

Lower Kings River Annual Trout and non-game fish Population
Survey:
2011 Electrofishing Results

Kings River Conservation District
Environmental Resource Division

In-House Report
April 2012

Report Addendum

Lower Kings River Annual Trout and non-game fish Population Survey: 2011 Electrofishing Results Report

This is an addendum to the report issued in April 2012 discussing the results of the fish population survey conducted in the Kings River during the fall of 2011. The purpose of this addendum is to correct miscalculations that occurred in the fish per hectare estimates for each of the survey sites and to correct mislabeled species in several of the Tables throughout the report.

Corrections;

Page 7, Paragraph 2; The estimated population density for this site is 2,054 fish*ha⁻¹. By species this represents 931 sculpin spp., 811 Sacramento suckerfish, 143 Sacramento pikeminnow, 114 three-spined stickleback, 51 California roach, and 3 Green sunfish.

Page 7, Paragraph 4; The estimated population density for this site is 2,365 fish*ha⁻¹. By species this represents 1,145 sculpin spp., 560 Sacramento suckerfish, 250 three-spined stickleback, 245 Lamprey spp., 115 Sacramento pikeminnow, 35 California roach, 15 rainbow trout.

Page 8, Paragraph 1; The estimated population density for this site is 1,600 fish*ha⁻¹. By species this represents 550 Sacramento suckerfish, 544 sculpin spp., 169 Lamprey spp., 150 California roach, 63 Sacramento pikeminnow, 56 three-spined stickleback, 38 hatchery rainbow trout, and 31 rainbow trout.

Page 8, Paragraph 3; The estimated population density for this site is 2,653 fish*ha⁻¹. By species this represents 1,060 sculpin spp., 900 lamprey spp., 360 Sacramento suckerfish, 260 California roach, 27 rainbow trout, 27 three-spined stickleback, 13 Sacramento pikeminnow, and 7 hatchery rainbow trout.

Page 8, Paragraph 5; The estimated population density for this site is 1,189 fish*ha⁻¹. By species this represents 925 sculpin spp., 146 California roach, 64 Sacramento pikeminnow, 50 Sacramento suckerfish, and 4 three-spined stickleback.

Page 9, Paragraph 1; The estimated population density for this site is 2,619 fish*ha⁻¹. By species this represents 1,444 California roach, 578 Sacramento suckerfish, 556 sculpin spp., 30 Sacramento pikeminnow, and 11 three-spined stickleback.

Page 12, Table 7; Northern pikeminnow should read "Sacramento pikeminnow." Northern pikeminnow are not present in the Kings River.

Page 18, Appendix A, Table 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) and the Kings River Water Association (KRWA), have conducted annual population studies 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 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. 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 Fisheries Management Program's (FMP) Technical Steering Committee (KRCD, CDFG and the 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 and measuring 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 LR-24 backpack electrofishers were utilized in the surveys. Electrofishers were set at 350 volts, 50 hertz on a 10% duty cycle, pulsed direct current.

KRCD, CDFG, KRWA, the Department of Water Resources (DWR), FishBio, The Fishery Foundation and Hanson Environmental staff participated in the population survey. Volunteers from the fishing public and students from Reedley College also lent assistance.

As 2011 saw a 192.12% water year, the fall electrofishing survey was pushed back to the final week of November. All sites were sampled between November 28 and December 1. Due to an unexpected water order, the survey had to be completed in four days as opposed to the planned six. Because of the limited timeline, the Winton Park and Alta sites were shocked simultaneously as were the Avocado Side Channel and Avocado Boulder sites the following day. The need for simultaneous sampling resulted in less than optimal crew sizes at each site. Smaller crews have the potential to leave gaps in electrofishing lines which create prospective openings for absconding fishes to evade capture. This may have resulted in artificially low species counts within those sites during the 2011 survey.

