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Abundance and Run Timing of Adult Pacific Salmon in the East Fork Andreafsky River, Yukon Delta National Wildlife Refuge, Alaska, 2012

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Cover Photo: USFWS East Fork Andreafsky River weir 2012, photo J. Stribrny.

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Abstract

A resistance board weir was used to collect abundance, run timing, and biological data from salmon returning to the East Fork Andreafsky River, a tributary to the lower Yukon River, from June 30 to August 1, 2012. An estimated 2,517 Chinook salmon *Oncorhynchus tshawytscha* migrated through the weir. Five age groups were identified from the 615 Chinook salmon sampled, with age 1.3 (63%) predominant. The sex composition was 29.6% female. An estimated 56,680 summer chum salmon *O. keta* also migrated through the weir. Four age groups were identified from 640 summer chum salmon sampled, with ages 0.3 (68%) and 0.4 (27%) predominant. The sex composition was 47.2% female. Additionally, there were 74,682 pink salmon *O. gorbuscha*, and 84 sockeye salmon *O. nerka,* counted passing through the weir. Other species counted during 2012 included 1,666 whitefish (Coregoninae), and 13 northern pike *Esox lucius*. The weir counts started late due to high water, therefore, passage estimates are conservative.

Introduction

The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) mandates that salmon populations and their habitats be conserved within National Wildlife Refuge lands, international treaty agreements be fulfilled, and a subsistence priority for rural residents be maintained (USFWS 1991). Compliance with ANILCA mandates cannot be ensured without reliable data on salmon stocks originating from and returning to refuge lands. The Andreafsky River is one of several lower Yukon River tributaries on the Yukon Delta National Wildlife Refuge (Refuge). The Andreafsky River and its primary tributary, the East Fork Andreafsky River, provide important spawning and rearing habitat for Chinook salmon *Oncorhynchus tshawytscha*, summer chum salmon *O. keta*, coho salmon *O. kisutch*, pink salmon *O. gorbuscha*, and sockeye salmon *O. nerka* (USFWS 1991). The Andreafsky River supports one of the largest returns in the Yukon River drainage of Chinook salmon, the second largest return of summer chum salmon (Bergstrom et al. 1998), and is believed to have the largest return of pink salmon (USFWS 1991). Furthermore, Andreafsky River salmon stocks contribute to a significant subsistence fishery in the lower Yukon River.

Consequently, accurate and timely escapement estimates from tributaries like the Andreafsky River are required for managers to determine exploitation rates, spawner-recruit relationships and maintain genetic diversity for the Yukon River basin (Labelle 1994). Throughout the Yukon River basin, there is a limited number of monitoring projects that collect these data. Therefore, Federal and State fishery managers utilize information from escapement projects, main-stem sonar stations, and test fisheries to distribute salmon harvest over time to avoid over-harvesting individual salmon stocks (Mundy 1982). However, due to run timing or the estimated abundance of returning individual stocks, certain stocks may be incidentally over-harvested in subsistence, commercial, or sport fisheries.

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Escapement monitoring on the East Fork Andreafsky River started with aerial surveys by the U.S. Fish and Wildlife Service (USFWS) from 1954-1960, and continued by the Alaska Department of Fish and Game (ADF&G) from 1961 to the present. Sonar and tower count methods were added by ADF&G from 1981 through 1988 (Appendix 1). The present weir project (operated by the USFWS Kenai Fish and Wildlife Field Office from 1994-2002 and the USFWS Fairbanks Fish and Wildlife Field Office since 2003 provides accurate escapement and biological data dating back to 1994 for Chinook salmon, summer chum salmon, and pink salmon, as well as coho salmon from 1995 to 2005. The Andreafsky River weir is one of the longest running escapement projects in the Yukon River drainage.

Poor salmon returns from 1998–2012 in the Yukon River resulted in harvest restrictions, complete fishery closures, and spawning escapements below management goals on many tributaries in the Yukon River drainage (Vania et al. 2002; Kruse 1998, JTC 2012). Chinook salmon and summer chum salmon runs improved with harvestable surpluses from 2002-2006 (JTC 2007). However, Chinook salmon runs again showed low run strength from 2007-2012 (JTC 2013). This project provides information on tributary run strength and quality of escapement for in-season management decisions, especially during years with low returns. This project monitors escapement downriver of where most harvest occurs in the Yukon River drainage.

Objectives

The project objectives for 2012 were to: (1) enumerate adult salmon escapement; (2) describe run timing of Chinook salmon and summer chum salmon returns; (3) estimate age, sex, and length composition of the adult Chinook salmon population; (4) estimate age, sex, and length composition of the adult summer chum salmon population; and (5) identify and count other fish species passing through the weir.

Study Area

The Andreafsky River is located in the lower Yukon River drainage in western Alaska (Figure 1). The regional climate is subarctic with extreme temperatures reaching 28˚ C in summer and −42˚C in winter at St. Mary's, Alaska (Leslie 1989). Mean July high and February low temperatures between 1976 and 2000 were 18˚C and –22˚C, respectively. Average yearly precipitation is approximately 48 cm of rain and 172 cm of snow. The Andreafsky River ice breakup period typically occurs in May or early June, and freeze-up usually begins in late October (USFWS 1991). Maximum discharge typically follows breakup. Sporadic high discharge generated by heavy rains occurs between late July and early September.

The Andreafsky River is one of the three largest Yukon River tributaries within Refuge boundaries (USFWS 1991) and drains a watershed of approximately 5,450 km^2. The main-stem Andreafsky River and the East Fork Andreafsky River parallel each other, flowing southwesterly for more than 200 river kilometers (rkm) and converge 7 rkm upstream of their confluence with the Yukon River. The mouth of the Andreafsky River is approximately 160 rkm upstream from the mouth of the Yukon River. The main-stem Andreafsky River and East Fork Andreafsky River flow through the Andreafsky Wilderness and portions of each river are within Refuge boundaries designated as Wild and Scenic Rivers.

The East Fork Andreafsky River originates in the Nulato Hills at approximately 700 m elevation and drains an area of about 1,950 km^2 (USFWS 1991). The river flows through alpine tundra at an average gradient of 7.6 m per km for 48 rkm. It then flows for 130 rkm through a forested river valley bordered by hills that rarely exceed 400 m elevation. Willow, spruce, alder, and birch dominate the riparian zone and much of the hillsides. This forested river section drops an average of 1.4 m/km, characterized by glides and riffles with gravel and rubble substrate. The river widens in the lower 38 rkm and the gradient changes to 0.14 m/km. Here the valley is a wetland, interspersed with forest and tundra, and bordered by hills typically less than 230 m elevation. Aquatic vegetation grows in the slower flowing stream channels. Water level fluctuations on the Yukon River affect the stage height in the lower sections of the East Fork and main-stem Andreafsky Rivers.

Methods

Weir Operation

A modified resistance board weir (Tobin 1994; Tobin and Harper 1995; Zabkar and Harper 2003) spanning 105 m was installed June 18-29, 2012, in the East Fork Andreafsky River (62° 07'N, 162° 48.4'W) approximately 43 rkm upstream from the Yukon-Andreafsky River confluence and 26 air-km northeast of St. Mary's, Alaska (Figure 1). The weir site is located approximately 2.4 rkm downstream from the 1994 weir site described by Tobin and Harper (1995) and 2.1 rkm downstream from the 1981-1988 sonar and counting tower site described by Sandone (1989). Weir panel picket spacing (4.8 cm inside edge to inside edge) was designed to function during higher water flow, but allow smaller pink salmon and resident fish to pass through the weir undetected (Zabkar and Harper 2003).

A staff gauge was installed upstream of the weir to measure daily water levels. Staff gauge measurements were calibrated to a monument with the three-foot mark of the staff gauge located twelve and a half feet below the horizontal from the monument. Two Onset Hobo Pro v2 (Bourne, Massachusetts) loggers recorded water temperature data throughout the season and were left on site to collect year-round data; water temperature data loggers deployed in 2011 were not located in 2012. Water temperatures and chemistry were collected twice daily at approximately 0730 hours and 1930 hours, using a YSI Professional Plus Multiprobe (Yellow Springs, Ohio); the data is presented in Appendix 9. Additionally two ProV2 loggers were installed 54 rkm upstream of the weir to capture water temperature data on the Chinook spawning grounds.

Two passage chutes were installed, one approximately one-third of the way across from the left bank, and the other centered between the banks, in water deep enough to allow fish passage in the event of low water conditions. A fish trap was installed on the left bank passage chute to facilitate biological sampling. All fish were enumerated and identified to species as they passed through the live trap, except whitefish, which were grouped in the subfamily Coregoninae. Fish were counted 24 hours per day and numbers recorded hourly from June 30 to July 30.

The weir was cleaned and its integrity visually checked daily. Cleaning consisted of raking debris from the upstream surface of the weir or walking across each panel to submerge it enough to allow the current to wash debris downstream. Repairs were made when necessary.

Biological Data

Adult salmon counting and sampling occurred daily to determine run timing and escapement. A stratified random sampling design (Cochran 1977) was used to collect age, length, and sex data for Chinook and summer chum salmon. Biological sampling of Chinook salmon and chum salmon occurred each week, with a sampling goal of 160 salmon/species spread throughout each week, and daily sampling spread throughout each 24-hour period. All target species within the weir live trap were sampled to prevent bias. Non-target species were identified and counted but not sampled, except for opportunistic samples of whitefish, which were sacrificed to construct a gonadosomatic index. The data from this sampling effort are presented in Appendix 10, but are not discussed in this report.

Sampling consisted of identifying salmon to species, determining sex, measuring fish lengths, collecting scales, and releasing fish upstream of the weir. Secondary external characteristics were used to determine sex. Lengths were measured from mid-eye to the fork of the caudal fin to the nearest 1 mm. Scales were removed from the area above the lateral line and posterior to the dorsal fin following the methods outlined by Koo (1962) and Devries and Frie (1996). Four scales were collected from each Chinook salmon sampled and one scale was collected from each summer chum salmon sampled. Scales were sent to ADF&G post season for age determination, from impressions made on cellulose acetate cards in a heated scale press and examined with a microfiche reader (Zabkar and Harper 2003). Age was determined by an ADF&G biologist and reported according to the European method (Koo 1962). Daily sex ratios were collected by visually examining each fish for external morphological features when sampling for age and length. The escapement counts and sex ratios were reported daily to the USFWS Fairbanks Fish and Wildlife Field Office and forwarded to ADF&G staff.

Data Analysis

Calculations for age and sex information were collected using a stratified random sample (Cochran 1977), with sampling weeks as the strata. Age-1.2 Chinook salmon were assumed to be males (Brady 1983; Bales 2007; Karpovich and DuBois 2007) regardless of their field determination. Each statistical week was defined as beginning on Sunday and ending the following Saturday. Incomplete weeks or weeks with low passage were combined with weeks prior to or after that week to maximize sample size in all strata. Within a stratum, the proportion of the samples composed of a given sex or age, $\hat{p}_{ij}$, was 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 and summer 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 the stratum weight $\hat{W}_j$ was calculated as:

$$\hat{W}_j = \frac{N_j}{N},$$

and N_j equals the total number of fish of a given species passing through the weir during week j, and N is the total number of fish of a given species passing through the weir during the run. Variance, $\hat{v}(\hat{p}_i)$ of sex and age compositions for the run was calculated as:

$$\hat{v}(\hat{p}_i) = \sum_{j-1} \hat{W}_j^2 \hat{v}(\hat{p}_{ij}).$$

Results and Discussion

Weir Operation

The weir was operational from June 30 through August 1, 2012. Two high water events in 2012 delayed the installation and removal of the weir. An electrical storm also caused a 4-hour period over which the weir was closed. The average river stage height during weir operations was 116 cm and ranged between 103 cm and 140 cm (Figure 2). Water temperature during weir operations averaged 11.4°C and ranged between 8.4 and 13.8°C (Figure 2, Appendix 9).

