ANIAK RIVER SONAR PROJECT
2000

By

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ABSTRACT

The Aniak River sonar project provided daily estimates of fish passage from 26 June through 31 July, 2000. User-configurable sonar continuously sampled the entire width of the river between the transducers, except for short periods when equipment was moved or serviced. An estimated 144,157 fish passed through the ensonified area during the period of operation. The peak daily passage of 8,329 fish occurred on 10 July, and the 50% passage date occurred on 13 July. The four and five-year age classes of Aniak River chum salmon comprised an estimated 73.8% and 23.9% of the escapement estimate, respectively.

INTRODUCTION

The Kuskokwim River commercial salmon fishery in June and July is directed toward the harvest of chum salmon *Oncorhynchus keta*. Commercial chum salmon harvests from 1990-1999 averaged 260,654 fish (Appendix A.1) and the exvessel value from in-river harvests averaged approximately $406 thousand (Burkey et al. 2000). The 2000 commercial harvest for chum salmon was 49,574 fish valued at $38 thousand. From 1990 to 1999, an average 75,556 chum salmon were harvested annually for subsistence purposes (Appendix A.2).

Management of the fishery resource requires timely estimates of run strength and escapement. Past sonar escapement estimates and aerial survey indices of abundance suggest that the Aniak River is one of the largest producers of chum salmon in the Kuskokwim drainage (Francisco et al. 1995). Prior tagging studies suggest that travel time of chum salmon migrating from the upper end of District 1 to the Aniak River sonar site is about seven or eight days (ADF&G 1961 and 1962). Because of its proximity to the Kuskokwim River commercial and subsistence fisheries, the Aniak River sonar project can provide management with timely estimates of fish passage.

Aniak River escapement data were collected using an echo counting and processing transceiver manufactured by Bendix Corporation[24] from 1980 to 1995. Data were collected with a single transceiver mounted on an 18.3 m artificial substrate located on the right bank and expanded to estimate total fish passage beyond the ensonified range (Schneiderhan 1989). Cumulative adjusted daily totals were subjectively estimated to be 150% of the actual count for the initial years of operation. Behavior of chum salmon observed during aerial spawning surveys on the Aniak River, and visual observations of fish migration patterns reported for the Anvik River (Buklis, 1981), lead to the supposition that on the order of two-thirds of the run passed through the ensonified portion of the river.

A second sonar counter was temporarily operated for a few days in 1984 to refine the expansion factor applied to the daily counts (Schneiderhan 1985). The second counter was deployed 1.5 km downstream from the existing counter and alternately operated on each bank. The proportions between daily counts at the historical site and each bank of the downstream site over a 16-day period resulted in a new expansion factor of 162%. This expansion factor was used from 1984 through 1995. In addition to the expansion of daily totals, sonar estimates were extrapolated for salmon escapement occurring before and after the operational period.

In the early 1980's, gillnet test fishing provided species apportionment and age, sex, and length (ASL) information of chum and chinook salmon (*O. tshawytscha*). From 1981 to 1985, attempts at beach seine test fishing and carcass sampling proved unsuccessful at obtaining adequate sample sizes for ASL data. In 1986, ASL sampling activities were discontinued to decrease operating costs. Supporting the decision to abandon chum salmon ASL data collection was

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previous age and sex composition data that indicated Aniak River chum salmon results were similar to commercial catch results from the lower Kuskokwim River districts (Schneiderhan 1988).

Salmon escapement objectives for the Aniak River were tentatively set at 250,000 chum and 25,000 chinook salmon in 1981, and formally established in 1982. The chum salmon objective was derived subjectively by relating historical sonar passage estimates to trends in harvest and aerial survey indices (Schneiderhan 1982b). In 1983, a review of the escapement objective based upon sonar estimates and other escapement indices suggested that the 1980-81 Aniak River sonar estimates likely represented record escapements, and much smaller escapements would probably provide adequate future spawning stocks and a sustainable harvest (Schneiderhan 1984).

Species apportionment activities were discontinued in 1986 because of inadequate sample sizes (Schneiderhan 1988). Early gillnet and beach seine test fishing investigations indicated that the abundance of fish species other than chum salmon was insufficient to compromise the utility of passage estimates for making chum salmon management decisions (Schneiderhan 1981, 1982a, 1982b, 1984, 1985). In the absence of species apportionment data, the sonar-based escapement objective was changed from species-specific objectives to 250,000 estimated fish counts (Schneiderhan 1985). After the implementation of the Salmon Escapement Goal Policy, the Aniak River escapement objective was termed a biological escapement goal (BEG) (Buklis 1993).

In 1996, the Aniak River sonar project was redesigned to provide full river ensonification, with user-configurable sonar equipment operating 24 hours per day on both banks throughout the chum salmon migration. Season sonar estimates were not extrapolated for salmon escapement that occurred before and after the operational period. A new sonar data collection site was established 1.5 km downstream from the historical site (Figure 1). Although fish passage estimates were not apportioned by species, periodic net sampling was employed to monitor broad changes in species composition, corroborate acoustically detected abundance trends, and obtain ASL samples of chum salmon.

Project operations in 2000 remained essentially unchanged since 1996. The BEG of 250,000 estimated fish counts was carried forward to the redesigned sonar project, but will be reassessed as more information is gathered. A timetable of developmental changes for the sonar project is presented in Appendix A.3.

The 2000 Aniak River sonar project objectives were to:

1) Collect fish abundance data with user-configurable sonar equipment 24 hours per day on both banks throughout the bulk of the chum salmon migration, from approximately 21 June through 31 July.
2) Provide daily fish passage estimates to fishery managers in Bethel.
3) Periodically drift a suite of gillnets to qualitatively monitor general trends in species composition, and to corroborate acoustically detected fish abundance trends.
4) Collect and archive ASL samples from chum salmon captured in beach seines.

METHODS

Site Description

The Aniak River sonar project site is located in Section 5 of T16N, R56W (Seward Meridian), approximately 19 km upstream from the mouth of the Aniak River (Figure 2). The Aniak River originates in the Aniak Lake basin about 145 km east and 32 km south of Bethel, Alaska. It flows north for nearly 129 km, where it joins the Kuskokwim River 1.6 km upstream from the community of Aniak.

The river at the sonar site is characterized by broad meanders, with large gravel bars on the inside bends and cut banks with exposed soil, tree roots and snags on the outside bends. Numerous transects were conducted in the immediate vicinity of the sonar site, using a Lowrance model X-16 chart recording fathometer, to determine the best location to deploy the sonar transducers. The river substrate at the sonar site is fine smooth gravel, sand and silt. The right bank river bottom slopes steeply to the thalweg at about 10-30 m, while the left bank slopes gradually to the thalweg at roughly 25-65 m, depending on water level.

Hydroacoustic Data Acquisition

Equipment

Sonar equipment for the right bank of the Aniak River included: 1) a Biosonics model 102 (SN 102-89-020) 120/420 kHz echosounder configured to transmit and receive at 420 kHz; 2) a 4 °x15 ° Biosonics single beam 420 kHz elliptical transducer (SN 16-420-4x15-006); 3) a 152.4 m (500 ft) Belden model 8412 cable (SN 703A); and 4) a Biosonics model 111 (SN 111-89-053) thermal chart recorder. A Hewlett Packard model 54501A (SN 2842A04372) digital storage oscilloscope (DSO) and a Nicolet 310 (SN 88DO4365) were used to examine signals from both the left and right bank systems.

We mounted the right bank transducer on an aluminum tripod and remotely aimed it with a Remote Oceans Systems (R.O.S.) model PT-25 (SN 1064) air filled, dual axis rotator. We controlled rotator movements with a R.O.S. model PTC-1 pan and tilt control unit connected to the rotator with 152.4 m of Belden model 9934 cable. A set of digital panel meters provided horizontal and vertical position readings, accurate to within ± 0.3 degrees.

Left bank sonar equipment included: 1) a Biosonics model 102 (SN 102-89-21) and model 101 (SN 101-034) 120/420 kHz echosounder configured to transmit and receive at 420 kHz; 2) a

3^{o}x10^{o} and a 4x15 (S/N 16-420-0415-007) Biosonics dual beam 420 kHz elliptical transducer; 3) three 304.8 m (1000 ft) Belden model 8412 cables (SN 601K, 602K, 702A); and 4) two Biosonics model 111 (SN 111-88-041, and 054) thermal chart recorders.

We mounted the left bank transducer on an aluminum tripod and remotely aimed it with a R.O.S. model PT-25 (SN 215) oil filled, dual axis rotator. We controlled left bank rotator movements with the same R.O.S. PTC-1 controller used for the right bank. All electronic equipment was housed in a 3.0 x 3.7 m (10 x 12 ft) portable wall tent on the right bank and powered by a single Honda model EM-3500 independently grounded generator. Left bank cables were attached to a 6.4 mm (1/4 in) steel cable suspended 3 m above the river. The cable bundle was marked with pink and blue flagging to allow safe boat passage.

Sampling Procedures

We conducted single beam acoustic sampling on both banks continuously 24 h per day, 7 days per week, except for short periods of time in which the generator was serviced and transducer adjustments were made. Inseason analysis consisted of visually scanning the echograms for fish traces and anomalous detections to verify consistent aim. A single fisheries technician operated and monitored equipment at the sonar site. Crewmembers identified and tallied fish traces on chart recordings while rotating through shifts of 0000-0800, 0800-1600, and 1600-2400 h. For consistency, crewmembers were trained to distinguish between fish traces and non-fish traces, such as those from debris and bottom. The number of fish traces was summed within range intervals and 15-minute periods and recorded onto forms. Range intervals were 2-5 m wide on the right bank and 5-10 m wide on the left bank. Completed data forms were transported to the main camp throughout the day and entered into Excel97 electronic spreadsheets by the project leader. Daily estimates were transmitted via single side band radio to area managers at 0730 h the following morning. Chart recorder output constituted the only record of detected echoes and fish passage. Chart recordings were annotated for date, time, and bank, and subsequently catalogued for storage.

We recorded all project activities in a project logbook. The logbook was used to document daily events of sonar activities and system diagnostics. During each shift, crew members were required to: 1) read the log from the previous shift; 2) sign the log book, including date and time; 3) record equipment problems, factors contributing to problems, and resolution of problems; 4) record equipment setting adjustments and their purpose; 5) record observations concerning weather, wildlife, boat traffic, etc.; and 6) record visitors to the site, including their arrival and departure times.

Equipment Settings and Thresholds

Sound pulses were generated by the echosounders at a center frequency of 420 kHz. We applied a 40 log(R) time-varied gain (TVG) function and a 5 kHz frequency bandwidth filter for all data on both banks. We set the right bank transmit pulse width at 0.2 ms and the left bank transmit pulse width at 0.4 ms. Maximum sampling range was 20 m on the right bank and 75 m on the

left bank. Minimum sampling range was 20 m on the right bank and 50 m on the left bank. Three printer thresholds, corresponding to intensities of gray-line were factory set at 6 dB intervals. Right bank chart recorder thresholds were set at -39.1, -33.1, and -27.1 dB during all sampling activities. The first left bank threshold was initially set at -42.7 dB, then changed to -40 dB on 5 July for the remainder of the season, with corresponding second and third thresholds at -34 and -28 dB.

Thresholds were calculated as follows:

$$TS_{dB} = V_o - SL - G_X - G_R - 2B\theta \quad (1)$$

Where:

TS_{dB} = target strength in dB
V_o = Volts out in dB
SL = transmitted source level in dB
G_X = through-system gain in dB
G_R = receiver gain in dB
$2B\theta$ = 2-way beam pattern factor in dB

Attenuation ($\propto$) was assumed to be negligible at the ensonification ranges sampled.

Transducer Deployment

The transducers were positioned in the river perpendicular to current flow. The wide axis of each elliptical beam was oriented horizontally and positioned close to the river bottom to maximize target residence time in the beam. Transducers were placed offshore 4 to 10 m from the right bank, and 10 to 20 m from the left bank. Daily visual inspections confirmed proper placement and orientation of the transducers.

Weirs extended from shore 3 to 10 m beyond the transducers to prevent chum salmon from passing undetected behind the transducers and to minimize detections in the near field (MacLennan and Simmonds 1992). The gap between weir pickets, 4.4 cm (1 ¾ in), was selected to divert chum salmon but allow passage of small, resident, non-target species.

Hydroacoustic Equipment Checks

Both sonar systems were bench calibrated in May 2000 (Appendix B1.). We estimated noise levels in situ at three range intervals for the right bank sonar system and at five intervals for the left bank sonar system by measuring the average peak voltage on the DSO. For our purposes, we defined noise as any unwanted signal including boundary and volume reverberation, electronic noise and ambient background noise. Structure reverberation peaks separated the range intervals.

Bottom Profiles and Stream Measurements

We recorded numerous bottom profiles outward from both banks using the chart recording fathometer prior to choosing exact deployment sites. On 21 June, we made paired depth and range measurements in 3 to 5 m intervals from each transducer to the opposite shore on both banks using the fathometer and a Laser Atlanta model Advantage (SN 10365) optical laser range finder.

Climatological and Hydrologic Measurements

In 2000, we measured ambient air temperature, and water conductivity and temperature once per day using an Extech model 34165 Conductivity/Temperature meter. Standard secchi disk readings were taken daily. Water level was recorded daily on the right bank at the site using a staff gauge.

In 1998, we established a benchmark to reference daily water level measurements and to be able to make valid comparisons between years. The benchmark at the southeast corner of the sonar tent platform is indicated by a black rectangular mark. We used the laser range finder to measure distance and angle from the benchmark to the staff gauge.

Analytical Methods

Abundance Estimation

Actual sonar counts in a spreadsheet are computed by time/space and summed for each bank. Counts are assumed to represent all fish passing the sonar site.

Missing Data

Generator maintenance, sonar equipment adjustments and malfunctions occasionally resulted in missing sonar data. When less than 10 minutes of a 15 minute interval were missed, the passage rate for the period within that interval was used to estimate passage for the unsampled portion of the interval. Data missing from more than 10 minutes were estimated from the average relative distribution (proportions) of passage rates 45 minutes before and after the missing block of data on that bank. When more than one hour of data were missed on both banks, the average proportions of passage rates were pooled from six hours before and after the missing block of data on that bank respectively. A right bank/left bank average proportion of passage rates were used to estimate fish passage when one of the sonar systems remained operational while the other was down for more than one hour. The number of fish traces tallied for both banks was summed with estimates for missing data to provide daily total fish passage estimates.

Species Composition Verification

Equipment and Procedures

We fished two gillnets periodically at times determined inseason to qualitatively monitor general trends in species composition and corroborate the presence or absence of fish as a reference to observed trends in the number of fish. We used a 13.6 cm (5-3/8") mesh multifilament net measuring 18.3 m (10 fathoms) long by 3.1 m (10 feet) deep and a 7.0 cm (2-3/4") mesh multifilament net measuring 18.3 m (10 fathoms) long by 1.5 m (five feet) deep. Each net was drifted at least once on each bank during the sampling period (Figure 3). Most drifts were approximately 2-3 minutes in duration. The procedure for gillnet fishing was to deploy the net off the bow of a skiff moving from midstream toward shore, then drift downstream with the net perpendicular to shore. The net was pulled into the boat at the end of the drift, and the fish were removed, identified, and unharmed fish were released back into the river.

ASL Sampling

Equipment and Procedures

The gravel bar in front of the sonar camp was used as the sampling site for the third consecutive year. We used a 3 x 46 m (10 x 150 ft) green 7.0 cm mesh beach seine to obtain ASL samples of chum salmon. After attaching a 30 m line to one end of the seine, we stacked the seine in a plastic fish tote and placed it in the stern of a skiff. We attached the opposite end of the seine to a pulley designed to pivot from the side of the skiff to the stern. As the skiff moved offshore, orientated upstream, the end of the 30 m lead was held in place by a crewmember on shore. We moved the skiff straight offshore until all of the lead line was deployed and the seine started to peel out of the tote. We then drove the skiff upstream and inshore, deploying the entire length of the seine. When the skiff reached the shore, the seine was released from the pulley and allowed to drift downstream while we guided it next to the shore. The lead was pulled in just enough to form a hook shape to the offshore end of the seine (Figure 4). We drifted the entire seine in this formation for approximately 100 m before we pulled in the lead line and closed the set.

All captured fish except chum salmon were tallied by species, fin clipped, recorded and released. Chum salmon were placed in a live box for sampling. One scale was taken from the preferred area of each chum salmon for use in age determination (INPFC 1963). Scales were wiped clean and mounted on gum cards. Sex was determined by visually examining external morphological characteristics, keying on the development of the kype, roundness of the belly and the presence

or absence of an ovipositor. Length was measured to the nearest millimeter from mid-eye to the fork of the tail. All data were recorded in a "rite-in-the-rain" notebook and later transcribed to standard mark-sense forms.

We followed a pulse sampling design whereby intensive sampling was conducted for one or two days followed by several days without sampling. The sampling goal was to obtain data from a sufficient number of fish within a given period of time to precisely estimate the true age composition of the escapement during that time (Molyneaux and DuBois 1996). The goal of each sampling pulse was 200 chum salmon scales (Bromaghin 1993). All ASL data were sent to the Bethel ADF&G office for analysis by research staff. Ages were reported using European notation, in which two digits, separated by a decimal, refer to the number of freshwater and marine annuli. The total age from the time of egg deposition is the sum of the two digits plus one.

