2012 Robles Fish Passage Facility

Progress Report

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

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1.0 EXECUTIVE SUMMARY

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

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

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

2.0 INTRODUCTION

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

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

3.0 FISHERIES MONITORING AND EVALUATION

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

I. Monitor Fish Passage Facility operations and performance.

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

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

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

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

5-year Reevaluation of Initial Evaluation and Monitoring Activities

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

3.1 Upstream Fish Migration Impediment Evaluation

Introduction

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

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

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

Methods

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

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

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

ENTRIX Site Assessments

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

Results

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

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

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

Discussion

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

3.1.1 Sandbar Monitoring

Introduction

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

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

Methods

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

Results

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

Discussion

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

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

3.2 Fish Attraction Evaluation

Introduction

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

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

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

Methods

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

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

Results

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

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

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

<u>Discussion</u>

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

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

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

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

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

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

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

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

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

3.3 Fish Passage Monitoring

Introduction

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

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

Methods

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

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

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

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

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

Results

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

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

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

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

Discussion

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

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

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

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

3.4 Downstream Fish Passage Evaluations

Introduction

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

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

Methods

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

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

Results

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

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

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

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

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

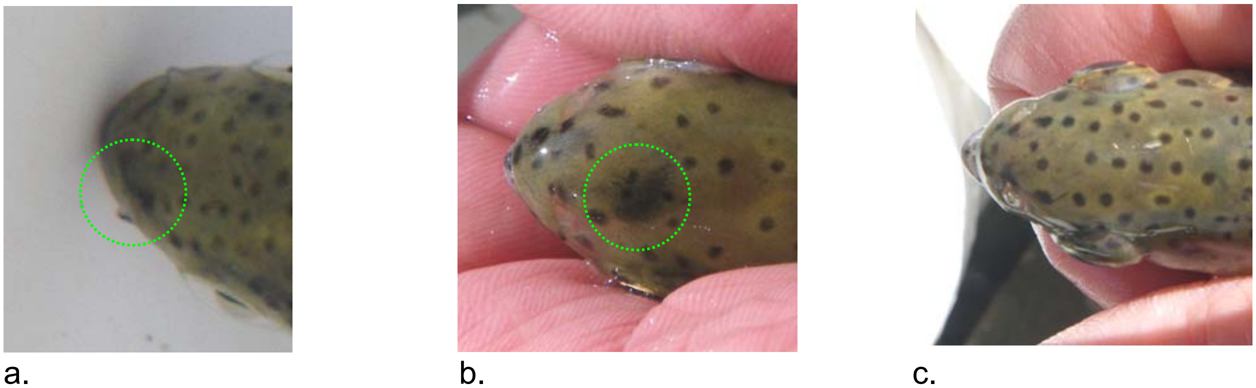

Figure 1. Photos of (a) snout injury from a 2011 smolt, (b) replicated injury with hatchery *O. mykiss*, and (c) uninjured snout of hatchery *O. mykiss* after netting installation. Dashed green circle indicates area of injury.

Discussion

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

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

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

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

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

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

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

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

3.5 Downstream Fish Migration through the Robles Reach

Introduction

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

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

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

4.0 ROBLES FACILITY OPERATIONS

4.1 Facility Status

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

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

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

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

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

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

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

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

4.2 Flow Observations and Control

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

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

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

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

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

The fish screens remained in place for the entire year.

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

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

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

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

4.3 Costs Associated with Operation and Monitoring

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

- **Fisheries Monitoring**:

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

- **Facility Operations**:

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

- **Capital Improvements**:

  No capital improvements were made during this fiscal year.

4.4 Assessment of the Effectiveness to Provide Fish Passage

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

4.5 Recommendations Regarding the Prioritization of Future Activities

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

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

4.6 Recommendations on any Revisions Deemed Necessary to the Operations

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

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

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

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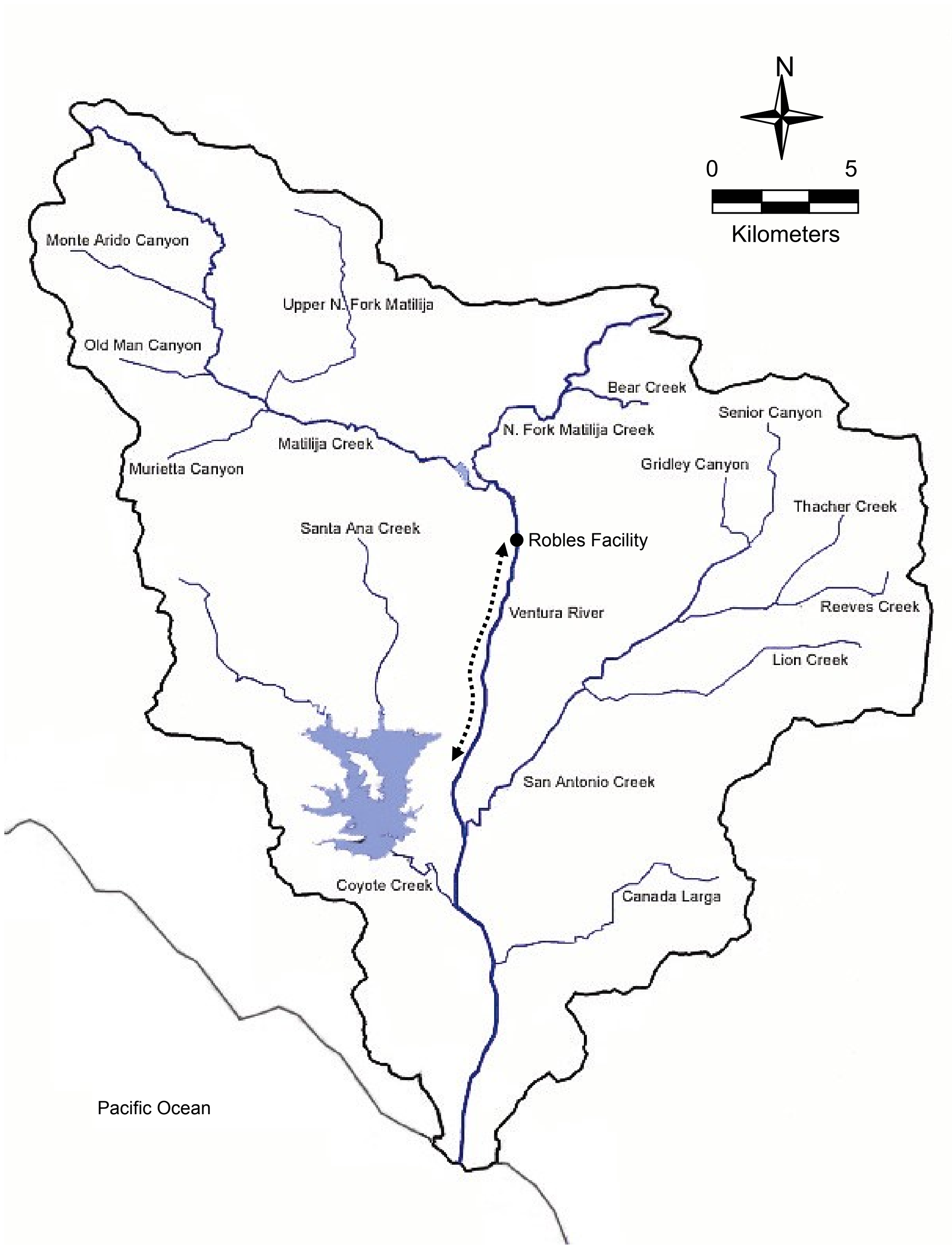
6.0 APPENDIXES



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.

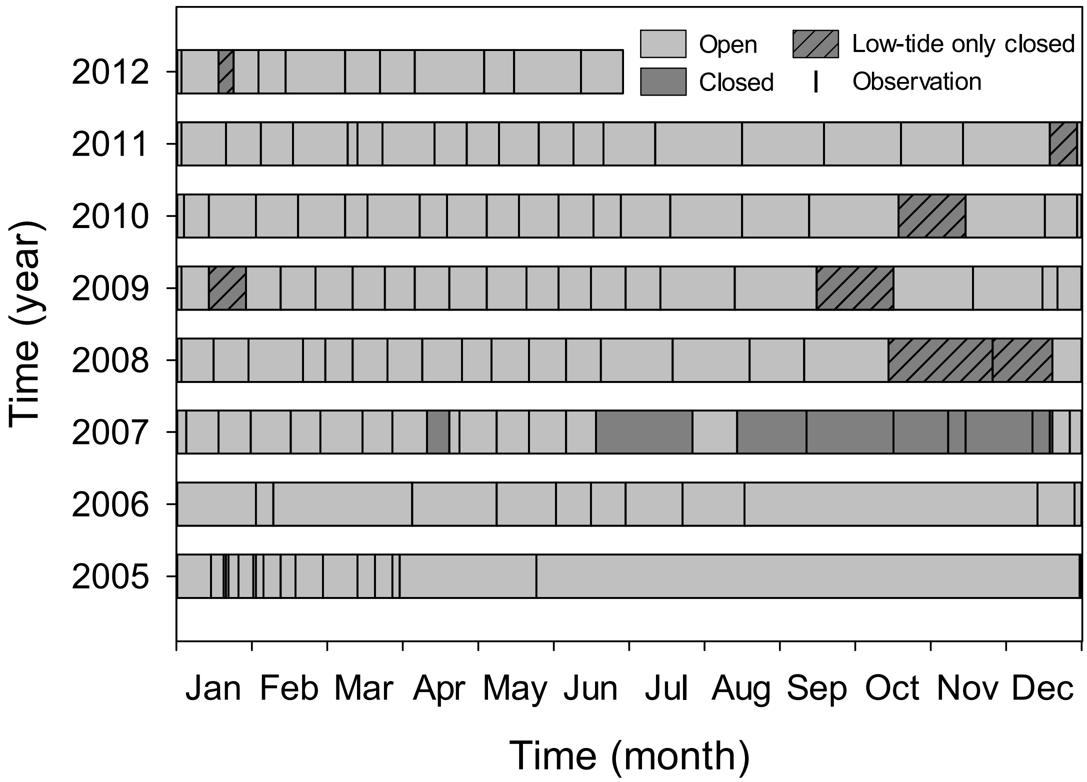
Site No.	Latitude (N)	Longitude (W)	km	Habitat Type[a]	Site Description	Length (m)	Slope (%)	Percent Substrate[b] SO	SD	GR	CB	BD	BR	Active Channel Width (m)
10[c]	34.365265°	119.311082°	11	RI	Near Casitas Springs at bottom of levy					TBD[d]				
3-2	34.373789°	119.308417°	12	RB	Near Casitas Springs at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

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

Appendix 3. Ventura River sandbar monitoring data from July 2011 through June 2012.

Date	Sandbar Breeched (Y/N)	Time (24h)	Tide Height (ft)	Tidal State	High Tide Time (24h)	High Tide Height (ft)	Low Tide Time (24h)	Low Tide Height (ft)	Mean Daily Discharge at Foster[a] (cfs)	Mean Daily Discharge at Robles (cfs)	Notes
07/13/2011	Y	14:16	2.2	slack	9:49	3.9	14:33	2.1	25.0	19	Open in center
08/17/2011	Y	09:15	3.1	flood	12:09	4.8	05:55	0.9	19.0	5	Open in center
09/19/2011	Y	14:30	4.6	slack	13:51	4.6	22:38	1.3	9.7	2	Open in center
10/20/2011	Y	13:30	3.8	flood	16:13	4.5	10:48	3.2	9.3	0	Open in center
11/14/2011	Y	16:15	0.7	ebb	10:10	5.6	17:55	0.1	7.9	14	Open in center
12/19/2011	N[b]	15:45	2.8	flood	17:19	3.2	11:34	0.8	6.2	10	If breached, center
12/30/2011	Y	11:45	3.6	flood	12:48	3.7	07:34	2.3	7.9	10	Open in center
01/03/2012	Y	12:00	0.8	ebb	05:01	4.9	12:44	0.7	7.0	10	Open in center
01/18/2012	N[b]	09:45	1.3	ebb	04:48	5.5	12:26	-0.3	5.4	9	If breached, center
01/24/2012	Y	11:15	4.9	ebb	09:29	5.9	16:26	-0.9	8.2	10	Open in center
02/03/2012	Y	13:45	-0.1	slack	00:14	3.3	13:31	-0.1	6.8	10	Open in center
02/14/2012	Y	09:38	0.6	slack	01:55	5.1	09:42	0.6	6.7	10	Open in center
03/09/2012	Y	14:02	1.1	ebb	09:44	5.2	15:55	-0.1	5.8	7	Open in west-center
03/23/2012	Y	10:20	4.3	flood	10:40	4.3	04:42	0.2	9.5	13	Open in west-center
04/06/2012	Y	14:35	0.7	ebb	09:53	4.9	15:46	0.3	14.0	14	Open in west-center
05/04/2012	Y	15:05	0.9	flood	20:34	6.3	14:34	0.8	7.8	16	Open in west-center
05/16/2012	Y	09:00	3.4	ebb	07:53	3.6	13:26	1.3	4.9	11	Open in west-center
06/12/2012	Y	13:55	2.7	flood	17:10	3.2	11:01	1.4	5.1	2	Open in center
06/29/2012	Y	14:00	2.8	flood	18:26	6.1	11:47	1.9	4.8	0	Open in center

[a]USGS gauging station number 11118500, downstream of Foster Park.
[b]Sandbar was closed at low tide and open during some high tides.

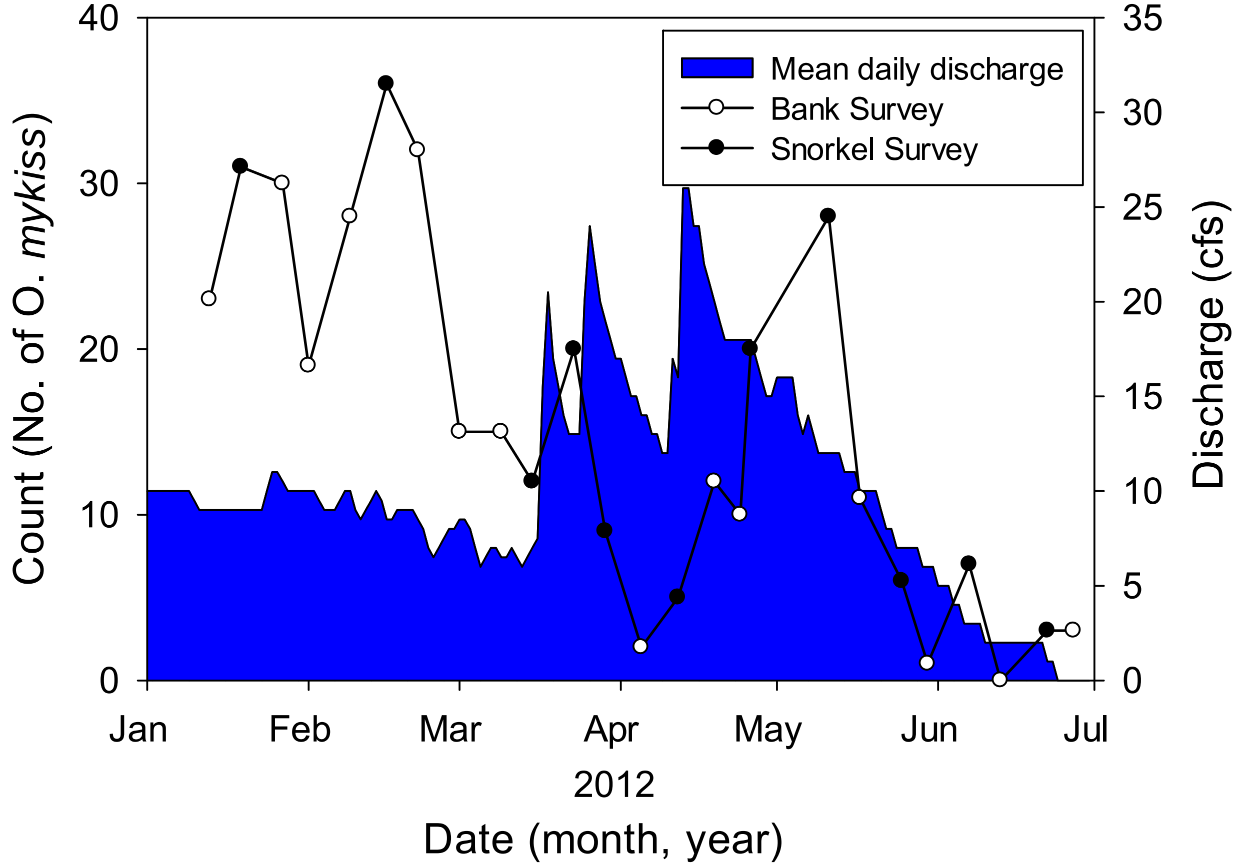


Appendix 4. Sandbar status at the mouth of the Ventura River from 2005 through June of 2012. Each observation is indicated by vertical lines and the sandbar status was assumed to remain the same until the next observation.