Biological Data

An estimated 2,517 Chinook salmon, 56,680 summer chum salmon, 74,682 pink salmon, and 84 sockeye salmon migrated through the weir in 2012 (Table 1). Passage estimates for Chinook and summer chum salmon were conservative due to an unknown number of fish passing before and after the weir was operational. Non-salmon species recorded moving through the weir included 1,666 whitefish and 13 northern pike.

The East Fork Andreafsky River weir recorded below-average Chinook salmon escapement (Figure 3), which in 2012 was similar drainage wide. The summer chum salmon escapement recorded at the weir in 2012 was also below average (Figure 4), but the drainage wide summer escapements were above average (JTC 2013).

Chinook Salmon

The 2012 Chinook salmon escapement estimate (2,517 fish) was below the 1994-2011 historical average of 4,487 fish (Figure 3; Appendix 2). Peak passage (428) occurred on July 20 (Table 2; Figure 4). The 2012 run timing was later than average; the first quartile passed on July 15 (historical average July 5), the mid-point of the run at the weir was July 19 (historical average July 9), and the third quartile passage date was July 22 (historical average July 15) (Appendix 2).

Chinook salmon passage calculations were not adjusted for differences in project duration among years.

Of the 2,517 Chinook salmon that passed through the weir in 2012, 615(24.4% of the run) were sampled for age, sex, and length composition. Female Chinook salmon lengths ranged from 592 to 937 mm, and male Chinook salmon ranged from 342 to 930 mm (Table 3). Of the 615 Chinook salmon sampled for age composition 43 (7%) were classified as unreadable, primarily due to scale regeneration. The weighted age composition of the remaining 572 Chinook salmon included five age groups: age-1.1 (0.4%) age-1.2 (10.2%), age-1.3 (62.9%), age-1.4 (26.3%), and age-1.5 (1.1%) (Table 4). Females composed an estimated 29.6% of the overall escapement. This estimate is 7.1percentage points lower than the historical average percent female of 36.7% (Appendices 7 and 8). The age distributions between female and male Chinook salmon were different. Females were predominately ages 1.3 (34.7%) and 1.4 (64.9%) and males were predominately ages 1.2 (14.5%) and 1.3 (74.5%).

The 2012 ADF&G aerial survey on the Andreafsky River estimated 227 Chinook salmon for the main stem, but no aerial surveys were conducted for the East Fork Andreafsky River (Appendix 1). The main-stem aerial count was below ADF&Gs Sustainable Escapement Goal (SEG) of 640 to 1,600 Chinook salmon (Hayes and Newland, 2009). The East Fork aerial SEG was discontinued and replaced with a weir-based SEG of 2,100-4,900 Chinook salmon since 2010.

Summer Chum Salmon

The 2012 summer chum salmon escapement estimate of 56,680, fish was below the 1994-2011 historical average of 74,188 fish (Figure 4; Appendix 1 and 3), but met ADF&Gs Biological Escapement Goal (BEG) of >40,000 fish (JTC 2013). However, weir operation began later than usual and fish passed before counting started. Peak passage (8,580 fish) occurred on July 6 (Table 1; Figure 4). The 2012 run timing was later than average; the first quartile passed on July 5 (historical average July 2), the mid-point of the run at the weir was July 8 (historical average July 6), and the third quartile passage date was July 15 (historical average July 12) (Table 2). Summer chum salmon calculations were not adjusted for differences in project duration among years.

Female summer chum salmon lengths ranged from 436 to 593 mm and male summer chum salmon ranged from 418 to 785 mm (Table 3). There were 640 summer chum salmon sampled for age composition with 34 (5.3%) classified as unreadable, primarily due to scale regeneration. The age composition of the remaining sampled summer chum salmon included four age groups: age-0.2 (0.6%), age-0.3 (68.2%), age-0.4 (27.2%), and age-0.5 (4.1%). The weighted proportions are presented in Table 5. Females comprised an estimated 47.2% of the overall escapement (Table 5). This estimate is 0.9 percentage points lower than the historical sex ratio (Appendix 8). Female summer chum salmon were predominantly age-0.3 (73.1%) and age 0.4 (24.1%), and male summer chum were predominantly age-0.3 (63.8%) and age-0.4 (29.9%).

Pink Salmon

Pink salmon have strong runs to the East Fork Andreafsky River during even-numbered years and relatively weak runs during odd-numbered years (Appendix 5). The 2012 escapement through the weir (74,682 fish) was less than the even-year 1994-2010 historical average of 232,561 fish. However, the 2012 pink salmon escapement estimate was incomplete because weir

operation began after the run had developed and ceased before the end of the run. Pink salmon counts on the Andreafsky River are not a precise estimate, but are a measure of relative year-to-year abundance as small pink salmon are able to pass uncounted between the weir pickets. Peak passage (29,428 fish) occurred between July 18 and July 22, with the highest single day passage occurring on July 20 (8,378 fish) (Table 1, Appendix 5).

Sockeye Salmon

The 2012 sockeye salmon escapement estimate of 84 fish was below the 1995-2011 historical average of 221 fish (Appendix 6). However, the 2012 sockeye salmon escapement estimate was incomplete because weir operation ceased before the end of the run. Large populations of sockeye salmon are absent in the Yukon River drainage (Bergstrom et al. 1995), but small populations have been identified in several Yukon River tributaries (Alt 1983; O'Brien 2006), including the Andreafsky River.

Conclusion

The East Fork Andreafsky River weir is an important tool for monitoring salmon stocks originating on the Refuge, and in assisting both ADF&G and USFWS inseason managers with management of Yukon River fisheries. Due to the complexity of the Yukon River mixed-stock salmon fishery and the difficulty in managing specific stocks, it is vital to continue collecting information from individual salmon populations, including stocks in the Andreafsky River drainage. The East Fork Andreafsky River weir is unique because it is the only enumeration project in the lower river downstream of the Pilot Station sonar. The numerical, biological, and run timing information collected from the East Fork Andreafsky River weir project is assumed to represent other Lower Yukon River systems experiencing lower salmon exploitation due to their location in the lower portion of the Yukon River drainage. This project allows managers to evaluate escapement goals, analyze trends in population size, length, age, and gender, formulate run projections, determine harvest allocations, and monitor long-term changes associated with climate change, harvest fluctuations, diseases, and other stressors.

Investigations of spawning and rearing locations for sockeye salmon are recommended to ensure long-term viability of this small unique population. Additionally, with the introduction of a limited commercial fishery for Arctic lamprey in 2003 and historical subsistence use, the East Fork Andreafsky River weir project was used as a platform to collect baseline data to better understand lamprey biology, relative abundance and distribution, and to construct a sampling protocol for lamprey larvae. This effort will continue in 2013.

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Table 1. — Salmon escapement estimates by stratum, recorded at the East Fork Andreafsky River weir, Alaska, 2012.

Stratum Date	Chinook salmon	Chum salmon	Pink salmon	Sockeye salmon
June 30-July 7	211	23,732	8,888	32
July 8-July 14	312	14,354	15,764	17
July 15-21	1,307	10,861	29,036	19
July 22-28	406	3,983*	19,825	10
July 29-Aug 1	281	750*	1,169	6
Total	2,517	56,680	74,682	84

* = Strata 4 and 5 were combined for chum salmon age, sex, and length calculations.

Table 2. — Daily and cumulative escapement estimates of Chinook salmon, summer chum salmon, pink salmon, and sockeye salmon, and daily and total escapement estimates of whitefish (Coregoninae) and northern pike through the East Fork Andreafsky River weir, Alaska, 2012.

	Chinook salmon		Chum salmon		Pink salmon		Sockeye salmon	Coho Salmon	Whitefish	Northern Pike	Grayling
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Daily	Daily	Daily	Daily
30-Jun	13	13	3,773	3773	568	568	0	0	29	0	0
1-Jul	3	16	698	4471	198	766	0	0	42	0	0
2-Jul	12	28	1,728	6199	271	1,037	2	0	29	0	0
3-Jul	2	30	366	6565	51	1,088	1	0	22	0	0
4-Jul	10	40	3,536	10,101	534	1,622	4	0	31	0	0
5-Jul	24	64	5,011	15,112	1,756	3,378	13	0	50	0	0
6-Jul	117	181	8,580	23,692	3,492	6,870	6	0	69	1	0
7-Jul	30	211	3,040	26,732	2,018	8,888	6	0	89	1	0
8-Jul	101	312	4,313	31,045	3,435	12,323	3	0	68	1	1
9-Jul	107	419	2,657	33,702	2,385	14,708	2	0	68	0	0
10-Jul	13	432	1,615	35,317	1,091	15,799	3	0	42	0	0
11-Jul	26	458	1,975	37,292	1,258	17,057	1	0	37	0	0
12-Jul	16	474	976	38,268	2,303	19,360	2	0	28	0	0
13-Jul	24	498	989	39,257	3,183	22,543	3	0	44	0	0
14-Jul	25	523	1,829	41,086	2,109	24,652	3	0	30	0	0
15-Jul	303	826	4,181	45,267	4,607	29,259	2	0	85	2	0
16-Jul	133	959	1,265	46,532	979	30,238	5	0	53	2	0
17-Jul	82	1,041	1,027	47,559	2,062	32,300	1	0	84	0	0
18-Jul	38	1,079	470	48,029	1,219	33,519	0	0	49	1	0
19-Jul	103	1,182	1,356	49,385	4,173	37,692	5	0	46	1	0
20-Jul	428	1,610	1,610	50,995	8,378	46,070	4	0	94	1	0
21-Jul	220	1,830	952	51,947	7,618	53,688	2	0	118	2	0
22-Jul	78	1,908	1,295	53,242	8,040	61,728	1	0	107	1	0
23-Jul	34	1,942	539	53,781	2,915	64,643	1	0	73	0	0
24-Jul	16	1,958	266	54,047	2,700	67,343	1	0	46	0	0
25-Jul	3	1,961	286	54,333	2,389	69,732	0	0	46	0	0
26-Jul	144	2,105	1,001	55,334	1,747	71,479	4	0	43	0	0
27-Jul	107	2,212	412	55,746	1,056	72,535	3	1	43	0	0
28-Jul	24	2,236	184	55,930	978	73,513	0	0	33	0	0
29-Jul	197	2,433	536	56,466	648	74,161	2	1	23	0	0
30-Jul	80	2,513	179	56,645	305	74,466	1	0	30	0	0
31-Jul	3	2,516	28	56,673	161	74,627	3	0	14	0	0
1-Aug	1	2,517	7	56,680	55	74,682	0	3	1	0	0
Total	2,517		56,680		74,682		84	5	1,666	13	1

Table 3. — Length-at-age of female and male Chinook salmon and summer chum salmon sampled at East Fork Andreafsky River weir, Alaska, 2012.