To estimate the age and sex composition of the chum salmon escapement in the Aniak River, daily passage estimates were temporarily stratified. Each stratum consisted of several days of fish passage and one pulse sample. Within each stratum, estimates of the age and sex composition were applied to the sum of the chum salmon passage to generate an estimate of the number of fish in each age-sex category. The numbers of fish were summed by age-sex category over all strata to estimate the total season passage by age and sex.

RESULTS

Hydroacoustic Data Acquisition

Sampling Procedures

Sonar project activities commenced on 16 June and ended on 3 August 2000. Hydroacoustic sampling began at 0001 on 26 June on both banks with the first full 24-hour period occurring on the same date. The water level was not significantly high to hinder camp set up and hydroacoustic deployment. (Appendix A.4). With few exceptions, the equipment ran continuously until sampling ended at midnight on 31 July. Passage estimates were available to fishery managers in Bethel at 0730 hours and 1700 hours daily. In addition to regular maintenance, a total of 27 hours (3%) on the left bank and 14 hours on the right bank of sampling time were missed because of paper jams, system diagnostic tests, moving the tripod, or aiming the transducer to compensate for changing water levels throughout the season.

Signal to noise ratios (SNR's) occurred on the right and left bank over narrow range intervals where the beam grazed high points in the river bottom with SNR's around 3 dB. Data collection at these points however, was not unduly corrupted since only a small range was affected.

Bottom Profiles and Stream Measurements

The river width on 21 June at the sonar site was 97m and the maximum depth was 4.0 m (Figure 5). The thalweg was located 29 m from the right bank and 68 m from the left bank. Cross talk between transducers was observed on the chart recordings, but did not interfere with data acquisition. When transducers were repositioned to compensate for changing water levels, the ensonified range was adjusted accordingly.

Fish Passage Estimates

Total passage during project sampling activities was estimated at 144,157 fish, with 63% passing on the right bank and 37% passing on the left bank (Table 1). A comparison of daily estimated passage between banks is presented in Figure 6 with a linear regression fit line. The significant ($p<0.001$) relationship indicates that left and right bank passages are correlated to one another. The peak daily passage of 8,329 fish occurred on 10 July (Figure 7). The 25%, 50%, and 75% quartile dates of passage were 8 July, 13 July, and 22 July (Table 1).

We examined the hourly fish count data for evidence of daily patterns of movement during 7-day periods of data collection. All time periods displayed fish passage increasing at night and declining during the day (Figure 8). When compared, this tendency is similar to 1999, 1997 and 1996 and not as pronounced in 1998 (Vania and Huttunen 1997, Vania 1998, Vania 1999).

Seasonal range distributions of targets that passed the site peaked at 6-10 m from the right bank transducer (Figure 9) and at 11-20 m from the left bank transducer (Figure 10). The outer 5-meter sampling range on the right bank accounted for 1% of the right bank passage estimates (Table 2). The outer 10-meter sampling range on the left bank accounted for 2% of the left bank passage estimates (Table 3). As the season progressed, the fish passage distribution on the left bank demonstrated an increasingly inshore movement.

Species Composition Verification

We conducted gillnet drifts lasting two to three minutes during three sampling periods to verify dominant species presence (Table 4). Sonar fish passage rates during these sampling periods ranged from 52 to 145 fish per hour. We made a total of 22 drifts, 8 with 13.6 cm mesh gillnet, 8 with 10.2 cm mesh gillnet and 6 with 7.0 cm mesh gillnet. The total catch consisted of 31 chum

salmon, 3 chinook salmon, 4 sockeye salmon, 3 coho salmon, 1 pink salmon (*O. gorbuscha*), 4 longnose suckers (*Catostomus catostomus*), and 2 humpback whitefish (*Coregonus clupeaformis*).

ASL Sampling

We made a total of 130 beach seine sets and obtained 882 ASL samples from migrating chum salmon (Table 5). The 0.3 and 0.4 age classes for chum salmon comprised an estimated 73.8% and 23.9% of the Aniak River escapement estimate in 2000, respectively (Table 6). The percentages of 0.3 and 0.4 age class chum salmon were similar to the 1998 season but differed from the 1999, 1997 and 1996 seasons that demonstrated higher percentages of 0.4 fish (Appendix A.5).

DISCUSSION

Hydroacoustic Data Acquisition

Sampling Procedures

For the 2000 season, we employed the 420 kHz transducer used since 1999 instead of the 120kHz model. One continued benefit was that the 420 kHz transducers are much smaller in size, allowing us greater flexibility with changing water levels. This meant less sampling time lost from moving weirs and tripods, and re-aiming. In addition, the smaller transducers can be placed in shallower water and because of a shorter near field, they can accommodate a relatively short weir length, beneficial in the fast Aniak River waters.

The Aniak River sonar site is approximately 97 meters from left bank to right bank where the hydroacoustic data acquisition occurs. Higher frequencies such as the 420kHz derogate transmission loss when ensonifying short ranges such as those utilized at the site. Although higher frequency transducers are characterized as having higher attenuation, the short ranges take care of that potential problem.

Fish Passage Estimates

A comparison of daily left bank percent passage rates for 1996-2000 displays the daily and seasonal changes in fish migration patterns at the sonar site (Figure 11). A comparison between water level and percent passage by bank may explain some of this variation. Water level

measurements were relative only to the year in which they were taken for 1996 and 1997 and thus cannot be directly compared. For years 1998-2000 however, water levels were set to a permanent benchmark. An analysis of each season indicates an inverse relationship between left bank percent passage and water level (Figures 12-16). A large gravel bar below the right bank transducer becomes exposed at lower water levels and appears to divert a higher percentage of fish through the left bank ensonified range. Four of the past five seasons have experienced left bank passage percentages between 36.5% and 41%. The only exception was a passage for left bank of 53% in 1997. This can be attributed to a dry summer in the Kuskokwim Area, with water levels notably low on the Aniak.

Species Composition Verification

Although the Aniak River supports anadromous and resident fish populations of several different species, the sonar estimates are not apportioned to species. Gillnet and beach seine test fishing investigations in the early 1980's indicated that the abundance of fish other than chum salmon was insufficient to compromise the utility of passage estimates for making chum salmon management decisions. However, recent beach seine sampling conducted near the sonar site to obtain ASL samples of chum salmon included significant numbers of several non-target resident and anadromous species that were detectable by the sonar. The degree to which these non-target species compromise the effectiveness of the sonar project is unknown.

A 1995 Aniak River sonar test fish feasibility study indicated that a species apportionment program is logistically feasible at the current site (Knuepfer 1995). The primary impediment to implementing such a program has been a lack of sufficient budgetary resources. In response to extremely poor returns of chum and coho salmon in 1997 and 1998, the Federal government made funds available for Kuskokwim River salmon fisheries research and management. This funding source will support the development of a species apportionment study to complement the Aniak River sonar project. Development requires a multi-year commitment and funding has been provided for three field seasons starting in 2001. Estimates of passage by species are not expected to be available until after the final year of data collection. The apportioned Aniak River sonar escapement would provide fishery managers information on the proportionate contribution of Aniak River chum salmon stocks to the total Kuskokwim River chum salmon escapement.

A secondary consideration to implementing a species apportionment program has been the potential for unacceptable levels of collateral fish mortality due to additional netting and fish handling. In 1998, we retained fish captured from two drift gillnet operations in a live box to observe the effects of netting and handling. Extraordinary care was given in handling the first catch, which we retained for six hours. All of the salmon (18 chum, 2 sockeye, and 1 coho) appeared healthy and energetically swam away when released. The remaining fish, two whitefish and one inconnu died. These fish appeared healthy when placed in the live box and may have sustained fatal injury while in the live box.

The second catch was handled in a manner more consistent with a typical test fishing operation with less care given to the fish while the speed of the operation increased. We retained this catch for five hours, which consisted of twenty-four (24) chum salmon, 2 chinook salmon, 2 pink salmon, and 1 long nose sucker. All of the fish except two chum salmon survived and swam away when release.

Apparently, some mortality can be expected, but with short drift periods and careful handling, we may be able to keep the fish mortality to a minimum. Below the left bank sonar site, a large amount of embedded logs will undoubtedly pose a serious risk to drift gillnetting. Much time and effort will be required to remove the debris before fishing to ensure a successful operation at this location. This removal will require dragging the river bottom with lead lines, torn up gillnets and ropes. A five-ton come-along may be needed to pull embedded debris from the river bottom to limit snags in the drift zones. Efforts should be made to start early next field season to ensure ample time for debris removal. The success of the proposed species apportionment program relies heavily on a drift zone free of debris. With such a strategy, fish survival will likely be minimal.

ASL Sampling

The techniques used to obtain ASL samples were designed to maximize the capture of chum salmon with the equipment available. The beach seine sampling areas are located 1.5 km and 2.5 km upstream of the sonar site. Although these data provide valuable biological ASL information on the chum salmon escapement, they are insufficient to provide quantitative species apportionment information.

Historical Data

In 1996, the Aniak River sonar project was redesigned and operations were significantly altered from past operations dating to 1980. Estimates before 1996 are difficult to substantiate because of a lack of project documentation and the inability of the Bendix equipment to verify aim. Comparisons between escapement estimates generated from these two very different types of project operations could lead to misinterpretation and should not be made. The established BEG of 250,000 fish for the Aniak River sonar project should be considered as interim under the redesigned sonar project. The goal will need to be reassessed as more information is gathered.

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TABLES

Table 1. Daily and cumulative estimates of fish passage at the Aniak River sonar site, 2000.

Date	Left Bank	Right Bank	Daily Total	Cumulative Total	LB % Passage	RB % Passage	(%)Percent Passage	Water Level[a]
26-Jun	139	1,517	1,656	1,656	0.08	0.92	1	381
27-Jun	106	1,535	1,641	3,297	0.06	0.94	2	386
28-Jun	29	985	1,014	4,311	0.03	0.97	3	382
29-Jun	108	572	680	4,991	0.16	0.84	3	382
30-Jun	172	308	480	5,471	0.36	0.64	4	377
1-Jul	612	849	1,461	6,932	0.42	0.58	5	380
2-Jul	599	1,227	1,826	8,758	0.33	0.67	6	385
3-Jul	941	3,794	4,735	13,493	0.20	0.80	9	393
4-Jul	873	4,389	5,262	18,754	0.17	0.83	13	397
5-Jul	1,242	3,238	4,480	23,234	0.28	0.72	16	400
6-Jul	1,429	3,525	4,954	28,187	0.29	0.71	20	408
7-Jul	1,462	2,824	4,286	32,474	0.34	0.66	23	416
8-Jul	1,438	3,019	4,457	36,930	0.32	0.68	26	419
9-Jul	2,458	4,483	6,941	43,871	0.35	0.65	30	422
10-Jul	2,411	5,919	8,329	52,200	0.29	0.71	36	427
11-Jul	2,106	3,457	5,563	57,763	0.38	0.62	40	429
12-Jul	3,483	4,203	7,686	65,449	0.45	0.55	45	435
13-Jul	2,495	5,586	8,082	73,531	0.31	0.69	51	442
14-Jul	1,333	2,516	3,849	77,379	0.35	0.65	54	440
15-Jul	1,227	2,043	3,270	80,649	0.38	0.62	56	432
16-Jul	1,391	1,978	3,369	84,018	0.41	0.59	58	432
17-Jul	1,533	2,214	3,747	87,765	0.41	0.59	61	429
18-Jul	1,749	2,264	4,013	91,778	0.44	0.56	64	432
19-Jul	2,265	2,978	5,242	97,021	0.43	0.57	67	440
20-Jul	2,126	3,093	5,219	102,240	0.41	0.59	71	446
21-Jul	1,746	2,299	4,045	106,285	0.43	0.57	74	452
22-Jul	2,291	2,751	5,041	111,326	0.45	0.55	77	457
23-Jul	2,501	3,630	6,131	117,457	0.41	0.59	81	465
24-Jul	2,183	3,193	5,376	122,833	0.41	0.59	85	468
25-Jul	1,873	2,360	4,233	127,066	0.44	0.56	88	471
26-Jul	1,438	1,585	3,022	130,088	0.48	0.52	90	475
27-Jul	2,100	2,278	4,378	134,466	0.48	0.52	93	478
28-Jul	1,791	1,718	3,509	137,975	0.51	0.49	96	482
29-Jul	921	982	1,903	139,878	0.48	0.52	97	484
30-Jul	989	1,031	2,020	141,897	0.49	0.51	98	485
31-Jul	1,183	1,077	2,260	144,157	0.52	0.48	100	483
TOTAL	**52,740**	**91,417**	**144,157**	**144,157**	37	63		

[a] Measured centimeters below benchmark.

Table 2. Estimated right bank daily fish passage per range strata, Aniak River sonar, 2000.

	Right Bank Strata			
	1	2	3	4
	Distance From Right Bank Transducer (m)			
	0-5	6-10	11-15	16-20
26-Jun	490	778	201	48
27-Jun	290	953	242	50
28-Jun	169	653	139	27
29-Jun	77	386	91	18
30-Jun	65	452	95	15
1-Jul	64	604	156	25
2-Jul	72	840	250	65
Week Total	1,227	4,666	1,174	248
Passage	16.8%	63.8%	16.0%	3.4%
3-Jul	960	2,118	539	137
4-Jul	1,835	1,908	572	45
5-Jul	1,194	1,462	554	28
6-Jul	1,869	1,203	397	46
7-Jul	817	1,577	401	28
8-Jul	177	2,299	497	46
9-Jul	145	3,401	857	71
Week Total	6,997	13,968	3,817	401
Passage	27.8%	55.5%	15.2%	1.6%
10-Jul	65	4,329	1,398	121
11-Jul	87	2,585	732	51
12-Jul	413	2,904	837	40
13-Jul	457	4,285	711	15
14-Jul	277	1,908	318	13
15-Jul	177	1,653	203	2
16-Jul	234	1,527	214	3
Week Total	1,710	19,191	4,413	245
Passage	6.7%	75.1%	17.3%	1.0%
17-Jul	195	1,736	275	6
18-Jul	190	1,587	466	20
19-Jul	294	2,242	422	6
20-Jul	427	2,204	441	7
21-Jul	335	1,598	3,441	1
22-Jul	252	1,849	635	3
23-Jul	922	2,093	604	11
Week Total	2,615	13,309	6,284	54
Passage	11.7%	59.8%	28.2%	0.2%
24-Jul	1,052	1,529	611	1
25-Jul	682	1,137	521	1
26-Jul	405	839	336	1
27-Jul	1,059	992	167	31
28-Jul	684	976	46	0
29-Jul	385	555	34	0
30-Jul	482	523	20	0
Week Total	4,749	6,551	1,735	34
Passage	36.3%	50.1%	13.3%	0.3%
31-Jul	436	618	22	0
Week Total	436	618	22	0
Passage	40.5%	57.4%	2.0%	0.0%
Season Total	**17,734**	**58,303**	**17,445**	**982**
Passage	**18.8%**	**61.7%**	**18.5%**	**1.0%**

Table3. Estimated daily left bank passage per range strata, Aniak river sonar, 2000.

	Left Bank Strata				
	1	2	3	4	5
	Distance From Left Bank Transducer				
	0-10	11-20	21-30	31-40	41-50
26-Jun	4	23	74	30	8
27-Jun	2	23	43	25	13
28-Jun	1	12	12	2	2
29-Jun	47	47	9	3	2
30-Jun	238	94	6	6	0
1-Jul	364	134	8	4	4
2-Jul	499	85	8	5	2
Week Total	1,155	418	160	75	31
Passage	62.8	22.7	8.7	4.1	1.7
3-Jul	694	109	102	28	8
4-Jul	379	227	125	76	29
5-Jul	601	367	95	129	44
6-Jul	114	904	167	123	80
7-Jul	138	990	190	90	42
8-Jul	202	933	158	105	33
9-Jul	376	1,352	293	272	163
Week Total	2,504	4,882	1,130	823	399
Passage	25.7	50.1	11.6	8.5	4.1
10-Jul	296	1,460	299	224	125
11-Jul	78	1,485	312	149	70
12-Jul	83	2,381	614	266	118
13-Jul	573	1,516	265	117	13
14-Jul	887	233	110	90	15
15-Jul	885	209	65	50	17
16-Jul	988	233	100	49	24
Week Total	3,790	7,517	1,765	945	382
Passage	271.9	539.2	126.6	67.8	27.4
17-Jul	912	356	132	119	12
18-Jul	970	548	134	76	5
19-Jul	1,459	589	119	81	12
20-Jul	1,280	642	114	82	8
21-Jul	804	693	119	105	25
22-Jul	744	1,186	218	100	32
23-Jul	1,168	1,039	168	51	64
Week Total	7,337	5,053	1,004	614	158
Passage	51.8	35.7	7.1	4.3	1.1
24-Jul	1,432	536	109	71	35
25-Jul	1,195	352	78	235	1
26-Jul	870	294	69	197	7
27-Jul	1,277	486	114	215	0
28-Jul	1,234	261	78	209	0
29-Jul	641	175	50	55	0
30-Jul	752	145	37	53	0
Week Total	7,401	2,249	535	1,035	43
Passage	65.7	20.0	4.8	9.2	0.4
31-Jul	752	308	64	59	0
Week Total	752	308	64	59	0
Passage	63.6	26.0	5.4	5.0	0.0
Season Total	22,939	20,427	4,658	3,551	1,013
Passage %	43	39	9	7	2

Table 4. Aniak River sonar catch results using drift gillnets,2000.

