SANTA CLARA VALLEY WATER DISTRICT

MASSON FISHWAY 2007-2008 MONITORING REPORT AND ALAMITOS AND MASSON FISHWAY 2003-2008 SUMMARY REPORT

Project No. 30102001

Prepared by:

Jason Nishijima
Lisa Porcella
David Salsbery

Guadalupe Watershed Program Support Unit

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I. PROJECT BACKROUND

Construction of the Alamitos Fishway on Guadalupe River was completed in November of 1999 and the Masson Fishway on Guadalupe Creek was completed in October of 2000. In the Final Mitigated Negative Declaration for the Masson Fishway dated February 1999 it was agreed that the Masson and Alamitos Fishways be monitored for five years post construction to assess the effectiveness of fish passage through both facilities.

Steelhead in the Central California Coast Distinct Population Segment (formerly Evolutionarily Significant Unit) were listed as threatened by the National Marine Fisheries Service in 1997. Due to their protected status the Santa Clara Valley Water District decided to employ a noninvasive means of documenting passage through the fishways. The equipment chosen to accomplish the task was the Vaki Riverwatcher, a computer based fishcounter which employs scanner plates and a digital camera to capture digital photos and silhouette images of fishes as they pass between the plates. The fishcounter provides information on the occurrence and timing of fish migration both upstream and downstream.

The Masson Fishway is located 22 miles upstream of the South San Francisco Bay on Guadalupe Creek in San Jose, California. This fishway is approximately 2 miles upstream of the Alamitos Fishway on Guadalupe River. Installation of the Masson and Alamitos Fishways has opened up an additional 17 miles of upstream habitat for migrating fish (Figure 1). The fishcounter was deployed in the Alamitos Fishway on the Guadalupe River for three monitoring seasons (years 1-3) from 2003 to 2006. In 2006-08, years 4 and 5, the fishcounter was placed in the Masson Fishway. The data collected at both facilities confirm usage of the fish passage facilities over a 5 year period under varying flow conditions (Figure 2).

Documentation of anadromous fish passage through the Masson Fishway confirmed seasonal continuity of fish passage in the Guadalupe system from the San Francisco Bay to Masson Dam. This report details the results of fish passage analysis at the Masson Fishway during the 2007-2008 migration and summarizes the results for all 5 years of monitoring.

II. METHODS

On October 22, 2007 the fishcounter was installed in the Masson Fishway for a second season. This was the fifth and final season of monitoring for both fishways. As was done at the Alamitos Fishway, District staff designed and manufactured a housing which enabled the counting device to fit directly into one of the existing fishway panels at the Masson Ladder.

The counter itself is a rectangular shaped unit which is completely submerged within the fishway. Fish are directed through the counter opening which is lined with infrared light emitting diodes. When a fish swims through the counter and breaks the plane of light beams, the fish is scanned and a resulting silhouette image is sent to the on-site computer. Other information recorded as the fish passes includes: the speed the fish was traveling, the direction the fish was moving (upstream vs. downstream), the body

depth of the passing fish (for depth to length ratios), along with the date and time. Fish moving in the upstream direction trigger an underwater black and white digital camera which takes up to 5 digital photos after each upstream passage of fish. This enables the user to scan through the images to confirm the presence of a fish and potentially identify the species. All of the data collected by the fishcounter is stored by the attached on-site computer.

The fishcounter structure has been altered over the years as field evaluations identified potential improvements. Initially, the panel was predominantly solid, with small metal grates to allow some flow through the weir separate from the fishcounter passage. A majority of the flow was forced through the counter opening (Figure 3). It was determined that the initial setup was not effective for all flows encountered at the Alamitos Fishway. It was found that during elevated flow events the water would wash over the top of the weir, allowing fish to jump over the weir and avoid passing through the fishcounter (Figure 4). Also, the fishcounter opening could reach velocities greater than 6 feet per second, which could encourage fish to leap over the counter, rather than swim through the elevated velocities at the counter opening. In order to improve fishcounter effectiveness at higher flows, large flow-through panels were added at the sides of the fishcounter to avoid the concentration of flow and excess velocities at the opening (Figure 5). This also aided in keeping water from flowing over the top of the structure in moderate flows. Regardless of the weir configuration, however, flows during larger events were too great to contain and water would cascade over the top of the weir.

Initially, the fishcounter camera was mounted on an extended arm angled away from the counter opening. During the first year of monitoring photo confirmation of fish passage was difficult to attain as turbidity limited photo quality. In addition, many of the subjects moved at night and the infrared lighting did not sufficiently illuminate the fish for photographs. Also, several fish did not appear in the photo frame as they either swam through the counter either above or below the view of the camera or too far from the camera to capture an image through the turbid water. The lighting issue was improved when an engineer from Vaki supplied a pair of red LED light-bars to replace the infrared light source. At the Alamitos Fishway, the opening of the fishcounter was extended by an acrylic structure to direct the fish to swim past the camera (Figure 5). At the Masson Fishway, a steel structure was fabricated which included a steel extension to the counter opening to direct fish past the camera (Figure 6) and the structure was extended vertically to prevent water from spilling over the top of the counter (Figure 7).

The weir which houses the counter in the Masson Fishway is considerably smaller (5.7 feet wide) than the original configuration at the Alamitos Fishway (15.2 feet wide) (Figure 7). The difference in fishway design is due to the lower magnitude of flows received at the Masson Fishway, since the Guadalupe Creek watershed has a significantly smaller surface area than the area upstream of the Alamitos Fishway, which passes the flows which drain from Alamitos, Calero and Guadalupe Creeks (Figure 1). The location higher in the watershed resulted in improved water clarity due to lower turbidity and reduced debris in the water column which allowed the system to take better photographs.

Another notable difference from the Alamitos Fishway installation included the placement of the fishcounter in the most downstream weir of the Masson Fishway to minimize changes to jump pool elevations in the fishway. The position of the fishcounter at the entrance of the fishway may have

resulted in fish passing through the fishcounter which were not traversing the fishway. The fishcounter was deployed further up the Alamitos Fishway in the third weir which reduced occurrences of fish which were not actively migrating through the fishway. Another difference between the two sites was the availability of a 110 volt outlet at the Masson Fishway which provided a more reliable power source than the solar panel/battery set up which was used at the Alamitos Fishway.

