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Abundance and Run Timing of Adult Salmon in the Gisasa River, Koyukuk National Wildlife Refuge, Alaska, 2010

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Jeffery L. Melegari

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 chum salmon *O. keta* in the Gisasa River. This was the 17th year of operating the weir at this location. In 2010, the weir was operated from June 17 through July 31. An estimated 1,516 Chinook salmon and 47,669 summer chum salmon passed through the weir. The most abundant other species was pink salmon *O. gorbuscha* (N = 123), followed by longnose sucker *Catostomus catostomus* (N = 50), northern pike *Esox lucius* (N = 31), Arctic grayling *Thymallus arcticus* (N = 16), sockeye salmon *O. nerka* (N = 15), and whitefish spp. (Coregoninae; N = 2). The estimated weekly sex composition for Chinook salmon ranged from 20% to 52% female fish, and averaged 24% for the season. Three primary age classes were identified, 1.2, 1.3, and 1.4, for Chinook salmon, with the predominant age class being 1.3 (47%). Length at age of female Chinook salmon was larger than males. The estimated weekly sex composition for summer chum salmon ranged from 35% to 66% female fish, and averaged 53% for the season. There were two primary age classes identified for chum salmon, 0.3 and 0.4, with the predominant age class being 0.3 (65%). Length at age of male chum salmon was larger than females.

Introduction

The Gisasa River, located within the Koyukuk National Wildlife Refuge in north-central 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 from 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, international treaty obligations are met, and subsistence opportunities are maintained.

Yukon River salmon stocks began to decline 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). Returns showed some improvement beginning in 2001 and continuing through 2005 (JTC 2006), with some declines again occurring in 2007 - 2009 (JTC 2009, 2010). Management of individual stocks does not occur and accurate escapement data are limited throughout the Yukon River drainage. In-season management of the salmon fisheries is conducted using: preseason projections based on parent stock returns, Pilot Station sonar counts, Eagle sonar counts, information provided by test fisheries, data from escapement projects, and harvest data from subsistence and commercial fisheries.

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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. Therefore, weirs or counting towers have been operated in five different Koyukuk River tributaries between 1994 and 2010 (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; O'Brien 2006). Chinook salmon escapement estimates from weir counts on the Gisasa River from 1994 to 2009 ranged from 1,427 to 4,023 fish. Chum salmon escapement estimates for the same period ranged from 10,155 to 261,305 fish. For 2010, the objectives of the Gisasa River weir were to: (1) determine daily passage, estimate seasonal escapement, and describe run timing of adult Chinook salmon and summer chum salmon, (2) determine sex and size composition of adult Chinook salmon 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 to the 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° 15.206' N, 157° 42.529' W (USGS 1:63,360 series, Kateel River B-4 quadrangle), 90 km upriver from the mouth of the Koyukuk River (Figure 1). Climate of 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 months to -57° C during winter months (USFWS 1993). The hydrology of this area is dynamic throughout the year, with lower flows generally occurring in 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 bed slopes gradually from the stream banks to the thalweg. The river width is approximately 45 m, and depth, measured at the trap located near the thalweg, ranged from 51 to over 100 cm throughout the 2010 season (Appendix 2). Predominant substrate at the weir site consists of medium size gravel 35-70 mm diameter.

Methods

Weir Construction and Deployment

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). The weir was visually inspected for integrity and cleaned of debris daily. 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 could be closed to hold fish for sampling. Water depth (cm) and temperature (°C) were recorded daily at the trap.

Biological Data

The target start date of the project was based on previous years' salmon run timing data. The end date of the project is determined in-season, normally when the daily count of both species has dropped to less than 1% of the seasonal passage to date and continued at this level for three or more consecutive days, or when logistical constraints require stopping before this point is reached. Daily counts were less than 1% for the last four days of counting for chum salmon and for two out of the last three days for Chinook salmon in 2010. All fish passing through the weir were identified to species and enumerated, with the exception of whitefish *Coregonus* and *Prosopium* spp. Non-salmon species were not handled, so it was difficult to identify different whitefish species. Therefore all whitefish species were grouped under the subfamily Coregoninae.

The daily counting schedule was variable, depending on the quantity of fish migrating upriver. Early in the season, when fish passage was low, the weir was unmonitored from 0000 hours to 0800 hours with the trap closed to prevent upstream passage. As fish passage increased, the counting schedule increased to 24 hours per day. Counts and sex ratios from the previous day were reported daily to the FFWFO using a 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 salmon and summer chum salmon. Sampling started at the beginning of each week and generally was conducted over a 3-4 day period, targeting 160 salmon/species/week. Lengths were measured to the nearest 5 mm from mid-eye to fork of the caudal fin (METF) 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 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 the ADF&G for processing. All age 1.1 and 1.2 Chinook salmon were assumed to be males (Brady 1983; Bales 2007; Karpovich and DuBois 2007) regardless of the field determination.

Data Analysis

Days with counts greater than 6 h but less that 24 h were adjusted for a 24 h 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 h of the day counted were disregarded and those days were treated as completely missed days. Completely missed days were estimated by linear interpolation from the daily counts before and after the missing period.

Calculations for age and sex information were treated as a stratified random sample (Cochran 1977) with statistical weeks as the strata. A statistical week was generally defined as beginning on Sunday and ending on Saturday. 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 salmon 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 at 1630 hours on June 17, with no fish counted on that day. Counting continued throughout the season with no substantial interruptions. The counting was discontinued at 2400 hours on July 31. The picket spacing (3.5cm space between pickets) within the trap and weir panels was narrow enough to prevent adult Chinook salmon and chum salmon from passing through the weir. However, some individuals of the smaller fish species, such as Arctic grayling *Thymallus arcticus*, whitefish spp. (Coregoninae), and some pink salmon *O. gorbuscha* likely passed through the weir undetected.