Date	Time of Day	# Of Drifts	Mesh (cm)	Chum	Chinook	Sockeye	Coho	Pink	DV	Sucker	Whitefish
7/2/00	2130	3	13.6	2	0	0	0	0	0	0	0
	2225	3	10.2	0	0	0	0	0	0	0	0
	2320	3	7	1	1	0	0	0	0	0	0
Fish passage = 97/hr											
7/8/00	1545	3	7	0	1	0	0	0	0	0	0
	1700	3	10.2	3	0	0	0	1	0	4	2
	1800	3	13.6	8	1	4	0	0	0	0	0
Fish passage = 145hr											
7/29/00	1600	2	13.6	1	0	0	3	0	0	0	0
	1630	2	10.2	16	0	0	0	0	1	0	0
Fish passage = 52/hr											
Total		**22**		**31**	**3**	**4**	**3**	**1**	**1**	**4**	**2**

Table 5. Aniak river sonar catch results using beach seine gear, 2000.

Date	Time of Day	# Of Sets	Chum	King	Pink	SK[a]	Coho	WF[a]	Sucker	Pike	DV[a]	RB[a]	GL[a]	IN[a]	Total Catch	Chum %
26-Jun	22:54 0:15	4	1	1	0	0	0	6	19	0	0	0	1	0	**28**	**4**
28-Jun	22:50 0:21	4	6	0	0	0	0	5	7	0	0	0	2	0	**20**	**30**
29-Jun	23:27 23:52	2	0	0	0	0	0	2	2	0	0	0	0	0	**4**	**0**
30-Jun	22:52 23:35	3	3	0	0	0	0	1	4	0	0	0	0	0	**8**	**38**
2-Jul	0:15 2:15	6	4	2	0	0	0	2	5	2	0	0	0	0	**15**	**27**
3-Jul	22:00 1:00	8	25	5	0	0	0	8	54	2	0	0	1	0	**95**	**26**
4-Jul	22:35 1:25	8	19	1	1	0	0	19	88	3	2	0	0	0	**133**	**14**
5-Jul	22:40 1:10	8	15	1	0	1	0	17	37	0	1	0	2	0	**74**	**20**
6-Jul	22:50 1:30	8	39	0	0	0	0	15	46	2	0	0	1	3	**106**	**37**
9-Jul	22:31 1:30	8	31	1	3	0	0	34	20	1	1	0	0	1	**92**	**34**
10-Jul	22:00 1:00	8	55	0	3	0	0	31	27	2	6	0	1	1	**126**	**44**
11-Jul	23:05 2:10	8	26	0	4	0	0	56	41	1	4	1	0	0	**133**	**20**
12-Jul	22:30 1:30	8	20	0	2	0	0	37	48	2	3	0	0	2	**114**	**18**
16-Jul	22:00 4:00	8	108	2	14	2	0	26	19	0	11	0	1	2	**185**	**58**
17-Jul	21:30 1:00	5	102	3	8	1	0	11	13	1	7	0	0	0	**146**	**70**
21-Jul	20:00 23:59	8	88	1	10	0	1	2	20	1	9	0	0	0	**132**	**67**
22-Jul	21:00 23:59	7	120	3	24	3	1	40	21	2	6	0	0	0	**220**	**55**
25-Jul	21:00 1:00	8	40	1	14	0	1	53	28	0	11	0	0	0	**148**	**27**
26-Jul	21:00 1:00	8	127	1	15	2	3	64	13	0	5	0	0	0	**230**	**55**
27-Jul	21:00 23:00	3	53	1	3	1	4	2	2	0	3	0	0	0	**69**	**77**
	Total	**130**	**882**	**23**	**101**	**10**	**10**	**431**	**514**	**19**	**69**	**1**	**9**	**9**	**2078**	**42**
	%		**42**	**1**	**5**	**0**	**0**	**21**	**25**	**1**	**3**	**0**	**0**	**0**	**100**	

[a]WF = Whitefish DV = Dolly Varden RB = Rainbow Trout GL = Grayling IN = Inconnu SK = Sockeye

Table 6. Age and sex of beach seine caught chum salmon from Aniak River escapement samples, collected near the sonar site and applied to passage estimates by time stratum in 2000.

Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 0.2 Esc.	0.2 %	0.3 Esc.	0.3 %	0.4 Esc.	0.4 %	0.5 Esc.	0.5 %	Total Esc.	Total %
6/29-7/6	102	Male	318	1.0	8,596	26.5	8,596	26.5	318	1.0	17,828	54.9
(6/26-7/7)		Female	0	0.0	9,870	30.4	4,776	14.7	0	0.0	14,645	45.1
		Subtotal	318	1.0	18,466	56.9	13,372	41.2	318	1.0	32,473	100.0
7/9-7/12	109	Male	0	0.0	13,184	32.1	5,650	13.8	377	0.9	19,210	46.8
(7/8- 7/13)		Female	0	0.0	16,950	41.3	4,897	11.9	0	0.0	21,847	53.2
		Subtotal	0	0.0	30,134	73.4	10,547	25.7	377	0.9	41,057	100.0
7/16 - 7/17	149	Male	0	0.0	7,409	31.6	2,207	9.4	0	0.0	9,617	41.0
(7/14 - 7/19)		Female	315	1.3	11,824	50.3	1,734	7.4	0	0.0	13,873	59.0
		Subtotal	315	1.3	19,233	81.9	3941	16.8	0	0.0	23,490	100.0
7/21-7/22	182	Male	449	2.2	6,962	34.1	1,572	7.7	0	0.0	8,983	47.1
(7/20 - 7/23)		Female	112	0.5	10,443	51.1	898	4.4	0	0.0	11,454	52.9
		Subtotal	561	2.7	17,405	85.2	2,470	12.1	0	0.0	20,437	100.0
7/25 - 7/27	189	Male	424	1.6	7,487	28.1	1,413	5.3	0	0.0	9,324	34.9
(7/24 – 7/31)		Female	989	3.7	13,703	51.3	2,684	10.0	0	0.0	17,376	65.1
		Subtotal	1,413	5.3	21,190	79.4	4,097	15.3	0	0.0	26,700	100.0
Season	731	Male	1,191	0.8	43,638	30.3	19,438	13.5	695	0.5	64962	45.1
		Female	1,417	1.0	62,790	43.5	14,989	10.4	0	0.0	79,195	54.9
		Total	2,608	1.8	106,428	73.8	34,427	23.9	695	0.5	144,157	100.0

FIGURES

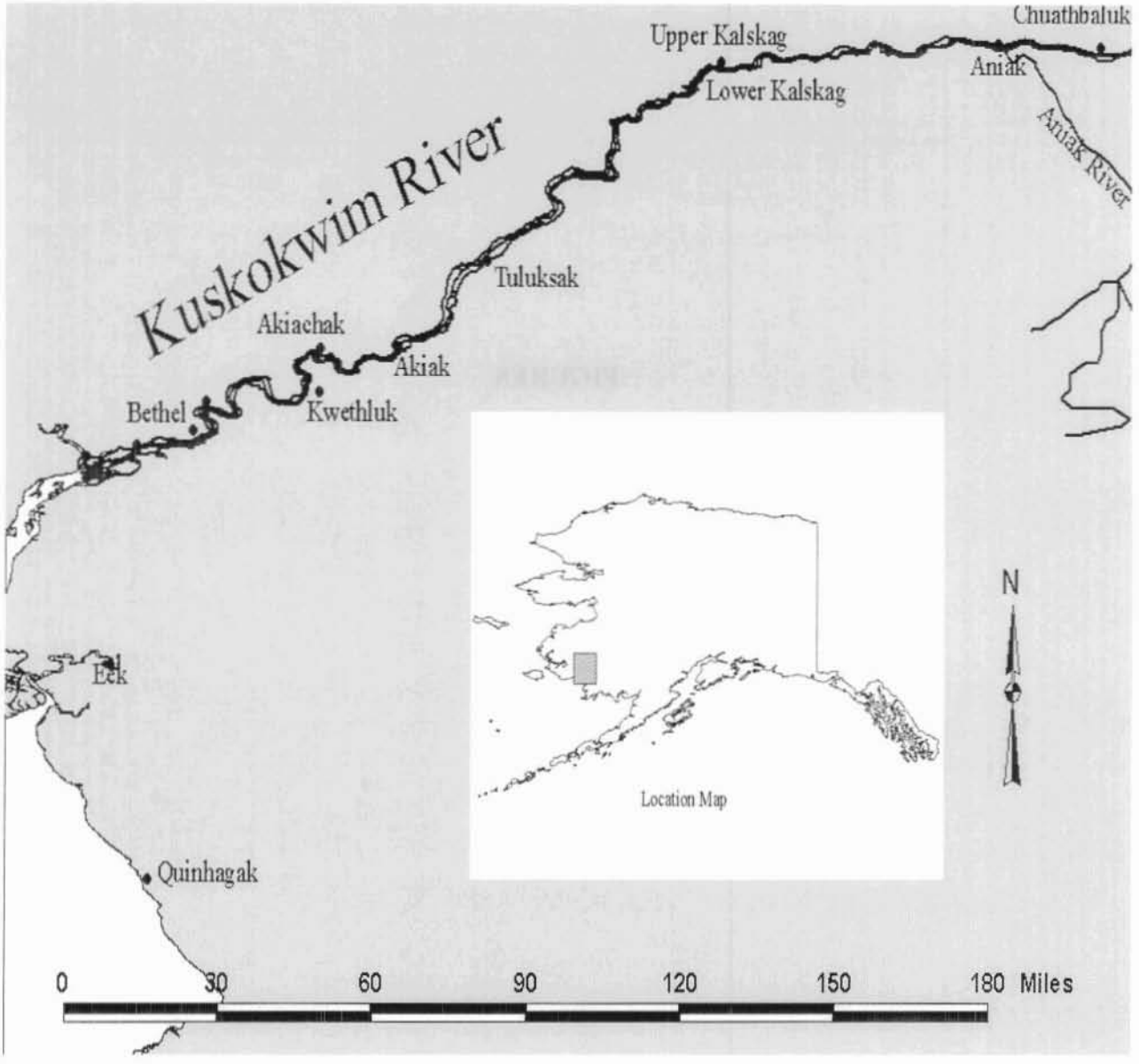


Figure 1. Map of the Kuskokwim Area.

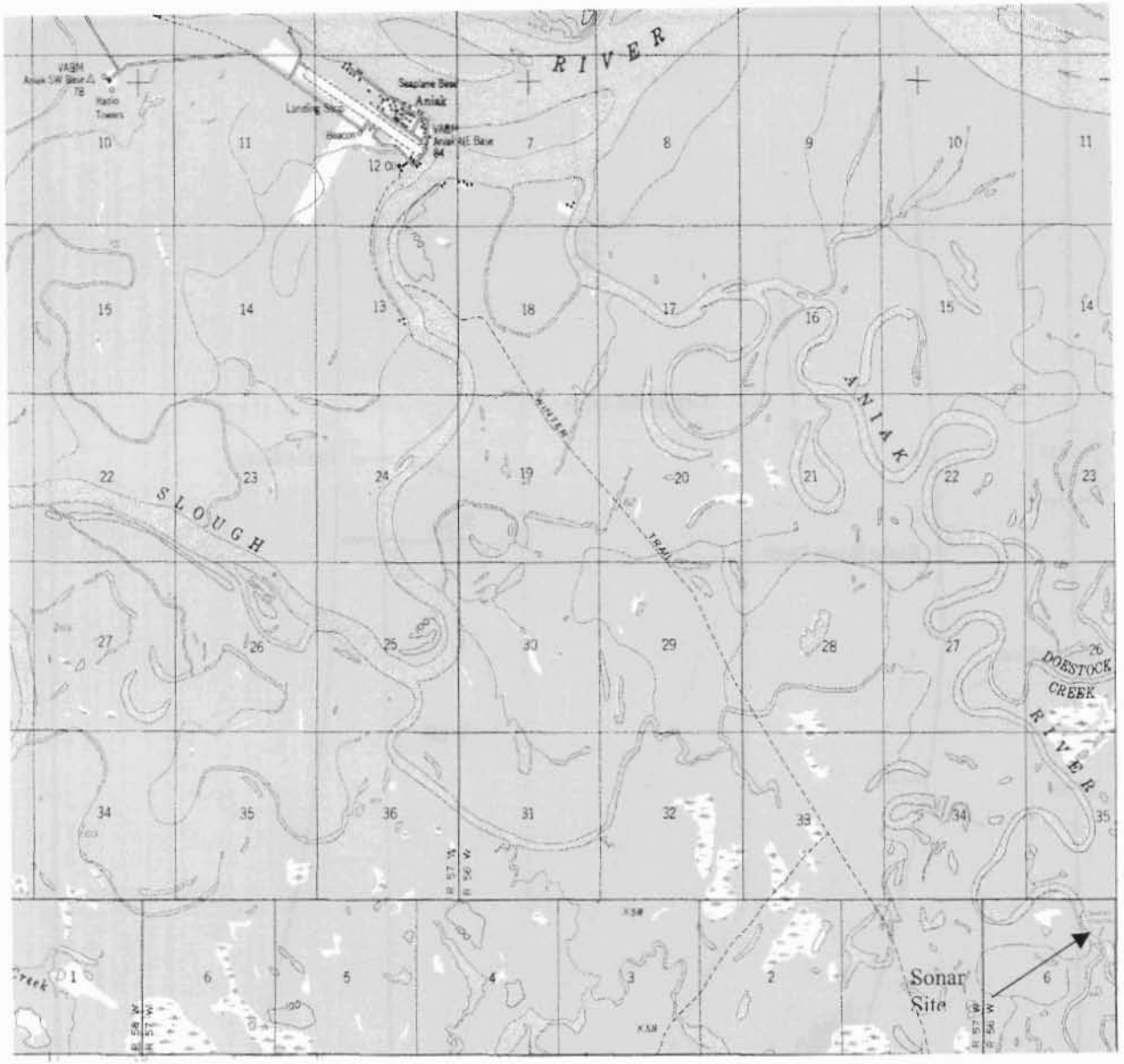


Figure 2. Aniak River sonar site map, 2000.

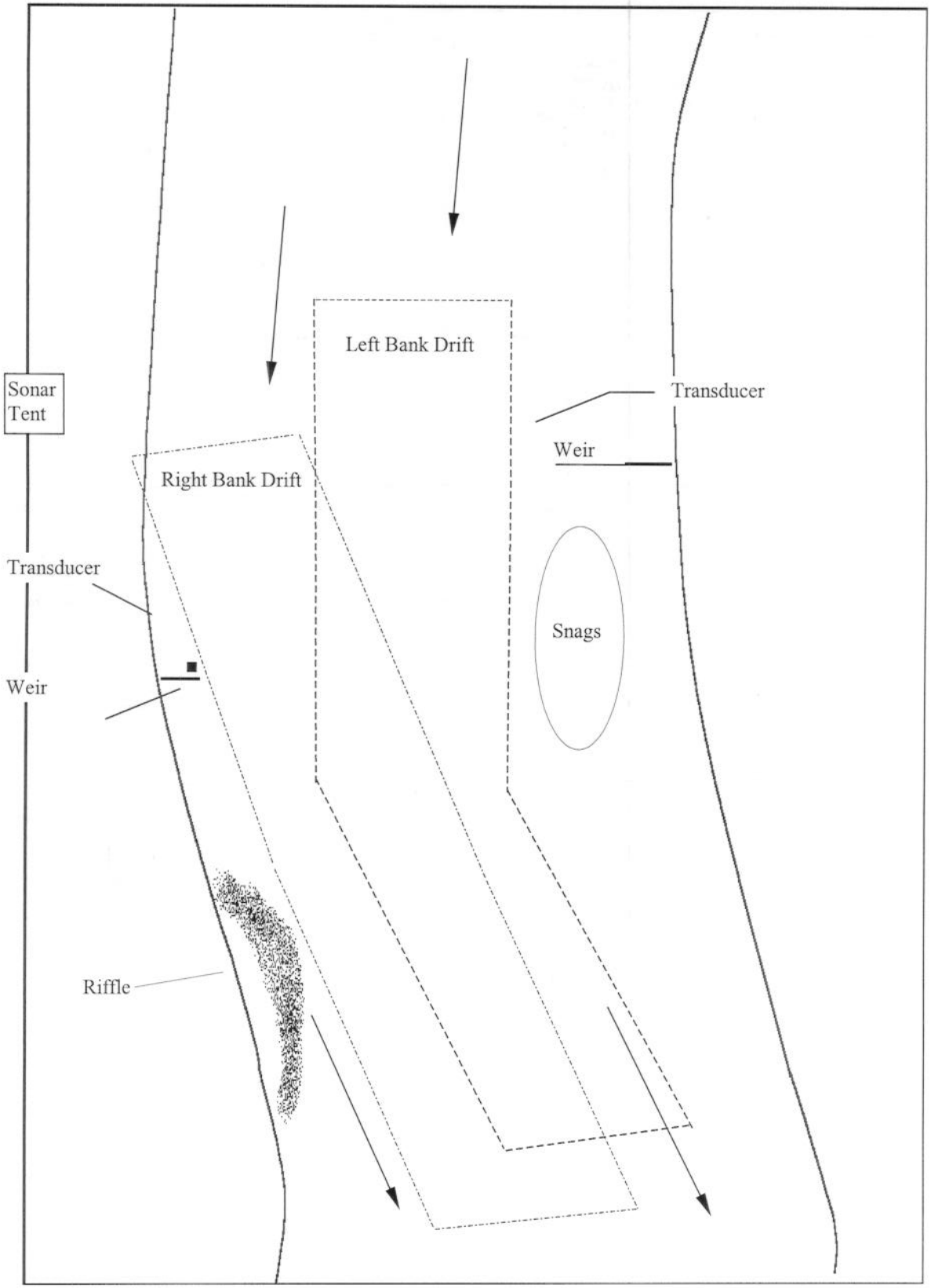


Figure 3. Aniak River drift gillnet stations, 2000.

