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UPPER COOK INLET SALMON ESCAPEMENT STUDIES, 1993

by

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and

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ABSTRACT

Sockeye salmon *Oncorhynchus nerka* spawning escapements into four river systems of Upper Cook Inlet, Alaska, were estimated using side-scanning sonar equipment. Estimated sockeye salmon escapements were 813,617 into the Kenai River, 149,939 into the Kasilof River, 37,556 into the Crescent River, and 141,694 into the Yentna River. Indices of escapements of other salmon species into the Yentna River were also obtained by sonar: 227,171 pink *O. gorbuscha*, 28,021 chum *O. keta*, and 37,752 coho *O. kitsutch* salmon. Age composition of sockeye salmon in the Kenai River was primarily distributed within three age classes: 2.3 (41.2%), 1.3 (30.5%) and 1.2 (12.2%). Age composition was distributed within four age classes in the Kasilof River: 1.3 (29.8%); 2.2 (28.0%); 2.3 (25.2%) and 1.2 (16.3%). Age-2.3 sockeye salmon were the most abundant (46.9%) age class in the Crescent River, followed by age class 1.3 (37.2%). Age composition of sockeye salmon in the Yentna River was primarily distributed within four age classes: 1.3 (35.5%), 1.2 (32.1%), 2.3 (14.5%), and 2.2 (11.7%). Length and sex ratio data were collected for sockeye salmon in each river. Sockeye salmon migration routes in all rivers was near shore. Peak salmon counts were recorded during the late afternoon hours and during the late evening and early morning hours in the Kenai River, and during the evening and early morning hours in the Kasilof and Yentna Rivers. Peak hourly counts in the Crescent River were related to the *post meridiem* high tides.

KEY WORDS: Pacific salmon, sockeye salmon, *Oncorhynchus nerka*, Upper Cook Inlet, Kenai River, Kasilof River, Crescent River, Yentna River, Susitna River, spawning escapements, hydroacoustic enumeration, biological sampling, migratory behavior.

INTRODUCTION

Prior to 1968, sockeye salmon escapement estimates in Upper Cook Inlet (UCI), Alaska (Figure 1) were based on surveys of clear water spawning areas and provided no information about the distribution or number of sockeye salmon which spawned in glacially occluded waters (King and Davis 1989). Commercial and recreational fishery management efforts were further hampered by lack of daily and cumulative estimates of escapement. These constraints were significantly reduced the development of hydroacoustic techniques to enumerate sockeye salmon in some glacial tributaries of UCI. Hydroacoustic enumeration of escapement began on the Kenai and Kasilof Rivers in 1968, was expanded to the Susitna River in 1978 and to the Crescent River in 1980. The Susitna River counting site was abandoned in 1985, and in 1986 counting operations began on the Yentna River, a major tributary of the Susitna River. Results of escapement enumeration studies were documented by Waltemyer et al. (1980), Tarbox et al. (1983), King and Tarbox (1984, 1986, 1987, 1988, 1989a, 1989b, 1990 and 1991), King (1990), King et al. (1992), King and Davis (1993), Davis and King (1993 and 1994) and Davis et al. (1993). Supporting data for this report were published in a separate archival report (Davis and King 1994).

The program objectives of UCI escapement projects in 1993 were to estimate (1) the daily and cumulative number of sockeye salmon entering the Kenai, Kasilof, Crescent, and Yentna Rivers, and (2) the age, length, and sex composition of those escapements. Indices of abundance were also obtained for Yentna River pink, chum and coho salmon.

METHODS

Bendix Corporation [1] side-scanning sonar counters described by King and Tarbox (1989a), Gaudet (1983) and Bendix Corp (1980 and 1984) were used to enumerate salmon escapements. Pulse width was 100 μs and the frequency was 515 Khz. Two- and four-degree transducer elements were multiplexed in an alternating mode. The counting threshold was preset at approximately -38 db by the manufacturer. Detection level could be lowered by increasing gain to the system. Counters were operated without artificial substrates in the Kenai and Crescent Rivers. A technical consultant tested the counters for proper operation prior to deployment, and reinspected counters when migrating fish densities neared maximum levels in each river system (A. Menin, Hydroacoustic Consulting, Sylmar, CA).

Project operational dates were: 1 July through 13 August on the Kenai River; 12 June through 5 August on the Kasilof River; 7 July through 7 August on the Yentna River; and 25 June through 2 August on the Crescent River. Counting operations ceased when daily

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

counts were $< 1\%$ of the cumulative count for 3 consecutive days following the cessation of commercial fishing.

Raw hourly output data were edited to account for debris, bottom echoes, or other sources of non-fish counts. At the Kenai, Kasilof, and Yentna River counting sites, hourly sonar counts by day were entered into a R-base program. This program calculated a daily average hourly count for inshore (1-6) and offshore (7-12) sonar sectors by

$$C_a = C_b / N, \qquad (1)$$

where:

C_a = average count per sector per hour;
C_b = valid hourly counts for all inshore or offshore sectors; and
N = number of sector per hour units which contained only valid counts.

The average count was then substituted into any sector/hour block where counts were deleted through editing. Sonar counts collected from the north bank of the Crescent River received the same treatment but calculations were made manually and computer entry of data occurred post-season. The daily average hourly count for the south bank of the Crescent River was calculated for each sector by:

$$C_c = C_d / N, \qquad (2)$$

where:

C_c = average count per sector per hour for the Crescent River south bank;
C_d = valid Crescent River south bank hourly counts per sector; and
N = number of hour units per sector which contained only valid counts.

Temporal and spacial behavior of sockeye salmon was assessed by examining distribution of fish by sector, hourly passage rate, bank preference, and cumulative proportion of sonar counts by day. Counting distances for counters operated at Crescent River were 4.6 m for the north bank and 21.3 m for the south bank. Counting range for the north bank of the Kenai River was 13.7 m to 21.0 m and the counting distance for the south bank was 6.1 m. Counting ranges at the Kasilof River were 15.1 m to 16.8 m on the north bank and 11.2 m to 17.4 m on the south bank. In the Yentna River, counting range for the north bank was 9.5 m to 15.2 m and 12.4 m to 15.2 m for the south bank. Reported ranges encompassed the period when 80% (10%-90%) of the run occurred.

Transducer orientation was accomplished manually except at Crescent River and the north bank of the Kenai River, where Erin[2] rotators were used. Correct orientation of the acoustic axis was tested periodically by the use of an artificial target. An air-tight plastic sphere was weighted and moved through the ensonified area at various distances from the

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transducer. Simultaneous detection of the target by the counter and visual recognition on an oscilloscope verified correct axis orientation.

Counters were monitored from 0700 through 2400 hours on the Kasilof, Crescent and Yentna Rivers, and throughout the 24 h period on the Kenai River. In addition to regularly scheduled monitoring, intensified monitoring was conducted during episodic fish passage. In all cases, visual counts from an oscilloscope were compared to the counts accumulated by the counter during a minimum 10-min period or for a minimum oscilloscope count of 100 fish. During periods of low density passage (<500 fish per hour), Kenai and Yentna River oscilloscope/counter observations were made at a minimum of 1 h per bank each day. When passage rates reached 500 fish per hour, minimum observation time increased to 2 h per bank per day. Kasilof and Crescent River counters were monitored for a minimum of 2 h per bank per day. If a relative error greater than 20% occurred between targets counted on the oscilloscope and targets recorded by the counter, counter adjustments were made to reduce the relative error. However, operators typically made adjustments to the counters to accommodate for less than 20% relative error. The basic counter adjustment consisted of changing the pulse repetition rate.

Information used to estimate species composition of sonar counts, and age, length, and sex composition of sockeye salmon escapements was obtained from salmon captured in fish wheels. Fish wheels were located on the north banks of the Kenai and Kasilof Rivers (1 at each site), the south bank of the Crescent River (1), and on both banks of the Yentna River. Fish wheels were operated up to 24 h per day at Yentna River, and during daylight hours at Crescent and Kasilof Rivers. The Kenai River fish wheel was typically operated during evening hours when the passage rate and nearness to shore of migrating sockeye salmon was approaching its daily peak, and was generally stopped as soon as the minimum sample size was reached. Fish wheel catches at the Yentna River site were expanded for each 24 h period based on the hourly catch rate during the hours of operation by

$$F_d = (F_h / H)\ 24, \qquad (3)$$

where:

F_d = expanded fish wheel catch for 24 hours;
F_h = fish wheel catch for hours operated; and
H = hours fish wheel operated.

Actual (not adjusted to 24 h) fish wheel catches were used to apportion sonar counts in the Crescent and Kenai Rivers. With the exception of the Kasilof River where all counts are treated as sockeye salmon, daily fish wheel catches were grouped into sample sizes of at least 150 salmon to apportion sonar counts. A fish wheel operated on the south bank of the Kenai River from 8 July through 28 July caught 129 sockeye salmon which provided length, sex, and age data but were not included in sonar count apportionment to species. Because of their size and number, Dolly Varden trout were included in sonar count apportionment at Crescent River.

Stream surveys for Tustumena Lake (Kasilof River) were conducted only on Bear Creek. Factors influencing the accuracy of escapement estimates for pink, coho, chum, and chinook

salmon in the Yentna River were discussed by Tarbox et al. (1981, 1983). Counts apportioned to these species in 1993 were considered to be index counts.

Sample sizes for estimating sockeye salmon age composition were based on methods for estimating multinomial proportions developed by Thompson (1987). Minimum sample sizes were calculated so that the estimated proportion of each major age class was within 5% of the true proportion 90% of the time. Previous years age composition proportions were analyzed to determine adequate sample sizes for a variety of age class ratios. The largest sample size calculated in this manner was chosen as a minimum sample size for 1993. The minimum sample size was increased by 10% to account for unreadable scales, and this number was used as the total sample size required. Sockeye salmon scale samples were collected daily from the Kenai, Kasilof, Crescent, and Yentna Rivers. The number of salmon sampled per day for age composition was based on a percentage of the previous day's escapement count. These percentages were calculated by dividing the total season sample size by the anticipated total escapement.

To detect shifts in age class proportions over time, sockeye salmon age class samples were divided into weekly periods and analyzed using the chi-square test of independence. The initial test included all periods. If a significant difference were detected ($p \leq 0.05$), each period was then tested against the following period to determine at what point the age class shift occurred. Age classes which were $\geq 10\%$ of the total escapement in each river were included in the analysis.

Mid-eye to fork-of-tail length (mm) and sex were also recorded for all sockeye salmon sampled. Sex ratios and mean lengths were calculated by grouping all samples together regardless of type or timing of sampling. Age classes which were $\geq 10\%$ of the total escapement in each river were included in length composition tables.

The hypothesis that the diel migratory pattern was independent of day was tested by performing a chi-square test on hourly sonar counts for each river. These data were further tested to determine if passage rates per hour were independent of day. For testing purposes data representing the middle 80% (10%-90%) of the run were used. Tests were conducted at the nominal $p \leq 0.05$ level of significance.

RESULTS

Kenai River

An estimated 819,202 salmon migrated past the Kenai River sonar site (Table 1) from 1 July through 13 August. Sockeye salmon composed 813,617 or 99.3% of the total number of fish enumerated (Table 2). The desired escapement goal range for this drainage is 400,000-700,000 fish. Sonar counts attributed to pink (2,867), coho (1,120) and chinook salmon (1,598) accounted for the remainder. The estimated sockeye salmon spawning escapement (sonar count minus sport harvest above the Soldotna bridge) was 697,294 fish

(Table 3). A total of 11,582 sockeye salmon were counted at the Hidden Lake weir. The late-run Russian River sockeye salmon escapement totaled 111,517 fish (Table 4).

Eighty percent of the sockeye salmon escapement passed the sonar counters in 25 d (Table 5; mean=17 d; range for 1979-93=6-25 d). The midpoint of the escapement was 18 July. Run timing was not appreciably different by bank (Davis and King 1994). Sockeye salmon migration along the south bank of the river accounted for 51% of the total escapement (Table 6). There were two distinct peaks in the daily numbers of fish passing the counters (Figure 2).

Distribution of the salmon migration along the south bank was shore oriented, with 93.0% of the counts within 3.0 m of the transducer (Table 7, Figure 3). Salmon passage on the north bank was predominantly (86.8%) within 10.2 m of the transducer.

A pattern of increased salmon passage in the evening and early morning hours was observed on the south bank (Figure 4). Fish passage measured between 1600 h and 0200 h accounted for 56.5% of the total migration (Davis and King 1994), exceeding the average for a constant hourly passage rate (4.2% per hour) by 10.3%. On the north bank the temporal passage of fish was less well defined. Averages for a constant hourly passage rate were exceeded at 1500 h and from 2200 h to 0400 h, accounting for 33.6% of the bank total.

A total of 4,631 sockeye salmon were captured in the fish wheel (Table 8). Lengths and scale samples were obtained from 2,088 sockeye salmon. The largest component (41.2%) of the sockeye salmon escapement was age-2.3 fish, followed by age-1.3 (30.5%) and -1.2 (12.2%) fish (Table 9). The proportion of the age-2.3 component was the highest recorded in the historical data base. Mean length by sex was within historical bounds for all age classes (Table 10). The male-to-female ratio fell within historical bounds. Female spawners constituted 58.5% of the total escapement.

Chi-square testing for changes in age class proportions over time detected a significant ($df=2$, $\chi^2=24.7$, $p=0.0$, $\alpha=4.61$) difference between period 2 (11 July-17 July) and period 3 (18 July-24 July). As the proportion of age-1.2 fish increased, the proportion of age-1.3 and -2.3 fish decreased.

Age-1.3 and -2.3 sockeye salmon were bound primarily for Quartz Creek, Tern Lake, the mainstem river, and the shorelines and outlets of Kenai and Skilak Lakes. Late-run sockeye salmon bound for Russian River were predominantly age-2.1 (29.6%), -2.2 (26.8%), and -1.2 (24.2%) fish (Marsh 1993), while those bound for Hidden Lake were predominantly age 1.2 (Fandrei 1993).

Kasilof River

A total of 149,939 salmon were counted at the Kasilof River sonar site from 12 June through 5 August (Table 11). The desired escapement range for this system is 150,000-250,000 sockeye salmon. Brood stock for artificial propagation at the Crooked

Creek Hatchery (9,098 fish) were taken from Bear Creek (Fandrei 1993, Table 12). Index area escapement counts conducted on Bear Creek totaled 36,002 sockeye salmon (Table 13).

The midpoint of the sockeye salmon escapement occurred on 8 July, 6 d before the mean for the previous 14 years and the earliest on record since 1981 (range 01-22 July; Table 14). Eighty percent of the escapement occurred in 37 d, 5 d greater than the historical mean (1979-92). Fish migrating adjacent to the south bank were observed earlier than those for the north bank. On 2 July the cumulative proportion for the north bank was 32% and for the south bank 45%. The cumulative proportion on the north bank reached 45% on 10 July. This degree of difference in run timing between banks has not been previously observed (Davis and King 1994).

Seventy-two percent of the salmon counts occurred on the south bank (Table 6), with 72.7% of the fish within 10.5 m of the transducer (Figure 5, Table 7). Fish distribution on the north bank was slightly more shore oriented, where 78.8% of the total counts occurred within 10.5 m of the transducer.

The average hourly passage rate on the north bank exceeded the 4.2% average for a consistent passage rate during three periods of the day: 0100 to 0500 hours; 1300 to 1400 h; and 1600 to 2300 h. Salmon counted during these hours accounted for 59.3% of the total. A more consistent passage rate was observed on the north bank than on the south bank (Figure 6). Salmon passage rates on the south bank exceeded the average from 2100 to 0700 h. Salmon counted during these hours comprised 46.7% of the total south bank escapement. There was one major peak in daily passage of fish past the counting site (Figure 2).

A total of 2,100 sockeye salmon were captured in the Kasilof River fish wheel (Table 15), of which 571 were sampled for age, length, and sex characteristics. Age-1.3 (29.8%), -2.2 (28.0%), -2.3 (25.2%) and -1.2 (16.3%) sockeye salmon were the predominant age classes (Table 16). The high proportion of age-2.3 fish has not been previously observed. Mean lengths by sex were within the historical range (Table 17). The male-to-female ratio was similar to that observed in previous years with the exception of age-1.3 fish, which was the highest recorded in 14 years of observation (1.5:1). Female spawners comprised 53.3% of the escapement.

Chi-square testing of all periods combined detected a significant ($df=12$, $\chi^2=170.3$, $p=0.0$, $\alpha=18.55$) change in age class proportions over time. Testing among periods detected significant changes in age class proportions except periods 1 and 2. The changes detected among periods 2 (28 June-2 July) and 3 (3-10 July, $df=3$, $\chi^2=9.97$, $p=0.019$) and periods 3 and 4 (11-17 July, $df=3$, $\chi^2=13.43$, $p=0.004$) were of lower magnitude than the change which occurred between period 4 and period 5 (18-24 July, $df=3$, $\chi^2=19.38$, $p=0.0$). As the proportions of 2-ocean fish increased, the proportions of 3-ocean fish decreased.

Crescent River

A total of 43,023 salmon were counted at the Crescent River sonar site from 25 June through 2 August (Table 18). Sockeye salmon represented 78.9% of the fish captured in the fish wheel (Table 19). Estimated sockeye salmon escapement was 37,556 fish. The desired sockeye salmon escapement goal for this system is 50,000 to 100,000 fish.

The midpoint of the sockeye salmon escapement occurred on 14 July, 2 d before the date of the historical mean, and 80% of the escapement passed the site in 23 d (Table 20). The peak in daily passage occurred on 4 July (Figure 2). No difference in run timing was detected between banks. Fifty six percent of the fish migrated along the south bank (Table 6).

Spacial distribution of fish was strongly shore oriented, with 97.9% of the north bank counts within 1.5 m of the transducer and 99.7% of the south bank counts within 1.8 m of the transducer (Table 7, Figure 7). Two peaks in the migration were observed (Figure 2).

All counts recorded on the south bank at Crescent River occurred in sectors one (99.7%) and two (0.3%) of the counting range. Printer skips (treated as false counts) regularly occurred in sectors one through six. Hourly averages for each sector were substituted where skips occurred or counts were deleted. Because of the spacial distribution of fish migrating adjacent to this bank, the method used for the treatment of false counts provided a more accurate estimate of daily escapement because it did not place a high hourly average count derived from sector one or two into sectors where very few targets were detected.

Fish migrated adjacent to the north bank at rates which exceeded the hourly average for a constant passage rate during the hours 1200 to 2200 (Figure 8). Sonar counts during those hours were 69.0% of the bank total. On the south bank the highest hourly passage rates occurred during the hours 1400 to 2200 h, accounting for 67.6% of the bank total.

A total of 2,336 sockeye salmon were captured in the fish wheel, of which 465 were sampled for age, length, and sex data. Age-2.3 fish were the most abundant (46.9%), with the other major component (37.2%) of the escapement represented by age-1.3 fish (Table 21). Average lengths by sex for age-2.3 and -1.3 fish were within the bounds of previous years observations (Table 22). The ratio of males-to-females was within historical bounds. Females accounted for 50.6% of the total sockeye salmon escapement.

Chi-square testing of age class proportions detected no significant change over time.

Yentna River

From 7 July through 7 August, 435,001 salmon were counted at the Yentna River sonar site (Table 23), of which 141,694 were sockeye salmon. The escapement goal range for the Yentna River is 100,000-150,000sockeye salmon. Sonar counts apportioned to species other than sockeye salmon were: pink salmon, 227,171; coho salmon, 37,752; and chum salmon, 28,021. Estimates of coho and chinook salmon escapements for other tributaries of the

Susitna River were also made (Table 24). No estimates for pink or chum salmon were available for the Susitna River above its confluence with the Yentna River.

The midpoint of the sockeye salmon escapement occurred on 22 July, 2 d earlier than the historical mean. Eighty percent of the escapement passed the counters in 16 d (Table 25). There was a bimodal entry pattern, but run timing was not appreciably different by bank (Davis and King 1993). Nearly all (87%) of the sockeye salmon migrated adjacent to the south bank (Table 6).

Of the salmon counted from the south bank, 93.8% were within 5.7 m of the transducer (Table 7, Figure 9). On the north bank, 97.4% of the salmon were counted within 6.2 m of the transducer.

The seasonal hourly passage rate on the north bank met or exceeded the average for a constant hourly passage rate (4.2%) during the hours 1400 to 2100 and 2300 to 0300 (Figure 10). Counts accumulated during these hours accounted for 57.9% of the north bank total. The percentage per hour for a constant hourly passage rate was exceeded during the hours of 1400, 1500, 1700 to 2200, and 2400 to 0400 on the south bank. Counts accumulated during these hours accounted for 52.5% of the south bank total. There were two distinct peaks in the daily numbers of fish passing the counters (Figure 2).

King and Tarbox (1990) indicated sockeye and pink salmon exhibited differential migratory behavior in the Yentna River. They found that sockeye salmon were proportionally higher in the fish wheel catch from 1200 through 2400 hours and pink salmon were more frequently captured from 0600 through 1200 hours. This observation identified a potential source of error in the use of total daily adjusted fish wheel catches to apportion sonar counts. To overcome this potential bias, fish wheels catches used to apportion sonar counts were collected by operating the fish wheels in 4 time blocks of 6 h each over a 24 h period.

A total of 9,492 sockeye salmon were captured in fish wheels at Yentna Station (Tables 26 and 27), of which 1,390 were sampled for age, sex, and length data. The major components of the escapement were ages 1.3 (35.5%), 1.2 (32.1%), 2.3 (14.5%) and 2.2 (11.7%, Table 28). Age-2.2 fish exceeded 10% of the total escapement for the second consecutive year. Mean lengths of age-2.3 fish remained on the low end of the size range, continuing a 3-year trend. Mean lengths for ages 1.2 and 1.3 were the were within historical ranges. Mean length increased for age-2.2 males by 25 mm and age -2.2 females by 26 mm over means calculated in 1992 (Table 29). The male-to-female ratios were within historical ranges for all age classes. Female spawners composed 48.3% of the total sockeye salmon escapement.

Significant differences ($df=9$, $\chi^2=84.4, p=0.0$) in Yentna River age class proportions over time were detected. Changes between period 1 and period 2 ($df=3$, $\chi^2=4.2, p=0.24$) and between period 2 and period 3 ($df=3$, $\chi^2=9.55, p=0.023$), although significant were of low magnitude. The greatest change in age class proportions occurred between period 3 (18-24 July) and period 4 (25-31 July, $df=3$, $\chi^2=58.07, p=0.0$).

Eighty percent of the pink salmon escapement occurred in 16 d, with the midpoint occurring on 22 July (Table 30). Pink salmon run duration (80%) in the Yentna River has ranged from 9 d to 21 d. Migratory timing has been remarkably consistent, with the midpoint occurring between 27 and 30 July in 11 of the 13 years for which data is available.

DISCUSSION

The 1993 field season and sonar counting operations were similar to past years. Counting conditions on all rivers were thought to be within design and operational tolerances of the Bendix side-scanning sonar system because (1) salmon passage was inshore and near the bottom during the peak of the run, (2) salmon densities were generally adequate for system adjustment, and (3) one species, sockeye salmon, composed most of the run (87%-99%) except in Yentna River (33%).

