Lower Kings River Annual Trout and Non-Game Fish Population Survey:
2015 Electrofishing Results

Kings River Conservation District
Environmental Resource Division

In-House Report
2016

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. Population surveys have been conducted 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 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 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 relative abundance and do not reflect absolute population density. 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, abundance, age, length and condition metrics for fish inhabiting the lower Kings River downstream of Pine Flat Dam.

This year's population survey followed the lowest water year on record (22% of average). The low water year was preceded by a 32% water year in 2014, which was also the warmest year in over a century. Although the Kings River watershed experienced less precipitation in 2015 than it did in 2014, summer temperatures remained slightly cooler. Despite low precipitation, the slightly cooler temperatures allowed for improved temperature management in the tailwater fishery than in the previous year.

Methods

In 2015 six survey sites (Figure 1) were sampled between November 3rd 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 were netted with ¼-inch mesh block seines to avoid fish immigration or emigration from the survey reach. Five to seven Smith-Root LR-24 and two Smith-Root LR-20B 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 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 ($\mu W/cm^3$) can be achieved (Kolz and Reynolds 1989) to increase power transfer to the fish in order to illicit the desired response.

Table 1: Voltage Goals (Kolz and Reynolds 1989)

Peak Voltage Goal	
Conductivity	**V goal**
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

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 lower Kings River downstream of Pine Flat Dam. This chart was used to guide shocker voltage settings at each site during the fall 2015 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.

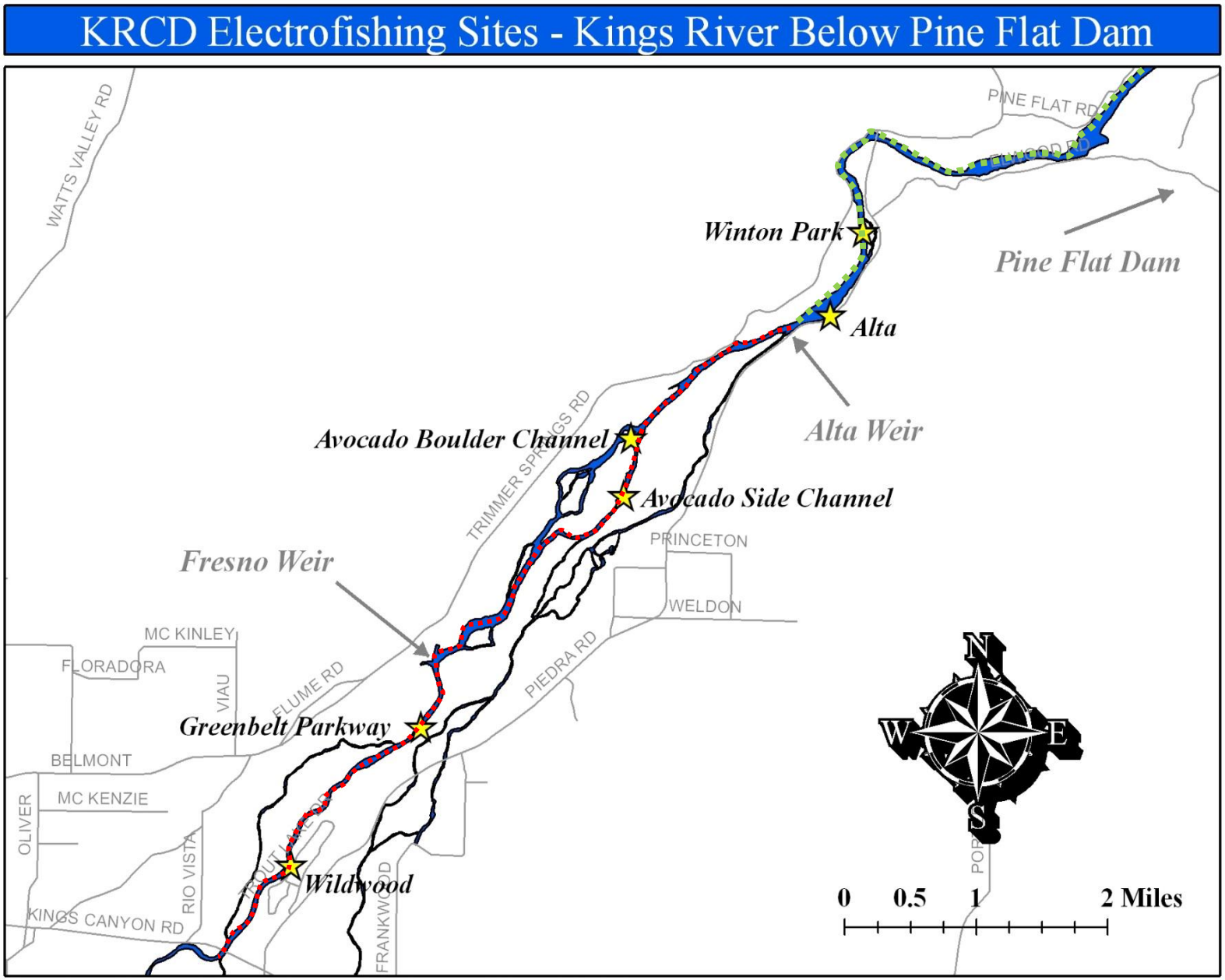

Figure 1: Electrofishing Survey Site Map. Green areas indicate the Put and Take management area and red areas indicate the Catch and Release management area.

Electrofishing was conducted using a crew of five to seven fishing and one to two for sample processing. Volunteers and staff from KRCD, KRWA, CDFW, the Regional Water Board, local irrigation districts, Fresno State University, Reedley College, Kaweah Fly Fishers, Fresno Fly Fishers and the general public participated in the surveys.