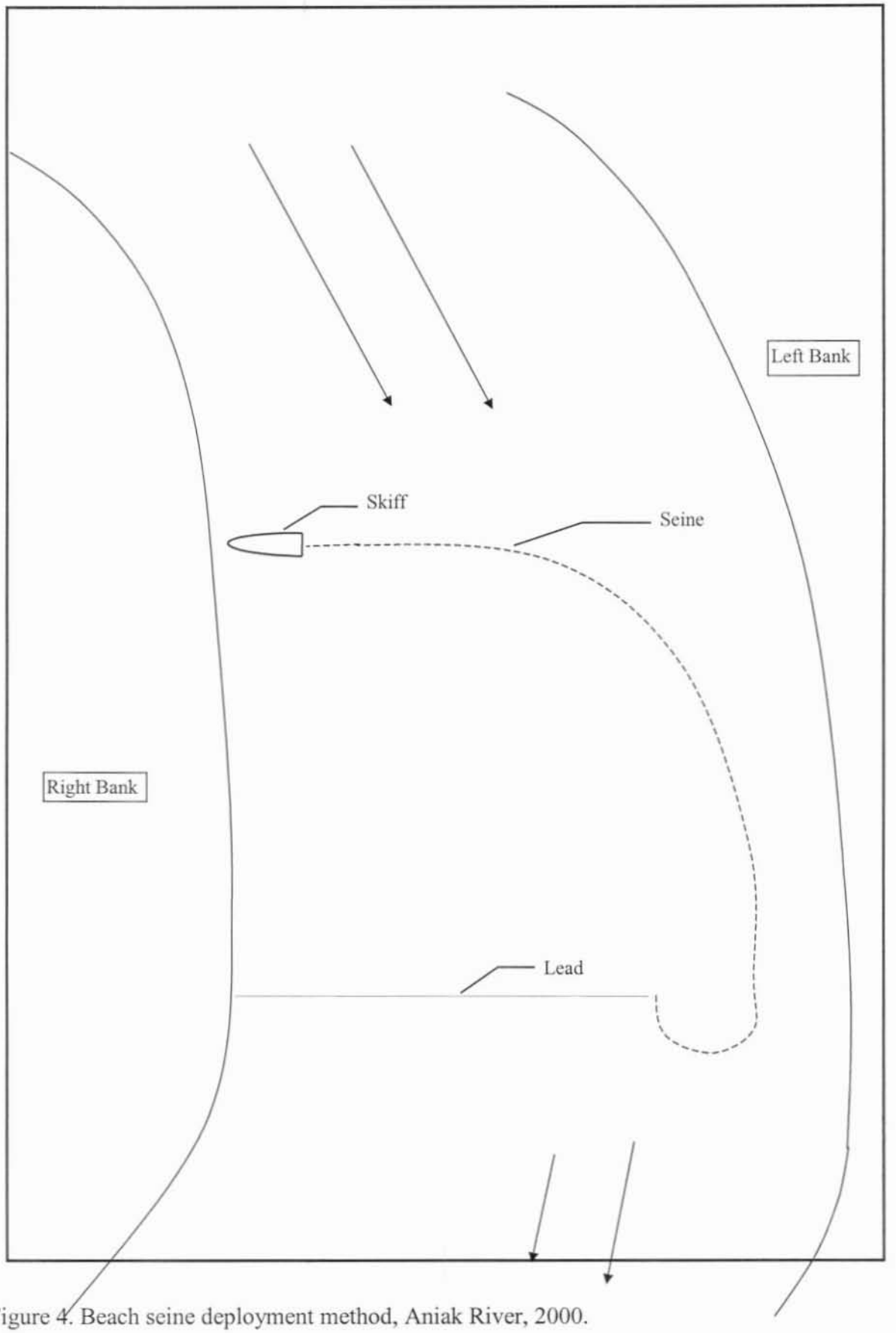


Figure 4. Beach seine deployment method, Aniak River, 2000.

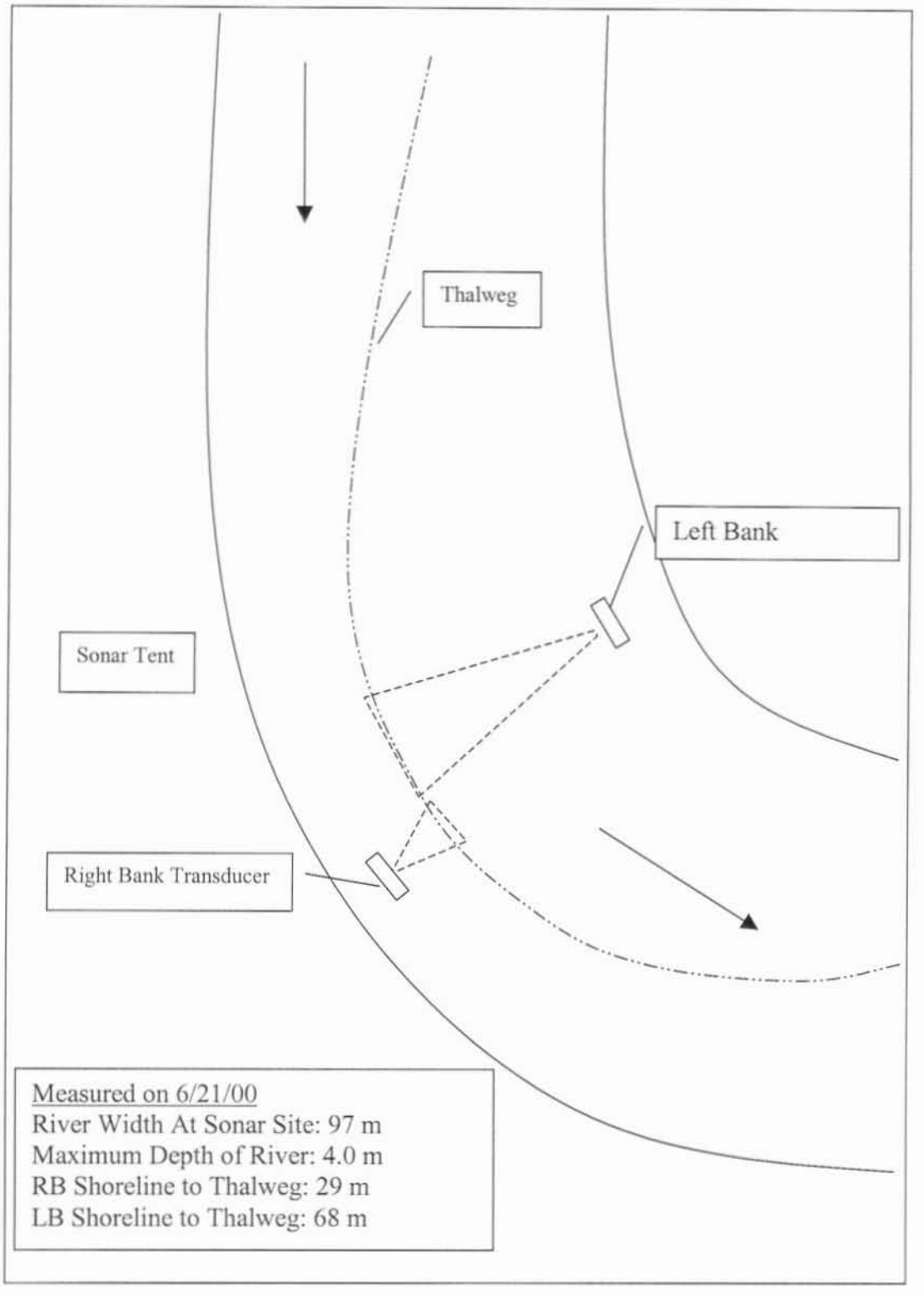


Figure 5. Aniak River sonar site stream measurements, 2000.

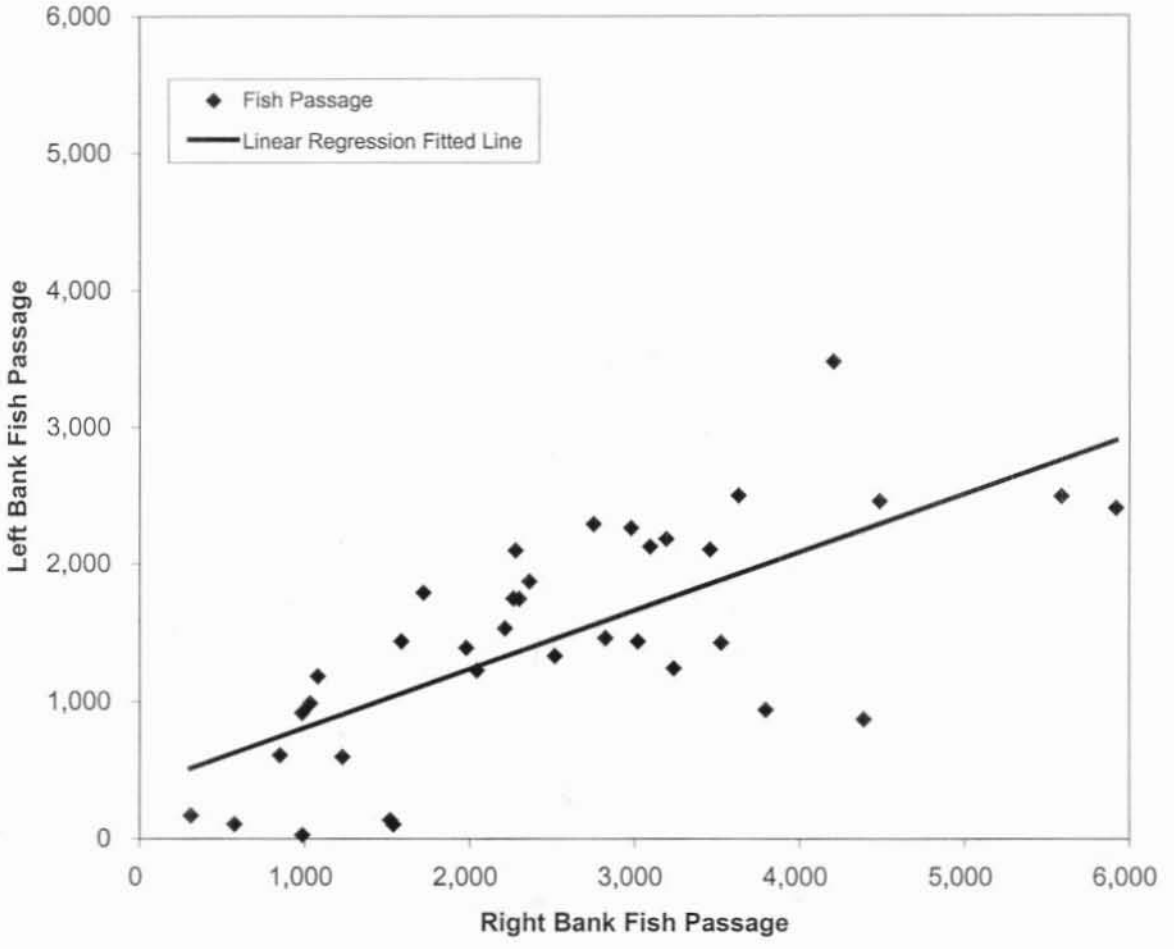


Figure 6. A comparison of daily estimated fish passage between banks, Aniak River 2000.

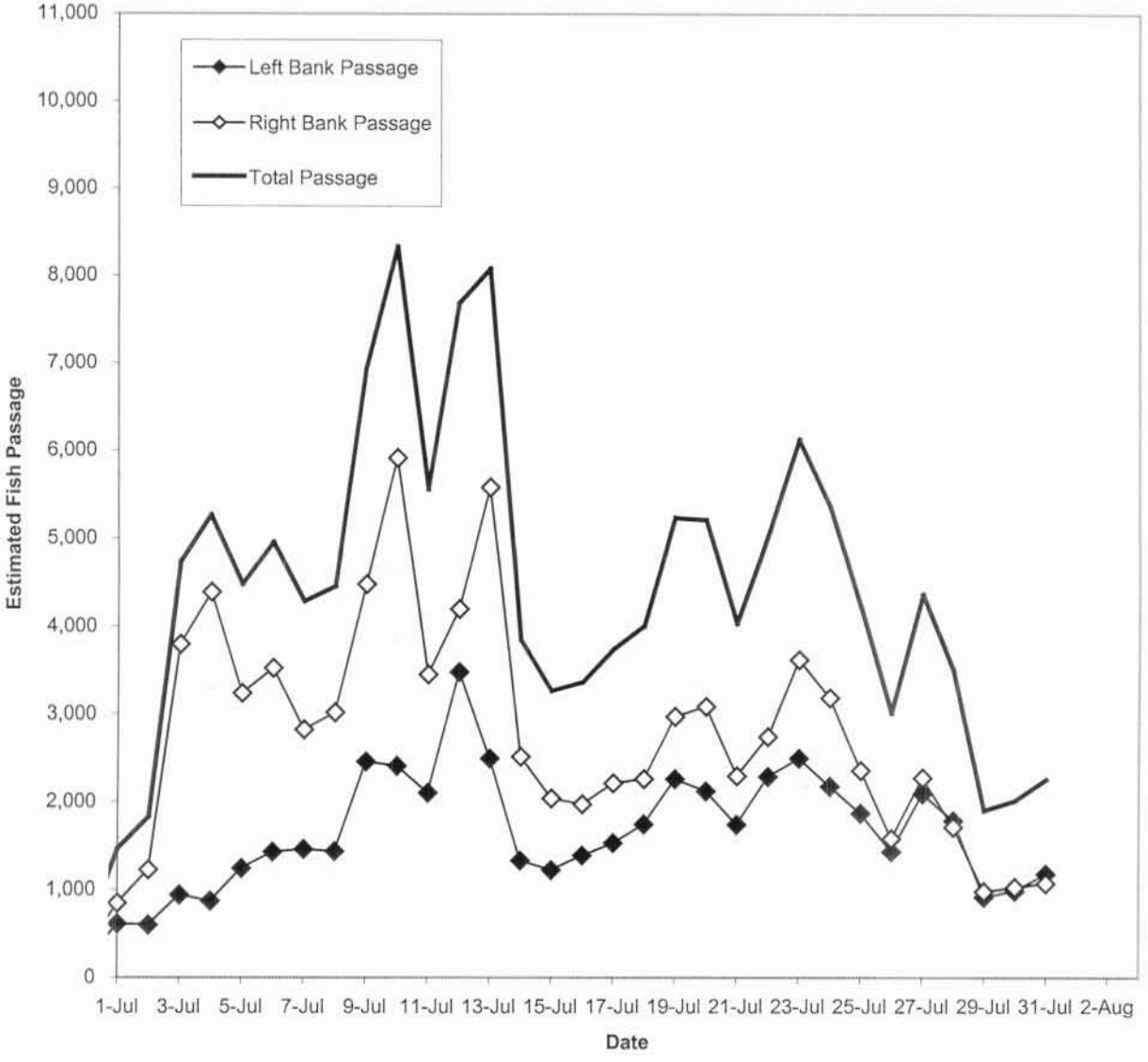


Figure 7. Estimated daily fish passage, Aniak River, 2000.

