

Lower Kings River Annual Trout and Non-Game Fish Population  
Survey:  
Kings River Conservation District  
2019 Electrofishing Results

Kings River Conservation District  
Environmental Resource Division

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The Kings River Conservation District (KRCD), in cooperation with the California Department of Fish and Wildlife (CDFW) and the Kings River Water Association (KRWA), have conducted annual population surveys of rainbow trout *Oncorhynchus mykiss* and other fish inhabiting the lower Kings River downstream of Pine Flat Dam from 1983 to the present. The population monitoring began as part of a Federal Energy Regulatory Commission (FERC) requirement for compliance with Item 4 of the Memorandum of Agreement between CDFW and KRCD, for FERC Project No. 2741 and as part of the Kings River Fishery Management Program.

A multiple-pass mark-and-recapture electrofishing survey was employed from 1983 through 1989. In 1990, the annual electrofishing survey was modified to a single pass count of captured fish using only a single block seine net at the upstream end of each sample reach. The decision to change to a single pass survey was made due to an absence of trout detected in the late 1980's thought to be a result of extreme drought conditions (KRCD 1993). The single pass reaches were expanded in length in an effort to locate trout. As a result of the change in survey methods the single pass data collected from 1990 through 2006 serve as an index of relative abundance and do not reflect absolute population density. Extrapolating density estimates from the single pass data produces, at best, uncertain population abundance estimates that do not support rigorous statistical analysis. In the fall of 2007 the Kings River Fisheries Management Program's (KRFMP) Technical Steering Committee (KRCD, CDFW and KRWA) revised the electrofishing survey protocol to a multiple 3-pass depletion technique with upstream and downstream block seines, which resulted in improved statistical rigor and the ability to estimate 95% confidence intervals on abundance estimates. Results of the 2019 survey are presented below and compared to results of prior surveys.

Throughout the years, rainbow trout captured during the annual population surveys have been identified as being of either "wild" or "hatchery" origin. Over time revisions to stocking practices have occurred as well as changes to the contribution of trout fry via the KRFMP's incubation efforts. Such changes have included diploid to triploid stocks, triploid to diploid and back again, all female fry to both sexes, clipping to not clipping adipose fins and the number of trout stocked per size class. Beginning in October 2018 the KRFMP began purchasing catchable sized trout (approximately 3 fish per pound) for additional stocking of the Kings River beyond the

regular CDFW annual allotment. Between October and March an additional 16,000 pounds, approximately 48,000 fish are stocked on a weekly basis with approximately 75% of those fish released into the put-and-take zone between the Corps of Engineer Bridge on Pine Flat Road and Alta Weir, and the remaining 25% stocked into the catch-and-release zone behind Avocado Lake. The changes in various management strategies has many times also changed the way that rainbow trout have been identified during the fall population surveys through the years.

**Methods**

Sampling occurred between December 2nd and 10th using standard multiple-pass depletion electrofishing techniques (Reynolds 1996). Survey sites were 300 feet in length and both the upstream and downstream ends of each survey reach were netted with ¼-inch mesh block seines to avoid fish immigration or emigration from the survey reach. Six to seven Smith-Root LR-24 or Smith-Root LR-20B backpack electrofishers were utilized in each survey reach. Survey sites can be referenced in Figure 1.

From 2007 – 2011 electroshocker settings were standardized at 350volts, 10% Duty Cycle, and a 50Hz frequency. To safely maximize catch-per-unit-of-effort (CPUE), tests were conducted using the LR-24 backpack electrofisher prior to the 2012 population survey. These tests specifically targeted fish response in the presence of an electrical field. It was quickly determined that the previous settings (350volts, 10% Duty Cycle, 50Hz Frequency) were not providing enough power to the water based on the Power Transfer Theory (Kolz 1989) for efficient power transfer resulting in fish escape (fishes evading capture). The Power Transfer Theory states that power is efficiently transferred to the fish when the conductivity of the fish is equal to the conductivity of the water. The difference in conductivities is commonly referred to as “mismatch.” By normalizing or standardizing the power curve, a constant transfer of power density

**Table 1: Voltage Goals for Smith-Root electroshockers by river conductivity.**

<b>PEAK VOLTAGE GOAL</b>	
<b>Volts</b>	<b>637</b>
<b>Amb. Cond.</b>	<b>37</b>

<b>Conductivity µS/m</b>	<b>V goal</b>
10	1892
20	1032
30	745
40	602
50	516
60	459
70	418
80	387
90	363
100	344
110	328
120	315
130	304
140	295
150	287
170	273
200	258
250	241
300	229
400	215
600	201
800	194

( $\mu\text{W}/\text{cm}^3$ ) can be achieved (Kolz and Reynolds 1989) to increase power transfer to the fish in order to illicit the desired response.

By adjusting the electrofisher settings the voltage required to overcome the mismatch between water conductivity and fish conductivity could be achieved. Data collected from the LR-24 backpack electroshockers internal voltmeter was used to generate a peak voltage goal chart (Table 1) based on water conductivity ( $\mu\text{S}/\text{m}$ ) observed in the lower Kings River downstream of Pine Flat Dam. This chart has been used to guide shocker voltage settings since 2012 at each site including during the fall 2019 population survey. Additionally, a Duty Cycle of 20% and a Frequency of 30Hz resulted in a high capture rate, quick recovery time and minimal mortality when compared to settings prior to 2012.

Electrofishing was conducted using six to seven, three-person fishing teams and one or two data processing teams. Volunteers and staff from KRCD, CDFW, KRWA, California Department of Water Resources, Reedley College, the Kings River Conservancy, local fly-fishing clubs, and other members of the public participated in the surveys.

Each fishing crew consisted of a backpack electrofisher operator, one or two netters and one person with a collection bucket. Data processing teams consisted of one data recorder and one or two biologists. In the field, each fish was identified to the lowest practical taxon, weighed to the nearest tenth of a gram, and total length measured to the nearest 1mm, except for rainbow trout which were measured to fork length and photographed. Scale samples were taken from rainbow trout between the dorsal fin and lateral line for aging. Rainbow trout were classified as either hatchery trout or wild trout based on characteristics observed while in hand. CDFW defines a wild trout as “A trout that was born in the wild and lives its life cycle in the wild, regardless of the origin of its parents.”

Rainbow trout of moderate to deep olive coloration, moderate to heavy spotting throughout the body, and missing or abraded fins were categorized as hatchery trout. Rainbow trout of any size, exhibiting silver to moderate coloring, light to moderate spotting or parr marks, and fins in excellent condition were classified as wild rainbow trout. Wild rainbow trout are assumed to have

originated via natural in-river reproduction; however, there is little morphological difference in rainbow trout who may have originated from the KRFMP incubator facility, or hatchery trout who have carried over from a past season. Because of this morphological similarity, trout of alternate origins may be misclassified as wild in the field.

After data collection was complete, captured fish were released outside of the netted survey reach. A minimum 30-minute hiatus was taken between passes. Biological data was manually recorded on data sheets printed on waterproof paper. Raw capture data was later entered into an Excel spreadsheet before importation into SAS, JMP 15.0.0 Statistical Software. JMP generated the total catch, biomass, density, fork length comparison, and age length distribution. 95% confidence interval population estimates, and maximum likelihood estimates were produced using Microfish 3.0 (Van Deveeter J.S. 2014).

### **Fish-Per-Hectare**

Fish-per-hectare (fish\*ha<sup>-1</sup>) is a population density estimate which takes the maximum likelihood of occurrence from each site and divides it by the surface area of the sample reach. A hectare is equivalent to 10,000 square meters or approximately 2.5 acres. This estimate accounts for both the length and width of each site.

### **Catch-Per-Unit-of-Effort**

Catch-per-unit-of-effort (CPUE) is a measure of relative abundance used in fisheries management to assess changes in population abundance over time (Reynolds 1996; Chipps and Garvey 2007). This index is mathematically defined as:

$$C/f = N$$

where C is the number of each species caught per site, f is the amount of effort used, and N is the species catch rate (number per hour of effort). For this survey, effort (f) was measured as the collective time (seconds) that each shocker in the group was energized during the three survey passes at each site. Each backpack electrofisher was equipped with a timer that recorded the number of seconds in operation. The total time was converted to hours and the resulting CPUE was translated to “fish per hour.” CPUE was calculated for each species collected.