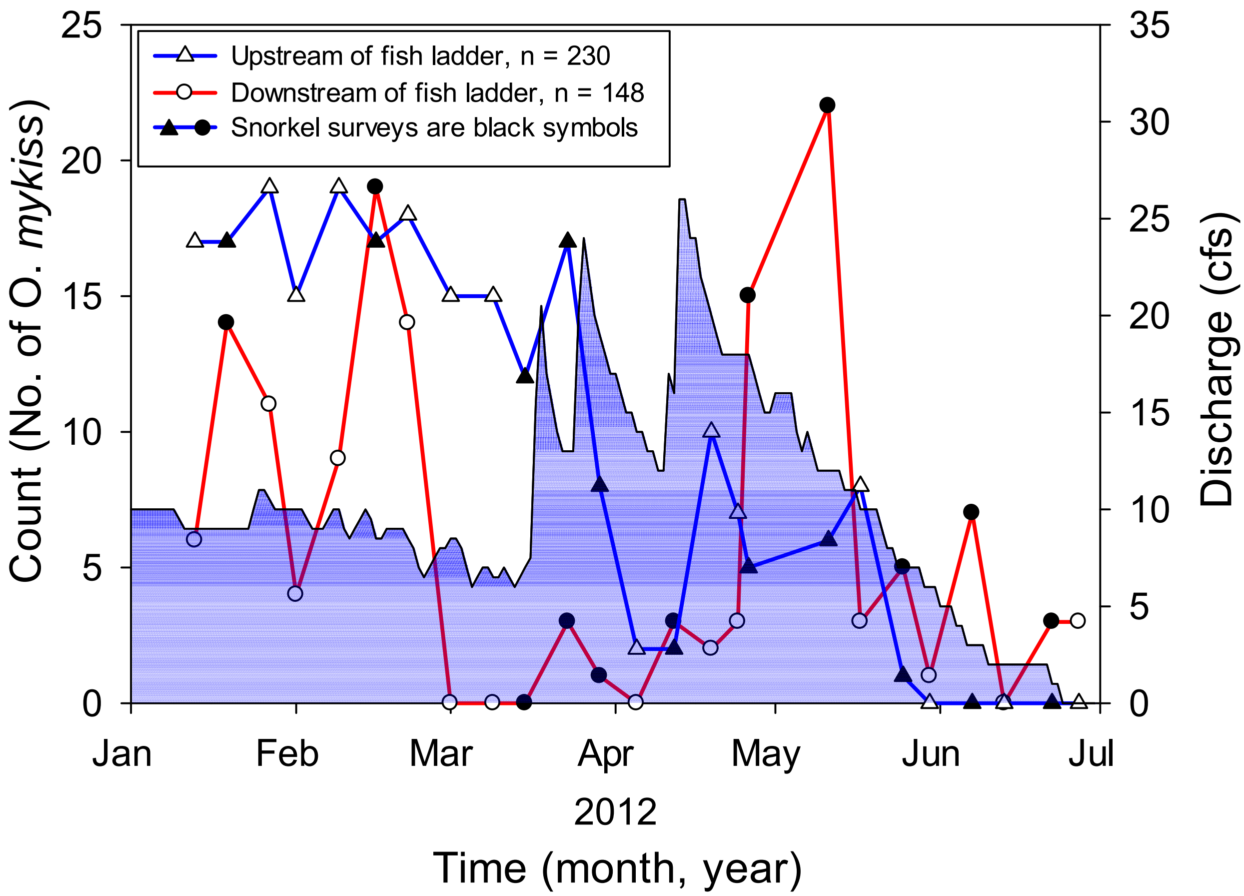
Appendix 5. Fish attraction counts at the Robles Fish Facility, January-June of 2012.

Date	Method	Direction	Length (m)	Temp. (°C)	Turbidity (NTU)	Robles Discharge (CFS)	Species[a]	Count
01/13/2012	Bank	Downstream	200	8	1	9	OMY	6
01/13/2012	Bank	Upstream	140	8	1	9	OMY	17
01/19/2012	Snorkel	Downstream	200	12	0	9	OMY	14
01/19/2012	Snorkel	Upstream	140	12	0	9	OMY	17
01/27/2012	Bank	Downstream	200	12	1	11	OMY	11
01/27/2012	Bank	Upstream	140	12	1	11	OMY	19
02/01/2012	Bank	Downstream	200	11	1	10	OMY	4
02/01/2012	Bank	Upstream	140	11	1	10	OMY	15
02/09/2012	Bank	Downstream	200	11	1	10	OMY	9
02/09/2012	Bank	Upstream	140	11	1	10	OMY	19
02/16/2012	Snorkel	Downstream	200	11	1	9	OMY	19
02/16/2012	Snorkel	Upstream	140	11	1	9	OMY	17
02/22/2012	Bank	Downstream	200	15	1	9	OMY	14
02/22/2012	Bank	Upstream	140	15	1	9	OMY	18
03/01/2012	Bank	Downstream	200	11	1	9	NFO	0
03/01/2012	Bank	Upstream	140	11	1	9	OMY	15
03/09/2012	Bank	Downstream	200	19	1	7	NFO	0
03/09/2012	Bank	Upstream	140	19	1	7	OMY	15
03/15/2012	Snorkel	Downstream	200	15	6	7	NFO	0
03/15/2012	Snorkel	Upstream	140	15	6	7	OMY	12
03/23/2012	Snorkel	Downstream	200	13	3	13	OMY	3
03/23/2012	Snorkel	Upstream	140	13	3	13	OMY	17
03/29/2012	Snorkel	Downstream	200	16	1	19	OMY	1
03/29/2012	Snorkel	Upstream	140	16	1	19	OMY	8
04/05/2012	Bank	Downstream	200	12	1	14	NFO	0
04/05/2012	Bank	Upstream	140	12	1	14	OMY	2
04/12/2012	Snorkel	Downstream	200	14	2	16	OMY	3
04/12/2012	Snorkel	Upstream	140	14	2	16	OMY	2
04/19/2012	Bank	Downstream	200	17	4	20	OMY	2
04/19/2012	Bank	Upstream	140	17	4	20	OMY	10
04/24/2012	Bank	Downstream	200	15	5	18	OMY	3
04/24/2012	Bank	Upstream	140	15	5	18	OMY	7
04/26/2012	Snorkel	Downstream	200	16	1	18	OMY	15
04/26/2012	Snorkel	Upstream	140	16	1	18	OMY	5
05/11/2012	Snorkel	Downstream	200	19	2	12	OMY	22
05/11/2012	Snorkel	Upstream	140	19	2	12	OMY	6
05/17/2012	Bank	Downstream	200	19	2	10	OMY	3
05/17/2012	Bank	Upstream	140	19	2	10	OMY	8
05/25/2012	Snorkel	Downstream	200	18	2	7	OMY	5
05/25/2012	Snorkel	Upstream	140	18	2	7	OMY	1
05/30/2012	Bank	Downstream	200	24	4	6	OMY	1
05/30/2012	Bank	Upstream	140	24	4	6	NFO	0
06/07/2012	Snorkel	Downstream	200	20	2	3	OMY	7
06/07/2012	Snorkel	Upstream	140	20	2	3	NFO	0
06/13/2012	Bank	Downstream	200	23	2	2	NFO	0
06/13/2012	Bank	Upstream	140	23	2	2	NFO	0
06/22/2012	Snorkel	Downstream	200	21	2	1	OMY	3
06/22/2012	Snorkel	Upstream	140	21	2	1	NFO	0
06/28/2012	Snorkel	Downstream	200	25	1	0	OMY	3
06/28/2012	Snorkel	Upstream	140	25	1	0	NFO	0
		Upstream	3,500				Upstream	230
		Downstream	5,000				Downstream	148
		Total	8,500				Total	378

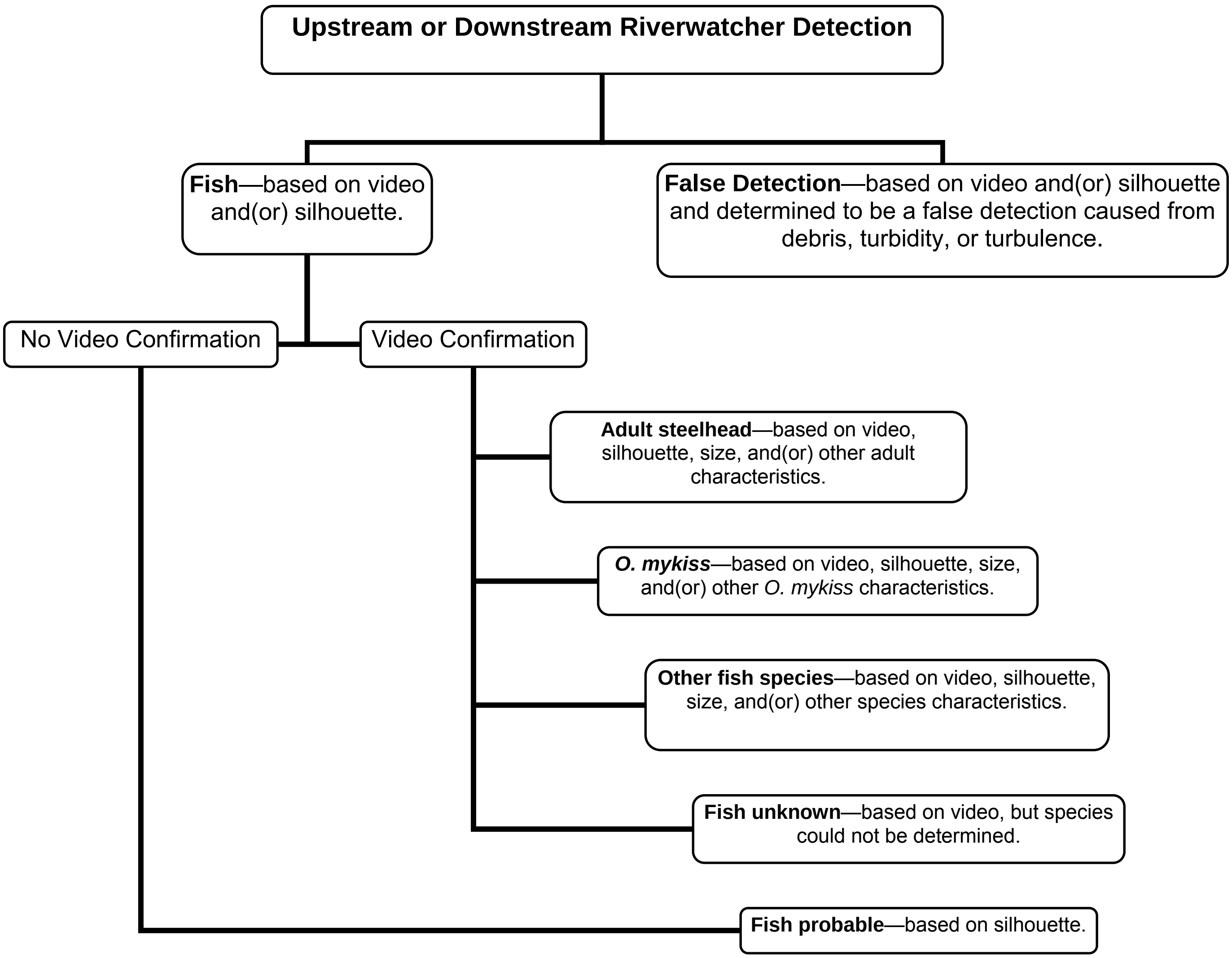
[a]OMY = *O. mykiss* and NFO = no fish observed.



Appendix 6. Total count of *O. mykiss* observed during fish attraction surveys during the fish passage season from January through June 2012 and discharge from the Robles Facility.



Appendix 7. Count of *O. mykiss* observed during fish attraction surveys upstream and downstream of the Robles Fish Facility during the fish passage season from January through June 2012.

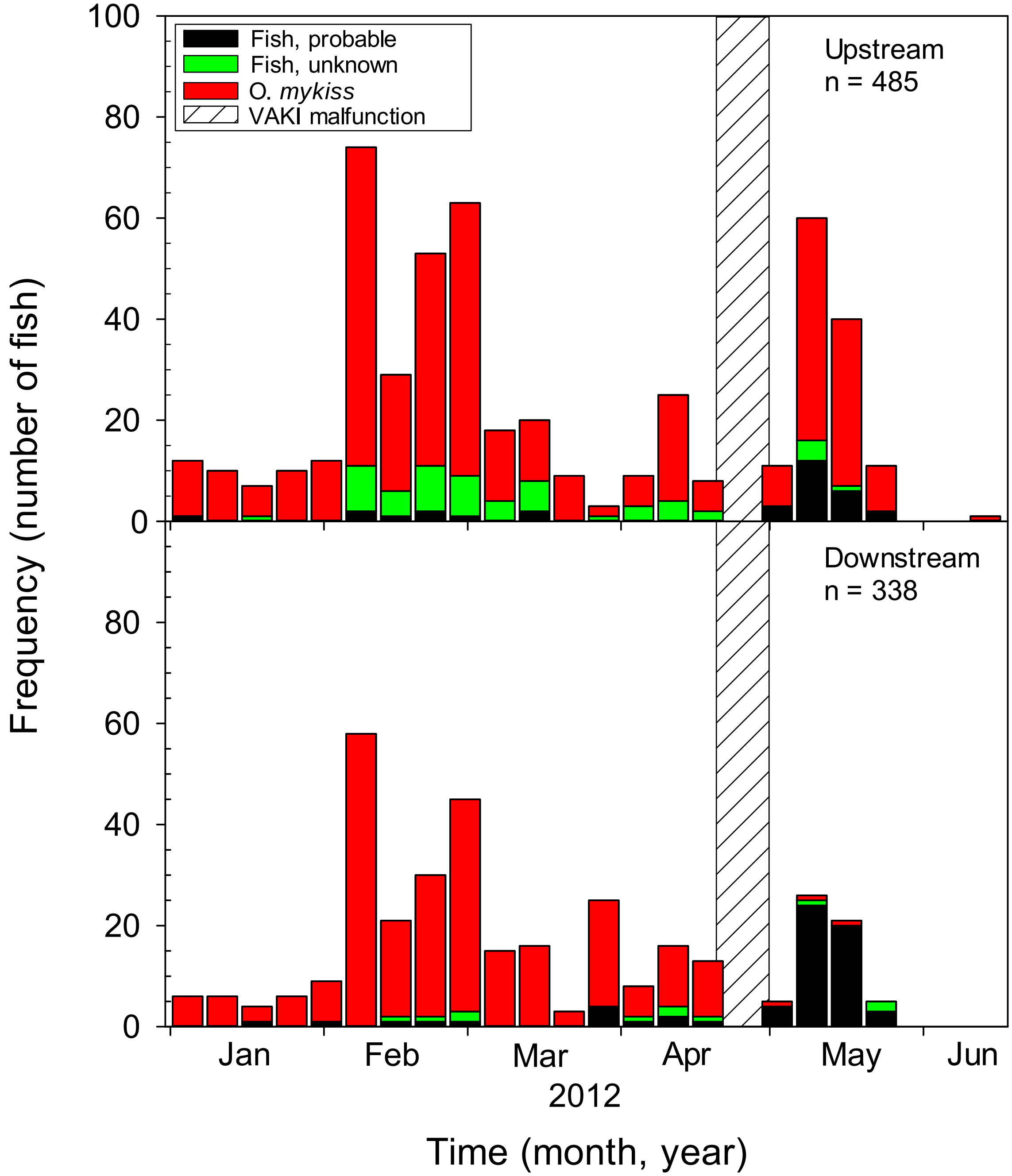


Appendix 8. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections.