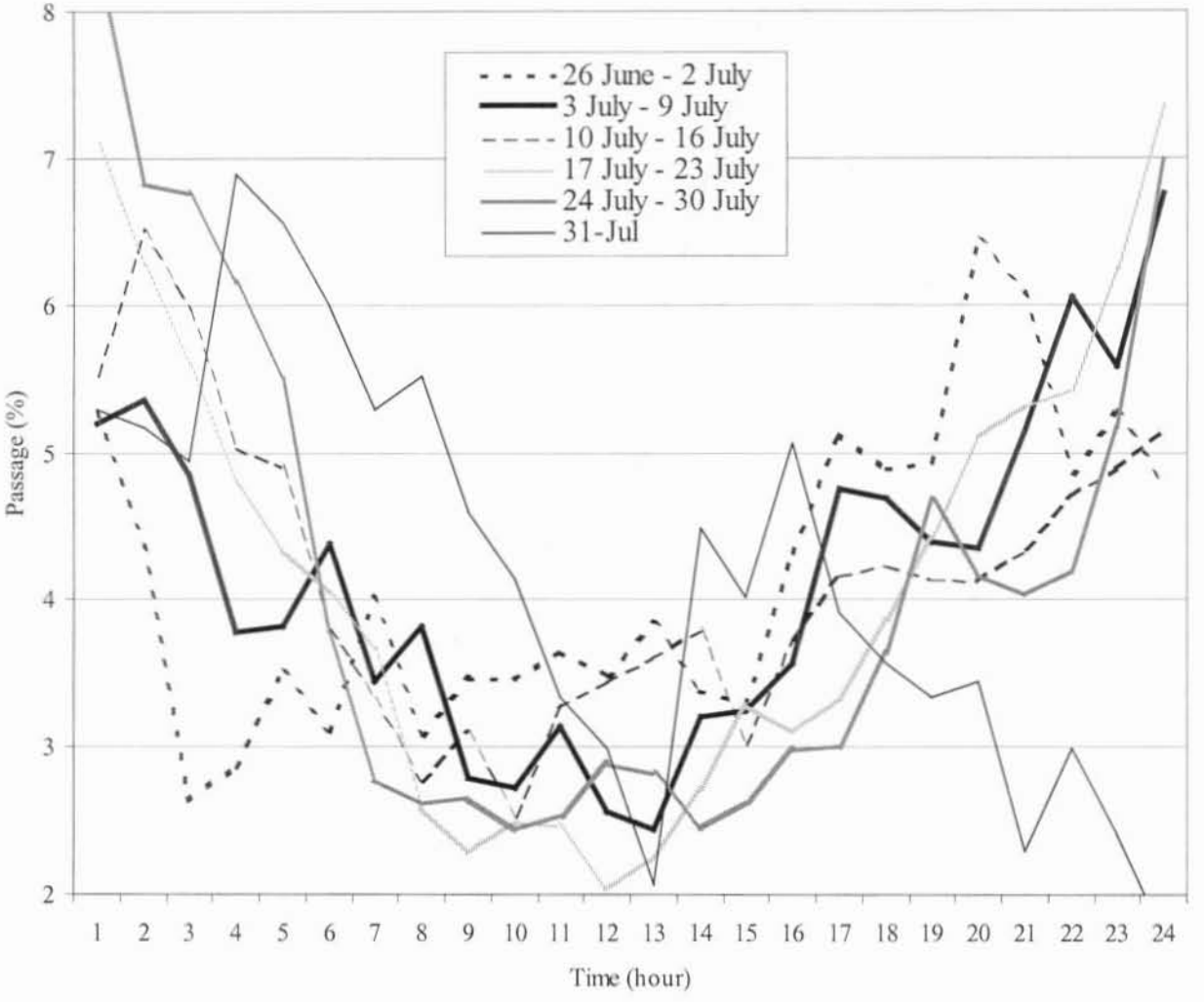


Figure 8. Diel distributions of fish detections, Aniak River, 2000.

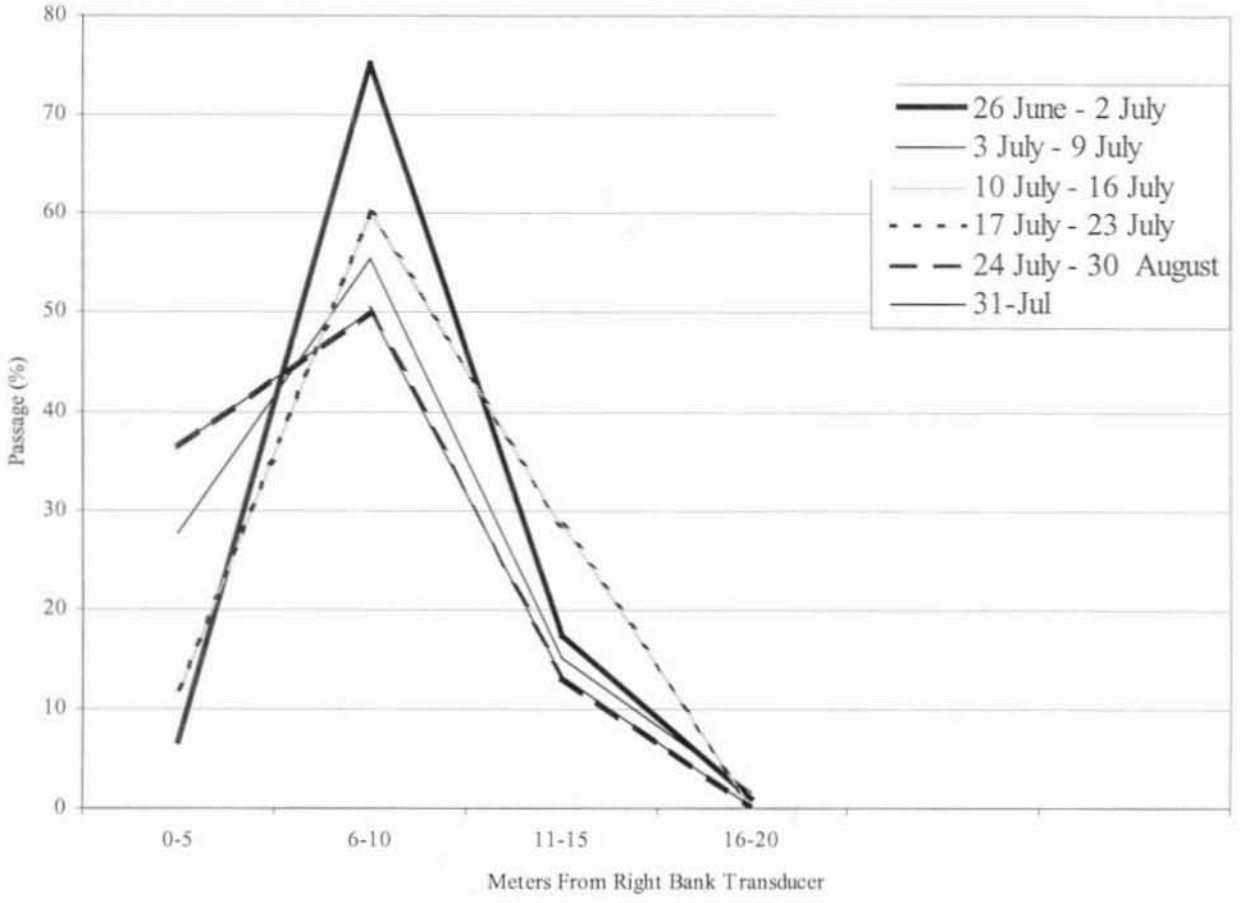


Figure 9. Right bank horizontal range distributions of fish passage, Aniak river sonar, 26 June – 31 July, 2000.

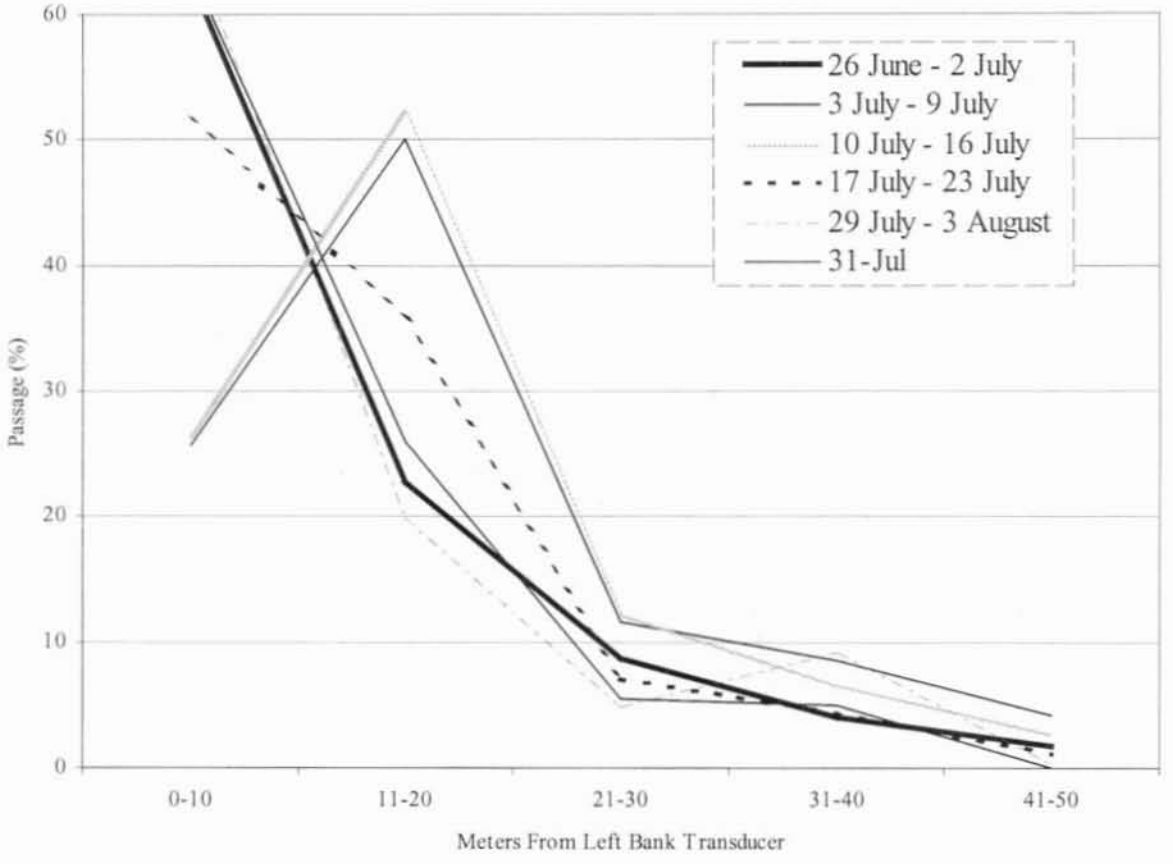


Figure 10. Left bank horizontal range distributions of fish passage, Aniak River sonar, 26 June – 31 July, 2000.

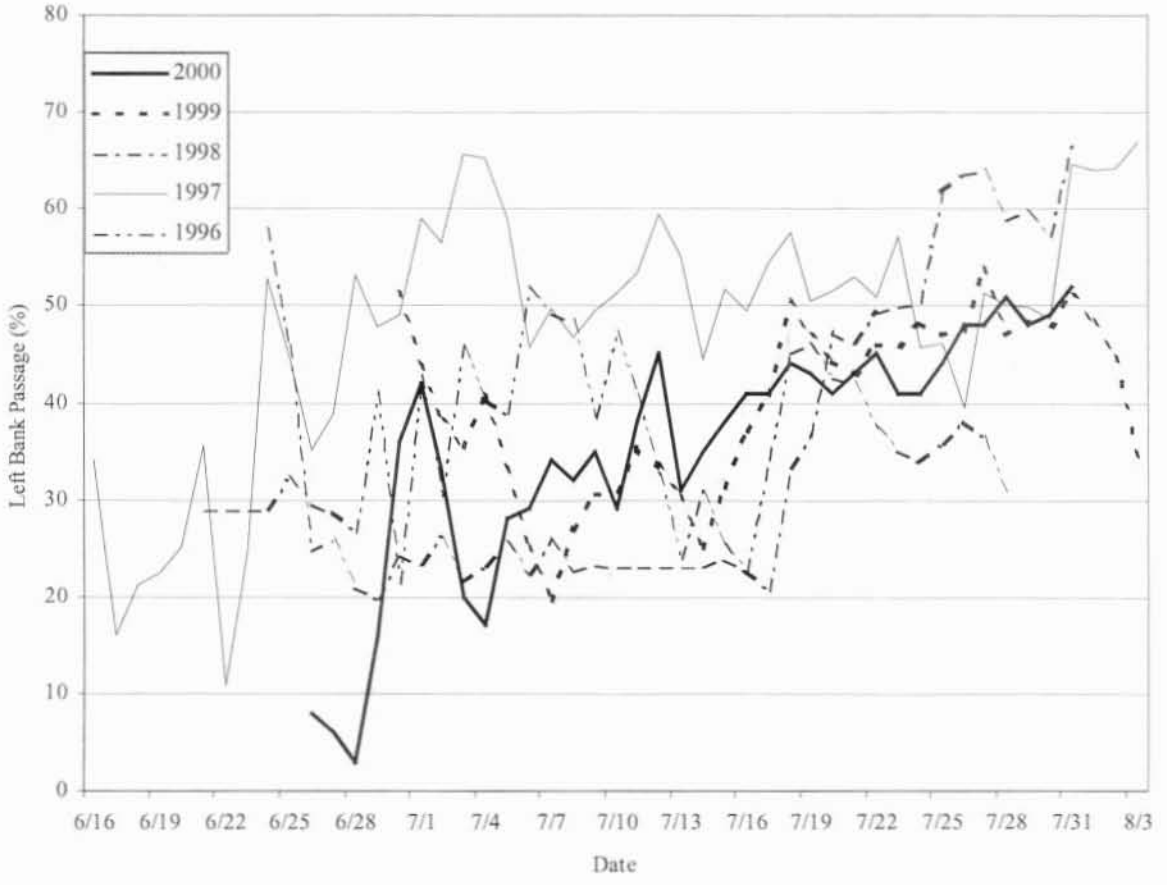


Figure 11. Daily left bank percent passage rates for Aniak River sonar, 1996-2000.

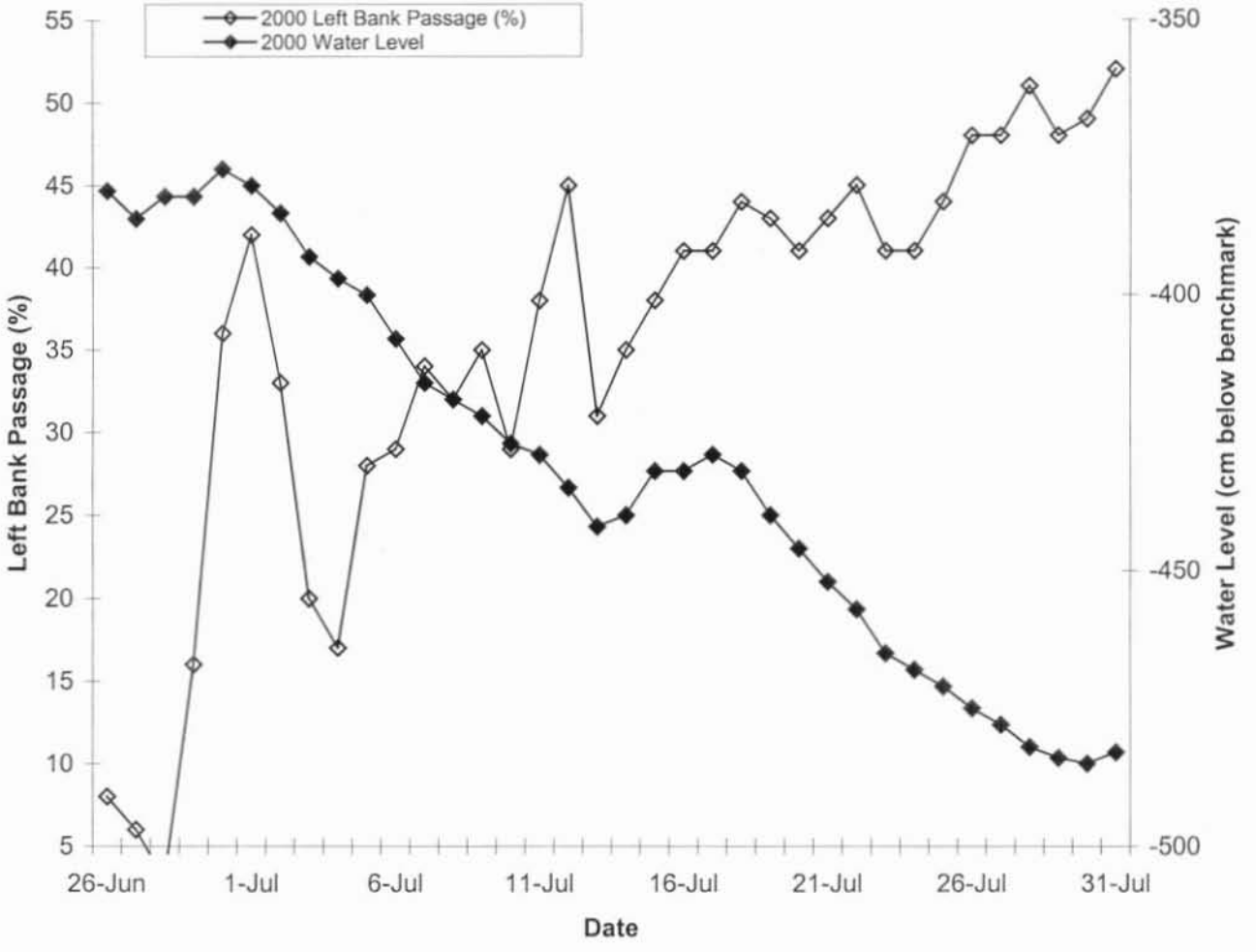


Figure 12. Daily left bank passage rate and water level for the Aniak River sonar, 2000.

