U.S. Fish & Wildlife Service

Abundance and Run Timing of Adult Salmon in the Gisasa River, Koyukuk National Wildlife Refuge, Alaska, 2008

Alaska Fisheries Data Series Number 2009–3

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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 and chum salmon in the Gisasa River. This was the fourteenth year of operating the weir at this location. In 2008, the weir was operated from June 24 through July 30 with counting interrupted for approximately 48 hours due to high water. An estimated 1,738 Chinook salmon *Oncorhynchus tshawytscha* and 36,938 summer chum salmon *O. keta* passed through the weir. The most abundant other species was pink salmon *O. gorbuscha* (N=1,316), followed by longnose sucker *Catostomus catostomus* (N=36), whitefish spp. (Coregoninae; N=15), Arctic grayling *Thymallus arcticus* (N=7), northern pike *Esox lucius* (N = 6), and sockeye salmon *O. nerka* (N = 5). The estimated weekly sex composition for Chinook salmon ranged from 8% to 32% female fish. Three primary age classes were identified, 1.2, 1.3, and 1.4, for Chinook salmon, with a dominant age class of 1.3 (64%). The estimated weekly sex composition for summer chum salmon ranged from 39% to 53% female fish. There were two primary age classes identified, 0.3 and 0.4, with a dominant age class of 0.4 (64%).

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*. 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. Salmon species from the Gisasa River contribute to mixed stock subsistence and commercial fisheries in the Yukon River (USFWS 1993).

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 improvement beginning in 2001 and continuing through 2005 (JTC 2006). 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; information provided by test fisheries; data from escapement 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) conducted these surveys on several index tributaries within the Koyukuk River drainage

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intermittently since 1960 (Barton 1984). Aerial surveys 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 provide a platform for collecting other biological data. Weirs or counting towers have been operated in five different Koyukuk River tributaries between 1994 and the present (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 ranged from 1,427 to 4,023 fish from 1994 to 2007. Chum salmon escapement estimates for the same period ranged from 10,155 to 172,259 fish. For 2008, 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 northeast, passing through the Koyukuk National Wildlife Refuge. Approximately 112 km from its source, the Gisasa river enters the Koyukuk River at approximately 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 great 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 was located approximately 4 km upriver from the mouth of the Gisasa River. This section of the river was straight with generally laminar flow. The bottom contour sloped gradually from the stream banks, river width was approximately 45 m, and maximum depth throughout the season ranged from 52cm to greater than 100cm (above the maximum height of the gauge). Substrate at the weir site primarily consisted of medium size gravel 25-50 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 construction and installation of resistance board weirs was described by Tobin (1994). The Gisasa River weir has been installed at the same site since the project was initiated. 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.

