

Lower Kings River Annual Trout and non-game fish Population
Survey:
2009 Electrofishing Results

Kings River Conservation District
Environmental Resources Division

In-House Report
April 2010

Report Addendum

Lower Kings River Annual Trout and non-game fish Population Survey: 2009 Electrofishing Results Report

This is an addendum to the report issued in April 2010 discussing the results of the fish population survey conducted in the Kings River during the fall of 2009. The purpose of this addendum is to correct miscalculations that occurred in the fish per hectare estimates for each survey site and to correct mislabeled species in several of the Tables throughout the report.

Corrections;

Page 5, Paragraph 1; The estimated population density for this site is 1,062 fish*ha⁻¹. By species this represents 894 sculpin spp., 95 Sacramento suckerfish, 38 Sacramento pikeminnow, 19 rainbow trout, 11 lamprey spp., 3 hatchery trout, and 3 three-spined stickleback.

Page 6, Paragraph 1; The estimated population density for this site is 4,925 fish*ha⁻¹. By species this represents 2,137 sculpin spp., 835 California Roach, 785 Sacramento suckerfish, 479 lamprey spp., 362 Sacramento pikeminnow, 317 three-spined stickleback, 6 hatchery trout, and 6 rainbow trout.

Page 6, Paragraph 3; The estimated population density for this site is 4,953 fish*ha⁻¹. By species this represents 1,697 sculpin spp., 1,628 Sacramento suckerfish, 975 Sacramento pikeminnow, 285 California roach, 196 three-spined stickleback, 70 rainbow trout, and 32 lamprey spp.

Page 7, Paragraph 1; The estimated population density for this site is 2,768 fish*ha⁻¹. By species this represents 837 sculpin spp., 721 lamprey spp., 391 Sacramento suckerfish, 189 Sacramento pikeminnow, 128 three-spined stickleback, 37 California Roach, 12 rainbow trout, and 6 largemouth bass.

Page 7, Paragraph 3; The estimated population density for this site is 1,329 fish*ha⁻¹. By species this represents 421 Sacramento pikeminnow, 329 sculpin spp., 236 Sacramento suckerfish, 207 California roach, 19 three-spined stickleback, 7 smallmouth bass, 4 bluegill, 4 brown bullhead catfish, 4 lamprey spp., 4 largemouth bass, and 4 white catfish.

Page 7, Paragraph 5; The estimated population density for this site is 3,052 fish*ha⁻¹. By species this represents 1,604 California roach, 660 Sacramento pikeminnow, 346 sculpin spp., 102 Sacramento suckerfish, 91 three-spined stickleback and 4 lamprey spp.

Page 11, Table 7: Northern pikeminnow should read "Sacramento pikeminnow." Northern pikeminnow are not present in the Kings River.

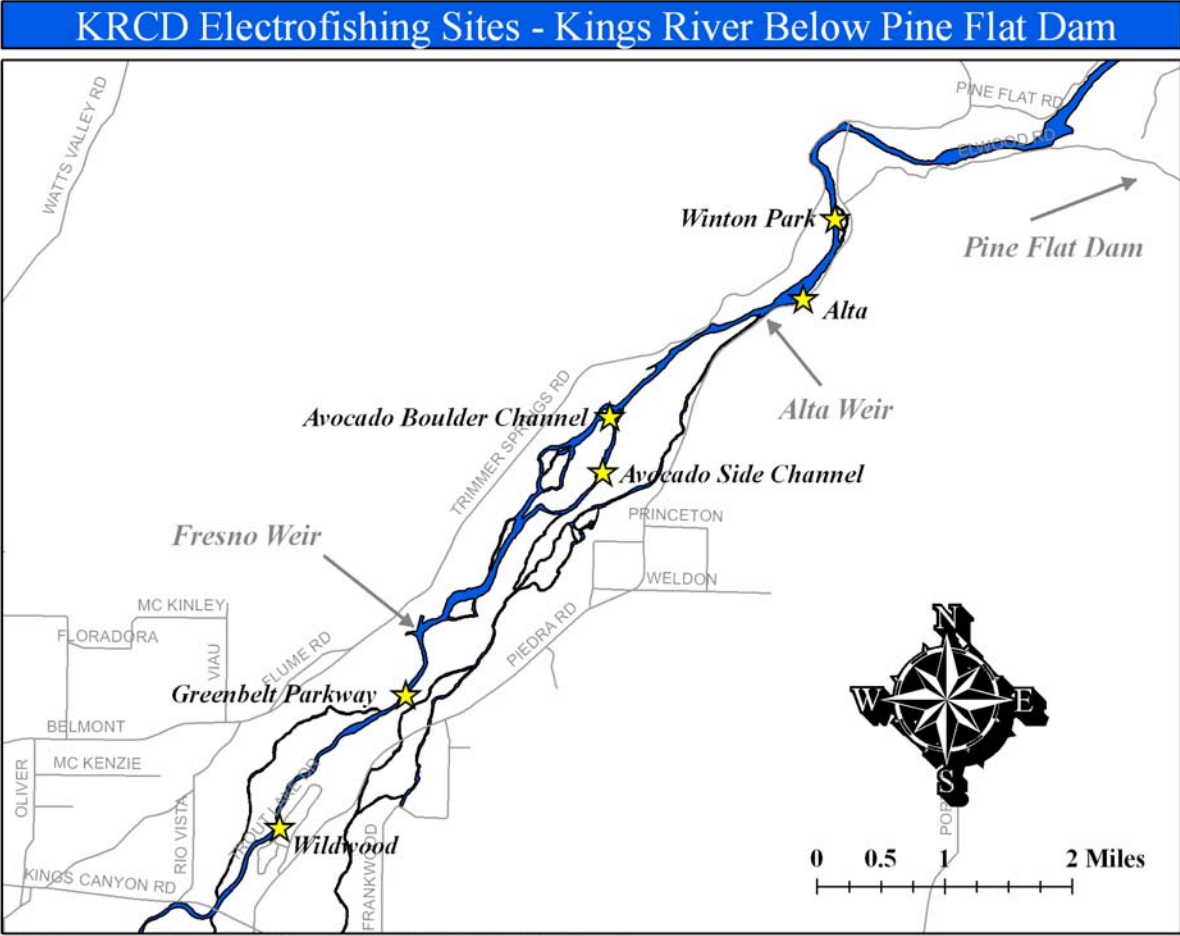
Page 12, Table 8: Northern pikeminnow should read "Sacramento pikeminnow." Northern pikeminnow are not present in the Kings River.

Page 19, Appendix A; Northern pikeminnow should read “Sacramento pikeminnow.” Northern pikeminnow are not present in the Kings River.