Kenai River

Temporal distribution of fish at the Kenai River counting site varied from the pattern observed in previous years. Historically the percentage of the daily total counts were lowest between 0500 and 0700 h, and generally increased to a peak at 0100 h. In 1993 the temporal distribution pattern on the north bank fit the historical pattern from 0900 until 1500 h, but the percentage of the daily total during the hours 0100 through 0800 was the highest observed for the previous 4 years. North bank hourly counts began to decrease at 1500 h and continued until 1900 h, when an increasing hourly passage rate began. The decrease in counts during the afternoon hours has not been previously observed. The percentage of total counts for the period 1700 h to 2100 h was the lowest observed in the previous 4 years.

In the 13 year data base, only 2 years (1984 and 1990) produced escapements with more age-1.3 males than females (range 0.5:1 to 1.1:1). The Salamatof Beach harvest, which has a very high proportion of fish bound for the Kenai River, had an age-1.3 female component of 52% (D. Waltemyer, ADF&G, Soldotna, personal communication).

The percentage of age-2.3 fish was the highest recorded in the Kenai River escapement (41.2%; range for 1970 - 1992, 5.2% - 21.1%). The high proportion of age-2.3 sockeye salmon returning to the Kenai River in 1993 can be attributed to a high smolt survival (30.8%, K. Tarbox, ADF&G, Soldotna, personal communication) of that year class. Of the estimated 5.8 million age-2. smolt which migrated out of the river in 1990, a small proportion returned as adults in 1992 (approximately 100,000 age-2.2 sockeye salmon). The remainder of the 1990 age-2. smolt returned as age-2.3 adults in 1993 and composed 49.5% of the total Kenai River return.

An estimated 5.2 million age-1. smolt also left the Kenai river in 1990 (King et al. 1990, 91). Since the age-1.2 component of the 1992 total Kenai River return was 1.1%, (approximately 91,000 fish), we expected that age-1.3 adults would contribute significantly to the total Kenai

River return in 1993. Age-1.3 fish represented 33.4% of 1993 the total Kenai return, giving a smolt-to-adult survival rate of 25.5%.

Age-1.2 adults returning to the Kenai River in 1993 were not expected to contribute significantly to the total return since the age-1. smolt migration estimate in 1991 was < 1 million fish (King et al. 1991). Age-1.2 fish composed 6.7% of the total Kenai River return in 1993.

The Russian River late-run sport harvest and escapement of age-2.2 sockeye salmon was 33,697 fish (L. Marsh, ADF&G, Soldotna, personal communication). The total estimated escapement at the Kenai River sonar enumeration site was 52,072 fish for this age class. We believe a high proportion of age-2.2 sockeye salmon entering the Kenai River are of Russian River origin, however, other Kenai River stocks also include an age-2.2 component (D. Waltemyer, ADF&G, Soldotna, personal communication). Historically, estimates of age-2.2 fish entering the Russian River have been higher than estimates made for that age class at the km 31 sonar site. Factors which may have contributed to this discrepancy include: 1) a small age composition sample size obtained from a relatively large escapement; 2) errors in scale aging; 3) inability to precisely determine the origin of Russian River confluence sport harvested fish; and 4) an error in the total escapement estimate.

During the period 1 July to 13 July spacial distribution of migrating salmon adjacent to the north bank of the Kenai River varied from the near-shore distribution generally observed. Higher counts were recorded in the distal portion of the counting range than in the proximal sectors, indicating an offshore distribution of migrating fish. We speculate that low water level combined with the long, gradual slope of the river's north bank substrate at the counting site and low turbidity were probably the main factors that contributed to the off-shore distribution pattern observed on the north bank. Although some fish may not have been counted, we do not feel that significant numbers of fish passed outside the counting distance. A non-statistical comparison of proportions of counts by bank by day indicated that proportions were similar (Figure 12). If large numbers of fish had passed the north bank counting site where distribution of fish was offshore, then a dissimilar proportion of counts would have probably appeared on the south bank where fish distribution was inshore. Regression analysis of daily proportions yielded R^2 values of 0.96 when data for all days of operation were used and 0.74 when the proportions by bank for the period 1 through 13 July were used (the period when offshore distribution occurred on the north bank). Additionally, low commercial set net harvest of Kenai River bound fish and low fish wheel catches at the km 31 sonar site during the 1 to 13 July time frame lead us to believe that relatively low densities of fish were present in the river during the time environmental conditions were affecting offshore migration. When the main body of fish arrived at the counting site, environmental conditions effecting fish behavior had changed (higher water levels and turbidity) and fish distribution was near shore. Near shore water depth is greater on the south bank than the north, and even in low water, low turbidity conditions fish distribution is rarely offshore. Spacial distribution of fish migrating along both banks may also be related to the presence of the main body of migrating fish. Dramatic increase in fish densities can be correlated with high proportions of daily counts in the inner sectors of the counting range on both banks.

The chi-square analysis of temporal distribution data revealed a significant difference ($p \leq 0.05$) in migration numbers per day between days, indicating that the diel migration pattern is not independent of date (diel counts or proportions are not consistent over time). Data used in these tests were limited to that collected during the middle 80% of the migration because we felt that it was more representative of typical fish behavior (more consistent passage rates and near-shore distribution). Although significant statistical differences were observed, general diel patterns occurred in each river which were fairly consistent throughout the migration.

Extended commercial fishing periods were in effect for areas surrounding the terminus of the Kenai River until 24 July, after which the commercial fishery was closed for 3 d. Unrestricted entry of fish into the river during that period accounts for the second peak in counts on 27 July (Figure 2).

Kasilof River

The percentage of age-2.3 fish was the highest recorded in the Kasilof River (25.2%; range for 1969 - 1992, 2.6% - 18.0%). The 1987 brood year produced 3.109 million age-.1 smolt, of which 139,000 returned as age-1.2 adults and 440,000 as age-1.3 adults (18.6% marine survival rate). The age-.2 smolt for the 1987 brood year numbered 3.521 million of which 241,000 returned as age-2.2 adults and 203,000 as age-2.3 adults (12.6% marine survival rate). The 1988 brood year produced 3.961 million age-.1 smolt of which 125,000 returned as age-1.2 adults and 218,000 as age-1.3 adults (8.66% marine survival rate). This poor marine survival rate of the 1988 brood year age-1. smolt had the effect of inflating the proportion of returning age-2.3 adults from the 1987 brood year (K. Tarbox, ADF&G, Soldotna, personal communication).

Run timing, counter limitations, and spawning locations relative to the sonar site made sonar escapement estimates for Kasilof River pink, coho, and chinook salmon impractical. Coho salmon entered the river primarily in August (G. Kyle, ADF&G, Soldotna, personal communication). The proportion of pink salmon was not known, but the average historical proportion of the pink salmon in the Kasilof River escapement is 1.9% (range 0.2-6.4%). Early- and late-run chinook salmon migrated past the sonar site during the time when sockeye were counted, but no counts were apportioned to this species. We believe that the ratio of sockeye salmon to chinook salmon captured in the fish wheel has been biased toward chinook salmon during the latter stages of the run.

Crescent River

The installation of a fish wheel at Crescent River reduced the time required to collect samples for age, length, and sex determination, reduced the degree of size selectivity inherent to the gear types formerly used (drifted gill nets and a fish trap), and increased gear fishing time.

Dolly Varden trout captured at Crescent River were thought to be migrating fish of adequate size to meet target detection thresholds of the counters and were included species

apportionment of daily sonar counts. Previous years' gill net and fish trap catches did not include Dolly Varden trout.

The use of Erin rotators on both banks of the Crescent River increased efficiency, enabling an unassisted operator to reorient the acoustic axis to acquire optimum aiming.

Crescent River hourly fish passage rates peaked during the afternoon and evening hours following high tides (Figure 11) on 32 of the 39 days of the enumeration operation. We conclude that daily migration timing is probably related to tides. However, we have not observed a bimodal entry pattern into Crescent River, so some other as yet unidentified variable(s) must also be influencing fish migration at this site.

Age composition of the sockeye salmon escapement in the Crescent River was typical of previous years.

Yentna River

The bimodal pattern of fish passage at the Yentna River sonar site may be attributed to high water conditions that occurred as passage rates reached their seasonal peak. Barrett (1985) reported a correlation between high discharge rates and decreased fish wheel catches in the Susitna and Yentna Rivers. Commercial fishing periods may also have effected the entry pattern of fish into the river, but evidence supporting this is inconclusive (D. Waltemyer, ADF&G, Soldotna, personal communication).

Yentna River age class composition was typical of previous years except age-2.2 fish which $\geq$ 10% of the total escapement for the second consecutive year.

The historical male-to-female ratio of 2-ocean sockeye salmon in the Yentna River has been low (except 1987 when the ratio for age-1.2 fish was 1.0:1), ranging from 1.3:1 to 3.4:1. The ratio of males to females for 3-ocean fish has been low (except 1987 and 1988 when proportions by sex were nearly equal), ranging from 0.6:1 to 0.9:1. We believe that a large proportion of sockeye salmon migrating along the western shore of northern Cook Inlet are Susitna River fish. We compared the ratio of males to females in the commercial catch from this area (Northern District, general sub-district) and found no evidence that harvest influenced the disproportionate male-to-female ratios in the Yentna River escapement.

Enumeration activities ceased on the Yentna River on 7 August. Migratory timing information could not be calculated for chum and coho salmon because migration continued past that date. In the years 1981 to 1984 a range of 69.8% to 92.0% (mean 78.7%) of the chum salmon escapement and 79.6% to 89.9% (mean 84.8%) of the coho salmon escapement was recorded by 12 August (King and Tarbox 1986).

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Table 1. Estimated salmon escapement into the Kenai River, 1 July through 13 August 1993. Species composition of daily sonar counts based on fish wheel catches.

	Sockeye		Pink		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
01-Jul	3,363	3,363	8	8	0	0	13	13
02-Jul	4,714	8,077	9	17	0	0	20	33
03-Jul	2,609	10,686	6	23	0	0	11	44
04-Jul	5,102	15,788	11	34	0	0	21	65
05-Jul	14,576	30,364	30	64	0	0	60	125
06-Jul	16,428	46,792	34	98	0	0	68	193
07-Jul	3,162	49,954	7	105	0	0	13	206
08-Jul	4,280	54,234	8	113	0	0	18	224
09-Jul	11,355	65,589	23	136	0	0	47	271
10-Jul	3,905	69,494	21	157	0	0	63	334
11-Jul	1,387	70,881	8	165	0	0	22	356
12-Jul	3,796	74,677	21	186	0	0	61	417
13-Jul	7,871	82,548	16	202	0	0	16	433
14-Jul	88,382	170,930	175	377	0	0	176	609
15-Jul	74,263	245,193	147	524	0	0	147	756
16-Jul	80,572	325,765	329	853	0	0	0	756
17-Jul	69,167	394,932	0	853	0	0	0	756
18-Jul	25,365	420,297	0	853	0	0	0	756
19-Jul	13,724	434,021	75	928	0	0	0	756
20-Jul	19,281	453,302	107	1,035	0	0	0	756
21-Jul	20,159	473,461	136	1,171	0	0	275	1,031
22-Jul	13,999	487,460	96	1,267	0	0	190	1,221
23-Jul	10,343	497,803	70	1,337	0	0	141	1,362
24-Jul	9,602	507,405	30	1,367	0	0	0	1,362
25-Jul	8,956	516,361	28	1,395	0	0	0	1,362
26-Jul	28,416	544,777	89	1,484	0	0	0	1,362
27-Jul	41,395	586,172	130	1,614	0	0	0	1,362
28-Jul	22,378	608,550	0	1,614	0	0	0	1,362
29-Jul	20,204	628,754	0	1,614	0	0	0	1,362
30-Jul	18,026	646,780	144	1,758	0	0	0	1,362
31-Jul	15,283	662,063	122	1,880	0	0	0	1,362
01-Aug	11,026	673,089	51	1,931	0	0	51	1,413
02-Aug	14,541	687,630	67	1,998	0	0	68	1,481
03-Aug	10,839	698,469	50	2,048	0	0	50	1,531
04-Aug	6,509	704,978	76	2,124	52	52	0	1,531
05-Aug	9,834	714,812	116	2,240	78	130	0	1,531
06-Aug	24,134	738,946	286	2,526	191	321	0	1,531
07-Aug	14,953	753,899	81	2,607	406	727	0	1,531
08-Aug	9,106	763,005	49	2,656	248	975	0	1,531
09-Aug	16,988	779,993	77	2,733	77	1,052	0	1,531
10-Aug	9,123	789,116	73	2,806	37	1,089	37	1,568
11-Aug	7,510	796,626	61	2,867	31	1,120	30	1,598
12-Aug	7,791	804,417	0	2,867	0	1,120	0	1,598
13-Aug	9,200	813,617	0	2,867	0	1,120	0	1,598

Table 2. Estimated sockeye salmon escapement recorded by side-scanning sonar in the Kenai, Kasilof, Crescent, and Susitna Rivers, 1978-1993.

Year	System			
	Kenai R.[a]	Kasilof R.[b]	Crescent R.	Susitna R.[c]
1978	398,900	116,600	[d]	94,400
1979	285,020	152,179	86,654	156,890
1980	464,038	187,154	90,863	190,866
1981	407,639	256,625	41,213	139,401[e]-340,232
1982	619,831	180,239	58,957	215,856[f]-265,332[g] 113,847[e]
1983	630,340	210,271	92,122	112,314-175,936[g] 104,414[e]
1984	344,571	231,685	118,345	194,480[f]-279,446[g] 149,375[e]
1985	502,820	505,049	128,628	107,124[e]-227,924[g]
1986	501,157	275,963	20,385[h]	92,076[e]
1987	1,596,871	249,250	120,219	66,054[e]
1988	1,021,469	204,000[i]	57,716	52,330[e]
1989	1,599,959	158,206	71,064	96,269[e]
1990	659,520	144,136	52,238	140,290[e]
1991	647,597	238,269	44,578	109,632[e]
1992	994,798	184,178	58,229	66,074[e]
1993	813,617	149,939	37,556	141,694[e]

[a] Includes counts after 22 June (1978-87) and after 1 July (1988-93).
[b] Includes counts or estimates prior to 15 June (1983-88) and post enumeration estimates (1981-86).
[c] Sonar counts from Susitna Station unless otherwise indicated.
[d] No counts conducted.
[e] Sonar counts from Yentna Station only.
[f] Sonar counts from Yentna Station and east bank of the Susitna River.
[g] Counts from Yentna Station and mark-recapture estimate from Sunshine Station.
[h] Counts through 16 July only.
[i] Combined counts from wiers on Bear and Glacier Flat Creeks and surveys of remaining spawning streams.

Table 3. Late-run Kenai River sockeye salmon escapement summary, 1968-1993.

Year	Estimated Escapement at Sonar Site[a]	Russian River Sport Harvest[b]	Kenai River Mainstem Sport Harvest[c]	Estimated Total Harvest Above Sonar Site[d]	Sonar Count Less Sport Harvest[e]
1968	88,000	5,820			
1969	53,000	1,150			
1970	73,000	600			
1971	300,000	10,730			
1972	318,000	16,050			
1973	367,000	8,930			
1974	161,000	8,500	8,030	16,530[f]	144,470
1975	142,000	8,390	5,110	13,500	128,500
1976	380,000	13,700	13,140	26,840	353,160
1977	708,000	27,440	16,933	44,373	663,627
1978	398,900	24,530	24,542	49,072	349,828
1979	285,020	26,840	12,328	39,158	245,862
1980	464,038	33,500	18,592	52,082	411,956
1981	407,639	23,720	14,450	38,171	369,468
1982	619,831	10,320	38,400	48,718	571,113
1983	630,340	16,000	48,310	64,306	566,034
1984	344,571	21,970	11,160	33,250	311,321
1985	502,820	58,410	40,440	98,850	403,970
1986	501,157	30,810	47,920	78,730	422,427
1987	1,596,871	40,580	148,300	188,880	1,407,991
1988	1,021,469	19,540	91,770	111,310	910,159
1989	1,599,959	55,210	165,340	220,550	1,379,409
1990	659,520	56,180	87,575	140,559	518,961
1991	647,597	31,450	108,271	216,781[g]	430,816
1992	994,798	26,101	161,957	188,058	806,740
1993	813,617	26,772	89,551[h]	116,323	697,294

[a] Bendix Corp. multiple transducer sonar 1968-1977, side-scanning sonar 1978-1993.
[b] Based on creel census data from Sport Fish Division, Soldotna.
[c] Sport Fish Division Statewide Harvest estimate, above the Soldotna bridge (and sonar site) only.
[d] Combined Russian River and mainstem (above bridge) harvests.
[e] Considered estimate of spawners above sonar site.
[f] Cross et al. (1983): 1974-1980.
[g] Includes 77,060 harvest at Hidden Creek weir: Fandrei 1991.
[h] Preliminary estimate: Sport Fish Division, Soldotna.

Table 4. Late-run sockeye salmon escapements in eight index areas, Kenai River drainage, 1969-1993.

Year	Railroad Creek[b]	Johnson Creek[b]	Carter-Moose Creek[b]	Ptarmigan Creek[b]	Tern (Mud) Lake[b]	Quartz Creek[c]	Hidden Lake[d]	Russian River[a] Above Weir	Russian River[a] Below Weir	Total Index Area Escapement
1969	100	75	598	5	487	487	500	28,920	1,100	32,272
1970	99	118	348	7	561	200	323	28,200	220	30,076
1971	194	160	3,201	45	1,370	808	1,958	54,430	10,000	72,166
1972	700	150	3,400		1,200		4,956	79,000	6,000	95,406
1973	521	1,714	660	1,041	1,731	3,173	690	24,970	6,690	41,190
1974		46	939	558		255	1,150	24,650	2,210	29,808
1975	522	105	1,278	186	1,214	1,068	1,375	31,970	630	38,348
1976	1,032		5,558		1,548	3,372	4,860	31,950	3,470	51,790
1977	1,262	450	6,515	1,513	2,230	3,037	1,055	21,410	17,090	54,562
1978	1,749	780	1,933	3,529	1,126	10,627	4,647	32,760	18,330	75,481
1979		588	3,986	523	1,693	277	5,762	87,920	3,920	104,669
1980	1,259	253	4,879	5,752	2,575	7,982	27,448	83,980	3,220	137,348
1981	1,276	142	4,370	1,421	3,402	5,998	15,939	44,530	4,160	81,238
1982	2,518	498	4,752	7,525	4,300	70,540	8,648	30,790	45,000	174,571
1983	1,289	338	1,819	9,709		73,345	11,297	34,040	44,000	175,837
1984	2,090	939	5,927	18,000	2,728	37,659	27,792	92,660	3,000	190,795
1985	2,884	151	5,928	26,879			24,784	136,970	8,650	206,246
1986	600	245	1,659				17,530	40,420	6,022	66,476
1987	736	74	625	14,187		45,400	43,487	53,930	76,732	235,171
1988	1,990	1,243	1,607	31,696			50,907	42,480	28,840	158,763
1989	4,959	2,276	5,958	3,484			7,770	138,320	28,480	191,247
1990			2,306	3,230			77,959	83,336	11,760	178,591
1991			750 *	2,764 *	1,750 [f]		35,676	78,175	22,267	141,382
1992			1,106 *	3,147 *	970 [f]		32,912	63,478	4,980	106,593
1993							11,582	99,259	12,258	123,099

[a] 1969-75, ADF&G archives, Division of Sport Fish, Anchorage. 1976-93, Marsh, L. 1993.
[b] United States Department of Agriculture, Forest Service, Seward, Alaska (1984-92).
[c] FRED Division weir count (1982-83).
[d] Weir count: 1971, 1973, 1976-89 (FRED Division); 1990-93 (Cook Inlet Aquaculture Association).
* Carter-Moose Creek survey conducted on lower 1.0 mile of creek, Ptarmigan Creek survey conducted on lower 1.5 miles of creek (1991-1992).
[f] Survey conducted on an unnamed stream at eastern end of Tern (Mud) Lake.

Table 5. Cumulative proportion by date of late-run sockeye salmon counts recorded in the Kenai River, 1981-1993.

