

Lower Kings River Annual Trout and non-game fish Population  
Survey:  
2008 Electrofishing Results

Kings River Conservation District  
Environmental Resources Division

In-House Report  
January 2009

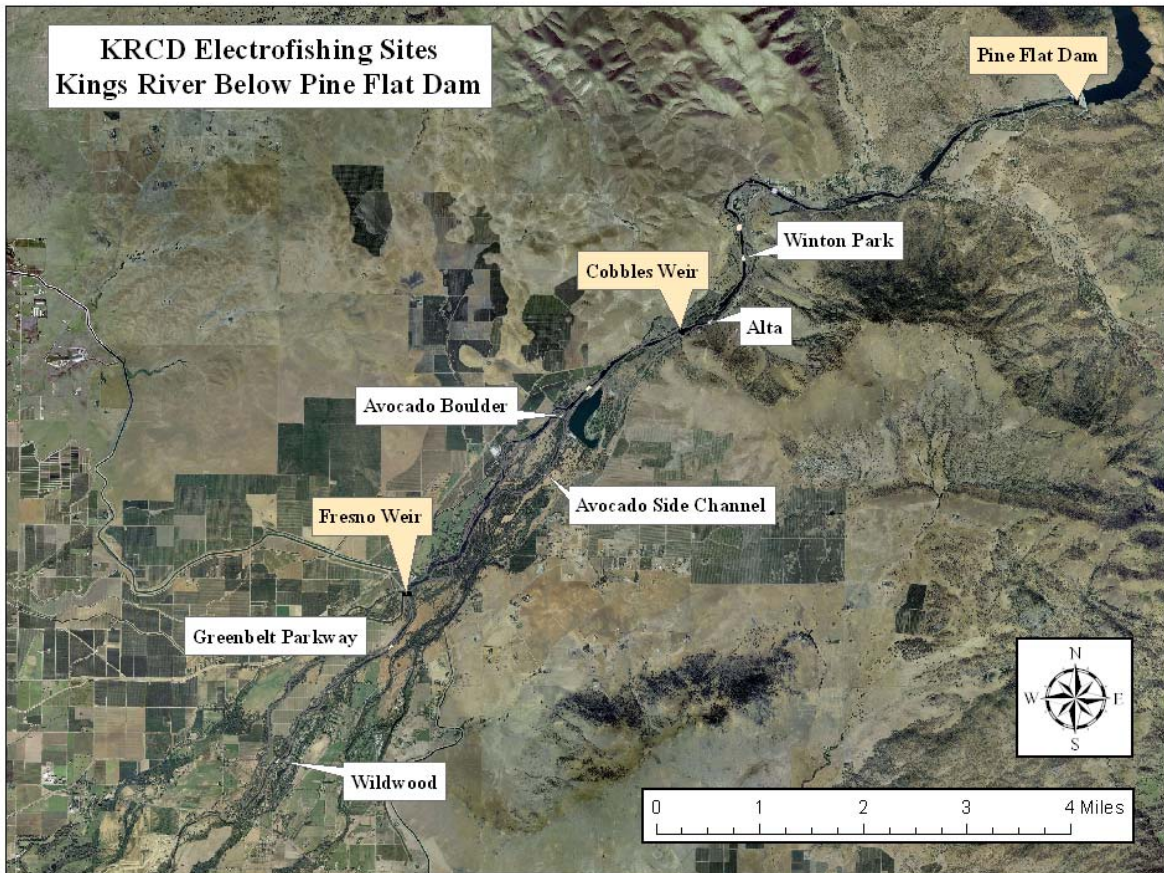
The Kings River Conservation District (KRCD), in cooperation with the California Department of Fish and Game (CDFG), began monitoring the rainbow trout (*Oncorhynchus mykiss*) population downstream of Pine Flat Dam in 1983 as part of a Federal Energy Regulatory Commission (FERC) requirement for compliance with Item 4 of the Memorandum of Agreement for FERC Project No. 2741. The survey has continued annually since that time. A multiple pass mark and recapture electrofishing survey was employed from 1983 until 1989. Starting 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. This change was made due to a lack of trout being sampled (KRCD 1993). These data, however, only provide a rough estimate of the density of trout per mile and do not stand up to rigorous statistical analysis. In the fall of 2007, the KRCD, as part of the Kings River Fisheries Management Program (FMP), 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.

## **Methods**

Over the course of six days, six separate sites (Figure 1) were sampled using standard multiple pass depletion electrofishing techniques (Nielsen 1983). Sample 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. The surveys were completed using Smith-Root backpack electrofishers types VII, VIII, Model 12, and LR-24's. Sampling was completed with the help of KRCD staff, Kings River Water Association (KRWA) staff, CDFG staff, and volunteers from the public.

