3A89-03

ANVIK AND ANDREAFSKY RIVER SALMON STUDIES, 1988

By

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Regional Information Report[1] No. [redacted]

Alaska Department of Fish and Game
Division of Commercial Fisheries, AYK Region
333 Raspberry Road
Anchorage, Alaska 99518

January, 1989

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ACKNOWLEDGMENTS

The author wishes to acknowledge and thank Lawrence S. Buklis, who authored the annual reports for these two projects since 1980, for providing the template for this report. The critical review of this report by Lawrence S. Buklis is also gratefully acknowledged.

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INTRODUCTION

The Anvik and Andreafsky Rivers are the two largest producers of summer chum salmon (*Oncorhynchus keta*) in the Yukon River drainage (Figure 1). Buklis (1982a) estimated that the Anvik River alone accounts for 35% of the total production. Other known major spawning populations occur in the Rodo, Nulato, Gisasa, Hogatza, Melozitna, Tozitna, Chena, and Salcha Rivers. Summer chum salmon spawn in lesser numbers in other tributaries of the Yukon River. Chinook (*O. tshawystcha*) and pink (*O. gorbuscha*) salmon occur in the Anvik and Andreafsky Rivers coincidentally with summer chum salmon. Although coho salmon (*O. kisutch*) are known to occur in small numbers in the fall their abundance is not monitored.

Commercial and subsistence fisheries that harvest Anvik and Andreafsky River summer chum salmon occur throughout the mainstem Yukon River from the coast of the delta to the mouths of the respective tributary streams. Set and drift gill nets are the legal fishing gear in Districts 1, 2, and 3, while set gill nets and fishwheels may be used in District 4. Most of the effort and harvest occurs in Districts 1 and 2, and in the lower portion of District 4. Fish taken commercially in the lower three districts are fresh frozen, while District 4 is primarily a roe fishery due to market conditions and flesh quality. Commercial and subsistence summer chum salmon fisheries in the remainder of District 4 and in District 6 are supported by stocks other than those of the Andreafsky and Anvik Rivers. Very few summer chum salmon are harvested in District 5 due to the lack of significant spawning populations in that portion of the drainage.

Stock identification studies on Yukon River summer chum salmon using scale patterns analysis and protein electrophoresis techniques are being conducted by the Alaska Department of Fish and Game (ADF&G) and the United States Fish and Wildlife Service (USFWS), respectively. These studies were initiated in 1987, and results are not yet available.

Chinook salmon are the primary target species of the lower Yukon River (Districts 1, 2, and 3) commercial fishery during June and early July. Fishing is usually permitted with unrestricted mesh size gill nets until changeover to 6 inch maximum mesh size is required by Emergency Order. In most years the majority of the summer chum salmon run passes through the lower river districts before the changeover to chum salmon gear occurs. As a result, most of the summer chum salmon commercial harvest in the lower Yukon is usually taken from the later portion of the run. During the 1988 commercial fishing season, however, a restricted mesh size fishery targeted on summer chum salmon was allowed prior to the directed chinook salmon fishery. This directed summer chum salmon directed fishery was implemented in response to indications of an abundance of summer chum salmon while the chinook salmon return was in an early stage of development.

The Board of Fisheries directed that, beginning with the 1985 season, there may be special small mesh gear openings during the chinook salmon season to optimize harvest of summer chum salmon. This requires a relatively large summer chum salmon run, and that the incidental harvest of chinook salmon would not be substantial enough to have an adverse affect on the management of that species.

The District 4 commercial fishery is directed primarily at chum salmon. Subsistence fisheries in all four districts take summer chum salmon primarily for sled dog food.

Summer chum salmon escapements to the major spawning areas in the Yukon River drainage have been estimated by aerial survey from fixed wing aircraft on a consistent basis since the early 1970's. Aerial surveys are subject to error and variability due to weather, stream conditions, timing of the survey relative to spawning stage, and subjectivity and experience on the part of the observer. The counts obtained are only indices of abundance since not all salmon present on the day of the survey are usually seen, and earlier and later spawners are not present. However, these indices, if obtained under standardized conditions, can be used to monitor the relative abundance of spawning escapements. Aerial surveys are the most feasible method of assessing salmon escapements in terms of cost and staff limitations in a watershed as immense and remote as that of the Yukon River. Escapement objectives have been established for both chinook and chum salmon in selected tributary streams for which there is a sufficient historical data base (ADF&G 1988).

Intensive studies are conducted for a few important and representative tributary stream salmon spawning populations in addition to the aerial survey program. The Anvik and Andreafsky Rivers were chosen for summer chum salmon research studies in 1972 and 1981, respectively. This report presents results of these studies for the 1988 field season, and provides recommendations for 1989 project operations.

ANVIK RIVER SALMON STUDY

The Anvik River (Figure 2) originates at an elevation of 1,300 feet and flows in a southerly direction approximately 120 miles to its mouth at mile 318 of the Yukon River. It is a narrow runoff stream with a substrate of gravel and cobble, except in the upper reach where bedrock is exposed. The Yellow River is a major tributary of the Anvik and is stained with tannic acid runoff. Downstream of the Yellow River confluence the Anvik River changes from a moderate gradient system to a low gradient system meandering through a much broader flood plain. Water clarity is reduced downstream of the Yellow River. Numerous oxbows, old channel cutoffs and sloughs are found throughout the lower river.

Salmon escapement was enumerated from counting towers located above the Yellow River from 1972 to 1978. A site 5.5 miles above the Yellow River was used from 1972 to 1975, and a site at Robinhood Creek, 2.5 miles above the Yellow River, was used from 1976 to 1978. Aerial surveys were flown each year (except 1974) in fixed-wing aircraft to estimate salmon abundance below the tower site. High and turbid water often affects the accuracy of visual salmon enumeration from counting towers and aircraft.

The Electrodynamics Division of the Bendix Corporation developed a side-scanning sonar counter during the 1970's capable of detecting and counting salmon

migrating along the banks of tributary streams. The sonar counter is designed to transmit a sonic beam along a 60 foot aluminum tube, or substrate. Echoes from salmon passing through the beam are reflected back to the transducer. The system electronics interpret the strength and number of the echoes, and tally salmon counts. Criteria for strength and frequency of the echoes are designed to optimize counting of salmon and minimize any non-salmon counts (i.e. debris or other fish species). Salmon escapement was enumerated by sonar beginning in 1979, replacing and proving superior to the tower counting method. One sonar counter has been installed on each bank of the Anvik River near Theodore Creek each year. Aerial survey data indicates that virtually all summer chum salmon spawners are found upstream of this site.

Methods and Materials

Sonar counters were operated without artificial aluminum substrate tubes throughout the season for the fourth consecutive year. Each sonar transducer was mounted on a rectangular aluminum frame. The east and west bank sites used in previous years were probed to locate uniform river bottom gradients that would provide optimum surfaces for insonification. Two steel pipes were set into the river bottom on each side of the river, onto which the transducer frames were guided by side mounted steel sleeves. Counting ranges were initially set to 60 ft. Weirs prevented salmon passage inshore of the transducer on each bank. Transducers were moved inshore or offshore and counting ranges were adjusted as required by fluctuating water levels.

Due to equipment failure a number of different model sonar counters were used to collect salmon passage data during the 1988 field season. Although counting ranges employed were similar, the counting range was divided into 12 or 16 sectors depending on the model of the counter. Therefore, sonar counts on each bank were totaled electronically in either the 12 or 16 sectors for each bank and printed hourly. Sector counts missing as a result of debris or printer malfunction were estimated by averaging the counts in the same sector for the hour before and after the sector count in question. Likewise, when salmon counts were not conducted for a full day, the salmon passage for that day was estimated as the mean of the salmon passage for the day before and after the day for which sonar counts were not available. When salmon were not counted for a large portion of a day counts were estimated for that time period based on the mean proportion of the corrected salmon counts for that period for 2 days before and after the day of the data omission. During the period 15 July - 25 July sonar counts were unavailable for the east bank. An estimate of salmon passage during this time period within the east bank counting range was made based on the proportion of east bank salmon passage for the period 21 June - 15 July. Since the proportion attributed to the east bank tended to increase during the season, this estimate was deemed conservative.

Counts were totaled daily for each bank using an electronic calculator. Since summer chum salmon greatly outnumber chinook and pink salmon, and the counters do not distinguish between species of salmon, all sonar counts for a large part of the season were attributed to summer chum salmon passage. During the latter

portion of the season, however, pink salmon were observed migrating upstream of the sonar site during sonar calibration activities. Pink salmon were enumerated during these periods and the daily corrected counts were adjusted based on the mean percent of pink salmon observed during these periods. Pink salmon passage was not estimated. A separate escapement estimate for chinook salmon was obtained by aerial survey.

Each sonar counter was calibrated four times daily by observing fish passage with an oscilloscope for a 15 minute period. Salmon passing through the sonar beam produce a distinct oscilloscope trace. Sonar and oscilloscope counts for each calibration period were related in the formula: Q=SS/SC, where SS = side scan sonar counts, and SC = oscilloscope counts. The existing fish velocity setting was multiplied by Q to obtain the correct new setting if the difference between the counts was greater than 15%. The system was then recalibrated at the new setting. A record was kept of all adjustments to the sonar equipment. Fish passage was visually enumerated from 10 ft counting towers during sonar calibration periods as a further check on sonar accuracy whenever water and light conditions allowed. Polaroid sunglasses were worn to reduce water surface glare.

Daily sonar counts were adjusted based on bank-specific calibration data. Usually, the daily adjustment factor for each bank was calculated as the sum of calibration oscilloscope counts for that day divided by the sum of calibration sonar counts for that day. Daily sonar counts for each bank were multiplied by the daily adjustment factor to obtain corrected daily sonar counts for each bank. The sum of the east and west bank corrected daily sonar counts yielded the estimated summer chum passage for that day. Occasionally, variations in bank-specific calibration factors in addition to variable rates of salmon passage necessitated the adjustment of bank-specific sonar counts within a day. Calibration periods within a day were defined by the time of each calibration. Sonar counts within each period were multiplied by the periodic adjustment factor, calculated as the sum of the oscilloscope counts for the calibrations which defined that period, divided by the sum of the associated calibration sonar counts for that period. The resulting corrected sonar counts for each period were summed, yielding the estimated summer chum salmon passage for that day for that bank. Mean and standard deviation of date of passage were calculated following the method presented by Mundy (1982).

Unadjusted sonar counts by hour and sector were corrected using the daily or periodic bank-specific adjustment factor for each day for each bank in order to determine the temporal and spatial segregation of the summer chum salmon run. The data were standardized by using only days with 24 hourly counts in the analysis. Periods used for the comparison of hourly passage data were bounded by days with less than 24 hourly counts. The comparison of the passage data by sector likewise required similar standardization. Although sector passage data were confined to the same basic periods as the hourly data, an additional requirement necessitated that periods contain days with the same total number of sectors.

Water depth profile at each bank-specific sonar site was measured at 3 m intervals across the width of the river by probing with a pole marked in 1 cm increments. River profile data was collected twice during the season.

Climatological data were collected at noon each day at the campsite. A pole marked in 1 cm increments was set in the river. Changes in water depth are presented as negative or positive from the initial reading of 0 cm. Water temperature was measured in degrees centigrade near shore, at a depth of about 0.5 m. Daily maximum and minimum air temperatures were recorded in degrees centigrade. Subjective notes were kept by the crew describing wind speed and direction, cloud cover, and precipitation.

A beach seine (100 ft long, 66 meshes deep, 2.5 in mesh) was set near the sonar site to capture chum and chinook salmon for age, sex, and size measurements. All captured salmon were enumerated by species and sex. Chum and chinook salmon were placed in a holding pen, identified by sex, measured from mid-eye to fork of tail in mm, and one scale was taken for age determination. Scales were removed from an area posterior to the base of the dorsal fin and above the lateral line on the left side of the fish. The adipose fin was clipped on each fish before release to prevent resampling. Additionally, chinook salmon carcasses were sampled in August to supplement the beach seine sample. Three scales were taken from each carcass. Scale samples were later pressed on acetate cards and the resulting impressions viewed on a microfiche reader for age determination.

Results and Discussion

Two sonar counters were operated on the Anvik River from 21 June through 27 July at the same sites used in previous years (Figure 2). The east bank transducer was located along a cutbank, 1.25 m offshore and at an depth of 25 cm. The west bank transducer was located along a gradually sloping gravel bar, approximately 60 m downstream from the east bank site. Placement of the transducer was 6.5 m offshore and at a depth of 12 cm. An approximate 20 m portion of the river transect was not insonified in the center of the channel on 26 June (Figure 3). The portion of the river transect which was not insonified on 10 July was 12 m (Figure 4). Similar river insonification was achieved during the initial placement of the transducers on 21 June and throughout the season. River transect data collected on 26 June and 10 July indicates that the bottom gradient was relatively smooth, with no major obstructions to the sonar beams. River widths on 26 June the east and west bank sonar sites were 60 m and 69 m, respectively, while on 10 July river widths were 63 m and 64 m, respectively. The apparent increase of 3 m in river width from 26 June to 10 July at the west bank sonar site did not actually occur since river water level decreased during that time period (Figure 5). A misalignment of the reference points during the transect measurement most likely was the cause of the apparent increase in river width. Maximum river depth observed during the collection of river profile data on 26 June and 10 July was 165 cm and 105 cm, respectively.

River water level declined in a consistent, regular manner throughout the duration of the project (Figure 5) due to sparse precipitation. River water level decreased approximately 90 cm during the duration of the project. Water temperature ranged from a low of 12 C on 22 June to a high of 18 C on 22 July, while air temperature ranged from a low daily minimum of 3 C on 24 June to a high daily maximum of 27 C observed on four individual days, 1, 15, 18, and 20

July (Figure 5).

The adjusted escapement count for the period 21 June through 27 July was 1,125,449 summer chum salmon (Table 1). During the four-day period 29 June through 2 July adjusted daily counts of summer chum salmon totaled 380,539 which represented approximately 34% of the total season sonar count. Escapement timing appeared to be slightly early to average, as it had been in 1979, 1983, and 1986 (Figure 6). Mean date of run passage was 5 July, with a standard deviation of 6.52 days. The daily escapement counts were skewed toward the early part of the run, as they were in 1986.

In response to an observed above average summer chum salmon run special restricted mesh size fishing periods were implemented for the commercial fishery prior to and following the first unrestricted mesh size fishing periods in District 1 and 2, statistical areas 334-10 and 334-20, respectively (Figure 1). A twice weekly restricted mesh size fishing schedule was initiated. After the magnitude of the summer chum run was deemed above average on 23 June fishing time per period was increased to 24 hours from the initial 12 hours. On 10 July, however, due to anticipated below average summer chum salmon escapement to the Andreafsky River, fishing time per period was reduced to 12 hours and the closed water area of the Andreafsky River mouth was extended in order to conserve summer chum salmon returning to that river system.

Buklis (1982) expanded the season escapement estimates for 1972 through 1978, making it possible to more directly compare visual count estimates to more recent annual sonar count estimates (Figure 7). The 1988 escapement estimate of 1,125,449 summer chum salmon was 26% greater than the parent year escapement in 1984, was approximately 131% above the escapement objective of 487,000 fish, and was also 82% above the long term (1972-1987) average of 617,000 fish.

A total of 29.75 hours of sonar calibration were conducted over a 36 day period at the west bank site. Sonar accuracy (sonar count/oscilloscope count) averaged 1.56 (Table 2). Although visual counts were not normally used to directly calibrate the sonar electronics, they did provide a measure of salmon species composition and an assessment of sonar aiming and counting accuracy. A net upstream total of 2,774 chum salmon and 4 chinook salmon were visually enumerated at the west bank site during all calibration periods combined. Sonar accuracy averaged 1.71 for 29.25 hours of oscilloscope calibration at the east bank site over a period of 37 days (Table 3). A net upstream total of 6,373 chum salmon and 2 chinook salmon were visually enumerated during these calibration periods. Due to oscilloscope failure visual salmon passage counts were used for calibration of sonar counts for the east bank site during the period 3 - 6 July (Table 3).

Temporal distribution of the east and west bank adjusted sonar counts by hour (Appendix Tables 1 and 2, respectively) indicates a distinct diel pattern of salmon passage (Figure 8). Based upon adjusted counts from days with complete hourly data, salmon passage was lowest 0800-2000 (averaging 2.9% of total daily passage per hour) and greatest during 0000-0700 (averaging 6.5% of total daily passage per hour). This pattern was relatively consistent throughout the season.

Spatial distribution of the adjusted sonar counts by sector (Figure 9) indicates that most of the salmon passage occurred in the first three sectors of both the west bank (Appendix Table 3) and, to a lesser extent, the east bank (Appendix Table 4). Using only 24-hour count days and combining the adjusted counts for both banks (N = 627,631), the west bank sectors 1 through 3 accounted for 66% of all adjusted sonar counts, while east bank sectors 1 through 3 accounted for 15%. The remaining 19% of the counts were distributed across the other 18 to 26 sonar counting sectors. Sonar sector number varied due to the different model sonar counters used during different time periods of the 1988 field season.

An aerial survey of the Anvik River (including Otter Creek, Beaver Creek, Swift River, and Yellow River) was flown on 16 July under fair survey conditions. A total of 172,350 chum salmon and 1,805 chinook salmon were enumerated. The chum salmon survey estimate was only 16% of the sonar count through the date of the survey, and 15% of the total season sonar count. The chinook salmon estimate was the largest aerial survey count ever recorded for the Anvik River drainage. The count of 1,261 chinook salmon in the mainstem Anvik River between Yellow River and McDonald Creek achieved the aerial survey escapement objective of 300 to 500 chinook salmon for this index area. A later survey on 7 September under fair conditions enumerated 1,203 coho salmon in the Anvik River system.

Fifteen (15) beach seine sets were made from 26 June to 23 July and a total of 631 chum salmon and 1 pink salmon were captured (Appendix Table 5) . No chinook salmon were captured by beach seine. However, chinook salmon carcass samples were collected by boat survey in August.

Of the 579 chum salmon sampled for age-sex-size data, 531 (92%) later proved to have ageable scales. Age composition was 6% age 3, 77% age 4, 16% age 5, and 1% age 6 (Appendix Table 6). Females accounted for 66% of the sample. Females have contributed more than 50% to the escapement sample of summer chum salmon in 14 of the 17 years of record. Age-4 salmon usually accounted for the majority of the Anvik River chum salmon escapement. Age-5 chum salmon dominated the escapement in 1972, 1976, 1981, and 1986, but in all other years since 1972 the 4-year-old age class has dominated (Figure 10). Age composition of the District 1 commercial catch in 1988 varied by mesh size and progression of the run. However, the preliminary estimate for the entire season is 74% age 4, 25% age 5, and 1% age 6 (J. Wilcock, Alaska Department of Fish and Game, Anchorage, personal communication). The age composition of the District 1 commercial catch and of the Anvik River escapement sample were similar in 1988, as has been observed in previous years.

Of the 266 chinook salmon sampled for age-sex-size data, 246 (92%) were identifiable by sex and later proved to have ageable scales. Age composition was 30% age 4, 38% age 5, 27% age 6, and 4% age 7 (Figure 11). Females accounted for 30% of the sample. The age 4 contribution to the total sample, on a percentage basis, was exceeded only in 1979 and 1982 (Appendix Table 7). These age compositions do not correspond closely with the age composition of the District 1 and 2 commercial harvest, which was approximately 17% age 4, 24.5% age 5, 30.9% age 6 and 26.8% age 7 (J. Wilcock, Alaska Department of Fish and Game, Anchorage, personal communication). This discrepancy in age class composition of the escapement and harvest was most likely due to the selectivity

of the restricted and unrestricted gear types, the magnitude of the catch attributed to each gear type, and the various chinook stocks present in the river during the harvest period. The percentage of females in the escapement sample was in the lower end of the overall 20% to 63% range observed in previous years for the Anvik River.

Although the chinook salmon aerial survey count for the Anvik River system was the highest ever recorded, the dominance of males in the escapement sample indicates that 1988 brood year production may be less than expected.

ANDREAFSKY RIVER SALMON STUDY

The Andreafsky River (Figure 12) includes two main branches, the East and West Forks, and is located 100 miles upstream from the mouth of the Yukon River. The Andreafsky River typically ranks second to the Anvik River in summer chum salmon escapement, second to the Salcha River in chinook salmon escapement, and supports the largest pink salmon population in the Yukon River drainage. Salmon escapements were estimated annually in each fork by aerial survey from fixed wing aircraft prior to 1981. A side-scanning sonar counter was installed in the East Fork for the first time in 1981 to obtain more complete and accurate escapement information than could be obtained by aerial survey.

The mainstem Andreafsky River, below the confluence of the East and West Forks, is not suitable for escapement enumeration due to its width and slack current. The East Fork was chosen for sonar enumeration in 1981 because it supports a greater average summer chum salmon escapement than the West Fork, based on historical aerial survey data. In addition, a feasible sonar site could be located lower on the East Fork than on the West Fork, potentially enumerating a greater proportion of the spawners and simplifying logistics. There is also less recreational use of the East Fork by the residents of St Marys, a village of 500 people located near the confluence of the Andreafsky and Yukon Rivers.

Sonar was used to enumerate summer chum salmon escapements to the East Fork Andreafsky River from 1981 through 1984. Flood conditions in 1985 prohibited accurate sonar enumeration with the transducer deployment methods available at that time (Buklis 1985). As a result, an improved transducer deployment method was developed and was available for use on the Andreafsky River beginning in 1986 (Buklis 1986).

Large pink salmon escapements in 1982 and 1984 affected the accuracy of estimating summer chum salmon escapement using side-scanning sonar. A contingency plan was developed for 1986, whereby visual counting from towers would be used instead of sonar to estimate the 1986 escapement by species to the East Fork Andreafsky River if water conditions permitted. Water levels and clarity were favorable, and tower counting was successfully applied for the entire season for the first time in 1986. The tower counting method was repeated in 1987 and 1988 due to the success of the 1986 project, and the desire to obtain daily salmon escapement counts by species.

Methods and Materials

The same site used previously for sonar and counting tower enumeration was selected for the tower site in 1988 (Figure 12). A weir was built from each shore, with an initial opening of approximately 18 m in the center for fish passage. The 20 ft counting tower was placed on the west side of the weir opening. A white canvas tarp was set on the river bottom across the weir opening to provide contrast for fish species identification and enumeration purposes. Polaroid sunglasses were worn during daylight hours, and 12 volt lamps were used to illuminate the weir opening during hours of darkness.

Daily counting shifts were from 0000 to 0800, 0800 to 1600, and from 1600 to 2400. A counting schedule was developed for a three-person crew which provided for four days of 24 hour counting per week. This schedule was constructed such that days with 16 hour counting did not occur consecutively, but were always bracketed by 24-hour count days. On the three days per week when only 16 hourly counts were made, observations of salmon passage for the 0800 to 1600 time period were not made.

Each hour on the half hour during the daily counting shift the observer counted fish passage by species and direction (i.e. upstream or downstream moving) for a 20 minute period using hand held tally counters. These counts were entered on a data form, and net upstream counts by species were multiplied by 3, or the inverse of the hourly fraction for which salmon passage was monitored, in order to expand the count for the entire hour. On those days when salmon passage was monitored for only 2 of the 3 counting periods, the resulting 16 hourly salmon counts were multiplied by an expansion factor for each species derived from 1987 project results (Buklis 1987) to obtain a daily escapement estimate for in-season management purposes. Post-season analysis using all days with 24 hourly counts were used to correct the daily count expansion for the 1988 season.

Methods for measuring stream profile, recording climatological data, and sampling fish for age, sex, and size data were the same as those described previously for the Anvik River study except that river profile data was collected three times during the season.

Results and Discussion

The tower counting project was operational from 21 June through 26 July, 1988. River water level was highest when the crew arrived to begin project operations on 19 June. Relative water depth decreased in a regular manner throughout the season (Figure 13). On 27 July, the water level was 53 cm lower than the water level at the start of the project. Similarly, the maximum water depth of the river along a set transect also declined during the season. During the collection of stream profile data maximum water depth was measured at 104 cm on 27 June, 84 cm on 7 July, and 69 cm on 20 July (Figure 14). Water clarity was generally good due to the infrequency of precipitation and the relatively

shallow water. Generally, observation of salmon passage was not prohibited by water clarity or depth at any time during the season. However, on at least one occasion wind and glare did limit the salmon visibility. Water temperature ranged from a low of 10 C on 19 and 23 June to a high of 18 C on 19, 21, 22, 23, and 24 July. Air temperature ranged from a low daily minimum of 3 C on 24 June to a high daily maximum of 30 C on 22 July (Figure 13).

The expanded escapement estimate for the period 21 June through 26 July was 68,937 summer chum salmon, 1,339 chinook salmon, and 295,723 pink salmon (Table 4). Expansion factors of 1.10 for summer chum salmon, 1.30 for chinook salmon, and 1.21 for pink salmon were derived to convert the 16-hour counts to 24-hour estimates on a post-season basis (Appendix Tables 8 through 10).

Peak expanded daily salmon counts occurred on 30 June for summer chum salmon (6,996 fish, 10% of the season total); 2 July for chinook salmon (252 fish, 19% of season total); and on 12 July for pink salmon (43,083 fish, 15% of season total). Mean date of summer chum salmon run passage was 3 July, with a standard deviation of 6.28 days. Escapement timing appeared to be relatively early for summer chum salmon as it had been in 1981, 1983, and 1986 (Figure 15). Additionally, the run appeared to be skewed toward the early portion of the migration, as was also seen in 1986.

