ANVIK RIVER SALMON ESCAPEMENT STUDY, 1995

By

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ABSTRACT

Since 1979 the Anvik River sonar project has estimated daily passage of summer chum salmon *Oncorhynchus keta* using shore-based sonar counters. During the period 19 June through 24 July 1994, an estimated 1,339,418 summer chum passed the sonar site on the Anvik River. This summer chum salmon estimate is 168% above the minimum escapement objective of 500,000 salmon. Overall, the 1995 summer chum salmon run was slightly early. Specifically, all quartile passage days were 2 d earlier than the long-term mean (1979-1994, excluding 1986) timing statistics. Age-4 fish comprised an estimated 53.3% of the passage; age-5 fish accounted for 39.6%. Proportion of age-4 salmon increased over time. Although age-5 salmon dominated the first sampling stratum, age-4 salmon dominated the last three sampling strata, increasing from 56.1% in the second stratum to 70.5% in the final stratum. Female chum salmon comprised an estimated 39.8% of the summer chum salmon passage. This was the lowest estimated percent female composition of the Anvik River escapement since 1974. However, because of the very large escapement, an adequate number of female salmon reached the spawning grounds. Although the proportion of female chum salmon increased throughout the run, male salmon dominated all sampling stratum ranging from 65.6% in the first sampling stratum to 53.2% in the final stratum. A total of 1,147 chinook salmon *O. tshawytscha* were enumerated on an aerial survey of the mainstem index area within Anvik River drainage under good aerial survey conditions. This count is 129% above the minimal escapement goal of 500 chinook salmon for this index area. Age-6 salmon dominated the chinook salmon escapement, accounting for 63.4% of the carcass samples. Age-5 salmon accounted for 23.8%. Female chinook salmon dominated the escapement, accounting for 63.1% of the sample.

INTRODUCTION

Two distinct runs of chum salmon *Oncorhynchus keta*, summer and fall, spawn in the Yukon River drainage. The Anvik River, which empties into the Yukon River at river kilometer (rkm) 512 (Figure 1), is the largest producer of summer chum salmon in the Yukon River drainage. Buklis (1982a) estimated that the Anvik River alone accounts for 35% of the total production. 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 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 during the fall.

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 selected spawning areas. The counts obtained 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 count 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 survey from fixed-wing aircraft on a consistent basis since the early 1960s. Chum salmon escapements have been estimated by this method since the early 1970s. Escapement goals based on aerial surveys have been established for both chinook and chum salmon in selected tributary streams for which there is a sufficient historical database (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 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.

Commencing in 1993, counting towers for chinook and summer chum assessment were operated by Sport Fish Division on the Chena and Salcha Rivers in the Tanana River drainage. However, because of persistent high turbid water in the Chena River, chinook and summer chum salmon counts were not used as an estimate of escapement for this river. During the 1995 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. Salmon counting towers were also operated on Kaltag River (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 the Alaska Cooperative Extension 4-H Program. Bering Sea Fishermen's Association (BSFA) provided partially 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), a major tributary of the Anvik, is located approximately 100 km upstream from the mouth of the Anvik River. Downstream of the confluence of the Yellow and Anvik Rivers, 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 also greatly reduce the water clarity of the Anvik River below this confluence. Numerous oxbows, old channel cutoffs, and sloughs are found throughout the lower 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 by aerial survey.

The Electrodynamics Division of the Bendix Corporation[2] developed a shore-based sonar counter during the 1970s capable of detecting and counting salmon migrating along the banks of streams. A pilot study using this sonar equipment to estimate chum salmon escapement to the Anvik River was conducted in 1979. Results of this study indicated that sonar enumeration of chum salmon escapements to the Anvik River was superior to the counting tower method (Mauney and Buklis

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

1980). Therefore, in 1980, sonar enumeration 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 1994 have been reported by Mauney and Buklis (1980), Buklis (1981, 1982b, 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 1995 field season.

Objectives

Because the majority of the subsistence harvest and some of the commercial summer chum salmon harvest occur in the Yukon River drainage above 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. 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.

METHODS

Sonar Deployment and Operation

A sonar counter has been installed and operated on each bank of the Anvik River near Theodore Creek (Figure 2) each year since 1979. The sonar counter is designed to operate by transmitting a sonic beam along an 18-m aluminum tube, or substrate. Echoes from salmon passing through the beam are reflected back to the transducer. The system electronics interpret the strength and number of the echoes, and tally salmon counts. Criteria for strength and frequency of the echoes are designed to count salmon and minimize non-salmon counts (i.e., debris or other fish species). Aerial survey data indicate that virtually all summer chum salmon spawning activity is located upstream of this site.

During the 1995 season, a 1981-model sonar counter was deployed and operated according to guidelines described by Bendix Corporation (1981) on each bank of the Anvik River to enumerate summer chum salmon passage. Sonar counters were operated without the prescribed artificial aluminum substrate tubes throughout the season. This practice of operation without an artificial substrate has been employed on the Anvik River since 1986 (Buklis 1986). The east and west bank sites used in previous years were probed to locate uniform river bottom gradients that would provide optimum surfaces for ensonification. Each sonar transducer was mounted on a rectangular aluminum frame. Two steel pipes were set into the river bottom on each side of the river, onto which the transducer frames were guided by side-mounted steel sleeves. Sandbags were placed on top of the transducer housing to ensure stability. Sonic beams emitted from each transducer were aimed perpendicular to shore; transducers were offset to prevent interference between units. To prevent fish passage inshore of the transducer, weirs constructed of T-stakes and rectangular mesh fencing were installed perpendicular to the shoreline and downstream of the transducer; they extended from the shore to approximately 1 m beyond the transducer. Counting towers of aluminum scaffolding material approximately 3 m in height were placed near the transducers on each bank for visual observation of salmon when water conditions permitted. Transducers were moved inshore or offshore, as required by fluctuating water levels. Consequently, depth at the transducer varied throughout the season. Transducers were aimed and counting range lengths were adjusted so that echoes resulting from the stream bottom or surface interface did not register as counts by the sonar electronics.

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

The east bank transducer was located along a cutbank approximately 60 m above the field camp site. Initial placement of the east bank transducer was approximately 1.0 m offshore and at a depth of 1 m. The west bank transducer was located along a gradually sloping gravel bar, approximately 3 m downstream of the east bank transducer. Initial placement of the west bank transducer was approximately 9.0 m offshore and was also in water about 1 m deep.

Sonar Calibration and Sampling

Each sonar counter was usually calibrated four times daily by observing fish passage using an oscilloscope. Salmon passing through the sonar beam produce a distinctive oscilloscope trace or spike. During each calibration period counts of salmon enumerated by the observer using the oscilloscope were compared to counts recorded by the sonar electronics. The fish velocity control setting on the sonar counter was adjusted immediately after a calibration if the oscilloscope:sonar counts ratio varied from 1.0 by 15% or more. The existing fish velocity setting was multiplied by this ratio to obtain the correct new setting. If adjustments were made

to the sonar unit an additional calibration was made to ensure that the oscilloscope:sonar count ratio was within accepted limits, ±15%, and to initialize the counting period. Each calibration lasted for at least 15 min or until 100 salmon were counted by the observer, whichever was less.

Attempts were also made to visually enumerate fish passage from 3 m counting towers during sonar calibration times as a further check on sonar accuracy and to train operators in oscilloscope monitoring. Observers wore polaroid sunglasses to reduce water surface glare. Attempts to visually enumerate salmon during calibration times were discontinued from the west bank when it became apparent that the presence of the observer on the tower interfered with the normal passage of salmon past the sonar site. Salmon passed farther offshore when the observer was on the tower. Tower observations were usually conducted in association with calibration periods on the east bank and immediately after calibration periods on the west bank. Observation of salmon passage on each bank was hampered by glare, which resulted from overcast skies and reflection of the sun off the water, and time of day. On overcast days observation of salmon passage was not possible.

Four daily calibration times were deemed adequate to monitor the diel timing pattern of the salmon migration. Calibrations were normally conducted during 0600, 1200, 1800, and 2400 hours. However, during the initial and last days of the project when fish passage was low, calibrations were conducted during 0800, 1300, 1800, and 2400 hours. Occasionally, calibration times deviated from prescribed times because of more important priorities. 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:

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

where A = periodic adjustment factor,
b = west or east 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.

The periodic adjustment factor was applied to the unadjusted sonar counts for each hour within the associated calibration period for each bank. The resulting corrected sonar counts for each hour within a day were summed, yielding the estimated summer chum salmon passage for that day for that bank. Corrected hourly counts were calculated and totalled for each day and bank using a portable 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 counts by the raw sonar counts. Raw sector counts for each day were corrected by using the overall daily correction factor. Corrected hourly and sector counts were used to determine the temporal and spatial distribution of the summer chum salmon run.

Sonar counters do not distinguish between species of salmon. However, a separate escapement estimate for chinook salmon was obtained by aerial survey. This count was not subtracted from the chum salmon sonar count because I assumed that most chinook salmon were not counted by the sonar counters. This assumption was based on tower observations which indicated that in most years, most chinook salmon migrated up the middle of the stream channel beyond the ensonified zones. Additionally, the number of chinook salmon annually observed during aerial surveys conducted under fair or good conditions have averaged <0.40% of the estimated sonar counts of summer chum salmon escapement from 1979-1994. In 1995 chinook salmon observed during an aerial survey flight corresponded to a very small portion of the sonar count, 0.15%. Therefore, it is assumed that the extremely low percentage of summer chum salmon counts possibly being registered by chinook salmon is inconsequential to the summer chum salmon count.

Similar to other odd-numbered years, pink salmon were not observed from the observation towers during the 1995 season. Additionally, only one pink salmon was captured in beach seine operations. Further, the capture of the lone pink salmon occurred on the last day of seining operations, 23 July. Therefore, because of the obvious low numbers of pink salmon passing the sonar site it is assumed that the extremely low percentage of summer chum salmon counts possibly being registered by pink salmon is inconsequential to the summer chum salmon count.

Missing hourly sector counts not recorded as a result of debris or printer malfunction were estimated by averaging the counts in the same sector for the hour before and after the count in question. When hourly counts were not recorded for more than 3 h and less than 12 h within one day, the corrected total daily count for that day was estimated by dividing the corrected partial daily count by the mean proportion of corrected counts for the corresponding hours for the first day before and after the day in question having full 24-h counts. When hourly counts were not recorded for 12 h or more within a day, the passage estimate for that day was estimated by averaging the estimated daily counts for the first day before and after the day in question having full 24-h counts. Estimated counts were not distributed by hour and sector for periods of unrecorded hourly counts which were estimated for a time period of greater than 2 h.

When flooding conditions or equipment malfunction resulted in suspension of counting operations on one bank for a more than one day, daily counts were estimated based on the salmon passage on the opposite bank in conjunction with an estimate of bank-specific passage proportion. During the 1995 season, counting operations on one bank were not suspended for more than one day.

Run timing statistics, quartile days, were calculated and compared to other years.

Age-Sex-Size Sampling

Season strata used for the comparison of 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 preseason 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 size measurements. All resident fresh-water fish captured were enumerated by species and released. Chinook and pink salmon were enumerated by sex and released. Chum salmon were placed in a holding pen, enumerated by sex, and measured in millimeters from mid-eye to fork-of-tail. Additionally, one scale was taken for age determination from chum salmon. 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 chum salmon before release to prevent resampling. Additionally, chinook salmon carcasses were sampled in August for determination of age and for use in a stock identification study. Three scales were taken from each chinook salmon carcass sampled. Scale samples were later pressed on acetate cards and the resulting impressions viewed on a microfiche reader for age determination.

Sample size goals for each species were based on 95% precision with a 10% accuracy for each time stratum. A sample size of 138 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). However, the sample size goal was increased to 160 per stratum to account for unageable 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% unageable rate (Bromaghin 1993). However, a sample size of 400 chinook salmon from the Anvik River spawning population was deemed necessary for inclusion into the scale pattern analysis baseline for the Lower River chinook salmon stock (D. Schneiderhan, Alaska Department of Fish and Game, Anchorage, personal communication).

Hydrological and Climatological Sampling

A water depth profile was measured 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 east bank sonar site was initially situated approximately 3 m upriver from the west bank site, one transect situated between the sites served to describe the profiles. Because of time restraints on the crew, transect profile data were collected only two times during the season.

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 by the crew describing wind speed and direction, cloud cover, and precipitation.

RESULTS AND DISCUSSION

Escapement Estimation

Sonar Assessment

Two sonar counters were operated on the Anvik River from 19 June through 24 July at the same sites used in previous years. A relatively small portion of the central river channel, approximately 14 m, was not ensonified on 30 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 10 m on 19 July. Because sonar beam width and height increased with distance from the transducer, the ensonified zone also encompassed most of the vertical water column within the counting range.

The escapement estimate for the period 19 June through 24 July was 1,339,418 summer chum salmon (Table 1). The day on which salmon were first counted at the Anvik River sonar site in 1995, 19 June, was the earliest on record along with 1993 and 1994 (Table 2). Quartile passage days for the summer chum salmon run occurred on 1 July, 6 July, and 11 July (Table 2; Figure 5). All quartile days were 2 d earlier than the 1979-1994 average (Table 2). The duration of the mid-50% portion of the 1995 run lasted 10 d, which is also the 1979-1994 average duration (Table 2). Based on historic timing statistics the 1995 chum run at the sonar site was evaluated as slightly early and of average duration (Figure 6).

Daily summer chum salmon passage ranged from 27,695 to 105,992 chum salmon between the first and third quartile days in 1995. Passage was greatest during the 7-d period, 2-8 July. This peak passage period was contained within the mid-50% of the run and included the median day of passage, 6 July. During this 7-d period, 486,293 salmon, or 36% of the total season escapement, passed the sonar site. Summer chum salmon passage peaked on two consecutive days, 6 July, 105,422, and 7 July, 105,992 (Table 1). Summer chum salmon passage during these two days accounted for 16% of the total estimated passage. As in 1993 and 1994, chum salmon were first counted passing the sonar site on 19 June, the earliest on record. However, this is more likely a function of initiation of project operations rather than summer chum salmon run

timing. In most years, some salmon pass by the sonar site prior to and after project operations. However, these numbers are small and probably comprise a small percent of the total run.

Buklis (1982a) expanded the season escapement estimates for 1972 through 1978, making it possible to more directly compare visual count estimates to more recent annual sonar count estimates. The 1995 Anvik River escapement was the second highest on record (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 1995 escapement estimate of 1,339,418 summer chum salmon was 159% greater than the weighted parent-year escapement from years 1989-1992 of 571,006 fish, and was 101% above the long-term (1972-1993) annual average of 665,715 fish.

A total of 38.17 h of sonar calibration were conducted over the 36-d period from 19 June - 24 July at the west bank site. West bank sonar accuracy (sonar count/oscilloscope count) averaged 1.05 (Table 3). Sonar accuracy averaged 1.0[illegible] for 32.77 h of oscilloscope calibration at the east bank site for the same period (Table 3).

Buklis (1982b) first noticed a distinct diurnal salmon migration pattern during the 1981 season with a higher proportion of the salmon migration past the sonar site during the evening hours. A similar pattern was observed during the years 1985 through 1994 by Buklis (1985, 1986, 1987) and Sandone (1989, 1990a, 1990b, 1993, 1994a, 1994b, 1995). In 1995 temporal distribution of the west (Appendix A) and east (Appendix B) bank adjusted sonar counts by hour also indicated a distinct diel pattern of salmon passage (Figure 8). Based upon adjusted counts for days with full 24-h counts, salmon passage was lowest, less than 4.0% of the daily passage per hour, from 0700 to 1800 hours (averaging 3.2% of the daily passage per hour) and greatest, greater than or equal to 5.0% of the passage, from 0000-0300 and 2100-2400 (averaging 5.5% of the daily passage per hour). Chum salmon passage during the periods 0300 - 0700 and 1800-2100 was intermediate, averaging 4.5% of the daily passage per hour. This pattern was relatively consistent throughout the season (Figure 9) and very similar to the historical temporal distribution pattern of the migration.

In all but one year that sonar was used to estimate Anvik River summer chum salmon escapement, a majority of the escapement passage has been associated with the west bank (Mauney and Buklis 1980; Buklis 1981, 1982b, 1983, 1984a, 1984b, 1985, 1986, 1987; Sandone 1989, 1990a, 1990b, 1993, 1994, 1994b, 1995). In 1992, only 43% of the total adjusted counts were observed on the west bank (Sandone 1994a). This percentage was very dissimilar to the historical average, and was attributed to very low water conditions which affected salmon migration patterns at the sonar site. In 1995, the salmon migration was considered temporally normal, but the spatial migration was equally divided between both banks. In 1995, approximately 51.3% of the chum salmon migrated along the west shore (Table 1). The 1985-94 average percent of adjusted counts of salmon which migrated along the west bank is 71.5%.

As in previous years, I assumed that only a very small portion of the total summer chum salmon passage was not counted during the operational period. This assumption was especially plausible in 1995 considering the low water levels encountered. This assumption is supported by the general absence of chum salmon passage in offshore sectors (Figure 8).

Combined chum salmon passage along the west bank (Figure 8) was greatest in near-shore sector 2, 24.5%, and decreased in sectors farther offshore (Appendix C). Sectors 1 through 3 accounted for 47.0% of the total chum salmon passage and 94.1% of the west bank passage estimate. This distribution of salmon passage along the west bank was very similar to previous years. Combined salmon passage along the east bank (Figure 8) did not exhibit the anomalous pattern observed during the 1992 migration, but was somewhat dissimilar to migration patterns observed for years prior to 1992 and for 1993. In those years, near-shore sectors accounted for the majority of the passage along the east bank. In 1995, salmon passage was near equally distributed throughout the eight near-shore sectors, sectors 25-32 (Appendix D). Chum salmon passage through these sectors ranged from 4.5% to 6.9% of the total 1995 combined salmon passage (Figure 8). This observed difference in salmon passage from most other years is probably associated with low water conditions, as experienced in 1992 and this year. Combined, these eight near-shore sectors accounted for 43.8% of the total 1995 chum salmon passage and 87.6% of the total east bank passage. Together, near-shore sectors 1-3 and 25-32 accounted for 90.9% of the estimated 1995 summer chum passage. The remaining 9.9% chum salmon passage was distributed over the remaining 21 sectors (Figure 8). Estimated sector-specific chum salmon passage in the offshore west-bank sectors 5-16 and east-bank sectors 17-22 was less than 1.0%. Total estimated passage in these offshore sectors was 2.9%.

In many years, summer chum salmon passage along the east bank has increased during the season. This bank-oriented migrational shift has been observed in 1990, 1991, 1993, and 1994 (Sandone 1990b; 1993, 1994b, 1995). During 1992, however, the opposite shift was observed. The 1992 summer chum migration shifted from a dominant east-bank to west bank migration (Sandone 1994a). The shift away from an east-bank migration was also evident in the 1995 migration. In 1995, percent of salmon passage along the east bank increased from 48.4% to 58.2% during the first three strata and then declined to 32.6% during the final stratum. This similarity with the 1992 migration may be related to the low water conditions experienced during both years.