# KRCD Electrofishing Sites - Kings River Below Pine Flat Dam

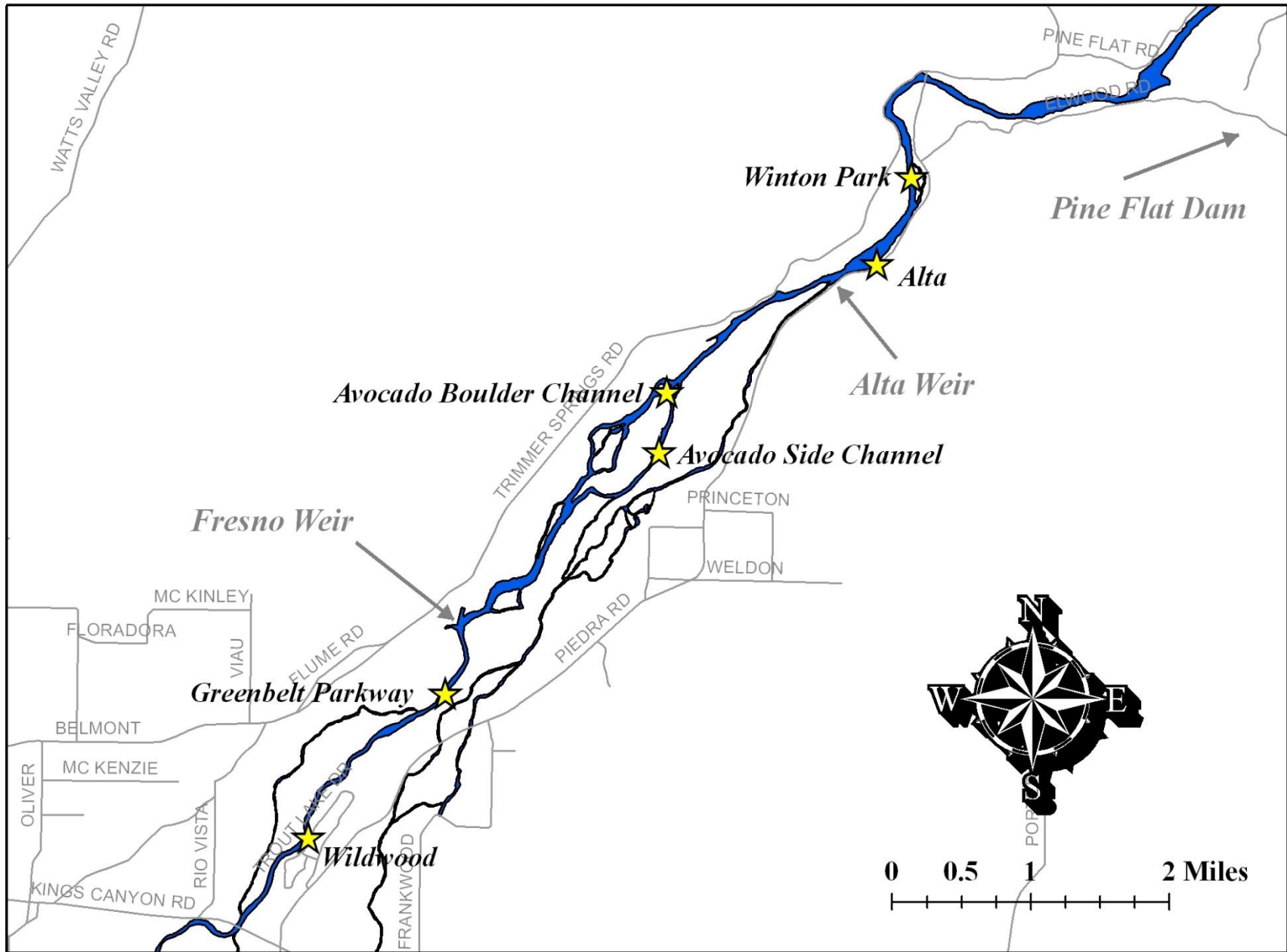


Figure 2: Electrofishing Survey Site Map.



## **Condition Factor**

Condition Factor (K-factor) is an index of an individual salmonid's body fitness and condition. The score is based upon a mathematical formula (Fulton 1902) which utilizes length (mm) and weight (g) parameters to determine the fitness of individuals within a population.

$$K = (W/L^3) \times 100,000$$

The condition factor assumes that heavier fish of a given length are in better condition (Bolger and Connolly 1989; Shah et al. 2011). A fish is said to be in better condition when the value of a K-factor is more than 1.00 and in worse condition than an average individual of the same length, when its value is less than 1.00 (Shah et al. 2011).

## **Rainbow Trout Density**

The number of wild trout per mile is extrapolated from the annual population estimate. This estimate is an index used to monitor changes in resident trout density from year to year. The resident trout per mile estimate is annually based on population data collected from the six survey sites located within the 12.5-mile river reach, which extends from Pine Flat Dam to the Highway 180 Bridge. The six sites total 1,800 feet or 2.7% of the reach length. In 2019, only five sites were sampled resulting in 1,500 feet or 2.3% of the reach length.

## **Results**

Due to inclement weather which resulted in safety concerns, the Alta electrofishing site was not surveyed in 2019. Because of this, the results which follow are for five of the six sites routinely surveyed.

A total of 1,775 fishes were collected during the fall 2019 population survey and 1,774 entered into the JMP software program for analysis; one rainbow trout of unknown origin escaped before it could be measured. The numbers reflected in this report were produced by the JMP software with the exception of CPUE which will reflect the total catch. Species collected included; sculpin *Cottus sp.*, Sacramento sucker *Catostomus occidentalis*, lamprey *Lampetra sp.*, California

roach *Hesperoleucus symmetricus*, Sacramento pikeminnow *Ptychocheilus grandis*, three-spined stickleback *Gasterosteus aculeatus*, hatchery reared rainbow trout *Oncorhynchus mykiss*, wild rainbow trout *O. mykiss*, and catfish *Ameiurus sp.* Although more than one species of sculpin, lamprey, and catfish may have been collected during the survey they have been classified within their respective genus for the purpose of this report. The total catch by taxa and site is presented in Table 2. Population estimates by maximum likelihood are summarized in Table 3. Percent composition is summarized by species in Table 4 and 95% confidence intervals for the population estimates by taxa and survey site are summarized in Appendix A (Table A1).

**Table 2: Total catch by species and survey site. NS indicates the site was not surveyed.**

Total Catch by Species December 2019							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Species Total
Wild Trout	1	NS	3	10	0	0	14
Hatchery Trout	0	NS	26	8	0	0	34
California Roach	0	NS	11	25	8	84	128
Catfish sp.	3	NS	0	2	1	0	6
Lamprey sp.	4	NS	5	169	2	8	188
Sacramento Pikeminnow	23	NS	6	4	21	8	62
Sacramento Sucker	44	NS	176	155	54	158	587
Sculpin sp.	340	NS	68	169	70	68	715
Three-spined Stickleback	8	NS	13	9	5	5	40
Site Total	423	0	308	551	161	331	1774

**Table 3: Population estimate by maximum likelihood**

Population Estimate (maximum likelihood) December 2019						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Wild Trout	1	NS	3	10	0	0
Hatchery Trout	0	NS	41	13	0	0
California Roach	0	NS	12	36	10	154
Catfish sp.	3	NS	0	2	1	0
Lamprey sp.	6	NS	8	228	2	12
Sacramento Pikeminnow	59	NS	8	8	22	9
Sacramento Sucker	66	NS	210	201	102	401
Sculpin sp.	455	NS	68	214	71	144
Three-spined Stickleback	9	NS	13	14	5	6
Site Total	599	0	363	726	213	726

### Catch-Per-Unit-of-Effort

Collectively the total CPUE across all five sites was 49 fish per hour. The CPUE for each taxon is summarized by site in Table 5. A comparison of CPUE values from 2007 to 2019 is summarized in Appendix B.

**Table 4: Total catch % by species. NS indicates the site was not surveyed.**

Total Catch (% by site) December 2019						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Wild Trout	0.2%	NS	1.0%	1.8%	0.0%	0.0%
Hatchery Trout	0.0%	NS	8.4%	1.5%	0.0%	0.0%
California Roach	0.0%	NS	3.6%	4.5%	5.0%	25.4%
Catfish sp.	0.7%	NS	0.0%	0.4%	0.6%	0.0%
Lamprey sp.	0.9%	NS	1.6%	30.7%	1.2%	2.4%
Sacramento Pikeminnow	5.4%	NS	1.9%	0.7%	13.0%	2.4%
Sacramento Sucker	10.4%	NS	57.1%	28.1%	33.5%	47.7%
Sculpin sp.	80.4%	NS	22.1%	30.7%	43.5%	20.5%
Three-spined Stickleback	1.9%	NS	4.2%	1.6%	3.1%	1.5%
Site Total	100.0%	0.0%	100.0%	100.0%	100.0%	100.0%

**Table 5: Catch per unit of effort. NS indicates the site was not surveyed.**

CPUE (fish/hr) 2019						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Wild Trout	0.11	NS	0.50	1.44	0.00	0.00
Hatchery Trout	0.00	NS	4.29	1.15	0.00	0.00
California Roach	0.00	NS	1.82	3.59	1.06	12.37
Catfish sp.	0.34	NS	0.00	0.29	0.13	0.00
Lamprey sp.	0.45	NS	0.83	24.28	0.26	1.18
Sacramento Pikeminnow	2.59	NS	0.99	0.57	2.77	1.18
Sacramento Sucker	4.95	NS	29.04	22.27	7.12	23.27
Sculpin sp.	38.29	NS	11.22	24.28	9.23	10.01
Three-spined Stickleback	0.90	NS	2.15	1.29	0.66	0.74

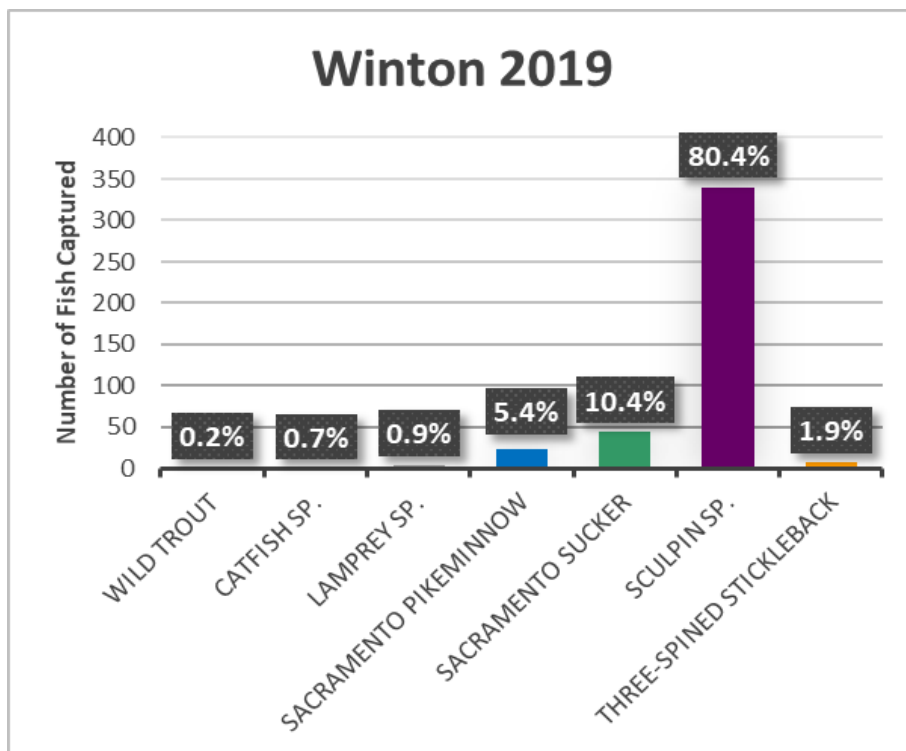
**Table 6: 95% confidence interval population estimates for each species summarized by site. Population estimates were generated using Microfish 3.0**