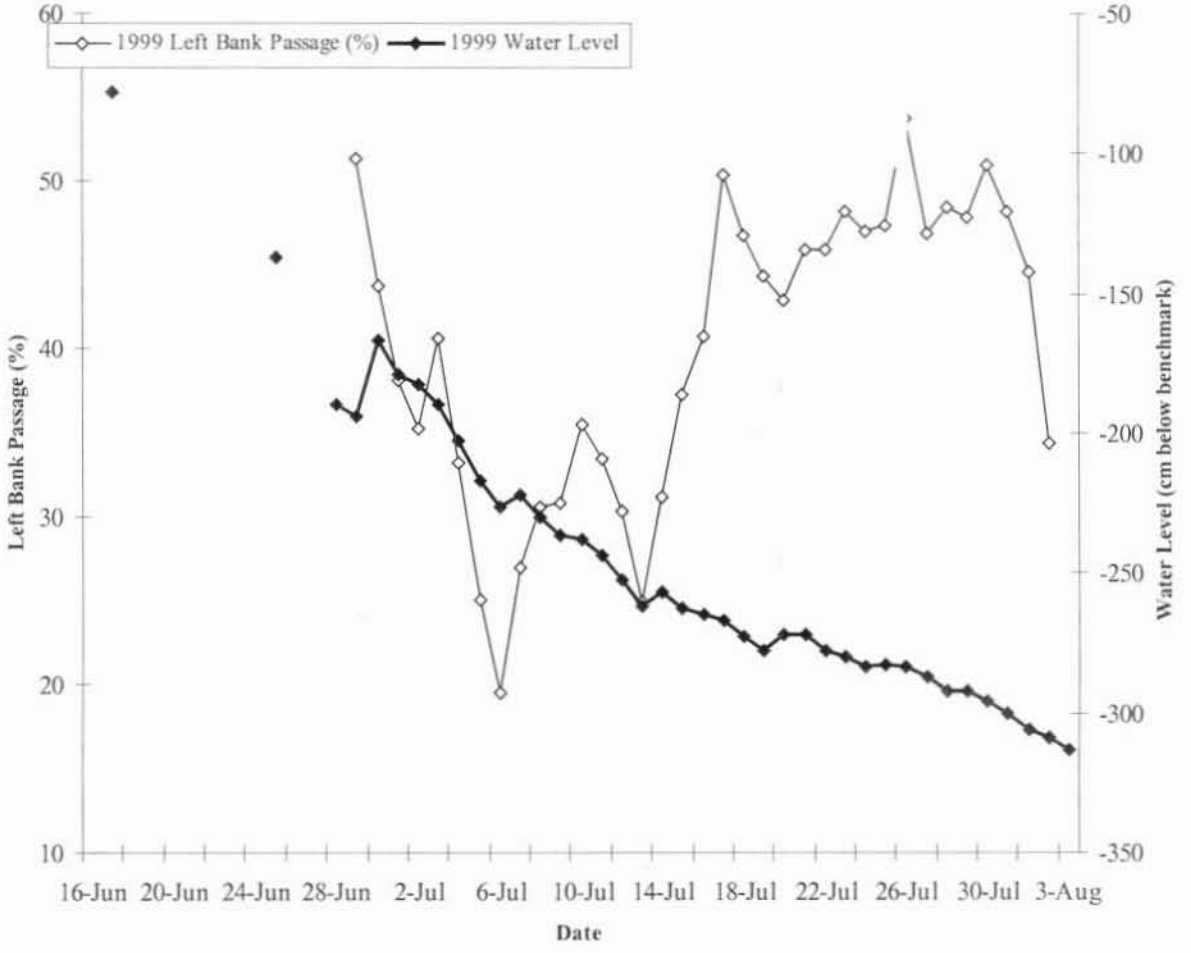


Figure 13. Daily left bank percent passage rate and water level for Aniak River sonar, 1999.

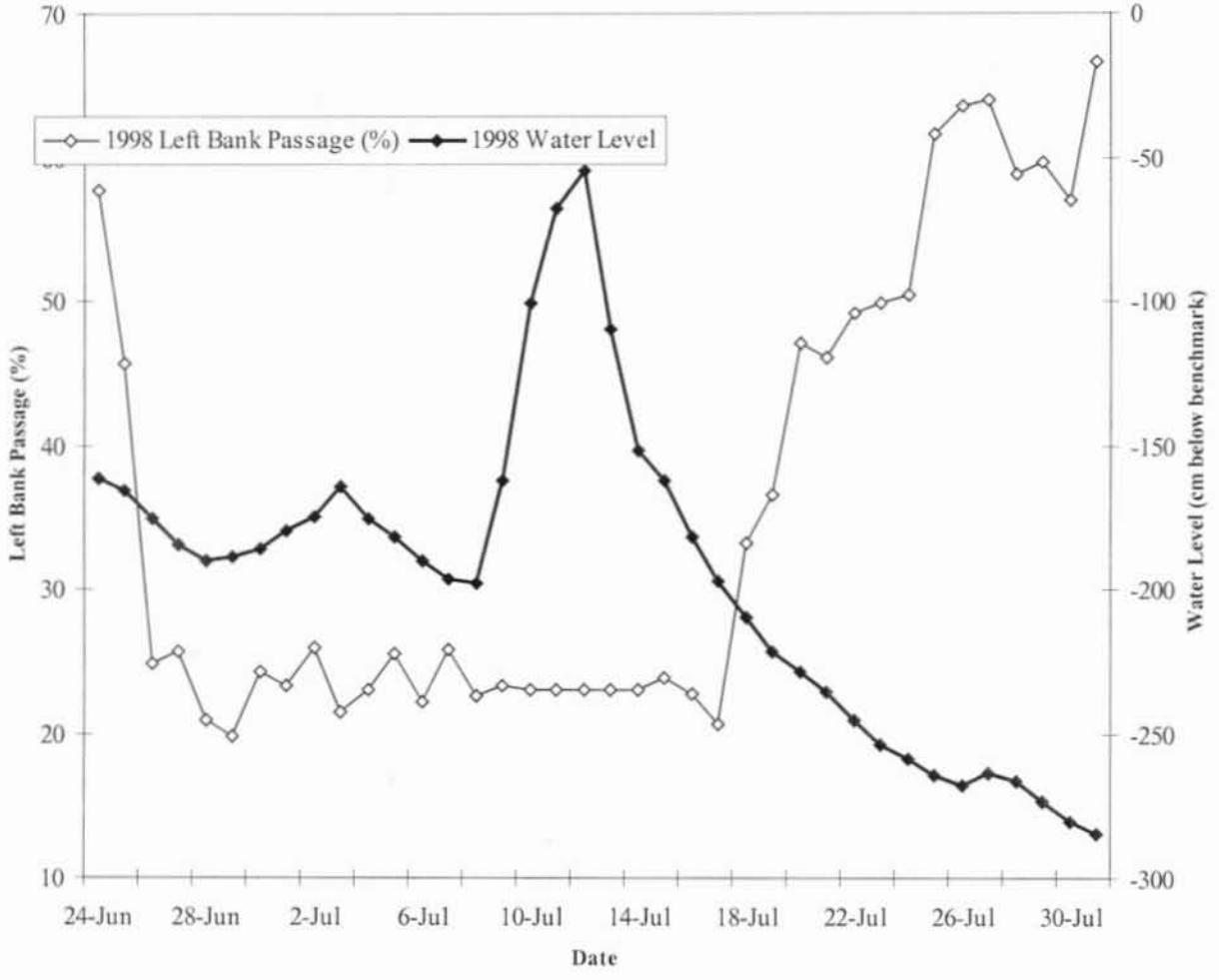


Figure 14. Daily left bank percent passage rate and water level for Aniak River sonar, 1998.

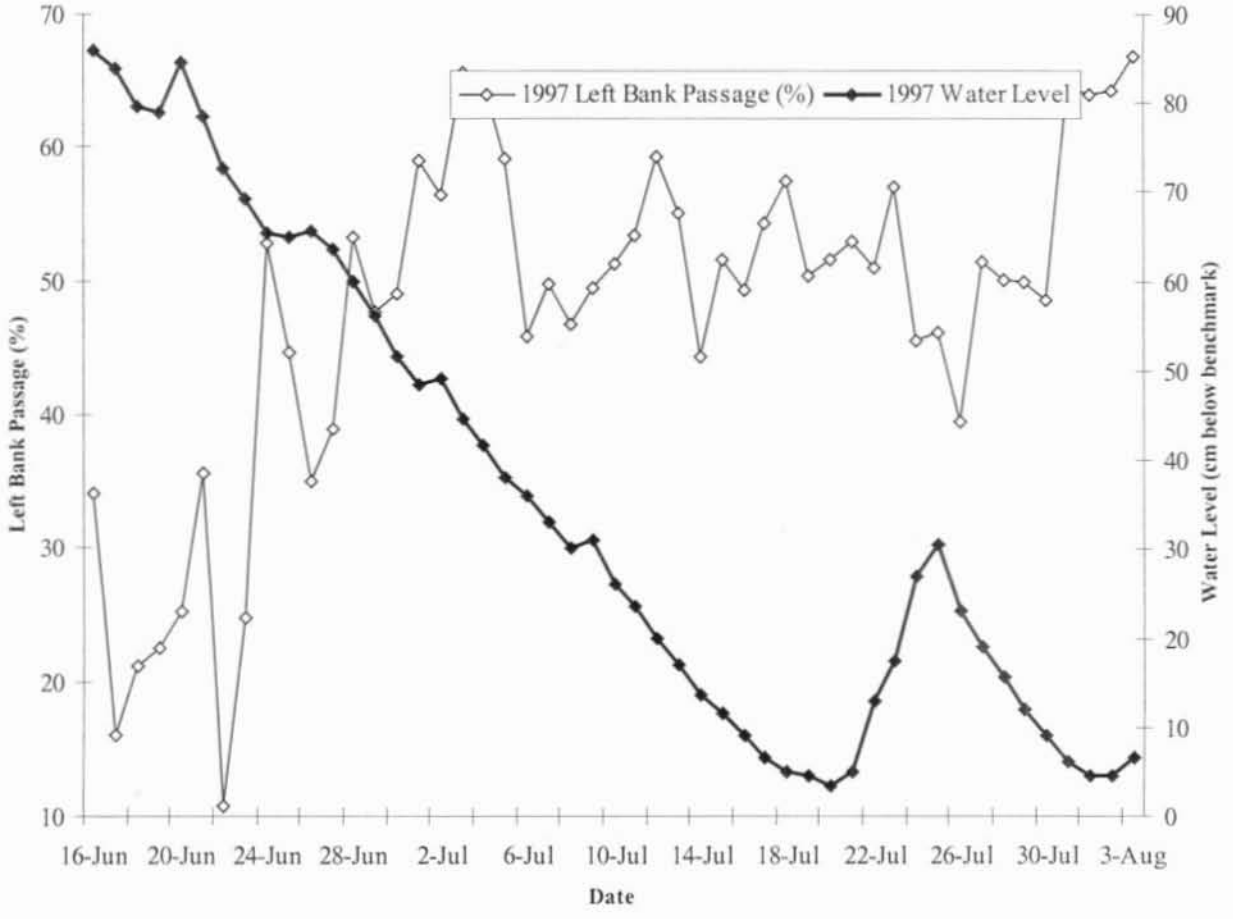


Figure 15. Daily left bank percent passage rate and water level for Aniak River, 1997.

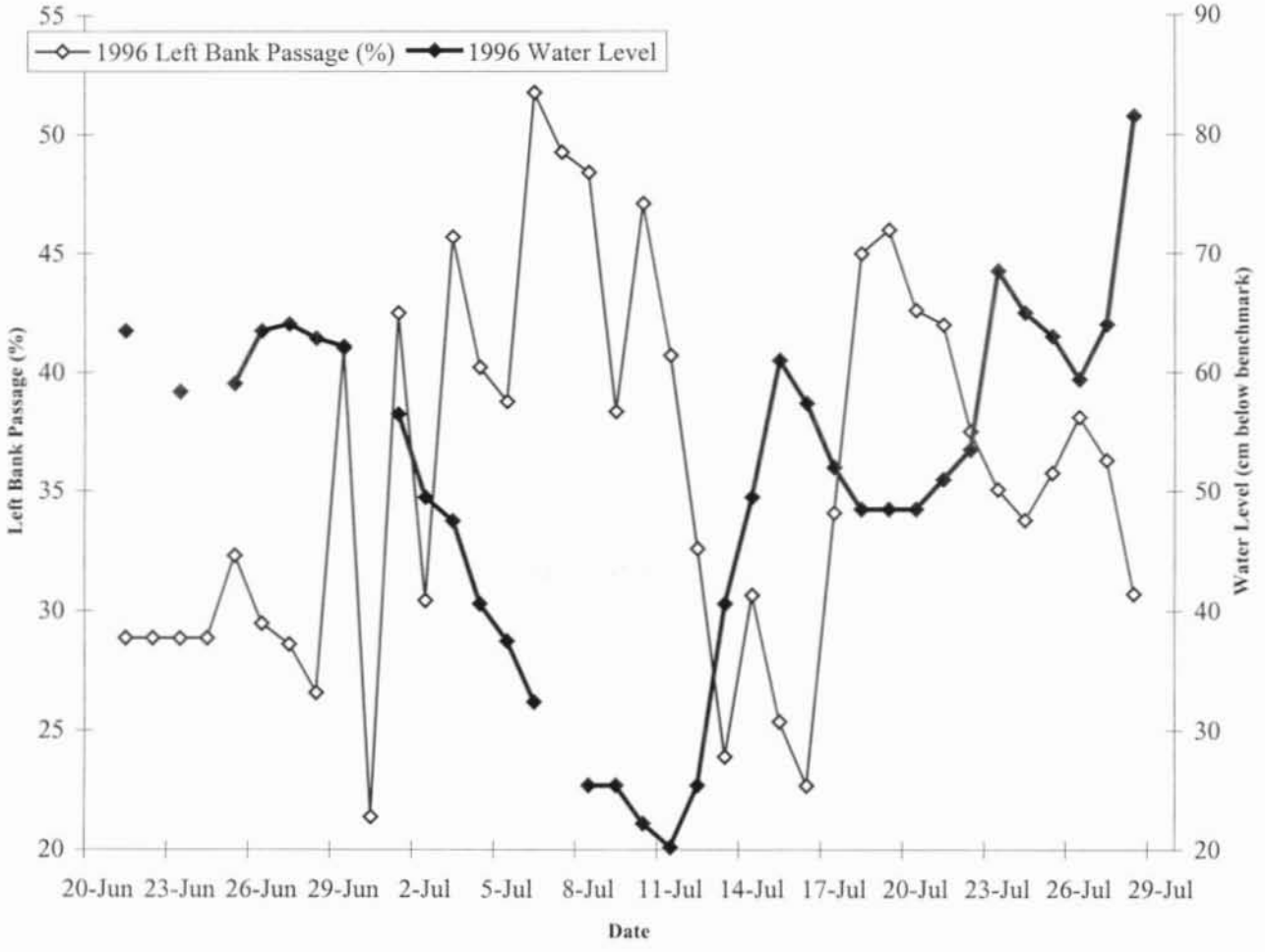


Figure 16. Daily left bank percent passage rate and water level for Aniak River sonar, 1996.

APPENDICES

APPENDIX A

Appendix A.1. Lower Kuskokwim River, District 1 and the middle Kuskokwim River, District 2, combined commercial salmon harvest and estimated exvessel value, 1990-1999[a].

Kuskokwim In-River Commercial Salmon Harvest

(Source: 1990-99 Kuskokwim Area Management Reports)

Year		Chinook	Sockeye	Coho	Pink	Chum	Total
1990	Fish	53,759	84,870	410,332	3,397	461,624	1,013,982
	Value	$435,052	$619,442	$1,639,224	$1,893	$824,067	$3,519,678
1991	Fish	37,778	108,946	500,935	378	431,802	1,079,839
	Value	$320,733	$512,858	$1,431,976	$157	$836,144	$3,101,868
1992	Fish	46,872	92,218	666,170	7,451	344,603	1,157,314
	Value	$397,894	$590,293	$2,150,242	$1,381	$760,934	$3,900,744
1993	Fish	8,735	27,008	610,786	64	43,337	689,930
	Value	$72,812	$140,824	$2,297,772	$59	$114,127	$2,625,594
1994	Fish	16,211	49,365	724,689	30,949	271,115	1,092,329
	Value	$126,961	$188,704	$3,002,387	$8,973	$383,630	$3,710,655
1995	Fish	30,846	92,500	471,461	93	605,918	1,200,818
	Value	$309,088	$460,982	$1,358,656	$50	$746,478	$2,875,254
1996[b]	Fish	6,973	33,512	935,510	1,621	200,298	1,177,914
	Value	$23,672	$97,622	$1,835,208	$744	$170,988	$2,128,234
1997	Fish	10,441	21,989	130,803	2	17,026	180,261
	Value	$36,888	$64,926	$315,650	$1	$19,522	$436,987
1998	Fish	17,359	60,906	210,481	92	207,809	496,647
	Value	$74,396	$209,870	$516,552	$55	$183,386	$984,259
1999	Fish	4,705	16,976	25,593	2	23,006	70,282
	Value	$23,337	$64,000	$54,052	$0.15	$16,794	$158,183
2000	Fish	26,115	109,939	307,439	17	49,574	493,084
	Value	$159, 695	$410,454	$589,135	$6	$37,897	$1,037,492
Avg. (1990-1999)	Fish	23,368	58,829	468,676	4,405	260,654	815,932
	Value	$182,083	$294,952	$1,460,172	$1,331	$405,607	$2,344,146

[a] Does not include test fish sales.

