Tanana Chiefs Conference, Fisheries Program

Abundance and Run Timing of Adult Salmon in Henshaw Creek, Kanuti National Wildlife Refuge, Alaska, 2008–2011

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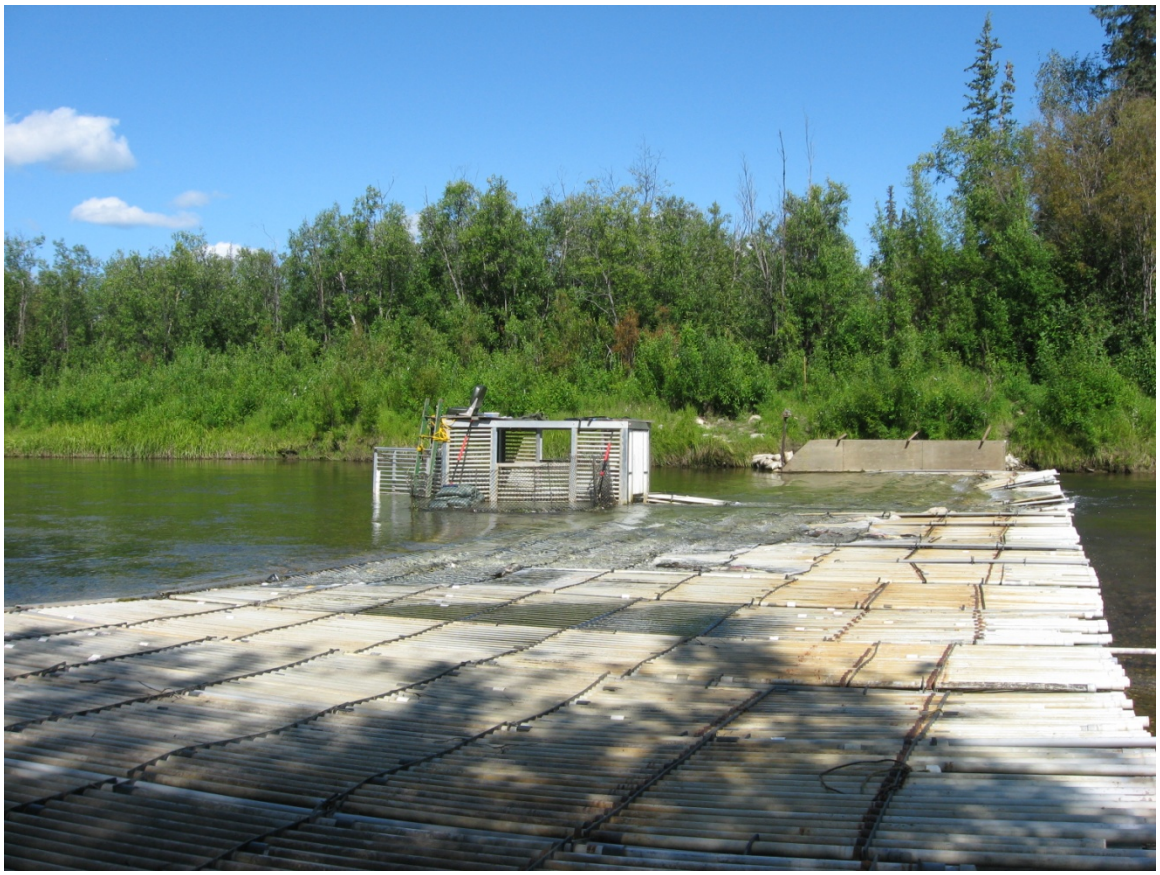

Tanana Chiefs Conference, Fisheries Program
Fairbanks, Alaska

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Abundance and Run Timing of Adult Salmon in Henshaw Creek, Kanuti National Wildlife Refuge, Alaska, 2008–2011

Aaron W. Dupuis

Abstract

From 2008 to 2011, a resistance board weir was used to collect information on abundance, run timing, and biology of returning salmon and other resident fish species migrating up Henshaw Creek, a tributary to the Koyukuk River, Alaska. The four-year mean Chinook salmon *Oncorhynchus tshawytscha* escapement was 1,246 fish (range, 766–1,796). The average Chinook salmon sex ratio was 40% female fish (range, 26%–50% female fish). Age class 1.3 predominated in 2008, 2010, and 2011, whereas age class 1.4 predominated in 2009. The four-year mean chum salmon O. keta escapement was 151,827 fish (range, 96,731–248,247). The average chum salmon sex ratio was 51% female fish (range, 46%–58% female fish). Age class 0.3 predominated from 2008 to 2010, whereas age class 0.4 predominated in 2011. The four other fish species that were counted were: longnose sucker *Catostomus catostomus*, arctic grayling *Thymallus arcticus*, whitefish (Coregoninae), and northern pike *Esox lucius*. The continued operation of this weir has provided a valuable data set going back to the year 2000. The future analysis of these data will be crucial for the management of Yukon River Chinook salmon and chum salmon.