95% Confidence Interval (Adjust to lower CI) December 2019						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Rainbow Trout	1 - 1	NS	-2 - 8	9 - 11	0 - 0	0 - 0
Hatchery Trout	0.00	NS	3 - 79	-14 - 40	0 - 0	0 - 0
California Roach	0.00	NS	6 - 18	36 - 36	-1 - 21	47 - 261
Catfish sp.	2 - 4	NS	0 - 0	2 - 2	1 - 1	0 - 0
Lamprey sp.	6 - 6	NS	8 - 8	174 - 282	- 11 - 15	12 - 12
Sacramento Pikeminnow	-87 - 205	NS	-6 - 22	-34 - 50	18 - 26	3 - 15
Sacramento Sucker	66 - 66	NS	181 - 239	161 - 241	3 - 201	40 - 762
Sculpin sp.	386 - 524	NS	65 - 71	176 - 252	65 - 75	-3 - 291
Three-spined Stickleback	3 - 15	NS	11 - 15	14 - 14	5 - 5	-3 - 15

Site 1 – Winton Park

Multiple-pass depletion sampling yielded 423 fishes representing seven taxa. Sculpin accounted for 80.4%, Sacramento sucker accounted for 10.4% and Sacramento pikeminnow for 5.4% of the catch. Three-spined stickleback, lamprey, catfish, and wild rainbow trout accounted for the remainder of the catch. Sculpin (1,900g), Sacramento sucker (234g), and Sacramento Pikeminnow (47.9g) represented the majority of the biomass collected.

The estimated population density for this site is 1,619fish\*ha<sup>-1</sup>. By species, this represents 1,230 sculpin, 178 Sacramento sucker, 159 Sacramento pikeminnow, 24 three-spine stickleback, 16 lamprey, 8 catfish and 3 wild rainbow trout.



**Figure 2: Species composition and number of fish captured in the Winton survey reach.**

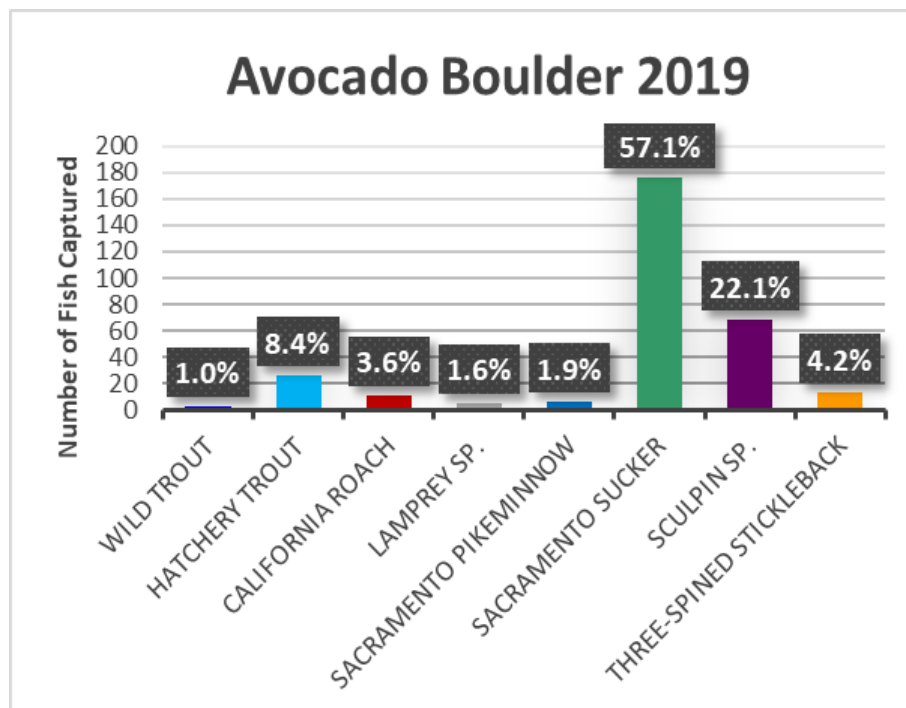
## Site 2 – Alta

This site was not surveyed in 2019.

## Site 3 – Avocado Boulder

Multiple-pass depletion sampling yielded 308 fishes representing eight taxa. Sacramento sucker accounted for 57.1%, sculpin accounted for 22.1%, and hatchery rainbow trout accounted for 8.4% of the catch. Three-spined stickleback, California Roach, Sacramento pikeminnow, lamprey, and wild rainbow trout accounted for the remainder of the catch. Sacramento sucker (43,250g), hatchery rainbow trout (4,095g) and wild rainbow trout (2,024g) represented the majority of the biomass collected.

The estimated population density for this site is 2,135 fish\*ha<sup>-1</sup>. By species, this represents 2,134 Sacramento sucker, 400 sculpin, 241 hatchery rainbow trout, 76 three-spine stickleback, 71 California roach, 47 Sacramento pikeminnow, 47 lamprey and 18 wild rainbow trout.



**Figure 3: Species composition, number of fish and percent of capture, for the Avocado Boulder survey reach.**

## Site 4 – Avocado Side Channel

Multiple-pass depletion sampling yielded 551 fishes representing nine taxa. Lamprey and sculpin each accounted for 30.7%, Sacramento sucker accounted for 28.1%, and California roach accounted for 4.5% of the catch. Wild rainbow trout, three-spined stickleback, hatchery rainbow trout, Sacramento pikeminnow, and catfish accounted for the remainder of the catch. Sacramento sucker (4,638.0g), hatchery rainbow trout (1,121.0g) and wild rainbow trout (958.0g) represented the majority of the biomass collected.

The estimated population density for this site is 4,840 fish\*ha<sup>-1</sup>. By species, this represents 1,520 lamprey, 1,426 sculpin, 1,340 Sacramento sucker, 240 California roach, 93 three-spine stickleback, 87 hatchery rainbow trout, 67 wild rainbow trout, 53 Sacramento pikeminnow, and 13 catfish.

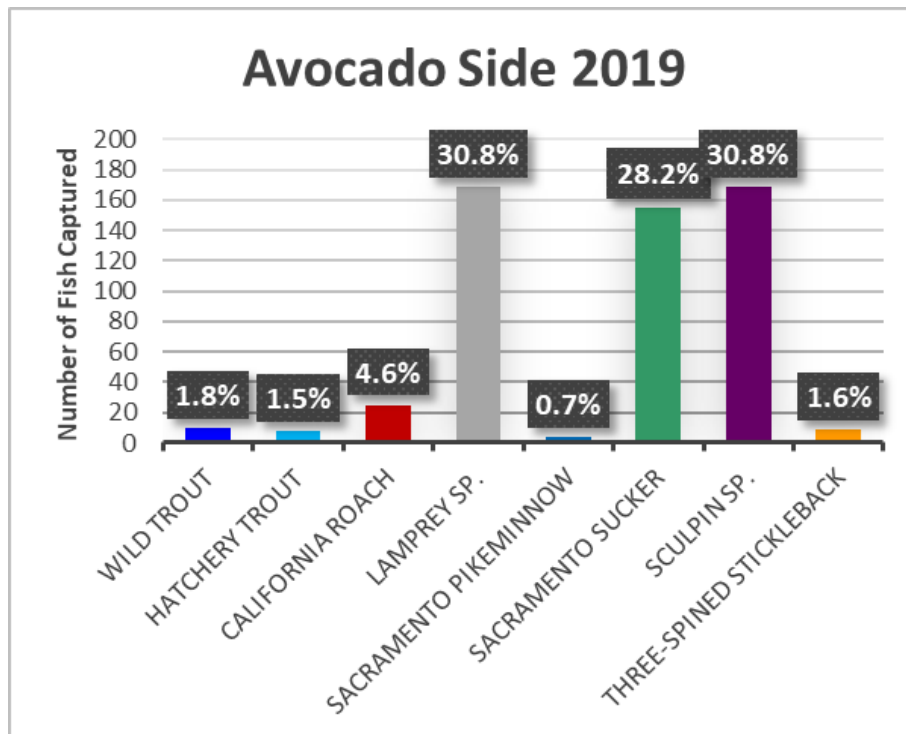
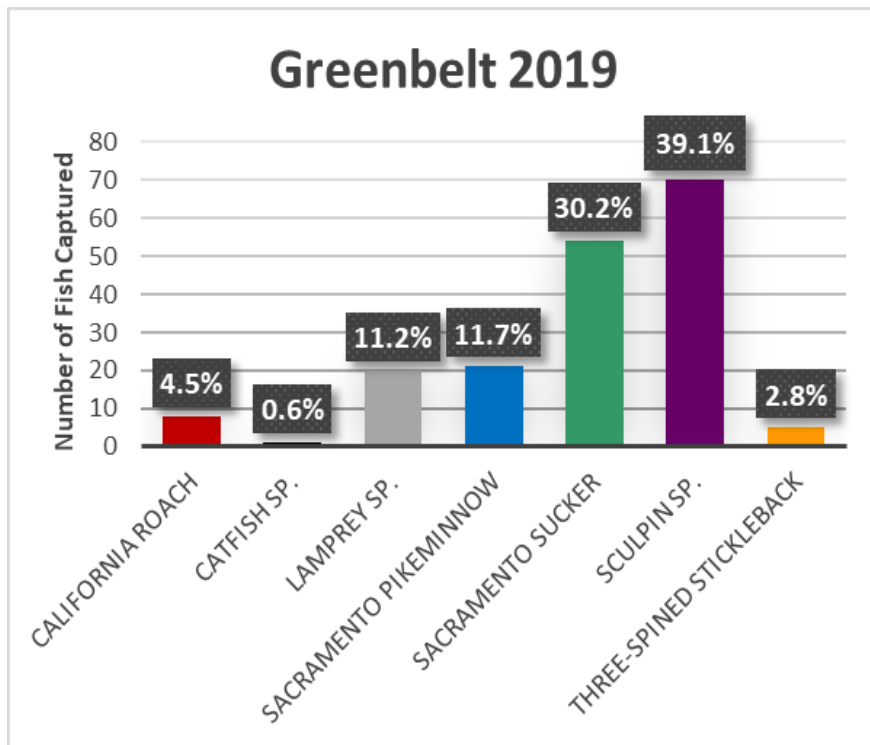


Figure 4: Species composition and number of fish captured in the Avocado Side Channel survey reach.