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.

All sites were sampled between November 12 and 19. Water temperatures taken 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 18.52° C to a low of 15.12° C.



Z:\DATA\Project Specific Data\Fisheries Management\Electrofishing Sites\mxd\sl\Electrofishing Sites 2008.mxd

**Figure 1: Map of the 2008 electrofishing survey sites**

Electrofishing was typically conducted using 6 to 7 fishing crews and 1 work-up crew when possible. Fishing crews consisted of a backpack electrofisher operator and a netter. Work-up crews consisted of 1 data recorder and 1 to 2 biologists identifying, measuring, and weighing the sampled fish. After all shocking was completed for the day, additional work-up crews were formed to complete the identification, enumeration, and measuring process.

All species of fish sampled were identified to the lowest practical taxon in the field, weighed to the nearest tenth of a gram, and measured to total length (1mm) for biomass estimates, density and population estimates, using MicroFish 3.0 software (Van Deventer. 2007). The data is also used for species composition analysis. Rainbow trout exhibiting obvious signs of having been in a hatchery (i.e. worn or abraded fins, clipped adipose fins) were treated as a separate species than those trout considered “wild.” After

being worked-up, sampled 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 being imported 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.

## Results

A total of 2,758 fish were collected during the fall 2008 electrofishing survey. Species included; California roach (*Hesperoluecus symetricus*), mosquito fish (*Gambusia affinis*), lamprey sp. (*Lampetra sp*; several species may be present but were not distinguished.), Sacramento pikeminnow (*Ptychocheilus grandis*), rainbow trout (*Oncorhynchus mykiss*), Sacramento sucker (*Catostomus occidentalis*), sculpin sp. (*Cottus sp*; several species may be present but were not distinguished.), white catfish (*Ameiurus catus*), and threespine stickleback (*Gasterosteus aculeatus*).

The total catch numbers are displayed by site in Table 1. These data represent the total number of each species caught after 3 passes 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. Catch Per Unit of Effort (C.P.U.E.) data for each species by site is displayed in

**Table 1: Total catch by species**

	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>	<b>Total</b>
<b>California Roach</b>	0	6	84	16	226	325	<b>657</b>
<b>Hatchery Trout</b>	0	0	1	0	0	0	<b>1</b>
<b>Lamprey sp</b>	2	47	5	75	2	0	<b>131</b>
<b>Mosquito Fish</b>	0	2	0	0	0	0	<b>2</b>
<b>Northern Pike minnow</b>	56	15	143	47	154	149	<b>564</b>
<b>Rainbow Trout</b>	7	4	7	8	1	0	<b>27</b>
<b>Sacramento Sucker</b>	82	157	227	99	103	21	<b>689</b>
<b>Sculpin sp</b>	151	133	133	71	29	45	<b>562</b>
<b>Threespined Stickleback</b>	0	36	20	19	0	48	<b>123</b>
<b>White Catfish</b>	0	0	1	0	1	0	<b>2</b>
<b>Total</b>	<b>298</b>	<b>400</b>	<b>621</b>	<b>335</b>	<b>516</b>	<b>588</b>	<b>2758</b>

Table 4.

Site 1 – Winton Park

Three-pass depletion sampling yielded 298 fish representing five species. In terms of abundance, sculpin represented 50.7% of the sampled fish while Sacramento sucker represented 27.5%. Other species collected included lamprey, Sacramento pikeminnow, and “wild” rainbow trout.

The estimated population density for this site is 1,129 fish\*ha<sup>-1</sup>. By species this represents 518 sculpin, 315 Sacramento sucker, 268 Sacramento pikeminnow, 20 rainbow trout, and 6 lamprey. In terms of biomass, Sacramento sucker (3,927.4g), sculpin (1,269.1g), and “wild” rainbow trout (325.9g), represented the majority of the sampled fish.

It should be noted that in 2007, though the number of “wild” trout collected at the Winton Park site was 7, the same as in 2008, the population (density) estimate was much higher. This is a result of the † non-descending removal pattern in 2007 that did not occur in 2008.

Site 2 – Alta

Three-pass depletion sampling yielded 400 fish representing eight species. In terms of abundance, Sacramento sucker represented 39% of the sampled fish while sculpin represented 33% and lamprey represented 12%. Other species collected included California roach, mosquito fish, Sacramento pikeminnow, “wild” rainbow trout, and threespine stickleback.

