

**FERC Project No. 2426**  
**South SWP Hydropower**  
***Pyramid Reach Fish Population Study***

**FIELD RESULTS AND DATA SUMMARY**

*July 10, 2019*

Consistent with Section 5.0 of the South SWP Hydropower Revised Study Plan and as approved in the Federal Energy Regulatory Commission (FERC) Study Plan Determinations dated June 14, 2017 and September 7, 2018, the California Department of Water Resources and Los Angeles Department of Water and Power (Licensees) provide the following Field Results and Data Summary for Study 4.1.3, *Pyramid Reach Fish Populations Study* (Study), which includes work completed to date, key findings, associated data files, variances, and remaining work. The Licensees consider these data to be public.

***Completed Work to Date:***

The Study is complete. As required by the FERC-approved Study Plan, Licensees have completed Step 1 (Classify Mesohabitat and Channels), Step 2 (Conduct eDNA sampling), Step 3 (Select Sampling Sites for Fish Population Sampling), and Step 4 (Sample Fish Population).

**Step 1: Classify Mesohabitat and Channels**

Mesohabitats of Piru Creek were classified from the normal maximum water surface elevation (NMWSE) of Lake Piru upstream to Pyramid Dam (Pyramid reach). A three-tiered habitat mapping classification system developed by Hawkins et al. (1993) was used to assist in the identification of individual habitat units in the field. The Licensees conducted extensive habitat mapping (i.e., mapped each individual unit) of 6.4 miles of Pyramid reach, from River Mile (RM) 0.86 to RM 3.77, and RM 14.97 to RM 18.42. Habitat units were also characterized in the canyon section (RM 4 to 15) as part of the environmental deoxyribonucleic acid (eDNA) sampling.

**Step 2: Conduct eDNA Sampling**

The Licensees conducted eDNA sampling in Pyramid reach at 500 meter (m) (1,640 feet) intervals, for a total of 60 sample sites, in spring 2018 (see attached map). All samples collected were analyzed for the presence of eDNA (i.e. specific mitochondrial DNA [mtDNA] regions) for three target fish species including rainbow trout (*Oncorhynchus mykiss*), Santa Ana sucker (*Catostomus santaanae*), and arroyo chub (*Gila orcutti*).

At each site, two sterivex filters were collected, and approximately one liter of stream water was passed through each filter. Analysis of all collected eDNA was completed by Genidaqs, a qualified genetics laboratory. The eDNA was isolated from each filter following Bergman et al. (2016) and analyzed using quantitative Polymerase Chain Reaction (qPCR) assays. A standard assay for rainbow trout existed and was used for this analysis. Assays for Santa Ana sucker and arroyo chub did not exist but were developed by Genidaqs for this Study using mtDNA sequences from the National Center for Biotechnology Information Nucleotide database. Because the assays were developed from mtDNA sequences, the eDNA analysis did not distinguish between genetically pure eDNA of the species of interest and hybrids if the mother of the hybrid was of the target species. Therefore, a positive detection for Santa Ana

sucker could also indicate a hybrid between a Santa Ana sucker and an Owens sucker (*Catostomus fumeiventris*). Based on the possibility of hybridization, and the inability of the analysis to differentiate pure from hybridized Santa Ana sucker, all suckers are referred to as sucker species (sucker spp.) in this report.

### **Step 3: Select Sampling Sites for Fish Population Sampling**

Using aerial imagery and habitat mapping data, the Licensees selected three sampling sites based on three criteria: (1) the site is reasonably accessible to field crews; (2) the site represents the overall mesohabitat ratios found in the stream segment of the reach in which the site is located; and (3) the site can be effectively sampled using backpack electrofishing equipment. On May 17, 2018, the Licensees conducted a field site visit with agencies<sup>1</sup> to discuss Preliminary Fish Sampling Sites 1, 2 and 3. After receiving feedback from the agencies, the Licensees agreed to relocate two of the sampling sites (Fish Sampling Site 1 and Fish Sampling Site 3) from their original locations. The Licensees filed a letter with FERC on August 1, 2018,<sup>2</sup> describing the Preliminary Fish Sampling Sites 1, 2 and 3 and the rationale for selecting the new locations (Fish Sampling Sites 1, 2 and 3). FERC agreed with the selection of Fish Sampling Sites 1, 2 and 3 in the Study Plan Determination dated September 7, 2018.

