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Subject: 30 Day Review and Comment Period - Chelan River Snorkel Surveys - 2016
Date: Friday, February 24, 2017 2:35:57 PM
Attachments: [2016 Chelan River Snorkel Surveys - Draft Annual Report - February 21 2017.pdf](#)

PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY

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To: Chelan River Fishery Forum

Washington Department of Ecology

Washington Department of Fish and Wildlife

United States Forest Service

National Park Service

United States Fish and Wildlife Service

National Marine Fisheries Service

CCT (Colville)

YN (Yakama)

CTUIR (Umatilla tribe)

City of Chelan

Lake Chelan Sportsman Association

United States Geological Survey

Washington State Parks and Recreation Commission

Washington State Recreation and Conservation Office
Lake Chelan Recreation Association
American Whitewater

From: Steven Hays, Fish & Wildlife Senior Advisor
Public Utility District No. 1 of Chelan County (Chelan PUD)
steve.hays@chelanpud.org
(509)661-4181

Re: Lake Chelan Hydroelectric Project No. 637 (Project)
30 Day Review and Comment Period – Snorkel Surveys in the
Chelan Falls Habitat Channel and Tailrace, and Reach 1 of
the Chelan River, WA - 2016

Dear Chelan River Fishery Forum and Other Parties:

Monthly snorkel surveys of the Chelan River Reach 1, Habitat Channel and Tailrace were conducted in 2016. This study is the first of two years of monthly surveys (the second year will be in 2018) that were called for in the Lake Chelan Comprehensive Plan, Chapter 7, Chelan River Biological Evaluation and Implementation Plan. The attached copy is provided for your review.

Please submit your comment letters on or before 5:00 p.m., March 28, 2017, to Steve Hays via email at steve.hays@chelanpud.org. In order to facilitate documentation of your comments and Chelan PUD's responses to comments regarding significant substantive issues, please provide those comments and any supportive rationales or data in a separate document so that it can be incorporated into the record of consultation. I have provided the report in PDF format. However, upon request I will provide a copy in MSWORD if you wish to propose editorial changes using the review features in MSWORD to make your suggested edits.

All comments received will be incorporated into a summary table and appended to the Final Report, Snorkel Surveys in the Chelan Falls

Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA - 2016, with a notation regarding how each comment or recommendation was incorporated in the report, or, if not incorporated, the reasons why the comment was not incorporated.

If you have any questions, please do not hesitate to contact me at (509-661-4181) or by email.

Steven Hays

Fish and Wildlife Senior Advisor

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Snorkel Surveys in the Chelan Falls Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA - 2016

Submitted to:

Chelan County Public Utility District
327 N. Wenatchee Avenue
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February 21, 2017
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Table of Contents

1.0 Introduction.....	1
1.1 Study Objectives.....	1
1.2 Study Site.....	2
2.0 Methods and Environmental Data	6
2.1 Chelan Falls Tailrace and Habitat Channel	6
2.2 Reach 1	7
2.3 Flows and Water Temperature	7
3.0 Results and Discussions.....	10
3.1 Reach 1	10
3.2 Habitat Channel	15
3.3 Chelan Falls Tailrace	21
4.0 Acknowledgments.....	27
5.0 Literature Cited	28

List of Figures

Figure 1. Aerial view of the Upper Chelan River (Reach 1), which extends from the spillway (lake outlet) to the top of the Canyon Reach, with identified habitat units (R = Riffle, P = Pool and MC = Multiple Channel).	4
Figure 2. Aerial view of the Lower Chelan River, which extends from the top of the pool upstream from Section 7 to the bottom of Section 1 (S1-S7), and the Chelan Falls Tailrace.	5
Figure 3. Mean daily flow (cfs) and temperature (°C) for Reach 1, Reach 4 and the Tailrace of the Chelan River, 2016. Please note that temperature data for Reach 1 is incomplete at this time.	9
Figure 4. The number of westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) observed in Reach 1 of the Chelan River, 2016.....	11
Figure 5. The number of westslope cutthroat trout, smallmouth bass and rainbow trout observed during monthly surveys in Reach 1 of the Chelan River, 2016.	12
Figure 6. The number of northern pikeminnow observed during monthly surveys in Reach 1 of the Chelan River, 2016.	14
Figure 7. The number of observations by species for bull trout (BT), Chinook adults (CK-Ad), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Habitat Channel of the Chelan River, 2016.....	16
Figure 8. The number of Chinook adults, fry and yearlings observed during monthly surveys in the Habitat Channel of the Chelan River, 2016.	17
Figure 9. The number of bull trout, northern pikeminnow and smallmouth bass observed during monthly surveys in the Habitat Channel of the Chelan River, 2016.	18
Figure 10. The number of rainbow and westslope cutthroat trout observed during monthly surveys in the Habitat Channel of the Chelan River, 2016.....	20
Figure 11. The number of observations by species for Chinook adults (CK-Ad), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Tailrace of the Chelan River, 2016.	22
Figure 12. The number of Chinook adults, fry and yearlings observed during monthly surveys in the Tailrace of the Chelan River, 2016.	23
Figure 13. The number of northern pikeminnow, smallmouth bass and rainbow trout observed during monthly surveys in the Tailrace of the Chelan River, 2016.	25
Figure 14. The number of westslope cutthroat trout observed during monthly surveys in the Tailrace of the Chelan River, 2016.	26

List of Tables

- Table 1.** Mean daily flow (cfs) and water temperature (°C) for Reach 1, Reach 4 and the Tailrace of the Chelan River for the dates when snorkel surveys were conducted, 2016. Please note that the temperature data reported for Reach 1 was recorded at the Low Level Outlet, which is located at the Lake Chelan Dam..... 8
- Table 2.** The number of observations by month for westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in Reach 1 of the Chelan River, 2016. 11
- Table 3.** The number of observations by month for bull trout (BT), Chinook adults (CK-Adult), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Habitat Channel of the Chelan River, 2016..... 16
- Table 4.** The number of observations by month for bull trout (BT), Chinook adults (CK-Ad), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Tailrace of the Chelan River, 2016. 22

1.0 Introduction

Chelan Public Utility District (PUD) completed a number of measures to improve fish habitat in the Chelan River under the terms of a new license agreement for the Lake Chelan Hydroelectric Project (FERC Project No. 637; issued in 2006). One of the measures was to improve spawning and rearing habitat for summer/fall Chinook and steelhead in the tailrace and lower reach (Reach 4) of the Chelan River. Chelan PUD constructed a habitat channel and associated systems (i.e., 6 pump station, delivery canal, and head-gate structure) to increase spawning and rearing habitat. Additional improvements included the removal of a gravel bar in the Tailrace Zone, and subsequent addition of spawning substrate which resulted in approximately 1.5 to 1.75 additional acres of spawning habitat within that zone. Also, substrate was removed along the left bank downstream of the Habitat Channel within the Confluence Zone to decrease the likelihood of redds becoming dewatered during tailrace fluctuations. Collectively, these alterations were completed by October 15, 2009.

In addition to modifications within the Lake Chelan Hydroelectric Project tailrace, the PUD provided year-round flows within Reaches 1-3 of the Chelan River for the first time in 75 years. Within those reaches, a baseline flow of 80 cfs is provided year-round independent of the runoff forecast. However, flow is supplemented during the May 15 to July 15 period based on the level of winter snow deposition and the forecasted runoff level. In dry water years, no supplementation is provided (i.e., flows remain at the 80 cfs baseline for the full year). In an average water year, flows are augmented to maintain flows of 200 cfs during the mid-May to mid-July period; and in a wet water year, flows are augmented to 320 cfs. In addition, excess water is spilled from the Lake Chelan Dam in most years during the months of May through July.

As detailed in the Lake Chelan Settlement Agreement, Attachment B, Section 7, Chelan PUD is obligated to assess the presence and habitat use of fish using snorkel evaluations. As such, portions of the Chelan River were snorkeled monthly beginning in January 2016 and concluded December 2016. This report summarizes findings from those efforts.

1.1 Study Objectives

Specific objectives of this study are to:

1. Snorkel the Lower Chelan River Habitat Channel (Reach 4; Sections 1–7 including the upstream pool) and the Chelan Falls Tailrace (from the buoy line upstream from the net pens to the Boat Restricted Buoy line), and enumerate observed fish by species and length; and
2. Establish and snorkel index sites of the Upper Chelan River from the spillway at the Lake Chelan outlet to the top of the Canyon Reach (Reach 1), and enumerate observed fish by species and length.

1.2 Study Site

The Chelan River is located in Chelan County in north-central Washington and is the outlet for Lake Chelan. Lake Chelan is 453 meters deep and 89 kilometers in length, and has minimum and maximum pool elevations of 328.9 and 335.3 meters (msl), respectively. The lake is typically drawn down beginning in early October for power production and flood control, with the lowest lake level normally attained in April. The lake is then refilled through May and June with refill achieved on or before June 30, with the lake being held near maximum pool through the first weekend in September for recreational purposes. Spill typically occurs during May through July when inflows exceed the amount needed for power generation and lake level management.

The Lake Chelan Hydroelectric Project was completed in 1927, and was authorized for power production and recreation. The original powerhouse configuration included two vertical shaft Francis-type turbine generators, producing 24 MW each, for a total plant capacity of 48 MW at 2,016 cfs. In 2009 and 2010, the original turbines were replaced with higher capacity units capable of producing 29.6 MW each, with a total plant capacity of 59.2 MW. After this alteration, the hydraulic capacity of the powerhouse increased to 5,200 cfs. The spillway for the Lake Chelan Hydroelectric Project is located at the outlet of Lake Chelan, and consists of a total of 8 spillbays with an overall hydraulic capacity of 29,000 cfs.

