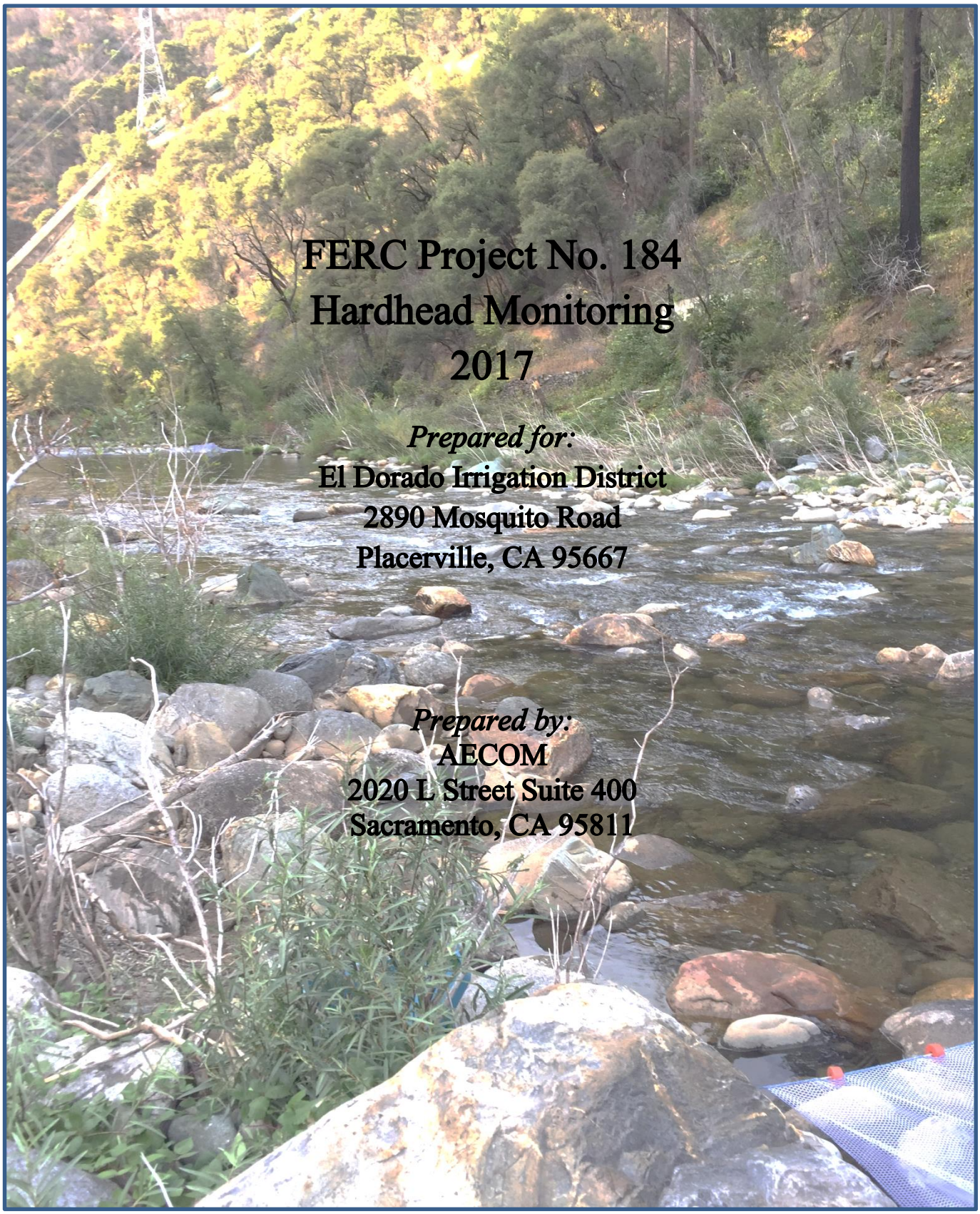

FERC Project No. 184
Hardhead Monitoring
2017

Prepared for:

El Dorado Irrigation District
2890 Mosquito Road
Placerville, CA 95667

Prepared by:

AECOM
2020 L Street Suite 400
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El Dorado Hydroelectric Project

FERC Project No. 184

Hardhead Monitoring 2017

Prepared by:

AECOM Technical Services, Inc.

Prepared for:

El Dorado Irrigation District

January 2018

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List of Abbreviations and Acronyms

csv	comma separated value
EID or District	El Dorado Irrigation District
FERC	Federal Energy Regulatory Commission
FS	U.S. Forest Service
g	gram
mm	millimeters
Plan	Project 184 Hardhead Monitoring Plan
Project No. 184	El Dorado Hydroelectric Project
SFAR	South Fork American River
SWRCB	California State Water Resources Control Board

1.0 SUMMARY

In October 2017, AECOM and EID surveyed the South Fork American River fish community at the established electrofishing site located immediately downstream of Akin Powerhouse and seven snorkel pools upstream of the powerhouse. No Hardhead were captured or observed during the 2017 surveys.

2.0 INTRODUCTION

The El Dorado Irrigation District (EID or District) owns and operates the El Dorado Hydroelectric Project (Project No. 184), which is licensed by the Federal Energy Regulatory Commission (FERC). The Project No. 184 Monitoring Program[1] requires monitoring of Hardhead (*Mylopharodon conocephalus*) fish population in the South Fork American River (SFAR). The specific monitoring requirements for hardhead are defined in the Project 184 Hardhead Monitoring Plan (Plan; EID, 2007), which was approved by FERC on June 6, 2008.

Hardhead (*Mylopharodon conocephalus*) surveys were previously conducted in 2004, 2005, 2007, and 2011 (ECORP 2005; GANDA 2007; GANDA 2008; ECORP 2012). Results of these surveys provided baseline data on Hardhead population structure, biomass estimates, and distribution in the SFAR near Akin Powerhouse.

As described in the Plan, post-license compliance monitoring for Hardhead is required at 5-year intervals. Objectives of the monitoring are to evaluate the status of fish populations in the SFAR, and collect Hardhead length, weight, and population data for comparison to baseline data. Surveys for the first 5-year monitoring interval were conducted in 2011; the second five-year monitoring interval was scheduled to occur in 2016. However, a series of early season storms in October 2016 increased flow and turbidity, and decreased visibility and as a result, the monitoring effort was delayed until October 2017[2].

This report presents results from the 2017 Hardhead monitoring effort.

[1] Section 7 of the El Dorado Relicensing Settlement Agreement, U.S. Forest Service (FS) 4(e) Condition No. 37, and California State Water Resources Control Board (SWRCB) Section 401 Clean Water Act Water Quality Certification Condition No. 13

[2] The SWRCB, FS, and FERC approved the time extension to conduct the monitoring in 2017 on January 11, January 31, and February 16, respectively.

3.0 STUDY AREA

Hardhead population, density, and biomass surveys were conducted on the SFAR in the vicinity of Akin Powerhouse and extending upstream for approximately 2.5 kilometers (Figure 1 and Figure 2). A multi-pass electrofishing survey was conducted immediately downstream of Akin Powerhouse. Snorkel surveys were conducted in seven pools on the SFAR upstream of Akin Powerhouse (Figure 1). GPS coordinates for each sampling site are shown in Table 1.

Figure 1. Project Area and Electrofishing and Snorkel Survey Sampling Sites, EID Project 184 Hardhead Monitoring, October 2017.

