2018 Guadalupe River Watershed Fisheries Monitoring

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Reports included:

Water Year 2018 Juvenile *Oncorhynchus mykiss* Rearing Monitoring in the Guadalupe River Watershed

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Water Year 2018

Juvenile *Oncorhynchus mykiss* Rearing Monitoring

in the Guadalupe River Watershed

Prepared by:

Santa Clara Valley Water District

Environmental Mitigation and Monitoring Unit

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Executive Summary

The Santa Clara Valley Water District (SCVWD) has been conducting juvenile steelhead (*Oncorhynchus mykiss, O. mykiss*) monitoring since 2004 as part of the downtown Guadalupe River Project. The monitoring was concluded in 2013, but SCVWD recommended the continuation and expansion of monitoring efforts to better understand *O. mykiss* numbers and distribution in the Guadalupe Watershed. In 2013 the Adaptive Management Team (AMT) approved the recommendation (No. 136), and in 2018 the National Marine Fisheries Service and California Department of Fish and Wildlife authorized the expansion of the monitoring under Section 10(a)1(A) Scientific Collecting Permit # 16417-2R and California Department of Fish and Wildlife Scientific Collecting Permit # 11325.

In Water Year (WY) 2018 monitoring was conducted at 23 stations in the Guadalupe Watershed, including stations in the Guadalupe River, Guadalupe Creek, Los Gatos Creek, Calero Creek, and Alamitos Creek. Multipass depletion backpack electrofishing was conducted at each station to determine the presence of *O. mykiss* as well as the composition of other fish species in the Guadalupe Watershed. Appropriately sized *O. mykiss* were tagged with a Passive Integrated Transponder (PIT) tags to study their movement within the Guadalupe Watershed.

Juvenile *O. mykiss* were present in Alamitos, Calero, and Guadalupe Creek during WY 2018, with 32 (0.2 *O. mykiss*/meter), 17 (0.14 *O. mykiss*/meter), and 66 (0.28 *O. mykiss*/meter) individuals captured in each creek respectively. No *O. mykiss* were detected in Guadalupe River or Los Gatos Creek. Based on the size range of fish collected, it can be deduced that production and successful summer rearing occurred and multiple age classes were present.

Seven species of non-native fish were observed amongst the five stations sampled, representing less than 4% of the total number of fish observed in WY 2018. The Guadalupe River and Los Gatos Creek had the highest percentage of non-natives (9.8% and 9.1% respectively). Of the seven species of non-natives, only the largemouth bass is considered a potential predator of *O. mykiss*.

This juvenile rearing monitoring is part of a continuing effort to better understand *O. mykiss* distribution and abundance in the Guadalupe Watershed. This report contains the results and analysis of the juvenile rearing monitoring conducted from WY 2004 – 2018.

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1. Introduction

The United States Army Corp of Engineers in partnership with the Santa Clara Valley Water District (SCVWD) constructed both the Guadalupe River Project (Downtown Project) and Upper Guadalupe River Project (UGRP). These projects together extend from approximately Norman Y. Mineta San Jose International Airport to Blossom Hill Road to protect downtown San Jose from Guadalupe River flooding. To offset the impacts of constructing the Downtown Project, the Guadalupe River Project Mitigation and Monitoring Plan (Downtown Project MMP) specified that a variety of mitigation be undertaken, including restoration of Guadalupe Creek from approximately Almaden Expressway to Masson Dam (Corps 2001a). The Downtown Project MMP also described the monitoring methods and measurable objectives for determining the success of mitigation. This included 10 years of monitoring for juvenile rearing of Central California Coast Steelhead (*Oncorhynchus mykiss*; *O. mykiss* for the remainder of the document) at 12 stations in the mainstem of the Guadalupe River and eight stations within Guadalupe Creek to demonstrate whether the associated measurable objective was being met: “The Guadalupe River must continue to support juvenile rearing at a level that is consistent with pre-project conditions and environmental conditions not affected by the Guadalupe River Project.” In water year (WY) 2018, SCVWD expanded the juvenile rearing monitoring to stations in Los Gatos Creek, Alamitos Creek, and Calero Creek to improve understanding of juvenile *O. mykiss* distribution and densities, collect genetic information, and implement an *O. mykiss* tracking study using Passive Integrated Transponders (PIT).

SCVWD conducted the required juvenile rearing monitoring from WY 2004 to 2013, and the measurable objective was met in each year. Instead of ending the monitoring, SCVWD recommended continuing and expanding it to better understand *O. mykiss* numbers and distribution throughout the Guadalupe River watershed. In WY 2013, the Downtown Project Adaptive Management Team (Guadalupe AMT) approved the recommendation (No. 136) to continue juvenile rearing monitoring at five of the previous monitoring stations on the Guadalupe River and expand the monitoring to 15 stations elsewhere in the watershed.

However, the Downtown Project permits did not authorize juvenile rearing monitoring at additional stations. From WY 2014 to WY 2017 juvenile rearing monitoring continued at a subsample of five of the original permitted stations (as flow conditions allowed) while the permits for monitoring at additional stations were acquired. Ultimately, additional monitoring in the Guadalupe River watershed was authorized under National Marine Fisheries Service (NMFS) Section 10(a)1(A) scientific collecting permit number 16417-2R and California Department of Fish and Wildlife (CDFW) Scientific Collecting Permit #11325 for the SCVWD's Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Adaptive Fishery Management Baseline Data Collection Project. These permits authorized annual sampling in the Guadalupe River, Coyote Creek, and Stevens Creek, but the Guadalupe River was the only watershed with a defined sampling strategy in place in time for monitoring in WY 2018.

To date, juvenile rearing monitoring results have been reported to the Guadalupe AMT in the annual Mitigation Monitoring Report (MMR) for the Guadalupe River Projects. Beginning in WY 2018, monitoring results will be reported in a stand-alone document to facilitate distribution to and review by FAHCE stakeholders as well as the Guadalupe AMT.

2. Methods

2.1 Station Selection

A total of 23 stations within the Guadalupe River watershed were sampled between October 16, 2018 and November 6, 2018. To provide continuity from the previous monitoring on Guadalupe River and Guadalupe Creek and maintain a long-term dataset, WY 2018 sampling occurred at a subset of locations from WY 2004-2017 monitoring. In addition, new sampling stations were identified to expand the survey area using stratified random selection, and each sampling station, whether previously sampled or new, was given a unique identification number. Private lands were removed from the random selection process. Only areas of SCVWD ownership or easement, or lands owned by other government agencies, were included to ensure sampling reaches could be easily accessed for multiple years to come. The rationale for station selection in each sub-watershed is described further below.

Guadalupe River

From 2004-2017, 12 stations were sampled on the mainstem of the Guadalupe River. These stations were distributed between Airport Parkway and the Highway 280 overcrossing near Grant Street. These stations were spaced approximately 450 m apart. The AMT recommendation for continuing juvenile rearing monitoring in the Guadalupe River watershed specified that five of the original 20 monitoring stations would continue to be sampled. The permits issued for conducting this work only allow a maximum of six stations to be sampled in each sub-watershed, so it was determined that for better spatial distribution throughout the entire Guadalupe River that the number of previously sampled stations be reduced to four. This allowed two additional stations be sampled in the upper portions of Guadalupe River up to the Alamitos Drop Structure, in areas not previously sampled. Stations 3, 6, 9, and 12 were originally selected to provide equal distribution throughout the previously sampled reach (Guadalupe mainstem from Airport Parkway to Highway 280); however, stations 6, 5, and 7 were unsafe to sample due to homeless activity in the area, so station 8 was selected. To randomly select the two remaining monitoring stations, the 10 km of mainstem Guadalupe River upstream of the original Downtown Project monitoring reach was broken into 10 1-km reaches. Two of the ten reaches were randomly selected using a random number generator. Those reaches were broken into 25 40-m stations, and a station was randomly selected using a random number generator in each reach. The previously sampled (WY 2004-2013), continuously sampled (WY 2004-2018), and new sampling stations (WY 2018) with unique station identifications numbers are mapped in Figure 1.

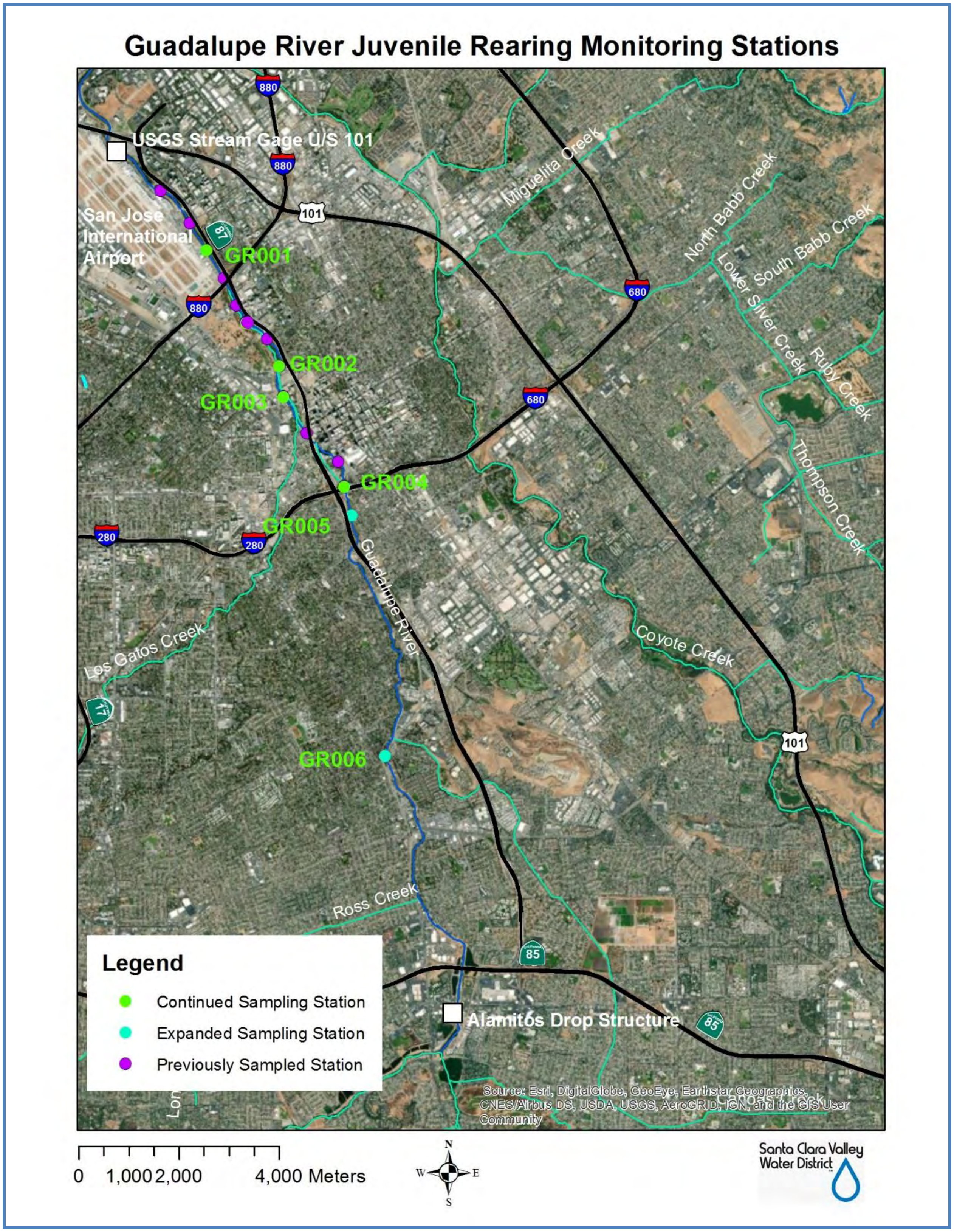

Figure 1: Guadalupe River juvenile rearing monitoring stations.

Guadalupe Creek

From 2004-2017, eight stations were sampled on Guadalupe Creek. These stations were distributed between Almaden Expressway and Stream Gage 43 (near the intersection of Shannon and Hicks Road). In previous reports these stations were numbers 13-20, a continuation of the Guadalupe River station numbers. In order to maintain a continuous dataset with the WY 2004-2017 monitoring, four of the previous sampling stations were selected for continued monitoring: Stations 14, 16, 18, and 20, which were respectively renamed as Stations GC001, GC002, GC003, and GC004. Two additional stations were selected on the remaining 4 km of Guadalupe Creek upstream of the area monitored for the Downtown Project to Guadalupe Reservoir. To randomly select the stations, the area was broken into four 1-km reaches. Two of the four reaches were randomly selected using a random number generator. Each 1-km reach was then broken into 25 40-m stations, and stations were randomly selected using a random number generator. The previously sampled, continuously sampled, and new sampling stations are mapped in Figure 2.

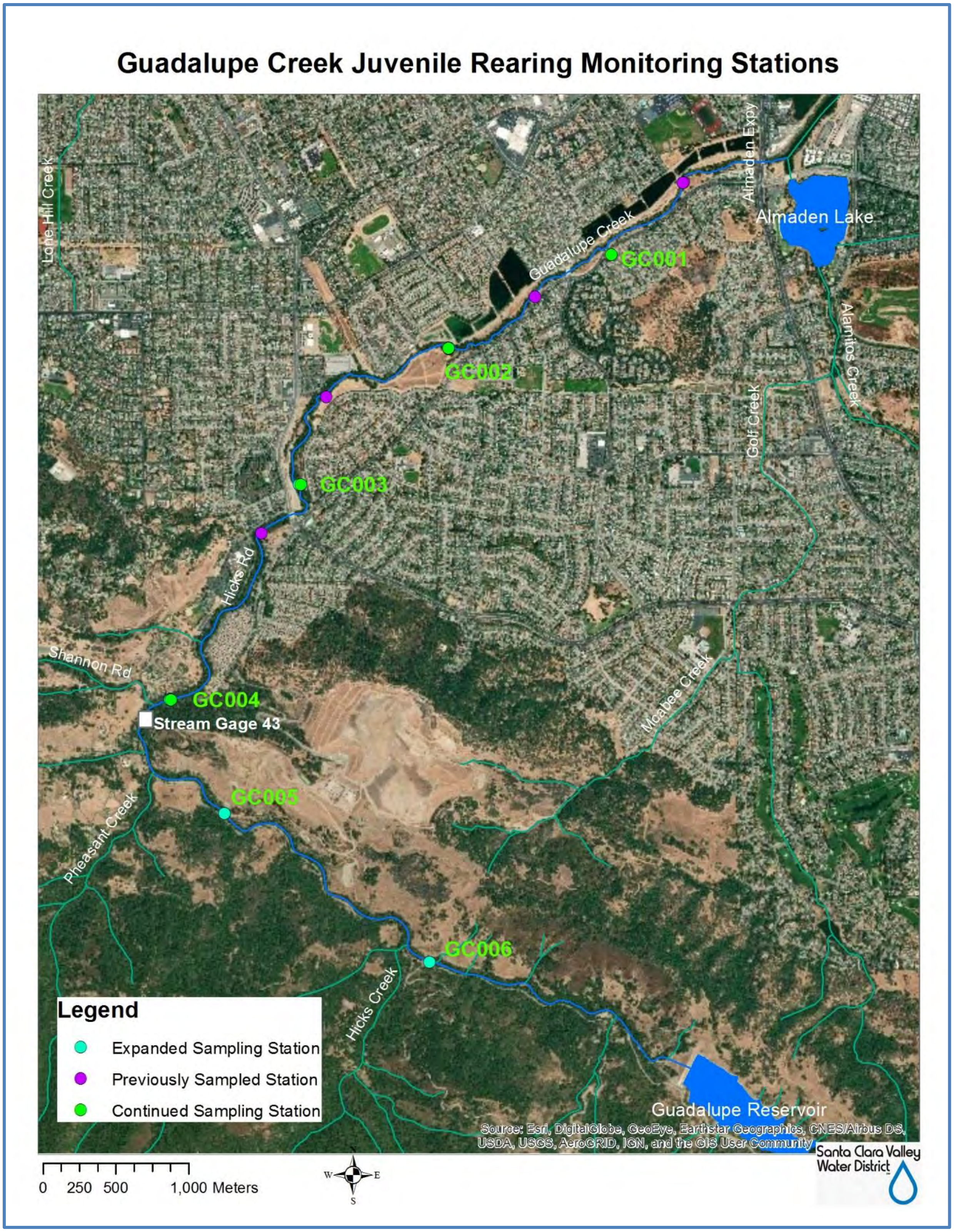

Figure 2: Guadalupe Creek juvenile rearing stations.

Los Gatos Creek

WY 2018 was the first year juvenile rearing sampling occurred on Los Gatos Creek. Four stations were randomly selected to represent the approximately 9 km reach of Los Gatos Creek from the confluence with the Guadalupe River to the Camden Avenue Drop Structure, which is the upstream extent of anadromy. To randomly select the stations, the area was broken into nine 1-km reaches. Four of the nine reaches were randomly selected using a random number generator. Those four 1-km reaches were broken into 25 40-m stations, and each station was randomly selected using a random number generator. They were then assigned station identification numbers 1-4. The results of the station selection can be seen in Figure 3.

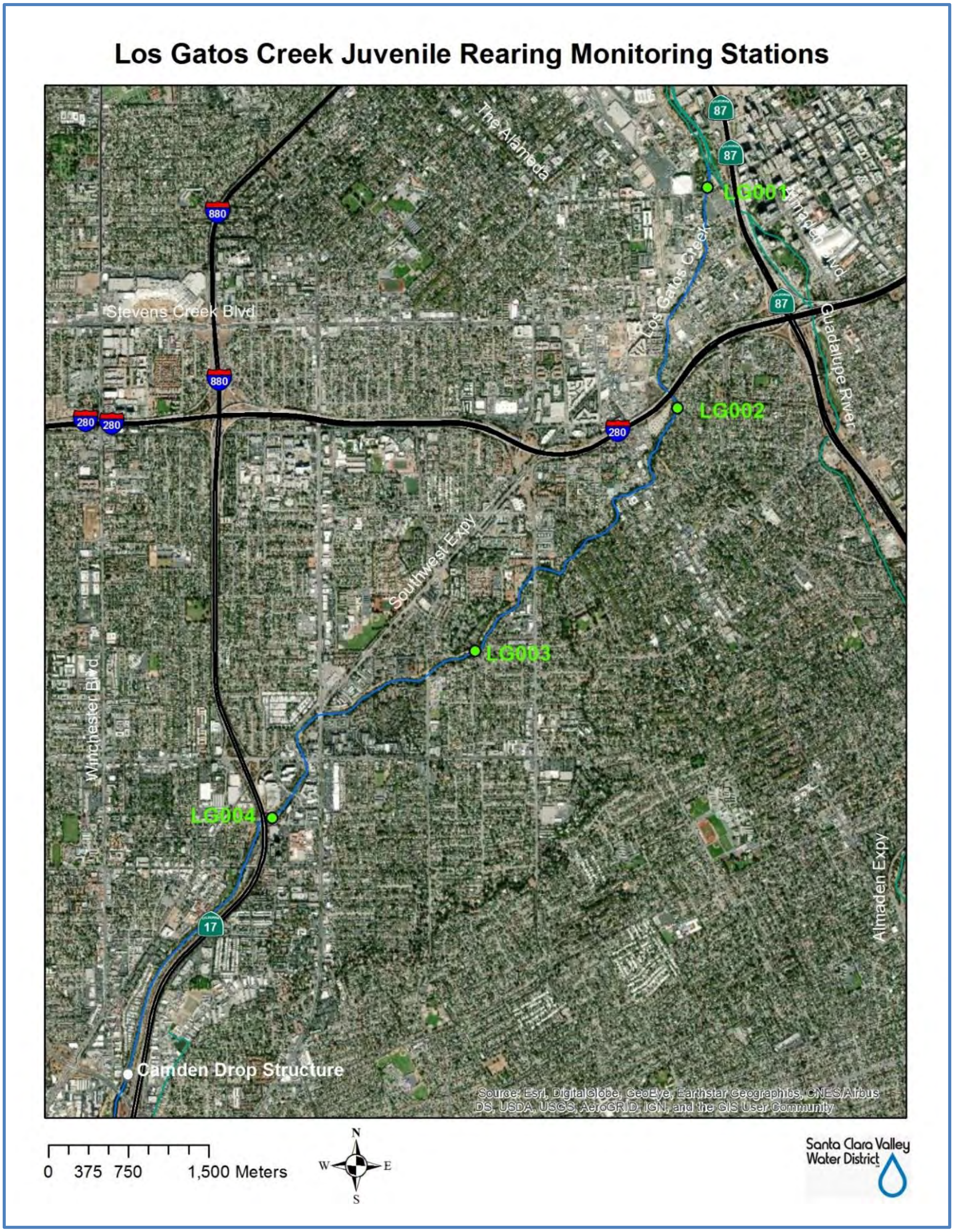

Figure 3: Los Gatos Creek juvenile rearing stations.

Alamitos Creek

WY 2018 was the first year juvenile rearing sampling occurred on Alamitos Creek. Four stations were randomly selected to represent the approximately 11 km of Alamitos Creek from the confluence with Lake Almaden to the base of the dam at Almaden Reservoir. To randomly select the stations, the area was broken into 11 1-km reaches. Four of the 11 reaches were randomly selected using a random number generator. Those reaches were broken into 25 40-m stations, and each station was randomly selected using a random number generator. They were assigned station identification numbers 1-4. Selected stations are mapped in Figure 4.

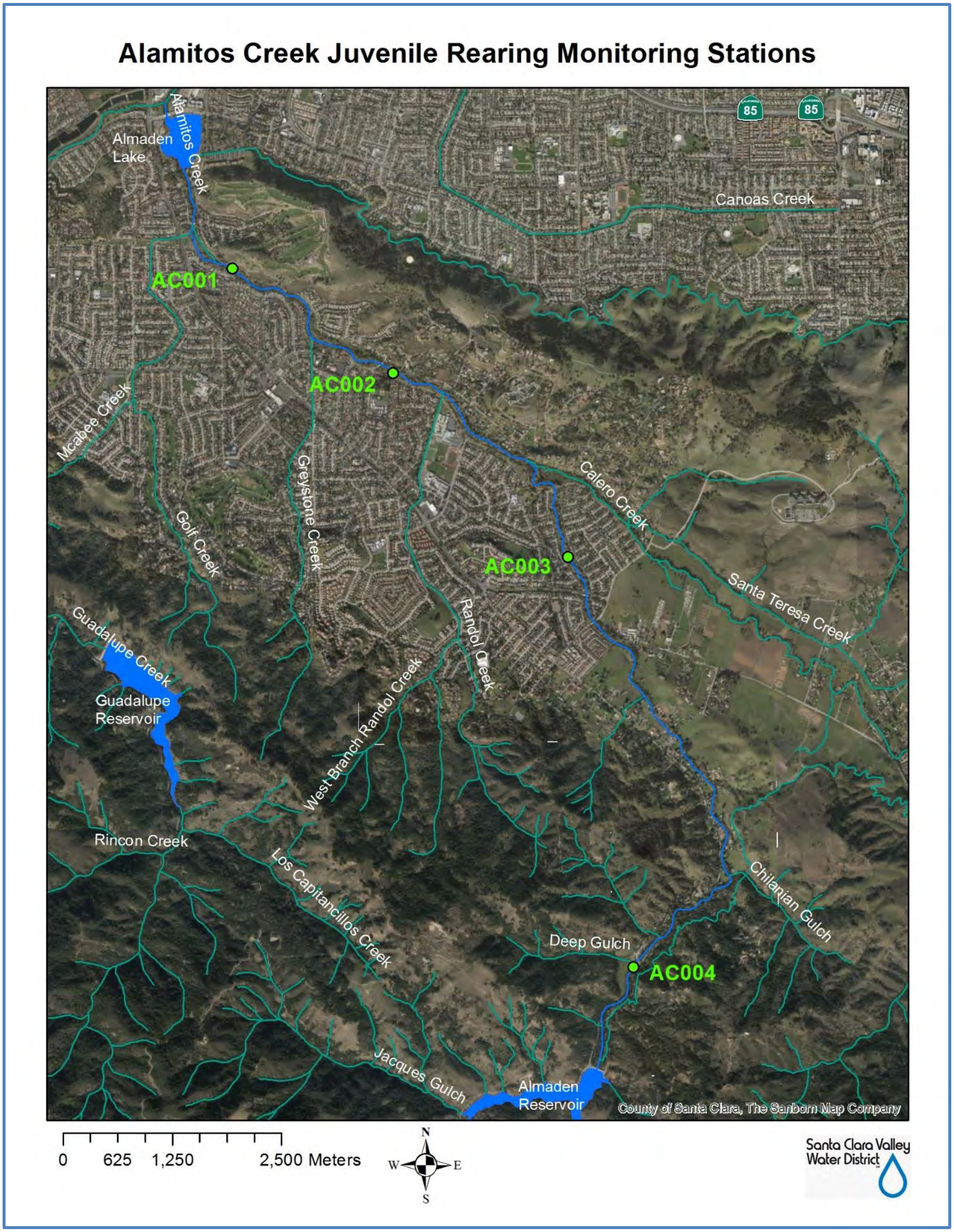

Figure 4: Alamitos Creek juvenile rearing sampling stations.