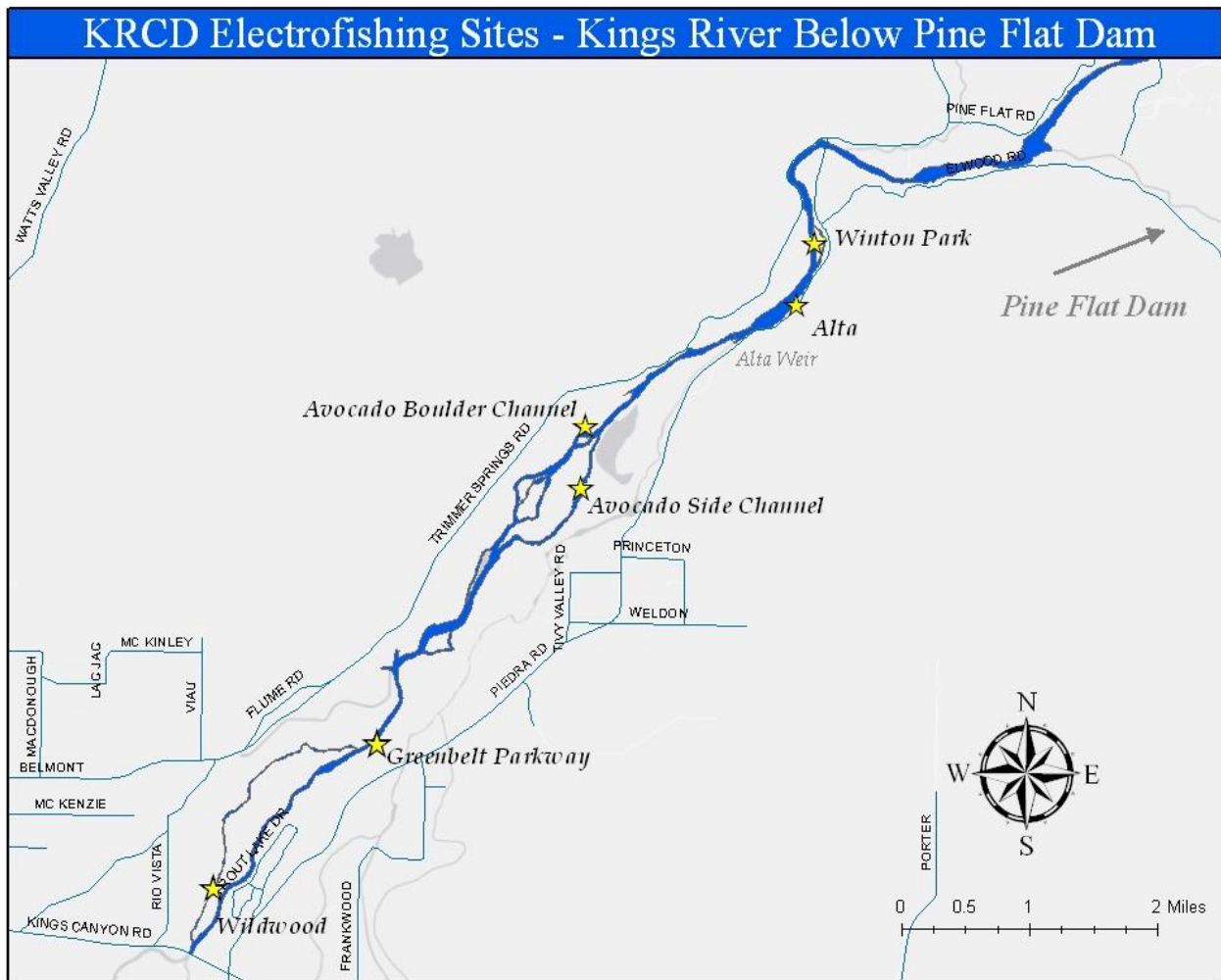


Figure 1: Electrofishing Survey site map

The previously mentioned 192.12% water year triggered a high level Exhibit D requirement, in which the Kings River Fisheries Management Program Framework Agreement called for flows at Piedra of at least 255 cfs (250 cfs at Fresno Weir, 5 cfs in the Dennis Cut). These flows were considerably higher than the 100 cfs flows that are required for safe electrofishing conditions. Clauses within Exhibit D in the Framework Agreement allow for flows to “be altered as necessary to facilitate monitoring, construction of Program features, flood control activities of the Corps of Engineers, or other considerations of overriding importance approved by the Executive Policy Committee.” In 2007, the Executive Policy Committee approved a systematic flow variance to resolve these issues, and allow for the flows to be reduced below Exhibit D requirements for monitoring purposes.

An additional part of the framework agreement, designated under section 1g of the agreement, addresses the “Rates of Change of Flow at Low River States.” This section outlines preferable rates of change in both the increase and decrease of flow in hourly time steps when releases from Pine Flat “are being made at a rate of 300 cubic feet per second or less.”

In the past, these ramping rates have been followed for irrigation orders, changes in minimum flows, and during electrofishing activities. Unfortunately, due to circumstances beyond the control of the program, maintenance efforts on Pine Flat Dam and the Pine Flat Powerhouse during the time of the scheduled 2011 electrofishing efforts made the hourly changes proposed in section 1g of the Framework Agreement not feasible.

As such, the Technical Steering Committee (TSC) requested, and was granted, a variance from the Executive Policy Committee addressing the “Rates of Change of Flow at Low River States,” as defined in section 1g. This variance allowed for a single change from Exhibit D level (or irrigation demand) flows down to 100 cfs for the period of time necessary to complete the monitoring activity, followed by a single change from 100 cfs back to the Exhibit D level (or irrigation demand) of flows after the activities were completed. The variance was granted by the Executive Policy Committee Meeting of November 21, 2011 via teleconference. These changes of instream flow during the survey are summarized in Table 1.