Biological Data

The seasonal estimates of fish passage at the weir were 1,516 Chinook salmon and 47,669 summer chum salmon (Table 1; Figure 2). The next most abundant species was pink salmon (N = 123), followed by longnose sucker *Catostomus catostomus* (N = 50), northern pike *Esox lucius* (N = 31), Arctic grayling (N = 16), sockeye salmon *O. nerka* (N = 15), and whitefish spp. (N = 2)

Chinook Salmon

The seasonal estimate of 1,516 Chinook salmon was 62% of the 1995-2009 average of 2,463 (1994 was only a partial count and is not included in the averages). The 2010 estimate was the second lowest weir estimate to date (Figure 2, Appendix 1). This is consistant with Chinook salmon returns throughout the Yukon River in 2010 which were also weak (JTC 2011). The first Chinook salmon was counted on June 30, when two were passed through the weir. During the final day of weir operation (July 31), four Chinook salmon (0.3% of the seasonal estimate) were counted through the weir. Overall, run timing appeared near average, with the first quarter and third quarter passage dates (July 12, and 21 respectively) one and two days respectively, later than the 1995-2009 average. The mid-point passage date however, occurred five days later than the 1995-2009 average. This occurred on July 20, when an uncharacteristically large number of Chinook salmon (400) were counted through the weir (Table 1; Figure 3), and coincided with the beginning of a rise in water levels.

Due to low fish passage during the early weeks of weir operations, sampling objectives for age, sex, and length data were not attained. Therefore, these weeks were combined to make the first statistical strata (6/30-7/10; Table 2). Samples were collected from 600 Chinook salmon during the season, with age unable to be determined for 108 (18%) of those samples, primarily due to scale regeneration. There were three primary age classes; 1.2, 1.3, and 1.4 from brood years 2006, 2005, and 2004, respectively. Age class 1.3 was predominant overall, accounting for 47% of the season total, with stratum estimates ranging from 37% to 49%. The second most abundant age class was 1.2, accounting for 45% of the season total, with stratum estimates ranging from 24% to 58%. Age class 1.4 accounted for 7% of the season total with stratum estimates ranging from 4% to 25%. The age distributions differed between males and females. Males were predominantly age 1.2 (60%) followed by age 1.3 (37%), while females were predominantly age 1.3 (73%) followed by age 1.4 (24%). The estimated sex ratio for the entire run was 24% female, and estimates for each stratum ranged from 20% to 52% female fish. Female Chinook salmon ranged from 595 to 900 mm METF and males ranged from 280 to 880 mm METF (Table 3). For length-at-age, the means of female fish were larger than males.

Chum Salmon

Overall, returns of summer chum salmon to the Yukon River during 2010 were variable, but most tributaries had good escapements (JTC 2011). The 1995-2009 average of seasonal estimates for summer chum salmon in the Gisasa River is greatly influenced by the high escapements during 1995, 1996, 2005, and 2006 (Figure 4),thus, the average may not be a good measure of central tendency. For this reason the 2010 estimate is also compared to the historical median. The 2010 estimate of 47,669 summer chum salmon was only 70% of the average (68,539), but was 142% of the median (33,481) for the same period (Figure 4; Figure 5; Appendix 1). The first chum salmon was counted on June 23. During the final day of counting (July 31), 432 summer chum salmon (0.9% of the seasonal estimate) were passed through the weir. Run timing was slightly earlier than average, with the first quarter passage date (July 5) one day earlier than the 1995-2009 average, while both the Mid-point and third quarter passage dates (July 9 and 14 respectively) occurring three days earlier than the 1995-2009 averages.

Due to low passage, sampling objectives for age, sex, and length data were not attained during the first statistical week of weir operations. Because of this low sample size, the first two statistical weeks were combined to make the first strata (6/23-7/3; Table 4). Age, sex, and length samples were collected from 1009 summer chum salmon, with age unable to be determined for 60 (6%) of those samples. Age class 0.3 was predominant, accounting for 65% of the season

total, with stratum estimates ranging from 50% to 75%. Age class 0.4 was the next most abundant, and accounted for 23% of the season total, with stratum estimates ranging from 14% to 44%. Also included were age classes 0.2 and 0.5, accounting for 10% and 2% of the season total respectively. Age distributions were similar for both sexes. The estimated sex ratio for the entire run was 53% female, and estimates for each stratum ranged from 35% to 66% female fish. Female summer chum salmon ranged from 440 to 635 mm METF and males ranged from 440 to 690 mm METF (Table 5). For length-at-age measurements, mean lengths of male fish were larger than females.

The information collected at the Gisasa River weir is vital to the difficult task of 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 17 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 counts of other species, at the Gisasa River weir, Alaska, 2010. Asterisks (*****) indicate first, mid, and third quarter points of Chinook salmon and summer chum salmon passage estimates.

