ANVIK RIVER SALMON ESCAPEMENT STUDY, 1996

By

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ABSTRACT

Since 1979 the Anvik River sonar project has provided data to estimate daily passage of summer chum salmon *Oncorhynchus keta* using side-looking sonar. During the period 18 June through 17 July 1996, an estimated 933,240 summer chum passed the sonar site on the Anvik River. This estimate is 1.87 times the minimum escapement objective of 500,000 summer chum salmon. Overall, the 1996 summer chum salmon run was early. Specifically, all quartile passage days were 6 to 7 days earlier than the long-term mean (1979-1995, excluding 1986) timing statistics. Female chum salmon comprised an estimated 47.3% of the summer chum salmon passage. This was the second lowest estimated percent female composition of the Anvik River chum salmon escapement since 1978. The proportion of female chum salmon increased throughout the run. Male chum salmon dominated the first two temporal strata and females dominated the last two strata. Age-3 chum salmon comprised an estimated 0.5% of the chum salmon passage, age-4 an estimated 55.4%, age-5 an estimated 42.3%, and age-6 accounted for an estimated 1.8%. A total of 839 chinook salmon *O. tshawytscha* were estimated on an aerial survey of the mainstem and tributaries within the Anvik River drainage under good aerial survey conditions. The mainstem estimate of 709 achieved the minimum escapement goal of 500 chinook salmon for this index area. However, the total survey estimate of 839 was below the minimum escapement goal of 1300 chinook salmon for the total drainage index. Age-5 fish dominated the chinook salmon escapement carcass samples, accounting for 55.4%. Age-6 fish accounted for 24.4% of the samples. Males dominated the sample, accounting for 64.9%.

INTRODUCTION

Two distinct runs of chum salmon *Oncorhynchus keta*, summer and fall, spawn in the Yukon River drainage. The Anvik River empties into the Yukon River at river kilometer (rkm) 512 (Figure 1) and is the largest producer of summer chum salmon in the Yukon River drainage. Other known major spawning populations occur in other tributaries of the Yukon River, such as, the Andreafsky (rkm 167), Rodo (rkm 719), Nulato (rkm 777), Melozitna (rkm 938), and the Tozitna Rivers (rkm 1,096); in tributaries to the Koyukuk River (rkm 817), such as, the Gisasa (rkm 907) and Hogatza (rkm 1,255) Rivers; and in tributaries to the Tanana River (rkm 1,118), such as the Chena (rkm 1,480), and Salcha (rkm 1,553) Rivers (Figure 1). Summer chum salmon also spawn in lesser numbers in other tributaries of the Yukon River. Chinook *O. tshawytscha* and pink *O. gorbuscha* salmon occur in the Anvik River coincidentally with summer chum salmon. Coho salmon *O. kisutch* spawn in the Anvik River drainage later during the fall.

Harvest of Anvik River Salmon

Commercial and subsistence harvests of Anvik River summer chum salmon occur throughout the mainstem Yukon River from the coast of the delta to the mouth of the Anvik River, and beginning in 1994, in a special harvest area within the Anvik River. This section of river includes Districts 1, 2, 3, and the extreme lower portion of District 4 (Figure 1). Set and drift gillnets are the legal fishing gear in Districts 1, 2, and 3; set gillnets and fish wheels are used in District 4. Most of the effort and harvest on the Anvik River stock occurs in Districts 1 and 2 and in the extreme lower portion of District 4 below the confluence of the Anvik and Yukon Rivers. Summer chum salmon taken commercially in Districts 1-3 are sold in the round whereas roe is the chief commercial product from the District 4 fishery. Whole chum salmon are usually not bought in District 4 because of poor flesh quality and greater distance from the market. Subsistence fisheries in Districts 1, 2, and 3 take summer chum salmon primarily for human consumption. Subsistence harvest of summer chum salmon in District 4 is primarily for sled dog food. Commercial and subsistence summer chum salmon fisheries in the remainder of District 4 and in District 6 are supported by stocks other than the Anvik River stock. Few summer chum salmon are harvested in District 5 because of the lack of spawning populations in that portion of the drainage.

In the lower portion of the Yukon River (Districts 1, 2, and 3), run timing of chinook and summer chum salmon greatly overlap from river-ice breakup through June or early July. During this period, management of the lower Yukon River has traditionally been directed at chinook salmon. The District 4 commercial fishery has been directed primarily at chum salmon. In the Lower Yukon Area, large-mesh gillnets (stretch mesh greater than 15.2 cm) were traditionally employed to harvest chinook salmon during June and early July. Although large-mesh nets are efficient for chinook salmon in these districts during the chinook-directed periods, the associated harvest of summer chum salmon was small in relation to the size of the summer chum salmon run. Thus, prior to the 1985 season, the Alaska Board of Fisheries (BOF), in an attempt to allow more harvest of summer chum salmon in the lower river, adopted regulations that allow special small-mesh (stretch mesh maximum of 6 inches) fishing periods during the chinook salmon season provided that (1) the summer chum salmon run was of sufficient size to support the additional exploitation, and (2) the incidental harvest of chinook salmon during these small-mesh fishing periods did not adversely affect conservation of that species.

Strong runs resulted in record commercial harvests of 1,620,269 summer chum salmon in 1988 and 1,456,928 chum in 1989 (Bergstrom et al. 1992). Distribution of the summer chum salmon catch among districts reflected stock distribution, market demand, and scheduled fishing time. Without harvest guidelines, increased market demand prompted allocation disputes between district fishermen. In February 1990, the BOF addressed the situation by establishing a river-wide guideline harvest range of 400,000 to 1,200,000 summer chum salmon (ADF&G 1990). This overall guideline was classified by district and subdistrict based on the previous 15-year average harvests.

Because of the relatively large summer chum salmon escapements to the Anvik River, which on the average (1979-1995) exceeded the present minimum escapement goal of 500,000 salmon by approximately 250,000 salmon, the BOF, in March 1994, adopted the Anvik River chum salmon fishery management plan. This plan contained regulations allowing a commercial summer chum salmon fishery within the Anvik River (ADF&G 1994).

For the 1996 season, the run-strength outlook for 5-year-old Yukon River summer chum salmon was for an average to above average run. This was based on evaluation of parent-year escapements in 1991, and the contribution of 4-year-old fish in the 1995 run. A below average to average return of age-4 summer chum salmon was expected. Overall, the 1996 outlook was for an average summer chum salmon run. Based on this subjective projection, the river-wide commercial harvest of summer chum salmon was expected to be 400,000 to 800,000 fish (ADF&G 1995).

The 1996 Yukon River summer chum salmon run was above average in abundance but less than the two previous years (JTC 1996). Based on this assessment, the targeted commercial harvests were increased to above pre-season projections. However, because of a weak summer chum salmon flesh market, the Lower Yukon Area summer chum salmon harvest was below the lower end of the guideline harvest range. Chum salmon roe markets remained relatively stable. The total estimated harvest of 71,991 fish in Subdistrics 4-B and 4-C was allowed to exceed the guideline harvest range 16,000 to 47,000 based on the summer chum salmon escapements documented in the Anvik, Kaltag, Nulato, and Gisasa Rivers and Clear Creek (JTC 1996).

Because of a large harvestable surplus of summer chum salmon in Subdistrict 4-A and the Anvik River Management Area, the sale of roe was allowed to approach the roe caps A total of 76,318 pounds of summer chum salmon roe were sold in the Anvik River Management Area and 181,050 pounds of roe were sold in Subdistrict 4-A. Prior to the fishing season, the BOF increased the roe cap for the Anvik Management Area to 100,000 pounds (JTC 1996).

This was the third consecutive year that commercial fishing was allowed within the Anvik River. In the Anvik River Management Area, a three 12-hour period per week fishing schedule was maintained throughout the entire season. Additionally, fishing periods were scheduled concurrently with Subdistrict 4-A openings. Permit holders fishing in the Anvik River were not limited to the amount of chum salmon taken per period. The management strategy to divert fishing effort from the mainstem Yukon River in Subdistrict 4-A to the Anvik River seemed to work well. The number of permit holders that fished in the Anvik River during concurrent periods with Subdistrict 4-A ranged from 3 to 16 and averaged 9 (JTC 1996).

Stock Identification Studies

Two stock identification studies have been conducted on Yukon River chum salmon stocks. Initially, a small-scale stock identification investigation using scale pattern analysis was conducted by the Alaska Department of Fish and Game (ADF&G). Although results of this pilot study indicated that separation between the summer and fall chum salmon stocks by scale pattern analysis was probably feasible, separation among summer chum or fall chum salmon stocks was not (Wilcock 1988). A more recent stock identification study (Wilmot et al. 1992) reported success in separating Yukon River chum salmon stocks using protein electrophoresis techniques. This study was initiated in 1987 by the United States Fish and Wildlife Service (USFWS) and continued through the 1991 season. Preliminary results indicated that among all represented chum salmon stocks of the Yukon River, two major groups were apparent, a summer-run group and a fall-run group. These investigators also reported that within the summer-run group, two major subdivisions were apparent, those of the lower river below rkm 800 and those of the mid-river (rkm 800-1,150). Wilmot et al. (1992) reported that estimated stock compositions of samples collected from District 1 commercial and test net fisheries during 1987 to 1990 indicated that the lower river summer-run chum salmon stocks contributed 75-100% to the catch until mid-July.

During the 1987 and 1988 field season, chum salmon genetic stock identification (GSI) collections were obtained at the mainstem Anvik River sonar site. Interestingly, these two collections were significantly different genetically (Wilmot et al. 1992). Although the collection obtained in 1987 was genetically similar to the lower river summer-run group, the collection obtained in 1988 was reported to be a separate group within the summer-run group and genetically distinct from the lower and mid-river groups (Wilmot et al. 1992). These investigators speculated that because the Anvik River is a large, productive river system that probably supports numerous spawning stocks, the mainstem collections at the sonar site in 1987 and 1988 most likely included different combinations of genetically distinct stocks. This apparent under-representation of Anvik River sub-populations in the genetic baseline data set was identified as one of the limitations of the study (Wilmot et al. 1992). More recent GSI studies on chum salmon tributary populations within the Anvik River indicate that there are genetically distinct populations within the Anvik River chum salmon stock (Crane et al. 1994).

Escapement Assessment

Accurate salmon escapement assessment on Yukon River tributaries is important for regulating fishery harvests, setting escapement goals, evaluating the effectiveness of management programs, and providing information for use in projecting subsequent returns. However, because of the vast size of the Yukon River drainage (853,000 km^2), low-level aerial surveys conducted from single-engine, fixed-wing aircraft have been used to provide indices of escapement for many spawning areas. Aerial survey estimates are only indices of abundance because the entire escapement is not present on the day of the survey and not all the fish present are seen and counted. Additionally, the quality of the survey estimate may vary because of weather and stream conditions, timing of the survey relative to spawning stage, number of other species of salmon present, and observer subjectivity and experience. Attempts to standardize the conditions under which these indices are conducted improves their usefulness in monitoring the relative abundance of spawning escapements.

Chinook salmon escapements to the major spawning areas in the Yukon River drainage have been estimated by aerial surveys from fixed-wing aircraft on a consistent basis since the early 1960s. Chum salmon escapements have been estimated from aerial surveys since the early 1970s. Escapement goals based on aerial surveys have been established for both chinook and chum salmon in selected tributary streams where a sufficient historical database exists (Schultz et al. 1993).

Comprehensive escapement assessment studies have been conducted on only a few selected spawning streams for each run of chum salmon in the Yukon River drainage. The Anvik River was chosen by ADF&G for summer chum salmon research studies in 1972 and the Andreafsky and Melozitna Rivers (Figure 1) in 1981. However, because of budget restrictions, the Melozitna River project was discontinued in 1984, and the Andreafsky River project was discontinued in 1989. During 1993, counting towers for chinook and summer chum salmon assessment were operated by Sport Fish Division on the Chena and Salcha Rivers in the Tanana River drainage. During the 1996 season, in addition to the Anvik River sonar project and the Chena and Salcha River counting-tower projects, the USFWS operated counting weirs on the East Fork Andreafsky River and Gisasa River. Additionally, counting towers were operated on Kaltag Creek (rkm 725), the mainstem Nulato River, and Clear Creek (rkm >1,255) of the Hogatza-Koyukuk River drainage. The Nulato River and Clear Creek counting-tower projects were funded and operated by the Tanana Chiefs Conference (TCC). The Kaltag counting-tower project was operated by the city of Kaltag and primarily funded by Alaska Cooperative Extension 4-H Program. Bering Sea Fishermen's Association (BSFA) provided partial funding.

Study Area

The Anvik River originates at an elevation of 400 m and flows in a southerly direction approximately 200 km to its mouth at rkm 512 of the Yukon River. It is a narrow runoff stream with a substrate mainly of gravel and cobble. However, bedrock is exposed in some of the upper reaches. The Yellow River (Figure 2) is a major tributary of the Anvik drainage and is located approximately 100 km upstream from the mouth of the Anvik River. Downstream from the confluence of the Yellow River, the Anvik River changes from a moderate gradient system to a low gradient system meandering through a much broader flood plain. Turbid waters from the Yellow River greatly reduce the water clarity of the Anvik River below their confluence. Numerous oxbows, old channel cutoffs, and sloughs are found throughout the lower Anvik River.

Anvik River salmon escapement was partially enumerated from two counting tower sites from 1972 to 1979 above the confluence of the Anvik and Yellow Rivers (Figure 2). A site 9 km above the Yellow River on the mainstem Anvik River was used from 1972 to 1975 (Lebida 1973; Trasky 1974, 1976; Mauney 1977). From 1976 to 1979 a site on the mainstem Anvik River near the confluence of Robinhood Creek and the Anvik River was used (Figure 2; Mauney 1979, 1980; Mauney and Geiger

1977). Other than 1974, aerial surveys were flown each year in fixed-wing aircraft to estimate salmon abundance below the tower site. High and turbid water often affected the accuracy of visual salmon enumeration from counting towers, as well as aerial surveys.

The Electrodynamics Division of the Bendix Corporation[2] developed a side-looking sonar device during the 1970s capable of estimating salmon abundance along the banks of streams. A pilot study using side-looking sonar to estimate chum salmon escapement to the Anvik River was conducted in 1979. Results of this study indicated that sonar estimation of chum salmon escapements to the Anvik River was superior to the counting tower method (Mauney and Buklis 1980). Therefore, in 1980, sonar replaced the tower counting method for estimating summer chum salmon escapement.

The Anvik River sonar site is located approximately 76 km upstream of the confluence of the Anvik and Yukon Rivers (Figure 2). Project results for escapement studies using sonar technology on the Anvik River from 1979 to 1995 have been reported by Mauney and Buklis (1980), Buklis (1981, 1982, 1983, 1984a, 1984b, 1985, 1986, 1987), and Sandone (1989, 1990a, 1990b, 1993, 1994a, 1994b, 1995). This report presents results of the Anvik River summer chum salmon escapement project for the 1996 field season.

Objectives

Because the majority of the subsistence harvest and some of the commercial summer chum salmon harvest occurs in the Yukon River drainage upstream from the mouth of the Anvik River, it is important to accurately assess the strength of the upriver run so that escapement and harvest needs can be met. In the past, the information derived from this project, in conjunction with Yukon River sonar passage estimates and subsistence and commercial harvests, has been used to assess the strength of the Yukon River summer chum salmon run above the mouth of the Anvik River. The timely and accurate reporting of information from the Anvik River sonar project is a critical component of Yukon River summer chum salmon management. The primary purpose of this project is to monitor the escapement of summer chum salmon to the Anvik River. The two primary objectives of this project are to:

1. estimate the daily summer chum salmon escapement passing the Anvik River sonar site; and

2. estimate the age and sex composition of the summer chum and chinook salmon spawning escapements.

[2]Use of a company's name does not constitute endorsement.

METHODS

Sonar Deployment and Operation

A sonar transceiver has been installed and operated on each bank of the Anvik River near Theodore Creek (Figure 2) each year since 1979. The sonar system operates by transmitting sound waves outward from shore along the river bed. Echoes from salmon passing through the sonar beam are reflected back to the transducer and filtered and processed in the transceiver. Echoes are counted and combined to estimate salmon abundance. Criteria for strength and frequency of the echoes are designed to estimate salmon passage and minimize debris counts. Aerial survey data indicate that summer chum salmon spawning activity is located primarily upstream of the sonar site.

During the 1996 season, a 1981-model sonar "counter" or transceiver was deployed and operated according to guidelines described by Bendix Corporation (1981) on each bank of the Anvik River to estimate summer chum salmon passage. Sonar was operated without the prescribed artificial aluminum substrate throughout the season. This practice of operation without an artificial substrate was first employed on the Anvik River in 1986 (Buklis 1986). The left (east) and right (west) bank sites used in previous years were probed to locate uniform river bottom gradients that would provide optimum linear surfaces for ensonification. Each sonar transducer was mounted on a rectangular aluminum frame. The aluminum frame was in turn mounted to a pipe configuration that easily allowed the transducer to be moved without affecting stability. Sandbags were placed on top of the pipe housing to ensure stability. Sonic waves from each transducer were aimed perpendicular to the current and transducers were offset to prevent interference (cross-talk) between opposite banks. To prevent fish passage inshore of the transducer, weirs constructed of T-stakes and rectangular mesh fencing were installed at a 45° angle from shore upstream towards mid-river and downstream of the transducer extending from shore to approximately 1 m beyond the transducer. Counting towers of aluminum scaffolding material approximately 3 m in height were placed upstream of the transducers on each bank for visual observation of salmon when water conditions permitted. Transducers, weirs, and counting towers were moved inshore or offshore, as required by fluctuating water levels. Consequently, depth at the transducer varied throughout the season.

Transducers were aimed and listening ranges adjusted so that echoes resulting from the stream bottom or surface interface did not register as counts by the sonar electronics. Sensitivity was adjusted to the highest setting without registering false counts. Sensitivity was measured in voltage from peak to peak.

The 1981-model counters used on the Anvik River sonar project divided the counting range into 16 sectors of equal length. Sector length was dependent on the length of the counting range. Sectors were consecutively numbered from the right (west) to left (east) bank. Therefore, sectors 1-16 were associated with the right bank counter, and sectors 17-32 were associated with the left bank counter. Sectors number 1 and 32 corresponded to the nearshore sectors of each bank.

The right bank transducer was located along a gradually sloping gravel bar approximately 100 m above the field camp site. Initial placement of the right bank transducer was approximately 13 m offshore in water about 0.6 m deep. Initial placement of the left bank transducer was approximately 13 m offshore at a depth of 0.5 m.

Sonar Calibration and Sampling

Each sonar transceiver was calibrated at least four times daily by observing fish passage using an oscilloscope. In this study and past studies using the Bendix system, the term calibrate refers to adjusting the ping rate to account for variable swimming speeds. Fish passing through the sonar beam produce a distinctive oscilloscope trace or spike. During each calibration period, the number of fish detected by an observer using an oscilloscope was compared to estimates recorded by the sonar electronics. The fish velocity control setting (pulse repetition rate) on the sonar counter was adjusted immediately after a calibration if the oscilloscope:sonar estimate ratio varied from 1.0 by 15% or more. The existing fish velocity setting was multiplied by this ratio to obtain a new setting. If adjustments were made to the sonar unit, the change was documented in the calibration log, and an additional calibration was made to ensure that the oscilloscope:sonar estimate ratio was within accepted limits and to initialize the counting period. Each calibration lasted for at least 15 minutes or until 100 fish were estimated by the observer, whichever came first.

Attempts were also made to visually count fish passage from 3 m counting towers during sonar calibration times as a further check on sonar accuracy and to train personnel in oscilloscope monitoring. Observers wore polaroid sunglasses to reduce water surface glare. Observation of fish passage was hampered by glare, which resulted from overcast skies and reflection of the sun off the water. On overcast days, observation of salmon passage was difficult. In future field seasons, the use of a white substrate would greatly enhance the visibility of fish. This substrate should be placed upstream of the transducer approximately 5 m to reduce the chance of affecting fish passage behavior through the beam. Additionally, a long float anchored perpendicular to the shore upstream of the beam would reduce glare by creating a 'slick' on the waters surface thereby improving visibility.

Four daily calibration times were deemed adequate to monitor the diel timing pattern of the salmon migration (Sandone 1996). Calibrations were normally conducted during 0600, 1200, 1800, and 2400 hours. Occasionally, calibration times deviated from prescribed times. Counting periods were defined by each calibration event. An adjustment factor, specific to each counting period and to each bank was calculated using the following formula:

$$A_{b,n} = \frac{(OC_{b,ts} + OC_{b,te})}{(SC_{b,ts} + SC_{b,te})}, \qquad 1$$

where A = periodic adjustment factor,
b = right or left bank,
n = counting period (0000-0600, 0600-1200, 1200-1800, and 1800-2400),
ts = time at start of counting period,
te = time at end of counting period,
OC = oscilloscope counts, and
SC = sonar counts.

Adjusted passage estimates were calculated by multiplying each periods adjustment factor by the unadjusted sonar estimates for each hour within the associated calibration period for each bank. The resulting corrected sonar estimates for each hour within a day were summed, yielding the estimated summer chum salmon passage for that day for that bank. Corrected hourly estimates were calculated and totaled for each day and bank using a desktop computer. The daily passage of salmon was determined by summing the daily bank estimates. Daily adjustment or correction factors for each bank and for both banks combined were calculated by dividing the daily corrected estimates by the raw sonar estimates. Raw sector estimates for each day were corrected by using the overall daily correction factor. Corrected hourly and sector estimates were used to determine the temporal and spatial distribution of the summer chum salmon run.