Throughout the season, spatial salmon passage along the west bank remained fairly constant, with salmon passage in sector 2 dominating all other sectors (Figure 10). Salmon migration along the east bank was fairly equal among the eight onshore sectors, sectors 25-32. This migration pattern was probably also caused in part by the low water conditions in 1995. Apparent minor shifts in spatial migration pattern was 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.

Management Implications Inseason Anvik River passage estimates in conjunction with the Yukon River sonar passage estimates played a major role in the management of the middle and upper Yukon River (Upper Yukon Area) fisheries in 1995. Comparison of passage data from these projects was used to assess summer chum salmon run size above the confluence of the Anvik and Yukon Rivers. Based on these projects, a harvestable surplus of summer chum salmon was identified within the Anvik River drainage and above the Anvik-Yukon Rivers confluence early in the season. However, because of a weak chum salmon market for salmon flesh, the Lower Yukon Area summer chum salmon harvest was below the lower end of the guideline harvest range (ADF&G 1995). 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 (ADF&G 1995). Because of the limited summer chum salmon harvest in the Lower Yukon Area, in conjunction with the large run of summer chum salmon, an extraordinary large surplus of summer chum salmon was available for harvest in the Upper Yukon Area. Consequently, the sale of roe in Subdistrict 4-A and the Anvik River Management Area was allowed to reach the roe caps. Additionally, based on escapement data from the Anvik River project and other escapement projects in the middle river area, a record harvest of chum salmon for salmon roe production was allowed in Subdistricts 4-B and 4-C. Few summer chum salmon were commercially harvested in District 5. The District 6 fishery was managed based on data from the counting tower projects on the Chena and Salcha Rivers.

Based on a preliminary Yukon River sonar passage estimate of approximately 3.7 million summer chum salmon, reported commercial and estimated subsistence harvests, and the estimated escapement to the Anvik River, approximately 1.7 million summer chum salmon escaped to tributaries above the Yukon River sonar site, other than to the Anvik River. This escapement level is nearly triple the estimated 1994 escapement level of 600,000 summer chum salmon (Sandone 1995). Escapement objectives appeared to have been achieved throughout the drainage for the second consecutive. A tower count of 236,890 summer chum salmon on the mainstem Nulato River (Table 4) suggested that the aerial survey escapement goal for the North Fork Nulato River, of 53,000 chum salmon, was probably achieved. A tower count on Clear Creek of the Hogatza-Koyukuk River drainage of 116,735 summer chum salmon (Table 4) indicated that the aerial survey escapement goal of 9,000 salmon was achieved. A tower count on the Salcha River of 31,329 summer chum salmon (Table 4) indicated that the aerial survey escapement goal of 3,500 was also probably achieved. Escapement surveys of the one other tributary which has an established escapement goal, Caribou Creek of the Hogatza River, was not conducted during 1995. However, because of the documented very large escapement to Clear Creek, which is proximal to the Caribou Creek drainage, I assume that escapement to that tributary was also good. Tower and weir counts of escapements to other upper river tributaries, which do not have established escapement goals (Table 4), indicated that summer chum salmon escapement was extremely good. Further, a weir count of 172,148 summer chum salmon on the East Fork of the Andreafsky River (Table 4) indicated that escapement to lower river tributaries was also good. This evaluation of good to excellent river-wide summer chum salmon escapement

is much different than the poor escapements observed for spawning stocks, other than the Anvik River, for a number of years prior to 1994.

Aerial Survey Assessment

An aerial survey of the Anvik River drainage was flown on 21 July under good survey conditions. A total of 1,996 chinook salmon were enumerated within the drainage above the sonar site. Within the aerial survey index area, from the Yellow River to McDonald Creek, 1,147 chinook salmon were counted. The chinook salmon count within the index area is 129% above the minimum escapement goal of 500 chinook salmon established for this index area. Summer chum salmon were observed but not counted. Pink salmon were not observed.

Age and Sex Composition

Summer Chum Salmon

Twenty-six beach seine sets were made from 27 June to 23 July on 18 individual days (Appendix E). Of the 1,964 summer chum salmon captured, 667 were sampled for age, sex, size information (Appendix E.) Stratum sampling sizes for summer chum salmon were 139, 159, 107, and 262 for the four sampling strata. Of those fish sampled for scales for age determination, 131, 147, 97, and 241, respectively, had ageable scales. Therefore, the sampling goal of 138 ageable scales per stratum was achieved only for the second and fourth strata. Although the first sampling stratum was only 5% below the sampling goal, the third sampling stratum was 30% below the goal. Overall, of the 667 chum salmon sampled for age-sex-size data, 92% had ageable scales. The 1995 percentage of ageable scales is slightly higher than the 90% expected.

Sample sizes have been sufficient since 1989 to examine sex and age composition by sampling stratum. In all years, age and sex 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 1995 run (Figure 11). In 1995 age-5 chum salmon dominated the first stratum (Figure 11), accounting for 52.9% of the passage. Age-4 salmon dominated the final three strata, increasing from an estimated 56.1% of the passage in the second stratum to 70.5% of the passage in the fourth stratum (Figure 11). Age composition of the escapement, weighted by strata escapement counts, was 2.7% age 3, 53.3% age 4, 39.6% age 5, and 4.4% age 6 (Appendix F). The contribution of age-3, age-4, and age-5 salmon were similar to the long-term (1972-1994) average contribution of these age groups, 3.0%, 58.3%, and 37.7%, respectively. Although a relatively small component, the contribution of age-6 salmon to the 1995 run was a record high contribution. The long-term average contribution of age-6 salmon to the escapement is 0.9% (Appendix F).

Although a below average to average summer chum salmon run was expected for the Yukon River in 1995 (ADF&G 1995), the run developed much better than expected. Unanticipated production from the 1990 brood year, in conjunction with very good production from the 1991 brood year, resulted in a total estimated summer chum salmon run of over 4.0 million fish in 1995.

Age-4 chum salmon dominated the Anvik River escapement in 16 of the 23 years of record. Age-5 chum salmon dominated the escapement in 1972, 1976, 1981, 1986, 1989, 1991, 1992, and 1994 (Figure 12). However, age-5 salmon dominated the escapement in 4 of the last 7 years. Because of this recent frequent domination of the escapement, and probably the run and return as well, the average age of maturation has increased from 4.29 years (1972-1985 average) to 4.37 years (1972-1995 average; Figure 13). The average age of the Anvik River escapement for the years 1989-1995 is 4.53 years. Additionally, my recent, unpublished research has indicated that production from three of the five most recent returning brood years, 1986-1990, have been dominated by age-5 salmon. Age-5 salmon has dominated production from the 1986, 1987 and 1989 brood years. Production from the remaining two brood years, 1988 and 1990, appears to have resulted in near equal returns of age-4 and -5 salmon. Bigler and Helle (1994) described shifts in both average size and age at maturity in Yukon River summer chum salmon. They explain 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 explain that reduced growth delays the onset of the spawning migration, hence, the apparent increase in the age of maturation.

In 1995, female chum salmon accounted for 39.8% of the escapement to the Anvik River. This is the lowest percentage 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 and for 20 of the 24 years of record (Appendix F). Overall, the female contribution has ranged from 39.1% in 1974 to 69.4% in 1982; the 1972-1994 mean percentage is 57.3%. From 1974 to 1989, the running mean percent female salmon in the Anvik River escapement increased. Since 1989, but prior to 1995, the running mean percent female appeared to have stabilized (Figure 13). However, in 1995, even with the commercial fishery in the lower portion of the Anvik River, which harvested only female chum salmon for roe production, the very low female component percentage of the Anvik River escapement was unexpected. However, because the 1995 summer chum salmon run to the Anvik River was very large, the number of females which escaped to spawn in 1995, approximately 533,000 salmon, was very large and even exceeded the minimum escapement goal for both sexes of chum salmon for the Anvik River. Therefore, although the quality of the escapement was poor, the number of female salmon in the escapement was more than adequate to provide for escapement needs.

Similar to recent years (Sandone 1990a, 1990b, 1993, 1994a, 1994b, 1995), the female component of the 1995 Anvik River escapement increased as the run progressed. In prior years, male chum salmon usually dominated at least the first sampling stratum, whereas, female salmon

increased as the run progressed, male chum salmon dominated each stratum, ranging from 65.6% in the first stratum to 53.2% in the final stratum (Figure 11).

Generally, in previous years, age class compositions of both the Anvik River escapement and the District 1 summer chum salmon commercial harvest have been very similar (Figure 14). However, in 1995 this trend did not persist. Although both escapement and harvest samples contained few age-3 and age-6 salmon, the District 1 commercial harvest was dominated by age-5 salmon while the Anvik River escapement was dominated by age-4 salmon. The preliminary, weighted age-class composition estimate of the 1995 District 1 summer chum salmon harvest was 0.0% age 3, 33.8% age 4, 58.7% age 5, and 7.2% age 6 (D. Schneiderhan, Alaska Department of Fish and Game, Anchorage, personal communication). Note that a smaller proportion of age-3 salmon were caught than were estimated in the escapement, while a larger proportion of age-6 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, male salmon dominated the Anvik River escapement and the District 1 harvest (Figure 15). Male salmon comprised 53.0% of the 1995 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, and the disproportionate harvest over the duration of the summer chum salmon run.

Chinook Salmon

As in most years, no chinook salmon were captured by beach seine. However, 436 chinook salmon carcass samples were collected by boat survey in August. Of the chinook salmon sampled for age-sex-size data, 404 (93%) provided ageable scales. Age composition was 9.2% age 4, 23.8% age 5, 63.4% age 6, and 3.7% age 7 (Figure 16). Females accounted for 63.1% of the sample (Appendix G), much greater than the 40.3% long-term average (1972-1993 excluding 1974 when no samples were obtained). The 1989 brood year dominated escapement samples in 1994 and 1995. The high proportion of female salmon estimated in the 1995 spawning population was in part because of the high proportion of age-6 salmon. Generally, age-6 chinook salmon in the Yukon River drainage is dominated by female salmon.

Age composition of the District 1 commercial harvest was approximately 3.2% age 4, 11.5% age 5, 81.0% age 6, and 4.3% age 7. Female chinook salmon accounted for 50.1% of the harvest (D. Schneiderhan, Alaska Department of Fish and Game, Anchorage, personal communication). Typically, the District 1 commercial catch and Anvik River escapement age composition samples of chinook salmon are quite dissimilar (Figure 17). Anvik River escapement has typically been composed of younger-aged salmon than the District 1 commercial harvest (Figure 17). This difference was also observed in 1995. As in other years, the age-6 chinook salmon contributed a higher proportion to the commercial fishery than to the Anvik River escapement, while age-4

and -5 chinook salmon contributed more to the escapement than to the commercial harvest. This difference is most likely because of the differences in age compositions and run strengths of the various chinook stocks present in the lower river during the harvest period and secondarily to the size-selective nature of the commercial gillnets.

Hydrologic and Climatological Sampling

River transect data collected on 30 June and 19 July indicated 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 65 m on 30 June to 57 m on 19 July. Maximum depth, and probably maximum river width, occurred on 18 June, the first day of record in 1995 (Appendix H). Similar to most previous years, river water level decreased in a consistent regular manner throughout the season. Rain events did not have long-lasting effects on river water level until 22 July, when continuous heavy rain caused the river water level to rise (Figure 4). During the season, water level dropped a total of 83.2 cm (Figure 4; Appendix H).

Instantaneous water temperature ranged from a low of 9° C recorded on 22, 23, and 28 June, to a high of 17° C recorded on 3 days, 13, 14, and 20 July. Daily minimum and maximum air temperatures ranged from a minimum low of 2° C, observed on 3 July, to a maximum high of 28° C, observed on 21 June (Figure 4; Appendix H).

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TABLES

Table 1. Anvik River sonar counts by day, 19 June - 24 July, 1995.

Date	West Bank				East Bank				Entire River		
	Raw Daily Count[a]	Adjust Factor	Corrected Daily Count[b]	Percent. of Daily Total	Raw Daily Count[a]	Adjust Factor[a]	Corrected Daily Count[b]	Percent. of Daily Total	Raw Daily Count[a]	Corrected Daily Count[b]	Corrected Season Count[b]
19-Jun [c]	398	0.99	395	100.0					0	395	395
20-Jun	2,518	1.45	3,648	100.0					2,518	3,648	4,043
21-Jun [d]	4,871	0.99	4,799	82.3	909	1.14	1,032	17.7	5,780	5,831	9,874
22-Jun	8,233	1.04	8,566	73.6	2,985	1.03	3,073	26.4	11,218	11,639	21,513
23-Jun	6,083	0.90	5,498	85.1	856	1.12	961	14.9	6,939	6,459	27,972
24-Jun	5,062	1.05	5,329	61.1	3,743	0.91	3,394	38.9	8,805	8,723	36,695
25-Jun	11,203	1.00	11,206	73.2	4,598	0.89	4,096	26.8	15,801	15,302	51,997
26-Jun	4,888	0.98	4,776	50.9	4,973	0.93	4,613	49.1	9,861	9,389	61,386
27-Jun	9,881	0.96	9,447	25.8	29,907	0.91	27,198	74.2	39,788	36,645	98,031
28-Jun	32,373	0.93	30,228	38.4	50,127	0.97	48,450	61.6	82,500	78,678	176,709
29-Jun	59,897	0.95	56,644	64.4	31,575	0.99	31,307	35.6	91,472	87,951	264,660
30-Jun	37,945	0.91	34,508	65.2	18,386	1.00	18,389	34.8	56,331	52,897	317,557
01-Jul	32,408	0.89	28,828	54.1	23,441	1.04	24,469	45.9	55,849	53,297	370,854
02-Jul	29,591	1.08	31,825	38.7	50,046	1.01	50,403	61.3	79,637	82,228	453,082
03-Jul	29,769	0.96	28,586	48.3	30,556	1.00	30,620	51.7	60,325	59,206	512,288
04-Jul	20,583	1.00	20,583	74.3	7,219	0.99	7,112	25.7	27,802	27,695	539,983
05-Jul	26,300	0.98	25,859	51.1	25,379	0.98	24,783	48.9	51,679	50,642	590,625
06-Jul	31,063	1.06	32,870	31.2	70,313	1.03	72,552	68.8	101,376	105,422	696,047
07-Jul	45,768	0.95	43,612	41.1	59,353	1.05	62,380	58.9	105,121	105,992	802,039
08-Jul	43,749	0.86	37,693	68.4	18,285	0.95	17,415	31.6	62,034	55,108	857,147
09-Jul	21,943	0.96	21,092	54.6	16,507	1.06	17,554	45.4	38,450	38,646	895,793
10-Jul	18,007	1.15	20,672	34.4	36,381	1.08	39,444	65.6	54,388	60,116	955,909
11-Jul	12,119 [f]	0.94	22,591	35.3	41,004	1.01	41,479	64.7	53,123	64,070	1,019,979
12-Jul	17,934	1.06	19,067	46.3	22,248	1.00	22,153	53.7	40,182	41,220	1,061,199
13-Jul	19,207	0.96	18,515	46.7	20,771	1.02	21,123	53.3	39,978	39,638	1,100,837
14-Jul	18,497	0.99	18,235	54.0	15,073	1.03	15,508	46.0	33,570	33,743	1,134,580
15-Jul	27,340	0.97	26,467	66.2	13,165	1.03	13,510	33.8	40,505	39,977	1,174,557
16-Jul	21,244	0.94	19,866	64.8	11,379	0.95	10,774	35.2	32,623	30,640	1,205,197
17-Jul	17,387	0.83	14,463	58.0	10,127	1.04	10,487	42.0	27,514	24,950	1,230,147
18-Jul	20,146	0.95	19,081	74.4	6,979	0.94	6,557	25.6	27,125	25,638	1,255,785
19-Jul	11,444	0.91	10,412	61.9	6,542	0.98	6,402	38.1	17,986	16,814	1,272,599
20-Jul	29,047	0.66	19,316	72.6	6,819	1.07	7,306	27.4	35,866	26,622	1,299,221
21-Jul	0 [h]		14,773	77.1	4,475	0.98	4,381	22.9	4,475	19,154	1,318,375
22-Jul	10,294	0.99	10,230	87.2	1,506	1.00	1,505	12.8	11,800	11,735	1,330,110
23-Jul	6,045	0.91	5,530	92.4	429	1.05	452	7.6	6,474	5,982	1,336,092
24-Jul	2,605	0.97	2,522	75.8	747	1.08	804	24.2	3,352	3,326	1,339,418
Total	693,237		687,732		646,803		651,686		1,342,247	1,339,418	
Percent[i]	51.6		51.3		48.2		48.7		100.0	100.0	
Mean		0.97		61.9		1.01		40.3			

[a] Includes estimates for missing hourly counts for 6 or less missing hourly counts per day.
[b] Includes estimates for missing hourly and daily counts.
[c] Counting operations were initiated on the west bank on 19 June at 1500 hours.
[d] Counting operations were initiated on the east the bank on 21 June at 1800 hours.
[f] Counting operations were interrupted, resulting in a partial daily count. Missing count data were estimated. See Appendix A and B for more information.
[g] Pertains only to the available raw sonar counts and the associated adjusted counts.
[h] Daily count unavailable. Daily bank-specific passage was estimated. See Appendix A and B for more information.
[i] Percent of entire river counts.

Table 2. Annual Anvik River sonar passage estimates and associated passage timing statistics of the summer chum salmon run, 1979-1995.

Year	Sonar Passage Estimate	Day of First Salmon Counts	First Quartile Day	Median Day	Third Quartile Day	Days Between Quartile Day		
						First & Median	Median & Third	First & Third
1979	277,712	23-Jun	02-Jul	08-Jul	12-Jul	6	4	10
1980	482,181	28-Jun	06-Jul	11-Jul	16-Jul	5	5	10
1981	1,479,582	20-Jun	27-Jun	02-Jul	07-Jul	5	5	10
1982	444,581	25-Jun	07-Jul	11-Jul	14-Jul	4	3	7
1983	362,912	21-Jun	30-Jun	07-Jul	12-Jul	7	5	12
1984	891,028	22-Jun	05-Jul	09-Jul	13-Jul	4	4	8
1985	1,080,243	05-Jul	10-Jul	13-Jul	16-Jul	3	3	6
1986	1,085,750	21-Jun	29-Jun	02-Jul	06-Jul	3	4	7
1987	455,876	21-Jun	05-Jul	12-Jul	16-Jul	7	4	11
1988	1,125,449	21-Jun	30-Jun	03-Jul	09-Jul	3	6	9
1989	636,906	20-Jun	01-Jul	07-Jul	13-Jul	6	6	12
1990	403,627	22-Jun	02-Jul	07-Jul	15-Jul	5	8	13
1991	847,772	21-Jun	01-Jul	10-Jul	16-Jul	9	6	15
1992	775,626	29-Jun	05-Jul	08-Jul	12-Jul	3	4	7
1993	517,409	19-Jun	05-Jul	12-Jul	18-Jul	7	6	13
1994	1,124,689	19-Jun	01-Jul	07-Jul	11-Jul	6	4	10
1995	1,339,418	19-Jun	01-Jul	06-Jul	11-Jul	5	5	10
Mean[a]	749,459 [b]	23-Jun	03-Jul	08-Jul	13-Jul	5.3	4.9	10.2
SE[a]	353,724 [b]	4.4	3.4	3.2	3.0	1.8	1.4	2.5

[a] The mean and SE 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 timing statistic and associated SE.