	Cumulative Proportion[a,b]														
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
22-Jun	0.001	0.002	0.001	0.002	0.001	0.003	0.001	0.000	0.001						
23-Jun	0.003	0.004	0.001	0.003	0.001	0.007	0.002	0.002	0.002						
24-Jun	0.006	0.005	0.002	0.004	0.002	0.010	0.003	0.003	0.002						
25-Jun	0.008	0.006	0.003	0.004	0.003	0.012	0.004	0.003	0.002						
26-Jun	0.010	0.006	0.004	0.005	0.004	0.013	0.005	0.004	0.003						
27-Jun	0.012	0.006	0.006	0.006	0.005	0.015	0.006	0.004	0.004						
28-Jun	0.013	0.009	0.007	0.007	0.006	0.017	0.007	0.006	0.005						
29-Jun	0.015	0.010	0.006	0.007	0.006	0.018	0.009	0.006	0.006						
30-Jun	0.017	0.011	0.009	0.006	0.007	0.021	0.010	0.007	0.007						
01-Jul	0.019	0.012	0.010	0.009	0.007	0.023	0.014	0.008	0.007	0.000	0.000	0.001	0.001	0.003	0.004
02-Jul	0.020	0.013	0.012	0.010	0.008	0.024	0.016	0.009	0.008	0.000	0.001	0.001	0.003	0.005	0.010
03-Jul	0.023	0.014	0.012	0.011	0.008	0.025	0.017	0.010	0.008	0.001	0.001	0.003	0.004	0.008	0.013
04-Jul	0.025	0.015	0.013	0.011	0.009	0.027	0.019	0.011	0.008	0.001	0.001	0.010	0.005	0.010	0.019
05-Jul	0.030	0.016	0.013	0.012	0.009	0.029	0.021	0.012	0.009	0.001	0.002	0.019	0.012	0.011	0.037
06-Jul	0.050	0.016	0.014	0.012	0.009	0.031	0.024	0.013	0.008	0.002	0.006	0.029	0.017	0.014	0.058
07-Jul	0.067	0.017	0.016	0.013	0.010	0.032	0.026	0.014	0.009	0.003	0.011	0.036	0.019	0.015	0.061
08-Jul	0.077	0.017	0.018	0.013	0.010	0.036	0.030	0.014	0.010	0.003	0.014	0.044	0.020	0.016	0.067
09-Jul	0.082	0.018	0.064	0.015	0.011	0.044	0.032	0.015	0.010	0.003	0.017	0.049	0.022	0.018	0.081
10-Jul	0.086	0.018	0.186	0.016	0.013	0.054	0.033	0.015	0.010	0.011	0.021	0.050	0.024	0.020	0.085
11-Jul	0.089	0.019	0.262	0.016	0.017	0.063	0.036	0.015	0.010	0.063	0.024	0.052	0.026	0.022	0.087
12-Jul	0.092	0.020	0.366	0.017	0.021	0.067	0.038	0.016	0.011	0.088	0.046	0.054	0.034	0.043	0.092
13-Jul	0.095	0.020	0.463	0.019	0.041	0.071	0.039	0.018	0.015	0.141	0.100	0.057	0.037	0.111	0.101
14-Jul	0.100	0.021	0.512	0.021	0.085	0.073	0.048	0.039	0.017	0.185	0.162	0.060	0.038	0.175	0.210
15-Jul	0.126	0.027	0.549	0.026	0.174	0.076	0.066	0.051	0.033	0.222	0.211	0.064	0.041	0.202	0.301
16-Jul	0.170	0.057	0.559	0.047	0.242	0.112	0.104	0.061	0.043	0.274	0.242	0.068	0.046	0.218	0.400
17-Jul	0.238	0.310	0.572	0.067	0.297	0.173	0.111	0.073	0.052	0.303	0.290	0.136	0.058	0.229	0.485
18-Jul	0.342	0.489	0.605	0.182	0.437	0.307	0.114	0.086	0.058	0.340	0.347	0.279	0.086	0.246	0.517
19-Jul	0.504	0.607	0.667	0.322	0.566	0.363	0.115	0.102	0.069	0.375	0.367	0.344	0.136	0.255	0.533
20-Jul	0.670	0.777	0.747	0.474	0.695	0.406	0.116	0.113	0.141	0.409	0.421	0.400	0.194	0.284	0.557
21-Jul	0.795	0.899	0.803	0.563	0.766	0.464	0.120	0.174	0.235	0.464	0.500	0.457	0.225	0.334	0.582
22-Jul	0.840	0.920	0.835	0.598	0.796	0.555	0.178	0.269	0.319	0.569	0.566	0.473	0.261	0.370	0.599
23-Jul	0.872	0.926	0.848	0.642	0.813	0.652	0.291	0.322	0.406	0.679	0.639	0.518	0.307	0.402	0.612
24-Jul	0.888	0.932	0.864	0.681	0.833	0.720	0.463	0.382	0.488	0.744	0.679	0.576	0.376	0.451	0.624
25-Jul	0.913	0.935	0.876	0.722	0.844	0.781	0.574	0.471	0.570	0.785	0.698	0.675	0.424	0.535	0.635
26-Jul	0.925	0.938	0.894	0.752	0.861	0.833	0.693	0.618	0.640	0.812	0.729	0.719	0.476	0.612	0.670
27-Jul	0.931	0.944	0.911	0.842	0.865	0.867	0.753	0.730	0.694	0.827	0.774	0.729	0.545	0.678	0.720
28-Jul	0.934	0.947	0.921	0.883	0.872	0.897	0.822	0.783	0.740	0.836	0.806	0.744	0.636	0.740	0.748
29-Jul	0.939	0.952	0.932	0.903	0.878	0.913	0.864	0.816	0.766	0.844	0.831	0.796	0.710	0.798	0.773
30-Jul	0.945	0.955	0.940	0.918	0.882	0.921	0.897	0.862	0.790	0.847	0.846	0.846	0.771	0.830	0.795
31-Jul	0.950	0.957	0.948	0.931	0.891	0.928	0.911	0.897	0.831	0.850	0.856	0.867	0.837	0.843	0.814
01-Aug	0.953	0.960	0.955	0.940	0.906	0.933	0.919	1.000	0.871	0.854	0.875	0.879	0.884	0.854	0.827
02-Aug	0.955	0.962	0.964	0.946	0.916	0.937	0.922		0.899	0.859	0.888	0.896	0.911	0.864	0.845
03-Aug	0.958	0.964	1.000	0.951	0.920	0.943	0.925		0.917	0.863	0.899	0.932	0.926	0.871	0.858
04-Aug	0.961	0.966		0.955	0.934	0.948	0.929		0.930	0.873	0.908	0.963	0.932	0.877	0.866
05-Aug	0.965	0.968		1.000	0.964	0.956	0.931		0.943	0.894	0.916	0.978	0.938	0.888	0.879
06-Aug	0.968	0.970			0.977	0.960	0.935		0.953	0.914	0.930	0.991	0.944	0.903	0.908
07-Aug	0.971	0.972			0.983	0.963	0.938		0.962	0.933	0.949	1.000	0.953	0.915	0.927
08-Aug	0.973	0.974			0.989	0.969	0.943		0.967	0.944	0.960		0.967	0.930	0.938
09-Aug	0.977	0.975			0.993	1.000	0.947		0.972	0.953	0.966		0.979	0.942	0.959
10-Aug	0.981	0.978			0.996		0.953		0.979	1.000	0.974		0.988	0.955	0.970
11-Aug	0.987	0.982			0.999		0.960		0.985		0.985		0.995	0.969	0.979
12-Aug	0.993	0.985			1.000		1.000		0.988		0.990		1.000	0.981	0.989
13-Aug	0.995	0.992							0.991		0.994			1.000	1.000
14-Aug	0.996	0.993							0.998		0.998				
15-Aug	1.000	0.993							1.000		1.000				
16-Aug		0.995													
17-Aug		0.998													
18-Aug		0.997													
19-Aug		0.997													
20-Aug		0.997													
21-Aug		0.998													
22-Aug		0.998													
23-Aug		0.999													
24-Aug		0.999													
25-Aug		0.999													
26-Aug		0.999													
27-Aug		0.999													
28-Aug		1.000													
29-Aug		1.000													
30-Aug		1.000													
31-Aug		1.000													
01-Sep		1.000													
02-Sep		1.000													
03-Sep		1.000													
04-Sep		1.000													
Midpoint	7/19	7/19	7/14	7/21	7/19	7/22	7/25	7/25	7/25	7/22	7/21	7/23	7/27	7/25	7/18
No. days for 80%	12	6	18	12	18	14	16	12	14	25	23	18	15	25	25

[a] Proportion accrued on last day (1981, 1982, 1984-1986, 1988) represents that portion of the escapement estimated after termination of enumeration operations.
[b] Inclusive dates: date proportion of escapement reached 10% through date proportion of escapment reached 90%.

Table 6. Distribution of sockeye salmon escapement by bank recorded by side-scanning sonar in the Kenai, Kasilof, Crescent, and Yentna Rivers, 1979-1993.

	Percentage of Total Fish Targets							
	Kenai River		Kasilof River		Crescent River		Yentna River	
Year	North Bank	South Bank	North Bank	South Bank	North Bank	South Bank	North Bank	South Bank
1979	72	28	53	47				
1980	61	39	52	48	49	51		
1981	72	28	69	31	57	43		
1982	39	61	73	27	54	46		
1983	42	58	51	49	39	61		
1984	65	35	56	44	71	29		
1985	54	46	70	30	70	30	9	91
1986	62	38	57	43	84	16	32	68
1987	48	52	55	45	64	34	10	90
1988	47	53	32	68	53	47	8	92
1989	57	43	39	61	52	48	12	88
1990	62	38	29	71	44	56	2	98
1991	73	27	39	61	33	67	8	92
1992	60	40	45	55	56	44	5	95
1993	49	51	28	72	41	56	14	86

Table 7. Summary of sonar counts by sector from Kenai, Kasilof, Crescent, and Yentna Rivers, 1993.

River	Bank	Dates	Proportion by Sector[a] 1	2	3	4	5	6	7	8	9	10	11	12	Total Counts
Kenai	north	7/01–7/12	0.3	0.5	0.6	0.9	0.6	1.1	2.3	13.7	14.0	19.5	23.3	23.2	36,935
		7/13–8/06[b]	0.9	6.7	18.3	23.8	11.1	8.7	9.4	7.9	5.1	3.2	2.4	2.5	330,681
		8/07–8/13	1.2	14.3	7.0	15.2	12.7	10.6	9.2	9.3	8.4	4.3	3.6	4.2	30,948
		all	0.9	6.7	15.8	21.0	10.2	8.2	8.7	8.6	6.2	4.8	4.5	4.5	398,564
Kenai	south	7/01–7/12	5.4	2.5	3.5	9.6	6.2	9.6	11.5	25.8	8.8	6.6	7.5	3.0	38,345
		7/13–8/07[b]	4.0	38.1	24.1	15.3	8.4	3.1	0.8	1.9	2.5	0.7	0.6	0.5	345,891
		8/08–8/13	1.3	0.2	1.7	55.4	32.5	2.6	1.0	0.8	0.4	0.7	2.6	0.8	36,402
		all	3.9	31.5	20.3	18.3	10.3	3.6	1.8	4.0	2.9	1.2	1.4	0.8	420,638
Kasilof	north	6/12–6/20	7.3	10.1	6.2	6.3	3.6	3.6	0.9	0.6	0.4	2.4	6.0	52.6	3,705
		6/21–7/24[b]	28.9	15.0	10.8	8.8	7.5	8.2	3.2	3.2	2.7	4.5	2.5	4.5	33,776
		7/25–8/05	45.1	7.7	8.0	6.5	7.1	10.5	0.9	2.1	1.8	4.7	2.3	3.2	3,840
		all	28.5	13.9	10.1	8.3	7.2	8.0	2.8	2.9	2.4	4.4	2.8	8.7	41,321
	south	6/12–6/17	1.6	2.5	4.5	6.7	4.6	4.2	6.6	6.7	6.6	13.6	20.5	21.9	9,513
		6/18–7/25[b]	17.5	19.4	17.9	10.8	4.1	2.6	3.0	3.0	3.0	5.1	6.6	7.1	88,617
		7/26–8/05	29.3	32.1	16.2	6.1	2.2	1.1	1.1	1.6	1.2	1.8	2.9	4.4	10,488
		all	17.3	19.2	16.6	10.0	3.9	2.6	3.1	3.2	3.1	5.5	7.5	8.2	108,618
Crescent	north	all	19.2	38.4	35.5	4.8	0.9	0.3	0.2	0.1	0.1	0.1	0.1	0.3	18,969
Crescent	south	all	99.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24,055
Yentna	north	7/07–7/11	29.2	21.9	15.0	10.1	5.8	5.3	2.5	0.9	2.1	1.8	1.8	3.5	565
		7/12–8/04[b]	28.4	29.3	22.8	10.3	4.5	2.3	0.7	0.4	0.3	0.4	0.2	0.5	55,737
		8/05–8/06	15.3	25.8	26.1	19.5	8.0	2.9	1.0	0.4	0.2	0.2	0.2	0.2	6,306
		all	27.1	28.8	23.0	11.2	4.9	2.4	0.7	0.4	0.3	0.4	0.2	0.5	62,608
Yentna	south	7/07–7/16	3.9	27.0	36.7	17.8	8.0	3.9	0.9	0.6	0.3	0.3	0.2	0.3	23,550
		7/17–8/03[b]	10.3	41.2	26.5	11.8	5.5	2.7	0.8	0.5	0.2	0.2	0.1	0.2	313,383
		8/04–8/07	14.0	25.4	17.5	12.8	10.0	9.0	3.5	2.5	1.4	1.3	0.9	1.7	35,460
		all	10.3	38.8	26.3	12.3	6.1	3.4	1.0	0.7	0.3	0.3	0.2	0.4	372,393

[a] Counts by sector and hour from Davis and King (1994).
[b] Dates during which 80% of total occurred (10% – 90%).

Table 8. Daily fish wheel catch by species for the Kenai River, 3 July through 12 August 1993.

		Sockeye		Pink		Coho		Chinook[a]	
Date	Hours Open	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
03-Jul	20.8	5	5	0	0	0	0	0	0
04-Jul	23.5	4	9	0	0	0	0	0	0
05-Jul	14.8	11	20	0	0	0	0	1	1
06-Jul	15.3	12	32	0	0	0	0	1	2
07-Jul	17.0	4	36	0	0	0	0	0	2
08-Jul	23.0	29	65	0	0	0	0	0	2
09-Jul	23.8	420	485	1	1	0	0	0	2
10-Jul	24.5	130	615	0	1	0	0	1	3
11-Jul	10.8	11	626	0	1	0	0	0	3
12-Jul	5.5	44	670	1	2	0	0	2	5
13-Jul	10.5	18	688	1	3	0	0	0	5
14-Jul	1.5	102	790	0	3	0	0	1	6
15-Jul	0.5	384	1,174	0	3	0	0	0	6
16-Jul	1.8	245	1,419	1	4	0	0	0	6
17-Jul	0.3	269	1,688	0	4	0	0	0	6
18-Jul	9.5	194	1,882	0	4	0	0	0	6
19-Jul	6.5	74	1,956	0	4	0	0	0	6
20-Jul	25.0	107	2,063	1	5	0	0	0	6
21-Jul	7.0	68	2,131	1	6	0	0	1	7
22-Jul	16.0	53	2,184	0	6	0	0	0	7
23-Jul	10.5	26	2,210	0	6	0	0	1	8
24-Jul	28.0	28	2,238	0	6	0	0	0	8
25-Jul	12.8	70	2,308	0	6	0	0	0	8
26-Jul	1.0	22	2,330	0	6	0	0	0	8
27-Jul	7.0	199	2,529	1	7	0	0	0	8
28-Jul	6.0	253	2,782	0	7	0	0	0	8
29-Jul	9.5	160	2,942	0	7	0	0	0	8
30-Jul	7.5	111	3,053	0	7	0	0	0	8
31-Jul	3.0	139	3,192	2	9	0	0	0	8
01-Aug	14.0	43	3,235	0	9	0	0	0	8
02-Aug	12.5	33	3,268	0	9	0	0	0	8
03-Aug	28.5	140	3,408	1	10	0	0	1	9
04-Aug	10.5	90	3,498	1	11	1	1	0	9
05-Aug	14.0	55	3,553	0	11	0	1	0	9
06-Aug	22.5	108	3,661	2	13	1	2	0	9
07-Aug	9.5	114	3,775	0	13	5	7	0	9
08-Aug	12.0	70	3,845	1	14	0	7	0	9
09-Aug	11.5	440	4,285	0	14	2	9	0	9
10-Aug	7.3	73	4,358	2	16	1	10	0	9
11-Aug	16.0	174	4,532	0	16	0	10	1	10
12-Aug	14.0	99	4,631	0	16	0	10	0	10

[a] Other species captured included Dolly Varden trout (23) and rainbow trout (3).

Table 9. Length composition of the major age classes of sockeye salmon collected in the Kenai River, 1980-1993. Length measured from mid-eye to fork-of-tail.

		Male			Female			Total			
Year	Age Class	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ratio Male-Female
1980	1.2	482	4	168	494	4	100	486		268	1.7:1
1981		493	6	85	513	6	73	502		158	1.2:1
1982		483	9	70	505	13	32	490	10	63	2.2:1
1983		524	9	25	520	6	30	522	5	55	0.8:1
1984		474	3	280	473	4	196	474	2	476	1.4:1
1985		492	3	184	490	3	186	491	2	370	1.0:1
1986		488	4	155	492	6	96	489	4	251	1.6:1
1987		514	8	39	503	5	56	507	5	95	0.7:1
1988		522	8	79	511	4	84	516	4	163	0.9:1
1989		493	6	114	494	4	92	493	4	206	1.2:1
1990		474	0	168	478	0	127	476	0	295	1.3:1
1991		488	2	613	497	13	577	492	6	1,190	1.1:1
1993		474	4	123	481	4	132	477	3	255	0.9:1
1980	1.3	580	3	180	561	2	192	570		372	0.9:1
1981		590	2	290	569	1	430	577		720	0.7:1
1982		596	2	723	572	1	841	583	2	1,564	0.9:1
1983		598	2	215	577	1	269	586	1	484	0.8:1
1984		582	2	385	559	1	395	571	1	780	1.0:1
1985		575	2	496	552	1	824	560	1	1,320	0.6:1
1986		584	3	112	564	2	200	571	2	312	0.6:1
1987		605	2	183	586	1	401	592	1	584	0.5:1
1988		598	1	428	572	2	624	583	1	1,052	0.7:1
1989		600	1	831	575	1	881	587	1	1,712	0.9:1
1990		586	0	358	559	0	318	574	0	676	1.1:1
1991		561	2	357	539	1	441	549	1	798	0.8:1
1992		572	2	370	547	1	714	556	1	1,084	0.5:1
1993		583	2	247	556	2	390	566	1	637	0.6:1
1984	2.2	505	4	116	508	3	159	507	2	275	0.7:1
1985		513	4	132	513	3	196	513	2	328	0.7:1
1980	2.3	589	3	67	579	3	80	584		147	0.8:1
1982		598	5	46	580	8	21	592	6	67	2.2:1
1983		595	4	25	582	4	36	587	3	61	0.7:1
1984		570	2	210	557	2	192	564	2	402	1.1:1
1985		570	3	106	555	2	129	562	2	235	0.8:1
1986		585	5	52	568	3	89	575	3	142	0.6:1
1988		596	3	53	577	3	92	584	2	145	0.6:1
1989		600	3	112	579	2	108	589	2	220	1.0:1
1990		589	0	177	568	0	132	580	0	309	1.3:1
1991		572	2	153	543	3	139	558	2	292	1.1:1
1992		569	4	46	546	2	88	554	2	134	0.5:1
1993		583	2	357	560	1	503	570	1	860	0.7:1

Table 10. Age composition of sockeye salmon collected in the Kenai River, 1970-1993.

Year	Percent Composition by Age Class[a]								Sample Size
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	Other	
1970	tr	10.0	17.0	tr	26.0	25.0	15.0	6.0	225
1971	0.0	8.0	39.0	1.0	3.0	38.0	11.0	0.0	168
1972	0.0	21.0	34.0	0.0	0.0	23.0	20.0	0.0	403
1973	0.0	5.0	68.0	1.0	1.0	8.0	16.0	0.0	632
1974	2.0	18.0	46.0	0.0	3.0	18.0	12.0	0.0	295
1975	2.0	10.0	36.0	2.0	4.0	31.0	14.0	1.0	162
1976	1.0	46.0	20.0	0.0	2.0	22.0	8.0	1.0	948
1977	0.0	6.0	76.0	1.0	tr	7.0	10.0	0.0	1,265
1978	0.0	2.5	86.7	0.0	0.0	4.9	5.4	tr	811
1979	tr	20.2	61.1	0.0	0.0	11.8	6.2	tr	601
1980	0.0	27.7	45.1	0.0	0.0	16.2	10.1	tr	715
1981	0.0	16.2	70.9	0.0	0.0	8.1	4.8	0.0	1,757
1982	0.1	5.8	87.5	tr	0.0	2.9	3.7	0.0	1,787
1983	0.4	8.2	79.1	0.2	0.5	2.2	8.9	0.4	1,765
1984	0.2	23.4	38.2	3.5	0.6	12.8	19.2	2.2	2,364
1985	0.1	15.9	56.4	0.3	0.1	14.7	11.4	1.1	2,201
1986	0.0	31.8	39.5	0.7	0.3	8.2	18.0	1.5	789
1987	0.0	12.8	78.4	0.1	0.0	3.2	5.2	0.3	745
1988	0.3	11.6	74.2	0.4	0.2	3.1	10.2	0.1	1,420
1989	0.1	9.1	75.3	1.0	0.5	4.1	9.7	0.2	2,275
1990	0.6	21.6	41.4	0.6	0.3	13.7	21.1	0.8	1,513
1991	0.2	48.2	31.6	0.1	0.5	5.7	11.4	2.7	2,504
1992	0.0	2.9	79.4	tr	tr	6.1	11.0	tr	1,338
1993	0.3	12.2	30.5	2.6	6.3	6.4	41.2	0.5	2,088

[a] Percentages weighted by total numbers in the escapement: 1978 (Bethe et al. 1980), 1979-1982, 1984-1993.

Table 11. Estimated salmon escapement into the Kasilof River, 12 June through 5 August 1993.

Date	Daily	Cum	Date	Daily	Cum
12–Jun	1,692	1,692	09–Jul	1,665	82,209
13–Jun	2,259	3,951	10–Jul	1,458	83,667
14–Jun	2,531	6,482	11–Jul	2,020	85,687
15–Jun	1,356	7,838	12–Jul	2,731	88,418
16–Jun	1,824	9,662	13–Jul	13,587	102,005
17–Jun	1,382	11,044	14–Jul	4,020	106,025
18–Jun	2,398	13,442	15–Jul	6,089	112,114
19–Jun	2,035	15,477	16–Jul	6,566	118,680
20–Jun	2,211	17,688	17–Jul	1,939	120,619
21–Jun	2,054	19,742	18–Jul	1,729	122,348
22–Jun	1,658	21,400	19–Jul	1,807	124,155
23–Jun	1,676	23,076	20–Jul	1,681	125,836
24–Jun	3,773	26,849	21–Jul	1,397	127,233
25–Jun	5,622	32,471	22–Jul	1,212	128,445
26–Jun	6,078	38,549	23–Jul	3,076	131,521
27–Jun	5,435	43,984	24–Jul	2,259	133,780
28–Jun	3,609	47,593	25–Jul	2,493	136,273
29–Jun	1,882	49,475	26–Jul	1,766	138,039
30–Jun	4,095	53,570	27–Jul	1,415	139,454
01–Jul	4,246	57,816	28–Jul	2,463	141,917
02–Jul	5,041	62,857	29–Jul	1,757	143,674
03–Jul	1,396	64,253	30–Jul	1,623	145,297
04–Jul	1,919	66,172	31–Jul	717	146,014
05–Jul	2,702	68,874	01–Aug	843	146,857
06–Jul	1,211	70,085	02–Aug	1,180	148,037
07–Jul	4,310	74,395	03–Aug	697	148,734
08–Jul	6,149	80,544	04–Aug	643	149,377
			05–Aug	562	149,939

Table 12. Kasilof River sockeye salmon escapement, 1968–1993.

Year	Escapement Estimated by Sonar Count[a]	Fish used for Artificial Propogation of Tustumena Lake[b]	Sonar Count Less Egg Take[c]
1968	89,000		
1969	46,000		
1970	38,000		
1971			
1972	113,000		
1973	40,000		
1974	70,000	205	69,795
1975	48,000	3,365	44,635
1976	139,000	5,463	133,537
1977	155,300	1,794	153,506
1978	116,600	6,681	109,919
1979	152,179	3,024	149,155
1980	187,154	6,030	181,124
1981	256,625	9,700	246,925
1982	180,239	11,571	168,668
1983	210,271	9,903	200,368
1984	231,685	11,141	220,544
1985	505,049	11,280	493,769
1986	275,963	11,952	264,011
1987	249,246	9,865	239,381
1988	204,000[d]	9,387	195,000
1989	158,206	7,367	150,839
1990	144,136	6,831	137,305
1991	238,269	8,850	229,419
1992	184,178	6,550	177,628
1993	149,939	9,098	140,841

[a] Multiple transducer sonar counts rounded to the nearest thousand (1968–78) from Namtvedt et al. (1979).
[b] From Cross et al. (1983): 1974–80, FRED Div., Soldotna, Alaska files: 1981–92; Fandrei, Cook Inlet Aquaculture Association, 1993.
[c] Considered estimate of natural spawners above sonar site.
[d] Combined counts from weirs on Bear and Glacier Flat Creeks and surveys of spawning streams.