Site 5 – Greenbelt Parkway

Multiple-pass depletion sampling yielded 161 fishes representing seven taxa. Sculpin accounted for 43.5%, Sacramento sucker accounted for 33.5%, and Sacramento pikeminnow accounted for 13.0% of the catch. California roach, three-spined stickleback, lamprey, and catfish accounted for the remainder of the catch. Sacramento sucker (773g), Sculpin (413g), and Sacramento pikeminnow (117g) represented the majority of the biomass collected.

The estimated population density for this site is 741 fish\*ha<sup>-1</sup>. By species, this represents 262 sculpin, 378 Sacramento sucker, 37 California roach, 19 three-spined stickleback, 81 Sacramento pikeminnow, 7 lamprey, and 4 catfish.

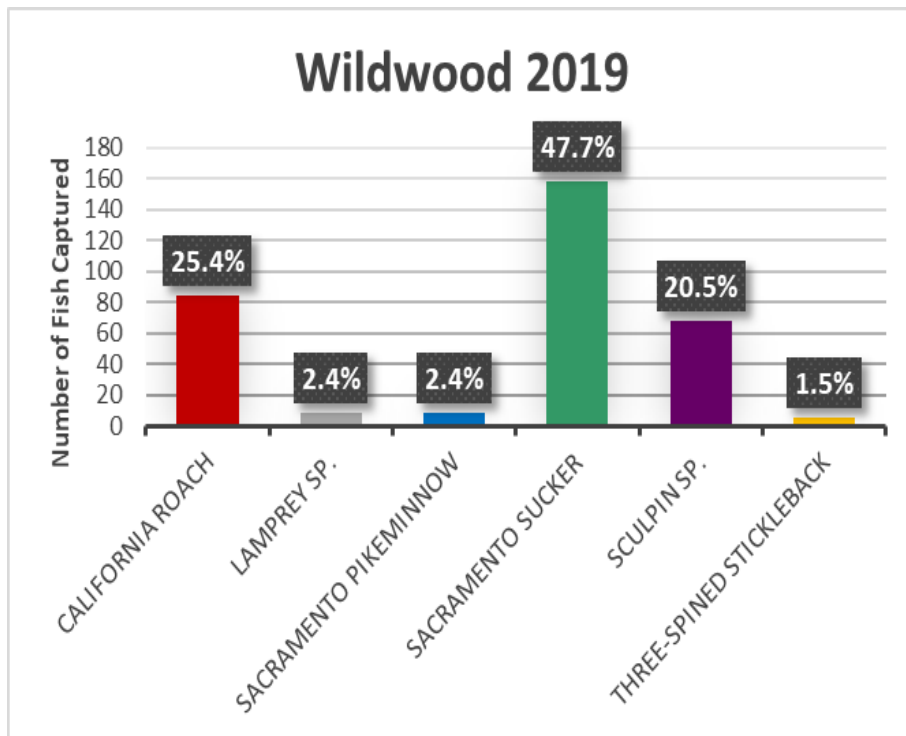


**Figure 5: Species composition and number of fish captured in the Greenbelt survey reach.**

Site 6 – Wildwood

Multiple-pass depletion sampling yielded 331 fishes representing six taxa. Sacramento sucker accounted for 47.7%, California roach accounted for 25.4%, and sculpin accounted for 20.5% of the catch. Sacramento pikeminnow, lamprey, and three-spined stickleback accounted for the remainder of the catch. Sacramento sucker (2,905g), sculpin (822g) and California roach (386g) represented the majority of the biomass collected.

The estimated population density for this site is 2,904 fish\*ha<sup>-1</sup>. By species, this represents 1,604 Sacramento sucker, 616 California roach, 576 sculpin, 48 lamprey, 36 Sacramento pikeminnow, and 24 three-spined stickleback.



**Figure 6: Species composition and number of fish captured in the Wildwood survey reach.**



## Species Composition

Species composition reflects a combination of environmental and historical events at a site; hence, changes in species composition can provide a sensitive measure of ecologically relevant changes in the environment (Philippi et al. 1998). Altogether nine taxa of fish were collected during the 2019 survey (Figure7). Comparative charts of species composition from 2010 – 2019 are presented in Appendix C.

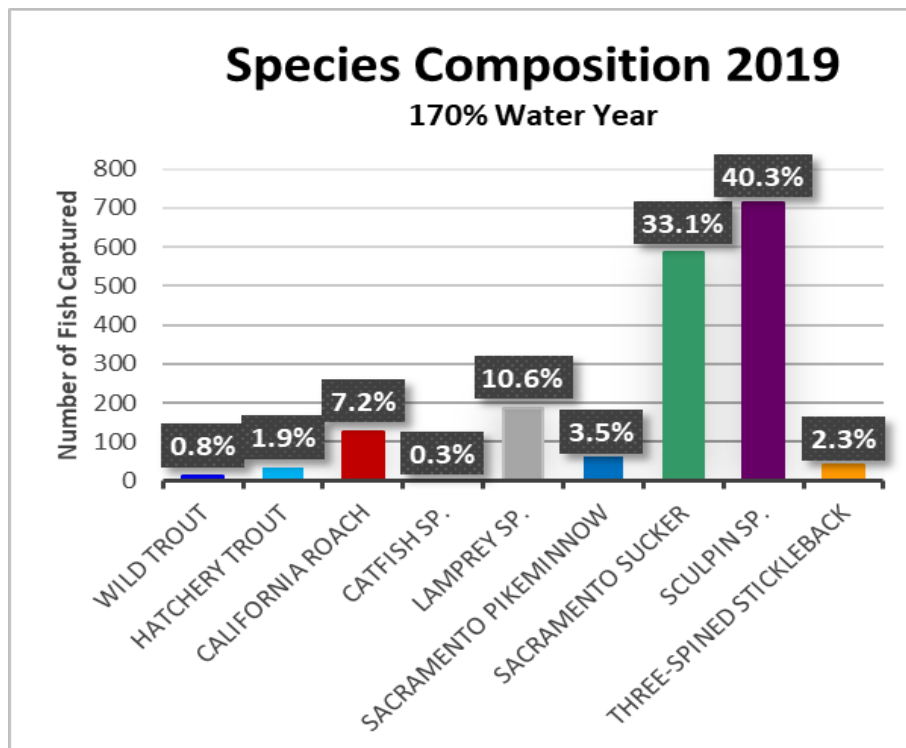


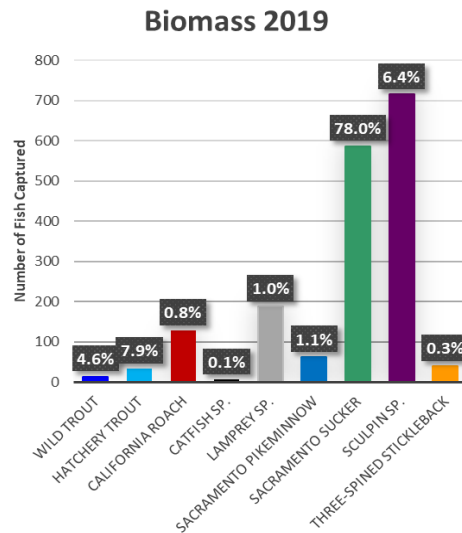
Figure 7: Species composition and number of fish captured during the Fall population survey.

## Wild Trout Density

Five sites were sampled over five days resulting in the capture of fourteen wild rainbow trout during the 2019 survey. This roughly translates to 49 wild rainbow trout per mile in similar reaches of the fishery. Since survey sites became standardized in 2007, the number of wild rainbow trout per mile has ranged from 0 to 88.

## Biomass

Biomass represents the weight of the fish population. The biomass for a given year equals the biomass of the previous year plus recruitment and growth minus harvest and mortality (Chippis and Garvey 2007). In 2019 the total biomass collected was 66,261g (146.4lbs.). Sacramento sucker accounted for 78% (51,800g; 114.2lbs.), hatchery rainbow trout accounted for 8% (5,216g; 11.5lbs.) sculpin accounted for 6% (4,227g; 9.31 lbs.). Wild rainbow trout, Sacramento pikeminnow, lamprey, California roach, three-spine stickleback and catfish accounted for the remaining 8% (5,018g; 11.4 lbs.). Biomass results for the 2019 survey are summarized by site in Table 6 and Figure 8.



**Figure 8: Collective biomass of fish captured during the Fall population survey.**

**Table 7: Biomass, weight in pounds. NS indicates the site was not surveyed.**

Total Weight (lbs) December 2019							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Species Total
Wild Trout	0.10	NS	4.46	2.11	0.00	0.00	<b>6.67</b>
Hatchery Trout	0.00	NS	9.03	2.47	0.00	0.00	<b>11.50</b>
California Roach	0.00	NS	0.00	0.24	0.08	0.85	<b>1.17</b>
Catfish sp.	0.04	NS	0.00	0.02	0.01	0.01	<b>0.08</b>
Lamprey sp.	0.03	NS	0.07	1.33	0.00	0.00	<b>1.43</b>
Sacramento Pikeminnow	0.11	NS	1.14	0.02	0.26	0.11	<b>1.64</b>
Sacramento Sucker	0.52	NS	95.35	10.23	1.70	6.40	<b>114.20</b>
Sculpin sp.	4.18	NS	0.94	1.47	0.91	1.81	<b>9.31</b>
Three-spined Stickleback	0.01	NS	0.38	0.02	0.00	0.00	<b>0.41</b>
<b>Site Total</b>	<b>4.99</b>	<b>0.00</b>	<b>111.37</b>	<b>17.91</b>	<b>2.96</b>	<b>9.18</b>	<b>146.41</b>
<b>Biomass %</b>	<b>3.4%</b>	<b>0.0%</b>	<b>76.1%</b>	<b>12.2%</b>	<b>2.0%</b>	<b>6.3%</b>	<b>100.0%</b>

## Length

The mean fork length for wild rainbow trout collected during the 2019 survey was 22.0 cm (approx. 8.75 inches). The mean fork length for wild rainbow trout collected between 2007 and 2019 (n = 190) is 19.0cm (approx. 7.5 inches). A comparison of these means is illustrated in Figure 9.

