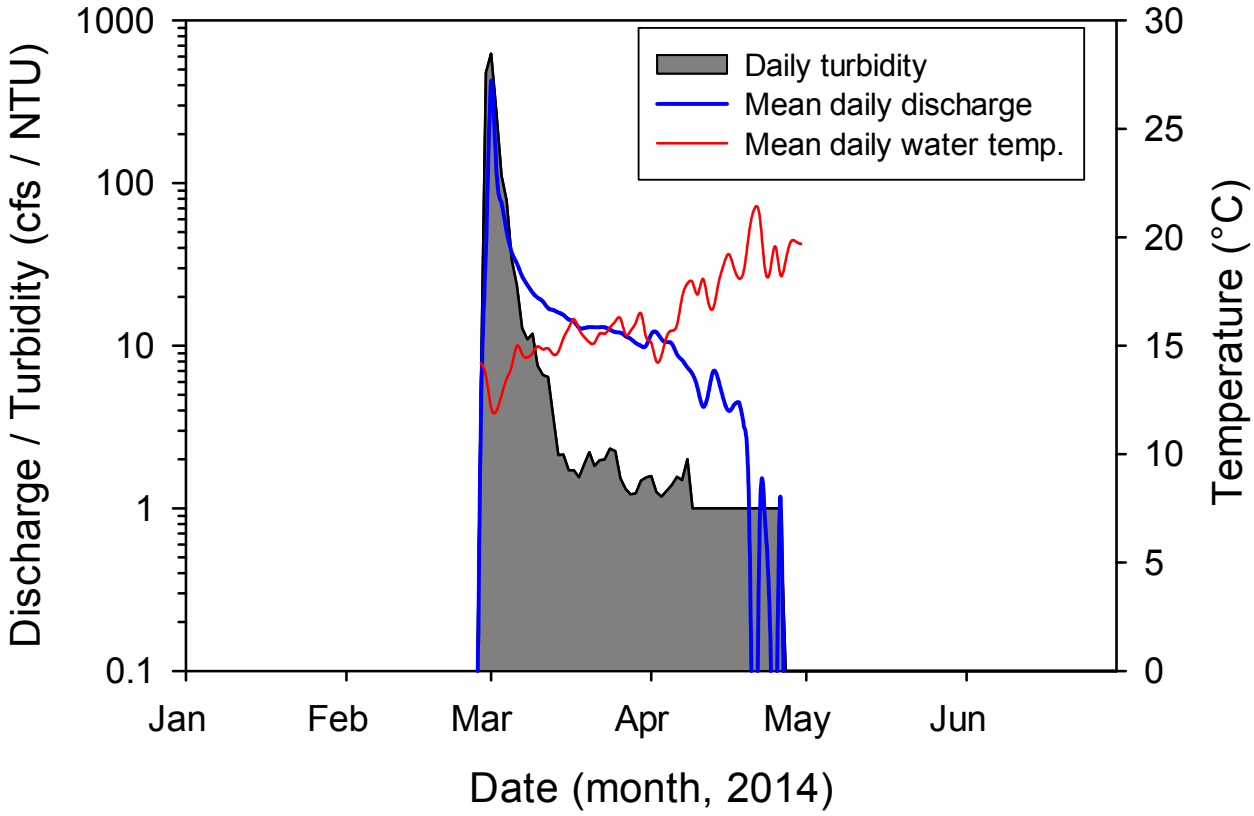
May-14	(1) Source Stream Mean Daily Flows: Matilija Ck D/S Dam (cfs)	(2) Source Stream Mean Daily Flows: North Fork Matilija Ck. (cfs)	(1) + (2) Source Stream Mean Daily Flows: Sum of Creek Flows (cfs)	BO Required Flow Release (cfs)	(3) Robles Facility Mean Daily Flows: Fishway Ladder (cfs)	(4) Robles Facility Mean Daily Flows: VRNMO Weir (cfs)	(5) Robles Facility Mean Daily Flows: Diversion Canal (cfs)	(4) + (5) Robles Facility Mean Daily Flows: Total Inflow (cfs)
1	3.1	1.0	4.1	30	0	0.0	0	0
2	3.2	1.0	4.1	30	0	0.0	0	0
3	3.0	1.0	4.0	30	0	0.0	0	0
4	3.2	1.0	4.1	30	0	0.0	0	0
5	3.3	1.0	4.3	30	0	0.0	0	0
6	3.7	1.0	4.7	30	0	0.0	0	0
7	3.4	1.0	4.4	30	0	0.0	0	0
8	3.5	1.1	4.6	30	0	0.0	0	0
9	3.7	1.1	4.8	30	0	0.0	0	0
10	3.8	1.0	4.8	30	0	0.0	0	0
11	3.3	1.0	4.2	30	0	0.0	0	0
12	3.2	1.0	4.2	30	0	0.0	0	0
13	3.2	0.9	4.1	30	0	0.0	0	0
14	3.1	1.0	4.1	30	0	0.0	0	0
15	3.1	1.0	4.0	30	0	0.0	0	0
16	3.1	1.0	4.0	30	0	0.0	0	0
17	3.1	1.0	4.1	30	0	0.0	0	0
18	3.2	1.0	4.1	30	0	0.0	0	0
19	3.2	1.0	4.2	30	0	0.0	0	0
20	3.2	1.0	4.2	30	0	0.0	0	0
21	3.3	1.0	4.3	30	0	0.0	0	0
22	3.3		3.3	30	0	0.0	0	0
23	3.5		3.5	30	0	0.0	0	0
24	3.5		3.5	30	0	0.0	0	0
25	3.7		3.7	30	0	0.0	0	0
26	3.6		3.6	30	0	0.0	0	0
27	3.5		3.5	30	0	0.0	0	0
28	3.5		3.5	30	0	0.0	0	0
29	3.5		3.5	30	0	0.0	0	0
30	3.4		3.4	30	0	0.0	0	0
31	3.4		3.4	30	0	0.0	0	0
Totals	104	21	124	930	0	0	0	0

