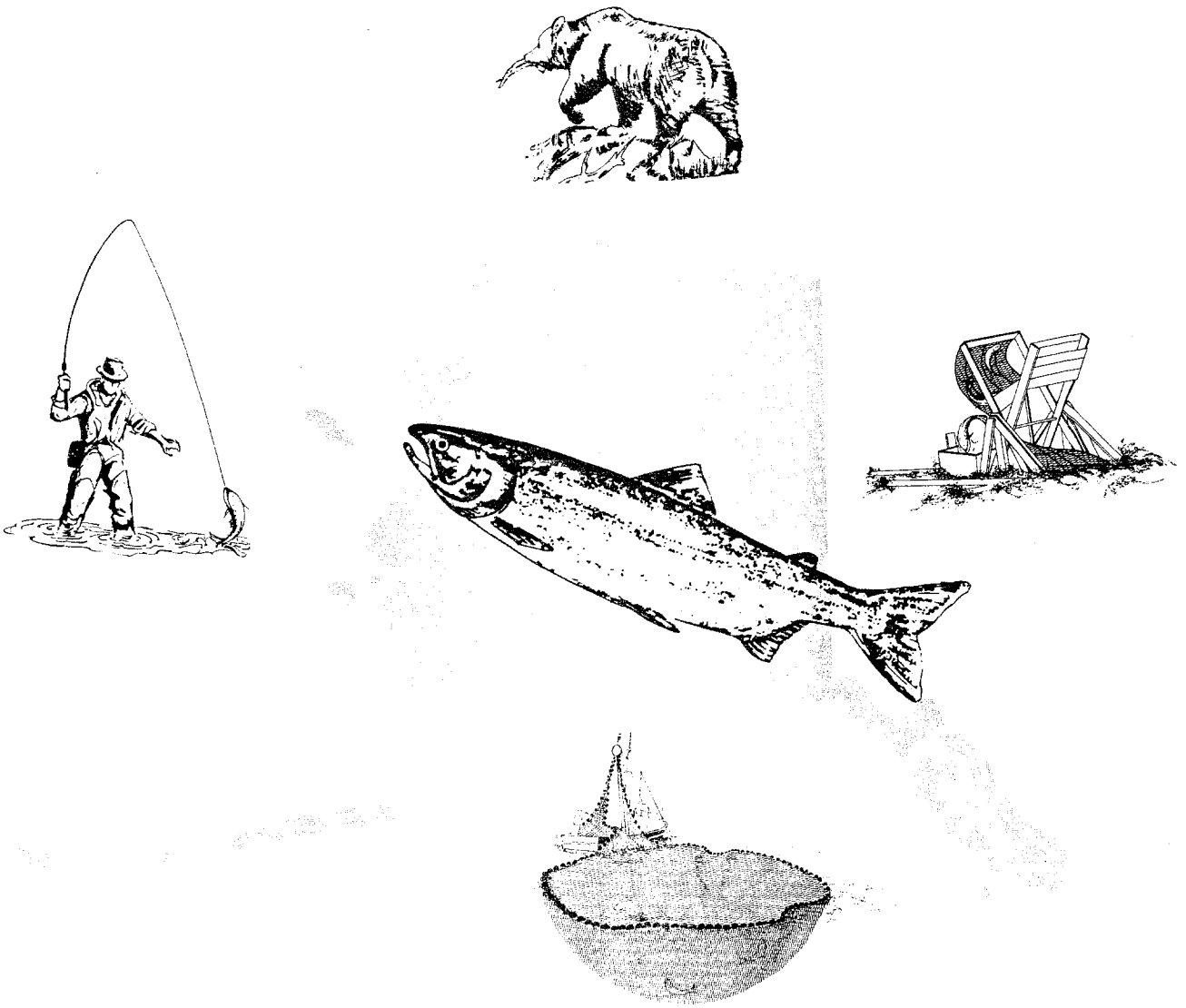
ABUNDANCE AND RUN TIMING OF ADULT SALMON IN THE EAST FORK ANDREAFSKY RIVER, YUKON DELTA NATIONAL WILDLIFE REFUGE, ALASKA, 1995

Alaska Fisheries Progress Report Number 96-1



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Abundance and Run Timing of Adult Salmon in the East Fork Andreafsky River, Yukon Delta National Wildlife Refuge, Alaska, 1995

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Abstract.— From June 16 to September 12, 1995, 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. This was the second of a five-year study initiated to provide reliable data necessary for managing refuge fishery resources that contribute to major commercial and subsistence fisheries. A total of 172,148 chum *Oncorhynchus keta*, 5,841 chinook *O. tshawytscha*, 1,972 pink *O. gorbuscha*, 113 sockeye *O. nerka*, and 10,901 coho *O. kisutch* salmon were counted through the weir. Picket spacing (4.8 cm gap) was wide enough for pink salmon to escape upstream undetected. Peak weekly passage occurred: July 2-8 for chum; July 9-15 for chinook; July 23-29 for pink; August 20-26 for sockeye; and August 27-September 2 for coho salmon.

Males composed an estimated 57% of the total sampled chum salmon escapement; sex composition shifted to predominately females as the run progressed. The sampled chum salmon escapement was composed primarily of age 0.4 (62%) and age 0.3 (35%) fish. Age composition shifted from predominately age 0.4 fish to predominately age 0.3 fish during mid-July.

Males composed an estimated 58% of the total sampled chinook salmon escapement and predominated until the end of July. The sampled chinook salmon escapement was composed primarily of age 1.4 (44%), 1.2 (37%), and age 1.3 (17%) fish. Females were primarily age 1.4 and males were primarily age 1.2.

Males composed an estimated 56% of the total sampled coho salmon escapement and predominated during every sample week. The sampled coho salmon escapement was composed primarily of age 2.1 (63%) and age 1.1 (35%) fish. Age 2.1 coho salmon were most abundant during every sample week.

Nine Dolly Varden *Salvelinus malma*, 9,383 whitefish (*Prosopium cylindraceum* and *Coregonus* spp.), one Arctic grayling *Thymallus arcticus*, and 83 northern pike *Esox lucius* were counted through the weir. Only larger sized resident species are represented because of picket spacing.

Introduction

The Andreafsky River is one of several lower Yukon River tributaries on the Yukon Delta National Wildlife Refuge (Refuge). The main stem Andreafsky River and its primary tributary, the East Fork, provide important spawning and rearing habitat for chum

Oncorhynchus keta, chinook *O. tshawytscha*, pink *O. gorbuscha*, sockeye *O. nerka*, and coho *O. kisutch* salmon (USFWS 1991). It supports the largest return of pink salmon in the Yukon River drainage and typically ranks second to the Anvik River in early run chum (summer chum) salmon escapement and second to the Salcha River in chinook salmon escapement (Sandone 1989). Andreafsky River salmon also contribute to a large subsistence fishery and pass through two commercial fishery districts between the Yukon and Andreafsky River mouths (Bergstrom et al. 1995).

The Alaska National Interest Lands Conservation Act (ANILCA) mandates that salmon populations and their habitats be conserved within the Refuge, international treaty obligations be fulfilled, and subsistence opportunities for local residents be provided. Salmon escapement studies for lower Yukon River tributaries on the Refuge and the endeavor to fulfill obligations included in the U.S./Canada Interim Yukon River Agreement are ranked as priorities in the Refuge Fishery Management Plan (USFWS 1991). Compliance with ANILCA mandates, however, is not ensured when reliable data on Refuge originating stocks are not available.

Adequate escapements to individual tributaries and main stem spawning areas are required to maintain genetic diversity and sustainable harvests, but management is complicated by the mixed stock nature of the Yukon River fishery. Managers attempt to distribute catch over time to avoid over-harvesting individual stocks as each may have distinct migratory timing (Mundy 1982). Stocks or species returning in low numbers or early and late portions of runs may be over-harvested incidentally during intensive harvesting of abundant stocks. Data are lacking on many of these individual stocks in the Yukon River drainage and are needed for more precise management.

Summer chum, chinook, and coho salmon abundances in the Andreafsky and other tributary rivers have been estimated on a limited basis by the Alaska Department of Fish and Game (Department) using aerial index surveys (Bergstrom et al. 1995). These surveys are usually conducted after salmon are on the spawning grounds thus too late for making management decisions that affect escapement. Weather delays and poor visibility also reduce the accuracy of some aerial index surveys. Even if conducted during optimal conditions these surveys provide only a relative index of abundance and tend to underestimate escapement (Bergstrom et al. 1995). In addition, age, sex, and length data cannot be collected using aerial index surveys.

In an effort to collect more accurate, timely, and complete escapement information than can be obtained by aerial index surveys, sonar was used to monitor summer chum salmon returns in the East Fork from 1981 to 1984 (Sandone 1989). The East Fork was chosen over the main stem because of the following: (1) sonar could be installed in the lower river because of favorable water depth and stream bottom conditions; (2) aerial index surveys prior to 1986 (Appendix 1) indicated that summer chum salmon were more abundant in the East Fork during most years; and (3) the East Fork received less recreational use than the main stem. However, the accuracy of escapement estimates was affected by large pink salmon returns in

1982 and 1984, and high water prevented proper transducer deployment in 1985 (Sandone 1989). In response to the difficulty of using sonar in the East Fork, a counting tower was used from 1986 to 1988. Favorable water conditions permitted extrapolation of summer chum, chinook, and pink salmon escapements from visual tower counts. Summer chum and chinook salmon escapements were estimated solely by aerial index surveys from 1989 to 1993 (Bergstrom et al. 1995).

Based on limited aerial index surveys, summer chum salmon returns were below desired escapement objectives throughout the Yukon River drainage from 1989 to 1993 (Bergstrom et al. 1995). Chum salmon returns to the Yukon River in 1993 were very poor, prompting closures of both commercial and subsistence fisheries. However, since 1988, the minimum escapement goal for the single largest producer of summer chum salmon in the Yukon River drainage, the Anvik River, had been met every year except for 1990 (Bergstrom et al. 1996). Chum salmon escapement objectives throughout the Yukon River drainage were generally achieved in 1994 and 1995.

Summer chum salmon stocks returning to the East Fork were below the aerial index escapement objective of 109,000 fish from 1979 to 1993 (Appendix 1). An aerial index survey conducted on July 11, 1993 under excellent survey conditions estimated only 10,935 summer chum salmon in the East Fork (Bergstrom et al. 1995). Although the survey was conducted prior to the peak of spawning, the estimate was well below the escapement objective for the East Fork. Aerial index surveys estimating chum salmon abundance were not conducted during 1994 and 1995.

