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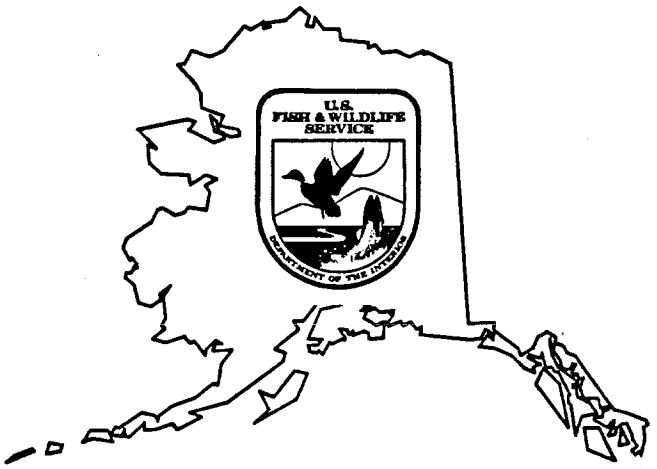
Abundance and Run Timing of Adult Salmon in the Gisasa River, Koyukuk National Wildlife Refuge, Alaska, 1999

David W. Wiswar



United States Department of the Interior
Fish and Wildlife Service
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Fishery Resources

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Abstract. — From June 23 to August 7, 1999 a resistance board weir was operated on the Gisasa River, a tributary to the Koyukuk River in west central Alaska. This was the sixth year of operating the weir at this site. A total of 2,631 chinook salmon *Oncorhynchus tshawytscha* and 9,920 summer chum salmon *O. keta* passed through the weir. The most abundant resident species was the longnose sucker *Catostomus catostomus* (N=104). Chinook salmon escapement was low but fell within the range of weir counts from 1994 to1998. Most of the chinook salmon (56%) passed through the weir between July 20-26. Females made up 29% of the chinook salmon sampled. Age groups 1.3 and 1.4 accounted for 70% of the run. Chum salmon escapement was only 13% of the average weir counts from previous years. Females comprised 52% of the chum salmon sampled. Age 0.4 chum salmon made up 54% of the run.

Chinook *Oncorhynchus tshawytscha* and summer chum salmon *O. keta* spawning in the Gisasa River contribute to the subsistence and commercial fisheries occurring in the Yukon drainage. The chinook and summer chum salmon runs enter the Yukon River in early June and continue through mid-July. Chinook salmon spawn throughout the Yukon drainage, whereas summer chum spawning distribution is in the lower and middle reaches (Minard 1996). Recent declines of Yukon River salmon stocks, particularly summer chum salmon (Schultz et al. 1993; Kruse 1998), have led to harvest restrictions, complete fishery closures, and spawning escapements below management goals. In the mixed stock fishery of the Yukon River, overfishing of some salmon stocks may have contributed to their decline. Management of individual stocks does not occur and accurate escapement data are limited throughout the Yukon drainage. Escapement estimates are primarily from aerial surveys (Barton 1984; Appendix 1), which are highly variable and are only an index of relative run strength.

Koyukuk National Wildlife Refuge (Refuge) is located near the villages of Nulato, Koyukuk, Galena, Huslia, and Hughes. The

residents of these villages depend on the Refuge's fishery resources for subsistence. Continued subsistence use by rural residents of fish and wildlife resources within National Wildlife Refuges and the conservation of those resources is mandated in the Alaska National Interests Lands Conservation Act (1980). Accurate monitoring of salmon escapement and specific stock assessment projects are important components in refining fisheries management and also fulfill Congressional mandates. To that end, a resistance board fish weir (Tobin 1994) was installed in the Gisasa River in 1994, the first year of a multi-year escapement study, that has continued through 1999. The objectives of the study are to: (1) determine daily escapement and run timing of adult salmon into the Gisasa River; (2) determine sex and size composition of chinook and chum salmon in the Gisasa River; (3) evaluate the effectiveness of aerial surveys as a method for salmon escapement estimation in the Gisasa River; and (4) determine presence and movement of resident fish in the Gisasa River. Poor weather conditions prevented an aerial survey from being conducted in 1999; therefore objective (3) is not addressed in this report.