	Chinook salmon		Chum salmon		Pink salmon	Longnose sucker	Northern pike	Arctic grayling	Sockeye salmon	Whitefish spp.
Date	Daily	Cum	Daily	Cum		Daily	Daily	Daily	Daily	Daily
Jun-17	0	0	0	0	0	0	0	0	0	0
Jun-18	0	0	0	0	0	0	0	0	0	0
Jun-19	0	0	0	0	0	5	1	0	0	0
Jun-20	0	0	0	0	0	4	1	0	0	0
Jun-21	0	0	0	0	0	11	1	0	0	0
Jun-22	0	0	0	0	0	11	0	0	0	0
Jun-23	0	0	1	1	0	8	0	0	0	0
Jun-24	0	0	0	1	0	1	3	0	0	0
Jun-25	0	0	0	1	0	3	1	0	0	0
Jun-26	0	0	0	1	0	1	2	0	0	0
Jun-27	0	0	2	3	0	1	0	0	0	0
Jun-28	0	0	11	14	0	1	2	0	0	0
Jun-29	0	0	8	22	0	2	0	0	0	0
Jun-30	2	2	361	383	0	0	0	1	0	0
Jul-01	3	5	741	1,124	0	0	0	1	0	0
Jul-02	22	27	2734	3,858	1	1	3	2	0	0
Jul-03	30	57	2620	6,478	0	0	1	1	0	0
Jul-04	9	66	2722	9,200	0	0	3	2	0	1
Jul-05	21	87	3056	12,256*	1	0	1	1	0	0
Jul-06	79	166	2734	14,990	0	0	0	1	0	0
Jul-07	32	198	2739	17,729	2	0	1	0	0	0
Jul-08	22	220	2977	20,706	1	0	1	1	0	0
Jul-09	22	242	3182	23,888*	2	0	2	3	0	1
Jul-10	69	311	3478	27,366	2	1	0	0	1	0
Jul-11	33	344	3439	30,805	5	0	2	0	2	0
Jul-12	54	398*	2501	33,306	2	0	1	0	0	0
Jul-13	38	436	1732	35,038	1	0	2	0	1	0
Jul-14	67	503	1491	36,529*	20	0	0	0	1	0
Jul-15	10	513	1366	37,895	2	0	0	2	2	0
Jul-16	54	567	1176	39,071	10	0	1	1	1	0
Jul-17	33	600	955	40,026	1	0	0	0	3	0
Jul-18	31	631	674	40,700	3	0	0	0	0	0
Jul-19	99	730	714	41,414	9	0	0	0	2	0
Jul-20	400	1,130*	857	42,271	4	0	0	0	1	0
Jul-21	69	1,199*	754	43,025	8	0	0	0	0	0
Jul-22	77	1,276	711	43,736	2	0	0	0	0	0
Jul-23	30	1,306	447	44,183	2	0	0	0	0	0
Jul-24	35	1,341	554	44,737	4	0	0	0	0	0
Jul-25	49	1,390	425	45,162	3	0	1	0	0	0
Jul-26	17	1,407	476	45,638	4	0	0	0	0	0
Jul-27	32	1,439	492	46,130	3	0	0	0	0	0
Jul-28	23	1,462	407	46,537	5	0	0	0	0	0
Jul-29	14	1,476	341	46,878	8	0	0	0	0	0
Jul-30	36	1,512	359	47,237	8	0	0	0	1	0
Jul-31	4	1,516	432	47,669	10	0	1	0	0	0
Total	1,516		47,669		123	50	31	16	15	2

Table 2. — Age and sex ratio estimates, by stratum, of Chinook salmon at Gisasa River weir, Alaska, 2010. Standard errors are in parentheses. Season totals are calculated from weighted strata totals. Unknown age indicates numbers of fish that could not be aged from the scales sampled and were not included in age calculations.

					Brood year and age							
					2007	2006	2005		2004		2003	
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
6/30-7/10	311	100	24 (4.3)	19	0%(0.0)	58%(5.5)	37%(5.4)	0%(0.0)	5%(2.4)	0%(0.0)	0%(0.0)	0%(0.0)
7/11 - 17	289	204	20 (2.8)	38	0%(0.0)	43%(3.9)	49%(3.9)	1%(0.8)	4%(1.5)	2%(1.0)	<1%(0.6)	<1%(0.6)
7/18 - 24	741	187	20 (2.9)	31	<1%(0.6)	45%(4.0)	49%(4.0)	<1%(0.6)	5%(1.8)	0%(0.0)	0%(0.0)	0%(0.0)
7/25 - 31	175	109	52 (4.8)	20	0%(0.0)	24%(4.5)	49%(5.3)	0%(0.0)	25%(4.6)	1%(1.1)	1%(1.1)	0%(0.0)
Total	1,516	600	24 (1.8)	108	<1%(0.3)	45%(2.4)	47%(2.5)	<1%(0.4)	7%(1.2)	<1%(0.2)	<1%(0.2)	<1%(0.1)
Female	369	158		25	0%(0.0)	0%(0.0)	73%(4.1)	0%(0.0)	24%(4.0)	1%(0.7)	1%(0.7)	<1%(0.5)
Male	1,147	442		83	<1%(0.4)	60%(2.8)	37%(2.7)	<1%(0.5)	1%(0.6)	<1%(0.2)	0%(0.0)	0%(0.0)

Table 3. — Length at age of female and male Chinook salmon sampled at Gisasa River weir, Alaska, 2010.

	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	350	-	-	-
1.2	0	-	-	-	-	209	540	4.3	535	280 - 830
1.3	94	776	5.2	774	595 - 875	138	724	4.9	724	560 - 880
2.2	0	-	-	-	-	5	576	69.4	529	405 - 790
1.4	34	839	7.0	841	710 - 900	6	800	17.0	801	755 - 855
2.3	2	805	15.5	805	789 - 820	0	-	-	-	-
1.5	2	875	15	875	860 - 890	0	-	-	-	-
2.4	1	807	-	-	-	0	-	-	-	-
Total	133					359				

Table 4. — Age and sex ratio estimates, by stratum, of summer chum salmon at Gisasa River weir, Alaska, 2010. Standard errors are in parentheses. Season totals are calculated from weighted strata totals. Unknown age data indicate numbers of fish that could not be aged from the scales sampled and were not included in age calculations.