Sonar counters do not distinguish between species of salmon. A separate escapement estimate for chinook salmon was obtained by aerial survey. This estimate was not subtracted from the chum salmon sonar estimate because chinook salmon are so few relative to summer chum salmon abundance.

Similar to other even-numbered years, pink salmon in 1996 were observed beginning in early July. Observations from the counting towers were used to estimate chum and pink salmon proportions on a daily basis. Beginning July 1 when the first pink salmon was observed, at least two tower observations were conducted from each bank during each 24-hour period.

Hourly sector estimates that are lacking as a result of debris or printer malfunction were calculated by averaging sectors for the hour before and after the missing data. When hourly data were not recorded for more than 3 hours and less than 12 hours within one day, the corrected total daily estimate for that day was calculated by dividing the corrected partial daily value by the mean proportion of corrected estimates for the corresponding hours for the first day before and after the day in question having data for a full 24-hours. When hourly data were not recorded for 12 hours or more within a day, the passage for that day was calculated by averaging the daily estimates for the first day before and after the day in question having data for a full 24-hours. Counts were not distributed by hour and sector for periods of unrecorded hourly estimates which were calculated for a time period of greater than 2 hours. When conditions forced a suspension of counting operations on only one bank for more than one day, daily estimates were made using salmon passage on the opposite bank in conjunction with bank-specific passage proportion based on data one week prior to the suspension.

Age-Sex-Size Sampling

Temporal strata used to compare hourly and sector passage data were defined by the early, early middle, late middle and late strata for age-sex-size sampling goals. Each stratum was initially determined pre-season based on historical run timing data; they represent an attempt to sample the escapement for age-sex-size information in relative proportion to the total run. Strata were defined as: 15 June-3 July; 4-8 July; 9-13 July; and 14-27 July. These strata were not adjusted inseason.

A beach seine (31 m long, 66 meshes deep, 6.35-cm mesh) was set approximately 100 m above the sonar site to capture chum and chinook salmon for age, sex, and length measurements. All resident fresh-water fish captured were tallied by species and released. Chinook and pink salmon were counted by sex and released. Chum salmon were placed in a holding pen and each was noted for sex, measured in millimeters from mid-eye to fork-of-tail, and one scale was taken for age determination from each chum salmon. Where possible, 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 (Clutter and Whitesel 1956). The adipose fin was clipped on each sampled chum salmon to prevent resampling. Additionally, chinook salmon carcasses were sampled in August for sex, age, length, and scales for use in a stock identification study. Three scales were taken from each chinook salmon carcass sampled.

Sample size goals for each species were based on 95% precision with a 10% accuracy for each time stratum. A sample size of 144 ageable chum salmon scales per stratum (early, early middle, late middle, and late) was needed to describe the age composition of the chum salmon escapement by stratum (Bromaghin 1993). The sample size goal was increased to 160 per stratum to account for illegible scales. A sample size of 198 for the season (1 stratum) was needed to describe the age and sex composition of the chinook salmon escapement based on the number of expected age classes and an assumed 10% illegible rate. However, a sample size of 400 chinook salmon was deemed necessary for the scale pattern analysis baseline for the Anvik River chinook salmon stock (D. Schneiderhan, Alaska Department of Fish and Game, Anchorage, personal communication).

Hydrological and Climatological Sampling

A river bottom profile was determined by measuring at 3-m intervals from established headpins across the width of the river by probing with a pole marked in 1-cm increments. Because the left bank sonar site was initially situated approximately 3 m upriver from the right bank site, one transect situated between the sites served to describe the profiles.

Climatological data were collected at approximately 1800 hours each day at the campsite. Relative river depth was monitored by staff gauge marked in 0.01-ft increments. Change in water depth was converted to centimeters and presented as negative or positive increments from the initial reading of 0.0 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 in a log by the crew describing wind speed and direction, cloud cover, and precipitation.

RESULTS AND DISCUSSION

Escapement Estimation

Sonar Assessment

Two sonar systems were operated on the Anvik River from 18 June (the earliest start on record) through 17 July at the same sites used in previous years. A relatively small portion of the central river channel, approximately 7 m, was not ensonified on 20 June (Figure 3). Because of decreasing river water level (Figure 4) and, consequently, cross-sectional area throughout the season, the central river channel not ensonified decreased to 4 m on 18 July. The sonar beam width and height increases with distance from the transducer. The ensonified zone encompassed approximately the bottom one-half of the vertical water column within the counting range throughout operations.

The escapement estimate for the period 18 June through 17 July was 933,240 summer chum salmon (Table 1). Daily pink salmon estimates were substracted from daily total estimates to produce daily chum salmon estimates. Quartile passage days for the summer chum salmon run occurred on 25 June, 1 July, and 6 July (Figure 5). Based on historic timing statistics the 1996 chum run was evaluated as early and of shorter duration (Figure 6). All quartiles were 6-7 days earlier than the 1979-1995 average (Table 2). The duration of the mid-50% portion of the 1996 run lasted 11 days, which is one day more than the 1979-1995 average duration (Table 2). Daily summer chum salmon passage between the first and third quartile days ranged from 28,156 to 61,740 chum salmon.

In 1996, chum salmon passage was greatest during the 7 day period, 1-7 July. This peak passage period was contained within the mid-50% of the run and included the median day of passage, 1 July. During this 7 day period, 346,406 chum salmon, or 37% of the total season escapement, passed the sonar site. Chum salmon passage over the course of the 1996 season (Figure 5) had a broad, protracted entry with no distinguished peak. Summer chum salmon passage peaked on 24 June with 63,193 and then again on 5 July with 61,740 (Table 1). In most years, some salmon pass by the sonar site prior to and after the cessation of project operations. However, these numbers are probably small and thought to comprise only a small fraction of the total run.

Buklis (1982) expanded the season escapement estimates for 1972 through 1978, making it possible to compare visual estimates to more recent annual sonar estimates (Figure 7). Assuming an average brood year contribution of 4% age-3, 60% age-4, 35% age-5, and 1% age-6 summer chum salmon, the 1996 escapement estimate of 933,240 summer chum salmon was 19% greater than the weighted parent-year escapement of 571,006 fish from the years 1989-1992, and was 18% above the long-term (1972-1995) annual average of 792,445 fish.

A total of 38.3 h of sonar calibration were conducted from 18 June - 17 July at the right bank site. Right bank sonar accuracy (sonar estimate / oscilloscope estimate) averaged 1.03 (Table 3). Sonar accuracy averaged 0.99 for 28.1 h of oscilloscope calibration at the left bank site for the same period (Table 3).

Buklis (1982) first reported a distinct diurnal salmon migration pattern during the 1981 season with a higher proportion of the migration passing the sonar site during the evening hours. Similar diurnal patterns were reported from 1985 through 1993 (Buklis 1985, 1986, 1987; Sandone 1989, 1990a, 1990b, 1993, 1994a, 1994b, 1995). In 1996, temporal distribution of the right (Appendix A) and left (Appendix B) bank adjusted sonar estimates by hour also indicated a distinct diel pattern of salmon passage (Figure 8). Based upon adjusted estimates for days with full 24-hour data, salmon passage was lowest (less than 3.7% of the daily passage per hour) from 0800 to 1900 hours (averaging 3.0% of the daily passage per hour) and greatest (greater than or equal to 4.7% of the daily passage) from 2300-0600 (averaging 5.3% of the daily passage per hour). Chum salmon passage for the hours 0700 and 2000-2200 was intermediate, averaging 4.3% of the daily passage per hour. This pattern was relatively consistent throughout the season (Figure 9) and similar to the historical temporal distribution pattern of the migration.

Prior to 1996, in all but one year that sonar was used to estimate Anvik River summer chum salmon escapement, a majority of the escapement passage had been associated with the right bank (Mauney and Buklis 1980; Buklis 1981, 1982, 1983, 1984a, 1984b, 1985, 1986, 1987; Sandone 1989, 1990a, 1990b, 1993, 1994, 1994b, 1995). In 1992, only 43% of the total adjusted estimates were observed on the right bank (Sandone 1994a). This percentage was unlike the historical average, and was attributed to low water conditions which affected chum salmon migration patterns at the sonar site. In 1996, similar to 1992, only 45% of the total adjusted chum salmon estimates were observed on the right bank (Table 1). Again, low water conditions on the Anvik River in 1996 may be the cause for such a shift in migration patterns. The 1985-1995 average percent of adjusted chum salmon abundance estimates which migrated along the right bank is 70.7%.

As in previous years, it was assumed that only a small portion of the total summer chum salmon passage was not counted during sonar operations. This assumption is supported by the general absence of chum salmon passage in offshore sectors (Figure 8).

Combined fish passage along the right bank (Figure 8) was greatest in near-shore sector 2 with 16.7% of the passage (Appendix C). Sectors 1 through 3 accounted for 39.2% of the fish passage and 88.1% of the total right bank passage estimate. This distribution pattern along the right bank was similar to that observed in previous years (Sandone 1996). In 1996, combined fish passage along the left bank (Figure 8) exhibited the patterns observed prior to 1992 where near-shore sectors accounted for the majority of the passage along that bank (Appendix D). Fish passage in sectors 1-4 accounted for 43.3% of the total passage and 78.1% of the left bank passage (Figure 8). Estimated sector-specific fish passage in the offshore right-bank sectors 5-16 and left-bank sectors 17-25 was less than 1.0%. Total estimated passage in these offshore sectors was 4.9%. The 1996 season experienced low water conditions similar to 1992 and 1995, yet produced different salmon passage proportions by sector. Instead, the 1996 passage was more similar to years prior to 1992.

In many years, summer chum salmon proportionate passage along the left bank has increased during the season. This bank-oriented migrational shift was observed in 1990, 1991, 1993, and 1994 (Sandone 1990b; 1993, 1994b, 1995). During 1992 and 1995, however, the opposite shift was observed. The 1992 and 1995 summer chum migration shifted from a dominate left bank to right bank migration (Sandone 1994a). The shift away from a left bank migration was also evident in the 1996 migration. In 1996, left bank passage was highest on 24 June at 73.1%. From this point onward, there was a decreasing trend in left bank passage to a low of 37.1% on 17 July. This similarity with the 1992 migration may also be caused by the low water conditions experienced during both years.

Throughout the season, spatial fish passage along the left and right banks remained relatively constant, with passage in the first two inshore sectors dominating that in all other sectors (Figure 11). Apparent minor shifts in spatial migration patterns were probably caused by placement of the transducer relative to fluctuations in water levels, and not by a shift in the spatial migration pattern of the salmon.

Pink salmon were first observed on 1 July and then increased in abundance steadily until 11 July when numbers stabilized for the duration of the project (Figure 10). Because the sonar was removed from the site before pink salmon passage had terminated, it was not possible to estimate total pink salmon run size. Tower observations during the final three days of operation were hampered by rising water causing turbid conditions. On 18 July, when the site was dismantled, water conditions had improved allowing a valid tower observation for each bank. Thus, on the right bank, pink and chum salmon proportions were estimated for 16 and 17 July using estimates from 15 and 18 July. On the left bank, pink and chum salmon proportions were estimated for 15 - 17 July using estimates from 14 and 18 July.

Management Implications

Inseason Anvik River chum salmon passage estimates in conjunction with Yukon River test fishing indices played a major role in the management of the Upper Yukon Area fisheries in 1996. Based on these projects, a harvestable surplus of summer chum salmon was identified within the Anvik River drainage and above the Anvik-Yukon River confluence early in the season. However, because of a weak market for chum salmon flesh, the Lower Yukon Area summer chum salmon harvest was below the lower end of the guideline harvest range (JTC 1996). Salmon roe markets remained relatively stable, which resulted in summer chum salmon harvests at or above the upper end of the guideline harvest ranges in the Upper Yukon Area (JTC 1996). Because of the limited summer chum salmon harvest in the Lower Yukon Area, in conjunction with the large run of summer chum salmon, a large surplus of summer chum salmon were available for harvest in the Upper Yukon Area. Consequently, the sale of roe in Subdistrict 4-A and the Anvik River Management Area were allowed to approach the cap on chum salmon roe sales. Additionally, based on escapement data from the Anvik River sonar project and other escapement projects in the middle Yukon River area, the second largest harvest of chum salmon roe was allowed in Subdistricts 4-B and 4-C. Atypically large harvests of summer chum salmon occurred in Subdistricts 5-A, 5-B, and 5-C. The District 6 fishery was managed to a large degree on the results from counting tower projects on the Chena and Salcha Rivers.

In 1996, the Yukon River sonar project was operated only in training mode. Thus, comparisons of Yukon River passage estimates to Anvik River passage estimates were not possible. Spawning escapement objectives appeared to have been achieved throughout the Yukon River drainage for the second consecutive year. A tower count of 136,781 summer chum salmon on the mainstem Nulato River (Table 4) suggested that the 53,000 chum salmon aerial survey escapement goal for the North Fork Nulato River was probably achieved. A tower count of 101,016 summer chum salmon on Clear Creek of the Hogatza-Koyukuk River drainage indicated that the aerial survey escapement goal of 9,000 salmon was achieved. A tower count of 74,912 summer chum salmon on the Salcha River indicated that the aerial survey escapement goal of 3,500 was also achieved. An aerial survey of 27,090 of Clear and Caribou Creeks of the Hogatza River was greater than the escapement goal minimum of 17,000 fish. Tower and weir counts of escapements to other upper river tributaries, which do not have established escapement goals, indicated that summer chum salmon escapement was extremely good. Further, a weir count of 108,856 summer chum salmon on the East Fork of the Andreafsky River indicated that escapement to lower river tributaries was also good.

Aerial Survey Assessment

An aerial survey of the Anvik River on 22 July, conducted under good condition, resulted in a count of 709 chinook salmon within the mainstem escapement index area. This count exceeded the minimum aerial survey escapement goal for this area of 500 chinook by 42%. In the tributaries, however, only 130 additive chinook salmon were counted; thus the total survey count of 839 chinook fell short of the overall survey goal of 1,300. Summer chum salmon were observed but counts were not conducted on this species.

Age and Sex Composition

Summer Chum Salmon

Beach seine sets were made from 22 June to 16 July on 13 individual days. A total of 1,907 summer chum salmon were captured; 674 were sampled for age, sex, and length information (Appendix E). Stratum sampling sizes for summer chum salmon using pre-season strata (based on long-term averages) were 183, 174, 150, and 167 for the four sampling strata. Of those fish sampled for age determination, 172, 162, 130, and 151, respectively, had ageable scales. Therefore, the sampling goal of 144 ageable scales per stratum was achieved for the first, second and fourth strata. Overall, of the 674 chum salmon sampled for age-sex-size data, 91% had ageable scales. The 1996 percentage of ageable scales is slightly higher than the 90% expected.

Stratum sampling sizes for summer chum salmon using 1996 strata breakdown were 43, 90, 150, and 391 for the four sampling strata (Appendix E). Thus, because of the early arrival of chum salmon in 1996, sampling stratums 1 and 2 were under-represented whereas stratum 4 was substantially over represented.

Typically, the age and sex composition of the escapement passing the sonar site has varied through the duration of the run. As in other years since 1989, the same general pattern of an increasing proportion of younger, female salmon was observed during the 1996 run (Figure 12). In 1996, age-5 chum salmon dominated the first two strata (stratum based on 1996 breakdown), accounting for 83.3% and 56.5% of the passage, respectively. The third strata was equally dominated by age-4 and age-5 chum salmon at 48.9% each. Age-4 salmon dominated the final strata, accounting for 66.6% of the passage. Age composition of the escapement, weighted by strata escapement estimates, was 0.5% age-3, 55.4% age-4, 42.3% age-5, and 1.8% age-6 (Appendix F). The contribution of age-3, age-4, and age-5 salmon were similar to the 1972-1995 average contribution of these age groups at 3.0%, 58.3%, and 37.7%, respectively.

Although an average summer chum salmon run was expected for the Yukon River in 1996 (ADF&G 1996), the run developed better than anticipated. The difference between the projection and actual run size for the drainage appeared to be the unexpected production of summer chum salmon from tributaries other than the Anvik River and the unexpected production of both major brood years which contributed to the Anvik River run.

Age-4 chum salmon have dominated the Anvik River escapement in 17 of the 24 years of record. Age-5 chum salmon dominated the escapement in 1972, 1976, 1981, 1986, 1989, 1991, 1992, and 1994 (Figure 13). Age-5 chum salmon have dominated the escapement in 4 of the last 8 years. The average age of maturation has increased from 4.29 years (1972-1985 average) to 4.37 years (1972-1996 average; Figure 14). The average age of the Anvik River escapement for the years 1989-1996 is 4.52 years. Bigler and Helle (1994) documented shifts in both average size and age at maturity in Yukon River summer chum salmon. They explained their results by density dependent pressures reducing the food availability during periods of large population numbers of North Pacific salmon in the ocean. They further explained that reduced growth can delay the onset of the spawning migration, and hence, the apparent increase in the age of maturation.

In 1996, female chum salmon accounted for an estimated 47.3% of the escapement to the Anvik River. This is the second lowest percentage (only 1995 was lower) of female salmon observed in the Anvik River escapement since 1974. Females have contributed more than 50% to the summer chum salmon escapement every year since 1979 (other than 1995 and 1996) and for 20 of the 25 years of record (Appendix F). Overall, the female contribution has ranged from 39.1% in 1974 to 69.4% in 1982; the 1972-1995 mean percentage is 56.5%. In 1996, even with a commercial fishery in the lower portion of the Anvik River, which harvested only female chum salmon for roe production, the low female component percentage of the Anvik River escapement was unexpected. However, because the 1996 summer chum salmon run to the Anvik River was large, the number of females which escaped to spawn in 1996, approximately 441,000 chum salmon, was also large.

Similar to recent trends (Sandone 1990a, 1990b, 1993, 1994a, 1994b, 1995), the female component of the 1996 Anvik River escapement increased as the run progressed. In 1996, male chum salmon dominated the first two strata, and females dominated the final two strata (Figure 12).

The relationship between age class compositions of the Anvik River escapement and the District 1 summer chum salmon commercial harvest has been strong since 1982 (Figure 15). Similar to 1995, both escapement and harvest samples in 1996 contained few age-3 and age-6 salmon, the District 1 commercial harvest was dominated by age-5 salmon, and the Anvik River escapement was dominated by age-4 salmon. The preliminary, weighted age-class composition estimate of the 1996 District 1 summer chum salmon harvest was 0.0% age-3, 40.7% age-4, 55.0% age-5, and 4.3% age-6 (D. Schneiderhan, Alaska Department of Fish and Game, Anchorage, personal communication). Note that a smaller proportion of age-3 chum salmon were estimated to have been caught than were estimated in the escapement, while a larger proportion of age-6 fish were caught than were estimated in the escapement.

Typically, male salmon dominate the District 1 commercial harvest, whereas female salmon dominate the Anvik River escapement. In 1995 and 1996, however, male salmon dominated the Anvik River escapement and the District 1 harvest (Figure 16). Male salmon comprised 51.0% of the 1996 District 1 commercial harvest. Differences in age and sex compositions between the Anvik River escapement and the harvest can be attributed to other summer chum salmon stocks vulnerable to harvest, the selective nature of the gillnets used in the District 1 fishery, the disproportionate harvest over the duration of the summer chum salmon run, and sampling uncertainty.

Chinook Salmon

No chinook salmon were captured by beach seine at the Anvik River sonar site. However, 262 chinook salmon carcasses were sampled for age, sex, and length in August. Age composition was 9.9% age-4, 55.4% age-5, 24.4% age-6, 9.9% age-7, and 0.4% age-8 (Figure 17). Females accounted for 35.1% of the sample (Appendix G), less than the long-term average of 41.1% (1972-1995, excluding 1974 when no samples were obtained).

Age composition of the District 1 chinook salmon commercial harvest was approximately 1.2% age-4, 36.9% age-5, 37.5% age-6, 24.0% age-7, and 0.2% age-8. Females accounted for 53.2% of the harvest (D. Schneiderhan, Alaska Department of Fish and Game, Anchorage, personal communication). Typically, the relationship between District 1 commercial catch and Anvik River escapement age composition samples of chinook salmon are moderate (Pearson correlation coefficients between 0.56 and 0.80; Figure 18). Anvik River escapement has typically been composed of younger-aged chinook salmon than the District 1 commercial harvest (Figure 18). This difference was also observed in 1996. As in other years, age-6 chinook salmon contributed a higher proportion to the commercial fishery than to the Anvik River escapement, while age-4 and age-5 chinook salmon contributed more to the escapement than to the commercial harvest.

Hydrologic and Climatological Sampling

River transect data collected on 20 June and 8 July indicates that the bottom gradient was relatively smooth on both banks and free of major obstructions to the sonar beam (Figure 3). River width data collected in conjunction with the transect profiles varied from approximately 57 m on 20 June to 52 m on 8 July. Maximum depth, and probably maximum river width, occurred on 27 June (Appendix H). From that time, similar to most previous years, river water level tended to decrease in a consistent manner throughout the season. The only rain events to have substantial impacts on water level occurred on 26 and 27 June when continuous heavy rain caused the river water level to rise (Figure 4). During the season, the water level varied a total of 36.0 cm (Figure 4; Appendix H).

Instantaneous water temperature ranged from a low of 12° C recorded on 16 July, to a high of 18° C recorded on 3 days, 7, 9, and 10 July. Daily minimum and maximum air temperatures ranged from a minimum low of 3° C, observed on 29 June, to a maximum high of 24° C, recorded on 4 days, 24 June, 4, 5, and 8 July (Figure 4; Appendix H).

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TABLES

Table 1. Anvik River chum salmon estimates by day, 18 June to 17 July, 1996.