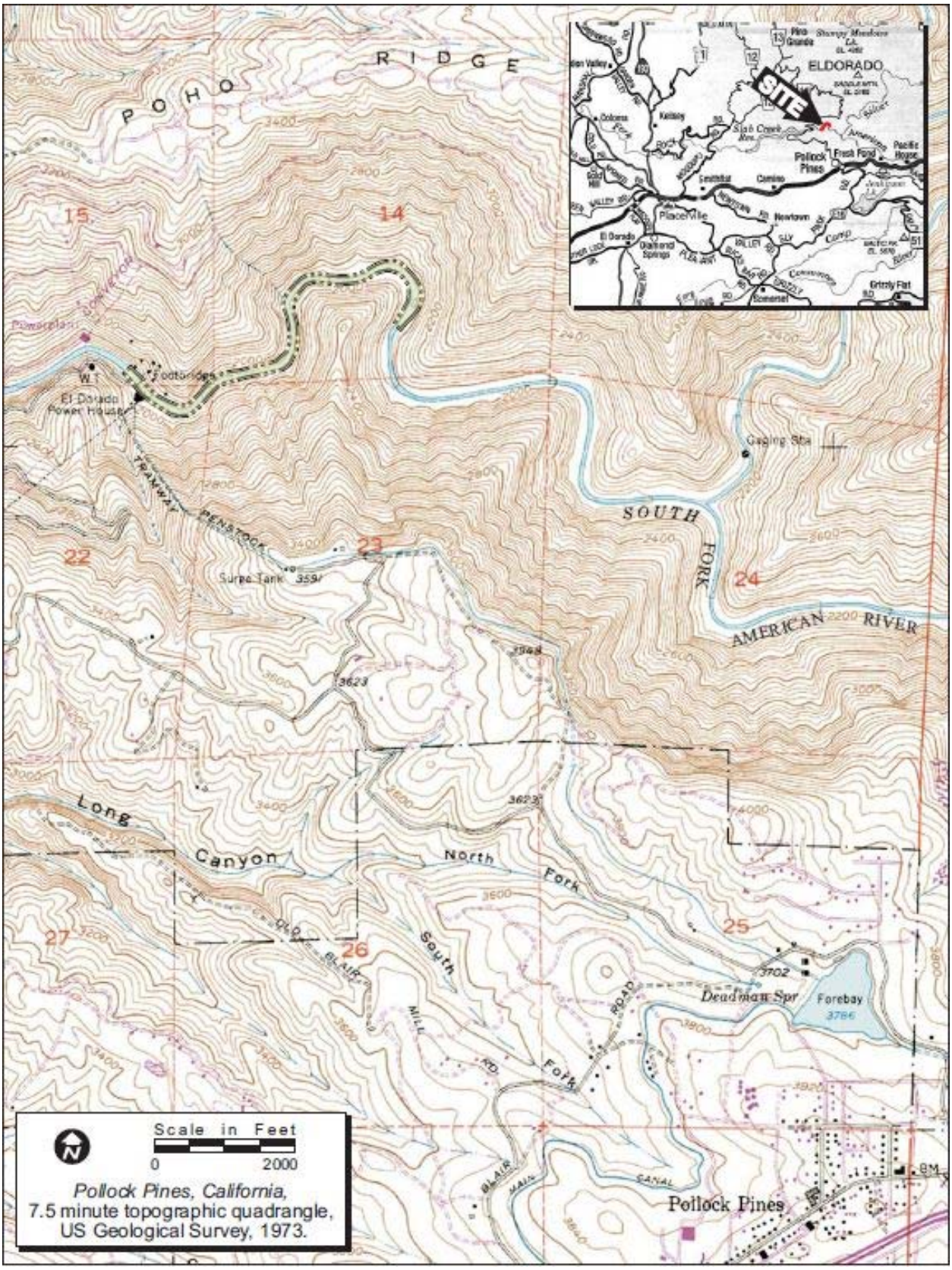

Figure 2. Project Area, EID Project 184 Hardhead Monitoring, October 2017.

Table 1. GPS coordinates of upstream and downstream boundaries of each Hardhead sampling site, October 2017.

Sampling Site	Upstream End UTM NAD 83 Easting	Upstream End UTM NAD 83 Northing	Downstream End UTM NAD83 Easting	Downstream End UTM NAD83 Northing
Electrofishing Site Downstream of Akin Powerhouse	0706761	4296610	0706761	4296608
Snorkel Pool 1	707042	4296570	706840	4296526
Snorkel Pool 2	707167	4296644	707067	4296593
Snorkel Pool 3	707400	429730	707193	4296659
Snorkel Pool 4	707413	4296939	707426	4296839
Snorkel Pool 5	707451	4297053	707423	4296997
Snorkel Pool 6	707545	4297106	707459	4297071
Snorkel Pool 7	707727	4297113	707625	4797105
Snorkel Pool 8 (not sampled)	707883	4296920	707941	4297065

4.0 METHODS

Sites sampled in 2011 were located in 2017 via GPS coordinates and site photos. Methods were consistent with those used in previous years sampling efforts (ECORP 2012). Site boundaries were established very near the site boundaries used for previous surveys; the site boundaries were adjusted slightly based on current habitat and flow conditions. Representative site photographs are provided in Attachment A.

4.1 Electrofishing

On October 10, 2017 a team of eight biologists (seven AECOM staff and one EID staff) conducted an electrofishing survey downstream of Akin Powerhouse (Figure 1). Four backpack electrofishing units and four netters/ bucket handlers were used to survey the site. Electrofishing sampling site boundaries were located and established at natural habitat breaks or logical locations for block net placement. The upstream and downstream site boundaries were documented by GPS coordinates and photographs. Once site boundaries were established, block nets were installed to prevent fish from moving in or out of the sampling site to ensure a closed population.

Prior to beginning the fish sampling effort, water quality parameters (water temperature, dissolved oxygen, and conductivity) were measured and recorded using a YSI Pro 2030 meter. Based on the measured water quality parameters, electrofishing unit settings were adjusted to ensure the highest capture efficiency while minimizing injury to fish. Water quality parameters are summarized in Table 2. Three salt blocks (four pounds each) were added per pass before electroshocking to raise water conductivity and improve catch rates. Conductivity was not measured after adding salt blocks. Electrofishing needed to begin immediately after adding salt blocks in order to finish each pass before the salt fully dissolved.

Fish sampling via multi-pass (or depletion) electrofishing consisted of applying an electrical current to the water using four backpack electrofishing units to temporarily stun or immobilize fish so that they could be captured. Electrofishing efforts were conducted in an upstream direction starting at the downstream site barrier. Two backpack electrofishing operators, with one netter each, focused on the margins on each side of the river. The other two backpack electrofishing operators, with one netter each, focused efforts towards the center of the channel.

Each time that the site was electrofished from the downstream site boundary upstream to the upstream site boundary was considered a pass. During each pass, captured fish were netted, removed from the sampling site, and relocated to an in-stream holding pen positioned upstream of the site boundary. Captured fish were identified to species, measured, and weighed at the completion of each pass. Fork length and total length were measured in millimeters (mm), and weight was measured to the nearest gram (g). Fish that weighed less than a gram were recorded as less than 1. After processing, captured fish were placed in a separate in-stream recovery holding pen located upstream of the site boundaries. Three passes were made at the sampling site. Only three electrofishing backpack units were used for pass 3 because one operator became sick and was unable to continue. Fish from the recovery holding pen were manually redistributed throughout the sampling site at the completion of the survey.

Table 2. Water quality parameters measured directly below Akin Powerhouse, October 10, 2017.

Sampling Site	Water Temp (°C)	Dissolved Oxygen (mg/l)	Specific Conductivity (µS)	Salt Added Per Pass (4lb blocks)
SFAR Downstream of Akin Powerhouse	10.4	11.8	60.5	3 blocks

4.2 Snorkeling

On October 11, 2017 a team of five biologists (four AECOM staff and one EID staff) conducted a two-pass snorkel survey in seven pools located upstream of Akin Powerhouse (Figure 1). Pool 8 was not surveyed in 2017 due to fire safety concerns and daylight constraints. During the two-pass, quantitative snorkel sampling effort, snorkelers entered the water at the downstream end of each pool and moved upstream (parallel to each other) at a slow and deliberate pace. All snorkelers stayed in visual range of each other to ensure that they remained evenly spaced and proceeded at the same speed in a straight line. The center snorkelers looked ahead to locate fish on the fringe of vision and the two margin snorkelers carefully searched for juveniles in areas where bank vegetation was present, in spaces between bedrock and boulders, under overhanging rock, and in other potential holding areas with slow moving water. Each fish was identified, counted, and categorized into pre-defined 3-inch (76mm) length classes to be consistent with previous efforts. An estimate was taken if a school of fish was seen and every individual could not be counted. Cyprinids between 0-3 inches in length were recorded as juvenile minnows because at this size it is difficult to positively identify to species while snorkeling. Snorkelers recorded data into a length category matrix on wrist-mounted underwater dive slates and data were recorded on write-in-rain datasheets at the end of each pass in each pool. Snorkelers began the upstream pass (Pass 1) at Pool 1 and worked upstream through all of the pools. After completing the upstream pass at Pool 7, snorkelers waited 30 minutes before returning to Pool 7 to start the downstream pass (Pass 2) through each pool. The upstream and downstream counts were combined for each pool and a mean value was determined for estimating fish abundance and for estimating biomass.