The season escapement estimate of 68,937 summer chum salmon was the second smallest total season count recorded for this stream since the study was initiated in 1981. Only the 1987 tower estimate was lower. The 1988 escapement level was 43% below the previous long-term (1981 - 1987, excluding 1985) average total season count of 120,400 fish. Like the 1987 estimate, the 1988 tower estimate was lower than all but one of the unexpanded peak aerial survey counts for the period 1973-1980 (Figure 16). Since peak aerial surveys are only an index of abundance, the 1988 tower count estimate would appear even weaker in comparison if total season abundance were known for the years prior to 1981.

The chinook salmon tower count estimate of 1,339 was the lowest tower count recorded for this river. Both the incomplete 1986 and complete 1987 tower count estimates, 1,530 (Buklis 1986) and 2,011 (Buklis 1987) salmon, respectively, were higher. Additionally, the 1988 estimate was lower than the sonar count estimates of 1981, 5,343 salmon (Buklis 1982b), 1983, 2,720 salmon (Buklis 1984a), and 1984, 2,473 salmon (Buklis 1984b). Although the sonar project was operational during 1982 and 1985, chinook salmon escapement sonar counts for theses years were not available (Buklis 1983 and 1985, respectively).

Pink salmon are more abundant in the Yukon River drainage in even-numbered years. The expanded pink salmon season escapement estimate of 295,723 fish was 137% greater than the 1986 escapement estimate and 337% greater than the 1987 estimate.

Although a few chinook salmon were observed before the summer chum salmon run commenced, summer chum salmon demonstrated the earliest salmon escapement timing at the tower site in terms of cumulative proportions followed by chinook and pink salmon (Figure 17). For days with 24 hourly counts, peak chum salmon passage, 36% of the season total, occurred during the hours of 2200 - 2400, peak chinook salmon passage, 16% of the season total, occurred during the hours 2100

- 2300, and peak pink salmon passage, 30% of the season total, occurred during the hours 2000 - 2300 (Figure 18).

It is interesting to note that the low daily count of 3,254 chum salmon on 29 June (Figure 15) may have been the result of the commercial fishery in District 2 on 26-27 June. During that fishing period 91,587 summer chum were harvested in 12 hours of fishing time (D.J. Bergstrom, Alaska Department of Fish and Game, Anchorage, personal communication). Additionally a fishing period on 23-24 June in District 1, which harvested 148,242 summer chum salmon in 12 hours of fishing time (D. J. Bergstrom, Alaska Department of Fish and Game, Anchorage, personal communication) may have also contributed to the decreased chum salmon escapement for that day. Likewise, other anomalous decreased tower counts of chum salmon may be attributed to substantial catches in the commercial fisheries of District 1 and 2 approximately 1 to 3 days earlier.

An aerial survey was flown of the West Fork and East Fork of the Andreafsky River on 16 July under fair and good conditions, respectively. A total of 45,432 summer chum salmon and 1,448 chinook salmon were counted on the West Fork, and 43,056 chum salmon and 1,020 chinook salmon were counted on the East Fork. The West Fork chum salmon count was 27% below the lower bound of the aerial survey escapement objective range of 62,000 - 116,000 fish. Although the West Fork chinook salmon count exceeded the escapement objective of 700 to 1,000 fish, the 1988 count was the lowest aerial survey estimate recorded for this stream since 1982 (ADF&G 1987). The summer chum salmon aerial survey estimates for the East Fork was 43% below the lower bound of the aerial survey escapement objective range of 76,000 - 110,000 fish. Since the chinook salmon survey estimate was only 80 fish below the minimum aerial survey escapement objective, the minimal escapement objective for chinook salmon was considered attained. In a latter survey conducted on 13 September, 830 and 1,913 coho salmon were observed in the West Fork and East Fork Andreafsky Rivers, respectively. Survey conditions during this survey were rated fair on the West Fork and good on the East Fork.

Twenty-one (21) beach seine sets were made from 21 June to 17 July. A total of 550 chum salmon, 7 chinook salmon, and 867 pink salmon was captured (Appendix Table 11). Additional chinook salmon samples were obtained by carcass survey of both the East and West Fork in August.

Of the 550 chum salmon sampled for age-sex-size data, 525 (95%) later proved to have ageable scales. Age composition was 1.3% age 3, 70% age 4, 26% age 5, and 3% age 6 (Appendix Table 12). Females accounted for 49% of the sample. Age-4 salmon accounted for the majority of samples in 1982, 1984-1986 and 1988, while age 5 was predominant in 1981, 1983, 1987 (Figure 19).

Age compositions were similar between the 1988 Anvik and Andreafsky River chum salmon escapement samples. Past differences in age-class contributions between the Anvik and Andreafsky River escapements were related to differences in relative strength of the contributing parent year escapements for each stock (Buklis 1987). It has been previously noted that summer chum salmon escapement abundance to the Anvik and Andreafsky Rivers did not always trend together (Buklis 1985). While the Anvik River consistently supports substantially larger escapements than the East Fork Andreafsky River, in some years

escapements are relatively strong for one stock and weak for the other, as compared to the long term average for that stock.

Of the 415 chinook salmon sampled for age-sex-size data, 403 (97%) were identifiable by sex and later proved to have ageable scales. Age composition was 28% age 4, 30% age 5, 27% age 6, and 16% age 7 (Appendix Table 13). Females accounted for 39% of the sample. Age 7 contribution to the total sample, on a percentage basis, was the largest since sampling of the Andreafsky River stock was initiated in 1981 (Figure 20). Age composition of the Andreafsky River escapement sample in 1988 was similar to that of the Anvik River escapement except for age-7 and age-5 salmon. The Anvik River escapement sample contained a higher percentage of age-5 chinook salmon than the Andreafsky River sample, 38% versus 30%, while the Andreafsky River escapement sample contained a higher proportion of age-7 chinook salmon than the Anvik River sample, 16% to 4%. The dissimilarity between the age-class compositions of the Andreafsky River escapement and District 1 and 2 commercial harvest was possibly due to the same factors previously discussed for the Anvik River.

Although chinook salmon escapement objectives were met in 1988, as in the Anvik River escapement, the dominance of males in the escapement sample indicated that production may be less than anticipated from the 1988 brood year for this stock. However, caution should be exercised when interpreting these data since the optimum sex ratio for maximum production is not known.

CONCLUSIONS AND RECOMMENDATIONS

Escapement to the Anvik River was estimated by side-scanning sonar to be 1,125,449 summer chum salmon in 1988, which was 131% above the sonar count escapement objective of 487,000 fish. Escapement to the East Fork Andreafsky River was estimated by tower count to be 68,937 summer chum salmon, which was 43% below the 1981-1987 (excluding 1985) average escapement count of 120,400 fish. Chinook salmon escapement objectives were achieved in both systems although percent females in both escapement samples were low. Pink salmon were present in large numbers in the Andreafsky River, with a total season tower count in the East Fork of 295,723 fish.

Presently, stock identification data is not available for the Yukon River summer chum salmon fisheries. Additionally, stock-specific run timing through these fisheries is not known. However, in 1988 an attempt was made to obtain the commercial summer chum harvest from among many stocks by distributing the commercial fishing effort in the lower river fishery throughout the duration of the chum salmon run. Commercial fishing was allowed during 9 and 8 directed chum salmon openings in District 1 and 2, respectively, from 9 June through 15 July. However, a concentration of commercial set gill net gear in and near the mouth of the Andreafsky River probably increased the exploitation rate on this stock. The total District 1 and 2 summer chum salmon harvest was 1,073,370 fish.

Summer chum salmon run timing at the lower Yukon River set gill net test fishery

(mile 20), at the Yukon River sonar site (mile 123), at the East Fork Andreafsky River tower site (mile 125), and at the Anvik River sonar site (mile 365) can be compared to provide a qualitative assessment of probable stock timing through the lower river fisheries (Figure 21). Given that the mean dates of passage at each of these four sites in 1988 was 21 June, 25 June, 3 July, and 5 July, respectively, it is probable that the Anvik River stock entered the Yukon River earlier than the Andreafsky River stock. Based on mean day of salmon passage and distance from the Yukon River test fish site to the Anvik and Andreafsky River counting site, 345 and 105 miles, respectively, the calculated mean swimming speeds of fish destined to Anvik and Andreafsky Rivers, 24.6 and 8.8 miles per day, respectively, are very similar to swimming speeds calculated for these two stocks by Buklis (1987). Buklis (1987) proposed that differential swimming speeds and milling behaviors by the two stocks were possible explanations, but hypothesized that later entry by the Andreafsky River stock seemed a more probable explanation.

Although in previous years the Andreafsky summer chum salmon stock may have supported a greater exploitation rate in the lower river fishery due to the delayed timing of the switch to chum salmon-directed mesh size, it is probable that the Anvik River stock contributed a greater number of fish to the catch. The annual similarity in age compositions of the District 1 commercial fishery and the Anvik River escapement, even in years when the Andreafsky River escapement age composition was very different, suggests that the Anvik River stock probably accounts for a large portion of the harvest (Buklis 1987).

Although the estimated chinook salmon escapement estimate falls within the aerial survey escapement objective range for both the Andreafsky and Anvik Rivers, the high proportion of male chinook salmon in the escapement samples indicates that 1988 brood year production may be less than anticipated for these stocks. Instead of basing the escapement objectives on numbers of salmon, a more appropriate escapement objective would be potential egg deposition or numbers of female salmon.

The method of deploying sonar transducers on the Anvik River, first used in 1986, was once again effective in 1988. The method should perform well even in very high water conditions, as were encountered in 1985. A similar set of transducer deployment assemblies is available for use on the East Fork Andreafsky River if sonar is used to enumerate salmon escapement in that stream in the future.

The schedule of sonar calibration times at the Anvik River should be altered in 1989 to reflect the need for more sonar calibrations during times of peak salmon passage. Additionally, daily adjustment factors should be replaced by period adjustment factors based on the time schedule of sonar calibrations. Period adjustment factors will be more specific to a discrete set of sonar counts thereby improving the accuracy of the daily estimate.

Tower counting proved to be a feasible method of obtaining daily salmon escapement counts by species for the East Fork Andreafsky River in 1988 for the third consecutive year. It is recommended that escapement to this system be estimated by tower counting in 1989, with sonar equipment available in reserve in case of high and turbid water conditions.

The addition of a third crew member in 1988 eliminated the need to estimate fish passage for the period 0800- 1600 for four of the seven days per week. Species-specific expansion factors for the 0800-1600 period in 1988 were very close to the calculated 1987 expansion factors. Based upon these results, a third crew member for the Andreafsky River tower project may not be warranted. If funding is available, however, or if a volunteer is assigned to this project as in 1988, the additional year of comparable data would be useful in ascertaining if a three-person crew is needed in the future. If funding limitations prohibit a three person crew in 1989, counting should be conducted for 24 hrs on at least 4 to 6 days during the run to determine a post-season count expansion factor for each species. The count expansion factors presented in this report for 1988 should be used to generate in-season daily escapement estimates in 1989.

The addition of a third crew member on the Anvik River sonar project is needed for data collection, logistics, and safety reasons. The sonar site on the Anvik River is located approximately 48 river miles upstream from the village of Anvik. Transportation to and from the sonar site is by outboard motorboat. One person travelling alone presents a safety problem, while two people travelling poses a problem associated with camp security and the collection of data. A third crewmember would also contribute significantly to the collection and preliminary analysis of the data in addition to providing logistical support.

Table 1. Anvik River summer chum salmon sonar counts by date, 1988.

Date	West Bank				East Bank				Entire River			
	Raw Daily	Adjust Factor a	Correct Daily	Percent of Entire River	Raw Daily	Adjust Factor a	Correct Daily	Percent of Entire River	Daily Count	Season Count	Daily Prop	Season Prop
21-Jun	2,295	1.09 b	2,502	100.0	2	0.41 b	1	0.0	2,503	2,503	0.0022	0.0022
22-Jun	1,000	1.09 b	1,090	99.8	6	0.41 b	2	0.2	1,092	3,595	0.0010	0.0032
23-Jun	1,666	1.09 b	1,816	98.6	60	0.41 b	25	1.4	1,841	5,436	0.0016	0.0048
24-Jun	1,901	0.88	1,673	90.3	439	0.41 b	180	9.7	1,853	7,289	0.0016	0.0065
25-Jun	2,843	1.68	4,776	90.7	1,191	0.41 b	488	9.3	5,264	12,553	0.0047	0.0112
26-Jun	7,811	0.80	6,249	68.0	1,933	1.52	2,938	32.0	9,187	21,740	0.0082	0.0193
27-Jun	15,539	1.24	19,268	78.1	3,281	1.65	5,414	21.9	24,682	46,422	0.0219	0.0412
28-Jun	41,675	1.11	46,152	80.2	10,076	1.13	11,386	19.8	57,538	103,960	0.0511	0.0924
29-Jun	68,821	1.26	86,714	89.5	8,807	1.15	10,128	10.5	96,842	200,802	0.0860	0.1784
30-Jun	87,792	0.82	71,889	85.3	18,714	0.66	12,351	14.7	84,240	285,042	0.0749	0.2533
01-Jul	- c	-	81,677 d	-	- c	-	12,889 d	-	94,566 d	379,608	0.0840	0.3373
02-Jul	51,078 e	0.77	91,465 f	87.2	- c	-	13,426	12.8 g	104,891	484,499	0.0932	0.4305
03-Jul	93,040	0.74	68,736	93.8	2,759 h	0.94	4,550 j	6.2	73,286	557,785	0.0651	0.4956
04-Jul	43,442	1.06	46,049	80.2	14,682 k	0.69	11,383 l	19.8	57,432	615,217	0.0510	0.5466
05-Jul	122,667	0.28	34,347	57.2	21,625	1.19	25,734	42.8	60,081	675,298	0.0534	0.6000
06-Jul	82,339	0.68	55,991	82.3	16,480	0.73	12,030	17.7	68,021	743,319	0.0604	0.6605
07-Jul	50,800	0.55	27,940	68.4	17,418	0.74	12,889	31.6	40,829	784,148	0.0363	0.6967
08-Jul	55,049	0.26	14,313	33.4	28,200	1.01	28,482	66.6	42,795	826,943	0.0380	0.7348
09-Jul	33,280	0.87	28,954	62.8	17,707	0.97	17,176	37.2	46,130	873,073	0.0410	0.7758
10-Jul	38,620	0.35	13,517	52.8	13,008	0.93	12,097	47.2	25,614	898,687	0.0228	0.7985
11-Jul	7,962 m	0.66	11,424 n	49.4	10,053 o	0.92	11,707 p	50.6	23,131	921,818	0.0206	0.8191
12-Jul	9,490 q	1.02	18,057 r,s	59.5	9,015 t	0.97	12,293 s,u	40.5	30,350	952,168	0.0270	0.8460
13-Jul	22,502	0.71	15,337 s	50.3	13,026	1.21	15,131 s	49.7	30,468	982,636	0.0271	0.8731
14-Jul	20,103	0.83	16,018 s	60.9	12,584	0.85	10,269 s	39.1	26,287	1,008,923	0.0234	0.8965
15-Jul	24,482	0.86	20,002 s	72.8	3,416 v	0.99	7,472 s,w	27.2	27,474	1,036,397	0.0244	0.9209
16-Jul	17,119	0.70	11,384 s	71.5	- c	- c	4,538 s	28.5 x	15,922	1,052,319	0.0141	0.9350
17-Jul	13,101	0.31	3,818 s	71.5	- c	0.72	1,522 s	28.5 x	5,340	1,057,659	0.0047	0.9398
18-Jul	9,281	1.05	9,063 s	71.5	- c	0.21	3,613 s	28.5 x	12,676	1,070,335	0.0113	0.9510
19-Jul	10,709	0.87	8,571 s	71.5	- c	0.35	3,416 s	28.5 x	11,987	1,082,322	0.0107	0.9617
20-Jul	7,552	0.56	3,848 s	71.5	- c	0.22	1,534 s	28.5 x	5,382	1,087,704	0.0048	0.9665
21-Jul	5,296	1.05	5,005 s	71.5	- c	0.27	1,995 s	28.5 x	7,000	1,094,704	0.0062	0.9727
22-Jul	4,320	0.99	3,806 s	71.5	- c	0.38	1,517 s	28.5 x	5,323	1,100,027	0.0047	0.9774
23-Jul	4,108	1.08	3,904 s	71.5	- c	0.63	1,556 s	28.5 x	5,460	1,105,487	0.0049	0.9823
24-Jul	5,307	0.97	4,479 s	71.5	- c	0.65	1,785 s	28.5 x	6,264	1,111,751	0.0056	0.9878
25-Jul	6,418	1.05	5,795 s	71.5	- c	0.59	2,310 s	28.5 x	8,105	1,119,856	0.0072	0.9950
26-Jul	3,475	0.91	2,688 s	61.4	1,690	1.00	1,690 s	38.6	4,378	1,124,234	0.0039	0.9989
27-Jul	1,837 y	0.53	828 s	68.1	387 z	1.00	387 s	31.9	1,215	1,125,449	0.0011	1.0000

-Continued-

Table 1. (page 2 of 2).

a Adjustment factor is the daily sum of calibration oscilloscope counts divided by the daily sum of calibration sonar counts. See Tables 2 and 3 for sonar calibration data.
b Sonar calibration data were pooled for 21-23 June for the west bank and 21-25 June for the east bank adjustment factor calculation due to low numbers of fish counted during calibration periods on these days.
c Data unavailable.
d Calculated as the mean of the daily counts of 30 June and 02 July.
e Raw count data are for the period 1000-2400; data unavailable for the period 0000-1000.
f Includes the estimated salmon count for the period 0000-1000. This estimate was derived by dividing the corrected count for the period 1000-2400 by 0.43, the mean proportion of the west bank counts recorded for that period during 29, 30 June and 03, 04 July.
g Percent of daily east bank salmon passage estimated; calculated as the mean percent of the east bank daily passage for the days 29, 30 June and 03, 04 July. The corrected east bank daily salmon passage count for 02 July was derived from this estimated percent.
h Raw count data are for the period 1000-2400; data unavailable for the period 0000-1000.
j Includes the estimated salmon count for the period 0000-1000. This estimate was derived by dividing the corrected count for the period 1000-2400 by 0.57, the mean proportion of the west bank counts for the period 1000-2400 for 29, 30 June and 02, 03 July.
k Raw count data are for the periods 0000-1300 and 1700-2400; data unavailable for the period 1300-1700.
l Includes the estimated salmon count for the period 1300-1700. This estimate was derived by dividing the corrected count for the periods 0000-1300 and 1700-2400 by 0.90, the mean proportion of the east bank counts for those periods during 30 June, 03, 05, and 06 July.
m Raw count data are for the period 0700-2400; data unavailable for the period 0000-0700.
n Includes the estimated salmon count for the period 0000-0700. This estimate was derived by dividing the corrected count for the period 0700-2400 by 0.46, the mean proportion of the west bank counts for that period during 09, 10, 13, and 14 July.
o Raw count data are for the periods 0000-1100 and 1900-2400; data unavailable for the period 1100-1900.
p Includes the estimated salmon count for the period 1100-1900. This estimate was derived by dividing the corrected count for the periods 0000-1100 and 1900-2400 by 0.52, the mean proportion of the east bank counts for those periods during 09, 10, 13, and 14 July.
q Raw count data are for the periods 0000-0100 and 0800-2400; data unavailable for the period 0100-0800.
r Includes the estimated salmon count for the period 0100-0800. This estimate was derived by dividing the corrected count for the periods 0000-0100 and 0800-2400 by 0.69, the mean proportion of the west bank counts for those periods during 9, 10, 13, and 14 July.
s Adjusted for estimated pink salmon passage.
t Raw count data are for the period 0000-0800 and 1900-2400; data unavailable for the period 0800-1900.
u Includes the estimated salmon count for the periods 0800-1900. This estimate was derived by dividing the corrected count for the periods 0000-0800 and 1900-2400 by 0.69, the mean proportion of the east bank counts for those periods during 09, 10, 13, and 14 July.
v Raw count data are for the period 0000-1200; data unavailable for the period 1200-2400.
w Includes the estimated salmon count for the period 1200-2400. This estimate was derived by dividing the corrected count for the period 0000-1200 by 0.43, the mean proportion of the east bank counts for that period during 13 and 14 July.
x Estimated percent of daily count; calculated as the mean percent of the daily east bank count for the days 21-30 June and 02-15 July. The corrected daily total for the associated days was determined from this percentage.
y Raw count data are for the period 0000-1600.
z Raw count data are for the period 0000-1400.

Table 2. Oscilloscope and visual calibration of salmon sonar counts at the Anvik River west bank site, 1988.

Date	Hours Count	Sonar Count	Scope Count	Sonar/ Scope	Visual Count a								
					Hours Count	Chum			Chinook			Pink		
						Up	Down	Net	Up	Down	Net	Up	Down	Net
21-Jun	0.50	1	1	1.00	0.50	0	0	0	0	0	0	0	0	0
22-Jun	0.75	29	39	0.74	0.00	-	-	-	-	-	-	-	-	-
23-Jun	1.00	50	47	1.06	1.00	9	0	9	0	0	0	0	0	0
24-Jun	1.00	182	161	1.13	1.00	4	0	4	0	0	0	0	0	0
25-Jun	1.00	208	350	0.59	1.00	100	0	100	0	0	0	0	0	0
26-Jun	1.00	618	493	1.25	0.50	94	0	94	0	0	0	0	0	0
27-Jun	1.00	263	326	0.81	0.50	120	0	120	0	0	0	0	0	0
28-Jun	1.00	1,592	1,207	1.32	0.50	406	0	406	0	0	0	0	0	0
29-Jun	0.50	688	870	0.79	0.00	-	-	-	-	-	-	-	-	-
30-Jun	1.00	1,704	1,610	1.06	0.50	327	0	327	0	0	0	0	0	0
01-Jul	0.00	-	-	-	0.00	-	-	-	-	-	-	-	-	-
02-Jul	0.75	2,015	1,542	1.31	0.00	-	-	-	-	-	-	-	-	-
03-Jul	1.00	2,111	1,651	1.28	0.50	151	0	151	0	0	0	0	0	0
04-Jul	0.75	945	1,002	0.94	0.25	24	0	24	0	0	0	0	0	0
05-Jul	1.00	6,690	1,882	3.55	0.00	-	-	-	-	-	-	-	-	-
06-Jul	1.00	1,745	1,178	1.48	0.25	18	0	18	0	0	0	0	0	0
07-Jul	0.75	1,189	658	1.81	0.00	-	-	-	-	-	-	-	-	-
08-Jul	0.50	1,646	423	3.89	0.00	-	-	-	-	-	-	-	-	-
09-Jul	0.50	263	230	1.14	0.00	-	-	-	-	-	-	-	-	-
10-Jul	1.00	1,442	508	2.84	0.25	59	0	59	0	0	0	0	0	0
11-Jul	0.75	513	340	1.51	0.25	67	6	61	0	0	0	1	0	1
12-Jul	0.75	594	606	0.98	0.75	204	13	191	0	0	0	4	0	4
13-Jul	1.00	704	503	1.40	0.75	244	10	234	1	0	1	4	0	4
14-Jul	1.00	645	536	1.20	0.50	151	7	144	3	0	3	5	0	5
15-Jul	0.25	214	183	1.17	0.00	-	-	-	-	-	-	-	-	-
16-Jul	0.00	-	-	-	0.00	-	-	-	-	-	-	-	-	-
17-Jul	0.50	489	151	3.24	0.25	75	7	68	0	0	0	6	0	6
18-Jul	1.00	349	366	0.95	1.00	219	10	209	0	0	0	16	0	16
19-Jul	1.00	587	508	1.16	0.25	111	4	107	0	0	0	3	1	2
20-Jul	1.00	389	219	1.78	0.75	139	9	130	0	0	0	7	0	7
21-Jul	1.00	161	169	0.95	0.50	40	3	37	0	0	0	2	1	1
22-Jul	1.00	161	160	1.01	0.75	79	12	67	0	0	0	8	3	5
23-Jul	1.00	142	153	0.93	1.00	93	1	92	0	0	0	10	2	8
24-Jul	1.00	176	170	1.04	0.50	67	7	60	0	0	0	5	0	5
25-Jul	1.00	145	152	0.95	1.00	42	4	38	0	0	0	5	0	5
26-Jul	1.00	104	95	1.09	1.00	33	8	25	0	0	0	3	0	3
27-Jul	0.50	85	45	1.89	0.25	2	3	(1)	0	0	0	1	0	1
Total	29.75	28,839	18,534	1.56	16.25	2,878	104	2,774	4	0	4	80	7	73

a Visual counts are listed as upstream or downstream, with "net" being the difference between the two. Numbers in parentheses are negative values. Errors in species identification or enumeration of fish may have been made due to poor water clarity, surface glare, oblique angle of vision, and lack of background contrast against the natural river bottom. In addition, visual counting was not conducted during all calibration periods due to the offshore movement of fish under certain conditions when a tower observer was present.

Table 3. Oscilloscope and visual calibration of salmon sonar counts at the Anvik River east bank site, 1988.