The Chelan River is about 6.6-km long and has a vertical drop of 122 m as it flows from Lake Chelan to the Columbia River at R.K. 809.9 (Hillman et al. 2000). As defined within the Lake Chelan Settlement Agreement, the Chelan River is partitioned into four reaches; for this evaluation, snorkel observations were conducted within Reaches 1 and 4, and within the tailrace of the powerhouse. The upper Chelan River, which extends from the spillway located at the lake outlet to the top of the Canyon Reach, is also referred to as Reach 1 and is approximately 3.69 km in length (Figure 1). This reach is low gradient (approximately 1 percent), and consists primarily of large cobble and small boulders. Gravel that occurs in this reach is located within the margins of the river channel. Reach 1 is moderately confined, and consists of glacial moraine deposits which are highly erosive. This erosion process contributes a substantial amount of sand and gravel to the Chelan River, which for the most part is transported out of the river during annual high spill events (CPUD 2003). Habitat within Reach 1 consists primarily of riffles and pools. However, there is a large multiple channel section that includes three main channels; this multiple channel is approximately 0.6 km in length. Vegetation within Reach 1 is sparse and consists primarily of alders and cottonwoods with occasional conifer stands (CPUD 2003). Reaches 2 and 3 of the Chelan River extend from the downstream margin of Reach 1 to the bottom of the canyon (downstream margin of Reach 3). Within these reaches there is a series of waterfalls that preclude upstream passage of fish into Reach 1.

The Habitat Channel, also referred to as Reach 4, extends from the mouth of the Chelan River Gorge to the powerhouse tailrace. This reach is approximately 0.79 km in length and consists of a pool at the upper end of the reach, and seven sections downstream from the pool. This reach has a very low gradient (0.4 percent), and is an active alluvial zone where cobbles and gravel from upper reaches are deposited after being flushed through the Chelan River Gorge during

annual high spill events. The primary substrates within Reach 4 are gravels and cobbles of various size and small boulders.

The Chelan tailrace is an excavated channel that has a relatively low gradient (4.2 m/km). The dominant substrate in the tailrace consists of gravel, cobble, and boulders, most of which were carried in by high flow events from the Chelan River. The majority of the spawning is concentrated in the main channel at depths that range from 1.2 - 5.5 meters (Giorgi 1992). The Chelan Falls Tailrace survey site begins approximately 135 meters downstream from the powerhouse and terminates at the Boat Restricted Buoy line (Figure 2).

Throughout 2016, snorkel surveys were conducted at three primary locations; the Upper Chelan River (Reach 1), the Habitat Channel (Reach 4) and the Tailrace area. Surveys were conducted on a monthly basis, with the exception of April when unexpectedly high flows did not permit surveys. This report summarizes data collected during the monthly snorkel surveys and provides a general overview of data collected during 2016. Detailed monthly summaries were prepared throughout the year, and provide a more detailed summary for each individual month (Stevenson 2016a-i).

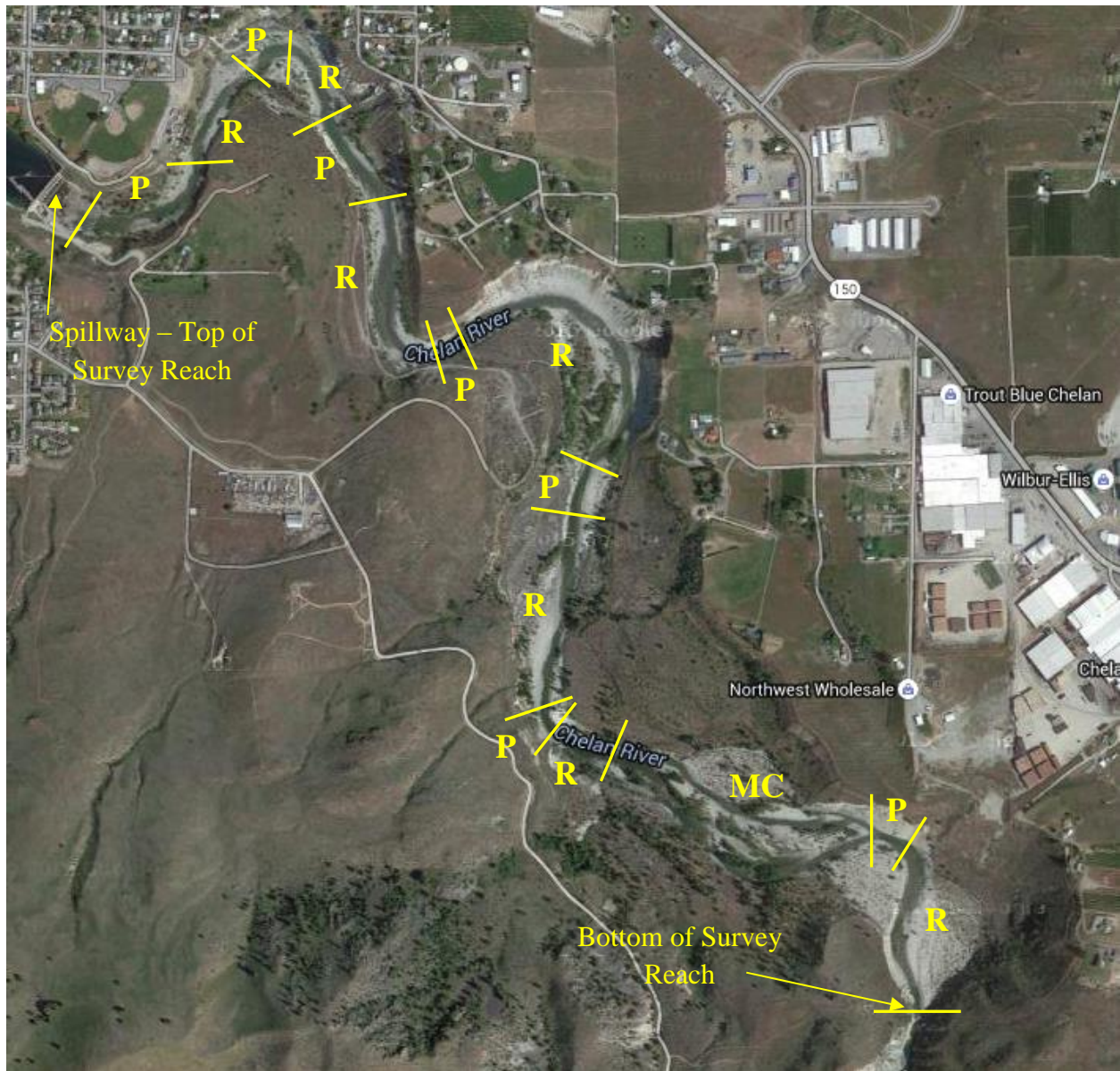


Figure 1. Aerial view of the Upper Chelan River (Reach 1), which extends from the spillway (lake outlet) to the top of the Canyon Reach, with identified habitat units (R = Riffle, P = Pool and MC = Multiple Channel).



Figure 2. Aerial view of the Lower Chelan River, which extends from the top of the pool upstream from Section 7 to the bottom of Section 1 (S1-S7), and the Chelan Falls Tailrace.

2.0 Methods and Environmental Data

Snorkel surveys were conducted on a monthly basis, with Reach 1 surveyed on one day and Reach 4 and the Tailrace surveyed on another. Exceptions to this format included the sampling of all survey areas on a single day in July, and the exclusion of sampling in April. For consistency, surveys were conducted around the 20th of each month, beginning with the January 2016 survey. However, due to unexpected early snow pack melting and subsequent runoff, Lake Chelan had nearly reached maximum lake level in late April, necessitating spill within the Chelan River. As such, it was not possible to snorkel at that time. As a result of increased spill towards the latter part of April, it was possible to suspend spill for a brief period during the first week of May, which allowed snorkel surveys on May 3rd and 4th.

Daytime and nighttime snorkel surveys were used to assess fish abundance and was based on water temperature. In a study assessing observer efficiency, Hillman et al. (1992) found that when water temperatures fall below 9°C, most juvenile salmonids seek cover within the substrate during daylight hours, and observer efficiency drops to less than 20%. As such, when water temperatures were less than 9°C, surveys were conducted at night to improve observer efficiency. Conversely, when water temperatures were greater than 9°C, daytime surveys were conducted. Based on these criteria, we snorkeled at night for the months of January, February, March and December and during the day for all other months.

Data were recorded for each location within a field notebook documenting the total number of fish observed by species and length. In the Habitat Channel, fish were enumerated by section number (i.e., Sections 1-7 and the uppermost pool). For all salmonids, length was recorded into bins of less than 6", 6" to 9", 9" to 12", or over 12" in length. For northern Pikeminnow and smallmouth bass, fish were categorized as being less than or greater than 6". All other species were recorded as either juvenile or adult. In this report, results are based on the total number of a given species, with some discussion of spatial and temporal occurrence along with size. Detailed counts by size for a given species are presented in Appendix A, which summarizes cumulative counts for all of 2016; additional detailed information is also presented in the individual monthly summaries (Stevenson 2016a-i).

2.1 Chelan Falls Tailrace and Habitat Channel

Whenever possible, it was desirable to snorkel upstream so that disturbed silt and detritus would not interfere with visibility. However, due to the depth and velocity of water within the tailrace area, that was not possible. Within that location, observers entered the water at the upstream boundary of the site and drifted downstream to the end of the sample area. Visibility remained favorable during all snorkel surveys.

Within the Habitat Channel, two observers snorkeled either up or downstream within the near-shore lanes, dependent on flow conditions. During periods of higher flows, it was necessary to snorkel downstream; when flows were lower, it was possible to snorkel upstream. In all flow conditions, it was necessary to snorkel downstream within the mid-channel lanes due to water

depth. For the Habitat Channel, each individual section was snorkeled with data recorded by section (e.g., Upper Pool, Section 7, Section 6, etc.).

2.2 Reach 1

Within Reach 1, the survey began at the most downstream index site and progressed upstream to the lake outlet. For each habitat unit snorkeled, two observers snorkeled the near shore lanes, and a third and sometimes fourth observer (dependent on visibility) snorkeled the mid-channel lanes.