Table 13. Peak sockeye salmon escapement counts in seven index areas, Kasilof River drainage, 1975–1993.

Year	Nikolai Creek [a]	Crystal Creek [a]	Clear Creek [a]	Glacier Flat Creek [b]	Seepage Creek [a]	Moose Creek [a]	Bear Creek [b]	Total Index Count [c]
1975	5,700	400	300	14,400	3,700	3,300	27,700	55,500
1976	12,000	800	300	7,100	800	14,000	51,800	86,800
1977	29,100	600	1,800	5,800	800	16,600	58,000	112,700
1978	34,200	200	200	4,700	1,100	15,900	43,400	99,700
1979	19,100	500	400	5,600	800	8,100	35,900	70,400
1980	10,000	1,000	2,100	15,500	1,800	15,600	125,000	171,000
1981	36,000	860	2,978	40,071	3,376	12,968	75,117	171,370
1982	16,800	1,785	4,183	17,348	1,638	13,400	51,350	106,504
1983	17,100	1,657	860	38,776	3,305	19,245	61,957	142,900
1984	8,270	141	2,619	76,217	6,250	13,999	54,328	161,824
1985 [d]	17,500	800	3,500	121,400	5,700	9,200	120,400	278,500
1986 [d]	11,900	1,400	2,700	60,600	2,000	21,200	102,900	202,700
1987	9,002	1,385	7,704	61,000	791	17,601	71,250	168,733
1988	10,841	593	5,809	40,015	1,387	17,727	127,532	203,904
1989	4,818	1,033	559	20,156	940	17,058	62,941	107,505
1990	7,474	879	220	14,355	1,217	18,800	46,300	89,245
1991	21,582	391	1,223	12,068	1,661	18,105	68,880	123,910
1992	10,145	1,105	1,979	9,144	349	15,235	44,100	82,057
1993							36,002	36,002

[a] Commercial Fisheries Division stream survey counts (1975–85); FRED Division stream survey counts (1982–92).

[b] FRED Division weir count, 1980–90, 1992. 1991 count is result of foot survey. 1993 count is result of foot survey and weir count, Cook Inlet Aquaculture Association, Gary Fandrei (personal communication).

[c] Counts standardized to common unit for years when entire stream not surveyed.

[d] Flagg (1986). Numbers rounded to nearest 100 fish.

Table 14. Cumulative proportion by date of sockeye salmon counts recorded in the Kasilof River, 1981 – 1993.

	Cumulative Proportion[a,b]														
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
14 – May			0.000												
15 – May			0.001												
16 – May			0.003												
17 – May			0.003												
18 – May			0.005												
19 – May			0.006												
20 – May			0.006												
21 – May			0.007												
22 – May			0.008												
23 – May	0.000		0.008												
24 – May	0.003		0.010												
25 – May	0.004		0.011												
26 – May	0.006		0.012												
27 – May	0.008		0.013												
28 – May	0.009		0.014												
29 – May	0.011		0.015												
30 – May	0.014		0.016												
31 – May	0.017		0.018												
01 – Jun	0.020		0.020												
02 – Jun	0.023		0.022												
03 – Jun	0.026		0.025												
04 – Jun	0.030		0.027												
05 – Jun	0.034		0.030												
06 – Jun	0.036		0.032												
07 – Jun	0.037		0.035												
08 – Jun	0.039		0.038												
09 – Jun	0.040		0.040			0.007									
10 – Jun	0.041		0.043	0.001	0.045	0.008									
11 – Jun	0.041		0.045	0.003	0.046	0.009									
12 – Jun	0.042		0.047	0.005	0.048	0.011	0.002	0.037	0.044						0.011
13 – Jun	0.043		0.049	0.007	0.050	0.012	0.003	0.041	0.051						0.026
14 – Jun	0.044		0.051	0.008	0.051	0.013	0.003	0.045	0.062	0.009					0.043
15 – Jun	0.044		0.055	0.010	0.053	0.015	0.004	0.048	0.073	0.014	0.001	0.002	0.002	0.004	0.052
16 – Jun	0.045		0.059	0.011	0.056	0.018	0.004	0.053	0.091	0.018	0.002	0.004	0.009	0.014	0.064
17 – Jun	0.046		0.064	0.013	0.058	0.020	0.005	0.059	0.106	0.021	0.004	0.006	0.015	0.020	0.073
18 – Jun	0.048		0.075	0.015	0.060	0.022	0.005	0.062	0.120	0.025	0.006	0.008	0.019	0.031	0.089
19 – Jun	0.049		0.082	0.027	0.063	0.025	0.006	0.066	0.146	0.028	0.007	0.009	0.026	0.038	0.103
20 – Jun	0.051		0.099	0.035	0.065	0.031	0.007	0.068	0.171	0.032	0.011	0.010	0.033	0.050	0.118
21 – Jun	0.054		0.114	0.040	0.068	0.039	0.007	0.071	0.190	0.038	0.014	0.012	0.044	0.064	0.131
22 – Jun	0.060	0.003	0.133	0.043	0.070	0.048	0.008	0.073	0.198	0.046	0.016	0.014	0.056	0.082	0.142
23 – Jun	0.066	0.007	0.162	0.045	0.074	0.058	0.009	0.074	0.201	0.053	0.019	0.015	0.070	0.101	0.154
24 – Jun	0.077	0.009	0.195	0.049	0.076	0.069	0.012	0.075	0.206	0.065	0.021	0.017	0.085	0.125	0.179
25 – Jun	0.093	0.022	0.223	0.053	0.078	0.075	0.015	0.077	0.212	0.077	0.024	0.019	0.096	0.146	0.216
26 – Jun	0.108	0.035	0.261	0.055	0.080	0.080	0.017	0.079	0.218	0.089	0.031	0.022	0.110	0.174	0.256
27 – Jun	0.125	0.051	0.288	0.058	0.082	0.089	0.019	0.082	0.222	0.105	0.037	0.025	0.135	0.215	0.293
28 – Jun	0.153	0.075	0.342	0.061	0.085	0.099	0.022	0.085	0.227	0.133	0.046	0.030	0.171	0.250	0.317
29 – Jun	0.169	0.094	0.389	0.064	0.090	0.111	0.025	0.095	0.238	0.157	0.057	0.037	0.204	0.290	0.329
30 – Jun	0.196	0.136	0.438	0.069	0.110	0.123	0.029	0.121	0.249	0.173	0.074	0.051	0.238	0.323	0.356

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Table 14. (page 2 of 2)

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
01–Jul	0.229	0.166	0.500	0.078	0.153	0.136	0.035	0.153	0.267	0.184	0.098	0.065	0.259	0.338	0.385
02–Jul	0.248	0.217	0.512	0.091	0.165	0.150	0.039	0.180	0.297	0.189	0.153	0.076	0.275	0.349	0.418
03–Jul	0.281	0.250	0.522	0.104	0.188	0.157	0.044	0.198	0.317	0.196	0.178	0.091	0.293	0.372	0.427
04–Jul	0.325	0.280	0.529	0.115	0.212	0.178	0.056	0.215	0.334	0.224	0.183	0.120	0.338	0.377	0.440
05–Jul	0.374	0.314	0.534	0.122	0.221	0.217	0.066	0.228	0.357	0.235	0.225	0.158	0.385	0.394	0.458
06–Jul	0.404	0.338	0.543	0.129	0.231	0.243	0.071	0.245	0.385	0.255	0.277	0.193	0.400	0.414	0.466
07–Jul	0.458	0.353	0.551	0.136	0.240	0.263	0.078	0.257	0.403	0.306	0.321	0.209	0.406	0.419	0.495
08–Jul	0.473	0.366	0.562	0.145	0.247	0.304	0.095	0.261	0.422	0.329	0.346	0.235	0.417	0.428	0.536
09–Jul	0.496	0.379	0.604	0.156	0.263	0.358	0.103	0.269	0.438	0.382	0.378	0.254	0.431	0.439	0.547
10–Jul	0.509	0.393	0.649	0.164	0.294	0.391	0.114	0.289	0.450	0.457	0.404	0.258	0.450	0.453	0.557
11–Jul	0.519	0.413	0.677	0.177	0.315	0.411	0.119	0.323	0.456	0.507	0.431	0.267	0.477	0.462	0.570
12–Jul	0.532	0.421	0.712	0.197	0.344	0.416	0.126	0.337	0.481	0.567	0.488	0.281	0.488	0.522	0.588
13–Jul	0.550	0.426	0.746	0.217	0.395	0.427	0.148	0.430	0.508	0.600	0.500	0.294	0.490	0.586	0.679
14–Jul	0.579	0.436	0.797	0.247	0.465	0.445	0.208	0.501	0.520	0.614	0.514	0.303	0.492	0.598	0.705
15–Jul	0.629	0.464	0.838	0.293	0.514	0.484	0.267	0.513	0.587	0.659	0.532	0.317	0.508	0.608	0.746
16–Jul	0.643	0.528	0.863	0.358	0.547	0.543	0.382	0.528	0.600	0.676	0.566	0.350	0.523	0.617	0.789
17–Jul	0.674	0.570	0.877	0.404	0.663	0.590	0.418	0.544	0.608	0.691	0.615	0.498	0.546	0.629	0.802
18–Jul	0.703	0.609	0.891	0.491	0.759	0.636	0.432	0.562	0.619	0.703	0.629	0.602	0.615	0.645	0.814
19–Jul	0.730	0.649	0.904	0.577	0.775	0.693	0.436	0.575	0.699	0.723	0.648	0.623	0.649	0.665	0.826
20–Jul	0.755	0.693	0.922	0.642	0.785	0.739	0.439	0.586	0.731	0.770	0.711	0.664	0.661	0.705	0.837
21–Jul	0.767	0.715	0.936	0.702	0.804	0.778	0.464	0.601	0.765	0.857	0.747	0.676	0.679	0.725	0.846
22–Jul	0.781	0.738	0.942	0.744	0.822	0.810	0.551	0.611	0.809	0.921	0.768	0.687	0.710	0.740	0.854
23–Jul	0.848	0.775	0.947	0.759	0.833	0.832	0.609	0.618	0.851	0.929	0.806	0.706	0.751	0.770	0.875
24–Jul	0.860	0.788	0.952	0.769	0.842	0.864	0.649	0.627	0.873	0.935	0.816	0.723	0.781	0.844	0.892
25–Jul	0.875	0.803	0.954	0.784	0.849	0.888	0.683	0.717	0.888	0.939	0.824	0.754	0.813	0.890	0.909
26–Jul	0.896	0.818	0.957	0.800	0.854	0.910	0.733	0.795	0.897	0.943	0.840	0.776	0.849	0.933	0.921
27–Jul	0.910	0.830	0.959	0.818	0.858	0.918	0.791	0.806	0.906	0.948	0.850	0.790	0.881	0.962	0.930
28–Jul	0.930	0.840	0.962	0.836	0.862	0.926	0.826	0.812	0.916	0.953	0.860	0.808	0.914	0.971	0.946
29–Jul	0.941	0.853	0.963	0.847	0.867	0.933	0.842	0.829	0.925	0.958	0.869	0.836	0.935	0.977	0.958
30–Jul	0.947	0.864	0.964	0.857	0.874	0.939	0.853	0.888	0.939	0.961	0.877	0.856	0.947	0.983	0.969
31–Jul	0.954	0.878	0.966	0.866	0.889	0.943	0.865	0.917	0.962	0.965	0.885	0.872	0.956	0.989	0.974
01–Aug	0.957	0.889	1.000	0.876	1.000	1.000	0.875	1.000	0.975	0.969	0.892	0.885	0.960	0.994	0.979
02–Aug	0.963	0.900		0.886			0.881		0.982	0.973	0.898	0.901	0.966	1.000	0.987
03–Aug	0.966	0.906		0.895			0.890		0.986	0.977	0.905	0.916	0.973		0.992
04–Aug	0.969	0.915		1.000			0.898		0.990	0.983	0.916	0.924	0.978		0.996
05–Aug	0.980	0.925					0.904		0.994	0.990	0.927	0.933	0.981		1.000
06–Aug	0.983	0.932					0.909		0.997	0.993	0.943	0.941	0.987		
07–Aug	0.986	0.939					0.917		1.000	0.997	0.958	0.946	0.994		
08–Aug	0.989	0.946					0.927			1.000	0.963	0.953	1.000		
09–Aug	0.991	0.961					0.938				0.969	0.963			
10–Aug	0.994	0.968					0.945				0.976	0.972			
11–Aug	0.998	0.979					0.949				0.982	0.977			
12–Aug	1.000	0.988					1.000				0.986	0.984			
13–Aug	1.000	1.000									0.990	0.989			
14–Aug											0.996	0.995			
15–Aug											1.000	1.000			
Midpoint	7/10	7/16	7/01	7/19	7/15	7/16	7/22	7/14	7/13	7/11	7/14	7/18	7/15	7/12	7/08
No. days for 80%	32	34	29	32	33	28	28	32	41	26	33	29	33	34	37

[a] Proportion accrued on first day (1983–1988) and last day represents that portion of the escapement estimated before and after enumeration operations.
[b] Inclusive dates: date proportion of escapement reached 10% through date proportion of escapment reached 90%.

Table 15. Daily fish wheel catch by species for the Kasilof River, 14 June through 5 August 1993.

Date	Hours open	Sockeye		Pink		Chinook[a]	
		Daily	Cum	Daily	Cum	Daily	Cum
14–Jun	23.5	24	24	0	0	3	3
15–Jun	20.8	15	39	0	0	0	3
16–Jun	20.8	24	63	0	0	0	3
17–Jun			63	0	0	0	3
18–Jun	27.6	15	78	0	0	1	4
19–Jun	23.8	13	91	0	0	0	4
20–Jun	24.6	18	109	0	0	0	4
21–Jun	23.4	12	121	0	0	0	4
22–Jun	23.7	17	138	0	0	0	4
23–Jun	24.4	13	151	0	0	0	4
24–Jun	19.7	26	177	0	0	0	4
25–Jun	17.6	89	266	0	0	0	4
26–Jun	10.4	37	303	1	1	1	5
27–Jun	14.2	67	370	0	1	0	5
28–Jun	13.8	50	420	0	1	0	5
29–Jun	14.5	22	442	0	1	0	5
30–Jun	20.1	152	594	0	1	1	6
01–Jul	9.5	78	672	0	1	1	7
02–Jul	11.3	136	808	0	1	2	9
03–Jul	13.8	33	841	0	1	1	10
04–Jul	16.8	51	892	0	1	2	12
05–Jul	10.2	47	939	3	4	1	13
06–Jul	13.4	26	965	0	4	0	13
07–Jul	9.8	57	1,022	0	4	1	14
08–Jul	10.9	57	1,079	1	5	3	17
09–Jul	14.8	38	1,117	1	6	2	19
10–Jul	11.3	9	1,126	0	6	2	21
11–Jul	23.6	31	1,157	5	11	5	26
12–Jul	17.5	27	1,184	2	13	3	29
13–Jul	18.5	28	1,212	1	14	3	32
14–Jul	8.4	120	1,332	3	17	0	32
15–Jul	10.0	114	1,446	2	19	0	32
16–Jul	9.0	194	1,640	4	23	0	32
17–Jul	17.3	76	1,716	4	27	3	35
18–Jul	14.0	39	1,755	1	28	6	41
19–Jul	14.8	42	1,797	1	29	11	52
20–Jul	15.5	31	1,828	0	29	3	55
21–Jul	12.4	23	1,851	0	29	0	55
22–Jul	19.4	22	1,873	1	30	2	57
23–Jul	21.7	36	1,909	3	33	2	59
24–Jul	16.4	22	1,931	0	33	0	59
25–Jul	14.4	15	1,946	1	34	3	62
26–Jul	23.3	22	1,968	8	42	4	66
27–Jul	18.8	27	1,995	2	44	1	67
28–Jul	15.5	13	2,008	2	46	2	69
29–Jul	1.8	9	2,017	0	46	1	70
30–Jul	30.3	41	2,058	5	51	8	78
31–Jul			2,058		51		78
01–Aug			2,058		51		78
02–Aug	14.4	22	2,080	0	51	1	79
03–Aug	23.0	6	2,086	1	52	1	80
04–Aug	15.0	10	2,096	0	52	2	82
05–Aug	20.3	4	2,100	0	52	3	85

[a] Other species captured included Dolly Varden trout (35), rainbow trout (2) and an undermined species of whitefish (2).

Table 16. Age composition of sockeye salmon collected in the Kasilof River, 1969-1993.

Year	Percent Composition by Age Class[a]								Sample Size
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	Other	
1969	0.0	14.0	39.0	1.0	0.0	30.0	16.0	0.0	399
1970	tr	32.0	37.0	2.0	0.0	16.0	11.0	2.0	297
1971	0.0	6.0	69.0	0.0	0.0	8.0	16.0	1.0	153
1972	tr	42.0	36.0	1.0	tr	3.0	18.0	0.0	668
1973	0.0	20.0	57.0	0.0	0.0	19.0	4.0	0.0	374
1974	0.0	35.0	59.0	0.0	tr	4.0	2.0	0.0	254
1975	1.0	29.0	7.0	0.0	0.0	58.0	4.0	1.0	931
1976	tr	32.0	20.0	0.0	tr	35.0	12.0	1.0	755
1977	tr	30.0	30.0	0.0	1.0	28.0	11.0	0.0	1,209
1978	0.0	42.0	35.0	0.0	0.0	14.0	9.0	0.0	967
1979	0.0	52.2	37.2	0.0	tr	8.4	1.7	0.5	590
1980	0.0	58.7	27.8	0.0	0.0	8.0	4.5	1.0	899
1981	0.0	30.2	62.2	0.0	0.0	6.0	1.6	0.0	1,479
1982	1.0	34.0	49.5	0.0	0.1	10.7	4.7	0.0	1,518
1983	0.0	48.4	34.3	0.0	0.0	12.8	4.5	0.0	1,997
1984	0.0	50.5	24.8	tr	0.2	17.9	6.6	0.0	2,269
1985	0.2	57.3	21.8	0.1	0.1	17.8	2.6	0.1	3,063
1986	0.0	40.9	42.0	0.3	0.1	11.9	4.6	0.2	1,660
1987		43.4	27.4	0.0	0.1	22.4	6.4	0.3	1,248
1988	0.9	37.5	32.9	0.1	0.1	18.6	10.6	0.2	2,282
1989	0.2	44.0	46.3	0.2	0.0	5.2	4.2	0.0	1,216
1990	0.4	32.9	20.7	0.3	0.0	33.2	12.4	0.3	762
1991	0.0	31.5	33.4	0.1	0.1	29.0	5.8	0.1	2,106
1992	0.0	21.2	27.6	0.0	0.2	35.0	15.9	0.0	1,717
1993	0.4	16.3	29.8	0.0	0.4	28.0	25.2	0.0	571

[a] Percentages weighted by total numbers in the escapement: 1979-1993.

Table 17. Length composition of the major age classes of sockeye salmon collected in the Kasilof River, 1980-1993. Length measured from mid-eye to fork-of-tail.

		Male			Female			Total			
Year	Age Class	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ratio Male-Female
1980	1.2	474	2	189	464	1	376	467		565	0.5:1
1981		503	2	241	492	3	146	499		387	1.7:1
1982		481	2	285	466	2	235	474	2	475	1.2:1
1983		493	2	113	491	3	78	492	2	191	1.4:1
1984		480	1	544	478	1	428	479	1	972	2.6:1
1985		474	1	723	472	1	897	473	1	1,620	0.8:1
1986		482	2	266	482	1	368	482	1	634	0.7:1
1987		472	2	282	470	2	257	471	1	539	1.1:1
1988		480	1	353	477	1	480	478	1	833	0.7:1
1989		481	2	245	480	2	290	480	1	535	0.8:1
1990		462	0	139	458	0	91	460	0	230	1.5:1
1991		467	2	326	461	2	305	464	1	631	1.1:1
1992		467	2	184	466	2	212	466	1	396	0.9:1
1993		479	4	40	479	3	53	479	2	93	0.8:1
1980	1.3	531	7	35	516	2	115	520		150	0.3:1
1981		566	1	422	558	1	369	562		791	1.1:1
1982		549	1	377	542	1	428	545	1	805	0.9:1
1983		558	2	170	547	2	187	552	1	357	0.9:1
1984		539	1	304	533	1	383	535	1	687	0.8:1
1985		531	2	341	527	1	433	529	1	774	0.8:1
1986		550	2	342	543	1	405	546	1	747	0.8:1
1987		553	2	191	552	2	154	552	2	345	1.2:1
1988		550	1	311	543	1	382	546	1	693	0.8:1
1989		550	2	266	542	2	296	546	1	562	0.9:1
1990		518	0	81	523	0	106	521	0	187	0.8:1
1991		531	1	418	518	1	335	525	1	753	1.3:1
1992		536	2	195	527	2	197	531	1	392	1.0:1
1993		550	3	101	542	3	69	547	2	170	1.5:1
1982	2.2	479	3	65	472	3	81	475	3	146	0.8:1
1984		484	2	202	482	1	223	483	1	425	0.9:1
1985		482	2	248	476	1	319	479	1	567	0.8:1
1986		492	4	78	489	2	115	490	2	193	0.7:1
1987		478	2	137	475	2	141	476	2	278	1.0:1
1988		486	2	173	479	1	220	482	1	393	0.8:1
1990		453	0	104	457	0	111	455	0	215	0.9:1
1991		471	2	289	480	11	301	475	5	590	1.0:1
1992		464	2	264	464	1	427	464	1	691	0.6:1
1993		486	3	58	480	2	102	482	2	160	0.7:1
1982	2.3	548	4	41	543	4	40	546	4	86	1.0:1
1984		533	3	102	526	3	80	530	2	182	1.3:1
1988		544	2	104	543	2	115	543	2	219	0.9:1
1990		514	0	63	529	0	61	522	0	124	1.0:1
1991		516	4	61	514	3	64	515	2	125	1.0:1
1992		534	3	112	532	2	122	533	2	234	0.9:1
1993		542	3	66	533	3	78	537	2	144	0.8:1

Table 18. Estimated salmon escapement into the Crescent River, 28 June through 2 August 1993. Species composition based on fish wheel catches.

