2007

HARDHEAD POPULATION SURVEYS SOUTH FORK AMERICAN RIVER

El Dorado Hydroelectric Project (FERC No. 184)

2008

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1.0 INTRODUCTION

The *El Dorado Relicensing Settlement Agreement* (EID 2003) specified that at least three years of hardhead (*Mylopharodon conocephalus*) monitoring to be implemented by the El Dorado Irrigation District (EID) during operation of the El Dorado Hydroelectric Project (FERC #184). This effort also satisfies the Fish Population Monitoring requirements with respect to hardhead set forth in the U.S. Forest Service 4(e) License Condition No. 37 (USFS 2003), Section 7 of the El Dorado Relicensing Settlement Agreement (Settlement) Monitoring Program, and the California State Water Resources Control Board Section 401 Clean Water Act Water Quality Certification Condition No. 13a (SWRCB 2006).

This monitoring effort was deemed necessary because existing data on hardhead were not sufficient to derive biomass indices for determining habitat quality in the vicinity of the Project; therefore, the USDA Forest Service (FS), the Ecological Resources Committee (ERC), and the California State Water Resources Control Board (SWRCB) requested that additional data on hardhead populations be collected for a period of three years. This additional monitoring effort focuses on the reach of the South Fork (SF) American River in the vicinity of Akin Powerhouse, where hardhead are known to be present. Ultimately, these data will be used by the resource agencies to derive biomass indices for fish in order to help describe the quality of the habitats present in the Project area.

EID contracted with the Garcia and Associates (GANDA) to perform the 2007 fish population surveys near Akin Powerhouse. The 2007 surveys comprised the third year of the three-year fish monitoring effort. To date, fish population monitoring in this reach has been conducted in 2004, 2005, and 2007. As in previous study years (ECORP 2005 and GANDA 2007), fish populations were surveyed in 2007 using a combination of electrofishing and snorkeling techniques. Results of the 2007 surveys are reported herein.

2.0 METHODS

2.1 Study Area

The study area was comprised of the reach of the SF American River, adjacent to Akin Powerhouse, located just upstream from Slab Creek Reservoir (Figure 1). This area was identified by Thomas R. Payne Associates (TRPA) as being known to support hardhead (TRPA 1998; as cited in Exhibit E of the Settlement Agreement). Based upon TRPA's habitat evaluation, the distribution of hardhead in the SF American River is thought to be limited to an area approximately four kilometers upstream of Akin Powerhouse, just downstream of the confluence with Silver Creek. In 2007 electrofishing once again occurred in an established riffle/run site immediately adjacent to Akin Powerhouse, and snorkel surveys were conducted in the large pools upstream of the powerhouse (extending approximately 1.5 km upstream).

2.2 Electrofishing Surveys

A team of eight biologists fished the 120-meter-long electrofishing site adjacent to Akin Powerhouse in October 2007 using a three-pass depletion method. The site was fished from bottom to top using four backpack electrofishers (Smith Root Models 12 and 15). Biologist worked in four teams of one electrofisher and one netter each. Two teams concentrated their efforts on the stream margins to focus on habitat for juvenile hardhead, while the other two teams worked together to fish the middle of the channel. All four teams moved upstream in unison.

Fish collected during each pass were processed immediately upon completion of the pass. All specimens were identified to species, weighed to the nearest gram using an electronic balance, and measured to fork length (FL) using a metric fish board. A weight of 0.5 grams was assumed for fish smaller than 60 mm FL because most of these specimens were too small to reliably weigh as individuals. However, all the small hardhead (<60 mm FL) able to be identified were weighed in groups using water displacement in a graduated cylinder in order to derive a more accurate weight estimate for hardhead biomass calculations. Following each pass, processed fish were placed in a live car in an instream holding area located just outside the site. After the completion of the survey, all collected fish were redistributed throughout the site.

Figure 1. Study area for hardhead population monitoring

South Fork American River, California

2.3 Snorkeling Surveys

A team of five biologists performed quantitative two-pass snorkel surveys in the first seven deep pools upstream of the Akin Powerhouse in October 2007 (Figure 1). At the beginning of the survey, divers entered the water at the downstream end of the pool and moved upstream at a slow and deliberate pace in parallel lanes. Divers enumerated, identified, and visually estimated the lengths of all fish observed while moving upstream in unison. Divers in the two outside lanes carefully searched the stream margins and submerged bank vegetation for juvenile fish. Special attention was paid to ensure that all members of the snorkeling team stayed on the same pace and covered all aspects of each pool. Divers in adjacent lanes communicated with each other regarding any fish that split lanes or moved from one lane to another so that no fish were missed or double-counted. Fish of each species were categorized into predefined three-inch (76mm) length classes (in order to be consistent with the previous survey efforts) and all data were recorded on wrist-mounted dive slates. Juvenile hardhead and Sacramento Pikeminnow (<6 inches) were combined in the analysis of snorkeling data, because of the uncertainty of positively identifying these fish.

For the first pass, divers began at Pool 1 and worked upstream through all seven pools. After completing the first pass in all pools, divers repeated their effort on a second pass in order to verify their observations. A minimum of 30 minutes was allowed for fish to re-equilibrate in a given pool between passes. For logistical reasons, the second pass was made in reverse, beginning at Pool 7 and ending at Pool 1. Mean values from the two passes were used for calculating fish abundance and for estimating biomass.

2.4 Physical Habitat Surveys

Physical habitat characteristics at each site were measured concurrently with fish population surveys (i.e., at the end of the three-pass depletion for the electrofishing site, and between snorkeling passes for the pools). Measured parameters included site length, width, and depth. Mean depth and maximum depth were measured across a minimum of 10 width transects spaced evenly along the length of each site. For deeper pool transects, depths were estimated visually

In 2007, physical habitat parameters were measured at Pools 3, 4, 6, and 7, where physical habitat surveys had not been completed during previous monitoring efforts. Physical habitat data for the electrofishing site and Pools 1, 2, and 5 were collected during the 2005 fish monitoring effort. It was assumed that site

dimensions did not change significantly between surveys years given the stability of the channel in this reach (e.g., the predominance of bedrock features, etc.). In 2007, all sites were documented with digital photographs and the locations of each site (i.e., the upstream and downstream boundaries) were recorded using a hand-held Garmin GPS unit.

2.5 Data Analysis

All 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) in order to generate fish population estimates per site. Fish abundance was calculated as the number of fish per acre for each species based on site dimensions. Biomass estimates were made by extrapolating the total weight of the catch per species (using the population estimates and length-weight relationships of the fish captured) and dividing by total site area. Biomass estimates are reported as grams of fish per acre for each species.

Biomass estimates for the snorkeling data were determined by extrapolating the length-weight data from the electrofishing survey. For each species and (3-inch) size class observed, the mean value for the corresponding fish species and size measured during the electrofishing effort was used to estimate weights per fish. This value was then multiplied by the mean number of fish observed in each size class during the snorkel surveys (fractional mean values were rounded up to the nearest whole number by convention such that a mean of 4.5 fish was treated as 5 fish). This method was used in all cases except for the two largest size classes (i.e., the 12-15 and 15-18 inch classes; [305-381 mm and 381-457 mm]) of rainbow trout (*Oncorhynchus mykiss*) and Sacramento sucker (*Catostomus occidentalis*), where the specimens observed during snorkeling were larger than any captured during the electrofishing survey. Weights for these larger fish were calculated using the length-weight relationship for the larger-sized fish (>6 inches FL) of each species captured during electrofishing. These specimens were assigned the estimated weight of the median fish in each three-inch size class (i.e., a 13.5-inch [343 mm] fish for the 12-15 inch class, and a 16.5-inch [419 mm] fish for the 15-18 inch class) based on the length-weight regression equations for each species.

Age structure of the sampled populations was determined from length-frequency relationships for individual species. Growth rates reported by Moyle (2002) were compared with the length-frequency histograms created from this data set to verify reasonable growth rates and generate realistic age structures.

Condition factor (the ratio of fish weight to length) was calculated for electrofishing data following Anderson and Gutreuter (1983) as:

$$CF = [Weight\ (g)\ X\ 100{,}000]/Length\ (mm)^3$$

Condition factor is commonly used as a general measure of fish health. Condition factor calculations were limited to fish 60 mm or larger, because this is roughly the minimum size for which an accurate individual weight can be obtained in the field using an electronic balance. Furthermore, condition factor values are interpreted for trout species only, because it is unclear how condition factor varies among species or groups of fishes with different body plans (e.g., cyprinids such as hardhead and Sacramento pikeminnow [*Ptychocheilus grandi*s], which tend naturally to be more fusiform. Among trout, condition factors greater than 1.0 are considered indicative of relatively good health. It is assumed, for example, that for most cyprinids (e.g., hardhead, pikeminnow), slightly lower condition factor values would be expected because these fish are typically thinner than trout of a given length. However, because variations in condition factor values are poorly understood for non-trout species, condition factor interpretations are limited to trout only.

Although all fish were identified to species in 2007, small hardhead and small Sacramento pikeminnow specimens are somewhat difficult to distinguish from each other in the field. Indeed, small hardhead and small Sacramento pikeminnow were not completely differentiated during the field surveys in 2004 and 2005. Therefore, for any between-year comparisons (of 2004, 2005, and 2007 data), juveniles specimens (approximately 60mm with fish in the hand and approximately 150 mm for observations made while snorkeling) of these species are lumped together as "hardhead/pikeminnow."

3.0 RESULTS

Seven species of fish were observed during the 2007 hardhead surveys. Juvenile hardhead (*Mylopharodon conocephalus*) and Sacramento pikeminnow (*Ptychocheilus grandi*s) were the most abundant species during both electrofishing and snorkeling surveys. Sacramento sucker (*Catostomus occidentalis*) was also relatively common. Rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), speckled dace (*Rhinichthys osculus*), and riffle sculpin (*Cottus gulosus*) were observed in relatively small numbers.

Photographs of electrofishing and snorkeling sites are provided in Appendix A. Copies of original field datasheets are provided in Appendix B. Length-frequency histograms for each species collected during electrofishing are presented in Appendix C.

3.1 Electrofishing Results

GANDA biologists captured a total of 662 fish from the 120-meter electrofishing site (for an estimated population of 1,022 fish total, a total abundance 1,529 fish/acre, and a total biomass of 6,860 g/acre). Catch data and population estimates for each species are provided in Table 1. Summaries of fish length-weight data, abundance, and biomass estimates by species are presented in Table 2.

Hardhead was the most abundant species captured during the electrofishing survey (721 fish/acre). The length-frequency distribution for this species (Appendix C) suggests that all of the hardhead collected were young-of-the-year (YOY), ranging in size from 29 mm to 83 mm FL. Hardhead had the third highest biomass of all species collected at the electrofishing site despite the presence of only smaller fish (747 g/acre).

Sacramento pikeminnow was the second most abundant species collected (494 fish/acre). Most pikeminnow appear to have been YOY (in the 20-110 mm FL range), although a few of the larger fish (115-130 mm FL) may have been age 1+ fish (Appendix C). Pikeminnow had the fourth highest biomass of all species collected at the electrofishing site (541 g/acre).

Sacramento sucker was the third most abundant species collected (156 fish/acre). Suckers ranged in size from 57 mm to 274 mm FL. More age classes are apparent on length frequency distribution for this species including YOY, age 1+, and age

2+ fish (Appendix C). Suckers, which tended to be among the largest specimens collected, had the highest biomass of all species collected at the electrofishing site (2,613 g/acre).

Riffle sculpin was the next most abundant species collected during electrofishing (73 fish/acre). Sculpin were common in the riffle habitats within the electrofishing site. Sculpin ranged in size from 35 mm to 100 mm FL. The length frequency distribution for sculpin suggests the presence of YOY, age 1+, and age 2+ fish (Appendix C). 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 sculpin. Sculpin had the sixth highest biomass of all species collected during electrofishing (295 g/acre).

Rainbow trout was the next most abundant species collected during electrofishing (41 fish/acre). Rainbow trout ranged in size from 59 mm to 320 mm FL. Most rainbow trout captured were YOY and age 1+ fish with several 2+ or possibly older fish (the ability to interpret the length frequency distribution in Appendix C is somewhat limited with respect to the larger rainbow specimens due to the limited number of individuals captured). These trout were in good condition as indicated by a mean condition factor of 1.05 (Table 2). Rainbow trout, which tended to be among the largest specimens collected, had the second highest biomass of all species collected at the electrofishing site (2,374 g/acre).

Speckled dace was equally abundant as rainbow trout at the electrofishing site (41 fish/acre). Speckled dace were more common in riffle habitats. Dace ranged in size from 40 to 96 mm FL. Most dace were YOY, age 1+ and age 2+ fish (Appendix C). Dace had the lowest biomass of all species collected during electrofishing (81 g/acre).

