UNITED WATER CONSERVATION DISTRICT

"Conserving Water Since 1927"

Fish Passage Monitoring and Studies, Vern Freeman Diversion Facility, Santa Clara River, Ventura County, California

Annual Report
2008 Monitoring Season

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Vern Freeman Diversion Facility
Santa Clara River, Ventura County, California

Annual Report
2008 Monitoring Season

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UNITED WATER CONSERVATION DISTRICT

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2008

Cover Photos (by Steve Howard): clockwise from top left: Freeman Diversion Dam, Hatchery Stray Adult Steelhead, Santa Clara River Steelhead Smolt

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The water year of 2008 was considered a “normal year” meaning it wasn’t wet or dry although normal and average are terms that do not fit well when attempting to characterize water years in this dynamic southern California climate. Rainfall in wet years can reach 40+ inches in the lower coast plain and even more in the mountain areas. Rainfall in dry years can be close to zero to a few inches. A total of 24.31 inches of rain was measured at the Red Rock gauge near Fillmore in 2008 and the majority of this rainfall occurred in the months of January and February.

The sandbar at the Santa Clara River Estuary (SCRE) was open to the ocean from January 1 to May 1 and was closed during the remainder of the steelhead migration season (January through June). Smolt trapping at the Freeman Diversion started on January 12 and ended on June 20, 2008. Steelhead smolts were first observed in the fish trap on January 30 and last observed on June 3, 2008. The fish ladder was in operation from January 6 to January 14 and from January 29 to March 21. Two adult steelhead were observed in the fish ladder on March 11 but these fish were of hatchery origin from an unknown location hundreds of miles north of this area. Adult steelhead returned to many southern California drainages this year, including drainages with long standing barriers. These returns were a product of an “above normal” downstream migration of smolts that most likely occurred during the flood events of 2005.

A total of 2 adult steelhead (strays of hatchery origin), 133 steelhead smolts, 12 resident coastal rainbow trout, and 12 young-of-the-year coastal rainbow trout were trapped at the Freeman Diversion Fish Trap. A total of 128 of the 133 smolts were transported via aerated coolers to the SCRE and 5 smolts were transported to the Ventura River Estuary (VRE) due to unusually shallow conditions in the Santa Clara River Estuary that were a result of the 2005 flood events. A total of 81 of the 128 smolts trapped and transported to the SCRE were surgically implanted with acoustic and PIT tags. No Pacific lamprey were observed during the 2008 migration season although a small number of adult lamprey could have traversed the fish ladder since there is currently no way to detect lamprey in the fish ladder except when the ladder is drained. Table 2,

Appendix A summarizes the daily fish ladder operations as well as the *O. mykiss* and physical data collected during monitoring activities in 2008.

Water temperature monitoring occurred in the estuary, mainstem Santa Clara River, Santa Paula Creek and Sespe Creek.

1.1 FREEMAN DIVERSION FACILITY

The Freeman Diversion Facility was constructed in 1991 and is located approximately 10.7 miles upstream from the Pacific Ocean. The main purpose of the facility is to conserve groundwater resources in the Oxnard plain. The facility is comprised of a concrete dam, a denil fishway (fish ladder), a fish screen bay, a downstream migrant trap, various canals and spreading grounds (Figure 1, Appendix A). The concrete dam is a complete barrier to steelhead and Pacific lamprey upstream migration. To avoid or minimize affects to migrating adult steelhead and Pacific lamprey, a fish ladder was constructed to facilitate anadromous migration through the facility. The fish screen bay is located directly downstream of where flow enters the facility and its function is to keep fish out of the canals and spreading grounds and to direct fish to the downstream migrant trap. Located at the end of the fish screen bay is a fish bypass pipe that can be used to direct fish back to the river when there is sufficient flow to allow for migration to the estuary.

1.2 FISH SPECIES COMPOSITION

The Santa Clara River is home to two native, anadromous fish species, the southern steelhead trout (*Oncorhynchus mykiss irideus*) and the Pacific lamprey (*Entosphenus tridentatus*). Steelhead and resident rainbow trout are known collectively as coastal rainbow trout. Steelhead is the common name for anadromous coastal rainbow trout. Anadromous or anadromy is a life cycle or life history trait that refers to fish species that live in the ocean and return to freshwater to spawn. Resident coastal rainbow trout live their entire lives in freshwater. Both resident as well as anadromous coastal rainbow trout exist in the Santa Clara River. Evidence from data collected at the Freeman Diversion suggests that resident rainbow trout can produce progeny that will migrate to the ocean. A steelhead that migrates from freshwater to the ocean between the ages of 1 to 3 years is referred to as a smolt. The term smolt reflects the physical and physiological changes coastal rainbow trout experience when preparing for

life in saltwater. An adult steelhead that has entered freshwater to spawn and later the same year or the following year returns back to the ocean is referred to as a kelt. Pacific lamprey are strictly anadromous and do not persist in freshwater alone. A downstream migrant Pacific lamprey is referred to as a macropthalmia. The term Macropthalmia, similar to smolt, reflects the physical and physiological changes juvenile Pacific lamprey experience when preparing for life in saltwater. Juvenile lamprey that live in freshwater for up to seven years before migrating to the ocean are referred to as ammocoetes. Southern steelhead are federally listed as endangered and Pacific lamprey currently have no federal protection. Pacific lamprey numbers have dropped precipitously since the early 2000's in the Santa Clara River and in many drainages on the west coast of the United States. There are two additional native fish species in the Santa Clara River, the federally-endangered tidewater goby (*Eucyclogobius newberryi*), which lives in the estuary and the unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*). The threespine stickleback is comprised of two sub-species in the Santa Clara River, the partially-armored (*Gasterosteus aculeatus microcephalus*) and unarmored threespine stickleback. The partially-armored stickleback, which is plentiful, exists in the Ventura County reach and the unarmored threespine stickleback exists in the Los Angeles reach of the Santa Clara River. The unarmored threespine stickleback sub-species is a federal and California endangered species and a California fully-protected species. The unarmored sub-species are not known to occur in Ventura County. Additional fish species known to occur in the Santa Clara River include: Arroyo chub (*Gila orcutti*), Santa Ana sucker (*Catostomus santaanae*), Owens sucker (*Catostomus fumeiventris*), Santa Ana-Owens sucker hybrids (*C. santaanae x fumeiventris*), largemouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), black bullhead (*Ameiurus melas*), prickly sculpin (*Cottus asper*), fathead minnow (*Pimephales promelas*), Mississippi (inland) silverside (*Menidia audens*), threadfin shad (*Dorosoma petenense*), common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*) and mosquitofish (*Gambusia affinis*). See Table 1, Appendix A.

1.3 ENVIRONMENTAL SETTING

The Santa Clara River has the largest watershed in southern California south of Point Conception with an area of approximately 1600 square miles. Its

headwaters originate on the north slope of the San Gabriel Mountains near Acton, California in Los Angeles County and the river flows approximately 116 miles from east to west to its estuary in the City of Ventura. The Santa Clara River and its tributaries have high annual flow variability, from extreme flood events to multi-year droughts.

Rainfall and Migration Opportunities

In 2008, Ventura County experienced, depending on the location, between 67.4% (Port Hueneme) and 115.0% (Casitas Dam) of normal rainfall. Santa Paula had 98.2% of normal rainfall in 2008 totaling 16.56 inches (http://www.vcwatershed.org/fws/media.html). The most rainfall in a 24 hour period was 6.2 inches on January 4, 2008 based on information at the Red Rock gauge near Fillmore (Figure 2, Appendix A). The majority of rainfall occurred during the month of January but other, smaller intensity storms occurred in February. These normal conditions typically result in a high potential for steelhead migration depending on when storm events occur during the rainy season. The majority of rainfall during the 2008 rain season occurred during the months of January and February and adult steelhead entered many of the southern California coastal rivers during these months in 2008 (CMWD 2008, Tim Robinson pers. comm.). The returns of adult steelhead in multiple coastal drainages were most likely a product of high intensity and long duration flows during 2005 that transported larger than the current normal numbers of smolts to the ocean. Two adult steelhead migrated up the Santa Clara River in 2008 and were observed in the fish ladder in March. These fish originated from an unknown hatchery in northern California based on missing adipose fins on both fish. The adipose fin is a small fatty fin located near the tail of coastal rainbow trout and other fishes in the salmonid family and many anadromous hatcheries clip this fin before stocking fish into rivers.

Tributaries

The major tributaries of the Santa Clara River include Santa Paula Creek, Sespe Creek and Piru Creek. Santa Paula Creek has two fish passage facilities located within the first four miles of the lower creek (USACE and Canyon Irrigation fish ladders) that have numerous physical and operational problems that result in blocking upstream passage. Sespe Creek is free flowing and currently has some

issues regarding illegal crossings within the lower river that could block both upstream and downstream passage at certain flows. Piru Creek has two major dams (Santa Felicia Dam and Pyramid Dam) that do not include fish passage facilities.

The main tributaries in the Santa Clara River that are considered to be the main steelhead bearing drainages are Santa Paula and Sespe Creeks. These tributaries were flowing during the entire 2008 migration season although water depths decreased dramatically by mid April (direct observations). It is unknown when steelhead smolts emigrate from the tributaries to the mainstem Santa Clara River. Currently, it is assumed that smolts emigrate from the tributaries following storm pulses based on data collected in the Santa Ynez River (Tim Robinson pers.com.). Steelhead smolts are observed at the Freeman Diversion from January to June but the majority of these fish are observed in March and May. This is an extended migration period that continues sometimes for months following storm events and these fish most likely enter the mainstem directly following storm events and rear and feed in the mainstem Santa Clara River during their migration to the ocean. The smolts tend to be shorter early in the season (169 millimeters or 6.7 inches average from January through March) and longer and more robust toward the end of the migration season (184 millimeters or 7.2 inches average from April through June). The smolts that are in the river later in the season are most likely feeding on the spring larvae of Santa Ana and Owens sucker and arroyo chub. There is the potential that the increased biomass from the spring spawn of non-native fishes is affecting smolt migration behavior by delaying or even stopping migration due to the increased food source. The effects on native fishes by the presence of non-native and exotic species can be far reaching above the basic principles of predation and/or competition for space.

1.4 REGULATORY STATUS (STEELHEAD)

NOAA Fisheries, otherwise known as the National Marine Fisheries Service (NMFS), listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA) of 1973. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) and represented groupings that were considered to be substantially isolated from other steelhead stocks reproductively and were an

important part of the evolutionary legacy of the species. Currently, the southern California steelhead ESU includes populations from the Santa Maria River in San Luis Obispo County south to the US/Mexican border in San Diego County (NMFS 2003). NOAA Fisheries later recognized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) under the ESA (NMFS 2005). The DPS policy differs from the ESU by delineating a group of organisms by "marked separation" rather than "substantial reproductive isolation". In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated and exist below complete barriers, are still part of the ESU; however, the anadromous *O. mykiss* (steelhead) are now part of a smaller subset identified as the southern California steelhead DPS (CMWD 2008).

The remainder of this report summarizes the monitoring and study methods and results at the United Water Conservation District (District) Vern Freeman Diversion Fish Passage Facility on the Santa Clara River in 2008.

2.1 INTRODUCTION

In southern California, steelhead and Pacific lamprey migrate downstream from their natal streams to the Pacific Ocean in the spring. Data collected from 1991 to 2008 at the Freeman Diversion indicate that the majority of downstream migration occurs in March, April, and May although migration can occur from January through June. This migration can occur when flows in the Santa Clara River are rapidly receding. When this occurs, it is necessary to trap all downstream migrant steelhead and lamprey and relocate them to the estuary or other appropriate habitats based on individual life stages.

The primary objective for trapping downstream migrants is to avoid impacts to steelhead smolts, kelts and lamprey macropthalmia during their downstream migration to the Pacific Ocean when there is not sufficient flow in the lower river. This reduction in flow could be natural and/or the result of diversions at the Freeman Diversion. Another important objective is to gather data regarding anadromous downstream migration in the Santa Clara River. Since there is a lack of specific knowledge regarding steelhead in southern California, these data can be useful during the steelhead recovery planning process and for managers of anadromous fishes in the Santa Clara River and regionally. Additionally, trapping activities aid in monitoring fish movement and assemblages within the Santa Clara River and can potentially mitigate for stranding and predation when conditions are not favorable in the lower river with or without diversions occurring at the Freeman Diversion.