The estimated population density for this site is 3,029 fish\*ha<sup>-1</sup>. By species this represents 1,298 Sacramento sucker, 983 sculpin, 393 lamprey, 202 threespine stickleback, 84 Sacramento pikeminnow, 34 California roach, 23 “wild” rainbow trout, and 11 mosquito fish. In terms of biomass, Sacramento sucker (1,287.9g), sculpin

---

† Non-descending removal pattern - population statistics are calculated on the assumption that with each successive pass, fewer fish will be captured. If this assumption is violated (i.e. more fish are caught on the second pass than on the first pass), population estimates may be higher than expected. As such, the calculated estimates are not considered to be reliable.

(775.6g), lamprey (306.5g), and “wild” rainbow trout (102.8g) represented the majority of the fish collected.

#### Site 3 – Avocado Boulder Project

Three-pass depletion sampling yielded 621 fish representing nine species. In terms of abundance, Sacramento sucker represented 36.6% of the fish collected while sculpin represented 21.4% and Sacramento pikeminnow represented 23%. Other fish collected included California roach, lamprey, hatchery rainbow trout, “wild” rainbow trout, white catfish, and threespine stickleback.

The estimated population density for this site is 6,112 fish\*ha<sup>-1</sup>. By species this represents 2,464 Sacramento pikeminnow, 1,653 Sacramento sucker, 931 sculpin, 798 California roach, 171 threespine stickleback, 44 “wild” rainbow trout, 38 lamprey, 6 white catfish, and 6 hatchery rainbow trout. In terms of biomass, Sacramento sucker (81,040.4g), sculpin (1,540.6g), and Sacramento pikeminnow (4,531.7g) represented the majority of the fish collected.

#### Site 4 – Avocado Side Channel

Three-pass depletion sampling yielded 335 fish representing seven species. In terms of abundance, Sacramento sucker represented 29.6% of the fish collected while lamprey represented 22.4%, and sculpin represented 21.2%. Other fish collected included California roach, Sacramento pikeminnow, “wild” rainbow trout, and threespine stickleback.

The estimated population density for this site is 2,768 fish\*ha<sup>-1</sup>. By species this represents 723 Sacramento sucker, 471 sculpin, 723 lamprey, 342 Sacramento pikeminnow, 297 California roach, 161 threespine stickleback, and 52 “wild” rainbow trout. In terms of biomass, sculpin (442.5g), Sacramento sucker (1,592.9g), and “wild” rainbow trout (360.9g) represented the majority of the fish collected.

#### Site 5 – Greenbelt Parkway

Three-pass depletion sampling yielded 516 fish representing seven species. In terms of abundance, California roach represented 43.8% of the fish collected while

Sacramento pikeminnow represented 29.8% and Sacramento sucker represented 20%. Other fish collected included lamprey, sculpin, white catfish, and “wild” rainbow trout.

The estimated population density for this site is 2,086 fish\*ha<sup>-1</sup>. By species this represents 934 California roach, 591 Sacramento pikeminnow, 439 Sacramento sucker, 107, sculpin, 7 lamprey, 4 white catfish, and 4 “wild” rainbow trout. In terms of biomass, Sacramento sucker (57,277.1g) and Sacramento pikeminnow (1,162.7g) represented the majority of the fish collected.

#### Site 6 – Wildwood

Three-pass depletion sampling yielded 588 fish representing six species. In terms of abundance, California roach represented 55.3% of the fish collected while Sacramento pikeminnow represented 25.3%. Other fish collected included Sacramento sucker, sculpin, and threespine stickleback.

The estimated population density for this site is 2,881 fish\*ha<sup>-1</sup>. By species this represents 1,579 California roach, 707 Sacramento pikeminnow, 306 sculpin, 201 threespine stickleback, and 88 Sacramento sucker. In terms of biomass, California roach (783.5g), Sacramento pikeminnow (678.1g), Sacramento sucker (451.7g), and sculpin (427.2g), represented the majority of the fish collected.

The number of “wild” trout per mile is extrapolated from population estimates generated in MicroFish 3.0. In 2008, there is an overall estimated 79 “wild” trout per mile (Table 5). Table 5 also shows that the estimated number of hatchery trout per mile is much less than the estimated number of “wild” trout per mile at only 3. These estimates are based on site specific data and may or may not represent conditions found in all sections of the Kings River.

Analysis of the length-frequency distribution ( Figure 3) for trout collected in the 2008 survey shows that the majority of the trout sampled fall within the 10cm to 20cm (4 to 8 inch) range. Length-frequency distributions from the 1980’s show similar patterns with the majority of the trout ranging in length from 10 cm to 20 cm range (KRCD 1993).