The Kings River Conservation District (KRCD), in cooperation with the California Department of Fish and Game (CDFG), has conducted annual population surveys of rainbow trout *Oncorhynchus mykiss* 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 the 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. The single pass data collected from 1990 through 2006 serve as an index of abundance and do not accurately reflect population numbers. Extrapolating density estimates from the single pass data is, at best, a crude estimate that does not stand up to rigorous statistical analysis. In the fall of 2007, the FMP Technical Steering Committee (KRCD, CDFG, and the Kings River Water Association (KRWA)) revised the electrofishing survey protocol to include a full biomass estimate using a multiple pass depletion technique with upstream and downstream block seines; identifying, measuring and weighing every fish sampled. The result is a more thorough analysis and estimation of the standing stock of fish inhabiting the Kings River below Pine Flat Dam.

Methods

Six survey sites (Figure 1) were sampled 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 block seines to avoid fish immigration or emigration from the survey reach. Smith-Root backpack electrofishers types VII, VIII, Model 12, and LR-24's were utilized in the electrofishing surveys. KRCD, KRWA, CDFG staff and volunteers from the fishing public and students from California State University Fresno and Reedley College participated in the population survey.



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

Figure 1: Kings River Conservation District annual electrofishing survey sites; Kings River, Choinumni Park to Highway 180 Bridge, Fresno County.

Electrofishing was typically conducted using six to eight fishing crews and one work-up crew when possible. Fishing crews consisted of a backpack electrofisher operator and a netter. Work-up crews consisted of one data recorder and one to two biologists identifying, measuring, and weighing the sampled fish. All fish captured were identified to the lowest practical taxon in the field, weighed to the nearest tenth of a gram, and measured to total length (1mm), with the exception of rainbow trout which were measured to fork length. Biomass, density, and population estimates were calculated using MicroFish 3.0 software (Van Deventer 2007). These data were also used for species composition analysis. 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 trout considered wild. 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 water proof 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 analysis of the data.

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 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 species abundance. 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 is in “fish per hour.” CPUE was calculated for each of the species sampled from this section of the Kings River.

Results

A total of 2,745 fish were collected during the fall 2009 population survey. Species collected were; bluegill *Lepomis macrochirus*, bullhead catfish *Ameiurus spp.*, California roach *Hesperoluecus symetricus*, lamprey spp. *Lampetra sp* (several species may be present but were not distinguished), largemouth bass *Micropterus salmoides*, Sacramento pikeminnow *Ptychocheilus grandis*, rainbow trout *Oncorhynchus mykiss*, Sacramento sucker *Catostomus occidentalis*, sculpin spp. *Cottus sp* (several species may be present but were not distinguished.), smallmouth bass *Micropterus dolomieu*, threespine stickleback *Gasterosteus aculeatus*, and white catfish *Ameiurus catus*.

Table 1: Total Catch by Species for the 2009 Kings River Population Survey below Pine Flat Dam.

Total Catch							
Common Name	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Bluegill	0	0	0	0	1	0	1
Bullhead Catfish	0	0	0	0	1	0	1
California Roach	0	93	30	6	51	345	525
Hatchery Trout	1	1	0	0	0	0	2
Lamprey spp.	4	57	5	79	1	1	147
Largemouth Bass	0	0	0	1	1	0	2
Sacramento Pikeminnow	14	48	60	29	88	152	391
Rainbow Trout	7	1	11	2	0	0	21
Sacramento Sucker	29	122	232	54	53	19	509
Sculpin spp.	276	275	244	109	84	51	1039
Smallmouth Bass	0	0	0	0	2	0	2
Threespine Stickleback	1	38	20	17	5	23	104
White Catfish	0	0	0	0	1	0	1
	332	635	602	297	288	591	2745

The Total Catch is displayed by site in Table 1. These data represent the total number of each species caught at each survey site. Percent composition, by species, is summarized in Table 2. Population estimates are summarized in Table 3a and 95% confidence intervals are summarized in Table 3b, both by species and site.

Site 1 – Winton Park

Multiple-pass depletion sampling yielded 332 fish representing seven species. Sculpin spp. accounted for 83.1% of the catch while Sacramento sucker accounted for 8.7%. Other species collected included lamprey, Sacramento pikeminnow, wild rainbow trout, hatchery trout, and threespine stickleback. Sacramento sucker (4,033.0g), sculpin spp.

Table 2: Percent composition by species; 2009 Kings River Population Survey, Fresno County.

Total Catch (% by species)							
Common Name	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Bluegill	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100%
Bullhead Catfish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100%
California Roach	0.0%	17.7%	5.7%	1.1%	9.7%	65.7%	100%
Hatchery Trout	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	100%
Lamprey spp.	2.7%	38.8%	3.4%	53.7%	0.7%	0.7%	100%
Largemouth Bass	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	100%
Sacramento Pikeminnow	3.6%	12.3%	15.3%	7.4%	22.5%	38.9%	100%
Rainbow Trout	33.3%	4.8%	52.4%	9.5%	0.0%	0.0%	100%
Sacramento Sucker	5.7%	24.0%	45.6%	10.6%	10.4%	3.7%	100%
Sculpin spp.	26.6%	26.5%	23.5%	10.5%	8.1%	4.9%	100%
Smallmouth Bass	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100%
Threespine Stickleback	1.0%	36.5%	19.2%	16.3%	4.8%	22.1%	100%
White Catfish	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100%

Table 3a: Population estimate by species and site; 2009 Kings River Population Survey, Fresno County. Estimate generated using Microfish 3.0 software.

Population Estimate (Maximum Likelihood)						
Common Name	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Bluegill	0	0	0	0	1	0
Bullhead Catfish	0	0	0	0	1	0
California Roach	0	150	45	6	56	440
Hatchery Trout	1	1	0	0	0	0
Lamprey spp.	4	86	5	118	1	1
Largemouth Bass	0	0	0	1	1	0
Sacramento Pikeminnow	14	65	154	31	114	181
Rainbow Trout	7	1	11	2	0	0
Sacramento Sucker	35	141	268	137	89	95
Sculpin spp.	330	384	268	137	89	95
Smallmouth Bass	0	0	0	0	2	0
Threespine Stickleback	1	57	31	21	5	25
White Catfish	0	0	0	0	1	0

(2,449.9g), and wild rainbow trout (706.8g), represented the majority of the biomass collected.

The estimated population density for this site is 899 fish*ha⁻¹. By species this represents seven hundred and forty-eight sculpin spp., seventy-nine Sacramento suckers, thirty-eight Sacramento pikeminnows, forty wild rainbow trout, eleven lamprey spp., three hatchery rainbow trout, and three threespine sticklebacks.

Site 2 – Alta

Multiple-pass depletion sampling yielded 635 fish representing eight species. Sculpin spp. accounted for 43.2% of the catch while Sacramento sucker accounted for 19.2% and California roach accounted for 14.6%. Other species collected included lamprey spp., Sacramento pikeminnow, wild rainbow trout, hatchery trout, and threespine

Table 3b: 95% confidence interval population estimate by species; 2009 Kings River Population Survey, Fresno County. Estimate generated using Microfish 3.0 software.

