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Abundance and Run Timing of Adult Salmon in the Gisasa River, Koyukuk National Wildlife Refuge, Alaska, 2016

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Cover Photo: Biological science technicians Jamie McGuire and Brianna Pelkie taking age, sex, and length data at the Gisasa River Weir, 2016. Photo courtesy of Matt Olson, USFWS.

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Jeremy G. Carlson

Abstract

A resistance board weir was operated by the U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office to collect information on abundance, run timing, and biology of returning adult Chinook Salmon *Oncorhynchus tshawytscha* and summer Chum Salmon *O. keta* in the Gisasa River. The weir has been operated at this location since 1994 and this is the third year video technology has been incorporated into the project. In 2016, the weir was operated from June 17 through July 28 during which an estimated 1,395 Chinook Salmon and 66,670 summer Chum Salmon passed through the weir. Other species enumerated through the weir, in order of abundance, were Sockeye Salmon *O. nerka (N* = 70), Northern Pike *Esox lucius* (*N* = 39), Pink Salmon *O. gorbuscha* (*N* = 38), Arctic Grayling *Thymallus arcticus* (*N* = 19), Round Whitefish *Prosopium cylindraceum* (*N* = 8), Longnose Sucker *Catostomus catostomus* (*N* = 7), and Dolly Varden *Salvelinus malma* (*N* = 5). The estimated weekly sex composition for Chinook Salmon ranged from 19.4% to 40.9% female fish and averaged 28.2% for the season. Three primary age classes of Chinook Salmon were identified, 1.2, 1.3, and 1.4, with the predominant age class being 1.3 (44.3%). Length-at-age of female Chinook Salmon was larger than males. The estimated weekly sex composition for summer Chum Salmon ranged from 32.2% to 75.7% female fish, and averaged 57.7% female fish for the season. There were two primary age classes identified for summer Chum Salmon, 0.3 and 0.4, with the predominant age class being 0.3 (62.7%). Length-at-age of male summer Chum Salmon was larger than females, except for age-0.2, which was only represented by one male.

Introduction

The Gisasa River, located within the Koyukuk National Wildlife Refuge in northcentral Interior Alaska, is a tributary of the Koyukuk River and provides spawning and rearing habitat for Chinook Salmon *Oncorhynchus tshawytscha* and Chum Salmon *O. keta*. These salmon species in the Gisasa River contribute to mixed stock subsistence and commercial fisheries in the Yukon River (USFWS 1993). The U.S. Fish and Wildlife Service (USFWS), through Section 302 of the Alaska National Interest Lands Conservation Act, has a responsibility to ensure that salmon populations within federal conservation units are conserved in their natural diversity, that international treaty agreements are met, and subsistence opportunities are maintained.

Yukon River salmon returns declined in the late 1990s (Kruse 1998). These declines led to harvest restrictions, complete fishery closures, and spawning escapements below management goals (Vania et al. 2002). Since the late 1990s, Chum Salmon returns have shown considerable variability with no pattern of declining numbers (JTC 2017). However, Chinook returns rebounded and continued to improve from 2001 to 2006, and then declined again from 2007 to the present (JTC 2017). In the Yukon River drainage management of individual stocks does not occur and accurate escapement data are limited. In-season management of the salmon fisheries is conducted using preseason projections based on parent stock returns; salmon counts from sonar projects at Pilot Station and Eagle; data from

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test fisheries and escapement assessment projects; and harvest data from subsistence and commercial fisheries.

Historically, escapement information on individual salmon stocks from the Koyukuk River has been collected by aerial surveys. The Alaska Department of Fish and Game (ADF&G) has conducted these surveys on several index tributaries within the Koyukuk River drainage intermittently since 1960 (Barton 1984). Aerial surveys, however, are highly variable and provide only a point in time index of relative run strength. Counts produced using weirs or counting towers provide a better estimation of escapement, and weirs provide a platform for collecting other biological data. Weirs or counting towers have historically been operated on five different Koyukuk River tributaries since 1994. Weirs are currently operated on the Gisasa River and at Henshaw Creek (Figure 1).

The USFWS, Fairbanks Fish and Wildlife Field Office (FFWFO), has operated a resistance board weir on the Gisasa River since 1994 (Melegari and Wiswar 1995). Historical Chinook Salmon escapement estimates from weir counts on the Gisasa River through 2016 range from 1,126 to 4,023 fish per year. Summer Chum Salmon escapement estimates for the same period range from 10,155 to 261,305 fish per year. The Gisasa River weir study objectives for 2016 were to: (1) determine daily fish passage, estimate seasonal escapement, and describe run timing of adult Chinook and summer Chum Salmon, (2) determine age, sex, and length composition of adult Chinook and summer Chum Salmon, and (3) document observations of resident fish.

Study Area

The Gisasa River headwaters originate in the Nulato Hills, and the river flows northeast as it passes through the Koyukuk National Wildlife Refuge. Approximately 112 km from its source, the Gisasa River enters the Koyukuk River at roughly 65° 15.149' N, 157° 42.925' W (USGS 1:63,360 series, Kateel River B-4 quadrangle), 90 km upriver from the mouth of the Koyukuk River (Figure 1). Climate in the region is continental subarctic with dramatic seasonal temperature variations and low precipitation. Mean annual air temperature at the village of Galena, 64 km southeast of the Gisasa River, is 3.8°C with extremes ranging from 32°C during summer to -57°C during winter (USFWS 1993). The hydrology of this area is dynamic throughout the year, with lower flows generally occurring in late summer. Peak flows usually occur during spring snow melt/breakup or occasionally during summer high precipitation events. Rivers in the area generally begin to freeze during October and breakup during May.

The weir site is located approximately 4 km upriver from the mouth of the Gisasa River. This section of the river is straight with generally laminar flow. The river channel cross section slopes gradually from both stream banks to the thalweg. The river width is approximately 45 m. The water depth at the trap near the thalweg ranged from 82 to 101 cm (Appendix 2). Predominant substrate at the weir site consists of medium-size gravel 35 to 70 mm diameter.

Methods

Weir Operation

A resistance board weir was used to enumerate and collect biological data from adult salmon as they migrated up the Gisasa River to spawn. The Gisasa River weir has been installed at the same site since the project was initiated in 1994, following the construction and installation methods described by Tobin (1994). More detailed information on deployment of the Gisasa River weir can be found in Melegari and Wiswar (1995). A live trap was installed approximately mid-channel, near the thalweg, allowing fish to be recorded as they passed through the weir and, when necessary, the trap was closed to collect fish for sampling. The weir was visually inspected for integrity and cleaned of debris daily.

Cleaning consisted of raking debris from the upstream surface of the weir or walking across each panel to submerge it enough to allow the current to wash debris downstream. The picket spacing within the trap and weir panels (3.5 cm between pickets) was narrow enough to prevent adult Chinook and summer Chum Salmon from passing through the weir. However, some individuals of smaller fish species, such as Arctic Grayling *Thymallus arcticus* and Whitefish spp., likely passed through the weir undetected.

The ability of small male Chinook to bypass the weir was identified as a concern after surveys conducted to collect Thiamine samples indicated that there may be higher abundances of small males on the spawning grounds than weir estimates support (McGuire and Morella 2015, personal communication, July 15). The perception of a high ratio of small male Chinook Salmon provided an opportunity to investigate the potential for small male Chinook to pass through the weir undetected which could significantly affect data quality. Weir panels will be replaced in the near future and this season provided an opportunity to assess the current picket spacing and make any adjustments. A GoPro video camera, placed upstream of the substrate rail facing downstream, was used to collect video footage in one-hour increments throughout the 2016 season at randomly assigned locations and times. Footage was then reviewed post-season and data tabulated in Appendix 9.

In 2014, a video camera system was installed on the upstream side of the weir trap box to capture video footage of migrating salmon which was used to enumerate fish passage by species. The video camera box funneled fish into a narrow passage chute providing motion capture footage to identify all species passing through the weir, and allowed for the continual movement of fish through the weir. The original passage chute used in 2014 was damaged that same year due to high water flows. Therefore, a new version was designed and fabricated in Fairbanks. The new chute was slightly narrower than the original and resolved an issue with the previous version that had allowed multiple fish to pass in front of the video camera simultaneously. The redesign improved species identification by limiting obstruction due to overlapping fish.

Once video counting began, motion capture features were enabled, and all counting was conducted from individual motion capture files. Motion capture files were saved to a hard drive and reviewed hourly. Fish were identified to species and total hourly counts were entered into an electronic data sheet daily. The video box was equipped with LED lights so that fish could be observed 24 hours per day. Adjustments to video settings and equipment were made as necessary to optimize image quality and performance of the system. During the first week of weir operation, manual counts of fish in the live video feed and counts of fish in files recorded with motion capture software were conducted simultaneously and compared to verify that the motion capture settings were adjusted properly and counts remained accurate.

After the initial verification period, only motion capture video files were used for the remainder of the season. Accuracy was monitored throughout the season with short-period comparison counts. In 2016, no fish were physically observed passing through the chute without detection by the video counting system.

Water depth (cm) was recorded twice daily at the weir trap at approximately 0800 hours and 2000 hours. In 2016, a YSI Professional Plus Multiprobe (Yellow Springs, Ohio) and a YSI 6920 V2 Multiparameter Water Quality Sonde were used to measure dissolved oxygen, temperature, pH, conductivity, and Turbidity (sonde only). Water measurements were taken twice daily by YSI Professional Plus Multiprobe at approximately 0800 hours and 2000 hours upstream of the weir in a section of river where water was well mixed. The YSI Multiparameter Water Quality Sonde was deployed on July 7 at 1420 hours in a location upstream of the weir where water was well mixed. Sonde measurements were automatically recorded every 20 minutes.

Biological Data

The target start date of June 18 was based on previous years' salmon run timing data. The end date of the project is determined in-season, when the daily count of both Chinook and summer Chum Salmon drops to less than 1% of the seasonal passage to date for three consecutive days, or when logistical constraints require stopping before this point is reached. In 2016 the weir was in operation from June 17 through July 28. All fish passing through the weir were identified to species and enumerated. A daily counting schedule was implemented and fish were counted 24 hours per day. Escapement counts and sex ratios from the previous day were reported daily to the FFWFO by satellite telephone.

A stratified random sampling scheme (Cochran 1977), with weeks as the strata, was used to collect age, sex, and length data from adult Chinook and summer Chum Salmon. Sampling was conducted throughout the week, targeting 160 salmon per species per week. Daily sampling was conducted throughout each 24-hour period. All target species within the trap were sampled to prevent bias. Non-target species were identified and counted, but not sampled for age, length, and sex. Sampling consisted of identifying salmon to species, determining sex, measuring length, collecting scales, and releasing fish upstream of the weir. Lengths were measured to the nearest 1 mm from mid-eye to fork of the caudal fin (MEFL) and sex was visually determined by external morphological characteristics. Scales were collected for aging and ages were reported using the European method (Foerster 1968). Three scales were collected from Chinook Salmon and one scale from summer Chum Salmon. Scales were collected from the left side of the fish, two rows above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin. Scales from both adult salmon species were sent to ADF&G for processing. Previous studies have shown that nearly all age-1.1 and -1.2 Chinook Salmon, including Chinook less than 650 mm (MEFL) are males (Brady 1983; Bales 2007; Karpovich and DuBois 2007). Therefore, all age-1.1 and -1.2 Chinook Salmon and those fish less than 650mm (MEFL) were assumed to be males regardless of the field determination.

Data Analysis

For days with partial counts, i.e., high water or other events where fish could pass uncounted, adjustments to the counts were made. Days with counts greater than 6 hours but less than 24 hours were adjusted for a 24-hour period using:

$$E_d = (24 / T_d) \bullet C_d ,$$

where E_d = estimated daily count for day d, T_d = number of hours sampled during day d, and C_d = number of fish counted during the time sampled in day d. Counts from days with less than 6 hours of the day counted were estimated using linear interpolation in season. However, a statistical arrival model was used to estimate the missed counts post season (Sethi and Bradley 2016).

Age and sex data were collected and analyzed using a stratified random sampling design (Cochran 1977) with statistical weeks as the strata. Due to when sampling was initiated in 2016, a statistical week for Chinook Salmon was defined as beginning on Tuesday and ending on Monday. A statistical week for Chum Salmon was defined as beginning on Friday and ending on Thursday. Within a week, the proportion of the samples composed of a given sex or age, $\hat{p}_{ij}$, were calculated as:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_j},$$

where n_{ij} is the number of fish by sex *i* or age *i* sampled in week *j*, and n_j is the total number of fish sampled in week *j*. The variance of $\hat{p}_{ij}$ was calculated as:

$$\hat{v}(\hat{p}_{ij}) = \frac{\hat{p}_{ij}(1 - \hat{p}_{ij})}{n_j - 1}.$$

Sex and age compositions for the total run of Chinook and Chum Salmon of a given sex or age, $\hat{p}_i$ were calculated as:

$$\hat{p}_i = \sum_{j-1} \hat{W}_j \hat{p}_{ij,}$$

where $\hat{W}_j$ = the stratum weight and was calculated as:

$$\hat{W}_j = \frac{N_j}{N},$$

and N_j equals the total number of fish of a given species passing through the weir during week *j*, and *N* is the total number of fish of a given species passing through the weir during the run. Variance, $\hat{v}(\hat{p}_i)$ of sex and age compositions for the run was calculated as:

$$\hat{v}(\hat{p}_i) = \sum_{j-1} \hat{W}_j^2 \hat{v}(\hat{p}_{ij}).$$

Results and Discussion

Weir Operation

The weir was fully operational and fish tight at 2030 hours on June 17, with one summer Chum Salmon counted on that day. Counting continued throughout the season with no substantial interruptions. Weir operations were stopped for the season at 1400 hours on July 28.