Table 1: Total catch, % by species

	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
California Roach	0.0%	0.9%	12.8%	2.4%	34.4%	49.5%	100.0%
Hatchery Trout	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
Lamprey sp	1.5%	35.9%	3.8%	57.3%	1.5%	0.0%	100.0%
Mosquito Fish	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Northern Pikeminnow	9.9%	2.7%	25.4%	8.3%	27.3%	26.4%	100.0%
Rainbow Trout	25.9%	14.8%	25.9%	29.6%	3.7%	0.0%	99.9%
Sacramento Sucker	11.9%	22.8%	32.9%	14.4%	14.9%	3.0%	99.9%
Sculpin sp	26.9%	23.7%	23.7%	12.6%	5.2%	8.0%	100.1%
Threespined Stickleback	0.0%	29.3%	16.3%	15.4%	0.0%	39.0%	100.0%
White Catfish	0.0%	0.0%	50.0%	0.0%	50.0%	0.0%	100.0%

Table 3a: Population estimates by site

	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	0	6	126	46	253	433
Hatchery Trout	0	0	1	0	0	0
Lamprey sp	2	70	6	112	2	0
Mosquito Fish	0	2	0	0	0	0
Northern Pikeminnow	91	15	389	53	160	194
Rainbow Trout	7	4	7	8	1	0
Sacramento Sucker	107	231	261	112	119	24
Sculpin sp.	176	175	147	73	29	84
Threespined Stickleback	0	36	27	25	0	55
White Catfish	0	0	1	0	1	0

Table 3b: 95% confidence interval (adjusted to lower CI)

	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
California Roach	0-0	6-8	126-126	16-211	233-273	368-498
Hatchery Trout	0-0	0-0	1-1	0-0	0-0	0-0
Lamprey sp.	2-2	70-70	5-15	112-112	2-7	0-0
Mosquito Fish	0-0	2-2	0-0	0-0	0-0	0-0
Northern Pikeminnow	56-151	15-17	143-800	47-63	154-167	154-234
Rainbow Trout	7-10	4-7	7-9	8-10	1-1	0-0
Sacramento Sucker	82-138	162-300	236-286	99-127	103-136	21-32
Sculpin sp.	154-198	135-215	133-161	71-78	29-31	45-168
Threespined Stickleback	0-0	36-37	20-46	19-42	0-0	48-67
White Catfish	0-0	0-0	1-1	0-0	1-1	0-0



**Table 4: Catch Per Unit of Effort (fish/hour)**

	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>California Roach</b>	0.0	1.2	2.1	2.8	40.8	29.5
<b>Green Sunfish</b>	0.0	0.4	0.0	0.0	0.0	0.0
<b>Lamprey sp.</b>	0.3	9.4	0.8	13.2	0.0	0.3
<b>Northern Pike minnow</b>	8.8	3.0	21.7	8.3	18.7	20.1
<b>Hatchery Trout</b>	0.0	0.0	0.2	0.0	0.0	0.0
<b>Rainbow Trout</b>	1.1	0.8	1.1	1.4	0.0	0.1
<b>Sacramento Sucker</b>	12.9	31.3	34.5	17.5	2.6	13.5
<b>Sculpin sp.</b>	23.7	26.6	20.2	12.5	5.7	3.8
<b>Threespined Stickleback</b>	0.0	7.2	3.0	3.3	6.0	0.0
<b>white catfish</b>	0	0	0.2	0	0	0.1

Estimated weight percentages found in Table 6 show that “wild” rainbow trout and hatchery rainbow trout represent less than 11% of the biomass at any given site. Typically, the greatest fish biomass was represented by Sacramento pikeminnow, Sacramento sucker, and sculpin.

### Discussion

With 74% of the average runoff, 2008 represented the second consecutive year of less than average precipitation. 2007 was the 7<sup>th</sup> driest year on record with only 39% of average runoff. Prolonged exposure to water temperatures in greater than 24°C is lethal to trout (Moyle 2002) and temperature issues become problematic in dry years when the

**Table 5: Estimated number of “wild” trout and hatchery trout per mile**

<b>NOV 2008</b>	Site	Number	Wild Trout	Number	Hatchery Trout
Site Name	Length (ft.)	Wild Trout	per mile	Hatchery Trout	per mile
Winton Park Boulder	300	7	123	0	0
Alta Weir	300	4	70	0	0
Avocado Boulder	300	7	123	1	18
Avocado Side Channel	300	8	141	0	0
County Park Boulder	300	1	18	0	0
Wildwood	300	0	0	0	0
<b>Total</b>	1800	27	<b>79</b>	1	<b>3</b>

