

Lower Kings River Annual Trout and Non-Game Fish Population
Survey:
2014 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 relative abundance and do not accurately 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 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 2014 using standard multiple-pass depletion electrofishing techniques (Reynolds 1996). To insure safe use of the LR-24 backpack shockers, sites were selected which had wadeable conditions no greater than 3 feet deep at flows ranging between 100 and 150 cubic feet per second (cfs). 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. Four to six Smith-Root LR-24 and two Smith-Root LR-20B backpack electrofishers were utilized in the surveys.

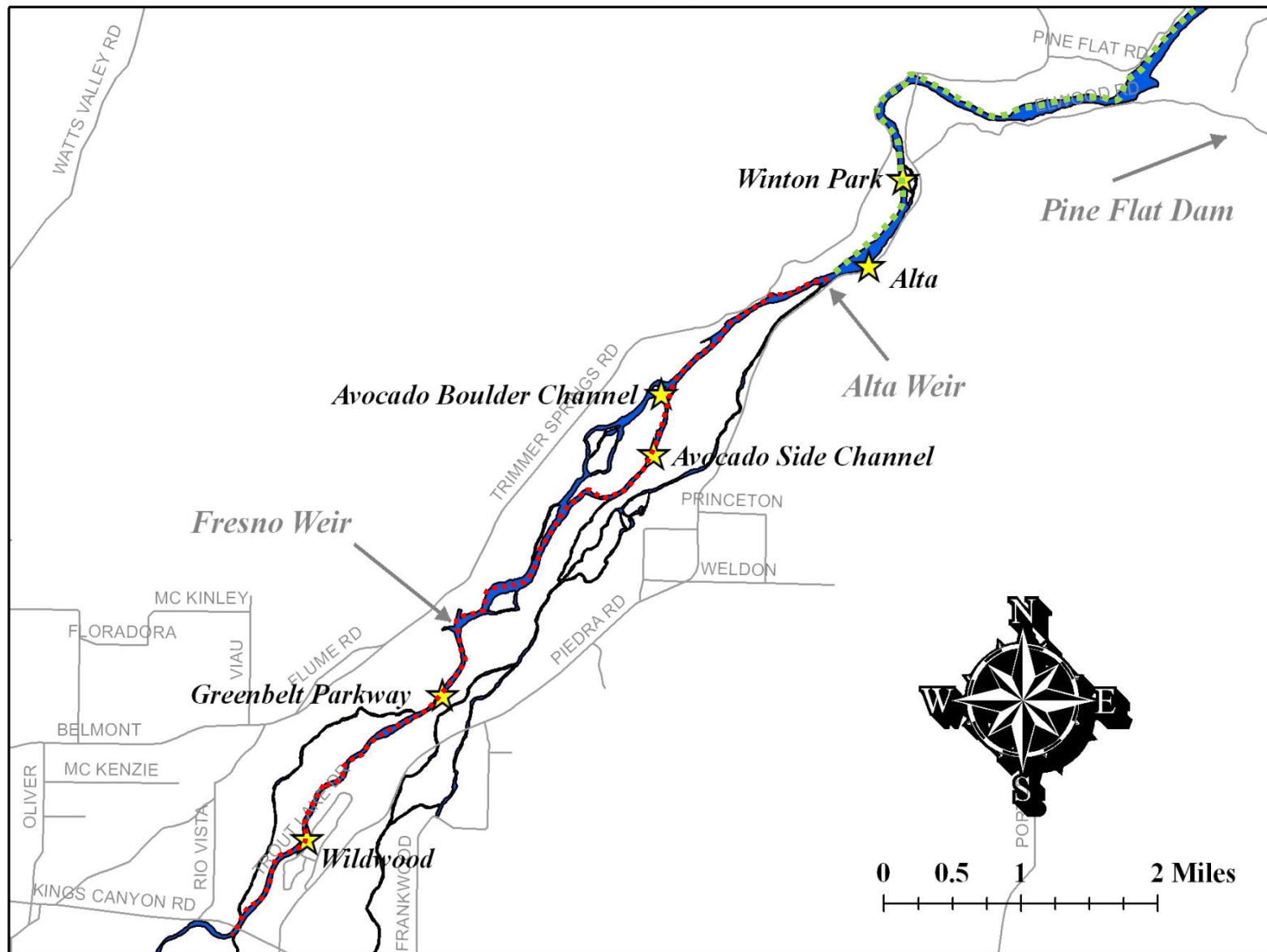
Prior to the 2012 population survey, a series of tests were run using the LR-24 backpack electrofisher in the Kings River. These tests specifically targeted fish response in the presence of an electrical field. It was quickly determined that the previous settings (350volts, 10% Duty Cycle, 50Hz Frequency) were not providing enough power to the water based on the Power Transfer Theory (Kolz 1989) for efficient power transfer resulting in 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.

**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

Electrofishing was conducted using five to eight fishing crews and one to two work-up crews when possible. Volunteers from KRCD, KRWA, CA Fish and Wildlife, The Water Board, local Irrigation Districts, Fresno State University, Reedley College, Kaweah Fly Fishers, Fresno Fly Fishers and the general public were vital to our endeavor.

KRCD Electrofishing Sites - Kings River Below Pine Flat Dam



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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.

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. 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. The *wild* designation refers to a rainbow trout that has inhabited the river from birth regardless of its lineage. This is opposed to what some may call a “native” trout which is assumed to have direct genetic ties to the original ancestor of the region.

