Tanana Chiefs Conference, Fisheries Program

Abundance and Run Timing of Adult Salmon in Henshaw Creek, Kanuti National Wildlife Refuge, Alaska, 2012–2013

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Cover Photo: Henshaw Creek weir crew 2013

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Brian McKenna

Abstract

The Tanana Chiefs Conference Fisheries program operated a resistance board weir in 2012 and 2013 to collect information on abundance and run timing of Chinook salmon *Oncorhynchus tshawytscha* and chum salmon *O. keta* migrating up Henshaw Creek, a tributary to the Koyukuk River, Alaska. The estimated escapement in 2012 was 922 Chinook salmon. The estimated escapement in 2013 declined to 772 Chinook salmon, falling below the 2000-2011 average estimated escapement of 987 Chinook salmon. The estimated sex composition for Chinook salmon was 40% female fish in 2012 and 44% female fish in 2013. Three age classes of Chinook salmon constituted the majority of the run in both years; age class 1.2, 1.3, and 1.4. The predominant age class for Chinook salmon in 2012 was age class 1.3 (49%), followed by age class 1.4 (34%) and age class 1.2 (16%). The predominant age class for Chinook salmon in 2013 was age class 1.4 (35%), followed by age class 1.2 (32%) and age class 1.3 (31%). The estimated escapement in 2012 was 292,082 summer chum salmon. The estimated escapement in 2013 was 285,008 summer chum salmon. Escapement for both years was above the 2000-2011 average estimated escapement of 98,709 summer chum salmon. The estimated sex composition for summer chum salmon was 53% female fish in 2012 and 58% female fish in 2013. Two age classes of summer chum salmon constituted the majority of the run in both years; age class 0.3 and 0.4. The predominant age class for summer chum salmon in 2012 was age class 0.3 (84%), followed by age class 0.4 (13%). Similarly, the predominant age class for summer chum salmon in 2013 was age class 0.3 (63%), followed by age class 0.4 (37%). Four other fish species passed through the weir including 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 long term data set dating back to the year 2000. The continuation of this project, and other escapement projects, is vital to successful management of Chinook salmon and chum salmon, as the data they provide aid managers in developing stock specific spawner-recruit relationships and evaluating how tributary systems respond to management actions. Furthermore, quality escapement data from tributaries like Henshaw Creek can help managers understand the contributions smaller tributaries make to the overall salmon runs throughout the Yukon River.

Introduction

Henshaw Creek, a tributary to the Koyukuk River, is located within the Kanuti National Wildlife Refuge (KNWR) in the Interior of Alaska. Henshaw Creek provides spawning and rearing habitat for Chinook salmon *Oncorhynchus tshawytscha* and chum salmon *O. keta*, as well as several other resident fish species. Chinook salmon and summer chum salmon from Henshaw Creek contribute to the mixed-stock fisheries in the Yukon and Koyukuk rivers (USFWS 1993). Since 1997, Chinook salmon and summer chum salmon runs of the Yukon River Basin have demonstrated an overall decline in productivity (Bergstrom et al. 2001; JTC 2013). These declines have led to harvest restrictions, fishery closures, and spawning escapements below management goals (Kruse 1998; JTC 2013). In 2000, the Alaska Board of Fisheries classified Yukon River Chinook salmon as a stock of yield concern in response to low returns (Hayes et al. 2006). Low returns of Chinook salmon in 2008 and 2009 resulted in a commercial fishery failure pursuant to the Magnuson-Stevens Fishery Act. Low returns of Chinook salmon continued through the 2012 and 2013 runs. In-season management efforts to protect Chinook salmon were enacted by fishery managers in an attempt to meet biological escapement goals and to comply with international treaty obligations. These management actions included intensified gear restrictions on subsistence fishers, coupled with fishery closures of subsistence salmon fishing periods (JTC 2013). These management actions resulted in increased hardships for Native Alaskans who rely heavily upon salmon as a subsistence food resource as well as a means to continue to practice their ancestral, cultural and traditional way of life. Because of the current state of the Yukon River Chinook salmon, and the complexity of mixed stock fisheries for both Chinook salmon and summer chum salmon, responsible management of these resources is paramount. In order to develop proper management strategies, managers need high quality data describing Chinook salmon and summer chum salmon escapements and age, sex, and length data (ASL). Without accurate escapement estimates from multiple Yukon River tributaries, managers are unable to determine stock specific spawner-recruit relationships (Labelle 1994), and will lack data to evaluate how these systems respond to management actions. Furthermore, quality escapement data from tributaries throughout the Yukon drainage can help to better understand the contributions smaller tributaries make to the overall salmon runs in the Yukon River.