	West Bank				East Bank				Entire River		
Date	Raw Daily Estimate [a]	Adjust Factor [a]	Corrected Daily Estimate [a]	Percent of Daily Total	Raw Daily Estimate [a]	Adjust Factor [a]	Corrected Daily Estimate [a]	Percent of Daily Total	Raw Daily Estimate [a]	Corrected Daily Estimate [a]	Corrected Season Estimate [a]
18-Jun [b]	10,853	0.93	10,102	98.9%	187	0.59	111	1.1%	11,040	10,213	10,213
19-Jun	3,181	0.94	3,034	65.7%	1,706	0.93	1,581	34.3%	4,887	4,615	14,828
20-Jun	8,061	1.11	8,975	53.3%	8,069	0.97	7,861	46.7%	16,130	16,836	31,664
21-Jun	27,317	0.95	25,822	59.3%	17,956	0.99	17,743	40.7%	45,273	43,565	75,229
22-Jun	15,799	0.96	15,188	44.3%	18,688	1.02	19,069	55.7%	34,487	34,257	109,486
23-Jun	20,857	0.87	18,174	36.3%	34,067	0.93	31,826	63.7%	54,924	50,000	159,486
24-Jun	17,963	0.95	16,989	26.9%	45,393	1.02	46,204	73.1%	63,356	63,193	222,679
25-Jun	13,747	0.95	13,025	46.3%	15,101	1.00	15,131	53.7%	28,848	28,156	250,835
26-Jun	17,358	1.00	17,345	49.1%	17,990	0.98	17,958	50.9%	35,348	35,303	286,138
27-Jun	19,207	1.15	22,070	47.6%	24,910	0.98	24,320	52.4%	44,117	46,390	332,528
28-Jun	16,017	1.00	15,981	46.5%	18,464	1.00	18,367	53.5%	34,481	34,348	366,876
29-Jun	14,677	0.99	14,594	44.1%	21,203	0.87	18,521	55.9%	35,880	33,115	399,991
30-Jun	22,005	0.69	15,244	33.2%	18,859	1.63	30,692	66.8%	40,864	45,936	445,927
1-Jul	26,696	0.85	23,313	39.9%	33,099	1.06	35,146	60.1%	59,795	58,459	504,386
2-Jul	25,199	1.04	25,896	46.9%	30,712	0.96	29,315	53.1%	55,911	55,211	559,597
3-Jul	17,859	0.89	15,334	39.0%	23,165	1.06	24,001	61.0%	41,024	39,335	598,932
4-Jul	18,877	1.03	19,076	43.2%	25,700	1.01	25,036	56.8%	44,577	44,112	643,044
5-Jul	25,869	1.00	25,697	41.6%	35,970	1.03	36,043	58.4%	61,839	61,740	704,784
6-Jul	19,624	0.91	17,471	45.4%	19,985	1.08	21,011	54.6%	39,609	38,482	743,266
7-Jul	24,166	0.94	21,783	44.4%	26,796	1.03	27,284	55.6%	50,962	49,067	792,333
8-Jul	16,087	0.96	14,134	41.3%	21,250	1.08	20,087	58.7%	37,337	34,221	826,554
9-Jul	13,371	0.97	11,262	48.6%	13,793	1.09	11,932	51.4%	27,164	23,194	849,748
10-Jul	10,803	1.00	8,216	45.4%	11,760	1.07	9,877	54.6%	22,563	18,093	867,841
11-Jul	10,758	0.97	5,899	55.8%	7,904	1.05	4,680	44.2%	18,662	10,579	878,420
12-Jul	10,763	1.04	6,959	53.4%	9,964	0.97	6,079	46.6%	20,727	13,038	891,458
13-Jul	14,040	0.98	7,727	60.0%	10,024	1.03	5,144	40.0%	24,064	12,871	904,329
14-Jul	9,350	0.99	5,763	57.2%	7,634	1.10	4,314	42.8%	16,984	10,077	914,406
15-Jul	7,180	0.91	3,508	47.3%	7,926	0.97	3,903	52.7%	15,106	7,411	921,817
16-Jul	11,433	0.78	4,064	56.7%	6,572	1.07	3,109	43.3%	18,005	7,173	928,990
17-Jul	7,750	0.92	2,672	62.9%	3,783	1.11	1,578	37.1%	11,533	4,250	933,240
Total	476,867		415,317		538,630		517923		1,015,497	933,240	
Percent [c]	46.96%		44.50%		53.04%		55.50%		100%	100%	
Mean		0.96				1.02					

[a] Includes estimates for missing hourly and daily counts. Missing data were estimated.

[b] Operations were initiated at 0000 on the west bank and 1700 on the east bank.

[c] Percent of the entire river estimates.

Table 2. Annual Anvik River sonar passage estimates and associated passage timing statistics of the summer chum salmon run, 1979-1996.

Year	Sonar Passage Estimate	First Day of Salmon Counts	First Quartile Day	Median Day	Third Quartile Day	Days Between Quartiles First & Median	Median & Third	First & Third
1979	277,712	23-Jun	2-Jul	8-Jul	12-Jul	6	4	10
1980	482,181	28-Jun	6-Jul	11-Jul	16-Jul	5	5	10
1981	1,479,582	20-Jun	27-Jun	2-Jul	7-Jul	5	5	10
1982	444,581	25-Jun	7-Jul	11-Jul	14-Jul	4	3	7
1983	362,912	21-Jun	30-Jun	7-Jul	12-Jul	7	5	12
1984	891,028	22-Jun	5-Jul	9-Jul	13-Jul	4	4	8
1985	1,080,243	5-Jul	10-Jul	13-Jul	16-Jul	3	3	6
1986	1,085,750	21-Jun	29-Jun	2-Jul	6-Jul	3	4	7
1987	455,876	21-Jun	5-Jul	12-Jul	16-Jul	7	4	11
1988	1,125,449	21-Jun	30-Jun	3-Jul	9-Jul	3	6	9
1989	636,906	20-Jun	1-Jul	7-Jul	13-Jul	6	6	12
1990	403,627	22-Jun	2-Jul	7-Jul	15-Jul	5	8	13
1991	847,772	21-Jun	1-Jul	10-Jul	16-Jul	9	6	15
1992	775,626	29-Jun	5-Jul	8-Jul	12-Jul	3	4	7
1993	517,409	19-Jun	5-Jul	12-Jul	18-Jul	7	6	13
1994	1,124,689	19-Jun	1-Jul	7-Jul	11-Jul	6	4	10
1995	1,339,418	19-Jun	1-Jul	6-Jul	11-Jul	5	5	10
1996	933,240	18-Jun	25-Jun	1-Jul	6-Jul	6	5	11
Mean [a]	792,445 [b]	22-Jun	2-Jul	7-Jul	12-Jul	5.4	4.9	10.2
SE [a]	361,807 [b]	4.3	3.7	3.5	3.3	1.7	1.3	2.4

[a] The mean and standard error of the timing statistics includes estimates from years 1979-1985 and 1987-1994. In 1986, sonar counting operations were terminated early, probably resulting in the incorrect calculation of the quartile statistics. Therefore, the 1986 run timing statistics were excluded from the calculation of the overall mean and timing statistic and associated SE.

[b] Includes 1986 passage data.

Table 3. Sonar and corresponding oscilloscope estimates of salmon passage at the Anvik River, 1996.

	West Bank				East Bank			
Date	Elapsed Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope	Elapsed Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope
18-Jun	1:38	352	336	1.05	16	22	13	1.69
19-Jun	1:17	94	90	1.04	74	126	117	1.08
20-Jun	2:18	283	287	0.99	71	219	205	1.07
21-Jun	0:59	611	581	1.05	114	456	434	1.05
22-Jun	1:26	474	463	1.02	86	420	420	1.00
23-Jun	1:01	660	648	1.02	55	587	545	1.08
24-Jun	1:00	733	705	1.04	19	500	510	0.98
25-Jun	1:06	550	538	1.02	55	375	371	1.01
26-Jun	1:24	633	620	1.02	52	306	299	1.02
27-Jun	1:15	569	657	0.87	12	323	306	1.06
28-Jun	1:06	526	551	0.95	52	697	682	1.02
29-Jun	1:01	671	672	1.00	39	706	603	1.17
30-Jun	1:16	613	455	1.35	77	521	487	1.07
1-Jul	0:59	771	766	1.01	41	678	720	0.94
2-Jul	0:42	763	802	0.95	30	527	511	1.03
3-Jul	1:08	662	620	1.07	34	478	503	0.95
4-Jul	1:17	646	689	0.94	60	610	628	0.97
5-Jul	0:54	695	723	0.96	33	596	616	0.97
6-Jul	1:13	743	670	1.11	50	563	601	0.94
7-Jul	1:02	587	550	1.07	27	482	500	0.96
8-Jul	0:57	637	614	1.04	49	455	488	0.93
9-Jul	1:01	612	609	1.00	53	423	461	0.92
10-Jul	1:16	545	542	1.01	61	454	502	0.90
11-Jul	1:10	488	465	1.05	83	483	517	0.93
12-Jul	1:25	618	660	0.94	58	489	467	1.05
13-Jul	0:58	518	501	1.03	64	431	441	0.98
14-Jul	1:16	550	540	1.02	83	381	423	0.90
15-Jul	1:44	558	511	1.09	87	481	464	1.04
16-Jul	1:59	700	541	1.29	75	352	374	0.94
17-Jul	2:30	439	391	1.12	76	225	249	0.90
Total	38:18	17,301	16,797	1.03	28:06	13,366	13,457	0.99
Mean				1.04				1.02

Table 4. Summer chum salmon escapement estimates for selected spawning areas in the Alaskan portion of the Yukon River drainage, 1973-1996.

Year	Andreafsky River East Fork Aerial [a]	Andreafsky River East Fork Sonar, Tower, or Weir Cnts	Andreafsky River West Fork [a]	Anvik River Tower & Aerial [b]	Anvik River Sonar	Rodo River [a]	Kaltag Cr. Tower Counts	Nulato River Aerial South Fork	Nulato River Aerial North Fork [c]	Nulato River Mainstem Tower Counts	Gisasa River Aerial	Gisasa River Weir	Hogatza River Clear & Caribou Cr. Aerial	Hogatza River Clear Cr. Tower Counts	Tozitna River [a]	Chena River Aerial	Chena River Tower	Salcha River Aerial	Salcha River Tower
1973	10,149 [d]		51,835	249,015												79 [d]		290	
1974	3,215 [d]		33,578	411,133		16,137		29,016	29,334		22,022				1,823	4,349		3,510	
1975	223,485		235,954	900,967		25,335		51,215	87,280		56,904		22,355		3,512	1,670		7,573	
1976	105,347		118,420	511,475		38,258		9,230 [d]	30,771		21,342		20,744		725 [d]	685		6,484	
1977	112,722		63,120	358,771		16,118		11,385	58,275		2,204 [d]		10,734		761 [d]	610		677 [d]	
1978	127,050		57,321	307,270		17,845		12,821	41,659		9,280 [d]		5,102		2,262	1,609		5,405	
1979	66,471		43,391		280,537			1,506	35,598		10,962		14,221			1,025 [d]		3,060	
1980	36,823 [d]		114,759		492,676			3,702 [d]	11,244 [d]		10,388		19,786		580	338		4,140	
1981	81,555	147,312 [f]			1,486,182			14,348								3,500		8,500	
1982	7,501 [d]	181,352 [f]	7,267 [d]		444,581						334 [d]		4,984 [d]		874	1,509		3,756	
1983		110,608 [f]			362,912			1,263 [d]	19,749		2,356 [d]		28,141		1,604	1,097		716 [d]	
1984	95,200 [d]	70,125 [f]	238,565		891,028								184 [d]			1,861		9,810	
1985	66,146		52,750		1,080,243	24,576		10,494	19,344		13,232		22,566		1,030	1,005		3,178	
1986	83,931	167,614 [g]	99,373		1,189,602			16,848	47,417		12,114				1,778	1,509		8,028	
1987	6,687 [d]	45,221 [g]	35,535		455,876			4,094	7,163		2,123		5,669 [d]			333		3,657	
1988	43,056	68,937 [g]	45,432		1,125,449	13,872		15,132	26,951		9,284		6,890		2,983	432		2,889 [d]	
1989	21,460 [d]				636,906											714 [d]		1,574 [d]	
1990	11,519 [d]		20,426 [d]		403,627	1,941 [d]		3,196 [d, h]	1,419 [d]		450 [d]		2,177 [d]		36	245 [d]		450 [d]	
1991	31,886		46,657		847,772	3,977		13,150	12,491		7,003		9,947		93	115 [d]		154 [d]	
1992	11,308 [d]		37,808 [d]		775,626	4,465		5,322	12,358		9,300		2,986		794	848 [d]		3,222	
1993	10,935 [d]		9,111 [d]		517,409	7,867		5,486	7,698		1,581				970	168	5,487	212	5,563
1994		200,981 [j, k]			1,124,689		47,295			148,762 [m]	6,827	51,116 [n]	8,247 [o]			1,137	9,984	4,916	39,450
1995		172,148 [j, p]			1,339,418	12,849	77,193	10,875	29,949	236,890	6,458	136,886		116,735	4,985	185 [d]	3,473 [q]	934 [d]	31,329
1996 [w]		108,856 [j]			933,240	4,380	51,284	8,490		136,781		157,459	27,090 [o]	101,016	2,310	2,061	12,162	9,722	74,912
E.O. [r]	>109,000		>116,000		>500,000 [s]				>53,000 [t]				>17,000 [v]					>3,500	

[a] Data obtained by aerial survey unless otherwise noted. Only peak counts are listed. Latest table revision :December 12, 1996

[b] From 1972-1979 counting tower operated; escapement estimate listed is the tower counts plus expanded aerial survey counts below the tower (see Buklis 1982).

[c] Includes mainstem counts below the confluence of the North and South Forks, unless otherwise noted.

[d] Incomplete survey and/or poor survey timing or conditions resulted in minimal or inaccurate count.

[f] Sonar count.

[g] Tower count.

[h] Mainstem counts below the confluence of the North and South Forks Nulato River included in the South Fork counts.

[j] Weir Count

[k] Weir installed on June 29. First full day of counts occurred on June 30.

[m] Tower counts delayed until June 29 because of high, turbid water. First full day of counts occurred on June 30.

[n] Weir installed on July 11. First full day of counts occurred on July 12.

[o] BLM helicopter survey.

[p] Weir operated from June 16 - September 12. Passage of chum salmon from August 1 - September 12 was 2,584 fish.

[q] Tower operations were severly hampered because of high, turbid water which prohibited observations from the tower. Tower operated during the periods July 10 - 15 and from July 19 - 30, 1995.

[r] Interim escapement objective.

[s] The Anvik River Escapement Objective was rounded upward to 500,000 from 487,000 in March, 1992.

[t] Interim escapement objective for North Fork Nulato River only.

[v] Consists of Clear and Caribou Creeks interim escapement objectives of 9,000 and 8,000, respectively.

[w] Preliminary.

FIGURES

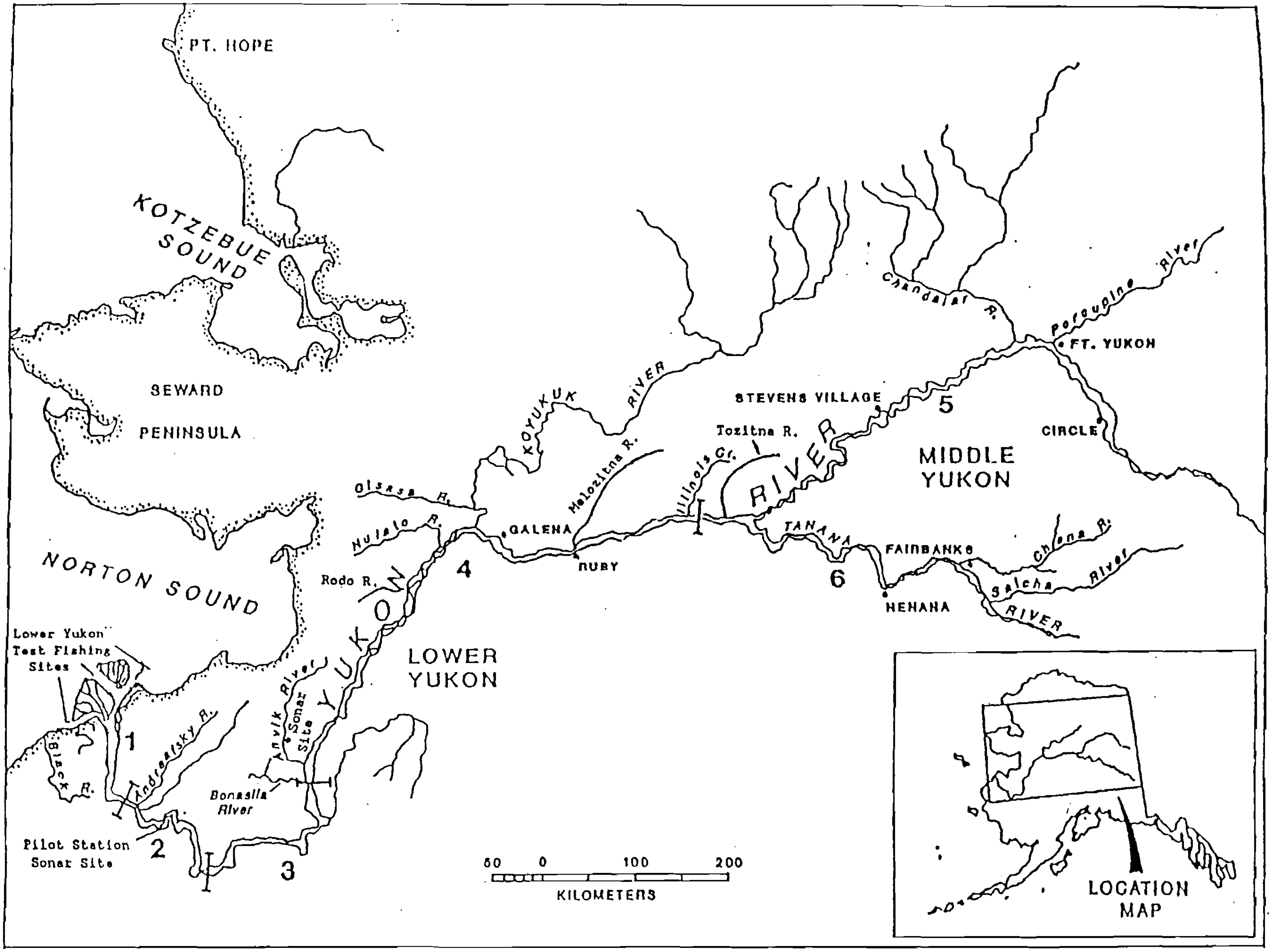

Figure 1. Alaskan portion of the Yukon River showing fishing district boundaries.

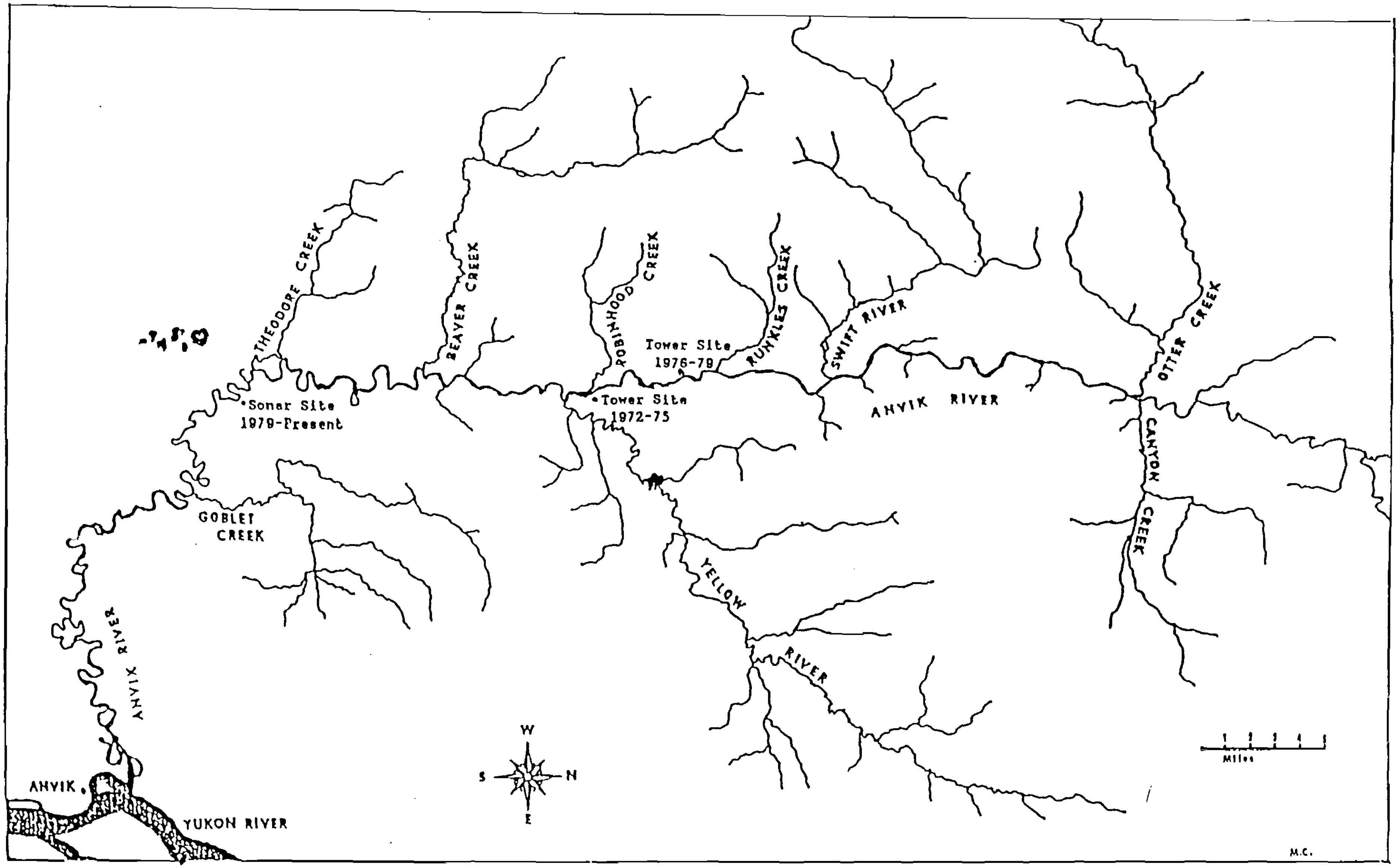

Figure 2. Map of the Anvik River drainage.

