

2005

HARDHEAD (*Mylopharodon conocephalus*)  
SURVEYS IN THE SOUTH FORK  
AMERICAN RIVER,

*El Dorado County, California for the  
El Dorado Hydroelectric Project (FERC No. 184)*

Garcia and Associates  
Natural and Cultural Resource Consultants



February 2007

**PREPARED FOR:**

El Dorado Irrigation District  
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Placerville, CA 95667

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## 1.0 INTRODUCTION

The *El Dorado Relicensing Settlement Agreement* (2003) for the El Dorado Hydroelectric Project (FERC #184) describes a fisheries monitoring plan to be carried out by the El Dorado Irrigation District (EID) during the specified years of the license. Existing data on hardhead (*Mylopharodon conocephalus*), a native species, are not sufficient to derive biomass indices for determining habitat quality; therefore, the U. S. Forest Service (USFS), the Ecological Resources Committee (ERC), and the California State Water Resources Control Board (SWRCB) have requested that additional data be collected for a period of three years. This additional monitoring effort is to be concentrated in the area adjacent to Akin Powerhouse on the South Fork American River, where hardhead are known to be present. Ultimately, these data will be used by the resource agencies to derive biomass indices for fish, these indices will then help describe the quality of the habitat.

The distribution of hardhead in the South Fork American River is thought to be limited to an area downstream of the confluence with Silver Creek, approximately 2.4 river miles from the Akin Powerhouse, in order to better determine its distribution. EID contracted with the Garcia and Associates (GANDA) to survey fish populations at several locations adjacent to Akin Powerhouse. These surveys, conducted in October 2005, comprised the second year of the three-year effort. Results of the 2005 surveys are presented in this report.

## 2.0 STUDY AREA

As stated above, the study area is located on the S.F. American River, adjacent to Akin Powerhouse, upstream of Slab Creek Reservoir (Figure 1). This area was identified by Thomas R. Payne Associates (TRPA) (1998; as cited in Exhibit E of the Settlement Agreement) as supporting hardhead.

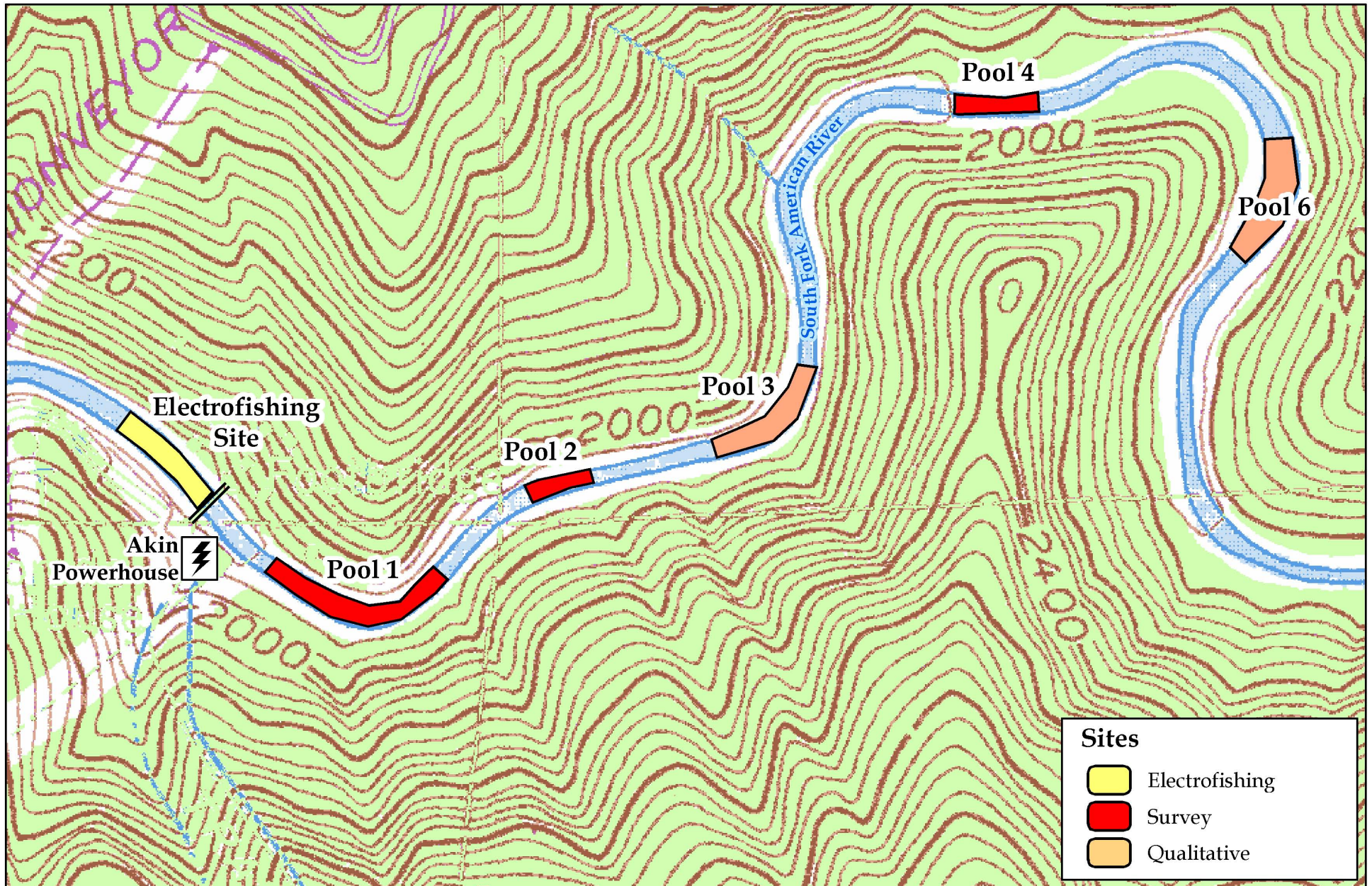
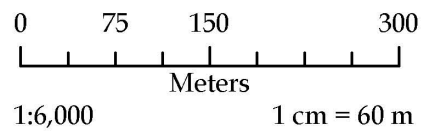


Figure 1. Location of hardhead electrofishing and snorkeling surveys conducted in October 2005 on the South Fork American River.



Source: USGS 7.5-minute topographic map (Pollock Pines)

## 3.0 METHODS

A 120-meter electrofishing site and three pools were surveyed in 2004 (ECORP 2005). As requested by the ERC, GANDA resurveyed the electrofishing site and the two lower pools sampled in 2004, along with the next pool with suitable habitat further upstream. Qualitative snorkel surveys were also conducted in two additional pools: the third pool upstream (sampled in 2004) and an additional pool upstream. The sites sampled are identified in Figure 1. The believed natural barrier for hardhead, noted during the 2005 amphibian surveys, has also been noted on Figure 1.

In addition to data on the target species, hardhead; GANDA collected data on all fish species encountered. Fish populations were sampled using a combination of electrofishing and visual (snorkeling) survey techniques. A 120-meter riffle-run site adjacent to the Akin Powerhouse was electrofished using a three-pass depletion method. Visual surveys were employed in three large pools upstream of the powerhouse.

### 3.1 Electrofishing

A team of seven biologists electrofished the site from bottom to top, using four backpack electrofishers and three netters / bucket carriers. Two electrofishers concentrated their efforts on the stream margins to focus on habitat for juvenile hardhead, while the other two electrofishers fished the middle of the stream with one netter.

Fish collected during each electrofishing pass were processed immediately upon completion of the pass. All specimens were identified to species where possible. All fish were measured (Fork Length) on a metric measuring board.

All fish 60 mm (FL) or greater, of all species, were weighed to the nearest gram with an electronic balance. A weight of 0.5 gram was assumed for fish (other than hardhead) smaller than 60 mm FL, which were too small to weigh reliably as individuals. For the remainder of the survey, fish from each pass were placed in an instream holding area located outside the survey reach. Following the three-pass depletion survey, all collected fish were redistributed throughout the survey reach.

Juvenile hardhead and Sacramento pikeminnow (*Ptychocheilus grandis*) are discussed together as they are difficult to differentiate. All small hardhead (<60 mm fork length [FL]) captured during the first pass were measured to derive an accurate length frequency distribution; small hardhead collected during the second and third passes were identified and enumerated, but were not measured. To determine the mass of juvenile hardhead that weighed less than 1 gram (i.e., less than 60 mm FL), these fish were kept separate and weighed as a group, to derive a more accurate cumulative weight for use in calculating biomass estimates.