Henshaw Creek has been determined to be an important producer of Chinook salmon and summer chum salmon, and has been monitored with a weir since 2000 (Barton 1984; Dupuis, 2012). The U.S. Fish and Wildlife Service (USFWS), Fairbank Fish and Wildlife Field Office (FFWFO) and, more recently, biologists with the Tanana Chiefs Conference (TCC) 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 salmon escapement projects currently operated within the Koyukuk River drainage (Carlson, 2012). Since 2000, escapement estimates in Henshaw Creek have ranged from 244 to 1,796 Chinook salmon and from 22,556 to 292,082 summer chum salmon (Appendix 1). Both Chinook salmon and summer chum salmon from Henshaw Creek contribute to the subsistence harvests of villages within the Kanuti National Wildlife Refuge as well as to the harvests of subsistence and commercial fisheries occurring in the Yukon River. Information collected at Henshaw Creek weir is important to fisheries managers who have the difficult task of managing the complex mixed stock, subsistence and commercial salmon fisheries in the Yukon River. Pre-season estimates, in-season management actions and post season evaluations of management actions are enhanced by the data from this project. Objectives of the Henshaw Creek weir were to (1)

determine daily escapement and run timing of adult salmon, (2) determine age, sex, and length compositions of adult salmon, (3) document upstream movement and presence of resident fishes, and (4) serve as an outreach platform for KNWR staff and Partners Program fisheries biologist to conduct an onsite science camp.

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 southeasterly 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 heavy 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 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 project start date 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 summer 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.

A stratified random sampling scheme (Cochran 1977), with weeks as the strata, was used to collect age, sex, and length data 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 summer chum salmon were measured to the nearest 5 mm from mid-eye to fork of the caudal fin (MEFL), and sex was visually determined by external morphological characteristics. Scales were used for ageing; with age class information reported using the European method (Foerster 1968). Three scales were collected from each Chinook salmon sampled, and one scale from each summer chum salmon sampled. 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 Field Office.

Data Analysis

Days with counts greater than 6 hours (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 enumerated in 2012 and 2013 using a resistance board weir. The start dates of the weir operations were similar in both years. In 2012 the weir was fully operational with enumeration beginning June 24 and ending August 4, with no interruptions occurring to suspend operation. In 2013 the weir was fully operational with enumeration beginning on June 30 and ending on August 5. One high water event interrupted weir operations and suspended enumeration efforts for nearly four and a half days, beginning at 22:45 hours on July 9 and ending at 12:00 hours on July 14. The partially enumerated days of July 9 and 14 were adjusted to provide full day passage estimates. However, no interpolation was made to estimate the passage for the complete missed days, July 10 through July 13. No interpolation was made due to the timing of the high water event coupled with the size of the escapement on July 9 and July 14. The first day of escapement for both species in 2013 was July 9. Estimated escapement on July 9 was 1 Chinook salmon and 51 chum salmon. Estimated escapement on July 14 was 152 Chinook salmon and 42,528 chum salmon (Table 1). The picket spacing (3.2cm space between pickets) within the trap and weir panels was narrow enough to prevent adult Chinook salmon and summer chum salmon from passing through the weir undetected. 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 most abundant non-salmon species in 2012 and 2013 was the longnose sucker *Catostomus catostomus.* Passage estimates for longnose sucker were N = 1,017 and 3,443 in 2012 and 2013 respectively. Passage estimates in 2012 and 2013 for Arctic grayling were N = 58 and 145, for whitefish spp. N = 109 and 44, and for northern pike *Esox Lucius* N = 27 and 15, respectively (Appendix 2).

Chinook salmon

The estimated escapement in 2012 was 922 Chinook salmon. The estimated escapement in 2013 declined to 772 Chinook salmon, falling below the 2000-2011 average escapement of 987 Chinook salmon (Figure 2). However, in 2013, no interpolation was estimated for the four complete days, July 10 through July 13, when enumeration was suspended, and it is assumed that Chinook salmon passed through the weir undetected and uncounted. Chinook salmon run timing was similar in both years. In 2012 the first Chinook salmon passed through the weir on July 5 (N = 1), and the final Chinook salmon passed through the weir on August 3 (N = 2). The 2012 mid-point of fish passage occurred on July 20, with the first and third quarter passage dates occurring on July 15 and July 24, respectively (Table 1, Figure 4). Similarly, in 2013 the first Chinook salmon passed through the weir on July 9 (N = 1), and on the final day of counting, August 5, one Chinook salmon passed through the weir (N = 1). The 2013 mid-point of fish passage occurred on July 19, with the first and third quarter passage dates occurring on July 15 and July 23, respectively (Table 1, Figure 4).