Introduction

Henshaw Creek, a tributary to the Koyukuk River, is located within the Kanuti National Wildlife Refuge in the Interior of Alaska. It provides spawning and rearing habitat for Chinook salmon *Oncorhynchus tshawytscha* and chum salmon *O. keta*, as well as several other resident species. Chinook salmon and chum salmon from Henshaw Creek contribute to the mixed-stock fisheries in the Yukon and Koyukuk rivers (USFWS 1993). However, since 1997, Yukon River Chinook salmon and summer chum salmon runs have demonstrated an overall decline in productivity (Bergstrom et al. 2001; JTC 2009). These declines have led to harvest restrictions, fishery closures, and spawning escapements below management goals (Kruse 1998; Salomone and Bergstrom 2004; JTC 2009). In 2000, the Alaska Board of Fisheries classified Yukon River Chinook salmon as a stock of yield concern in response to poor returns and low harvests (Hayes et al. 2006). Additionally, low returns of Chinook salmon in 2008 and 2009 resulted in a commercial fishery failure pursuant to the Magnuson-Stevens Fishery Act. Because of the state of the Yukon River Chinook salmon and the complexity of mixed stock fisheries for both Chinook salmon and chum salmon, responsible management of this resource is paramount. The managers need high quality data describing Chinook salmon and chum salmon escapements and ASL if proper management strategies are to be developed.

Prior to 1999, three stock status and escapement projects were conducted in the Koyukuk River drainage to enumerate salmon stocks; the Gisasa River weir (O'Brian and Berkbigler 2006), South Fork Koyukuk River weir (Wiswar 1998), and the Clear Creek counting tower (C. Kretsinger, Bureau of Land Management, Fairbanks, personal communication). Henshaw Creek

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has historically contributed significant numbers of Chinook salmon and summer chum salmon (Barton 1984; Berkbigler and Elkin 2006; Appendix 1) to the Koyukuk River, and has been monitored with a weir since 2000. The U. S. Fish and Wildlife Service (USFWS), Fairbanks Fish and Wildlife Field Office (FFWFO) and, more recently, biologists with the Tanana Chiefs Conference have collected salmon escapement and ASL data from the weir since it was installed (e.g., VanHatten 2002; O'Brien and Berkbigler 2005). The Henshaw Creek weir project is one of two current (Gisasa River) salmon escapement projects operated within the Koyukuk River drainage (e.g., Melegari and Wiswar 1995; Melegari 1996, 1997). Since 2000, escapement estimates in Henshaw Creek have ranged from 244 to 1,637 Chinook salmon and from 22,556 to 237,481 chum salmon. The data collected at the Henshaw Creek weir is used by USFWS and ADF&G-DCF managers to help direct in season management decisions and post season evaluations. The objectives of the Henshaw Creek weir study from 2008–2011 were to determine (1) daily escapement and run timing of adult salmon, (2) age, sex, and length (ASL) compositions of adult salmon, and (3) the upstream movement and presence of resident fishes.

Study Area

Henshaw Creek is a small, clear water tributary of the Koyukuk River in north-central Alaska (Figure 1). The creek originates in the Alatna Hills and flows in a southeasterly direction for approximately 144 km before entering the Koyukuk River. The weir site is approximately 1.5 km upstream from the mouth of Henshaw Creek. The climate of this area is cold and continental, and is characterized by extreme seasonal temperature variations and low precipitation. Summer air temperatures range from 18˚C to 21˚C, with winter lows nearing -57˚C (USFWS 1993). Stream discharge is the highest during the spring in response to snow melt with occasional peak discharge periods in the summer as a result of rain showers.

Channel configuration is typically meandering with alternating cut banks and gravel bars. The substrate is composed primarily of medium to large gravel (8–64 mm) and small cobble (64–128 mm) in the areas of higher water velocity. Sand and silt substrate is common in the pools. The channel width at the weir site is approximately 30 m with an average depth of 0.6 m for most of the summer.

Methods

Weir Construction and Deployment

A resistance board weir was used to enumerate and collect biological data from adult salmon as they migrated up Henshaw Creek to spawn. The Henshaw Creek weir has been installed at the same site since the project was initiated in 2000, following the construction and installation methods described by Tobin (1994). Each picket of the weir was made of schedule-40 polyvinyl chloride (PVC) electrical conduit with 2.5 cm inside diameter with individual pickets spaced 3.2 cm apart. 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 start date of the project was based on previous years' run timing data. The end date of the project was determined in-season when the daily count of each species dropped to less than 1% of the seasonal passage to date and remained at this level for at least three consecutive days. Run timing and abundance of adult Chinook salmon and chum salmon were estimated by recording the number of each species of fish passing through the weir each day. Because non-salmon fish species were not handled, it was difficult to differentiate between whitefish species. Therefore, all whitefish were grouped under the subfamily *Coregoninae*.

The daily counting schedule was dependent upon the level of fish passage through the weir. During the beginning and end of the run, when hourly counts were low, counting was conducted between 0800 and 2400 hours, with the trap closed from 2400 to 0800 hours to prevent upstream passage during unmonitored times. As the run increased in strength, the counting schedule increased to 24 hours a day, seven days a week.

