YUKON RIVER SONAR PROJECT REPORT

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by

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and

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ABSTRACT

The Yukon River sonar project was operated in training mode for both the crew and senior project staff from 20 June through 25 August 1996. Training included all aspects of sonar and drift gillnet species apportionment sampling, data entry, processing, and analysis, implementing a new schedule of system analyses, and deployment and aiming of the transducers. Species apportionment test-fishing results are presented. A total of 1,291 fish were captured during 420 drifts lasting a total of 2,789.5 minutes. The catch included 19 chinook *Oncorhynchus tshawytscha*, 552 summer chum *O. keta*, 303 fall chum *O. keta*, 50 coho *O. kisutch*, 247 pink salmon *O. gorbuscha*, and 120 fish of other species. The bottom topography along the left bank revealed changes from the previous year, and will require close inspection during the next field season. Equipment tests indicate that all equipment performed according to expectations with the exception of the aiming feedback portion of the radio telemetry hardware, and one rotator which malfunctioned during the field season.

KEY WORDS: salmon, hydroacoustic, sonar, Yukon River, species apportionment, net selectivity

INTRODUCTION

The Yukon River sonar project is located at river km 197 near Pilot Station (Figure 1), far enough upriver to avoid the wide, multiple channels of the Yukon River Delta. There is only one major spawning tributary (the Andreafsky River) downstream from the sonar site. Traditionally, fish passage estimates from the sonar project have been used in conjunction with data from other sources to provide information upon which to base management decisions for the commercial and subsistence salmon (*Oncorhynchus spp.*) fisheries which occur along more than 1,600 km of the Yukon River in Alaska and Canada.

Single-beam sonar, operating at 120 kHz center frequency, is used to estimate upstream passage of fish. The passage estimates are apportioned to species using catch data from seven different mesh sizes of gillnets drifted through the acoustic sampling areas. Net selectivity curves were developed for this project and have been updated periodically as more data is obtained (Mesiar et al. 1991, Fleischman et al. 1992, 1993, 1995). In 1995, a rigorous schedule of system analyses was initiated to ensure consistent equipment performance and to verify that the majority of migrating fish are detected and counted. The system analyses included a periodic schedule of equipment performance checks, hydrologic measurements, and a close scrutiny of the river bottom conditions using both down-looking and side-scanning sonar devices.

The Yukon River sonar project has undergone many changes since 1986 (Maxwell et al. 1997). The most recent challenge has been the loss of sonar personnel from the Arctic-Yukon-Kuskokwim region. During the 1996 field season, the project was operated solely for the purpose of training sonar personnel. Passage estimates were not generated. Staff involved in the training process included the Department's Yukon River sonar crew, a crew member funded by a regional organization (Association of Village Council Presidents, AVCP), and additional AYK sonar personnel.

The primary objective for the 1996 field season was to provide training to the largely new staff on all aspects of the Yukon River sonar project. The work schedule was set up to enhance training as opposed to collecting abundance data. Therefore, passage estimates were not generated. Rather, representative data sets were collected at various times to gain proficiency with the processes of data collection and processing. Gillnet species apportionment and system analyses data are included.

TRAINING PROCEDURES/METHODS

Hydroacoustic Procedures

Equipment

Sonar equipment used during training exercises 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 (4°x9° narrow, 12°x22° wide elliptical beams); 3) two 304.8 m (1000 ft) Carol model 1302 microphone conductor cables connecting sounder to transducer; 4) a Hydroacoustic Technology, Inc. (H.T.I.) model 401 chart recorder interface coupled with a Panasonic KXP1624 dot matrix printer; and 5) a Hewlett-Packard model 54501A digital storage oscilloscope (DSO).

Left-bank sonar equipment included: 1) a Biosonics model 101 (SN 83-039) 120/420 kHz 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°x5° narrow, 4°x9° wide elliptical beam) for left-bank offshore; an I.T.C. model 5398 120 kHz transducer (SN 005) configured for dual-beam use, Case I (2°x5° narrow, 4°x9° wide elliptical beam) for left-bank nearshore; 3) two 304.8 m (1000 ft) Belden model 8412 microphone conductor cables purchased new this year connecting sounder to transducers; 4) an H.T.I. model 401 chart recorder interface coupled with a Panasonic KXP2624 dot matrix printer; and 5) a Hewlett-Packard model 54501A DSO.

All sonar systems were fully calibrated in May 1996 (Table 1). Dual-beam data were digitized, processed, and electronically stored with a Biosonics model 281 echo signal processor installed in a Compaq 386 20e personal computer. Tests of the radio telemetry system were performed using a Stanford Research Systems (SRS) model DS345 synthesized function generator.

We used a radio telemetry system designed and built by the electronics shop at the Geophysical Institute of the University of Alaska, Fairbanks to transmit raw acoustic data from the right bank to the left bank, to remotely start and stop the right-bank generator, and to remotely control the right bank rotator.

Transducers were mounted on metal tripods and remotely aimed with Remote Ocean Systems (ROS) model PT-25 dual-axis rotators. Rotator movements were controlled with an ROS model PTC-1 controller with position feedback to the nearest 0.1°. Gasoline generators (650 W to 3500 W) supplied all 110 VAC power.

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

Training Exercises

Training began on 20 June 1996 when the first transducer was deployed. Instruction was provided for each of the following exercises during the 1996 field season:

1. Use of the Lowrance fathometer and Imagenix sidescanning sonar equipment to produce detailed bottom profiles of the sampling area;

2. Coordination of paired fathometer and laser rangefinding data to produce a bathymetric map of the acoustic sampling area;

3. Deployment of the nearshore and offshore pods;

4. Determination of equipment settings/thresholds including confounding factors;

5. Aiming transducers, including theory and pragmatic considerations;

6. Acoustic and gillnet sampling theory and application;

7. Data entry, error-checking, processing, and analysis;

8. Time-varied gain and output power performance verification tests on the echosounders;

9. Measurement of signal transmission loss through the cables;

10. Measurement techniques to describe acoustic noise levels and calculation of signal to noise ratios;

11. Setting up the radio telemetry equipment and testing transmitted signal integrity;

12. Testing the accuracy of echogram print thresholds;

13. Beam mapping techniques using a standard acoustic target;

14. Collecting dual-beam standard target data to document through system equipment performance;

15. Hydrologic measurements including conductivity; and

16. Miscellaneous but essential repairs including soldering cables, replacing machine and underwater terminations, mending nets, and coiling cables.

Bottom Profiles and Mapping Data

Numerous bottom profiles were recorded along both the left and right banks using a Lowrance X-15 fathometer prior to choosing deployment sites. Inseason, the fathometer was used to monitor changing bottom conditions and watch for the formation of sand bars capable of rerouting fish to unensonified regions of the river. We acquired a laser rangefinder capable of measuring both magnetic direction to 0.1° and distance to 0.1 m this season. By collecting depth readings with paired angle and distance measurements, we were able to create a detailed bathymetric map of the sampling area (Figure 2).

Visual bottom images of the study area along both banks were made using an Imagenex model 001 sidescanning sonar unit and digital audio tape (DAT) recorder. These data were recorded while motoring parallel to each shore in five minute segments and across the river between the two transducers.

Transducer Deployment

The right (north) bank transducer was deployed approximately 3.5 meters from shore along a smoothly sloping rocky bottom (Figure 3). The transducer was moved both further from and closer to shore as water level fluctuations warranted. The right-bank transducer was aimed along the bottom, sampling a single stratum to a range of approximately 100 m.

The left-bank river bottom drops off gradually, with a slightly steeper slope nearshore (Figure 4). This bottom profile requires the deployment of two transducers to obtain the maximum sampling range possible. One transducer was deployed within 10 m of shore to sample both a nearshore stratum (0-40 m) with a low aim and a midshore stratum (40-250 m) with a higher aim. Changing water levels and bottom conditions required occasionally relocating this transducer during the field season. The second transducer was not deployed until the latter portion of the season because the rotator was not functional. Traditionally, this transducer is deployed within 60-70 m from shore. This season, we attempted deployment approximately 100 m from shore. Because of the silty river bottom, it is necessary to retrieve, reposition, and reaim this transducer at least every other day. During the second retrieval, it became clear that positioning the transducer at that range was too ambitious, and posed a hazard to the equipment. All subsequent deployments of the offshore transducer were confined to a maximum range of 60 m from shore.

Left- and right-bank tripods were deployed almost directly across the river from each other at a point where the river was approximately 976 m wide. The river width is extremely variable, depending on water level. The river width at the same location measured 1,030 m during the 1995 field season.

Equipment Settings, Thresholds

We used a 40 log(R) time-varied gain (TVG), 5 kHz bandwidth, and 0.4 ms pulsewidth during all sampling and training activities. Trigger intervals were chosen to maximize the clarity of the tracings without overloading printer buffers; trigger intervals ranged from 0.3 - 0.5 s depending on the sampling range of the strata. The receiver gain was set at -6 dB on the left bank and 0 dB on the more highly reflective right bank.

The minimum printer threshold for each bank was set so that a salmon-size target (-28 to -32 dB) would be detected at least 6 dB off the maximum acoustic response axis of the beam. The 2 degree transducer beam fit the left-bank sampling area's vertical water column cross-sectional area well. The minimum target strength we accepted was lowered an additional 3 dB to allow for uncertainty in echo amplitude due to a variety of factors such as aspect and noise (MacLennan and Simmonds, 1992). On the left bank, the silty bottom is very sound absorptive. Because it is necessary to detect bottom reflections in order to properly aim the transducer, a lower minimum threshold is desired. For this reason, the second grayline set at -42 dB was used as the minimum target threshold, while the first grayline set at -46 dB was used primarily for aiming the transducer. The third and fourth grayline levels on the left bank were set at -39 dB and -37 dB. The more highly reflective bottom of the right bank does not require a lower threshold for aiming. Printer thresholds on the right bank were set at -42, -38, -35, and -32 dB. Threshold levels (in mV) were recorded in the log and converted to target strength, TS_{dB}, as follows:

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

where

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

Aiming

A large emphasis was placed on aiming during the training sessions. Because it is necessary to change the transducer aim between strata during sampling, it was imperative that every crew member became facile at recognizing and achieving a good aim. The aiming strategy in 1996 was the same as in 1995, to maximize fish detection. Crew members were trained to search for an aim in which fish movement was substantially perpendicular to the beam with light bottom echoes detected throughout the range. Crew practiced finding initial aims after transducer deployment, rotating between strata, and matching aims to existing charts using bottom striations as a guide.

Hydroacoustic Sampling

Representative elements of normal sonar sampling activities generally took place on Mondays, Wednesdays, and Fridays from 24 June through 14 August. On these scheduled sampling days, sampling procedures established in 1995 were followed unless other training opportunities took place (Maxwell et al. 1997). We altered the sampling schedule on four occasions in order to obtain a block of data on a single statum. On these occasions, a single stratum was sampled continuously on the left bank for a twelve-hour time period. The left-bank midshore stratum (stratum 4) was sampled continuously for the twelve-hour period on 12 July and 29 July; the offshore stratum (stratum 5) was sampled continuously on 31 July, and the nearshore stratum (stratum 3) was sampled continuously on 5 August. Analysis of this single stratum data has not been completed.

Data Entry/Analysis

Fish tracings were tallied on field data forms. Crew were trained to carefully review all chart printouts to check the accuracy of the counting personnel in defining fish tracings and the quality of the chart image for indications of signal problems, changes in bottom conditions, or aiming problems. The data were entered into an R:Base database. R:Base cross-tab functions and error-checking subroutines were used to check the accuracy of the data entry. All acoustic and gillnet species apportionment data were processed using a customized statistical application software package (SAS) (Maxwell et al. 1997).

Hydroacoustic Equipment Tests

The hydroacoustic equipment was professionally calibrated prior to the field season and both echosounders were physically examined, functionally checked, and comprehensive transmitter, receiver, and gain measurements were made. We measured the transmitter output by plugging a 50 ohm resistor into the machine output port and attaching an oscilloscope probe in parallel with the load. For this test it is extremely important that the 50 ohm load is in place prior to transmitting, and that the correct oscilloscope probe is utilized (this is a high resistance probe which protects the DSO from damage). The voltage signal displayed on the oscilloscope was measured from peak-to-peak and converted to decibel Volts (dBV). Results were compared to those obtained in pre-season laboratory calibrations.

We checked the time-varied gain circuitry of the receiver channels in both echosounders by measuring the voltage 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) using a DSO and a nominal velocity of sound at 1490 m/s. We compared the measured voltages with calculated theoretical values and pre-season calibrated values.

To verify that the complete sonar system was operating normally, we estimated the target strength of a 4.5 kg, 10.2 cm diameter, lead downrigger weight (approximate salmon-size target); a 38.1 mm stainless steel sphere; and a 32.6 mm (1.25 inch) copper sphere on five occasions from measurements made by a Biosonics Model 281 dual-beam echo signal processor (ESP). The targets were suspended singly from the side of a skiff anchored offshore from the left bank. We aimed the beam at the suspended target, maximizing the echo amplitude in both the horizontal and vertical planes. During data collection, signals were filtered for bandwidth (5 kHz), and half-amplitude pulse width (0.36-0.52 ms). Target data were converted from the ESP software output format to an Access database format and analyzed using database and Excel spreadsheet functions. During post-processing, the target data were first isolated from extraneous echoes by selecting echoes within a limited range bin, then filtered for noise-corrupted echoes using the following criteria: 1) the beam pattern factor (2Bθ) less than or equal to 12 dB; 2) the wide peak amplitude greater than or equal to the narrow peak amplitude; and 3) the quarter-amplitude pulse width greater than or equal to the half-amplitude pulse width for both narrow and wide beams. No target strength data were obtained from the right bank because of the difficult logistics involved in suspending a fixed target in the beam there.