Salmon escapement at the Gisasa River weir between 1994 and 1998 has ranged from 2,000 to 4,000 chinook and about 15,000 to 158,000 chum salmon (Wiswar 1999). Other historical data on salmon abundance in the Gisasa River are limited to aerial surveys conducted between 1969 and 1998 (Barton 1984; unpublished data, Alaska Department of Fish and Game [ADF&G]; Appendix 1). Aerial survey counts of chinook salmon in the Gisasa River have been higher during recent years. Counts, for years when survey conditions were rated fair to good, averaged 445 (range = 161 - 951) in the years 1974 - 1984 and 1185 (range = 410 - 2775) from 1985 to 1998. Aerial survey counts of chum salmon from the Gisasa River were highest from 1974 to 1976 averaging 33,423 (range = 21,342 - 56,904). Counts from 1985 to 1995, when survey conditions were rated fair to good, averaged 7,547 (range = 1,581 - 13,232) (Schultz et al. 1993; Bergstrom et al. 1996; unpublished data, ADF&G).

Study Area

The Gisasa River is a tributary of the Koyukuk River in west central Alaska (Figure 1). The Gisasa River flows northeast 112 km from its origin in the Nulato Hills to the Koyukuk River (65° 16'N latitude, 157° 40'W longitude, USGS. 1:63,360 series, Kateel River B-4 quadrangle). The lower third of the Gisasa River flows through the Refuge. Climate of the region is continental subarctic which is characterized by extreme seasonal variations of temperature and relatively low precipitation. The village of Galena, approximately 64 km southeast of the mouth of the Gisasa River, has a mean annual temperature of 3.8° C. Summer and winter temperature extremes range from 32° to -59° C, respectively. Stream flow is characterized by peak flows during late May and early June in response to snowmelt. Rainstorms may produce secondary peaks in summer. Rivers in the area usually begin to freeze during October (USFWS 1993).

The weir site is approximately 4 km upriver from the mouth of the Gisasa River. This section of the river is relatively straight. The river channel slopes gradually between the stream banks and average maximum depth is approximately 0.5 m. Substrate at the weir site consists primarily of medium-sized gravel.

Methods

Weir Operation

Construction and installation of the weir is described by Tobin (1994). Each picket of the weir was schedule 40 polyvinyl chloride (PVC) electrical conduit with a 2.5 cm inside diameter. The space between individual pickets was 3.2 cm. During operation the weir was visually inspected daily for holes and structural integrity. Fish carcasses and debris were cleaned from the weir as they accumulated, often several times a day. Cleaning usually involved walking on the weir panels until they were partially submerged and allowing the current to flush the debris off. Occasionally larger debris would have to be physically pushed off the weir.

Water temperature (°C) was recorded daily at approximately 1200 hours from a thermometer suspended approximately midway between the water surface and the riverbed.

Biological Data

All fish passing through the weir were counted and identified to species. Daily counts began at 0001 hours and ended at midnight. Fish were released from the trap and counted at varying time intervals, corresponding to the intensity of migration.

Length and sex ratio were determined from a weekly target sample of 160 chinook and chum salmon. Samples were generally taken over a 4 d period beginning on Monday of each week and consisted of the first 40 fish passing through the weir. Lengths from chinook and chum salmon were measured to the nearest 0.5 cm from the mid-eye to fork of the caudal fin (MEL). Three scales were collected from chinook salmon and one scale from chum salmon from the preferred area located on the left side of the fish and 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 chinook and chum salmon were sent to ADF&G Commercial Fisheries Management and Development Division for processing, where acetate impressions of the scales were made and aged. All ages are reported using the European method (Jearld 1983).

Fishers along the Yukon River in 1998 reported that chinook appeared smaller than those harvested in previous years. In 1999, this comparison of mean lengths of chinook salmon among years (1994-1999) was continued using a Tukey test ($P < 0.05$; SYSTAT 1998).

Data were treated as a stratified random sample (Cochran 1977); statistical weeks were defined as strata. Within a week, the proportion of the sample composed of a given sex/age, p_{ij}, was calculated as

$$p_{ij} = \frac{n_{ij}}{n_j}$$

where n_{ij} is the number of fish of sex/age i sampled in week j, and n_j is the total number of fish sampled in week j. The variance of p_{ij} was calculated as

$$v(p_{ij}) = \frac{p_{ij}\,(1-p_{ij})}{n_j-1}$$

Sex/age composition for the total run of summer chum and chinook salmon of a given sex/age, p_i, was calculated as

$$p_i = \sum_{j=1} W_j\, p_{ij}$$

where the stratum weight

$$W_j = \frac{N_j}{N}$$

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 of sex/age composition for the run will be calculated as

$$v(p_i) = \sum_{j=1} W_j^2 v(p_{ij}).$$

Results

Weir Operation

Operation of the weir began on June 23 and continued through August 7, 1999. Spawning activity immediately upstream of the weir resulted in areas where gravel accumulated on the weir panels. High river discharge prevented daily counting between July 31 and August 2.

Water Temperature

Water temperatures ranged from 9° to 18°C and averaged 13.2°C. The high temperature was recorded on July 12-14; the low temperature was on July 25.

