2013 Robles Fish Passage Facility
Progress Report

Ventura River channel in the Robles Reach upstream of Hwy 150 (top) and Santa Ana Blvd. (bottom) bridges during March of 2013. Due to low precipitation, the river channel was dry throughout the steelhead migration season.

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TABLE OF CONTENTS

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 2013 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 2012 to 30 June 2013.

The monitoring and evaluation studies related to the Robles Fish Facility conducted during the 2012-2013 reporting period are included in two main sections of this progress report. The Fisheries Monitoring and Evaluation section includes: upstream fish migration impediment evaluation, sandbar monitoring at the mouth of the Ventura River, fish attraction evaluation, fish passage monitoring, downstream fish passage evaluations, and downstream fish migration through the Robles Reach. The Facility Operation section includes: information and data on the facility status, flow observations and control, costs associated with operation and monitoring, assessment of the effectiveness to provide fish passage, recommendations of priorities for future activities, and revisions deemed necessary to the operations.

Because little precipitation occurred during the 2013 migration season, river flows were too low (or non-existent) to collect data and evaluate potential impediments to upstream fish migration. 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. A total of only 17 *O. mykiss* were counted in the area upstream and downstream of the Robles Fish Facility during the fish attraction evaluations in 2013. This number likely represents multiple counts of some *O. mykiss* due to smolting rates and migration behavior. During the fish passage season, only 3 fish were documented migrating through the Robles Fish Facility in 2013.

2.0 INTRODUCTION

NOAA Fisheries listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA, 16 U.S.C. § 1531 et. seq.) of 1973, as amended. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) that were considered to be substantially 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 spawning runs by the season in which the peak occurs as they return from the ocean (Busby et al. 1996). Summer steelhead are generally found in river systems that drain from farther inland, such as the Columbia River basin. Winter steelhead runs are typically found in the coastal systems where the river systems are not as large. The winter steelhead life history pattern is the most abundant anadromous life history within the natural range of the species (Busby et al. 1996).

3.0 FISHERIES MONITORING AND EVALUATION

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

I. Monitor Fish Passage Facility operations and performance.

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

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

5-year Reevaluation of Initial Evaluation and Monitoring Activities

As described in the BO, a 5-year reevaluation of the initial fish flow operations would be conducted to determine if monitoring and evaluations have been completed (NMFS 2003a). The initiation of the 5-year period began in 2006, which was the first year the Robles Fish Facility was fully operational. An annual and ongoing reevaluation began after the 2010 fish passage season. Through the Cooperative Decision Making Process, the Robles Biological Committee will review each of the specific evaluations and determine if the original objectives have been addressed and could be discontinued or if additional study would be needed. It is recommended that all aspects of the monitoring and evaluation for the Robles Fish Facility be continued during 2014. 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.

3.1 Upstream Fish Migration Impediment Evaluation

Introduction

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

rates that cause channel surface flow to rapidly recede and cease shortly after storm events (Cooke et al. 1992).

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

approximately 30-100 cfs (the upper limit is dependent on the ability to safely conduct the surveys), which is correlated with discharge at the Robles Fish Facility. The number of repeated surveys has been dependent on the number and duration of significant rain events, rate of hydrograph recession, and time constraints due to other aspects of the monitoring and evaluation program. The impediment surveys will most likely be conducted over a period of 3-4 wet years given the natural variation of water conditions. The selected impediment sites will be resurveyed as many times as needed to develop a statistically rigorous data set to evaluate fish passage in relation to Robles Fish Facility discharge.

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

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

ENTRIX Site Assessments

An effort was made to locate and determine the status of the ENTRIX (1999) 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 2013, dry conditions prevented data collection for the Upstream Fish Migration Impediment Evaluation. Precipitation in the Ventura Basin was 50-60% of normal for the 2013 water year. Daily mean discharge from the Robles Fish Facility ranged from 0 to 13 cfs. There were several very small rain events during the 2013 water year. However, they were not sufficient to create the runoff and discharge needed to conduct the impediment evaluations. Of the total 15.3 inches of precipitation measured in Matilija Canyon (Ventura County site 207c), about 65% occurred before January 2013.

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

(CDFG) were also involved in this assessment and selection process. Based on this field review, Site 2 was no longer considered a potential impediment. Site 10 and was identified as a replacement site during the January field trip. Site 8, which was originally selected during dry conditions, was not considered as restrictive as other potential sites after evaluating data collected during 2010 and 2011. Consequently, Site 8 was replaced with Site 9 during the January field trip. The complete list of impediment sites that the BC visited and determined to be satisfactory for monitoring during the 2012 season can be found in Appendix 2. However, at the time the new site selections were made (i.e., 11 January 2012), insufficient flows were available to make final site selection or transect placements. During 2013, and 2012, the lack of surface flow did not allow for confirmation of these site changes. As soon as sufficient flows exist, available members of the BC will visit sites 9 and 10. If, after further evaluations with sufficient flows, Site 10 does not appear to be adequate, then Site 8 will continue to be monitored.

Discussion

Flows were inadequate during 2013 to conduct this evaluation and it will be continued once conditions permit.

3.1.1 Sandbar Monitoring

Introduction

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

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

Methods

During each sandbar inspection, observations and recordings were made that included: date, time, status of the sandbar, general location of the mouth, tidal stage, water temperature, and discharge at the Robles Fish Facility and the USGS Foster Park gage station. The sandbar was closed on 02 January 2013 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 2012 through June 2013, the mouth of the Ventura River was inspected 20 times to determine if the sandbar was open or closed. Eleven of the observations occurred during the fish passage augmentation season (01 January to 30 June 2013) and nine were outside of the fish passage augmentation season. The sandbar was open only 12% of the time during the fish passage augmentation season (Appendix 3). 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 January and middle of March), and the sandbar was closed for the remainder of the 2013 fish passage augmentation season. During the majority of 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 that overtopped the sandbar. However, these overtoppings were not sufficient to erode the sandbar enough to cause water to exit the lagoon. This occurred for 75% of the closed sandbar observations. When the sandbar was open, the period was brief due to low flows that allowed the sandbar to reform quickly. On the days the sandbar was inspected during the reporting period, the mean daily discharge at the USGS Foster Park gage station ranged from < 1 to 5 cfs and 0 to 10.5 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. During the period that the sandbar was closed in December of 2007, the lagoon had a surface area of 4.7 ha. During an open period in August of 2008, the estuary had a surface area of 2.8 ha, which represents an approximately 70% increase in surface area during periods when the sandbar was closed (Lewis et al. 2010).

The tendency for the sandbar to remain open in all but very dry years is likely due to a few factors. Although the 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 two consecutive years of below-normal precipitation (both 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 (approximately 2-3 cfs during August of 2013). Furthermore, the amount of time the sandbar was closed over this reporting period was the greatest since monitoring began in 2005.

3.2 Fish Attraction Evaluation

Introduction

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

The entrance of the fish ladder at the Robles Fish Facility is located approximately 20 m downstream of the spillway gates and is where fish migrating upstream enter and where fish migrating downstream exit the 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 170 cfs (50 cfs through

the entire ladder and an additional 120 cfs can be supplemented at the lower end of the ladder). The distance from the entrance pool downstream to the lower most interim rock weir is approximately 200 m. This reach includes all four rock weirs and the facility's low-flow road crossing, which is also the weir used to measure discharge 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

Fish attraction surveys were conducted on a weekly basis during the fish passage season from January through April of 2013. The particular survey methodology used was determined based on water visibility, river discharge, and expected steelhead life history stage present at the time of the survey. Since no *O. mykiss* were observed until April, bank surveys were predominantly used and snorkel surveys were used monthly to validate the bank surveys. Bank surveys were conducted by one or two surveyors in an upstream direction. The surveyors wore polarized sunglasses to reduce water-surface reflection. Snorkel surveys were conducted by one or two surveyors in an upstream direction. All fish species were identified and enumerated to the greatest extent possible permitted by the ambient river conditions and fish densities at the time of each survey. Lengths of each *O. mykiss* were estimated to the nearest cm if only a few individuals (generally < 10) were present. At times of greater *O. mykiss* abundance, they were grouped and assigned to the nearest length (cm) category. In order to collect additional information that may help determine *O. mykiss* upstream and downstream movements through the Robles Fish Facility, an upstream study reach was added for surveying in 2009. The upstream study reach included observations in the screenbay of

the facility and the area immediately upstream of the low-flow fish exit in the forebay. The total distance of this upstream reach was approximately 140 m.

If a BO-defined storm event would have occurred during 2013, video-camera monitoring would have been conducted using a camera positioned at the fish ladder entrance to determine when adult steelhead enter the ladder during the 10 or 12-day ramp down period. However, due to the lack of significant precipitation, the video camera was not installed during 2013 because no BO-defined storm events occurred.

