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Abundance and Run Timing of Adult Salmon in the East Fork Andreafsky River, Yukon Delta National Wildlife Refuge, Alaska, 1997

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Abundance and Run Timing of Adult Salmon in the East Fork Andreafsky River, Yukon Delta National Wildlife Refuge, Alaska, 1997

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Abstract.— From June 15 to September 13, 1997, 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 fourth 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 51,139 chum *Oncorhynchus keta*, 3,186 chinook *O. tshawytscha*, 429 pink *O. gorbuscha*, 100 sockeye *O. nerka*, and 9,472 coho *O. kisutch* salmon were counted through the weir. Picket spacing (4.8 cm gap maximum) was wide enough for pink salmon to escape upstream undetected. Peak weekly passage occurred: July 6-12 for chum and chinook; July 13-19 for pink; August 24-30 for sockeye; and August 24-30 for coho salmon.

Three age groups were identified from 1,403 chum salmon sampled from the weir escapement between June 22 and September 13. This escapement was composed primarily of age 0.4 (76%) and 0.3 (17%) fish. Females composed an estimated 51% of the sampled chum salmon escapement, and except for August 24-30, were predominate after July 12 . Age composition differed between sexes.

The 1997 weir escapement of 51,139 chum salmon was substantially less than in 1994 (N=200,981), 1995 (N=172,148), and 1996 (N=108,450). Relatively low numbers of chum salmon returning to the East Fork during 1997 was probably a result of a poor brood year escapement during 1993. Run timing during 1997 was later than in 1994-1996.

Three age groups were identified from 410 chinook salmon sampled from the weir escapement between June 22 and September 13. This escapement was composed primarily of age 1.2 (49%) and 1.4 (34%) fish. Males composed an estimated 63% of the sampled chinook salmon escapement. Age composition differed between sexes. Males were predominately age 1.2 (67%) followed by age 1.3 (21%), and females were primarily age 1.4 (71%) followed by age 1.2 (18%).

The 1997 weir escapement of 3,186 chinook salmon was less than in 1994 (N=7,801) and 1995 (N=5,841), but greater than in 1996 (N=2,955). Strong escapements during 1993 and 1994 indicate potentially strong age 1.2 and age 1.3 components in the 1998 East Fork return. Until July 8, timing of chinook salmon returning to the East Fork appeared normal relative to 1994-1996, but daily escapements began to decline rather than build after that date. After July 8, chinook salmon passed the weir in pulses, and the major portion of the run was protracted and appeared late.

Four age groups were identified from 555 coho salmon sampled from the weir escapement between August 10 and September 13. Males composed an estimated 59% of this

escapement and predominated after August 10. Age 2.1 coho salmon were most abundant (93%).

The 1997 weir escapement of 9,472 coho salmon was within the range of 1995 and 1996 weir escapements (N=10,901 and 8,037 respectively). Run timing resembled that in 1995 but was later than in 1996.

Three Dolly Varden *Salvelinus malma*, 5,458 whitefish (*Prosopium cylindraceum* and *Coregonus* spp.), and 27 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). The Andreafsky River drainage supports the largest return of pink salmon in the Yukon River drainage and typically ranks second to the Anvik River in summer chum salmon (arbitrarily determined as those in the escapement prior to August 1) 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 maintained. 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. Escapement data are lacking on many of these individual stocks in the Yukon River drainage and are needed for more precise management.

Relative abundances of summer chum, chinook, and coho salmon have been estimated in the Andreafsky and other tributary rivers 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, 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 tower counts. Summer chum and chinook salmon escapements were monitored 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 extremely 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, has been met every year except 1990 (Bergstrom et al. 1997). Chum salmon escapement objectives throughout the Yukon River drainage were generally achieved from 1994 to 1996. Preliminary analysis of comparative commercial harvest and escapement data by the Department indicate the 1997 summer chum salmon return was below average in magnitude for the Yukon River drainage (Bergstrom et al. 1997). Although minimum escapement goals generally were met or considered adequate in the Yukon River drainage, chum salmon escapements in the Andreafsky, Gisasa, and South Fork Koyukuk Rivers were poor during 1997 (Bergstrom et al. 1997).

Summer chum salmon stocks returning to the East Fork were below the aerial index 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 aerial index objective for the East Fork. Aerial index surveys estimating the relative abundance of summer chum salmon were not conducted from 1994 to 1997.

Chinook salmon escapement objectives were generally achieved in the lower Yukon River drainage since 1992 (Bergstrom et al. 1997). Chinook salmon returning to the East Fork

have generally exceeded the aerial index objective of 1,500 fish from 1990 to 1995 (Appendix 1). The aerial index estimate was 5,855 chinook salmon during 1993. This was substantially greater than historical aerial index and tower count estimates which ranged from 274 to 2,503 fish between 1961 and 1995. Aerial index surveys of the East Fork were not completed in 1994 and 1996. The aerial index estimate was 1,140 chinook salmon during 1997.

Coho, pink, and sockeye salmon abundance data are extremely limited or unavailable, and escapement objectives have not been established for these species in lower Yukon River tributaries. 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. From 1995 to 1997, 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 more than 200 river-kilometers (rkm) before converging. The main stem continues for another 7 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 affect the stage height in this section of the East Fork.

Methods

Weir Operation

A resistance board weir (Tobin 1994; Tobin and Harper 1995) 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 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 in June 1995 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. Staff gauge measurements were recalculated to correspond with the average water depth across the river channel at the upstream edge of the weir. Water temperatures were generally collected once daily between 0800 and 0900 hours.

The weir was operated from June 15 to September 13, 1997. Two live traps were installed near mid-channel to facilitate efficient fish passage and sampling during low water periods. All fish were enumerated to species as they passed through the live traps 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 between pickets were not counted. Picket spacing was variable (3.5 and 4.8 cm), because new and recycled weir panels were used. Panels with wider picket intervals were designed to remain functional during higher flows and allow independent passage of pink salmon between pickets. 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.

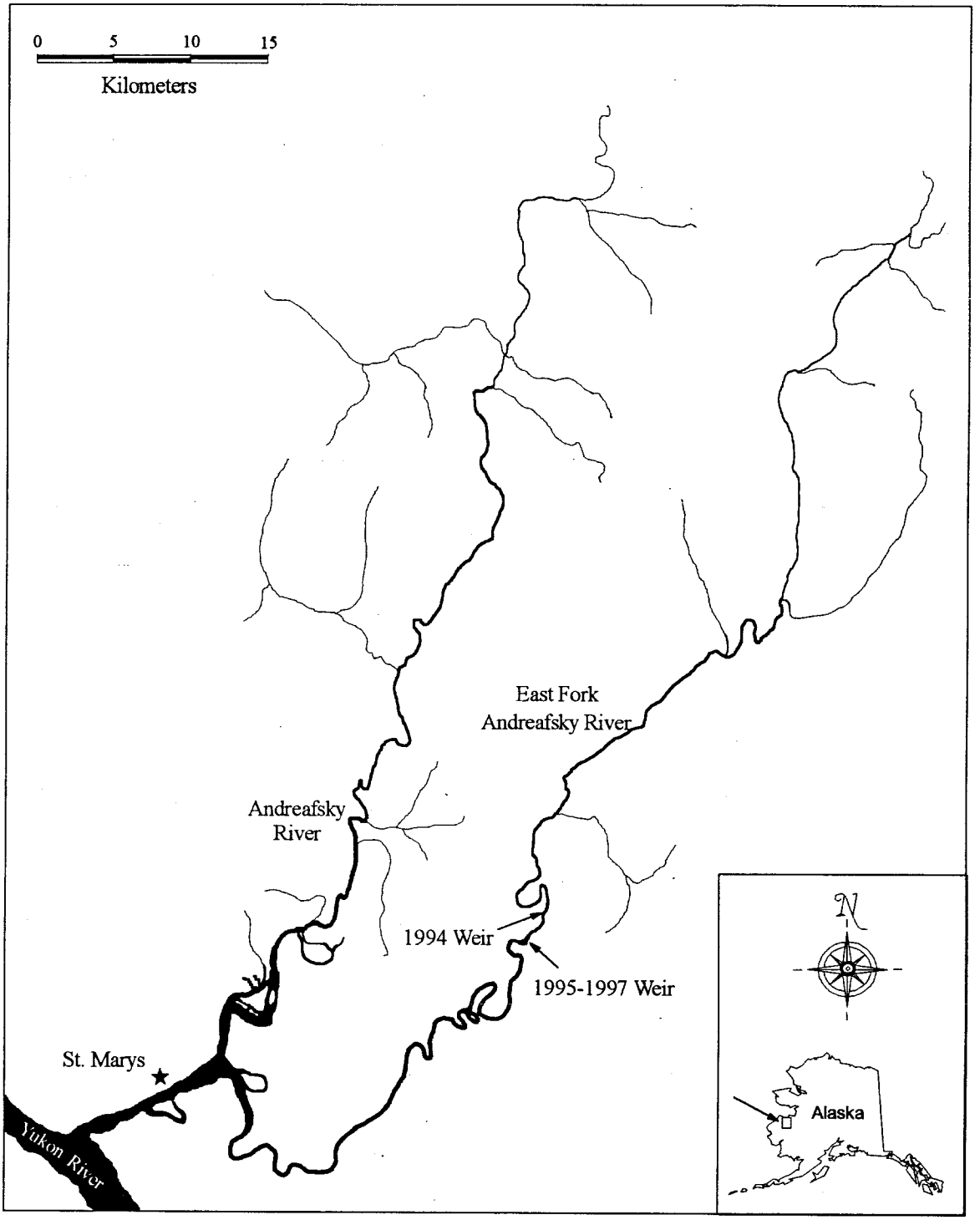

FIGURE 1.—Weir locations in the East Fork Andreafsky River, Alaska, 1994-1997.

