YUKON RIVER SONAR PROJECT REPORT

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by

Cecil F. Rich

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AUTHORS

Cecil F. Rich is a Fishery Biologist II for the Alaska Department of Fish and Game, Commercial Fisheries Division, 333 Raspberry Road, Anchorage, Alaska 99518.

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ABSTRACT

The Yukon River sonar project has provided daily passage estimates for chinook salmon *Oncorhynchus tshawytscha*, and summer and fall chum salmon *O. keta* for most years since 1986. During this time, the project has undergone important changes, including a frequency switch from 420 kHz to 120 kHz and a change in aiming strategies from one in which the transducer was aimed at an angle to the current to one that is aimed closer to perpendicular in order to maximize fish detection. Fish passage for each species was estimated in 2000 through a two component process: (1) estimation of total fish passage with 120 kHz single-beam sonar, and (2) estimation of species proportions by sampling with a series of gillnets of different mesh sizes. An estimated 1,320,569 fish passed through the sonar sampling area between 10 June and 14 September, 27% along the right bank and 73% along the left bank. Included were an estimated 63,451 $\pm$ 4,814 (s.e.) large chinook salmon (>655 mm long), 9,242 $\pm$ 1,549 small chinook salmon (<655 mm), 421,589 $\pm$ 11,381 summer chum salmon, and 253,512 $\pm$ 9,871 fall chum salmon. Occasional sonar periods were missed due to strong wave action. Passage estimates include estimated data from the missed periods. Routine system analyses did not reveal any problems that might interfere with sampling.

KEY WORDS: salmon, hydroacoustic, escapement, species apportionment, net selectivity

INTRODUCTION

Commercial and subsistence fisheries harvest salmon *Oncorhynchus spp.* over more than 1,600 km of the Yukon River in Alaska and Canada. These salmon fisheries are critical to the way of life and economy of people in dozens of communities along the river, in many instances providing the largest single source of food and/or income to local residents.

Management of these fisheries is complex and difficult due to the number, diversity, and geographic range of fish stocks and user groups. Information upon which to base management decisions comes from several sources, each of which has unique strengths and weaknesses. Assessments of abundance in tributaries obtained through aerial and foot surveys, mark-recapture, weirs, towers, or sonar techniques provide stock-specific estimates or escapement indices. Most of this information is obtained after the majority of the fisheries have been conducted. Gillnet test fisheries near the river mouth provide in-season indices of run-strength, but interpretation of these data is confounded by gillnet selectivity, changes in net site characteristics, and varying fish migration routes through the multi-channel river mouth. Also, the functional relationship between test-fishery catches and abundance is unknown.

Hydroacoustic estimates of fish passage from this project complement information obtained from other sources. The project uses fixed location, single-beam sonar to estimate daily upstream passage of fish. A series of gillnets with different mesh sizes were drifted through the acoustic sampling areas to apportion the passage estimates to species. The project is located at river km 197 near Pilot Station, far enough upriver to avoid the wide, multiple channels of the Yukon River delta. Because salmon migrate from the river mouth to the sonar site in two to three days, the project provides timely fish abundance information to managers of fisheries downstream of the sonar site. There is only one major spawning tributary (the Andreafsky River) downstream from the sonar site.

The Yukon River sonar project has provided daily passage estimates to fisheries managers for most years since 1986. The main challenges faced by the project have been to use sonar technology to detect fish migrating past the sonar site and to develop viable methods for estimating the relative abundance of each species detected. The project has used hydroacoustic equipment since 1993 that operates at a lower frequency (120 kHz) than formerly (420 kHz), and is capable of detecting fish at longer ranges. In addition, species apportionment methodology has been streamlined, and net selectivity has been estimated more accurately (Fleischman et al. 1995). Project objectives in 2000 were to provide daily and seasonal passage estimates for chinook and chum salmon, estimate the precision of these estimates, and perform routine system analyses to ensure consistent data collection and to provide early detection of problems that might arise.

METHODS

Hydroacoustic Data Acquisition

Equipment

Sonar equipment for the right bank (relative to a downstream perspective) of the Yukon River included: 1) a Biosonics[1] Model 101 (SN 83-036) 120/420 kHz echosounder configured to transmit and receive at 120 kHz; 2) an International Transducer Co. (I.T.C.) Model 5398 120 kHz transducer (SN 003) configured for dual-beam use as Case II (3.6°x9.2° narrow, 12.3°x22° wide beam); 3) two 304.8 m (1,000 ft) Carol Model 1302 microphone conductor cables (SN's 201 and 202) connecting sounder to transducer; 4) a Hydroacoustic Technology, Inc. (H.T.I.) Model 403 digital chart recorder coupled with a Panasonic KXP 1624 dot matrix printer; and 5) a Hewlett-Packard Model 54501A digital storage oscilloscope.

Left-bank sonar equipment included: 1) a Biosonics 102 (SN 89-019) 120/420 kHz echosounder configured to operate at 120 kHz; 2) an I.T.C. Model 5398 120 kHz transducer (SN 008) configured for dual-beam use, Case I (2.0°x4.9° narrow, 4.2°x9.9° wide beam); an I.T.C. Model 5398 120 kHz transducer (SN 005) configured for dual-beam use, Case I (2.1°x4.9° narrow, 3.8°x9.7° wide beam); 3) four 304.8 m (1,000 ft) Belden Model 8412 microphone conductor cables (SN's 501 and 502 were used with transducer 008, and 503 and 504 were used with transducer 005) connecting sounder to transducers; 4) H.T.I. Models 401 and 403 digital chart recorders coupled with a Panasonic KX-P3696 dot matrix printer; and 5) a Hewlett-Packard Model 54501A digital storage oscilloscope.

In addition, a complete backup system was kept in camp in the event of a failure. This backup system consisted of: 1) a Biosonics Model 101 (SN 83-039) echosounder configured to operate at 120 kHz; 2) an I.T.C. Model 5398 120 kHz transducer (SN 004) configured for dual-beam use, Case I (2.0°x4.6° narrow, 3.9°x9.2° wide beam) and Case II (4°x9.4° narrow, 13°x22.5° wide beam); 3) two 304.8 m (1,000 ft) Belden Model 8412 microphone conductor cables (SN's 605K and 606K); 4) an H.T.I. Model 403 digital chart recorder; and 5) three Panasonic KX-P3696 dot matrix printers.

Each sounder/transducer/cable configuration was calibrated prior to the field season (Table 1).

Transducers were mounted on metal tripods and remotely aimed with Remote Ocean Systems (ROS) PT-25 dual-axis rotators. Rotator movements were controlled with a ROS PTC-1 controller

[1] Mention of a company's name does not constitute endorsement by ADF&G.

with position feedback to the nearest 0.1° (±0.3°). Gasoline generators (3500 W) supplied 120 VAC power.

Sampling Procedures

We deployed a single transducer on the left (south) bank and right bank at a point where the river is approximately 1,000 m wide (Figure 1). The right bank has a stable, rocky bottom that drops off steeply to the thalweg (Figure 2) with a vertical angle of 8.7° calculated from a depth of 22.9 m at a range of 150 m. We positioned the right-bank transducer 5-10 m from shore, adjusting the aim between two strata (0-50 m) and (50-150 m) to position the beam as close to the river bottom as possible for each sample.

The left-bank river bottom drops off gradually with a vertical angle of 2.3°, calculated from a depth of 11.9 m at 300 m, with a slightly steeper slope nearshore, 4.2° calculated from a depth of 3.7 m at 50 m (Figure 3). A single transducer was deployed nearshore approximately 10 m from shore utilizing three aims to sample a nearshore stratum (0-60 m), a midshore stratum (60-160 m), and an offshore stratum (160-300 m). The transducer was repositioned frequently to compensate for the dynamic water level.

Each acoustic sampling stratum was subdivided into five equal range sectors. Sample data were tallied by sector in 15-minute intervals during daily sampling periods from 0530 to 0830, 1330 to 1630, and 2130 to 0030 alternating every ½ hour between strata.

We counted echoes as fish if at least one ping in the cluster passed the second printer threshold level (see Equipment Settings, Thresholds, Data Storage) and the targets did not resemble inert downstream objects. Multiple fish tracings were marked if there was a discontinuity in the tracing and the second mark indicated movement in a direction different from the first. Fish tracings were tallied on field data forms and then entered into an RBase database. The data were checked daily for data entry or tallying errors, then processed using statistical data processing (SAS) software.

All personnel were trained to distinguish between fish tracings and non-target echoes. The project leader or the crew leader reviewed chart printouts daily to insure the accuracy of marked fish tracings and reduce individual biases. Each chart image was checked for indications of signal loss and changes in bottom reverberation markings that might indicate a movement of the transducer or a change in bottom structure.

We sampled continuously for 24 hours on 28 June, 12 and 26 July, and 16 and 30 August to estimate uncertainty associated with the normal sonar sampling schedule. Sampling was divided among sampling strata in proportions consistent with the regular sampling schedule.

Equipment Settings, Thresholds, Data Storage

We used a 40 log(R) time-varied gain (TVG), a 10 kHz bandwidth, and 0.4 ms transmit pulse duration during all sampling activities. Pulse repetition rates were set below the maximum allowed by range to avoid overloading printer buffers. On the left bank, the nearshore strata transmit intervals were set to 0.3 s, the midshore strata was set at 0.4 s and the offshore strata was set at 0.5 s. The transmit interval for the right bank nearshore strata was set at 0.3 s and the offshore strata was initially set at 0.4 s to avoid overloading the printer buffer but was later set at 0.3 s to increase fish detection ability.

All sampling was conducted using elliptical dual beam transducers operating in single beam mode. On the right bank, the narrow beam (3.6°x9.2°) was used although it was later decided that the wide beam would be preferable as it covers a larger proportion of the water column. On the left bank, the nearshore region was sampled using the wide beam (4.2°x9.9°), while the midshore and offshore regions were sampled with the narrow beam (2.0°x4.9°).

Echoes were digitized by chart recorders, then printed on wide carriage, continuous-feed paper using dot matrix printers, and paper charts were archived. Four printer thresholds corresponding to degrees of gray-line were set for all strata in approximately 3 dB increments. Initially, the lowest sampling threshold, set at –42 dB, was approximately 11 dB lower than the theoretical on-axis target strength of a chum salmon of minimal length (450 mm), calculated using Love's equation (Love, 1977). Lowering the threshold by 11 dB allows for detection across the nominal beam width (6 dB) and some variability (~5 dB) induced by fish aspect and noise corruption. Left bank thresholds were adjusted frequently to compensate for environmentally induced signal loss by reducing the threshold to a level where bottom reflections were again detectable across the strata's range (Appendix A). On the right bank, the majority of sampling was conducted at a threshold of –40 to –50 dB. On occasion, this threshold was raised to eliminate unwanted noise, or lowered to compensate for loss associated with wave action (Appendix B). Threshold levels (in mV) were recorded and converted to target strength, TS_{dB}, as follows:

$$TS_{dB} = 20 \bullet \log\left(\frac{T_{mV}}{1000mV}\right) - \left(SL + G_S + G_R\right) \qquad (1)$$

where

T_{mV} = chart recorder threshold in mV,
SL = transmitted source level in dB,
G_S = through-system gain,
G_R = receiver gain.

Aiming

The transducer was always aimed to maximize fish detection. Horizontally, the beam was oriented along the best bottom profile approximately perpendicular to fish movement so the majority of fish would present the largest possible reflective surface. Since most fish travel close to the substrate, the maximum response angle of the beam was oriented along the river bottom through as much of the range as possible.

Fluctuating water level required frequent repositioning and subsequent re-aiming of the transducer beam. The left-bank transducers were re-aimed more often to compensate for the dynamic bottom conditions on that side of the river. Rotator settings for each new aim were documented and chart printouts of the new aim were marked and dated. Because rotator position displays are only accurate to about 0.3 degrees, returning to the same rotator settings did not guarantee a return to the same aim. All personnel were trained to first re-aim to established pan and tilt settings, then refine that aim to match bottom striations on the current chart printout with those of displayed chart samples when changing between sampling strata, and to notify a supervisor if an acceptably close chart image match could not be re-established.

System Analyses

The hydroacoustic system was routinely analyzed following procedures first established in 1995 (Maxwell et al., 1997). System analyses included equipment performance checks, bottom profiles using down-looking sonar, hydrologic measurements, and drift gillnetting both behind the transducer and over the sandbar in the middle of the river to test for target species outside of the counting range.

Hydroacoustic Equipment Checks

We measured the transmitter output through a 50 ohm load periodically during the field season and compared our results to values obtained from pre-season calibrations. Through the field season we checked the TVG circuitry of both echosounders by measuring the voltages of internally generated calibration signals amplified by the 40 log (R) TVG circuitry at four ranges (25 m, 50 m, 100 m, and 250 m). We calculated and compared the theoretical voltage at 1 m using measured voltage and range values.

Bottom Profiles

Bottom profiles were recorded along both banks using a Lowrance X-15 fathometer (192 kHz) with a 20 degree conical beam to locate deployment sites with suitable linear bottom profiles. Inseason, the fathometer was used regularly to monitor changing bottom conditions and to watch for the formation of sandbars capable of re-routing fish to unensonified areas. A bathymetric map of the sampling area was created during the 1999 field season (Figure 4) to document bottom conditions and sandbar formation.

Hydrologic Measurements

Hydrological measurements were recorded daily. Water level was measured using a staff gauge located offshore from the field camp. The water level measurements were adjusted to the United States Geological Survey Water Resources Division reference located approximately 500 m downstream of Pilot Station to allow comparison of water levels from previous years. Conductivity, air and water temperature, and secchi disk measurements were collected daily offshore along both banks.

Species Composition Data Acquisition

Equipment and Procedures

Gillnets were drifted in three zones (right bank, left-bank nearshore, and left-bank offshore) within corresponding sonar sampling areas to estimate species composition. Eight mesh sizes were fished to effectively capture all size classes of fish present and detectable by the hydroacoustic equipment. During the summer season (prior to 19 July), gillnets of mesh sizes 216 mm (8.5 in), 43 meshes deep (MD); 191 mm (7.5 in), 48 MD; 165 mm (6.5 in), 55 MD; 133 mm (5.25 in), 69 MD; 102 mm (4 in), 90 MD; and 70 mm (2.75 in), 131 MD, were used. The 216 mm (8.5 in) and 133 mm (5.25 in), were discontinued starting 19 July. At this time the following nets were added, 146 mm (5.75 in), 63 MD and 127 mm (5.0 in), 72 MD. All nets were 45.7 m (25 fathoms, 52.5 stretch fathoms) long and 7.6 m (25 ft) deep. Nets were constructed of Momoi MTC-50 or MT-50, shade 11 or 3, double knot multifilament nylon twine and hung using a 2:1 hanging ratio.

Gillnetting took place between sonar periods twice daily from 0915 to 1215 and 1715 to 2015. During each gillnet sampling period four nets were drifted within each of three zones, one on the right bank and two on the left bank, for a total of 24 drifts per day. The shoreward end of the left-bank nearshore drift was approximately 5 to 10 m from shore. The left-bank offshore drift originated further offshore (approximately 70 m) so as not to overlap with the nearshore drift. All drifts with one net were completed before switching to the next net. The two left-bank drifts with a given net were not done consecutively (i.e., drifts were done on alternate banks: left-right-left), so that there was a minimum of 20 minutes between the drifts on the same bank.

Four times were recorded to the nearest second onto field data sheets for each drift: net start out (SO), net full out (FO), net start in (SI), and net full in (FI). Fishing time (t), in minutes, for each drift was approximated as

$$t = SI - FO + \frac{FO - SO}{2} + \frac{FI - SI}{2}. \qquad \textbf{(2)}$$

Drifts were generally eight minutes in duration, but were shortened when necessary to avoid snags and limit catches during times of high fish passage.

Captured fish were identified to species and measured to the nearest 5 mm length. Salmon species were measured from mid-eye to fork of tail; non-salmon species were measured from snout to fork of tail. Fish species, length and sex were entered onto field data sheets. Each drift record included the date, fishing time, sampling period, mesh size, length of net, and captain's initials. Scale samples were collected from chinook salmon, mounted on scale cards, and referenced to test-fishing data sheets. Data were transferred from field data sheets into an R:Base database and processed using SAS software. Scale data will be processed and reported separately.

Prior to 1999, any chinook salmon that was less than 700 mm in length was called a "jack". This length was originally calculated as the average length of a chinook salmon under 10 lbs (Tracy Lingnau, ADF&G, Anchorage, personal communication). In 1999, this length was changed when analysis of age and length data collected from 1993 through 1998 produced an average length of 655 mm separating four and five year old chinook salmon (Pfisterer and Maxwell 2000).

Genetic sampling of chum salmon occurred from 5 July through 1 August. Information collected on each fish included age, sex, length and genetic data. Thirty fish were selected at random following each fishing period. On days in which only one fishing period occurred, 60 fish were sampled from that period. Heart, liver and muscle tissues were extracted from the selected chum salmon, placed in numbered cryotubes, and then frozen in liquid nitrogen. The ADF&G genetics laboratory will analyze these data.

Captured fish were distributed to local villagers or sold to local processors whenever possible. We recorded quantities of fish distributed daily for local subsistence needs.

Species Proportions

Species proportions were estimated from relative gillnet sampling catch-per-unit-effort (CPUE) data, after first adjusting for gillnet size-selectivity. Separate gillnet selectivity curves (Maxwell, 2000) were used for chinook salmon, summer run chum salmon, fall run chum salmon, coho salmon (*O. kisutch*), pink salmon *(O. gorbuscha)*, whitefish *(Coregonus spp.)*, cisco *(C. sardinella, C. laurettae)*, and a combined group of all other species.

Analytical Methods

Fish Passage

Daily fish passage was estimated by summing the counts over all sectors, converting this number to an hourly passage rate, averaging the passage rate from each sampling period, and expanding

the final count temporally to obtain the daily estimate. Total daily passage was estimated separately for each zone. Zone 1 consisted of the entire counting range on the right bank, corresponding to strata 1 and 2. Zone 2 consisted of the counting range from 0 to 60 m on the left bank, corresponding to stratum 3. Zone 3 consisted of the counting range from 60 to 300 m, corresponding to strata 4 and 5.

Total fish (y) passing through stratum s of zone z during sample q of sonar period p of day d was calculated by summing net upstream targets over all sectors c,

$$y_{dzpsq} = \sum_{c} y_{dzpsqc} . \tag{3}$$

The passage rate (r) in fish per hour, for stratum s of zone z during sonar period p of day d, was computed as:

$$r_{dzps} = \frac{\sum_{q} y_{dzpsq}}{\sum_{q} h_{dzpsq}} , \tag{4}$$

where h_{dzpsq} is the duration, in hours, of sample q of sonar period p of day d for stratum s of zone z. The passage rate for zone z during sonar period p of day d was computed as the sum of passage rates for strata associated with each zone,

$$r_{dzp} = \sum_{s} r_{dzps} . \tag{5}$$

The passage rate for zone z during day d was estimated by the average sonar period passage rate,

$$\hat{r}_{dz} = \frac{\sum_{p} r_{dzp}}{n_{sdz}} , \tag{6}$$

where n_{Sdz} is the number of sonar periods during day d on zone z. Finally, the total passage of fish in zone z during day d was estimated as

$$\hat{y}_{dz} = 24\, \hat{r}_{dz} . \tag{7}$$

Sonar sampling periods, each three hours in duration, were spaced at regular (systematic) intervals of eight hours. Treating the systematically sampled sonar counts as a simple random sample would yield an over-estimate of the variance of the total, since sonar counts were highly autocorrelated (Wolter 1985). To accommodate these data characteristics, a variance estimator based on the squared differences of successive observations, recommended by Brannian (1986) and modified from Wolter (1985), was employed;

$$\hat{V}ar(\hat{y}_{dz}) = 24^2 \frac{1 - f_{dz}}{n_{Sdz}} \frac{\sum_{p=2}^{n_{Sdz}} (\hat{r}_{dzp} - \hat{r}_{dz,p-1})^2}{2(n_{Sdz} - 1)}, \tag{8}$$

where f_{dz} denotes the first-stage sampling fraction, 8 hrs/24 hrs = 0.33.

Missing Data

Equipment malfunctions and other uncontrollable events occasionally result in missing sonar data. When individual subsamples within a sonar period were missed, fish passage was estimated based on existing subsamples for that period. If a portion of a subsample was missed, fish passage was estimated from the remaining sample provided the sample contained at least five of the fifteen minutes. Data missing from a single stratum for an entire period or more was estimated from data obtained from period(s) sampled during the same day.

Species Composition

The catch (c) of species i and length l during drift j of mesh m during gillnet sampling period f in zone z on day d was first adjusted for gillnet selectivity (s) of species i and length l in mesh m. Adjusted catch (a) was calculated as

$$a_{ildzfmj} = \frac{c_{ildzfmj}}{s_{ilm}}, \tag{9}$$

if selectivity was at least 0.10. If selectivity was less than 0.10, adjusted catch was set to zero.

The proportion (p) of species i during test-fishing period f in zone z on day d was then estimated by the ratio of the sum of the catch of all lengths of species i to the sum of the product of the gillnet selectivity and effort (e) to the total of the same quantity summed over all species, i.e.,

$$\hat{p}_{idzf} = \frac{\dfrac{\sum_m c_{idzf}}{\sum_m s_{ilm} e_{dzfm}}}{\sum_i \sum_l \left(\dfrac{\sum_m c_{ildzfm}}{\sum_m s_{ilm} e_{dzfm}} \right)}. \tag{10}$$

For zone z on day d, the proportion of species i was estimated as

$$\hat{p}_{idz} = \frac{\dfrac{\sum_{f}\sum_{m} c_{ildzfm}}{\sum_{f}\sum_{m} s_{ilm} e_{dzfm}}}{\sum_{i}\sum_{l}\left(\dfrac{\sum_{f}\sum_{m} c_{ildzfm}}{\sum_{f}\sum_{m} c_{ildzfm} e_{dzfm}}\right)}. \tag{11}$$

The estimator of the variance of p_{idz}

$$\hat{V}ar(\hat{p}_{idz}) = \frac{1}{n_{Tdz}} \frac{\sum_{f}(\hat{p}_{idz} - \hat{p}_{idz})^2}{n_{Tdz} - 1} \tag{12}$$

where:

n_{Tdz} = number of gillnet sampling periods in zone z during day d.

Fish Passage by Species

The passage of species i in zone z during day d was estimated by

$$\hat{y}_{idz} = \hat{y}_{dz} \bullet \hat{p}_{idz}. \tag{13}$$

Finally, passage estimates were summed over all zones and all days to obtain a seasonal estimate for species Y_i,

$$\hat{Y}_i = \sum_{d}\sum_{z} \hat{y}_{idz}. \tag{14}$$

Except for the timing of sonar and gillnet sampling periods, sonar-derived estimates of total fish passage were independent of gillnet-derived estimates of species proportions. Therefore the variance of their product (daily species passage estimates y_{idz}) was estimated as the variance of the product of two independent random variables (Goodman, 1960),

$$\hat{V}ar(\hat{y}_{idz}) = \hat{y}^2_{dz}\hat{V}ar(\hat{p}_{idz}) + \hat{p}^2_{idz}\hat{V}ar(\hat{y}_{dz}) - \hat{V}ar(\hat{y}_{dz})\hat{V}ar(\hat{p}_{idz}) \tag{15}$$

Finally, passage estimates (equation **14**) are assumed independent between zones and among days, so the variance of their sum (equation **15**) was estimated by the sum of their variances.

than four, the reporting period was extended by including data from an adjacent day whose data (both passage rate and species composition) appeared most similar. In 2000, reporting periods longer than one day were used on 15 occasions.

Hydroacoustic Estimates

An estimated 1,320,569 ± 13,449 s.e. fish passed through the sonar beams during the 2000 field season; 356,781 ± 5,198 (27 %) along the right bank, 647,363 ± 11,799 (49 %) along the left bank nearshore, and 316,425 ± 3,826 (24 %) along the left bank midshore and offshore. Tables 4 and 5 provide daily records of passage estimates by zone, standard errors, and the total passage coefficients of variation.

Chum salmon were the most abundant species during both summer and fall seasons (Figure 7). Chum salmon passage estimates totaled 675,001 with 421,589 ± 11,381 passing the sonar site during the summer season from 12 June through 18 July and 253,512 ± 9,871 passing during the fall season from 19 July through 31 August (Table 6). The summer chum salmon run was dominated by two main pulses occurring around the 6th and 29th of June, while the fall chum salmon run consisted of two small pulses occurring around the 31st of July and the 13th of August. Chinook salmon passage estimates were composed of 63,451 ± 4,814 fish greater than 655 mm in length, and 9,242 ± 1,549 "jacks" shorter than 655 mm. Coho salmon passage estimates reached 183,192 ± 8,871. Other species, totaling 389,583 ± 13,953 fish, included pink salmon, cisco, whitefish, inconnu (*Stenodus leucichthys*), burbot (*Lota lota*), sucker (*Catostomus catostomus*), Dolly Varden (*Salvelinus malma*), sockeye salmon (*Oncorhynchus nerka*), and northern pike (*Esox lucius*). Daily passage estimates by species for the summer and fall seasons are listed in Tables 7 and 8.

Passage estimates for both chum and chinook salmon were the lowest on record. Chum and chinook passage estimates were 32% and 61% below 1998 estimates respectively (Figure xx). The summer chum salmon run started at about the same time as in 1998 and 1999 with 25% of the 2000 run occurring by 24 June, about four days later than the 1995 and 1997 runs (both 20 June). About 75% of the 2000 run passed through by 7 July, compared to 4 July 1999, 5 July 1997 and 1998 and 3 July 1995. Twenty-five percent of the fall season chum salmon run passed the sonar site by 30 July, six days earlier than in 1999, with the majority of the run (75%) passing by 20 August, 2000 (Figure 10).

The chinook salmon run was four days earlier than 1998 and 1999 with 25 % of the run passing by 21 June (Figure 11). The majority of the chinook salmon (75%) passed the sonar site by 30 June, earlier than in 1999 (4 July) and 1998 (6 July) but later than in 1997 (24 June) and 1995 (27 June). The last chinook salmon captured in 2000 was on 11 August.

The summer and fall passage was plotted as a percentage in 20 m range increments by bank and season for 1995 through 2000 to illustrate the horizontal distribution of fish in the sampling area (Figures 14 and 15). Passage levels declined sharply as a function of the distance offshore. On the

measures appear to be more a result of sampling location rather then temporal differences. Offshore from the left bank, secchi disk measurements varied from 3 to 14 cm below the surface with an average visibility of 8.5 cm. Secchi disk visibility ranged from 3 to 17 cm off the right bank with an average visibility of 10.7 cm. Right bank secchi disk visibility remained higher throughout most of the field season compared to left bank (Figure 16).

Inseason transmitter output measurements from the project's echosounders showed little deviation (1.44 – 1.80 dBV) from pre-season values (Table 1b).

A reverberation band appeared though most of the field season in the left bank nearshore strata and may have affected our ability to detect fish during some periods (Maxwell and Huttunen, 1998; Maxwell, 2000).

As in 1998 and 1999, range-dependent signal loss was observed on left bank during the 2000 field season. Signal loss was detected by the decrease in signal amplitude reflected from the bottom structure. The majority of the signal loss was detected at ranges greater than 150 m. There was no apparent range-dependent signal loss observed on the right bank, however, the maximum range on right bank was less than 150 m. Previous comparisons between signal loss at range and turbidity indicated that a strong relationship exists (Pfisterer and Maxwell 2000).

DISCUSSION

Yukon River sonar passage estimates for 2000 agreed well with other salmon assessment projects in the drainage. The horizontal distribution of fish detected on the left bank was closer to shore than in previous years (Figures 14 and 15). Horizontal distribution is probably due to a combination of factors such as fish passage rate, species composition and water level. The extremely low fish passage this year may help to explain the close distribution of fish to the shore. The sharp decline in fish passage with increasing range suggests that most fish pass within the ensonified range.