A stratified random sampling scheme was used to collect age, sex, and length ratio information from both adult salmon species. Sampling started at the beginning of each week and generally was conducted over a three to four day period, targeting 160 salmon/species/week. Lengths of Chinook salmon and chum salmon were measured to the nearest 5 mm from mid-eye to fork of the caudal fin (MEL), and sex was visually determined by secondary sex characteristics. Scales were used for ageing; with age class information reported using the European technique (Foerster 1968). Three scales were collected from Chinook salmon and one scale from chum salmon. Scales were sampled from the 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 adult salmon species were sent to the Alaska Department of Fish and Game Division of Commercial Fisheries. Age 1.2 Chinook salmon were assumed to be males regardless of their field determination (Brady 1983; Bales 2007; Karpovich and Dubois 2007). Daily escapement counts and sex ratios were reported to the U. S. Fish and Wildlife Service Fairbanks Fish and Wildlife Service Field Office.

Data Analysis

Days with counts greater than 6 h but less than 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 Monday and ending on Sunday. 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

Chinook salmon and summer chum salmon escapements were estimated using a resistance board weir from 2008 to 2011. The start date of weir operations ranged from June 23 in 2010 to July 5 in 2009. The end date of weir operations ranged from August 2 in 2011 to August 8 in 2008 and 2010. There were many factors that influenced the operation dates of this weir but the common problems were logistical difficulties and high water events. The weir was operational throughout all field seasons; however, high water events occurred randomly in all years, which prevented counting for short periods. The picket spacing (3.2cm 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* and whitefish spp. (Coregoninae), likely passed through the weir undetected.

Biological Data

The longnose sucker *Catostomus catostomus* was the most abundant non-salmon species counted at the weir, with a four-year average count of 2,662 fish (range, 1,825–3,837; Appendix 1). This

was followed by Arctic grayling with a four-year average of 76 fish (range, 35– 107; Appendix 1), northern pike *Esox lucius* with an average of 10 fish (range, 3– 20: Appendix 2), and whitefish (Coregonus spp.) with an average of 47 fish (range, 7–151; Appendix 2).

Chinook salmon

From 2008 to 2011, the largest Chinook salmon escapement estimate was 1,796 fish in 2011; the lowest escapement estimate was 766 fish in 2008 (Table 1; Figure 2). The average annual escapement estimate for the four-year period was 1,246 fish. The average middle point of fish passage from 2008 to 2011 was July 18, and ranged from July 15 in 2011 to July 20 in 2010 (Table 1).

In 2008, samples were collected from 415 Chinook salmon, with age unable to be determined for 66 (16%) of those samples. In 2009, samples were collected from 565 Chinook salmon, with age unable to be determined from 217 (38%) of those samples. In 2010, samples were collected from 299 Chinook salmon, with age unable to be determined from 90 (30%) of those samples. In 2011, samples were collected from 501 Chinook salmon, with age unable to be determined from 72 (14%) of those samples.

Since 2008, up to nine age classes of Chinook salmon have been identified (i.e., 1.1, 1.2, 1.3, 1.4, 1.5, 2.2, 2.3, 2.4, and 2.5). Age class 1.3 was most abundant in 2008 (69%), 2010 (58%), and 2011 (50%; Table 3). Age class 1.4 was most abundant in 2009 (37%; Table 3). Age classes 1.1, 2.2, 2.3, 2.4, and 2.5 were present in most years but individually they made up less than one percent of the run. The mean sex ratio for Chinook salmon for the four-year period was 40% female fish and ranged from 26% female fish in 2008 to 50% female fish in 2010 (Table 5). Female Chinook salmon lengths varied considerably throughout the four-year period and ranged from 430 to 940 mm MEL in 2008, 440 to 970 mm MEL in 2009, 470 to 1,000 mm in 2010, and 430 to 960 mm MEL in 2011 (Table 6). Male Chinook salmon lengths ranged from 400 to 840 mm MEL in 2008, 445 to 940 mm MEL in 2009, 390 to 910 mm MEL in 2010, and 360 to 930 mm MEL in 2011 (Table 6)

Chum salmon

From 2008 to 2011, the largest chum salmon escapement estimate was 248,247 fish in 2011; the lowest escapement estimate was 96,731 in 2008 (Table 2; Figure 3). The average annual escapement estimate for the four-year period was 151,827 fish. The average middle point of fish passage from 2008 to 2011 was July 19, and ranged from July 16 in 2011 to July 22 in 2008 (Table 2).

In 2008, age, sex, and length samples were collected from 767 chum salmon, with age unable to be determined from 121 (15%) of those samples. In 2009, ASL samples were collected from 800 chum salmon, with age unable to be determined from 317 (39%) of those samples. In 2010, ASL samples were collected from 676 chum salmon, with age unable to be determined from 114 (17%) of those samples. In 2011, ASL samples were collected from 790 chum salmon, with age unable to be determined from 210 (27%).

