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Abundance and Run Timing of Adult Salmon in the Gisasa River, Koyukuk National Wildlife Refuge, Alaska, 1998

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United States Department of the Interior
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Abstract. — From June 21 to August 2, 1998 a resistance board weir was operated on the Gisasa River, a tributary to the Koyukuk River in west central Alaska. This was the fifth year of weir operation at this site. A total of 1,997 chinook salmon *Oncorhynchus tshawytscha* and 14,794 summer chum salmon *O. keta* passed through the weir. The most abundant resident species were longnose sucker *Catostomus catostomus* (N=55) and Arctic grayling *Thymallus arcticus* (N=21). Chinook escapement was low but fell within the range of weir counts from 1994-1997. Females comprised 17% of the chinook salmon sampled. Most of the chinook (64%) passed through the weir between July 10-18. Five age groups were identified for chinook salmon; the predominant age group was 1.3 (58%). Chum salmon escapement was only 14% of the 1995-1997 weir counts. Females comprised 46% of the chum salmon sampled. Three age groups were identified with age 0.3 comprising 45% of the run.

Introduction

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 continues through mid-July. Chinook salmon spawn throughout the Yukon drainage while 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), 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 the 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 (Melegari and Wiswar 1995), the first year of a multi-year escapement study, that has continued through 1998. 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.

Salmon escapement at the Gisasa River weir between 1994 and 1997 has ranged from 2,000 to 4,000 chinook and about 32,000 to 158,00 chums (Melegari and Wiswar 1995; Melegari 1996, 1997; Wiswar 1998). Other historical data on the fishery resources 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 chum salmon from the Gisasa River were highest from 1974 to 1976 averaging 33,423 (range = 21,342 - 56,904). Counts, for years when survey conditions were rated fair to good, from 1985 to 1993 averaged 7,805 (range = 1,581 - 13,232) 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) from 1974 - 1984 and 1218 (range = 410 - 2775) from 1985 - 1995 (Schultz et al. 1993; Bergstrom et al. 1996).

Study Area

The Gisasa River is a tributary of the Koyukuk River in west central interior 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° C 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 generally 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 from 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. Chum salmon were collected opportunistically off the weir as they floated back down stream after spawning. One scale and a section of vertebrae anterior to the caudal peduncle were collected to compare age structures. 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. Vertebrae were aged by USFWS personnel. All ages are reported using the European method (Jearld 1983). A students t-test ($P < 0.05$; Zar 1984) was used to compare mean length at age of males and females.

Data were treated as a stratified random sample (Cochran 1977); statistical weeks were defined as strata. Within a week, the proportion of the sample comprised 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 passed through the weir during week j and N is the total number of fish of a given species passed through the weir during the run. Variance of sex/age composition for the run will be calculated as

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

Fishers along the Yukon River reported that chinook appeared smaller than those harvested in previous years (Associated Press 1998). A Tukey test (Zar 1984; SYSTAT 1998) was used to determine if there was a significant difference ($P< 0.05$) in length of male and female chinook salmon in 1998 when compared to samples from previous years at the Gisasa River weir.

Results

Weir Operation

Operation of the weir began on June 21 and continued through August 2, 1998. Spawning activity immediately upstream of the weir resulted in areas where gravel accumulated on the weir

panels. High river discharge accounted for two periods in July when no counting occurred.

Water Temperature

Water temperatures ranged from 9° to 15°C and averaged 12.1°C. The high temperature was recorded on June 30; the low temperature was on July 29.

Biological Data

Chum salmon (N=14,794) were the most abundant salmon species counted through the weir followed by chinook (N=1,997) pink *O. gorbuska* (N=55) and sockeye salmon *O. nerka* (N=7; Appendix 2). Four resident species were counted. The most abundant were longnose sucker *Catostomus catostomus* (N=55) followed by Arctic grayling *Thymallus arcticus* (N=21), northern pike *Esox lucius* (N=4), and whitefish spp. (N=3).

Chinook salmon.—The first chinook salmon observed at the weir was on June 27 (Appendix 2). About 64% of the chinook passed through the weir during the 9 d of July 10-18 (Figure 2; Appendix 2). The median migration day, the day when 50% of the total count passed the weir, was July 15. The sex ratio for the run was 17% female with weekly ratios ranging from 10% early in the run to 28% during the latter part of July (Table 1). Male chinook ranged from 410 to 875 mm MEL (Tables 2 and 3). Females ranged from 490 to 905 mm MEL. Female chinook salmon were larger than males ($P<0.001$). The chinook run was comprised of five age groups (Table 3). Age group 1.3 comprised about 58% of the run (Table 4).