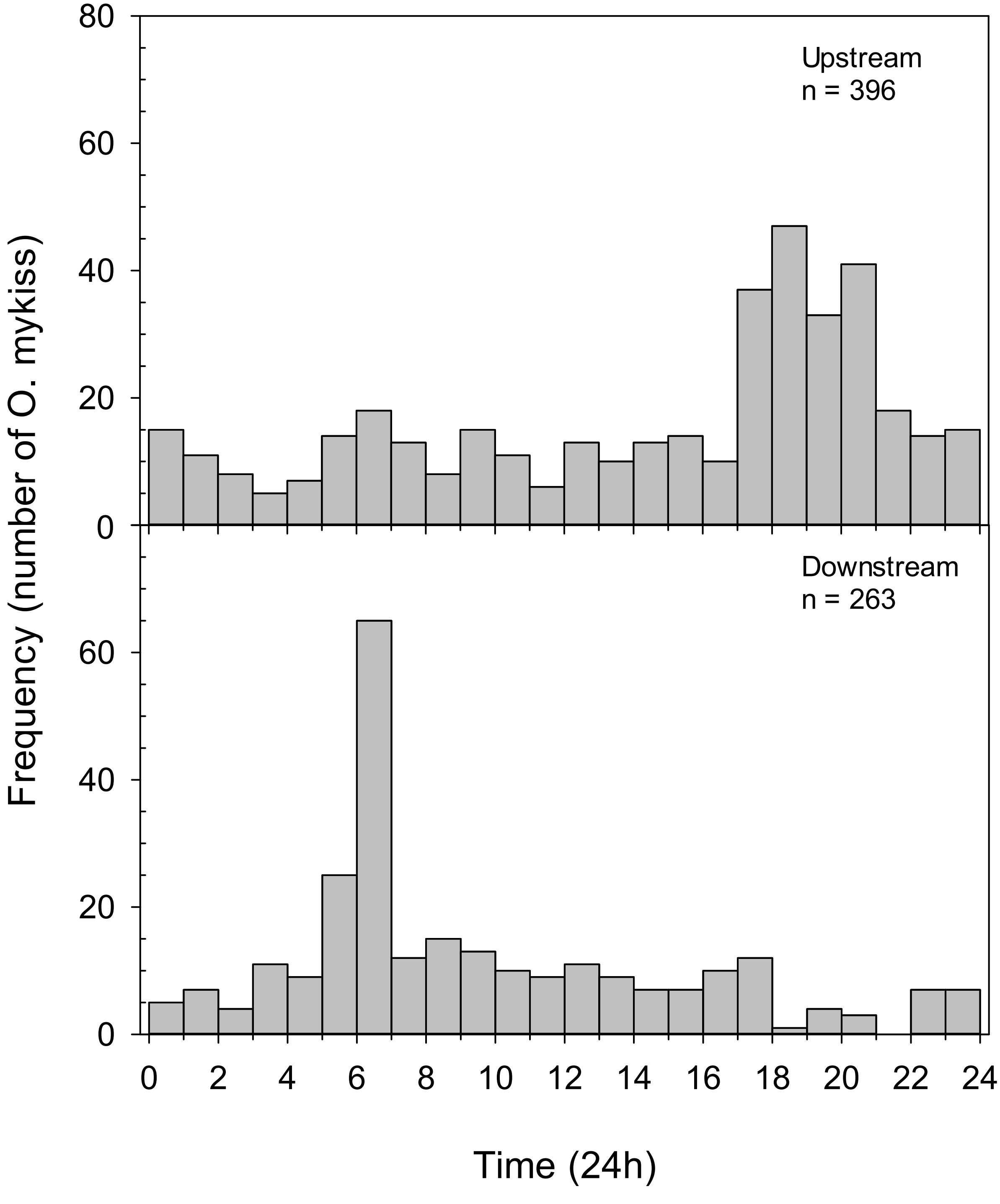
Appendix 9. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* from January through June of 2012.

	Upstream	Downstream
O. *mykiss*	396	263
Fish, non O. *mykiss*[a]	16	6
Fish, unknown	57	11
Fish, probable	32	64
False detections	885	1,438
Total	1,386	1,782
Mean date - O. *mykiss*	12-Mar	27-Feb
Mean date - fish, non O. *mykiss*	11-Mar	5-Mar
Mean date - fish, unknown	9-Mar	3-Apr
Mean date - fish, probable	17-Apr	29-Apr
Mean time - O. *mykiss* (24h)	14:23	9:37
Mean time - fish, non O. *mykiss* (24h)	16:30	13:10
Mean time - fish, unknown (24h)	11:35	13:05
Mean time - fish, probable (24h)	13:35	9:37
Mean length - O. *mykiss* (cm)	31	29
Mean length - fish, non O. *mykiss* (cm)	45	49
Mean length - fish, unknown (cm)	29	29
Mean length - fish, probable (cm)	30	26
Mean daily temperature - O. *mykiss* (°C)	14.4	12.9
Mean daily temperature - fish, non O. *mykiss* (°C)	13.6	13.0
Mean daily temperature - fish, unknown (°C)	13.8	15.9
Mean daily temperature - fish, probable (°C)	17.8	18.4
Mean daily turbidity - O. *mykiss* (NTU)	5	6
Mean daily turbidity - fish, non O. *mykiss* (NTU)	6	4
Mean daily turbidity - fish, probable (NTU)	3	3
Mean daily turbidity - fish, unknown (NTU)	5	4
Mean daily turbidity - false detections (NTU)	17	25
Mean daily discharge - O. *mykiss* (cfs)	10.3	10.7
Mean daily discharge - fish, non O. *mykiss* (cfs)	12.6	9.4
Mean daily discharge - fish, probable (cfs)	11.0	12.6
Mean daily discharge - fish, unknown (cfs)	10.2	12.3
Mean daily discharge - false detections (cfs)	14.8	15.0

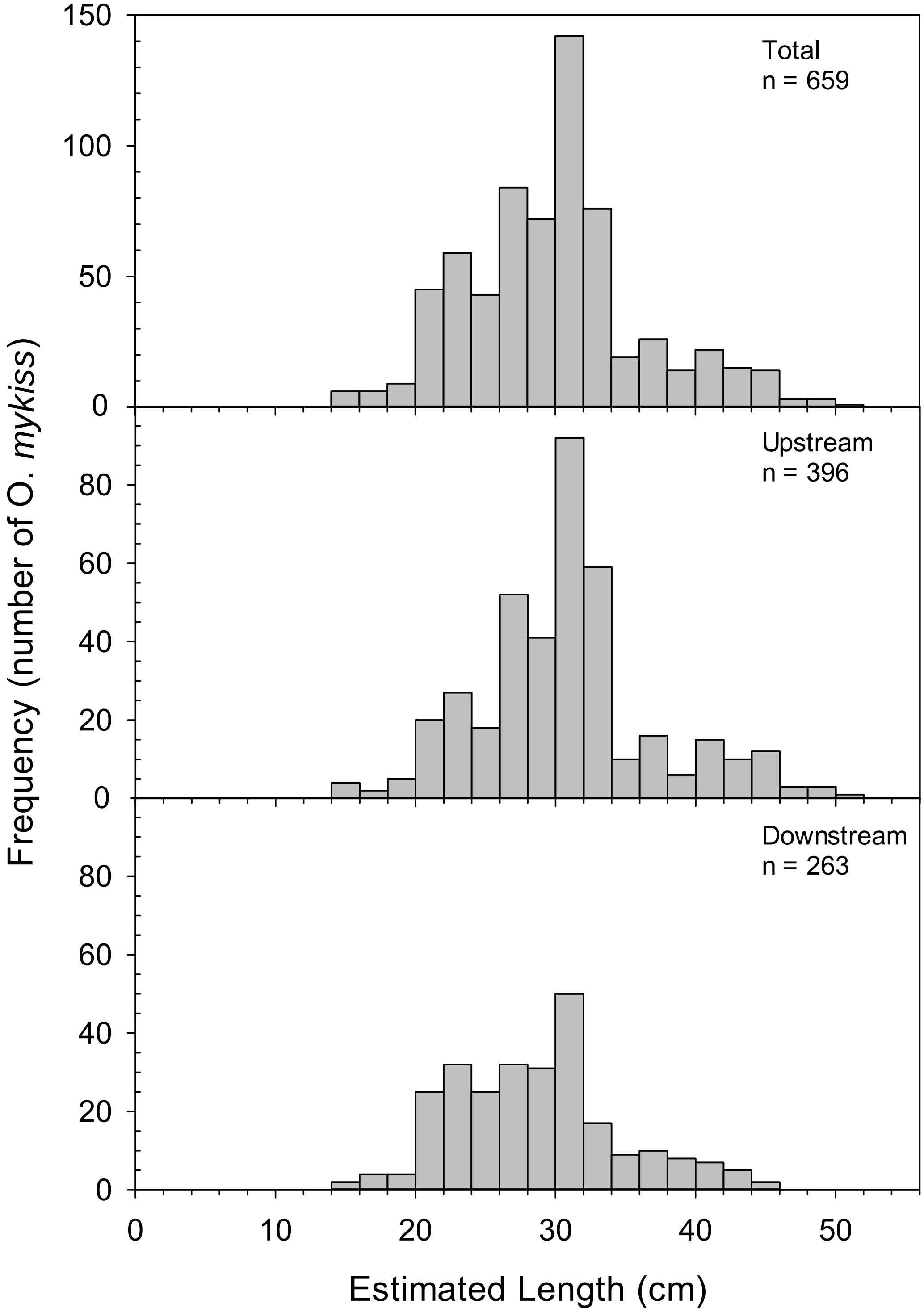
[a]Fish, non O. mykiss includes 1 sunfish (up) and 21 largemouth bass



Appendix 10. Weekly Riverwatcher upstream and downstream detections classified as *O. mykiss*, fish probable, and fish unknown from January through June of 2012.



Appendix 11. Time (24h) of *O. mykiss,* fish probable, and fish unknown passage through the Riverwatcher in upstream and downstream directions from January through June of 2012.



Appendix 12. Length frequency distribution of *O. mykiss* detected passing through the Riverwatcher from January through June of 2012.

Appendix 13. Date, time, TL, direction, discharge, turbidity, and temperature at time of all upstream and downstream Riverwatcher detections that were determined to be fish.

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
4-Jan-2012	12:23	Fish Probable	28	Up	10	4	11.8
4-Jan-2012	22:24	O. mykiss	32	Up	10	4	11.8
4-Jan-2012	22:38	O. mykiss	41	Up	10	4	11.8
4-Jan-2012	22:38	O. mykiss	34	Down	10	4	11.8
5-Jan-2012	0:26	O. mykiss	41	Up	10	4	12.0
5-Jan-2012	0:37	O. mykiss	34	Down	10	4	12.0
5-Jan-2012	10:22	O. mykiss	34	Up	10	4	12.0
5-Jan-2012	12:43	O. mykiss	30	Up	10	4	12.0
6-Jan-2012	1:42	O. mykiss	34	Up	10	4	11.8
6-Jan-2012	2:55	O. mykiss	32	Up	10	4	11.8
6-Jan-2012	17:52	O. mykiss	27	Up	10	4	11.8
6-Jan-2012	19:54	O. mykiss	41	Up	10	4	11.8
7-Jan-2012	6:08	O. mykiss	28	Down	10	4	10.9
7-Jan-2012	6:35	O. mykiss	44	Down	10	4	10.9
7-Jan-2012	6:45	O. mykiss	23	Down	10	4	10.9
7-Jan-2012	15:36	O. mykiss	20	Down	10	4	10.9
7-Jan-2012	15:36	O. mykiss	30	Up	10	4	10.9
7-Jan-2012	19:29	O. mykiss	44	Up	10	4	10.9
8-Jan-2012	1:43	O. mykiss	27	Up	10	4	10.4
8-Jan-2012	6:50	O. mykiss	23	Down	10	4	10.4
8-Jan-2012	6:55	O. mykiss	32	Up	10	4	10.4
8-Jan-2012	17:31	O. mykiss	37	Down	10	4	10.4
8-Jan-2012	17:34	O. mykiss	25	Up	10	4	10.4
9-Jan-2012	3:33	O. mykiss	22	Up	10	4	10.3
9-Jan-2012	4:23	O. mykiss	41	Up	10	4	10.3
9-Jan-2012	6:56	O. mykiss	22	Down	10	4	10.3
9-Jan-2012	20:34	O. mykiss	44	Up	10	4	10.3
10-Jan-2012	6:15	O. mykiss	41	Down	10	4	10.6
11-Jan-2012	8:51	O. mykiss	19	Up	9	4	10.4
12-Jan-2012	19:48	O. mykiss	20	Up	9	4	10.9
13-Jan-2012	7:03	O. mykiss	23	Down	9	4	10.2
13-Jan-2012	7:04	O. mykiss	32	Up	9	4	10.2
14-Jan-2012	6:51	O. mykiss	23	Down	9	4	9.3
14-Jan-2012	6:58	O. mykiss	28	Up	9	4	9.3
15-Jan-2012	8:28	O. mykiss	23	Down	9	4	9.7
15-Jan-2012	8:28	O. mykiss	27	Up	9	4	9.7
15-Jan-2012	21:01	O. mykiss	19	Up	9	4	9.7
16-Jan-2012	0:28	O. mykiss	32	Up	9	4	10.3
16-Jan-2012	5:52	O. mykiss	23	Down	9	4	10.3
17-Jan-2012	8:28	O. mykiss	23	Down	9	4	9.1
17-Jan-2012	8:34	Fish Unknown	25	Up	9	4	9.1
17-Jan-2012	8:35	Fish Probable	27	Down	9	4	9.1
20-Jan-2012	23:42	O. mykiss	30	Up	9	4	10.2
21-Jan-2012	13:00	O. mykiss	28	Up	9	5	11.7
21-Jan-2012	17:31	O. mykiss	27	Up	9	5	11.7
22-Jan-2012	7:12	O. mykiss	30	Down	9	5	10.7
22-Jan-2012	9:43	O. mykiss	34	Up	9	5	10.7
22-Jan-2012	16:20	O. mykiss	32	Up	9	5	10.7
22-Jan-2012	17:59	O. mykiss	25	Up	9	5	10.7
23-Jan-2012	2:24	O. mykiss	28	Up	9	4	11.2

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
23-Jan-2012	6:18	O. mykiss	22	Down	9	4	11.2
23-Jan-2012	21:27	O. mykiss	27	Up	9	4	11.2
24-Jan-2012	6:47	O. mykiss	25	Down	10	4	11.4
24-Jan-2012	11:55	O. mykiss	25	Up	10	4	11.4
25-Jan-2012	20:10	O. mykiss	25	Up	11	4	12.0
26-Jan-2012	16:41	Largemouth Bass	39	Up	11	4	12.9
26-Jan-2012	17:50	O. mykiss	23	Up	11	4	12.9
27-Jan-2012	14:52	O. mykiss	34	Down	11	4	13.2
27-Jan-2012	23:24	O. mykiss	42	Up	11	4	13.2
28-Jan-2012	6:50	O. mykiss	40	Down	10	4	11.9
28-Jan-2012	6:57	O. mykiss	19	Down	10	4	11.9
28-Jan-2012	15:39	O. mykiss	25	Up	10	4	11.9
30-Jan-2012	1:49	O. mykiss	23	Up	10	4	11.0
30-Jan-2012	6:06	O. mykiss	28	Down	10	4	11.0
30-Jan-2012	6:36	Fish Probable	17	Down	10	4	11.0
31-Jan-2012	6:02	O. mykiss	32	Down	10	4	11.4
31-Jan-2012	16:22	Largemouth Bass	50	Up	10	4	11.4
31-Jan-2012	17:53	O. mykiss	27	Up	10	4	11.4
31-Jan-2012	18:31	O. mykiss	28	Up	10	4	11.4
1-Feb-2012	1:47	O. mykiss	32	Up	10	4	12.1
1-Feb-2012	6:05	O. mykiss	30	Down	10	4	12.1
1-Feb-2012	17:55	O. mykiss	30	Up	10	4	12.1
1-Feb-2012	20:55	O. mykiss	28	Up	10	4	12.1
2-Feb-2012	5:56	O. mykiss	30	Down	10	4	11.9
2-Feb-2012	6:09	O. mykiss	34	Down	10	4	11.9
2-Feb-2012	18:17	O. mykiss	30	Up	10	4	11.9
3-Feb-2012	3:57	O. mykiss	30	Down	10	5	11.5
3-Feb-2012	6:14	O. mykiss	23	Down	10	5	11.5
3-Feb-2012	17:43	O. mykiss	30	Up	10	5	11.5
3-Feb-2012	18:00	O. mykiss	19	Up	10	5	11.5
3-Feb-2012	23:11	O. mykiss	23	Up	10	5	11.5
4-Feb-2012	0:03	O. mykiss	28	Up	9	5	10.9
4-Feb-2012	17:55	O. mykiss	27	Up	9	5	10.9
4-Feb-2012	22:36	O. mykiss	17	Down	9	5	10.9
5-Feb-2012	0:19	O. mykiss	27	Up	9	6	11.1
5-Feb-2012	0:23	O. mykiss	28	Up	9	6	11.1
5-Feb-2012	0:32	O. mykiss	34	Up	9	6	11.1
5-Feb-2012	1:50	O. mykiss	28	Down	9	6	11.1
5-Feb-2012	2:52	O. mykiss	29	Up	9	6	11.1
5-Feb-2012	5:18	O. mykiss	20	Down	9	6	11.1
5-Feb-2012	6:12	O. mykiss	32	Down	9	6	11.1
5-Feb-2012	18:03	O. mykiss	30	Up	9	6	11.1
5-Feb-2012	18:14	O. mykiss	20	Up	9	6	11.1
5-Feb-2012	23:41	O. mykiss	28	Up	9	6	11.1
6-Feb-2012	1:55	O. mykiss	30	Up	9	5	10.9
6-Feb-2012	5:17	O. mykiss	25	Down	9	5	10.9
6-Feb-2012	6:22	O. mykiss	23	Down	9	5	10.9
6-Feb-2012	19:08	O. mykiss	30	Up	9	5	10.9
6-Feb-2012	19:12	O. mykiss	27	Up	9	5	10.9
7-Feb-2012	6:37	O. mykiss	23	Down	10	4	11.5
7-Feb-2012	17:00	O. mykiss	15	Up	10	4	11.5
7-Feb-2012	19:45	O. mykiss	28	Up	10	4	11.5
7-Feb-2012	20:19	O. mykiss	27	Down	10	4	11.5