Data not available at time of publication

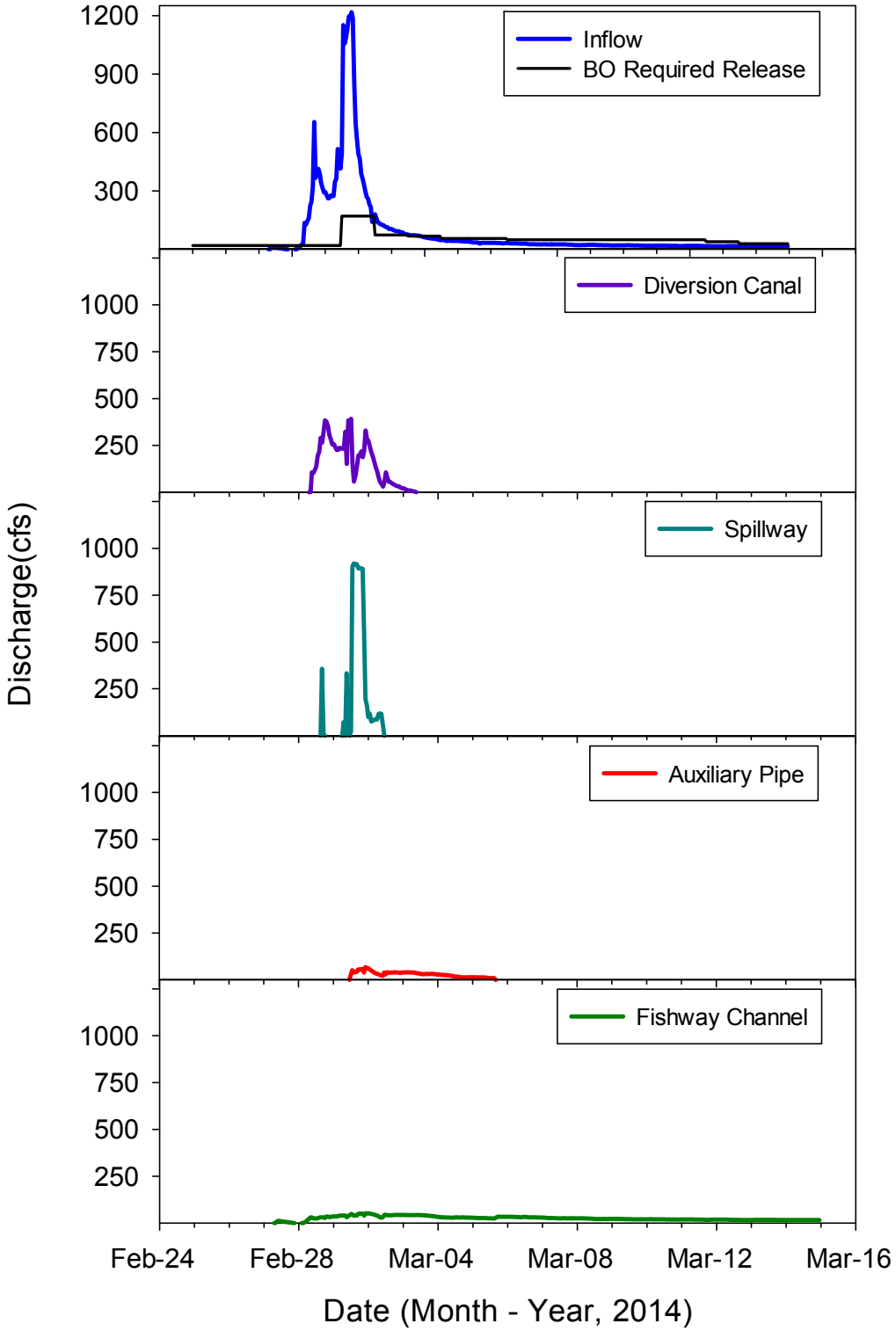
	(1)	(2)	(1) + (2)		(3)	(4)	(5)	(4) + (5)
	Source Stream Mean Daily Flows			BO	Robles Facility Mean Daily Flows			
	Matilija Ck	North Fork	Sum of Creek	Required	Fishway	VRNMO	Diversion	Total
Jun-14	D/S Dam (cfs)	Matilija Ck. (cfs)	Flows (cfs)	Flow Release (cfs)	Ladder (cfs)	Weir (cfs)	Canal (cfs)	Inflow (cfs)
1	3.4		3.4	30	0	0.0	0	0
2	3.4		3.4	30	0	0.0	0	0
3	3.3		3.3	30	0	0.0	0	0
4	3.3		3.3	30	0	0.0	0	0
5	3.2		3.2	30	0	0.0	0	0
6	3.2		3.2	30	0	0.0	0	0
7	3.2		3.2	30	0	0.0	0	0
8	3.2		3.2	30	0	0.0	0	0
9	3.1		3.1	30	0	0.0	0	0
10	3.0		3.0	30	0	0.0	0	0
11	3.0		3.0	30	0	0.0	0	0
12	3.0		3.0	30	0	0.0	0	0
13	2.8		2.8	30	0	0.0	0	0
14	2.8		2.8	30	0	0.0	0	0
15	2.8		2.8	30	0	0.0	0	0
16	2.7		2.7	30	0	0.0	0	0
17	2.7		2.7	30	0	0.0	0	0
18	2.7		2.7	30	0	0.0	0	0
19	2.6		2.6	30	0	0.0	0	0
20	2.5		2.5	30	0	0.0	0	0
21	2.5		2.5	30	0	0.0	0	0
22	2.5		2.5	30	0	0.0	0	0
23	2.3		2.3	30	0	0.0	0	0
24	2.3		2.3	30	0	0.0	0	0
25	2.3		2.3	30	0	0.0	0	0
26	2.2		2.2	30	0	0.0	0	0
27	2.2		2.2	30	0	0.0	0	0
28	2.2		2.2	30	0	0.0	0	0
29	2.1		2.1	30	0	0.0	0	0
30	2.0		2.0	30	0	0.0	0	0
Totals	82	0	82	900	0	0	0	0

