

Lower Kings River Annual Trout and Non-Game Fish Population  
Survey:  
2013 Electrofishing Results

Kings River Conservation District  
Environmental Resource Division

In-House Report  
2014

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 downstream of Pine Flat Dam from 1983 to the present. The population monitoring is performed as part of a Federal Energy Regulatory Commission (FERC) requirement for compliance with Item 4 of the Memorandum of Agreement for FERC Project No. 2741.

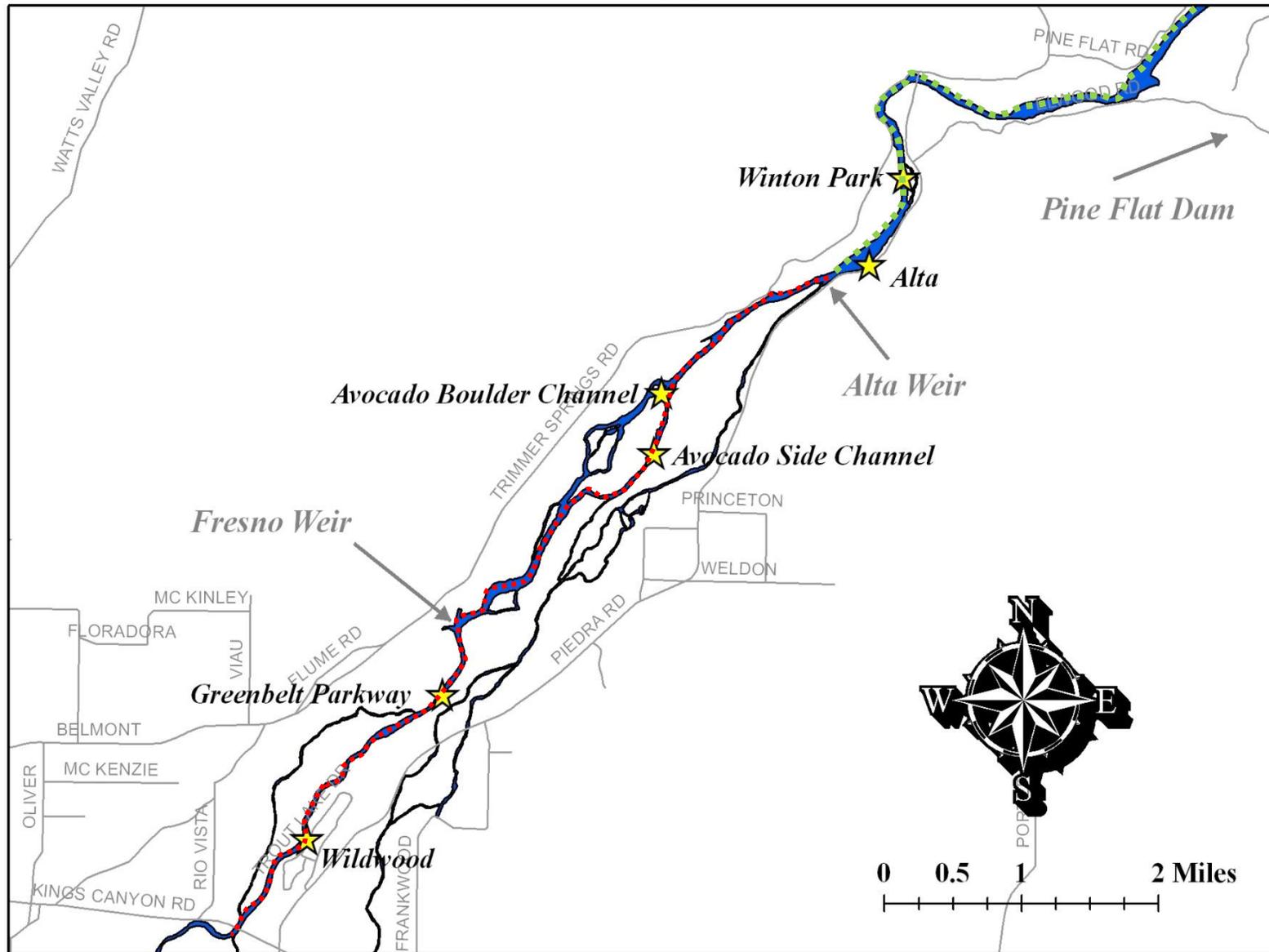
A multiple pass mark and recapture electrofishing survey was employed from 1983 through 1989. In 1990, the annual electrofishing survey was modified to a single pass count of captured trout using only a single block seine net at the upstream end of the sample reach. The decision to change to a single pass survey was made due to an absence of trout detected in the late 1980's as a result of extreme drought conditions and low flow 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 abundance and do not accurately reflect absolute population, density or abundance. Extrapolating density estimates from the single pass data produces, at best, an uncertain estimate that does not stand up to rigorous statistical analysis. In the fall of 2007 the Fisheries Management Program's (FMP) Technical Steering Committee (KRCD, CDFW and the KRWA) revised the electrofishing survey protocol using a multiple (3) pass depletion technique with upstream and downstream block seines, which resulted in more confidence and reliable quantitative estimates of fish biomass density and abundance, age, length and condition metrics for fish inhabiting the Kings River below Pine Flat Dam.

## **Methods**

Six survey sites (Figure 1) were sampled between November 12th and 19th 2013 using standard multiple-pass depletion electrofishing techniques (Reynolds 1996). Survey sites were 300 feet in length and both the upstream and downstream ends were netted with ¼-inch mesh block seines to avoid fish immigration or emigration from the survey reach. Smith-Root LR-24 backpack electrofishers were utilized in the surveys.