Female						Male					
Mid-eye to fork length (mm)						Mid-eye to fork length (mm)					
Age	N	Mean	Median	SE	Range	Age	N	Mean	Median	SE	Range
Chinook salmon											
1.2	0*	-	-	-	-	1.1	2	360	360	17.5	342-377
1.3	59	730	743	7.6	603-831	1.2	71	531	531	5.5	430-632
1.4	94	810	806	5.0	713-937	1.3	308	669	743	7.6	513-811
1.5	1	851	NA	NA	851	1.4	37	796	806	9.7	714-930
UNK	16					UNK	27				
All Ages	154					All Ages	418				
Chum salmon											
0.2	2	492	493	40.5	452-533	0.2	1	539	539	0	495-580
0.3	234	516	515	1.7	436-580	0.3	205	551	551	2.6	475-640
0.4	62	537	540	3.8	478-593	0.4	81	576	579	4.2	480-670
0.5	5	552	548	10.9	530-590	0.5	16	595	601	9.1	520-590
0.6	0	-	-	-	-	0.6	-	-	-	-	-
UNK	20					UNK	14				
All Ages	323					All Ages	317				

*1.2 female Chinook salmon are assumed male regardless of field determination.

Table 4. — Age and sex ratio estimates by stratum of Chinook salmon sampled at East Fork Andreafsky River weir, Alaska, 2012. Standard errors are in parentheses. Season totals are calculated using weighted weekly strata totals. Unknown age data are from unreadable scale samples and are included in percent female calculations.

					Brood year and age							
					2009	2008	2007		2006		2005	
Strata Dates	Run Size (N)	Samples Size (n)	Unknown Age	Percent Female	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
6/30-7/7	211	102	8	24.3%(4.3)	1.1%(1.1)	21.3%(4.2)	57.4%(5.1)	0.0%(0.0)	20.2%(4.1)	0.0%(0.0)	0.0%(0.0)	0.0%(0.0)
7/8-14	312	150	13	22.0%(3.4)	0.0%(0.0)	16.1%(3.1)	68.6%(4.0)	0.0%(0.0)	15.3%(3.1)	0.0%(0.0)	0.0%(0.0)	0.0%(0.0)
7/15-21	1,307	162	9	26.5%(3.5)	0.7%(0.7)	7.8%(2.2)	65.4%(3.9)	0.0%(0.0)	26.1%(3.6)	0.0%(0.0)	0.0%(0.0)	0.0%(0.0)
7/22-28	406	160	9	28.8%(3.6)	0.0%(0.0)	9.2%(2.4)	68.2%(3.8)	0.0%(0.0)	21.9%(3.4)	0.0%(0.0)	0.6%(0.7)	0.0%(0.0)
7/29-8/1	281	40	4	57.5%(7.9)	0.0%(0.0)	8.3%(4.7)	41.7%(8.3)	0.0%(0.0)	50.0%(8.5)	0.0%(0.0)	0.0%(0.0)	0.0%(0.0)
Total	2,517	614	43	29.6%(2.2)	0.4%(0.4)	10.2%(1.4)	62.9%(2.4)	0.0%(0.0)	26.3%(2.2)	0.0%(0.0)	1.1%(0.1)	0.0%(0.0)
Female	745	170	16	-	0.0%(0.0)	0.0%(0.0)	34.7%(4.5)	0.0%(0.0)	64.9%(4.5)	0.0%(0.0)	0.4%(0.4)	0.0%(0.0)
Male	1,772	445	27	-	0.6%(0.5)	14.5%(1.9)	74.5%(2.5)	0.0%(0.0)	10.4%(1.9)	0.0%(0.0)	0.0%(0.0)	0.0%(0.0)

Table 5. — Age and sex ratio estimates by stratum of summer chum salmon sampled at East Fork Andreafsky River weir, Alaska, 2012. Standard errors are in parentheses. Season totals are calculated using weighted weekly strata totals. Unknown age data are from unreadable scale samples and are listed for informational purposes. They are not included in age calculations, but were used in the cumulative percent female calculation.

					Brood Year Age				
					2009	2008	2007	2006	2005
Strata Dates	Run Size (N)	Samples Size (n)	Unknown Age	Percent Female	0.2	0.3	0.4	0.5	0.6
6/30-7/7	26,732	160	9	41.9%(3.9)	0.7%(0.7)	58.3%(4.0)	35.8%(3.9)	5.3%(1.8)	0.0%(0.0)
7/8-14	14,354	160	8	52.5%(4.0)	0.7%(0.7)	73.7%(3.6)	21.1%(3.3)	4.6%(1.7)	0.0%(0.0)
7/15-21	10,861	160	6	47.5%(4.0)	0.6%(0.6)	81.9%(3.1)	16.9%(3.0)	0.6%(0.6)	0.0%(0.0)
7/22-8/1	4,733	160	11	60.0%(3.9)	0.0%(0.0)	75.8%(3.5)	20.8%(3.3)	3.4%(1.5)	0.0%(0.0)
Total	56,680	640	34	47.2%(1.8)	0.6%(0.2)	68.2%(1.8)	27.2%(1.8)	4.1%(0.1)	0.0%(0.0)
Female	26,729	323	20	-	0.9%(0.7)	73.1%(3.0)	24.1%(2.9)	1.9%(1.0)	0.0%(0.0)
Male	29,951	317	14	-	0.3%(0.7)	63.8%(3.2)	29.9%(3.1)	6.0%(1.6)	0.0%(0.0)

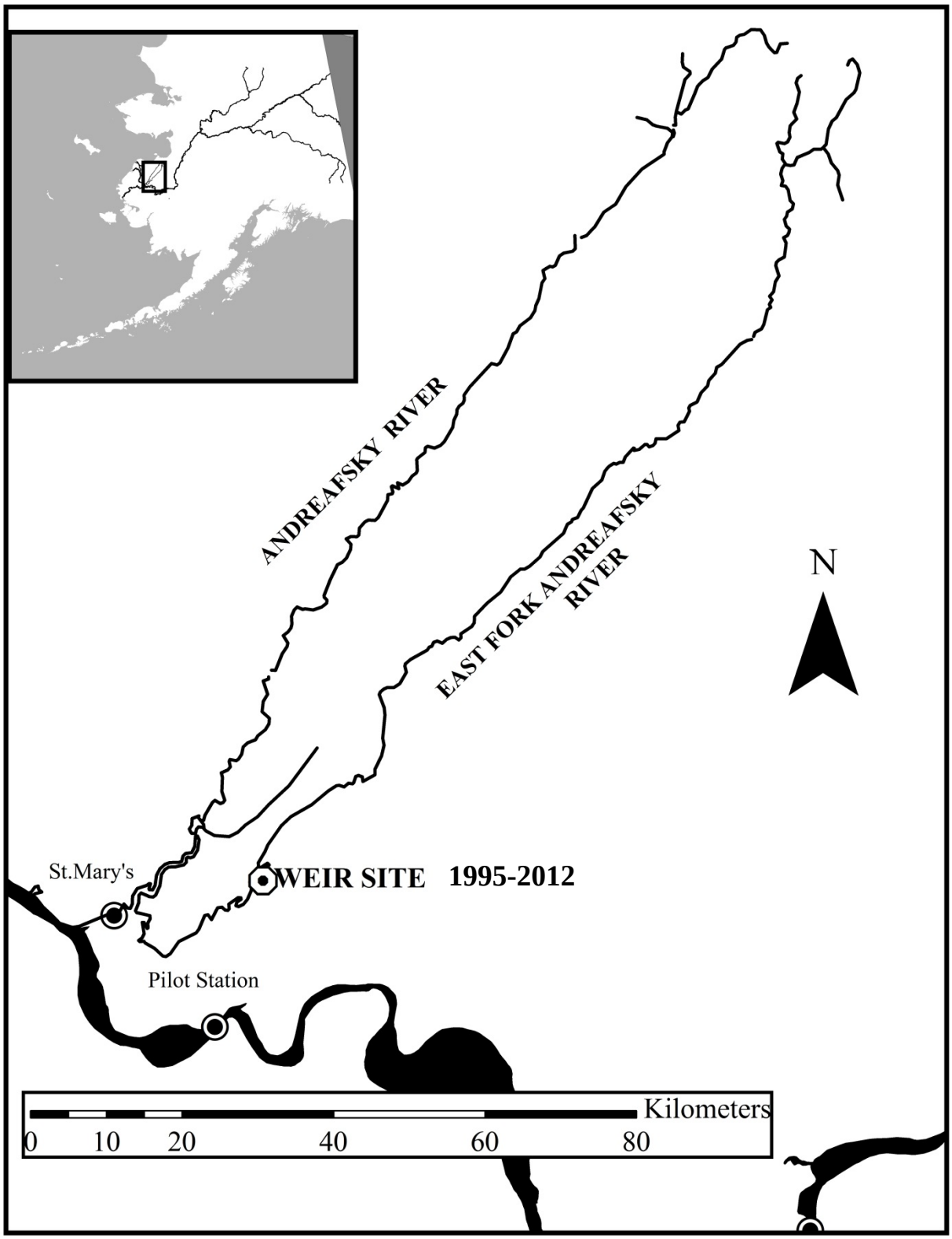


Figure 1. — Weir location on the East Fork Andreafsky River, Alaska, 1995-2012.

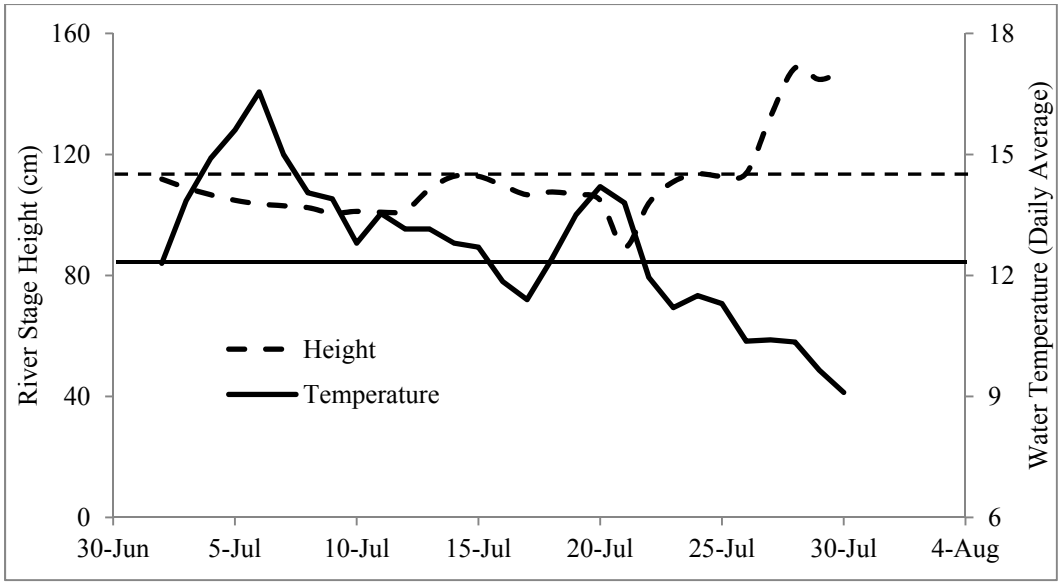


Figure 2. — River stage heights (cm) and water temperatures (°C) at the East Fork Andreafsky River weir with seasonal averages, 2012. Solid line indicates seasonal average water temperature. Dashed line indicates seasonal average water height.