Table 1: Change in discharge rates from November 28th - December 1st 2011

Discharge from Pine Flat Dam		
Date	Time	Discharge (cfs)
11/28/2011	0000	260
	1200	100
11/29/2011	0000	280
	1200	100
	1430	280
11/30/2011	0100	290
	1300	100
12/1/2011	0100	500
	1200	100
	1300	500
	0000	700

Electrofishing was conducted using four 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. 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 measured to fork length. Scale samples were taken from each rainbow trout just behind the dorsal fin for later aging in the lab. Rainbow trout exhibiting obvious signs of hatchery origin (i.e. worn or abraded fins, clipped adipose fins) were treated as a separate species than those considered to be stream reared and therefore classified 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 analysis of the data. 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 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.

Fish-Per-Hectare

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

Results

A total of 1,834 fish were collected during the fall 2011 population survey. Species collected included; California roach *Hesperoluecus symmetricus*, Green Sunfish *Lepomis cyanellus*, lamprey spp. *Lampetra sp* (several species may be present but not distinguished), Sacramento pikeminnow *Ptycheilus grandis*, rainbow trout *Oncorhynchus mykiss*, Sacramento Sucker *Catostomus occidentalis*, sculpin spp. *Cottus spp.* and three-spined stickleback *Gasterosteus aculeatus*. The total catch is displayed by site in Table 2. These data represent the total number of each species caught at each survey site. Percent composition is summarized by species in Table 3. Population estimates are summarized in Table 4 and 95% confidence intervals are summarized in Appendix A (Table A).

Table 2: Total Catch

Total Catch by species for the 2011 Kings River Population Survey below Pine Flat Dam							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
California Roach	6	7	23	25	26	212	299
Green Sunfish	1	0	0	0	0	0	1
Hatchery Trout	0	0	6	1	0	0	7
Lamprey sp.	0	48	17	90	0	0	155
Sacramento Pikeminnow	33	22	9	2	12	8	86
Rainbow Trout	0	3	5	4	0	0	12
Sacramento Sucker	63	98	68	44	13	77	363
Sculpin sp.	252	213	85	144	60	93	847
Three-spined Stickleback	9	38	9	4	1	3	64
	364	429	222	314	112	393	1834

Table 3: Percent composition by species

Total Catch (% by species) December 2011							
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
California Roach	2.0%	2.3%	7.7%	8.4%	8.7%	70.9%	100.0%
Green Sunfish	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Hatchery Trout	0.0%	0.0%	85.7%	14.3%	0.0%	0.0%	100.0%
Lamprey sp.	0.0%	31.0%	11.0%	58.0%	0.0%	0.0%	100.0%
Sacramento Pikeminnow	38.4%	25.6%	10.5%	2.3%	14.0%	9.2%	100.0%
Rainbow Trout	0.0%	25.0%	41.7%	33.3%	0.0%	0.0%	100.0%
Sacramento Sucker	17.4%	27.0%	18.7%	12.1%	3.6%	21.2%	100.0%
Sculpin sp.	29.8%	25.1%	10.0%	17.0%	7.1%	11.0%	100.0%
Three-spined Stickleback	14.1%	59.4%	14.1%	6.3%	1.5%	4.6%	100.0%

Table 4: Population estimate by species and site: 2011 Kings River Population Survey, Fresno County. Estimate generated using Microfish 3.0 software.

Population Estimate (maximum likelihood) December 2011						
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	18	7	24	39	41	390
Green Sunfish	1	0	0	0	0	0
Hatchery Trout	0	0	6	1	0	0
Lamprey sp.	0	49	27	135	0	0
Sacramento Pikeminnow	50	23	10	2	18	8
Rainbow Trout	0	3	5	4	0	0
Sacramento Sucker	284	112	88	54	14	156
Sculpin sp.	326	229	87	159	259	150
Three-spined Stickleback	40	50	9	4	1	3

Site 1 – Winton Park

Multiple-pass depletion sampling yielded 364 fishes representing six species. Sculpin spp. accounted for 69.2% of the catch while Sacramento sucker accounted for 17.3%. Other species collected included three-spined stickleback, Sacramento pikeminnow, California roach, and green sunfish. Sacramento sucker (1,326.5g), sculpin spp. (2,547.0g), and Sacramento pikeminnow (84.7g), represented the majority of the biomass collected.

The estimated population density for this site is 5,247.0 fish*ha⁻¹. By species, this represents two thousand three hundred seventy-nine sculpin spp., two thousand seventy-two Sacramento sucker, three hundred sixty-five Sacramento pikeminnow, two hundred ninety-two three-spined stickleback, one hundred thirty-two California roach, and seven green sunfish.

Site 2 – Alta

Multiple-pass depletion sampling yielded 429 fishes representing seven species. Sculpin spp. accounted for 49.7% of the catch and Sacramento sucker accounted for 22.8%. Other species collected included lamprey spp., three-spined stickleback, Sacramento pikeminnow, California roach and wild rainbow trout. Sculpin spp. (1,136.0g) and Sacramento sucker (974.5g) represented the majority of the biomass collected.

The estimated population density for this site is 11,825 fish*ha⁻¹. By species, this represents five thousand seven hundred twenty-five sculpin spp., two thousand eight hundred Sacramento sucker, one thousand two hundred fifty three-spined stickleback, one thousand two hundred twenty-five lamprey spp., five hundred seventy-five Sacramento pikeminnow, one hundred seventy-five California roach, and seventy-five wild rainbow trout.