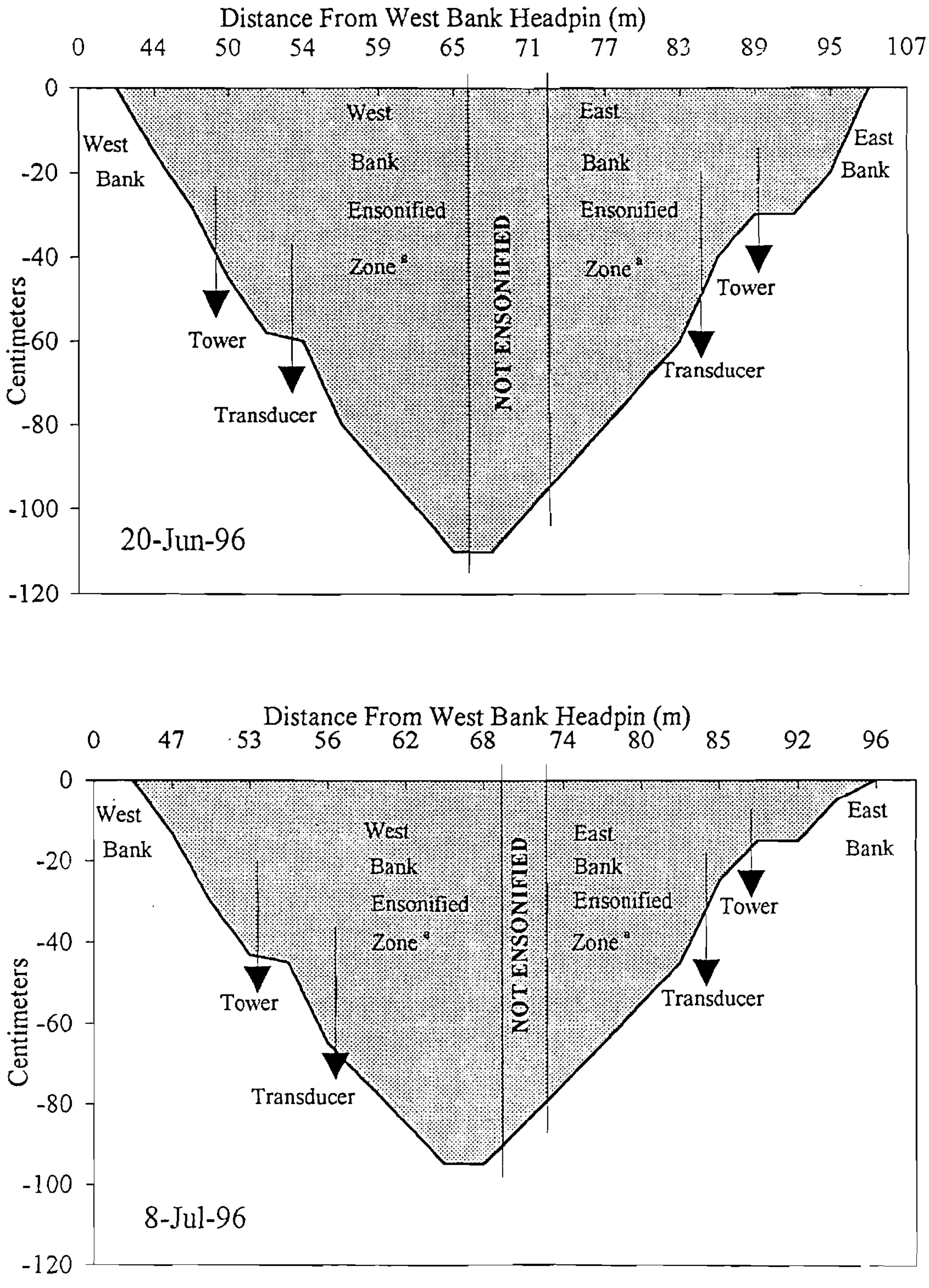

Figure 3. Anvik River depth profiles, 20 June and 8 July, 1996.

[a] This zone is only an approximation of the changing ensonification zones that occurred throughout the season.

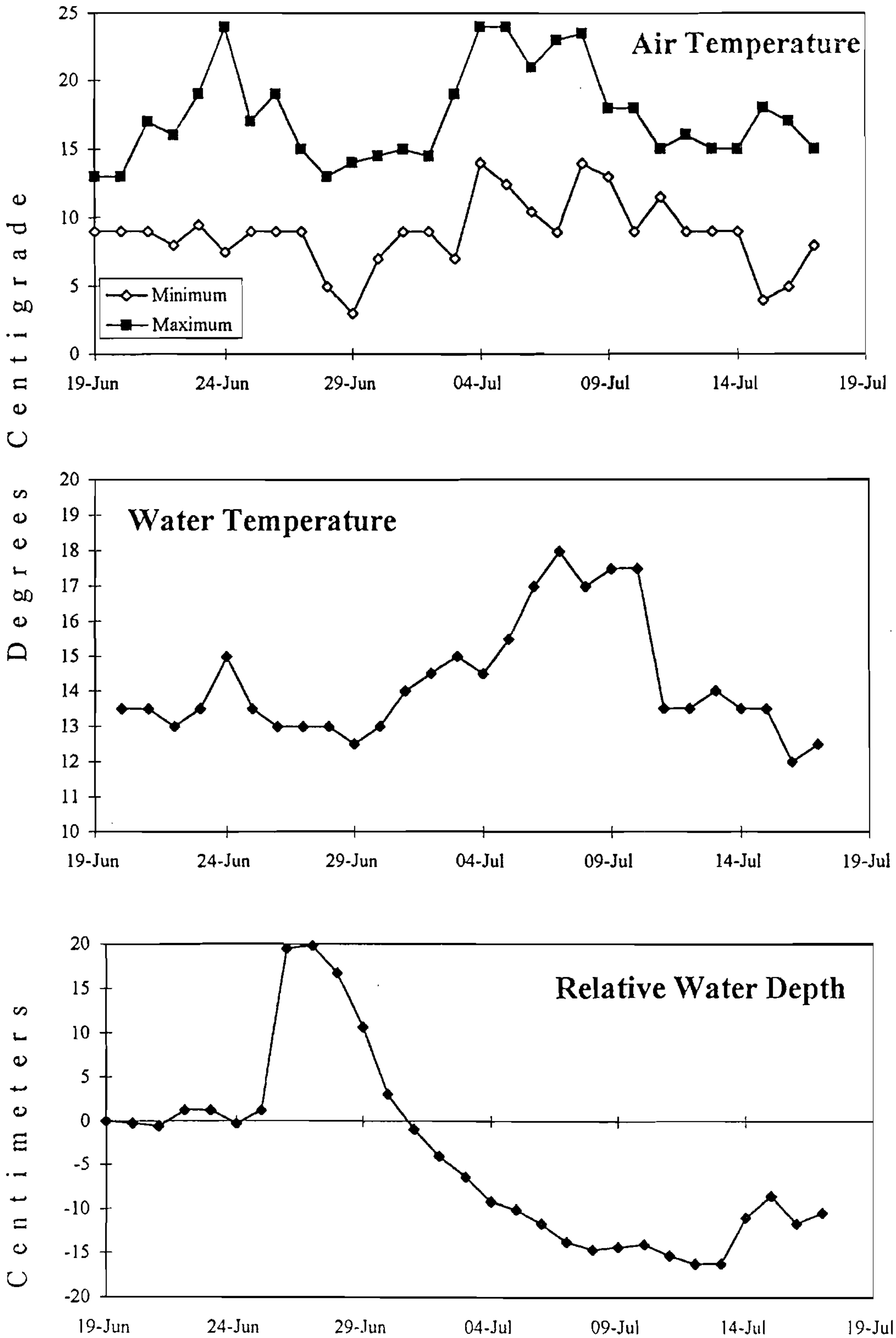

Figure 4. Daily minimum and maximum air temperatures, water temperature, and relative water depth at the Anvik River sonar site, 1996.

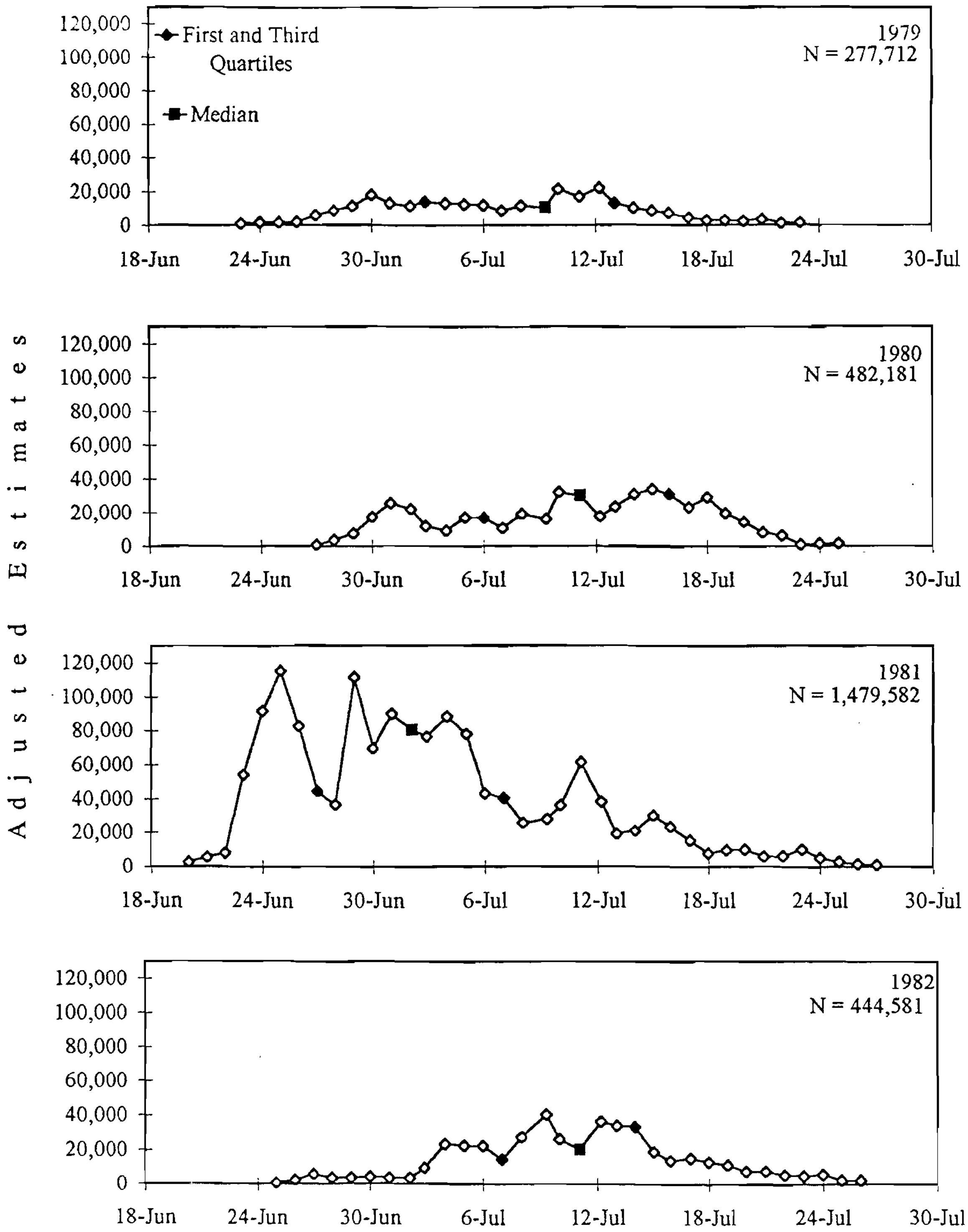

Figure 5. Daily Anvik River adjusted chum salmon estimates by day, 1979-1996 (N = total number of corrected estimates).

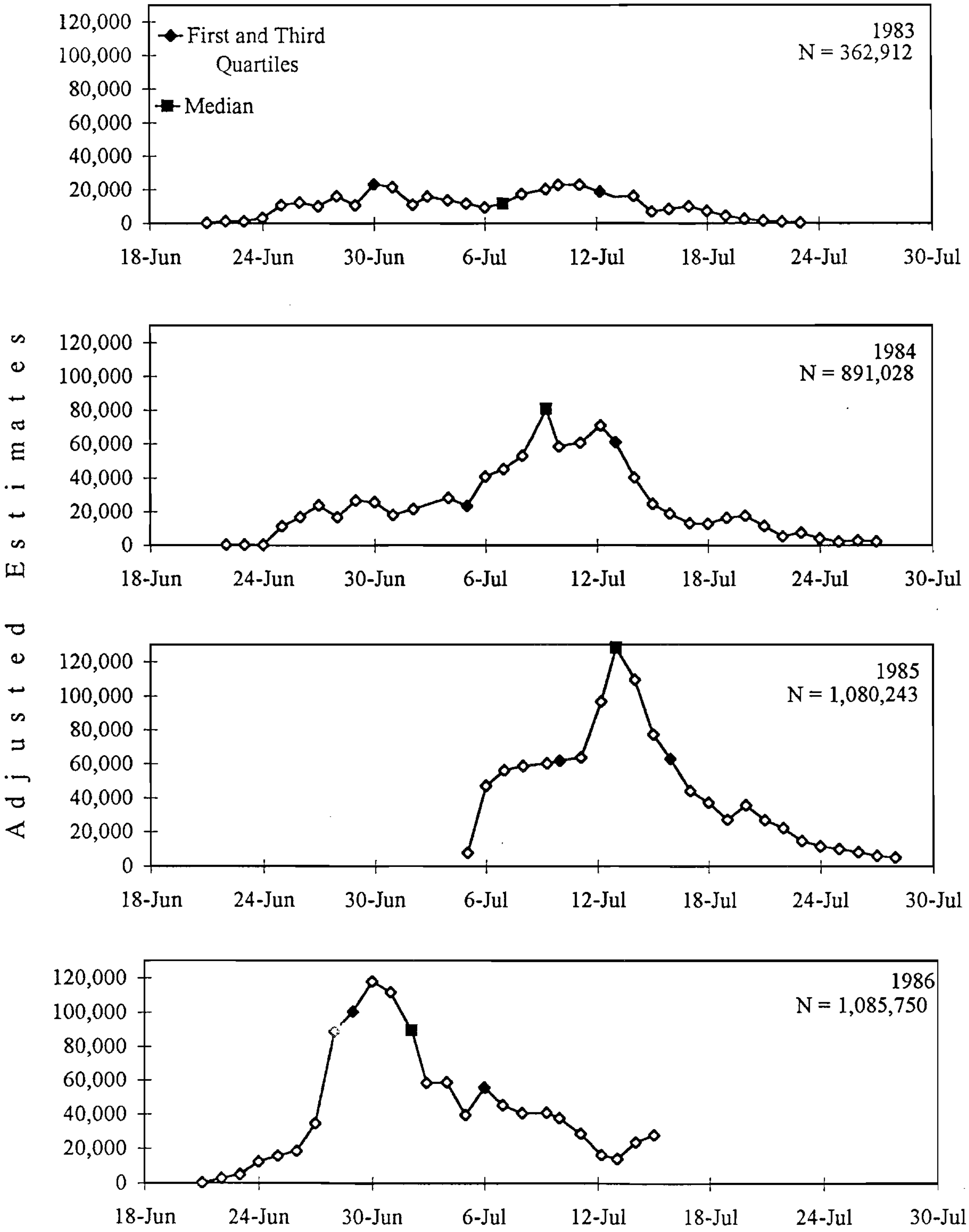

Figure 5. (page 2 of 5).

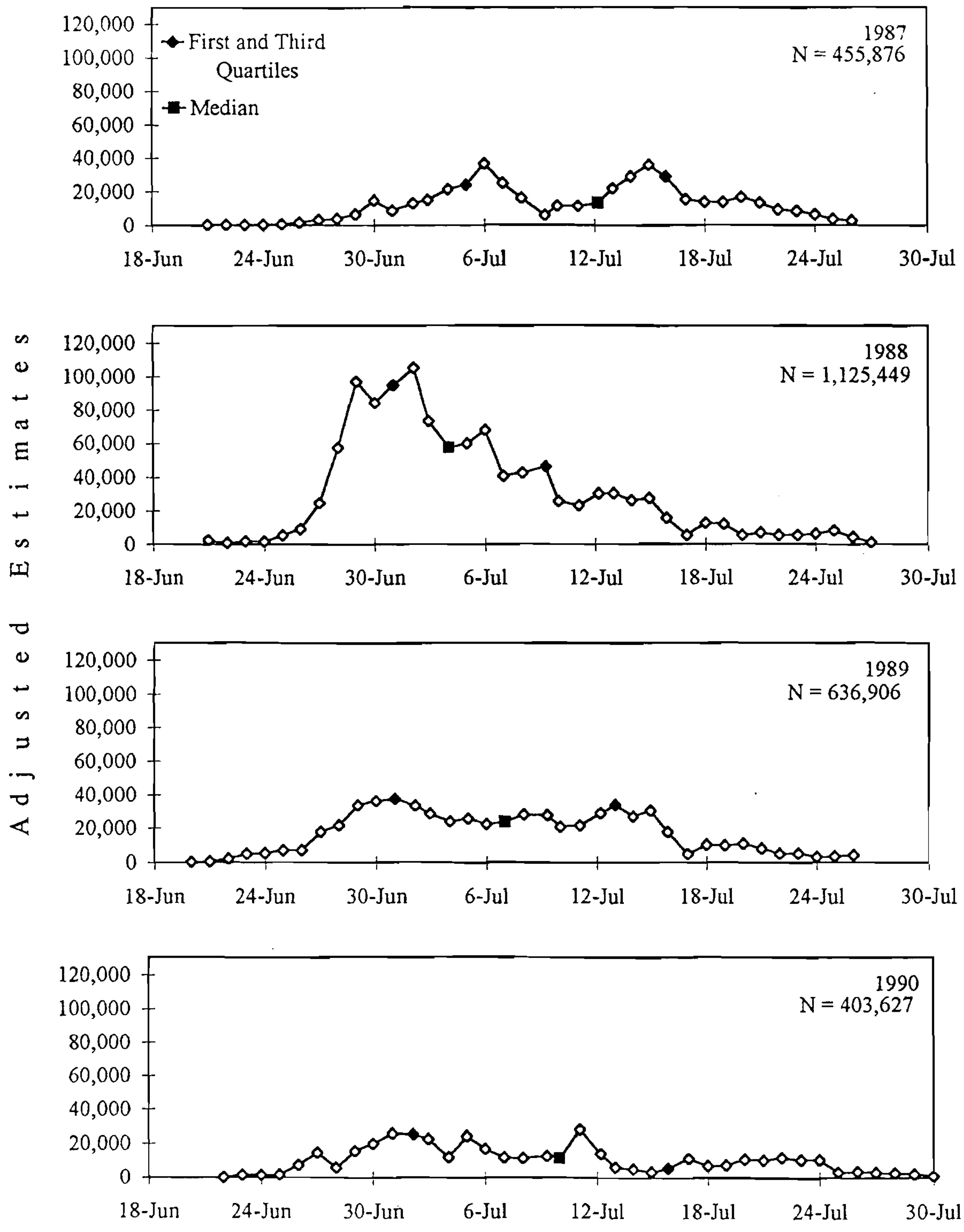

Figure 5. (page 3 of 5).