Fishing crews each 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 was identified to the lowest practical taxon, weighed to the nearest tenth of a gram, and total length measured to the nearest 1mm, with the exception of rainbow trout which were measured to fork length and photographed. Scale samples were taken from each rainbow trout just behind the dorsal fin for aging. Rainbow trout exhibiting obvious signs of hatchery origin (i.e. worn or abraded fins, clipped adipose fins) were treated as a separate species; trout considered to be stream reared were classified as *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 and 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-1) 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 an index of an individual salmonid's body fitness and condition. The score is based upon a mathematical formula (Fulton1902) 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; Tasaduq 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 et al. 2011). Condition factors were calculated for wild rainbow trout collected from the 2015 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 4,362 fishes were collected during the fall 2015 population survey. Of those, 4,286 were entered into the MicroFish software program for analysis. We were unable to obtain length/weight data for the remaining 76 fishes. The numbers reflected in this report will be those produced by the MicroFish software with the exception of CPUE. Species collected included; California roach *Hesperoluecus symettricus*, Sacramento sucker *Catostomus occidentalis*, Sacramento pikeminnow *Ptycheilus grandis*, sculpin *Cottus sp.,* lamprey *Lampetra spp*, three-spined stickleback *Gasterosteus aculeatus,* bass *Micropterus punctulatus,* mosquitofish *Gambusia affinis,* white catfish *Ameriurus catus,* wild rainbow trout and a hatchery reared rainbow trout *Oncorhynchus mykiss*. Although more than one species of catfish, lamprey, sculpin, etc. 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 taxa and site 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 A).

Table 2: Total catch by species

Total Catch by Species November 2015							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Rainbow Trout	1	0	1	0	0	0	2
Hatchery Trout	0	0	1	0	0	0	1
Bass	0	1	0	1	55	4	61
California Roach	33	183	292	211	73	720	1512
Catfish	0	0	0	0	2	0	2
Lamprey	2	107	25	54	0	1	189
Mosquitofish	2	23	0	0	13	19	57
Sacramento Pikeminnow	126	50	200	158	108	158	800
Sacramento Sucker	422	371	289	200	24	23	1329
Sculpin	160	7	27	4	7	6	211
Three-spined Stickleback	48	31	14	20	0	9	122
Site Total	**793**	**773**	**847**	**648**	**282**	**940**	**4283**

Table 3: Population estimate by maximum likelyhood

Population Estimate (maximum likelihood) November 2015						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Rainbow Trout	1	0	1	0	0	0
Hatchery Trout	0	0	1	0	0	0
Bass	0	1	0	1	56	4
California Roach	34	189	350	253	113	1060
Catfish	0	0	0	0	2	0
Lamprey	2	160	38	54	0	1
Mosquitofish	2	23	0	0	20	19
Sacramento Pikeminnow	141	247	501	185	175	161
Sacramento Sucker	538	536	366	268	24	25
Sculpin	164	10	27	8	7	6
Three-spined Stickleback	75	31	21	20	0	40

Table 4: Total catch % by species

Total Catch (% by species) November 2015							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Rainbow Trout	50.0%	0.0%	50.0%	0.0%	0.0%	0.0%	100.0%
Hatchery Trout	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
Bass	0.0%	1.6%	0.0%	1.6%	90.2%	6.6%	100.0%
California Roach	2.2%	12.1%	19.3%	14.0%	4.8%	47.6%	100.0%
Catfish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Lamprey	1.1%	56.6%	13.2%	28.6%	0.0%	0.5%	100.0%
Mosquitofish	3.5%	40.4%	0.0%	0.0%	22.8%	33.3%	100.0%
Sacramento Pikeminnow	15.8%	6.3%	25.0%	19.8%	13.5%	19.8%	100.0%
Sacramento Sucker	31.8%	27.9%	21.7%	15.0%	1.8%	1.7%	100.0%
Sculpin	75.8%	3.3%	12.8%	1.9%	3.3%	2.8%	100.0%
Three-spined Stickleback	39.3%	25.4%	11.5%	16.4%	0.0%	7.4%	100.0%

Site 1 – Winton Park

Multiple-pass depletion sampling yielded 794 fishes representing eight taxa. Sacramento sucker accounted for 53.1%, sculpin accounted for 20.2%, and Sacramento pikeminnow accounted for 15.9% of the catch. Three-spine stickleback, California roach, lamprey, mosquitofish, and wild rainbow trout accounted for the rest of the catch. Sacramento sucker (3,926.1g), sculpin (1,589.1g) and wild rainbow trout (267.9g), represented the majority of the biomass collected.

The estimated population density for this site is 2,818 fish*ha^{-1}. By species, this represents one thousand five hundred eighty-four Sacramento sucker, four hundred eighty-three sculpin, four hundred fifteen Sacramento pikeminnow, two hundred twenty-one three-spine stickleback, one hundred California roach, six lamprey, six mosquitofish, and three wild rainbow trout.

Site 2 – Alta

Multiple-pass depletion sampling yielded 773 fishes representing eight taxa. Sacramento sucker accounted for 48.0%, California roach accounted for 23.7%, and lamprey accounted for 13.8% of the catch. Sacramento pikeminnow, three-spined stickleback, mosquitofish, sculpin, and bass accounted for the rest of the catch. Sacramento sucker (1621.9g), lamprey (293.7g), and California roach (188.8g) represented the majority of the biomass collected.

The estimated population density for this site is 4,018 fish*ha^{-1}. By species, this represents one thousand nine hundred twenty-nine Sacramento sucker, nine hundred fifty-one California roach, five hundred fifty-six lamprey, two hundred sixty Sacramento pikeminnow, one hundred sixty-one three-spined stickleback, one hundred twenty mosquitofish, thirty-six sculpin, and five bass.

Site 3 – Avocado Boulder Project

Multiple-pass depletion sampling yielded 849 fishes representing eight taxa. California roach accounted for 34.4%, Sacramento sucker accounted for 34.0%, and Sacramento pikeminnow accounted for 23.6% of the catch. Sculpin, lamprey, three-spined stickleback, hatchery rainbow trout, and wild rainbow trout accounted for the rest of the catch. Sacramento

sucker (30,283.9g), Sacramento pikeminnow (1,471.1g), and California roach (1,328.7g) represented the majority of the biomass collected.

The estimated population density for this site is 5,640 fish*ha^{-1}. By species, this represents one thousand nine hundred forty California roach, one thousand nine hundred twenty Sacramento sucker, one thousand three hundred twenty-nine Sacramento pikeminnow, one hundred seventy-nine sculpin, one hundred sixty-six lamprey, ninety-three three-spined stickleback, seven hatchery rainbow trout, and seven wild rainbow trout.