4.3 Physical Habitat Data

Physical habitat data were measured and recorded at the electrofishing sampling site at the conclusion of the electrofishing survey. Total sample site length was measured as the distance between both block nets and cross-transects were established every 10 meters beginning at the upstream block net. Wetted width (meter) was measured at each cross-transect and depth (centimeter) was measured at the 25%, 50%, and 75% widths of each cross-transect. Habitat composition and substrate type were estimated within the sample site. Flow measurements were to be taken along a single a cross-transect within the electrofishing site in an area determined to have the most laminar flow. Flow was to be measured at 20 intervals along the cross-transect to calculate discharge in cubic feet per second (cfs). However, flow was unable to be measured due to an equipment malfunction. The estimated flow at the sample site was approximately 74 cfs. The flow was estimated by adding flows measured on the SFAR below Kyburz (57 cfs) and Silver Creek below Camino Reservoir (17 cfs) at the time of the electrofishing survey.

The seven snorkel pools are composed of bedrock and go through few changes from year to year. Therefore, physical habitat data were not recorded for each pool. Maximum depth was visually estimated and recorded for each pool.

Stream discharge measurements for all surveys are provided in Table 3. Figure 1 provides the locations of the electrofishing survey site and the seven snorkel survey pools.

Table 3. Stream discharge measurements for 2004, 2005, 2007, 2011, and 2017.

Sampling Date	Flow (cfs) at Electrofishing Sample Site	Flow (cfs) at Gauging Station South Fork American River Downstream of Kyburz
October 13-14, 2004	77	48
October 18-19, 2005	N/A	52
October 18-19, 2007	N/A	42
October 19-20, 2011	168	121
October 10-11, 2017	74*	57

*Estimated by adding flows measured at SFAR below Kyburz and Silver Creek below Camino Reservoir

4.4 Data Analysis

Fish capture data, taken from field data sheets, were entered into an Excel database. These data were converted to comma separated value (csv) files and analyzed using MicroFish 3.0 software. Total length was used for consistency while calculating a length range per species because Prickly Sculpin (*Cottus asper*) were only measured in total length. Fish weighing less than 1 g were omitted from the condition factor calculations but included for population estimates. Population estimates and total weight estimates generated by MicroFish 3.0 were used to calculate condition factor. Biomass and fish density were unable to be calculated due to low fish captures.

Condition factor (the ratio of fish weight to length) is a commonly used metric among fisheries biologists as a general indicator of fish health. Condition factor was calculated for this effort using the following formula as described by Anderson and Gutreuter (1983):

$$\textit{Condition Factor} = \textit{Weight (g)} * 100{,}000/\textit{length (millimeter}^3\textit{)}$$

Condition factor is species-specific. A trout with a condition factor value of 1.0 is considered a fish of average condition. For most Cyprinids, including Hardhead and Sacramento Pikeminnow (*Ptychocheilus grandis*), slightly lower values would be expected since Cyprinids tend to be thinner than trout for a given length. However, since condition factor is not usually calculated for Cyprinids, a value for a Hardhead of average condition has not been established.

5.0 RESULTS

5.1 Electrofishing Survey

A total of 83 fish were captured representing five species (Table 4). Sacramento Sucker (*Catostomus occidentalis*) had the highest number of fish captured with 23 individuals. Prickly Sculpin had the second highest number of captures with 21 individuals. Rainbow Trout (*Oncorhynchus mykiss*) were the least captured species with 12 individuals captured. Rainbow Trout were also the least captured species in the 2011 survey. Speckled Dace (*Rhinichthys osculus*) and Sacramento Pikeminnow were also captured. Hardhead were not captured during the electrofishing survey. Summaries of length and weight data, condition factor, and biomass estimates are presented in Table 5. Completed field datasheets are provided in Attachment B. Length-frequency histograms for fish captured during the electrofishing survey are presented in Attachment C.

Table 4. Catch data and population estimates for fish captured during electrofishing surveys immediately downstream of Akin Powerhouse on the South Fork American River, October 10, 2017.

Species	Depletion Pattern	Total Number Captured	Population Estimate	Standard Error
Hardhead	0:0:0	0	0	0.0
Rainbow Trout	7:3:2	12	12	1.2
Speckled Dace	8:3:2	13	13	1.1
Sacramento Pikeminnow	7:6:1	14	14	2.2
Sacramento Sucker	5:8:10	23	34	N/A
Prickly Sculpin	8:8:5	21	33	16.9

Table 5. Summary of length and weight data, condition factor, and biomass estimates for fish captured during electrofishing surveys immediately downstream of Akin Powerhouse on the South Fork American River, October 10, 2017.

Species	Length Range (mm)	Mean Length (mm)	Mean Weight (g)	Mean Condition Factor	Estimated Biomass* (g)	Biomass/Area* (g/acre)
Hardhead	N/A	N/A	N/A	N/A	N/A	N/A
Rainbow Trout	(61-156)	94.1	9.5	1.0	N/A	N/A
Speckled Dace	(32-100)	54.2	3.4	1.4	N/A	N/A
Sacramento Pikeminnow	(29-46)	37.9	1.1	0.9	N/A	N/A
Sacramento Sucker	(31-88)	53.4	2.3	1.2	N/A	N/A
Prickly Sculpin	(36-114)	64.9	6.5	1.2	N/A	N/A

*The number of individuals required to calculate a relevant biomass estimate is a minimum of 10 specimens of each species for each age class

5.2 Snorkel Survey

Visual snorkel surveys were conducted on seven pools on the SFAR upstream of Akin powerhouse. Juvenile minnows were observed in Pools 1, 3, and 7 but in much lower numbers than in 2011. Rainbow Trout was the second most abundant species observed. Brown Trout, Prickly Sculpin, Sacramento Sucker, and Sacramento Pikeminnow were also observed but in very low numbers. The total numbers of fish observed per species during the snorkel survey is presented in Attachment D and represent the pooled average of the upstream and downstream pass.

5.3 Physical Habitat Data

The total length of the electrofishing sampling site was 108 meters. A summary of the physical habitat data collected at 10 meter intervals within the electrofishing sampling site is shown in Table 6. The habitat type consisted of 30% riffle, 5% pool, 5% run, and 60% run. Substrate composition within the site was comprised of 20% cobble, 50% boulder, 20% bedrock, 5% gravel, and 5% sand. Habitat and substrate types are shown in Table 7.

Table 6. Summary of physical habitat data measured during electrofishing surveys immediately downstream of Akin Powerhouse on the South Fork American River, October 10, 2017.

Cross-Transect	Wetted Width (m)	Depth 1 – 25 (cm)	Depth 2 – 50 (cm)	Depth 3 – 75 (cm)	Average Depth (cm)
0	29.3	48.8	67.1	45.7	53.9
1	24.7	73.2	88.4	85.3	82.3
2	26.7	67.1	54.9	76.2	66.1
3	25.9	61.0	70.1	67.1	66.1
4	23.6	33.5	36.6	57.9	42.7
5	23.8	67.1	61.0	67.1	65.1
6	22.4	42.7	36.6	97.5	58.9
7	23.5	24.4	27.4	57.9	36.6
8	24.4	30.5	24.4	67.1	40.7
9	21.3	45.7	33.5	70.1	49.8
10	22.3	39.6	64.0	88.4	64.0
11	25.3	76.2	64.0	94.5	78.2
Average	24.4	50.8	52.3	72.9	58.7

Table 7. Summary of habitat type and substrate composition estimated during electrofishing surveys immediately downstream of Akin Powerhouse on the South Fork American River, October 10, 2017.