95% Confidence Interval (Adjust to lower CI)						
Common Name	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Bluegill	0-0	0-0	0-0	0-0	1-1	0-0
Bullhead Catfish	0-0	0-0	0-0	0-0	1-1	0-0
California Roach	0-0	76-224	45-45	5-7	47-65	385-495
Hatchery Trout	1-1	1-1	0-0	0-0	0-0	0-0
Lamprey spp.	3-5	86-86	2-8	118-118	1-1	1-1
Largemouth Bass	0-0	0-0	0-0	1-1	1-1	0-0
Sacramento Pikeminnow	13-15	37-93	-77-385	25-37	83-145	155-207
Rainbow Trout	6-8	1-1	9-13	-22-26	0-0	0-0
Sacramento Sucker	22-48	122-160	238-276	49-79	47-81	2-54
Sculpin spp.	295-365	310-458	250-286	108-166	82-96	7-183
Smallmouth Bass	0-0	0-0	0-0	0-0	-3-7	0-0
Threespine Stickleback	1-1	57-57	-1-63	9-33	3-7	19-31
White Catfish	0-0	0-0	0-0	0-0	1-1	0-0

stickleback. Sacramento sucker (1,997.6.9g), sculpin spp. (1,736.2.6g), Sacramento Pikeminnow (955.8g), and California roach (942.4g) represented the majority of the biomass collected.

The estimated population density for this site is 3,539 fish*ha⁻¹. By species this represents One thousand five hundred and thirty sculpin spp., six hundred and seventy-nine Sacramento suckers, five hundred and eighteen California roaches, three hundred and seventeen lamprey spp., two hundred and sixty-seven Sacramento pikeminnows, two hundred and twelve threespine sticklebacks, six wild rainbow trout, and six hatchery rainbow trout.

Site 3 – Avocado Boulder Project

Multiple-pass depletion sampling yielded 602 fish representing seven species. Sculpin spp. accounted for 40.5% of the catch while Sacramento sucker accounted for 38.5% and Sacramento pikeminnow accounted for 10%. Other species collected included California roach, lamprey spp., wild rainbow trout, and threespine stickleback. Sacramento sucker (99,915.1g), Sacramento pikeminnow (5,592.3g), sculpin spp. (1,797.7g), and wild rainbow trout (1,473.4g) represented the majority of the biomass collected.

The estimated population density for this site is 3,809 fish*ha⁻¹. By species this represents One thousand five hundred and forty-five sculpin spp., one thousand four hundred and sixty nine Sacramento suckers, three hundred and eighty Sacramento pikeminnows, one hundred and ninety California roaches, one hundred and twenty-seven threespine sticklebacks, seventy wild rainbow trout, and thirty-two lamprey spp.

Site 4 – Avocado Side Channel

Multiple-pass depletion sampling yielded 297 fish representing eight species. Sculpin spp. accounted for 36.7% of the catch while lamprey spp. accounted for 26.6% and Sacramento sucker accounted for 18.2%. Other species collected included California roach, largemouth bass, Sacramento pikeminnow, wild rainbow trout, and threespine stickleback. Sacramento sucker (2,394.1g), sculpin spp. (925.1g), lamprey spp. (461.7g), and “wild” rainbow trout (231.8g) represented the majority of the biomass collected.

The estimated population density for this site is 1,815 fish*ha⁻¹. By species this represents six hundred and sixty-six sculpin spp., four hundred and eighty-three lamprey spp., three hundred and thirty Sacramento suckers, one hundred and seventy-seven Sacramento pikeminnows, one hundred and four threespine sticklebacks, thirty-seven California roaches, twelve wild rainbow trout, and six largemouth bass.

Site 5 – Greenbelt Parkway

Multiple-pass depletion sampling yielded 288 fish representing eleven species. Sacramento pikeminnow represented 30.6% of the catch while sculpin spp. accounted for 29.2%. Sacramento suckerfish accounted for 18.4%, and California roach accounted for 17.7% of the catch. Other species collected included bluegill, bullhead catfish spp., lamprey, largemouth bass, smallmouth bass, threespine stickleback, and white catfish. Sacramento sucker (26,683.8g), sculpin spp. (746.4g), and Sacramento pikeminnow (685.9g) represented the majority of the biomass collected.

The estimated population density for this site is 1,063 fish*ha⁻¹. By species this represents three hundred and twenty-five Sacramento pikeminnows, three hundred and ten sculpin spp., one hundred and ninety-six Sacramento suckers, one hundred and eighty-eight California roaches, nineteen threespine sticklebacks, seven smallmouth bass, four bluegill, four bullhead catfish spp., four lamprey spp., four largemouth bass, and four white catfish.

Site 6 – Wildwood

Multiple-pass depletion sampling yielded 591 fish representing six species. California roach accounted 58.4% of the catch while Sacramento pikeminnow accounted for 25.7%. Other species collected included lamprey spp., Sacramento suckerfish, sculpin spp., and threespine stickleback. Sacramento suckerfish (2,632.3g), California roach (1,443.6g), Sacramento pikeminnow (1,380.8g), and sculpin spp. (1,368.2), represented the majority of the biomass collected.

The estimated population density for this site is 2,155 fish*ha⁻¹. By species this represents one thousand two hundred and fifty-eight California roaches, five hundred and