We estimated the vertical limits of the effective beam in the water column on the left bank using the 4.2 kg, 10.2 cm lead downrigger weight suspended 2-3 m out from the side of a skiff anchored offshore from the left-bank transducer. The beam was panned horizontally achieving maximum signal strength from the downrigger weight to center the target in the beam. The vertical detection limits of the beam were determined by slowly raising the weight at discrete intervals from the bottom to surface. During these trials, printer thresholds were set at the normal sampling threshold levels.

We tested the accuracy of the printer threshold levels by sending a TVG-amplified internal calibration tone from the echosounder through the digital chart recorder interface to the printer. Threshold level steps displayed as different gray scales at range on the chart recordings were compared with time-dependent signal measurements on a DSO.

Right-bank data were transmitted across the river to the left-bank control tent. We tested the radio telemetry equipment on four occasions to confirm that the amplitude of the acoustic signals was not changed during transmission. A series of 0.1-10.0 $V_{p\text{-}p}$ signals, generated by an SRS synthesized function generator, were inserted into both channels of the radio equipment, transmitted to the left bank, and measured with the left-bank DSO, after an appropriate warm-up period. To obtain a baseline measurement, the same function generator was transported to the left-bank, and the signals were measured directly with the left-bank DSO.

New cables were purchased this year for the left-bank. All cables were tested for transmission loss prior to deployment while still new and "dry." The cables were tested by transmitting a known signal through the cable and through a 50 ohm load, and measuring the resulting voltage at the opposite end. Cables were tested again approximately mid-season and at the end of the season. Initial tests were performed using a 10 VAC signal. In later tests the signal was reduced to 1 VAC.

We practiced measuring noise on each of the sampling strata. The measurements were made by visually dividing each strata into a maximum of four regions containing similar noise levels, then measuring the average peak voltage in each of these intervals with a DSO. Prominent bottom features and targets were excluded from the measurements. A signal to noise ratio was then calculated for each of these regions by subtracting the noise level in dB from the lowest data acquisition threshold level (also in dB).

Bank-to-Bank Transects

Two bank-to-bank transects were recorded weekly to gain facility with the equipment and develop the ability to monitor bottom topography and look for fish in the unensonified regions of the river. One transect was run from the left-bank transducer pod to the right-bank pod. A second transect was begun upstream from the left-bank transducer and directed across river to the entrance of First Slough (also known as Jesse Slough).

Hydrologic Measurements

Hydrologic measurements were recorded daily. Water level was measured using a staff gauge located offshore from the field camp on the right bank. Conductivity, air temperature and water temperature measurements were taken offshore along both banks beginning approximately mid-season. Post-season, relative water level measurements from both 1995 and 1996 were adjusted to absolute benchmark data obtained from the United States Geological Survey, Water Resources Division. The USGS measures water level from a permanent reference mark located downstream of Pilot Station using a Sutron 8200 datalogger coupled to a PS-2 pressure sensor.

Species Composition Data Acquisition

Equipment and Procedures

Gillnets were drifted in three zones (right bank, left bank nearshore, and left bank offshore) within the sonar sampling range to practice collecting data which allowed the estimation of species composition. Seven different 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; 127 mm (5 in), 72 MD; 102 mm (4 in), 90 MD; and 70 mm (2.75 in), 131 MD, were used. Large mesh gear, 216 mm (8.5 in) and 191 mm (7.5 in), was dropped during the fall season (starting 19 July) and a 140 mm (5.5 in, 65 MD) mesh was added. 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 on Monday, Wednesday, and Friday between the sonar periods from 0915 to 1215 and 1715 to 2015. General sampling procedures from the 1995 field season were followed so that data from captured fish could be added to the historic database to build upon mesh-specific catchability relationships already established (Maxwell et al. 1997). A single "beachwalk" (Fleischman et al. 1995) was performed. The beachwalks were deemed unnecessary this year because we were able to drift close to shore during normal drifting operations.

Four times were recorded to the nearest second onto field data sheets for each drift: net start out (net starting out of boat, 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 very 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. Data were transferred from field data sheets to an R:Base database and processed using SAS software.

Captured fish were distributed to local villagers whenever possible.

Species Proportions

Species proportions were estimated from relative gillnet catch-per-unit-effort (CPUE) data, after first adjusting for gillnet size-selectivity. Separate gillnet selectivity curves were used for chinook salmon, summer chum salmon, fall chum salmon, coho salmon, pink salmon, whitefish *(Coregonus)*, cisco *(C. sardinella, C. laurettae)*, and a combined group of all other species. These gillnet selectivity curves and a summary of their development are presented in Maxwell et al. (1997).

Analytical Methods

Species Composition

The catch (c) of species i and length l during drift j of mesh m during test-fish 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

$$a_{ildzfmj} = \frac{c_{ildzfmj}}{s_{ilm}}, \tag{3}$$

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

Total effort (e), in fathom-hours, of drift j with mesh size m during test-fishing period f in zone z on day d was calculated as

$$e_{dzfmj} = \frac{25 \bullet t_{dzfmj}}{60}, \tag{4}$$

since all nets were 45.7 m (25 fathoms) long. CPUE (C) for length l of species i in drifts of mesh m during test-fishing period f in zone z on day d was computed as the total adjusted catch divided by total effort,

$$C_{ildzfm} = \frac{\sum_j a_{ildzfmj}}{\sum_j e_{dzfmj}}. \tag{5}$$

The mean CPUE across meshes having non-zero CPUE was computed, i.e.,

$$C_{ildzf} = \frac{1}{n_{mildzf}} \sum_{m} C_{ildzfm}, \qquad (6)$$

where n_{mildzf} is the number of meshes having adjusted catches of length *l* of species *i* greater than 0 during test-fish period *f* of day *d* in zone *z*. The total CPUE for species *i* was computed by summing over all lengths,

$$C_{idzf} = \sum_{l} C_{ildzf} \; . \qquad (7)$$

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 mean CPUE of all lengths of species *i* having non-zero CPUE to the total of the same quantity summed over all species, i.e.,

$$\hat{p}_{idzf} = \frac{C_{idzf}}{\sum_{i} C_{idzf}} \; . \qquad (8)$$

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

$$\hat{p}_{idz} = \frac{\sum_{f} C_{idzf}}{\sum_{i} \sum_{f} C_{idzf}}, \qquad (9)$$

which is equivalent to the mean of the two test-fishing period proportions, weighted by the total CPUE for all species in each test-fishing period.

SAS program code was used to calculate species proportion estimates.

RESULTS

Training operations were successfully conducted from 20 June through 25 August. Crew members and senior sonar project staff were provided with the opportunity to learn all aspects of the Yukon River sonar project, which is the most complex of all AYK user-configurable sonar projects.

Data from this season is extremely limited. Because all activities were focused on training rather than management-level data collection, it was not appropriate to attempt passage estimation. Test-fishing data collected can augment historic data used to generate net selectivity curves, and are therefore appended to this report. A large quantity of time was spent developing system analyses skills. The results from each of the tests have been included. These procedures will become part of normal data collection activities in the future, and the resulting information will become incorporated into the baseline data for the project.

Test-Fishing Results

A total of 1,291 fish were captured during 420 drifts lasting a total of 2,789.5 minutes. The catch included 8 large chinook (>700 mm), 11 small chinook (<700 mm), 552 summer chum, 303 fall chum, 50 coho, and 247 pink salmon, and 45 whitefish, 46 cisco, and 29 fish of other species (Appendix A). Species proportion estimates are summarized in Table 2.

Bottom Profiles/Sandbars

No changes were noted in the steeply sloping, rocky bottom along the right bank during the field season. Left-bank profiles revealed a basically linear bottom perpendicular from shore or at a slight upstream aspect relative to the current. When motoring downstream or upstream, an undulating bottom pattern was observed, indicating the presence of ridges oriented perpendicular to flow and parallel to the acoustic beam (Figure 5). This profile restricted aiming to a narrower margin which made it more difficult to find a good aim at a single transducer location. In many instances, repeated transducer deployments were necessary to find an optimum aim.

The two sand bars described last year (Maxwell et al. 1997) were present from the beginning of the season this year. The large Atchuelinguk River sand bar extended above the water line throughout the summer. The left bank river bend sand bar was also present throughout the season (Figure 2). Toward the latter part of the field season the river bend sand bar was less than 3 m deep in its shallowest regions and approximately 250 m offshore. We drifted a 6.5" mesh gillnet across this sand bar and caught a total of 4 chum and 2 coho salmon. A drift conducted within the right bank sampling area immediately following the drift across the sand bar, captured 12 chum and 2 coho salmon.

Hydrologic measurements

Left-bank conductivity measurements peaked at 202 μS and remained from 4 to 51 μS higher than right bank measurements (Figure 6). Water level rapidly dropped approximately 1.25 m during the summer season, reaching the season low on 24 July. It then climbed steadily to a peak on 13 August before again declining. Significant inverse relationships were observed between water level and left-bank and right-bank conductivity ($R=-0.974$ and $R= -0.863$; $p<0.001$). Daily staff gauge measurements made at the project were adjusted to USGS discharge data from Pilot Station in order to compare water levels from 1995 and 1996. The lowest water level recorded at field camp during the 1995 field season was 83.34 cm higher than the lowest water level recorded in 1996 (Figure 7). The high water mark observed in 1996, created from flooding upriver, briefly brought the water level up to levels recorded in 1995. However, the decline following this period ended much lower than final readings in 1995. Water level measurements began and ended on different dates for both 1995 and 1996 making a complete comparison difficult. Water temperatures ranged from 12 to 18.5 degrees Celsius exhibiting small fluctuations throughout the field season.

Equipment Tests

Plots of echosounder TVG test values, radio telemetry test values, and printer threshold test results (Figures 8, 9, and 10) all depict consistent equipment performance on both banks throughout the field season. Small fluctuations in TVG measurement values were noted during two testing periods on the left-bank echosounder, however. One transmitter output test, performed on the left-bank echosounder (S/N: 101-83-039), produced values approximately 1 dB higher than pre-season calibration values for each power setting.

An average signal loss of 1.9 dB was observed during transmission through the 304.8 m (1,000 ft) transducer cables. Signal loss in the new left-bank Belden model 8412 transducer cables prior to submergence was slightly less (1.5 dB/304.8 m) than later measurements (2.0 dB and 1.9 dB per 304.8 m). Three measurements made on the older right-bank Carol model 1302 cables revealed small differences between one pre-deployment (2.1 dB) and two post-deployment measurements (1.7 dB, and 2.0 dB per 304.8 m).

Calculated signal to noise ratios (SNR's) varied considerably between measurements. In general, the closer ranges of each stratum exhibited lower noise levels. SNR's varied from 28 dB to 6 dB.

We make all attempts to operate in SNR environments of at least 10 dB. For the majority of measurements at range, the SNR was greater than 10 dB.

An approximate salmon-size target (4.5 kg, 10.2 cm diameter lead downrigger weight) was detected from the river bottom to approximately 1.5 m off the bottom at a range of 126 m from the left-bank nearshore transducer on 11 July. The water depth at this range was not recorded. The target was first positioned horizontally along the maximum response axis (MRA) of the beam by panning the transducer until DSO voltage measurements of the target echo were maximized. On 5 August, the same target was deployed 78 m from the transducer and positioned along the horizontal MRA of the transducer beam. The target was detected from the river bottom to approximately 3.5 m in water 5.5 m deep. The vertical MRA at 78 m was estimated at approximately 1 m above the river bottom by measuring the target echo amplitude in one foot increments.

Dual-beam data collected on the 4.2 kg, 10.2 cm lead weight revealed mean target strength estimates of –25 dB ± 8 dB (s.d.); -32 dB ± 4 dB; -34 dB ± 2 dB; and –32 dB ± 4 dB (Table 3). Mean target strength estimates for the 38.1 mm diameter stainless steel sphere collected on three occasions were –47 dB ± 3 dB; -41 dB ± 2 dB; and –35 dB ± 6 dB. Target strength estimates of a 25.4 mm electrical grade copper sphere revealed a mean target strength of –32 dB ± 6 dB. The range and number of echoes obtained for each sample are included in Table 3.

DISCUSSION

Training operations ran smoothly during the course of the field season. On sampling days (Monday, Wednesday, Friday) the crew was given ample opportunity to run through traditional sampling strategies and obtain representative data for processing and analysis practice. On Tuesdays and Thursdays, the majority of time was devoted to system analyses training, data entry and analysis exercises, and discussion of sonar theory and practices. In order to avoid unnecessary personnel costs, the crew size was decreased and crew hours were limited to 37.5 hours per week, except for a short period during camp set-up and break-down. Later in the season, the number of sampling days was further reduced to provide additional time for the more complex equipment training and data analysis. Although the largely fragmented data from this season has only limited use, we have included results from the system analyses exercises as baseline data.

The water level in 1996 (Figure 7) was extremely low during most of the field season. According to reports from villagers, there was no highwater breakup event. Sand bars formed and detected during the summer of 1995 were still in place when the crew arrived in 1996, and they became more threatening to complete data acquisition as the field season progressed. Submerged sand dunes which began to appear in the fall of 1995 were still in place at the start of the 1996 season. If these conditions continue, they may jeopardize data collection in future field seasons. The sand bar which formed off the left bank extended downstream into the acoustic sampling area approximately 350 m offshore. This submerged sand bar filled much of the river bend area and extended a long distance across the river. If these same sand bars are not scoured out prior to the 1997 field season, it may be necessary to address questions of fish behavior in the area of acoustic sampling. Periodic gillnetting in this region and possible relocation of the left-bank transducer may be required if initial transect data indicate that the bar is still in place at the start of the 1997 field season.

Developing a bathymetric map (Figure 2) provided a picture of the river bottom. This data should be collected early each season to chart the progress of potential problems. The laser rangefinder proved to be a very beneficial tool for this map-making process. We were able to pair angle and distance measurements from a reference point with water depth. We simplified the analytical process by transferring the raw data to an electronic spreadsheet for calculations and plotting. Contour lines were hand drawn.