Calero Creek

WY 2018 was the first year juvenile rearing sampling occurred on Calero Creek. Three sampling stations were selected to represent the approximately 6 km portion of Calero Creek from the confluence with Alamitos Creek to the base of the dam at Calero Reservoir. To randomly select the stations, the area was broken into six 1-km reaches. Three of the six reaches were randomly selected using a random number generator. Those 1-km reaches were broken into 25 40-m stations, and each station was randomly selected using a random number generator. They were then assigned station identification numbers 1-3. Selected stations are mapped in Figure 5.

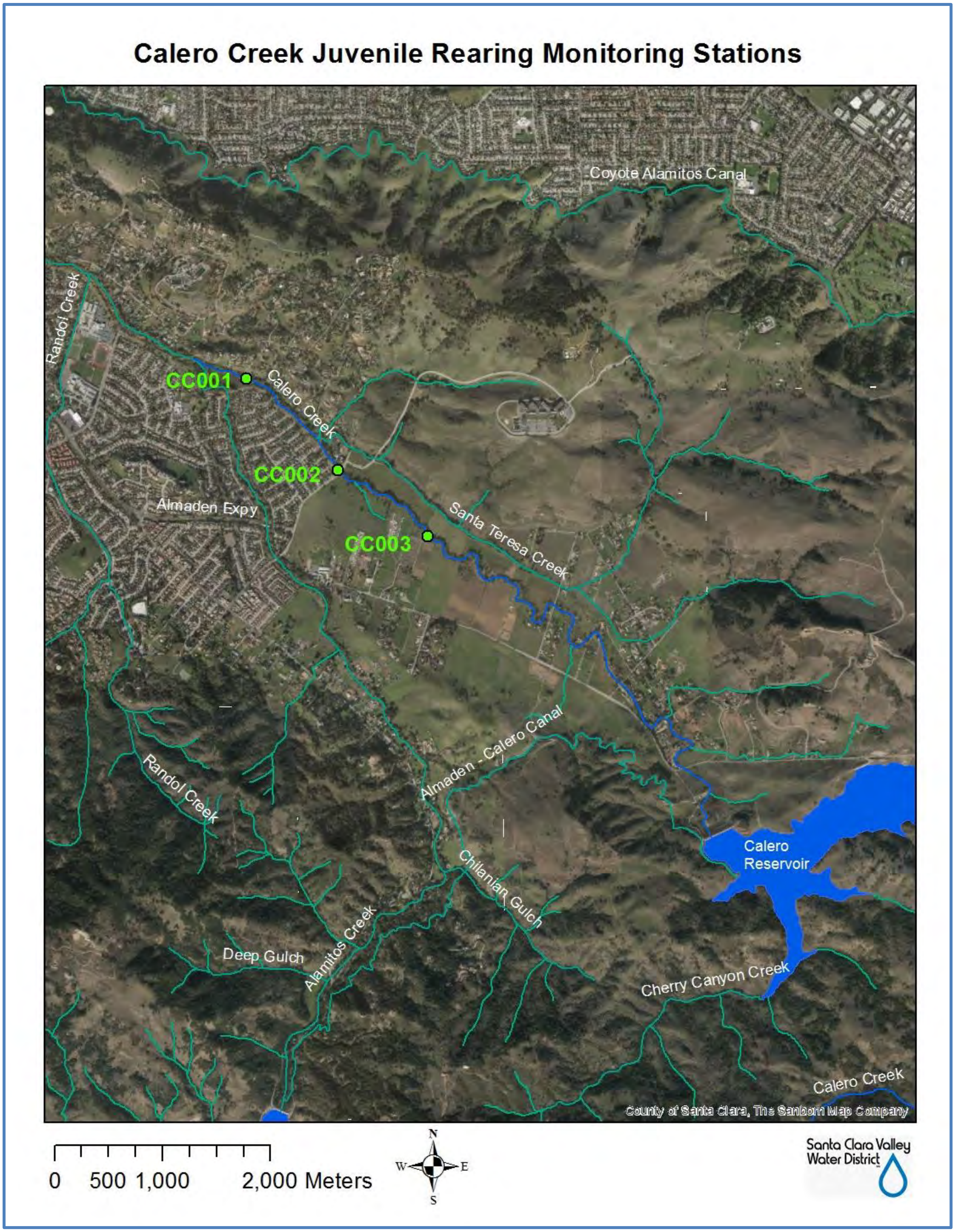

Figure 5: Calero Creek juvenile rearing sampling stations.

2.2 Sampling Methods

Each sampling station was 40-m except for one 35-m station on the Guadalupe River (GR002), that had to be shortened due to excessive water depth. Each station was set as close as possible to the randomly selected point to include at least two distinct habitat types, described below. Multi-pass depletion backpack electrofishing was used for juvenile rearing monitoring (Johnson et al. 2007). This method allowed for: consistency with previous juvenile rearing monitoring methods, population estimates to be extrapolated, and a variety of habitat types to be sampled.

Habitat Typing

Each sampling reach was 40-m in length. Each 40-m reach was habitat typed using the classifications described in Table 1. Each sampling station was selected to contain at least two distinct habitat types. Habitat typing followed Ode (2007) for habitat type descriptions (Table 1). Average wetted width and depth was estimated and the presence of any anthropogenic influences (bridge, dam, etc.) was noted. Prior to the start of sampling, ambient conditions (weather) were noted and water quality (dissolved oxygen, conductivity, and temperature) were collected at the downstream end of the sampling stations. Ocular estimates of percent cover of macrophytes/emergent vegetation, boulders, woody debris, undercut banks, overhanging vegetation, submerged roots (live and dead), and artificial structures were recorded for each sampling station (Table 2). Each habitat feature was ranked on a 0-4 point scale described below, with 0 being absent and 4 being a very heavy presence (Table 2). Primary and secondary substrate types were determined based upon ocular estimates (Table 3; Ode 2007).

Table 1: Habitat type classifications (Ode 2007).

Habitat Type	Description
Cascades	Short, high gradient drop in streambed elevation often accompanied by boulders and considerable turbulence.
Falls	High gradient drop in elevation of the streambed associated with an abrupt change in the bedrock.
Rapids	Sections of stream with swiftly flowing water and considerable surface turbulence. Rapids tend to have larger substrate sizes than riffles.
Riffles	Shallow sections where the water flows over coarse streambed particles that create mild to moderate surface turbulence.
Step-Run	A series of runs that are separated by short riffles or flow obstructions that cause discontinuous breaks in slope.
Runs	Sections without flow obstructions. The stream bed is typically even and the water flows faster than it does in a pool.
Glides	A section of stream with little or no turbulence, but faster velocity than pools.
Pool	A reach of stream that is characterized by deep, low-velocity water and a smooth surface.

Table 2: Ocular estimate scale (Ode 2007).

Scale	0	1	2	3	4
Percent Coverage	0%	<10%	10-40%	40-75%	>75%
Descriptor	Absent	Sparse	Moderate	Heavy	Very Heavy

Table 3: Substrate classes

Particle Size	Size Category
Boulder	> 250 mm
Cobble	65-250 mm
Gravel	2.0-65 mm
Sand	<2.0 mm (gritty texture)
Silt/Clay	Not gritty
Bedrock	No individual particles

Electrofishing

Block nets were installed at both the upstream and downstream ends of sampling reaches to block immigration into and emigration out of sampling reaches. Electrofishing commenced from down to upstream and worked laterally across the stream to ensure all portions of the wetted width were sampled. Smith-Root LR24 Backpack Electrofishing Units were used at all sampling stations. The LR24 quick set option was used to establish the initial power and waveform settings. The quick set output was verified with conductivity readings. Electrofishers were run using direct current, at a frequency of 30 HZ, duty cycle of 12%, and voltage that ranged between 150 and 190 volts. The electrofisher operator was flanked by two netters. Verbal communication and spatial awareness were used to ensure the entire width of the stream was covered. Triple-pass depletion elecotrofishing methods were deployed at all stations unless conditions did not allow (temperature constraints); these sites are pointed out in the Results and Discussion section.

Fish Processing

Fish were held in aerated dark-colored containers during processing. Length measurements were recorded to the nearest millimeter at the fork of the tail (fork-length). For each pass, up to 30 individuals of each species were measured, and all other individuals of that species were counted for a total number.

Carbon dioxide (CO_2) was administered to *O. mykiss* using Alka-Seltzer Gold, in doses to induce light narcosis (1 tablet per 2.5 liters of stream water). *O. mykiss* were exposed to the anesthesia for no more than 5 minutes. *O. mykiss* were observed for listing, and upon listing were removed from the anesthetizing solution, weighed, measured, tail-clipped for a genetic sample, and PIT tagged if large enough (≥65 mm fork-length).

Fin clips were taken for genetic analysis of all *O. mykiss* from the caudal fin. Clips were a 1-2 mm square. Medical grade scissors used to collect the clips were sterilized with an alcohol dilution with a final concentration of 60-80% isopropyl. Tissue samples were placed in sterile chromatography paper and placed in a labeled envelope denoting the field specimen number, species, stream, stream location, date, and fork-length. Tissues collected will be sent to the NMFS Southwest Fisheries Science Center. After exposure to the anesthesia and handling, fish were placed in an aerated dark-colored live well, then moved to an in-channel live car for recovery, and then released.

All PIT tagging was conducted in accordance with the PIT Tag Marking Procedures Manual (CBFWA 1999) by staff trained in the procedure. *O. mykiss* of 65 mm in fork-length or greater were tagged with a Passive Integrated Transponder (PIT) tag. Biomark single-use preloaded needles were used in the tagging process. *O. mykiss* greater than or equal to 65 mm fork-length received 12 mm half-duplex PIT tags. *O. mykiss* larger than 150 mm fork-length received 23 mm tags. The permits allow for fish greater than 100 mm to be tagged with 23 mm tags, but to be conservative of the fishes' welfare, the minimum size was increased to 150 mm. PIT tags were scanned prior to insertion to verify they were viable. PIT tag numbers and associated biological data for each fish is included in Appendix A.

2.3 Data Analysis

MicroFish 3.0 was used to calculate population estimates for each station using a maximum-likelihood iterative process; the associated standard errors and 95% confidence intervals (95% CI) are reported. This method uses the number of fish captured (n) and the difference in capture between electrofishing passes (i.e., depletion rate) to calculate an estimate of fish likely to have been present but not captured, thus generating a population estimate (N) for each station. Population estimates are restricted to the sampled areas and are only an index of the overall population. If the number of a particular species was too low (i.e., only one fish was captured) or all fish of a particular species were captured on the first pass, then maximum-likelihood population estimate could not be produced. If the lower confidence interval was less than the total catch it was set equal to total catch, as it is certain at least that many fish were present in the sampling reach. These calculations assume emigration and immigration were prevented by the erection of upstream and downstream block nets. It is assumed that shocking efficiency did not change between passes and that staff did not become more efficient using the equipment, nor did fish learn to avoid the electrical field between passes. To enable comparison of WY 2018 results with that of previous monitoring years, when different reach lengths may have been sampled, results were standardized to catch per meter.

3. Results and Discussion

3.1 Guadalupe River

Sampling occurred at six stations on the Guadalupe River on October 25, 29, and 31, 2018. Most sampling days were sunny and clear, but overcast conditions occurred on the 25th. Flows at the United States Geological Survey (USGS) gage upstream of Highway 101 (USGS #11169025), which provides the best representation of the juvenile rearing stations on the mainstem Guadalupe River, were approximately 28 cubic feet per second (cfs) during all sampling days. Stations located upstream of Los Gatos Creek (GR004, GR005, and GR006) will have flow lower than what occurs at Highway 101.

GR001

This was the most downstream station sampled on the Guadalupe River and was one of the stations that had been sampled during the previous monitoring effort (when it was referred to as Site 3). This station is low gradient. A dense riparian corridor is present

(Figure 6), but the channel is situated between two levees and urban development. The sampling station was 40-m in length with an average wetted width of 7.0 m and an average depth of 0.5 m. Two habitat types were present within the station: riffle and run. Each made up 50 % of the sampled area. The primary substrate was gravel with a secondary substrate of cobble. Water quality and habitat complexity at the time of sampling are summarized in Table 4.

Figure 6: Photos of station GR001, looking upstream (left) and looking downstream (right).

Table 4: Guadalupe River station GR001 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
881	16.85	10.24	18.9

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
3	0	2	2	2	2	0

Fish captured and associated population estimates are summarized in Table 5. Four species of fish were captured: prickly sculpin (*Cottus asper*), riffle sculpin (*Cottus gulosus*), Sacramento sucker (*Catostomus occidantalis*) and green sunfish (*Lepomis* *cyanellus*). The most abundant species was prickly sculpin (n=18). No *O. mykiss* were captured.

Table 5: Number captured and Population estimate at Station GR001 on the Guadalupe River.

Species	Native	n	N	SE	95% CI
Prickly sculpin	Yes	18	18	0.505	18-19
Riffle sculpin	Yes	1	-	-	-
Sacramento sucker	Yes	1	-	-	-
Green sunfish	No	3	3	1.271	3-8

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GR001 had low capture rates (23 total fish) and high rates of depletion per pass causing the population estimates to equal the number of fish captured. Of the four species captured, three are considered native.

Station GR001 has 14 years of comparable data (2004-2017, except drought conditions precluded sampling at this station in 2014). Figure 7 shows the standardized capture of *O. mykiss* between 2004 and 2018. This station historically has low production of *O. mykiss*: of the 14 years of data, *O. mykiss* were only collected in four of the years, and the highest capture rate (in 2005) was 0.10 fish per meter. The average *O. mykiss* capture rate for this station is 0.02 fish per meter. These results indicate that *O. mykiss* occurrence in this downstream portion of the Guadalupe River is very low, inconsistent, and potentially that recolonization has not occurred after the severe drought conditions and channel drying that occurred in 2014-2016.

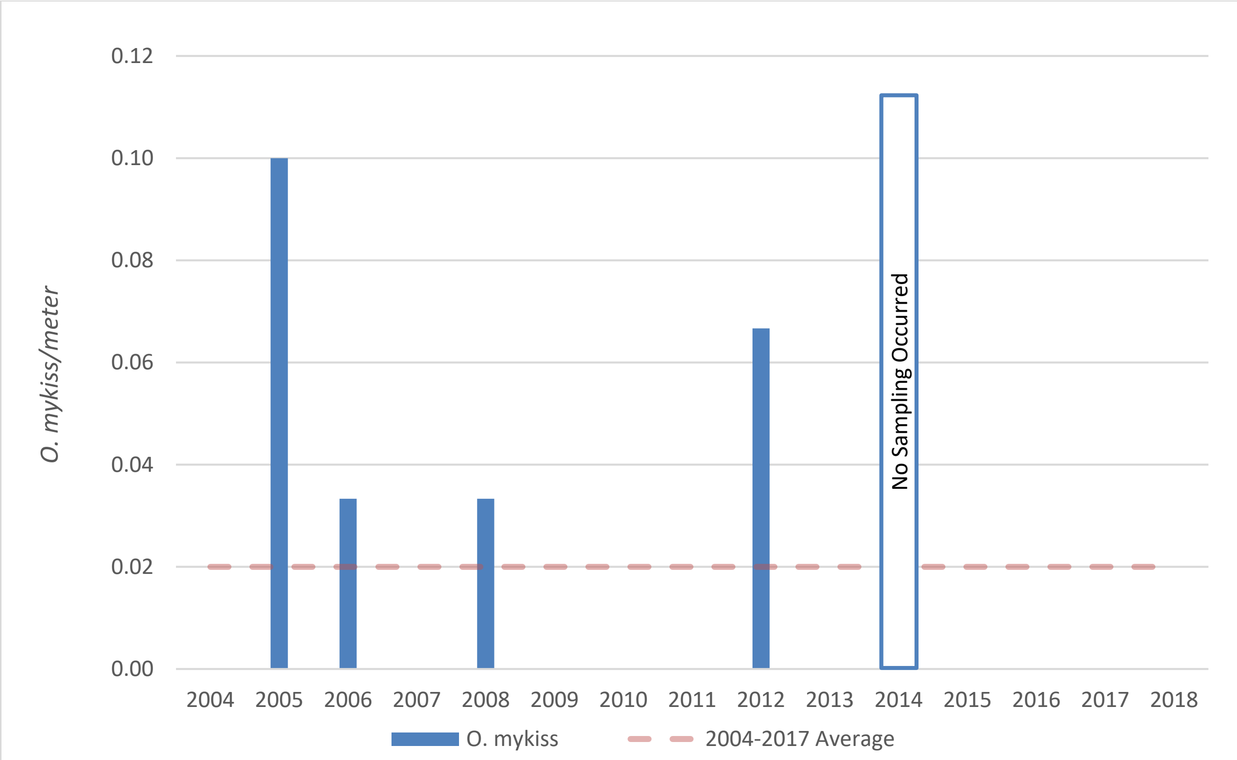

Figure 7: Station GR001 (previously Station 3) standardized *O. mykiss* capture 2004-2018.

GR002

This station was a continued sampling location previously referred to as Site 8. This station is bordered by the Guadalupe Park and Gardens and Highway 87. A dense riparian corridor is present, but there is a high level of anthropogenic disturbances (homeless, trash and debris). The sampling station was only 35 m in length (rather than 40 m) due to a pool at the downstream end and portions of the glide on the upstream end that were too deep to sample. The average wetted width was 6.5 m and the average depth was 0.5 m. Two habitat types were present within the station: riffle and glide (Figure 8). The riffle habitat was 71% of the reach; glide habitat was 29%. The primary substrate was large cobble with a secondary substrate of gravel. Water quality and habitat complexity at the time of sampling is summarized in Table 6.

Figure 8: Photos of station GR002, looking upstream (left) and looking downstream (right).

Table 6: Guadalupe River station GR002 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
803	17.03	8.46	22.5

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	3	1	2	3	3	0

Prickly sculpin were the only species collected. Fish captured and associated population estimates are summarized in Table 7. No *O. mykiss* were captured at this sampling station. Station GR002 had low species diversity and the population estimate equaled the number of fish captured. No non-native fish were collected.

Station GR002 has 12 years of comparable data (drought conditions in 2014-2015 and higher than normal flows in 2017 precluded sampling at this station in those years). Figure 9 shows the standardized capture of *O. mykiss* between 2004 and 2018. *O. mykiss* were collected in eight of the 12 years of data, and the highest fish per meter observed was in 2008 at 0.60 fish. The average *O. mykiss* per meter based on the

2004-2017 sampling period was 0.15 fish. Previous sampling results indicate that juvenile *O. mykiss* used this site in most years. Current results indicate that rearing in this portion of the Guadalupe River is extremely low or recolonization has not occurred after the drought conditions (including dry-backs) starting in 2014.

Table 7: Number captured and population estimate at Station GR002 on the Guadalupe River.

Species	Native	n	N	SE	95% CI
Prickly sculpin	Yes	24	24	0.752	24-26

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

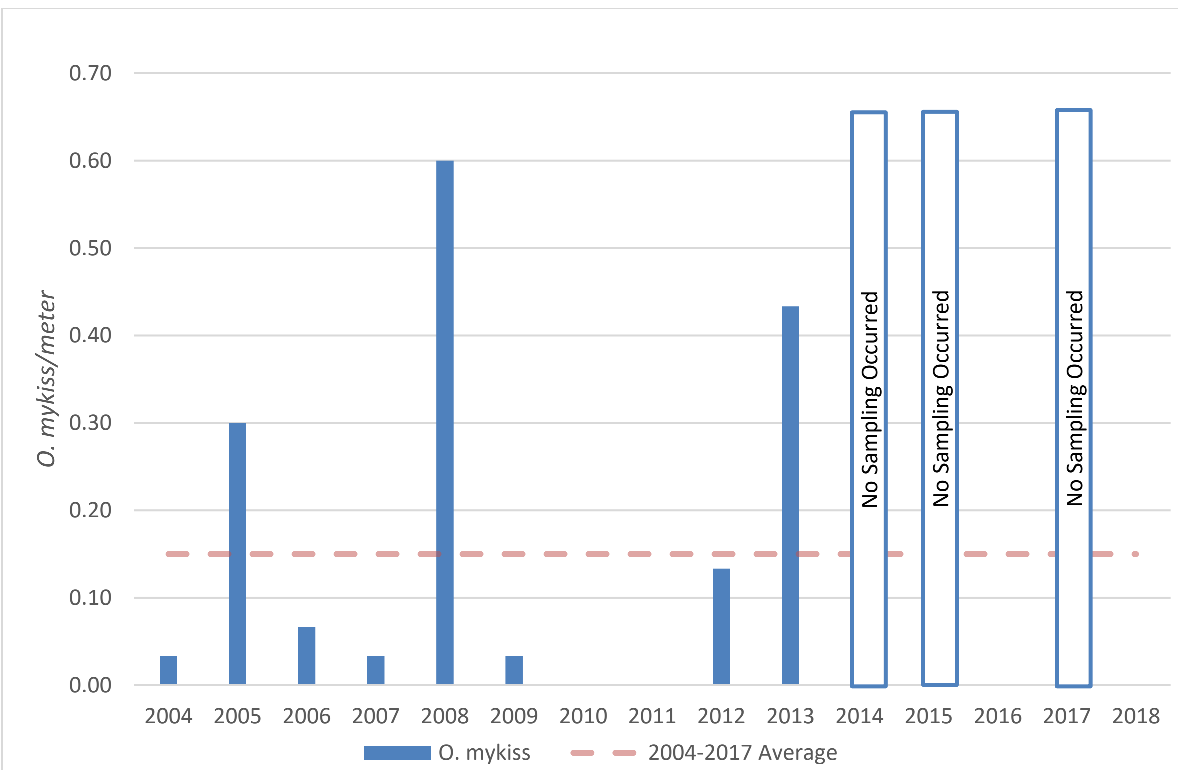

Figure 9: Station GR002 (previously Station 8) standardized *O. mykiss* capture 2004-2018.

GR003

This station was a continued sampling location previously referred to as Site 9. This station includes the St. John Street passage remediation project, which created riffle habitat and added large woody debris to remove a fish passage barrier. A portion of the station was under the St. John Street Bridge. The sampling station was 40 m in length with an average wetted width of 8.5 m and an average depth of 0.45 m. Two habitat types were present within the station: riffle and run (Figure 10). Each made up 50% of the station. The primary substrate was large cobble with a secondary substrate of boulders. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 8.

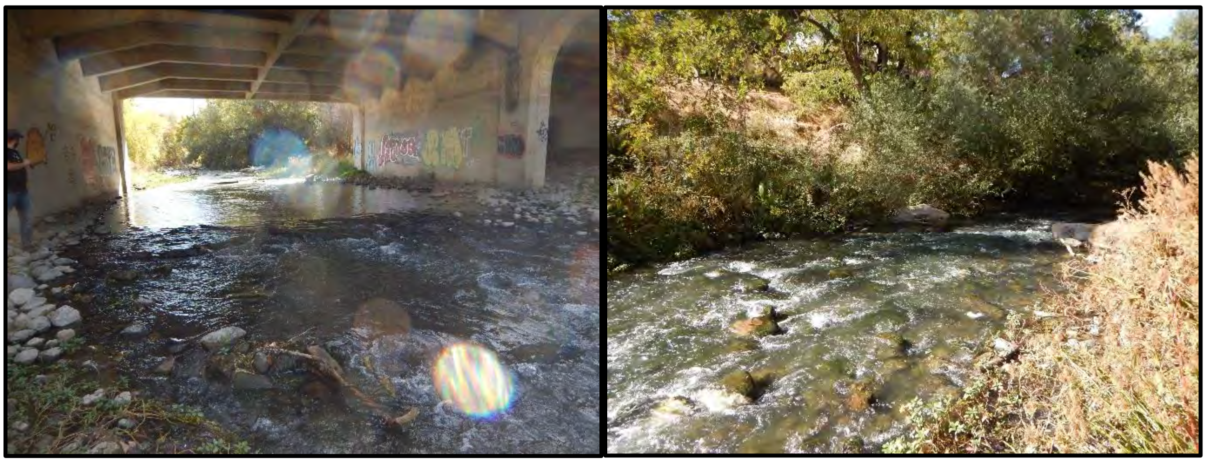

Figure 10: Photos of station GR003, looking upstream (left) and looking downstream (right).