Chinook salmon escapement objectives were generally achieved for streams in the lower Yukon River drainage since 1992 (Bergstrom et al. 1996). Chinook salmon returning to the East Fork have typically exceeded the aerial index escapement objective of 1,500 fish (Appendix 1) since 1984. The aerial index escapement was 5,855 chinook salmon in 1993. This was substantially greater than historical aerial index and tower count estimates that ranged from 274 to 2,503 fish between 1961 and 1992. An aerial index survey of the East Fork was not completed in 1994.

Coho, pink, and sockeye salmon abundance data are extremely limited or unavailable, and escapement objectives have not been established for these species in the lower Yukon River drainage. The status of these stocks is generally undetermined. Although no commercial fisheries are currently directed at these species, there has been a trend of increasing coho salmon harvest since 1984 (Bergstrom et al. 1996), and an interest to develop a commercial coho salmon fishery.

In compliance with ANILCA mandates, the U.S. Fish and Wildlife Service (Service) initiated a five-year study of the East Fork in 1994 to: (1) enumerate adult salmon; (2) describe run timing of chum, chinook, and pink salmon returns; (3) estimate the age, sex, and length composition of adult chum and chinook salmon populations; and (4) identify and count other fish species passing through the weir. In 1995, weir operation was extended into September to collect abundance, run timing, and age, sex, and length composition data from returning coho salmon.

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 28.9 and -42.2°C at St. Marys, Alaska (Leslie 1989). Mean July high and February low temperatures between 1967 and 1983 were 17.6 and -18.2°C. Average yearly precipitation was approximately 48 cm of rain and 189 cm of snow. River ice breakup typically occurs in May or early June and the river usually begins to freeze in late October (USFWS 1991). Maximum discharge is most often reached following breakup, and sporadic high discharge periods are generated by heavy rains that are prevalent between late July and early September.

Draining a watershed of 5,450 km^2, the Andreafsky River is one of the three largest Yukon River tributaries within Refuge boundaries (USFWS 1991). The main stem and its largest tributary, the East Fork, parallel each other in a southwesterly direction for over 200 river-kilometers (rkm) before converging. The main stem continues for another seven rkm before discharging into the Yukon River approximately 160 rkm from the Bering Sea. Flowing through the Andreafsky Wilderness for most of their length, the East Fork and Andreafsky River main stem are designated as wild rivers in the National Wild and Scenic River System.

The East Fork originates in the Nulato Hills at approximately 700 m elevation and drains an area of about 1,950 km^2. The river cuts through alpine tundra at an average gradient of 7.6 m per km for 48 rkm. It then flows 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. Dropping at an average rate of 1.4 m per km, this 130-rkm long section is characterized by glides and riffles flowing over gravel and rubble substrate. The East Fork widens in the lowermost 38 rkm and meanders through a wet lowland valley interspersed with forest and tundra and bordered by hills that are typically less than 230 m elevation. A gradient of 0.14 m per km and smaller substrate particles allow an abundance of aquatic vegetation to grow in the lower stream channel. Water fluctuations in the Yukon River also have a substantial effect on the stage height in this section of the East Fork.

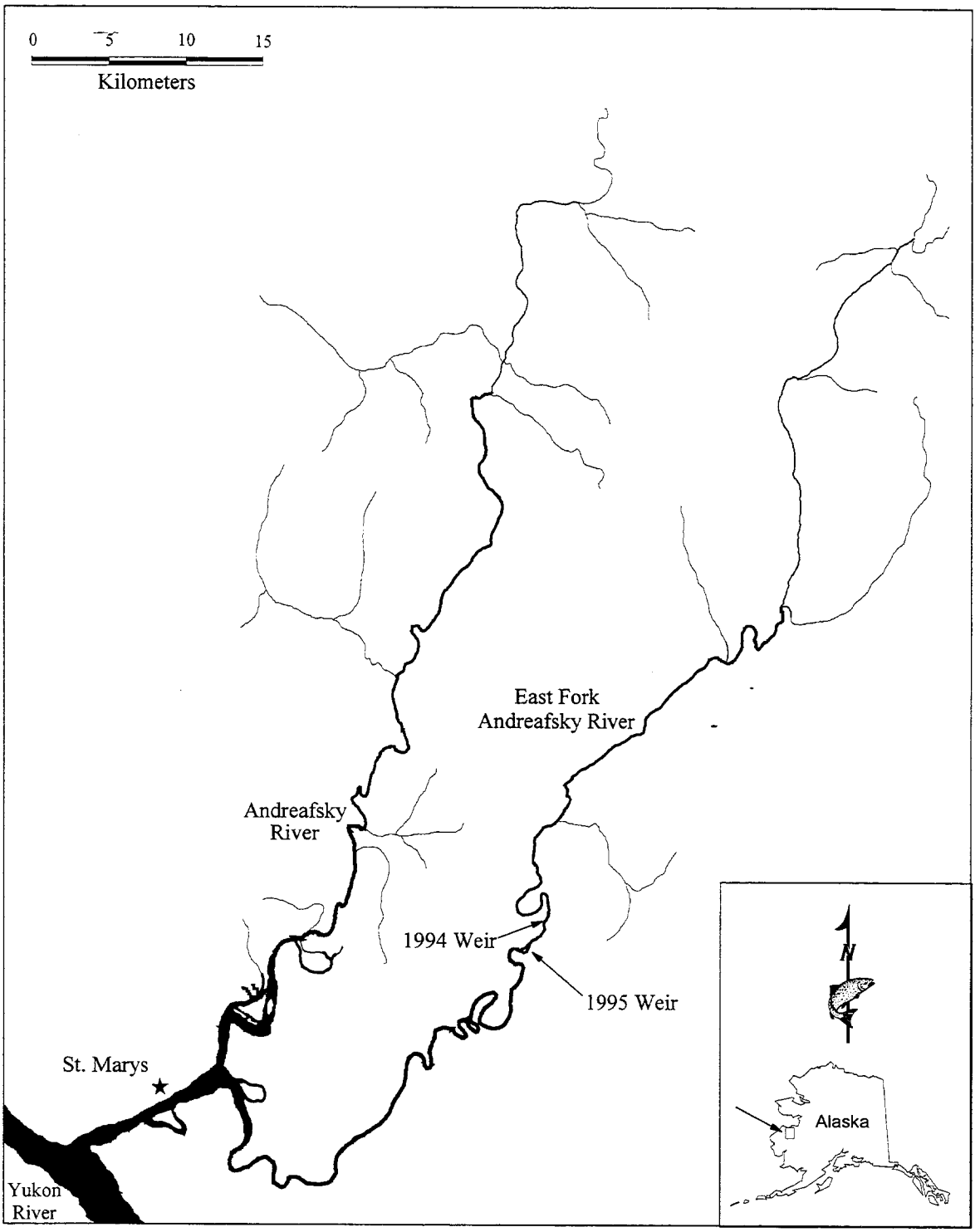

FIGURE 1.—Weir location in the East Fork Andreafsky River, Alaska, 1995.

Methods

Weir Operation

A resistance board weir (Tobin and Harper 1995; Tobin 1994) spanning 105 m was installed in the East Fork (62°07'N, 162°48'W) approximately 43 rkm upstream from the Yukon River and 26 air-km NE from St. Marys, Alaska (Figure 1). This new location is approximately 2.4 rkm downstream from the 1994 weir site described by Tobin and Harper (1995) and 2.1 rkm downstream from the sonar and counting tower site described by Sandone (1989). The weir was moved downstream to this wider section of river to enhance its performance during high water conditions which are common in late summer.

A staff gauge was installed upstream of the weir to measure daily water levels. Stream discharge was estimated using a Marsh-McBirney® (Model 201-D) flow meter, top setting wading rod, and methodology described by Hamilton and Bergersen (1984). Water temperatures were collected once daily between 0630 and 0930 hours.

The weir was operated from June 16 to September 12, 1995. All fish were enumerated to species as they passed through the live trap or gaps created by partially removed pickets on fish passage panels (Tobin and Harper 1995). Salmon and resident fish that did not pass through these areas, but escaped upstream through gaps (3.5 and 4.8 cm) between pickets were not counted. Fish were passed and counted intermittently between 0001 hours and midnight each day. The duration of each counting session varied depending on the intensity of fish passage through the weir and was recorded to the nearest 0.25 h at each counting station.

The weir was inspected for holes and cleaned daily. An observer outfitted with snorkeling gear checked weir integrity and substrate conditions. Cleaning consisted of raking debris from the upstream surface of the weir or walking across each panel until it was partially submerged allowing the current to wash accumulations downstream.

Biological Data

Sample weeks or strata began on a Sunday and ended the following Saturday. However, partial weeks of weir operation shortened the first and last strata. Sampling commenced near the start of each stratum, and an effort was made to obtain a weekly quota of 160 chum, 140 chinook, and 140 coho salmon in as short a period (1-3 d) as possible to approximate a pulse or snapshot sample (Geiger et al. 1990). All target species within the trap were sampled to prevent bias.

Fish sampling consisted of measuring length, determining sex, collecting scales, and then releasing the fish upstream of the weir. Length was measured from mid-eye to fork-of-caudal-fin and rounded to the nearest 5 mm. Sex was determined by observing

external characteristics. Scales were removed from the preferred area for age determination (Koo 1962; Mosher 1968). One scale was collected from each chum salmon and four scales were collected from each chinook and coho salmon. Scale impressions were made on cellulose acetate cards using a heated scale press and examined with a microfiche reader. Age was determined by a Department biologist and reported according to the European Method (Koo 1962).

Mean lengths of males and females by age were compared using a two-tailed t test at $\alpha=0.05$ (Zar 1984). Age and sex composition were estimated using a stratified sampling design (Cochran 1977). Chi-square contingency table analysis was used to test for differences in age composition between the sexes. Because the standard test only applies to data collected under simple random sampling, adjustments were made to the test statistic, following Rao and Thomas (1989), to account for the impact of our stratified sampling design on the results. The X^2 statistic, hereafter referred to as $X^2(\hat{\delta}.)$, was divided by the mean generalized design effect, $\hat{\delta}$, as a first-order correction to the standard test (Rao and Thomas 1989). Estimated design effects for the cells and marginals are presented in the results. Age composition and associated variances for each stratum were calculated as:

$$\hat{A}_h = N_h \, p_h \; ; \tag{1}$$

$$\hat{V}\,[\hat{A}_h] = N_h^2 \left(\frac{p_h(1-p_h)}{n_h - 1} \right) \; ; \tag{2}$$

where:

$\hat{A}_h$ = estimated escapement for a species of a given age and sex during stratum h;
N_h = escapement for a species during stratum h;
p_h = proportion of the sample in stratum h of a given age and sex; and,
n_h = total number of a species in the sample for stratum h.