For pools, the entire habitat unit was snorkeled. In the multiple channel, most of the habitat unit was snorkeled except when shallow water prevented observations. Similarly, within riffles most of the habitat unit was snorkeled unless shallow depths prevented observations. In very long riffle habitat units only index areas were snorkeled. In some instances, where the whole habitat unit was not snorkeled, the location of snorkeling was based on historic observations.

2.3 Flows and Water Temperature

Mean daily temperatures during the study period varied from about 3°C to 24°C in the different sections of the study area (Reaches 1-4 and powerhouse tailrace) (Table 1; Figure 3). Temperatures were very similar throughout the study period in the different reaches. Temperatures in January, February, March and December were the coolest (<9°C) and necessitated nighttime snorkel observations while for all other months, daytime snorkel observations were used. As expected, the warmest stream temperatures occurred in July and August.

Stream flow in Reach 1 and Reach 4 were similar except during periods when the tailrace pumps were used to augment flows in Reach 4 (Table 1; Figure 3). This was most noticeable in mid-October when flows were increased to enhance conditions for spawning summer/fall Chinook salmon. Stream flows peaked on several occasions in both reaches as spill from Lake Chelan was initiated. Flows in the powerhouse tailrace were generally between 2,300-2,500 cfs for most of the study period except for an extended period between mid-March and early May when mean daily flows were about 1,200 cfs. Stream flows in the powerhouse tailrace decreased occasionally for brief periods from late June to late September.

Table 1. Mean daily flow (cfs) and water temperature (°C) for Reach 1, Reach 4 and the Tailrace of the Chelan River for the dates when snorkel surveys were conducted, 2016. Please note that the temperature data reported for Reach 1 was recorded at the Low Level Outlet, which is located at the Lake Chelan Dam.

Month	Reach 1			Reach 4			Tailrace		
	Date	Flow (cfs)	Temp (°C)	Date	Flow (cfs)	Temp (°C)	Date	Flow (cfs)	Temp (°C)
January	20	87	5.1	19	87	5.0	19	2,335	5.3
February	23	84	6.1	22	84	6.1	22	2,352	6.3
March	30	84	9.0	29	287	8.8	29	1,267	8.9
April	---	---	---	---	---	---	---	---	---
May	3	89	13.9	4	290*	16.3	4	985	16.4
June	29	634*	20.5	29	634*	22.0	29	2,355	21.5
July	27	83	21.3	28	83	23.0	28	2,381	22.8
August	29	81	21.5	30	81	21.2	30	1,114	21.6
September	23	85	18.6	24	85	17.4	24	1,563	18.3
October	29	87	14.1	30	290	---	30	2,406	14.2
November	29	254	10.7	30	254	---	30	2,325	10.7
December	20	88	5.8	21	88	---	21	2,516	5.8

Notes:

No survey was conducted in April, 2016 due to high flows.

Flows with an asterisk in Reach 1 and 4 were adjusted mean daily flows to reflect discharge at the time of the survey. The flow of 290 cfs on May 4 occurred at the time of the survey. Shortly after the survey was completed, spill was ramped up and the mean daily flow was 3,776 cfs. Similarly, on June 29 mean flow at the time of the surveys was 634 cfs although the mean daily flow for that date was 943 cfs. All other flows reflect mean daily flow for the entire day.

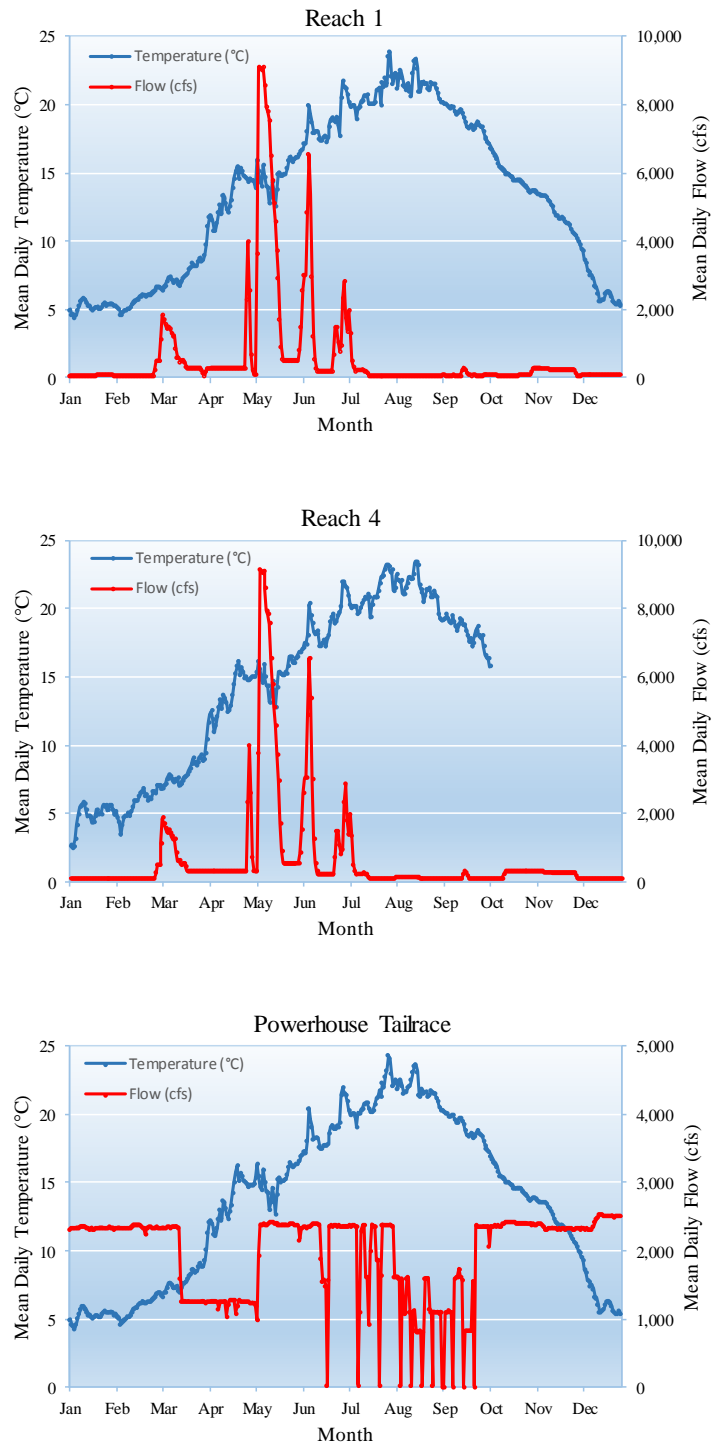


Figure 3. Mean daily flow (cfs) and temperature (°C) for Reach 1, Reach 4 and the Tailrace of the Chelan River, 2016. Please note that temperature data for Reach 1 is incomplete at this time.

3.0 Results and Discussions

Collectively, a total of 35,191 fish were observed during snorkel surveys conducted in 2016. Of those, 2,245 fish were observed in Reach 1, 21,482 fish within the Habitat Channel, and 11,464 fish within the Tailrace (Appendix A; Tables A-1 and A-2). The results provide information regarding relative abundance, distribution and diversity throughout the study area.

It should be noted that while the following discussions include all species observed in 2016, only species of interest are presented in graphical and tabular form within the body of the report; incidental, or non-species of interest observations are enumerated in Appendix A. Within this document, a species of interest refers to a species that is listed under the Endangered Species Act (ESA; e.g., bull trout), a species that is identified within the Lake Chelan Settlement Agreement to be monitored, or a species that may have a significant impact on other species through predation or some other means (e.g., smallmouth bass and northern pikeminnow).

3.1 Reach 1

Within Reach 1, the most frequently observed species of interest was westslope cutthroat trout (*Oncorhynchus clarki lewisi*), with a total of 981 observations (Table 2; Figure 4). The next most frequently observed species was smallmouth bass (*Micropterus dolomieu*), with a total of 824 observations. Other species of interest included 358 rainbow trout (*O. mykiss*) and 50 northern pikeminnow (*Ptychocheilus oregonensis*). Observations of non-species of interest included 1 adult Chinook (*O. tshawytscha*), 2 cyprinid fry (*Rhinichthys sp.*), 2 adult suckers (*Catostomus sp.*), 19 adult tench (*Tinca tinca*), 4 adult mountain whitefish (*Prosopium williamsoni*) and 4 adult trout of unknown species (Appendix A; Table A-2).

The number of westslope cutthroat trout observed varied over the year (Table 2; Figure 5). The greatest number of westslope cutthroat trout were observed in July (214 fish) and the fewest observed in January (6 fish). There were 200 westslope cutthroat trout 6-8 inches in length released into Reach 1 on May 4, 2016 that along with recruitment from Lake Chelan contributed to observations thereafter. The most numerous size class observed in Reach 1 was from 9-12 inches (74%) and greater than 12 inches (18%) suggesting that growth and/or recruitment to Reach 1 is occurring. No juvenile sized (≤ 3 inches) westslope cutthroat trout were observed during the year, which suggests that little or no reproduction occurred in 2016. Westslope cutthroat trout were most often observed in pool (74%) and multiple channel habitats (17%) and the least abundant in riffle habitat (9%).