	Habitat				Substrate Composition					
Habitat Type	Riffle	Run	Glide	Pool	**Substrate Type**	Bedrock	Boulder	Cobble	Gravel	Sand
Percentage	30	5	60	5	Percentage	20	50	20	5	5

5.4 Species Summaries

Rainbow Trout

Rainbow Trout were the least abundant species captured during the electrofishing survey with 12 individuals captured. The mean total length for Rainbow Trout was 94.1 mm and the mean weight was 9.5 g. Captured fish had a mean condition factor of 1.0 (i.e., considered average condition).

Rainbow Trout were the second most abundant species observed during the snorkel survey. Rainbow Trout were observed in all seven pools, with the majority of fish found at the head of each pool where the current was the strongest and bubble curtains were present. Rainbow Trout estimated from 9 to 12 inches in length was the most common size class observed followed by the 12 to 15 inch length category.

Brown Trout

Brown Trout were not captured during the electrofishing survey. One Brown Trout, estimated to be 15 to 18 inches in length, was observed during the snorkel survey in Pool 4 on Pass 1 but was not observed on Pass 2.

Speckled Dace

A total of 13 Speckled Dace were captured during the electrofishing survey. This species was not captured during the 2011 electrofishing survey. Mean total length was 54.2 mm, mean weight was 3.4 g, and the mean condition factor was 1.4. Speckled Dace was not observed during the snorkel survey.

Sacramento Pikeminnow

A total of 14 Sacramento Pikeminnow were captured during the electrofishing survey. The absence of a frenum and maxilla extending to the midpoint of the eye identified captures as Sacramento Pikeminnow and not Hardhead. Mean total length was 37.4 mm. Out of 14 fish captured, only one had a weight greater than 1 g. MicroFish 3.0 does not compute condition factor on fish less than 1 g. The condition factor for the one Sacramento Pikeminnow was 0.88.

One Sacramento Pikeminnow was observed in Pool 3 and two were observed in Pool 6 during the electrofishing survey. All three were estimated to be 12 to 15 inches in length.

Sacramento Sucker

Sacramento Sucker was captured/observed in both the electrofishing survey and snorkel survey. This species was the most abundant species captured during the electrofishing survey with 23 individuals captured. Mean total length was 53.4 mm, mean weight was 2.3 g, and mean condition factor was 1.2. Sacramento Sucker was observed in Pools 1, 2 and 3 during the snorkel survey; all were estimated to be 12 to 15 inches in length.

Prickly Sculpin

Sculpin captured during the 2017 electrofishing survey were identified as Prickly Sculpin based on their long anal fin (16–19 rays) which is approximately three times longer than the caudal peduncle (Moyle 2002). Prickly Sculpin was the second most abundant species with 21 individuals captured. Mean total length was 64.9 mm, mean weight was 6.5 g, and mean condition factor was 1.2. One Prickly Sculpin was observed in Pool 1 during the snorkel survey.

6.0 DISCUSSION/CONCLUSIONS

No juvenile or adult Hardhead were captured or observed during the 2017 electrofishing and snorkel surveys. Two Cyprinid species (Sacramento Pikeminnow and Speckled Dace) were captured during electrofishing surveys. Other species captured during electrofishing surveys included Rainbow Trout, Sacramento Sucker, and Prickly Sculpin. Small schools of Cyprinids from 0 to 3 inches in length were observed during the snorkel survey but were unable to be identified to species. At this size, visually differentiating among Sacramento Pikeminnow, Hardhead, and Speckled Dace during snorkel surveys is too difficult to be reliable. For the purpose of this report, Cyprinids observed during snorkel surveys that were estimated to be 0 to 3 inches in length were identified as juvenile minnows. Adult Sacramento Pikeminnow 12 to 15 inches in length were positively identified in a few of the pools. Other species observed during snorkel surveys included Rainbow Trout, Brown Trout, and Sacramento Sucker. All fish captured and observed during the surveys visually appeared to be in good condition.

As in 2017, no Hardhead were captured or observed in the 2011 surveys. Juvenile Hardhead were captured and observed in the 2004, 2005, and 2007 surveys, although juvenile Hardhead and Pikeminnow were grouped together in the 2005 report. No adult Hardhead have been captured or observed during any survey year.

One potential factor that may affect the presence of Hardhead within the survey area during the survey period is water temperature. Hardhead are typically found in streams with summer water temperatures in excess of 20 °C, and optimal water temperatures for Hardhead appear to be 24 °C to 28 °C (Moyle 2002). Water temperature data recorded on the SFAR upstream of the El Dorado Powerhouse indicate that water temperatures typically reach 20 °C to 25 °C only during the summer months (EID 2008 – 2016). Water temperatures on the SFAR upstream of the Powerhouse do not typically warm to 20 °C until June or July and decrease below 20° C by August or September (EID 2008 – 2016). Water temperatures recorded during Hardhead surveys conducted in October 2004, 2005, 2007, 2011, and 2017 ranged from 10.4 °C to 12.1 °C, which is well below the water temperature preference of Hardhead. It is possible that the less than optimal water temperatures on the SFAR upstream of the El Dorado Powerhouse may limit the presence of Hardhead within the survey area at the time surveys are conducted.

7.0 REFERENCES

Anderson, R. O. and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. Pages 283-300 in L. A. Nielsen, D. L. Johnson, and S. S. Lampton, editor. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

ECORP. 2005. Hardhead Fishery Survey Data Report, El Dorado Irrigation District, Hydroelectric Project 184. Draft Report prepared for the El Dorado Irrigation District, May 2005. ECORP Consulting Inc. 2012. 2011 Hardhead (Mylopharodon conocephalus) Surveys in the South Fork American River, El Dorado Hydroelectric Project, FERC No. 184. Prepared by ECORP Consulting, Inc., Rocklin, California for El Dorado Irrigation District, Placerville, California.

ECORP. 2012. 2011 Hardhead (Mylopharodon conocephalus) Surveys in the South Fork American River, El Dorado Hydroelectric Project, FERC No. 184. Prepared by ECORP Consulting, Inc., Rocklin, California for El Dorado Irrigation District, Placerville, California.

EID (El Dorado Irrigation District) 2007. Project 184, Hardhead Monitoring Plan. Version 3.0. El Dorado Irrigation District, Placerville, CA.

EID, 2008 – 2016. Project 184 Water Temperature Monitoring Reports. Data and Reports available online at: http://www.eid.org/our-services/hydroelectric/project-184/project-184-document-library.

GANDA, 2007. 2005 Hardhead Population Surveys South Fork American River El Dorado Hydroelectric Project (FERC No. 184). Prepared by Garcia and Associates.

GANDA, 2008. 2007 Hardhead Population Surveys South Fork American River El Dorado Hydroelectric Project (FERC No. 184). Prepared by Garcia and Associates.

Moyle, P. B. 2002. Inland Fishes of California, Revised and Expanded. University of California Press, Berkley and Los Angeles, California.

Attachment A

Representative Site Photographs

South Fork American River, snorkel survey Pool 1 looking upstream, October 11, 2017.

South Fork American River, snorkel survey Pool 2 looking downstream, October 11, 2017.

South Fork American River, snorkel survey Pool 3 looking downstream, October 11, 2017.

South Fork American River, snorkel survey Pool 4 looking downstream, October 11, 2017.

South Fork American River, snorkel survey Pool 5 looking downstream, October 11, 2017.

South Fork American River, snorkel survey Pool 6 looking downstream, October 11, 2017.

South Fork American River, snorkel survey Pool 7 looking downstream, October 11, 2017.

South Fork American River, electrofishing survey downstream block net, October 10, 2011.

South Fork American River, electrofishing survey upstream block net, October 10, 2017.

South Fork American River, electrofishing survey site looking downstream, October 10, 2017.