Estimated "Wild" Trout Per Mile 1983 - 2009

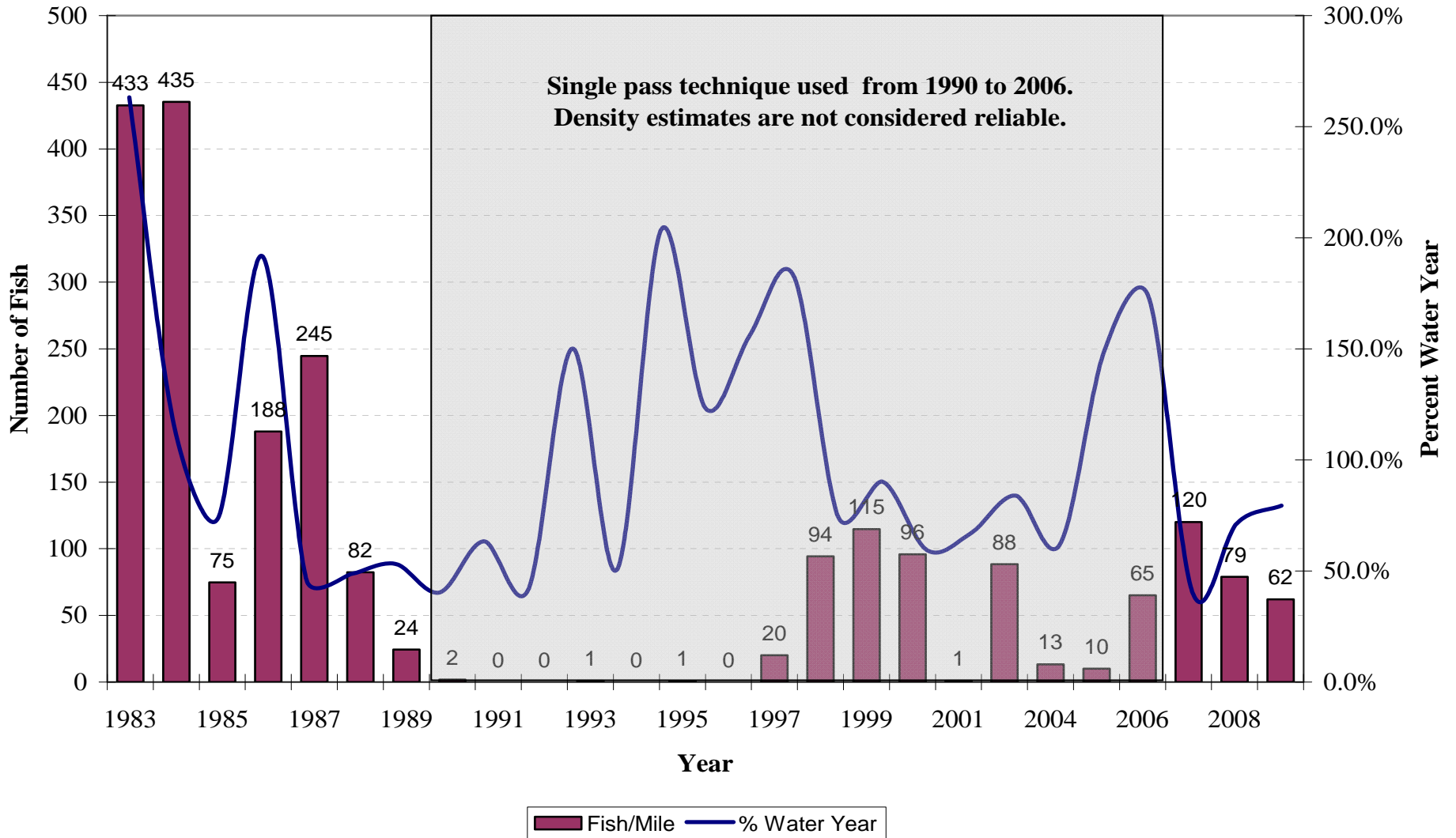


Figure 2: Estimated number of "wild" trout per mile in the Kings River between Pine Flat Dam and the Highway 180 bridge, Fresno County. Density is extrapolated from the number of "wild" trout collected from six sample sites located within the reach of the Kings River between Pine Flat Dam and the Highway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

Table 4: Catch per Unit of Effort (C.P.U.E.) for the 2009 Kings River Population Survey, Fresno County. Value represents the number of fish caught per hour of electrofishing effort.

C.P.U.E. (fish/hr)						
Common Name	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 spp.	0.5	8.4	0.6	13.4	0.1	0.1
Large mouth 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 spp.	35.9	40.5	27.8	18.5	9.8	5.8
Smallmouth Bass	0.0	0.0	0.0	0.0	0.2	0.0
Threespine Stickleback	0.1	5.6	2.3	2.9	0.6	2.6
White Catfish	0.0	0.0	0.0	0.0	0.1	0.0

fifty-four Sacramento pikeminnows, one hundred and eighty-six sculpin spp., eighty-four threespine sticklebacks, and sixty-nine Sacramento suckers.

Catch Per Unit of Effort

The Winton Park and Avocado Boulder sites produced the greatest number of wild trout per hour at 0.9 and 1.3 respectively (Table 4). A comparison of CPUE by species from 2007 to 2009 is found in Appendix A.

Wild Trout Density

The number of wild trout per mile, a measure of trout density, is extrapolated from the population estimates. This estimate is an index of trout density and is used to monitor changes in wild trout density from year to year. The population survey comprised 1,800 linear feet of the Kings River. Twenty-one (21) wild trout were collected and the resulting density estimate is 62 wild trout per mile in the Kings River from Pine Flat Dam to the Highway 180 Bridge (Table 5). Wild trout density estimates for all population surveys are illustrated in Figure 2. The wild trout per mile estimate is

Table 5: Estimated number of “wild” trout per mile extrapolated from the 2009 population estimate. Kings River, Fresno County.

November 2009			
Site Name	Site Length (ft)	Number of "Wild" Trout Collected	Estimated # of "Wild" Trout Per Mile
Winton Park Boulder	300	7	123
Alta Weir	300	1	18
Avocado Boulder	300	11	194
Avocado Side Channel	300	2	35
County Park Boulder	300	0	0
Wildwood	300	0	0
Total	1800	21	62

based on population data collected from six survey sites throughout the coldwater fishery from Pine Flat Dam to the Highway 180 Bridge. The six sites total 1,800 feet or 2.7% of the total coldwater fishery length. Six hundred (600) feet of river length is surveyed in each section (Put & Take, Catch & Release, and Catch & Release d/s of Fresno Weir) representing 2%, 2.9%, and 3.9% of the section length respectively. Though the proportion of sampled river length among the overall and section estimates remains similar, the results show a more contrasting picture of wild trout abundance by section (Table 6). No trout were collected below Fresno Weir in 2009 and therefore, the estimated number of wild trout per mile is zero. Trout density for the Put & Take section is seventy wild trout per mile and the trout density for the Catch & Release section is one hundred and fourteen wild trout per mile.

Table 6: Estimated number of wild trout per mile extrapolated from the 2009 population estimate. Kings River, Fresno County. P&T – Put & Take section from ACOE Bridge to Cobbles (Alta) Weir, C&R – Catch & Release section from Cobbles Weir to Fresno Weir, C&R d/s Fresno Weir – Catch & Release section from Fresno Weir to the Highway 180 Bridge

November 2009			
Site Name	Site Length (ft)	Number of "Wild" Trout Collected	Estimated # of "Wild" Trout Per Mile
Winton Park Boulder	300	7	123
Alta Weir	300	1	18
P&T Total	600	8	70
Avocado Boulder	300	11	194
Avocado Side Channel	300	2	35
C&R Total	600	13	114
County Park Boulder	300	0	0
Wildwood	300	0	0
C&R d/s Fresno Weir	600	0	0