Results

A total of 17 *O. mykiss* were counted from January through April of 2013 in the entire 340 m study reach (Appendix 5), which covered the upstream and downstream reaches. During the 4-month period, a total of 4,220 m were surveyed by either bank or snorkel methods. The water temperatures during the study period ranged from 10 °C in January to 18 °C in April and turbidity was less than 2 NTUs when the surveys were conducted. *O. mykiss* were observed only during April of the survey period and peaked at 7 fish. The discharge at the Robles Fish Facility ranged from 0 to 13 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.

The 200 m reach downstream of the fish facility was surveyed on 14 separate occasions, 9 bank and 5 snorkel surveys. During April, complete surveys could not be conducted due to dry conditions in some of the habitat units. A cumulative total of 2,260 m were surveyed from January through April 2013. A total of 17 *O. mykiss* were observed downstream of the Robles Fish Facility (Appendix 5). The peak count for the downstream reach was 7 *O. mykiss* in mid April. The estimated fork lengths of *O. mykiss* observed ranged from 14 to 24 cm.

The 140 m reach upstream of the facility was surveyed on 14 separate occasions, 10 bank and 4 snorkel surveys. A cumulative total of 1,960 m were surveyed from January through April 2013. No *O. mykiss* were observed in the upstream reach during the survey period.

Discussion

The total count of 17 *O. mykiss* from the downstream reach likely included repeated counts of the same *O. mykiss* over the study period. Because the surveys were conducted weekly, some *O. mykiss* likely remained in the wetted study reach for more than one week and were counted at least one additional time. Without tracking individual *O. mykiss* (e.g., mark/recapture, telemetry, or other tagging studies), the time spent by individual *O. mykiss* in close proximity to the Robles Fish Facility cannot be determined by observation methods alone.

From observational counts alone, the ability to interpret the fine-scale migration behavior of the *O. mykiss* near the Robles Fish Facility is limited. Abundance trends from observations were significantly lower than previous years. For example, a total of 378 *O. mykiss* were counted during 2012. In dry years, like in 2013, the surveyed habitat eventually becomes dry, which occurred in May. On 01 May 2013, NMFS conducted a fish rescue of 14 *O. mykiss* from the entrance pool and released them in North Fork Matilija Creek. Within a few days, the entire study area both upstream and downstream of the Robles Fish Facility was completely dry.

Because little precipitation occurred during the migration season, a surface water connection to the lower Ventura River did not exist during the study period and therefore smolts did not have an opportunity to migrate to the ocean.

The onset of smoltification can be identified by vanishing parr marks, silvering of the body, and darkening of the margins of the fins among other characteristics (Chrisp and Bjornn 1978; Hasler and Scholz 1983; Quinn 2005; Spina et al. 2005). Based on

qualitative observations during the snorkel surveys, it appeared that the *O. mykiss* were going through the smoltfication process. During the survey period, 10 *O. mykiss* (59% of all *O. mykiss* observed) were categorized into five classifications that included parr, three transitional phases (T-1, T-2, and T-3), and full smolt, following the methods of Hasler and Scholz (1983). This method has been used successfully to classify smolting steelhead (Allen Scholz, Eastern Washington University, personal communication). All of the classified *O. mykiss* were considered to be in the early to mid smoltification stages (T-1 and T-2).

O. mykiss were not observed until the end of the survey period in April when surface flow was < 1 cfs. Moreover, the surface flow stopped over the Robles measurement weir downstream in the lower study reach on 03 April and the first *O. mykiss* was observed on 10 April (Appendix 6). The limited number of *O. mykiss* that migrated downstream to the Robles Fish Facility in 2013 makes conclusions problematic; however, the fact that *O. mykiss* in early stages of smoltification still migrated downstream as flows were diminishing was noteworthy. A similar pattern of smolt migration occurred during 2009 when the majority of smolts were observed only after the surface flow connection ended in the Robles Reach.

3.3 Fish Passage Monitoring

Introduction

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

operate in greater turbidity than more traditional monitoring equipment. Because of this advertised capability, the Riverwatcher was selected to be used in the Robles Fish Facility by the Technical Advisory Group.

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

Methods

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

review). These two downstream cameras are independent of the Riverwatcher system and have to be reviewed separately for downstream detections. Once the DVR memory is full, it is exchanged with a second DVR and the data are reviewed before the DVRs have to be exchanged again.

The Riverwatcher scanner and cameras are positioned at the bottom of an aluminum frame (crowder) covered with 1/2 inch aluminum bars, spaced 1 1/2 inches on center resulting in 1-inch spacing between the bars, which directs the fish to swim between the scanner plates. The crowder can be raised and lowered in guide slots of the fish bypass channel with the aid of an A-frame hoist for cleaning or repair. The Riverwatcher is usually operated during the entire flow augmentation season as long as sufficient water elevations in the fish bypass are present and debris and turbidity are low enough so that the crowder will not be damaged and the Riverwatcher will function. The Riverwatcher was operated from 25 January 2013 to 23 April 2013 of the reporting period. During this time, the crowder was removed from the fish bypass channel and cleaned or inspected 12 times. Typically, during times of higher debris, the cleaning and inspections occur multiple times per day, and at times of low debris, cleaning and inspections occur only once every 2-3 days. The lack of storm flows during 2013 reduced the need for frequent crowder cleaning. The crowder was removed for cleaning for a combined total of approximately 3 h during the operation period. The Riverwatcher was operated a total of 89 days, which was 79% of the time the Riverwatcher could have possibly been operated during the fish augmentation period. The first 23 days of January were not monitored due to Riverwatcher repair. An upgraded PC that operates the Riverwatcher and stores data required extensive hardware and software modifications. This work had to be completed via modem from VAKI's Iceland IT department, which took longer than anticipated due to a repair backlog and complications of conducting remote off-site work.

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 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 were still able to pass through the Riverwatcher undetected by the video cameras. This occurs if fish swim very close, high, or low relative to the cameras. In addition, this can happen if a fish swims upstream through the scanners but stops before entering the video field of view. High

turbidity can also obscure the video detection and identification of fish. The "false detection" classification was used when no fish was observed in the video and the silhouette was not similar to that of a typical fish silhouette. Because false detections tended to occur frequently during higher discharges, when turbidity and debris also were high, it was likely that most false detections during these periods are caused by debris, high turbidity, and water turbulence. During low-flow periods (<10 cfs), which was the case during 2013, 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. Once the turbidity falls below about 25-30 NTUs, then the Riverwatcher is fully functional (Table 1). When the Riverwatcher is fully functional, the scanner and video systems are functioning sufficiently to detect and confirm fish that can be detected.

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

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

Results

During the 2013 fish migration season, the Riverwatcher recorded 43 total detections, of which 10 were upstream and 33 were downstream (Appendix 9). Of the total downstream detections, only 3 (9%) were determined to be fish and all were classified as unknown fish (i.e., video confirmation, but not species ID). Of the total 10 upstream detections, all were considered to be false detections from debris, turbulence, or air bubbles. The mean date for the downstream migrating fish was 17 April (Appendix 8).

Detections of the 3 unknown fish all occurred on 17 April. The detections occurred in the morning about 06:30 h and at 17:40 h (Appendix 9). The lengths of the three

detections were 20, 19, and 15 cm. The software program that operates the Riverwatcher estimates the TL of a fish detection based on a ratio of height to length (Vaki 2003). This ratio can be changed depending on available data for the target species. Based on morphometric measurements of *O. mykiss* mortalities over the last several years, an *O. mykiss* height to TL ratio was estimated to be 5.1:1 for fish ranging from about 10 to 28 cm. During a validation and calibration pilot study, it was estimated that the Riverwatcher was underestimating the test fish heights by about 10 mm. A correction was added to the TL to height ratio to calibrate it to the known fish heights. This correction was used to estimate the TL of Riverwatcher detections from January through June of 2010. However, the resulting TL estimates appeared to be over estimated when compared to known *O. mykiss* lengths that were measured in 2009. It was decided that a more accurate method would be to use a regression model to convert Riverwatcher estimated fish heights to lengths. Again, from the morphometric measurements, a sigmoid regression was conducted to develop a best-fit model for converting the Riverwatcher fish heights to total lengths ($TL = 687.68 / (1 + \exp(-(D - 50.78)/23.97)) / 10$, p-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.

The physical river conditions of temperature, turbidity, and discharge were similar at the time of fish detections since they occurred on the same day (Appendix 9). The mean water temperature recorded during the time migrating fish were detected was approximately 13 °C. The mean turbidity levels at the time of passage was about 1 NTU. The discharge from the Robles Fish Facility at the time of passage was 0.0 cfs. This was recorded at the measurement weir but there was still nominal flow through the ladder.