The counter was maintained throughout the salmonid migration season, between October and May. Typical maintenance included clearing debris build up from the counter, downloading data from the database, and resetting the system. On May 19, 2008, the fishcounter was decommissioned for the season.

III. RESULTS

2003-2007

During the 5 monitoring seasons, several native and non-native fish species have been documented passing the fishcounter. Chinook salmon (*Oncorhynchus tshawytscha*) (Figures 8 and 9), steelhead (*Oncorhynchus mykiss*) (Figures 10 - 13), Pacific lamprey (*Lampetra tridentata*) (Figures 14 and 15), Sacramento sucker (*Catostomus occidentalis*) (Figures 16 and 17), common carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*) and green sunfish (*Lepomis cyanellus*) have been identified in photograph and silhouette images from the fishcounter. Analysis is focused on salmonid fish passage (Figures 18 - 23).

In the 2003-04 season at the Alamitos Fishway, 22 salmonids were documented moving through the counter upstream, while 4 were documented moving downstream. In 2004-05, 28 salmonids were documented moving upstream through the Alamitos Fishway, while 12 were documented moving downstream. In 2005-06, 15 salmonids were documented moving through the counter upstream, while 4 were documented moving downstream. In the first year at the Alamitos Fishway, 2003-04, distinguishing between Chinook salmon and steelhead was difficult due to the lack of conclusive photographs, therefore salmonids were lumped into one category. In subsequent reports in 2004-05 and 2005-06 smaller salmonids recorded in February through April were judged likely to be steelhead based on size and timing. Species designations in Figures 18-20 should not be considered absolute, but are the best fit based on knowledge of the system. In the first year at the Masson Fishway, in 2006-07, 42 steelhead were documented moving upstream through the counter, while 14 were documented moving downstream. No Chinook salmon were recorded at the Masson Fishway in 2006-07. For each season the counter results are considered confirmation that salmonids utilize both fishways, however, these numbers are not considered absolute population estimates due to the difficulties described in the methods section.

2007-2008

In the fifth and final year of monitoring, from October 22, 2007 through May 19, 2008, various fish utilized the Masson Fishway and moved through the fishcounter device. Analysis of photographs and silhouettes recorded by the fishcounter confirmed that steelhead, Pacific lamprey, and Sacramento sucker utilized the fishway in 2008. A Chinook salmon may have passed the Masson Fishway on January 26, 2008 but images were not conclusive to determine if the fish was a late migrating Chinook salmon or early migrating steelhead. A total of 39 occurrences of steelhead passed the fishcounter upstream and 24

steelhead passed downstream (Figure 22). Similar sized counter hits which occurred within a few minutes of each other in opposing directions were assumed to be a single fish passing the fishcounter but not traversing the fishway. These hits cancel each other out and therefore should not be counted in an overall tally of fish migrating through the fishway. Using this adjustment, a total of 27 steelhead were counted moving upstream through the Masson Fishway and 12 steelhead were recorded moving downstream. Fish spawning surveys executed in April of 2008 identified steelhead redds upstream of Masson Dam in Guadalupe Creek.

Images collected in 2008 were the first image documentation that Pacific lamprey utilize the Masson Fishway. Past silhouettes, while similar to lamprey, were not sufficiently distinct to identify the object passing the fishway. Subsequent surveys confirmed presence of adult Pacific lamprey and redds upstream of the fishcounter in 2008.

Moving the fishcounter upstream in the Guadalupe Watershed combined with lower than usual precipitation in 2006-07 and 2007-08 reduced the instream turbidity levels and improved conditions for fishcounter photographs. In addition, a metal counter opening was added which brought the subjects closer to the camera and improved the photo quality. As a result, photos were of sufficient quality to identify both steelhead and Pacific lamprey. The seasonal timing (late February through early March) was also consistent with the expected steelhead and lamprey migrations. These two species, in particular, may have been present in previous years at the Alamitos Fishway, but not confirmed due to lack of confidence in the image quality.

Water temperature data in the fishway is automatically collected every three hours by the fishcounter. Temperatures ranged from 5-10^{o}C through the end of February. Temperatures gradually increased through March and were consistently about 11^{o}C by early April. Temperatures remained below 14^{o}C through the month of April.

Temperatures warmed more gradually than the previous year in Guadalupe Creek (Figures 24 and 25). Temperature trends at the Masson Fishway varied from those at the Alamitos Fishway in the winter season. Temperatures reached much lower extremes at Masson than were encountered at the Alamitos Fishway where Lake Almaden likely warms the temperature downstream, keeping the temperature above 10°C through the winter.

Steelhead forklength estimations were created by multiplying the measured depth of the fish by 4.4. The 4.4:1 length to depth ratio was based on measured values from adult salmonids previously captured in the field. Using this length to depth ratio, adult steelhead ranging in size from 39cm to 63cm in forklength were documented using the fishway in April of 2008. Juvenile *O. mykiss* positively identified on photographs captured by the fishcounter in February and May of 2008 were estimated at 14cm and 25cm in forklength (Figure 22).

IV. DISCUSSION

Similar to monitoring in 2006-07, the results in 2007-08 illustrate a higher than expected total for steelhead. The previous three years at the Alamitos Fishway located downstream of Masson revealed

very low estimates (less than 5) for steelhead passage for any season. Correspondence with other Vaki Riverwatcher users reveals the units may count up movements more consistently than down movements. Thus a fish traversing up and down multiple times may have been inadvertently counted more than once, incorrectly raising the upmigrant steelhead estimate. However, the Alamitos Fishway deployment was not as effective at blocking fish attempting to jump over the structure. It is possible that additional steelhead passed the Alamitos Fishway while avoiding the fishcounter by leaping over the entire structure. Also, steelhead may have been assumed to be Chinook salmon due to lack of clear photographs. The disparity between steelhead counts may be attributed to an overestimate at the Masson Fishway, an underestimate at the Alamitos Fishway, differences between steelhead year classes (number of migrating adult steelhead in a season), or a combination of all factors. Due to various technical issues associated with this monitoring, the results show presence/absence and a rather coarse estimate rather than absolute numbers of migrant steelhead.

The timing of the steelhead run in Guadalupe Creek in 2007-08 was later than observed in 2006-07. The bulk of the steelhead recorded in 2007 were in March, while the majority of steelhead showed up in 2008 in April (Figure 23). The timing of steelhead occurrence does not seem tied to flow events, since the early spring flows were similar across the years. However, temperature data (Figure 24 and 25) show that water temperature at the Masson Fishway increased earlier in the 2007 season than in 2008, implying the temperature may have had an effect on the timing of steelhead migration each season. However, with 2 years of data there is insufficient data at this time to show a strong correlation.