Prior to the 2012 population survey, a series of tests were run using the LR-24 backpack electrofisher in the Kings River. These tests specifically targeted fish response in the presence of an electrical field. It was quickly determined that the previous settings (350volts, 10% Duty

# KRCD Electrofishing Sites - Kings River Below Pine Flat Dam



Z:\DATA\Project Specific Data\Fisheries Management\Electrofishing Sites\mxd's\2009 E-fishing map.mxd

**Figure 1: Electrofishing Survey Site Map.** Green areas indicate the Put and Take management area and red areas indicate the Catch and Release management area.

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

A voltage goal is the voltage required to overcome the mismatch between water conductivity and fish conductivity. Data collected from the LR-24 backpack electroshocker’s internal volt meter was used to generate a peak voltage goal chart (Table 1) based on water conductivity observed in the Kings River below Pine Flat Dam. This chart was used to guide shocker voltage settings during the fall population survey. It was also determined during the testing period that a Duty Cycle of 20% and a Frequency of 30Hz resulted in a high capture rate and quick recovery when compared to previous settings.

Electrofishing was conducted using five to eight fishing crews and one work-up crew when possible. Volunteers from KRCD, KRWA, CA Fish and Wildlife, the Department of Water Resources, local Irrigation Districts, Fresno State University, Reedley College, Kaweah Fly Fishers, Fresno Fly Fishers and the general public were vital to our endeavor. Fishing crews consisted of a backpack electrofisher operator and a netter. Work-up crews consisted of one data recorder and one to two biologists. In the field each fish captured was identified to the lowest practical taxon, weighed to the nearest tenth of a gram, and measured total length (1mm), with the exception of rainbow trout, which were photographed and measured to fork length. Scale samples were taken from each rainbow trout just behind the dorsal fin for aging in

**Table 1: Voltage Goals (Kolz and Reynolds 1989)**

<b>Peak Voltage Goal</b>	
<b>Conductivity</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

the lab. Rainbow trout exhibiting obvious signs of hatchery origin (i.e. worn or abraded fins, clipped adipose fins) were treated as a separate species than those considered to be stream reared and therefore classified *wild*. 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 the MicroFish 3.0 program (Van Deventer 2007). Microfish generated the Total Catch and Population Estimate (Maximum Likelihood) tables used for data analysis. Biomass, density and population estimates were also calculated using the MicroFish software.

### **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 & Garvey 2007). This index is mathematically defined as:

$$C/f = N$$

where C is the number of each species caught, 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 in time (seconds). 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 sampled.

### **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.

## Condition Factor

Condition Factor (K-factor) is a qualitative assessment of an individual salmonid's body fitness and condition. The score is based upon a mathematical formula (Fulton, 1902) which utilizes length and weight 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; Tasaduq, H. 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 (Tasaduq, H. Shah et al. 2011). Condition factors were calculated for wild rainbow trout collected from the 2013 survey and a one-sample t-test was used to test the sample mean for statistically significant differences among survey reaches.

## Results

A total of 6,328 fishes were collected during the fall 2013 population survey. Of those, 6,017 were entered into the Microfish software program for analysis. We were unable to obtain length/weight data for the remaining 311 fishes. The numbers reflected in this report will be those produced by the Microfish software with the exception of Catch-Per-Unit-of-Effort (CPUE). Actual numbers can be found in Appendix A (Table A).

Species collected included; Sacramento pikeminnow *Ptycheilus grandis*, sculpin *Cottus sp.*, California roach *Hesperoluecus symmetricus*, Sacramento sucker *Catostomus occidentalis*, three-spined stickleback *Gasterosteus aculeatus*, lamprey *Lampetra spp*, rainbow trout (both wild and hatchery reared) *Oncorhynchus mykiss*, smallmouth bass *Micropterus dolomieu*, white catfish *Ameiurus catus* and mosquito fish *Gambusia affinis*. The total catch is displayed by species and site in Table 2. These data represent the total number of each species caught at each survey site. Percent composition is summarized by species in Table 3. Population estimates are summarized in Table 4 and 95% confidence intervals for the population estimates by survey site are summarized in Appendix A (Table A).

**Table 2: Total catch by species**

<b>Total Catch by Species November 2013</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>Smallmouth Bass</b>	0	0	0	0	5	0	5
<b>California Roach</b>	0	52	179	248	220	444	1143
<b>Hatchery Trout</b>	2	1	1	1	0	0	5
<b>Lamprey sp.</b>	3	35	7	102	3	0	150
<b>Mosquito fish</b>	0	1	0	0	0	0	1
<b>Sacramento Pikeminnow</b>	170	99	333	130	375	759	1866
<b>Rainbow Trout</b>	3	0	4	4	0	0	11
<b>Sacramento Sucker</b>	356	257	256	73	51	162	1155
<b>Sculpin sp.</b>	493	188	290	189	176	130	1466
<b>Three-spined Stickleback</b>	15	65	6	10	15	101	212
<b>White Catfish</b>	0	0	0	0	3	0	3
<b>Site Total</b>	1042	698	1076	757	848	1596	6017