Brown trout was the least abundant species collected at the electrofishing site (3 fish/acre). Brown trout was the only non-native fish species encountered. The two brown trout collected (89 and 300 mm FL) were probably YOY and age 2+, respectively. These fish were in good condition as indicated by a mean condition factor of 1.07 (Table 2). Brown trout had the fifth highest biomass of all species collected during electrofishing (504 g/acre) despite the fact that only two individuals were captured.

Table 1. Electrofishing catch data and population estimates, SF American River, October 2007.

FISH SPECIES	Pass 1	Pass 2	Pass 3	Total Catch	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Population Estimate
Rainbow trout	17	9	2	28	28	33	**29**
Brown trout	0	2	0	2	2	15	**2**
Hardhead	123	88	73	284	328	682	**505**
Sacramento pikeminnow	115	63	58	236	263	429	**346**
Sacramento sucker	30	26	10	66	66	109	**84**
Riffle sculpin	14	9	6	29	29	51	**36**
Speckled dace	9	4	4	17	17	29	**20**
TOTAL	*308*	*201*	*153*	*662*	*733*	*1,348*	***1,022***

Table 2. Summary of fish length-weight data, abundance, and biomass, SF American River, October 2007.

FISH SPECIES	Length Range (mm FL)	Mean length (mm FL)	Mean Weight (g)	Mean Condition Factor[2]	Total Weight (g)	Abundance (fish/acre)	Biomass (g/acre)
Rainbow trout	59-320	149	57	1.05	1,662	41	2,374
Brown trout	89-300	195	177	1.07	353	3	504
Hardhead	29-83	45	1[1]	0.88	523	721	747
Sacramento pikeminnow	30-110	48	1	0.82	379	494	541
Sacramento sucker	57-274	98	22	1.15	1,829	156	2,613
Riffle sculpin	35-100	72	6	1.31	207	73	295
Speckled dace	40-96	59	9	0.97	56	41	81
TOTAL						*1,529*	*6,860*

[1]Values are based on fish >60mm FL (n=4), the minimum size to obtain an accurate individual weight in the field
[2]Fish smaller than 60 mm FL were assumed to weigh 0.5 g, except hardhead, for which a group weight was calculated: 242 fish weighed 190 grams (0.79 g/fish). Biomass estimates were based on population estimates calculated with Microfish 3.0

3.2 Snorkeling Results

Juvenile hardhead and pikeminnow were also the most abundant species observed during the snorkeling portion of the 2007 surveys. Most of these fish were found along the vegetated margins, although some schools appeared to move into the middle of the channel by afternoon. Hardhead were observed through Pool 7, where there may be a partial barrier to migration in some years (see Figure A-17); however, we were unable to confirm the upstream extent to the distribution of hardhead. Rainbow trout was the next most abundant species observed. Rainbow trout were concentrated around the head of the pools during snorkel surveys. Rainbow trout observed ranged from age 1+ to age 4+ (possibly 5+). No YOY trout were observed in pools. Sacramento sucker was the only other species observed during snorkel surveys (four adult suckers were observed during the snorkel surveys). No brown trout, riffle sculpin, or speckled dace were observed during snorkel surveys.

Of the seven pools surveyed, the highest total fish abundance was observed in Pool 1 (1,061 fish/acre) and the lowest abundance was observed in Pool 2 (125 fish/acre). Total fish biomass was highest for Pool 7 (27,639 g/acre) and lowest for Pool 3 (1,617 g/acre). High fish biomass in Pool 7 was due to the presence of numerous large rainbow trout within a relatively small total pool area (0.12 acres). 2007 fish observations and biomass estimates are summarized per species in Tables 3A-3G below.

As described in the methods section, biomass estimates for larger rainbow trout and suckers that were only observed during snorkeling were derived from length-weight regressions of the electrofishing data. The regressions are presented in Figures 2 and 3 below.

3.3 Physical Habitat Data

The 120-meter-long electrofishing site covered 0.70 acres, averaging 23.6 meters wide and 0.5 meters deep (max depth 1.0 meters). Of the seven pools surveyed, Pool 1 was the largest, covering 1.69 acres. Pool 1 was 230 meters long and averaged 29.7 meters wide and 2.7 meters deep (max depth 8.0 meters). Pool 7 was the smallest pool surveyed, covering only 0.12 acres. Pool 7 was 50 meters long and averaged 9.9 meters wide and 1.5 meters deep (max depth 12.0 meters). Physical habitat parameters for all sites are summarized in Table 4 below.

Table 3A. Numbers of fish by species and length category observed during snorkel surveys and estimated biomass for Pool 1, SF American River, October 2007.

POOL 1 6,831 m² or 1.70 acres	**Length Category (inches)**						**Mean #Fish Observed**[1]	**Total Weight** (g)	**Abundance** (fish/acre)	**Biomass** (g/acre)
	0-3	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**				
Rainbow trout	0	0	2	3	0	0	**5**	**714**	**3**	**423**
(Pass 1, Pass 2)	0, 0	0, 0	4, 0	4, 2	0, 0	0, 0				
Unidentified trout	0	0	1	1	0	0	**2**	**257**	**1**	**153**
(Pass 1, Pass 2)	0, 0	0, 0	1, 0	1, 0	0, 0	0, 0				
Hardhead/pikeminnow	1,795	1	0	0	0	0	**1,796**	**1,728**	**1056**	**1,025**
(Pass 1, Pass 2)	2880, 709	1, 0	0, 0	0, 0	0, 0	0, 0				
Sacramento sucker	0	0	0	0	1	0	**1**	**406**	**1**	**241**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 1	0, 0				
Riffle sculpin	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Speckled dace	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
TOTAL	***1,795***	***1***	***3***	***4***	***1***	***0***	***1,804***	***3,106***	***1,061***	***1,842***

[1] Estimated numbers of individuals and biomass projections are presented as the mean of the two passes; Fish estimates are rounded up to the next whole number.

Table 3B. Numbers of fish by species and length category observed during snorkel surveys and estimated biomass for Pool 2, SF American River, October 2007.

POOL 2 1,470 m² or 0.36 acres	**Length Category (inches)**						**Mean #Fish Observed**[1]	**Total Weight** (g)	**Abundance** (fish/acre)	**Biomass** (g/acre)
	0-3	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**				
Rainbow trout	0	0	1	4	2	1	**8**	**1,945**	**22**	**5,347**
(Pass 1, Pass 2)	0, 0	0, 0	1, 1	4, 3	2, 0	1, 1				
Unidentified trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Hardhead/pikeminnow	37	0	0	0	0	0	**37**	**36**	**103**	**98**
(Pass 1, Pass 2)	2, 72	0, 0	0, 0	0, 0	0, 0	0, 0				
Sacramento sucker	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Riffle sculpin	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Speckled dace	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
TOTAL	***37***	***0***	***1***	***4***	***2***	***1***	***45***	***1,980***	***125***	***5,444***

[1] Estimated numbers of individuals and biomass projections are presented as the mean of the two passes; Fish estimates are rounded up to the next whole number.

Table 3C. Numbers of fish by species and length category observed during snorkel surveys and estimated biomass for Pool 3, SF American River, October 2007.

POOL 3 2,908 m² or 0.72 acres	**Length Category (inches)**						**Mean #Fish Observed**[1]	**Total Weight** (g)	**Abundance** (fish/acre)	**Biomass** (g/acre)
	0-3	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**				
Rainbow trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Unidentified trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Hardhead/pikeminnow	195	0	0	0	0	0	**195**	**187**	**271**	**260**
(Pass 1, Pass 2)	3, 381	0, 0	0, 0	0, 0	0, 0	0, 0				
Sacramento sucker	0	0	0	0	1	1	**2**	**975**	**3**	**1,357**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 1	1, 0				
Riffle sculpin	0	0	0	0	0	0	0	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Speckled dace	0	0	0	0	0	0	0	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
TOTAL	***195***	***0***	***0***	***0***	***1***	***1***	***197***	***1,162***	***274***	***1,617***

[1] *Estimated numbers of individuals and biomass projections are presented as the mean of the two passes; Fish estimates are rounded up to the next whole number.*

Table 3D. Numbers of fish by species and length category observed during snorkel surveys and estimated biomass for Pool 4, SF American River, October 2007.

POOL 4 1,055 m² or 0.26 acres	**Length Category (inches)**						**Mean #Fish Observed**[1]	**Total Weight** (g)	**Abundance** (fish/acre)	**Biomass** (g/acre)
	0-3	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**				
Rainbow trout	0	3	3	3	2	0	**11**	**1,492**	**42**	**5,720**
(Pass 1, Pass 2)	0, 0	3, 2	5, 1	3, 2	3, 0	0, 0				
Unidentified trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Hardhead/pikeminnow	119	0	0	0	0	0	**119**	**114**	**458**	**438**
(Pass 1, Pass 2)	163, 75	0, 0	0, 0	0, 0	0, 0	0, 0				
Sacramento sucker	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Riffle sculpin	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Speckled dace	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
TOTAL	***119***	***3***	***3***	***3***	***2***	***0***	***130***	***1,606***	***500***	***6,158***

[1] *Estimated numbers of individuals and biomass projections are presented as the mean of the two passes; Fish estimates are rounded up to the next whole number.*

Table 3E. Numbers of fish by species and length category observed during snorkel surveys and estimated biomass for Pool 5, SF American River, October 2007.

POOL 5 1,827 m² or 0.45 acres	**Length Category (inches)**						**Mean #Fish Observed**[1]	**Total Weight** (g)	**Abundance** (fish/acre)	**Biomass** (g/acre)
	0-3	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**				
Rainbow trout	1	1	4	2	1	0	**9**	**983**	**20**	**2,183**
(Pass 1, Pass 2)	1, 0	0, 1	3, 4	1, 3	1, 0	0, 0				
Unidentified trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Hardhead/pikeminnow	125	0	0	0	0	0	**125**	**120**	**278**	**266**
(Pass 1, Pass 2)	60, 190	0, 0	0, 0	0, 0	0, 0	0, 0				
Sacramento sucker	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Riffle sculpin	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Speckled dace	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
TOTAL	***126***	***1***	***4***	***2***	***1***	***0***	***134***	***1,103***	***298***	***2,449***

[1] *Estimated numbers of individuals and biomass projections are presented as the mean of the two passes; Fish estimates are rounded up to the next whole number.*

Table 3F. Numbers of fish by species and length category observed during snorkel surveys and estimated biomass for Pool 6, SF American River, October 2007.

POOL 6 1,561 m² or 0.39 acres	**Length Category (inches)**						**Mean #Fish Observed**[1]	**Total Weight** (g)	**Abundance** (fish/acre)	**Biomass** (g/acre)
	0-3	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**				
Rainbow trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Unidentified trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Hardhead/pikeminnow	97	0	0	0	0	0	**97**	**93**	**249**	**241**
(Pass 1, Pass 2)	134, 60	0, 0	0, 0	0, 0	0, 0	0, 0				
Sacramento sucker	0	0	0	0	0	1	**1**	**569**	**3**	**1,475**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	1, 0				
Riffle sculpin	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Speckled dace	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
TOTAL	***97***	***0***	***0***	***0***	***0***	***1***	***98***	***662***	***251***	***1,717***

[1] Estimated numbers of individuals and biomass projections are presented as the mean of the two passes; Fish estimates are rounded up to the next whole number.

Table 3G. Numbers of fish by species and length category observed during snorkel surveys and estimated biomass for Pool 7, SF American River, October 2007.

POOL 7 494 m² or 0.12 acres	**Length Category (inches)**						**Mean #Fish Observed**[1]	**Total Weight** (g)	**Abundance** (fish/acre)	**Biomass** (g/acre)
	0-3	**3-6**	**6-9**	**9-12**	**12-15**	**15-18**				
Rainbow trout	0	0	2	13	2	0	**17**	**3,352**	**142**	**27,474**
(Pass 1, Pass 2)	0, 0	0, 0	0, 3	9, 16	1, 2	0, 0				
Unidentified trout	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Hardhead/pikeminnow	21	0	0	0	0	0	**21**	**20**	**175**	**165**
(Pass 1, Pass 2)	17, 25	0, 0	0, 0	0, 0	0, 0	0, 0				
Sacramento sucker	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Riffle sculpin	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
Speckled dace	0	0	0	0	0	0	**0**	**0**	**0**	**0**
(Pass 1, Pass 2)	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0				
TOTAL	***21***	***0***	***2***	***13***	***2***	***0***	***38***	***3,372***	***317***	***27,639***

[1] Estimated numbers of individuals and biomass projections are presented as the mean of the two passes; Fish estimates are rounded up to the next whole number.