The estimated fork length for steelhead is based on the depth of the fish (measured as the fish passes through the fishcounter) multiplied by 4.4, a length to depth ratio created from field measurements and correspondence with other Vaki Riverwatcher users. In 2008 there were multiple downmigrant steelhead that were estimated at reduced lengths when compared with earlier upmigrant steelhead (Figure 22). It is possible that the “smaller” downmigrant steelhead were in fact the same fish moving back downstream with a more slender profile after spawning.

While numerous Chinook salmon were counted at the Alamitos Fishway in previous years, Chinook salmon were not recorded at the Masson Fishway in 2006-07. In 2007-08 one fish was considered a possible Chinook salmon. One likely cause for the lack of Chinook salmon compared to the first three years of monitoring is the difference in habitat between the sites. The Masson Fishway is located further upstream than the Alamitos Fishway and encounters less flow. Typically, Chinook salmon spawn downstream in the watershed in areas with greater flow, while steelhead tend to prefer locations further upstream. Spawning surveys over the past 10 years in the Guadalupe watershed confirm this trend. An additional factor that may have limited Chinook in Guadalupe Creek is poor passage conditions at the mouth may have restricted access. Another factor which makes comparisons across monitoring years more difficult is the recent overall decline in the population of Chinook salmon. It has been well documented that Chinook salmon numbers along the entire west coast were reduced in 2007-08. Overall, the 5 seasons of data collected at the Alamitos and Masson Fishways have demonstrated the successful passage of numerous fish species both native (steelhead, Sacramento sucker and Pacific lamprey) and nonnative (Chinook salmon, carp, largemouth bass and green sunfish). The usage of the fishways by steelhead in particular demonstrates the success of the fishways in allowing access to upstream habitat which has not been fully available to anadromous fishes since the 1930’s when water

diversions began at the Alamitos drop structure location. The permanent Alamitos drop structure was built in the 1970's.