2.2 METHODS

2.2.1 DOWNSTREAM MIGRANT TRAP CHECKS

Trapping is triggered when there is not sufficient flow in the lower river based on depth criteria at critical riffles. The current flow threshold for sufficient upstream and downstream migration is 160 cfs measured at critical riffles in the lower Santa Clara River. This threshold was developed from the results of a steelhead

migration instream flow study conducted by Thomas R. Payne and Associates in the lower Santa Clara River (TRPA 2005). This study evaluated surface water depths at various flows to understand what minimum flows would be required for steelhead to successfully migrate from the ocean to the Freeman Diversion Fish Ladder.

Downstream migrant steelhead smolts, kelts, lamprey macropthalmia and other fish entering the fish screen bay within the diversion facility are prevented from entering the diversion canal by a self cleaning, 3/16-inch mesh screen which directs the fish to a downstream migrant fish trap. If fish trapping is not warranted due to sufficient migration flows in the lower river, the downstream migrant trap is lifted from the fish trap bay and all downstream migrants enter a fish bypass pipe and exit to the river downstream of the diversion. During periods when flow between the diversion and the ocean is not contiguous and at least 160 cfs, fish are collected in the downstream migrant trap. Steelhead smolts, kelts and lamprey macropthalmia trapped at the facility are transported in aerated coolers by truck to the Santa Clara River Estuary. Resident coastal rainbow trout that are not exhibiting phenotypic smolting characteristics and lamprey ammocoetes are transported, depending on flow conditions, to the Santa Clara River, Santa Paula Creek or Sespe Creek. Currently, Sespe Creek is the preferred relocation site for resident coastal rainbow trout and lamprey ammocoetes. All other native aquatic species are returned to the river upstream of the diversion. Non-native and exotic aquatic species are removed from the river unless they are considered special status species in neighboring watersheds such as, but not limited to the Santa Ana sucker.

The downstream migrant trap consists of 3/16-inch mesh metal screens. Flow enters through a weir gate with an opening that directs fish and other aquatic species into the trap from the fish screen bay. The trap is situated to keep all intercepted fish immersed in at least two feet of flowing water.

The trap is checked daily in the morning and downstream migrants are removed from the trap with a dip net, counted and measured. Other trapped aquatic species are counted and documented during each trap check. All fisheries personnel are trained in species identification and handling. A species identification handbook drafted by Steve Howard (lead biologist) is also available.

Data Collection – Steelhead smolts are measured (fork length) to the nearest millimeter in a wet fish measuring board. This is typically done with fish out of water no more than 10 seconds. Lamprey ammocoetes and macropthalmia are measured to total length from head to tail. Smolt condition factor (Wedemeyer 1996) will be quantified in the future by weighing and measuring each fish. Water temperature is measured in the fish trap prior to handling fish and monitored in the transport cooler during transport. Fish are not transported at temperatures above 20°C so these activities occur early in the morning. General fish condition is assessed as well as degree of smoltification or smolt condition. Smolt condition or level of smoltification will be quantified in the future based on methods in Haner et al. 1995. Haner et al. found that mean skin reflectance of steelhead and spring chinook salmon was significantly correlated with mean gill ATPase activity and mean skin guanine concentration. Water temperature, dissolved oxygen, pH, conductivity, salinity and turbidity are measured at the relocation site with a multi-parameter water quality meter. Photos are taken with a digital camera of all salmonids and lamprey collected and transported. All data are documented on standardized datasheets and transferred daily to an electronic database.

Fish Transportation – Fish are collected from the fish trap with 1/8th inch or smaller mesh dip nets, data are collected and the fish are typically placed in 100 quart aerated coolers. No more than 25 smolts, ammocoetes or macropthalmia are placed in an individual cooler. No more than one adult steelhead or kelt is placed in individual coolers. If a low number of smolts or macropthalmia are collected, these fish might be placed in aerated buckets to minimize handling during release. Fish handling and transport time is generally no more than one hour.

Fish Transport Locations

Anadromous Fish

All anadromous downstream migrant fish (steelhead smolts and kelts, Pacific lamprey macropthalmia) are transported from the Freeman Diversion to the Santa Clara River Estuary (Photo 1, Appendix B). The specific relocation site in the estuary depends on the condition of the dynamic estuary. The estuary is monitored daily during the migration season to inform relocation activities.

Generally fish are released in the estuary in fresh water that has at least 1 foot of depth and instream cover nearby. Areas of the estuary that are known to be low in oxygen are avoided.

Acclimation Schedule - Fish are acclimated to the receiving water using the schedule in Table 3.

Table 3 – Fish acclimation schedule.

Degree Differential (between cooler and receiving water)	Acclimation Minutes
0-2	10
3-5	20
6-7	30
8 and over*	40

* Fish transportation should not occur when the water temperature is too high (>20°C). If this occurs we will need to change our fish transport schedule. If the estuary water temperature is over 23°C the lead fisheries biologist will be contacted before acclimating.

Non-Anadromous Fish

Non-anadromous fish (resident rainbow trout and Pacific lamprey ammocoetes) are transported via aerated coolers to either the mainstem Santa Clara River in Santa Paula or Sespe Creek (Photo 2, Appendix B). Depending on conditions in Sespe Creek and access problems, resident rainbow trout might be transported to Santa Paula Creek upstream of Steckel Park. All other native, non-anadromous fish and aquatic species are transported and released upstream of the Freeman Diversion Dam.

2.2.2 ACOUSTIC AND PIT TAGGING

United Water Conservation District biologists assisted Elise Kelley (UCSB researcher) with a steelhead smolt tagging study. A federal 10(a)(10)(A) permit was submitted to Elise Kelley from NMFS that allowed for up to 200 smolts to be

tagged on the Santa Clara River, and up to 50 smolts to be tagged on the Santa Ynez River. The tags used in this project were acoustic (Vemco) and PIT tags (Biomark). Acoustic hydrophones were deployed in the ocean near the mouth of the SCRE to detect tagged fish at a distance of approximately 200-400 meters depending on various water quality conditions. PIT (Passive Integrated Transponder) tags do not emit a signal and require a fish to swim close to a powered antenna to detect tagged fish. Therefore, a handheld PIT tag reader or an antenna placed within a fish ladder or weir is required. PIT tags last the life of the fish (unlike acoustic tags which have a 60-90 day battery life) and are a good technology for recording returning adults.

2.3 RESULTS

2.3.1 DOWNSTREAM MIGRANT TRAP CHECKS

The downstream migrant trap was in operation from January 12 to June 20, 2008. Smolts entered the trap from January 20 to June 3, 2008 (Figure 3, Appendix A). A total of 133 steelhead smolts (Photos 3 and 4, Appendix B), 12 resident coastal rainbow trout (Photo 5, Appendix B) and 12 young-of-the-year coastal rainbow trout (Photo 6, Appendix B) were trapped and relocated during the 2008 migration season. The young-of-the-year coastal rainbow trout arrived from May 16 to June 20, 2008. Of the 133 steelhead smolts that were trapped and transported, 128 were transported to the SCRE and 5 were transported to the VRE. The 5 smolts were transported to the VRE due to extremely shallow conditions in the SCRE which was the result of sand deposition from the 2005 flood events. No lamprey macropthalmia were observed or collected at the Freeman Diversion facility in 2008.

Additional fish collected in the Freeman downstream migrant trap include: partially armored threespine stickleback (N=5751), Arroyo chub (N=336), Santa Ana suckers (N=831), Owens suckers (N=74), Santa Ana/Owens sucker hybrids (N=138), fathead minnow (N=60), largemouth bass (N=59), green sunfish (N=8), brown bullhead (N=50), black bullhead (N=5), prickly sculpin (N=463) and mosquitofish (N=4) (Table 4, Appendix A). Sucker species were identified based on lip morphology but the validity of this method is questionable. The majority of the stickleback and prickly sculpin were young-of-the-year indicating that these fish are more likely reproducing in the forebay upstream of the diversion.

Amphibians and reptiles collected in the Freeman downstream migrant fish trap include: Western toad (N=41), bullfrog (N=15), African clawed frog (N=165), tree frog (N=57) and Western pond turtle (N=6) (Table 5, Appendix A).

2.3.2 ACOUSTIC AND PIT TAGGING

A total of 81 smolts of the 133 trapped were successfully tagged at the Vern Freeman Diversion facility and transported and released at the Santa Clara River Estuary. The remaining 52 smolts were not tagged because of small fish size, poor condition and/or time constraints. Each tagged smolt was acclimated to temperature before release. Smolt survival rate was based on acoustic detections by hydrophones deployed in the ocean directly past the surf line. A total of 48 of the 81 tagged smolts were detected, with an assumed survival rate of 59% (Kelley, 2008). Survival was assumed based on detections from any one the hydrophones deployed in ocean. It is possible that some of the smolts successfully exited the estuary and avoided detection by either swimming parallel to the coast, outside of detection range, and/or by hydrophones that shifted from their original deployment location (Kelley, 2008). The smolt emigration portion of the study provided some data on estuary residency (from release time in the estuary to detection time in the ocean) and time smolts remained near shore at the mouth of the estuary. The PIT tagging portion of the study will provide data within the next 3 years when and if the tagged fish return to the river, as the PIT tags are designed to last the life of the fish. The District will be installing a Biomark PIT tag antenna and transceiver within the Freeman Diversion Fish Ladder. The PIT tag antenna will be 24” x 24” square and placed to direct adult steelhead through it when they migrate through the fish ladder.

In the future, Casitas Municipal Water District and Cachuma Resource Conservation District biologists plan to incorporate PIT tagging monitoring into their steelhead monitoring programs (Tim Robinson and Scott Lewis pers. comm.). PIT tag monitoring of steelhead in the Santa Clara, Ventura and Santa Ynez Rivers will enable us to collect data regarding smolt-to-adult return (SAR) ratios within each of these watersheds, time spent in the ocean, upstream migration timing, as well as possible straying between the three watersheds.

3.1 INTRODUCTION

The Freeman Diversion Facility is equipped with a denil fish ladder (fishway) that was constructed to facilitate steelhead and Pacific lamprey upstream migration over the concrete diversion dam. Although denil fishways are not ideal for lamprey passage, the fish ladder has passed hundreds of lamprey in the 1990's (Chase 2001). There is some uncertainty regarding how many steelhead have passed the diversion dam because of lack of an efficient monitoring program due to extreme environmental constraints. Even with the uncertainties in the data, a low number of wild adult steelhead (N=8) have passed through the fish ladder since it was constructed in 1991. Two fin clipped hatchery adult steelhead were observed in the fish ladder this year.

3.2 METHODS

In years with sufficient rainfall, upstream migrant monitoring is conducted to determine if adult steelhead use and effectively navigate the fish ladder. Data were collected using standardized data sheets that include: date and time, adult upstream migrants observed and/or relocated, numbers of fish observed, flow and water quality parameters, and photos were taken to document the physical condition of individual fish. Fork length measurements were taken when possible. Water quality data were collected using a Horiba multi-parameter U-20 series meter. Currently, there is no active fish trap deployed within the fish ladder to monitor upstream migration. In order to monitor steelhead upstream migration, the district installed a passive monitoring device that counts upstream migrants when they jump over a false weir and through an infrared (IR) scanning devise. The IR scanning device was checked daily by running an object through the beams. The results of these checks were documented on data sheets. To date, no fish have been documented by the counter. The only other option for upstream migration monitoring is during fish ladder shutdowns or when flow is reduced within the fish ladder. Monitoring during hour long shutdowns of the fish ladder only allows for intermittent observations during the migration season. It would benefit steelhead recovery efforts and increase knowledge regarding

Pacific lamprey migration if an active trap was installed within the fish ladder. An active trap would temporarily trap all upstream migrants so that information can be gathered regarding ladder efficiency, migration timing, fish condition, water quality at migration, etc.