The bank-to-bank transect data are inconclusive as to fish abundance. These transects were performed by a myriad of crews over the course of the summer. In some cases, the settings were not adequate to properly observe fish. Other problems inherent with this procedure include differential boat avoidance and river bottom coverage with depth. The 20° fathometer beam provides better coverage in shallow regions than a narrow beam, but makes fish detections difficult near the bottom in deeper regions. In general, the fathometer detects few fish in any region of the river. Comparisons of ensonified areas with areas outside the sonar beam are inconclusive.

No serious anomalies were detected from equipment tests during the field season. The small fluctuations observed during TVG tests (Figure 8) are most likely due to measurement error.

Different staff conducted different elements of these tests, which made data less consistent. We tried alternate methods of measuring TVG response in order to increase the precision of the measurements. For the Hewlett Packard Model 54501A DSO's, the most precise method was to use the DSO's ΔV function positioning one cursor at the bottom of the curve (not necessarily at zero line) and the second at the top. Measuring from the zero line to the top of the curve or using the DSO's V_{p-p} function yielded less precise results.

The one decibel increase in the transmission measurement compared to pre-season values is not significant. This increase could have been caused by small differences in the resistances of both the load and probes used to make the measurements.

Printer threshold tests showed good agreement between DSO and chart measurements. The radio telemetry tests also showed good agreement between the right-bank reference measurements and measurements made on the left bank. The slope of the transfer function was almost exactly 1.0. The noise level measurements at this point are very imprecise. Quantitative procedures must be established to reduce ambiguity in these measurements.

A large degree of variability in the dual-beam standard target data remained after discarding a high portion of the noise-corrupted raw data based on the acceptance criteria outlined in the methods section. This method may provide only limited information about system performance. More data samples and further analyses are required in order to determine the value of this procedure.

We encountered serious problems with part of the radio telemetry equipment during the course of the field season. Early in the season, we experienced a short circuit in one of the radios. After the equipment was fixed, it was badly damaged by air freight during the return trip to the field camp. We were immediately forced to send it back for additional repairs. The lack of the telemetry equipment required crew members on both banks during any paired sonar sampling activities. Once the radio equipment was re-installed, it worked well with the exception of the aiming and generator control functions. We traced the problem to a weak output signal generated from the 150 MHz transmitter in the remote unit, and this has been repaired.

A second equipment problem occurred with the left-bank offshore rotator. The rotator stopped working as soon as it was placed in the water. Two new rotators were purchased this year. One was used as a replacement in the middle of the summer. We were unable to deploy the offshore transducer until this replacement was received. Post-season, the rotator was sent to the manufacturer for repair and gear replacement. A high gear ratio (1551:1) enhances transducer aiming. Three high-gear ratio rotators are available for the 1997 season.

Porcupines created the most annoying problem of the season by severing both new transducer cables prior to deployment. The rotator cables were also chewed in several places. We resolved the problem by raising all cables off the ground. This makes it more difficult to move the transducer and increases the likelihood of radio frequency noise, but it is a necessary step and will be carried out at the beginning of the next field season.

The HTI Model 401 chart recorder interfaces and Panasonic Model KXP-1624 and KXP-2623 printers worked most of the time. We experienced far fewer problems with these items than during the 1995 season.

The Yukon River sonar project continues to present numerous challenges to successful operation. The dynamic sand bottom is continually changing. Successful estimation of fish passage is dependent on a variety of factors including an evenly-sloped bottom profile, a good aim which maximizes fish detection, constant vigilance to ensure that the equipment is functioning normally, and a crew dedicated to the collection of only the highest quality data. The unusually low water conditions presented a new challenge to a largely new sonar crew in an already complex assessment environment. The Yukon River, with its extremely dynamic nature and sheer size provided an extraordinary opportunity for hands-on field training during the 1996 season.

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Table 1. Pre-season sonar equipment calibration data, 1996.

Sounder	Cables	Transducer	Receiver Gain L	Standard Volts In	Vdet NB 40	G1 NB 40	Vdet WB 40	G1 WB 40	0 dB cal NB 40	0 dB cal WB 40
101-039	1000' Belden 502Y/501Y	ITC 004 Case I	0	0	4.55	-170.02	4.69	-169.76	2.9	3.08
101-039	1000' Belden 504Y/503Y	ITC 005 Case I	0	0	4.25	-170.62	4.45	-170.22	2.9	3.08
101-036	1000' Carol 202/201	ITC 003 Case II	0	-8	2.00	-175.22	2.165	-174.56	4.94	5.49

Continued

Sounder	Cables	Transducer	-13 dB Vs	-13 dB SL	-10 dB Vs	-10 dB SL	-6 dB Vs	-6 dB SL	-3 dB Vs	-3 dB SL	0 dB Vs	0 dB SL
101-039	1000' Belden 502Y/501Y	ITC 004 Case I	-14.81	211.92	-11.94	214.79	-8.18	218.55	-5.29	221.44	-2.2	224.53
101-039	1000' Belden 504Y/503Y	ITC 005 Case I	-15.44	211.29	-12.4	214.33	-8.5	218.23	-5.65	221.08	-2.52	224.21
101-036	1000' Carol 202/201	ITC 003 Case II	-2.36	206.77	0.59	209.72	4.51	213.64	7.47	216.6	10.48	219.61

2. Species proportions arranged by report period and zone from the Yukon River sonar project, 1996.

REPORT NUMBER	FIRST DAY	LAST DAY	ZONE	NUMBER TESTFISH PERIODS	NUMBER FISH CAUGHT	CHINOOK	JACK	SUMMER CHUM	PINK	FALL CHUM	COHO	WHITE-FISH	CISCO	OTHER
1	6/28/96	6/28/96	1	2	58	0.0000	0.0058	0.8828	0.0185	0.0000	0.0000	0.0085	0.0000	0.0844
1	6/28/96	6/28/96	2	2	12	0.0632	0.0000	0.4933	0.0213	0.0000	0.0000	0.0000	0.1883	0.2339
1	6/28/96	6/28/96	3	2	32	0.0184	0.0000	0.9624	0.0191	0.0000	0.0000	0.0000	0.0000	0.0000
2	7/1/96	7/3/96	1	3	65	0.0000	0.0000	0.8229	0.1130	0.0000	0.0000	0.0055	0.0537	0.0048
2	7/1/96	7/3/96	2	3	44	0.0000	0.0221	0.5557	0.2488	0.0000	0.0000	0.0249	0.0164	0.1320
2	7/1/96	7/3/96	3	3	37	0.0000	0.0159	0.8312	0.1529	0.0000	0.0000	0.0000	0.0000	0.0000
3	7/5/96	7/10/96	1	5	97	0.0000	0.0000	0.7328	0.1768	0.0000	0.0000	0.0249	0.0214	0.0441
3	7/5/96	7/10/96	2	5	77	0.0000	0.0000	0.0744	0.7011	0.0000	0.0000	0.1382	0.0180	0.0683
3	7/5/96	7/10/96	3	5	40	0.0000	0.0000	0.7596	0.1778	0.0000	0.0000	0.0331	0.0000	0.0295
4	7/12/96	7/12/96	1	2	26	0.0572	0.0000	0.4464	0.2710	0.0000	0.0000	0.0000	0.1303	0.0950
4	7/12/96	7/12/96	2	2	9	0.0000	0.0000	0.0426	0.2899	0.0000	0.0000	0.3198	0.3478	0.0000
4	7/12/96	7/12/96	3	2	14	0.0440	0.0781	0.6505	0.2273	0.0000	0.0000	0.0000	0.0000	0.0000
5	7/15/96	7/15/96	1	2	23	0.0000	0.0000	0.6622	0.2637	0.0000	0.0000	0.0263	0.0478	0.0000
5	7/15/96	7/15/96	2	2	14	0.0000	0.0000	0.0000	0.9136	0.0000	0.0000	0.0864	0.0000	0.0000
5	7/15/96	7/15/96	3	2	10	0.0000	0.0000	0.3856	0.4353	0.0000	0.0000	0.0827	0.0963	0.0000
6	7/17/96	7/17/96	1	2	20	0.0000	0.0000	0.8749	0.0986	0.0000	0.0000	0.0000	0.0000	0.0264
6	7/17/96	7/17/96	2	2	12	0.0000	0.0000	0.1493	0.8507	0.0000	0.0000	0.0000	0.0000	0.0000
6	7/17/96	7/17/96	3	2	13	0.0000	0.0000	0.4890	0.4188	0.0000	0.0000	0.0000	0.0923	0.0000
7	7/19/96	7/19/96	1	2	32	0.0000	0.0000	0.0000	0.2842	0.7056	0.0000	0.0102	0.0000	0.0000
7	7/19/96	7/19/96	2	2	7	0.0000	0.0000	0.0000	0.2953	0.5822	0.0000	0.1225	0.0000	0.0000
7	7/19/96	7/19/96	3	2	12	0.0000	0.0000	0.0000	0.2451	0.6970	0.0000	0.0319	0.0259	0.0000
8	7/22/96	7/22/96	1	2	17	0.0000	0.0000	0.0000	0.4230	0.3970	0.0000	0.0000	0.1467	0.0333
8	7/22/96	7/22/96	2	2	8	0.0000	0.0000	0.0000	0.1460	0.2407	0.0737	0.0701	0.0904	0.3791
8	7/22/96	7/22/96	3	1	2	0.0000	0.0000	0.0000	0.5150	0.0000	0.0000	0.4850	0.0000	0.0000
9	7/24/96	7/26/96	1	4	44	0.0000	0.0000	0.0000	0.0862	0.7748	0.0737	0.0122	0.0000	0.0530
9	7/24/96	7/26/96	2	4	39	0.0000	0.0000	0.0000	0.0570	0.8101	0.0262	0.0642	0.0292	0.0134
9	7/24/96	7/26/96	3	4	36	0.0000	0.0000	0.0000	0.0999	0.8478	0.0164	0.0000	0.0359	0.0000
10	7/29/96	7/29/96	1	2	16	0.0000	0.0000	0.0000	0.1180	0.6772	0.2047	0.0000	0.0000	0.0000
10	7/29/96	7/29/96	3	2	39	0.0000	0.0000	0.0000	0.0696	0.8728	0.0154	0.0000	0.0422	0.0000
11	7/31/96	7/31/96	1	2	7	0.0000	0.0000	0.0000	0.0487	0.4035	0.0000	0.1501	0.0647	0.3329
11	7/31/96	7/31/96	3	2	9	0.0000	0.0000	0.0000	0.1620	0.5178	0.1002	0.0000	0.2200	0.0000
12	8/7/96	8/7/96	1	2	14	0.0000	0.0000	0.0000	0.0000	0.1623	0.7932	0.0000	0.0000	0.0445
12	8/7/96	8/7/96	2	2	11	0.0000	0.0000	0.0000	0.0000	0.5837	0.3445	0.0718	0.0000	0.0000
12	8/7/96	8/7/96	3	1	1	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000
13	8/9/96	8/9/96	1	2	3	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000
13	8/9/96	8/9/96	2	2	3	0.0000	0.0000	0.0000	0.0000	0.7677	0.0000	0.2323	0.0000	0.0000
13	8/9/96	8/9/96	3	2	3	0.0000	0.0000	0.0000	0.0000	0.7091	0.1469	0.1441	0.0000	0.0000
14	8/12/96	8/14/96	1	3	42	0.0000	0.0000	0.0000	0.0000	0.7057	0.2645	0.0000	0.0000	0.0298
14	8/12/96	8/14/96	2	3	7	0.0000	0.0000	0.0000	0.0000	0.4388	0.3506	0.0000	0.2108	0.0000
14	8/12/96	8/14/96	3	3	31	0.0000	0.0000	0.0000	0.0000	0.7272	0.2358	0.0145	0.0000	0.0224

Table 3. Dual-beam target strength estimates of a variety of spherical targets ensonified at the Yukon River sonar project, 1996.