Site 4 – Avocado Side Channel

Multiple-pass depletion sampling yielded 648 fishes representing seven taxa. California roach accounted for 32.6%, Sacramento sucker accounted for 30.9%, and Sacramento pikeminnow accounted for 24.4% of the catch. Lamprey, three-spined stickleback, sculpin, and bass accounted for the rest of the catch. Sacramento sucker (12,878.9g), California roach (764.8g), and Sacramento pikeminnow (621.3g) represented the majority of the biomass collected.

The estimated population density for this site is 3,913 fish*ha^{-1}. By species, this represents one thousand two hundred seventy-four California roach, one thousand two hundred eight Sacramento sucker, nine hundred fifty-four Sacramento pikeminnow, three hundred twenty-six lamprey, one hundred twenty-one three-spined stickleback, twenty-four sculpin, and six bass.

Site 5 – Greenbelt Parkway

Multiple-pass depletion sampling yielded 282 fishes representing seven taxa. Sacramento pikeminnow accounted for 38.3%, California roach accounted for 25.9%, and bass accounted for 19.5% of the catch. Sacramento sucker, mosquitofish, sculpin, and catfish accounted for the rest of the catch. Sacramento sucker (10,520.1g), bass (616.0g) and Sacramento pikeminnow (478.8g) represented the majority of the biomass collected.

The estimated population density for this site is 1,074 fish*ha^{-1}. By species, this represents four hundred eleven Sacramento pikeminnow, two hundred seventy-eight California roach, two hundred ten bass, ninety-one Sacramento sucker, fifty mosquitofish, twenty-seven sculpin, and eight catfish.

Site 6 – Wildwood

Multiple-pass depletion sampling yielded 940 fishes representing eight taxa. California roach accounted for 76.6%, Sacramento pikeminnow accounted for 16.8%, and Sacramento sucker accounted for 2.4% of the catch. Mosquitofish, Three-spined stickleback, sculpin, bass, and lamprey accounted for the rest of the catch. Sacramento sucker (3,538.5g), California roach (2001.5g) and Sacramento pikeminnow (810.2g) represented the majority of the biomass collected.

The estimated population density for this site is 3,327 fish*ha^{-1}. By species, this represents two thousand five hundred forty-nine California roach, five hundred fifty-nine Sacramento pikeminnow, eighty-one Sacramento sucker, sixty-seven mosquitofish, thirty-two three-spined stickleback, twenty-one sculpin, fourteen bass, and four lamprey.

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 eleven taxa of fish were collected during the 2015 survey (Figure 2). Comparative charts of species composition from 2010 – 2015 are presented in Appendix C.

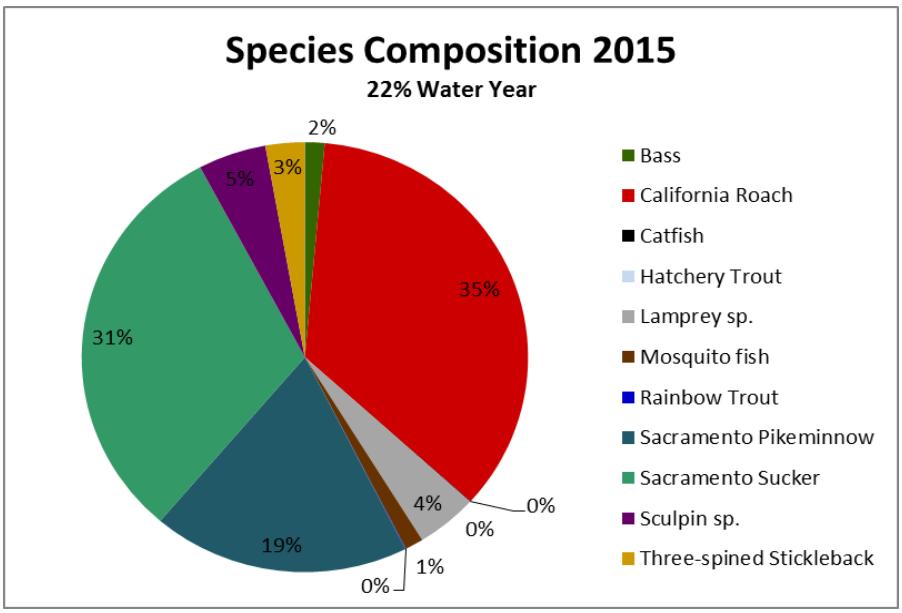

Figure 2: 2015 Composition of fish species collected during the annual fall population survey. Note that a 0% label represents fishes caught that equal

Catch-Per-Unit-of-Effort

The CPUE for each taxon is summarized by site in Table 5. A comparison of CPUE values from 2007 to 2015 is summarized in Appendix B.

Table 5: Catch per unit of effort

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

Wild 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 wild trout density from year to year. The wild trout per mile estimate is based on population data collected from the six survey sites located within the 12.5 mile fishery, which extends from Pine Flat Dam to the Highway 180 Bridge. The six sites total 1,800 feet or 2.7% of the fishery length. In order to provide a representative depiction of the fishery two sites totaling 600 feet (300ft. ea.) are surveyed within each of the three management zones. This is further broken down to 2.3% of the Put and Take zone, 2.9% of the Catch and Release zone and 3.3% of the Catch and Release zone below Fresno Weir. Six sites were sampled over six days, however only two wild trout were collected during the 2015 survey. Historical wild trout density estimates dating back to 1983 are summarized in Figure 3.

Speraman's Rho statistic was used to determine a probable correlation between percent water year and wild rainbow trout per mile. Data sets were used from 2010 – 2015 however no correlation was found ($r = 0.2845$, $p = 0.4581$).

$$r_s = 1 - \frac{6 \sum D^2}{N^3 - N}$$

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 and Garvey 2007). In 2015, the total biomass collected was 75,891.7g (168.8 lbs.). Sacramento sucker accounted for 82.7% (62,769.4g; 138.6 lbs.), California Roach accounted for 6% (4,578.1g; 10.1 lbs.) and Sacramento pikeminnow accounted for 5% (3,808.3g; 8.6 lbs.). Sculpin, bass, lamprey, wild rainbow trout, hatchery rainbow trout, three-spine stickleback, mosquito fish and catfish accounted for the remaining 6.3% (4,735.9g; 10.7 lbs.). Biomass results for the 2015 survey are summarized by site in Table 7.