## Condition Factor (K)

All wild rainbow trout collected in 2019 were found to be in good condition (Table 8). The condition factor for these trout ranged from 0.95 to 1.25.

## Age

Scale samples from twelve of the fourteen wild rainbow trout collected in 2019 were used to estimate trout age based on counts of annuli and circuli. The majority of resident rainbow trout sampled appeared to be > 1 and < 2 years of age. Ages were further verified by back calculating fork length using the estimated growth rate of 0.5mm per day (FishBio, 2014) and assessing labeled photographs taken in the field. The mean age of resident rainbow trout caught since 2008 is 1.8 years. Age/length frequency distribution for 2019 is illustrated in Figure 10.

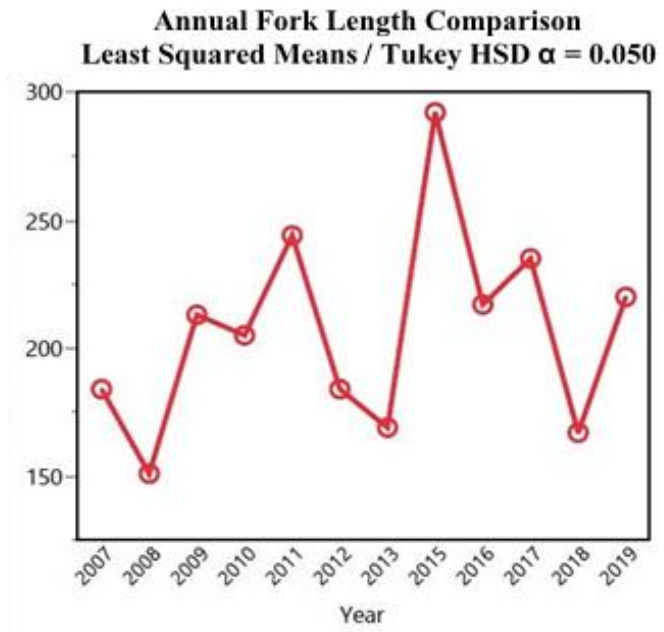
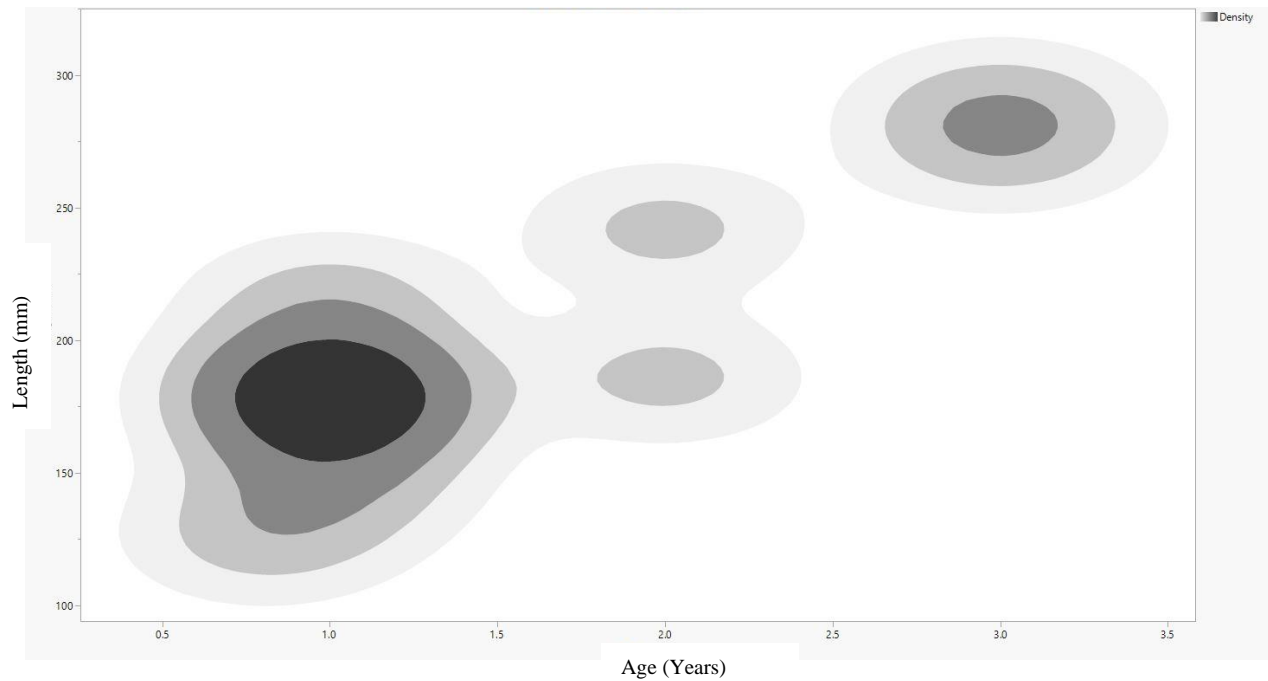


Figure 9: Changes in mean fork length 2007 - 2019

Table 8: Wild rainbow trout age class and condition factor (K-factor) where 1 is equal to good. Age: NS indicates no sample, YOY indicates young of the year.

SITE	AGE	K-FACTOR
Avocado Boulder Channel	1+	1.20
Avocado Boulder Channel	3	1.14
Avocado Boulder Channel	NS	1.17
Avocado Side Channel	NS	1.15
Avocado Side Channel	1+	1.21
Avocado Side Channel	3	1.22
Avocado Side Channel	2	1.18
Avocado Side Channel	YOY	1.12
Avocado Side Channel	1+	1.25
Avocado Side Channel	1+	1.22
Avocado Side Channel	2+	1.14
Avocado Side Channel	1+	1.24
Avocado Side Channel	1+	1.19
Winton	1+	0.95

## Age/Length (mm) Frequency Distribution of Wild Trout Fork Lengths Fall 2019



**Figure 10: Age/Length Frequency distribution ranges of wild trout 2019. Darker areas indicate ranges with a higher frequency of age length intersects and lighter areas showing ranges of less frequent occurrences.**

### Conclusion

2019 marked the thirteenth year of multiple-pass depletion sampling since 2007. In addition, this year marked the eighth year that the KRFMP utilized deliberate voltage adjustment by site for the LR-24 units in concurrence with water conductivity. It is not certain how the change in voltage adjustments may have influenced 2012 – 2019 catch efficiency and the interpretation of trends over time in survey results.

Collectively, 1,775 fishes were collected within the five survey areas sampled in 2019. Collected fish represented nine species, with 0.3% of the total catch ( $n = 6$ ) represented by non-natives. The 2019 survey results were dominated by sculpin (40%), Sacramento sucker (33%), and lamprey (11%), which together represented 84% of fish surveyed.

The 2019 catch totaled only 44% of the previous 11-year average (2007 – 2019) or 37% of the 7-year average where six sites were surveyed. As compared to the 2018 totals; California roach

declined by 71%, Sculpin declined by 70% and Sacramento sucker declined by 64%. Three-spine stickleback were at their lowest in 11 years. Surveying fewer sites in 2019 contributed to the overall decline, but even within those sites surveyed in both 2018 and 2019 species declines were apparent. We have theorized many different factors could have contributed to these apparent declines. 1) Sampling later in the year may have caused fish to differ in spatial distribution within the river than they would have been in November due to factors such as food availability, water temperatures, or life history needs. 2) The need to pulse river flows daily in order to make it possible to conduct the electrofish survey under safely wadeable conditions may have affected distribution of fish within reaches as they move to areas of suitable habitat. Turbidity was not an issue as sites were still in the process of ramping down to minimum flows prior to the initiation of the first pass. Turbidity has been observed to generally occur only when ramping up, rainfall is occurring, or Mill Creek is at a high rate of flow. 3) Flows approximately 50 cfs higher than normal made some spots on the last two days of survey fairly turbulent, difficult to wade, and difficult to net fish. 4) Not enough personnel in the water to effectively prevent fish from getting through the line of electricity and past netters. 5) an increased stocking regime (October through March) in place since October 2018 appeared to increase both the numbers of anglers engaged in recreational fishing on the river as well as the numbers of avian predators of fish present at stocking locations from October through March. It is important to note these observations are anecdotal as there is no documented data available for pre- and post-stocking numbers of anglers or avian fish predators present. 6) Reduced prey availability for insectivorous fish inhabiting the Kings River may have led to reduced fitness and thus reduced survival and fecundity. Reduced prey availability of benthic macroinvertebrates could be due to various factors such as high flows which may displace eggs and larval stages or reduced flows which may leave larval stages dewatered. Prey availability may also be decreased due to increased competition for invertebrate prey between native minnows and hatchery trout. No data is currently available to address the status of benthic macroinvertebrates in the lower Kings River. 7) It is also possible that none or all of the variables listed previously may have contributed to our results.