Date	Range (m)	Target Description	Average Target Strength (dB)	Standard Deviation (dB)	Max TS (dB)	Min TS (dB)	# Echoes prior to filtering	# Echoes after filtering
7/11/96	126	4.2 kg, 10.2 cm lead weight	-25	8	-10	-38	145	41
8/5/96	78	4.2 kg, 10.2 cm lead weight	-32	4	-21	-44	342	155
8/16/96	21	4.2 kg, 10.2 cm lead weight	-34	2	-30	-40	646	317
8/19/96	76	4.2 kg, 10.2 cm lead weight	-32	4	-21	-45	866	299
8/16/96	21	38.1mm stainless steel	-47	3	-37	-53	771	166
8/19/96	75	38.1mm stainless steel	-41	2	-34	-45	736	396
8/24/96	60	38.1 mm stainless steel	-35	6	-21	-52	1036	320
8/24/96	60	1.25"copper sphere	-32	6	-20	-48	324	133

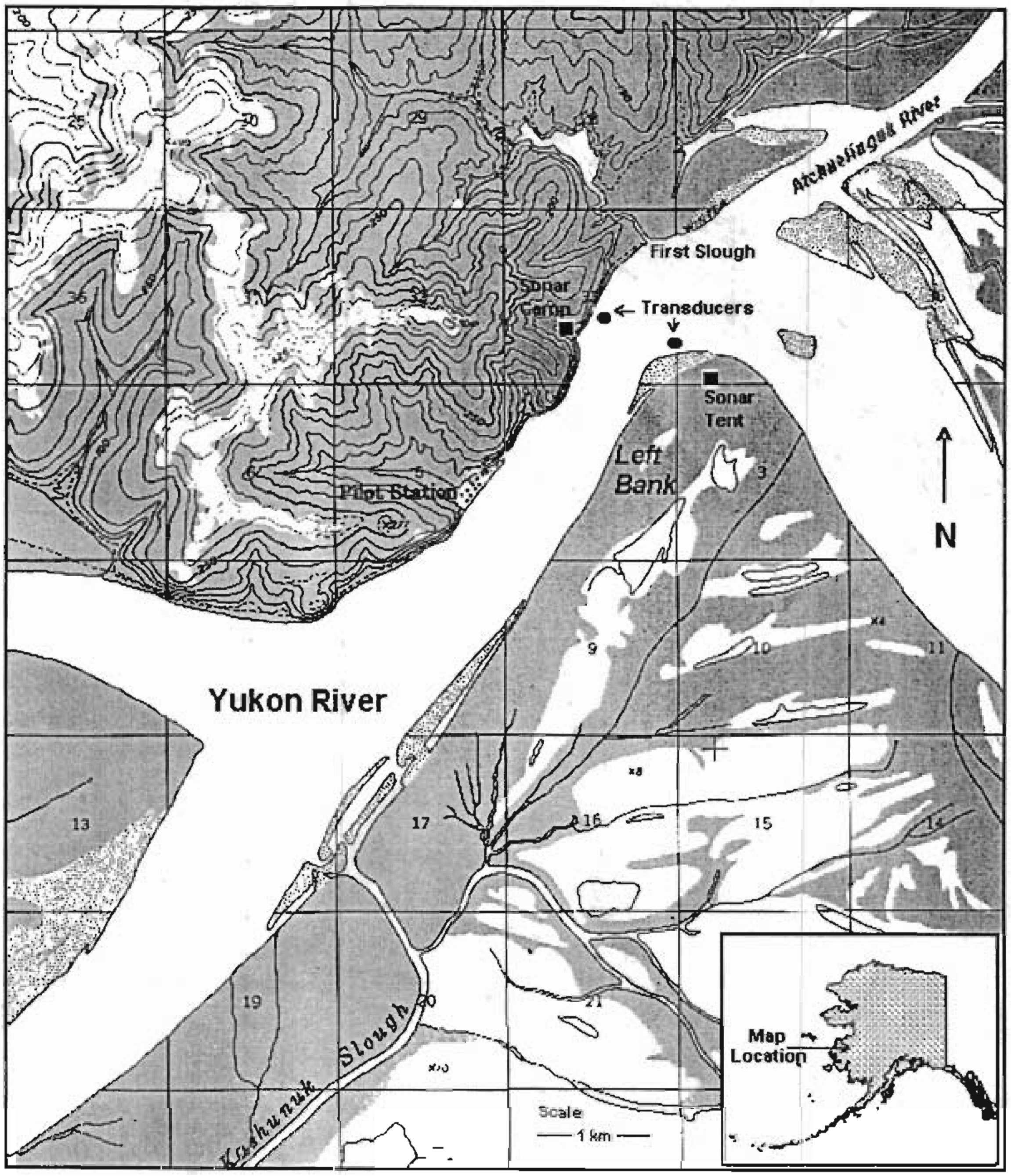

Figure 1. Topographical map of the Yukon River in the vicinity of the sonar site.

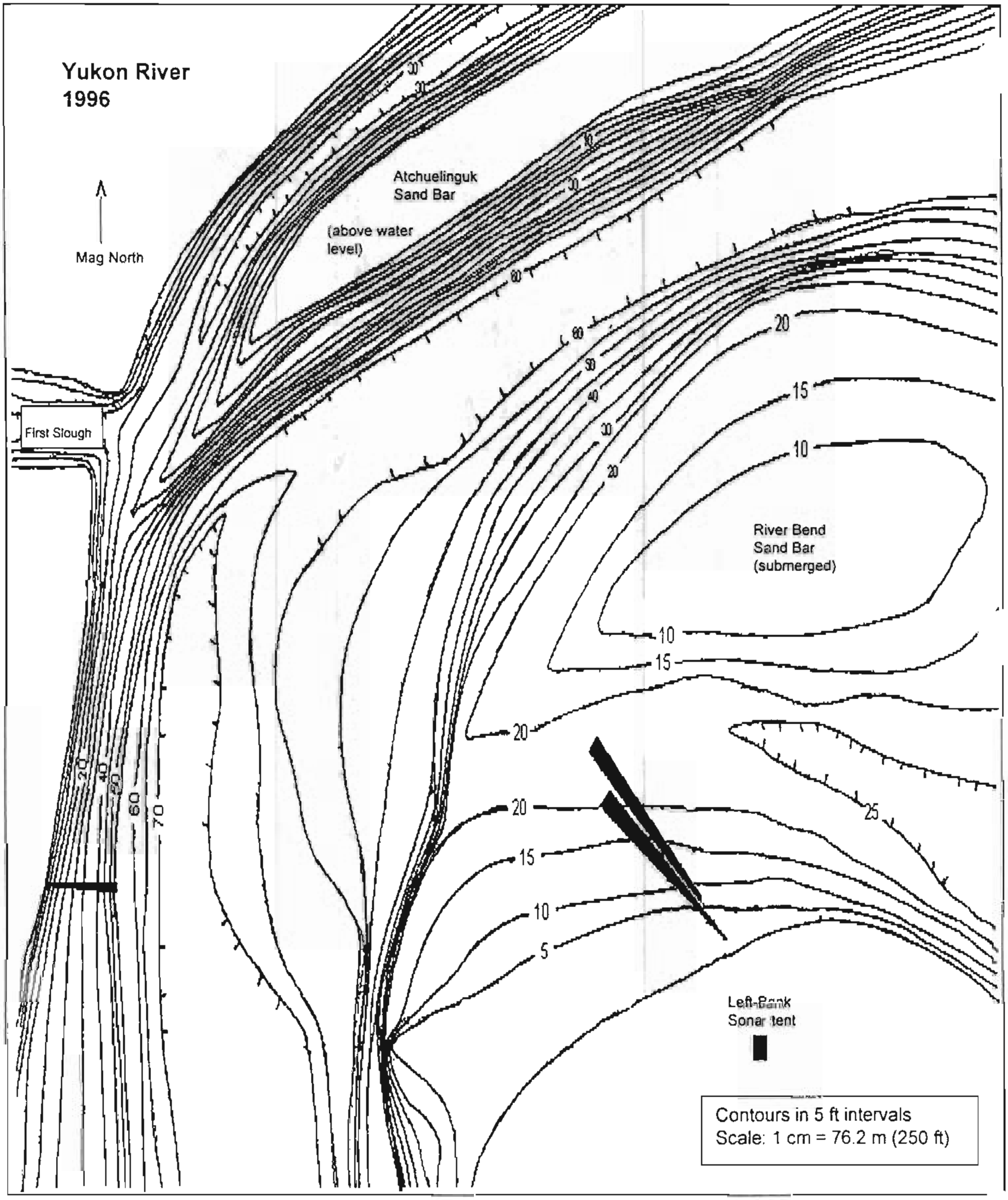

Figure 2. Bathymetric map of the Yukon River at the sonar project site, 1996.

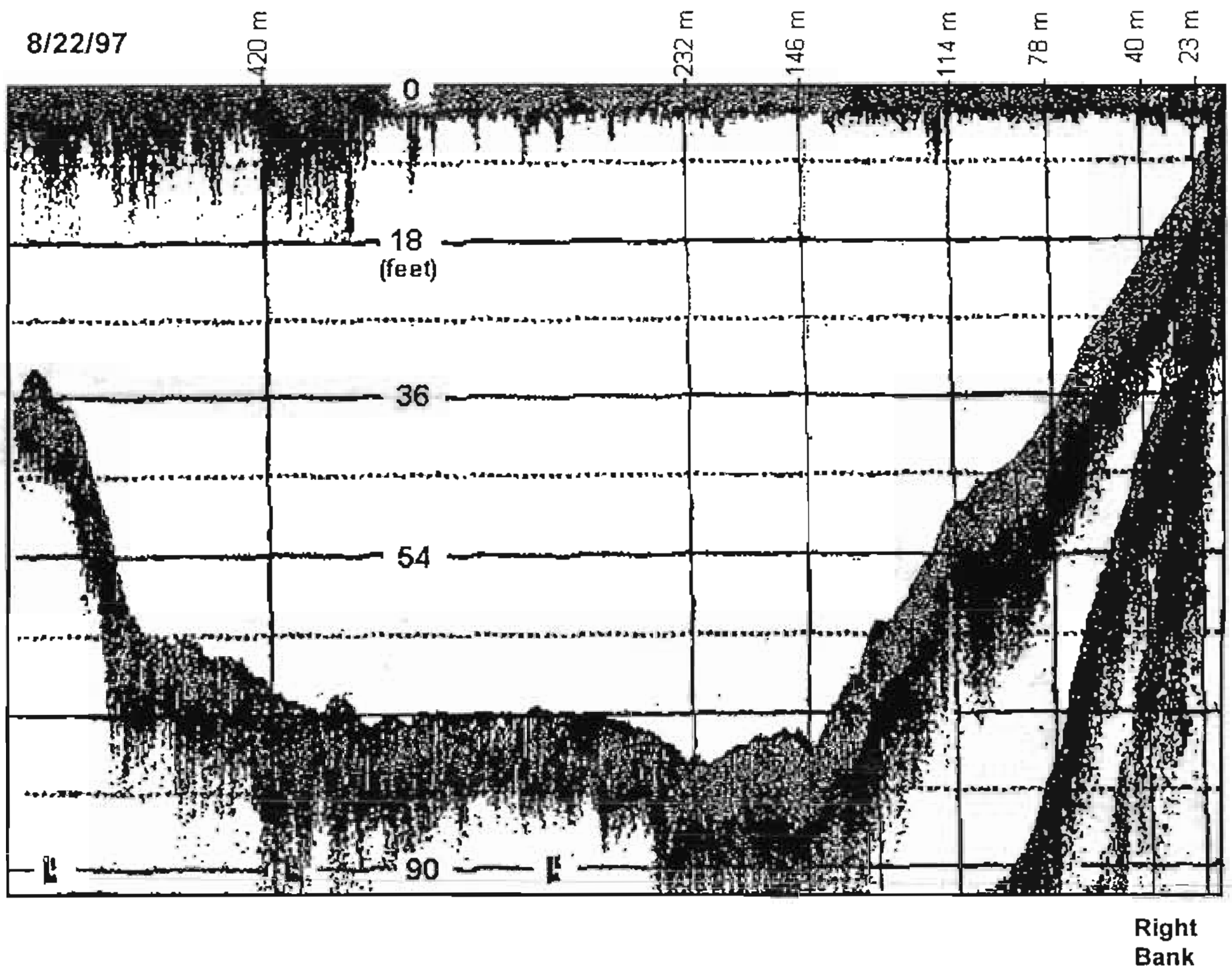

Figure 3. Fathometer chart recording of the Yukon River bottom from mid-river to the right-bank transducer on 22 August 1996 at the sonar project site.

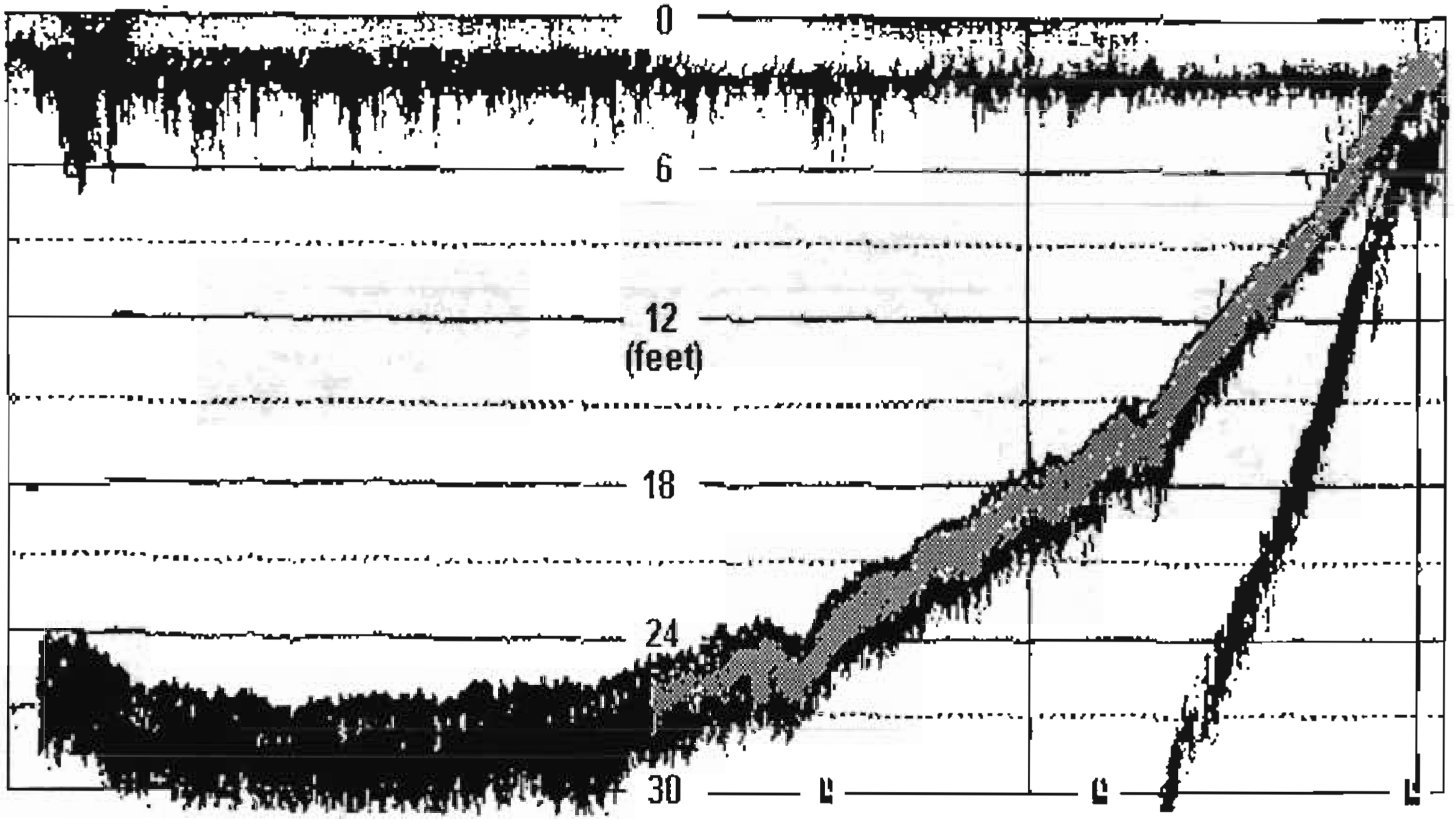

Figure 4. Fathometer chart recording of the Yukon River bottom slightly upstream from the left-bank transducer on 8 August 1996 at the sonar project site.