**Table 3: Total catch % by species**

<b>Total Catch (% by species) November 2013</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>Smallmouth Bass</b>	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
<b>California Roach</b>	0.0%	4.5%	15.7%	21.8%	19.2%	38.8%	100.0%
<b>Hatchery Trout</b>	40.0%	20.0%	20.0%	20.0%	0.0%	0.0%	100.0%
<b>Lamprey sp.</b>	2.0%	23.3%	4.7%	68.0%	2.0%	0.0%	100.0%
<b>Mosquito fish</b>	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
<b>Sacramento Pikeminnow</b>	9.1%	5.3%	17.8%	7.0%	20.1%	40.7%	100.0%
<b>Rainbow Trout</b>	27.2%	0.0%	36.4%	36.4%	0.0%	0.0%	100.0%
<b>Sacramento Sucker</b>	30.8%	22.3%	22.2%	6.3%	4.4%	14.0%	100.0%
<b>Sculpin sp.</b>	33.6%	12.8%	19.8%	12.9%	12.0%	8.9%	100.0%
<b>Three-spined Stickleback</b>	7.1%	30.4%	2.8%	4.7%	7.1%	47.9%	100.0%
<b>White Catfish</b>	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%

**Table 4: Population estimate by maximum likelihood**

<b>Population Estimate (maximum likelihood) November 2013</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Smallmouth Bass</b>	0	0	0	0	5	0
<b>California Roach</b>	0	54	192	263	297	480
<b>Hatchery Trout</b>	2	1	1	1	0	0
<b>Lamprey sp.</b>	3	35	7	105	5	0
<b>Mosquito fish</b>	0	1	0	0	0	0
<b>Sacramento Pikeminnow</b>	194	172	353	183	1255	908
<b>Rainbow Trout</b>	3	0	4	4	0	0
<b>Sacramento Sucker</b>	394	268	282	88	69	202
<b>Sculpin sp.</b>	521	191	305	218	195	152
<b>Three-spined Stickleback</b>	15	64	6	10	28	150
<b>White Catfish</b>	0	0	0	0	3	0

### Site 1 – Winton Park

Multiple-pass depletion sampling yielded 1,042 fishes representing seven species. Sculpin accounted for 47.3% of the catch while Sacramento sucker accounted for 34.2%. Other species collected included Sacramento pikeminnow, three-spine stickleback, lamprey, hatchery trout and wild rainbow trout. Sculpin (3,703.7g), Sacramento sucker (3,619.8g), and hatchery rainbow trout (387.7g), represented the majority of the biomass collected.

The estimated population density for this site is 3,363 fish\*ha<sup>-1</sup>. By species, this represents one thousand five hundred forty-eight sculpin, one thousand one hundred seventy-one Sacramento sucker, five hundred seventy-six Sacramento pikeminnow, forty-four three-spined stickleback, nine lamprey, nine wild rainbow trout and six hatchery rainbow trout.

### Site 2 – Alta

Multiple-pass depletion sampling yielded 698 fishes representing eight species. Sacramento sucker accounted for 36.9%, sculpin accounted for 27% and Sacramento pikeminnow accounted for 14.2% of the catch. Other species collected included three-spined stickleback, California roach, lamprey, mosquito fish and hatchery rainbow trout. Sacramento sucker (1125.1g) and sculpin. (741.1g) represented the majority of the biomass collected.

The estimated population density for this site is 4,086 fish\*ha<sup>-1</sup>. By species, this represents one thousand three hundred ninety-three Sacramento sucker, nine hundred ninety-three sculpin, eight hundred ninety-four Sacramento pikeminnow, three hundred thirty-three three-spined stickleback, two hundred eighty-one California roach, one hundred eighty-two lamprey, five hatchery rainbow trout and five mosquito fish.

### Site 3 – Avocado Boulder Project

Multiple-pass depletion sampling yielded 1,076 fishes representing eight species. Sacramento pikeminnow accounted for 30.9% of the catch, sculpin accounted for 27% and Sacramento sucker accounted for 23.8%. Other species collected included California roach, lamprey, three-spined stickleback, wild rainbow trout and hatchery rainbow trout. Sacramento sucker (29,074.8g), Sacramento pikeminnow (3,557.8g), and sculpin (2,071.0g) represented the majority of the biomass collected.

The estimated population density for this site is 7,640 fish\*ha<sup>-1</sup>. By species, this represents two thousand three hundred forty-five Sacramento pikeminnow, two thousand twenty-six sculpin, one thousand eight hundred seventy-three Sacramento sucker, one thousand two hundred seventy-six California roach, forty-six lamprey, forty three-spined stickleback, twenty-seven wild rainbow trout, and seven hatchery rainbow trout.

#### Site 4 – Avocado Side Channel

Multiple-pass depletion sampling yielded 757 fishes representing eight species. California roach accounted for 32.8%, sculpin accounted for 25.0%, and Sacramento pikeminnow accounted for 17.2%. Other species collected included lamprey, Sacramento sucker, three-spined stickleback, wild rainbow trout, and hatchery trout. Sacramento sucker (8,546.7g), sculpin spp. (883.80g), and California roach (802.30g) represented the majority of the biomass collected.

The estimated population density for this site is 5,019 fish\*ha<sup>-1</sup>. By species, this represents one thousand five hundred thirteen California roach, one thousand two hundred fifty-five sculpin, one thousand fifty-three Sacramento pikeminnow, six hundred four lamprey, five hundred seven Sacramento sucker, fifty-eight three-spined stickleback, twenty-three rainbow trout and six hatchery rainbow trout.

#### Site 5 – Greenbelt Parkway

Multiple-pass depletion sampling yielded 848 fishes representing eight species. Sacramento pikeminnow accounted for 44.2%, California roach 25.9% and sculpin represented 20.8%. Sacramento sucker, three-spined stickleback, lamprey, smallmouth bass, and white catfish accounted for the rest of the catch. Sculpin (981.0g), California roach (913.0g), Sacramento pikeminnow (896.3g), and Sacramento sucker (804.7g) represented the majority of the biomass collected.