Date	Hours Count	Sonar Count	Scope Count	Sonar/ Scope	Visual Count a									
					Hours Count	Chum			Chinook			Pink		
						Up	Down	Net	Up	Down	Net	Up	Down	Net
21-Jun	0.50	0	0	0.00	0.50	0	0	0	0	0	0	0	0	0
22-Jun	0.50	0	0	0.00	0.50	4	0	4	0	0	0	0	0	0
23-Jun	1.00	2	2	1.00	1.00	2	0	2	0	0	0	0	0	0
24-Jun	1.00	6	7	0.86	1.00	11	0	11	0	0	0	0	0	0
25-Jun	1.00	129	47	2.74	1.00	6	0	6	0	0	0	0	0	0
26-Jun	1.00	33	50	0.66	1.00	14	0	14	0	0	0	0	0	0
27-Jun	1.00	60	99	0.61	1.00	8	0	8	0	0	0	2	0	2
28-Jun	1.00	273	309	0.88	0.75	72	0	72	0	0	0	0	0	0
29-Jun	0.50	117	135	0.87	0.50	81	0	81	0	0	0	0	0	0
30-Jun	1.00	1,308	866	1.51	1.00	402	0	402	0	0	0	0	0	0
01-Jul	0.00	-	-	-	0.00	-	-	-	-	-	-	-	-	-
02-Jul	0.00	-	-	-	0.00	-	-	-	-	-	-	-	-	-
03-Jul	0.75	225	-	1.07 b	0.75	211	5	206	0	0	0	0	0	0
04-Jul	0.50	254	358	0.71	0.50	59	4	55	0	0	0	0	0	0
04-Jul	0.50	494	-	1.28 b	0.50	383	1	382	1	0	1	2	0	2
05-Jul	0.75	810	-	0.84 b	0.75	966	3	963	0	0	0	3	0	3
06-Jul	0.50	205	-	1.41 b	0.50	145	0	145	0	0	0	0	0	0
06-Jul	0.75	366	277	1.32	0.75	277	1	276	0	0	0	1	0	1
07-Jul	1.00	514	519	0.99	1.00	558	4	554	2	0	2	3	0	3
08-Jul	0.50	549	532	1.03	0.50	437	2	435	0	0	0	6	0	6
09-Jul	0.50	262	243	1.08	0.00	-	-	-	-	-	-	-	-	-
10-Jul	1.00	529	489	1.08	1.00	405	5	400	0	0	0	2	0	2
11-Jul	0.75	433	421	1.03	0.50	105	4	101	0	0	0	2	0	2
12-Jul	1.00	392	476	0.82	1.00	459	13	446	0	0	0	14	0	14
13-Jul	1.00	659	557	1.18	1.00	564	16	548	0	0	0	15	0	15
14-Jul	1.00	545	539	1.01	1.00	493	23	470	0	0	0	23	0	23
15-Jul	0.50	53	58	0.91	0.50	129	4	125	0	0	0	10	0	10
16-Jul	0.00	-	-	-	0.00	-	-	-	-	-	-	-	-	-
17-Jul	0.25	47	34	1.38	0.25	32	4	28	0	0	0	2	0	2
18-Jul	1.00	1,582	339	4.67	1.00	218	19	199	0	0	0	20	0	20
19-Jul	1.00	796	275	2.89	1.00	190	14	176	0	0	0	19	0	19
20-Jul	1.00	714	157	4.55	1.00	93	11	82	0	1	(1)	5	6	(1)
21-Jul	0.75	411	113	3.64	0.75	43	6	37	0	0	0	15	1	14
22-Jul	1.00	198	76	2.61	1.00	70	16	54	0	0	0	9	0	9
23-Jul	1.00	195	122	1.60	1.00	75	15	60	0	0	0	10	1	9
24-Jul	1.00	95	62	1.53	1.00	42	10	32	0	0	0	2	0	2
25-Jul	1.00	61	36	1.69	0.75	3	4	(1)	0	0	0	1	0	1
26-Jul	1.25	19	19	1.00	1.25	1	2	(1)	0	0	0	3	0	3
27-Jul	0.50	8	8	1.00	0.50	2	1	1	0	0	0	1	1	0
Total	29.25	12,344	7,225	1.71	28.00	6,560	187	6,373	3	1	2	170	9	161

a Visual counts are listed as upstream or downstream, with "net" being the difference between the two. Numbers in parentheses are negative values. Errors in species identification or enumeration of fish may have been made due to poor water clarity, surface glare, oblique angle of vision, and lack of background contrast against the natural river bottom. In addition, visual counting was not conducted during all calibration periods due to the offshore movement of fish under certain conditions when a tower observer was present.

b Oscilloscope counts unavailable due to instrument failure; visual salmon passage counts used for calibration of sonar counts.

Table 4. East Fork Andreafsky River expanded tower counts of salmon escapement by species and date, 1988. a

Date	Summer Chum Salmon				Chinook Salmon				Pink Salmon			
	Daily Count	Total Count	Daily Prop	Total Prop	Daily Count	Total Count	Daily Prop	Total Prop	Daily Count	Total Count	Daily Prop	Total Prop
21-Jun	536	536	0.0078	0.0078	60	60	0.0448	0.0448	21	21	0.0001	0.0001
22-Jun b	301	837	0.0044	0.0121	3	63	0.0019	0.0467	23	44	0.0001	0.0001
23-Jun	(129)	708	(0.0019)	0.0103	0	63	0.0000	0.0467	15	59	0.0001	0.0002
24-Jun b	465	1,174	0.0067	0.0170	0	63	0.0000	0.0467	25	84	0.0001	0.0003
25-Jun	2,709	3,883	0.0393	0.0563	0	63	0.0000	0.0467	555	639	0.0019	0.0022
26-Jun b	2,148	6,031	0.0312	0.0875	4	67	0.0029	0.0496	109	748	0.0004	0.0025
27-Jun	6,252	12,283	0.0907	0.1782	12	79	0.0090	0.0586	228	976	0.0008	0.0033
28-Jun	6,588	18,871	0.0956	0.2737	18	97	0.0134	0.0720	669	1,645	0.0023	0.0056
29-Jun b	3,254	22,125	0.0472	0.3209	55	151	0.0408	0.1128	955	2,600	0.0032	0.0088
30-Jun b	6,996	29,121	0.1015	0.4224	39	190	0.0291	0.1419	1,768	4,368	0.0060	0.0148
01-Jul	4,647	33,768	0.0674	0.4898	81	271	0.0605	0.2024	2,589	6,957	0.0088	0.0235
02-Jul	5,247	39,015	0.0761	0.5659	252	523	0.1881	0.3905	4,215	11,172	0.0143	0.0378
03-Jul b	1,825	40,840	0.0265	0.5924	90	613	0.0670	0.4575	2,632	13,804	0.0089	0.0467
04-Jul	4,086	44,926	0.0593	0.6517	30	643	0.0224	0.4799	4,182	17,986	0.0141	0.0608
05-Jul b	865	45,790	0.0125	0.6642	43	686	0.0320	0.5119	3,394	21,380	0.0115	0.0723
06-Jul	2,828	48,618	0.0410	0.7053	105	791	0.0784	0.5903	10,632	32,012	0.0360	0.1082
07-Jul	2,136	50,754	0.0310	0.7362	69	860	0.0515	0.6419	8,031	40,043	0.0272	0.1354
08-Jul b	1,808	52,563	0.0262	0.7625	23	883	0.0175	0.6593	20,843	60,886	0.0705	0.2059
09-Jul	4,467	57,030	0.0648	0.8273	42	925	0.0314	0.6907	20,940	81,826	0.0708	0.2767
10-Jul	2,220	59,250	0.0322	0.8595	69	994	0.0515	0.7422	18,570	100,396	0.0628	0.3395
11-Jul b	2,782	62,032	0.0404	0.8998	94	1,088	0.0699	0.8121	23,443	123,839	0.0793	0.4188
12-Jul	1,773	63,805	0.0257	0.9255	93	1,181	0.0694	0.8815	43,083	166,922	0.1457	0.5645
13-Jul b	439	64,244	0.0064	0.9319	35	1,216	0.0262	0.9077	7,166	174,087	0.0242	0.5887
14-Jul	423	64,667	0.0061	0.9381	24	1,240	0.0179	0.9256	24,939	199,026	0.0843	0.6730
15-Jul	975	65,642	0.0141	0.9522	51	1,291	0.0381	0.9637	32,394	231,420	0.1095	0.7826
16-Jul b	706	66,348	0.0102	0.9624	12	1,303	0.0087	0.9725	23,958	255,378	0.0810	0.8636
17-Jul	432	66,780	0.0063	0.9687	12	1,315	0.0090	0.9814	20,103	275,481	0.0680	0.9316
18-Jul b	868	67,648	0.0126	0.9813	0	1,315	0.0000	0.9814	8,120	283,602	0.0275	0.9590
19-Jul	228	67,876	0.0033	0.9846	9	1,324	0.0067	0.9881	3,468	287,070	0.0117	0.9707
20-Jul	231	68,107	0.0034	0.9880	3	1,327	0.0022	0.9904	2,742	289,812	0.0093	0.9800
21-Jul b	238	68,344	0.0034	0.9914	4	1,330	0.0029	0.9933	1,644	291,456	0.0056	0.9856
22-Jul	207	68,551	0.0030	0.9944	6	1,336	0.0045	0.9978	1,509	292,965	0.0051	0.9907
23-Jul b	152	68,703	0.0022	0.9966	0	1,336	0.0000	0.9978	715	293,680	0.0024	0.9931
24-Jul	204	68,907	0.0030	0.9996	3	1,339	0.0022	1.0000	1,488	295,168	0.0050	0.9981
25-Jul	30	68,937	0.0004	1.0000	0	1,339	0.0000	1.0000	555	295,723	0.0019	1.0000

a Tower counts were conducted for 24 hours unless otherwise noted. Numbers in parentheses are negative values.
b Tower counts were conducted for 16 hours. Therefore, daily escapement estimates were expanded using an expansion factor. Hourly tower counts and the expansion factors are presented by species in Appendix Tables 8-10.

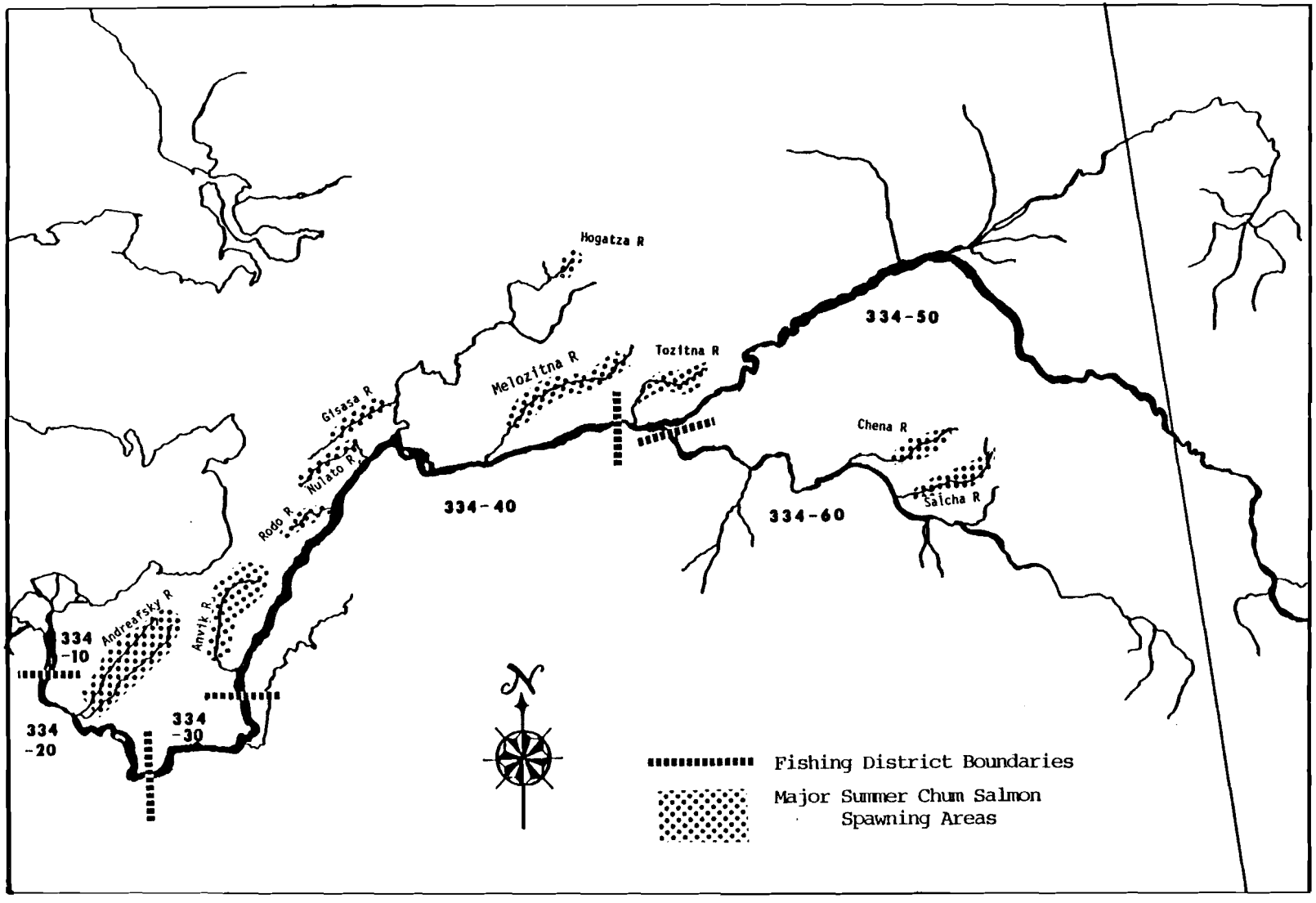

Figure 1. Map of the Yukon River, showing fishing districts and major summer chum salmon spawning areas.

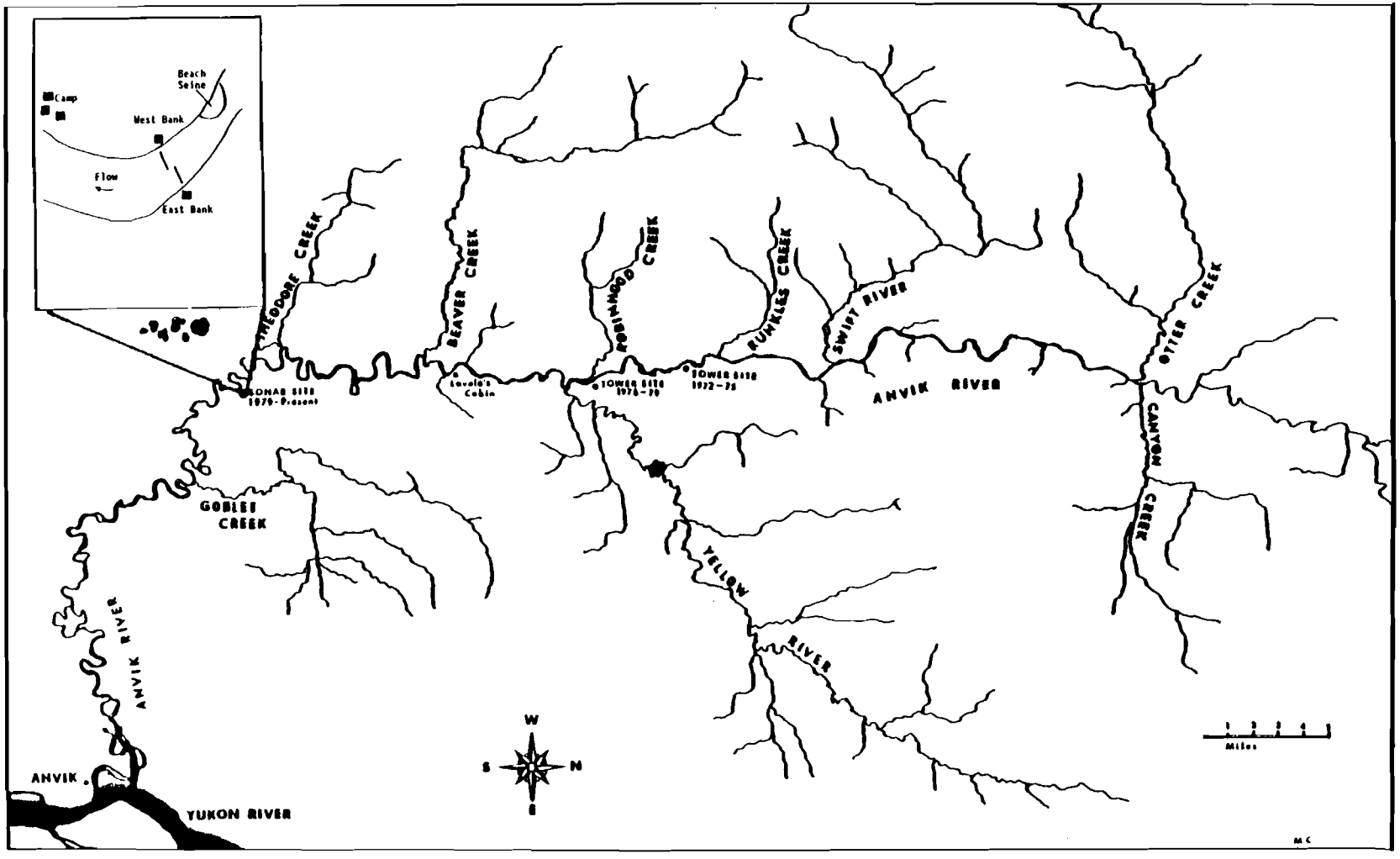

Figure 2. Map of the Anvik River with schematic sketch of the sonar site camp area (inset).

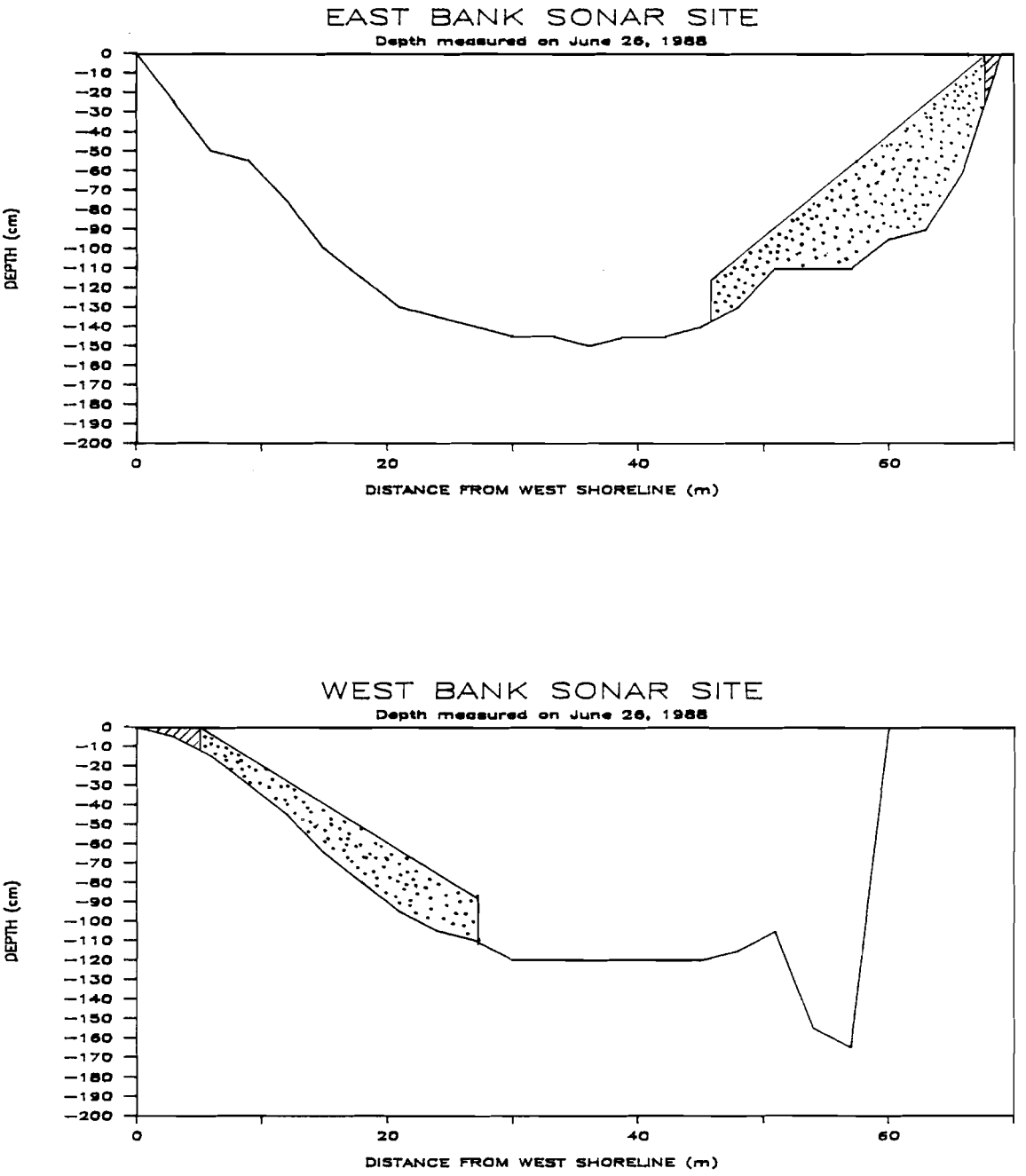

Figure 3. Anvik River depth profiles, east and west bank sonar sites, 26 June, 1988. Stippled areas show approximate range of insonification, and weirs are indicated with cross hatching.

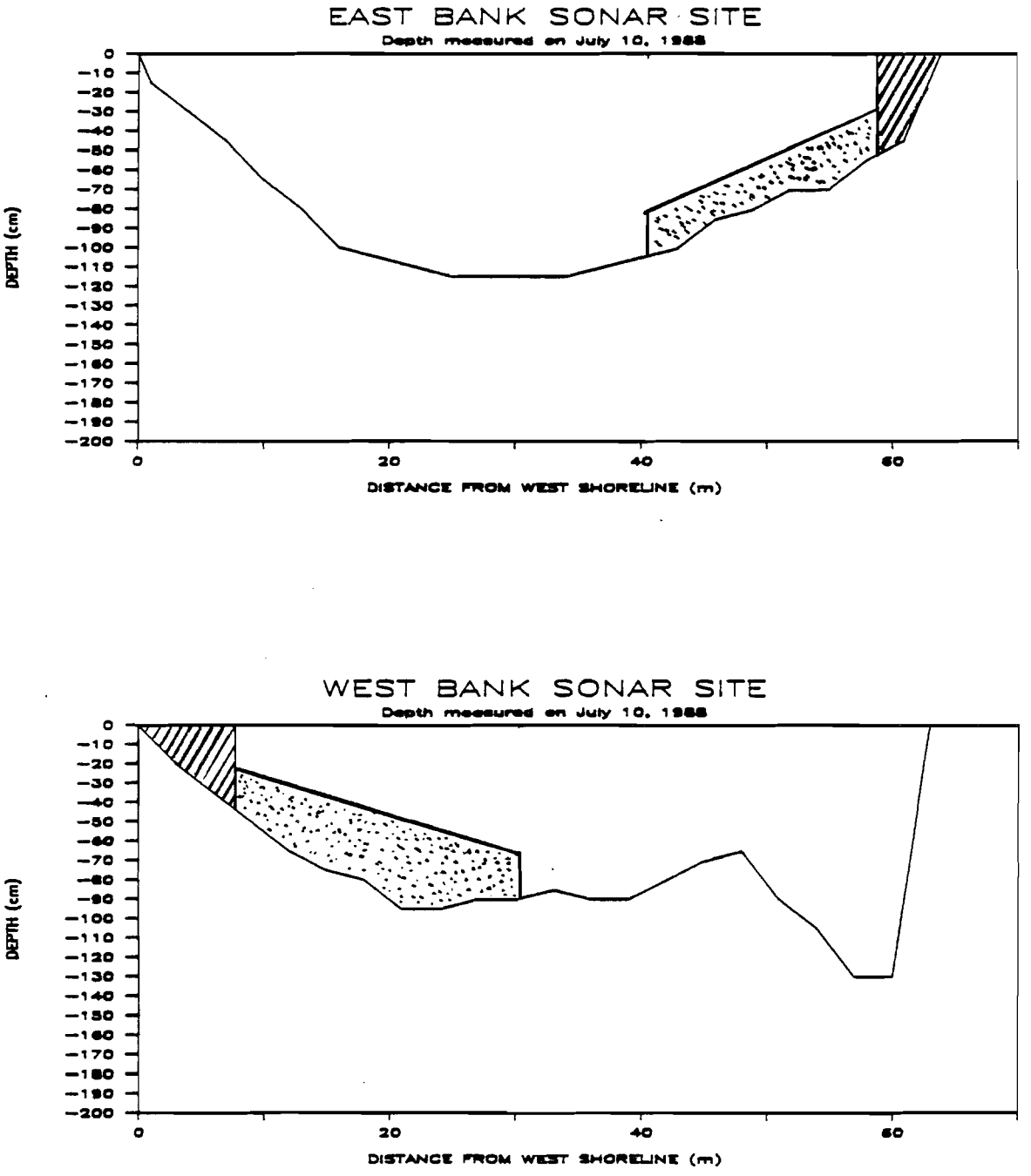

Figure 4. Anvik River depth profiles, east and west bank sonar sites, 10 July, 1988. Stippled areas show approximate range of insonification, and weirs are indicated with cross hatching.