Once 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⁻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.

Results

A total of 4,105 fishes were collected during the fall 2014 population survey. Of those, 4,039 were entered into the Microfish software program for analysis. We were unable to obtain length/weight data for the remaining 66 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; California roach *Hesperoluecus symettricus*, Sacramento pikeminnow *Ptycheilus grandis*, sculpin *Cottus sp.*, three-spined stickleback *Gasterosteus aculeatus*, Sacramento sucker *Catostomus occidentalis*, lamprey *Lampetra spp*, bass *Micropterus punctulatus*, catfish (both white *Ameriurus catus* & black bullhead *Ameriurus melas*), mosquito fish *Gambusia affinis* and one 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 is displayed by species and site in Table 2. These data represent the total number of each species caught at each survey site. Population estimates are summarized in Table 3. Percent composition is summarized by species in Figure 2 and 95% confidence intervals for the population estimates by survey site are summarized in Appendix A (Table A).

Site 1 – Winton Park

Multiple-pass depletion sampling yielded 705 fishes representing seven species. Sculpin accounted for 51.1% of the catch while Sacramento pikeminnow accounted for 24.4%. Other species collected included, Sacramento sucker, three-spine stickleback, California roach, lamprey and catfish. Sacramento sucker (3,052.0g), Sculpin (2,656.3g) and Sacramento pikeminnow (528.6g), represented the majority of the biomass collected.

Table 2: Total catch by species

Total Catch by Species November 2014							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Bass	0	1	1	0	26	1	29
California Roach	23	101	188	100	178	465	1055
Hatchery Trout	0	0	1	0	0	0	1
Lamprey sp.	2	109	40	207	3	1	362
Mosquito fish	0	1	0	2	3	14	20
Sacramento Pikeminnow	172	49	272	58	117	291	959
Rainbow Trout	0	0	0	0	0	0	0
Sacramento Sucker	114	89	149	67	34	80	533
Sculpin sp.	360	54	129	81	34	59	717
Three-spined Stickleback	32	219	32	58	4	63	408
White Catfish	2	0	2	2	15	0	21
Site Total	705	623	814	575	414	974	4105

Table 3: Population Estimate by maximum likelihood

Population Estimate (maximum likelihood) November 2014						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Bass	0	1	1	0	27	1
California Roach	26	152	249	104	228	517
Hatchery Trout	0	0	1	0	0	0
Lamprey sp.	3	159	43	210	5	1
Mosquito fish	0	1	0	2	3	13
Sacramento Pikeminnow	208	55	311	86	150	328
Rainbow Trout	0	0	0	0	0	0
Sacramento Sucker	121	99	169	71	34	93
Sculpin sp.	396	61	141	107	36	62
Three-spined Stickleback	46	258	55	60	6	164
White Catfish	2	0	2	2	15	0

The estimated population density for this site is 2,362 fish*ha⁻¹. By species, this represents one thousand one hundred sixty-six sculpin, six hundred twelve Sacramento pikeminnow, three hundred fifty-six Sacramento sucker, one hundred thirty-five three-spine stickleback, seventy-seven California roach, nine lamprey, and six catfish.

Site 2 – Alta

Multiple-pass depletion sampling yielded 623 fishes representing eight species. Three-spine stickleback accounted for 35.2%, lamprey accounted for 17.5% and California roach accounted for 16.2% of the catch. Other species collected included Sacramento sucker, sculpin, Sacramento pikeminnow, bass and mosquito fish. Sacramento sucker (1450.9g) and Sacramento

pikeminnow (599.1g) represented the majority of the biomass collected.

The estimated population density for this site is 4,086 fish*ha⁻¹. By species, this represents one thousand three hundred forty-one three-spine stickleback, eight hundred twenty-seven lamprey, seven hundred ninety California roach, five hundred fifteen Sacramento sucker, three hundred seventeen sculpin, two hundred eighty-six Sacramento pikeminnow, five bass and five mosquito fish.

Site 3 – Avocado Boulder Project

Multiple-pass depletion sampling yielded 814 fishes representing nine species. Sacramento pikeminnow accounted for 33.4% of the catch, California roach accounted for 23.1% and Sacramento sucker accounted for 18.3%. Other species collected included Sculpin, lamprey, three-spined stickleback, catfish, spotted bass and hatchery rainbow trout. Sacramento sucker (19,474.1g), Sacramento pikeminnow (4,210.2g), and California roach (947.8g) represented the majority of the biomass collected.

The estimated population density for this site is 6,456 fish*ha⁻¹. By species, this represents two thousand sixty-six Sacramento pikeminnow, one thousand six hundred fifty-four California roach, one thousand one hundred twenty-two Sacramento sucker, nine hundred thirty-six sculpin, three hundred sixty-five three-spine stickleback, two hundred eighty-six lamprey sp., thirteen catfish, seven hatchery trout and seven bass.

Site 4 – Avocado Side Channel

Multiple-pass depletion sampling yielded 575 fishes representing eight species. Lamprey accounted for 36.0%, California roach accounted for 17.4%, and sculpin accounted for 14.1%. Other species collected included Sacramento sucker, three-spined stickleback, Sacramento pikeminnow, mosquito fish and catfish. Sacramento sucker (5296.8g), lamprey sp. (777.1g), and Sculpin (537.8g) represented the majority of the biomass collected.