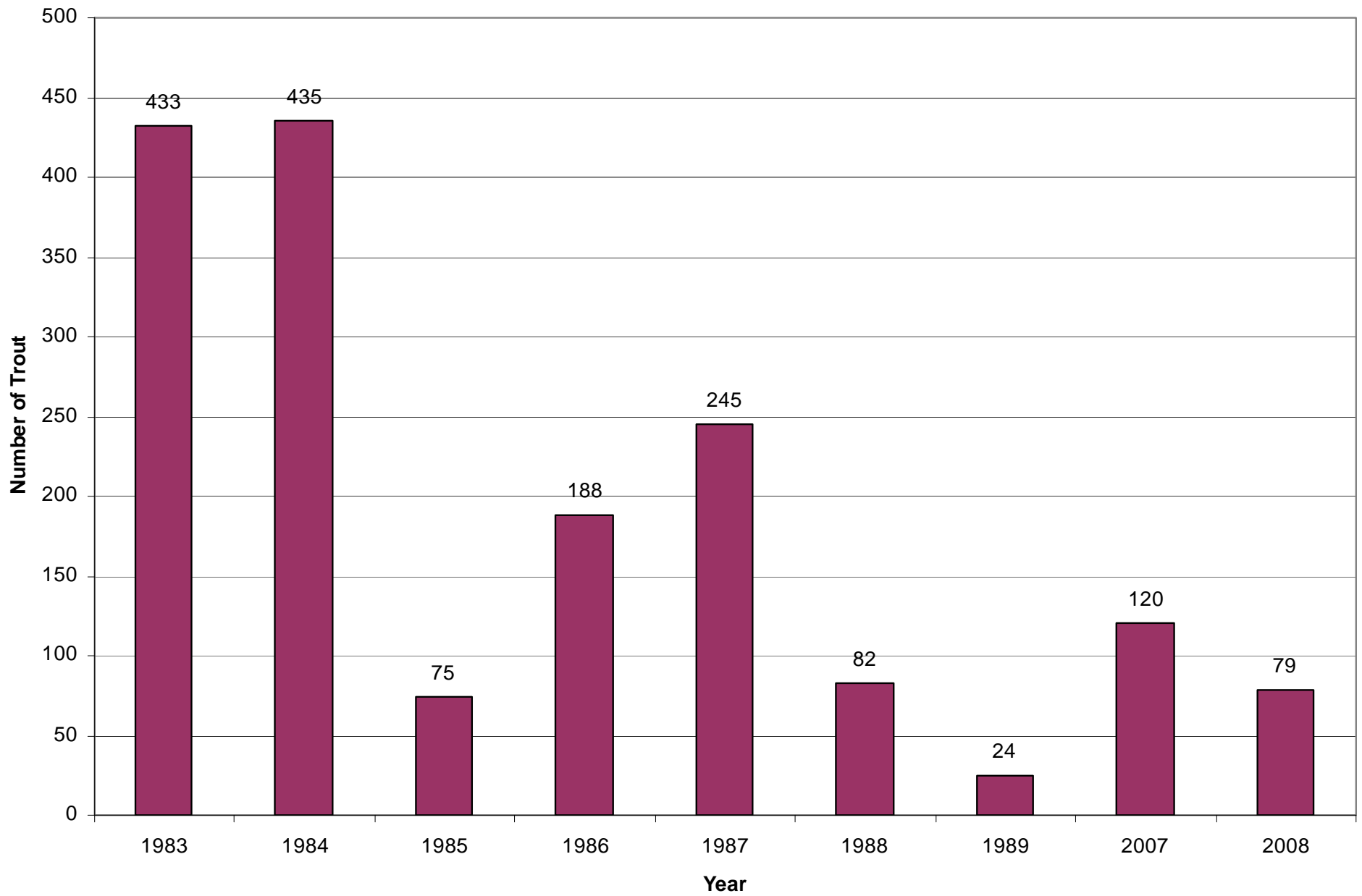
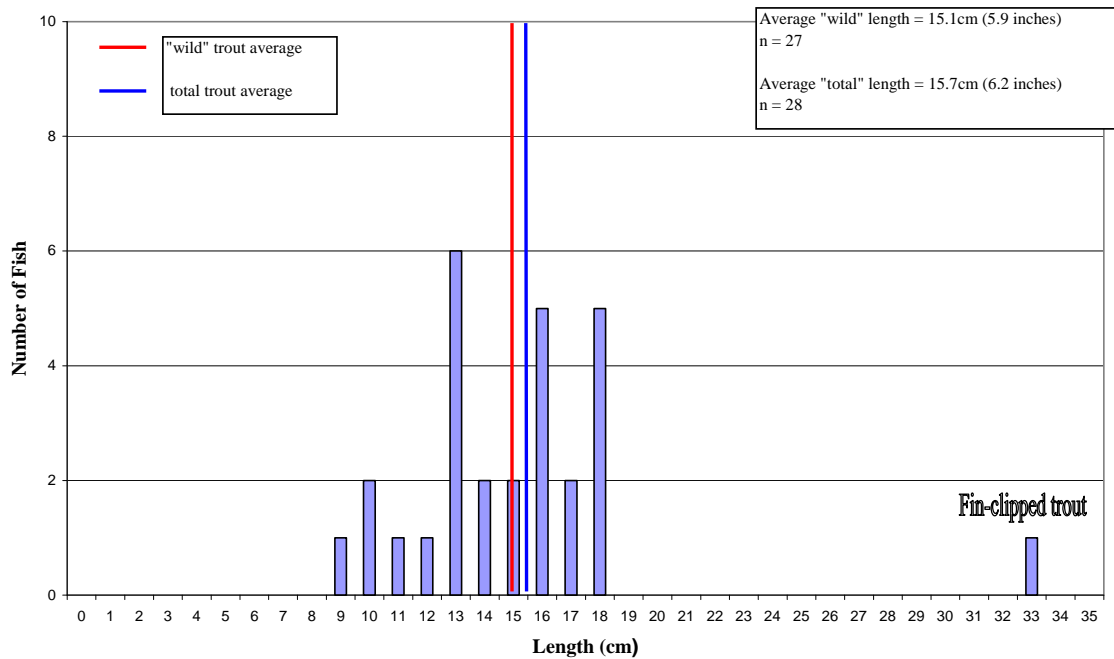