Biological Data

Sample weeks or strata began on a Sunday and ended the following Saturday. However, partial weeks of weir operation shortened the length of the first and last strata. Sampling generally commenced near the beginning of the week, 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 and sex specific escapements in a stratum, A_{hij}, and their variances, $V[A_{hij}]$, were estimated as:

$$\hat{A}_{hij} = N_h \, p_{hij} \; ; \tag{1}$$

and

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

where

N_h = total escapement of a given species during stratum h;
$\hat{p}_{hij}$ = estimated proportion of age i and sex j fish, of a given species, in the sample in stratum h; and
n_h = total number of fish, of a given species, in the sample for stratum h.

Abundance estimates and their variances for each stratum were summed to obtain age and sex specific escapements for the season as follows:

$$\hat{A}_{ij} = \sum \hat{A}_{hij} \; ; \tag{3}$$

and

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

where

$\hat{A}_{ij}$ = estimated total escapement for age i and sex j fish of a given species.

Results

Weir Operation

The weir was functional during most of the operational period. Low to moderate stage heights averaging 37 cm persisted through most of the operational period of the weir with minimum and maximum levels reaching 19 and 121 cm (Appendix 2). A high water event caused portions of the weir to submerge from September 1 to September 3. Submerged sections were intermittently monitored, but no fish were observed escaping over the panels. Water temperatures averaged 13.2°C from June 16 to September 13 (Appendix 2). Minimum and maximum temperatures reached 8 and 18°C.

Biological Data

Five species of Pacific salmon, including 51,139 chum, 3,186 chinook, 429 pink, 100 sockeye, and 9,472 coho salmon, were counted upstream through the weir (Appendix 3). Other species counted through the weir include three Dolly Varden *Salvelinus malma*, 5,458 whitefish *Prosopium cylindraceum* and *Coregonus* spp., and 27 northern pike *Esox lucius* (Appendix 3).

Chum salmon.—Chum salmon (N=51,139) passed through the weir from June 16 to September 13. Peak passage (N=17,372) occurred the week of July 6-12 (Figure 2; Appendix 3), and the median passage date was July 9 (Figure 3; Appendix 4). Counts did not exceed 100 fish per day after August 5.

Three age groups were identified from 1,403 chum salmon sampled from the weir escapement between June 22 and September 13 (Appendix 5). During this period, 49,351 chum salmon were counted through the weir. Females composed an estimated 51% of this escapement, and except for August 24-30, were predominate after July 12 (Figure 3; Appendix 5). The sampled escapement was composed primarily of age 0.4 (76%) and age 0.3 (17%) chum salmon with age 0.4 fish being most abundant except from July 20-26 and August 3-9.

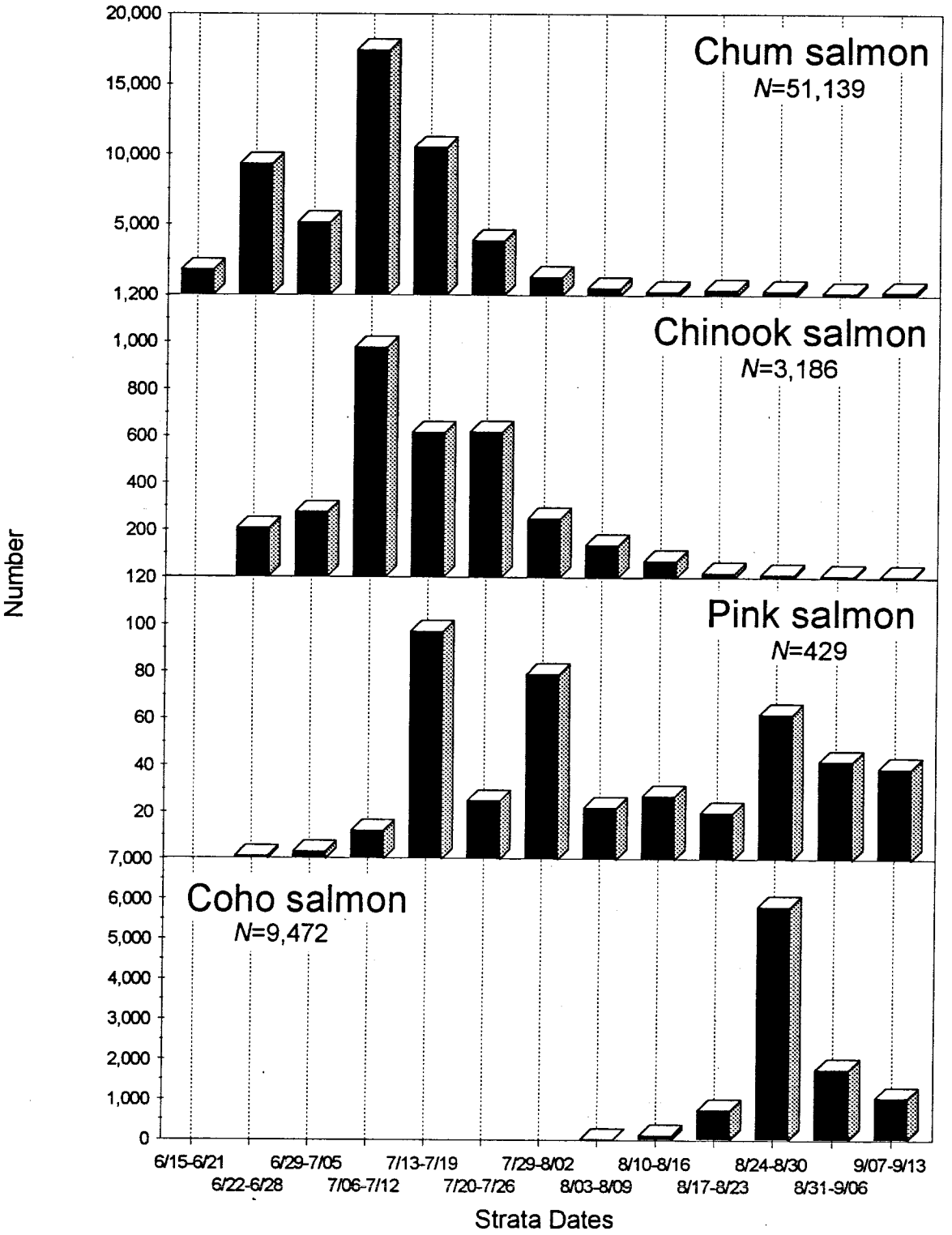

FIGURE 2.—Chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1997.