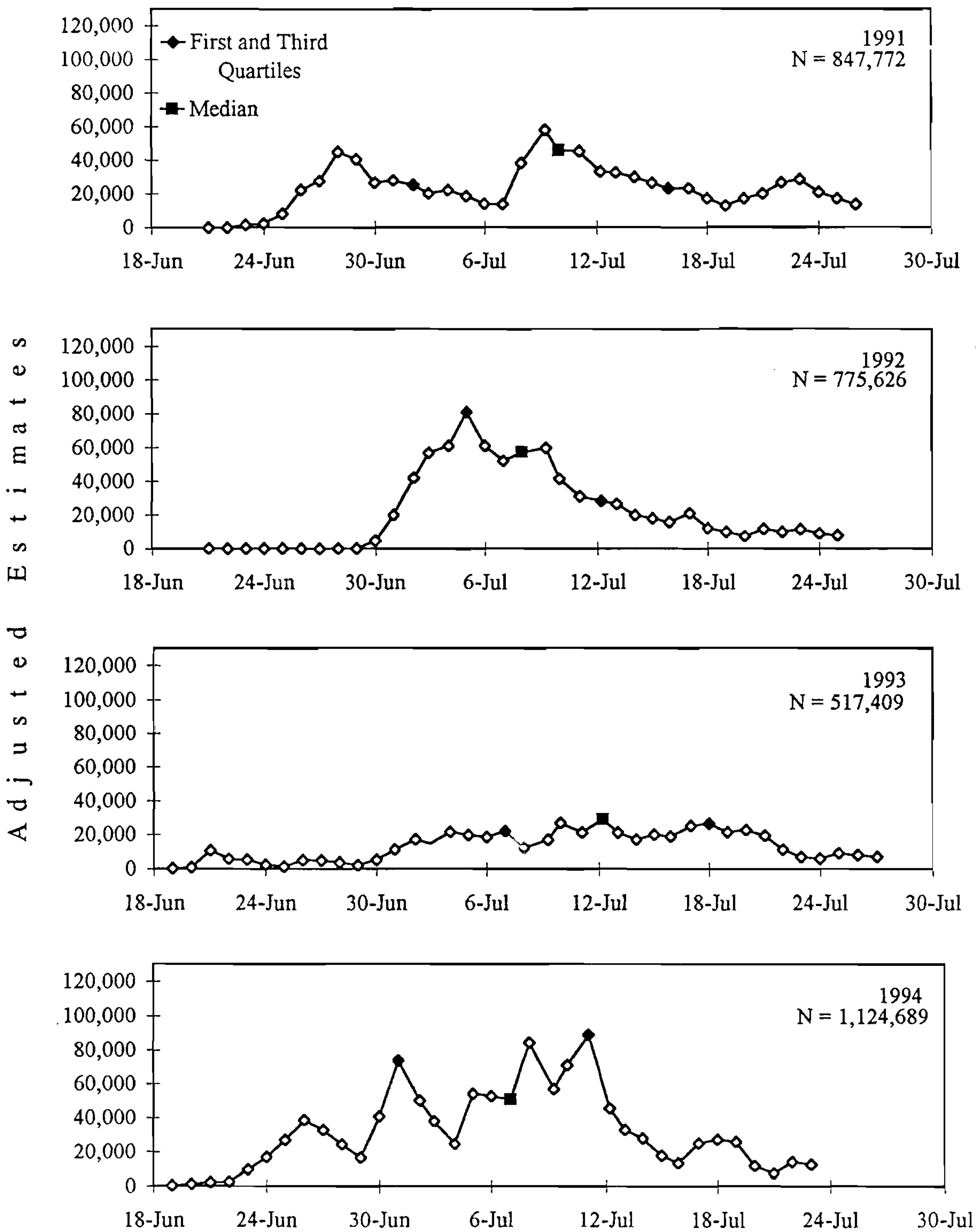

Figure 5. (page 4 of 5).

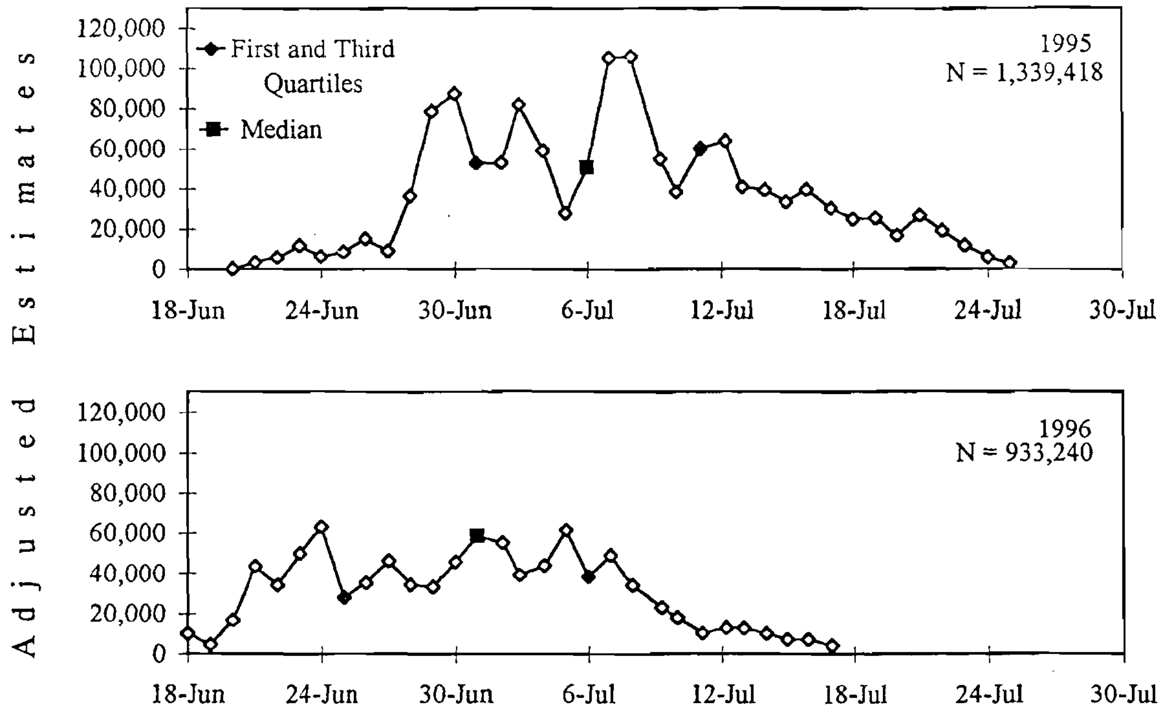

Figure 5. (page 5 of 5).

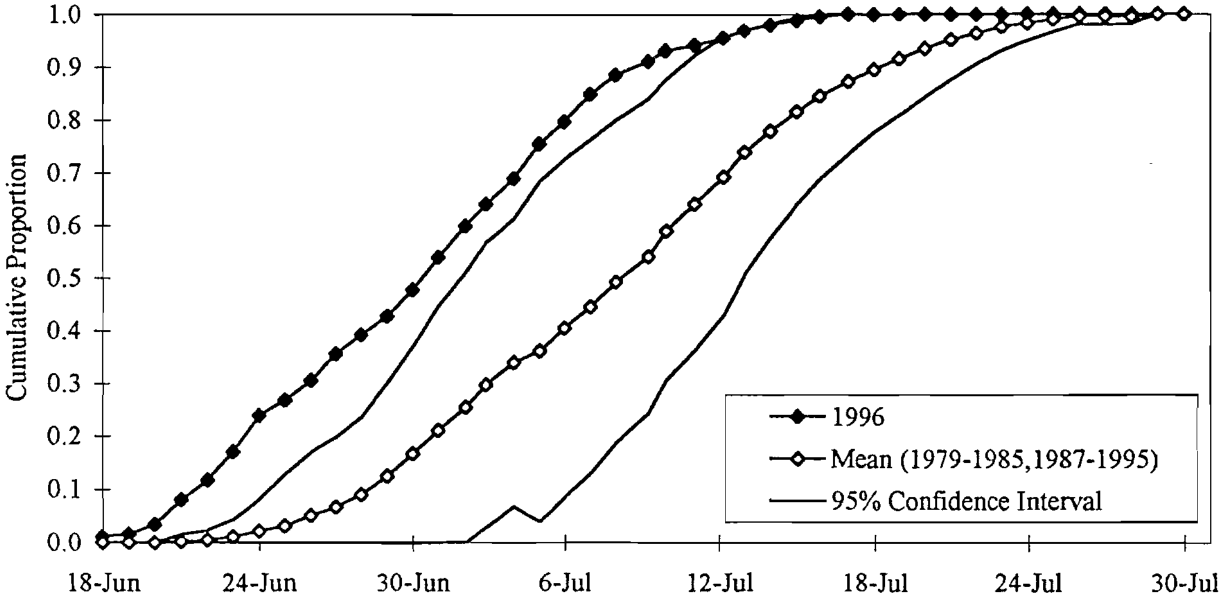

Figure 6. 1996 run timing curve compared to the mean (1979-1985 and 1987-1995) for Anvik River summer chum salmon.

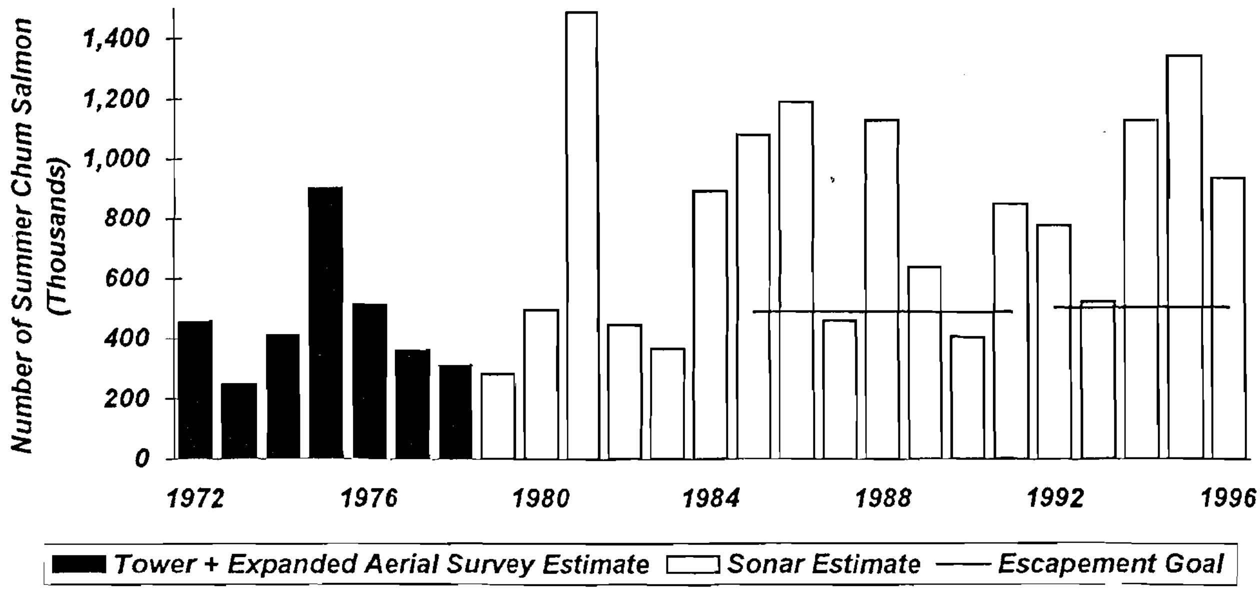

Figure 7. Anvik River summer chum salmon escapement estimated by combined tower and expanded aerial survey count, 1972-1978, and by sonar, 1979-1996.

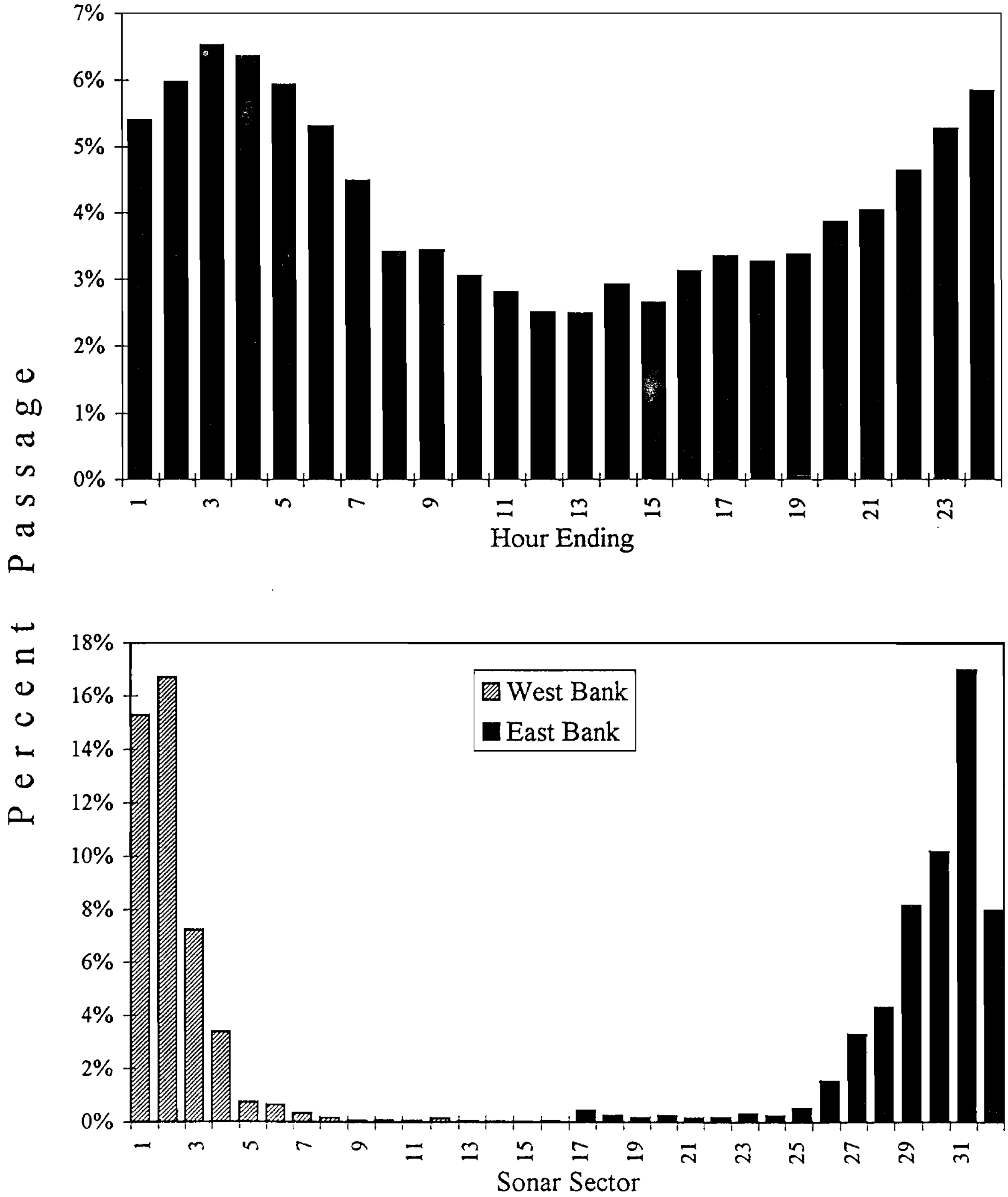

Figure 8. Estimated percent of corrected sonar estimates in relation to hour of the day (above) and sonar sector (below), Anvik River, 1996. Note that only days with full 24-hour estimates were used.

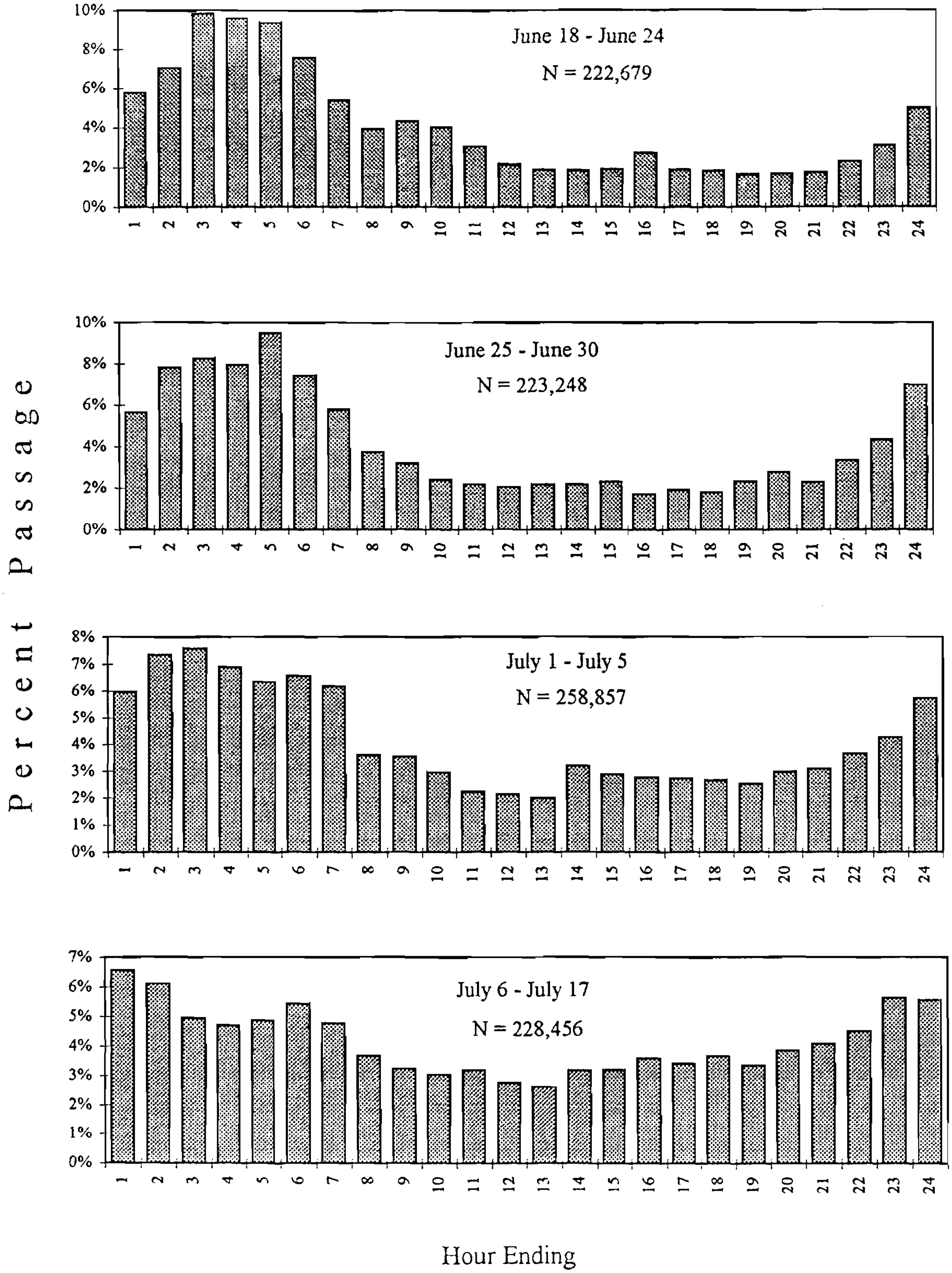

Figure 9. Estimated percent of corrected sonar estimates by temporal sampling statum (based on 1996 stratum breakdown) and hour of the day, Anvik River, 1996. Note that only days with full 24-hour estimates were used.

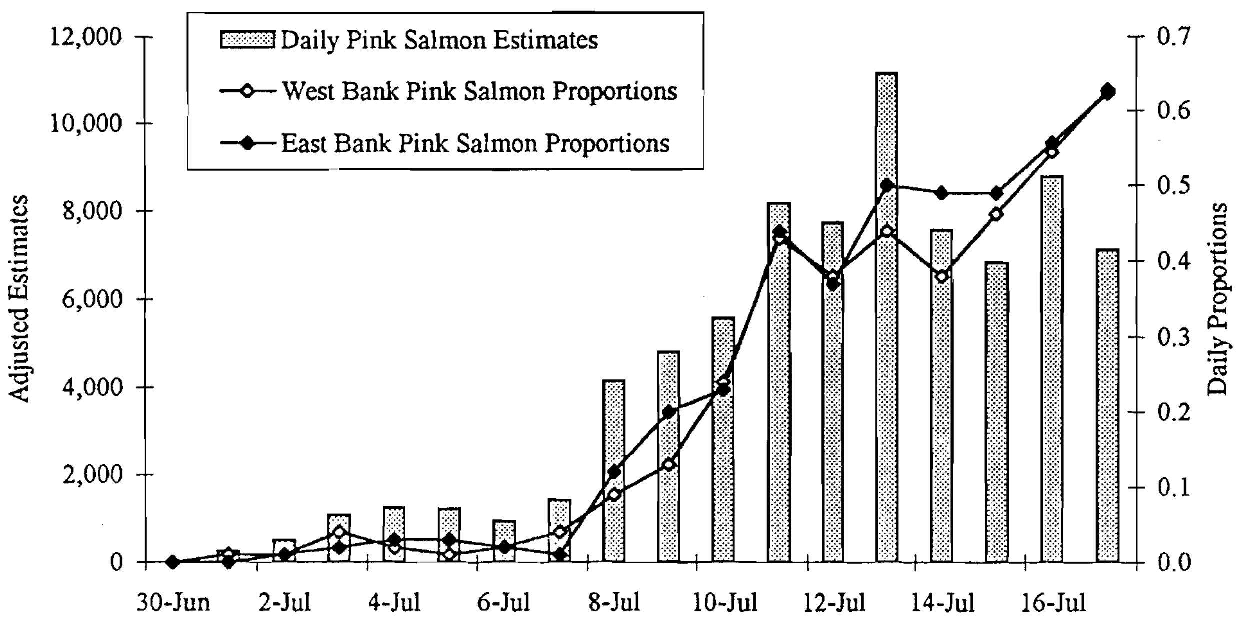

Figure 10. 1996 pink salmon adjusted estimates for the Anvik River through 17 July.