The 24-hour sonar estimates compared reasonably with the normal nine hour estimates. Of the five days in which 24-hour samples were collected, the 24-hour estimates were higher on four days and lower on one. Based on this small sample size, it appears that the normal sampling routine is adequate to assess fish passage at this site. Also, comparisons made in previous years have yielded similar observations (Maxwell, 2000; Pfisterer and Maxwell, 2000; Maxwell and Huttunen, 1998; Maxwell et al., 1997).

Right bank bottom profiles were similar to prior years with little or no change throughout the season. On the left bank, the profile at the sampling site remained linear throughout the field season although there were a few time gaps when profiles were not completed. Suitable profiles for sonar assessment were found on both sides of the river.

Two sandbars observed in past years were present this field season. The Atchuelinguk sandbar remained far upstream of the sampling region. Downward progression of this sandbar is unlikely due to its proximity to the cutbank on the Yukon River and the confluence of 1st Slough and the Yukon River downstream of the bar. The upper portion of the bar was fished daily during the 1999 summer season and every other day during the fall season and on two occasions in 2000. The number of fish caught over the bar was small compared to the normal apportionment drifts. During the next field season it will remain important to continue monitoring the movement of the sandbar, the fish distribution, and the presence of fish along the sandbar.

Estimating fish passage in the Yukon River continues to present major technical and logistic challenges. The sampling environment is often demanding due to the extremely dynamic nature of the water level, turbidity, bottom substrate, and range-dependent signal loss. The hydroacoustic system that we employ in the Yukon River appears to work well for the purpose of detecting passing salmon. We were able to compensate for identified signal loss throughout the field season by modifying equipment parameters in response to the frequent environmental changes. The system changes are largely subjective and thus, hard to objectively quantify as to absolute detectability. Successful estimation of fish passage depends upon constant attention to the frequent changes and diligent re-checking of every part of the acoustic and environmental system.

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Table 1a. Pre-season Yukon River sonar equipment calibration data, 2000.

Sounder	Sounder	Transducer	Receiver Gain L	Vdet NB 40	G1 NB 40	Vdet WB 40	G1 WB 40
101-83-036	1000' Carol 202/201	ITC 003 Case II	0	0.000	-172.454	-3.609	-176.063
101-83-039	1000' Belden 606K/605K	ITC 004 Case II	0	0.000	-175.756	4.801	-170.955
101-83-039	1000' Belden 606K/605K	ITC 004 Case I	0	-0.602	-170.256	0.000	-169.654
102-89-019	1000' Belden 502Y/501Y	ITC 008 Case I	0	0.000	-181.753	0.796	-180.957
102-89-019	1000' Belden 504Y/503Y	ITC 005 Case I	0	-12.217	-193.269	-0.158	-181.210

Continued

Sounder	Cables	Transducer	-13 dB SL	-10 dB SL	-6 dB SL	-3 dB SL	0 dB SL
101-83-036	1000' Carol 202/201	ITC 003 Case II	206.080	209.220	213.217	216.121	219.237
101-83-039	1000' Belden 606K/605K	ITC 004 Case II	205.649	208.508	212.444	215.576	218.697
101-83-039	1000' Belden 606K/605K	ITC 004 Case I	210.489	213.869	218.015	220.963	224.107
102-89-019	1000' Belden 502Y/501Y	ITC 008 Case I	213.155	216.033	220.059	223.002	226.108
102-89-019	1000' Belden 504Y/503Y	ITC 005 Case I	213.754	216.840	220.810	223.711	226.946

Table 1b. Comparison of transmit power of left and right banks echosounders measured pre and post-season.

Biosonics echosounder 101-89-019 (left bank)

Setting	Pre-season (dBV)	Post-season (dBV)	Difference (dBV)
0 dB	49.86	48.40	1.46
-3 dB	46.82	45.30	1.52
-6 dB	43.84	42.40	1.44
-10 dB	40.07	38.60	1.47
-13 dB	37.20	35.73	1.47

Biosonics echosounder 101-83-036 (right bank)

Setting	Pre-season (dBV)	Post-season (dBV)	Difference (dBV)
0 dB	44.59	43.01	1.58
-3 dB	41.47	39.91	1.56
-6 dB	38.57	36.99	1.58
-10 dB	34.49	32.90	1.59
-13 dB	31.80	30.00	1.80

Table 2. Summary of daily testfishing catches by species from 9 June to 18 July for the Yukon River sonar project, 2000.

Date	Drift Time	Chinook >=655mm	Chinook <655mm	Summer Chum	Coho	Pink	Whitefish Species	Cisco	Other Species	Total Catch
06/09/00	2:49:05	9	0	31	0	0	0	3	8	51
06/10/00	2:14:40	6	4	45	0	0	1	2	10	68
06/11/00	2:40:08	4	0	14	0	0	1	3	9	31
06/12/00	2:31:00	11	1	31	0	0	1	1	2	47
06/13/00	2:32:30	10	2	93	0	0	0	1	4	110
06/14/00	2:25:45	10	0	36	0	0	2	1	2	51
06/15/00	2:14:29	10	1	28	0	0	0	0	1	40
06/16/00	2:22:16	7	0	22	0	0	0	0	3	32
06/17/00	2:45:20	8	2	21	0	0	0	1	3	35
06/18/00	2:44:37	14	2	21	0	0	0	1	4	42
06/19/00	2:32:43	8	3	36	0	0	0	0	1	48
06/20/00	1:44:24	33	8	215	0	0	0	0	1	257
06/21/00	1:29:47	23	5	161	0	0	0	1	2	192
06/22/00	1:25:28	30	5	153	0	0	0	1	0	189
06/23/00	1:51:59	19	1	121	0	0	0	0	3	144
06/24/00	1:55:50	21	1	111	0	1	0	0	6	140
06/25/00	1:55:08	19	5	65	0	0	0	0	0	89
06/26/00	2:05:22	17	4	75	0	0	0	1	1	98
06/27/00	1:54:21	11	3	28	0	0	0	0	2	44
06/28/00	1:50:22	10	3	171	0	0	0	0	2	186
06/29/00	1:33:33	12	1	156	0	0	0	0	2	171
06/30/00	1:38:31	21	1	153	0	2	0	2	0	179
07/01/00	1:54:58	23	1	102	0	1	0	3	2	132
07/02/00	2:01:48	16	4	106	0	5	0	4	2	137
07/03/00	2:00:51	10	5	72	0	11	1	1	1	101
07/04/00	2:20:18	15	0	57	0	5	0	0	4	81
07/05/00	2:18:20	9	1	62	0	10	0	2	6	90
07/06/00	2:20:18	6	0	79	0	8	2	3	5	103
07/07/00	2:16:45	4	0	157	0	10	1	7	4	183
07/08/00	2:29:33	4	0	60	0	15	3	9	0	91
07/09/00	2:24:52	8	0	35	0	6	1	2	1	53
07/10/00	2:32:30	5	1	40	0	32	1	7	5	91
07/11/00	2:19:58	3	0	56	0	13	3	3	4	82
07/12/00	2:19:15	6	0	68	0	27	7	4	4	116
07/13/00	2:28:03	6	0	33	0	17	1	6	0	63
07/14/00	2:26:52	1	0	26	0	11	0	2	1	41
07/15/00	2:35:33	1	0	13	0	5	1	3	5	28
07/16/00	2:32:29	2	0	5	0	22	1	2	3	35
07/17/00	2:31:27	1	0	10	0	36	3	5	5	60
07/18/00	2:51:56	0	0	49	0	6	1	2	2	60
Summer Totals	90:03:04	433	64	2,817	0	243	31	83	120	3,791

Table 3. Summary of daily testfishing catches by species from 19 July to 14 September for the Yukon River sonar project, 2000.

Date	Drift Time	Chinook >=655mm	Chinook <655mm	Fall Chum	Coho	Pink	Whitefish Species	Cisco	Other Species	Total Catch
07/19/00	2:11:26	2	0	21	0	12	0	5	1	39
07/20/00	2:21:48	1	0	29	0	13	5	8	1	56
07/21/00	2:33:42	1	0	12	0	12	2	7	3	36
07/22/00	2:28:57	1	0	42	0	9	8	2	2	63
07/23/00	2:40:59	0	0	27	0	7	2	3	1	40
07/24/00	2:27:19	0	0	13	0	11	2	5	0	31
07/25/00	2:55:24	4	1	5	0	9	8	1	1	25
07/26/00	2:49:11	0	0	38	0	11	7	6	0	62
07/27/00	2:29:37	0	0	60	1	10	6	15	4	96
07/28/00	2:42:53	0	0	50	3	6	12	29	8	108
07/29/00	2:42:39	0	0	46	4	1	3	11	1	66
07/30/00	2:41:45	0	0	75	2	5	3	15	0	100
07/31/00	2:18:05	0	0	99	1	3	1	40	0	144
08/01/00	2:49:26	0	0	58	11	4	13	19	0	105
08/02/00	2:41:31	0	0	35	5	1	7	20	0	68
08/03/00	2:21:59	0	0	13	0	0	3	11	1	28
08/04/00	2:40:38	0	0	26	4	0	12	5	2	49
08/05/00	2:35:44	0	0	12	12	1	13	28	1	67
08/06/00	2:36:12	0	0	23	10	0	15	10	2	60
08/07/00	2:27:50	0	0	41	21	1	10	25	0	98
08/08/00	2:38:45	0	0	13	50	0	6	14	1	84
08/09/00	2:40:44	0	0	26	40	0	10	17	0	93
08/10/00	2:38:07	0	0	4	49	0	6	25	4	88
08/11/00	2:26:21	1	0	1	37	1	4	10	1	54
08/12/00	2:24:42	0	0	21	25	0	3	6	0	55
08/13/00	2:35:13	0	0	61	48	1	13	23	2	148
08/14/00	2:13:53	0	0	49	100	1	15	41	5	211
08/15/00	2:26:52	0	0	29	77	0	11	13	1	131
08/16/00	2:17:36	0	0	40	71	0	8	30	3	152
08/17/00	2:27:31	0	0	25	118	0	12	28	0	183
08/18/00	2:17:52	0	0	7	81	0	21	33	3	145
08/19/00	2:23:41	0	0	9	65	0	34	3	2	113
08/20/00	2:40:55	0	0	41	89	0	14	93	3	240
08/21/00	2:15:24	0	0	31	119	0	22	18	1	191
08/22/00	2:18:12	0	0	23	134	0	8	41	2	208
08/23/00	2:16:39	0	0	14	86	0	12	14	3	129
08/24/00	2:12:21	0	0	33	63	0	9	8	2	115
08/25/00	2:24:54	0	0	35	55	0	5	5	1	101
08/26/00	2:02:33	0	0	11	92	0	3	7	2	115
08/27/00	2:26:49	0	0	8	62	0	4	5	1	80
08/28/00	2:32:31	0	0	3	44	0	6	2	1	56
08/29/00	2:29:59	0	0	3	25	0	1	3	1	33
08/30/00	2:33:39	0	0	15	30	0	3	6	3	57
08/31/00	2:21:10	0	0	9	36	0	3	6	0	54
09/01/00	2:32:38	0	0	3	56	0	5	16	2	82
09/02/00	2:26:45	0	0	7	34	0	2	3	2	48
09/03/00	2:37:15	0	0	9	48	0	7	18	1	83
09/04/00	2:19:12	0	0	4	26	0	4	16	1	51
09/05/00	2:30:40	0	0	6	30	0	6	18	1	61
09/06/00	2:32:25	0	0	1	30	0	18	55	4	108
09/07/00	2:22:20	0	0	4	20	0	7	23	0	54
09/08/00	2:19:57	0	0	5	18	0	6	10	0	39
09/09/00	2:35:53	0	0	4	9	0	13	12	1	39
09/10/00	2:47:57	0	0	0	12	0	13	33	4	62
09/11/00	2:23:09	0	0	3	15	0	6	7	2	33
09/12/00	2:32:38	0	0	1	11	0	10	16	1	39
09/13/00	2:29:32	0	0	4	11	0	6	10	2	33
09/14/00	2:36:51	0	0	8	10	0	9	13	5	45
Fall Totals	144:50:40	10	1	1,295	2,000	119	477	966	96	4,954
Season Totals	234:53:44	443	65	4,112	2,000	362	508	1,049	216	8,755

Table 4. Daily estimates of fish passage by zone from 12 June to 18 July for the Yukon River sonar project, 2000.

Report Period	Date	Right Bank Passage[a]	Right Bank SE	Left Bank Nearshore[b] Passage	Left Bank Nearshore[b] SE	Left Bank Offshore[c] Passage	Left Bank Offshore[c] SE	Total Passage	Total Passage SE	Total Passage CV	Percent Right Bank	Percent Left Bank
1	6/10/00	638	56	532	37	0	10	1,170	68	0.058	54.53	45.47
2	6/11/00	340		595	170	211	43	1,146	176	0.218	29.68	70.32
3	6/12/00	469		2,251	399	179	14	2,899	399	0.138	16.18	83.82
4	6/13/00	1095		2,429	232	166	22	3,690	233	0.090	29.68	70.32
4	6/14/00	665		1,247	119	327	44	2,239	127	0.081	29.68	70.32
4	6/15/00	364	156	1,096	105	275	37	1,735	192	0.111	20.98	79.02
5	6/16/00	517	19	657	75	131	25	1,305	82	0.063	39.62	60.38
5	6/17/00	594	22	689	79	101	19	1,384	84	0.061	42.92	57.08
6	6/18/00	494	58	1,046	101	287	38	1,827	122	0.067	27.04	72.96
6	6/19/00	867	102	2,007	193	509	67	3,383	228	0.067	25.63	74.37
7	6/20/00	6,138	1545	9,800	2211	1,580	501	17,518	2744	0.157	35.04	64.96
8	6/21/00	11,139	2274	30,599	5078	2,613	660	44,351	5603	0.126	25.12	74.88
9	6/22/00	12,631	1084	14,903	2401	2,068	559	29,602	2693	0.091	42.67	57.33
10	6/23/00	8,823	557	10,729	3276	2,516	194	22,068	3329	0.151	39.98	60.02
11	6/24/00	7,275	335	3,547	279	4,516	129	15,338	455	0.030	47.43	52.57
12	6/25/00	6,856	774	5,972	1055	3,622	205	16,450	1324	0.081	41.68	58.32
13	6/26/00	4,928	239	3,323	517	4,250	725	12,501	922	0.074	39.42	60.58
14	6/27/00	5,338	706	1,253	565	3,386	560	9,977	1064	0.107	53.5	46.5
15	6/28/00	12,832	1649	6,541	2446	4,224	74	23,597	2951	0.125	54.38	45.62
16	6/29/00	21,549	2220	28,342	4999	7,550	410	57,441	5485	0.095	37.52	62.48
17	6/30/00	15,642	1182	16,818	940	8,251	452	40,711	1576	0.039	38.42	61.58
18	7/1/00	10,371	832	11,785	489	6,907	1212	29,063	1549	0.053	35.68	64.32
19	7/2/00	6,679	231	7,842	1810	5,192	491	19,713	1889	0.096	33.88	66.12
20	7/3/00	6,179	846	4,134	554	3,588	107	13,901	1017	0.073	44.45	55.55
21	7/4/00	4,332	182	3,610	473	2,438	138	10,380	525	0.051	41.73	58.27
21	7/5/00	3,495	147	3,936	515	2,151	122	9,582	550	0.057	36.47	63.53
22	7/6/00	3,640	188	6,153	922	2,974	340	12,767	1001	0.078	28.51	71.49
23	7/7/00	7,613	1410	7,911	1232	2,973	262	18,497	1891	0.102	41.16	58.84
24	7/8/00	6,974	147	11,140	2681	8,802	836	26,916	2812	0.104	25.91	74.09
25	7/9/00	3,881	278	5,069	309	3,343	181	12,293	453	0.037	31.57	68.43
26	7/10/00	3,837	126	4,989	247	2,981	227	11,807	358	0.030	32.5	67.5
27	7/11/00	4,004	400	7,770	1964	4,423	357	16,197	2036	0.126	24.72	75.28
28	7/12/00	4,828	115	8,717	2483	5,782	1151	19,327	2740	0.142	24.98	75.02
29	7/13/00	3,593	145	5,078	458	6,422	608	15,093	775	0.051	23.81	76.19
29	7/14/00	4,628	187	3,749	338	3,777	358	12,154	527	0.043	38.08	61.92
29	7/15/00	3,823	154	5,285	477	3,963	375	13,071	626	0.048	29.25	70.75
30	7/16/00	3,023	161	5,017	340	3,919	713	11,959	806	0.067	25.28	74.72
30	7/17/00	2,986	159	4,684	317	2,449	445	10,119	570	0.056	29.51	70.49
31	7/18/00	4,914	185	6,614	563	3,521	60	15,049	596	0.040	32.65	67.35
Summer Totals		207,994	4,836	257,859	10,308	122,367	2,802	588,220	11,727			

[a]Right Bank passage extrapolated on 6/11, 6/13, and 6/14

[b]Left Bank Nearshore Range: 0 - 60 m

[c]Left Bank Offshore Range: 60 - 300 m

[d]Estimated from left bank passage

Table 5. Daily estimates of fish passage by zone from 19 July to 14 September for the Yukon River sonar project, 2000.

Report Period	Date	Right Bank Passage	Right Bank SE	Left Bank Nearshore[a] Passage	Left Bank Nearshore[a] SE	Left Bank Offshore[b] Passage	Left Bank Offshore[b] SE	Total Passage	Total Passage SE	Total Passage CV	Percent Right Bank	Percent Left Bank
32	19-Jul-00	2,201	114	5,282	421	4,012	309	11,495	534	0.046	19.15	80.85
32	20-Jul-00	2,267	118	4,385	349	2,736	211	9,388	425	0.045	24.15	75.85
32	21-Jul-00	2,702	140	2,600	207	1,365	105	6,667	271	0.041	40.53	59.47
32	22-Jul-00	2,577	134	4,793	382	3,098	239	10,468	470	0.045	24.62	75.38
32	23-Jul-00	2,622	136	4,426	353	3,017	232	10,065	444	0.044	26.05	73.95
33	24-Jul-00	1,804	77	3,608	149	1,854	118	7,266	205	0.028	24.83	75.17
33	25-Jul-00	1,809	77	3,069	127	1,456	93	6,334	175	0.028	28.56	71.44
33	26-Jul-00	1,565	67	4,276	177	2,715	173	8,556	256	0.03	18.29	81.71
33	27-Jul-00	2,781	118	6,541	271	4,057	258	13,379	393	0.029	20.79	79.21
33	28-Jul-00	2,725	116	7,683	318	4,504	287	14,912	444	0.03	18.27	81.73
34	29-Jul-00	1,633	47	5,561	440	3,711	142	10,905	465	0.043	14.97	85.03
34	30-Jul-00	1,882	54	9,398	744	7,061	271	18,341	794	0.043	10.26	89.74
34	31-Jul-00	2,040	58	16,827	1332	8,100	311	26,967	1369	0.051	7.56	92.44
35	1-Aug-00	2,632	88	12,080	1651	6,011	913	20,723	1889	0.091	12.7	87.3
36	2-Aug-00	1,739	57	8,526	395	4,557	257	14,822	475	0.032	11.73	88.27
36	3-Aug-00	1,590	52	6,281	291	4,376	247	12,247	385	0.031	12.98	87.02
36	4-Aug-00	1,549	50	6,147	285	3,526	199	11,222	351	0.031	13.8	86.2
36	5-Aug-00	1,270	41	5,476	254	2,817	159	9,563	302	0.032	13.28	86.72
37	6-Aug-00	839	82	5,557	337	3,114	608	9,510	700	0.074	8.82	91.18
38	7-Aug-00	990	84	8,171	813	3,652	163	12,813	834	0.065	7.73	92.27
39	8-Aug-00	1,105	68	6,707	614	3,616	504	11,428	797	0.07	9.67	90.33
40	9-Aug-00	1,051	104	5,621	204	2,962	341	9,634	411	0.043	10.91	89.09
41	10-Aug-00	1,255	74	4,779	321	2,141	185	8,175	378	0.046	15.35	84.65
42	11-Aug-00	980	62	5,049	365	1,924	162	7,953	404	0.051	12.32	87.68
42	12-Aug-00	837	53	8,472	613	3,851	325	13,160	695	0.053	6.36	93.64
43	13-Aug-00	1,485	443	15,701	1132	9,403	707	26,589	1406	0.053	5.59	94.41
44	14-Aug-00	2,014	60	14,294	839	7,122	734	23,430	1116	0.048	8.6	91.4
45	15-Aug-00	4,106	577	12,424	1994	5,961	1080	22,491	2340	0.104	18.26	81.74
46	16-Aug-00	4,483	127	11,581	952	6,827	729	22,891	1206	0.053	19.58	80.42
47	17-Aug-00	5,007	391	10,136	691	4,805	214	19,948	822	0.041	25.1	74.9
48	18-Aug-00	5,715	885	6,158	456	3,908	306	15,781	1041	0.066	36.21	63.79
49	19-Aug-00	5,042	509	8,498	554	3,373	474	16,913	889	0.053	29.81	70.19
50	20-Aug-00	6,853	568	10,922	791	6,401	327	24,176	1027	0.042	28.35	71.65
51	21-Aug-00	8,041	458	10,382	1624	6,336	319	24,759	1718	0.069	32.48	67.52
52	22-Aug-00	7,698	509	17,517	2213	6,647	988	31,862	2476	0.078	24.16	75.84
53	23-Aug-00	6,265	367	12,666	2134	3,971	1038	22,902	2401	0.105	27.36	72.64
54	24-Aug-00	5,273	99	13,514	1842	5,634	203	24,421	1856	0.076	21.59	78.41
55	25-Aug-00	4,988	456	9,724	538	3,069	409	17,781	815	0.046	28.05	71.95
56	26-Aug-00	3,848	434	7,052	317	2,757	146	13,657	556	0.041	28.18	71.82
57	27-Aug-00	2,821	129	6,298	669	1,925	169	11,044	702	0.064	25.54	74.46
58	28-Aug-00	3,198	182	7,205	1962	1,905	230	12,308	1984	0.161	25.98	74.02
59	29-Aug-00	3,414	231	6,462	541	1,689	146	11,565	606	0.052	29.52	70.48
59	30-Aug-00	2,400	162	7,636	639	2,122	184	12,158	684	0.056	19.74	80.26
59	31-Aug-00	3,522	238	5,412	453	2,042	177	10,976	541	0.049	32.09	67.91
59	1-Sep-00	3,184	215	5,227	437	2,430	210	10,841	531	0.049	29.37	70.63
60	2-Sep-00	2,104	218	4,781	844	2,259	204	9,144	896	0.098	23.01	76.99
61	3-Sep-00	1,406	76	3,389	178	1,450	52	6,245	200	0.032	22.51	77.49
61	4-Sep-00	1,611	87	2,035	107	1,382	49	5,028	146	0.029	32.04	67.96
62	5-Sep-00	1,161	102	3,759	403	3,195	462	8,115	622	0.077	14.31	85.69
62	6-Sep-00	971	85	2,232	239	1,506	218	4,709	335	0.071	20.62	79.38
62	7-Sep-00	1,618	142	1,269	136	735	106	3,622	224	0.062	44.67	55.33
62	8-Sep-00	896	79	1,822	195	562	81	3,280	226	0.069	27.32	72.68
62	9-Sep-00	811	71	2,110	226	916	133	3,837	271	0.071	21.14	78.86
62	10-Sep-00	647	57	1,734	186	687	99	3,068	218	0.071	21.09	78.91
63	11-Sep-00	1,047	245	1,805	348	456	40	3,308	428	0.129	31.65	68.35
63	12-Sep-00	1,042	244	1,042	201	731	64	2,815	323	0.115	37.02	62.98
64	13-Sep-00	771	157	2,179	419	1,073	225	4,023	501	0.124	19.16	80.84
64	14-Sep-00	900	183	1,223	235	546	114	2,669	319	0.12	33.72	66.28
FALL TOTALS		148,787	1,906	389,504	5,740	194,058	2,606	732,349	6,586			
SEASON TOTALS		356,781	5,198	647,363	11,799	316,425	3,826	1,320,569	13,449			

[a]Left Bank Nearshore Range: 0 - 60 m

[b]Left Bank Offshore Range: 60 - 300 m

Table 6. Cumulative passage estimates by species for the Yukon River sonar project, 2000.

Species	Cumulative Estimated Passage	Standard Error	Coefficient of Variation	Lower 90% Confidence Interval	Upper 90% Confidence Interval
Target Species					
Large Chinook Salmon	63,451	4,814	0.076	55,532	71,370
Small Chinook Salmon	9,242	1,549	0.168	6,694	11,790
	==========				
Total Chinook Salmon	72,693				
Summer Chum	421,589	11,381	0.027	402,867	440,311
Fall Chum	253,512	9,871	0.039	237,274	269,750
	==========				
Total Chum	675,101				
Non-target Species*					
Coho Salmon	183,192	8,871	0.048	168,599	197,785
Other Species	389,583	13,953	0.036	366,630	412,536
	==========				
Total	1,320,569				

*Estimates used in the process of apportioning target species, not for estimating passage rates of non-target species.

Table 7. Daily estimates of fish passage by species from 10 June to 18 July for the Yukon River sonar project, 2000.

Report Period	Date	Chinook > 655 mm	Chinook < 655 mm	Summer Chum	Other Species	Total all Species
1	06/10/00	72	39	781	278	1,170
2	06/11/00	175	0	671	300	1,146
3	06/12/00	799	65	1,752	283	2,899
4	06/13/00	863	117	2,598	112	3,690
4	06/14/00	444	60	1,677	58	2,239
4	06/15/00	312	42	1,277	104	1,735
5	06/16/00	166	25	981	133	1,305
5	06/17/00	176	27	1,035	146	1,384
6	06/18/00	617	122	914	174	1,827
6	06/19/00	1,128	232	1,699	324	3,383
7	06/20/00	4,811	785	11,770	152	17,518
8	06/21/00	7,482	2,008	33,651	1,210	44,351
9	06/22/00	5,401	1,037	22,542	622	29,602
10	06/23/00	3,299	108	18,175	486	22,068
11	06/24/00	1,778	132	12,479	949	15,338
12	06/25/00	3,209	801	12,440	0	16,450
13	06/26/00	2,570	229	8,947	755	12,501
14	06/27/00	1,739	402	7,384	452	9,977
15	06/28/00	1,582	777	21,030	208	23,597
16	06/29/00	6,039	517	50,093	792	57,441
17	06/30/00	4,567	235	32,898	3,011	40,711
18	07/01/00	3,577	252	20,900	4,334	29,063
19	07/02/00	1,519	637	14,919	2,638	19,713
20	07/03/00	818	357	10,620	2,106	13,901
21	07/04/00	1,273	59	6,316	2,732	10,380
21	07/05/00	1,183	64	5,812	2,523	9,582
22	07/06/00	483	0	7,785	4,499	12,767
23	07/07/00	482	0	11,089	6,926	18,497
24	07/08/00	641	0	18,780	7,495	26,916
25	07/09/00	1,066	0	8,575	2,652	12,293
26	07/10/00	792	53	5,970	4,992	11,807
27	07/11/00	349	0	10,683	5,165	16,197
28	07/12/00	554	0	10,895	7,878	19,327
29	07/13/00	441	0	9,339	5,313	15,093
29	07/14/00	498	0	6,790	4,866	12,154
29	07/15/00	466	0	7,035	5,570	13,071
30	07/16/00	220	0	5,482	6,257	11,959
30	07/17/00	217	0	3,933	5,969	10,119
31	07/18/00	0	0	11,872	3,177	15,049
Summer Totals		61,808	9,182	421,589	95,641	588,220

Table 8. Daily estimates of fish passage by species from 19 July to 14 September for the Yukon River sonar project, 2000.