Chinook males in the Gisasa River in 1998 were similar in length to males in 1996 and 1997 ($P>0.05$). However, they were smaller than those fish sampled in 1994 and 1995 ($P<0.05$) (Table 5). Female chinook in 1998 and 1994 were smaller in length than other years ($P<0.05$).

Chum salmon.—Chum salmon were first counted on June 21 (Appendix 2). Their numbers increased gradually through early July then peaked. Highest escapement counts of over 900 fish/d were recorded during a 5 d period between July 6 and 10 which accounted for 35% of the run. The median migration day was July 10. The sex ratio for the run was 46% female with weekly ratios ranging from 42% about midway through the run to 69% during the last week escapement was monitored (Table 6). Male chums ranged from 450 to 715 mm MEL (Tables 7 and 8). Females ranged from 470 to 625 mm MEL. Male chum salmon were larger than females ($P<0.001$). There was 80% agreement when comparing vertebrae to scales for age estimates. Only scale ages are reported here. Three age groups were determined (Tables 8 and 9). Age 0.3 chum salmon comprised 45% of the run.

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 1998, water temperatures in the Gisasa River compared with 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 run of average strength in 1998 (JTC 1998a). The chinook run fell short of its expectation in the Yukon drainage producing a weak harvest and escapement (JTC 1998b). Escapement numbers for chinook in the Gisasa River fell within the low

range of previously reported weir counts (1,952-4,023 fish) (Melegari and Wiswar 1995; Melegari 1996, 1997; Wiswar 1998).

The commercial chinook salmon harvest in the lower Yukon River was about 43% female fish (JTC 1998b). This contrasts with the 17% female escapement observed in the Gisasa River. While the overall number of returning chinook may not appear to be of critical concern, the poor return of female chinook salmon will probably affect recruitment.

Six year old fish generally comprise the majority of returning chinook salmon in the Yukon River (Brady 1983). However, in 1998, six year old fish comprised only 34% of the commercial harvest in the lower Yukon River. The poor return of this age class occurred in the Gisasa River as well where six year old chinook (1992 brood year) comprised only 18% of the run in 1998. Gisasa River chinook escapement was predominately (58%) 5 year old fish (age group 1.3)(Table 4).

The preliminary forecast for the Yukon River chum salmon run in 1998 predicted an average to above average return (JTC 1998a). This was based on the 1994 escapement in the drainage which was high relative to previous years' assessments. However, post season analysis of the commercial harvest and escapement data on chum salmon throughout the drainage showed a very weak run (JTC 1998b). The 1998 escapement in the Gisasa River was only about 14% of the average of the 1995 through 1997 weir counts (Figure 2)(Melegari 1996,1997; Wiswar 1998). The summer chum salmon run in 2002, which will reflect this year's escapement with 4 year old fish, will probably be very low.

ADF&G conducted an aerial survey on July 31, 1998 (Appendix 2). Survey conditions were rated poor to fair with the river described as being murky. The surveyors counted 889 chinook which was about 45% of the escapement count at the weir.

Acknowledgments

Jeff Melegari was responsible for initial management of the project. Riley Morris and Bill Carter staffed the weir and were responsible for data collection and daily weir operations.

References

Associated Press. 1998. Yukon kings were stressed, biologists study cause of poor runs. Fairbanks Daily News-Miner. 1998 August 3: Section A; 3 (column 4).

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

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

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

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). Habitat division, Resource Assessment Branch, Alaska Department of Fish and Game, 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). 1998a. Joint technical committee report, February 25-26, 1998. Whitehorse, Yukon Territory.

JTC (The United States/Canada Yukon River Joint Technical Committee). 1998b. Yukon River salmon season review for 1998 and technical committee report, November 18-19, 1998. Whitehorse, Yukon Territory.

Melegari, J.L. and D.W. Wiswar. 1995. Abundance and run timing of adult salmon in the Gisasa River, Koyukuk National Wildlife, Alaska, 1994. U.S. Fish and Wildlife Service, Fairbanks Fishery Resources Office, Fishery Data Series Number 95-1, Fairbanks, Alaska.