					Brood year and age			
					2007	2006	2005	2004
Strata dates	Run size (N)	Sample size (n)	% Female	Unknown age	0.2	0.3	0.4	0.5
6/23 - 7/3	6,478	174	35 (3.6)	19	1% (0.9)	50% (4.0)	44% 4.0)	5% (1.7)
7/4 - 7/10	20,888	176	52 (3.8)	11	8% (2.2)	63% (3.8)	26% (3.4)	2% (1.2)
7/11 - 17	12,660	251	57 (3.1)	10	10% (1.9)	75% (2.8)	15% (2.3)	<1% (0.4)
7/18 -23	4,711	183	65 (3.5)	8	21% (3.1)	66% (3.6)	14% (2.6)	0% (0.0)
7/24 - 31	2,932	225	66 (3.0)	12	25% (3.0)	60% (3.4)	15% (2.4)	<1% (0.5)
Total	47,669	1009	53 (2.0)	60	10% (1.1)	65% (1.9)	23% (1.7)	2% (0.6)
Female	25,276	562		29	14% (0.9)	65% (2.6)	20% (2.3)	1% (0.6)
Male	22,393	447		31	6% (2.2)	64% (2.9)	27% (2.7)	3% (1.1)

Table 5. — Length at age of female and male summer chum salmon sampled at Gisasa River weir, Alaska, 2010.

	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	88	514	2.4	513	440 - 585	41	536	3.7	532	490 - 610
0.3	350	534	1.3	530	445 - 610	256	562	1.9	562	440 - 660
0.4	90	552	3.2	550	500 - 635	111	597	3.4	595	505 - 690
0.5	5	574	8.2	577	550 - 600	8	604	15.2	590	560 - 685
Total	533					416				

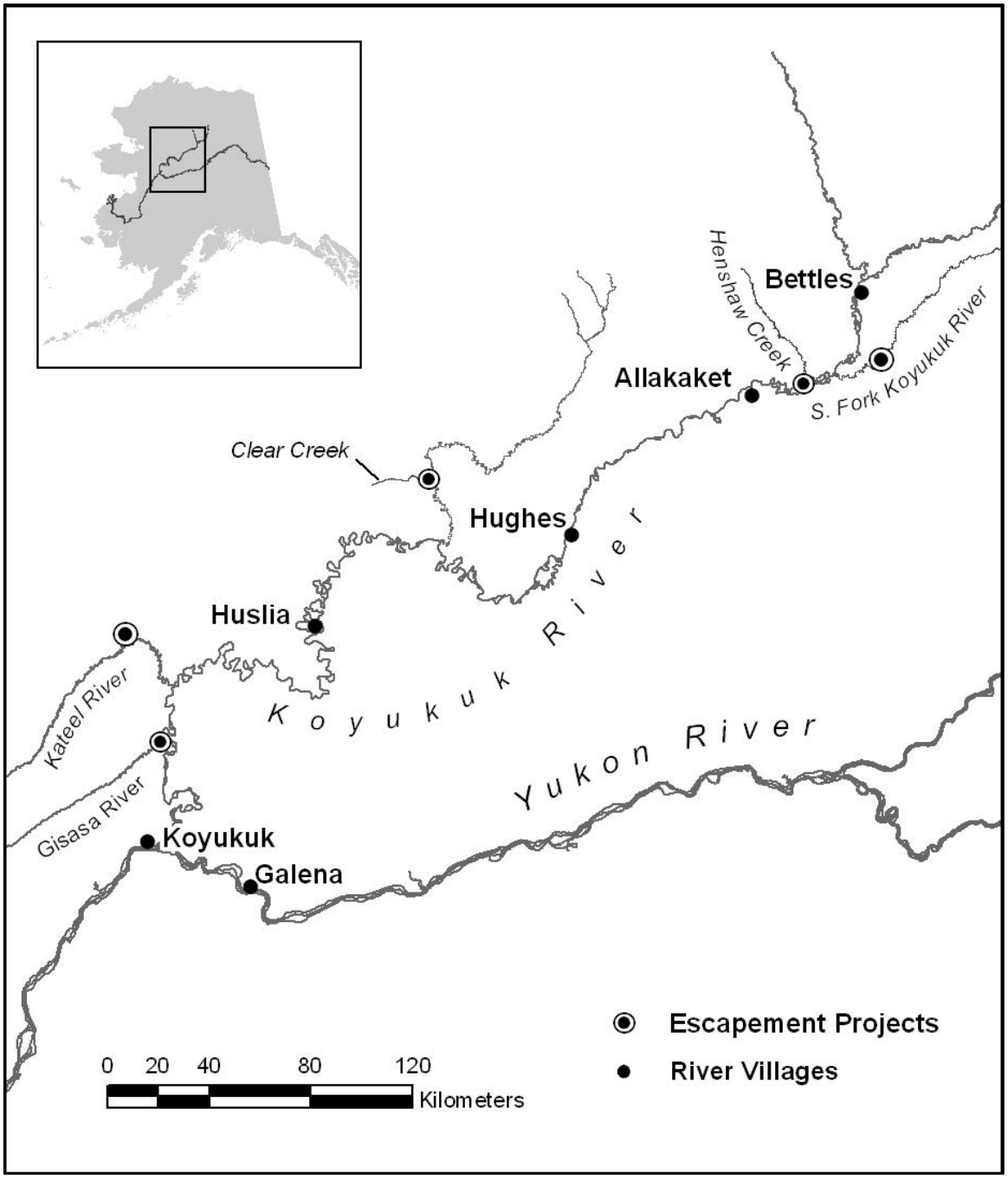

Figure 1 — Location of the Gisasa River weir and other active and historical tributary escapement project sites in the Koyukuk River drainage, Alaska.