The remainder of the section describes each upstream migration monitoring method in detail.

3.2.1 LADDER OPERATION

The Freeman Diversion Fish Ladder was operated based on results from negotiations between NMFS biologists and the District hydrologist and biologist. These new operating criteria were revised in the United States Bureau of Reclamations *Biological Assessment of the Operation of the Vern Freeman Diversion Dam and Fish Ladder, Santa Clara River, Ventura County, California.*

3.2.2 VIDEO OBSERVATION

Upstream migration monitoring was conducted using a false weir and infrared counter (Photo 7 Appendix B). The false weir creates a barrier within the ladder that forces upstream migrant steelhead to jump out of the water approximately six inches to get over a small “fall or cascade” to continue upstream. Consequently, the upstream migrants jump through the infrared counter that passively counts and films each fish that negotiates the weir. The weir was designed with a bar screen at the bottom of the structure to allow for Pacific lamprey upstream migration past the false weir. It is unclear if Pacific lamprey will be able to pass through the bar screen based on a lack of data regarding approach water velocities at the screen. Approach velocities at the bar screen and potential monitoring alternatives will be evaluated during the next couple of years of operations.

Once upstream migrant steelhead jump over the false weir, two video monitoring systems document the event as well as species identification and size. A Digital Video Recorder (DVR) is the primary device used and a Video Cassette Recorder (VCR) is used as a back-up system (Photo 8, Appendix B). Both systems receive the same image from a single camera mounted on the side of the ladder four feet upstream of the false weir. The camera is positioned so it captures images of upstream migrant steelhead jumping over the weir structure.

A twenty-five watt fluorescent light is used to illuminate the false weir at night.

The IR scanner device is equipped with sensors on both sides of the false weir with multiple closely spaced invisible beams that when broken by a fish jumping through the beams, it signals the DVR to record the event. The DVR records events for twenty seconds before and then ten seconds after being triggered.

To evaluate the efficiency of the IR scanner device, the video monitoring system was checked daily to ensure proper function and included reviewing any alarm triggered video footage and making any necessary adjustments to the water levels, scanning devices, or recording equipment. Any recorded images saved on the DVR are reviewed by staff during these checks.

3.2.3 LADDER SHUTDOWNS

During shutdowns/dewatering of the ladder, a thorough examination of the entire fish ladder was conducted to check for the presence of any fish species. The ladder was shut down for operational reasons such as high storms flows, channel flushes, and/or removal of debris from the weir. Also, the ladder was periodically shut down opportunistically to survey the facility for steelhead and/or Pacific lamprey migrants.

3.3 RESULTS

3.3.1 LADDER OPERATION

The fish ladder was in operation from January 6 to January 14 and January 29 to March 21, 2008. Two adult steelhead were observed in the fish ladder on March 11, 2008 during repair of the IR scanners (Photos 9 and 10, Appendix B). These fish were both missing adipose fins, which is indicative of hatchery steelhead cultured in the Pacific Northwest. No anadromous fish hatcheries exist in southern California and the resident rainbow trout hatchery located in Fillmore does not clip adipose fins. See section 4.2.3 for additional information.

3.3.2 VIDEO OBSERVATION

The DVR and VHS recording equipment were operated continually from January 6 to January 14 and January 29 to March 21, 2008; during the operation of the fish ladder. Throughout this period the alarm trigger system and video recordings

were monitored and checked daily.

In 2008, all alarm triggers were determined to be “false hits”; triggered by something other than steelhead. The “false hits” triggered by the scanning devices were most often triggered by surging water levels. Occasionally, birds, insects or debris blowing in the wind would trigger a “false hit”.

In the future, additional video observation monitoring equipment will be incorporated into the current system. The objective of a more extensive monitoring system will be to gain knowledge of steelhead behavior before they enter the ladder and provide timing of passage through the ladder. These data could be extremely useful regarding management and operations of the Freeman Diversion Fish Ladder.

3.3.3 LADDER SHUTDOWNS

The fish ladder was shut down a total of sixteen times in 2008. Two shut down events occurred in January (14th & 30th). Eight events occurred in February (1st, 2nd, 3rd, 7th, 15th, 17th, 22nd & 24th). Six events occurred in March with two of the events occurring on March 11. The remaining events for March were on the 12th, 13th, 17th & 20th.

4.1 INTRODUCTION

During high flow events when the river is highly turbid resulting from elevated concentrations of total suspended solids (over 3000 ntu's), District operations staff "turn-out" all river flows from the facility and the fish screen bay section of the diversion structure can become dewatered or extremely shallow. When the water is turned out of the facility, head gates are closed to retain sufficient depth in the fish screen bay to avoid potential predation from birds. Additional operations and maintenance activities include "flushes" where District operations staff "turn-out" all river flows from the facility to maintain the active channel toward the facility headworks or to conduct maintenance of the canal gates and screens. During all "turn-out" events when the fish ladder is in operation, the fish ladder must be shut down and inspected for potential fish stranding. When the fish ladder is shut down it slowly dewaters. This creates the potential for fish to become stranded in the fish ladder.

The primary objective of fish stranding surveys is to rescue any fish that become stranded when diversion operations cause river flow to rapidly diminish downstream of the Freeman Diversion in the Santa Clara River and within the fish screen bay and fish ladder during dewatering operations.

4.2 METHODS

4.2.1 FISH SCREEN BAY STRANDING SURVEYS

During turn-out and flushing events, the fish screen bay was thoroughly examined for the presence of steelhead, Pacific lamprey and other aquatic species. Two or more biologists survey the fish screen bay as it dewaters. These surveys are conducted by seining the entire area with either 3/8 or 1/4 inch mesh brailed seines that are 4 feet deep and from 10 to 20 feet long (Photo 11, Appendix B). The primary objective of these surveys was to capture and relocate steelhead and Pacific lamprey stranded during dewatering of the fish screen bay to appropriate habitats either in the estuary (smolts, kelts, macropthalmia) or the

Santa Clara River or associated tributaries (resident coastal rainbow trout and Pacific lamprey ammocoetes). Also, the fish screen bay was periodically dewatered opportunistically to look for steelhead and Pacific lamprey migrants that could potentially be held up in the fish screen bay. All fish were transported via aerated coolers. Non-native aquatic species were removed from the river. All data collected during stranding surveys were documented on standardized datasheets. Fish were transported utilizing materials and methods described in Section 2.2 of this report.

4.2.2 Lower Santa Clara River Stranding Surveys

Stranding surveys were conducted in the Santa Clara River below the Freeman Diversion when bypass flows were significantly reduced or when releases were stopped all together, due to turn-out or flushing events. These surveys were conducted by entering the non-wetted area of the floodplain via a Polaris Ranger All Terrain Vehicle that was stocked with equipment necessary to collect, hold and transport stranded fish. Stranded fish were captured either with dip nets or 1/8 inch to 1/4 inch mesh brailed seines and placed in aerated coolers. In 2008, no upstream migrant steelhead or Pacific lamprey were collected. In years when upstream migrant steelhead and Pacific lamprey are collected during these surveys they will be relocated upstream of the Freeman Diversion Dam. Downstream migrant steelhead were relocated to the Santa Clara River Estuary. In 2008, no downstream migrant Pacific lamprey were collected. In years when downstream migrant Pacific lamprey are collected during these surveys they will be relocated to the estuary.

4.2.3 Fish Ladder Stranding Surveys

Stranding surveys were conducted in the fish ladder during turn-out and flushing events. When the fish ladder is in operation and one of these events occurs, the fish ladder becomes dewatered and the potential exists for steelhead and Pacific lamprey to become stranded either between the denil plates or in the resting pools in the fish ladder. A biologist was present and conducted surveys when these operations occurred by walking the length of the ladder searching for any stranded fish as the ladder dewatered. Dip nets and buckets were used to rescue any stranded fish.

Fish ladder stranding surveys were also periodically conducted by briefly dewatering the ladder to visually survey for steelhead and Pacific lamprey that that might be held up in the fish ladder. If a fish was observed in the denil sections of the ladder it was captured with a dip net, placed in a bucket and relocated to an appropriate location based on its life stage. If a fish was observed in one of the resting pools of the ladder and appeared to not be in immediate danger, flow was turned back in the ladder to allow the fish to continue migrating upstream on its own.

4.3 RESULTS

4.3.1 FISH SCREEN BAY STRANDING SURVEYS

A total of 20 turn-out events occurred during the 2008 water year. Ten of these events were sediment flushes. The remaining turn-out events were due to high turbidity levels from high sediment loads. Thirteen fish screen bay stranding surveys were conducted. Six of these stranding surveys yielded a total of 40 steelhead smolts and 2 resident coastal rainbow trout (Table 6, Appendix A). Two smolts were relocated to the Santa Clara River at the 101 bridge due to sufficient flows in the river. One smolt perished a few hours following the tagging surgery (see section 2.3.2). This fish was preserved in a freezer. The remaining 37 rescued smolts were relocated to the Santa Clara River Estuary.

4.3.2 LOWER SANTA CLARA RIVER STRANDING SURVEYS

Visual surveys were conducted following turn-out events. During one stranding survey, 3 resident coastal rainbow trout were observed stranded below the Freeman Diversion (Table 6, Appendix A). All 3 fish appeared to have been previously smolting but appeared to be losing their smolt characteristics. Two of the fish were found near the base of the diversion dam and were successfully relocated to Sespe Creek. One of the fish was found approximately 1.5 miles downstream of the diversion and was dead on arrival. This fish was preserved in a freezer.

The day prior to this planned flushing event we installed two fyke nets, with live cars attached to each, about 500 feet downstream of the Freeman Diversion. Sheets of plywood and fence posts were installed as weirs and sandbags were used as anchors. This was our best attempt to minimize the impacts to

steelhead and Pacific lamprey that may become stranded below the diversion during this flushing event. The fyke nets failed due to high water velocity and debris but this procedure will be further modified to be an effective method for reducing potential stranding in the future.

4.3.3 Fish Ladder Stranding Surveys

There were a total of 8 turn-out events and 8 random ladder checks that caused the fish ladder to become dewatered requiring stranding surveys. A biologist walked the length of the fish ladder during each event as the ladder dewatered.

On March 11, 2008, during a routine check, 2 adult hatchery steelhead were observed in the lowest resting pool of the fish ladder (Table 6, Appendix A). Following a visual survey of these fish, the fish ladder exit gate was opened slightly, slowly filling the ladder with water to allow the fish to continue their migration upstream. These fish, however, did not continue their migration upstream. They were both later observed in a pool directly below the fish ladder where they had excavated a redd (spawning bed) (Photo 12, Appendix B). The redd was not viable since it was excavated in sand. Viable steelhead redds require clean gravels in cold, clear water. The redd was excavated by a biologist a few weeks later and no eggs were observed. The construction of the redd was not observed since it occurred at higher flows and the water clarity was poor. If the female laid eggs, they most likely were swept downstream by high water velocities and because there were no interstitial spaces for the eggs to deposit as would occur on a gravel bed. On March 19, the same day the redd was observed, one of the hatchery steelhead was observed below the fish ladder entrance pool attempting to migrate downstream in shallow water. The fish was not successful and migrated back to the pool and was not observed again. This was the smaller of the two fish and it appeared to be the female.

On April 3, 2008 the District performed a flush and the larger steelhead, believed to be the male, was observed and captured. The fish was released to the Freeman Fish Trap Bay while we attempted to obtain guidance from a local California Department of Fish and Game (CDFG) steelhead biologist. Since these fish were of hatchery origin, The CDFG office in Santa Barbara offered to lend a coded wire tag reader to potentially identify the origin of this fish. Unfortunately, no coded wire tag was detected. Many anadromous hatcheries

implant smolts with coded wire tags before they are released to rivers. We repeatedly attempted to contact the local CDFG steelhead biologist for guidance but we received no reply. The NMFS gave no guidance since UWCD was in the section 7 consultation process. Since no guidance was received from the respective resource agencies and the fish was not listed under the federal endangered species act because it was of hatchery origin, we decided to relocate it to the Santa Clara River so it could emmigrate back to the ocean (Photo 13, Appendix B). I contacted many of my previous colleagues in Oregon and northern California and their reactions were, “remove the fish from the river” since it was of hatchery origin. I agreed with this opinion since it is common in northern rivers to segregate hatchery stocks from wild stocks in terminal fisheries (rivers). Dams are usually used for this purpose. Hatchery fish are not allowed past some dams and wild fish are allowed to pass and spawn eliminating the potential, at least in the upper watershed, for introgression between wild and hatchery fish. This method was used on the McKenzie River during my past employment with the Oregon Department of Fish and Wildlife.

