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Abundance and Run Timing of Adult Salmon in the East Fork Andreafsky River, Yukon Delta National Wildlife Refuge, Alaska, 1998

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Abstract.— From June 23 to September 13, 1998, 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 fifth year of a study initiated to provide reliable data necessary for managing refuge fishery resources that contribute to major commercial and subsistence fisheries.

A total of 67,591 chum *Oncorhynchus keta*, 4,011 chinook *O. tshawytscha*, 227,208 pink *O. gorbuscha*, 185 sockeye *O. nerka*, and 5,417 coho *O. kisutch* salmon were counted through the weir. Picket spacing (4.8 cm gap maximum) was wide enough for smaller pink salmon to escape upstream undetected. Peak weekly passage occurred: July 5-11 for chum and chinook; July 12-18 for pink and sockeye; and September 6-12 for coho salmon. A potentially large number of coho salmon may have escaped uncounted past the weir during a high water event which submerged portions of the weir from August 17-28.

Four age groups were identified from 888 chum salmon sampled from the weir escapement between June 29 and September 10. This escapement was composed primarily of age 0.3 (86%) and 0.4 (11%) fish. Females composed an estimated 55% of the sampled chum salmon escapement, and were predominate between July 6 and August 13. Age composition did not differ between sexes.

The 1998 weir escapement of 67,591 chum salmon was substantially less than in 1994 (N=200,981), 1995 (N=172,148), and 1996 (N=108,450) and slightly greater than in 1997 (N=51,139). The relatively poor chum salmon return during 1998 may have resulted from poor brood year production during 1993 and anomalous conditions that existed in the marine ecosystem during 1997 and 1998. Run timing initially appeared to be late, but the median passage date was similar to the 1994-1997 average.

Five age groups were identified from 378 chinook salmon sampled from the weir escapement between July 3 and August 6. This escapement was composed primarily of age 1.3 (69%) and 1.2 (18%) fish. Males composed an estimated 75% of the sampled chinook salmon escapement. Age composition differed between sexes. Males were predominately age 1.3 (70%) followed by age 1.2 (23%), and females were primarily age 1.3 (66%) followed by age 1.4 (25%).

The 1998 weir escapement of 4,011 chinook salmon was less than in 1994 (N=7,801) and 1995 (N=5,841), but greater than in 1996 (N=2,955) and 1997 (N=3,186). Strong escapements during 1993, 1994 and 1995 indicate potentially strong age 1.2, 1.3 and 1.4 components in the 1999 East Fork return. Although chinook salmon initially appeared late, the median passage date during 1998 was similar to the 1994-1997 average.

Three age groups were identified from 277 coho salmon sampled from the weir escapement between July 29 and September 10. Males composed an estimated 62% of this escapement. Age 2.1 coho salmon were most abundant (94%) followed by age 3.1 fish (4%).

Due to a high water event which submerged the weir from August 17-28, the escapement count of 5,417 coho salmon probably under-represents the actual escapement. Weir counts during 1995, 1996 and 1997 were 10,901, 8,037 and 9,472, respectively. Additionally, 36, 45, and 16% of the escapement passed the weir between August 17-28, 1995, 1996, and 1997, respectively.

Twenty Dolly Varden *Salvelinus malma*, 4,082 whitefish (*Prosopium cylindraceum* and *Coregonus* spp.), 35 northern pike *Esox lucius*, and seven Arctic grayling *Thymallus arcticus* 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 escapement (for management purposes, summer chum are those in the weir escapement prior to August 1). The Andreafsky River also supports one of the largest returns of chinook salmon in the Yukon River drainage, typically ranking second or third to the Salcha and Chena Rivers (Bergstrom et al. 1998). These Andreafsky River stocks 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.

In compliance with ANILCA mandates, the U.S. Fish and Wildlife Service (Service) initiated a multi-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 1998, 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

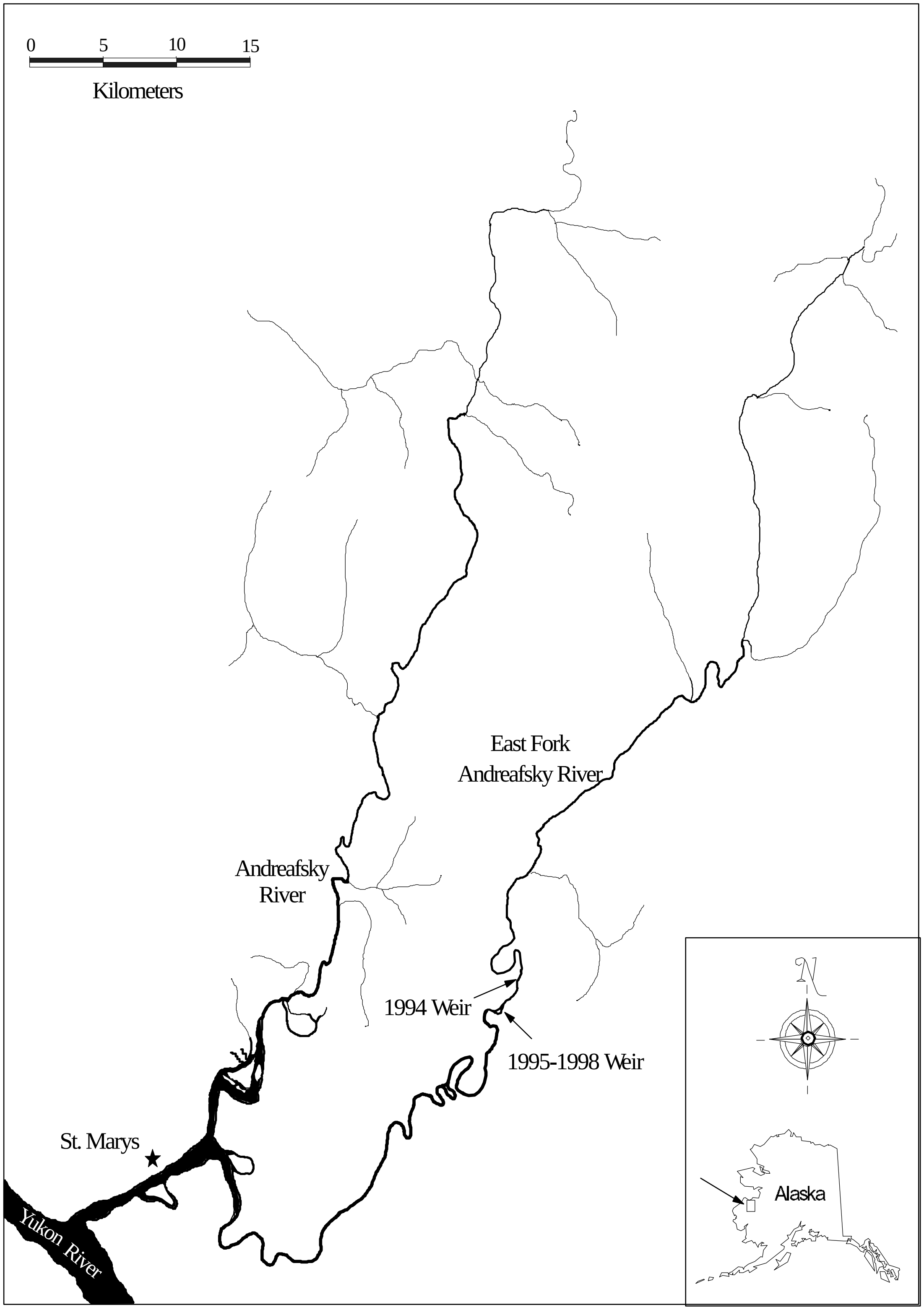

FIGURE 1.—Weir locations in the East Fork Andreafsky River, Alaska, 1994-1998.

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 23 to September 13, 1998. Two live traps were installed to facilitate efficient fish passage and sampling during various river stage heights. 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 smaller 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.

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 O^2 statistic, hereafter referred to as $O^2(\hat{*}.)$, was divided by the mean generalized design effect, $\hat{*}.$, 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:

$$\hat{A}_{hij} = N_h \, p_{hij} \; ; \qquad (1)$$

and

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

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:

$$\hat{A}_{ij} = \sum \hat{A}_{hij} \; ; \qquad \textbf{(3)}$$

and

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

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. Moderate to high stage heights averaging 67 cm persisted through most of the operational period of the weir with minimum and maximum levels reaching 38 and 184 cm (Appendix 1). A high water event caused the weir to submerge from August 17-28. Coho salmon were observed escaping over submerged weir panels, however water turbidity prevented counting these fish. Water temperatures averaged 10.5°C from June 23 to September 13 (Appendix 1). Minimum and maximum temperatures reached 6.0 and 17.0°C.