## 3.2 Snorkeling

A team of 5-6 biologists conducted two-pass snorkel surveys in the first, second, and fourth deep pools upstream of the Akin Powerhouse (Figure 1). For two-pass, quantitative, snorkel sampling, divers entered the water at the downstream end of each pool and moved upstream at a slow and deliberate pace. Divers stayed in visual range of each other to ensure that they remained evenly spaced and matched each other's speed (i.e., proceeded upstream in a line). Divers carefully looked ahead to locate fish on the fringe of vision, and the two outside divers carefully searched the bank vegetation for juvenile fish. Each fish was identified, counted, and categorized into predefined 3-inch (76mm) length classes (to be consistent with the 2004 effort). Divers either recorded data onto a matrix on wrist-mounted underwater dive slates or verbally relayed data to a streamside observer. For the first pass, divers began at Pool 1 and worked upstream through all the pools before returning to Pool 1 to repeat the process.

Once the divers had returned to the bottom of Pool 1 and had allowed an additional 30 minutes for the fish to re-equilibrate, the divers repeated their effort with a second pass in pools 1, 2, and 4 to verify observations. Mean values from the two passes were used for calculating fish abundance and for estimating biomass.

Additionally, single-pass, qualitative, snorkeling was conducted in the third and sixth pools upstream of the powerhouse. The fifth pool was a shallow corner pool that did not have suitable habitat for hardhead. Qualitative surveys consisted of single-pass snorkel surveys; otherwise, the survey methods were the same as with the two-pass surveys. Since the divers had to swim through Pool 3, which had been sampled in 2004, we recorded the fish observed as we passed. Additionally, two divers went upstream to Pool 6 to see whether hardhead were present in that pool.

## 3.3 Physical Habitat Data

Habitat parameters of length, width and depth were measured at each site with a 100 m tape measure. Width and depth measurements were collected every 10 meters for the length of each habitat unit. Depth in the pools was estimated visually. All sites were documented with digital photographs (Appendix B) and site locations were recorded using a hand-held Garmin GPS unit.

## 3.4 Data Analysis

All of the fisheries and habitat data were entered into Microsoft Excel spreadsheets. Electrofishing data were analyzed using the MicroFish 3.0 software package, which is based on the removal-depletion model (Van Deventer and Platts 1989) to generate fish population and biomass estimates. MicroFish estimates biomass by extrapolating the total weight of a sample based on the population estimates and the length-weight relationships of the fish captured. Biomass estimates were then divided by the area of the habitat feature to calculate grams of fish per acre. The age structure of the sampled populations was determined from length-frequency



relationships. Growth rates reported by Moyle (2002) were compared with the length frequency graphs created from this data set to verify reasonable growth rates and generate a realistic age structure.

Biomass estimates for the snorkeling data were determined by extrapolating the length-weight data from the electrofishing survey. For each species and size class observed, the mean value for the corresponding fish species and size class measured during the electrofishing effort was used to estimate the biomass per fish. This value was then multiplied by the mean number of fish observed during the snorkel surveys. This method was used in all cases except for the two largest size classes (12-15 and 15-18 inches; [305-381 mm and 381-457 mm]) of rainbow trout (*Oncorhynchus mykiss*), in which fish observed during snorkeling were larger than any captured during electroshocking.

Biomass of a rainbow trout larger than 12 inches (305 mm) was calculated by using the length-weight regression of those rainbow trout larger than six inches (152 mm), and used that equation to estimate the weight of the larger fish. The weight of 13.5 inch (343 mm) and 16.5 inch (419 mm) fish (the median length of the 12-15 and 15-18 inch size classes) was also based upon this regression equation [ $y = 1.7012x - 251.68$ ; where  $y$  = weight in grams and  $x$  = length in millimeters] to complete our biomass estimate.

Condition factor is a commonly used metric among trout biologists as a general measure of health (i.e., how fat is a fish of a given length), and was calculated for the 2004 data. Therefore, condition factor was calculated for this effort using the formula:  $CF = [Weight (g) \times 100,000] / Length (mm)^3$ , as described by Anderson and Gutreuter (1983). Condition factor calculations were limited to those fish 60 mm or longer, since this is roughly the minimum size for which an accurate individual weight can be obtained in the field (using a 1 gram scale). Condition Factor is the proportion of the fish's weight to length (i.e., it is dependent of fish shape) and is thus species-specific. For trout, condition factors of greater than 1.0 are considered good. For most cyprinids (e.g., hardhead), slightly lower values are expected because these fish tend to be thinner than trout for a given length. However, since condition factor is not usually calculated for cyprinids, it is not known what would constitute a 'good' value for hardhead; therefore, we are not interpreting the health of the hardhead based upon the condition factor.

## 4.0 RESULTS

### 4.1 Electrofishing Data

GANDA biologists captured 444 fish in the 120-meter electroshocking site (Table 1). Hardhead and Sacramento pikeminnow were the most abundant fish captured; these species are discussed together as they are difficult to differentiate as small juveniles. Sacramento suckers (*Catostomus occidentalis*) were the second most abundant species captured. Rainbow trout and speckled dace (*Rhinichthys osculus*) were also common, while riffle sculpin (*Cottus gulosus*) were present in small numbers. Brown trout (*Salmo trutta*) were the least common fish captured. Summaries of the fish length-weight data and biomass estimates are presented in Table 2 and field datasheets are provided Appendix C.

Table 1. Electrofishing Catch Data for the S.F. American River, October 2005.

	Pass 1	Pass 2	Pass 3	Total Catch	Lower 95% Conf. Limit	Upper 95% Conf. Limit	Population Estimate
Rainbow trout	18	13	8	39	39	75	52
Brown trout	3	6	1	10	10	21	12
Hardhead / pikeminnow	136	106	49	291	324	442	383
Sacramento sucker	26	17	6	49	49	65	55
Riffle sculpin	10	5	3	18	18	24	19
Speckled dace	17	18	2	37	37	49	41
<b>Total Fish Caught</b>	210	165	69	444			

Table 2. Summary of Fish Length- Weight Data for the S.F. American River, October 2005.

2832 M <sup>2</sup> or 0.70 Acres	Length Range FL in mm	Mean length FL in mm	Mean Weight (g) <sup>1</sup>	Mean Condition Factor <sup>2</sup>	Estimated Biomass (g)	Biomass/ Area grams / acre
Rainbow trout	75-300	154	61	1.13	3,157	4,510
Brown trout	106-286	163	69	1.09	824	1,177
Hardhead / pikeminnow	21-150	49	7	0.9	511	730
Sacramento sucker	31-407	74	101	1.17	1,854	2,649
Riffle sculpin	41-112	77	12	1.41	157	224
Speckled dace	25-92	39	9	1.51	48	69

<sup>1</sup>Values are based on fish 60mm or greater; 60 mm FL is the minimum size to obtain an accurate individual weight in the field

<sup>2</sup>Fish smaller than 60 mm FL were assumed to weigh 0.5g, except hardhead, for which an group weight was calculated: 115 fish weighed 59 grams (0.51 g/fish). Biomass estimates were calculated with Microfish 3.0

## 4.2 Snorkel Data

GANDA biologists quantitatively snorkeled the first, second, and fourth pools upstream of the Akin Powerhouse in the S.F. American River.

Hardhead and Sacramento pikeminnow were the most abundant fish observed in pools (Table 3A-C). Rainbow trout were the next most abundant fish observed and comprised the greatest biomass. Sacramento suckers, riffle sculpin, and brown trout were observed in small numbers. No speckled dace were observed in the pools. Estimated numbers of individuals and biomass projections are presented as averages of the two passes.

Table 3A. Numbers of fish by species and length observed during snorkel surveys in Pool 1, and estimated biomass and biomass per acre, October 2005.

Pool 1 6831 M <sup>2</sup> or 1.70 acres	Length Category (inches)						Estimated # of Fish <sup>1</sup>	Estimated Biomass (g)	Grams / Acre
	0-3	3-6	6-9	9-12	12-15	15-18			
<b>Rainbow trout</b>	0	0	1	1.5	.5	1	<b>4</b>	<b>1042</b>	<b>613</b>
(first pass, second pass)	0, 0	0, 0	2, 0	2, 1	1, 0	0, 2			
<b>Brown trout</b>	0	0.5	0	0	0	0	<b>0.5</b>	<b>9</b>	<b>5</b>
(first pass, second pass)	0, 0	1, 0	0, 0	0, 0	0, 0	0, 0			
<b>Hardhead / pikeminnow</b>	865.5	0.5	0	0	0	0	<b>865.5</b>	<b>445</b>	<b>262</b>
(first pass, second pass)	606, 1125	0, 1	0, 0	0, 0	0, 0	0, 0			
<b>Sacramento sucker</b>	0.5	0	0	0	0	1	<b>1.5</b>	<b>408</b>	<b>240</b>
(first pass, second pass)	0, 1	0, 0	0, 0	0, 0	0, 0	2, 0			
<b>Riffle sculpin</b>	0.5	0	0	0	0	0	<b>0.5</b>	<b>1</b>	<b>0</b>
(first pass, second pass)	0, 1	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Speckled dace</b>	0	0	0	0	0	0	<b>0</b>	<b>0</b>	<b>0</b>
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Total observed / size</b>	<b>866.5</b>	<b>1</b>	<b>1</b>	<b>1.5</b>	<b>0.5</b>	<b>2</b>	<b>872</b>	<b>1904</b>	<b>1120</b>

<sup>1</sup> Estimated numbers of individuals and biomass projections are presented as averages of the two passes

Table 3B. Numbers of fish by species and length observed during snorkel surveys in Pool 2, and estimated biomass and biomass per acre, October 2005.