Since 2008, four age classes of chum salmon have been identified (i.e., 0.2, 0.3, 0.4, and 0.5). Age class 0.3 was most abundant in 2008 (73%), 2009 (78%), and 2010 (65%; Table 4). Age class 0.4 was most abundant in 2011 (54%; Table 4). The average sex ratio for the four-year period was 51% female fish and ranged from 46% female fish in 2008 to 58% female fish in 2011 (Table 5). Female chum salmon lengths during the four-year period have ranged from 430 to 650 mm MEL in 2008, 430 to 635 mm MEL in 2009, 440 to 610 mm MEL in 2010, and 330 to 635 mm MEL in 2011 (Table 7). Male chum salmon lengths during the four-year period have ranged from 460 to 690 mm MEL in 2008, 440 to 680 mm MEL in 2009, 475 to 695 mm MEL in 2010, and 450 to 635 mm MEL in 2011 (Table 7).

The information collected at the Henshaw Creek 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 8 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 count of Chinook salmon passage at the Henshaw Creek weir, Alaska, 2008 to 2011. Shaded areas indicate first and third quarter points, and the midpoint of salmon passage estimates.

	2008		2009		2010		2011	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jul-1								
Jul-2								
Jul-3							1	1
Jul-4	3	3					8	9
Jul-5	8	11	48	48			6	15
Jul-6	13	24	44	92			9	24
Jul-7	4	28	24	116	3	3	45	69
Jul-8	6	34	11	127	6	9	48	117
Jul-9	34	68	17	144	8	17	75	192
Jul-10	34	102	24	168	11	28	156	348
Jul-11	42	144	49	217	34	62	59	407
Jul-12	40	184	64	281	40	102	67	474
Jul-13	34	218	80	361	43	145	105	579
Jul-14	59	277	132	493	45	190	181	760
Jul-15	44	321	71	564	47	237	207	967
Jul-16	19	340	82	646	30	267	138	1,105
Jul-17	22	362	182	828	36	303	62	1,167
Jul-18	33	395	128	956	49	352	79	1,246
Jul-19	141	536	190	1,146	68	420	40	1,286
Jul-20	59	595	72	1,218	130	550	48	1,334
Jul-21	29	624	67	1,285	92	642	52	1,386
Jul-22	20	644	78	1,363	47	689	65	1,451
Jul-23	25	669	42	1,405	1	690	50	1,501
Jul-24	16	685	53	1,458	27	717	53	1,554
Jul-25	14	699	49	1,507	16	733	47	1,601
Jul-26	21	720	24	1,531	27	760	62	1,663
Jul-27	6	726	11	1,542	17	777	34	1,697
Jul-28	11	737	20	1,562	18	795	36	1,733
Jul-29	5	742	20	1,582	11	806	18	1,751
Jul-30	5	747	13	1,595	10	816	18	1,769
Jul-31	4	751	12	1,607	19	835	4	1,773
Aug-1	4	755	6	1,613	10	845	11	1,784
Aug-2	3	758	6	1,619	6	851	12	1,796
Aug-3	0	758	6	1,625	2	853		
Aug-4	1	759	6	1,631	4	857		
Aug-5	3	762	5	1,636	0	857		
Aug-6	2	764	1	1,637	0	857		
Aug-7	1	765	0	1,637	0	857		
Aug-8	1	766			0	857		
Total		766		1,637		857		1,796

Table 2. Daily and cumulative count of chum salmon passage at the Henshaw Creek weir, Alaska, 2008 to 2011. Shaded areas indicate first and third quarter points, and the midpoint of salmon passage estimates.

	2008		2009		2010		2011	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-28							1	1
Jun-29							0	1
Jun-30							0	1
Jul-1							0	1
Jul-2	0	0					718	719
Jul-3	1	1					1,651	2,370
Jul-4	23	24					1,627	3,997
Jul-5	97	121	1,349	1,349	4	4	1,429	5,426
Jul-6	39	160	2,402	3,751	28	32	1,134	6,560
Jul-7	308	468	3,062	6,813	510	542	3,860	10,420
Jul-8	801	1,269	2,209	9,022	992	1,534	7,795	18,215
Jul-9	1,525	2,794	2,547	11,569	1,474	3,008	11,469	29,684
Jul-10	2,592	5,386	3,157	14,726	1,956	4,964	11,470	41,154
Jul-11	2,984	8,370	3,032	17,758	5,240	10,204	9,540	50,694
Jul-12	2,753	11,123	2,666	20,424	6,850	17,054	10,744	61,438
Jul-13	2,105	13,228	3,792	24,216	7,577	24,631	14,050	75,488
Jul-14	2,504	15,732	3,345	27,561	9,055	33,686	20,821	96,309
Jul-15	2,208	17,940	3,554	31,115	9,067	42,753	21,189	117,498
Jul-16	2,447	20,387	4,587	35,702	5,755	48,508	16,788	134,286
Jul-17	3,282	23,669	6,455	42,157	5,203	53,711	12,029	146,315
Jul-18	2,733	26,402	9,763	51,920	5,450	59,161	9,728	156,043
Jul-19	4,815	31,217	13,102	65,022	8,361	67,522	4,916	160,959
Jul-20	6,681	37,898	12,953	77,975	7,633	75,155	2,994	163,953
Jul-21	6,950	44,848	11,464	89,439	3,053	78,208	3,702	167,655
Jul-22	6,427	51,275	9,495	98,934	1,752	79,960	4,936	172,591
Jul-23	6,688	57,963	9,035	107,969	450	80,410	8,494	181,085
Jul-24	6,072	64,035	8,186	116,155	2,843	83,253	11,699	192,784
Jul-25	5,406	69,441	6,857	123,012	3,528	86,781	12,483	205,267
Jul-26	3,541	72,982	5,493	128,505	3,261	90,042	11,755	217,022
Jul-27	1,673	74,655	3,678	132,183	2,330	92,372	9,398	226,420
Jul-28	1,199	75,854	4,179	136,36	2,014	94,386	7,456	233,87