Table 8: Guadalupe River station GR003 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)
613	17.00	10.23	20.0

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
2	4	1	0	1	1	4

Two sampling passes were conducted at this station; a third pass was not made due to increasing water temperature that had the potential to exceed the maximum water temperature allowed under the permitted sampling conditions (18.0°C). The four species of fish captured were: California roach (*Hesperoleucus symmetricus*), prickly sculpin, Sacramento sucker, and mosquitofish (*Gambusia affinis*). The most abundant species encountered was California roach (n=41). Fish captured and associated population estimates are summarized in Table 9. No *O. mykiss* were captured at this sampling station.

Table 9: Number captured and population estimates at Station GR003 on the Guadalupe River.

Species	Native	n	N	SE	95% CI
California roach	Yes	41	62	0	41-62
Prickly sculpin	Yes	23	23	0.968	23-25
Sacramento sucker	Yes	5	8	10.919	5-34
Mosquitofish	No	1	-	-	-

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GR003 had the highest total capture of fish in the Guadalupe River (70 total fish). The maximum likelihood iterations indicate that the number of California roach and Sacramento sucker is likely higher than what was captured. Sampling conditions were difficult due to the width and the velocity in the riffle, and fish were likely missed during the passes.

Station GR003 has 13 years of comparable data (drought conditions precluded sampling at this station in 2014-2015). Figure 11 shows the standardized capture of *O. mykiss* between 2004 and 2018. Of the 13 years of data, *O. mykiss* were collected in seven of the years sampled and the highest fish per meter observed was in 2012 at 0.43 fish. The average *O. mykiss* per meter based on the 2004-2017 dataset for this station is 0.12 fish. Previous sampling results indicate that juvenile *O. mykiss* used this site in most years. No *O. mykiss* have been captured since the dry-backs in 2015. Current results indicate that rearing in this portion of the Guadalupe River is extremely low, variable, or recolonization has not occurred after the drought conditions (including dry-backs) starting in 2014.

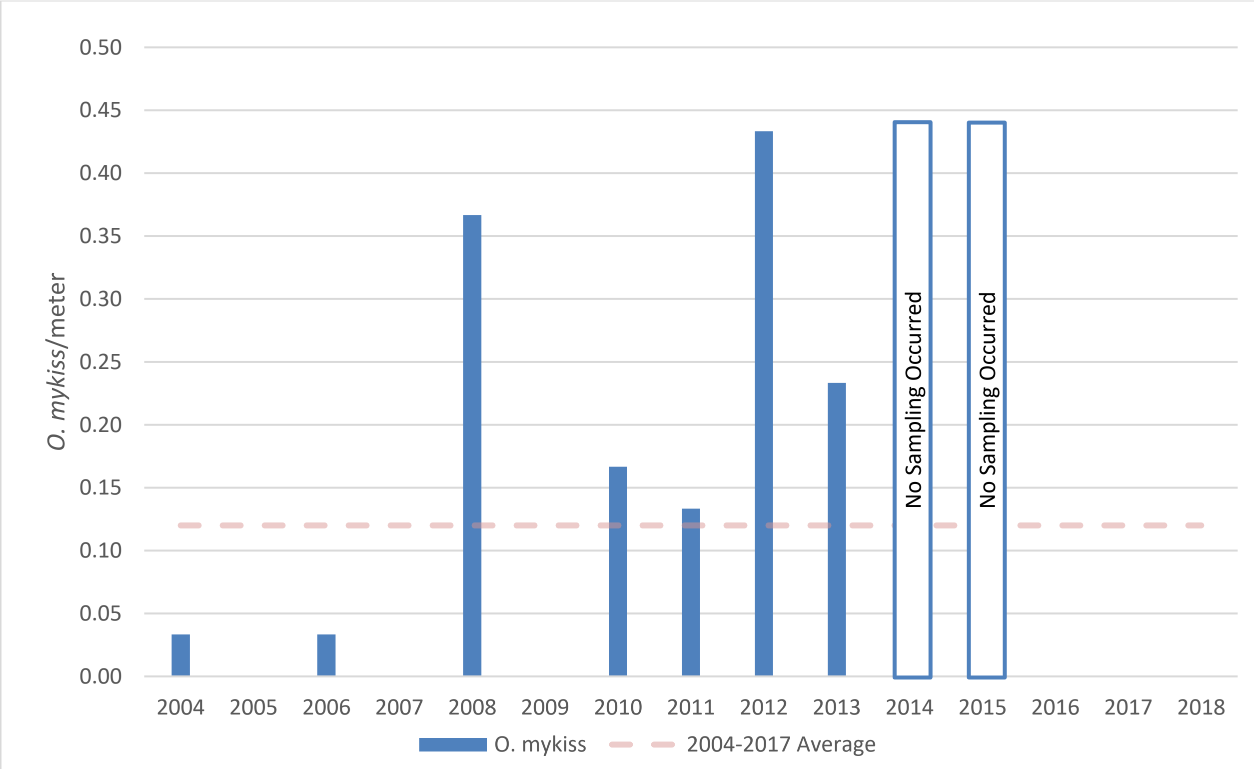

Figure 11: Station GR003 (previously Station 9) standardized *O. mykiss* capture 2004-2018.

GR004

This station was a continued sampling location. During the data collection effort between 2004 and 2017, this station was known as Site 12. This station falls within the Downtown Project's hardscaped reach. The channel bottom consists of cellular concrete mattress (CCM), with natural substrates deposited on the surface. The sampling station was 40 m in length with an average wetted width of 3.0 m and an average depth of 0.5 m. Habitat at the station was 90% run, 5% pool, and 5% riffle (Figure 12). The primary substrate was silt with a secondary substrate of boulders over the top of the CCM. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 10.

Figure 12: Photos of station GR004, looking upstream (left) and looking downstream (right).

Table 10: Guadalupe River station GR004 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
817	16.38	6.62	55.0

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
4	2	1	0	0	0	4

The five species of fish captured were: California roach, prickly sculpin, Sacramento sucker, largemouth bass (*Micropterus salmoides*), and mosquitofish. The most abundant species encountered was Sacramento sucker (n=16). Fish captured and associated population estimates are summarized in Table 11. In station GR004 the maximum likelihood iterations indicate that the number of California roach and Sacramento sucker is likely higher than what was captured. No *O. mykiss* were captured at this sampling station.

Table 11: Number captured and population estimates at Station GR004 on the Guadalupe River.

Species	Native	n	N	SE	95% CI
California roach	Yes	11	14	5.64	11-26
Prickly sculpin	Yes	1	-	-	-
Sacramento sucker	Yes	16	17	2.241	16-22
Largemouth bass	No	2	2	1.038	2-15
Mosquitofish	No	1	-	-	-

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GR004 has 13 years of comparable data. As at previous sites, drought induced dry-backs occurred in this reach in 2015. Figure 13 shows the standardized capture of *O. mykiss* between 2004 and 2018. This station historically has low occurrence of *O. mykiss*. Of the 13 years of data, only two years had collection of *O. mykiss* with the highest fish per meter observed in 2012 at 0.20 fish. The average *O. mykiss* per meter based on the 2004-2017 dataset for this station is 0.03 fish. Results indicate that juvenile rearing in this portion of the Guadalupe River is historically extremely low.

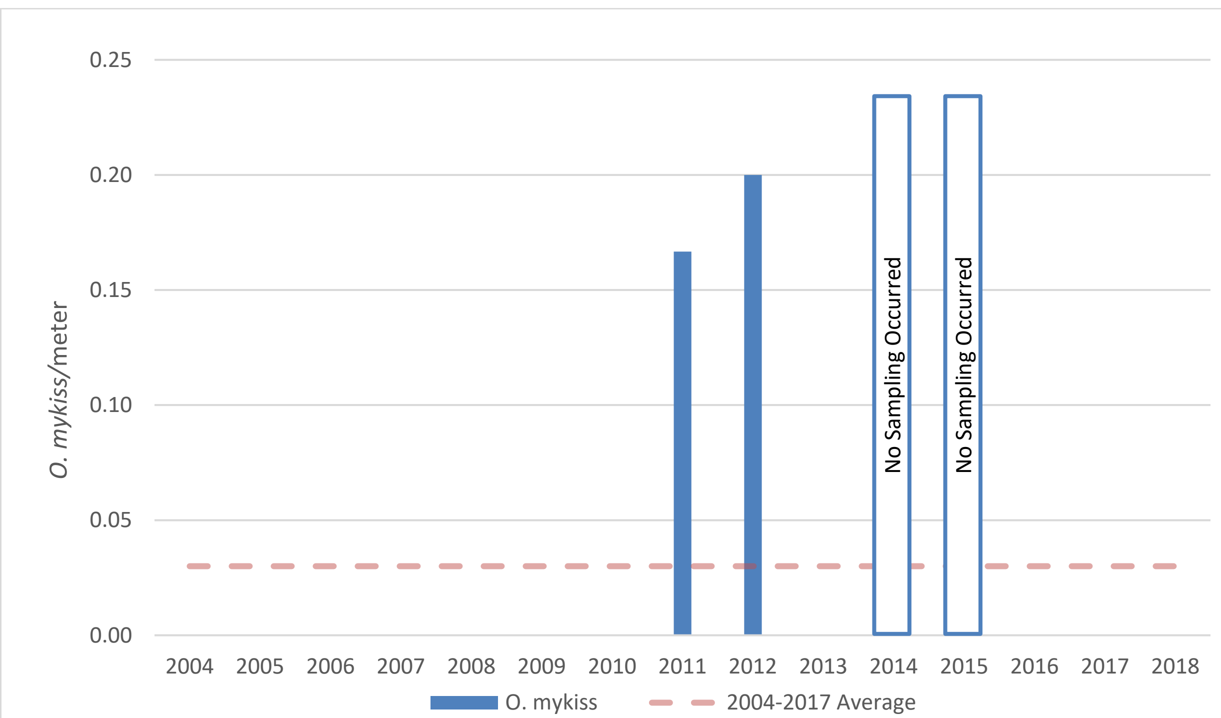

Figure 13: Station GR004 (previously Station 8) standardized *O. mykiss* capture 2004-2018.

GR005

This is a new (WY 2018) monitoring station, directly downstream of the Virginia Street bridge. The sampling station was 40 m in length with an average wetted width of 8.0 m and an average depth of 0.7 m. Three habitat types were present within the station: riffle, run, and cascade (Figure 14). The “cascade” portion of the habitat was the result of an unpermitted, human-made rock and rubble creek crossing placed in the creek. The crossing was reported and removed by a volunteer group following sampling activities. Homeless camps were present in the area. The riffle including the small “cascades” made up 25% of the habitat with the run making up the remaining 75%. The primary substrate was silt with a secondary substrate of boulders. A lot of debris and fallen limbs were present in the lower portion of the station limiting visibility of the substrate. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 12.

Figure 14: Photos of station GR005, looking upstream (left) and looking downstream (right).

Table 12: Guadalupe River station GR005 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)
863	15.25	8.83	52

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	3	0	2	1	2	4

The third electrofishing pass was abbreviated as an adult Chinook salmon (*Oncorhynchus tshawytscha*) was captured (Figure 15). The Chinook salmon was estimated at 650 mm and was adipose fin-clipped, indicating that it was of hatchery origin and had strayed into Guadalupe River. The Chinook salmon was not observed until the third pass. All sampling ceased at the station after the Chinook salmon was captured. A total of seven species of fish were captured: California roach, Sacramento sucker, Chinook salmon, common carp (*Cyprinus carpio*), green sunfish, largemouth bass, and mosquitofish. The most abundant species encountered was Sacramento sucker (n=9). Fish captured and associated population estimates are summarized in Table 13. No *O. mykiss* were captured at this sampling station.

Figure 15: Hatchery stray Chinook salmon captured in GR005.

Table 13: Number captured and population estimates at Station GR005 on the Guadalupe River.

Species	Native	n	N	SE	95% CI
California roach	Yes	8	8	0.769	8-10
Sacramento sucker	Yes	9	9	0.947	9-11
Chinook salmon[1]	No	1	-	-	-
Common carp	No	1	-	-	-
Green sunfish	No	3	5	9.677	3-32
Largemouth bass	No	1	-	-	-
Mosquitofish	No	4	6	0	4-6

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

In station GR005 the maximum likelihood iterations indicate that the number of green sunfish and mosquitofish was likely higher than what was captured. This station had the highest species richness on the Guadalupe River, but consisted of 71% non-native species.

GR006

This is a new (WY 2018) monitoring station. It is the most upstream station on the mainstem Guadalupe River and is within the UGRP Segment 10B, where geomorphic and riparian mitigation has been implemented. The sampling station was 40 m in length with an average wetted width of 2.0 m and an average depth of 0.2 m. Habitat at the station was 60% riffle and 40% glide (Figure 16). The primary substrate was cobble with a secondary substrate of boulders. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 14.

[1] While Chinook salmon are native to California, there is no historical data suggesting they were historically present in Santa Clara County. Genetic analysis indicates that Chinook salmon in the Guadalupe River watershed are hatchery strays (Garcia-Rossi and Hedgecock 2002). For this analysis, Chinook salmon were considered a non-native species.

Figure 16: Photos of station GR006, looking upstream (left) and looking downstream (right).

Table 14: Guadalupe River station GR006 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)			
553	16.58	9.70	26.5			
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
4	2	0	1	2	2	0

Four species of fish were captured: prickly sculpin, Sacramento sucker, largemouth bass, and mosquitofish. The most abundant species encountered was Sacramento sucker (n=16). Fish captured and associated population estimates are summarized in Table 15.

Table 15: Number captured and population estimates at Station GR006 on the Guadalupe River.

Species	Native	n	N	SE	95% CI
Prickly sculpin	Yes	1	-	-	-
Sacramento sucker	Yes	16	16	0.9	16-18
Largemouth bass	No	1	-	-	-
Mosquitofish	No	1	-	-	-

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GR006 had low capture rates and the population estimates equaled the number of fish captured. Based on these results, it is not expected that other species of fish were present that were not accounted for in this census.

Discussion

No *O. mykiss* were collected at any of the sampling stations on the Guadalupe River in WY 2018. Based on the previous Guadalupe River Project monitoring (WYs 2004-2017), it is not uncommon for this species to be absent at individual sampling stations on mainstem Guadalupe River. Since 2004, no sampling station in the Guadalupe River has consistently had *O. mykiss*. The 2018 sampling effort is the fourth continuous year with no detections, the longest period with no *O. mykiss* detections since juvenile rearing monitoring began. Habitat is present that could support rearing of *O. mykiss*.

It is not entirely clear why juvenile *O. mykiss* have not been detected in Guadalupe River in recent years. There have been no detectable changes in physical habitat on the Guadalupe River that would trigger such a decrease. All stations sampled had some sort of habitat complexity (i.e., undercut banks, large woody debris, or submerged roots) that could be used as *O. mykiss* refugia, and riffle habitat that should support fast-water feeding requirements. The measurable objectives for streamside vegetation in the Downtown Project are being met, and other fisheries monitoring indicators, such as suitable habitat area, have indicated that habitat is available and consistent with unaltered index reaches (SCVWD and Stillwater Sciences 2018). Previous MMRs have discussed the influence that sampling timing appears to have on the number of *O. mykiss* detected in mainstem Guadalupe River. In years that sampling occurred after a rain event, more *O. mykiss* were observed, but in each year between 2004-2013 fish were detected in portion of the Guadalupe River (SCVWD and Stillwater Sciences 2013). In 2018 sampling occurred prior to any storm events that would have stimulated downstream fish migration. Data collected in December 2018 on a Vaki RiverWatcher located on the Guadalupe River at the Alamitos Drop Structure also supports the hypothesis that rain events may influence abundance in the Guadalupe River. After the first rain event, juvenile *O. mykiss* were observed moving downstream through the counting system (SCVWD 2019). In addition, sampling by Hobbs et al. (2014) which occurred later in the season in December 2013, and January, February, and March 2014, also yielded *O. mykiss* on the mainstem Guadalupe River. *O. mykiss* PIT tagged on the Guadalupe River by Hobbs et al. (2014) were recorded out-migrating in February and March of the same year. Together, these results could potentially indicate that the Guadalupe River is not a primary producer of *O. mykiss*, or preferred area of summer rearing of *O. mykiss*, but serves as a migration corridor or for winter rearing and smoltification. In the future, SCVWD will attempt to monitor juvenile rearing prior to any storm events to help control for the influence that downstream fish migration likely has on capture rates.

Patterns in the capture of other native fish add to the evidence that fish populations have not yet rebounded after the severe drought conditions in 2014-2016. Prior to 2014, the average annual catch of all native fish in the four consistently sampled stations was 4.48 fish per meter (California roach were particularly plentiful). In 2015 and 2016, some stations yielded zero fish or were completely dry. From 2015 to 2018 the average annual catch was 0.56 fish per meter. In 2018 the average total catch was 0.69 fish per meter. This is higher than the post-drought average, but still much lower than what was historically observed. It is expected that over time, after *O. mykiss* and other native fish populations rebound in upper watershed tributaries, *O. mykiss* migration into the mainstem Guadalupe River, and other native fish populations, will increase. Future juvenile rearing monitoring will be used to evaluate this expectation.

3.2 Guadalupe Creek

Sampling occurred at six stations on the Guadalupe Creek on October 16, 17, and November 6, 2018. All sampling days were sunny and clear. Flows at the four stations upstream of Masson Dam on Guadalupe Creek (GR003 – GR006), based on ALERT Gage 5017 Guadalupe Creek below Guadalupe Reservoir, were 2.1 cfs. Flows at the two stations downstream of Masson Dam (GC001 and GC002), based on ALERT gage 5114 Masson Fish Ladder- Low Flow Only, were approximately 2.5 cfs.

GC001

This was the most downstream station sampled and had been sampled during the previous monitoring effort; during the data collection effort between 2004 and 2017, this station was known as Site 14. This sampling station is surrounded by urban residential housing and falls within a mitigation reach for the Downtown Project, where extensive geomorphic and riparian restoration occurred. The restoration was completed in 2002. The sampling station was 40 m in length with an average wetted width of 2.25 m and an average depth of 0.25 m. Two habitat types were present within the station: riffle and run (Figure 17). Each made up 50% of the sampled area. The primary substrate was cobble with a secondary substrate of silt. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 16.

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Figure 17: Photos of station GC001, looking upstream (left) and looking downstream (right).

Table 16: Station GC001 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)			
482	15.82	9.54	0.6			
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
3	1	1	0	2	2	0

Three species of fish were captured during the survey: *O. mykiss,* prickly sculpin, and largemouth bass. The most abundant species encountered was prickly sculpin (n=21). One *O. mykiss* was captured and PIT tagged during the sampling effort (additional details on captured *O. mykiss* are provided in the Discussion section). Fish captured and associated population estimates are summarized in Table 17. The maximum likelihood iterations indicate that the number of largemouth bass is likely higher than what was captured.

Table 17: Number captured and population estimates at Station GC001 on Guadalupe Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	1	-	-	-
Prickly sculpin	Yes	21	21	0.849	21-23
Largemouth bass	No	5	6	3.572	5-15

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GC001 has 13 years of comparable data. No data was collected in this reach in 2015 due to drought-induced drybacks. Figure 18 shows the standardized capture of *O. mykiss* between 2004 and 2018. In most years *O. mykiss* were captured at this station. The highest capture rate occurred in 2006 at 0.20 fish/meter. The average *O. mykiss* density at this site between 2004-2017 was 0.05 fish per meter. The density during the 2018 monitoring was 0.03 *O. mykiss* per meter. This was lower than the average from previous years' data collection effort. Results indicate that juvenile rearing in this portion of Guadalupe Creek is variable, numbers were below average for this station in 2018, but recolonization did occur after the 2014 drought conditions and dry-backs of 2015.

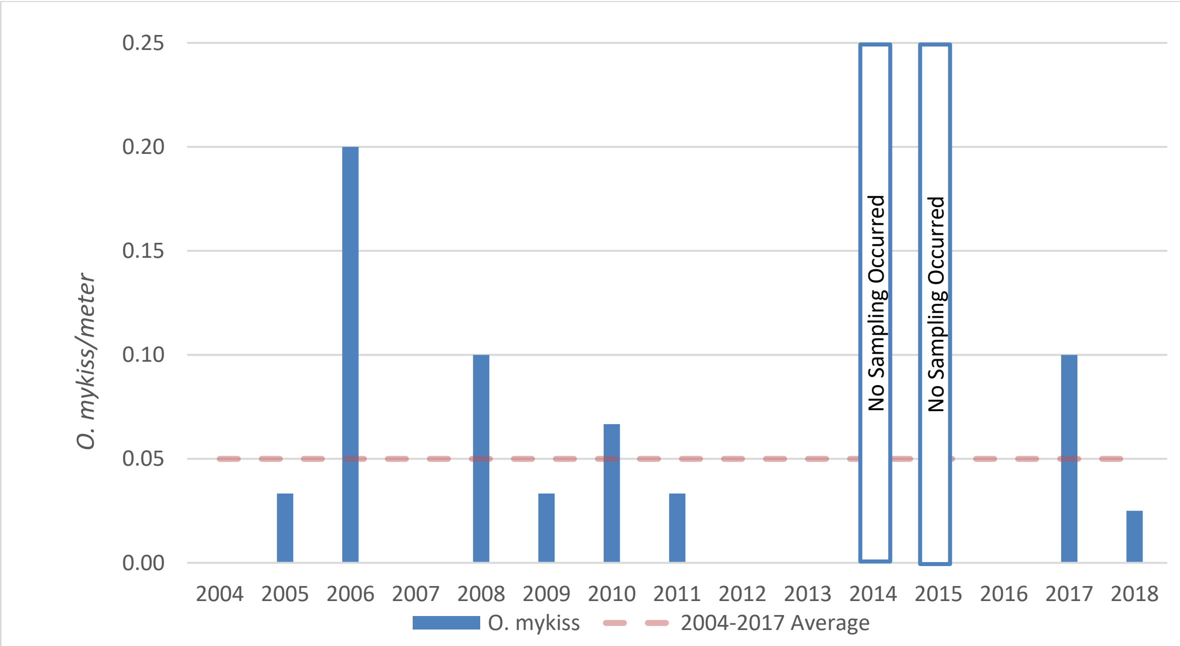

Figure 18: Station GC001 (previously Station 14) standardized *O. mykiss* capture 2004-2018.

GC002

This station was sampled during the previous monitoring effort; during the data collection effort between 2004 and 2017, this station was known as Site 16. The station is also within the mitigation reach for the Downtown Project. The sampling station was 40 m in length with an average wetted width of 4.0 m and an average depth of 0.3 m. Three habitat types were present within the station: riffle, glide, and run (Figure 19). The run habitat made up 35%, the riffle 40%, and the glide made up the remaining 25%. The primary substrate was cobble with a secondary substrate of silt. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 18.

Figure 19: Photos of station GC002, looking upstream (left) and looking downstream (right).

Table 18: Station GC002 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
468	17.60	9.60	1.2

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	1	1	0	3	2	0

Four species of fish were captured during the survey: *O. mykiss*, prickly sculpin, riffle sculpin, and largemouth bass. The most abundant species encountered was prickly sculpin (n=12), and the maximum likelihood iteration indicated the population was likely higher than what was captured (N=14). Two *O. mykiss* were captured during the sampling effort and were PIT tagged prior to being released. Fish captured and associated population estimates are summarized in Table 19. American bullfrog (*Lithobates catesbeianus*) larvae were also collected in this reach.

Table 19: Number captured and population at Station GC002 on Guadalupe Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	2	2	0.384	2-7
Prickly sculpin	Yes	12	14	3.8	12-22
Riffle sculpin	Yes	9	9	0.461	9-10
Largemouth bass	No	4	4	0.969	4-7

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GC002 has 13 years of comparable data. No data was collected in this reach in 2015 due to drought-induced drybacks. Figure 20 shows the standardized capture of *O. mykiss* between 2004 and 2018. In most years *O. mykiss* were captured at this station. The highest capture rate was 0.10 fish/meter, and occurred in years 2005, 2010, and 2017. The average *O. mykiss* density at this site between 2004-2017 was 0.04 fish per meter. The density during the 2018 monitoring was 0.05 *O. mykiss* per meter. Results indicate that juvenile rearing in this portion of Guadalupe Creek is variable, and 2018 had higher than average densities. This station was the only station to have detection of *O. mykiss* in 2016, and has continued to support these fish after the drought starting in 2014 and drybacks of 2015.