Discussion

There were an estimated 40 false detections recorded by the Riverwatcher. They were likely due to debris, low-flow surface turbulence, and settings of the Riverwatcher to detect smaller fish. This number of false detections was considerably less for 2013 than

in previous years. Given the low flow conditions, few false detections would be expected. For the 2013 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 2014.

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. *O. mykiss* juveniles were observed holding in areas for extended periods of time before either moving downstream or back upstream, which is commonly found in all salmonid smolts (Quinn 2005). Early smolt transformation stages of *O. mykiss* were observed during the fish attraction surveys. Because the smolt migration rate is positively correlated with the smoltification process (Quinn 2005), some holding and lack of rapid downstream migration would be expected for *O. mykiss* in early to middle stages of smolting.

3.4 Downstream Fish Passage Evaluations

Introduction

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

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

Methods

Due to low precipitation and discharge, trapping was not conducted during 2013 and no data were collected for the Downstream Passage Evaluation. For a full description of evaluation methods, see CMWD (2011).

3.5 Downstream Fish Migration through the Robles Reach

Introduction

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

The purpose of the downstream migration evaluation is to determine how 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 pilot study using radio telemetry was used for evaluations.

Due to low precipitation, trapping was not conducted during 2013 and no data were collected for the Downstream Fish Migration through the Robles Reach. For a full description of evaluation methods, see CMWD (2011).

4.0 ROBLES FACILITY OPERATIONS

4.1 Facility Status

The Robles Fish Passage Facility started the 2012-2013 season in a fully functional mode, with the Fish Ladder Flow meter requiring verification after the transducers were adjusted. The 2012-2013 season was characterized by a below average rainfall year as measured at Casitas Dam; 12.35 inches of rain were measured at Casitas Dam. This is compared to the average annual rainfall at the dam of 24.06 inches. This was the second consecutive year with below average rainfall. No peak flow events as defined by the BA/BO occurred during the Fish Flow Operations Season. No water diversions occurred. No water was downloaded from Lake Matilija. Lake Matilija remained in spill condition the entire year. The measurement weir had flows on and off throughout the winter with the last flow over the weir recorded in April. The entrance pool loss surface water in May. The Ventura River did not have surface flow continuity at any point during the year. The highest daily mean flow measured at the Robles Fish Passage measurement weir was 13 cfs on January 24, 2013.

The 2012 Report identified several projects to be completed during the summer and fall. The principal projects were:

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

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

Modify the diffuser panel in the auxiliary water system-Casitas completed the approved modification to the first diffuser panel in the auxiliary system. Insufficient

flows were available this year to determine if the modifications improved the flow through the system.

Align the fish passage flow meter transducers-The transducers were aligned using a factory provided laser. Insufficient flows were available to determine if the alignment improved the accuracy of this flow meter.

Adjust interim weir three to improve fish passage-This work was completed. Some additional fine-tuning may be needed once the weirs are re-watered with winter rains.

Modify the differential level sensors at the fish ladder entrance to individually read water levels-Casitas is continuing work with the instrumentation engineer to record the fish ladder entrance pool level.

4.2 Flow Observations and Control

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

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

- Robles-Casitas Diversion Canal – located on the diversion canal approximately 1,300 feet downstream of the Robles headworks – trapezoidal channel with a good rating for flows up to 600 cfs.
- Ventura River near Meiners Oaks (VRNMO) – located approximately 540 feet downstream of the Robles Fish Passage spillway – concrete weir section – good rating to 70 cfs, use of equations above 70 cfs with poor ratings above 1000 cfs (no verifications at higher flows). **This is the most reliable flow measurement for the fish passage and downstream releases with a 50-year plus history.** This site was formerly a USGS site.
- Fish Ladder-A 4 path flow meter by Accusonics located near the Riverwatcher. This flow meter has not been accurate since the installation of the replacement Vaki shroud. **This flow measurement device was functional during the 2012-13 season but the readings were not verified.**
- Auxiliary Water Supply-An American Sigma flow meter. This meter has not provided reliable readings. Troubleshooting the problem is problematic because of infrequent flows necessitating the use of the auxiliary (attraction flow) flow system and because NMFS interpretation of the BO does not allow the system to be dewatered for inspections. The problem is believed to be "sloshing" in the pipe. Modifications to the auxiliary water supply system were approved and implemented for the 2012-2013 season. However, there were insufficient flows available to determine if the modifications improved the accuracy of the meter readings.

All of the instruments can suffer from inaccuracies from time to time. The inaccuracies can be caused by clogging of bubbler lines, electronic creep, debris accumulating on sensors, changes to the measured cross sections, human interactions and equipment problems. For this reason, the data is verified against field measurements and observations. The information gathered from each of these locations has been reduced to the daily reporting of flows in the form of average cubic-feet per second. The spreadsheets are in Appendix 10, entitled "Ventura River Flow Assessment for the Robles Fish Passage Facility – FY 12-13". Since no BO defined peaks occurred during

the season, no 15-minute flows for storm peaks, as previously requested by NMFS, are included in the report.

The fish screens remained in place for the entire year.

No storm peaks occurred this year that triggered BA/BO required supplemental flow releases. The river had no surface flow continuity. Surface flow at no time met the adult steelhead passage requirements. This is the third season since Robles Fish Passage Facility was completed that there were insufficient flows for adult steelhead to migrate up or downstream and the fourth season without a BO defined peak flow event. This is the first time since the construction of the Fish Passage Facility that there has not been a BO defined peak flow event in consecutive years.

4.3 Costs Associated with Operation and Monitoring

The BA/BO specified that the District provide the costs that are associated with the activity. The following is a summary of the direct costs incurred by the District during the 2012-13 fiscal years:

- **Fisheries Monitoring**:

Salaries & Benefits	$340,898
Equipment/Material	$ 67,552
	$408,450

- **Facility Operations**:

Salaries & Benefits	$ 65,698
Equipment/Materials	$ 13,921
Outside Contracts	$ 0
Utilities	$ 1,899
Permit	$ 1,086
	$82,604

- **Capital Improvements**:

  No capital improvements were made during this fiscal year.

4.4 Assessment of the Effectiveness to Provide Fish Passage

Casitas has entered into an agreement with HydroScientific West to complete the first phase of the performance (hydraulic) testing. Performance testing of the fish screen was completed March 24 and 25, 2011.

Because of inadequate flows, no additional performance testing was completed during the 2012-2013 season. Casitas priorities for 2013-2014 season includes completing flow measurements in the spillway-entrance box channel 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 BO. These measurements can be completed under relatively low flow conditions.

All performance testing will be completed in general accordance with the NMFS approved Performance Evaluation Program and Biological Committee recommendations.

4.5 Recommendations Regarding the Prioritization of Future Activities

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

- Final adjustment of interim weir three if needed once re-watered.
- Modify the differential level sensors at the fish ladder entrance to individually read water levels.

4.6 Recommendations on any Revisions Deemed Necessary to the Operations

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

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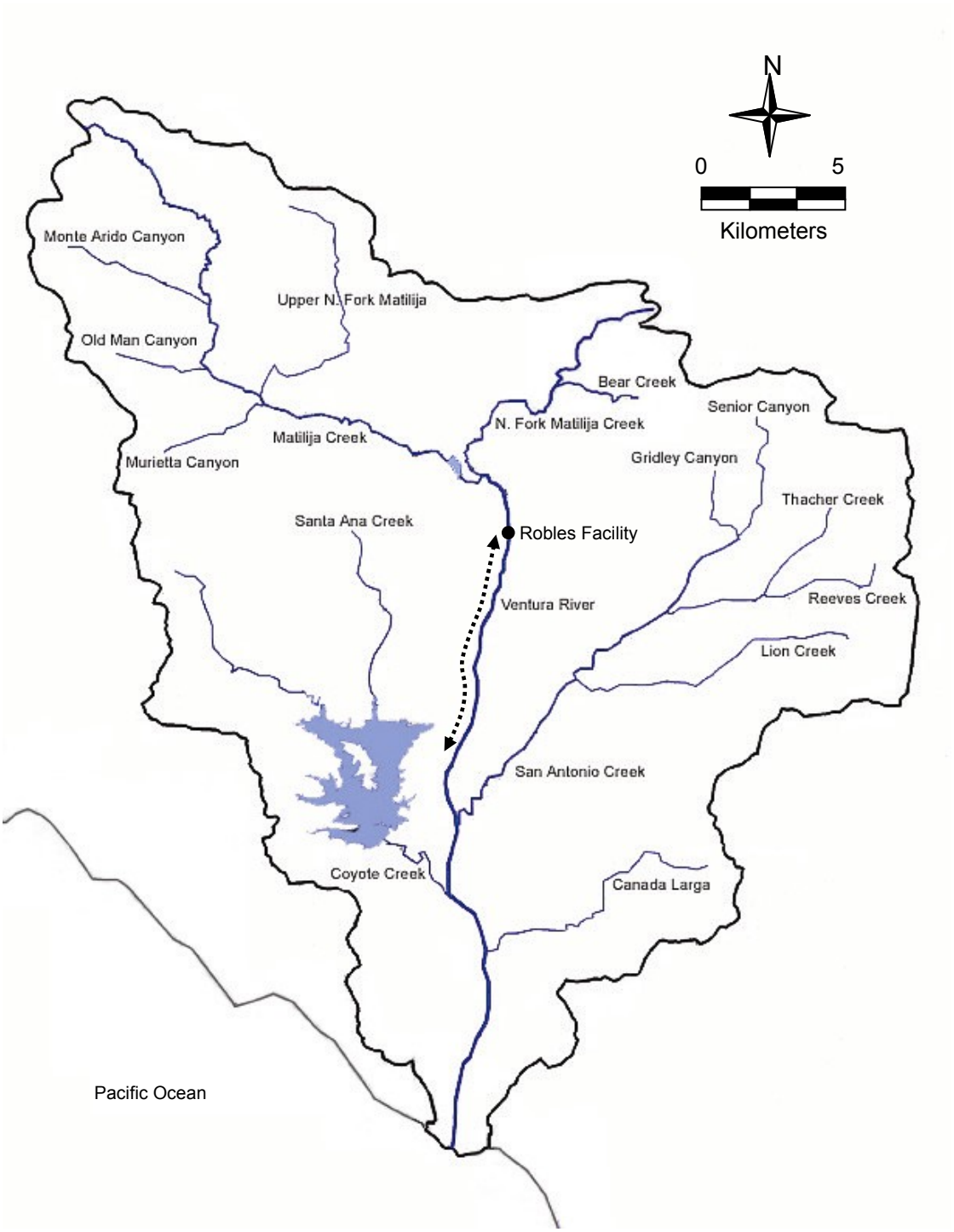
6.0 APPENDIXES



