Hardhead Monitoring Report

Sacramento Municipal Utility District

Hydro License Implementation • June 2017

Upper American River Project

FERC Project No. 2101

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Acronyms and Abbreviations

Acronym	Definition
CDFW	California Department of Fish and Wildlife
FERC	Federal Energy Regulatory Commission
GPS	Global Positioning System
mm	millimeters
RM	river mile
SMUD	Sacramento Municipal Utility District
SWRCB	State Water Resources Control Board
UARP	Upper American River Project
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION AND BACKGROUND

This Hardhead Monitoring Report (Report) addresses monitoring requirements set forth in Sacramento Municipal Utility District's (SMUD) Hardhead Monitoring Plan (SMUD 2016). The requirements for this Plan are found in State Water Resources Control Board (SWRCB) Condition 8.A, and U.S. Forest Service (USFS) 4(e) Condition 31.1, located in Appendices A and B, respectively, of the Federal Energy Regulatory Commission's (FERC) Order Issuing New License for the Upper American River Project (UARP), dated July 23, 2014. The Plan was developed in consultation with the SWRCB, USFS, California Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. The objectives of the Plan are to assess the abundance and distribution of hardhead (*Mylopharodon conocephalus*) within the Slab Creek Dam Reach of the South Fork American River. FERC approved the Plan on August 12, 2016. This Report presents the results of implementing the Plan in 2016.

SMUD owns and operates the Upper American River Project (UARP) which is licensed by FERC (FERC Project No. 2101). The UARP lies within El Dorado and Sacramento counties, primarily within lands of the Eldorado National Forest. The UARP consists of three major storage reservoirs: Loon Lake, Union Valley, and Ice House (with a combined capacity of approximately 379,000 acre-feet), eight smaller regulating or diversion reservoirs, and eight powerhouses. The UARP also includes recreation facilities containing over 700 campsites, five boat ramps, hiking paths, and bicycle trails at the reservoirs.

The Slab Creek Dam Reach is located on the South Fork of the American River from the base of the Slab Creek Reservoir dam to the normal high water line of Chili Bar Reservoir. This section of river is 8.0 miles long, extends from 1,620 to 990 feet elevation, and has a mean gradient of about 79 feet/mile (1.5 percent). There are no apparent fish migration barriers in the Slab Creek Dam Reach (DTA and Stillwater 2004a); however, high gradient riffles and cascades in the upper half of the reach may limit upstream fish migration above approximately river mile (RM) 4.0 (DTA and Stillwater Sciences 2004b). Tributaries to this reach include Redbird Creek, Iowa Canyon Creek, South Canyon Creek, North Canyon Creek, Mosquito Creek, Jaybird Creek, Rock Creek, and White Rock Creek.

2.0 MONITORING PLAN OBJECTIVES

The primary objectives and rationale for monitoring hardhead in the Slab Creek Dam Reach is to evaluate the longitudinal distribution of hardhead under the new flow regime associated with the terms and conditions of the license that was implemented in 2014. This modified flow regime increased summer baseflows from the previous minimum of 36 cubic feet per second (cfs) up to 63 cfs–90 cfs, depending on the month (i.e., lower flows occurring in late summer) and water year type.

3.0 SURVEY SITES AND SCHEDULE

The Plan (SMUD 2016) specifies that hardhead surveys will be conducted in years 2, 3, 5, 6, 10, 11, 15, 16 (i.e., 2016, 2017, 2019, 2020, 2024, 2025, 2029, 2030), and thereafter for 2 consecutive years during every 10 years for the term of the license and any extensions. In accordance with the Plan, surveys were conducted during the late summer/early fall of 2016 to maximize comparability to historical data from relicensing studies (DTA and Stillwater Sciences 2005, Stillwater Sciences 2008). The next survey will be conducted in 2017.

Snorkel surveys were conducted in a 2.3-mi section of the Slab Creek Dam Reach from immediately downstream of Mosquito Road Bridge down to the confluence with Rock Creek (Table 1, Figure 1). Six survey sites were chosen in this section of the reach and identified in the Plan (SMUD 2016) based on sampling locations that were previously surveyed during relicensing studies (DTA and Stillwater Sciences 2005, Stillwater Sciences 2008).

Table 1. Slab Creek Dam Reach Hardhead Survey Sites

Survey Site[1]	River Mile[3]	Location Description	Date Surveyed	Unit	UTM Coordinates				Unit Length (m)
					Downstream End		Upstream End		
					N	E	N	E	
Slab 5	2.3	Above Rock Creek	08/10/2016	Pool	4295028	693095	4295031	693143	37
				Run	4295007	693030	4295028	693095	60
Slab 6	2.5	Below Mosquito Creek	08/10/2016	Run	4295067	693511	4295060	693539	34
				Pool	4295099	693451	4295057	693511	70
Slab 7	3.0		08/11/2016	Pool (1)	4294481	693984	4294453	693994	30
				Pool (2)	4294453	693994	4294428	694018	30
Slab 8	3.4		08/11/2016	Run (1)	4294768	694460	4294798	694495	46
				Run (2)	4294795	694510	4294798	694595	18
				Pool	4294795	694510	4294807	694554	48
Slab 9	3.7	Below Mosquito Bridge	08/11/2016	Run	4294506	694728	4294497	694722	37
				Pool	4294542	694711	4294506	694728	30.5
Slab 10	4.2		08/10/2016	Pocket Water	4294145	695350	4294153	695408	30
				Run	4294153	695405	4294181	695445	48

[1] Sites Slab 1 through 4 are downstream of the confluence with Rock Creek, below the study reach
[2] Universal Transverse Mercator (UTM) coordinates, North American Datum 1983 (NAD 83)
[3] River mile (RM) = the number of miles above the upstream end of Chili Bar Reservoir