Pool 2 1470 M <sup>2</sup> or 0.36 acres	Length Category (inches)						Estimated # of Fish <sup>1</sup>	Estimated Biomass (g)	Grams / Acre
	0-3	3-6	6-9	9-12	12-15	15-18			
<b>Rainbow trout</b>	0	0	2.5	1.5	2	.5	6.5	1426	3960
(first pass, second pass)	0, 0	0, 0	1, 4	2, 1	1, 3	0, 1			
<b>Brown trout</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Hardhead / pikeminnow</b>	53.5	0	0	0	0	0	53.5	27	76
(first pass, second pass)	25, 82	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Sacramento sucker</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Riffle sculpin</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Speckled dace</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Total observed / size</b>	<b>53.5</b>	<b>0</b>	<b>2.5</b>	<b>1.5</b>	<b>2</b>	<b>0.5</b>	<b>60</b>	<b>1453</b>	<b>4036</b>

<sup>1</sup> Estimated numbers of individuals and biomass projections are presented as averages of the two passes

Table 3C. Numbers of fish by species and length observed during snorkel surveys in Pool 4, and estimated biomass and biomass per acre, October 2005.

Pool 4 1827 M <sup>2</sup> or 0.45 acres	Length Category (inches)						Estimated # of Fish <sup>1</sup>	Estimated Biomass (g)	Grams / Acre
	0-3	3-6	6-9	9-12	12-15	15-18			
<b>Rainbow trout</b>	0	0	7	5.5	4	0	16.5	3108	6907
(first pass, second pass)	0, 0	0, 0	7, 7	7, 4	2, 6	0, 0			
<b>Brown trout</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Hardhead / pikeminnow</b>	20	0	0	0	0	0	20	10	23
(first pass, second pass)	3, 37	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Sacramento sucker</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Riffle sculpin</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Speckled dace</b>	0	0	0	0	0	0	0	0	0
(first pass, second pass)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0			
<b>Total observed / size</b>	<b>20</b>	<b>0</b>	<b>7</b>	<b>5.5</b>	<b>4</b>	<b>0</b>	<b>36.5</b>	<b>3118</b>	<b>6929</b>

<sup>1</sup> Estimated numbers of individuals and biomass projections are presented as averages of the two passes

GANDA also qualitatively snorkeled the third and sixth pools upstream of the Akin Powerhouse. Juvenile hardhead / pikeminnow and rainbow trout were observed in both of these pools. The fifth pool upstream of the Akin Powerhouse was a shallow corner pool was not suitable habitat for hardhead and was not surveyed. Qualitative (1-pass) snorkel data for the third and sixth pools are presented in Tables 4A and 4B below.

Table 4A. Qualitative Snorkel Data for Pool 3, October 2005.

Pool 3 (qualitative)	Length Category (inches)						# of Fish Observed
	0-3	3-6	6-9	9-12	12-15	15-18	
Rainbow trout	0	0	2	1	0	0	3
Brown trout	0	0	0	0	0	0	0
Hardhead /pikeminnow	400	0	0	0	0	0	400
Sacramento sucker	0	0	0	0	0	0	0
Riffle sculpin	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	0	0	0
Total observed / size	400	0	2	1	0	0	403

Table 4B. Qualitative Snorkel Data for Pool 6, October 2005.

Pool 6 (qualitative)	Length Category (inches)						# of Fish Observed
	0-3	3-6	6-9	9-12	12-15	15-18	
Rainbow Trout	0	0	2	3	3	1	9
Brown Trout	0	0	0	0	0	0	0
Hardhead / Pikeminnow	300	0	0	0	0	0	300
Sacramento Sucker	0	0	0	0	0	0	0
Riffle Sculpin	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	0	0	0
Total observed / size	300	0	2	3	3	1	309

### 4.3 Habitat Data

GANDA measured the habitat units of the sites surveyed. The summary habitat data are presented in Table 5.

Table 5. Habitat Data for the S.F. American River, October 2005.

Site	Length (m)	Width (m)	Mean Depth (m)	Max Depth (m)	Area (m <sup>2</sup> )	Acres	Hectares
Electrofishing site	120	23.6	0.45	1	2832	0.70	0.28
Pool 1	230	29.7	2.7	8	6831	1.69	0.68
Pool 2	70	21	2.2	6.5	1470	0.36	0.14
Pool 4	90	20.3	1.3	3.2	1827	0.45	0.18

## 4.4 Species Summaries

### Hardhead and Sacramento Pikeminnow

Hardhead and Sacramento pikeminnow were the most abundant fish captured during the electrofishing effort. A total of 291 hardhead and Sacramento pikeminnows were captured during this effort (for an estimated population of 383 fish), 153 of which were measured and weighed, and 138 of which were counted but not measured as they were young-of-the-year fish. A length-frequency histogram for these fish is presented in Appendix A. Of fish captured which were large enough to accurately identify, 27 were hardhead and three were Sacramento pikeminnow. We expect the smaller fish to follow a similar distribution between these two species, with -90 percent hardhead and -10 percent pikeminnow. But given that we were unable to confidently identify some of the smaller fish, we have combined these two species for analysis. Most of the fish were young-of-the-year, ranging from 21 mm to 105 mm FL. Moyle (2002) reports that hardhead typically spawn in April and May, but can prolong spawning activities into August. In the S.F. American River, there appears to have been two distinct spawning periods in 2005, with peaks in the length-frequency histogram at 35 mm and 80 mm FL. Three of the larger young-of-the-year (90, 94, and 104 mm) were positively identified as pikeminnow. Three age 1+ hardhead (125 – 150 mm) were also caught. This age characterization is consistent with the growth data presented by Moyle (2002).

Juvenile hardhead were also the most abundant fish in the pools. Most hardhead were found along the vegetated margins, although one large school was found mid-channel in Pool 1. In general, hardhead were most abundant in Pool 1 and less abundant upstream in pools 2 and 4. Juvenile hardhead were also abundant in pools 3 and 6, based on qualitative sampling.

### Sacramento Sucker

Sacramento suckers were the second most abundant fish captured (after the hardhead/pikeminnow group) during the electrofishing survey, but were largely absent in the snorkeling surveys. In the riffle / run habitats, suckers were present in similar numbers as rainbow trout and speckled dace. Most suckers were young-of-the-year and age 1+ fish (Appendix A). However, we captured fish up to 407 mm FL during the electrofishing surveys, which may be 10 years old or older (Moyle 2002). During the snorkeling survey one young-of-the-year and two large adult suckers were observed in the slack water in the middle of Pool 1 (the average number of suckers observed for the two passes was one adult fish, even though the two fish were observed lying next to each other).