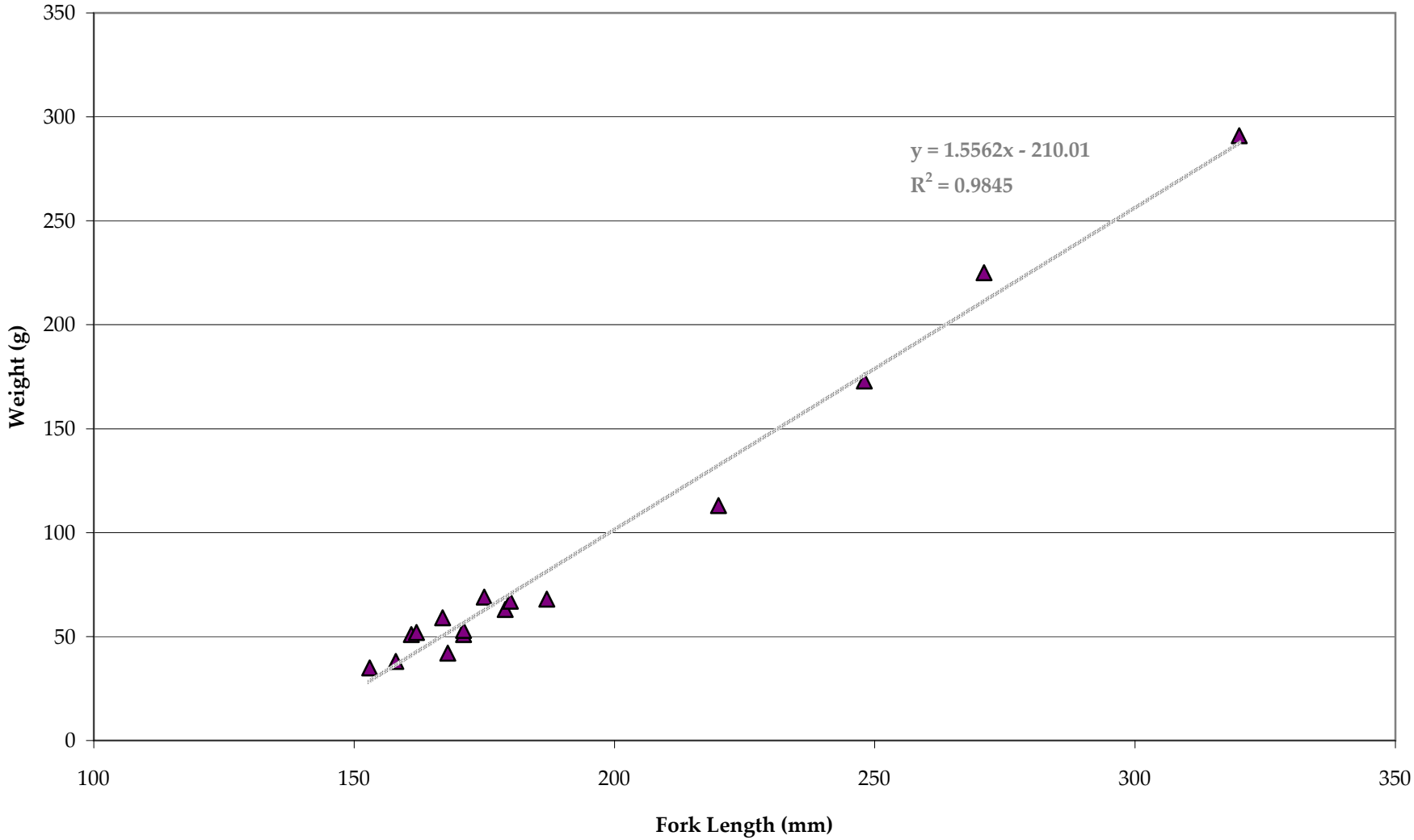

Figure 2. Length-Weight Regression for Large Rainbow Trout (2007 Electrofishing Data)

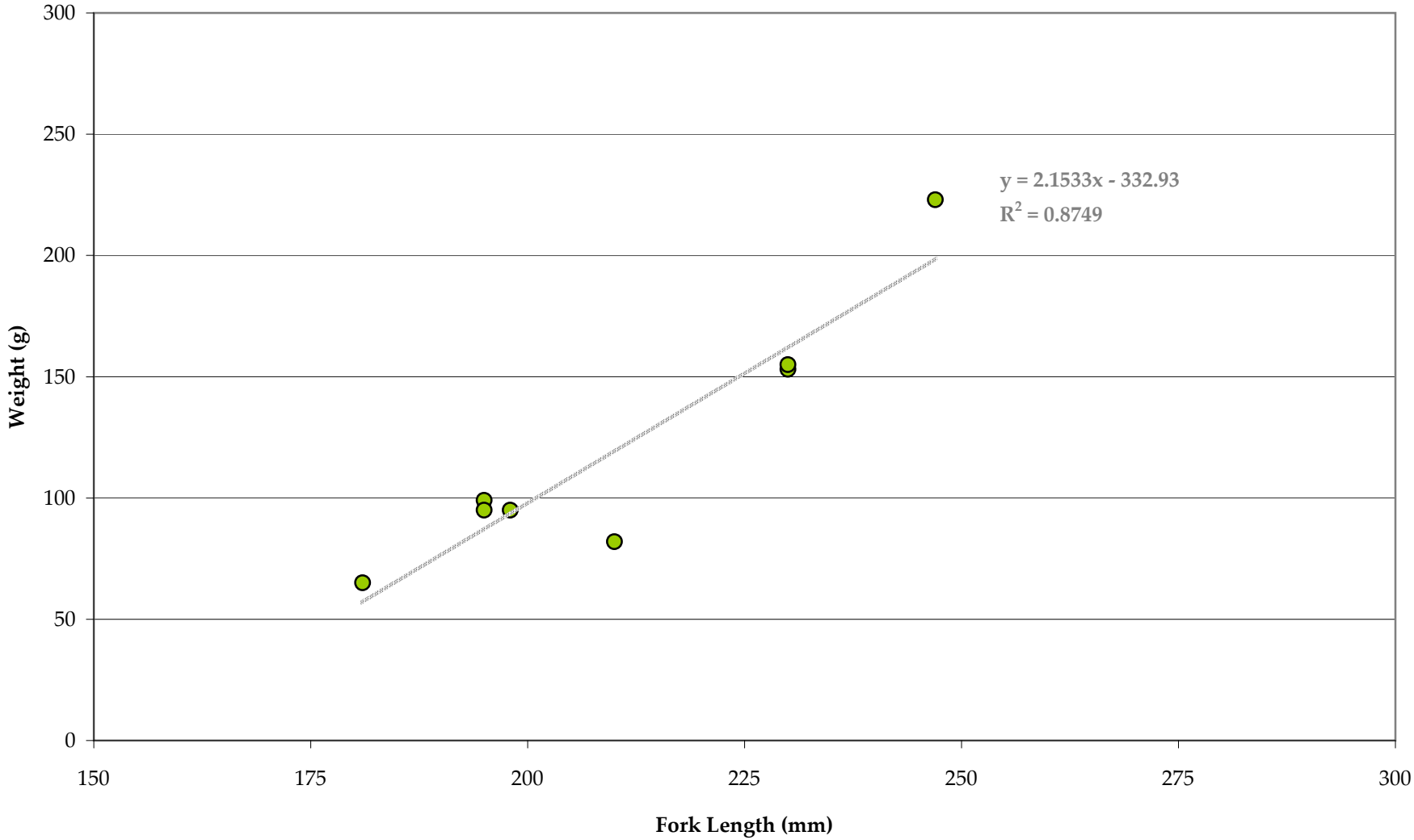

Figure 3. Length-Weight Regression for Large Sacramento Suckers (2007 Electrofishing Data)

Table 4. Physical habitat characteristics of fish population survey sites, SF American River, October 2007.

SITE	Length (m)	Width (m)	Mean Depth (m)	Max Depth (m)	Area (m^2)	Area (acres)	Area (hectares)
E-Fishing	120	23.6	0.5	1.0	2,832	0.70	0.28
Pool 1	230	29.7	2.7	8.0	6,831	1.69	0.68
Pool 2	70	21	2.2	6.5	1,470	0.36	0.14
Pool 3	146	19.9	1.3	2.8	2,908	0.72	0.29
Pool 4	60	17.6	2.2	5.0	1,055	0.26	0.11
Pool 5	90	20.3	1.3	3.2	1,827	0.45	0.18
Pool 6	77	20.3	2.2	4.5	1,561	0.39	0.16
Pool 7	50	9.9	1.5	12.0	4,94	0.12	0.05

4.0 DISCUSSION/CONCLUSIONS

Moyle (2002) reports that hardhead typically spawn in April and May, but can prolong spawning activities into August. This characterization is consistent with the age/size class distributions observed in the study area of the SF American River. As indicted by the abundance of juvenile hardhead present, hardhead spawning almost certainly occurs within the study area. However, no adult hardhead (or pikeminnow) were observed in either the shallow riffle/run/pocket water habitats of the electrofishing site adjacent to Akin Powerhouse, or in the deep pools upstream of the powerhouse during either the 2004, 2005 or 2007 surveys.

In previous study years (2004 and 2005) not all hardhead and Sacramento pikeminnow were able to be identified to species during electrofishing surveys, nor could the small juveniles be identified during snorkeling surveys. A length-frequency histogram for these two species combined is presented for all survey years' electrofishing data in Figure 4 for reference. In 2004 and 2005, the total number of cyprinids (i.e., hardhead plus pikeminnow) was assumed to be approximately 90 percent hardhead and 10 percent pikeminnow; these estimates were based upon those individuals positively identified during the elecrofishing surveys. In 2007, this ratio in the electrofishing data was approximately 60 percent hardhead and 40 percent pikeminnow (based on either total catch, abundance, or biomass). Population estimates for both Hardhead and Sacramento pikeminnow appear to be higher in 2007 than in 2005, especially the number of Sacramento pikeminnow.

Biomass estimates for cyprinids was also higher in 2007 than in prior years in most habitat units sampled (Table 5). Biomass estimates in pools 1 and 2 were higher in 2004 than in 2005, whereas the biomass estimate in the electrofishing site was higher in 2005 than in 2004.

Table 5. Biomass estimates (g/ac) of hardhead / Sacramento Pikeminnow in the habitat units surveyed in 2004, 2005, and 2007.

	E-fish	Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6	Pool 7
2004	241	456	449	0	--	--	--	--
2005	730	262	76	205[1]	--	23	77[1]	--
2007	1,288	1,025	98	260	438	266	241	165

[1] Biomass for these pools is based on qualitative, single-pass observation.

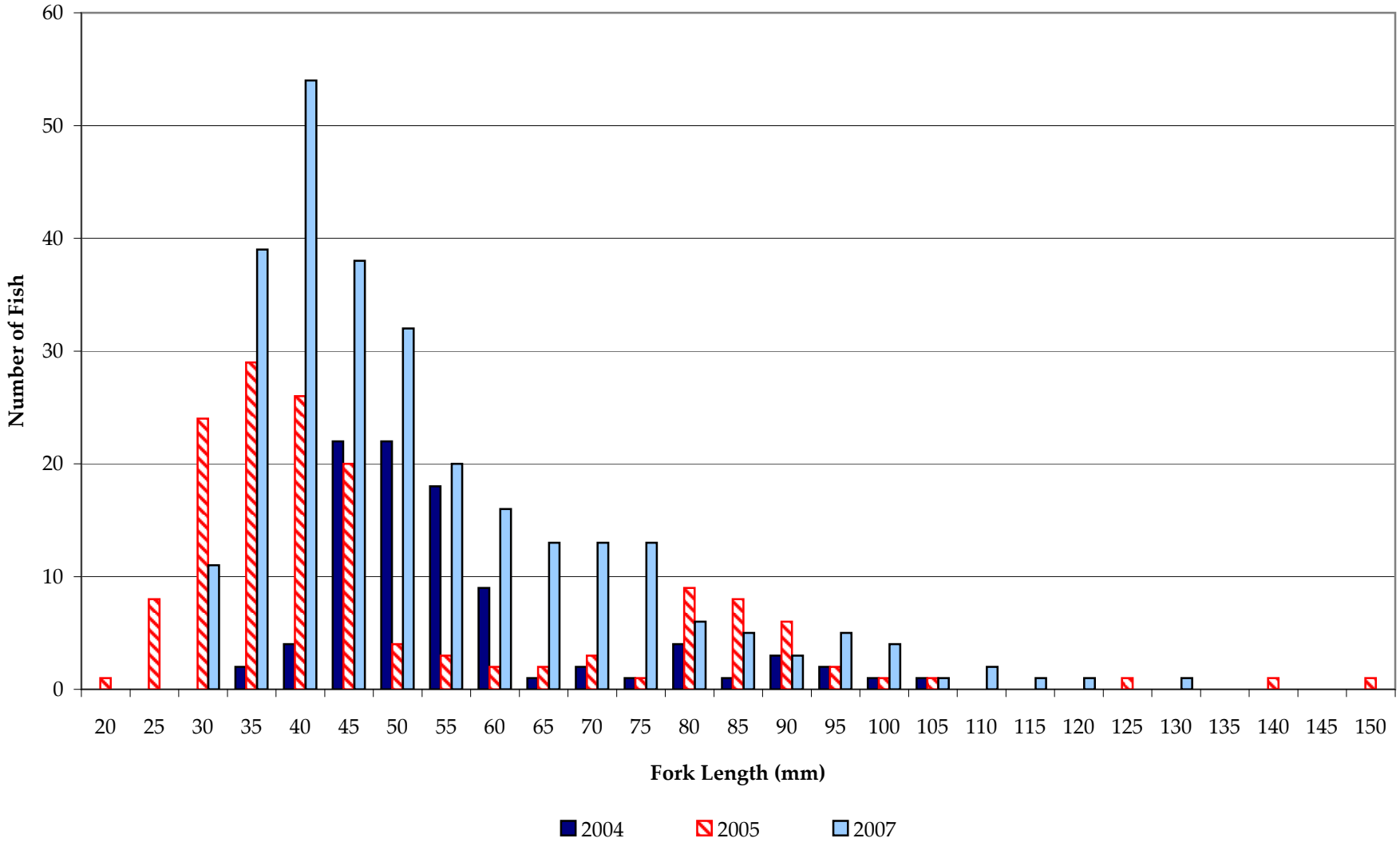

Figure 4. Length-Frequency Distribution of Hardhead/Pikeminnow for All Study Years (Electrofishing Data)