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

Appendix 2. Summary data of impediments sites selected for upstream fish migration impediment evaluations selected or assessed by the Biological Committee during January 2012.

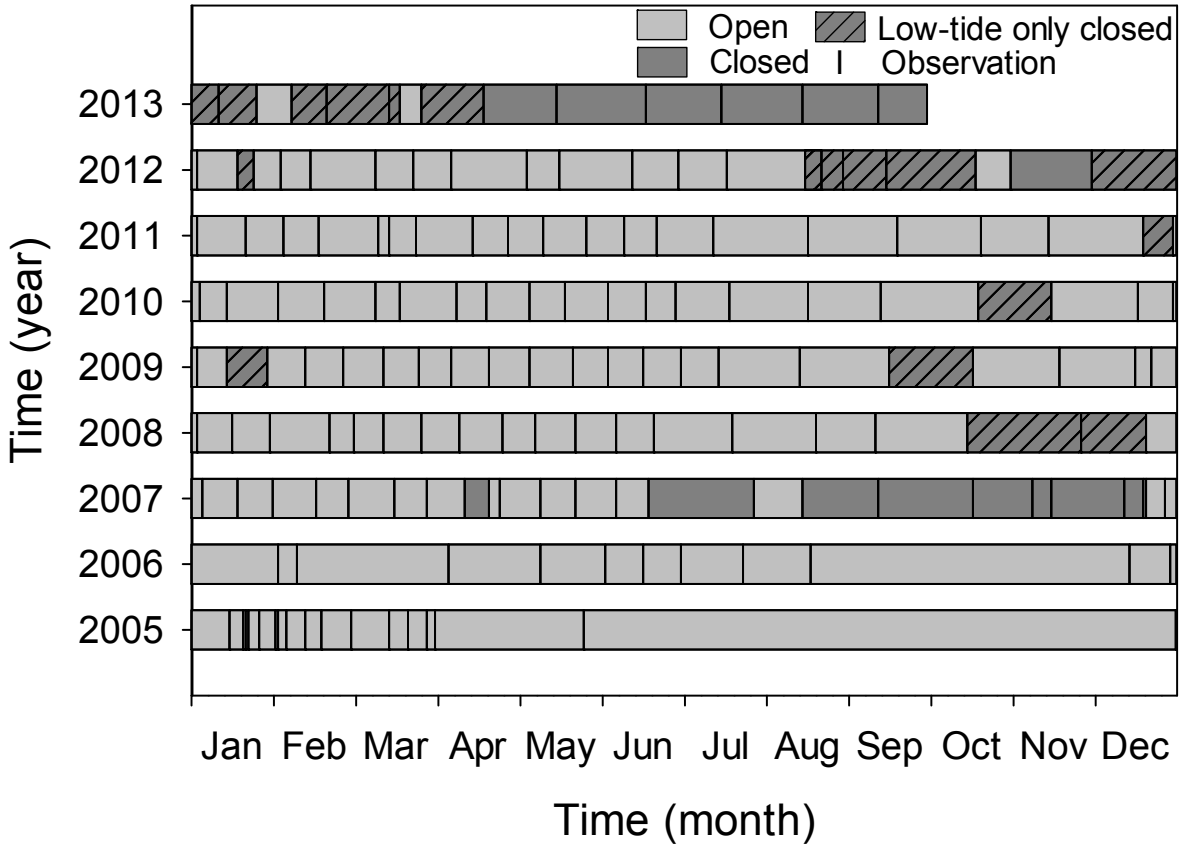
Site No.	Latitude (N)	Longitude (W)	km	Habitat Type[a]	Site Description	Length (m)	Slope (%)	Percent Substrate[b]						Active Channel Width (m)
								SO	SD	GR	CB	BD	BR	
10[c]	34.365265°	119.311082°	11	RI	Near Casitas Springs at bottom of levy					TBD[d]				
3-2	34.373789°	119.308417°	12	RB	Near Casitas Springs at top of levy	22.0	3.7	10	5	10	65	10	0	27.0
4	34.384743°	119.310030°	14	RI	0.5 km upstream of San Antonio Cr. confluence	23.8	5.0	0	0	0	15	85	0	27.9
5-2	34.396095°	119.309537°	15	RI	0.4 km downstream of Santa Ana Blvd. bridge	8.4	7.0	0	5	5	45	45	0	50.6
6-1	34.411318°	119.301491°	17	CB	1.4 km upstream of Santa Ana Blvd. bridge	26.1	5.0	0	0	0	65	35	0	33.8
9	34.426708°	119.301831°	19	RB	0.2 km upstream of Hwy 150 bridge					TBD[d]				
7	34.438184°	119.299528°	20	RB	1.1 km upstream of Hwy 150 bridge	31.6	2.0	5	0	10	40	45	0	65.9
8[e]	34.454189°	119.293143°	22	CB	1.2 km downstream of Robles Fish Facility	9.2	10.0	0	0	10	45	45	0	32.4

[a]The habitat types are: RB = rapid with protruding boulders, RI = riffle, and CB = cascade over boulders.
[b]The substrate types are: SO = silt and organics, SD = sand, GR = gravel, CB = cobble, BD = boulders, and BR = bedrock.
[c]Site 10 was selected to replace Site 2.
[d]Insufficient discharge prevented site characterization during 2012 and 2013.
[e]Site 8 will only be monitored if Site 10 is determined to be unsuitable after sufficient flows have occurred.

Appendix 3. Ventura River sandbar monitoring data from July 2012 through June 2013.

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
07/17/2012	Y	10:00	3.72	slack	10:09	3.73	3:46	-0.39	4.7	0	Open in center
08/15/2012	N[b]	9:40	4.11	slack	9:30	4.11	14:38	1.99	2.4	0	If breached, center
08/21/2012	N[b]	12:30	5.41	slack	12:29	5.41	19:09	0.99	1.5	0	If breached, center
08/29/2012	N[b]	20:40	6.20	slack	20:40	6.20	3:29	-0.46	1.3	0	If breached, center
09/14/2012	N[b]	9:21	4.99	slack	9:08	5.00	15:01	1.06	0.8	0	If breached, center
10/17/2012	Y	11:30	6.41	ebb	10:40	6.64	17:51	-0.73	0.4	0	Open in center
10/30/2012	N	11:05	5.35	ebb	9:41	5.91	16:48	-0.06	0.2	0	If breached, center
11/29/2012	N[b]	11:30	4.02	ebb	8:46	5.90	16:10	-0.35	0.3	0	If breached, center
12/31/2012	N[b]	12:15	4.06	ebb	10:12	5.31	17:26	-0.17	0.3	0.9	If breached, center
01/02/2013	N[b]	10:30	4.14	flood	11:35	4.34	0:57	2.34	0.2	0.7	If breached, center
01/11/2013	N[b]	8:55	6.79	ebb	8:19	6.90	15:30	-1.74	0.2	<0.1	If breached, center
01/25/2013	Y	15:45	-0.46	flood	21:20	3.82	15:03	-0.61	0.4	10.5	Open in center
02/07/2013	N[b]	10:28	3.44	ebb	7:27	6.38	14:32	-1.42	0.2	4.9	If breached, center
02/20/2013	N[b]	9:59	1.88	ebb	19:38	3.36	13:07	0.18	0.5	5.9	If breached, center
03/15/2013	N[b]	9:50	2.24	flood	12:34	3.53	6:35	0.40	1.1	0.8	If breached, center
03/19/2013	Y	18:30	2.90	flood	19:09	2.93	11:34	0.95	0.7	0.7	Open in center
03/27/2013	N[b]	10:30	4.77	ebb	10:09	4.81	16:12	0.30	0.6	<0.1	If breached, center
04/19/2013	N	13:54	1.17	flood	18:57	3.77	12:10	0.70	0.5	0	If breached, center
05/16/2013	N	9:45	0.68	flood	16:24	3.42	8:58	0.59	2.0	0	If breached, center
06/18/2013	N	8:35	2.39	ebb	5:59	3.09	11:21	1.57	0.5	0	If breached, center