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Jul-29	1,500	77,354	4,585	140,947	1,474	95,860	4,720	238,596	
Jul-30	2,050	79,404	3,752	144,699	1,618	97,478	3,135	241,731	
Jul-31	2,638	82,042	2,691	147,390	1,535	99,013	2,579	244,310	
Aug-1	2,906	84,948	1,910	149,300	1,465	100,478	2,330	246,640	
Aug-2	2,738	87,686	1,596	150,896	1,388	101,866	1,607	248,247	
Aug-3	2,308	89,994	1,612	152,508	947	102,813			
Aug-4	1,935	91,929	1,625	154,133	778	103,591			
Aug-5	2,050	93,979	1,485	155,618	527	104,118			
Aug-6	1,267	95,246	1,043	156,661	559	104,677			
Aug-7	774	96,020	272	156,933	411	105,088			
Aug-8	711	96,731			310	105,398			
Total		96,731		156,933		105,398		248,247	

Table 3. Brood year and age class distribution of Chinook salmon sampled at Henshaw Creek weir, Alaska, 2008 to 2011.

Escapement (n)	Sample (n)	Unknown age	Brood year and age class							
			2001	2002	2003	2004	2005	2006	2007	2008
				2008						
766	415	66	1.5	1.4	1.3	1.2	1.1			
			2%	11%	69%	17%	0%			
				2009						
1,637	565	217		1.5	1.4	1.3	1.2	1.1		
				0%	37%	28%	34%	0%		
				2010						
857	299	90			1.5	1.4	1.3	1.2	1.1	
					0.5%	20%	58%	20%	0%	

2011

1,796	501	72		1.5	1.4	1.3	1.2	1.1
				0%	30%	50%	20%	0%

Table 4. Brood year and age class distribution of chum salmon sampled at Henshaw Creek weir, Alaska, 2008-2011.

Escapement (n)	Sample (n)	Unknown age	Brood year and age						
			2002	2003	2004	2005	2006	2007	2008
				2008					
96,731	767	121	0.5	0.4	0.3	0.2			
			5%	18%	73%	4%			
				2009					
156,933	800	317		0.5	0.4	0.3	0.2		
				0%	19%	78%	3%		
				2010					
105,398	676	114			0.5	0.4	0.3	0.2	
					0%	26%	65%	9%	
				2011					
248,247	790	210				0.5	0.4	0.3	0.2
						0%	54%	43%	3%

Table 5. Sex ratios and escapement estimates of Chinook salmon and chum salmon in Henshaw Creek, Alaska, 2008 to 2011.

	Chinook salmon		Chum salmon	
Year	Escapement (n)	Percent female	Escapement (n)	Percent female
2008	766	26% (2.2)	96,731	46% (1.9)
2009	1,637	48% (2.3)	156,933	53% (2.0)
2010	857	50% (2.9)	105,398	48% (2.2)
2011	1,796	36% (2.3)	248,247	58% (2.0)

Table 6. Length at age of female and male Chinook salmon sampled at Henshaw Creek weir, Alaska, 2008 to 2011.

	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
						2008					
1.1	-	-	-	-	-		2	430	30.0	-	400-460
1.2	4	536	18.2	537	500-570		56	537	7.0	530	450-680
1.3	57	696	10.4	705	440-830		185	684	3.5	680	495-790
1.4	25	822	9.6	810	765-940		9	784	13.0	745	705-840
1.5	5	888	14.2	890	845-925		-	-	-	-	-
Total	91						252				
						2009					
1.1	-	-	-	-	-		-	-	-	-	-
1.2	44	574	7.9	583	440-660		70	580	5.0	583	445-665
1.3	34	713	10.2	720	580-825		63	693	7.1	690	550-815
1.4	106	838	4.9	840	690-970		22	815	18.0	825	630-940
1.5	-	-	-	-	-		-	-	-	-	-
Total	184						155				
						2010					
1.1	-	-	-	-	-		1	-	-	-	390
1.2	8	522	13.6	530	470-575		34	532	7.1	540	420-600
1.3	57	767	5.7	760	630-850		63	722	6.7	730	565-850
1.4	34	826	7.5	820	750-945		7	765	52.0	790	510-910
1.5	1	-	-	-	1,000		-	-	-	-	-
Total	100						105				
						2011					
1.1	-	-	-	-	-		1	-	-	-	515
1.2	3	472	36.7	440	430-545		85	526	5.6	530	360-640
1.3	36	730	11.8	730	530-860		176	697	3.9	690	545-815
1.4	102	850	4.4	850	755-960		22	837	13.7	840	700-930
1.5	1	-	-	-	905		-	-	-	-	-
Total	142						284				

Table 7. Length at age of female and male chum salmon sampled at Henshaw Creek weir, Alaska, 2008 to 2011.