V. FIGURES

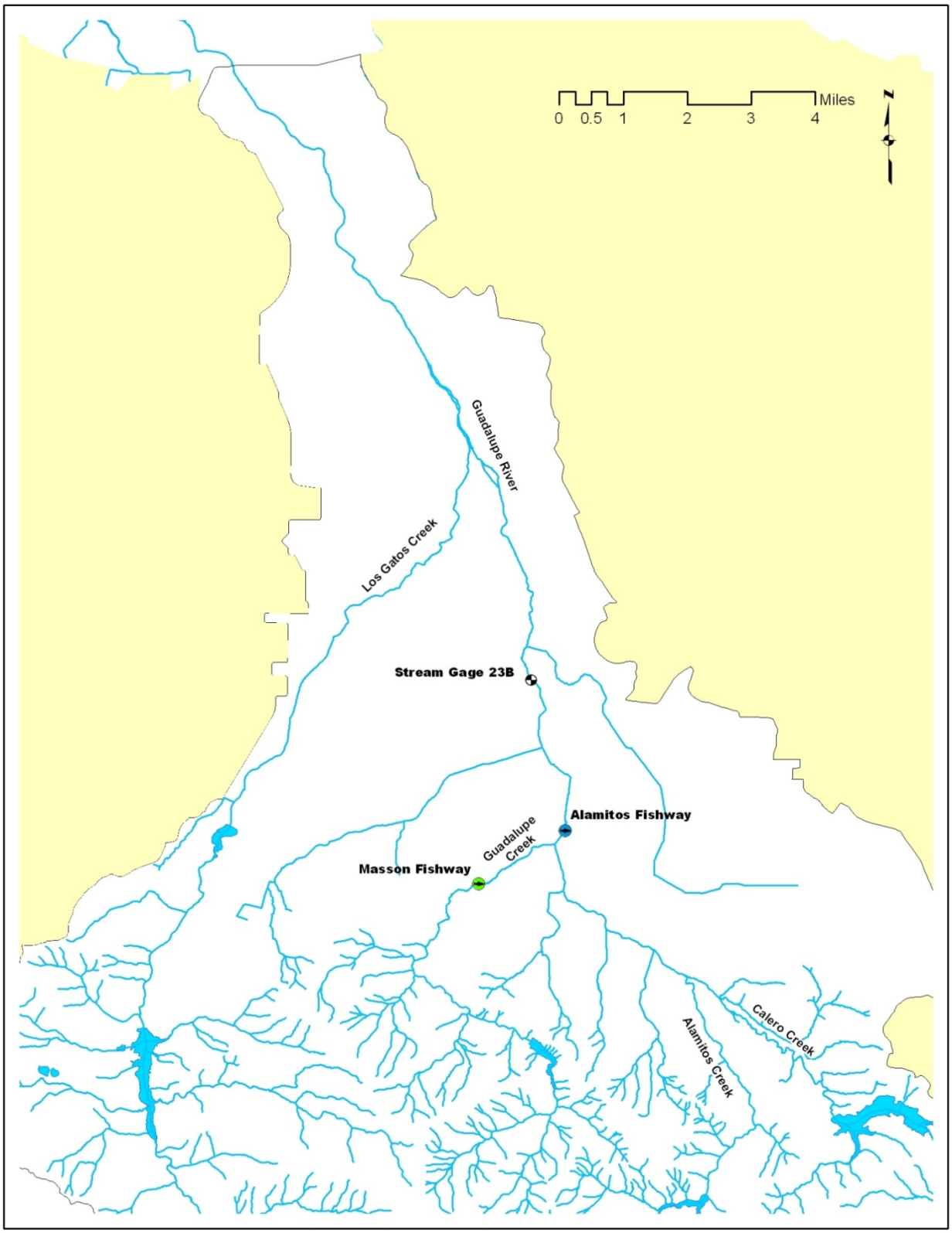

Figure 1. Guadalupe Watershed Map

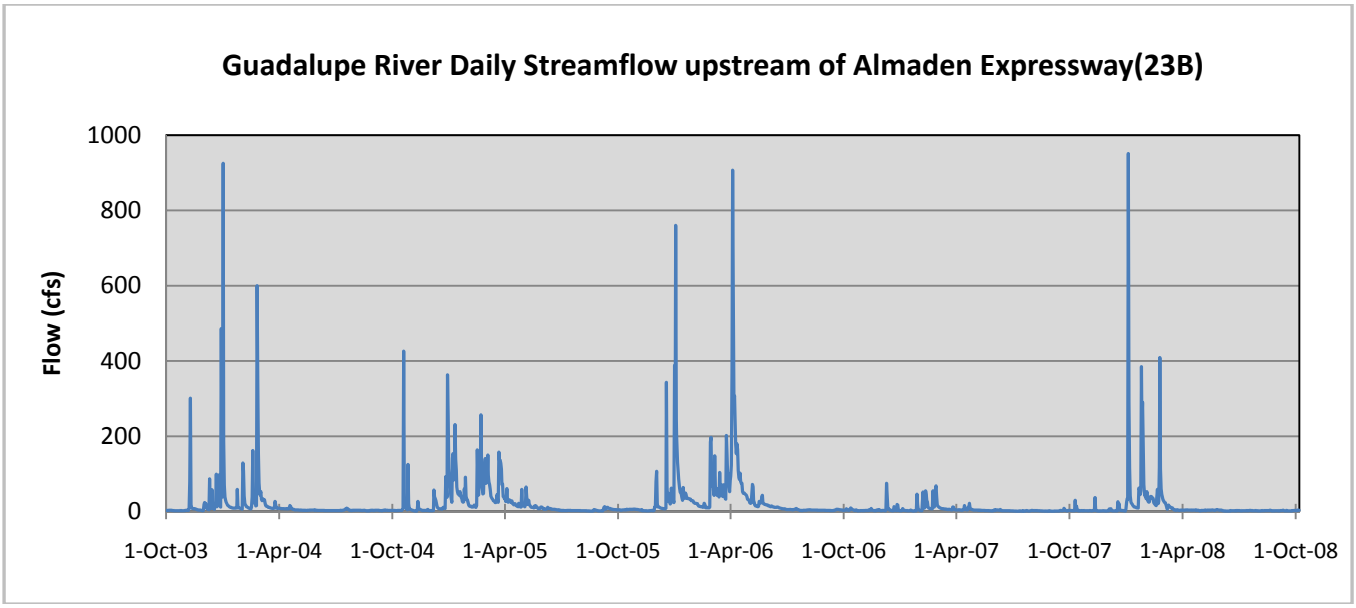

Figure 2. Guadalupe River Streamflows 2003-2008

Figure 3. Alamitos Fishway deployment 2003-2004
Note small flow through weirs on sides.

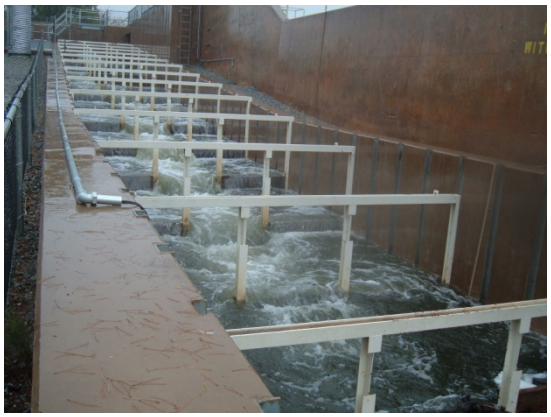

Figure 4. Alamitos Fishway October 2004 during high flow conditions with fishcounter overtopping

Figure 5. Alamitos Fishway deployment 2004-2006
Note larger flow through weirs and plexiglass extention

Figure 6. Masson Fishway deployment 2006-2008 Note flow through weirs on sides and metal extension collar to direct fish past the camera