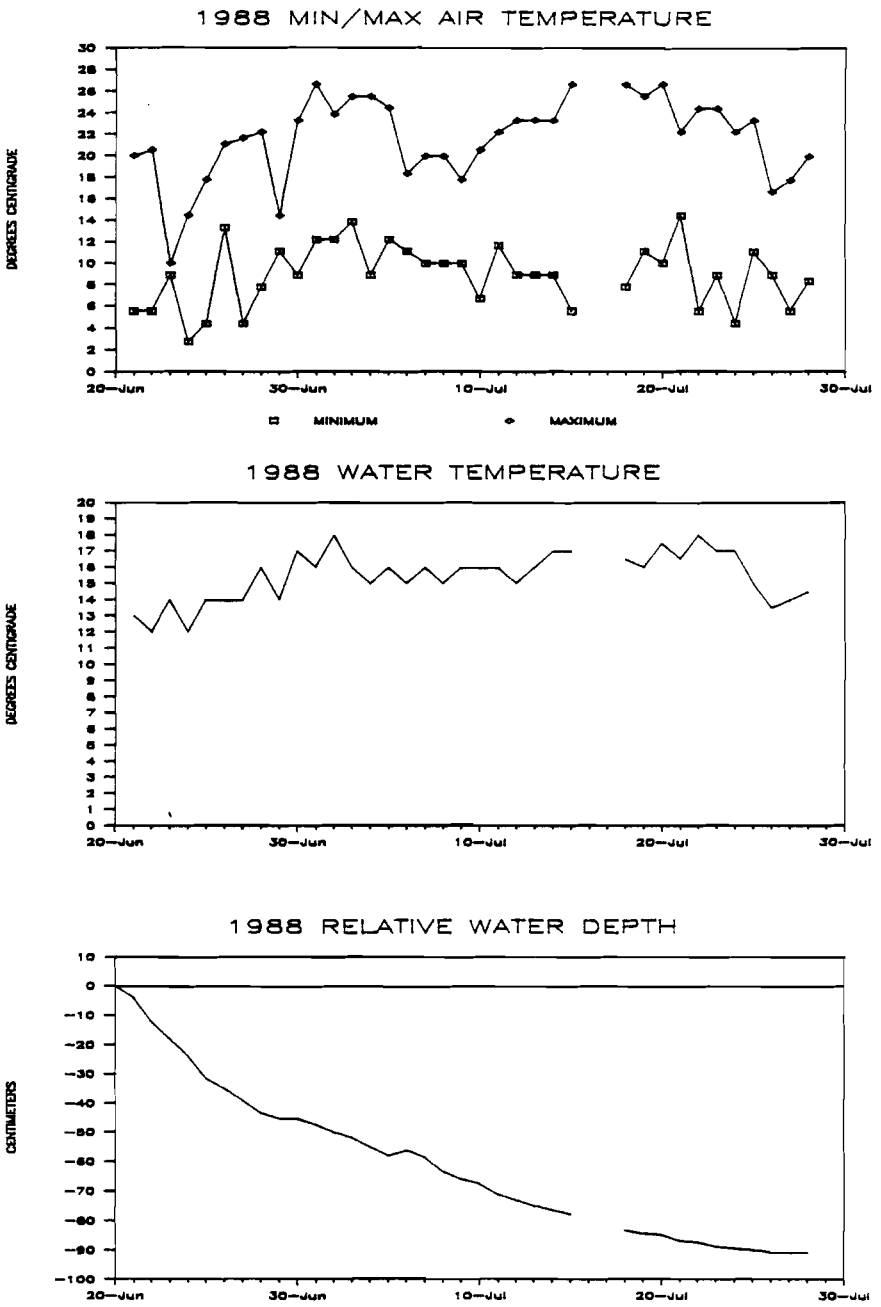

Figure 5. Air temperatures (daily minimum and maximum), water temperature, and relative water depth measured at noon daily at the Anvik River sonar site, 1988.

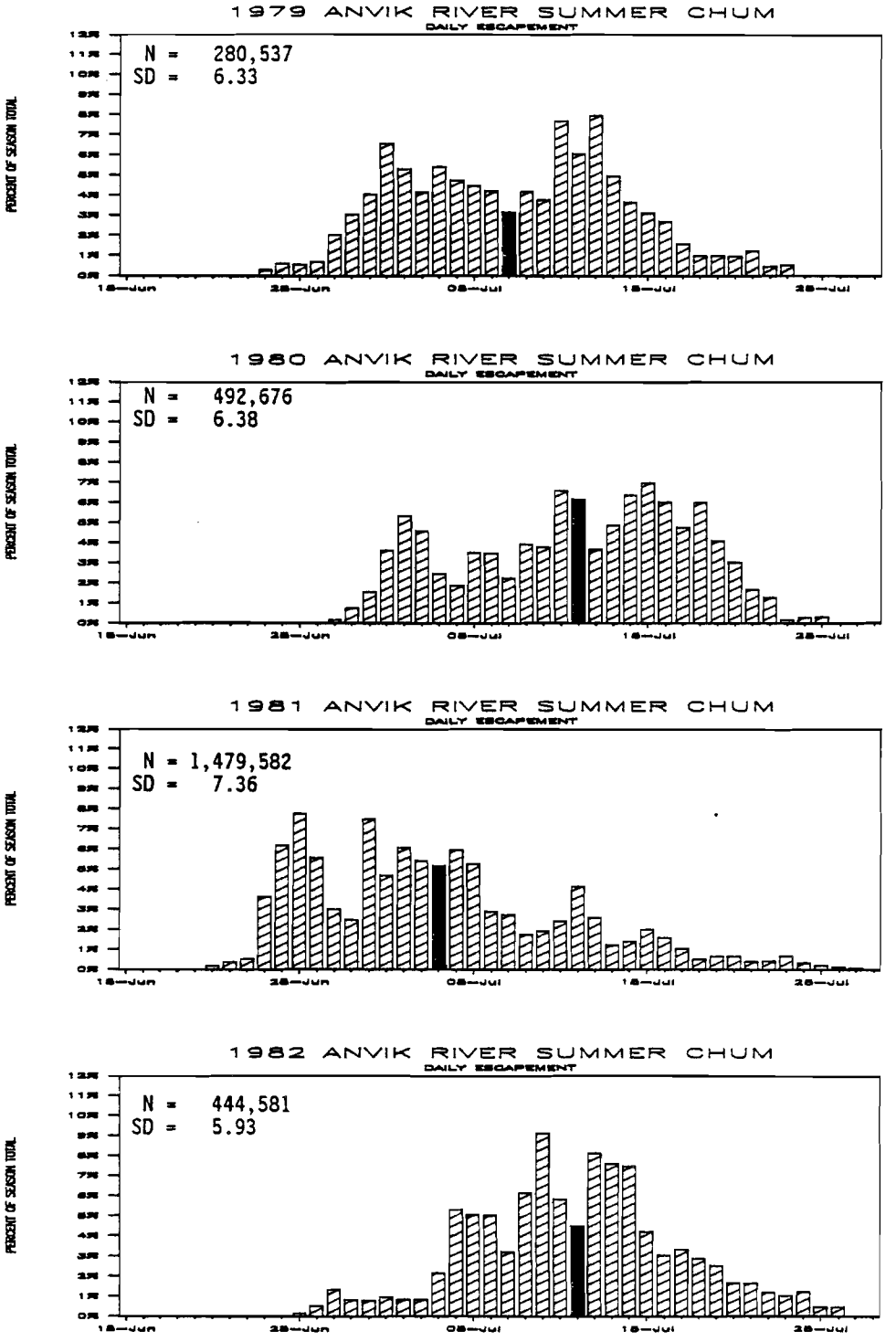

Figure 6. Anvik River corrected sonar counts of summer chum salmon passage by day, 1979-1988 (N = total). Mean date of the run passage (calculated with Day 1 = 16 June) is indicated by shaded bar, and the standard deviation (SD) of the mean is given.

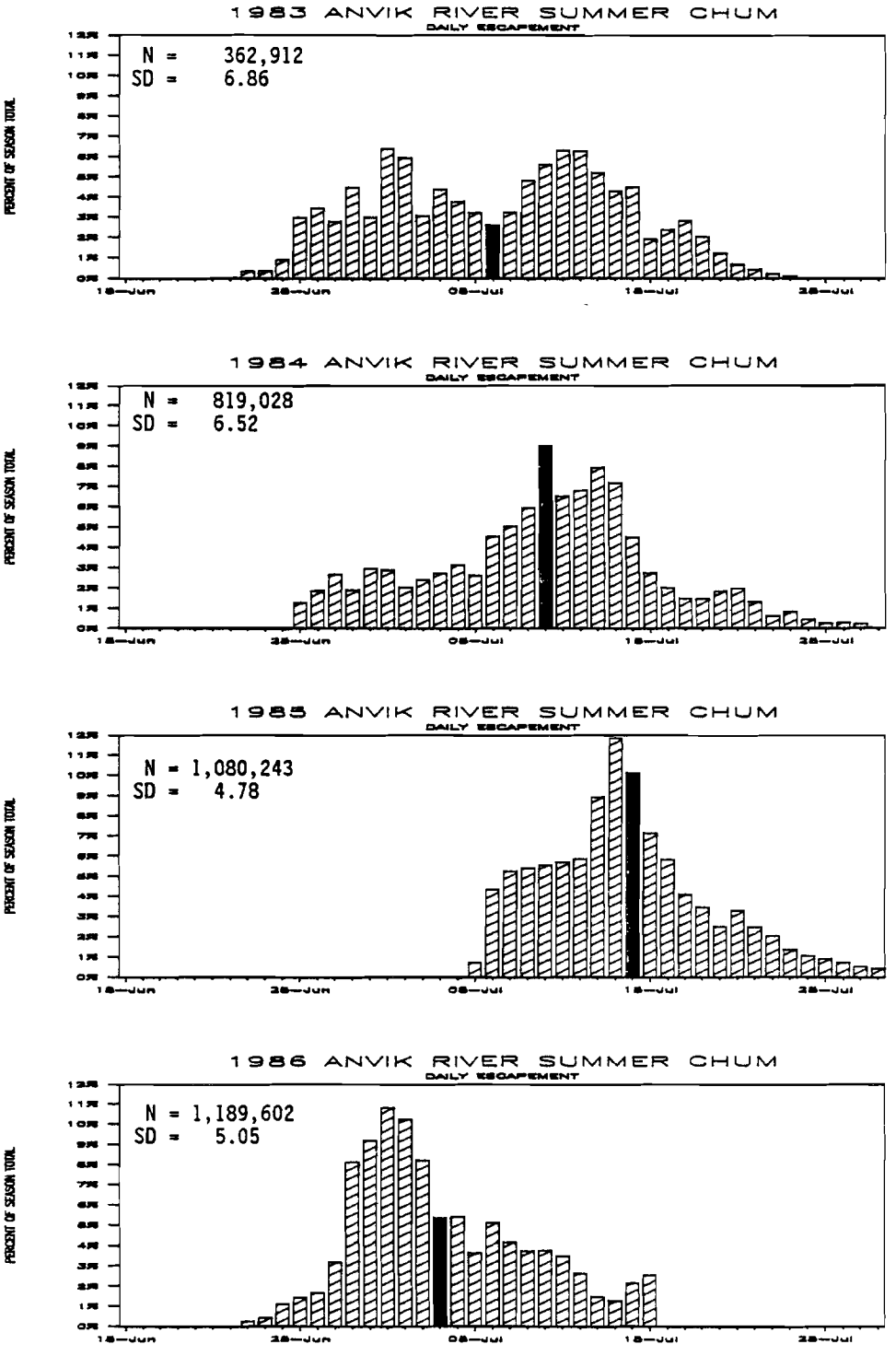

Figure 6. Continued (page 2 of 3).

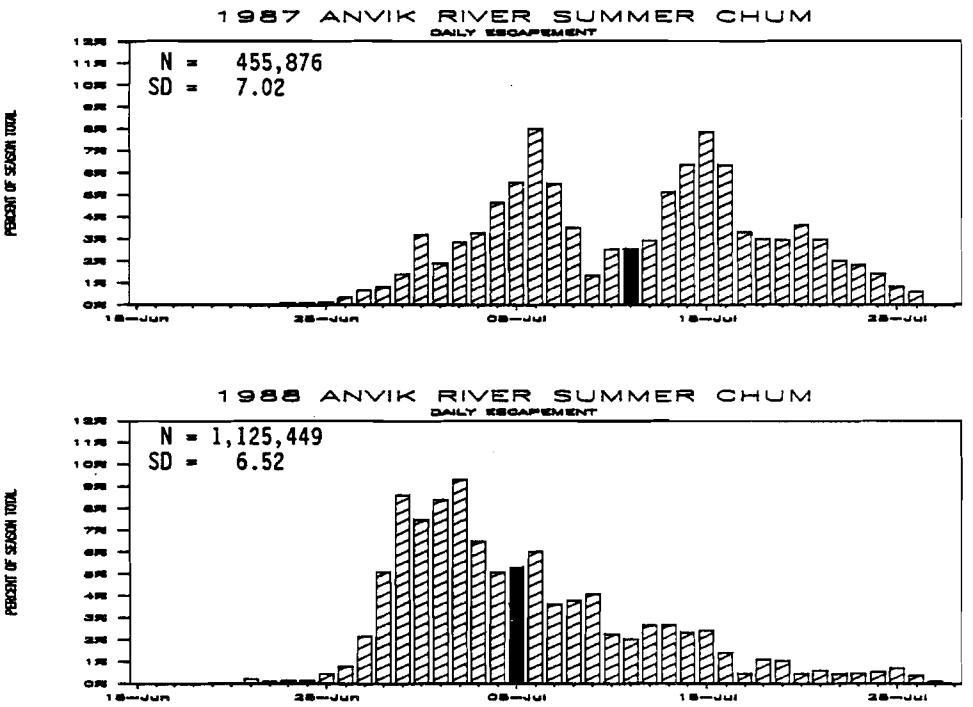

Figure 6. Continued (page 3 of 3).

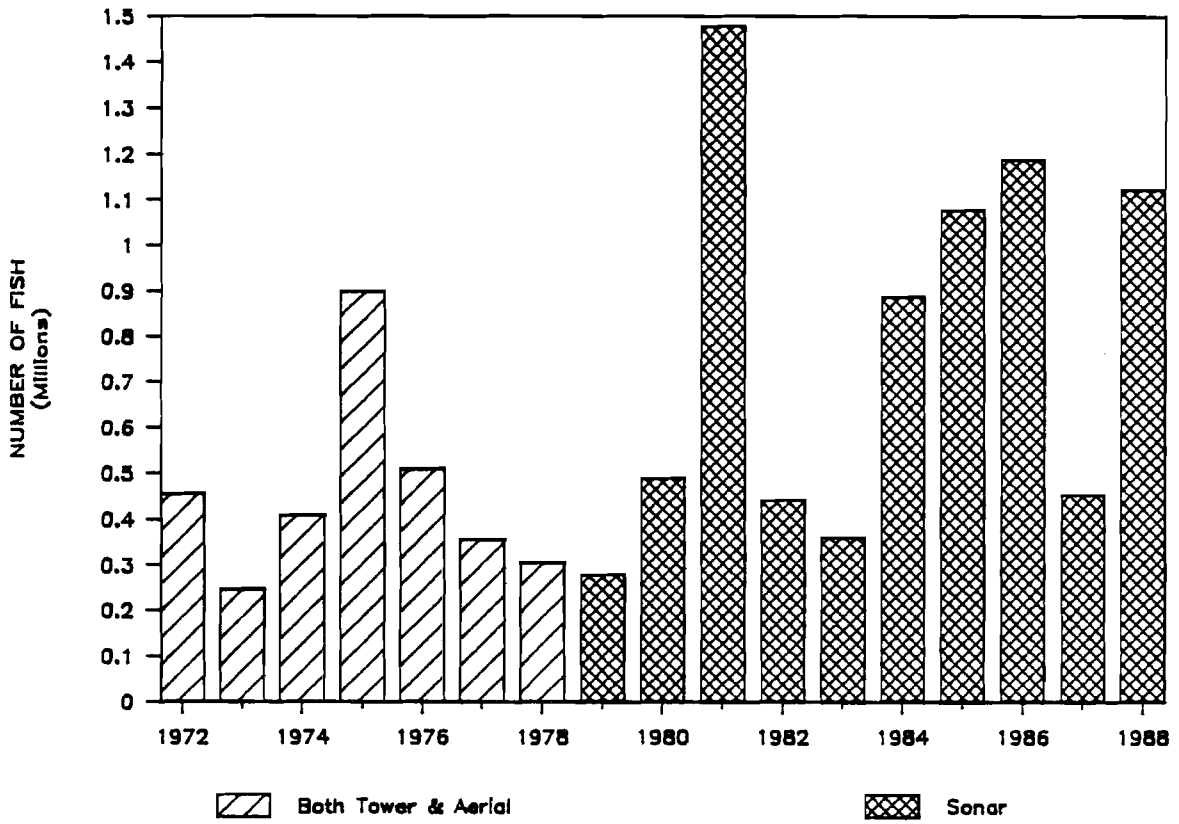

Figure 7. Anvik River summer chum salmon escapement estimated by combined tower and aerial survey count, 1972-1978, and by side-scanning sonar, 1979-1988.

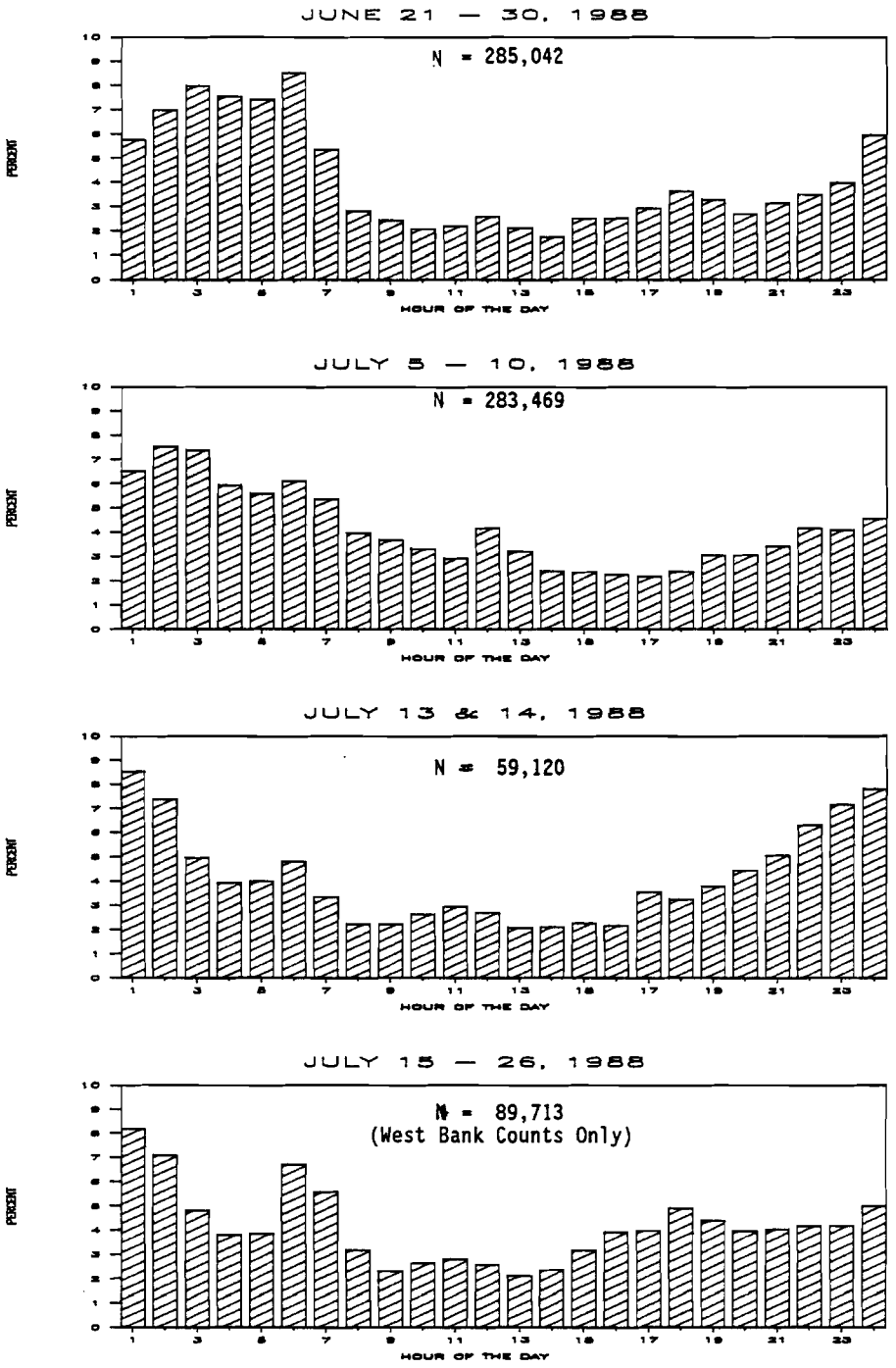

Figure 8. Anvik River corrected sonar counts of summer chum salmon passage by hour of the day. Only days with 24-hour counts were used. Periods were bounded by days with less than 24-hour counts (see Appendix Tables 1 and 3).

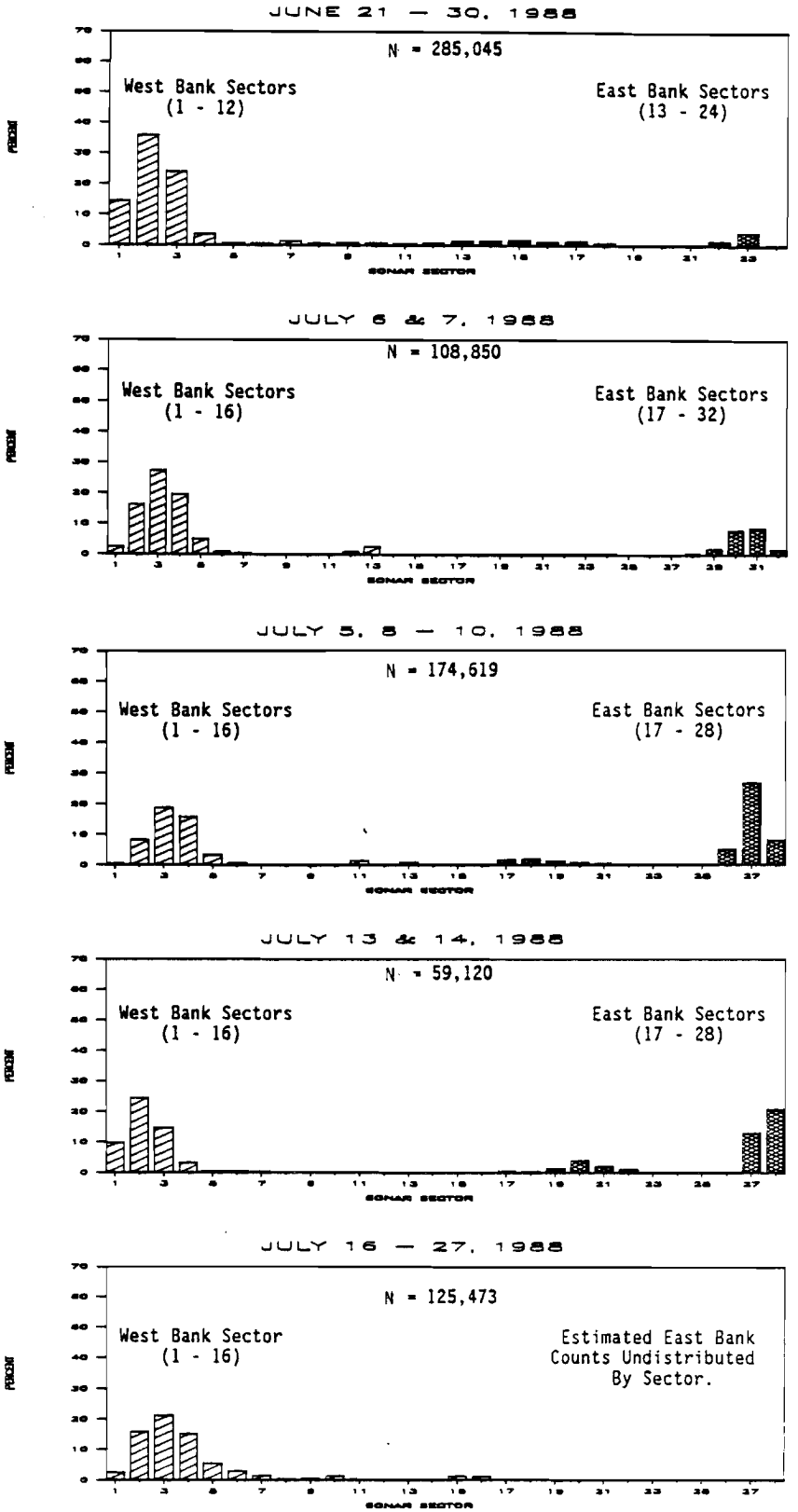

Figure 9. Anvik River corrected sonar counts of summer chum salmon passage by sonar sector. Only days with 24-hour counts were used. Periods which included equal sonar sector size (see Appendix Tables 2 and 4) were bounded by days with less than 24-hour counts (see Appendix Tables 1 and 3).