On June 9, 2008 one resident coastal rainbow trout was observed stranded between two denil plates in the lowest section of the fish ladder located directly above the fish ladder entrance pool (Table 6, Appendix A). The fish ladder had been non-operational since March, but the entrance pool had been maintained and this is where the fish had likely been holding before it entered the lower section of the ladder. This fish appeared to have been previously smolting but appeared to be losing its smolt characteristics. It appeared healthy and was relocated to Sespe Creek.

5.1 INTRODUCTION

Water quality monitoring for 2008 was conducted to monitor conditions that steelhead and Pacific lamprey are exposed to in various areas within the watershed. Water quality parameters such as dissolved oxygen, pH, conductivity, salinity, and turbidity were not included due to mechanical sensor issues with our water quality meter. In the future, we will have complete data sets of water quality parameters at steelhead and Pacific lamprey release sites. This monitoring will be expanded in the future and will include more extensive watershed-wide temperature monitoring.

5.2 METHODS

Water quality monitoring for 2008 included water temperature measurements utilizing Onset Hobo® temperature loggers at various sites within the Santa Clara River watershed and in-situ water quality measurements taken during fish relocation activities using a Horiba U-22 multi-parameter water quality meter. The majority of the temperature loggers were placed at mid-depth and programmed to take measurements every hour. Insitu water quality measurements were collected when steelhead were relocated to the Santa Clara River Estuary, mainstem Santa Clara River or Sespe Creek. The dissolved oxygen sensor in the water quality meter was not in good working order during the majority of the 2008 season so these data are not presented in this report.

5.3 RESULTS

Water temperature monitoring occurred at six sites (Table 7, Appendix A and Figure 4, Appendix A). These sites include:

- Santa Clara River Estuary
- Freeman Fish Trap Bay
- Freeman Fish Screen Bay
- Santa Clara River at VCWPD Site

- Santa Paula Creek at Steckel Park
- Sespe Creek at Grand Avenue

Graphs depicting data at these six sites can be found in (Figures 5-10, Appendix A).

5.3.1 SANTA CLARA RIVER ESTUARY

The Santa Clara River Estuary temperature monitoring site was located near the north bank approximately 500 feet downstream of the Harbor Boulevard Bridge (Photo 14, Appendix B). The logger was placed at a depth and location so that when the sandbar breeches, the logger will be out of water (~0.5 feet from the bottom). The objective at this location was to monitor water temperatures at or near the steelhead smolt release point and to potentially monitor sandbar breeching when there was a loss of water at the monitoring site. The estuary was closed to the ocean from approximately May 2, 2008 to August 9, 2008. The sandbar breached on August 9, 2008 following a storm event and the data indicates this with a wider diurnal variation in temperature since the logger is logging air temperature. The analysis of these data includes dates from May 2 to August 9, 2008 when the logger was submerged under water. The minimum water temperature collected at this site was 8.9 ^{o}C and the maximum temperature was 20.5 ^{o}C (Table 8, Appendix A).

5.3.2 FREEMAN FISH TRAP BAY

The Santa Clara River Freeman Fish Trap Bay temperature monitoring site was located within the fish trap bay. The logger was attached to a rung of a permanent ladder structure within the fish trap bay. The logger was attached with zipties approximately 1.0 feet from the bottom of the bay (Photo 15, Appendix B). The objective at this location was to monitor water temperatures in the fish trap bay where the downstream migrant fish trap is located. Steelhead smolts and several other aquatic species were trapped at this location during the migration season (typically January-June). Temperature monitoring is critical at this location as this is where the fish remain until the daily trap check occurs. Occasionally resident and young-of-the-year coastal rainbow trout as well as steelhead kelts may also be found in the trap. The minimum water temperature collected at this site was 13.4 ^{o}C and the maximum temperature was 32.2 ^{o}C (Table 8, Appendix A).

5.3.3 FREEMAN FISH SCREEN BAY

The Santa Clara River Freeman Fish Screen Bay temperature monitoring site was located within the fish screen bay. The fish screen bay consists of a concrete channel where downstream migrants enter the diversion and migrate to the downstream migrant fish trap. The logger was located approximately 50 feet downstream from the intake to the fish screen bay and attached to an eye hook 0.5 feet from the bottom along a concrete wall (Photo 16, Appendix B). The objective at this location was to monitor water temperatures in the main stem as flow enters the Freeman Facility. Downstream migrant steelhead and Pacific lamprey and other aquatic species temporarily rear in the fish screen bay prior to entering the trap. The downstream migrant fish trap is typically taken out of operation between June and January and all fish that enter the facility rear in the fish screen bay until trapping operations reconvene in January. The minimum water temperature collected at this site was 6.6 ^{o}C and the maximum temperature was 32.7 ^{o}C (Table 8, Appendix A).

5.3.4 SANTA CLARA RIVER AT VCWPD PROJECT

The Ventura County Watershed Protection District (VCWPD) Project temperature monitoring site in the Santa Clara River was located approximately 100 feet downstream from the most downstream groin at the county bank stabilization site off South Mountain Road in Santa Paula. The logger was attached to a fence post with zip ties 0.9 feet from the bottom (Photo 17, Appendix B). The objective at this location was to monitor water temperatures in the main stem Santa Clara River between Sespe Creek and the Freeman Diversion. In the future, we will be adding more temperature monitoring sites throughout the Santa Clara River to closely monitor temperatures during the steelhead and Pacific lamprey migration season. The minimum water temperature collected at this site was 12.3 ^{o}C and the maximum temperature was 23.6 ^{o}C (Table 8, Appendix A).

5.3.5 SANTA PAULA CREEK AT STECKEL PARK

The Santa Paula Creek temperature monitoring site was located ~50 feet upstream of the Steckel Park Bridge. The logger was attached 0.2 feet from the bottom with zip ties to a fence post. The fence post was located under a boulder and secured to an alder tree via cable along the bank (Photo 18, Appendix B).

The objective at this location was to monitor water temperatures in Santa Paula Creek. This location is ideal for monitoring temperatures due to adequate flows, areas of scour and instream cover. Temperature monitoring in Santa Paula Creek will be expanded to include multiple monitoring sites in the future. The minimum water temperature collected at this site was 11.4 °C and the maximum temperature was 28.2 °C (Table 8, Appendix A).

5.3.6 Sespe Creek at Grand Avenue

The Sespe Creek at Grand Avenue temperature monitoring site was located directly downstream of the USGS Gauge along Grand Avenue. The logger was attached to a steel pipe with zipties 2.0 feet from the bottom along the bank (Photo 19, Appendix B). The objective at this location was to monitor water temperatures at the resident and young-of-the-year coastal rainbow trout release location in Sespe Creek. This is an easily accessible pool with sufficient flow creating areas of scour and plenty of instream cover consisting primarily of riparian vegetation and boulder substrate. The minimum water temperature collected at this site was 13.7 °C and the maximum temperature was 30.6 °C (Table 9, Appendix A).

5.4 Discussion

The maximum water temperatures at most sites extend above what is considered the chronic or incipient upper lethal temperature limit of 25ºC for many anadromous salmonids although higher temperatures reaching 29 ºC can be tolerated for a short period of time (Myrick and Cech 2001) if water quality conditions are good. The maximum water temperature of 32.7ºC at the Freeman Fish Screen Bay most likely occurred when the water was turned out of the diversion and the logger was exposed to the air. The remaining extreme water temperatures are not uncommon in southern California. Southern California coastal rainbow trout have adapted to a wide variation in water temperatures by seeking out thermal refugia when available. Other behavioral responses to upper thermal extremes include increase feeding when food is available to offset the cost of an elevated metabolic rate although feeding does decline after about 19ºC but growth can still occur up to 25ºC (Myrick and Cech 2000). Also, the duration of exposure is important since these fish will experience upper thermal limits over a period of a few hours during any given day and only seasonally and

these fish can maintain body weight at 25 ºC for 30 days (Myrick and Cech 2000). In drainages where thermal refugia and low food production occurs, thermal stress alone can cause mortalities.

Next year, additional temperature monitoring sites will be added throughout the watershed; including the Santa Clara River, Santa Paula Creek, Sespe Creek and Piru Creek. Once we acquire enough temperature loggers, we will conduct temperature monitoring at reference pools that contain thermal refugia.

Behler, J. L. and F. W. King. 1996. National Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, Inc. New York.

California Department of Fish and Game. 2009. California Natural Diversity Database, Special Animals (883 taxa). The Natural Resources Agency, Biogeographic Data Branch.

Chase, S. 2001. Contributions to the life history of adult Pacific lamprey (*Lampetra tridentata*) in the Santa Clara River of southern California. Bulletin of the Southern California Academy of Sciences 100(2):74–85.

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

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

Kelley, E. 2008. Steelhead trout smolt survival in the Santa Clara and Santa Ynez River Estuaries. Prepared for The California Department of Fish and Game Fisheries Restoration Grant Program University of California, Santa Barbara. August 2008. 61 pp

Myrick, C. A., and J. J. Cech, Jr. 2000. Temperature influences on California rainbow trout physiological performance. Fish Physiology and Biochemistry 22(3):245–254.

Myrick, C. A. and J. J. Cech, Jr. 2001. Bay-Delta Modeling Forum. Technical publication 01-1. Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations.

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

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

Thomas R. Payne and Associates (TRPA). 2005. Assessing passage of steelhead over riffles in the lower Santa Clara River. Draft Final Report. 31 pp.

Wedemeyer, G.A. 1996. Physiology of Fish in Intensive Culture Systems. Chapman and Hall, New York, New York.

Appendix A

Tables and Figures

Table 1 - Santa Clara River Fish Species

Common Name	Scientific Name	Status	Resident - Anadromous	Regulatory Status
Tidewater Goby	*Eucyclogobius newberryi*	Native	Resident	FE, DFG: SSC
Partially Armored Stickleback	*G. a. microcephalus*	Native	Resident	--
Unarmored Stickleback	*G.a. williamsoni*	Native	Resident	FE, SE, DFG: FP
Arroyo Chub	*Gila orcuttii*	Native	Resident	DFG: SSC
Pacific Lamprey	*Entosphenus tridentatus*	Native	Anadromous	--
Rainbow Trout	*Oncorhynchus mykiss*	Native	Resident	--
Steelhead Trout	*Oncorhynchus mykiss irideus*	Native	Anadromous	FE, DFG: SSC
Black Bullhead	*Ameiurus melas*	Introduced	Resident	--
Brown Bullhead	*Ameiurus nebulosus*	Introduced	Resident	--
Santa Ana Sucker	*Catostomus santaanae*	Introduced*	Resident	*FT, DFG: SSC
Owens Sucker	*Catostomus fumeiventris*	Introduced	Resident	**DFG: SSC
Hybrid Sucker	*C.santaanae x C. fumeiventris*	Introduced	Resident	--
Prickly Sculpin	*Cottus asper*	Introduced	Resident	--
Common Carp	*Cyprinus carpio*	Introduced	Resident	--
Goldfish	*Carassius auratus*	Introduced	Resident	--
Threadfin Shad	*Dorosoma petenense*	Introduced	Resident	--
Mosquitofish	*Gambusia affinis*	Introduced	Resident	--
Channel Catfish	*Ictalurus punctatus*	Introduced	Resident	--
Green Sunfish	*Lepomis cyanellus*	Introduced	Resident	--
Bluegill	*Lepomis macrochirus*	Introduced	Resident	--
Mississippi Silverside	*Menidia audens*	Introduced	Resident	--
Largemouth Bass	*Micropterus salmoides*	Introduced	Resident	--
Fathead Minnow	*Pimephales promelas*	Introduced	Resident	--
Black Crappie	*Pomoxis nigromaculatus*	Introduced	Resident	--
White Crappie	*Pomoxis annularis*	Introduced	Resident	--
Brown Trout	*Salmo trutta trutta*	Introduced	Resident	--

FE = Federally Endangered Species; FT = Federally Threatened Species; SE = State Endangered Species; DFG: FP = California Department of Fish and Game - Fully Protected Species; DFG: SSC = California Department of Fish and Game - Species of Special Concern.