Table 2. The number of observations by month for westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in Reach 1 of the Chelan River, 2016.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Cutthroat Trout	6	12	18	0	82	189	214	129	111	86	72	62	981
Northern Pikeminnow	1	0	1	0	0	7	29	8	3	0	1	0	50
Rainbow Trout	22	39	41	0	22	34	41	31	44	32	38	14	358
Smallmouth Bass	48	34	87	0	77	95	184	256	23	8	0	12	824
Total	77	85	147	0	181	325	468	424	181	126	111	88	2,213

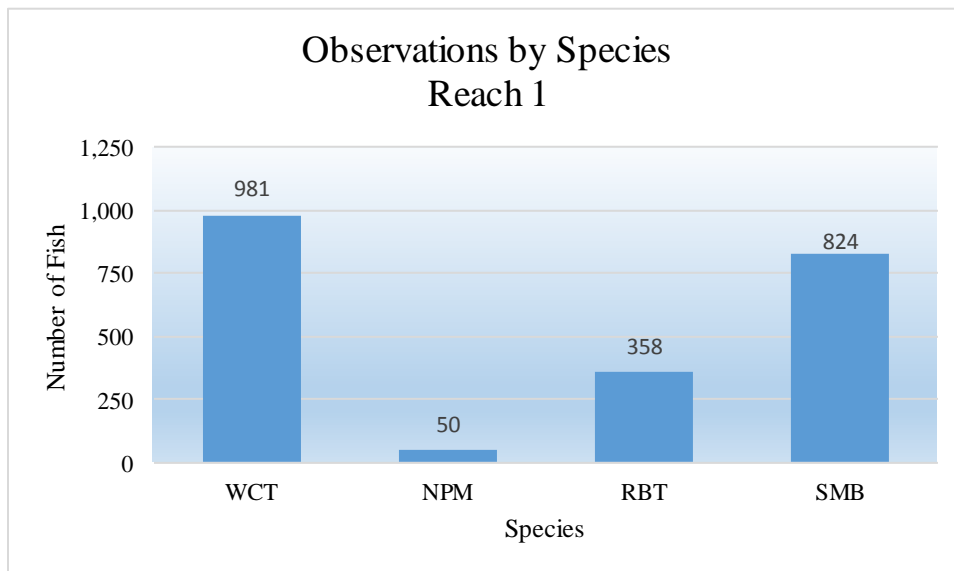


Figure 4. The number of westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) observed in Reach 1 of the Chelan River, 2016.

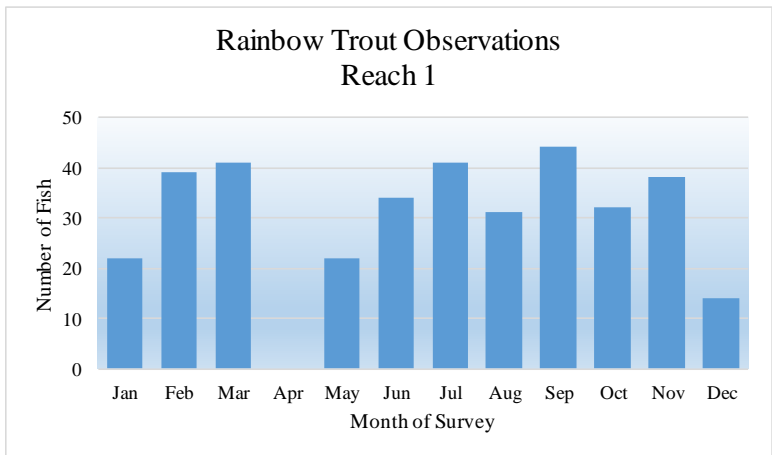
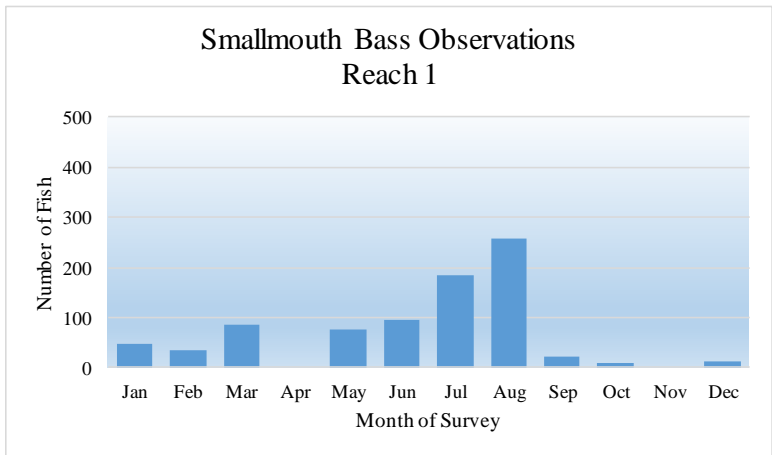
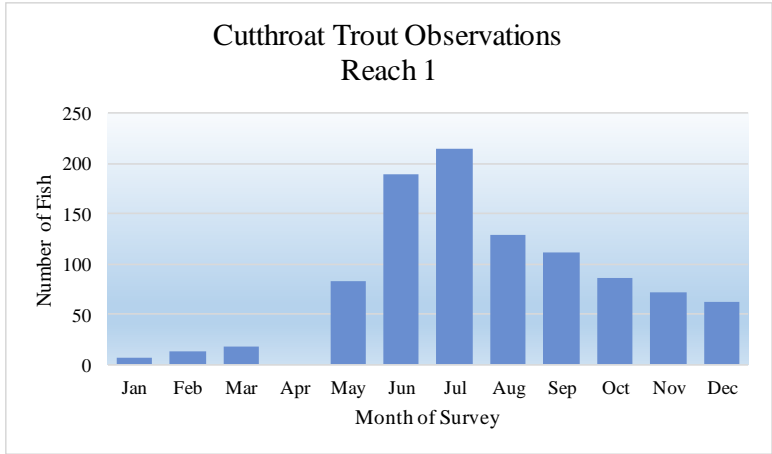


Figure 5. The number of westslope cutthroat trout, smallmouth bass and rainbow trout observed during monthly surveys in Reach 1 of the Chelan River, 2016.

Smallmouth bass were the second most abundant fish species observed in Reach 1 (Table 2; Figure 5). The abundance of smallmouth bass changed over time with most fish observed in August (256 fish), and the fewest in November (no fish). To some extent, prevailing stream temperatures likely influenced the number of fish observed. That is, as water temperature decreased, smallmouth bass concealed themselves in cover making them more difficult to observe. However, it is unlikely that declining water temperature fully explains the reduction in smallmouth bass observations throughout the study area. The greatest decrease in smallmouth bass observations within Reach 1 were noted for the August and September surveys, with 256 and 23 observations, respectively. At this time, water temperatures were in excess of 20°C. It is more likely that water temperature influenced observer efficiency during surveys conducted in October, November and December when temperatures began to decline sharply. A more plausible explanation in regard to the decline in smallmouth bass observations is that they began to move downstream and ultimately took up residence in deep pools within Reaches 2 and 3, or migrated downstream and eventually entered the Columbia River.

There were nearly equal percentages of juvenile (< 6 inches - 56%) and adult (> 6 inches - 44%) smallmouth bass observed in Reach 1. There was no nest building or defending behavior observed for smallmouth bass in Reach 1. This may explain why no bass less than 3 inches were observed. Smallmouth bass also appeared to favor available pool (60%) and multiple channel habitats (28%) more than riffle habitat (12%).

A total of 358 rainbow trout were observed in Reach 1, with 30 (8%) observed in riffle habitat, 219 (61%) in pool habitat, and 109 (31%) within the multiple channel (Table 2; Figure 5). Rainbow trout were primarily classified into the larger size classes with 171 fish in the 9-12" group (47.8%) and 170 greater than 12" (47.5%). Only 15 rainbow trout were estimated to be in the 6-9" group (4.2%) and 2 were less than 6" (0.6%). No rainbow trout spawning was observed during the snorkel surveys, as were no young-of-the-year.

Northern pikeminnow were also observed in Reach 1 (50 fish) but their abundance was very concentrated with 43 fish observed in the uppermost pool surveyed (Table 2; Figure 6). All of the northern pikeminnow observed were greater than 6 inches suggesting that little or no reproduction occurs within Reach 1. This also suggests that recruitment to Reach 1 is likely from Lake Chelan. Other fish species were observed within Reach 1 but their abundance was very low (Appendix Table A-2).

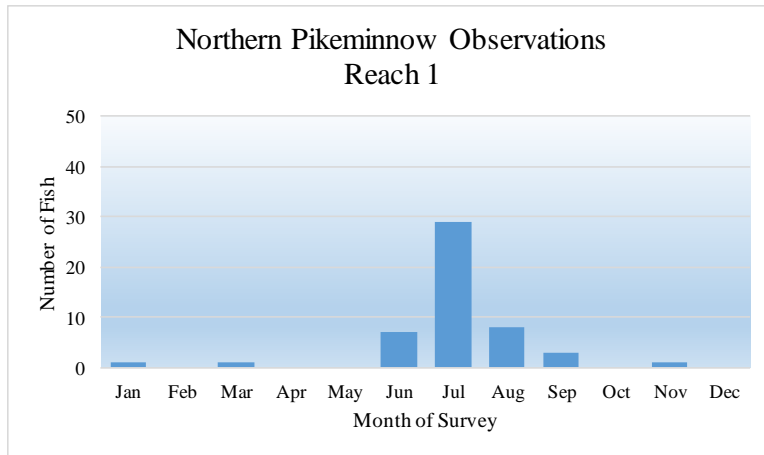


Figure 6. The number of northern pikeminnow observed during monthly surveys in Reach 1 of the Chelan River, 2016.

3.2 Habitat Channel

Within the Habitat Channel, the most frequently observed species of interest was Chinook salmon, with a total of 11,874 observations (Table 3; Figure 7). Chinook fry made up the majority of observations for this species (n = 11,405), but also included 445 adult Chinook and 24 yearling Chinook. Observations of other species of interest included 3,240 northern pikeminnow, 1,104 smallmouth bass, 339 rainbow trout, 107 westslope cutthroat trout and 13 bull trout (*Salvelinus confluentus*).

Non-species of interest observed within the Habitat Channel included 4,482 adult suckers, 127 cyprinid fry (dace), 112 three-spine stickleback (*Gasterosteus aculeatus*), 36 mountain whitefish, 15 chiselmouth (*Acrocheilus alutaceus*), 9 adult sockeye (*O. nerka*), 5 adult bullhead (*Ameiurus sp.*), 5 peamouth (*Mylocheilus caurinus*), 5 adult steelhead (*O. mykiss*), 4 bluegill (*Lepomis macrochirus*), 3 sculpin (*Cottus sp.*) and 2 adult coho (*O. kisutch*) (Appendix A; Table A-1). The majority of adult suckers were observed during the May and June snorkel surveys (n = 4,349), which coincides with the expected spawning period for both bridgelip (*C. Columbianus*) and largescale (*C. macrocheilus*) suckers; the species most likely inhabiting the Chelan River at various times throughout the year.