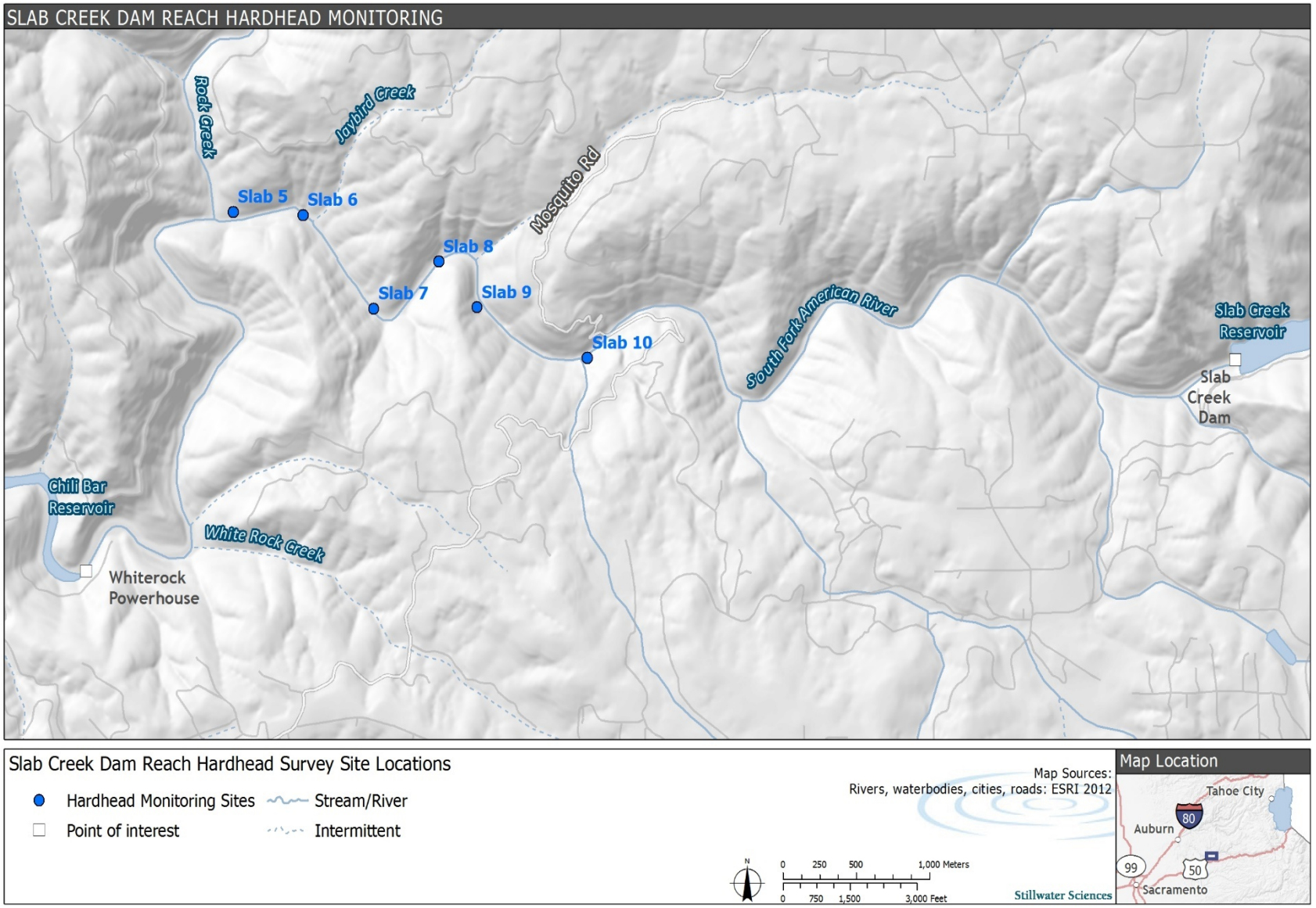

Figure 1. Hardhead survey site locations in the Slab Creek Dam Reach of the South Fork American River

4.0 METHODS

Daytime single-pass snorkel surveys were conducted using procedures described in Thurow (1994) and Dolloff et al. (1996). Each survey site included two to three units representative of local habitat types (e.g., riffle, run, pool) and channel conditions. Habitat units were surveyed in their entirety, with surveys beginning at the downstream end of the habitat unit and terminating at the upstream end of the habitat unit. The field crew consisted of four snorkelers positioned in lanes parallel to one another across the width of the stream. Lane width was determined on-site and depended on habitat complexity and visibility as determined by measurements using a Secchi disk. Prior to sampling, observers calibrated estimated fish lengths by viewing variably sized objects of known lengths underwater.

Snorkelers identified and counted fish observed in their lane while moving upstream at a slow and uniform pace. Fish were counted as they passed below or to the side of each observer, with surveyors communicating as best as possible in an effort to avoid potential double-counting. Fish were identified to species, where possible, and assigned to an estimated 25-millimeter (mm) size class based on total length (TL).

The location of each survey site was documented using a handheld global positioning system (GPS) device and photographs were taken of habitat units within a survey site (Attachment 3). Additional information collected from each survey site included: unit number, habitat type, unit length, average unit width, substrate composition, percent cover, underwater visibility, and water chemistry (i.e., water temperature, dissolved oxygen, and conductivity).

Data from the snorkel surveys were entered into a database and the abundance, size distribution, and range of each species observed was evaluated. Variation in species composition and distribution was evaluated in comparison to observations from previous surveys conducted in 2004 and 2007.

Water temperature data from a logger installed in 2016 at Mosquito Bridge was compared to available temperature data collected from a nearby location in 2004 and 2007.

5.0 RESULTS

Surveys were conducted on August 10 and 11, 2016. Conditions during the surveys included calm weather, clear skies, and water visibility (estimated with a Secchi disk) that ranged from approximately 9 to 19 ft. Discharge during the snorkel effort was 78.4 cfs based on releases from Slab Creek Dam.