*Santa Ana Sucker is listed as FT and DFG:SSC in its native drainage; this does not include the Santa Clara River.

**Owens Sucker is listed as DFG: SSC in its native drainage; this does not include the Santa Clara River.

Table 2 - Freeman Diversion Operations and Steelhead Monitoring Data

January

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Ladder Operation																															
Smolt Trapping																															
Smolts																														1	
Adult Steelhead																															
Turbidity (ntu)												37.4		27.9	20.6	27.5	25.1	15.0	15.9	17.1	19.1	12.6	1000+	1000+	1000+	1000+	1000+	1000+	1000+	617.0	573.0
Estuary	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open

February

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Ladder Operation																													
Smolt Trapping																													
Smolts	1																												
Adult Steelhead																													
Turbidity (ntu)	553.0	690.0	644.0	340.0	232.0	305.0	194.0	190.0	322.0	352.0		129.0	211.0	165.0	179.0	171.0	138.0	61.0	101.0	167.0	166.0	157.0	180.0	1000+		343.0	220.0	157.0	106.0
Estuary	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open

March

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Ladder Operation																															
Smolt Trapping																															
Smolts																					1			2			2		3		3
Adult Steelhead											2																				
Turbidity (ntu)	131.0	137.0			90.9	87.7	84.2	58.7	53.1	57.8	49.6	54.9	42.9	69.4	73.2	57.9	47.6	50.8	51.3	49.1	34.0	20.9	23.0	31.1	30.0	39.4	25.1	26.6	16.5	23.8	63.0
Estuary	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open

April

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ladder Operation																														
Smolt Trapping																														
Smolts	4		1	1			20				8		4	6	14	3	2	5	4	1	3			9	1	1	9	5	5	1
Adult Steelhead																														
Turbidity (ntu)	37.5	29.6	26.6	68.6	82.2	96.6	32.0	45.1	24.4	15.7	18.5	22.4	20.1	20.6	20.9	16.7	8.0	21.3	7.5	8.5	10.1	6.1		5.7		7.1	12.5	23.9	8.9	10.8
Estuary	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open

May

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Ladder Operation																															
Smolt Trapping																															
Smolts		1					1	1					1			3	2	3													
Adult Steelhead																															
Turbidity (ntu)	5.1	6.9	4.5	3.8	6.1	5.1	9.6	4.7	5.3	4.6	4.2	5.4	7.2	8.0	6.7	4.8	6.3	4.9	5.9	9.9	6.7	3.1	8.2	5.3	21.5	9.5	8.0	4.0		9.2	6.9
Estuary	Open	Open	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed

June

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Ladder Operation																															
Smolt Trapping																															
Smolts			1																												
Adult Steelhead																															
Turbidity (ntu)	5.5	6.7	4.9	3.6	7.7	4.1	4.1	5.9	6.3	8.2	2.9	3.9	4.6	5.2	3.2	4.1	6.5	4.0	4.0	10.0											
Estuary	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed											

Steelhead Migration Monitoring Complete

Table 4 - Freeman Diversion Fish Monitoring Species Totals 2008

Fish Species: **STK** = Steelhead Adult Kelt, **ST** = Steelhead Adult, **RS** = Smolt, **RT** = Resident Rainbow, **YOY** = Young-of-the-Year *O. mykiss*, **PL (Adult)** = Lamprey Adult, **PL (Am)** = Lamprey Ammocoete, **TS** = Stickleback, **AC** = Arroyo Chub, **SS** = Santa Ana Sucker, **OS** = Owens Sucker, **SSxOS** = Sucker Hybrid, **FM** = Fathead Minnow, **LB** = Largemouth Bass, **GS** = Green Sunfish, **BB**= Brown Bullhead, **BC** = Black Bullhead, **PS** = Prickly Sculpin, **MF** = Mosquitofish

Amphibian & Reptile Species: **WT** = Western Toad, **AT** = Arroyo Toad, **SFT** = Spadefoot Toad, **BF** = Bullfrog, **CRLF** = Red-legged Frog, **PT** = Pond Turtle, **AF** = African Clawed Frog, **TF** = Tree Frog

	Native Fishes									Non-native Fishes									
	STK	ST	RS	RT	YOY	PL (Adult)	PL (Am)	TS	AC	SS	OS	SS x OS	FM	LB	GS	BB	BC	PS	MF
Total	0	2	133	12	12	0	0	5751	336	831	74	138	60	59	8	50	5	463	4

	Amphibians and Reptiles							
	WT	AT	SFT	CRLF	BF	AF	TF	PT
Total	41	0	0	0	15	165	57	6

Biologists: Steve Howard, Sara Gray, **Fish Technicians:** Jeannette Miller, Chris In, Geoff Mosdale

Table 5 - Santa Clara River Reptile and Amphibian Species

Common Name	Scientific Name	Status	Regulatory Status
Two-striped Garter Snake	*Thamnophis couchi hammondi*	Native	DFG: SSC
Southwestern Pond Turtle	*Clemmys marmorata pallida*	Native	DFG: SSC
Red-earred Slider	*Chrysemys scripta elegans*	Introduced	--
California Treefrog	*Hyla cadaverina*	Native	--
Pacific Treefrog	*Hyla regilla*	Native	--
Western Toad	*Bufo boreas*	Native	--
Bullfrog	*Rana catesbeiana*	Introduced	--
African Clawed Frog	*Xenopus laevis*	Introduced	--

DFG: SSC = California Department of Fish & Game - Species of Special Concern

TABLE 6 - FISH STRANDING SURVEY RESULTS

Stranding Survey Location	Adult Steelhead	Smolts	Resident *O. mykiss*	Total
Freeman Fish Screen Bay	0	40	2	42
Lower Santa Clara River	0	0	3	3
Fish Ladder	*2	0	1	3

*Hatchery adult steelhead missing adipose fins.

TABLE 7 - TEMPERATURE LOGGER SITES

Location	Logger #	Date Deployed	Max Depth (ft)	Logger Depth (feet from bottom)	Graph Figure	Photo
Santa Clara River Estuary	1044855	4/26/2007	4.0	0.5	2	1
Freeman Fish Trap Bay	1269160	5/16/2008	3.0	1.0	3	2
Freeman Fish Screen Bay	1044854	6/20/2007	3.0	0.5	4	3
Santa Clara River at the County Project	1269162	3/27/2007	3.1	0.9	5	4
Santa Paula Creek at Steckel Park	1269161	3/27/2008	1.8	0.2	6	5
Sespe Creek at Grand Avenue	1269163	4/31/2008	4.0	2.0	7	6

TABLE 8 - WATER TEMPERATURE STATISTICS BY LOGGER SITE (JANUARY 1, 2008 TO JUNE 20, 2008)

Location	Max Temp (Degrees C)	Date Max Temp	Min Temp (Degrees C)	Date Min Temp	Mean Temp (Degrees C)
Santa Clara River Estuary	31.306	06/21/08	8.916	03/03/08	20.467
Freeman Fish Trap Bay	32.150	6/19/08	13.449	5/27/08	21.029
Freeman Fish Screen Bay	32.742	6/20/08	6.611	01/30/08	16.763
Santa Clara River at County Project	23.593	06/22/08	12.268	03/31/08	18.137
Santa Paula Creek at Steckel Park	28.245	06/21/08	11.394	03/31/08	18.673

TABLE 9 - WATER TEMPERATURE STATISTICS BY LOGGER SITE (APRIL 31, 2008 TO JULY 17, 2008)

Location	Max Temp (Degree C)	Date Max Temp	Min Temp (Degrees C)	Date Min Temp	Mean Temp (Degrees C)
***Sespe Creek at Grand Avenue**	30.621	07/07/08	13.666	05/27/08	22.420