Abundance estimates and their variances for each stratum were summed to obtain age and sex composition estimates for combined strata as follows:

$$\hat{A}_{st} = \sum \hat{A}_h \; ; \tag{3}$$

$$\hat{V}\,[\hat{A}_{st}] = \sum \hat{V}(\hat{A}_h) \; ; \tag{4}$$

where:

$\hat{A}_{st}$ = estimated escapement for a species of a given age and sex for combined strata.

Results

Weir Operation

The weir was functional throughout the operational period. A stream discharge of 26.6 m^3/s was measured 15 m upstream of the weir on August 17 (Appendix 2). On this date, the staff gauge indicated a stage height of 46 cm. The average and maximum water depths across the channel at this level were 45 and 70 cm. Water velocity averaged 0.45 m/s across the channel and reached 0.84 m/s at the thalweg. Low to moderate stage heights averaging 39 cm persisted throughout the operational period of the weir with minimum and maximum levels reaching 27 and 65 cm. Water temperatures averaged 12.5°C from June 18 to September 12 (Appendix 2). Minimum and maximum temperatures reached 7 and 16°C.

Biological Data

Five species of Pacific salmon, including 172,148 chum, 5,841 chinook, 1,972 pink, 113 sockeye, and 10,901 coho salmon, were counted upstream through the weir (Appendix 3). Other species counted through the weir include nine Dolly Varden *Salvelinus malma*, 9,383 whitefish *Prosopium cylindraceum* and *Coregonus* spp., one Arctic grayling *Thymallus arcticus*, and 83 northern pike *Esox lucius* (Appendix 3).

Chum salmon.—Chum salmon (N=172,148) passed through the weir from June 16 to September 12. On the first day of operation, 52 chum salmon were counted through the weir. Peak passage (N=61,797) occurred the week of July 2-8 (Figure 2; Appendix 3). The median passage date was July 5 (Figure 3; Appendix 4), and counts declined to less than 100 fish per day for 37 days prior to weir removal.

Four age groups were identified from 833 chum salmon sampled from the weir escapement between June 18 and August 2 (Appendix 5). During this period, 169,694 chum salmon were counted through the weir. Males composed an estimated 57% of this escapement, but sex composition shifted to predominately females as the run progressed (Figure 3; Appendix 5). The sampled escapement was composed primarily of age 0.4 (62%) and age 0.3 (35%) fish. Age 0.4 chum salmon were most abundant until mid-July, and the age composition of the escapement shifted to primarily age 0.3 fish thereafter. Age composition differed between sexes ($X^2(\hat{\delta})$=15.0, df=3, P=0.002). Males were primarily age 0.4 (68%) followed by age 0.3 (29%), and females were more evenly distributed among ages 0.4 (55%) and 0.3 (43%). In sampled fish, the mean length of age 0.3, 0.4, and 0.5 males was greater than that of same-aged females (two-tailed t test: age 0.3, t=10.9, df=371, P<0.001; age 0.4, t=12.5, df=432, P<0.001; age 0.5, t=2.4, df=18, P=0.027)(Table 1).

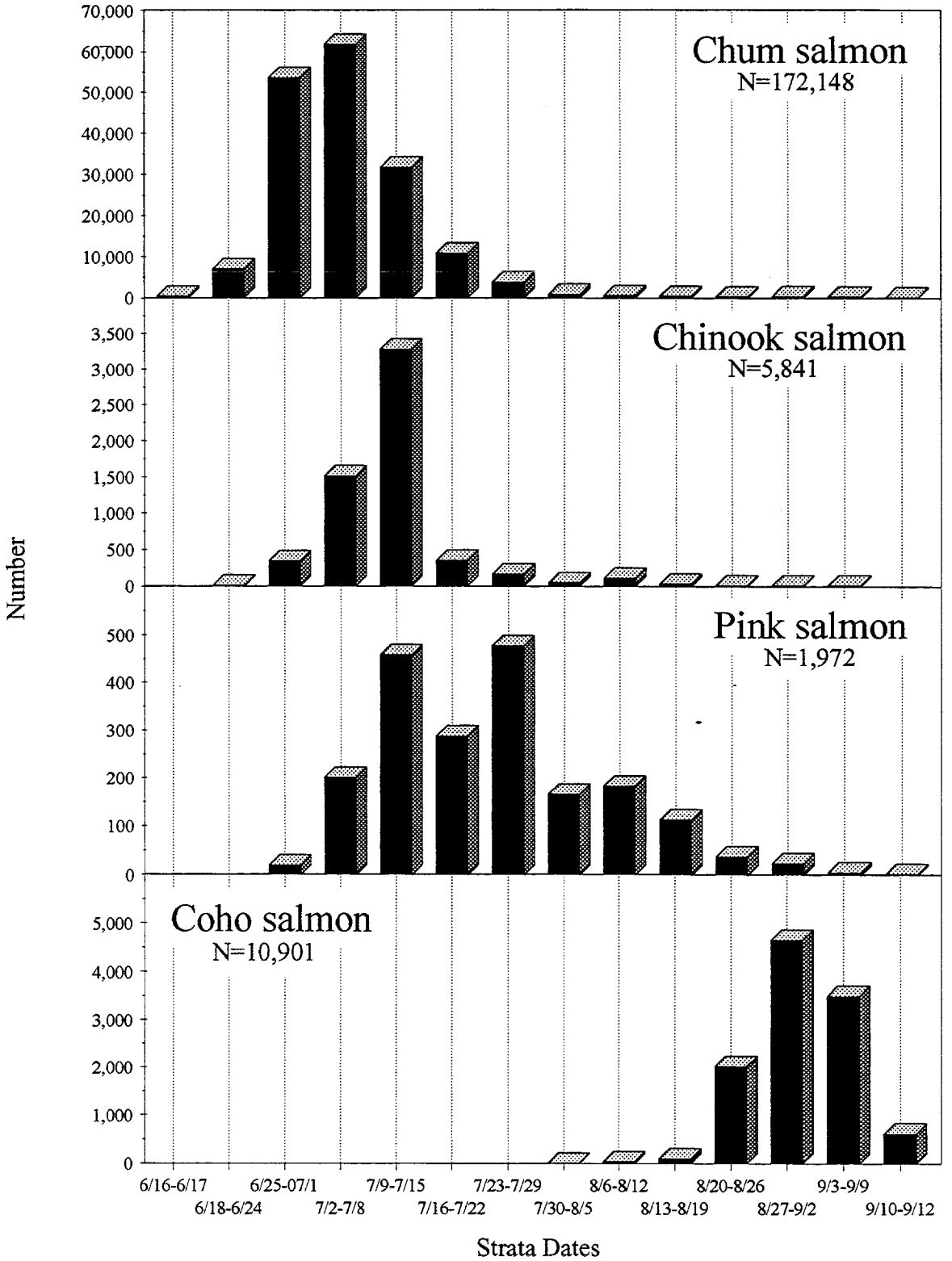

FIGURE 2.—Chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1995. The first and last strata are incomplete weeks.

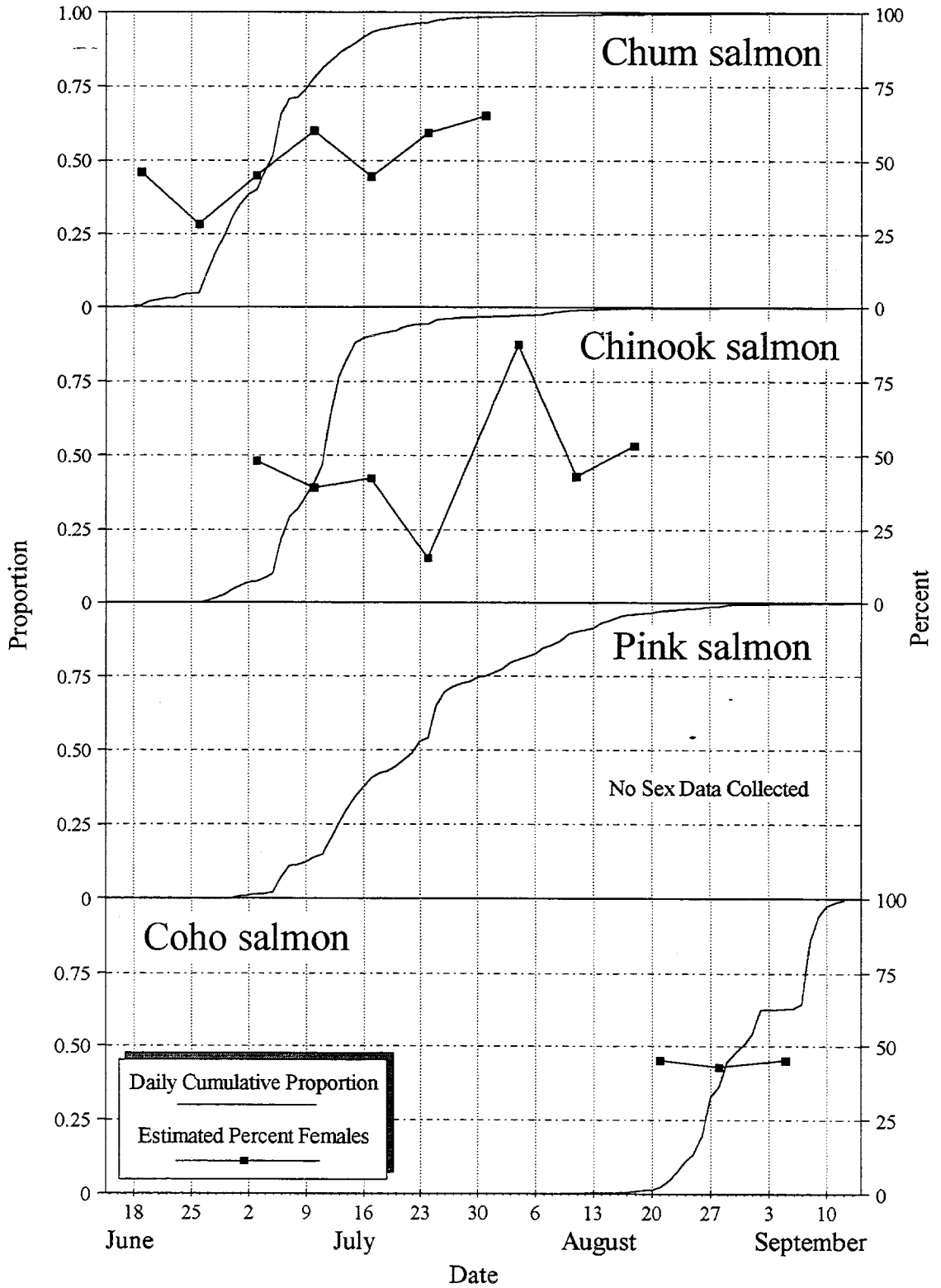

FIGURE 3.—Cumulative daily proportion and sex composition of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1995.