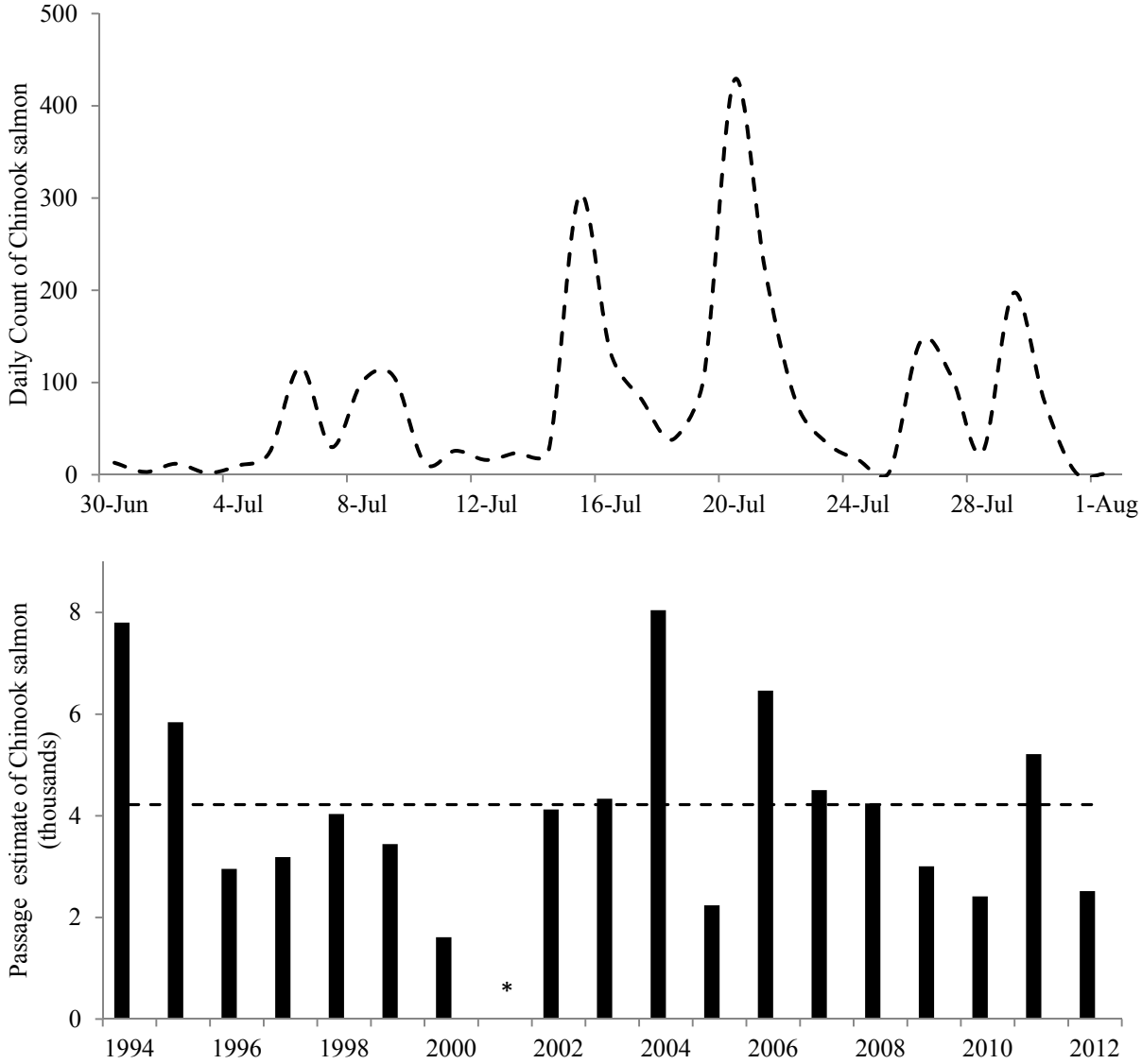


Figure 3. — Daily count (top) in 2012 and annual escapement estimates (bottom), 1994 to 2012, of Chinook salmon migrating through the East Fork Andreafsky River weir, Alaska. Historical average is represented by the dashed, horizontal line. Asterisk denotes missing annual count.

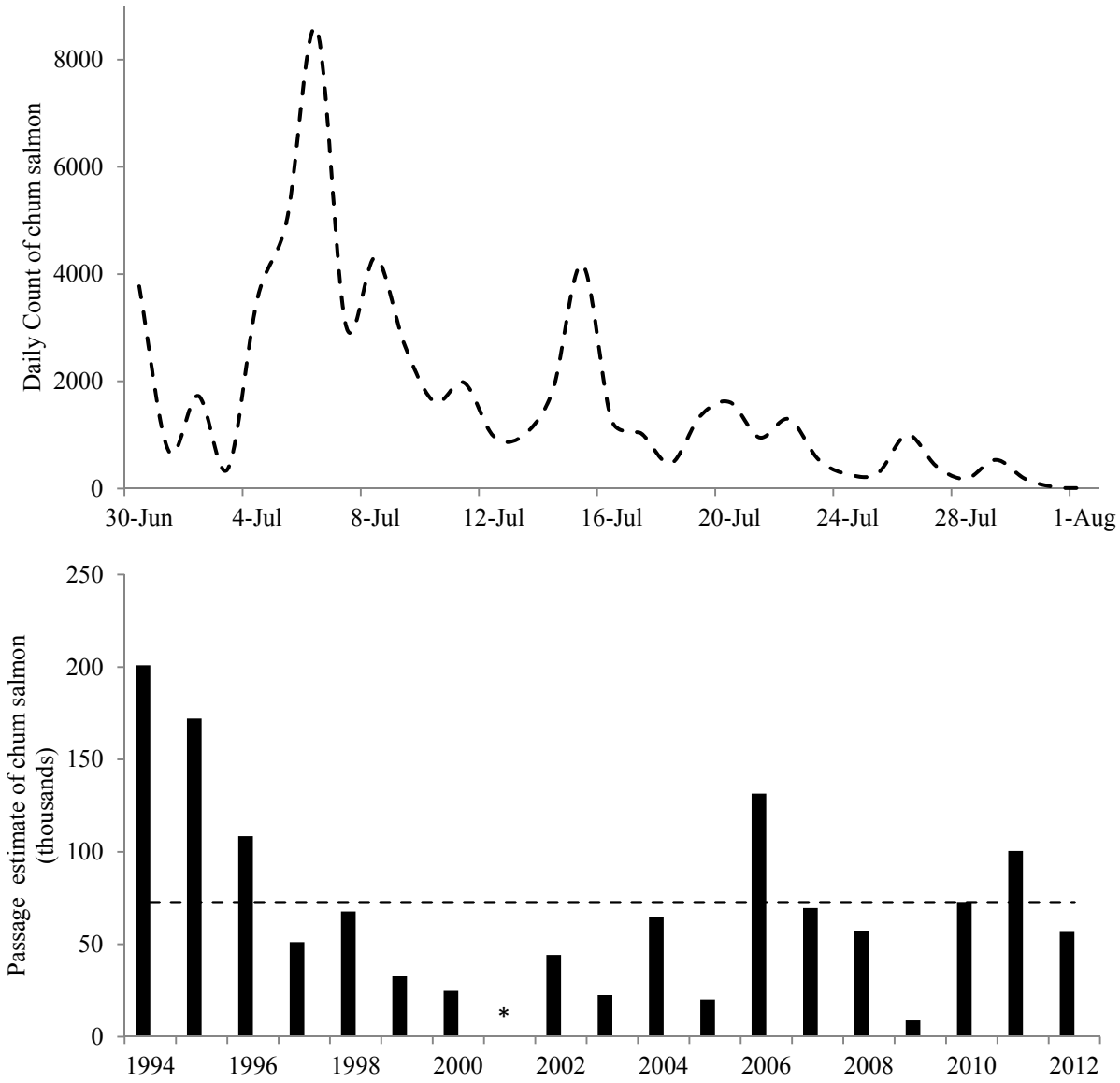


Figure 4. —Daily count (top) in 2012 and annual escapement estimates (bottom), 1994 to 2012, of summer chum salmon migrating through the East Fork Andreafsky River weir, Alaska. Historical average is represented by the dashed, horizontal line. Asterisk denotes missing annual count due to high water.

Appendix 1. — Historical Chinook, summer chum, and coho salmon escapement estimates for the Andreafsky River, Alaska, 1954-2012. Data provided by ADF&G from JTC (2012).

	East Fork Andreafsky River												Main-stem Andreafsky River					
	Aerial Index Estimates						Sonar, Tower, or Weir						Aerial Index Estimates					
Year	Chinook salmon		Chum salmon		Coho salmon		Chinook salmon		Chum salmon		Coho salmon		Chinook salmon		Chum salmon		Coho salmon	
1954		*a*		*a*									2,000	*a*	7,000	*a*		
1955																		
1956	336	*b*	15,356	*b*														
1957																		
1958	50	*b*	3,500	*b*									150	*b*	30,000	*b*		
1959	150	*b*	4,000	*b*									300	*b*	7,000	*b*		
1960	1,020		10,530										1,220		6,016			
1961	1,003		8,110															
1962	675	*b*	18,040										762	*b*	19,530			
1963																		
1964	867		8,863										705		12,810			
1965													355	*b*	14,670	*b*		
1966	361		25,619	*b*									303		18,145			
1967													276	*b*	14,495	*b*		
1968	380		17,600										383	*b*	74,600	*b*		
1969	231	*b*	119,000										374	*b*	159,500	*b*		
1970	665		84,090										574	*b*	91,710	*b*		
1971	1,904		98,095										1,682		71,745			
1972	798	*b*	41,460	*b*									582	*b*	25,573			
1973	825		10,149	*b*									788		51,835			
1974			3,215	*b*									285		33,578			
1975	993		223,485										301		235,954			
1976	818		105,347										643		118,420			
1977	2,008		112,722										1,499		63,120			
1978	2,487		127,050										1,062		57,321			
1979	1,180		66,471										1,134		43,391			
1980	958	*b*	36,823	*b*									1,500		115,457			
1981	2,146	*b*	81,555		1,657	*b*	5,343	*c*	147,312	*c*			231	*b*				
1982	1,274		7,501	*b*					180,078	*c*			851		7,267	*b*		
1983							2,720	*c*	110,608	*c*								
1984	1,573	*b*	95,200	*b*					70,125	*c*			1,993		238,565			
1985	1,617		66,146										2,248		52,750			
1986	1,954		83,931				1,530	*d*	167,614	*d*			3,158		99,373			
1987	1,608		6,687	*b*			2,011	*d*	45,221	*d*			3,281		35,535			
1988	1,020		43,056		1,913		1,339	*d*	68,937	*d*			1,448		45,432		830	
1989	1,399		21,460	*b*									1,089					
1990	2,503		11,519	*b*									1,545		20,426	*b*		
1991	1,938		31,886										2,544		46,657			
1992	1,030	*b*	11,308	*b*									2,002	*b*	37,808	*b*		
1993	5,855		10,935	*b*									2,765		9,111	*b*		
1994	300	*b*					7,801		200,981				213	*b*				
1995	1,635						5,841		172,148		10,901		1,108					
1996							2,955		108,450		8,037		624					
1997	1,140						3,186		51,139		9,472		1,510					

Appendix 1. — Continued.