The only species increase of note in 2019 was a 129% rise in hatchery rainbow trout. This surge is likely due to increased frequency and quantity of rainbow trout stocking by the CDFW

San Joaquin Hatchery in 2019. Beginning in October fish stocking generally occurred twice a week. Based on the size of hatchery trout captured during the survey it is likely most has been stocked in recent weeks by the CDFW San Joaquin Hatchery, although the larger captured trout may have been holdovers from fish stocked by Calaveras Trout Farm during the October 2018 through March 2019 supplemental stocking period. Captured hatchery trout ranged from approximately 7” to 12” and ranged from 0.16 lbs to 0.58 lbs. Fish released since July up to the initiation of electrofishing have varied from a minimum of 13 fish to the pound upwards of 0.83 fish per pound, and most typically in the 2 to 3 fish per pound range. Condition factors for the hatchery trout captured ranged from 0.74 to 1.41. Prior to the initiation of electrofishing in 2019 the river was last stocked on November 26 (2,240 rainbow trout at 2.8 fish per pound) and November 27 (1,008 rainbow trout at 2.4 fish per pound). Routine stocking locations range from 0.1 to 0.7 miles away from the four sample sites located above Fresno Weir.

Since our return to multiple-pass depletion surveys in 2007 we have yet to discover any affirmative correlations linking observed environmental variables to species composition or abundance. It is unlikely that variations in species composition can be attributed to any one cause and far more likely that a combination of environmental and anthropogenic factors influence the fishery. The KRCD and the KRFMP will continue monitoring and investigation of environmental and population variables within the tailwater fishery.

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## **Appendix A**

Tables A1 – A13: Catch per Unit of Effort (CPUE) by species; 2007 – 2019. Note: Nine sites were sampled during the 2007 survey and eight sites were sampled during the 2010 survey. Data collected from the additional sites were not used in this comparison. NS indicates the site was not sampled.

**Table A1: CPUE 2007**

CPUE (fish/hr) 2007						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Rainbow Trout	0.9	0.4	1.1	0.0	0.3	0.0
Hatchery Trout	1.2	2.3	0.3	0.7	0.0	0.0
California Roach	0.4	0.3	2.7	3.1	16.2	7.5
Green Sunfish	0.0	0.0	0.0	0.0	0.0	0.0
Lamprey sp.	0.1	22.5	0.7	19.0	0.3	0.6
Sacramento Pikeminnow	11.9	2.2	10.1	21.8	25.6	53.6
Sacramento Sucker	41.7	50.5	52.4	34.7	32.7	44.7
Sculpin sp.	48.1	50.1	23.5	29.5	23.7	34.3
Three-spined Stickleback	0.9	3.5	0.9	2.2	0.0	1.8

**Table A2: CPUE 2008**

CPUE (fish/hr) 2008						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Rainbow Trout	1.1	0.8	1.1	1.4	0.1	0.0
Hatchery Trout	0.0	0.0	0.2	0.0	0.0	0.0
California Roach	0.0	1.2	12.8	2.8	29.5	40.8
Lamprey sp.	0.3	9.4	0.8	13.2	0.3	0.0
Mosquitofish	0.0	0.4	0.0	0.0	0.0	0.0
Sacramento Pikeminnow	8.8	3.0	21.7	8.3	20.1	18.7
Sacramento Sucker	12.9	31.3	34.5	17.5	13.5	2.6
Sculpin sp.	23.7	26.6	20.2	12.5	3.8	5.7
Three-spined Stickleback	0.0	7.2	3.0	3.3	0.0	6.0
White Catfish	0.0	0.0	0.2	0.0	0.1	0.0

**Table A3: CPUE 2009**

CPUE (fish/hr) 2009						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Rainbow Trout	0.9	0.1	1.3	0.3	0.0	0.0
Hatchery Trout	0.1	0.1	0.0	0.0	0.0	0.0
Bluegill	0.0	0.0	0.0	0.0	0.1	0.0
Bullhead Catfish	0.0	0.0	0.0	0.0	0.1	0.0
California Roach	0.0	1.3.7	3.4	1.0	6.0	38.9
Lamprey sp.	0.5	8.4	0.6	13.4	0.1	0.1
Largemouth Bass	0.0	0.0	0.0	0.2	0.1	0.0
Sacramento Pikeminnow	1.8	7.1	6.8	4.9	10.3	17.2
Sacramento Sucker	3.8	18.0	26.4	9.1	6.2	2.1
Sculpin sp.	35.9	40.5	27.8	18.5	9.8	5.8
Small Mouth Bass	0.0	0.0	0.0	0.0	0.2	0.0
Three-spined Stickleback	0.1	5.7	2.4	2.9	0.6	2.6
White Catfish	0.0	0.0	0.0	0.0	0.1	0.0

**Table A4: CPUE 2010**

<b>CPUE (fish/hr) 2010</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	1.1	0.0	0.0	0.7	0.0	0.0
<b>Hatchery Trout</b>	0.0	0.2	0.3	0.0	0.0	0.0
<b>Brook Trout</b>	0.1	1.0	0.0	0.2	0.0	0.0
<b>California Roach</b>	0.7	3.0	7.4	1.2	13.0	54.2
<b>Lamprey sp.</b>	0.0	8.9	1.0	6.7	0.2	0.7
<b>Sacramento Pikeminnow</b>	1.3	2.0	4.3	1.7	8.7	11.2
<b>Sacramento Sucker</b>	4.7	29.5	17.7	10.0	2.6	8.4
<b>Sculpin sp.</b>	51.8	42.5	28.3	22.9	14.7	11.8
<b>Three-spined Stickleback</b>	2.0	9.2	0.6	0.0	0.0	6.2

**Table A5: CPUE 2011**

<b>CPUE (fish/hr) 2011</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.0	0.6	0.6	0.7	0.0	0.0
<b>Hatchery Trout</b>	0.0	0.0	0.7	0.2	0.0	0.0
<b>California Roach</b>	0.7	1.5	2.7	5.6	4.1	28.8
<b>Green Sunfish</b>	0.1	0.0	0.0	0.0	0.0	0.0
<b>Lamprey sp.</b>	0.0	10.2	2.0	20.1	0.0	0.0
<b>Sacramento Pikeminnow</b>	4.0	4.7	1.1	0.5	1.9	1.1
<b>Sacramento Sucker</b>	7.7	20.9	8.0	9.8	2.0	10.5
<b>Sculpin sp.</b>	30.6	45.4	10.0	32.1	9.4	12.6
<b>Three-spined Stickleback</b>	1.1	8.1	1.1	0.9	0.2	0.4

**Table A6: CPUE 2012**

<b>CPUE (fish/hr) 2012</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.9	0.3	1.4	0.8	0.1	0.0
<b>Hatchery Trout</b>	0.0	0.0	0.0	1.2	0.0	0.0
<b>California Roach</b>	0.0	3.4	9.3	4.0	15.2	19.9
<b>Lamprey sp.</b>	0.0	9.5	2.7	10.2	0.5	0.0
<b>Mosquitofish</b>	0.0	0.0	0.0	1.2	0.0	0.0
<b>Sacramento Pikeminnow</b>	0.1	1.5	19.9	22.6	8.1	17.1
<b>Sacramento Sucker</b>	13.0	36.5	39.4	32.6	12.2	65.1
<b>Sculpin sp.</b>	41.0	36.0	32.4	24.1	13.1	11.7
<b>Three-spined Stickleback</b>	0.0	3.3	0.7	3.2	0.5	2.6
<b>White Catfish</b>	0.0	0.0	0.0	0.0	0.1	0.0

**Table A7: CPUE 2013**

<b>CPUE (fish/hr) 2013</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.43	0.00	0.58	0.63	0.00	0.00
<b>Hatchery Trout</b>	0.29	0.16	0.15	0.16	0.00	0.00
<b>Bass</b>	0.00	0.00	0.00	0.00	0.62	0.00
<b>California Roach</b>	0.00	9.92	28.61	39.22	27.09	57.51
<b>Lamprey sp.</b>	0.43	6.30	1.02	15.94	0.37	0.00
<b>Mosquitofish</b>	0.00	0.16	0.00	0.00	0.00	0.00
<b>Sacramento Pikeminnow</b>	24.43	22.52	50.66	20.63	46.18	98.32
<b>Sacramento Sucker</b>	51.15	53.07	40.88	11.88	6.28	20.98
<b>Sculpin sp.</b>	70.83	37.64	49.34	29.38	21.67	16.84
<b>Three-spined Stickleback</b>	2.16	11.18	1.17	1.56	1.85	13.08
<b>White Catfish</b>	0.00	0.00	0.00	0.00	0.37	0.00

**Table A8: CPUE 2014**

<b>CPUE (fish/hr) 2014</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.00	0.00	0.00	0.00	0.00	0.00
<b>Hatchery Trout</b>	0.00	0.00	0.13	0.00	0.00	0.00
<b>Bass</b>	0.00	0.13	0.13	0.00	3.65	0.13
<b>California Roach</b>	2.16	12.77	25.00	11.38	24.96	60.55
<b>Lamprey sp.</b>	0.19	13.78	5.32	23.55	0.42	0.13
<b>Mosquitofish</b>	0.00	0.13	0.00	0.23	0.42	1.82
<b>Sacramento Pikeminnow</b>	16.14	6.19	36.17	6.60	16.41	37.89
<b>Sacramento Sucker</b>	10.69	11.25	19.81	7.62	4.77	10.42
<b>Sculpin sp.</b>	33.77	6.83	17.15	9.22	4.77	7.68
<b>Three-spined Stickleback</b>	3.00	27.69	4.26	6.60	0.56	8.20
<b>White Catfish</b>	0.19	0.00	0.27	0.23	2.10	0.00

**Table A9: CPUE 2015**

<b>CPUE (fish/hr) 2015</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.12	0.00	0.12	0.00	0.00	0.00
<b>Hatchery Trout</b>	0.00	0.00	0.12	0.00	0.00	0.00
<b>Bass</b>	0.00	0.14	0.00	0.18	7.90	0.49
<b>California Roach</b>	3.92	25.17	36.05	38.86	10.49	87.59
<b>Lamprey sp.</b>	0.24	14.72	3.09	9.94	0.00	0.12
<b>Mosquitofish</b>	0.24	3.16	0.00	0.00	1.87	2.31
<b>Sacramento Pikeminnow</b>	14.96	6.88	24.69	29.10	15.52	19.22
<b>Sacramento Sucker</b>	50.12	51.03	35.68	36.83	3.45	2.80
<b>Sculpin sp.</b>	19.00	0.96	3.33	0.74	1.01	0.73
<b>Three-spined Stickleback</b>	5.70	4.26	1.73	3.68	0.00	1.09
<b>White Catfish</b>	0.00	0.00	0.00	0.00	0.29	0.00