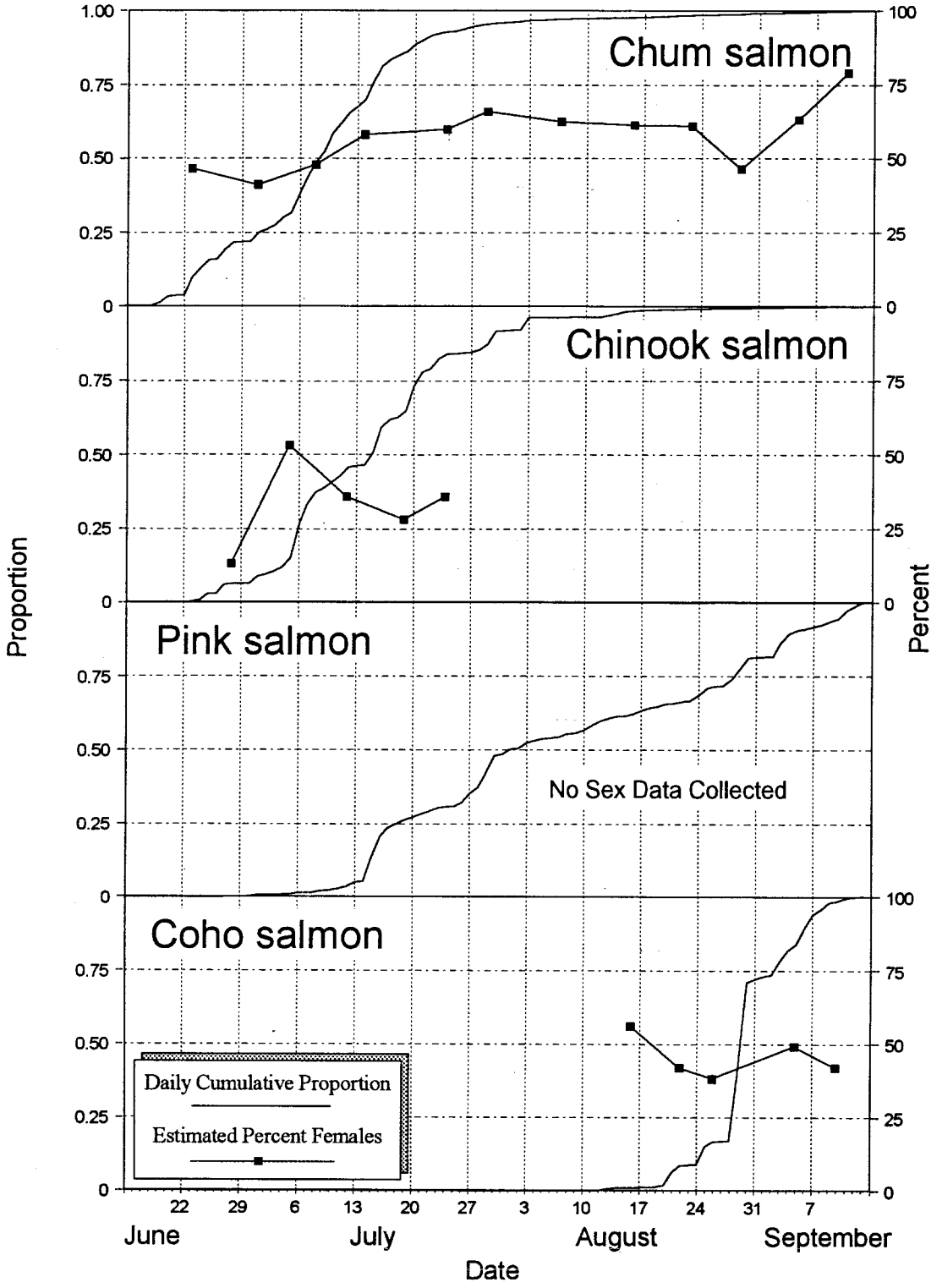

FIGURE 3.—Cumulative daily proportion and sex composition of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1997.

Age composition differed between sexes ($X^2(\hat{\delta}.)=17.3$, df=2, $P<0.001$). Both males and females were primarily age 0.4 (77 and 76%, respectively), however, only 13% males were age 0.3 while 21% of females were of this age. In sampled fish, the mean length of males was greater than that of same-aged females (two-tailed t test: age 0.3, $t=6.6$, df=385, $P<0.001$; age 0.4, $t=17.7$, df=933, $P<0.001$; age 0.5, $t=3.9$, df=79, $P<0.001$)(Table 1).

TABLE 1.—Lengths at age for chum salmon sampled at the East Fork Andreafsky River weir, Alaska, 1997.

		Mid-Eye to Fork Length (mm)		
Age	*N*	Mean	SE	Range
		Female		
0.3	263	514	2.0	390-615
0.4	508	546	1.4	445-645
0.5	26	570	6.6	510-650
Total	797	536	1.3	390-650
		Male		
0.3	124	538	3.1	460-670
0.4	427	588	1.9	470-750
0.5	55	599	4.1	515-650
Total	606	579	1.8	460-750

Chinook salmon.—Chinook salmon (N=3,186) passed through the weir from June 23 to September 12. Peak passage (N=976) occurred the week of July 6-12 (Figure 2; Appendix 3), and the median passage date was July 15 (Figure 3; Appendix 4). Counts did not exceed 30 fish per day after August 3.

Three age groups were identified from 410 chinook salmon sampled from the weir escapement between June 22 and September 13 (Appendix 6). During this period, 3,186 chinook salmon were counted through the weir. Males composed an estimated 63% of this escapement (Figure 3; Appendix 6). Age 1.2 chinook salmon were most abundant (49%) followed by age 1.4 (34%) fish.

Age composition differed between sexes ($X^2(\hat{\delta}.)=136.4$, df=2, $P<0.001$). Males were predominately age 1.2 (67%) followed by age 1.3 (21%), and females were primarily age 1.4 (71%) followed by age 1.2 (18%). In sampled fish, the mean length of age 1.4 females was greater than that of same-aged males (two-tailed t test: $t=2.1$, df=249, $P<0.001$)(Table 2).

TABLE 2.—Lengths at age for chinook salmon sampled at the East Fork Andreafsky River weir, Alaska, 1997.

Age	*N*	Mid-Eye to Fork Length (mm)		
		Mean	SE	Range
		Female		
1.2	34	595	9.9	495-790
1.3	17	712	23.4	560-840
1.4	100	828	5.1	565-940
Total	151	763	9.3	495-940
		Male		
1.2	182	578	4.2	350-760
1.3	47	678	11.8	480-845
1.4	30	780	11.4	630-970
Total	259	619	5.8	350-970

Pink salmon.—Although able to pass uncounted between panel pickets, 429 pink salmon passed through the weir at counting stations from June 27 to September 13. Peak passage (N=97) occurred the week of July 13-19 (Figure 2; Appendix 3), and the median passage date was August 1 (Figure 3; Appendix 4).

Sockeye salmon.—Sockeye salmon (N=100) passed through the weir from June 29 to September 13. Peak passage (N=25) occurred the week of August 24-30 (Appendix 3), and the median passage date was August 25.

Coho salmon.—Coho salmon (N=9,472) passed through the weir from August 7 to September 13. Peak passage (N=5,826) occurred the week of August 24-30 (Figure 2; Appendix 3), and the median passage date was August 30. Counts exceeded 100 fish per day only once after September 9 (Appendix 3).

Four age groups were identified from 555 coho salmon sampled from the weir escapement between August 10 and September 13 (Appendix 7). During this period, 9,471 coho salmon were counted through the weir. Males composed an estimated 59% of this escapement and predominated after August 16 (Figure 3; Appendix 7). Age 2.1 coho salmon were most abundant (93%).

Age composition did not differ between sexes ($X^2(\hat{\delta}.)$=5.4, df=2, P=0.145). In sampled fish, the mean length of age 2.1 females was greater than that of same-aged males (two-tailed t test: t=2.6, df=524, P=0.009)(Table 3).

TABLE 3.—Lengths at age for coho salmon sampled at the East Fork Andreafsky River weir, Alaska, 1997.

Age	*N*	Mid-Eye to Fork Length (mm)		
		Mean	SE	Range
		Female		
1.1	8	531	15.9	470-610
2.1	231	545	2.7	405-620
2.2	3	535	16.1	505-560
3.1	2	530	0.0	530
Total	244	544	2.6	405-620
		Male		
1.1	7	521	19.9	440-575
2.1	295	534	2.8	395-630
2.2	5	511	18.9	470-570
3.1	4	511	23.8	460-565
Total	311	533	2.6	395-565

Discussion

Weir Operation

Low water levels prevailed through much of the operational period of the weir making it difficult to efficiently pass fish using conventional methods. To facilitate fish passage, pickets or entire weir panels were removed to count fish through areas where they preferred to pass during low water.

Although no fish were observed escaping over panels that were submerged during the high water event which occurred September 1-3, a small number of coho salmon probably passed undetected.

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

Biological Data

Chum salmon.—The chum salmon escapement during 1997 (N=51,139) was poor relative to 1994-1996 escapements which ranged from 108,450 to 200,981 fish (Tobin and Harper 1995; 1996; 1997)(Appendix 1). Preliminary analysis of comparative commercial harvest and escapement data by the Department indicate the 1997 summer chum salmon return was below average in magnitude for the Yukon River drainage (Bergstrom et al. 1997). Although

minimum escapement goals were met or considered adequate in the Anvik, Nulato, Chena, and Salcha Rivers and Kaltag and Clear Creeks, escapements in the Andreafsky, Gisasa, and South Fork Koyukuk Rivers were poor during 1997 (Bergstrom et al. 1997).

Poor chum salmon escapement to the East Fork may have resulted from poor brood year production during 1993. This is supported by the fact that, except in the Anvik River, chum salmon returns throughout the Yukon River drainage were extremely poor during 1993 (Bergstrom et al. 1995). The East Fork aerial index estimate was only 10,935 fish during 1993 (Appendix 1). Although the aerial index survey was conducted prior to the peak of spawning during 1993, survey conditions were excellent, and the survey results were far below minimum escapement goals. Additionally, age 0.3 fish (1993 brood year) composed only 17% of the sampled escapement during 1997. Comparatively, age 0.3 fish averaged 50% of the sampled escapement from 1994 to 1996.

Based on the 1994 weir escapement (N=200,981), a strong return of age 0.3 chum salmon is expected in the East Fork during 1998. A low proportion of age 0.4 fish is expected as a result of poor parent year escapement.

Timing of chum salmon returning to the East Fork during 1998 was later than 1994-1996 (Tobin and Harper 1995; 1996; 1997). Median passage dates during 1994, 1995, 1996, and 1997 were July 8, 5, 4, and 9, respectively. However, the true median passage date for the 1994 East Fork chum salmon escapement would have been earlier than July 8 if uncounted fish that passed prior to weir installation are considered (Tobin and Harper 1995).

Chinook salmon.—Chinook salmon escapement to the East Fork during 1997 (N=3,186) was poor relative to the 1994 and 1995 weir escapements (N=7,801 and 5,841, respectively) and similar in magnitude to the 1996 weir escapement (N=2,955)(Tobin and Harper 1995; 1996; 1997)(Appendix 1). An aerial index survey conducted by the Department during 1997 resulted in an estimate of 1,140 chinook salmon (Appendix 1). This estimate was 76% of the aerial index escapement objective of 1,500 fish.

Based on parent year escapements and analysis of brood year returns, the 1998 chinook salmon escapement is expected to be composed primarily of age 1.2 and 1.3 fish. Although escapement data are insufficient for 1992, previous returns from the 1992 brood year indicate the proportion of age 1.4 fish in the escapement will be smaller than in 1997.