### **Step 4: Sample Fish Population**

Multiple-pass depletion electrofishing (Reynolds 1996; Temple and Pearsons 2007) using two Smith Root LR 24 units was conducted at Fish Sampling Sites 1, 2, and 3 selected under Step 3 on Pyramid reach in October 2018. The upstream and downstream ends of each site were blocked with fine mesh nets to prevent fish passage. Electrofishing was conducted by qualified biologists in accordance with a California Department of Fish and Wildlife (CDFW)-issued Scientific Collecting Permit.

Captured fish were retained in aerated buckets until each pass was completed. All fish were identified to species (when possible) and counted. Individuals were measured to the nearest millimeter (mm) (fork length when applicable) and weighed by digital scale to the nearest gram. Scale samples were collected on a subsample of largemouth bass (*Micropterus salmoides*) for validating length-age indices. In a collaborative effort, the Licensees coordinated with United Water Conservation District (UWCD) biologists who collected scale samples from rainbow trout captured during electrofishing efforts. UWCD staff collected rainbow trout scale samples under a separate CDFW Scientific Collecting Permit.

Scale samples were collected from rainbow trout equal to or greater than 120 mm in fork length and from largemouth bass equal to or greater than 150 mm in length. Scales from each sampled individual were mounted on glass microscope slides and examined under a dissecting microscope by an experienced biologist to determine age. For rainbow trout, lengths and ages of individuals for which age was able to be determined were used to construct a model which was utilized to estimate ages for individuals from which scales were not collected or age determination was not possible through scale analysis. Length-age regression was not possible for largemouth bass because scale analysis yielded a single age

<sup>1</sup> Agencies present on May 17, 2018 included CDFW, National Marine Fisheries Service, State Water Resources Control Board, and US Forest Service.

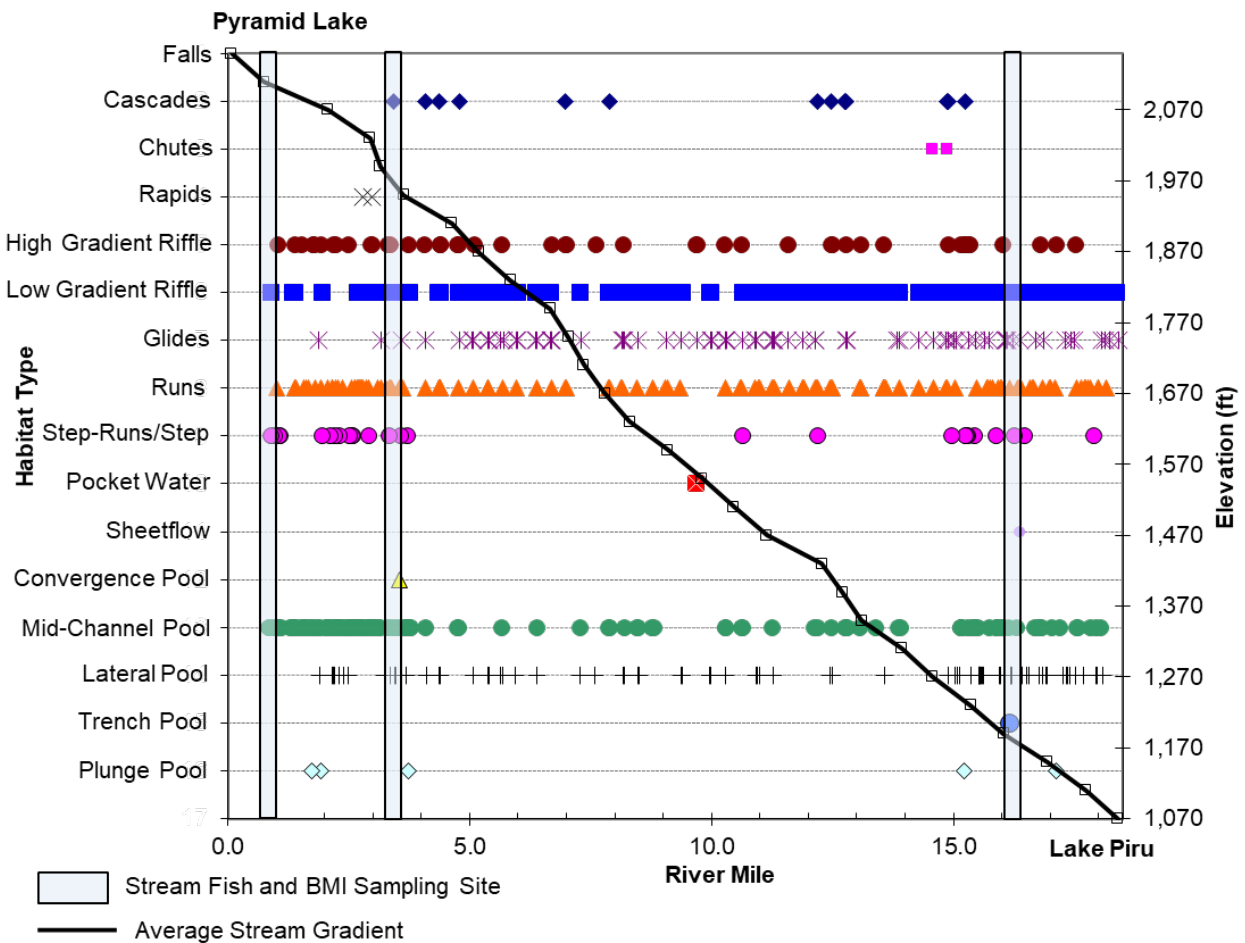
<sup>2</sup> FERC Accession Number 20180803-5090