Biofouling in bubbler line, adjusted data

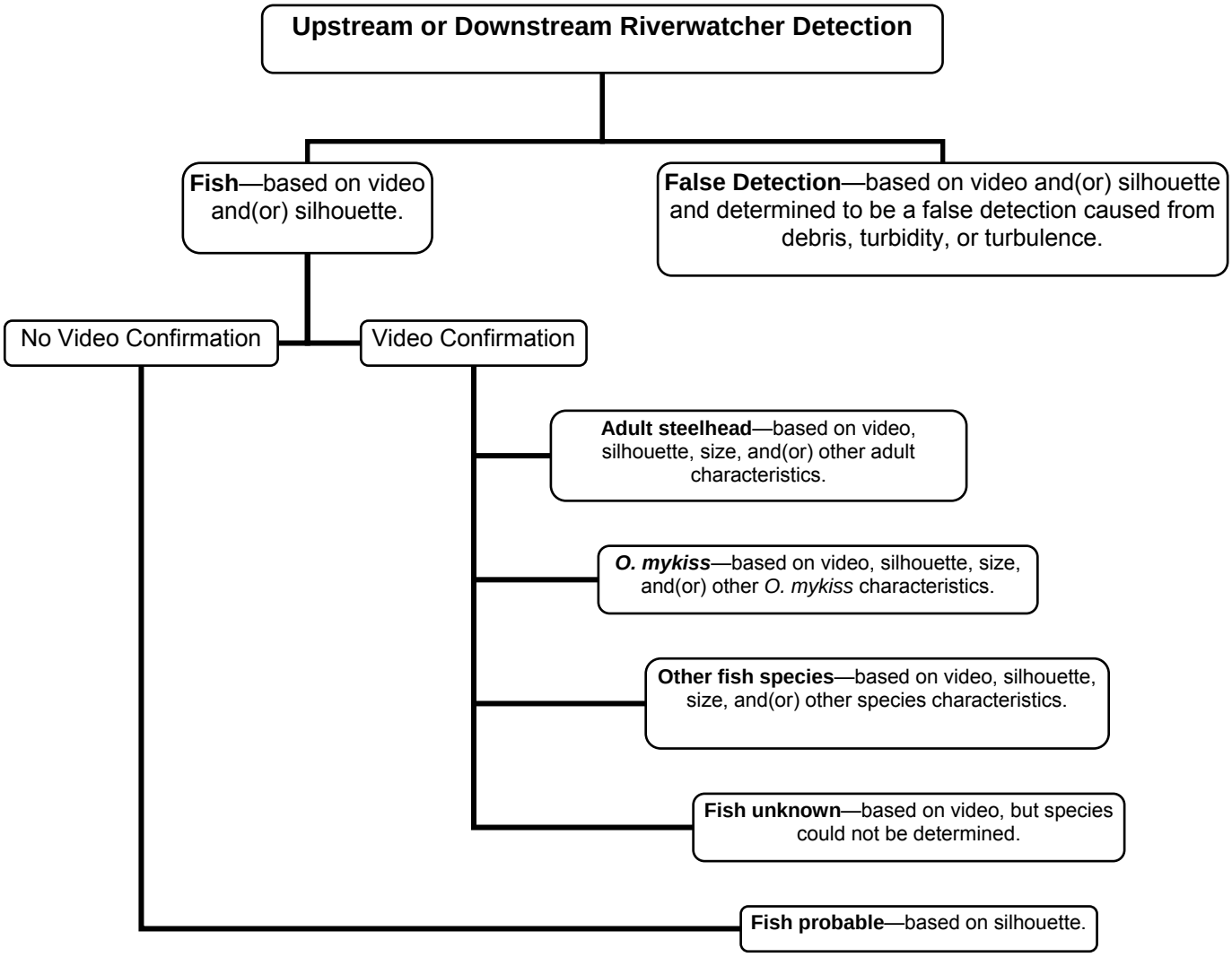
Data not available at time of publication



Appendix 19. Mean daily discharge, water temperature, and turbidity at the Robles Fish Facility during the 2014 fish passage season.



Appendix 20. Mean hourly discharge of inflow, diversion, spillway, auxiliary, and fishway at the Robles Fish Facility during the 01 March 2014 storm event.



Appendix 21. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections.

Appendix 22. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* from March through April of 2014.

	Upstream	Downstream
O. *mykiss*	1	0
Fish, non O. *mykiss*	5	3
Fish, unknown	0	0
Fish, probable	3	1
False detections	371	634
Total	379	638
Mean date - O. *mykiss*	03/10/2014	n/a
Mean date - fish, non O. *mykiss*	03/24/2014	03/29/2014
Mean date - fish, unknown	n/a	n/a
Mean date - fish, probable	03/25/2014	03/25/2014
Mean time - O. *mykiss* (24h)	17:24	n/a
Mean time - fish, non O. *mykiss* (24h)	16:14	15:19
Mean time - fish, unknown (24h)	n/a	n/a
Mean time - fish, probable (24h)	14:43	15:51
Mean length - O. *mykiss* (cm)	30	n/a
Mean length - fish, non O. *mykiss* (cm)	21	23
Mean length - fish, unknown (cm)	n/a	n/a
Mean length - fish, probable (cm)	40	39
Mean daily temperature - O. *mykiss* (°C)	15.0	n/a
Mean daily temperature - fish, non O. *mykiss* (°C)	14.4	14.1
Mean daily temperature - fish, unknown (°C)	n/a	n/a
Mean daily temperature - fish, probable (°C)	16.1	16.1
Mean daily turbidity - O. *mykiss* (NTU)	8	n/a
Mean daily turbidity - fish, non O. *mykiss* (NTU)	4	2
Mean daily turbidity - fish, probable (NTU)	n/a	n/a
Mean daily turbidity - fish, unknown (NTU)	2	2
Mean daily turbidity - false detections (NTU)	36	72
Mean daily discharge - O. *mykiss* (cfs)	20.0	n/a
Mean daily discharge - fish, non O. *mykiss* (cfs)	12.4	10.0
Mean daily discharge - fish, probable (cfs)	n/a	n/a
Mean daily discharge - fish, unknown (cfs)	12.0	12.0
Mean daily discharge - false detections (cfs)	30.0	57.0