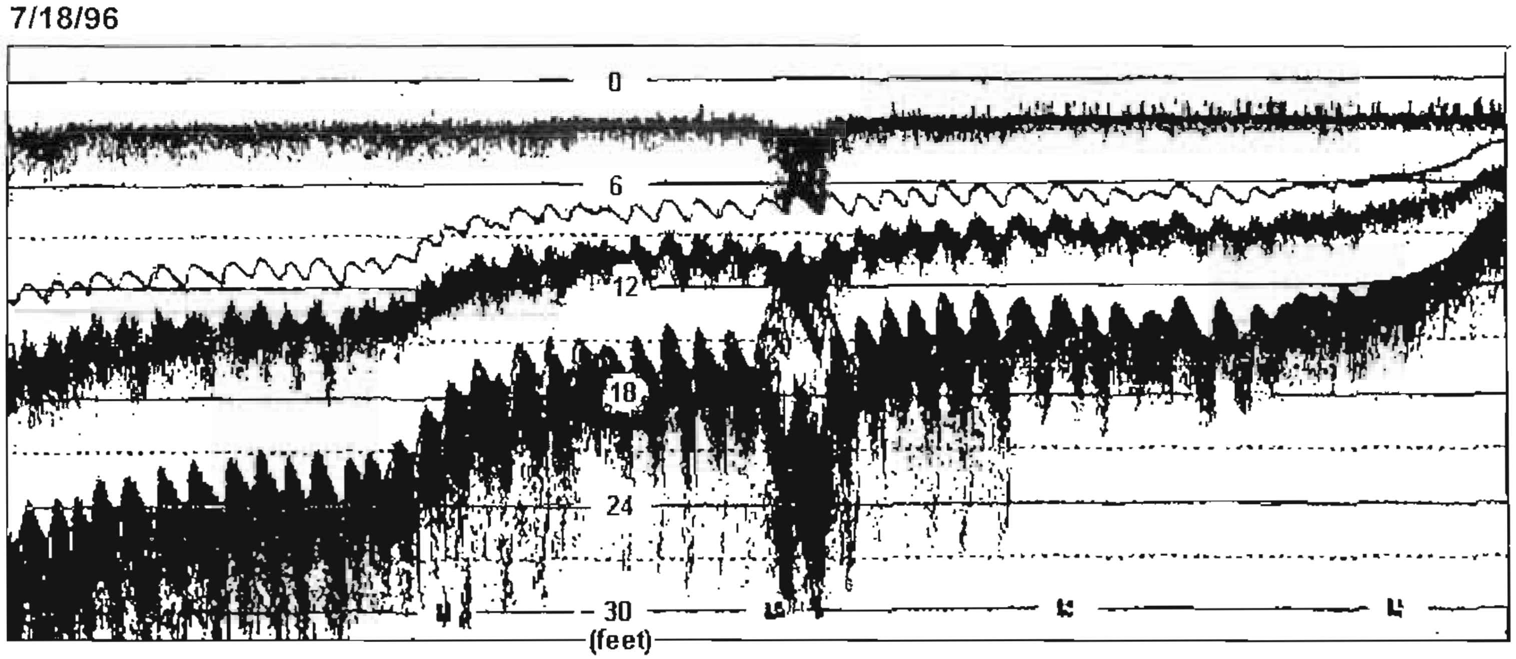

Figure 5. Fathometer chart recording of a strong downstream aspect along the left-bank of the Yukon River at the sonar project site on 18 July 1996.

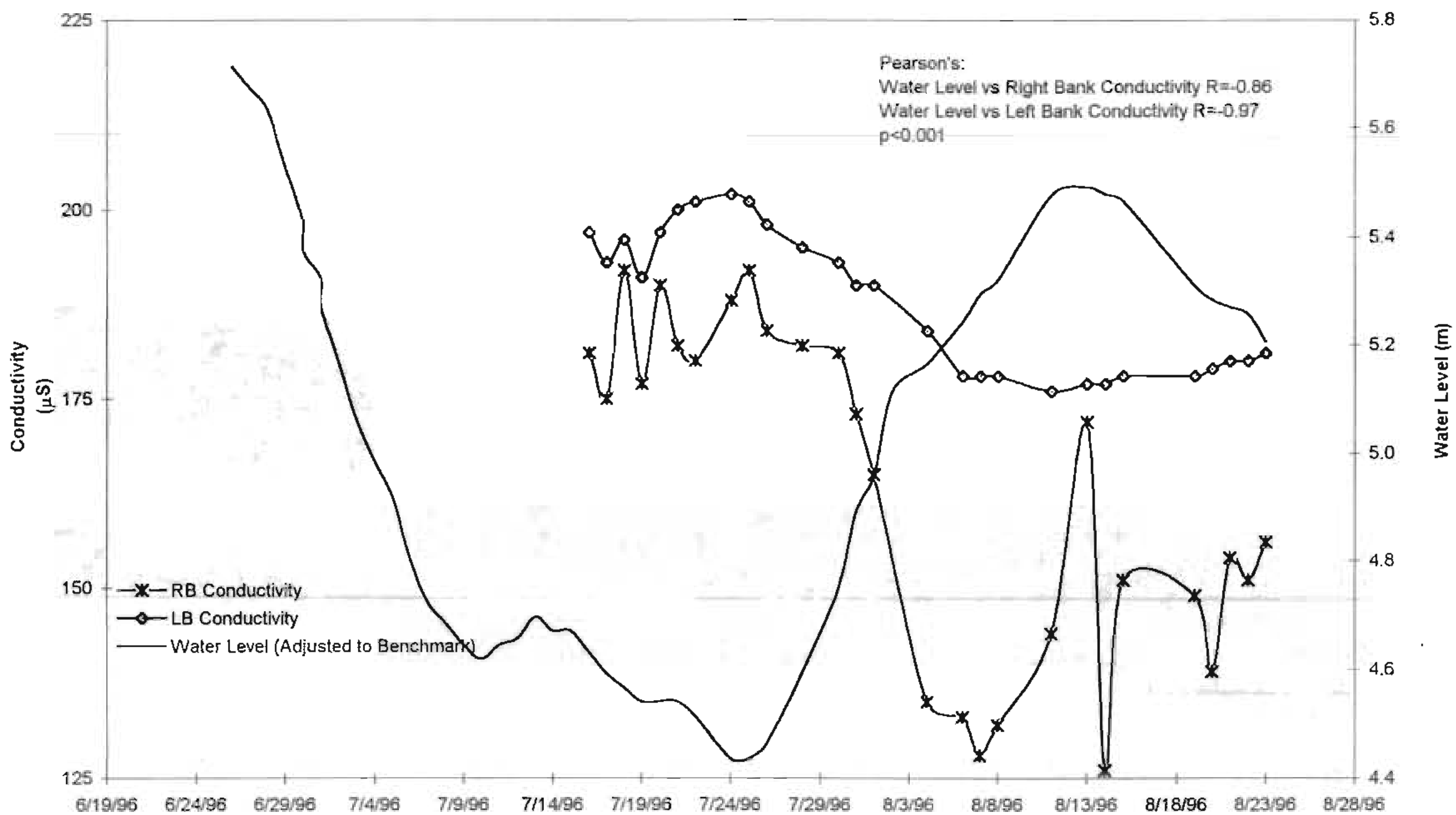

Figure 6. Daily conductivity and water level of the Yukon River recorded at the sonar project site, 1996.

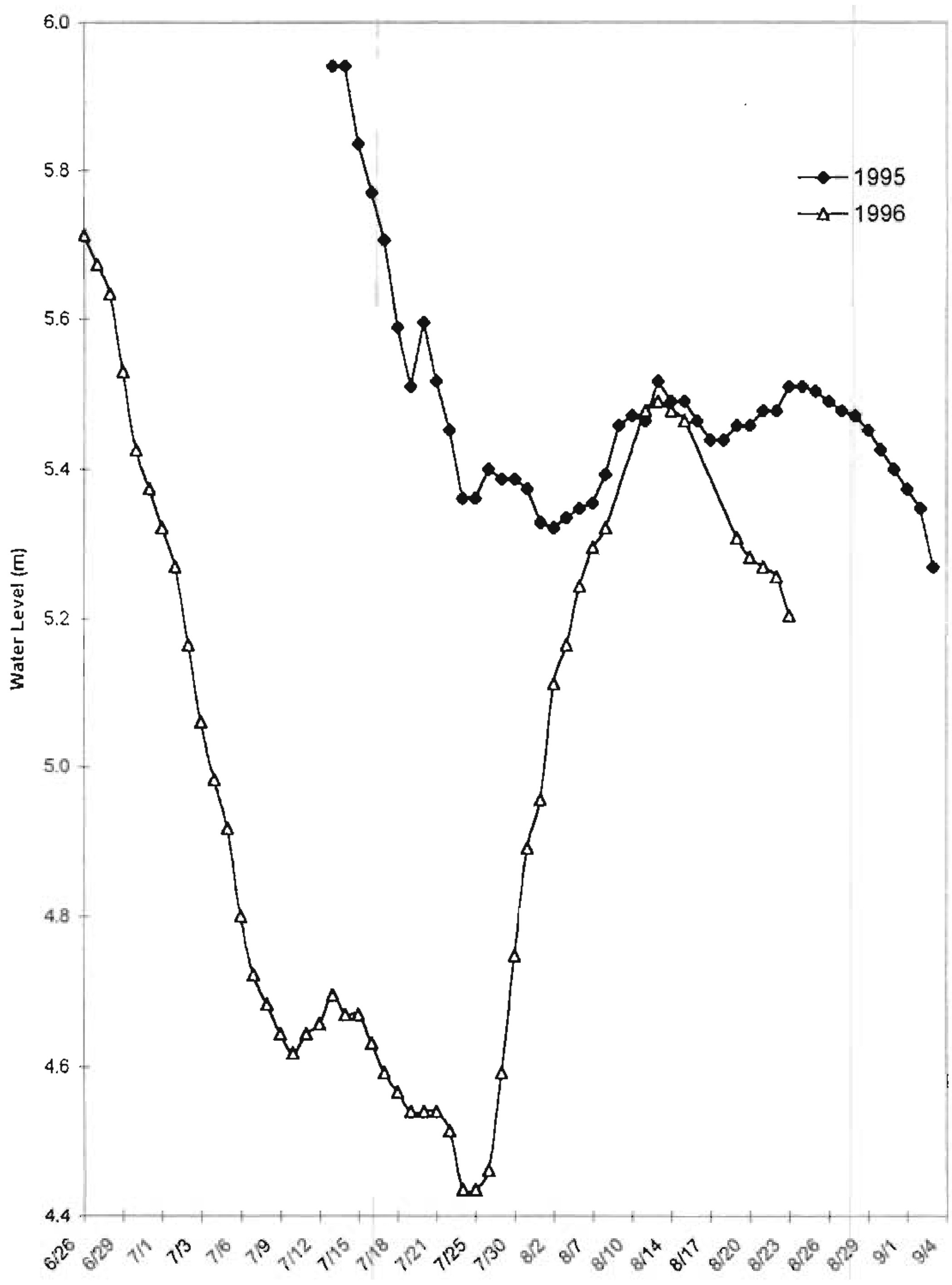

Figure 7. Yukon River water level measured daily in front of the sonar camp in 1995 and1996.