Site 3 – Avocado Boulder Project

Multiple-pass depletion sampling yielded 222 fishes representing eight species. Sculpin spp. accounted for 38.2% of the catch while Sacramento sucker accounted for 30.5% and California roach accounted for 10.4%. Other species collected included lamprey spp., three-spined stickleback, Sacramento pikeminnow, hatchery rainbow trout and wild rainbow trout. Wild rainbow trout (26,627.0g) Sacramento sucker (22,705.5g), hatchery rainbow trout (3,353.2g) and sculpin (1,006.3g) represented the majority of the biomass collected.

The estimated population density for this site is 8,885.0 fish*ha⁻¹. By species, this represents three thousand fifty-four Sacramento sucker, three thousand nineteen sculpin spp., nine hundred thirty-seven Lamprey spp., eight hundred thirty-three California roaches, three hundred forty-eight Sacramento pikeminnows, three hundred twelve three-spined stickleback, two hundred eight hatchery trout and one hundred seventy-four wild rainbow trout.

Site 4 – Avocado Side Channel

Multiple-pass depletion sampling yielded 314 fishes representing eight species. Sculpin spp. accounted for 52.8%, while lamprey spp. accounted for 28.7% and Sacramento sucker accounted for 14.0%. Other Species collected included California roach, wild rainbow trout, three-spined stickleback, Sacramento pikeminnow, and hatchery trout. Sacramento sucker (5,982.0g), sculpin spp. (1,252.4g), and “wild” rainbow trout (834.0g) represented the majority of the biomass collected.

The estimated population density for this site is 17,512.0 fish*ha⁻¹. By species, this represents six thousand nine hundred ninety-six sculpin spp., five thousand nine hundred forty lamprey spp., two thousand three hundred seventy-six Sacramento sucker, one thousand seven hundred sixteen California roach, one hundred seventy-six stickleback, one hundred seventy-six wild rainbow trout, eighty-eight Sacramento pikeminnow, and forty-four hatchery trout.

Site 5 – Greenbelt Parkway

Multiple-pass depletion sampling yielded 112 fishes representing five species. Sculpin spp. accounted for 53.6%, California Roach 23.2%, and Sacramento sucker represented 11.6%. Sacramento pikeminnow and three-spined stickleback accounted for the rest of the catch. Sacramento sucker (1,274.3g), sculpin spp. (622.1g), and California roach (223.7g) represented the majority of the biomass collected.

The estimated population density for this site is 4,563.0 fish*ha⁻¹. By species, this represents three thousand five hundred forty-nine sculpin spp., five hundred sixty-two California roach, two hundred forty-six Sacramento pikeminnow, one hundred ninety-two Sacramento sucker and fourteen three-spined stickleback.

Site 6 – Wildwood

Multiple-pass depletion sampling yielded 393 fishes representing five species. California roach accounted for 53.9% of the catch while Sculpin accounted for 23.7% and Sacramento sucker 19.6%. Other species collected included Sacramento pikeminnow and three-spined stickleback. California roach (1,206.4g), Sculpin sp. (1,112.2), Sacramento sucker (382.3g), represented the majority of the biomass collected.

The estimated population density for this site is 11,321.0 fish*ha⁻¹. By species, this represents six thousand two hundred forty California roach, two thousand four hundred ninety-six Sacramento sucker, two thousand four hundred sculpin spp., one hundred twenty-eight Sacramento pikeminnow and forty-eight three-spined stickleback.

Catch Per Unit of Effort

The Catch per Unit of Effort for each species is summarized by site in Table 5. The Avocado Side Channel and Alta sites were the most productive, generating 0.70 and 0.64 wild trout per hour respectively. A comparison of CPUE values from 2007 to 2011 are summarized in Appendix B.

Table 5: Catch per unit of effort

C.P.U.E (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

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 coldwater fishery from Pine Flat Dam to the Highway 180 Bridge. The six sites total 1,800 feet or 37% of the total coldwater 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.

Twelve wild trout were collected during the 2011 electrofishing survey. The estimated wild trout density is thirty-five (35) trout per mile within the cold water fishery from Pine Flat Dam to the Highway 180 Bridge (Table 6). Historical wild trout density estimates dating back to 1983 are summarized in Figure 3.

Table 6: Estimate of wild trout per mile

Site	Site Length (ft)	Number	"Wild" Trout
	Length (ft.)	Wild Trout	per mile
Winton Park Boulder	300	0	53
Alta Weir	300	3	88
Avocado Boulder	300	5	70
Avocado Side Channel	300	4	0
Greenbelt	300	0	0
Wildwood	300	0	0
Total	1800	12	35

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 2011, the total biomass collected was 75,244.9g (165.9lbs). Wild trout biomass totaled 27,632.3g (60.92lbs). This represents 36.7% of the total biomass collected during the survey. Sacramento sucker accounted for 43.3% of the biomass (32,645.1g; 71.97lbs). Sculpin accounted for 10.2% of the total biomass with hatchery trout, California roach, lamprey, Sacramento pikeminnow, three-spined stickleback and green sunfish accounted for the final 9.8%. Biomass results for the 2011 survey are summarized by site in Table 7.