Figure 7. Masson Fishway March 2007 base flow

Figure 8. Chinook silhouette from December 2004

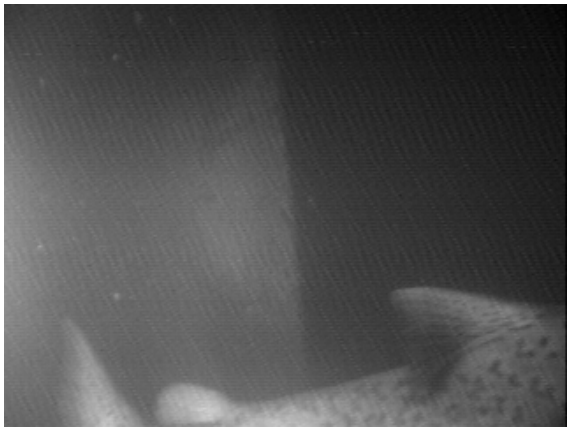

Figure 9. Chinook photo from December 2004

Figure 10. Steelhead silhouette from March 2007

Figure 11. Daytime steelhead photo from March 2007

Figure12 . Steelhead silhouette from April 2008

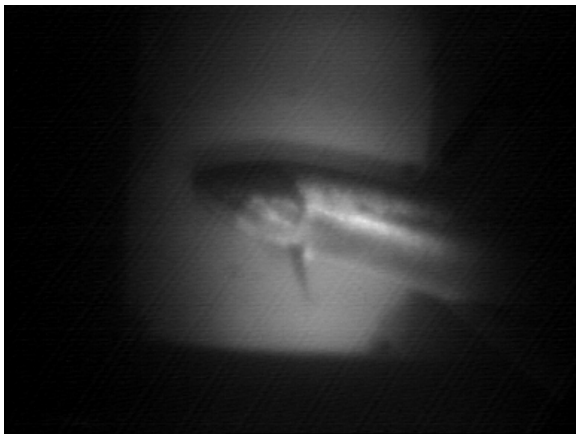