The estimated population density for this site is 7,015 fish\*ha<sup>-1</sup>. By species, this represents four thousand seven hundred forty-one Sacramento pikeminnow, one thousand one hundred twenty-two California roach, seven hundred thirty-six sculpin, two hundred sixty-one Sacramento sucker, one hundred six three-spined stickleback, nineteen smallmouth bass, nineteen lamprey, and eleven white catfish.

## Site 6 – Wildwood

Multiple-pass depletion sampling yielded 1,596 fishes representing five species. Sacramento pikeminnow accounted for 47.6% of the catch while California roach accounted for 27.8% and Sacramento sucker 10.2%. Other species collected included sculpin and three-spined stickleback. Sacramento sucker (2,821.1g), Sacramento pikeminnow (2,525.0g) and California roach (1304.3g) represented the majority of the biomass collected.

The estimated population density for this site is 6,871 fish\*ha<sup>-1</sup>. By species, this represents three thousand two hundred ninety-seven Sacramento pikeminnow, one thousand seven hundred forty-three California roach, seven hundred thirty-four Sacramento sucker, five hundred forty-five three-spined stickleback and five hundred fifty-two sculpin.

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

The Catch per Unit of Effort for each species is summarized by site in Table 5. The Avocado Side Channel was the most productive in terms of wild rainbow trout, generating 0.63 trout per hour. A comparison of CPUE values from 2007 to 2013 is summarized in Appendix B.

**Table 5: Catch per unit of effort**

<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>Smallmouth 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>Hatchery Trout</b>	0.29	0.16	0.15	0.16	0.00	0.00
<b>Lamprey sp.</b>	0.43	6.30	1.02	15.94	0.37	0.00
<b>Mosquito fish</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>Rainbow Trout</b>	0.43	0.00	0.58	0.63	0.00	0.00
<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

### **Wild Trout Density**

The number of wild trout per mile is extrapolated from the annual population estimate. This estimate is an index of trout density and is used to monitor changes in wild trout density from year to year. The wild trout per mile estimate is based on population data collected from the

six survey sites throughout the cold water fishery from Pine Flat Dam to the Highway 180 Bridge. The six sites total 1,800 feet or 2.8% of the total cold water fishery length. Six hundred feet of river length is surveyed in both the Put and Take and Catch and Release sections of river above Fresno Weir. In addition six hundred feet of the Catch & Release section downstream of Fresno Weir are also surveyed representing 2.3%, 2.9% and 3.3% of the section length respectively.

Eleven wild trout were collected during the 2013 electrofishing survey. The estimated wild trout density is approximately thirty-two (32.27) trout per mile between Pine Flat Dam and the Highway 180 Bridge (Table 6). Historical wild trout density estimates dating back to 1983 are summarized in Figure 2.

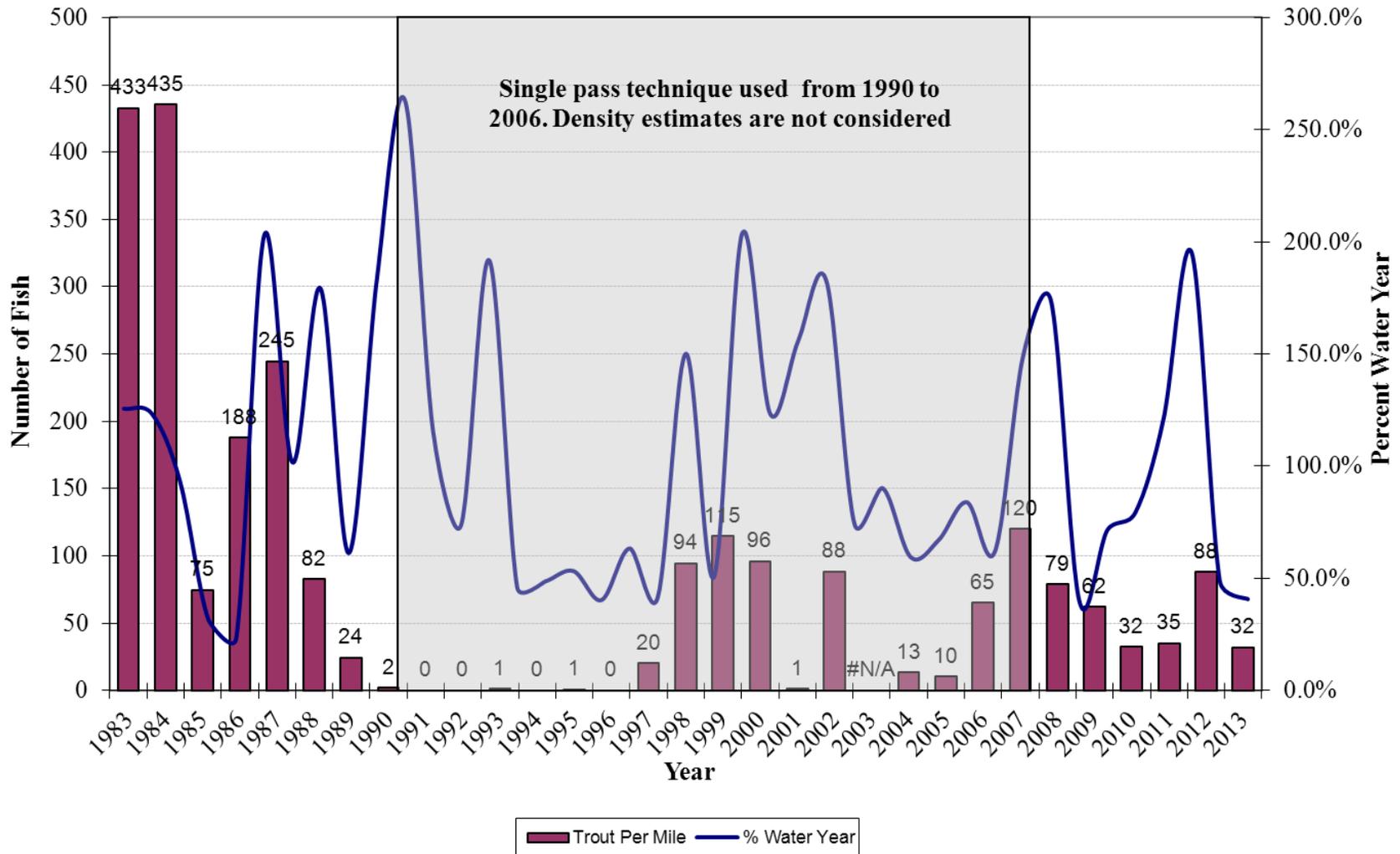
**Table 6: The estimated number of “wild” trout per mile based on data collected November 2013**