5.1 HABITAT CHARACTERISTICS

Survey sites were approximately 200–300 ft in length and included at least two habitat units (e.g., run or pool). Most habitat units were dominated by boulder and/or cobble substrates (Table 2). Fish cover, primarily in the form of large boulders, was present in all units except for a pool at site Slab 5; other forms of cover commonly present included overhanging vegetation and bubble curtains (Table 2). Water quality conditions during the sampling effort included dissolved oxygen levels near saturation (generally greater than 90%), cool water temperatures (ranging from 14.8 °C to 18.1 °C), and low conductivity (Table 3).

Table 2. Physical Characteristics at Survey Sites During Hardhead Monitoring in the Slab Creek Dam Reach, August 2016

Survey Site	Habitat Type	Substrate %					Cover			Average Width (ft)	Unit Length (ft)
		Bedrock	Boulder	Cobble	Gravel	Sand	Dominant	Sub-Dominant	Total %		
Slab 5	Pool	5	5	85	5	0	N/A	N/A	N/A	64	121
	Run	0	35	60	5	0	Boulder	Overhanging Vegetation	30	64	197
Slab 6	Run	20	40	30	10	0			30	53	112
	Pool	15	40	35	10	0			25	57	230
Slab 7	Pool 1	20	20	25	35	0			12	67	98
	Pool 2	20	20	25	35	0			13	63	98
Slab 8	Pool	30	35	30	5	0			15	57	157
	Run 1	30	30	30	10	0		Bubble Curtain	32	59	151
	Run 2	10	45	25	10	10		Overhanging Vegetation	42	82	59
Slab 9	Run	10	65	15	5	5			55	46	121
	Pool	10	70	15	5	0		Bubble Curtain	45	52	100
Slab 10	Run	25	50	20	0	5		Large Woody Debris	55	65	157
	Pocket Water	5	70	25	0	0	Undercut Bank	Bubble Curtain	85	60	98

Table 3. Water Quality Conditions at Survey Sites During Monitoring for Hardhead in the Slab Creek Dam Reach, August 2016

Survey Site	Habitat Unit	Conductivity (µS/cm)	Temp (°C)	Dissolved Oxygen	
				%	mg/L
Slab 5	Pool	23.6	18.1	94.5	8.97
	Run	24.6	18.1	95.8	9.16
Slab 6	Run	23.6	17.8	94.3	8.99
	Pool	23.6	17.8	93.7	8.92
Slab 7	Pool 1	24.0	17.9	90.0	8.49
	Pool 2	24.1	17.7	93.6	8.91
Slab 8	Pool	24.0	16.4	93.0	9.14
	Run 1	24.1	16.2	96.4	9.46
	Run 2	24.0	16.6	94.4	9.12
Slab 9	Run	24.1	15.1	95.3	9.56
	Pool	24.0	15.2	93.8	9.43
Slab 10	Run	23.3	14.9	88.4	8.74
	Pocket Water	23.4	14.8	98.1	9.96

5.2 SNORKEL SURVEYS

Seven fish species were observed in the Slab Creek Dam Reach during the 2016 snorkel effort: hardhead, Sacramento pikeminnow (*Ptychocheilus grandis*), speckled dace (*Rhinichthys osculus*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), Sacramento sucker (*Catostomus occidentalis*), and sculpin (*Cottus spp.*) (Figure 2).

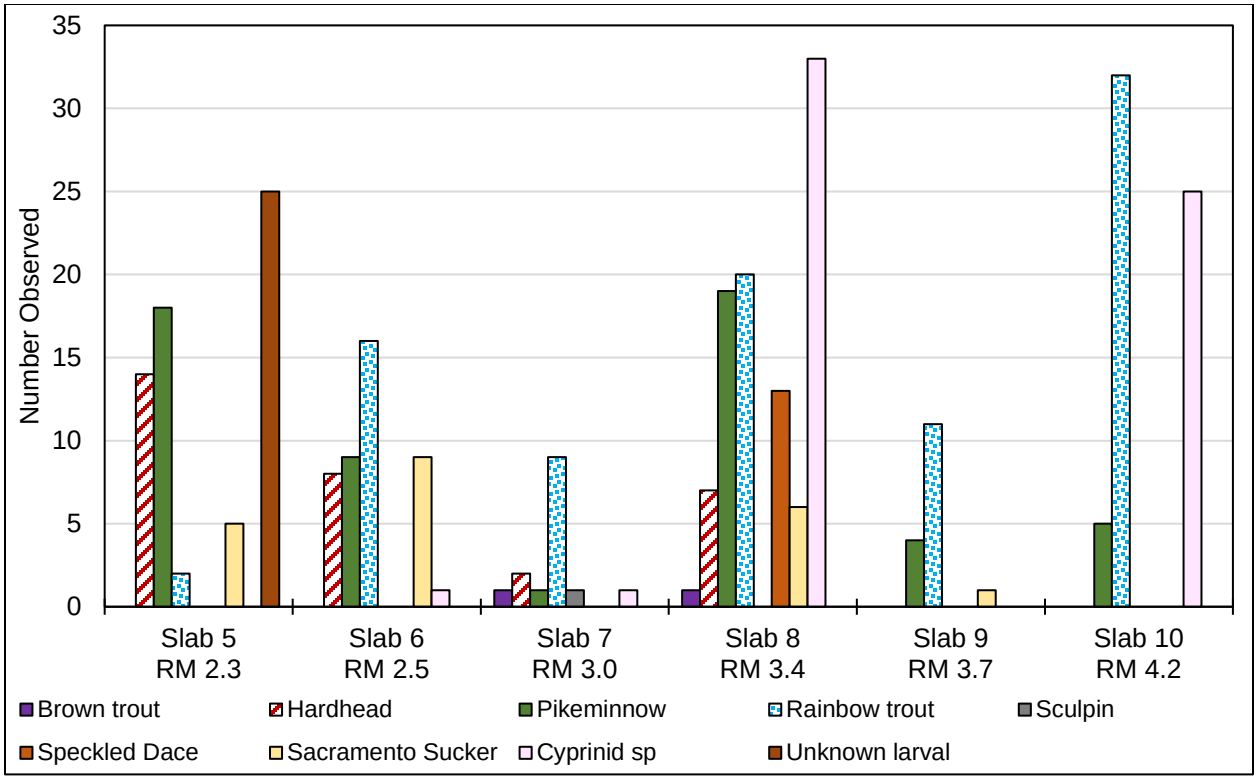

Figure 2. Fish Species Observed During Snorkel Surveys in the Slab Creek Dam Reach in August 2016