Report Period	Date	Chinook > 655 mm	Chinook < 655 mm	Fall Chum	Coho	Other Species	Total all Species
32	07/19/00	232	0	6,211	0	5,052	11,495
32	07/20/00	203	0	4,730	0	4,455	9,388
32	07/21/00	156	0	2,817	0	3,694	6,667
32	07/22/00	225	0	5,277	0	4,966	10,468
32	07/23/00	215	0	5,046	0	4,804	10,065
41	07/24/00	83	10	3,007	98	4,068	7,266
41	07/25/00	74	10	2,513	89	3,648	6,334
41	07/26/00	92	9	3,889	103	4,463	8,556
41	07/27/00	145	16	5,949	167	7,102	13,379
41	07/28/00	165	15	6,641	184	7,907	14,912
42	07/29/00	0	0	7,511	264	3,130	10,905
42	07/30/00	0	0	13,288	410	4,643	18,341
42	07/31/00	0	0	18,952	680	7,335	26,967
43	08/01/00	0	0	14,579	1,408	4,736	20,723
44	08/02/00	0	0	6,547	646	7,629	14,822
44	08/03/00	0	0	5,889	507	5,851	12,247
44	08/04/00	0	0	5,006	496	5,720	11,222
44	08/05/00	0	0	4,119	430	5,014	9,563
45	08/06/00	0	0	5,668	300	3,542	9,510
46	08/07/00	0	0	7,630	606	4,577	12,813
47	08/08/00	0	0	3,322	6,077	2,029	11,428
48	08/09/00	0	0	2,797	4,843	1,994	9,634
49	08/10/00	0	0	651	2,314	5,210	8,175
50	08/11/00	29	0	1,304	2,872	3,748	7,953
50	08/12/00	24	0	2,174	5,157	5,805	13,160
51	08/13/00	0	0	14,650	3,046	8,893	26,589
52	08/14/00	0	0	8,137	8,986	6,307	23,430
53	08/15/00	0	0	5,854	8,368	8,269	22,491
54	08/16/00	0	0	5,858	10,792	6,241	22,891
55	08/17/00	0	0	4,206	10,632	5,110	19,948
56	08/18/00	0	0	1,165	7,910	6,706	15,781
57	08/19/00	0	0	3,592	7,098	6,223	16,913
58	08/20/00	0	0	6,086	4,887	13,203	24,176
59	08/21/00	0	0	7,696	7,659	9,404	24,759
60	08/22/00	0	0	5,769	11,797	14,296	31,862
61	08/23/00	0	0	3,349	8,407	11,146	22,902
62	08/24/00	0	0	10,188	8,175	6,058	24,421
63	08/25/00	0	0	5,860	7,853	4,068	17,781
64	08/26/00	0	0	2,516	7,594	3,547	13,657
65	08/27/00	0	0	1,622	4,250	5,172	11,044
66	08/28/00	0	0	886	6,141	5,281	12,308
67	08/29/00	0	0	1,744	3,166	6,655	11,565
67	08/30/00	0	0	2,025	3,251	6,882	12,158
67	08/31/00	0	0	1,814	3,190	5,972	10,976
67	09/01/00	0	0	1,966	3,238	5,637	10,841
68	09/02/00	0	0	2,468	3,563	3,113	9,144
69	09/03/00	0	0	2,138	2,201	1,906	6,245
69	09/04/00	0	0	1,528	1,737	1,763	5,028
70	09/05/00	0	0	2,171	2,598	3,346	8,115
70	09/06/00	0	0	1,104	1,373	2,232	4,709
70	09/07/00	0	0	581	844	2,197	3,622
70	09/08/00	0	0	583	786	1,911	3,280
70	09/09/00	0	0	800	1,021	2,016	3,837
70	09/10/00	0	0	625	802	1,641	3,068
71	09/11/00	0	0	156	1,059	2,093	3,308
71	09/12/00	0	0	93	1,109	1,613	2,815
72	09/13/00	0	0	488	1,308	2,227	4,023
72	09/14/00	0	0	277	700	1,692	2,669
Fall Totals		1,643	60	253,512	183,192	293,942	732,349
Season Totals		63,451	9,242	253,512	183,192	389,583	1,320,569

Table 9. Comparison of 24-hour sampling estimates with daily nine-hour sampling estimates for the Yukon River sonar project, 2000.

Date	Sampling Method	Right Bank Passage	Left Bank Nearshore Passage	Left Bank Offshore Passage	Total Passage	Total % Differences
6/28/00	24-hr	17,451	14,387	5,387	37,225	8.85%
	9-hr	17,191	17,442	5,887	40,520	
7/12/00	24-hr	5,073	7,851	5,695	18,619	4.11%
	9-hr	4,886	8,717	5,782	19,385	
7/26/00	24-hr	2,110	3,869	2,707	8,686	-1.50%
	9-hr	1,565	4,276	2,715	8,556	
8/16/99	24-hr	4,108	9,940	5,973	20,021	14.33%
	9-hr	4,483	11,581	6,827	22,891	
8/30/00	24-hr	2,416	7,052	2,337	11,805	2.99%
	9-hr	2,400	7,636	2,122	12,158	
		========	========	========	========	
TOTAL	24-hr	31,158	43,099	22,099	96,356	7.42%
	9-hr	30,525	49,652	23,333	103,510	
% Differences by zone:		-2.03%	15.20%	5.58%	7.42%	

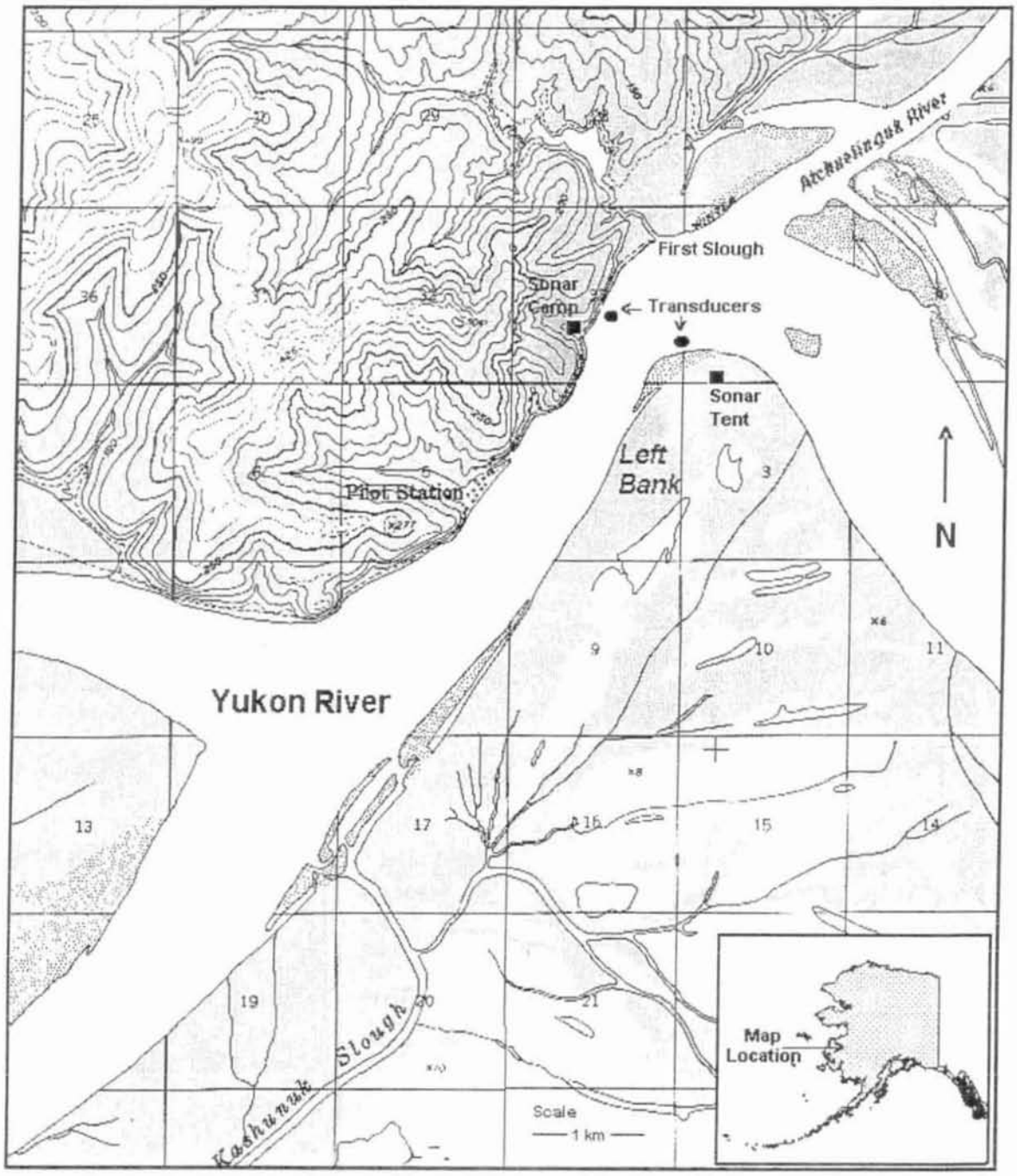


Figure 1. Topographical map of the Yukon River in the vicinity of the sonar site.

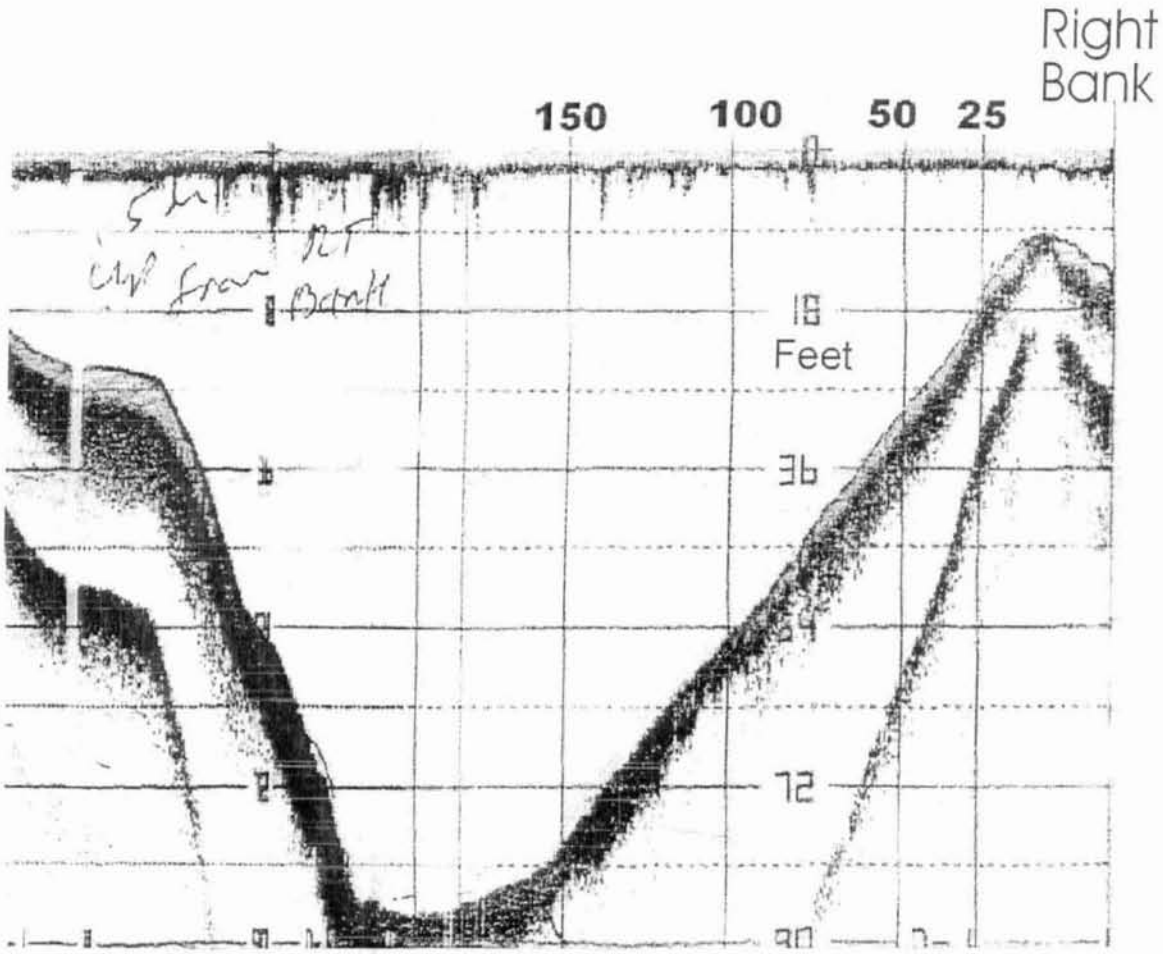


Figure 2. Yukon River right-bank profile recorded on 21 June 2000. The flat slope beginning at about 150 m is the thalweg beyond the project's ensonified range.

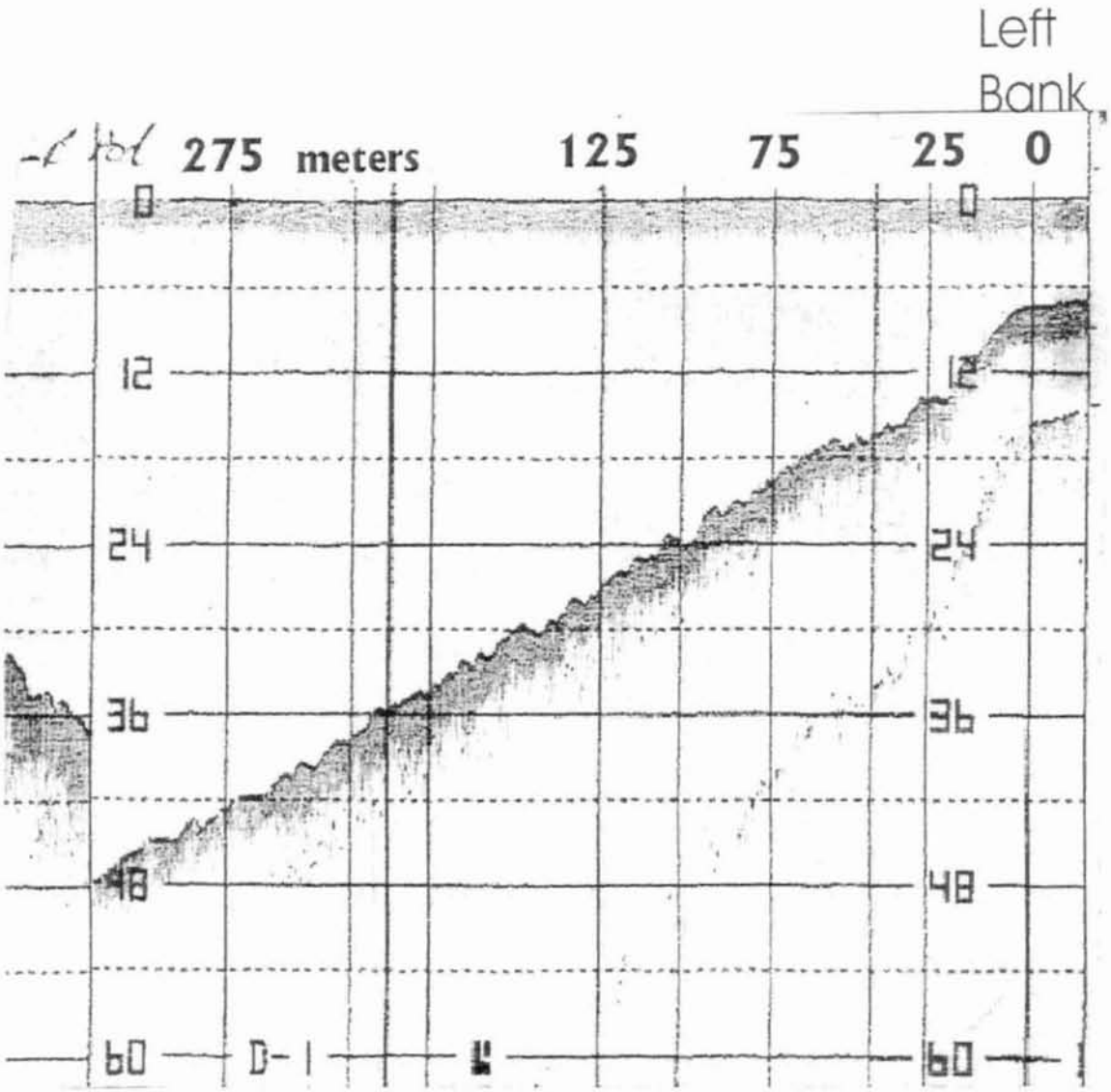


Figure 3. Yukon River left-bank profile recorded on 9 September 2000.

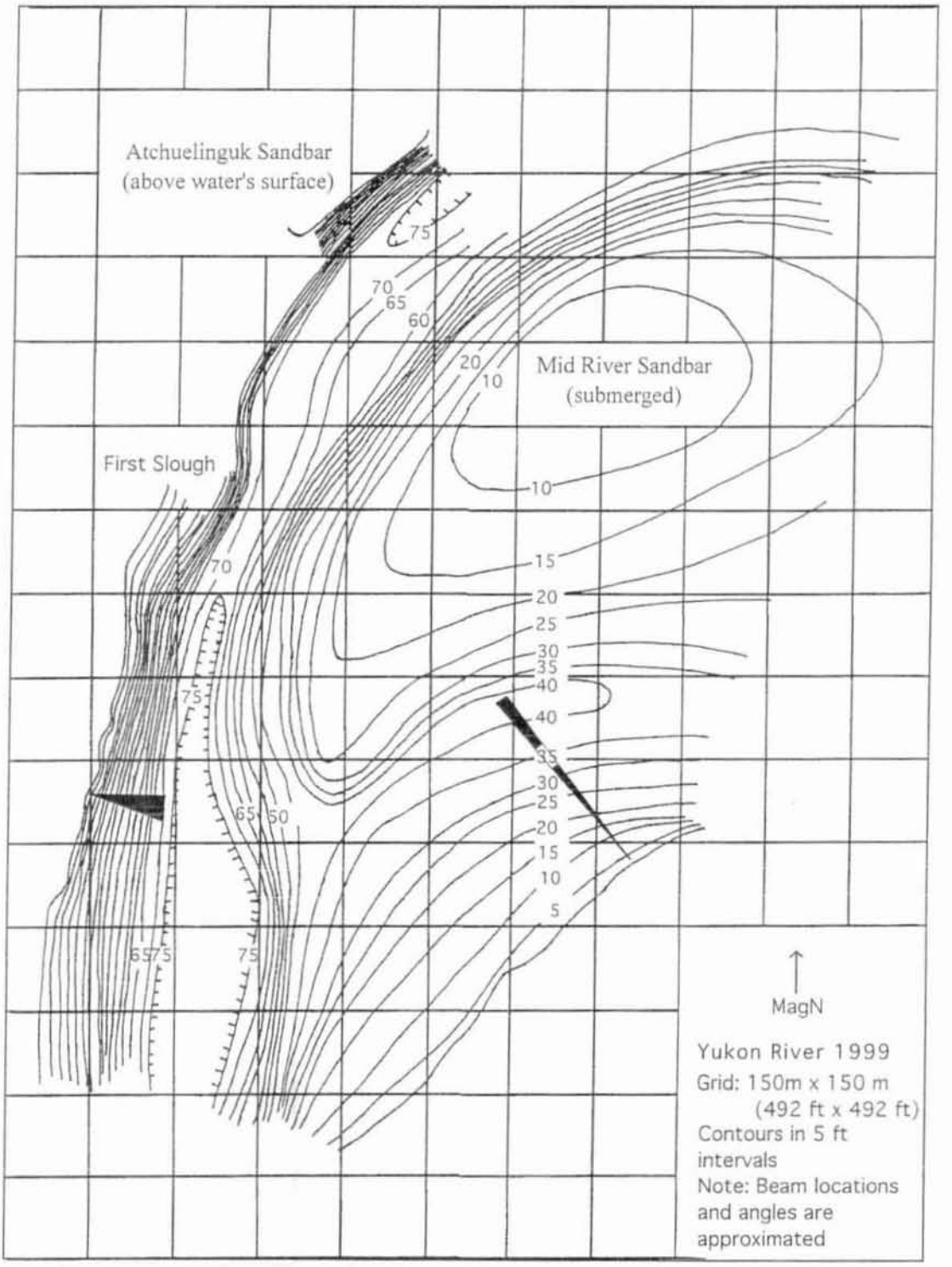


Figure 4. Bathymetric map of the Yukon River sonar sampling area, 1999.

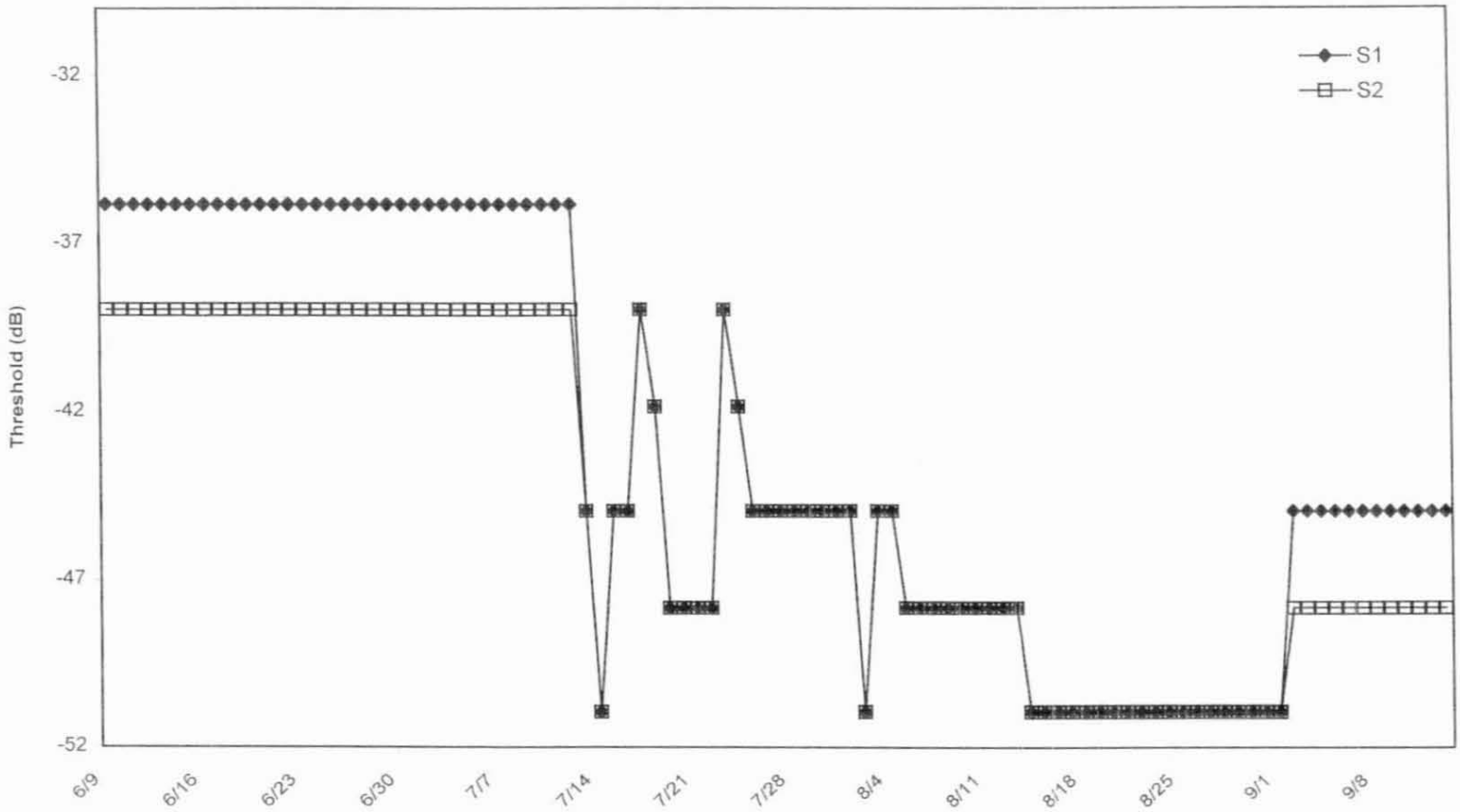


Figure 5. Thresholds used on right bank by strata and day, Yukon River sonar, 2000.

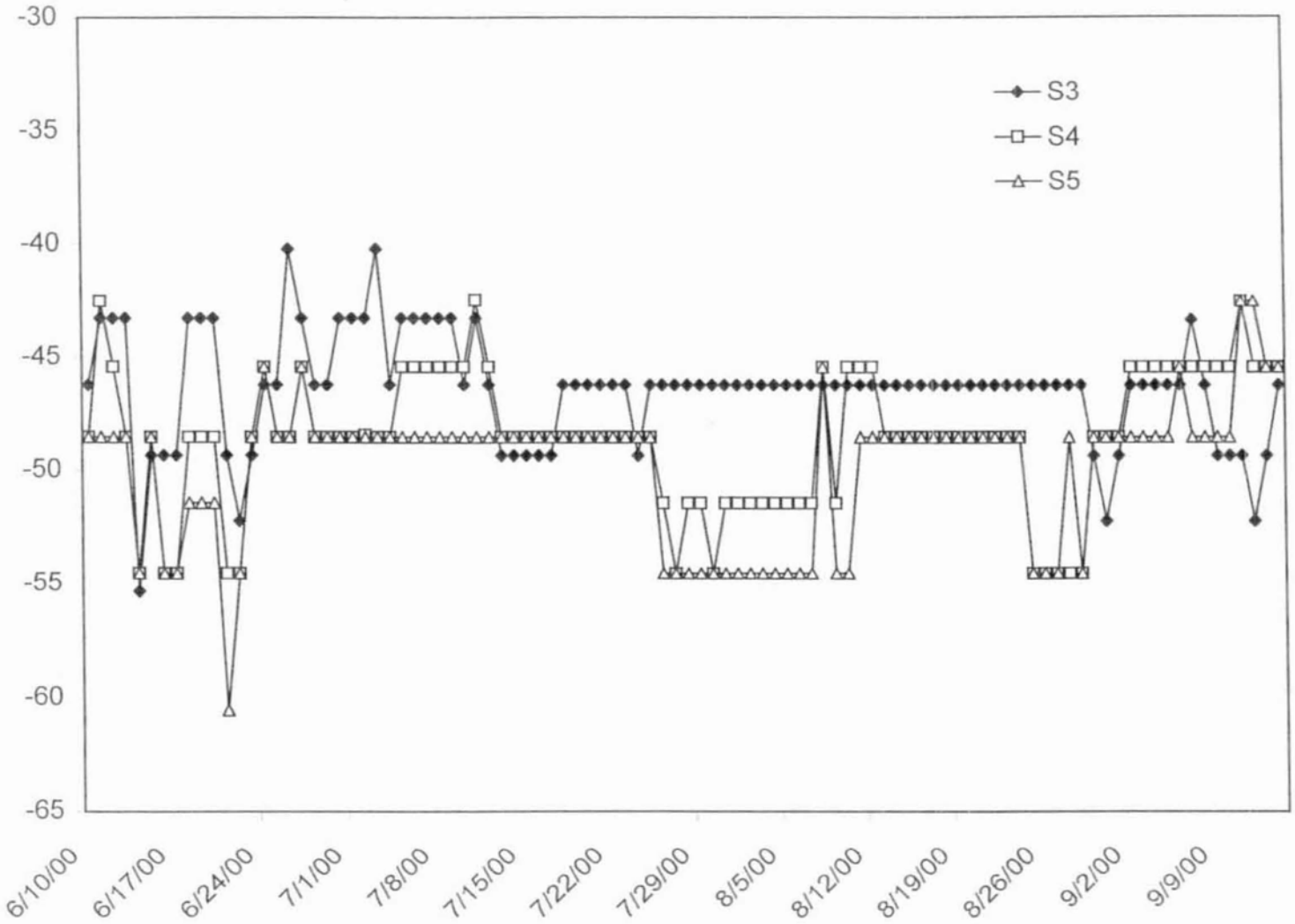


Figure 6. Thresholds used on left bank by strata and day, Yukon River sonar, 2000.