Figure 13. Nighttime steelhead photo from April 2008

Figure 14. Lamprey silhouette from March 2008

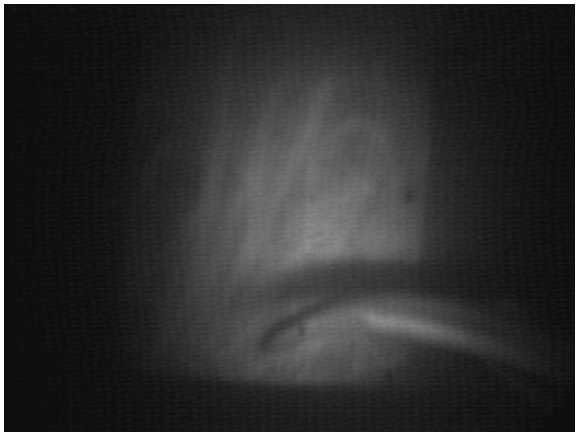

Figure 15. Lamprey photo from March 2008

Figure 16. Sacramento sucker silhouette from 2008

Figure 17. Sacramento sucker photo from 2008

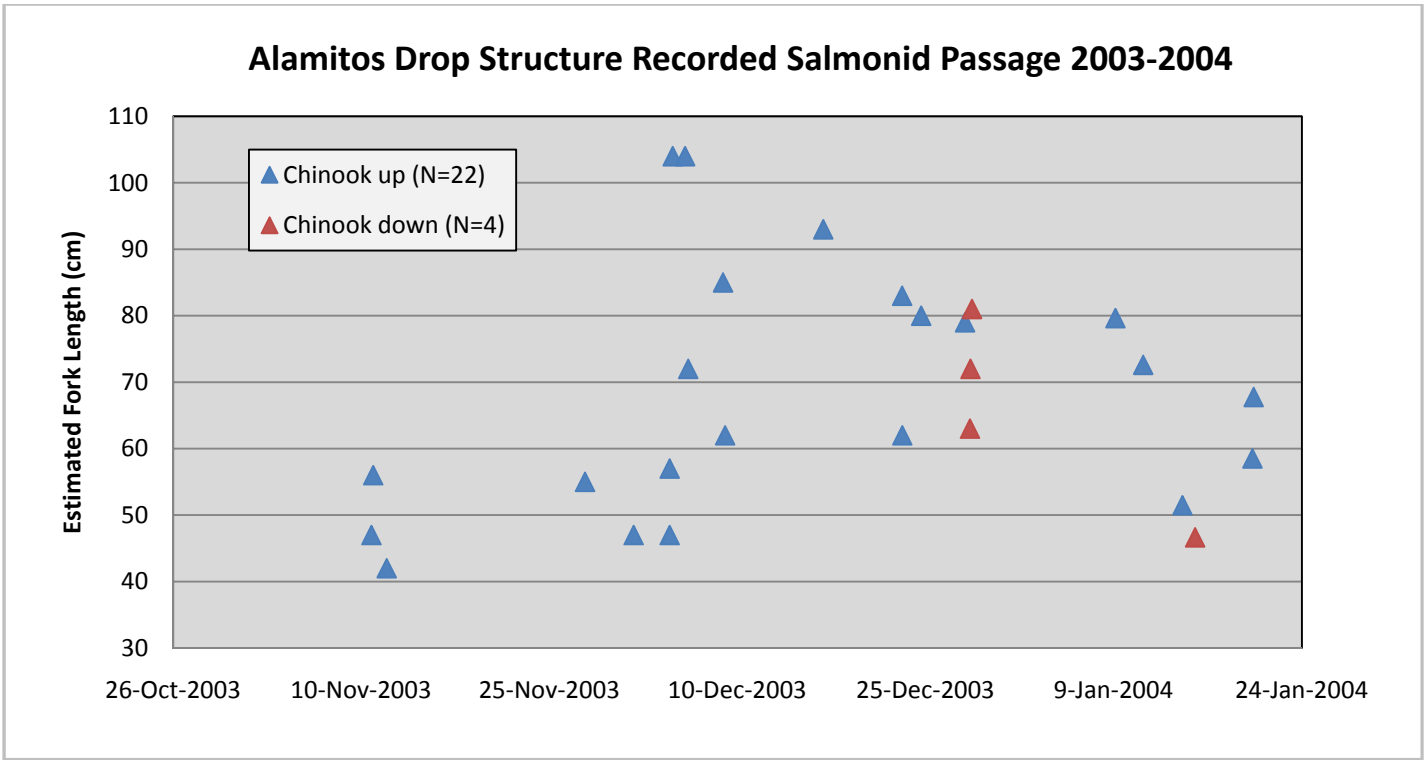

Figure 18. Salmonid Passage recorded at Alamitos Fishway 2003-2004