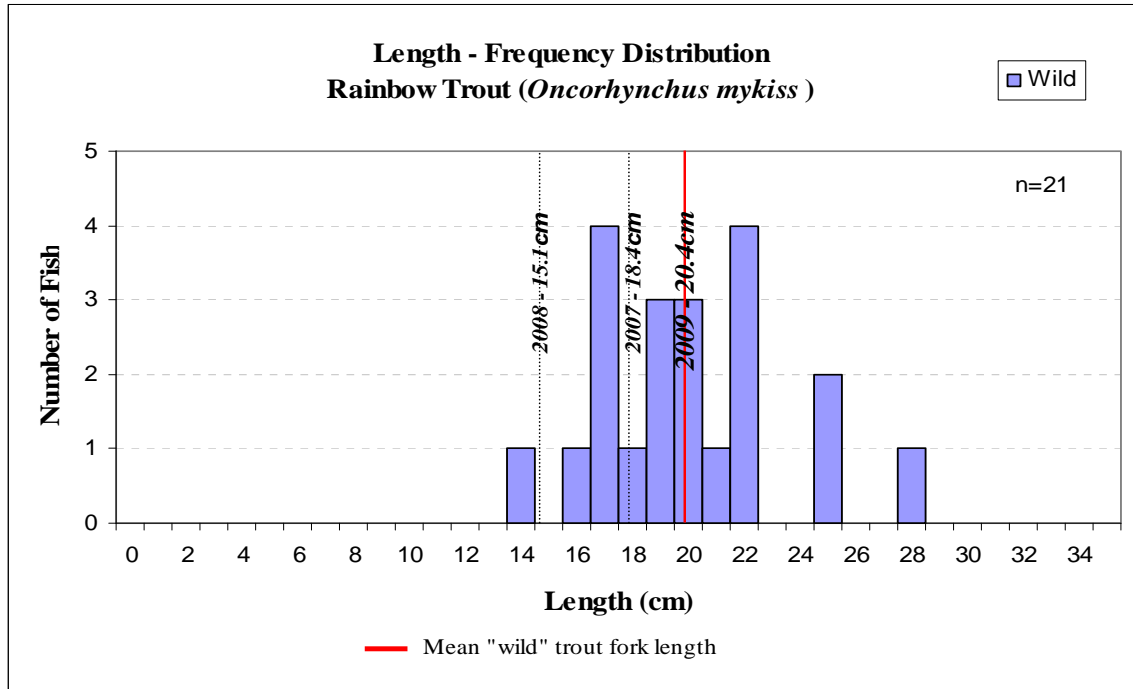


Figure 3: Length-frequency distribution of rainbow trout collected from the Kings River during the 2009 population survey, Fresno County. Average fork length of “wild” trout is approximately 8 inches (20.4cm).

Length

The average fork length of wild trout collected during the 2009 survey was 20.4cm (8.0 inches; Figure 3). This represents a 26% increase in average fork length from the 2008 survey in which wild trout length averaged just 15.1cm (KRCDD, 2008b). This also represents a 10% increase in average length from the 2007 survey (KRCDD, 2008a).

Analysis of Variance (ANOVA) of length data collected during the 2007, 2008, and 2009 surveys showed a significant difference ($p=0.001$) in fork length among survey years (Figure 4). Post Hoc analysis of fork-length data using the Games-Howell

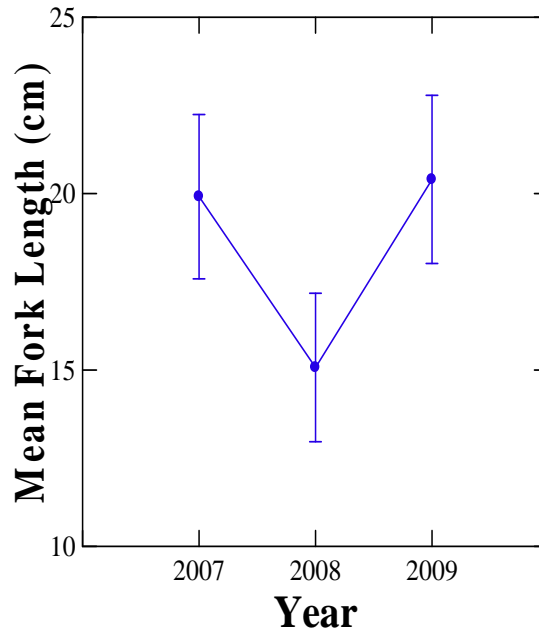


Figure 4: Mean Fork-Length of “wild” trout collected from the Kings River below Pine Flat Dam during the annual KRCDD fall population surveys; Fresno County.

Table 7: Summary of total weight (grams) by species collected during the 2009 population survey; Kings River, Fresno County.

Total Weight (grams) - November 2009							
Species	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
Bluegill	0.0	0.0	0.0	0.0	20.2	0.0	20.2
Bullhead Catfish	0.0	0.0	0.0	0.0	346.6	0.0	346.6
California Roach	0.0	942.4	285.6	35.6	198.9	1443.6	2906.1
Hatchery Trout	451.2	217.1	0.0	0.0	0.0	0.0	668.3
Lamprey spp.	17.3	342.9	16.0	461.7	3.4	2.5	843.8
Largemouth Bass	0.0	0.0	0.0	3.0	14.7	0.0	17.7
Northern Pikeminnow	146.8	955.8	5592.3	311.5	685.9	1380.8	9073.1
Rainbow Trout	706.8	49.6	1473.4	231.8	0.0	0.0	2461.6
Sacramento Sucker	4033.0	1997.6	99915.1	2394.1	26683.8	2632.3	137655.9
Sculpin spp.	2449.9	1736.2	1797.7	925.1	746.4	1368.2	9023.5
Smallmouth Bass	0.0	0.0	0.0	0.0	78.0	0.0	78.0
Threespine Stickleback	0.1	27.6	13.1	9.9	1.4	16.7	68.8
White Catfish	0.0	0.0	0.0	0.0	5.7	0.0	5.7

found significant differences between 2007 and 2008 ($p=0.048$) and between 2008 and 2009 ($p<0.001$). Length frequency data for non-game species is found in Appendix 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 2009, the total biomass collected was 163,169.3g (359.7lbs). Wild trout biomass totaled 2,461.6g (5.4lbs). This represents 1.5% of the total biomass collected during the survey. Sacramento sucker accounted for 84.3% of the biomass totaling 137,655.9g (303.5lbs). Sacramento pikeminnow and sculpin spp. accounted for 5.6% and 5.5% of the total biomass respectively. Biomass results for the 2009 survey are summarized in Table 7. Wild rainbow trout accounted for less than 11% of the total biomass at any of the six sites surveyed (Table 8). Sacramento sucker accounted for the majority of the biomass present at all survey sites.

Conclusion

This year marked the third year of multiple pass depletion sampling since the Fisheries Management Program returned to this technique in 2007. A total of 2,745 fish were collected during the survey. The total was similar to the 2008 total of 2,758 fish however, species richness increased in 2009 from 10 species to 13. The increase in species richness is attributed to warm water species (i.e. largemouth bass, smallmouth

Table 8: Summary of estimated weight (% by site) collected during the 2009 population survey; Kings River, Fresno County.

Estimated Weight, % by Site - November 2009						
Species	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%	1.4%	0.0%
California Roach	0.0%	12.2%	0.2%	1.0%	0.8%	23.4%
Hatchery Trout	6.7%	4.5%	0.0%	0.0%	0.0%	0.0%
Lamprey sp.	0.3%	4.8%	0.0%	8.5%	0.0%	0.1%
Large-mouth Bass	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%
Northern Pikeminnow	2.2%	14.8%	2.3%	8.0%	2.2%	24.0%
Rainbow Trout	10.5%	1.0%	1.5%	6.4%	0.0%	0.0%
Sacramento Sucker	49.8%	36.1%	94.2%	55.5%	92.1%	37.0%
Sculpin sp.	30.5%	26.0%	1.7%	20.2%	2.9%	15.2%
Smallmouth Bass	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%
Threespined Stickleback	0.0%	0.7%	0.0%	0.3%	0.0%	0.3%
White Catfish	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

bass, bullhead catfish) and likely represents fluctuating changes in species dispersal rather than new colonization as these species have been collected in previous surveys (KRCD 1999a). Species abundance also varied from 2008 to 2009 but standing stock continues to be dominated by the same four species; sculpin spp., California roach, Sacramento sucker, and Sacramento pikeminnow. Sculpin spp. accounted for 37.8% of the total catch while California roach accounted for 19.1%, Sacramento sucker accounted for 18.5%, and Sacramento pikeminnow accounted for 14.2%. Wild rainbow trout accounted for less than 1 percent (0.8%) of the total catch.