Biological Data

Five species of Pacific salmon, including 67,591 chum, 4,011 chinook, 227,208 pink, 185 sockeye, and 5,417 coho salmon, were counted upstream through the weir (Appendix 2). Other species counted through the weir include 20 Dolly Varden *Salvelinus malma*, 4,082 whitefish *Prosopium cylindraceum* and *Coregonus* spp., 35 northern pike *Esox lucius*, and seven Arctic grayling *Thymallus Arcticus* (Appendix 2).

Chum salmon.—Chum salmon (N=67,591) passed through the weir from June 16 to September 13. Peak passage (N=27,661) occurred the week of July 5-11 (Figure 2; Appendix 2), and the median passage date was July 7 (Figure 3; Appendix 3). Counts did not exceed 100 fish per day after August 7.

Four age groups were identified from 888 chum salmon sampled from the weir escapement between June 29 and September 10 (Table 1; Appendix 4). During this period, 66,532 chum salmon were counted through the weir. Females composed an estimated 55% of this escapement, and were predominate between July 6 and August 13 (Figure 3; Appendix 4). The sampled escapement was composed primarily of age 0.3 (86%) and age 0.4 (11%) chum salmon.

There was no significant difference in age composition between sexes ($O^{2}(\hat{*}.)=4.5$, df =2, P=0.104). In sampled fish, the mean length of males was greater than that of same-aged females for fish age 0.3 and greater (two-tailed t test: age 0.3, t=13.2, df =724, P<0.001; age 0.4, t=6.9, df =136, P<0.001; age 0.5, t=3.7, df =18, P=0.002)(Table 1).

TABLE 1.—Lengths at age for chum salmon sampled at the East Fork Andreafsky River weir, Alaska, 1998.

		Mid-Eye to Fork Length (mm)		
Age	*N*	Mean	SE	Range
		Male		
0.2	1	525	—	535
0.3	300	556	1.8	475-690
0.4	75	573	4.1	485-665
0.5	12	592	7.4	545-620
Total	388	561	1.7	475-690
		Female		
0.2	3	498	7.3	485-510
0.3	426	528	1.3	430-620
0.4	63	535	3.6	470-615
0.5	8	546	10.4	520-610
Total	500	579	1.2	430-620

Chinook salmon.—Chinook salmon (N=4,011) passed through the weir from June 27 to September 11. Peak passage (N=1,850) occurred the week of July 5-11 (Figure 2; Appendix 3), and the median passage date was July 11 (Figure 3; Appendix 3). Counts did not exceed 30 fish per day after July 30.

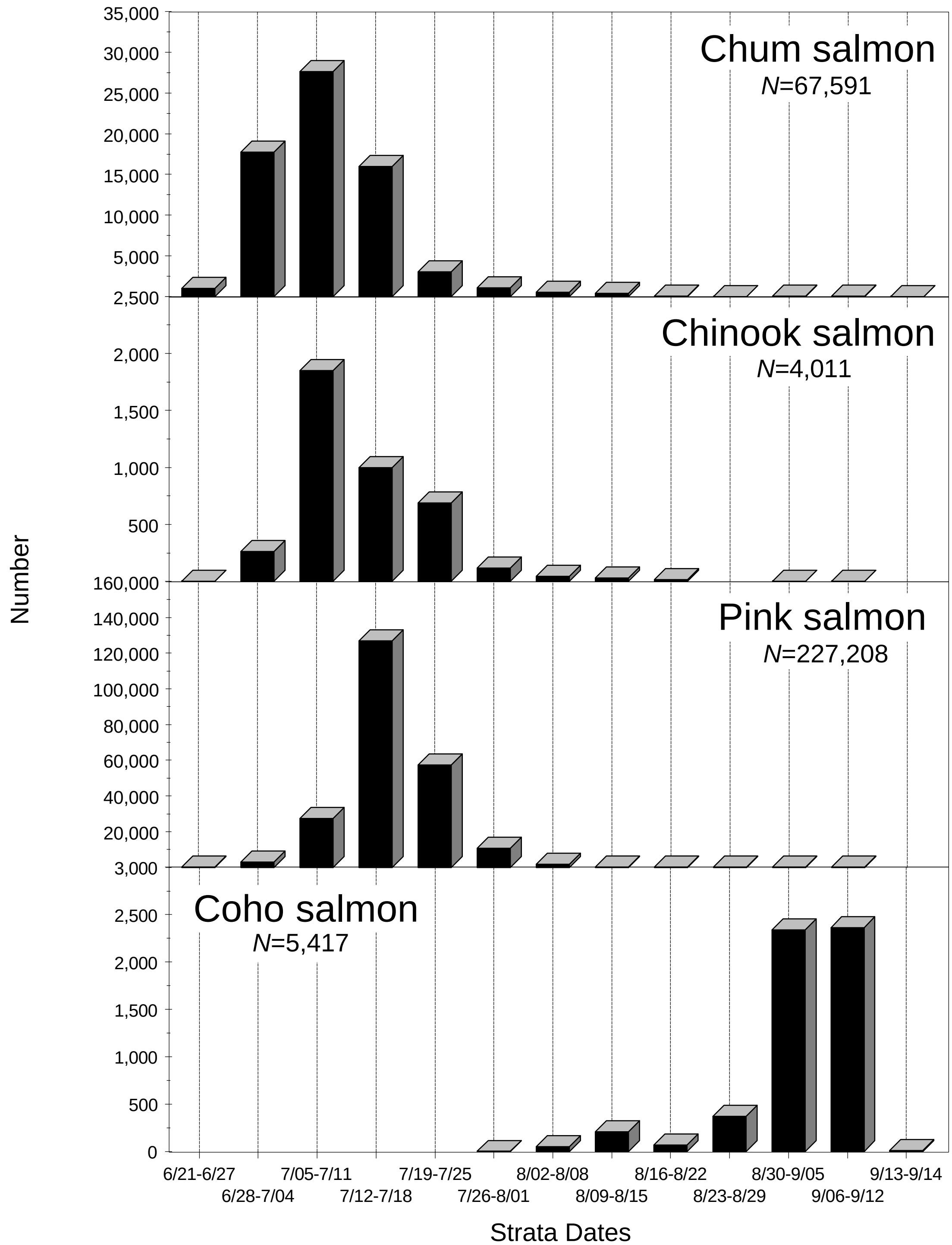

FIGURE 2.—Chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1998.