Biological Data

Chum salmon (N=9,920) were the most abundant salmon species counted through the weir followed by chinook salmon (N=2,631) (Appendix 2). Four resident species were counted. The most abundant were longnose sucker *Catostomus catostomus* (N=104) followed by northern pike *Esox lucius* (N=12), Arctic grayling *Thymallus arcticus* (N=8), and whitefish spp. (N=7).

Chinook salmon.—The first chinook salmon observed at the weir was on June 28 (Appendix 2). About 56% of the chinook passed through the weir during the 7 d period of July 20-26 (Figure 2). During this time, there were two 2 d pulses where daily counts were near or exceeded 300 fish/d. The median migration day, the day when 50% of the total count passed the weir, was July 21. The sex ratio for the run was 29% female with weekly ratios (discounting the first two sample periods) ranging from 11% early in the run to 50% during the latter part of July (Table 1). Male chinook salmon ranged from 410 to 905 mm MEL (Table 2 and Appendix 3). Females ranged from 620 to 935 mm MEL. The chinook salmon run was composed of 10 age groups (Table 3). Age groups 1.3 and 1.4 made up 70% of the run. Male chinook sampled from 1996-1999 were more similar in length and smaller than those fish in 1994-1995 (Table 4). Female chinook in 1999 were similar in length to those fish sampled in 1996-1997 and larger than fish sampled in 1998.

Chum salmon.—Chum salmon were first counted on June 30 (Appendix 2). There was no peak period of abundance as observed in most previous years (Figure 2). Escapement counts between July 7 and 29 ranged between 200 and 500 fish/d and accounted for 85% of the run. The median migration day was July 20. The sex ratio for the run was 52% female with weekly ratios ranging from 45% early in the run to 58% during the last week escapement was monitored (Table 5). Male chums ranged from 435 to 670 mm MEL (Table 6 and Appendix 4). Females ranged in length from 460 to 620 mm MEL. Age 0.4 chum salmon made up 54% of the run (Table 7).

Discussion

Weir Operation

The weir performed well and was effective in allowing accurate counts of migrating salmon. Picket spacing of the trap and the weir panels was adequate to prevent adult chum and chinook salmon from passing between the pickets. Smaller-sized resident species may have passed through the weir undetected.

Water Temperature

In 1999, water temperatures in the Gisasa River were within the range of those temperatures reported at the time of chum salmon spawning in a review by Hale (1981).

Biological Data

The preseason outlook for chinook salmon was for a weak to below average run in 1999 (ADF&G 1999). Analysis of post-harvest data and escapement numbers from tributaries shows that this was indeed how the run developed (JTC 1999). Escapement numbers for chinook in the Gisasa River fell within the low range of previously reported weir counts (1,952-4,023 fish) (Wiswar 1999) and agrees with the post-season analysis.

Peak run timing of chinook salmon in the Gisasa River was a week to 10 days late from the previous years' average (Figure 2). Fisheries managers in the lower Yukon River reported the run was similarly late. Ice and low temperatures prevailed in the nearshore waters of the Bering Sea into June and presumably this was the cause for the delay.

The chinook salmon sex ratio in the lower Yukon River ranged from 45 to 61% female in the commercial harvest and test net fishery, respectively (ADF&G, unpublished data). This contrasts with the 29% female escapement observed in the Gisasa River. The female sex ratio in the Gisasa River has been low (17-23%) in recent years (1996-1998). Although the reason for the low female sex ratio is unclear, selective harvest for larger fish due to mesh size may be a factor. Low female sex ratios should be taken into account when assessing escapement in spawning tributaries and future preseason forecasts for run strength.

Six-year-old fish generally make up the majority of returning chinook salmon in the Yukon River (Brady 1983). In 1999, six-year-old fish in the commercial harvest and test net fishery in the lower Yukon River composed 81-85% of the fish (ADF&G, unpublished data). Conversely, in the Gisasa River, six-year-old chinook (1993 brood year) composed only 35% of the run and 5-year-old fish (age groups 1.3 and 0.4) made up 39% (Table 4).

The preliminary forecast for the Yukon River summer chum salmon run in 1999 predicted a below-average return notwithstanding the above-average escapements in 1994 and 1995 which would return 5- and 4-year-old fish (ADF&G 1999). Ocean conditions that are suspected to have contributed to the run failures in 1997-1998 (Kruse 1998) were expected to prevail and affect the run in 1999. Commercial harvest and escapement data on chum salmon throughout the drainage showed very weak runs (JTC 1999). The 1999 escapement in the Gisasa River was only about 13% of the average of the 1994 through 1998 weir counts (Figure 2) (Wiswar1999). The summer chum salmon run in 2003, which will reflect this year's escapement of 4-year-old fish, will probably be very low.