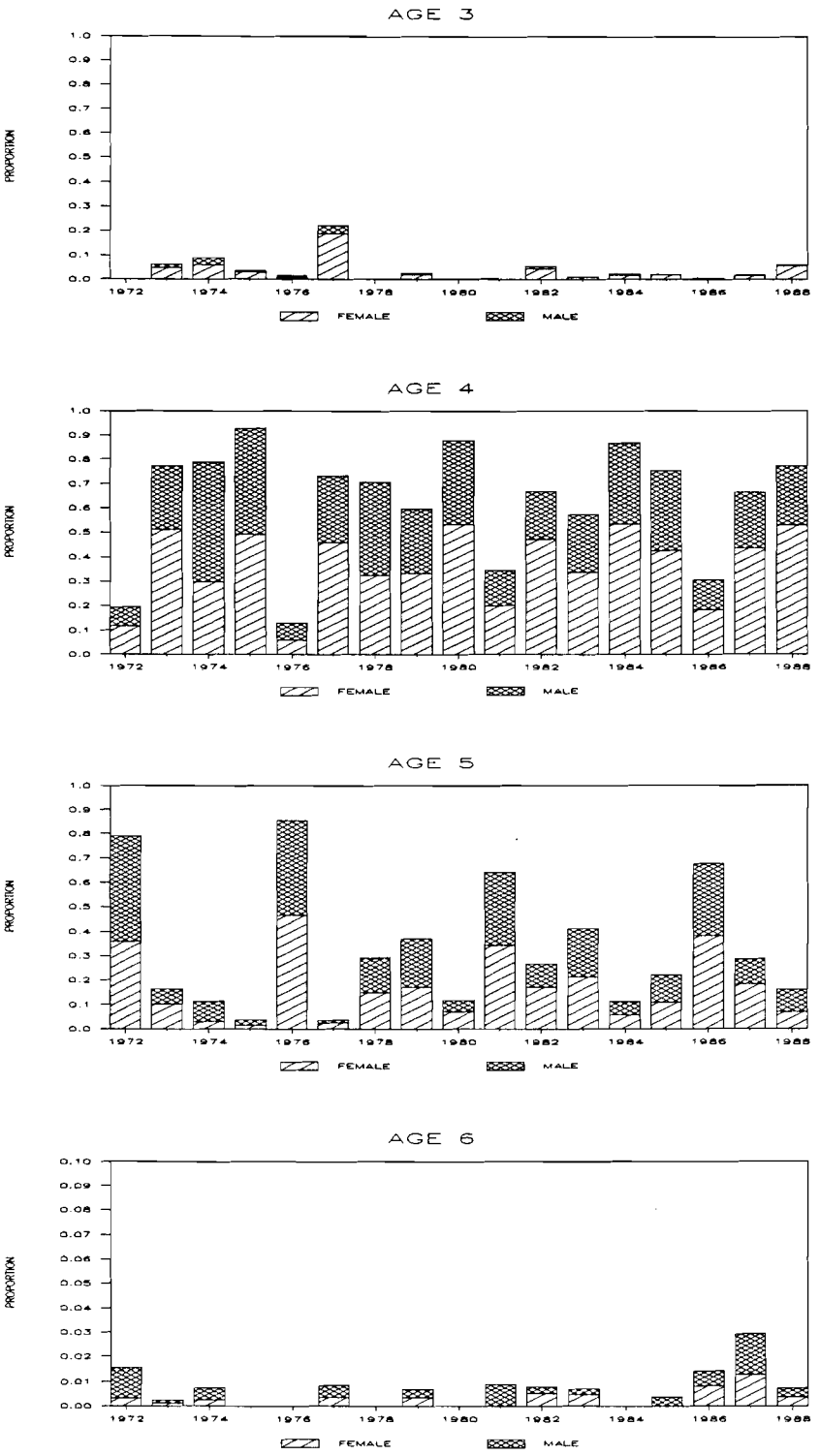

Figure 10. Age and sex composition of sampled Anvik River summer chum salmon, 1972-1988. (Note different Y-axis scale for age-6 salmon).

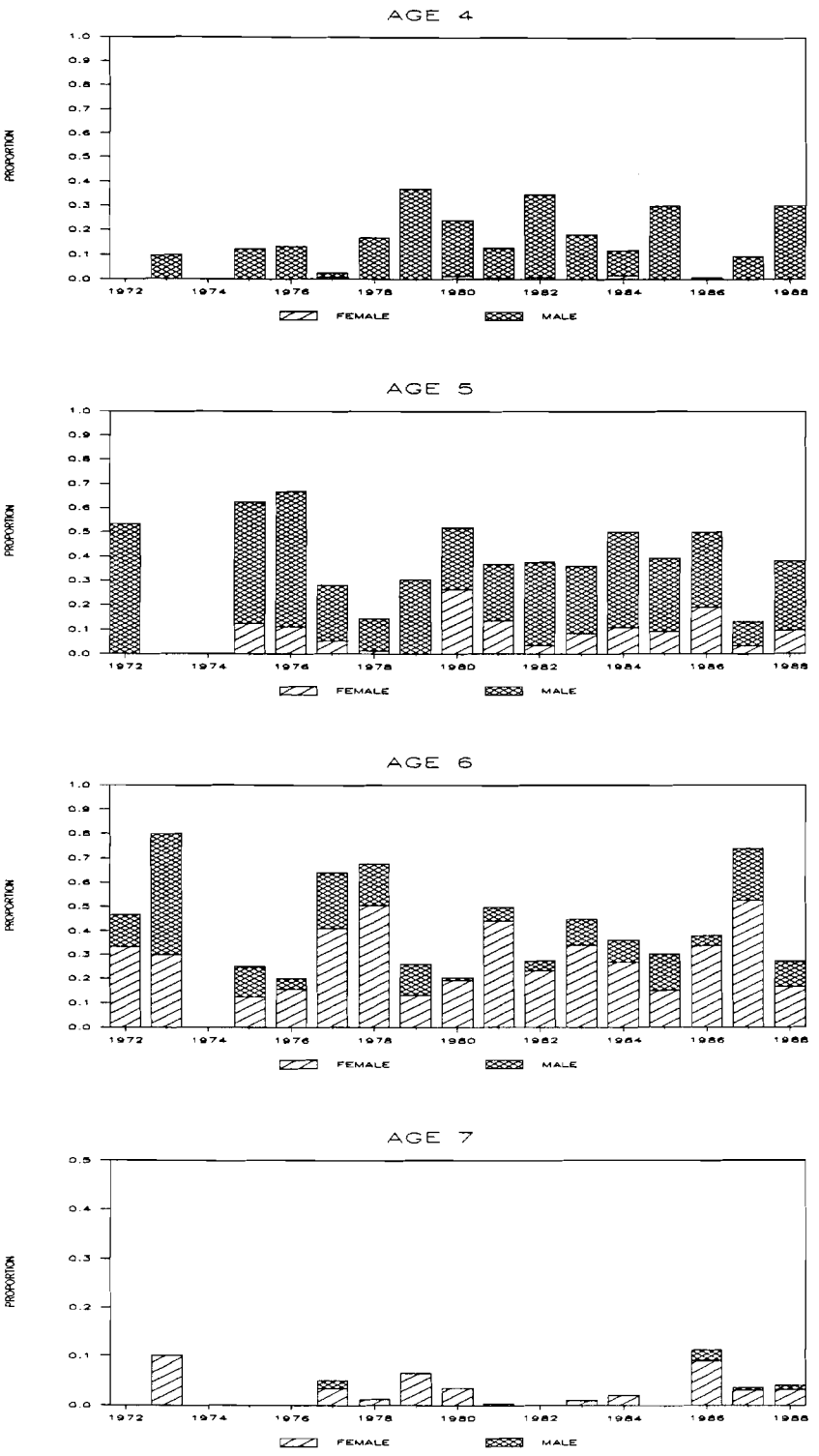

Figure 11. Age and sex composition of sampled Anvik River chinook salmon, 1972-1988. (Note different Y-axis scale for age-7 salmon).

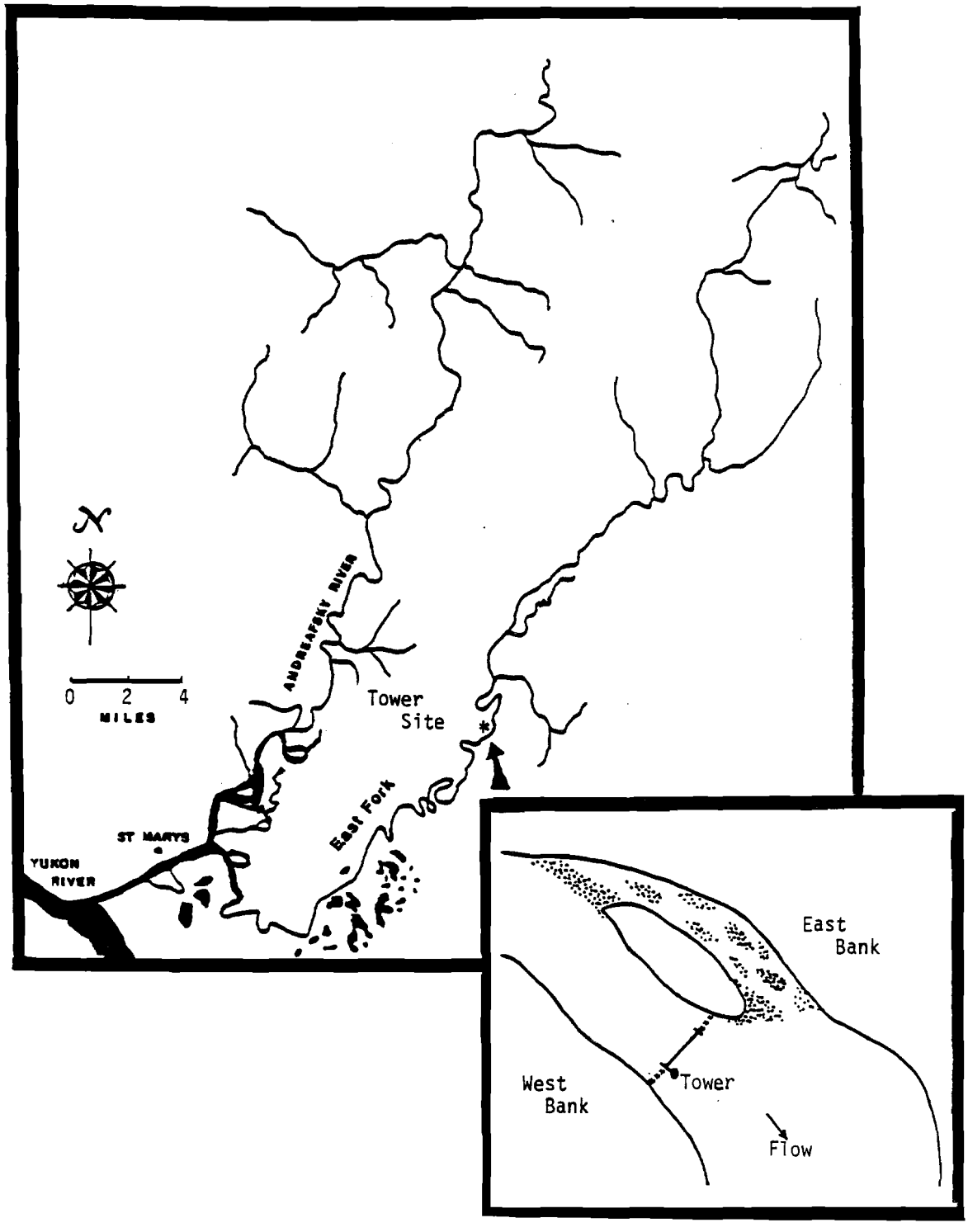

Figure 12. Map of the Andreafsky River, and of the tower site (inset) located at river mile 20 of the East Fork.

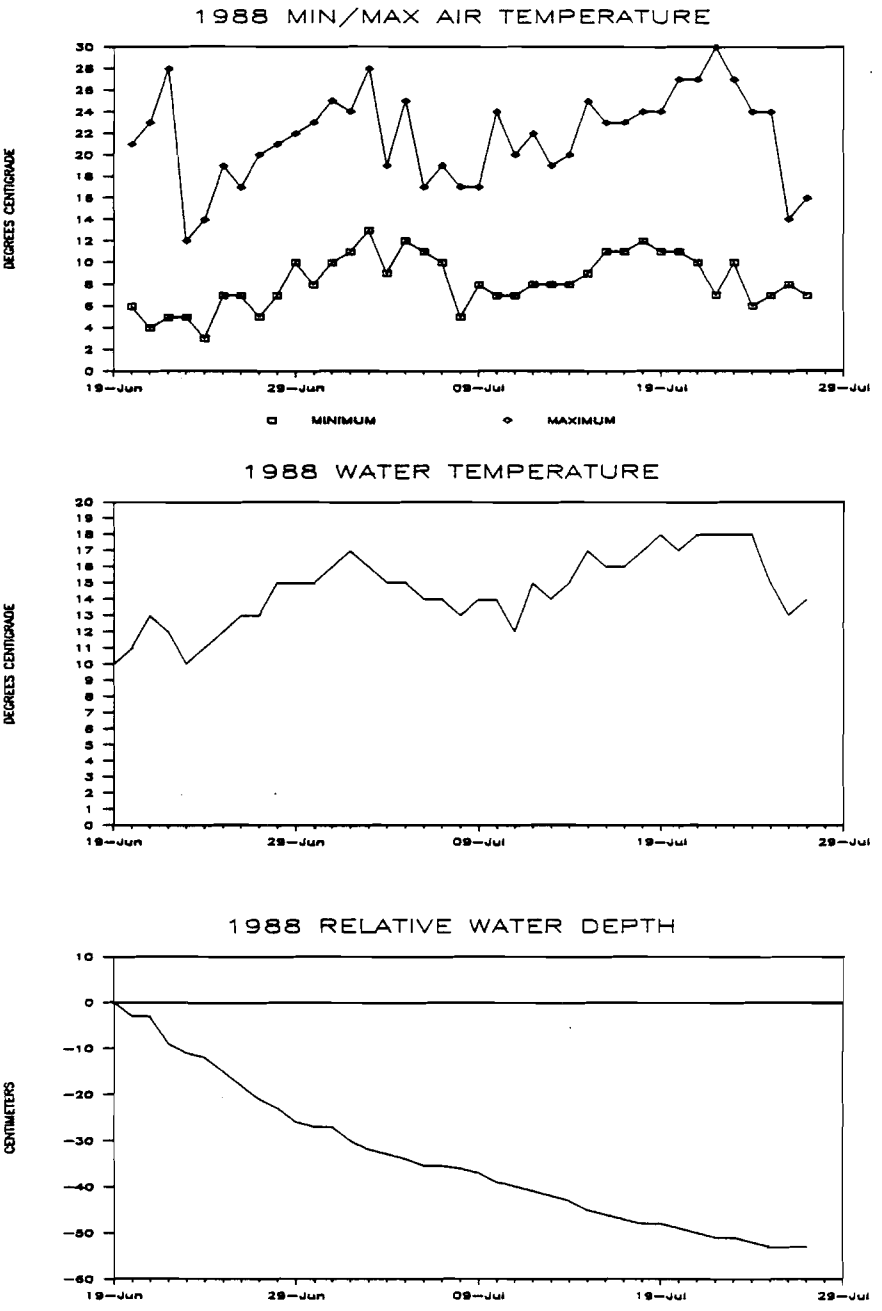

Figure 13. Air temperatures (daily minimum and maximum), water temperature, and relative water depth measured at noon daily at the East Fork Andreafsky River tower site, 1988.

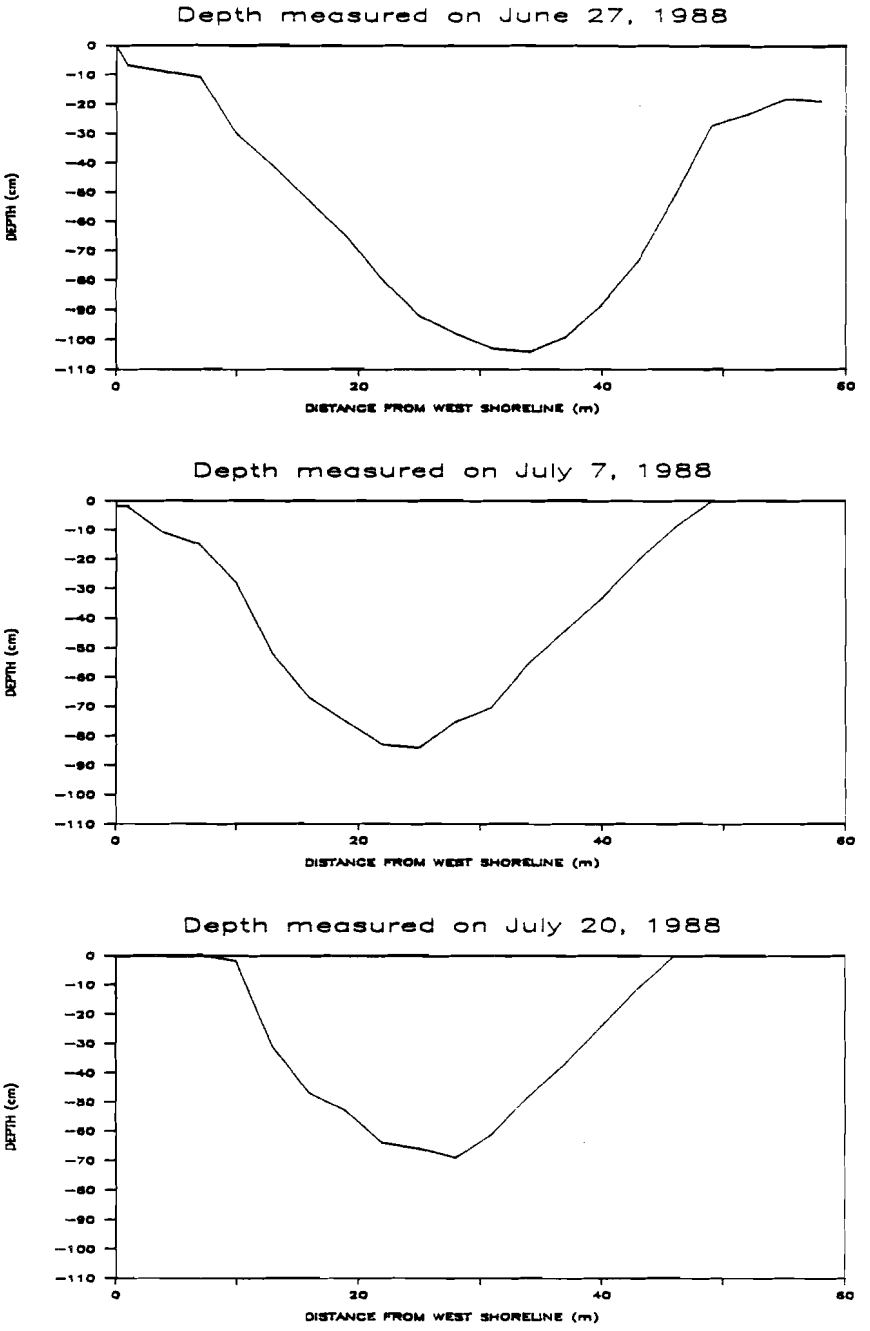

Figure 14. River depth profiles of the East Fork Andreafsky River tower site 27 June, 7 July, and 20 July, 1988. Starting location on west bank shoreline was not consistent for all three profiles.

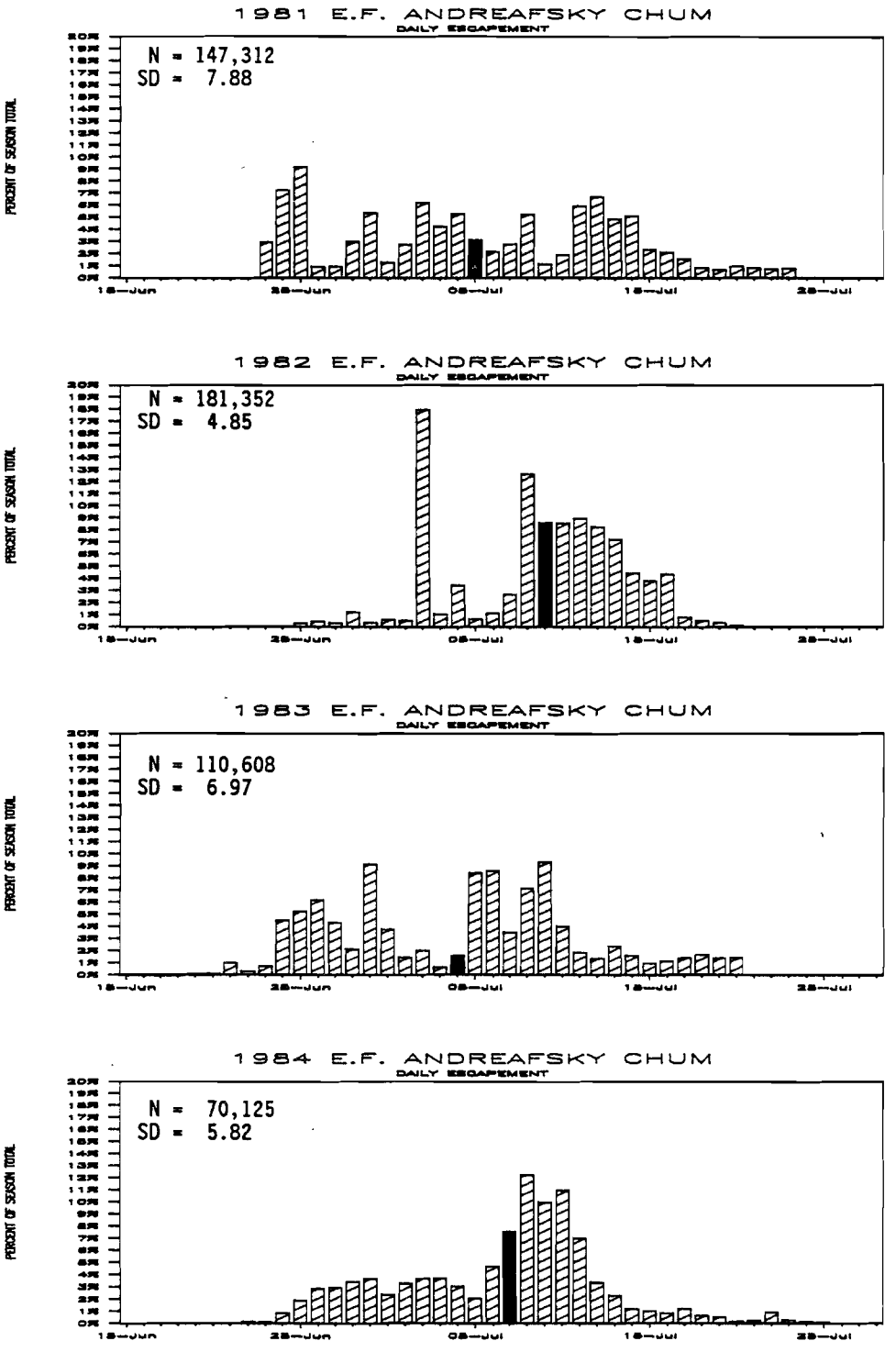

Figure 15. East Fork Andreafsky River summer chum salmon sonar or tower counts by day, 1981-1988. Mean date of run passage (calculated with Day 1 = 16 June) is indicated by shaded bar, and standard deviation (SD) of the mean is given.