*Limited data available for Sespe Creek for 2008

Figure 1 – Schematic of Freeman Diversion Facility

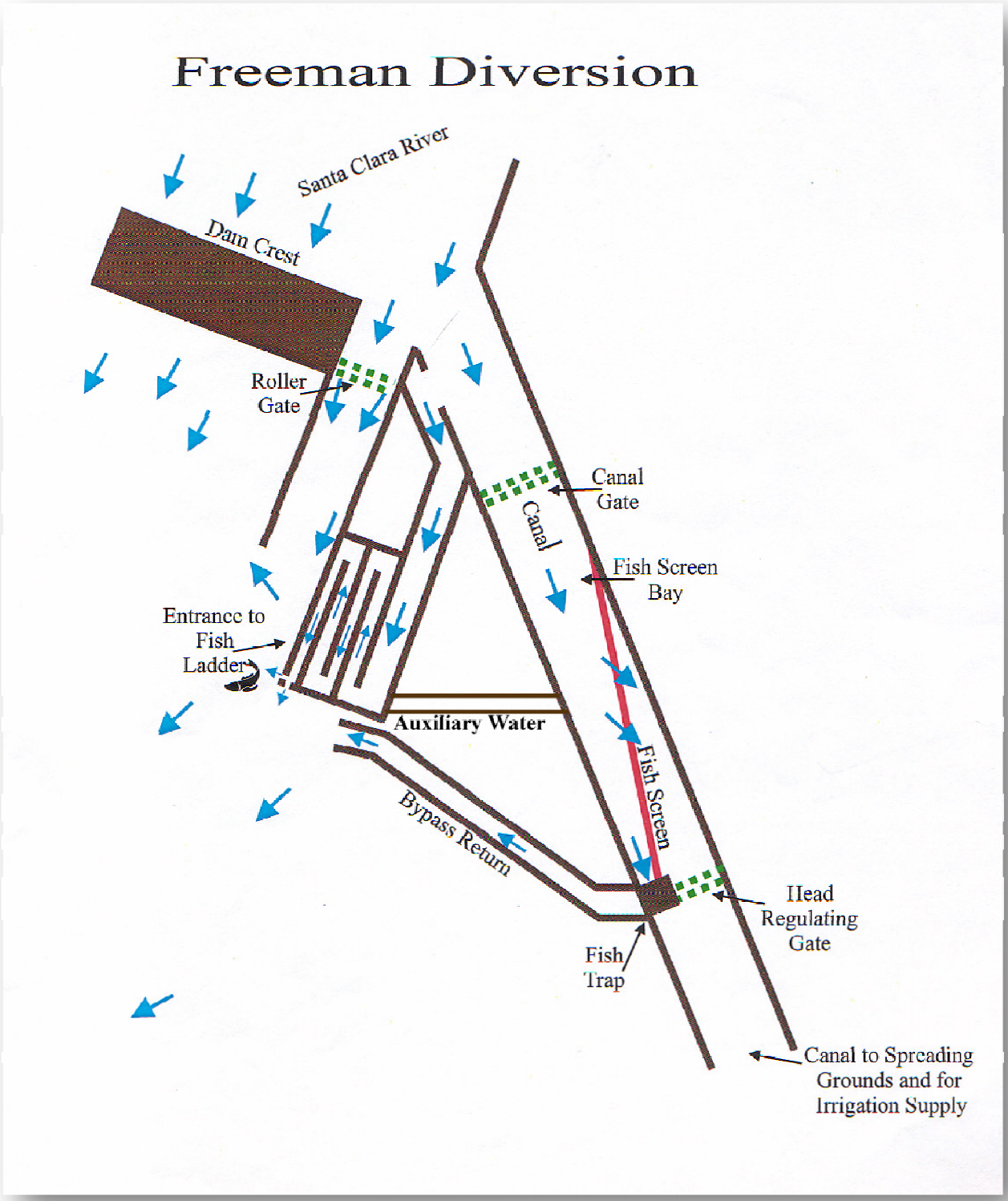


Figure 2 - Rainfall near Fillmore, CA

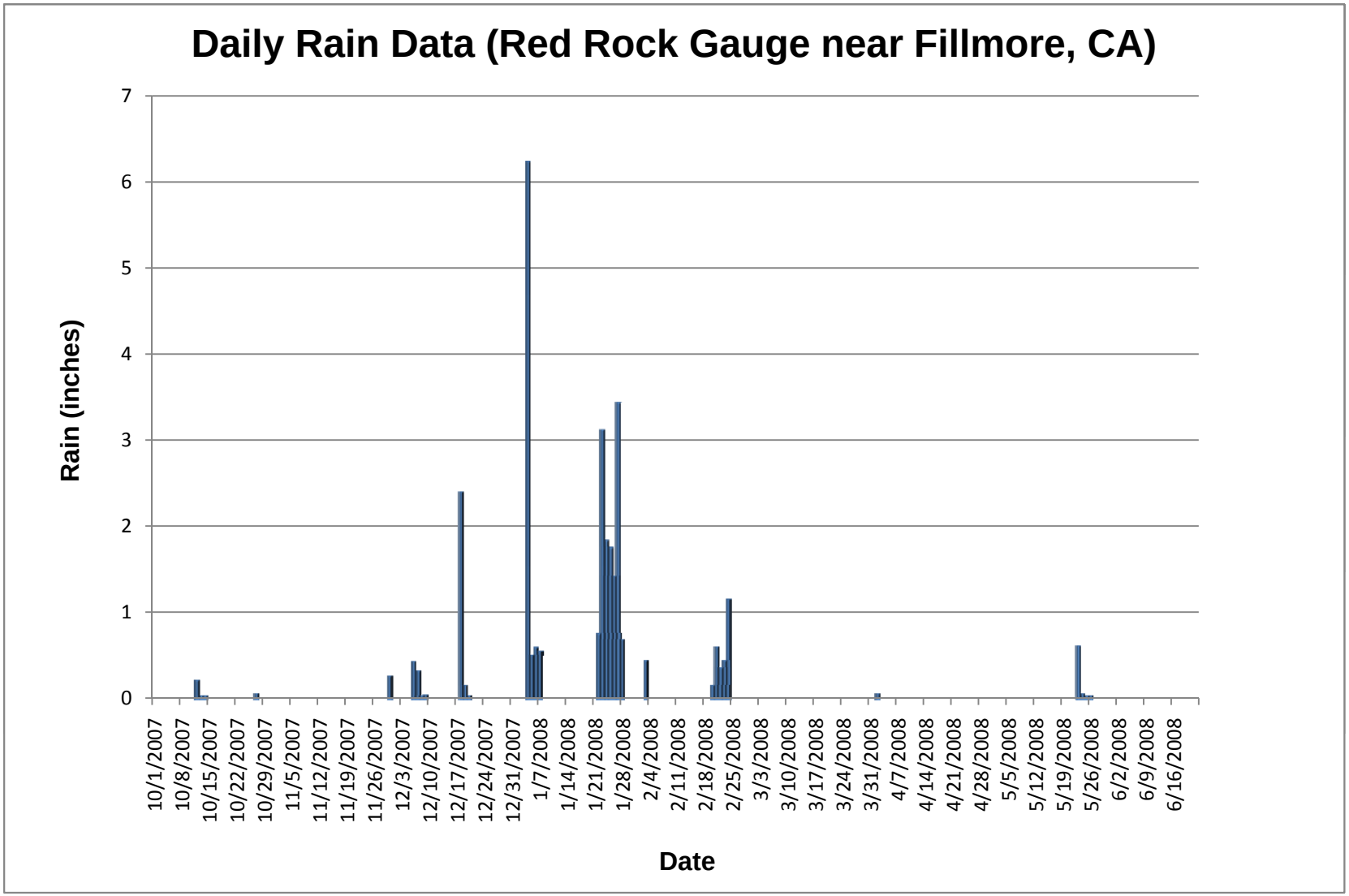


Figure 3 - *O. mykiss* trapping results

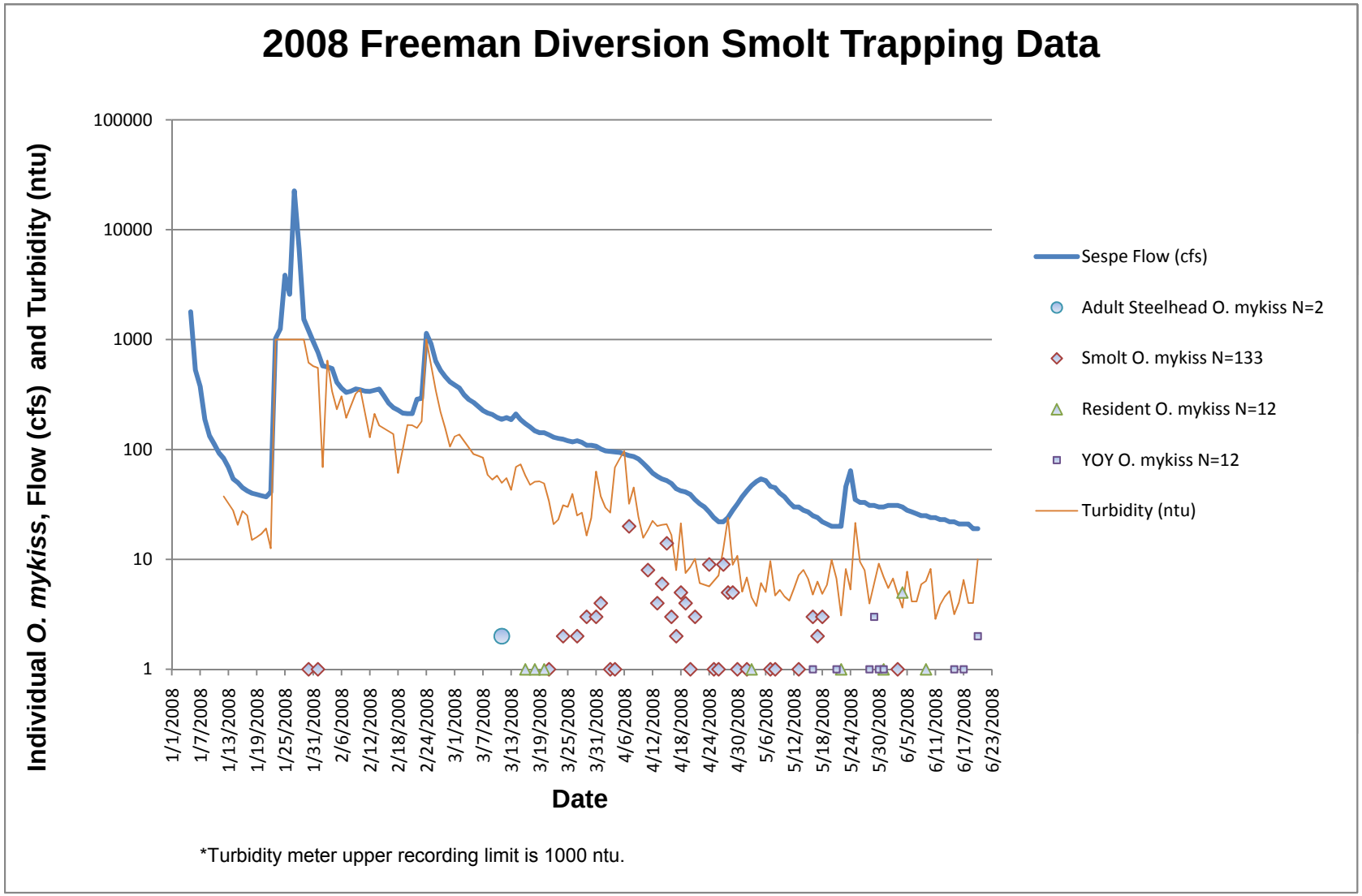


Figure 4 – Water temperature monitoring locations

1. Santa Clara River Estuary
2. Freeman Fish Trap Bay
3. Freeman Fish Screen Bay
4. Santa Clara River at VCWPD Site
5. Santa Paula Creek at Steckel Park
6. Sespe Creek at Grand Avenue