class. Instead, ages for unknown-age largemouth bass were estimated by analyzing the largemouth bass length-frequency distribution (Devries and Frie 1996), which showed two distinct age classes (Age 0 and Age 1). These were the only two age classes of largemouth bass encountered during the sampling effort.

**Key Accomplishments/Summary of Findings:**

**Mesohabitats**

Figure 1 provides the distribution of mesohabitat types identified in Pyramid reach during the habitat mapping effort. In general, habitats typical of lower gradient streams (pools, runs, glides, and low gradient riffles) were the most common.



Key:  
 ft = feet

**Figure 1. Mesohabitat Types Recorded within Pyramid Reach**

Extensive habitat mapping of 6.35 miles of Pyramid reach was divided into three stream segments: two segments located within the first 4 miles immediately downstream of Pyramid Dam and one directly upstream of the NMWSE of Lake Piru. These segments were identified to

assist in selecting sampling sites for backpack electrofishing. Table 1 shows that mid-channel pools (31 percent) accounted for the largest percent of habitat types, followed by runs (17 percent), and low-gradient riffles (15 percent). A total of 33,515 feet was mapped in detail.

**Table 1. Habitat Units Found within the Extensively Mapped 6.35 Miles of Pyramid Reach**

Habitat Unit	Total		Stream Segment 1 (RM 0.86-2.99)		Stream Segment 2 (RM 3.0-3.77)		Stream Segment 3 (RM 14.97-18.42)	
	Total length (feet)	Proportion (%)	Total length (feet)	Proportion (%)	Total length (feet)	Proportion (%)	Total length (feet)	Proportion (%)
Mid-Channel Pool	10,351.7	31	6,130.3	54	1,512.1	33	2,709.3	15
Run	5,536.6	17	2,105.8	19	498.6	11	2,932.3	17
Low-Gradient Riffle	5,159.4	15	590.4	5	665.8	15	3,903.2	22
Lateral Pool	3,398.1	10	242.7	2	288.6	6	2,866.7	16
Glide	3,145.5	9	203.4	2	229.6	5	2,712.6	15
Split Channel	2,843.8	8	757.7	7	823.3	18	1,262.8	7
Step Pool	1,567.8	5	669.1	6	246.0	5	652.7	4
High-Gradient Riffle	911.8	3	393.6	3	91.8	2	426.4	2
Cascade	183.7	<1	0	0	131.2	3	52.5	<1
Plunge Pool	154.2	<1	91.8	1	19.7	<1	42.6	<1
Rapids	72.2	<1	72.2	1	0	0	0	0
Not Classified	49.2	<1	49.2	<1	0	0	0	0
Trench Pool	49.2	<1	0	0	0	0	49.2	<1
Convergence Pool	45.9	<1	0	0	45.9	1	0	0
Sheet Flow	39.4	<1	0	0	0	0	39.4	<1
Falls	6.6	<1	6.6	<1	0	0	0	0
<b>Total</b>	<b>33,515.0</b>	<b>100</b>	<b>11,312.7</b>	<b>100</b>	<b>4,552.6</b>	<b>100</b>	<b>17,649.7</b>	<b>100</b>