The picket spacing (3.5 cm between pickets) within the trap and weir panels was narrow enough to prevent adult Chinook and summer Chum Salmon from passing through the weir. However, some individuals of smaller fish species, such as Arctic Grayling *Thymallus arcticus* and Whitefish spp., likely passed through the weir undetected. The video camera system worked well and all fish passing through were identified. As in 2015, Whitefish that passed through the weir were confidently identified as Round Whitefish.

The investigation into the ability of small Chinook Salmon to bypass the weir resulted in 47 hours of video collected; no Chinook Salmon observed were passing through the weir pickets (Appendix 9). This supports the assumption that all size and age classes of Chinook Salmon were detected with the current weir picket spacing and that no adjustments are required. Fish species observed bypassing the weir through the pickets were Round Whitefish (*N* = 18) and Northern Pike (*N* = 1). A total of three Chum Salmon were observed bypassing the weir through the space between the substrate rail and the weir panel. In addition, 34 Chum Salmon were also observed bypassing the weir underneath the substrate rail at one specific sampling location. However, this bypass was due to the removal of a sandbag for deployment of the GoPro camera which resulted in a scour hole thus allowing fish to pass. This instance was not considered an indication of an ongoing issue because during normal weir operation the daily inspection of the weir includes ensuring that all sandbags remain in place and that no washout is occurring along any of the substrate rail.

The average river stage height during weir operations was 89 cm and ranged between 82 cm and 101 cm. In 2016, the weir was moved slightly upstream on the left bank to ensure that the weir was installed perpendicular to the flow of the main current. This resulted in the trap being moved to deeper water thus reflecting an increase in water depth at the trap from previous years. Water temperature during the season averaged 15.2˚C and ranged from 11.6˚C to 20.3˚C (Figure 2, Appendix 2). Water quality data was also collected by YSI handheld (Appendix 7) and YSI sonde (Appendix 8) units during the 2016 season. There was a significant difference in conductivity readings between the YSI handheld and sonde units in 2016. This was attributed to a calibration error for the sonde before initial deployment.

Biological Data

An estimated 1,395 Chinook Salmon and 66,670 summer Chum Salmon (Table 1) passed through the weir during the period of operation. The next most abundant species was Sockeye Salmon *O. nerka* (*N* = 70), followed by Northern Pike *Esox lucius* (*N* = 39), Pink Salmon *O. gorbuscha* (*N* = 38), Arctic Grayling *Thymallus arcticus* (*N* = 19), Round Whitefish *Prosopium cylindraceum* (*N* = 8), Longnose Sucker *Catostomus catostomus* (*N* = 7), and Dolly Varden *Salvelinus malma* (*N* = 5).

Chinook Salmon — The seasonal estimate of 1,395 Chinook Salmon was 36% lower than the 1995–2015 average of 2,178 fish (1994 and 2014 were partial counts and are not included in the averages). The 2016 estimate was the fourth lowest weir estimate to date (Figure 3, Appendix 1). Overall, the Chinook Salmon estimate on the Gisasa River was similar to other runs throughout the Yukon River drainage in 2016, which were below average but still met or exceeded escapement goals (JTC 2017). The first Chinook Salmon were counted on June 22, when two Chinook Salmon passed through the weir. During the final day of weir operation (July 28), three Chinook Salmon (0.2% of the seasonal estimate) were counted through the weir. In 2016, run timing was early, with the first quarter point occurring 6 days earlier than the 1995-2015 average (July 5), the mid-point occurring eight days earlier than average (July 8) and the third quarter point occurring 6 days earlier than average (July 15) (Table 1; Figure 4).

Due to low fish passage rates throughout the season, sample size objectives for age, sex, and length data were not attained in any of the four statistical weeks (strata). Therefore, the first two statistical weeks were combined to form the first stratum and the following two weeks were combined to form the second stratum (Table 2). Scale samples were collected from 258 Chinook Salmon during the season. Age was not determined for 20 (7.8%) of the scale samples, primarily due to illegibility and regenerated scales. There were three primary age classes; 1.2, 1.3, and 1.4 from brood years 2012, 2011, and 2010, respectively. Age class 1.3 was predominant overall, accounting for 44.5% of the season total, with stratum estimates ranging from 43.8% to 44.9% (Table 2). Age class 1.2 accounted for 33.0% of the total and age class 1.4 accounted for 20.9%. Also included were age classes 1.1, 1.5, 2.2, and 2.3, which each accounted for less than 1% of the total. The age distributions differed between males and females. Males were predominantly age-1.3 (48.4%) followed by age-1.2 (45.6%), whereas females were predominantly age-1.4 (62.8%) followed by age-1.3 (34.0%). The estimated sex ratio for the entire run was 28.2% female, and estimates for each stratum ranged from 19.4% to 40.9% female fish. The estimate for the 2016 run was just slightly lower than the average historical sex ratio (28.6%; Appendix 5). Female Chinook salmon ranged from 696 to 901 mm MEFL with an average for all age classes of 788 mm. Males ranged from 360 to 853 mm MEFL for all age classes with an average of 615 mm (Table 3). The mean length-at-age of females for all age classes was larger than males.

Chum Salmon — The seasonal estimate of 66,670 summer Chum Salmon was 3% lower than the 1995–2015 average of 68,889 fish (1994 and 2014 were partial counts and are not included in the averages) (Figure 5). The average seasonal estimate for summer Chum Salmon in the Gisasa River is greatly influenced by high escapements during 1995, 1996, 2005, and 2006 (Figure 5; Appendix 1), and may not be a good measure of central tendency. Thus, the 2016 estimate was also compared to the historical median. The 2016 estimate of 66,670 summer Chum Salmon was 65% higher than the 1995–2015 median of 40,299 fish (Figure 5) and was consistent with the average escapements observed in most monitored tributaries in the Yukon River drainage in 2016 (JTC 2017). The first Chum Salmon was counted on June 17 with 33 fish counted on that day. During the final day of counting (July 28), 795 summer Chum Salmon (1.2% of the seasonal estimate) passed through the weir. Run timing started earlier than average, with the first quarter passage date (July 1) 4 days earlier than the 1995–2015 average. However, there was a lull in the run mid-season with a second pulse of fish beginning to pass the weir on July 19 (Figure 4). Thus, the mid-point of the run (July 8) occurred 2 days earlier than the 1995–2015 average and the third quarter (July 19) occurred three days later than the 1995–2015 average.

Sample size objectives for age, sex, and length data were attained for three of six statistical weeks (Table 4). Age, sex, and length data were collected from 1,039 summer Chum Salmon, with age unable to be determined for 75 (7.2%) of the scale samples. The predominant age class was 0.3, accounting for 62.7% of the season total, with weekly stratum estimates ranging from 26.7% to 74.8%. Age class 0.4 was the next most abundant, and accounted for 34.2% of the season total, with weekly stratum estimates ranging from 24.4% to 63.7% (Table 4). Also observed were age classes 0.2 and 0.5, which accounted for 1.1% and 2.1% of the total, respectively. There was a higher percentage of age-0.3 females (65.3%) than males (59.1%) and a higher percentage of age-0.4 males (37.7%) than females (31.6%). Age-0.2 fish were comprised of <1% male and 1.7% female fish and age-0.5 fish were comprised of 1.4% females and 2.9% males. The estimated sex ratio for the entire run was 57.7% female, and estimates for each stratum ranged from 32.2% to 75.7% female fish (Table 4). Female summer Chum Salmon lengths ranged from 464 to 616 mm METF with an average for all age classes of 534 mm. Males ranged from 479 to 667 mm METF with an average for all age classes of 568 mm (Table 5). For length-at-age measurements, mean lengths of male fish were larger than females, except for age-0.2, which was represented by one male.

The information collected at the Gisasa River weir is vital to managing the complex mixed-stock subsistence and commercial salmon fisheries in the Yukon River. In-season management and post-season evaluations of management actions are greatly enhanced by the data from this and other stock assessment projects. Additionally, this project has produced 23 years of data enabling analyses of trends in population status, size, length, age, and gender composition of the run, developing future run projections, and setting and evaluating harvest and escapement goals and allocations. Furthermore, these time series data will become increasingly valuable as stressors such as climate change, disease, selective harvest, and overall demand on the resources of the dynamic Yukon River system continue to increase.

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Table 1. — Daily and cumulative (Cum) estimates of Chinook Salmon and summer Chum Salmon passage, and daily estimates of other species, at the Gisasa River weir, Alaska, 2016. Asterisks (*) indicate first, mid, and third quarter points of Chinook salmon and summer Chum Salmon passage estimates.

	Chinook Salmon		Chum Salmon		Sockeye Salmon	Northern Pike	Pink Salmon	Arctic Grayling	Round Whitefish	Longnose Sucker	Dolly Varden
Date	Daily	Cum	Daily	Cum	Daily	Daily	Daily	Daily	Daily	Daily	Daily
Jun-17	0	0	33	33	0	5	0	2	0	3	0
Jun-18	0	0	39	72	0	2	0	2	1	1	0
Jun-19	0	0	67	139	0	1	0	4	0	0	0
Jun-20	0	0	504	643	0	6	0	1	1	1	0
Jun-21	0	0	131	774	0	1	0	0	2	0	0
Jun-22	2	2	739	1,513	0	2	0	0	0	0	0
Jun-23	1	3	386	1,899	0	1	0	0	0	0	1
Jun-24	1	4	727	2,626	0	0	0	3	0	0	2
Jun-25	1	5	842	3,468	0	1	0	3	0	1	0
Jun-26	5	10	962	4,430	0	1	0	0	0	0	0
Jun-27	5	15	1,490	5,920	0	0	0	0	0	0	0
Jun-28	14	29	3,215	9,135	0	0	0	0	0	0	1
Jun-29	6	35	2,230	11,365	0	0	0	0	0	0	0
Jun-30	36	71	3,608	14,973	0	1	0	0	0	0	0
Jul-01	26	97	2,788	17,761*	0	1	0	0	1	0	0
Jul-02	47	144	2,230	19,991	0	0	0	1	0	0	0
Jul-03	48	192	2,301	22,292	0	0	0	0	1	0	0
Jul-04	108	300	3,280	25,572	1	0	0	0	0	0	0
Jul-05	51	351*	2,109	27,681	0	1	0	1	0	0	0
Jul-06	130	481	2,150	29,831	0	0	0	0	0	0	0
Jul-07	76	557	2,417	32,248	1	1	0	0	0	0	0
Jul-08	144	701*	2,290	34,538*	0	1	1	0	0	0	0
Jul-09	32	733	1,468	36,006	2	0	0	1	1	0	0
Jul-10	50	783	1,609	37,615	2	0	0	0	0	0	0
Jul-11	42	825	1,757	39,372	1	2	0	0	0	0	0
Jul-12	34	859	1,485	40,857	1	1	1	1	0	0	0
Jul-13	98	957	1,734	42,591	0	1	0	0	0	0	0
Jul-14	79	1,036	985	43,576	0	1	2	0	0	0	0
Jul-15	36	1,072*	1,496	45,072	0	1	0	0	0	0	0
Jul-16	45	1,117	1,387	46,459	3	1	1	0	0	0	0
Jul-17	30	1,147	774	47,233	2	0	2	0	0	0	0
Jul-18	18	1,165	659	47,892	3	0	0	0	0	0	0
Jul-19	40	1,205	2,243	50,135*	1	0	2	0	0	0	1
Jul-20	23	1,228	1,996	52,131	4	1	3	0	0	1	0
Jul-21	31	1,259	1,771	53,902	5	1	1	0	1	0	0
Jul-22	38	1,297	2,447	56,349	7	0	4	0	0	0	0
Jul-23	20	1,317	2,676	59,025	10	1	1	0	0	0	0
Jul-24	14	1,331	1,895	60,920	4	1	5	0	0	0	0
Jul-25	35	1,366	1,667	62,587	9	0	6	0	0	0	0
Jul-26	19	1,385	1,490	64,077	5	0	2	0	0	0	0
Jul-27	7	1,392	1,798	65,875	7	1	5	0	0	0	0
Jul-28	3	1,395	795	66,670	2	2	2	0	0	0	0
Total	1,395	1,395	66,670	66,670	70	39	38	19	8	7	5

Table 2. — Age and sex ratio estimates, by stratum, of Chinook Salmon at Gisasa River weir, Alaska, 2016. Standard errors are in parentheses. Season totals are calculated from weighted strata totals. Unknown age indicates the number of fish that could not be aged from the scales sampled and were not included in age calculations. Fish ages courtesy of ADF&G.