Until July 8, timing of chinook salmon returning to the East Fork appeared normal relative to 1994-1996, but daily escapements began to decline rather than build after that date. After July 8, chinook salmon passed the weir in pulses, and the major portion of the run was protracted and appeared late (Figure 2). Median passage dates during 1994, 1995, 1996, and 1997 were July 11, 12, 8, and 15, respectively.

Pink salmon.—Although pink salmon returns to the East Fork are historically small in magnitude during odd years, the 1997 escapement (N=429) was only 22% of that during 1995 (N=1,972)(Tobin and Harper 1996). However, comparison of pink salmon escapement

magnitudes should be used with caution, because the weir was moved downstream to a wider section of river during 1995 (Tobin and Harper 1996). Weir span, picket spacing, and location of counting stations were different each year, therefore, weir counts for pink salmon are, at best, an indicator of run timing.

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. The magnitude of sockeye salmon escapements through the weir have been small, ranging from 33 fish in 1994 to 248 fish in 1996. Median passage dates range from July 20 in 1996 to August 25 in 1997. Run magnitude and timing results are potentially unreliable because of low sockeye salmon abundances and the potential for misidentification with other species.

Coho salmon.—Coho salmon escapement to the East Fork during 1997 (N=9,472) was within the range of 1995 and 1996 weir escapements (N=10,901 and 8,037 respectively) (Tobin and Harper 1996; 1997). During 1997, 53% of the total coho salmon escapement passed the weir over a 2-d period (N=2,335 on 8/29 and N=2,714 on 8/30). This large pulse of fish coincided with a 0.5-m rise in river stage height (Appendix 2).

Run timing in the East Fork during 1997 resembled that in 1995 and was slightly later than in 1996 (Tobin and Harper 1996; 1997). During all three years, peak passage occurred in late August. Median passage dates during 1995 and 1997 were August 31 and 30, respectively. The median passage date during 1996 was August 26.

Recommendations

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

1. In response to the poor chum salmon escapement during 1998, develop benchmarks to alert fishery managers when in-season projections indicate undesirable escapement magnitudes in the East Fork.

2. Continue weir operation into 1998 to monitor the result of the poor summer chum salmon returns during 1993.

3. Continue weir operation into late September to obtain 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, 1961-1997. All data, except weir counts are from Bergstrom et al. (1997).

	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
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		
1996				2,955 [d]	108,450 [d]	8,037 [d]	624		
1997	1,140			3,186 [d]	51,139 [d]	9,472 [d]	1,510		
I.O.	>1,500	>109,000					>1,400	>116,000	

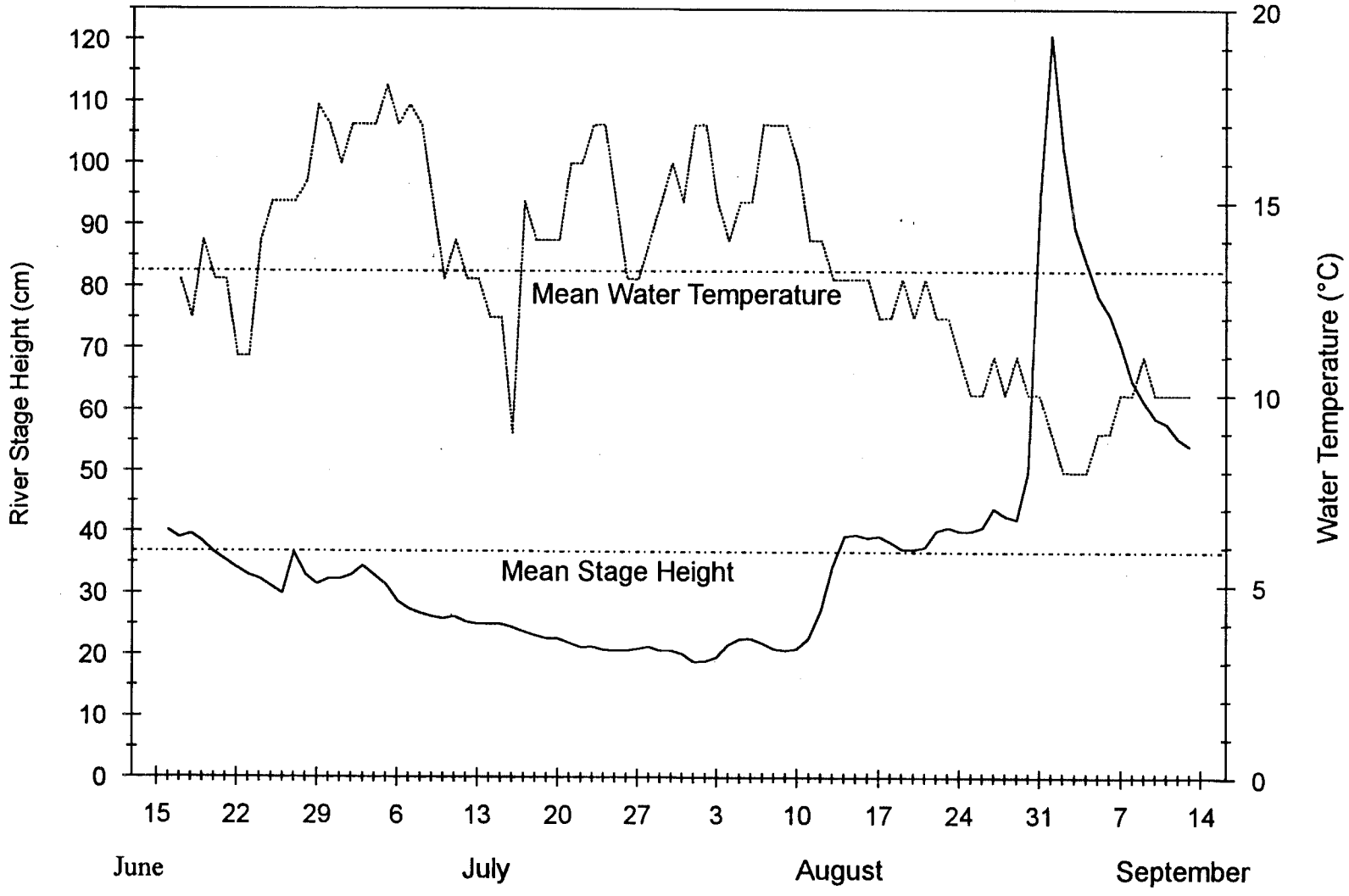
I.O. Interim aerial index objective

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, 1997.

Appendix 3.-Daily escapement and counting effort at the East Fork Andreafsky River weir, Alaska, 1997.

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 1					
06/15	4.25	0	0	0	0	0	0	19	0
06/16	12.00	1	0	0	0	0	0	41	1
06/17	13.25	4	0	0	0	0	0	33	0
06/18	16.75	71	0	0	0	0	0	114	1
06/19	26.75	539	0	0	0	0	0	163	10
06/20	15.50	981	0	0	0	0	0	126	0
06/21	13.25	192	0	0	0	0	0	63	1
Total:	101.75	1,788	0	0	0	0	0	559	13
				Stratum 2					
06/22	11.25	53	0	0	0	0	0	19	1
06/23	15.75	3,141	14	0	0	0	0	51	1
06/24	12.50	1,620	21	0	0	0	0	81	1
06/25	20.75	1,422	59	0	0	0	0	76	1
06/26	14.50	208	0	0	0	0	0	63	1
06/27	11.50	1,691	101	1	0	0	0	127	1
06/28	16.50	1,196	11	0	0	0	0	85	0
Total:	102.75	9,331	206	1	0	0	0	502	6
				Stratum 3					
06/29	16.00	61	1	0	1	0	0	143	0
06/30	21.50	80	0	0	0	0	0	76	0
07/01	15.50	1,537	75	2	1	0	0	91	0
07/02	22.50	619	24	0	0	0	0	75	0
07/03	21.50	756	29	0	0	0	0	57	0
07/04	24.50	1,264	49	1	0	0	0	104	0
07/05	25.50	831	98	0	0	0	0	45	0
Total:	147.00	5,148	276	3	2	0	0	591	0
				Stratum 4					
07/06	21.25	3,428	356	2	0	0	0	47	0
07/07	37.25	2,980	227	0	1	0	0	38	0
07/08	31.50	2,440	123	1	0	0	0	36	1
07/09	29.75	1,799	49	2	0	0	0	12	0
07/10	31.25	3,195	64	1	1	0	1	15	0
07/11	31.00	1,792	69	2	0	0	0	9	0
07/12	31.75	1,738	88	4	0	0	0	6	0
Total:	213.75	17,372	976	12	2	0	1	163	1
				Stratum 5					
07/13	30.25	1,062	15	6	0	0	0	2	0
07/14	27.75	1,302	16	1	2	0	0	3	0
07/15	30.50	3,222	124	35	1	0	0	5	0
07/16	31.75	2,441	274	31	2	0	0	9	0
07/17	30.25	1,150	91	13	1	0	0	16	0
07/18	26.50	715	25	5	1	0	0	1	0
07/19	29.25	624	70	6	0	0	0	3	0
Total:	206.25	10,516	615	97	7	0	0	39	0

(Continued)

Appendix 3.-(Continued)