Table 7: Biomass as measured in pounds, by species, by site

Total Weight (lbs) November 2015							
	Winton	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
Rainbow Trout	0.6	0.0	0.6	0.0	0.0	0.0	1.3
Hatchery Trout	0.0	0.0	1.2	0.0	0.0	0.0	1.3
Bass	0.0	0.1	0.0	0.2	1.4	0.1	1.1
California Roach	0.1	0.4	2.9	1.7	0.5	4.4	10.1
Catfish	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Lamprey	0.0	0.6	0.3	0.4	0.0	0.0	1.7
Mosquitofish	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Sacramento Pikeminnow	0.5	0.4	3.2	1.4	1.1	1.8	8.6
Sacramento Sucker	8.7	3.6	66.8	28.4	23.2	7.8	138.6
Sculpin	3.5	0.2	0.5	0.1	0.2	0.2	4.9
Three-spined Stickleback	0.1	0.0	0.0	0.0	0.0	0.0	0.3
Site Total	**12.9**	**5.3**	**73.8**	**32.2**	**26.4**	**14.3**	**166.2**
Biomass %	**7.8%**	**3.2%**	**44.4%**	**19.4%**	**15.9%**	**8.6%**	**100.0%**

Length

The mean fork length for wild rainbow trout collected during the 2015 survey was 20.6cm (approx. 8 inches). The mean fork length for wild rainbow trout collected between 2007 and 2015 is 17.6cm (approx. 7 inches). No wild trout were collected in 2014, therefore mean fork length from the 2013 report (n = 11) was utilized for comparison. The mean fork length of trout captured during the 2013 survey was 16.8cm (approx. 6.6 inches). A significant (ANOVA, $p = 0.001$) increase of 3.8cm from 2013 - 2015. A comparison of mean fork length from 2007 – 2015 can be found to the right in Figure 4.

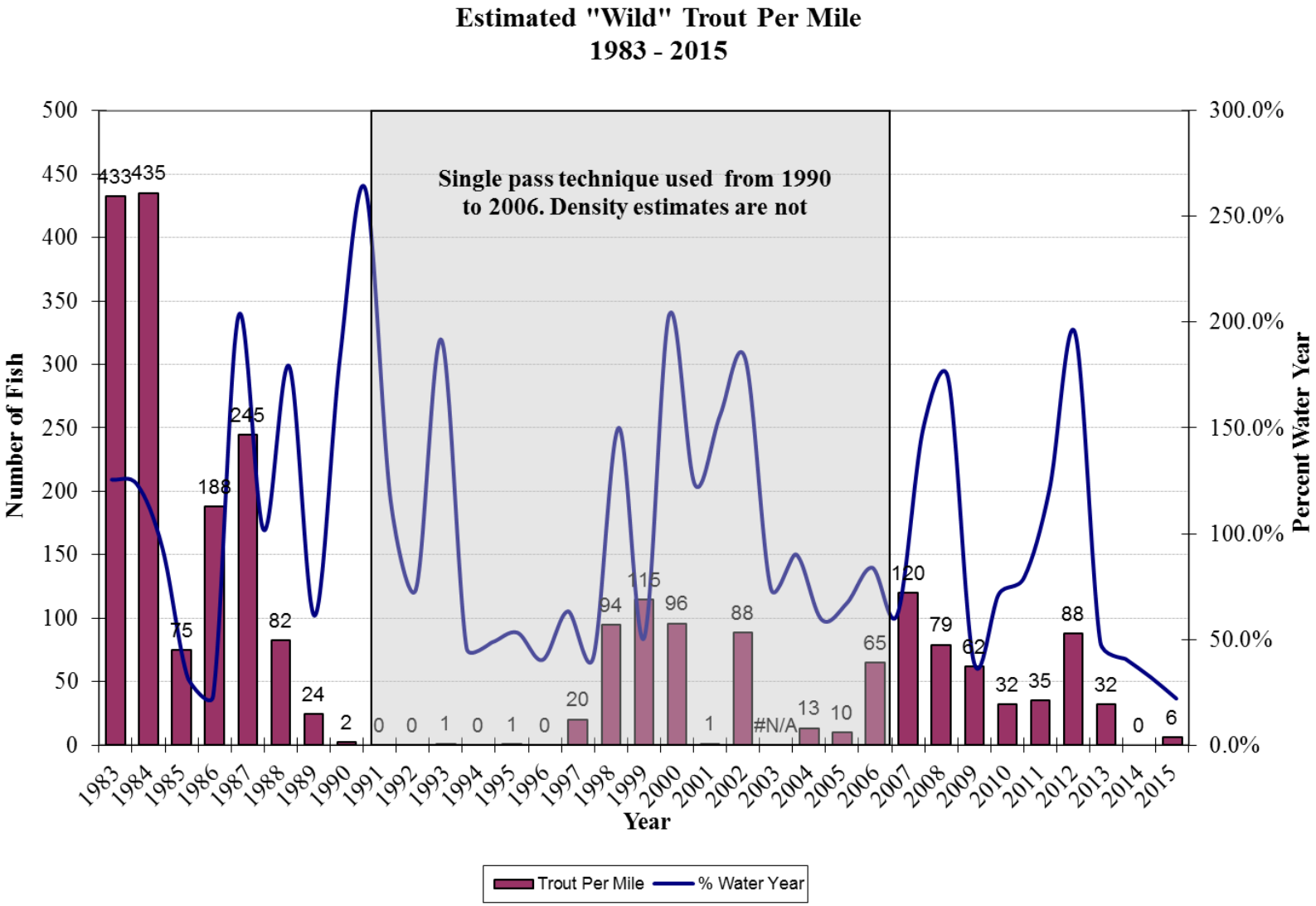

Figure 3: Estimated number of "wild" trout per mile in the Kings River between Pine Flat Dam and the Highway 180 bridge, Fresno County. Density is extrapolated from the number of wild trout collected from six sample sites located within the reach of the Kings River between Pine Flat Dam and the Highway 180 Bridge. (Kings River Conservation District, 2014).