Samples were collected from 318 Chinook salmon in 2012 and 241 Chinook salmon in 2013. Age was unable to be determined for 9% of the 2012 samples, and 6% of the 2013 samples, primarily due to scale regeneration (Table 2). In 2012, four age classes were identified; age classes 1.2, 1.3, 1.4, and 1.5, from brood years 2008, 2007, 2006, and 2005 respectively. In 2013 six age classes were identified; age classes 1.1, 1.2, 1.3, 1.4, 2.3, and 1.5, from brood years 2010, 2009, 2008, 2007, 2007, and 2006 respectively. In 2012 age classes 1.3 (49%) and 1.4 (34%) were predominant. In 2013, age classes 1.2 (32%), 1.3 (31%), and 1.4 (35%) each constituted roughly one third of the season total. The contribution of age class 1.2 doubled from 16% in 2012 to 32% in 2013, while the contribution from age class 1.3 declined from 49% in 2012 to 31% in 2013. The contribution of age class 1.4 remained stable; 34% in 2012 and 35% in 2013 (Table 2).

The estimated sex ratio for the entire Chinook salmon run was 40% female in 2012, and 44% female in 2013 (Table 2). Female Chinook salmon length-at-age ranged from 554 mm to 975 mm MEFL in 2012 and 700 mm to 910 mm MEFL in 2013. Male Chinook salmon length-at-age ranged from 491 mm to 930 mm MEFL in 2012 and 367 mm to 900 mm MEFL in 2013 (Table 3). Mean length-at-age of female Chinook salmon was larger than males in age classes 1.3 and 1.4 for both years, along with age class 2.3 in 2013.

Chum salmon

An estimated 292,082 summer chum salmon passed through the weir in 2012. The estimated escapement in 2013 was 285,008 summer chum salmon. Escapement for both years was above the 2000-2011 average escapements of 98,709 summer chum salmon. However, in 2013, no interpolation was estimated for the four complete days, July 10 through July 13, when enumeration was suspended, and it is assumed that chum salmon passed through the weir undetected and uncounted. Summer chum salmon run timing was similar in both years. In 2012 the first chum salmon passed through the weir July 6 (N = 3), and on the final day of counting, August 4, 1,939 chum salmon passed through the weir. The 2012 mid-point of summer chum salmon passage was July 20, with the first and third quarter passage dates occurring on July 15 and July 26 respectively. The 2013 mid-point of summer chum salmon passage was July 19, with the first and third quarter passage dates occurring on July 15 and July 23 respectively (Table 1, Figure 4).

Samples were collected from 600 chum salmon in 2012 and 520 chum salmon in 2013. Age was unable to be determined for 20% of 2012 samples and 8% of 2013 samples, primarily due to scale regeneration. In 2012 four age classes of chum salmon were identified; age classes 0.2, 0.3, 0.4, and 0.5 from brood years 2009, 2008, 2007 and 2006 respectively (Table 4). In 2013 three age classes were identified; age classes 0.3, 0.4, and 0.5 from brood years 2009, 2008, and 2007 respectively. Age class 0.3 was predominant in both years, accounting for 84% of the season total in 2012, and 63% in 2013. Age class 0.4 was the next highest contributor, accounting for 13% in 2012 and nearly tripling to 37% in 2013 (Table 4).

The estimated sex ratio for the entire summer chum run was 53% female in 2012 and 58% female in 2013 (Table 4). Female chum salmon length-at-age ranged from 426 mm to 632 mm MEFL in 2012 and from 469 mm to 610 mm MEFL in 2013. Male chum salmon length-at-age ranged from 492 mm to 665 mm MEFL in 2012 and from 480 mm to 663 mm MEFL in 2013 (Table 5). Mean length-at-age of male chum salmon was larger than females in age classes 0.3 and 0.4 for both years (Table 5).