Attachment B

Completed Field Datasheets

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Electrofishing Data Sheet Cover Page

Project/Reach: EID Hardhead **Date:** 10/10/17

Personnel:

• **Electrofishing Data Sheet**	☐
• **Fish Capture Data Sheet**	☐
• **Streamflow Data Sheet**	☐
• **Habitat Data Sheet**	☐
• **Habitat and Cover Data Sheet**	☐
• **Photo Log**	☐

Notes:

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www.aecom.com 916.414.5800

Electrofishing Data Sheet

Project:	Reach:	Date:
EID Hardhead	Below Powerhouse	10/10/17
Site Location:	**Start/End Time:**	**QA/QC:**
South Fork American R.	11:45 - ~~11~~ 16:20	

Electrofishing Unit Operators: Brian Deason, Norm Porferanda, Chris Beck, Stuart Griffin

Netters: Steve Paglughi, Charlie Battaglia, Pam Brillante, Jack Rayl

Live Car Tenders: Steve Paglughi, Pam Brillante

Data Recorder: Chris Beck, Pam Brillante

Parameter	Value		Time	Method
Water Temperature	10.4 °C		11:30	YSI Pro 2030
Specific Conductivity	60.5 uS		11:30	YSI Pro 2030
D.O.	11.8 mg/L	%	11:30	YSI Pro 2030
Ambient Conductivity	44.2 uS		11:30	YSI Pro 2030

Salt Added: (Y) N

Specific Conductivity after salt: not measured

Type of Electrofisher(s): Smith Root Backpack efisher

Upstream Barrier Type: Block Net

Downstream Barrier Type: Block Net

Settings:

Pulse Frequency	40	Hz
Pulse Duration	5	ms
Duty Cycle	12	%
Output Voltage	400	volts
Current	.8	amps

Electrofisher Running Time:

Pass 1				Pass 2				Pass 3				Pass 4			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1521	723	1625	1209	1466	1071	1025	891	1251	678	747	/				

11:45 - 12:50 | 13:55 - 14:50 | 15:40 - 16:20

* efisher 4 not used due to illness by staff

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AECOM

Fish Capture Data Sheet

Project: EID Hardhead	Reach: Below Powerhouse.	Date: 10/10/17
Gear: electrofishing	Personnel:	QA/QC:

Species	FL (mm)	TL (mm)	Weight (g)	Pass
RBT	69	74	8	1
RBT	105	114	12	
RBT	104	111	16	
RBT	77	82	6	
Sac. Sucker	83	88	6	
Speck Dace	65	70	2	
Sac Sucker	47	50	<1	
Sp. Dace	56	60	2	
Pr. Sc	—	114	18	
P. minnow	44	46	<1	
P. minnow	32	34	<1	
P. minnow	34	37	<1	
Sp. dace	38	40	<1	
Sp. Dace	32	34	<1	
P. minnow	29	33	<1	
P. minnow	30	34	<1	
RBT	58	61	2	
Pr. Sc	—	50	<1	
Pr. Sc	—	61	2	
S. sucker	50	54	2	
Pr. Sc	—	52	2	
Pr. Sc	—	54	<1	
P. minnow	34	36	<1	
RBT	144	156	34	
Pr. Sc	—	95	12	
Pr. Sc	—	104	15	
Pr. Sc	—	99	11.3	
RBT	81	87	5.0	
Sp. Dace	64	71	3.1	
Sp. Dace	66	71	3.6	
P. minnow	40	44	<1	
S. sucker	58	62	2.4	
S. sucker	37	43	<1	
Sp. Dace	35	37	<1	
Sp. Dace	29	32	<1	

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Fish Capture Data Sheet

Project: EID Hurdhead	Reach: Below Powerhouse	Date: 10/10/17
Gear: efishing	Personnel:	QA/QC:

Species	FL (mm)	TL (mm)	Weight (g)	Pass
S. Sucker	37	39	< 1	2
S. Sucker	60	63	3.3	
S. Sucker	52	55	< 1	
S. Sucker	55	58	< 1	
P. minnow	43	45	< 1	
P. minnow	34	36	< 1	
P. minnow	37	40	< 1	
P. minnow	33	35	< 1	
P. minnow	30	32	< 1	
S. Sucker	35	37	< 1	
P. minnow	26	28	< 1	
Sp. Dace	64	68	5.8	
Pr. Sc	—	52	1.7	
Pr. Sc	—	45	< 1	
RBT	104	110	8.6	
RBT	77	82	5.4	
S. Sucker	48	51	3.2	
Pr. Sc	—	80	6.0	
Pr. Sc	—	41	< 1	
Sp. Dace	42	45	1.7	
S. Sucker	53	56	2.0	
S. Sucker	60	63	1.3	
Sp. Dace	30	33	1.2	
Pr. Sc	—	49	1.0	
Pr. Sc	—	43	< 1	
Pr. Sc	—	52	1.3	
Pr. Sc	—	36	< 1	

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Fish Capture Data Sheet

Project:	Reach:	Date:
EID Hardhead	Below Powerhouse	10/10/17
Gear:	**Personnel:**	**QA/QC:**
efishing		

Species	FL (mm)	TL (mm)	Weight (g)	Pass
RBT	84	87	6.3	3
RBT	80	85	6.0	2 (mort)
Pr. Sc.	—	101	15.2	3
RBT	76	80	5.0	
Pr. Sc	—	102	14.6	
Sp. Dace	95	100	9.9	
S. Sucker	57	61	2.0	
S. Sucker	30	31	<1	
S. Sucker	55	59	2.0	
S. Sucker	55	59	2.3	
S. Sucker	64	67	2.7	
S. Sucker	44	46	1.4	
Sp. Dace	42	44	1.2	
S. Sucker	43	45	1.2	
Pr. Sc	—	41	1.0	
S. Sucker	43	45	<1	
Pr. Sc	—	46	<1	
S. Sucker	49	51	1.8	
S. Sucker	43	45	1.0	
Pr. Sc	—	46	1.0	
P. minnow	46	50	1.1	

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Streamflow Data Sheet

Project:	Reach:	Date:
EID Hardhead	Below Powerhouse.	10/12/17
Meter Used:	**Personnel:**	
Rickly Hydrological	Stuart Griffin, Chris Beck, Brian Deason	

Flow measurements taken within section: Y N

Location Description (if outside section):

Coordinates(GPS):

* Flow meter unable to measure flow

Average Wetted Width and Depth:

Station	Distance (ft)	Depth (d) (ft)	Width (w) (ft)	Area (d * w) (ft^2)	Flow (ft/s)	Discharge (area *x* flow)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Total wetted width (ft)					Total discharge (cfs)	

* Wetted widths ≥ 10ft, measure flow at 10 stations; wetted widths <10 ft, measure flow at 5 stations

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Habitat Data Sheet

Project:	Reach:	Date:
EID Hardhead	Below Powerhouse	10/12/17
Personnel: Chris Beck, Stuart Griffin, Brian Deason		

Section Length(ft): 357 ft (108m)	Braided Channel Length(ft):
Downstream Boundary(GPS): S 0706761	4296608
Upstream Boundary(GPS): S 0706761	4296610

Average Wetted Width and Depth:

Cross-Section	Wetted Width (ft)	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Average Depth
0	96	1.62	2.2	1.5	X	X	1.77
1	81	2.42	2.9	2.8	X	X	2.71
2	87.7	2.26	1.8	2.52	X	X	2.19
3	85	2.0	2.32	2.2	X	X	2.17
4	77.5	1.08	1.18	1.9	X	X	1.39
5	78	2.16	2.0	2.18	X	X	2.11
6	73.4	1.35	1.22	3.15	X	X	1.91
7	77	0.80	.88	1.9	X	X	1.19
8	80	1.0	.80	2.24	X	X	1.35
9	70	1.5	1.12	2.32	X	X	1.65
10	73	1.34	2.14	2.90	X	X	2.13
11	83	2.52	2.08	3.11	X	X	2.48

Average Width(ft): 80.13 Average Depth(ft):

Notes: Cross Section 0 is downstream block net

Depth 1 = 25% from right bank

Depth 2 = 50% from right bank

Depth 3 = 75% from right bank

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Habitat and Cover Data Sheet