Melegari, J.L. 1996. Abundance and run timing of adult salmon in the Gisasa River, Koyukuk National Wildlife, Alaska, 1995. U.S. Fish and Wildlife Service, Fairbanks Fishery Resources Office, Fishery Data Series Number 96-1, Fairbanks, Alaska.

Melegari, J.L. 1997. Abundance and run timing of adult salmon in the Gisasa River, Koyukuk National Wildlife, Alaska, 1996. U.S. Fish and Wildlife Service, Fairbanks Fishery Resources Office, Fishery Data Series Number 97-1, Fairbanks, Alaska.

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., R.R. Holder, L.H. Barton, D.J. Bergstrom, C. Blaney, G.J. Sandone, D.J. Schneiderhan. 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, Alaska.

SYSTAT 1998. Statistic, version 8.0 edition. SPSS Inc. Chicago, Illinois,

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 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. 1998. Abundance and run timing of adult salmon in the Gisasa River, Koyukuk National Wildlife, Alaska, 1997. U.S. Fish and Wildlife Service, Fairbanks Fishery Resources Office, Fishery Data Series Number 98-3, Fairbanks, Alaska

Zar, J.H. 1984. Biostatistical analysis, second edition. Prentice and Hall, Englewood Cliffs, N. J.

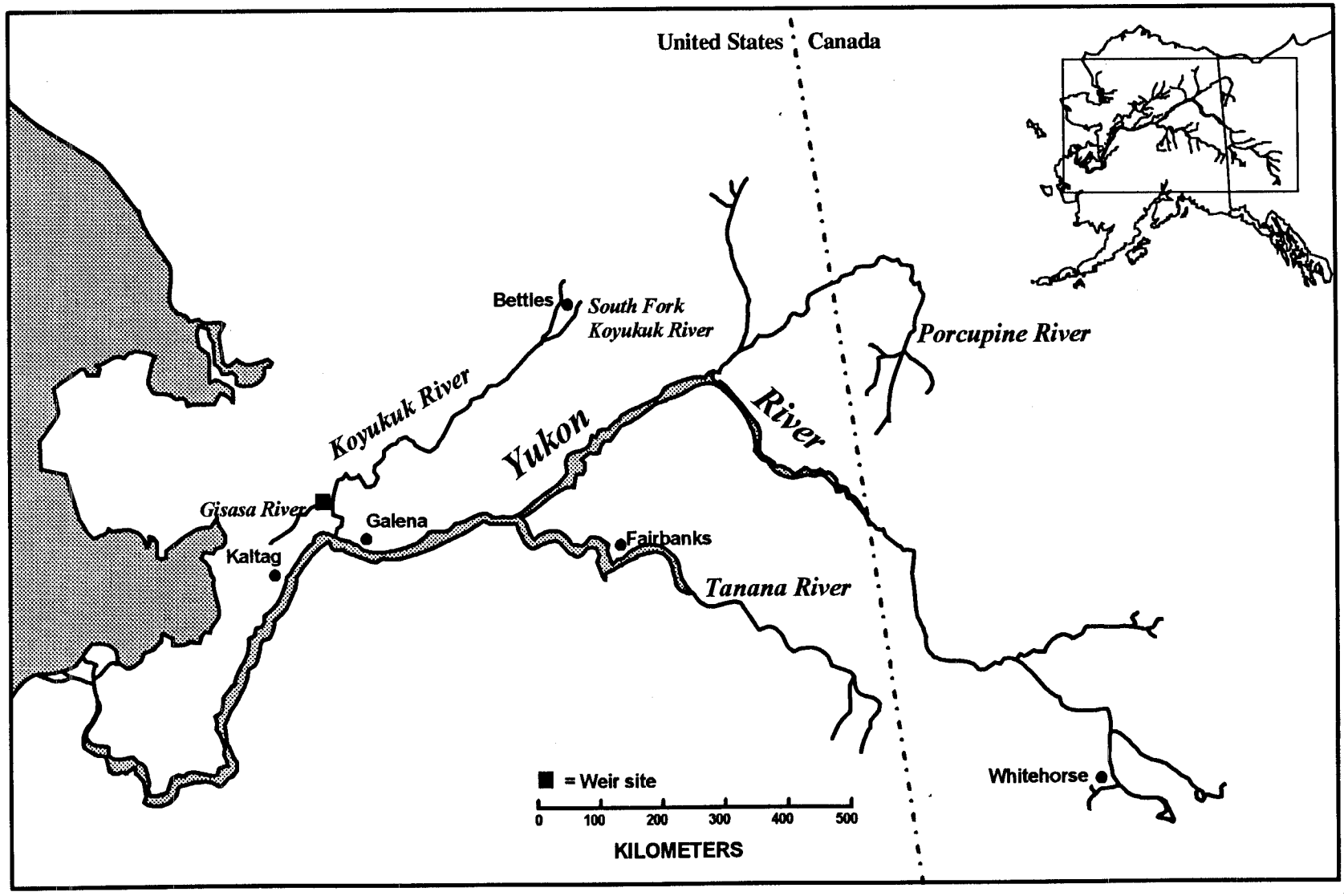
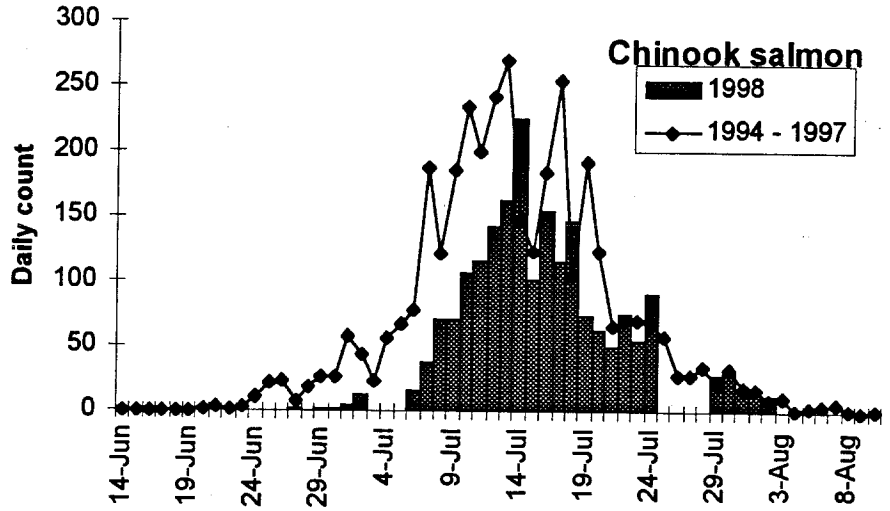