TABLE 1.—Lengths at age for chum salmon sampled at the East Fork Andreafsky River weir, Alaska, 1995.

Age	N	Mid-Eye to Fork Length (mm)		
		Mean	SE	Range
		Female		
0.2	4	510	11.4	480-535
0.3	211	516	2.0	445-595
0.4	185	528	2.1	420-640
0.5	7	560	9.5	530-605
Total	407	522	1.5	420-640
		Male		
0.2	2	505	5.0	500-510
0.3	162	551	2.6	465-625
0.4	249	567	2.1	480-670
0.5	13	590	7.7	545-655
Total	426	561	1.7	465-670

Chinook salmon.—Chinook salmon (N=5,841) passed through the weir from June 20 to September 5. Peak passage (N=3,728) occurred the week of July 9-15 (Figure 2; Appendix 3), and the median passage date was July 12 (Figure 3; Appendix 4). Weekly chinook salmon escapement declined abruptly after the run peaked and did not exceed 10 fish per day for 30 days prior to weir removal.

Four age groups were identified from 343 chinook salmon sampled from the weir escapement between July 2 and August 18 (Appendix 6). During this period, 5,482 chinook salmon were counted through the weir. Males composed an estimated 58% of this escapement (Figure 3; Appendix 6). Age 1.4 chinook salmon were most abundant (44%) followed by age 1.2 (37%) and age 1.3 (17%) fish. Age composition differed between sexes ($X^2(\hat{\delta}.)$=112.1, df=3, P<0.001). Females were primarily age 1.4 (77%), and males were primarily age 1.2 (59%). In sampled fish, the mean length of age 1.3, and 1.4 females was greater than that of same-aged males (two-tailed t test: age 1.3, t=3.1, df=52, P=0.003; age 1.4, t=5.9, df=161, P<0.001)(Table 2).

TABLE 2.—Lengths at age for chinook salmon sampled at the East Fork Andreafsky River weir, Alaska, 1995.

		Mid-Eye to Fork Length (mm)		
Age	N	Mean	SE	Range
		Female		
1.2	8	494	9.6	455-540
1.3	19	782	21.0	525-880
1.4	118	857	5.0	665-980
1.5	5	868	22.6	785-910
Total	150	829	8.3	455-980
		Male		
1.2	112	519	5.5	380-715
1.3	35	696	16.8	435-940
1.4	45	797	10.0	535-915
1.5	1	915	-	-
Total	193	618	8.8	380-940

Pink salmon.—Although able to pass uncounted between panel pickets, 1,972 pink salmon passed through the weir at counting stations from June 27 to September 12. Peak passage (N=477) occurred the week of July 23-29 (Figure 2; Appendix 3), and the median passage date was July 23 (Figure 3; Appendix 4). Weekly pink salmon escapement peaked twice and followed a downward trend after the second peak declining to less than 10 fish per day for 26 days prior to weir removal.

Sockeye salmon.—Sockeye salmon (N=113) passed through the weir from July 1 to September 11. Peak passage (N=31) occurred the week of August 20-26 (Appendix 3), and the median passage date was August 16.

Coho salmon.—Coho salmon (N=10,901) passed through the weir from August 3 to September 12. Peak passage (N=4,649) occurred the week of August 27-September 2 (Figure 2; Appendix 3), and the median passage date was August 31 (Figure 3). Although weekly coho salmon escapement declined after peak passage occurred (8/27-9/2), the largest daily weir count of this species (N=2,403) occurred the following week on September 8 (Appendix 3).

Three age groups were identified from 356 coho salmon sampled from the weir escapement between August 20 and September 9 (Appendix 7). During this period, 10,161 coho salmon were counted through the weir. Males composed an estimated 56% of this escapement and predominated during every sample week (Figure 3; Appendix 7). Age 2.1 coho salmon were most abundant (63%) followed by age 1.1 (35%) fish. Age 2.1 coho salmon were also most abundant in the escapement during all sample weeks. Age composition did not differ between sexes ($X^2(\hat{\delta}.)=1.5$, df=2, $P=0.46$). In sampled fish, the mean length of age 1.1 and 2.1 females was greater than that of same-aged males (two-tailed t test: age 1.1, $t=2.3$, df=121, $P=0.025$; age 2.1, $t=1.8$, df=225, $P=0.077$)(Table 3).

TABLE 3.—Lengths at age for coho salmon sampled at the East Fork Andreafsky River weir, Alaska, 1995.

		Mid-Eye to Fork Length (mm)		
Age	N	Mean	SE	Range
		Female		
1.1	50	536	5.0	455-600
2.1	104	538	3.4	420-620
3.1	4	543	16.1	500-570
Total	158	538	2.8	420-620
		Male		
1.1	73	519	5.2	430-650
2.1	123	529	4.3	405-625
3.1	2	528	62.5	465-590
Total	198	525	3.3	405-650

Discussion

Weir Operation

The weir was an effective method for counting and sampling salmon returning to the East Fork. However, low water levels during late-summer made it difficult to efficiently pass fish using conventional methods. To facilitate fish passage during these periods, entire weir panels were removed to count fish through areas where they preferred to pass.

Biological Data

Picket spacing allowed pink salmon and smaller resident fish to pass upstream yet effectively blocked passage of other salmon species. Consequently, pink salmon and resident fish counts are conservative.

Although panels and pickets were removed to facilitate fish passage during low water periods, counts declined substantially during the week of July 16-22 (Figure 2). Extremely low water levels and high water temperatures prevailed during that week (Appendix 2), and salmon were observed holding in deep segments of river.

Chum salmon.—The 1995 weir escapement of 172,148 chum salmon was less than that in 1994 (N=200,981). Weekly escapement trends and observations of chum salmon in the river prior to weir installation during 1994 indicated that a substantial proportion of the run was not censused (Tobin and Harper 1995). If the uncounted 1994 escapement is considered, the difference in abundance between the two years would be substantially greater than indicated. Weir counts for both years exceeded all historical counts except for a 1982 sonar total of 181,352 summer chum salmon (Appendix 1). Strong summer chum salmon returns to the East Fork during 1994 and 1995 corresponded with other Yukon River returns in that minimum escapement objectives were generally exceeded drainage-wide (Bergstrom et al. 1996).

Run timing in the East Fork during 1995 resembled that in 1994 (Tobin and Harper 1995). In both years, migrating chum salmon were present in the river during mid-June, and peak passage occurred in early July. Median passage dates during 1994 and 1995 were July 8 and July 5, respectively. However, 1994 counts did not include a portion of the summer chum salmon return that passed the weir prior to installation. If these uncounted fish are considered, the median passage date for 1994 would have actually been earlier than July 8.

Chum salmon from the 1990 brood year were most abundant in the sampled escapement during 1994 and 1995. In 1995, age 0.4 fish were most abundant in the chum salmon escapement, followed by age 0.3 fish. During 1994, age 0.3 fish were most abundant in the sampled escapement, followed by age 0.4 fish. However, 1994 data suggest a lower percentage of age 0.4 chum salmon in the escapement than was probably present in the population (Tobin and Harper 1995). The first segment of this return was not represented in the sample and was probably composed primarily of age 0.4 fish.

Chinook salmon.—The 1995 weir escapement of 5,841 chinook salmon was less than that in 1994 (N=7,801). Chinook salmon escapements to the East Fork during 1994 and 1995 corresponded with lower Yukon River tributaries in that minimum escapement objectives were met or exceeded (Schultz et al. 1994; Bergstrom et al. 1996).

Run timing in the East Fork during 1995 resembled that in 1994 (Tobin and Harper 1995). In both years, migrating chinook salmon were present in the river during late-June, and peak passage occurred during the second week of July. Median passage dates during 1994 and 1995 were July 11 and July 12, respectively.

Chinook salmon from the 1989 brood year were most abundant in the sampled escapement during 1994 and 1995. In 1995, age 1.4 fish were most abundant in the chinook salmon escapement, followed by age 1.2 fish. During 1994, age 1.3 fish were most abundant in the sampled escapement, followed by age 1.4 fish. Age 1.3 and 1.2 fish were predominate in the male escapement during 1994 and 1995, respectively, and age 1.4 fish were predominate among females during both years.

Pink salmon.—The 1995 weir escapement of 1,972 pink salmon was less than that in 1994 (N=316,530). Pink salmon returns to the Yukon River drainage are historically strongest during even years (Bergstrom et al. 1995). If the uncounted percentage of 1994 and 1995 escapements are considered, the difference in abundance between the two years would be substantially greater than indicated.

Timing of the 1995 pink salmon return to the East Fork did not resemble that in 1994 (Tobin and Harper 1995). Peak passage occurred during the last week of July in 1995 and the third week of July in 1994. Median passage dates during 1994 and 1995 were July 18 and July 23, respectively. Extremely low water levels during the third week of July, 1995, probably delayed pink salmon migration through the weir thus creating a false peak in late-July (Figure 2).

Sockeye salmon.—Large populations of sockeye salmon are absent in the Yukon River drainage (Bergstrom et al. 1995), and little is known about the population in the East Fork. Additional years of data are needed to determine the stability of the East Fork sockeye salmon returns.

Coho salmon.—Historical data pertaining to coho salmon populations in the East Fork are limited. Two aerial index surveys of the East Fork documented 1,657 and 1,913 coho salmon in 1981 and 1988, respectively (Appendix 1). Although the weir was removed prior to obtaining data for the entire coho salmon return, the 1995 weir escapement of 10,901 fish represents the most comprehensive coho salmon escapement data collected from the East Fork. The September 8 weir count of 2,403 coho salmon suggests that strong numbers of this species returning to the East Fork could continue beyond the weir removal date (9/12).