Summer chum salmon escapement at the Henshaw Creek weir represented an estimated 13.7% of the entire Yukon summer chum run counted by the Pilot Station Sonar in 2012 (JTC 2013). Similarly, summer chum salmon at the Henshaw Creek weir represented an estimated 10.4% of the entire Yukon summer chum run counted by the Pilot Station Sonar in 2013 (JTC 2014). 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. The data collected at the Henshaw Creek weir is used by USFWS and ADF&G managers to help direct in-season management decisions and post season evaluations. Additionally, the time series data from Henshaw Creek is used to evaluate long term trends in salmon escapements and stock compositions. These analyses, and the data that support them, will become increasingly important when determining the impacts of fishing regulation changes (e.g. net mesh size restrictions) in the Yukon River and the effects of climate change on salmon stocks. Additionally, this project has collected and produced 13 years of data allowing managers to analyze trends in population status, size, length, age, and gender composition, as well as helping to develop future run projections, and creating and evaluating harvest and escapement goals and

allocations throughout the Yukon River. Finally, these long term time series data are increasing in importance due to the continual increase of stresses placed on these salmon resources.

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Table 1. — Daily and cumulative estimates of Chinook salmon and chum salmon passage at Henshaw Creek weir, Alaska, 2012 and 2013. Shaded cells indicate first and third quarter points, and the midpoint of salmon passage estimates.

	Chinook 2012		Chinook 2013		Chum 2012		Chum 2013	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
Jun-30	0	0	0	0	0	0	0	0
Jul-1	0	0	0	0	0	0	0	0
Jul-2	0	0	0	0	0	0	0	0
Jul-3	0	0	0	0	0	0	0	0
Jul-4	0	0	0	0	0	0	0	0
Jul-5	1	1	0	0	0	0	0	0
Jul-6	1	2	0	0	3	3	0	0
Jul-7	3	5	0	0	25	28	0	0
Jul-8	2	7	0	0	149	177	0	0
Jul-9	5	12	1	1	2,671	2,848	51	51
Jul-10	28	40	0	1	5,984	8,832	0	51
Jul-11	43	83	0	1	8,865	17,697	0	51
Jul-12	40	123	0	1	10,241	27,938	0	51
Jul-13	56	179	0	1	14,319	42,257	0	51
Jul-14	36	215	152	153	14,927	57,184	42,518	42,569
Jul-15	52	267	74	227	17,038	74,222	30,280	72,849
Jul-16	62	329	36	263	16,207	90,429	24,293	97,142
Jul-17	28	357	50	313	13,441	103,870	20,596	117,738
Jul-18	23	380	32	345	12,964	116,834	17,742	135,480
Jul-19	39	419	46	391	14,432	131,266	17,597	153,077
Jul-20	99	518	54	445	19,950	151,216	15,590	168,667
Jul-21	62	580	56	501	16,296	167,512	17,992	186,659
Jul-22	58	638	42	543	14,228	181,740	16,279	202,938
Jul-23	46	684	46	589	12,890	194,630	13,207	216,145
Jul-24	58	742	37	626	10,424	205,054	9,828	225,973
Jul-25	39	781	25	651	10,407	215,461	7,806	233,779
Jul-26	21	802	31	682	8,751	224,212	8,542	242,321
Jul-27	39	841	31	713	12,127	236,339	9,382	251,703
Jul-28	17	858	18	731	11,320	247,659	7,768	259,471
Jul-29	25	883	9	740	9,623	257,282	6,040	265,511
Jul-30	15	898	13	753	7,928	265,210	4,266	269,777
Jul-31	10	908	4	757	6,768	271,978	3,911	273,688
Aug-1	8	916	4	761	7,038	279,016	3,390	277,078
Aug-2	4	920	2	763	6,514	285,530	2,600	279,678
Aug-3	2	922	7	770	4,613	290,143	2,242	281,920
Aug-4	0	922	1	771	1,939	292,082	1,627	283,547
Aug-5	-	-	1	772	-	-	1,461	285,008
Total		922		772		292,082		285,008

Table 2. — Age and sex ratio estimates of Chinook salmon at the Henshaw Creek weir, Alaska, 2012 and 2013. 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 class						
Run size (n)	Sample size (N)	Unknown Age	Percent Female	2010	2009	2008	2007	2007	2006	2005
2012										
922	318	29	40%			1.2	1.3		1.4	1.5
						16% (2.1)	49% (2.9)		34% (2.8)	<1% (0.3)
2013										
772	241	15	44%	1.1	1.2	1.3	1.4	2.3	1.5	
				<1% (0.5)	32% (3.4)	31% (3.3)	35% (3.4)	1% (0.8)	<1% (0.3)	

Table 3. — Length at age of male and female Chinook salmon sampled at the Henshaw Creek weir, Alaska, 2012 and 2013.