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 6					
07/20	32.25	1,220	264	4	1	0	0	6	0
07/21	30.75	800	148	4	0	0	1	4	0
07/22	31.50	668	35	4	2	0	0	3	0
07/23	34.25	405	103	5	1	0	0	2	1
07/24	31.00	313	57	2	0	0	0	1	0
07/25	28.50	121	0	0	0	0	0	0	0
07/26	33.25	339	11	6	0	0	0	0	1
Total:	221.50	3,866	618	25	4	0	1	16	2
				Stratum 7					
07/27	33.50	400	3	13	0	0	0	0	0
07/28	34.00	219	29	9	3	0	0	1	0
07/29	39.25	234	58	20	3	0	1	9	1
07/30	42.75	131	144	26	2	0	0	28	1
07/31	33.00	86	2	2	0	0	0	2	0
08/01	34.00	134	8	7	3	0	0	7	1
08/02	32.50	81	4	2	2	0	0	1	0
Total:	249.00	1,285	248	79	13	0	1	48	3
				Stratum 8					
08/03	32.50	182	128	8	1	0	0	0	0
08/04	30.25	48	2	3	0	0	0	2	0
08/05	31.50	101	1	3	0	0	0	1	1
08/06	31.75	77	0	1	0	0	0	2	0
08/07	31.50	29	1	1	0	1	0	0	0
08/08	31.50	31	2	5	0	0	0	0	0
08/09	32.00	44	2	1	0	0	0	2	0
Total:	221.00	512	136	22	1	1	0	7	1
				Stratum 9					
08/10	33.00	17	1	4	0	0	0	0	0
08/11	32.50	14	1	7	0	0	0	3	0
08/12	29.75	65	7	6	0	10	0	15	0
08/13	31.00	36	14	4	2	47	0	246	1
08/14	30.75	33	18	3	0	35	0	346	0
08/15	31.25	31	26	0	0	6	0	163	0
08/16	26.50	46	2	3	0	8	0	73	0
Total:	214.75	242	69	27	2	106	0	846	1
				Stratum 10					
08/17	31.75	37	4	5	0	7	0	29	0
08/18	31.25	58	3	4	1	12	0	22	0
08/19	31.00	43	3	2	2	13	0	44	0
08/20	31.00	95	2	4	5	50	0	46	0
08/21	31.00	54	1	1	5	414	0	84	0
08/22	30.50	37	4	2	1	222	0	120	0
08/23	30.75	31	2	2	1	22	0	52	0
Total:	217.25	355	19	20	15	740	0	397	0

(Continued)

Appendix 3.-(Continued)

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 11					
08/24	30.50	41	1	8	1	16	0	23	0
08/25	27.25	41	4	10	8	577	0	26	0
08/26	30.50	18	0	3	2	150	0	43	0
08/27	30.00	20	0	1	1	10	0	42	0
08/28	30.00	38	1	9	2	24	0	32	0
08/29	29.25	57	2	15	5	2,335	0	53	0
08/30	15.75	73	3	16	6	2,714	0	332	0
Total:	193.25	288	11	62	25	5,826	0	551	0
				Stratum 12					
08/31	7.00	21	1	1	0	122	0	51	0
09/01	12.50	14	0	1	0	73	0	68	0
09/02	14.75	13	0	0	4	53	0	155	0
09/03	15.00	53	4	20	2	421	0	355	0
09/04	24.00	28	0	13	1	355	0	134	0
09/05	22.25	38	1	5	1	219	0	92	0
09/06	29.00	31	1	2	2	514	0	134	0
Total:	124.50	198	7	42	10	1,757	0	989	0
				Stratum 13					
09/07	26.00	51	0	3	3	435	0	135	0
09/08	26.50	28	2	3	1	169	0	178	0
09/09	27.00	22	1	5	4	223	0	96	0
09/10	26.50	24	0	4	4	52	0	77	0
09/11	27.50	48	0	12	2	83	0	98	0
09/12	27.75	42	2	6	3	64	0	77	0
09/13	18.00	23	0	6	2	16	0	89	0
Total:	179.25	238	5	39	19	1,042	0	750	0
				All Strata					
Total:	2392.00	51,139	3,186	429	100	9,472	3	5,458	27

Appendix 4.-Daily, cumulative, and cumulative proportion of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1997.

	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
06/15	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000
06/16	1	1	0.000	0	0	0.000	0	0	0.000	0	0	0.000
06/17	4	5	0.000	0	0	0.000	0	0	0.000	0	0	0.000
06/18	71	76	0.001	0	0	0.000	0	0	0.000	0	0	0.000
06/19	539	615	0.012	0	0	0.000	0	0	0.000	0	0	0.000
06/20	981	1,596	0.031	0	0	0.000	0	0	0.000	0	0	0.000
06/21	192	1,788	0.035	0	0	0.000	0	0	0.000	0	0	0.000
06/22	53	1,841	0.036	0	0	0.000	0	0	0.000	0	0	0.000
06/23	3,141	4,982	0.097	14	14	0.004	0	0	0.000	0	0	0.000
06/24	1,620	6,602	0.129	21	35	0.011	0	0	0.000	0	0	0.000
06/25	1,422	8,024	0.157	59	94	0.030	0	0	0.000	0	0	0.000
06/26	208	8,232	0.161	0	94	0.030	0	0	0.000	0	0	0.000
06/27	1,691	9,923	0.194	101	195	0.061	1	1	0.002	0	0	0.000
06/28	1,196	11,119	0.217	11	206	0.065	0	1	0.002	0	0	0.000
06/29	61	11,180	0.219	1	207	0.065	0	1	0.002	0	0	0.000
06/30	80	11,260	0.220	0	207	0.065	0	1	0.002	0	0	0.000
07/01	1,537	12,797	0.250	75	282	0.089	2	3	0.007	0	0	0.000
07/02	619	13,416	0.262	24	306	0.096	0	3	0.007	0	0	0.000
07/03	756	14,172	0.277	29	335	0.105	0	3	0.007	0	0	0.000
07/04	1,264	15,436	0.302	49	384	0.121	1	4	0.009	0	0	0.000
07/05	831	16,267	0.318	98	482	0.151	0	4	0.009	0	0	0.000
07/06	3,428	19,695	0.385	356	838	0.263	2	6	0.014	0	0	0.000
07/07	2,980	22,675	0.443	227	1,065	0.334	0	6	0.014	0	0	0.000
07/08	2,440	25,115	0.491	123	1,188	0.373	1	7	0.016	0	0	0.000
07/09	1,799	26,914	0.526	49	1,237	0.388	2	9	0.021	0	0	0.000
07/10	3,195	30,109	0.589	64	1,301	0.408	1	10	0.023	0	0	0.000
07/11	1,792	31,901	0.624	69	1,370	0.430	2	12	0.028	0	0	0.000
07/12	1,738	33,639	0.658	88	1,458	0.458	4	16	0.037	0	0	0.000
07/13	1,062	34,701	0.679	15	1,473	0.462	6	22	0.051	0	0	0.000
07/14	1,302	36,003	0.704	16	1,489	0.467	1	23	0.054	0	0	0.000

(Continued)

Appendix 4.-(Continued)

Date	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
07/15	3,222	39,225	0.767	124	1,613	0.506	35	58	0.135	0	0	0.000
07/16	2,441	41,666	0.815	274	1,887	0.592	31	89	0.207	0	0	0.000
07/17	1,150	42,816	0.837	91	1,978	0.621	13	102	0.238	0	0	0.000
07/18	715	43,531	0.851	25	2,003	0.629	5	107	0.249	0	0	0.000
07/19	624	44,155	0.863	70	2,073	0.651	6	113	0.263	0	0	0.000
07/20	1,220	45,375	0.887	264	2,337	0.734	4	117	0.273	0	0	0.000
07/21	800	46,175	0.903	148	2,485	0.780	4	121	0.282	0	0	0.000
07/22	668	46,843	0.916	35	2,520	0.791	4	125	0.291	0	0	0.000
07/23	405	47,248	0.924	103	2,623	0.823	5	130	0.303	0	0	0.000
07/24	313	47,561	0.930	57	2,680	0.841	2	132	0.308	0	0	0.000
07/25	121	47,682	0.932	0	2,680	0.841	0	132	0.308	0	0	0.000
07/26	339	48,021	0.939	11	2,691	0.845	6	138	0.322	0	0	0.000
07/27	400	48,421	0.947	3	2,694	0.846	13	151	0.352	0	0	0.000
07/28	219	48,640	0.951	29	2,723	0.855	9	160	0.373	0	0	0.000
07/29	234	48,874	0.956	58	2,781	0.873	20	180	0.420	0	0	0.000
07/30	131	49,005	0.958	144	2,925	0.918	26	206	0.480	0	0	0.000
07/31	86	49,091	0.960	2	2,927	0.919	2	208	0.485	0	0	0.000
08/01	134	49,225	0.963	8	2,935	0.921	7	215	0.501	0	0	0.000
08/02	81	49,306	0.964	4	2,939	0.922	2	217	0.506	0	0	0.000
08/03	182	49,488	0.968	128	3,067	0.963	8	225	0.524	0	0	0.000
08/04	48	49,536	0.969	2	3,069	0.963	3	228	0.531	0	0	0.000
08/05	101	49,637	0.971	1	3,070	0.964	3	231	0.538	0	0	0.000
08/06	77	49,714	0.972	0	3,070	0.964	1	232	0.541	0	0	0.000
08/07	29	49,743	0.973	1	3,071	0.964	1	233	0.543	1	1	0.000
08/08	31	49,774	0.973	2	3,073	0.965	5	238	0.555	0	1	0.000
08/09	44	49,818	0.974	2	3,075	0.965	1	239	0.557	0	1	0.000
08/10	17	49,835	0.975	1	3,076	0.965	4	243	0.566	0	1	0.000
08/11	14	49,849	0.975	1	3,077	0.966	7	250	0.583	0	1	0.000
08/12	65	49,914	0.976	7	3,084	0.968	6	256	0.597	10	11	0.001
08/13	36	49,950	0.977	14	3,098	0.972	4	260	0.606	47	58	0.006
08/14	33	49,983	0.977	18	3,116	0.978	3	263	0.613	35	93	0.010