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Table 3. Sonar and corresponding oscilloscope counts of salmon at the Anvik River west and east bank sonar sites, 1995.

Date	West Bank Sonar Site				East Bank Sonar Site			
	Elasped Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope	Elasped Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope
19-Jun	00:45	46	47	0.98	00:00			
20-Jun	02:00	200	301	0.66	00:00			
21-Jun	01:30	368	354	1.04	00:15	104	116	0.90
22-Jun	01:38	424	419	1.01	01:01	85	83	1.02
23-Jun	01:15	168	168	1.00	01:27	36	44	0.82
24-Jun	02:20	538	623	0.86	01:01	192	171	1.12
25-Jun	00:56	370	371	1.00	02:00	203	172	1.18
26-Jun	01:00	268	251	1.07	01:03	127	117	1.09
27-Jun	01:28	613	595	1.03	01:11	689	617	1.12
28-Jun	01:19	1,518	1,206	1.26	00:35	701	708	0.99
29-Jun	00:26	644	609	1.06	00:35	461	447	1.03
30-Jun	00:35	674	631	1.07	00:30	274	271	1.01
01-Jul	01:01	676	589	1.15	01:17	467	482	0.97
02-Jul	00:21	542	604	0.90	00:22	316	309	1.02
03-Jul	00:34	527	500	1.05	00:46	563	533	1.06
04-Jul	00:08	201	201	1.00	00:15	94	100	0.94
05-Jul	00:18	326	318	1.03	00:56	650	597	1.09
06-Jul	01:09	949	1,105	0.86	00:14	482	503	0.96
07-Jul	00:22	599	517	1.16	00:15	384	405	0.95
08-Jul	00:54	1,021	901	1.13	01:16	716	661	1.08
09-Jul	00:29	425	419	1.01	00:45	542	601	0.90
10-Jul	00:43	515	600	0.86	00:21	336	400	0.84
11-Jul	00:58	594	576	1.03	00:20	416	408	1.02
12-Jul	01:06	594	666	0.89	01:29	878	884	0.99
13-Jul	00:48	521	507	1.03	00:50	457	475	0.96
14-Jul	00:55	734	705	1.04	00:51	426	410	1.04
15-Jul	00:33	384	350	1.10	01:45	636	668	0.95
16-Jul	00:44	627	582	1.08	00:47	385	363	1.06
17-Jul	01:12	555	461	1.20	01:00	241	238	1.01
18-Jul	01:22	803	704	1.14	01:00	199	198	1.01
19-Jul	01:48	1,013	924	1.10	01:35	506	466	1.09
20-Jul	01:28	791	556	1.42	00:47	102	107	0.95
21-Jul	01:59	1,422	1,004	1.42	02:15	403	435	0.93
22-Jul	01:25	484	450	1.08	01:30	195	174	1.12
23-Jul	01:36	429	402	1.07	01:16	37	40	0.93
24-Jul	01:03	173	173	1.00	01:15	30	33	0.91
Total	38:10	20,563	19,216	1.07	32:46	12,303	12,203	1.01
Mean				1.05				1.00

Table 4. Summer chum salmon escapement counts for selected spawning areas in the Alaskan portion of the Yukon River drainage, 1973-1995.

	Andreafsky River			Anvik River			Kaltag Cr.	Nulato River			Gisasa River		Hogatza River		Tozitna	Chena River		Salcha River	
	East Fork							Aerial					Clear & Caribou Cr.	Clear Creek					
Year	Aerial [a]	Sonar, Tower, or Weir Cnts	West Fork [a]	Tower & Aerial [b]	Sonar	Rodo River [a]	Tower Counts	South Fork	North Fork [c]	Mainstem Tower Counts	Aerial	Weir	Aerial	Tower Counts	River [a]	Aerial	Tower	Aerial	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, ^]	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	10,108	4,916	39,343
1995 [w]		172,148 [j, p]			1,339,418	12,849	75,240	10,875	29,949	236,890	6,458	136,886		116,735	4,985	185 [d]	3,475 [q]	934 [d]	31,329
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, 1995
[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 June30.
[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

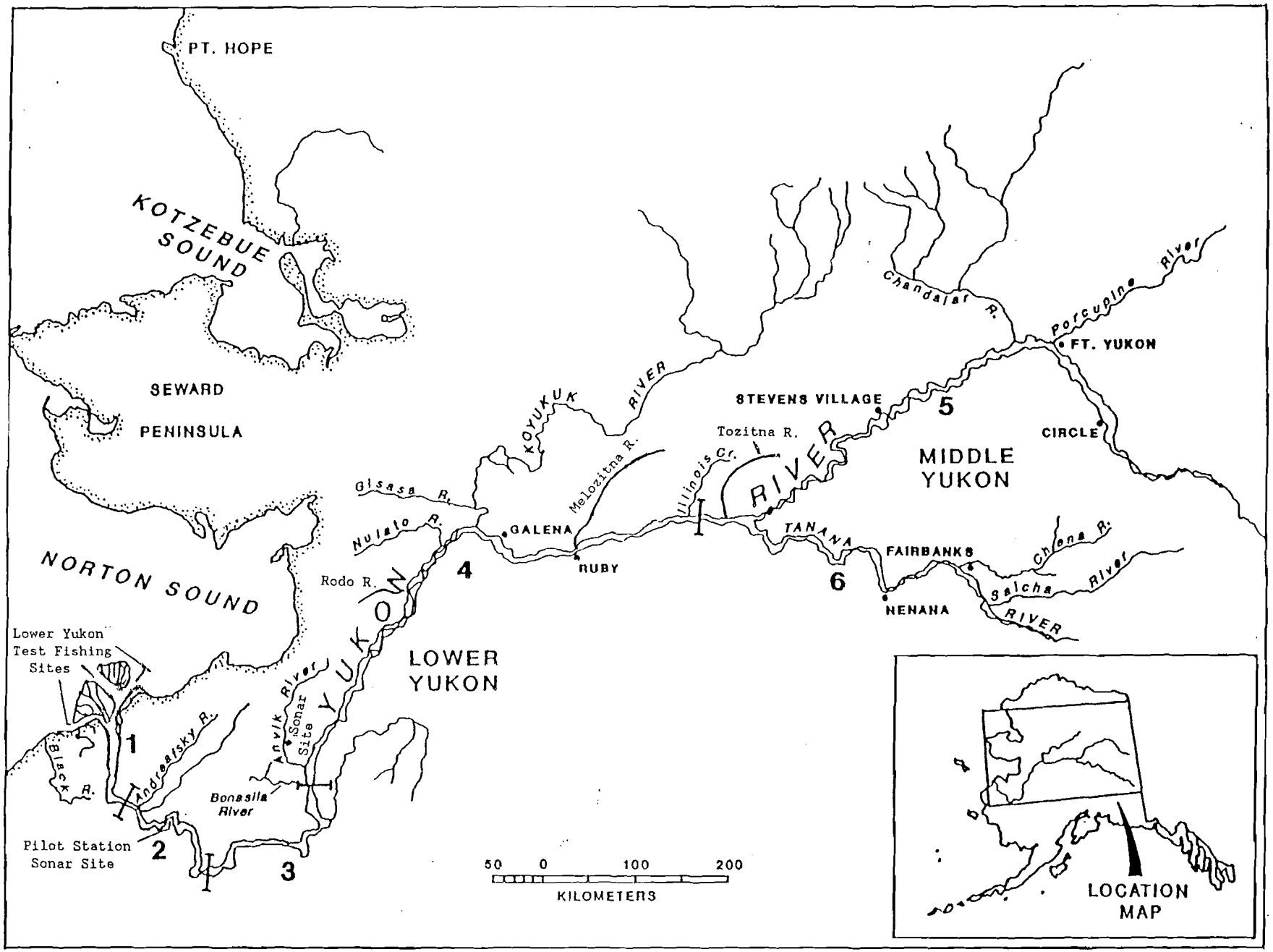

Figure 1. Alaskan portion of the Yukon River showing fishing district boundaries.

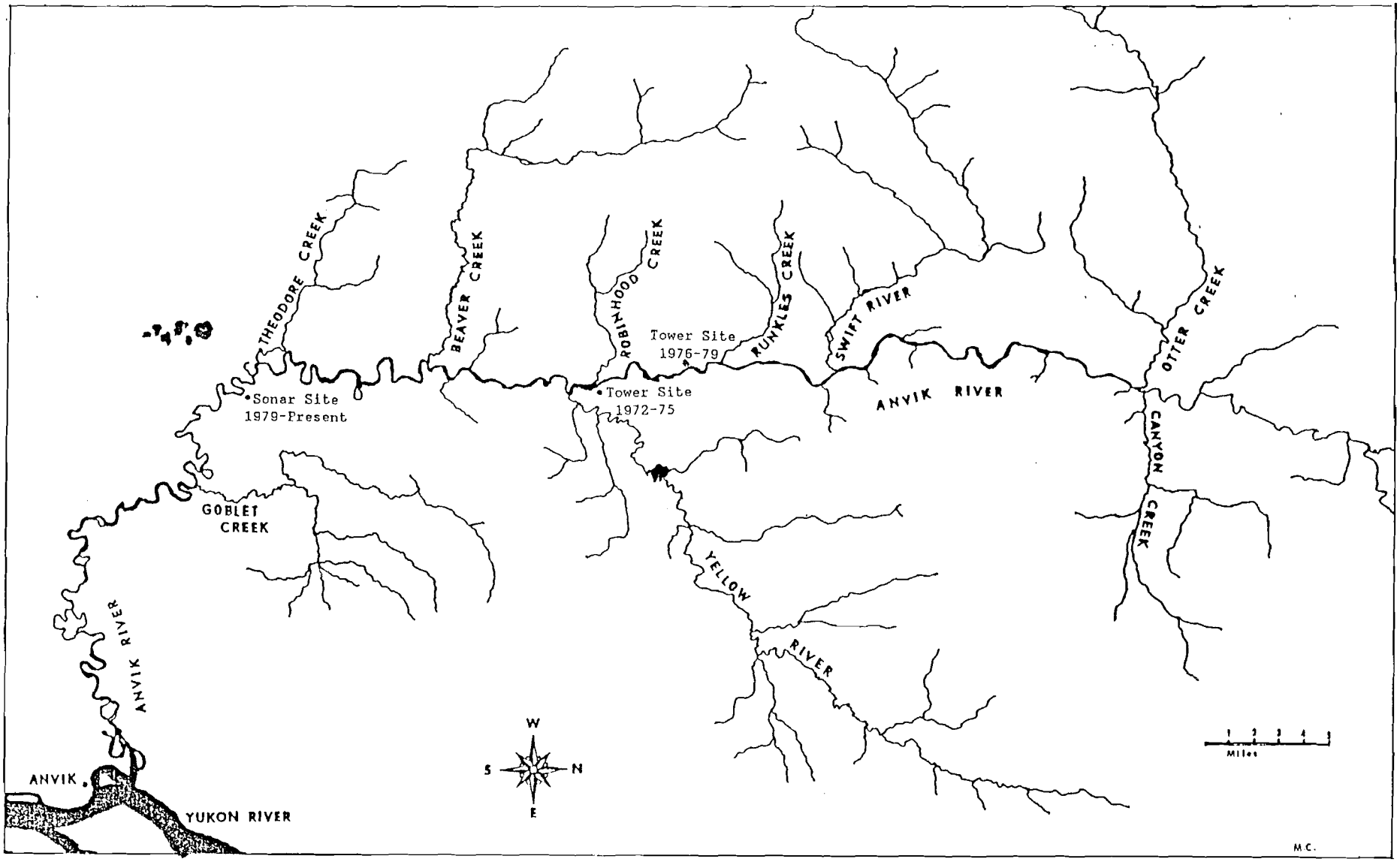

Figure 2. Map of the Anvik River drainage.

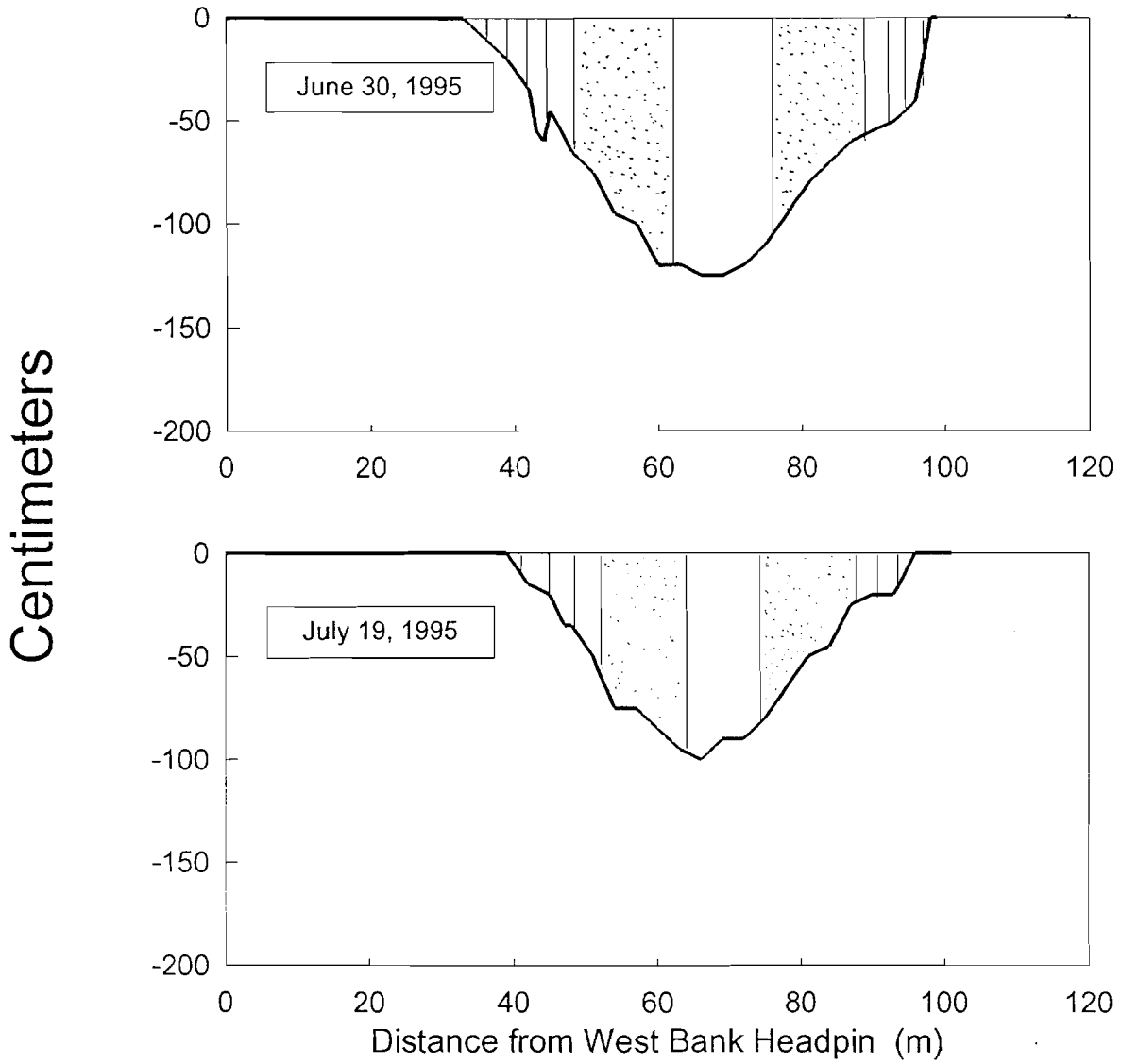

Figure 3. Anvik River depth profiles, 30 June and 19 July, 1995. Stippled areas are approximate insonfication zones; weired areas are indicated by vertical lines.

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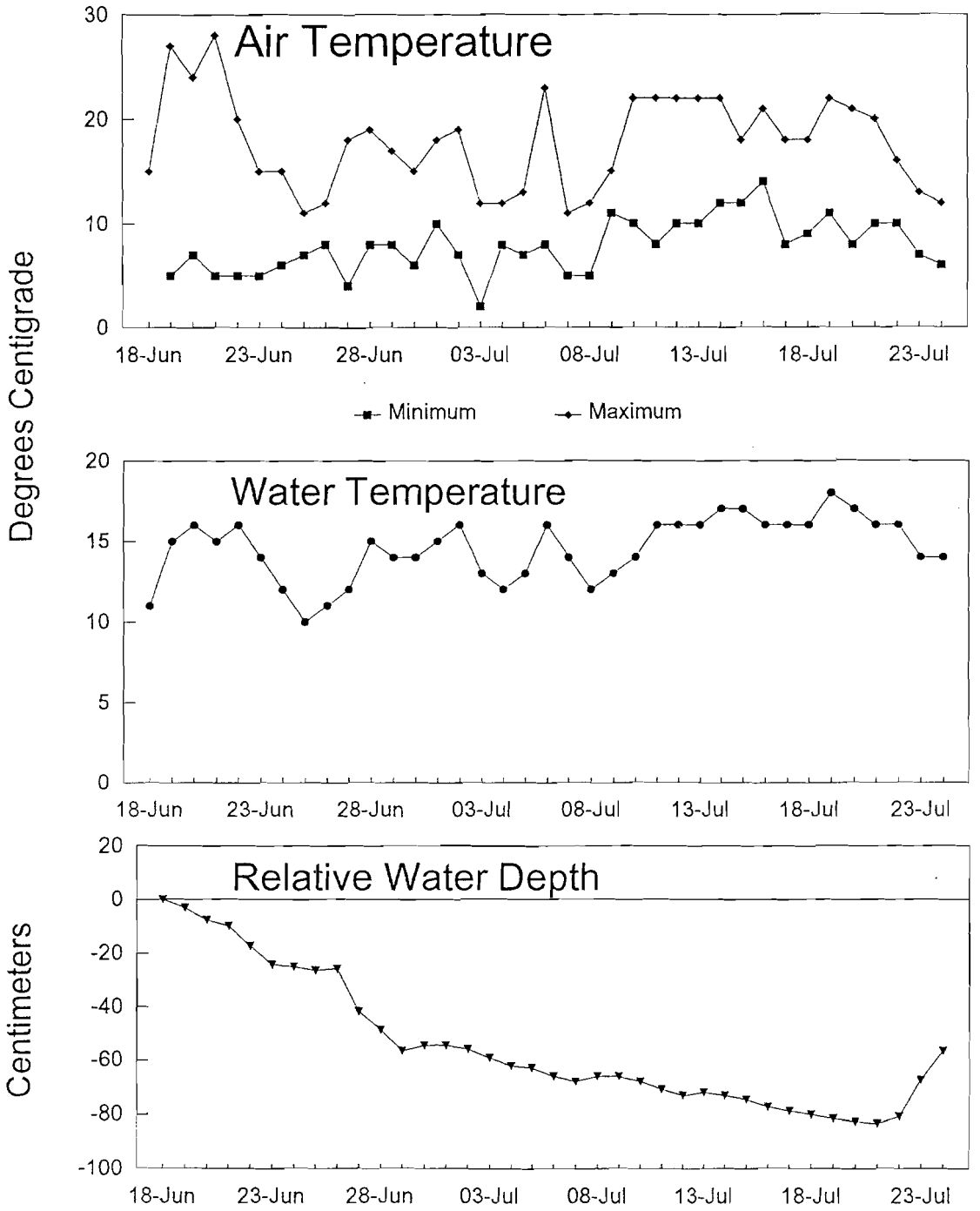

Figure 4. Daily minimum and maximum air temperatures, instantaneous water temperature, and relative water depth measured during the early evening hours daily at the Anvik River sonar site, 1995.