Annual runoff for Water Year 2009 was 1,348,173 acre feet (af) or 79.4% of average. It was the third consecutive year of drought conditions in California. The predicted end of year storage (EOY) in Pine Flat Reservoir was approximately 120,000af to 140,000af. Problems with the Friant Kern Canal forced operators to utilize the Kings River for conveyance of Central Valley Project (CVP) water to meet demands. This additional water increased storage in the reservoir and resulted in EOY storage of 199,750af. The extra water maintained the temperature control pool longer into the season and late season demand helped to mitigate any water temperature issues that typically result from low water and warm climatic conditions. Active temperature management, including weekly reservoir profiles and blending of water from multiple release points on the Pine Flat Dam, began on September 10, 2009 and were completed on November 2, 2009.

All six survey sites were sampled between November 9 and 17. Water temperatures recorded every 15 minutes with a Hydrolab Sonde at the Army Corps of Engineers (ACOE) bridge, approximately 0.5 miles downstream from Pine Flat Dam, ranged from a high of 15.94° C to a low of 12.89° C. Releases from Pine Flat Dam were approximately 100 cubic feet per second (cfs) for the duration of the survey. This represented the minimum release from Pine Flat Dam during an Exhibit “C” year and did not necessitate a variance in scheduled releases.

Due to downstream demand from one of the KRWA member units, releases had to be ramped down starting at midnight the evening before the survey to provide flows that were near 100cfs for the survey. Releases were ramped up each afternoon to meet the downstream user demands. The ramping of flows occurred on November 9, 10, and 12. The ramping rates were consistent with the rates outlined in the FMP Framework Agreement.

The total number of wild trout collected during the survey (21) was down slightly from the twenty-seven wild trout collected in the 2008 survey. These numbers are similar and do not represent a drastic decrease in the number of wild rainbow trout collected. Increases in abundance were observed in only two species regularly collected during the annual population survey. Lamprey spp. abundance increased by 12% in 2009 and sculpin spp. abundance increased by 85%. The reason behind the increase in abundance is unknown however the decrease in predator abundance (i.e. trout, pikeminnow) may have had some effect. The proportion of wild rainbow trout collected decreased slightly from 96% in 2008 to 93% in 2009. The number of hatchery trout collected increased from 1 to 2 in the 2009 survey as well.

Analysis of trout density overlaid with the hydrologic record (Figure 2) shows striking similarities between the periods 1986-1989 and 2006-2009. In the former, 1986 saw a 191.8% water year. This was followed by a period of dry years (45.8%, 48.6%, and 53.2%). By 1989, the estimated wild trout density had been reduced to just twenty-four trout per mile. In 2006, the Kings River drainage experienced a 173.3% water year. This too was followed by a period of dry years (39.9%, 71.5%, and 79.4%). By 2009, the estimated wild trout density had decreased to sixty-two trout per mile. During the 1980s, minimum discharge from the Pine Flat Dam was 50cfs, a temperature control pool in the reservoir was not available for late season use, and little in the way of habitat

enhancement had been accomplished. Furthermore, starting in 1981, the trout creel limit was increased from five trout to ten trout during the trout season (Saturday nearest May 1 to November 15) and five trout during the off season (KRCD 1999b). In 1990, the trout bag limit was changed to five trout year round and in 1996, the Catch and Release section from Alta Weir to the Highway 180 Bridge was established (KRCD 1999b). With the signing of the Kings River Fisheries Management Program's Framework Agreement in 1999, minimum discharge from Pine Flat Dam was increased to 100cfs and a temperature control pool of 100,000 acre feet was established. As part of the FMP Habitat Enhancement Master Plan, habitat enhancement work began in 2005 with the placement of thousands of boulders within the river channel as well as thousands of tons of gravel for spawning.

The data suggests that changes in minimum flow requirements and habitat enhancement projects have improved conditions for trout, particularly during the winter when discharge from Pine Flat Dam is at its lowest. This has perhaps improved survivorship by increasing the amount of available habitat by both increasing minimum instream flow and creating habitat with the placement of boulders in the channel. Only three years of data have been collected using the multiple-pass depletion technique since the Framework Agreement was signed. Further monitoring is required.

In the spring of 2009, 150,000 triploid trout eggs were incubated in streamside incubators maintained by the FMP and volunteers from the Public Advisory Group. The emerging fry were released into the Kings River. The red blood cells of triploid trout are larger than those of diploid trout and can be used to distinguish between the two. The blood cells of the triploid trout serve as a means to mark trout hatched in the incubators. The triploid trout were used to study the contributions of the incubators to the standing stock of rainbow trout in the Kings River. During the fall survey, blood samples were drawn from nineteen wild trout in the three to eight inch range as part of the incubator effectiveness study being conducted by the Fisheries Management Program. Seventeen of the 19 samples drawn were readable and two of the seventeen were determined to be triploid. Because these fish were, for all intents and purposes, wild trout, they were classified as such for the purposes of the population survey. It is too early to conclude anything from these results however a report detailing the findings of incubator

contributions to the trout population will be made available following the completion of the study.

The abundance of Sacramento sucker has long been an issue with many local anglers. This species has not escaped the effects of drought, however. While it remains one of the most abundant species found in this section of the Kings River, Sacramento sucker is the third most abundant species accounting for 18.5% of the total catch. It does account for the majority of biomass but this has as much to do with the size and weight of adult fish as it does its abundance. In 2007, two thousand and twenty-one Sacramento suckers were captured during the fall population survey. This number has been reduced by 75% in just two years to five hundred and nine suckers captured in 2009. Despite the change in abundance, the percent biomass only decreased by 2.7% in the same time period. Fluctuations in the sucker population are expected to continue, with increases in abundance following wet periods and decreases in abundance following dry periods.

Six of the eight species regularly collected during the fall survey have experienced decreases in abundance since 2007. The exceptions to this phenomenon are California roach and threespine stickleback. While these species have declined since 2008, their current abundance remains above what was observed in 2007. The fluctuations in abundance of all species are likely due to a number of factors, not the least of which is the hydrology.

Despite the minor decrease in the number of wild trout collected, the increase in average fork length is encouraging, suggesting that perhaps the habitat improvement projects are having a positive influence on the trout population. Further monitoring is warranted however, as fluctuations in trout abundance within survey sites that have received habitat enhancements suggests that the population is not yet stable (Figure 6).