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
7-Feb-2012	20:21	O. mykiss	32	Up	10	4	11.5
7-Feb-2012	22:22	O. mykiss	17	Up	10	4	11.5
7-Feb-2012	23:59	O. mykiss	23	Down	10	4	11.5
8-Feb-2012	0:14	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	4:02	O. mykiss	23	Down	10	4	12.3
8-Feb-2012	6:14	O. mykiss	28	Down	10	4	12.3
8-Feb-2012	8:52	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	8:53	O. mykiss	34	Up	10	4	12.3
8-Feb-2012	8:58	O. mykiss	30	Down	10	4	12.3
8-Feb-2012	8:58	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	9:12	O. mykiss	25	Down	10	4	12.3
8-Feb-2012	9:12	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	9:13	O. mykiss	35	Up	10	4	12.3
8-Feb-2012	9:13	O. mykiss	34	Up	10	4	12.3
8-Feb-2012	11:53	O. mykiss	25	Down	10	4	12.3
8-Feb-2012	11:53	O. mykiss	25	Up	10	4	12.3
8-Feb-2012	11:55	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	12:04	O. mykiss	27	Up	10	4	12.3
8-Feb-2012	12:13	O. mykiss	27	Down	10	4	12.3
8-Feb-2012	12:15	O. mykiss	22	Up	10	4	12.3
8-Feb-2012	12:19	O. mykiss	30	Down	10	4	12.3
8-Feb-2012	12:26	O. mykiss	37	Up	10	4	12.3
8-Feb-2012	12:51	O. mykiss	25	Down	10	4	12.3
8-Feb-2012	13:13	O. mykiss	23	Up	10	4	12.3
8-Feb-2012	13:20	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	14:02	O. mykiss	27	Up	10	4	12.3
8-Feb-2012	14:08	O. mykiss	28	Down	10	4	12.3
8-Feb-2012	14:55	Fish Probable	23	Up	10	4	12.3
8-Feb-2012	22:27	O. mykiss	34	Down	10	4	12.3
8-Feb-2012	22:32	O. mykiss	30	Up	10	4	12.3
8-Feb-2012	23:49	O. mykiss	27	Down	10	4	12.3
9-Feb-2012	0:04	Fish Unknown	30	Up	10	4	12.8
9-Feb-2012	0:17	O. mykiss	32	Up	10	4	12.8
9-Feb-2012	5:38	O. mykiss	27	Down	10	4	12.8
9-Feb-2012	5:40	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	6:48	O. mykiss	28	Down	10	4	12.8
9-Feb-2012	6:48	O. mykiss	30	Down	10	4	12.8
9-Feb-2012	6:52	O. mykiss	37	Up	10	4	12.8
9-Feb-2012	6:52	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	7:03	O. mykiss	23	Down	10	4	12.8
9-Feb-2012	8:26	O. mykiss	27	Down	10	4	12.8
9-Feb-2012	8:41	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	8:46	O. mykiss	25	Down	10	4	12.8
9-Feb-2012	9:01	Fish Unknown	32	Up	10	4	12.8
9-Feb-2012	9:06	O. mykiss	30	Down	10	4	12.8
9-Feb-2012	9:22	O. mykiss	32	Up	10	4	12.8
9-Feb-2012	18:08	O. mykiss	30	Up	10	4	12.8
9-Feb-2012	18:17	O. mykiss	34	Up	10	4	12.8
9-Feb-2012	19:49	O. mykiss	25	Down	10	4	12.8
9-Feb-2012	19:55	O. mykiss	28	Up	10	4	12.8
9-Feb-2012	20:40	O. mykiss	34	Down	10	4	12.8
9-Feb-2012	20:42	O. mykiss	30	Up	10	4	12.8
9-Feb-2012	20:53	O. mykiss	30	Up	10	4	12.8

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
10-Feb-2012	1:04	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	1:14	Fish Probable	34	Up	9	4	13.0
10-Feb-2012	5:33	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	5:55	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	6:27	O. mykiss	23	Down	9	4	13.0
10-Feb-2012	6:27	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	6:32	O. mykiss	22	Down	9	4	13.0
10-Feb-2012	9:18	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	9:28	O. mykiss	25	Down	9	4	13.0
10-Feb-2012	9:45	O. mykiss	32	Up	9	4	13.0
10-Feb-2012	9:48	O. mykiss	25	Down	9	4	13.0
10-Feb-2012	9:48	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	9:50	O. mykiss	32	Down	9	4	13.0
10-Feb-2012	9:50	O. mykiss	32	Up	9	4	13.0
10-Feb-2012	9:56	O. mykiss	27	Down	9	4	13.0
10-Feb-2012	10:01	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	10:03	O. mykiss	23	Down	9	4	13.0
10-Feb-2012	10:03	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	10:39	O. mykiss	27	Down	9	4	13.0
10-Feb-2012	10:39	O. mykiss	34	Up	9	4	13.0
10-Feb-2012	12:26	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	12:33	Fish Unknown	27	Up	9	4	13.0
10-Feb-2012	12:37	O. mykiss	23	Down	9	4	13.0
10-Feb-2012	12:50	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	12:53	O. mykiss	27	Up	9	4	13.0
10-Feb-2012	12:57	O. mykiss	30	Down	9	4	13.0
10-Feb-2012	13:08	Fish Unknown	32	Up	9	4	13.0
10-Feb-2012	13:16	O. mykiss	32	Down	9	4	13.0
10-Feb-2012	13:17	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	13:19	O. mykiss	32	Down	9	4	13.0
10-Feb-2012	13:56	O. mykiss	23	Up	9	4	13.0
10-Feb-2012	14:05	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	14:14	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	14:18	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	14:19	O. mykiss	23	Up	9	4	13.0
10-Feb-2012	14:29	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	14:36	O. mykiss	25	Down	9	4	13.0
10-Feb-2012	16:20	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	16:20	O. mykiss	32	Up	9	4	13.0
10-Feb-2012	17:00	O. mykiss	28	Down	9	4	13.0
10-Feb-2012	17:10	O. mykiss	27	Up	9	4	13.0
10-Feb-2012	18:14	O. mykiss	28	Up	9	4	13.0
10-Feb-2012	19:08	O. mykiss	30	Down	9	4	13.0
10-Feb-2012	19:16	O. mykiss	30	Up	9	4	13.0
10-Feb-2012	22:33	O. mykiss	28	Down	9	4	13.0
11-Feb-2012	1:01	O. mykiss	28	Down	9	4	12.8
11-Feb-2012	1:03	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	3:21	O. mykiss	30	Down	9	4	12.8
11-Feb-2012	5:54	O. mykiss	30	Down	9	4	12.8
11-Feb-2012	8:57	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	10:11	O. mykiss	32	Down	9	4	12.8
11-Feb-2012	10:14	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	11:19	O. mykiss	27	Down	9	4	12.8

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
11-Feb-2012	15:08	Fish Unknown	34	Up	9	4	12.8
11-Feb-2012	16:16	O. mykiss	32	Down	9	4	12.8
11-Feb-2012	16:20	Fish Unknown	30	Up	9	4	12.8
11-Feb-2012	17:39	O. mykiss	27	Up	9	4	12.8
11-Feb-2012	17:49	O. mykiss	23	Up	9	4	12.8
11-Feb-2012	18:12	O. mykiss	25	Up	9	4	12.8
11-Feb-2012	18:48	O. mykiss	20	Up	9	4	12.8
12-Feb-2012	1:19	O. mykiss	30	Down	9	4	12.2
12-Feb-2012	1:21	Fish Unknown	30	Up	9	4	12.2
12-Feb-2012	4:39	Fish Unknown	34	Up	9	4	12.2
12-Feb-2012	6:44	O. mykiss	30	Down	9	4	12.2
12-Feb-2012	10:12	Fish Unknown	23	Up	9	4	12.2
12-Feb-2012	10:24	O. mykiss	30	Down	9	4	12.2
12-Feb-2012	12:19	O. mykiss	32	Up	9	4	12.2
12-Feb-2012	12:31	O. mykiss	28	Down	9	4	12.2
12-Feb-2012	15:51	O. mykiss	27	Up	9	4	12.2
12-Feb-2012	16:48	Largemouth Bass	41	Up	9	4	12.2
12-Feb-2012	17:25	O. mykiss	22	Up	9	4	12.2
12-Feb-2012	18:15	O. mykiss	27	Up	9	4	12.2
12-Feb-2012	18:20	O. mykiss	32	Up	9	4	12.2
12-Feb-2012	19:54	O. mykiss	28	Up	9	4	12.2
13-Feb-2012	1:05	O. mykiss	27	Up	10	4	12.3
13-Feb-2012	5:20	O. mykiss	30	Down	10	4	12.3
13-Feb-2012	6:38	O. mykiss	22	Down	10	4	12.3
13-Feb-2012	6:38	O. mykiss	28	Down	10	4	12.3
13-Feb-2012	6:42	O. mykiss	28	Down	10	4	12.3
13-Feb-2012	14:36	O. mykiss	27	Up	10	4	12.3
15-Feb-2012	3:50	O. mykiss	20	Down	10	4	10.7
15-Feb-2012	17:30	O. mykiss	28	Up	10	4	10.7
15-Feb-2012	18:40	O. mykiss	28	Up	10	4	10.7
15-Feb-2012	21:53	O. mykiss	37	Up	10	4	10.7
16-Feb-2012	2:55	O. mykiss	30	Down	9	4	10.7
16-Feb-2012	3:00	Fish Probable	23	Up	9	4	10.7
16-Feb-2012	4:40	O. mykiss	30	Down	9	4	10.7
16-Feb-2012	5:03	O. mykiss	34	Down	9	4	10.7
16-Feb-2012	5:21	O. mykiss	23	Down	9	4	10.7
16-Feb-2012	17:42	O. mykiss	30	Up	9	4	10.7
16-Feb-2012	17:56	O. mykiss	30	Up	9	4	10.7
16-Feb-2012	18:11	O. mykiss	27	Up	9	4	10.7
16-Feb-2012	18:40	O. mykiss	32	Up	9	4	10.7
16-Feb-2012	21:32	O. mykiss	28	Up	9	4	10.7
17-Feb-2012	4:22	O. mykiss	34	Down	9	4	11.0
17-Feb-2012	4:23	Fish Probable	23	Down	9	4	11.0
17-Feb-2012	6:20	O. mykiss	23	Down	9	4	11.0
17-Feb-2012	15:20	O. mykiss	34	Up	9	4	11.0
17-Feb-2012	16:52	O. mykiss	27	Down	9	4	11.0
17-Feb-2012	16:56	O. mykiss	28	Up	9	4	11.0
17-Feb-2012	17:01	O. mykiss	28	Down	9	4	11.0
17-Feb-2012	17:02	Fish Unknown	32	Up	9	4	11.0
17-Feb-2012	17:10	O. mykiss	30	Down	9	4	11.0
17-Feb-2012	17:12	Fish Unknown	28	Up	9	4	11.0
17-Feb-2012	17:36	O. mykiss	30	Up	9	4	11.0
17-Feb-2012	18:24	O. mykiss	28	Up	9	4	11.0

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
18-Feb-2012	6:12	O. mykiss	23	Down	9	4	11.6
18-Feb-2012	6:24	Fish Unknown	30	Down	9	4	11.6
18-Feb-2012	17:06	O. mykiss	34	Up	9	4	11.6
18-Feb-2012	17:24	Largemouth Bass	34	Up	9	4	11.6
18-Feb-2012	18:06	O. mykiss	32	Up	9	4	11.6
18-Feb-2012	21:46	O. mykiss	44	Up	9	4	11.6
19-Feb-2012	5:07	O. mykiss	30	Down	9	4	12.0
19-Feb-2012	5:07	O. mykiss	38	Down	9	4	12.0
19-Feb-2012	5:26	O. mykiss	37	Up	9	4	12.0
19-Feb-2012	6:06	O. mykiss	32	Down	9	4	12.0
19-Feb-2012	6:38	Largemouth Bass	50	Down	9	4	12.0
19-Feb-2012	8:10	O. mykiss	40	Down	9	4	12.0
19-Feb-2012	15:31	O. mykiss	27	Up	9	4	12.0
19-Feb-2012	15:41	Fish Unknown	30	Up	9	4	12.0
19-Feb-2012	16:05	O. mykiss	44	Up	9	4	12.0
19-Feb-2012	16:17	Fish Unknown	34	Up	9	4	12.0
19-Feb-2012	16:23	O. mykiss	28	Down	9	4	12.0
19-Feb-2012	16:32	Fish Unknown	32	Up	9	4	12.0
19-Feb-2012	16:56	Largemouth Bass	49	Up	9	4	12.0
19-Feb-2012	17:16	O. mykiss	27	Down	9	4	12.0
19-Feb-2012	17:19	Fish Unknown	32	Up	9	4	12.0
19-Feb-2012	17:23	O. mykiss	28	Up	9	4	12.0
19-Feb-2012	18:08	O. mykiss	22	Up	9	4	12.0
19-Feb-2012	18:50	O. mykiss	32	Up	9	4	12.0
20-Feb-2012	6:22	O. mykiss	27	Down	9	4	11.2
20-Feb-2012	6:40	O. mykiss	37	Down	9	4	11.2
20-Feb-2012	14:09	Largemouth Bass	50	Down	9	4	11.2
20-Feb-2012	14:10	Largemouth Bass	42	Up	9	4	11.2
20-Feb-2012	14:28	Largemouth Bass	49	Down	9	4	11.2
20-Feb-2012	14:29	Largemouth Bass	50	Up	9	4	11.2
20-Feb-2012	14:38	Largemouth Bass	44	Down	9	4	11.2
20-Feb-2012	15:46	O. mykiss	46	Up	9	4	11.2
20-Feb-2012	17:27	O. mykiss	32	Up	9	4	11.2
20-Feb-2012	17:28	Fish Probable	41	Down	9	4	11.2
20-Feb-2012	17:30	O. mykiss	41	Up	9	4	11.2
20-Feb-2012	18:51	O. mykiss	27	Up	9	4	11.2
21-Feb-2012	5:23	O. mykiss	30	Down	9	4	11.8
21-Feb-2012	6:43	O. mykiss	35	Down	9	4	11.8
21-Feb-2012	8:00	O. mykiss	28	Up	9	4	11.8
21-Feb-2012	13:34	O. mykiss	37	Up	9	4	11.8
21-Feb-2012	14:13	O. mykiss	28	Down	9	4	11.8
21-Feb-2012	17:30	O. mykiss	34	Up	9	4	11.8
21-Feb-2012	18:03	O. mykiss	20	Up	9	4	11.8
21-Feb-2012	18:06	O. mykiss	41	Up	9	4	11.8
21-Feb-2012	19:20	O. mykiss	27	Up	9	4	11.8
21-Feb-2012	21:58	O. mykiss	37	Up	9	4	11.8
22-Feb-2012	1:05	O. mykiss	37	Down	9	5	13.1
22-Feb-2012	6:23	O. mykiss	34	Down	9	5	13.1
22-Feb-2012	17:28	O. mykiss	30	Up	9	5	13.1
22-Feb-2012	18:06	O. mykiss	27	Up	9	5	13.1
22-Feb-2012	18:24	O. mykiss	23	Up	9	5	13.1
23-Feb-2012	0:08	O. mykiss	43	Up	8	5	13.7
23-Feb-2012	0:55	O. mykiss	27	Down	8	5	13.7

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
23-Feb-2012	2:44	O. mykiss	34	Down	8	5	13.7
23-Feb-2012	2:45	O. mykiss	34	Down	8	5	13.7
23-Feb-2012	2:47	O. mykiss	41	Up	8	5	13.7
23-Feb-2012	3:00	O. mykiss	41	Down	8	5	13.7
23-Feb-2012	3:07	O. mykiss	37	Up	8	5	13.7
23-Feb-2012	6:35	O. mykiss	37	Down	8	5	13.7
23-Feb-2012	7:41	O. mykiss	34	Up	8	5	13.7
23-Feb-2012	11:42	Fish Unknown	23	Up	8	5	13.7
23-Feb-2012	11:50	Fish Unknown	23	Up	8	5	13.7
23-Feb-2012	12:22	Fish Unknown	32	Up	8	5	13.7
23-Feb-2012	16:29	O. mykiss	23	Up	8	5	13.7
23-Feb-2012	18:51	O. mykiss	46	Up	8	5	13.7
23-Feb-2012	18:53	O. mykiss	32	Up	8	5	13.7
23-Feb-2012	19:19	O. mykiss	44	Up	8	5	13.7
23-Feb-2012	19:51	O. mykiss	27	Up	8	5	13.7
23-Feb-2012	22:12	O. mykiss	37	Down	8	5	13.7
23-Feb-2012	22:12	O. mykiss	39	Up	8	5	13.7
24-Feb-2012	0:30	O. mykiss	47	Up	7	5	14.1
24-Feb-2012	0:40	O. mykiss	44	Up	7	5	14.1
24-Feb-2012	5:55	O. mykiss	22	Down	7	5	14.1
24-Feb-2012	6:22	O. mykiss	41	Down	7	5	14.1
24-Feb-2012	7:41	O. mykiss	30	Down	7	5	14.1
24-Feb-2012	14:18	O. mykiss	32	Up	7	5	14.1
24-Feb-2012	14:34	Fish Unknown	32	Up	7	5	14.1
24-Feb-2012	14:36	O. mykiss	28	Up	7	5	14.1
24-Feb-2012	14:43	O. mykiss	27	Up	7	5	14.1
24-Feb-2012	14:58	Fish Unknown	27	Down	7	5	14.1
24-Feb-2012	15:32	O. mykiss	44	Up	7	5	14.1
24-Feb-2012	16:45	Fish Probable	44	Up	7	5	14.1
24-Feb-2012	19:11	Fish Probable	34	Up	7	5	14.1
25-Feb-2012	3:41	O. mykiss	39	Down	7	5	14.6
25-Feb-2012	3:47	O. mykiss	39	Up	7	5	14.6
25-Feb-2012	6:08	O. mykiss	42	Down	7	5	14.6
25-Feb-2012	9:25	O. mykiss	35	Down	7	5	14.6
25-Feb-2012	10:52	O. mykiss	32	Up	7	5	14.6
25-Feb-2012	14:57	O. mykiss	34	Up	7	5	14.6
25-Feb-2012	16:43	O. mykiss	25	Down	7	5	14.6
25-Feb-2012	16:43	O. mykiss	30	Up	7	5	14.6
25-Feb-2012	17:06	O. mykiss	27	Down	7	5	14.6
25-Feb-2012	17:06	O. mykiss	30	Up	7	5	14.6
25-Feb-2012	19:09	O. mykiss	49	Up	7	5	14.6
25-Feb-2012	20:59	Fish Unknown	41	Up	7	5	14.6
25-Feb-2012	23:57	O. mykiss	42	Down	7	5	14.6
26-Feb-2012	2:10	O. mykiss	41	Up	7	5	12.5
26-Feb-2012	2:27	O. mykiss	39	Down	7	5	12.5
26-Feb-2012	2:32	O. mykiss	41	Up	7	5	12.5
26-Feb-2012	3:45	O. mykiss	35	Down	7	5	12.5
26-Feb-2012	6:13	Fish Unknown	27	Down	7	5	12.5
26-Feb-2012	6:32	O. mykiss	25	Down	7	5	12.5
26-Feb-2012	16:38	Fish Probable	30	Up	7	5	12.5
26-Feb-2012	18:45	O. mykiss	30	Up	7	5	12.5
26-Feb-2012	20:19	O. mykiss	30	Up	7	5	12.5
26-Feb-2012	20:29	O. mykiss	34	Up	7	5	12.5