The estimated population density for this site is 3,877 fish*ha⁻¹. By species, this represents one thousand two hundred sixty-eight lamprey, six hundred forty-six sculpin, six hundred twenty-eight California roach, five-hundred twenty Sacramento pikeminnow, four hundred twenty-nine Sacramento sucker, three hundred sixty-two three-spine stickleback, twelve catfish sp. and twelve mosquito fish.

Site 5 – Greenbelt Parkway

Multiple-pass depletion sampling yielded 414 fishes representing nine species. California roach accounted for 43.0% and Sacramento pikeminnow represented 28.3%. Sacramento sucker, sculpin, bass, catfish, three-spined stickleback, lamprey and mosquito fish accounted for the rest of the catch. Sacramento sucker (8116.4g), California roach (770.2g) and Sacramento pikeminnow (586.9g) represented the majority of the biomass collected.

The estimated population density for this site is 1,920 fish*ha⁻¹. By species, this represents eight hundred seventy California roach, five hundred seventy-one Sacramento pikeminnow, one hundred thirty-seven sculpin, one hundred thirty Sacramento sucker, one hundred two bass sp., fifty-seven catfish, twenty-three three-spined stickleback, nineteen lamprey, and eleven mosquito fish.

Site 6 – Wildwood

Multiple-pass depletion sampling yielded 974 fishes representing eight species. California roach accounted for 47.7% of the catch, Sacramento pikeminnow accounted for 29.9% and Sacramento sucker accounted for 8.2%. Other species collected included three-spined stickleback, mosquito fish, lamprey sp. and bass. Sacramento sucker (2,802.0g), Sacramento pikeminnow (1901.9g) and California roach (1713.7g) represented the majority of the biomass collected.

The estimated population density for this site is 4,173.21 fish*ha⁻¹. By species, this represents one thousand eight hundred thirty California roach, one thousand one hundred sixty-one Sacramento pikeminnow, five hundred eighty three-spined stickleback, three hundred twenty-nine Sacramento sucker, two hundred nineteen sculpin, forty-six mosquito fish, four lamprey and four bass sp.

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, Thomas et al). Altogether eleven species of fish were collected during the 2014 survey (Figure 2). Comparative charts from 2010 – 2014 can be referenced in Appendix C.

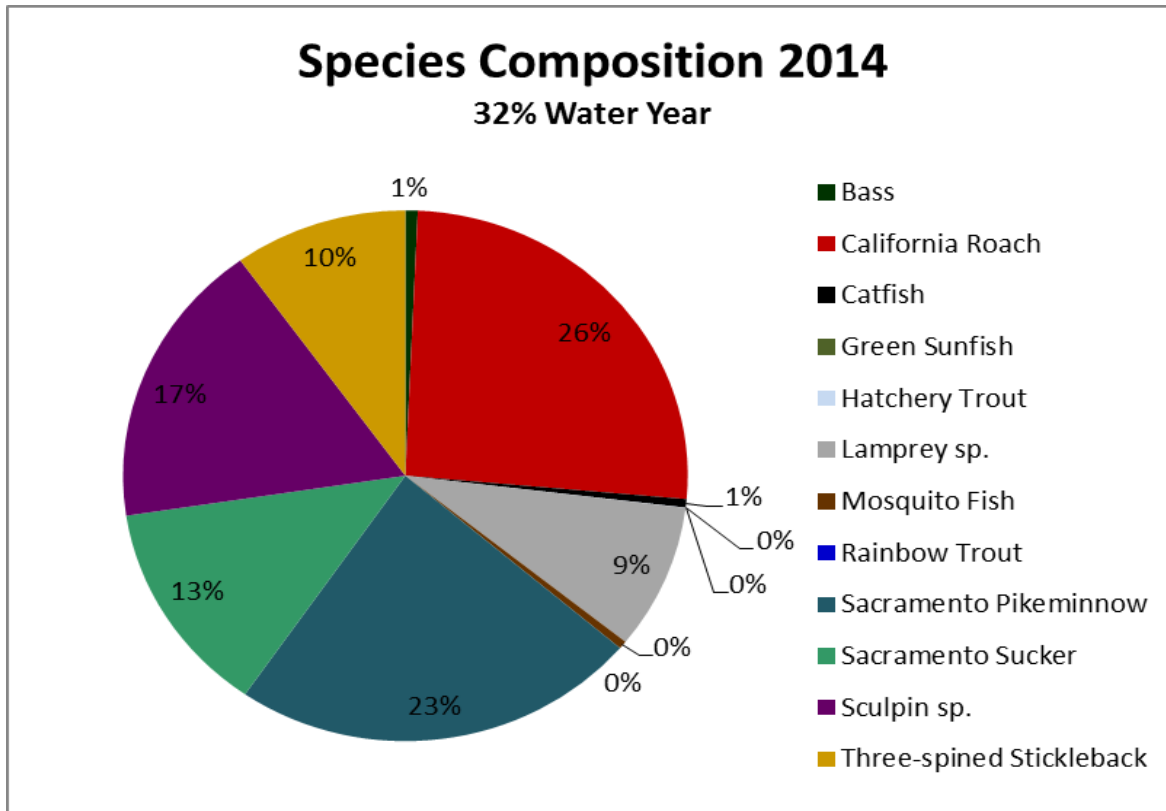


Figure 2: 2014 Composition of fish species collected during the annual fall population survey.