	Male					Female				
	Mid-eye to fork length (mm)					Mid-eye to fork length (mm)				
Age	N	Mean	SE	Median	Range	N	Mean	SE	Median	Range
2012										
1.1	0	-	-	-	-	0	-	-	-	-
1.2	50	559	41.7	556	491 - 690	0	-	-	-	-
1.3	98	696	49.4	692	556 - 809	38	747	74.3	765	554 - 863
1.4	20	785	67.9	778	643 - 930	82	830	47.0	831	717 - 975
2.3										
1.5	0	-	-	-	-	1	915	-	915	915
Total	168					121				
2013										
1.1	2	374	9.2	374	367 - 380	0	-	-	-	-
1.2	60	519	50.0	517	409 - 638	0	-	-	-	-
1.3	45	717	59.7	733	543 - 830	26	757	31.6	756	700 - 820
1.4	14	813	49.9	807	736 - 900	72	819	41.5	814	722 - 903
2.3	1	673	-	673	673	2	744	50.9	744	708 - 780
1.5	0	-	-	-	-	1	910	-	910	910
Total	122					101				

Table 4. — Age and sex ratio estimates of chum salmon at the Henshaw Creek weir, Alaska, 2012 and 2013. 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.

Run size (n)	Sample size (N)	Unknown Age	Percent Female	Brood Year and age			
				2009	2008	2007	2006
2012							
292,082	600	122	53%	0.2	0.3	0.4	0.5
				<1% (0.4)	84% (1.8)	13% (1.6)	2% (0.7)
2013							
285,008	520	43	58%	0.3	0.4	0.5	
				63% (2.7)	37% (2.7)	<1% (0.1)	

Table 5. — Length at age of female and male chum salmon sampled at the Henshaw Creek weir, Alaska, 2012 and 2013.

	Male					Female				
	Mid-eye to fork length (mm)					Mid-eye to fork length (mm)				
Age	N	Mean	SE	Median	Range	N	Mean	SE	Median	Range
2012										
0.2	1	503	-	503.0	503	3	511	8.5	510	503 - 520
0.3	184	560	26.8	557.0	492 - 665	225	539	28.1	542.0	426 -612
0.4	31	577	24.8	575.0	537 - 613	27	548	36.3	555.0	457 - 632
0.5	3	592	22.0	591.0	571 - 615	4	572	19.8	566	557 - 600
Total	219					259				
2013										
0.2	0	-	-	-	-	0	-	-	-	-
0.3	118	547.0	24.8	550.0	480 - 599	221	521.6	24.8	517.0	469 - 599
0.4	65	584.0	31.3	580.0	511 - 663	72	552.5	26.2	551.0	496 - 610
0.5	0	-	-	-	-	1	560.0	-	560.0	560
Total	183					294				