Project:	Reach	Date:
EID Hardhead	Below Powerhouse	10/12/17
Personnel: Chris Beck, Stuart Griffin, Brian Deason		**QA/QC:**

% Canopy Closure: 0 %

Habitat Type:		Substrate Type:	
% Riffle	30 %	% Bedrock	60
% Run	5 %	% Boulder	30
% Pocket Water		% Cobble	10
% Glide	60 %	% Gravel	
% Pool	5 %	% Sand	
% Lateral Scour Pool		% Silt/Fines	
% Backwater Pool			100%
% Corner Pool			
	100%		

Instream Cover Type:	
% Boulder	10
% Wood	
% Overhanging Vegetation	1 %
% Bedrock	74 %
% Water Turbulence	15 %
	100%

Notes:

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Photo Log

Project/Reach: EID Hardhead **Camera:** Iphone 6 **Date:** 10/10/17

Photo ID #	Photo Description	Photographer	Amended File Name
1	Upstream block net	Chris Beck	EID Hardhead efishing
2	Downstream block net	Chris Beck	EID Hardhead efishing
3	upstream looking downstream	Chris Beck	EID Hardhead efishing

File Pathway:

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	Pool: # 1	Date: 10/11/17
Survey Method: Snorkel	Staff: Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Pastenaga	QA/QC:
Pass: 1	Direction: Upstream	Max Depth: 20 ft

Species	Length	Total
J. Minnow	0-3"	12

Species	Length	Total
J. minnow	0-3"	20

Species	Length	Total
SSK	12-15	1
	12-15	1
J. minnow	0-3	1
Scu	0-3	1

Species	Length	Total
RBT	9-12	3
	12-15	7
	0-3	2
	6-9	6
	9-12	6

J. minnow = juvenile minnows

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 2	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglughi	**QA/QC:**
Pass: 1	**Direction:** Upstream	**Max Depth:** 8 ft

Species	Length	Total
RBT	6-9	1
	12-15	2
	3-6	1
	6-9	1
	6-9	2
	9-12	2

Species	Length	Total

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 3	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglughi	**QA/QC:**
Pass: 1	**Direction:** Upstream	**Max Depth:** 15 ft.

Species	Length	Total
RBT	6-9	4
	12-15	2

Species	Length	Total
SSK	12-15	1

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 4	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglingh	**QA/QC:**
Pass: 1	**Direction:** Upstream	**Max Depth:** 10 ft.

Species	Length	Total
RBT	9-12	3
	12-15	3
BT	15-18	1

Species	Length	Total

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 5	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglughi	**QA/QC:**
Pass: 1	**Direction:** Upstream	**Max Depth:** 15+

Species	Length	Total
RBT	9-12	1

Species	Length	Total

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** ~~#~~ 6	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Peglugh	**QA/QC:**
Pass: 1	**Direction:** Upstream	**Max Depth:** 8 ft

Species	Length	Total
RBT	6-9	1
	12-15	2

Species	Length	Total
Pikeminnow	12-15	2

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 7	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglughi	**QA/QC:**
Pass: 1	**Direction:** Upstream	**Max Depth:** 7 ft

Species	Length	Total
RBT	12-15	1
	9-12	2
	6-9	1
	12-15	1

Species	Length	Total

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 1	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglvgh.	**QA/QC:**
Pass: 2	**Direction:** ~~Upstream~~ Downstream	**Max Depth:** 20 ft

Species	Length	Total
J. Minnow	0-3	8

Species	Length	Total
J. minnow	0-3	2

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 2	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglirghi	**QA/QC:**
Pass: 2	**Direction:** ~~Upstream~~ Downstream	**Max Depth:** 8 ft

Species	Length	Total
SSK	12-15	1

Species	Length	Total
RBT	3-6	1
	6-9	1

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 3	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglinghi	**QA/QC:**
Pass: 2	**Direction:** ~~Upstream~~ Downstream	**Max Depth:** 15 ft.

Species	Length	Total
P. minnow	12-15	1
J. minnow	0-3	45

Species	Length	Total
J. minnow	0-3	15

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** 4	**Date:** 10/11/17
Survey Method: ~~Habitat~~ Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglughi	**QA/QC:**
Pass: 2	**Direction:** ~~Upstream~~ Downstream	**Max Depth:** 10 ft.

Species	Length	Total
RBT	9-12	8
	12-15	2
	9-12	1
	6-9	5
	9-12	2
	12-15	1

Species	Length	Total

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	**Pool:** # 5	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglughi	**QA/QC:**
Pass: 2	**Direction:** ~~Upstream~~ Downstream	**Max Depth:** 15 ft.

Species	Length	Total
no fish		

Species	Length	Total

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Hardhead	Pool: 6	Date: 10/11/17
Survey Method: Snorkel	Staff: Chris Beck, Stuart Griffing Brian Deason, Charles Battaglia, Steve, Paglughi	QA/QC:
Pass: 2	Direction: ~~Upstream~~ Downstream	Max Depth: 8ft

Species	Length	Total
no fish		

Species	Length	Total

Species	Length	Total

Species	Length	Total

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Direct Observation Data Sheet – Snorkel Surveys

Project: EID Headboard	**Pool:** #7	**Date:** 10/11/17
Survey Method: Snorkel	**Staff:** Chris Beck, Stuart Griffin, Brian Deason, Charles Battaglia, Steve Paglugh	**QA/QC:**
Pass: 2	**Direction:** ~~Upstream~~ Downstream	**Max Depth:** 7 ft.