Estimated "Wild" Trout Per Mile 1983 - 2011

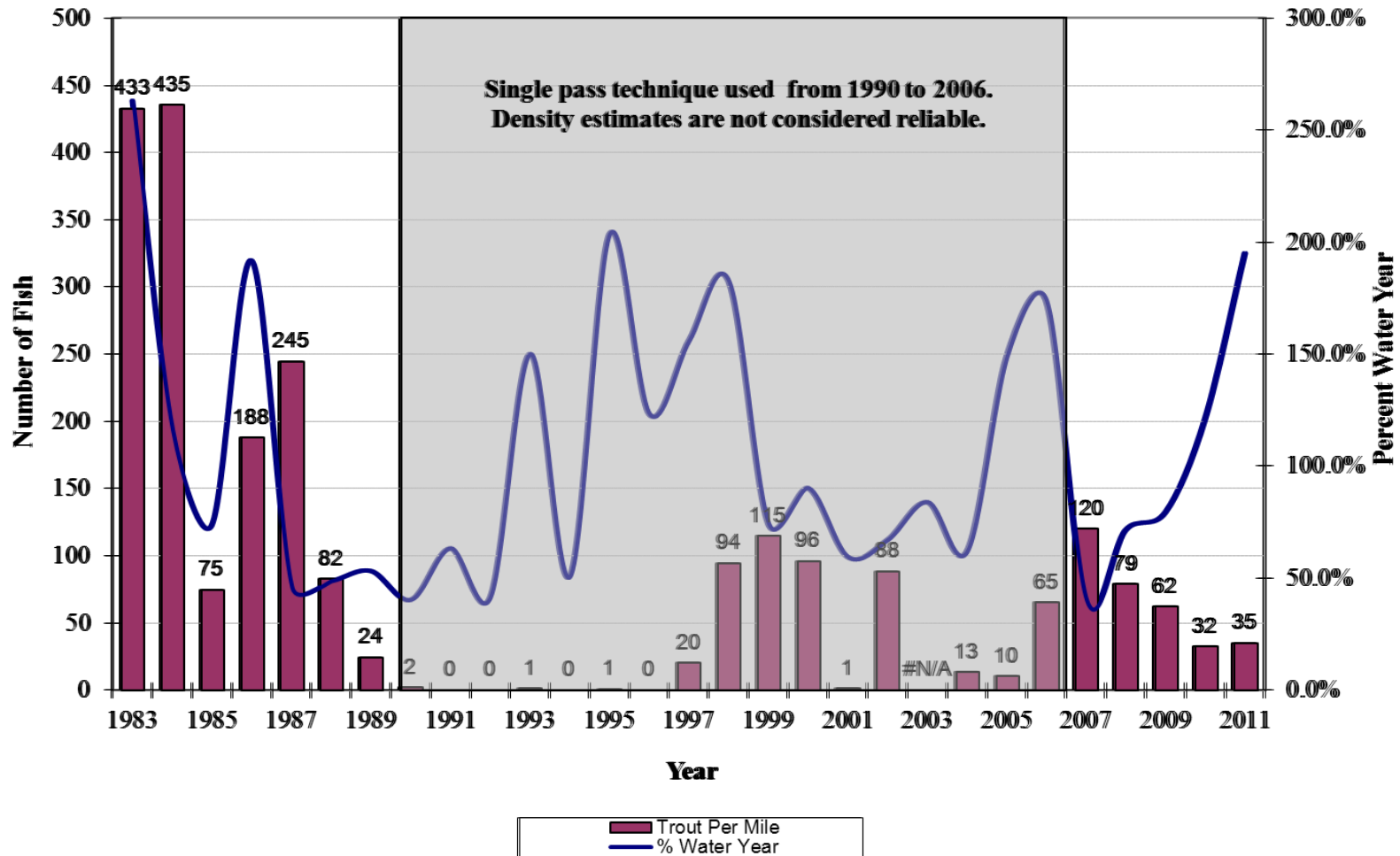


Figure 3: Estimated number of "wild" trout per mile in the Kings River between Pine Flat Dam and the Highway 180 bridge, Fresno County. Density is extrapolated from the number of wild trout collected from six sample sites located within the reach of the Kings River between Pine Flat Dam and the Highway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

Table 7: Biomass percent species composition by site

Total Weight % by Species - December 2011							
Species	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
California Roach	1.4%	2.8%	13.3%	11.8%	11.1%	59.6%	100.0%
Green Sunfish	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Hatchery Trout	0.0%	0.0%	86.7%	13.3%	0.0%	0.0%	100.0%
Lamprey sp.	0.0%	25.4%	12.6%	62.0%	0.0%	0.0%	100.0%
Northern Pikeminnow	15.4%	7.0%	31.4%	11.2%	19.1%	15.9%	100.0%
Rainbow Trout	0.0%	4.7%	72.3%	23.0%	0.0%	0.0%	100.0%
Sacramento Sucker	4.1%	3.0%	69.5%	18.3%	3.9%	1.2%	100.0%
Sculpin sp.	33.2%	14.8%	13.1%	16.3%	8.1%	14.5%	100.0%
Three-spined Stickleback	14.9%	50.1%	23.4%	4.3%	1.6%	5.7%	100.0%