	Sockeye		Pink		Chum		Coho		Dolly Varden	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
25–Jun	357	357	0	0	2	2	0	0	7	7
26–Jun	366	723	0	0	2	4	0	0	7	14
27–Jun	87	810	0	0	1	5	0	0	1	15
28–Jun	353	1,163	0	0	2	7	0	0	7	22
29–Jun	105	1,268	0	0	1	8	0	0	2	24
30–Jun	174	1,442	0	0	2	10	0	0	3	27
01–Jul	657	2,099	0	0	4	14	0	0	13	40
02–Jul	205	2,304	0	0	2	16	0	0	4	44
03–Jul	587	2,891	0	0	4	20	0	0	12	56
04–Jul	3,996	6,887	0	0	26	46	0	0	79	135
05–Jul	2,071	8,958	0	0	14	60	0	0	41	176
06–Jul	293	9,251	0	0	2	62	0	0	6	182
07–Jul	421	9,672	2	2	3	65	0	0	35	217
08–Jul	592	10,264	4	6	3	68	0	0	50	267
09–Jul	894	11,158	6	12	6	74	0	0	74	341
10–Jul	644	11,802	4	16	4	78	0	0	54	395
11–Jul	1,467	13,269	35	51	0	78	0	0	50	445
12–Jul	1,234	14,503	30	81	0	78	0	0	41	486
13–Jul	1,381	15,884	35	116	35	113	0	0	17	503
14–Jul	2,916	18,800	74	190	73	186	0	0	36	539
15–Jul	2,992	21,792	108	298	47	233	0	0	31	570
16–Jul	2,301	24,093	83	381	36	269	0	0	24	594
17–Jul	1,627	25,720	98	479	66	335	0	0	99	693
18–Jul	1,421	27,141	87	566	57	392	0	0	87	780
19–Jul	1,105	28,246	139	705	70	462	0	0	130	910
20–Jul	765	29,011	96	801	48	510	0	0	90	1,000
21–Jul	929	29,940	96	897	40	550	0	0	77	1,077
22–Jul	911	30,851	94	991	39	589	0	0	75	1,152
23–Jul	881	31,732	90	1,081	82	671	0	0	65	1,217
24–Jul	743	32,475	77	1,158	70	741	0	0	54	1,271
25–Jul	671	33,146	84	1,242	58	799	0	0	41	1,312
26–Jul	952	34,098	117	1,359	82	881	0	0	59	1,371
27–Jul	659	34,757	105	1,464	60	941	0	0	23	1,394
28–Jul	639	35,396	104	1,568	57	998	0	0	22	1,416
29–Jul	402	35,798	103	1,671	168	1,166	0	0	18	1,434
30–Jul	611	36,409	38	1,709	184	1,350	0	0	44	1,478
31–Jul	426	36,835	71	1,780	131	1,481	0	0	36	1,514
01–Aug	331	37,166	89	1,869	180	1,661	0	0	48	1,562
02–Aug	390	37,556	107	1,976	211	1,872	0	0	57	1,619

Table 19. Daily fish wheel catch by species for the Crescent River, 28 June through 2 August 1993.

Date	Hours open	Sockeye		Pink		Chum		Coho		Dolly Varden	
		Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
28-Jun	1.0	3	3	0	0	0	0	0	0	0	0
29-Jun			3		0		0		0		0
30-Jun			3		0		0		0		0
01-Jul	3.0	4	7	0	0	0	0	0	0	0	0
02-Jul	3.0	0	7	0	0	0	0	0	0	0	0
03-Jul	7.0	7	14	0	0	0	0	0	0	0	0
04-Jul	10.0	47	61	0	0	0	0	0	0	0	0
05-Jul	8.0	64	125	0	0	0	0	0	0	1	1
06-Jul	11.5	26	151	0	0	1	1	0	0	2	3
07-Jul	11.5	10	161	0	0	0	1	0	0	1	4
08-Jul	24.0	70	231	0	0	0	1	0	0	8	12
09-Jul	19.0	40	271	0	0	1	2	0	0	3	15
10-Jul	14.5	36	307	1	1	0	2	0	0	1	16
11-Jul	6.0	98	405	1	2	0	2	0	0	2	18
12-Jul	8.5	109	514	4	6	0	2	0	0	5	23
13-Jul	4.5	66	580	1	7	1	3	0	0	2	25
14-Jul	6.0	94	674	3	10	3	6	0	0	3	28
15-Jul	8.5	92	766	4	14	1	7	0	0	1	29
16-Jul	6.0	100	866	3	17	2	9	0	0	2	31
17-Jul	8.0	68	934	3	20	2	11	0	0	1	32
18-Jul	12.0	80	1,014	6	26	4	15	0	0	8	40
19-Jul	11.5	57	1,071	7	33	4	19	0	0	5	45
20-Jul	12.0	70	1,141	9	42	4	23	0	0	10	55
21-Jul	12.0	104	1,245	12	54	3	26	0	0	9	64
22-Jul	10.5	79	1,324	7	61	5	31	0	0	6	70
23-Jul	12.0	99	1,423	15	76	9	40	0	0	11	81
24-Jul	13.5	105	1,528	6	82	10	50	0	0	4	85
25-Jul	13.5	59	1,587	10	92	8	58	0	0	6	91
26-Jul	14.5	103	1,690	10	102	6	64	0	0	4	95
27-Jul	14.0	91	1,781	10	112	13	77	0	0	4	99
28-Jul	11.5	105	1,886	12	124	11	88	0	0	5	104
29-Jul	14.5	89	1,975	23	147	37	125	0	0	4	108
30-Jul	10.5	110	2,085	7	154	33	158	0	0	8	116
31-Jul	11.0	107	2,192	18	172	33	191	0	0	9	125
01-Aug	13.5	60	2,252	18	190	37	228	0	0	11	136
02-Aug	12.5	84	2,336	21	211	41	269	0	0	10	146

Table 20. Cumulative proportion by date of sockeye salmon counts recorded in the Crescent River, 1979–1993.

	Cumulative Proportion [a,b]														
Date	1979	1980	1981	1982	1983	1984 [c]	1985	1986 [d]	1987	1988	1989	1990	1991	1992	1993
15–Jun						0.000	0.000								
16–Jun						0.001	0.000								
17–Jun						0.002	0.000								
18–Jun						0.003	0.000								
19–Jun						0.003	0.000								
20–Jun						0.005	0.001								
21–Jun						0.008	0.001								
22–Jun						0.012	0.001								
23–Jun						0.017	0.001								
24–Jun						0.020	0.001								
25–Jun						0.024	0.001	0.000							0.010
26–Jun						0.027	0.001	0.000				0.003	0.002		0.019
27–Jun						0.036	0.002	0.000				0.007	0.004		0.022
28–Jun		0.000				0.041	0.002	0.004				0.013	0.006		0.031
29–Jun	0.000	0.000				0.049	0.005	0.022				0.021	0.010		0.034
30–Jun	0.000	0.000				0.069	0.007	0.039				0.025	0.013		0.038
01–Jul	0.004	0.000	0.000	0.000	0.000	0.081	0.008	0.080	0.012	0.008	0.008	0.034	0.017	0.045	0.056
02–Jul	0.025	0.000	0.012	0.000	0.000	0.100	0.012	0.144	0.016	0.038	0.020	0.055	0.031	0.072	0.061
03–Jul	0.037	0.000	0.036	0.001	0.001	0.118	0.016	0.252	0.020	0.149	0.043	0.065	0.033	0.096	0.077
04–Jul	0.051	0.000	0.061	0.001	0.002	0.140	0.057	0.363	0.023	0.223	0.096	0.077	0.040	0.115	0.183
05–Jul	0.059	0.000	0.083	0.002	0.019	0.156	0.138	0.395	0.027	0.269	0.129	0.098	0.061	0.138	0.239
06–Jul	0.068	0.000	0.097	0.002	0.041	0.170	0.188	0.442	0.058	0.338	0.181	0.128	0.063	0.153	0.246
07–Jul	0.079	0.000	0.117	0.005	0.068	0.184	0.196	0.517	0.084	0.404	0.231	0.141	0.064	0.159	0.258
08–Jul	0.091	0.000	0.149	0.021	0.098	0.225	0.226	0.590	0.112	0.488	0.293	0.155	0.079	0.173	0.273
09–Jul	0.107	0.000	0.166	0.057	0.118	0.268	0.251	0.626	0.160	0.554	0.334	0.184	0.090	0.192	0.297
10–Jul	0.182	0.029	0.180	0.098	0.137	0.322	0.274	0.676	0.193	0.581	0.369	0.207	0.092	0.212	0.314
11–Jul	0.268	0.089	0.193	0.127	0.167	0.360	0.293	0.724	0.243	0.598	0.412	0.264	0.100	0.243	0.353
12–Jul	0.327	0.126	0.202	0.157	0.207	0.387	0.319	0.776	0.269	0.625	0.463	0.286	0.131	0.291	0.386
13–Jul	0.395	0.132	0.215	0.190	0.266	0.409	0.364	0.862	0.305	0.655	0.502	0.299	0.143	0.333	0.423
14–Jul	0.423	0.145	0.234	0.217	0.338	0.425	0.388	0.926	0.333	0.688	0.502	0.321	0.188	0.374	0.501
15–Jul	0.462	0.161	0.266	0.245	0.392	0.454	0.415	0.956	0.370	0.692	0.518	0.345	0.245	0.420	0.580
16–Jul	0.488	0.176	0.311	0.258	0.431	0.499	0.445	1.000	0.386	0.697	0.611	0.393	0.292	0.459	0.642
17–Jul	0.511	0.193	0.347	0.286	0.457	0.548	0.480		0.406	0.717	0.674	0.472	0.355	0.508	0.685
18–Jul	0.537	0.228	0.386	0.328	0.499	0.599	0.506		0.448	0.748	0.691	0.540	0.425	0.535	0.723
19–Jul	0.572	0.286	0.434	0.377	0.559	0.639	0.525		0.513	0.771	0.710	0.574	0.461	0.569	0.752
20–Jul	0.610	0.370	0.493	0.460	0.617	0.684	0.546		0.548	0.781	0.750	0.610	0.497	0.606	0.772
21–Jul	0.673	0.455	0.550	0.533	0.667	0.721	0.573		0.593	0.808	0.776	0.653	0.524	0.649	0.797
22–Jul	0.731	0.520	0.604	0.586	0.702	0.743	0.596		0.671	0.828	0.804	0.705	0.582	0.697	0.821
23–Jul	0.779	0.596	0.655	0.636	0.732	0.783	0.632		0.773	0.853	0.829	0.742	0.649	0.769	0.845
24–Jul	0.807	0.651	0.703	0.685	0.764	0.802	0.665		0.819	0.885	0.855	0.762	0.688	0.827	0.865
25–Jul	0.814	0.681	0.727	0.713	0.787	0.813	0.698		0.856	0.917	0.884	0.801	0.718	0.874	0.883
26–Jul	0.820	0.721	0.741	0.751	0.813	0.824	0.729		0.877	0.941	0.907	0.839	0.753	0.909	0.908
27–Jul	0.829	0.750	0.760	0.784	0.839	0.838	0.756		0.893	0.959	0.930	0.864	0.801	0.922	0.925
28–Jul	0.848	0.786	0.776	0.801	0.858	0.852	0.775		0.905	0.965	0.958	0.880	0.836	0.935	0.942
29–Jul	0.869	0.811	0.798	0.816	0.881	0.870	0.794		0.915	0.976	0.968	0.896	0.866	0.953	0.953
30–Jul	0.892	0.837	0.821	0.826	0.915	0.882	0.821		0.920	0.989	0.978	0.933	0.885	0.964	0.969
31–Jul	0.907	0.856	0.836	0.833	0.945	0.893	1.000		0.938	1.000	0.994	0.956	0.916	0.977	0.981
01–Aug	0.921	0.878	0.847	1.000	1.000	1.000			0.960		1.000	0.973	0.966	0.988	0.990
02–Aug	0.932	0.896	0.866						0.975			0.986	0.978	1.000	1.000
03–Aug	0.943	0.914	0.886						0.985			0.993	0.984		
04–Aug	0.950	0.932	0.901						0.994			1.000	0.987		
05–Aug	0.958	0.944	0.918						0.996				0.992		
06–Aug	0.966	0.954	0.934						1.000				0.996		
07–Aug	0.975	0.961	0.949										1.000		
08–Aug	0.983	0.970	0.964												
09–Aug	0.989	0.980	0.973												
10–Aug	0.993	0.985	1.000												
11–Aug	0.997	0.989													
12–Aug	1.000	0.994													
13–Aug		0.998													
14–Aug		1.000													
Midpoint	7/17	7/22	7/21	7/21	7/19	7/17	7/18		7/19	7/09	7/13	7/18	7/21	7/17	7/14
No. days for 80%	23	23	29	21+	22+	31+	26+		21	23	22	25	21	23	23

[a] Proportion accrued on last day (1981–1985) represents that portion of the escapment estimated after enumeration operations.
[b] Inclusive dates: date proportion of escapement reached 10% through date proportion of escapement reached 90%.
[c] In 1984 the enumeration site was relocated from the outlet of Crescent Lake to a site approximately 2 miles from the terminus of the river at Cook Inlet.
[d] Enumeration activities terminated 16 July 1986. Estimated proportions from King and Tarbox (1988).

Table 21. Age composition of sockeye salmon collected in the Crescent River, 1979-1993.

Year	Percent Composition by Age Class[a]								Sample Size
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	Other	
1979	tr	27.8	70.1	0.0	0.0	tr	tr	tr	643
1980	0.0	6.5	86.9	0.0	0.0	2.9	1.6	2.1	511
1981	0.0	8.2	32.1	0.0	0.0	9.6	49.9	tr	1,117
1982	0.0	12.9	79.2	0.1	0.0	0.8	7.0	0.0	711
1983	0.0	10.9	42.2	0.2	0.7	27.4	18.6	0.0	731
1984	0.0	3.5	16.9	0.0	0.0	20.0	59.4	tr	780
1985	0.2	4.7	31.3	0.0	0.3	20.5	43.0	0.0	594
1986	0.0	6.5	15.8	0.0	0.0	13.0	64.0	0.7	139
1987	0.0	2.6	47.7	0.0	0.0	4.2	45.0	0.5	191
1988	0.0	10.4	44.9	0.5	0.1	17.8	26.1	0.1	741
1989	0.0	2.6	84.2	0.6	0.0	0.6	15.0	0.1	728
1990	0.0	3.7	48.5	0.4	0.1	3.5	43.2	0.5	591
1991	0.0	14.9	50.4	0.3	0.0	16.8	16.5	1.1	357
1992	0.0	2.6	21.7	0.0	0.0	12.4	61.9	1.6	194
1993	0.2	8.8	37.2	0.0	0.9	5.8	46.9	0.2	465

[a] Percentages weighted by total numbers in the escapement: 1979-1981, 1986-1993.

Table 22. Length composition of the major age classes of sockeye salmon collected in the Crescent River, 1980-1993. Length measured from mid-eye to fork-of-tail.

		Male			Female			Total			
Year	Age Class	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ratio Male-Female
1980	1.2	472	6	47	471	7	31	472		78	1.5:1
1981		522	9	59	491	9	33	511	9	92	1.8:1
1982		467	6	47	487	7	25	474	5	72	1.9:1
1991		517	6	36	490	8	17	509	5	53	2.1:1
1980	1.3	568	2	167	549	2	223	557		390	0.7:1
1981		576	3	121	555	3	172	564		293	0.7:1
1982		586	1	303	556	1	259	572	1	562	1.2:1
1983		570	2	111	542	2	169	553	1	280	0.7:1
1984		574	5	60	552	2	72	562	3	132	0.8:1
1985		565	4	75	551	2	111	557	2	186	0.7:1
1987		601	3	54	573	3	37	590	2	91	1.5:1
1988		581	2	195	550	2	138	567	1	333	1.4:1
1989		593	1	320	561	2	271	578	1	591	1.2:1
1990		592	3	184	571	0	120	584	0	304	1.5:1
1991		560	3	105	543	3	75	553	2	180	1.4:1
1992		555	9	24	535	5	18	546	6	42	1.3:1
1993		578	3	81	559	2	92	568	2	173	0.9:1
1981	2.2	487	6	40	519	5	57	506		97	0.7:1
1983		494	4	93	488	3	89	491	3	182	1.0:1
1984		499	4	81	507	4	75	503	3	156	1.1:1
1985		496	5	75	490	4	47	494	4	122	1.6:1
1988		487	5	72	496	4	60	491	3	132	1.2:1
1991		515	5	42	498	6	18	510	4	60	2.3:1
1992		486	12	10	492	5	14	490	6	24	0.7:1
1980	2.3	584	2	158	554	2	237	566		395	0.7:1
1983		569	4	43	550	2	80	556	2	123	0.5:1
1984		581	2	261	553	2	202	569	1	463	1.3:1
1985		568	4	94	551	2	161	557	2	255	0.6:1
1986		573	5	44	556	3	45	564	3	89	1.0:1
1987		595	4	49	573	3	37	586	3	86	1.3:1
1988		585	3	110	556	2	83	572	2	193	1.3:1
1989		594	3	72	568	3	37	586	2	109	1.9:1
1990		601	0	165	571	0	72	592	0	237	2.3:1
1991		558	4	36	537	4	23	550	3	59	1.6:1
1992		572	4	58	547	3	62	559	2	120	0.9:1
1993		585	2	104	558	2	114	571	1	218	0.9:1

Table 23. Estimated salmon escapement into the Yentna River, 7 July through 7 August 1993. Species composition of daily sonar counts based on fish wheel catches.

	Sockeye		Pink		Chum		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
07–Jul	144	144	124	124	25	25	11	11	24	24
08–Jul	162	306	136	260	27	52	14	25	29	53
09–Jul	192	498	156	416	31	83	18	43	37	90
10–Jul	202	700	163	579	33	116	18	61	39	129
11–Jul	151	851	121	700	24	140	14	75	30	159
12–Jul	126	977	106	806	20	160	12	87	23	182
13–Jul	164	1,141	196	1,002	40	200	11	98	4	186
14–Jul	184	1,325	216	1,218	44	244	12	110	5	191
15–Jul	717	2,042	859	2,077	179	423	47	157	16	207
16–Jul	17,010	19,052	2,895	4,972	508	931	391	548	53	260
17–Jul	21,259	40,311	3,584	8,556	439	1,370	572	1,120	10	270
18–Jul	10,688	50,999	3,516	12,072	804	2,174	467	1,587	0	270
19–Jul	3,143	54,142	2,067	14,139	170	2,344	164	1,751	18	288
20–Jul	5,353	59,495	2,591	16,730	265	2,609	244	1,995	15	303
21–Jul	6,251	65,746	3,066	19,796	233	2,842	286	2,281	0	303
22–Jul	6,912	72,658	5,252	25,048	309	3,151	413	2,694	0	303
23–Jul	8,697	81,355	10,214	35,262	483	3,634	881	3,575	0	303
24–Jul	10,276	91,631	12,959	48,221	543	4,177	1,645	5,220	2	305
25–Jul	8,865	100,496	16,352	64,573	1,471	5,648	2,633	7,853	0	305
26–Jul	7,622	108,118	14,847	79,420	1,403	7,051	3,041	10,894	6	311
27–Jul	6,586	114,704	13,192	92,612	1,590	8,641	2,916	13,810	0	311
28–Jul	3,060	117,764	16,700	109,312	2,108	10,749	2,172	15,982	0	311
29–Jul	3,736	121,500	18,127	127,439	1,141	11,890	1,898	17,880	0	311
30–Jul	4,973	126,473	18,578	146,017	2,187	14,077	3,404	21,284	13	324
31–Jul	4,810	131,283	16,889	162,906	2,079	16,156	4,016	25,300	0	324
01–Aug	1,660	132,943	14,407	177,313	890	17,046	1,458	26,758	0	324
02–Aug	1,688	134,631	9,891	187,204	755	17,801	1,269	28,027	0	324
03–Aug	2,445	137,076	10,569	197,773	1,999	19,800	3,190	31,217	0	324
04–Aug	2,467	139,543	12,486	210,259	3,390	23,190	3,136	34,353	25	349
05–Aug	976	140,519	7,792	218,051	1,822	25,012	1,620	35,973	14	363
06–Aug	673	141,192	5,819	223,870	1,901	26,913	1,040	37,013	0	363
07–Aug	502	141,694	3,301	227,171	1,108	28,021	739	37,752	0	363

Table 24. Salmon escapement observations in Susitna River tributaries, 1993.

	Method	Source	Number of Fish Observed or Estimated				
			Sockeye	Pink	Chum	Coho	Chinook
Chelatna Lake	Weir	[a]	20,235				
Deception Creek		[b]					1,221
Rabideux Creek		[b]				nc	
Birch Creek		[b]				178	
Question Creek		[b]				370	
Answer Creek		[b]				34	
Goose Creek		[b]					347
Little Willow Creek		[b]					705
Montana Creek		[b]					1,218
Prairie Creek		[b]					3,023
Sheep Creek		[b]					nc
Willow Creek		[b]					2,227
Alexander Creek		[b]					2,763
Deshka River		[b]					5,769
Lake Creek		[b]					2,322
Peters Creek		[b]					1,668
Lake Creek		[b]					2,869
Cache Creek		[b]					1,690
Talachulitna River		[b]					3,269

[a] Cook Inlet Aquaculture Association records, Soldotna.
[b] Sport Fish Division records, Alaska Department of Fish and Game, Anchorage.

Table 25. Cumulative proportion by date of sockeye salmon counts recorded in the Yentna River, 1983–1993.