Chinook that spawn within the Chelan River are classified as summer/fall Chinook (Chapman et al. 1994). Summer/fall Chinook are an ocean-type race of the species, and migrate to the ocean as subyearlings. Emergence of Chinook fry began in late December, with peak observations occurring in May (Table 3; Figure 8). Few Chinook fry were observed after the peak in May. This suggests that most natural origin subyearlings Chinook moved out of the Chelan River and migrated into the Columbia River before June. While most of the juvenile Chinook were subyearlings, there was a few yearling Chinook observed.

Adult Chinook were first observed in May and June in low numbers, with a moderate increase in July and August. However, significant numbers of adult summer/fall Chinook were not observed until September, with peak abundance and spawning occurring in mid- to late-October (Table 3; Figure 8).

Bull trout were first observed within the Habitat Channel during the September survey, and were subsequently observed each month through December (Table 3; Figure 9). Bull trout observations were relatively low, ranging between 1 and 6 individuals for any given survey. Timing of observations for bull trout coincided with the typical time period when bull trout spawn. It should be noted, however, no bull trout appeared to be in the process of building a redd, spawning, or defending a redd. In October, one bull trout was observed in a summer/fall Chinook redd next to a female Chinook. The bull trout was actively gulping substrate within the redd and expelling the substrate. This behavior suggests that the bull trout was actively feeding on Chinook eggs within the redd. Given these observations, it is more likely that the bull trout moved into the Habitat Channel for feeding opportunities.

Table 3. The number of observations by month for bull trout (BT), Chinook adults (CK-Adult), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Habitat Channel of the Chelan River, 2016.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Bull Trout	0	0	0	0	0	0	0	0	1	6	3	3	13
Ck-Adult	0	0	0	0	1	6	31	11	229	166	1	0	445
Ck-1	5	3	15	0	0	0	0	0	0	0	0	1	24
Ck-0	2	218	4,540	0	6,637	7	1	0	0	0	0	0	11,405
Cutthroat Trout	0	7	3	0	7	68	13	3	3	2	0	1	107
Northern Pikeminnow	0	0	0	0	91	2,996	150	0	3	0	0	0	3,240
Rainbow Trout	24	23	46	0	8	36	45	40	29	11	36	41	339
Smallmouth Bass	3	9	32	0	218	324	328	158	29	0	0	3	1,104
Total	34	260	4,636	0	6,962	3,437	568	212	294	185	40	49	16,677

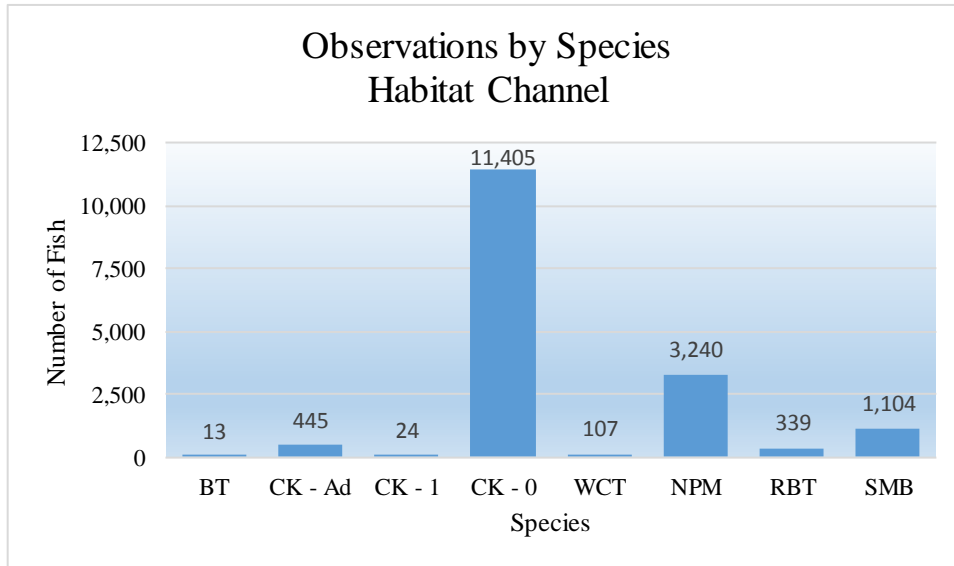


Figure 7. The number of observations by species for bull trout (BT), Chinook adults (CK-Ad), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Habitat Channel of the Chelan River, 2016.

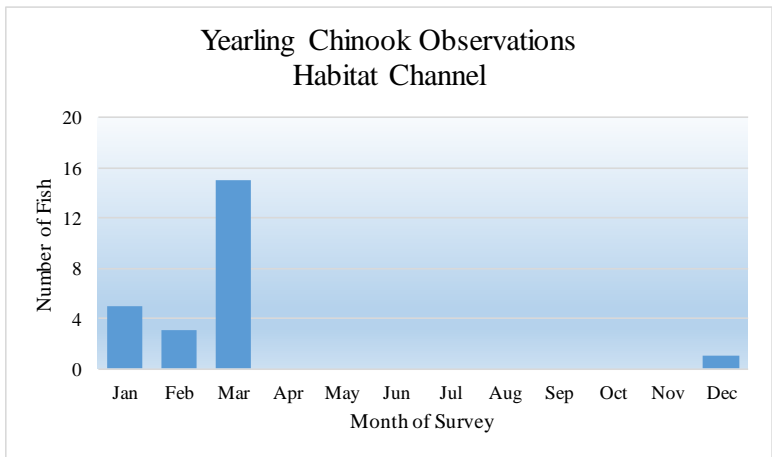
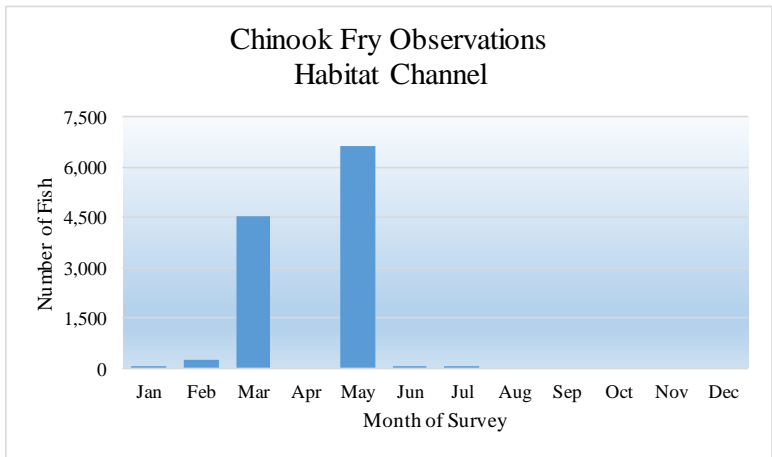
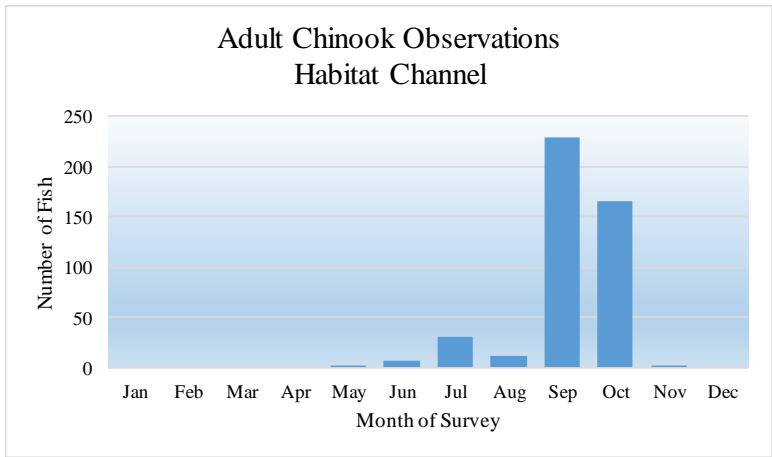


Figure 8. The number of Chinook adults, fry and yearlings observed during monthly surveys in the Habitat Channel of the Chelan River, 2016.