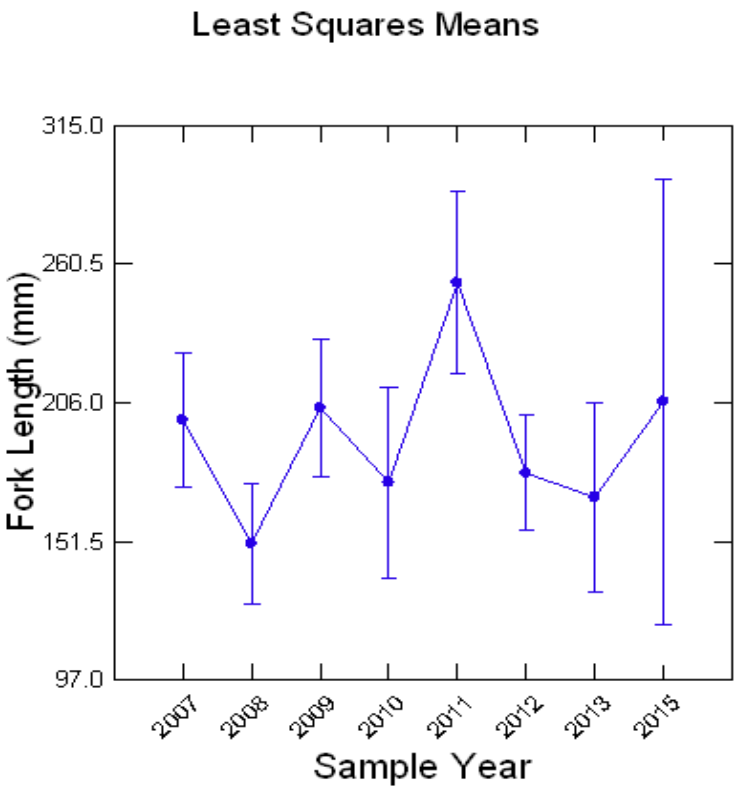

Figure 4: Mean length of wild trout collected from the Kings River tailwater fishery 2007 – 2015.

Age

Scale samples from the two wild rainbow trout collected in 2015 were used to estimate trout age based on counts of annuli and circuli. The mean age of wild trout captured in 2015 was 3.7 years. In eight years no wild rainbow trout < 1yr. of age have been collected and only one trout > 4yrs. of age has been recorded. The mean age of wild rainbow trout caught since 2008 is 2 years. No wild trout were captured during the 2014 survey. A depiction of the age/length frequency distribution can be referenced in Figure 5.

Condition Factor (K)

Both wild trout collected in 2015 were found to be in good condition. The trout collected from the Avocado Boulder site had a K-factor of 1.29 (very good) and the trout collected at the Winton site had a K-factor of 1.18 (good).

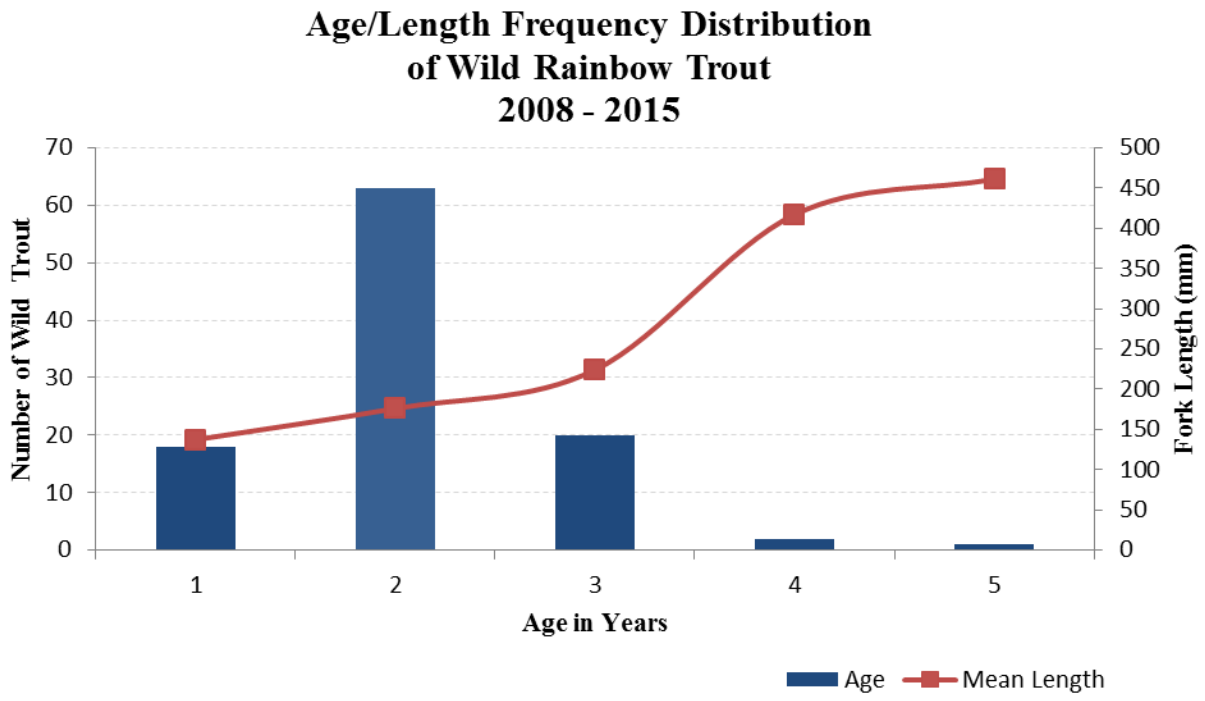

Figure 5: Age/length frequency distribution of wild rainbow trout 2008 – 2015.

Conclusion

This year marked the eighth year of multiple pass depletion sampling since the FMP returned to triple-pass depletion in 2007. In addition, this year marked the fourth 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 – 2015 catch efficiency.

A total of 4,362 fishes were collected during the 2015 survey. Decreases from 2014 were documented in the abundance of catfish, sculpin, lamprey and three-spined stickleback. The most significant increases in abundance were seen in bass and Sacramento sucker. Bass increased for the second year in a row with a 150% increase (n = 61) over last year's 480% rise. The number of Sacramento sucker collected doubled (n = 1,329) from those caught in 2014.

Standing stock was dominated by California roach, Sacramento sucker and Sacramento pikeminnow. California roach accounted for 35% of the total catch, Sacramento sucker accounted for 31% and Sacramento pikeminnow accounted for 18.7%.