	Cumulative Proportion [a,b]												
Date	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
27–Jun		0.000											
28–Jun		0.000											
29–Jun	0.001	0.000				0.001							
30–Jun	0.004	0.000	0.000			0.002							
01–Jul	0.008	0.001	0.001	0.001	0.000	0.002	0.000						
02–Jul	0.013	0.001	0.001	0.001	0.001	0.003	0.001						
03–Jul	0.016	0.001	0.002	0.002	0.001	0.003	0.001						
04–Jul	0.017	0.002	0.003	0.003	0.001	0.004	0.002						
05–Jul	0.018	0.002	0.003	0.004	0.001	0.005	0.002						
06–Jul	0.020	0.002	0.004	0.004	0.002	0.005	0.003						
07–Jul	0.021	0.002	0.004	0.005	0.003	0.006	0.003	0.004	0.003	0.002	0.000	0.002	0.001
08–Jul	0.023	0.002	0.004	0.005	0.003	0.006	0.004	0.008	0.006	0.005	0.001	0.003	0.002
09–Jul	0.026	0.002	0.005	0.006	0.004	0.007	0.004	0.012	0.009	0.008	0.001	0.005	0.004
10–Jul	0.056	0.002	0.005	0.007	0.005	0.008	0.005	0.016	0.012	0.010	0.002	0.007	0.005
11–Jul	0.092	0.003	0.006	0.009	0.006	0.009	0.005	0.019	0.014	0.013	0.002	0.008	0.006
12–Jul	0.155	0.003	0.008	0.011	0.007	0.010	0.005	0.022	0.015	0.014	0.002	0.010	0.007
13–Jul	0.230	0.003	0.011	0.012	0.008	0.011	0.006	0.025	0.016	0.016	0.003	0.012	0.008
14–Jul	0.344	0.003	0.034	0.015	0.009	0.011	0.007	0.029	0.019	0.017	0.003	0.016	0.009
15–Jul	0.454	0.004	0.059	0.017	0.010	0.014	0.006	0.034	0.023	0.019	0.004	0.022	0.014
16–Jul	0.521	0.005	0.096	0.023	0.010	0.022	0.010	0.039	0.026	0.020	0.005	0.035	0.134
17–Jul	0.563	0.016	0.131	0.142	0.011	0.027	0.014	0.043	0.051	0.022	0.005	0.062	0.284
18–Jul	0.599	0.043	0.179	0.232	0.012	0.036	0.020	0.046	0.103	0.025	0.009	0.086	0.360
19–Jul	0.838	0.155	0.351	0.345	0.013	0.041	0.027	0.090	0.161	0.105	0.028	0.120	0.382
20–Jul	0.681	0.329	0.567	0.458	0.014	0.042	0.034	0.197	0.202	0.217	0.100	0.148	0.420
21–Jul	0.732	0.527	0.693	0.554	0.014	0.043	0.047	0.269	0.234	0.284	0.193	0.184	0.464
22–Jul	0.801	0.627	0.722	0.626	0.016	0.052	0.059	0.303	0.280	0.327	0.302	0.229	0.513
23–Jul	0.846	0.665	0.758	0.681	0.019	0.162	0.107	0.375	0.359	0.383	0.378	0.296	0.574
24–Jul	0.882	0.711	0.786	0.755	0.145	0.193	0.218	0.484	0.453	0.452	0.425	0.373	0.647
25–Jul	0.905	0.734	0.824	0.785	0.359	0.253	0.331	0.630	0.532	0.505	0.451	0.447	0.709
26–Jul	0.925	0.780	0.867	0.808	0.507	0.371	0.442	0.771	0.646	0.573	0.505	0.519	0.763
27–Jul	0.940	0.811	0.894	0.836	0.636	0.491	0.528	0.821	0.749	0.667	0.575	0.606	0.810
28–Jul	0.950	0.831	0.905	0.855	0.782	0.606	0.587	0.858	0.799	0.734	0.837	0.674	0.831
29–Jul	0.958	0.847	0.913	0.866	0.903	0.752	0.625	0.886	0.854	0.769	0.674	0.734	0.857
30–Jul	0.969	0.859	0.921	0.874	0.942	0.831	0.655	0.918	0.864	0.796	0.720	0.794	0.893
31–Jul	0.976	0.890	0.925	0.885	0.960	0.861	0.686	0.937	0.868	0.825	0.754	0.825	0.927
01–Aug	0.980	0.933	0.929	0.893	0.970	0.882	0.709	0.946	0.873	0.859	0.779	0.858	0.938
02–Aug	0.986	0.948	0.937	0.901	0.978	0.908	0.750	0.960	0.879	0.907	0.806	0.881	0.950
03–Aug	0.988	0.955	0.941	0.909	0.983	0.917	0.789	0.969	0.889	0.947	0.850	0.896	0.967
04–Aug	0.990	0.962	0.945	0.920	0.987	0.924	0.825	0.975	0.907	0.962	0.891	0.910	0.985
05–Aug	0.991	0.965	0.949	0.926	0.990	0.935	0.857	0.981	0.923	0.971	0.930	0.915	0.992
06–Aug	0.992	0.967	0.953	0.934	0.994	0.940	0.875	0.984	0.936	0.978	0.942	0.922	0.996
07–Aug	0.992	0.970	0.955	0.939	0.997	1.000	0.889	0.989	0.944	0.985	0.959	0.929	1.000
08–Aug	0.992	0.972	0.958	0.944	1.000		0.900	0.992	0.949	0.990	0.975	0.941	
09–Aug	0.993	0.975	0.959	0.949			0.932	0.994	0.954	0.994	0.986	0.966	
10–Aug	0.994	0.977	0.959	0.954			0.962	0.996	0.958	0.995	0.994	0.984	
11–Aug	0.995	0.979	0.962	0.958			0.986	1.000	0.962	0.998	0.999	1.000	
12–Aug	0.996	0.981	0.968	0.962			0.996		0.966	1.000	1.000		
13–Aug	0.997	0.982	0.974	0.965			1.000		0.975				
14–Aug	0.997	0.984	0.977	0.968					0.985				
15–Aug	0.998	0.985	0.979	0.970					0.992				
16–Aug	0.998	0.986	0.982	0.973					0.995				
17–Aug	0.998	0.987	0.985	0.975					0.997				
18–Aug	0.998	0.988	0.987	0.977					0.998				
19–Aug	0.998	0.989	0.988	0.979					0.999				
20–Aug	0.999	0.990	0.990	0.980					1.000				
21–Aug	0.999	0.990	0.991	0.981									
22–Aug	0.999	0.990	0.992	0.984									
23–Aug	0.999	0.991	0.993	0.987									
24–Aug	1.000	0.992	0.994	0.989									
25–Aug	1.000	0.993	0.994	0.992									
26–Aug	1.000	0.994	0.995	0.994									
27–Aug	1.000	0.994	0.996	0.996									
28–Aug	1.000	0.995	0.997	0.996									
29–Aug	1.000	0.996	0.998	0.998									
30–Aug		0.997	0.998	0.999									
31–Aug		0.997	0.999	0.999									
01–Sep		0.998	0.999	1.000									
02–Sep		0.999	0.999	1.000									
03–Sep		0.999	0.999	1.000									
04–Sep		1.000	1.000	1.000									
05–Sep		1.000	1.000	1.000									
Midpoint	7/16	7/21	7/20	7/21	7/26	7/28	7/27	7/25	7/25	7/25	7/26	7/26	7/22
No. days for 80%	14	14	12	17	6	11+	17	11	18	15	17	17	16

[a] Proportion accrued on last day (1986) represents that portion of the escapement estimated after enumeration operations.
[b] Inclusive dates: date proportion of escapement reached 10% through date proportion of escapement reached 90%.

Table 26. Daily adjusted fish wheel catch by species for the north bank of the Yentna River, 7 July through 6 August 1993.

		Sockeye		Pink		Chum		Coho		Chinook	
Date	Hours open[a]	Daily	Cum[b]	Daily	Cum[b]	Daily	Cum[b]	Daily	Cum[b]	Daily	Cum[b]
07-Jul	20.3	4	4	0	0	0	0	0	0	0	0
08-Jul	22.1	5	9	0	0	0	0	0	0	1	1
09-Jul	22.2	3	12	1	1	1	1	0	0	1	2
10-Jul	19.1	19	31	4	5	3	4	0	0	3	5
11-Jul	22.0	4	35	0	5	0	4	1	1	1	6
12-Jul	25.6	6	41	4	9	0	4	0	1	2	8
13-Jul	22.3	10	51	20	29	0	4	1	2	0	8
14-Jul	22.3	13	64	20	49	3	7	0	2	0	8
15-Jul	18.3	31	95	51	100	12	19	0	2	0	8
16-Jul	12.9	169	264	113	213	17	36	6	8	0	8
17-Jul	14.5	252	516	129	342	15	51	18	26	3	11
18-Jul	9.8	179	695	118	460	22	73	5	31	0	11
19-Jul	13.9	54	749	202	662	28	101	12	43	5	16
20-Jul	13.8	139	888	259	921	23	124	17	60	2	18
21-Jul	15.0	102	990	342	1,263	21	145	18	78	0	18
22-Jul	16.6	67	1,057	406	1,669	23	168	14	92	1	19
23-Jul	12.6	122	1,179	615	2,284	72	240	44	136	0	19
24-Jul	7.5	112	1,291	803	3,087	51	291	64	200	3	22
25-Jul	4.8	65	1,356	1,465	4,552	75	366	95	295	0	22
26-Jul	7.7	97	1,453	648	5,200	81	447	118	413	3	25
27-Jul	6.1	118	1,571	771	5,971	122	569	114	527	0	25
28-Jul	6.9	77	1,648	1,158	7,129	136	705	80	607	0	25
29-Jul	4.8	65	1,713	1,350	8,479	80	785	75	682	0	25
30-Jul	4.7	66	1,779	1,506	9,985	143	928	133	815	0	25
31-Jul	5.1	113	1,892	1,652	11,637	193	1,121	160	975	0	25
01-Aug	5.5	92	1,984	1,540	13,177	39	1,160	87	1,062	0	25
02-Aug	5.8	62	2,046	828	14,005	50	1,210	83	1,145	0	25
03-Aug	6.4	60	2,106	780	14,785	143	1,353	131	1,276	0	25
04-Aug	8.3	29	2,135	520	15,305	176	1,529	121	1,397	3	28
05-Aug	7.5	10	2,145	519	15,824	135	1,664	46	1,443	0	28
06-Aug	9.0	8	2,153	365	16,189	101	1,765	48	1,491	0	28

[a] Fish wheel catch adjusted for 24 h: (daily catch * 24 h) / hours open.
[b] Total catch by species: 931 sockeye salmon; 4,789 pink salmon; 549 chum salmon; 432 coho salmon; 17 chinook salmon.

Table 27. Daily adjusted fish wheel catch by species for the south bank of the Yentna River, 7 July through 7 August 1993.

		Sockeye		Pink		Chum		Coho		Chinook	
Date	Hours open[a]	Daily	Cum[b]	Daily	Cum[b]	Daily	Cum[b]	Daily	Cum[b]	Daily	Cum[b]
07-Jul	22.7	11	11	3	3	4	4	0	0	4	4
08-Jul	21.7	10	21	13	16	0	4	0	0	6	10
09-Jul	22.9	13	34	16	32	1	5	0	0	1	11
10-Jul	22.2	25	59	5	37	1	6	3	3	4	15
11-Jul	22.5	3	62	6	43	0	6	4	7	1	16
12-Jul	22.6	17	79	15	58	6	12	2	9	2	18
13-Jul	21.9	9	88	33	91	1	13	2	11	1	19
14-Jul	22.3	5	93	61	152	10	23	2	13	0	19
15-Jul	22.0	163	256	123	275	35	58	9	22	1	20
16-Jul	12.8	1,243	1,499	189	464	34	92	28	50	4	24
17-Jul	9.6	2,000	3,499	308	772	38	130	50	100	0	24
18-Jul	11.9	946	4,445	296	1,068	69	199	42	142	0	24
19-Jul	15.4	542	4,987	315	1,383	23	222	26	168	2	26
20-Jul	15.0	835	5,822	352	1,735	37	259	35	203	2	28
21-Jul	14.7	1,156	6,978	482	2,217	38	297	49	252	0	28
22-Jul	13.3	1,164	8,142	868	3,085	51	348	69	321	0	28
23-Jul	13.2	1,156	9,298	1,342	4,427	62	410	116	437	0	28
24-Jul	10.3	1,407	10,705	1,713	6,140	70	480	221	658	0	28
25-Jul	10.4	1,172	11,877	1,964	8,104	185	665	337	995	0	28
26-Jul	9.8	779	12,656	1,420	9,524	130	795	294	1,289	0	28
27-Jul	11.7	730	13,386	1,278	10,802	144	939	302	1,591	0	28
28-Jul	9.2	493	13,879	2,223	13,025	287	1,226	334	1,925	0	28
29-Jul	8.8	616	14,495	2,471	15,496	158	1,384	292	2,217	0	28
30-Jul	10.1	741	15,236	2,006	17,502	257	1,641	454	2,671	2	30
31-Jul	8.9	909	16,145	2,540	20,042	318	1,959	725	3,396	0	30
01-Aug	7.0	415	16,560	3,072	23,114	230	2,189	360	3,756	0	30
02-Aug	4.1	439	16,999	2,150	25,264	176	2,365	297	4,053	0	30
03-Aug	8.5	381	17,380	1,251	26,515	240	2,605	457	4,510	0	30
04-Aug	9.3	286	17,666	1,050	27,565	248	2,853	274	4,784	0	30
05-Aug	9.6	195	17,861	1,100	28,665	243	3,096	293	5,077	3	33
06-Aug	9.5	144	18,005	884	29,549	311	3,407	179	5,256	0	33
07-Aug	9.1	140	18,145	920	30,469	309	3,716	206	5,462	0	33

[a] Fish wheel catch adjusted for 24 h: (daily catch * 24 h) / hours open.
[b] Total catch by species: 8,561 sockeye salmon; 12,416 pink salmon; 1,508 chum salmon; 78 coho salmon; 25 chinook salmon.

Table 28. Age composition of sockeye salmon collected in the Yentna River, 1986-1993.

Year	Percent Composition by Age Class[a]											Sample Size
	0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.2	
1986	0.0	2.1	1.9	22.7	56.5	0.2	0.6	5.9	10.0	0.1		492
1987	1.3	2.4	0.9	23.3	50.6	1.0	0.0	8.6	11.7	0.0		1,089
1988	2.7	2.4	0.4	33.5	41.9	0.2	1.7	6.5	10.4	0.1		1,727
1989	0.2	0.2	1.3	27.2	63.5	0.4	0.2	3.0	4.0	0.0		1,362
1990	0.8	2.4	0.3	29.9	47.6	0.7	0.1	9.8	8.2	0.1		1,710
1991	2.0	10.1	0.1	25.2	44.1	0.1	0.1	7.0	11.1	0.1		1,509
1992	1.6	0.6	1.0	31.1	29.6	0.1	0.4	16.9	18.3	0.1	0.4	1,451
1993	1.0	4.6	0.1	32.1	35.5	0.0	0.4	11.7	14.5	0.1	0.0	1,390

[a] Percentages weighted by total numbers in the escapement.

Table 29. Length composition of the major age classes of sockeye salmon collected in the Yentna River, 1986-1993. Length measured from mid-eye to fork-of-tail.

		Male			Female			Total			
Year	Age Class	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ave Length (mm)	Stndrd Error	Sample Size	Ratio Male-Female
1991	0.3	572	5	59	550	2	100	558	2	159	0.6:1
1986	1.2	455	3	104	472	5	52	461	3	156	2.0:1
1987		484	3	158	477	2	156	480	2	314	1.0:1
1988		461	2	408	486	3	170	469	2	578	2.4:1
1989		463	4	246	485	4	122	471	3	368	2.0:1
1990		446	0	305	446	0	238	446	0	543	1.3:1
1991		460	3	253	484	2	130	468	2	383	2.0:1
1992		443	2	360	469	3	115	449	2	475	3.1:1
1993		465	2	279	484	2	167	472	1	446	1.7:1
1986	1.3	579	3	172	563	2	216	570	2	388	0.8:1
1987		591	2	246	565	2	222	580	1	468	1.1:1
1988		580	2	365	552	1	359	567	1	724	1.0:1
1989		575	3	390	553	1	474	563	1	864	0.8:1
1990		573	0	400	552	0	526	561	0	926	0.7:1
1991		562	2	301	542	1	356	551	1	657	0.9:1
1992		546	4	188	543	2	242	545	2	430	0.8:1
1993		561	2	228	549	1	266	554	1	494	0.9:1
1992	2.2	451	3	181	471	6	53	455	3	234	3.4:1
1993		476	4	93	487	3	69	481	3	162	1.3:1
1986	2.3	588	5	25	555	4	44	567	3	69	0.6:1
1987		583	4	62	566	3	52	577	3	114	1.2:1
1988		585	4	92	554	3	87	570	2	179	1.1:1
1990		574	0	73	542	0	96	555	0	169	0.8:1
1991		561	4	78	536	3	86	547	2	164	0.9:1
1992		564	3	123	538	4	126	552	2	249	1.0:1
1993		562	3	74	544	2	128	550	2	202	0.6:1

Table 30. Cumulative proportion by date of pink salmon counts recorded in the Yentna River, 1981–1993.

	Cumulative Proportion												
Date	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
27–Jun		0.000											
28–Jun		0.000											
29–Jun	0.000	0.000				0.000	0.000						
30–Jun	0.002	0.000	0.000			0.000	0.000						
01–Jul	0.003	0.000	0.001	0.000	0.001	0.000	0.002						
02–Jul	0.005	0.000	0.001	0.000	0.002	0.000	0.004						
03–Jul	0.007	0.000	0.001	0.000	0.003	0.000	0.008						
04–Jul	0.008	0.000	0.002	0.000	0.003	0.000	0.011						
05–Jul	0.008	0.000	0.003	0.000	0.005	0.001	0.015						
06–Jul	0.011	0.000	0.003	0.000	0.007	0.001	0.018						
07–Jul	0.015	0.000	0.003	0.000	0.011	0.001	0.022	0.000	0.003	0.000	0.002	0.000	0.001
08–Jul	0.021	0.000	0.003	0.000	0.012	0.001	0.025	0.000	0.008	0.000	0.005	0.000	0.002
09–Jul	0.025	0.000	0.004	0.000	0.015	0.001	0.029	0.000	0.013	0.000	0.006	0.001	0.004
10–Jul	0.037	0.000	0.004	0.000	0.018	0.001	0.031	0.000	0.018	0.000	0.007	0.001	0.005
11–Jul	0.039	0.000	0.005	0.001	0.021	0.001	0.035	0.000	0.026	0.000	0.009	0.001	0.006
12–Jul	0.039	0.000	0.006	0.001	0.025	0.001	0.041	0.000	0.034	0.000	0.010	0.001	0.007
13–Jul	0.042	0.000	0.009	0.001	0.030	0.001	0.047	0.000	0.043	0.001	0.012	0.001	0.008
14–Jul	0.050	0.000	0.030	0.001	0.033	0.002	0.051	0.000	0.052	0.001	0.014	0.002	0.009
15–Jul	0.057	0.000	0.039	0.001	0.038	0.003	0.056	0.001	0.058	0.001	0.016	0.002	0.014
16–Jul	0.061	0.000	0.056	0.001	0.042	0.007	0.065	0.001	0.060	0.001	0.018	0.003	0.134
17–Jul	0.062	0.001	0.098	0.003	0.046	0.011	0.075	0.001	0.071	0.002	0.019	0.005	0.284
18–Jul	0.072	0.002	0.171	0.008	0.050	0.014	0.088	0.001	0.105	0.002	0.027	0.009	0.360
19–Jul	0.082	0.010	0.288	0.023	0.053	0.015	0.099	0.002	0.158	0.014	0.063	0.017	0.382
20–Jul	0.105	0.021	0.400	0.067	0.056	0.016	0.110	0.005	0.196	0.030	0.092	0.028	0.420
21–Jul	0.132	0.040	0.511	0.126	0.060	0.017	0.135	0.013	0.224	0.050	0.120	0.050	0.464
22–Jul	0.158	0.056	0.565	0.190	0.064	0.021	0.156	0.019	0.255	0.084	0.151	0.078	0.513
23–Jul	0.236	0.078	0.638	0.277	0.078	0.059	0.180	0.032	0.287	0.132	0.180	0.126	0.574
24–Jul	0.311	0.126	0.704	0.365	0.135	0.125	0.222	0.061	0.349	0.190	0.216	0.212	0.647
25–Jul	0.398	0.162	0.743	0.420	0.226	0.222	0.307	0.129	0.420	0.263	0.257	0.322	0.709
26–Jul	0.464	0.192	0.791	0.466	0.329	0.369	0.407	0.231	0.493	0.342	0.308	0.459	0.763
27–Jul	0.512	0.237	0.820	0.510	0.475	0.535	0.537	0.338	0.570	0.433	0.361	0.561	0.810
28–Jul	0.580	0.330	0.843	0.578	0.636	0.695	0.624	0.459	0.638	0.514	0.441	0.668	0.831
29–Jul	0.639	0.447	0.855	0.669	0.763	0.830	0.668	0.589	0.691	0.580	0.499	0.751	0.857
30–Jul	0.705	0.562	0.864	0.728	0.833	0.894	0.701	0.662	0.730	0.640	0.567	0.815	0.893
31–Jul	0.752	0.654	0.871	0.784	0.877	0.924	0.729	0.722	0.748	0.722	0.640	0.862	0.927
01–Aug	0.795	0.735	0.879	0.837	0.903	0.957	0.741	0.768	0.759	0.815	0.677	0.899	0.938
02–Aug	0.819	0.824	0.903	0.873	0.926	0.979	0.767	0.826	0.770	0.884	0.703	0.924	0.950
03–Aug	0.834	0.896	0.908	0.903	0.942	0.991	0.799	0.878	0.781	0.927	0.751	0.941	0.967
04–Aug	0.849	0.934	0.912	0.925	0.956	0.996	0.838	0.909	0.812	0.947	0.804	0.954	0.985
05–Aug	0.865	0.953	0.918	0.943	0.966	0.999	0.870	0.931	0.850	0.964	0.870	0.961	0.992
06–Aug	0.883	0.962	0.924	0.956	0.978	1.000	0.887	0.951	0.883	0.976	0.911	0.967	0.996
07–Aug	0.897	0.969	0.931	0.962	0.991		0.895	0.969	0.912	0.984	0.951	0.971	1.000
08–Aug	0.905	0.978	0.936	0.969	1.000		0.901	0.982	0.924	0.990	0.971	0.979	
09–Aug	0.913	0.984	0.937	0.975			0.921	0.990	0.938	0.994	0.985	0.990	
10–Aug	0.918	0.989	0.938	0.982			0.950	0.995	0.943	0.997	0.995	0.997	
11–Aug	0.924	0.991	0.943	0.986			0.975	1.000	0.948	0.998	0.999	1.000	
12–Aug	0.929	0.994	0.951	0.988			0.989		0.952	1.000	1.000		
13–Aug	0.930	0.996	0.958	0.991			0.996		0.963				
14–Aug	0.931	0.997	0.966	0.992			1.000		0.974				
15–Aug	0.935	0.998	0.971	0.994					0.989				
16–Aug	0.942	0.998	0.978	0.994					0.994				
17–Aug	0.949	0.999	0.984	0.995					0.997				
18–Aug	0.958	0.999	0.988	0.996					0.998				
19–Aug	0.967	0.999	0.990	0.997					0.999				
20–Aug	0.979	0.999	0.992	0.997					1.000				
21–Aug	0.984	0.999	0.993	0.997									
22–Aug	0.989	1.000	0.993	0.998									
23–Aug	0.992	1.000	0.994	0.998									
24–Aug	0.995	1.000	0.995	0.998									
25–Aug	0.997	1.000	0.996	0.999									
26–Aug	0.999	1.000	0.996	0.999									
27–Aug	1.000	1.000	0.997	0.999									
28–Aug	1.000	1.000	0.998	0.999									
29–Aug		1.000	0.998	0.999									
30–Aug		1.000	0.999	1.000									
31–Aug		1.000	0.999	1.000									
01–Sep		1.000	0.999	1.000									
02–Sep		1.000	0.999	1.000									
03–Sep		1.000	1.000	1.000									
04–Sep		1.000	1.000	1.000									
05–Sep		1.000	1.000	1.000									
Midpoint	7/27	7/30	7/21	7/27	7/28	7/27	7/27	7/29	7/27	7/28	7/30	7/27	7/22
No. days[a] for 80%	20	12	16	14	9	8+	20	11	21	12	17	11	16

[a] Inclusive dates: dates proportion of escapment reached 10% through date proportion of escapment reached 90%.