					Brood year and age							
					2013	2012	2011		2010		2009	
Strata dates	Run size (*N*)	Sample size (*n*)	% Female	Unknown age	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
6/17 - 7/11	825	165	19.4 (3.1)	7	0.6%(0.6)	38.6%(3.9)	44.9%(4.0)	0.6%(0.0)	14.6%(5.2)	0.6%(0.0)	0.0%(0.0)	0.0%(0.0)
7/12 - 28	570	93	40.9 (5.1)	13	0.0%(0.0)	25.0%(4.9)	43.8%(5.6)	0.0%(0.0)	30.0%(3.3)	0.0%(1.0)	1.3%(0.0)	0.0%(0.0)
Total	1,395	258	28.2 (2.8)	20	0.4%(0.4)	33.0%(3.0)	44.5%(3.3)	0.4%(0.4)	20.9%(2.7)	0.4%(0.4)	0.5%(0.5)	0.0%(0.0)
Female	394	70		7	0.0%(0.0)	0.0%(0.0)	40.0%(6.2)	0.0%(0.0)	62.8%(6.3)	1.4%(1.4)	1.9%(1.9)	0.0%(0.0)
Male	1,001	188		12	0.5%(0.5)	45.6%(3.8)	48.4%(3.8)	0.5%(0.5)	4.9%(1.7)	0.0%(0.0)	0.0%(0.0)	0.0%(0.0)

Table 3. — Length-at-age of female and male Chinook Salmon sampled at Gisasa River weir, Alaska, 2016.

	Female					Male				
		Mid-eye to fork length (mm)					Mid-eye to fork length (mm)			
Age	*N*	Mean	SE	Median	Range	*N*	Mean	SE	Median	Range
1.1	0	-	-	-	-	1	410	-	-	-
1.2	0	-	-	-	-	81	553	5.6	545	450-710
2.1	0	-	-	-	-	0	-	-	-	-
1.3	21	755	5.2	755	720-824	85	667	7.4	661	360-853
2.2	0	-	-	-	-	1	617	-	-	-
1.4	39	808	8.2	803	696-901	8	722	29.6	736	568-828
2.3	1	770	-	-	-	0	-	-	-	-
1.5	1	725	-	-	-	0	-	-	-	-
2.4	0	-	-	-	-	0	-	-	-	-
Total	62	788				176	615			

Table 4. — Age and sex ratio estimates, by stratum, of summer Chum Salmon at Gisasa River weir, Alaska, 2016. Standard errors are shown in parentheses. Season totals are calculated from weighted strata totals. Unknown age data indicates number of fish that could not be aged from the scales sampled and were not included in age calculations. Fish ages courtesy of ADF&G.

					Brood year and age			
					2013	2012	2011	2010
Strata dates	Run size (*N*)	Sample size (*n*)	% Female	Unknown age	0.2	0.3	0.4	0.5
6/17-23	1,899	149	32.2 (3.8)	14	0.0% (0.0)	26.7% (3.8)	63.7% (4.2)	9.6% (2.5)
6/24-30	13,074	239	48.5 (3.2)	13	0.0% (0.0)	39.8% (3.3)	56.6% (3.3)	3.5% (1.2)
7/1-7	17,275	173	48.0 (3.8)	10	1.2% (0.9)	62.6% (3.8)	33.1% (3.7)	3.1% (1.4)
7/8-14	11,328	183	57.4 (3.7)	14	1.8% (1.0)	71.0% (3.5)	25.4% (3.4)	1.8% (1.0)
7/15-21	10,326	151	68.9 (3.8)	15	2.2% (1.3)	74.3% (3.8)	23.5% (3.7)	0.0% (0.0)
7/22-28	12,768	144	77.7 (3.6)	9	0.7% (0.7)	74.8% (3.7)	24.4% (3.7)	0.0% (0.0)
Total	66,670	1,039	57.8 (1.6)	75	1.1% (0.4)	62.7% (1.6)	34.2% (1.6)	2.1% (0.5)
Female	38,522	565		43	1.7% (0.6)	65.3% (2.1)	31.6% (2.1)	1.4% (0.5)
Male	28,148	474		32	0.4% (0.4)	59.1% (2.5)	37.7% (2.5)	2.9% (0.8)

Table 5. — Length-at-age of female and male summer Chum Salmon sampled at Gisasa River weir, Alaska, 2016.

	Female					Male				
		Mid-eye to fork length (mm)					Mid-eye to fork length (mm)			
Age	*N*	Mean	SE	Median	Range	*N*	Mean	SE	Median	Range
0.2	8	494	5.0	490	476-515	1	472	-	-	-
0.3	321	528	1.3	527	464-595	229	557	1.6	557	479-616
0.4	184	546	1.9	548	465-616	192	580	1.9	580	504-655
0.5	9	562	4.5	556	547-587	20	597	7.1	597	532-667
Total	522	534				442	568			

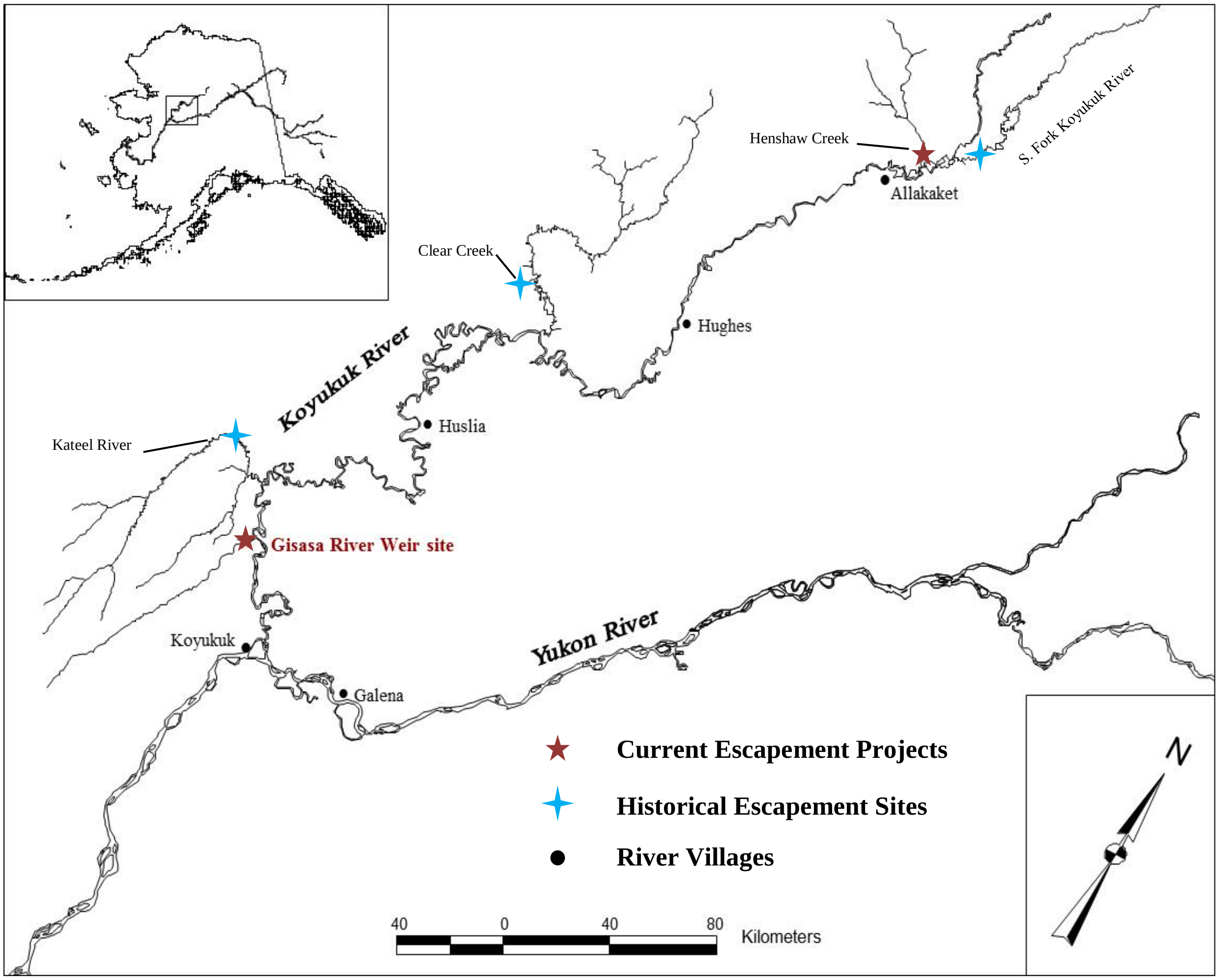

Figure 1. — Location of the Gisasa River weir and other active and historical tributary escapement project sites in the Koyukuk River drainage, Alaska.

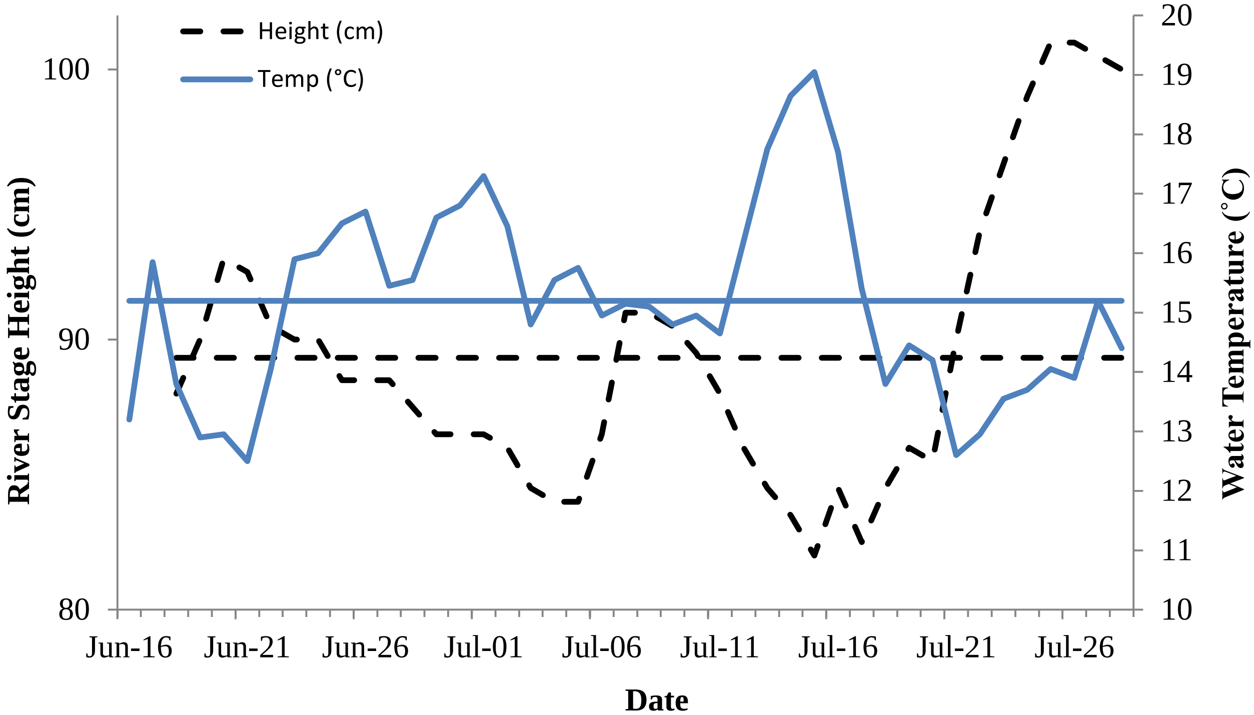

Figure 2. — Average daily river stage height and water temperature at the Gisasa River weir, Alaska, 2016. Horizontal lines represent the 2016 average for river stage height (dashed) and water temperature (solid). Average daily water temperature and river stage height were calculated using the average of the morning and evening values.

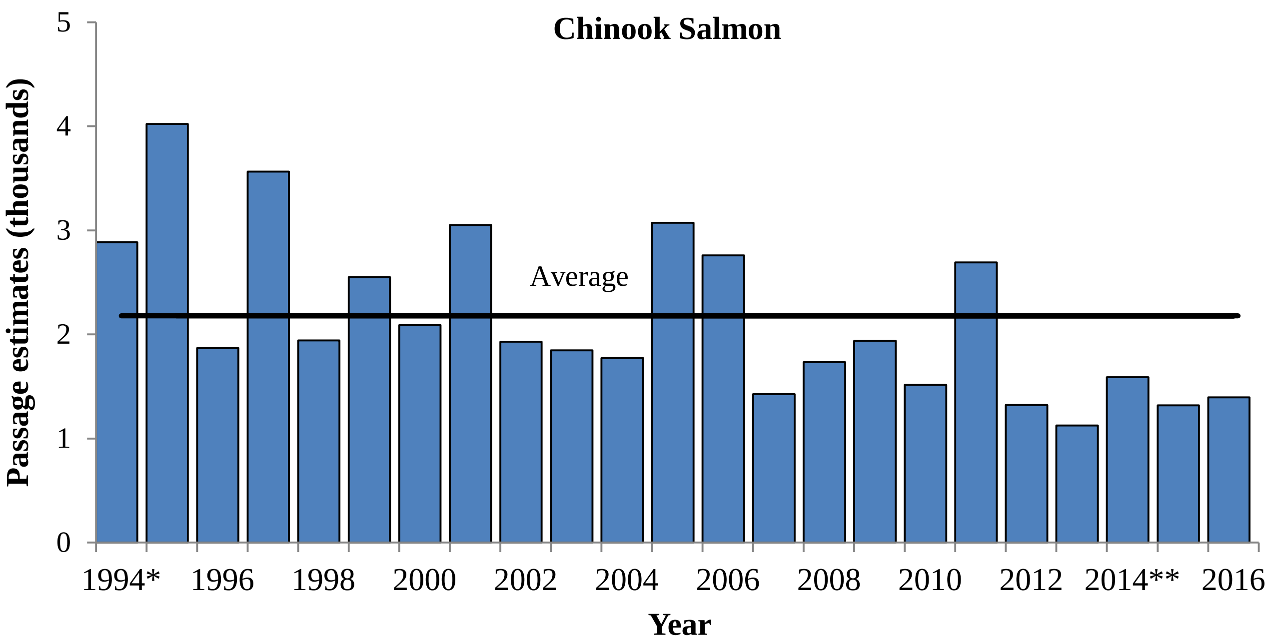

Figure 3. — Chinook Salmon escapement estimates at the Gisasa River weir 1994-2016. *Data from the first year of operation (1994) is only a partial count; counting did not begin until July 10, after the run was underway and this data is not included in averages. **Data from 2014 is a partial count due to extremely high water and is not included in the average. Horizontal line represents the 1995-2015 average.