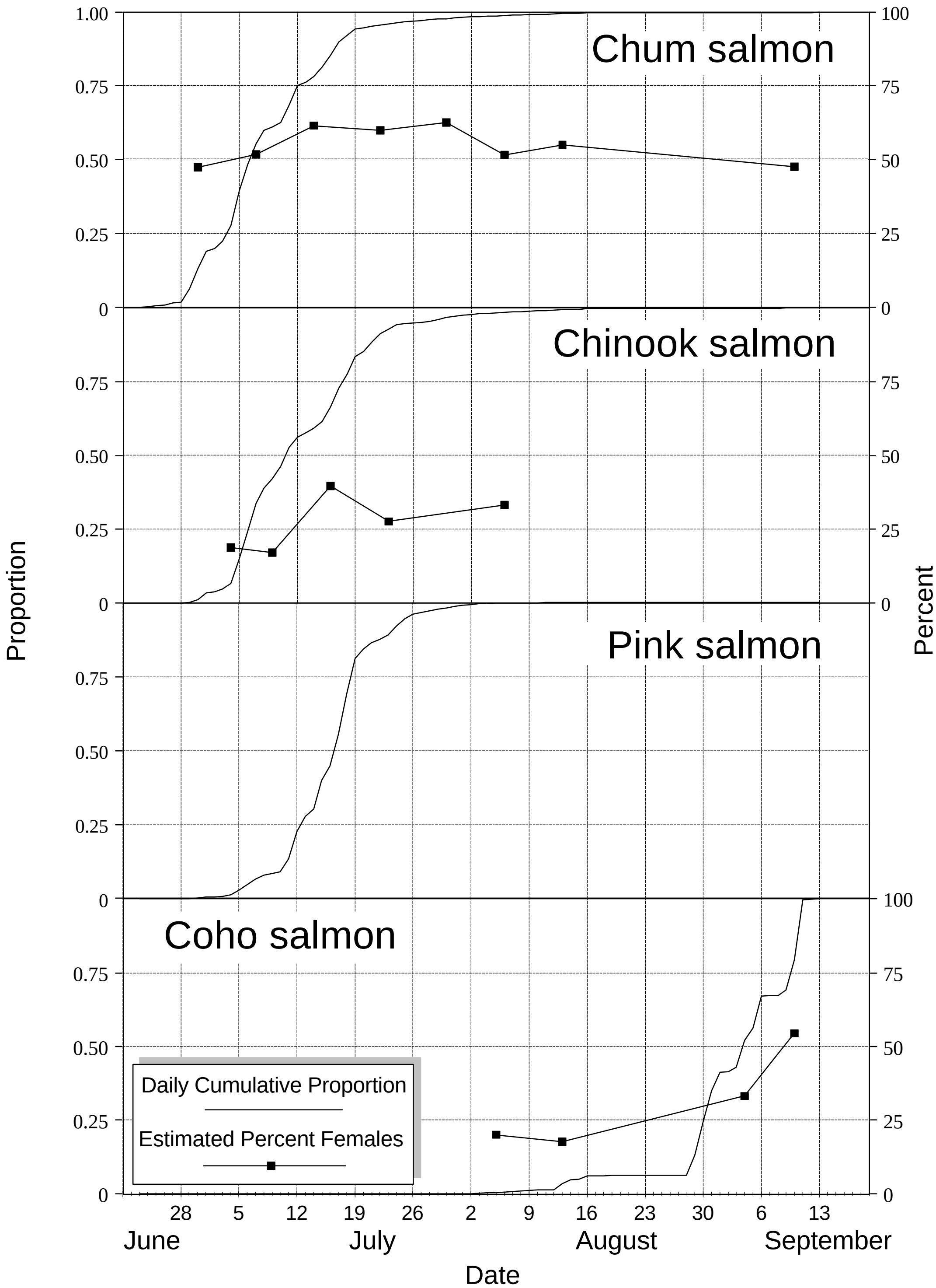

FIGURE 3.—Cumulative daily proportion and sex composition of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1998.

Five age groups were identified from 378 chinook salmon sampled from the weir escapement between July 3 and August 6 (Table 2; Appendix 5). During this period, 3,962 chinook salmon were counted through the weir. Males composed an estimated 75% of this escapement and predominated every week (Figure 3; Appendix 5). Age 1.3 chinook salmon were most abundant (69%) followed by age 1.2 (18%) and age 1.4 (11%) fish.

Age composition differed between sexes ($O^{2}(\hat{*}.)=33.2$, df =2, $P<0.001$). Males were predominately age 1.3 (70%) followed by age 1.2 (23%), and females were primarily age 1.3 (66%) followed by age 1.4 (25%). In sampled fish, the mean length of age 1.3 and age 1.4 females was greater than that of same-aged males (two-tailed *t* test: Age 1.3, $t=8.6$, df =265, $P<0.001$; Age 1.4, $t=2.9$, df =43, $P=0.006$)(Table 2). There was no significant difference ($P=0.244$) in the mean lengths of age 1.2 males and same-aged females.

TABLE 2.—Lengths at age for chinook salmon sampled at the East Fork Andreafsky River weir, Alaska, 1998.

		Mid-Eye to Fork Length (mm)		
Age	*N*	Mean	SE	Range
		Male		
1.2	57	533	7.0	430-705
1.3	193	704	4.4	520-875
1.4	18	751	18.1	605-880
2.3	1	750	—	750
Total	269	671	5.8	430-880
		Female		
1.2	5	562	25.5	480-625
1.3	74	774	6.2	585-885
1.4	27	801	7.2	720-865
1.5	3	862	38.1	790-920
Total	109	773	6.8	480-920

Pink salmon.—Although some were able to pass uncounted between panel pickets, 227,208 pink salmon passed through the weir at counting stations from June 25 to September 11. Peak passage ($N=126{,}971$) occurred the week of July 12-18 (Figure 2; Appendix 2), and the median passage date was July 17 (Figure 3; Appendix 3).

Sockeye salmon.—Sockeye salmon ($N=185$) passed through the weir from June 29 to September 11. Peak passage ($N=46$) occurred the week of July 12-18 (Appendix 2), and the median passage date was July 25.

Coho salmon.—Coho salmon (N=5,417) passed through the weir from July 28 to September 13. Peak passage (N=2,337) occurred the week of August 30-September 5 (Figure 2; Appendix 2), and the median passage date was September 4.

Three age groups were identified from 277 coho salmon sampled from the weir escapement between July 29 and September 10 (Table 3; Appendix 6). During this period, 4,964 coho salmon were counted through the weir. Males composed an estimated 62% of this escapement (Figure 3; Appendix 6). Age 2.1 coho salmon were most abundant (94%) followed by age 3.1 fish (4%). There was no significant difference (P>0.05) in the mean lengths of males and same-aged females (Table 3).

TABLE 3.—Lengths at age for coho salmon sampled at the East Fork Andreafsky River weir, Alaska, 1998.

		Mid-Eye to Fork Length (mm)		
Age	*N*	Mean	SE	Range
		Male		
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
		Female		
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

An unknown number of salmon passed over or through a damaged portion of the weir during the high water event which submerged the weir from August 17-28. During this period, a presumably large number of coho salmon and small numbers of other salmon escaped undetected. No attempt has been made to estimate the uncounted portion of these escapements, and the season total for coho salmon should be considered an incomplete count.

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.—Chum salmon escapement to the East Fork during 1998 (*N*=67,591) was poor relative to 1994-1996 weir escapements which ranged from 108,450 to 200,981 fish and slightly greater than the 1997 weir escapement (*N*=51,139)(Appendix 7). Preliminary escapement and commercial harvest data indicate summer chum salmon returns to the Yukon River drainage were below average in magnitude during 1998 (unpublished data, Alaska Department of Fish and Game).

The poor escapement during 1998 may be linked to a combination of a poor escapement during 1993 and poor ocean survival. Except in the Anvik River, chum salmon returns throughout the Yukon River drainage were extremely poor during 1993 (Bergstrom et al. 1995). Conversely, chum salmon escapement to the East Fork during 1994 is the second largest in magnitude on record (Appendix 7), which indicated a potentially strong return of age 0.3 fish during 1998. Kruse (1998) suggests anomalous conditions that existed in the marine ecosystem may have adversely affected the growth and survival of salmon in the marine ecosystem during 1997 and 1998.

Superficially, strong escapements to the East Fork during 1994 and 1995 indicate a good chum salmon return during 1999. However, if unfavorable conditions existed in the marine ecosystem during 1997 and 1998, all major age components of the 1999 return may have been adversely affected.

Although chum salmon initially appeared to be returning late during 1998, the median passage date at the weir was within one day of the 1994-1997 average (Tobin and Harper 1995; 1996; 1997; 1998).

Chinook salmon.—Chinook salmon escapement to the East Fork during 1998 (*N*=4,011) was smaller in magnitude than 1994 and 1995 weir escapements (*N*=7,801 and 5,841, respectively) and greater than 1996 and 1997 weir escapements (*N*=2,955 and 3,186, respectively)(Appendix 7). However, 1994 and 1995 escapements were greater in magnitude than all historical counts except for a 1993 aerial index estimate of 5,855 fish.

Based on strong parent year escapements and brood year returns, the chinook salmon return to the East Fork should be relatively strong during 1999. Chinook salmon return to the East Fork primarily as ages 1.2, 1.3 and 1.4, and strong parent year escapements from 1993 to 1995 suggest good returns for these major age groups. It is possible that poor ocean conditions will affect the 1999 chinook salmon return, but the weir escapement during 1998 was proportional to expectations based on brood year escapements and gave no indication that chinook salmon were affected similarly as chum salmon.

The proportion of females in the 1998 weir escapement (25%) was low relative to previous weir escapements (range=29-42%). This is likely a result of a weak parent year escapement for age 1.4 fish, the predominate age among females, and disproportionately large parent year escapements for other age groups.

Although chinook salmon initially appeared late, the median passage date during 1998 was similar to the 1994-1997 average (Tobin and Harper 1995; 1996; 1997; 1998).