5.0 REFERENCES

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Sub-consultants

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Appendix A:
2007 Site Photos

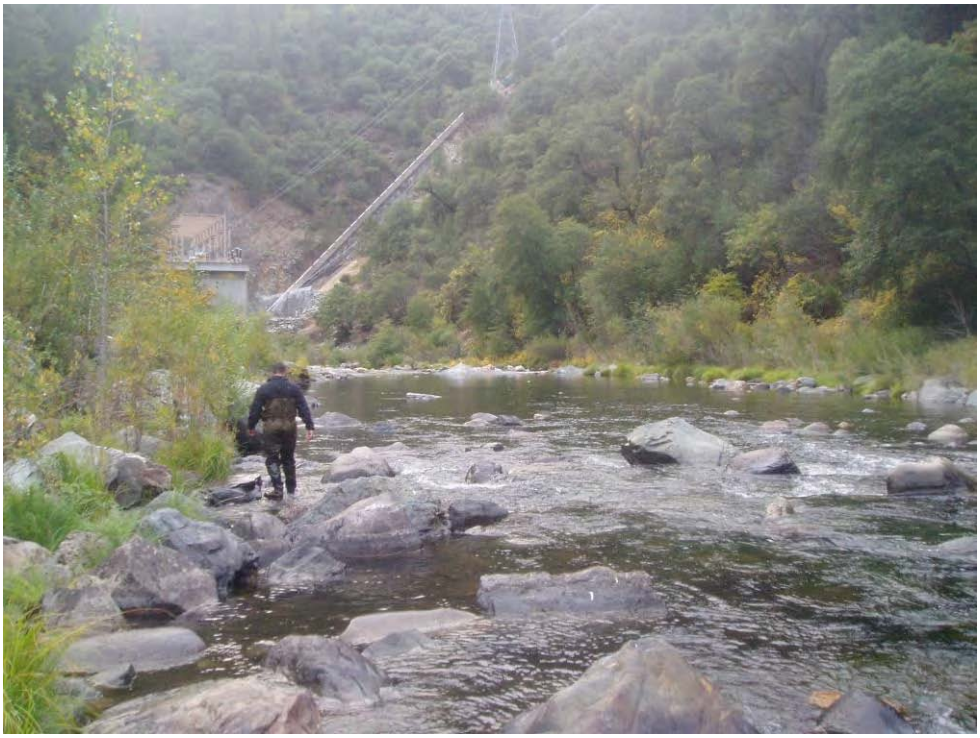

Figure A-1 Looking toward bottom of electrofishing site with net in place in the distance