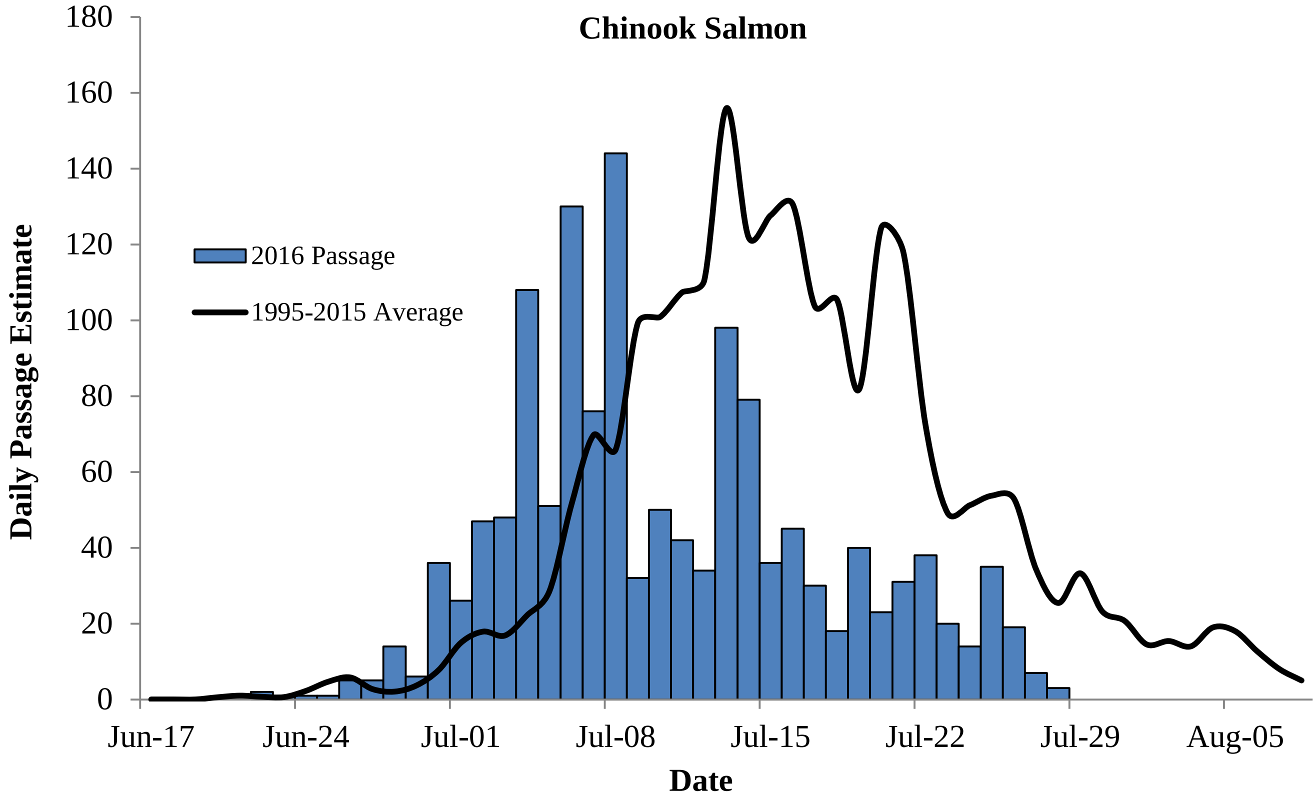

Figure 4. — Daily 2016 and average daily 1995-2015 Chinook Salmon passage estimates through Gisasa River weir, Alaska.

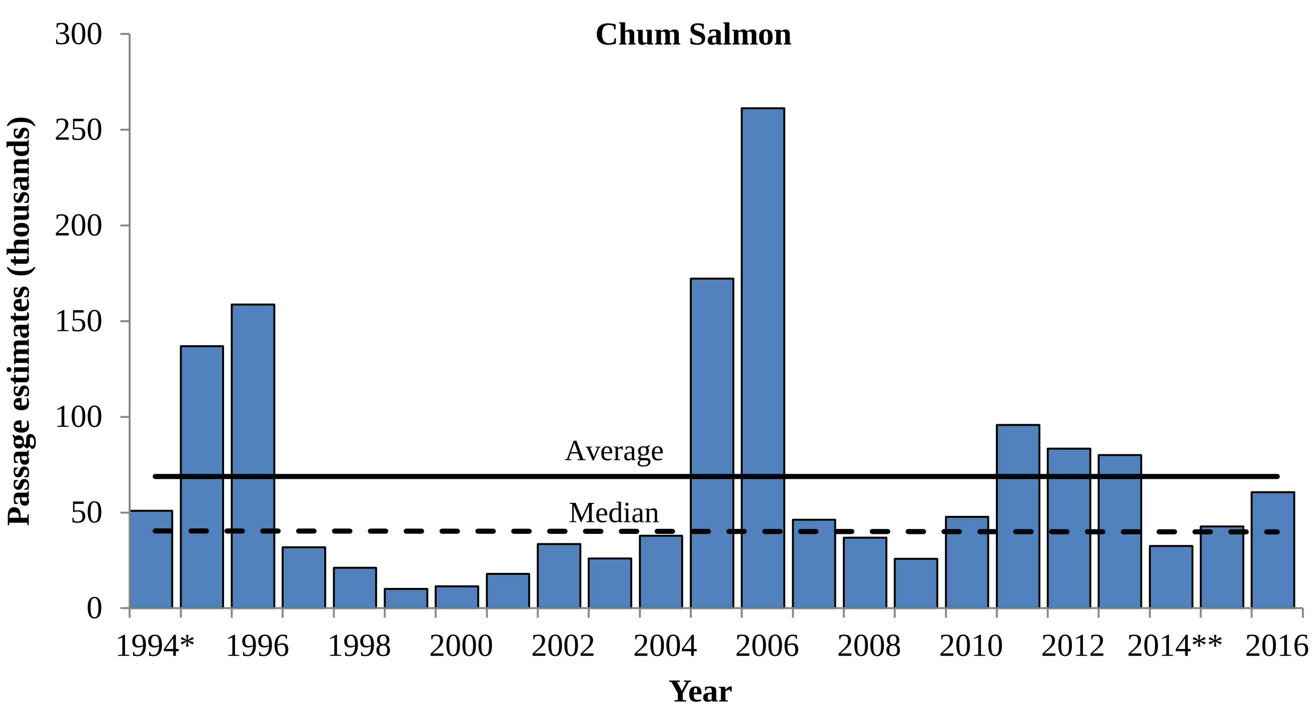

Figure 5. — Chum Salmon escapement estimates at the Gisasa River weir 1994-2016. *Data from the first year of operation (1994) is only a partial count; counting did not begin until July 10, after the run was underway and 1994 data is not included in averages. **Data from 2014 is only a partial count due to high water events and is not included in the averages. Horizontal lines represent the 1995-2015 average (solid) and median (dashed).

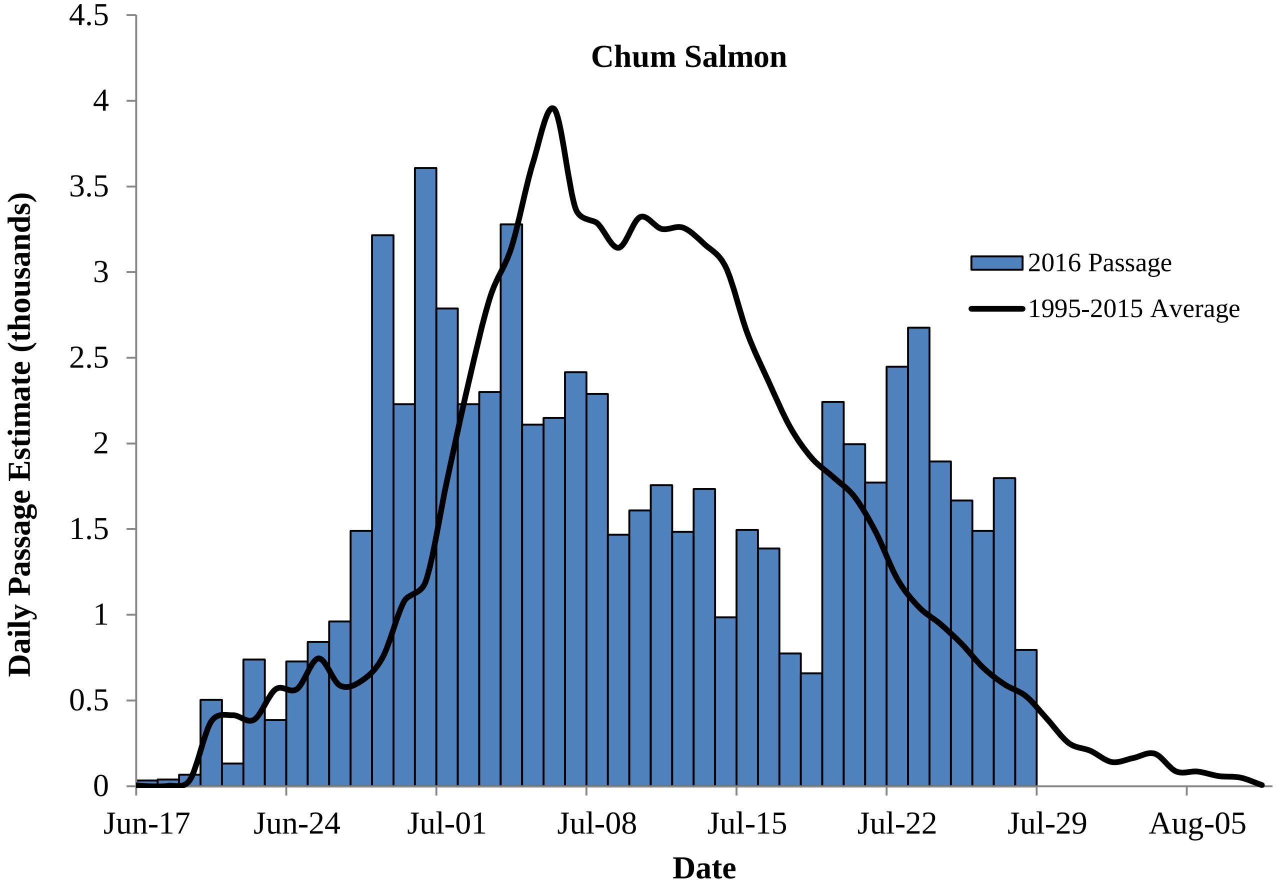

Figure 6. — Daily 2016 and average daily 1995-2015 Chum Salmon passage estimates through Gisasa River weir, Alaska.

Appendix 1. — Historical Chinook Salmon and summer Chum Salmon counts in the Gisasa River, Alaska 1960-2016. Aerial index data is from Barton (1984) and Alaska Department of Fish and Game from JTC (2017).

	Aerial index estimates			Weir escapement estimates	
Year	Chinook Salmon	Chum Salmon	Survey rating	Chinook Salmon	Chum Salmon
1960	300	400	Good		
1961	266	0	Good		
1974	161	22,022	Good		
1975	385	56,904	Good		
1976	332	21,342	Good		
1977	255	2,204	Good		
1978	45	9,280	Good		
1979	484	10,962	Good		
1980	951	10,388	Good		
1982	421	334	Good		
1983	572	2,356	Good		
1985	735	13,232	Good		
1986	1,346	12,114	Good		
1987	731	2,123	Good		
1988	797	9,284	Good		
1990	884	450	Good		
1991	1,690	7,003	Good		
1992	910	9,300	Good		
1993	1,573	1,581	Good		
1994	2,775	6,827	Good	2,888[a]	51,116[a]
1995	410	6,458	Good	4,023	136,886
1996				1,991	158,752
1997	144	686	Good	3,764	31,800
1998	889		Poor	2,414	21,142
1999				2,644	10,155
2000				2,089	11,410
2001	1298		Good	3,052	17,946
2002	506		Good	2,025	33,481
2003				1,901	25,999
2004	731		Good	1,774	37,851
2005	958		Good	3,111	172,259
2006	843	1,000	Fair	3,031	261,306
2007	593		Fair	1,427	46,257
2008	487	20470	Fair	1,738	36,938
2009	515	1,060	Good	1,955	25,904
2010	264	1,096	Fair	1,516	47,669
2011	906	13,228	Good	2,692	95,796
2012				1,323	83,423
2013	201	9,300	Surveyed too late	1,126	80,055
2014				1,589[a]	32,523[a]
2015	558	5,601	Good	1,319	42,747
2016				1,395	66,670

[a] Partial weir count.