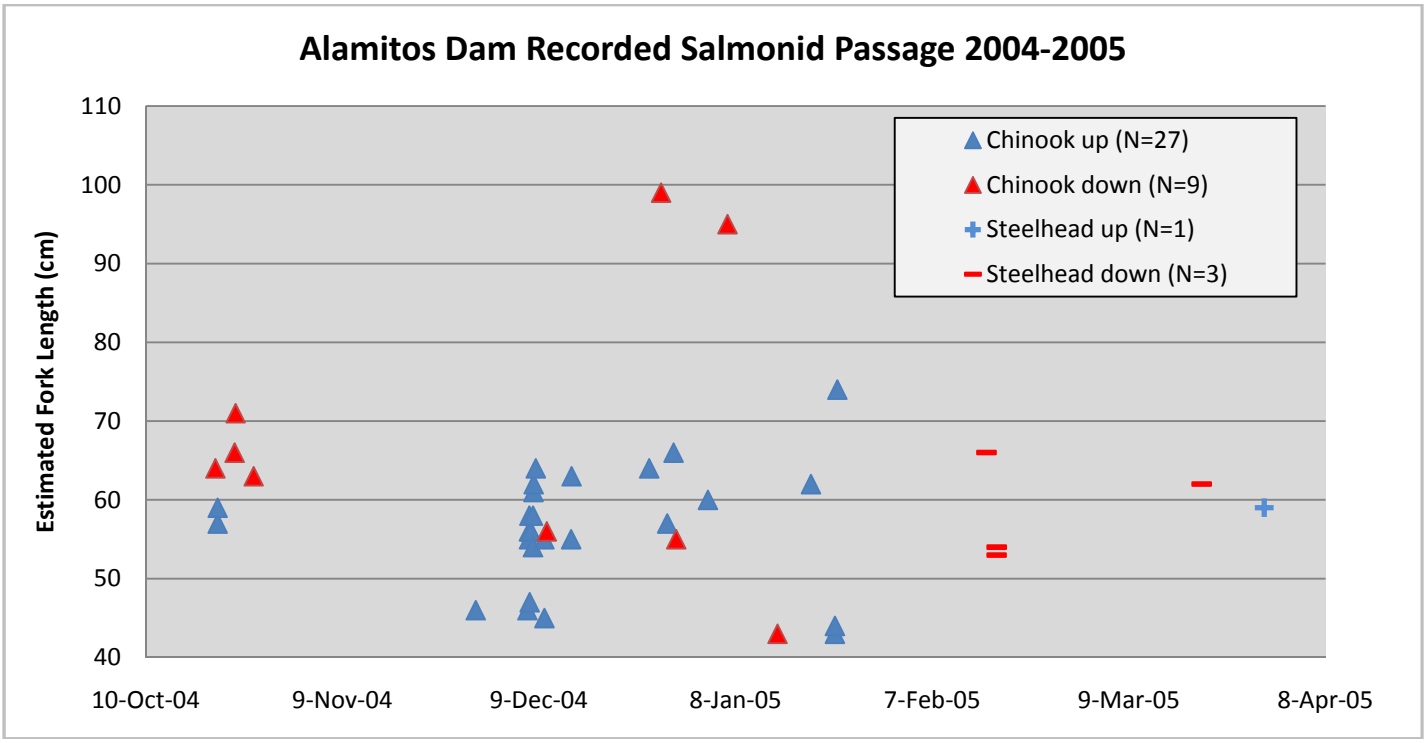

Figure 19. Salmonid Passage recorded at Alamitos Fishway 2004-2005

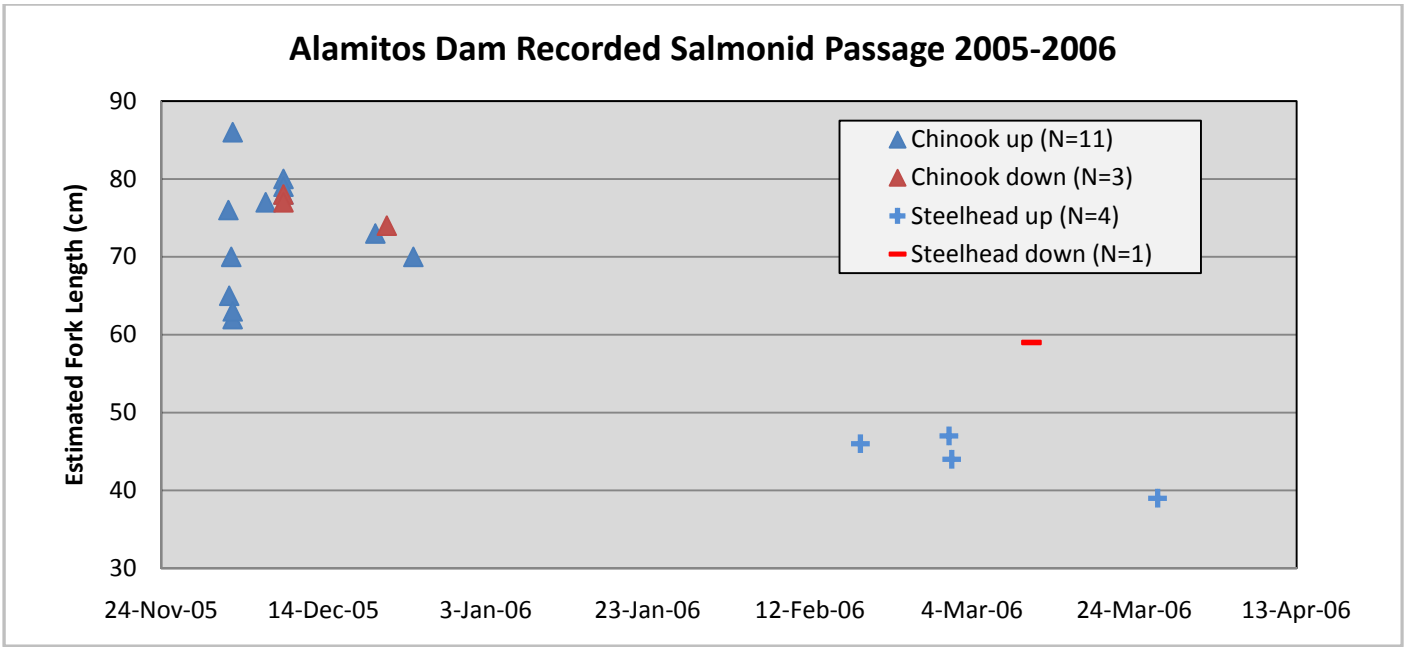

Figure 20. Salmonid Passage recorded at Alamitos Fishway 2005-2006

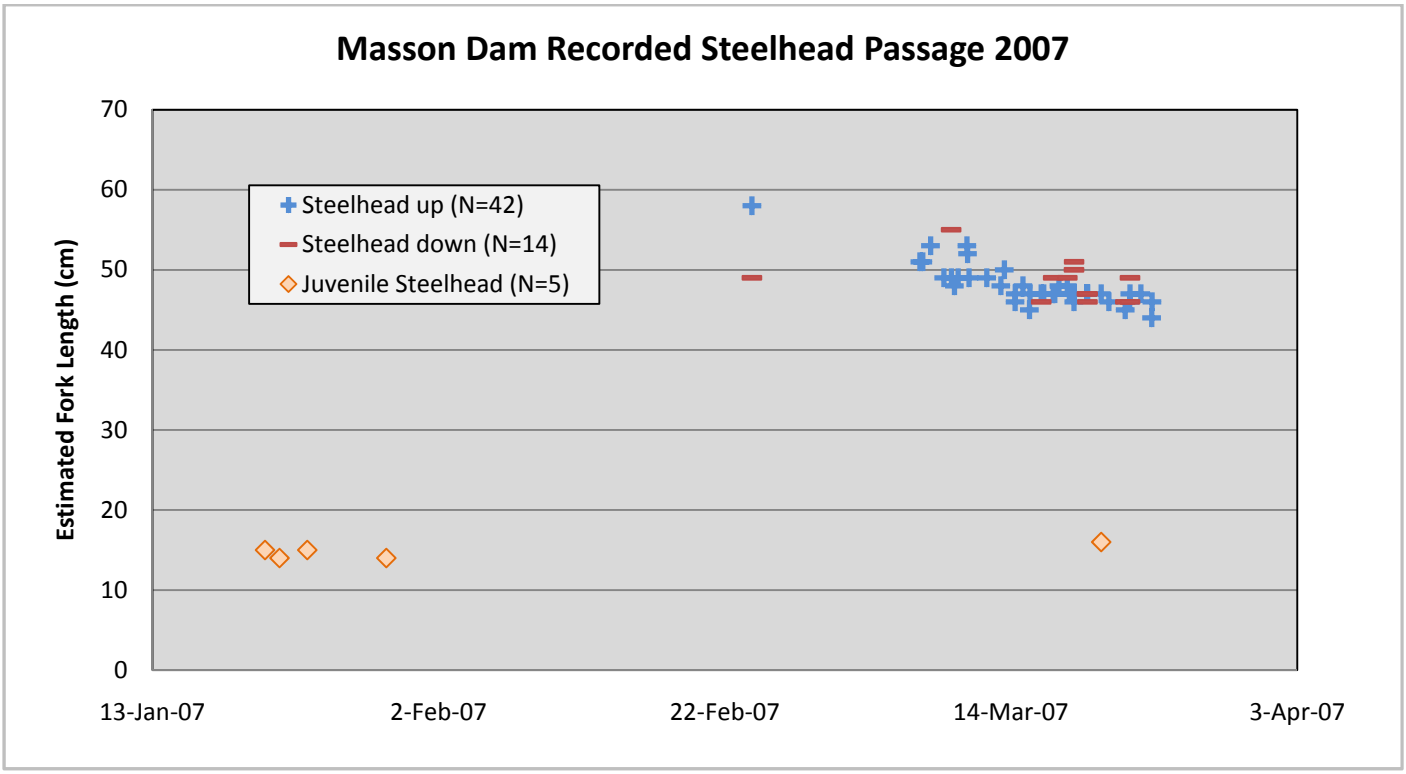

Figure 21. Salmonid Passage recorded at Masson Fishway 2006-2007

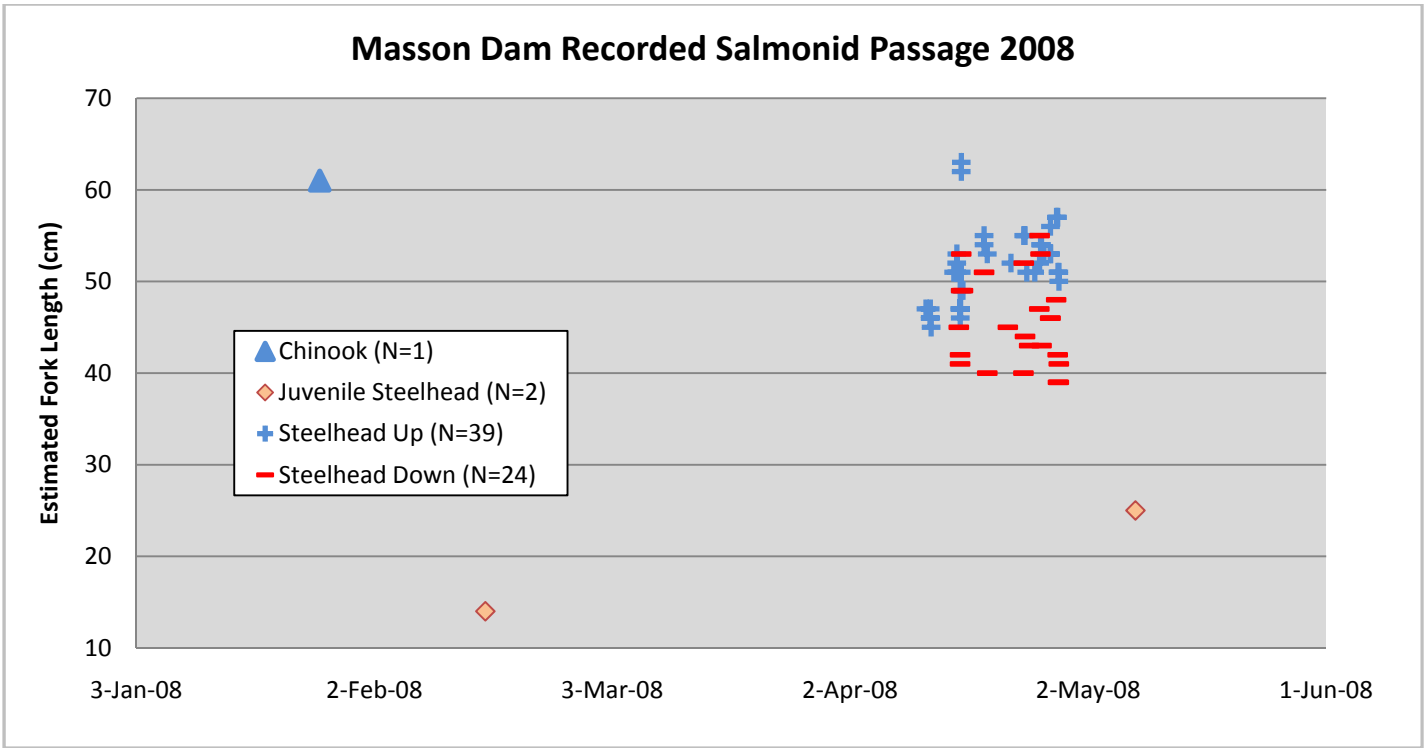