Species	Length	Total
RBT	6-9	1

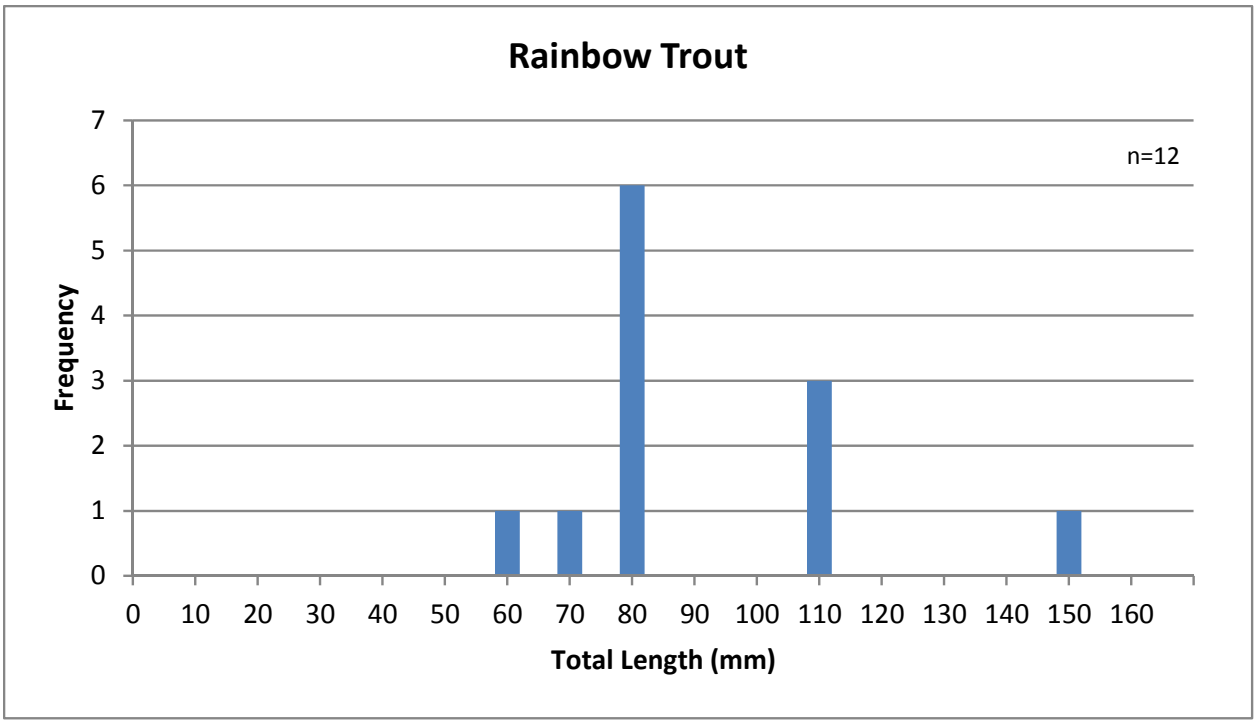
Species	Length	Total
J. minnow	0-3	4

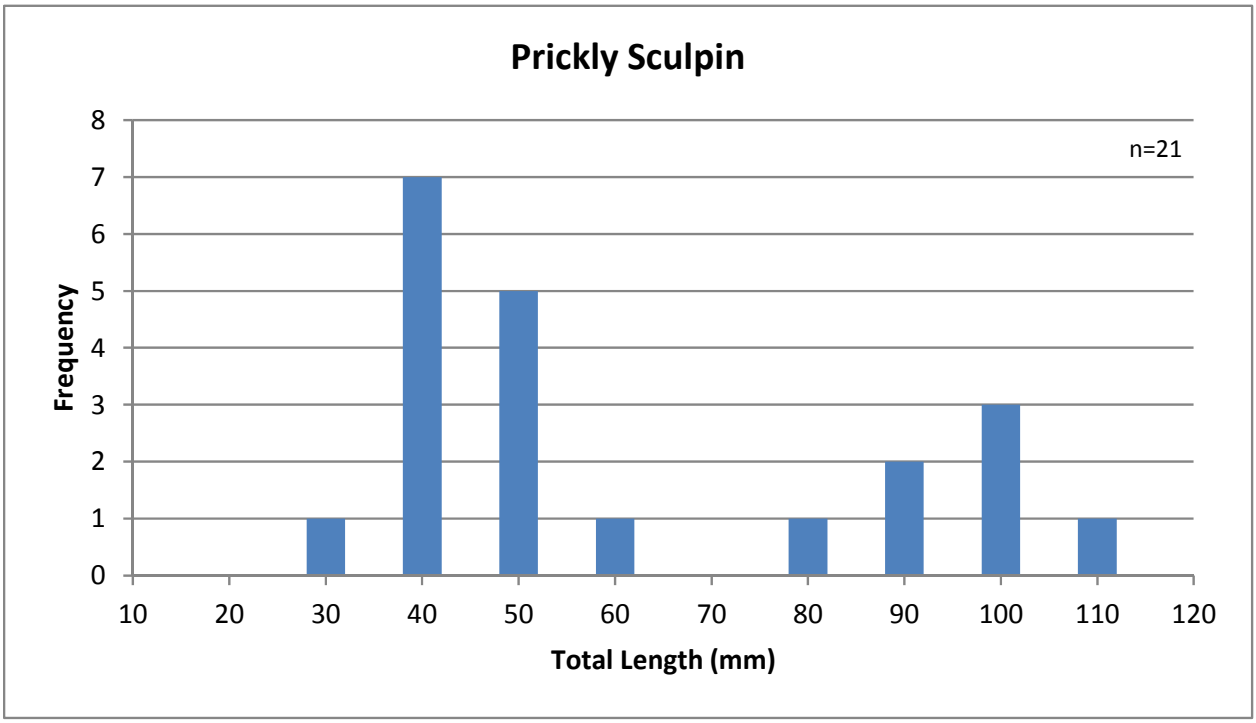
Species	Length	Total

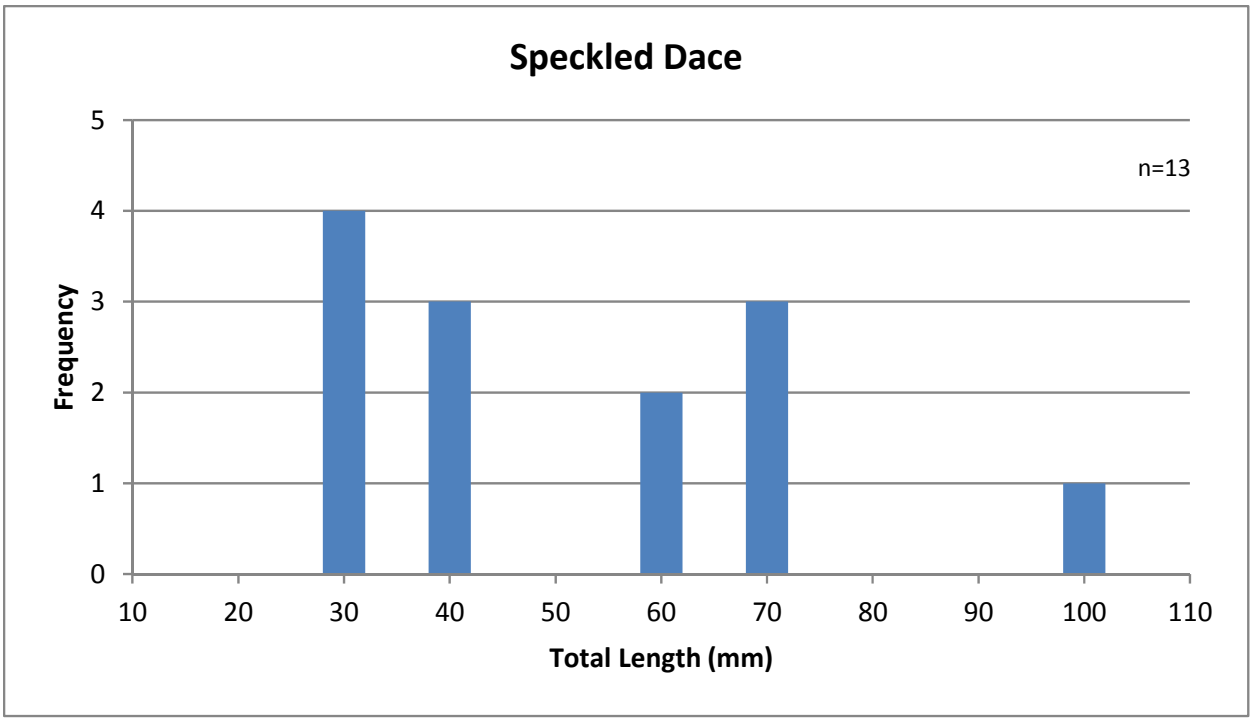
Species	Length	Total

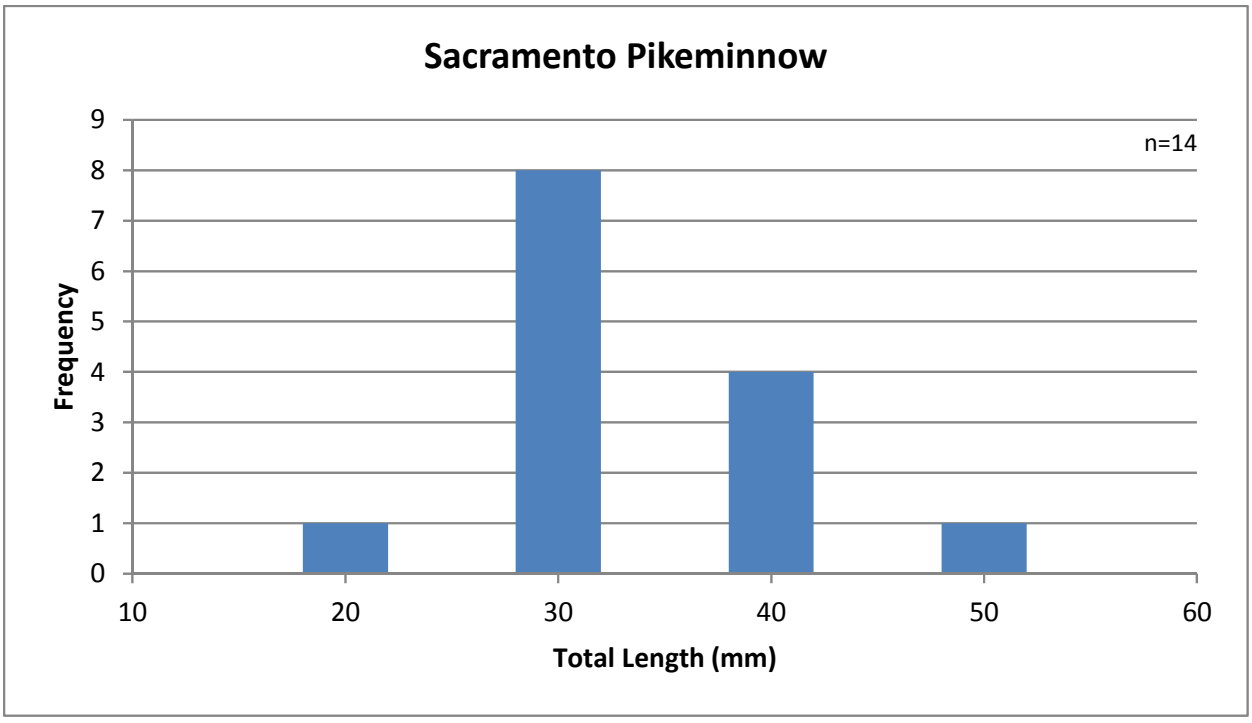
Attachment C

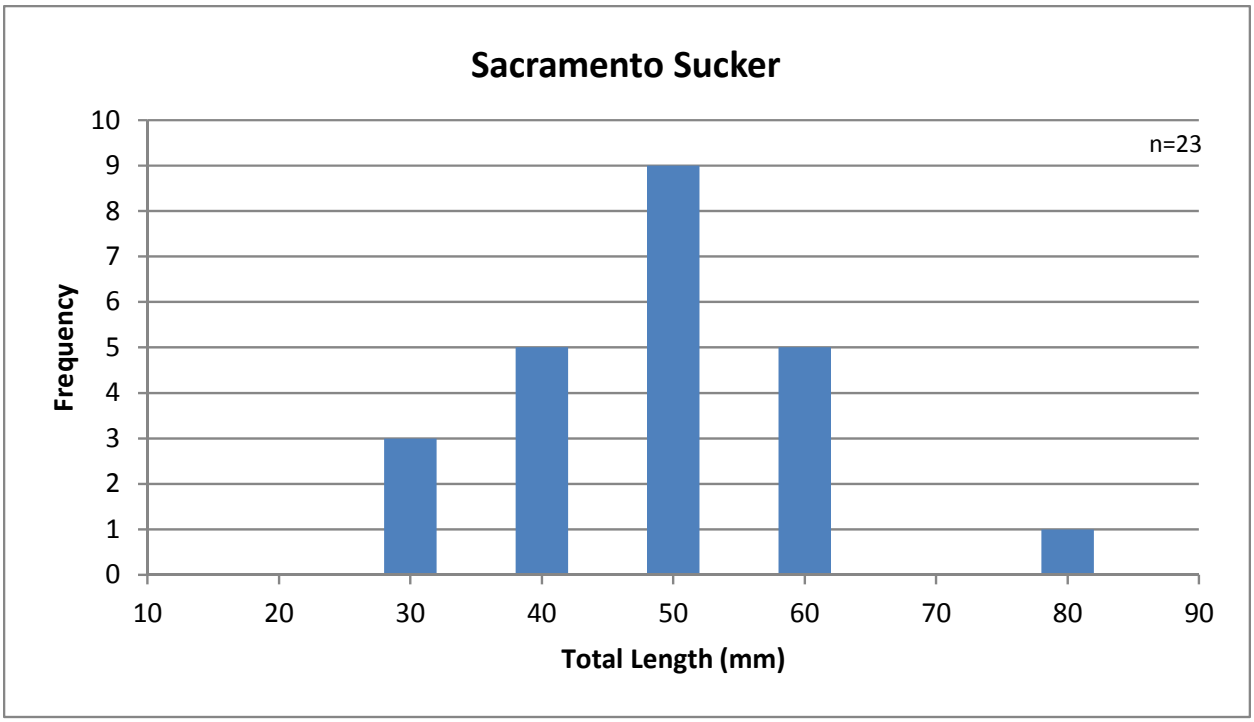
Length-Frequency Histograms for Fish Captured During the Electrofishing Survey


Rainbow Trout
n=12
Frequency
0
1
2
3
4
5
6
7
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
Total Length (mm)


Prickly Sculpin
n=21
Frequency
0
1
2
3
4
5
6
7
8
10 20 30 40 50 60 70 80 90 100 110 120
Total Length (mm)


Speckled Dace
n=13
Frequency
0
1
2
3
4
5
10
20
30
40
50
60
70
80
90
100
110
Total Length (mm)


Sacramento Pikeminnow
n=14
Frequency
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
Total Length (mm)


Sacramento Sucker
n=23
Frequency
0
1
2
3
4
5
6
7
8
9
10
10
20
30
40
50
60
70
80
90
Total Length (mm)

Attachment D

Number of Fish Observed, by Species and Length, During Snorkel Surveys

Attachment D - Number of Fish Observed, by Species and Length, During Snorkel Surveys

Pool 1

	Juvenile Minnow	RBT (0-3")	RBT (3-6")	RBT (6-9")	RBT (9-12")	RBT (12-15")	SSK (12-15")	SCU (0-3")	SPK (12-15")	BT (15-18")
Pass 1	33	2	0	6	9	7	2	1	0	0
Pass 2	10	0	0	0	0	0	0	0	0	0
Mean # of Fish	21.5	1	0	3	4.5	3.5	1	0.5	0	0