Length

The mean fork length for wild rainbow trout collected during the 2011 survey was 25.5cm (approx. 10 inches). Mean fork length for wild rainbow trout collected in 2010 was 17.25cm (approx. 6.8 inches). Although mean fork length increased by 8.25cm subsequent to the 2010 survey no statistical significance ($p = 0.105$) was found. The length-frequency distribution from 2007 - 2011 is illustrated in Figure 4. Length frequency data for non-game species is located in Appendix B.

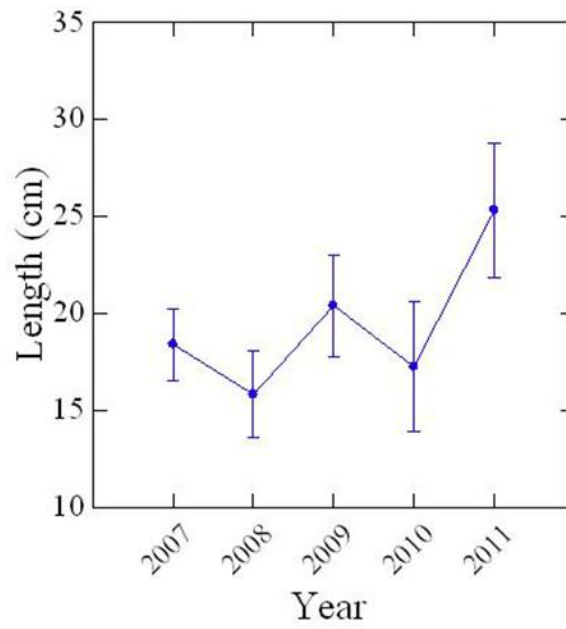


Figure 2: Mean Fork Length of "wild" trout collected from the Kings River below Pine Flat Dam during the annual population surveys; Fresno County.

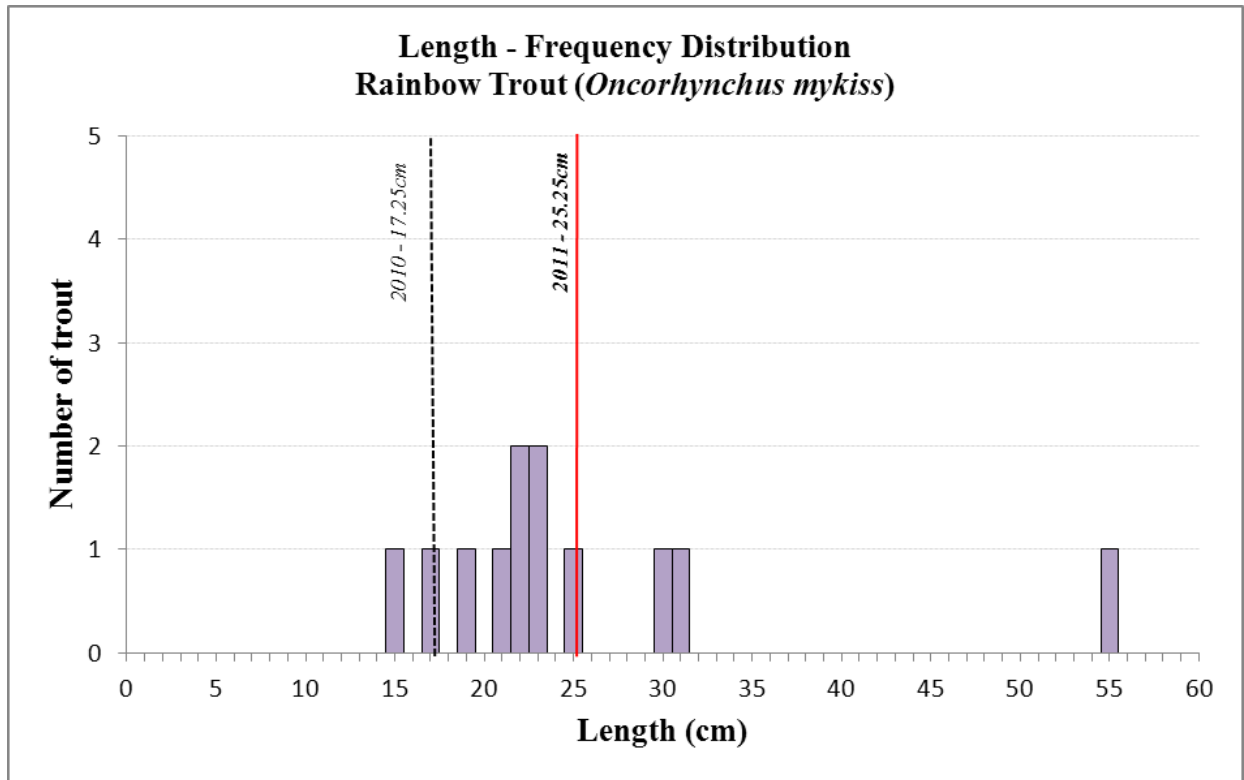


Figure 4: Length-frequency distribution of rainbow trout collected from the Kings River during the 2011 population survey, Fresno County. Average fork length of “wild” trout is approximately 8 inches (20.48cm).