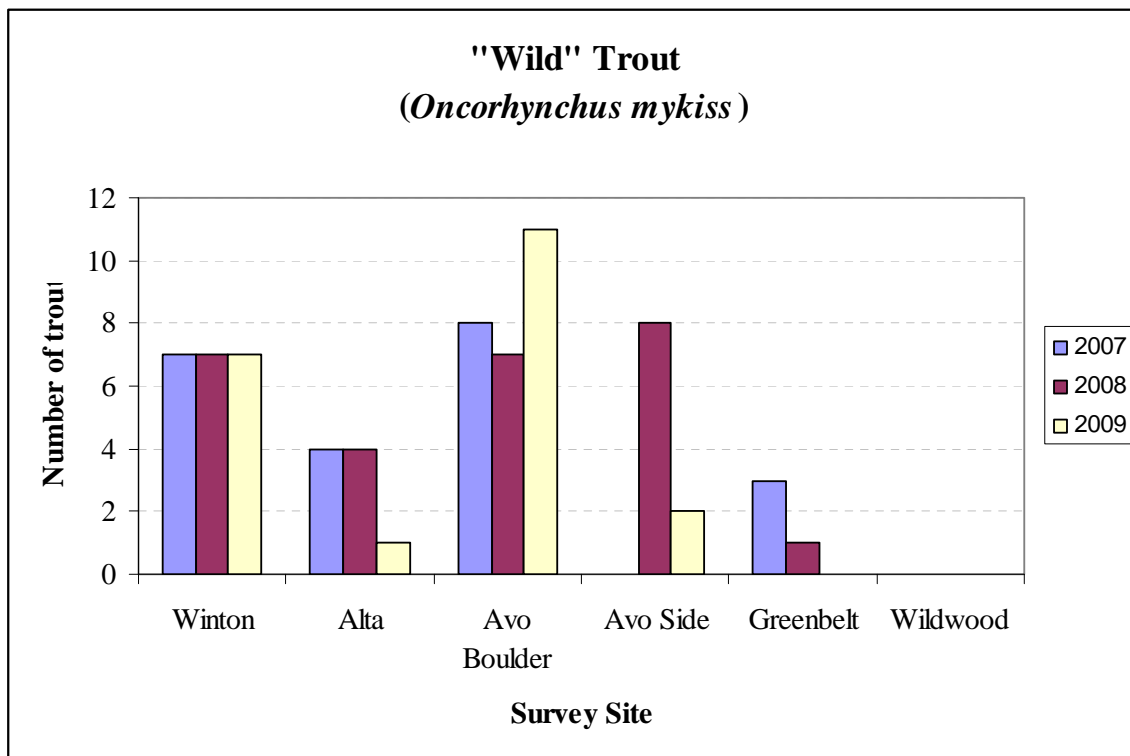


Figure 6: Analysis of within site variation of “wild” trout collected from 2007 to 2009. The Winton Park site has remained stable, producing seven “wild” trout each of the last three years. The Avocado Side Channel site remains highly variable, producing zero “wild” trout in 2007, eleven in 2008, and only two in 2009.

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Appendix A

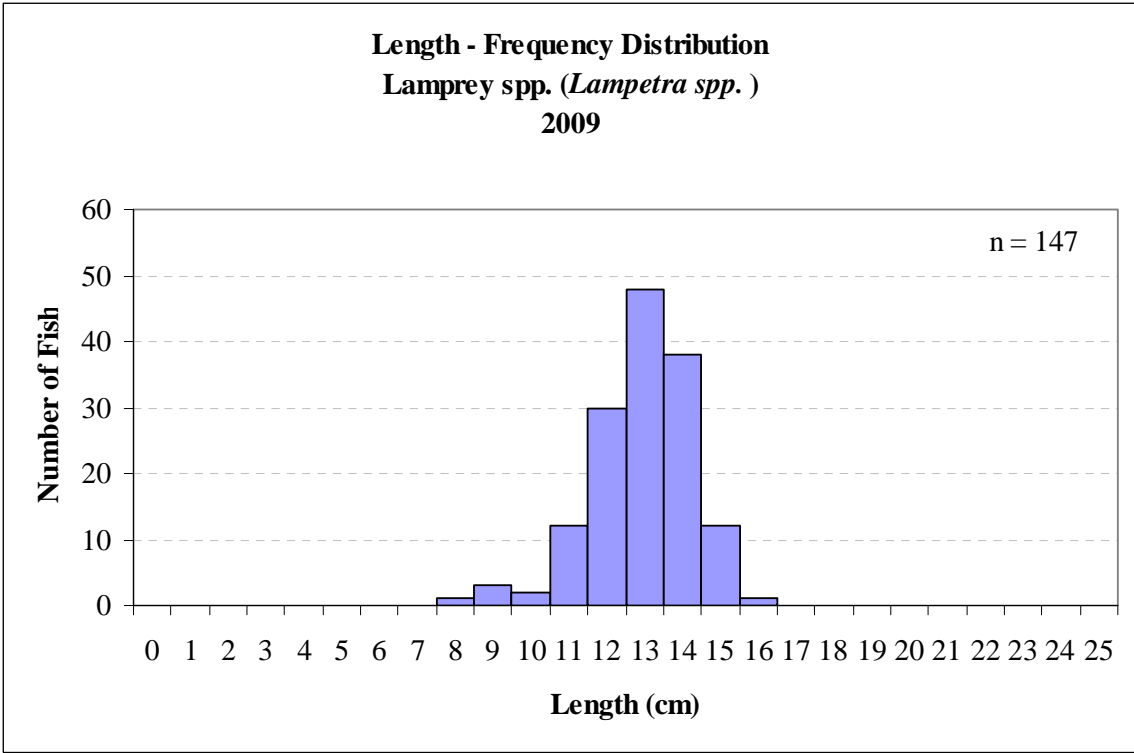
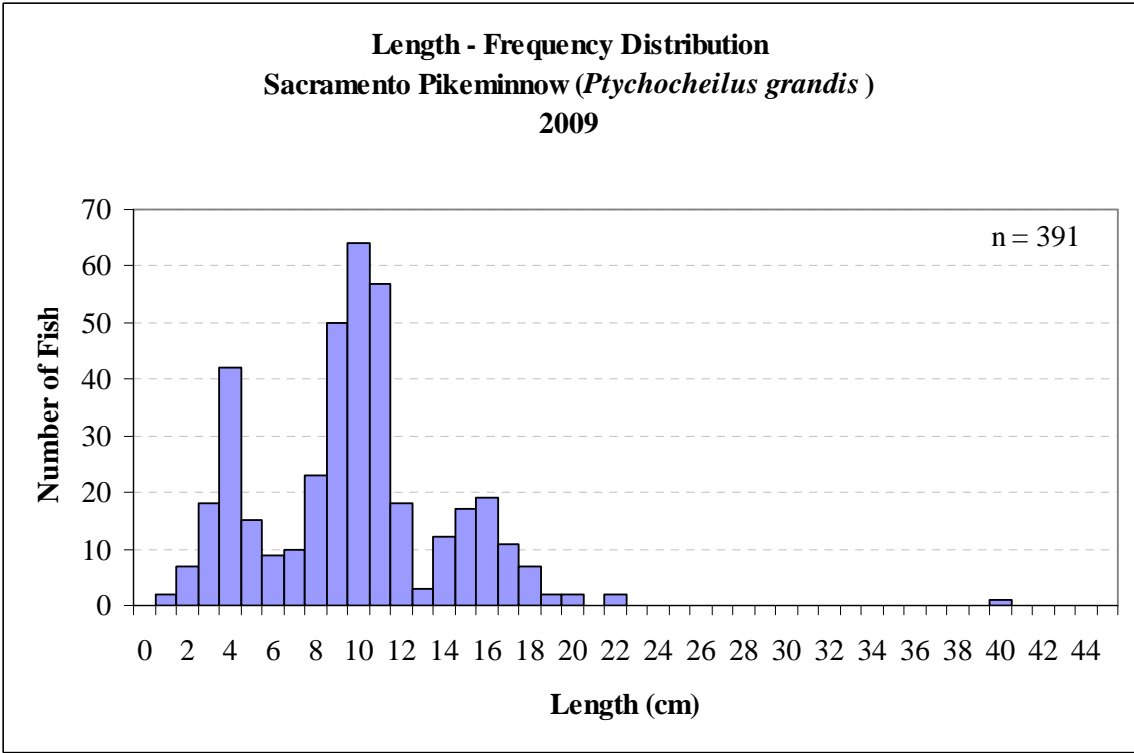
Catch Per Unit of Effort (CPUE) by species; 2007 to 2009. Note: Nine sites were sampled during the 2007 survey. The three extra sites were not taken into account for the purposes of this comparison. Data for the three additional sites can be found in the 2007 population survey report (KRCD 2007).