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



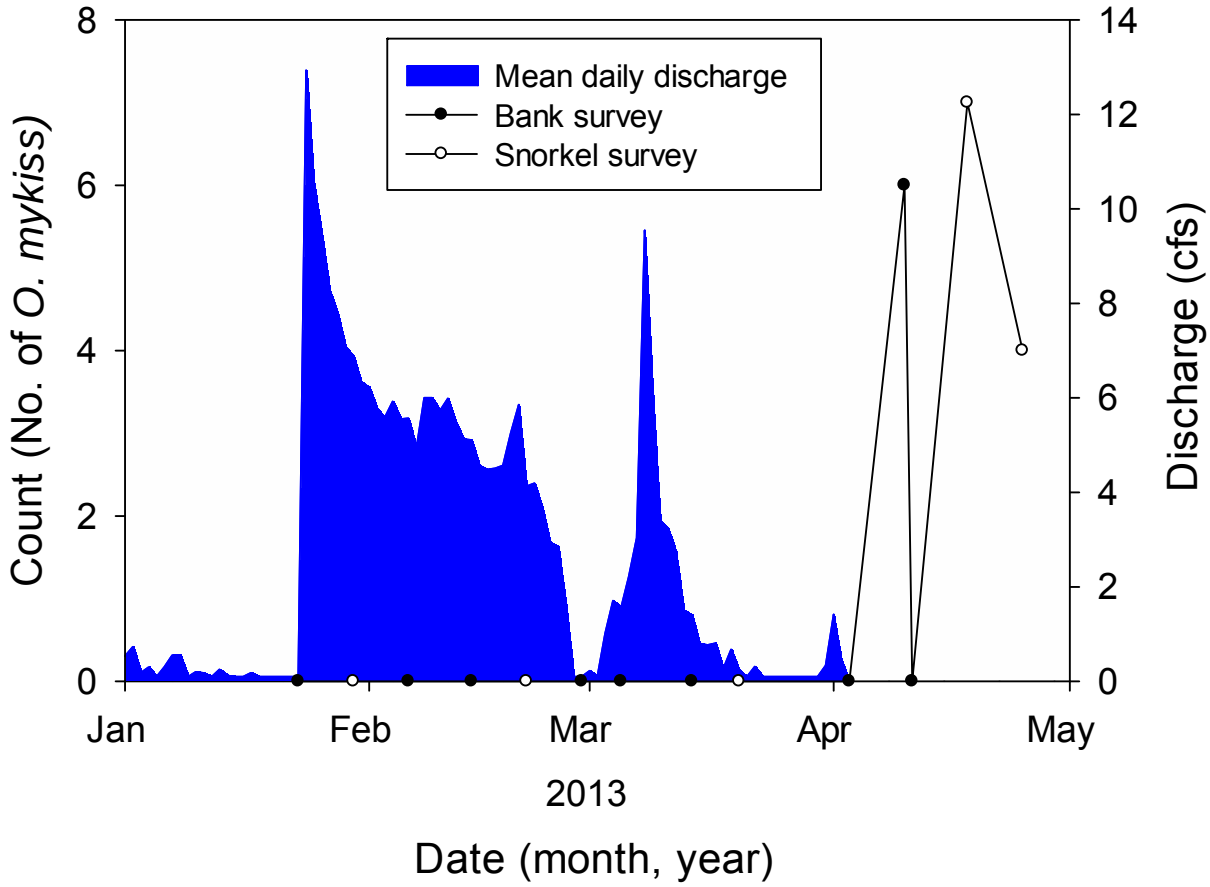
Appendix 4. Sandbar status at the mouth of the Ventura River from 2005 through September of 2013. Each observation is indicated by vertical lines and the sandbar status was assumed to remain in the same until the next observation.

Appendix 5. Fish attraction counts at the Robles Fish Facility, January-April of 2013.

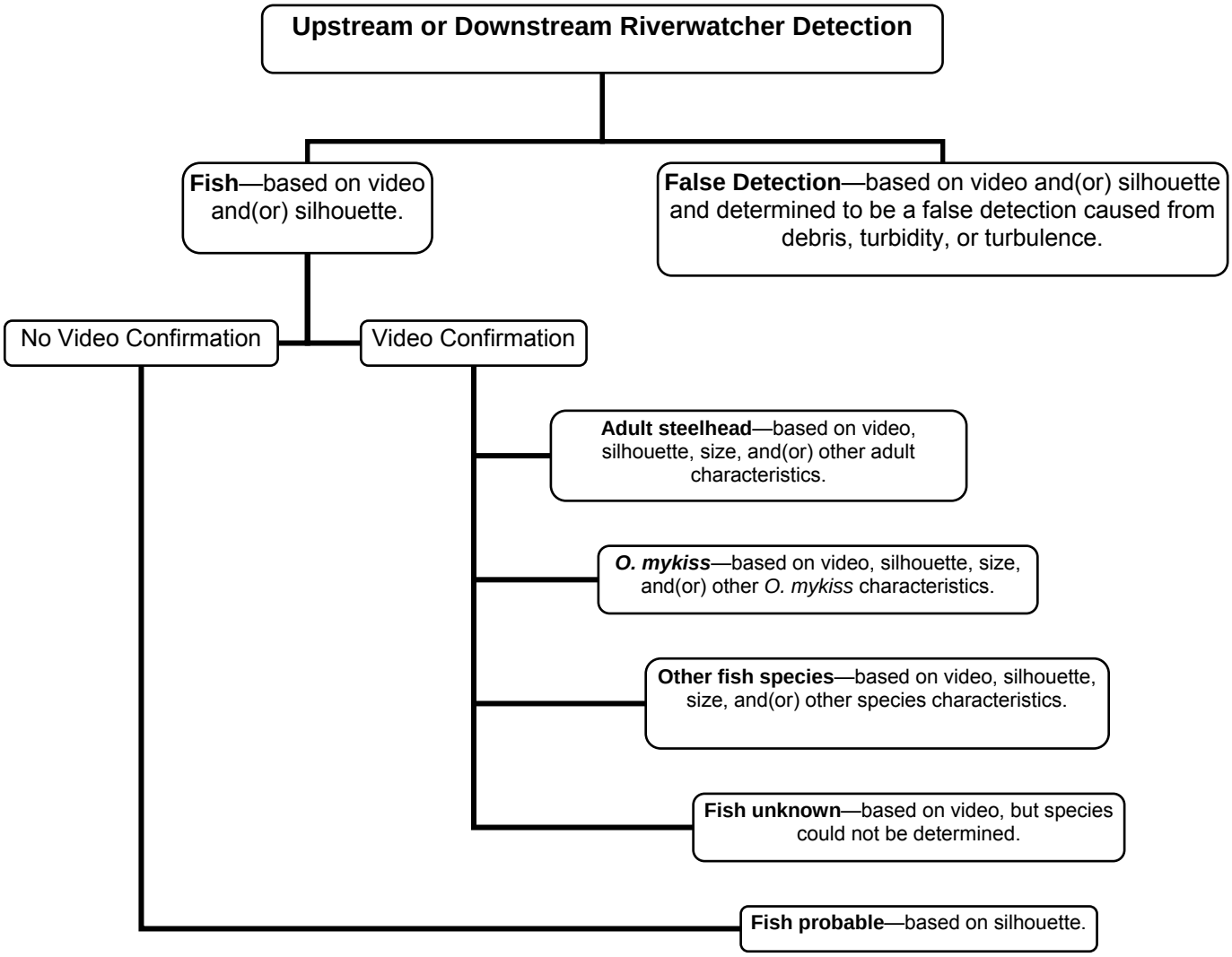
Date	Method	Direction	Length (m)	Temp. (°C)	Turbidity (NTU)	Robles Discharge (CFS)	Species[a]	Count
01/23/2013	Bank	Downstream	200	11	1	<0.1	NFO	0
01/23/2013	Bank	Upstream	140	11	1	<0.1	NFO	0
01/30/2013	Snorkel	Downstream	200	10	2	6.9	NFO	0
01/30/2013	Snorkel	Upstream	140	10	2	6.9	NFO	0
02/06/2013	Bank	Downstream	200	13	1	5.6	NFO	0
02/06/2013	Bank	Upstream	140	13	1	5.6	NFO	0
02/14/2013	Bank	Downstream	200	13	1	5.1	NFO	0
02/14/2013	Bank	Upstream	140	13	1	5.1	NFO	0
02/21/2013	Snorkel	Downstream	200	12	0	4.1	NFO	0
02/21/2013	Snorkel	Upstream	140	12	0	4.1	NFO	0
02/28/2013	Bank	Downstream	200	15	1	<0.1	NFO	0
02/28/2013	Bank	Upstream	140	15	1	<0.1	NFO	0
03/05/2013	Bank	Downstream	200	14	1	1.6	NFO	0
03/05/2013	Bank	Upstream	140	14	1	1.6	NFO	0
03/14/2013	Bank	Downstream	200	15	1	1.4	NFO	0
03/14/2013	Bank	Upstream	140	15	1	1.4	NFO	0
03/20/2013	Snorkel	Downstream	200	15	1	0.2	NFO	0
03/20/2013	Snorkel	Upstream	140	15	1	0.2	NFO	0
04/03/2013[b]	Bank	Downstream	130	15	1	0.0	NFO	0
04/03/2013	Bank	Upstream	140	15	1	0.0	NFO	0
04/10/2013[b]	Bank	Downstream	130	18	2	0.0	OMY	6
04/10/2013	Bank	Upstream	140	18	2	0.0	NFO	0
04/11/2013[b]	Bank	Downstream	130	13	1	0.0	NFO	0
04/11/2013	Bank	Upstream	140	13	1	0.0	NFO	0
04/18/2013[b]	Snorkel	Downstream	35	17	2	0.0	OMY	7
04/18/2013	Snorkel	Upstream	140	17	2	0.0	NFO	0
04/25/2013[b]	Snorkel	Downstream	35			0.0	OMY	4
04/25/2013	Bank	Upstream	140			0.0	NFO	0