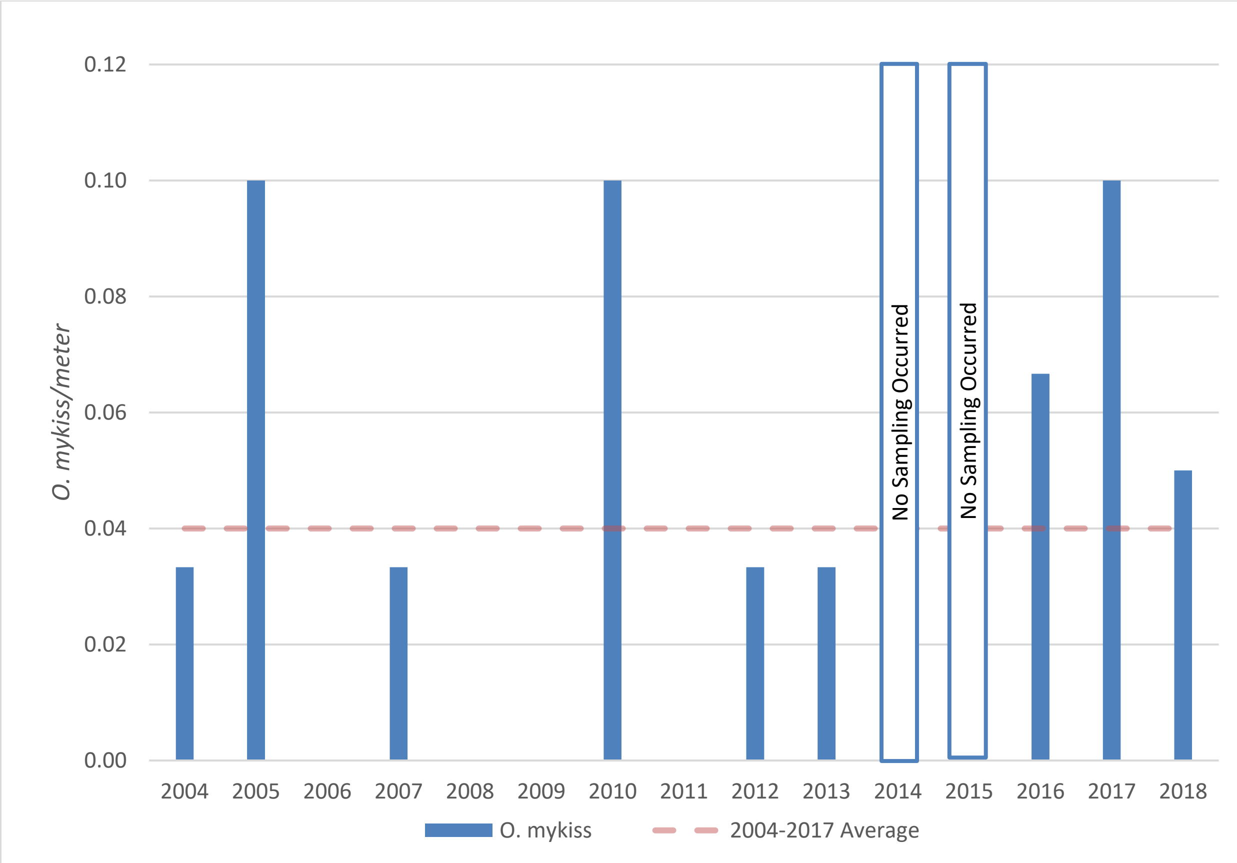

Figure 20: Station GC002 (previously Station 16) standardized *O. mykiss* capture 2004-2018.

GC003

This station was sampled during the previous monitoring effort; during the data collection effort between 2004 and 2017, this station was known as Site 18. The station is upstream of Masson Dam, and is in an urban residential area. The sampling station was 40 m in length with an average wetted width of 4.0 m and an average depth of 0.2 m. Three habitat types were present within the station: riffle, run, and pool (Figure 21). Habitat at the station was 48% riffle, 25% run, and 27% pool. The primary substrate was cobble with a secondary substrate of gravel. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 20.

Figure 21: Photos of station GC003, looking upstream (left) and looking downstream (right).

Table 20: Station GC003 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
445	13.07	9.70	13.0

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	1	1	0	3	1	0

Four species of fish were captured during the survey: *O. mykiss*, California roach, riffle sculpin, and Sacramento sucker. The most abundant species encountered was riffle sculpin (n=58). Thirty-three *O. mykiss* were captured during the sampling effort, 30 of which were ≥65 mm so they were PIT tagged prior to being released. Fish captured and associated population estimates are summarized in Table 21.

In station GC003 the maximum likelihood iterations indicate that the number of California roach and *O. mykiss* is likely higher than what was captured. An estimate of 50 *O. mykiss* within the station was generated, but the standard error associated with the data is high. No non-native fish species were present in the reach.

Table 21: Numbered captured population estimates at Station GC003 on the Guadalupe Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	33	50	18.355	33-87
California roach	Yes	30	32	2.654	30-37
Riffle sculpin	Yes	58	58	1.058	58-60
Sacramento sucker	Yes	3	3	0.709	3-6

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GC003 has 14 years of comparable data. Figure 22 shows the standardized capture of *O. mykiss* between 2004 and 2018. No sampling occurred in 2014 due to drought conditions. In all but four years, *O. mykiss* were captured at this station. This reach did not experience drybacks in 2015, but flow conditions were very low and no *O. mykiss* were captured in 2015 or 2016. In 2017 the fish returned, but in low density. The average *O. mykiss* density at this site between 2004-2017 was 0.10 fish per meter. The 2018 sampling resulted in the highest observed capture rate at 0.83 fish per meter and an estimated density of 1.25 *O. mykiss* per meter. This is one of the highest densities recorded during the 14-year monitoring period and was the highest observed capture rate for the entire Guadalupe River watershed 2018 monitoring effort. Results indicate that juvenile rearing in this portion of Guadalupe Creek is variable, and 2018 had much higher than average densities.

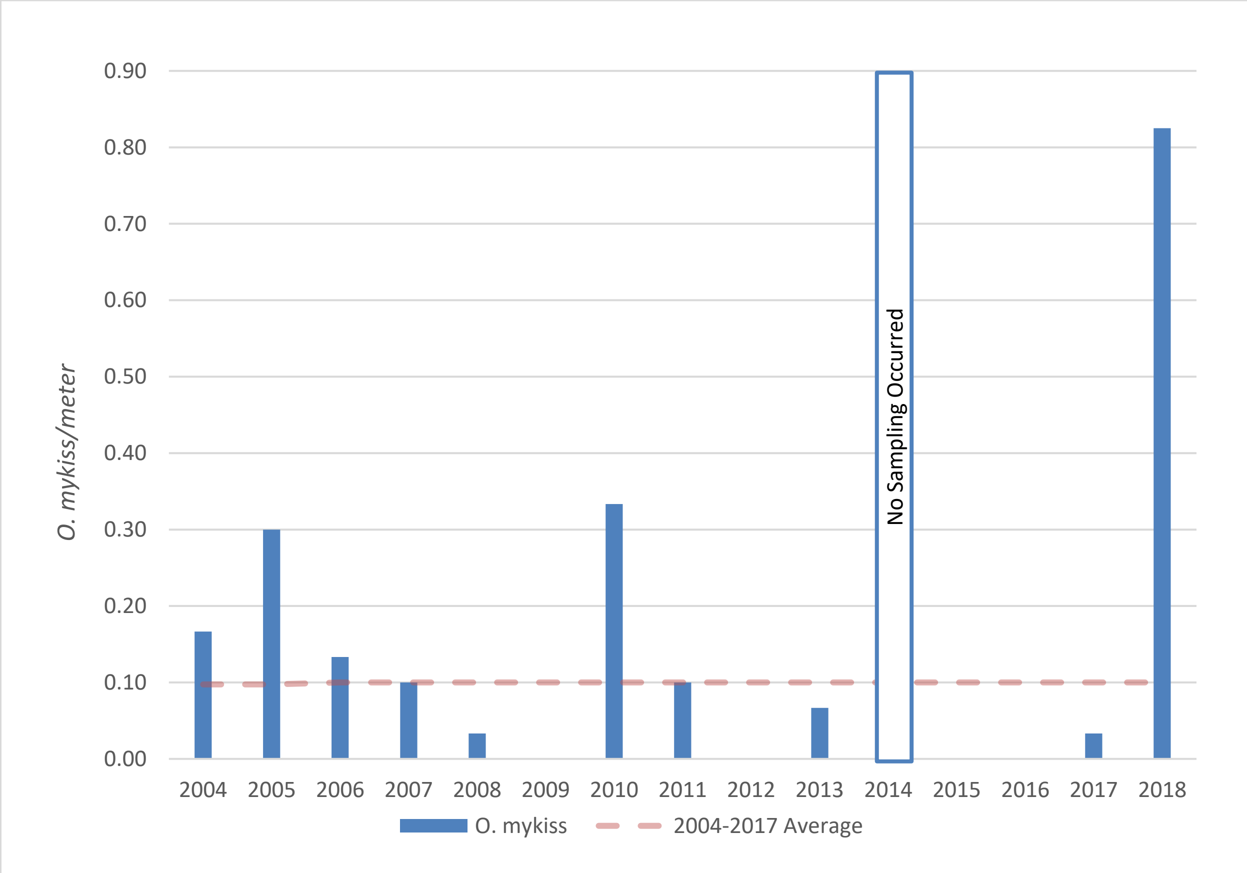

Figure 22: Station GC003 (previously Station 18) standardized *O. mykiss* capture 2004-2018.

GC004

This station was sampled during the previous monitoring effort; during the data collection effort between 2004 and 2017, this station was known as Site 20 and was the most upstream station sampled. The station is situated amongst rural residential areas. The sampling station was 40 m in length with an average wetted width of 6.0 m and an average depth of 0.15 m. Three habitat types were present within the station: riffle, run, and pool (Figure 23). Habitat at the station was 55% riffle, 28% run, and 28% pool. The primary substrate was cobble with a secondary substrate of boulders. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 22.

Figure 23: Photos of station GC004, looking upstream (left) and looking downstream (right).

Table 22: Station GC004 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)			
402	16.49	10.87	11.2			
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
1	3	1	2	3	2	0

Two species of fish were captured during the survey: *O. mykiss* and riffle sculpin. The most abundant species encountered was riffle sculpin (n=125). Eight *O. mykiss* were captured during the sampling effort, four of which were ≥65 mm so they were PIT tagged prior to being released. Fish captured and associated population estimates are summarized in Table 23.

Table 23: Number captured and population estimates at Station GC004 on the Guadalupe Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	8	8	0.512	8-9
Riffle sculpin	Yes	125	139	7.285	125-153

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station GC004 has 14 years of comparable data. Figure 24 shows the standardized capture of *O. mykiss* between 2004 and 2018. In all but three years, *O. mykiss* were captured at this station. This reach did not experience drybacks in 2015, but flow conditions were very low and no *O. mykiss* were captured in 2015 or 2016. In 2017 the fish returned. The highest density of *O. mykiss* occurred in 2005 at 1.03 fish per meter. This was the highest density recorded at any station during the entire 14-year monitoring period. The average *O. mykiss* density at this site between 2004-2017 was 0.45 fish per meter. The density during the 2018 monitoring was lower than the average from previous years data collection effort at 0.20 *O. mykiss* per meter, and this station has seen below average results during the last six sampling years. Though the densities are below average, the reach still appears to consistently support rearing, and recolonization occurred after the 2014 drought conditions.

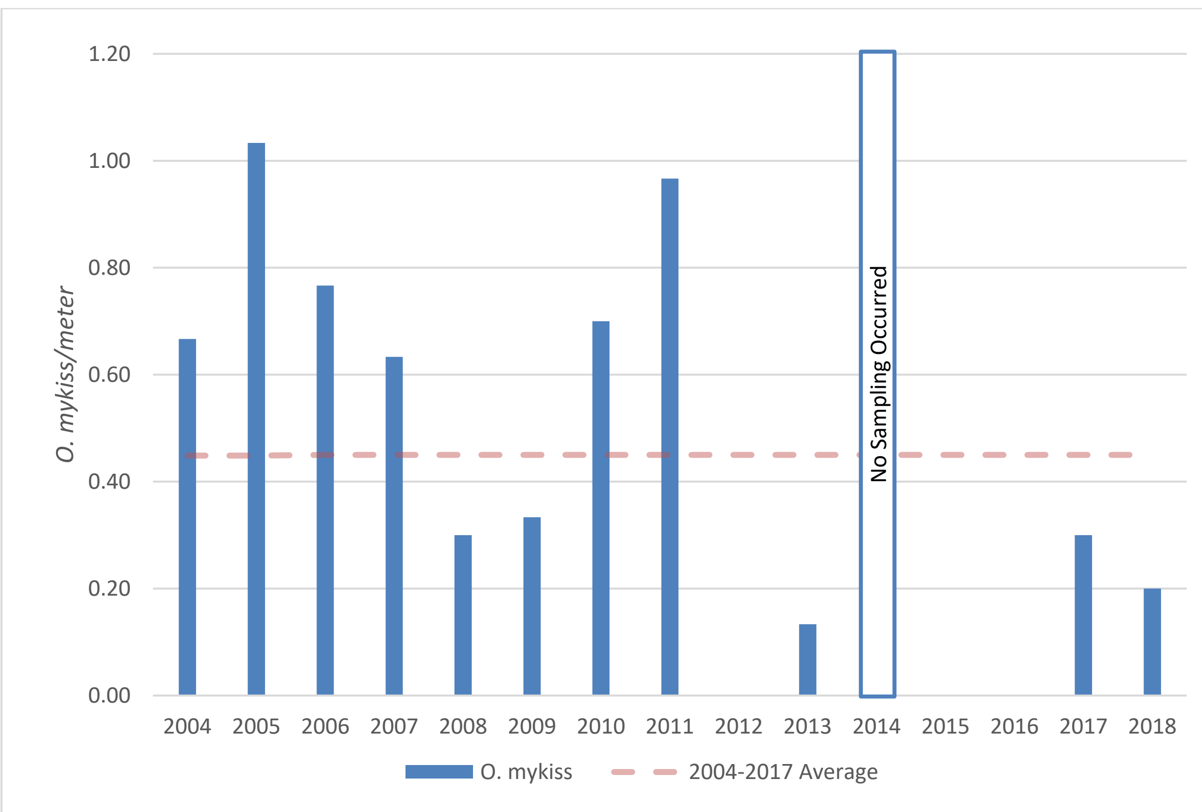

Figure 24: Station GC004 (previously Station 20) standardized *O. mykiss* capture 2004-2018.

GC005

This station was part of the expanded monitoring effort (WY 2018) and was selected randomly. The station is surrounded by limited residential housing, but land disturbance to the east is present. The sampling station was 40 m in length with an average wetted width of 3.0 m and an average depth of 0.2 m. Three habitat types were present within the station: riffle, run, and a side channel pool (Figure 25). The riffle habitat made up 55%, the run 45%, and the pool was in a small side channel surrounded by a riffle to run transition. The primary substrate was cobble with a secondary substrate of boulders. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 24.

Figure 25: Photos of station GC005, looking upstream (left) and looking downstream (right).

Table 24: Station GC005 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
427	14.51	11.61	10.70

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
1	3	1	2	3	1	0

Two species of fish were captured during the survey: *O. mykiss* and riffle sculpin. The most abundant species encountered was riffle sculpin (n=73). Seventeen *O. mykiss* were captured during the sampling effort, 10 of which were ≥65 mm so they were PIT tagged prior to being released. Fish captured and associated population estimates are summarized in Table 25. In station GC005 the maximum likelihood iterations indicate that the number of both prickly sculpin and *O. mykiss* is likely higher than what was captured.

Table 25: Number captured and population estimates at Station GC005 on Guadalupe Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	17	20	4.464	17-29
Riffle sculpin	Yes	73	77	3.211	73-83

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Since this was the first year of sampling at this station no comparisons over time can be made, but the 2018 results for this station can be compared with the long-term average for Guadalupe Creek. This station had an observed density (based on n) of 0.43 *O. mykiss* per meter and an estimated density (based on N) of 0.50 *O. mykiss* per meter. The average *O. mykiss* density from the 2004-2017 sampling period for repeated Guadalupe Creek stations is 0.16 *O. mykiss* per meter. This station was above the long-term average for Guadalupe Creek and very similar to the average *O. mykiss* density of the closest repeated station—Station GC004 with 0.45 *O. mykiss* per meter.

GC006

This station was part of the expanded monitoring effort and was selected randomly. The station is surrounded by limited rural residential housing and was the most upstream station sampled. The sampling station was 40 m in length with an average wetted width of 3.5 m and an average depth of 0.2 m. Three habitat types were present within the station: riffle, run, and pool (Figure 26). The riffle habitat made up 58%, the run 25%, and the pool the remaining 17%. The primary substrate was cobble with a secondary substrate of cobble. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 26.

Figure 26: Photos of station GC006, looking upstream (left) and looking downstream (right).

Table 26: Station GC006 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
411	15.23	13.80	21.90

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
1	1	1	1	4	2	0

Three species of fish were captured during the survey: *O. mykiss*, riffle sculpin, and Sacramento sucker. The most abundant species encountered was riffle sculpin (n=22). Five *O. mykiss* were captured during the sampling effort, three of which were ≥65 mm so they were PIT tagged prior to being released. Fish captured and associated population estimates are summarized in Table 27. The maximum likelihood iterations did not provide a population estimate higher than what was observed. Sacramento sucker were encountered in this station, but not in the two stations downstream.

Table 27: Number captured and Population estimate at Station GC006 on the Guadalupe Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	5	5	0.444	5-6
Riffle sculpin	Yes	22	22	0.814	22-24
Sacramento sucker	Yes	3	3	0.709	3-6

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

As with Station GC005, this was the first year of sampling at this station so no comparisons over time can be made, but the 2018 results for this station can be compared with the long-term average for Guadalupe Creek. This station had an observed density (based on n) of 0.13 *O. mykiss* per meter. The average *O. mykiss* density from the 2004-2017 sampling period for repeated Guadalupe Creek stations is 0.16 *O. mykiss* per meter. This station is slightly below the long-term average for Guadalupe Creek, but still supported *O. mykiss*.

Discussion

Based on the results of the WY 2018 sampling, Guadalupe Creek continues to support rearing of *O. mykiss*. A total of 66 *O. mykiss* were collected in the six sampling stations. Fork-lengths ranged from 56 mm to 199 mm (Figure 27). Growth rates of juvenile *O. mykiss* in California are highly variable and are dependent on temperature, food availability, seasonal flow, and population densities/competition (Moyle 2002). According to Moyle (2002), in small streams with low summer flows, such as the Guadalupe Creek, young-of-the-year steelhead measure 50–90 mm, and fish at the end of their second year measure 100–160 mm. Smith and Leicester (2016) aged 32 fish from Guadalupe Creek and found that young-of-the-year *O. mykiss* ranged from 85–114 mm, and fish in their second year ranged from 110–195 mm. This is a faster growth rate than predicted by Moyle (2002), but this is expected in warmer, more productive systems. Based on Moyle (2002) and Smith and Leicester (2016) growth rates, *O. mykiss* captured in Guadalupe Creek in WY 2018 were predominantly young-of-the-year, with some that had been through a second summer, and one fish that may have been it its third year. The abundance of young-of-the-year fish observed indicates that Guadalupe Creek had successful reproduction and summer rearing in 2018.

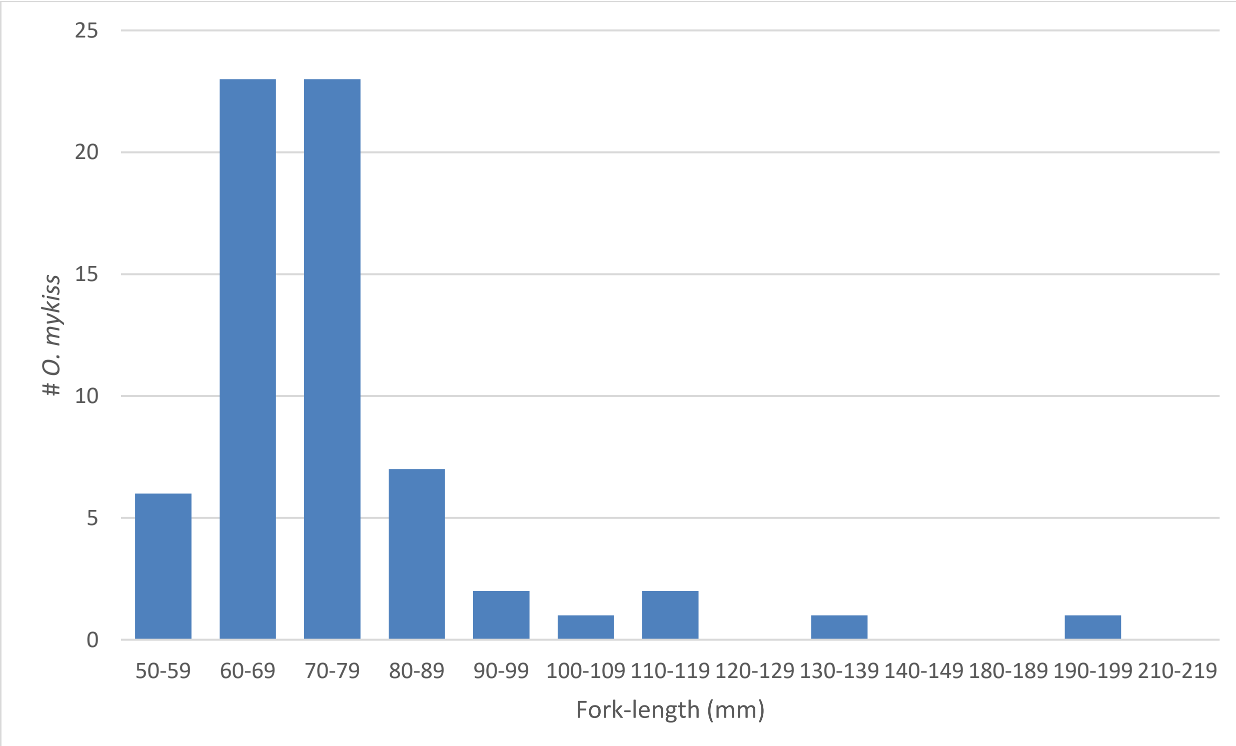

Figure 27: Guadalupe Creek *O. mykiss* length histogram. All measurements are in fork-length and binned in 10 mm increments.

The average *O. mykiss* density for all repeated sampling stations in 2018 was 0.28 fish per meter (based on the number of fish caught [n]). The average *O. mykiss* per meter for the repeated sampling stations between 2004-2017 was 0.16 fish. The number of *O. mykiss* observed in 2018 was higher than average. When the expanded sampling stations (GC005 and GC006) are included in the 2018 average, it maintains a 0.28 *O. mykiss* per meter average (based on n); therefore, expanding the sampling upstream of the previously sampled stations (WYs 2004-2017) did not impact the average. The maximum likelihood iteration indicates that it is likely that the number of *O. mykiss* present in Guadalupe Creek is higher than what was observed during our sampling effort (0.35 fish per meter based on N). Based on the density of *O. mykiss* at each station, juvenile rearing appears to occur throughout Guadalupe Creek with no clear up- to downstream trend (Figure 28).