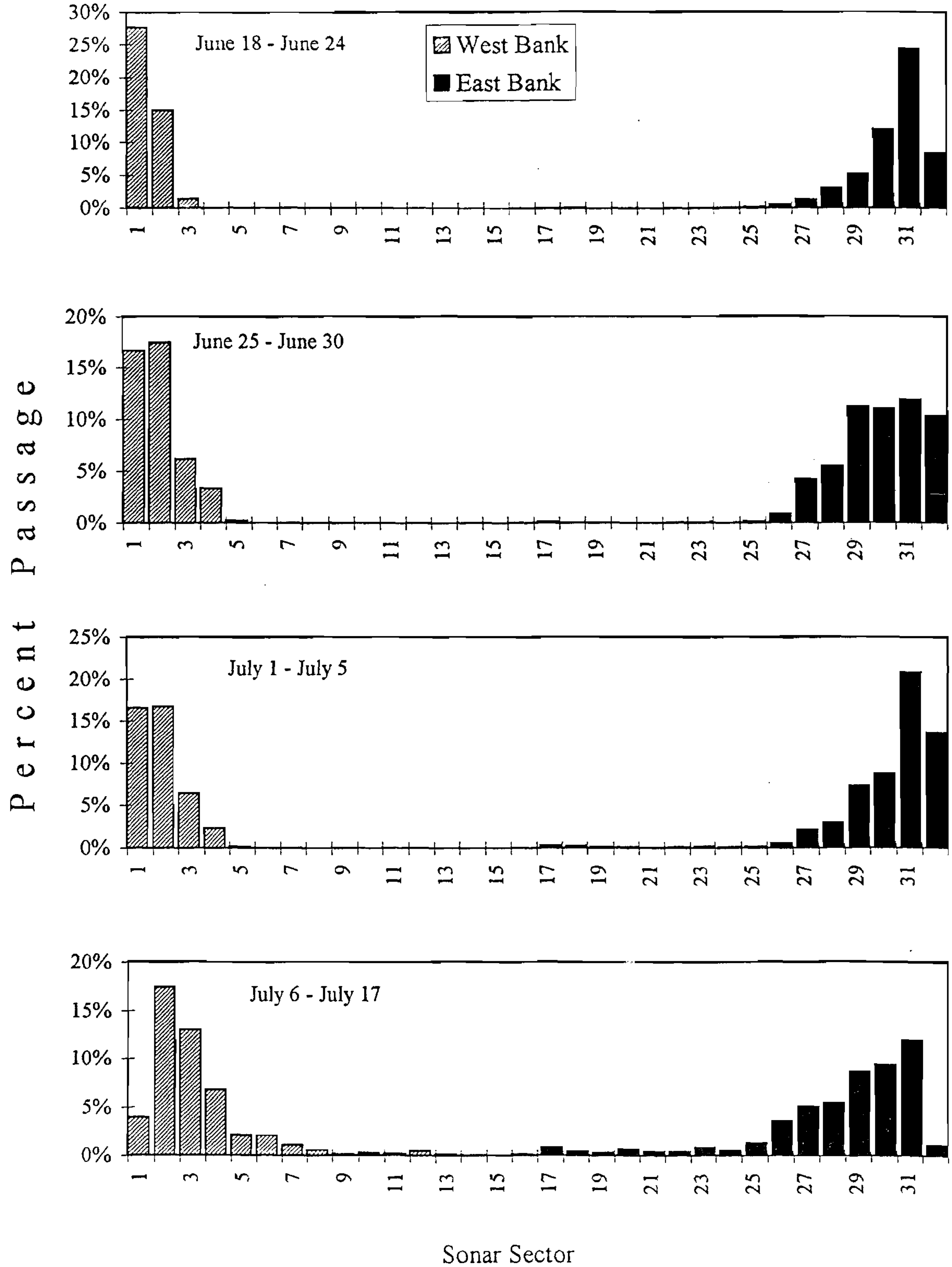

Figure 11. Estimated percent of corrected sonar estimates by temporal sampling stratum (based on 1996 stratum breakdown) and sonar sector, Anvik River, 1996. Note that only days with full 24-hour estimates were used.

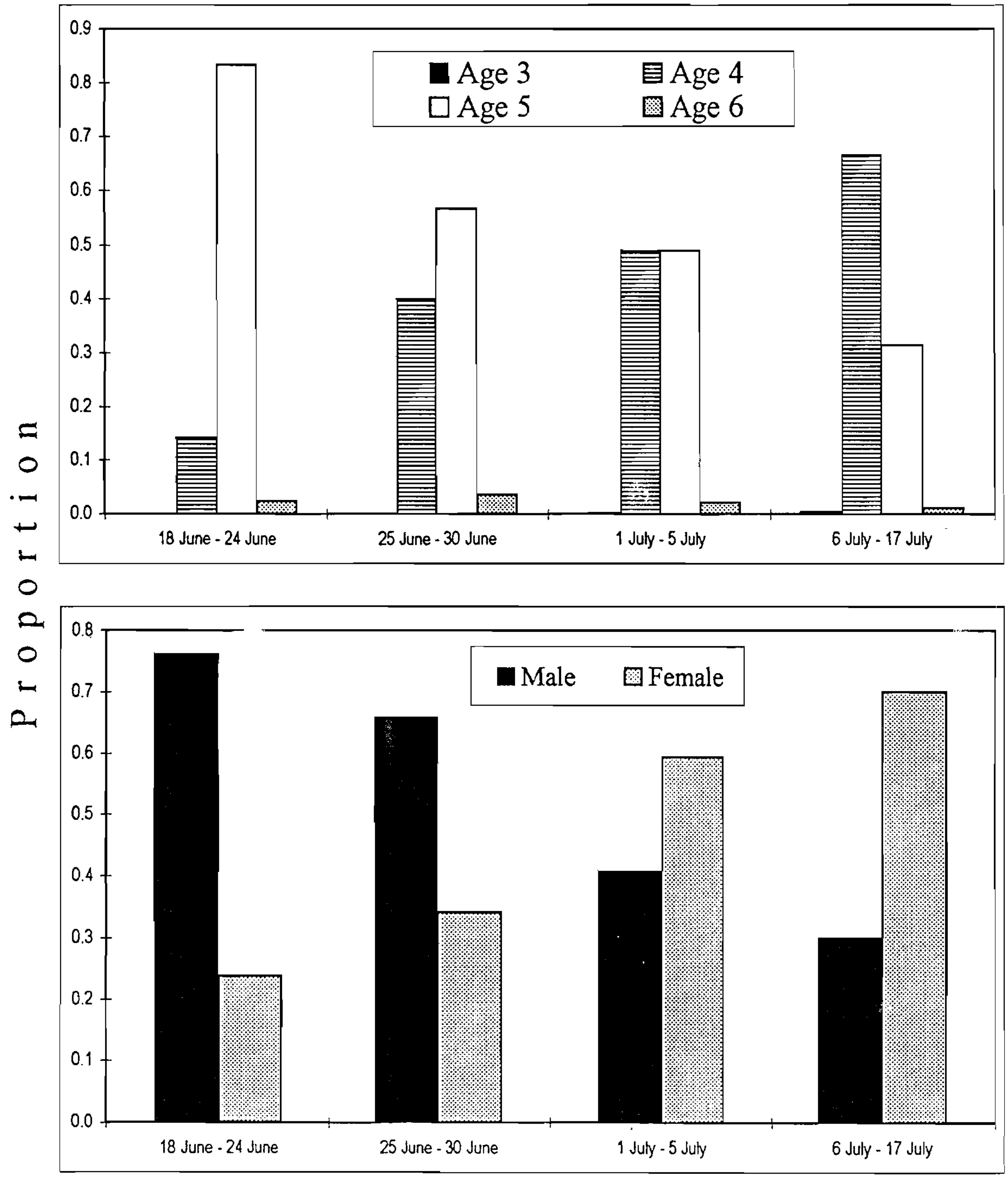

Figure 12. Age and sex composition of sampled Anvik River summer chum salmon by temporal sampling stratum (based on 1996 stratum breakdown), 1996.

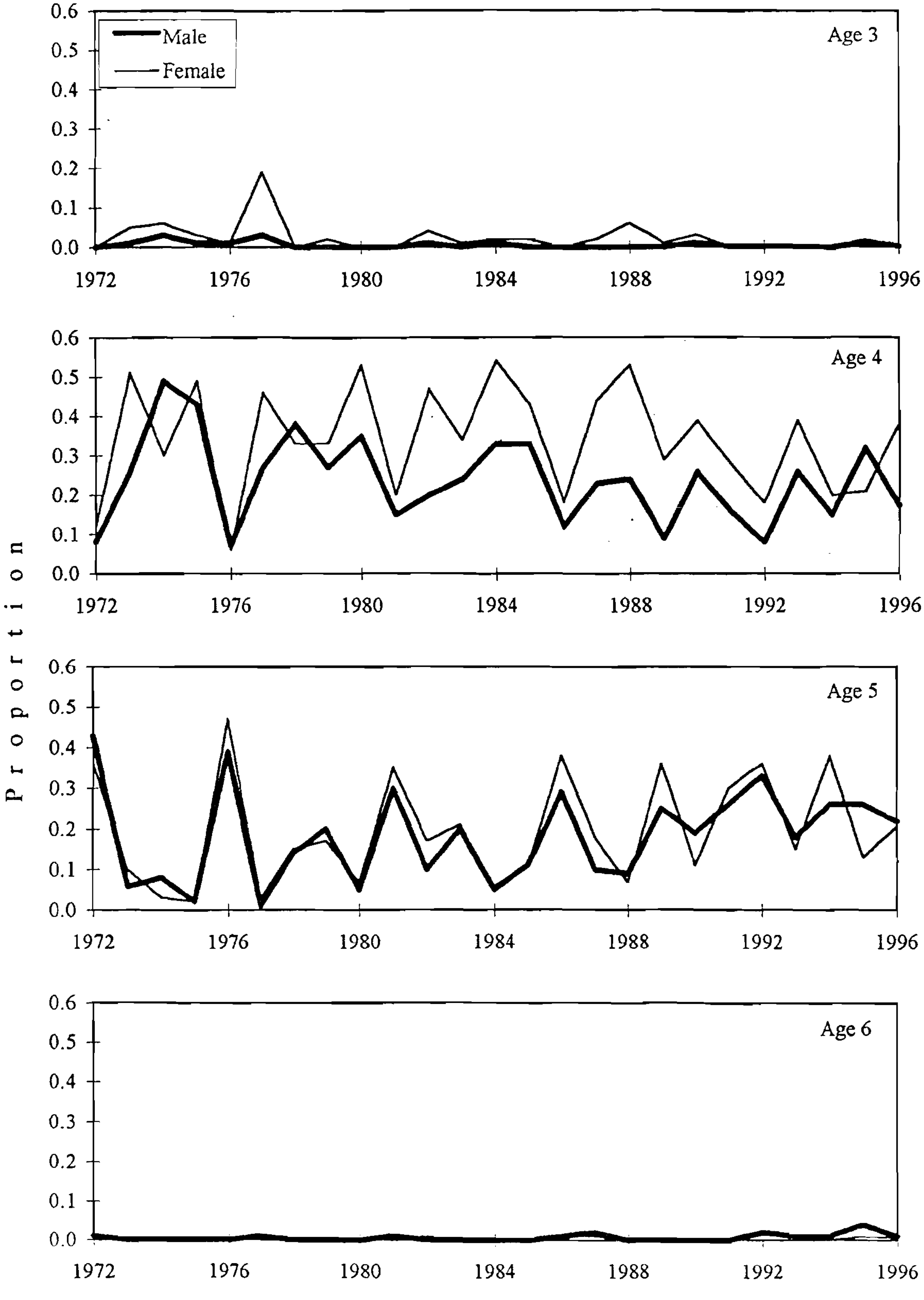

Figure 13. Estimated age and sex composition of the Anvik River summer chum salmon escapement, 1972-1996.

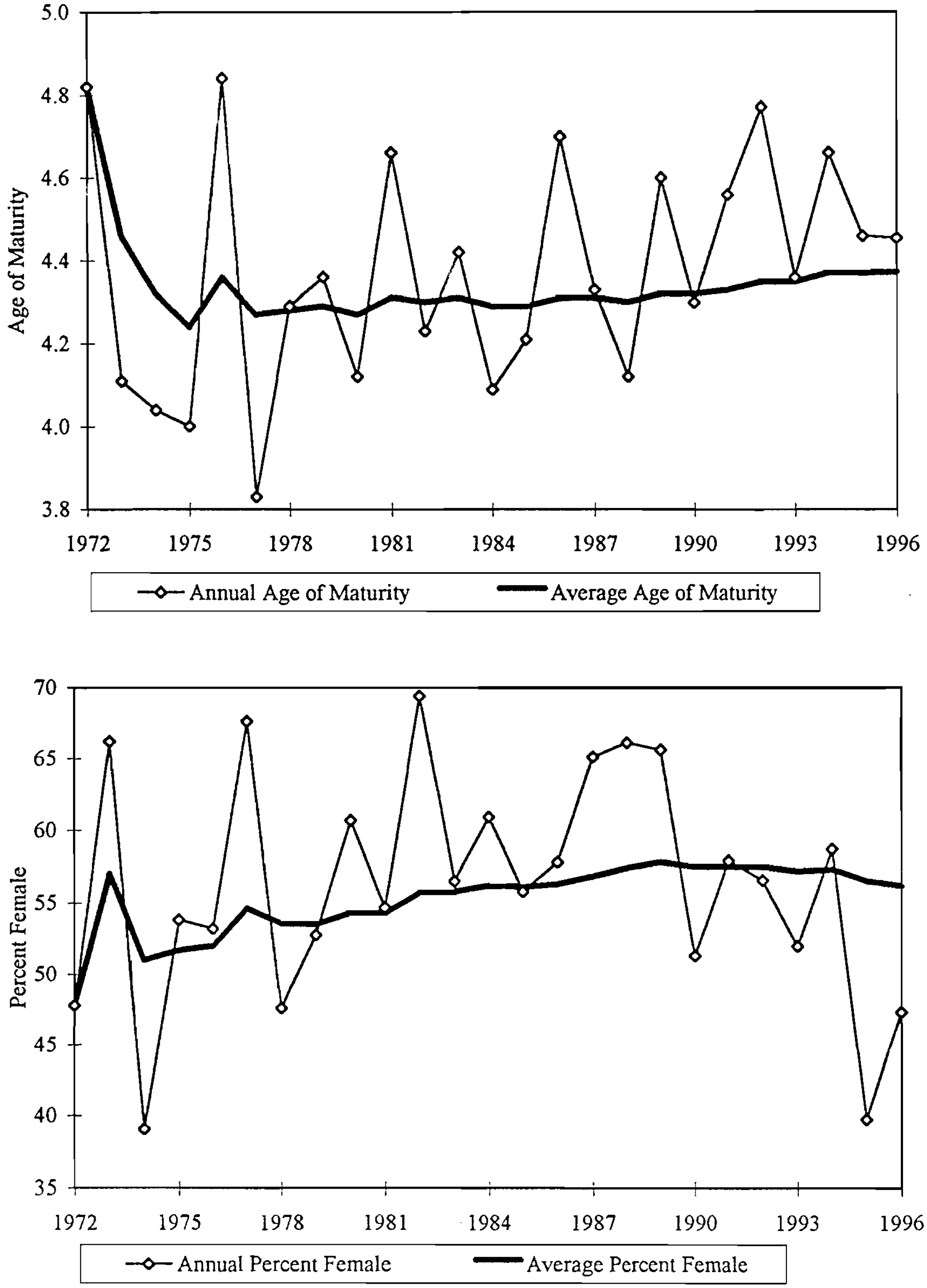

Figure 14. Annual and running average of the age of maturity (top) and percent female (bottom) of the summer chum salmon escapement to the Anvik River, 1972-1996.

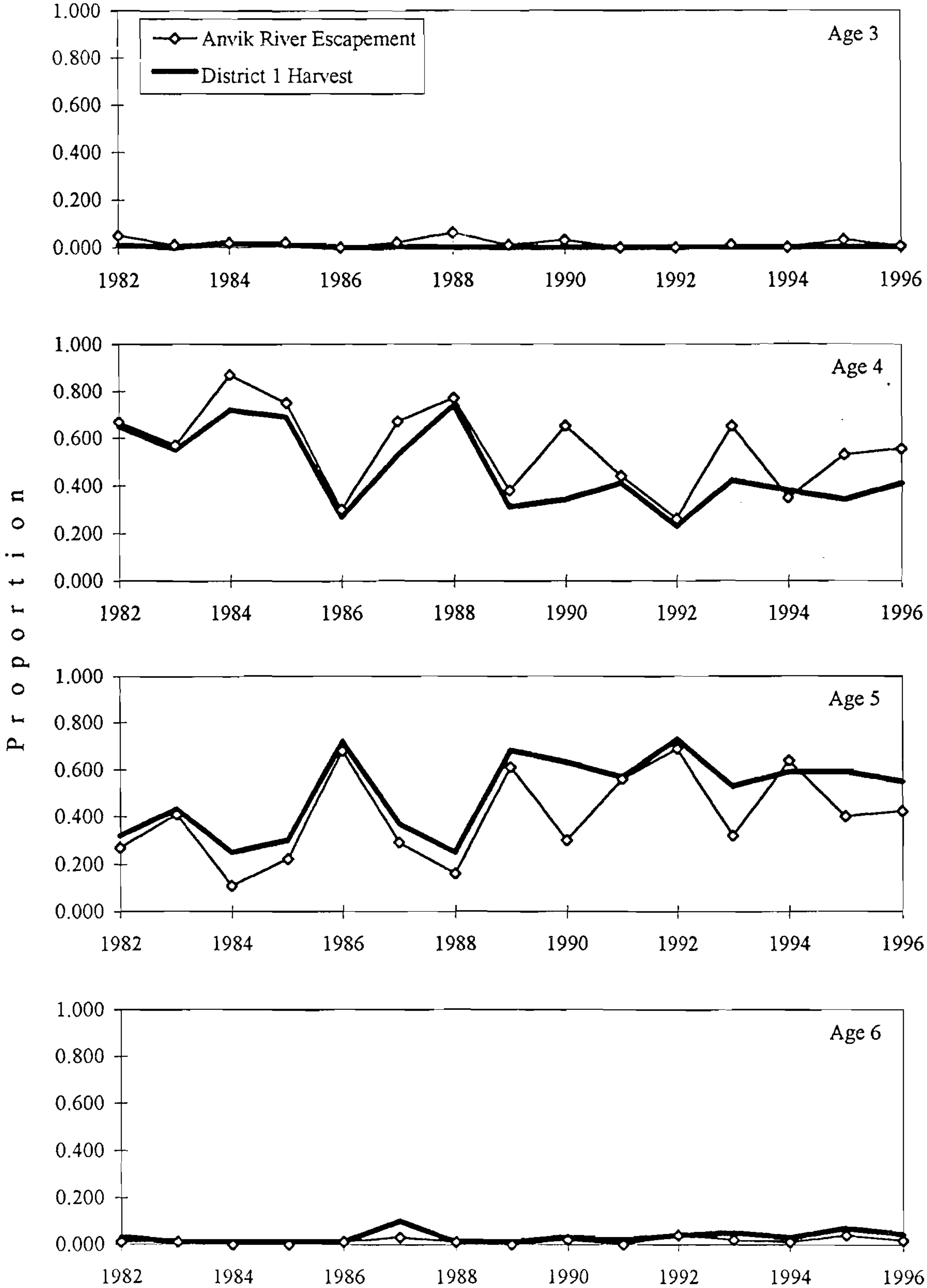

Figure 15. Estimated age composition of the Anvik River summer chum salmon escapement and District 1 commercial harvest, Yukon River, 1982-1996.

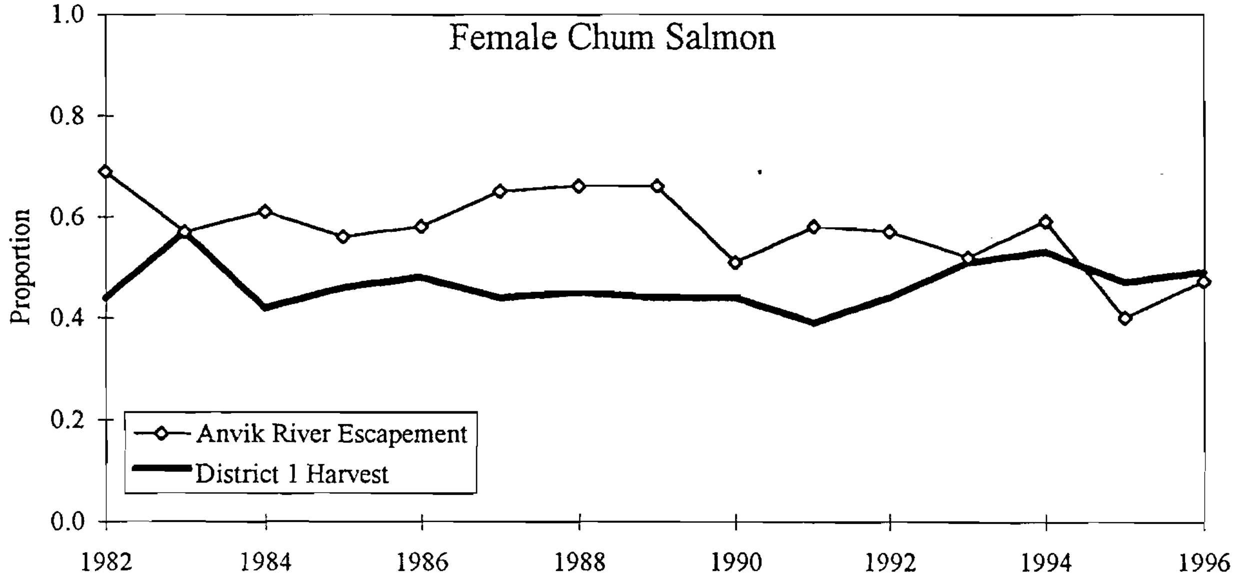

Figure 16. Estimated proportion of female summer chum salmon in the Anvik River escapement and the Yukon River District 1 commercial harvest, 1982-1996.