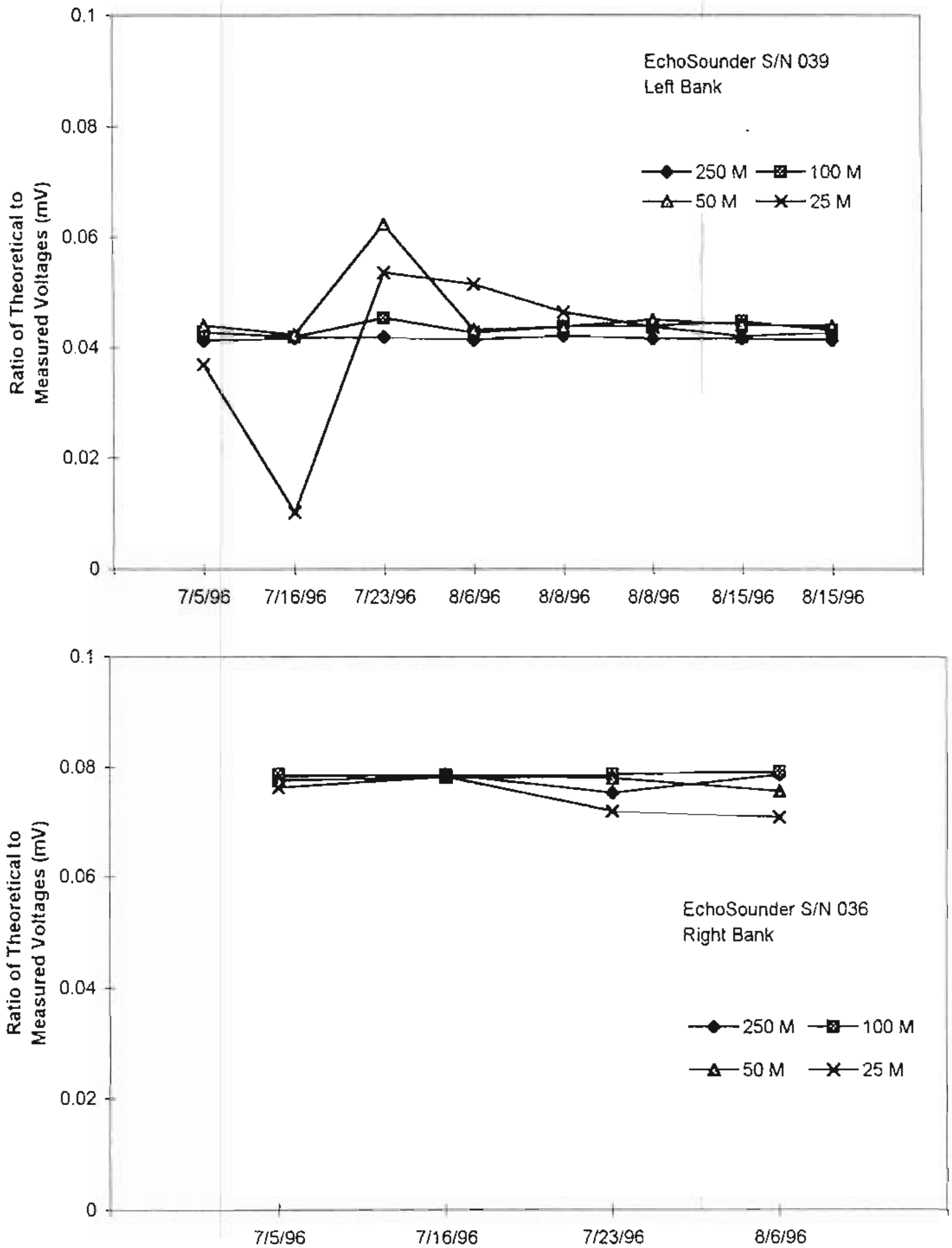

Figure 8. Time-varied gain performance verification for the Yukon River sonar project's echosounders, 1996.

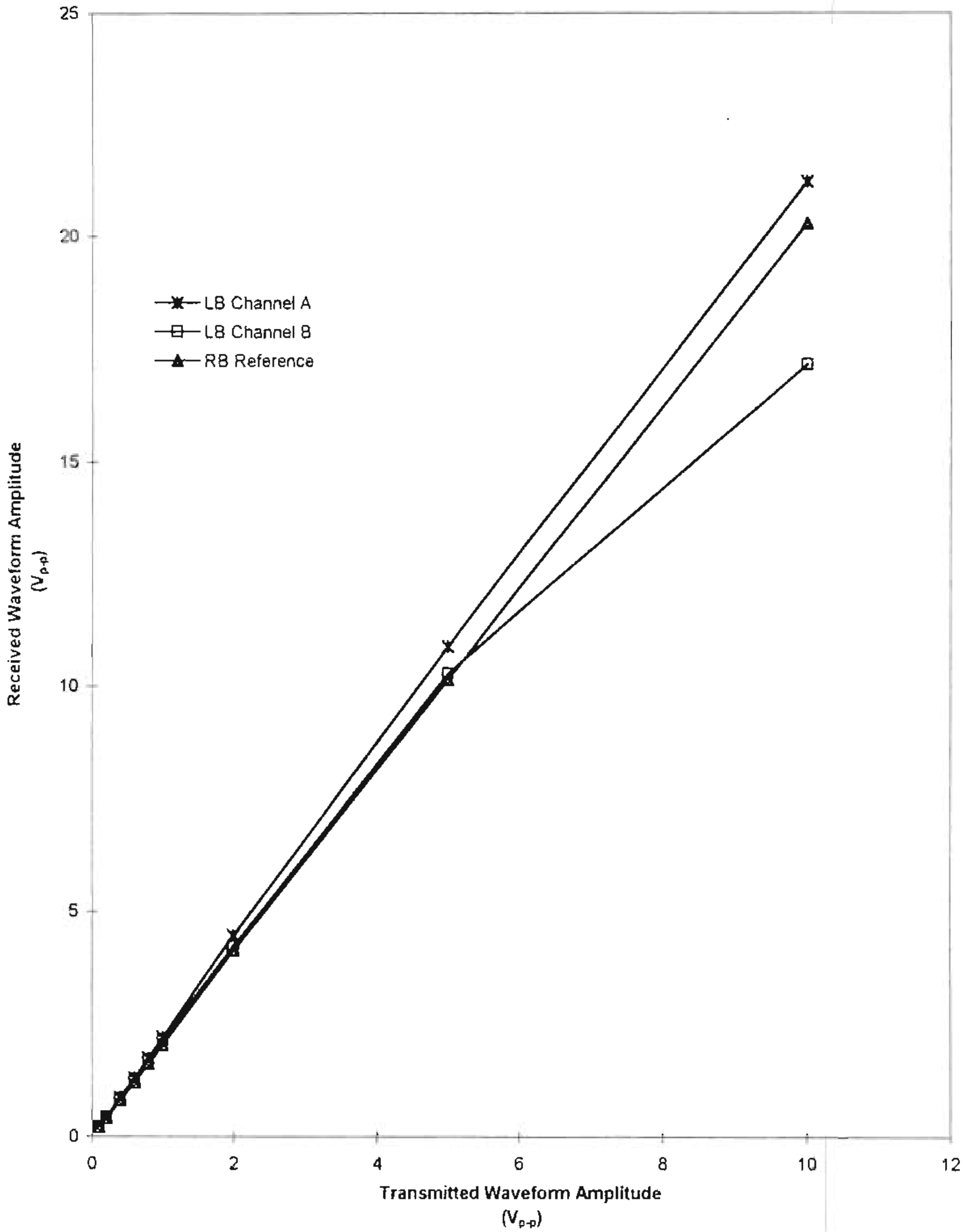

Figure 9. Comparison of signal amplitude before and after telemetry across the Yukon River, 1996.

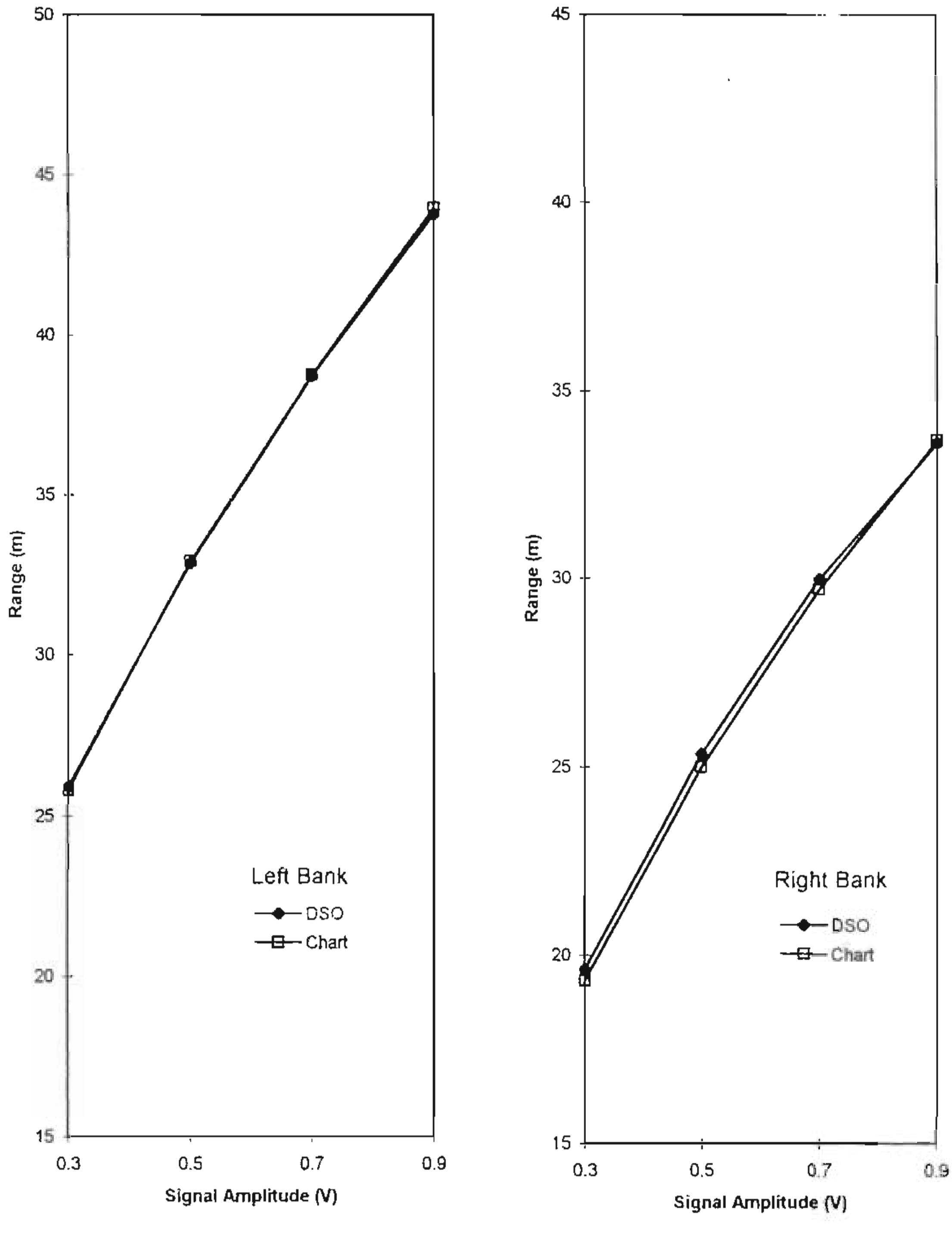

Figure 10. Measured DSO and chart recorder printed signal amplitude values by bank from the Yukon River sonar project, 1996.

APPENDICES

Appendix A. Yukon River sonar gillnet catch data by species and drift, 1996.

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
6/24/96	1	1	4	4.81	0	0	1	0	0	1	0	0	0	2
6/24/96	1	1	5	3.34	0	0	21	0	0	0	0	0	0	21
6/24/96	1	1	6.5	4.78	0	0	59	0	0	0	0	0	0	59
6/24/96	1	1	7.5	4.54	0	1	2	0	0	0	0	0	0	3
6/24/96	1	2	2.75	4.73	0	0	4	0	0	0	1	0	0	5
6/24/96	1	2	5	2.58	0	0	8	0	0	0	0	0	0	8
6/24/96	1	2	6.5	2.15	0	0	2	0	0	0	0	0	0	2
6/24/96	1	2	7.5	5.1	0	0	5	0	0	0	0	0	0	5
6/28/96	1	1	2.75	4.33	0	0	2	0	0	0	0	0	1	3
6/28/96	1	1	5	2.89	0	0	4	0	0	0	0	0	0	4
6/28/96	1	1	6.5	3.69	0	0	11	0	0	1	0	0	1	13
6/28/96	1	1	7.5	5.15	0	1	7	0	0	0	0	0	0	8
6/28/96	1	2	4	3.93	0	0	10	0	0	2	1	0	1	14
6/28/96	1	2	5	5.25	0	0	3	0	0	0	0	0	0	3
6/28/96	1	2	6.5	6.32	0	2	32	0	0	0	0	0	0	34
6/28/96	1	2	8.5	4.27	0	0	1	0	0	0	0	0	0	1
6/28/96	2	1	2.75	6.49	0	0	0	0	0	0	0	1	0	1
6/28/96	2	1	5	5.44	0	0	1	0	0	0	0	0	1	2
6/28/96	2	1	6.5	2.6	0	0	1	0	0	0	0	0	0	1
6/28/96	2	1	7.5	5.25	1	0	2	0	0	0	0	0	0	3
6/28/96	2	2	4	5.17	0	0	0	0	0	0	0	1	0	1
6/28/96	2	2	5	10.25	1	0	5	0	0	1	0	0	0	7
6/28/96	2	2	6.5	4.51	0	0	0	0	0	0	0	0	0	0
6/28/96	2	2	8.5	8.61	0	0	0	0	0	1	0	0	0	1
6/28/96	3	1	2.75	5.75	0	0	1	0	0	0	0	0	0	1
6/28/96	3	1	5	7.83	0	0	12	0	0	0	0	0	0	12
6/28/96	3	1	6.5	7.65	0	0	8	0	0	0	0	0	0	8
6/28/96	3	1	7.5	7.25	1	0	4	0	0	0	0	0	0	5
6/28/96	3	2	4	10.01	0	0	2	0	0	1	0	0	0	3
6/28/96	3	2	5	8.22	0	0	6	0	0	0	0	0	0	6
6/28/96	3	2	6.5	7.43	0	0	5	0	0	0	0	0	0	5
7/1/96	1	1	4	4.46	1	0	3	0	0	1	0	1	0	6
7/1/96	1	1	5	2.52	0	0	9	0	0	1	0	0	0	10
7/1/96	1	1	6.5	2.53	0	0	13	0	0	1	0	0	0	14
7/1/96	1	1	8.5	3.92	0	0	5	0	0	0	0	0	0	5
7/1/96	2	1	4	10.69	0	1	2	0	0	7	0	0	0	10
7/1/96	2	1	5	5.94	0	0	4	0	0	1	1	0	0	6
7/1/96	2	1	6.5	3.94	0	0	6	0	0	2	0	0	1	9
7/1/96	2	1	8.5	3.71	0	0	1	0	0	0	0	0	0	1
7/1/96	3	1	4	9.21	0	0	0	0	0	0	0	0	0	0
7/1/96	3	1	5	5.49	0	0	10	0	0	1	0	0	0	11
7/1/96	3	1	6.5	8.23	0	0	2	0	0	1	0	0	0	3
7/1/96	3	1	8.5	7.18	0	0	2	0	0	0	0	0	0	2