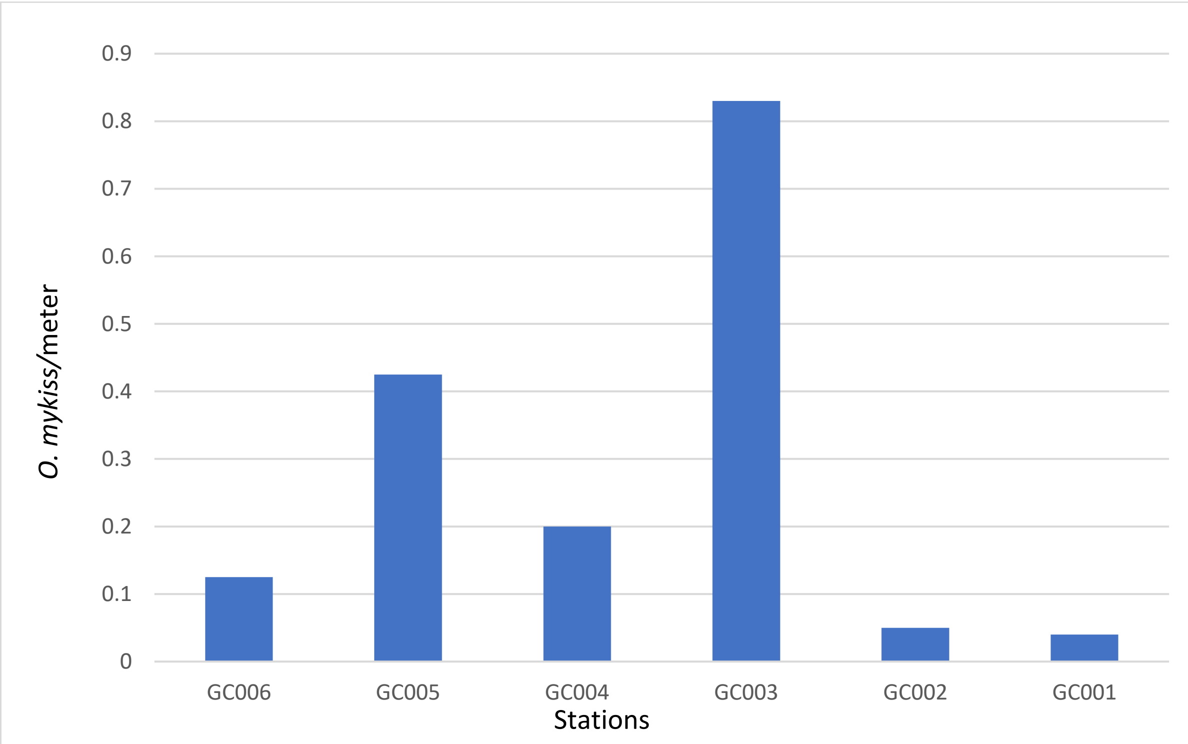

Figure 28: 2018 *O. mykiss* catch per unit effort oriented up- to downstream on Guadalupe Creek.

Guadalupe Creek supports four species of native fish, with multiple age classes of *O. mykiss,* and few non-native species. Of the 66 *O. mykiss* encountered during the sampling efforts, five had a Neascus-type parasitic infection commonly called "blackspot" disease. The visible black spots associated with fish are the metacercaria stage of the free-swimming parasite that produce a melanin-induced fibrous cyst (Schaaf et al. 2017). None of the fish observed were classified as a severe infection (raised cysts present on greater than 25% of the body). Most infected fish were recorded as minor with only a few raised cysts (Figure 29). The impacts to *O. mykiss* associated with this infection are not known.

When data from 2004-2017 is also considered, the results indicate that *O. mykiss* production is variable, and the species is resilient. After not collecting any *O. mykiss* in Guadalupe Creek in 2015 and only two in 2016, there has been a steady increase in total number of O. mykiss collected. Guadalupe Creek is clearly important for production of *O. mykiss* in the Guadalupe River watershed.

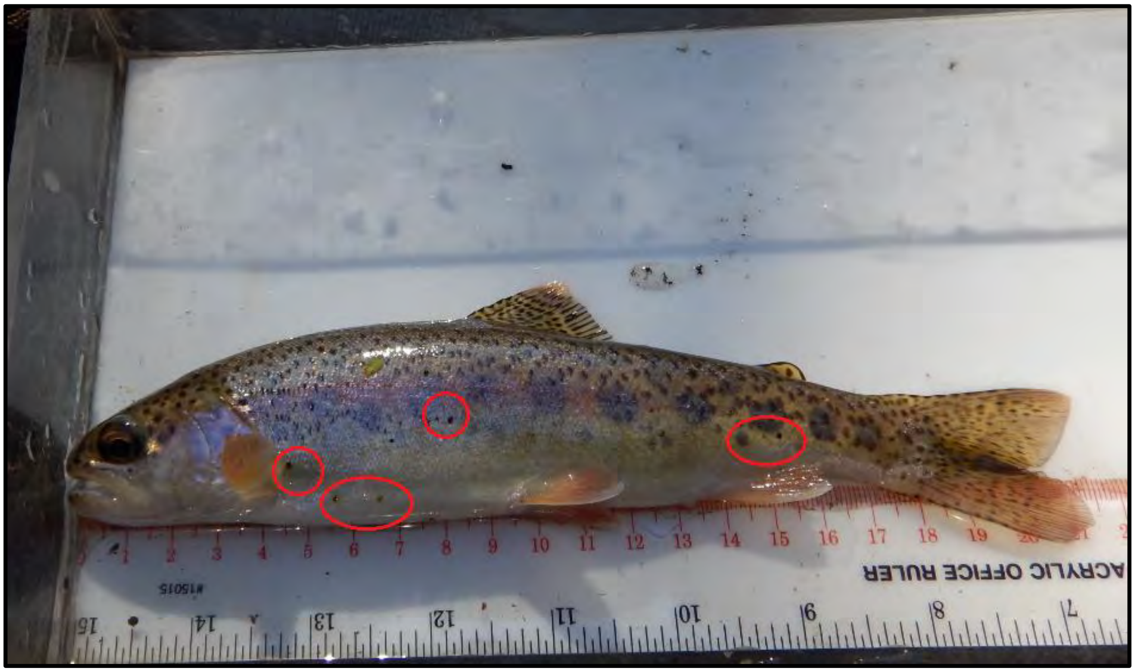

Figure 29: Guadalupe Creek *O. mykiss* with minor blackspot disease. Melanin induced cysts are circled in red.

3.3 Los Gatos Creek

Sampling occurred at four new stations on Los Gatos Creek on November 1 and 5, 2018; juvenile rearing monitoring had not been conducted previously in this system. All sampling days were sunny and clear. Flows on Los Gatos Creek, based on ALERT gage 5050 – Los Gatos Creek at Lincoln Avenue, were approximately 5.0 cfs.

LG001

This was the most downstream station sampled on Los Gatos Creek. The station is bordered by urban development and there were numerous homeless encampments and other signs of human disturbance during sampling. The sampling station was 40 m in length with an average wetted width of 4.5 m and an average depth of 0.3 m. Two habitat types were present within the station: riffle and run (Figure 30). Each habitat type made up 50% of the area sampled. The primary substrate was gravel with a secondary substrate of cobble. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 28.

Two species of fish were captured during the survey: California roach and Sacramento sucker. The most abundant species encountered was California roach (n=78). No *O. mykiss* were captured. Fish captured and associated population estimates are summarized in Table 29.

Figure 30: Photos of station LG001, looking upstream (left) and looking downstream (right).

Table 28: Station LG001 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
439	16.91	10.12	18.20

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	2	1	2	2	2	0

Table 29: Number captured and population estimates at Station LG001 on Los Gatos Creek.

Species	Native	n	N	SE	95% CI
California roach	Y	78	113	23.41	78-159
Sacramento sucker	Y	3	3	0	3-3

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Station LG001 had high capture rates for California roach, and the population estimates indicates that the number of fish was likely higher. All fish captured at this station were native. The lack of non-native fish at this station is positive and the habitat that is present could potentially support rearing of *O. mykiss*.

LG002

The station is situated amongst urban residential areas. Large stands of non-native *Arundo donax* were present along the entire right bank and a sakrete wall lined portions of the left bank. The sampling station was 40 m in length with an average wetted width of 4.5 m and an average depth of 0.65 m. Three habitat types were present within the station: riffle, run, and pool (Figure 31). The riffle habitat made up 20%, the run made up 35%, and the pool made up the remaining 35%. The primary substrate was gravel with a secondary substrate of cobble. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 30.

Figure 31: Photos of station LG002, looking upstream (left) and looking downstream (right).

Table 30: Station LG002 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)
457	15.96	10.18	12.90

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
3	2	1	2	1	2	2

Three species of fish were captured: California roach, Sacramento sucker, and mosquitofish. The most abundant species encountered was California roach (n=43). No *O. mykiss* were captured. Fish captured and associated population estimates are summarized in Table 31.

Table 31: Number captured and population estimate at Station LG002 on Los Gatos Creek.

Species	Native	n	N	SE	95% CI
California roach	Y	43	46	3.249	43-53
Sacramento sucker	Y	27	27	0.925	27-29
Mosquitofish	N	4	6	0	4-6

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

There were high capture rates of native fish at Station LG002. The only non-native species captured was mosquitofish. The pool habitat in the downstream portion of this station is suitable for non-native predatory fish, so the absence of these species is positive.

LG003

The station is bordered by residential development. Trash and other impacts associated with homeless encampments and other human uses were prevalent in the area surrounding this station. The sampling station was 40 m in length with an average wetted width of 3.5 m and an average depth of 0.3 m. Three habitat types were present within the station: riffle, run, and glide (Figure 32). The riffle habitat made up 28%, the run 65% and the glide the remaining 7%. The primary substrate was cobble with a secondary substrate of boulders. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 32.

Figure 32: Photos of station LG003, looking upstream (left) and looking downstream (right).

Table 32: Station LG003 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)		Temperature (°C)		Dissolved Oxygen (mg/l)		Turbidity (NTU)
448		16.63		10.73		13.40
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
1	3	1	2	2	2	0

Two species of fish were captured during the survey: prickly sculpin and Sacramento sucker. The most abundant species encountered was Sacramento sucker (n=15). No *O. mykiss* were captured. Fish captured and associated population estimates are summarized in Table 33. Station LG003 had lower capture rates for California roach and Sacramento sucker than the reaches downstream, but no non-native fish were captured. The lack of non-native fish at this station is positive, and the habitat that is present could potentially support rearing of *O. mykiss*.

Table 33: Number captured and population estimates at Station LG003 on Los Gatos Creek.

Species	Native	n	N	SE	95% CI
Prickly sculpin	Y	2	2	0.384	2-7
Sacramento sucker	Y	16	17	1.997	16-21

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

LG004

This is the most upstream station and is situated amongst commercial development. The sampling station was 40 m in length with an average wetted width of 4.0 m and an average depth of 0.6 m. Two habitat types were present within the station: riffle and run (Figure 33). The riffle habitat made up 45% of the habitat and the run the remaining 55%. The primary substrate was cobble with a secondary substrate of gravel. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 34.

Five species of fish were captured during the survey: Sacramento sucker, common carp, goldfish (*Carassius auratus*), largemouth bass, and mosquitofish. The most abundant species encountered was Sacramento sucker (n=10) and it was the only native species observed at the station. No *O. mykiss* were captured at this sampling station. Fish captured and associated population estimates are summarized in Table 35.

Figure 33: Photos of station LG004, looking upstream (left) and looking downstream (right).

Table 34: Station LG004 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)		Temperature (°C)		Dissolved Oxygen (mg/l)		Turbidity (NTU)
451		16.85		7.80		16.40
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
1	3	1	2	3	2	0

Table 35: Number captured and population estimates at Station LG004 on Los Gatos Creek.

Species	Native	n	N	SE	95% CI
Sacramento sucker	Y	10	14	8.151	10-32
Common carp	N	1	-	-	-
Goldfish	N	2	2	1.876	2-26
Largemouth bass	N	3	3	1.271	3-8
Mosquitofish	N	7	7	0.124	7-7

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Though the native Sacramento Sucker was the most abundant species, the overall species richness was 80% non-native. This station also supported goldfish and common carp, which were not seen at other sampling stations within the system.

Discussion

No *O. mykiss* were collected in Los Gatos Creek in WY 2018, although all stations had some suitable habitat complexity (i.e., undercut banks, large woody debris, or submerged roots) that could be used as refugia and had riffle habitat that should support fast-water feeding requirements. Since this was the first year of sampling on this creek, the historic densities are not known. *O. mykiss* are present in the system, at least periodically, as they have been observed by others. For example, Hobbs et al. (2014) sampled Los Gatos Creek in January and February 2014 and captured a total of nine *O. mykiss* at two stations, but captured none in October 2014 at a sampling station near Bascom Avenue (Hobbs et al. 2015). It is likely that *O. mykiss* production is not high in this system, and/or Los Gatos Creek could be subject to some of the same issues as the mainstem Guadalupe River, such as lack of population recovery from drought conditions. Additional juvenile rearing monitoring in future years will help evaluate this hypothesis.

Los Gatos Creek had a relatively low proportion of non-native species in the three downstream-most sampling reaches, and although the upstream-most reach had more non-native species, native fish were still more abundant. As with *O. mykiss* productivity, a better understanding of occurrence and trends of other native and non-native fish are expected to develop as additional juvenile rearing data is collected.

3.4 Alamitos Creek

Sampling occurred at four stations on Alamitos Creek on October 18 and 22, 2018. Most sampling days were overcast. Flows at the two upstream-most stations, based on ALERT gage 1544 Alamitos Creek below Almaden Reservoir, were approximately 2.6 cfs. Flows at the two downstream-most stations (AC001 and AC002), which are downstream of the confluence with Calero Creek, were approximately 5.0 cfs, based on ALERT gage 5070 Alamitos Creek at Greystone.

AC001

This was the most downstream station sampled on Alamitos Creek. The station is situated in an urban residential area with a walking trail along the left bank. The sampling station was 40 m in length with an average wetted width of 4.5 m and an average depth of 0.2 m. Two habitat types were present within the station: riffle and run (Figure 34). The riffle habitat made up 55% of the habitat and the run the remaining 45%. The primary substrate was cobble with a secondary substrate of gravel. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 36.

Figure 34: Photos of station AC001, looking upstream (left) and looking downstream (right).

Table 36: Station AC001 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)
483	16.89	9.63	13.50

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
3	1	1	2	1	2	0

Four species of fish were captured during the survey: *O. mykiss*, California roach, prickly sculpin, and Sacramento sucker. The most abundant species encountered was California roach (n=193). Four *O. mykiss* were captured and PIT tagged at this station. Fish captured and associated population estimates are summarized in Table 37. The maximum likelihood iterations provided population estimates higher than what was recorded for California roach and prickly sculpin. All fish species captured were native.

Table 37: Number captured and population at Station AC001 on Alamitos Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Y	4	4	0.969	4-7
California roach	Y	193	219	10.534	193-240
Prickly sculpin	Y	31	38	7.29	31-53
Sacramento sucker	Y	22	22	1.114	22-24

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

Since this was the first year of sampling within this station, no direct comparisons of densities of *O. mykiss* over time can be made. As more data is collected trends can begin to be evaluated.

AC002

The station is situated in an urban residential area with a walking trail along the right bank. The sampling station was 40 m in length with an average wetted width of 4.5 m and an average depth of 0.4 m. Three habitat types were present within the station:

riffle, run, and pool (Figure 35). The riffle habitat made up 40% of the habitat, the run 35%, and a pool the remaining 25%. The primary substrate was cobble with a secondary substrate of boulders. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 38.

Figure 35: Photos of station AC002, looking upstream (left) and looking downstream (right).

Table 38: Station AC002 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
462	17.01	9.94	22.90

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
2	2	0	0	2	2	0

Five species of fish were captured during the survey: *O. mykiss*, California roach, prickly sculpin, Sacramento sucker, and tule perch (*Hysterocarpus traskii*). The most abundant species encountered was prickly sculpin (n=36). Ten *O. mykiss* were captured and PIT tagged at this station. Fish captured and associated population estimates are summarized in Table 39.

Table 39: Number captured and population estimates at Station AC002 on Alamitos Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	10	20	25.403	10-73
California roach	Yes	26	27	1.73	26-31
Prickly sculpin	Yes	30	32	2.828	30-38
Sacramento sucker	Yes	7	24	84.855	7-200
Tule perch[2]	No	1	-	-	-

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

At station AC002 the maximum likelihood iterations provided population estimates higher than what was observed for California roach, prickly sculpin, Sacramento sucker, and *O. mykiss*. A population estimate of 20 *O. mykiss* within the station was calculated, but the standard error is high. Tule perch are native to California and were historically observed in the Coyote Creek watershed in 1922 (Hubbs 1925). This species was thought to be extirpated in Santa Clara County until 1999 when a single specimen was captured in Coyote Creek (SCVWD 2015). Tule perch do not show up in the historic records in Guadalupe Watershed, but are now established in Calero Reservoir (Leal et al. 2017). It is assumed that the reservoir is the source for the population in Alamitos Creek. Though the species is regionally native, it was likely not present in the Guadalupe Watershed until introductions to Calero Reservoir.

Since this was the first year of sampling within this station, no direct comparisons of densities of *O. mykiss* over time can occur. As more data is collected in this station trends will be able to be evaluated overtime.

AC003

The station is located upstream of the Calero Creek confluence and is situated in an urban residential area. The right bank through half of the station has large boulders that were placed by a previous bank protection project. The sampling station was 40 m in

[2] Tule perch are native to California and were observed in the Coyote Creek watershed in 1922 (Hubbs 1925). Though the species is regionally native, it was likely not historically present in the Guadalupe Watershed. For this analysis the species is considered non-native.

length with an average wetted width of 3.0 m and an average depth of 0.3 m. Four habitat types were present within the station: riffle, run, glide, and rapids (Figure 36). The riffle habitat only made up 0.2% of the habitat, but the rapids through the large boulders of the bank protection directly downstream contributed to 28%. The run habitat made up 1% with the glide contributing the remaining 70.8%. The primary substrate was cobble with a secondary substrate of boulders. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 40.

Figure 36: Photos of station AC003, looking upstream (left) and looking downstream (right).

Table 40: Station AC003 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)
401	15.38	9.93	20.20

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
3	3	1	1	2	2	0

Four species of fish were captured during the survey: *O. mykiss*, California roach, Sacramento sucker, and green sunfish. The most abundant species encountered was

California roach (n=156). Ten *O. mykiss* were captured and PIT tagged at this station. Fish captured and associated population estimates are summarized in Table 41.

Table 41: Number captured and population estimates at Station AC003 on Alamitos Creek.

Species	Native	N	N	SE	95% CI
O. mykiss	Yes	10	12	4.152	10-21
California roach	Yes	156	226	32.81	156-291
Sacramento sucker	Yes	23	90	204.048	23-495
Green sunfish	No	2	2	1.038	2-15

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

In station AC003 the maximum likelihood iterations provided population estimates higher than what was recorded for California roach, Sacramento sucker, and *O. mykiss*. This was the first station where non-native green sunfish were observed, but the density was the lowest out of all fish species captured. Since this was the first year of sampling within this station, no direct comparisons of densities of *O. mykiss* over time can occur. As more data is collected in this station trends will be able to be evaluated overtime.

AC004

AC004 is the most upstream station on Alamitos Creek. Portions of the station were underneath the bridge that connects Almaden and Bertram Roads. The bridge footing extended into the channel. The sampling station was 40 m in length with an average wetted width of 5.0 m and an average depth of 0.3 m. Three habitat types were present within the station: riffle, run, and glide (Figure 37). The riffle habitat made up 50% of the habitat, the run 15%, and the glide contributed the remaining 35%. The primary substrate was boulders with a secondary substrate of cobbles. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 42.

Figure 37: Photos of station AC004, looking upstream (left) and looking downstream (right).

Table 42: Station AC004 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)			
390	16.50	10.87	14.0			
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
1	4	1	2	3	2	1

Three species of fish were captured during the survey: *O. mykiss,* California roach, and prickly sculpin. *O. mykiss* were the most abundant species present and of the eight captured, six were ≥65 mm so they were PIT tagged prior to being released. Fish captured and associated population estimates are summarized in Table 43.

Table 43: Number captured and population estimates at Station AC004 on Alamitos Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	8	9	2.612	8-15
California roach	Yes	7	8	2.993	7-15
Prickly sculpin	Yes	2	2	0	2-2

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

In station AC004 the maximum likelihood iterations provided population estimate higher than what was recorded for California roach and *O. mykiss*. All fish species captured were native. Since this was the first year of sampling within this station, no direct comparisons of densities of *O. mykiss* over time can occur. As more data is collected at this station trends will be able to be evaluated overtime.

Discussion

A total of 32 *O. mykiss* were collected in the four Alamitos Creek sampling stations. Fork-lengths ranged from 60 mm to 345 mm (Figure 38). Based on Moyle (2002) and Smith and Leicester (2016) growth rates, approximately half of the *O. mykiss* captured in WY 2018 were young-of-the-year and the other half have been through their second summer. One large, presumably resident rainbow trout measuring 345 mm was also captured. This size suggests the fish was at the end of its fourth year (Moyle 2002). Based on the results of the WY 2018 sampling, Alamitos Creek had successful reproduction and appears to support rearing of *O. mykiss* throughout its length (Figure 39). Alamitos Creek had successful reproduction and summer rearing in 2018. The *O. mykiss* in this system also showed signs of blackspot disease. Of the 31 captured, 15 had visible symptoms, with one being recorded as severe (Figure 40). Of all systems sampled, blackspot disease was most prevalent in Alamitos Creek *O. mykiss*.

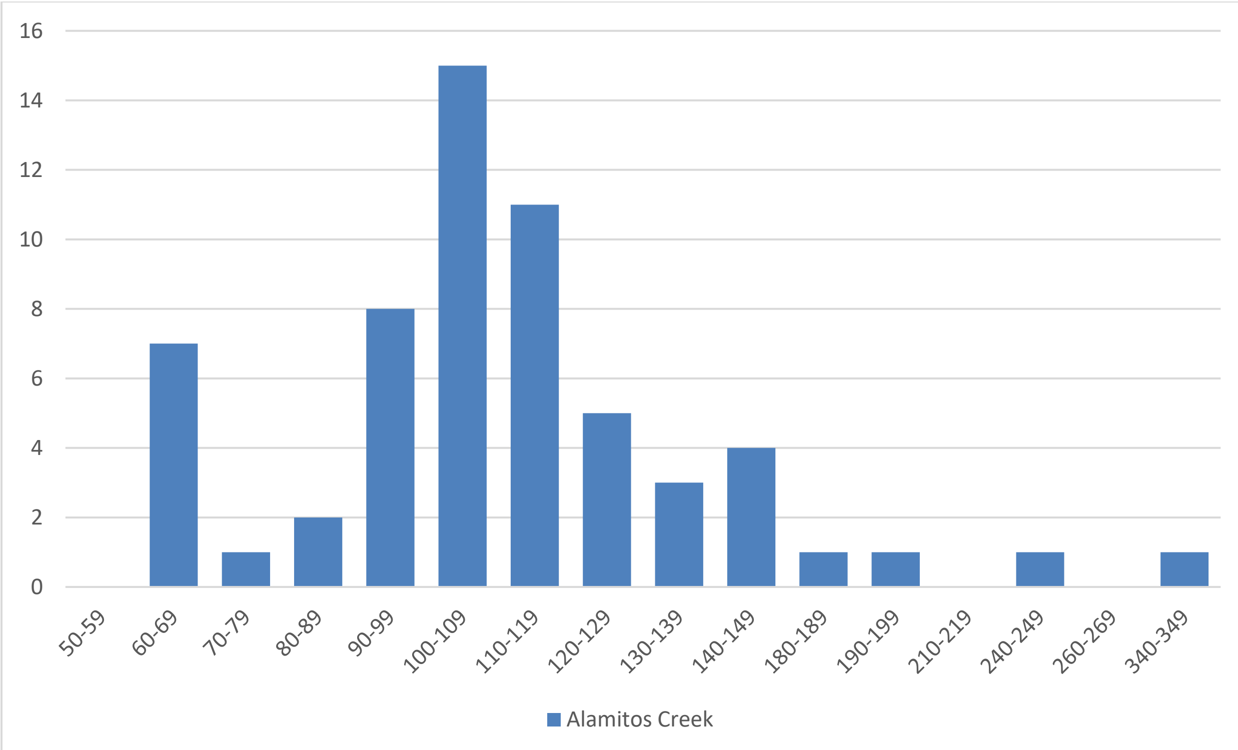

Figure 38: Alamitos Creek O. mykiss length histogram. All measurements are in fork-length and binned in 10 mm increments.

The average catch of *O. mykiss* in Alamitos Creek in 2018 was 0.20 fish per meter (Figure 39). When compared to the average standardized catch at repeated sampling stations between 2004-2018 on Guadalupe Creek (0.17 *O. mykiss* per meter) it is above average. During a fish relocation for a habitat improvement project approximately 500 m downstream of station AC001, SCVWD's Stream Maintenance Program (SMP) staff documented a density of 0.53 *O. mykiss* per meter (64 total fish). This was higher than the densities at any of the sampling stations. This sampling also led to the ability to PIT tag an additional 26 fish in the Alamitos Creek sub-watershed. The sizes and tag number of these fish can be seen in Appendix A.

Alamitos Creek is also supporting four other species of native fish, has a small population of tule perch that were once thought to be extirpated in Santa Clara County, and has relatively few non-native species. Non-native fish (including tule perch) made up less than 1% of the total number captured.