Figure 2: Multi-pass sampling, wild trout per mile, 1982 – 1989, 2007 – 2008



**Figure 3: Length-frequency distribution for total trout sampled**

temperature control pool, located in the Pine Flat Reservoir, holds very little cold water, as was the case in 2008. Active temperature management strategies employed by the FMP held both the frequency of occurrence and duration of temperatures exceeding 24°C to a minimum. Even so, abundance estimates were greatly reduced this year compared to 2007. This was true for all species collected except California roach which experienced an increase in abundance. As shown in Table 2, species composition varied substantially among sites reflecting, in part, site-specific variation in habitat characteristics.

**Table 6: Estimated weight, % by species**

	<b>Winton</b>	<b>Alta</b>	<b>Avo Boulder</b>	<b>Avo Side</b>	<b>Greenbelt</b>	<b>Wildwood</b>
<b>California Roach</b>	0.0%	0.8%	0.7%	5.3%	1.6%	31.7%
<b>Hatchery Trout</b>	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%
<b>Kern Brook Lamprey</b>	0.1%	12.5%	0.1%	11.3%	0.0%	0.0%
<b>Mosquito Fish</b>	0.0%	0%*	0.0%	0.0%	0.0%	0.0%
<b>Sacramento Pikenimow</b>	3.2%	2.7%	11.3%	5.0%	1.8%	26.8%
<b>Rainbow Trout</b>	4.5%	2.8%	0.4%	10.8%	0.0%	0.0%
<b>Sacramento Sucker</b>	71.5%	52.0%	85.6%	53.7%	96.3%	15.7%
<b>Sculpin sp.</b>	20.6%	28.0%	1.6%	13.6%	0.3%	24.2%
<b>Threespined Stickleback</b>	0.0%	1.1%	0.0%	0.3%	0.0%	1.6%
<b>White Catfish</b>	0.0%	0.0%	0%**	0.0%	0%**	0.0%

Streamside incubators were not operated during the winter of 2007-2008. As such, the few trout collected that fell into the age 0-1 category were likely reared instream. Eighty-nine percent (25 of 28) of the trout collected, including the hatchery trout, fell into the age 1-2 or older category. Due to the time of the sampling, we were unlikely to collect any young of the year (y-o-y) trout.

As noted in the 2007 electrofishing report, a couple of the survey sites did receive habitat improvement work prior to the 2008 sampling event. Both the Winton Park and Avocado Side Channel sites received numerous boulders and several tons of spawning gravel between December 2007 and March 2008. While the Winton Park site produced the same estimate of “wild” trout (7) in 2007 and 2008, the Avocado Side Channel produced 8 “wild” trout in 2008. This is an increase over the 2007 sampling event in which this site produced no “wild” trout at all.