Age

Scale samples collected from rainbow trout in the field were analyzed in the lab. Counts of annuli and circuli produced approximate ages for nine wild trout and six hatchery trout. Ages of wild trout collected ranged from 2 to 4 years of age and ages of hatchery trout ranged from 2 to 5 years of age (Table 8). The median age of wild trout captured in 2011 was 2 years.

Conclusion

This year marked the fifth year of multiple pass depletion sampling since the FMP returned to triple-pass depletion in 2007. A total of 1834 fishes were collected during the survey. Species richness decreased from thirteen species in 2009 to nine in 2011. Species abundance also varied from the last survey but standing stock continues to be dominated by the same three species; sculpin spp., California roach and Sacramento sucker. Sculpin spp. accounted for 46.2%

of the total catch while Sacramento sucker accounted for 19.8% and California roach accounted for 16.3%. Wild rainbow trout accounted for less than 1 percent (0.65%) of the total catch.

The total number of wild trout collected during the survey (12) was up one from the eleven wild trout collected in 2010. The variation of wild trout collected among sites is illustrated in Figure 5.

Table 8: Approximate ages of wild and hatchery trout from the 2011 electrofishing survey.

Rainbow Trout Size & Age					
Date	Site	Length (mm)	Weight (g)	Wild	Age
11/30/2011	Alta	153	39.8	y	2
11/30/2011	Alta	167	50.9	y	2
11/30/2011	Alta	189	80.6	y	2
12/1/2011	Avo Bo	173	56.4	n	2
12/1/2011	Avo Bo	191	68	n	2
12/1/2011	Avo Bo	222	151.7	y	2
12/1/2011	Avo Bo	223	170.4	y	3
12/1/2011	Avo Bo	245	168.2	y	3
12/1/2011	Avo Bo	446	814.2	n	5
12/1/2011	Avo Bo	448	929.6	n	5
12/1/2011	Avo Bo	552	1939.2	y	4
12/1/2011	Avo Side	211	110.2	y	2
12/1/2011	Avo Side	230	121.1	y	3
12/1/2011	Avo Side	314	305.2	n	4
12/1/2011	Avo Side	366	516.8	n	5

An increase in abundance from the 2010 survey was observed in only one of the eight species regularly collected during the annual population survey. Lamprey spp. abundance increased by 85% while all other species decreased in relative abundance. While collective abundance fell the average length and weight of many species collected increased from previous years. The fluctuations in abundance of all species are likely due to a number of factors, including climate, geomorphology, biological influences and hydrology.