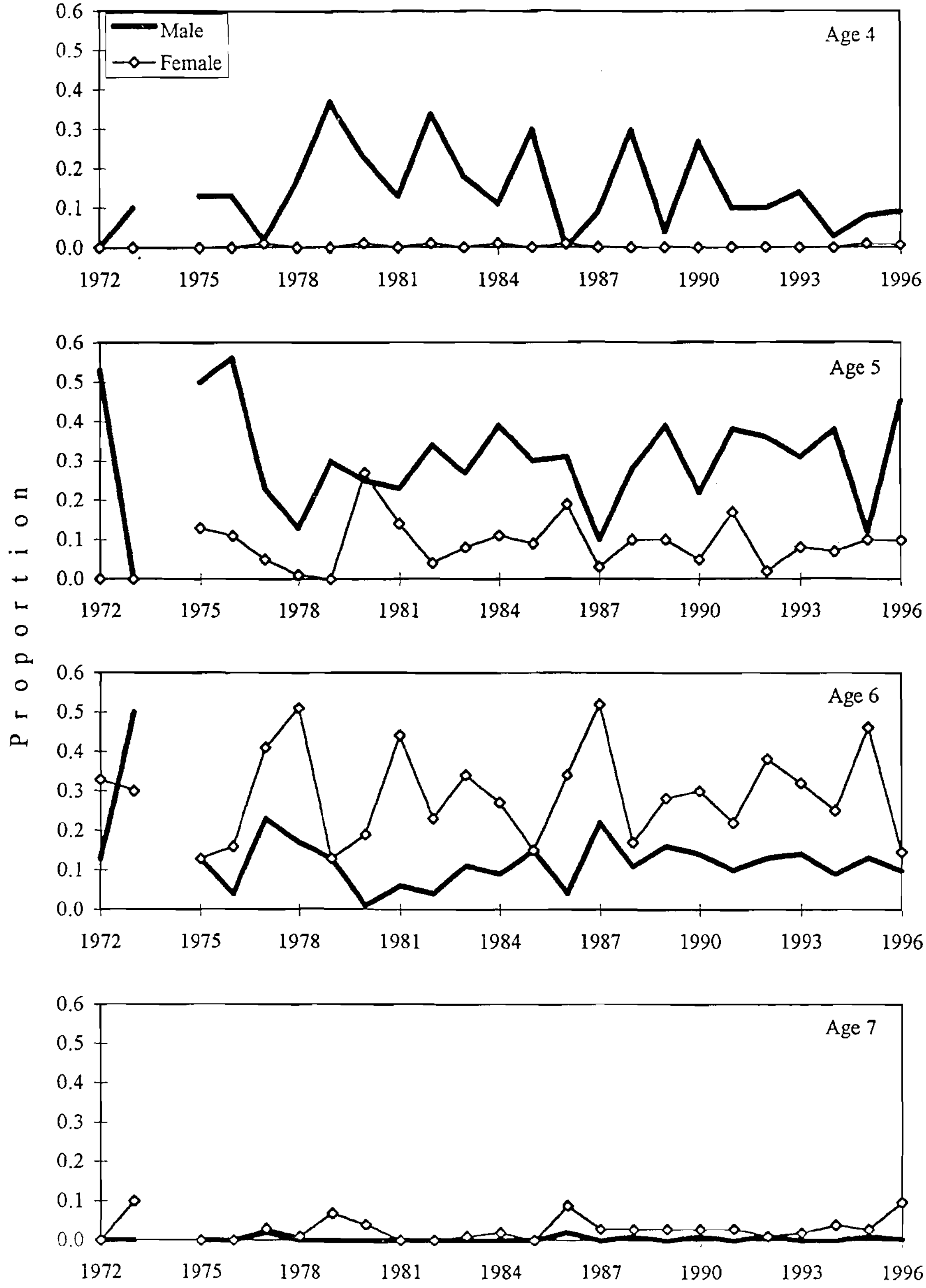

Figure 17. Estimated age and sex composition of the Anvik River chinook salmon escapement, 1972-1996.

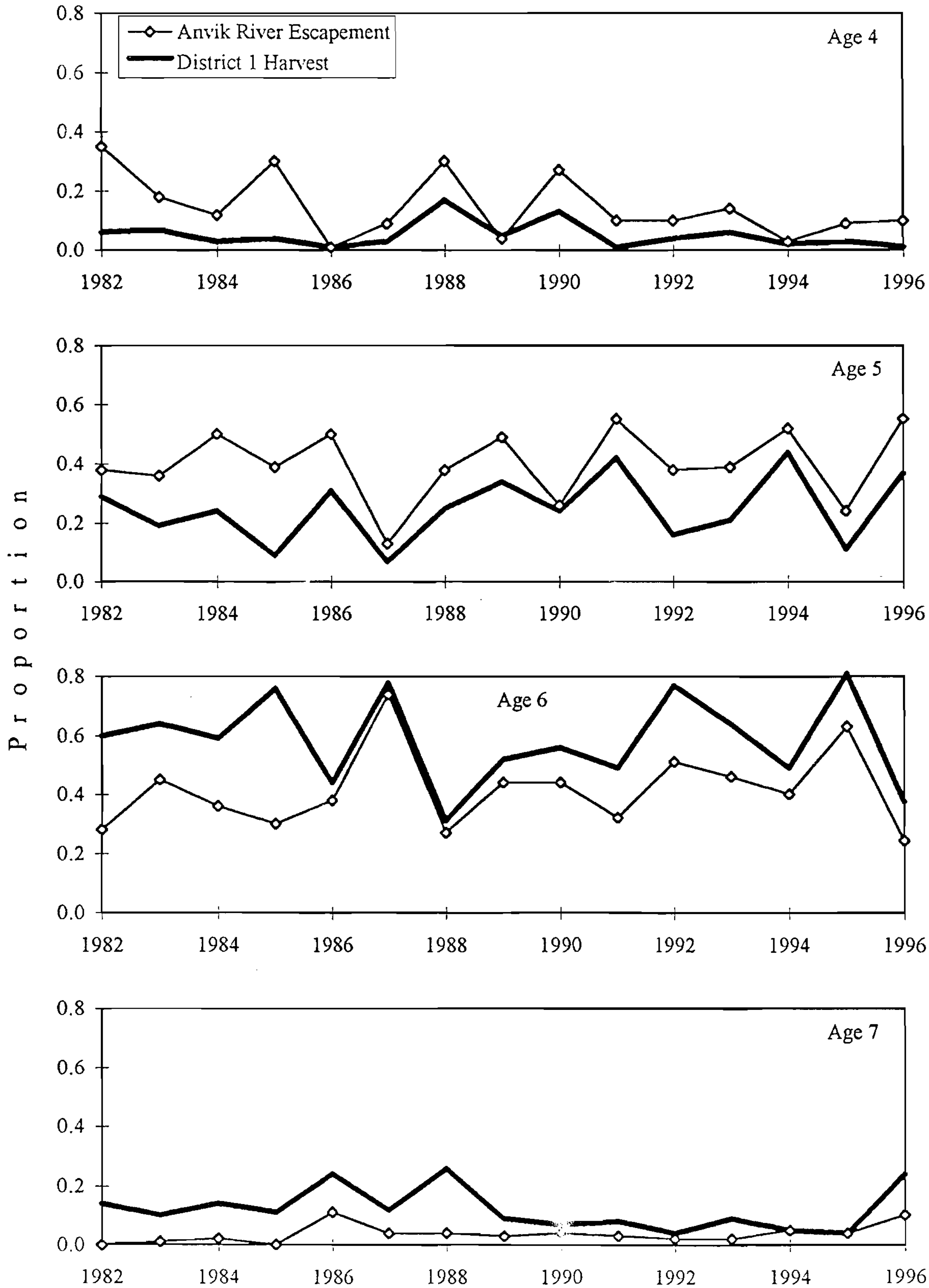

Figure 18. Estimated age composition of the Anvik River chinook salmon escapement and the Yukon River District 1 commercial harvest, 1982-1996.

APPENDIX

Appendix A. Right bank Anvik River corrected sonar estimates by hour and date, 18 June -17 July, 1996.

Hour	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul
0000 - 0100	1,012	70	100	1,213	922	1,340	1,032	956	946	993	858	912	889	1,213
0100 - 0200	1,014	284	285	1,270	986	2,259	843	1,527	1,221	1,513	1,457	789	1,184	1,853
0200 - 0300	1,204	379	983	1,954	2,086	1,940	1,126	1,558	1,378	1,393	1,589	889	1,329	2,190
0300 - 0400	1,437	248	494	2,214	2,202	1,773	1,060	1,359	1,521	1,409	1,290	841	1,385	1,986
0400 - 0500	1,474	254	722	1,875	2,293	1,621	955	1,453	1,558	2,615	1,255	945	1,510	1,937
0500 - 0600	1,002	285	577	1,471	1,724	1,176	1,211	1,098	1,020	2,238	1,047	498	1,390	1,721
0600 - 0700	877	98	217	944	1,174	1,135	887	731	443	1,873	1,171	834	652	2,172
0700 - 0800	490	294	480	707	569	819	557	233	460	793	840	394	944	1,060
0800 - 0900	316	247	681	1,690	321	318	717	131	924	889	631	223	359	963
0900 - 1000	569	113	497	1,752	273	251	520	117	621	719	358	203	361	584
1000 - 1100	197	222	91	1,570	127	182	624	127	539	793	206	264	203	169
1100 - 1200	115	54	31	1,323	81	229	316	107	521	675	224	216	273	293
1200 - 1300	28	5	40	1,199	97	183	323	133	483	593	144	612	147	123
1300 - 1400	31	10	92	808	157	261	463	124	304	475	99	990	115	882
1400 - 1500	36	9	84	799	101	231	634	205	263	577	243	946	25	689
1500 - 1600	26	5	658	814	111	390	692	275	261	385	89	579	70	568
1600 - 1700	41	16	172	550	79	254	755	287	646	249	56	555	67	415
1700 - 1800	6	48	148	551	61	284	710	375	589	201	84	392	110	417
1800 - 1900	16	25	106	429	85	462	494	400	594	592	319	319	59	487
1900 - 2000	32	16	42	377	85	393	715	268	801	651	416	306	276	419
2000 - 2100	48	84	71	421	191	364	563	365	316	511	414	349	298	430
2100 - 2200	36	40	384	506	294	527	477	267	503	374	945	506	699	457
2200 - 2300	30	66	634	602	636	509	581	392	715	633	777	778	947	787
2300 - 2400	66	163	1,388	783	533	1,270	735	536	717	924	1,469	1,254	1,952	1,745
Total	10,102	3,034	8,975	25,822	15,188	18,174	16,989	13,025	17,345	22,070	15,981	14,594	15,244	23,559

continued

Appendix A (page 2 of 2).

2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul
1,839	1,082	1,167	1,342	1,513	1,370	1,176	1,162	829	456	635	750	739	326	370	359
1,956	1,283	1,708	1,368	1,434	1,546	844	1,020	874	422	561	631	622	188	344	504
1,630	1,128	1,997	1,475	1,364	1,186	681	702	774	239	518	446	493	190	378	307
1,443	986	1,508	1,754	1,040	1,663	732	496	541	187	437	388	457	182	545	260
1,278	985	1,285	1,570	1,097	1,690	994	511	493	242	378	515	361	249	429	221
1,279	1,122	1,226	1,954	971	1,818	950	567	602	329	623	629	556	357	384	225
1,224	723	834	1,908	745	1,391	743	421	440	389	556	651	596	355	465	278
773	706	612	852	408	1,063	533	247	195	429	376	530	408	412	399	416
1,119	565	544	769	228	956	511	252	229	373	380	461	374	204	405	407
1,212	473	438	580	258	762	576	273	243	384	363	476	363	141	399	247
1,151	406	310	450	265	669	448	735	242	347	289	462	315	84	519	337
1,010	334	239	501	308	340	407	538	278	338	292	441	308	118	348	323
907	286	434	476	374	357	322	467	188	405	345	386	307	83	384	214
1,011	277	475	916	438	340	415	533	228	437	513	511	364	225	403	259
765	396	457	892	349	619	510	477	266	447	393	452	291	289	395	211
810	423	389	881	907	522	377	259	353	528	503	538	345	367	384	187
843	423	423	933	718	606	387	241	382	591	494	452	294	278	284	284
820	339	455	932	667	837	492	247	548	430	572	518	306	316	260	192
562	524	507	746	701	568	186	219	541	452	538	514	363	391	259	185
725	640	757	779	518	941	395	454	536	597	397	622	267	455	323	174
780	624	636	975	723	832	427	767	448	491	358	768	282	288	243	373
898	603	989	1,101	679	681	682	905	533	601	451	883	254	390	281	293
928	573	914	1,544	978	996	1,484	1,046	535	658	521	879	283	318	264	305
1,187	1,012	1,164	1,256	1,215	1,037	1,222	453	467	643	644	818	274	319	467	613
26,150	15,912	19,467	25,953	17,897	22,789	15,495	12,995	10,767	10,415	11,134	13,721	9,221	6,527	8,931	7,173

Appendix B. Left bank Anvik River corrected sonar estimates by hour and date, 18 June -17 July, 1996.

Hour	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul
0000 - 0100		97	908	543	775	1,315	1,456	1,492	697	905	921	898	1,078	1,462
0100 - 0200		92	880	209	1,159	1,462	1,647	2,328	749	863	802	757	982	1,787
0200 - 0300		57	241	1,357	2,736	2,136	2,122	2,134	913	765	485	720	1,252	1,717
0300 - 0400		80	377	2,149	3,649	2,359	2,905	1,795	946	840	583	624	699	1,854
0400 - 0500		160	404	1,270	1,749	1,523	2,816	1,475	898	956	827	748	892	1,759
0500 - 0600		55	134	875	1,421	1,906	2,372	861	481	657	691	787	492	1,679
0600 - 0700		77	299	533	346	1,617	1,970	246	248	536	814	941	408	2,360
0700 - 0800		12	258	207	190	719	2,072	107	458	684	891	1,034	478	2,200
0800 - 0900		24	246	1,135	349	428	1,759	65	852	988	1,084	893	279	2,391
0900 - 1000		6	108	1,362	183	409	1,595	47	310	644	967	976	308	1,535
1000 - 1100		32	30	1,377	27	330	1,223	90	401	792	1,168	1,109	145	1,541
1100 - 1200		7	17	666	12	244	1,294	74	507	1,015	1,503	696	109	1,323
1200 - 1300		3	33	704	32	213	1,407	116	387	529	811	1,050	34	2,515
1300 - 1400		15	29	632	44	108	2,403	158	285	413	595	1,016	2,520	1,576
1400 - 1500		2	42	387	92	418	1,117	213	348	419	552	627	2,515	456
1500 - 1600		10	239	741	42	513	1,476	163	270	1,438	225	435	4,389	774
1600 - 1700		8	78	578	118	801	2,243	304	709	1,360	287	260	5,147	1,012
1700 - 1800	15	19	84	452	62	1,864	2,246	484	1,051	1,556	188	398	1,316	739
1800 - 1900	1	133	112	236	43	2,813	1,671	542	283	1,438	640	423	652	742
1900 - 2000	7	44	64	83	133	2,807	2,453	572	1,124	1,669	705	362	664	949
2000 - 2100	5	163	101	184	410	2,474	2,223	423	876	1,538	612	563	1,414	1,074
2100 - 2200	22	149	289	503	2,015	2,103	1,795	450	1,819	1,579	911	715	1,321	1,241
2200 - 2300	15	125	1,191	778	1,977	1,699	2,155	425	2,011	1,344	797	1,002	1,960	1,151
2300 - 2400	45	212	1,698	780	1,504	1,564	1,784	569	1,335	1,396	1,305	1,489	1,639	1,307
Total	111	1,581	7,861	17,743	19,069	31,826	46,204	15,131	17,958	24,320	18,367	18,521	30,692	35,146

continued

Appendix B (page 2 of 2).

2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul
1,746	1,057	1,384	1,613	1,502	1,375	986	993	668	454	451	596	611	412	461	253
1,372	1,166	1,550	1,541	1,310	1,544	1,157	980	1,005	479	494	660	551	576	419	177
1,501	1,482	1,955	1,604	1,195	1,434	1,344	897	1,078	378	563	510	553	460	660	216
1,308	1,272	1,770	1,711	922	1,172	1,029	673	913	229	447	591	423	346	555	225
1,128	1,126	1,551	1,485	1,040	1,121	1,014	675	665	144	253	508	287	243	430	149
1,334	922	1,248	1,190	1,060	1,001	1,168	479	657	232	342	496	304	313	341	183
1,223	1,044	1,140	1,060	801	1,055	788	454	416	249	377	360	270	351	309	141
1,278	819	625	992	428	920	750	234	256	282	303	374	284	253	314	121
1,360	736	1,003	1,020	311	838	825	223	222	214	192	306	269	268	171	173
1,588	876	584	1,178	268	815	780	278	263	255	197	281	306	215	202	163
1,408	797	423	1,244	282	762	709	498	253	225	194	316	205	170	254	125
1,206	726	323	1,174	295	829	505	486	228	190	196	303	243	191	242	169
1,073	662	273	951	379	796	595	354	343	287	358	405	248	203	164	127
898	535	224	1,858	360	761	668	387	311	202	293	381	224	163	204	110
904	422	252	1,726	348	922	592	319	468	214	220	344	244	206	213	136
794	756	363	1,656	536	890	673	415	343	343	262	312	249	169	194	201
1,053	692	311	1,749	817	1,181	574	425	375	369	402	269	331	248	198	158
1,168	916	772	1,712	923	1,068	830	413	554	376	433	429	363	361	195	166
1,307	906	1,318	1,815	1,322	1,413	1,044	733	482	392	635	378	289	352	237	185
1,155	1,437	1,448	1,792	1,365	1,267	1,223	1,073	591	416	634	381	412	318	243	250
1,238	1,437	1,792	1,773	1,432	1,583	1,416	1,111	629	487	594	518	399	455	186	199
1,097	1,432	1,926	2,153	1,582	1,584	1,402	1,023	718	523	544	551	394	427	248	150
1,352	1,661	1,909	2,033	1,640	1,683	1,170	981	716	677	626	456	434	471	314	222
1,068	1,611	1,741	1,968	1,406	1,680	1,625	890	740	709	620	561	511	534	261	191
29,561	24,491	25,884	37,001	21,523	27,693	22,867	14,993	12,893	8,326	9,630	10,289	8,405	7,702	7,013	4,188

Appendix C. Right bank Anvik River corrected sonar estimates by sector, 18 June - 17 July, 1996.

West bank sector	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul
1	5942	1,939	4,982	15,501	8,943	11,255	13,079	8,942	10,893	9,981	4,677	1,942	838	4,204	13,328
2	4007	1,072	3,647	8,960	5,628	6,382	3,670	3,799	5,569	9,921	7,090	7,383	5,230	6,124	9,869
3	129	16	341	1,330	613	535	234	282	817	1,979	2,803	3,232	4,678	8,137	2,518
4	2	3	2	31	4	2	7	1	61	176	1,224	1,958	4,094	4,713	420
5	0	0	0	0	0	0	1	0	5	7	170	68	364	339	16
6	0	0	0	0	0	0	0	0	0	2	17	6	40	35	0
7	0	0	0	0	0	0	0	0	0	1	1	5	1	4	0
8	0	2	0	0	0	0	0	0	0	3	0	0	0	1	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
11	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
12	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0
13	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10,102	3,034	8,975	25,822	15,188	18,174	16,989	13,025	17,345	22,070	15,981	14,594	15,244	23,559	26,150

continued

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3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul
8,277	9,320	8,422	4,279	3,920	568	247	86	82	176	126	54	437	1,016	1,037
6,324	8,761	12,920	8,517	9,872	5,422	3,621	2,620	2,597	3,094	3,500	1,650	2,309	5,163	4,186
1,105	1,214	3,943	4,039	5,862	5,224	3,562	3,461	2,928	2,988	3,839	2,549	1,405	1,992	1,410
186	167	628	907	1,731	2,269	2,261	1,960	1,751	2,108	2,845	2,049	1,404	733	533
19	6	35	127	389	669	1,145	866	672	769	992	615	261	23	6
1	0	2	22	403	845	1,155	758	697	784	936	705	224	2	1
0	0	3	4	118	160	346	382	385	399	654	634	250	1	1
0	0	0	2	99	84	155	130	294	162	253	417	163	0	0
0	0	0	0	86	67	112	45	64	26	58	70	18	0	0
0	0	0	0	128	66	101	64	70	44	106	157	35	1	0
0	0	0	0	59	31	25	91	122	69	95	75	5	0	0
0	0	0	0	58	62	254	131	428	311	67	86	9	0	0
0	0	0	0	25	13	11	15	180	78	62	58	0	0	0
0	0	0	0	22	6	1	36	44	37	39	5	0	0	0
0	0	0	0	13	8	0	27	45	44	52	33	0	0	0
0	0	0	0	6	1	0	97	56	43	99	63	7	0	0
15,912	19,467	25,953	17,897	22,789	15,495	12,995	10,767	10,415	11,134	13,721	9,221	6,527	8,931	7,173

Appendix D. Left bank Anvik River corrected sonar estimates by sector, 18 June - 17 July, 1996.