### Rainbow Trout

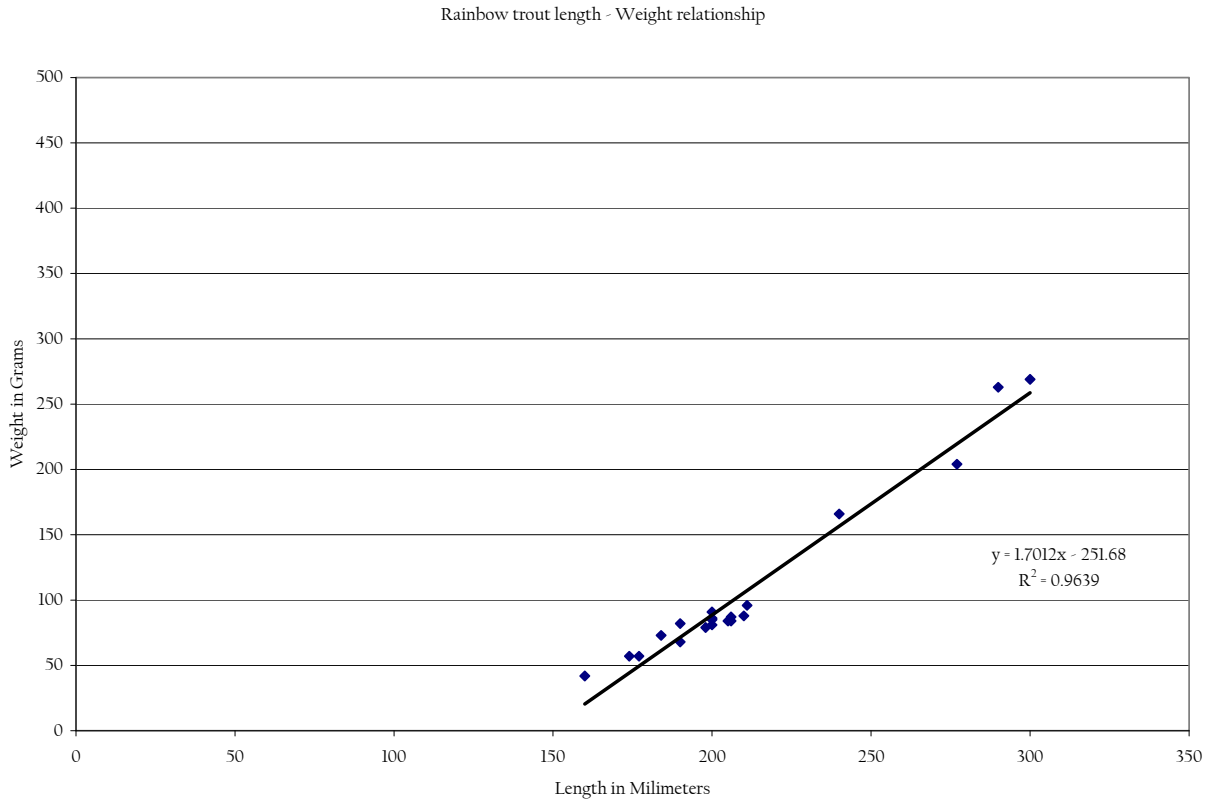
Rainbow trout were the third most abundant fish captured during the electrofishing survey, and the second most abundant fish observed during the snorkel surveys. Most fish captured during the electrofishing survey were young-of-the-year and age 1+ fish as indicated by the length frequency histogram (Appendix A), with several 2+ or possibly older fish also caught (the length frequency analysis is vague with respect to the age classification of the larger fish). These fish were in good condition as measured by the condition factor of 1.13 (Table 2).



Rainbow trout were concentrated around the head of the pools during snorkel surveys, and were not observed in the middle or in the pool tailouts. Rainbow trout observed ranged from age 1+ to age 4+ (possibly 5+). We did not observe any young-of-the-year trout in pools.

To estimate the biomass of the rainbow trout longer than 12 inches FL (305 mm) (for which we had no data from the electrofishing surveys), we calculated a regression from the length-weight data as described in the methods. This regression is presented in Figure 2.

Figure 2. Length-Weight Regression of Rainbow Trout Larger than 6 inches (152 mm).



### Brown Trout

Brown trout were the least abundant fish captured during the electrofishing surveys; they were also the only non-native species encountered. Young-of-the-year, age 1+ and age 2+ fish were captured. The few brown trout captured were in good condition, with a condition factor of 1.09 (Table 2). The only brown trout observed during snorkel surveys was one young-of-the-year trout observed in Pool 1.

### Speckled Dace

Speckled dace were common in the riffle habitats. Most fish were young-of-the-year and age 1+ fish (Appendix A). The one large adult captured may have been an age 3+ fish. We did not

catch any dace that clearly fell in the 2+ age class. No dace were observed during the snorkeling surveys.

### Riffle Sculpin

Riffle sculpin were common in the riffle habitats (electrofishing survey). The length frequency distribution (Appendix A) suggests the presence of young-of-the-year, age 1+, and age 2+ fish. Age 2+ fish appeared to be the most abundant age class (although, age 3+ may also be included in this group), which may reflect a higher capture efficiency for larger sculpins. One small sculpin was observed in the tailout of Pool 1. No other sculpin were observed during the snorkel surveys.

## 5.0 SUMMARY

GANDA surveyed the fish community in the S.F. American River adjacent to and upstream of Akin Powerhouse in October 2005. Hardhead were the most abundant fish observed. Since small hardhead and small Sacramento pikeminnows are difficult to tell apart, these fish were lumped together for analysis. Of those fish which were large enough to identify reliably, hardhead comprised 90 percent of the two species and Sacramento pikeminnow comprised the remaining 10 percent.

Hardhead spawning occurred throughout the survey area, as indicated by the distribution of juvenile fish. However, no adult hardhead (or pikeminnow) were observed in either the shallow riffle and pocket water habitats, or in the large pools. There appears to be two distinct spawning periods for hardhead/pikeminnow: one probably due to spawning associated with rainfall events, and a second spawning period associated with snowmelt. During future efforts, we recommend collecting scale samples and analyzing the growth patterns to determine whether the two peaks observed in the Length-frequency analysis are both young-of-the-year hardhead and pikeminnow.

Most of the fish observed were native to the S.F. American River, with brown trout the only non-native species. Brown trout were the least abundant of the fish community encountered. All of the fish encountered visually appeared to be in good condition.

## 6.0 REFERENCES

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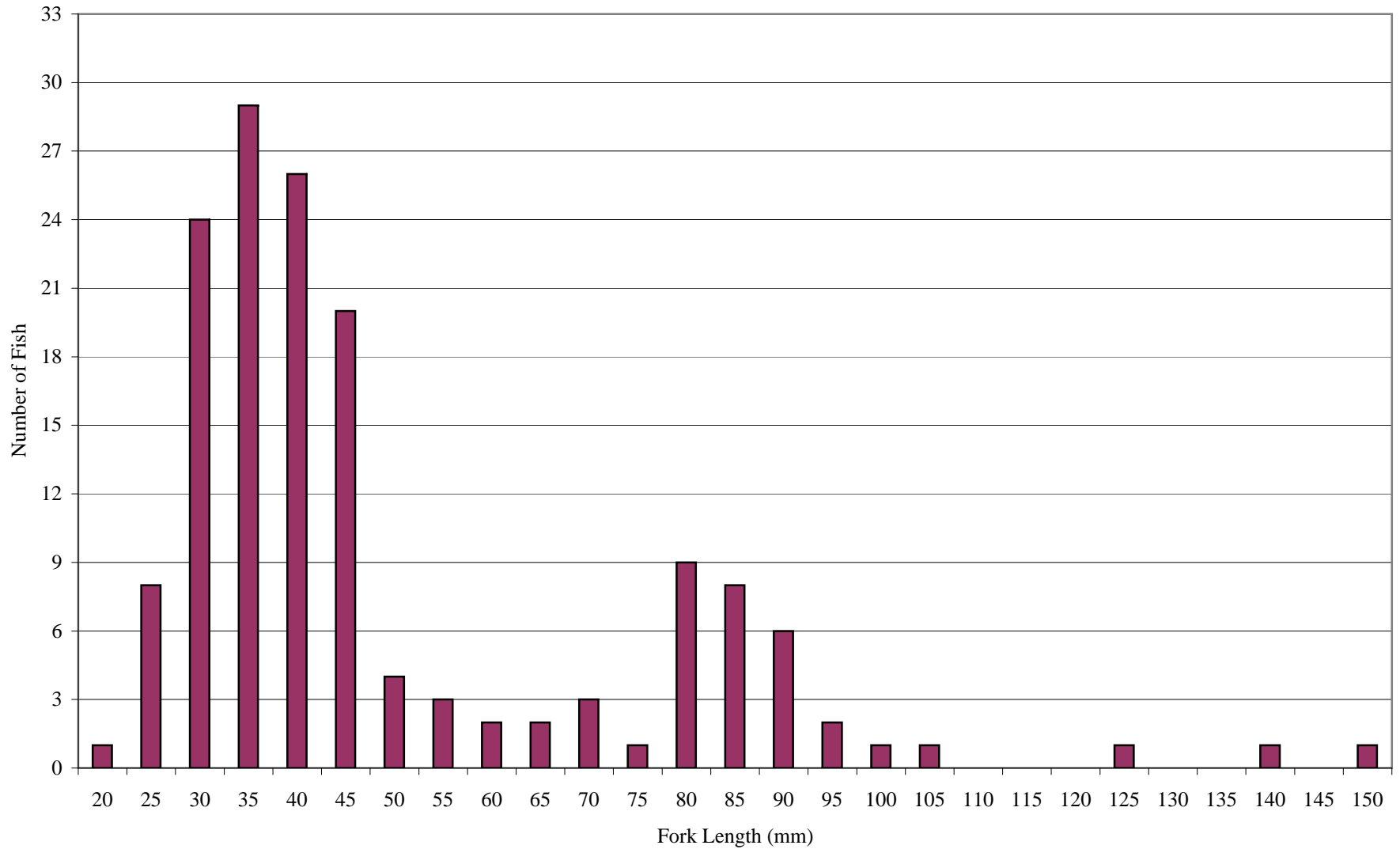
### Sub-consultants

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(707) 826-0844 [dpa@humboldt1.com](mailto:dpa@humboldt1.com)