	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
						2008					
0.2	12	525	5.7	530	490-555		14	536	6.1	535	490-575
0.3	234	532	1.7	535	430-650		234	557	1.7	555	490-690
0.4	52	554	3.2	550	515-610		72	579	4.0	577	505-680
0.5	13	570	4.6	570	545-600		15	575	6.4	580	535-635
Total	311						335				
						2009					
0.2	16	523	7.5	530	460-565		4	543	12.7	553	505-560
0.3	221	543	2.2	545	430-630		152	565	2.9	565	440-680
0.4	43	559	5.1	560	510-635		47	582	5.7	508	500-675
0.5	-	-	-	-	-		-	-	-	-	-
Total	280						203				
						2010					
0.2	38	508	4.5	505	440-570		20	532	7.1	540	475-595
0.3	204	533	2.0	530	460-610		176	555	2.1	555	480-620
0.4	50	559	3.6	555	500-610		70	597	4.7	600	495-695
0.5	-	-	-	-	-		1	-	-	-	495
Total	296						266				
						2011					
0.2	11	521	8.8	515	465-560		5	538	24.0	557	450-580
0.3	168	539	2.2	545	430-595		99	562	2.7	560	480-620
0.4	178	549	2.1	550	330-635		119	570	2.3	570	500-635
0.5	-	-	-	-	-		-	-	-	-	-
Total	357						223				

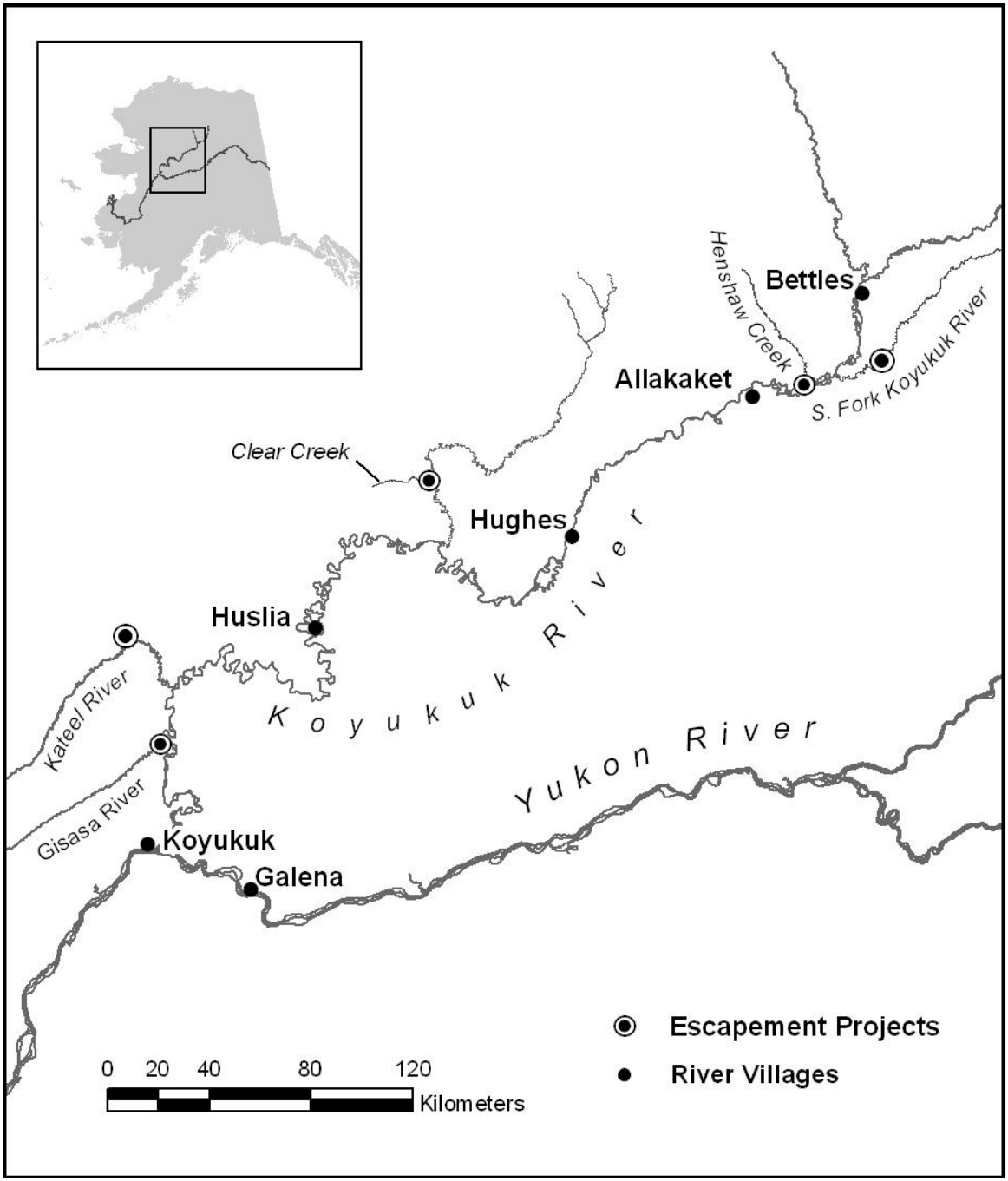

Figure 1. Location of the Henshaw Creek weir and other active and historical tributary escapement project sites in the Koyukuk River drainage, Alaska.