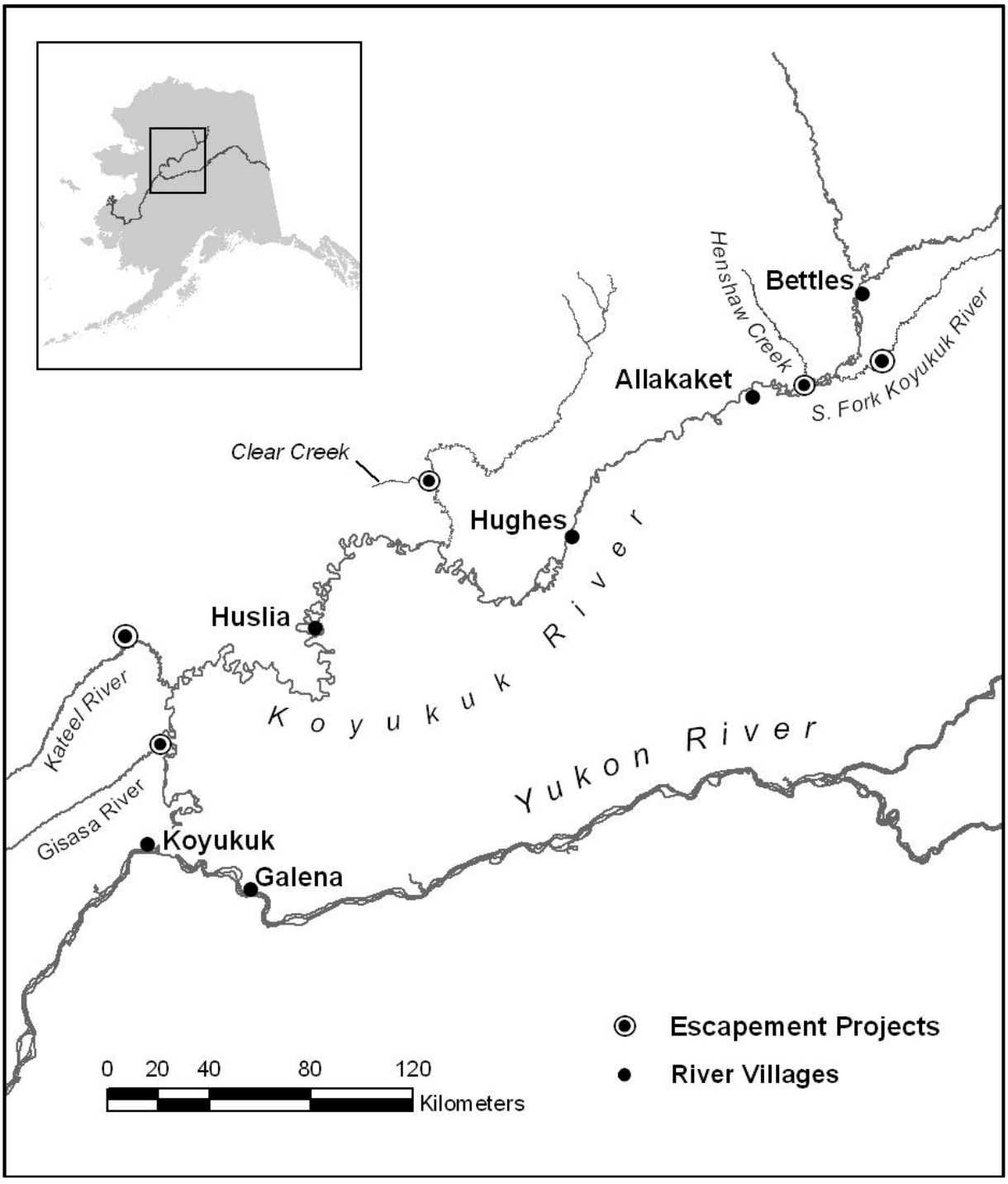

Figure 1. — Location of the Gisasa River weir and other active and historical tributary escapement project sites in the Koyukuk River drainage, Alaska.

Biological Data

The target start date of the project was based on previous years' salmon run timing data. The end date of the project has generally been determined in-season 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. Due to logistic constraints, operations were stopped slightly before this point was reached in 2008. All fish passing through the weir were identified to species and enumerated, with the exception of whitefish spp *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 lower, the weir was unmonitored from 0000 hours to 0800 hours with the trap closed to prevent upstream passage. As the 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 with ages being reported using the European method (Foerster 1968). Three scales were collected from Chinook salmon and one scale from chum salmon. Scales were sampled 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. Age 1.2 Chinook salmon were assumed to be males (Brady 1983; Bales 2007; Karpovich and DuBois 2007) regardless of their field determination.

Data Analysis

Passage was estimated for approximately 48 hours early in the run due to high water in 2008. 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 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. Each statistical week was 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 1000 hours on June 24, with one summer chum salmon counted on that day. The water rose rapidly overnight interrupting counting for June 25 and June 26. The weir was again fully operational on June 26 at approximately 1830 hours. Since this resulted in less than 6 hours of counts for that day it was treated as a completely missed day and chum salmon counts were interpolated. Because no Chinook salmon were counted before the high water, and only one Chinook salmon was counted on each of the three days following the high water event, no adjustments were made to the Chinook salmon counts for the missed time. After June 26 no additional counting time was missed. The last day of counting was July 30. The counting was discontinued at 1200 hours and adjusted for 24 hours. 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 and whitefish, likely passed through the weir undetected.

Biological Data

The seasonal estimates of fish passage at the weir were 1,738 Chinook salmon and 36,938 summer chum salmon (Table 1). The most abundant other species was pink salmon *O. gorbuscha* (N=1,316), followed by longnose sucker *Catostomus catostomus* (N=36), whitefish spp. (Coregoninae; N=15), Arctic grayling *Thymallus arcticus* (N=7), northern pike *Esox lucius* (N = 6), and sockeye salmon *O. nerka* (N = 5).