Catch Per Unit of Effort

The Catch per Unit of Effort for each species is summarized by site in Table 5. A comparison of CPUE values from 2007 to 2014 is summarized in Appendix B.

Table 5: Catch per unit of effort

CPUE (fish/hr) 2014						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	2.16	12.77	25.00	11.38	24.96	60.55
Hatchery Trout	0.00	0.00	0.13	0.00	0.00	0.00
Lamprey sp.	0.19	13.78	5.32	23.55	0.42	0.13
Mosquito fish	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
Bass	0.00	0.13	0.13	0.00	3.65	0.13
Rainbow Trout	0.00	0.00	0.00	0.00	0.00	0.00
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

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. Although six sites were sampled over six separate days, no wild trout were found during this year's survey. Historical wild trout density estimates dating back to 1983 are summarized in Figure 3.

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 & Garvey 2007). In 2014, the total biomass collected was 59,404.2g (131.0 lbs). Sacramento sucker accounted for 67.6% (40,192.2g; 88.6 lbs), Sacramento pikeminnow accounted for 13.8% (8169.0g; 18 lbs) and Sculpin accounted for 8.7% (5,196.6g; 11.5 lbs), California roach, lamprey, bass, three-spine stickleback, hatchery trout, catfish and mosquito fish accounted for the other 9.9%. Biomass results for the 2014 survey are summarized by site in Table 7.

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

Total Weight (lbs) November 2014							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Bass	0.0	0.0	0.0	0.0	0.6	0.0	0.7
California Roach	0.0	0.3	2.1	0.5	1.7	3.8	8.4
Hatchery Trout	0.0	0.0	0.2	0.0	0.0	0.0	0.2
Lamprey sp.	0.0	0.8	0.3	1.7	0.0	0.0	2.9
Mosquito fish	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sacramento Pikeminnow	1.2	1.3	9.3	0.8	1.3	4.2	18.0
Rainbow Trout	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sacramento Sucker	6.7	3.2	42.9	11.7	17.9	6.2	88.6
Sculpin sp.	5.9	0.7	1.9	1.2	0.6	1.2	11.5
Three-spined Stickleback	0.0	0.3	0.1	0.1	0.0	0.1	0.6
White Catfish	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Site Total	13.9	6.7	56.8	15.9	22.3	15.4	131.0
Biomass %	10.6%	5.1%	43.4%	12.1%	17.0%	11.8%	100.0%