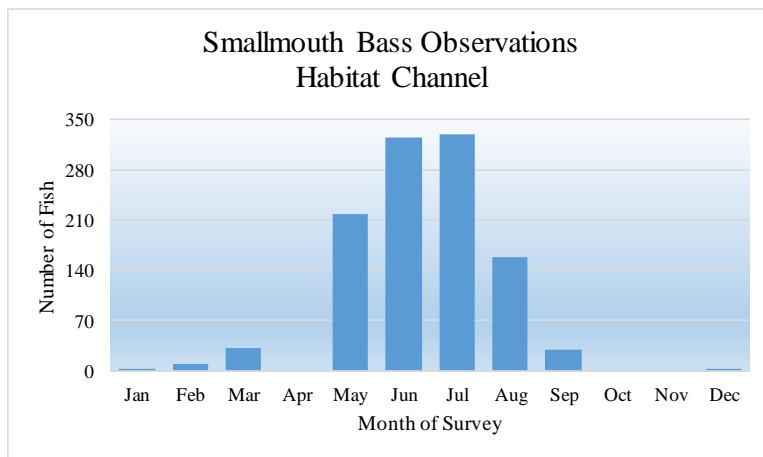
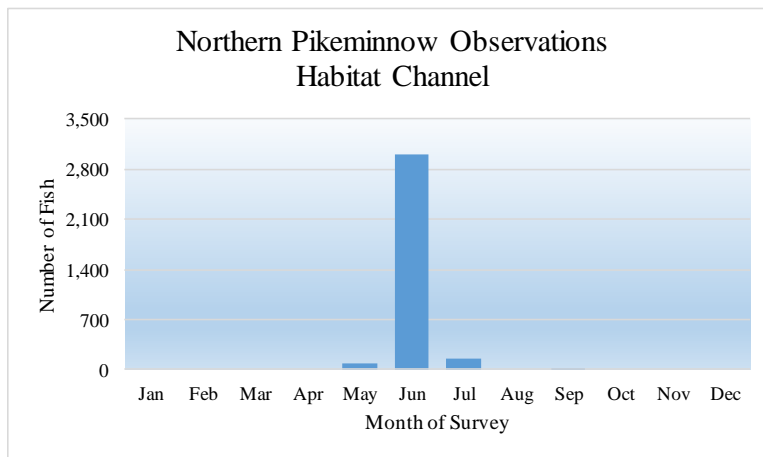
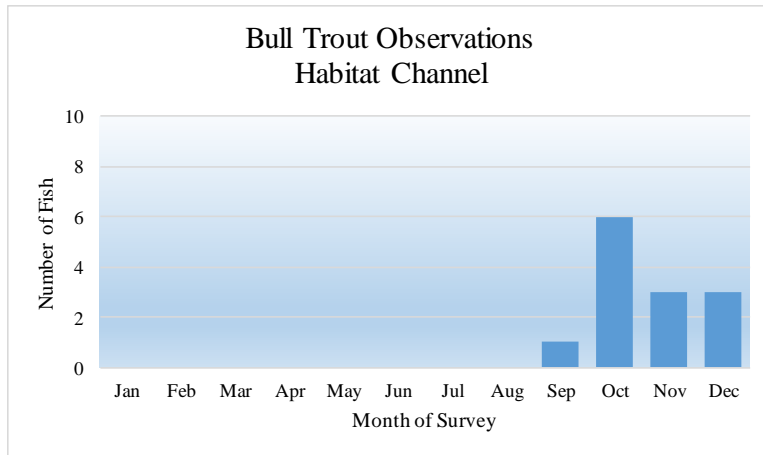


Figure 9. The number of bull trout, northern pikeminnow and smallmouth bass observed during monthly surveys in the Habitat Channel of the Chelan River, 2016.

Northern pikeminnow were the second-most abundant species observed. Northern pikeminnow were observed from May through July, but peaked during the month of June (n=2,996; Table 3; Figure 9). This increase in abundance coincides with the typical spawning period of northern pikeminnow in Washington state (Wydoski and Whitney 2003). This observation and the absence of northern pikeminnow in either the Habitat Channel or Tailrace during other months of survey suggests that northern pikeminnow do not utilize these areas to any great extent except for the purpose of reproduction.

Within the Habitat Channel, smallmouth bass were observed throughout the year, but observations were most pronounced May through August (Table 3; Figure 9). As discussed above, the decreased rate of observation outside the peak period was likely due in part to smallmouth bass seeking cover during periods of cold water temperature, making them more difficult to observe. However, the factor most likely responsible for the decline in observation after spawning and nest defense is the emigration of smallmouth bass into the Columbia River.

During the survey conducted on May 4, a total of 31 smallmouth bass nests in various states of construction were observed within the Habitat Channel (Stevenson 2016d). The following month, during the June 29 survey, over 5,400 smallmouth bass fry were observed within Sections 2-6 of the Habitat Channel (Stevenson 2016e). Of the 1,104 smallmouth bass observed (not including fry) within the Habitat Channel during 2016, 55.7% (n=615) were less than 6" in length, and 44.3% were greater than 6" (n=489).

In addition to the species discussed above, rainbow trout were observed within the Habitat Channel during the 2016 surveys. For this species, between 8 and 46 fish were observed during any given survey, and individuals of this species were observed in every month when surveys were conducted (Table 3; Figure 10). Of the 339 rainbow trout observed within the Habitat Channel, 18.9 % were less than 6" in length, 20.9% were between 6 and 9", 39.5% were between 9 and 12", and 20.6% were greater than 12" in length.

Given the number of small individuals observed throughout the year, and the consistency of observations for this species, it appears that rainbow trout utilize the Habitat Channel for both rearing and residency. It should be noted that there were six adult steelhead observed in the habitat channel. Four were observed from January to May and one was observed in both July and December. It is possible that some of the smaller individuals that are classified as rainbow trout are actually progeny of spawning steelhead within the Habitat Channel.

During the 2016 period, a total of 107 westslope cutthroat trout were counted within the Habitat Channel (Table 3; Figure 10). With the exception of the survey conducted in June, the number of westslope cutthroat trout was typically low and ranged between 0-13 observations for this species in any given month. However, in June the number of cutthroat observed during that survey was 68 fish. As mentioned earlier, a total of 200 westslope cutthroat trout were released on May 4 within Reach 1. On the same day following the release, and after our survey had concluded, spill was initiated from Lake Chelan and flows within Reach 1 peaked at 9,024 cfs by the end of the day. Spill continued at a relatively high level for the next two weeks, and did not fall below 8,500 cfs for the first five days following the release of the westslope cutthroat trout (Table 1; Figure 3).

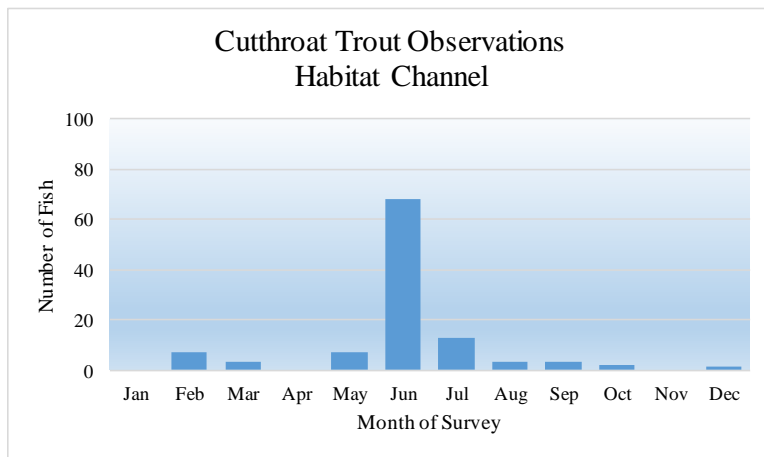
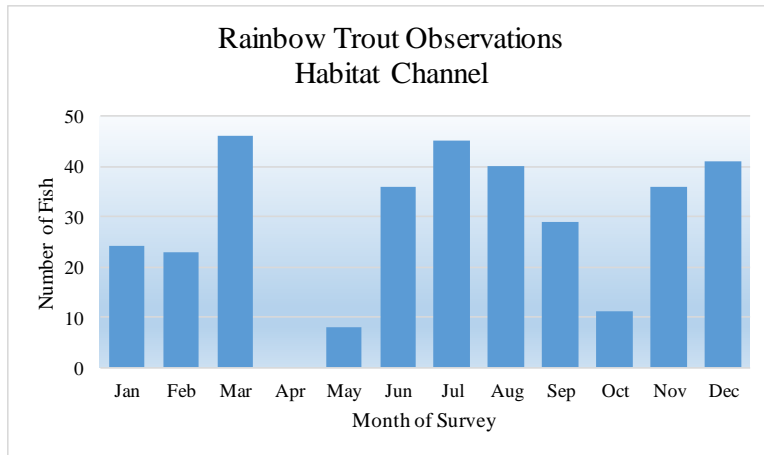


Figure 10. The number of rainbow and westslope cutthroat trout observed during monthly surveys in the Habitat Channel of the Chelan River, 2016.

It is likely that the influx of westslope cutthroat trout into the Habitat Channel in June was due to the initiation of spill following the release in Reach 1, with the fish being transported into the lower river.

3.3 Chelan Falls Tailrace

As with the Habitat Channel, the most frequently observed species within the tailrace was Chinook salmon, with a total of 4,541 observations (Table 4; Figure 11). Of those, 4,018 were subyearling Chinook, 504 were adult Chinook and 19 were yearling Chinook. Observations of other species of interest included 2,946 northern pikeminnow, 778 smallmouth bass, 35 rainbow trout and 5 westslope cutthroat trout. Non-species of interest included 1,902 suckers, 705 cyprinid fry (dace), 431 three-spine stickleback, 35 bluegill (*Lepomis macrochirus*), 21 reidside shiner (*Richardsonius balteatus*), 22 mountain whitefish, 19 carp (*Cyprinus carpio*), 9 walleye (*Stizostedion vitreum*), 5 sculpin, 4 tench, 2 largemouth bass (*Micropterus salmoides*), 2 adult sockeye, 1 bull trout and 1 adult steelhead (Appendix A; Table A-1).

For adult Chinook, peak observations occurred during the month of October, with a total of 405 fish; observations in September for adult Chinook was 57 fish (Table 4; Figure 12). As discussed in Section 3.2, peak counts in the Habitat Channel occurred during the month of September, followed by October. This may suggest that as adult Chinook enter the Chelan River, they occupy the Habitat Channel first, then the Tailrace area.

Chinook fry observations in the Tailrace began in February and increased until May, with a peak observation of 2,679 fish (Table 4; Figure 12). This pattern is the same as observed in the Habitat Channel but with fewer fish observed. However, while the Tailrace had a total of 504 adults observed compared to 445 adults in the Habitat Channel, there were nearly three times as many juveniles observed in the Habitat Channel as in the Tailrace (11,405 in the Habitat Channel vs. 4,018 in the Tailrace). This observation is likely due to the difference in habitat between the two sites. Within the Habitat Channel, flows are augmented with water provided through the pump station, delivery canal and head-gate system during the period of March through May. As such, water inundates areas of riparian habitat, which is dominated by willows with low water velocities providing excellent habitat. Most of our observations of Chinook fry in the Habitat Channel were within the inundated stream margins. This area provided excellent habitat and protection from larger predators. Conversely, the Tailrace lacks similar habitat, and is dominated by large cobble and boulders, higher water velocities with little slack water habitat, and little to no instream cover.

It is likely that Chinook fry that have emerged from redds within the Tailrace move to the Columbia River more quickly after emergence than fry that emerge from redds within the Habitat Channel. The pattern of observations for yearling Chinook in the Tailrace was similar to the Habitat Channel. That is, there were few yearling Chinook observed with a slight increase beginning early in the year and peaking in May, with a total of 15 fish (Table 4; Figure 12).