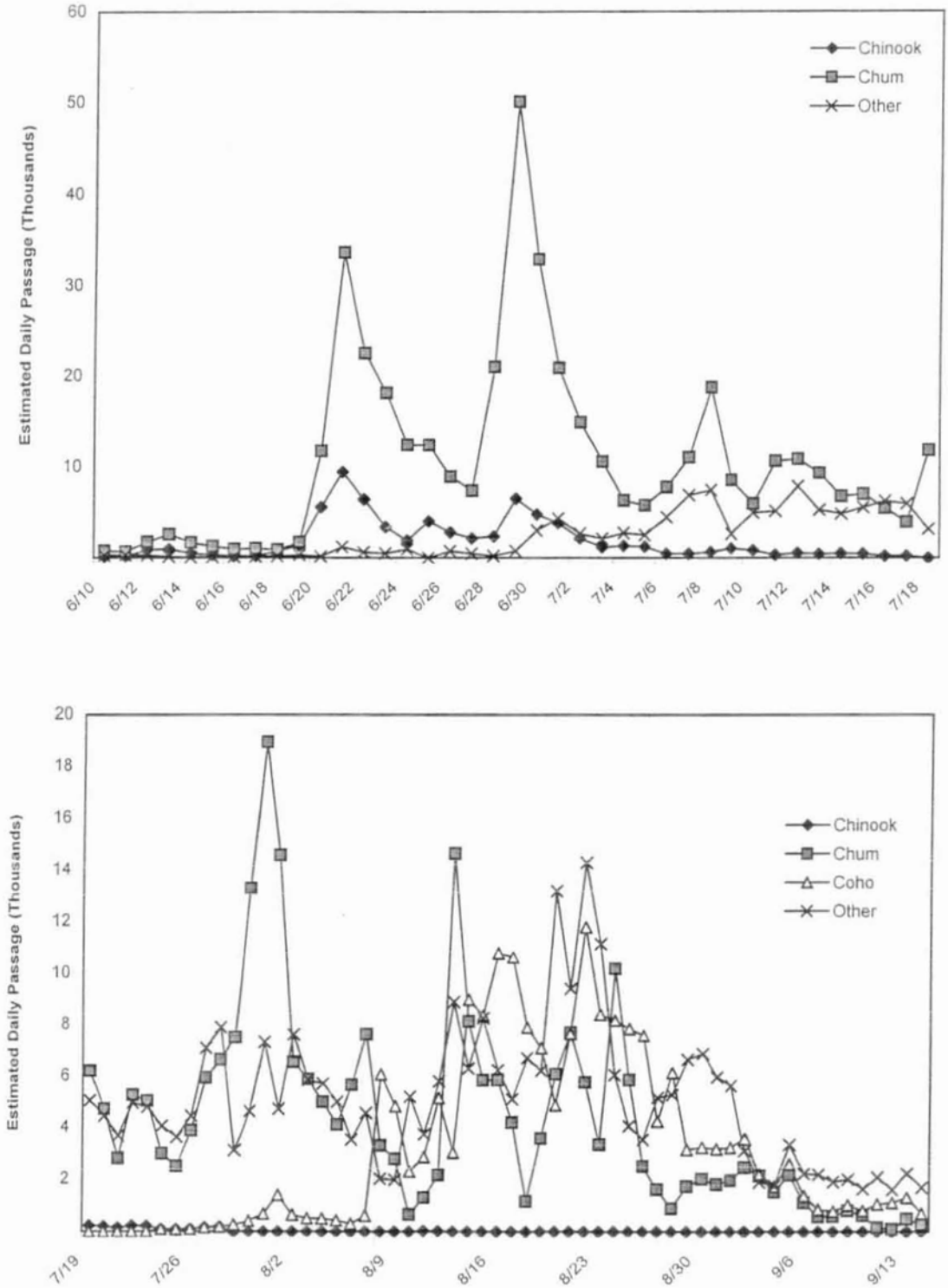
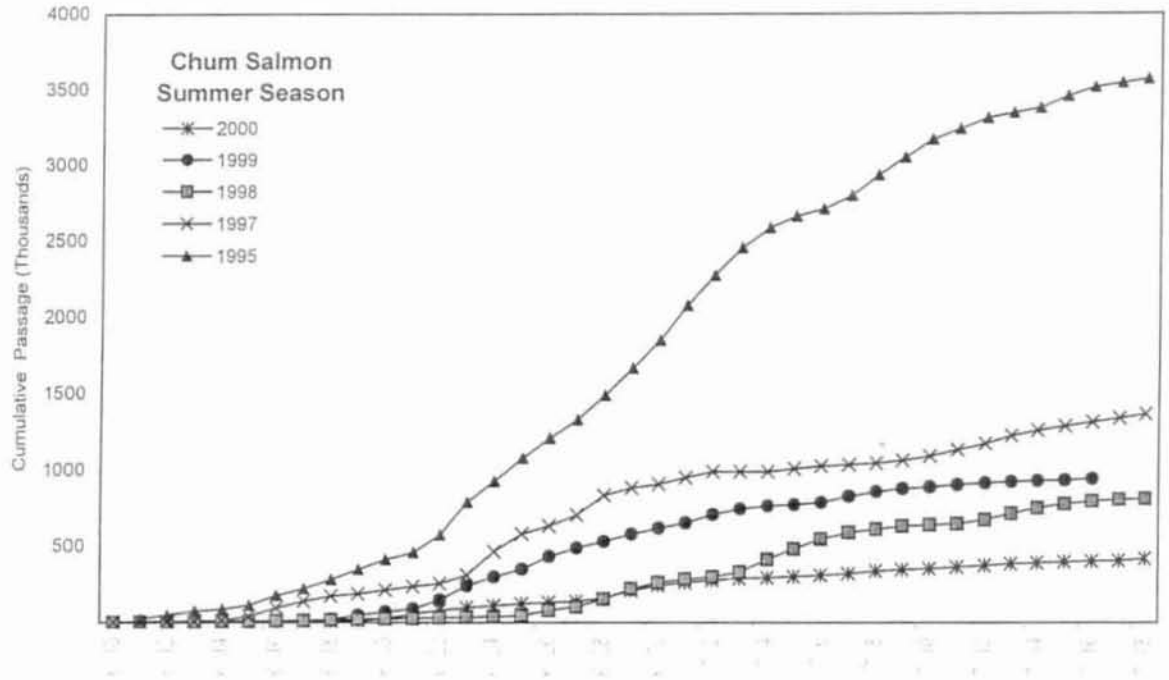


Figure 7. Estimated daily passage by species for summer (top) and fall (bottom) seasons, Yukon River sonar, 2000.



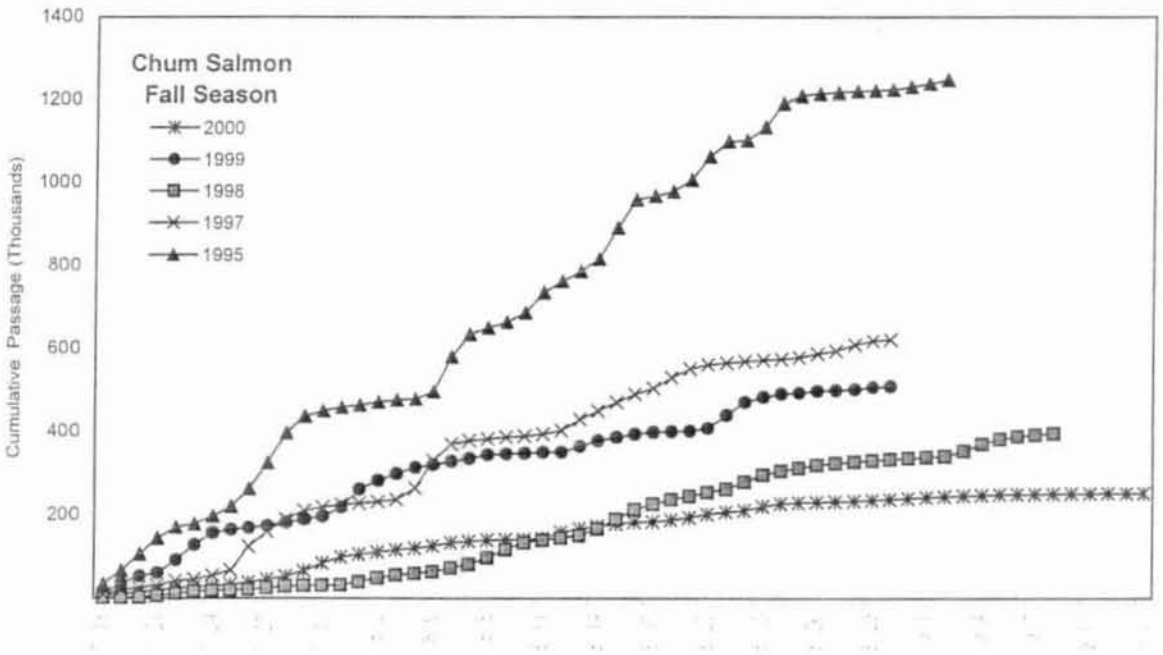


Figure 8. Cumulative passage for summer chum salmon (top) and fall chum salmon (bottom), Yukon River sonar 1995, 1997, 1998, 1999, and 2000.

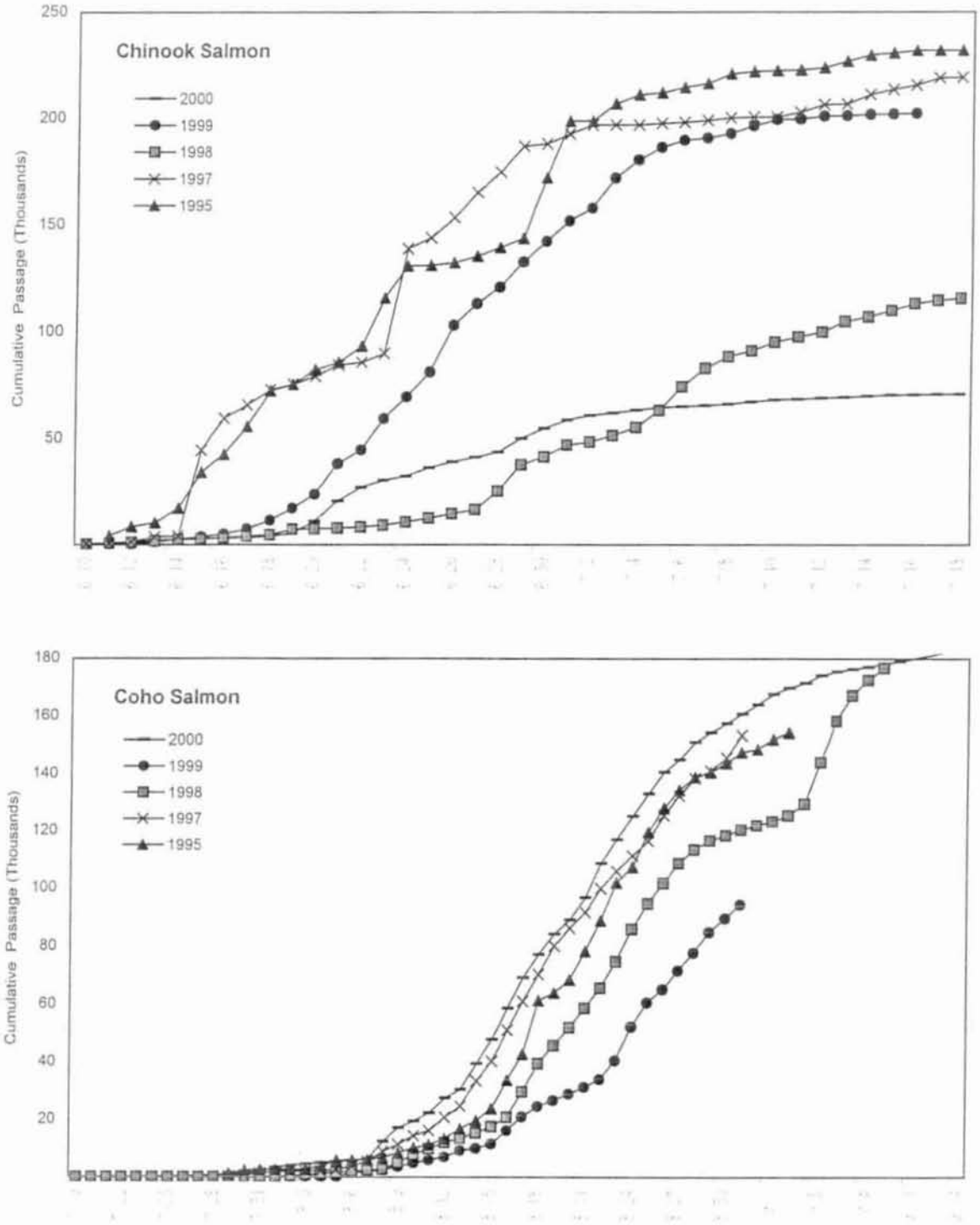


Figure 9. Cumulative passage for chinook salmon (top) and coho salmon (bottom), Yukon River sonar 1995, 1997, 1998, 1999 and 2000.

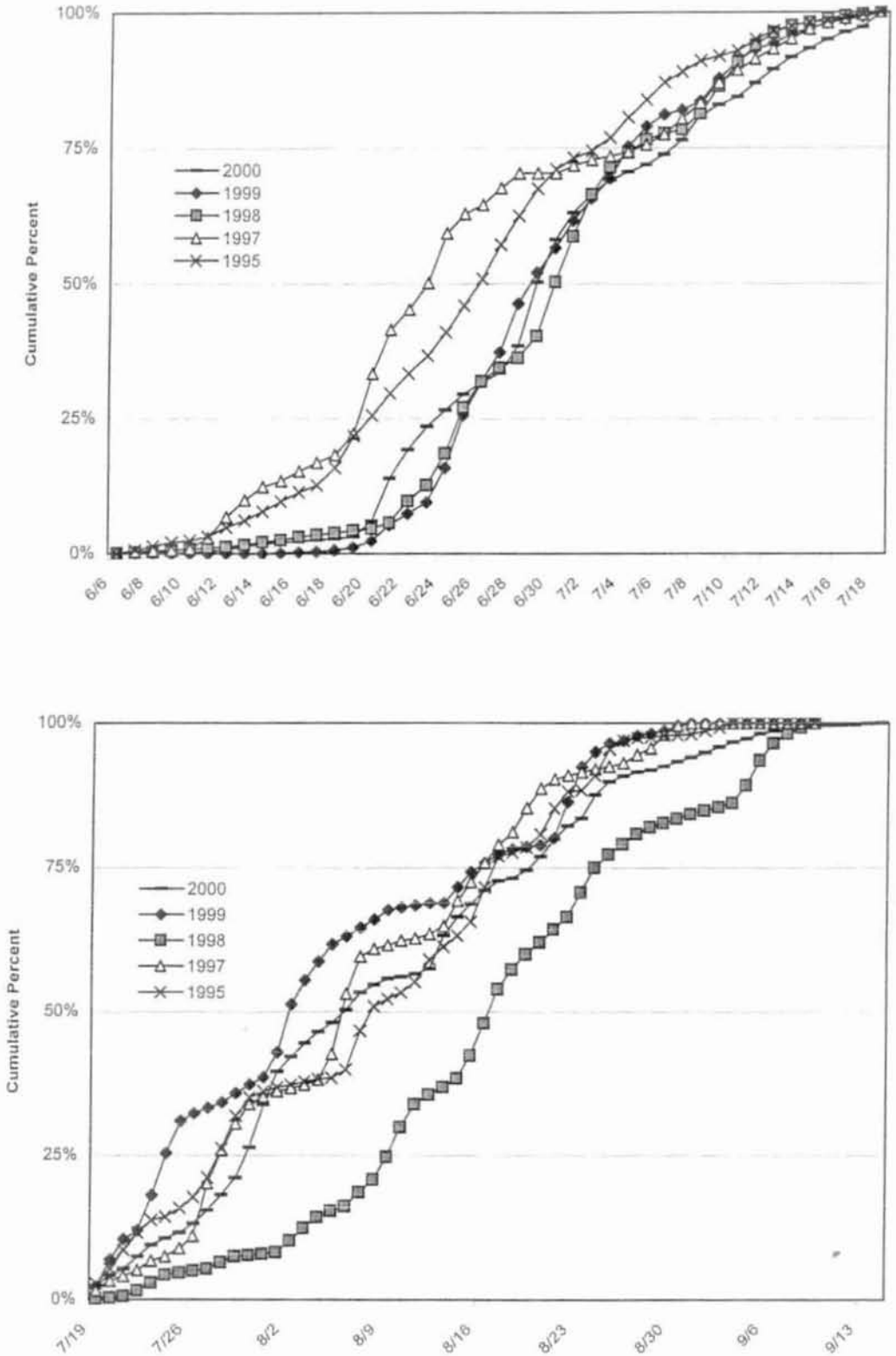


Figure 10. Cumulative percent of total passage by day for summer (top) and fall (bottom) chum salmon, Yukon River sonar, 2000.

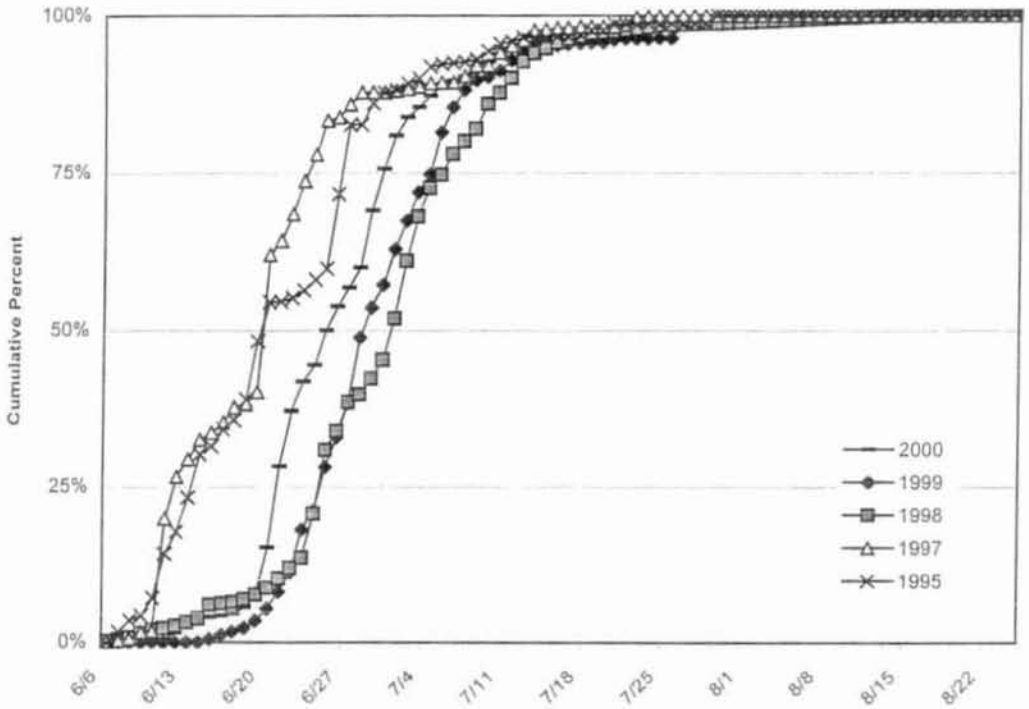


Figure 11. Cumulative percent of total passage by day for chinook salmon, Yukon River sonar, 2000.

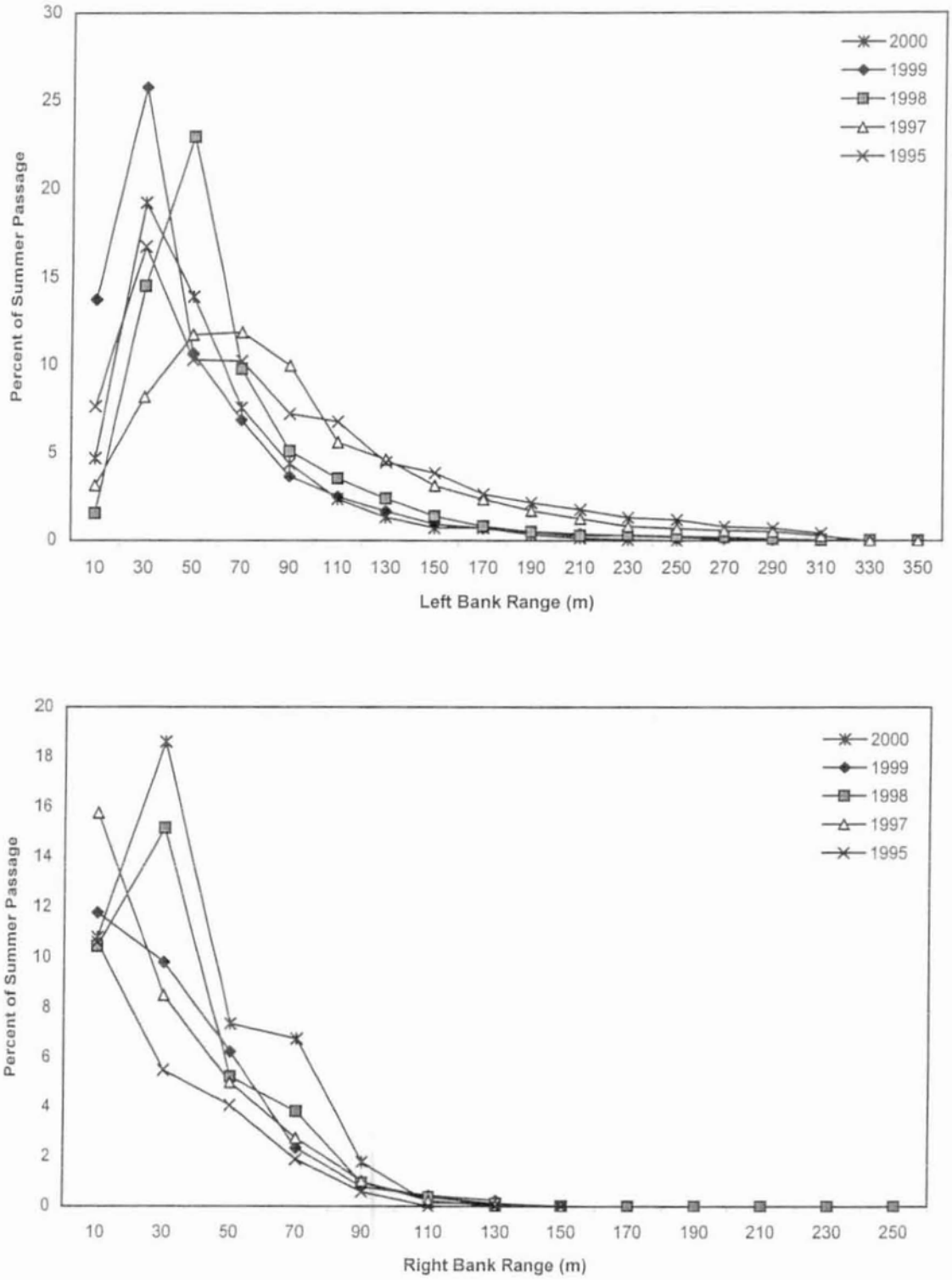
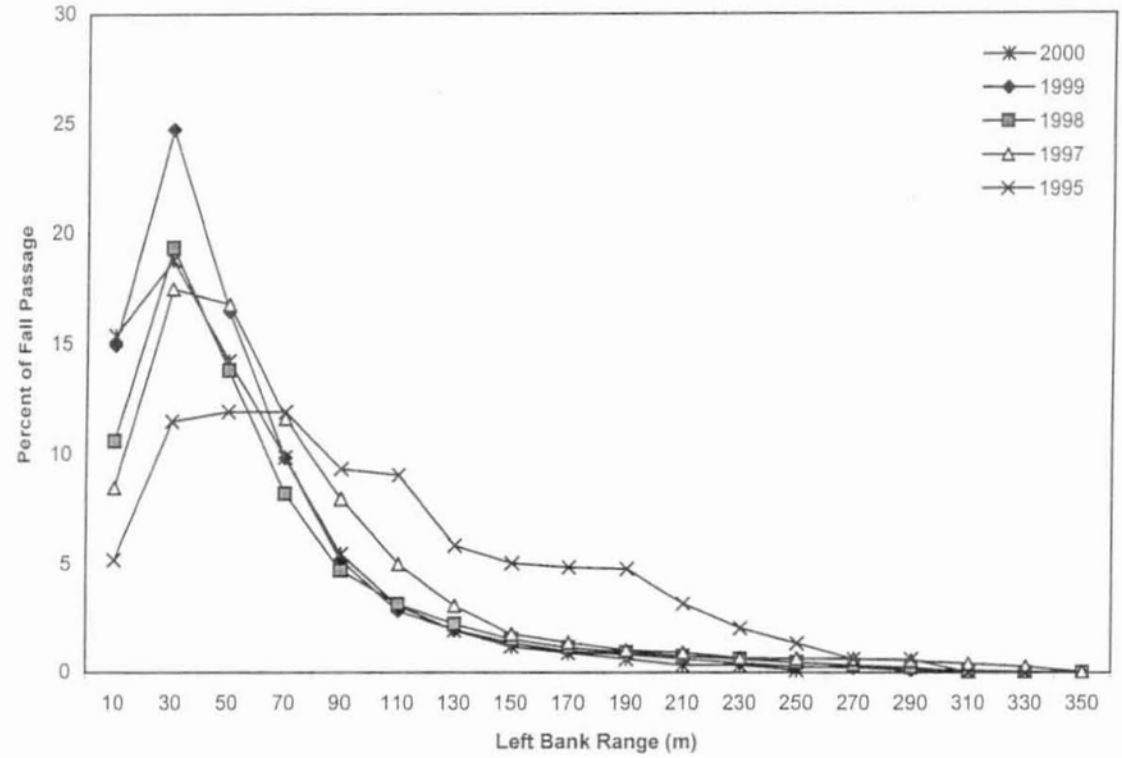


Figure 12. Horizontal distribution of left and right bank passage estimates for the Yukon River sonar project from 12 June through 18 July 1995 through 2000.



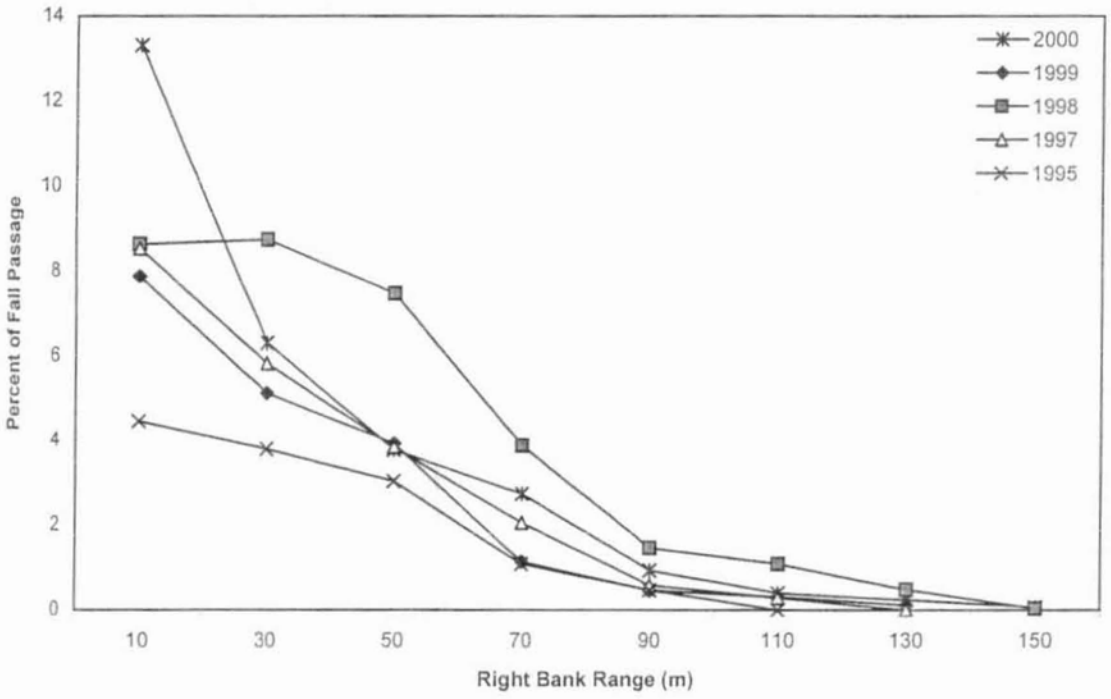


Figure 13. Horizontal distribution of left and right bank passage estimates for the Yukon River sonar project from 19 July through 31 August 1995 through 2000.