Appendix 2. — Water depth, water temperature, and air temperature data collected at the Gisasa River weir, 2016. Water depth is the water level at the trap.

	Water depth (m)		Water temperature (˚C)		Air temperature (˚C)	
Date	AM	PM	AM	PM	AM	PM
Jun-16			13.2	-	19	-
Jun-17			15.2	16.5	22	16
Jun-18	0.88	0.88	14.1	13.5	12	12
Jun-19	0.90	0.90	11.9	13.9	11	11
Jun-20	0.92	0.94	12.4	13.5	11	16
Jun-21	0.94	0.91	11.9	13.1	10	15
Jun-22	0.91	0.90	11.8	16.3	13	22
Jun-23	0.90	0.90	14.5	17.3	16	20
Jun-24	0.90	0.90	15.2	16.8	13	22
Jun-25	0.88	0.89	14.6	18.4	17	24
Jun-26	0.89	0.88	15.7	17.7	17	22
Jun-27	0.89	0.88	15.1	15.8	12	20
Jun-28	0.88	0.87	13.7	17.4	13	23
Jun-29	0.86	0.87	15.9	17.3	16	18
Jun-30	0.87	0.86	14.9	18.7	12	25
Jul-1	0.87	0.86	15.7	18.9	15	26
Jul-2	0.86	0.86	16.6	16.3	13	20
Jul-3	0.85	0.84	14.4	15.2	15	21
Jul-4	0.84	0.84	13.8	17.3	13	23
Jul-5	0.84	0.84	15.1	16.4	12	17
Jul-6	0.85	0.88	14.1	15.8	10	15
Jul-7	0.91	0.91	14.2	16.1	11	16
Jul-8	0.91	0.91	14.0	16.2	10	19
Jul-9	0.91	0.90	14.0	15.6	11	20
Jul-10	0.90	0.89	14.2	15.7	13	13
Jul-11	0.88	0.88	12.4	16.9	4	23
Jul-12	0.86	0.86	13.9	18.5	11	26
Jul-13	0.85	0.84	15.4	20.1	14	30
Jul-14	0.84	0.83	17.1	20.2	17	31
Jul-15	0.82	0.82	17.8	20.3	19	24
Jul-16	0.85	0.84	17.3	18.1	15	17
Jul-17	0.82	0.83	15.6	15.2	13	14
Jul-18	0.84	0.85	13.7	13.9	12	15
Jul-19	0.86	0.86	12.8	16.1	12	18
Jul-20	0.85	0.86	14.4	14.0	12	12
Jul-21	0.88	0.92	12.5	12.7	11	13
Jul-22	0.94	0.94	11.6	14.3	10	15
Jul-23	0.96	0.97	12.7	14.4	12	17
Jul-24	0.98	1.00	12.7	14.7	11	17
Jul-25	1.01	1.01	12.2	15.9	8	22
Jul-26	1.01	1.01	12.9	14.9	8	16
Jul-27	1.01	1.00	13.4	17.0	11	21
Jul-28	1.00		14.4		12	

Appendix 3. — Historical daily and cumulative Chinook Salmon counts from Gisasa River weir, 1994-2016. Boxes indicate first quarter, mid, and third quarter points of the run.

	1994[a]	1995		1996		1997		1998		1999		2000		2001	
Date	Daily	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-15															
Jun-16															
Jun-17															
Jun-18															
Jun-19				0	0	0	0								
Jun-20				4	4	0	0								
Jun-21		0	0	9	13	0	0	0	0						
Jun-22		1	1	6	19	0	0	0	0						
Jun-23		0	1	8	27	0	0	0	0	0	0				
Jun-24		2	3	32	59	0	0	0	0	0	0				
Jun-25		4	7	63	122	0	0	0	0	0	0				
Jun-26		1	8	69	191	0	0	0	0	0	0				
Jun-27		5	13	16	207	1	1	2	2	0	0				
Jun-28		19	32	46[c]	253	3	4	0	2	1	1	0	0		
Jun-29		23	55	76[b]	329	9	13	1	3	0	1	0	0		
Jun-30		46	101	30	359	2	15	2	5	0	1	0	0		
Jul-1		82	183	57	416	33	48	5	10	0	1	0	0		
Jul-2		46	229	72	488	11	59	13[b]	23	0	1	0	0		
Jul-3		35	264	28	516	6	65	18[c]	41	0	1	0	0		
Jul-4		57	321	35	551	78	143	22[c]	63	0	1	0	0		
Jul-5		39	360	41	592	120	263	26[c]	89	1	2	0	0		
Jul-6		92	452	78	670	64	327	30[b]	119	2	4	13	13		
Jul-7		258	710	234	904	70	397	37	156	1	5	8	21	18	18
Jul-8		175	885	51	955	138	535	71	227	5	10	70	91	41	59
Jul-9		184	1,069	63	1,018	310	845	71	298	45	55	40	131	43	102
Jul-10		300	1,369	81	1,099	320	1,165	107	405	60	115	21	152	26	128
Jul-11		385	1,754	70	1,169	144	1,309	116	521	80	195	28	180	100	228
Jul-12	212	281	2,035	51	1,220	424	1,733	142	663	19	214	40	220	63	291
Jul-13	259	468	2,503	215	1,435	137	1,870	163	826	83	297	82	302	63	354
Jul-14	189	205	2,708	158	1,593	38	1,908	225	1,051	49	346	103	405	117	471
Jul-15	239	104	2,812	40	1,633	112	2,020	102	1,153	50	396	345	750	306	777
Jul-16	355	211	3,023	26	1,659	146	2,166	155	1,308	89	485	223	973	196	973
Jul-17	248	126	3,149	14	1,673	632	2,798	115	1,423	37	522	59	1,032	299	1,272
Jul-18	219	72	3,221	38	1,711	92	2,890	147	1,570	154	676	177	1,209	238	1,510
Jul-19	302	155	3,376	54	1,765	257	3,147	74	1,644	30	706	66	1,275	258	1,768
Jul-20	248	62	3,438	93	1,858	88	3,235	62	1,706	397	1,103	41	1,316	388	2,156
Jul-21	70	87	3,525	15	1,873	91	3,326	50	1,756	363	1,466	66	1,382	254	2,410
Jul-22	42	79	3,604	17	1,890	142	3,468	75	1,831	27	1,493	188	1,570	74	2,484
Jul-23	100	68	3,672	18	1,908	98	3,566	54	1,885	26	1,519	53	1,623	44	2,528
Jul-24	99	87	3,759	45	1,953	38	3,604	90	1,975	70	1,589	89	1,712	25	2,553
Jul-25	65	42	3,801	4	1,957	120	3,724	84[c]	2,059	307	1,896	42	1,754	36	2,589
Jul-26	48	21	3,822	21	1,978	25	3,749	78[c]	2,137	276	2,172	13	1,767	37	2,626
Jul-27	39	45	3,867	13	1,991	15	3,764	73[c]	2,210	103	2,275	23	1,790	14	2,640
Jul-28	33	35	3,902					67[c]	2,277	106	2,381	18	1,808	27	2,667
Jul-29	32	11	3,913					61[b]	2,338	68	2,449	79	1,887	149	2,816
Jul-30	24	42	3,955					33	2,371	40	2,489	52	1,939	20	2,836
Jul-31	9	29	3,984					17	2,388	33[c]	2,522	27	1,966	88	2,924
Aug-1	21	14	3,998					14	2,402	27[c]	2,549	27	1,993	18	2,942
Aug-2	12	8	4,006					12	2,414	20[c]	2,569	34	2,027	23	2,965
Aug-3	5	17	4,023							13[b]	2,582	24	2,051	9	2,974
Aug-4	2									13	2,595	16	2,067	28	3,002
Aug-5	3									15	2,610	10	2,077	29	3,031
Aug-6	5									23	2,633	3	2,080	12	3,043
Aug-7	6									11	2,644	9	2,089	4	3,047
Aug-8	1													5	3,052

continued

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	2002		2003		2004		2005		2006		2007		2008	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-15														
Jun-16														
Jun-17														
Jun-18														
Jun-19														
Jun-20														
Jun-21														
Jun-22	0	0												
Jun-23	0	0									0	0		
Jun-24	0	0			0	0					0	0	0	0
Jun-25	0	0			0	0					0	0	0	0
Jun-26	1	1			14	14					0	0	1	1
Jun-27	0	1			14	28					0	0	1	2
Jun-28	3	4	2	2	6	34			0	0	0	0	1	3
Jun-29	0	4	8	10	9	43	37[b]	37	1	1	0	0	1	4
Jun-30	4	8	8	18	14	57	21	58	3[b]	4	2	2	2	6
Jul-1	5	13	25	43	14	71	25	83	46[c]	50	6	8	4	10
Jul-2	5	18	32	75	18	89	45	128	89[c]	139	10	18	10	20
Jul-3	9	27	25[c]	100	35	124	29	157	132[b]	271	41	59	8	28
Jul-4	0	27	18[c]	118	10	134	39	196	82	353	29	88	25	53
Jul-5	15	42	11[b]	129	36	170	42	238	72	425	19	107	32	85
Jul-6	41	83	23	152	38	208	229	467	58	483	24	131	35	120
Jul-7	134	217	36	188	39	247	256	723	52	535	13	144	44	164
Jul-8	103	320	73	261	34	281	145	868	77	612	32	176	38	202
Jul-9	135	455	186	447	283	564	158	1,026	134	746	31	207	55	257
Jul-10	134	589	222	669	127	691	93	1,119	159	905	41	248	84	341
Jul-11	100	689	109	778	147	838	93	1,212	211	1,116	43	291	84	425
Jul-12	259	948	88	866	17	855	329	1,541	255	1,371	56	347	31	456
Jul-13	359	1,307	120	986	142	997	255	1,796	216	1,587	59	406	36	492
Jul-14	66	1,373	26	1,012	55	1,052	197	1,993	227	1,814	99	505	68	560
Jul-15	78	1,451	79	1,091	265	1,317	125	2,118	239	2,053	64	569	62	622
Jul-16	37	1,488	41	1,132	40	1,357	208	2,326	141	2,194	48	617	143	765
Jul-17	48	1,536	94	1,226	170	1,527	86	2,412	224	2,418	47	664	323	1,088
Jul-18	23	1,559	217	1,443	47	1,574	179	2,591	157	2,575	94	758	55	1,143
Jul-19	37	1,596	102	1,545	11	1,585	58	2,649	101	2,676	106	864	29	1,172
Jul-20	63	1,659	94	1,639	19	1,604	47	2,696	59	2,735	43	907	35	1,207
Jul-21	22	1,681	50	1,689	18	1,622	130	2,826	69	2,804	30	937	157	1,364
Jul-22	27	1,708	57	1,746	20	1,642	80	2,906	48	2,852	136	1,073	41	1,405
Jul-23	16	1,724	11	1,757	28	1,670	58	2,964	32	2,884	39	1,112	53	1,458
Jul-24	18	1,742	53	1,810	20	1,690	21	2,985	32	2,916	44	1,156	70	1,528
Jul-25	15	1,757	8	1,818	15	1,705	24	3,009	26	2,942	70	1,226	50	1,578
Jul-26	73	1,830	22	1,840	13	1,718	30	3,039	38	2,980	138	1,364	18	1,596
Jul-27	91	1,921	8	1,848	12	1,730	16	3,055	14	2,994	37	1,401	59	1,655
Jul-28	61[c]	1,982	9	1,857	8	1,738	23	3,078	19	3,013	26	1,427	39	1,694
Jul-29	32[c]	2,014	16	1,873	15	1,753	8	3,086	18	3,031			40	1,734
Jul-30	2[b]	2,016	6	1,879	13	1,766	12	3,098					4b	1,738
Jul-31	9	2,025	3	1,882	7	1,773	13	3,111						
Aug-1			13	1,895	1	1,774								
Aug-2			0	1,895										
Aug-3			6	1,901										
Aug-4														
Aug-5														
Aug-6														
Aug-7														
Aug-8														