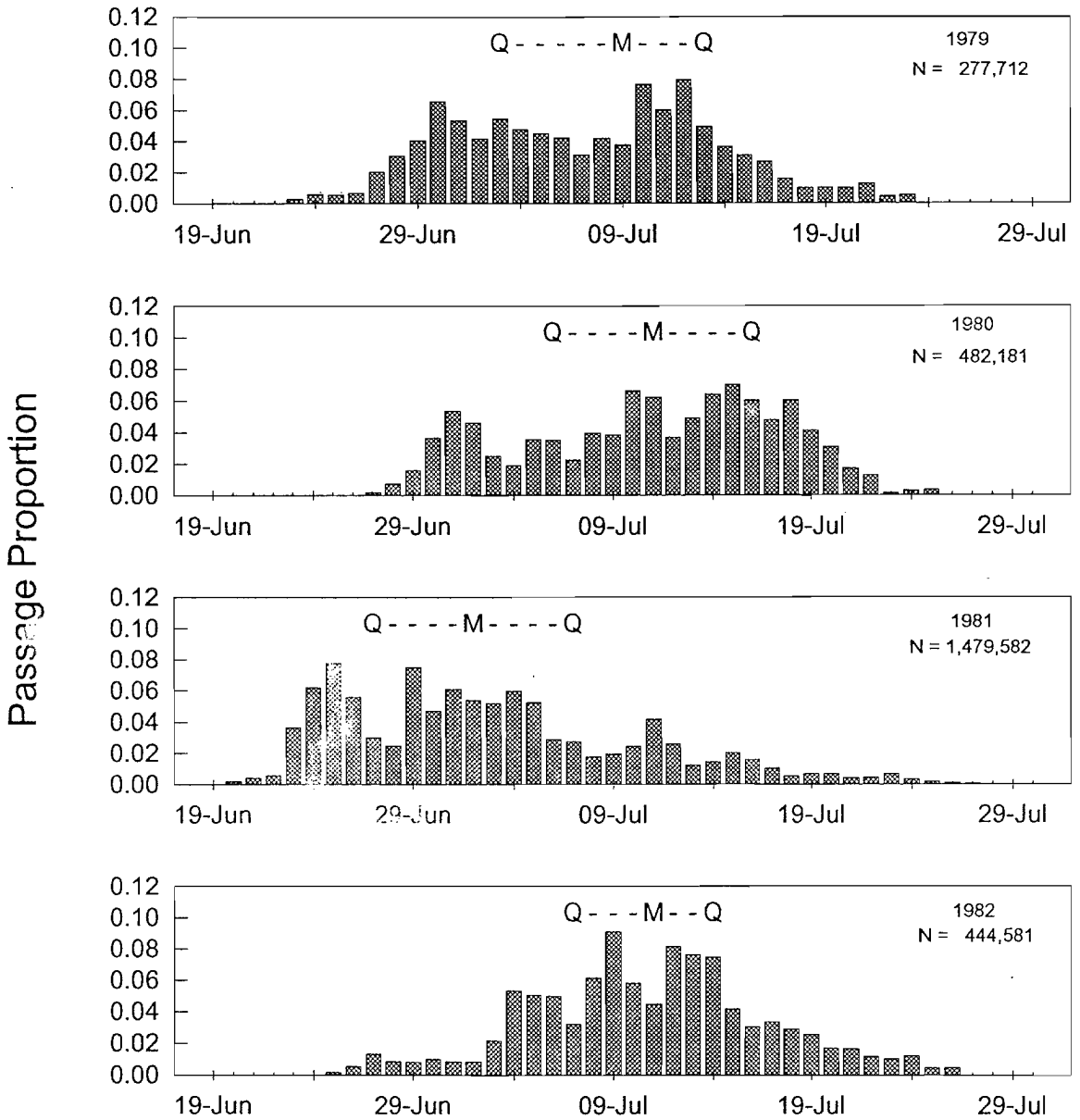

Figure 5. Daily proportion of corrected Anvik River sonar counts of summer chum salmon passage by day, 1979-1995 (N = total number of corrected counts). The first and third quartile passage days are indicated by the "Q"s, while the median day of passage is indicated by the "M".

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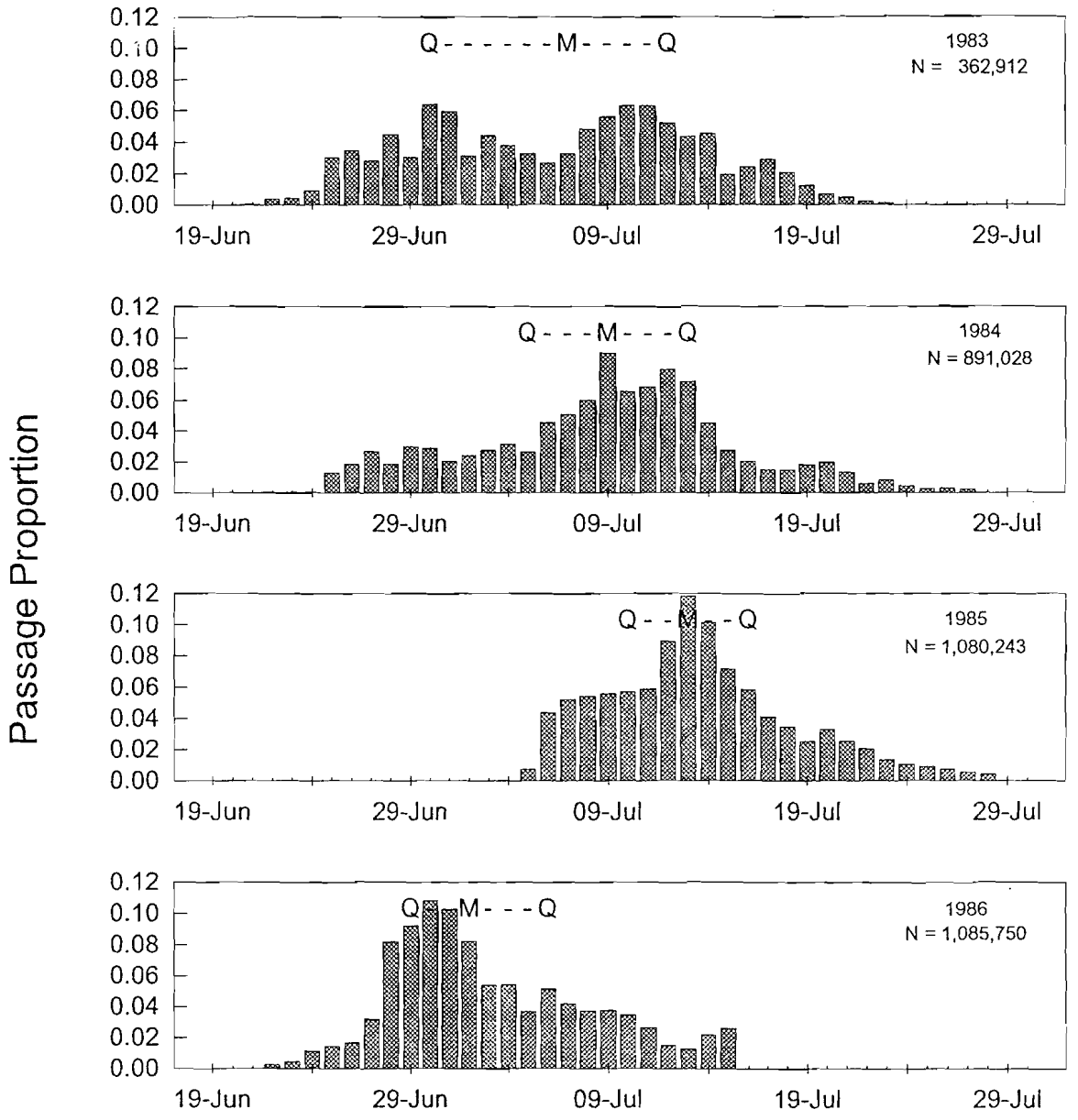


Figure 5. (page 2 of 5).

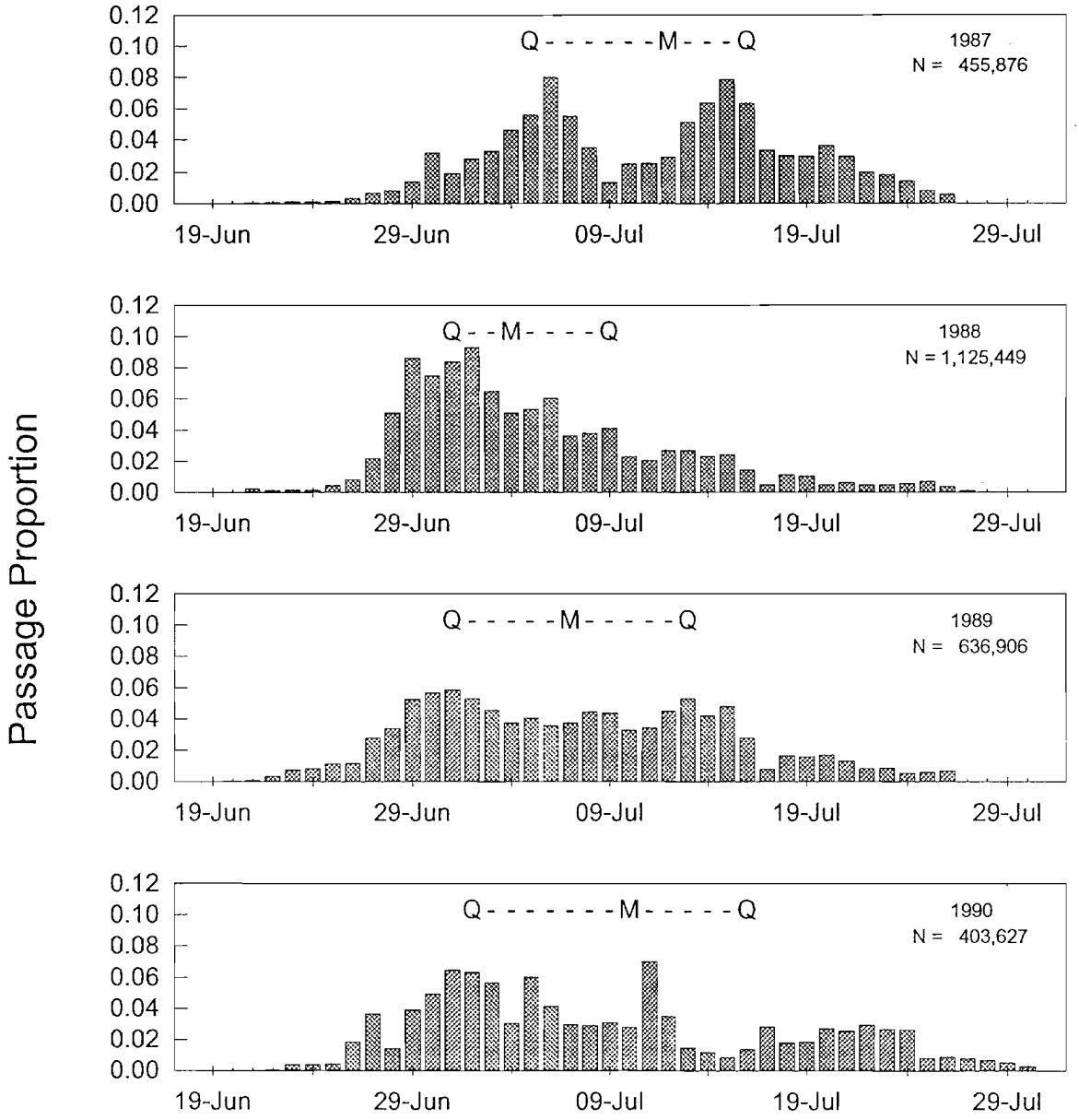


Figure 5. (page 3 of 5).

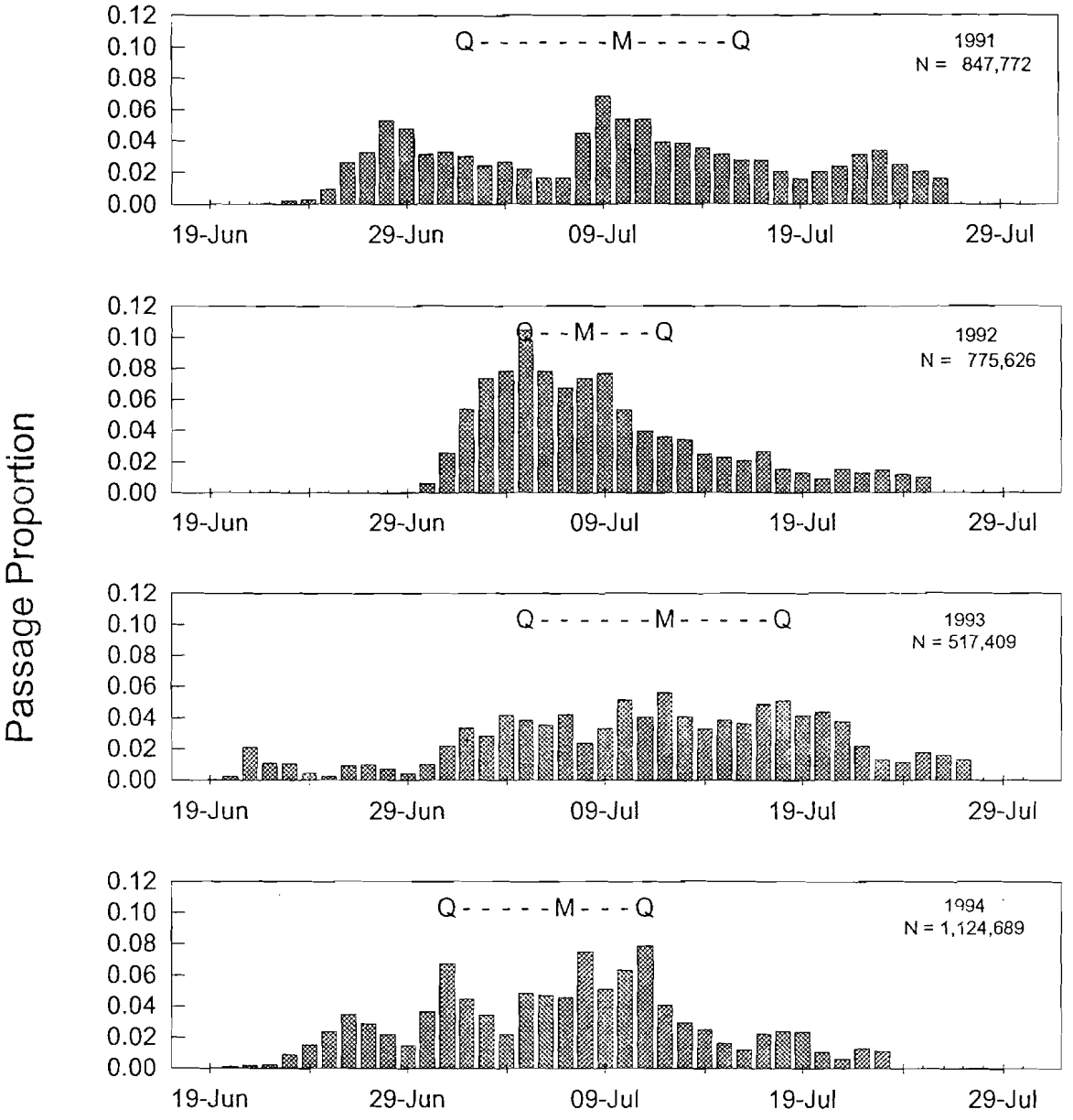
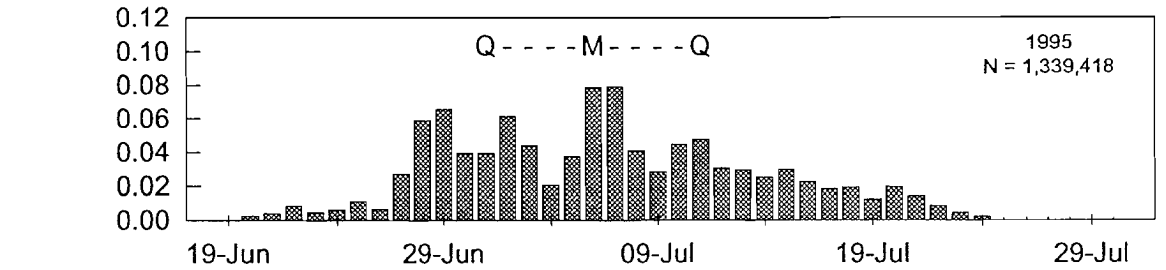


Figure 5. (page 4 of 5).



Passage Proportion

Figure 5. (page 5 of 5).

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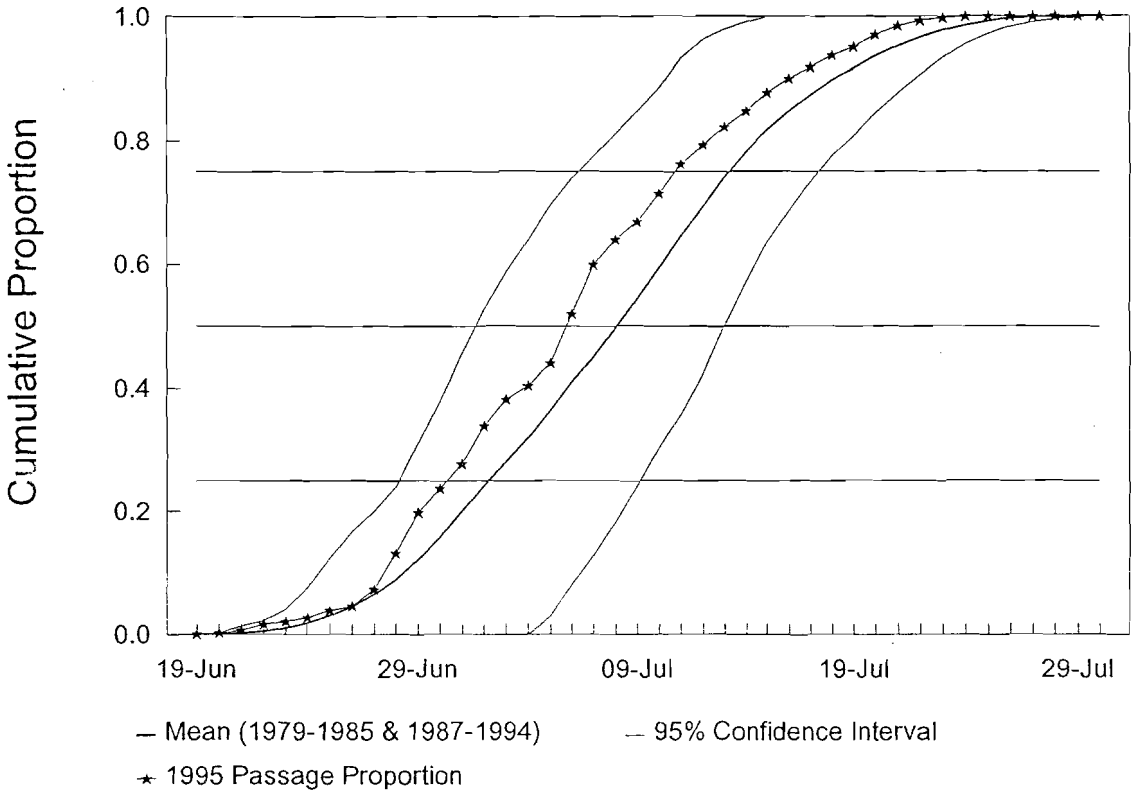

Figure 6. Mean (1979-1985 & 1987-1994) and the 1995 run timing curves for Anvik River summer chum salmon. Horizontal lines indicate quartile proportions.