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, 2008. Asterisks (*****) indicate first, median, and third quartiles of Chinook salmon and summer chum salmon passage estimates.

	Chinook salmon		Chum salmon		Pink salmon	Longnose sucker	Whitefish spp.	Arctic grayling	Northern pike	Sockeye salmon
Date	Daily	Cum	Daily	Cum	Daily	Daily	Daily	Daily	Daily	Daily
Jun-24	0	0	2[a]	2	0	1	0	0	0	0
Jun-25	0	0	29[b]	31	0	0	0	0	0	0
Jun-26	1	1	56[b]	87	0	0	0	0	0	0
Jun-27	1	2	82	169	0	3	0	0	0	0
Jun-28	1	3	187	356	0	1	0	0	0	0
Jun-29	1	4	195	551	0	0	0	0	0	0
Jun-30	2	6	185	736	0	1	0	0	0	0
Jul-01	4	10	633	1,369	0	1	0	0	0	0
Jul-02	10	20	834	2,203	0	8	1	1	0	0
Jul-03	8	28	1,285	3,488	0	4	0	1	0	0
Jul-04	25	53	1,434	4,922	0	2	1	0	2	0
Jul-05	32	85	1,371	6,293	1	1	0	0	0	0
Jul-06	35	120	1,117	7,410	0	2	2	0	0	0
Jul-07	44	164	1,216	8,626	0	0	2	0	0	0
Jul-08	38	202	1,325	9,951*	1	2	0	1	1	0
Jul-09	55	257	1,110	11,061	2	5	0	0	0	0
Jul-10	84	341	1,146	12,207	3	2	3	0	0	0
Jul-11	84	425	1,230	13,437	1	2	0	2	0	0
Jul-12	31	456*	1,429	14,866	2	1	0	1	1	0
Jul-13	36	492	2,300	17,166	4	0	3	0	1	0
Jul-14	68	560	1,955	19,121*	11	0	1	1	0	0
Jul-15	62	622	1,949	21,070	29	0	1	0	0	2
Jul-16	143	765	1,518	22,588	38	0	1	0	0	2
Jul-17	323	1,088*	1,363	23,951	45	0	0	0	0	0
Jul-18	55	1,143	940	24,891	52	0	0	0	0	0
Jul-19	29	1,172	971	25,862	59	0	0	0	0	1
Jul-20	35	1,207	836	26,698	91	0	0	0	0	0
Jul-21	157	1,364*	969	27,667	109	0	0	0	0	0
Jul-22	41	1,405	951	28,618*	68	0	0	0	1	0
Jul-23	53	1,458	1,203	29,821	94	0	0	0	0	0
Jul-24	70	1,528	1,581	31,402	88	0	0	0	0	0
Jul-25	50	1,578	1,691	33,093	103	0	0	0	0	0
Jul-26	18	1,596	1,112	34,205	137	0	0	0	0	0
Jul-27	59	1,655	1,005	35,210	173	0	0	0	0	0
Jul-28	39	1,694	883	36,093	100	0	0	0	0	0
Jul-29	40	1,734	625	36,718	66	0	0	0	0	0
Jul-30	4[c]	1,738	220[c]	36,938	39	0	0	0	0	0
Total	1,738		36,938		1,316	36	15	7	6	5

[a] Counting began at 10:00 h, chum salmon passage estimates expanded to 24 hrs.
[b] Weir shut down due to high water, daily passage interpolated.
[c] Counting ceased at 12:00 h, passage estimates expanded to 24 hrs.

Chinook Salmon

The first Chinook salmon was counted on June 26. During the final day of weir operation, July 30, 4 Chinook salmon (0.2% of the seasonal estimate) were estimated to have passed through the weir. Run timing was near average, with the first quartile passage date (July 12) one day later than the 1995-2007 average. Both the median, and third quartile passage dates (July 17 and 21, respectively) were two days later than the 1995-2007 average (Table 1). The seasonal estimate of 1,738 Chinook salmon was 68% of the average (1995-2007) and was the second lowest weir estimate to date (Figure 2, Appendix 1).