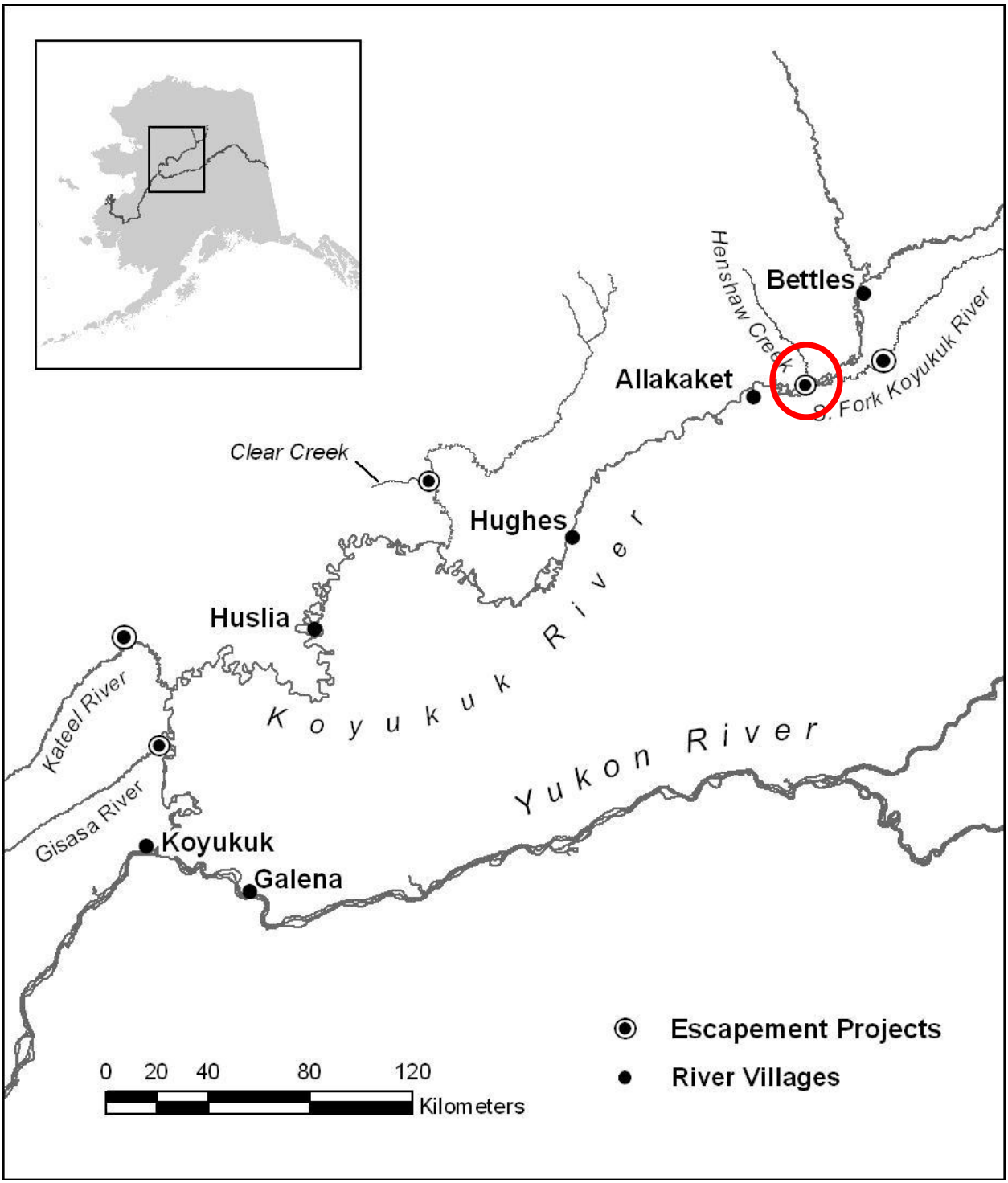

Figure 1. — Location of the Henshaw Creek weir and other active and historical tributary escapement project sites in the Koyukuk River drainage, Alaska.

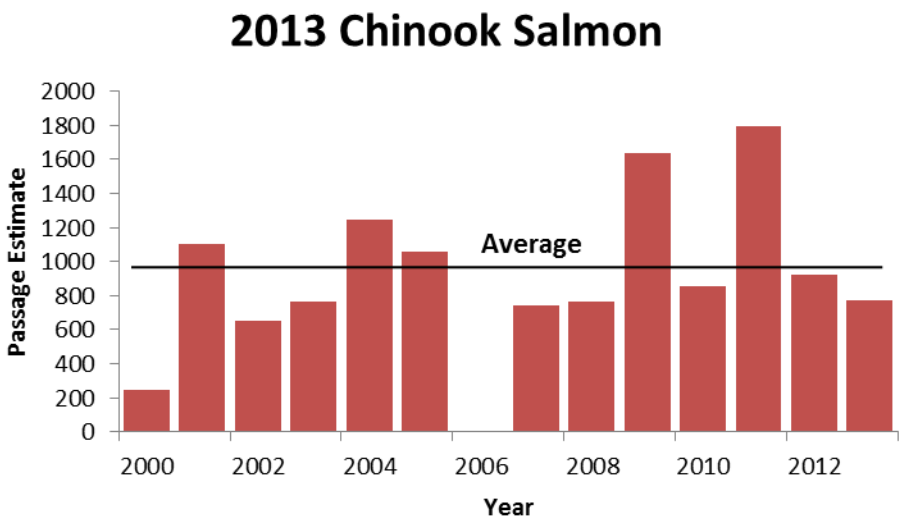

Figure 2. — Annual estimates of Chinook salmon escapement at Henshaw Creek weir, Alaska, 2000 through 2013. The weir was not operational in 2006 due to high water events. Therefore, no data was collected in 2006. The horizontal line represents the average escapement estimate (N = 987) from 2000 through 2011, omitting 2006.