(Continued)

Appendix 4.-(Continued)

Date	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
08/15	31	50,014	0.978	26	3,142	0.986	0	263	0.613	6	99	0.010
08/16	46	50,060	0.979	2	3,144	0.987	3	266	0.620	8	107	0.011
08/17	37	50,097	0.980	4	3,148	0.988	5	271	0.632	7	114	0.012
08/18	58	50,155	0.981	3	3,151	0.989	4	275	0.641	12	126	0.013
08/19	43	50,198	0.982	3	3,154	0.990	2	277	0.646	13	139	0.015
08/20	95	50,293	0.983	2	3,156	0.991	4	281	0.655	50	189	0.020
08/21	54	50,347	0.985	1	3,157	0.991	1	282	0.657	414	603	0.064
08/22	37	50,384	0.985	4	3,161	0.992	2	284	0.662	222	825	0.087
08/23	31	50,415	0.986	2	3,163	0.993	2	286	0.667	22	847	0.089
08/24	41	50,456	0.987	1	3,164	0.993	8	294	0.685	16	863	0.091
08/25	41	50,497	0.987	4	3,168	0.994	10	304	0.709	577	1,440	0.152
08/26	18	50,515	0.988	0	3,168	0.994	3	307	0.716	150	1,590	0.168
08/27	20	50,535	0.988	0	3,168	0.994	1	308	0.718	10	1,600	0.169
08/28	38	50,573	0.989	1	3,169	0.995	9	317	0.739	24	1,624	0.171
08/29	57	50,630	0.990	2	3,171	0.995	15	332	0.774	2,335	3,959	0.418
08/30	73	50,703	0.991	3	3,174	0.996	16	348	0.811	2,714	6,673	0.704
08/31	21	50,724	0.992	1	3,175	0.997	1	349	0.814	122	6,795	0.717
09/01	14	50,738	0.992	0	3,175	0.997	1	350	0.816	73	6,868	0.725
09/02	13	50,751	0.992	0	3,175	0.997	0	350	0.816	53	6,921	0.731
09/03	53	50,804	0.993	4	3,179	0.998	20	370	0.862	421	7,342	0.775
09/04	28	50,832	0.994	0	3,179	0.998	13	383	0.893	355	7,697	0.813
09/05	38	50,870	0.995	1	3,180	0.998	5	388	0.904	219	7,916	0.836
09/06	31	50,901	0.995	1	3,181	0.998	2	390	0.909	514	8,430	0.890
09/07	51	50,952	0.996	0	3,181	0.998	3	393	0.916	435	8,865	0.936
09/08	28	50,980	0.997	2	3,183	0.999	3	396	0.923	169	9,034	0.954
09/09	22	51,002	0.997	1	3,184	0.999	5	401	0.935	223	9,257	0.977
09/10	24	51,026	0.998	0	3,184	0.999	4	405	0.944	52	9,309	0.983
09/11	48	51,074	0.999	0	3,184	0.999	12	417	0.972	83	9,392	0.992
09/12	42	51,116	1.000	2	3,186	1.000	6	423	0.986	64	9,456	0.998
09/13	23	51,139	1.000	0	3,186	1.000	6	429	1.000	16	9,472	1.000

The boxes indicate the first to the third quartiles of the cumulative proportions. The center boxes indicate the medians of the cumulative proportions.

Appendix 5.-Estimated age and sex composition of weekly chum salmon escapements through the East Fork Andreafsky River weir, Alaska, 1997, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group			
		1993	1992	1991	
		0.3	0.4	0.5	Total
Stratum 1: 06/15 - 06/21					
No Samples Collected					
Stratum 2: 06/22 - 06/28					
Sampling Date: 06/23					
Female:	Number in Sample:	1	65	4	70
	Estimated % of Escapement:	0.7	43.6	2.7	47.0
	Estimated Escapement:	63	4,071	250	4,384
	Standard Error:	62.1	377.3	123.0	
Male:	Number in Sample:	3	69	7	79
	Estimated % of Escapement:	2.0	46.3	4.7	53.0
	Estimated Escapement:	188	4,321	438	4,947
	Standard Error:	106.9	379.4	161.0	
Total:	Number in Sample:	4	134	11	149
	Estimated % of Escapement:	2.7	89.9	7.4	100.0
	Estimated Escapement:	250	8,392	689	9,331
	Standard Error:	123.0	228.9	199.0	
Stratum 3: 06/29 - 07/05					
Sampling Dates: 06/30 & 07/01					
Female:	Number in Sample:	8	51	2	61
	Estimated % of Escapement:	5.4	34.7	1.4	41.5
	Estimated Escapement:	280	1,786	70	2,136
	Standard Error:	95.3	199.9	48.6	
Male:	Number in Sample:	1	76	9	86
	Estimated % of Escapement:	0.7	51.7	6.1	58.5
	Estimated Escapement:	35	2,662	315	3,012
	Standard Error:	34.5	209.8	100.7	
Total:	Number in Sample:	9	127	11	147
	Estimated % of Escapement:	6.1	86.4	7.5	100.0
	Estimated Escapement:	315	4,448	385	5,148
	Standard Error:	100.7	144.0	110.5	
Stratum 4: 07/06 - 07/12					
Sampling Dates: 07/07 & 07/08					
Female:	Number in Sample:	14	52	1	67
	Estimated % of Escapement:	10.1	37.4	0.7	48.2
	Estimated Escapement:	1,750	6,499	125	8,374
	Standard Error:	443.3	712.7	124.5	
Male:	Number in Sample:	8	54	10	72
	Estimated % of Escapement:	5.8	38.8	7.2	51.8
	Estimated Escapement:	1,000	6,749	1,250	8,998
	Standard Error:	343.0	717.9	380.6	
Total:	Number in Sample:	22	106	11	139
	Estimated % of Escapement:	15.8	76.3	7.9	100.0
	Estimated Escapement:	2,750	13,248	1,375	17,372
	Standard Error:	537.6	626.7	397.6	

(Continued)

Appendix 5.-(Continued)

		Brood Year and Age Group			
		1993	1992	1991	
		0.3	0.4	0.5	Total
Stratum 5: 07/13 - 07/19					
Sampling Date: 07/14					
Female:	Number in Sample:	13	66	3	82
	Estimated % of Escapement:	9.3	47.1	2.1	58.6
	Estimated Escapement:	976	4,958	225	6,159
	Standard Error:	257.1	442.3	128.3	
Male:	Number in Sample:	13	42	3	58
	Estimated % of Escapement:	9.3	30.0	2.1	41.4
	Estimated Escapement:	976	3,155	225	4,357
	Standard Error:	257.1	406.0	128.3	
Total:	Number in Sample:	26	108	6	140
	Estimated % of Escapement:	18.6	77.1	4.3	100.0
	Estimated Escapement:	1,953	8,112	451	10,516
	Standard Error:	344.5	372.0	179.4	
Stratum 6: 07/20 - 07/26					
Sampling Dates: 07/22 & 07/24					
Female:	Number in Sample:	49	31	2	82
	Estimated % of Escapement:	36.0	22.8	1.5	60.3
	Estimated Escapement:	1,393	881	57	2,331
	Standard Error:	156.9	137.1	39.3	
Male:	Number in Sample:	24	26	4	54
	Estimated % of Escapement:	17.6	19.1	2.9	39.7
	Estimated Escapement:	682	739	114	1,535
	Standard Error:	124.6	128.5	55.2	
Total:	Number in Sample:	73	57	6	136
	Estimated % of Escapement:	53.7	41.9	4.4	100.0
	Estimated Escapement:	2,075	1,620	171	3,866
	Standard Error:	163.0	161.3	67.1	
Stratum 7: 07/27 - 08/02					
Sampling Dates: 07/28 & 07/29					
Female:	Number in Sample:	35	59	1	95
	Estimated % of Escapement:	24.5	41.3	0.7	66.4
	Estimated Escapement:	315	530	9	854
	Standard Error:	43.7	50.0	8.5	
Male:	Number in Sample:	16	31	1	48
	Estimated % of Escapement:	11.2	21.7	0.7	33.6
	Estimated Escapement:	144	279	9	431
	Standard Error:	32.0	41.9	8.5	
Total:	Number in Sample:	51	90	2	143
	Estimated % of Escapement:	35.7	62.9	1.4	100.0
	Estimated Escapement:	458	809	18	1,285
	Standard Error:	48.7	49.1	11.9	

(Continued)

Appendix 5.-(Continued)