[b] Does not include roe sales

Appendix A. 2. Lower Kuskokwim River, District 1 and the middle Kuskokwim River, District 2 and the Upper Kuskokwim River combined subsistence salmon harvest, 1990-1999.

Kuskokwim In-River Subsistence Salmon Harvest

(Source: 1990-99 Kuskokwim Area Annual Management Reports)

Year	Chinook	Chum	Sockeye	Coho	Total
1990	85,979	126,508	36,276	44,791	293,554
1991	85,554	93,075	52,984	50,370	281,983
1992	64,795	96,491	32,067	40,168	233,521
1993	87,512	59,396	49,349	31,737	227,994
1994	93,242	72,025	37,159	33,050	235,476
1995	96,436	67,862	27,791	36,277	228,366
1996	78,063	88,965	34,213	32,741	233,982
1997	81,577	39,970	40,077	29,032	190,656
1998	86,115	67,665	37,578	27,239	218,597
1999	73,194	43,601	46,677	25,004	188,476
Average (1990-1999)	83,247	75,556	39,417	35,041	233,261

Appendix A. 3. Timetable of developmental changes at the Aniak River sonar project, 1980-2000.

YEAR	EVENT
1980	• Aniak River sonar project established • 1978 model, non-configurable Bendix sonar counter used with 60 ft artificial substrate • Single bank operation (1980-95) • Cumulative adjusted daily sonar estimates expanded by 150% to account for salmon passing outside the ensonified area • Sonar estimates are extrapolated for pre and post season salmon escapement (1980-82, 85-89, 91-96) • Gillnet test fishing to provide species apportionment and ASL information • Three correction factor calibrations per day averaged to adjust daily estimates
1981	• 1981 model, non-configurable Bendix sonar counter used with 60 ft artificial substrate • A tentative escapement goal of 250,000 chum and 25,000 king salmon is established for the Aniak River • Gillnet and beach seine test fishing to provide species apportionment and ASL information
1982	• Sonar equipment unchanged • Escapement goals for AYK Region updated; 250,000 chum and 25,000 king salmon escapement goal is established for the Aniak River • Gillnet test fishing to provide species apportionment and ASL information • Four correction factor calibrations applied to 6 hour time periods to adjust daily estimates
1983	• Sonar equipment unchanged • Review of escapement goal based upon sonar estimates indicated 1980-81 Aniak River • Sonar estimates likely represented unusual record escapements, and much smaller escapements would probably provide adequate future spawning stocks as well as catches for user groups. Goal remains 250,000 chum and 25,000 king salmon. • Sonar estimates are not extrapolated for pre- and post-season salmon escapement (1983-84, 90, 96-97)
1984	• Sonar equipment unchanged • No apportionment of estimates made due to insufficient test gillnets catches. In the absence of sufficient species apportionment data, the sonar based escapement objective would be 250,000 estimated salmon counts. • Cumulative adjusted daily sonar estimates expanded by 162% to account for salmon passing outside the ensonified area.

-Continued-

Appendix A.3. (Page 2 of 2)

YEAR	EVENT
1985	• Sonar equipment unchanged • Gillnet test fishing and carcass samples provide ASL information
1986	• Sonar equipment unchanged • ASL sampling activities are discontinued to decrease operating costs. • Species apportionment activities are discontinued due to inadequate sample sizes.
1988	• Sonar operations eliminated use of the 60 ft artificial substrate. Sampling range unknown
1989	• Sonar operations same as 1988
1990	• No formal project documentation (1990-95)
1993	• Fire destroys 1981 model Bendix sonar counter. Replaced with a 1978 model Bendix sonar counter • Historic data in Kuskokwim Area Management Report is adjusted to reflect 162% expansion factor applied to 1980-83 season estimates.
1994	• Sonar operations continue with 1978 model counter
1995	• Sonar operations continue with 1978 model counter • Reliable escapement estimates are not generated
1996	• Established a new sonar data collection site 1.5 km downstream from the historical site • Project operations redesigned to provide full river ensonification, with user-configurable sonar equipment 24 hours per day on both banks. • Periodic net sampling to monitor broad changes in species composition, corroborate acoustically detected abundance trends, and obtain ASL samples of chum salmon • Sonar estimates are not extrapolated for pre- and post-season salmon escapement (1996-97) • Regional Information Report documents project operations and data collection activities
2000	• Project operations remain the same as 1996 for years 1997 through 2000.

Appendix A. 4. Climatological and hydrological measurements, Aniak river sonar site, 2000.

Date	Time	Water (C)	Air (C)	Secchi (m)	Water Level-Below benchmark (cm)	Conduct	Air min (c)	Air max	General Conditions (sunny, overcast, rain, etc…)
26-Jun-00	815	12.4	15	50	381	74.7			clear skies, sunny, no wind
27-Jun-00	817	12.5	7	48	386	79.6			slightly overcast, no wind
28-Jun-00	947	11.8	9	48	382	79.7			overcast, no rain,
29-Jun-00	827	9.5	8	48	382	68			overcast, no rain
30-Jun-00	846	9.9	8	47	377	75			rain drizzle
1-Jul-00	845	9.1	9	51	380	78.5	42	100	mostly sunny with scattered clouds, winds SW @ 0-5
2-Jul-00	830	9.5	10	52	385	81.5	40	72	mostly sunny with few clouds, winds SW @ 0-5
3-Jul-00	900	12	12	50	393	82.2	52	72	overcast with winds SE @ 0-5
4-Jul-00	840	11.1	10	52	397	80.5	44	82	blue skies with clouds forming
5-Jul-00	830	11.9	11	53	400	83	73	90	mostly cloudy with brakes of blue sky, winds @ SW 0-5
6-Jul-00	850	12.1	12	55	408	84.3	50	94	mostly clear
7-Jul-00	810	11.9	12	70	416	86.5	53	96	overcast, no wind
8-Jul-00	850	11.2	12	80	419	83.8	52	80	overcast, no wind
9-Jul-00	815	11.4	12	80	422	84.5	52	82	overcast , winds SE @ 5
10-Jul-00	806	11.9	10	75	427	84.8	51	67	overcast, winds NW @ 5
11-Jul-00	800	11.2	8	80	429	88.2	42	83	clear skies, sunny, winds SE @ 5
12-Jul-00	800	12.8	10	80	435	88.9	47	99	clear, sunny, no wind
13-Jul-00	808	13.8	13	80	442	88.9	44	80	mostly cloudy, no wind
14-Jul-00	819	11.5	10	75	440	87.6	52	82	overcast, no wind
15-Jul-00	850	10.9	10	70	432	89.2	49	59	overcast, intermittent rain, winds S @ 10-15
16-Jul-00	840	10.7	10	75	432	87.7	48	59	overcast, no rain
17-Jul-00	905	10.5	10	75	429	84.8	48	59	overcast, rain, winds SW @ 0-5
18-Jul-00	940	10.4	9	100	432	88.4	46	52	overcast, no wind
19-Jul-00	815	11.3	10	95	440	88.7	49	80	overcast, calm
20-Jul-00	800	10.5	5	92	446	93.1	30	77	overcast with occasional showers, winds SW @ 0-5
21-Jul-00	812	10.1	7	90	452	90.1	47	82	clear skies, no wind
22-Jul-00	742	10.1	4	100	457	96.5	20	70	overcast, no wind .
23-Jul-00	850	11.3	9	95	465	91.4	23	90	partly cloudy, no wind
24-Jul-00	826	11.3	9	100	468	93.7	30	80	overcast, no wind
25-Jul-00	825	11.3	8	100	471	93.5	41	84	overcast, winds NW @ 0-5
26-Jul-00	835	10.4	9	100	475	95.2	42	76	mostly cloudy, no wind
27-Jul-00	825	11	6	101	478	95.2	42	64	mostly clear, winds W @ 0-5
28-Jul-00	840	11.2	6	101	482	95.6	36	74	overcast with scattered showers, winds SW @ 0-5
29-Jul-00	835	9.8	6	102	484	94	38	58	overcast with intermittent showers, winds E @ 5
30-Jul-00	850	9.4	7	104	485	93.8	41	68	overcast with scattered showers, winds W @ 0-5
31-Jul-00	915	9.3	6	100	483	96.4	42	54	heavy rain, winds W @ 0-5

Appendix A. 5. Historic age class of beach seine caught chum salmon from Aniak River escapement samples, collected near the site and applied passage estimates by time stratum, 1996-2000

Year	Stratum Dates	Sample Size	0.2 Esc.	%	0.3 Esc.	%	0.4 Esc.	%	0.5 Esc.	%	Total Esc.
2000	6/26-7/7	102	318	1.0	18,466	56.9	13,372	41.2	318	1.0	32,473
1999	7/1-7/8	151	0	0	8,347	37.7	13,618	61.6	146	0.7	22,111
1998	6/24-705	72	0	0	29,332	83.3	5,377	15.3	489	1.4	35,198
1997	6/16-7/06	139	491	0.7	31,886	46.8	35,319	51.8	491	0.7	68,186
1996	6/21-7/04	78	0	0	48,595	55.1	37,294	42.3	2,260	2.6	88,149
2000	7/8-7/13	109	0	0	30,134	73.4	10,547	25.7	377	0.9	41,057
1999	7/9-7/14	182	0	0	15,401	48.9	16,094	51.1	0	0	31,495
1998	7/06-7/12	165	0	0	35,425	78.2	9,611	21.2	275	0.6	45,311
1997	7/07-7/13	169	252	0.6	28,224	66.3	13,356	31.4	756	1.8	42,588
1996	7/06-7/14	94	0	0	59,429	63.6	34,034	36.4	0	0	93,463
2000	7/14-7/19	149	315	1.3	19,233	81.9	3,941	16.8	0	0	23,490
1999	7/15-7/20	175	213	0.6	22,612	60.6	14,292	38.3	213	0.6	37,331
1998	7/13-7/18	220	0	0	44,671	85.5	7,603	14.5	0	0	52,274
1997	7/14-7/17	138	610	2.9	11,896	56.5	8,540	40.6	0	0	21,046
1996	7/15-7/17	120	473	2.5	14,820	78.3	3,468	18.3	158	0.8	18,919
2000	7/20-7/23	182	561	2.7	17,405	85.2	2,470	12.1	0	0	20,437
1999	7/21-7/25	187	0	0	27,752	70.6	11,563	29.4	0	0	39,315
1998	7/19-7/22	204	308	0.5	56,966	90.7	5,235	8.3	308	0.5	62,817
1997	7/18-7/22	124	446	0.8	39,669	71.8	14,709	26.6	446	0.8	55,270
2000	7/24-7/31	189	1,413	5.3	21,190	79.4	4,097	15.3	0	0	26,700
1998	7/23-7/27	210	511	1	49,340	91.9	3,835	7.1	0	0	53,686
1997	7/23-7/26	156	598	2.6	16,883	72.4	5,827	25	0	0	23,308
1996	7/18-728	167	4,866	4.8	74,813	73.7	19,463	19.2	2,433	2.4	101,575
1999	7/26-8/3	192	0	0	31,926	67.2	15,344	32.3	247	0.5	47,518
1998	7/28-7/31	173	0	0	28,227	93.6	1,917	6.4	0	0	30,144
1997	7/27-8/03	127	1,231	2.4	43,505	83.5	7,388	14.2	0	0	52,124
2000	Season	731	2,608	1.8	106,428	73.8	34,427	23.9	695	0.5	144,157
1999	Season	1003	213	0.1	106,038	59.6	70,912	39.9	607	0.3	177,771
1998	Season	1044	819	0.3	243,961	87.3	33,579	12	1,071	0.4	279,430
1997	Season	853	3,628	1.4	172,063	65.5	85,138	32.4	1,693	0.6	262,522
1996	Season	459	5,339	2	197,657	65	94,260	31	4,851	2	302,106

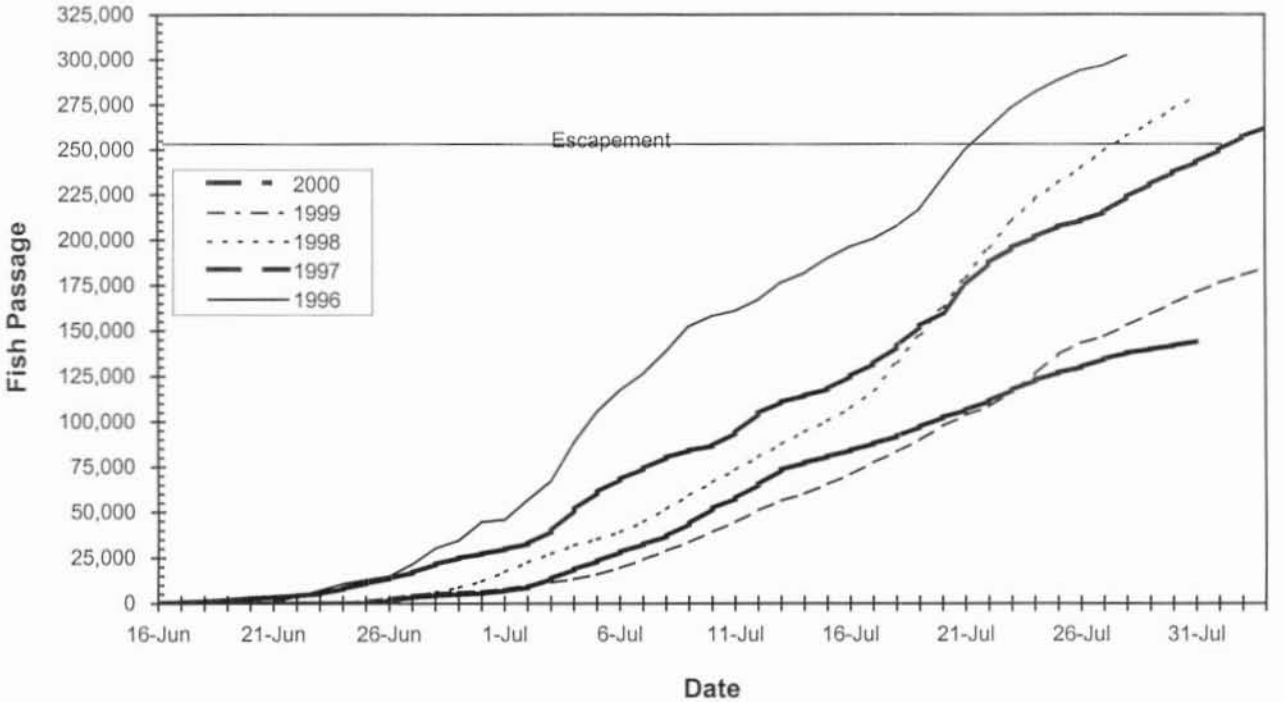
Appendix A. 6. Daily and cumulative estimates of fish passage at the Aniak River sonar site, '96-00.