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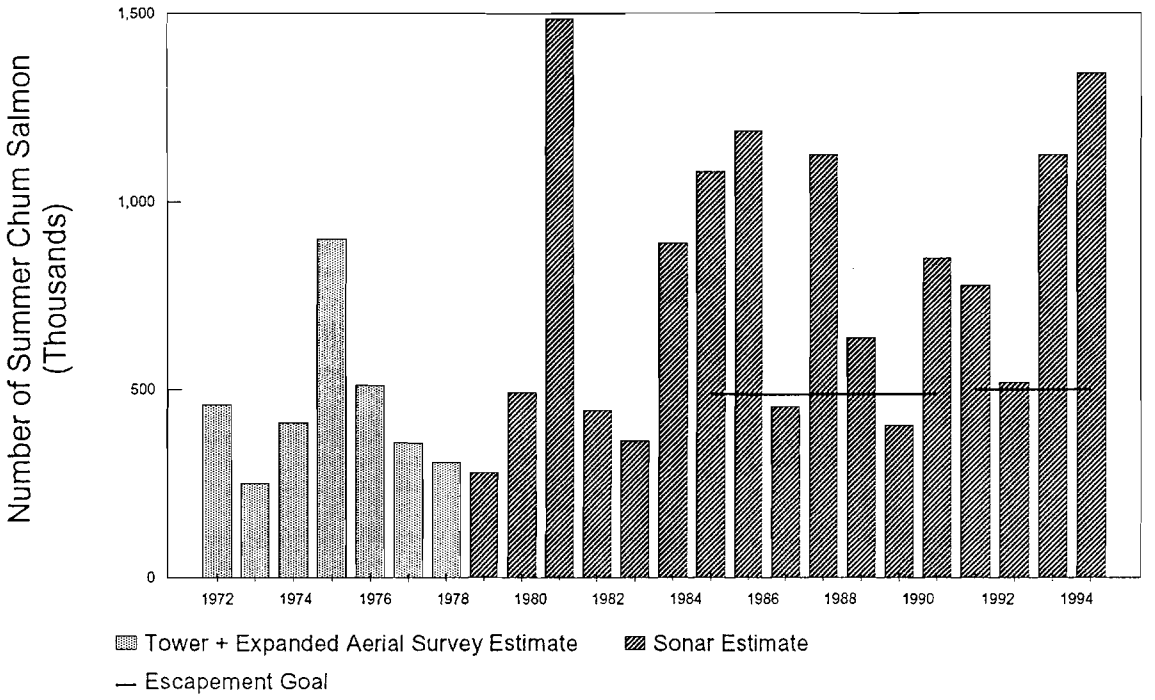

Figure 7. Anvik River summer chum salmon escapement estimated by combined tower and expanded aerial survey count, 1972-1978, and by shore-based sonar, 1979-1995. Sonar count escapement goal of 487,000 salmon, effective from 1985 to 1991, and the present, minimum escapement goal of 500,000 salmon are indicated by the horizontal lines.

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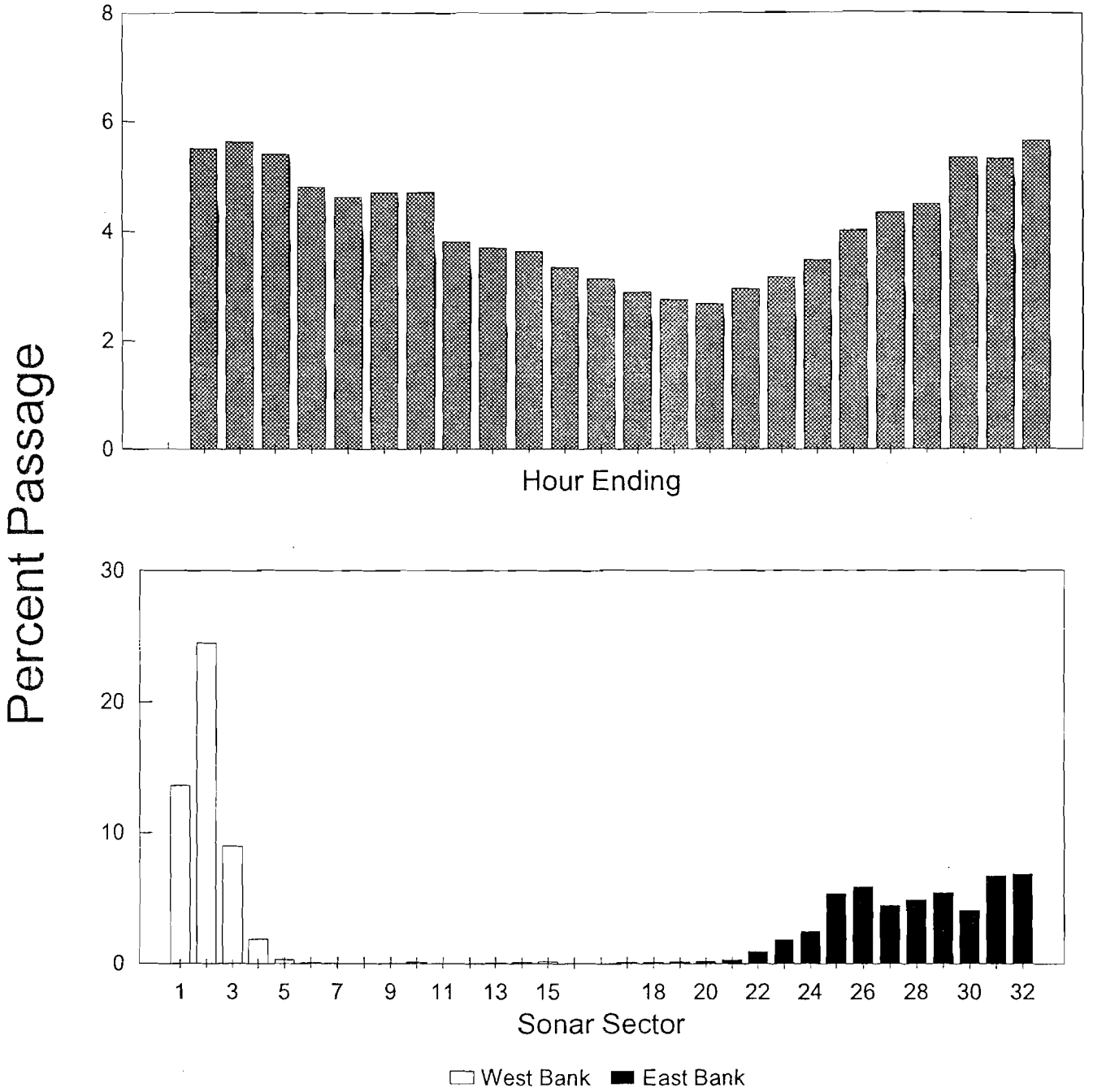


Figure 8. Estimated percent of corrected sonar counts in relation to hour of the day (above) and sonar sector (below), Anvik River, 1995. Note that only days with full 24-hour counts were used.

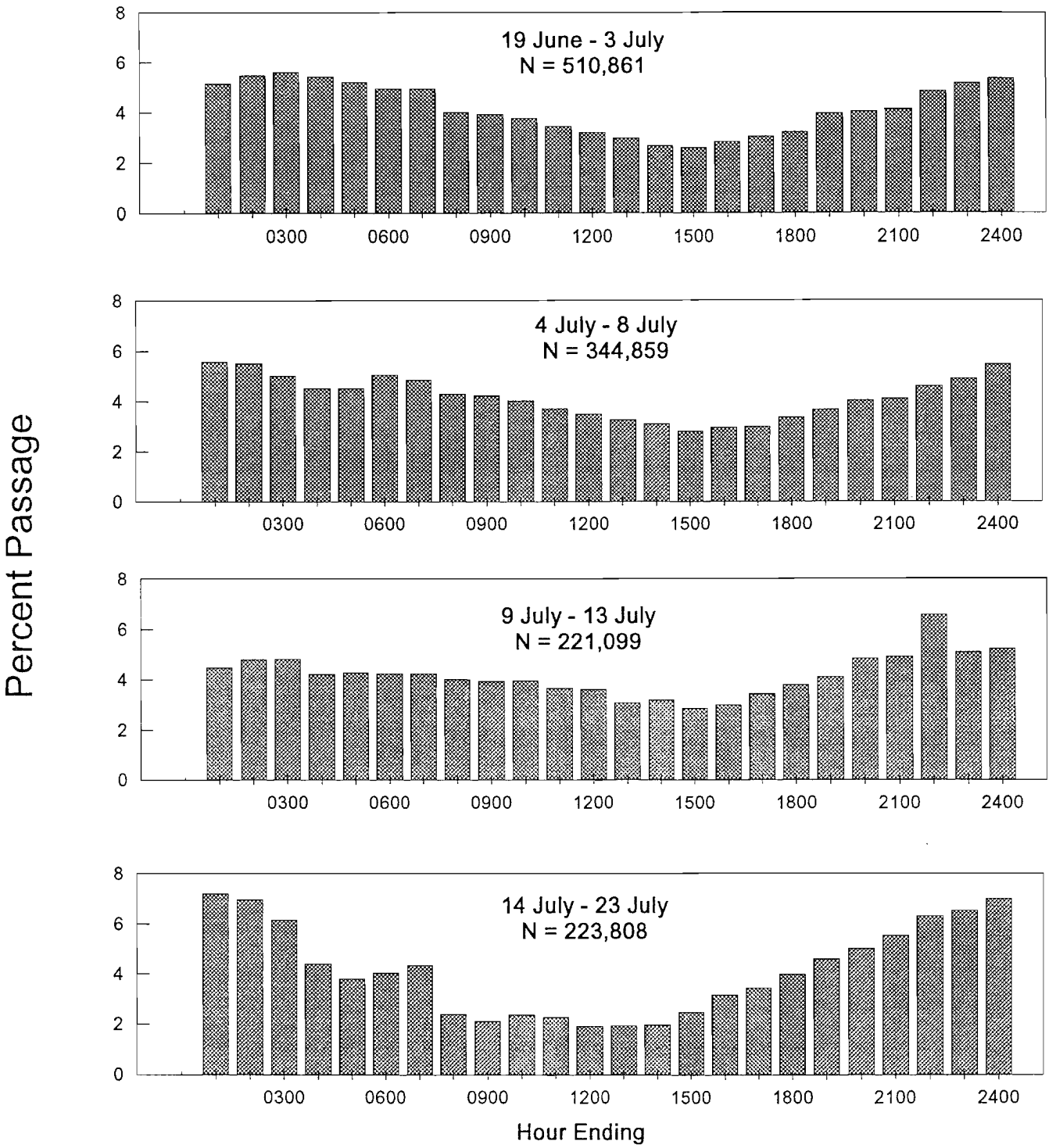


Figure 9. Estimated percent of corrected sonar counts by sampling stratum and hour of the day, Anvik River, 1995. Note that only days with full 24-hour counts were used.

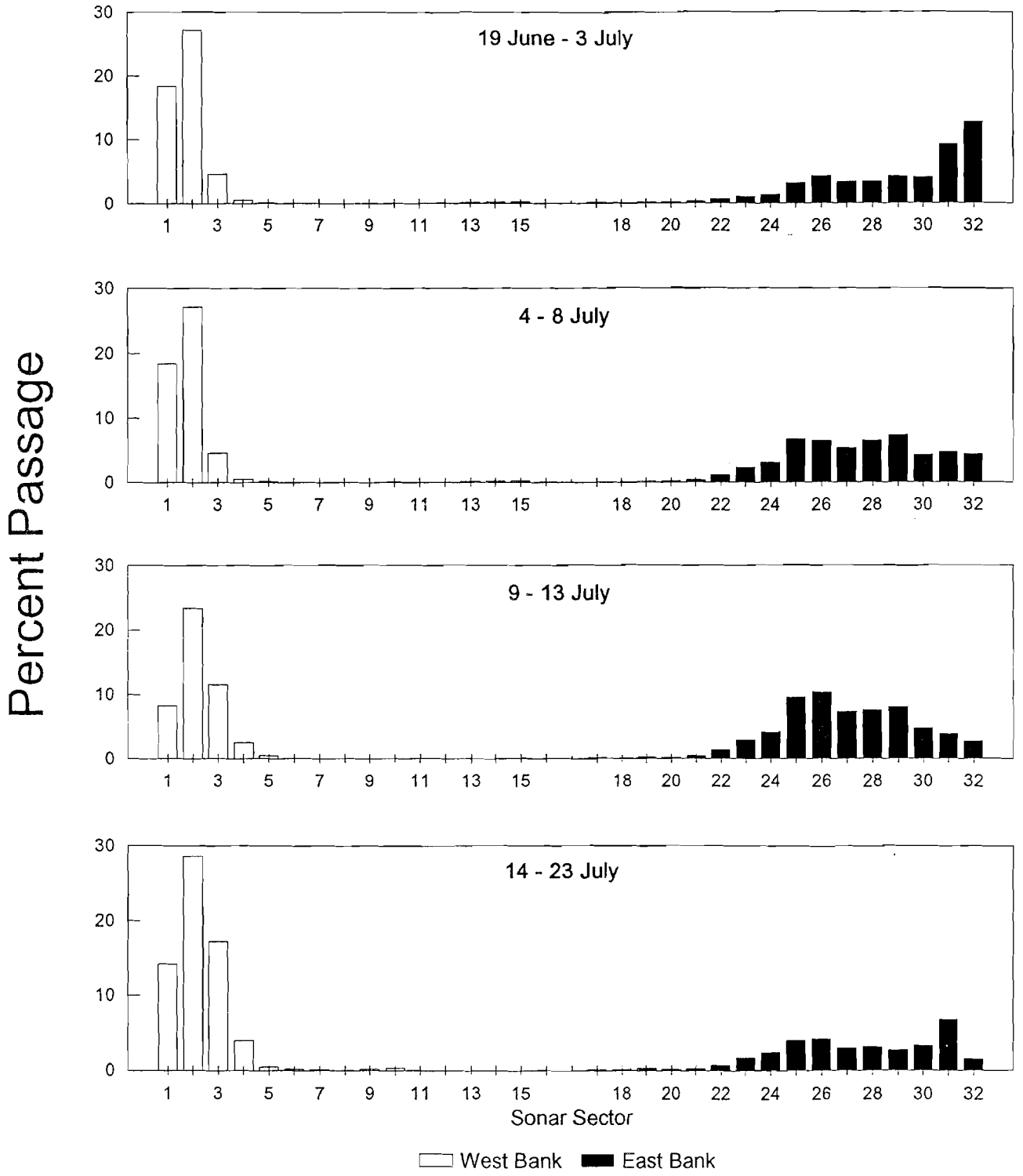


Figure 10. Estimated percent of corrected sonar counts by sampling stratum and sonar sector, Anvik River 1995. Note that only days with full 24-hour counts were used.

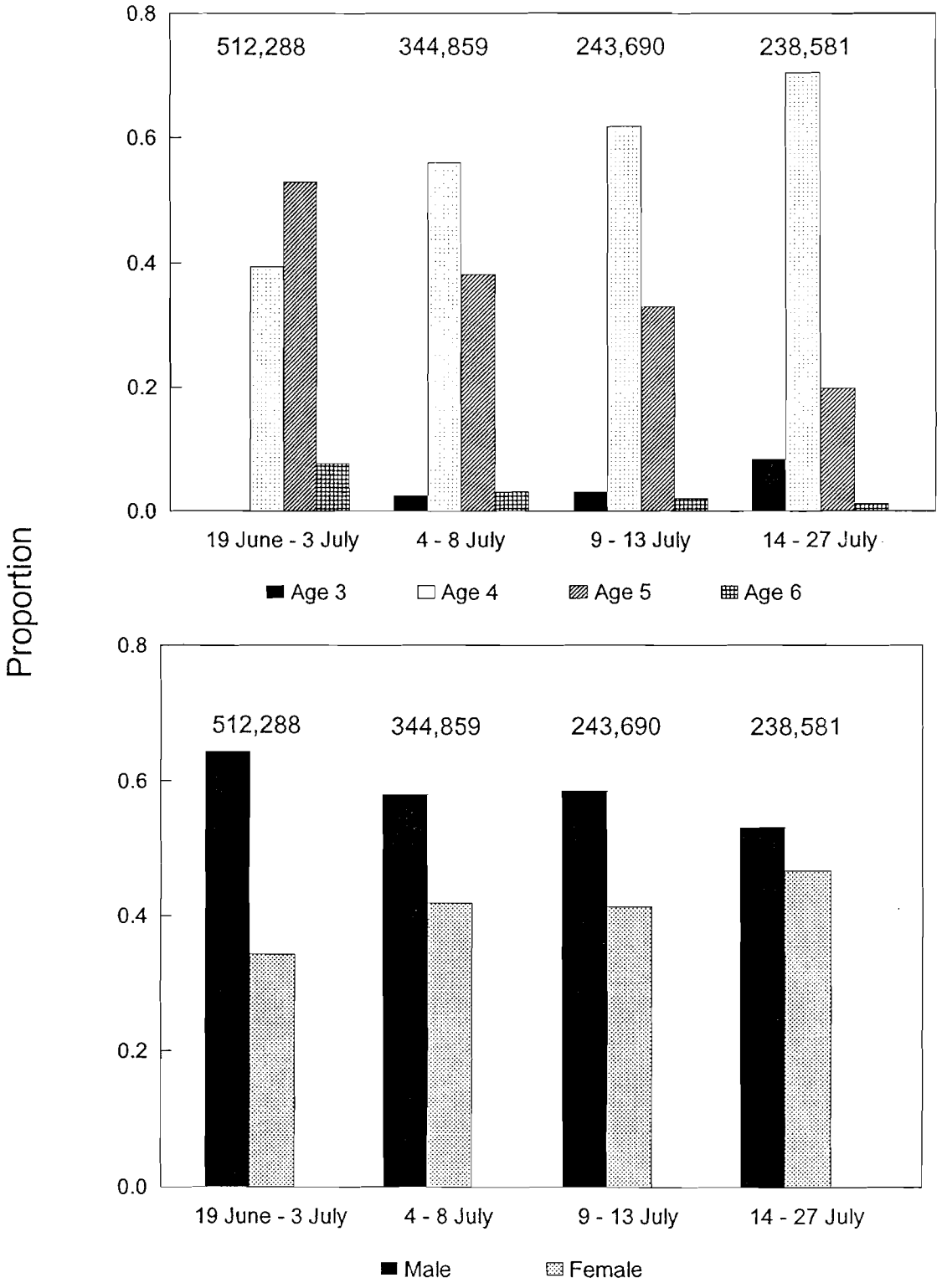


Figure 11. Age and sex compositon of sampled Anvik River summer chum salmon by sampling stratum, 1995. Numbers above bars indicate estimated passage during that stratum.