<b>Wild Trout Per-Mile November 2013</b>			
<b>Site Name</b>	<b>Number of Wild Trout</b>	<b>Site Length (ft.)</b>	<b>Wild Trout Per mile</b>
Winton	3	300	53
Alta	0	300	0
Avo Boulder	4	300	70
Avo Side	4	300	70
Greenbelt	0	300	0
Wildwood	0	300	0
<b>Total:</b>	<b>(11 / 1800ft.) • 5,280 ft. per mile = 32 wild trout</b>		

## **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 (Chipps & Garvey 2007). In 2013, the total biomass collected was 69,369.60g (152.93lbs). Sacramento sucker accounted for 66.3% (45,992.2g; 101.4lbs), sculpin accounted for 13.4% (9274.2g; 20.45lbs) and Sacramento pikeminnow, California roach, hatchery trout, wild rainbow trout, lamprey, three-spined stickleback, small mouth bass, white catfish and mosquito fish accounted for the other 19.4%. Wild trout biomass totaled 631.90g (1.39lbs), contributing only 0.9% to the 2013 catch. Biomass results for the 2013 survey are summarized by site in Table 7.

**Estimated "Wild" Trout Per Mile  
1983 - 2013**



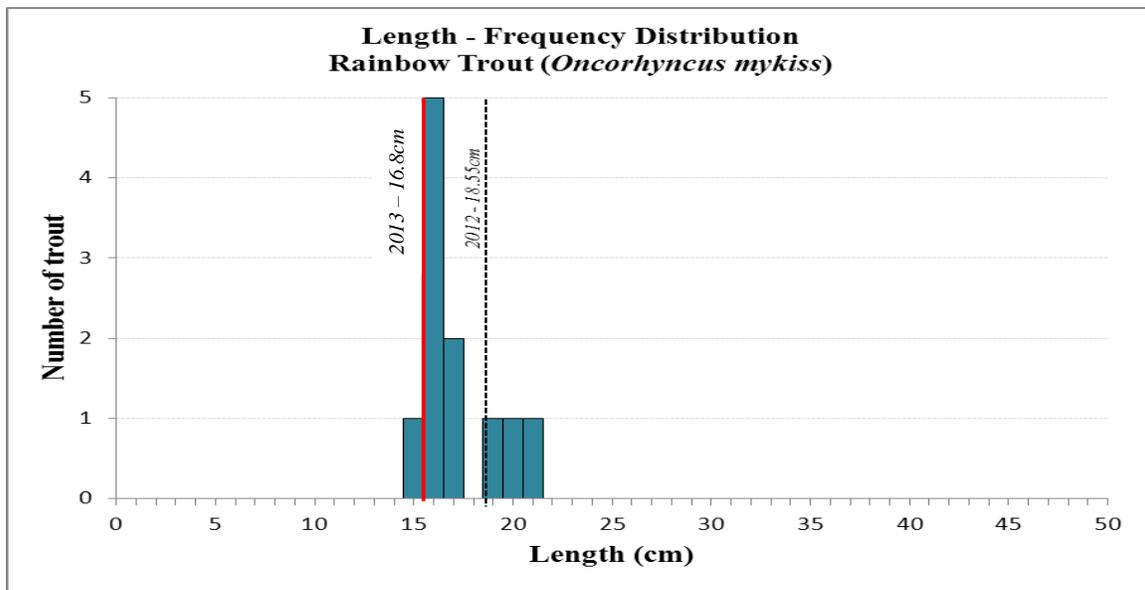
**Figure 2: Estimated number of “wild” trout per mile in the Kings River between Pine Flat Dam and the Highway 180 bridge, Fresno County. Density is extrapolated from the number of wild trout collected from six sample sites located within the reach of the Kings River between Pine Flat Dam and the Highway 180 Bridge. (Kings River Conservation District, 2012).**

**Table 7: Biomass summary, in pounds, by Site and Species.**

Total Weight (lbs) November 2013							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Smallmouth Bass	0.00	0.00	0.00	0.00	0.25	0.00	0.25
California Roach	0.00	0.20	1.46	1.77	2.01	2.88	8.33
Hatchery Trout	0.85	0.64	0.14	0.15	0.00	0.00	1.79
Lamprey sp.	0.03	0.26	0.06	0.90	0.02	0.00	1.28
Mosquito fish	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sacramento Pikeminnow	0.55	0.84	7.84	0.96	1.98	5.57	17.74
Rainbow Trout	0.42	0.00	0.53	0.45	0.00	0.00	1.39
Sacramento Sucker	7.98	2.48	64.10	18.84	1.77	6.22	101.40
Sculpin sp.	8.17	1.63	4.57	1.95	2.16	1.97	20.45
Three-spined Stickleback	0.02	0.08	0.01	0.01	0.02	0.16	0.30
White Catfish	0.00	0.00	0.00	0.00	0.01	0.00	0.01
<b>Site Total</b>	<b>18.02</b>	<b>6.14</b>	<b>78.71</b>	<b>25.03</b>	<b>8.24</b>	<b>16.79</b>	<b>152.93</b>
<b>Biomass %</b>	<b>11.8%</b>	<b>4.0%</b>	<b>51.5%</b>	<b>16.4%</b>	<b>5.4%</b>	<b>11.0%</b>	<b>100.0%</b>