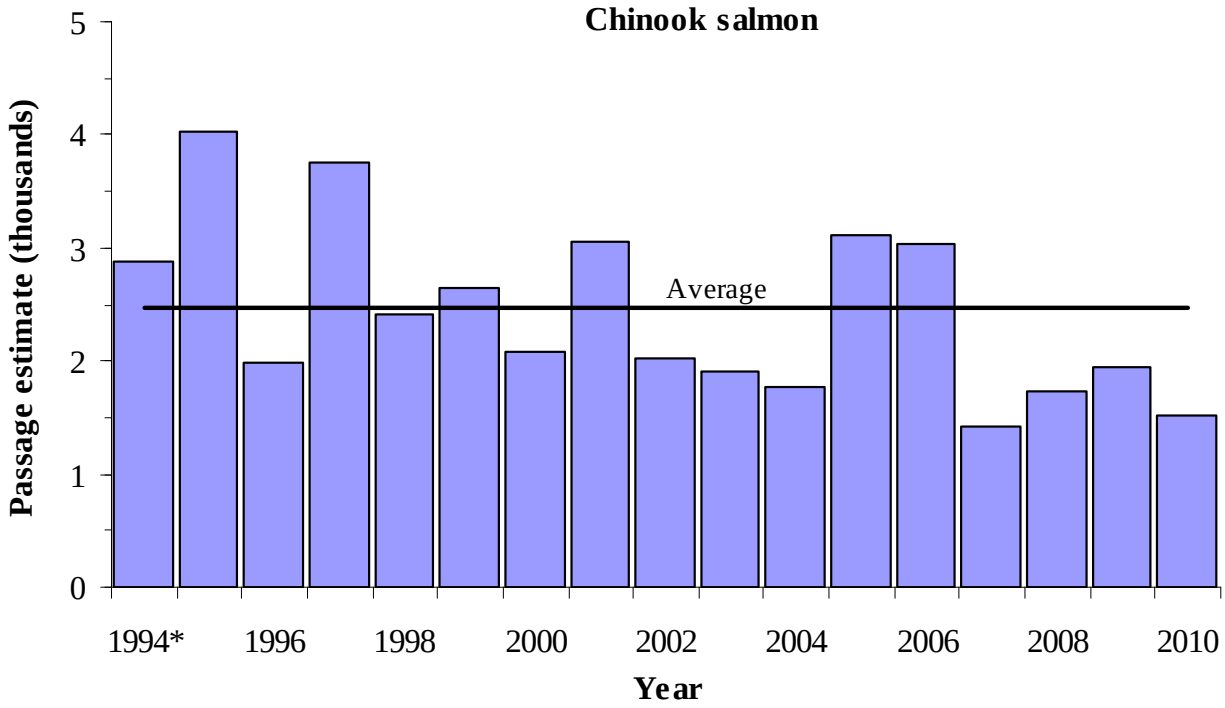

Figure 2 — Chinook salmon escapement estimates at the Gisasa River weir 1994 - 2010. *Data from the first year of operation (1994) is only a partial count, counting did not begin until July 10, after the run was underway and this data is not included in averages. Horizontal line represents the 1995 – 2009 average.

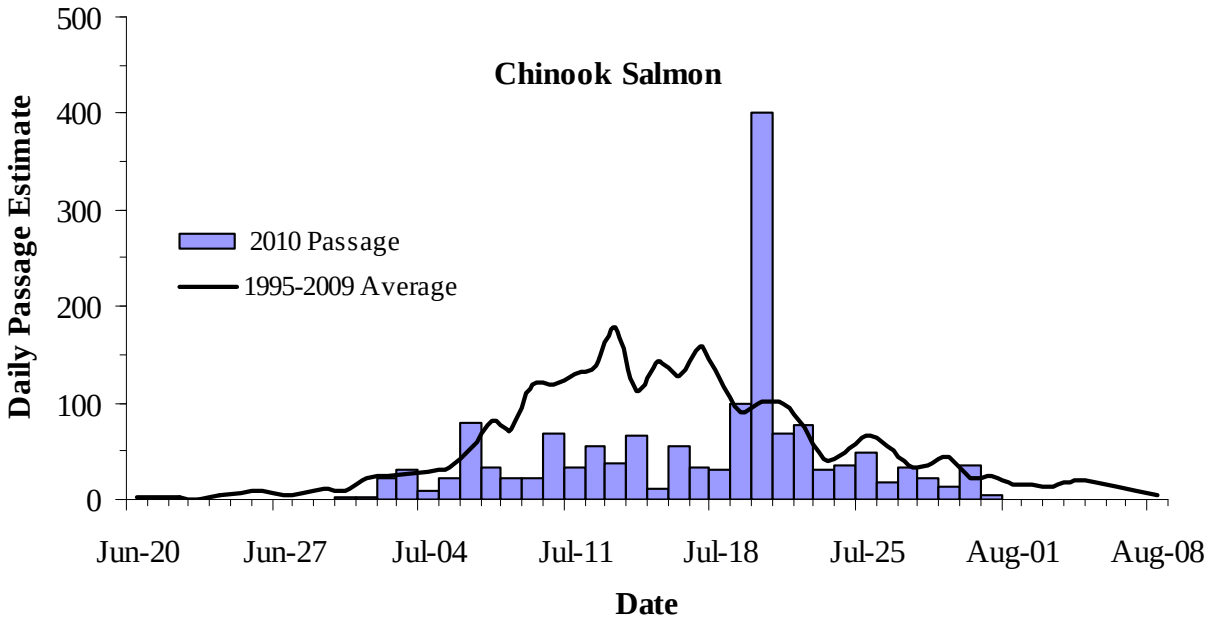

Figure 3 — Daily and 1995-2009 average daily estimated Chinook salmon passage through Gisasa River Weir, Alaska, 2010.