Nine sites were sampled during the 2007 annual population survey, three more than usual. The three additional sites included a control site for the Large Woody Debris Pilot Project (LWD) and the Doyal’s and Avocado Test sites. A total of 20 “wild” trout were collected between these three sites. Recalculating the †“wild” trout per mile estimate for the 2007 survey, excluding data from the three additional sites, results in an estimated density of 114 “wild” trout per mile (120 “wild” trout per mile including data from the 3 additional sites). The revised results are displayed in Table 7. This is lower

**Table 7: Recalculated 2007 “wild” trout per mile estimate**

<b>Nov 2007</b>					
Site Name	Site Length (ft.)	Number Wild Trout	Wild Trout per mile	Number Hatchery Trout	Hatchery Trout per mile
Winton Park Boulder	300	24	422	9	158
Alta Weir	300	4	70	29	510
Avocado Boulder	300	8	141	2	35
Avocado Side Channel	300	0	0	8	141
County Park Boulder	300	3	53	0	0
Wildwood	300	0	0	0	0
Avocado Test	X	X	X	X	X
Doyal's Test	X	X	X	X	X
LWD Control	X	X	X	X	X
<b>Total</b>	1800	39	<b>114</b>	48	<b>141</b>

† “Wild” Trout Per Mile estimates are extrapolated from the trout population estimates generated in MicroFish 3.0.

**Table 8: Actual trout collected: 2007 vs. 2008 & revised “wild” trout per mile estimate**

	Winton		Alta		Avo Boulder		Avo Side		Greenbelt		Wildwood	
Hatchery Trout	9	0	21	0	2	1	5	0	0	0	0	0
Rainbow Trout	7	7	4	4	8	7	0	8	3	1	0	0
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">2007</div> <div>Total 22</div> <div style="border: 1px solid black; padding: 2px;">2008</div> <div>Total 27</div> </div>												
Est. "wild" trout per mile	2007	114										
	2008	79										

than the

original estimate but still higher than the 2008 estimate of 79 “wild” trout per mile. A comparison of the 2008, multi-pass population estimate (79 trout/mile) to the 1983 to 1989 multi-pass mark and recapture population estimates (Figure 2) shows that the 2008 estimate is still at the lower end of the density scale when compared to the 1980s.

In addition, the 2007 “wild” trout population estimate for the Winton Park site was artificially inflated due to a non-descending removal pattern. This led to the higher than expected “Wild” Trout Per Mile estimate for 2007 and explains why we collected fewer “wild” trout in 2007 yet had a higher “wild” trout per mile estimate than in 2008 (Table 8). These density estimates are extrapolated from trout population estimates and may or may not reflect actual population numbers. Interpretations of stream condition based on these estimates should be made with caution.

Overall, 2008 produced a much higher proportion of “wild” trout than 2007 (96% to 33%). When comparing just the 6 sites that are sampled annually, 2008 also produced more “wild” trout with 27 collected while only 22 were collected from the same six sites in 2007 (Table 8).

As with the data collected during the 1980’s, the length-frequency distribution fails to show the age-class structure that would be expected in a self-sustaining trout fishery. Length-frequency data from a “hook and line” survey (Calibrated Fisherman), conducted ten days prior to the start of the electrofishing survey, do show a larger size-class present in the river (KRCD 2008). A total of 12 trout were landed during the survey however, of the 12, only 4 were classified as “wild.” The average length of the “wild” trout was 26.7cm (10.5 inches). The average length for all trout collected during the Calibrated Fisherman survey was slightly longer at 30.4 cm (11.9 inches). The length-frequency distribution showing both results from the 2008 electrofishing and angler

surveys is displayed in Figure 12. This suggests that the age-class structure might actually be present but that larger trout are not being sampled during the electrofishing survey. The lack of larger, older trout collected during the electrofishing survey is likely a result of backpack electrofishing site requirements (i.e. shallow, wadeable water) that would be less favorable habitat for larger trout. In addition, the angler survey results are biased towards a larger size class by the simple fact that the anglers are targeting the larger fish. The two data sets are not meant to be directly compared but rather serve to compliment each other and provide a more complete picture of the trout population inhabiting the river.

While in general, fish populations have undergone a reduction in abundance, likely due to successive dry years, the proportion of “wild” trout collected has increased significantly as well as the total number of “wild” trout collected. This is encouraging, although continued monitoring is necessary.