Table 4. The number of observations by month for bull trout (BT), Chinook adults (CK-Ad), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Tailrace of the Chelan River, 2016.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CK-Adult						3	27	11	57	405	1		504
CK-1		1	3		15								19
CK-0		89	1,250		2,679								4,018
Cutthroat Trout	0	0	0	0	0	0	0	0	0	5	0	0	5
Northern Pikeminnow	0	0	4	0	4	1,288	1,645	0	4	1	0	0	2,946
Rainbow Trout	1	1	18	0	0	0	1	0	0	5	6	3	35
Smallmouth Bass	1	0	30	0	24	144	270	297	12	0	0	0	778
Total	2	91	1,305	0	2,722	1,435	1,943	308	73	416	7	3	8,305

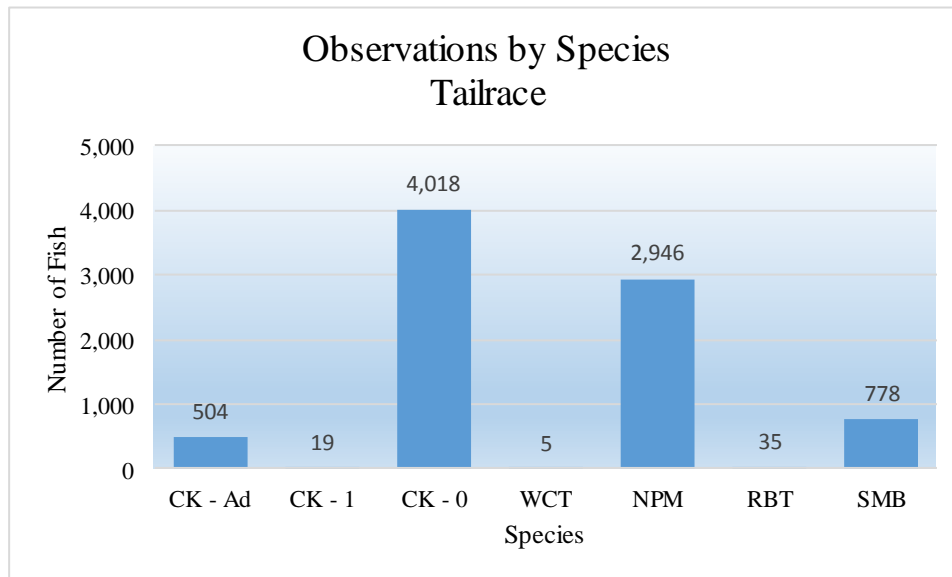


Figure 11. The number of observations by species for Chinook adults (CK-Ad), Chinook yearlings (CK-1), Chinook fry (CK-0), westslope cutthroat trout (WCT), northern pikeminnow (NPM), rainbow trout (RBT) and smallmouth bass (SMB) in the Tailrace of the Chelan River, 2016.

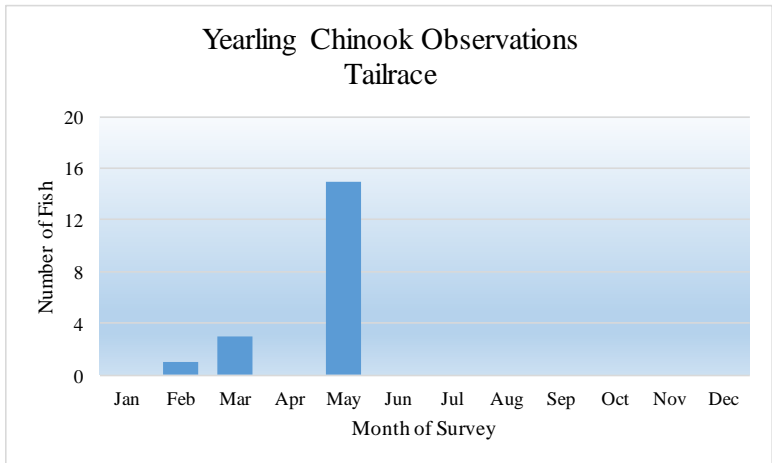
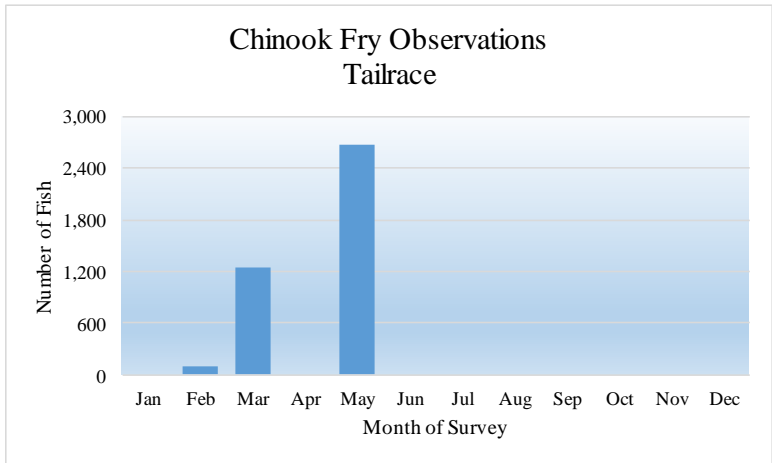
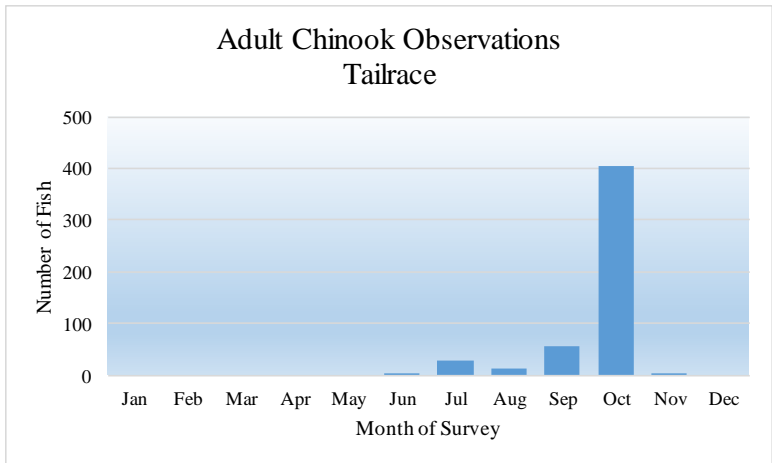


Figure 12. The number of Chinook adults, fry and yearlings observed during monthly surveys in the Tailrace of the Chelan River, 2016.

Northern pikeminnow were second only to Chinook in regard to the overall number of fish observed in 2016 (n=2,946). Northern pikeminnow were observed primarily during the months of June and July, with limited sightings in March, May, September and October (Table 4; Figure 13). As discussed in the previous section, the limited observations of northern pikeminnow at times other than during spawning suggests northern pikeminnow do not utilize the Chelan River and tailrace to any extent other than to reproduce.

During surveys conducted within the tailrace of the Chelan Falls powerhouse in 2016, there were a total of 778 smallmouth bass observed (Appendix Table A-1; Table 4; Figures 11 and 13). Of those, 642 (82.5%) were less than 6" in length and 136 (17.5%) were greater than 6". In addition to the sub-adult and adult smallmouth bass within the Tailrace, 4 smallmouth nests were counted in May (3 within the Tailrace and 1 within the swim area adjacent to the Tailrace) and 1,500 fry in June (Stevenson 2016e). The lack of smallmouth nests and fry observed in the Tailrace relative to the Habitat Channel suggests that sub-adults are migrating out of the Habitat Channel and rearing to some extent in the Tailrace. The significant decrease in smallmouth bass observations between August and September (297 vs. 12 fish) suggests that smallmouth bass migrate into the Columbia River after spawning and nest defense.

A limited number of rainbow trout (n=35) and westslope cutthroat trout (n=5) were observed within the Tailrace during 2016 snorkel surveys compared to observations within the Habitat Channel (Table 4; Figures 13 and 14). This was not unexpected given the habitat variation between the two locations. Within the Habitat Channel there is substantial instream structures including large boulders, engineered log structures, overhead riparian vegetation and slack water areas. This habitat does not exist for the most part within the Tailrace.