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ʼendix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
7/3/96	1	1	2.75	4.46	0	0	1	0	0	0	0	4	0	5
7/3/96	1	1	5	4.39	0	0	7	0	0	0	0	0	0	7
7/3/96	1	1	6.5	4.26	0	0	0	0	0	0	0	0	0	0
7/3/96	1	1	7.5	5.41	0	0	9	0	0	3	0	0	0	12
7/3/96	1	2	4	3.93	0	0	4	0	0	5	1	1	0	11
7/3/96	1	2	5	4.28	0	0	12	0	0	1	0	0	1	14
7/3/96	1	2	6.5	4.42	0	0	4	0	0	0	0	0	0	4
7/3/96	1	2	7.5	4.3	0	0	0	0	0	0	0	0	0	0
7/3/96	2	1	2.75	5.61	0	0	0	0	0	0	0	1	0	1
7/3/96	2	1	5	2.56	0	0	1	0	0	0	0	0	0	1
7/3/96	2	1	6.5	3.34	0	0	2	0	0	1	0	0	0	3
7/3/96	2	1	7.5	7	0	0	2	0	0	3	0	0	1	6
7/3/96	2	2	4	10.52	0	2	0	0	0	5	1	0	1	9
7/3/96	2	2	5	10.23	0	0	0	0	0	3	0	0	0	3
7/3/96	2	2	6.5	11.07	0	0	2	0	0	0	0	0	0	2
7/3/96	2	2	7.5	9.4	0	0	1	0	0	0	0	0	1	2
'/3/96	3	1	2.75	8.56	0	0	0	0	0	0	0	0	0	0
,/3/96	3	1	5	9.93	0	0	3	0	0	1	0	0	0	4
7/3/96	3	1	6.5	10.98	0	1	3	0	0	0	0	0	0	4
7/3/96	3	1	7.5	8.79	0	0	4	0	0	0	0	0	0	4
7/3/96	3	2	4	7.62	0	0	0	0	0	2	0	0	0	2
7/3/96	3	2	5	9.2	0	0	9	0	0	1	0	0	0	10
7/3/96	3	2	6.5	11.16	0	0	2	0	0	0	0	0	0	2
7/3/96	3	2	7.5	8.73	0	0	4	0	0	0	0	0	0	4
7/5/96	1	1	4	3.19	0	0	5	0	0	2	0	0	0	7
7/5/96	1	1	5	3.9	0	0	14	0	0	0	0	0	0	14
7/5/96	1	1	6.5	3.23	0	0	1	0	0	0	0	0	2	3
7/5/96	1	1	7.5	4.75	0	0	5	0	0	0	0	0	0	5
7/5/96	1	2	5	4.63	0	0	6	0	0	0	0	0	0	6
7/5/96	1	2	6.5	5.49	0	0	6	0	0	0	0	0	0	6
7/5/96	1	2	7.5	4.84	0	0	3	0	0	0	0	0	0	3
7/5/96	2	1	4	5.22	0	0	1	0	0	17	0	0	0	18
7/5/96	2	1	5	6.35	0	0	0	0	0	10	1	0	0	11
7/5/96	2	1	6.5	6.46	0	0	1	0	0	1	0	0	1	3
7/5/96	2	1	7.5	6.07	0	0	0	0	0	0	0	0	0	0
7/5/96	2	2	5	9.25	0	0	0	0	0	3	2	0	1	6
7/5/96	2	2	6.5	4.3	0	0	1	0	0	0	1	0	0	2
7/5/96	2	2	7.5	8.22	0	1	0	0	0	0	0	0	0	1
7/5/96	3	1	4	6.8	0	0	0	0	0	1	0	0	0	1
7/5/96	3	1	5	9.17	0	0	4	0	0	1	0	0	0	5
7/5/96	3	1	6.5	9.04	0	0	3	0	0	0	0	0	0	3
/5/96	3	1	7.5	8.03	0	0	1	0	0	0	0	0	0	1
7/5/96	3	2	5	9.03	0	0	4	0	0	2	0	0	0	6

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Appendix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
7/5/96	3	2	6.5	10.47	0	0	4	0	0	0	0	0	0	4
7/5/96	3	2	7.5	8.17	0	0	0	0	0	0	0	0	0	0
7/8/96	1	1	2.75	4.99	0	0	1	0	0	0	3	1	0	5
7/8/96	1	1	5	3.27	0	1	10	0	0	1	0	0	0	12
7/8/96	1	1	6.5	4.11	0	0	5	0	0	0	0	0	0	5
7/8/96	1	1	7.5	4.68	0	0	6	0	0	3	0	0	0	9
7/8/96	1	2	4	4.86	0	0	0	0	0	4	0	1	1	6
7/8/96	1	2	5	5.96	0	0	5	0	0	8	0	0	1	14
7/8/96	1	2	6.5	3.95	0	0	1	0	0	0	0	0	0	1
7/8/96	1	2	8.5	4.38	0	0	1	0	0	0	0	0	0	1
7/8/96	2	1	2.75	9.09	0	0	0	0	0	1	0	3	1	5
7/8/96	2	1	5	6.33	0	0	2	0	0	2	1	0	0	5
7/8/96	2	1	6.5	6.07	0	0	0	0	0	2	0	0	0	2
7/8/96	2	1	7.5	8.44	0	0	0	0	0	0	0	0	0	0
7/8/96	2	2	4	7.64	0	0	0	0	0	11	1	0	0	12
7/8/96	2	2	5	6.64	0	0	0	0	0	7	3	0	0	10
7/8/96	2	2	6.5	5.02	0	0	0	0	0	0	0	0	0	[illegible]
7/8/96	2	2	8.5	7.02	0	0	0	0	0	0	0	0	0	[illegible]
7/8/96	3	1	2.75	9.12	0	0	0	0	0	1	0	0	0	1
7/8/96	3	1	5	8.53	1	0	7	0	0	0	0	0	0	8
7/8/96	3	1	6.5	8.2	0	0	0	0	0	0	0	0	1	1
7/8/96	3	1	7.5	8.89	0	0	0	0	0	0	0	0	0	0
7/8/96	3	2	4	10.27	0	0	0	0	0	4	0	0	0	4
7/8/96	3	2	5	9.08	0	0	4	0	0	0	0	0	0	4
7/8/96	3	2	6.5	8.24	0	0	2	0	0	0	0	0	0	2
7/8/96	3	2	8.5	10.48	0	0	0	0	0	0	0	0	0	0
7/10/96	1	1	4	9.84	0	0	1	0	0	0	0	0	0	1
7/10/96	1	1	5	4.82	0	0	6	0	0	8	0	0	0	14
7/10/96	1	1	6.5	4.58	0	0	4	0	0	3	0	0	0	7
7/10/96	1	1	8.5	3.84	0	0	0	0	0	0	0	0	0	0
7/10/96	2	1	4	7.39	0	0	0	0	0	1	2	0	0	3
7/10/96	2	1	5	5.44	0	0	0	0	0	0	2	0	0	2
7/10/96	2	1	6.5	5.42	0	0	0	0	0	1	1	0	1	3
7/10/96	2	1	8.5	5.65	0	0	0	0	0	0	0	0	0	0
7/10/96	3	1	4	9.85	0	0	0	0	0	1	0	0	0	1
7/10/96	3	1	5	8.11	0	0	0	0	0	0	1	0	0	1
7/10/96	3	1	6.5	8.53	0	0	1	0	0	0	0	0	0	1
7/10/96	3	1	8.5	8.82	0	0	0	0	0	0	0	0	0	0
7/12/96	1	1	2.75	4.56	0	0	3	0	0	0	0	4	0	7
7/12/96	1	1	5	2.78	0	0	5	0	0	1	0	0	0	6
7/12/96	1	1	6.5	5.53	1	0	5	0	0	1	0	0	1	8
7/12/96	1	1	7.5	5.03	0	0	5	0	0	4	0	0	0	
7/12/96	1	2	5	4.51	0	0	3	0	0	1	0	0	0	

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endix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
7/12/96	1	2	6.5	4.65	0	0	3	0	0	2	0	0	0	5
7/12/96	1	2	8.5	5.48	0	0	1	0	0	1	0	0	0	2
7/12/96	2	1	2.75	6.25	0	0	0	0	0	0	1	3	0	4
7/12/96	2	1	5	6.24	0	0	0	0	0	1	0	0	0	1
7/12/96	2	1	6.5	6.36	0	0	0	0	0	0	0	0	0	0
7/12/96	2	1	7.5	5.23	0	0	0	0	0	1	0	0	0	1
7/12/96	2	2	4	9.12	0	0	0	0	0	1	0	1	0	2
7/12/96	2	2	4	4.73	0	0	0	0	0	0	0	0	0	0
7/12/96	2	2	5	8.88	0	0	1	0	0	1	0	0	0	2
7/12/96	2	2	6.5	8.87	0	0	0	0	0	0	0	0	0	0
7/12/96	2	2	8.5	8.97	0	0	0	0	0	0	0	0	0	0
7/12/96	3	1	2.75	9.38	0	0	1	0	0	0	0	0	0	1
7/12/96	3	1	5	8.32	0	0	3	0	0	0	0	0	0	3
7/12/96	3	1	6.5	8.38	0	0	1	0	0	0	0	0	0	1
7/12/96	3	1	7.5	8.07	1	0	0	0	0	0	0	0	0	1
7/12/96	3	2	4	10.36	0	0	2	0	0	0	0	0	0	2
'2/96	3	2	5	8.98	0	1	2	0	0	3	0	0	0	6
ı2/96	3	2	6.5	9.03	0	0	2	0	0	0	0	0	0	2
7/12/96	3	2	8.5	9.78	0	0	0	0	0	0	0	0	0	0
7/15/96	1	1	4	4.61	0	0	1	0	0	0	0	0	0	1
7/15/96	1	1	5	3.91	0	0	1	0	0	1	1	0	0	3
7/15/96	1	1	6.5	4.2	0	0	5	0	0	0	0	0	0	5
7/15/96	1	1	8.5	4.07	0	0	0	0	0	0	0	0	0	0
7/15/96	1	2	2.75	3.91	0	0	0	0	0	0	0	2	0	2
7/15/96	1	2	5	4.06	0	0	4	0	0	5	0	0	0	9
7/15/96	1	2	6.5	4.32	0	0	2	0	0	1	0	0	0	3
7/15/96	1	2	7.5	4.21	0	0	1	0	0	0	0	0	0	1
7/15/96	2	1	4	9.29	0	0	0	0	0	1	0	0	0	1
7/15/96	2	1	5	6.57	0	0	0	0	0	0	1	0	0	1
7/15/96	2	1	6.5	6.28	0	0	0	0	0	1	0	0	0	1
7/15/96	2	1	8.5	9.05	0	0	1	0	0	0	0	0	0	1
7/15/96	2	2	2.75	6.38	0	0	0	0	0	1	0	0	0	1
7/15/96	2	2	5	6.55	0	0	0	0	0	9	1	0	0	10
7/15/96	2	2	6.5	6.46	0	0	0	0	0	0	0	0	0	0
7/15/96	2	2	7.5	6.12	0	0	0	0	0	2	0	0	0	2
7/15/96	3	1	4	8.6	0	0	0	0	0	1	0	0	0	1
7/15/96	3	1	5	9.1	0	0	2	0	0	2	0	0	0	4
7/15/96	3	1	6.5	7.96	0	0	0	0	0	0	0	0	0	0
7/15/96	3	1	8.5	9.04	0	0	0	0	0	0	0	0	0	0
7/15/96	3	2	2.75	9.66	0	0	0	0	0	0	0	1	0	1
7/15/96	3	2	5	8.55	0	0	3	0	0	0	0	0	0	3
5/96	3	2	6.5	8.16	0	0	0	0	0	0	1	0	0	1
./15/96	3	2	7.5	13.06	0	0	0	0	0	0	0	0	0	0