	East Fork Andreafsky River						Main-stem Andreafsky River		
	Aerial Index Estimates			Sonar, Tower, or Weir			Aerial Index Estimates		
Year	Chinook salmon	Chum salmon	Coho salmon	Chinook salmon	Chum salmon	Coho salmon	Chinook salmon	Chum salmon	Coho salmon
1998	1,027			4,034	67,720	5,417	*e* 1,249	*b*	
1999		*b*		3,444	32,587	2,963	870	*b*	
2000	1,018			1,609	24,785	8,451	427		
2001	1,065			1,148	*f* 2,134	*f* 15,896	*e* 570		
2002	1,447			4,123	44,194	3,577	977		
2003	1,116	*b*		4,336	22,461	8,231	1,578	*b*	
2004	2,879			8,045	64,883	11,146	1,317		
2005	1,715			2,239	20,127	5,303	1,492		
2006	590	*b*		6,463	102,260	23	*g* 824		
2007	1,758			4,504	69,642	9	*g* 976		
2008	278	*b*		4,242	57,259	2	*g* 262	*b*	
2009	80	*b*		3,004	8,770	4	*g* 1,664		
2010	537	*b*		2,413	72,893	10	*g* 849		
2011	620			5,213	100,473	0	*g* 1,141		
2012	NA			2,516	56,680	5	*g* 227	*b*	
SEG *h*	960 - 1,900			2,100 - 4,900			640 - 1,600		
BEG *i*					65,000 - 130,000				

a Counts for both forks were combined into Andreafsky River count.

b Incomplete survey and/or poor survey timing or conditions resulting in minimal or inaccurate count.

c Sonar count.

d Tower count.

e Incomplete count, missing data not estimated.

f Weir installed too late for an accurate count.

g Incomplete count, weir removed.

h Sustainable Escapement Goals.

i Biological Escapement Goals.

Appendix 2. — Historical daily Chinook salmon escapements recorded at the East Fork Andreafsky River weir, 1994-2012. Data for 2001 were not used in calculations and are shown for informational purposes only. Boxes represent quartiles, highlighted box indicates midpoint in the run.

Date	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
15-Jun				0							
16-Jun		0		0							
17-Jun		0		0		0					
18-Jun		0		0		0					
19-Jun		0	0	0		0			0	0	
20-Jun		1	0	0		0			0	0	
21-Jun		0	10	0		0			1	0	
22-Jun		1	0	0		0			20	0	
23-Jun		0	33	14	0	0			0	4	67
24-Jun		2	6	21	0	0			0	2	26
25-Jun		0	0	59	0	0			3	7	15
26-Jun		0	59	0	0	0			1	3	55
27-Jun		41	42	101	1	0			26	12	181
28-Jun		48	19	11	0	0			314	19	534
29-Jun	1	67	6	1	10	0			119	4	290
30-Jun	188	104	8	0	34	47	9		27	0	461
1-Jul	141	81	72	75	93	19	16		319	176	582
2-Jul	54	71	21	24	17	9	39		105	295	25
3-Jul	222	17	205	29	36	0	89		230	22	375
4-Jul	156	55	124	49	75	12	74		5	6	353
5-Jul	651	107	309	98	336	97	38		20	83	263
6-Jul	225	678	258	356	373	42	407		356	136	1,187
7-Jul	1,156	433	280	227	386	114	18		307	336	878
8-Jul	108	155	244	123	204	197	71		130	469	463
9-Jul	351	260	186	49	129	216	17		178	823	503
10-Jul	375	250	111	64	167	256	30		191	48	368
11-Jul	288	382	72	69	255	507	57		264	107	122
12-Jul	581	1,022	52	88	138	214	35		166	345	315
13-Jul	779	697	100	15	62	331	55		191	311	106
14-Jul	433	375	96	16	61	97	18		158	340	105
15-Jul	352	292	62	124	91	22	90	169	140	2	53
16-Jul	389	97	95	274	197	33	76	87	210	7	58
17-Jul	144	46	110	91	263	75	62	41	119	25	54
18-Jul	285	38	55	25	184	63	48	196	94	235	29
19-Jul	161	25	42	70	240	65	34	71	75	158	40
20-Jul	53	37	69	264	67	302	22	107	50	28	57
21-Jul	66	74	51	148	129	55	12	175	29	10	40
22-Jul	62	33	26	35	117	67	21	66	12	2	13
23-Jul	209	24	2	103	57	15	6	15	32	23	17
24-Jul	149	7	4	57	66	54	11	5	16	58	12
25-Jul	25	78	6	0	12	24	10	17	7	31	19
26-Jul	51	21	3	11	8	5	9	7	3	4	5
27-Jul	92	12	6	3	8	34	7	17	6	22	14
28-Jul	20	15	16	29	11	6	3	10	3	108	23
29-Jul	10	9	13	58	23	159	57	41	4	28	19
30-Jul	13	5	7	144	31	80	4	16	2	4	7
31-Jul	10	1	10	2	17	59	20	11	46	0	15
1-Aug	1	8	4	8	20	38	12	8	55	2	13
2-Aug		2	2	4	4	18	4	12	48	5	4
3-Aug		13	2	128	11	42	24	4	10	1	3
4-Aug		5	5	2	1	11	19	8	3	1	6
5-Aug		6	6	1	7	5	14	6	3	4	5
6-Aug		6	2	0	9	2	9	1	4	0	10
7-Aug		19	7	1	10	1	4	11	4	1	8
8-Aug - 23- Sept		121	37	115	74	51	58	47	17	29	247
Total	7,801	5,841	2,955	3,186	4,034	3,444	1,609	**	4,123	4,336	8,045

(continued)

Appendix 2. — Continued.

Date	2005	2006	2007	2008	2009	2010	2011	2012
15-Jun								
16-Jun								
17-Jun								
18-Jun								
19-Jun			0					
20-Jun			0			0	0	
21-Jun			0	0		0	0	
22-Jun			0	0	0	0	0	
23-Jun			0	0	0	0	0	
24-Jun			0	0	0	0	0	
25-Jun			7	1	0	0	1	
26-Jun	16		2	0	0	1	1	
27-Jun	2		0	5	0	3	1	
28-Jun	42	0	0	1	0	0	0	
29-Jun	88	6	4	10	0	13	9	
30-Jun	238	51	7	7	0	16	25	13
1-Jul	11	40	134	14	1	18	29	3
2-Jul	89	13	197	44	1	41	41	12
3-Jul	135	51	75	41	2	54	33	2
4-Jul	114	128	277	50	0	25	19	10
5-Jul	111	276	141	133	0	41	20	24
6-Jul	154	437	476	301	3	124	261	117
7-Jul	271	574	442	610	15	16	149	30
8-Jul	169	392	157	777	7	36	385	101
9-Jul	46	86	299	110	0	353	473	107
10-Jul	7	165	255	7	2	295	346	13
11-Jul	15	449	86	11	34	69	300	26
12-Jul	9	1,108	653	23	247	92	489	16
13-Jul	58	201	103	53	106	24	14	24
14-Jul	108	67	96	76	142	34	26	25
15-Jul	49	117	28	265	13	27	121	303
16-Jul	55	262	25	355	13	278	319	133
17-Jul	30	714	34	277	251	274	194	82
18-Jul	14	371	132	283	37	21	64	38
19-Jul	22	264	78	130	76	7	517	103
20-Jul	17	164	35	57	53	9	275	428
21-Jul	50	161	95	58	112	32	343	220
22-Jul	51	166	249	130	201	22	306	78
23-Jul	15	117	59	104	222	47	140	34
24-Jul	22	48	63	75	126	59	74	16
25-Jul	46	25	102	49	104	59	51	3
26-Jul	4	8	33	35	39	81	44	144
27-Jul	4	2	149	26	37	23	48	107
28-Jul	4		4	61	262	94	61	24
29-Jul	0		4	39	221	101	24	197
30-Jul	4		3	24	172	14	10	80
31-Jul	3				178	10		3
1-Aug	2				171			1
2-Aug	2				94			
3-Aug	8				62			
4-Aug	4							
5-Aug	8							
6-Aug	4							
7-Aug	3							
8-Aug - 23- Sept	135							
Total	2,239	6,463	4,504	4,242	3,004	2,413	5,213	2,517

Appendix 2. — Historical daily summer chum salmon estimates recorded at the East Fork Andreafsky River weir 1994-2012. Data for 2001 were not used in calculations and are shown for informational purposes only. Boxes represent quartiles, highlighted box indicates midpoint in the run.

Date	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
15-Jun				0							
16-Jun		52		1							
17-Jun		332		4		0					
18-Jun		191		71		0					
19-Jun		423	62	539		0			0	0	
20-Jun		2,198	424	981		0			0	0	
21-Jun		861	3,315	192		0			117	2	
22-Jun		1,170	1,036	53		0			1,782	87	
23-Jun		228	11,195	3,141	13	1			0	564	3,045
24-Jun		1,951	798	1,620	18	1			6	182	1,062
25-Jun		364	303	1,422	264	0			522	484	985
26-Jun		504	7,306	208	175	7			694	183	2,467
27-Jun		12,620	3,435	1,691	535	8			2,448	396	4,638
28-Jun		11,201	1,463	1,196	65	0			6,754	546	8,461
29-Jun	609	9,256	2,335	61	3,153	331			1,765	219	3,807
30-Jun	19,254	10,938	314	80	4,585	4,459	837		836	271	7,081
1-Jul	12,435	8,654	9,164	1,537	4,003	765	1,725		4,403	928	1,590
2-Jul	2,840	5,553	3,326	619	652	459	1,460		2,467	339	153
3-Jul	4,973	2,710	8,973	756	1,687	24	1,750		2,291	713	5,689
4-Jul	13,321	10,678	10,018	1,264	3,561	3,000	2,070		28	175	3,940
5-Jul	12,552	10,026	7,355	831	7,996	4,605	2,300		347	484	2,011
6-Jul	4,043	23,584	3,351	3,428	6,030	1,185	3,717		4,423	1,051	1,791
7-Jul	27,527	8,514	3,124	2,980	4,696	1,619	72		2,254	1,376	2,474
8-Jul	5,251	732	4,771	2,440	3,088	1,569	1,548		845	2,476	2,096
9-Jul	3,883	4,808	3,500	1,799	845	1,754	942		2,265	2,025	1,990
10-Jul	12,416	6,473	2,303	3,195	1,003	2,135	727		1,732	244	2,069
11-Jul	6,896	6,072	1,275	1,792	4,003	1,897	855		1,221	412	1,609
12-Jul	8,424	3,973	1,497	1,738	4,401	501	477		1,099	1,762	1,815
13-Jul	14,628	4,552	1,680	1,062	829	710	911		1,055	586	1,071
14-Jul	11,611	2,990	1,038	1,302	1,248	1,223	352		544	254	896
15-Jul	8,275	2,874	935	3,222	2,160	412	638	196	1,014	33	605
16-Jul	4,690	3,449	1,280	2,441	2,747	507	551	133	581	123	569
17-Jul	4,886	2,739	774	1,150	3,038	547	464	95	420	445	465
18-Jul	4,532	1,495	852	715	1,580	494	377	229	492	1,078	326
19-Jul	2,977	651	1,848	624	1,365	666	290	102	392	708	217
20-Jul	1,091	1,150	1,721	1,220	370	816	206	74	192	681	276
21-Jul	1,351	807	1,116	800	335	242	424	228	153	283	142
22-Jul	2,228	591	605	668	304	240	280	72	61	47	59
23-Jul	1,320	742	246	405	248	201	116	29	201	306	77
24-Jul	868	290	291	313	200	173	84	32	98	222	116
25-Jul	1,349	1,214	196	121	220	131	159	155	26	348	171
26-Jul	1,977	521	365	339	166	73	130	116	22	218	85
27-Jul	2,196	605	278	400	130	132	64	110	60	220	69
28-Jul	841	265	738	219	202	92	43	88	123	389	73
29-Jul	564	211	334	234	145	245	173	78	17	220	52
30-Jul	524	248	272	131	115	242	70	37	36	61	37
31-Jul	410	94	260	86	140	200	172	10	119	80	34
1-Aug	239	160	93	134	191	158	89	24	81	104	17
2-Aug		81	158	81	91	118	125	40	33	111	21
3-Aug		147	91	182	76	124	109	28	36	40	28
4-Aug		59	192	48	56	117	83	17	40	91	22
5-Aug		77	132	101	73	45	57	13	3	182	25
6-Aug		115	215	77	71	17	31	2	7	52	31
7-Aug		76	163	29	104	11	5	7	13	85	33
8-Aug - 23-Sept		1,879	1,934	1,396	743	331	302	219	76	575	593
Total	200,981	172,148	108,450	51,139	67,720	32,587	24,785	**	44,194	22,461	64,883

(continued)

Appendix 3. — Continued.