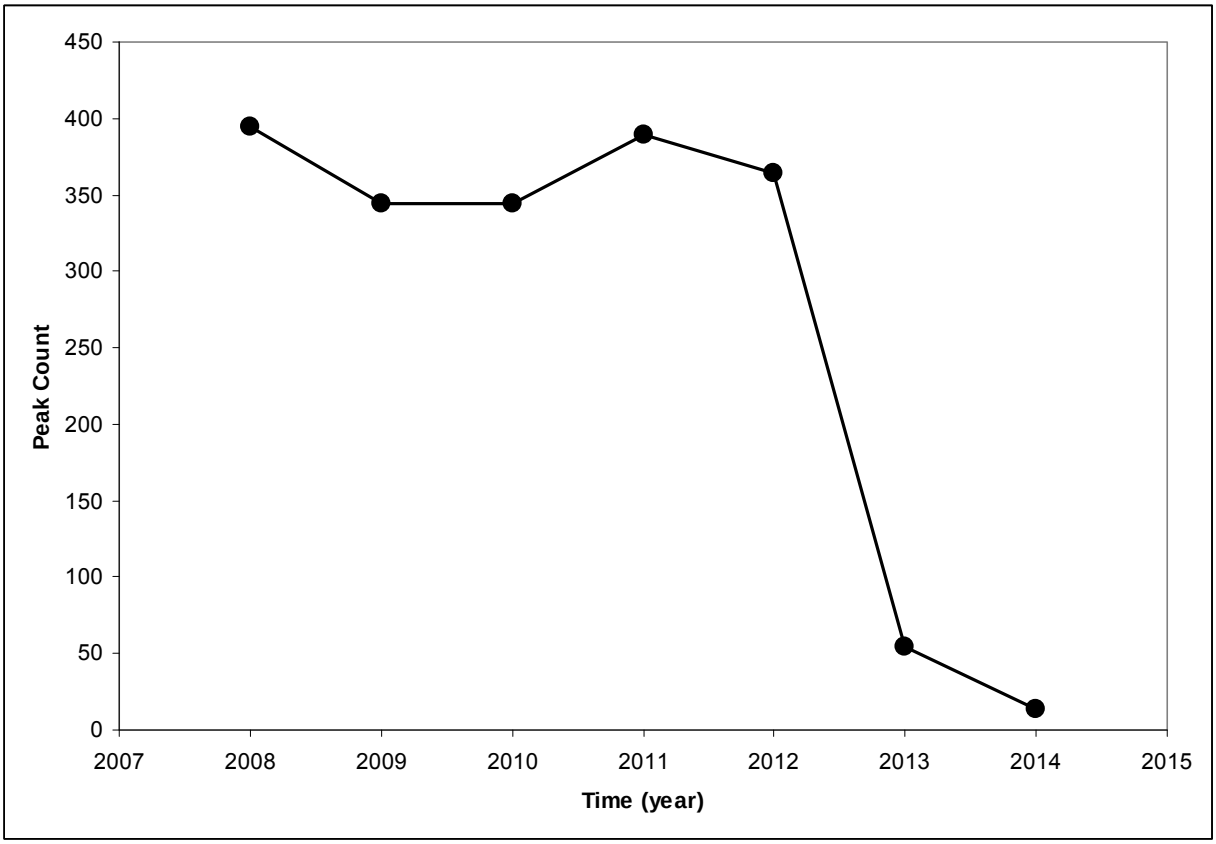
Appendix 23. Date, time, TL, direction, discharge, turbidity, and temperature at time of all Riverwatcher and post-storm video Fish Attraction Evaluation detections that were determined to be fish. Discharge was measured at the measurement weir.

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
03/10/2014	17:24	*O. mykiss*	30	Up	20	8	15.0
03/11/2014[a]	12:30	*O. mykiss*	20	Down	19	7	14.8
03/11/2014[a]	12:34	*O. mykiss*	20	Up	19	7	14.8
03/11/2014[a]	14:50	*O. mykiss*	25-30	Down	19	7	14.8
03/11/2014[a]	14:50:20	*O. mykiss*	25-30	Up	19	7	14.8
03/11/2014[a]	14:54	*O. mykiss*	25-30	Down	19	7	14.8
03/11/2014	16:50	LMB	39	Up	19	7	14.8
03/11/2014	17:15	LMB	34	Up	19	7	14.8
03/12/2014[a]	13:18	*O. mykiss*	20	Up	17	6	14.9
03/12/2014[a]	13:25	*O. mykiss*	20-25	Up	17	6	14.9
03/18/2014	18:38	LMB	35	Down	13	2	15.8
03/18/2014	19:01	LMB	20	Up	13	2	15.8
03/25/2014	13:21	Fish, probable	34	Up	12	2	16.1
03/25/2014	15:24	Fish, probable	44	Up	12	2	16.1
03/25/2014	15:24	Fish, probable	42	Up	12	2	16.1
03/25/2014	15:51	Fish, probable	39	Down	12	2	16.1
03/28/2014	12:15	LMB	34	Up	11	1	15.7
03/29/2014	15:59	LMB	49	Down	10	1	16.1
04/09/2014	6:46	LMB	23	Down	7	1	17.9
04/21/2014	15:49	LMB	46	Up	0	1	21.3

[a]Post-storm video Fish Attraction Evaluation detected *O. mykiss*. The camera was installed from 02 to 19 March 2014.