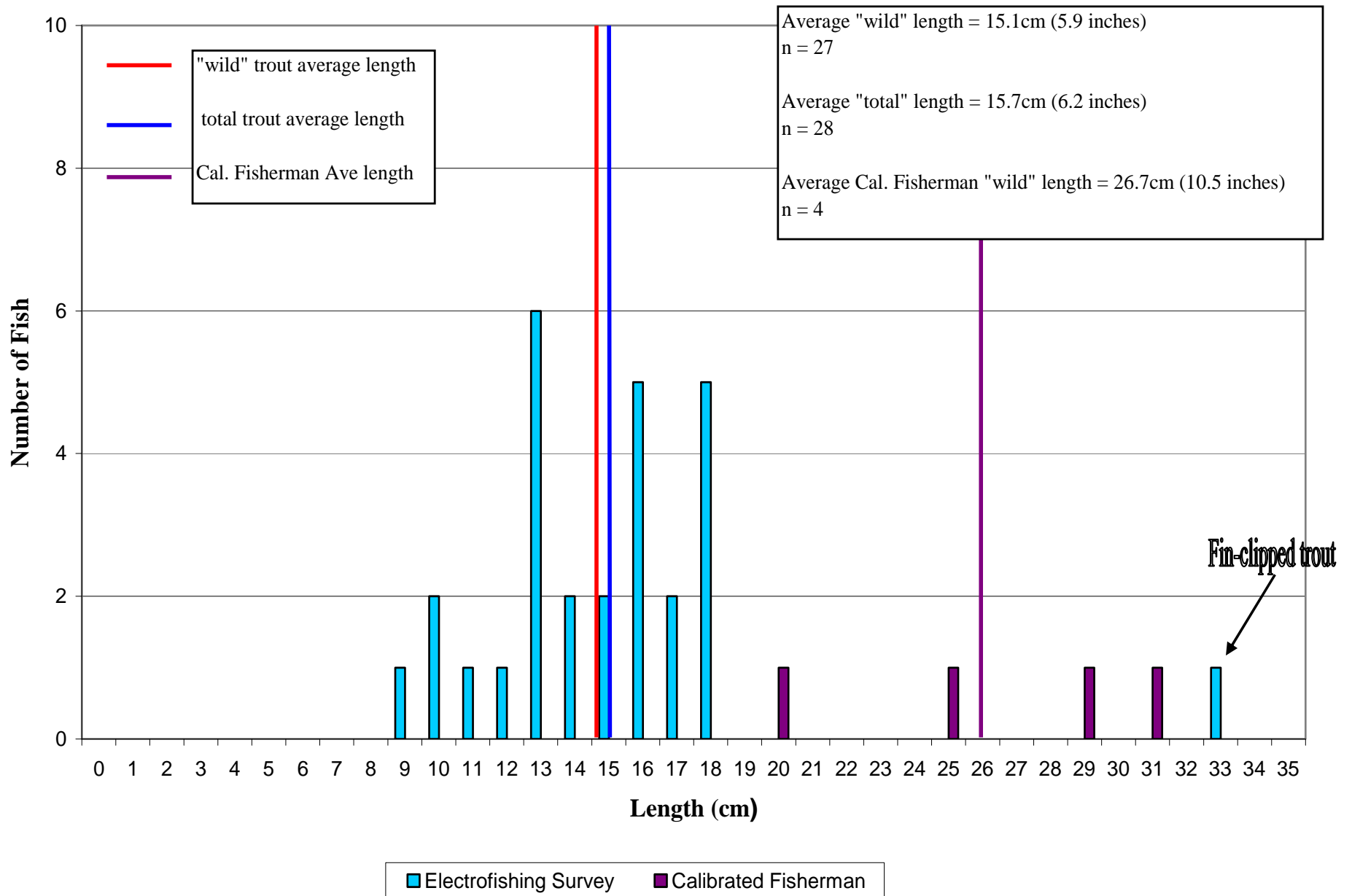


Figure 12: Length-frequency comparison of Electrofishing and Calibrated Fisherman Surveys

## Literature Cited

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). 2008. *Calibrated Fisherman: A 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). 2007. *Lower Kings River annual Trout and Non-Game Fish Population Survey: 2007 Electrofishing Results*. In-house Report

Nielsen, Larry A., D. Johnson. 1983. *Fisheries Techniques*. Southern Printing Company, Inc., Blacksburg, Virginia.

Van Deventer, J.S. 2007. *User's Guide for Microfish 3.0 Demonstration version*. [www.MicroFish.org](http://www.MicroFish.org)