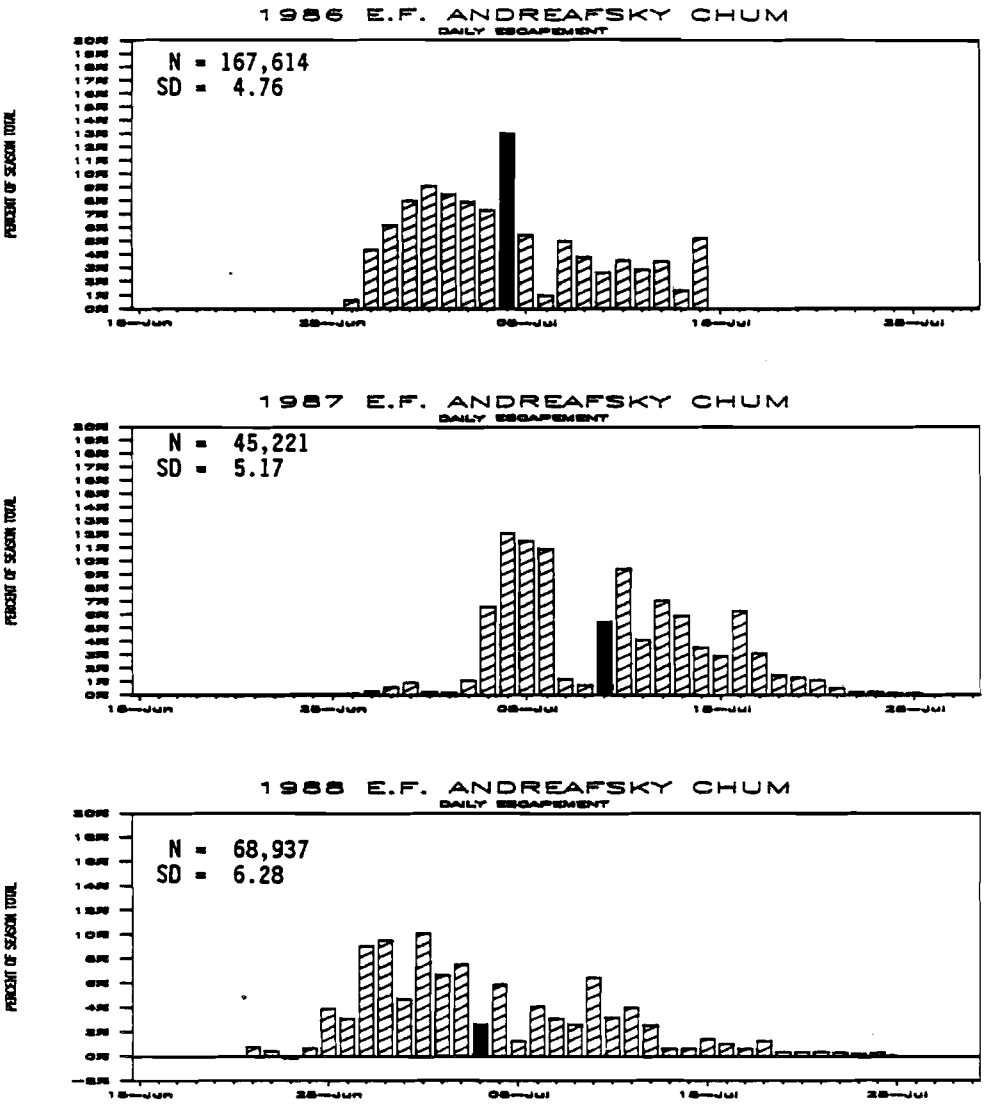

Figure 15. Continued (page 2 of 2).

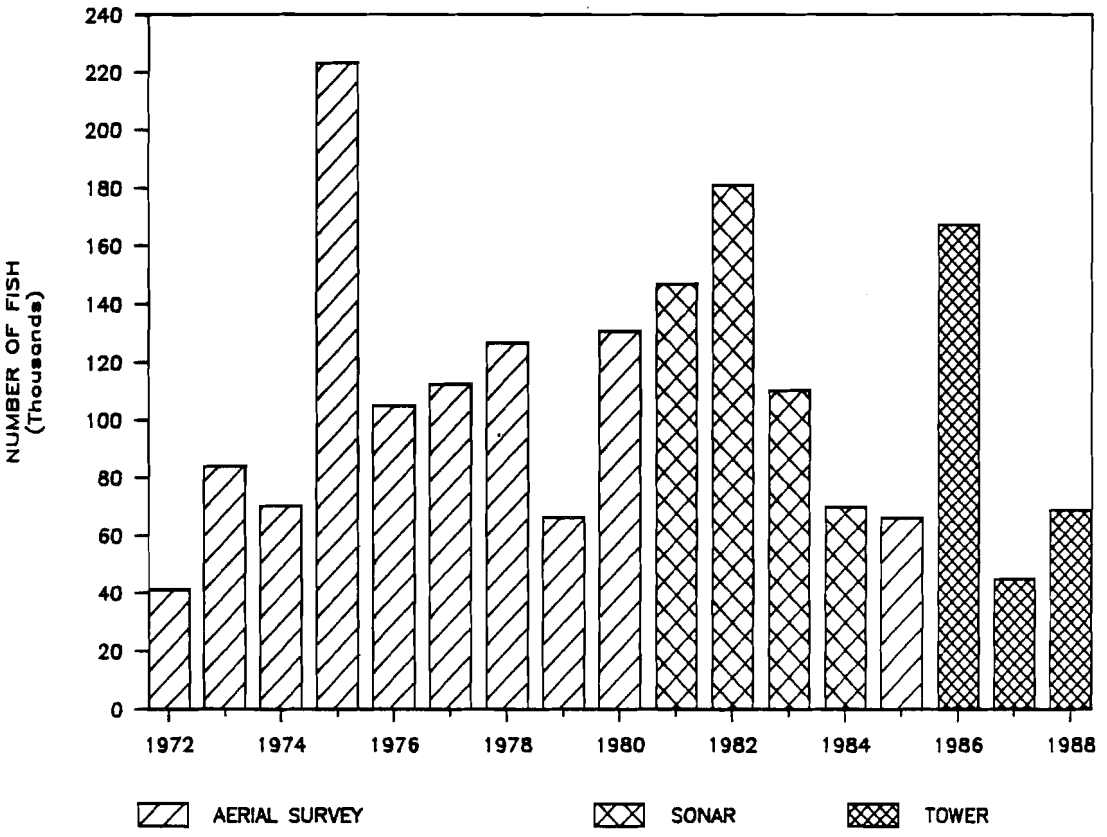

Figure 16. East Fork Andreafsky River summer chum salmon escapement as estimated by aerial survey, 1972-1980 and 1985, by side-scanning sonar, 1981-1984, and by tower counts, 1986-1988.

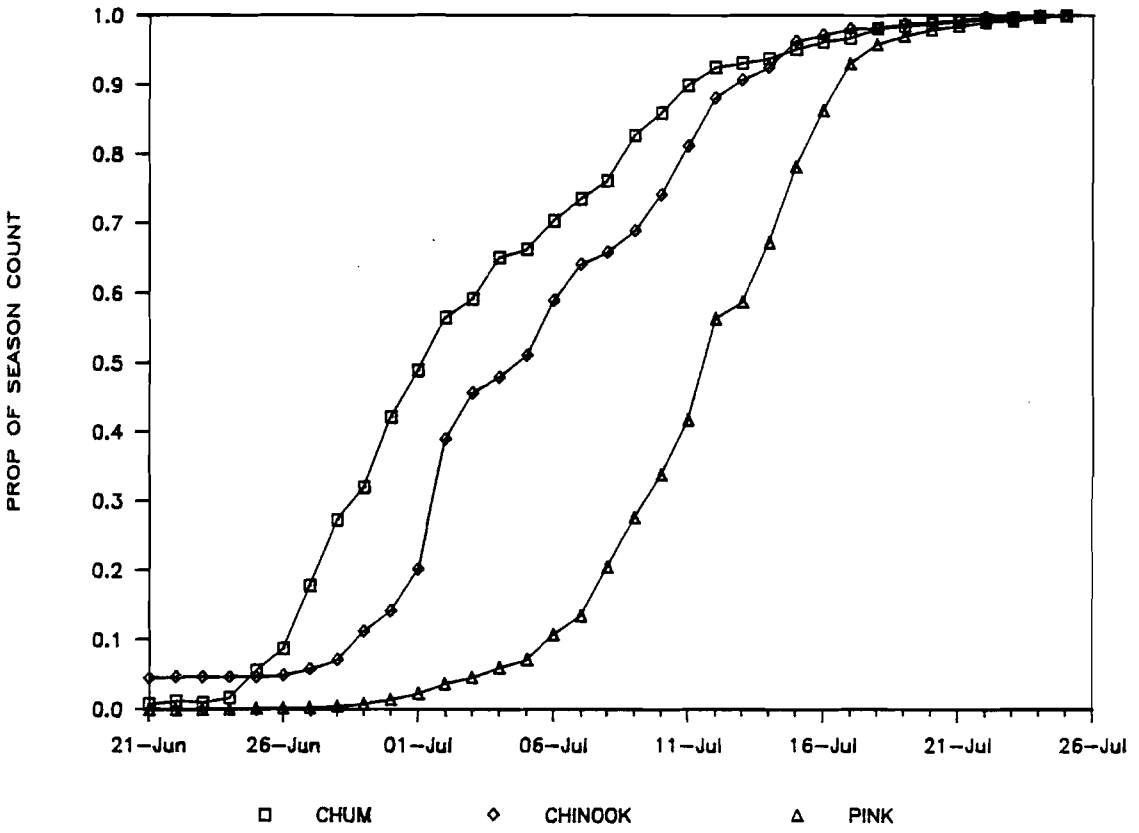

Figure 17. Cumulative proportion of summer chum, chinook, and pink salmon tower counts by date for the East Fork Andreafsky River, 1988.

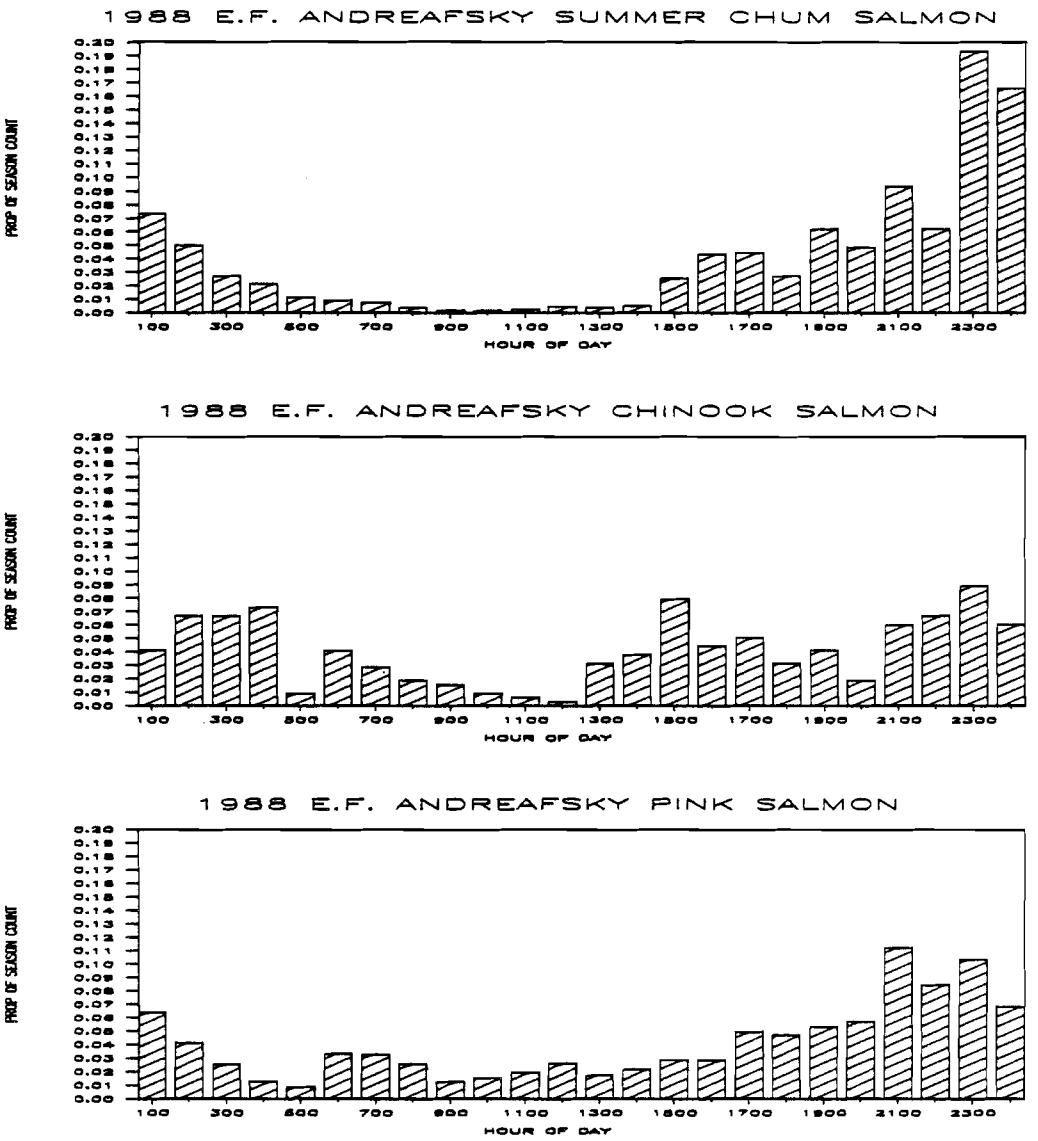

Figure 18. Distribution of summer chum, chinook, and pink salmon tower counts by hour of the day for the East Fork Andreafsky River, 1988. Only days with 24-hour counts were used (see Appendix Tables 8, 9, and 10, respectively).

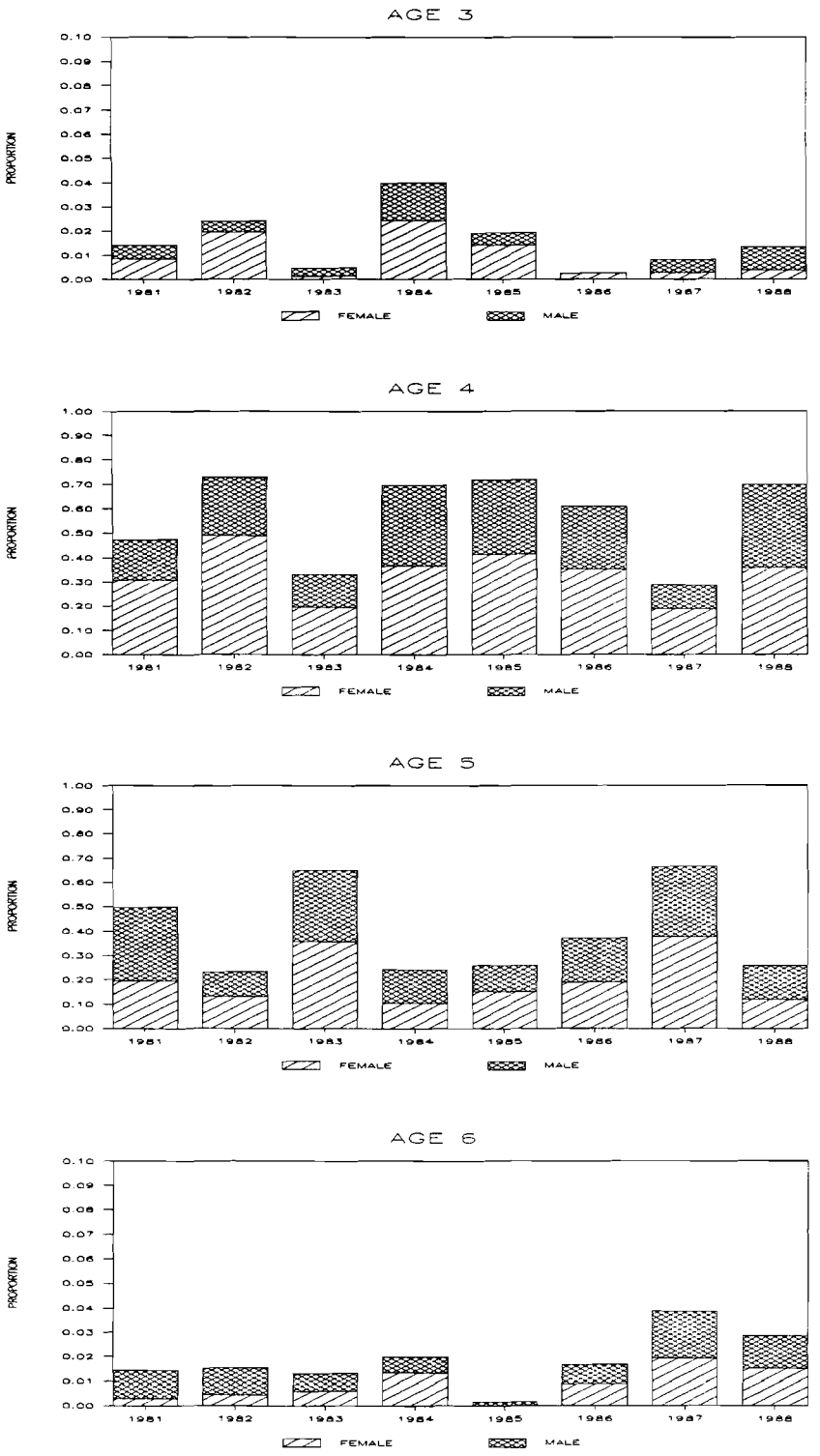

Figure 19. Age and sex composition of sampled East Fork Andreafsky River summer chum salmon, 1981-1988. (Note different Y-axis scale for age-3 and -6 salmon.)

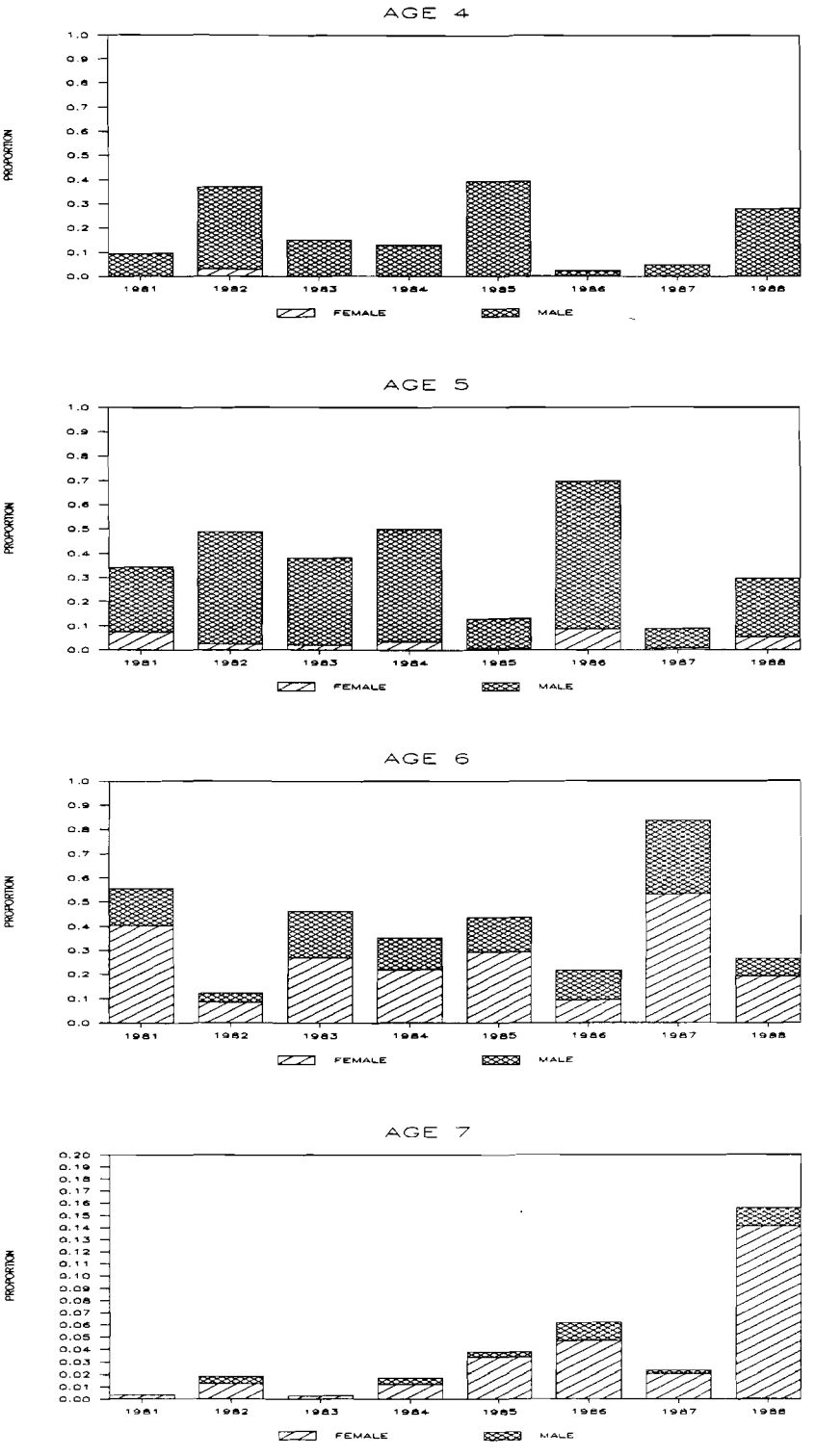

Figure 20. Age and sex composition of sampled Andreafsky River chinook salmon, 1981-1988. (Note different Y-axis scale for age-7 salmon.)

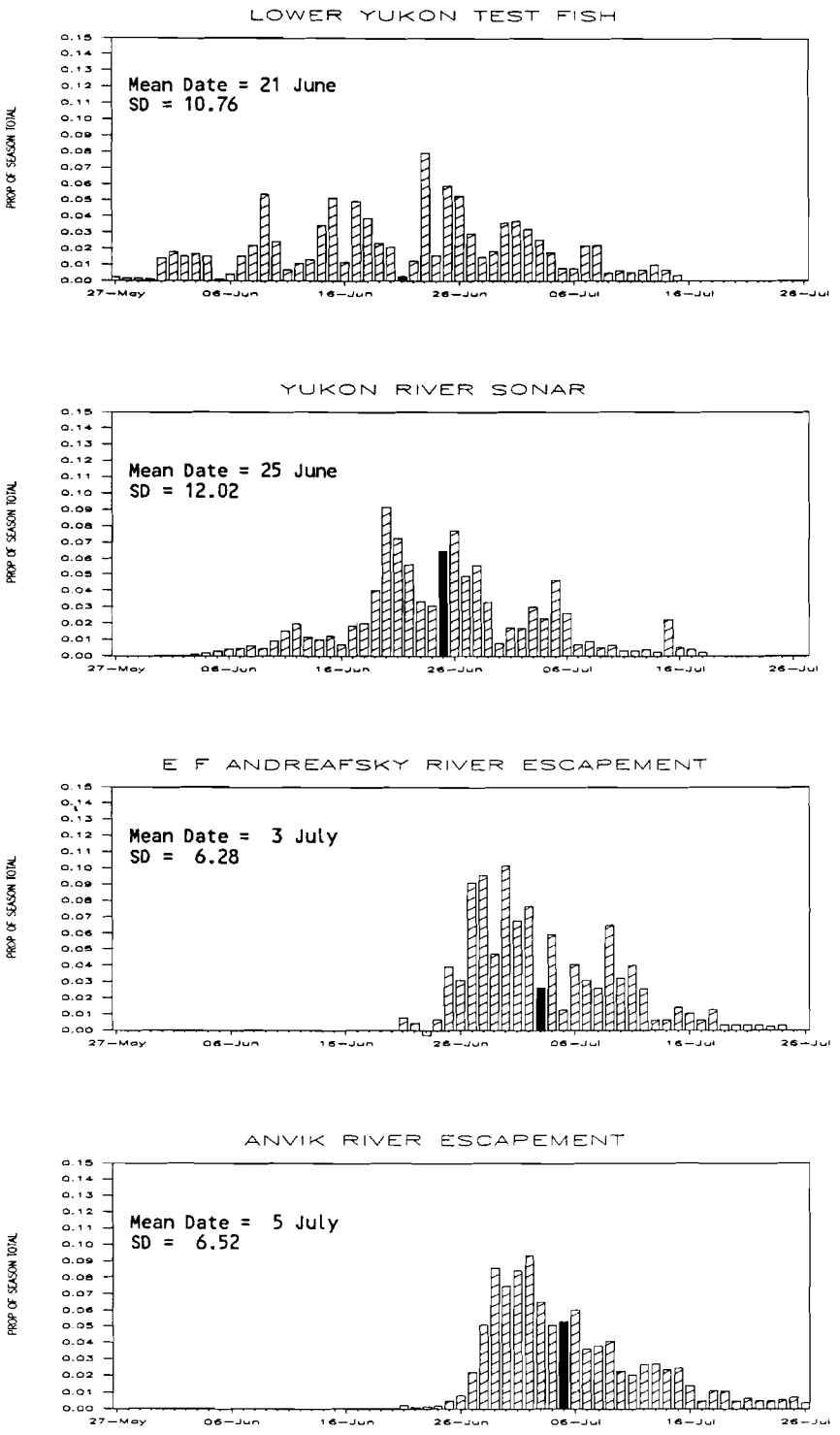

Figure 21. Run timing of Yukon River summer chum salmon in 1988 as indicated by catches, sonar counts, or tower counts at four sites. Mean date of run passage, indicated by the shaded bar, and standard deviation (SD) of the mean are given.

APPENDICES

Appendix Table 1. West bank Anvik River corrected sonar counts by hour of the day, 21 June - 27 July, 1988.