5.2.1 Cyprinids

Cyprinid species were observed throughout the study reach. Sacramento pikeminnow were observed at every survey site, while hardhead observations were concentrated in the lower to mid-section of the study reach at sites Slab 5 through Slab 8 (Figure 2). A third cyprinid, speckled dace, was only observed at site Slab 8 (Figure 2). A total of 56 Sacramento pikeminnow falling in multiple age-classes and ranging from 25–349 mm in TL were observed in the study reach in 2016 (Figure 3). Multiple age-classes of hardhead were also observed (a total of 31 individuals ranging from 50–349 mm in TL) (Figure 3). A total of 60 cyprinids were observed that could not be positively identified to species, but were determined to be either Sacramento pikeminnow or hardhead; the majority of these fish were <25 mm in TL (Figure 3). A total of 13 speckled dace were observed at site Slab 8 (Figure 2), all of which fell within the 25–49 mm size class (Figure 3).

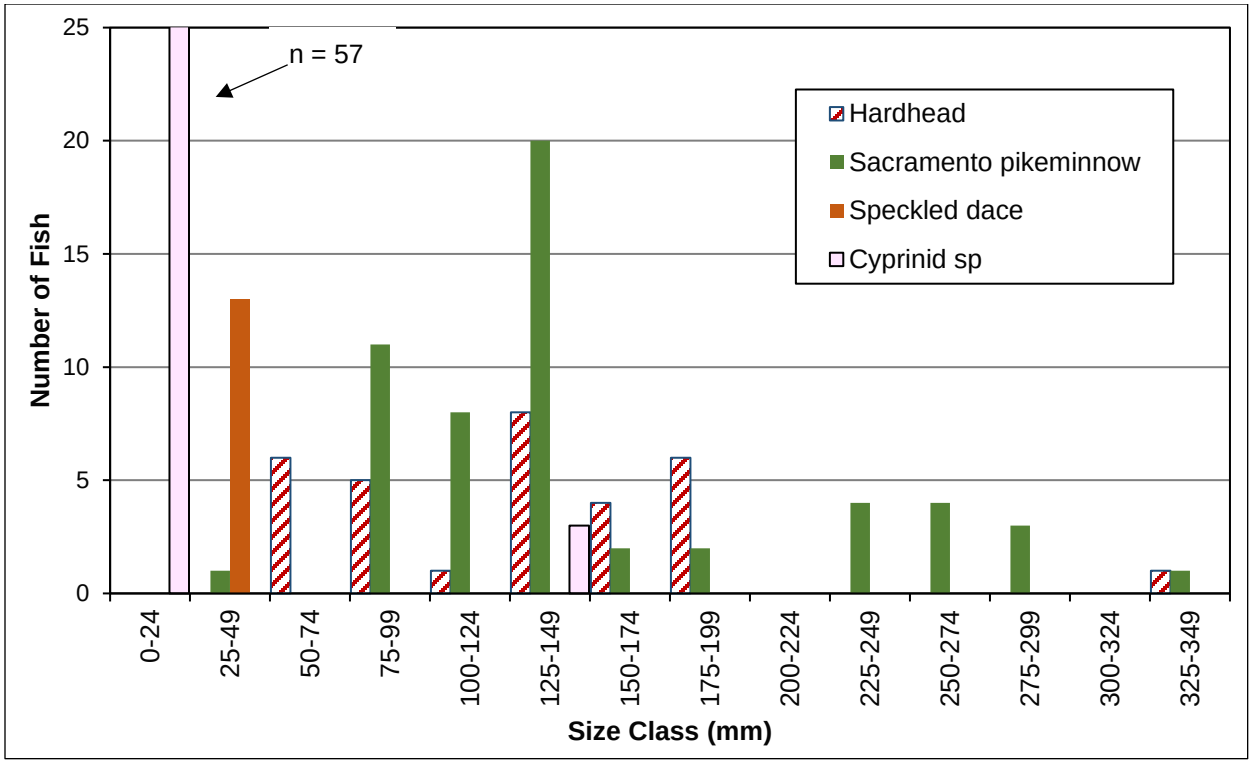

Figure 3. Length Frequency Histogram for Cyprinids Observed During Snorkel Surveys in the Slab Creek Dam Reach in August 2016

5.2.2 Salmonids

Salmonid species were observed throughout the study reach. Rainbow trout were observed at every survey site, while brown trout observations were limited to sites Slab 7 and Slab 8 (Figure 2). A total of 90 rainbow trout were observed ranging from 25–349 mm in TL, with multiple age-classes present based on length frequency distribution (Figure 4). Two brown trout, both estimated to be 150–199 mm in TL, were observed (Figure 4).