Pink salmon.—Pink salmon escapement to the East Fork during 1998 (*N*=227,208) was within the range of even-year weir escapements (*N*=316,530 and 214,837 during 1994 and 1996, respectively)(Appendix 7). Run timing during 1998 was similar to previous even-year weir escapements (Tobin and Harper 1995; 1997).

Pink salmon escapement magnitudes should be compared cautiously, 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 also 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.—Due to a high water event which submerged the weir submerged from August 17-28, the escapement count of 5,417 coho salmon probably under-represents the actual escapement. Weir counts during 1995, 1996 and 1997 were 10,901, 8,037 and 9,472, respectively (Appendix 7). Additionally, 36, 45, and 16% of the escapement passed the weir between August 17-28, 1995, 1996, and 1997, respectively (Tobin and Harper 1996; 1997; 1998). 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)(Tobin and Harper 1998). This large pulse of fish coincided with a 0.5-m rise in river stage height.

Recommendations

The East Fork weir has been an important tool for monitoring refuge-originating salmon stocks and assisting the Department with management of lower Yukon River fisheries. No other project in the lower Yukon River drainage can match the accurate, precise, and reliable escapement and biological data provided by the East Fork weir. Recent literature

(Beamish et al. 1998; Kruse 1998; Meyers et al. 1998) indicates that current and future maritime conditions may adversely affect salmon populations. If these conditions result in a trend of poor recruitment among Yukon River stocks, long-term operation of the East Fork weir will be of key importance and is recommended.

In response to the poor chum salmon escapements during 1997 and 1998, we recommend developing benchmarks to alert fishery managers when in-season projections indicate undesirable escapement magnitudes in the East Fork.

We also recommend continuing weir operation into mid-September to obtain comprehensive escapement data for coho salmon returns.

Acknowledgments

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We appreciate the assistance from Bering Sea Fishermen's Association (BSFA). A memorandum of understanding with BSFA enabled us to conduct weir operations into September. Western Alaska Salmon Investigations funds acquired by BSFA through a Bureau of Indian Affairs grant were used for operations and distributed among two local village councils, Algaaciq of St. Marys and Yupiit of Andreafsky, for hiring personnel to work with a U.S. Fish and Wildlife Service crew leader. Two personnel from St. Marys were hired through these councils.

Thanks to the entire Yukon Delta National Wildlife Refuge staff for their support. We also appreciate the assistance of the Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, A-Y-K Region and Richard Price for scale sample analysis.

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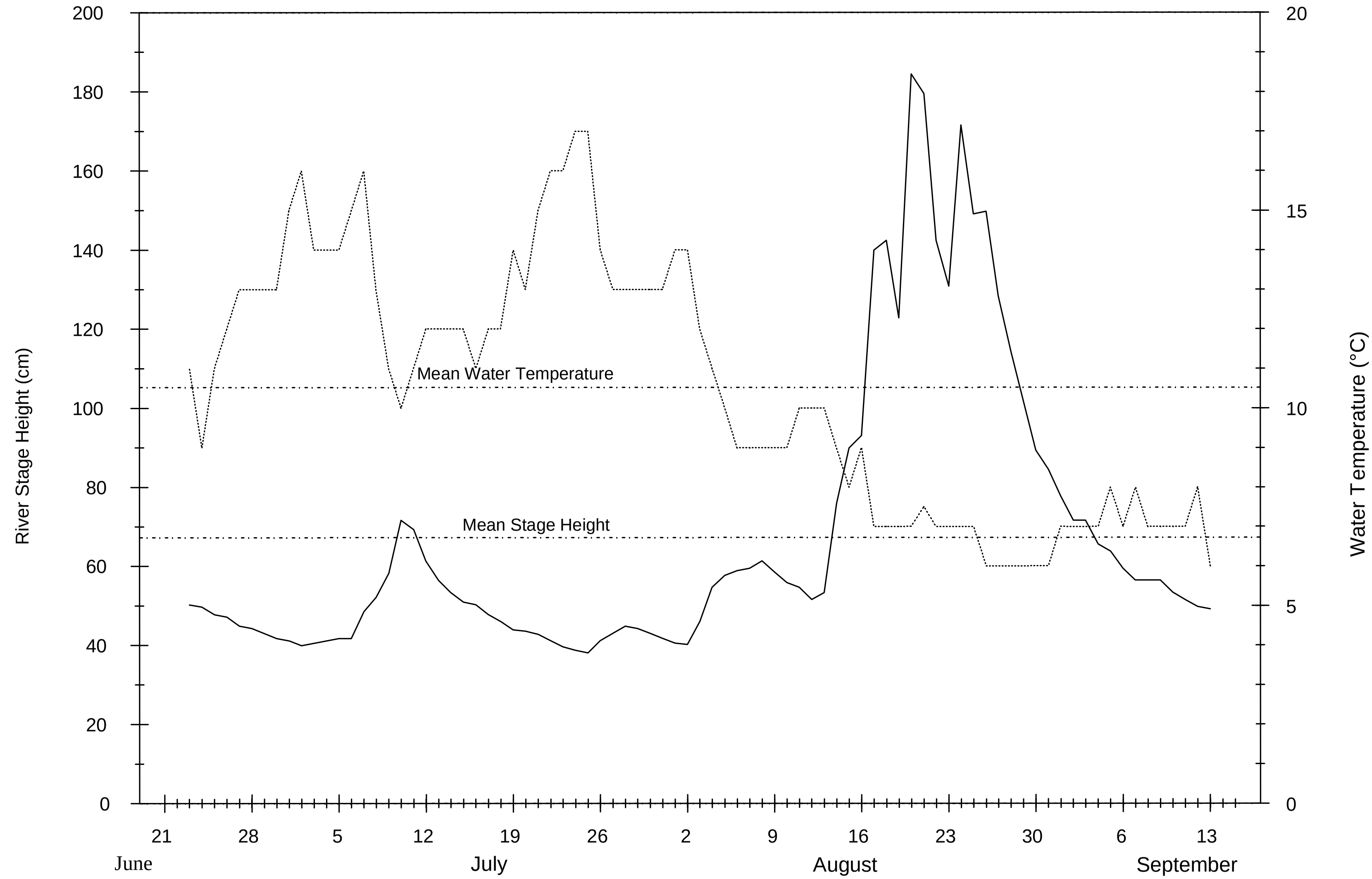

Appendix 1.-River stage heights and water temperatures at the East Fork Andreafsky River weir, 1998.

Appendix 2.-Daily escapement and counting effort at the East Fork Andreafsky River weir, Alaska, 1998.

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 1					
06/23	3.00	13	0	0	0	0	0	60	0
06/24	9.25	18	0	0	0	0	0	42	2
06/25	12.25	264	0	8	0	0	3	80	2
06/26	14.00	175	0	3	0	0	0	55	2
06/27	11.00	535	1	22	0	0	0	40	0
Total:	49.50	1,005	1	33	0	0	3	277	6
				Stratum 2					
06/28	10.75	65	0	2	0	0	0	25	0
06/29	16.00	3,153	10	112	3	0	0	24	2
06/30	21.50	4,585	34	258	0	0	0	35	0
07/01	16.25	4,003	93	750	0	0	0	55	1
07/02	12.50	652	17	65	0	0	0	32	0
07/03	22.75	1,687	36	704	0	0	0	60	0
07/04	16.25	3,561	75	1,008	0	0	0	29	2
Total:	116.00	17,706	265	2,899	3	0	0	260	5
				Stratum 3					
07/05	19.25	7,996	336	3,595	0	0	14	65	0
07/06	13.75	6,030	373	4,136	0	0	1	59	1
07/07	13.25	4,696	386	4,292	0	0	0	53	1
07/08	12.00	3,088	204	2,968	3	0	0	94	1
07/09	17.50	845	129	1,382	0	0	0	89	0
07/10	14.25	1,003	167	1,169	0	0	0	108	0
07/11	14.50	4,003	255	9,872	4	0	0	178	4
Total:	104.50	27,661	1,850	27,414	7	0	15	646	7
				Stratum 4					
07/12	14.75	4,401	138	21,285	8	0	0	175	3
07/13	15.25	829	62	11,399	3	0	0	102	2
07/14	11.50	1,248	61	5,846	0	0	0	138	1
07/15	15.25	2,160	91	21,785	10	0	0	148	0
07/16	20.25	2,747	197	11,087	7	0	0	105	1
07/17	14.25	3,038	263	23,930	5	0	1	134	1
07/18	14.25	1,580	184	31,639	13	0	0	189	0
Total:	105.50	16,003	996	126,971	46	0	1	991	8
				Stratum 5					
07/19	14.00	1,365	240	27,014	17	0	0	185	1
07/20	10.75	370	67	7,204	3	0	0	120	1
07/21	12.50	335	129	4,672	1	0	0	142	0
07/22	11.75	304	117	2,460	6	0	0	82	2
07/23	11.50	248	57	3,512	3	0	0	78	1
07/24	11.00	200	66	7,181	1	0	0	75	0
07/25	13.00	220	12	5,278	9	0	0	86	0
Total:	84.50	3,042	688	57,321	40	0	0	768	5