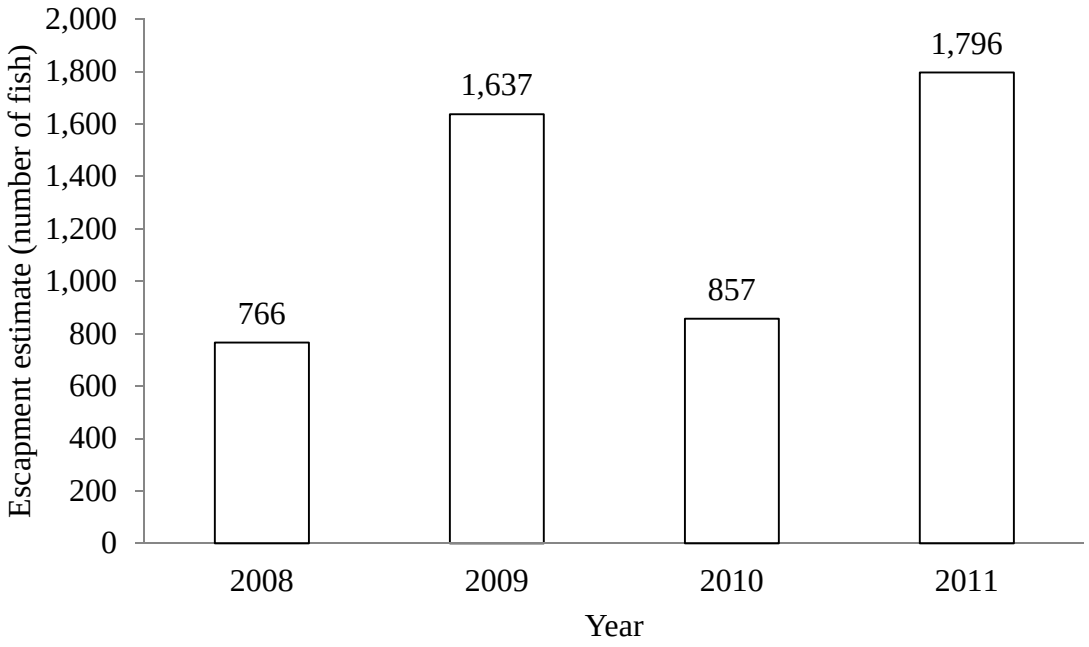

Figure 2. Chinook salmon escapement estimates at the Henshaw Creek weir, Alaska, 2008 to 2011.

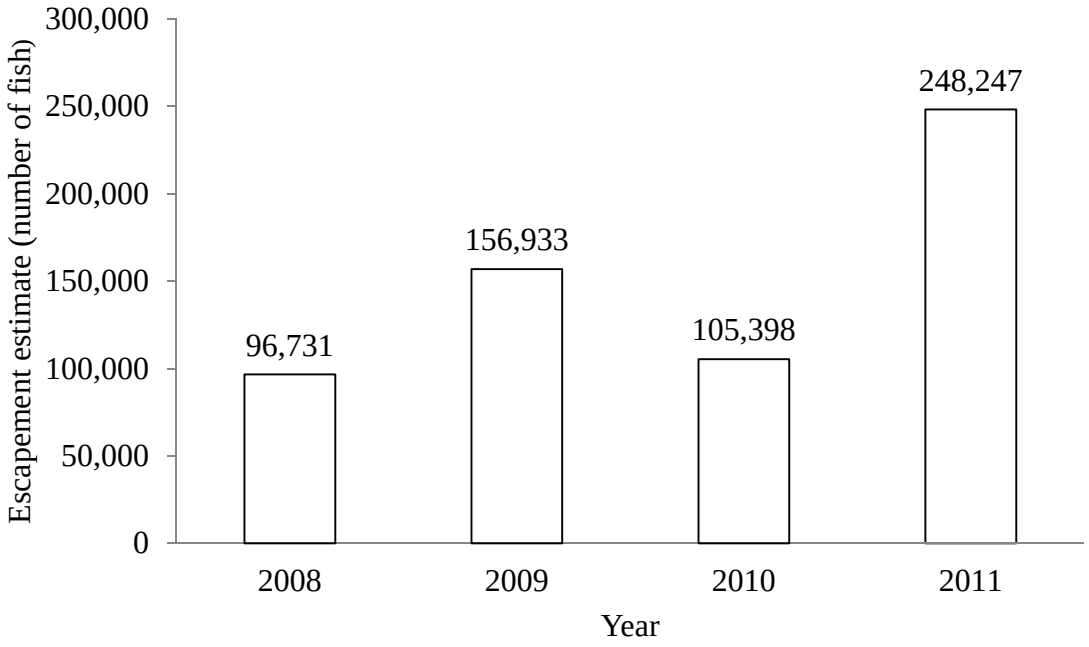

Figure 3. Chum salmon escapement estimates at the Henshaw Creek weir, Alaska, 2008 to 2011.