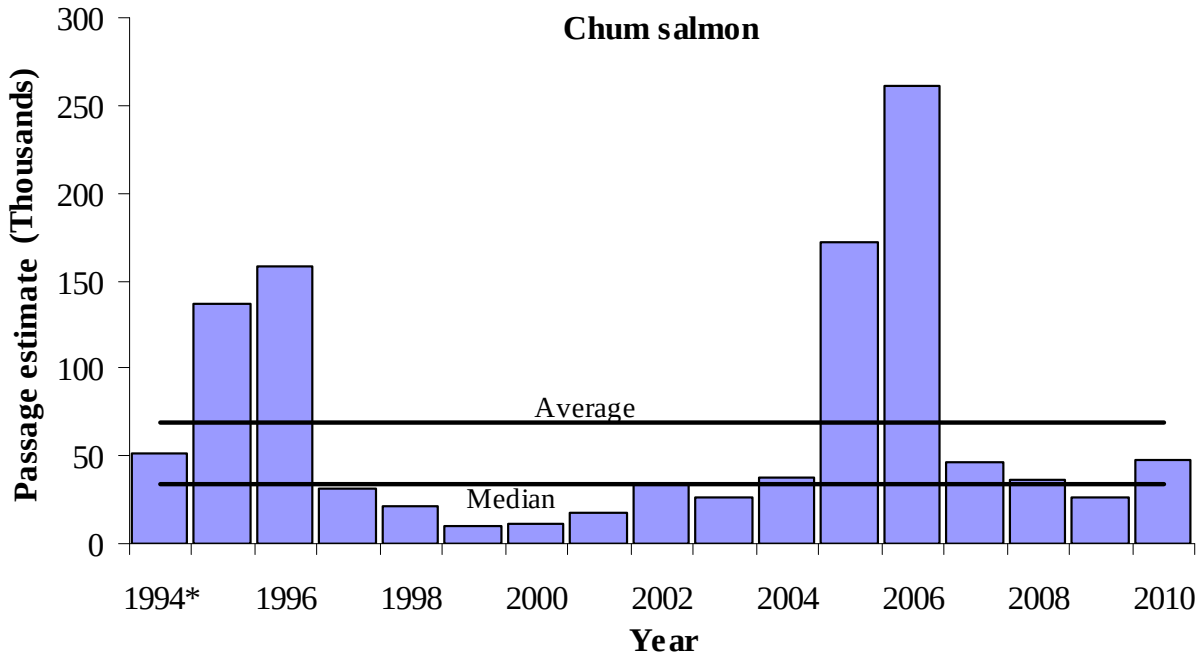

Figure 4 — Chum salmon escapement estimates at the Gisasa River weir 1994-2010. *Data from the first year of operation (1994), is only a partial count; counting did not begin until July 10, after the run was underway and 1994 data is not included in averages. Horizontal lines represent the 1995-2009 average and median.

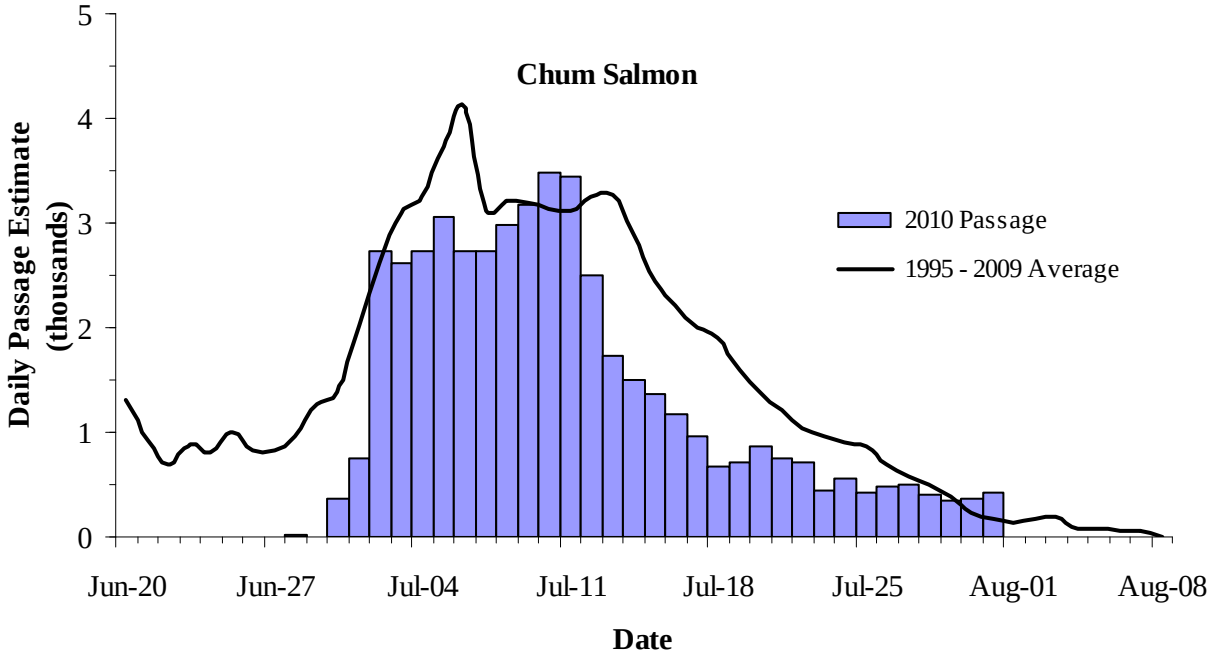

Figure 5 — Daily and 1995-2009 average estimated Chum salmon passage through Gisasa River Weir, Alaska, 2010.

Appendix 1. — Historical Chinook salmon and summer chum salmon escapement in the Gisasa River, 1960 - 2010 (Aerial index data from Barton 1984; Alaska Department of Fish and Game unpublished data)

	Aerial index estimates			Weir 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	3,030	261,305
2007	593		Fair	1,427	46,257
2008	487		Fair	1,738	36,938
2009	515	1,060	Good	1,955	25,904
2010	264[b]		Fair/Good[b]	1,516	47,669

[a] Partial weir count.
[b] Preliminary data

Appendix 2. — Water depth, water temperature, and air temperature data collected at the Gisasa River weir, 2010. Depth is the water depth at the trap.