- Continued -

Appendix 2.-(Continued)

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 6					
07/26	10.25	166	8	3,496	0	0	0	56	0
07/27	13.00	130	8	1,186	0	0	0	32	0
07/28	15.50	202	11	1,496	6	1	0	21	0
07/29	14.75	145	23	1,134	5	0	0	30	0
07/30	19.00	115	31	982	5	1	0	27	0
07/31	18.50	140	17	1,315	4	0	0	40	0
08/01	14.00	191	20	962	5	0	0	47	0
Total:	105.00	1,089	118	10,571	25	2	0	253	0
				Stratum 7					
08/02	18.00	91	4	474	1	1	0	34	0
08/03	18.75	76	11	440	6	5	0	44	0
08/04	20.50	56	1	303	4	8	0	18	0
08/05	22.00	73	7	127	3	8	0	13	0
08/06	15.50	71	9	73	2	5	0	7	0
08/07	14.00	104	10	104	5	16	0	13	0
08/08	23.25	77	3	140	2	9	0	6	0
Total:	132.00	548	45	1,661	23	52	0	135	0
				Stratum 8					
08/09	20.25	34	5	68	2	5	0	5	0
08/10	15.25	57	7	36	1	8	0	2	1
08/11	22.00	39	1	40	4	3	0	15	0
08/12	23.75	77	8	43	2	4	0	30	0
08/13	22.25	100	7	52	12	111	0	44	0
08/14	20.00	58	1	40	2	71	0	18	0
08/15	10.75	34	0	11	1	9	0	19	0
Total:	134.25	399	29	290	24	211	0	133	1
				Stratum 9					
08/16	11.25	32	12	18	3	61	0	23	0
08/17 *									
08/18 *									
08/19	4.00	16	2	2	0	8	0	3	0
08/20 *									
08/21 *									
08/22 *									
Total:	15.25	48	14	20	3	69	0	26	0
				Stratum 10					
08/23 *									
08/24 *									
08/25 *									
08/26 *									
08/27 *									
08/28 *									
08/29	6.25	2	0	2	0	371	0	6	0
Total:	6.25	2	0	2	0	371	0	6	0

* No counts due to high water

- Continued -

Appendix 2.-(Continued)

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 11					
08/30	12.00	4	1	1	3	618	0	64	0
08/31	16.00	11	1	2	0	568	1	58	0
09/01	20.00	8	0	2	1	336	0	41	0
09/02	20.75	4	0	0	1	17	0	25	0
09/03	23.00	5	0	4	0	80	0	18	0
09/04	20.25	8	0	5	0	490	0	34	0
09/05	18.75	1	0	0	0	228	0	29	0
Total:	130.75	41	2	14	5	2,337	1	269	0
				Stratum 12					
09/06	25.50	8	0	2	0	591	0	27	1
09/07	24.75	6	1	3	0	12	0	31	0
09/08	27.75	4	0	0	1	0	0	40	0
09/09	25.00	3	1	2	6	94	0	41	0
09/10	21.25	9	0	2	0	555	0	68	1
09/11	19.50	10	1	1	2	1,104	0	50	0
09/12	23.75	3	0	2	0	6	0	48	0
Total:	167.50	43	3	12	9	2,362	0	305	2
				Stratum 13					
09/13	16.75	4	0	0	0	13	0	13	1
Total:	16.75	4	0	0	0	13	0	13	1
				All Strata					
Total:	1167.75	67,591	4,011	227,208	185	5,417	20	4,082	35

Appendix 3.-Daily, cumulative, and cumulative proportion of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1998.

	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
06/23	13	13	0.000	0	0	0.000	0	0	0.000	0	0	0.000
06/24	18	31	0.000	0	0	0.000	0	0	0.000	0	0	0.000
06/25	264	295	0.004	0	0	0.000	8	8	0.000	0	0	0.000
06/26	175	470	0.007	0	0	0.000	3	11	0.000	0	0	0.000
06/27	535	1,005	0.015	1	1	0.000	22	33	0.000	0	0	0.000
06/28	65	1,070	0.016	0	1	0.000	2	35	0.000	0	0	0.000
06/29	3,153	4,223	0.062	10	11	0.003	112	147	0.001	0	0	0.000
06/30	4,585	8,808	0.130	34	45	0.011	258	405	0.002	0	0	0.000
07/01	4,003	12,811	0.190	93	138	0.034	750	1,155	0.005	0	0	0.000
07/02	652	13,463	0.199	17	155	0.039	65	1,220	0.005	0	0	0.000
07/03	1,687	15,150	0.224	36	191	0.048	704	1,924	0.008	0	0	0.000
07/04	3,561	18,711	0.277	75	266	0.066	1,008	2,932	0.013	0	0	0.000
07/05	7,996	26,707	0.395	336	602	0.150	3,595	6,527	0.029	0	0	0.000
07/06	6,030	32,737	0.484	373	975	0.243	4,136	10,663	0.047	0	0	0.000
07/07	4,696	37,433	0.554	386	1,361	0.339	4,292	14,955	0.066	0	0	0.000
07/08	3,088	40,521	0.600	204	1,565	0.390	2,968	17,923	0.079	0	0	0.000
07/09	845	41,366	0.612	129	1,694	0.422	1,382	19,305	0.085	0	0	0.000
07/10	1,003	42,369	0.627	167	1,861	0.464	1,169	20,474	0.090	0	0	0.000
07/11	4,003	46,372	0.686	255	2,116	0.528	9,872	30,346	0.134	0	0	0.000
07/12	4,401	50,773	0.751	138	2,254	0.562	21,285	51,631	0.227	0	0	0.000
07/13	829	51,602	0.763	62	2,316	0.577	11,399	63,030	0.277	0	0	0.000
07/14	1,248	52,850	0.782	61	2,377	0.593	5,846	68,876	0.303	0	0	0.000
07/15	2,160	55,010	0.814	91	2,468	0.615	21,785	90,661	0.399	0	0	0.000
07/16	2,747	57,757	0.855	197	2,665	0.664	11,087	101,748	0.448	0	0	0.000
07/17	3,038	60,795	0.899	263	2,928	0.730	23,930	125,678	0.553	0	0	0.000
07/18	1,580	62,375	0.923	184	3,112	0.776	31,639	157,317	0.692	0	0	0.000
07/19	1,365	63,740	0.943	240	3,352	0.836	27,014	184,331	0.811	0	0	0.000
07/20	370	64,110	0.948	67	3,419	0.852	7,204	191,535	0.843	0	0	0.000

Boxed areas encompass first quartile, median, and third quartile.