continued

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	2009		2010		2011		2012		2013		2014[a]		2015	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-15														
Jun-16														
Jun-17			0	0									0	0
Jun-18			0	0	0	0							0	0
Jun-19			0	0	0	0							0	0
Jun-20			0	0	0	0	0	0	0	0			0	0
Jun-21			0	0	0	0	0	0	0	0			0	0
Jun-22			0	0	0	0	0	0	0	0			0	0
Jun-23	0	0	0	0	0	0	0	0	0	0			0	0
Jun-24	0	0	0	0	0	0	0	0	0	0			0	0
Jun-25	0	0	0	0	0	0	0	0	0	0			3	3
Jun-26	0	0	0	0	1	1	0	0	0	0			0	3
Jun-27	0	0	0	0	3	4	0	0	0	0			0	3
Jun-28	0	0	0	0	3	7	0	0	0	0			0	3
Jun-29	0	0	0	0	7	14	0	0	0	0			13	16
Jun-30	0	0	2	2	8	22	0	0	0	0			1	17
Jul-1	5	5	3	5	30	52	0	0	0	0			7	24
Jul-2	0	5	22	27	32	84	2	2	1	1	12[d]	12[d]	6	30
Jul-3	6	11	30	57	33	117	4	6	1	2	46	58	2	32
Jul-4	3	14	9	66	74	191	2	8	4	6	46	104	7	39
Jul-5	7	21	21	87	94	285	9	17	14	20	116[b]	220	10	49
Jul-6	12	33	79	166	115	400	11	28	19	39	229	449	46	95
Jul-7	12	45	32	198	96	496	17	45	30	69	268	717	72	167
Jul-8	44	89	22	220	153	649	28	73	51	120	100	817	28	195
Jul-9	36	125	22	242	212	861	71	144	77	197	138	955	20	215
Jul-10	23	148	69	311	135	996	190	334	43	240	146	1,101	38	253
Jul-11	254	402	33	344	109	1,105	51	385	39	279	324	1,425	25	278
Jul-12	40	442	54	398	138	1,243	124	509	35	314	87	1,512	50	328
Jul-13	288	730	38	436	95	1,338	40	549	19	333	77[b]	1,589	67	395
Jul-14	40	770	67	503	167	1,505	72	621	61	394			116	511
Jul-15	189	959	10	513	131	1,636	28	649	118	512			74	585
Jul-16	201	1,160	54	567	157	1,793	17	666	155	667			46	631
Jul-17	90	1,250	33	600	65	1,858	18	684	28	695			60	691
Jul-18	200	1,450	31	631	140	1,998	25	709	50	745			27	718
Jul-19	20	1,470	99	730	86	2,084	57	766	127	872			53	771
Jul-20	27	1,497	400	1,130	204	2,288	146	912	69	941			92	863
Jul-21	86	1,583	69	1,199	125	2,413	73	985	34	975			29	892
Jul-22	105	1,688	77	1,276	100	2,513	31	1,016	37	1,012			138	1,030
Jul-23	20	1,708	30	1,306	61	2,574	43	1,059	38	1,050			34	1,064
Jul-24	39	1,747	35	1,341	29	2,603	48	1,107	20	1,070			101	1,165
Jul-25	140	1,887	49	1,390	15	2,618	40	1,147	10	1,080			37	1,202
Jul-26	13	1,900	17	1,407	29	2,647	86	1,233	11	1,091			8	1,210
Jul-27	12	1,912	32	1,439	20	2,667	17	1,250	11	1,102			27	1,237
Jul-28	9	1,921	23	1,462	11	2,678	31	1,281	4	1,106			19	1,256
Jul-29	20	1,941	14	1,476	6	2,684	19	1,300	11	1,117			25	1,281
Jul-30	14[b]	1,955	36	1,512	8	2,692	23	1,323	5	1,122			11	1,292
Jul-31			4	1,516					4	1,126			27	1,319
Aug-1														
Aug-2														
Aug-3														
Aug-4														
Aug-5														
Aug-6														

continued

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	2016	
Date	Daily	Cum
Jun-15		
Jun-16		
Jun-17	0	0
Jun-18	0	0
Jun-19	0	0
Jun-20	0	0
Jun-21	0	0
Jun-22	2	2
Jun-23	1	3
Jun-24	1	4
Jun-25	1	5
Jun-26	5	10
Jun-27	5	15
Jun-28	14	29
Jun-29	6	35
Jun-30	36	71
Jul-1	26	97
Jul-2	47	144
Jul-3	48	192
Jul-4	108	300
Jul-5	51	351
Jul-6	130	481
Jul-7	76	557
Jul-8	144	701
Jul-9	32	733
Jul-10	50	783
Jul-11	42	825
Jul-12	34	859
Jul-13	98	957
Jul-14	79	1,036
Jul-15	36	1,072
Jul-16	45	1,117
Jul-17	30	1,147
Jul-18	18	1,165
Jul-19	40	1,205
Jul-20	23	1,228
Jul-21	31	1,259
Jul-22	38	1,297
Jul-23	20	1,317
Jul-24	14	1,331
Jul-25	35	1,366
Jul-26	19	1,385
Jul-27	7	1,392
Jul-28	3	1,395
Jul-29		
Jul-30		
Jul-31		
Aug-1		
Aug-2		
Aug-3		
Aug-4		
Aug-5		
Aug-6		

[a] Incomplete count, counting did not begin until after the run had started.
[b] Partial daily count, count expanded to 24 hours.
[c] Weir not operated due to high water, counts interpolated.
[d] Partial daily count, counting started at 1800 hours.

Appendix 4. — Historical daily and cumulative summer Chum Salmon counts from Gisasa River weir, 1994-2016. Boxes indicate first quarter, mid, and third quarter points of the run.

	1994[a]	1995		1996		1997		1998		1999		2000	
Date	Daily	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-15						0	0						
Jun-16						8	8						
Jun-17						0	8						
Jun-18						1	9						
Jun-19				160	160	8	17						
Jun-20				2,620	2,780	11	28						
Jun-21		3	3	3,679	6,459	10	38	8	8				
Jun-22		131	134	3,234	9,693	30	68	20	28				
Jun-23		254	388	6,736	16,429	28	96	69	97	0	0		
Jun-24		382	770	7,461	23,890	60	156	114	211	0	0		
Jun-25		653	1,423	7,855	31,745	535	691	279	490	0	0		
Jun-26		955	2,378	5,744	37,489	247	938	147	637	0	0		
Jun-27		1,123	3,501	4,422	41,911	696	1,634	202	839	0	0		
Jun-28		2,117	5,618	4,982[c]	46,893	1,074	2,708	253	1,092	0	0	27	27
Jun-29		1,950	7,568	5,542[b]	52,435	696	3,404	291	1,383	0	0	146	173
Jun-30		2,678	10,246	4,939	57,374	373	3,777	297	1,680	1	1	35	208
Jul-1		2,747	12,993	5,849	63,223	769	4,546	359	2,039	0	1	6	214
Jul-2		2,911	15,904	7,692	70,915	681	5,227	390[b]	2,429	0	1	11	225
Jul-3		3,253	19,157	5,703	76,618	852	6,079	838[c]	3,267	1	2	33	258
Jul-4		2,967	22,124	7,250	83,868	1,431	7,510	1,286[c]	4,553	113	115	140	398
Jul-5		3,908	26,032	10,615	94,483	1,895	9,405	1,734[c]	6,287	115	230	462	860
Jul-6		5,663	31,695	10,640	105,123	1,678	11,083	2,182[b]	8,469	50	280	410	1,270
Jul-7		6,765	38,460	7,103	112,226	1,466	12,549	1,075	9,544	257	537	386	1,656
Jul-8		7,439	45,899	6,241	118,467	1,162	13,711	1,017	10,561	376	913	493	2,149
Jul-9		8,347	54,246	4,698	123,165	925	14,636	1,041	11,602	517	1,430	366	2,515
Jul-10		10,664	64,910	4,612	127,777	1,096	15,732	911	12,513	467	1,897	352	2,867
Jul-11		11,207	76,117	4,571	132,348	1,052	16,784	740	13,253	423	2,320	414	3,281
Jul-12	6,178	9,710	85,827	4,511	136,859	1,394	18,178	658	13,911	281	2,601	500	3,781
Jul-13	4,528	9,699	95,526	4,045	140,904	1,081	19,259	623	14,534	299	2,900	559	4,340
Jul-14	5,195	6,519	102,045	4,868	145,772	1,113	20,372	735	15,269	497	3,397	500	4,840
Jul-15	5,449	4,396	106,441	3,691	149,463	1,140	21,512	534	15,803	423	3,820	678	5,518
Jul-16	3,347	4,690	111,131	2,160	151,623	1,339	22,851	687	16,490	426	4,246	778	6,296
Jul-17	3,450	3,344	114,475	1,750	153,373	1,248	24,099	644	17,134	277	4,523	579	6,875
Jul-18	2,193	2,761	117,236	1,282	154,655	693	24,792	487	17,621	372	4,895	931	7,806
Jul-19	2,089	2,706	119,942	1,081	155,736	795	25,587	385	18,006	372	5,267	512	8,318
Jul-20	2,007	2,944	122,886	456	156,192	721	26,308	253	18,259	388	5,655	390	8,708
Jul-21	1,416	2,461	125,347	465	156,657	724	27,032	310	18,569	300	5,955	298	9,006
Jul-22	1,864	1,709	127,056	265	156,922	1,233	28,265	262	18,831	202	6,157	370	9,376
Jul-23	2,138	1,524	128,580	334	157,256	1,081	29,346	267	19,098	267	6,424	291	9,667
Jul-24	1,676	1,343	129,923	320	157,576	564	29,910	292	19,390	354	6,778	173	9,840
Jul-25	2,120	1,280	131,203	348	157,924	918	30,828	294[c]	19,684	644	7,422	154	9,994
Jul-26	1,994	1,073	132,276	492	158,416	367	31,195	296[c]	19,980	433	7,855	100	10,094
Jul-27	1,325	1,158	133,434	336	158,752	605	31,800	297[c]	20,277	252	8,107	141	10,235
Jul-28	994	896	134,330					299[c]	20,576	239	8,346	112	10,347
Jul-29	671	656	134,986					301[b]	20,877	315	8,661	215	10,562
Jul-30	360	500	135,486					91	20,968	165	8,826	206	10,768
Jul-31	321	439	135,925					69	21,037	184[c]	9,010	171	10,939
Aug-1	247	299	136,224					58	21,095	203[c]	9,213	90	11,029
Aug-2	205	330	136,554					47	21,142	221[c]	9,434	116	11,145
Aug-3	225	332	136,886							240[b]	9,674	88	11,233
Aug-4	238									135	9,809	72	11,305
Aug-5	259									168	9,977	44	11,349
Aug-6	194									109	10,086	25	11,374
Aug-7	169									69	10,155	36	11,410
Aug-8	130												

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	2001		2002		2003		2004		2005		2006	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-15												
Jun-16												
Jun-17												
Jun-18												
Jun-19												
Jun-20												
Jun-21												
Jun-22			19	19								
Jun-23			3	22								
Jun-24			68	90			36	36				
Jun-25			150	240			459	495				
Jun-26			128	368			1,005	1,500				
Jun-27			228	596			1,527	3,027				
Jun-28			356	952	248	248	1,499	4,526			1,560	1,560
Jun-29			570	1,522	230	478	1,732	6,258	3,357b	3,357	2,788	4,348
Jun-30			1,331	2,853	561	1,039	1,007	7,265	1,850	5,207	3,996b	8,344
Jul-1			1,116	3,969	890	1,929	853	8,118	2,226	7,433	10,192c	18,536
Jul-2			803	4,772	655	2,584	900	9,018	2,092	9,525	16,387c	34,923
Jul-3			833	5,605	680c	3,264	858	9,876	2,884	12,409	22,583b	57,506
Jul-4			430	6,035	706c	3,970	709	10,585	3,702	16,111	21,897	79,403
Jul-5			1,059	7,094	731b	4,701	1,201	11,786	6,330	22,441	19,597	99,000
Jul-6			1,765	8,859	609	5,310	1,855	13,641	8,352	30,793	19,538	118,538
Jul-7	229	229	2,293	11,152	1,181	6,491	1,093	14,734	8,404	39,197	12,310	130,848
Jul-8	705	934	2,122	13,274	957	7,448	1,836	16,570	6,564	45,761	14,500	145,348
Jul-9	758	1,692	1,879	15,153	1,222	8,670	1,939	18,509	5,980	51,741	16,121	161,469
Jul-10	1,176	2,868	2,446	17,599	1,004	9,674	1,655	20,164	4,621	56,362	14,216	175,685
Jul-11	1,305	4,173	1,493	19,092	1,455	11,129	1,596	21,760	4,807	61,169	13,101	188,786
Jul-12	1,522	5,695	1,731	20,823	1,303	12,432	1,568	23,328	10,256	71,425	11,011	199,797
Jul-13	1,781	7,476	1,898	22,721	1,361	13,793	1,824	25,152	12,057	83,482	8,398	208,195
Jul-14	2,032	9,508	1,608	24,329	909	14,702	1,632	26,784	11,537	95,019	6,795	214,990
Jul-15	1,741	11,249	1,017	25,346	1,287	15,989	1,289	28,073	9,813	104,832	6,286	221,276
Jul-16	998	12,247	1,225	26,571	529	16,518	1,503	29,576	9,981	114,813	5,477	226,753
Jul-17	727	12,974	1,186	27,757	1,321	17,839	1,240	30,816	8,076	122,889	6,257	233,010
Jul-18	575	13,549	1,086	28,843	1,924	19,763	917	31,733	9,758	132,647	4,847	237,857
Jul-19	708	14,257	774	29,617	1,439	21,202	951	32,684	7,031	139,678	4,734	242,591
Jul-20	616	14,873	728	30,345	823	22,025	685	33,369	5,716	145,394	3,991	246,582
Jul-21	549	15,422	669	31,014	626	22,651	846	34,215	5,324	150,718	3,082	249,664
Jul-22	492	15,914	544	31,558	432	23,083	572	34,787	4,490	155,208	2,498	252,162
Jul-23	432	16,346	377	31,935	264	23,347	478	35,265	4,285	159,493	1,922	254,084
Jul-24	266	16,612	272	32,207	411	23,758	600	35,865	3,776	163,269	1,929	256,013
Jul-25	250	16,862	268	32,475	209	23,967	577	36,442	2,571	165,840	1,689	257,702
Jul-26	142	17,004	315	32,790	168	24,135	357	36,799	2,112	167,952	1,360	259,062
Jul-27	114	17,118	226	33,016	212	24,347	333	37,132	1,460	169,412	847	259,909
Jul-28	149	17,267	178[c]	33,194	310	24,657	207	37,339	1,141	170,553	681	260,590
Jul-29	146	17,413	130[c]	33,324	316	24,973	186	37,525	779	171,332	716	261,306
Jul-30	87	17,500	82[b]	33,406	264	25,237	131	37,656	575	171,907		
Jul-31	76	17,576	75	33,481	120	25,357	132	37,788	352	172,259		
Aug-1	67	17,643			204	25,561	63	37,851				
Aug-2	63	17,706			207	25,768						
Aug-3	56	17,762			231	25,999						
Aug-4	50	17,812										
Aug-5	43	17,855										
Aug-6	41	17,896										
Aug-7	44	17,940										
Aug-8	6	17,946										