This year's survey produced one hatchery trout and two wild rainbow trout. This translated to 5.87 wild trout per mile. Variation in wild rainbow trout capture numbers from 2007 to 2015 are illustrated below in Figure 6. Changes in species composition are illustrated in Figure 7.

Since our return to triple-pass-depletion in 2007 we have yet to discover any affirmative correlations linking observed variables to species composition or abundance. New approaches to analyzing this data will be examined in the coming year. The Kings River Fisheries Management Program will continue comprehensive monitoring and investigation of environmental variables within the tailwater fishery; endeavoring to better understand the factors driving population dynamics and variations in species richness within the river.

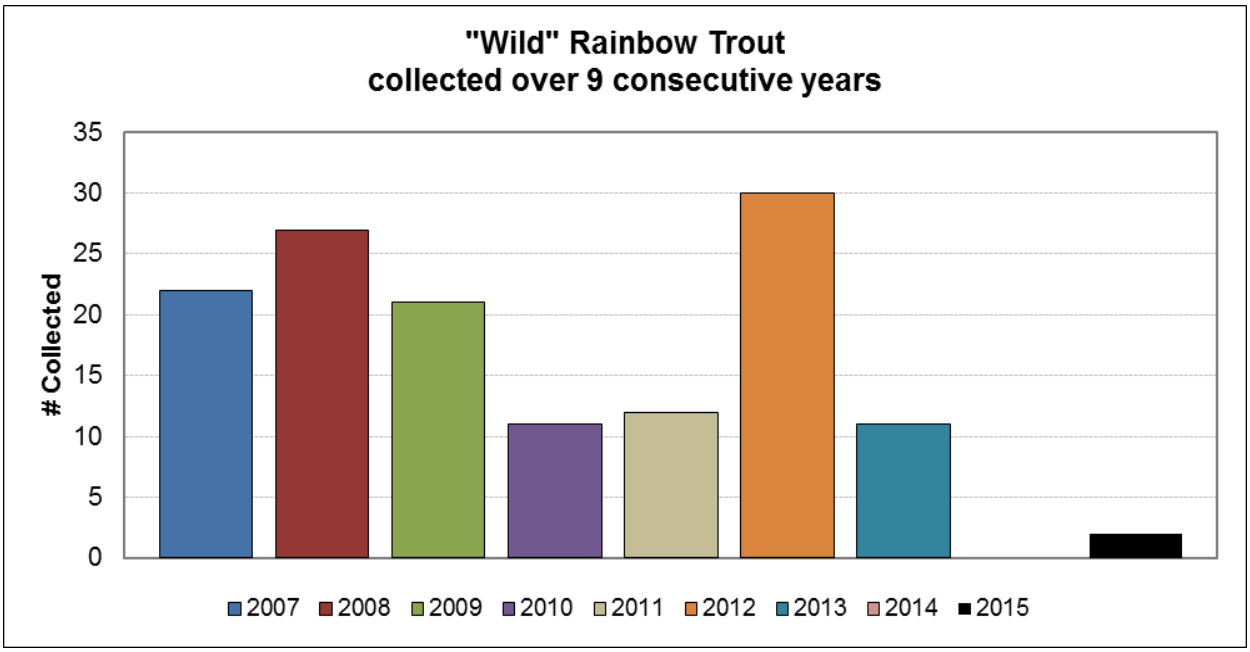

Figure 6: Number of "wild" rainbow trout caught during the fall population survey 2007 - 2015