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Appendix 3.-(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
07/21	335	64,445	0.953	129	3,548	0.885	4,672	196,207	0.864	0	0	0.000
07/22	304	64,749	0.958	117	3,665	0.914	2,460	198,667	0.874	0	0	0.000
07/23	248	64,997	0.962	57	3,722	0.928	3,512	202,179	0.890	0	0	0.000
07/24	200	65,197	0.965	66	3,788	0.944	7,181	209,360	0.921	0	0	0.000
07/25	220	65,417	0.968	12	3,800	0.947	5,278	214,638	0.945	0	0	0.000
07/26	166	65,583	0.970	8	3,808	0.949	3,496	218,134	0.960	0	0	0.000
07/27	130	65,713	0.972	8	3,816	0.951	1,186	219,320	0.965	0	0	0.000
07/28	202	65,915	0.975	11	3,827	0.954	1,496	220,816	0.972	1	1	0.000
07/29	145	66,060	0.977	23	3,850	0.960	1,134	221,950	0.977	0	1	0.000
07/30	115	66,175	0.979	31	3,881	0.968	982	222,932	0.981	1	2	0.000
07/31	140	66,315	0.981	17	3,898	0.972	1,315	224,247	0.987	0	2	0.000
08/01	191	66,506	0.984	20	3,918	0.977	962	225,209	0.991	0	2	0.000
08/02	91	66,597	0.985	4	3,922	0.978	474	225,683	0.993	1	3	0.001
08/03	76	66,673	0.986	11	3,933	0.981	440	226,123	0.995	5	8	0.001
08/04	56	66,729	0.987	1	3,934	0.981	303	226,426	0.997	8	16	0.003
08/05	73	66,802	0.988	7	3,941	0.983	127	226,553	0.997	8	24	0.004
08/06	71	66,873	0.989	9	3,950	0.985	73	226,626	0.997	5	29	0.005
08/07	104	66,977	0.991	10	3,960	0.987	104	226,730	0.998	16	45	0.008
08/08	77	67,054	0.992	3	3,963	0.988	140	226,870	0.999	9	54	0.010
08/09	34	67,088	0.993	5	3,968	0.989	68	226,938	0.999	5	59	0.011
08/10	57	67,145	0.993	7	3,975	0.991	36	226,974	0.999	8	67	0.012
08/11	39	67,184	0.994	1	3,976	0.991	40	227,014	0.999	3	70	0.013
08/12	77	67,261	0.995	8	3,984	0.993	43	227,057	0.999	4	74	0.014
08/13	100	67,361	0.997	7	3,991	0.995	52	227,109	1.000	111	185	0.034
08/14	58	67,419	0.997	1	3,992	0.995	40	227,149	1.000	71	256	0.047
08/15	34	67,453	0.998	0	3,992	0.995	11	227,160	1.000	9	265	0.049
08/16	32	67,485	0.998	12	4,004	0.998	18	227,178	1.000	61	326	0.060
08/17	0	67,485	0.998	0	4,004	0.998	0	227,178	1.000	0	326	0.060
08/18	0	67,485	0.998	0	4,004	0.998	0	227,178	1.000	0	326	0.060
08/19	16	67,501	0.999	2	4,006	0.999	2	227,180	1.000	8	334	0.062

Fish were not counted on 8/17, 8/18 and 8/20-28 due to high water which submerged the weir.

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Appendix 3.-(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
08/20	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/21	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/22	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/23	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/24	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/25	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/26	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/27	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/28	0	67,501	0.999	0	4,006	0.999	0	227,180	1.000	0	334	0.062
08/29	2	67,503	0.999	0	4,006	0.999	2	227,182	1.000	371	705	0.130
08/30	4	67,507	0.999	1	4,007	0.999	1	227,183	1.000	618	1,323	0.244
08/31	11	67,518	0.999	1	4,008	0.999	2	227,185	1.000	568	1,891	0.349
09/01	8	67,526	0.999	0	4,008	0.999	2	227,187	1.000	336	2,227	0.411
09/02	4	67,530	0.999	0	4,008	0.999	0	227,187	1.000	17	2,244	0.414
09/03	5	67,535	0.999	0	4,008	0.999	4	227,191	1.000	80	2,324	0.429
09/04	8	67,543	0.999	0	4,008	0.999	5	227,196	1.000	490	2,814	0.519
09/05	1	67,544	0.999	0	4,008	0.999	0	227,196	1.000	228	3,042	0.562
09/06	8	67,552	0.999	0	4,008	0.999	2	227,198	1.000	591	3,633	0.671
09/07	6	67,558	1.000	1	4,009	1.000	3	227,201	1.000	12	3,645	0.673
09/08	4	67,562	1.000	0	4,009	1.000	0	227,201	1.000	0	3,645	0.673
09/09	3	67,565	1.000	1	4,010	1.000	2	227,203	1.000	94	3,739	0.690
09/10	9	67,574	1.000	0	4,010	1.000	2	227,205	1.000	555	4,294	0.793
09/11	10	67,584	1.000	1	4,011	1.000	1	227,206	1.000	1,104	5,398	0.996
09/12	3	67,587	1.000	0	4,011	1.000	2	227,208	1.000	6	5,404	0.998
09/13	4	67,591	1.000	0	4,011	1.000	0	227,208	1.000	13	5,417	1.000

Boxed areas encompass first quartile, median, and third quartile.

Fish w ere not counted on 8/17, 8/18 and 8/20-28 due to high w ater w hich submerged the w eir.

Appendix 4.-Estimated age and sex composition of weekly chum salmon escapements through the East Fork Andreafsky River weir, Alaska, 1998, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group				
		1995	1994	1993	1992	
		0.2	0.3	0.4	0.5	Total
Stratum 1: 06/21 - 06/27						
No Samples Collected						
Stratum 2: 06/28 - 07/04						
Sampling Dates: 06/29 & 06/30						
Male:	Number in Sample:	0	56	12	5	73
	Estimated % of Escapement:	0.0	39.7	8.5	3.5	51.8
	Estimated Escapement:	0	7,032	1,507	628	9,167
	Standard Error:	0.0	729.3	415.9	275.6	
Female:	Number in Sample:	0	58	7	3	68
	Estimated % of Escapement:	0.0	41.1	5.0	2.1	48.2
	Estimated Escapement:	0	7,283	879	377	8,539
	Standard Error:	0.0	733.4	323.7	215.1	
Total:	Number in Sample:	0	114	19	8	141
	Estimated % of Escapement:	0.0	80.9	13.5	5.7	100.0
	Estimated Escapement:	0	14,315	2,386	1,005	17,706
	Standard Error:	0.0	586.5	508.9	344.8	
Stratum 3: 07/05 - 07/11						
Sampling Dates: 07/06 & 07/07						
Male:	Number in Sample:	0	59	10	1	70
	Estimated % of Escapement:	0.0	39.3	6.7	0.7	46.7
	Estimated Escapement:	0	10,880	1,844	184	12,908
	Standard Error:	0.0	1,104.0	563.7	183.9	
Female:	Number in Sample:	0	73	6	1	80
	Estimated % of Escapement:	0.0	48.7	4.0	0.7	53.3
	Estimated Escapement:	0	13,462	1,106	184	14,753
	Standard Error:	0.0	1,129.6	442.9	183.9	
Total:	Number in Sample:	0	132	16	2	150
	Estimated % of Escapement:	0.0	88.0	10.7	1.3	100.0
	Estimated Escapement:	0	24,342	2,951	369	27,661
	Standard Error:	0.0	734.4	697.6	259.2	
Stratum 4: 07/12 - 07/18						
Sampling Dates: 07/13 & 07/14						
Male:	Number in Sample:	0	46	6	0	52
	Estimated % of Escapement:	0.0	32.9	4.3	0.0	37.1
	Estimated Escapement:	0	5,258	686	0	5,944
	Standard Error:	0.0	634.7	273.7	0.0	
Female:	Number in Sample:	0	79	7	2	88
	Estimated % of Escapement:	0.0	56.4	5.0	1.4	62.9
	Estimated Escapement:	0	9,030	800	229	10,059
	Standard Error:	0.0	670.1	294.5	160.4	
Total:	Number in Sample:	0	125	13	2	140
	Estimated % of Escapement:	0.0	89.3	9.3	1.4	100.0
	Estimated Escapement:	0	14,288	1,486	229	16,003
	Standard Error:	0.0	418.0	392.2	160.4	

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Appendix 4.-(Continued)