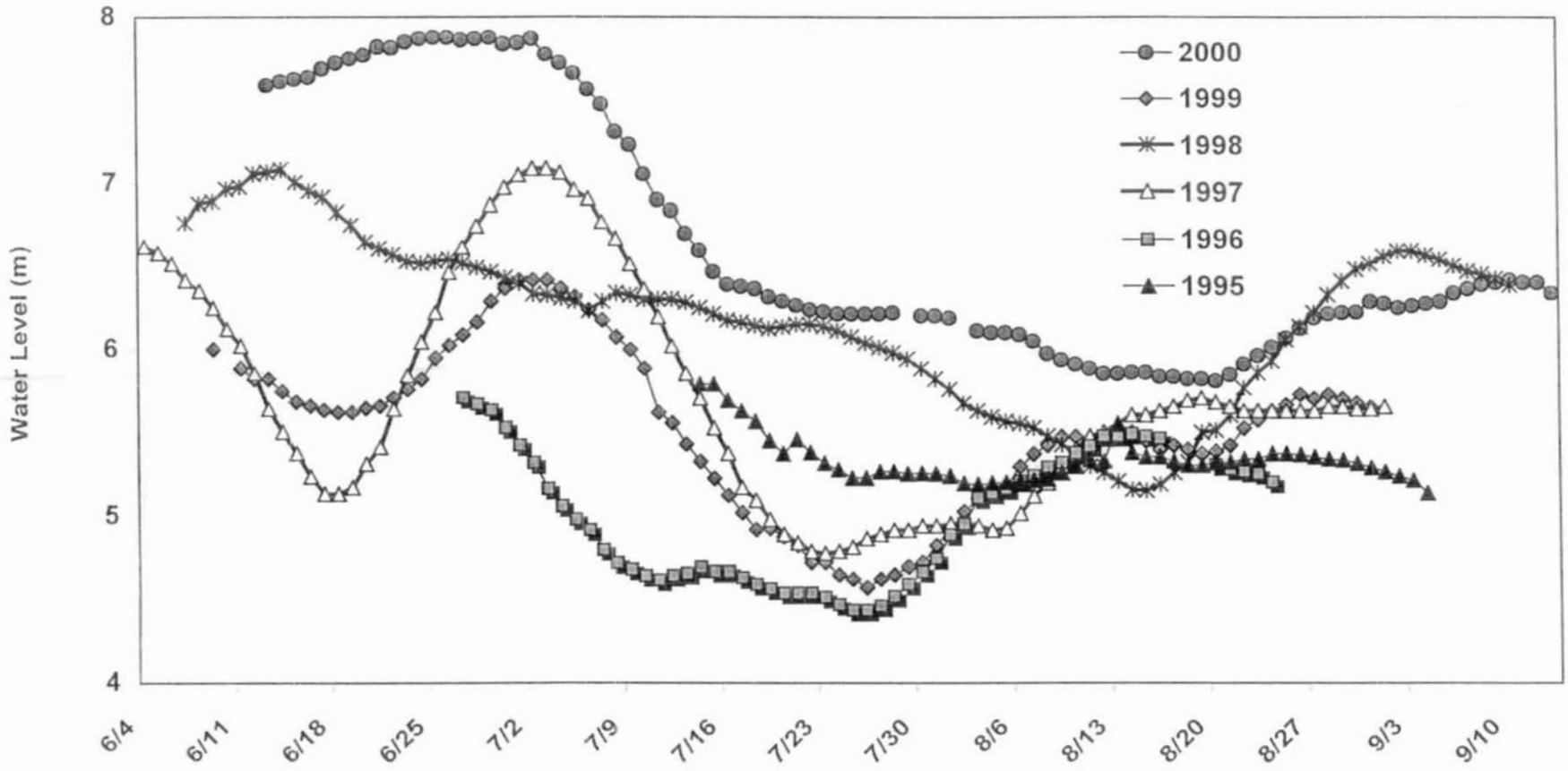


Figure 14. Yukon River daily water level measured in front of the sonar camp during the 1995 through 2000 field seasons.

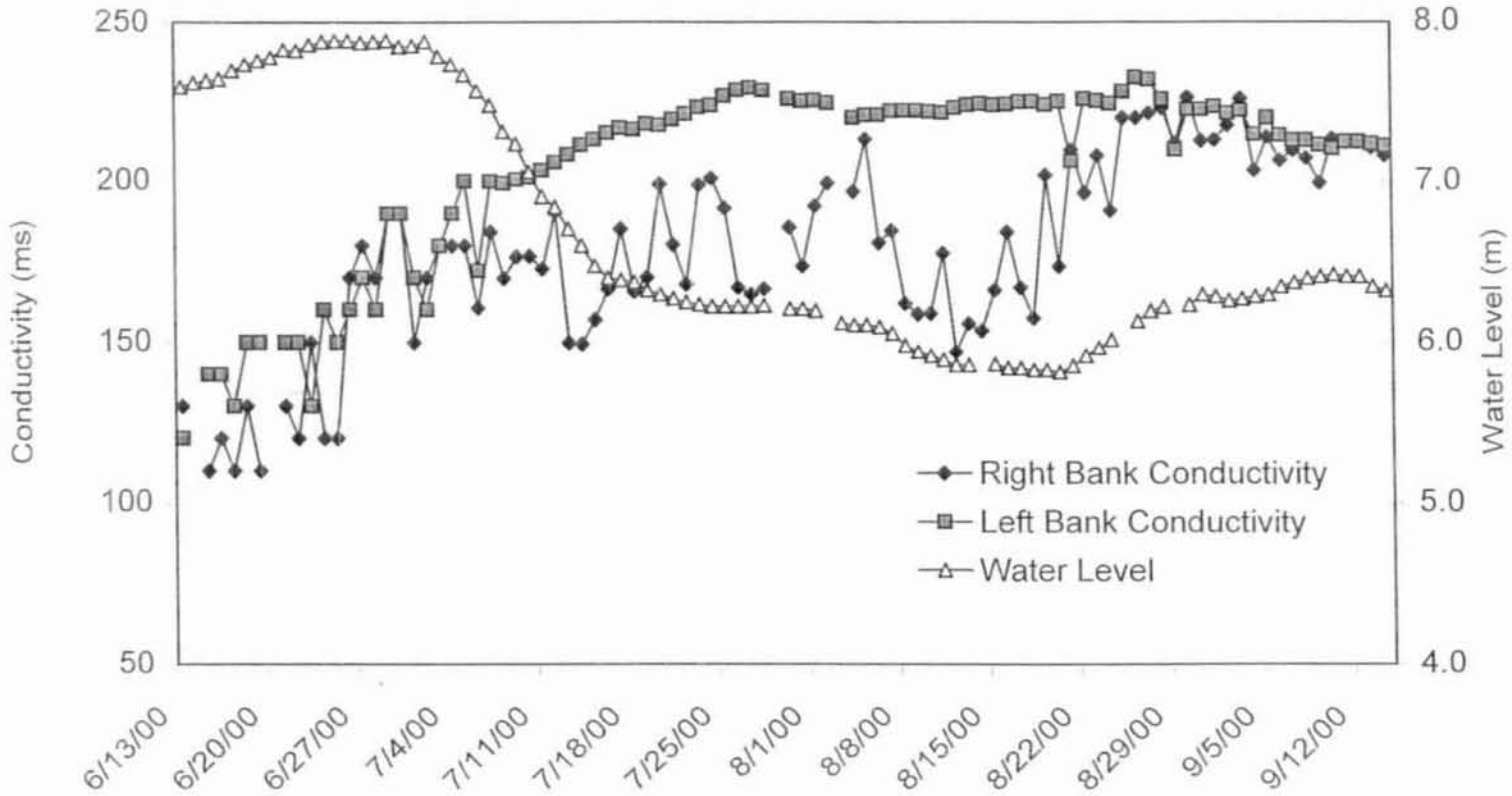


Figure 15. Daily conductivity and water level of the Yukon River recorded at the sonar project site, 2000.

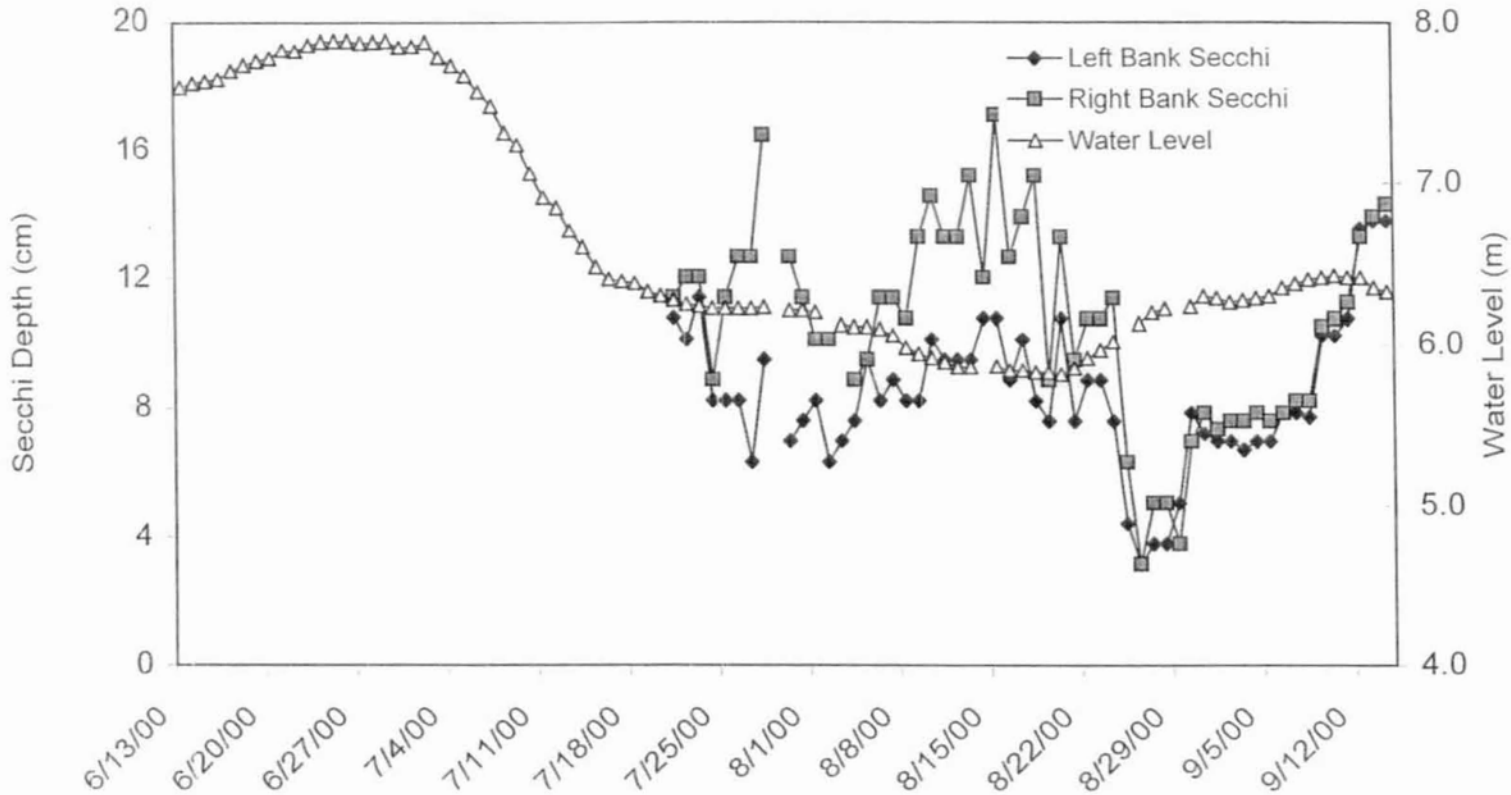


Figure 16. Comparison of daily right and left bank secchi measurements and water level at the Yukon R sonar project, 2000.

APPENDICES

APPENDICES

Appendix A. Yukon River sonar threshold levels and parameters for the left bank, 2000.

Appendix A. Yukon River sonar threshold levels and parameters for the left bank, 2000.

Date	Stratum	Transmit (dB)	Receiver Gain (dB)	Threshold (Volts)	Attenuation	Source Level (dB)	System Gain (dB)	Threshold (dB)
6/10/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
6/10/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/10/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/11/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/11/00	4	0	-12	0.31	0	226.95	-181.21	-43.91
6/11/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/12/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/12/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
6/12/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/13/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/13/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/13/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/14/00	3	0	0	0.31	0	226.95	-193.27	-43.85
6/14/00	4	0	0	0.31	0	226.95	-181.21	-55.91
6/14/00	5	0	0	0.31	0	226.95	-181.21	-55.91
6/15/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
6/15/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/15/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/16/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
6/16/00	4	0	0	0.31	0	226.95	-181.21	-55.91
6/16/00	5	0	0	0.31	0	226.95	-181.21	-55.91
6/17/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
6/17/00	4	0	0	0.31	0	226.95	-181.21	-55.91
6/17/00	5	0	0	0.31	0	226.95	-181.21	-55.91
6/18/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/18/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/18/00	5	-3	0	0.31	0	223.71	-181.21	-52.67
6/19/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/19/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/19/00	5	-3	0	0.31	0	223.71	-181.21	-52.67
6/20/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/20/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/20/00	5	-3	0	0.31	0	223.71	-181.21	-52.67
6/21/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
6/21/00	4	0	0	0.31	0	226.95	-181.21	-55.91
6/21/00	5	0	6	0.31	0	226.95	-181.21	-61.91
6/22/00	3	-3	0	0.31	0	223.71	-193.27	-40.61
6/22/00	4	0	0	0.31	0	226.95	-181.21	-55.91
6/22/00	5	0	0	0.31	0	226.95	-181.21	-55.91
6/23/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
6/23/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/23/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/24/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
6/24/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
6/24/00	5	-3	-6	0.31	0	223.71	-181.21	-46.67
6/25/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
6/25/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/25/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/26/00	3	-3	-12	0.31	0	223.71	-193.27	-28.61
6/26/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/26/00	5	0	-6	0.31	0	226.95	-181.21	-49.91

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Appendix A. Page 2 of 4.

Date	Stratum	Transmit (dB)	Receiver Gain (dB)	Grey1	Attenuation	Source Level (dB)	System Gain (dB)	Threshold (dB)
6/27/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/27/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
6/27/00	5	-3	-6	0.31	0	223.71	-181.21	-46.67
6/28/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
6/28/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/28/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
6/30/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
6/30/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
6/30/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/1/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
7/1/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
7/1/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/2/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
7/2/00	4	-3	-3	0.31	0	223.71	-181.21	-49.67
7/2/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/3/00	3	-3	-12	0.31	0	223.71	-193.27	-28.61
7/3/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
7/3/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/4/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/4/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
7/4/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/5/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
7/5/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
7/5/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/10/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/10/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
7/10/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/11/00	3	-6	-6	0.31	0	220.81	-193.27	-31.71
7/11/00	4	-6	-6	0.31	0	220.81	-181.21	-43.77
7/11/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/12/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/12/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
7/12/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/13/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
7/13/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
7/13/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/18/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/18/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
7/18/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/24/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
7/24/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
7/24/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/25/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/25/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
7/25/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
7/26/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/26/00	4	-3	0	0.31	0	223.71	-181.21	-52.67
7/26/00	5	0	0	0.31	0	226.95	-181.21	-55.91
7/27/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/27/00	4	0	0	0.31	0	226.95	-181.21	-55.91
7/27/00	5	0	0	0.31	0	226.95	-181.21	-55.91

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Appendix A. Page 3 of 4.

Date	Stratum	Transmit (dB)	Receiver Gain (dB)	Grey1	Attenuation	Source Level (dB)	System Gain (dB)	Threshold (dB)
7/28/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/28/00	4	-3	0	0.31	0	223.71	-181.21	-52.67
7/28/00	5	0	0	0.31	0	226.95	-181.21	-55.91
7/30/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/30/00	4	0	0	0.31	0	226.95	-181.21	-55.91
7/30/00	5	0	0	0.31	0	226.95	-181.21	-55.91
7/31/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
7/31/00	4	-3	0	0.31	0	223.71	-181.21	-52.67
7/31/00	5	0	0	0.31	0	226.95	-181.21	-55.91
8/8/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/8/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
8/8/00	5	-3	-6	0.31	0	223.71	-181.21	-46.67
8/9/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/9/00	4	-3	0	0.31	0	223.71	-181.21	-52.67
8/9/00	5	0	0	0.31	0	226.95	-181.21	-55.91
8/10/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/10/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
8/10/00	5	0	0	0.31	0	226.95	-181.21	-55.91
8/11/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/11/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
8/11/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
8/13/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/13/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
8/13/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
8/25/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/25/00	4	0	0	0.31	0	226.95	-181.21	-55.91
8/25/00	5	0	0	0.31	0	226.95	-181.21	-55.91
8/28/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/28/00	4	0	0	0.31	0	226.95	-181.21	-55.91
8/28/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
8/29/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
8/29/00	4	0	0	0.31	0	226.95	-181.21	-55.91
8/29/00	5	0	0	0.31	0	226.95	-181.21	-55.91
8/30/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
8/30/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
8/30/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
8/31/00	3	-3	0	0.31	0	223.71	-193.27	-40.61
8/31/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
8/31/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
9/1/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
9/1/00	4	0	-6	0.31	0	226.95	-181.21	-49.91
9/1/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
9/2/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
9/2/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/2/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
9/6/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
9/6/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/6/00	5	-3	-6	0.31	0	223.71	-181.21	-46.67
9/7/00	3	0	-12	0.31	0	226.95	-193.27	-31.85
9/7/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/7/00	5	0	-6	0.31	0	226.95	-181.21	-49.91

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Appendix A. Page 3 of 4.

Date	Stratum	Transmit (dB)	Receiver Gain (dB)	Grey1	Attenuation	Source Level (dB)	System Gain (dB)	Threshold (dB)
9/8/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
9/8/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/8/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
9/9/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
9/9/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/9/00	5	0	-6	0.31	0	226.95	-181.21	-49.91
9/11/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
9/11/00	4	0	-12	0.31	0	226.95	-181.21	-43.91
9/11/00	5	0	-12	0.31	0	226.95	-181.21	-43.91
9/12/00	3	-3	0	0.31	0	223.71	-193.27	-40.61
9/12/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/12/00	5	0	-12	0.31	0	226.95	-181.21	-43.91
9/13/00	3	0	-6	0.31	0	226.95	-193.27	-37.85
9/13/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/13/00	5	-3	-6	0.31	0	223.71	-181.21	-46.67
9/14/00	3	-3	-6	0.31	0	223.71	-193.27	-34.61
9/14/00	4	-3	-6	0.31	0	223.71	-181.21	-46.67
9/14/00	5	-3	-6	0.31	0	223.71	-181.21	-46.67

Appendix B. Yukon River sonar threshold levels and parameters for the right bank, 2000.

Appendix B. Yukon River sonar threshold levels and parameters for the right bank, 2000.

Date	Stratum	Transmit (dB)	Receiver Gain (dB)	Threshold (Volts)	Threshold (dB)
6/10/00	1	-3	-18	0.31	-35.84
6/10/00	2	0	-18	0.31	-38.96
6/21/00	1	0	-18	0.31	-38.96
6/21/00	2	0	-18	0.31	-38.96
7/14/00	1	0	-18	0.31	-38.96
7/14/00	2	0	-12	0.31	-44.96
7/14/00	1	0	-12	0.31	-44.96
7/14/00	2	0	-12	0.31	-44.96
7/15/00	1	0	-6	0.31	-50.96
7/15/00	2	0	-6	0.31	-50.96
7/16/00	1	0	-12	0.31	-44.96
7/16/00	2	0	-12	0.31	-44.96
7/18/00	1	0	-18	0.31	-38.96
7/18/00	2	0	-18	0.31	-38.96
7/19/00	1	0	-18	0.31	-38.96
7/19/00	2	-3	-12	0.31	-41.84
7/19/00	1	-3	-12	0.31	-41.84
7/19/00	2	-3	-12	0.31	-41.84
7/20/00	1	-3	-6	0.31	-47.84
7/20/00	2	-3	-6	0.31	-47.84
7/20/00	1	-3	-12	0.31	-41.84
7/20/00	2	-3	-12	0.31	-41.84
7/24/00	1	0	-18	0.31	-38.96
7/24/00	2	0	-18	0.31	-38.96
7/25/00	1	-3	-12	0.31	-41.84
7/25/00	2	-3	-12	0.31	-41.84
7/26/00	1	0	-12	0.31	-44.96
7/26/00	2	0	-12	0.31	-44.96
8/3/00	1	0	-6	0.31	-50.96
8/3/00	2	0	-6	0.31	-50.96
8/4/00	1	0	-12	0.31	-44.96
8/4/00	2	0	-12	0.31	-44.96
8/6/00	1	-3	-6	0.31	-47.84
8/6/00	2	-3	-6	0.31	-47.84
8/15/00	1	0	-6	0.31	-50.96
8/15/00	2	0	-6	0.31	-50.96
9/3/00	1	0	-12	0.31	-44.96
9/3/00	2	-3	-6	0.31	-47.84
9/4/00	1	0	-12	0.31	-44.96
9/4/00	2	-3	-6	0.31	-47.84
9/4/00	1	0	-6	0.31	-50.96
9/4/00	2	0	-6	0.31	-50.96

Appendix C. Yukon River sonar hourly passage rate by stratum, 2000.

Appendix C. Yukon River sonar hourly passage rate by stratum, 2000.

Report Period	Date	Period	Right Bank Nearshore	Right Bank Offshore	Left Bank Nearshore	Left Bank Midshore	Left Bank Offshore
0	06/09/00	3	17.2	2.1	55.5	5.2	0.0
1	06/10/00	1	28.0	1.3	17.9	5.4	0.0
1	06/10/00	2	18.8	5.1	22.0	6.0	0.0
1	06/10/00	3			26.7	4.4	0.0
2	06/11/00	1			25.4	3.3	0.0
2	06/11/00	2			37.4	10.0	0.0
2	06/11/00	3			11.6	13.1	0.0
3	06/12/00	1			46.4	4.5	2.1
3	06/12/00	2	14.6	4.9	94.6	7.5	1.1
3	06/12/00	3			140.3	6.2	1.0
4	06/13/00	1			99.7	3.1	0.0
4	06/13/00	2			120.0	13.7	1.0
4	06/13/00	3			84.0	3.0	0.0
4	06/14/00	1			98.6	9.3	0.0
4	06/14/00	2			25.1	10.3	3.3
4	06/14/00	3			32.1	17.9	0.0
4	06/15/00	1			47.8	11.6	0.0
4	06/15/00	2	16.4	5.5	40.3	8.3	0.0
4	06/15/00	3	5.6	2.7	48.8	12.4	2.1
5	06/16/00	1	12.3	6.0	39.7	3.1	0.0
5	06/16/00	2	18.5	6.3	17.6	4.6	0.0
5	06/16/00	3			24.8	7.6	1.1
5	06/17/00	1	11.3	12.9	21.7	2.1	0.0
5	06/17/00	2	18.6	6.1	24.0	5.4	0.0
5	06/17/00	3	15.5	9.9	40.4	5.2	0.0
6	06/18/00	1	10.6	6.1	47.6	4.1	1.1
6	06/18/00	2	16.4	5.3	24.2	10.7	0.0
6	06/18/00	3	19.3	4.2	58.9	18.9	1.0
6	06/19/00	1	15.2	11.2	86.9	9.5	1.0
6	06/19/00	2	14.5	10.3	92.1	22.6	0.0
6	06/19/00	3	37.2	19.8	72.0	29.5	1.0
7	06/20/00	1	43.4	24.4	138.6	17.9	0.0
7	06/20/00	2	187.3	48.8	493.4	47.1	2.1
7	06/20/00	3	317.9	145.2	592.9	126.2	4.1
8	06/21/00	1	390.3	60.0	1041.1	73.9	4.1
8	06/21/00	2	201.1	80.2			
8	06/21/00	3	545.6	115.1	1508.8	137.5	2.2
9	06/22/00	1	533.1	111.4	442.5	62.1	0.0
9	06/22/00	2	348.5	101.2	804.8	115.9	14.0
9	06/22/00	3	409.1	75.5	615.5	66.5	0.0
10	06/23/00	1	344.3	76.6	610.8	92.7	3.1
10	06/23/00	2	337.5	51.9	637.6	90.5	2.1
10	06/23/00	3	223.3	69.4	92.7	111.0	15.0
11	06/24/00	1	267.6	46.0	153.6	191.6	5.2
11	06/24/00	2	247.6	80.0	126.1	168.4	9.5
11	06/24/00	3	194.3	73.8	163.7	189.8	0.0

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Report Period	Date	Period	Right Bank Nearshore	Right Bank Offshore	Left Bank Nearshore	Left Bank Midshore	Left Bank Offshore
12	06/25/00	1	296.0	42.8	253.4	133.8	11.8
12	06/25/00	2	243.4	86.0	326.4	155.2	12.4
12	06/25/00	3	133.0	55.6	166.6	133.4	6.1
13	06/26/00	1	204.5	33.1	78.3	163.2	7.2
13	06/26/00	2	171.2	25.0	164.0	222.4	12.2
13	06/26/00	3	132.1	50.1	173.2	123.1	3.1
14	06/27/00	1	137.5	32.7	44.7	73.4	6.3
14	06/27/00	2	137.0	47.0	95.6	170.4	6.3
14	06/27/00	3	142.8	170.5	16.3	151.6	15.3
15	06/28/00	1	346.4	38.5	89.5	175.9	6.1
15	06/28/00	2	409.0	53.9	165.0	160.4	18.9
15	06/28/00	3	654.6	101.6	563.1	153.7	13.1
16	06/29/00	1	568.0	100.5	1043.4	240.0	23.8
16	06/29/00	2	916.7	144.8	1571.4	307.2	26.9
16	06/29/00	3	825.2	138.6	927.9	303.1	42.7
17	06/30/00	1	681.1	117.2	624.4	325.9	23.8
17	06/30/00	2	507.9	154.3	663.1	342.4	35.2
17	06/30/00	3	394.5	100.2	814.7	275.2	29.0
18	07/01/00	1	379.3	78.4	440.7	305.2	39.3
18	07/01/00	2	349.5	145.9	521.4	164.7	23.8
18	07/01/00	3	266.9	76.4	511.0	293.8	36.6
19	07/02/00	1	176.6	82.1	547.1	237.9	39.3
19	07/02/00	2	208.3	88.6	256.3	166.3	26.9
19	07/02/00	3	226.0	53.1	176.9	153.1	25.4
20	07/03/00	1	158.4	24.8	240.0	150.0	8.3
20	07/03/00	2	286.9	38.2	165.8	131.4	22.8
20	07/03/00	3	221.4	42.5	110.8	119.0	17.1
21	07/04/00	1	170.5	27.6	109.8	101.1	12.4
21	07/04/00	2	145.1	51.7	203.8	94.1	15.5
21	07/04/00	3	120.0	26.6	137.6	67.1	14.5
21	07/05/00	1	106.6	34.5	87.5	91.0	14.2
21	07/05/00	2	128.6	37.7	218.3	82.6	16.1
21	07/05/00	3	89.7	40.0	186.2	50.7	14.2
22	07/06/00	1	106.1	20.0	185.1	68.3	11.4
22	07/06/00	2	141.0	14.8	324.4	120.0	13.4
22	07/06/00	3	120.7	52.4	259.7	139.3	19.3
23	07/07/00	1	174.1	40.5	480.0	115.9	20.0
23	07/07/00	2	325.1	109.9	284.7	100.3	2.1
23	07/07/00	3	217.2	84.9	224.1	132.2	1.0
24	07/08/00	1	251.7	58.6	581.7	421.0	54.4
24	07/08/00	2	216.6	68.4	637.0	308.4	35.2
24	07/08/00	3	213.1	63.4	173.8	272.1	9.2