Upstream	1,960	Upstream	0
Downstream	2,260	Downstream	17
Total	4,220	Total	17

[a]OMY = *O. mykiss* and NFO = no fish observed.
[b]Partial survey due to dry habitat units.



Appendix 6. Total count of *O. mykiss* observed during fish attraction surveys during the fish passage season from January through April 2013 at the Robles Facility.



Appendix 7. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections.

Appendix 8. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* from January through June of 2013.

	Upstream	Downstream
O. *mykiss*	0	0
Fish, non O. *mykiss*	0	0
Fish, unknown	0	3
Fish, probable	0	0
False detections	10	30
Total	10	33
Mean date - O. *mykiss*	n/a	n/a
Mean date - fish, non O. *mykiss*	n/a	n/a
Mean date - fish, unknown	n/a	17 Apr
Mean date - fish, probable	n/a	n/a
Mean time - O. *mykiss* (24h)	n/a	n/a
Mean time - fish, non O. *mykiss* (24h)	n/a	n/a
Mean time - fish, unknown (24h)	n/a	10:17
Mean time - fish, probable (24h)	n/a	n/a
Mean length - O. *mykiss* (cm)	n/a	n/a
Mean length - fish, non O. *mykiss* (cm)	n/a	n/a
Mean length - fish, unknown (cm)	n/a	18
Mean length - fish, probable (cm)	n/a	n/a
Mean daily temperature - O. *mykiss* (°C)	n/a	n/a
Mean daily temperature - fish, non O. *mykiss* (°C)	n/a	n/a
Mean daily temperature - fish, unknown (°C)	n/a	13.5
Mean daily temperature - fish, probable (°C)	n/a	n/a
Mean daily turbidity - O. *mykiss* (NTU)	n/a	n/a
Mean daily turbidity - fish, non O. *mykiss* (NTU)	n/a	n/a
Mean daily turbidity - fish, probable (NTU)	n/a	n/a
Mean daily turbidity - fish, unknown (NTU)	n/a	1
Mean daily turbidity - false detections (NTU)	2	1
Mean daily discharge - O. *mykiss* (cfs)	n/a	n/a
Mean daily discharge - fish, non O. *mykiss* (cfs)	n/a	n/a
Mean daily discharge - fish, probable (cfs)	n/a	n/a
Mean daily discharge - fish, unknown (cfs)	n/a	0
Mean daily discharge - false detections (cfs)	2.3	0.3

Appendix 9. Date, time, TL, direction, discharge, turbidity, and temperature at time of all Riverwatcher 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)
4/17/2013	6:35	Fish, unknown	20	Down	0	1	13.5
4/17/2013	6:35	Fish, unknown	19	Down	0	1	13.5
4/17/2013	17:43	Fish, unknown	15	Down	0	1	13.5

Appendix 10. Monthly flow summary for Robles Fish Facility, water year 2012-2013.

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Jul-12	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	1	0	1	0.5	0	0	0	0	0
2	1	0	2	0.5	0	0	0	0	0
3	2	0	2	0.4	0	0	0	0	0
4	1	1	2	0.5	0	0	0	0	0
5	1	1	2	0.4	0	0	0	0	0
6	1	1	2	0.5	0	0	0	0	0
7	1	0	2	0.3	0	0	0	0	0
8	1	0	2	0.2	0	0	0	0	0
9	1	0	1	0.2	0	0	0	0	0
10	1	0	1	0.2	0	0	0	0	0
11	1	0	1	0.2	0	0	0	0	0
12	1	0	2	0.2	0	0	0	0	0
13	1	0	1	0.2	0	0	0	0	0
14	1	0	1	0.2	0	0	0	0	0
15	1	0	1	0.2	0	0	0	0	0
16	1	0	1	0.2	0	0	0	0	0
17	1	0	1	0.2	0	0	0	0	0
18	1	0	1	0.1	0	0	0	0	0
19	1	0	2	0.1	0	0	0	0	0
20	1	0	1	0.1	0	0	0	0	0
21	1	0	1	0.1	0	0	0	0	0
22	1	0	1	0.1	0	0	0	0	0
23	1	0	1	0.1	0	0	0	0	0
24	1	0	1	0.1	0	0	0	0	0
25	1	0	1	0.1	0	0	0	0	0
26	1	0	1	0.1	0	0	0	0	0
27	1	0	1	0.1	0	0	0	0	0
28	1	0	1	0.1	0	0	0	0	0
29	1	0	1	0.1	0	0	0	0	0
30	1	0	1	0.1	0	0	0	0	0
31	1	0	1	0.1	0	0	0	0	0
Totals	33	13	46		0	0	0	0	0

Ventura River Flow Assessment
Water Year 2012 - 2013

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

Ventura River Flow Assessment
Water Year 2012 - 2013

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

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Oct-12	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	0	0	1	0.1	0	0	0	0	0
2	0	0	1	0.1	0	0	0	0	0
3	0	0	1	0.1	0	0	0	0	0
4	0	0	1	0.1	0	0	0	0	0
5	0	0	1	0.1	0	0	0	0	0
6	0	0	1	0.1	0	0	0	0	0
7	1	0	1	0.1	0	0	0	0	0
8	1	0	1	0.1	0	0	0	0	0
9	1	0	1	0.1	0	0	0	0	0
10	1	0	1	0.1	0	0	0	0	0
11	1	0	1	0.1	0	0	0	0	0
12	1	0	1	0.1	0	0	0	0	0
13	1	0	1	0.1	0	0	0	0	0
14	1	0	1	0.1	0	0	0	0	0
15	1	0	1	0.1	0	0	0	0	0
16	0	0	1	0.1	0	0	0	0	0
17	1	0	1	0.1	0	0	0	0	0
18	1	0	1	0.1	0	0	0	0	0
19	1	0	1	0.1	0	0	0	0	0
20	1	0	1	0.1	0	0	0	0	0
21	1	1	1	0.1	0	0	0	0	0
22	1	1	1	0.1	0	0	0	0	0
23	1	1	1	0.1	0	0	0	0	0
24	1	1	2	0.1	0	0	0	0	0
25	1	1	2	0.1	0	0	0	0	0
26	1	1	2	0.1	0	0	0	0	0
27	1	1	1	0.1	0	0	0	0	0
28	1	0	1	0.1	0	0	0	0	0
29	1	0	1	0.1	0	0	0	0	0
30	1	1	1	0.1	0	0	0	0	0
31	1	1	1	0.1	0	0	0	0	0
Totals	21	13	34		0	0	0	0	0