C.P.U.E. (fish/hr) 2007						
Common Name	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
Northern 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
Threespined Stickleback	0.9	3.5	0.9	2.2	0.0	1.8

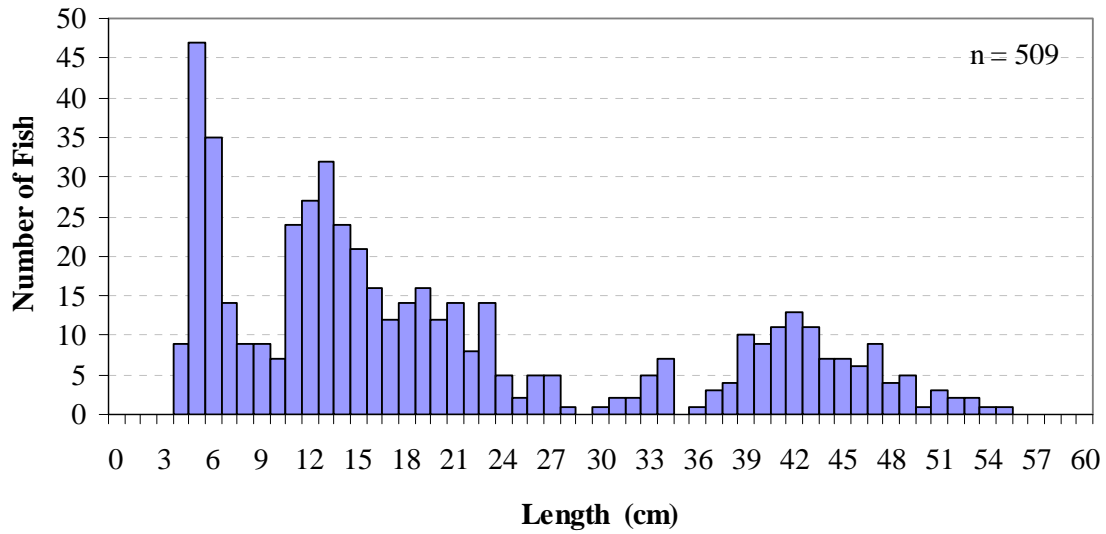
C.P.U.E. (fish/hr) 2008						
Common Name	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	0.0	1.2	12.8	2.8	29.5	40.8
Hatchery Trout	0.0	0.0	0.2	0.0	0.0	0.0
Kern Brook Lamprey	0.3	9.4	0.8	13.2	0.3	0.0
Mosquito Fish	0.0	0.4	0.0	0.0	0.0	0.0
Northern Pikeminnow	8.8	3.0	21.7	8.3	20.1	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
Threespined 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

C.P.U.E. (fish/hr) 2009						
Common Name	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
Rainbow Trout	0.9	0.1	1.3	0.3	0.0	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
Smallmouth Bass	0.0	0.0	0.0	0.0	0.2	0.0
Threespined 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

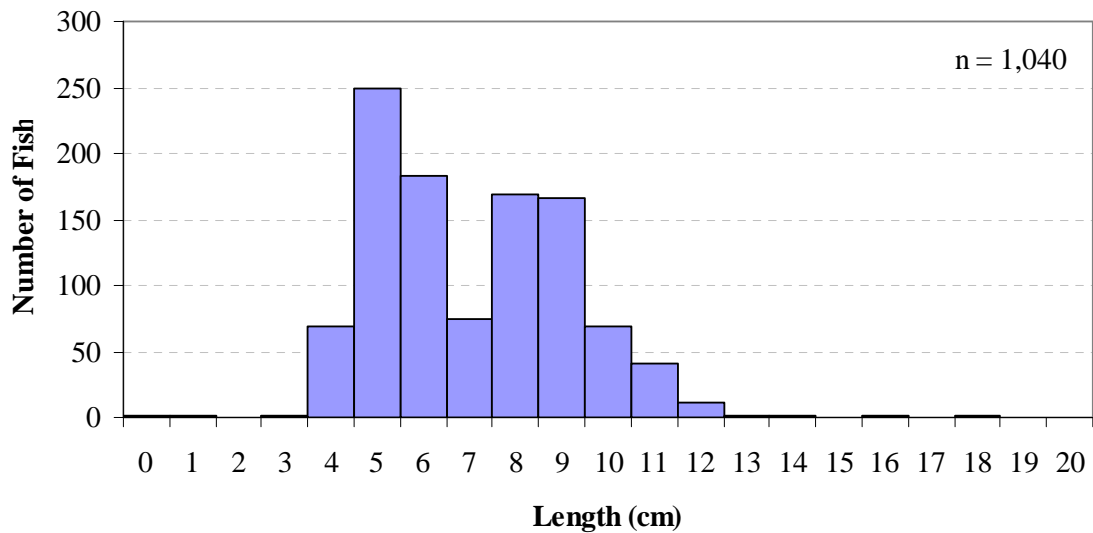
Appendix B



Length - Frequency Distribution
Sacramento Sucker (*Cotostamus occidentalis*)
2009



Length - Frequency Distribution
Sculpin spp. (*Cottus spp.*)
2009



Length - Frequency Distribution
Threespine stickleback (*Gasterosteus aculeatus*)
2009