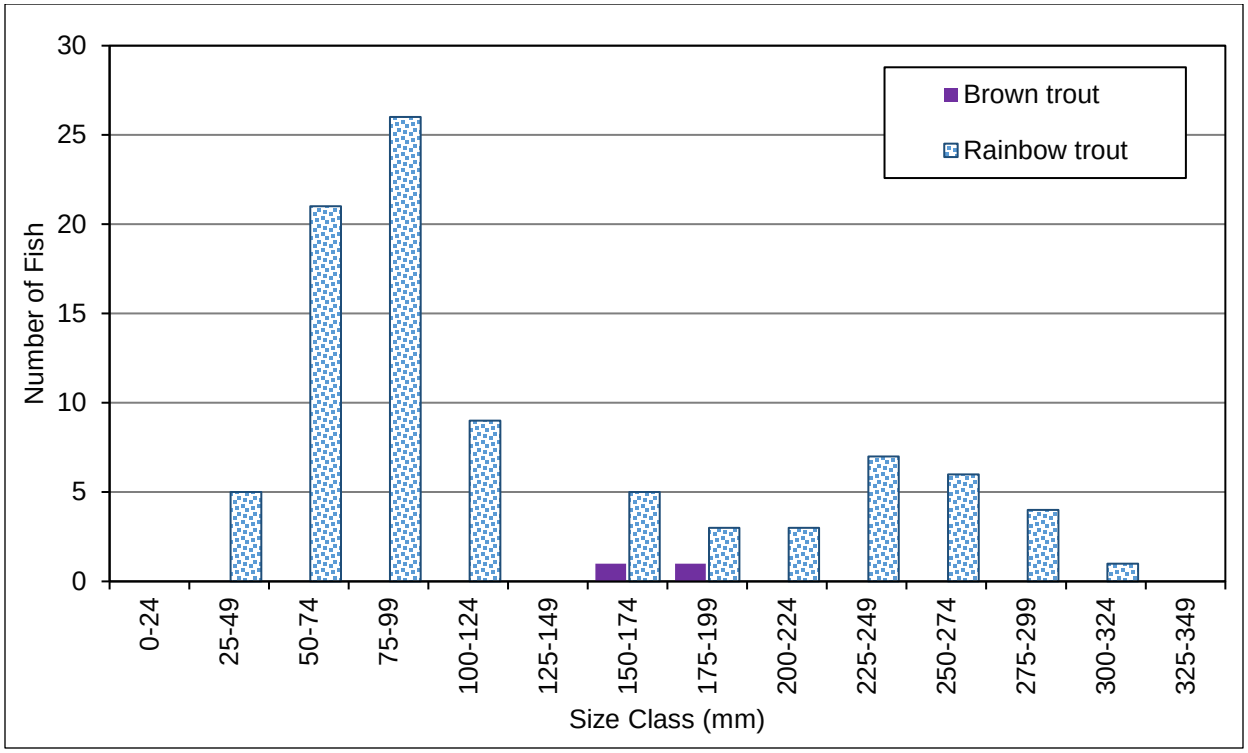

Figure 4. Length Frequency Histogram for Salmonids Observed During Snorkel Surveys in the Slab Creek Dam Reach in August 2016

5.2.3 Additional species

Additional species observed included Sacramento sucker and sculpin (Figure 2). A total of 21 Sacramento suckers in multiple age-classes, ranging from 25–324 mm in TL, were observed at sites Slab 6 through Slab 9 (Figures 2 and 5). One sculpin with a TL between 25–49 mm was observed at site Slab 7 (Figures 2 and 5). In addition, a school of larval fish (<25 mm) that was too small for positive identification to family was observed at site Slab 5 (Figure 5).

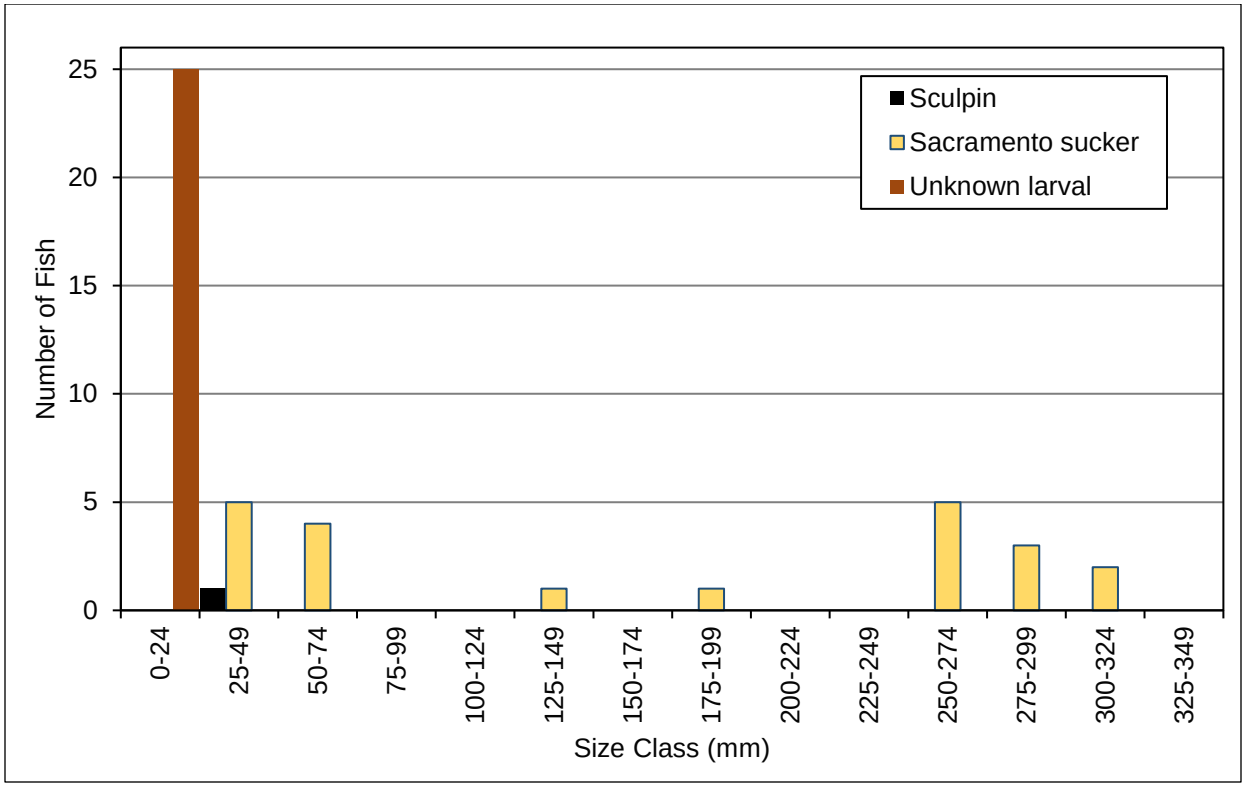

Figure 5. Length Frequency Histogram for Sculpin, Sacramento Sucker, and Unknown Larval Fish Observed During Snorkel Surveys in the Slab Creek Dam Reach in August 2016

5.3 HISTORICAL COMPARISON

The species observed during the 2016 snorkel surveys were similar to those observed during snorkel surveys conducted in the study reach in 2004 and 2007, with the following exceptions: 1) speckled dace were not observed in 2004, 2) smallmouth bass were only observed in 2007, and 3) California roach were only observed in 2004. It should be noted that numerous larval fish that were too small to be identified to species were observed, typically in large schools, during the 2007 and 2016 snorkel efforts; these fish were <50 mm and were identified to genus where possible. Larval fish were not observed during 2004, likely because the survey occurred later in the season when surviving young of the year had grown. Species composition by survey year (excluding larval fish that could not be identified to genus) is presented in Figure 6.