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
27-Feb-2012	4:51	O. mykiss	17	Down	8	4	12.0
27-Feb-2012	6:37	O. mykiss	34	Down	8	4	12.0
27-Feb-2012	18:26	O. mykiss	25	Up	8	4	12.0
27-Feb-2012	18:49	O. mykiss	22	Up	8	4	12.0
27-Feb-2012	19:27	O. mykiss	23	Up	8	4	12.0
27-Feb-2012	21:33	O. mykiss	27	Up	8	4	12.0
28-Feb-2012	5:29	O. mykiss	28	Down	8	4	11.0
28-Feb-2012	5:49	O. mykiss	23	Up	8	4	11.0
28-Feb-2012	6:03	O. mykiss	30	Down	8	4	11.0
28-Feb-2012	6:03	O. mykiss	30	Down	8	4	11.0
28-Feb-2012	15:25	O. mykiss	41	Up	8	4	11.0
28-Feb-2012	20:12	O. mykiss	20	Up	8	4	11.0
29-Feb-2012	1:40	O. mykiss	27	Down	8	4	11.4
29-Feb-2012	1:47	O. mykiss	32	Up	8	4	11.4
29-Feb-2012	4:28	Fish Unknown	30	Up	8	4	11.4
29-Feb-2012	4:28	Fish Probable	20	Down	8	4	11.4
29-Feb-2012	4:52	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	4:59	O. mykiss	42	Down	8	4	11.4
29-Feb-2012	5:03	O. mykiss	35	Down	8	4	11.4
29-Feb-2012	6:14	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	15:22	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	15:22	O. mykiss	20	Up	8	4	11.4
29-Feb-2012	15:25	O. mykiss	30	Down	8	4	11.4
29-Feb-2012	15:29	O. mykiss	25	Up	8	4	11.4
29-Feb-2012	15:29	O. mykiss	17	Down	8	4	11.4
29-Feb-2012	15:44	O. mykiss	27	Up	8	4	11.4
29-Feb-2012	16:12	O. mykiss	19	Down	8	4	11.4
29-Feb-2012	17:39	O. mykiss	30	Up	8	4	11.4
29-Feb-2012	17:39	O. mykiss	27	Up	8	4	11.4
29-Feb-2012	18:16	O. mykiss	30	Up	8	4	11.4
29-Feb-2012	19:20	O. mykiss	41	Up	8	4	11.4
1-Mar-2012	3:35	O. mykiss	25	Down	9	4	12.2
1-Mar-2012	5:02	O. mykiss	28	Down	9	4	12.2
1-Mar-2012	6:15	O. mykiss	27	Down	9	4	12.2
1-Mar-2012	6:36	O. mykiss	39	Down	9	4	12.2
1-Mar-2012	6:37	O. mykiss	35	Up	9	4	12.2
1-Mar-2012	6:37	O. mykiss	25	Up	9	4	12.2
1-Mar-2012	6:44	O. mykiss	37	Down	9	4	12.2
1-Mar-2012	7:20	Fish Unknown	34	Up	9	4	12.2
1-Mar-2012	7:47	O. mykiss	35	Up	9	4	12.2
1-Mar-2012	7:55	O. mykiss	28	Down	9	4	12.2
1-Mar-2012	7:56	O. mykiss	28	Up	9	4	12.2
1-Mar-2012	7:57	O. mykiss	27	Up	9	4	12.2
1-Mar-2012	8:39	O. mykiss	28	Down	9	4	12.2
1-Mar-2012	9:25	O. mykiss	19	Up	9	4	12.2
1-Mar-2012	9:30	O. mykiss	25	Down	9	4	12.2
1-Mar-2012	10:01	O. mykiss	30	Up	9	4	12.2
1-Mar-2012	10:02	O. mykiss	23	Down	9	4	12.2
1-Mar-2012	10:05	O. mykiss	28	Up	9	4	12.2
1-Mar-2012	10:11	Fish Unknown	27	Up	9	4	12.2
1-Mar-2012	10:16	Fish Unknown	28	Up	9	4	12.2
1-Mar-2012	10:33	O. mykiss	27	Down	9	4	12.2
1-Mar-2012	17:46	O. mykiss	37	Up	9	4	12.2

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
1-Mar-2012	17:48	Largemouth Bass	44	Up	9	4	12.2
1-Mar-2012	18:05	O. mykiss	35	Up	9	4	12.2
1-Mar-2012	18:47	O. mykiss	30	Up	9	4	12.2
1-Mar-2012	22:12	O. mykiss	27	Up	9	4	12.2
1-Mar-2012	23:05	O. mykiss	41	Down	9	4	12.2
1-Mar-2012	23:06	O. mykiss	22	Up	9	4	12.2
1-Mar-2012	23:06	O. mykiss	44	Up	9	4	12.2
1-Mar-2012	23:46	O. mykiss	27	Up	9	4	12.2
2-Mar-2012	0:51	O. mykiss	35	Down	9	4	12.5
2-Mar-2012	0:52	O. mykiss	44	Up	9	4	12.5
2-Mar-2012	6:09	O. mykiss	22	Down	9	4	12.5
2-Mar-2012	6:10	O. mykiss	39	Down	9	4	12.5
2-Mar-2012	6:19	O. mykiss	42	Up	9	4	12.5
2-Mar-2012	6:24	O. mykiss	22	Down	9	4	12.5
2-Mar-2012	6:24	O. mykiss	35	Down	9	4	12.5
2-Mar-2012	6:37	O. mykiss	34	Up	9	4	12.5
2-Mar-2012	6:41	O. mykiss	27	Up	9	4	12.5
2-Mar-2012	9:26	O. mykiss	28	Down	9	4	12.5
2-Mar-2012	9:27	O. mykiss	42	Up	9	4	12.5
2-Mar-2012	10:08	Fish Unknown	27	Up	9	4	12.5
2-Mar-2012	11:40	O. mykiss	15	Down	9	4	12.5
2-Mar-2012	11:44	O. mykiss	44	Up	9	4	12.5
2-Mar-2012	12:47	O. mykiss	37	Down	9	4	12.5
2-Mar-2012	13:56	Largemouth Bass	49	Down	9	4	12.5
2-Mar-2012	14:12	O. mykiss	25	Up	9	4	12.5
2-Mar-2012	15:59	Fish Unknown	34	Up	9	4	12.5
2-Mar-2012	16:13	O. mykiss	23	Up	9	4	12.5
2-Mar-2012	16:44	Fish Unknown	32	Down	9	4	12.5
2-Mar-2012	16:46	O. mykiss	30	Up	9	4	12.5
2-Mar-2012	17:18	O. mykiss	27	Down	9	4	12.5
2-Mar-2012	17:19	O. mykiss	30	Up	9	4	12.5
2-Mar-2012	17:27	O. mykiss	30	Down	9	4	12.5
2-Mar-2012	17:28	Fish Unknown	34	Up	9	4	12.5
2-Mar-2012	17:42	O. mykiss	23	Down	9	4	12.5
2-Mar-2012	19:52	O. mykiss	42	Up	9	4	12.5
2-Mar-2012	20:42	Fish Unknown	20	Up	9	4	12.5
2-Mar-2012	21:03	O. mykiss	23	Up	9	4	12.5
3-Mar-2012	1:59	O. mykiss	42	Up	8	6	13.0
3-Mar-2012	5:14	O. mykiss	30	Down	8	6	13.0
3-Mar-2012	5:48	O. mykiss	39	Down	8	6	13.0
3-Mar-2012	6:08	O. mykiss	41	Down	8	6	13.0
3-Mar-2012	17:37	O. mykiss	28	Up	8	6	13.0
3-Mar-2012	18:35	O. mykiss	34	Up	8	6	13.0
3-Mar-2012	21:37	O. mykiss	34	Up	8	6	13.0
3-Mar-2012	21:53	O. mykiss	32	Up	8	6	13.0
3-Mar-2012	23:46	O. mykiss	35	Up	8	6	13.0
3-Mar-2012	23:46	O. mykiss	34	UP	8	6	13.0
4-Mar-2012	5:37	O. mykiss	22	Down	7	5	13.9
4-Mar-2012	5:57	O. mykiss	27	Down	7	5	13.9
4-Mar-2012	6:24	O. mykiss	34	Down	7	5	13.9
4-Mar-2012	9:25	O. mykiss	23	Up	7	5	13.9
4-Mar-2012	17:01	O. mykiss	28	Up	7	5	13.9
4-Mar-2012	18:03	O. mykiss	23	Up	7	5	13.9

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
4-Mar-2012	18:30	O. mykiss	27	Up	7	5	13.9
4-Mar-2012	22:16	O. mykiss	42	Up	7	5	13.9
4-Mar-2012	22:44	Fish Unknown	20	Up	7	5	13.9
5-Mar-2012	3:16	O. mykiss	34	Up	6	4	14.5
5-Mar-2012	5:44	O. mykiss	30	Down	6	4	14.5
5-Mar-2012	5:54	O. mykiss	20	Down	6	4	14.5
5-Mar-2012	5:57	Fish Unknown	25	Up	6	4	14.5
5-Mar-2012	6:02	O. mykiss	23	Down	6	4	14.5
5-Mar-2012	6:40	O. mykiss	35	Down	6	4	14.5
9-Mar-2012	16:15	Fish Unknown	25	Up	7	4	13.3
9-Mar-2012	18:48	O. mykiss	23	Up	7	4	13.3
9-Mar-2012	19:57	O. mykiss	30	Up	7	4	13.3
9-Mar-2012	22:21	O. mykiss	23	Down	7	4	13.3
9-Mar-2012	22:22	O. mykiss	22	Up	7	4	13.3
10-Mar-2012	1:14	O. mykiss	41	Up	7	4	14.0
10-Mar-2012	1:46	O. mykiss	32	Down	7	4	14.0
10-Mar-2012	1:56	O. mykiss	35	Up	7	4	14.0
10-Mar-2012	4:06	O. mykiss	30	Down	7	4	14.0
10-Mar-2012	5:54	Fish Unknown	23	Up	7	4	14.0
10-Mar-2012	10:12	O. mykiss	32	Down	7	4	14.0
10-Mar-2012	10:12	O. mykiss	41	Up	7	4	14.0
10-Mar-2012	13:07	O. mykiss	27	Down	7	4	14.0
10-Mar-2012	13:07	O. mykiss	25	Up	7	4	14.0
10-Mar-2012	13:12	O. mykiss	22	Down	7	4	14.0
10-Mar-2012	17:30	O. mykiss	41	Down	7	4	14.0
10-Mar-2012	17:31	O. mykiss	17	Up	7	4	14.0
10-Mar-2012	18:00	O. mykiss	23	Down	7	4	14.0
11-Mar-2012	3:13	O. mykiss	30	Down	7	4	13.7
11-Mar-2012	4:01	Fish Unknown	23	Up	7	4	13.7
11-Mar-2012	11:18	Fish Unknown	20	Up	7	4	13.7
11-Mar-2012	12:20	O. mykiss	23	Up	7	4	13.7
11-Mar-2012	13:46	O. mykiss	25	Down	7	4	13.7
11-Mar-2012	13:46	O. mykiss	23	Up	7	4	13.7
11-Mar-2012	13:47	O. mykiss	22	Up	7	4	13.7
11-Mar-2012	17:40	Fish Unknown	25	Up	7	4	13.7
11-Mar-2012	17:57	O. mykiss	50	Up	7	4	13.7
11-Mar-2012	18:05	Fish Unknown	27	Up	7	4	13.7
11-Mar-2012	21:02	O. mykiss	19	Up	7	4	13.7
11-Mar-2012	23:01	O. mykiss	27	Up	7	4	13.7
11-Mar-2012	23:39	O. mykiss	34	Down	7	4	13.7
12-Mar-2012	3:07	O. mykiss	20	Down	7	4	13.9
12-Mar-2012	3:07	O. mykiss	42	Down	7	4	13.9
12-Mar-2012	3:35	O. mykiss	47	Up	7	4	13.9
12-Mar-2012	3:51	O. mykiss	25	Down	7	4	13.9
12-Mar-2012	4:49	O. mykiss	25	Down	7	4	13.9
12-Mar-2012	6:11	O. mykiss	35	Down	7	4	13.9
12-Mar-2012	10:59	Fish Unknown	27	Up	7	4	13.9
12-Mar-2012	11:19	O. mykiss	19	Down	7	4	13.9
12-Mar-2012	11:23	O. mykiss	20	Up	7	4	13.9
12-Mar-2012	14:10	O. mykiss	34	Up	7	4	13.9
12-Mar-2012	14:16	O. mykiss	37	Down	7	4	13.9
12-Mar-2012	18:36	O. mykiss	27	Up	7	4	13.9
13-Mar-2012	5:26	O. mykiss	22	Down	6	4	12.9

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
16-Mar-2012	11:10	Fish Probable	28	Up	8	4	13.7
16-Mar-2012	11:35	O. mykiss	20	Down	8	4	13.7
16-Mar-2012	11:53	O. mykiss	35	Down	8	4	13.7
16-Mar-2012	15:27	O. mykiss	25	Down	8	4	13.7
16-Mar-2012	15:50	Fish Probable	30	Up	8	4	13.7
16-Mar-2012	15:56	O. mykiss	27	Down	8	4	13.7
16-Mar-2012	16:38	O. mykiss	30	Down	8	4	13.7
16-Mar-2012	16:44	Fish Unknown	27	Up	8	4	13.7
16-Mar-2012	18:43	O. mykiss	28	Up	8	4	13.7
16-Mar-2012	22:38	O. mykiss	41	Up	8	4	13.7
19-Mar-2012	10:47	O. mykiss	44	Down	17	12	12.2
19-Mar-2012	15:36	O. mykiss	32	Up	17	12	12.2
20-Mar-2012	15:02	Largemouth Bass	46	Up	16	8	12.7
20-Mar-2012	16:02	O. mykiss	42	Down	16	8	12.7
21-Mar-2012	9:00	O. mykiss	47	Up	14	16	14.1
21-Mar-2012	12:45	O. mykiss	39	Up	14	16	14.1
21-Mar-2012	19:21	O. mykiss	42	Up	14	16	14.1
22-Mar-2012	4:57	O. mykiss	42	Down	13	18	15.2
22-Mar-2012	5:00	O. mykiss	49	Up	13	18	15.2
22-Mar-2012	12:58	O. mykiss	42	Up	13	18	15.2
22-Mar-2012	15:00	O. mykiss	49	Up	13	18	15.2
22-Mar-2012	19:17	Largemouth Bass	50	Up	13	18	15.2
23-Mar-2012	0:40	O. mykiss	42	Up	13	15	14.4
24-Mar-2012	22:44	O. mykiss	23	Up	13	7	14.1
26-Mar-2012	16:11	Largemouth Bass	30	Up	24	18	12.5
27-Mar-2012	7:35	O. mykiss	22	Down	22	5	13.3
27-Mar-2012	13:37	O. mykiss	25	Down	22	5	13.3
27-Mar-2012	14:48	Largemouth Bass	42	Up	22	5	13.3
27-Mar-2012	15:40	O. mykiss	22	Down	22	5	13.3
27-Mar-2012	16:13	O. mykiss	23	Down	22	5	13.3
27-Mar-2012	16:23	O. mykiss	28	Up	22	5	13.3
27-Mar-2012	17:19	O. mykiss	25	Down	22	5	13.3
27-Mar-2012	23:26	O. mykiss	15	Down	22	5	13.3
27-Mar-2012	23:27	O. mykiss	15	Up	22	5	13.3
27-Mar-2012	23:27	Fish Probable	17	Down	22	5	13.3
27-Mar-2012	23:27	Fish Probable	17	Down	22	5	13.3
27-Mar-2012	23:29	Fish Probable	16	Down	22	5	13.3
28-Mar-2012	13:36	O. mykiss	23	Down	20	5	13.5
28-Mar-2012	16:25	O. mykiss	25	Down	20	5	13.5
29-Mar-2012	14:47	O. mykiss	17	Down	19	6	14.8
30-Mar-2012	0:49	O. mykiss	27	Down	18	5	15.1
30-Mar-2012	5:54	O. mykiss	34	Down	18	5	15.1
30-Mar-2012	7:30	O. mykiss	20	Down	18	5	15.1
30-Mar-2012	8:32	O. mykiss	25	Down	18	5	15.1
30-Mar-2012	8:38	O. mykiss	22	Down	18	5	15.1
30-Mar-2012	8:51	O. mykiss	23	Down	18	5	15.1
30-Mar-2012	9:19	O. mykiss	32	Down	18	5	15.1
30-Mar-2012	16:31	O. mykiss	34	Down	18	5	15.1
31-Mar-2012	3:51	Fish Unknown	28	Up	17	5	14.1
31-Mar-2012	8:14	O. mykiss	23	Down	17	5	14.1
31-Mar-2012	9:09	O. mykiss	22	Down	17	5	14.1
31-Mar-2012	11:49	O. mykiss	22	Down	17	5	14.1
31-Mar-2012	23:36	Fish Probable	23	Down	17	5	14.1