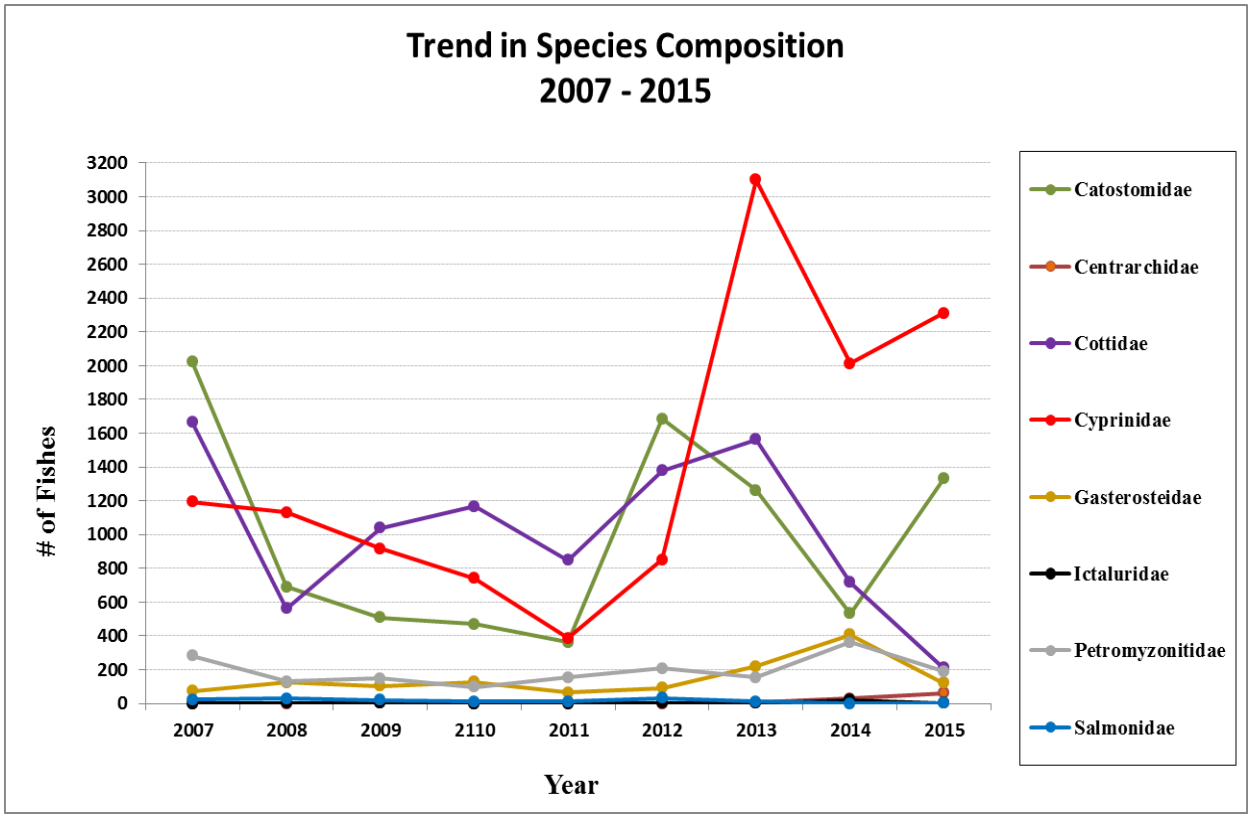

Figure 7: Trend in species composition 2007- 2015. Catostomidae: Sacramento sucker, Centrarchidae: Bass, green sunfish, bluegill, Cottidae: sculpin, Cyprinidae: Sacramento pikeminnow, California roach, Gasterosteidae: stickleback, Ictaluridae: catfish, Petromyzonitidae: lamphrey, Salmonidae: trout. This graph would be meaningful is you used common names and made it similar to the other=s more me. Shows warm water species dominance? Sculpin decline?

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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

95% Confidence Interval (Adjust to lower CI) November 2015						
	Winton	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**
Bass	0 - 0	1 - 1	0 - 0	1 - 1	55 -59	4 - 6
California Roach	33 - 38	183 - 196	314 - 386	222 - 284	73 - 170	914 - 1206
Hatchery Trout	0 - 0	0 - 0	1 - 1	0 - 0	0 - 0	0 - 0
Lamprey sp.	2 - 15	160 - 160	38 - 38	54 - 54	0 - 0	1 - 1
Mosquito fish	2 - 2	23 - 24	0 - 0	0 - 0	20 - 20	19 - 20
Rainbow Trout	48 - 67	0 - 0	273 - 349	86 - 86	117 - 183	298 - 358
Sacramento Pikeminnow	126 - 156	50 - 1250	200 - 893	162 - 208	108 - 256	158 - 166
Sacramento Sucker	477 - 599	438 - 634	317 - 415	215 - 321	24 - 26	23 - 31
Sculpin sp.	160 - 170	10 -10	27 - 29	4 - 50	7 - 9	4 - 6
Three-spined Stickleback	48 - 124	31 - 32	21 - 21	20 - 21	0 - 0	9 - 390
Catfish	0 - 0	0 - 0	0 - 0	0 - 0	2 - 7	0 - 0

Appendix B

Table B – I: Catch per Unit of Effort by species; 2007 – 2014. 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**
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 C: 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 D: 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 E: CPUE 2010

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

Table F: CPUE 2011

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

Table G: CPUE 2012

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

Table H: CPUE 2013

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

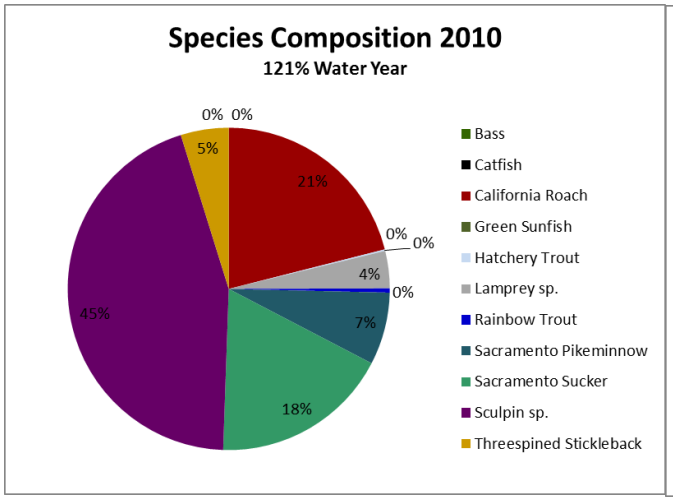
Table I: CPUE 2014

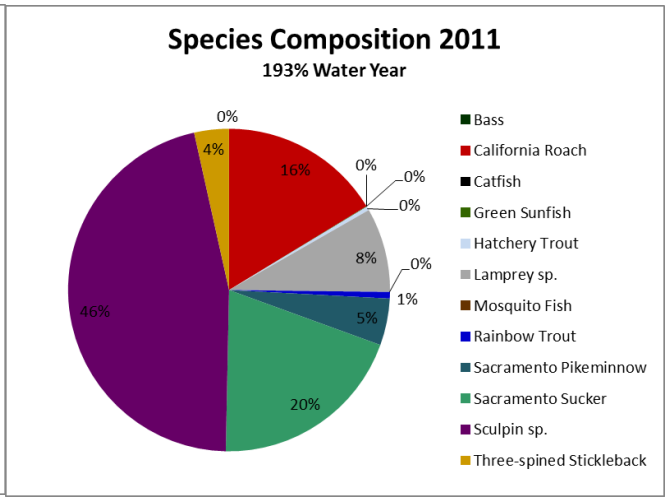
CPUE (fish/hr) 2014						
	Winton	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**
Rainbow Trout	0.00	0.00	0.00	0.00	0.00	0.00
Hatchery Trout	0.00	0.00	0.13	0.00	0.00	0.00
Bass	0.00	0.13	0.13	0.00	3.65	0.13
California Roach	2.16	12.77	25.00	11.38	24.96	60.55
Lamprey sp.	0.19	13.78	5.32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