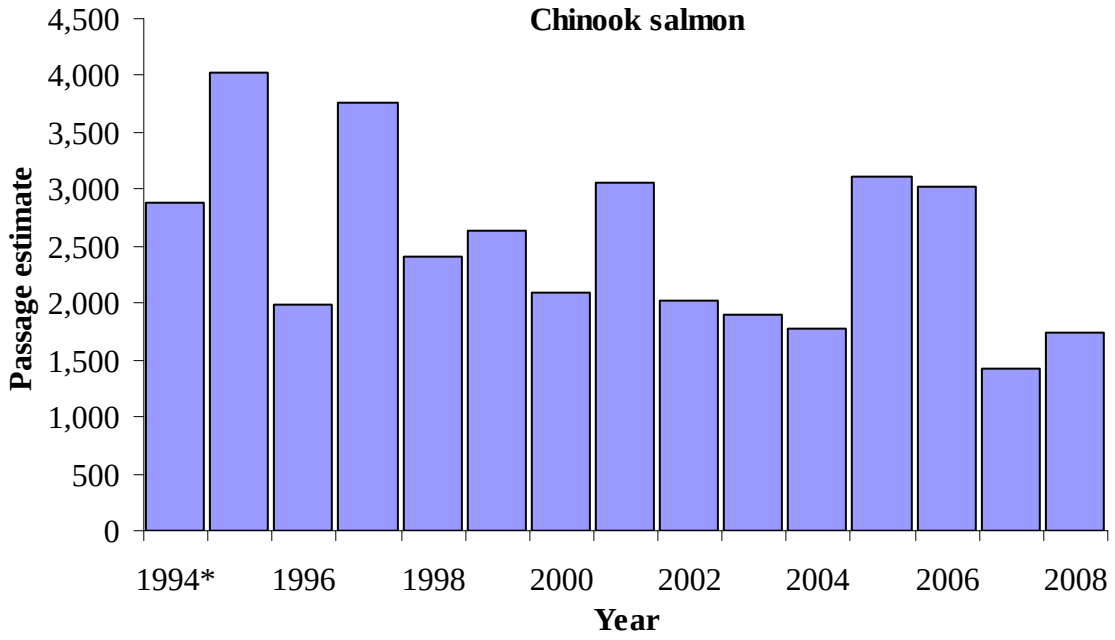

Figure 2. — Chinook salmon escapement estimates at the Gisasa River weir 1994-2007. *Data from the first year of operation (1994) is only a partial count, counting did not begin until July 10, after the run was underway and this data is not included in averages.

Due to low passage, minimal samples for age, sex, and length were collected during the first statistical week of weir operations. Therefore, the first two statistical weeks were combined to make the first strata. Samples were collected from 538 Chinook salmon but age was unable to be determined for 72 (13%) of those samples. There were three primary age classes; 1.3, 1.2, and 1.4 from brood years 2003, 2004, and 2002, respectively (Table 2). Age class 1.4 was predominant overall, accounting for 64% of the season total, with stratum estimates ranging from 52% to 70%. The second most abundant age class was 1.2, accounting for 18% of the season total, with stratum estimates ranging from 13% to 26%. Age class 1.4 accounted for 14% of the season total with stratum estimates ranging from 3% to 23%. The age distributions differed between males and females. Males were overwhelmingly dominated by age 1.3 fish (70%), while females were more evenly distributed across age classes 1.4 (48%) and 1.3 (34%). The estimated sex ratio for the entire run was only 18% female, and estimates for each stratum ranged from 8% to 32% female fish. Female Chinook salmon ranged from 620 to 960 mm METF and males ranged from 380 to 845 mm METF (Table 3). For length-at-age measurements, mean lengths of female fish were larger than males.

Table 2. — Age and sex ratio estimates, by stratum, of Chinook salmon sampled at Gisasa River weir, Alaska, 2008. 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					
					2005	2004	2003	2002		2001
Strata dates	Run size (N)	Sample size (n)	% Female	Unknown age	1.1	1.2	1.3	1.4	2.3	1.5
6/23 - 7/6	120	87	9 (3.1)	14	0% (0.0)	26% (5.2)	70% (5.4)	3% (1.9)	0.0% (0.0)	1% (1.4)
7/7 - 13	372	156	8 (2.1)	17	1% (1.0)	22% (3.5)	68% (4.0)	8% (2.3)	0.0% (0.0)	1% (1.0)
7/14 -20	715	149	15 (2.9)	21	0% (0.0)	13% (3.0)	70% (4.1)	13% (3.0)	0.0% (0.0)	3% (1.5)
7/21 - 30	531	146	32 (3.9)	20	0% (0.0)	20% (3.6)	52% (4.5)	23% (3.8)	0.8% (0.8)	4% (1.7)
Total	1,738	538	18 (1.8)	72	0.3% (0.2)	18% (1.8)	64% (2.3)	14% (1.8)	0.2% (0.2)	3% (0.9)
Female	316	89		19	0% (0.0)	0% (0.0)	34% (6.0)	48% (6.5)	0.0% (0.0)	18% (5.0)
Male	1,422	449		53	0.4% (1.0)	21% (2.1)	70% (2.4)	8% (1.5)	0.3% (0.3)	0.0% (0.0)