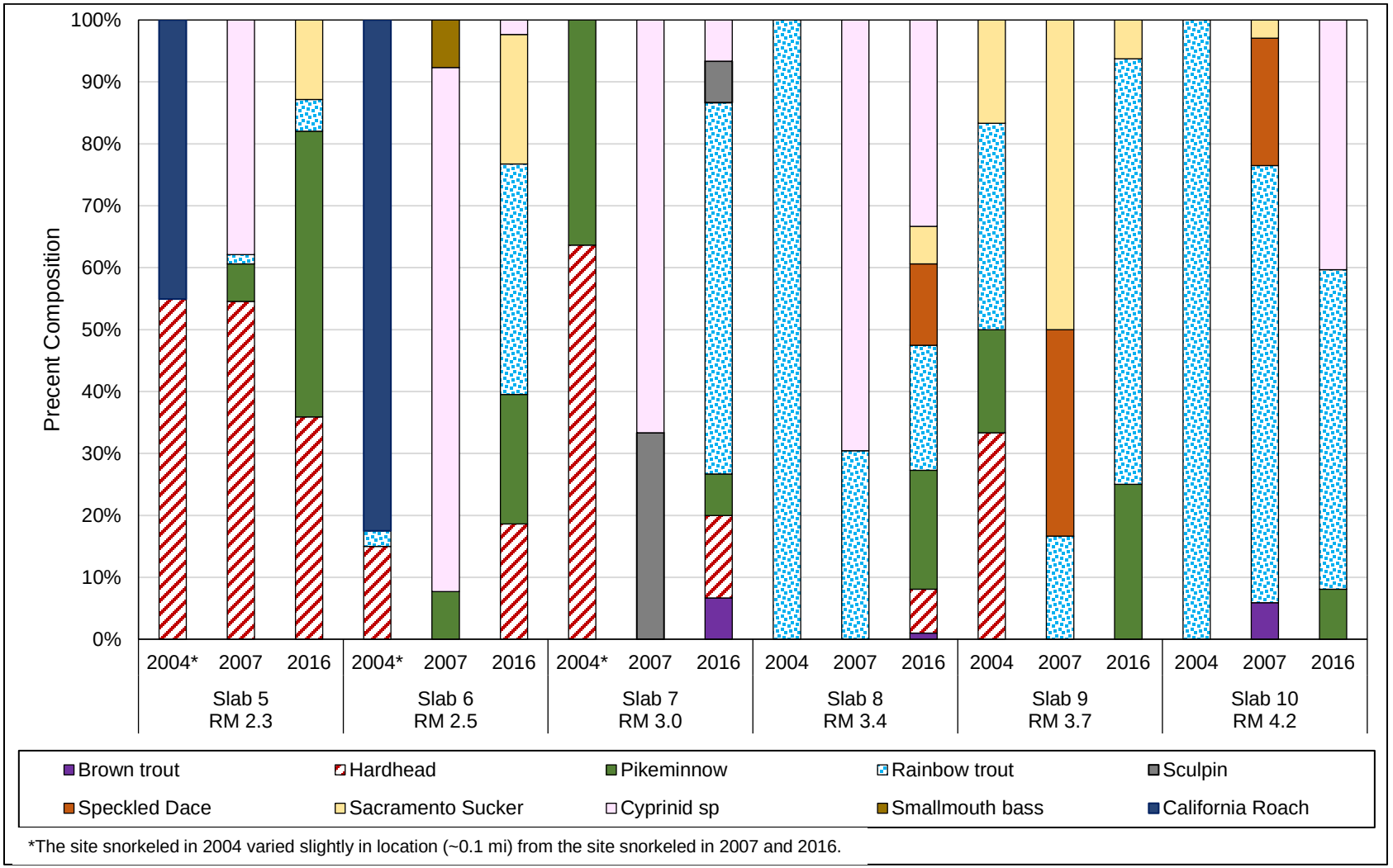

Figure 6. Species Composition and Distribution Observed During Snorkel Surveys Conducted in October 2004, July/August 2007, and August 2016 in the Slab Creek Dam Reach (larval fish [<50 mm] that could not be positively identified to genus have been excluded)

In all three survey years, observations of hardhead were concentrated in the lower section of the study reach (Figures 7 and 8). The greatest longitudinal extent of hardhead observations occurred in the fall of 2004, when they were documented at sites Slab 5 through Slab 7 and at site Slab 9 (Figure 7). A slightly more constricted distribution was observed during the 2016 survey effort, when hardhead were observed at all survey sites except Slab 9 and Slab 10 (Figure 7). The most limited distribution of hardhead was observed during a series of snorkel efforts conducted in 2007 during which hardhead were observed at sites Slab 5 through Slab 7 in the spring, but only at site Slab 5 during the summer and fall (Figure 7). Hardhead were observed in greater density in the spring of 2007, however, than they were in the other two survey years (Figure 8).