The sex ratio of chum salmon in the Gisasa River (52% female) was higher than that reported in the commercial fishery in the lower Yukon River (43%). Age structure of

chum salmon in the Gisasa River mirrored that reported in the test fishery and commercial harvest in the lower river; ~45% age 0.3 and ~55% age 0.4 fish.

Acknowledgments

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References

ADF&G (Alaska Department of Fish and Game). 1999. 1999 Yukon area subsistence, personal use, and commercial salmon fisheries outlook and management strategies. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report 3A99-23, Anchorage.

Barton, L.H. 1984. A catalog of Yukon River salmon spawning escapement surveys. Alaska Department of Fish and Game, Technical Data Report 121, Juneau.

Bergstrom, D., K. Schultz, and B. Borba. 1996. Salmon Fisheries in the Yukon area, Alaska, 1995. Alaska Department of Fish and Game, Regional Information Report No. 3A96-03, Anchorage.

Brady, J. 1983. Lower Yukon River salmon test and commercial fisheries, 1981. Alaska Department of Fish and Game Technical Data Report 89, Juneau.

Cochran, W.G. 1977. Sampling techniques, 3rd edition. John Wiley and Sons, New York.

Hale, S.S. 1981. Freshwater habitat relationships, chum salmon (Oncorhynchus keta). Alaska Department of Fish and Game, Habitat Division, Resource Assessment Branch, Anchorage.

Jearld, A. Jr. 1983. Age determination. Pages 301-324 *in* L.A. Nelson and D.L. Johnson, editors. Fishery Techniques. American Fisheries Society, Bethesda, Maryland.

JTC (The United States/Canada Yukon River Joint Technical Committee). 1999. Joint technical committee report, October, 1999. Anchorage, Alaska.

Kruse, G.H. 1998. Salmon run failures in 1997-1998: a link to anomalous ocean conditions? Alaska Fishery Research Bulletin 5(1):55-63.

Minard, J. 1996. Age, sex, and length of Yukon River salmon catches and escapements, 1994. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report Number 3A96-16, Anchorage.

Schultz, K.C., and six coauthors. 1993. Annual management report for subsistence, personal use, and commercial fisheries of the Yukon area, 1992. Alaska Department of Fish and Game, Regional Information Report Number. 3A93-10, Anchorage.

SYSTAT. 1998. Statistics, version 8.0

edition. SPSS Inc., Chicago.

Tobin, J.H. 1994. Construction and performance of a portable resistance board weir for counting migrating adult salmon in rivers. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Technical Report Number 22, Kenai, Alaska.

USFWS (U.S. Fish and Wildlife Service). 1993. Fishery Management Plan Koyukuk National Wildlife Refuge and Northern Unit of Innoko National Wildlife Refuge. Fishery Assistance Office, Fairbanks, Alaska.

Wiswar, D.W. 1999. Abundance and run timing of adult salmon in the Gisasa River, Koyukuk National Wildlife, Alaska, 1998. U.S. Fish and Wildlife Service, Fairbanks Fishery Resources Office, Fishery Data Series Number 99-1, Fairbanks, Alaska.