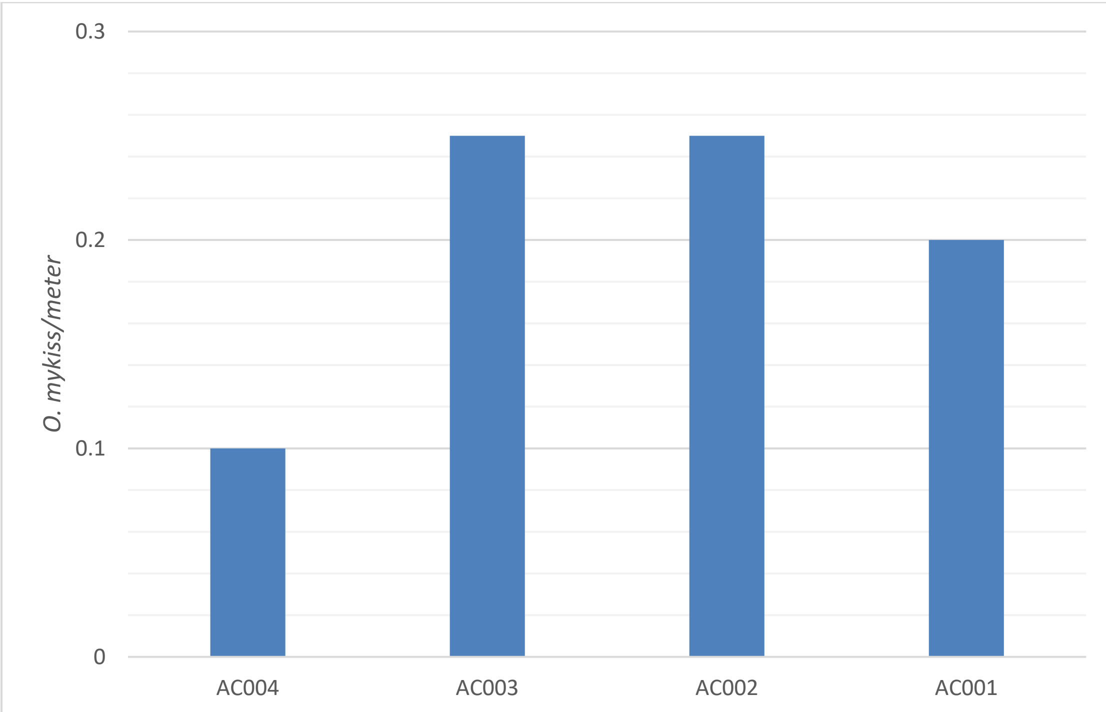

Figure 39: *O. mykiss* catch per unit effort oriented up- to downstream on Alamitos Creek.

Figure 40: Alamitos Creek *O. mykiss* with visible signs of blackspot disease (left being severe and right being minor).

3.5 Calero Creek

Sampling occurred at three stations on Calero Creek on October 23 and 24, 2018. The sampling days were a mix of overcast and clear. Flows on Calero Creek based on ALERT gage 5013 Calero Creek below Calero Reservoir were approximately 6.0 cfs.

CC001

This was the most downstream station sampled on Calero Creek. The station is situated in urban residential and was approximately 300 m upstream of the confluence with Alamitos Creek. The sampling station was 40 m in length with an average wetted width of 3.5 m and an average depth of 0.3 m. Three habitat types were present within the station: riffle, run, and pool (Figure 41). The riffle habitat made up 53% of the habitat, the run 35%, and the pool the remaining 12%. A small side channel pool was present but lacked connectivity to the main channel. The primary substrate was gravel with a secondary substrate of cobble. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 44.

Figure 41: Photos of station CC001, looking upstream (left) and looking downstream (right).

Table 44: Station CC001 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)
547	16.30	8.96	25.0

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
3	1	1	2	2	2	0

Five species of fish were captured during the survey: *O. mykiss*, California roach, prickly sculpin, Sacramento sucker, and tule perch. The most abundant species encountered was California roach (n=10). Four *O. mykiss* were captured and PIT tagged at this station. Fish captured and associated population estimates are summarized in Table 45.

Table 45: Number captured and population estimate at Station CC001 on Calero Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	4	4	0.205	4-5
California roach	Yes	10	14	8.151	10-32
Largemouth bass	No	1	-	-	-
Prickly sculpin	Yes	5	5	0.787	5-7
Sacramento sucker	Yes	8	8	0.11	8-8
Tule perch	No	2	2	0.384	2-7

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

In station CC001 the maximum likelihood iterations provided population estimate higher than what was recorded for California roach. Non-native predatory largemouth bass were observed, but the density was the lowest out all fish species captured. As in Alamitos Creek, tule perch were captured but in low densities. Since this was the first year of sampling within this station, no direct comparisons of densities of *O. mykiss* over time can occur. As more data is collected in this station trends will be able to be evaluated.

CC002

The station is situated in an urban residential area. A small sakrete structure at an outfall was present. The sampling station was 40 m in length with an average wetted width of 3.0 m and an average depth of 0.3 m. Three habitat types were present within the station: riffle, run, and pool (Figure 42). The riffle habitat made up 42% of the habitat, the run 35%, and a pool the remaining 23%. The primary substrate was cobble with a secondary substrate of silt. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 46.

Figure 42: Photos of station CC002, looking upstream (left) and looking downstream (right).

Table 46: Station CC002 water quality data and ocular estimates of habitat complexity.

Water Quality			
Conductivity (µS/cm)	**Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**Turbidity (NTU)**
477	16.33	8.78	38.0

Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	**Boulders**	**Woody Debris**	**Undercut Banks**	**Overhanging Vegetation**	**Roots**	**Artificial Structures**
0	2	1	2	3	2	1

Three species of fish were captured during the survey: *O. mykiss*, California roach, and Sacramento sucker. The most abundant species encountered was California roach (n=21). Four *O. mykiss* were captured and PIT tagged at this station. Fish captured and associated population estimates are summarized in Table 47.

Table 47: Number captured and population estimates at Station CC002 on Calero Creek.

Species	Native	n	N	SE	95% CI
O. mykiss	Yes	4	8	17.588	4-50
California roach	Yes	21	29	10.533	21-51
Sacramento sucker	Yes	6	6	1.002	6-9

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

In station CC002 the maximum likelihood iterations provided population estimates higher than what was recorded for California roach and *O. mykiss*. All fish species captured were native. Since this was the first year of sampling within this station, no direct comparisons of densities of *O. mykiss* over time can occur. As more data is collected in this station trends will be able to be evaluated.

CC003

The station is situated in a rural/agricultural area. The sampling station was 40 m in length with an average wetted width of 3.5 m and an average depth of 0.25 m. Two habitat types were present within the station: riffle and glide (Figure 43). The riffle habitat made up 45% of the habitat with the glide making up the remaining 55%. The primary substrate was silt with a secondary substrate of gravel. Results of the water quality monitoring and the ocular assessment of habitat complexity can be seen in Table 48. Equipment failure limited the ability to collect DO and turbidity measurements.

Figure 43: Photos of station CC001, looking upstream (left) and looking downstream (right).

Table 48: Station CC003 water quality data and ocular estimates of habitat complexity.

Water Quality						
Conductivity (µS/cm)		Temperature (°C)		Dissolved Oxygen (mg/l)		Turbidity (NTU)
489		14.0		-		-
Habitat Complexity Scoring						
Macrophytes/Emergent Vegetation	Boulders	Woody Debris	Undercut Banks	Overhanging Vegetation	Roots	Artificial Structures
1	0	1	1	3	2	0

Three species of fish were captured during the survey: *O. mykiss,* California roach, and Sacramento sucker. The most abundant species encountered was Sacramento sucker (n=20). Nine *O. mykiss* were captured and PIT tagged at this station. Fish captured and associated population estimates are summarized in Table 49.

Table 49: Number captured and population estimates at Station CC002 on Calero Creek.

Species	Native	N	N	SE	95% CI
O. mykiss	Yes	9	16	17.311	9-53
California roach	Yes	14	20	10.039	14-41
Sacramento sucker	Yes	20	24	5.268	20-35

n = total number captured, N = calculated population estimate, SE = standard error, CI = confidence interval

In station CC003 the maximum likelihood iterations provided population estimates higher than what was recorded for all fish species. All species captured were native. Since this was the first year of sampling within this station, no direct comparisons of densities of *O. mykiss* over time can occur. As more data is collected in this station trends will be able to be evaluated.

Discussion

A total of 17 *O. mykiss* were collected in three sampling stations. Fork-lengths ranged from 67 mm to 263 mm (Figure 44). Based on Moyle (2002) growth rates, *O. mykiss* captured in Calero Creek in 2018 were mostly young-of-the-year, but some may have been in their second year. Based on Smith and Leicester (2016) growth rates, nearly all *O. mykiss* captured in 2018 were young-of-the-year. There were two fish collected that were in their third year (Moyle 2002). Calero Creek is supporting multiple age classes of *O. mykiss* and rearing appears to be distributed throughout the system, although higher densities were observed at the most upstream station (Figure 45). Based on the results of the WY 2018 sampling, Calero Creek supports rearing of *O. mykiss,* and had successful reproduction and summer rearing in 2018.

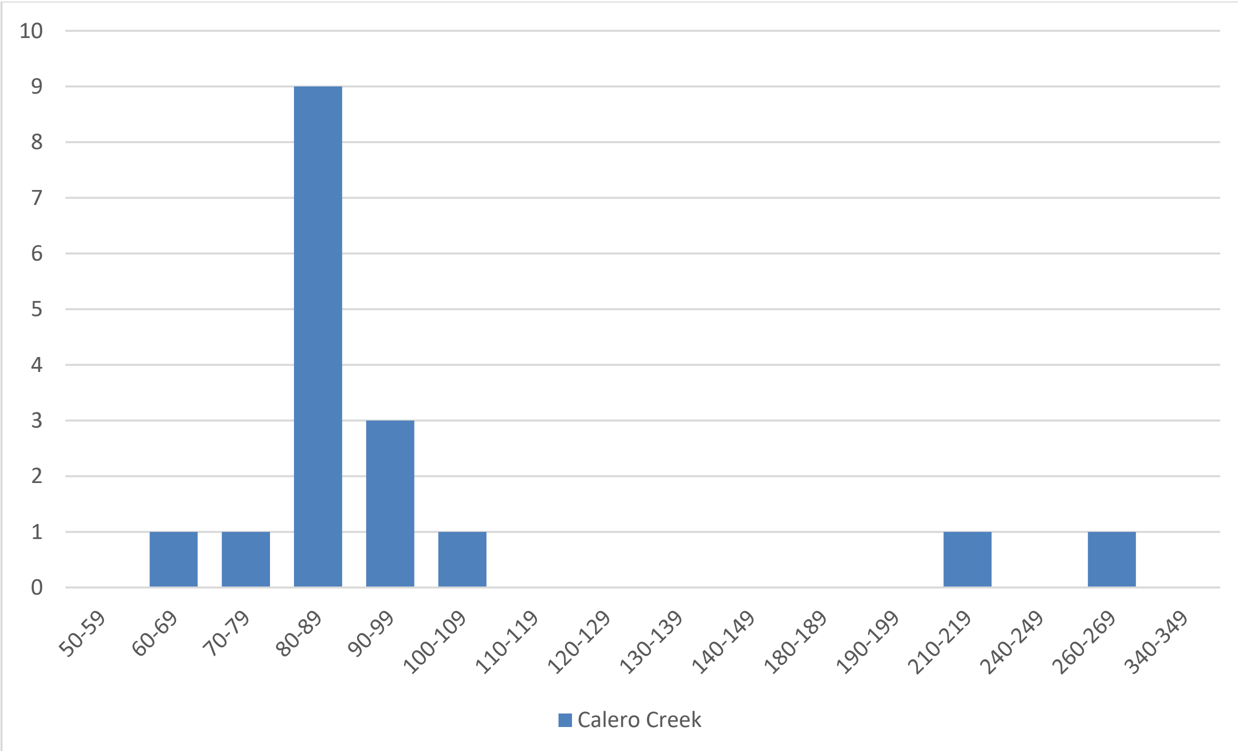

Figure 44: Calero Creek *O. mykiss* length histogram. All measurements are in fork-length and binned in 10 mm increments.

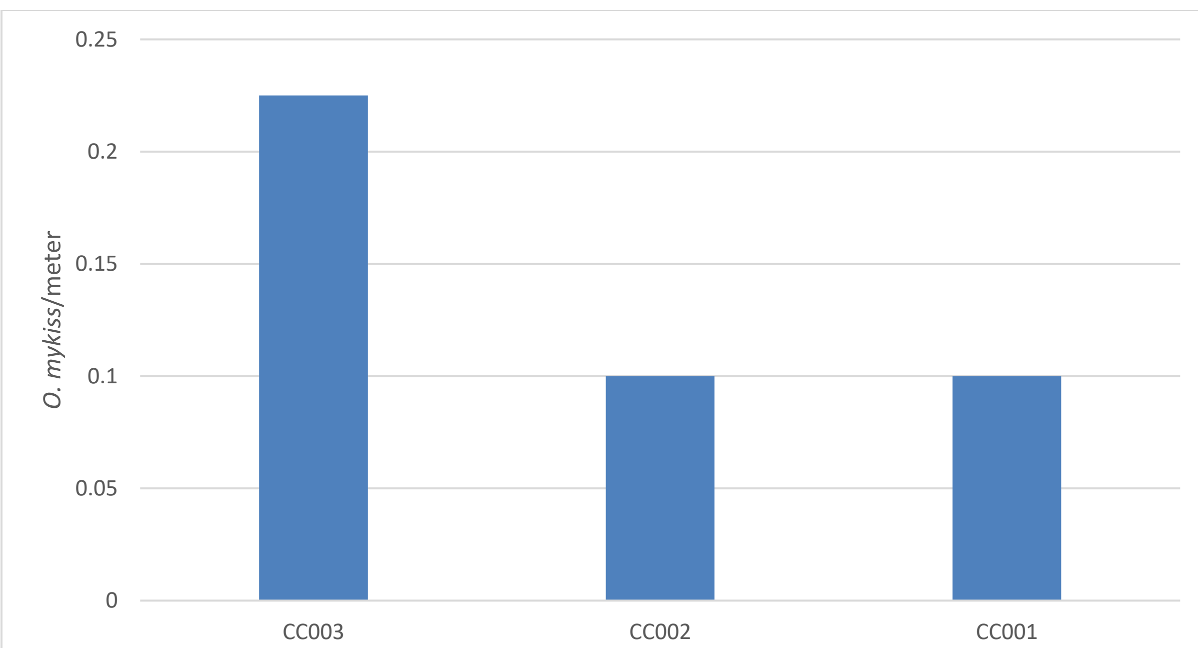

Figure 45: *O. mykiss* catch per unit effort oriented up- to downstream on Calero Creek.

The average catch of *O. mykiss* on Calero Creek in 2018 was 0.14 fish per meter. This is lower than the long-term average catch at repeated sampling stations on Guadalupe Creek (0.17 *O. mykiss* per meter) and Alamitos Creek (0.20 *O. mykiss* per meter). Guadalupe and Alamitos creeks are larger sub-watersheds, so it is expected that they would support higher fish densities. Although Calero Creek had a lower rearing density than Guadalupe Creek and Alamitos Creek, it still had a structured *O. mykiss* population and is contributing the overall production in the system. No blackspot disease was observed on *O. mykiss* in Calero Creek (Figure 46).

Figure 46: *O. mykiss* captured on Calero Creek.

4. Conclusion

In WY2018, juvenile *O. mykiss* were observed in Guadalupe, Alamitos, and Calero Creeks. They were not observed in the Guadalupe River or Los Gatos Creek. Based on historic data, it is not uncommon to not detect *O. mykiss* in the Guadalupe River at all sampling stations, as the occurrence data from 2004-2017 has always been sporadic. However, this is the longest duration (four years) where an *O. mykiss* has not been captured on the Guadalupe River during this monitoring. It is unknown if it is normal for no detections to occur in Los Gatos Creek in some years, as this is the first year of sampling this creek. It is important to remember that electrofishing sampling only allows for specific habitats to be sampled. It is not feasible in deep pools, which may be the preferred habitat for *O. mykiss* inhabiting these two systems.

The average densities (fish per meter) and average length of *O. mykiss* detected in Guadalupe, Alamitos, and Calero Creeks can be seen in Table 50. Guadalupe Creek had the highest densities and a smaller average length. The average lengths of *O. mykiss* in Calero and Alamitos Creeks are slightly skewed by the presence of a few larger fish (likely residents), but when the distribution of size is seen in Figure 47 it shows that fish in the young of the year size range are still larger. Based on the size range of fish collected, production and successful summer rearing occurred and multiple age classes were present in the Guadalupe Watershed in 2018.

Table 50: 2018 average density and length of O. mykiss captured within Guadalupe, Alamitos, and Calero Creeks.

Sub-Watershed	*O. mykiss*/meter	Average length
Guadalupe Creek	0.275	75.8
Calero Creek	0.142	104.2
Alamitos Creek	0.200	105.3

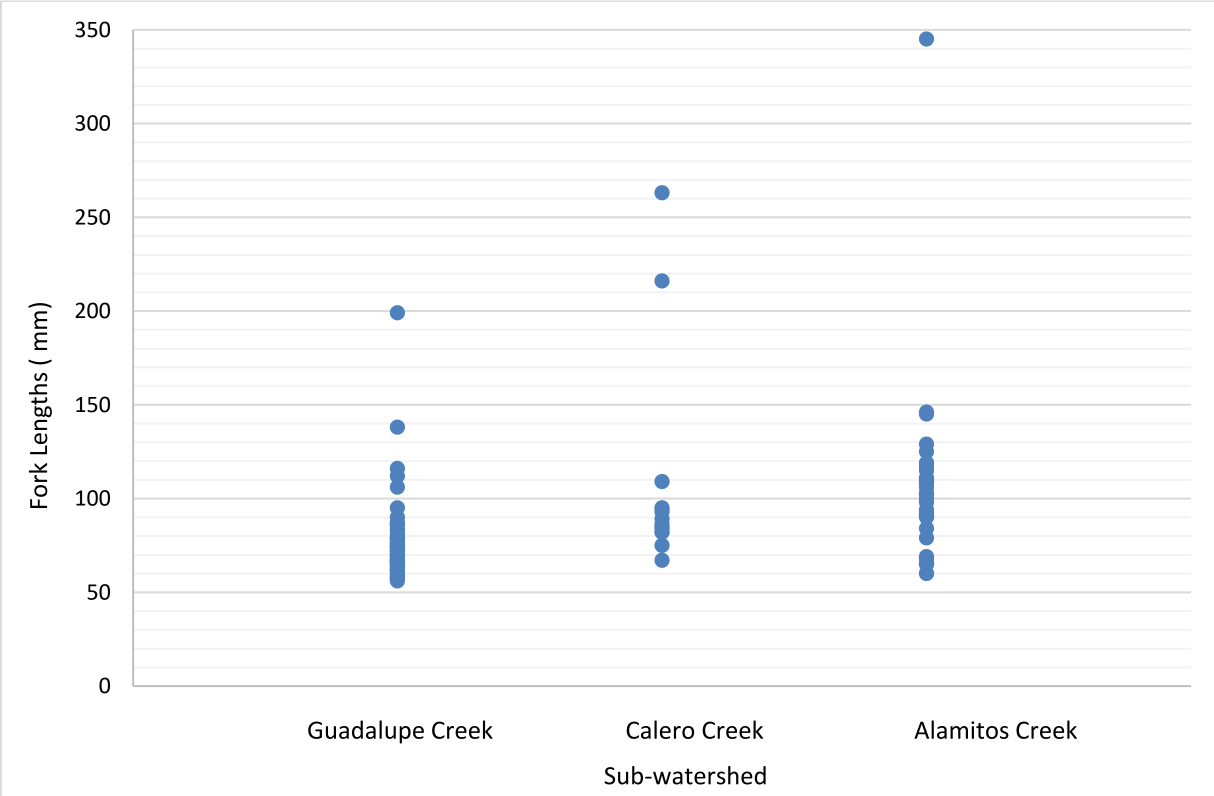

Figure 47*: O. mykiss* size distribution (fork length) for Guadalupe, Calero, and Alamitos Creek sub-watersheds.

In addition to *O. mykiss* data, information on the presence of non-native fish species in the Guadalupe Watershed was obtained. A total of seven different species not native to the Guadalupe Watershed were observed: largemouth bass, green sunfish, common carp, goldfish, mosquitofish, Chinook salmon, and tule perch. Of these seven species, only largemouth bass is considered a major predator of juvenile *O. mykiss,* though all others can impact the habitat and natural communities within the system. Los Gatos Creek and the Guadalupe River had the highest percentage of non-native species detected, with the number approaching 10% of captured fish. Guadalupe Creek, Alamitos Creek, and Calero Creek had a low percentage of non-natives, with less than 3% of captured fish being non-native in each of these sub-watersheds. Looking at the Guadalupe Watershed as a whole, the overall percentage of non-native fish is less than 4% of all fish observed (Table 51).

Table 51: Total capture of fish per sub-watershed and percentage of total capture that was non-native species.

Sub-watershed	Guadalupe River	Guadalupe Creek	Los Gatos Creek	Alamitos Creek	Calero Creek	Guadalupe Watershed
Total Fish Captured	194	451	197	542	104	1488
Percent Non-native	9.8%	2.0%	9.1%	0.6%	2.9%	3.5%

Juvenile *O. mykiss* are persisting in the Guadalupe Watershed, with multiple age classes present, and in Guadalupe Creek at levels that would be considered above average. Non-native fish are contributing to a small percentage of the total abundance, with Alamitos Creek having the lowest levels at less than 1.0% non-native species. Since this is the first year of expanded monitoring it is difficult to assess any trends at this time, but as more data become available a better understanding of the Guadalupe Watershed will develop.