Figure A-2 Looking toward top of electrofishing site with net in place

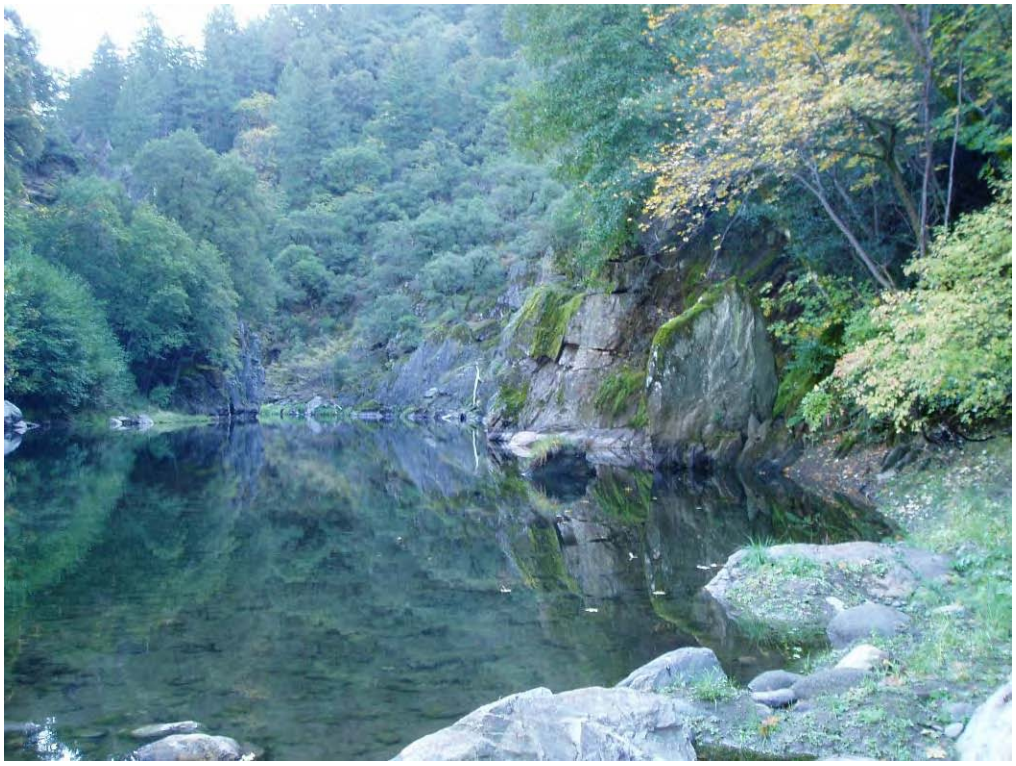

Figure A-3 Bottom of Pool 1 looking upstream

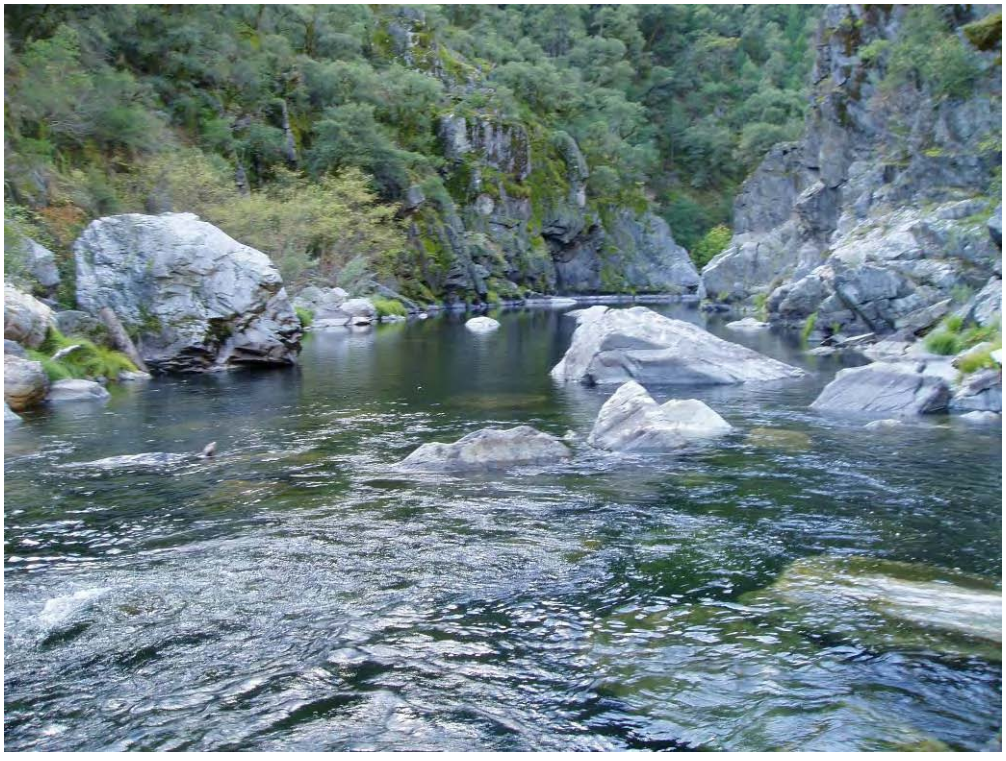

Figure A-4 Top of Pool 1 looking downstream

Figure A-5 Bottom of Pool 2 looking upstream

Figure A-6 Top of Pool 2 looking downstream

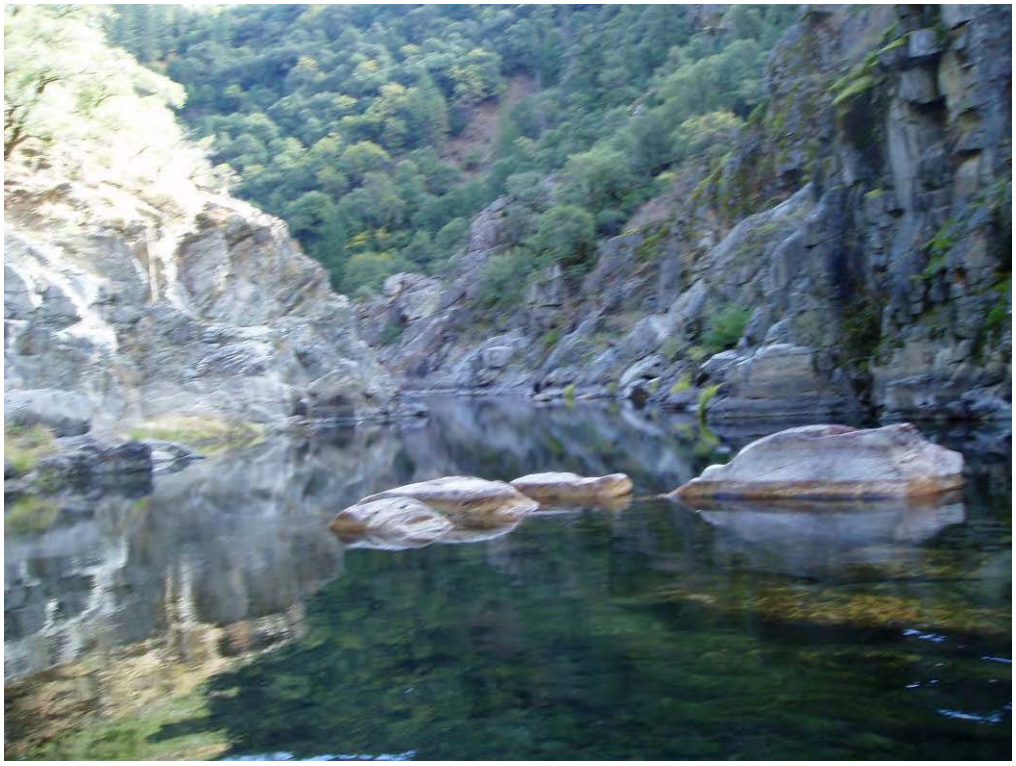

Figure A-7 Bottom of Pool 3 looking upstream

Figure A-8 Top of Pool 3 looking downstream

Figure A-9 Bottom of Pool 4 looking upstream

Figure A-10 Top of Pool 4 looking downstream

Figure A-11 Bottom of Pool 5 looking upstream

Figure A-12 Top of Pool 5 looking downstream

Figure A-13 Bottom of Pool 6 looking upstream

Figure A-14 Top of Pool 6 looking downstream

Figure A-15 Bottom of Pool 7 looking upstream

Figure A-16 Top of Pool 7 looking downstream

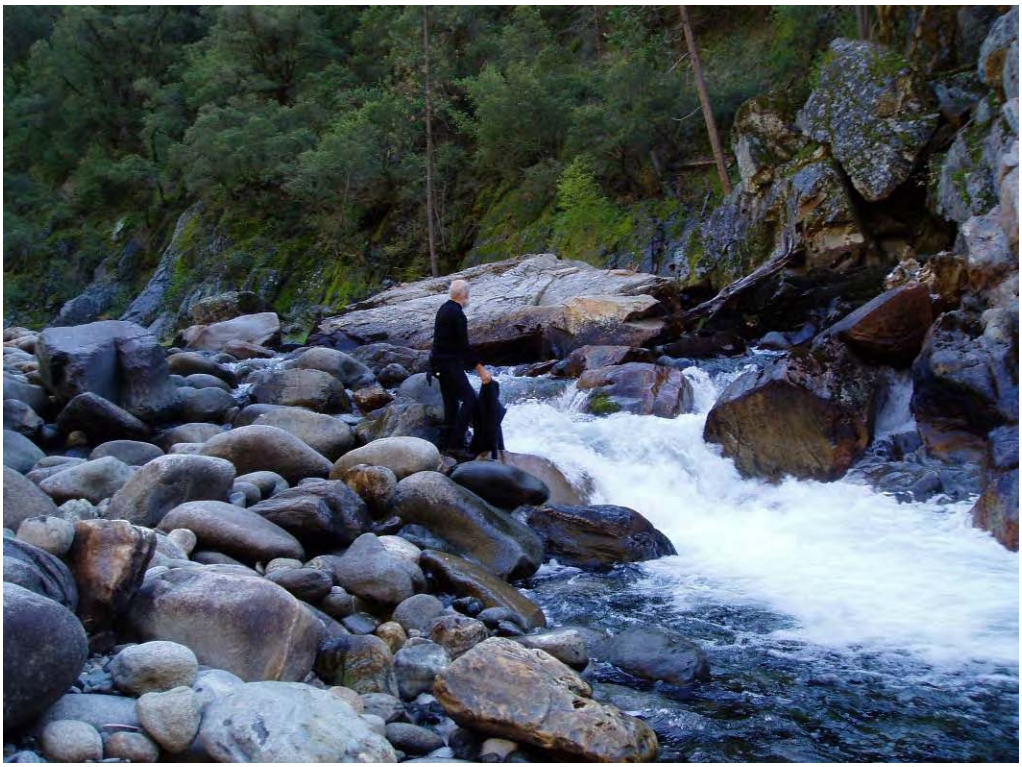

Figure A-17 Partial barrier at the top of Pool 7

Appendix B:
Field Datasheets for 2007 Fish Surveys

Date 10 / 18 / 2007 Stream Name: South Fork American River Lat: _____ Long: _____ Quad: _____

Site Info: Electroshocking below Akin Powerhouse

Stream Temp: 10.7 Water Temp: _____ Time: 1155-1303 Pass: One Effort: D'Lorcan E. Scott

Crew Leader: R Aramayo Crew: R. Jackman, I. Chan, D. Parkinson, T. Parkinson, K. Wiseman

D.O. = 10.09
% sat: 90.3%
conduct: 53.1
ph: 8.6

	Species	Length	Weight
1	RBT	162	52
2	RBT	167	59
3	RBT	180	67
4	SUC	104	13
5	PM*	105	12
6	SCULP	100	8
7	SUC	140	28
8	SUC	85	8
9	SUC	125	24
10	SUC	85	8
11	SUC	140	31
12	SCULP	80	7
13	RBT	85	6
14	SUC	90	10
15	PM	78	3
16	SUC	230	153
17	RBT	171	51
18	RBT	77	4
19	SUC	66	3
20	DACE	55	2
21	PM	54	1
22	SCULP	52	1
23	PM	50	<1
24	PM	44	<1
25	PM	35	<1

scales #1 and 2 are final →

	Species:	Length	Weight
26	RBT	150	33
27	PM	56	<1
28	PM	54	<1
29	RBT	89	9
30	PM	59	1
31	PM	78	3
32	SCULP	67	2
33	SCULP	49	<1
34	SCULP	80	6
35	PM	61	2
36	RBT	175	69
37	RBT	122	106
38	PM	50	<1
39	PM	85	5
40	RBT	59	2
41	RBT	179	63
42	DACE	40	<1
43	SUC	210	82
44	SUC	198	95
45	PM	45	<1
46	RBT	171	53
47	SCULP	83	7
48	PM	59	2
49	PM	50	1
50	SCULP	54	11

Scale #2

	Species	Length	Weight
51	SCULP	88	11
52	SCULP	93	12
53	RBT	64	3
54	PM	75	1
55	PM	60	1
56	SUC	70	4
57	DACE	65	4
58	PM	78	5
59	RBT	81	6
60	PM	40	<1
61	PM	56	1
62	HARD	60	2
63	HARD	47	<1
64	HARD	47	<1
65	PM	50	<1
66	HARD	54	<1
67	SUC	80	6
68	PM	36	<1
69	HARD	50	<1
70	HARD	36	<1
71	PM	66	2
72	HARD	52	1
73	PM	61	3
74	HARD	47	1
75	RBT	134	23

Scale #3

	Species	Length	Weight
76	HARD	58	1
77	PM	56	1
78	HARD	49	1
79	PM	65	2
80	HARD	54	1
81	HARD	74	3
82	HARD	43	<1
83	HARD	45	<1
84	HARD	45	1
85	PM	45	<1
86	PM	45	<1
87	PM	56	2
88	HARD	48	1
89	HARD	57	2
90	SUC	63	3
91	HARD	41	<1
92	HARD	40	<1
93	HARD	42	<1
94	SCULP	50	1
95	HARD	55	1
96	HARD	46	<1
97	PM	69	3
98	HARD	41	<1
99	HARD	39	<1
100	DACE	52	2

Date 10/18/2007 Stream Name: South Fork American River Lat: _____ Long: _____ Quad: _____

Site Info: See page 1

Stream Temp: _____ Water Temp: _____ Time: _____ Pass: One Effort: _____

Crew Leader: _____ Crew: _____

	Species	Length	Weight
1	HARD	38	<1
2	PM	63	2
3	PM	55	2
4	PM	58	2
5	HARD	38	<1
6	SCULP	35	1
7	SUC	74	6
8	DACE	46	1
9	HARD	40	<1
10	PM	61	2
11	PM	50	1
12	DACE	51	2
13	HARD	50	<1
14	DACE	53	1
15	HARD	50	1
16	HARD	50	1
17	PM	36	<1
18	HARD	46	<1
19	HARD	37	<1
20	HARD	31	<1
21	HARD	34	<1
22	HARD	35	<1
23	HARD	32	<1
24	RBT	248	173
25	SUC	93	12

	Species:	Length	Weight
26	SUC	80	9
27	PM	72	3
28	HARD	74	4
29	HARD	37	<1
30	HARD	77	6
31	PM	35	<1
32	HARD	76	4
33	HARD	66	2
34	PM	55	1
35	HARD	48	1
36	HARD	38	<1
*37	HARD	79	5
38	PM	38	<1
39	PM	45	<1
40	PM	44	<1
41	PM	43	<1
42	SUC	80	7
43	PM	56	1
44	PM	46	<1
45	PM	50	<1
46	PM	48	<1
*47	PM	111	14
48	PM	40	<1
49	HARD	72	4
50	PM	55	<1

	Species	Length	Weight
51	PM	46	<1
52	PM	34	<1
53	PM	76	6
54	PM	48	<1
55	PM	36	<1
56	SCULP	73	5
57	HARD	40	<1
58	PM	100	9
59	HARD	72	3
60	HARD	40	<1
61	PM	35	<1
62	HARD	56	1
63	PM	42	<1
64	PM	36	<1
65	SUC	57 MORT	1
66	PM	35	<1
67	PM	36	<1
68	PM	38	<1
69	PM	94	9
70	PM	41	<1
71	PM	30	<1
72	PM	60	1
73	SUC	85	7
74	SUC	81	6
75	SUC	60	2

	Species	Length	Weight
76	SCULP	69	3
77	HARD	48	<1
78	PM	31	<1
79	PM	50	<1
80	PM	41	<1
81	PM	50	<1
82	PM	56	2
83	SUC	66	3
84	HARD	40	<1
85	HARD	40	<1
86	PM	48	<1
87	SUC	71	5
88	PM	43	<1
89	PM	38	<1
90	HARD	60	1
91	SUC	71	4
92	PM	60	1
93	PM	61	2
94	HARD	40	<1
95	HARD	41	<1
96	HARD	45	<1
97	SUC	77	6
98	PM	47	<1
99	PM	35	<1
100	HARD	34	<1

* SCALE SAMPLE 2 (37); SAMPLE 3 (47)
** 700 ml start in <1 weight Beaker (Hardhead only)

Date 10/18/07 Stream Name: South Fork American River Lat: _____ Long: _____ Quad: _____

Site Info: See Page 1

Stream Temp: _____ Water Temp: _____ Time: _____ Pass: ONE Effort: _____

Crew Leader: _____ Crew: _____

	Species	Length	Weight
1	PM	41	<1
2	PM	50	1
3	PM	38	<1
4	PM	48	<1
5	SUC	79	6
6	PM	37	<1
7	SUC	58	1
8	HARD	68	3
9	SUC	61	2
10	PM	45	<1
11	PM	45	<1
12	PM	64	1
13	HARD	38	<1
14	PM	48	<1
15	PM	38	<1
16	PM	53	<1
17	PM	30	<1
18	PM	45	<1
19	PM	40	<1
20	PM	36	<1
21	PM	41	<1
22	PM	40	<1
23	PM	54	<1
24	HARD	55	<1
25	HARD	44	<1

	Species:	Length	Weight
26	HARD	29	<1
27	HARD	45	<1
28	HARD	30	<1
29	HARD	36	<1
30	PM	54	<1
31	HARD	52	<1
32	HARD	52	<1
33	HARD	40	<1
34	HARD	34	<1
35	HARD	34	<1
36	PM	50	<1
37	HARD	34	<1
*38	HARD	83	5
39	PM	40	<1
40	HARD	44	<1
41	PM	40	<1
42	HARD	58	1
43	HARD	35	<1
44	HARD	40	<1
45	HARD	46	<1
46	PM	42	<1
47	HARD	38	<1
48	HARD	70	2
49	HARD	38	<1
50	HARD	72	2

	Species	Length	Weight
51	HARD	43	<1
52	HARD	68	2
53	PM	37	<1
54	HARD	45	<1
55	PM	44	<1
56	HARD	37	<1
57	HARD	46	<1
58	HARD	48	<1
59	HARD	52	1
60	PM	42	<1
61	HARD	49	<1
62	HARD	37	<1
63	HARD	41	<1
64	HARD	40	<1
65	HARD	36	<1
66	PM	50	<1
67	HARD	44	<1
68	HARD	54	<1
69	HARD	45	<1
70	HARD	50	<1
71	PM	42	<1
72	HARD	46	<1
73	HARD	38	<1
74	HARD	59	2
75	PM	39	<1

	Species	Length	Weight
76	HARD	48	<1
77	HARD	46	<1
78	HARD	41	<1
79	DACE	45	<1
80	HARD	42	<1
81	↓	37	<1
82	↓	34	<1
83	↓	33	<1
84	↓	43	<1
85	PM	40	<1
86	HARD	32	<1
87	↓	34	<1
88	↓	34	<1
89	PM	39	<1
90	HARD	32	<1
91	SUC	67	3
92	PM	41	<1
93	HARD	36	<1
94	↓	38	<1
95	↓	38	<1
96	↓	30	<1
97	↓	44	<1
98	PM	34	<1
99	HARD	40	<1
100	HARD	45	<1

* SCALE SAMP #4; ↑(38)

BIOMASS OF 67<1 gr. hardhead : 50 grams

Date 16 / 18 / 07 Stream Name: South Fork American River Lat: _____ Long: _____ Quad: _____

Site Info: See page 1

Stream Temp: _____ Water Temp: _____ Time: _____ Pass: ONE Effort: _____

Crew Leader: _____ Crew: _____

	Species	Length	Weight		Species:	Length	Weight		Species	Length	Weight		Species	Length	Weight
1	HARD	35	<1	26				51				76			
2	DACE	45	<1	27				52				77			
3	PM	46	<1	28				53				78			
4	↓	35	<1	29				54				79			
5	HARD	41	<1	30				55				80			
6	PM	42	<1	31				56				81			
7	HARD	33	<1	32				57				82			
8	HARD	31	<1	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			

HARDHEAD:
BIOMASS: 80 grams
START VOL: 500 mL

PIKE MINNOW:
BIOMASS: 60

Date 10 / 18 / 07 Stream Name: South Fork American River Lat: ______ Long: ______ Quad: ______