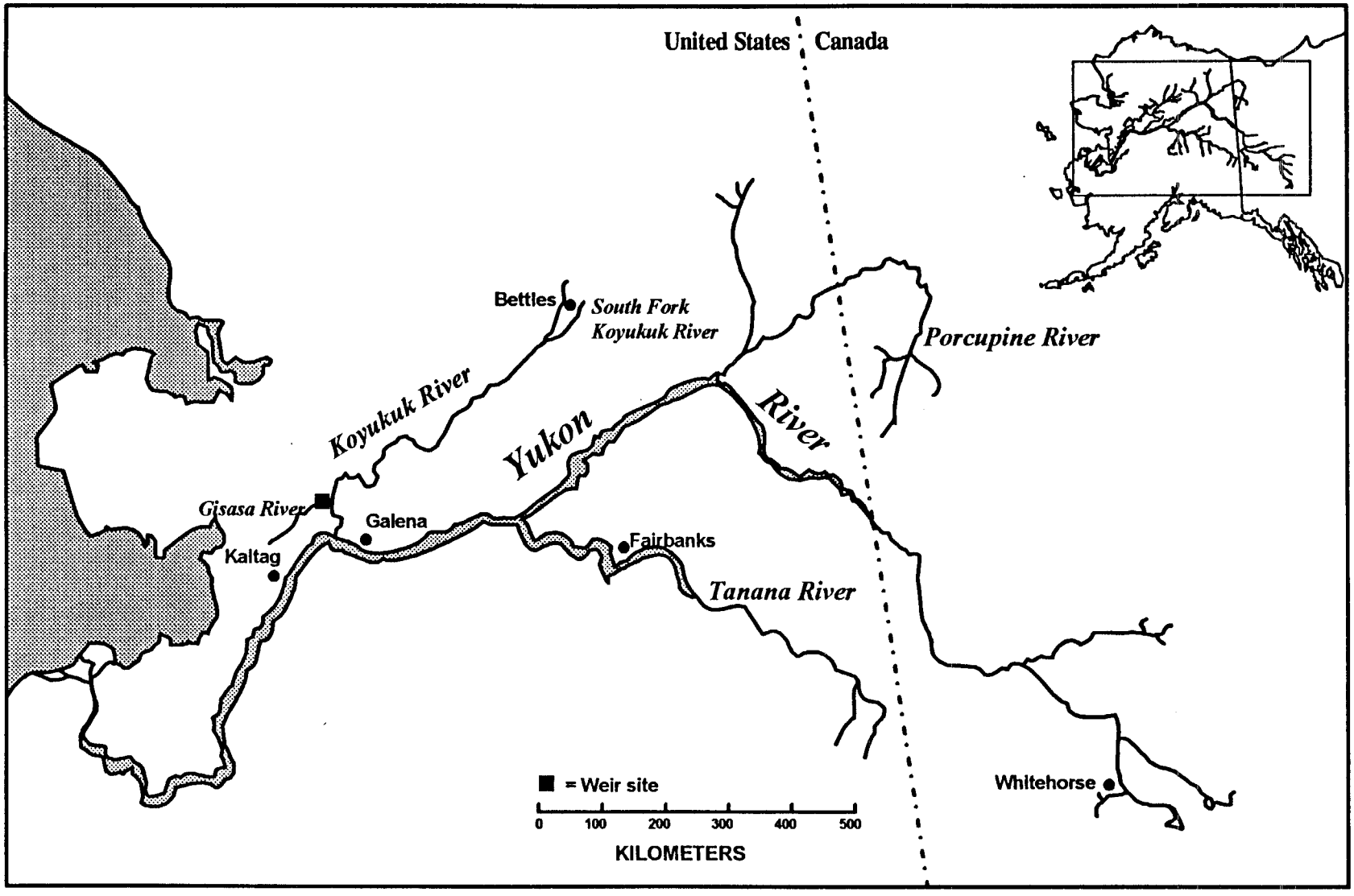

FIGURE 1.— Location of Gisasa River weir.