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Appendix A

Santa Clara Valley Water District

Water Year 2018 *Oncorhynchus mykiss* Tagging Metadata

in the Guadalupe River Watershed

Site:	Time Start	Time End	Crew	Temp	Conductivity	FISH ID	Species	Weight (g)	Length (mm)	PIT ID (Decimal)	Genetics (Y/N)	Scales (Y/N)	Tagger	Fish Condition/Comments
GC006	9:15	10:45	JW,LL, JN, CL, CG, SG	15.23	411	2018GCRK001	O. mykiss	3.53	60	NA	Y	N	NA	
GC006	9:15	10:45	JW,LL, JN, CL, CG, SG	15.23	411	2018GCRK002	O. mykiss	7.81	83	900.226000319227	y	N	LL	
GC006	9:15	10:45	JW,LL, JN, CL, CG, SG	15.23	411	2018GCRK003	O. mykiss	9.25	87	900.226000319276	y	N	LL	
GC006	9:15	10:45	JW,LL, JN, CL, CG, SG	15.23	411	2018GCRK004	O. mykiss	14.28	106	900.226000319293	y	N	LL	
GC006	9:15	10:45	JW,LL, JN, CL, CG, SG	14.51	411	2018GCRK005	O. mykiss	2.35	58	NA	y	N	NA	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK006	O. mykiss	4.75	67	900.226000319318	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK007	O. mykiss	4.62	72	900.226000319305	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK008	O. mykiss	4.01	65	NA	y	N	NA	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK009	O. mykiss	3.72	66	900.226000319334	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK010	O. mykiss	3.76	63	NA	y	N	NA	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK011	O. mykiss	6.37	72	900.226000319341	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK012	O. mykiss	3.58	65	900.226000319308	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK013	O. mykiss	31.33	138	900.226000319389	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK014	O. mykiss	6.82	81	900.226000319385	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK015	O. mykiss	4.58	66	900.226000319338	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK016	O. mykiss	4.45	64	NA	y	N	NA	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK017	O. mykiss	3.42	57	NA	y	N	NA	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK018	O. mykiss	3.09	56	NA	y	N	NA	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK019	O. mykiss	5.32	74	900.226000319324	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK020	O. mykiss	3.84	62	NA	y	N	NA	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK021	O. mykiss	6.93	86	900.226000319364	y	N	LL	
GC005	11:33	13:00	JW,LL, JN, CL, CG, SG	14.51	427	2018GCRK022	O. mykiss	5.32	72	NA	y	N	NA	
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK023	O. mykiss	3.93	62	NA	y	N	NA	
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK024	O. mykiss	6.66	79	900.226000319345	y	N	LL	
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK025	O. mykiss	3.08	57	NA	y	N	NA	
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK026	O. mykiss	3.53	58	NA	y	N	NA	
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK027	O. mykiss	8.33	84	900.226000319358	y	N	LL	scarred
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK028	O. mykiss	6.12	76	900.226000319329	y	N	LL	
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK029	O. mykiss	4.97	70	900.226000319351	y	N	LL	
GC004	13:30	15:50	JW,LL, JN, CL, CG, SG	16.49	402	2018GCRK030	O. mykiss	3.28	59	NA	y	N	NA	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK031	O. mykiss	3.23	61	NA	y	N	NA	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK032	O. mykiss	5.62	75	900.226000319346	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK033	O. mykiss	3.82	62	NA	Y	N	NA	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK034	O. mykiss	4.22	66	900.226000319394	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK035	O. mykiss	6.02	79	900.226000319386	Y	N	LL	minor blackspot
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK036	O. mykiss	4.36	62	NA	Y	N	NA	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK037	O. mykiss	5.9	77	900.226000319340	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK038	O. mykiss	4.52	70	900.226000319317	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK039	O. mykiss	5.14	72	900.226000319337	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK040	O. mykiss	8.05	86	900.226000319344	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK041	O. mykiss	4.23	68	900.226000319330	Y	N	LL	minor blackspot
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK042	O. mykiss	6.06	75	900.226000319307	Y	N	JW	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK043	O. mykiss	4.08	67	900.226000319309	Y	N	JW	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK044	O. mykiss	3.83	65	900.226000319333	Y	N	LL	

GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK045	O. mykiss	5.66	74	900.226000319361	Y	N	LL	bleeder
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK046	O. mykiss	96.04	199	900.228000613702	Y	N	LL	minor blackspot
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK047	O. mykiss	4.61	65	900.226000319381	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK048	O. mykiss	6.62	76	900.226000319342	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK049	O. mykiss	4.35	66	900.226000319399	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK050	O. mykiss	4.63	70	900.226000319377	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK051	O. mykiss	5.68	72	900.226000319371	Y	N	LL	black spot
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK052	O. mykiss	6.23	75	900.226000319395	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK053	O. mykiss	4.95	69	900.226000319325	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK054	O. mykiss	6.2	78	900.226000319356	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK055	O. mykiss	6.22	79	900.226000319374	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK056	O. mykiss	4.36	69	900.226000319379	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK057	O. mykiss	4.53	67	900.226000319354	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK058	O. mykiss	18.15	112	900.226000319328	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK059	O. mykiss	3.85	68	900.226000319393	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK060	O. mykiss	5.05	79	900.226000319327	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK061	O. mykiss	5.23	74	900.226000319362	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK062	O. mykiss	11.22	90	900.226000319304	Y	N	LL	
GC003	9:50	12:19	JW,LL, JN, CL, CG	13.07	445	2018GCRK063	O. mykiss	5.31	74	900.226000319398	Y	N	LL	1 blackspot
GC001	8:19 AM	9:30	CL, JW, SG, LL	15.82	482	2018GCRK064	O. mykiss	12.4	95	900.226000319294	Y	N	JW	
GC002	9:45 AM	10:30	CL, JW, SG, LL	17.6	482	2018GCRK065	O. mykiss	8.7	87	900.226000319214	Y	N	LL	
GC002	9:45 AM	10:30	CL, JW, SG, LL	17.6	482	2018GCRK066	O. mykiss	18.2	116	900.226000319278	Y	N	CL	
CC002	7:36 AM	9:15	JN, JW, CL, LL, NJ, KJ, PS, SG	16.33	477	2018CALE001	O. mykiss	215.3	263	900.228000613704	Y	N	LL	
CC002	7:36 AM	9:15	JN, JW, CL, LL, NJ, KJ, PS, SG	16.33	477	2018CALE002	O. mykiss	7.5	82	900.226000319280	Y	N	LL	
CC002	7:36 AM	9:15	JN, JW, CL, LL, NJ, KJ, PS, SG	16.33	477	2018CALE003	O. mykiss	125.2	216	900.228000613705	Y	N	LL	
CC002	7:36 AM	9:15	JN, JW, CL, LL, NJ, KJ, PS, SG	16.33	477	2018CALE004	O. mykiss	14.3	109	900.226000319268	Y	N	LL	
CC001	9:41 AM	11:10 AM	JN, JW, CL, LL, NJ, KJ, PS, SG	16.3	547	2018CALE005	O. mykiss	11.5	95	900.226000319336	Y	N	LL	
CC001	9:41 AM	11:10 AM	JN, JW, CL, LL, NJ, KJ, PS, SG	16.3	547	2018CALE006	O. mykiss	7.3	82	900.226000319302	Y	N	LL	
CC001	9:41 AM	11:10 AM	JN, JW, CL, LL, NJ, KJ, PS, SG	16.3	547	2018CALE007	O. mykiss	10.1	89	900.226000319332	Y	N	LL	
CC001	9:41 AM	11:10 AM	JN, JW, CL, LL, NJ, KJ, PS, SG	16.5	547	2018CALE008	O. mykiss	5.2	67	900.226000319373	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE009	O. mykiss	9.3	84	900.226000319357	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE010	O. mykiss	7.8	84	900.226000319347	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE011	O. mykiss	5.4	75	900.226000319323	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE012	O. mykiss	10.4	86	900.226000319300	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE013	O. mykiss	8.5	85	900.226000319231	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE014	O. mykiss	12.5	94	900.226000319244	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE015	O. mykiss	8.3	82	900.226000319287	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE016	O. mykiss	10.2	93	900.226000319230	Y	N	LL	
CC003	7:21 AM	8:45	JW,CL, LL, KJ, JT, SG	14	489	2018CALE017	O. mykiss	9.4	86	900.226000319212	Y	N	LL	
AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM029	O. mykiss	5.35	68	900.226000319284	Y	N	LL	
AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM030	O. mykiss	4.23	66	900.226000319260	Y	N	LL	
AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM031	O. mykiss	4.35	65	900.226000319291	Y	N	LL	
AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM032	O. mykiss	3.25	65	900.226000319292	Y	N	LL	
AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM033	O. mykiss	4.86	69	900.226000319295	Y	N	LL	
AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM034	O. mykiss	3.02	60	NA	Y	N	LL	
AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM035	O. mykiss	20.6	125	900.226000319250	Y	N	JW	Blackspot

AC004	8:30	10:10	CL, JW, SG, DT, LL, CG	16.50	390	2018ALM036	O. mykiss	3.06	60	NA	Y	N	JW	
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM037	O. mykiss	17.5	109	900.226000319246	Y	N	LL	Blackspot and scar on side
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM038	O. mykiss	36.5	145	900.226000319258	Y	N	LL	severe blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM039	O. mykiss	14.8	79	900.226000319263	Y	N	LL	Blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM040	O. mykiss	24.9	109	900.226000319201	Y	N	CL	Blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM041	O. mykiss	12.5	94	900.226000319218	Y	N	JW	Blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM042	O. mykiss	18.6	106	900.226000319269	Y	N	JW	Blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM043	O. mykiss	20.2	111	900.226000319200	Y	N	JW	Blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM044	O. mykiss	19	108	900.226000319311	Y	N	JW	Blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM045	O. mykiss	42.3	146	900.226000319257	Y	N	LL	Blackspot
AC003	11:30	13:03	CL, JW, SG, DT, LL, CG	15.38	401	2018ALM046	O. mykiss	16.8	110	900.226000319290	Y	N	LL	Blackspot
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM047	O. mykiss	7.7	84	900.226000319343	Y	N	LL	Minor blackspot
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM048	O. mykiss	13.8	98	900.226000319306	Y	N	LL	Minor blackspot
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM049	O. mykiss	13	100	900.226000319349	Y	N	LL	
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM050	O. mykiss	9.6	91	900.226000319312	Y	N	LL	
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM051	O. mykiss	14.1	102	900.226000319315	Y	N	LL	
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM052	O. mykiss	12.8	103	900.226000319382	Y	N	LL	
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM053	O. mykiss	10	91	900.226000319365	Y	N	LL	
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM054	O. mykiss	445	345	900.228000613703	Y	N	LL	Blackspot
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM055	O. mykiss	9.4	92	900.226000319363	Y	N	LL	
AC002	8:13	9:38 AM	CL, JW, LL, SG, KJ	17.06	462	2018ALM056	O. mykiss	10.2	90	900.226000319390	Y	N	LL	
AC001	10:30	12:02 PM	CL, JW, LL, SG, KJ	16.89	462	2018ALM057	O. mykiss	23	119	900.226000319378	Y	N	CL	
AC001	10:30	12:02 PM	CL, JW, LL, SG, KJ	16.89	462	2018ALM058	O. mykiss	25.1	115	900.226000319396	Y	N	CL	
AC001	10:30	12:02 PM	CL, JW, LL, SG, KJ	16.89	462	2018ALM059	O. mykiss	20.8	117	900.226000319368	Y	N	LL	Blackspot
AC001	10:30	12:02 PM	CL, JW, LL, SG, KJ	16.89	462	2018ALM060	O. mykiss	28.2	129	900.226000319380	Y	N	CL	Minor blackspot
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM001	O. mykiss	43.06	146	900.226000319370	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM002	O. mykiss	15.14	111	900.226000319353	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM003	O. mykiss	-	199	900.226000319320	Y	N	LL	Blackspot
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM004	O. mykiss	17.2	109	900.226000319322	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM005	O. mykiss	13.3	102	900.226000319339	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM006	O. mykiss	15.09	107	900.226000319313	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM007	O. mykiss	8.33	89	900.226000319367	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM008	O. mykiss	-	248	900.226000319355	N	N	LL	Blackspot
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM009	O. mykiss	12.92	103	900.226000319350	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM010	O. mykiss	21.42	119	900.226000319366	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM011	O. mykiss	19.34	117	900.226000319375	Y	N	JW	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM012	O. mykiss	16.51	111	900.226000319326	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM013	O. mykiss	23.78	122	900.226000319387	Y	N	JW	Blackspot
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM014	O. mykiss	26.74	132	900.226000319376	Y	N	JW	Blackspot
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM015	O. mykiss	30.42	141	900.226000319319	Y	N	LL	Blackspot
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM016	O. mykiss	32.1	136	900.226000319352	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM017	O. mykiss	13.3	103	900.226000319314	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM018	O. mykiss	32.7	138	900.226000319391	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM019	O. mykiss	25.26	129	900.226000319310	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM020	O. mykiss	11.5	97	900.226000319372	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM021	O. mykiss	81.27	186	900.226000319301	Y	N	LL	

Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM022	O. mykiss	19.01	117	900.226000319384	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM023	O. mykiss	14.39	104	900.226000319316	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM024	O. mykiss	11.97	102	900.226000319397	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM025	O. mykiss	10	95	900.226000319388	N	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM026	O. mykiss	14.48	106	900.226000319360	N	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM027	O. mykiss	18.58	115	900.226000319321	Y	N	LL	
Mazzone	10:22	12:00 PM	JW, LL, CV, SG, JN	15.9	545	2018ALM028	O. mykiss	23.03	122	900.226000319348	Y	N	LL	

GUADALUPE RIVER 2018 ADULT SALMONID MIGRATION MONITORING USING THE VAKI RIVERWATCHER PASSIVE MONITORING SYSTEM

January 30, 2018 - May 31, 2018

Prepared by:

Santa Clara Valley Water District

Environmental Mitigation and Monitoring Unit

January 30, 2019

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INTRODUCTION

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

The Alamitos fish ladder is located 32 kilometers upstream of the South San Francisco Bay on the Guadalupe River between Coleman Road and Blossom Hill Road, just downstream of Almaden Lake in San Jose, California. The fish ladder was installed in November 1999 at the Alamitos Drop Structure, a 13-foot tall structure that had previously created an impassable barrier to fish migration. The installation of the Alamitos Fishway opened up an additional 27 kilometers of upstream habitat for migrating fish. The Vaki was first deployed in the most downstream weir of the Alamitos Fishway for three monitoring seasons (years 1-3) from 2003 to 2006.On January 30th, 2018, the Vaki was reinstalled at the Alamitos fish ladder for a fourth season of monitoring following a 12-year break at this location; the 2018 monitoring year will be the focus of this report. The Vaki provided documentation of anadromous fish passage through the Alamitos Fishway, confirming that the fish ladder afforded passage for salmonids around the drop structure, providing seasonal continuity of fish passage in the Guadalupe system from the San Francisco Bay to upstream tributaries.

INSTALLATION, MAINTENANCE, AND METHODS

The Vaki was installed on January 30, 2018. This is later in the season than originally intended, as installation was delayed due to unforeseen complications with fabrication and implementation. Initially, the Vaki was unintentionally and unknowingly installed approximately 0.3 meters above the bottom of the channel due to a piece of woody debris sitting on the bottom of the channel. This allowed for fish to pass under the counter and not be recorded by the system. The issue was resolved on March 6, 2018 by removing the wood and lowering the Vaki to sit flush on the bottom of the channel.

The counter itself is a rectangular-shaped unit outfitted with infrared light emitting diodes on the interior and is completely submerged underwater within the fish ladder. Adult fish are directed through the counter opening by use of weirs in the ladder, and when it swims through the counter and breaks the plane of light beams, the fish is scanned and a resulting silhouette image is sent to the onsite computer. Other information recorded as the fish passes includes the speed the fish was traveling, the direction the fish was moving (upstream or downstream), the body depth of the passing fish (for depth to length ratios), along with the date and time. A fish detection then triggers an underwater digital camera which records a 4.1 second video for fish traveling upstream or a 14.4 second video for fish traveling downstream. This enables the user to scan through the videos to confirm the presence of a fish and improves confidence in species identification. All the data collected by the Vaki are stored by the attached onsite computer. Data is manually downloaded twice per week and stored on the SCVWD network. The files are manually vetted as soon as possible.

The Vaki was maintained and cleaned twice a week by removing debris and algal build up on the scanner plates and plexiglass in front of the camera with a Mr. Long Arm brush. Data was manually downloaded from the onsite database, which was reset during each of these checks.

Because this Vaki runs off solar power, there were a few instances after several cloudy and rainy days where the battery reserve would drop so low that the Vaki would only record a silhouette image for each detection with no accompanying video. The Vaki completely lost power due to this same issue on the nights of March 22 and 23, 2018, but it was restarted the morning on March 24. The Vaki also had a brief 3-hour cessation on March 6, 2018 when the large woody debris beneath the Vaki was removed. One factor that must also be considered is that during the time of cleaning fish can still move up and down through the system and they will not be detected by the Vaki. It is a brief window, but there is a potential that migrating fish could be missed during cleaning and maintenance. These are all periods that migrating fish could have been missed.

The Vaki records silhouettes and videos off all items large enough to break the plain of the diodes. Scanned infrared silhouettes and video images were reviewed to ensure that only fish passage events were included in the overall passage counts. Video images were used to identify fish to species when conditions provided clear images. Silhouettes can also be used to identify the fish to species if identifying characteristics are depicted. Detections without videos were only sorted into specific species categories if the silhouette was particularly clear and the confidence level was high, otherwise these detections were sorted into the "unknown fish" category. Length to depth ratios were used to estimate the length of a specific individual based upon their body depth as detected by the Vaki. The length to depth ratios for *O. mykiss* were 4.1:1 for small and medium fish (<300 mm) and 4.8:1 for large fish (Cuthbert et al. 2012).

Steelhead with a standard length greater than 350 mm were classified as adult *O. mykiss*, while anything 350 mm and below were determined to be juveniles (Moyle, 2002). The scanner plates trigger a detection and a video recording only when a body depth of 40 mm or greater is detected. This results in a lack of detection for *O. mykiss* with an estimated fork length of 159 mm or less.

Only *O. mykiss* detections in the adult size range were analyzed to provide an estimate of the actual number of individual fish recorded. Juvenile fish could not be analyzed as their body depth could result in no detections on the Vaki and juvenile fish could travel through the weir bars limiting the ability to assess up and down movement. In attempt to reduce repeated detections of the same fish, data were analyzed using a direction, timing, and size criteria. A series of detections were considered the same fish if two or more detections occurred in an up to down or down to up pattern, were within 5 mm of body depth, and occurred within a 15-minute time period.

RESULTS

During the monitoring season, several native and non-native fish were documented passing through the Vaki. *O. mykiss*, Sacramento sucker (*Catostomus occidentalis*), common carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*), *Lepomis spp.*, goldfish (*Carassius auratus*), *Pomoxis spp.,* brown bullhead (*Ameiurus nebulosus*), and prickly sculpin (*Cottus asper*) were all positively identified from the Vaki video footage and silhouettes. Examples of positive identifications can be seen in Appendix A. Unknown fish detections were instances where fish were detected, but they could not be identified to species based on the silhouette or video. There was a total of 1,109 fish detections throughout the time the Vaki was installed with *O. mykiss* being the most commonly detected fish with 355 detections (Figure 1). After *O. mykiss* detections, carp and goldfish were the second largest group of fish detected with 310 detections.

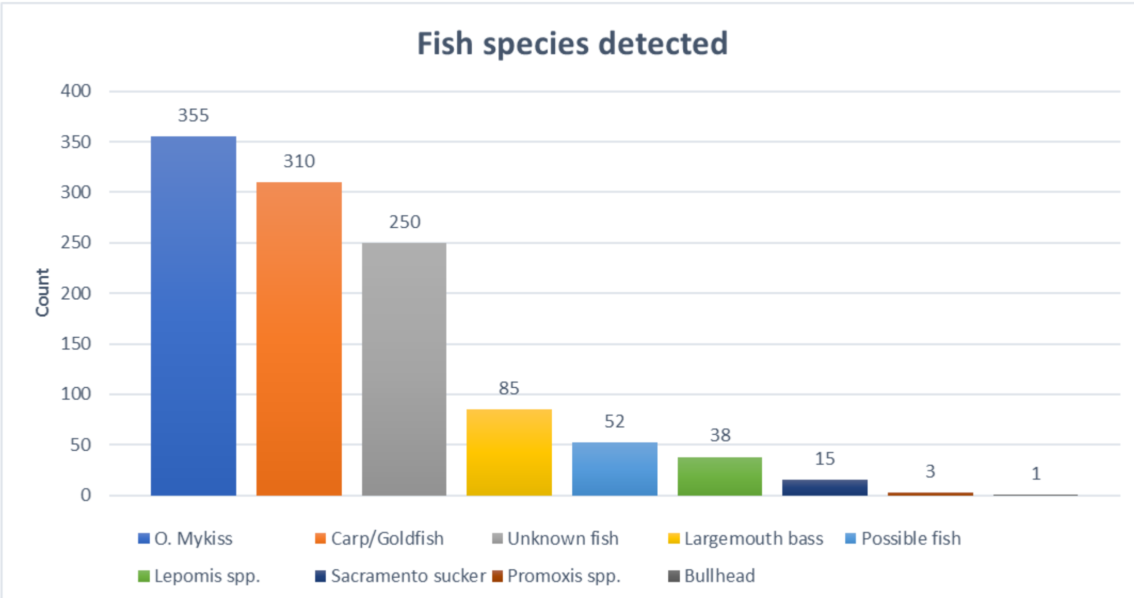

Figure 1: Number of detections of each fish species throughout the Guadalupe River Vaki deployment period.

Of the 355 *O. mykiss* detections, 167 recorded were moving upstream and 188 were moving downstream (Table 1 and Figure 2). There was a total of 31 Vaki detections classified as *O. mykiss* in the adult size range, with 14 moving upstream and17 going down. These are not individual fish but are just individual detections.

Table 1: Total *O. mykiss* detections based on age classification and direction of movement.

Age Class	Upstream	Downstream
Juvenile (≤350 mm)	153	171
Adult (>350 mm)	14	17
Total	167	188

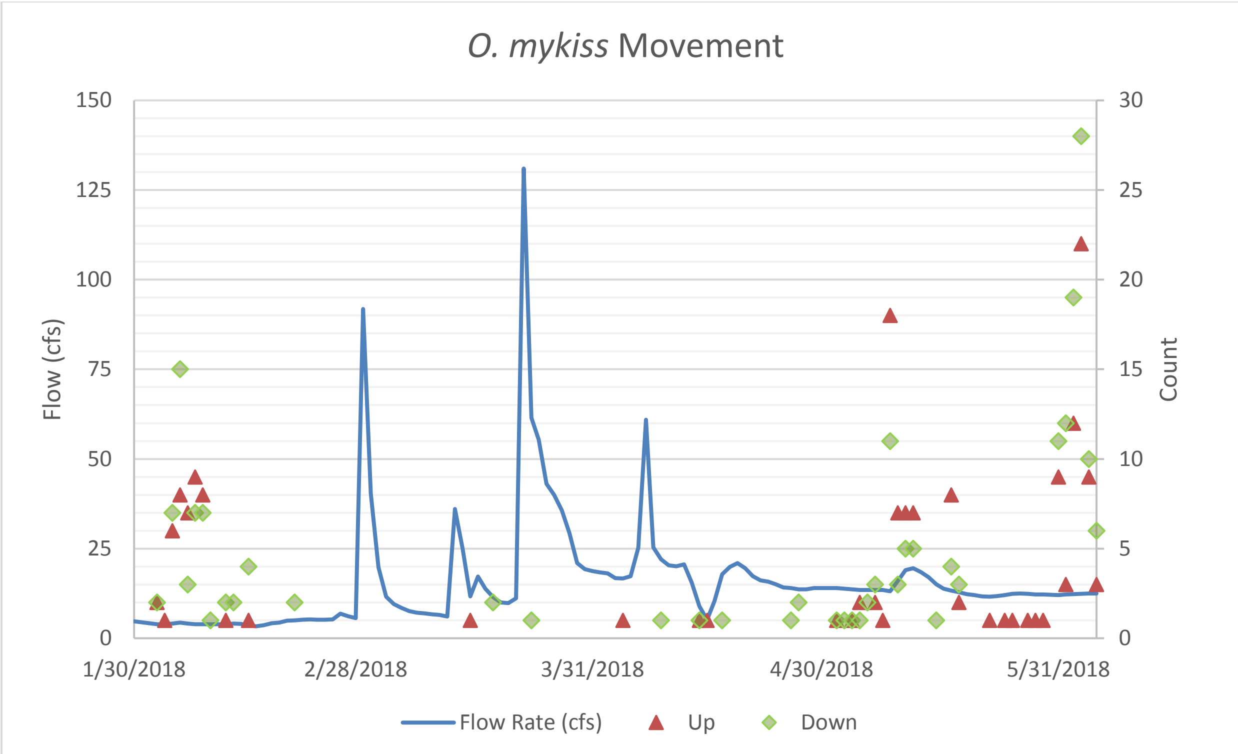

Figure 2: *O. mykiss* detections per day in relation to cubic feet per second daily averages on the Guadalupe River stream gage ALERT 5023b above Almaden Expwy.

The size range of *O. mykiss* detected ranged from 160 mm to 610 mm. The timing and estimated size of adult *O. mykiss* detections can be seen in Figure 3. The size and timing of juvenile movement was not included in this figure as it does not provide a complete picture of the movement of juvenile *O. mykiss* due to the size limitation of the Vaki software. The average estimated size of adult fish moving upstream was 388 mm and downstream was 410 mm. The three largest *O. mykiss* detected were estimated at 610 mm, 590 mm, and 580 mm and were all moving downstream (Figure 3 and 4).

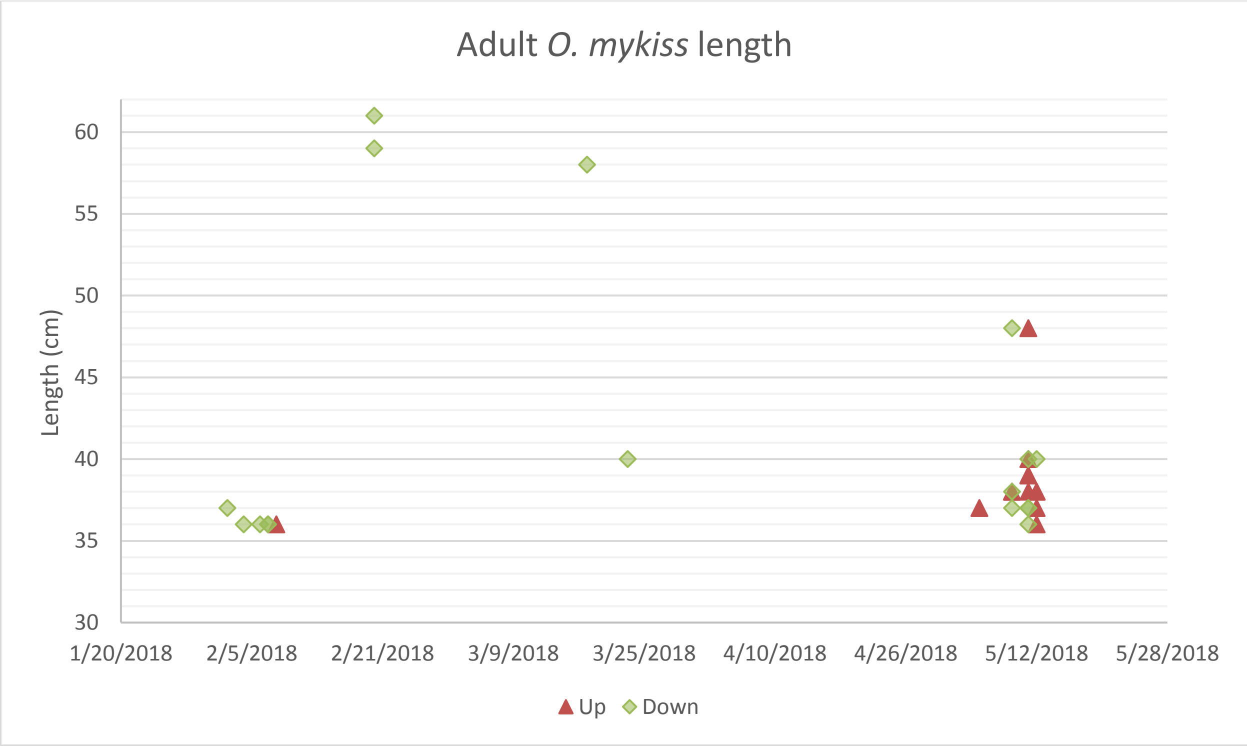

Figure 3: Adult O. mykiss estimated length and date of migration (adult O. mykiss were identified as fish greater than 350 mm).