**Table A10: CPUE 2016**

<b>CPUE (fish/hr) 2016</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.00	0.00	0.30	0.78	0.00	0.17
<b>Hatchery Trout</b>	0.27	0.00	1.20	0.39	0.00	0.00
<b>Bass</b>	0.00	0.00	0.00	0.00	2.41	0.17
<b>Bluegill</b>	0.00	0.00	0.00	0.00	0.16	0.00
<b>California Roach</b>	1.51	61.70	54.12	32.36	14.29	95.87
<b>Green Sunfish</b>	0.00	0.00	0.00	0.00	0.32	0.00
<b>Lamprey sp.</b>	0.41	24.53	3.90	26.74	0.32	0.00
<b>Mosquitofish</b>	0.00	2.83	0.00	0.00	0.16	2.64
<b>Sacramento Pikeminnow</b>	7.12	13.58	26.69	1.94	6.42	7.26
<b>Sacramento Sucker</b>	73.84	73.77	95.80	40.12	78.33	91.75
<b>Sculpin sp.</b>	28.77	5.09	3.60	0.78	5.94	0.17
<b>Three-spined Stickleback</b>	12.60	14.72	14.24	25.00	0.96	19.47

**Table A11: CPUE 2017**

<b>CPUE (fish/hr) 2017</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	NS	NS	NS	0.38	0.00	NS
<b>Hatchery Trout</b>	NS	NS	NS	0.50	0.10	NS
<b>Bass</b>	NS	NS	NS	0.00	0.31	NS
<b>California Roach</b>	NS	NS	NS	12.47	17.82	NS
<b>Green Sunfish</b>	NS	NS	NS	0.00	0.52	NS
<b>Lamprey sp.</b>	NS	NS	NS	14.99	0.84	NS
<b>Sacramento Pikeminnow</b>	NS	NS	NS	1.76	2.62	NS
<b>Sacramento Sucker</b>	NS	NS	NS	40.55	17.40	NS
<b>Sculpin sp.</b>	NS	NS	NS	18.89	16.35	NS
<b>Three-spined Stickleback</b>	NS	NS	NS	3.65	8.60	NS

**Table A12: CPUE 2018**

<b>CPUE (fish/hr) 2018</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.08	0.27	1.11	1.25	0.00	0.00
<b>Hatchery Trout</b>	0.33	0.54	0.63	0.47	0.00	0.00
<b>Bass</b>	0.00	0.00	0.00	0.16	0.14	0.00
<b>California Roach</b>	0.00	0.67	6.95	1.57	8.68	37.16
<b>Catfish sp.</b>	0.00	0.00	0.00	0.00	0.14	0.00
<b>Hardhead</b>	0.00	0.00	0.00	0.00	0.14	0.00
<b>Lamprey sp.</b>	0.16	9.53	1.58	23.98	0.81	0.69
<b>Sacramento Pikeminnow</b>	0.49	1.48	1.90	0.78	19.27	5.39
<b>Sacramento Sucker</b>	26.47	52.35	61.14	58.78	23.61	41.28
<b>Sculpin sp.</b>	50.82	87.38	22.43	26.96	32.43	16.40
<b>Three-spined Stickleback</b>	0.90	1.34	2.53	5.02	2.04	1.15

**Table A13: CPUE 2019**

<b>CPUE (fish/hr) 2019</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Rainbow Trout</b>	0.11	NS	0.83	1.44	0.00	0.00
<b>Hatchery Trout</b>	0.00	NS	3.96	1.15	0.00	0.00
<b>California Roach</b>	0.00	NS	1.82	3.59	1.06	12.37
<b>Catfish sp.</b>	0.34	NS	0.00	0.29	0.13	0.00
<b>Lamprey sp.</b>	0.45	NS	0.83	24.28	0.26	1.18
<b>Sacramento Pikeminnow</b>	2.59	NS	0.99	0.57	2.77	1.18
<b>Sacramento Sucker</b>	4.95	NS	29.04	22.27	7.12	23.27
<b>Sculpin sp.</b>	38.29	NS	11.22	24.14	9.23	10.01
<b>Three-spined Stickleback</b>	0.90	NS	2.15	1.29	0.66	0.74

## **Appendix B**

Tables B1 – B13: Species Composition Fall Population Surveys; 2007 – 2019. Note: Nine sites were sampled during the 2007 survey and eight sites were sampled during the 2010 survey. Data collected from the additional sites were not used in this comparison. NS indicates the site was not sampled.

Table B1: Species Composition 2007

November 2007								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
California Roach	3	3	20	22	143	53	244	4.6%
Lamprey sp.	1	202	5	136	3	4	351	6.5%
Rainbow Trout - "Wild"	7	4	8	0	3	0	22	0.4%
Rainbow Trout - Hatchery	9	21	2	5	0	0	37	0.7%
Sacramento Pikeminnow	93	20	75	156	226	378	948	17.7%
Sacramento Sucker	326	454	390	248	288	315	2,021	37.7%
Sculpin sp.	376	450	175	211	209	242	1,663	31.0%
Three-spined Stickleback	7	31	7	16	0	13	74	1.4%
<b>Total Fish Captured</b>	<b>822</b>	<b>1,185</b>	<b>682</b>	<b>794</b>	<b>872</b>	<b>1,005</b>	<b>5,360</b>	
<b>% of Total</b>	<b>15%</b>	<b>22%</b>	<b>13%</b>	<b>15%</b>	<b>16%</b>	<b>19%</b>	<b>100%</b>	

Table B2: Species Composition 2008

November 2008								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
California Roach	0	6	84	16	226	325	657	23.8%
Catfish sp.	0	0	1	0	1	0	2	0.1%
Lamprey sp.	2	47	5	75	2	0	131	4.7%
Mosquitofish	0	2	0	0	0	0	2	0.1%
Rainbow Trout - "Wild"	7	4	7	8	1	0	27	1.0%
Rainbow Trout - Hatchery	0	0	1	0	0	0	1	0.0%
Sacramento Pikeminnow	56	15	143	47	154	149	564	20.4%
Sacramento Sucker	82	157	227	99	103	21	689	25.0%
Sculpin sp.	151	133	133	71	29	45	562	20.4%
Three-spined Stickleback	0	36	20	19	0	48	123	4.5%
<b>Total Fish Captured</b>	<b>298</b>	<b>400</b>	<b>621</b>	<b>335</b>	<b>516</b>	<b>588</b>	<b>2,758</b>	
<b>% of Total</b>	<b>11%</b>	<b>15%</b>	<b>23%</b>	<b>12%</b>	<b>19%</b>	<b>21%</b>	<b>100%</b>	

Table B3: Species Composition 2009

November 2009								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	1	3	0	4	0.1%
Bluegill	0	0	0	0	1	0	1	0.0%
California Roach	0	93	30	6	51	345	525	19.1%
Catfish sp.	0	0	0	0	2	0	2	0.1%
Lamprey sp.	4	57	5	79	1	1	147	5.4%
Rainbow Trout - "Wild"	7	1	11	2	0	0	21	0.8%
Rainbow Trout - Hatchery	1	1	0	0	0	0	2	0.1%
Sacramento Pikeminnow	14	48	60	29	88	152	391	14.2%
Sacramento Sucker	29	122	232	54	53	19	509	18.5%
Sculpin sp.	276	275	244	109	84	51	1,039	37.9%
Three-spined Stickleback	1	38	20	17	5	23	104	3.8%
<b>Total Fish Captured</b>	<b>332</b>	<b>635</b>	<b>602</b>	<b>297</b>	<b>288</b>	<b>591</b>	<b>2,745</b>	
<b>% of Total</b>	<b>12%</b>	<b>23%</b>	<b>22%</b>	<b>11%</b>	<b>10%</b>	<b>22%</b>	<b>100%</b>	



**Table B4: Species Composition 2010**

November 2010								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Brook Trout	1	7	0	1	0	0	9	0.3%
California Roach	6	19	51	5	69	401	551	21.0%
Lamprey sp.	0	57	7	28	1	5	98	3.7%
Rainbow Trout - "Wild"	8	0	0	3	0	0	11	0.4%
Rainbow Trout - Hatchery	1	1	2	0	0	0	4	0.2%
Sacramento Pikeminnow	11	13	30	7	46	83	190	7.2%
Sacramento Sucker	40	189	122	42	14	62	469	17.9%
Sculpin sp.	440	272	195	96	78	87	1,168	44.5%
Three-spined Stickleback	17	59	4	0	0	46	126	4.8%
<b>Total Fish Captured</b>	<b>524</b>	<b>617</b>	<b>411</b>	<b>182</b>	<b>208</b>	<b>684</b>	<b>2,626</b>	
<b>% of Total</b>	<b>20%</b>	<b>23%</b>	<b>16%</b>	<b>7%</b>	<b>8%</b>	<b>26%</b>	<b>100%</b>	

**Table B5: Species Composition 2011**

December 2011								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
California Roach	6	7	23	25	26	212	299	16.3%
Green Sunfish	1	0	0	0	0	0	1	0.1%
Lamprey sp.	0	48	17	90	0	0	155	8.5%
Rainbow Trout - "Wild"	0	3	5	4	0	0	12	0.7%
Rainbow Trout - Hatchery	0	0	6	1	0	0	7	0.4%
Sacramento Pikeminnow	33	22	9	2	12	8	86	4.7%
Sacramento Sucker	63	98	68	44	13	77	363	19.8%
Sculpin sp.	252	213	85	144	60	93	847	46.2%
Three-spined Stickleback	9	38	9	4	1	3	64	3.5%
<b>Total Fish Captured</b>	<b>364</b>	<b>429</b>	<b>222</b>	<b>314</b>	<b>112</b>	<b>393</b>	<b>1,834</b>	
<b>% of Total</b>	<b>20%</b>	<b>23%</b>	<b>12%</b>	<b>17%</b>	<b>6%</b>	<b>21%</b>	<b>100%</b>	