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	2007		2008		2009		2010		2011	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-15										
Jun-16										
Jun-17							0	0		
Jun-18							0	0	0	0
Jun-19							0	0	0	0
Jun-20							0	0	4	4
Jun-21							0	0	13	17
Jun-22							0	0	117	134
Jun-23	0	0			2[b]	2	1	1	228	362
Jun-24	5	5	2[b]	2	3	5	0	1	312	674
Jun-25	9	14	29[c]	31	3	8	0	1	331	1,005
Jun-26	5	19	56[c]	87	27	35	0	1	365	1,370
Jun-27	12	31	82	169	26	61	2	3	494	1,864
Jun-28	31	62	187	356	70	131	11	14	652	2,516
Jun-29	214	276	195	551	126	257	8	22	1,213	3,729
Jun-30	1,513	1,789	185	736	550	807	361	383	2,345	6,074
Jul-1	1,925	3,714	633	1,369	817	1,624	741	1,124	2,606	8,680
Jul-2	2,870	6,584	834	2,203	515	2,139	2,734	3,858	3,053	11,733
Jul-3	2,926	9,510	1,285	3,488	667	2,806	2,620	6,478	3,841	15,574
Jul-4	2,666	12,176	1,434	4,922	828	3,634	2,722	9,200	4,311	19,885
Jul-5	2,322	14,498	1,371	6,293	838	4,472	3,056	12,256	4,460	24,345
Jul-6	2,196	16,694	1,117	7,410	1,451	5,923	2,734	14,990	5,013	29,358
Jul-7	2,028	18,722	1,216	8,626	947	6,870	2,739	17,729	5,622	34,980
Jul-8	2,207	20,929	1,325	9,951	1,197	8,067	2,977	20,706	4,774	39,754
Jul-9	1,817	22,746	1,110	11,061	1,062	9,129	3,182	23,888	4,072	43,826
Jul-10	1,620	24,366	1,146	12,207	1,002	10,131	3,478	27,366	2,894	46,720
Jul-11	1,446	25,812	1,230	13,437	1,961	12,092	3,439	30,805	1,718	48,438
Jul-12	1,155	26,967	1,429	14,866	1,578	13,670	2,501	33,306	1,456	49,894
Jul-13	1,000	27,967	2,300	17,166	2,060	15,730	1,732	35,038	1,121	51,015
Jul-14	1,368	29,335	1,955	19,121	1,484	17,214	1,491	36,529	2,759	53,774
Jul-15	1,184	30,519	1,949	21,070	1,180	18,394	1,366	37,895	3,729	57,503
Jul-16	908	31,427	1,518	22,588	863	19,257	1,176	39,071	4,656	62,159
Jul-17	1,134	32,561	1,363	23,951	957	20,214	955	40,026	5,152	67,311
Jul-18	1,152	33,713	940	24,891	736	20,950	674	40,700	4,292	71,603
Jul-19	918	34,631	971	25,862	628	21,578	714	41,414	5,106	76,709
Jul-20	1,177	35,808	836	26,698	969	22,547	857	42,271	5,457	82,166
Jul-21	909	36,717	969	27,667	680	23,227	754	43,025	4,533	86,699
Jul-22	903	37,620	951	28,618	606	23,833	711	43,736	2,501	89,200
Jul-23	1,151	38,771	1,203	29,821	519	24,352	447	44,183	1,551	90,751
Jul-24	1,257	40,028	1,581	31,402	312	24,664	554	44,737	1,413	92,164
Jul-25	1,740	41,768	1,691	33,093	349	25,013	425	45,162	939	93,103
Jul-26	1,703	43,471	1,112	34,205	224	25,237	476	45,638	859	93,962
Jul-27	1,532	45,003	1,005	35,210	150	25,387	492	46,130	743	94,705
Jul-28	1,254	46,257	883	36,093	143	25,530	407	46,537	495	95,200
Jul-29			625	36,718	210	25,740	341	46,878	334	95,534
Jul-30			220	36,938	164	25,904	359	47,237	262	95,796
Jul-31							432	47,669		
Aug-1										
Aug-2										
Aug-3										
Aug-4										
Aug-5										
Aug-6										
Aug-7										
Aug-8										

continued

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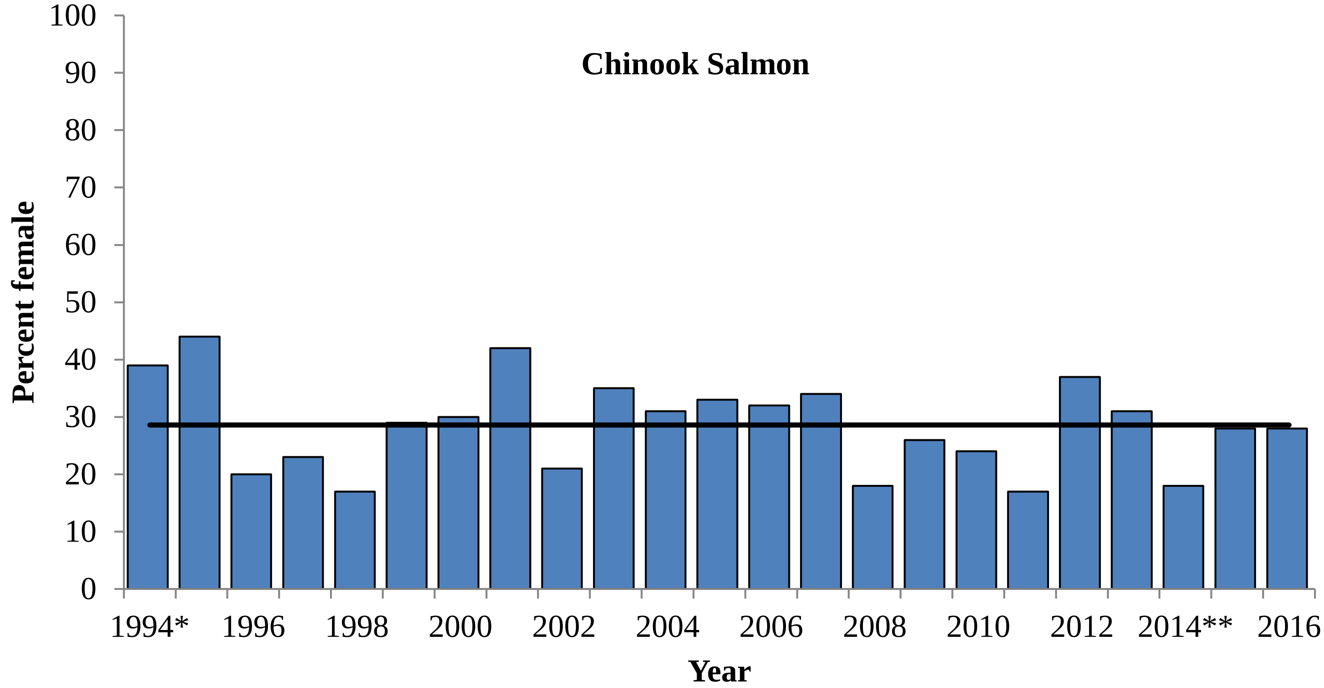
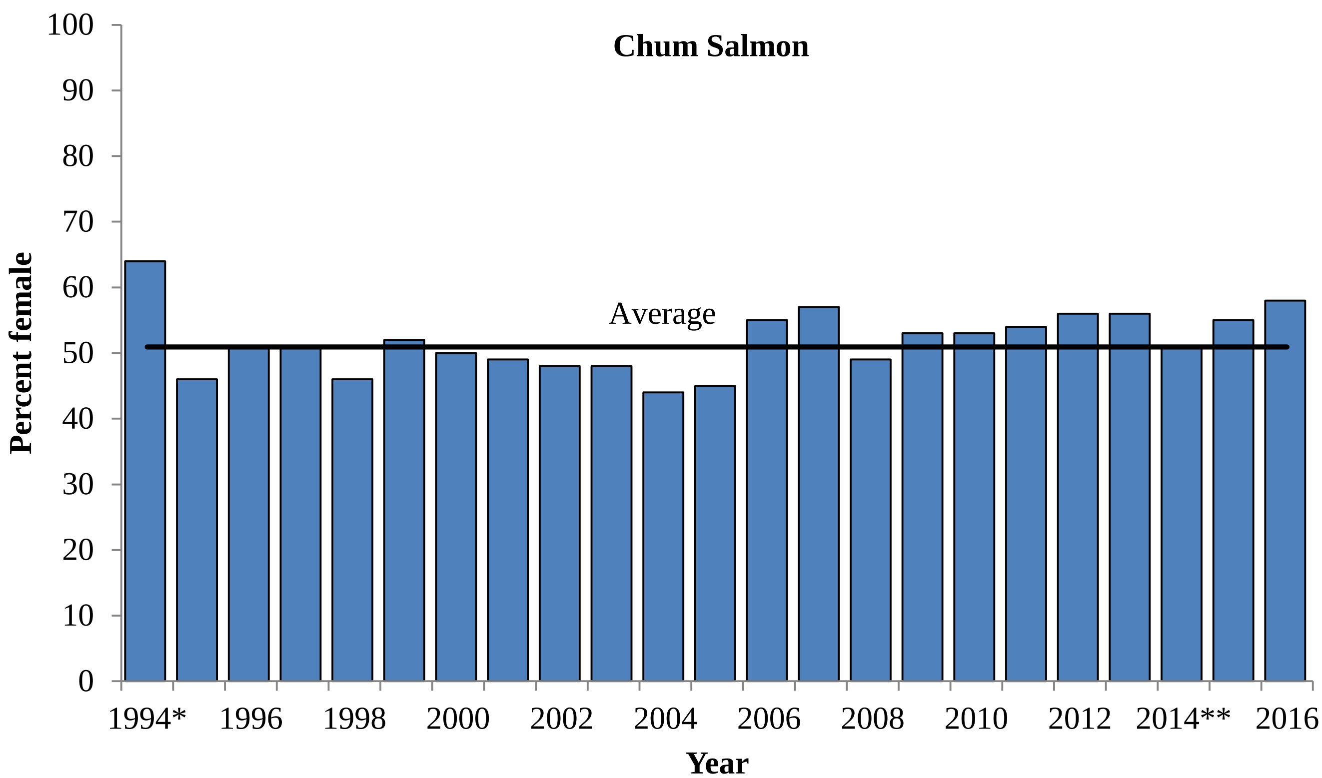
	2012		2013		2014		2015		2016	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-15										
Jun-16										
Jun-17							0	0	33	33
Jun-18							6	6	39	72
Jun-19							10	16	67	139
Jun-20	0	0	0	0			8	24	504	643
Jun-21	0	0	0	0			12	36	131	774
Jun-22	0	0	0	0			329	365	739	1,513
Jun-23	0	0	0	0			27	392	386	1,899
Jun-24	0	0	0	0			60	452	727	2,626
Jun-25	0	0	0	0			877	1,329	842	3,468
Jun-26	0	0	0	0			131	1,460	962	4,430
Jun-27	0	0	2	2			392	1,852	1,490	5,920
Jun-28	1	1	0	2			490	2,342	3,215	9,135
Jun-29	7	8	0	2			1,446	3,788	2,230	11,365
Jun-30	74	82	2	4			596	4,384	3,608	14,973
Jul-1	1,426	1,508	1	5			793	5,177	2,788	17,761
Jul-2	1,563	3,071	288	293	792[d]	792[d]	351	5,528	2,230	19,991
Jul-3	2,094	5,165	1,444	1,737	2,616	3,408	785	6,313	2,301	22,292
Jul-4	2,830	7,995	2,519	4,256	3,280	6,688	1,811	8,124	3,280	25,572
Jul-5	3,027	11,022	5,534	9,790	5,095[b]	11,783	851	8,975	2,109	27,681
Jul-6	4,073	15,095	4,661	14,451	3,599	15,382	1,087	10,062	2,150	29,831
Jul-7	4,023	19,118	7,316	21,767	4,356	19,738	909	10,971	2,417	32,248
Jul-8	3,008	22,126	5,834	27,601	2,244	21,982	984	11,955	2,290	34,538
Jul-9	2,408	24,534	3,562	31,163	2,776	24,758	1,841	13,796	1,468	36,006
Jul-10	4,898	29,432	6,163	37,326	2,064	26,822	2,009	15,805	1,609	37,615
Jul-11	4,548	33,980	6,081	43,407	2,975	29,797	2,464	18,269	1,757	39,372
Jul-12	5,000	38,980	4,963	48,370	1,377	31,174	2,668	20,937	1,485	40,857
Jul-13	4,451	43,431	4,502	52,872	1,349[b]	32,523	2,474	23,411	1,734	42,591
Jul-14	3,398	46,829	5,745	58,617			3,614	27,025	985	43,576
Jul-15	4,150	50,979	4,814	63,431			2,213	29,238	1,496	45,072
Jul-16	3,415	54,394	2,617	66,048			2,236	31,474	1,387	46,459
Jul-17	2,823	57,217	1,363	67,411			1,499	32,973	774	47,233
Jul-18	2,279	59,496	1,697	69,108			907	33,880	659	47,892
Jul-19	2,905	62,401	2,196	71,304			1,164	35,044	2,243	50,135
Jul-20	3,599	66,000	1,803	73,107			1,365	36,409	1,996	52,131
Jul-21	3,740	69,740	1,247	74,354			1,119	37,528	1,771	53,902
Jul-22	2,505	72,245	1,756	76,110			1,164	38,692	2,447	56,349
Jul-23	2,687	74,932	1,237	77,347			589	39,281	2,676	59,025
Jul-24	1,883	76,815	717	78,064			909	40,190	1,895	60,920
Jul-25	1,311	78,126	408	78,472			528	40,718	1,667	62,587
Jul-26	1,328	79,454	476	78,948			428	41,146	1,490	64,077
Jul-27	1,163	80,617	393	79,341			409	41,555	1,798	65,875
Jul-28	1,484	82,101	250	79,591			310	41,865	795	66,670
Jul-29	800	82,901	158	79,749			385	42,250		
Jul-30	522	83,423	170	79,919			210	42,460		
Jul-31			136	80,055			287	42,747		
Aug-1										
Aug-2										
Aug-3										
Aug-4										
Aug-5										
Aug-6										