Table 3. — Length at age of female and male Chinook salmon sampled at Gisasa River weir, Alaska, 2008.

	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	-	-	-	-	2	390	10.0	390	380 - 400
1.2	0	-	-	-	-	91	536	5.6	525	440 - 690
1.3	26	752	9.8	760	620 - 835	275	689	2.7	685	550 - 820
1.4	32	827	7.5	825	760 - 910	27	762	9.5	770	660 - 845
1.5	12	865	16.6	868	735 - 960	0	-	-	-	-
2.3	0	-	-	-	-	1	710	-	-	-
Total	70					396				

Chum Salmon

The first chum salmon was counted on June 24. During the final day of counting, July 30, 220 summer chum salmon (0.6% of the seasonal estimate) were estimated to have passed through the weir. Run timing was near average, with the first quartile passage date (July 8) two days later than the 1995-2007 average, median passage date (July 14) three days later, and the third quartile passage date (July 22) five days later than the 1995-2007 average. The average (1995-2007) seasonal estimate for summer chum salmon was greatly influenced by the high escapements during 1995, 1996, 2005, and 2006 (Figure 3). Therefore, while the 2008 estimate of 36,938 summer chum salmon was only 50% of the average (74,250), it was still 5% greater than the median (33,481) for the same period (Figure 3, Appendix 1).

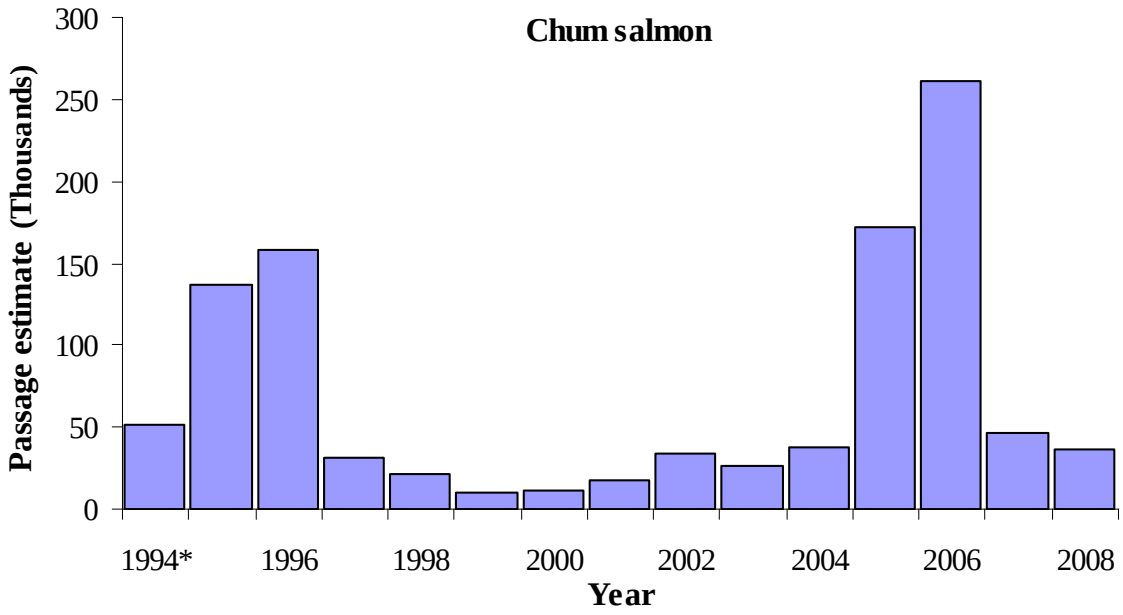

Figure 3. — Chum salmon escapement estimates at the Gisasa River weir 1994-2008. *Data from the first year of operation (1994), is only a partial count, counting did not begin until July 10, after the run was underway and this data is not included in averages.