Appendix 24. *O. mykiss* presence/absence 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	34.16875	-119.18532	25.1	10.0
		0.9	Main Street riffle	34.16896	-119.18546	34.0	8.0
2	Ventura River	9.4	Foster Park pool 1	34.21141	-119.18474	25.0	15.4
		10.0	Foster Park pool 2	34.21304	-119.18592	46.0	16.0
		10.1	Foster Park riffle	34.21184	-119.18527	45.0	11.0
3	Ventura River	13.0	San Antonio conf. pool 1	34.22825	-119.18451	33.0	22.0
		13.0	San Antonio conf. riffle	34.22805	-119.18453	42.0	14.0
		12.9	San Antonio conf. pool 2	34.21184	-119.18527	50.0	10.0
4	Ventura River	18.8	Hwy 150 pool 1	34.25584	-119.18132	43.3	14.0
		18.8	150 pool 2	34.25612	-119.18075	49.5	9.0
		18.7	Hwy 150 riffle	34.25540	-119.18157	43.6	11.0
5	Ventura River	22.1	Land Cons. pool 1	34.27204	-119.17589	50.1	19.1
		22.2	Land Cons. pool 2	34.27268	-119.17578	48.6	15.1
		22.1	Land Cons. Riffle	34.27245	-119.17590	44.6	18.8
6	Ventura River	23.2	Robles weir pools	34.27782	-119.17435	58.7	19.0
		23.3	Robles glide	34.27817	-119.17440	78.3	17.3
		23.4	Robles entrance pool	34.27866	-119.17440	39.8	21.8
		23.4	Fish ladder entrance box	34.27866	-119.17440	15.0	3.0
		23.5	Robles screenbay	34.27890	-119.17466	42.2	13.5
		23.5	Robles forebay	34.27900	-119.17433	33.0	17.2
7	San Antonio Cr.	0.2	Lower San Antonio pool 1	34.22852	-119.18325	16.0	6.0
		0.2	Lower San Antonio riffle	34.22858	-119.18342	20.2	3.5
		0.4	Lower San Antonio pool 2	34.22862	-119.18394	40.0	6.0
8	San Antonio Cr.	9.4	Upper San Antonio riffle	34.25943	-119.15056	25.0	5.0
		9.5	Upper San Antonio pool	34.25960	-119.15055	19.8	5.5
9	NF Matilija Cr.	0.1	Lower NF pool 1	34.29104	-119.18063	7.3	13.3
		0.1	Lower NF pool 2	34.29119	-119.18083	7.9	10.9
		0.2	Lower NF riffle	34.29112	-119.18120	17.8	8.0
10	NF Matilija Cr.	6.6	Upper NF pool	34.30572	-119.16513	29.0	9.0
		6.6	Upper NF riffle	34.30557	-119.16517	33.1	7.5
11	Matilija Cr.	0.3	Lower Matilija pool	34.28975	-119.18108	21.1	24.7
		0.3	Lower Matilija riffle	34.28979	-119.18092	15.9	8.0
12	Matilija Cr.	2.1	Upper Matilija pool	34.29513	-119.18962	89.4	13.7
		2.1	Upper Matilija riffle	34.29538	-119.19025	51.0	9.0
14	San Antonio Cr.	4.4	Frasier St. pool	34.24171	-119.16902	12.8	13.8
		4.4	Frasier St. riffle	34.24174	-119.16895	30.8	5.9
15	Ventura River	8.5	Bedrock pool	34.20723	-119.17960	50.0	17.0
		8.5	Bedrock pool riffle	34.20740	-119.17976	37.0	6.0

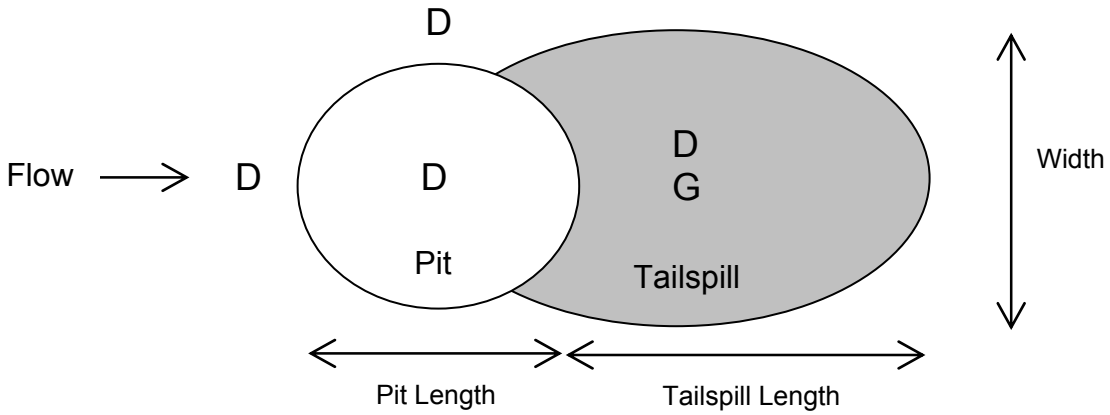


Appendix 25. Peak snorkel counts of *O. mykiss* from 2008-2014 at index sites.