[a] Incomplete count, counting did not begin until after the run had started.
[b] Partial daily count, count expanded to 24 hours.
[c] Weir not operated due to high water, counts interpolated.
[d] Partial daily count, counting started at 1800 hours.

Appendix 5. — Historical percentages of female Chinook Salmon and summer Chum Salmon for the Gisasa River weir 1994-2016. *Data from the first year of operation (1994) is only a partial count; counting did not begin until July 10, after the run was underway and this data is not included in the average. **Data from 2014 is a partial count due to extremely high water and is not included in the average. Horizontal line represents the 1995-2015 average.





Appendix 6. — Historical percentages of female Chinook Salmon and summer Chum Salmon sampled at Gisasa River weir, Alaska. *Asterisk indicates incomplete data from the first year of operation (1994); data collection did not begin until July 10. **Asterisks indicate incomplete data from 2014 when high water events impeded weir operation for all but 12 days. Data from 1994 and 2014 were not included in the average.

Year	Chinook Salmon %	Chum Salmon %
1994*	39	64
1995	44	46
1996	20	51
1997	23	51
1998	17	46
1999	29	52
2000	30	50
2001	42	49
2002	21	48
2003	35	48
2004	31	44
2005	33	45
2006	32	55
2007	34	57
2008	18	49
2009	26	53
2010	24	53
2011	17	54
2012	37	56
2013	31	56
2014**	18	51
2015	28	55
2016	28	58

Appendix 7. — Water quality parameters collected by YSI handheld unit during the 2016 season at the Gisasa River weir, Alaska.

	Conductivity (µs/cm)		Dissolved Oxygen (mg/L)		pH	
Date	AM	PM	AM	PM	AM	PM
Jun-16	305.6	-	10.15	-	7.78	-
Jun-17	323.9	333.4	9.60	9.87	7.88	7.91
Jun-18	310.3	313.0	9.71	9.80	7.82	8.05
Jun-19	301.3	313.3	10.20	10.27	8.12	7.99
Jun-20	304.5	312.3	10.13	10.63	8.07	8.18
Jun-21	298.8	305.7	10.44	10.64	8.04	8.07
Jun-22	295.8	331.9	10.43	10.06	8.07	8.10
Jun-23	320.1	341.5	9.85	9.70	8.16	8.04
Jun-24	321.1	334.9	9.12	10.12	8.10	8.05
Jun-25	320.8	351.6	9.48	9.55	8.16	8.15
Jun-26	331.5	346.4	9.35	10.08	8.11	8.14
Jun-27	328.4	335.1	9.34	10.29	8.14	8.22
Jun-28	319.5	348.4	9.76	10.51	8.21	8.15
Jun-29	336.9	347.2	9.33	10.01	7.99	8.21
Jun-30	328.7	359.9	9.25	9.84	8.21	8.15
Jul-1	338.8	362.4	8.96	9.84	8.13	8.21
Jul-2	345.0	342.0	8.36	9.90	8.14	8.27
Jul-3	328.3	335.5	9.74	10.65	8.15	8.18
Jul-4	325.4	354.1	9.36	10.12	8.05	8.16
Jul-5	337.7	345.6	8.59	10.06	8.24	8.24
Jul-6	325.1	338.9	9.27	10.04	8.16	8.19
Jul-7	328.9	344.0	9.36	10.13	8.15	8.13
Jul-8	328.3	345.6	9.50	10.34	8.15	8.32
Jul-9	328.6	341.3	9.63	10.90	8.21	8.31
Jul-10	330.9	342.0	9.61	10.77	8.18	8.32
Jul-11	318.8	355.1	9.69	10.56	8.25	8.38
Jul-12	333.0	371.5	9.46	10.34	8.20	8.25
Jul-13	347.2	387.6	9.20	10.34	8.23	8.31
Jul-14	363.3	389.6	8.37	10.11	8.15	8.32
Jul-15	370.8	392.6	8.36	9.58	8.14	8.29
Jul-16	369.3	378.1	8.17	9.66	8.13	8.25
Jul-17	360.9	350.9	9.10	9.87	8.17	8.25
Jul-18	336.0	336.5	8.85	10.08	8.20	8.24
Jul-19	328.2	355.9	10.05	10.89	8.18	8.34
Jul-20	344.2	339.6	9.34	10.35	8.23	8.30
Jul-21	323.9	321.8	9.35	10.66	8.17	8.30
Jul-22	315.0	336.3	10.42	10.80	8.27	8.32
Jul-23	326.4	337.8	10.20	10.76	8.21	8.29
Jul-24	321.1	335.5	10.37	11.04	8.27	8.41
Jul-25	317.7	349.5	9.94	10.81	8.26	8.38
Jul-26	236.1	340.7	9.92	10.49	8.25	8.30
Jul-27	331.2	363.5	9.77	10.65	8.29	8.34
Jul-28	344.3		9.59		8.26	

Appendix 8. — Water quality data collected by YSI sonde during the 2016 season at the Gisasa River weir, Alaska. Daily water quality values are averages of readings taken at 20-minute intervals.

Date	Temperature (°C)	Conductivity (µS/cm)	pH	Turbidity (NTU)	DO	
					mg/L	(% saturation)
7-Jul	15.39	610.6	8.1	20.2	10.0	100.0
8-Jul	15.22	610.0	8.2	1.0	10.1	101.2
9-Jul	14.90	605.3	8.2	1.4	10.3	101.7
10-Jul	14.96	607.3	8.2	0.5	10.2	101.7
11-Jul	14.58	603.4	8.2	6.8	10.6	104.5
12-Jul	16.22	632.8	8.2	3.3	10.3	105.6
13-Jul	17.74	660.1	8.2	15.6	10.1	106.0
14-Jul	18.81	678.6	8.2	7.6	9.8	105.3
15-Jul	19.18	685.5	8.2	1.0	9.7	104.9
16-Jul	18.08	674.4	8.2	0.5	9.9	104.5
17-Jul	15.79	640.7	8.2	0.3	9.9	100.2
18-Jul	14.05	602.8	8.2	6.3	10.3	100.7
19-Jul	14.45	609.7	8.2	0.8	10.8	106.4
20-Jul	14.54	613.0	8.2	1.2	10.3	101.6
21-Jul	12.88	574.3	8.1	4.6	10.5	99.8
22-Jul	12.84	570.8	8.2	2.4	10.9	103.4
23-Jul	13.63	582.9	8.2	2.1	10.7	103.2
24-Jul	13.73	573.2	8.2	3.9	10.6	102.9
25-Jul	14.06	579.9	8.2	3.5	10.8	104.8
26-Jul	14.18	584.2	8.2	2.5	10.6	103.8
27-Jul	15.15	599.2	8.2	2.0	10.6	105.7
28-Jul	15.07	600.3	8.1	1.8	9.9	98.4
Average	15.25	613.6	8.2	4.1	10.3	103.0
Max	19.18	685.5	8.2	20.2	10.9	106.4
Min	12.84	570.8	8.1	0.3	9.7	98.4

Appendix 9. — Weir bypass data collected during the 2016 season at the Gisasa River weir, Alaska. *Asterisk indicates that fish bypassed the weir by going between a weir panel and the base rail.

Sample event	Date	Substrate Rail	Hour	Chinook	Chum	Longnose Sucker	Grayling	Northern Pike	Other	Comments
1	1-Jul	2	13	0	0	0	0	0	0	
2	2-Jul	1	23	0	0	0	0	0	4	
3	2-Jul	9	21	0	0	0	0	0	0	
4	2-Jul	2	9	0	0	0	0	0	10	
5	4-Jul	7	5	0	0	0	0	0	0	
6	3-Jul	5	15	0	0	0	0	0	0	
7	4-Jul	6	21	0	0	0	0	0	0	
8	4-Jul	1	17	0	0	0	0	1	4	
9	5-Jul	7	10	0	0	0	0	0	0	
10	5-Jul	5	8	0	0	0	0	0	0	
11	6-Jul	5	12	0	0	0	0	0	0	
12	6-Jul	3	17	0	0	0	0	0	0	
13	7-Jul	3	3	-	-	-	-	-	-	too turbid
14	8-Jul	1	24	0	0	0	0	0	0	
15	9-Jul	9	8	0	0	0	0	0	0	
16	9-Jul	5	16	0	1	0	0	0	0	*btw panel and rail
17	9-Jul	3	22	0	0	0	0	0	0	
18	9-Jul	5	17	0	2	0	0	0	0	*btw panel and rail
19	9-Jul	7	18	0	0	0	0	0	0	
20	10-Jul	9	2	-	-	-	-	-	-	equipment failure
21	12-Jul	9	22	0	0	0	0	0	0	
22	12-Jul	3	2	-	-	-	-	-	-	equipment failure
23	12-Jul	3	1	0	0	0	0	0	0	
24	12-Jul	4	23	0	12	0	0	0	0	Under rail
25	12-Jul	5	3	-	-	-	-	-	-	equipment failure
26	13-Jul	7	7	0	0	0	0	0	0	
27	14-Jul	6	11	0	0	0	0	0	0	
28	15-Jul	7	17	0	0	0	0	0	0	
29	15-Jul	2	11	0	0	0	0	0	0	
30	15-Jul	9	10	0	0	0	0	0	0	
31	17-Jul	4	17	0	19	0	0	0	0	under rail
32	16-Jul	9	24	0	0	0	0	0	0	
33	17-Jul	7	18	0	0	0	0	0	0	
34	17-Jul	9	24	0	0	0	0	0	0	
35	18-Jul	3	14	0	0	0	0	0	0	
36	23-Jul	1	4	0	0	0	0	0	0	
37	23-Jul	1	7	-	-	-	-	-	-	equipment failure
38	20-Jul	5	21	-	-	-	-	-	-	equipment failure
39	20-Jul	2	16	0	0	0	0	0	0	
40	21-Jul	8	13	-	-	-	-	-	-	too turbid
41	22-Jul	1	15	0	0	0	0	0	0	
42	21-Jul	9	18	0	0	0	0	0	0	
43	22-Jul	1	22	0	0	0	0	0	0	
44	22-Jul	6	8	0	0	0	0	0	0	
45	23-Jul	1	23	0	0	0	0	0	0	
46	23-Jul	4	15	0	3	0	0	0	0	under rail
47	24-Jul	3	15	0	0	0	0	0	0	
48	24-Jul	5	20	0	0	0	0	0	0	
49	25-Jul	5	10	0	0	0	0	0	0	
50	25-Jul	6	9	0	0	0	0	0	0	
51	25-Jul	6	7	0	0	0	0	0	0	
52	27-Jul	3	22	0	0	0	0	0	0	
53	27-Jul	7	10	0	0	0	0	0	0	
54	27-Jul	3	19	0	0	0	0	0	0	