Estimated "Wild" Trout Per Mile 1983 - 2014

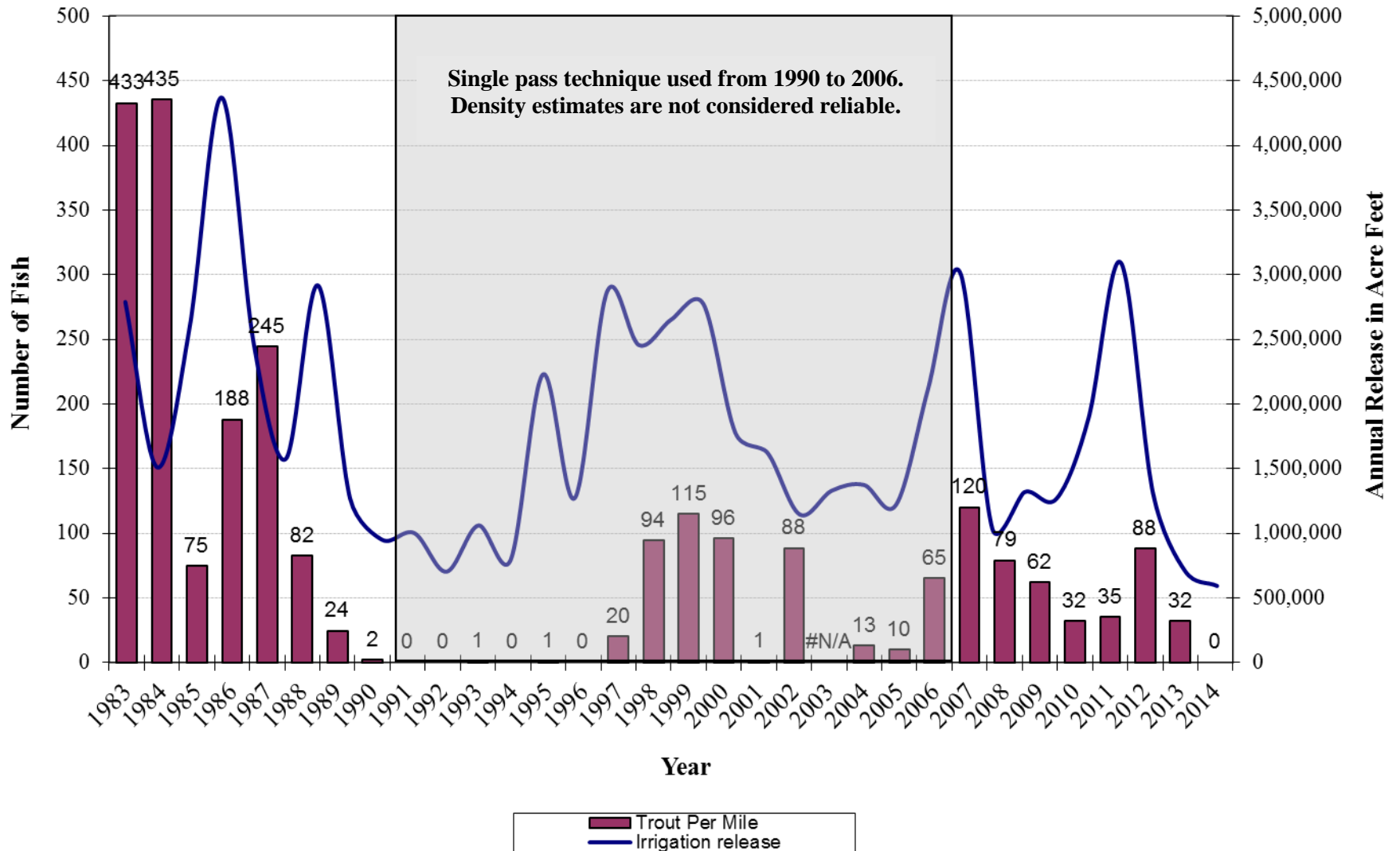


Figure 3: Estimated number of “wild” trout per mile in the Kings River between Pine Flat Dam and the Highway 180 bridge, Fresno County. Density is extrapolated from the number of wild trout collected from six sample sites located within the reach of the Kings River between Pine Flat Dam and the Highway 180 Bridge. (Kings River Conservation District, 2013).

Discussion

There are many variables that must be taken into consideration when reviewing electrofishing data. The information in this report is a representation of demographics as they occur each fall within the 12.5mile tailwater fishery.

The 2014 population survey followed a 32% water year. This was preceded by a 40.7% water year in 2013 and a 48.8% water year in 2012. In addition, California experienced its warmest year on record (1895 – 2014) with a statewide average temperature measuring 4.1°F above normal (NOAA, 2014). These conditions placed a great amount of stress on Sierra Nevada fisheries statewide. By the first week of September, temperature profiles from Pine Flat Reservoir revealed that all cold water storage had been depleted and tailwater temperatures exceeded 20°C for the next six weeks. It is not clear what impacts water conditions had within our study area.

This year marked the seventh year of multiple pass depletion sampling since the FMP returned to triple-pass depletion in 2007. In addition, this year marked the third year that the FMP utilized deliberate voltage adjustment by site for the LR-24 units in concurrence with water conductivity. This change may have minimally increased the 2012-2014 catch numbers.

As mentioned in the methods, site selection included the need for wadeable conditions no greater than 3 feet deep in releases from 100cfs to 150cfs. This means that the sample sites could not be entirely representative of the total 12.5 mile stretch of the fishery. The survey excludes deep pools and runs that cannot be easily navigated on foot. This likely leads to unintentional sample bias; skewing numbers in favor of fishes that inhabit shallow glides, riffles and slack-water while skewing against the former.

A total of 4,106 fishes were collected during the 2014 survey. Decreases from the 2013 survey were documented in the abundance of wild rainbow trout, three-spine stickleback, hatchery rainbow trout, Sacramento sucker and Sacramento pikeminnow.

Most notably catfish increased by 600% (n=18), bass increased by 480% (n=24) and lamprey increased 138% (n=208) over the previous year. Standing stock was dominated by California roach, Sacramento pikeminnow and Sacramento sucker. California roach accounted for 26% of the total catch, Sacramento pikeminnow accounted for 22% and Sacramento sucker accounted for 17%. Trends in species composition are located in Figures 4 and 5.