		Brood Year and Age Group			
		1993	1992	1991	
		0.3	0.4	0.5	Total
Stratum 8: 08/03 - 08/09					
Sampling Dates: 08/04 - 08/07					
Female:	Number in Sample:	45	37	3	85
	Estimated % of Escapement:	33.3	27.4	2.2	63.0
	Estimated Escapement:	171	140	11	322
	Standard Error:	17.9	16.9	5.6	
Male:	Number in Sample:	24	22	4	50
	Estimated % of Escapement:	17.8	16.3	3.0	37.0
	Estimated Escapement:	91	83	15	190
	Standard Error:	14.5	14.0	6.4	
Total:	Number in Sample:	69	59	7	135
	Estimated % of Escapement:	51.1	43.7	5.2	100.0
	Estimated Escapement:	262	224	27	512
	Standard Error:	19.0	18.8	8.4	
Stratum 9: 08/10 - 08/16					
Sampling Dates: 08/11 - 08/16					
Female:	Number in Sample:	36	39	1	76
	Estimated % of Escapement:	29.3	31.7	0.8	61.8
	Estimated Escapement:	71	77	2	150
	Standard Error:	7.0	7.1	1.4	
Male:	Number in Sample:	14	30	3	47
	Estimated % of Escapement:	11.4	24.4	2.4	38.2
	Estimated Escapement:	28	59	6	92
	Standard Error:	4.9	6.6	2.4	
Total:	Number in Sample:	50	69	4	123
	Estimated % of Escapement:	40.7	56.1	3.3	100.0
	Estimated Escapement:	98	136	8	242
	Standard Error:	7.5	7.6	2.7	
Stratum 10: 08/17 - 08/23					
Sampling Dates: 08/18 - 08/23					
Female:	Number in Sample:	34	38	6	78
	Estimated % of Escapement:	26.8	29.9	4.7	61.4
	Estimated Escapement:	95	106	17	218
	Standard Error:	11.2	11.6	5.4	
Male:	Number in Sample:	12	31	6	49
	Estimated % of Escapement:	9.4	24.4	4.7	38.6
	Estimated Escapement:	34	87	17	137
	Standard Error:	7.4	10.9	5.4	
Total:	Number in Sample:	46	69	12	127
	Estimated % of Escapement:	36.2	54.3	9.4	100.0
	Estimated Escapement:	129	193	34	355
	Standard Error:	12.2	12.6	7.4	

(Continued)

Appendix 5.-(Continued)

		Brood Year and Age Group			
		1993	1992	1991	
		0.3	0.4	0.5	Total
Stratum 11: 08/24 - 08/30					
Sampling Dates: 08/25 - 08/29					
Female:	Number in Sample:	10	26	1	37
	Estimated % of Escapement:	12.7	32.9	1.3	46.8
	Estimated Escapement:	36	95	4	135
	Standard Error:	9.2	13.1	3.1	
Male:	Number in Sample:	6	30	6	42
	Estimated % of Escapement:	7.6	38.0	7.6	53.2
	Estimated Escapement:	22	109	22	153
	Standard Error:	7.4	13.5	7.4	
Total:	Number in Sample:	16	56	7	79
	Estimated % of Escapement:	20.3	70.9	8.9	100.0
	Estimated Escapement:	58	204	26	288
	Standard Error:	11.2	12.6	7.9	
Stratum 12: 08/31 - 09/06					
Sampling Dates: 09/04 & 09/05					
Female:	Number in Sample:	5	9	0	14
	Estimated % of Escapement:	22.7	40.9	0.0	63.6
	Estimated Escapement:	45	81	0	126
	Standard Error:	17.1			
Male:	Number in Sample:	1	5	2	8
	Estimated % of Escapement:	4.5	22.7	9.1	36.4
	Estimated Escapement:	9	45	18	72
	Standard Error:	8.5			
Total:	Number in Sample:	6	14	2	22
	Estimated % of Escapement:	27.3	63.6	9.1	100.0
	Estimated Escapement:	54	126	18	198
	Standard Error:	18.1	19.6	11.7	
Stratum 13: 09/07 - 09/13					
Sampling Dates: 09/08 - 09/11					
Female:	Number in Sample:	13	35	2	50
	Estimated % of Escapement:	20.6	55.6	3.2	79.4
	Estimated Escapement:	49	132	8	189
	Standard Error:	10.5	12.9	4.5	
Male:	Number in Sample:	2	11	0	13
	Estimated % of Escapement:	3.2	17.5	0.0	20.6
	Estimated Escapement:	8	42	0	49
	Standard Error:	4.5	9.8	0.0	
Total:	Number in Sample:	15	46	2	63
	Estimated % of Escapement:	23.8	73.0	3.2	100.0
	Estimated Escapement:	57	174	8	238
	Standard Error:	11.0	11.5	4.5	

(Continued)

Appendix 5.-(Continued)

		Brood Year and Age Group			
		1993	1992	1991	
		0.3	0.4	0.5	Total
Strata 2 - 13: 06/22 - 09/13					
Sampling Dates: 06/23 - 09/11					
Female:	Number in Sample:	263	508	26	797
	% Females in Age Group:	20.7	76.3	3.1	100.0
	Estimated % of Escapement:	10.6	39.2	1.6	51.4
	Estimated Escapement:	5,243	19,356	778	25,377
	Standard Error:	550.5	953.1	226.2	
	Estimated Design Effects:	1.863	2.222	1.926	2.213
Male:	Number in Sample:	124	427	55	606
	% Males in Age Group:	13.4	76.5	10.1	100.0
	Estimated % of Escapement:	6.5	37.1	4.9	48.6
	Estimated Escapement:	3,216	18,329	2,429	23,974
	Standard Error:	461.9	942.0	448.0	
	Estimated Design Effects:	2.044	2.216	2.498	2.213
Total:	Number in Sample:	387	935	81	1,403
	Estimated % of Escapement:	17.1	76.4	6.5	100.0
	Estimated Escapement:	8,459	37,685	3,207	49,351 *
	Standard Error:	680.5	796.2	497.1	
	Estimated Design Effects:	1.902	2.048	2.369	

* 1,788 fish that w ere counted through the w eir during stratum 1 are not included in this total.

Appendix 6.-Estimated age and sex composition of weekly chinook salmon escapements through the East Fork Andreafsky River weir, Alaska, 1997, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group			
		1993	1992	1991	
		1.2	1.3	1.4	Total
Stratum 1: 06/15 - 06/21					
No Chinook Salmon Counted or Sampled					
Stratum 2: 06/22 - 06/28					
Sampling Dates: 06/23, 06/25, 06/27 & 06/28					
Female:	Number in Sample:	1	0	1	2
	Estimated % of Escapement:	6.7	0.0	6.7	13.3
	Estimated Escapement:	14	0	14	27
	Standard Error:	13.2	0.0	13.2	
Male:	Number in Sample:	8	5	0	13
	Estimated % of Escapement:	53.3	33.3	0.0	86.7
	Estimated Escapement:	110	69	0	179
	Standard Error:	26.4	25.0	0.0	
Total:	Number in Sample:	9	5	1	15
	Estimated % of Escapement:	60.0	33.3	6.7	100.0
	Estimated Escapement:	124	69	14	206
	Standard Error:	26.0	25.0	13.2	
Stratum 3: 06/29 - 07/05					
Sampling Dates: 07/01 - 07/03 & 07/05					
Female:	Number in Sample:	22	7	3	32
	Estimated % of Escapement:	36.7	11.7	5.0	53.3
	Estimated Escapement:	101	32	14	147
	Standard Error:	15.3	10.2	6.9	
Male:	Number in Sample:	18	4	6	28
	Estimated % of Escapement:	30.0	6.7	10.0	46.7
	Estimated Escapement:	83	18	28	129
	Standard Error:	14.6	7.9	9.5	
Total:	Number in Sample:	40	11	9	60
	Estimated % of Escapement:	66.7	18.3	15.0	100.0
	Estimated Escapement:	184	51	41	276
	Standard Error:	15.0	12.3	11.4	
Stratum 4: 07/06 - 07/12					
Sampling Dates: 07/06 - 07/12					
Female:	Number in Sample:	7	5	44	56
	Estimated % of Escapement:	4.5	3.2	28.4	36.1
	Estimated Escapement:	44	31	277	353
	Standard Error:	15.0	12.7	32.5	
Male:	Number in Sample:	73	18	8	99
	Estimated % of Escapement:	47.1	11.6	5.2	63.9
	Estimated Escapement:	460	113	50	623
	Standard Error:	36.0	23.1	16.0	
Total:	Number in Sample:	80	23	52	155
	Estimated % of Escapement:	51.6	14.8	33.5	100.0
	Estimated Escapement:	504	145	327	976
	Standard Error:	36.0	25.6	34.1	

(Continued)

Appendix 6.-(Continued)