However, in the Tuluksak River, a tributary to the Kuskokwim River, also in western Alaska, salmon returns were monitored from early June to September 18. The majority of the return passed through a weir over a 41 day period starting in mid August. Daily weir escapements averaged 352 coho salmon per day during the peak escapement week and declined to an average of 45 fish per day from September 10-18, 1991 (Harper 1995). Coho

salmon were also counted through the East Fork weir over a 41 day period. Daily weir escapements averaged 664 coho salmon per day during the peak escapement week and declined to an average of 204 fish per day for the final three days of weir operation (9/10-12).

Recommendations

Based on the data in this report, the following is recommended:

1. Install an additional live trap and passing chute on the weir in a location that would facilitate efficient fish passage and sampling during low water periods.

2. Extend weir operation into late-September to obtain more comprehensive escapement data for coho salmon returns.

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Appendix 1.-Chum, chinook, and coho salmon escapement counts for the Andreafsky River, Alaska, 1961-1995. All data, except weir counts, are from Bergstrom et al. (1996).

	East Fork Andreafsky River						Main Stem Andreafsky River		
	Aerial Index Surveys			Sonar, Tower, or Weir			Aerial Index Surveys		
Year	Chinook Salmon	Chum Salmon	Coho Salmon	Chinook Salmon	Chum Salmon	Coho Salmon	Chinook Salmon	Chum Salmon	Coho Salmon
1961	1,003								
1962	675 *a*						762 *a*		
1963									
1964	867						705		
1965							344 *a*		
1966	361						303		
1967							276 *a*		
1968	380						383		
1969	274 *a*						231 *a*		
1970	665						574 *a*		
1971	1,904						1,682		
1972	798						582 *a*		
1973	825	10,149 *a*					788	51,835	
1974		3,215 *a*					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 *a*	36,823 *a*					1,500	114,759	
1981	2,146 *a*	81,555	1,657 *a*		147,312 *b*		231 *a*		
1982	1,274	7,501 *a*			181,352 *b*		851	7,267 *a*	
1983					110,608 *b*				
1984	1,573 *a*	95,200 *a*			70,125 *b*		1,993	238,565	
1985	1,617	66,146					2,248	52,750	
1986	1,954	83,931		1,530 *c*	167,614 *c*		3,158	99,373	
1987	1,608	6,687 *a*		2,011 *c*	45,221 *c*		3,281	35,535	
1988	1,020	43,056	1,913	1,339 *c*	68,937 *c*		1,448	45,432	830
1989	1,399	21,460 *a*					1,089		
1990	2,503	11,519 *a*					1,545	20,426 *a*	
1991	1,938	31,886					2,544	46,657	
1992	1,030 *a*	11,308 *a*					2,002 *a*	37,808 *a*	
1993	5,855	10,935 *a*					2,765	9,111 *a*	
1994	300 *a*			7,801 *d*	200,981 *ad*		213 *a*		
1995	1,635			5,841 *d*	172,148 *d*	10,901 *d*	1,108		
E.O.	>1,500	>109,000					>1,400	>116,000	

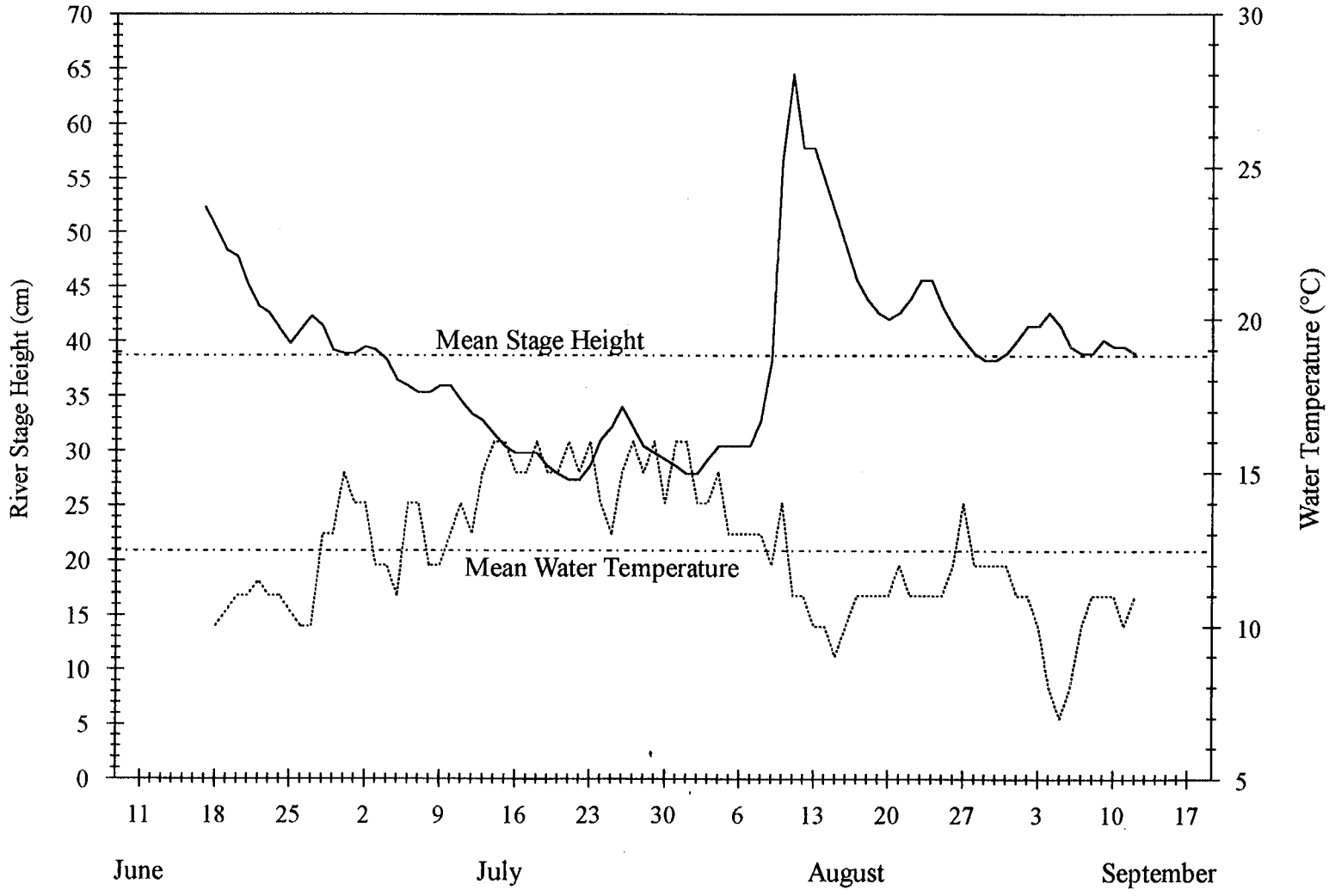
E.O. Interim escapement objective for aerial index surveys.

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

b Sonar count

c Tower count

d Weir count



Appendix 2.-River stage heights and water temperatures at the East Fork Andreafsky River weir, Alaska, 1995.

Appendix 3.-Daily escapement and counting effort at the East Fork Andreafsky River weir, Alaska, 1995.

Date	Hours of Counting	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Arctic Grayling	Northern Pike
					Stratum 1					
06/16	2.75	52	0	0	0	0	0	26	0	1
06/17	10.75	332	0	0	0	0	0	72	0	3
Total:	13.50	384	0	0	0	0	0	98	0	4
					Stratum 2					
06/18	12.50	191	0	0	0	0	0	116	0	7
06/19	7.75	423	0	0	0	0	0	85	0	2
06/20	10.50	2,198	1	0	0	0	0	139	0	3
06/21	14.50	861	0	0	0	0	0	203	0	1
06/22	13.75	1,170	1	0	0	0	0	206	0	3
06/23	10.50	228	0	0	0	0	1	64	0	3
06/24	14.25	1,951	2	0	0	0	0	71	1	2
Total:	83.75	7,022	4	0	0	0	1	884	1	21
					Stratum 3					
06/25	7.75	364	0	0	0	0	1	43	0	0
06/26	8.75	504	0	0	0	0	0	16	0	1
06/27	13.00	12,620	41	1	0	0	0	86	0	2
06/28	18.75	11,201	48	0	0	0	0	325	0	2
06/29	13.75	9,256	67	2	0	0	0	251	0	5
06/30	16.00	10,938	104	3	0	0	0	345	0	5
07/01	13.25	8,654	81	13	2	0	0	386	0	5
Total:	91.25	53,537	341	19	2	0	1	1,452	0	20
					Stratum 4					
07/02	12.25	5,553	71	4	0	0	0	275	0	6
07/03	9.00	2,710	17	4	1	0	0	122	0	5
07/04	13.75	10,678	55	5	0	0	0	137	0	2
07/05	14.25	10,026	107	9	1	0	0	134	0	3
07/06	15.75	23,584	678	98	4	0	0	284	0	2
07/07	14.75	8,514	433	77	0	0	0	187	0	1
07/08	8.25	732	155	4	0	0	0	172	0	0
Total:	88.00	61,797	1,516	201	6	0	0	1,311	0	19
					Stratum 5					
07/09	8.25	4,808	260	18	0	0	0	75	0	3
07/10	11.25	6,473	250	33	1	0	0	103	0	1
07/11	12.75	6,072	382	23	1	0	0	126	0	1
07/12	15.75	3,973	1,022	100	0	0	0	188	0	3
07/13	14.75	4,552	697	109	0	0	0	299	0	0
07/14	14.75	2,990	375	94		0	0	249	0	0
07/15	12.00	2,874	292	81	0	0	0	185	0	1
Total:	89.50	31,742	3,278	458	2	0	0	1,225	0	9

(Continued)

Appendix 3.-(Continued).