Date	Water depth (cm)	Water temperature (°C)	Air temperature (°C)	
			Min	Max
6/20/2010	64	13.0	13.0	24.0
6/21/2010	68	14.0	8.7	24.5
6/22/2010	61	14.0	19.1	26.1
6/23/2010	58	16.0	10.0	26.0
6/24/2010	54	16.0	15.5	16.0
6/25/2009	70	16.0	11.5	24.9
6/26/2010	64	14.0	12.4	18.1
6/27/2010	58	14.0	8.8	23.6
6/28/2010	56	14.0	5.0	19.0
6/29/2010	54	14.0	5.0	25.0
6/30/2010	52	15.0	4.9	25.0
7/1/2010	50	15.0	14.2	25.6
7/2/2010	58	17.0	12.0	24.0
7/3/2010	65	17.0	10.4	25.1
7/4/2010	57	16.0	10.0	25.0
7/5/2010	58	14.0	12.0	20.0
7/6/2010	100+	12.0	10.0	12.0
7/7/2010	82	13.0	7.0	26.0
7/8/2010	72	15.0	8.6	27.4
7/9/2010	73	17.5	8.5	27.5
7/10/2010	60	17.0	12.0	28.0
7/11/2010	58	17.0	14.0	25.0
7/12/2010	60	14.0	9.3	17.8
7/13/2010	60	14.0	7.5	19.5
7/14/2010	57	12.0	7.0	16.0
7/15/2010	56	13.0	4.5	20.0
7/16/2010	55	12.0	4.5	20.0
7/17/2010	53	12.5	10.0	17.0
7/18/2010	51	12.0	10.0	15.5
7/19/2010	52	12.0	10.0	18.0
7/20/2010	68	13.0	10.5	20.0
7/21/2010	69	13.0	8.0	21.5
7/22/2010	68	12.0	7.5	18.0
7/23/2010	67	11.0	7.5	18.0
7/24/2010	73	11.0	8.5	17.0
7/25/2010	70	11.0	8.0	18.0
7/26/2010	66	12.0	10.5	20.0
7/27/2010	63	13.0	7.0	20.0
7/28/2010	60	12.0	7.0	18.5
7/29/2010	60	13.0	10.0	19.0
7/30/2010	59	13.0	11.5	21.5
7/31/2010	58	11.0	9.0	25.0

+ Water level exceeded the maximum of the depth gage (100cm).

Appendix 3 — Historical daily and cumulative Chinook salmon counts from Gisasa River Weir, 1994-2009. 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	0	0	2	2	0	0				
Jun-28		19	32	46[c]	253	0	0	0	2	1	1	0	0		
Jun-29		23	55	76[b]	329	0	0	1	3	0	1	0	0		
Jun-30		46	101	30	359	0	0	2	5	0	1	0	0		
Jul-1		82	183	57	416	1	1	5	10	0	1	0	0		
Jul-2		46	229	72	488	3	4	13[b]	23	0	1	0	0		
Jul-3		35	264	28	516	9	13	18[c]	41	0	1	0	0		
Jul-4		57	321	35	551	2	15	22[c]	63	0	1	0	0		
Jul-5		39	360	41	592	33	48	26[c]	89	1	2	0	0		
Jul-6		92	452	78	670	11	59	30[b]	119	2	4	13	13		
Jul-7		258	710	234	904	6	65	37	156	1	5	8	21	18	18
Jul-8		175	885	51	955	78	143	71	227	5	10	70	91	41	59
Jul-9		184	1,069	63	1,018	120	263	71	298	45	55	40	131	43	102
Jul-10		300	1,369	81	1,099	64	327	107	405	60	115	21	152	26	128
Jul-11		385	1,754	70	1,169	70	397	116	521	80	195	28	180	100	228
Jul-12	212	281	2,035	51	1,220	138	535	142	663	19	214	40	220	63	291
Jul-13	259	468	2,503	215	1,435	310	845	163	826	83	297	82	302	63	354
Jul-14	189	205	2,708	158	1,593	320	1,165	225	1,051	49	346	103	405	117	471
Jul-15	239	104	2,812	40	1,633	144	1,309	102	1,153	50	396	345	750	306	777
Jul-16	355	211	3,023	26	1,659	424	1,733	155	1,308	89	485	223	973	196	973
Jul-17	248	126	3,149	14	1,673	137	1,870	115	1,423	37	522	59	1,032	299	1,272
Jul-18	219	72	3,221	38	1,711	38	1,908	147	1,570	154	676	177	1,209	238	1,510
Jul-19	302	155	3,376	54	1,765	112	2,020	74	1,644	30	706	66	1,275	258	1,768
Jul-20	248	62	3,438	93	1,858	146	2,166	62	1,706	397	1,103	41	1,316	388	2,156
Jul-21	70	87	3,525	15	1,873	632	2,798	50	1,756	363	1,466	66	1,382	254	2,410
Jul-22	42	79	3,604	17	1,890	92	2,890	75	1,831	27	1,493	188	1,570	74	2,484
Jul-23	100	68	3,672	18	1,908	257	3,147	54	1,885	26	1,519	53	1,623	44	2,528
Jul-24	99	87	3,759	45	1,953	88	3,235	90	1,975	70	1,589	89	1,712	25	2,553
Jul-25	65	42	3,801	4	1,957	91	3,326	84[c]	2,059	307	1,896	42	1,754	36	2,589
Jul-26	48	21	3,822	21	1,978	142	3,468	78[c]	2,137	276	2,172	13	1,767	37	2,626
Jul-27	39	45	3,867	13	1,991	98	3,566	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