Date	2005	2006	2007	2008	2009	2010	2011	2012
15-Jun								
16-Jun								
17-Jun								
18-Jun								
19-Jun			0					
20-Jun			0			0	146	
21-Jun			0	1		0	19	
22-Jun			2	57	0	0	2	
23-Jun			0	30	0	2	21	
24-Jun			29	73	6	0	1,294	
25-Jun			1166	34	10	6	2,935	
26-Jun	256		348	1160	0	410	381	
27-Jun	9		70	902	5	285	1,088	
28-Jun	424	1,272	362	865	19	53	684	
29-Jun	473	2,822	1644	1920	289	5435	2,522	
30-Jun	432	14,912	1785	1095	78	3088	4,900	3,773
1-Jul	239	10,229	3581	1718	228	1534	5,090	698
2-Jul	1,081	2,395	3463	2963	417	3196	7,241	1,728
3-Jul	1,063	1,272	2694	2367	114	5269	6,694	366
4-Jul	1,238	2,822	4834	4572	10	3338	1,486	3,536
5-Jul	993	14,912	4725	8125	17	2689	2,975	5,011
6-Jul	1,218	10,229	3852	5285	1137	7086	6,172	8,580
7-Jul	1,839	2,395	1980	2598	583	1136	2,753	3,040
8-Jul	1,270	7,291	1919	2763	42	5336	5,628	4,313
9-Jul	1,112	14,018	4559	1438	11	7921	8,644	2,657
10-Jul	1,370	9,389	6021	193	176	3878	4,639	1,615
11-Jul	195	7,738	1455	300	549	1808	6,598	1,975
12-Jul	197	4,225	2362	1276	634	1470	5,788	976
13-Jul	1,458	3,614	1219	1955	269	702	683	989
14-Jul	1,242	2,351	1394	2019	547	1391	1,725	1,829
15-Jul	557	3,478	860	2322	411	1405	4,069	4,181
16-Jul	449	2,631	1867	3646	498	4138	2,990	1,265
17-Jul	196	1,609	3294	1497	483	2378	3,911	1,027
18-Jul	246	725	3834	1324	224	281	1,006	470
19-Jul	141	330	1349	896	176	400	1,554	1,356
20-Jul	523	1,127	468	691	186	525	1,319	1,610
21-Jul	493	1,441	700	594	235	1189	1,498	952
22-Jul	182	2,564	1895	572	332	930	930	1,295
23-Jul	167	1,637	1417	535	175	785	581	539
24-Jul	54	1,294	1208	383	164	896	425	266
25-Jul	80	924	1784	335	113	1030	468	286
26-Jul	28	944	645	142	165	686	478	1,001
27-Jul	32	921	444	191	72	585	466	412
28-Jul	100		95	149	148	956	384	184
29-Jul	112		179	168	47	284	181	536
30-Jul	74		139	105	33	200	105	179
31-Jul	79				33	192		28
1-Aug	50				25			7
2-Aug	25				64			
3-Aug	23				45			
4-Aug	5							
5-Aug	24							
6-Aug	30							
7-Aug	14							
8-Aug - 23-Sept	334							
Total	20,127	131,511	69,642	57,259	8,770	72,893	100,473	56,680

Appendix 3. — Historical daily coho salmon estimates recorded at the East Fork Andreafsky River weir, 1995-2011. Data for 1998 and 2001 were not used in calculations and are shown for informational purposes only.

Date	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
15-Jun -										
4-Aug	1	85	0	16	9	52	0	1	12	11
5-Aug	0	20	0	8	4	14	0	0	2	8
6-Aug	0	10	0	5	4	13	0	0	4	10
7-Aug	1	26	1	16	0	12	0	0	28	14
8-Aug	1	20	0	9	0	35	0	0	25	16
9-Aug	3	26	0	5	1	79	0	0	27	98
10-Aug	8	138	0	8	2	125	0	1	5	62
11-Aug	12	105	0	3	2	89	0	0	9	115
12-Aug	5	50	10	4	5	51	0	0	19	86
13-Aug	3	16	47	111	1	211	0	0	40	78
14-Aug	3	11	35	71	1	137	1	0	194	71
15-Aug	9	19	6	9	0	64	22	0	146	63
16-Aug	5	276	8	61	5	34	33	0	98	56
17-Aug	11	92	7		2	23	5	0	50	48
18-Aug	24	179	12		0	137	5	0	2	163
19-Aug	41	1,052	13	8	0	108	51	1	7	384
20-Aug	24	100	50		1	333	532	0	21	170
21-Aug	95	149	414		42	303	270	0	11	185
22-Aug	246	9	222		48	59	312	3	3	150
23-Aug	305	32	22		0	10	343	6	24	80
24-Aug	414	12	16		26	44	583	3	263	185
25-Aug	245	1,539	577		8	533	217	7	1,744	243
26-Aug	692	449	150		4	1,401	857	0	634	453
27-Aug	1,436	5	10		4	1,643	382	0	288	17
28-Aug	368	1	24		3	279	403	2	197	4
29-Aug	938	179	2,335	371	0	626	103	0	243	38
30-Aug	335	1,489	2,714	618	2	278	1,078	0	552	178
31-Aug	265	374	122	568	1	192	2,264	0	729	490
1-Sep	444	374	73	336	411	358	1,576	0	172	505
2-Sep	863	147	53	17	162	238		14	107	897
3-Sep	14	100	421	80	1,255	162		29	9	234
4-Sep	29	250	355	490	704	160		43	646	167
5-Sep	6	337	219	228	122	39		640	275	609
6-Sep	21	78	514	591	40	46		738	14	1,550
7-Sep	164	84	435	12	0	52		413	42	1,011
8-Sep	2,403	24	169	0	14	48		345	459	578
9-Sep	854	16	223	94	19	55		103	268	337
10-Sep	391	1	52	555	41	94	85	237	9	535
11-Sep	127	0	83	1,104	20	31	30	117	211	259
12-Sep	95	0	64	6		79	20	726	231	13
13-Sep		0	16	13		30	43	113	399	57
14-Sep		0				22	21	35	8	37
15-Sep		3				16	16		4	201
16-Sep		160				28				240
17-Sep						19				241
18-Sep						3				42
19-Sep						5				157
20-Sep						5				
21-Sep						34				
22-Sep						32				
23-Sep						10				
Total	10,901	8,037	9,472	5,417	2,963	8,451	9,252	3,577	8,231	11,146

****** = incomplete count, missing data not estimated.

***** = incomplete count, weir removed.

(continued)

Appendix 4. — Continued.

Date	2005	2006	2007	2008	2009	2010	2011	2012
15-Jun - 4-Aug	2	23	9	2	4	10	0	5
5-Aug	0							
6-Aug	0							
7-Aug	1							
8-Aug	4							
9-Aug	2							
10-Aug	2							
11-Aug	0							
12-Aug	0							
13-Aug	0							
14-Aug	4							
15-Aug	9							
16-Aug	37							
17-Aug	6							
18-Aug	173							
19-Aug	24							
20-Aug	4							
21-Aug	2							
22-Aug	2							
23-Aug	21							
24-Aug	101							
25-Aug	19							
26-Aug	102							
27-Aug	128							
28-Aug	1,084							
29-Aug	475							
30-Aug	647							
31-Aug	218							
1-Sep	23							
2-Sep	23							
3-Sep	476							
4-Sep	483							
5-Sep	77							
6-Sep	128							
7-Sep	207							
8-Sep	80							
9-Sep	194							
10-Sep	343							
11-Sep	202							
12-Sep								
13-Sep								
14-Sep								
15-Sep								
16-Sep								
17-Sep								
18-Sep								
19-Sep								
20-Sep								
21-Sep								
22-Sep								
23-Sep								
Total	5,303	23	9	2	4	10	0	5

** = incomplete count, missing data not estimated.
* = incomplete count, weir removed.

Appendix 5. — Historical daily pink salmon escapement estimates recorded at the East Fork Andreafsky River weir, 1994-2011. Data for 2001 were not used in calculations and are shown for informational purposes only.