Date	Hours of Counting	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Arctic Grayling	Northern Pike
					Stratum 6					
07/16	10.50	3,449	97	64	0	0	0	118	0	0
07/17	14.00	2,739	46	60	0	0	0	122	0	1
07/18	15.25	1,495	38	31	3	0	0	101	0	1
07/19	11.50	651	25	15	0		0	80	0	0
07/20	19.00	1,150	37	30	1	0	0	55	0	0
07/21	15.00	807	74	40	2	0	0	58	0	0
07/22	13.75	591	33	48	0	0	0	27	0	1
Total:	99.00	10,882	350	288	6	0	0	561	0	3
					Stratum 7					
07/23	11.00	742	24	77	0	0	0	9	0	0
07/24	11.00	290	7	25	0	0	0	7	0	0
07/25	10.25	1,214	78	216	8	0	0	65	0	0
07/26	8.50	521	21	88	2	0	0	45	0	0
07/27	10.25	605	12	37	1	0	0	18	0	0
07/28	10.00	265	15	20	0	0	0	17	0	1
07/29	12.25	211	9	14	1	0	0	15	0	1
Total:	73.25	3,848	166	477	12	0	0	176	0	2
					Stratum 8					
07/30	9.25	248	5	29	3	0	0	25	0	0
07/31	13.50	94	1	11	0	0	0	11	0	1
08/01	15.25	160	8	22	4	0	0	14	0	0
08/02	14.75	81	2	23	0	0	0	4	0	0
08/03	12.75	147	13	44	3	1	0	4	0	0
08/04	14.25	59	5	20	0	0	0	3	0	0
08/05	10.00	77	6	17	0	0	0	1	0	0
Total:	89.75	866	40	166	10	1	0	62	0	1
					Stratum 9					
08/06	11.00	115	6	22	0	0	0	6	0	0
08/07	12.00	76	19	37	1	1	0	9	0	0
08/08	12.75	78	20	20	1	1	0	37	0	0
08/09	9.50	70	25	29	0	3	0	60	0	0
08/10	11.75	61	25	46	0	8	0	493	0	0
08/11	9.50	35	7	18	0	12	0	330	0	0
08/12	8.50	60	4	11	0	5	0	114	0	0
Total:	75.00	495	106	183	2	30	0	1,049	0	0
					Stratum 10					
08/13	8.50	73	11	12	3	3	0	50	0	1
08/14	11.75	62	2	32	3	3	0	43	0	0
08/15	10.75	49	2	20	3	9	0	25	0	0
08/16	13.50	95	3	19	5	5	0	127	0	0
08/17	11.75	64	3	17	5	11	0	148	0	0
08/18	12.50	83	3	6	1	24	0	118	0	0
08/19	14.75	41	2	7	1	41	1	42	0	0
Total:	83.50	467	26	113	21	96	1	553	0	1

(Continued)

Appendix 3.-(Continued).

Date	Hours of Counting	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Arctic Grayling	Northern Pike
					Stratum 11					
08/20	13.25	45	1	4	3	24	0	48	0	0
08/21	12.25	47	2	7	1	95	0	22	0	0
08/22	13.00	43	0	6	13	246	0	81	0	0
08/23	17.25	35	1	4	9	305	0	135	0	0
08/24	13.75	35	1	8	4	414	0	93	0	0
08/25	15.25	56	0	3	0	245	0	112	0	0
08/26	16.50	53	0	5	1	692	0	166	0	0
Total:	101.25	314	5	37	31	2,021	0	657	0	0
					Stratum 12					
08/27	17.50	57	0	9	0	1,436	0	134	0	0
08/28	12.25	31	3	0	4	368	0	123	0	0
08/29	15.00	53	1	7	1	938	0	76	0	0
08/30	12.00	34	0	5	1	335	1	53	0	1
08/31	13.75	63	0	0	2	265	1	23	0	0
09/01	14.00	48	1	0	3	444	0	28	0	0
09/02	15.00	75	0	2	0	863	0	43	0	0
Total:	99.50	361	5	23	11	4,649	2	480	0	1
					Stratum 13					
09/03	10.75	36	0	1	0	14	1	33	0	0
09/04	12.00	25	0	0	2	29	0	39	0	1
09/05	12.75	30	1	1	0	6	0	44	0	1
09/06	14.25	50	0	1	3	21	0	37	0	0
09/07	9.75	60	0	1	1	164	1	26	0	0
09/08	14.50	96	3	1	2	2,403	1	99	0	0
09/09	14.50	42	0	0	0	854	0	155	0	0
Total:	88.50	339	4	5	8	3,491	3	433	0	2
					Stratum 14					
09/10		42	0	1	1	391	1	188	0	0
09/11		37	0	0	1	127	0	157	0	0
09/12		15	0	1	0	95	0	97	0	0
Total:	0.00	94	0	2	2	613	1	442	0	0
					All Strata					
Total:	1075.75	172,148	5,841	1,972	113	10,901	9	9,383	1	83

Appendix 4.-Daily, cumulative, and cumulative proportion of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1995.

	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
Date	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
06/16	52	52	0.000	0	0	0.000	0	0	0.000	0	0	0.000
06/17	332	384	0.002	0	0	0.000	0	0	0.000	0	0	0.000
06/18	191	575	0.003	0	0	0.000	0	0	0.000	0	0	0.000
06/19	423	998	0.006	0	0	0.000	0	0	0.000	0	0	0.000
06/20	2,198	3,196	0.019	1	1	0.000	0	0	0.000	0	0	0.000
06/21	861	4,057	0.024	0	1	0.000	0	0	0.000	0	0	0.000
06/22	1,170	5,227	0.030	1	2	0.000	0	0	0.000	0	0	0.000
06/23	228	5,455	0.032	0	2	0.000	0	0	0.000	0	0	0.000
06/24	1,951	7,406	0.043	2	4	0.001	0	0	0.000	0	0	0.000
06/25	364	7,770	0.045	0	4	0.001	0	0	0.000	0	0	0.000
06/26	504	8,274	0.048	0	4	0.001	0	0	0.000	0	0	0.000
06/27	12,620	20,894	0.121	41	45	0.008	1	1	0.001	0	0	0.000
06/28	11,201	32,095	0.186	48	93	0.016	0	1	0.001	0	0	0.000
06/29	9,256	41,351	0.240	67	160	0.027	2	3	0.002	0	0	0.000
06/30	10,938	52,289	0.304	104	264	0.045	3	6	0.003	0	0	0.000
07/01	8,654	60,943	0.354	81	345	0.059	13	19	0.010	0	0	0.000
07/02	5,553	66,496	0.386	71	416	0.071	4	23	0.012	0	0	0.000
07/03	2,710	69,206	0.402	17	433	0.074	4	27	0.014	0	0	0.000
07/04	10,678	79,884	0.464	55	488	0.084	5	32	0.016	0	0	0.000
07/05	10,026	89,910	0.522	107	595	0.102	9	41	0.021	0	0	0.000
07/06	23,584	113,494	0.659	678	1,273	0.218	98	139	0.070	0	0	0.000
07/07	8,514	122,008	0.709	433	1,706	0.292	77	216	0.110	0	0	0.000
07/08	732	122,740	0.713	155	1,861	0.319	4	220	0.112	0	0	0.000
07/09	4,808	127,548	0.741	260	2,121	0.363	18	238	0.121	0	0	0.000
07/10	6,473	134,021	0.779	250	2,371	0.406	33	271	0.137	0	0	0.000

(Continued)

Appendix 4.-(Continued).

	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
Date	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
07/11	6,072	140,093	0.814	382	2,753	0.471	23	294	0.149	0	0	0.000
07/12	3,973	144,066	0.837	1,022	3,775	0.646	100	394	0.200	0	0	0.000
07/13	4,552	148,618	0.863	697	4,472	0.766	109	503	0.255	0	0	0.000
07/14	2,990	151,608	0.881	375	4,847	0.830	94	597	0.303	0	0	0.000
07/15	2,874	154,482	0.897	292	5,139	0.880	81	678	0.344	0	0	0.000
07/16	3,449	157,931	0.917	97	5,236	0.896	64	742	0.376	0	0	0.000
07/17	2,739	160,670	0.933	46	5,282	0.904	60	802	0.407	0	0	0.000
07/18	1,495	162,165	0.942	38	5,320	0.911	31	833	0.422	0	0	0.000
07/19	651	162,816	0.946	25	5,345	0.915	15	848	0.430	0	0	0.000
07/20	1,150	163,966	0.952	37	5,382	0.921	30	878	0.445	0	0	0.000
07/21	807	164,773	0.957	74	5,456	0.934	40	918	0.466	0	0	0.000
07/22	591	165,364	0.961	33	5,489	0.940	48	966	0.490	0	0	0.000
07/23	742	166,106	0.965	24	5,513	0.944	77	1,043	0.529	0	0	0.000
07/24	290	166,396	0.967	7	5,520	0.945	25	1,068	0.542	0	0	0.000
07/25	1,214	167,610	0.974	78	5,598	0.958	216	1,284	0.651	0	0	0.000
07/26	521	168,131	0.977	21	5,619	0.962	88	1,372	0.696	0	0	0.000
07/27	605	168,736	0.980	12	5,631	0.964	37	1,409	0.715	0	0	0.000
07/28	265	169,001	0.982	15	5,646	0.967	20	1,429	0.725	0	0	0.000
07/29	211	169,212	0.983	9	5,655	0.968	14	1,443	0.732	0	0	0.000
07/30	248	169,460	0.984	5	5,660	0.969	29	1,472	0.746	0	0	0.000
07/31	94	169,554	0.985	1	5,661	0.969	11	1,483	0.752	0	0	0.000
08/01	160	169,714	0.986	8	5,669	0.971	22	1,505	0.763	0	0	0.000
08/02	81	169,795	0.986	2	5,671	0.971	23	1,528	0.775	0	0	0.000
08/03	147	169,942	0.987	13	5,684	0.973	44	1,572	0.797	1	1	0.000
08/04	59	170,001	0.988	5	5,689	0.974	20	1,592	0.807	0	1	0.000
08/05	77	170,078	0.988	6	5,695	0.975	17	1,609	0.816	0	1	0.000

(Continued)

Appendix 4.-(Continued).