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Report Period	Date	Period	Right Bank Nearshore	Right Bank Offshore	Left Bank Nearshore	Left Bank Midshore	Left Bank Offshore
25	07/09/00	1	145.9	26.5	228.8	150.0	9.3
25	07/09/00	2	135.0	46.3	187.2	133.4	9.2
25	07/09/00	3	112.2	19.1	217.6	110.8	5.2
26	07/10/00	1	149.3	15.2	236.9	83.8	11.6
26	07/10/00	2	151.0	17.7	196.3	127.2	6.2
26	07/10/00	3	129.0	17.3	190.3	134.5	9.3
27	07/11/00	1	102.8	23.0	245.1	142.1	6.2
27	07/11/00	2	167.3	28.6	478.0	192.4	16.6
27	07/11/00	3	137.2	41.6	248.3	188.1	7.5
28	07/12/00	1	148.9	47.4	247.5	89.0	5.0
28	07/12/00	2	142.9	50.3	558.1	270.0	13.4
28	07/12/00	3	151.1	62.7	284.2	333.1	12.2
29	07/13/00	1	128.2	46.9	263.8	229.7	8.3
29	07/13/00	2	124.1	32.7	263.2	305.1	27.0
29	07/13/00	3	92.4	24.8	107.8	219.3	13.4
29	07/14/00	1	132.2	46.3	149.5	151.5	32.1
29	07/14/00	2	130.9	69.4	93.6	163.4	
29	07/14/00	3	146.9	52.8	225.5	117.9	7.1
29	07/15/00	1	90.0	53.2	284.2	250.2	29.4
29	07/15/00	2	106.7	44.8	185.1	140.7	17.1
29	07/15/00	3	153.1	30.0	191.4	55.9	2.0
30	07/16/00	1	102.1	18.1	176.9	114.8	7.2
30	07/16/00	2	133.7	17.7	250.3	248.0	17.5
30	07/16/00	3	90.0	16.2	199.7	97.2	5.1
30	07/17/00	1	87.3	18.4	212.1	89.0	10.3
30	07/17/00	2	107.7	9.4	156.2	123.1	6.2
30	07/17/00	3	124.3	26.2	217.2	75.5	2.0
31	07/18/00	1	196.7	33.1	314.2	136.8	5.5
31	07/18/00	2	149.7	49.8	232.9	141.7	2.0
31	07/18/00	3	144.7	40.2	279.7	151.0	3.1
32	07/19/00	1	85.4	15.9	240.0	137.6	2.1
32	07/19/00	2	60.0	28.3	283.0	209.5	9.3
32	07/19/00	3	67.6	17.9	137.3	136.8	6.2
32	07/20/00	1	84.5	18.1	209.5	108.6	6.9
32	07/20/00	2	73.6	19.1	220.7	145.4	10.2
32	07/20/00	3	66.2	21.8	117.9	69.8	1.0
32	07/21/00	1	82.5	13.8	134.2	78.6	1.0
32	07/21/00	2	116.0	25.6	97.6	52.8	3.1
32	07/21/00	3	81.4	18.4	93.1	33.1	2.0
32	07/22/00	1	68.9	7.0	251.3	138.3	6.9
32	07/22/00	2	126.3	28.3	113.9	85.9	6.2
32	07/22/00	3	71.7	20.0	233.9	148.9	1.0
32	07/23/00	1	113.3	18.4	245.1	186.0	6.0
32	07/23/00	2	68.2	18.6	131.4	102.4	3.1
32	07/23/00	3	91.3	18.0	176.7	76.6	3.1

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Report Period	Date	Period	Right Bank Nearshore	Right Bank Offshore	Left Bank Nearshore	Left Bank Midshore	Left Bank Offshore
33	07/24/00	1	64.1	9.0	161.7	63.1	4.1
33	07/24/00	2	80.0	14.7	145.9	61.0	1.0
33	07/24/00	3	45.5	12.4	143.4	100.3	2.1
33	07/25/00	1	58.0	6.9	107.4	40.3	2.1
33	07/25/00	2	75.9	10.9	150.0	92.1	2.0
33	07/25/00	3	65.3	9.3	126.2	40.5	5.1
33	07/26/00	1	57.9	8.7	174.9	83.8	7.2
33	07/26/00	2	50.7	14.2	170.7	98.3	4.2
33	07/26/00	3	47.7	16.6	188.9	144.8	1.0
33	07/27/00	1	61.4	11.2	273.1	129.3	7.2
33	07/27/00	2	101.6	40.2	275.2	133.4	3.1
33	07/27/00	3	91.4	41.8	269.5	225.5	8.6
33	07/28/00	1	83.2	33.2	399.7	186.2	11.2
33	07/28/00	2	97.7	34.6	300.0	214.7	17.6
33	07/28/00	3	62.8	29.3	260.7	126.2	7.1
34	07/29/00	1	50.1	13.0	227.6	144.2	5.2
34	07/29/00	2	60.0	14.0	192.2	161.4	8.3
34	07/29/00	3	43.3	23.8	275.2	142.8	2.0
34	07/30/00	1	47.7	21.5	339.7	186.2	15.5
34	07/30/00	2	56.6	24.1	345.8	312.6	12.4
34	07/30/00	3	58.7	26.7	489.3	355.9	0.0
34	07/31/00	1	61.4	20.0	862.4	345.5	11.2
34	07/31/00	2	54.7	43.3	613.4	326.9	9.0
34	07/31/00	3	51.7	23.9	627.5	313.7	6.2
35	08/01/00	1	99.3	21.8	540.0	289.7	6.2
35	08/01/00	2	83.4	21.8	617.0	295.0	12.0
35	08/01/00	3	64.0	38.7	352.9	140.3	8.1
36	08/02/00	1	48.0	14.5	428.1	253.4	7.2
36	08/02/00	2	54.0	25.3	372.2	189.2	7.2
36	08/02/00	3	60.0	15.5	265.4	110.5	2.1
36	08/03/00	1			284.0	165.8	13.5
36	08/03/00	2	31.0	41.6	262.2	213.8	6.4
36	08/03/00	3	50.1	9.7	239.0	146.3	1.1
36	08/04/00	1	64.8	15.0	299.0	134.5	5.2
36	08/04/00	2	47.5	9.9	290.5	180.0	6.2
36	08/04/00	3	40.4	16.0	179.0	106.8	8.1
36	08/05/00	1	44.7	11.0	183.1	123.1	5.2
36	08/05/00	2	46.0	10.7	303.0	114.4	11.2
36	08/05/00	3	31.8	14.7	198.6	97.2	1.0
37	08/06/00	1	13.9	11.3	195.5	91.0	11.2
37	08/06/00	2	29.0	11.3	226.0	152.6	26.9
37	08/06/00	3	30.7	8.7	273.1	99.3	8.1

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Report Period	Date	Period	Right Bank Nearshore	Right Bank Offshore	Left Bank Nearshore	Left Bank Midshore	Left Bank Offshore
51	08/21/00	1	207.3	72.0	507.5	228.2	11.4
51	08/21/00	2	275.7	88.7	534.0	277.6	11.2
51	08/21/00	3	228.0	133.3	256.3	240.0	23.4
52	08/22/00	1	225.3	78.0	881.7	252.4	41.7
52	08/22/00	2	285.7	78.7	836.9	305.2	44.5
52	08/22/00	3	209.3	85.3	470.8	168.4	18.8
53	08/23/00	1	221.6	84.8	290.7	95.2	15.8
53	08/23/00	2	198.7	40.7	646.0	197.9	52.4
53	08/23/00	3	173.3	64.0	646.6	115.9	19.3
54	08/24/00	1	149.4	57.9	759.7	225.5	27.9
54	08/24/00	2	178.0	40.4	594.0	218.4	23.8
54	08/24/00	3	188.0	45.3	335.6	191.4	17.3
55	08/25/00	1	126.5	33.3	393.6	170.5	6.2
55	08/25/00	2	188.7	52.5	447.0	103.7	2.1
55	08/25/00	3	183.4	39.3	375.0	89.0	12.0
56	08/26/00	1	118.7	29.3	313.2	127.1	0.0
56	08/26/00	2	155.9	42.3	269.5	101.7	2.1
56	08/26/00	3	104.7	30.3	298.9	109.7	4.1
57	08/27/00	1	122.0	12.0	264.0	74.0	25.0
57	08/27/00	2	100.7	17.3	314.2	68.3	1.0
57	08/27/00	3	88.0	12.7	209.0	71.4	1.0
58	08/28/00	1	137.7	20.0	228.6	88.0	4.0
58	08/28/00	2	105.3	25.3	454.1	91.0	2.1
58	08/28/00	3	98.0	13.3	218.0	51.0	2.0
59	08/29/00	1	68.1	9.1	181.0	73.0	1.1
59	08/29/00	2	110.0	31.0	281.0	53.0	3.0
59	08/29/00	3	178.6	30.0	345.8	75.0	6.0
59	08/30/00	1	105.0	13.7	244.2	70.9	2.2
59	08/30/00	2	67.3	17.4	488.3	113.9	9.3
59	08/30/00	3	68.7	28.0	222.0	65.0	4.0
59	08/31/00	1	86.3	24.7	185.1	62.1	7.2
59	08/31/00	2	91.4	33.1	254.5	96.0	5.0
59	08/31/00	3	135.3	69.4	237.0	79.0	6.0
59	09/01/00	1	94.1	32.1	211.0	53.0	2.0
59	09/01/00	2	127.3	24.7	203.4	133.1	19.7
59	09/01/00	3	90.7	29.3	239.0	84.0	12.0
60	09/02/00	1	85.2	28.3	293.7	57.8	10.3
60	09/02/00	2	63.4	32.8	153.0	91.5	11.0
60	09/02/00	3	41.8	11.6	151.0	98.0	13.7

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Report Period	Date	Period	Right Bank Nearshore	Right Bank Offshore	Left Bank Nearshore	Left Bank Midshore	Left Bank Offshore
61	09/03/00	2	60.7	11.6	152.5	52.6	7.6
61	09/03/00	3	44.0	15.9	114.1	47.8	1.0
61	09/04/00	1	46.4	20.7	81.0	46.6	3.1
61	09/04/00	2	49.8	21.6	94.0	48.4	10.5
61	09/04/00	3	49.3	13.6	79.3	60.0	4.1
62	09/05/00	1	23.2	15.2	74.5	43.4	2.0
62	09/05/00	2	43.6	13.8	259.0	182.1	46.6
62	09/05/00	3	38.7	10.7	136.3	111.0	14.2
62	09/06/00	1	20.5	8.3	126.8	77.9	19.7
62	09/06/00	2	56.7	9.3	75.0	39.3	3.1
62	09/06/00	3	16.0	10.7	77.3	42.1	6.2
62	09/07/00	1	22.5	6.9	43.0	21.0	9.0
62	09/07/00	2	97.8	6.2	44.0	21.0	1.0
62	09/07/00	3	55.7	13.4	71.6	36.8	3.1
62	09/08/00	1	25.6	4.1	60.0	20.7	2.0
62	09/08/00	2	46.6	4.0	91.5	22.8	1.0
62	09/08/00	3	25.3	6.2	76.3	21.7	2.1
62	09/09/00	1	28.3	6.8	46.0	18.3	2.0
62	09/09/00	2	31.7	4.2	136.3	44.4	12.2
62	09/09/00	3	26.3	4.0	81.4	31.5	6.0
62	09/10/00	1	15.0	1.4	44.7	14.0	1.0
62	09/10/00	2	31.7	4.1	114.0	32.6	6.1
62	09/10/00	3	25.3	3.3	58.0	23.8	8.3
63	09/11/00	1	18.6	0.7	39.7	9.3	8.4
63	09/11/00	2	55.1	8.1	121.0	16.6	7.2
63	09/11/00	3	45.7	2.7	65.0	12.2	3.3
63	09/12/00	1	19.8	2.8	38.6	16.8	7.2
63	09/12/00	2	78.4	4.9	45.8	23.8	13.4
63	09/12/00	3	21.2	3.3	45.8	25.3	4.8
64	09/13/00	1	20.4	0.7	23.4	8.3	2.1
64	09/13/00	2	41.6	5.5	130.0	49.7	7.1
64	09/13/00	3	24.3	4.1	119.0	64.0	3.1
64	09/14/00	1	12.4	3.5	68.1	21.4	0.0
64	09/14/00	2	55.8	10.0	39.0	21.0	0.0
64	09/14/00	3	25.9	5.0	45.8	21.7	4.2

Appendix D. SAS program code used in 2000.