Figure 4: Images of adult *O. mykiss* captured by the Vaki RiverWatcher. A 610 mm total length (left) moving downstream and 380 mm total length (right) moving upstream.

DISCUSSION

Ideally the Vaki would have been installed by October or November to ensure capture of the entire steelhead migration season. Adult *O. mykiss* typically begin their upstream migration between December and March, peaking in January and February (Moyle, 2002). With the Vaki being installed on January 30th, two months of potential migration data was not recorded.

The data collected are particularly challenging to analyze and draw conclusions from due to the gap created in the initial install and late-season installation. The higher number of adults moving downstream versus upstream could be explained by these two issues. When the data were analyzed in attempt to reduce repeat detections the 31 adult sized range detections were reduced to 26 individuals with 14 of the fish recorded moving downstream and 12 passing upstream.

The 360 mm to 610 mm size range detected for adult *O. mykiss* is very broad. It is likely that some of the fish detections closer to the 360 mm size range are resident rainbow trout moving through the system. During the 2018 juvenile rearing monitoring conducted in the Guadalupe Watershed, the largest *O. mykiss* captured was 345 mm fork length, which would generate a total length greater than 350 mm. Only one fish in this size range was collected during that sampling effort and it made up less than 1% of the population (SCVWD 2019).

Limited movement of *O. mykiss* was observed during the large flow events (greater than 50 cfs at ALERT stream gage 5023b) that occurred in the month of March. No adult-sized fish were observed moving upstream in March or April. The concentration of *O. mykiss* observed in the beginning of February moving up- and downstream after the Vaki installation could have been the result of flow events that occurred in December and January.

The lack of Chinook salmon (*Oncorhynchus tshawytscha*) detections can be attributed to the late Vaki installation date on January 30th, which would be late for Chinook salmon migration. The 2018 abbreviated monitoring period provided more lessons learned than beneficial data. The shortcomings and technological issues that occurred in 2018 were taken into consideration for the WY 2019 monitoring. Through these experiences it is hoped that better data collection will occur moving forward.

WORKS CITED

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Santa Clara Valley Water District (SCVWD). 2019. Water Year 2018 Juvenile *Oncorhynchus mykiss* Rearing Monitoring in the Guadalupe River Watershed. Prepared by the Environmental Mitigation and Monitoring Unit. San Jose, CA.

Moyle, P. B. (2002). *Inland fishes of California*. Berkeley: University of California Press.

Appendix A

<u>Sample Silhouettes and Video Imag</u>

Fish Silhouettes

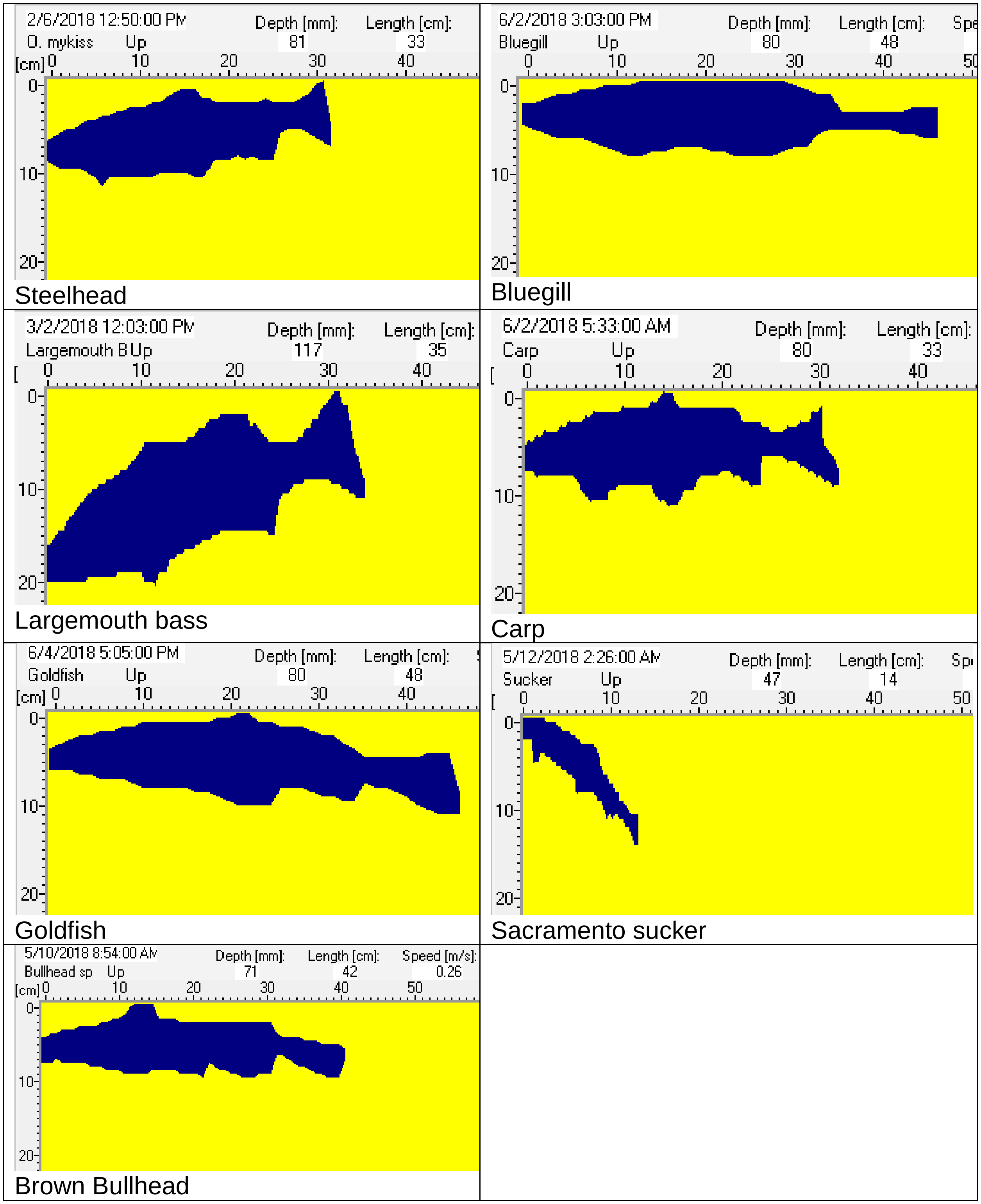

Figure 1: A sample of the silhouette images generated by the Vaki for each fish species in the report.

Fish Video Images

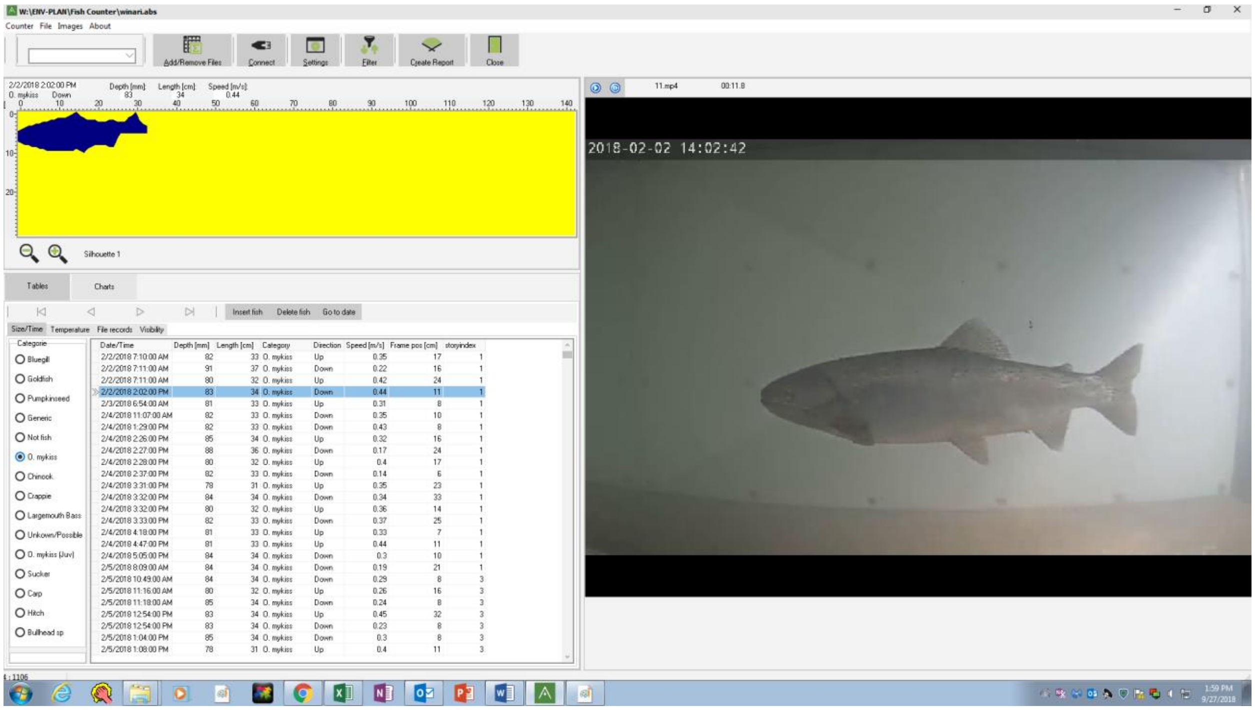

Figure 2: Vaki video image of an adult steelhead (*Oncorhynchus. mykiss*).

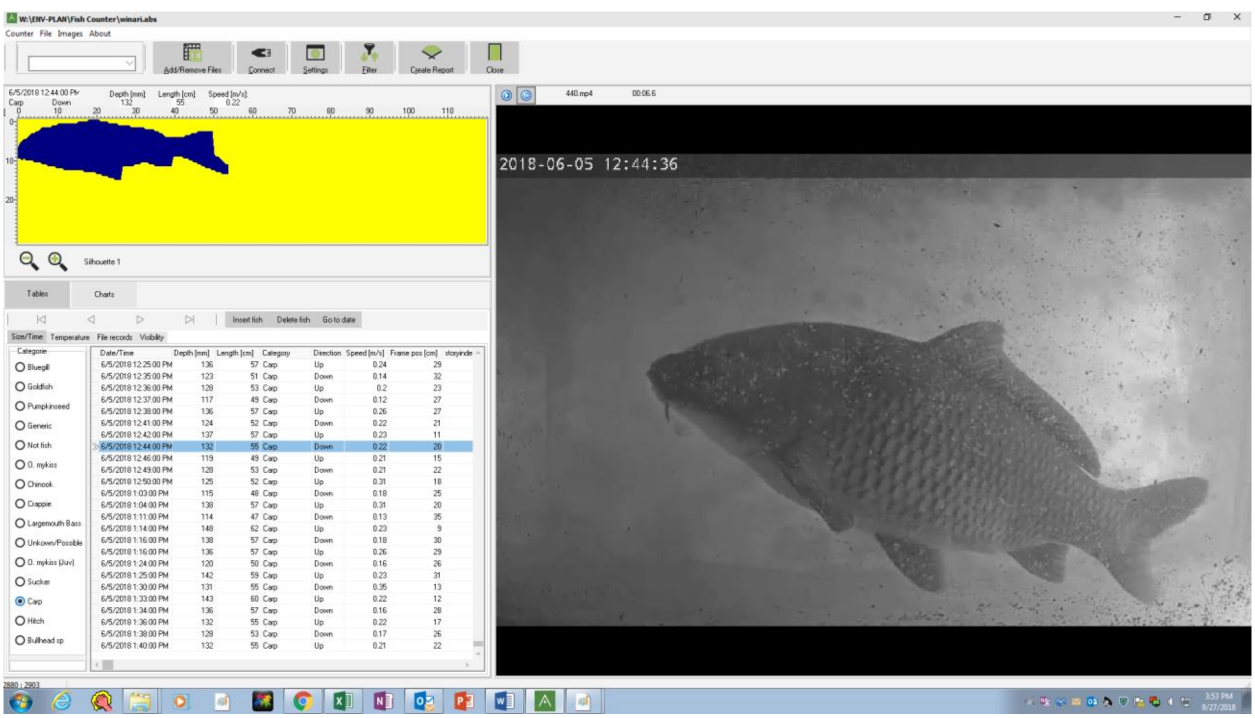

Figure 3: Vaki video image of a carp (*Cyprinus carpio*).

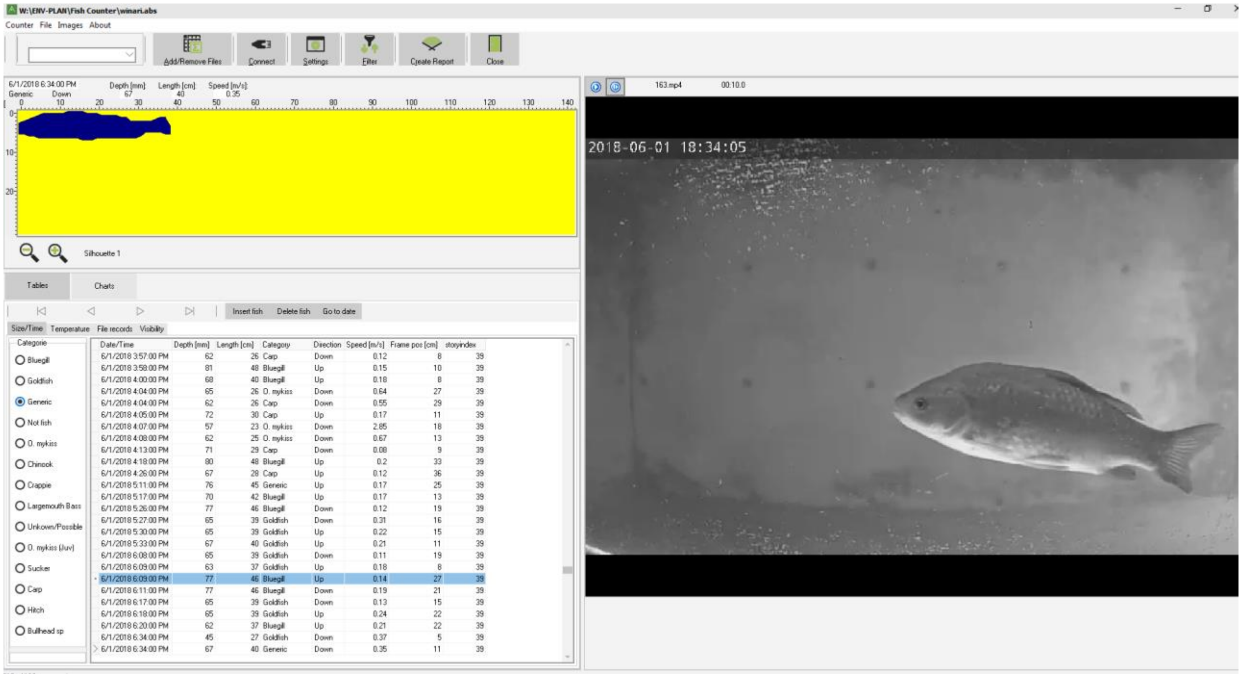

Figure 4: Vaki video image of a goldfish (*Carassius auratus)*.

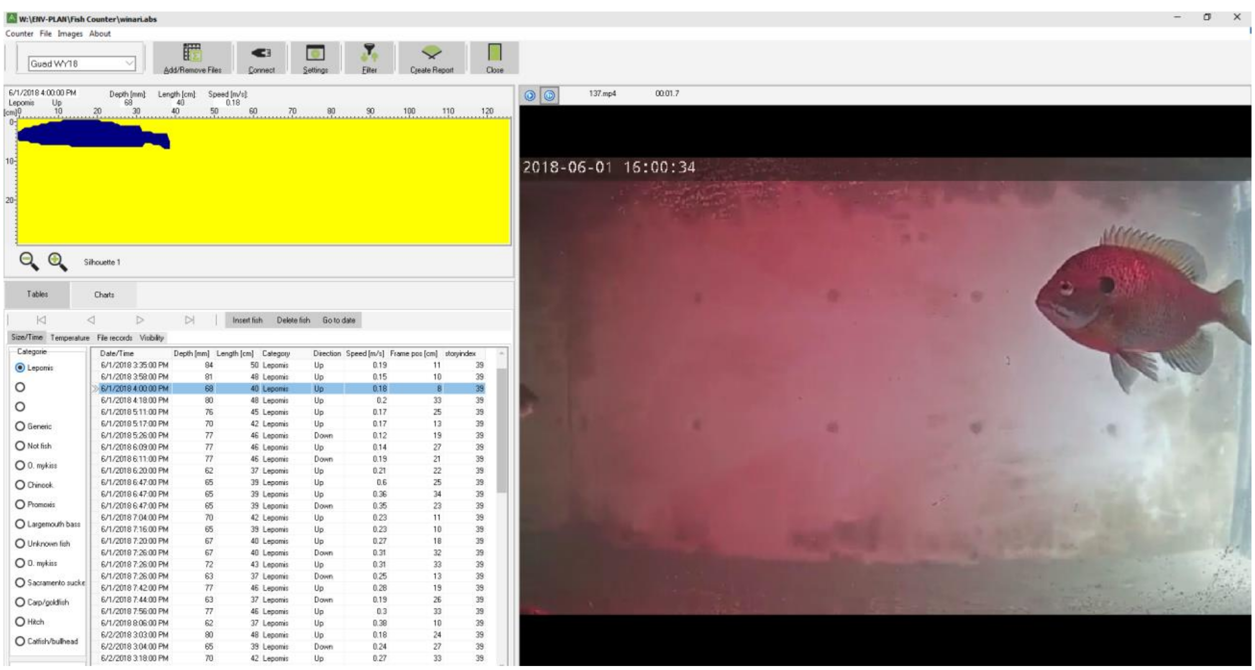

Figure 5: Vaki video image of a bluegill (*Lepomis macrochirus*; classified as *Lepomis spp*).

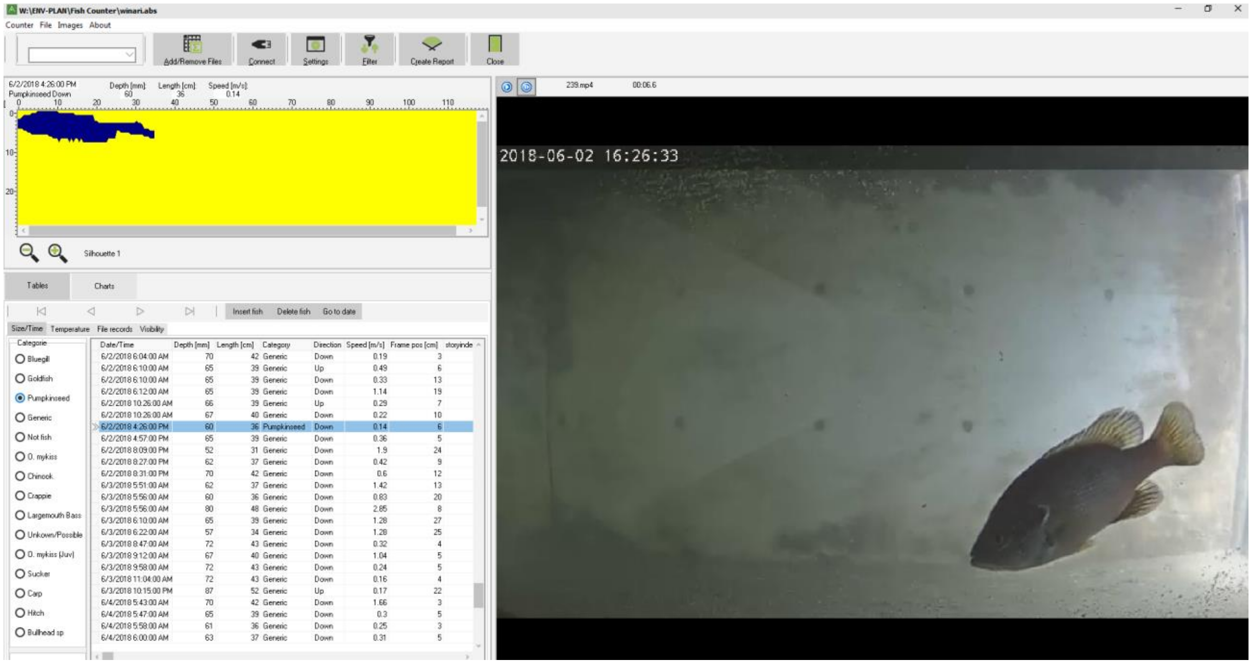

Figure 6: Vaki video image of a green sunfish (*Lepomis cyanellus*; classified as *Lepomis sp*p).

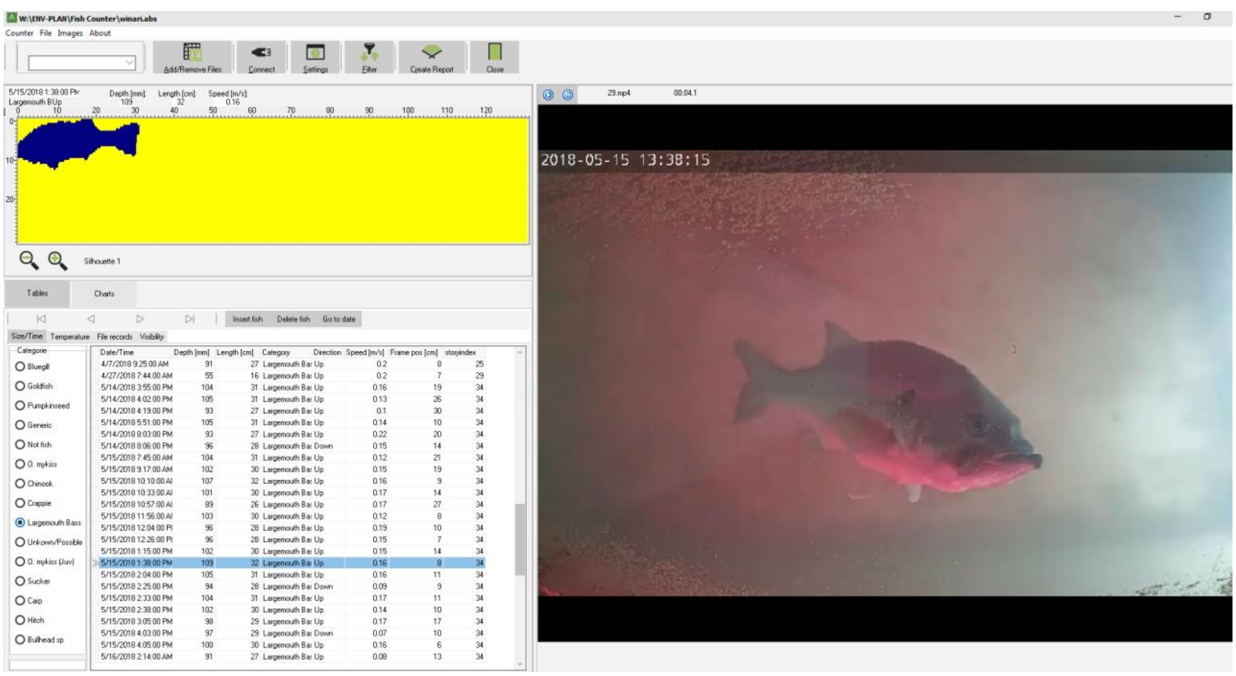

Figure 7: Vaki video image of a Largemouth bass (*Micropterus salmoides*).