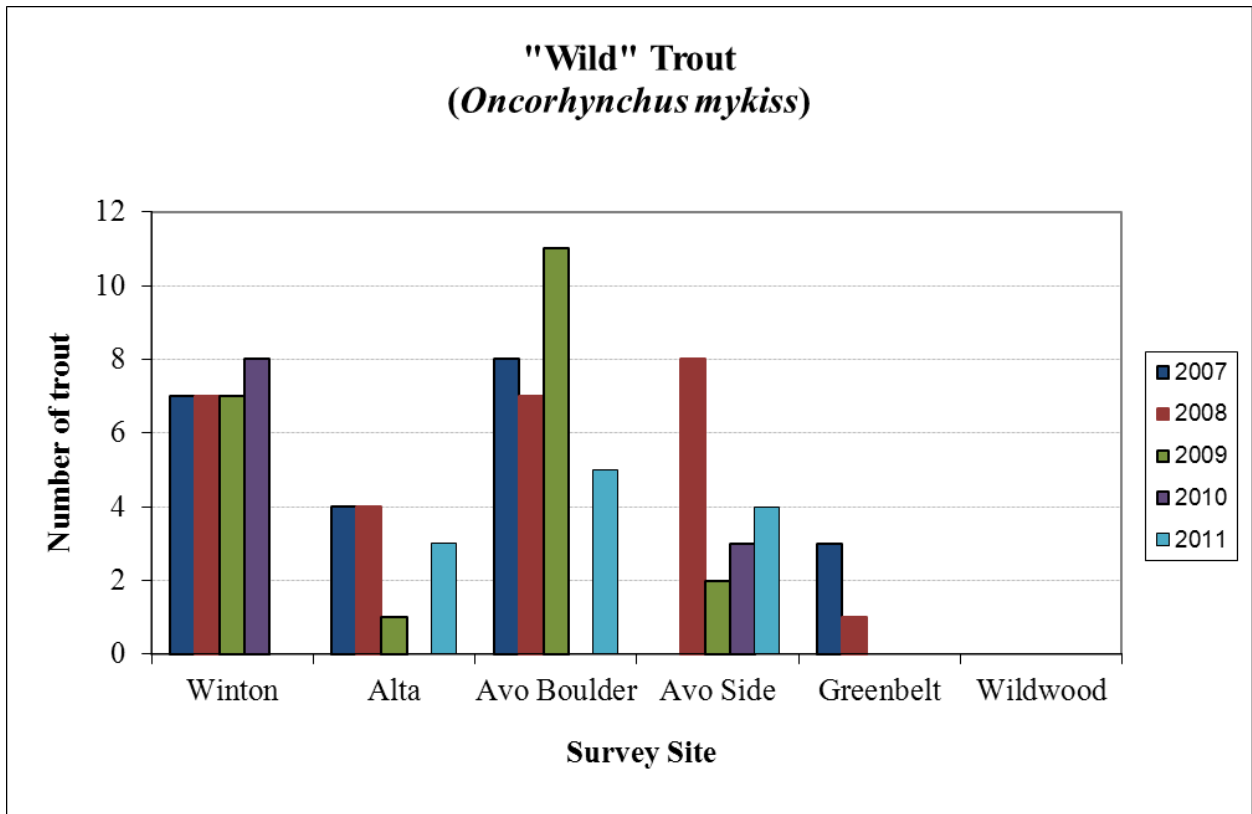


Figure 5: Analysis of within site variation of “wild” trout collected from 2007 to 2011.

Works Cited

- Chipps, Steven R., J.E. Garvey. (2007). Assessment of Diets and Feeding Patterns. *Analysis and Interpretation of Freshwater Fisheries Data*. Bethesda, Maryland, USA. American Fisheries Society.
- KRCD (Kings River Conservation District). 1993. *Wild Rainbow Trout Population Monitoring Downstream of Pine Flat Power Plant* (FERC Project No. 2741)
- KRCD (Kings River Conservation District). 1999a. *Rainbow Trout and Fish Population Monitoring in the Kings River Downstream of Pine Flat Power Plant* (1998). In-house Report No. 99-002. Unpublished
- KRCD (Kings River Conservation District). 1999b. *Summary of holistic angler regulations and the catchable trout planting program on the Lower Kings River (Fresno County)*. In-house Report No. 99-004. Unpublished
- KRCD (Kings River Conservation District). 2007. *Lower Kings River annual Trout and Non-Game Fish Population Survey: 2007 Electrofishing Results*. In-house Report
- KRCD (Kings River Conservation District). 2008a. *Calibrated Fisherman: hook and line survey on the Kings River downstream of Pine Flat Dam (Fresno County, California)*. In-house Report # 2008-003
- KRCD (Kings River Conservation District). 2008b. *Lower Kings River Annual Trout and non-game fish Population Survey: 2008 Electrofishing Results*. Unpublished.
- KRCD (Kings River Conservation District). 2009. *Lower Kings River Annual Trout and non-game fish Population Survey: 2009 Electrofishing Results*. In-house Report
- Moyle, P.B. 2002. *Inland Fisheries of California, Revised and Expanded*. University of California Press, Berkeley and Los Angeles, California.
- Reynolds, James B., 1996. *Electrofishing*. Pages 221-251 in B.R. Murphey and D. Willis, editors. *Fisheries Techniques*, 2nd edition. American Fisheries Society, Bethesda, Maryland.
- Van Deventer, J.S. 2007. *User's Guide for Microfish 3.0 Demonstration version*.
www.MircoFish.org

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)						
Common Name	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	6 - 140	7 - 7	23 - 28	25 - 75	26 - 79	220 - 560
Green Sunfish	1 - 1	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
Hatchery Trout	0 - 0	0 - 0	6 - 7	1 - 1	0 - 0	0 - 0
Lamprey sp.	0.0 - 0.0	3.4 - 4.9	5.0 - 6.6	5.1 - 5.7	0.0 - 0.0	0.0 - 0.0
Northern Pikeminnow	50 - 50	22 - 27	9 - 16	2 - 7	18 - 18	8 - 10
Rainbow Trout	0 - 0	3 - 8	5 - 8	4 - 5	0 - 0	0 - 0
Sacramento Sucker	63 - 1,198	98 - 128	68 - 115	44 - 71	13 - 19	77 - 293
Sculpin sp.	276 - 376	216 - 242	85 - 91	145 - 173	60 - 1,068	93 - 224
Three-spined Stickleback	9 - 390	38 - 72	9 - 11	4 - 7	1 - 1	3 - 8

Appendix B

Table B – F: Catch per Unit of Effort by species; 2007 – 2011. 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

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
Three-spined Stickleback	0.9	3.5	0.9	2.2	0.0	1.8

Table C

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
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

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
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

C.P.U.E (fish/hr) 2010						
Common Name	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 Sucker	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

C.P.U.E (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