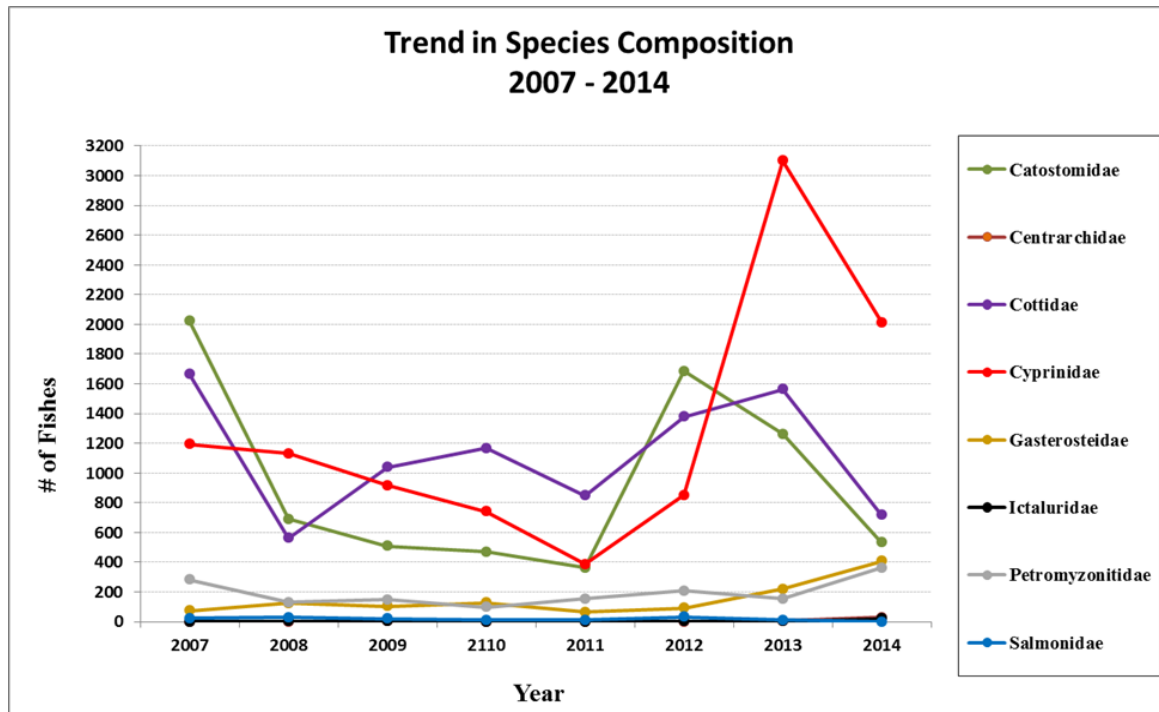


Figure 4: Trend in Species Composition from 2007 to 2014 as grouped by taxonomic Family; Sacramento Sucker *Catostomidae*, Bass & Green Sunfish *Centrarchidae*, Sculpin *Cottidae*, Pikeminnow & Roach *Cyprinidae*, Stickleback *Gasterosteidae*, Catfish *Ictaluridae*, Lamprey *Petromyzonitidae*, Trout *Salmonidae*.

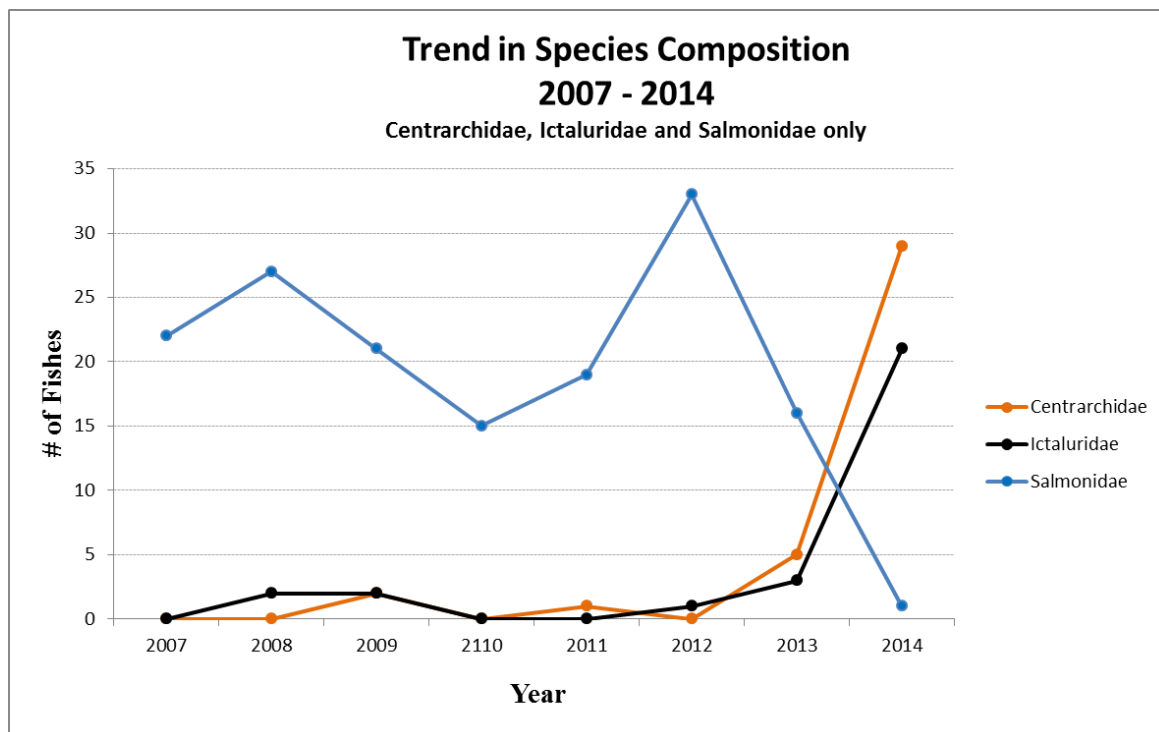


Figure 5: Bottom section of Figure 4, above. Representing Bass & Green Sunfish *Centrarchidae*, Catfish *Ictaluridae* and Trout (not of hatchery origin) *Salmonidae*.

This year's survey produced only one hatchery trout and zero wild rainbow trout; disallowing us from calculating wild trout per mile. Variation in catch numbers amongst sites from 2007 to 2014 are illustrated below in Figure 7.

The Kings River Fisheries Management Program is continuing work on comprehensive monitoring and the investigation of variables within the 12.5 mile tailwater fishery. It is our goal to better understand the factors driving population dynamics and variations in species richness within the Kings River with the hope of managing a healthy ecosystem for fish and fisherman alike.