Date	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
15-Jun				0							
16-Jun		0		0							
17-Jun		0		0		0					
18-Jun		0		0		0					
19-Jun		0	12	0		0			0	0	
20-Jun		0	4	0		0			0	0	
21-Jun		0	40	0		0			52	0	
22-Jun		0	42	0		0			462	0	
23-Jun		0	157	0	0	0			0	0	19
24-Jun		0	67	0	0	0			22	0	15
25-Jun		0	24	0	8	0			148	3	24
26-Jun		0	153	0	3	0			338	0	102
27-Jun		1	218	1	22	0			431	6	189
28-Jun		0	80	0	2	0			7,808	4	341
29-Jun	8	2	78	0	112	0			5,076	3	374
30-Jun	451	3	41	0	258	0	18		1,509	0	1,671
1-Jul	409	13	184	2	750	0	5		6,192	16	1,049
2-Jul	194	4	107	0	65	0	383		3,345	12	140
3-Jul	305	4	347	0	704	0	52		6,876	13	1,186
4-Jul	780	5	1,254	1	1,008	0	224		257	13	2,327
5-Jul	1,027	9	6,678	0	3,595	0	162		1,626	16	5,175
6-Jul	772	98	4,676	2	4,136	2	1,228		13,433	24	4,203
7-Jul	4,026	77	3,834	0	4,292	2	354		10,268	94	17,994
8-Jul	1,736	4	7,472	1	2,968	1	972		4,815	172	13,079
9-Jul	4,263	18	8,905	2	1,382	2	1,680		8,765	259	16,044
10-Jul	4,744	33	10,290	1	1,169	10	897		12,942	16	22,171
11-Jul	3,313	23	5,822	2	9,872	20	7,849		10,764	43	15,664
12-Jul	8,447	100	4,662	4	21,285	17	2,726		9,207	185	15,661
13-Jul	13,568	109	9,484	6	11,399	18	7,044		9,161	173	15,313
14-Jul	24,842	94	11,760	1	5,846	7	1,468		7,819	189	25,780
15-Jul	22,460	81	9,754	35	21,785	2	966	10	6,958	28	16,578
16-Jul	20,612	64	13,476	31	11,087	2	1,206	4	8,224	13	22,322
17-Jul	27,053	60	12,222	13	23,930	4	1,446	5	6,724	96	16,143
18-Jul	18,277	31	12,682	5	31,639	4	1,686	26	8,701	702	14,713
19-Jul	20,792	15	14,282	6	27,014	14	1,926	15	6,058	459	15,635
20-Jul	23,511	30	17,477	4	7,204	69	2,170	47	1,983	288	28,631
21-Jul	10,872	40	18,780	4	4,672	38	2,549	61	1,239	98	19,851
22-Jul	8,975	48	13,018	4	2,460	41	1,143	19	564	18	12,446
23-Jul	17,692	77	4,744	5	3,512	25	454	18	1,060	107	9,880
24-Jul	15,120	25	3,778	2	7,181	23	609	38	1,092	107	9,973
25-Jul	3,566	216	2,473	0	5,278	22	1,055	124	385	124	12,352
26-Jul	10,225	88	3,365	6	3,496	11	335	53	429	43	12,184
27-Jul	13,821	37	3,768	13	1,186	24	731	68	232	47	10,978
28-Jul	15,302	20	5,036	9	1,496	11	612	94	305	130	9,686
29-Jul	9,736	14	1,035	20	1,134	26	415	56	49	140	7,911
30-Jul	6,159	29	205	26	982	13	202	22	62	29	5,421
31-Jul	2,476	11	706	2	1,315	2	244	10	232	65	4,258
1-Aug	996	22	169	7	962	(10)	145	17	131	69	2,669
2-Aug		23	107	2	474	5	129	19	61	54	2,342
3-Aug		44	127	8	440	48	81	17	73	33	1,206
4-Aug		20	300	3	303	60	65	12	34	34	843
5-Aug		17	237	3	127	28	49	5	11	35	890
6-Aug		22	61	1	73	14	33	10	13	17	729
7-Aug		37	109	1	104	13	17	10	7	20	789
8-Aug - 23-Sept		304	535	196	478	175	161	60	48	306	2,719
Total	316,530	1,972	214,837	429	227,208	743	43,491	820	165,991	4,303	399,670

****** = incomplete count, missing data not estimated.

(continued)

Appendix 5. — Continued.

Date	2005	2006	2007	2008	2009	2010	2011	2012
15-Jun								
16-Jun								
17-Jun								
18-Jun								
19-Jun			0					
20-Jun			0			0	0	
21-Jun			0	0		0	0	
22-Jun			0	10	0	2	0	
23-Jun			0	13	0	0	0	
24-Jun			0	5	0	2	2	
25-Jun			0	83	0	8	11	
26-Jun	0		0	214	0	69	0	
27-Jun	2		0	343	0	105	0	
28-Jun	10	43	0	393	0	8	0	
29-Jun	27	54	3	964	0	1,756	0	0
30-Jun	97	314	2	580	0	2,641	0	568
1-Jul	15	281	5	883	0	1,284	0	198
2-Jul	89	134	38	2,197	2	8,021	0	271
3-Jul	453	326	36	1,969	2	7,348	0	51
4-Jul	652	1,431	143	4,814	0	3,307	0	534
5-Jul	985	281	184	19,968	1	1,633	0	1,756
6-Jul	2,334	134	251	19,672	6	4,088	0	3,492
7-Jul	3,071	326	164	24,204	26	246	0	2,018
8-Jul	2,443	1,431	125	16,687	38	3,532	1	3,435
9-Jul	1,692	1,325	278	4,900	9	25,726	0	2,385
10-Jul	1,266	3,092	461	331	9	28,744	0	1,091
11-Jul	1,453	8,096	112	247	57	12,550	1	1,258
12-Jul	385	13,219	315	645	73	10,095	0	2,303
13-Jul	2,865	7,941	74	1,351	84	6,127	0	3,183
14-Jul	5,106	11,605	129	1,559	94	5,145	0	2,109
15-Jul	2,489	13,327	103	3,432	94	6,053	7	4,607
16-Jul	1,992	14,844	367	6,532	74	37,603	10	979
17-Jul	678	7,204	518	6,793	90	42,852	11	2,062
18-Jul	945	1,117	843	7,304	125	12,174	8	1,219
19-Jul	450	2,858	524	7,461	99	10,984	76	4,173
20-Jul	1,140	2,816	642	5,356	94	13,445	48	8,378
21-Jul	1,852	8,969	342	6,588	239	12,256	103	7,618
22-Jul	814	17,205	1,040	2,759	133	15,201	132	8,040
23-Jul	723	18,690	393	2,995	183	11,412	77	2,915
24-Jul	256	18,357	306	5,388	191	6,490	79	2,700
25-Jul	158	13,319	1,231	2,986	83	10,558	67	2,389
26-Jul	425	16,186	475	2,450	104	9,282	93	1,747
27-Jul	307	11,435	403	4,106	107	9,708	183	1,056
28-Jul	889		143	7,982	156	7,151	165	978
29-Jul	744		206	8,201	45	2,908	86	648
30-Jul	687		236	7,543	32	4,733	59	305
31-Jul	341				38	3,811		161
1-Aug	430				28			55
2-Aug	140				50			
3-Aug	79				29			
4-Aug	55							
5-Aug	91							
6-Aug	114							
7-Aug	41							
8-Aug - 23-Sept	245							
Total	39,030	196,360	10,092	189,908	2,395	339,058	1,219	74,682

Appendix 6. — Historical daily sockeye salmon estimates recorded at the East Fork Andreafsky River weir, 1994-2011. Data for 2001 were not used in calculations and are shown for informational purposes only.

Date	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
15-Jun				0							
16-Jun		0		0							
17-Jun		0		0		0					
18-Jun		0		0		0				0	
19-Jun		0	0	0		0			0	0	
20-Jun		0	0	0		0			0	0	
21-Jun		0	0	0		0			0	0	
22-Jun		0	0	0		0			0	0	
23-Jun		0	0	0	0	0			0	0	0
24-Jun		0	0	0	0	0			0	0	0
25-Jun		0	0	0	0	0			0	0	0
26-Jun		0	0	0	0	0			0	0	0
27-Jun		0	0	0	0	0			0	0	1
28-Jun		0	0	0	0	0			0	0	2
29-Jun	0	0	0	1	3	1			0	1	5
30-Jun	0	0	0	0	0	0	0		0	0	2
1-Jul	0	2	0	1	0	0	0		0	0	0
2-Jul	0	0	6	0	0	0	0		0	0	3
3-Jul	0	1	9	0	0	0	0		0	0	5
4-Jul	0	0	16	0	0	1	0		0	1	3
5-Jul	0	1	6	0	0	8	0		0	4	9
6-Jul	0	4	1	0	0	1	0		1	4	7
7-Jul	2	0	7	1	0	2	0		0	4	22
8-Jul	1	0	0	0	3	6	0		0	2	18
9-Jul	0	0	10	0	0	2	0		0	2	14
10-Jul	0	1	6	1	0	0	0		0	13	15
11-Jul	1	1	6	0	4	7	1		0	14	18
12-Jul	0	0	8	0	8	0	0		1	4	16
13-Jul	0	0	7	0	3	0	0		0	4	19
14-Jul	0	0	9	2	0	0	1		0	1	10
15-Jul	1	0	4	1	10	0	0	0	0	8	3
16-Jul	2	0	5	2	7	1	0	0	3	13	6
17-Jul	0	0	4	1	5	5	0	0	1	23	9
18-Jul	2	3	8	1	13	2	0	1	2	0	7
19-Jul	0	0	7	0	17	0	0	0	3	9	12
20-Jul	3	1	6	1	3	2	0	0	1	3	12
21-Jul	2	2	3	0	1	0	0	0	1	1	7
22-Jul	0	0	4	2	6	0	0	4	1	8	2
23-Jul	0	0	4	1	3	0	0	1	2	11	7
24-Jul	1	0	1	0	1	0	0	2	4	11	10
25-Jul	1	8	1	0	9	1	0	1	0	2	16
26-Jul	1	2	3	0	0	0	0	0	0	15	9
27-Jul	5	1	3	0	0	0	0	2	1	25	16
28-Jul	4	0	2	3	6	0	0	0	2	19	6
29-Jul	3	1	0	3	5	0	0	0	0	9	5
30-Jul	2	3	0	2	5	1	1	0	0	18	6
31-Jul	0	0	5	0	4	1	1	0	4	7	7
1-Aug	2	4	1	3	5	0	0	0	3	16	8
2-Aug		0	1	2	1	0	0	0	3	4	9
3-Aug		3	1	1	6	0	1	1	0	11	3
4-Aug		0	4	0	4	1	1	0	0	40	7
5-Aug		0	1	0	3	0	1	0	0	5	2
6-Aug		0	4	0	2	2	0	0	1	11	8
7-Aug		1	3	0	5	0	0	0	0	9	9
8-Aug - 23-Sept	0	74	82	71	46	69	72	3	9	162	153
Total	33	113	248	100	188	113	79	15	43	494	508

= incomplete count, missing data not estimated.