### Length

The mean fork length for wild rainbow trout collected during the 2013 survey was 16.8cm (approx. 6.6 inches). The length-frequency distribution is illustrated below in Figure 3. Mean fork length for wild rainbow trout collected during the 2012 survey was 18.4cm (approx. 7.25 inches). A significant (ANOVA,  $p = 0.00$ ) decrease of 1.6cm subsequent to the 2012 survey was observed. A comparison of mean fork length from 2007 – 2013 can be found in Figure 4.



**Figure 3: Length-frequency distribution of rainbow trout collected from the Kings River during the 2013 population survey, Fresno County. Average fork length of "wild" trout was approximately 6.6 inches (16.8cm). (Kings River Conservation District, 2012).**

## Age

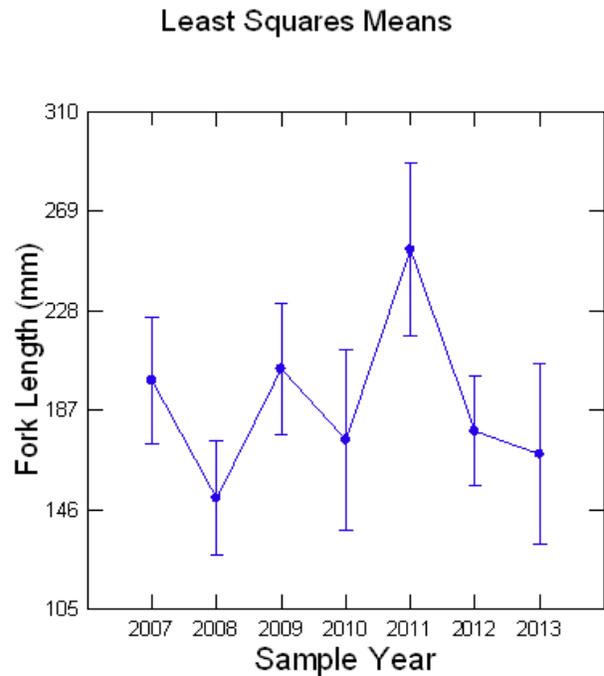
Scale samples from the 11 wild rainbow trout collected in the field were analyzed in the lab. Counts of annuli and circuli were used to produce approximate ages. The mean age of wild trout captured in 2013 was 2 years. Only one trout was estimated to be in the 1+ age range and zero trout qualified as being 3 years of age or older. In the past six years no wild rainbow trout < 1yr. of age have been collected and only one trout > 4yrs. of age was collected (Figure 5). Scale samples were not taken from hatchery trout in 2013.

## Condition Factor (K)

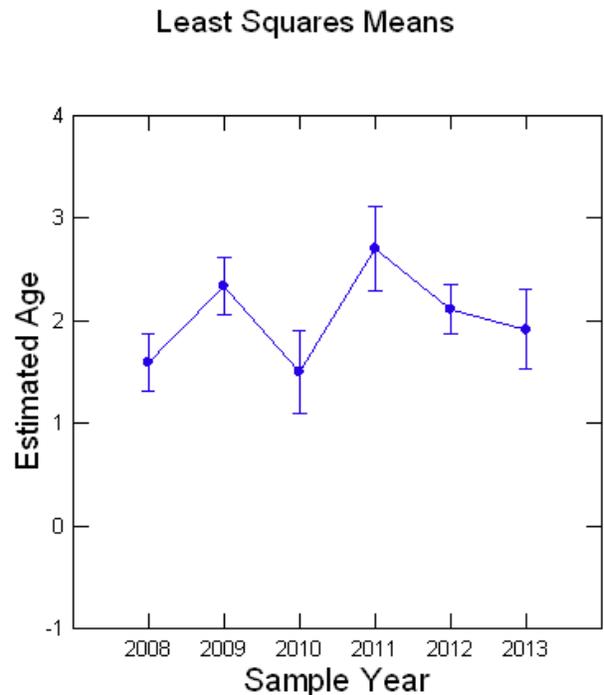
The condition factor of wild trout ranged from 1.1 (good) to 1.31 (excellent) with a sample mean of 1.16 (very good). Results were significantly higher (one-sample t-test;  $P = 0.000$ ) than the 1.00 rating for rainbow trout. Of eleven wild trout analyzed, all had fairly homogenous condition factor scores and little variation in age (Figure 6). Although fewer wild trout were caught in 2013, the mean condition factor increased by 18.4%.

## Conclusion

This year marked the sixth year of multiple pass depletion sampling since the FMP returned to triple-pass depletion in 2007.