Site Info: See pass One, page 1

Stream Temp: ______ Water Temp: ______ Time: 15-1600 Pass: TWO Effort: ______

Crew Leader: ______ Crew: ______

<60 mm
PM: 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / |||

HARD: 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / 卌 卌 / |||

#	Species	Length	Weight	#	Species:	Length	Weight	#	Species	Length	Weight	#	Species	Length	Weight
1	RBT	153	35	26	PM	70	3	51	SCULP	88	8	76			
2	RBT	161	51	27	SCULP	82	6	52	SUC	78	5	77			
3	RBT	220	113	28	DACE	68	3	53	SUC	84	6	78			
4	~~HARD~~	~~46~~	~~<1~~	29	DACE	46	<1	54	SCULP	91	9	79			
5	SUC	195	99	30	SCULP	54	0.5	55	SUC	61	2	80			
6	PM	74	3	31	SUC	58	2	56	SUC	61	2	81			
7	HARD	75	3	*32	HARD	75	4	57	SUC	83	6	82			
8	RBT	320	291	33	SCULP	47	0.5	58	SUC	64	3	83			
9	SUC	247	223	34	BRT	300	347	59	SUC	73	4	84			
10	PM	62	1	35	SCULP	89	12	60	SUC	74	5	85			
11	SUC	181	65	36	RBT	168	42	61	DACE	41	0.5	86			
12	SUC	130	25	37	PM	110	10	62				87			
13	PM	76	5	38	BRT	89	6	63				88			
14	SUC	121	24	39	SUC	85	8	64				89			
15	SUC	130	29	*40	HARD	76	4	65				90			
16	SUC	128	28	41	RBT	187	68	66				91			
17	SCULP	88	9	42	SUC	195	95	67				92			
18	DACE	96	10	43	SUC	91	9	68				93			
19	SCULP	84	8	44	SUC	75	6	69				94			
20	SUC	80	5	45	SUC	69	5	70				95			
21	HARD	72	4	46	SUC	74	6	71				96			
22	SCULP	82	7	47	SUC	79	6	72				97			
23	RBT	158	38	48	SUC	62	2	73				98			
24	RBT	66	2	49	HARD	68	3	74				99			
25	RBT	78	3	50	SUC	65	3	75				100			

*SCALES SAMPLED (#32); #40
↑PASS TWO

Start volume for biomass: 500 mL

Hardhead biomass: 60 grams (<60mm)

Pike minnow biomass: 65 (<60mm)

Page 1 of 1

Date 10/18/07 Stream Name: South Fork American River Lat: _____ Long: _____ Quad: _____

Site Info: see Pass One, page One

Stream Temp: _____ Water Temp: _____ Time: 1650-1745 Pass: Three Effort: _____

Crew Leader: _____ Crew: _____

<60 mm

PM: ||||-||||-||||-||||-||||-||||-|||

HARD: ||||-||||-||||-||||-||||-||||-||||-|||

	Species	Length	Weight		Species:	Length	Weight		Species	Length	Weight		Species	Length	Weight
1	RBT	271	225	26	SCULP	48	0.5	51				76			
2	SUC	230	155	27	HARD	80	5	52				77			
3	SUC	120	22	28	HARD	82	5	53				78			
4	SUC	82	6	29	DACE	77	5	54				79			
5	SUC	87	6	30	SUC	68	3	55				80			
6	SUC	74	4	31	SUC	72	3	56				81			
7	PM	98	8	32	SCULP	52	3	57				82			
8	SCULP	97	12	33				58				83			
9	SCULP	86	6	34				59				84			
10	DACE	89	8	35				60				85			
11	SCULP	95	9	36				61				86			
12	PM	90	7	37				62				87			
13	PM	88	6	38				63				88			
14	DACE	86	7	39				64				89			
15	SUC	68	3	40				65				90			
16	PM	77	5	41				66				91			
17	HARD	65	3	42				67				92			
18	RBT	75	6	43				68				93			
19	HARD	74	3	44				69				94			
20	HARD	72	3	45				70				95			
21	PM	80	5	46				71				96			
22	DACE	44	0.5	47				72				97			
23	SUC	78	5	48				73				98			
24	SUC	87	9	49				74				99			
25	SCULP	46	0.5	50				75				100			

Date 10/19/2007 **Stream Name:** South Fork American River **Lat:** _____ **Long:** _____ **Quad:** _____

Site Info: Snorkel survey of seven pool upstream of Akin Powerhouse

Stream Temp: 10.9 **~~Air Temp~~:** pH: 8.16, D.O.: 9.41, 84% conductivity: 56.6 **Time:** _____ **Pool:** ONE I

Crew Leader: R. Aramayo **Crew:** I. Chan, R. Jackman, D. Parkinson, C. Scott TIME: PASS 1: 1005 - 1057 PASS 2: ~1635-1700

	Species	< 3"	3" - 6"	6" - 9"	9" - 12"	12" - 15"	15" - 18"	18" - 21"		
PASS 1	RBT			4	4					
	CYPR spp.	2880	1							
	UNK TROUT			1	1					
PASS 2	RBT				2					
	CYPR spp	709								
	SUC					1				

Photos: 18-21: P1 bottom looking upstream; 22: P1 Top looking downstream

Station									
Width									
Depth									
1/4									
1/2									
3/4									
Max									

Date 10 / 19 / 2007 **Stream Name:** South Fork American River **Lat:** _____ **Long:** _____ **Quad:** _____

Site Info: See Pool 1 datasheet

Stream Temp: _____ **Air Temp:** _____ **Time:** PASS1: 1110-1125 **Pool:** TWO

Crew Leader: Seepool 1 **Crew:** PASS2: 1615-1630

	Species	< 3"	3" - 6"	6" - 9"	9" - 12"	12" - 15"	15" - 18"	18" - 21"		
PASS 1	RBT			1	4	2	1			
	CYPR spp	2								
PASS 2	RBT			1	3		1			
	CYPR spp.	72								

Photos: 23: bottom P2 looking upstream; 24: P2 top looking downstream

Station									
Width									
Depth									
1/4									
1/2									
3/4									
Max									

Date 10/19/2007 **Stream Name:** South Fork American River **Lat:** _____ **Long:** _____ **Quad:** _____

Site Info: See pool 1 datasheet

Stream Temp: see pool 1 **Air Temp:** _____ **Time:** PASS1: 1132-1140 **Pool:** THREE

Crew Leader: _____ **Crew:** _____ PASS2: 1520-1535

	Species	< 3"	3" - 6"	6" - 9"	9" - 12"	12" - 15"	15" - 18"	18" - 21"			
PASS 1	RBT										
	CYPR spp	9									
	SUC						1				
PASS 2	CYPR spp	381									
	SUC					1					

Photos: 25: P3 bottom looking upstream; 36: P3 top looking downstream

NOTE:

Station	1	2	3	4	5	6	7	8	9	10
Width	21	18.3	17.7	13.7	18.0	20.3	18.4	20.1	28.1	23.6
Depth										
1/4	0.5	1.3	0.7	0.9	1.5	1.5	2.2	1.1	0.9	0.8
1/2	0.1	1.4	0.9	1.1	1.3	1.4	2.5	2.0	1.8	0.4
3/4	1.1	1.5	1.1	0.8	0.0	1.5	2.8	2.5	2.0	0.4
Max										

length: 146m

* all measurements in meters

Date 10/19/2007 **Stream Name:** South Fork American River **Lat:** _____ **Long:** _____ **Quad:** _____

Site Info: See pool 1 datasheet

Stream Temp: _____ **Air Temp:** _____ **Time:** PASS1: 1145-1200 **Pool:** FOUR

Crew Leader: _____ **Crew:** _____ PASS2: 1500-1515

	Species	< 3"	3" - 6"	6" - 9"	9" - 12"	12" - 15"	15" - 18"	18" - 21"		
PASS 1	RBT		3	5	3	3				
	CYPRspp.	163								
PASS 2	RBT		2	1	2					
	CYPRspp.	75								

Photo: 26-27: P4 top looking downstream ; 35: P4, bottom looking upstream

*all meas. in meters

Station	1	2	3	4	5	6	7	8	9	10
Width	~~8.7~~	10.2	11.0	17.7	15.5	7.8	27.4	32.5	26.4	18.7
Depth										
1/4	0.9	1.0	1.5	1.5	1.5	1.4	2.8	3.0	2.2	0.9
1/2	1.0	1.5	2.0	2.2	2.0	2.2	3.5	4.0	2.5	0.5
3/4	1.5	1.9	2.0	3.0	3.1	3.5	4.6	5.0	2.5	0.2
Max										

Length: 60 meters

Date 10 / 19 / 2007 Stream Name: South Fork American River Lat: _____ Long: _____ Quad: _____

Site Info: see pool 1 datasheet

Stream Temp: _____ Air Temp: _____ Time: PASS 1: ~1220-1245 Pool: FIVE

Crew Leader: _____ Crew: _____ PASS 2: ~1440 - 1455

	Species	< 3"	3" - 6"	6" - 9"	9" - 12"	12" - 15"	15" - 18"	18" - 21"		
PASS 1	RBT	1		3	1	1				
	CYPR spp.	60								
PASS 2	RBT		1	4	3					
	CYPR spp.	190								

Photos: 28: P5 bottom looking upstream; 29: P5 top looking downstream

Station									
Width									
Depth									
1/4									
1/2									
3/4									
Max									

Date 10 / 19 / 2007 **Stream Name:** South Fork American River **Lat:** _____ **Long:** _____ **Quad:** _____

Site Info: See pool 1 datasheet

Stream Temp: _____ **Air Temp:** _____ **Time:** PASS1: ~1300 - 1315 **Pool:** SIX

Crew Leader: _____ **Crew:** _____ PASS 2: ~1420 - 1435

	Species	< 3"	3" - 6"	6" - 9"	9" - 12"	12" - 15"	15" - 18"	18" - 21"		
PASS 1	CYPR spp.	134					1			
	SUC						1			
PASS 2	CYPR spp.	60								

* meas. in meters

Station	1	2	3	4	5	6	7	8	9	10
Width	9.4	16.7	27.0	24.0	24.0	21.0	16.9	16.4	22.8	24.5
Depth										
1/4	0.95	4.5	2.0	2.0	2.5	1.5	0.75	2.1	2.2	0.9
1/2	0.9	4.0	4.0	4.5	4.5	4.0	3.0	2.1	1.0	1.1
3/4	0.8	1.5	3.5	3.2	2.1	2.5	1.5	2.6	0.5	0.6
Max										

Length: 77m

Date 10/19/07 Stream Name: South Fork American River Lat: _____ Long: _____ Quad: _____

Site Info: see Pool 1 datasheet

Stream Temp: _____ Air Temp: _____ Time: PASS 1: ~1320-1335 Pool: SEVEN

Crew Leader: _____ Crew: _____ PASS 2: ~1405-1420

	Species	< 3"	3" - 6"	6" - 9"	9" - 12"	12" - 15"	15" - 18"	18" - 21"		
PASS 1	RBT				9	1				
	CYPR spp.	17								
PASS 2	RBT			3	16	2				
	CYPR spp.	25								

Photos: 32: P7 top looking downstream ; 31: partial barrier at top of pool 7

all measurements in meters

Station	1	2	3	4	5	6	7	8	9	10
Width	5.1	9.15	11.9	10.8	15.6	10.5	6.4	8.4	10.7	10.2
Depth										
1/4	1.1	1.1	1.1	1.4	1.5	2.2	1.5	1.0	1.0	2.0
1/2	1.2	0.6	1.2	1.5	1.9	2.4	2.0	0.4	0.0	1.7
3/4	0.9	0.7	1.0	2.0	3.0	2.6	1.5	2.5	2.5	1.5
Max										