	2000				1999				1998				1997				1996			
Date	Left Bank	Right Bank	Daily Total	% Pass	Left Bank	Right Bank	Daily Total	% Pass	Left Bank	Right Bank	Daily Total	% Pass	Left Bank	Right Bank	Daily Total	% Pass	Left Bank	Right Bank	Daily Total	% Pass
16-Jun													74	143	217	0				
17-Jun													52	272	324	0				
18-Jun													119	445	564	0				
19-Jun													155	535	690	1				
20-Jun													248	737	985	1				
21-Jun													205	371	576	1	261	643	904	0
22-Jun													92	760	852	2	770	1,898	2,668	1
23-Jun													270	821	1,091	2	1,034	2,549	3,583	2
24-Jun									231	169	400	0	1,412	1,261	2,673	3	1,001	2,467	3,468	4
25-Jun									227	270	497	0	1,344	1,667	3,011	4	696	1,459	2,155	4
26-Jun	139	1,517	1,656	1					292	884	1,176	1	964	1,789	2,753	5	606	1,450	2,056	5
27-Jun	106	1,535	1,641	2					470	1,360	1,830	1	1,238	1,940	3,178	6	1,941	4,843	6,784	7
28-Jun	29	985	1,014	3					447	1,689	2,136	2	2,445	2,145	4,590	8	2,252	6,216	8,468	10
29-Jun	108	572	680	3					520	2,106	2,626	3	1,663	1,822	3,485	10	1,868	2,684	4,552	11
30-Jun	172	308	480	4					841	2,626	3,467	4	1,151	1,193	2,344	10	2,169	7,973	10,142	15
1-Jul	612	849	1,461	5	571	733	1,304	1	1,209	3,992	5,201	6	1,455	1,011	2,466	11	508	687	1,195	15
2-Jul	599	1,227	1,826	6	737	1,196	1,933	2	1,353	3,864	5,217	8	1,650	1,270	2,920	12	3,307	7,559	10,866	19
3-Jul	941	3,794	4,735	9	582	1,069	1,651	3	1,008	3,702	4,710	10	4,621	2,420	7,041	15	4,697	5,576	10,273	22
4-Jul	873	4,389	5,262	13	691	1,009	1,700	4	1,072	3,576	4,648	11	7,628	4,070	11,698	20	8,462	12,573	21,035	29
5-Jul	1,242	3,238	4,480	16	866	1,738	2,604	5	839	2,451	3,290	13	5,760	3,986	9,746	23	6,633	10,469	17,102	35
6-Jul	1,429	3,525	4,954	20	894	2,673	3,567	7	885	3,103	3,988	14	3,199	3,783	6,982	26	6,213	5,788	12,001	39
7-Jul	1,462	2,824	4,286	23	880	3,645	4,525	10	1,409	4,059	5,468	16	2,984	3,014	5,998	28	4,507	4,640	9,147	42
8-Jul	1,438	3,019	4,457	26	1,300	3,528	4,828	12	1,622	5,560	7,182	19	2,770	3,152	5,922	31	5,920	6,307	12,227	46
9-Jul	2,458	4,483	6,941	30	1,446	3,295	4,741	15	1,798	5,939	7,737	21	1,975	2,016	3,991	32	5,247	8,433	13,680	50
10-Jul	2,411	5,919	8,329	36	1,810	4,058	5,868	18	1609[a]	5,370	5,370	24	1,272	1,207	2,479	33	2,669	2,995	5,664	52
11-Jul	2,106	3,457	5,563	40	1,878	3,423	5,301	21	1609[a]	5,370	5,370	26	3,849	3,350	7,199	36	1,210	1,762	2,972	53
12-Jul	3,483	4,203	7,686	45	2,120	4,215	6,335	25	1609[a]	5,370	5,370	29	6,466	4,429	10,895	40	1,987	4,109	6,096	55
13-Jul	2,495	5,586	8,082	51	1,615	3,710	5,325	28	1609[a]	5,370	5,370	31	3,366	2,738	6,104	42	2,233	7,108	9,341	58
14-Jul	1,333	2,516	3,849	54	977	2,949	3,926	30	1609[a]	5,370	5,370	34	1,632	2,040	3,672	44	1,604	3,629	5,233	60
15-Jul	1,227	2,043	3,270	56	1,634	3,620	5,254	33	1,410	4,509	5,919	36	1,779	1,665	3,444	45	2,007	5,901	7,908	63
16-Jul	1,391	1,978	3,369	58	1,961	3,299	5,260	36	1,604	5,473	7,077	38	3,515	3,602	7,117	48	1,496	5,099	6,595	65
17-Jul	1,533	2,214	3,747	61	2,730	3,959	6,689	40	2,021	7,773	9,794	42	3,704	3,109	6,813	50	1,505	2,911	4,416	66
18-Jul	1,749	2,264	4,013	64	2,973	2,931	5,904	43	5,163	10,363	15,526	48	5,392	3,977	9,369	54	3,083	3,770	6,853	69
19-Jul	2,265	2,978	5,242	67	2,971	3,384	6,355	47	5,466	9,485	14,951	53	5,668	5,568	11,236	58	4,253	4,992	9,245	72
20-Jul	2,126	3,093	5,219	71	3,488	4,382	7,870	51	7,151	8,035	15,186	58	3,826	3,591	7,417	61	7,244	9,758	17,002	77
21-Jul	1,746	2,299	4,045	74	2,545	3,380	5,925	54	7,560	8,849	16,409	64	7,833	6,971	14,804	67	6,777	9,360	16,137	83
22-Jul	2,291	2,751	5,041	77	2,137	2,510	4,647	57	7,997	8,274	16,271	70	6,339	6,105	12,444	71	4,404	7,338	11,742	87
23-Jul	2,501	3,630	6,131	81	3,712	4,377	8,089	62	7,120	7,151	14,271	75	4,760	3,584	8,344	74	4,149	7,681	11,830	90
24-Jul	2,183	3,193	5,376	85	4,838	5,203	10,041	67	6,285	6,195	12,480	80	2,714	3,234	5,948	77	2,758	5,408	8,166	93
25-Jul	1,873	2,360	4,233	88	4,990	5,623	10,613	73	5,572	3,466	9,038	83	2,654	3,098	5,752	79	2,458	4,415	6,873	95
26-Jul	1,438	1,585	3,022	90	2,988	3,325	6,313	77	5,244	3,003	8,247	86	1,290	1,974	3,264	80	2,042	3,317	5,359	97
27-Jul	2,100	2,278	4,378	93	1,922	1,653	3,575	79	6,177	3,473	9,650	89	2,428	2,296	4,724	82	1,095	1,922	3,017	98

28-Jul	1,791	1,718	3,509	96	2,777	3,149	5,926	82	4,842	3,392	8,234	92	4,251	4,231	8,482	85	1,643	3,708	5,351	100
29-Jul	921	982	1,903	97	2,998	3,191	6,189	86	4,263	2,892	7,155	95	3,457	3,464	6,921	88				
30-Jul	989	1,031	2,020	98	2,873	3,125	5,998	89	4,465	3,361	7,826	98	3,273	3,465	6,738	90				
31-Jul	1,183	1,077	2,260	100	3,089	2,970	6,059	92	4,616	2,313	6,929	100	3,568	1,959	5,527	92				
1-Aug					2,498	2,676	5,174	95					4,340	2,451	6,791	95				
2-Aug					1,788	2,222	4,010	98					4,750	2,646	7,396	98				
3-Aug					1,472	2,804	4,276	100					3,707	1,838	5,545	100				
Total	**52,740**	**91,417**	**144,157**		**72,749**	**105,020**	**177,771**		**101,179**	**170,207**	**279,430**		**139,307**	**123,215**	**262,522**		**112,709**	**189,397**	**302,106**	

[a]Sonar not operational. Passage estimated using the average passage from 8-9 July & 15-16 July.

Appendix A. 7. Estimated cumulative fish passage, Aniak River sonar, 1996-2000.

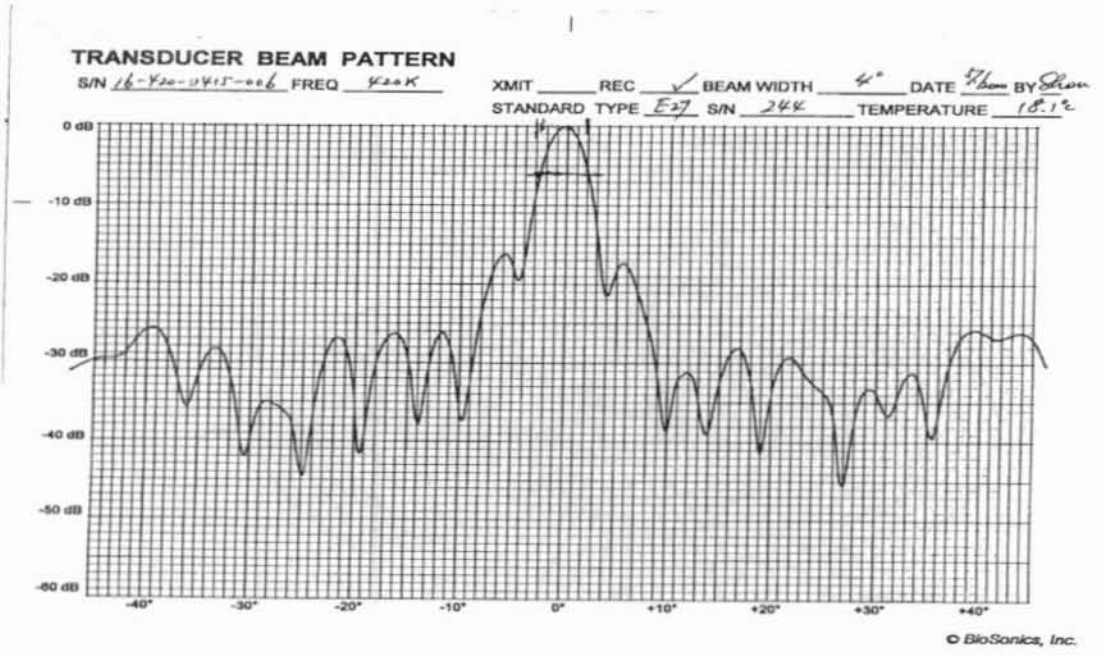


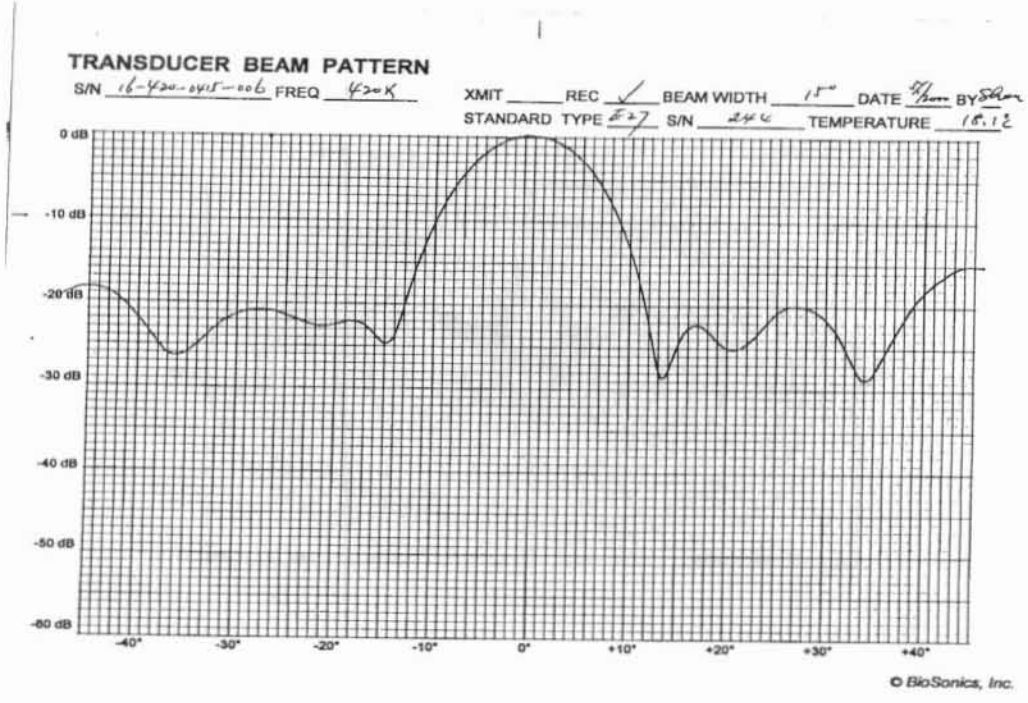
APPENDIX B

Appendix B. 1. BioSonics bench calibration data; calibrated 1 May, 2000.

SOUNDER:	101-034	102-020	102-021
Cables (S/N):	1000' Belden 601K, 602K	500' Belden 703A	1,000 Belden 702A
Transducer:	Biosonics 09-420-004	Biosonics 16-420-006	16-420-007
Receiver Gain L	0	0	0
Standard Volts In	2.570	0.673	1.980
Vdet NB 40	0.000	2.696	3.080
G1 NB 40	-190.153	-182.779	-190.998
Vdet WB 40	5.977	N/A	N/A
G1 WB 40	-184.176	N/A	N/A
-13 dB Vrms	0.02546	0.453	0.311
-13 dB SL	205.979	213.097	209.842
-10 dB Vrms	0.03606	0.601	0.431
-10 dB SL	209.004	215.562	212.680
-6 dB Vrms	0.05657	0.919	0.647
-6 dB SL	212.915	219.252	216.202
-3 dB Vrms	0.07814	1.237	0.884
-3 dB SL	215.720	221.834	218.912
0 dB Vrms	0.10677	1.556	1.202
0 dB SL	218.432	223.822	221.582

Appendix B. 2. Polar plots for Biosonics transducer (S/N 16-420-006).





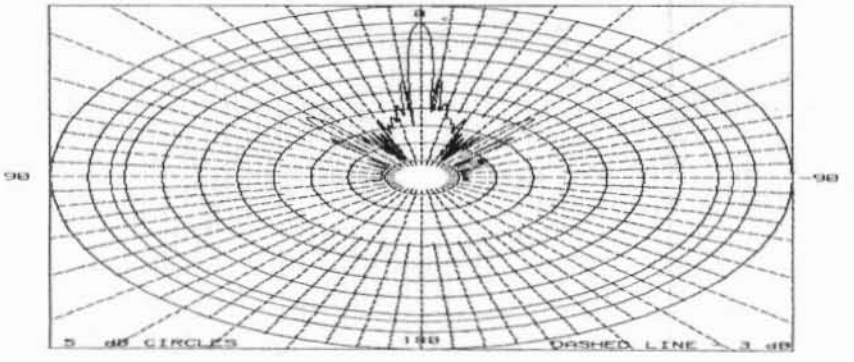
Appendix B. 3. Polar plots for Biosonics transducer (S/N 09-420-004).

APL U of W 27 Apr 2000 - 16:37:05
BIO 101-83-034

XDUCER BIO 09-420-3X10/7X21-004

STANDARD E 37 SN.003
STANDARD SENSITIVITY =-222.3 FREQUENGY 420 kHz
RANGE = 6 M
PREAMP GAIN = 20 dB DRIVE VOLTAGE 0 dBv
No. data points = 475

ANGLE 0.00 | dBuPa/V-1M 206.3 | Freq. kHz 420.000

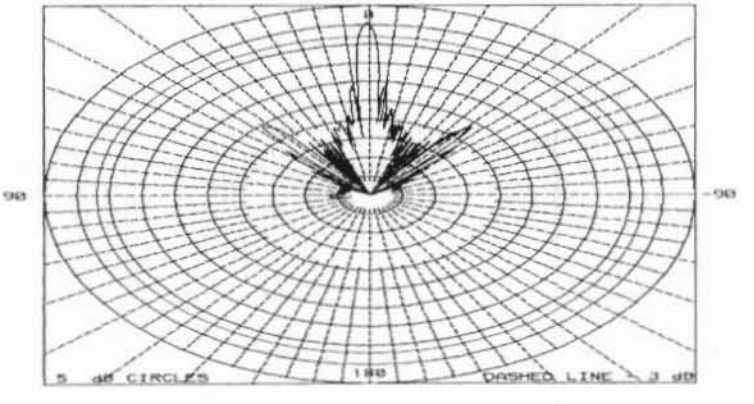


APL U of W 27 Apr 2000 - 17:20:47
BIO 101-83-034

XDUCER BIO 09-420-3X10/7X21-004

STANDARD E 37 SN.003
STANDARD SENSITIVITY = 141.6 FREQUENGY 420 kHz
RANGE = 6 M
PREAMP GAIN = 0 dB DRIVE VOLTAGE 8.2 dBv
No. data points = 646

ANGLE -.07 | dBv/uPa -134.8 | Freq. kHz 420.000



APPENDIX C

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF MINING, LAND AND WATER

TONY KNOWLES, GOVERNOR

550 W. 7th AVENUE, SUITE 900C
ANCHORAGE, ALASKA 99501-3577
PHONE: (907) 269-8552
FAX: (907) 269-8913

February 2, 2000

Lowell Fair
Alaska Department of Fish and Game
Commercial Fisheries Division
333 Raspberry Road
Anchorage, AK 99518

Re: Land Use Permit: LAS 13916

Dear Mr. Fair:

The Southcentral Region, Land Office, Division of Mining, Land and Water has received your annual report for land use permit LAS 13916. We found the written report to be satisfactory. However, we would appreciate receiving the during and after use photographs required in the second paragraph of Stipulation #11.

In an attempt to streamline the administrative portion of the land use permit program, the division is discontinuing the permit validation program. With its elimination, permits are being amended to specifically define the permit term and the authorized use periods.

LAS 13916 was initially issued with terms allowing it to be validated on an annual basis through 2002. With this letter, **the remaining term of the subject land use permit is amended to February 1, 2000 through May 31, 2002. Within this permit term, you are authorized to do the following:**

(i) **establish and use a temporary camp per the attached site development plan each 06/01 – 08/10 term covered under the remaining term of the subject permit and**

(ii) **cache a disassembled weir, plywood table, frame, kitchen sink, stovepipe and out-house each 08/11 – 05/31 term covered under the remaining term of the subject permit.**

Develop, Conserve, and Enhance Natural Resources for Present and Future Alaskans.

Appendix C. 1. State of Alaska, Department of Natural Resources Land Use and Cache Permit for the Aniak River sonar project.