	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
Date	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
08/06	115	170,193	0.989	6	5,701	0.976	22	1,631	0.827	0	1	0.000
08/07	76	170,269	0.989	19	5,720	0.979	37	1,668	0.846	1	2	0.000
08/08	78	170,347	0.990	20	5,740	0.983	20	1,688	0.856	1	3	0.000
08/09	70	170,417	0.990	25	5,765	0.987	29	1,717	0.871	3	6	0.001
08/10	61	170,478	0.990	25	5,790	0.991	46	1,763	0.894	8	14	0.001
08/11	35	170,513	0.991	7	5,797	0.992	18	1,781	0.903	12	26	0.002
08/12	60	170,573	0.991	4	5,801	0.993	11	1,792	0.909	5	31	0.003
08/13	73	170,646	0.991	11	5,812	0.995	12	1,804	0.915	3	34	0.003
08/14	62	170,708	0.992	2	5,814	0.995	32	1,836	0.931	3	37	0.003
08/15	49	170,757	0.992	2	5,816	0.996	20	1,856	0.941	9	46	0.004
08/16	95	170,852	0.992	3	5,819	0.996	19	1,875	0.951	5	51	0.005
08/17	64	170,916	0.993	3	5,822	0.997	17	1,892	0.959	11	62	0.006
08/18	83	170,999	0.993	3	5,825	0.997	6	1,898	0.962	24	86	0.008
08/19	41	171,040	0.994	2	5,827	0.998	7	1,905	0.966	41	127	0.012
08/20	45	171,085	0.994	1	5,828	0.998	4	1,909	0.968	24	151	0.014
08/21	47	171,132	0.994	2	5,830	0.998	7	1,916	0.972	95	246	0.023
08/22	43	171,175	0.994	0	5,830	0.998	6	1,922	0.975	246	492	0.045
08/23	35	171,210	0.995	1	5,831	0.998	4	1,926	0.977	305	797	0.073
08/24	35	171,245	0.995	1	5,832	0.998	8	1,934	0.981	414	1,211	0.111
08/25	56	171,301	0.995	0	5,832	0.998	3	1,937	0.982	245	1,456	0.134
08/26	53	171,354	0.995	0	5,832	0.998	5	1,942	0.985	692	2,148	0.197
08/27	57	171,411	0.996	0	5,832	0.998	9	1,951	0.989	1,436	3,584	0.329
08/28	31	171,442	0.996	3	5,835	0.999	0	1,951	0.989	368	3,952	0.363
08/29	53	171,495	0.996	1	5,836	0.999	7	1,958	0.993	938	4,890	0.449
08/30	34	171,529	0.996	0	5,836	0.999	5	1,963	0.995	335	5,225	0.479
08/31	63	171,592	0.997	0	5,836	0.999	0	1,963	0.995	265	5,490	0.504

(Continued)

Appendix 4.-(Continued).

	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
Date	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
09/01	48	171,640	0.997	1	5,837	0.999	0	1,963	0.995	444	5,934	0.544
09/02	75	171,715	0.997	0	5,837	0.999	2	1,965	0.996	863	6,797	0.624
09/03	36	171,751	0.998	0	5,837	0.999	1	1,966	0.997	14	6,811	0.625
09/04	25	171,776	0.998	0	5,837	0.999	0	1,966	0.997	29	6,840	0.627
09/05	30	171,806	0.998	1	5,838	0.999	1	1,967	0.997	6	6,846	0.628
09/06	50	171,856	0.998	0	5,838	0.999	1	1,968	0.998	21	6,867	0.630
09/07	60	171,916	0.999	0	5,838	0.999	1	1,969	0.998	164	7,031	0.645
09/08	96	172,012	0.999	3	5,841	1.000	1	1,970	0.999	2,403	9,434	0.865
09/09	42	172,054	0.999	0	5,841	1.000	0	1,970	0.999	854	10,288	0.944
09/10	42	172,096	1.000	0	5,841	1.000	1	1,971	0.999	391	10,679	0.980
09/11	37	172,133	1.000	0	5,841	1.000	0	1,971	0.999	127	10,806	0.991
09/12	15	172,148	1.000	0	5,841	1.000	1	1,972	1.000	95	10,901	1.000

Appendix 5.-Estimated age and sex composition of weekly chum salmon escapement through the East Fork Andreafsky River weir, Alaska, 1995, and estimated design effects of the stratified sampling method.

		Brood Year and Age Group				
		1992	1991	1990	1989	
		0.2	0.3	0.4	0.5	Total
Stratum 1: 6/16 - 6/17 No samples collected						
Stratum 2: 6/18 - 6/24 Sampling Date: 6/20						
Female:	Number in Sample:	0	14	47	4	65
	Estimated % of Escapement:	0.0	9.9	33.3	2.8	46.1
	Estimated Escapement:	0	697	2,341	199	3,237
Male:	Number in Sample:	0	8	61	7	76
	Estimated % of Escapement:	0.0	5.7	43.3	5.0	53.9
	Estimated Escapement:	0	398	3,038	349	3,785
Total:	Number in Sample:	0	22	108	11	141
	Estimated % of Escapement:	0.0	15.6	76.6	7.8	100.0
	Estimated Escapement:	0	1,096	5,379	548	7,022
	Standard Error:	0	215	251	159	
Stratum 3: 6/25 - 7/01 Sampling Date: 6/26						
Female:	Number in Sample:	0	11	25	2	38
	Estimated % of Escapement:	0.0	8.2	18.7	1.5	28.4
	Estimated Escapement:	0	4,395	9,988	799	15,182
Male:	Number in Sample:	0	21	69	6	96
	Estimated % of Escapement:	0.0	15.7	51.5	4.5	71.6
	Estimated Escapement:	0	8,390	27,568	2,397	38,355
Total:	Number in Sample:	0	32	94	8	134
	Estimated % of Escapement:	0.0	23.9	70.1	6.0	100.0
	Estimated Escapement:	0	12,785	37,556	3,196	53,537
	Standard Error:	0	1,979	2,124	1,100	
Stratum 4: 7/02 - 7/08 Sampling Date: 7/03						
Female:	Number in Sample:	0	24	33	1	58
	Estimated % of Escapement:	0.0	18.6	25.6	0.8	45.0
	Estimated Escapement:	0	11,497	15,809	479	27,785
Male:	Number in Sample:	0	17	54	0	71
	Estimated % of Escapement:	0.0	13.2	41.9	0.0	55.0
	Estimated Escapement:	0	8,144	25,869	0	34,012
Total:	Number in Sample:	0	41	87	1	129
	Estimated % of Escapement:	0.0	31.8	67.4	0.8	100.0
	Estimated Escapement:	0	19,641	41,677	479	61,797
	Standard Error:	0	2,543	2,560	479	

(Continued)

Appendix 5.-(Continued).

		Brood Year and Age Group				
		1992	1991	1990	1989	
		0.2	0.3	0.4	0.5	Total
Stratum 5: 7/09 - 7/15 Sampling Date: 7/10						
Female:	Number in Sample:	0	36	35	0	71
	Estimated % of Escapement:	0.0	30.5	29.7	0.0	60.2
	Estimated Escapement:	0	9,684	9,415	0	19,099
Male:	Number in Sample:	0	22	25	0	47
	Estimated % of Escapement:	0.0	18.6	21.2	0.0	39.8
	Estimated Escapement:	0	5,918	6,725	0	12,643
Total:	Number in Sample:	0	58	60	0	118
	Estimated % of Escapement:	0.0	49.2	50.8	0.0	100.0
	Estimated Escapement:	0	15,602	16,140	0	31,742
	Standard Error:	0	1,467	1,467	0	
Stratum 6: 7/16 - 7/22 Sampling Dates: 7/17 - 7/18						
Female:	Number in Sample:	0	29	17	0	46
	Estimated % of Escapement:	0.0	28.2	16.5	0.0	44.7
	Estimated Escapement:	0	3,064	1,796	0	4,860
Male:	Number in Sample:	0	39	18	0	57
	Estimated % of Escapement:	0.0	37.9	17.5	0.0	55.3
	Estimated Escapement:	0	4,120	1,902	0	6,022
Total:	Number in Sample:	0	68	35	0	103
	Estimated % of Escapement:	0.0	66.0	34.0	0.0	100.0
	Estimated Escapement:	0	7,184	3,698	0	10,882
	Standard Error:	0	510	510	0	
Stratum 7: 7/23 - 7/29 Sampling Date: 7/24						
Female:	Number in Sample:	0	54	15	0	69
	Estimated % of Escapement:	0.0	46.6	12.9	0.0	59.5
	Estimated Escapement:	0	1,791	498	0	2,289
Male:	Number in Sample:	2	31	14	0	47
	Estimated % of Escapement:	1.7	26.7	12.1	0.0	40.5
	Estimated Escapement:	66	1,028	464	0	1,559
Total:	Number in Sample:	2	85	29	0	116
	Estimated % of Escapement:	1.7	73.3	25.0	0.0	100.0
	Estimated Escapement:	66	2,820	962	0	3,848
	Standard Error:	47	159	155	0	

(Continued)

Appendix 5.-(Continued).

		Brood Year and Age Group				
		1992	1991	1990	1989	
		0.2	0.3	0.4	0.5	Total
Stratum 8: 7/30 - 8/05 Sampling Dates: 7/31 - 8/02						
Female:	Number in Sample:	4	43	13	0	60
	Estimated % of Escapement:	4.3	46.7	14.1	0.0	65.2
	Estimated Escapement:	38	405	122	0	565
Male:	Number in Sample:	0	24	8	0	32
	Estimated % of Escapement:	0.0	26.1	8.7	0.0	34.8
	Estimated Escapement:	0	226	75	0	301
Total:	Number in Sample:	4	67	21	0	92
	Estimated % of Escapement:	4.3	72.8	22.8	0.0	100.0
	Estimated Escapement:	38	631	198	0	866
	Standard Error:	19	40	38	0	
Strata 9 - 14: 8/06 - 9/12 No samples collected						
Strata 2 - 8 Combined: 6/18 - 8/05 Sampling Dates: 7/17 - 7/18						
Female:	Number in Sample:	4	211	185	7	407
	% Females in Age Group:	0.1	43.2	54.7	2.0	100.0
	Estimated % of Escapement:	0.0	18.6	23.6	0.9	43.0
	Estimated Escapement:	38	31,533	39,968	1,477	73,017
	Estimated Design Effects:	0.045	1.579	1.765	1.862	1.677
Male:	Number in Sample:	2	162	249	13	426
	% Males in Age Group:	0.1	29.2	67.9	2.8	100.0
	Estimated % of Escapement:	0.0	16.6	38.7	1.6	57.0
	Estimated Escapement:	66	28,225	65,640	2,746	96,677
	Estimated Design Effects:	0.161	1.643	1.748	1.703	1.677
Total:	Number in Sample:	6	373	434	20	833
	Estimated % of Escapement:	0.1	35.2	62.2	2.5	100.0
	Estimated Escapement:	104	59,758	105,609	4,223	169,694 *
	Standard Error:	50	3,588	3,683	1,210	
	Estimated Design Effects:	0.119	1.630	1.668	1.744	

* 2,454 fish that were counted through the weir during stratum 1 and strata 9 through 14 are not included in this total.