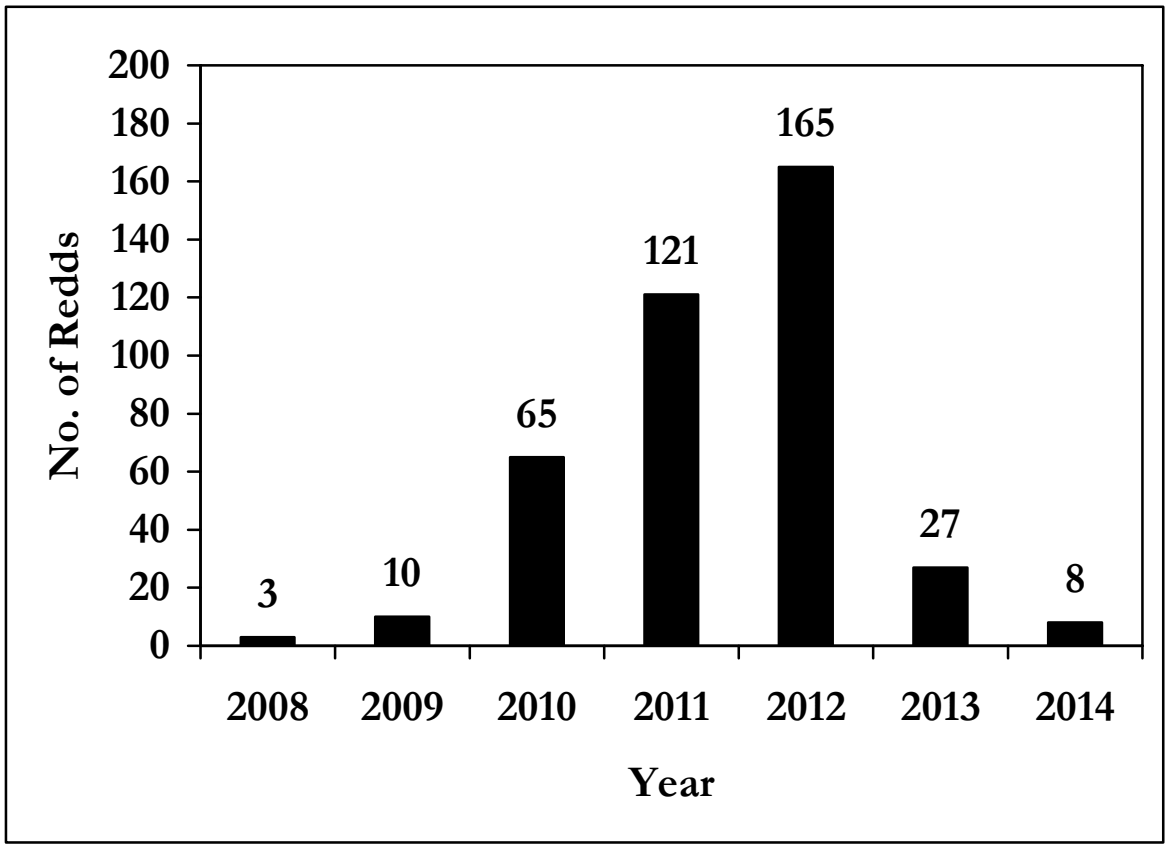
Appendix 26. *O. mykiss* spawning index sites in the Ventura Basin.

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		2.2	Upstream of Lake Matilija	34.49198	-119.31645	15.0	10.0	150
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[a]	1	NF Matilija Cr.	4.1	Near Wheeler's Springs Reach	34.50826	-119.28955	300	4.5	1350
								Total =	58,292

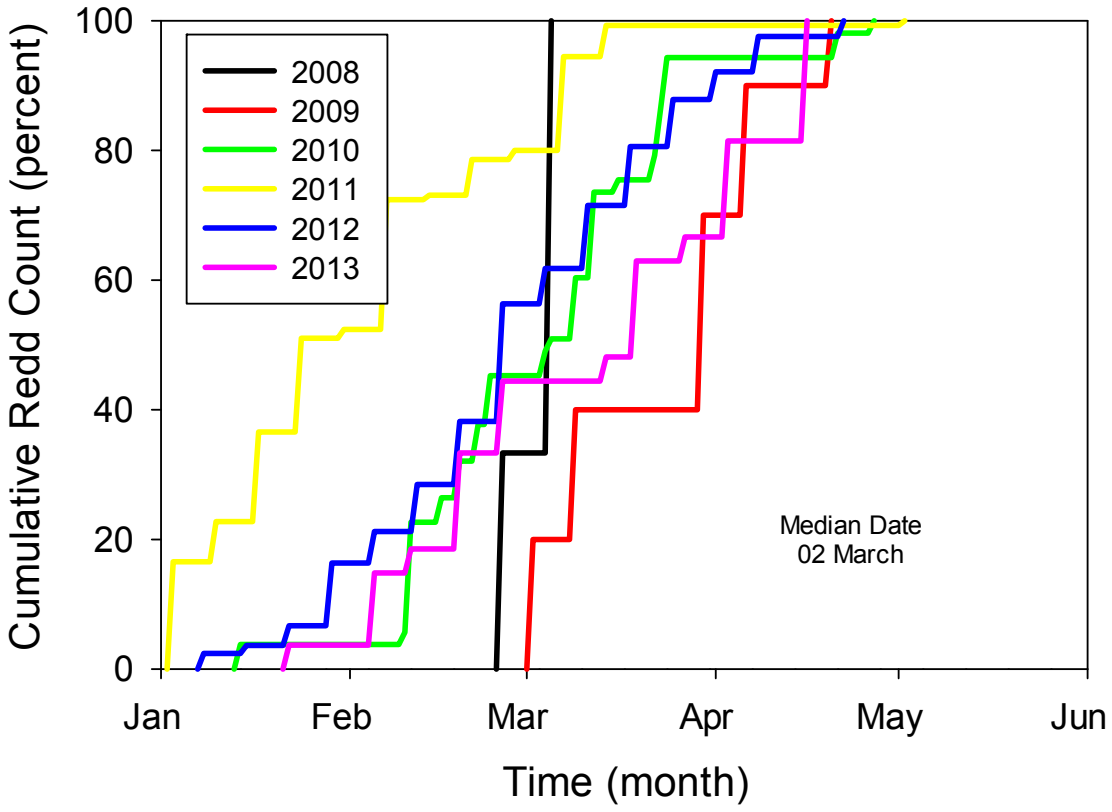
[a]Site 25 added in March 2014 and includes previous site 16.



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 2014 spawning years.



Appendix 29. Cumulative spawning distributions from 2008 through 2013 spawning years at index sites. Median spawning date for 6-year sampling period was 02 March.