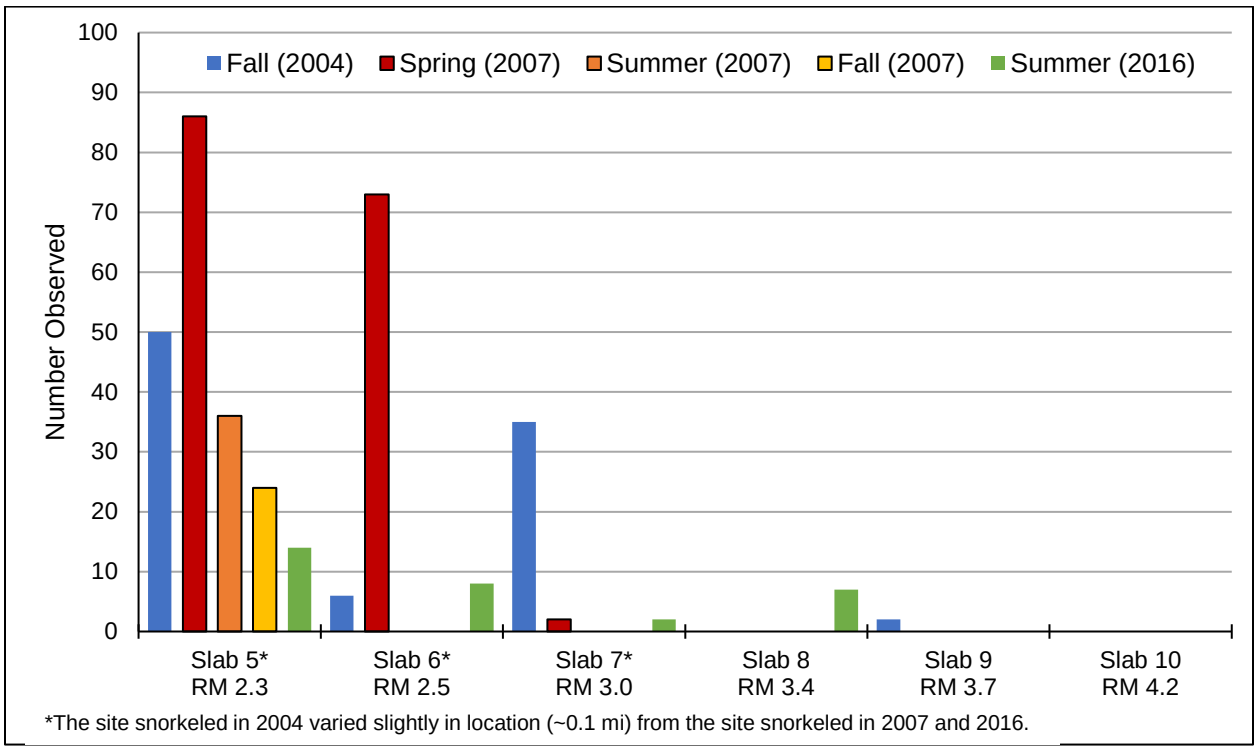

Figure 7. Longitudinal Distribution of Hardhead Observed During Snorkel Efforts by Season and Year within the Slab Creek Dam Reach

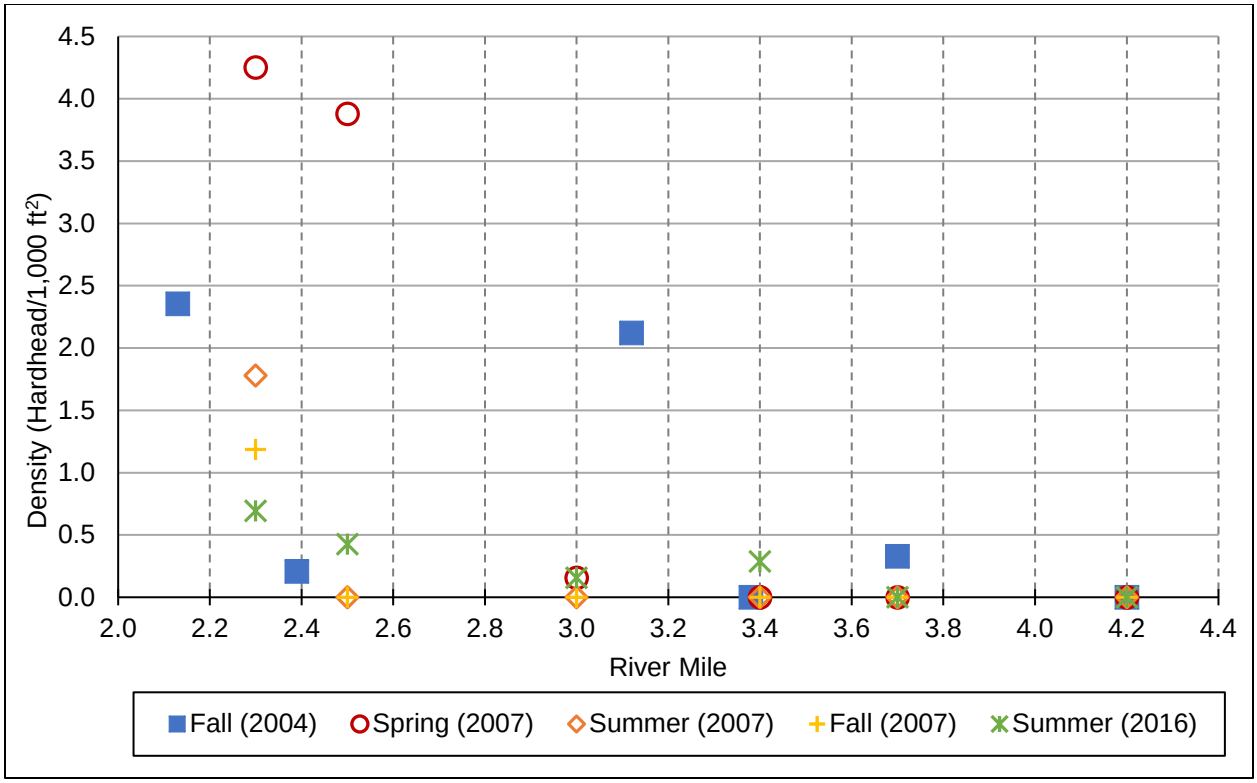

Figure 8. Hardhead Density Observed During Snorkel Efforts by Season and Year within the Slab Creek Dam Reach

6.0 DISCUSSION

The new flow regime in the Slab Creek Dam Reach, as required by the license and described in Section 2.0, began in October 2014. Flows measured at Slab Creek Dam during the summer and early fall of 2016 ranged from approximately 78–230 cfs, with higher flows occurring earlier in the summer (CDWR 2017). While an increase in discharge from Slab Creek Reservoir will typically reduce water temperature in the Slab Creek Dam Reach, there are a number of other influencing factors, such as seasonal variation in thermal stratification patterns in Slab Creek Reservoir, water year type, UARP operations, and ambient air temperatures.