Appendix 3 — Continued

	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					4[b]	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														

Appendix 3 — Continued

	2009		2010	
Date	Daily	Cum	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			0	0
Jun-23	0	0	0	0
Jun-24	0	0	0	0
Jun-25	0	0	0	0
Jun-26	0	0	0	0
Jun-27	0	0	0	0
Jun-28	0	0	0	0
Jun-29	0	0	0	0
Jun-30	0	0	2	2
Jul-1	5	5	3	5
Jul-2	0	5	22	27
Jul-3	6	11	30	57
Jul-4	3	14	9	66
Jul-5	7	21	21	87
Jul-6	12	33	79	166
Jul-7	12	45	32	198
Jul-8	44	89	22	220
Jul-9	36	125	22	242
Jul-10	23	148	69	311
Jul-11	254	402	33	344
Jul-12	40	442	54	398
Jul-13	288	730	38	436
Jul-14	40	770	67	503
Jul-15	189	959	10	513
Jul-16	201	1,160	54	567
Jul-17	90	1,250	33	600
Jul-18	200	1,450	31	631
Jul-19	20	1,470	99	730
Jul-20	27	1,497	400	1,130
Jul-21	86	1,583	69	1,199
Jul-22	105	1,688	77	1,276
Jul-23	20	1,708	30	1,306
Jul-24	39	1,747	35	1,341
Jul-25	140	1,887	49	1,390
Jul-26	13	1,900	17	1,407
Jul-27	12	1,912	32	1,439
Jul-28	9	1,921	23	1,462
Jul-29	20	1,941	14	1,476
Jul-30	14[b]	1,955	36	1,512
Jul-31			4	1,516
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 counting due to high water, counts interpolated.

Appendix 4 — Historical daily and cumulative summer chum salmon counts from Gisasa River Weir, 1994-2009. 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												

Appendix 4 — Continued

	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	3,357[b]	3,357	2,788	4,348
Jun-30			1,331	2,853	561	1,039	1,007	7,265	1,850	5,207	3,996[b]	8,344
Jul-1			1,116	3,969	890	1,929	853	8,118	2,226	7,433	10,192[c]	18,536
Jul-2			803	4,772	655	2,584	900	9,018	2,092	9,525	16,387[c]	34,923
Jul-3			833	5,605	680[c]	3,264	858	9,876	2,884	12,409	22,583[b]	57,506
Jul-4			430	6,035	706[c]	3,970	709	10,585	3,702	16,111	21,897	79,403
Jul-5			1,059	7,094	731[b]	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										

Appendix 4 — Continued

	2007		2008		2009		2010	
Date	Daily	Cum	Daily	Cum	Daily	Cum	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							0	0
Jun-23	0	0			2[b]	2	1	1
Jun-24	5	5	2[b]	2	3	5	0	1
Jun-25	9	14	29[c]	31	3	8	0	1
Jun-26	5	19	56[c]	87	27	35	0	1
Jun-27	12	31	82	169	26	61	2	3
Jun-28	31	62	187	356	70	131	11	14
Jun-29	214	276	195	551	126	257	8	22
Jun-30	1,513	1,789	185	736	550	807	361	383
Jul-1	1,925	3,714	633	1,369	817	1,624	741	1,124
Jul-2	2,870	6,584	834	2,203	515	2,139	2,734	3,858
Jul-3	2,926	9,510	1,285	3,488	667	2,806	2,620	6,478
Jul-4	2,666	12,176	1,434	4,922	828	3,634	2,722	9,200
Jul-5	2,322	14,498	1,371	6,293	838	4,472	3,056	12,256
Jul-6	2,196	16,694	1,117	7,410	1,451	5,923	2,734	14,990
Jul-7	2,028	18,722	1,216	8,626	947	6,870	2,739	17,729
Jul-8	2,207	20,929	1,325	9,951	1,197	8,067	2,977	20,706
Jul-9	1,817	22,746	1,110	11,061	1,062	9,129	3,182	23,888
Jul-10	1,620	24,366	1,146	12,207	1,002	10,131	3,478	27,366
Jul-11	1,446	25,812	1,230	13,437	1,961	12,092	3,439	30,805
Jul-12	1,155	26,967	1,429	14,866	1,578	13,670	2,501	33,306
Jul-13	1,000	27,967	2,300	17,166	2,060	15,730	1,732	35,038
Jul-14	1,368	29,335	1,955	19,121	1,484	17,214	1,491	36,529
Jul-15	1,184	30,519	1,949	21,070	1,180	18,394	1,366	37,895
Jul-16	908	31,427	1,518	22,588	863	19,257	1,176	39,071
Jul-17	1,134	32,561	1,363	23,951	957	20,214	955	40,026
Jul-18	1,152	33,713	940	24,891	736	20,950	674	40,700
Jul-19	918	34,631	971	25,862	628	21,578	714	41,414
Jul-20	1,177	35,808	836	26,698	969	22,547	857	42,271
Jul-21	909	36,717	969	27,667	680	23,227	754	43,025
Jul-22	903	37,620	951	28,618	606	23,833	711	43,736
Jul-23	1,151	38,771	1,203	29,821	519	24,352	447	44,183
Jul-24	1,257	40,028	1,581	31,402	312	24,664	554	44,737
Jul-25	1,740	41,768	1,691	33,093	349	25,013	425	45,162
Jul-26	1,703	43,471	1,112	34,205	224	25,237	476	45,638
Jul-27	1,532	45,003	1,005	35,210	150	25,387	492	46,130
Jul-28	1,254	46,257	883	36,093	143	25,530	407	46,537
Jul-29			625	36,718	210	25,740	341	46,878
Jul-30			220	36,938	164	25,904	359	47,237
Jul-31							432	47,669
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 counting due to high water, counts interpolated.