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
31-Mar-2012	23:41	O. mykiss	22	Down	17	5	14.1
1-Apr-2012	0:12	Fish Unknown	17	Up	17	5	13.7
1-Apr-2012	7:34	O. mykiss	28	Down	17	5	13.7
1-Apr-2012	12:29	O. mykiss	30	Up	17	5	13.7
1-Apr-2012	20:12	O. mykiss	32	Up	17	5	13.7
2-Apr-2012	6:33	O. mykiss	20	Down	16	4	13.6
3-Apr-2012	6:34	O. mykiss	28	Down	15	4	14.9
3-Apr-2012	15:32	Largemouth Bass	60	Up	15	4	14.9
4-Apr-2012	0:32	Fish Probable	27	Down	15	4	15.8
4-Apr-2012	0:32	Fish Unknown	23	Up	15	4	15.8
4-Apr-2012	6:51	Fish Unknown	23	Down	15	4	15.8
5-Apr-2012	0:15	O. mykiss	23	Down	14	4	14.7
5-Apr-2012	7:04	O. mykiss	23	UP	14	4	14.7
5-Apr-2012	8:31	O. mykiss	25	Up	14	4	14.7
5-Apr-2012	8:43	O. mykiss	27	Down	14	4	14.7
5-Apr-2012	8:46	O. mykiss	25	Down	14	4	14.7
6-Apr-2012	7:01	O. mykiss	25	Up	14	4	14.2
7-Apr-2012	8:52	Fish Unknown	22	Up	13	5	14.8
7-Apr-2012	20:18	O. mykiss	27	Up	13	5	14.8
8-Apr-2012	7:58	O. mykiss	27	Down	13	5	15.4
8-Apr-2012	16:10	Largemouth Bass	53	Up	13	5	15.4
8-Apr-2012	22:21	O. mykiss	27	Up	13	5	15.4
9-Apr-2012	19:07	Fish Unknown	27	Up	12	5	15.7
10-Apr-2012	7:21	O. mykiss	25	Down	12	4	15.6
10-Apr-2012	7:26	O. mykiss	22	Up	12	4	15.6
10-Apr-2012	9:21	O. mykiss	30	Up	12	4	15.6
10-Apr-2012	11:38	O. mykiss	27	Down	12	4	15.6
10-Apr-2012	19:44	O. mykiss	23	Up	12	4	15.6
10-Apr-2012	20:41	O. mykiss	28	Up	12	4	15.6
11-Apr-2012	0:14	O. mykiss	23	Up	17	5	14.8
11-Apr-2012	2:38	O. mykiss	22	Up	17	5	14.8
11-Apr-2012	4:47	O. mykiss	25	Up	17	5	14.8
11-Apr-2012	6:31	O. mykiss	37	Down	17	5	14.8
11-Apr-2012	6:42	O. mykiss	39	Up	17	5	14.8
11-Apr-2012	7:14	Fish Probable	35	Down	17	5	14.8
11-Apr-2012	7:42	O. mykiss	28	Up	17	5	14.8
11-Apr-2012	7:43	Fish Probable	27	Down	17	5	14.8
11-Apr-2012	8:26	O. mykiss	30	Up	17	5	14.8
11-Apr-2012	8:54	O. mykiss	27	Down	17	5	14.8
11-Apr-2012	9:19	Fish Unknown	32	Down	17	5	14.8
11-Apr-2012	10:35	O. mykiss	27	Up	17	5	14.8
11-Apr-2012	12:07	O. mykiss	23	Down	17	5	14.8
11-Apr-2012	18:04	Fish Unknown	27	Up	17	5	14.8
11-Apr-2012	18:05	Fish Unknown	28	Down	17	5	14.8
11-Apr-2012	18:15	O. mykiss	30	Up	17	5	14.8
11-Apr-2012	19:27	O. mykiss	23	Up	17	5	14.8
12-Apr-2012	6:54	O. mykiss	23	Down	16	6	13.6
12-Apr-2012	7:15	O. mykiss	28	Down	16	6	13.6
12-Apr-2012	7:48	O. mykiss	32	Up	16	6	13.6
12-Apr-2012	10:11	O. mykiss	27	Up	16	6	13.6
12-Apr-2012	18:39	Fish Unknown	25	Up	16	6	13.6
12-Apr-2012	19:36	O. mykiss	32	Up	16	6	13.6
12-Apr-2012	20:28	O. mykiss	16	Up	16	6	13.6

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
12-Apr-2012	20:28	O. mykiss	27	Up	16	6	13.6
13-Apr-2012	6:59	O. mykiss	27	Down	26	309	12.2
14-Apr-2012	11:56	Fish Unknown	32	Up	26	70	12.7
14-Apr-2012	12:54	O. mykiss	28	Down	26	70	12.7
14-Apr-2012	13:54	O. mykiss	22	Down	26	70	12.7
14-Apr-2012	19:42	O. mykiss	19	Down	26	70	12.7
14-Apr-2012	19:44	O. mykiss	23	Up	26	70	12.7
14-Apr-2012	21:17	O. mykiss	25	Up	26	70	12.7
15-Apr-2012	4:42	O. mykiss	20	Up	24	10	14.0
15-Apr-2012	6:16	O. mykiss	34	Down	24	10	14.0
15-Apr-2012	6:31	O. mykiss	34	Up	24	10	14.0
15-Apr-2012	10:17	O. mykiss	37	Down	24	10	14.0
15-Apr-2012	19:11	O. mykiss	23	Down	24	10	14.0
15-Apr-2012	22:07	O. mykiss	30	Down	24	10	14.0
16-Apr-2012	6:49	O. mykiss	32	Down	24	5	15.1
16-Apr-2012	9:21	O. mykiss	16	Up	24	5	15.1
16-Apr-2012	20:06	O. mykiss	32	Down	24	5	15.1
16-Apr-2012	21:26	O. mykiss	32	Up	24	5	15.1
17-Apr-2012	6:01	O. mykiss	28	Down	22	5	16.5
17-Apr-2012	6:51	Fish Probable	28	Down	22	5	16.5
17-Apr-2012	7:37	O. mykiss	22	Up	22	5	16.5
17-Apr-2012	10:24	O. mykiss	27	Down	22	5	16.5
17-Apr-2012	19:17	Fish Unknown	28	Down	22	5	16.5
17-Apr-2012	19:33	Fish Unknown	32	Up	22	5	16.5
18-Apr-2012	6:09	O. mykiss	27	Down	21	6	17.3
18-Apr-2012	6:09	Fish Unknown	28	Up	21	6	17.3
18-Apr-2012	7:34	O. mykiss	30	Down	21	6	17.3
18-Apr-2012	7:47	O. mykiss	27	Up	21	6	17.3
18-Apr-2012	9:20	O. mykiss	25	Down	21	6	17.3
1-May-2012	17:28	Fish Probable	37	Up	16	2	17.2
2-May-2012	12:37	O. mykiss	30	Down	16	2	16.4
2-May-2012	12:58	Fish Probable	30	Up	16	2	16.4
4-May-2012	18:26	O. mykiss	30	Up	16	3	17.3
4-May-2012	19:02	O. mykiss	34	Up	16	3	17.3
4-May-2012	19:09	Fish Probable	30	Down	16	3	17.3
4-May-2012	19:31	Fish Probable	34	Up	16	3	17.3
4-May-2012	20:17	O. mykiss	30	Up	16	3	17.3
5-May-2012	5:39	Fish Probable	20	Down	14	3	17.9
5-May-2012	6:06	Fish Probable	27	Down	14	3	17.9
5-May-2012	6:34	Fish Probable	32	Down	14	3	17.9
5-May-2012	10:33	O. mykiss	34	Up	14	3	17.9
5-May-2012	11:13	O. mykiss	34	Up	14	3	17.9
5-May-2012	17:20	O. mykiss	30	Up	14	3	17.9
5-May-2012	20:11	O. mykiss	25	Up	14	3	17.9
5-May-2012	21:00	O. mykiss	32	Up	14	3	17.9
6-May-2012	5:53	Fish Probable	30	Down	13	3	18.5
6-May-2012	6:01	Fish Probable	30	Down	13	3	18.5
6-May-2012	6:12	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:13	Fish Probable	28	Down	13	3	18.5
6-May-2012	6:15	Fish Probable	28	Down	13	3	18.5
6-May-2012	6:15	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:26	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:28	Fish Probable	30	Down	13	3	18.5

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
6-May-2012	6:43	O. mykiss	34	Up	13	3	18.5
6-May-2012	6:44	Fish Probable	32	Down	13	3	18.5
6-May-2012	15:59	O. mykiss	30	Up	13	3	18.5
6-May-2012	19:28	O. mykiss	34	Up	13	3	18.5
6-May-2012	20:15	O. mykiss	28	Up	13	3	18.5
6-May-2012	23:30	O. mykiss	37	Up	13	3	18.5
7-May-2012	5:41	Fish Probable	25	Down	14	3	19.3
7-May-2012	6:04	O. mykiss	37	Up	14	3	19.3
7-May-2012	6:13	Fish Probable	25	Down	14	3	19.3
7-May-2012	6:26	Fish Probable	32	Down	14	3	19.3
7-May-2012	13:50	O. mykiss	35	Up	14	3	19.3
7-May-2012	18:03	O. mykiss	37	Up	14	3	19.3
7-May-2012	18:07	O. mykiss	34	Up	14	3	19.3
7-May-2012	20:09	O. mykiss	27	Up	14	3	19.3
7-May-2012	20:14	Fish Unknown	34	Up	14	3	19.3
8-May-2012	1:12	Fish Unknown	41	Up	13	3	19.6
8-May-2012	1:38	Fish Probable	30	Up	13	3	19.6
8-May-2012	1:58	Fish Probable	41	Up	13	3	19.6
8-May-2012	1:58	Fish Probable	30	Up	13	3	19.6
8-May-2012	1:59	Fish Unknown	39	Up	13	3	19.6
8-May-2012	2:10	Fish Probable	22	Up	13	3	19.6
8-May-2012	2:15	O. mykiss	39	Up	13	3	19.6
8-May-2012	2:21	Fish Probable	22	Down	13	3	19.6
8-May-2012	2:27	Fish Probable	41	Up	13	3	19.6
8-May-2012	4:14	O. mykiss	27	Up	13	3	19.6
8-May-2012	4:39	O. mykiss	41	Up	13	3	19.6
8-May-2012	5:35	Fish Probable	20	Up	13	3	19.6
8-May-2012	5:55	Fish Probable	23	Up	13	3	19.6
8-May-2012	12:05	Fish Unknown	34	Up	13	3	19.6
8-May-2012	17:12	Fish Unknown	28	Down	13	3	19.6
8-May-2012	17:22	Largemouth Bass	42	Up	13	3	19.6
8-May-2012	18:07	Fish Probable	34	Up	13	3	19.6
8-May-2012	19:05	O. mykiss	34	Up	13	3	19.6
8-May-2012	19:58	O. mykiss	32	Up	13	3	19.6
9-May-2012	1:00	O. mykiss	39	Up	12	3	20.2
9-May-2012	3:57	Fish Probable	23	Down	12	3	20.2
9-May-2012	4:14	O. mykiss	35	Up	12	3	20.2
9-May-2012	5:13	Fish Probable	22	Down	12	3	20.2
9-May-2012	5:56	Fish Probable	23	Up	12	3	20.2
9-May-2012	6:09	Fish Probable	22	Down	12	3	20.2
9-May-2012	15:16	Largemouth Bass	49	Down	12	3	20.2
9-May-2012	18:13	O. mykiss	34	Up	12	3	20.2
9-May-2012	18:54	Sunfish	39	Up	12	3	20.2
9-May-2012	19:02	O. mykiss	34	Up	12	3	20.2
9-May-2012	19:14	O. mykiss	30	Up	12	3	20.2
9-May-2012	20:09	Fish Probable	27	Up	12	3	20.2
9-May-2012	20:09	Fish Probable	25	Down	12	3	20.2
9-May-2012	20:11	Fish Probable	32	Up	12	3	20.2
9-May-2012	20:12	O. mykiss	30	Up	12	3	20.2
9-May-2012	20:14	O. mykiss	28	Up	12	3	20.2
10-May-2012	5:21	Fish Probable	27	Down	12	3	20.4
10-May-2012	5:45	O. mykiss	34	Up	12	3	20.4
10-May-2012	5:55	Fish Probable	27	Down	12	3	20.4

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
10-May-2012	12:24	O. mykiss	27	Up	12	3	20.4
10-May-2012	18:17	O. mykiss	30	Up	12	3	20.4
10-May-2012	18:28	O. mykiss	35	Up	12	3	20.4
10-May-2012	20:08	O. mykiss	28	Up	12	3	20.4
11-May-2012	5:11	Fish Probable	27	Down	12	3	20.0
11-May-2012	5:39	O. mykiss	28	Up	12	3	20.0
11-May-2012	5:42	Fish Probable	28	Down	12	3	20.0
11-May-2012	6:15	Fish Probable	23	Down	12	3	20.0
11-May-2012	6:19	Fish Probable	23	Down	12	3	20.0
11-May-2012	17:16	O. mykiss	34	Up	12	3	20.0
11-May-2012	17:46	O. mykiss	28	Down	12	3	20.0
11-May-2012	17:52	O. mykiss	37	Up	12	3	20.0
11-May-2012	19:04	O. mykiss	37	Up	12	3	20.0
11-May-2012	20:05	O. mykiss	32	Up	12	3	20.0
11-May-2012	20:26	O. mykiss	34	Up	12	3	20.0
11-May-2012	20:54	O. mykiss	27	Up	12	3	20.0
11-May-2012	20:57	Fish Probable	22	Up	12	3	20.0
11-May-2012	20:57	Fish Probable	20	Down	12	3	20.0
11-May-2012	20:59	O. mykiss	28	Up	12	3	20.0
12-May-2012	5:16	Fish Probable	22	Down	12	3	19.9
12-May-2012	6:53	Fish Probable	23	Down	12	3	19.9
12-May-2012	18:24	O. mykiss	34	Up	12	3	19.9
12-May-2012	19:01	O. mykiss	34	Up	12	3	19.9
12-May-2012	19:35	O. mykiss	34	Up	12	3	19.9
12-May-2012	20:30	O. mykiss	34	Up	12	3	19.9
12-May-2012	20:35	O. mykiss	32	Up	12	3	19.9
12-May-2012	20:36	Fish Probable	32	Down	12	3	19.9
12-May-2012	20:40	O. mykiss	34	Up	12	3	19.9
13-May-2012	5:18	Fish Probable	32	Down	12	3	20.0
13-May-2012	5:36	Fish Probable	23	Down	12	3	20.0
13-May-2012	5:40	Fish Probable	28	Down	12	3	20.0
13-May-2012	5:47	Fish Probable	28	Down	12	3	20.0
13-May-2012	9:11	O. mykiss	34	Up	12	3	20.0
13-May-2012	9:14	Fish Probable	35	Down	12	3	20.0
13-May-2012	12:22	O. mykiss	30	Up	12	3	20.0
13-May-2012	17:26	O. mykiss	32	Up	12	3	20.0
13-May-2012	18:54	O. mykiss	25	Up	12	3	20.0
13-May-2012	20:22	Fish Probable	28	Up	12	3	20.0
13-May-2012	20:22	Fish Probable	23	Down	12	3	20.0
13-May-2012	20:23	O. mykiss	28	Up	12	3	20.0
13-May-2012	20:34	O. mykiss	28	Up	12	3	20.0
13-May-2012	20:37	O. mykiss	27	Up	12	3	20.0
13-May-2012	22:52	O. mykiss	35	Up	12	3	20.0
14-May-2012	5:02	Fish Probable	20	Down	11	3	20.1
14-May-2012	5:12	Fish Probable	37	Down	11	3	20.1
14-May-2012	5:32	O. mykiss	30	Up	11	3	20.1
14-May-2012	6:02	O. mykiss	27	Up	11	3	20.1
14-May-2012	7:14	O. mykiss	34	Up	11	3	20.1
14-May-2012	11:20	O. mykiss	30	Up	11	3	20.1
14-May-2012	20:25	Fish Probable	34	Up	11	3	20.1
14-May-2012	20:25	Fish Probable	27	Down	11	3	20.1
14-May-2012	20:27	O. mykiss	30	Up	11	3	20.1
15-May-2012	5:35	O. mykiss	34	Up	11	2	20.0