* *

* = incomplete count, weir removed

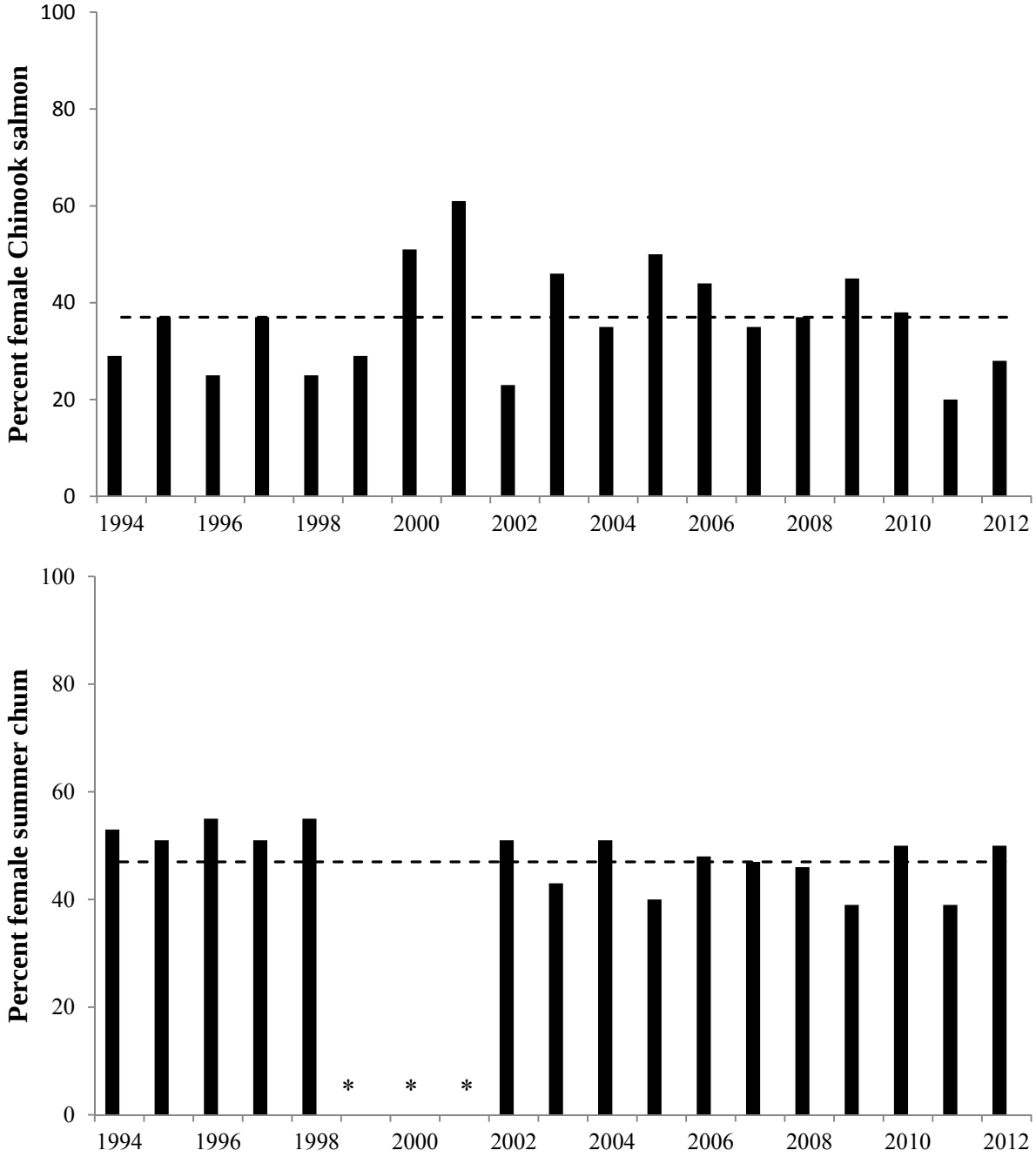
Appendix 6. — continued

Date	2005	2006	2007	2008	2009	2010	2011	2012
15-Jun								
16-Jun								
17-Jun								
18-Jun								
19-Jun			0					
20-Jun			0			0	1	
21-Jun			0	0		0	0	
22-Jun			0	0	0	0	0	
23-Jun			0	0	0	1	3	
24-Jun			0	0	0	0	5	
25-Jun			0	0	0	1	12	
26-Jun	0		0	0	0	2	10	
27-Jun	0		1	0	0	0	16	
28-Jun	0	0	0	0	0	0	18	
29-Jun	0	0	0	0	0	9	31	0
30-Jun	1	0	0	0	1	1	33	0
1-Jul	1	0	6	1	0	1	42	0
2-Jul	0	0	8	16	0	2	33	2
3-Jul	0	9	2	10	0	2	24	1
4-Jul	0	50	17	29	0	6	6	4
5-Jul	0	15	5	27	0	10	15	13
6-Jul	0	27	0	15	5	5	24	6
7-Jul	0	16	6	18	3	3	15	6
8-Jul	0	12	6	25	0	6	16	3
9-Jul	0	13	9	3	1	9	36	2
10-Jul	0	12	6	2	3	15	23	3
11-Jul	0	16	2	2	5	5	16	1
12-Jul	1	20	6	5	9	2	8	2
13-Jul	0	4	2	5	2	3	4	3
14-Jul	15	3	1	3	5	1	8	3
15-Jul	0	7	1	15	2	1	15	2
16-Jul	1	5	2	6	2	7	11	5
17-Jul	0	18	4	5	6	2	5	1
18-Jul	0	21	5	2	3	2	2	0
19-Jul	0	26	5	5	4	5	13	5
20-Jul	0	21	3	6	1	5	3	4
21-Jul	2	32	1	5	2	5	14	2
22-Jul	0	12	4	2	2	3	7	1
23-Jul	0	31	4	9	5	12	4	1
24-Jul	5	19	4	3	4	3	10	1
25-Jul	5	15	8	5	3	6	1	0
26-Jul	2	13	8	12	6	9	4	4
27-Jul	5	9	4	12	1	7	7	3
28-Jul	4		5	7	4	3	1	0
29-Jul	7		5	7	2	3	2	2
30-Jul	1		1	10	1	3	2	1
31-Jul	1				0	9		3
1-Aug	0				2			0
2-Aug	0				0			
3-Aug	0				0			
4-Aug	0							
5-Aug	2							
6-Aug	4							
7-Aug	0							
8-Aug - 23-Sept	94							
Total	151	426	141	272	84	169	500	84

Appendix 7. — Percent female by year for Chinook and chum salmon. Asterisks denote unavailable data.

Year	Chinook	Summer chum
1994	29%	53%
1995	37%	51%
1996	25%	55%
1997	37%	51%
1998	25%	55%
1999	29%	*
2000	51%	*
2001	61%	*
2002	23%	51%
2003	46%	43%
2004	35%	51%
2005	50%	40%
2006	44%	48%
2007	35%	47%
2008	37%	46%
2009	45%	39%
2010	38%	50%
2011	20%	39%
2012	30%	47%
Average	36.7%	48.1%

Appendix 8. — Annual estimates of percent female for Chinook salmon and summer chum salmon 1994-2012 at the East Fork Andreafsky River weir, Alaska. Dashed line denotes average percent female from 1994-2012.



*data unavailable

Appendix 9. —Field season water quality data at the East Fork. Andreafsky River weir, Alaska, 2012. Reported values are the arithmetic means for morning and evening readings.

Date	Water Temp (^{0}C)	Height (cm)	Dissolved Oxygen (mg/L)	Conductivity (µs/cm)	pH
20-Jun	13.8	NA	12.05	67.7	7.81
22-Jun	14.2	NA	12.3	66.8	7.76
23-Jun	13.1	NA	10.6	65.6	7.5
24-Jun	12.2	NA	11.2	63.4	7.8
25-Jun	10.7	NA	12.1	56.2	7. 6
26-Jun	11.5	NA	12.1	57.0	7.9
27-Jun	12	NA	11.8	60.2	7.62
28-Jun	12.1	NA	12.8	62	7.8
30-Jun	14.4	NA	11.4	68.4	7.8
1-Jul	14.7	NA	10.8	70.2	7.7
2-Jul	13.6	NA	10.4	69.2	7.69
3-Jul	12.1	NA	11.6	66.3	7.71
4-Jul	12.3	111.9	12.2	66.2	7.7
5-Jul	13.9	108.9	11.3	71.5	7.8
6-Jul	14.9	106.7	10.5	73.0	7.6
7-Jul	15.6	104.9	10.2	73.3	7.6
8-Jul	16.6	103.6	11.0	76.2	43.5
9-Jul	15.0	103.0	10.3	75.0	7.6
10-Jul	14.1	102.4	11.0	72.9	7.6
11-Jul	13.9	100.6	11.5	72.9	7.8
12-Jul	12.8	101.2	10.0	71.3	7.6
13-Jul	13.5	100.9	10.3	73.0	7.6
14-Jul	13.2	50.7	10.2	72.3	7.6
15-Jul	13.2	108.6	10.3	68.2	7.6
16-Jul	12.8	56.4	10.0	68.0	7.5
17-Jul	12.7	112.8	10.0	69.8	7.5
18-Jul	11.9	109.7	10.4	70.5	7.5
19-Jul	11.4	53.3	10.0	70.1	7.4
20-Jul	12.4	107.6	7.6	72.9	7.3
21-Jul	13.5	106.7	7.3	75.6	7.6
22-Jul	14.2	104.9	8.0	78.3	7.5
23-Jul	13.8	89.3	8.3	74.5	7.7
24-Jul	12.0	103.9	8.7	75.5	7.7
25-Jul	11.2	110.9	8.0	74.3	7.6
26-Jul	11.5	113.5	7. 5	71.3	7.6
27-Jul	11.3	112.8	7.5	69.6	7.6
28-Jul	10.4	113.8	7.5	66.8	7.5
29-Jul	10.4	132.6	7.3	62.8	7.4
30-Jul	10.4	148.6	6.7	56.9	7.4
31-Jul	9.7	144.8	6.0	57.6	7.41
1-Aug	9.1	147.8	5.4	57.4	7.43
Average	12.7	0.0	9.22	71.6	7.57

Appendix 10.— East Fork Andreafsky River whitefish gonadosomatic index data, 2012. Length is from mid-eye to fork in the tail (MEFK).

Date	Species	Sex	Length (mm) MEFK	Whole (wt.) grams	Egg (wt.) grams	Egg/whole·100= GSI
1-Jul	Broad Whitefish	Male	556			
1-Jul	Humpback Whitefish	Male	481			
1-Jul	Humpback Whitefish	Male	462			
3-Jul	Humpback Whitefish	Male	498	1858.2		
3-Jul	Humpback Whitefish	Male	475	1427.2		
5-Jul	Humpback Whitefish	Male	486	1466		
5-Jul	Humpback Whitefish	Male	512	1612.7		
7-Jul	Humpback Whitefish	Female	464	1604.3	80.7	5.03
7-Jul	Humpback Whitefish	Female	493	1947.6	96.3	4.94
7-Jul	Humpback Whitefish	Female	487	1885.1	124.1	6.58
8-Jul	Humpback Whitefish	Female	502	1694.7	79.2	4.67
11-Jul	Humpback Whitefish	Male	513	1540.1		
11-Jul	Humpback Whitefish	Female	479	1785.2	72.1	4.04
11-Jul	Humpback Whitefish	Female	497	1853.5	78.1	4.21
13-Jul	Humpback Whitefish	Female	442	1425.7	72.3	5.07
13-Jul	Humpback Whitefish	Female	499	2119.9	114.9	5.42
5-Jul	Humpback Whitefish	Male	468	1504.1		
15-Jul	Humpback Whitefish	Male	486	1760.6		
15-Jul	Humpback Whitefish	Male	452	1703.2		
15-Jul	Humpback Whitefish	Female	435	1261.3	46.5	3.69
16-Jul	Humpback Whitefish	Female	500	1834.6	138.5	7.55
16-Jul	Humpback Whitefish	Female	477	1753.8	95.1	5.42
16-Jul	Humpback Whitefish	Male	469	1479.8		
16-Jul	Humpback Whitefish	Female	488	1906.4	85.4	4.48
16-Jul	Humpback Whitefish	Female	499	2054	118.5	5.77
21-Jul	Humpback Whitefish	Male	458	1261.7		
21-Jul	Humpback Whitefish	Female	452	1286.4	86.7	6.74
21-Jul	Humpback Whitefish	Male	481	1525.4		
21-Jul	Humpback Whitefish	Female	501	1948	96.2	4.94
23-Jul	Humpback Whitefish	Female	452	1574	96.7	6.14
23-Jul	Humpback Whitefish	Female	454	1288.1	81.1	6.30
23-Jul	Humpback Whitefish	Male	424	894.4		
23-Jul	Broad Whitefish	Female	525	1780.9	19.7	1.11
27-Jul	Humpback Whitefish	Male	504	1618.5		
27-Jul	Humpback Whitefish	Female	459	1586.5	103	6.49
27-Jul	Humpback Whitefish	Female	480	1869.4	157.6	8.43
27-Jul	Broad Whitefish	Male	466	1413.6		
27-Jul	Humpback Whitefish	Female	496	1842.1	144.3	7.83
27-Jul	Broad Whitefish	Female	482	1410.5	10.5	0.74
27-Jul	Humpback Whitefish	Female	437	1485.1	91.6	6.17
27-Jul	Humpback Whitefish	Female	427	1037	33.3	3.21
27-Jul	Humpback Whitefish	Female	472	1665.6	94.9	5.70