Due to low passage, minimal samples for age, sex, and length were collected 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. Age, sex, and length samples were collected from 717 summer chum salmon but age was unable to be determined for 58 (8%) of those samples. There were two primary age classes; 0.4 and 0.3, from brood years 2003 and 2004, respectively (Table 4). Age class 0.4 was predominant, accounting for 64% of the season total, with stratum estimates ranging from 48% to 77%. Age class 0.3 accounted for 28% of the season total, with stratum estimates ranging from 14% to 44%. Also included were age classes 0.5 and 0.2, accounting for 7% and 0.3% of the season total respectively. The estimated sex ratio for the entire run was 49% female, and estimates for each stratum ranged from 39% to 53% female fish. Female summer chum salmon ranged from 350 to 640 mm METF and males ranged from 490 to 680 mm METF (Table 5). For length-at-age measurements, mean lengths of male fish were larger than females.

Table 4. — Age and sex ratio estimates, by stratum, of summer chum salmon sampled at Gisasa River weir, Alaska, 2008. 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			
					2005	2004	2003	2002
Strata dates	Run size (N)	Sample size (n)	% Female	Unknown age	0.2	0.3	0.4	0.5
6/23 - 7/6	7,410	176	39 (3.7)	9	0% (0.0)	14% (2.7)	77% (3.3)	10% (2.3)
7/7 - 13	9,756	160	53 (4.0)	11	0% (0.0)	24% (3.5)	69% (3.8)	7% (2.1)
7/14-20	9,532	163	48 (3.9)	13	0.7% (0.7)	28% (3.7)	67% (3.8)	4% (1.6)
7/21 - 30	10,240	218	53 (3.4)	25	0.5% (0.5)	44% (3.6)	48% (3.6)	8% (1.9)
Total	36,938	717	49 (1.9)	58	0.3% (0.2)	28% (1.7)	64% (1.8)	7% (1.0)
Female	18,110	348		29	0.3% (0.0)	31% (2.5)	62% (2.7)	6% (1.4)
Male	18,828	369		29	0.3% (0.0)	26% (2.4)	67% (2.6)	7% (1.4)

Table 5. — Length at age of female and male summer chum salmon sampled at Gisasa River weir, Alaska, 2008.

	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	1	470	-	-	-	1	575	-	-	-
0.3	100	535	2.1	535	470 - 580	85	553	3.0	550	495 - 630
0.4	197	552	2.0	555	350 - 640	228	581	2.0	580	490 - 680
0.5	21	561	4.6	565	520 - 590	26	596	6.7	600	505 - 650
Total	319					340				

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 14 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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Appendix 1. — Historical Chinook salmon and summer chum salmon escapement in the Gisasa River, 1960 - 2008 (Aerial index data from Barton 1984; Alaska Department of Fish and Game unpublished data)

	Aerial index estimates			Weir estimates	
Year	Chinook salmon	Chum salmon	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	1000	Fair	3,030	261,305
2007	593		Fair	1,427	46,257
2008	487[b]		Fair[b]	1,738	36,938

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

Appendix 2. — Water depth and temperature data collected at the Gisasa River weir, 2008. Depth is the water depth at the trap. Measurements taken daily at 0800 hours.

Date	Depth (cm)	Temperature (°C)
6/24/08	70	-
6/25/08	>100[a]	-
6/26/08	85	-
6/27/08	80	
6/28/08	78	11
6/29/08	86	9
6/30/08	78	11
7/1/08	84	10
7/2/08	80	10
7/3/08	76	10
7/4/08	71	13
7/5/08	68	14
7/6/08	66	14
7/7/08	64	14
7/8/08	64	14
7/9/08	62	14
7/10/08	60	14
7/11/08	58	12
7/12/08	56	12
7/13/08	56	11
7/14/08	59	11
7/15/08	58	11
7/16/08	56	12
7/17/08	58	12
7/18/08	57	10
7/19/08	56	11
7/20/08	55	10
7/21/08	57	10
7/22/08	62	10
7/23/08	59	9
7/24/08	57	10
7/25/08	55	10
7/26/08	54	12
7/27/08	54	12
7/28/08	54	11
7/29/08	52	12
7/30/08	54	9

[a] Water rose above maximum gauge height (100cm), exact depth not available.