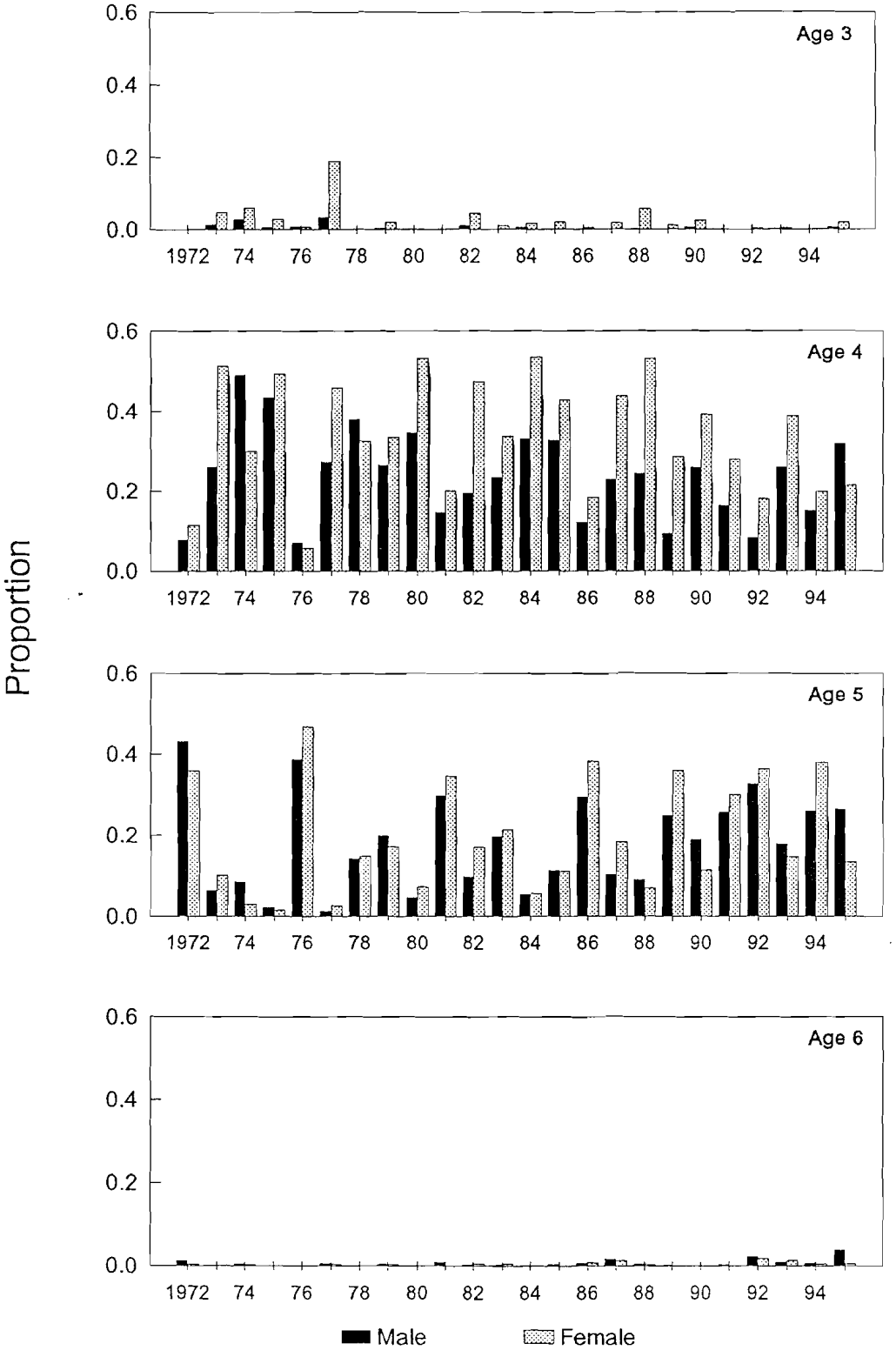
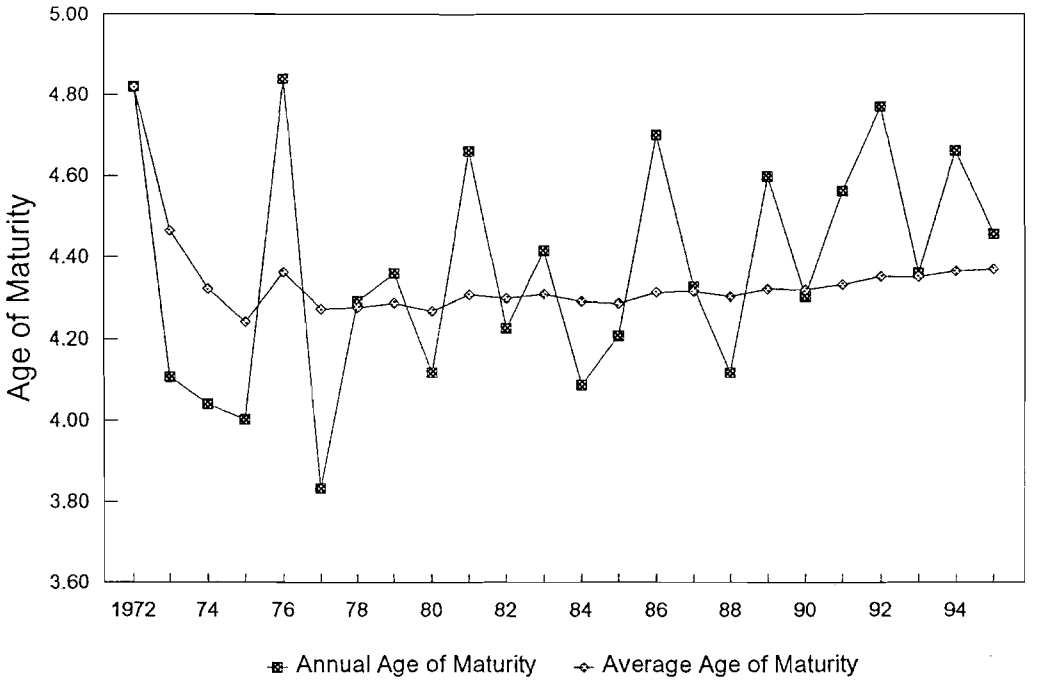


Figure 12. Estimated age and sex compostion of the Anvik River summer chum salmon escapement, 1972-1995.



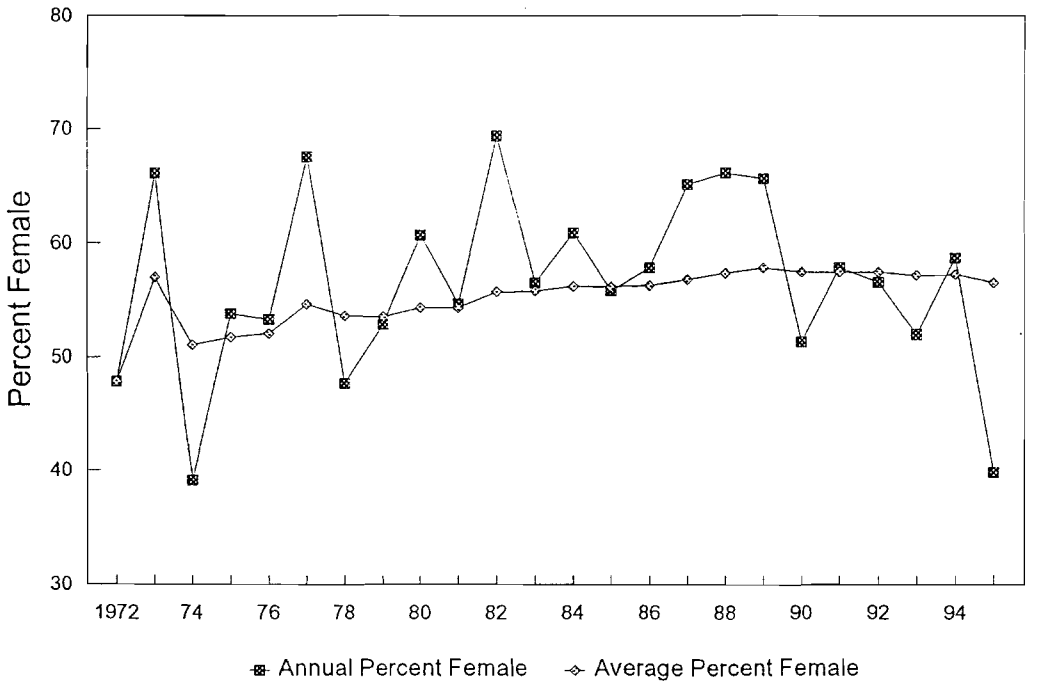


Figure 13. Annual and running average of the age of maturity (top) and percent female (bottom) of the summer chum salmon escapement to the Anvik River, 1972-1995.

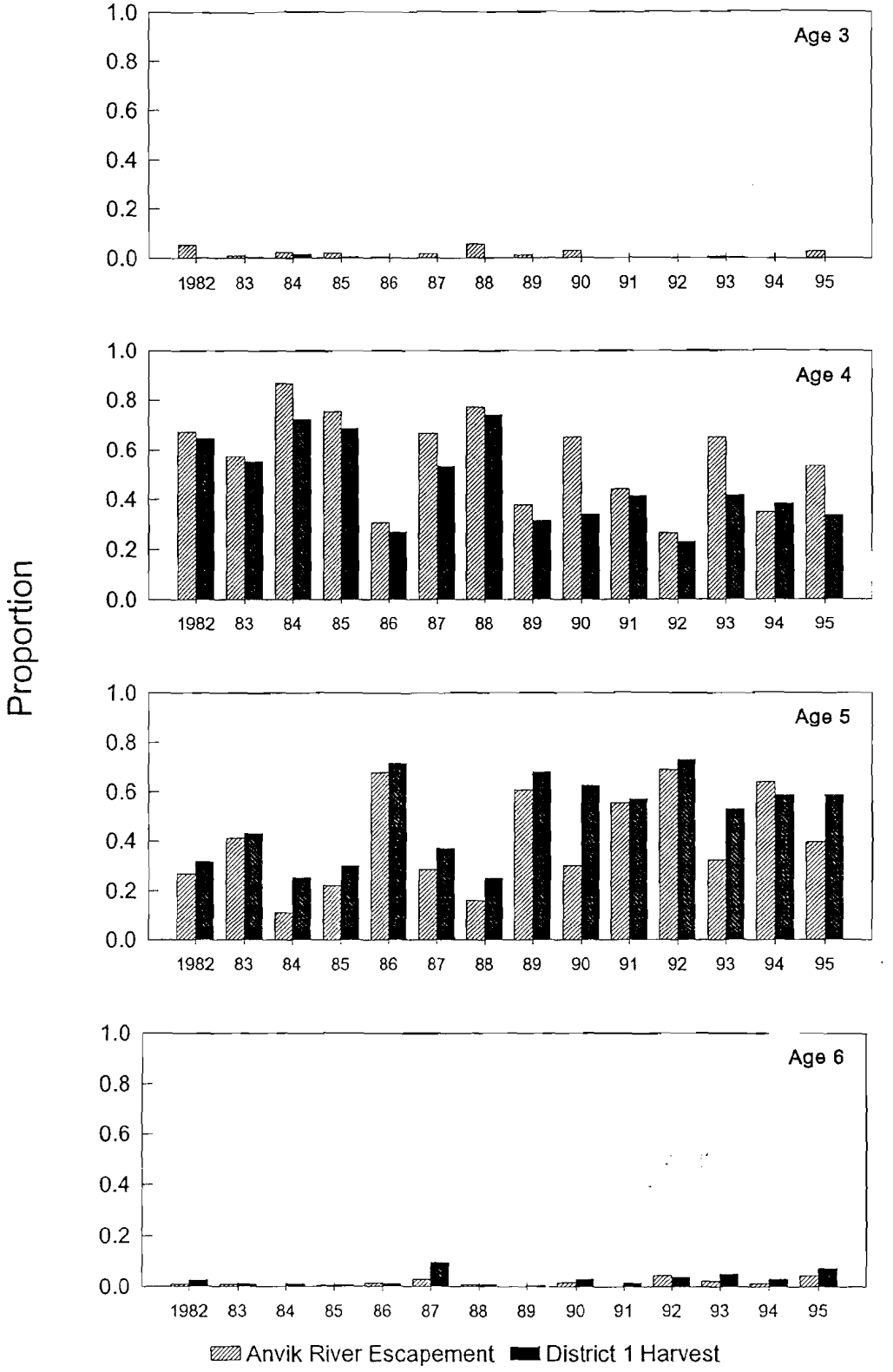


Figure 14. Estimated age compostion of the Anvik River summer chum salmon escapement and District 1 commercial harvest, Yukon River, 1982-1995.

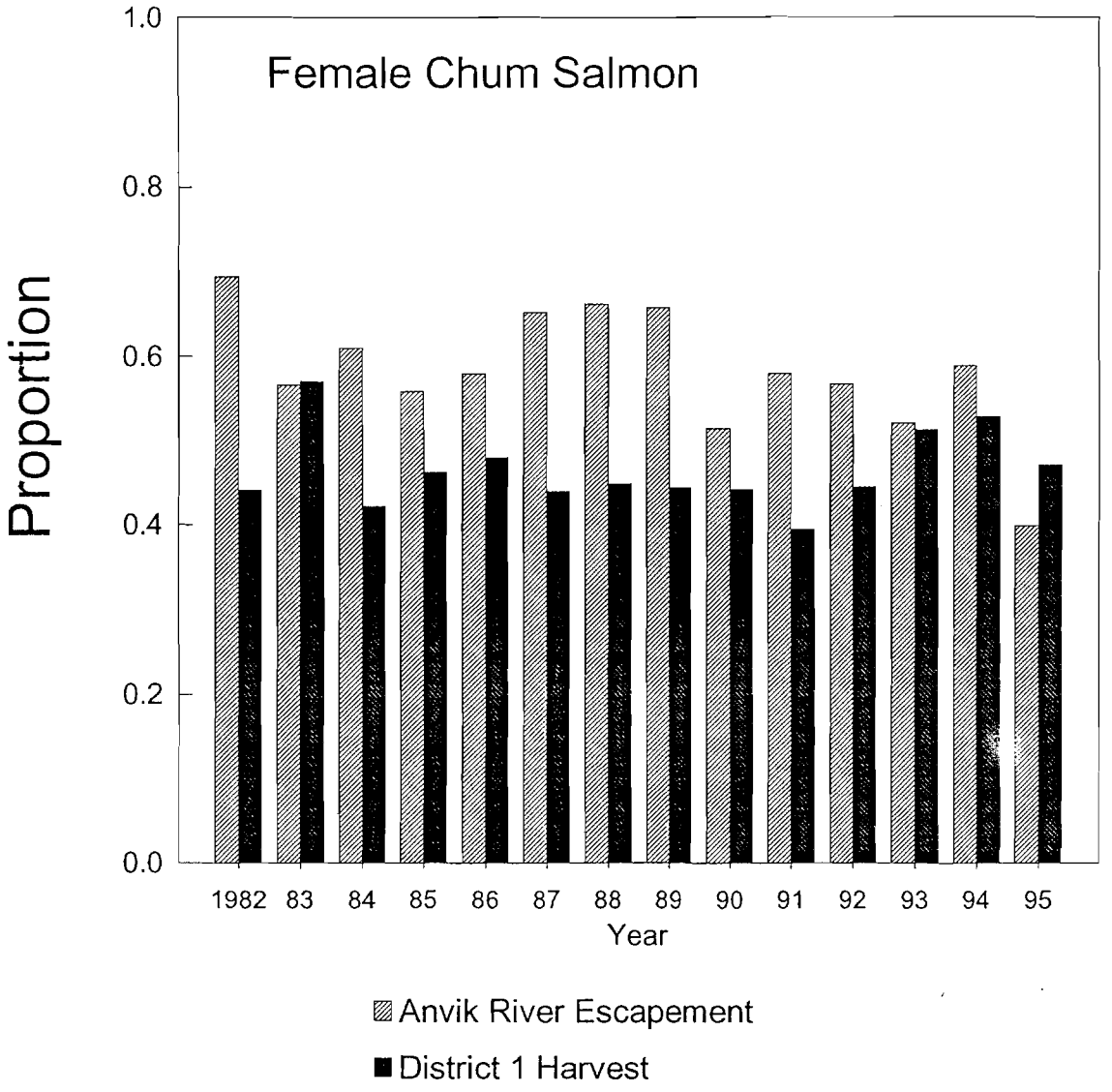


Figure 15. Estimated proportion of female summer chum salmon in the Anvik River escapement and the District 1 commercial harvest, Yukon River, 1982-1995.