Appendix D. SAS program code used in 2000.

```
*********************************************************************
*********************************************************************
**                                                                 **
** FILE: yuk2000v1.sas                                             **
** TITLE: 2000 Yukon River Sonar Data Processing Program           **
** PLATFORM: SAS 6.12                                              **
** DATE: 11 May, 2000                                              **
**                                                                 **
*********************************************************************
*********************************************************************;



*********************************************************************
* 1.0 SET TITLE AND PAGE LENGTH AND WIDTH FOR OUTPUT AND FILENAMES.  *
*********************************************************************;
title1 'YUKON RIVER SONAR - 2000 DATA PROCESSING PROGRAM - Version 1';
options linesize=132 pagesize=50;
filename rptper   'c:\Rbwin\Pilot00\DataSas\rptper00.dat';
filename tfishdat 'c:\Rbwin\Pilot00\DataSas\tfish00.dat';
filename netsel   'c:\Rbwin\Pilot00\DataSas\netsel00.dat';
filename sonar    'c:\Rbwin\Pilot00\DataSas\sonar00.dat';



*********************************************************************
*********************************************************************
**                                                                 **
** 2.0 INPUT REPORTING PERIOD DEFINITIONS.                         **
**                                                                 **
*********************************************************************
*********************************************************************;



*********************************************************************
* 2.1 READ REPORTING PERIODS FROM AN EXTERNAL ASCII FILE.            *
*********************************************************************;
data rptdays;
  infile rptper firstobs=8;
  informat day mmddyy8.;
  format day date7.;
  input report day plotchar$;
  label report='REPORT PERIOD'
        plotchar='PLOTTING CHARACTER';
run;


*********************************************************************
* 2.2 COMPUTE NUMBER OF DAYS IN EACH REPORT PERIOD.                  *
*********************************************************************;
proc summary data=rptdays nway;
  class report;
```

```
  var day;
  output out=temp1 n=ndays;
run;


*********************************************************************
* 2.3 MERGE REPORT DEFINITION DATA WITH NUMBER OF DAYS IN EACH       *
*     REPORT PERIOD.                                                 *
*********************************************************************;
data rptdays;
  merge rptdays temp1(drop= _type_ _freq_);
  by report;
run;



*********************************************************************
*********************************************************************
**                                                                 **
** 3.0 INPUT TESTFISH DATA.                                        **
**                                                                 **
*********************************************************************
*********************************************************************;



*********************************************************************
* 3.1 READ TESTFISH DATA FROM ASCII FILE UNLOADED FROM RBASE.        *
*********************************************************************;
data testfish;
  infile tfishdat delimiter=',';
  informat day mmddyy. startout fullout startin fullin time8.;
  input day tfperiod qlbzone$ qbank$ mesh fathoms startout fullout
        startin fullin qmethod$ refno$ captain$ spcode length sex$;

  * STRIP DATA FROM RBASE STRINGS AND CONVERT TEXT TO UPPER CASE;
  bank = upcase(substr(qbank,2,1));
  lbzone = upcase(substr(qlbzone,2,1));
  method = upcase(substr(qmethod,2,1));

  * DEFINE ZONE VARIABLE;
  if bank eq 'R' then
    zone = 1;
  else if bank eq 'L' and lbzone eq 'N' then
    zone = 2;
  else if bank = 'L' and lbzone eq 'F' then
    zone = 3;
  else
    zone = .;

  * DEFINE SEASON VARIABLE AND CORRECT ANY CHUM SPECIATION ERRORS;
  if month(day) le 6 or (month(day) eq 7 and day(day) le 18) then
    season = 'early';
  else
    season = 'late';
  if season eq 'early' and spcode eq 6 then
    spcode = 5;
```

```
if season eq 'late' and spcode eq 5 then
  spcode = 6;

* COMPUTE DRIFT TIME IN MINUTES AND EFFORT IN FATHOM HOURS;
if fullout lt startout then
  do;
    t1 = startout;
    t2 = fullout + 86400;
    t3 = startin + 86400;
    t4 = fullin + 86400;
  end;
else if startin lt fullout then
  do;
    t1 = startout;
    t2 = fullout;
    t3 = startin + 86400;
    t4 = fullin + 86400;
  end;
else if fullin lt startin then
  do;
    t1 = startout;
    t2 = fullout;
    t3 = startin;
    t4 = fullin;
  end;
else
  do;
    t1 = startout;
    t2 = fullout;
    t3 = startin;
    t4 = fullin;
  end;
driftmin = (t3 + t4 - t1 - t2)/120;
fathhrs = fathoms*driftmin/60;

* DEFINE SPECIES NAMES;
length species $ 8;
if spcode eq 0 or spcode = . then
  species = 'NONE';
else if spcode eq 1 and length ge 655 then
  species = 'CHINOOK';
else if spcode eq 1 then
  species = 'JACK';
else if spcode eq 3 then
  species = 'COHO';
else if spcode eq 4 then
  species = 'PINK';
else if spcode eq 5 then
  species = 'SCHUM';
else if spcode eq 6 then
  species = 'FCHUM';
else if spcode eq 7 then
  species = 'CISCO';
else if spcode ge 8 and spcode le 9 then
  species = 'WHITE';
else
  species = 'OTHER';
```

```
  * DEFINE VARIABLE NEEDED IN SECTION 8.1;
  _type_ = 0;

  * FORMAT VARIABLES;
  format day date7. startout time5.;
  label day='DATE';

  * DROP UNNEEDED VARIABLES;
  drop t1 t2 t3 t4 spcode fullout startin fullin qlbzone bank qbank
       qmethod refno captain sex season lbzone;
run;


*********************************************************************
* 3.2 DETERMINE MOST RECENT TESTFISH DAY AND SAVE.                  *
*********************************************************************;
proc summary data=testfish;
  var day;
  output out=maxtfday max=maxtfday;
run;


*********************************************************************
*********************************************************************
**                                                                 **
** 4.0 COMPUTE TRADITIONAL CPUE FOR FISHERY MANAGERS.              **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 4.1 ISOLATE DRIFT DATA, AND DO PRELIMINARY DATA PROCESSING.       *
*********************************************************************;
data tradcpue;
  set testfish;

  * KEEP DRIFT DATA;
  if method eq 'D';

  * COMBINE CHINOOK SIZE CLASSES;
  if species eq 'JACK' then
    species = 'CHINOOK';

  * DEFINE MESH GROUPS;
  if mesh lt 5.25 then
    delete;
  else if mesh le 6.5 then
    meshgrp = 1;
  else
    meshgrp = 2;

  * DEFINE BANK VARIABLE;
```

```
  if zone eq 1 then
    bank = 'RIGHT';
  else if zone eq 2 or zone eq 3 then
    bank = 'LEFT';
  else
    bank = '.';
  if bank ne '.';

  * DEFINE NEW VARIABLES;
  if meshgrp eq 2 and species eq 'CHINOOK' then
    chinn = 1;
  else
    chinn = 0;
  if meshgrp eq 1 and species eq 'SCHUM' then
    schumn = 1;
  else
    schumn = 0;
  if meshgrp eq 1 and species eq 'FCHUM' then
    fchumn = 1;
  else
    fchumn = 0;
  if meshgrp eq 1 and species eq 'COHO' then
    cohon = 1;
  else
    cohon = 0;

  * DROP UNNECESSARY VARIABLES;
  drop fathoms length method zone driftmin species _type_;
run;


*********************************************************************
* 4.2 COMPUTE THE NUMBER OF FISH OF EACH SPECIES CAUGHT IN EACH      *
*     DRIFT.                                                         *
*********************************************************************;
proc summary data=tradcpue nway;
  class day bank tfperiod meshgrp mesh startout fathhrs;
  var chinn schumn fchumn cohon;
  output out=tradcpue sum(chinn)=
                      sum(schumn)=
                      sum(fchumn)=
                      sum(cohon)=;
run;


*********************************************************************
* 4.3 CREATE NEW FATHOM*HOURS VARIABLE FOR EACH MESH GROUP.          *
*********************************************************************;
data tradcpue;
  set tradcpue;
  if meshgrp eq 1 then
    fathhrss = fathhrs;
  else
    fathhrss = 0;
  if meshgrp eq 2 then
    fathhrsl = fathhrs;
  else
```

```
    fathhrsl = 0;
run;

*********************************************************************
* 4.4 SUM CATCH AND EFFORT BY DAY AND BANK.                         *
*********************************************************************;
proc summary data=tradcpue nway;
  class day bank;
  var chinn schumn fchumn cohon fathhrss fathhrsl;
  output out=tradcpue sum(chinn)=
                      sum(schumn)=
                      sum(fchumn)=
                      sum(cohon)=
                      sum(fathhrss)=
                      sum(fathhrsl)=;
run;

*********************************************************************
* 4.5 SPLIT DATA BY BANK.                                           *
*********************************************************************;
data lcpue;
  set tradcpue;
  if bank eq 'LEFT';
run;

data rcpue;
  set tradcpue;
  if bank eq 'RIGHT';
run;

*********************************************************************
* 4.6 DETERMINE THE FIRST TESTFISH DAY, COMBINE WITH THE MAXIMUM    *
*     TESTFISH DAY, AND CREATE A FILE WITH A RECORD FOR EVERY DAY.  *
*********************************************************************;
proc summary data=testfish;
  var day;
  output out=mintfday min=mintfday;
run;

data daylist;
  merge mintfday maxtfday;
  do day = mintfday to maxtfday;
    output;
  end;
  drop _type_ _freq_ mintfday maxtfday;
run;

*********************************************************************
* 4.7 MERGE FILES BY BANK WITH THE FILE WITH A RECORD FOR EVERY DAY. *
*********************************************************************;
data lcpue;
  merge lcpue daylist;
  by day;
```

```
run;

data rcpue;
  merge rcpue daylist;
  by day;
run;


*********************************************************************
* 4.8 SET MISSING VALUES TO ZERO AND COMPUTE CPUE.                  *
*********************************************************************;
data lcpue;
  set lcpue;

  * SET MISSING VALUES TO ZERO;
  if chinn eq . then
    chinn = 0;
  if schumn eq . then
    schumn = 0;
  if fchumn eq . then
    fchumn = 0;
  if cohon eq . then
    cohon = 0;
  if fathhrss eq . then
    fathhrss = 0;
  if fathhrsl eq . then
    fathhrsl = 0;

  * COMPUTE CPUE;
  if fathhrsl gt 0 then
    chinc = round(chinn/fathhrsl, 0.01);
  else
    chinc = 0;
  if fathhrss gt 0 then
    do;
      schumc = round(schumn/fathhrss, 0.01);
      fchumc = round(fchumn/fathhrss, 0.01);
      cohoc = round(cohon/fathhrss, 0.01);
    end;
  else
    do;
      schumc = 0;
      fchumc = 0;
      cohoc = 0;
    end;

  * FORMAT VARIABLES FOR OUTPUT;
  format chinc schumc fchumc cohoc fathhrss fathhrsl 6.2;
  label fathhrss ='SMALL MESH FATHOM HOURS'
        chinn = 'CHINOOK CATCH'
        chinc = 'CHINOOK CPUE'
        fathhrsl = 'LARGE MESH FATHOM HOURS'
        schumn = 'SUMMER CHUM CATCH'
        schumc = 'SUMMER CHUM CPUE'
        fchumn = 'FALL CHUM CATCH'
        fchumc = 'FALL CHUM CPUE'
        cohon = 'COHO CATCH'
```

```
        cohoc = 'COHO CPUE';
run;


data rcpue;
  set rcpue;

  * SET MISSING VALUES TO ZERO;
  if chinn eq . then
    chinn = 0;
  if schumn eq . then
    schumn = 0;
  if fchumn eq . then
    fchumn = 0;
  if cohon eq . then
    cohon = 0;
  if fathhrss eq . then
    fathhrss = 0;
  if fathhrsl eq . then
    fathhrsl = 0;

  * COMPUTE CPUE;
  if fathhrsl gt 0 then
    chinc = round(chinn/fathhrsl, 0.01);
  else
    chinc = 0;
  if fathhrss gt 0 then
    do;
      schumc = round(schumn/fathhrss, 0.01);
      fchumc = round(fchumn/fathhrss, 0.01);
      cohoc = round(cohon/fathhrss, 0.01);
    end;
  else
    do;
      schumc = 0;
      fchumc = 0;
      cohoc = 0;
    end;

  * FORMAT VARIABLES FOR OUTPUT;
  format chinc schumc fchumc cohoc fathhrss fathhrsl 6.2;
  label fathhrss ='SMALL MESH FATHOM HOURS'
        chinn = 'CHINOOK CATCH'
        chinc = 'CHINOOK CPUE'
        fathhrsl = 'LARGE MESH FATHOM HOURS'
        schumn = 'SUMMER CHUM CATCH'
        schumc = 'SUMMER CHUM CPUE'
        fchumn = 'FALL CHUM CATCH'
        fchumc = 'FALL CHUM CPUE'
        cohon = 'COHO CATCH'
        cohoc = 'COHO CPUE';
run;


*********************************************************************
* 4.9 PRINT CPUE INFORMATION.                                       *
*********************************************************************;
```

```
title2 'LEFT BANK CPUE IN FATHOM*HOURS';
title3 'Small meshes: 5.25, 6.5';
title4 'Large Meshes: 7.5, 8.5';
proc print data=lcpue label;
  var day fathhrsl chinn chinc fathhrss schumn schumc fchumn fchumc
      cohon cohoc;
  sum chinc schumc fchumc cohoc;
run;

title2 'RIGHT BANK CPUE IN FATHOM*HOURS';
title3 'Small meshes: 5.25, 6.5';
title4 'Large Meshes: 7.5, 8.5';
proc print data=rcpue label;
  var day fathhrsl chinn chinc fathhrss schumn schumc fchumn fchumc
      cohon cohoc;
  sum chinc schumc fchumc cohoc;
run;


*********************************************************************
*********************************************************************
**                                                                 **
** 5.0 PRINT SUMMARY TESTFISH RESULTS FOR MOST RECENT DAY.         **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 5.1 MERGE TESTFISH DATA WITH LAST TESTFISH DAY, AND DISCARD ALL   *
*     BUT MOST RECENT DAY'S DATA.                                   *
*                                                                   *
*     NOTE: TO OBTAIN MORE THAN 1 DAY'S DATA, CHANGE THE ZERO IN THE *
*           IF STATEMENT TO A LARGER NUMBER.                        *
*********************************************************************;
data tfrecnt;
  merge testfish maxtfday;
  by _type_;
  if day ge maxtfday - 0;
  drop maxtfday _type_ _freq_;
run;


*********************************************************************
* 5.2 COMPUTE THE NUMBER OF FISH OF EACH SPECIES CAUGHT IN EACH     *
*     DRIFT.                                                        *
*********************************************************************;
proc summary data=tfrecnt nway;
  class day tfperiod mesh startout zone method species;
  id fathoms driftmin fathhrs;
  var length;
  output out=tfrecnt n=ncatch;
run;
```

```
*********************************************************************
* 5.3 TRANSPOSE DATA TO GET ONE LINE PER DRIFT, EACH SPECIES IN A    *
*     SEPARATE VARIABLE.                                             *
*********************************************************************;
proc transpose data=tfrecnt out=tfrecntw;
  var ncatch;
  id species;
  by day tfperiod mesh startout zone method fathoms driftmin;
run;


*********************************************************************
* 5.4 CREATE DUMMY DATASET CONTAINING ALL SPECIES.  IN SUBSEQUENT    *
*     PRINTS THIS ENSURES ALL SPECIES ARE LISTED, EVEN IF NON WERE   *
*     CAUGHT.                                                        *
*********************************************************************;
data spplist;
  chinook = 0;
  jack = 0;
  schum = 0;
  fchum = 0;
  coho = 0;
  pink = 0;
  white = 0;
  cisco = 0;
  other=0;
run;


*********************************************************************
* 5.5 MERGE TESTFISH DRIFT DATA WITH SPECIES LIST.                   *
*********************************************************************;
data tfrecntw;
  set tfrecntw(in=a drop=_name_) spplist;
  if a;
run;


*********************************************************************
* 5.6 TRANSPOSE DATA BACK TO GET NUMBER CAUGHT INTO A SINGLE COLUMN. *
*********************************************************************;
proc transpose data=tfrecntw name=species out=temp1;
  var chinook jack schum pink fchum coho white cisco other;
  by day tfperiod mesh startout zone method fathoms driftmin;
run;


*********************************************************************
* 5.7 SET MISSING VALUES TO 0.                                       *
*********************************************************************;
data temp1;
  set temp1;
  if col1 eq . then
    col1 = 0;
  rename col1 = ncatch;
run;
```

```
*********************************************************************
* 5.8 COMPUTE NUMBER OF FISH CAUGHT IN EACH DRIFT.                  *
*********************************************************************;
proc summary data=temp1 nway;
  class day tfperiod mesh startout zone method fathoms driftmin;
  var ncatch;
  output out=temp2 sum(ncatch)=sumcatch;
run;


*********************************************************************
* 5.9 TRANSPOSE DATA TO GET ONE LINE PER DRIFT, EACH SPECIES IN A   *
*     SEPARATE VARIABLE.                                            *
*********************************************************************;
proc transpose data=temp1 out=tfrecntw;
  var ncatch;
  id species;
  by day tfperiod mesh startout zone method fathoms driftmin;
run;


*********************************************************************
* 5.10 MERGE CATCH BY SPECIES WITH TOTAL CATCH.                     *
*********************************************************************;
data tfrecntw;

  * MERGE DATA;
  merge tfrecntw(drop=_name_) temp2(drop= _type_ _freq_);
  by day tfperiod mesh startout zone method fathoms driftmin;

  * FORMAT VARIABLES FOR OUTPUT;
  format driftmin 6.2;
  label driftmin = 'FISHING TIME: MINUTES'
        chinook = 'CHINOOK >=700mm'
        jack = 'CHINOOK <700mm'
        schum = 'SUMMER CHUM'
        fchum = 'FALL CHUM'
        white = 'WHITEFISH'
        cisco = 'CISCO SPECIES'
        other = 'OTHER SPECIES'
        startout = 'TIME DRIFT BEGAN'
        tfperiod = 'TESTFISH PERIOD'
        sumcatch = 'TOTAL CATCH';
run;


*********************************************************************
* 5.11 PRINT TESTFISH HARVESTS ON MOST RECENT DAY, BY DRIFT.        *
*********************************************************************;
title2 'SUMMARY OF MOST RECENT TESTFISH HARVESTS - BY DRIFT';
title3 'Zone 1 = RB : Zone 2 = LBN : Zone 3 = LBO';
proc print data=tfrecntw noobs label;
  var day tfperiod mesh startout zone method;
  sum driftmin chinook jack schum fchum coho pink white cisco other
      sumcatch;
run;
```

```
*********************************************************************
* 5.12.1 OPTIONAL                                                   *
*                                                                   *
*         COMPUTE TESTFISH CPUE ON MOST RECENT DAY, BY DRIFT.       *
*********************************************************************;
data cpuercnt;
  set tfrecntw;
  effort = fathoms*driftmin/60;
  chinook = round(chinook/effort, 0.01);
  jack = round(jack/effort, 0.01);
  schum = round(schum/effort, 0.01);
  fchum = round(fchum/effort, 0.01);
  coho = round(coho/effort, 0.01);
  pink = round(pink/effort, 0.01);
  white = round(white/effort, 0.01);
  cisco = round(cisco/effort, 0.01);
  other = round(other/effort, 0.01);
  sumcpue = chinook + jack + schum + fchum + coho + pink + white +
            cisco + other;
  drop effort sumcatch;
run;


*********************************************************************
* 5.12.2 PRINT TESTFISH CPUE ON MOST RECENT DAY, BY DRIFT.          *
*********************************************************************;
title2 'SUMMARY OF MOST RECENT TESTFISH CPUE - BY DRIFT';
title3 'CPUE IS REPORTED IN UNITS OF CATCH PER FATHOM*HOUR';
title4 'OPTIONAL OUTPUT';
proc print data=cpuercnt noobs label;
  format chinook jack schum fchum coho pink white cisco other
         sumcpue 6.2;
  var day tfperiod mesh startout zone method;
  sum driftmin chinook jack schum fchum coho pink white cisco other
      sumcpue;
run;


*********************************************************************
*********************************************************************
**                                                                 **
** 6.0 PROCESS TESTFISH DATA FOR ESTIMATION OF SPECIES PROPORTIONS. **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 6.1 DISCARD BEACHWALK DATA.                                       *
*********************************************************************;
data tfdata;
  set testfish;
```

```
  if method eq 'D';

run;


*********************************************************************
* 6.2 ISOLATE UNIQUE DRIFTS.                                        *
*********************************************************************;
proc sort data=tfdata;
  by day tfperiod zone mesh startout;
run;

* ISOLATE UNIQUE DRIFTS;
proc summary data=tfdata;
  var fathhrs;
  by day tfperiod zone mesh startout;
  output out=drifts mean(fathhrs)=fathhrs;
run;

* COMBINE MULTIPLE DRIFTS OF SAME MESH SIZE;
proc summary data=drifts;
  var fathhrs;
  by day tfperiod zone mesh;
  output out=drifts sum(fathhrs)=fathhrs;
run;


*********************************************************************
* 6.3 CREATE TEXT STRING BASED ON MESH SIZE.                        *
*                                                                   *
* NOTE: THE LIST OF MESH SIZES MUST INCLUDE ALL THOSE USED. THE     *
*       INCLUSION OF MESH SIZES NOT USED WILL NOT CAUSE PROBLEMS.   *
*********************************************************************;
data drifts;
  set drifts;

  if mesh = 2.75 then
    mname = 'M275';
  else if mesh = 4.0 then
    mname = 'M40';
  else if mesh = 5.0 then
    mname = 'M50';
  else if mesh = 5.25 then
    mname = 'M525';
  else if mesh = 5.375 then
    mname = 'M5375';
  else if mesh = 5.5 then
    mname = 'M55';
  else if mesh = 5.75 then
    mname = 'M575';
  else if mesh = 6.0 then
    mname = 'M60';
  else if mesh = 6.5 then
    mname = 'M65';
```

```
  else if mesh = 7.0 then
    mname = 'M70';
  else if mesh = 7.5 then
    mname = 'M75';
  else if mesh = 8.0 then
    mname = 'M80';
  else if mesh = 8.5 then
    mname = 'M85';
  else
    mname = 'new';

  drop _freq_ _type_;
run;


*********************************************************************
* 6.4 TRANSPOSE FATHOM-HOURS TO GET ONE ROW PER ZONE WITHIN A DAY    *
*     AND TESTFISH PERIOD.                                           *
*********************************************************************;
proc transpose data=drifts out=driftsw;
  var fathhrs;
  id mname;
  by day tfperiod zone;
run;


*********************************************************************
* 6.5 ISOLATE RECORDS WITH A CAPTURED FISH.                          *
*********************************************************************;
data catches;
  set tfdata;
  if species ne 'NONE';
run;


*********************************************************************
* 6.6 COMBINE DATA ON CAPTURED FISH WITH FATHOM-HOURS OF ALL MESH    *
*     SIZES DRIFTED IN EACH ZONE DURING EACH TESTFISH PERIOD EACH    *
*     DAY.                                                           *
*********************************************************************;
data catches;
  merge catches(in=y) driftsw;
  by day tfperiod zone;
  if y;
run;


*********************************************************************
* 6.7 TRANSPOSE FATHOM-HOURS TO GET ONE RECORD FOR EACH MESH SIZE    *
*     FISHED.                                                        *
*********************************************************************;
data catches;
  set catches;
```

```
  drop _type_ _name_ fathoms method driftmin fathhrs;
run;

proc sort data=catches;
  by day tfperiod zone mesh startout species length;
run;

proc transpose data=catches out=catches;
  by day tfperiod zone mesh startout species length;
run;



*********************************************************************
* 6.8 CREATE VARIABLES FOR MESH SIZE AND FATHOM-HOURS.              *
*                                                                   *
* NOTE: THE LIST OF MESH SIZES MUST MATCH THE LIST IN SECTION 6.3.  *
*********************************************************************;
data catches;
  set catches;

  if _name_ = 'M275' then
    mesh2 = 2.75;
  else if _name_ = 'M40' then
    mesh2 = 4.0;
  else if _name_ = 'M50' then
    mesh2 = 5.0;
  else if _name_ = 'M525' then
    mesh2 = 5.25;
  else if _name_ = 'M5375' then
    mesh2 = 5.375;
  else if _name_ = 'M55' then
    mesh2 = 5.5;
  else if _name_ = 'M575' then
    mesh2 = 5.75;
  else if _name_ = 'M60' then
    mesh2 = 6.0;
  else if _name_ = 'M65' then
    mesh2 = 6.5;
  else if _name_ = 'M70' then
    mesh2 = 7.0;
  else if _name_ = 'M75' then
    mesh2 = 7.5;
  else if _name_ = 'M80' then
    mesh2 = 8.0;
  else if _name_ = 'M85' then
    mesh2 = 8.5;

  fathhrs = col1;

  if fathhrs > 0;

  keep day tfperiod zone mesh startout species length mesh2 fathhrs;
run;
```

```
*********************************************************************
* 6.9 READ NET SELECTIVITY PARAMETERS.                              *
*********************************************************************;
data netsel;
  infile netsel firstobs=5;
  input species$ a b t;
run;


*********************************************************************
* 6.10 SORT DATA AND COMBINE TESTFISH DATA WITH NET SELECTIVITY     *
*      PARAMETERS.                                                  *
*********************************************************************;
proc sort data=catches;
  by species;
run;

proc sort data=netsel;
  by species;
run;

data sppapp;
  merge catches(in=y) netsel;
  by species;
  if y;
run;


*********************************************************************
* 6.11 COMPUTE NET SELECTIVITY AND CREATE VARIABLES NEEDED FOR      *
*      COMPUTATION OF SPECIES PROPORTIONS.                          *
*********************************************************************;
data sppapp;
  set sppapp;

  * COMPUTE NET SELECTIVITY;
  if length le 0 or length eq . or mesh le 0 or mesh eq . then
    select = .;
  else
    do;
      lpr = length/(mesh2*50.8);
      dum1 = exp(-a*(lpr-t));
      select = ((1-b)**(1-1/b))*dum1*((1-min(1,b*dum1))**(1/b-1));
    end;

  * CREATE NEW VARIABLES;
  if mesh = mesh2 then
    catch = 1;
  else
    catch = 0;
  seleff = select*fathhrs;
  _type_ = 0;

  drop lpr dum1 a b t;
run;
```

```
*********************************************************************
* 6.12.0 OPTIONAL                                                   *
*                                                                   *
*        PRINT DETAILS OF EACH FISH CAUGHT ON MOST RECENT DAY.      *
*********************************************************************;


*********************************************************************
* 6.12.1 RESTRICT ATTENTION TO FISH CAUGHT ON THE MOST RECENT DAY.  *
*********************************************************************;
data tfrecnt2;
  merge sppapp maxtfday;
  by _type_;

  * RESTRICT DATA TO FISH CAUGHT ON MOST RECENT DAY;
  if day ge maxtfday - 0;
  if mesh = mesh2;

  * PREPARE VARIABLES FOR OUTPUT;
  format catch 7.3
         fathhrs 5.2;
  label tfperiod = 'TESTFISH PERIOD'
        startout = 'TIME DRIFT BEGAN'
        fathhrs = 'FATHOM-HOURS'
        select = 'NET SELECTIVITY';

  * DROP UNNEEDED VARIABLES;
  drop mesh2 seleff maxtfday _type_ _freq_;
run;


*********************************************************************
* 6.12.2 PRINT DETAILS OF EACH FISH CAUGHT ON MOST RECENT DAY, BY   *
*        DRIFT.                                                     *
*********************************************************************;
proc sort data=tfrecnt2;
  by day tfperiod zone mesh startout fathhrs species length select;
run;

title2 'DETAILS OF FISH CAUGHT ON MOST RECENT DAY';
title3 'EXCLUDES FISH CAUGHT DURING BEACHWALKS';
title4 'OPTIONAL OUTPUT';
proc print data=tfrecnt2 noobs label;
  var day tfperiod zone mesh startout fathhrs species length select;
run;


*********************************************************************
* 6.13  COMBINE CISCO AND WHITEFISH WITH OTHERS.                    *
*********************************************************************;
data sppapp;
```

```
  set sppapp;
  if species eq 'CISCO' or species eq 'WHITE' then
    species = 'OTHER';
run;


*********************************************************************
* 6.14.0 COMPUTE SPECIES PROPORTIONS WITHIN TESTFISH PERIODS.       *
*********************************************************************;

*********************************************************************
* 6.14.1 SUM CATCH AND SELECTIVITY*EFFORT ACROSS MESH SIZES WITHIN  *
*        DAY, TESTFISH PERIOD, ZONE, SPECIES, AND LENGTH.           *
*********************************************************************;
proc summary data=sppapp nway;
  class day tfperiod zone species length;
  var catch seleff;
  output out=tfprop sum(catch)=catch
                    sum(seleff)=seleff;
run;


*********************************************************************
* 6.14.2 COMPUTE RATIO OF CATCH TO SELECTIVITY*EFFORT.              *
*********************************************************************;
data tfprop;
  set tfprop;
  if seleff > 0 then
    ratio = catch/seleff;
  else
    ratio = 0;

  drop catch seleff _type_ _freq_;
run;


*********************************************************************
* 6.14.3 SUM CATCH TO SELECTIVITY*EFFORT RATIO ACROSS SPECIES AND   *
*        LENGTHS WITHIN DAY, TESTFISH PERIOD, AND ZONE.             *
*********************************************************************;
proc summary data=tfprop;
  class day tfperiod zone;
  var ratio;
  output out=sppsum sum(ratio)=sumratio;
run;


*********************************************************************
* 6.14.4 COMBINE RATIO FOR SPECIES AND LENGTH WITH THE TOTAL ACROSS *
*        SPECIES AND LENGTH, AND COMPUTE CATEGORY PROPORTIONS.      *
*********************************************************************;
proc sort data=tfprop;
  by day tfperiod zone species length;
```

```
run;

proc sort data=sppsum;
  by day tfperiod zone;
run;

data tfprop;
  merge tfprop(in=y) sppsum;
  by day tfperiod zone;
  if y;

  catprop = ratio/sumratio;
run;



*********************************************************************
* 6.14.5 COMPUTE SPECIES PROPORTIONS FOR TESTFISH PERIODS BY SUMMING *
*        ACROSS LENGTHS WITHIN SPECIES.                              *
*********************************************************************;
proc summary data=tfprop nway;
  class day tfperiod zone species;
  var catprop;
  output out=tfprop sum(catprop)=tfprop;
run;



*********************************************************************
* 6.14.6 TRANSPOSE PROPORTIONS BY SPECIES, CREATING A VARIABLE FOR   *
*        EACH SPECIES CAPTURED, AND TRANPOSE BACK.                   *
*********************************************************************;
proc transpose data=tfprop (drop = _type_ _freq_) out=tfpropw;
  var tfprop;
  id species;
  by day tfperiod zone;
run;

data tfpropw;
  set tfpropw;
  drop _name_;
run;

proc transpose data=tfpropw name=species out=tfprop;
  by day tfperiod zone;
run;

data tfprop;
  set tfprop;
  if coll >= 0.0 then
    tfprop=coll;
  else
    tfprop = 0;
  drop coll;
run;
```

```
*********************************************************************
* 6.15.0 COMPUTE SPECIES PROPORTIONS WITHIN REPORTING PERIODS.      *
*********************************************************************;

*********************************************************************
* 6.15.1 ADD REPORTING PERIOD DESIGNATIONS TO sppapp.               *
*********************************************************************;
proc sort data=sppapp;
  by day tfperiod zone;
run;

proc sort data=rptdays;
  by day;
run;

data sppapp;
  merge sppapp(in=y) rptdays;
  by day;
  if y;
run;


*********************************************************************
* 6.15.2 SUM CATCH AND SELECTIVITY*EFFORT ACROSS MESH SIZES WITHIN  *
*        REPORTING PERIOD, ZONE, SPECIES, AND LENGTH.               *
*********************************************************************;
proc summary data=sppapp nway;
  class report zone species length;
  var catch seleff;
  output out=rpprop sum(catch)=catch
                    sum(seleff)=seleff;
run;


*********************************************************************
* 6.15.3 COMPUTE RATIO OF CATCH TO SELECTIVITY*EFFORT.              *
*********************************************************************;
data rpprop;
  set rpprop;
  if seleff > 0 then
    ratio = catch/seleff;
  else
    ratio = 0;

  drop catch seleff _type_ _freq_;
run;


*********************************************************************
* 6.15.4 SUM CATCH TO SELECTIVITY*EFFORT RATIO ACROSS SPECIES AND   *
*        LENGTHS WITHIN REPORTING PERIOD AND ZONE.                  *
*********************************************************************;
proc summary data=rpprop;
```

```
  class report zone;
  var ratio;
  output out=sppsum sum(ratio)=sumratio;
run;


*********************************************************************
* 6.15.5 COMBINE RATIO FOR SPECIES AND LENGTH WITH THE TOTAL ACROSS  *
*        SPECIES AND LENGTH, AND COMPUTE CATEGORY PROPORTIONS.       *
*********************************************************************;
proc sort data=rpprop;
  by report zone species length;
run;

proc sort data=sppsum;
  by report zone;
run;

data rpprop;
  merge rpprop(in=y) sppsum;
  by report zone;
  if y;

  catprop = ratio/sumratio;
run;


*********************************************************************
* 6.15.6 COMPUTE SPECIES PROPORTIONS FOR REPORTING PERIODS BY        *
*        SUMMING ACROSS LENGTHS WITHIN SPECIES.                      *
*********************************************************************;
proc summary data=rpprop nway;
  class report zone species;
  var catprop;
  output out=rpprop sum(catprop)=rpprop;
run;


*********************************************************************
* 6.15.7 TRANSPOSE PROPORTIONS BY SPECIES, CREATING A VARIABLE FOR   *
*        EACH SPECIES CAPTURED, AND TRANPOSE BACK.                   *
*********************************************************************;
proc transpose data=rpprop (drop = _type_ _freq_) out=rppropw;
  var rpprop;
  id species;
  by report zone;
run;

data rppropw;
  set rppropw;
  drop _name_;
run;

proc transpose data=rppropw name=species out=rpprop;
```

```
  by report zone;
run;

data rpprop;
  set rpprop;
  if coll >= 0.0 then
    rpprop=coll;
  else
    rpprop = 0;
  drop coll;
run;


*********************************************************************
* 6.16 ADD REPORTING PERIOD INFORMATION TO tfprop AND COMBINE       *
*      TESTFISH AND REPORTING PERIOD DATASETS.                      *
*********************************************************************;
data tfprop;
  merge tfprop(in=y) rptdays;
  by day;
  if y;
run;

proc sort data=tfprop;
  by report zone species;
run;

proc sort data=rpprop;
  by report zone species;
run;

data tfprop;
  merge tfprop(in=y) rpprop;
  by report zone species;
  if y;

  if rpprop = . then
    rpprop = 0;

  drop plotchar ndays;
run;


*********************************************************************
* 6.17.0 ESTIMATE VARIANCE OF SPECIES PROPORTIONS.                  *
*********************************************************************;


*********************************************************************
* 6.17.1 COMPUTE SQUARED DEVIATIONS.                                *
*********************************************************************;
data tfprop;
  set tfprop;
  square = (tfprop - rpprop)**2;
run;
```

```
*********************************************************************
* 6.17.2 SUM SQUARED DEVIATIONS OVER ALL TESTFISH PERIODS IN EACH    *
*        REPORT PERIOD, BY ZONE AND SPECIES.                         *
*********************************************************************;
proc summary data=tfprop nway;
  class report zone species;
  var square;
  output out=propvar sum(square)=propvar
                              n = ntfp;
run;


*********************************************************************
* 6.17.3 COMPUTE VARIANCE.                                           *
*********************************************************************;
data propvar;
  set propvar;
  if ntfp > 1 then
    propvar = propvar/(ntfp*(ntfp-1));
  else
    propvar = 0;
  drop _type_ _freq_;
run;