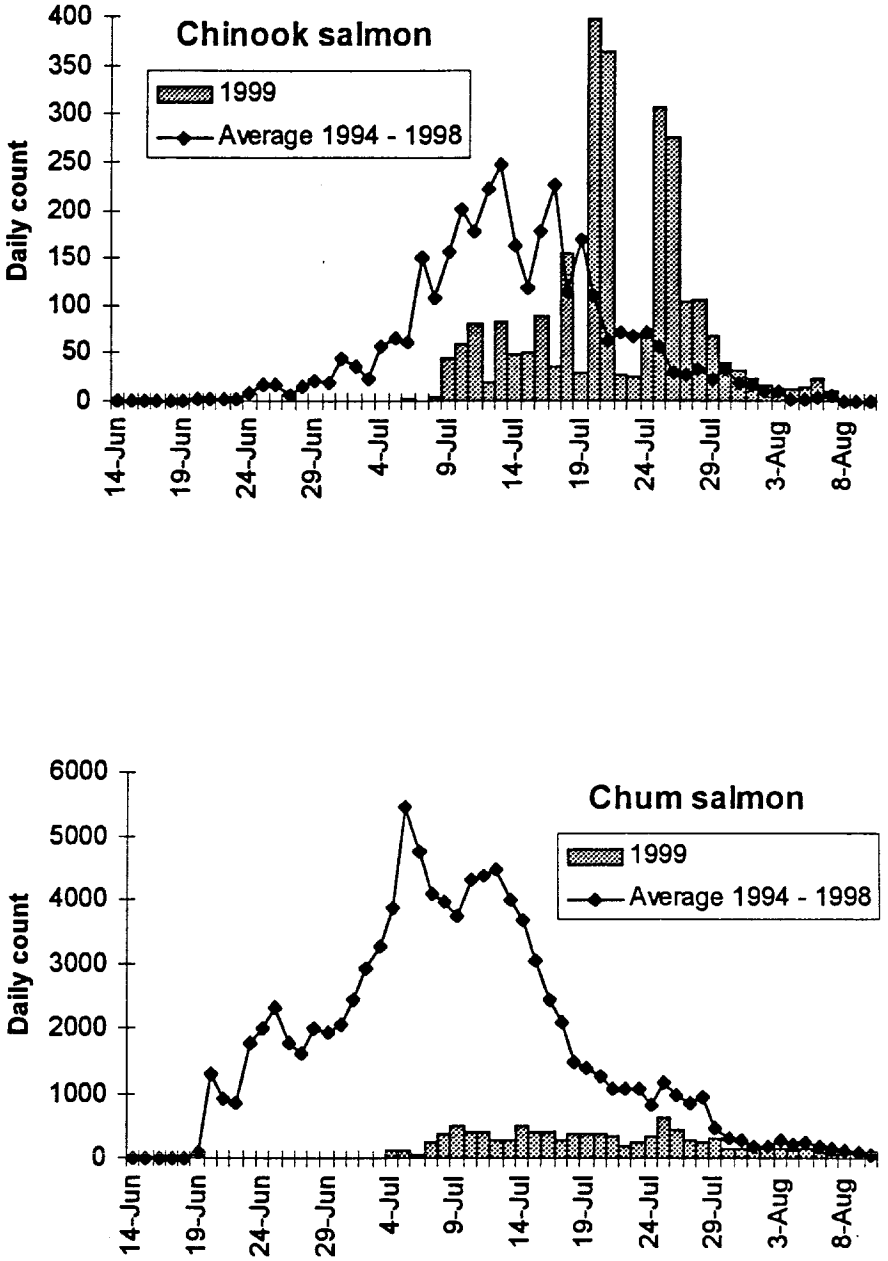

FIGURE 2.—Daily counts of chinook and chum salmon at the Gisasa River weir, 1999, with average daily counts from 1994 through 1998.

TABLE 1.—Sex ratio of chinook salmon sampled at the Gisasa River weir, Alaska, 1999.

Time period	Total number of chinook passing through the weir	N	Percent female (SE)	Estimated number of females
June 23-27	0	0	0	0
June 28- July 4	1	1	100 (0.0)	1
July 5-11	194	194	11 (2.2)	21
July 12-18	481	350	14 (1.9)	69
July 19-25	1,220	954	24 (1.4)	297
July 26- August 1	649	512	50 (2.2)	326
August 2 -7	86	70	49 (6.0)	42
Run total	2,631	2,081	29 (0.9)	755

TABLE 2.—Lengths of chinook salmon sampled at the Gisasa River weir, Alaska, 1999.

	Males				Females			
		Mid-eye to fork length (mm)				Mid-eye to fork length (mm)		
Time period	N	Mean	SE	Range	N	Mean	SE	Range
July 5-11	74	669.2	9.5	425-810	9	834.4	19.4	755-900
July 12-18	141	635.7	7.7	425-835	16	782.5	18.5	620-900
July 19-25	149	652.1	8.8	410-875	44	823.0	7.7	710-915
July 26- August 1	65	690.4	13.2	425-895	71	828.7	5.3	705-935
August 2 -7	9	611.7	51.3	445-905	10	827.0	16.5	755-920

TABLE 3.—Percent weekly age estimates of chinook salmon passing through the Gisasa River weir, 1999. SE in parentheses.

			Brood year and age										
			1990	1991	1992		1993	1994		1995		1996	
Time period	Run	N	0.8		0.6	1.5	1.4	0.4	1.3	0.3	1.2	0.2	1.1
Jun 23-27	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun 28-Jul 4	1	0	0	0	0	0	0	0	0	0	0	0	0
Jul 5-11	194	83	1 (1.2)	0	2 (1.7)	0	28 (4.9)	2 (1.7)	48 (5.5)	10 (3.3)	7 (2.9)	1 (1.2)	0
Jul 12-18	481	157	0	0	1 (0.6)	0	20 (3.2)	3 (1.3)	46 (4.0)	4 (1.7)	25 (3.5)	0	0
Jul 19-25	1,220	193	0	0	2 (0.9)	1 (0.7)	32 (3.4)	5 (1.5)	35 (3.4)	13 (2.4)	12 (2.4)	0	1 (0.5)
Jul 26-Aug 1	649	136	0	0	0	1 (0.7)	57 (4.3)	4 (1.8)	21 (3.5)	7 (2.3)	9 (2.4)	0	1 (0.7)
Aug 2-7	86	19	0	0	0	0	0	0	58 (11.6)	0	21 (9.6)	0	21 (9.6)
Total	2,630	588	0 (0.3)	0	1 (0.8)	1 (0.6)	35 (3.7)	4 (1.5)	35 (4.3)	9 (2.3)	14 (3.2)	0 (0.3)	1 (1.8)

TABLE 4.— Mean-mid eye to fork length (MEL) of chinook salmon from the Gisasa river weir, 1994-1999. Matrix of pairwise comparison probabilities. Mean lengths tested by a Tukey test (α= 0.05). SE in parentheses.