Date	Time (24h)	Fish Category	Total Length (cm)	Direction	Mean Daily Discharge (cfs)	Mean Daily Turbidity (NTU)	Mean Daily Temperature (°C)
15-May-2012	5:55	Fish Probable	23	Down	11	2	20.0
15-May-2012	6:23	O. mykiss	30	Up	11	2	20.0
15-May-2012	6:25	Fish Probable	30	Down	11	2	20.0
15-May-2012	19:54	Fish Probable	27	Up	11	2	20.0
15-May-2012	20:22	O. mykiss	34	Up	11	2	20.0
15-May-2012	21:28	O. mykiss	34	Up	11	2	20.0
15-May-2012	21:28	Fish Probable	23	Down	11	2	20.0
15-May-2012	21:32	O. mykiss	27	Up	11	2	20.0
16-May-2012	5:49	O. mykiss	30	Up	11	2	21.2
16-May-2012	13:38	O. mykiss	27	Down	11	2	21.2
16-May-2012	19:56	O. mykiss	30	Up	11	2	21.2
16-May-2012	22:24	O. mykiss	27	Up	11	2	21.2
16-May-2012	22:29	O. mykiss	23	Up	11	2	21.2
17-May-2012	14:54	Fish Probable	20	Down	10	2	21.5
17-May-2012	20:39	O. mykiss	23	Up	10	2	21.5
17-May-2012	20:42	Fish Probable	23	Up	10	2	21.5
17-May-2012	20:42	Fish Probable	27	Down	10	2	21.5
17-May-2012	20:44	O. mykiss	34	Up	10	2	21.5
17-May-2012	20:56	Fish Probable	22	Up	10	2	21.5
17-May-2012	20:57	O. mykiss	30	Up	10	2	21.5
18-May-2012	5:17	Fish Probable	20	Down	10	2	20.6
18-May-2012	6:34	Fish Probable	27	Down	10	2	20.6
18-May-2012	19:49	O. mykiss	34	Up	10	2	20.6
18-May-2012	20:54	O. mykiss	23	Up	10	2	20.6
18-May-2012	21:39	O. mykiss	20	Up	10	2	20.6
18-May-2012	23:05	Fish Probable	41	Up	10	2	20.6
18-May-2012	23:06	Fish Probable	27	Down	10	2	20.6
18-May-2012	23:08	O. mykiss	34	Up	10	2	20.6
18-May-2012	23:08	Fish Probable	30	Down	10	2	20.6
18-May-2012	23:23	O. mykiss	37	Up	10	2	20.6
19-May-2012	4:57	Fish Probable	23	Down	10	3	20.4
19-May-2012	5:45	Fish Probable	34	Down	10	3	20.4
19-May-2012	5:47	O. mykiss	27	Up	10	3	20.4
19-May-2012	9:35	Fish Unknown	27	Up	10	3	20.4
19-May-2012	20:36	O. mykiss	37	Up	10	3	20.4
19-May-2012	23:07	O. mykiss	28	Up	10	3	20.4
20-May-2012	5:38	O. mykiss	30	Up	10	3	21.3
20-May-2012	6:14	Fish Probable	27	Down	10	3	21.3
20-May-2012	6:49	Fish Probable	27	Down	10	3	21.3
20-May-2012	14:04	Fish Unknown	34	Down	10	3	21.3
20-May-2012	14:53	Fish Unknown	28	Down	10	3	21.3
20-May-2012	14:57	O. mykiss	27	Up	10	3	21.3
20-May-2012	20:38	O. mykiss	32	Up	10	3	21.3
20-May-2012	21:22	O. mykiss	34	Up	10	3	21.3
21-May-2012	0:08	O. mykiss	34	Up	9	3	21.8
21-May-2012	5:13	Fish Probable	23	Down	9	3	21.8
21-May-2012	5:38	O. mykiss	34	Up	9	3	21.8
21-May-2012	5:54	O. mykiss	32	Up	9	3	21.8
21-May-2012	20:37	Fish Probable	34	Up	9	3	21.8
21-May-2012	20:40	O. mykiss	27	Up	9	3	21.8
22-May-2012	20:55	O. mykiss	37	Up	8	3	22.2
25-May-2012	20:54	Fish Probable	27	Up	7	3	20.4
10-Jun-2012	4:54	O. mykiss	34	Up	2	4	21.5

Appendix 14. Descaling references, species, criteria, source of descaling, and amount of descaling for comparison to measured descaling from Robles Fish Facility monitoring and evaluations during 2011.

			Source of Descaling							
Citation	Species	Descaling Method or Criteria	Natural	Test Fish Transport	Passage Facility	Trap	Handling	Percent Descaled	Mean Total Descaling	Sample Size
Wunderlich and Dilley 1986	Steelhead	3 categories[a]	X	X		Floating net trap	X	L/M/H 12.5/6/2.1		91
Dilley and Wunderlich 1992	Chinook	2 categories[b]	X			Scoop trap	X	P/D 20/17		59
	Coho	2 categories[b]	X			Scoop trap	X	P/D 18/5		104
Hawkes et al. 1991	Steelhead	% of total	X		Dam facility	Facility trap	X		8.7	26,000
Neitzel et al. 1990	Steelhead	16%[c]	X	X	Drum screens	Fyke net	X	0.3		341
Mensik et al. 2006	Steelhead (wild)	20%[d]	X		Dam facility	Facility trap	X	2.2		10,786
	Steelhead (hatchery)	20%	X		Dam facility	Facility trap	X	3.2		32,192
Axel et al. 2011	Steelhead	16%	X		Dam facility	Facility trap	X	7.3		1,155
Fish Passage Center[e]	Steelhead	20%	X		Dam facility	Facility trap	X	2.1		73,091
Fish Passage Center[e]	Steelhead	20%	X			Scoop trap	X	6.9		19,746
Fish Passage Center[e]	Steelhead	20%	X			Screw trap	X	4.9		27,120
Hostetter et al. 2011	Steelhead	3 categories[f]	X		Dam facility	Facility trap	X	</5-20/> 66/30/4		22,451
CMWD 2011	Steelhead	% of total	X		V-screen and ladder	Weir fence trap	X	0.0[g]	3.4	25

[a]Descaling was L = low at <10%, M = moderate from 10-50%, and H = high at >50%.
[b]Descaling was P = partial at 3-16% and D = descaled at >16%.
[c]Criterion for 16% was if any two of five zones on one side of a smolt had at least 40% descaling. This would equal a total descaling of 8%.
[d]Criterion for 20% was based on any two of five zones on one side of a smolt had at least 50% descaling. This is a total descaling of 10%.
[e]Data was acquired from the Fish Passage Center data base for the 2009-2012 smolt migration years (www.fpc.org).
[f]Descaling was categorized into <5%, 5-20%, and >20%.
[g]Percentage was standardized to be comparable to the 20% criterion.

Appendix 15. Monthly flow summary for Robles Fish Facility, water year 2011-2012.

Ventura River Flow Assessment
Water Year 2011 - 2012

Jul-11	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	12	3	15	2.8	24	24	0	24	0
2	12	3	15	2.7	23	23	0	23	0
3	11	3	14	2.7	22	22	0	22	0
4	11	3	14	2.6	22	22	0	22	0
5	11	3	14	2.5	19	19	0	19	0
6	10	3	13	2.5	19	19	0	19	0
7	10	3	13	2.7	21	21	0	21	0
8	10	3	13	2.7	21	21	0	21	0
9	10	3	13	2.6	21	21	0	21	0
10	10	3	13	2.7	22	22	0	22	0
11	10	3	13	2.7	22	22	0	22	0
12	10	3	13	2.8	22	22	0	22	0
13	11	3	14	2.7	22	22	0	22	0
14	11	3	14	2.9	24	24	0	24	0
15	11	3	14	3.1	26	26	0	26	0
16	11	3	14	3.0	24	24	0	24	0
17	11	2	13	2.9	23	23	0	23	0
18	10	2	12	2.6	21	21	0	21	0
19	9	2	12	2.4	17	17	0	17	0
20	9	2	11	2.3	15	15	0	15	0
21	9	2	11	2.3	15	15	0	15	0
22	9	2	11	2.4	17	17	0	17	0
23	9	2	11	2.4	17	17	0	17	0
24	9	2	11	2.3	15	15	0	15	0
25	8	2	10	2.1	11	11	0	11	0
26	8	2	10	3.0	10	10	0	10	0
27	8	2	10	2.0	10	10	0	10	0
28	8	2	10	2.0	10	10	0	10	0
29	8	2	10	1.9	7	7	0	7	0
30	8	2	10	2.0	10	10	0	10	0
31	8	2	10	1.9	7	7	0	7	0
Totals	301	77	379		558	558	0	558	0

(pink) The computer had a power failure. No data collected assume 10 CFS
(grey) Tubing partially plugged values adjusted

Ventura River Flow Assessment
Water Year 2011 - 2012

Aug-11	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	7	2	9	1.9	7	7	0	7	0
2	7	2	9	1.8	5	5	0	5	0
3	7	2	8	1.7	4	4	0	4	0
4	7	2	8	1.8	5	5	0	5	0
5	7	2	8	1.7	4	4	0	4	0
6	7	2	8	1.7	4	4	0	4	0
7	7	2	8	1.7	4	4	0	4	0
8	7	2	8	1.6	4	4	0	4	0
9	7	2	8	1.6	4	4	0	4	0
10	7	2	8	1.6	4	4	0	4	0
11	7	1	9	1.7	4	4	0	4	0
12	7	2	9	1.7	4	4	0	4	0
13	7	1	9	1.7	4	4	0	4	0
14	7	1	8	1.7	4	4	0	4	0
15	7	1	8	1.6	4	4	0	4	0
16	7	1	8	1.5	3	3	0	3	0
17	7	1	8	1.5	3	3	0	3	0
18	6	1	8	1.4	3	3	0	3	0
19	6	1	8	1.5	3	3	0	3	0
20	7	1	8	1.5	7	7	0	7	0
21	7	1	8	1.7	7	7	0	7	0
22	7	1	8	1.0	6	6	0	6	0
23	7	1	8	0.1	5	5	0	5	0
24	6	1	7	0.2	5	5	0	5	0
25	6	1	7	0.2	4	4	0	4	0
26	6	1	7	0.2	4	4	0	4	0
27	6	1	7	0.2	4	4	0	4	0
28	6	1	7	0.2	3	3	0	3	0
29	5	1	7	0.1	3	3	0	3	0
30	5	1	7	0.1	2	2	0	2	0
31	5	1	7	0.1	4	4	0	4	0
Totals	202	42	245		130	130	0	130	0

(shaded) Tubing partially plugged values adjusted

Ventura River Flow Assessment
Water Year 2011 - 2012

Sep-11	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	5	1	7	0	4	4	0	4	0
2	5	1	6	0	3	3	0	3	0
3	5	1	6	0	2	2	0	2	0
4	5	1	6	0	2	2	0	2	0
5	5	1	6	0	2	2	0	2	0
6	5	1	6	0	1	1	0	1	0
7	5	1	6	0	1	1	0	1	0
8	5	1	6	0	0	0	0	0	0
9	5	1	7	0	0	0	0	0	0
10	5	1	6	0	0	0	0	0	0
11	6	1	7	0	2	2	0	2	0
12	6	1	7	0	3	3	0	3	0
13	6	1	7	0	2	2	0	2	0
14	6	1	7	0	2	2	0	2	0
15	6	1	7	0	2	2	0	2	0
16	6	1	7	0	2	2	0	2	0
17	6	1	7	0	2	2	0	2	0
18	6	1	7	0	2	2	0	2	0
19	5	1	6	0	2	2	0	2	0
20	5	1	6	0	2	2	0	2	0
21	5	1	6	0	2	2	0	2	0
22	5	1	6	0	3	3	0	3	0
23	5	1	6	0	2	2	0	2	0
24	5	1	6	0	3	3	0	3	0
25	5	1	6	0	4	4	0	4	0
26	5	1	7	0	4	4	0	4	0
27	5	1	6	0	3	3	0	3	0
28	5	1	6	0	2	2	0	2	0
29	5	1	6	0	2	2	0	2	0
30	5	1	6	1	2	2	0	2	0
Totals	155	37	192		64	64	0	64	0

Ventura River Flow Assessment
Water Year 2011 - 2012

Oct-11	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	4	1	5	1	3	3	0	3	0
2	4	1	5	1	3	3	0	3	0
3	4	1	5	1	2	2	0	2	0
4	4	1	5	1	3	3	0	3	0
5	8	2	10	2	10	10	0	10	0
6	6	1	7	1	10	10	0	10	0
7	5	1	6	1	7	7	0	7	0
8	5	1	6	1	7	7	0	7	0
9	5	1	6	1	7	7	0	7	0
10	5	1	6	1	6	6	0	6	0
11	5	1	6	1	6	6	0	6	0
12	4	1	5	1	6	6	0	6	0
13	4	1	5	1	5	5	0	5	0
14	4	1	5	1	5	5	0	5	0
15	4	1	5	1	6	6	0	6	0
16	4	1	5	1	6	6	0	6	0
17	4	1	5	1	5	5	0	5	0
18	4	1	5	1	4	4	0	4	0
19	4	1	5	1	3	3	0	3	0
20	4	1	5	1	0	0	0	0	0
21	4	1	5	1	0	0	0	0	0
22	4	1	5	1	0	0	0	0	0
23	4	1	5	1	0	0	0	0	0
24	4	1	5	1	0	0	0	0	0
25	4	1	5	1	0	0	0	0	0
26	4	1	5	1	0	0	0	0	0
27	4	1	5	1	0	0	0	0	0
28	4	1	5	1	0	0	0	0	0
29	4	1	5	1	0	0	0	0	0
30	4	1	5	1	0	0	0	0	0
31	4	1	5	1.0	0	0	0	0	0
Totals	135	34	168		102	102	0	102	0

Ventura River Flow Assessment
Water Year 2011 - 2012

Nov-11	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	4	1	5	1.0	0	0	0	0	0
2	4	1	5	1.0	0	0	0	0	0
3	4	1	5	1.0	0	0	0	0	0
4	5	1	6	1.1	0	0	0	0	0
5	5	1	6	1.1	0	0	0	0	0
6	5	2	7	1.2	0	0	0	0	0
7	5	1	7	1.2	0	0	0	0	0
8	5	1	7	1.1	0	0	0	0	0
9	6	1	7	1.2	0	0	0	0	0
10	5	1	7	1.2	0	0	0	0	0
11	5	1	7	1.2	15	15	0	15	0
12	8	2	10	1.6	20	20	0	20	0
13	7	2	8	1.4	18	18	0	18	0
14	6	2	8	1.3	14	14	0	14	0
15	6	2	8	1.3	10	10	0	10	0
16	6	2	8	1.4	10	10	0	10	0
17	6	2	8	1.4	10	10	0	10	0
18	6	2	8	1.3	10	10	0	10	0
19	6	2	8	1.3	10	10	0	10	0
20	11	3	14	2.0	10	10	0	10	0
21	10	2	12	2.2	10	10	0	10	0
22	9	2	11	1.8	10	10	0	10	0
23	9	2	11	1.7	10	10	0	10	0
24	9	2	10	1.7	10	10	0	10	0
25	9	2	10	1.6	10	10	0	10	0
26	8	2	10	1.6	10	10	0	10	0
27	8	2	9	1.6	10	10	0	10	0
28	8	2	10	1.5	10	10	0	10	0
29	8	2	10	1.4	10	10	0	10	0
30	9	2	11	1.6	10	10	0	10	0
Totals	204	47	251		226	226	0	226	0