East bank sector	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul
17	5	50	66	41	48	78	42	254	53	10	4	0	20	186	199
18	3	19	67	21	30	50	27	48	17	6	7	0	13	78	80
19	1	10	23	10	5	23	9	14	12	2	2	0	2	35	28
20	0	2	10	2	2	12	2	3	5	8	6	0	2	42	34
21	0	2	9	3	2	6	6	8	3	3	2	0	2	12	15
22	1	6	8	14	9	11	15	10	5	60	42	0	11	13	44
23	3	30	54	34	20	29	24	20	13	77	40	0	42	58	61
24	2	18	48	27	19	22	19	27	14	39	29	0	33	45	40
25	3	51	115	66	50	86	38	42	20	57	104	3	169	141	71
26	4	107	311	258	147	341	104	123	74	297	191	66	1,307	708	95
27	9	239	747	709	328	561	257	245	122	1,056	1,141	1,150	5,864	4,317	172
28	37	413	1,537	1,967	1,036	1,229	744	650	198	1,489	3,914	1,807	4,272	5,121	232
29	15	249	1,984	3,111	2,151	2,208	2,074	1,205	558	2,729	5,973	4,765	9,976	9,990	1,044
30	21	228	1,831	4,982	4,590	6,043	9,153	3,026	2,925	2,809	3,338	6,047	6,625	6,392	2,519
31	5	151	994	5,693	8,428	15,496	23,685	6,860	9,299	3,132	2,091	3,212	1,927	4,774	13,289
32	1	6	58	806	2,204	5,630	10,005	2,595	4,642	12,548	1,482	1,471	428	3,233	11,637
Total	111	1,581	7,861	17,743	19,069	31,826	46,204	15,131	17,958	24,320	18,367	18,521	30,692	35,146	29,561

continued

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3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul
218	47	381	968	708	102	116	87	132	128	148	131	79	53	64
78	46	421	317	125	117	117	85	103	96	121	141	94	90	99
40	32	148	285	104	74	74	75	76	97	109	87	86	59	55
64	27	97	150	178	221	232	210	209	247	264	232	95	30	25
23	24	81	185	273	133	120	131	119	137	149	139	59	38	43
53	37	137	229	209	118	93	104	80	103	105	89	89	98	123
103	76	235	300	185	248	213	195	177	243	334	179	177	125	140
84	56	119	141	179	185	165	175	182	210	299	126	118	89	64
117	47	103	192	266	342	375	382	360	442	624	326	283	230	288
232	196	320	492	1,016	1,041	1,001	974	1,075	1,249	1,513	727	563	635	554
368	302	493	723	1,583	1,652	1,537	1,390	1,401	1,775	2,167	1,066	717	723	535
635	730	1,165	1,023	2,253	2,419	1,762	1,695	1,284	1,469	1,468	1,082	673	736	474
2,524	2,383	3,437	1,897	4,333	5,028	3,160	2,473	1,406	1,706	1,571	1,447	1,399	1,260	541
3,495	4,152	6,569	4,002	7,356	5,482	2,999	2,297	773	878	701	1,073	1,236	1,186	410
9,514	11,591	15,426	7,994	8,747	5,633	2,964	2,558	903	825	699	1,513	1,929	1,621	754
6,943	6,137	7,870	2,625	178	72	64	65	45	26	18	47	104	39	20
24,491	25,884	37,001	21,523	27,693	22,867	14,993	12,896	8,326	9,630	10,289	8,405	7,702	7,013	4,188

Appendix E. Anvik River beach seine catch by species, sex, and date, and the number of chum salmon sampled for age, sex, size information, by sex and date, 1996.

	Chum Salmon						Other				
	Number Captured			Number Sampled			Number Captured				
Date	Male	Female	Total	Male	Female	Total	Pink Salmon	Grayling	Whitefish	Char	Other
22-Jun	33	10	43	33	10	43	0	0	0	0	
25-Jun	177	99	276	27	13	40	0	0	0	0	
28-Jun	63	44	107	30	20	50	0	0	0	0	
2-Jul	48	44	92	15	35	50	5	0	0	0	
4-Jul	85	105	190	23	27	50	9	3	1	0	
5-Jul	45	57	102	22	28	50	6	2	0	0	1 Pike
7-Jul	40	35	75	39	35	74	0	4	0	0	
10-Jul	12	45	57	12	39	51	10	0	1	0	
11-Jul	67	133	200	19	31	50	84	4	4	0	
12-Jul	86	210	296	15	34	49	10	1	2	0	
14-Jul	34	159	193	10	38	48	41	0	1	0	
15-Jul	27	118	145	10	43	53	5	2	2	1	
16-Jul	27	104	131	15	51	66	38	1	0	0	
Stratum Totals (based on pre-season long-term average)											
18 June - 3 July	321	197	518	105	78	183	5	0	0	0	
Percent	62.0%	38.0%		57.4%	42.6%						
4 July - 8 July	170	197	367	84	90	174	15	9	1	0	
Percent	46.3%	53.7%		48.3%	51.7%						
9 July - 13 July	165	388	553	46	104	150	104	5	7	0	
Percent	29.8%	70.2%		30.7%	69.3%						
14 July - 17 July	88	381	469	35	132	167	84	3	3	1	
Percent	18.8%	81.2%		21.0%	79.0%						
Season Totals	744	1,163	1,907	270	404	674	208	17	11	1	
Percent	39.0%	61.0%		40.1%	59.9%						
Stratum Totals (based on 1996 stratum breakdown)											
18 June - 24 June	33	10	43	33	10	43	0	0	0	0	
Percent	76.7%	23.3%		76.7%	23.3%						
25 June - 30 June	240	143	383	57	33	90	0	0	0	0	
Percent	62.7%	37.3%		63.3%	36.7%						
1 July - 5 July	178	206	384	60	90	150	20	5	1	0	
Percent	46.4%	53.6%		40.0%	60.0%						
6 July - 17 July	293	804	1,097	120	271	391	188	12	10	1	
Percent	26.7%	73.3%		30.7%	69.3%						
Season Totals	744	1,163	1,907	270	404	674	208	17	11	1	
Percent	39.0%	61.0%		40.1%	59.9%						

Appendix F. Age and sex composition of Anvik River summer chum salmon, 1972-1996.

Number of Fish [a]

	Total Sample				Age 0.2			Age 0.3			Age 0.4			Age 0.5		
Year	Male	Female	Total	Number Aged	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1972	167	153	320	320	0	0	0	25	37	62	138	115	253	4	1	5
1973	265	518	783	783	11	37	48	204	401	605	49	79	128	1	1	2
1974	245	157	402	402	12	24	36	197	120	317	34	12	46	2	1	3
1975	270	314	584	584	4	17	21	253	288	541	13	9	22	0	0	0
1976	281	320	601	601	5	4	9	43	35	78	233	281	514	0	0	0
1977	191	398	589	589	20	111	131	161	270	431	7	15	22	3	2	5
1978	289	263	552	552	0	1	1	210	180	390	79	82	161	0	0	0
1979	273	306	579	579	2	12	14	154	193	347	115	99	214	2	2	4
1980	167	258	425	425	0	1	1	147	226	373	20	31	51	0	0	0
1981	151	182	333	333	0	0	0	49	67	116	99	115	214	3	0	3
1982	117	265	382	382	4	17	21	75	181	256	37	65	102	1	2	3
1983	183	238	421	421	0	4	4	99	142	241	83	90	173	1	2	3
1984	138	215	353	353	2	6	8	117	189	306	19	20	39	0	0	0
1985	233	294	527	527	0	11	11	172	225	397	59	58	117	2	0	2
1986	205	281	486	486	0	2	2	59	89	148	143	186	329	3	4	7
1987	190	355	545	545	0	10	10	125	238	363	56	100	156	9	7	16
1988	180	351	531	531	1	30	31	129	282	411	48	37	85	2	2	4
1989	199	389	588	588	0	9	9	55	179	234	143	201	344	1	0	1
1990	172	227	399	399	3	12	15	98	169	267	67	45	112	4	1	5
1991	239	313	552	552	0	0	0	96	153	249	141	160	301	2	0	2
1992	162	262	424	424	0	3	3	39	98	137	115	154	269	8	7	15
1993	325	335	660	546	1	3	4	140	201	341	106	81	187	6	8	14
1994	494	730	1,224	560	0	0	0	87	120	207	138	208	346	4	3	7
1995	400	267	667	589	7	18	25	194	150	344	137	65	202	15	3	18
1996	270	404	674	615	1	2	3	107	234	341	134	126	260	7	4	11

Continued

Percent of Sample [b]															
	Total Sample			Age 0.2			Age 0.3			Age 0.4			Age 0.5		
Year	Male	Female	Female Running Avera	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1972	52.2	47.8	47.8	0.0	0.0	0.0	7.8	11.6	19.4	43.1	35.9	79.1	1.3	0.3	1.6
1973	33.8	66.2	57.0	1.4	4.7	6.1	26.1	51.2	77.3	6.3	10.1	16.3	0.1	0.1	0.3
1974	60.9	39.1	51.0	3.0	6.0	9.0	49.0	29.9	78.9	8.5	3.0	11.4	0.5	0.2	0.7
1975	46.2	53.8	51.7	0.7	2.9	3.6	43.3	49.3	92.6	2.2	1.5	3.8	0.0	0.0	0.0
1976	46.8	53.2	52.0	0.8	0.7	1.5	7.2	5.8	13.0	38.8	46.8	85.5	0.0	0.0	0.0
1977	32.4	67.6	54.6	3.4	18.8	22.2	27.3	45.8	73.2	1.2	2.5	3.7	0.5	0.3	0.8
1978	52.4	47.6	53.6	0.0	0.2	0.2	38.0	32.6	70.7	14.3	14.9	29.2	0.0	0.0	0.0
1979	47.2	52.8	53.5	0.3	2.1	2.4	26.6	33.3	59.9	19.9	17.1	37.0	0.3	0.3	0.7
1980	39.3	60.7	54.3	0.0	0.2	0.2	34.6	53.2	87.8	4.7	7.3	12.0	0.0	0.0	0.0
1981	45.3	54.7	54.3	0.0	0.0	0.0	14.7	20.1	34.8	29.7	34.5	64.3	0.9	0.0	0.9
1982	30.6	69.4	55.7	1.0	4.5	5.5	19.6	47.4	67.0	9.7	17.0	26.7	0.3	0.5	0.8
1983	43.5	56.5	55.8	0.0	1.0	1.0	23.5	33.7	57.2	19.7	21.4	41.1	0.2	0.5	0.7
1984	39.1	60.9	56.2	0.6	1.7	2.3	33.1	53.5	86.7	5.4	5.7	11.0	0.0	0.0	0.0
1985	44.2	55.8	56.1	0.0	2.1	2.1	32.6	42.7	75.3	11.2	11.0	22.2	0.4	0.0	0.4
1986	42.2	57.8	56.3	0.0	0.4	0.4	12.1	18.3	30.5	29.4	38.3	67.7	0.6	0.8	1.4
1987	34.9	65.1	56.8	0.0	1.8	1.8	22.9	43.7	66.6	10.3	18.3	28.6	1.7	1.3	2.9
1988	33.9	66.1	57.4	0.2	5.6	5.8	24.3	53.1	77.4	9.0	7.0	16.0	0.4	0.4	0.8
1989 [c]	34.4	65.6	57.8	0.0	1.2	1.2	9.4	28.5	37.9	24.8	35.9	60.7	0.1	0.0	0.1
1990 [c]	48.7	51.3	57.5	0.6	2.5	3.2	26.0	39.1	65.1	18.8	11.3	30.1	1.2	0.4	1.6
1991 [c]	42.1	57.9	57.5	0.0	0.0	0.0	16.4	27.8	44.2	25.6	30.1	55.6	0.2	0.0	0.2
1992 [c]	43.4	56.6	57.5	0.0	0.3	0.3	8.4	18.1	26.5	32.6	36.3	69.0	2.4	1.8	4.2
1993 [c,d]	48.0	52.0	57.2	0.1	0.5	0.6	26.1	38.8	64.8	17.8	14.6	32.4	0.9	1.3	2.2
1994 [c,d]	41.3	58.7	57.3	0.0	0.0	0.0	15.2	19.8	35.0	25.8	38.0	63.8	0.7	0.5	1.2
1995 [c,d]	60.2	39.8	56.5	0.7	2.0	2.7	31.9	21.4	53.3	26.2	13.4	39.6	3.8	0.5	4.4
1996 [c]	40.5	47.3	56.2	0.2	0.3	0.5	17.4	38.0	55.4	21.8	20.5	42.3	1.1	0.7	1.8

[a] Samples collected by carcass survey 1972-1981, by beach seine 1983-1992, and by both methods combined in 1982.

[b] Sample percentages not weighted by time period or escapement counts.

[c] Sample percentages weighted by time period and escapement counts.

[d] Sex composition based on entire beach seine catch. Age composition based on aged scales.

Appendix G. Age and sex composition of Anvik River chinook salmon escapement samples, 1972-1996.

Number of Chinook Salmon [a]

	Sample			Age 4 [c]			Age 5			Age 6			Age 7		
Year	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	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	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
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
1989	226	155	381	17 [b]	0	17	149	38	187	60	106	166	0	11	11
1990	252	148	400	106 [b]	0	106	86	18	104	56	119	175	4	11	15
1991	223	155	378	39	0	39	145	63	208	38	82	120	1	10	11
1992	185	130	315	30	0	30	113	7	120	40	120	160	2	3	5
1993	197	143	340	47	0	47	104	27	131	46	109	155	0	7	7
1994	280	190	470 [d]	12	0	12	178	32	210	44	117	161	1	21	22
1995	161	275	436 [d]	34	3	37	52	44	96	55	201	256	4	11	15
1996	170	92	262	24	2	26	119	26	145	26	38	64	1	26	27

Continued

Appendix G (page 2 of 2).

Percent of Total Sample [c]

Year	Sample [a]			Age 4			Age 5			Age 6			Age 7		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1972	66.7	33.3	100.0	0.0	0.0	0.0	53.3	0.0	53.3	13.3	33.3	46.7	0.0	0.0	0.0
1973	60.0	40.0	100.0	10.0	0.0	10.0	0.0	0.0	0.0	50.0	30.0	80.0	0.0	10.0	10.0
1974	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-
1975	75.0	25.0	100.0	12.5	0.0	12.5	50.0	12.5	62.5	12.5	12.5	25.0	0.0	0.0	0.0
1976	73.3	26.7	100.0	13.3	0.0	13.3	55.6	11.1	66.7	4.4	15.6	20.0	0.0	0.0	0.0
1977	49.6	50.4	100.0	1.7	0.9	2.6	23.1	5.1	28.2	23.1	41.0	64.1	1.7	3.4	5.1
1978	46.8	53.2	100.0	16.9	0.0	16.9	13.0	1.3	14.3	16.9	50.6	67.5	0.0	1.3	1.3
1979	80.4	19.6	100.0	37.0	0.0	37.0	30.4	0.0	30.4	13.0	13.0	26.1	0.0	6.5	6.5
1980	49.4	50.6	100.0	22.9	1.2	24.1	25.3	26.5	51.8	1.2	19.3	20.5	0.0	3.6	3.6
1981	41.4	58.6	100.0	12.5	0.4	12.9	23.2	13.7	36.9	5.7	44.1	49.8	0.0	0.4	0.4
1982	72.5	27.5	100.0	34.1	0.7	34.8	34.1	3.6	37.7	4.3	23.2	27.5	0.0	0.0	0.0
1983	56.5	43.5	100.0	18.3	0.0	18.3	27.5	8.5	35.9	10.8	34.0	44.8	0.0	1.0	1.0
1984	58.7	41.3	100.0	10.5	1.4	12.0	39.1	10.9	50.0	9.1	26.8	35.9	0.0	2.2	2.2
1985	75.8	24.2	100.0	30.3	0.0	30.3	30.3	9.1	39.4	15.2	15.2	30.3	0.0	0.0	0.0
1986	37.3	62.7	100.0	0.0	0.7	0.7	31.0	19.0	50.0	4.2	33.8	38.0	2.1	9.2	11.3
1987	41.4	58.6	100.0	9.5	0.0	9.5	9.9	3.2	13.1	21.6	52.3	73.9	0.5	3.2	3.6
1988	70.3	29.7	100.0	30.5	0.0	30.5	28.5	9.8	38.2	10.6	16.7	27.2	0.8	3.3	4.1
1989	59.3	40.7	100.0	4.5	0.0	4.5	39.1	10.0	49.1	15.7	27.8	43.6	0.0	2.9	2.9
1990	63.0	37.0	100.0	26.5	0.0	26.5	21.5	4.5	26.0	14.0	29.8	43.8	1.0	2.8	3.8
1991	59.0	41.0	100.0	10.3	0.0	10.3	38.4	16.7	55.0	10.1	21.7	31.7	0.3	2.6	2.9
1992	58.7	41.3	100.0	9.5	0.0	9.5	35.9	2.2	38.1	12.7	38.1	50.8	0.6	1.0	1.6
1993	57.9	42.1	100.0	13.8	0.0	13.8	30.6	7.9	38.5	13.5	32.1	45.6	0.0	2.1	2.1
1994	59.6	40.4	100.0 [d]	3.0	0.0	3.0	44.0	7.9	51.9	10.9	28.9	39.8	0.2	5.2	5.4
1995	36.9	63.1	100.0 [d]	8.4	0.7	9.2	12.9	10.9	23.8	13.6	49.8	63.4	1.0	2.7	3.7
1996	64.9	35.1	100.0 [d]	9.2	0.8	9.9	45.4	9.9	55.4	9.9	14.5	24.4	0.4	9.9	10.3

[a] Samples collected mainly by carcass survey. In some years a very few fish were also collected by beach seine or hook and line.

[b] Includes one age-3 male.

[c] Sample percentages not weighted by time period or escapement counts.

[d] Sex ratio based on total number of carcasses sampled.

Appendix H. Climatological and hydrological observations, Anvik River sonar site, 1996.

Date	Time	Precip. (code) [a]	Wind (direction and velocity)	Sky (code) [b]	Temperature (C) Air Min °C	Max ° C	Water ° C	Water Gauge Actual (ft.)	Relative (ft.)	Relative (cm.)	Water color (code) [c]	Remarks
19-Jun	1700	O	S 5-10	3	9	13		2.0	0.00	0.00	BR	Water guage set 1400 at 2.0
20-Jun	2000	I	S 5	3	9	13	14	2.0	-0.01	-0.30	BR	Water extremely low - bugs very bad.
21-Jun	1630	O	S 2-5	3	9	17	14	2.0	-0.02	-0.61	BR	
22-Jun	1845	I	S 2	3	8	16	13	2.0	0.04	1.22	BR	Heavy rain intermittedly.
23-Jun	1800	O	O	2	10	19	14	2.0	0.04	1.22	BR	Charged by bear at seine site.
24-Jun	1800	O	E 5-10	1 & 3	8	24	15	2.0	-0.01	-0.30	BR	Clear till 1730, overcast 2200 (wind S 10).
25-Jun	1800	O	O	4	9	17	14	2.0	0.04	1.22	BR	Heavy downpours all day.
26-Jun	1800	R-I	E 5-10	4	9	19	13	2.6	0.64	19.51	BR	Heavy rains.
27-Jun	1936	I-O	W 5	3	9	15	13	2.7	0.65	19.81	BR	A.M. rain - afternoon partly sunny.
28-Jun	1900	O	W 0-5	1	5	13	13	2.6	0.55	16.76	DK	
29-Jun	1900	O	S-SE 0-5	3	3	14	13	2.4	0.35	10.67	DK	Ice on deck of boat 0600.
30-Jun	1900	O	SW 0-10	2	7	15	13	2.1	0.10	3.05	BR	Water dropping fast.
01-Jul	1900	O	S-SE 0-10	1	9	15	14	2.0	-0.03	-0.91	BR	
02-Jul	1830	O	NE 0-5	3	9	15	15	1.9	-0.13	-3.96	BR	
03-Jul	1839	O	NE 5-10	2	7	19	15	1.8	-0.21	-6.40	BR	
04-Jul	1830	O	NE 0-5	1	14	24	15	1.7	-0.30	-9.14	BR	Very warm day - put in well.
05-Jul	1830	O	E 0-5	1	13	24	16	1.7	-0.33	-10.06	BR	Warm night, nice day, bad mosquitoes.
06-Jul	1900	O	E 0-2	1	11	21	17	1.6	-0.38	-11.58	DK	
07-Jul	1800	O	E 0-2	1	9	23	18	1.6	-0.45	-13.72	BR	
08-Jul	1800	O	E 0-2	1	14	24	17	1.5	-0.48	-14.63	BR	Sunny till 1900, 2100 rain and thunder.
09-Jul	1800	R-I	O	4 & 1	13	18	18	1.5	-0.47	-14.33	BR	Rain till 1330, sunny afternoon.
10-Jul	1800	I	E-SE 0-5	3	9	18	18	1.5	-0.46	-14.02	BR	Heavy rain late afternoon.
11-Jul	1800	O	E 0-5	3	12	15	14	1.5	-0.50	-15.24	BR	River falling even though it rained 7-10.
12-Jul	1800	O	E 0-6	3	9	16	14	1.5	-0.53	-16.15	BR	
13-Jul	1800	I	E 0-2	3	9	15	14	1.5	-0.53	-16.15	BR	Intermittent rain till 1400.
14-Jul	1800	O	E 0-2	4	9	15	14	1.6	-0.36	-10.97	BR	
15-Jul	1800	O	E 0-2	1	4	18	14	1.7	-0.28	-8.53	DK	
16-Jul	1900	I	E 0-2	4	5	17	12	1.6	-0.38	-11.58	DK	
17-Jul	1900	I	O	4	8	15	13	1.7	-0.34	-10.36	DK	

[a] Precipitation code: = No precipitation; I = Intermittent rain; R = Continuous rain; S = Snow; S&R = Snow and rain mixed; H =Hail; and T = Thunder showers.

[b] Instantaneous sky code: 0 = No observation; 1 = Clear sky (cloud cover less than 10%); 2 = Cloud cover less than 50%; 3 = Cloud cover between 50% and 100%; 4 = Completely overcast; and 5 = Fog or thick haze.

[c] Instantaneous water color code: Cl = Clear; Lt = Light brown; Br = Brown; Dk = Dark brown; and Tr = Turbid: murky or glacial.