Pool 2

	Juvenile Minnow	RBT (0-3")	RBT (3-6")	RBT (6-9")	RBT (9-12")	RBT (12-15")	SSK (12-15")	SCU (0-3")	SPK (12-15")	BT (15-18")
Pass 1	0	0	1	4	2	2	0	0	0	0
Pass 2	0	0	1	1	0	0	1	0	0	0
Mean # of Fish	0	0	1	2.5	1	1	0.5	0	0	0

Pool 3

	Juvenile Minnow	RBT (0-3")	RBT (3-6")	RBT (6-9")	RBT (9-12")	RBT (12-15")	SSK (12-15")	SCU (0-3")	SPK (12-15")	BT (15-18")
Pass 1	0	0	0	0	4	2	1	0	0	0
Pass 2	60	0	0	0	0	0	0	0	1	0
Mean # of Fish	30	0	0	0	2	1	0.5	0	0.5	0

Pool 4

	Juvenile Minnow	RBT (0-3")	RBT (3-6")	RBT (6-9")	RBT (9-12")	RBT (12-15")	SSK (12-15")	SCU (0-3")	SPK (12-15")	BT (15-18")
Pass 1	0	0	0	0	3	3	0	0	0	1
Pass 2	0	0	0	5	11	3	0	0	0	0
Mean # of Fish	0	0	0	2.5	7	3	0	0	0	0.5

Pool 5

	Juvenile Minnow	RBT (0-3")	RBT (3-6")	RBT (6-9")	RBT (9-12")	RBT (12-15")	SSK (12-15")	SCU (0-3")	SPK (12-15")	BT (15-18")
Pass 1	0	0	0	0	1	0	0	0	0	0
Pass 2	0	0	0	0	0	0	0	0	0	0
Mean # of Fish	0	0	0	0	0.5	0	0	0	0	0

Pool 6

	Juvenile Minnow	RBT (0-3")	RBT (3-6")	RBT (6-9")	RBT (9-12")	RBT (12-15")	SSK (12-15")	SCU (0-3")	SPK (12-15")	BT (15-18")
Pass 1	0	0	0	1	0	2	0	0	2	0
Pass 2	0	0	0	0	0	0	0	0	0	0
Mean # of Fish	0	0	0	0.5	0	1	0	0	1	0

Pool 7

	Juvenile Minnow	RBT (0-3")	RBT (3-6")	RBT (6-9")	RBT (9-12")	RBT (12-15")	SSK (12-15")	SCU (0-3")	SPK (12-15")	BT (15-18")
Pass 1	0	0	0	1	2	2	0	0	0	0
Pass 2	4	0	0	1	0	0	0	0	0	0
Mean # of Fish	2	0	0	1	1	1	0	0	0	0