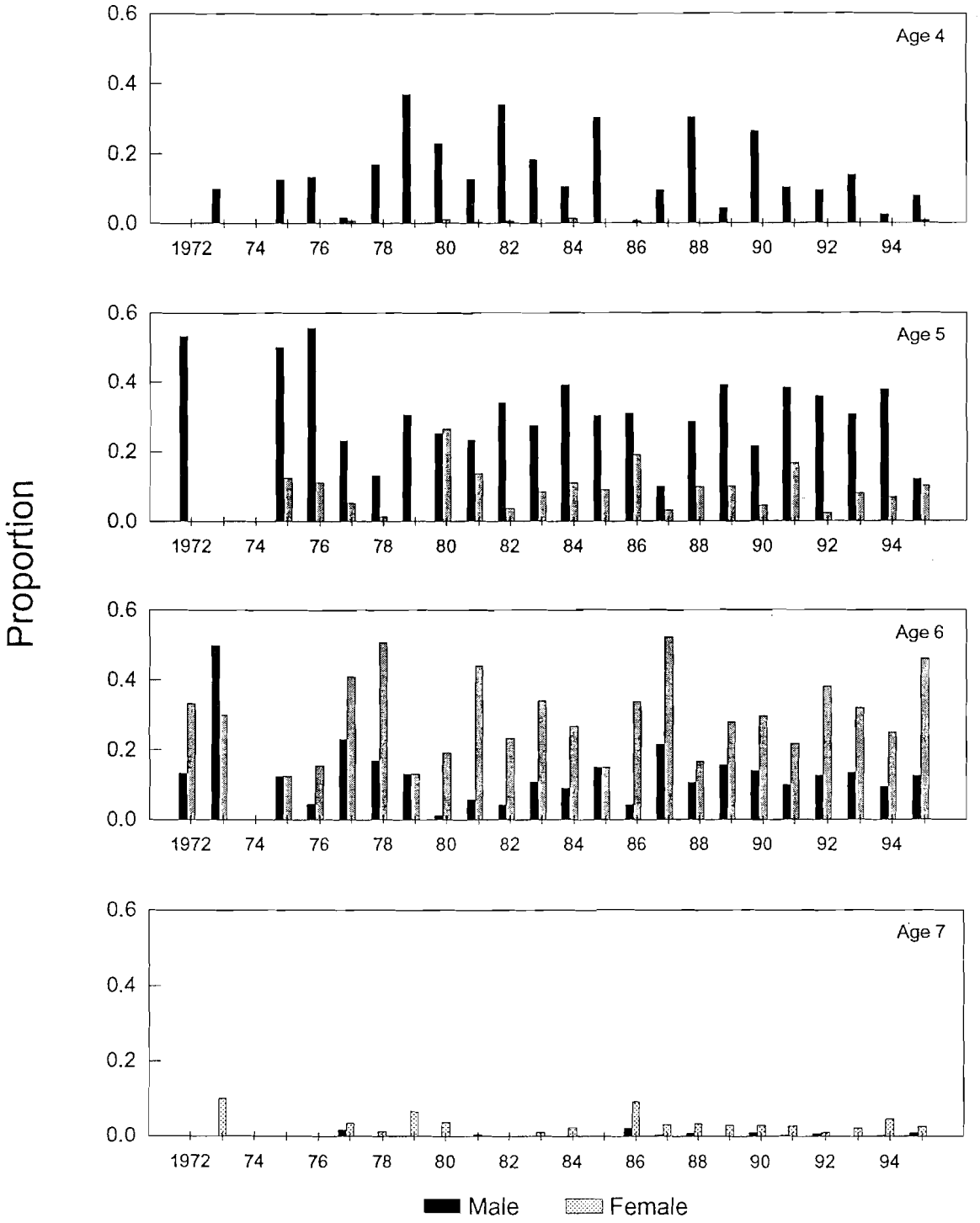


Figure 16. Estimated age and sex compostion of the Anvik River chinook salmon escapement, 1972-1995.

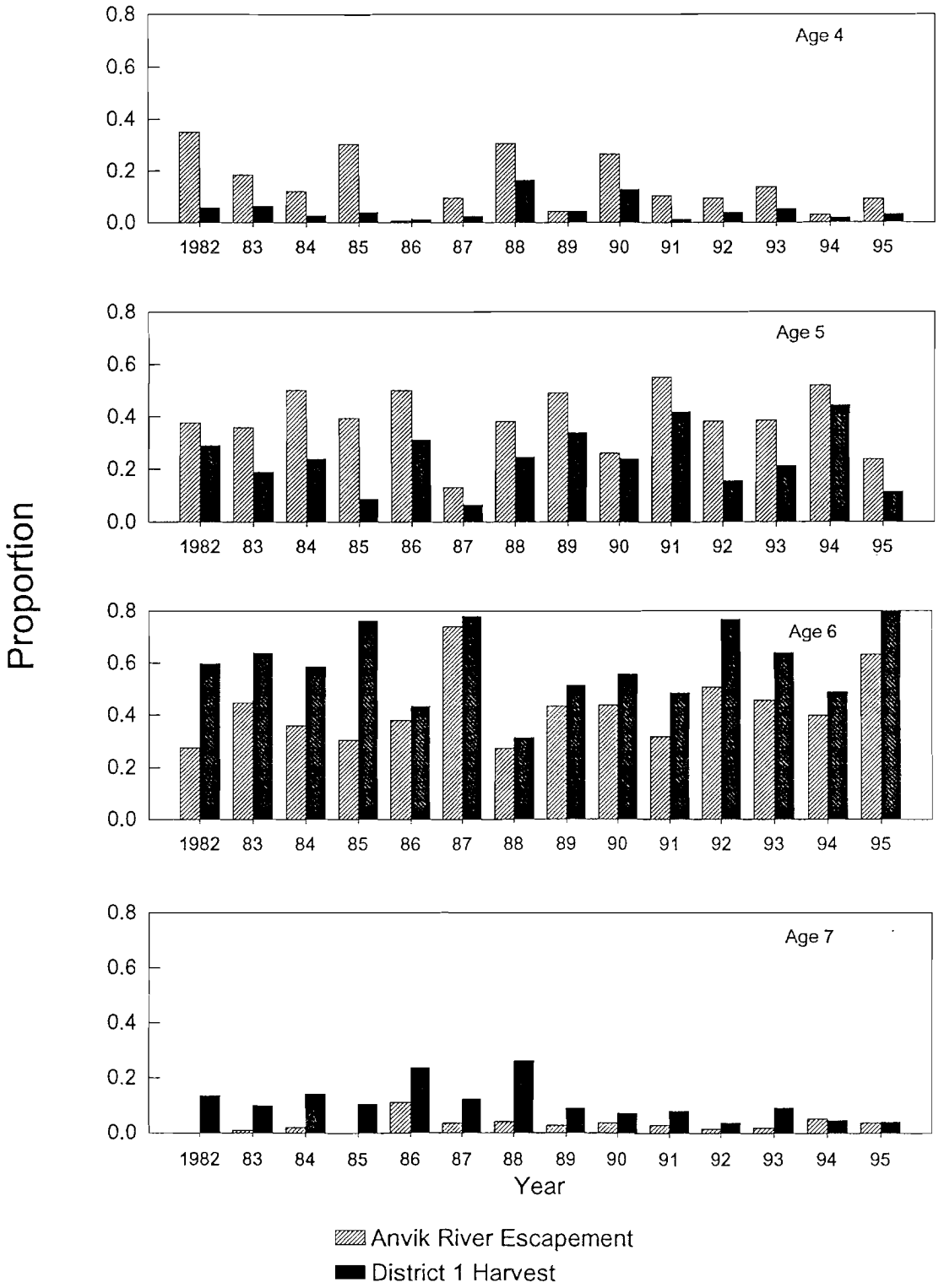


Figure 17. Estimated age composition of the Anvik River chinook salmon escapement and the District 1 commercial harvest, Yukon River, 1982-1995.

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APPENDIX

Appendix A. West bank Anvik River corrected sonar counts by hour and date, 19 June - 24 July, 1995.

Hour Ending	19-June[a]	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul
01:00		137	196	189	579	541	351	442	535	1,128	3,219	3,035	2,371	2,099	1,582	2,149	1,043	1,701	1,813
02:00		110	299	233	502	424	432	365	378	1,915	3,518	2,136	2,568	2,428	1,423	1,989	1,354	1,706	1,516
03:00		155	178	149	455	354	834	186	805	1,569	3,606	2,139	2,520	1,996	1,376	1,571	1,105	1,583	1,267
04:00		180	276	294	370	513	1,004	140	495	1,257	3,484	1,547	2,033	1,656	1,753	1,097	1,076	1,446	1,101
05:00		144	153	366	386	333	608	123	429	1,247	3,617	1,950	2,029	1,925	1,785	1,142	1,486	1,656	1,519
06:00		93	168	451	513	334	569	162	388	1,708	3,477	2,501	2,183	1,665	1,661	1,204	1,833	1,882	1,695
07:00		98	155	518	272	289	588	295	305	1,758	3,807	1,819	1,994	1,270	1,395	1,214	1,758	1,549	1,882
08:00		55	253	801	215	324	527	134	347	1,047	3,670	1,413	1,268	1,194	1,295	743	1,218	1,387	968
09:00		121	130	739	131	148	544	64	295	1,091	3,569	1,049	949	932	686	531	1,031	1,749	1,105
10:00		102	150	622	92	109	465	94	406	895	3,088	964	983	759	830	402	1,144	1,924	1,023
11:00		119	98	601	53	88	350	50	537	863	3,118	925	852	977	1,065	296	1,074	1,271	1,341
12:00		191	104	531	34	80	299	56	295	1,299	2,622	987	653	1,198	1,032	239	1,163	1,569	1,267
13:00		119	168	383	10	121	486	134	509	1,242	2,194	850	635	1,481	731	288	1,043	1,583	1,407
14:00		287	171	524	24	164	259	64	430	831	763	1,079	392	1,296	675	320	676	1,006	1,759
15:00		253	266	390	42	131	512	57	423	508	960	846	433	976	1,104	273	639	1,130	2,004
16:00	12	354	290	257	48	54	407	86	321	579	839	858	619	720	1,091	337	825	968	2,071
17:00	2	270	248	170	80	91	295	166	338	588	631	729	502	901	966	404	615	756	1,777
18:00	55	156	193	159	114	40	318	172	214	527	631	807	440	1,185	915	481	823	708	1,744
19:00	41	184	145	139	147	145	338	191	227	644	826	1,366	582	1,573	1,315	466	970	704	1,894
20:00	58	157	137	129	150	211	303	193	460	785	970	1,224	451	1,383	818	791	780	1,172	2,243
21:00	57	186	166	103	364	208	299	312	149	1,604	1,084	1,418	405	1,043	794	841	879	1,093	2,092
22:00	96	66	124	184	127	210	438	486	332	1,939	1,781	1,350	1,074	1,189	942	1,099	937	1,076	2,672
23:00	59	68	85	285	268	188	532	382	506	2,341	2,275	1,403	1,259	999	1,426	1,205	1,095	1,565	3,174
24:00	15	43	646	349	522	229	448	422	323	2,863	2,895	2,113	1,633	980	1,926	1,501	1,292	1,686	4,278
Total	395	3,648	4,799	8,566	5,498	5,329	11,206	4,776	9,447	30,228	56,644	34,508	28,828	31,825	28,586	20,583	25,859	32,870	43,612

continued

Appendix A. (p 2 of 2).

Hour Ending	08-Jul	09-Jul	10-Jul	11-Jul [b]	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul [c]	22-Jul	23-Jul	24-Jul
01:00	3,151	1,270	762	1,213	1,018	491	1,238	1,740	2,340	962	1,173	920	995		1,085	181	180
02:00	3,252	1,341	668	938	977	952	986	1,810	1,864	975	1,244	964	683		1,002	201	120
03:00	2,861	1,265	598	988	885	686	652	1,033	940	516	820	808	2,172		918	221	82
04:00	2,593	1,013	571	1,026	1,247	888	541	760	515	379	309	547	1,074		835	241	77
05:00	2,847	1,022	871	905	1,036	946	580	1,097	642	590	387	371	858		751	260	73
06:00	2,990	1,109	813	886	869	931	693	1,135	651	654	430	483	1,097		668	280	79
07:00	2,905	898	1,382	1,064	880	862	461	970	571	875	674	416	2,119		576	374	162
08:00	2,175	927	1,178	1,043	878	601	309	800	372	242	582	163	802		313	148	170
09:00	1,617	587	846	1,386	757	695	286	838	367	161	326	119	782		254	93	107
10:00	1,380	723	849	929	805	1,345	285	914	532	166	455	117	298		407	284	111
11:00	1,440	663	865		823	681	541	570	557	228	667	187	172		464	111	85
12:00	1,025	985	984		649	587	318	366	637	208	518	202	334		220	158	73
13:00	917	950	1,018		362	650	338	395	671	312	468	275	184		268	157	41
14:00	444	988	1,045		432	692	530	652	345	296	511	198	211		189	211	55
15:00	472	806	923		538	519	767	660	436	239	632	311	428		287	165	61
16:00	539	783	776		440	549	682	782	483	468	667	333	1,324		259	186	53
17:00	667	809	818		354	553	1,034	990	602	535	758	369	771		230	191	74
18:00	889	816	752		438	612	1,053	885	609	882	833	392	1,481		202	256	116
19:00	1,026	691	736		636	770	1,106	1,031	658	804	1,098	414	614		174	251	130
20:00	559	711	788		763	1,022	750	1,366	780	741	1,416	468	268		149	349	133
21:00	556	803	496		688	1,139	852	2,035	883	1,050	1,041	207	327		143	255	137
22:00	900	730	895		1,783	856	926	2,092	1,112	914	1,307	238	1,269		105	302	84
23:00	1,054	527	1,023		1,080	575	1,321	1,751	1,573	1,058	1,456	646	406		340	311	129
24:00	1,434	675	1,015	1,021	729	913	1,986	1,795	1,726	1,208	1,309	1,264	657		391	344	190
Total	37,693	21,092	20,672	22,591	19,067	18,515	18,235	26,467	19,866	14,463	19,081	10,412	19,316	14,773	10,230	5,530	2,522

[a] Counting initiated on 19 June at 1500 hours

[b] Counts unavailable for the hours ending 1100 - 2300. Daily passage was estimated by dividing the sum of the available counts by the proportion of the daily counts for the same period on 10 and 12 July.

[c] Counts unavailable because of salmon continually digging redds in the ensonfied zone.

Appendix B. East bank Anvik River corrected sonar counts by hour and date, 19 June - 24 July, 1995.

Hour Ending	19-June	20-Jun	21-Jun [a]	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul
01:00				99	57	64	356	144	494	941	2,308	992	1,155	1,300	2,028	427	839	2,290	3,081
02:00				111	81	104	294	151	743	699	3,155	1,038	1,799	1,053	2,121	581	382	2,618	3,252
03:00				177	70	141	333	175	750	998	2,505	1,293	1,503	1,906	2,434	653	584	2,485	3,435
04:00				209	64	73	250	84	927	1,301	2,732	1,011	1,588	2,473	2,056	687	632	2,759	3,092
05:00				172	53	133	214	56	481	1,663	2,588	1,167	995	2,513	1,481	415	405	2,628	2,731
06:00				183	43	63	141	21	283	1,210	2,043	881	810	2,147	1,586	299	466	2,514	3,411
07:00				398	112	160	112	6	1,905	1,296	1,442	597	653	2,303	1,797	373	324	2,519	2,910
08:00				106	13	56	148	3	429	934	586	632	820	2,223	1,983	197	715	3,588	3,065
09:00				365	7	38	156	3	607	1,657	906	391	729	2,665	2,079	109	395	4,160	3,259
10:00				232	8	11	312	0	1,220	2,509	695	369	433	2,071	1,851	97	463	3,803	3,022
11:00				321	2	11	56	3	1,001	2,319	706	676	412	1,401	973	96	492	3,716	2,670
12:00				159	14	29	152	2	1,087	2,148	985	200	308	1,153	824	70	498	3,392	2,573
13:00				156	23	23	390	9	520	2,039	1,062	318	190	856	547	48	389	2,681	2,616
14:00				51	16	7	434	48	794	1,668	1,390	129	168	1,364	660	92	637	2,686	2,791
15:00				19	1	30	13	7	489	2,657	671	256	251	1,688	316	65	702	2,350	1,875
16:00				53	1	62	37	9	1,111	2,296	814	544	412	2,064	543	136	590	2,691	1,962
17:00				20	80	122	352	27	1,722	2,289	901	640	624	2,167	601	106	1,045	2,583	2,192
18:00				28	153	220	40	86	1,916	1,833	1,025	1,005	809	2,562	844	181	1,547	3,232	1,875
19:00			40	14	47	474	32	283	2,061	2,259	1,067	1,173	1,281	2,883	895	191	1,790	3,353	1,990
20:00			234	66	7	290	54	181	2,157	2,640	1,027	1,015	1,573	3,059	1,104	218	2,536	3,364	1,911
21:00			184	10	18	390	61	416	1,815	2,815	1,160	786	1,758	2,725	940	241	2,554	3,166	2,342
22:00			210	85	12	276	69	1,018	1,757	3,752	494	1,152	1,957	2,557	1,429	500	2,246	3,485	2,482
23:00			231	22	27	348	26	1,166	1,445	3,446	695	1,473	2,068	2,737	906	489	2,206	3,281	2,297
24:00			133	17	52	269	64	715	1,484	3,081	350	651	2,173	2,533	622	841	2,346	3,208	1,546
Total	0	0	1,032	3,073	961	3,394	4,096	4,613	27,198	48,450	31,307	18,389	24,469	50,403	30,620	7,112	24,783	72,552	62,380

continued

Appendix B. (page 2 of 2).

Hour Ending	08-Jul	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul
0100	2,731	702	1,171	1,926	1,259	1,262	805	883	584	1,109	365	350	620	375	158	28	56
0200	2,357	604	1,336	1,955	1,294	1,447	829	1,036	690	991	456	452	686	381	84	47	43
0300	1,709	722	1,495	2,106	1,585	1,287	774	1,147	686	1,150	574	354	531	201	134	17	16
0400	1,059	600	1,505	1,534	1,178	778	912	731	537	907	376	299	515	186	43	26	19
0500	748	474	1,532	1,611	1,060	865	702	562	251	548	144	187	321	79	54	14	19
0600	1,190	480	1,383	1,780	1,349	650	816	689	206	276	148	185	302	183	40	10	19
0700	1,292	524	1,715	1,779	788	537	421	506	285	293	195	198	346	131	130	21	32
0800	779	410	1,988	1,538	730	567	272	420	129	157	117	80	96	91	39	19	38
0900	677	314	1,781	1,918	975	788	235	394	213	156	91	86	91	88	31	11	33
1000	620	299	1,530	1,534	817	807	236	564	205	166	205	34	120	105	61	12	23
1100	351	349	1,762	1,608	622	712	319	309	241	183	108	46	111	91	50	22	19
1200	243	429	1,596	1,392	625	705	253	194	157	166	217	43	79	60	43	10	22
1300	228	525	941	1,269	516	547	189	229	176	206	193	30	67	62	53	14	23
1400	243	539	1,237	1,045	385	654	123	199	212	206	200	24	56	145	38	11	46
1500	207	751	1,081	772	317	579	192	348	242	151	208	16	45	263	37	12	32
1600	104	754	1,276	1,186	424	396	229	314	242	281	215	111	110	282	34	18	22
1700	140	867	1,600	1,613	469	475	226	386	234	357	197	176	283	257	18	10	39
1800	141	993	1,950	1,803	421	543	430	390	285	342	139	156	90	273	58	8	30
1900	283	999	1,668	1,738	895	907	1,067	648	561	543	341	210	167	289	116	19	41
2000	268	1,107	2,199	2,319	967	803	1,142	687	917	590	379	416	271	311	38	23	49
2100	396	1,187	2,055	2,349	1,268	842	1,559	733	1,003	438	390	644	490	101	34	28	58
2200	478	1,524	2,214	2,651	2,073	1,789	1,595	742	954	473	378	885	559	84	67	23	42
2300	505	1,215	2,049	2,152	945	1,688	1,266	787	858	365	457	839	772	172	66	23	57
2400	666	1,186	2,380	1,901	1,191	1,495	916	612	906	433	464	581	578	171	79	26	26
Total	17,415	17,554	39,444	41,479	22,153	21,123	15,508	13,510	10,774	10,487	6,557	6,402	7,306	4,381	1,505	452	804

[a] Counting initiated on 21 June at 1800 hours.