The mean monthly water temperature at the upstream end of the study reach (Mosquito Bridge at RM 4.3) was colder during the early summer months (June and July) of 2016 in comparison to 2004 and 2007 (Figure 9). Later in the summer (August and September), the mean monthly water temperature at Mosquito Bridge in 2016 was slightly colder in comparison to records from 2007 and warmer in comparison to 2004 (Figure 9). The mean monthly average water temperature at Mosquito Bridge was consistently warmer in the summer months of 2007 than in either 2004 or 2016 (Figure 9).

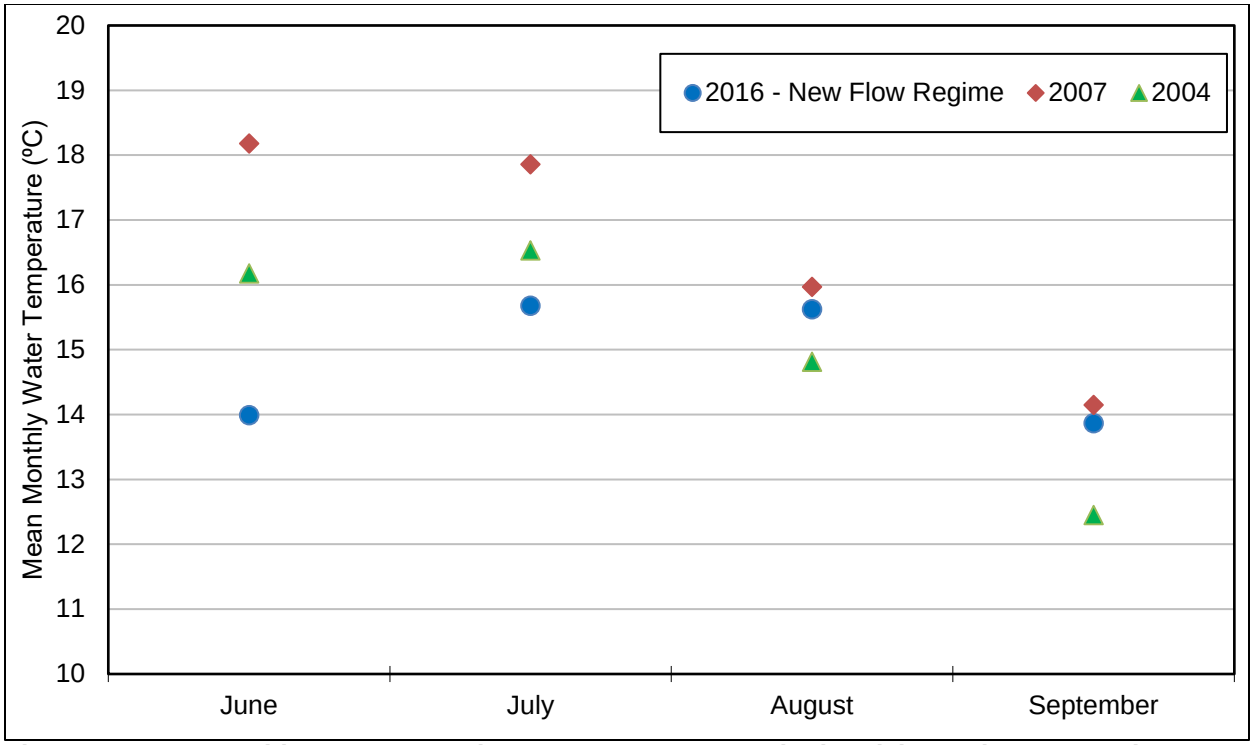

Figure 9. Mean monthly June-September water temperatures in the Slab Creek Dam Reach at Mosquito Bridge by year

Although increased summer baseflows under the new flow regime may influence water temperature in the study reach, there is currently insufficient data to determine if this will affect the distribution and/or density of hardhead in Slab Creek Dam Reach. As described in Section 3.0, monitoring for hardhead in Slab Creek Dam Reach will continue for the term of the current license.

7.0 LITERATURE CITED

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Attachment 1
Survey Site Photographs

Photo 1. Slab 5 at River Mile 2.25. Looking Upstream at Run Habitat.

Photo 2. Slab 5 at River Mile 2.25. Looking Upstream at Pool Habitat.

Photo 3. Slab 6 at River Mile 2.50. Looking Downstream at Run Habitat.

Photo 4. Slab 6 at River Mile 2.50. Looking Upstream at Pool Habitat.

Photo 5. Slab 7 at River Mile 3.00. Looking Upstream at Pool Habitat.

Photo 6. Slab 7 at River Mile 3.00. Looking Downstream at Pool Habitat.

Photo 7. Slab 8 at River Mile 3.40. Looking Upstream at Pool Habitat.

Photo 8. Slab 8 at River Mile 3.40. Looking Upstream at Run Habitat.

Photo 9. Slab 9 at River Mile 3.70. Looking Upstream at Run Habitat.

Photo 10. Slab 9 at River Mile 3.70. Looking Downstream at Run Habitat.

Photo 11. Slab 10 at River Mile 4.20. Looking Upstream at Run Habitat.

Photo 12. Slab 10 at River Mile 4.20. Looking Upstream at Pocket Water Habitat.