Length: 50 m

Appendix C:
Length-Frequency Histograms for Electrofishing Data

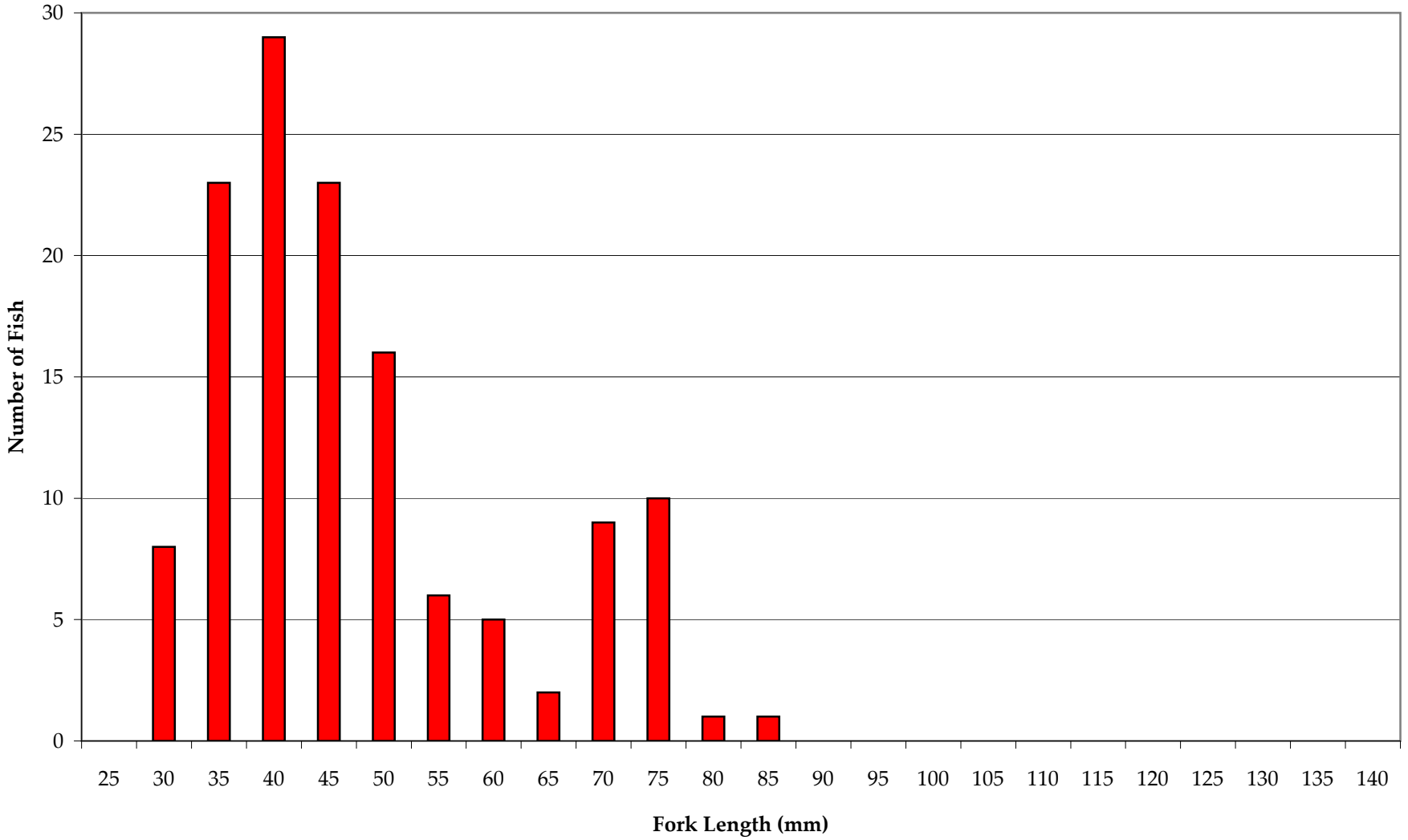

Figure C-1. Length-Frequency Distribution for Hardhead Minnow (2007 Electrofishing Data)

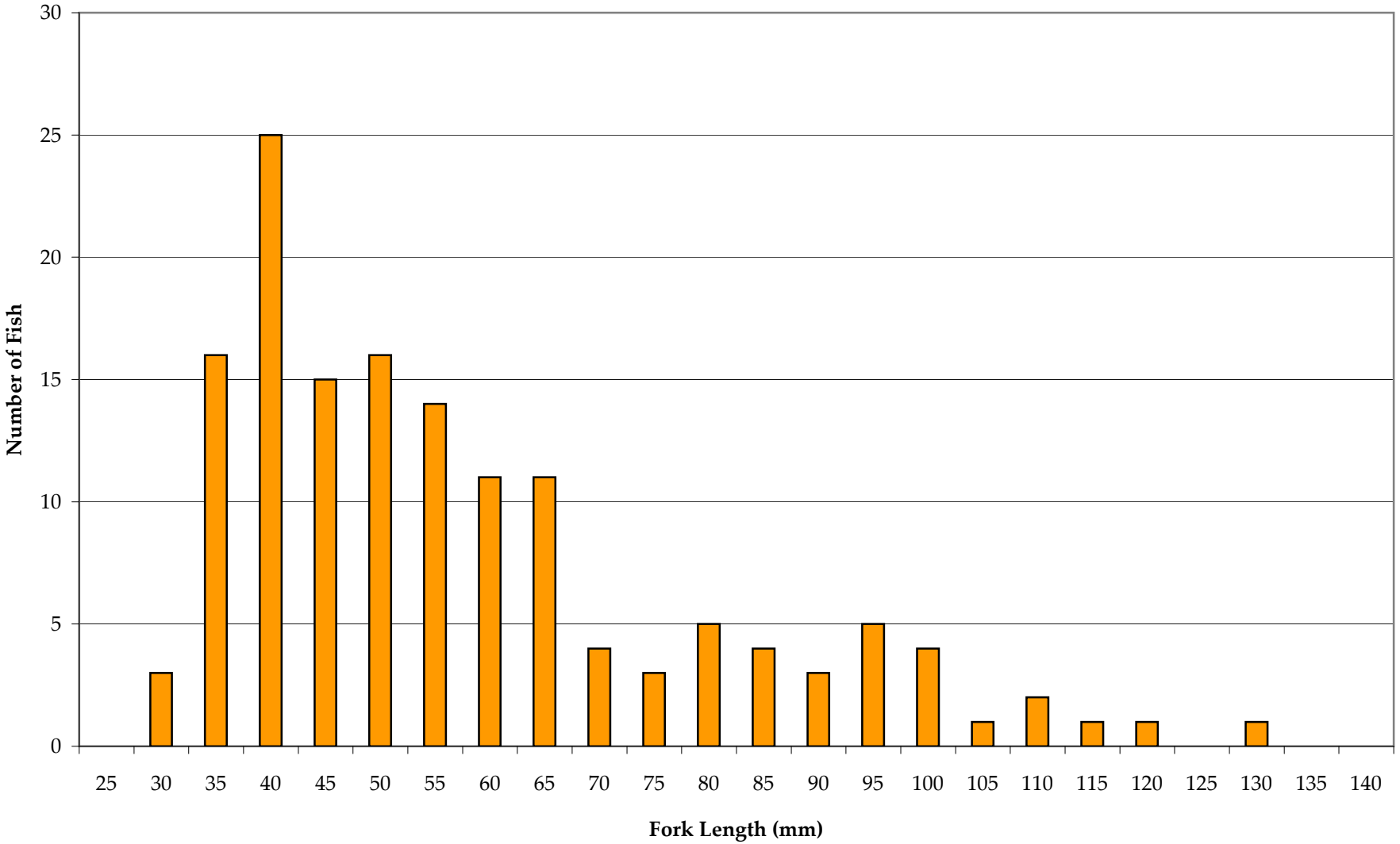

Figure C-2. Length-Frequency Distribution for Sacramento Pikeminnow (2007 Electrofishing Data)

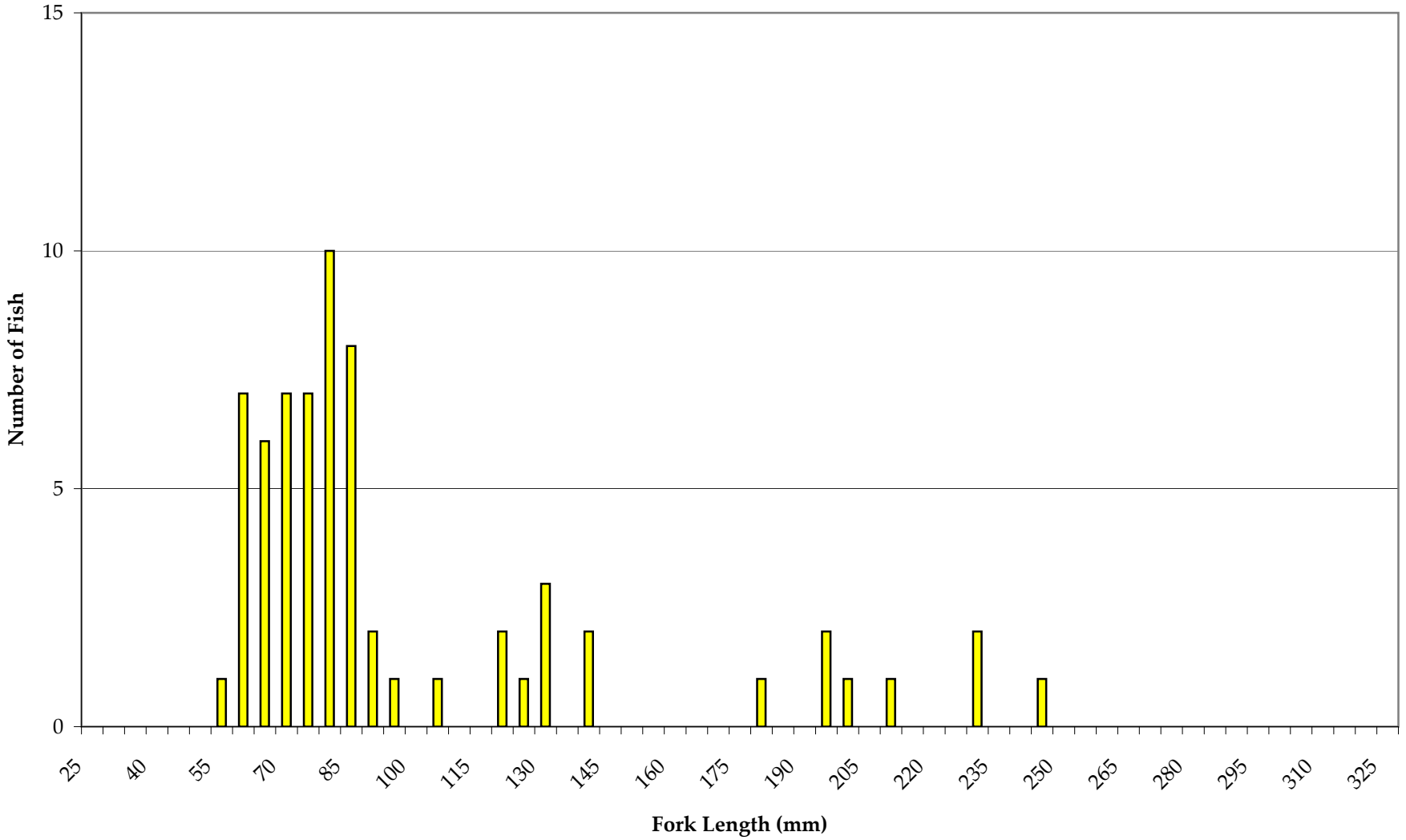

Figure C-3. Length-Frequency Distribution for Sacramento Sucker (2007 Electrofishing Data)

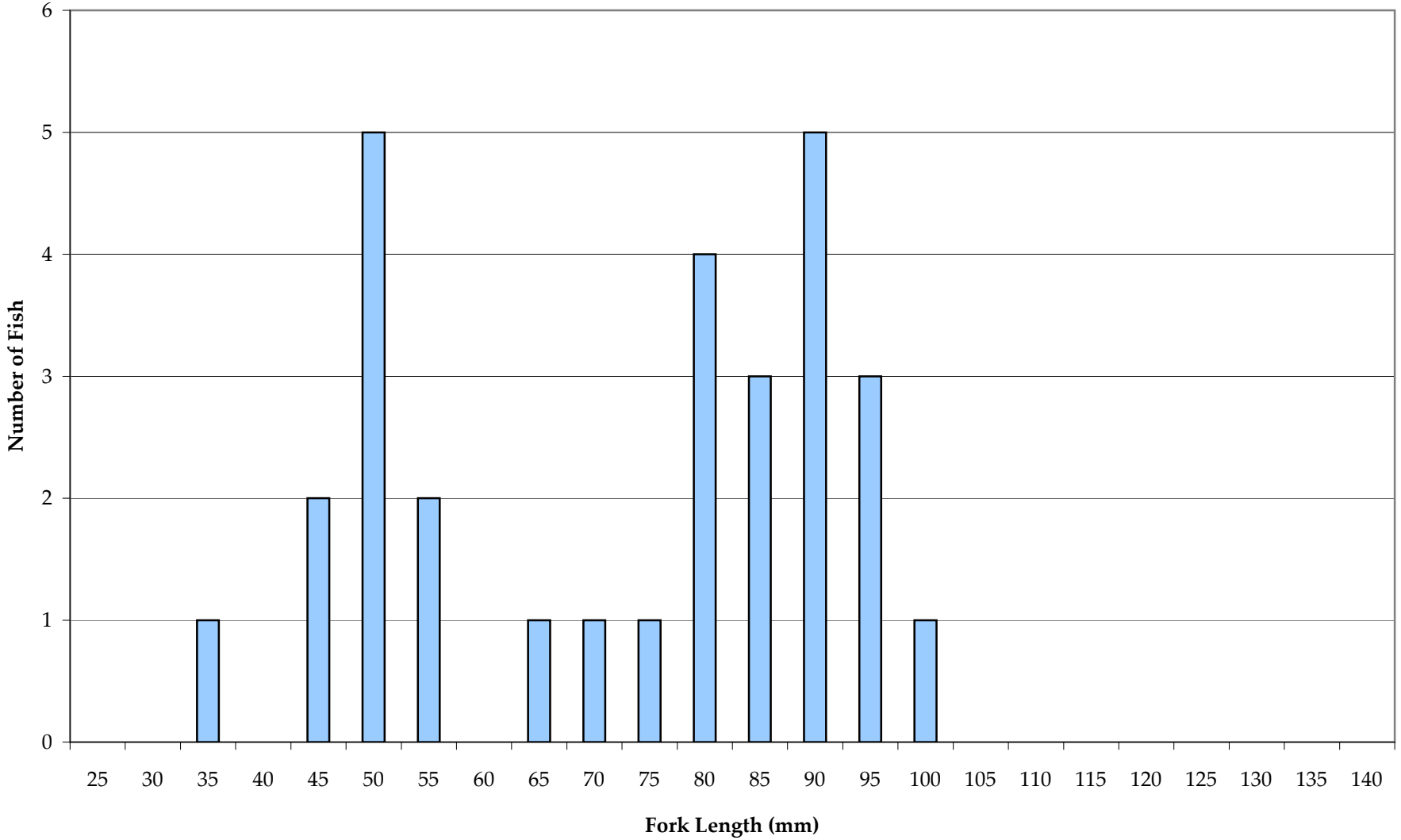

Figure C-4. Length-Frequency Distribution for Riffle Sculpin (2007 Electrofishing Data)