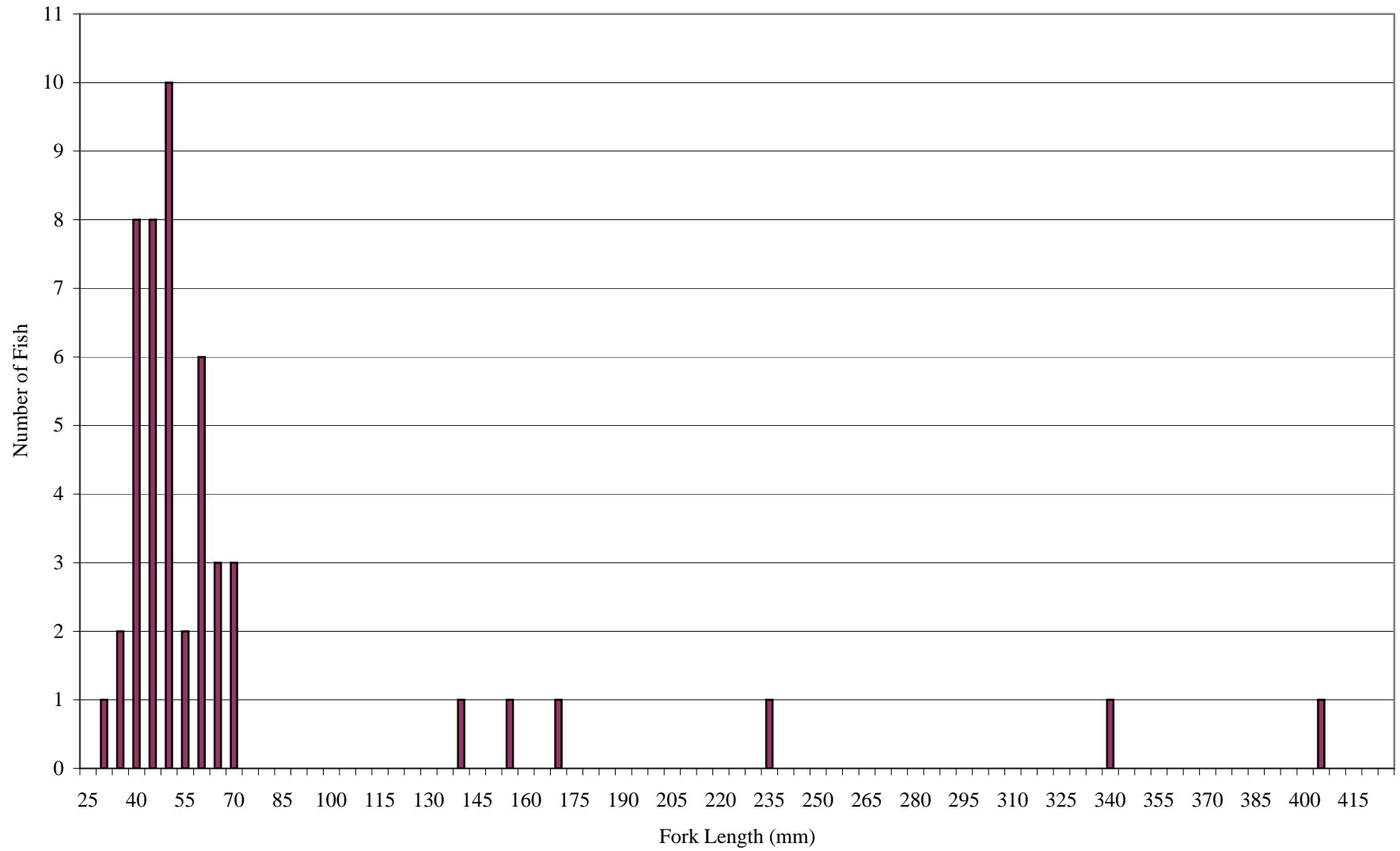
## Appendix A:

Length Frequency Histograms for Fish Captured during the Electrofishing Survey

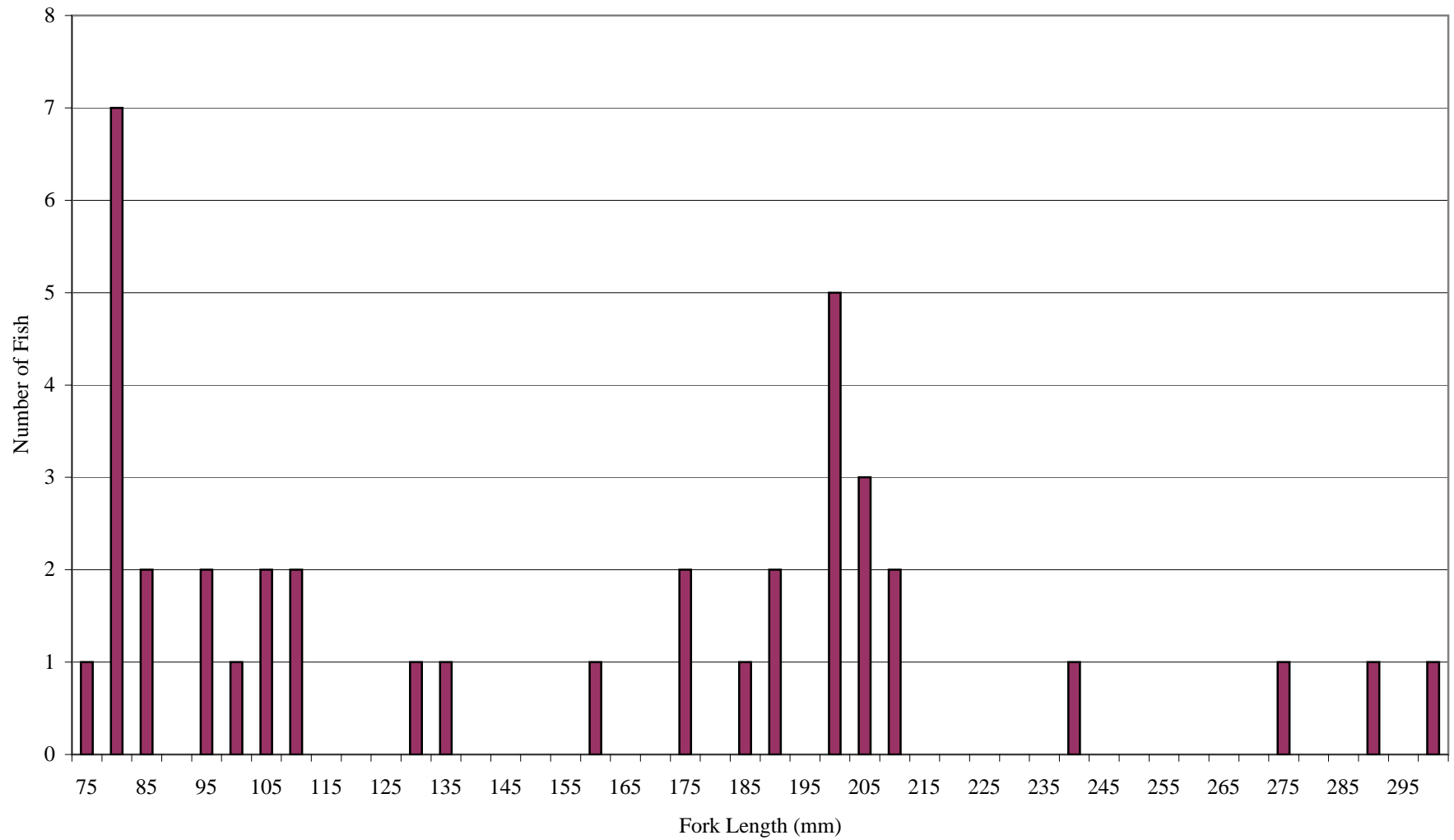
Hardhead / Sacramento Pikeminnow



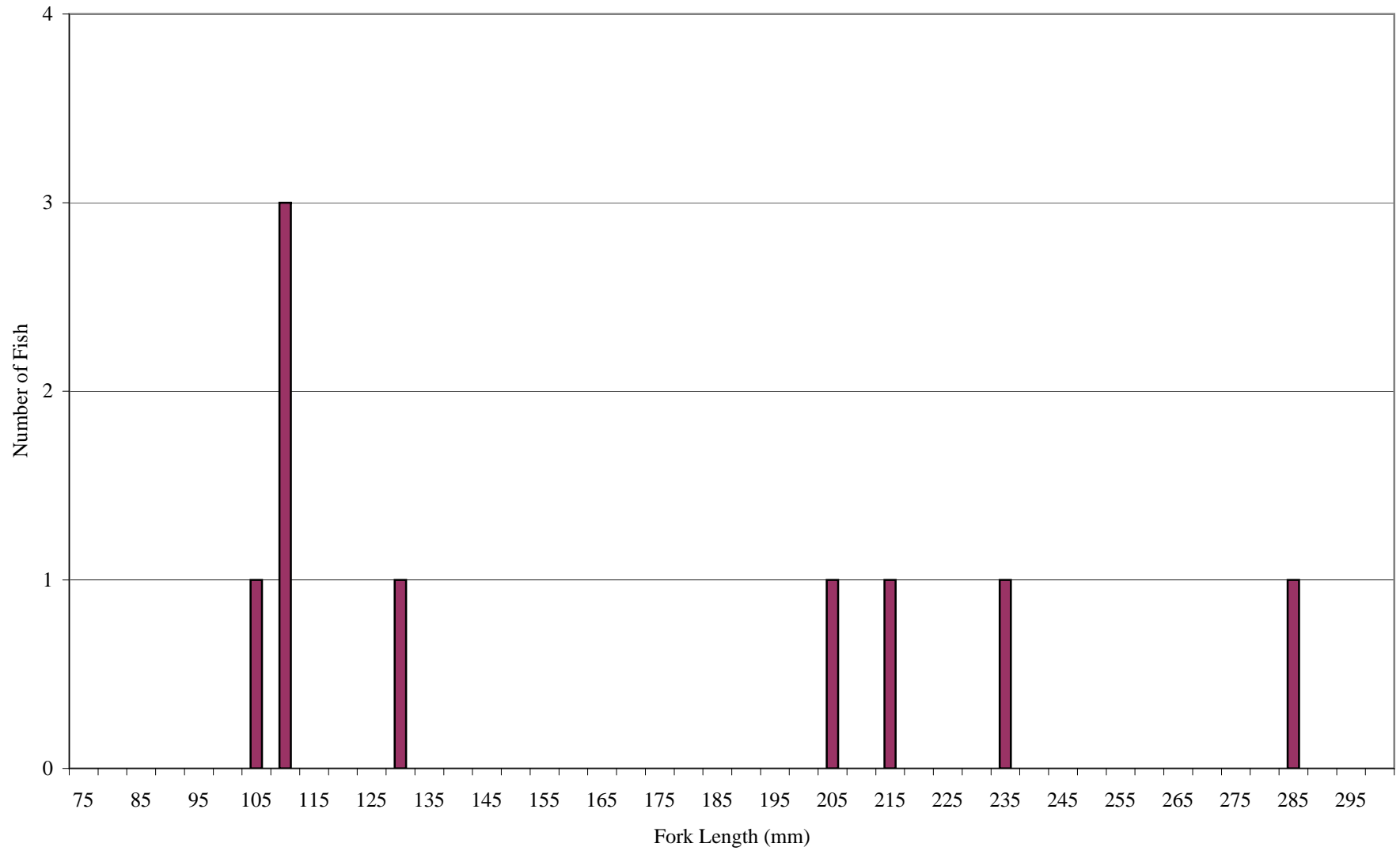
Sacramento Sucker



# Rainbow Trout

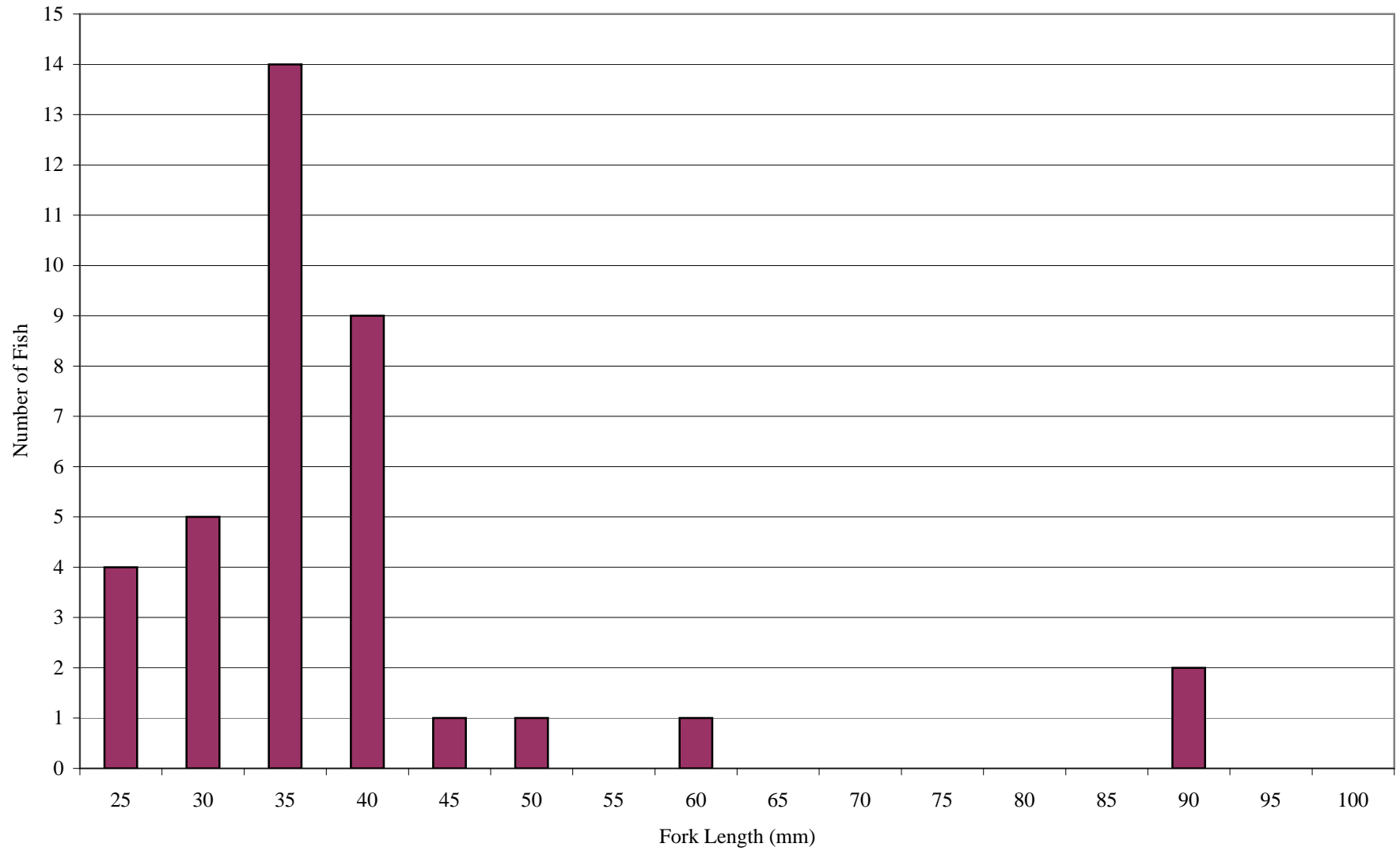


### Brown Trout

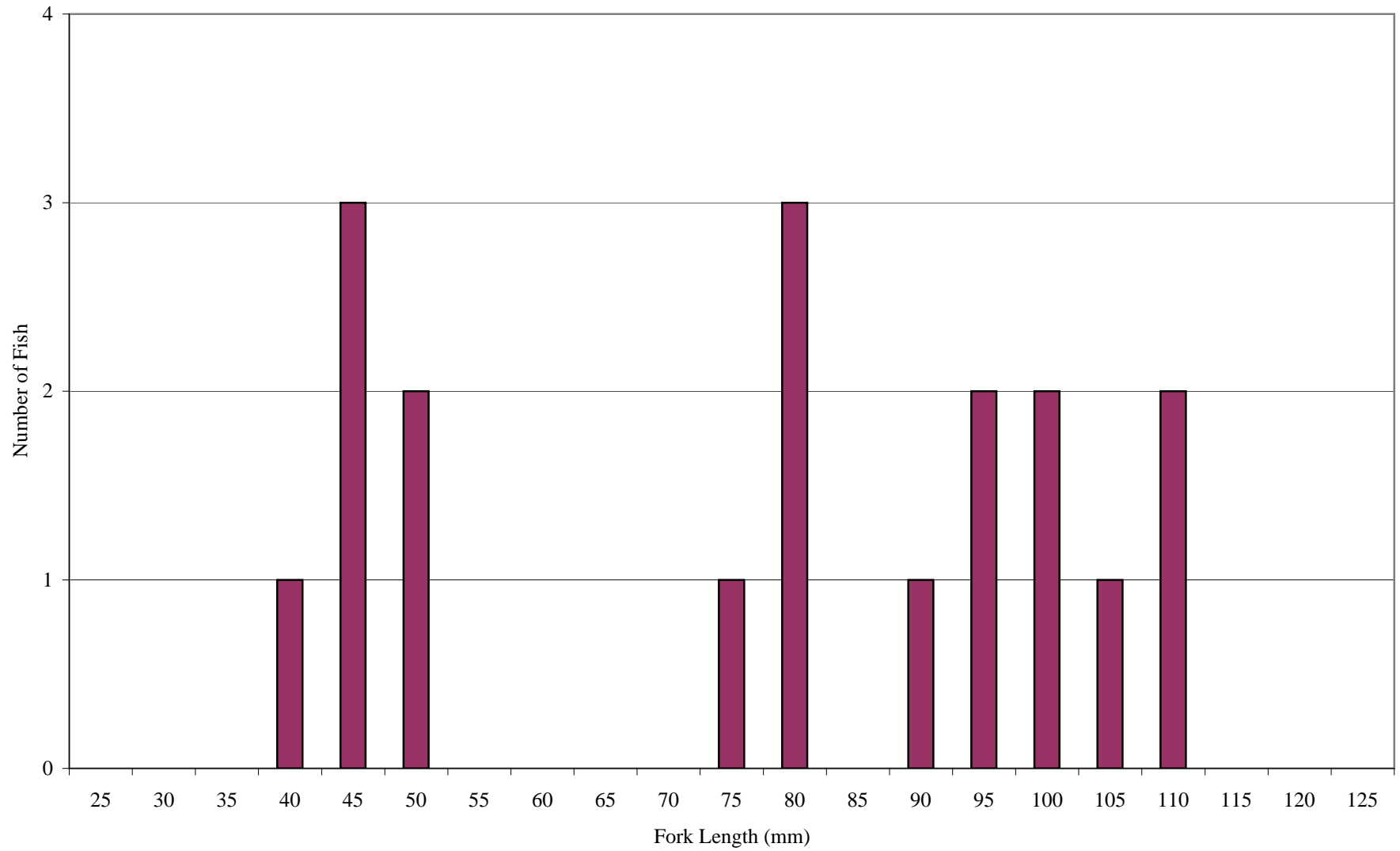




### Speckeled Dace



### Riffle Sculpin



## Appendix B:

Site Photos



Photo 1. Electroshocking Site 1, from bottom looking upstream to Akin Powerhouse.



Photo 2. Electroshocking Site 1, from top looking downstream to SMUD powerhouse.



Photo 3. Snorkel Pool 1, from bottom looking upstream.



Photo 4. Snorkel Pool 1, from top looking downstream.



Photo 5. Snorkel Pool 2, from bottom looking upstream.



Photo 6. Snorkel Pool 2, from top looking downstream.



Photo 7. Snorkel Pool 4, from top looking downstream.



Photo 8. Snorkel Pool 4, from bottom looking upstream.

## Appendix C:

Field Datasheets for Fish Surveys



Date 10/1/18/2005 Stream Name: South Fork American River Lat: \_\_\_\_\_ Long: \_\_\_\_\_ Quad: \_\_\_\_\_  
 Site Info: SITE ONE Water Temp: 52°F Time: 11:55-12:30 Pass: ONE Effort: 10:2455; DP: 1600 (PPA 15B) T.P.: 1541 (12) RJ: 1619 (11A)  
 Stream Temp: \_\_\_\_\_ Crew: I. Chan, P. Jackson, C. Scott, T. Parkinson, D. Parkinson, J. Williams

Ave. wt of HARDHEAD < 1: 59g (HARDHEAD under 1gr)

Species	Length	Weight	Species	Length	Weight	Species	Length	Weight
1	RBT	277	204	76	RBT	111	15	
2		200	85	77		111	17	
3		200	91	78		234	138	
4		198	79	79				
5		240	166	80	HARD	39		
6		210	88	81		40		
7		200	269	82		33		
8		190	82	83		38		
9		184	73	84		36		
10		206	84	85		34		
11		98	9	86		38		
12		107	52	87		36		
13		177	57	88		34		
14		160	42	89		30		
15		105	11	90		36		
16		86	6	91		33		
17		93	7	92		30		
18		78	6	93		32		
19				94		51		
20				95		52		
21				96		38		
22				97		35		
23				98		33		
24				99		37		
25				100		44		
26	SUC	407	782	51	HARD	125	19	
27		168	61	52		150	34	
28		155	47	53		86	5	
29		50	<1	54		81	5	
30		341	504	55		78	4	
31		70	3	56		78	5	
32		67	3	57		81	4	
33		68	3	58		88	6	
34		51	1	59		83	8	
35		57	1	60		99	8	
36		40	<1	61		39	8	
37		61	3	62		68	2	
38		41	<1	63		26	4	
39		59	3	64		82	4	
40		61	3	65		91	6	
41		45	<1	66		90	7	
42		31	<1	67		32	5	
43		45	<1	68		83	5	
44		31	<1	69		89	6	
45		49	<1	70		84	6	
46		38	<1	71		33	4	
47		52	<1	72		78	4	
48		41	<1	73		37	4	
49		44	<1	74		75	4	
50		38	<1	75		39	4	

RBT 18  
 SUC 26  
 HARD 155  
 RBT 3  
 DACE 17  
 SCUP 10

162  
 93/59

HARD: +5 (<1)



Date 10/18/2005 Stream Name: South Fork American River Lat: \_\_\_\_\_ Long: \_\_\_\_\_ Quad: \_\_\_\_\_

Site Info: ENE CONT. B

Stream Temp: \_\_\_\_\_ Water Temp: 52 F Time: \_\_\_\_\_ Pass: ONE Effort: \_\_\_\_\_

Crew Leader: \_\_\_\_\_ Crew: \_\_\_\_\_

Species	Length	Weight	Species	Length	Weight	Species	Length	Weight		