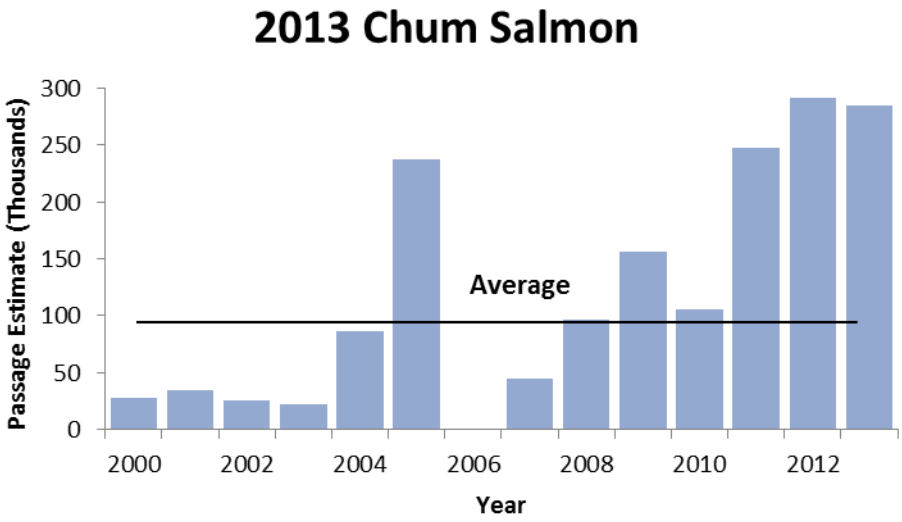

Figure 3. — Annual estimates of Chum salmon escapement at the Henshaw Creek weir, Alaska, 2000 through 2013. The weir was not operational in 2006 due to high water events. Therefore, no data was collected in 2006. The horizontal line represents the average escapement estimate (N = 98,709) from 2000 through 2011, omitting 2006.

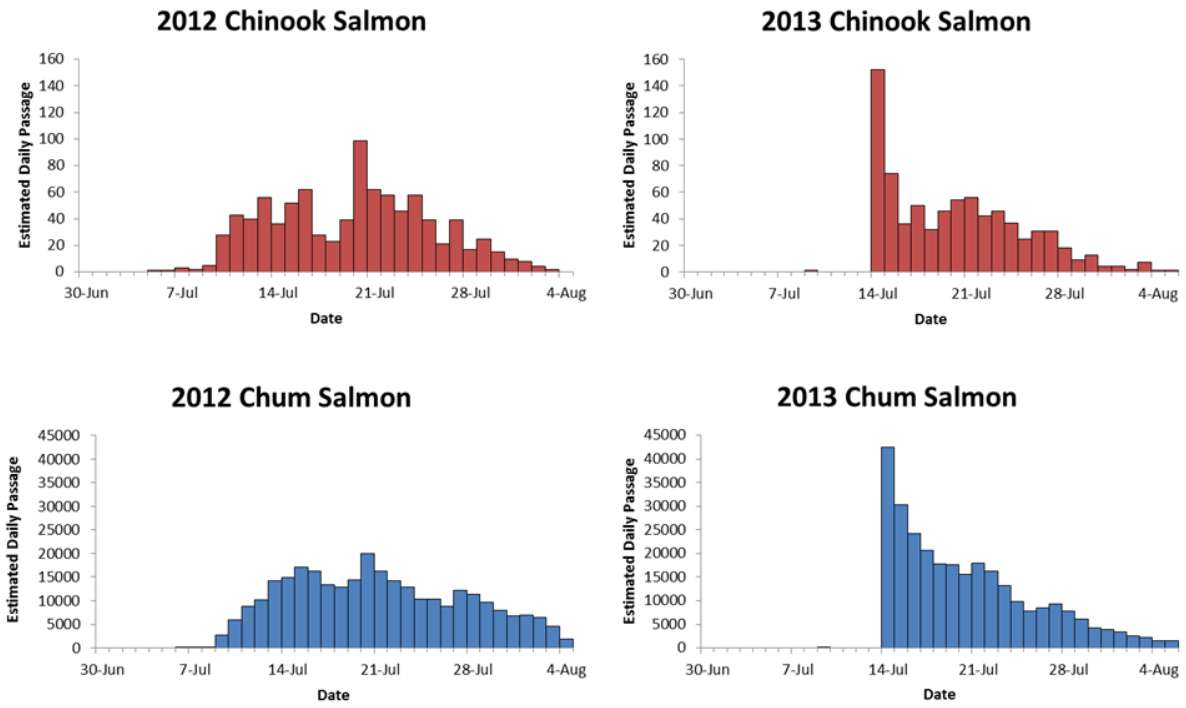

Figure 4. — Daily estimates of Chinook salmon and chum salmon escapement at the Henshaw Creek weir, Alaska, 2012 and 2013. In 2013, a high water event interrupted weir operations and suspended enumeration efforts, beginning at 22:45 hours on July 9 and ending at 12:00 hours on July 14. The partially enumerated days of July 9 and 14 were adjusted to provide full day passage estimates. However, no interpolation was made to estimate the passage for the complete missed days, July 10 through July 13.