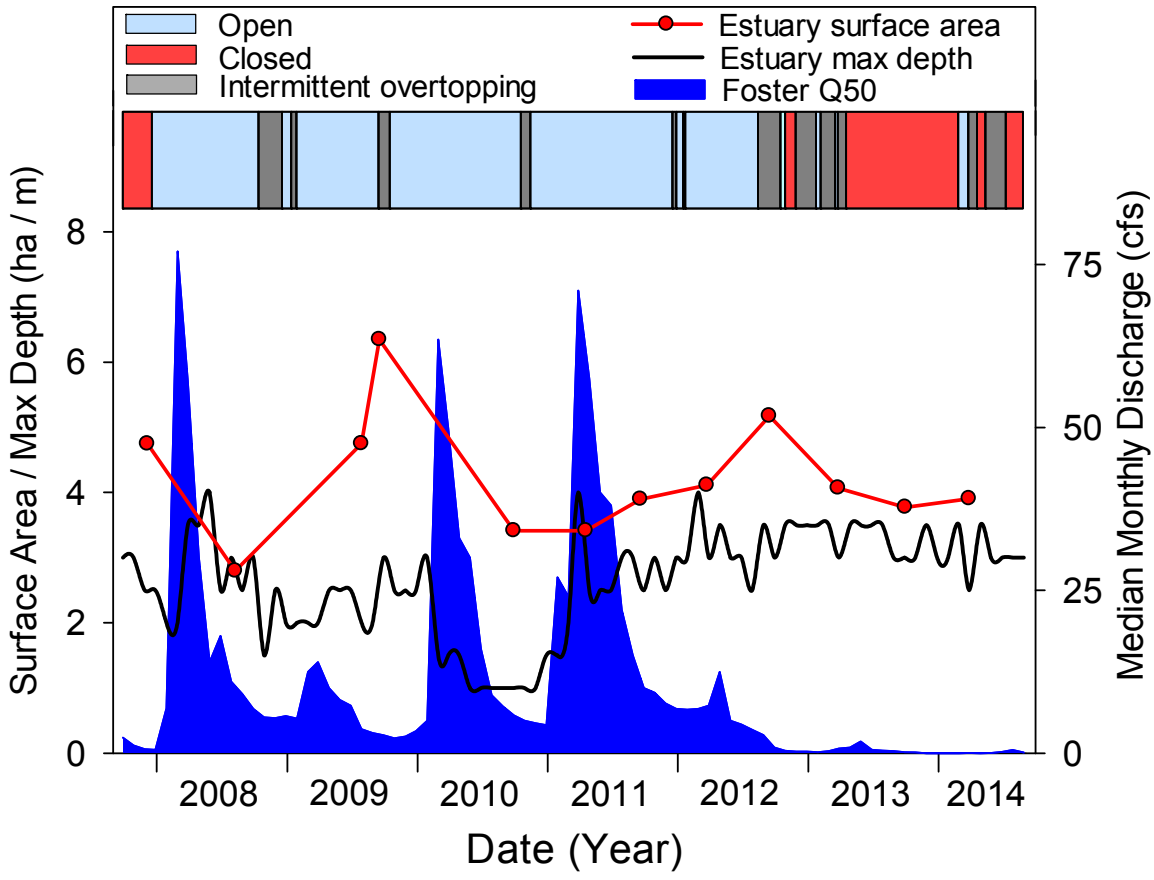
Appendix 30. Water quality monitoring sites and sampling summary.

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	Continuous Grab Continuous	30 min Monthly Hourly
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

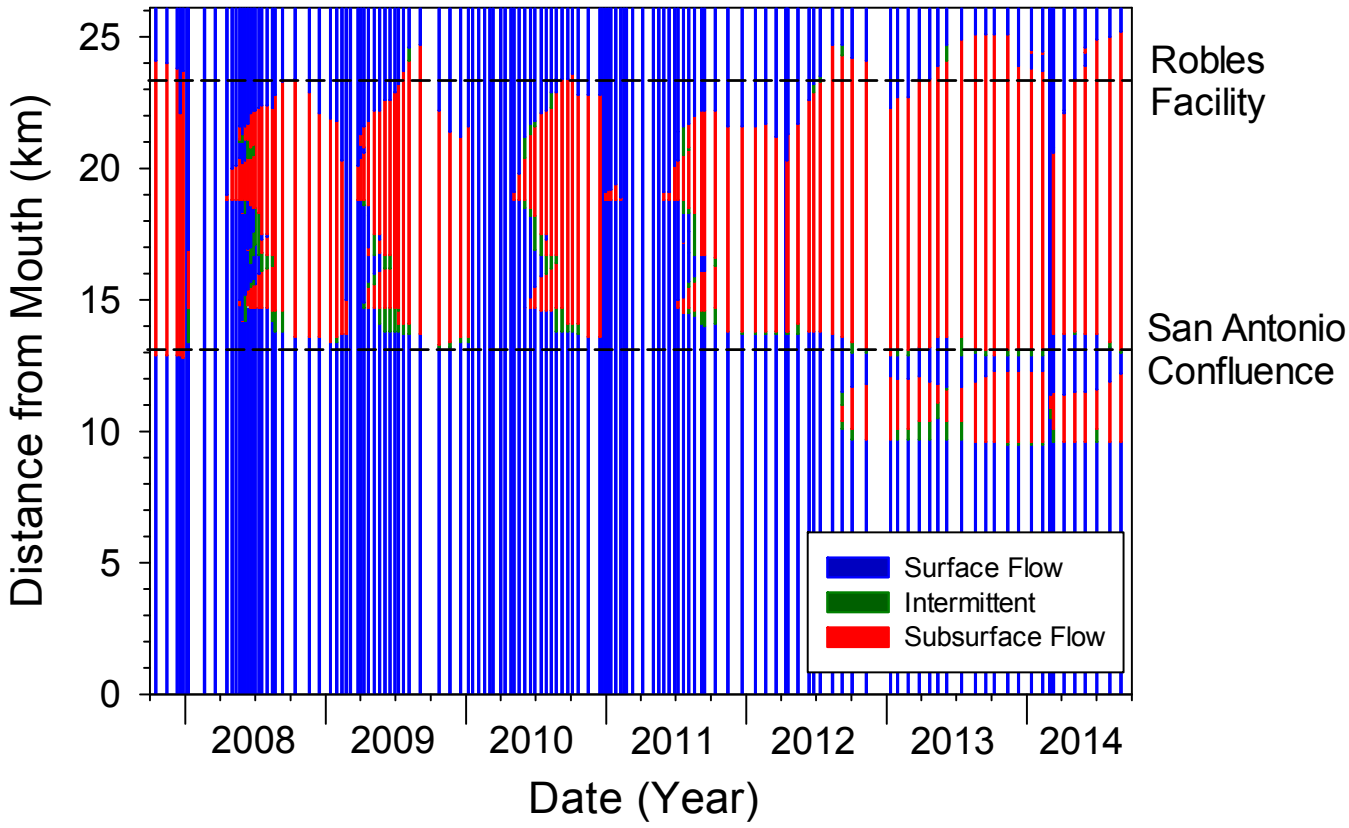
[a]Site location is identified by the river system and kilometers from its confluence. C = Coyote Creek, M = Matilija Creek, N = North Fork Matilija Creek, S = San Antonio Creek, V = Ventura River.