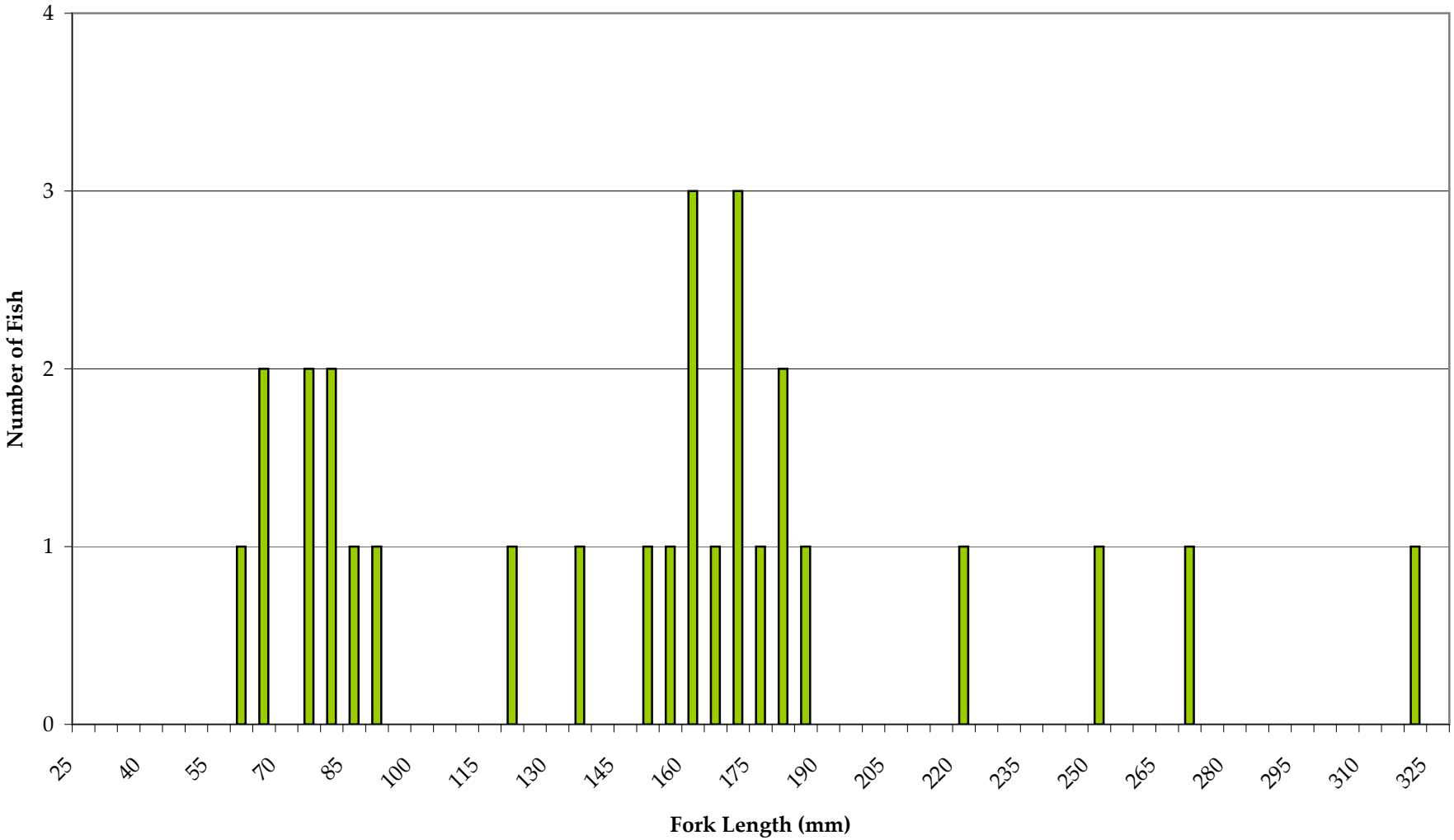

Figure C-5. Length-Frequency Distribution for Rainbow Trout (2007 Electrofishing Data)

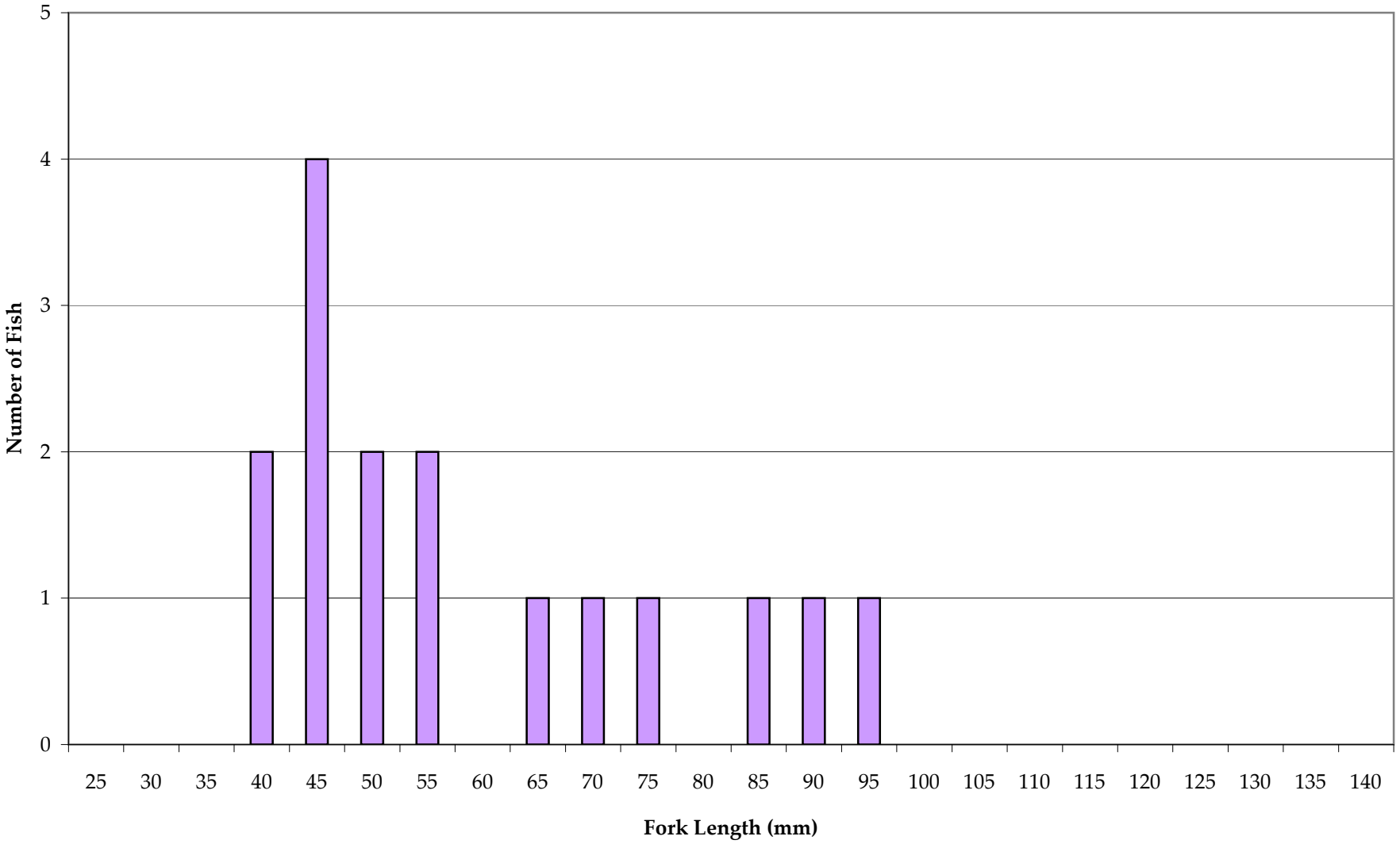

Figure C-6. Length-Frequency Distribution for Speckled Dace (2007 Electrofishing Data)

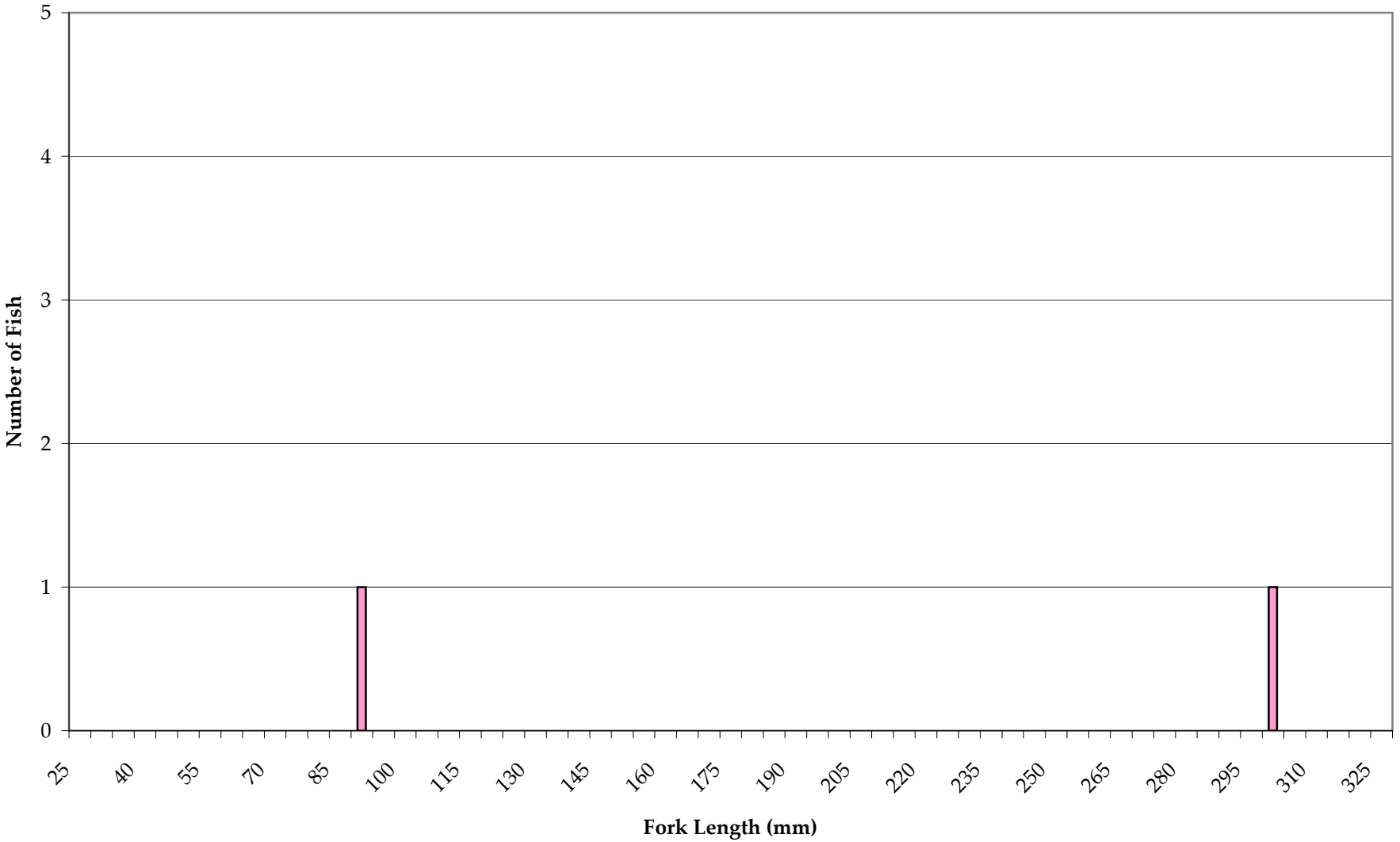

Figure C-7. Length-Frequency Distribution for Brown Trout (2007 Electrofishing Data)