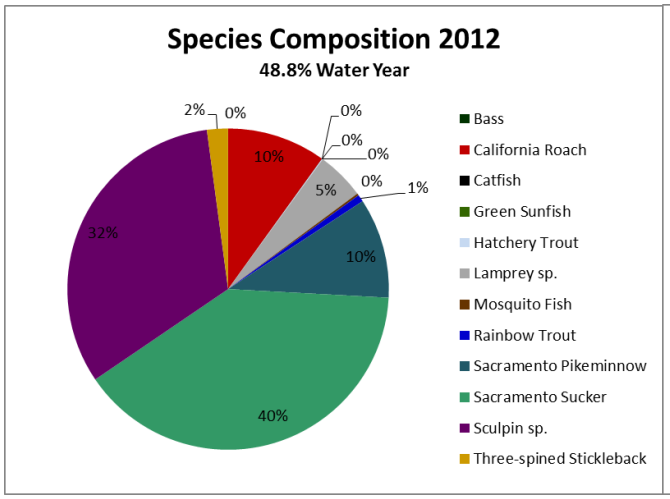
Table J: CPUE 2015

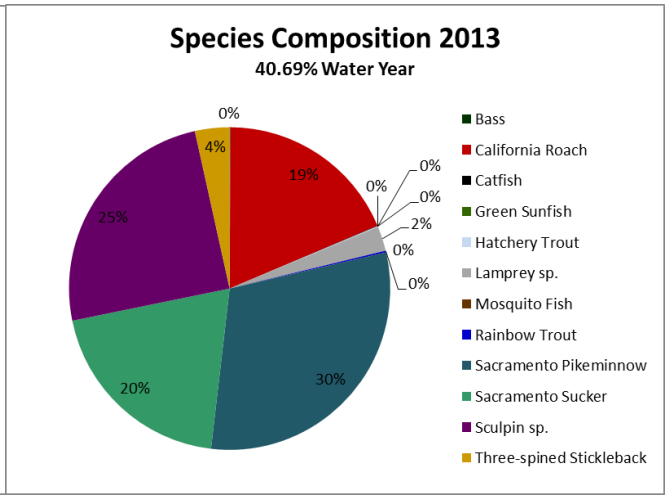
CPUE (fish/hr) 2015						
	Winton	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**
Rainbow Trout	0.12	0.00	0.12	0.00	0.00	0.00
Hatchery Trout	0.00	0.00	0.12	0.00	0.00	0.00
Bass	0.00	0.14	0.00	0.18	7.90	0.49
California Roach	3.92	25.17	36.05	38.86	10.49	87.59
Lamprey sp.	0.24	14.72	3.09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

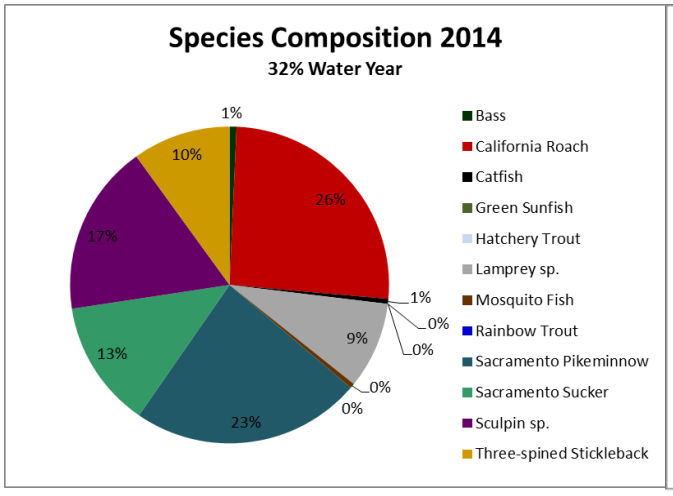
Appendix C

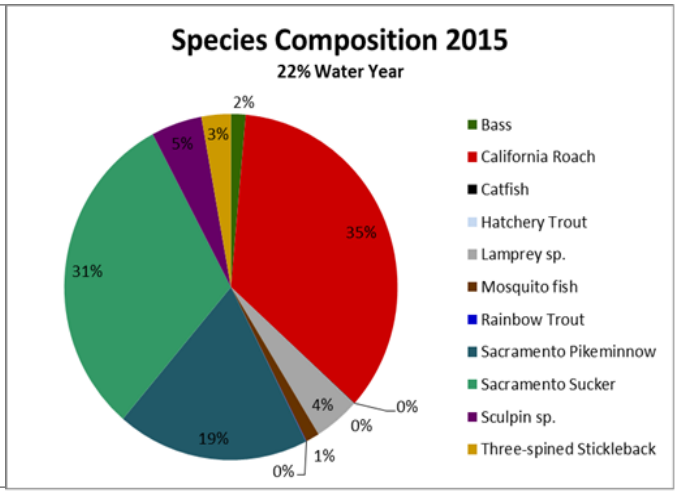

Species Composition 2010
121% Water Year
0% 0%
5%
21%
0%
0%
4%
0%
45%
7%
18%
Bass
Catfish
California Roach
Green Sunfish
Hatchery Trout
Lamprey sp.
Rainbow Trout
Sacramento Pikeminnow
Sacramento Sucker
Sculpin sp.
Threespined Stickleback


Species Composition 2011
193% Water Year
0%
4%
16%
0%
0%
0%
8%
0%
1%
46%
5%
20%
Bass
California Roach
Catfish
Green Sunfish
Hatchery Trout
Lamprey sp.
Mosquito Fish
Rainbow Trout
Sacramento Pikeminnow
Sacramento Sucker
Sculpin sp.
Three-spined Stickleback


Species Composition 2012
48.8% Water Year
2%
0%
10%
0%
0%
0%
5%
0%
1%
32%
10%
40%
Bass
California Roach
Catfish
Green Sunfish
Hatchery Trout
Lamprey sp.
Mosquito Fish
Rainbow Trout
Sacramento Pikeminnow
Sacramento Sucker
Sculpin sp.
Three-spined Stickleback


Species Composition 2013
40.69% Water Year
0%
4%
19%
0%
0%
0%
2%
0%
0%
25%
20%
30%
Bass
California Roach
Catfish
Green Sunfish
Hatchery Trout
Lamprey sp.
Mosquito Fish
Rainbow Trout
Sacramento Pikeminnow
Sacramento Sucker
Sculpin sp.
Three-spined Stickleback


Species Composition 2014
32% Water Year
1%
10%
26%
17%
1%
0%
9%
0%
13%
0%
23%
Bass
California Roach
Catfish
Green Sunfish
Hatchery Trout
Lamprey sp.
Mosquito Fish
Rainbow Trout
Sacramento Pikeminnow
Sacramento Sucker
Sculpin sp.
Three-spined Stickleback


Species Composition 2015
22% Water Year
2%
3%
5%
35%
31%
4%
0%
19%
1%
0%
Bass
California Roach
Catfish
Hatchery Trout
Lamprey sp.
Mosquito fish
Rainbow Trout
Sacramento Pikeminnow
Sacramento Sucker
Sculpin sp.
Three-spined Stickleback