Ventura River Flow Assessment
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	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows					Robles Facility Daily Flows			
Dec-11	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck. (cfsd)	Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	Fishway Ladder (cfsd)	VRNMO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)	Robles Diversion (AF)
1	8	2	10	1.6	10	10	0	10	0
2	8	2	9	1.5	10	10	0	10	0
3	7	2	9	1.5	10	10	0	10	0
4	7	2	9	1.5	10	10	0	10	0
5	7	2	9	1.4	10	10	0	10	0
6	7	2	9	1.4	10	10	0	10	0
7	7	2	9	1.5	10	10	0	10	0
8	7	2	9	1.5	10	10	0	10	0
9	7	2	9	1.5	10	10	0	10	0
10	7	2	8	1.5	10	10	0	10	0
11	7	2	8	1.5	10	10	0	10	0
12	7	2	9	1.6	10	10	0	10	0
13	7	2	9	1.6	10	10	0	10	0
14	7	2	9	1.5	10	10	0	10	0
15	7	2	9	1.6	10	10	0	10	0
16	8	2	9	1.5	10	10	0	10	0
17	7	2	9	1.5	10	10	0	10	0
18	7	2	9	1.5	10	10	0	10	0
19	7	2	9	1.5	10	10	0	10	0
20	7	2	9	1.5	10	10	0	10	0
21	7	2	9	1.6	10	10	0	10	0
22	7	2	9	1.5	10	10	0	10	0
23	7	2	8	1.5	10	10	0	10	0
24	7	2	8	1.5	10	10	0	10	0
25	7	2	8	1.5	10	10	0	10	0
26	7	2	8	1.5	10	10	0	10	0
27	7	2	8	1.5	10	10	0	10	0
28	7	2	8	1.5	10	10	0	10	0
29	7	2	8	1.5	10	10	0	10	0
30	6	2	8	1.4	10	10	0	10	0
31	6	2	8	1.4	10	10	0	10	0
Totals	217	52	269		310	310	0	310	0

Ventura River Flow Assessment Water Year 2011 - 2012									
	(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-12	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	6	2	8	1.4	10	10	0	10	0
2	6	2	8	1.4	10	10	0	10	0
3	6	2	8	1.4	10	10	0	10	0
4	6	2	8	1.6	10	10	0	10	0
5	6	2	8	1.6	10	10	0	10	0
6	6	2	8	1.6	10	10	0	10	0
7	6	2	8	1.7	10	10	0	10	0
8	6	2	8	1.6	10	10	0	10	0
9	6	2	8	1.6	10	10	0	10	0
10	6	2	8	1.6	10	10	0	10	0
11	6	2	8	1.7	9	9	0	9	0
12	6	2	8	1.7	9	9	0	9	0
13	6	2	8	1.7	9	9	0	9	0
14	6	2	8	1.7	9	9	0	9	0
15	6	2	8	1.8	9	9	0	9	0
16	6	2	8	1.7	9	9	0	9	0
17	6	2	8	1.8	9	9	0	9	0
18	6	2	8	1.8	9	9	0	9	0
19	6	2	8	1.7	9	9	0	9	0
20	6	2	8	1.7	9	9	0	9	0
21	7	2	9	1.9	9	9	0	9	0
22	6	2	7	2.0	9	9	0	9	0
23	7	2	9	2.0	9	9	0	9	0
24	6	2	8	2.0	10	10	0	10	0
25	6	2	7	1.9	11	11	0	11	0
26	6	2	7	1.9	11	11	0	11	0
27	5	2	7	1.9	11	11	0	11	0
28	5	2	7	1.8	10	10	0	10	0
29	5	2	7	1.8	10	10	0	10	0
30	5	2	7	1.8	10	10	0	10	0
31	5	2	7	1.8	10	10	0	10	0
Totals	184	51	235		299	299	0	299	0

Ventura River Flow Assessment
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Feb-12	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	5	2	7	1.8	10	10	0	10	0
2	5	2	7	1.8	10	10	0	10	0
3	5	2	6	1.7	10	10	0	10	0
4	5	1	6	1.6	9	9	0	9	0
5	5	1	6	1.6	9	9	0	9	0
6	5	2	6	1.6	9	9	0	9	0
7	5	2	6	1.6	10	10	0	10	0
8	5	1	6	1.7	10	10	0	10	0
9	5	1	6	1.7	10	10	0	10	0
10	5	1	6	1.6	9	9	0	9	0
11	5	1	6	1.6	9	9	0	9	0
12	5	1	6	1.7	9	9	0	9	0
13	5	1	6	1.8	10	10	0	10	0
14	5	2	6	1.7	10	10	0	10	0
15	5	1	6	1.7	10	10	0	10	0
16	5	1	6	1.6	9	9	0	9	0
17	5	1	6	1.6	9	9	0	9	0
18	5	1	6	1.6	9	9	0	9	0
19	5	1	6	1.6	9	9	0	9	0
20	5	1	6	1.6	9	9	0	9	0
21	5	1	6	1.6	9	9	0	9	0
22	5	1	6	1.6	9	9	0	9	0
23	4	1	6	1.5	8	8	0	8	0
24	4	1	5	1.4	7	7	0	7	0
25	4	1	6	1.4	7	7	0	7	0
26	4	1	5	1.4	7	7	0	7	0
27	4	1	5	1.5	8	8	0	8	0
28	4	1	6	1.5	8	8	0	8	0
29	4	1	6	1.5	8	8	0	8	0
Totals	130	40	169		255	247	0	247	0

Ventura River Flow Assessment Water Year 2011 - 2012									
	(1)	(2)	(1)+(2)		(3)	(4)	(5)	(4)+(5)	(5) X 1.98
	Source Stream Daily Flows				Robles Facility Daily Flows				
	Matilija Ck	North Fork	Sum of Creek	Forebay	Fishway	VRNMO	Diversion	Total Inflow	Robles
Mar-12	D/S Dam	Matilija Ck.	Flows	Avg. Depth	Ladder	Weir	Canal		Diversion
	(cfsd)	(cfsd)	(cfsd)	(ft)	(cfsd)	(cfsd)	(cfsd)	(cfsd)	(AF)
1	5	1	6	1.6	9	9	0	9	0
2	4	1	5	1.6	9	9	0	9	0
3	4	1	5	1.5	8	8	0	8	0
4	4	1	5	1.4	7	7	0	7	0
5	4	1	5	1.3	6	6	0	6	0
6	4	1	5	1.3	7	7	0	7	0
7	4	1	5	1.4	7	7	0	7	0
8	4	1	5	1.4	7	7	0	7	0
9	4	1	5	1.4	7	7	0	7	0
10	4	1	5	1.4	7	7	0	7	0
11	4	1	5	1.4	7	7	0	7	0
12	4	1	5	1.3	7	7	0	7	0
13	4	1	5	1.3	6	6	0	6	0
14	4	1	5	1.3	7	7	0	7	0
15	4	1	5	1.4	7	7	0	7	0
16	4	1	5	1.5	8	8	0	8	0
17	21	15	36	2.5	16	16	3	19	6
18	13	15	28	3.1	21	21	3	24	6
19	10	14	24	2.7	17	17	0	17	0
20	9	7	17	2.4	16	16	0	16	0
21	8	2	9		14	14	0	14	0
22	8	2	9		13	13	0	13	0
23	7	2	9		13	13	0	13	0
24	7	2	9		13	13	0	13	0
25	14	8	22		20	20	0	20	0
26	17	8	25		24	24	0	24	0
27	13	4	17		22	22	0	22	0
28	11	3	14		20	20	0	20	0
29	11	3	14		19	19	0	19	0
30	10	2	12		18	18	0	18	0
31	10	2	12		17	17	0	17	0
Totals	230	105	335		374	374	6	380	12
	Data loss due to computer failure								

Ventura River Flow Assessment
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Apr-12	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	9	2	12		17	17	0	17	0
2	8	2	10		16	16	0	16	0
3	8	2	10		15	15	0	15	0
4	8	2	9		15	15	0	15	0
5	7	2	9		14	14	0	14	0
6	7	2	8		14	14	0	14	0
7	6	2	8		13	13	0	13	0
8	6	2	8		13	13	0	13	0
9	6	2	7		12	12	0	12	0
10	6	2	7		12	12	0	12	0
11	9	3	12		17	17	0	17	0
12	8	2	10		16	16	0	16	0
13	22	46	68		26	26	27	53	53
14	24	60	84		26	26	11	37	22
15	17	59	76		24	24	0	24	0
16	14	26	40		24	24	0	24	0
17	12	3	15		22	22	0	22	0
18	11	3	14		21	21	0	21	0
19	11	2	13		20	20	0	20	0
20	10	2	12		19	19	0	19	0
21	9	2	11		18	18	0	18	0
22	9	2	11		18	18	0	18	0
23	9	2	11		18	18	0	18	0
24	9	2	11		18	18	0	18	0
25	8	2	10		18	18	0	18	0
26	9	2	11		18	18	0	18	0
27	8	2	10		17	17	0	17	0
28	7	2	9		16	16	0	16	0
29	7	2	9		15	15	0	15	0
30	7	2	8		15	15		15	0
Totals	289	243	532		527	527	38	565	75

Data loss due to computer failure

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May-12	(1) Matilija Ck D/S Dam (cfsd)	(2) North Fork Matilija Ck. (cfsd)	(1)+(2) Sum of Creek Flows (cfsd)	Forebay Avg. Depth (ft)	(3) Fishway Ladder (cfsd)	(4) VRNMO Weir (cfsd)	(5) Diversion Canal (cfsd)	(4)+(5) Total Inflow (cfsd)	(5) X 1.98 Robles Diversion (AF)
	Source Stream Daily Flows				Robles Facility Daily Flows				
1	7	2	9		16	16	0	16	0
2	7	2	9		16	16	0	16	0
3	7	2	9		16	16	0	16	0
4	7	2	8		16	16	0	16	0
5	7	2	8		14	14	0	14	0
6	6	2	8		13	13	0	13	0
7	6	1	7		14	14	0	14	0
8	5	1	7		13	13	0	13	0
9	5	1	6		12	12	0	12	0
10	5	1	6		12	12	0	12	0
11	5	1	6		12	12	0	12	0
12	5	1	6		12	12	0	12	0
13	5	1	6		12	12	0	12	0
14	5	1	6		11	11	0	11	0
15	5	1	6		11	11	0	11	0
16	4	1	6		11	11	0	11	0
17	4	1	5		10	10	0	10	0
18	4	1	5		10	10	0	10	0
19	4	1	5		10	10	0	10	0
20	4	1	5		10	10	0	10	0
21	4	1	4		9	9	0	9	0
22	3	1	4		8	8	0	8	0
23	3	1	4		8	8	0	8	0
24	3	1	4		7	7	0	7	0
25	3	1	4		7	7	0	7	0
26	3	1	4		7	7	0	7	0
27	3	1	4		7	7	0	7	0
28	3	1	4		7	7	0	7	0
29	3	1	3		6	6	0	6	0
30	3	1	3		6	6	0	6	0
31	3	1			6	6	0	6	0
Totals	137	38	171		329	329	0	329	0

Data loss due to computer failure

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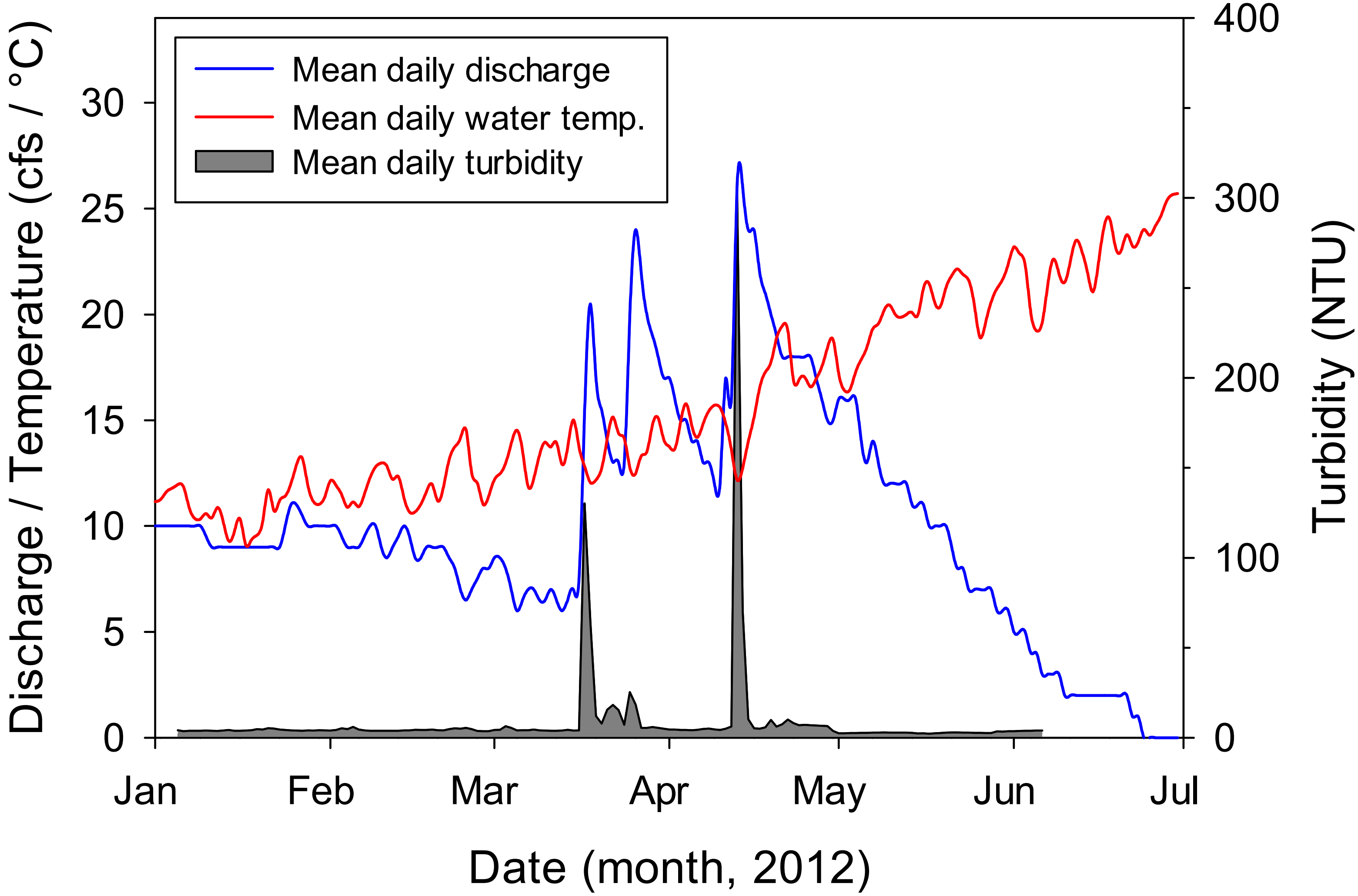
	(1)	(2)	(1)+(2)			(3)	(4)	(5)	(4)+(5)		(5) X 1.98
	Source Stream Daily Flows					Robles Facility Daily Flows					
Jul-12	Matilija Ck D/S Dam (cfsd)	North Fork Matilija Ck. (cfsd)	Sum of Creek Flows (cfsd)		Forebay Avg. Depth (ft)	Fishway Ladder (cfsd)	VRN MO Weir (cfsd)	Diversion Canal (cfsd)	Total Inflow (cfsd)		Robles Diversion (AF)
1	1.4	0.0	1.4		0.5	0	0	0	0		0
2	1.4	0.5	1.9		0.5	0	0	0	0		0
3	1.5	0.5	2.0		0.4	0	0	0	0		0
4	1.4	0.5	1.9		0.5	0	0	0	0		0
5	1.4	0.5	1.9		0.4	0	0	0	0		0
6	1.3	0.5	1.8		0.5	0	0	0	0		0
7	1.3	0.5	1.8		0.3	0	0	0	0		0
8	1.2	0.4	1.6		0.2	0	0	0	0		0
9	1.0	0.4	1.4		0.2	0	0	0	0		0
10	1.0	0.4	1.4		0.2	0	0	0	0		0
11	1.1	0.4	1.5		0.2	0	0	0	0		0
12	1.1	0.4	1.5		0.2	0	0	0	0		0
13	1.1	0.4	1.5		0.2	0	0	0	0		0
14	1.0	0.4	1.4		0.2	0	0	0	0		0
15	1.0	0.4	1.4		0.2	0	0	0	0		0
16	1.0	0.4	1.4		0.2	0	0	0	0		0
17	1.0	0.5	1.5		0.2	0	0	0	0		0
18	1.0	0.5	1.5		0.1	0	0	0	0		0
19	1.1	0.4	1.5		0.1	0	0	0	0		0
20	1.0	0.4	1.4		0.1	0	0	0	0		0
21	1.0	0.4	1.3		0.1	0	0	0	0		0
22	1.0	0.4	1.4		0.1	0	0	0	0		0
23	1.0	0.4	1.4		0.1	0	0	0	0		0
24	1.1	0.4	1.5		0.1	0	0	0	0		0
25	1.0	0.4	1.4		0.1	0	0	0	0		0
26	0.9	0.4	1.3		0.1	0	0	0	0		0
27	0.9	0.4	1.3		0.1	0	0	0	0		0
28	0.8	0.4	1.2		0.1	0	0	0	0		0
29	0.8	0.4	1.2		0.1	0	0	0	0		0
30	0.8	0.4	1.2		0.1	0	0	0	0		0
31	0.8	0.4	1.2		0.1	0	0	0	0		0
Totals	33	13	46			0	0	0	0		0



Appendix 16. Mean daily discharge, water temperature, and turbidity from the Robles Fish Facility during the fish passage season.