Hour	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul
1	600	12	106	35	76	79	1,979	3,131	4,394	4,350	-	-	4,503	2,145	1,628	3,314	2,226	838
2	389	100	301	75	67	102	2,161	3,474	5,196	6,611	-	-	3,545	2,346	1,847	4,693	2,636	1,010
3	428	90	268	68	102	140	3,187	3,627	6,389	7,351	-	-	4,577	3,130	1,927	5,094	2,223	987
4	247	49	380	73	82	167	3,117	4,277	6,396	5,963	-	-	3,355	2,033	2,334	3,795	1,453	1,117
5	156	19	83	52	82	103	2,625	3,141	5,243	8,005	-	-	5,464	1,421	2,897	2,883	1,294	1,179
6	282	7	57	55	34	110	1,384	3,425	6,602	11,024	-	-	5,807	1,167	2,579	2,588	1,777	1,133
7	183	3	89	70	101	194	563	2,645	4,090	6,178	-	-	5,893	867	2,098	2,468	1,487	1,006
8	32	32	21	81	104	172	306	520	3,336	2,243	-	-	1,078	2,147	1,108	2,285	1,054	833
9	73	53	11	13	55	105	151	313	4,133	708	-	-	1,346	3,611	683	2,394	763	677
10	64	56	10	26	8	105	115	145	2,693	999	-	-	1,144	931	1,086	2,219	774	583
11	13	38	4	16	123	30	100	12	3,675	735	-	983	923	436	1,103	1,792	625	476
12	1	92	15	51	192	246	129	15	3,168	1,569	-	953	1,987	536	1,198	5,480	677	564
13	0	108	11	35	188	198	107	20	2,732	979	-	2,131	4,609	598	1,109	2,411	535	570
14	0	23	11	55	94	30	67	22	2,359	770	-	949	7,499	907	1,365	1,278	476	370
15	3	39	45	65	188	83	141	993	3,342	708	-	1,941	1,418	846	1,417	1,336	494	225
16	2	22	17	116	113	75	190	1,615	2,063	822	-	2,357	1,067	155	779	957	761	315
17	3	9	20	128	501	98	186	1,650	3,005	1,113	-	3,165	1,993	788	885	772	905	282
18	2	13	26	66	801	284	185	2,581	2,273	2,210	-	2,682	1,412	1,903	1,472	729	702	338
19	1	68	40	62	657	585	250	1,728	2,308	2,001	-	3,032	1,514	2,639	1,425	1,202	800	270
20	1	40	46	78	203	546	274	1,880	1,709	1,183	-	3,392	1,618	2,723	1,000	945	811	273
21	0	24	7	111	311	651	280	2,557	1,295	1,036	-	4,732	1,645	2,748	921	1,433	815	340
22	9	112	147	120	210	573	243	2,661	698	782	-	5,643	1,434	3,567	1,113	2,056	1,897	184
23	3	46	56	194	259	843	1,141	2,215	1,619	2,262	-	4,258	2,394	4,701	1,386	1,911	1,299	241
24	8	36	46	27	225	726	386	3,505	7,997	2,287	-	3,112	2,511	3,704	988	1,955	1,456	500
TOTAL	2,502	1,090	1,816	1,673	4,776	6,249	19,268	46,152	86,714	71,889	-	39,330	68,736	46,049	34,347	55,991	27,940	14,313

Hour	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul
1	2,281	780	-	508	1,884	1,633	1,945	1,038	175	505	1,005	371	198	310	229	305	1,056	208	133
2	2,693	837	-	-	1,658	1,254	1,810	1,012	284	485	986	288	109	409	139	379	347	131	89
3	3,118	925	-	-	1,054	822	1,189	453	231	404	352	302	146	188	94	503	323	126	42
4	2,142	1,267	-	-	727	666	1,031	275	179	319	582	199	76	209	109	130	154	157	23
5	1,924	1,715	-	-	796	571	796	307	172	339	385	371	174	93	152	94	347	240	38
6	2,299	2,270	-	-	989	851	1,594	537	252	502	957	270	531	227	205	222	481	249	84
7	2,320	1,605	-	-	616	735	877	444	180	563	771	368	185	239	217	276	596	298	58
8	1,935	180	444	-	349	457	626	257	147	371	346	185	87	133	126	142	288	147	84
9	1,610	210	364	138	286	374	422	274	113	316	157	101	89	91	132	129	130	141	75
10	1,137	127	410	168	302	296	536	459	102	228	161	53	129	66	112	222	205	94	55
11	631	122	310	199	353	429	482	499	143	295	148	144	118	74	153	208	180	79	59
12	441	72	231	155	391	343	663	330	188	207	103	118	142	103	134	69	182	75	40
13	601	64	225	105	305	304	391	255	129	250	163	118	140	40	81	109	188	56	43
14	335	141	320	105	268	477	469	274	142	196	193	118	165	101	98	139	194	49	52
15	419	141	242	110	466	462	769	320	117	318	197	118	281	126	102	163	242	98	49
16	599	219	294	198	506	470	936	443	130	449	243	118	289	195	200	113	231	166	50
17	682	237	358	291	659	709	769	536	154	433	230	118	415	147	303	210	181	90	-
18	465	148	333	371	564	529	937	672	121	506	278	141	534	177	219	273	448	105	-
19	506	280	334	360	611	838	930	664	154	504	155	143	399	257	235	277	135	110	-
20	666	388	296	283	405	582	845	555	162	524	192	119	281	237	302	170	91	82	-
21	571	433	274	766	452	513	650	512	231	455	309	92	327	249	193	300	167	142	-
22	405	506	191	1,355	614	706	788	660	192	481	349	114	211	197	235	197	188	144	-
23	393	538	246	2,027	688	1,034	752	542	200	476	415	116	195	232	327	327	112	74	-
24	779	310	384	2,542	1,034	1,630	848	666	163	620	641	145	339	178	336	192	273	103	-
TOTAL	28,954	13,517	5,255	9,680	15,976	16,685	21,055	11,983	4,061	9,745	9,317	4,229	5,561	4,277	4,437	5,148	6,739	3,162	974

Appendix Table 2. East bank Anvik River corrected sonar counts by hour of the day, 21 June - 27 July, 1988.

Hour	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul
1	0	0	0	0	19	135	391	419	319	374	-	-	-	47	1,213	950	679	2,130
2	0	0	1	2	18	138	213	377	492	214	-	-	-	703	1,817	1,066	525	2,062
3	0	0	1	1	5	87	153	260	274	347	-	-	-	733	1,786	847	363	1,837
4	0	0	2	1	22	62	101	157	158	306	-	-	-	749	1,089	492	379	1,307
5	0	0	2	0	7	131	568	354	365	279	-	-	-	542	948	329	306	1,147
6	0	0	0	2	11	138	243	314	297	383	-	-	-	350	914	588	621	1,176
7	0	0	2	1	7	126	92	219	353	350	-	-	-	321	1,032	548	588	924
8	0	0	1	1	16	128	172	272	299	288	-	-	-	321	1,069	445	305	864
9	0	0	2	1	18	131	102	619	278	197	-	-	-	286	1,202	299	435	1,051
10	0	0	3	0	21	81	170	828	371	310	-	-	-	258	802	316	420	983
11	0	0	0	0	14	252	167	692	367	106	-	-	219	218	857	302	420	906
12	0	0	0	14	14	96	167	920	491	221	-	-	143	57	762	199	409	1,105
13	0	0	1	11	14	24	145	884	377	232	-	-	88	150	1,100	212	348	1,247
14	0	0	1	15	16	111	114	820	248	264	-	-	152	-	693	241	348	839
15	0	0	0	24	18	120	111	798	357	183	-	-	109	-	565	218	348	1,015
16	0	0	0	7	24	88	267	783	782	238	-	-	162	-	615	262	348	921
17	0	0	0	4	33	248	244	471	445	195	-	-	252	-	631	307	290	660
18	0	0	0	21	38	230	264	393	751	235	-	-	314	313	832	299	255	733
19	0	0	1	14	21	150	208	244	461	593	-	-	107	431	915	382	389	1,301
20	0	0	1	9	27	58	290	200	282	947	-	-	209	733	1,115	516	830	945
21	0	0	1	10	30	67	241	454	520	1,404	-	-	293	1,048	1,061	799	1,166	1,036
22	0	0	0	15	34	120	323	481	988	2,455	-	-	205	716	1,414	810	976	1,035
23	0	1	2	13	41	70	213	250	381	1,775	-	-	340	956	1,286	872	1,092	1,678
24	0	1	2	12	19	147	455	175	474	457	-	-	-	1,196	2,017	732	1,051	1,579
TOTAL	1	2	25	180	488	2,938	5,414	11,386	10,128	12,351	-	-	2,593	10,131	25,734	12,030	12,889	28,482

Hour	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul
1	1,684	788	585	857	794	736	825	-	-	-	-	-	-	-	-	-	-	-	29
2	1,453	725	706	998	766	692	781	-	-	-	-	-	-	-	-	-	-	-	46
3	1,233	595	607	694	610	457	443	-	-	-	-	-	-	-	-	-	-	-	65
4	902	601	346	644	586	360	298	-	-	-	-	-	-	-	-	-	-	-	34
5	794	455	360	391	744	263	80	-	-	-	-	-	-	-	-	-	-	-	12
6	948	488	568	536	725	289	149	-	-	-	-	-	-	-	-	-	-	-	45
7	813	391	407	383	425	211	138	-	-	-	-	-	-	-	-	-	-	-	24
8	859	300	319	329	307	209	113	-	-	-	-	-	-	-	-	-	-	-	20
9	879	281	209	-	554	113	123	-	-	-	-	-	-	-	-	-	-	-	18
10	714	322	258	-	791	179	47	-	-	-	-	-	-	-	-	-	-	-	36
11	639	448	215	-	753	212	77	-	-	-	-	-	-	-	-	-	-	-	13
12	535	417	-	-	499	371	310	-	-	-	-	-	-	-	-	-	-	-	5
13	556	379	-	-	288	339	-	-	-	-	-	-	-	-	-	-	-	-	22
14	379	384	-	-	200	315	-	-	-	-	-	-	-	-	-	-	-	-	18
15	286	308	-	-	173	241	-	-	-	-	-	-	-	-	-	-	-	-	-
16	223	411	-	-	201	104	-	-	-	-	-	-	-	-	-	-	-	-	-
17	248	326	-	-	530	211	-	-	-	-	-	-	-	-	-	-	-	-	-
18	338	490	-	-	540	297	-	-	-	-	-	-	-	-	-	-	-	-	-
19	611	649	-	-	522	281	-	-	-	-	-	-	-	-	-	-	-	-	-
20	571	659	759	780	967	690	-	-	-	-	-	-	-	-	-	-	-	-	-
21	660	502	1,008	672	1,008	1,030	-	-	-	-	-	-	-	-	-	-	-	-	-
22	727	736	1,117	835	1,362	1,050	-	-	-	-	-	-	-	-	-	-	-	-	-
23	197	746	1,017	755	1,292	1,225	-	-	-	-	-	-	-	-	-	-	-	-	-
24	926	698	769	871	1,127	825	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	17,176	12,097	9,249	8,745	15,761	10,696	3,382	-	-	-	-	-	-	-	-	-	-	1,690	387

Appendix Table 3. West bank Anvik River corrected sonar counts by sonar sector, 21 June - 27 July, 1988.

WEST BANK SECTOR	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul
1	2,168	38	51	36	30	3,062	11,171	8,141	10,304	6,538	-	461	467	320	182	2,213	622	125
2	307	198	281	13	34	1,862	6,660	26,308	38,057	29,083	-	8,948	21,622	8,043	8,516	13,878	3,973	1,343
3	14	182	614	99	52	122	742	9,951	30,520	26,453	-	16,287	22,618	15,388	13,336	20,314	9,620	5,604
4	2	311	258	185	311	337	68	847	3,755	4,630	-	10,725	16,777	12,943	8,419	12,947	8,468	5,177
5	0	65	34	50	67	72	15	137	737	633	-	1,173	2,884	2,302	1,102	3,108	2,455	1,459
6	0	11	1	8	27	6	2	197	886	300	-	300	599	504	204	578	459	218
7	0	87	45	128	423	93	37	118	965	2,377	-	79	182	164	77	269	198	78
8	1	23	70	181	403	49	129	58	267	599	-	33	58	61	26	99	47	31
9	1	45	89	402	1,455	228	102	214	194	240	-	824	760	321	80	66	49	30
10	2	39	205	373	909	128	210	81	103	281	-	22	421	111	476	84	64	41
11	1	17	99	125	460	170	78	48	168	339	-	9	2,119	4,448	1,366	158	35	22
12	4	73	69	72	605	122	55	52	759	419	-	4	43	13	176	234	910	67
13											-	5	16	11	171	2,006	1,012	85
14											-	2	8	7	5	6	8	24
15											-	225	29	512	13	22	13	7
16											-	233	134	900	197	10	8	3
Total	2,502	1,090	1,816	1,673	4,776	6,249	19,268	46,152	86,714	71,892	-	39,330	68,737	46,049	34,347	55,991	27,940	14,313

WEST BANK SECTOR	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul
1	176	321	112	2,405	3,328	2,528	1,735	62	77	153	308	144	251	280	150	87	54	14	3
2	2,977	1,899	2,117	5,152	7,312	7,246	7,006	1,791	596	1,546	2,125	1,176	1,734	1,312	1,071	832	653	243	82
3	9,651	4,389	2,111	1,438	3,752	4,982	7,988	4,560	1,269	2,857	2,860	947	1,490	1,110	1,241	1,041	979	464	182
4	10,704	3,578	391	230	833	1,116	3,276	3,982	1,167	3,110	2,306	770	638	589	765	1,098	886	614	169
5	3,037	648	108	47	178	162	436	536	242	1,053	793	211	562	299	326	793	1,218	467	147
6	653	243	73	27	116	95	119	165	98	348	208	220	206	197	278	598	1,095	345	103
7	241	95	42	30	97	90	130	158	77	193	136	136	15	28	94	243	548	116	38
8	96	33	24	12	59	51	52	53	22	76	48	21	23	20	17	20	37	29	12
9	89	34	28	20	50	31	77	109	55	80	121	36	29	30	26	28	71	41	13
10	159	67	51	21	36	33	38	41	28	137	129	330	53	59	98	92	579	256	39
11	101	1,261	36	16	52	76	30	39	24	35	35	51	24	20	28	43	39	66	17
12	211	33	14	20	45	135	11	8	5	22	33	16	24	26	25	19	30	115	40
13	802	497	38	29	31	26	8	16	10	27	26	25	25	31	40	35	49	21	13
14	11	343	3	16	11	9	14	22	21	35	23	32	32	40	11	20	45	45	7
15	30	38	13	111	38	91	81	265	277	6	57	63	391	95	29	126	267	49	22
16	17	38	96	105	39	15	57	177	92	68	110	52	65	143	238	71	189	278	87
Total	28,954	13,517	5,255	9,680	15,976	16,685	21,055	11,983	4,061	9,745	9,317	4,229	5,561	4,277	4,437	5,148	6,739	3,162	974

Appendix Table 4. East bank Anvik River corrected sonar counts by sonar sector, 21 June - 27 July, 1988.

EAST BANK SECTOR	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul	08-Jul
16														239		20	44	
15														234		12	33	
14														425		9	30	
13														220		15	37	
12	0	1	16	101	109	214	535	877	1,272	1,307	-	-	58	201	37	47	161	1,351
11	0	1	7	53	95	365	1,106	1,272	860	616	-	-	17	18	7	25	278	1,778
10	1	0	0	24	80	508	1,176	1,703	912	918	-	-	6	270	10	23	389	926
9	0	0	0	2	52	485	807	1,255	442	438	-	-	3	498	5	11	162	523
8	0	0	0	0	37	342	629	1,489	394	1,481	-	-	8	168	8	23	95	333
7	0	0	0	0	40	225	276	738	205	726	-	-	3	89	12	58	96	123
6	0	0	0	0	5	30	23	89	26	104	-	-	4	83	7	42	65	19
5	0	0	0	0	1	27	21	73	16	43	-	-	10	59	20	248	371	29
4	0	0	0	0	5	11	15	37	92	207	-	-	80	250	417	1,116	1,184	117
3	0	0	0	0	23	173	218	762	1,490	1,711	-	-	954	2,785	6,666	5,531	3,266	808
2	0	0	0	0	40	488	587	2,990	4,226	4,536	-	-	1,334	3,716	18,172	4,777	4,776	14,582
1	0	0	1	0	0	70	21	99	192	263	-	-	118	876	372	73	1,903	7,891
Total	1	2	25	180	488	2,938	5,414	11,386	10,128	12,351	-	-	2,593	10,131	25,734	12,030	12,889	28,482

EAST BANK SECTOR	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul
16																			
15																			
14																			
13																			
12	966	859	385	319	230	67	8	-	-	-	-	-	-	-	-	-	-	-	24
11	975	970	635	374	194	63	0	-	-	-	-	-	-	-	-	-	-	-	17
10	740	766	567	193	551	370	0	-	-	-	-	-	-	-	-	-	-	-	11
9	478	434	242	101	1,529	926	0	-	-	-	-	-	-	-	-	-	-	-	12
8	276	241	150	91	606	740	1	-	-	-	-	-	-	-	-	-	-	-	13
7	127	143	98	85	378	347	0	-	-	-	-	-	-	-	-	-	-	-	6
6	19	28	5	4	2	0	0	-	-	-	-	-	-	-	-	-	-	-	0
5	29	40	13	4	0	3	1	-	-	-	-	-	-	-	-	-	-	-	1
4	97	140	90	19	31	11	0	-	-	-	-	-	-	-	-	-	-	-	3
3	872	888	292	257	167	49	3	-	-	-	-	-	-	-	-	-	-	-	87
2	8,378	5,872	4,530	4,623	5,072	2,747	859	-	-	-	-	-	-	-	-	-	-	-	160
1	4,218	1,715	2,243	2,673	7,001	5,373	2,510	-	-	-	-	-	-	-	-	-	-	-	53
Total	17,176	12,097	9,249	8,745	15,761	10,696	3,382	-	-	-	-	-	-	-	-	-	-	1,690	387

Appendix Table 5. Anvik River salmon beach seine catch by species, sex, and date, 1988. a

Date	Number Of Sets	Chum			Chinook			Pink		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
26-Jun	1	9	11	20	0	0	0	0	0	0
27-Jun	1	55	41	96	0	0	0	0	0	0
28-Jun										
29-Jun										
30-Jun										
01-Jul										
02-Jul										
03-Jul	1	57	49	106	0	0	0	0	0	0
04-Jul										
05-Jul										
06-Jul										
07-Jul										
08-Jul										
09-Jul										
10-Jul										
11-Jul	3	13	24	37	0	0	0	0	0	0
12-Jul	2	7	36	43	0	0	0	0	0	0
13-Jul	3	25	28	53	0	0	0	0	0	0
14-Jul	2	15	16	31	0	0	0	0	0	0
15-Jul										
16-Jul										
17-Jul										
18-Jul										
19-Jul	1	15	151	166	0	0	0	1	0	1
20-Jul										
21-Jul										
22-Jul	1	9	70	79	0	0	0	0	0	0
23-Jul										
Totals	15	205	426	631	0	0	0	1	0	1

a Beach seining was conducted at a site on the west bank approximately 200 meters upstream from the sonar site from 26 June through 14 July. However, due to low catches at this site, seining was conducted on 19 and 22 July at site located in the immediate vicinity of the ADF&G field camp.

Appendix Table 6. Age and sex composition of Anvik River summer chum salmon escapement samples, 1972-1988. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 0.2 MALE	AGE 0.2 FEMALE	AGE 0.2 TOTAL	AGE 0.3 MALE	AGE 0.3 FEMALE	AGE 0.3 TOTAL	AGE 0.4 MALE	AGE 0.4 FEMALE	AGE 0.4 TOTAL	AGE 0.5 MALE	AGE 0.5 FEMALE	AGE 0.5 TOTAL
1972	167	153	320	0	0	0	25	37	62	138	115	253	4	1	5
1973	265	518	783	11	37	48	204	401	605	49	79	128	1	1	2
1974	245	157	402	12	24	36	197	120	317	34	12	46	2	1	3
1975	270	314	584	4	17	21	253	288	541	13	9	22	0	0	0
1976	281	320	601	5	4	9	43	35	78	233	281	514	0	0	0
1977	191	398	589	20	111	131	161	270	431	7	15	22	3	2	5
1978	289	263	552	0	1	1	210	180	390	79	82	161	0	0	0
1979	273	306	579	2	12	14	154	193	347	115	99	214	2	2	4
1980	167	258	425	0	1	1	147	226	373	20	31	51	0	0	0
1981	151	182	333	0	0	0	49	67	116	99	115	214	3	0	3
1982	117	265	382	4	17	21	75	181	256	37	65	102	1	2	3
1983	183	238	421	0	4	4	99	142	241	83	90	173	1	2	3
1984	138	215	353	2	6	8	117	189	306	19	20	39	0	0	0
1985	233	294	527	0	11	11	172	225	397	59	58	117	2	0	2
1986	205	281	486	0	2	2	59	89	148	143	186	329	3	4	7
1987	190	355	545	0	10	10	125	238	363	56	100	156	9	7	16
1988	180	351	531	1	30	31	129	282	411	48	37	85	2	2	4

PERCENT OF TOTAL SAMPLE b

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 0.2 MALE	AGE 0.2 FEMALE	AGE 0.2 TOTAL	AGE 0.3 MALE	AGE 0.3 FEMALE	AGE 0.3 TOTAL	AGE 0.4 MALE	AGE 0.4 FEMALE	AGE 0.4 TOTAL	AGE 0.5 MALE	AGE 0.5 FEMALE	AGE 0.5 TOTAL
1972	52.19%	47.81%	100.00%	0.00%	0.00%	0.00%	7.81%	11.56%	19.38%	43.13%	35.94%	79.06%	1.25%	0.31%	1.56%
1973	33.84%	66.16%	100.00%	1.40%	4.73%	6.13%	26.05%	51.21%	77.27%	6.26%	10.09%	16.35%	0.13%	0.13%	0.26%
1974	60.95%	39.05%	100.00%	2.99%	5.97%	8.96%	49.00%	29.85%	78.86%	8.46%	2.99%	11.44%	0.50%	0.25%	0.75%
1975	46.23%	53.77%	100.00%	0.68%	2.91%	3.60%	43.32%	49.32%	92.64%	2.23%	1.54%	3.77%	0.00%	0.00%	0.00%
1976	46.76%	53.24%	100.00%	0.83%	0.67%	1.50%	7.15%	5.82%	12.98%	38.77%	46.76%	85.52%	0.00%	0.00%	0.00%
1977	32.43%	67.57%	100.00%	3.40%	18.85%	22.24%	27.33%	45.84%	73.17%	1.19%	2.55%	3.74%	0.51%	0.34%	0.85%
1978	52.36%	47.64%	100.00%	0.00%	0.18%	0.18%	38.04%	32.61%	70.65%	14.31%	14.86%	29.17%	0.00%	0.00%	0.00%
1979	47.15%	52.85%	100.00%	0.35%	2.07%	2.42%	26.60%	33.33%	59.93%	19.86%	17.10%	36.96%	0.35%	0.35%	0.69%
1980	39.29%	60.71%	100.00%	0.00%	0.24%	0.24%	34.59%	53.18%	87.76%	4.71%	7.29%	12.00%	0.00%	0.00%	0.00%
1981	45.35%	54.65%	100.00%	0.00%	0.00%	0.00%	14.71%	20.12%	34.83%	29.73%	34.53%	64.26%	0.90%	0.00%	0.90%
1982	30.63%	69.37%	100.00%	1.05%	4.45%	5.50%	19.63%	47.38%	67.02%	9.69%	17.02%	26.70%	0.26%	0.52%	0.79%
1983	43.47%	56.53%	100.00%	0.00%	0.95%	0.95%	23.52%	33.73%	57.24%	19.71%	21.38%	41.09%	0.24%	0.48%	0.71%
1984	39.09%	60.91%	100.00%	0.57%	1.70%	2.27%	33.14%	53.54%	86.69%	5.38%	5.67%	11.05%	0.00%	0.00%	0.00%
1985	44.21%	55.79%	100.00%	0.00%	2.09%	2.09%	32.64%	42.69%	75.33%	11.20%	11.01%	22.20%	0.38%	0.00%	0.38%
1986	42.18%	57.82%	100.00%	0.00%	0.41%	0.41%	12.14%	18.31%	30.45%	29.42%	38.27%	67.70%	0.62%	0.82%	1.44%
1987	34.86%	65.14%	100.00%	0.00%	1.83%	1.83%	22.94%	43.67%	66.61%	10.28%	18.35%	28.62%	1.65%	1.28%	2.94%
1988	33.90%	66.10%	100.00%	0.19%	5.65%	5.84%	24.29%	53.11%	77.40%	9.04%	6.97%	16.01%	0.38%	0.38%	0.75%

a Samples collected by carcass survey 1972-1981, by beach seine 1983-1988 and by both methods combined in 1982.
b Sample percentages not weighted by time period or escapement counts.