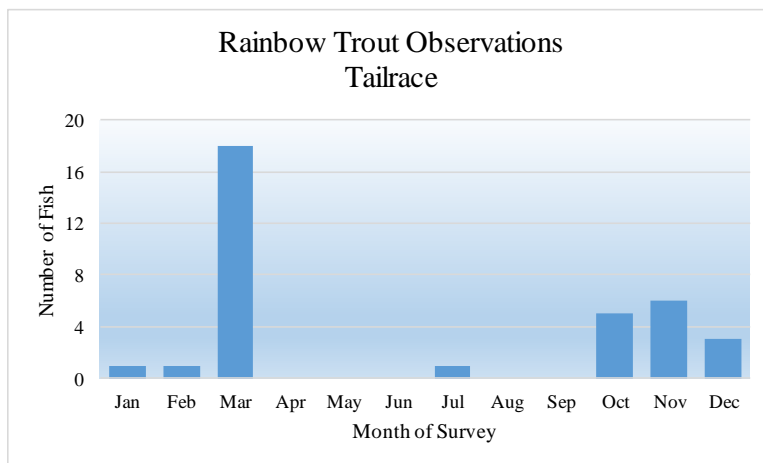
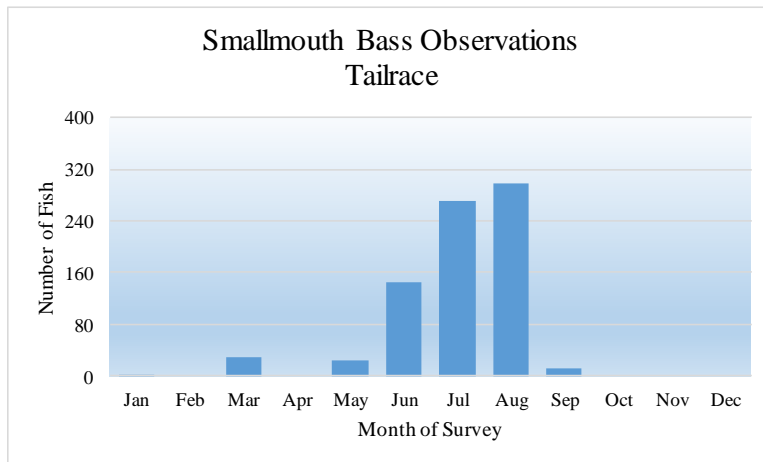
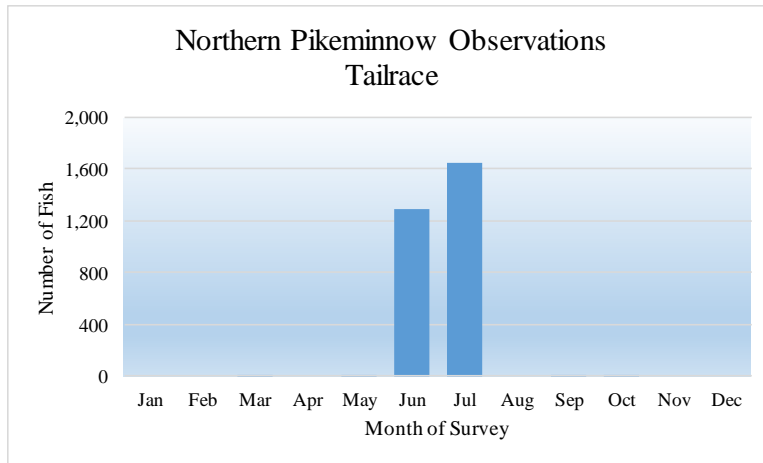


Figure 13. The number of northern pikeminnow, smallmouth bass and rainbow trout observed during monthly surveys in the Tailrace of the Chelan River, 2016.

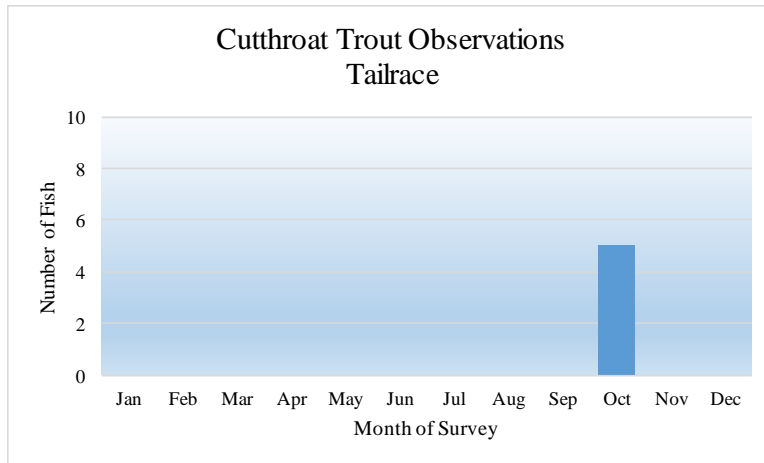


Figure 14. The number of westslope cutthroat trout observed during monthly surveys in the Tailrace of the Chelan River, 2016.

4.0 Acknowledgments

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5.0 Literature Cited

- Chapman, D., A. Giorgi, T. Hillman, D. Deppert, M. Erho, S. Hays, C. Peven, B. Suzumoto and R. Klinge. 1994. Status of summer/fall Chinook salmon in the Mid-Columbia Region. Don Chapman Consultants, Inc. Boise, ID 83705.
- Chelan Public Utility District (Public Utility District No. 1 of Chelan County). 2003. Lake Chelan Settlement Agreement, Final, Lake Chelan Hydroelectric Project, FERC Project No. 637.
- Giorgi, A. E. 1992. Fall Chinook salmon spawning in Rocky Reach pool: effects of a three foot increase in pool elevation. Research report prepared for Chelan County Public Utility District, Wenatchee, Washington.
- Hillman, T. W., J. W. Mullan, and J. S. Griffith. 1992. Accuracy of underwater counts of juvenile Chinook salmon, coho salmon, and steelhead. *North American Journal of Fisheries Management* 12:598-603, 1992.
- Hillman, T., D. Chapman, A. Giorgi, M. Miller, and S. Kreiter. 2000. Potential productivity of anadromous salmonids in Lake Chelan, Washington. Final report prepared for Public Utility District No. 1 of Chelan County, Wenatchee, Washington.
- Stevenson, J. R. 2016a. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - January 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Stevenson, J. R. 2016b. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - February 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Stevenson, J. R. 2016c. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - March 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Stevenson, J. R. 2016d. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - May 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.

- Stevenson, J. R. 2016e. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - June 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Stevenson, J. R. 2016f. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - August 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Stevenson, J. R. 2016g. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - September 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Stevenson, J. R. 2016h. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary - October 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Stevenson, J. R. 2016i. Snorkel surveys in the Chelan Falls Dam Habitat Channel and Tailrace, and Reach 1 of the Chelan River, WA, Monthly Survey Summary – November and December 2016. Prepared for Chelan County Public Utility District, 327 N. Wenatchee Avenue Wenatchee, WA 98801.
- Wydoski, R. S., and R. R. Whitney. 2003. Inland fishes of Washington. Second edition, revised and expanded. American Fisheries Society, Bethesda, Maryland in association with the University of Washington press, Seattle, Washington.

Appendix A

Table A-1. Cumulative summary of fish observation during snorkel surveys of the Chelan Falls tailrace, Habitat Channel and swim area, 2016.

Species	Tailrace	1	2	3	4	5	6	7	Pool	Total
Bluegill	35	0	2	0	0	0	0	0	2	39
Bullhead	0	0	0	0	0	0	0	0	5	5
Bull Trout 9-12"	0	0	0	0	0	0	0	0	3	3
Bull Trout ≥12"	1	1	3	0	3	1	0	0	2	11
Carp	19	0	0	0	0	0	0	0	0	19
Chinook - Adult	504	21	39	20	14	24	14	8	305	949
Chinook - Yearling	19	0	4	2	0	2	2	0	14	43
Chinook - Subyearling	4,018	244	2,586	1,209	2,646	1,425	1,958	3	1,334	15,423
Chiselmouth	0	0	3	0	5	0	0	0	7	15
Coho - Adult	0	0	0	0	0	0	0	0	2	2
Cutthroat 9-12"	5	1	0	1	15	9	3	2	57	93
Cutthroat ≥12"	0	0	1	0	0	2	2	1	13	19
Dace	705	111	9	6	0	0	1	0	0	832
Largemouth Bass >6"	2	0	0	0	0	0	0	0	0	2
Peamouth	0	0	0	0	0	0	0	0	5	5
Pikeminnow <6"	4	0	0	0	0	0	0	0	0	4
Pikeminnow ≥6"	2,942	1,652	464	43	55	89	154	1	782	6,182
Rainbow <6"	16	2	17	12	6	6	10	0	11	80
Rainbow 6-9"	2	3	11	5	6	9	17	10	10	73
Rainbow 9-12"	4	2	10	14	23	15	35	17	18	138
Rainbow ≥12"	13	5	8	3	11	4	13	5	21	83
Sculpin	5	1	0	0	0	2	0	0	0	8
Redside Shiner	21	0	0	0	0	0	0	0	0	21
Smallmouth <6"	642	81	92	28	70	76	67	21	180	1,257
Smallmouth ≥6"	136	44	47	23	35	50	62	26	202	625
Sockeye - Adult	2	0	0	0	0	0	0	0	9	11
Steelhead - Adult	1	0	0	1	1	0	2	0	1	6
Stickleback	431	84	12	6	10	0	0	0	0	543
Sucker	1,902	379	751	267	417	1,133	342	35	1,158	6,384
Tench	4	0	0	0	0	0	0	0	0	4
Walleye	9	0	0	0	0	0	0	0	0	9
Whitefish <6"	1	0	1	0	0	0	0	0	0	2
Whitefish ≥6"	21	7	4	4	7	2	8	0	3	56
Total	11,464	2,638	4,064	1,644	3,324	2,849	2,690	129	4,144	32,946

Table A-2. Cumulative summary of fish observation during snorkel surveys of Reach 1 of the Chelan River, 2016. Note that the habitat units are in order (left to right) from the downstream site to the upstream site.

Species	Riffle	Pool	Channel	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Total
Chinook - Adult	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cutthroat <6"	0	0	0	0	0	0	0	0	0	0	3	0	0	0	7	10
Cutthroat 6-9"	1	2	4	0	0	0	1	0	3	1	12	0	5	9	42	80
Cutthroat 9-12"	5	100	139	4	42	0	75	0	16	12	32	0	45	39	206	715
Cutthroat ≥12"	2	29	27	1	5	0	30	0	11	1	4	0	9	13	44	176
Cyprinid - Fry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Pikeminnow ≥6"	0	5	0	0	1	0	0	0	0	0	1	0	0	0	43	50
Rainbow <6"	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Rainbow 6-9"	0	1	5	2	0	0	5	0	1	0	1	0	0	0	0	15
Rainbow 9-12"	7	27	51	1	19	0	27	0	3	2	3	0	4	7	20	171
Rainbow ≥12"	5	23	52	1	22	0	26	0	8	1	1	0	4	4	23	170
Smallmouth <6"	6	20	161	8	14	0	31	0	16	4	52	0	35	39	76	462
Smallmouth ≥6"	8	20	66	7	19	0	25	0	6	3	39	0	11	28	130	362
Sucker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Tench	0	0	0	0	0	0	0	0	0	0	1	0	0	0	18	19
Unknown Trout	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	4
Whitefish ≥6"	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	4
Total	34	232	506	24	122	0	220	0	64	26	150	0	113	140	614	2,245