Year	N	Mid-eye to fork length (mm)	1994	1995	1996	1997	1998	1999
			Male chinook salmon					
1994	126	721.1 (8.7)	1.000					
1995	225	716.9 (7.7)	0.999	1.000				
1996	327	650.3 (5.4)	0.000	0.000	1.000			
1997	416	630.4 (5.2)	0.000	0.000	0.093	1.000		
1998	341	660.9 (5.3)	0.000	0.000	0.770	0.001	1.000	
1999	438	654.6 (4.8)	0.000	0.000	0.993	0.008	0.959	1.000
			Female chinook salmon					
1994	80	751.3 (11.2)	1.000					
1995	178	851.5 (4.8)	0.000	1.000				
1996	80	829.3 (8.6)	0.000	0.174	1.000			
1997	140	837.5 (5.0)	0.000	0.492	0.960	1.000		
1998	68	762.3 (10.9)	0.933	0.000	0.000	0.000	1.000	
1999	150	822.3 (4.3)	0.000	0.003	0.981	0.440	0.000	1.000

TABLE 5.—Sex ratio of chum salmon sampled at the Gisasa River weir, Alaska, 1999.

Time period	Total number of chum passing through the weir	N	Percent female (SE)	Estimated number of females
June 23-27	0	0	0	0
June 28- July 4	115	115	48 (4.7)	55
July 5-11	2,141	2,141	45 (1.1)	961
July 12-18	2,574	802	52 (1.8)	1,332
July 19-25	2,575	903	51 (1.7)	1,312
July 26- August 1	1,739	678	58 (1.9)	1,013
August 2 -7	776	236	58 (3.2)	447
Run total	9,920	4,875	52 (0.8)	5,120

TABLE 6.—Lengths of chum salmon sampled at the Gisasa River weir, Alaska, 1999.

	Males				Females			
		Mid-eye to fork length (mm)				Mid-eye to fork length (mm)		
Time period	N	Mean	SE	Range	N	Mean	SE	Range
June 28- July 4	14	589.3	7.2	525-620	26	565.8	4.5	525-600
July 5-11	100	596.8	2.6	525-670	62	567.3	2.4	530-620
July 12-18	86	576.8	2.8	515-640	85	556.9	2.5	515-605
July 19-25	74	568.8	2.8	525-625	86	548.0	2.4	485-595
July 26- August 1	62	558.3	3.2	510-625	98	532.4	2.0	490-585
August 2 -7	50	547.5	4.5	435-610	70	524.9	2.7	460-575

TABLE 7.— Percent weekly age estimates of chum salmon passing through the Gisasa River weir, 1999. SE in parentheses.

			Brood year and age			
			1993	1994	1995	1996
Time period	Run	N	0.5	0.4	0.3	0.2
June 23-27	0	0	0	0	0	0
June 28- July 4	115	37	3 (2.7)	81 (6.5)	16 (6.1)	0
July 5-11	2,141	142	2 (1.2)	82 (3.3)	16 (3.1)	0
July 12-18	2,574	152	1 (0.7)	56 (4.0)	43 (4.0)	0
July 19-25	2,575	140	2 (1.2)	47 (4.2)	51 (4.2)	0
July 26- August 1	1,739	141	1 (0.7)	30 (3.9)	69 (3.9)	0
August 2-7	776	100	5 (2.2)	42 (5.0)	52 (5.0)	1 (1.0)
Total	9,920	712	2 (1.0)	54 (3.8)	44 (3.7)	0 (0.0)

APPENDIX 1.— Salmon escapement counts from aerial counts in the Gisasa River, 1974-1998 (source: Barton 1984; Alaska Department of Fish and Game, unpublished data).

	Escapement counts	
Year	Chinook salmon	Chum salmon
1974	161	22,022
1975	385	56,904
1976	332	21,342
1977[a]	255	2,204
1978[a]	45	9,280
1979	484	10,962
1980	951	10,388
1981	—	—
1982[a]	421	334
1983[a]	572	2,356
1984	—	—
1985	735	13,232
1986	1,346	12,114
1987	731	2,123
1988	797	9,284
1989	—	—
1990[a]	884	450
1991	1,690	7,003
1992	910	9,300
1993	1,573	1,581
1994	2,775	6,827
1995	410	6,458
1996	—	—
1997[a]	144	686
1998	889	—

[a] Incomplete surveys due to poor survey conditions.

APPENDIX 2.—Daily and cumulative (chinook and chum salmon only) counts of fish passing through the Gisasa River weir, 1999. (Cum = cumulative; *asterisk denotes that daily counts were estimated due to high river flow).