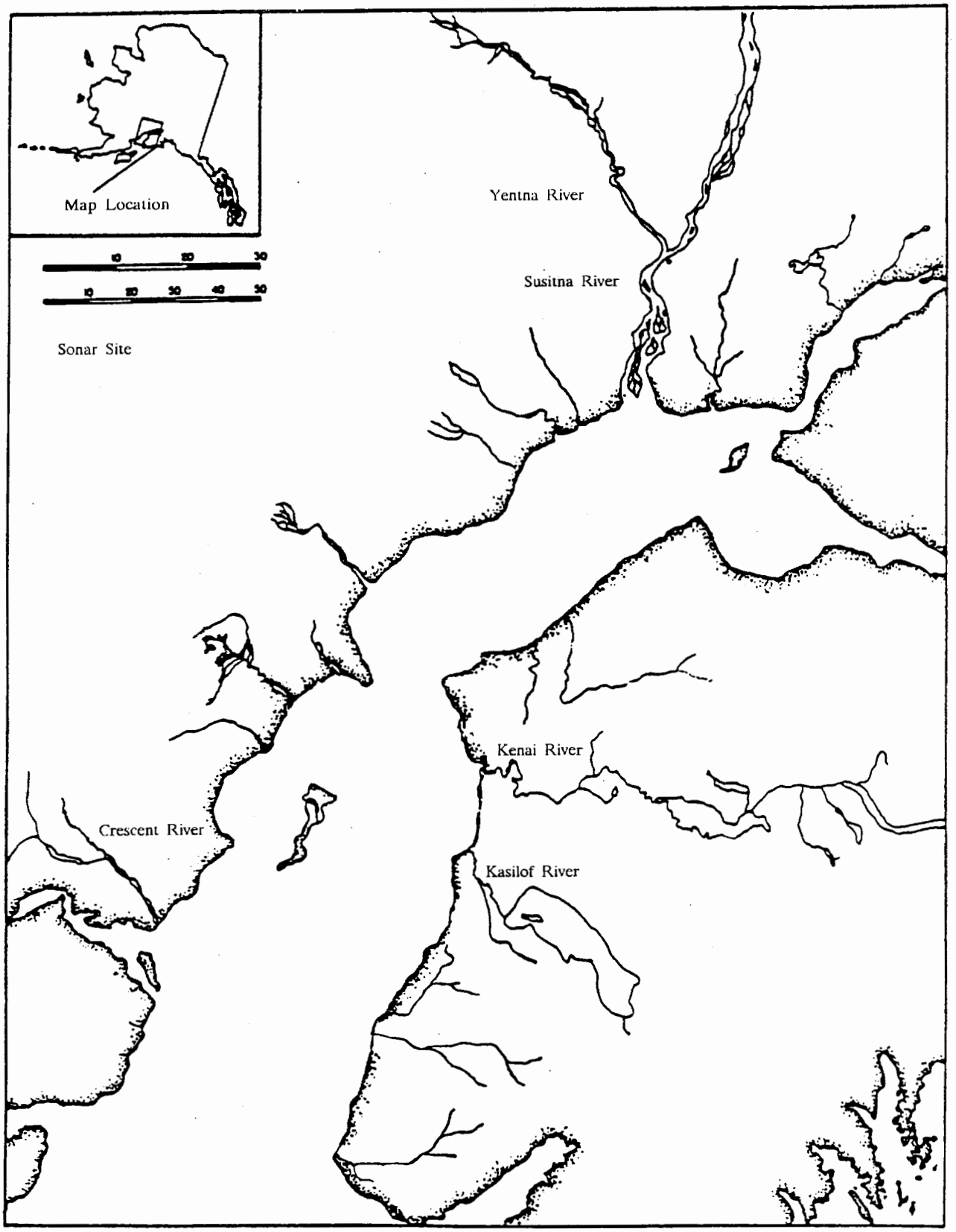

Figure 1. Upper Cook Inlet, Alaska, and sites where salmon escapement was monitored with side-scanning sonar.

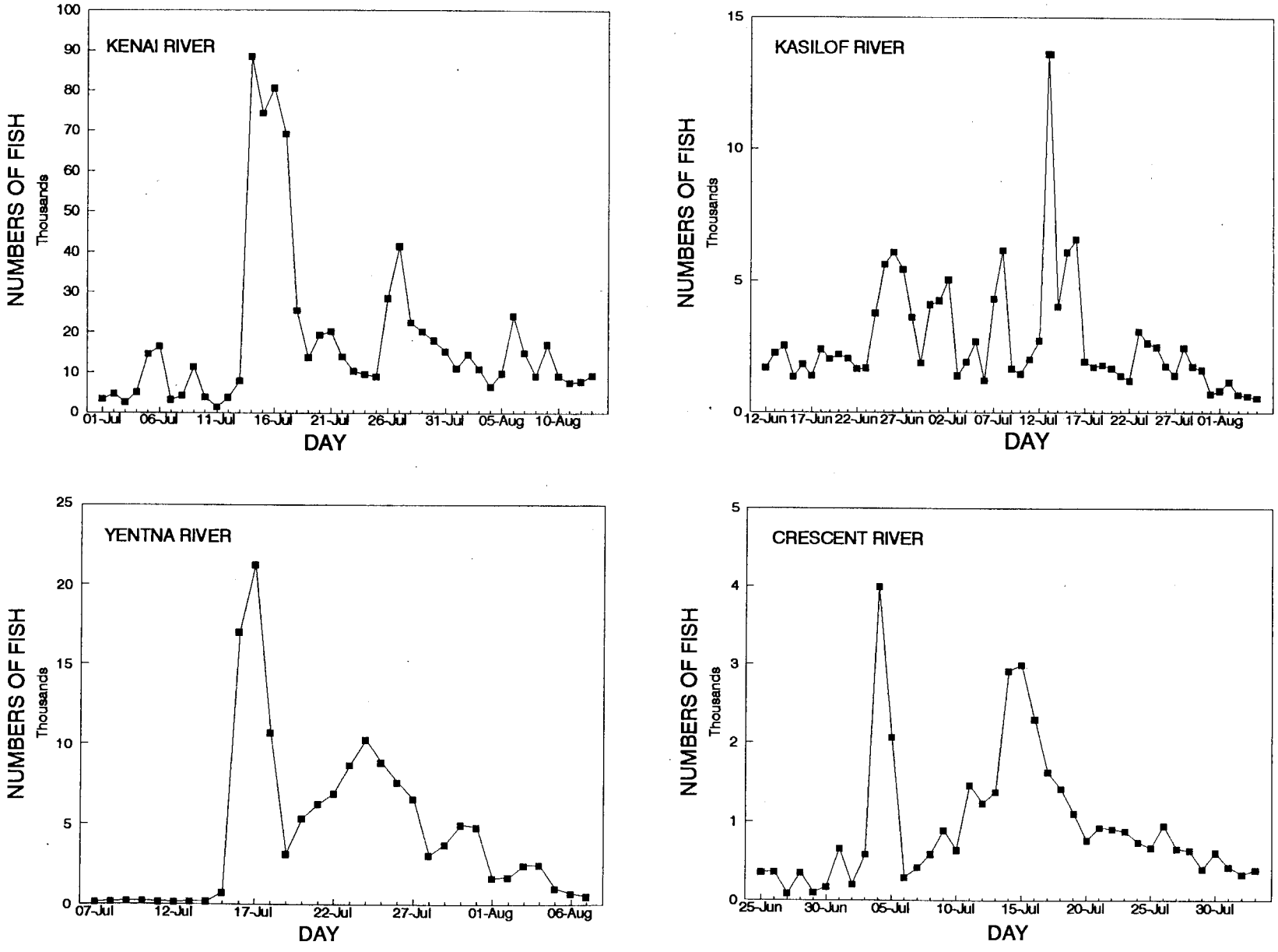

Figure 2. Daily escapement of sockeye salmon into the Kenai, Kasilof, Crescent, and Yentna Rivers, 1993.

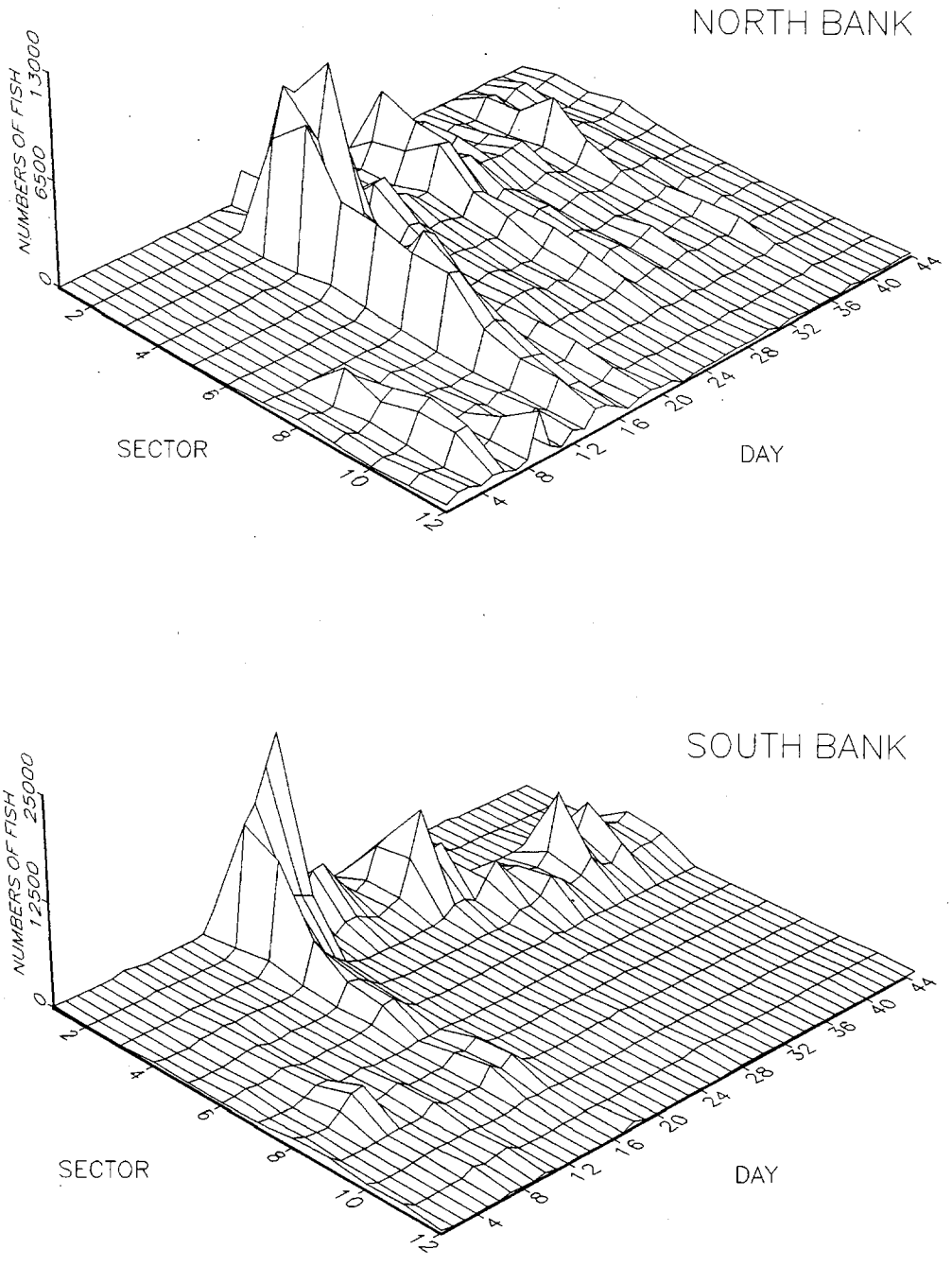

Figure 3. Distribution of salmon sonar counts by sector, Kenai River, 1993.

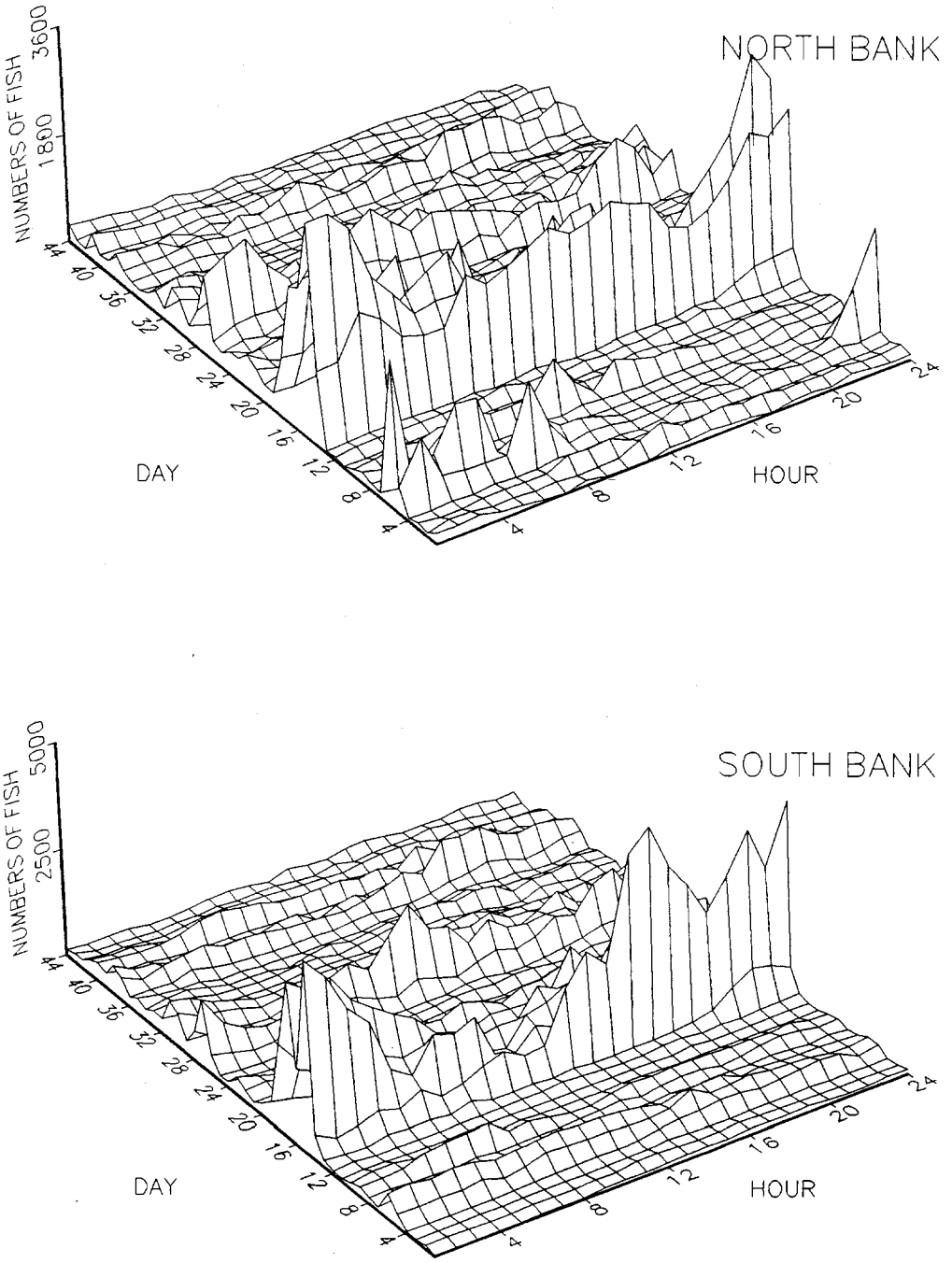

Figure 4. Hourly distribution of salmon migrating past the Kenai River sonar counters, 1993.

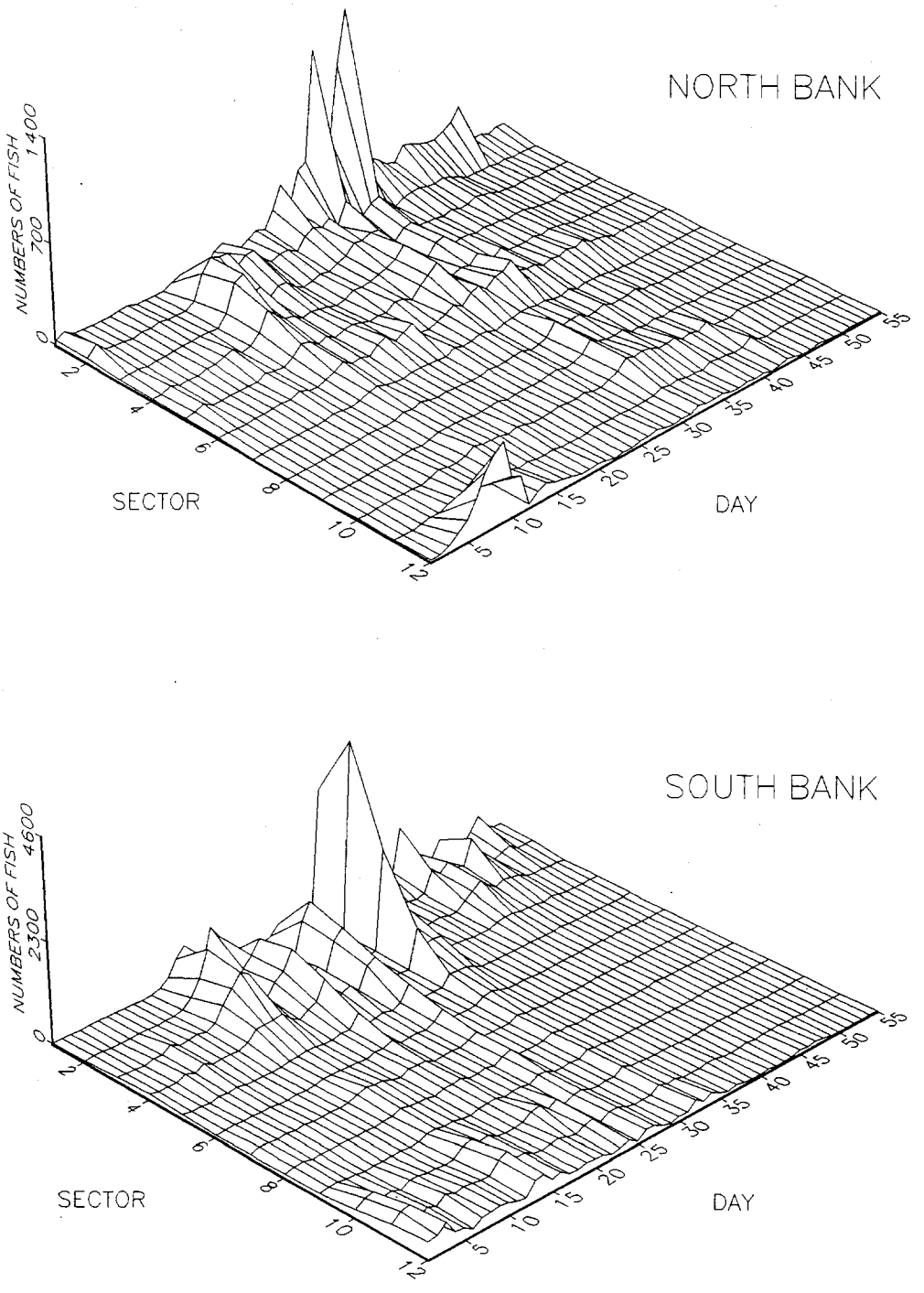

Figure 5. Distribution of salmon sonar counts by sector in the Kasilof River, 1993.

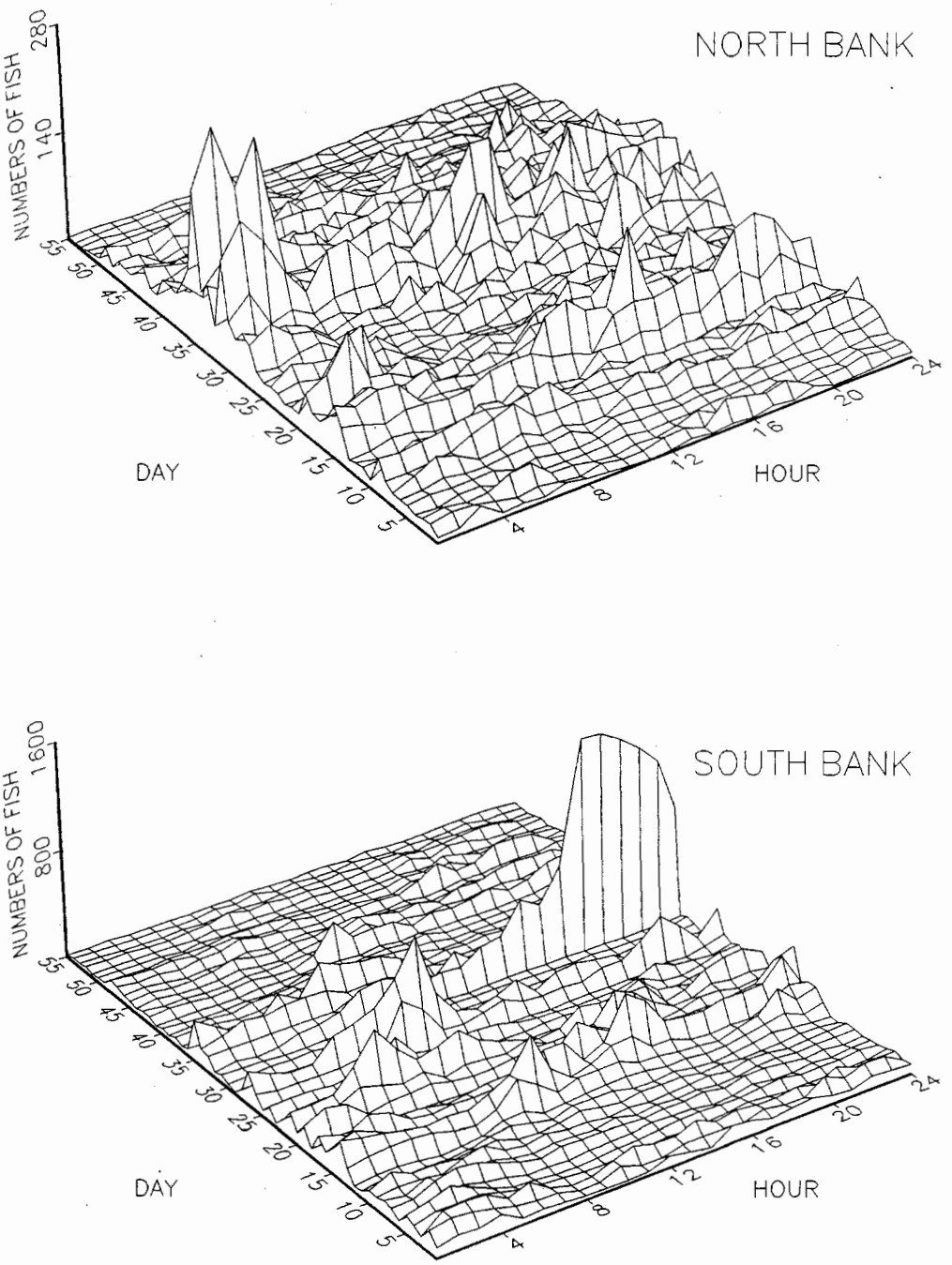

Figure 6. Hourly distribution of salmon migrating past the Kasilof River sonar counters, 1993.