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Nov-12	D/S Dam	Matilija Ck	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	1	1	1	0.0	0	0	0	0	0
2	1	1	2	0.0	0	0	0	0	0
3	1	1	2	0.0	0	0	0	0	0
4	1	1	1	0.0	0	0	0	0	0
5	1	1	1	0.0	0	0	0	0	0
6	1	1	1	0.0	0	0	0	0	0
7	1	1	2	0.0	0	0	0	0	0
8	1	1	1	0.0	0	0	0	0	0
9	1	1	2	0.0	0	0	0	0	0
10	2	1	2	0.0	0	0	0	0	0
11	1	1	2	0.0	0	0	0	0	0
12	1	1	2	0.0	0	0	0	0	0
13	1	1	2	0.0	0	0	0	0	0
14	1	1	2	0.0	0	0	0	0	0
15	1	1	2	0.0	0	0	0	0	0
16	1	1	2	0.0			0	0	0
17	6	2	8	0.0			0	0	0
18	2	1	3	0.0			0	0	0
19	1	1	2	0.0			0	0	0
20	1	1	2	0.0			0	0	0
21	1	1	2	0.0			0	0	0
22	1	1	2	0.0			0	0	0
23	1	1	2	0.0			0	0	0
24	1	1	2	0.0			0	0	0
25	1	1	2	0.0			0	0	0
26	1	1	2	0.0			0	0	0
27	1	1	2	0.0			0	0	0
28	1	1	2	0.0			0	0	0
29	4	2	6	0.7	10	10	0	10	0
30	3	2	5	0.7	7	7	0	7	0
Totals	41	28	69		17	17	0	17	0

No Data Available

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Dec-12	D/S Dam	Matilija Ck	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	2	2		0.10	1	1	0.00	1.00	0.00
2	2	1		0.10	1	1	0.00	1.00	0.00
3	2	1		0.10	1	1	0.00	1.00	0.00
4	2	1		0.10	1	1	0.00	1.00	0.00
5	2	1		0.10	1	1	0.00	1.00	0.00
6	2	1		0.10	1	1	0.00	1.00	0.00
7	2	1		0.10	1	1	0.00	1.00	0.00
8	2	1		0.10	1	1	0.00	1.00	0.00
9	2	1		0.10	1	1	0.00	1.00	0.00
10	2	1		0.10	1	1	0.00	1.00	0.00
11	2	1		0.10	1	1	0.00	1.00	0.00
12	2	1		0.20	6	6	0.00	6.00	0.00
13	4	2		0.10	3	3	0.00	3.00	0.00
14	3	1		0.10	1	1	0.00	1.00	0.00
15	3	1		0.10	1	1	0.00	1.00	0.00
16	3	1		0.10	1	1	0.00	1.00	0.00
17	3	1		0.10	1	1	0.00	1.00	0.00
18	3	1		0.16	1	1	0.00	1.13	0.00
19	2	1		0.16	0	0	0.00	0.00	0.00
20	2	1		0.16	0	0	0.00	0.00	0.00
21	2	1		0.18	0	0	0.00	0.00	0.00
22	3	1		0.20	0	0	0.00	0.00	0.00
23	3	1		0.21	0	0	0.00	0.02	0.00
24	4	2		0.21	5	5	0.00	5.13	0.00
25	3	1		0.20	2	2	0.00	2.20	0.00
26	3	1		0.20	1	1	0.00	1.20	0.00
27	3	1		0.19	1	1	0.00	0.91	0.00
28	3	1		0.33	0	0	0.00	0.00	0.00
29	3	1		0.78	2	2	0.00	1.81	0.00
30	3	1		0.74	1	1	0.00	1.28	0.00
31	3	1		0.69	1	1	0.00	0.89	0.00
Totals	80	38	0		39	39	0	39	0

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Jan-13	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	3	1	4	0.71	1	1	0	1	0
2	3	1	4	0.67	1	1	0	1	0
3	3	1	4	0.68	0	0	0	0	0
4	3	1	4	0.65	0	0	0	0	0
5	3	1	4	0.67	0	0	0	0	0
6	3	1	4	0.68	0	0	0	0	0
7	3	1	5	0.80	1	1	0	1	0
8	3	1	4	0.88	1	1	0	1	0
9	3	1	4	0.88	0	0	0	0	0
10	3	1	5	0.90	0	0	0	0	0
11	3	1	4	0.86	0	0	0	0	0
12	3	1	4	0.81	0	0	0	0	0
13	3	1	4	0.86	0	0	0	0	0
14	3	1	4	0.87	0	0	0	0	0
15	3	1	4	0.87	0	0	0	0	0
16	3	1	4	0.85	0	0	0	0	0
17	3	1	5	0.84	0	0	0	0	0
18	3	1	4	0.69	0	0	0	0	0
19	3	1	4	0.60	0	0	0	0	0
20	3	1	4	0.67	0	0	0	0	0
21	3	1	4	0.83	0	0	0	0	0
22	3	1	4	0.84	0	0	0	0	0
23	3	1	4	0.88	0	0	0	0	0
24	8	5	13	2.34	13	13	0	13	0
25	6	2	8	1.79	11	11	0	11	0
26	6	2	8	1.67	9	9	0	9	0
27	5	2	7	1.54	8	8	0	8	0
28	5	2	7	1.43	8	8	0	8	0
29	5	2	7	1.38	7	7	0	7	0
30	5	2	6	1.37	7	7	0	7	0
31	5	2	6	1.32	6	6	0	6	0
Totals	114	46	161		73	73	0	73	0

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Feb-13	D/S Dam	Matilija Ck	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	5	2	6	1.35	6	6	0	6	0
2	5	1	6	1.30	6	6	0	6	0
3	5	1	6	1.28	6	6	0	6	0
4	5	1	6	1.27	6	6	0	6	0
5	5	1	6	1.25	6	6	0	6	0
6	5	1	6	1.22	6	6	0	6	0
7	5	1	6	1.18	5	5	0	5	0
8	5	1	6	1.27	6	6	0	6	0
9	5	1	6	1.27	6	6	0	6	0
10	5	1	6	1.25	6	6	0	6	0
11	5	1	6	1.25	6	6	0	6	0
12	5	1	6	1.19	5	5	0	5	0
13	5	1	6	1.18	5	5	0	5	0
14	5	1	6	1.19	5	5	0	5	0
15	5	1	6	1.16	5	5	0	5	0
16	5	1	6	1.14	4	4	0	4	0
17	5	1	6	1.13	5	5	0	5	0
18	5	1	6	1.15	5	5	0	5	0
19	5	1	6	1.20	5	5	0	5	0
20	5	1	6	1.25	6	6	0	6	0
21	4	1	6	1.13	4	4	0	4	0
22	4	1	6	1.09	4	4	0	4	0
23	4	1	6	1.10	4	4	0	4	0
24	4	1	5	1.03	3	3	0	3	0
25	4	1	6	1.03	3	3	0	3	0
26	4	1	6	0.96	2	2	0	2	0
27	4	1	5	0.81	0	0	0	0	0
28	4	1	5	0.82	0	0	0	0	0
Totals	128	38	166		128	128	0	128	0

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Mar-13	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1		1	1	0.89	0	0	0	0	0
2		1	1	0.80	0	0	0	0	0
3		1	1	0.95	1	1	0	1	0
4		1	1	0.99	2	2	0	2	0
5		1	1	0.99	2	2	0	2	0
6		1	1	1.04	2	2	0	2	0
7		1	1	1.07	3	3	0	3	0
8		2	2	1.63	10	10	0	10	0
9		2	2	1.28	6	6	0	6	0
10		2	2	1.08	3	3	0	3	0
11		2	2	1.06	3	3	0	3	0
12		2	2	1.06	3	3	0	3	0
13		1	1	0.99	2	2	0	2	0
14		1	1	0.98	1	1	0	1	0
15		1	1	0.93	1	1	0	1	0
16		1	1	0.93	1	1	0	1	0
17		1	1	0.91	1	1	0	1	0
18		1	1	0.91	0	0	0	0	0
19		1	1	0.93	1	1	0	1	0
20		1	1	0.90	0	0	0	0	0
21		1	1	0.87	0	0	0	0	0
22		1	1	0.87	0	0	0	0	0
23		1	1	0.76	0	0	0	0	0
24		1	1	0.76	0	0	0	0	0
25		1	1	0.68	0	0	0	0	0
26		1	1	0.52	0	0	0	0	0
27		1	1	0.53	0	0	0	0	0
28		1	1	0.60	0	0	0	0	0
29		1	1	0.74	0	0	0	0	0
30		1	1	0.72	0	0	0	0	0
31		1	1	0.83	0	0	0	0	0
Totals	0	39	39		42	42	0	42	0