Figure 5 - Santa Clara River Estuary Water Temperature

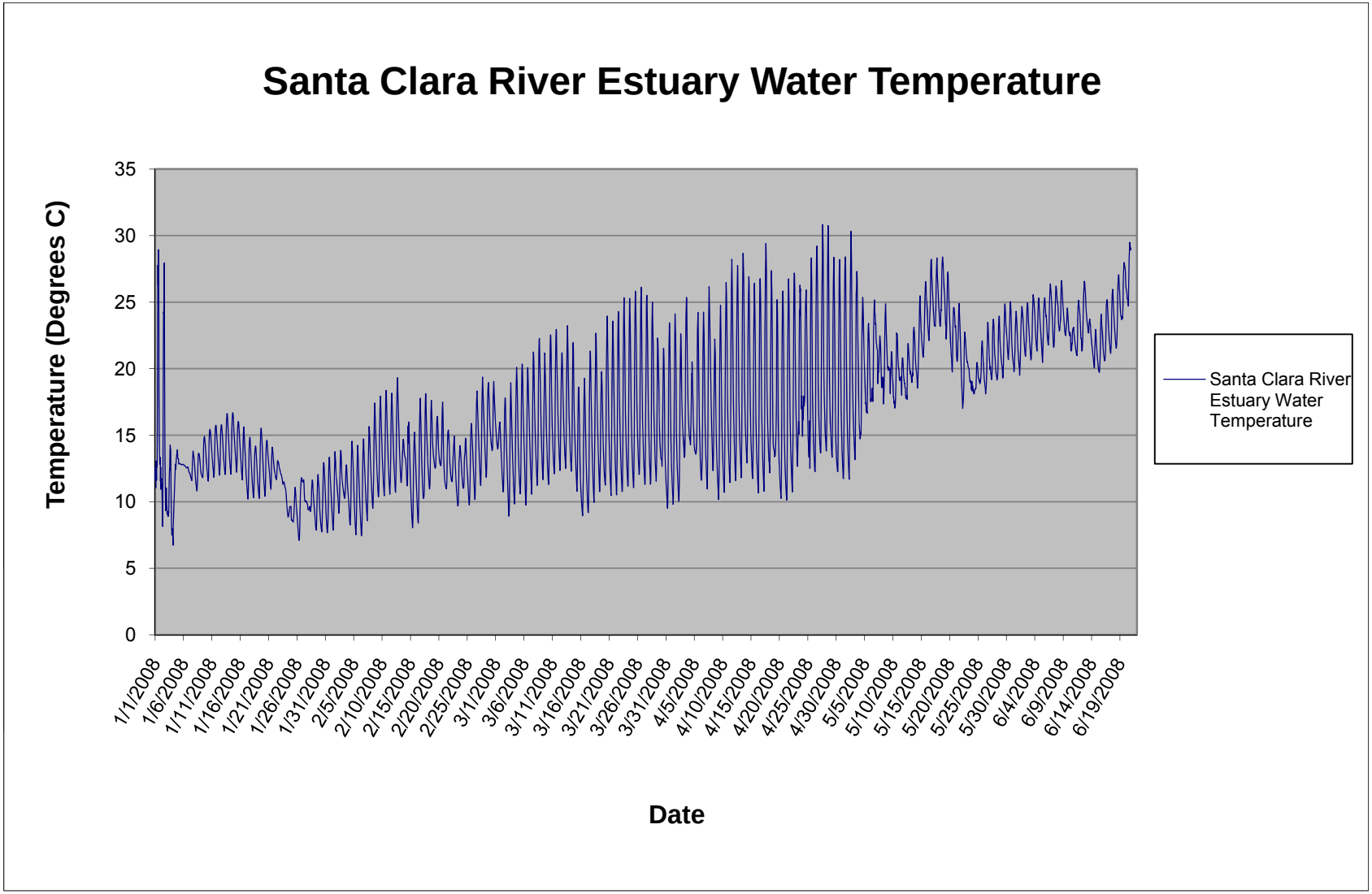


Figure 6 - Freeman Fish Trap Bay Water Temperature

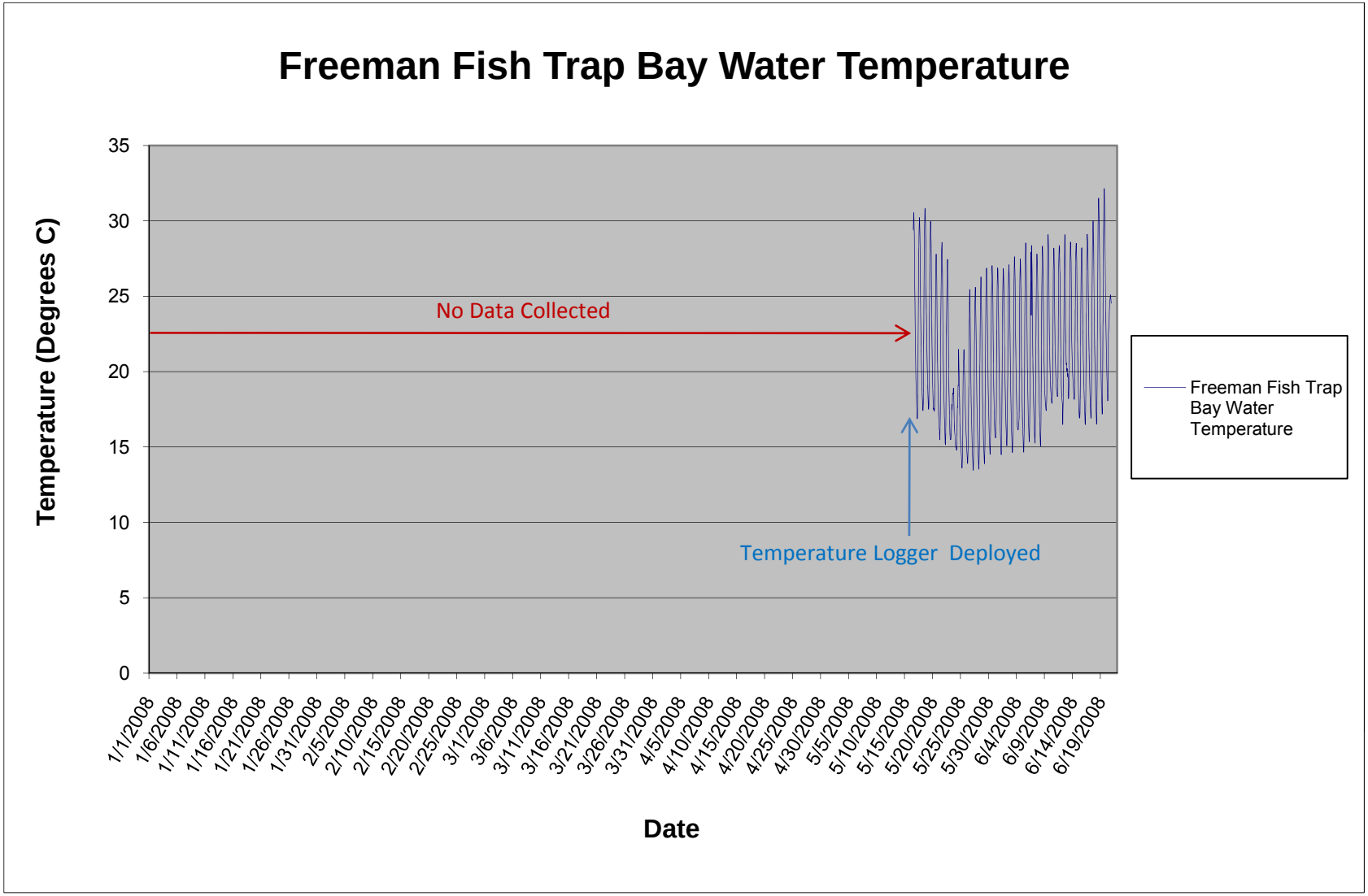


Figure 7 - Freeman Fish Bay Water Temperature

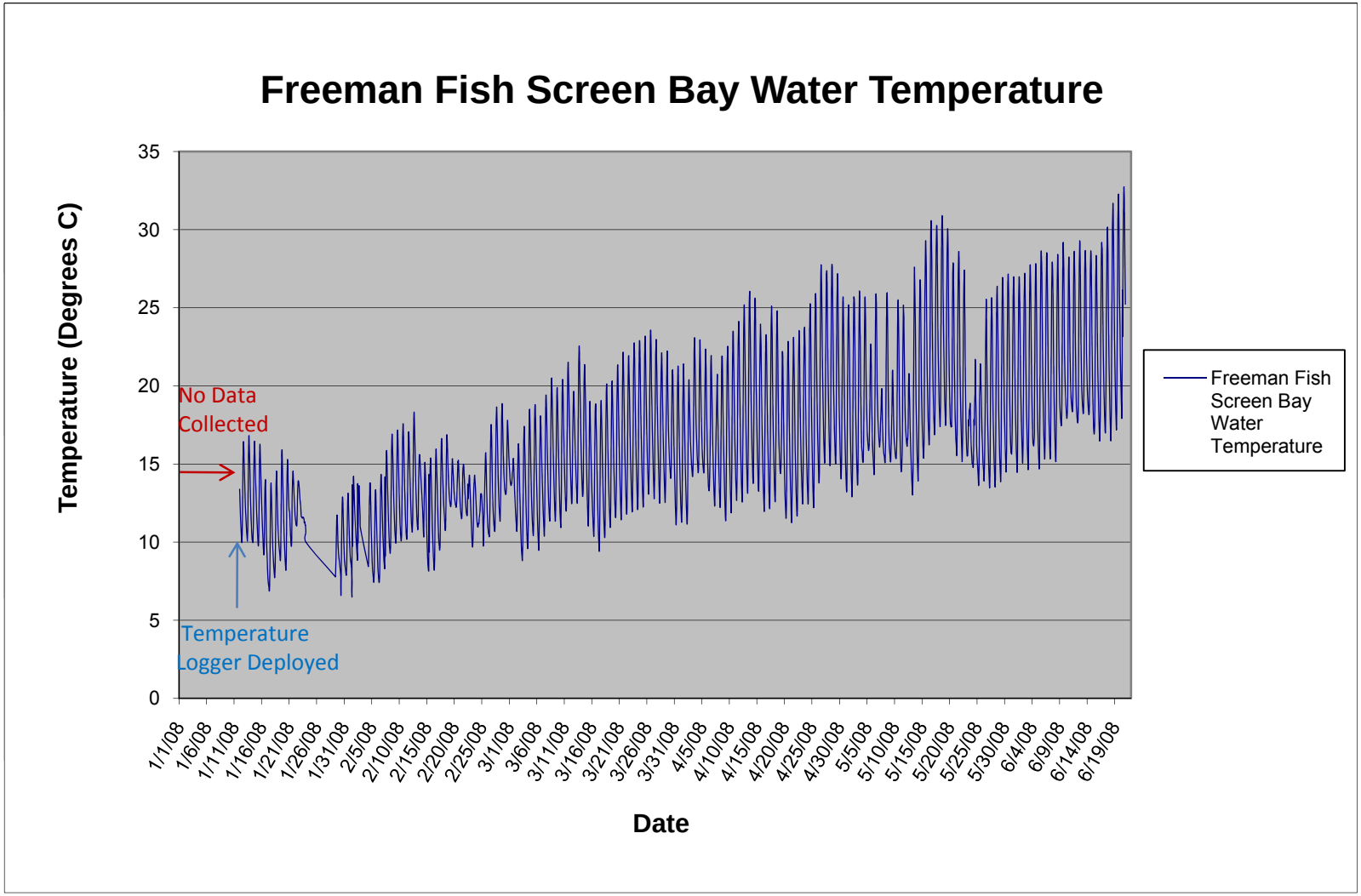
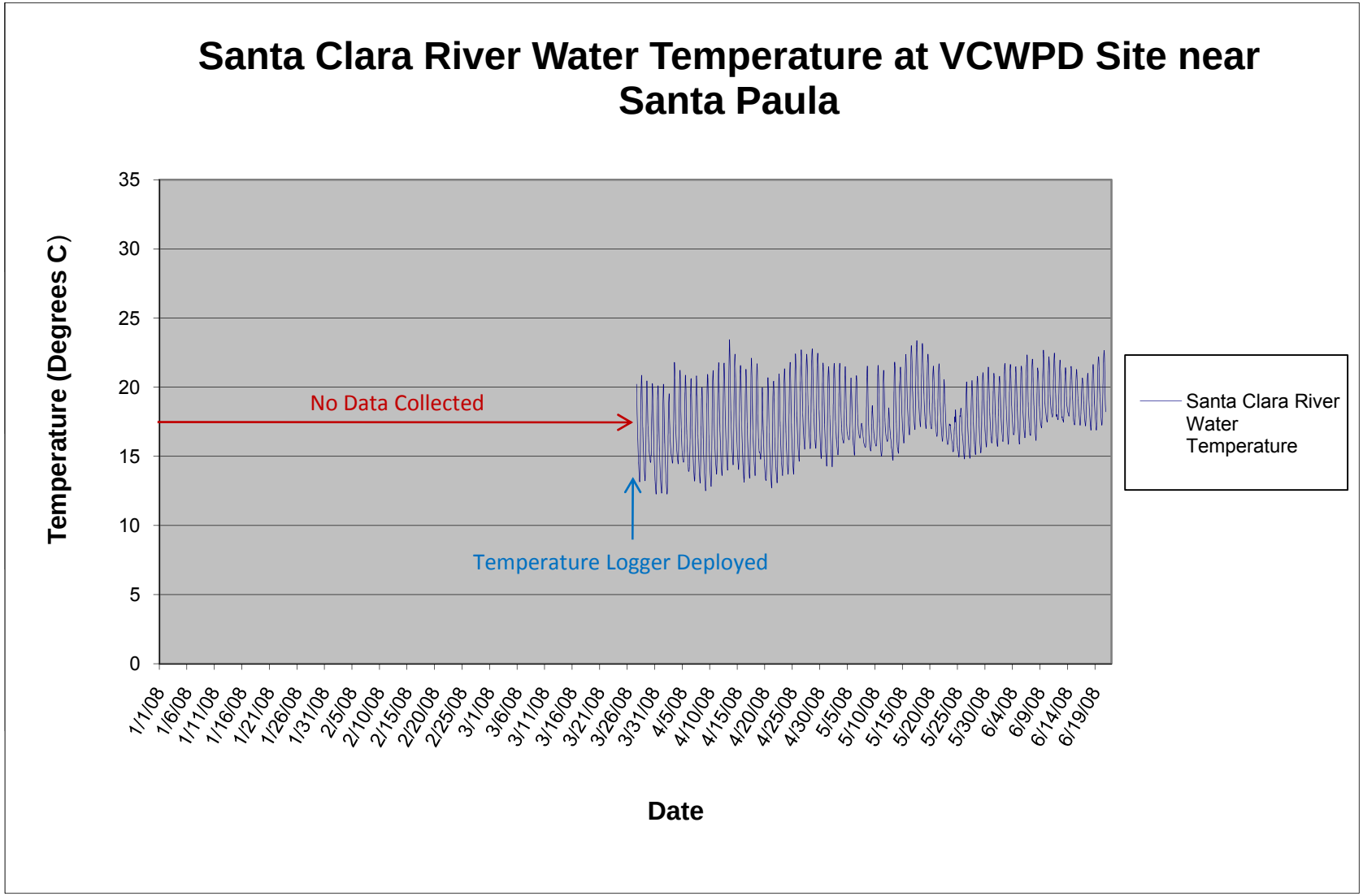