Appendix Table 7. Age and sex composition of Anvik River chinook salmon escapement samples, 1972-1988. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1972	10	5	15	0	0	0	8	0	8	2	5	7	0	0	0
1973	6	4	10	1	0	1	0	0	0	5	3	8	0	1	1
1974	NO SAMPLES COLLECTED														
1975	6	2	8	1	0	1	4	1	5	1	1	2	0	0	0
1976	33	12	45	6	0	6	25	5	30	2	7	9	0	0	0
1977	58	59	117	2	1	3	27	6	33	27	48	75	2	4	6
1978	36	41	77	13	0	13	10	1	11	13	39	52	0	1	1
1979	37	9	46	17	0	17	14	0	14	6	6	12	0	3	3
1980	41	42	83	19	1	20	21	22	43	1	16	17	0	3	3
1981	109	154	263	33	1	34	61	36	97	15	116	131	0	1	1
1982	100	38	138	47	1	48	47	5	52	6	32	38	0	0	0
1983	173	133	306	56 b	0	56	84	26	110	33	104	137	0	3	3
1984	162	114	276	29	4	33	108	30	138	25	74	99	0	6	6
1985	25	8	33	10	0	10	10	3	13	5	5	10	0	0	0
1986	53	89	142	0	1	1	44	27	71	6	48	54	3	13	16
1987	92	130	222	21	0	21	22	7	29	48	116	164	1	7	8
1988	173	73	246	75	0	75	70	24	94	26	41	67	2	8	10

PERCENT OF TOTAL SAMPLE c

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1972	66.67%	33.33%	100.00%	0.00%	0.00%	0.00%	53.33%	0.00%	53.33%	13.33%	33.33%	46.67%	0.00%	0.00%	0.00%
1973	60.00%	40.00%	100.00%	10.00%	0.00%	10.00%	0.00%	0.00%	0.00%	50.00%	30.00%	80.00%	0.00%	10.00%	10.00%
1974	NO SAMPLES COLLECTED														
1975	75.00%	25.00%	100.00%	12.50%	0.00%	12.50%	50.00%	12.50%	62.50%	12.50%	12.50%	25.00%	0.00%	0.00%	0.00%
1976	73.33%	26.67%	100.00%	13.33%	0.00%	13.33%	55.56%	11.11%	66.67%	4.44%	15.56%	20.00%	0.00%	0.00%	0.00%
1977	49.57%	50.43%	100.00%	1.71%	0.85%	2.56%	23.08%	5.13%	28.21%	23.08%	41.03%	64.10%	1.71%	3.42%	5.13%
1978	46.75%	53.25%	100.00%	16.88%	0.00%	16.88%	12.99%	1.30%	14.29%	16.88%	50.65%	67.53%	0.00%	1.30%	1.30%
1979	80.43%	19.57%	100.00%	36.96%	0.00%	36.96%	30.43%	0.00%	30.43%	13.04%	13.04%	26.09%	0.00%	6.52%	6.52%
1980	49.40%	50.60%	100.00%	22.89%	1.20%	24.10%	25.30%	26.51%	51.81%	1.20%	19.28%	20.48%	0.00%	3.61%	3.61%
1981	41.44%	58.56%	100.00%	12.55%	0.38%	12.93%	23.19%	13.69%	36.88%	5.70%	44.11%	49.81%	0.00%	0.38%	0.38%
1982	72.46%	27.54%	100.00%	34.06%	0.72%	34.78%	34.06%	3.62%	37.68%	4.35%	23.19%	27.54%	0.00%	0.00%	0.00%
1983	56.54%	43.46%	100.00%	18.30%	0.00%	18.30%	27.45%	8.50%	35.95%	10.78%	33.99%	44.77%	0.00%	0.98%	0.98%
1984	58.70%	41.30%	100.00%	10.51%	1.45%	11.96%	39.13%	10.87%	50.00%	9.06%	26.81%	35.87%	0.00%	2.17%	2.17%
1985	75.76%	24.24%	100.00%	30.30%	0.00%	30.30%	30.30%	9.09%	39.39%	15.15%	15.15%	30.30%	0.00%	0.00%	0.00%
1986	37.32%	62.68%	100.00%	0.00%	0.70%	0.70%	30.99%	19.01%	50.00%	4.23%	33.80%	38.03%	2.11%	9.15%	11.27%
1987	41.44%	58.56%	100.00%	9.46%	0.00%	9.46%	9.91%	3.15%	13.06%	21.62%	52.25%	73.87%	0.45%	3.15%	3.60%
1988	70.33%	29.67%	100.00%	30.49%	0.00%	30.49%	28.46%	9.76%	38.21%	10.57%	16.67%	27.24%	0.81%	3.25%	4.07%

a Samples collected by carcass survey each year, with a very few fish also taken by beach seine or hook and line in some years.
b Includes one age 3 male.
c Sample percentages not weighted by time period or escapement counts.

Appendix Table 8. East Fork Andreafsky River summer chum salmon tower counts by hour and date, 1988. a,b

	EXPANDED HOURLY COUNT (3X ACTUAL 20 MINUTE COUNT) FOR HOUR ENDING:																								
DATE	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	TOTAL
21-Jun	3	12	66	87	45	9	0	0	0	0	0	0	2	6	0	3	0	6	0	3	135	27	24	108	536
22-Jun	42	88	57	36	30	21	0	0									0	0	0	0	0	0	0	0	274
23-Jun	0	(6)	0	(42)	(18)	(30)	(15)	0	0	0	0	0	3	3	0	0	0	(3)	0	0	(3)	0	(18)	0	(129)
24-Jun	0	0	0	60	0	3	(33)	(6)									0	0	0	90	165	0	18	126	423
25-Jun	0	50	250	444	282	54	15	0	0	0	9	0	9	3	0	12	33	18	81	129	12	150	192	966	2,709
26-Jun	312	9	144	123	0	0	30	0									0	3	9	18	150	183	63	909	1,953
27-Jun	87	333	123	81	33	0	0	0	(6)	0	0	0	0	0	6	0	12	0	135	42	1,080	189	2,184	1,953	6,252
28-Jun	813	330	48	18	18	0	24	3	9	0	0	0	0	0	0	0	45	30	0	24	270	300	2,817	1,839	6,588
29-Jun	1,302	345	228	333	72	42	9	6									0	3	240	237	84	18	6	33	2,958
30-Jun	153	87	237	72	24	33	15	3									18	27	108	1,836	1,335	1,425	495	492	6,360
01-Jul	612	480	189	132	33	6	18	(6)	0	(3)	0	0	(3)	9	294	189	42	123	573	243	216	750	573	177	4,647
02-Jul	180	108	87	6	(6)	30	45	0	3	6	6	3	39	39	120	648	669	330	792	312	255	159	552	864	5,247
03-Jul	585	534	291	69	18	15	24	27									21	9	9	6	21	6	(3)	27	1,659
04-Jul	66	72	93	57	30	15	18	3	0	3	(3)	3	6	(3)	249	324	180	15	186	120	66	210	1,677	699	4,086
05-Jul	225	210	96	27	12	54	78	27									6	9	0	(3)	3	12	(3)	33	786
06-Jul	123	156	33	18	6	3	12	6	0	3	3	6	(6)	(15)	101	303	447	201	183	213	174	198	264	396	2,828
07-Jul	204	141	171	66	30	78	6	42	51	45	3	6	3	21	69	123	387	168	84	90	63	138	105	42	2,136
08-Jul	576	258	24	0	0	0	(3)	3									84	15	123	144	147	81	48	144	1,644
09-Jul	129	57	6	15	12	30	63	3	(6)	(3)	0	(6)	(3)	0	267	189	18	6	447	543	1,488	492	240	480	4,467
10-Jul	591	270	66	33	15	153	27	30	3	0	6	6	60	105	33	36	51	99	144	114	192	120	6	60	2,220
11-Jul	33	66	15	18	15	30	66	12									54	42	69	90	537	882	411	189	2,529
12-Jul	369	129	36	15	12	27	21	63	0	0	3	6	3	(3)	(3)	66	84	153	108	240	237	63	96	48	1,773
13-Jul	12	0	27	12	0	21	12	0									18	42	39	81	69	45	12	9	399
14-Jul	21	42	6	3	0	12	24	3	12	3	3	0	3	21	18	27	6	27	24	54	72	24	12	6	423
15-Jul	9	21	27	27	12	36	30	12	0	12	93	183	60	48	24	6	6	36	48	36	6	30	177	36	975
16-Jul	15	54	27	66	39	90	60	6									24	21	30	30	96	6	66	12	642
17-Jul	54	45	12	24	6	3	0	18	27	18	3	9	3	12	6	18	54	33	36	27	21	3	3	(3)	432
18-Jul	42	60	21	9	9	9	3	0									27	21	6	15	465	69	6	27	789
19-Jul	51	18	18	9	6	0	0	6	3	0	0	3	15	3	0	42	27	15	9	3	(3)	3	3	(3)	228
20-Jul	72	45	21	12	0	6	18	0	0	0	0	0	0	0	3	24	12	0	9	3	3	0	3	0	231
21-Jul	9	33	27	39	9	3	3	6									12	21	18	6	27	3	6	(6)	216
22-Jul	0	12	9	0	0	12	48	6	3	0	6	12	3	3	9	3	6	12	9	21	6	9	18	0	207
23-Jul	21	30	9	0	24	3	3	24									(3)	6	0	0	0	3	3	15	138
24-Jul	15	12	3	0	27	3	6	0	3	0	3	0	0	0	3	3	0	3	9	36	45	24	3	6	204
25-Jul	6	0	9	0	3	0	0	0	0	3	0	0	3	0	0	3	0	6	0	0	(3)	0	0	0	30
TOTAL	6,732	4,101	2,476	1,869	798	771	627	297	102	87	135	231	200	252	1,199	2,019	2,340	1,497	3,528	4,803	7,431	5,622	10,059	9,684	66,860

a Counts obtained for all 24-hour count days were used to develop an expansion factor for days with 16 hourly counts. The 24 hourly counts for these days combined was 46,090 summer chum salmon, while the combined count for the hours 0000-0800 and 1600-2400 was 41,865 summer chum salmon, resulting in an expansion factor of 1.10. This factor was used in Table 4 to obtain daily estimates of summer chum salmon escapement for days with 16 hourly counts.

b Numbers in parentheses are negative values.

Appendix Table 9. East Fork Andreafsky River chinook salmon tower counts by hour and date, 1988. a,b

DATE	EXPANDED HOURLY COUNT (3X ACTUAL 20 MINUTE COUNT) FOR HOUR ENDING:																								TOTAL
	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
21-Jun	0	0	3	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	15	3	3	60
22-Jun	0	2	0	0	0	0	0	0									0	0	0	0	0	0	0	0	2
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0									0	3	0	0	0	0	0	0	3
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	3	0	12
28-Jun	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	3	0	3	3	18
29-Jun	0	0	3	3	0	3	6	0									0	0	12	9	0	6	0	0	42
30-Jun	0	0	3	0	0	0	0	3									6	0	0	12	3	0	0	3	30
01-Jul	0	0	6	3	0	6	0	0	0	0	0	0	0	0	18	9	3	9	9	6	3	6	3	0	81
02-Jul	6	3	0	0	0	3	12	6	3	3	3	0	21	21	3	3	18	3	27	3	9	21	60	24	252
03-Jul	30	18	0	9	0	0	3	0									0	3	(3)	0	9	0	0	0	69
04-Jul	0	0	3	15	3	(3)	0	0	0	0	0	0	3	0	6	(3)	0	0	0	0	0	0	0	6	30
05-Jul	3	3	12	0	0	(3)	6	3									0	0	0	6	0	0	0	3	33
06-Jul	0	9	6	3	0	0	0	0	0	0	0	0	0	0	30	15	18	9	0	6	3	0	0	6	105
07-Jul	18	12	6	0	0	6	6	9	6	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	69
08-Jul	9	0	0	0	3	0	0	0									0	0	0	0	6	0	0	0	18
09-Jul	0	0	6	0	0	9	3	0	0	0	0	0	0	3	6	0	0	0	0	0	0	9	0	6	42
10-Jul	3	6	12	18	0	6	0	0	6	3	0	0	3	0	6	0	0	0	0	0	3	3	0	0	69
11-Jul	6	3	9	6	0	6	12	6									0	0	0	0	9	0	6	9	72
12-Jul	9	6	12	6	3	3	6	0	0	0	0	0	0	6	6	9	0	6	3	3	0	6	6	3	93
13-Jul	6	0	12	3	0	0	0	0									0	0	0	0	3	0	3	0	27
14-Jul	0	6	0	9	0	0	0	0	0	0	0	3	0	0	0	0	6	0	0	0	0	0	0	0	24
15-Jul	3	18	9	6	0	9	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	(6)	3	3	51
16-Jul	6	0	0	0	0	3	0	0									0	0	0	0	0	0	0	0	9
17-Jul	0	3	0	0	0	0	0	0	0	3	0	3	0	3	0	0	0	0	0	0	0	0	0	0	12
18-Jul	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
19-Jul	0	0	0	0	0	0	0	0	0	0	3	(3)	0	0	0	3	0	0	0	0	0	6	0	0	9
20-Jul	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
21-Jul	0	6	0	0	0	0	0	0									0	(3)	0	0	0	0	0	0	3
22-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	6
23-Jul	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3
25-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	99	95	102	90	12	48	54	30	15	9	6	3	30	36	75	42	54	33	48	45	87	69	93	72	1,247

a Counts obtained for all 24-hour count days were used to develop an expansion factor for days with 16 hourly counts. The 24 hourly counts for these days combined was 939 chinook salmon, while the combined count for the hours 0000-0800 and 1600-2400 was 723 chinook salmon, resulting in an expansion factor of 1.30. This factor was used in Table 4 to obtain daily estimates of chinook salmon escapement for days with 16 hourly counts.

b Numbers in parentheses are negative values.

Appendix Table 10. East Fork Andreafsky River pink salmon tower counts by hour and date, 1988. a,b

	EXPANDED HOURLY COUNT (3X ACTUAL 20 MINUTE COUNT) FOR HOUR ENDING:																							
DATE	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	TOTAL
21-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	9	0	6	21
22-Jun	0	8	0	0	9	0	2	0									0	0	3	0	3	0	0	(6)	19
23-Jun	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	(3)	0	3	9	3	0	0	15
24-Jun	0	0	0	0	0	0	0	0									3	0	0	6	12	0	0	0	21
25-Jun	123	36	45	21	42	36	42	48	24	(9)	15	15	21	6	9	18	36	9	12	21	(21)	(12)	30	(12)	555
26-Jun	0	9	0	0	6	0	0	0									0	0	3	9	21	18	12	12	90
27-Jun	6	3	0	0	0	0	(3)	0	(3)	0	0	0	3	0	0	0	0	0	3	0	33	9	81	96	228
28-Jun	39	39	0	6	6	0	12	3	0	0	3	0	3	0	0	0	3	9	3	15	51	69	207	201	669
29-Jun	279	60	18	102	6	45	36	9									0	6	78	63	30	30	18	9	789
30-Jun	93	72	78	21	3	15	9	6									15	9	27	222	270	384	81	156	1,461
01-Jul	264	186	108	33	18	24	30	12	0	3	0	0	0	0	36	39	87	102	345	138	153	633	291	87	2,589
02-Jul	213	90	18	15	6	15	27	24	0	15	9	9	33	24	30	132	267	177	411	267	324	270	846	993	4,215
03-Jul	690	444	318	114	36	12	9	54									159	102	27	81	60	21	21	27	2,175
04-Jul	117	90	132	99	51	99	54	(3)	15	12	6	18	12	42	396	294	180	60	312	117	105	183	1,161	630	4,182
05-Jul	495	546	345	141	75	87	135	279									15	6	12	45	45	63	48	468	2,805
06-Jul	264	510	99	126	39	30	30	63	3	9	6	9	(3)	3	582	1,146	1,707	804	861	762	696	1,140	828	918	10,632
07-Jul	441	408	288	39	27	474	45	219	96	267	63	57	120	120	348	507	534	1,407	537	402	621	351	453	207	8,031
08-Jul	6,837	2,139	108	0	12	45	39	51									552	225	1,164	1,212	2,211	822	597	1,212	17,226
09-Jul	825	327	51	48	9	162	303	21	27	24	36	45	45	213	1,551	645	138	156	1,524	3,654	5,547	2,445	942	2,202	20,940
10-Jul	3,195	1,551	345	102	111	1,587	369	342	42	36	96	69	825	1,392	1,026	747	528	1,059	1,587	504	1,077	966	396	618	18,570
11-Jul	276	330	48	33	66	237	549	351									483	321	663	600	1,206	3,186	5,940	5,085	19,374
12-Jul	4,074	1,902	345	93	144	606	813	930	240	90	39	57	36	279	306	1,476	3,978	3,558	2,469	2,796	4,020	5,139	7,461	2,232	43,083
13-Jul	579	144	75	18	63	474	627	171									276	453	414	549	651	921	354	153	5,922
14-Jul	291	507	129	63	93	297	2,130	282	150	45	144	111	102	402	273	294	123	255	624	855	8,967	4,452	2,550	1,800	24,939
15-Jul	867	1,062	1,227	1,068	444	777	654	507	426	1,608	3,186	4,164	1,839	1,692	1,020	279	48	873	1,002	780	270	795	4,758	3,048	32,394
16-Jul	972	1,224	594	909	1,107	2,793	3,951	2,709									258	222	240	117	1,320	324	1,734	1,326	19,800
17-Jul	969	564	1,644	612	594	2,523	1,722	2,349	1,266	909	276	690	372	189	207	93	2,133	588	558	900	441	213	156	135	20,103
18-Jul	240	822	210	144	525	321	180	504									228	162	165	405	1,380	600	342	483	6,711
19-Jul	423	294	102	72	63	30	246	129	63	57	18	18	51	27	30	93	135	402	405	69	42	93	138	468	3,468
20-Jul	582	510	258	123	78	78	51	129	33	39	15	39	15	27	21	36	78	36	108	60	36	45	291	54	2,742
21-Jul	81	87	207	267	144	69	33	54									3	(3)	15	21	60	(3)	246	78	1,359
22-Jul	33	129	294	72	33	54	69	96	156	30	48	42	72	39	81	51	9	36	9	15	24	27	69	21	1,509
23-Jul	24	12	24	6	60	12	3	102									30	24	60	(3)	9	9	81	138	591
24-Jul	114	153	30	6	6	(6)	33	66	6	30	21	15	0	6	9	36	36	(9)	12	186	243	234	141	120	1,488
25-Jul	123	36	45	21	42	36	42	48	24	(9)	15	15	21	6	9	18	36	9	12	21	(21)	(12)	30	(12)	555
TOTAL	23,529	14,294	7,185	4,374	3,921	10,932	12,242	9,555	2,568	3,156	3,996	5,373	3,567	4,467	5,934	5,904	12,078	11,055	13,671	14,892	29,895	23,427	30,303	22,953	275,128

a Counts obtained for all 24 hour-count days were used to develop an expansion factor for days with 16 hourly counts. The 24 hourly counts for these days combined was 200,928 pink salmon, while the combined count for the hours 0000-0800 and 1600-2400 was 165,963 pink salmon, resulting in an expansion factor of 1.21. This factor was used in Table 4 to obtain daily estimates of pink salmon escapement for days with 16 hourly counts.

b Numbers in parentheses are negative values.

Appendix Table 11. East Fork Andreafsky River salmon beach seine catch by species, sex, and date, 1988.

Date	Number Of Sets	Chum			Chinook			Pink		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
21-Jun	2	3	4	7	0	0	0	0	0	0
22-Jun	3	16	12	28	0	0	0	0	0	0
23-Jun	1	0	0	0	0	0	0	0	0	0
24-Jun	1	26	12	38	0	0	0	0	0	0
25-Jun	1	19	24	43	0	0	0	0	0	0
26-Jun										
27-Jun	1	44	46	90	0	0	0	1	0	1
28-Jun	2	22	15	37	0	0	0	0	0	0
29-Jun										
30-Jun	1	70	56	126	2	0	2	20	1	21
01-Jul										
02-Jul										
03-Jul										
04-Jul										
05-Jul	2	13	6	19	0	0	0	35	12	47
06-Jul	1	3	6	9	1	0	1	14	13	27
07-Jul	1	17	10	27	0	0	0	139	48	187
08-Jul	1	8	22	30	0	0	0	68	45	113
09-Jul	2	9	9	18	1	0	1	16	1	17
10-Jul										
11-Jul	1	13	11	24	1	1	2	203	52	255
12-Jul										
13-Jul										
14-Jul	1	8	2	10	1	0	1	88	51	139
15-Jul										
16-Jul										
17-Jul	1	15	29	44	0	0	0	39	21	60
Totals	21	286	264	550	6	1	7	623	244	867

Appendix Table 12. Age and sex composition of East Fork Andreafsky River summer chum salmon escapement samples, 1981-1988. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 0.2 MALE	AGE 0.2 FEMALE	AGE 0.2 TOTAL	AGE 0.3 MALE	AGE 0.3 FEMALE	AGE 0.3 TOTAL	AGE 0.4 MALE	AGE 0.4 FEMALE	AGE 0.4 TOTAL	AGE 0.5 MALE	AGE 0.5 FEMALE	AGE 0.5 TOTAL
1981	170	181	351	2	3	5	58	108	166	106	69	175	4	1	5
1982	161	295	456	2	9	11	108	224	332	46	60	106	5	2	7
1983	366	468	834	3	1	4	114	164	278	243	298	541	6	5	11
1984	222	229	451	7	11	18	149	165	314	63	47	110	3	6	9
1985	237	329	566	3	8	11	172	235	407	61	86	147	1	0	1
1986	346	429	775	0	2	2	200	272	472	140	148	288	6	7	13
1987	150	212	362	2	1	3	36	68	104	105	136	241	7	7	14
1988	266	259	525	5	2	7	180	187	367	73	62	135	8 b	8	16

PERCENT OF TOTAL SAMPLE c

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 0.2 MALE	AGE 0.2 FEMALE	AGE 0.2 TOTAL	AGE 0.3 MALE	AGE 0.3 FEMALE	AGE 0.3 TOTAL	AGE 0.4 MALE	AGE 0.4 FEMALE	AGE 0.4 TOTAL	AGE 0.5 MALE	AGE 0.5 FEMALE	AGE 0.5 TOTAL
1981	48.4%	51.6%	100.0%	0.6%	0.9%	1.4%	16.5%	30.8%	47.3%	30.2%	19.7%	49.9%	1.1%	0.3%	1.4%
1982	35.3%	64.7%	100.0%	0.4%	2.0%	2.4%	23.7%	49.1%	72.8%	10.1%	13.2%	23.2%	1.1%	0.4%	1.5%
1983	43.9%	56.1%	100.0%	0.4%	0.1%	0.5%	13.7%	19.7%	33.3%	29.1%	35.7%	64.9%	0.7%	0.6%	1.3%
1984	49.2%	50.8%	100.0%	1.6%	2.4%	4.0%	33.0%	36.6%	69.6%	14.0%	10.4%	24.4%	0.7%	1.3%	2.0%
1985	41.9%	58.1%	100.0%	0.5%	1.4%	1.9%	30.4%	41.5%	71.9%	10.8%	15.2%	26.0%	0.2%	0.0%	0.2%
1986	44.6%	55.4%	100.0%	0.0%	0.3%	0.3%	25.8%	35.1%	60.9%	18.1%	19.1%	37.2%	0.8%	0.9%	1.7%
1987	41.4%	58.6%	100.0%	0.6%	0.3%	0.8%	9.9%	18.8%	28.7%	29.0%	37.6%	66.6%	1.9%	1.9%	3.9%
1988	50.7%	49.3%	100.0%	1.0%	0.4%	1.3%	34.3%	35.6%	69.9%	13.9%	11.8%	25.7%	1.5%	1.5%	3.0%

a Samples collected by carcass survey in 1981, by beach seine in 1983 and 1986-88, and by both methods combined in 1982 and 1984-85.
b Includes 1 age 0.6 male.
c Sample percentages not weighted by time period or escapement counts.

Appendix Table 13. Age and sex composition of Andreafsky River chinook salmon escapement samples, 1981-1988. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1981	154	143	297	29	0	29	80	22	102	45	120	165	0	1	1
1982	276	49	325	110 b	10	120	151	8	159	13	27	40	2	4	6
1983	251	104	355	54	0	54	129	7	136	68	96	164	0	1	1
1984	307	112	419	54 c	0	54	194	15	209	57	92	149	2	5	7
1985	296	147	443	175	0	175	55	2	57	64	130	194	2	15	17
1986	211	64	275	5	1	6	168	24	192	34	26	60	4	13	17
1987	168	215	383	19 c	0	19	31	3	34	117	204	321	1	8	9
1988	247	156	403	113 c	0	113	98	21	119	30	78	108	6	57	63

PERCENT OF TOTAL SAMPLE d

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1981	51.85%	48.15%	100.00%	9.76%	0.00%	9.76%	26.94%	7.41%	34.34%	15.15%	40.40%	55.56%	0.00%	0.34%	0.34%
1982	84.92%	15.08%	100.00%	33.85%	3.08%	36.92%	46.46%	2.46%	48.92%	4.00%	8.31%	12.31%	0.62%	1.23%	1.85%
1983	70.70%	29.30%	100.00%	15.21%	0.00%	15.21%	36.34%	1.97%	38.31%	19.15%	27.04%	46.20%	0.00%	0.28%	0.28%
1984	73.27%	26.73%	100.00%	12.89%	0.00%	12.89%	46.30%	3.58%	49.88%	13.60%	21.96%	35.56%	0.48%	1.19%	1.67%
1985	66.82%	33.18%	100.00%	39.50%	0.00%	39.50%	12.42%	0.45%	12.87%	14.45%	29.35%	43.79%	0.45%	3.39%	3.84%
1986	76.73%	23.27%	100.00%	1.82%	0.36%	2.18%	61.09%	8.73%	69.82%	12.36%	9.45%	21.82%	1.45%	4.73%	6.18%
1987	43.86%	56.14%	100.00%	4.96%	0.00%	4.96%	8.09%	0.78%	8.88%	30.55%	53.26%	83.81%	0.26%	2.09%	2.35%
1988	61.29%	38.71%	100.00%	28.04%	0.00%	28.04%	24.32%	5.21%	29.53%	7.44%	19.35%	26.80%	1.49%	14.14%	15.63%

a Samples collected by carcass survey of the East Fork and West Fork each year, with additional samples collected by beach seine from the East Fork for the years 1982 through 1988.
b Includes 7 age 3 males.
c Includes 1 age 3 male.
d Sample percentages not weighted by time period or escapement counts.