No Data Available

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Apr-13	D/S Dam	Matilija Ck	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1		1	1	0.95	1	1	0	1	0
2		1	1	0.82	0	0	0	0	0
3		1	1	0.76	0	0	0	0	0
4		1	1	0.75	0	0	0	0	0
5		1	1	0.75	0	0	0	0	0
6		1	1	0.74	0	0	0	0	0
7		1	1	0.67	0	0	0	0	0
8		1	1	0.72	0	0	0	0	0
9		1	1	0.62	0	0	0	0	0
10		1	1	0.44	0	0	0	0	0
11		1	1	0.18	0	0	0	0	0
12		1	1	0.23	0	0	0	0	0
13		1	1	0.30	0	0	0	0	0
14		1	1	0.36	0	0	0	0	0
15		1	1	0.56	0	0	0	0	0
16		1	1	0.71	0	0	0	0	0
17		1	1	0.60	0	0	0	0	0
18		1	1	0.49	0	0	0	0	0
19		1	1	0.41	0	0	0	0	0
20		1	1	0.33	0	0	0	0	0
21		1	1	0.32	0	0	0	0	0
22		1	1	0.32	0	0	0	0	0
23		1	1	0.38	0	0	0	0	0
24		1	1	0.45	0	0	0	0	0
25		1	1	0.49	0	0	0	0	0
26		1	1	0.41	0	0	0	0	0
27		1	1	0.30	0	0	0	0	0
28		1	1	0.19	0	0	0	0	0
29		1	1	0.18	0	0	0	0	0
30		1	1	0.20	0	0	0	0	0
Totals	0	25	25		2	2	0	2	0

No Data Available

Ventura River Flow Assessment
Water Year 2012 - 2013

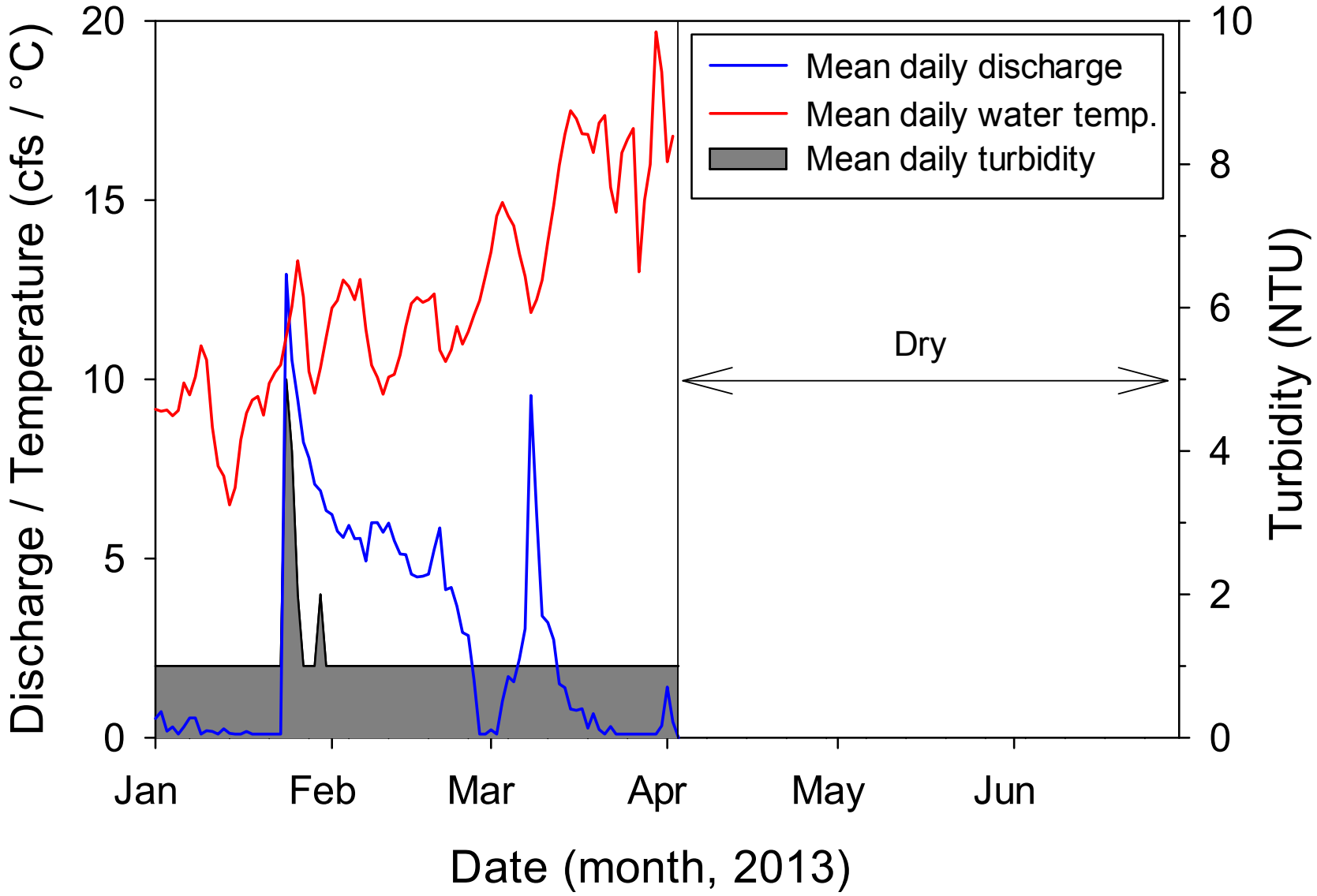
	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)		(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows					
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow		Robles
May-13	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal			Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)		(AF)
1		1	1	0.37	0	0	0	0		0
2		1	1	0.23	0	0	0	0		0
3		1	1	0.16	0	0	0	0		0
4		1	1	0.14	0	0	0	0		0
5		1	1	0.18	0	0	0	0		0
6		1	1	0.38	0	0	0	0		0
7		1	1	0.51	0	0	0	0		0
8		1	1	0.42	0	0	0	0		0
9			0	0.35	0	0	0	0		0
10			0	0.19	0	0	0	0		0
11			0	0.17	0	0	0	0		0
12			0	0.16	0	0	0	0		0
13			0	0.13	0	0	0	0		0
14			0	0.10	0	0	0	0		0
15			0	0.10	0	0	0	0		0
16			0	0.10	0	0	0	0		0
17			0	0.09	0	0	0	0		0
18			0	0.07	0	0	0	0		0
19			0	0.04	0	0	0	0		0
20			0	0.05	0	0	0	0		0
21			0	0.00	0	0	0	0		0
22			0	0.02	0	0	0	0		0
23			0	0.01	0	0	0	0		0
24			0	0.01	0	0	0	0		0
25			0	0.01	0	0	0	0		0
26			0	0.01	0	0	0	0		0
27			0	0.01	0	0	0	0		0
28			0	0.00	0	0	0	0		0
29			0	0.00	0	0	0	0		0
30			0	0.00	0	0	0	0		0
31			0	0.00	0	0	0	0		0
Totals	0	6	6		0	0	0	0		0

No Data Available

Ventura River Flow Assessment
Water Year 2012 - 2013

	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)		(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows					
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow		Robles
Jun-13	D/S Dam	Matilija Ck	Flows	Avg. Depth	Ladder	Weir	Canal			Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)		(AF)
1			0	0.00	0	0	0	0		0
2			0	0.00	0	0	0	0		0
3			0	0.00	0	0	0	0		0
4			0	0.00	0	0	0	0		0
5			0	0.00	0	0	0	0		0
6			0	0.00	0	0	0	0		0
7			0	0.00	0	0	0	0		0
8			0	0.00	0	0	0	0		0
9			0	0.00	0	0	0	0		0
10			0	0.00	0	0	0	0		0
11			0	0.00	0	0	0	0		0
12			0	0.00	0	0	0	0		0
13			0	0.00	0	0	0	0		0
14			0	0.00	0	0	0	0		0
15			0	0.00	0	0	0	0		0
16			0	0.01	0	0	0	0		0
17			0	0.00	0	0	0	0		0
18			0	0.00	0	0	0	0		0
19			0	0.00	0	0	0	0		0
20			0	0.00	0	0	0	0		0
21			0	0.00	0	0	0	0		0
22			0	0.00	0	0	0	0		0
23			0	0.00	0	0	0	0		0
24			0	0.01	0	0	0	0		0
25			0	0.00	0	0	0	0		0
26			0	0.00	0	0	0	0		0
27			0	0.00	0	0	0	0		0
28			0	0.00	0	0	0	0		0
29			0	0.01	0	0	0	0		0
30			0	0.01	0	0	0	0		0
Totals	0	0	0		0	0	0	0		0

No Data Available



Appendix 11. Mean daily discharge, water temperature, and turbidity from the Robles Fish Facility during the 2013 fish passage season.