Figure 8 - Santa Clara River Water Temperature near Santa Paula, CA



Note: Surface water data at this site is influenced by a groundwater seep

Figure 9 - Santa Paula Creek Water Temperature

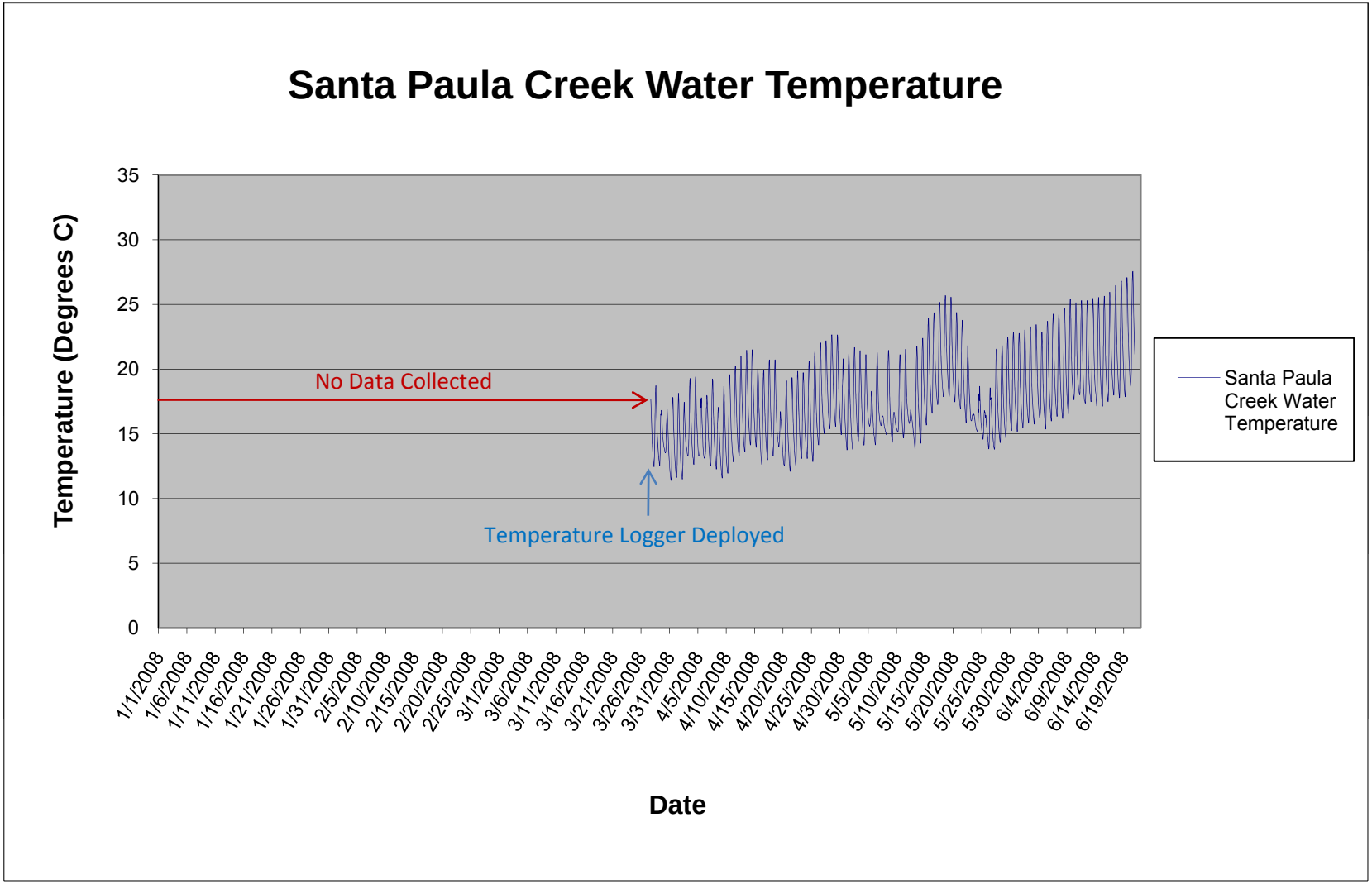
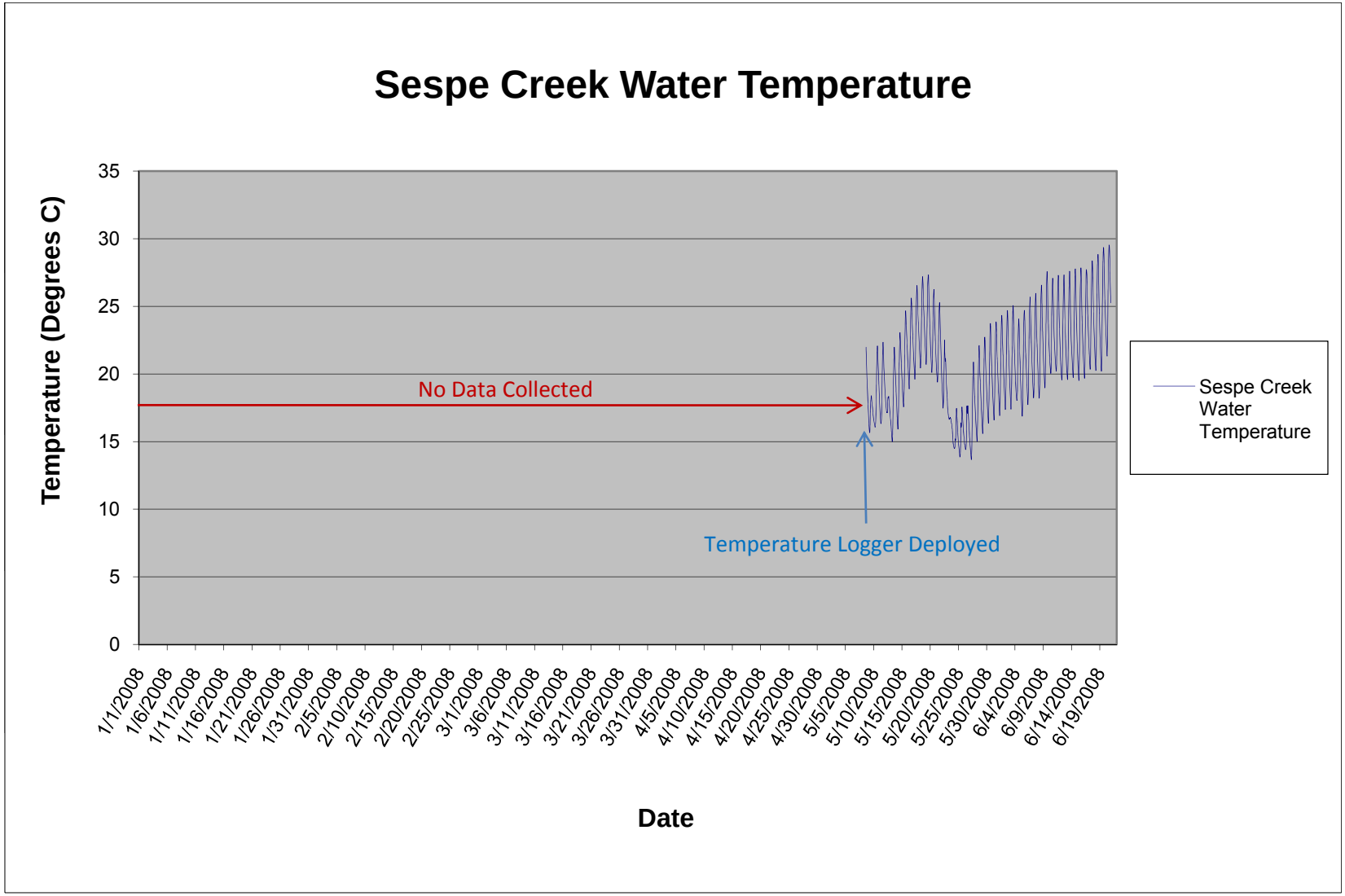


Figure 10- Sespe Creek Water Temperature



Appendix B

Photos

Photo 1 – Santa Clara River Estuary Smolt Relocation Site

Photo 2 – Resident Rainbow Trout Relocation Site (Santa Clara River near Santa Paula)

Photo 3 - Santa Clara River Steelhead Smolt (3/21/08)

Photo 4 - Santa Clara River Steelhead Smolt (4/21/08)

Photo 5 – Santa Clara River Resident Rainbow Trout (3/20/08)

Photo 6 – Santa Clara River Young of the Year Rainbow Trout (5/29/07)

Photo 7 - Upstream Migration Monitoring Infrared Scanners

Photo 8 – Upstream Migration Monitoring DVR/VCR System

Photo 9 – Adipose Fin Clipped Adult Steelhead 1 (3/11/08)

Photo 10 – Adipose Fin Clipped Adult Steelhead 2 (3/11/08)

Photo 11 – Fish Screen Bay Stranding Survey

Photo 12 - Steelhead Redd Downstream of Freeman Diversion (3-19-08)

Photo 13 – Spent Hatchery Adult Steelhead Release at Santa Clara River Estuary (4-9-08)

Photo 14 – Santa Clara River Estuary Temperature Monitoring Site

Photo 15 – Fish Trap Bay Temperature Monitoring Site

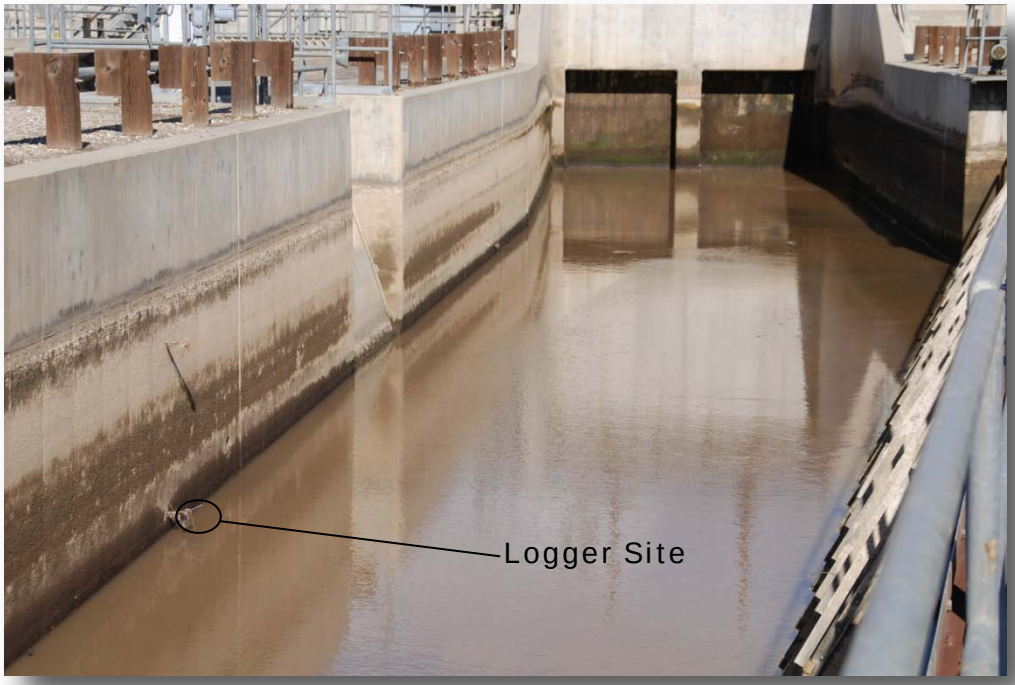


Photo 16 – Fish Screen Bay Temperature Monitoring Site

Photo 17 - Santa Clara River Temperature Monitoring Site

Photo 18 – Santa Paula Creek Temperature Monitoring Site

Photo 19 - Sespe Creek Temperature Monitoring Site

Appendix B

Watershed Photos

Site 1-Santa Clara River Estuary @ Harbor Boulevard Bridge (Downstream View)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08

Site 2-Santa Paula Creek-Above Harvey Diversion (View from Left to Right Bank)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08

Site 3-Santa Clara River @ 12th Street Bridge (Downstream View)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08

Site 4-Sespe Creek @ Highway 126 (Upstream View)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08

Site 5-Hopper Creek @ Hwy 126 (Downstream View)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08

Site 6-Santa Clara River @ Torrey Road Bridge (Downstream View)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08

Site 6-Santa Clara River @ Torrey Road Bridge (Upstream View)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08

Site 7-Sespe Creek @ Old Telegraph Road Bridge (Downstream View)

1-16-08

2-13-08

3-24-08

5-1-08

5-14-08

7-2-08