Appendix 1. — Historical estimates of Chinook salmon and summer chum salmon escapement at the Henshaw Creek weir, Alaska, 1960 – 2013 (Aerial index data from Baron 1984; Alaska Department of Fish and Game unpublished data).

Year	Aerial index estimates		Survey rating	Tower estimates		Weir estimates	
	Chinook salmon	Chum salmon		Chinook salmon	Chum salmon	Chinook salmon	Chum salmon
1960	Present		Poor				
1969	6	300	Not Rated				
1975	118	1,219	Not Rated				
1976	94	624	Fair				
1982	48	12	Fair				
1983	553	3,288	Good-Fair				
1984	253	532	Poor				
1985	393	3,724	Good				
1986	561	2,475	Fair				
1987	20	35	Not Rated				
1988	180	1,106	Good-Poor				
1990	369	1,237	Good-Fair				
1991	455	2,148	Good				
1992	Present	Present	Poor				
1993	330	1,173	Good				
1994	526	2,165	Fair				
1995	271	15,397	Good				
1996	69	12,890	Fair				
1997	593	1,800	Fair				
1998	97	151	Fair				
1999	119	2,703	Poor	0	1,510		
2000						244	27,271
2001						1,103	35,031
2002						649	25,249
2003						763	22,556
2004						1,248	86,474
2005						1,059	237,481
2006						0*	4*
2007						740	44,425
2008						766	96,731
2009						1,637	156,933
2010						857	105,398
2011						1,796	248,247
2012						922	292,082
2013						772	285,008

*Escapement estimates in 2006 were not completed due to persistent flooding events.

Appendix 2. — Daily passage estimates of non-salmon fish species at the Henshaw Creek weir, Alaska, 2012 and 2013.

	Longnose Sucker		Arctic Grayling		Northern Pike		Whitefish sp.	
Date	2012	2013	2012	2013	2012	2013	2012	2013
Jun-30	0	0	1	1	0	0	0	0
Jul-1	0	0	2	3	1	0	0	0
Jul-2	351	4	0	2	0	0	0	0
Jul-3	295	1	0	0	0	0	0	0
Jul-4	1	0	0	0	0	0	0	0
Jul-5	5	0	0	0	1	0	0	0
Jul-6	57	0	1	0	0	0	0	0
Jul-7	313	1	0	1	0	0	0	0
Jul-8	54	1	0	0	0	0	0	0
Jul-9	5	2	5	0	0	0	0	0
Jul-10	14	0	3	0	2	0	3	0
Jul-11	5	0	2	0	4	0	7	0
Jul-12	6	0	6	0	4	0	1	0
Jul-13	22	0	7	0	2	0	48	0
Jul-14	1	224	4	54	0	6	1	0
Jul-15	3	127	1	9	1	2	4	2
Jul-16	123	49	2	1	1	0	7	0
Jul-17	11	8	1	10	0	1	0	0
Jul-18	2	1	1	3	0	0	0	0
Jul-19	0	2	1	3	0	0	0	0
Jul-20	0	11	3	4	0	0	0	2
Jul-21	79	4	9	2	1	1	7	3
Jul-22	226	7	0	6	2	0	0	1
Jul-23	233	7	1	7	1	1	3	1
Jul-24	192	10	0	2	1	1	5	5
Jul-25	84	12	1	4	0	0	1	0
Jul-26	201	55	0	3	0	1	0	0
Jul-27	402	99	1	5	1	0	7	0
Jul-28	147	169	2	2	0	0	0	3
Jul-29	203	74	2	2	0	1	0	2
Jul-30	116	46	1	2	0	0	1	2
Jul-31	90	19	0	1	1	0	0	3
Aug-1	114	22	1	3	1	0	7	2
Aug-2	48	19	0	6	0	0	3	4
Aug-3	8	20	0	6	2	1	1	8
Aug-4	32	11	0	1	1	0	3	3
Aug-5	-	12	-	2	-	0	-	3
Total	3,443	1,017	58	145	27	15	109	44