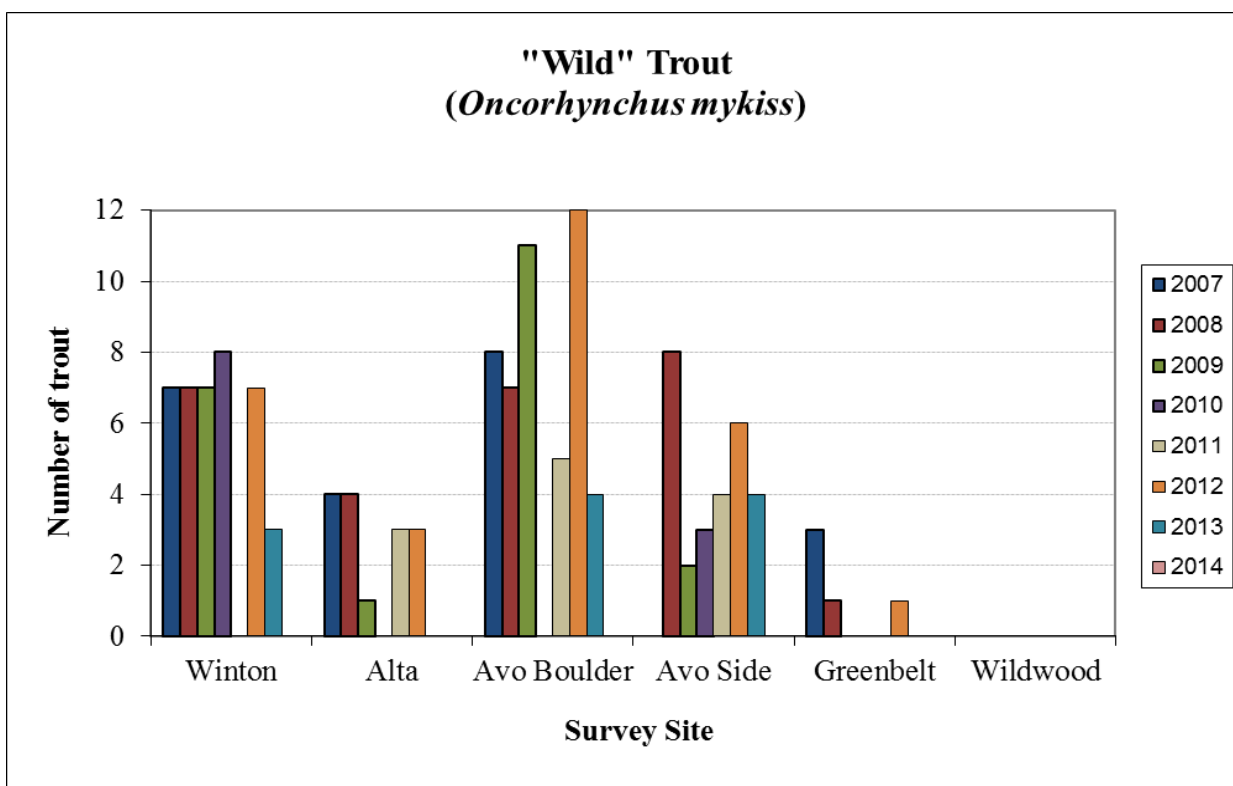


Figure 7: Analysis of within site variation of "wild" trout collected from 2007 to 2014. (Kings River Conservation District, 2013).

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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 2014						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Bass	0 - 0	1 - 1	1 - 1	0 - 0	26 - 36	1 - 1
California Roach	23 - 34	152 - 152	191 - 307	100 - 110	181 - 275	487 - 547
Hatchery Trout	0 - 0	0 - 0	1 - 1	0 - 0	0 - 0	0 - 0
Lamprey sp.	3 - 3	159 - 159	39 - 51	207 - 215	3 - 32	1 - 1
Mosquito fish	0 - 0	1 - 1	0 - 0	2 - 7	3 - 8	13 - 13
Sacramento Pikeminnow	177 - 239	48 - 67	273 - 349	86 - 86	117 - 183	298 - 358
Rainbow Trout	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
Sacramento Sucker	114 - 130	88 - 113	147 - 191	67 - 78	34 - 36	80 - 109
Sculpin sp.	374 - 418	54 - 72	129 - 154	80 - 141	34 - 41	58 - 69
Three-spined Stickleback	46 - 46	230 - 286	31 - 115	58 - 64	6 - 6	62 - 418
Catfish	2 - 26	0 - 0	2 - 15	2 - 15	15 - 17	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
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	13.7	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

CPUE (fish/hr) 2010						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
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
Hatchery Trout	0.0	0.2	0.3	0.0	0.0	0.0
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
Rainbow Trout	1.1	0.0	0.0	0.7	0.0	0.0
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
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
Hatchery Trout	0.0	0.0	0.7	0.2	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
Rainbow Trout	0.0	0.6	0.6	0.7	0.0	0.0
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
California Roach	0.0	3.4	9.3	4.0	15.2	19.9
Hatchery Trout	0.0	0.0	0.0	1.2	0.0	0.0
Lamprey sp.	0.0	9.5	2.7	10.2	0.5	0.0
Mosquito fish	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
Rainbow Trout	0.9	0.3	1.4	0.8	0.1	0.0
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
Smallmouth Bass	0.0	0.0	0.0	0.0	0.6	0.0
California Roach	0.0	9.9	28.6	39.2	27.1	57.5
Hatchery Trout	0.3	0.2	0.1	0.2	0.0	0.0
Lamprey sp.	0.4	6.3	1.0	15.9	0.4	0.0
Mosquito fish	0.0	0.2	0.0	0.0	0.0	0.0
Sacramento Pikeminnow	24.4	22.5	50.7	20.6	46.2	98.3
Rainbow Trout	0.4	0.0	0.6	0.6	0.0	0.0
Sacramento Sucker	51.1	53.1	40.9	11.9	6.3	21.0
Sculpin sp.	70.8	37.6	49.3	29.4	21.7	16.8
Three-spined Stickleback	2.2	11.2	1.2	1.6	1.8	13.1
White Catfish	0.0	0.0	0.0	0.0	0.4	0.0