**Table B6: Species Composition 2012**

November 2012								
	Winton	Alta	AvoBoulder	AvoSide	Greenbelt	Wildwood	Total	% of Total
California Roach	0	37	79	30	121	155	422	9.9%
Catfish sp.	0	0	0	0	1	0	1	0.0%
Lamprey Sp.	0	103	23	76	4	0	206	4.8%
Mosquitofish	0	0	0	9	0	0	9	0.2%
Rainbow Trout - "Wild"	8	3	12	6	1	0	30	0.7%
Rainbow Trout - Hatchery	0	0	3	0	0	0	3	0.1%
Sacramento Pikeminnow	1	17	44	169	64	133	428	10.1%
Sacramento Sucker	107	396	334	244	97	507	1,685	39.6%
Sculpin Sp.	336	391	275	180	104	91	1,377	32.4%
Three-spined Stickleback	0	36	6	24	4	20	90	2.1%
<b>Total Fish Captured</b>	<b>452</b>	<b>983</b>	<b>776</b>	<b>738</b>	<b>396</b>	<b>906</b>	<b>4,251</b>	
<b>% of Total</b>	<b>11%</b>	<b>23%</b>	<b>18%</b>	<b>17%</b>	<b>9%</b>	<b>21%</b>	<b>100%</b>	

**Table B7: Species Composition 2013**

November 2013								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	0	4	0	4	0.1%
California Roach	0	63	196	251	221	443	1,174	18.6%
Catfish sp.	0	0	0	0	3	0	3	0.0%
Lamprey sp.	3	40	7	102	3	0	155	2.5%
Mosquitofish	0	1	0	0	0	0	1	0.0%
Rainbow Trout - "Wild"	2	1	4	4	0	0	11	0.2%
Rainbow Trout - Hatchery	1	1	2	1	0	0	5	0.1%
Sacramento Pikeminnow	170	143	347	132	375	758	1,925	30.4%
Sacramento Sucker	356	336	280	75	51	164	1,262	20.0%
Sculpin sp.	493	239	337	189	176	130	1,564	24.7%
Three-spined Stickleback	15	71	8	10	15	101	220	3.5%
<b>Total Fish Captured</b>	<b>1,040</b>	<b>895</b>	<b>1,181</b>	<b>764</b>	<b>848</b>	<b>1,596</b>	<b>6,324</b>	
<b>% of Total</b>	<b>16%</b>	<b>14%</b>	<b>19%</b>	<b>12%</b>	<b>13%</b>	<b>25%</b>	<b>100%</b>	

**Table B8: Species Composition 2014**

November 2014								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	1	1	0	26	1	29	0.7%
California Roach	23	101	188	100	178	465	1,055	25.7%
Catfish sp.	2	0	2	2	15	0	21	0.5%
Rainbow Trout - Hatchery	0	0	1	0	0	0	1	0.0%
Lamprey sp.	2	109	40	207	3	1	362	8.8%
Mosquitofish	0	1	0	2	3	14	20	0.5%
Sacramento Pikeminnow	172	49	272	58	117	291	959	23.4%
Sacramento Sucker	114	89	149	67	34	80	533	13.0%
Sculpin sp.	360	54	129	81	34	59	717	17.5%
Three-spined Stickleback	32	219	32	58	4	63	408	9.9%
<b>Total Fish Captured</b>	<b>705</b>	<b>623</b>	<b>814</b>	<b>575</b>	<b>414</b>	<b>974</b>	<b>4,105</b>	
<b>% of Total</b>	<b>17%</b>	<b>15%</b>	<b>20%</b>	<b>14%</b>	<b>10%</b>	<b>24%</b>		

**Table B9: Species Composition 2015**

November 2015								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	1	0	1	55	4	61	1.4%
California Roach	33	183	292	211	73	720	1,512	35.3%
Catfish sp.	0	0	0	0	2	0	2	0.0%
Lamprey sp.	2	107	25	54	0	1	189	4.4%
Mosquitofish	2	23	0	0	13	19	57	1.3%
Rainbow Trout - "Wild"	1	0	1	0	0	0	2	0.0%
Rainbow Trout - Hatchery	0	0	1	0	0	0	1	0.0%
Sacramento Pikeminnow	126	50	200	158	108	158	800	18.7%
Sacramento Sucker	422	371	289	200	24	23	1,329	31.0%
Sculpin sp.	160	7	27	4	7	6	211	4.9%
Three-spined Stickleback	48	31	14	20	0	9	122	2.8%
<b>Total Fish Captured</b>	<b>794</b>	<b>773</b>	<b>849</b>	<b>648</b>	<b>282</b>	<b>940</b>	<b>4,286</b>	
<b>% of Total</b>	<b>19%</b>	<b>18%</b>	<b>20%</b>	<b>15%</b>	<b>7%</b>	<b>22%</b>	<b>100%</b>	

**Table B10: Species Composition 2016**

November 2016								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	0	15	1	16	0.3%
Bluegill	0	0	0	0	3	0	3	0.1%
California Roach	11	327	359	167	89	580	1,533	27.1%
Lamprey sp.	3	130	26	138	2	0	299	5.3%
Mosquitofish	0	15	0	0	1	16	32	0.6%
Rainbow Trout - "Wild"	0	0	2	4	0	1	7	0.1%
Rainbow Trout - Hatchery	2	0	8	2	0	0	12	0.2%
Sacramento Pikeminnow	52	72	175	10	40	44	393	6.9%
Sacramento Sucker	539	391	364	207	488	556	2,545	45.0%
Sculpin sp.	210	27	24	4	37	1	303	5.4%
Three-spined Stickleback	92	78	95	129	6	118	518	9.2%
<b>Total Fish Captured</b>	<b>909</b>	<b>1,040</b>	<b>1,053</b>	<b>661</b>	<b>681</b>	<b>1,317</b>	<b>5,661</b>	
<b>% of Total</b>	<b>16%</b>	<b>18%</b>	<b>19%</b>	<b>12%</b>	<b>12%</b>	<b>23%</b>	<b>100%</b>	

**Table B11: Species Composition 2017**

November 2017								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	NS	NS	NS	0	3	NS	3	0.2%
California Roach	NS	NS	NS	99	170	NS	269	19.8%
Green Sunfish	NS	NS	NS	0	5	NS	5	0.4%
Lamprey sp.	NS	NS	NS	119	8	NS	127	9.4%
Rainbow Trout - "Wild"	NS	NS	NS	3	0	NS	3	0.2%
Rainbow Trout - Hatchery	NS	NS	NS	4	1	NS	5	0.4%
Sacramento Pikeminnow	NS	NS	NS	14	25	NS	39	2.9%
Sacramento Sucker	NS	NS	NS	322	166	NS	488	36.0%
Sculpin sp.	NS	NS	NS	150	156	NS	306	22.6%
Three-spined Stickleback	NS	NS	NS	29	82	NS	111	8.2%
<b>Total Fish Captured</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>740</b>	<b>616</b>	<b>0</b>	<b>1,356</b>	
<b>% of Total</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>55%</b>	<b>45%</b>	<b>0%</b>	<b>100%</b>	

**Table B12: Species Composition 2018**

November 2018								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	1	1	0	2	0.0%
California Roach	0	5	44	10	64	324	447	8.9%
Catfish sp.	0	0	0	0	1	0	1	0.0%
Hardhead	0	0	0	0	1	0	1	0.0%
Lamprey sp.	2	71	10	153	6	6	248	4.9%
Rainbow Trout - "Wild"	1	2	7	8	0	0	18	0.4%
Rainbow Trout - Hatchery	4	4	4	3	0	0	15	0.3%
Sacramento Pikeminnow	6	11	12	5	142	47	223	4.4%
Sacramento Sucker	324	390	387	375	174	360	2,010	40.0%
Sculpin sp.	622	651	142	172	239	143	1,969	39.2%
Three-spined Stickleback	11	10	16	32	15	10	94	1.9%
<b>Total Fish Captured</b>	<b>970</b>	<b>1,144</b>	<b>622</b>	<b>759</b>	<b>643</b>	<b>890</b>	<b>5,028</b>	
<b>% of Total</b>	<b>19%</b>	<b>23%</b>	<b>12%</b>	<b>15%</b>	<b>13%</b>	<b>18%</b>	<b>100%</b>	

**Table B13: Species Composition 2019**

<b>December 2019</b>								
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>	<b>Total</b>	<b>% of Total</b>
<b>California Roach</b>	0	NS	11	25	8	84	<b>128</b>	<b>7.2%</b>
<b>Catfish sp.</b>	3	NS	0	2	1	0	<b>6</b>	<b>0.3%</b>
<b>Lamprey sp.</b>	4	NS	5	169	2	8	<b>188</b>	<b>10.6%</b>
<b>Rainbow Trout - "Wild"</b>	1	NS	3	10	0	0	<b>14</b>	<b>0.8%</b>
<b>Rainbow Trout - Hatchery</b>	0	NS	26	8	0	0	<b>34</b>	<b>1.9%</b>
<b>Sacramento Pikeminnow</b>	23	NS	6	4	21	8	<b>62</b>	<b>3.5%</b>
<b>Sacramento Sucker</b>	44	NS	176	155	54	158	<b>587</b>	<b>33.1%</b>
<b>Sculpin sp.</b>	340	NS	68	169	70	68	<b>715</b>	<b>40.3%</b>
<b>Three-spined Stickleback</b>	8	NS	13	9	5	5	<b>40</b>	<b>2.3%</b>
<b>Total Fish Captured</b>	<b>423</b>	<b>0</b>	<b>308</b>	<b>551</b>	<b>161</b>	<b>331</b>	<b>1,774</b>	
<b>% of Total</b>	<b>24%</b>	<b>0%</b>	<b>17%</b>	<b>31%</b>	<b>9%</b>	<b>19%</b>	<b>100%</b>	