		Brood Year and Age Group				
		1995	1994	1993	1992	
		0.2	0.3	0.4	0.5	Total
Stratum 5: 07/19 - 07/25						
Sampling Dates: 07/20 & 07/22						
Male:	Number in Sample:	1	51	8	2	62
	Estimated % of Escapement:	0.6	32.9	5.2	1.3	40.0
	Estimated Escapement:	20	1,001	157	39	1,217
	Standard Error:	19.1	112.2	52.8	27.0	
Female:	Number in Sample:	1	83	9	0	93
	Estimated % of Escapement:	0.6	53.5	5.8	0.0	60.0
	Estimated Escapement:	20	1,629	177	0	1,825
	Standard Error:	19.1	119.1	55.8	0.0	
Total:	Number in Sample:	2	134	17	2	155
	Estimated % of Escapement:	1.3	86.5	11.0	1.3	100.0
	Estimated Escapement:	39	2,630	334	39	3,042
	Standard Error:	27.0	81.7	74.6	27.0	
Stratum 6: 07/26 - 08/01						
Sampling Dates: 07/27, 07/28 & 07/30						
Male:	Number in Sample:	0	18	5	1	24
	Estimated % of Escapement:	0.0	28.1	7.8	1.6	37.5
	Estimated Escapement:	0	306	85	17	408
	Standard Error:	0.0	59.8	35.7	16.5	
Female:	Number in Sample:	1	32	7	0	40
	Estimated % of Escapement:	1.6	50.0	10.9	0.0	62.5
	Estimated Escapement:	17	545	119	0	681
	Standard Error:	16.5	66.6	41.5	0.0	
Total:	Number in Sample:	1	50	12	1	64
	Estimated % of Escapement:	1.6	78.1	18.8	1.6	100.0
	Estimated Escapement:	17	851	204	17	1,089
	Standard Error:	16.5	55.0	52.0	16.5	
Stratum 7: 08/02 - 08/08						
Sampling Dates: 08/03, 08/05 & 08/06						
Male:	Number in Sample:	0	39	10	0	49
	Estimated % of Escapement:	0.0	36.8	9.4	0.0	46.2
	Estimated Escapement:	0	202	52	0	253
	Standard Error:	0.0	23.2	14.0	0.0	
Female:	Number in Sample:	1	48	7	1	57
	Estimated % of Escapement:	0.9	45.3	6.6	0.9	53.8
	Estimated Escapement:	5	248	36	5	295
	Standard Error:	4.6	23.9	11.9	4.6	
Total:	Number in Sample:	1	87	17	1	106
	Estimated % of Escapement:	0.9	82.1	16.0	0.9	100.0
	Estimated Escapement:	5	450	88	5	548
	Standard Error:	4.6	18.4	17.6	4.6	

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Appendix 4.-(Continued)

		Brood Year and Age Group				
		1995	1994	1993	1992	
		0.2	0.3	0.4	0.5	Total
Stratum 8: 08/09 - 08/15						
Sampling Dates: 08/11 - 08/13						
Male:	Number in Sample:	0	28	20	2	50
	Estimated % of Escapement:	0.0	24.1	17.2	1.7	43.1
	Estimated Escapement:	0	96	69	7	172
	Standard Error:	0.0	13.4	11.8	4.1	
Female:	Number in Sample:	0	47	18	1	66
	Estimated % of Escapement:	0.0	40.5	15.5	0.9	56.9
	Estimated Escapement:	0	162	62	3	227
	Standard Error:	0.0	15.4	11.3	2.9	
Total:	Number in Sample:	0	75	38	3	116
	Estimated % of Escapement:	0.0	64.7	32.8	2.6	100.0
	Estimated Escapement:	0	258	131	10	399
	Standard Error:	0.0	15.0	14.7	5.0	
Strata 9-10: 08/16 - 08/29						
No Samples Collected						
Strata 11-12: 08/30 - 09/12						
Sampling Dates: 09/01, 09/03 & 09/07 - 09/10						
Male:	Number in Sample:	0	3	4	1	8
	Estimated % of Escapement:	0.0	18.8	25.0	6.3	50.0
	Estimated Escapement:	0	16	21	5	42
	Standard Error:	0.0	7.6	8.4	4.7	
Female:	Number in Sample:	0	6	2	0	8
	Estimated % of Escapement:	0.0	37.5	12.5	0.0	50.0
	Estimated Escapement:	0	32	11	0	42
	Standard Error:	0.0	9.4	6.5	0.0	
Total:	Number in Sample:	0	9	6	1	16
	Estimated % of Escapement:	0.0	56.3	37.5	6.3	100.0
	Estimated Escapement:	0	47	32	5	84
	Standard Error:	0.0	9.7	9.4	4.7	
Stratum 13: 09/13 - 09/14						
No Samples Collected						
Strata 1-13: 06/21 - 09/14						
Sampling Dates: 06/29 - 09/10						
Male:	Number in Sample:	1	300	75	12	388
	% Males in Age Group:	0.1	82.3	14.7	2.9	100.0
	Estimated % of Escapement:	0.0	37.3	6.6	1.3	45.3
	Estimated Escapement:	20	24,791	4,420	881	30,112
	Estimated Design Effects:		1.873 [1]	1.855	1.714	1.850
Female:	Number in Sample:	3	426	63	8	500
	% Females in Age Group:	0.1	88.9	8.8	2.2	100.0
	Estimated % of Escapement:	0.1	48.7	4.8	1.2	54.7
	Estimated Escapement:	42	32,390	3,190	798	36,420
	Estimated Design Effects:		1.844 [1]	1.738	1.802	1.850
Total:	Number in Sample:	4	726	138	20	888
	Estimated % of Escapement:	0.1	85.9	11.4	2.5	100.0
	Estimated Escapement:	61	57,181	7,610	1,679	66,532 [2]
	Standard Error:	31.9	1,033.6	953.1	461.4	
	Estimated Design Effects:		1.794 [1]	1.810	1.747	

[1] Ages 0.2 and 0.3 were combined into one group for contingency table analysis.

[2] 1,059 fish that were counted through the weir during strata 1, 9, 10 and 13 are not included in this total.

Appendix 5.-Estimated age and sex composition of weekly chinook salmon escapements through the East Fork Andreafsky River weir, Alaska, 1998, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group					
		1994	1993	1992	1992	1991	
		1.2	1.3	1.4	2.3	1.5	Total
Stratum 1: 06/21 - 06/27							
No Samples Collected							
Stratum 2: 06/28 - 07/04							
Sampling Dates: 07/03 & 07/04							
Male:	Number in Sample:	5	6	2	0	0	13
	Estimated % of Escapement	31.3	37.5	12.5	0.0	0.0	81.3
	Estimated Escapement:	83	99	33	0	0	215
	Standard Error:	30.7	32.1	21.9	0.0	0.0	
Female:	Number in Sample:	0	1	2	0	0	3
	Estimated % of Escapement	0.0	6.3	12.5	0.0	0.0	18.8
	Estimated Escapement:	0	17	33	0	0	50
	Standard Error:	0.0	16.1	21.9	0.0	0.0	
Total:	Number in Sample:	5	7	4	0	0	16
	Estimated % of Escapement	31.3	43.8	25.0	0.0	0.0	100.0
	Estimated Escapement:	83	116	66	0	0	265
	Standard Error:	30.7	32.9	28.7	0.0	0.0	
Stratum 3: 07/05 - 07/11							
Sampling Dates: 07/05 - 07/09							
Male:	Number in Sample:	28	73	6	0	0	107
	Estimated % of Escapement	21.7	56.6	4.7	0.0	0.0	82.9
	Estimated Escapement:	402	1,047	86	0	0	1,534
	Standard Error:	65.0	78.2	33.2	0.0	0.0	
Female:	Number in Sample:	2	11	7	0	2	22
	Estimated % of Escapement	1.6	8.5	5.4	0.0	1.6	17.1
	Estimated Escapement:	29	158	100	0	29	316
	Standard Error:	19.5	44.0	35.7	0.0	19.5	
Total:	Number in Sample:	30	84	13	0	2	129
	Estimated % of Escapement	23.3	65.1	10.1	0.0	1.6	100.0
	Estimated Escapement:	430	1,205	186	0	29	1,850
	Standard Error:	66.6	75.2	47.5	0.0	19.5	
Stratum 4: 07/12 - 07/18							
Sampling Dates: 07/12 - 07/16							
Male:	Number in Sample:	14	71	8	1	0	94
	Estimated % of Escapement	9.0	45.5	5.1	0.6	0.0	60.3
	Estimated Escapement:	89	453	51	6	0	600
	Standard Error:	21.0	36.6	16.2	5.9	0.0	
Female:	Number in Sample:	3	41	17	0	1	62
	Estimated % of Escapement	1.9	26.3	10.9	0.0	0.6	39.7
	Estimated Escapement:	19	262	109	0	6	396
	Standard Error:	10.1	32.3	22.9	0.0	5.9	
Total:	Number in Sample:	17	112	25	1	1	156
	Estimated % of Escapement	10.9	71.8	16.0	0.6	0.6	100.0
	Estimated Escapement:	109	715	160	6	6	996
	Standard Error:	22.9	33.1	27.0	5.9	5.9	

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Appendix 5.-(Continued)