**Figure 4: Mean length of wild trout collected from the Kings River from Pine Flat Dam to the 180 Bridge; 2007 to 2013**



**Figure 5: Mean age of wild trout collected from the Kings River from Pine Flat Dam to the 180 Bridge; 2007 to 2013**

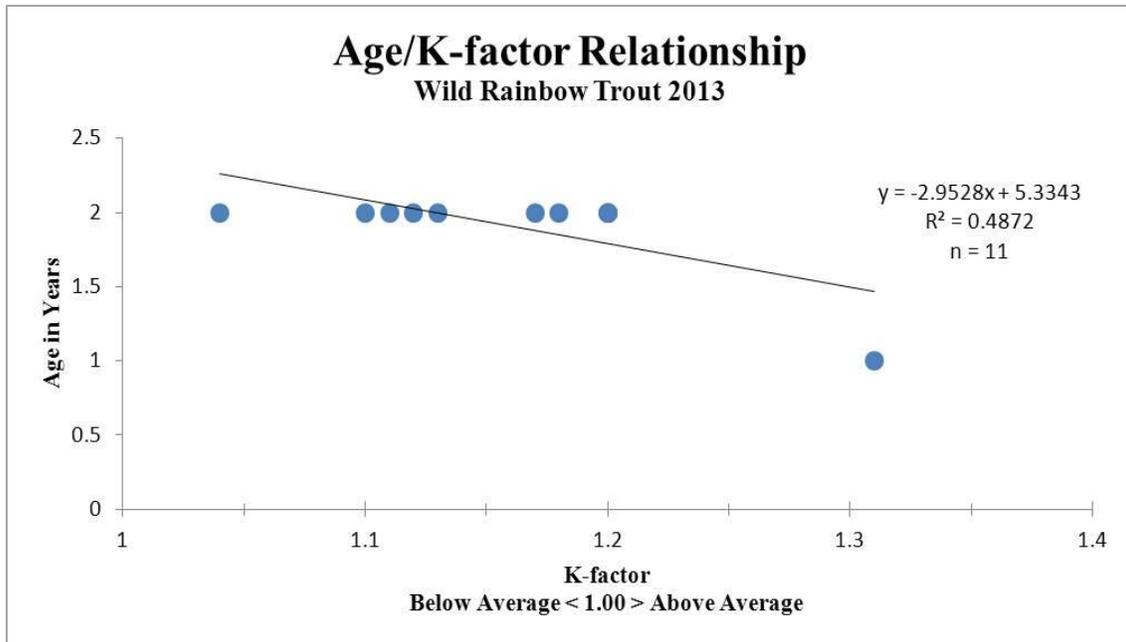
In addition, this year marked the second year that the FMP utilized deliberate voltage adjustment by site for the LR-24 units in concurrence with water conductivity. It is not certain how this may have influenced 2012 – 2013 catch numbers. 2013 catch numbers may have also been influenced at the Avocado Boulder Channel by poor net placement at the downstream end of the survey reach. Approximately one meter of netting collapsed into the river near the right bank and was not caught until after the first pass. The net was pulled up and retied before the second pass began; however there is no way of knowing how many fishes may have passed through the breach in the perimeter.

A total of 6,328 fishes were collected during the 2013 survey. Minor decreases from the 2012 survey were documented in the abundance of lamprey, wild rainbow trout and Sacramento sucker. A slight increase in abundance was observed in hatchery rainbow trout and sculpin. Most notably Sacramento pikeminnow increased by 336%, California roach increased by 171% and three-spined stickleback increased 136% over the previous year. Standing stock was dominated by Sacramento pikeminnow and sculpin. Sacramento pikeminnow accounted for 29.5% of the total catch and sculpin accounted for 23.2%. Wild rainbow trout accounted for less than 1 % (0.2%) of the total catch.

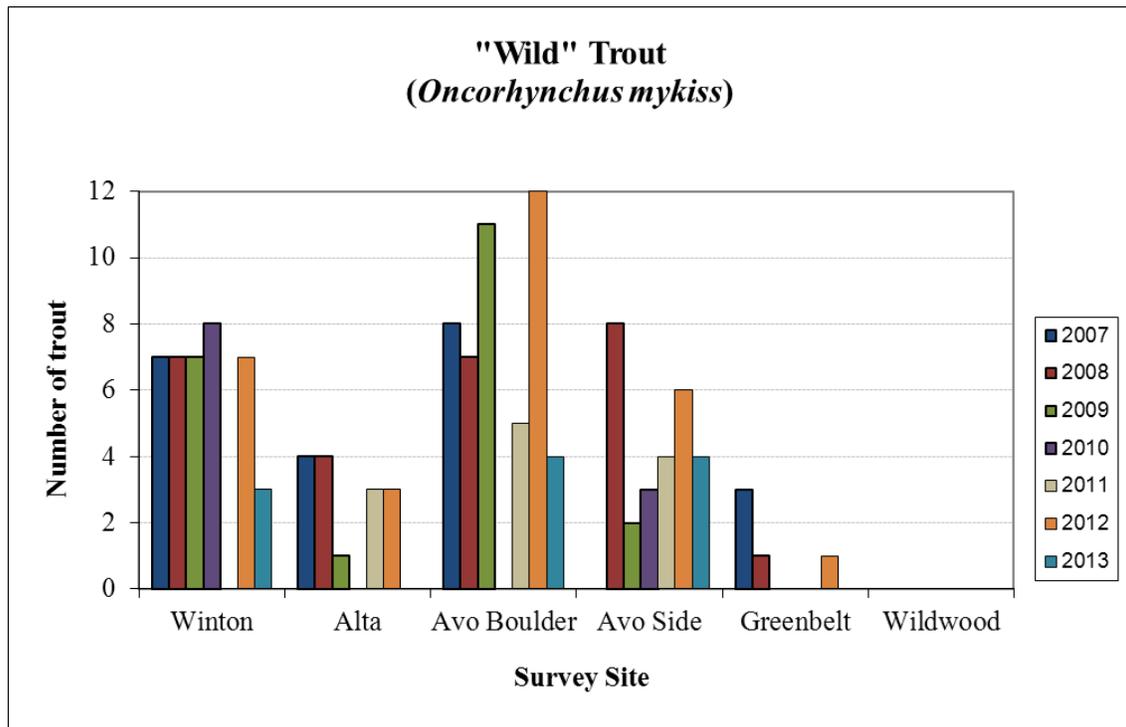
The total number of hatchery trout collected in 2013 increased by 60% (from 3 in 2012 to 5 in 2013), however total abundance of trout decreased by 48.5%. The total number of wild trout collected during the survey (11) was down from the thirty-three wild trout collected in 2012 (Kings River Conservation District, 2012). This translated to approximately thirty-two trout per mile. Variation in catch numbers amongst sites from 2007 to 2013 are illustrated in Figure 8.