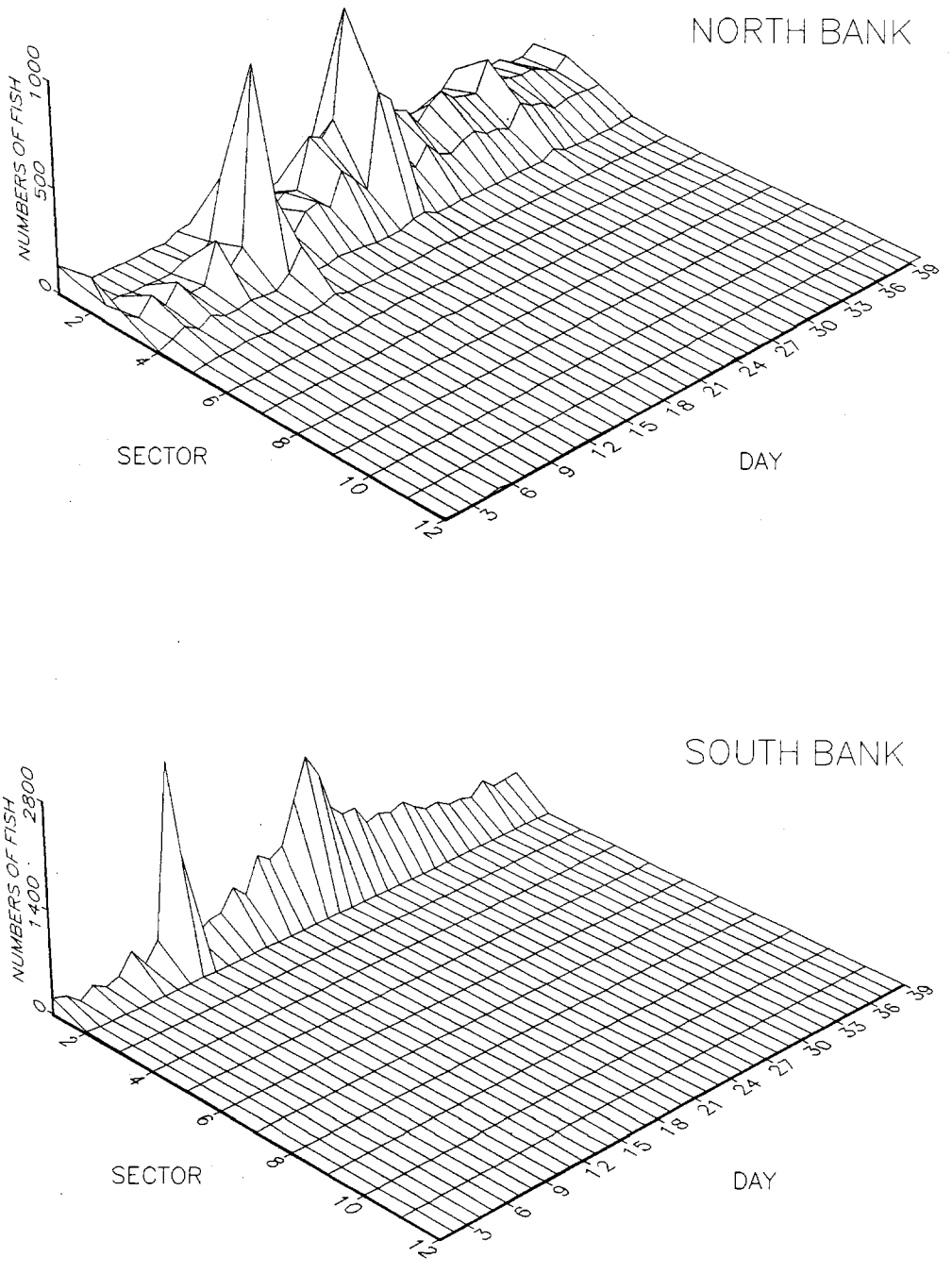

Figure 7. Distribution of salmon sonar counts by sector in the Crescent River, 1993.

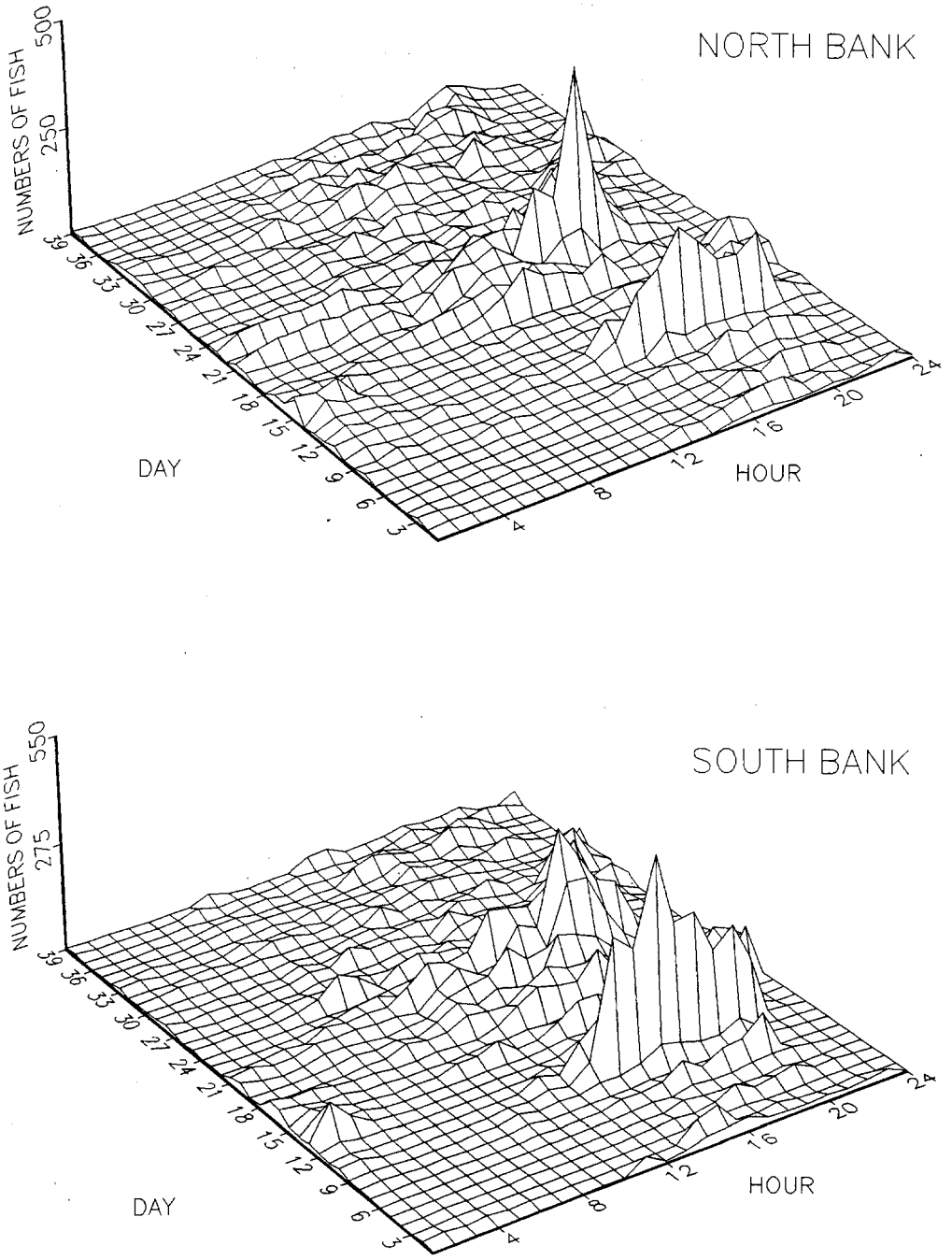

Figure 8. Hourly distribution of salmon migrating past the Crescent River sonar counters, 1993.

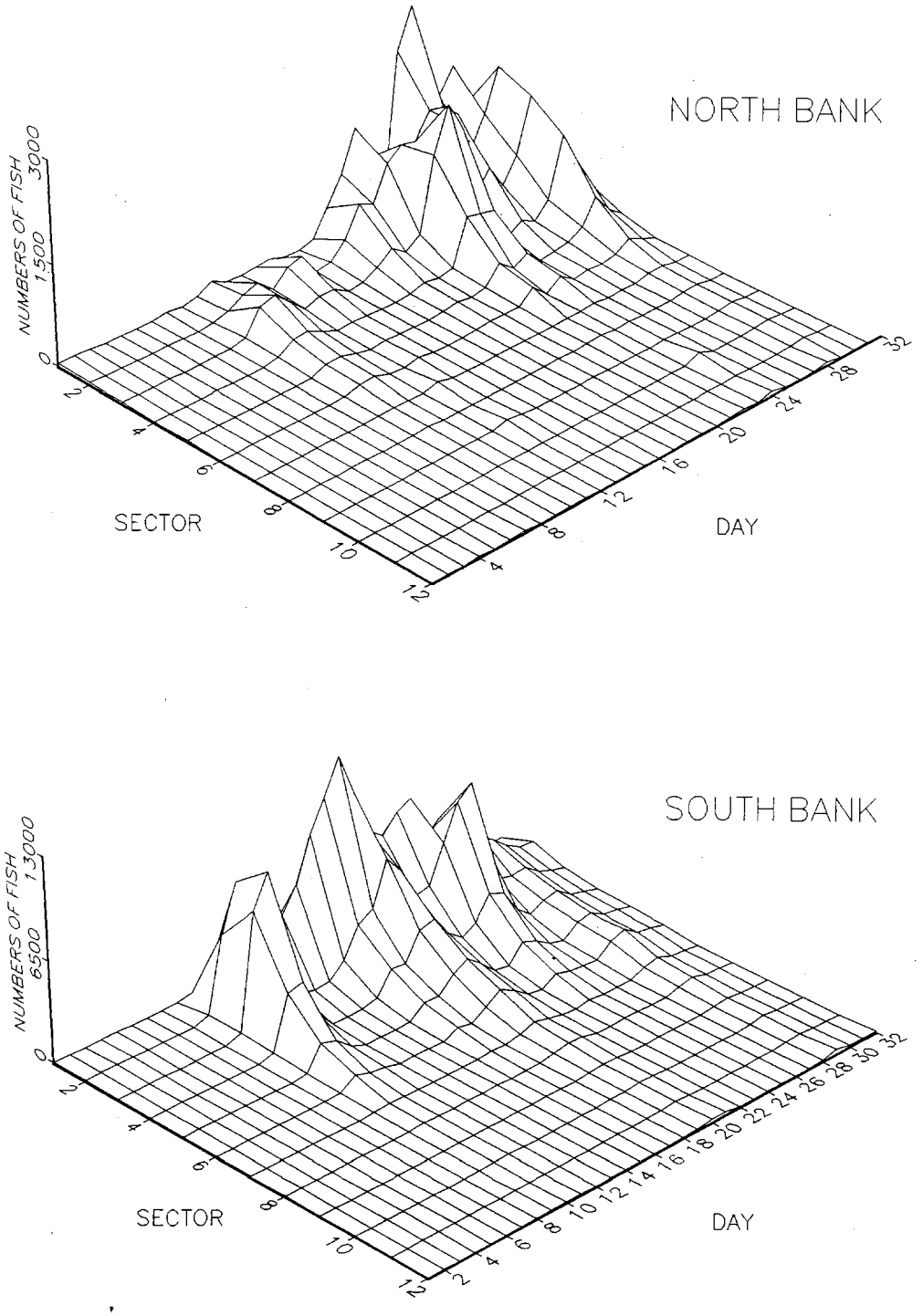

Figure 9. Distribution of salmon sonar counts by sector in the Yentna River, 1993.

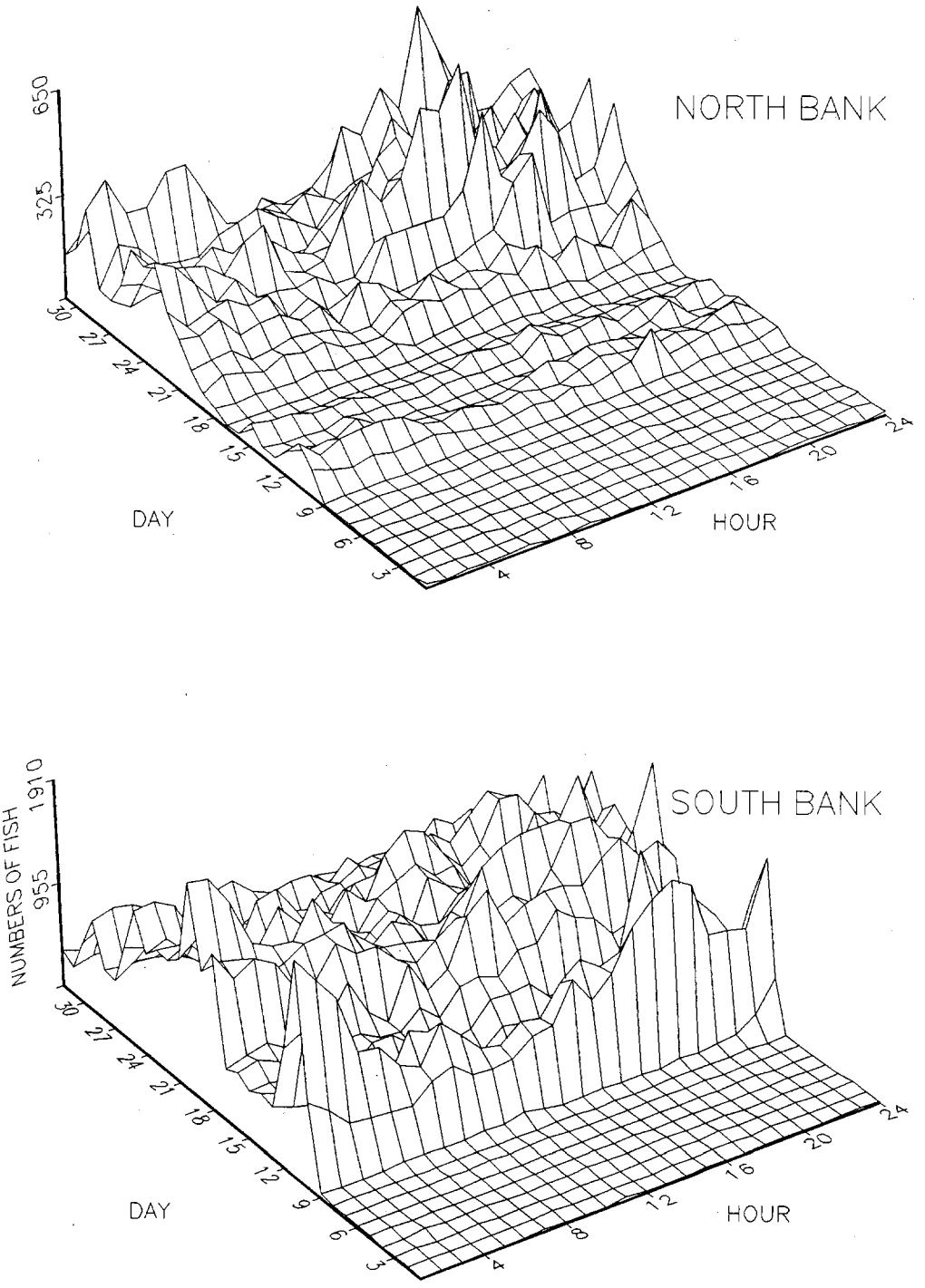

Figure 10. Hourly distribution of salmon migrating past the Yentna River sonar counters, 1993.

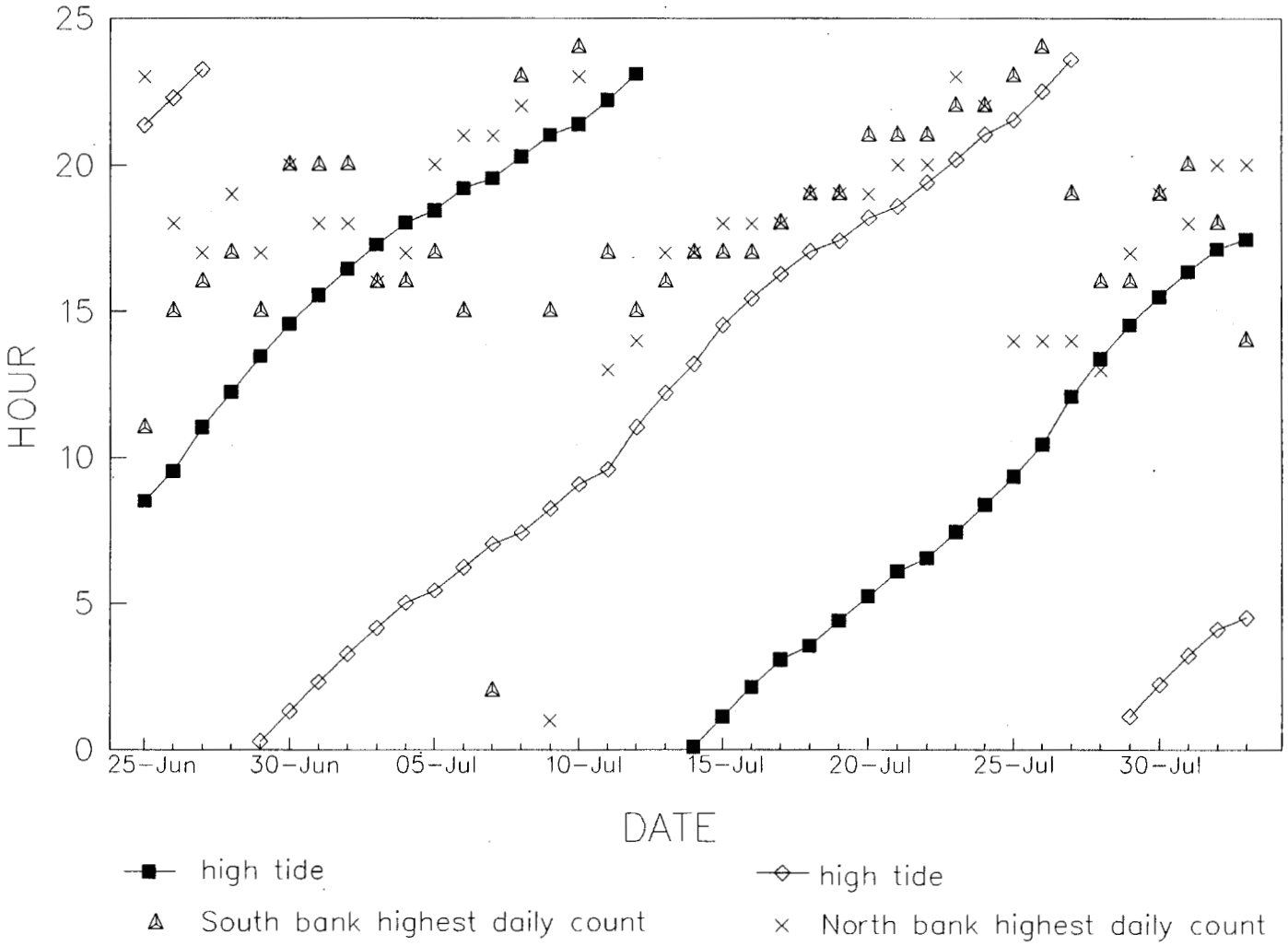

Figure 11. Peak hourly sonar counts in the Crescent River, and daily high tides in nearby Tuxedni Bay, 1993.

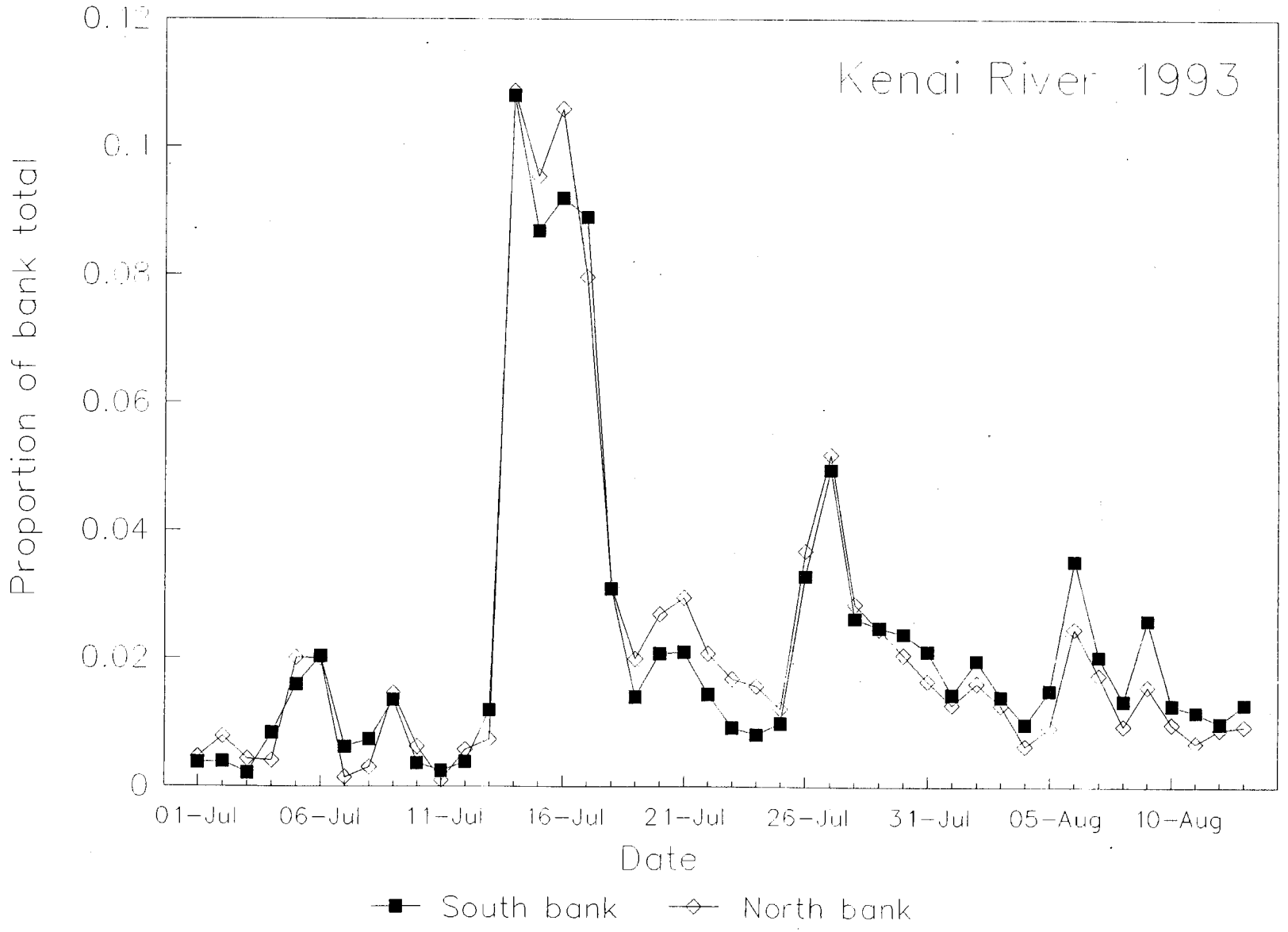

Figure 12. Proportion of total sonar counts by bank by day for the Kenai River, 1994.