	Chinook		Summer chum		Longnose sucker	Northern pike	Arctic grayling	Whitefish spp.
Date	Daily	Cum	Daily	Cum	Daily	Daily	Daily	Daily
23-Jun	0	0	0	0	2	0	0	0
24-Jun	0	0	0	0	6	1	0	1
25-Jun	0	0	0	0	7	0	0	0
26-Jun	0	0	0	0	2	0	0	0
27-Jun	0	0	0	0	6	1	0	1
28-Jun	1	1	0	0	7	0	0	0
29-Jun	0	1	0	0	1	1	0	0
30-Jun	0	1	1	1	1	0	0	0
1-Jul	0	1	0	1	3	0	0	0
2-Jul	0	1	0	1	7	0	0	1
3-Jul	0	1	1	2	6	1	1	2
4-Jul	0	1	113	115	4	0	0	0
5-Jul	1	2	115	230	2	1	0	1
6-Jul	2	4	50	280	1	1	0	0
7-Jul	1	5	257	537	4	0	0	0
8-Jul	5	10	376	913	3	0	0	0
9-Jul	45	55	517	1,430	10	2	0	0
10-Jul	60	115	403	1,833	24	3	3	0
11-Jul	80	195	423	2,256	4	0	0	0
12-Jul	19	214	281	2,537	4	0	2	0
13-Jul	83	297	299	2,836	0	0	0	0
14-Jul	49	346	497	3,333	0	0	0	0
15-Jul	50	396	423	3,756	0	0	0	0
16-Jul	89	485	426	4,182	0	1	0	0
17-Jul	37	522	276	4,458	0	0	0	0
18-Jul	154	676	372	4,830	0	0	0	1

APPENDIX 2.— Continued.

Date	Chinook		Summer chum		Longnose sucker	Northern pike	Arctic grayling	Whitefish spp.
	Daily	Cum	Daily	Cum	Daily	Daily	Daily	Daily
20-Jul	397	1,103	388	5,590	0	0	0	0
21-Jul	363	1,466	348	5,938	0	0	0	0
22-Jul	27	1,493	202	6,140	0	0	0	0
23-Jul	26	1,519	267	6,407	0	0	0	0
24-Jul	70	1,589	354	6,761	0	0	0	0
25-Jul	307	1,896	644	7,405	0	0	0	0
26-Jul	276	2,172	433	7,838	0	0	1	0
27-Jul	103	2,275	272	8,110	0	0	0	0
28-Jul	106	2,381	239	8,349	0	0	0	0
29-Jul	68	2,449	315	8,664	0	0	0	0
30-Jul	40	2,489	165	8,829	0	0	0	0
31-Jul*	32	2,521	160	8,989	0	0	0	0
1-Aug*	24	2,545	155	9,144	0	0	0	0
2-Aug*	16	2,561	150	9,294	0	0	0	0
3-Aug	8	2,569	145	9,439	0	0	0	0
4-Aug	13	2,582	135	9,574	0	0	0	0
5-Aug	15	2,597	168	9,742	0	0	0	0
6-Aug	23	2,620	109	9,851	0	0	1	0
7-Aug	11	2,631	69	9,920	0	0	0	0
Total	2,631		9,920		104	12	8	7

APPENDIX 3.—Length at age of male and female chinook salmon sampled at the Gisasa River weir, Alaska, 1999.

	Males				Females			
		Mid-eye to fork length (mm)				Mid-eye to fork length (mm)		
Age	N	Mean	SE	Range	N	Mean	SE	Range
0.2	1	645			0			
0.3	37	645.7	14.7	480-805	13	834.2	11.5	755-920
1.2	86	522.8	4.8	425-655	0			
0.4	18	629.4	20.7	430-740	3	818.3	7.3	805-830
1.3	202	674.6	4.4	425-835	10	785.0	24.4	660-900
1.4	83	759.2	7.2	575-905	123	824.0	4.6	620-935
0.6	6	611.7	33.2	515-720	0			
1.5	2	762.5	112.5	650-875	1	850		
0.8	1	570			0			

APPENDIX 4.—Length at age of male and female chum salmon sampled at the Gisasa River weir, Alaska, 1999. Age estimates from scales.

	Males				Females			
		Mid-eye to fork length (mm)				Mid-eye to fork length (mm)		
Age	N	Mean	SE	Range	N	Mean	SE	Range
0.2	1	475			0			
0.3	132	561.4	2.2	500-640	184	537.6	1.8	485-610
0.4	197	585.2	2.1	435-670	184	554.9	1.8	460-620
0.5	4	563.8	12.1	540-595	10	553.0	9.8	500-590