Key:  
RM = river mile  
% = percent

### eDNA

Rainbow trout were detected at 59 of the 60 sampling locations (98 percent) throughout the entire reach. Sucker spp. were detected at 54 of the 60 sampling locations (90 percent) between approximately RM 1.9 and RM 18.3 and were absent in an approximately 1.5-mile-long stretch directly below Pyramid Dam. Arroyo chub were detected in 14 of the 60 sampling locations (23.3 percent), which were distributed sporadically in Pyramid reach with four detections between RM 2 and RM 7, seven detections between RM 8 and RM 13, and three detections between RM 17 and just downstream of RM 18 (Table 2). The full Genidaqs report is available on the relicensing website.

**Table 2. eDNA Sampling Results for Pyramid Reach**

Pyramid Reach Segment	Total Number of Samples Collected	Target Species mtDNA Detections in Samples Collected		
		Rainbow Trout	Sucker spp.	Arroyo Chub
Pyramid Dam to Fish Creek (RM 0.0 - 6.5)	22	22	16	4
Fish Creek to Agua Blanca Creek (RM 6.6 - 16.65)	32	31	32	7
Agua Blanca to Piru Lake NMWSE (RM 16.66 - 18.5)	6	6	6	3
<b>Total</b>	<b>60</b>	<b>59</b>	<b>54</b>	<b>14</b>

Key:

RM = river mile

NMWSE = normal maximum water surface elevation

### Fish Population

A total of four species were observed during backpack electrofishing. Sampling at Fish Sampling Site 1 yielded rainbow trout (n=78), largemouth bass (n=49), and prickly sculpin (n=10, *Cottus asper*). Sampling at Fish Sampling Site 2 yielded rainbow trout (n=47) and sucker spp. (n=81) that could not be identified to species. Sampling at Fish Sampling Site 3 yielded no fish and field crew members did not visually observe any fish within the site during the entirety of the sampling effort. Additionally, backpack electrofishing was conducted for approximately 200m immediately upstream and downstream of Fish Sampling Site 3, and no fish were captured or observed. Sampling results are presented in Table 3.

Game fish (rainbow trout and largemouth bass) were assessed based on relative stock density (RSD) calculations. Consistent with the FERC-approved study plan, RSD was calculated as the percent of fish sampled that were greater than 150 mm (6 inches) in length (Nevada Irrigation District and Pacific Gas and Electric Company 2010). Fulton's condition factor, an independent measure of fish condition for fish displaying fusiform body shape, was calculated cumulatively and by site (Table 3). All sampled fish visually appeared to be free of parasites and disease.

Fish community analysis for Fish Sampling Site 1 and Fish Sampling Site 2 includes species composition and relative abundance of each species (Table 3). In addition, species diversity and species richness were calculated using the Shannon Diversity Index and richness rarefaction, respectively (Table 3). Species richness, as estimated by rarefaction at a standard sample size of 100 individuals, shows that three species are present within Fish Sampling Site 1 and two species are present within Fish Sampling Site 2, with a standard error of less than 0.01 for each site estimate. The Shannon Diversity Index calculations illustrate relatively low diversity across both sites, with Fish Sampling Site 1 having slightly greater calculated diversity than Fish Sampling Site 2. Rarefaction calculations were completed using the 'vegan' package (Oksanen et al. 2018) in R Statistical Software (R Core Team 2018).