		Brood Year and Age Group					
		1994	1993	1992	1992	1991	
		1.2	1.3	1.4	2.3	1.5	Total
Stratum 5: 07/19 - 07/25							
Sampling Dates: 07/20 - 07/23							
Male:	Number in Sample:	9	36	2	0	0	47
	Estimated % of Escapement	13.8	55.4	3.1	0.0	0.0	72.3
	Estimated Escapement:	95	381	21	0	0	497
	Standard Error:	28.3	40.7	14.1	0.0	0.0	
Female:	Number in Sample:	0	18	0	0	0	18
	Estimated % of Escapement	0.0	27.7	0.0	0.0	0.0	27.7
	Estimated Escapement:	0	191	0	0	0	191
	Standard Error:	0.0	36.6	0.0	0.0	0.0	
Total:	Number in Sample:	9	54	2	0	0	65
	Estimated % of Escapement	13.8	83.1	3.1	0.0	0.0	100.0
	Estimated Escapement:	95	572	21	0	0	688
	Standard Error:	28.3	30.7	14.1	0.0	0.0	
Strata 6-7: 07/26 - 08/08							
Sampling Dates: 07/30 & 08/03 - 08/06							
Male:	Number in Sample:	1	7	0	0	0	8
	Estimated % of Escapement	8.3	58.3	0.0	0.0	0.0	66.7
	Estimated Escapement:	14	95	0	0	0	109
	Standard Error:	13.1	23.3	0.0	0.0	0.0	
Female:	Number in Sample:	0	3	1	0	0	4
	Estimated % of Escapement	0.0	25.0	8.3	0.0	0.0	33.3
	Estimated Escapement:	0	41	14	0	0	54
	Standard Error:	0.0	20.5	13.1	0.0	0.0	
Total:	Number in Sample:	1	10	1	0	0	12
	Estimated % of Escapement	8.3	83.3	8.3	0.0	0.0	100.0
	Estimated Escapement:	14	136	14	0	0	163
	Standard Error:	13.1	17.6	13.1	0.0	0.0	
Strata 8-13: 08/09 - 09/14							
No Samples Collected							
Strata 1-13: 06/21 - 09/14							
Sampling Dates: 07/03 - 08/06							
Male:	Number in Sample:	57	193	18	1	0	269
	% Males in Age Group:	23.1	70.2	6.5	0.2	0.0	100.0
	Estimated % of Escapement	17.2	52.4	4.8	0.2	0.0	74.6
	Estimated Escapement:	683	2,076	191	6	0	2,956
	Estimated Design Effects:	1.197	1.121			1.173 [1]	1.020
Female:	Number in Sample:	5	74	27	0	3	109
	% Females in Age Group:	4.8	66.3	25.4	0.0	3.5	100.0
	Estimated % of Escapement	1.2	16.8	6.5	0.0	0.9	25.4
	Estimated Escapement:	48	667	256	0	35	1,006
	Estimated Design Effects:	1.057	0.945			1.084 [1]	1.020
Total:	Number in Sample:	62	267	45	1	3	378
	Estimated % of Escapement	18.4	69.2	11.3	0.2	0.9	100.0
	Estimated Escapement:	730	2,743	447	6	35	3,962 [2]
	Standard Error:	82.9	95.3	64.6	5.9	20.3	
	Estimated Design Effects:	1.187	1.112			1.107 [1]	

[1] Ages 1.4, 2.3 and 1.5 were combined into one group for contingency table analysis.
[2] 49 fish that were counted through the weir during stratum 1 and strata 8-13 are not included in this total.

Appendix 6.-Estimated age and sex composition of weekly coho salmon escapements through the East Fork Andreafsky River weir, Alaska, 1998.

		Brood Year and Age Group			
		1995	1994	1993	
		1.1	2.1	3.1	Total
Strata 1-5: 06/21 - 07/25					
No Samples Collected					
Strata 6-7: 07/26 - 08/08					
Sampling Dates: 07/28 & 08/03 - 08/05					
Male:	Number in Sample:	0	4	0	4
	Estimated % of Escapement:	0.0	80.0	0.0	80.0
	Estimated Escapement:	0	43	0	43
	Standard Error:	0.0	10.3	0.0	
Female:	Number in Sample:	0	1	0	1
	Estimated % of Escapement:	0.0	20.0	0.0	20.0
	Estimated Escapement:	0	11	0	11
	Standard Error:	0.0	10.3	0.0	
Total:	Number in Sample:	0	5	0	5
	Estimated % of Escapement:	0.0	100.0	0.0	100.0
	Estimated Escapement:	0	54	0	54
	Standard Error:	0.0	0.0	0.0	
Stratum 8: 08/09 - 08/15					
Sampling Dates: 08/11 - 08/13					
Male:	Number in Sample:	1	12	1	14
	Estimated % of Escapement:	5.9	70.6	5.9	82.4
	Estimated Escapement:	12	149	12	174
	Standard Error:	11.9	23.0	11.9	
Female:	Number in Sample:	0	3	0	3
	Estimated % of Escapement:	0.0	17.6	0.0	17.6
	Estimated Escapement:	0	37	0	37
	Standard Error:	0.0	19.3	0.0	
Total:	Number in Sample:	1	15	1	17
	Estimated % of Escapement:	5.9	88.2	5.9	100.0
	Estimated Escapement:	12	186	12	211
	Standard Error:	11.9	16.3	11.9	
Strata 9-10: 08/16 - 08/29					
No Samples Collected					
Stratum 11: 08/30 - 09/05					
Sampling Dates: 08/31 - 09/04					
Male:	Number in Sample:	1	80	6	87
	Estimated % of Escapement:	0.8	61.5	4.6	66.9
	Estimated Escapement:	18	1,438	108	1,564
	Standard Error:	17.5	97.3	42.0	
Female:	Number in Sample:	2	39	2	43
	Estimated % of Escapement:	1.5	30.0	1.5	33.1
	Estimated Escapement:	36	701	36	773
	Standard Error:	24.6	91.6	24.6	
Total:	Number in Sample:	3	119	8	130
	Estimated % of Escapement:	2.3	91.5	6.2	100.0
	Estimated Escapement:	54	2,139	144	2,337
	Standard Error:	30.0	55.6	48.1	

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Appendix 6.-(Continued)

		Brood Year and Age Group			
		1995	1994	1993	
		1.1	2.1	3.1	Total
Stratum 12: 09/06 - 09/12					
Sampling Dates: 09/07, 09/09 & 09/10					
Male:	Number in Sample:	0	67	1	68
	Estimated % of Escapement:	0.0	53.6	0.8	54.4
	Estimated Escapement:	0	1,266	19	1,285
	Standard Error:	0.0	102.9	18.4	
Female:	Number in Sample:	0	55	2	57
	Estimated % of Escapement:	0.0	44.0	1.6	45.6
	Estimated Escapement:	0	1,039	38	1,077
	Standard Error:	0.0	102.5	25.9	
Total:	Number in Sample:	0	122	3	125
	Estimated % of Escapement:	0.0	97.6	2.4	100.0
	Estimated Escapement:	0	2,305	57	2,362
	Standard Error:	0.0	31.6	31.6	
Stratum 13: 09/13 - 09/14					
No Samples Collected					
Strata 1-13: 06/21 - 09/14					
Sampling Dates: 07/28 - 09/10					
Male:	Number in Sample:	2	163	8	173
	% Males in Age Group:	1.0	94.5	4.5	100.0
	Estimated % of Escapement:	0.6	58.3	2.8	61.8
	Estimated Escapement:	30	2,896	139	3,066
	Standard Error:	21.1	143.9	47.3	
Female:	Number in Sample:	2	98	4	104
	% Females in Age Group:	1.9	94.2	3.9	100.0
	Estimated % of Escapement:	0.7	36.0	1.5	38.2
	Estimated Escapement:	36	1,788	74	1,898
	Standard Error:	24.6	139.2	35.7	
Total:	Number in Sample:	4	261	12	277
	Estimated % of Escapement:	1.3	94.4	4.3	100.0
	Estimated Escapement:	66	4,685	213	4,964 [1]
	Standard Error:	32.3	66.0	58.7	

[1] 453 fish that were counted through the weir during strata 1-5, 8 and 13 are not included in this total.

Appendix 7.-Chum, chinook, and coho salmon escapement counts for the Andreafsky River, Alaska, 1961-1998. All data, except weir counts are from Bergstrom et al. (1998).

	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		
1998	1,027 [e]			4,011 [d]	67,591 [d]	5,417 [ad]	1,249 [ae]		
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*

[e] *Preliminary data (V. Golembeski, Alaska Department of Fish & Game, personal communication)*