1	DACE	91	11	26	SCULP	91	12	76	HARD	35
2		42	<1	27		112	19	77		41
3		40	<1	28		75	6	78		41
4		36	<1	29		100	15	79		43
5		58	3	30		43	<1	80		43
6		38	<1	31		43	<1	81		41
7		25	<1	32		79	5	82		39
8		38	<1	33		52	<1	83		30
9		36	<1	34		43	<1	84		46
10		48	<1	35		41	<1	85		44
11		34	<1	36				86		34
12		30	<1	37				87		44
13		35	<1	38				88		42
14		25	<1	39				89		44
15		31	<1	40				90		34
16		37	<1	41				91		31
17		37	<1	42				92		48
18				43				93		41
19				44				94		44
20				45				95		46
21				46				96		43
22				47				97		36
23				48				98		34
24				49				99		46
25				50				100		39
				51	HARD	67	4			
				52		82	6			
				53		40				
				54		32				
				55		21				
				56		30				
				57		32				
				58		31				
				59		38				
				60		29				
				61		36				
				62		29				
				63		45				
				64		45				
				65		38				
				66		38				
				67		33				
				68		38				
				69		41				
				70		37				
				71		27				
				72		46				
				73		45				
				74		36				
				75		40				







Date 10/18/2005 Stream Name: South Fork American River Lat: \_\_\_\_\_ Long: \_\_\_\_\_ Quad: \_\_\_\_\_

Site Info: SITE ONE

RJ:1515

Stream Temp: \_\_\_\_\_ Water Temp: 52°F Time: 400-450pm Pass: Three Effort: T.P.: \_\_\_\_\_ DP: \_\_\_\_\_

Crew Leader: R. Aramayo Crew: J. Chan, R. Jackson, D. Parkinson, T. Parkinson, C. Scott, J. Williams

REM 906  
10410

Species	Length	Weight	Species	Length	Weight	Species	Length	Weight
1	RBT	210	105					
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12	RBT							
13	MURT	200	81					
14		109	15					
15		109	13					
16		130	23					
17		137	29					
18		96	10					
19		82	7					
20		82	6					
21								
22								
23								
24								
25								
26	SUMP	105	17					
27		79	6					
28		95	11					
29								
30								
31								
32								
33								
34								
35								
36								
37	DACE	40	<1					
38		3.5	<1					
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
51	HARD	84	6					
52		83	4					
53		65	1					
54		80	7					
55		78	4					
56		88	6					
57		60	2					
58								
59								
60								
61								
62								
63								
64								
65								
66								
67								
68								
69	HARD	COUNT	<60					
70	HARD	HIT HIT	<60					
71	HARD	HIT HIT						
72								
73								
74								
75								
76	SUC	65	4					
77		70	4					
78		60	2					
79		47	1					
80		65	2					
81	MURT	49	1					
82								
83								
84								
85								
86								
87								
88								
89								
90								
91								
92								
93								
94								
95								
96								
97								
98								
99								
100								

RBT 1  
RBT 8  
SUMP 3  
DACE 2  
HARD 47  
SUC 6  
PIKE 2



Date 10 / 19 / 2005 Stream Name: South Fork American River Lat:      Long:      Quad:     

Site Info: Site Two SNORSEL POOL ONE

Stream Temp:      Water Temp: 52° Time: 1025-1100 Pass: ONE Effort:     