Figure 22. Salmonid Passage recorded at Alamitos Fishway 2007-2008

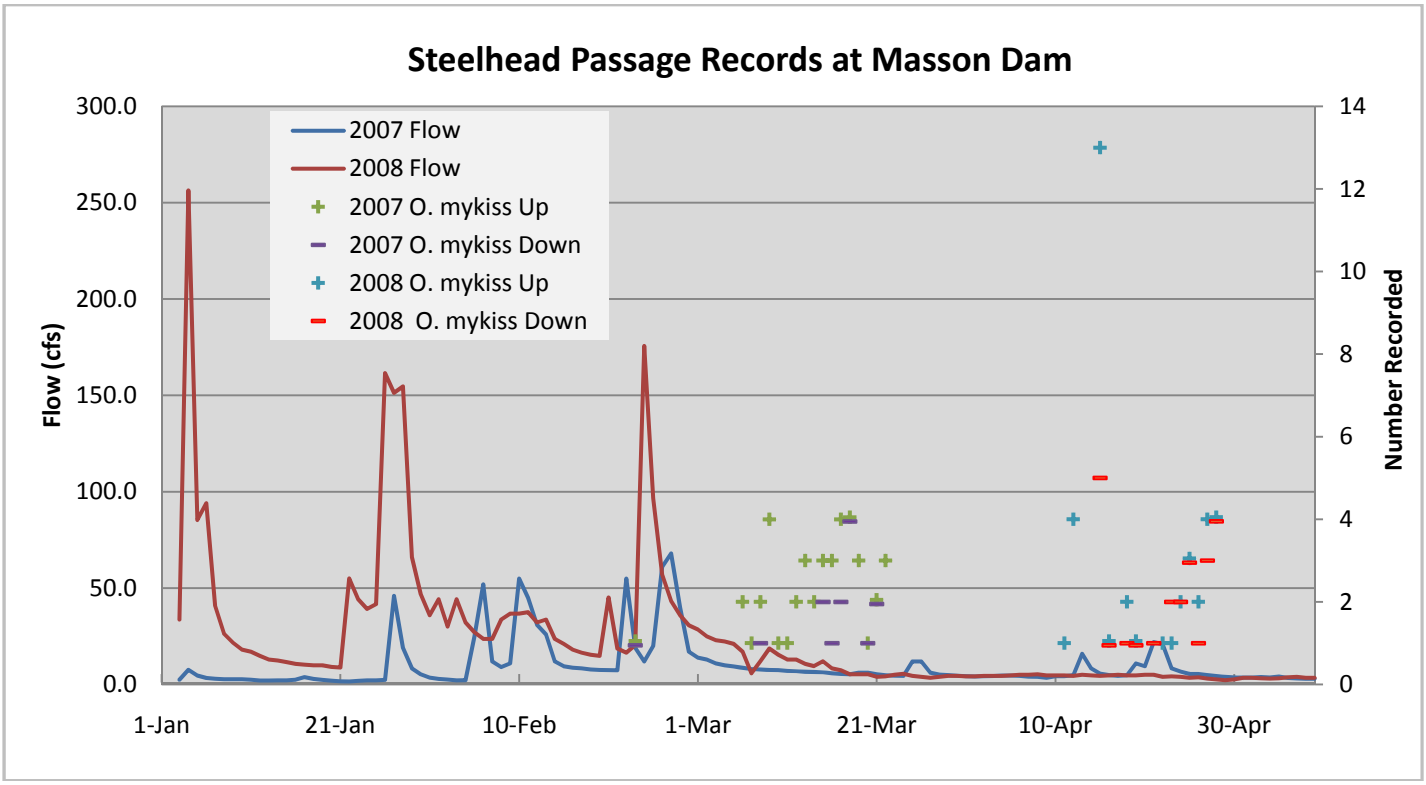

Figure 23. Flow vs. number of steelhead movements recorded at Masson Fishway 2007-2008

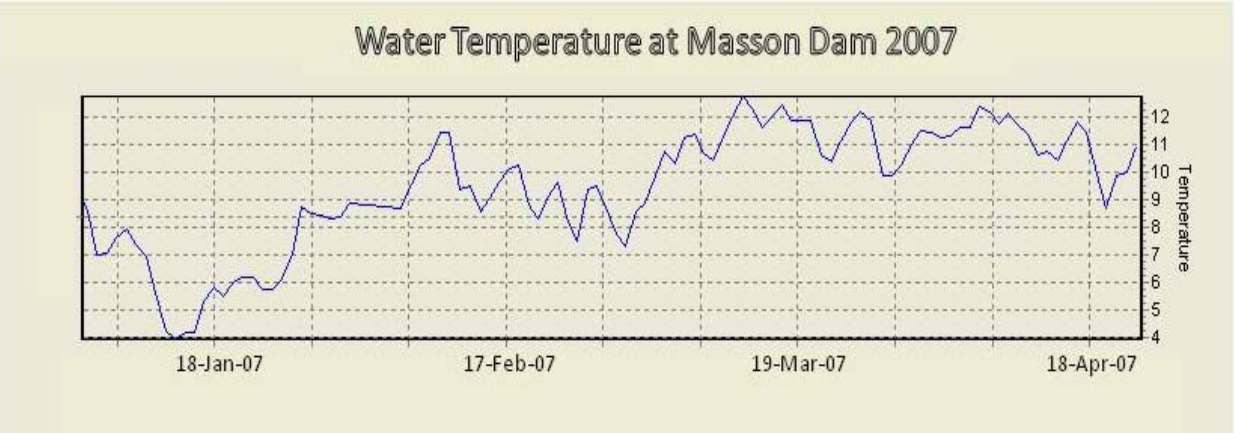

Figure 24. Water temperature (^{o}C) at Masson Fishway 2007

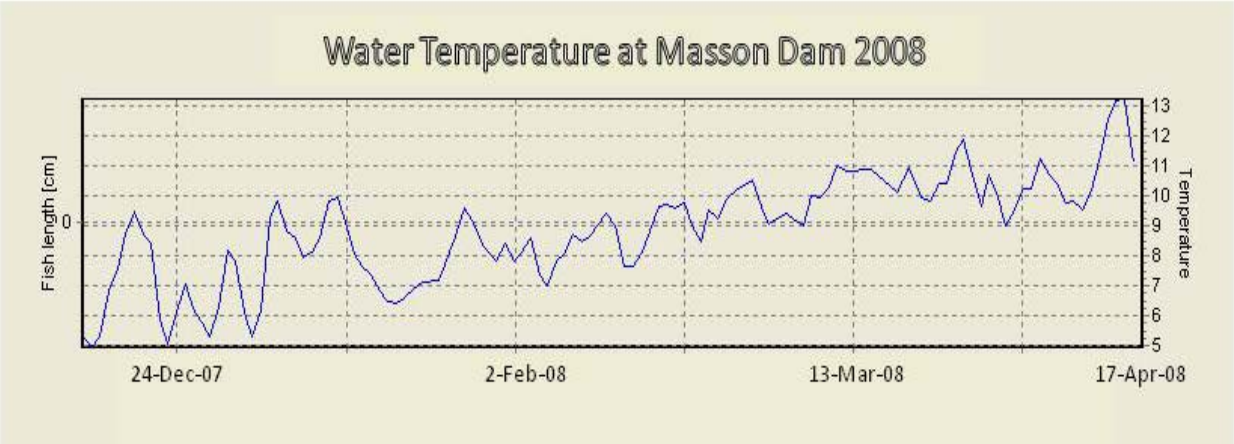

Figure 25. Water temperature (^{o}C) at Masson Fishway 2008