**Table 3. Population Summary of Backpack Electrofishing on Pyramid Reach**

Species		Fish Sampling Site 1			Fish Sampling Site 2	
		Rainbow Trout	Largemouth Bass	Prickly Sculpin	Rainbow Trout	Sucker spp.
Abundance	Number captured by pass (total)	52-16-10 (78)	31-12-6 (49)	5-4-1 (10)	29-7-11-0 (47)	46-25-8-2 (81)
	Estimated abundance	82	52	10	54	86
	95% CI	75-89	46-58	7-13	42-66	76-96
	Fish/100 m	14.88	9.44	1.81	7.69	12.24
	Fish/mile	785.77	498.29	95.83	405.86	646.38
Length (mm)	Range (Average)	68-360 (131.14)	57-206 (130.27)	70-135 (107.9)	57-173 (97.74)	70-205 (128.28)
Weight (grams)	Total	2330.20	2214.40	243.10	610.50	2404.30
	Range (Average)	3.85-281.29 (31.07)	2.80-163.20 (46.13)	4.80-71.50 (24.31)	2.10-50.40 (12.99)	4.50-108.70 (30.74)
	Total estimated weight (grams)	2449.70	2350.0	243.10	701.40	2617.30
	Weight (grams)/100 m	422.90	401.89	44.12	86.90	342.25
	Pounds/acre	23.46	22.50	2.33	9.59	35.78
	Kilogram/hectare	26.29	25.22	2.61	10.75	40.10
Condition Factor	Relative – range	0.80-1.31	0.81-1.13	0.80-1.64	0.61-1.19	0.73-1.18
	Fulton's – range (average)	0.90-1.62 (1.21)	1.32-1.91 (1.59)	1.26-2.97 (1.59)	0.70-1.47 (1.21)	0.99-1.60 (1.36)
RSD (% of population > 150 mm FL)		18	24		6	6
Community Diversity	Proportion of Catch per Site	0.57	0.36	0.07	0.37	0.63
	Shannon Index (H')	0.88			0.66	
	Richness <sup>1</sup> (Standard Error)	3.00 (< 0.01)			2.00 (< 0.01)	

Notes:

<sup>1</sup> Richness values were calculated using rarefaction and apply to a sampling size of 100 individuals. Values are estimated number of species present.

Key:

% = percent

< = less than

> = greater than

CI = confidence interval

FL = fork length

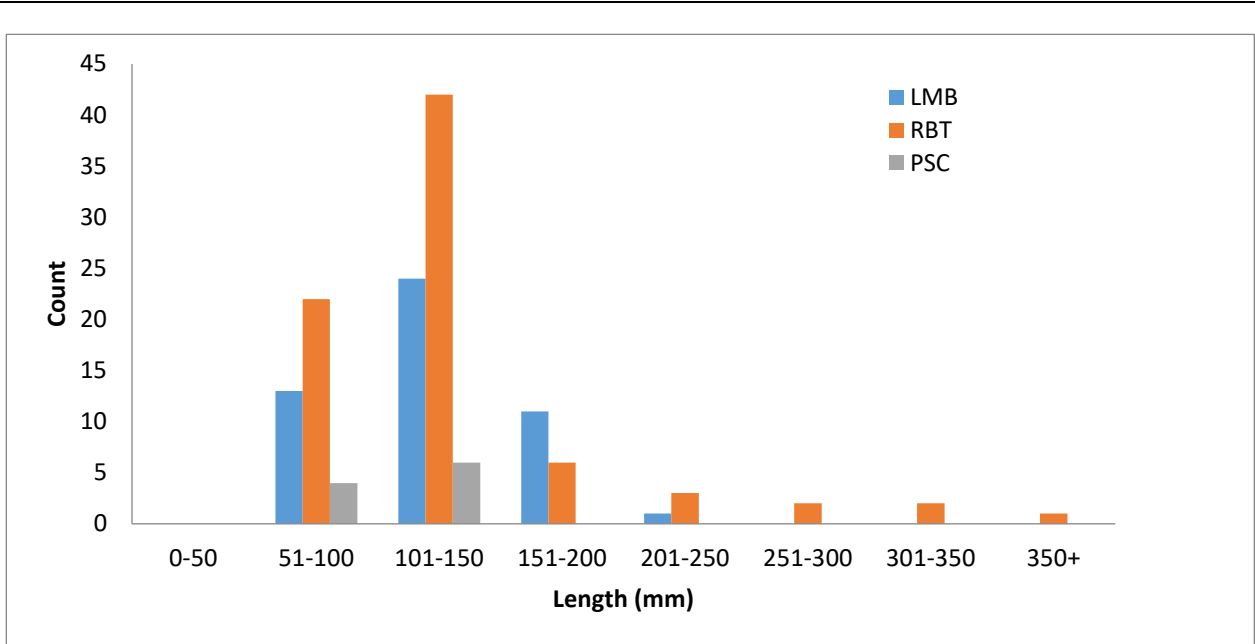
H' = Shannon's Diversity Index

m = meters

mm = millimeters

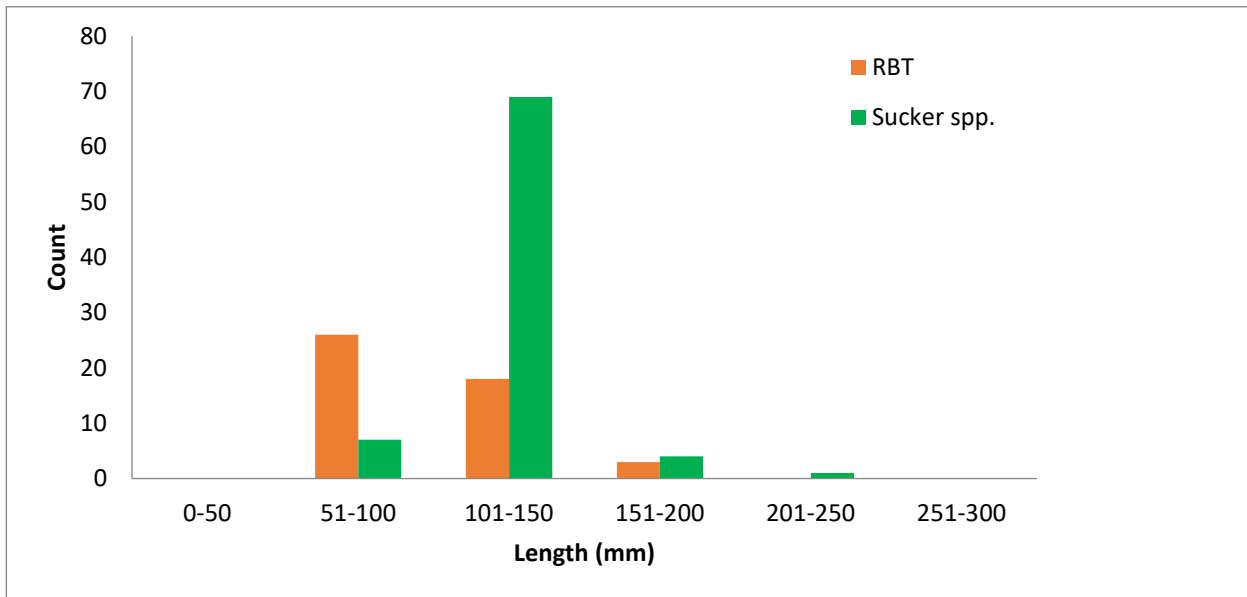
RSD = relative stock density

Fish sampled in Fish Sampling Site 1 were generally larger than those in Fish Sampling Site 2. The majority of rainbow trout and largemouth bass in Fish Sampling Site 1 were in the 101 to 150 mm range, with one individual rainbow trout up to 360 mm (Figure 2). Fish Sampling Site 1 showed a broader range of size classes than did Fish Sampling Site 2. Most of the sucker spp. in Fish Sampling Site 2 were in the 101 to 105 mm range with few individuals outside this size class. Rainbow trout in Fish Sampling Site 2 were most abundant in the 51 to 100 mm size class, supplemented by fish in the 101 to 150 mm range. No rainbow trout were observed over 200 mm in Fish Sampling Site 2, and only one sucker spp. was found over 200 mm (Figure 3).



Key:  
 Count = number of individuals captured  
 LMB = largemouth bass  
 mm = millimeters  
 PSC = prickly sculpin  
 RBT = rainbow trout

**Figure 2. Length Frequencies of Fish Sampled at Fish Sampling Site 1 on Pyramid Reach**



Key:  
 Count = number of individuals captured  
 mm = millimeters  
 RBT = rainbow trout  
 Sucker spp. = unknown sucker species

**Figure 3. Length Frequencies of Fish Sampled at Fish Sampling Site 2 on Pyramid Reach**

Overall catch per unit effort (CPUE, fish per minute) was calculated cumulatively, as well as by species, for each site. Sampling effort was calculated by summing the total time the backpack electrofishing units were in use, or “on,” over all passes within the site. Overall effort and CPUE between Fish Sampling Sites 1 and 2 were similar (Table 4)

**Table 4. CPUE with Species Composition for Fish Sampling Sites 1 and 2 on Pyramid Reach**

Species	Total Catch	Overall CPUE	Fish Sampling Site 1		Fish Sampling Site 2	
			Raw	CPUE	Raw	CPUE
Rainbow Trout	125	0.22	78	0.29	47	0.18
Largemouth Bass	49	0.08	49	0.18	0	0.00
Sucker spp.	81	0.14	0	0.00	81	0.32
Prickly Sculpin	10	0.02	10	0.03	0	0.00
<b>Total Catch</b>	<b>265</b>		<b>137</b>		<b>128</b>	
<b>Overall CPUE</b>	<b>0.46</b>		<b>0.50</b>		<b>0.50</b>	
<b>Effort (seconds)</b>	<b>34,781</b>		<b>16,285</b>		<b>15,436</b>	
<b>Effort (minutes)</b>	<b>579.68</b>		<b>271.42</b>		<b>257.27</b>	