FIGURE 1.— Location of Gisasa River weir.



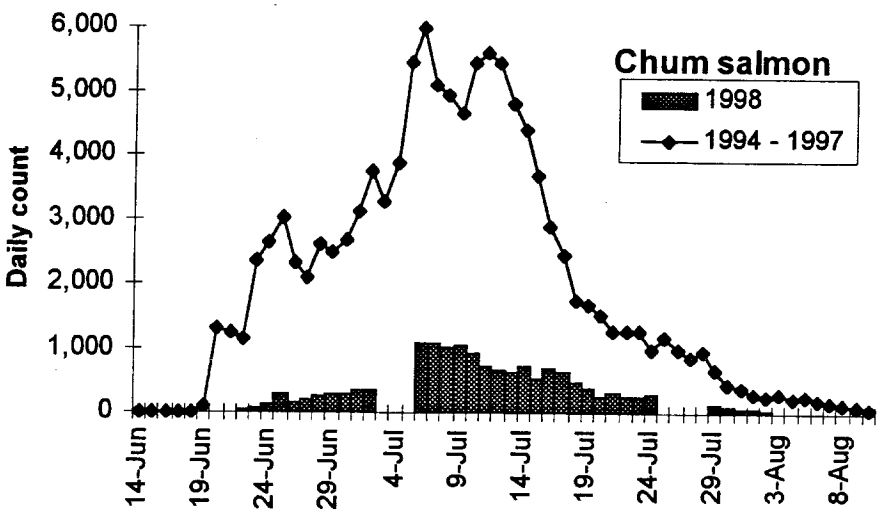


FIGURE 2.—Daily counts of chinook and chum salmon at the Gisasa River weir, 1998, with average daily counts from 1994 through 1997.

TABLE 1.—Sex ratio of chinook salmon sampled at the Gisasa River weir, Alaska, 1998.