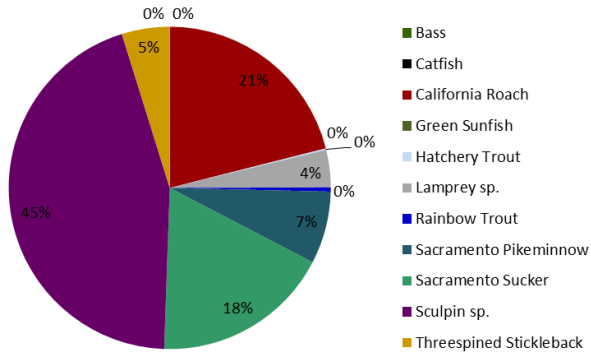
Table I: CPUE 2014

CPUE (fish/hr) 2014						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	2.16	12.77	25.00	11.38	24.96	60.55
Hatchery Trout	0.00	0.00	0.13	0.00	0.00	0.00
Lamprey sp.	0.19	13.78	5.32	23.55	0.42	0.13
Mosquito fish	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
Bass	0.00	0.13	0.13	0.00	3.65	0.13
Rainbow Trout	0.00	0.00	0.00	0.00	0.00	0.00
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

Appendix C

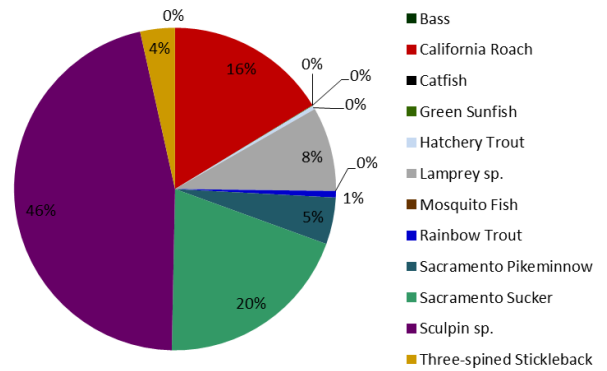
Species Composition 2010

121% Water Year



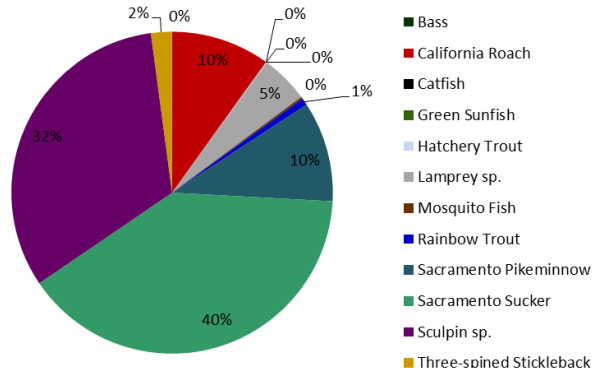
Species Composition 2011

193% Water Year



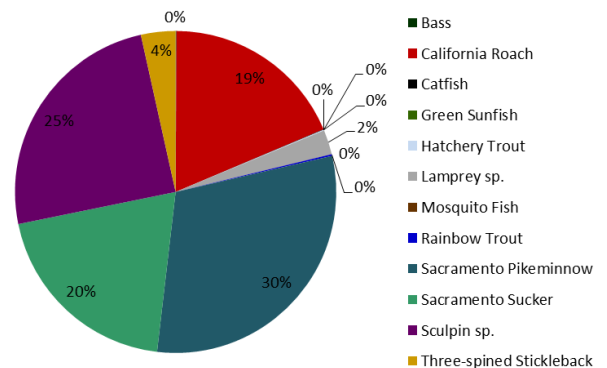
Species Composition 2012

48.8% Water Year



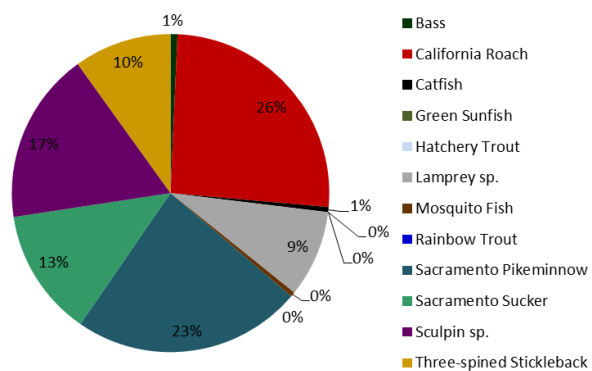
Species Composition 2013

40.69% Water Year



Species Composition 2014

32% Water Year



Species	2010	2011	2012	2013	2014
Bass	0	0	0	5	29
California Roach	576	299	422	1174	1055
Hatchery Trout	5	7	3	5	1
Lamprey sp.	131	155	206	155	362
Mosquito fish	0	0	9	1	20
Sacramento Pikeminnow	233	86	428	1926	959
Rainbow Trout	13	12	30	11	0
Sacramento Sucker	552	363	1685	1262	533
Sculpin sp.	1871	847	1377	1564	717
Three-spined Stickleback	218	64	90	220	408
White Catfish	0	0	1	3	21
Green Sunfish	0	1	0	0	0
Brook Trout	9	0	0	0	0
Total	3608	1834	4251	6328	4105