Appendix 1. Daily counts of longnose sucker and Arctic grayling passing the Henshaw Creek weir, Alaska, 2008 to 2011. Asterisk indicates missing counts.

	Longnose sucker				Arctic grayling			
Date	2008	2009	2010	2011	2008	2009	2010	2011
Jun-23			354				0	
Jun-24			342	0			0	0
Jun-25			10	387			1	6
Jun-26			38	0			0	0
Jun-27			0	35			0	5
Jun-28			5	0			2	0
Jun-29			109	0			0	0
Jun-30			75	0			1	0
Jul-1			97	0			0	0
Jul-2	0		215	0	0		1	2
Jul-3	33		99	3	0		0	4
Jul-4	8		83	1	0		0	5
Jul-5	62	0	157	0	0	20	0	2
Jul-6	243	2	166	5	10	3	0	7
Jul-7	6	43	*	4	1	4	*	5
Jul-8	345	461	*	0	0	9	*	6
Jul-9	264	21	*	3	4	1	*	2
Jul-10	219	15	2	13	2	0	2	2
Jul-11	63	46	17	13	5	4	1	3
Jul-12	600	1574	5	0	2	1	7	1
Jul-13	54	526	1	6	0	7	4	0
Jul-14	17	190	0	5	2	2	0	2
Jul-15	78	34	1	233	34	1	0	1
Jul-16	4	8	1	283	0	3	1	0
Jul-17	0	10	1	18	0	5	2	0
Jul-18	0	101	0	10	0	10	1	0
Jul-19	1	146	0	20	3	9	0	0
Jul-20	41	94	0	170	8	5	0	0
Jul-21	154	73	8	162	6	8	0	0
Jul-22	13	108	*	115	0	2	*	5
Jul-23	4	52	0	104	0	3	0	0
Jul-24	79	45	0	42	4	2	0	2
Jul-25	375	40	0	9	0	1	1	3
Jul-26	145	13	0	24	0	1	0	1
Jul-27	8	13	0	51	0	2	0	4
Jul-28	8	16	0	148	0	0	1	1
Jul-29	49	27	0	86	3	0	0	1
Jul-30	34	70	1	27	1	1	0	1
Jul-31	3	61	1	8	2	0	0	0
Aug-1	25	16	5	12	2	1	1	2
Aug-2	5	2	4	40	0	0	1	0
Aug-3	4	3	6		0	0	3	
Aug-4	0	3	7		0	0	0	
Aug-5	0	6	7		0	1	4	
Aug-6	0	18	8		0	0	1	
Aug-7	0	0	0		0	1	0	
Aug-8	6		0		0		0	
Total	2,950	3,837	1,825	2,037	89	107	35	73

Appendix 2. Daily counts of northern pike and whitefish spp. passing the Henshaw Creek weir, Alaska, 2008 to 2011. Asterisk indicates missing counts.

	Northern pike				Whitefish spp.			
Date	2008	2009	2010	2011	2008	2009	2010	2011
Jun-23			0				0	
Jun-24			0	0			0	0
Jun-25			1	6			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			0	0
Jul-1			0	0			0	0
Jul-2	0		0	1	0		0	0
Jul-3	0		0	0	0		0	2
Jul-4	0		0	2	0		0	0
Jul-5	0	0	0	0	0	0	1	1
Jul-6	0	0	0	0	0	0	0	1
Jul-7	0	0	*	1	0	0	*	0
Jul-8	0	0	*	1	0	0	*	21
Jul-9	0	1	*	1	0	0	*	40
Jul-10	0	1	0	0	0	0	1	30
Jul-11	4	0	1	2	0	0	0	7
Jul-12	0	0	0	0	0	0	0	0
Jul-13	0	0	0	0	0	0	0	0
Jul-14	1	0	0	0	0	1	0	5
Jul-15	0	2	0	1	1	1	0	2
Jul-16	1	0	0	0	4	0	0	1
Jul-17	0	2	0	0	0	1	0	0
Jul-18	0	0	0	0	0	0	0	0
Jul-19	0	1	0	0	1	3	0	1
Jul-20	0	3	0	0	1	1	0	5
Jul-21	0	0	0	0	0	0	0	4
Jul-22	0	0	*	1	0	0	*	4
Jul-23	0	0	0	2	0	1	0	11
Jul-24	0	0	0	1	0	1	0	7
Jul-25	0	0	0	0	1	0	0	1
Jul-26	0	0	0	0	0	0	0	0
Jul-27	0	0	0	0	0	0	0	1
Jul-28	0	0	0	1	0	5	0	1
Jul-29	0	0	0	0	3	1	0	1
Jul-30	0	0	1	0	0	0	1	2
Jul-31	0	0	0	0	1	0	0	1
Aug-1	1	0	0	0	2	0	1	0
Aug-2	0	0	0	0	0	0	1	2
Aug-3	0	0	0		0	0	0	
Aug-4	0	0	0		0	0	1	
Aug-5	0	0	0		0	0	1	
Aug-6	0	0	0		0	0	0	
Aug-7	0	0	0		0	0	0	
Aug-8	0		0		0		0	
Total	7	10	3	20	14	15	7	151