		Brood Year and Age Group			
		1993	1992	1991	
		1.2	1.3	1.4	Total
Stratum 5: 07/13 - 07/19					
Sampling Dates: 07/13 - 07/19					
Female:	Number in Sample:	0	0	30	30
	Estimated % of Escapement:	0.0	0.0	28.3	28.3
	Estimated Escapement:	0	0	174	174
	Standard Error:	0.0	0.0	24.6	
Male:	Number in Sample:	57	9	10	76
	Estimated % of Escapement:	53.8	8.5	9.4	71.7
	Estimated Escapement:	331	52	58	441
	Standard Error:	27.2	15.2	16.0	
Total:	Number in Sample:	57	9	40	106
	Estimated % of Escapement:	53.8	8.5	37.7	100.0
	Estimated Escapement:	331	52	232	615
	Standard Error:	27.2	15.2	26.5	
Stratum 6: 07/20 - 07/26					
Sampling Dates: 07/20, 07/21 & 07/24					
Female:	Number in Sample:	3	4	11	18
	Estimated % of Escapement:	6.0	8.0	22.0	36.0
	Estimated Escapement:	37	49	136	222
	Standard Error:	20.1	23.0	35.1	
Male:	Number in Sample:	22	7	3	32
	Estimated % of Escapement:	44.0	14.0	6.0	64.0
	Estimated Escapement:	272	87	37	396
	Standard Error:	42.0	29.4	20.1	
Total:	Number in Sample:	25	11	14	50
	Estimated % of Escapement:	50.0	22.0	28.0	100.0
	Estimated Escapement:	309	136	173	618
	Standard Error:	42.3	35.1	38.0	
Strata 7 - 13: 07/27 - 09/13					
Sampling Dates: 08/03, 08/08, 08/12, 08/13, 08/17, 08/19, 08/20, 08/22, 08/25 & 09/08					
Female:	Number in Sample:	1	1	11	13
	Estimated % of Escapement:	4.2	4.2	45.8	54.2
	Estimated Escapement:	21	21	227	268
	Standard Error:	20.1	20.1	50.2	
Male:	Number in Sample:	4	4	3	11
	Estimated % of Escapement:	16.7	16.7	12.5	45.8
	Estimated Escapement:	83	83	62	227
	Standard Error:	37.5	37.5	33.3	
Total:	Number in Sample:	5	5	14	24
	Estimated % of Escapement:	20.8	20.8	58.3	100.0
	Estimated Escapement:	103	103	289	495
	Standard Error:	40.9	40.9	49.6	

(Continued)

Appendix 6.-(Continued)

		Brood Year and Age Group			
		1993	1992	1991	
		1.2	1.3	1.4	Total
Strata 2 - 13: 06/22 - 09/13					
Sampling Dates: 06/23 - 09/08					
Female:	Number in Sample:	34	17	100	151
	% Females in Age Group:	18.2	11.2	70.6	100.0
	Estimated % of Escapement:	6.8	4.2	26.4	37.4
	Estimated Escapement:	217	134	841	1,192
	Standard Error:	38.0	34.6	75.0	
	Estimated Design Effects:	1.030	1.328	1.290	1.251
Male:	Number in Sample:	182	47	30	259
	% Males in Age Group:	67.1	21.1	11.8	100.0
	Estimated % of Escapement:	42.0	13.2	7.4	62.6
	Estimated Escapement:	1,337	422	235	1,994
	Standard Error:	78.2	61.0	46.0	
	Estimated Design Effects:	1.135	1.434	1.375	1.251
Total:	Number in Sample:	216	64	130	410
	Estimated % of Escapement:	48.8	17.4	33.8	100.0
	Estimated Escapement:	1,554	555	1,076	3,186
	Standard Error:	80.0	67.6	77.9	
	Estimated Design Effects:	1.155	1.406	1.214	

Appendix 7.-Estimated age and sex composition of weekly coho salmon escapements through the East Fork Andreafsky River weir, Alaska, 1997 and estimated design effects of the stratified sampling design.

		Brood Year and Age Group				
		1993	1992	1991		
		1.1	2.1	2.2	3.1	Total
Strata 1 - 8: 06/15 -08/09						
No Samples Collected						
Stratum 9: 08/10 -08/16						
Sampling Dates: 08/12 - 08/16						
Female:	Number in Sample:	0	28	1	0	29
	Estimated % of Escapement:	0.0	53.8	1.9	0.0	55.8
	Estimated Escapement:	0	57	2	0	59
	Standard Error:	0.0	5.3	1.5	0.0	
Male:	Number in Sample:	1	22	0	0	23
	Estimated % of Escapement:	1.9	42.3	0.0	0.0	44.2
	Estimated Escapement:	2	45	0	0	47
	Standard Error:	1.5	5.2	0.0	0.0	
Total:	Number in Sample:	1	50	1	0	52
	Estimated % of Escapement:	1.9	96.2	1.9	0.0	100.0
	Estimated Escapement:	2	102	2	0	106
	Standard Error:	1.5	2.0	1.5	0.0	
Stratum 10: 08/17 -08/23						
Sampling Dates: 08/17 - 08/22						
Female:	Number in Sample:	2	48	1	1	52
	Estimated % of Escapement:	1.6	38.7	0.8	0.8	41.9
	Estimated Escapement:	12	286	6	6	310
	Standard Error:	7.7	29.7	5.4	5.4	
Male:	Number in Sample:	2	68	2	0	72
	Estimated % of Escapement:	1.6	54.8	1.6	0.0	58.1
	Estimated Escapement:	12	406	12	0	430
	Standard Error:	7.7	30.3	7.7	0.0	
Total:	Number in Sample:	4	116	3	1	124
	Estimated % of Escapement:	3.2	93.5	2.4	0.8	100.0
	Estimated Escapement:	24	692	18	6	740
	Standard Error:	10.8	15.0	9.4	5.4	
Stratum 11: 08/24 -08/30						
Sampling Dates: 08/25 & 08/26						
Female:	Number in Sample:	3	45	0	0	48
	Estimated % of Escapement:	2.4	35.7	0.0	0.0	38.1
	Estimated Escapement:	139	2,081	0	0	2,219
	Standard Error:	78.6	247.0	0.0	0.0	
Male:	Number in Sample:	1	72	2	3	78
	Estimated % of Escapement:	0.8	57.1	1.6	2.4	61.9
	Estimated Escapement:	46	3,329	92	139	3,607
	Standard Error:	45.7	255.1	64.4	78.6	
Total:	Number in Sample:	4	117	2	3	126
	Estimated % of Escapement:	3.2	92.9	1.6	2.4	100.0
	Estimated Escapement:	185	5,410	92	139	5,826
	Standard Error:	90.4	132.7	64.4	78.6	

(Continued)

Appendix 7.-(Continued)

		Brood Year and Age Group				
		1993	1992	1991		
		1.1	2.1	2.2	3.1	Total
Stratum 12: 08/31 - 09/06						
Sampling Dates: 09/04 & 09/05						
Female:	Number in Sample:	1	62	0	1	64
	Estimated % of Escapement:	0.8	47.3	0.0	0.8	48.9
	Estimated Escapement:	13	832	0	13	858
	Standard Error:	12.9				
Male:	Number in Sample:	2	65	0	0	67
	Estimated % of Escapement:	1.5	49.6	0.0	0.0	51.1
	Estimated Escapement:	27	872	0	0	899
	Standard Error:	18.2				
Total:	Number in Sample:	3	127	0	1	131
	Estimated % of Escapement:	2.3	96.9	0.0	0.8	100.0
	Estimated Escapement:	40	1,703	0	13	1,757
	Standard Error:	22.2	25.5	0.0	12.9	
Stratum 13: 09/07 - 09/13						
Sampling Dates: 09/08 - 09/10						
Female:	Number in Sample:	2	48	1	0	51
	Estimated % of Escapement:	1.6	39.3	0.8	0.0	41.8
	Estimated Escapement:	17	410	9	0	436
	Standard Error:	11.3	43.5	8.0	0.0	
Male:	Number in Sample:	1	68	1	1	71
	Estimated % of Escapement:	0.8	55.7	0.8	0.8	58.2
	Estimated Escapement:	9	581	9	9	606
	Standard Error:	8.0	44.2	8.0	8.0	
Total:	Number in Sample:	3	116	2	1	122
	Estimated % of Escapement:	2.5	95.1	1.6	0.8	100.0
	Estimated Escapement:	26	991	17	9	1,042
	Standard Error:	13.8	19.2	11.3	8.0	
Strata 9 - 1 08/10 - 09/13						
Sampling Dates: 08/12 - 09/10						
Female:	Number in Sample:	8	231	3	2	244
	% Females in Age Group:	4.7	94.4	0.4	0.5	100.0
	Estimated % of Escapement:	1.9	38.7	0.2	0.2	41.0
	Estimated Escapement:	181	3,666	17	19	3,883
	Standard Error:	80.8	263.2	9.8	14.0	
	Estimated Design Effects:	2.208	1.862	0.399	0.652	1.871
Male:	Number in Sample:	7	295	5	4	311
	% Males in Age Group:	1.7	93.6	2.0	2.6	100.0
	Estimated % of Escapement:	1.0	55.2	1.2	1.6	59.0
	Estimated Escapement:	96	5,232	113	147	5,588
	Standard Error:	50.5	271.0	65.4	79.0	
	Estimated Design Effects:	1.634	1.894	2.298	2.576	1.871
Total:	Number in Sample:	15	526	8	6	555
	Estimated % of Escapement:	2.9	94.0	1.4	1.8	100.0
	Estimated Escapement:	277	8,898	129	167	9,471 *
	Standard Error:	94.7	137.4	66.1	80.2	
	Estimated Design Effects:	2.011	2.110	2.059	2.358	

* 1 fish that was counted through the weir during stratum 8 is not included in this total.