Time period	Total number of chinook passing through the weir	N	Percent female (SE)	Estimated number of females
June 21-28	2	0		
June 29- July 5	20	10	10 (10.0)	2
July 6-12	559	151	16 (3.0)	89
July 13-19	981	180	13 (2.5)	131
July 20-26	331	68	28 (5.5)	92
July 27- August 2	104	43	26 (6.7)	27
Run total	1,997	452	17 (1.8)	341

TABLE 2.—Lengths of chinook salmon sampled at the Gisasa River weir, Alaska, 1998.

	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 21-28	0				0			
June 29- July 5	9	730.6	23.2	650-875	1	795		
July 6-12	127	664.0	7.6	430-825	24	725.4	19.1	560-865
July 13-19	156	658.6	8.4	415-865	24	781.5	20.9	490-905
July 20-26	49	647.0	15.6	410-810	19	782.9	11.2	710-875
July 27- August 2								

TABLE 3.—Length at age of male and female chinook salmon sampled at the Gisasa River weir, Alaska, 1998.

	Males				Females			
		Mid-eye to fork length (mm)				Mid-eye to fork length (mm)		
Age	N	Mean	SE	Range	N	Mean	SE	Range
1.2	58	514.1	6.6	410-670	1	560		
1.3	195	693.4	3.9	500-805	21	704.8	16.1	565-855
1.4	39	730.1	13.1	430-865	29	801.9	8.3	665-875
1.5	2	807.5	27.5	780-835	6	870.0	11.3	835-905
2.4	1	715						

TABLE 4.—Percent weekly age estimates of chinook salmon passing through the Gisasa River weir, 1998. SE in parentheses.

			Brood year and age				
			1991		1992	1993	1994
Time period	Run	N	2.4	1.5	1.4	1.3	1.2
June 21-28	2	0					
June 29- July 5	20	9	0	0	11.1 (11.1)	88.9 (11.1)	0
July 6-12	559	132	0	0.8 (0.8)	20.5 (3.5)	62.1 (4.2)	16.7 (3.3)
July 13-19	981	146	0.7 (0.7)	4.0 (1.6)	16.1 (3.0)	61.7 (4.0)	17.4 (3.1)
July 20-26	331	62	0	1.6 (1.6)	25.8 (5.6)	54.8 (6.3)	17.7 (4.9)
July 27- August 2	104	0					
Total	1,997	352	0.3 (.3)	2.5 (0.9)	18.0 (2.0)	57.7 (2.5)	16.2 (2.0)

TABLE 5.— Mean mid eye to fork length (MEL) of Chinook salmon from the Gisasa river weir, 1994-1998. Mean length tested by a Tukey test (α= 0.05) and followed by the same letter are not significantly different (P> 0.05).

	Male chinook		Female chinook	
Year	Mid-eye to fork length (mm)		Mid-eye to fork length (mm)	
1998	660.9	z	762.3	x
1997	639.7	z	837.5	w
1996	650.3	z	829.3	w
1995	716.9	y	851.5	w
1994	721.1	y	751.3	x

TABLE 6.—Sex ratio of chum salmon sampled at the Gisasa River weir, Alaska, 1998.

Time period	Total number of chum passing through the weir	N	Percent female (SE)	Estimated number of females
June 21-28	1,083	179	53 (3.7)	569
June 29- July 5	1,296	533	46 (2.7)	598
July 6-12	6,533	160	42 (3.9)	2,736
July 13-19	4,095	160	46 (4.0)	1,868
July 20-26	1,384	160	60 (3.9)	830
July 27- August 2	403	174	69 (3.5)	278
Run total	14,794	1,366	46 (2.1)	6,879

TABLE 7.—Lengths of chum salmon sampled at the Gisasa River weir, Alaska, 1998.

	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 21-28	85	594.9	3.0	520-665	94	565.9	2.3	510-610
June 29- July 5								
July 6-12	93	586.7	3.3	530-715	67	554.9	2.6	510-625
July 13-19	67	563.3	2.7	515-650	73	539.9	2.8	485-595
July 20-26	64	558.2	3.2	450-615	96	529.9	2.7	470-605
July 27 - August 2								

TABLE 8.—Length at age of male and female chum salmon sampled at the Gisasa River weir, Alaska, 1998. Ages 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
0.3	148	560.6	1.9	450-635	155	536.2	2.0	470-595
0.4	113	593.0	2.6	515-670	125	557.0	1.9	495-605
0.5	33	595.2	6.4	535-715	24	577.7	4.4	545-625

TABLE 9.— Percent weekly age estimates of chum salmon passing through the Gisasa River weir, 1998. SE in parentheses.