Appendix C. West bank Anvik River corrected sonar counts by sector, 19 June - 24 July, 1995 [a]

West Bank Sector	19-June [b]	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul
1	61	1,109	1,006	1,828	1,059	1,186	3,558	1,016	2,549	14,326	23,122	16,059	9,742	9,885	7,405	3,295	6,132	6,893	8,727
2	140	1,651	2,202	5,206	3,172	2,931	6,120	2,474	5,360	14,446	30,033	16,219	16,011	17,716	15,421	10,156	11,858	17,633	25,389
3	33	441	656	1,104	735	787	1,077	730	1,170	1,217	3,129	1,529	2,702	3,487	4,727	5,361	6,184	7,196	8,119
4	6	143	66	86	56	86	114	104	168	100	250	160	240	447	619	1,033	1,139	886	1,105
5	0	57	12	26	19	18	50	19	43	34	53	121	37	90	164	283	287	144	138
6	0	12	2	2	5	2	7	4	17	6	6	19	7	18	29	77	67	24	26
7	0	7	0	0	0	2	1	1	5	5	5	14	3	3	15	18	24	3	10
8	0	0	0	0	0	0	1	1	0	2	0	11	2	3	6	13	11	4	3
9	0	13	4	1	5	11	11	3	10	10	2	28	6	9	12	10	16	8	12
10	0	42	14	14	4	19	14	13	18	15	9	39	19	16	25	34	17	22	18
11	14	19	2	12	1	1	10	5	7	4	12	14	16	16	34	50	35	22	27
12	0	7	14	0	190	1	14	3	13	3	3	7	5	8	10	9	17	11	8
13	1	78	5	11	77	97	34	4	45	39	16	245	12	14	16	12	17	11	7
14	11	52	240	22	107	174	181	273	26	18	6	30	8	22	58	22	14	3	8
15	129	17	579	254	70	5	12	20	11	1	2	10	7	6	27	187	4	1	11
16	1	1	0	0	0	8	2	104	5	2	0	2	9	84	21	23	39	7	5
Total	396	3,649	4,802	8,566	5,500	5,328	11,206	4,774	9,447	30,228	56,648	34,507	28,826	31,824	28,589	20,583	25,861	32,868	43,613

continued

Appendix C. (p 2 of 2).

West Bank Sector	08-Jul	09-Jul	10-Jul	11-Jul [c]	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul [d]	22-Jul	23-Jul	24-Jul
1	3,078	2,272	2,787	2,571	9,041	9,077	8,059	6,704	3,626	1,271	4,801	2,621	2,146		1,208	899	353
2	15,267	7,936	10,432	5,897	8,080	8,693	9,137	12,999	8,681	4,903	6,904	4,845	7,665		4,377	2,895	1,509
3	12,938	7,089	5,827	2,000	1,431	478	995	5,036	5,933	6,681	6,682	2,264	5,804		3,670	879	534
4	4,458	2,460	898	354	441	5	9	1,467	1,586	1,590	685	480	1,498		828	599	63
5	937	537	156	46	35	7	0	233	41	14	7	107	533		108	26	23
6	126	73	29	17	15	11	0	28	1	0	0	40	347		23	37	14
7	78	38	36	21	0	16	4	1	0	0	0	16	146		1	37	20
8	36	15	10	6	0	4	5	0	0	0	0	5	45		2	8	4
9	61	58	40	17	2	5	4	0	0	0	0	7	362		3	5	1
10	67	77	65	32	2	30	10	0	0	0	0	20	622		7	20	0
11	129	96	133	42	2	34	5	0	0	0	0	4	30		3	2	1
12	52	39	38	10	2	28	3	0	0	0	0	1	25		0	2	0
13	28	19	47	16	2	33	4	0	0	0	0	1	23		0	5	0
14	158	52	30	120	3	26	0	0	0	0	0	0	20		0	5	0
15	235	277	84	205	3	40	0	0	0	0	0	0	21		0	16	2
16	41	52	60	44	9	28	0	0	0	0	0	0	33		1	95	1
Total	37,689	21,090	20,672	22,591	19,068	18,515	18,235	26,468	19,868	14,459	19,079	10,411	19,320	14,776	10,231	5,530	2,525

[a] Daily sector counts may deviate from daily counts because of rounding errors.
[b] Counting initiated on 19 June at 1500 hours
[c] Counts unavailable for the hours ending 1100 - 2300. Daily passage was estimated by dividing the sum of the available counts by the proportion of the daily counts for the same period on 10 and 12 June. See Appendix A.
[d] Counts unavailable because salmon were continually digging redds within the ensonified zone and disrupting counts.

Appendix D. East bank Anvik River corrected sonar counts by sector, 19 June - 24 July, 1995 [a]

East Bank Sector	19-June	20-Jun	21-Jun [a]	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul	06-Jul	07-Jul
17			1	20	35	3	182	18	146	62	43	40	38	44	44	27	53	52	107
18			0	1	16	0	28	17	136	65	37	20	38	32	44	30	56	51	82
19			1	0	6	0	3	9	157	44	65	39	58	64	60	42	105	42	169
20			0	0	3	0	0	10	315	84	108	92	111	131	101	115	194	132	234
21			0	0	4	0	0	1	391	130	140	137	147	222	153	136	317	259	445
22			0	0	8	2	1	7	759	342	354	423	378	704	503	331	1,006	1,012	1,218
23			0	2	7	5	5	19	916	624	640	600	660	1,288	870	557	1,864	2,387	2,438
24			0	1	7	23	12	32	1,135	665	798	854	731	1,556	1,396	618	2,600	3,601	2,993
25			6	130	74	465	337	312	1,987	1,453	1,710	2,028	1,599	3,554	2,525	1,121	4,840	8,130	6,993
26			83	169	92	606	551	436	2,456	2,385	2,533	2,932	2,102	4,364	3,057	994	4,171	8,513	6,629
27			105	217	97	566	513	477	1,937	2,385	1,803	1,996	1,549	3,183	2,266	741	2,806	7,945	5,344
28			75	211	115	310	297	387	1,790	3,101	1,902	1,760	1,664	3,503	2,420	650	2,714	9,922	7,103
29			130	315	117	358	440	473	2,045	4,553	2,409	1,895	2,033	3,841	3,006	722	2,268	11,349	8,779
30			133	409	97	345	377	400	2,424	4,999	2,585	1,328	1,788	3,646	2,392	345	811	6,187	5,780
31			265	794	134	398	602	786	4,383	12,029	6,699	1,718	4,390	9,959	5,287	325	545	6,833	7,274
32			231	805	152	313	745	1,230	6,225	15,528	9,482	2,526	7,183	14,310	6,495	359	436	6,139	6,788
Total			1,030	3,074	964	3,394	4,093	4,614	27,202	48,449	31,308	18,388	24,469	50,401	30,619	7,113	24,786	72,554	62,376

continued

Appendix D. (p 2 of 2).

East Bank Sector	08-Jul	09-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul
17	75	40	85	78	55	66	39	38	44	33	13	16	31	92	4	0	0
18	71	49	65	56	38	29	23	16	20	29	13	10	47	81	13	23	2
19	66	68	94	93	72	182	95	82	144	76	75	1	72	22	42	1	1
20	133	81	168	99	81	62	44	37	48	56	30	0	39	17	27	1	1
21	174	211	310	203	159	131	125	89	98	108	38	2	4	1	12	1	0
22	535	642	994	726	377	417	338	364	346	353	132	0	1	2	4	0	0
23	828	1,117	1,930	1,694	893	1,020	844	826	892	829	342	3	2	14	2	0	0
24	834	1,317	2,452	2,345	1,608	1,570	1,184	1,269	1,302	1,252	387	0	1	0	1	2	1
25	2,200	3,197	5,896	5,610	3,077	3,350	2,253	2,218	2,132	1,875	634	4	4	7	4	0	0
26	2,148	3,092	6,083	6,579	3,552	3,578	2,509	2,240	2,100	1,925	585	8	20	16	4	0	0
27	1,669	2,157	4,099	4,433	2,748	2,704	1,916	1,838	1,293	1,278	323	40	26	28	7	2	0
28	2,154	2,065	4,604	4,790	2,660	2,555	2,042	1,723	1,119	1,268	406	181	92	113	19	3	0
29	2,417	1,740	5,139	5,627	2,922	2,554	1,816	1,331	681	846	382	497	312	116	132	34	19
30	1,584	814	2,671	3,497	1,911	1,648	1,225	839	312	362	838	1,122	1,448	893	281	60	103
31	1,340	550	2,690	3,310	1,243	901	691	391	141	132	1,992	3,547	4,387	2,643	764	259	521
32	1,185	416	2,162	2,338	758	353	367	207	97	65	365	971	818	339	190	65	155
Total	17,413	17,556	39,442	41,478	22,154	21,120	15,511	13,508	10,769	10,487	6,555	6,402	7,304	4,384	1,506	451	803

[a] Daily sector counts may slightly deviate from daily hourly counts because of rounding errors.
[b] Counting initiated on 21 June at 1800 hours.

Appendix E. Anvik River salmon beach seine catch by species, sex, and date, and number of chum salmon sampled for age, sex, size information, by sex and date, 1995.

Date	Number of Sets	Chum Salmon Number Captured			Chum Salmon Number Sampled			Chum Salmon Number Aged			Pink Salmon Number Captured			Non-salmon Species Number Captured			
		Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	grayling	whitefish	char	other
24-Jun [a]		2	1	3	2	1	3	2	1	3			0	0	0	0	
25-Jun [a]		9	3	12	7	3	10	7	3	10			0	0	0	0	
26-Jun																	
27-Jun [a]		7	0	7	7	0	7	7	0	7			0	2	2	0	1 pike
27-Jun	4	39	10	49	34	10	44	32	9	41			0	0	0	0	
28-Jun [a]		5	3	8	5	3	8	4	3	7			0	0	0	0	
28-Jun	2	39	28	67	39	28	67	38	25	63			0	4	3	1	
29-Jun																	
30-Jun	1	89	51	140	0	0	0	0	0	0			0	1	0	0	
01-Jul	1	113	65	178	0	0	0	0	0	0			0	1	1	0	
02-Jul	1	111	56	167	0	0	0	0	0	0			0	1	0	0	
03-Jul																	
04-Jul																	
05-Jul	1	75	53	128	21	17	38	21	17	38			0	1	0	0	
06-Jul	1	24	24	48	18	16	34	16	16	32			0	8	0	0	
07-Jul	1	39	23	62	39	23	62	35	20	55			0	3	0	1	
08-Jul	1	115	83	198	14	11	25	12	10	22			0	1	0	0	
09-Jul	1	100	76	176	15	10	25	15	8	23			0	1	0	0	
10-Jul	1	91	65	156	0	0	0	0	0	0			0	1	0	0	
11-Jul																	
12-Jul																	
13-Jul	2	53	31	84	52	30	82	47	27	74			0	9	0	0	
14-Jul	2	50	31	81	50	30	80	45	30	75			0	0	0	0	
15-Jul	1	59	51	110	0	0	0	0	0	0			0	4	2	0	2 suckers
16-Jul	1	45	56	101	0	0	0	0	0	0			0	2	0	0	
17-Jul																	
18-Jul																	
19-Jul																	
20-Jul	1	38	15	53	36	14	50	31	11	42			0	4	6	1	
21-Jul																	
22-Jul	2	33	23	56	31	23	54	31	20	51			0	0	1	0	
23-Jul	2	31	49	80	30	48	78	30	43	73			1	1	4	0	1 f chinook
Stratum Totals																	
19 June - 3 July	9	414	217	631	94	45	139	90	41	131	0	0	0	9	6	1	
Percent		65.6	34.4		67.6	32.4		68.7	31.3								
4 June - 8 July	4	253	183	436	92	67	159	84	63	147	0	0	0	13	0	1	
Percent		58.0	42.0		57.9	42.1		57.1	42.9								
9 June -13 July	4	244	172	416	67	40	107	62	35	97	0	0	0	11	0	0	
Percent		58.7	41.3		62.6	37.4		63.9	36.1								
14 June -23 Jul	9	256	225	481	147	115	262	137	104	241	0	0	1	11	13	1	
Percent		53.2	46.8		56.1	43.9		56.8	43.2								
Season Totals	26	1,167	797	1,964	400	267	667	373	243	616	0	0	1	44	19	3	
Percent		59.4	40.6		60.0	40.0		60.6	39.4								

[a] Fish captured in experimental fish trap.

Appendix F. Age and sex composition of Anvik River summer chum salmon, 1972 - 1995.

	Number of Fish [a]															
	Total Sample			Number	Age 0.2			Age 0.3			Age 0.4			Age 0.5		
Year	Male	Female	Total	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	0	0	0	589	7	18	25	194	150	344	137	65	202	15	3	18

continued

Appendix F. (page 2 of 2).

Year	Total Sample				Age 0.2			Age 0.3			Age 0.4			Age 0.5		
	Percent of Sample [b]															
	Male	Female		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1972	52.2	47.8	47.8	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	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	100.0	0.7	2.0	2.7	31.9	21.4	53.3	26.2	13.4	39.6	3.8	0.5	4.4

[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 unless otherwise noted.
[c] Sample percentages weighted by time period and escapement counts.
[d] Sex compostion based on entire beach seine catch. Age compostion based on aged scales.

Appendix G. Age and sex composition of Anvik River chinook salmon escapement samples, 1972-1995.

Year	Number of Chinook Salmon[a]														
	Sample			Age 4[c]			Age 5			Age 6			Age 7		
	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

-continued-

Appendix G. (page 2 of 2).

Year	Sample[a] Male	Sample[a] Female	Sample[a] Total	Percent of Total Sample[c] Age 4 Male	Age 4 Female	Age 4 Total	Age 5 Male	Age 5 Female	Age 5 Total	Age 6 Male	Age 6 Female	Age 6 Total	Age 7 Male	Age 7 Female	Age 7 Total
1972	66.7	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

[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, 1995.

Date	Time	Precip. (Code) [a]	Wind (Direction and Velocity)	Cloud Cover (Code [b]	Temperature Air Min. ° C	Temperature Air Max. ° C	Temperature Instant. Water ° C	Water Gauge Actual (ft.)	Water Gauge Relative (ft.)	Water Gauge Relative (cm)	Water Color (code) [c]	Comments
18-Jun	17:30	N	S 0 - 5	2		15	11	1.10	0.00	0.0	Lt	
19-Jun	17:30	N	calm	1	5	27	15	1.00	-0.10	-3.0	Lt	hot day
20-Jun	19:15	N	NW 0 - 5	1	7	24	16	0.85	-0.25	-7.6	Lt	hot sunny day; light wind; buggy
21-Jun	19:40	N	calm	1	5	28	15	0.77	-0.33	-10.1	Lt	sunny hot day; buggy
22-Jun	18:00	N	calm	2	5	20	16	0.53	-0.57	-17.4	Lt	overcast; cooler; nice
23-Jun	18:30	N	calm	3	5	15	14	0.30	-0.80	-24.4	Lt	moved water gauge out into deeper water: change = -2.47 ft
24-Jun	19:20	N	NW 0 - 5	3	6	15	12	2.75	-0.82	-25.0	Lt	water dropping fast
25-Jun	18:30	I	S 5 -15	4	7	11	10	2.70	-0.87	-26.5	Br	heay rains; high winds
26-Jun	18:00	N	calm	4	8	12	11	2.72	-0.85	-25.9	Lt	river rising after 25 June heavy rains
27-Jun	18:30	N	calm	1	4	18	12	2.20	-1.37	-41.8	Lt	river dropping; sunny hot day
28-Jun	18:00	N	calm	1	8	19	15	1.98	-1.59	-48.5	Lt	river dropping fast; lots of fish
29-Jun	18:00	N	calm	1	8	17	14	1.72	-1.85	-56.4	Lt	
30-Jun	19:00	N	calm	3	6	15	14	1.78	-1.79	-54.6	Lt	
01-Jul	18:00	N	calm	2	10	18	15	1.79	-1.78	-54.3	Lt	
02-Jul	19:00	N	W 0 - 5	1	7	19	16	1.74	-1.83	-55.8	Lt	moved water gauge out: change = -0.11 ft.
03-Jul	19:00	N	calm	4	2	12	13	1.74	-1.94	-59.1	Lt	frost in morning
04-Jul	20:00	N	S 0 - 5	4	8	12	12	1.65	-2.03	-61.9	Lt	water dropping fast
05-Jul	19:00	N	calm	2	7	13	13	1.62	-2.06	-62.8	Lt	
06-Jul	18:40	N	S 0 - 10	1	8	23	16	1.52	-2.16	-65.8	Lt	very hot day; water dropping
07-Jul	18:50	I	SSW 5-20	4	5	11	14	1.46	-2.22	-67.7	Lt	extremely windy; cold
08-Jul	16:30	I	S 0-5	4	5	12	12	1.52	-2.16	-65.8	Lt	
09-Jul	19:30	N	calm	2	11	15	13	1.52	-2.16	-65.8	Lt	overcast day to blue sky at 1930
10-Jul	17:00	N	calm	1	10	22	14	1.46	-2.22	-67.7	Lt	beautiful synny hot day; minimal amount of bugs
11-Jul	18:00	N	calm	1	8	22	16	1.36	-2.32	-70.7	Lt	sunny; hot; light breeze; bug control
12-Jul	18:00	N	calm	1	10	22	16	1.29	-2.39	-72.8	Lt	hot; light breeze
13-Jul	18:30	N	calm	1	10	22	16	1.33	-2.35	-71.6	Lt	hot; light breeze
14-Jul	19:00	N	calm	3	12	22	17	1.29	-2.39	-72.8	Lt	hot; humid; sunny till 1800
15-Jul	19:30	N	calm	3	12	18	17	1.24	-2.44	-74.4	Lt	humid
16-Jul	19:00	N	calm	2	14	21	16	1.15	-2.53	-77.1	Lt	sunny
17-Jul	19:00	N	calm	4	8	18	16	1.10	-2.58	-78.6	Lt	sunny and warm
18-Jul	17:30	N	NW 0-5	4	9	18	16	1.06	-2.62	-79.9	Lt	gusty winds throughout day
19-Jul	19:00	N	calm	1	11	22	18	1.01	-2.67	-81.4	Lt	sunny; warmer
20-Jul	19:00	N	NE 0-5	3	8	21	17	0.97	-2.71	-82.6	Lt	intermittent gusts
21-Jul	19:00	I&R	NE 0-5	4	10	20	16	0.95	-2.73	-83.2	Lt	afternoon sunny; evening rain
22-Jul	18:30	I	calm	4	10	16	16	1.03	-2.65	-80.8	Lt	heavy rain all last night;
23-Jul	19:15	R	calm	4	7	13	14	1.48	-2.20	-67.1	Lt	continuous heavy rain
24-Jul	19:00	R&I	calm	4	6	12	14	1.83	-1.85	-56.4	Lt	continuous rain all night
25-Jul	18:30	N	calm	1	3	20	14	2.46	-1.22	-37.2	Lt	hot and clear; water rising

[a] Precipitation code for the preceding 24-h period: N = No precipitation; I = Intermittent rain; R = Continuous rain; S = Snow; S&R = Snow and rain mixedH = Hail; and T = Thunder showers.
[b] Instanteous cloud cover code: 0 = No observation; 1 = Clear sky, cloud cover not more than 10% of sky; 2 = Cloud cover not more than 50% of sky; 3 = Cloud cover more than 50% but less than 100% of sky; 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.