Though the number of wild trout and overall mean fork-length decreased, the condition factor increased denoting that the trout in the river were healthy. The mean age of wild trout was two years. Surprisingly, zero trout under one year of age have been collected in the past six years of surveys.

The Kings River Fisheries Management Program continues comprehensive monitoring and investigation within the tailwater fishery; pursuing a deeper understanding of those factors which drive population dynamics and variations in species richness within the river.



**Figure 6:** Relationship between age and condition factor in wild rainbow trout collected during the 2013 survey.



**Figure 7:** Analysis of within site variation of "wild" trout collected from 2007 to 2013. (Kings River Conservation District, 2012).

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## **Appendix A**

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

<b>95% Confidence Interval (Adjust to lower CI) November 2013</b>						
	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>Smallmouth Bass</b>	0 - 0	0 - 0	0 - 0	0 - 0	5 - 6	0 - 0
<b>California Roach</b>	0 - 0	52 - 58	180 - 204	251 - 275	240 - 354	460 - 500
<b>Hatchery Trout</b>	2 - 2	1 - 1	1 - 1	1 - 1	0 - 0	0 - 0
<b>Lamprey sp.</b>	3 - 4	35 - 35	7 - 8	102 - 110	3 - 32	0 - 0
<b>Mosquito fish</b>	0 - 0	1 - 1	0 - 0	0 - 0	0 - 0	0 - 0
<b>Sacramento Pikeminnow</b>	174 - 214	99 - 270	339 - 367	130 - 236	375 - 2360	851 - 965
<b>Rainbow Trout</b>	3 - 6	0 - 0	4 - 6	4 - 6	0 - 0	0 - 0
<b>Sacramento Sucker</b>	371 - 417	258 - 278	263 - 301	73 - 107	51 - 98	168 - 236
<b>Sculpin sp.</b>	505 - 537	188 - 195	293 - 317	195 - 241	179 - 211	131 - 173
<b>Three-spined Stickleback</b>	15 - 16	64 - 64	6 - 6	10 - 11	15 - 79	101 - 208
<b>White Catfish</b>	0 - 0	0 - 0	0 - 0	0 - 0	3 - 8	0 - 0

## **Appendix B**

**Table B – H: Catch per Unit of Effort by species; 2007 – 2013. 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.**

**Table B: CPUE 2007**

CPUE (fish/hr) 2007						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
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
Hatchery Trout	1.2	2.3	0.3	0.7	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
Rainbow Trout	0.9	0.4	1.1	0.0	0.3	0.0
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 C: CPUE 2008**

CPUE (fish/hr) 2008						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	0.0	1.2	12.8	2.8	29.5	40.8
Hatchery Trout	0.0	0.0	0.2	0.0	0.0	0.0
Lamprey sp.	0.3	9.4	0.8	13.2	0.3	0.0
Mosquito fish	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
Rainbow Trout	1.1	0.8	1.1	1.4	0.1	0.0
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 D: CPUE 2009**

CPUE (fish/hr) 2009						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
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
Hatchery Trout	0.1	0.1	0.0	0.0	0.0	0.0
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
Rainbow Trout	0.9	0.1	1.3	0.3	0.0	0.0
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 E: 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>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>Hatchery Trout</b>	0.0	0.2	0.3	0.0	0.0	0.0
<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>Rainbow Trout</b>	1.1	0.0	0.0	0.7	0.0	0.0
<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 F: 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>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>Hatchery Trout</b>	0.0	0.0	0.7	0.2	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>Rainbow Trout</b>	0.0	0.6	0.6	0.7	0.0	0.0
<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 G: 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>California Roach</b>	0.0	3.4	9.3	4.0	15.2	19.9
<b>Hatchery Trout</b>	0.0	0.0	0.0	1.2	0.0	0.0
<b>Lamprey sp.</b>	0.0	9.5	2.7	10.2	0.5	0.0
<b>Mosquito fish</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>Rainbow Trout</b>	0.9	0.3	1.4	0.8	0.1	0.0
<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 H: 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>Smallmouth Bass</b>	0.0	0.0	0.0	0.0	0.6	0.0
<b>California Roach</b>	0.0	9.9	28.6	39.2	27.1	57.5
<b>Hatchery Trout</b>	0.3	0.2	0.1	0.2	0.0	0.0
<b>Lamprey sp.</b>	0.4	6.3	1.0	15.9	0.4	0.0
<b>Mosquito fish</b>	0.0	0.2	0.0	0.0	0.0	0.0
<b>Sacramento Pikeminnow</b>	24.4	22.5	50.7	20.6	46.2	98.3
<b>Rainbow Trout</b>	0.4	0.0	0.6	0.6	0.0	0.0
<b>Sacramento Sucker</b>	51.1	53.1	40.9	11.9	6.3	21.0
<b>Sculpin sp.</b>	70.8	37.6	49.3	29.4	21.7	16.8
<b>Three-spined Stickleback</b>	2.2	11.2	1.2	1.6	1.8	13.1
<b>White Catfish</b>	0.0	0.0	0.0	0.0	0.4	0.0