Key:

CPUE = catch per unit effort, number per minute

Age analysis results for rainbow trout and largemouth bass are presented in Table 5 and show multiple age classes for both species. Figure 4 and Figure 5 display the length frequencies associated with the different age classes for rainbow trout sampled at Fish Sampling Site 1 and Fish Sampling Site 2. During scale analysis, spawn checks were identified on two rainbow trout scale samples for which age determination was possible (285 and 350 mm fork lengths). Additionally, two other rainbow trout scale samples appeared to display spawn checks, but due to scale regeneration, these were not confirmed (265 and 301 mm fork lengths). The presence of multiple age classes and spawning checks indicates that the rainbow trout population is healthy and naturally reproductive.

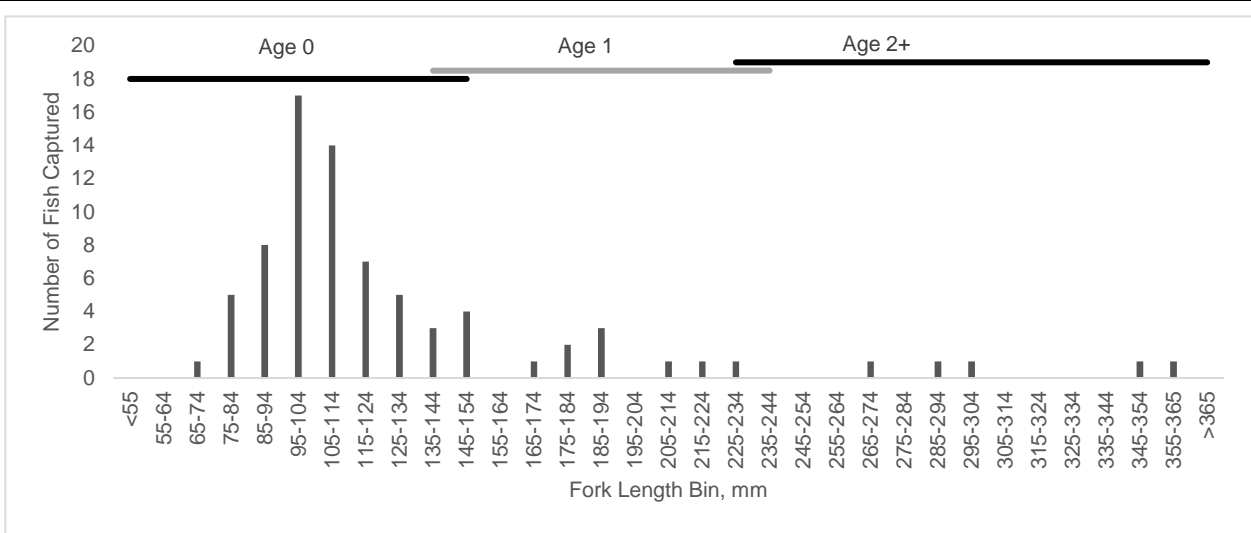
**Table 5. Age Distribution of Game Fish at Fish Sampling Sites 1 and 2 on Pyramid Reach**

Species	Total		Fish Sampling Site 1		Fish Sampling Site 2	
	Age	Count (%)	Age	Count (%)	Age	Count (%)
Rainbow Trout	0	104 (83%)	0	62 (79%)	0	42 (89%)
	1	15 (12%)	1	10 (13%)	1	5 (11%)
	2	6 (5%)	2	6 (8%)	2	0
Largemouth Bass	0	15 (31%)	0	15 (31%)	0	0
	1	34 (69%)	1	34 (69%)	1	0
	2	0	2	0	2	0

Key:

% = percent

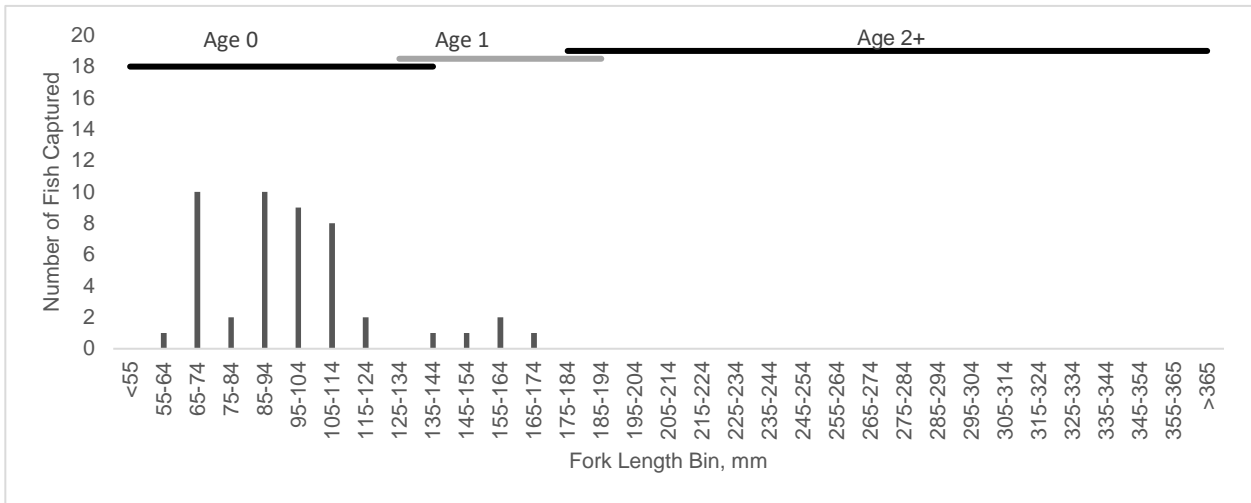




Key:

mm = millimeters

**Figure 4. Age-Length Frequency Relationship for Rainbow Trout Sampled at Fish Sampling Site 1**



Key:

mm = millimeters

**Figure 5. Age-Length Frequency Relationship for Rainbow Trout Sampled at Fish Sampling Site 2**

While conducting the Pyramid Reach Fish Population Study, there was one incidental observation to report. During electrofishing efforts at Fish Sampling Site 1, American bullfrogs (*Lithobates catesbeianus*) were observed and eradicated when possible. Adult bullfrogs were not observed at Fish Sampling Site 2 or Fish Sampling Site 3; however, bullfrog tadpoles were observed at Fish Sampling Site 1.

**Associated Data Files**

*(All associated data can be found in the folder with this summary. Note: Confidential CEII/privileged information will not be posted publicly):*

File Name	Data Description	File Type	File location
Pyramid Reach Fish Pop Database	Database containing all raw data collected during backpack electrofishing	XLSX	Project Website
Pyramid Reach Electrofishing Data Sheet	Blank backpack electrofishing data sheet	PDF	Project Website
eDNA Sampling Data Sheet	Blank eDNA sampling data sheet	PDF	Project Website
Piru Creek eDNA Report Final	Report from Genidaqs containing eDNA results	PDF	Project Website
20180511_dwr_sswp_P2426_Pyramid_Reach_Habitat_Units	Habitat data from Pyramid reach	XLSX	Project Website
Pyramid Reach Sampling Sites for eDNA, Stream Fish, and BMI between RM's 0.0 and 18.3	Two page map of Pyramid reach including habitat mapping locations and sampling sites for eDNA, stream fish, and BMI	PDF	Project Website

Key:

*BMI =benthic macroinvertebrates*

*eDNA = environmental deoxyribonucleic acid*

*RM = river mile*

***Variances from Study Methods, Schedule, or Approach and Abnormalities in Expected Field Conditions:***

There was one variance from the FERC-approved Study Plan. The Study Plan stated that the habitat mapping would occur from July 2017 to September 2017, and that fieldwork would occur from June 2018 to September 2018. Habitat mapping was not completed until May 2018, and fieldwork was completed between March 2018 and October 2018. Habitat mapping was conducted in 2018 to more accurately represent conditions to be encountered during the 2018 fieldwork. The eDNA sampling effort began three months early in order to take advantage of favorable stream conditions. The fish sampling took place one month later than anticipated, at the request of CDFW and to comply with water temperature requirements listed in the Scientific Collecting Permit. While this variance is a modification to the FERC-approved Study Plan, it did not affect the overall Study or the quality of data collected.

***Remaining Work:***

None; the Study is complete.

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