Crew Leader: Arcus Crew: Jackman, Cham, D. Parkinson, T. Parkinson, D. Longman, C. Scott

Species	Length	Weight	Species No.	Species	Length	Weight	Species	Length	Weight	Species	Length	Weight
1	HARD*	0-3	-350	26	BRT	250	1	51	SAC	15	1	76
2			10	27				52		18	1	77
3		0-3	1	28				53				78
4		0-3	100	29				54				79
5		0-3	85	30				55				80
6				31	R-BT	6-9	2	56				81
7				32		9-12	2	57				82
8				33		14	1	58				83
9				34				59				84
10				35				60				85
11				36				61				86
12				37				62				87
13				38				63				88
14				39				64				89
15				40				65				90
16				41				66				91
17				42				67				92
18				43				68				93
19				44				69				94
20				45				70				95
21				46				71				96
22				47				72				97
23				48				73				98
24				49				74				99
25				50				75				100

0-3 HARD are cyprinids - could be greenback or hardhead



Date 10/19/2005 Stream Name: South Fork American River Lat: \_\_\_\_\_ Long: \_\_\_\_\_ Quad: \_\_\_\_\_

Site Info: Pan-Two Water Temp: 72°F Time: 1109-1119 Pass: ONG Effort: \_\_\_\_\_

Crew Leader: Aramayo Crew: Chan, Jackson, Scott, D. Parkinson, J. Parkinson, D. Corcoran

	Species	Length	Weight	Species	Length	Weight	Species	Length	Weight
1	HARD*	0-3	2.5	26	RGT	6-9	1	51	76
2				27		9-12	2	52	77
3				28		12-15	1	53	78
4				29				54	79
5				30				55	80
6				31				56	81
7				32				57	82
8				33				58	83
9				34				59	84
10				35				60	85
11				36				61	86
12				37				62	87
13				38				63	88
14				39				64	89
15				40				65	90
16				41				66	91
17				42				67	92
18				43				68	93
19				44				69	94
20				45				70	95
21				46				71	96
22				47				72	97
23				48				73	98
24				49				74	99
25				50				75	100



Garcia and Associates (GANDA)

\* Handhead / Pike minnow 6-3

El Dorado Irrigation District  
Fish Population Surveys

Date 10/19/2005 Stream Name: South Fork American River Lat: \_\_\_\_\_ Long: \_\_\_\_\_ Quad: \_\_\_\_\_

Site Info: Pool Four

Stream Temp: 52° Water Temp: 52° Time: 1205-1220 Pass: ONE Effort: \_\_\_\_\_

Crew Leader: Aramayo Crew: Chan, Jackson, D. Parkinson, T. Parkinson, C. Scott

Species	Length	Weight	Species	Length	Weight	Species	Length	Weight
1	HARD*	0-3	3			76		
2						77		
3						78		
4						79		
5						80		
6						81		
7						82		
8						83		
9						84		
10						85		
11						86		
12						87		
13						88		
14						89		
15						90		
16						91		
17						92		
18						93		
19						94		
20						95		
21						96		
22						97		
23						98		
24						99		
25						100		
26	SUC	0-3	1					
27		0-3	.5					
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
51	RBT							
52		9-12			MORT			
53		6-9			7			
54		12-15			2			
55								
56								
57								
58								
59								
60								
61								
62								
63								
64								
65								
66								
67								
68								
69								
70								
71								
72								
73								
74								
75								

\*HARD/PM if 0-3





Date 10 / 17 / 2005 Stream Name: South Fork American River Lat: \_\_\_\_\_ Long: \_\_\_\_\_ Quad: \_\_\_\_\_

Site Info: POOL ONE / TWO / FOUR POOL 1: 1405-1426 POOL 2: 1434-1443 POOL 4: 1513-1544  
 Stream Temp: 52.0 Water Temp: 52.0 Time: TWO Pass: TWO Effort: \_\_\_\_\_

Crew Leader: R. Aramayo Crew: J. Chan, R. Jackson, C. Scott, D. Parkinson, T. Parkinson

Species	Length	Weight	No.	Species	Length	Weight	No.	Species	Length	Weight	No.
1	POOL-DNF		26	POOL-TWD			51	POOL-FOUR			76
2	HARD 0-3	70.9	27	HARD 0-3	.82		52	HARD 0-3	37		77
3		75	28				53				78
4		40	29	RBT 6-9	4		54	RBT 6-9	7		79
5		150	30	9-12	1		55	9-12	4		80
6		151	31	12-15	3		56	12-15	6		81
7	HARD 3-6	1	32	15-18	1		57				82
8	RBT 9-12	1	33				58				83
9	15-18	2	34				59				84
10	SUC 0-3	1	35				60				85
11			36				61				86
12	SCUD 0-3	1	37				62				87
13			38				63				88
14			39				64				89
15			40				65				90
16			41				66				91
17			42				67				92
18			43				68				93
19			44				69				94
20			45				70				95
21			46				71				96
22			47				72				97
23			48				73				98
24			49				74				99
25			50				75				100

\* HARD 0-5 are pike narrow or headhead



Upper Pool → 100 m long  
 Pool → 15 m wide  
 Max depth 8m  
 Near depth 4m

Page \_\_\_\_\_ of \_\_\_\_\_

Date 10/17/2008 Stream Name: South Fork American River Lat: \_\_\_\_\_ Long: \_\_\_\_\_ Quad: \_\_\_\_\_

Site Info: Upper pool (Pool 5) QUAL + POOL 3 QUAL

Stream Temp: \_\_\_\_\_ Water Temp: \_\_\_\_\_ Time: \_\_\_\_\_ Pass: \_\_\_\_\_ Effort: \_\_\_\_\_

Crew Leader: \_\_\_\_\_ Crew: Bob Bl

Crew No	Pool 5		Pool 3		Crew No
	Species	Length	Species	Length	
1	HARD	0-3	RBT	6-9	26
2				9-12	27
3				12-15	28
4				15-18	29
5					30
6					31
7					32
8					33
9					34
10					35
11					36
12					37
13					38
14					39
15					40
16					41
17					42
18					43
19					44
20					45
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					99
					100



10/18/2005

# PHYSICIAN HABITAT - SITE ONE

WIDTHS + DEPTHS ELECTROSHOCK SITE BOTTOM

TOP	10 m	20 m	30 m	40 m	50 m	60 m	70 m	80 m	90 m	100 m	110 m	120 m
WIDTH (FT)	70.5	74.4	67.6	58.3	77.0	79.2	78.6	78.0	80.6	91.4	83.5	79.3
DEPTH MEAN (m)	17	19	20	13	16	18	15	14	22	20	19	18
DEPTH MAX (m)	30	40	26	22	30	30	27	34	37	26	33	34

PHYS HPT - SITE 1 10/18/2005 TOP 10

19/19/2005 DEPTHS, LENGTHS & WIDTHS FOR POOLS 1, 2 AND 4

DEPTHS

TOP

Meters POOL 4

	10	20	30	40	50	60	70	80	90	100
MAX	3.2	3.0	2.1	1.5	1.3	1.0	1.2	1.0	0.8	0.8
MEAN	2.5	2.2	2.0	1.2	1.1	0.8	0.8	0.7	0.6	0.5

POOL 2

	10	20	30	40	50	60	70
MAX	1.3	2.1	3.0	6.5	5.3	2.0	2.0
MEAN	1.0	1.8	2.1	5.9	3.7	1.5	1.2

POOL 1

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
MAX	3.9	2.9	2.9	3.1	3.2	3.7	4.2	5.0	4.8	4.0	4.9	3.0	4.5	6.1	8.0	4.6	4.8
MEAN	0.8	1.7	3.1	2.7	2.5	2.4	3.0	3.9	4.6	3.8	3.9	2.1	2.6	4.6	5.0	3.9	2.4

	180	190	200	210	220	230
MAX	2.3	2.9	4.0	4.0	2.5	1.0
MEAN	2.0	1.9	2.0	2.0	1.5	0.4

TOP

Lengths & widths

POOL 4

LENGTH: 289 ft	20	30	40	50	60	70	80	90	
WIDTHS (METERS UNLESS OTHERWISE SPECIFIED)	26.5	18.5	24.2	17.9	21.0	19.6	66 ft	57 ft	56 ft

POOL 2

LENGTH: 230 ft	10	20	30	40	50	60	70	
WIDTHS (M)	16.8	12.7	25.2	22.8	23.6	23.8	24.7	61.5 ft

POOL 1

LENGTH: 739 ft	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
WIDTHS (M)	20.6	19.8	22.6	26.8	26.4	27.3	24.3	24.4	25.1	23.9	28.0	35.7	26.9	37.0	46.3	51.5
	170	180	190	200	210	220	230									
	34.9	32.2	34.4	32.5	19.8	27.5	107 ft									

BOTTOM

on 14 90ft, combine Bottom 90+100 values

POOL