*********************************************************************
* 6.17.4 MERGE VARIANCE ESTIMATE WITH SPECIES PROPORTION ESTIMATES.  *
*********************************************************************;
data spprop;
  merge rpprop(in=y) propvar;
  by report zone species;
  if y;
run;



*********************************************************************
* 6.18.0 PRINT SPECIES PROPORTIONS BY REPORT PERIOD AND ZONE.        *
*********************************************************************;



*********************************************************************
* 6.18.1 GET DAY INFORMATION INTO spprop DATASET.                    *
*********************************************************************;
proc summary data=rptdays nway;
  class report;
  var day;
  output out=temp min(day)=fday
                  max(day)=lday;
run;

data spprop;
```

```
  merge spprop(in=y) temp;
  by report;
  if y;
  drop _type_ _freq_;
run;


*********************************************************************
* 6.18.2 TRANSPOSE DATA TO GET A VARIABLE FOR EACH SPECIES.         *
*********************************************************************;
proc sort data=spprop;
  by report fday lday zone ntfp;
run;

proc transpose data=spprop out=sppropw;
  by report fday lday zone ntfp;
  id species;
  var rpprop;
run;


*********************************************************************
* 6.18.3 PRINT REPORT PERIOD SPECIES PROPORTIONS DATA.              *
*********************************************************************;
title2 'SPECIES PROPORTIONS BY REPORT PERIOD AND ZONE';
proc print data=sppropw noobs label;
  label report = 'REPORT NUMBER'
        fday = 'FIRST DAY'
        lday = 'LAST DAY'
        ntfp = 'NUMBER TESTFISH PERIODS'
        schum='SUMMER CHUM'
        fchum='FALL CHUM'
        other='NON-SALMON';
  format chinook jack schum pink fchum coho other 6.4
         fday lday date7.;
  var report fday lday zone ntfp chinook jack schum pink fchum coho
      other;
run;


*********************************************************************
*********************************************************************
**                                                                 **
** 7.0 INPUT SONAR DATA AND CONSTRUCT BASIC DATA SETS.             **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 7.1 READ SONAR DATA FROM ASCII FILE UNLOADED FROM RBASE DATABASE. *
*********************************************************************;
data sonarct;
  infile sonar delimiter=',';
```

```
  informat day mmddyy8. startime endtime time8.;
  input day speriod stratum startime endtime sector secwidth strtrang
        upcount dwncount operator$ minutes;

  * DEFINE ZONE VARIABLE BASED ON STRATA;
  if stratum le 2 then
    zone = 1;
  else if stratum eq 3 then
    zone = 2;
  else if stratum gt 3 then
    zone = 3;
  else
    delete;

  * COMPUTE DURATION OF COUNTS IN HOURS, ADJUSTING FOR COUNTING TIMES
  WHICH SPAN MIDNIGHT;
  counthrs = (endtime - startime)/3600;
  if counthrs lt 0 then
    counthrs = counthrs + 24;

  * DEFINE VARIABLE NEEDED IN SECTION 4.1;
  _type_ = 0;

  * FORMAT VARIABLES;
  format day date7. startime endtime time5.;
  label day='DATE';

  * DROP UNNEEDED VARIABLES;
  drop operator minutes;
run;


*********************************************************************
* 7.2 DETERMINE 24 HOUR COUNT DAYS.                                 *
*********************************************************************;
proc summary data=sonarct nway;
  class day;
  var speriod;
  output out=days24 min=;
run;

data days24;
  set days24;
  if speriod eq 0;
  drop _type_ _freq_ speriod;
run;


*********************************************************************
* 7.3 CONSTRUCT DATA SET CONSISTING ONLY OF DATA FROM 24 HOUR COUNT  *
*     DAYS.                                                         *
*********************************************************************;
proc sort data=sonarct;
  by day;
run;

proc sort data=days24;
```

```
  by day;
run;

data sonar24;
  merge sonarct days24(in=a);
  by day;
  if a;
run;


*********************************************************************
* 7.4 CONSTRUCT DATA SET CONSISTING ONLY OF DATA COLLECTED DURING    *
*     THE NORMAL SONAR PERIODS.                                      *
*********************************************************************;
data sonarct;
  set sonarct;
  if speriod ge 1 and speriod le 3;
run;


*********************************************************************
* 7.5 DETERMINE MOST RECENT DAY IN SONAR DATA AND SAVE.              *
*********************************************************************;
proc summary data=sonarct;
  var day;
  output out=maxsday max=maxsday;
run;


*********************************************************************
*********************************************************************
**                                                                 **
** 8.0 PLOT UPSTREAM TARGETS PER HOUR FOR EACH BANK AND SONAR       **
**     PERIOD ON THE MOST RECENT DAY.                              **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 8.1 COMPUTE UPSTREAM TARGETS PER METER OF RANGE DURING EACH PERIOD *
*     FOR THE MOST RECENT DAY.                                       *
*********************************************************************;
data rangdist;
  merge sonarct maxsday;
  by _type_;

  * ONLY KEEP DATA FROM MOST RECENT DAY;
  if day eq maxsday;

  * DEFINE BANK VARIABLE;
  if zone eq 1 then
    bank = 'RIGHT';
  else if zone eq 2 or zone eq 3 then
    bank = 'LEFT';
  if bank eq 'RIGHT' or bank eq 'LEFT';
```

```
  * COMPUTE STARTING AND ENDING RANGE OF EACH STRATUM;
  range1 = round(strtrang+(sector-1)*secwidth,1);
  range2 = round(strtrang+sector*secwidth,1);

  * COMPUTE NUMBER OF TARGETS PER METER PER HOUR;
  upcntpm = upcount/secwidth;

  * INSERT ROW IN DATASET FOR EACH 1 METER RANGE INTERVAL, AND DEFINE
    MIDPOINT OF RANGE INTERVAL;
  binsize = 10;
  do range = range1 to (range2-1);
    rangebin = range - mod(range,binsize) + binsize/2;
    output;
  end;
run;


*********************************************************************
* 8.2 SUM TARGETS PER METER AND COUNTING TIME OVER UNIQUE STARTING   *
*     TIMES FOR EACH METER OF RANGE AND EACH SONAR PERIOD.           *
*********************************************************************;
proc summary data=rangdist nway;
  class day bank speriod rangebin range;
  var upcntpm counthrs;
  output out=passrate sum(upcntpm)=
                      sum(counthrs)=;
run;


*********************************************************************
* 8.3 CALCULATE UPSTREAM PASSAGE RATE PER HOUR PER METER.            *
*********************************************************************;
data passrate;
  set passrate (drop= _type_ _freq_);

  * CALCULATE PASSAGE RATE;
  psperbin = upcntpm/counthrs;
  label psperbin = 'TARGETS PER HOUR:'
        rangebin = 'RANGE (METERS)';
run;


*********************************************************************
* 8.4 SUM HOURLY PASSAGE RATES ACROSS RANGE WITHIN RANGEBINS.        *
*********************************************************************;
proc summary data=passrate nway;
  class day bank speriod rangebin;
  var psperbin;
  output out=passrate sum(psperbin)=;
run;


*********************************************************************
* 8.5 CHART DISTRIBUTION OF UPSTREAM PASSAGE RATE BY BANK AND SONAR  *
*     PERIOD.                                                        *
```

```
*********************************************************************;
title2 'UPSTREAM PASSAGE RATE (TARGETS PER HOUR) AT RANGE';
title3 'BY BANK AND SONAR PERIOD';
proc chart data=passrate;
  by day bank speriod;
  vbar rangebin / sumvar=psperbin discrete;
run;


*********************************************************************
*********************************************************************
**                                                                 **
** 9.0 PROCESS SONAR DATA.                                         **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 9.1 SUM UPSTREAM COUNTS ACROSS SECTORS.                           *
*********************************************************************;
proc summary data=sonarct nway;
  class day speriod zone stratum startime;
  id endtime counthrs;
  var upcount;
  output out=sumsctrs sum=;
run;


*********************************************************************
* 9.2.0 COMPUTE INTERMEDIATE QUANTITIES NECESSARY TO DETERMINE THE  *
*       DURATION OF SONAR PERIODS, THIS IS NECESSITATED BY SONAR    *
*       PERIODS EXTENDING PAST MIDNIGHT.                            *
*********************************************************************;

*********************************************************************
* 9.2.1 CREATE NEW STARTING AND ENDING TIME VARIABLES, ADJUSTING    *
*       FOR SAMPLING INTERVALS WHICH EXTEND PAST MIDNIGHT.          *
*********************************************************************;
data sumsctrs;
  set sumsctrs (drop = _type_ _freq_);

  * DEFINE newend TO EQUAL endtime UNLESS endtime EQUALS MIDNIGHT;
  if endtime eq 0 then
    newend = 86400;
  else
    newend = endtime;

  * DEFINE newstart TO EQUAL startime UNLESS SAMPLING INTERVAL EXTENDS
    ACROSS MIDNIGHT, IN WHICH CASE THE INTERVAL IS SHIFTED TO START AT
    TIME 0;
  newstart = startime;
  if startime gt newend then do
    newstart = 0;
    newend = newend + (86400 - startime);
  end;
```

```
  * SPLIT SONAR PERIODS CONTAINING MIDNIGHT INTO TWO;
  if newstart le 43200 then
    s1 = newstart;
  else
    s2 = newstart;
  if newend le 43200 then
    e1 = newend;
  else
    e2 = newend;
  format startime time5.;
  drop newstart newend;
run;


*********************************************************************
* 9.2.2 COMPUTE MINIMUM AND MAXIMUM VALUES OF NEW TIME VARIABLES.    *
*********************************************************************;
proc summary data=sumsctrs nway;
  class day speriod zone stratum;
  var s1 s2 e1 e2;
  output out=temp1 min(s1) = mins1
                   max(e1) = maxe1
                   min(s2) = mins2
                   max(e2) = maxe2;
run;


*********************************************************************
* 9.2.3 MERGE DATA WITH INTERMEDIATE TIME STATISTICS.                 *
*********************************************************************;
data sumsctrs;
  merge sumsctrs(in=a) temp1(drop = _type_ _freq_);
  by day speriod zone stratum;
  if a;
  drop endtime s1 s2 e1 e2;
run;


*********************************************************************
* 9.3 SUM UPSTREAM COUNT AND COUNTING TIME ACROSS ALL SAMPLE TIMES    *
*     WITHIN A SONAR PERIOD AND STRATUM.                              *
*********************************************************************;
proc summary data=sumsctrs nway;
  class day speriod zone stratum;
  var upcount counthrs startime mins1 mins2 maxe1 maxe2;
  output out=strathpr n(upcount)=ncounts
                      sum(upcount)=
                      sum(counthrs)=
                      min(startime)=
                      min(mins1)=
                      min(mins2)=
                      max(maxe1)=
                      max(maxe2)=;
run;
```

```
*********************************************************************
* 9.4 MERGE DATA WITH REPORT PERIOD DEFINITIONS AND COMPUTE HOURLY   *
*     PASSAGE RATE WITHIN STRATA.                                    *
*********************************************************************;
data strathpr;
  merge strathpr(in=a) rptdays(keep=report day);
  by day;
  if a;
  strathpr = upcount/counthrs;
  format strathpr 7.1;
  drop _type_ _freq_;
run;


*********************************************************************
* 9.5.0 OPTIONAL                                                     *
*                                                                    *
*       TRANSPOSE AND PRINT STRATUM MEANS DATA IN A FORMAT WHICH     *
*       FACILITATES INTERPOLATION.  THIS MAY BE NEEDED TO ESTIMATE   *
*       COUNTS IN MISSED SONAR PERIODS.                              *
*********************************************************************;


*********************************************************************
* 9.5.1 TRANSPOSE HOURLY PASSAGE RATE DATA TO GET ONE VARIABLE FOR   *
*       EACH STRATUM.                                                *
*********************************************************************;
proc transpose data=strathpr out=strahprw;
  by report day speriod;
  var strathpr;
  id stratum;
run;


*********************************************************************
* 9.5.2 FORMAT DATASET FOR OUTPUT.                                   *
*********************************************************************;
data strahprw;
  set strahprw (drop= _name_);
  format _1-_5 8.1;
  label _1='1: RIGHT BANK #1'
        _2='2: RIGHT BANK #2'
        _3='3: LEFT BANK NEARSHORE'
        _4='4: LEFT BANK MIDSHORE'
        _5='5: LEFT BANK OFFSHORE'
        speriod = 'SONAR PERIOD';
run;


*********************************************************************
* 9.5.3 PRINT HOURLY PASSAGE RATES                                   *
*********************************************************************;
title2 'HOURLY PASSAGE RATE BY STRATUM';
title3 'USED FOR ESTIMATING COUNTS IN MISSED SONAR PERIODS';
title4 'OPTIONAL OUPUT';
proc print data=strahprw label noobs;
```

```
  var report day speriod _1 _2 _3 _4 _5;
run;


*********************************************************************
* 9.6 SUM HOURLY PASSAGE RATES ACROSS STRATA WITHIN EACH ZONE AND    *
*     SONAR PERIOD.                                                  *
*********************************************************************;
proc summary data=strathpr nway;
  class zone report day speriod;
  var strathpr startime mins1 mins2 maxe1 maxe2;
  output out=perhpr sum(strathpr)=perhpr
                    min(startime)=
                    min(mins1)=
                    min(mins2)=
                    max(maxe1)=
                    max(maxe2)=;
run;


*********************************************************************
* 9.7 COMPUTE DURATION OF SONAR PERIODS AND REDEFINE startime WHERE  *
*     NECESSARY.                                                     *
*********************************************************************;
data perhpr;
  set perhpr;

  * COMPUTE TIME FROM FIRST TO LAST SAMPLE WITHIN EACH
    SONAR PERIOD;
  if mins1 eq . and maxe1 eq . then
    hoursdur = (maxe2 - mins2)/3600;
  else if mins2 eq . and maxe2 eq . then
    hoursdur = (maxe1 - mins1)/3600;
  else
    hoursdur = (maxe1 + 86400 - mins2)/3600;

  * REDEFINE startime WHERE NECESSARY;
  if mins1 ne . and mins2 ne . then
    startime = mins2;

  * DROP UNNEEDED VARIABLES;
  drop _type_ _freq_ mins1 mins2 maxe1 maxe2;
run;


*********************************************************************
* 9.8.0: OPTIONAL                                                    *
*                                                                    *
*        PLOT SONAR PERIOD HOURLY PASSAGE RATES OVER TIME.           *
*********************************************************************;


*********************************************************************
* 9.8.1 FORMAT DATASET FOR OUTPUT.                                   *
*********************************************************************;
```

```
data hprplot;
  set perhpr;
  datetime=dhms(day,hour(startime),minute(startime),second(startime));
  label datetime='STARTING TIME OF SONAR PERIOD'
        perhpr='HOURLY PASSAGE RATE';
  format datetime datetime7.;
run;


*********************************************************************
* 9.8.2 PLOT SONAR PERIOD HOURLY PASSAGE RATES.                     *
*********************************************************************;
title2 'HOURLY PASSAGE RATE WITHIN SONAR PERIODS';
title3 'OPTIONAL OUTPUT';
proc plot data=hprplot;
  plot perhpr*datetime=zone;
run;



*********************************************************************
* 9.9 COMPUTE SQUARED DIFFERENCES BETWEEN CONSECUTIVE HOURLY        *
*     PASSAGE RATES WITHIN EACH REPORTING PERIOD.                   *
*********************************************************************;
data varcnt1;
  set perhpr;

  * LAG DATA FOR COMPUTATION OF CONSECUTIVE SQUARED
    DIFFERENCES;
  lzone=lag(zone);
  lreport=lag(report);
  lperhpr=lag(perhpr);

  * COMPUTE SQUARED DIFFERENCES;
  if report eq lreport and zone eq lzone then
    sqdiff = (perhpr-lperhpr)**2;
  else
    sqdiff = 0;

  * DROP UNNEEDED VARIABLES;
  drop lzone lreport lperhpr;
run;


*********************************************************************
* 9.10 FOR EACH REPORT PERIOD AND ZONE, COMPUTE MEAN HOURLY PASSAGE *
*      RATE, SUM OF THE SQUARED DIFFERENCES BETWEEN CONSECUTIVE     *
*      PASSAGE RATES, NUMBER OF SONAR PERIODS, AND DEGREES OF       *
*      FREEDOM ACROSS SONAR PERIODS FOR PURPOSES OF VARIANCE        *
*      ESTIMATION.                                                  *
*********************************************************************;
proc summary data=varcnt1 nway;
  class report zone;
  id day;
  var perhpr sqdiff hoursdur;
  output out=varcnt2 mean(perhpr)=perhprmn
                     sum(sqdiff)=ssqdiff
```

```
                    n=n
                    sum(hoursdur)=sumdur;
run;

*********************************************************************
* 9.11.0 FOR EACH REPORT PERIOD AND ZONE, ESTIMATE THE VARIANCE AND  *
*        CV OF THE MEAN SONAR PERIOD HOURLY PASSAGE RATE.            *
*********************************************************************;

*********************************************************************
* 9.11.1 MERGE DATA FILES.                                           *
*********************************************************************;
data varcnt2;
  merge varcnt2(drop= _type_ _freq_)
        rptdays(keep=report ndays);
  by report;
run;

*********************************************************************
* 9.11.2 REMOVE DUPLICATE ROWS CAUSED BY MERGE.                      *
*********************************************************************;
proc summary data=varcnt2 nway;
  class report day zone;
  var perhprmn ssqdiff n sumdur ndays;
  output out=varcnt2 min(perhprmn)=
                     min(ssqdiff)=
                     min(n)=
                     min(sumdur)=
                     min(ndays)=;
run;

*********************************************************************
* 9.11.3 COMPUTE VARIANCE AND CV.                                    *
*********************************************************************;
data varcnt2;
  set varcnt2(drop=_type_ _freq_);
  if n gt 1 then
    varzps=((24*ndays)**2)*(1-sumdur/(24*ndays))*(ssqdiff/(2*n*(n-1)));
  else
    varzps = 0;
  cvzps=sqrt(varzps)/(24*ndays*perhprmn);
run;

*********************************************************************
* 9.12 FOR EACH DAY AND ZONE, COMPUTE MEAN HOURLY PASSAGE RATE       *
*      ACROSS SONAR PERIODS.                                         *
*********************************************************************;
proc summary data=varcnt1 nway;
  class day zone;
  id report;
  var perhpr;
  output out=daycnt mean=perhprmn;
run;
```

```
*********************************************************************
* 9.13 SORT DATA BY REPORT PERIOD AND ZONE, AND APPLY REPORT PERIOD  *
*      BASED CV ESTIMATES TO DAY-BASED HOURLY PASSAGE RATE           *
*      ESTIMATES AND COMPUTE DAILY PASSAGE ESTIMATE AND VARIANCE.    *
*********************************************************************;
proc sort data=daycnt;
  by report zone;
run;

data daycnt;
  merge daycnt (drop= _type_ _freq_)
        varcnt2(drop= day perhprmn ssqdiff n sumdur ndays);
  by report zone;
  daypass = round(24*perhprmn,1);
  vdaypass = (cvzps*daypass)**2;
  drop perhprmn varzps cvzps;
run;



*********************************************************************
*********************************************************************
**                                                                 **
** 10.0 COMBINE SONAR AND TESTFISH DATA.                           **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 10.1 SORT SONAR PASSAGE ESTIMATES.                                *
*********************************************************************;
proc sort data=daycnt;
  by report zone;
run;


proc sort data=sppropw;
  by report zone;
run;


*********************************************************************
* 10.2 MERGE SONAR PASSAGE ESTIMATES WITH SPECIES PROPORTION        *
*      ESTIMATES.                                                   *
*********************************************************************;
data combined;
  merge daycnt sppropw(drop=fday lday ntfp);
  by report zone;
run;


*********************************************************************
* 10.3 TRANSPOSE DATA TO GET PROPORTIONS IN A SINGLE VARIABLE.      *
*********************************************************************;
```

```
proc sort data=combined;
  by report day zone;
run;

proc transpose data=combined out=combined name=species;
  by report day zone daypass vdaypass;
  var chinook jack schum pink fchum coho other;
run;


*********************************************************************
* 10.4 ISOLATE VARIANCE OF SPECIES PROPORTIONS.                     *
*********************************************************************;
proc summary data=spprop nway;
  class report zone species rpprop;
  var propvar;
  output out=temp min=;
run;


*********************************************************************
* 10.5 INCORPORATE ESTIMATED VARIANCE OF SPECIES PROPORTIONS.       *
*********************************************************************;
proc sort data=combined;
  by report zone species rpprop;
run;

data combined;
  merge combined temp(drop=_type_ _freq_);
  by report zone species rpprop;
  if report ge 1;

  passest = round(rpprop*daypass, 1);
  passvar = (daypass**2)*propvar + (rpprop**2)*vdaypass -
            vdaypass*propvar;
  drop vdaypass rpprop propvar;
run;


*********************************************************************
* 10.6 RECOMPUTE DAYPASS SO IT EQUALS SUM OF ROUNDED SPECIES PASSAGE *
*      ESTIMATES.                                                   *
*********************************************************************;
proc summary data=combined nway;
  class report day zone;
  var passest;
  output out=temp1 sum(passest)=daypass;
run;

proc sort data=daycnt;
  by report day zone;
run;

data daycnt;
  merge daycnt(drop = daypass) temp1(drop = _type_ _freq_);
  by report day zone;
run;
```

```
proc sort data=combined;
  by report day zone;
run;

data combined;
  merge combined(drop = daypass) temp1(drop = _type_ _freq_);
  by report day zone;
run;


*********************************************************************
* 11.0 PRINT DAILY SONAR PASSAGE ESTIMATES AND ESTIMATED STANDARD    *
*      ERRORS.                                                       *
*********************************************************************;

*********************************************************************
* 11.1 SORT DATA BY REPORT PERIOD AND DAY.                           *
*********************************************************************;
proc sort data=daycnt;
  by report day;
run;


*********************************************************************
* 11.2 TRANSPOSE PASSAGE ESTIMATES TO GET ZONE-SPECIFIC ESTIMATES    *
*      INTO SEPARATE VARIABLES.                                      *
*********************************************************************;
proc transpose data=daycnt out=daycntw1;
  by report day;
  id zone;
  var daypass;
run;


*********************************************************************
* 11.3 TRANSPOSE VARIANCE ESTIMATES TO GET ZONE-SPECIFIC ESTIMATES   *
*      INTO SEPARATE VARIABLES.                                      *
*********************************************************************;
proc transpose data=daycnt out=daycntw2;
  by report day;
  id zone;
  var vdaypass;
run;


*********************************************************************
* 11.4 COMBINE DATASETS, COMPUTE TOTAL DAILY PASSAGE AND STANDARD    *
*      ERRORS OF ALL ESTIMATES.                                      *
*********************************************************************;
data daycntw;

  * COMBINE DATASETS WITH PASSAGE AND VARIANCE ESTIMATES.
    DATASET rptdays IS NEEDED FOR PLOTTING CHARACTERS;
  merge daycntw1 (drop=_name_ rename=(_1=pass1 _2=pass2 _3=pass3))
        daycntw2 (drop=_name_ rename=(_1=var1 _2=var2 _3=var3))
        rptdays;
```

```
  by report day;

  * REPLACE MISSING VALUES WITH ZEROS.  MISSING VALUES
    SHOULD BE REMOVED BY USING OPTIONAL OUTPUT IN SECTION
    6.5 AND ESTIMATING DATA FOR MISSED PERIODS.;
  if pass1 eq . then
    pass1 = 0;
  if pass2 eq . then
    pass2 = 0;
  if pass3 eq . then
    pass3 = 0;
  if var1 eq . then
    var1 = 0;
  if var2 eq . then
    var2 = 0;
  if var3 eq . then
    var3 = 0;

  * COMPUTE TOTAL PASSAGE AND STANDARD ERRORS;
  se1 = sqrt(var1);
  se2 = sqrt(var2);
  se3 = sqrt(var3);
  total = pass1 + pass2 + pass3;
  setotal = sqrt(var1 + var2 + var3);
  if total gt 0 then
    cvtotal = setotal/total;
  else
    cvtotal = 0;

  * COMPUTE PERCENT BY BANK;
  if total > 0 then
    do;
      rightper = 100*pass1/total;
      leftper = 100-rightper;
    end;

  * FORMAT VARIABLES FOR OUTPUT;
  format pass1 pass2 pass3 total comma9.0
         se1 se2 se3 setotal 7.0
         leftper rightper 6.2
         cvtotal 5.3;
  label pass1 = 'RIGHT BANK PASSAGE'
        pass2 = 'LEFT BANK NEARSHORE PASSAGE'
        pass3 = 'LEFT BANK OFFSHORE PASSAGE'
        total = 'TOTAL PASSAGE'
        se1 = 'RIGHT BANK SE'
        se2 = 'LEFT BANK NEARSHORE SE'
        se3 = 'LEFT BANK OFFSHORE SE'
        rightper = 'PERCENT RIGHT BANK'
        leftper = 'PERCENT LEFT BANK'
        setotal = 'TOTAL PASSAGE SE'
        cvtotal = 'TOTAL PASSAGE CV';

  * DROP UNNEEDED VARIABLES;
  drop var1 var2 var3;
run;
```

```
*********************************************************************
* 11.5 PRINT PASSAGE ESTIMATES AND ESTIMATED STANDARD ERRORS.       *
*********************************************************************;
title2 'DAILY PASSAGE ESTIMATES - BY ZONE';
proc print data=daycntw noobs label;
  var report day pass1 se1 pass2 se2 pass3 se3 total setotal cvtotal
      rightper leftper;
  sum pass1 pass2 pass3 total;
run;


*********************************************************************
* 11.6 PLOT ESTIMATED DAILY TOTAL PASSAGE OVER TIME.                *
*********************************************************************;
title2 'DAILY PASSAGE ESTIMATES';
proc chart data=daycntw;
  vbar day/sumvar=total discrete;
run;



*********************************************************************
*********************************************************************
**                                                                 **
** 12.0 COMPUTE AND PRINT PASSAGE ESTIMATES BY DAY AND SPECIES.    **
**                                                                 **
*********************************************************************
*********************************************************************;


*********************************************************************
* 12.1 RETRIEVE NEEDED VARIABLES.                                   *
*********************************************************************;
data final;
  set combined (keep= report day zone species passest passvar);
run;


*********************************************************************
* 12.2 SUM ESTIMATES ACROSS ZONES.                                  *
*********************************************************************;
proc summary data=final nway;
  class report day species;
  var passest passvar;
  output out=final sum(passest)=total
                   sum(passvar)=vartotal;
run;


*********************************************************************
* 12.3 TRANSPOSE DAILY SPECIES PASSAGE ESTIMATES TO GET A SEPARATE  *
*      COLUMN FOR EACH SPECIES.                                     *
*********************************************************************;
proc transpose data=final out=finalw;
  by report day;
```

```
  id species;
  var total;
run;


*********************************************************************
* 12.4 SUM PASSAGE ESTIMATES OVER SPECIES.                          *
*********************************************************************;
proc summary data=final nway;
  by report day;
  var total;
  output out=temp sum(total)=allspp;
run;


*********************************************************************
* 12.5 COMBINE SPECIES AND TOTAL ESTIMATES, AND COMPUTE TOTAL SALMON *
*      AND TOTAL NON-SALMON ESTIMATES.                              *
*********************************************************************;
data finalw;
  merge finalw(drop=_name_) temp(drop= _type_ _freq_);
  by report day;

  * FORMAT VARIABLES FOR OUTPUT;
  format chinook jack coho other comma7.
         schum fchum pink allspp comma9.;
  label chinook = 'LARGE CHINOOK'
        jack = 'SMALL CHINOOK'
        schum = 'SUMMER CHUM'
        fchum = 'FALL CHUM'
        other = 'NON SALMON'
        allspp = 'TOTAL ALL SPECIES';
run;


*********************************************************************
* 12.6 PRINT DAILY PASSAGE ESTIMATES BY SPECIES.                    *
*********************************************************************;
title2 'ESTIMATED DAILY PASSAGE - BY SPECIES';
proc print data=finalw noobs label;
  var report day;
  sum chinook jack schum pink fchum coho other allspp;
run;


*********************************************************************
*********************************************************************
**                                                                 **
** 13.0 COMPUTE CUMULATIVE PASSAGE TO DATE, BY SPECIES, WITH       **
**      CONFIDENCE INTERVALS.                                      **
**                                                                 **
*********************************************************************
*********************************************************************;

*********************************************************************
* 13.1 ISOLATE PASSAGE FROM LAST DAY.                               *
```

```
*********************************************************************;
data temp;
  set combined (keep = day zone species passest);
  _type_ = 0;
run;

data temp;
  merge temp maxsday;
  by _type_;
  if day eq maxsday;
  drop _type_ _freq_ day maxsday;
run;


proc sort data=temp;
  by species;
run;


proc transpose data=temp out=temp;
  by species;
  var passest;
  id zone;
run;


data temp;
  set temp(drop = _name_);
  rename _1=zone1;
  rename _2=zone2;
  rename _3=zone3;
run;


*********************************************************************
* 13.2 SUM PASSAGE ESTIMATES BY SPECIES OVER ALL DAYS.              *
*********************************************************************;
proc summary data=final nway;
  class species;
  var day total vartotal;
  output out=final max(day)=
                   sum(total)=
                   sum(vartotal)=;
run;


*********************************************************************
* 13.3 COMBINE TOTALS WITH ESTIMATES FOR THE MOST RECENT DAY.       *
*********************************************************************;
data final;
  merge final temp;
  by species;
run;


*********************************************************************
* 13.4 COMPUTE STANDARD ERRORS AND CONFIDENCE LIMITS.               *
```

```
*********************************************************************;
data final;
  set final (drop= _type_ _freq_);

  * COMPUTE STANDARDS ERRORS AND CV'S;
  setotal = sqrt(vartotal);
  if total gt 0 then
    cvtotal = setotal/total;
  else
    cvtotal = 0;

  * COMPUTE CONFIDENCE LIMITS;
  lower = total - 1.645*setotal;
  if lower lt 0 then
    lower = 0;
  upper = total + 1.645*setotal;

  * COMPUTE DAILY TOTAL;
  if zone1 = . then zone1 = 0;
  if zone2 = . then zone2 = 0;
  if zone3 = . then zone3 = 0;

  daytotal = zone1 + zone2 + zone3;

  * FORMAT VARIABLES FOR OUTPUT;
  format total setotal lower upper zone1 zone2 zone3 daytotal comma9.
         cvtotal 5.3;
  label total = 'ESTIMATED PASSAGE TO DATE'
        setotal = 'ESTIMATED STANDARD ERROR'
        cvtotal = 'COEFFICIENT OF VARIATION'
        lower = 'LOWER LIMIT 90% CI'
        upper = 'UPPER LIMIT 90% CI'
        zone1 = 'RIGHT BANK DAILY'
        zone2 = 'LEFT BANK NEARSHORE DAILY'
        zone3 = 'LEFT BANK OFFSHORE DAILY'
        daytotal = 'DAILY TOTAL';

  * DEFINE VARIABLE TO CONTROL PRINT ORDER IN FOLLOWING
    PRINT;
  if species eq 'CHINOOK' then
      order = 1;
  else if species eq 'JACK' then
    order = 2;
  else if species eq 'SCHUM' then
    order = 3;
  else if species eq 'FCHUM' then
    order = 4;
  else if species eq 'COHO' then
    order = 5;
  else if species eq 'PINK' then
    order = 6;
  else
    order = 7;
run;

*********************************************************************
```

```
* 13.5 SORT PASSAGE ESTIMATES AND PRINT.                                *
*************************************************************************;
proc sort data=final;
  by order;
run;

title2 'DAILY AND CUMULATIVE ESTIMATED PASSAGE TO DATE - BY SPECIES';
title3 'WITH MEASURES OF PRECISION FOR CUMULATIVE ESTIMATES';
proc print data=final label;
  label species = 'SPECIES';
  var day species zone1 zone2 zone3 daytotal total setotal cvtotal
      lower upper;
  sum zone1 zone2 zone3 daytotal total;
run;


*************************************************************************
*************************************************************************
**                                                                     **
** 14.0 PROCESS 24 HOUR SONAR DATA.                                    **
**                                                                     **
*************************************************************************
*************************************************************************;


*************************************************************************
* 14.1 SUM UPSTREAM COUNTS ACROSS SECTORS.                              *
*************************************************************************;
proc summary data=sonar24 nway;
  class day speriod stratum startime;
  id zone counthrs;
  var upcount;
  output out=sonar24 sum=;
run;


*************************************************************************
* 14.2 SUM UPSTREAM COUNTS AND COUNTING TIME ACROSS ALL SAMPLE TIMES *
*      WITHIN EACH STRATA.                                              *
*************************************************************************;
proc summary data=sonar24 nway;
  class day stratum;
  id zone;
  var upcount counthrs;
  output out=sonar24 sum(upcount)=
                     sum(counthrs)=;
run;


*************************************************************************
* 14.3 ESTIMATE DAILY PASSAGE RATE WITHIN EACH STRATA.                  *
*************************************************************************;
data sonar24;
  set sonar24(drop=_type_ _freq_);
  passage = 24*upcount/counthrs;
run;
```

```
*********************************************************************
* 14.4 ESTIMATE DAILY PASSAGE BY DAY AND BANK.                      *
*********************************************************************;
proc summary data=sonar24 nway;
  class day zone;
  var passage;
  output out=sonar24 sum=;
run;


*********************************************************************
* 14.5 TRANSPOSE DATA.                                              *
*********************************************************************;
proc transpose data=sonar24 out=sonar24w;
  var passage;
  id zone;
  by day;
run;


*********************************************************************
* 14.6 PREPARE DATA FOR OUTPUT.                                     *
*********************************************************************;
data sonar24w;
  set sonar24w (drop=_name_);
  total = _1 + _2 + _3;
  format _1 _2 _3 total comma10.0;
  label _1 = 'RIGHT BANK PASSAGE'
        _2 = 'LEFT BANK NEARSHORE PASSAGE'
        _3 = 'LEFT BANK OFFSHORE PASSAGE'
        total = 'TOTAL PASSAGE';
run;


*********************************************************************
* 14.7 PRINT 24 HOUR PASSAGE ESTIMATES.                             *
*********************************************************************;
title2 'DAILY PASSAGE ESTIMATES - BY ZONE';
title3 'FOR 24-HOUR COUNT DAYS';
proc print data=sonar24w label noobs;
  var day _1 _2 _3 total;
run;
```