			Brood year and age		
			1992	1993	1994
Time period	Run	N	0.5	0.4	0.3
June 21-28	1,083	166	18.7 (3.0)	63.9 (3.7)	17.5 (3.0)
June 29- July 5	1,296	0			
July 6-12	6,533	140	9.3 (2.5)	43.6 (4.2)	47.1 (4.2)
July 13-19	4,095	145	1.4 (1.0)	21.4 (3.4)	77.2 (3.5)
July 20-26	1,384	0			
July 27- August 2	403	147	7.5 (2.2)	27.2 (3.7)	65.3 (3.9)
Total	14,794	598	6.1 (1.1)	30.6 (2.1)	45.3 (2.1)

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, 1998. (Cum = cumulative).

Date	Chinook salmon		Chum salmon		Pink salmon	Sockeye salmon	Longnose sucker	Arctic grayling	Northern pike	Whitefish spp.
	Daily	Cum	Daily	Cum	Daily	Daily	Daily	Daily	Daily	Daily
Jun 21	0	0	8	8	0	0	4	0	0	0
Jun 22	0	0	20	28	0	0	1	1	0	0
Jun 23	0	0	69	97	0	0	2	2	0	1
Jun 24	0	0	114	211	0	0	5	1	0	1
Jun 25	0	0	270	481	0	0	1	0	0	1
Jun 26	0	0	147	628	0	0	0	0	0	0
Jun 27	2	2	202	830	0	0	0	0	0	0
Jun 28	0	2	253	1,083	0	0	0	0	1	0
Jun 29	1	3	291	1,374	0	0	4	3	0	0
Jun 30	2	5	297	1,671	0	0	9	1	0	0
Jul 1	5	10	359	2,030	0	0	4	0	0	0
Jul 2 [a]	12	22	349	2,379	0	0	2	1	0	0
Jul 3	No counts, high water									
Jul 4	No counts, high water									
Jul 5	No counts, high water									
Jul 6 [a]	15	37	1,091	3,470	0	0	1	2	0	0
Jul 7	37	74	1,075	4,545	0	0	3	0	0	0
Jul 8	71	145	1,017	5,562	0	0	1	1	0	0
Jul 9	71	216	1,041	6,603	0	0	0	0	0	0
Jul 10	107	323	911	7,514	0	0	2	1	0	0
Jul 11	116	439	740	8,254	0	1	4	0	0	0
Jul 12	142	581	658	8,912	0	0	1	1	0	0
Jul 13	163	744	623	9,535	0	1	0	0	1	0
Jul 14	225	969	735	10,270	0	0	1	0	0	0
Jul 15	102	1,071	534	10,804	0	0	2	1	0	0
Jul 16	155	1,226	687	11,491	0	0	3	0	0	0
Jul 17	115	1,341	644	12,135	0	2	2	1	0	0
Jul 18	147	1,488	487	12,622	3	0	0	0	0	0
Jul 19	74	1,562	385	13,007	0	0	0	2	1	0
Jul 20	62	1,624	253	13,260	1	0	0	0	0	0
Jul 21	50	1,674	310	13,570	2	0	1	2	0	0
Jul 22	75	1,749	262	13,832	1	1	0	0	0	0
Jul 23	54	1,803	267	14,099	2	0	0	1	0	0
Jul 24	90	1,893	292	14,391	6	0	1	0	0	0
Jul 25	No counts, high water									
Jul 26	No counts, high water									

APPENDIX 2.—Continued.

Date	Chinook salmon Daily	Chinook salmon Cum	Chum salmon Daily	Chum salmon Cum	Pink salmon Daily	Sockeye salmon Daily	Longnose sucker Daily	Arctic grayling Daily	Northern pike Daily	Whitefish spp. Daily
Jul 27	No counts, high water									
Jul 28	No counts, high water									
Jul 29 [a]	28	1,921	138	14,529	13	0	0	0	0	0
Jul 30	33	1,954	91	14,620	9	0	0	0	0	0
Jul 31	17	1,971	69	14,689	11	1	1	0	1	0
Aug 1	14	1,985	58	14,747	3	1	0	0	0	0
Aug 2	12	1,997	47	14,794	4	0	0	0	0	0
Total	1,997		14,794		55	7	55	21	4	3

[a] Partial counts due to high water occurred on following days: July 3, 6, and 29.