Appendix 6.-Estimated age and sex composition of weekly chinook salmon escapement through the East Fork Andreafsky River weir, Alaska, 1995, and estimated design effects of the stratified sampling method.

		Brood Year and Age Group				
		1991	1990	1989	1988	
		1.2	1.3	1.4	1.5	Total
Strata 1 - 3: 6/16 - 7/01 No samples collected						
Stratum 4: 7/02 - 7/08 Sampling Dates: 7/02 & 7/04 - 7/07						
Female:	Number in Sample:	3	11	41	0	55
	Estimated % of Escapement:	2.6	9.6	36.0	0.0	48.2
	Estimated Escapement:	40	146	545	0	731
Male:	Number in Sample:	25	14	20	0	59
	Estimated % of Escapement:	21.9	12.3	17.5	0.0	51.8
	Estimated Escapement:	332	186	266	0	785
Total:	Number in Sample:	28	25	61	0	114
	Estimated % of Escapement:	24.6	21.9	53.5	0.0	100.0
	Estimated Escapement:	372	332	811	0	1,516
	Standard Error:	61	59	71	0	
Stratum 5: 7/09 - 7/15 Sampling Dates: 7/10 - 7/12						
Female:	Number in Sample:	5	5	41	2	53
	Estimated % of Escapement:	3.7	3.7	30.6	1.5	39.6
	Estimated Escapement:	122	122	1,003	49	1,297
Male:	Number in Sample:	51	17	12	1	81
	Estimated % of Escapement:	38.1	12.7	9.0	0.7	60.4
	Estimated Escapement:	1,248	416	294	24	1,981
Total:	Number in Sample:	56	22	53	3	134
	Estimated % of Escapement:	41.8	16.4	39.6	2.2	100.0
	Estimated Escapement:	1,370	538	1,297	73	3,278
	Standard Error:	140	105	139	42	
Stratum 6: 7/16 - 7/22 Sampling Dates: 7/17 - 7/21						
Female:	Number in Sample:	0	3	18	1	22
	Estimated % of Escapement:	0.0	5.8	34.6	1.9	42.3
	Estimated Escapement:	0	20	121	7	148
Male:	Number in Sample:	21	1	8	0	30
	Estimated % of Escapement:	40.4	1.9	15.4	0.0	57.7
	Estimated Escapement:	141	7	54	0	202
Total:	Number in Sample:	21	4	26	1	52
	Estimated % of Escapement:	40.4	7.7	50.0	1.9	100.0
	Estimated Escapement:	141	27	175	7	350
	Standard Error:	24	13	25	7	

(Continued)

Appendix 6.-(Continued).

		Brood Year and Age Group				
		1991	1990	1989	1988	
		1.2	1.3	1.4	1.5	Total
Stratum 7: 7/23 - 7/29 Sampling Dates: 7/24 & 7/26 - 7/27						
Female:	Number in Sample:	0	0	1	1	2
	Estimated % of Escapement:	0.0	0.0	7.7	7.7	15.4
	Estimated Escapement:	0	0	13	13	26
Male:	Number in Sample:	10	0	1	0	11
	Estimated % of Escapement:	76.9	0.0	7.7	0.0	84.6
	Estimated Escapement:	128	0	13	0	140
Total:	Number in Sample:	10	0	2	1	13
	Estimated % of Escapement:	76.9	0.0	15.4	7.7	100.0
	Estimated Escapement:	128	0	26	13	166
	Standard Error:	20	0	17	13	
Stratum 8: 7/30 - 8/05 Sampling Date: 8/04						
Female:	Number in Sample:	0	0	6	1	7
	Estimated % of Escapement:	0.0	0.0	75.0	12.5	87.5
	Estimated Escapement:	0	0	30	5	35
Male:	Number in Sample:	0	0	1	0	1
	Estimated % of Escapement:	0.0	0.0	12.5	0.0	12.5
	Estimated Escapement:	0	0	5	0	5
Total:	Number in Sample:	0	0	7	1	8
	Estimated % of Escapement:	0.0	0.0	87.5	12.5	100.0
	Estimated Escapement:	0	0	35	5	40
	Standard Error:	0	0	5	5	
Stratum 9: 8/06 - 8/12 Sampling Date: 8/11						
Female:	Number in Sample:	0	0	3	0	3
	Estimated % of Escapement:	0.0	0.0	42.9	0.0	42.9
	Estimated Escapement:	0	0	45	0	45
Male:	Number in Sample:	1	2	1	0	4
	Estimated % of Escapement:	14.3	28.6	14.3	0.0	57.1
	Estimated Escapement:	15	30	15	0	61
Total:	Number in Sample:	1	2	4	0	7
	Estimated % of Escapement:	14.3	28.6	57.1	0.0	100.0
	Estimated Escapement:	15	30	61	0	106
	Standard Error:	15	20	21	0	

(Continued)

Appendix 6.-(Continued).

		Brood Year and Age Group				
		1991	1990	1989	1988	
		1.2	1.3	1.4	1.5	Total
Stratum 10: 8/13 - 8/19						
Sampling Date: 8/18						
Female:	Number in Sample:	0	0	8	0	8
	Estimated % of Escapement:	0.0	0.0	53.3	0.0	53.3
	Estimated Escapement:	0	0	14	0	14
Male:	Number in Sample:	4	1	2	0	7
	Estimated % of Escapement:	26.7	6.7	13.3	0.0	46.7
	Estimated Escapement:	7	2	3	0	12
Total:	Number in Sample:	4	1	10	0	15
	Estimated % of Escapement:	26.7	6.7	66.7	0.0	100.0
	Estimated Escapement:	7	2	17	0	26
	Standard Error:	3	2	3	0	
Strata 11 - 14: 8/20 - 9/12						
No samples collected						
Strata 4 - 10: 7/02 - 8/19						
Sampling Dates: 7/02 - 8/18						
Female:	Number in Sample:	8	19	118	5	150
	% Females in Age Group:	7.1	12.6	77.2	3.2	100.0
	Estimated % of Escapement:	3.0	5.3	32.3	1.3	41.9
	Estimated Escapement:	162	289	1,771	73	2,296
	Estimated Design Effects:	1.357	1.096	1.200	1.224	1.205
Male:	Number in Sample:	112	35	45	1	193
	% Males in Age Group:	58.7	20.1	20.4	0.8	100.0
	Estimated % of Escapement:	34.1	11.7	11.9	0.4	58.1
	Estimated Escapement:	1,871	641	650	24	3,186
	Estimated Design Effects:	1.202	1.276	1.118	1.533	1.205
Total:	Number in Sample:	120	54	163	6	343
	Estimated % of Escapement:	37.1	17.0	44.2	1.8	100.0
	Estimated Escapement:	2,033	930	2,421	98	5,482 *
	Standard Error:	157	123	161	45	
	Estimated Design Effects:	1.202	1.222	1.189	1.299	

* 359 fish that were counted through the weir during strata 1 through 3 and strata 11 through 14 are not included in this total.

Appendix 7.-Estimated age and sex composition of weekly coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1995, and estimated design effects of the stratified sampling method.

		Brood Year and Age Group			
		1992	1991	1990	
		1.1	2.1	3.1	Total
Strata 1 - 10: 6/16 - 8/19 No samples collected					
Stratum 11: 8/20 - 8/26 Sampling Dates: 8/21 - 8/22					
Female:	Number in Sample:	15	34	3	52
	Estimated % of Escapement:	13.0	29.6	2.6	45.2
	Estimated Escapement:	264	598	53	914
Male:	Number in Sample:	22	41	0	63
	Estimated % of Escapement:	19.1	35.7	0.0	54.8
	Estimated Escapement:	387	721	0	1,107
Total:	Number in Sample:	37	75	3	115
	Estimated % of Escapement:	32.2	65.2	2.6	100.0
	Estimated Escapement:	650	1,318	53	2,021
	Standard Error:	88	90	30	
Stratum 12: 8/27 - 9/02 Sampling Date: 8/28					
Female:	Number in Sample:	17	36	1	54
	Estimated % of Escapement:	13.5	28.6	0.8	42.9
	Estimated Escapement:	627	1,328	37	1,992
Male:	Number in Sample:	31	41	0	72
	Estimated % of Escapement:	24.6	32.5	0.0	57.1
	Estimated Escapement:	1,144	1,513	0	2,657
Total:	Number in Sample:	48	77	1	126
	Estimated % of Escapement:	38.1	61.1	0.8	100.0
	Estimated Escapement:	1,771	2,841	37	4,649
	Standard Error:	202	203	37	
Stratum 13: 9/03 - 9/09 Sampling Dates: 9/05 - 9/08					
Female:	Number in Sample:	18	34	0	52
	Estimated % of Escapement:	15.7	29.6	0.0	45.2
	Estimated Escapement:	546	1,032	0	1,579
Male:	Number in Sample:	20	41	2	63
	Estimated % of Escapement:	17.4	35.7	1.7	54.8
	Estimated Escapement:	607	1,245	61	1,912
Total:	Number in Sample:	38	75	2	115
	Estimated % of Escapement:	33.0	65.2	1.7	100.0
	Estimated Escapement:	1,154	2,277	61	3,491
	Standard Error:	154	156	43	

(Continued)

Appendix 7.-(Continued).

		Brood Year and Age Group			
		1992	1991	1990	
		1.1	2.1	3.1	Total
Stratum 14: 9/10 - 9/12 No samples collected					
Strata 11 - 13: 8/20 - 9/09 Sampling Dates: 8/21 - 9/08					
Female:	Number in Sample:	50	104	4	158
	% Females in Age Group:	32.0	66.0	2.0	100.0
	Estimated % of Escapement:	14.1	29.1	0.9	44.1
	Estimated Escapement:	1,437	2,958	90	4,485
	Estimated Design Effects:	1.086	1.083	0.893	1.084
Male:	Number in Sample:	73	123	2	198
	% Males in Age Group:	37.7	61.3	1.1	100.0
	Estimated % of Escapement:	21.0	34.2	0.6	55.9
	Estimated Escapement:	2,138	3,478	61	5,676
	Estimated Design Effects:	1.097	1.080	1.058	1.084
Total:	Number in Sample:	123	227	6	356
	Estimated % of Escapement:	35.2	63.3	1.5	100.0
	Estimated Escapement:	3,575	6,436	150	10,161 *
	Standard Error:	269	271	64	
	Estimated Design Effects:	1.089	1.088	0.967	

* 740 fish that were counted through the weir during strata 1 through 10 and stratum 14 are not included in this total.