[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.

[c]Continuous samples were collected at the identified frequency. Grab samples were collected once at the identified frequency. Grab profile samples were collected once at the identified frequency at 0.5 m intervals from surface to bottom.



Appendix 31. Ventura River estuary/lagoon water depth, surface area, sandbar status, and discharge at Foster Park since 2008.

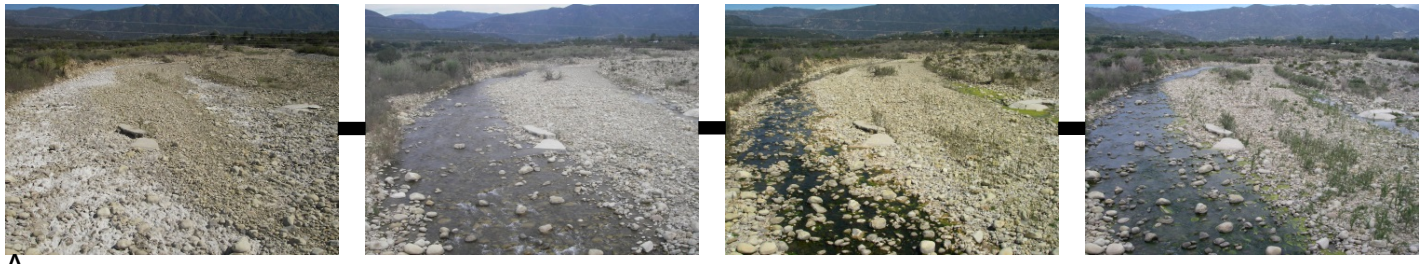


Appendix 32. Ventura River channel surface flow monitoring from 2008 to 2014.

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.



A.

2007 2008 2009 2010

B.

C.

2011 2012 2013 2014

D.

Appendix 34. Multiple year photo comparison of ephemeral and perennial reaches of the Ventura River. Photo series A and C are looking upstream from Hwy150 bridge. Photo series B and D are looking upstream from the bridge near the Shell Rd exit off Hwy 33.

Appendix 35. Storm flow assessment worksheets for the two BO-defined storms.

Flow Assessment at Robles Diversion and Fish Passage Facility

Date: 3/1/14 Time: 9:00 Prepared by: _____

INITIAL STORM EVENTS

Current Flow Conditions

Fish Ladder (cfs)	41
Auxiliary Pipeline (cfs)	0
Measurement Weir (cfs)	41
Robles Canal (cfs)	348
Spillway Gates (Open/Closed)	1 — 2 — 3 — 4 —
Cutoff Wall (Overflow - Yes/No)	

Estimated Inflow to Robles (cfs) 389

Matilija W.S. Elevation	
Matilija Creek @ Matilija Hot Spgs	
North Fork Matilija Creek (cfs)	
Lake Casitas W.S Elevation	

Initial Storm Peak

Date	2/23/14
Time	15:00
Matilija Dam Peak Flow (cfs)	294

Current day is 1 days after Peak.

Robles Release Requirements

Day	DATE	Robles Inflow	Table 2-3 Initial Rel.	Table 2-4 Selection	Release Schedule: Table 2-4 Rel. (cfs)
1	3/1	389	171		171
2	3/2				100
3	3/3				82
4	3/4				74
5	3/5				68
6	3/6				62
7	3/7				56
8	3/8				56
9	3/9				51
10	3/10				50
11	3/11				40
12	3/12				31

OVERLAPPING EVENTS

Overlapping (OL) Storm Peak

Date	
Time	
OL Peak Flow (cfs)	
Days since initial Peak	

Days since OL Peak to < 600 cfs	
Table 2-6 Initial Release (cfs)	
Table 2-7 Initial Release (cfs)	

OPERATOR INSTRUCTIONS

Fish Ladder Flow set at _____ cfs

Auxiliary Flow set at _____cfs.

Diversion Setpoints:
Maximum _____
Minimum _____

Other Instructions: _____

POSTED: _____ BY: _____

Cont.

Flow Assessment at Robles Diversion and Fish Passage Facility

Date: 3/2/14 Time: 9:00 Prepared by: _____

INITIAL STORM EVENTS

Current Flow Conditions

Fish Ladder (cfs)	≈50
Auxiliary Pipeline (cfs)	?
Measurement Weir (cfs)	176
Robles Canal (cfs)	51
Spillway Gates (Open/Closed)	1 — | 2 4% | 3 — | 4 —
Cutoff Wall (Overflow - Yes/No)	N

Estimated Inflow to Robles (cfs) 227

Matilija W.S. Elevation	
Matilija Creek @ Matilija Hot Spgs	
North Fork Matilija Creek (cfs)	
Lake Casitas W.S Elevation	

Initial Storm Peak

Date	3/1/14
Time	14:25
Mailija Dam Peak Flow (cfs)	1303

Current day is 1 days after Peak.

Robles Release Requirements

Day	DATE	Robles Inflow	Table 2-3 Initial Rel.	Table 2-4 Selection	Release Schedule: Table 2-4 Rel. (cfs)
1	3/2	227			74
2	3/3				68
3	3/4				62
4	3/5				56
5	3/6				56
6	3/7				50
7	3/8				50
8	3/9				50
9	3/10				50
10	3/11				50
11	3/12				48
12	3/13				30

OVERLAPPING EVENTS

Overlapping (OL) Storm Peak

Date	
Time	
OL Peak Flow (cfs)	
Days since initial Peak	

Days since OL Peak to < 600 cfs	
Table 2-6 Initial Release (cfs)	
Table 2-7 Initial Release (cfs)	

OPERATOR INSTRUCTIONS

Fish Ladder Flow set at _____ cfs

Auxiliary Flow set at _____cfs.

Diversion Setpoints:
Maximum _____
Minimum _____

Other Instructions: _____

POSTED: _____ BY: _____