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Appendix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
7/17/96	1	1	2.75	4.28	0	0	2	0	0	0	0	0	0	2
7/17/96	1	1	5	5.12	0	0	1	0	0	1	0	0	0	2
7/17/96	1	1	6.5	4.75	0	0	8	0	0	1	0	0	0	9
7/17/96	1	1	7.5	4.6	0	0	0	0	0	0	0	2	0	2
7/17/96	1	2	4	6.38	0	0	0	0	0	0	0	0	1	1
7/17/96	1	2	5	4.9	0	0	8	0	0	0	0	0	0	8
7/17/96	1	2	6.5	3.81	0	0	0	0	0	0	0	0	0	0
7/17/96	1	2	8.5	5.37	0	0	1	0	0	0	0	0	0	1
7/17/96	2	1	2.75	6.41	0	0	2	0	0	0	0	0	0	2
7/17/96	2	1	5	6.53	0	0	1	0	0	0	0	0	0	1
7/17/96	2	1	6.5	6.08	0	0	2	0	0	2	0	0	0	4
7/17/96	2	1	7.5	6.5	0	0	0	0	0	1	1	2	0	4
7/17/96	2	2	4	8.71	0	0	0	0	0	3	0	0	0	3
7/17/96	2	2	5	8.65	0	0	0	0	0	1	0	0	0	1
7/17/96	2	2	6.5	8.88	0	0	1	0	0	1	0	0	0	2
7/17/96	2	2	8.5	9.14	0	0	0	0	0	1	0	0	0	1
7/17/96	3	1	2.75	8.51	0	0	1	0	0	0	0	0	0	1
7/17/96	3	1	5	9.53	0	0	3	0	0	0	0	0	0	3
7/17/96	3	1	6.5	8.61	0	0	1	0	0	0	0	0	0	1
7/17/96	3	1	7.5	8.57	0	0	0	0	0	0	0	0	0	0
7/17/96	3	2	4	10.33	0	0	1	0	0	1	0	1	0	3
7/17/96	3	2	5	9.36	0	0	1	0	0	4	0	0	0	5
7/17/96	3	2	6.5	9.03	0	0	1	0	0	2	0	0	0	3
7/17/96	3	2	8.5	10.28	0	0	0	0	0	0	0	0	0	0
7/19/96	1	1	4	5.61	0	0	0	1	0	7	1	0	0	9
7/19/96	1	1	5	4.15	0	0	0	3	0	1	0	0	0	4
7/19/96	1	1	6.5	3.73	0	0	0	9	0	5	0	0	0	14
7/19/96	1	1	8.5	4.69	0	0	0	1	0	0	0	0	0	1
7/19/96	1	2	2.75	5.21	0	0	0	2	0	0	0	0	0	2
7/19/96	1	2	5	4.68	0	0	0	5	0	2	0	0	0	7
7/19/96	1	2	6.5	4.72	0	0	0	5	0	2	0	0	0	7
7/19/96	1	2	7.5	4.44	0	0	0	0	0	0	0	0	0	0
7/19/96	2	1	4	7.38	0	0	0	1	0	0	0	0	0	1
7/19/96	2	1	5	7.25	0	0	0	2	0	0	0	0	0	2
7/19/96	2	1	6.5	8.23	0	0	0	1	0	1	1	0	0	3
7/19/96	2	1	8.5	6.02	0	0	0	0	0	0	0	0	0	0
7/19/96	2	2	2.75	9.59	0	0	0	0	0	0	0	0	0	0
7/19/96	2	2	5	8.84	0	0	0	0	0	1	1	0	0	2
7/19/96	2	2	6.5	9.11	0	0	0	0	0	0	0	0	0	0
7/19/96	2	2	7.5	9.48	0	0	0	0	0	0	0	0	0	0
7/19/96	3	1	4	8.54	0	0	0	0	0	0	0	0	0	0
7/19/96	3	1	5	8.22	0	0	0	2	0	0	0	0	0	[illegible]
7/19/96	3	1	6.5	8.34	0	0	0	4	0	1	0	0	0	5

-Continued-

endix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
7/19/96	3	1	8.5	11.65	0	0	0	0	0	0	0	0	0	0
7/19/96	3	2	2.75	10.21	0	0	0	0	0	0	1	1	0	2
7/19/96	3	2	5	8.74	0	0	0	2	0	0	0	0	0	2
7/19/96	3	2	6.5	8.43	0	0	0	2	0	0	0	0	0	2
7/19/96	3	2	7.5	9.97	0	0	0	3	0	0	0	0	0	3
7/22/96	1	1	2.75	4.77	0	0	0	0	0	0	0	2	0	2
7/22/96	1	1	4	5.27	0	0	0	0	0	1	0	0	0	1
7/22/96	1	1	5	3.97	0	0	0	1	0	2	0	0	0	3
7/22/96	1	1	6.5	4.78	0	0	0	1	0	0	0	0	0	1
7/22/96	1	2	2.75	4.95	0	0	0	0	0	0	0	1	0	1
7/22/96	1	2	4	4.71	0	0	0	0	0	0	0	0	0	0
7/22/96	1	2	5	6.29	0	0	0	5	0	2	0	0	1	8
7/22/96	1	2	6.5	4.36	0	0	0	0	0	1	0	0	0	1
7/22/96	2	1	2.75	6.37	0	0	0	0	0	0	0	1	0	1
7/22/96	2	1	4	6.98	0	0	0	0	0	0	0	0	0	0
7/22/96	2	1	5	6.08	0	0	0	0	0	1	0	0	1	2
2/96	2	1	6.5	8.59	0	0	0	1	0	0	0	0	0	1
22/96	2	2	2.75	8.58	0	0	0	1	0	0	0	0	0	1
7/22/96	2	2	4	7.61	0	0	0	0	0	0	1	0	0	1
7/22/96	2	2	5	7.24	0	0	0	1	1	0	0	0	0	2
7/22/96	2	2	6.5	6.4	0	0	0	1	0	0	0	0	0	1
7/22/96	3	1	2.75	9.16	0	0	0	0	0	0	0	0	0	0
7/22/96	3	1	4	8.08	0	0	0	0	0	0	0	0	0	0
7/22/96	3	1	5	8.32	0	0	0	0	0	0	0	0	0	0
7/22/96	3	1	6.5	8.28	0	0	0	0	0	0	0	0	0	0
7/22/96	3	2	2.75	8.58	0	0	0	0	0	1	0	0	0	1
7/22/96	3	2	4	10.94	0	0	0	1	0	1	0	0	0	2
7/22/96	3	2	5	8.78	0	0	0	1	0	0	1	0	0	2
7/22/96	3	2	6.5	8.04	0	0	0	0	0	0	0	0	0	0
7/24/96	1	1	2.75	3.98	0	0	0	0	0	1	1	0	0	2
7/24/96	1	1	4	4.54	0	0	0	0	0	0	0	0	0	0
7/24/96	1	1	5	3.82	0	0	0	0	0	0	0	0	0	0
7/24/96	1	1	6.5	4.18	0	0	0	2	0	0	0	0	0	2
7/24/96	1	2	2.75	5.68	0	0	0	0	0	0	0	0	0	0
7/24/96	1	2	4	5.82	0	0	0	2	0	1	0	0	0	3
7/24/96	1	2	5	5.22	0	0	0	1	0	0	1	0	1	3
7/24/96	1	2	6.5	5.6	0	0	0	2	0	0	0	0	0	2
7/24/96	2	1	2.75	7.29	0	0	0	0	0	0	0	0	0	0
7/24/96	2	1	4	7.48	0	0	0	0	0	0	0	0	0	0
7/24/96	2	1	5	8.74	0	0	0	0	0	0	0	0	0	0
7/24/96	2	1	6.5	7.51	0	0	0	2	0	0	0	0	0	2
4/96	2	2	2.75	5.48	0	0	0	0	0	0	0	0	0	0
/24/96	2	2	4	7.24	0	0	0	1	0	1	0	0	0	2

-Continued-

Appendix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
7/24/96	2	2	5	6.95	0	0	0	3	0	1	1	0	1	6
7/24/96	2	2	6.5	4.89	0	0	0	3	0	0	0	0	0	3
7/24/96	3	1	2.75	8.16	0	0	0	0	0	0	0	0	0	0
7/24/96	3	1	4	8.81	0	0	0	0	0	1	0	0	0	1
7/24/96	3	1	5	8.69	0	0	0	2	0	0	0	0	0	2
7/24/96	3	1	6.5	8.43	0	0	0	4	0	1	0	0	0	5
7/24/96	3	2	2.75	5.83	0	0	0	0	0	0	0	0	0	0
7/24/96	3	2	4	11.53	0	0	0	0	0	0	0	0	0	0
7/24/96	3	2	5	9.49	0	0	0	1	0	0	0	0	0	1
7/24/96	3	2	6.5	6.59	0	0	0	2	0	0	0	0	0	2
7/26/96	1	1	2.75	4.37	0	0	0	0	0	0	0	0	0	0
7/26/96	1	1	4	4.88	0	0	0	4	1	2	0	0	0	7
7/26/96	1	1	5	4.43	0	0	0	2	0	0	0	0	0	2
7/26/96	1	1	6.5	4.4	0	0	0	6	0	0	0	0	0	6
7/26/96	1	2	2.75	4.86	0	0	0	0	0	0	0	0	0	0
7/26/96	1	2	5	4.92	0	0	0	7	0	1	0	0	0	8
7/26/96	1	2	6.5	4.46	0	0	0	19	0	0	0	0	0	1
7/26/96	2	1	2.75	7.13	0	0	0	0	0	0	0	2	0	.
7/26/96	2	1	4	8.43	0	0	0	0	0	1	0	0	0	1
7/26/96	2	1	5	6.38	0	0	0	1	0	0	0	0	0	1
7/26/96	2	1	6.5	1.98	0	0	0	2	0	0	0	0	0	2
7/26/96	2	2	2.75	7.18	0	0	0	1	0	0	1	0	0	2
7/26/96	2	2	5	5.42	0	0	0	9	1	0	0	0	0	10
7/26/96	2	2	6.5	7.83	0	0	0	10	0	0	0	0	0	10
7/26/96	3	1	2.75	7.24	0	0	0	1	0	0	0	2	0	3
7/26/96	3	1	4	8.53	0	0	0	1	0	0	0	0	0	1
7/26/96	3	1	5	8.02	0	0	0	3	1	0	0	0	0	4
7/26/96	3	1	6.5	4.45	0	0	0	15	0	0	0	0	0	15
7/26/96	3	2	2.75	8.47	0	0	0	0	0	0	0	0	0	0
7/26/96	3	2	5	8.88	0	0	0	7	0	0	0	0	0	7
7/29/96	1	1	2.75	4.37	0	0	0	0	0	0	0	0	0	0
7/29/96	1	1	4	5.18	0	0	0	0	1	0	0	0	0	1
7/29/96	1	1	5	3.88	0	0	0	0	1	0	0	0	0	1
7/29/96	1	1	6.5	4.67	0	0	0	4	0	0	0	0	0	4
7/29/96	1	2	2.75	4.67	0	0	0	0	0	0	0	0	0	0
7/29/96	1	2	4	3.69	0	0	0	0	1	2	0	0	0	3
7/29/96	1	2	5	5.3	0	0	0	3	0	1	0	0	0	4
7/29/96	1	2	6.5	3.87	0	0	0	5	0	0	0	0	0	5
7/29/96	3	1	2.75	8.19	0	0	0	0	0	0	0	0	0	0
7/29/96	3	1	2.75	8.54	0	0	0	0	0	0	0	0	0	0
7/29/96	3	1	4	6.42	0	0	0	0	0	0	0	0	0	0
7/29/96	3	1	4	6.47	0	0	0	0	0	0	0	0	0	
7/29/96	3	1	5	6.38	0	0	0	4	0	0	0	0	0	[illegible]

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endix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
7/29/96	3	1	5	6.78	0	0	0	1	0	0	0	0	0	1
7/29/96	3	1	6.5	8.33	0	0	0	6	0	0	0	0	0	6
7/29/96	3	1	6.5	6.65	0	0	0	7	0	1	0	0	0	8
7/29/96	3	2	2.75	5.42	0	0	0	0	0	0	0	2	0	2
7/29/96	3	2	2.75	9.12	0	0	0	0	0	0	0	0	0	0
7/29/96	3	2	4	6.99	0	0	0	1	0	1	0	0	0	2
7/29/96	3	2	4	8.7	0	0	0	1	0	0	0	0	0	1
7/29/96	3	2	5	6.69	0	0	0	2	0	0	0	0	0	2
7/29/96	3	2	5	8.98	0	0	0	1	0	0	0	0	0	1
7/29/96	3	2	6.5	7	0	0	0	9	1	0	0	0	0	10
7/29/96	3	2	6.5	8.13	0	0	0	5	0	0	0	0	0	5
7/31/96	1	1	2.75	4.98	0	0	0	0	0	0	0	0	0	0
7/31/96	1	1	4	5.73	0	0	0	0	0	1	0	0	2	3
7/31/96	1	1	5	4.59	0	0	0	1	0	0	0	0	0	1
7/31/96	1	1	6.5	3.93	0	0	0	0	0	0	0	0	0	0
7/31/96	1	2	2.75	3.78	0	0	0	0	1	0	0	1	0	2
1/96	1	2	4	5.06	0	0	0	0	0	0	2	0	0	2
1/96	1	2	5	3.88	0	0	0	0	0	0	0	0	0	0
7/31/96	1	2	6.5	4.5	0	0	0	1	0	0	0	0	0	1
7/31/96	3	1	2.75	9.46	0	0	0	0	0	0	0	0	0	0
7/31/96	3	1	2.75	6.55	0	0	0	0	0	0	0	0	0	0
7/31/96	3	1	4	6.19	0	0	0	0	0	0	0	0	0	0
7/31/96	3	1	4	8.66	0	0	0	0	0	0	0	0	0	0
7/31/96	3	1	5	8.38	0	0	0	1	1	0	0	0	0	2
7/31/96	3	1	5	6.96	0	0	0	0	0	0	0	0	0	0
7/31/96	3	1	6.5	7.99	0	0	0	2	0	0	0	0	0	2
7/31/96	3	1	6.5	8.24	0	0	0	0	0	0	0	0	0	0
7/31/96	3	2	2.75	7.68	0	0	0	0	0	0	0	0	0	0
7/31/96	3	2	2.75	7.83	0	0	0	0	0	0	0	2	0	2
7/31/96	3	2	4	7.74	0	0	0	0	0	0	0	0	0	0
7/31/96	3	2	4	8.6	0	0	0	0	0	0	0	0	0	0
7/31/96	3	2	5	7.48	0	0	0	0	0	0	0	0	0	0
7/31/96	3	2	5	8.41	0	0	0	0	0	1	0	0	0	1
7/31/96	3	2	6.5	8.53	0	0	0	0	0	0	0	0	0	0
7/31/96	3	2	6.5	8.49	0	0	0	2	0	0	0	0	0	2
8/7/96	1	1	2.75	4.82	0	0	0	0	0	0	0	0	0	0
8/7/96	1	1	4	4.24	0	0	0	0	2	0	0	0	0	2
8/7/96	1	1	5	5.18	0	0	0	1	3	0	0	0	0	4
8/7/96	1	1	6.5	3.72	0	0	0	0	0	0	0	0	0	0
8/7/96	1	2	2.75	2.68	0	0	0	0	0	0	0	0	0	0
8/7/96	1	2	4	4.53	0	0	0	1	0	0	0	0	0	1
7/96	1	2	5	4.03	0	0	0	0	5	0	0	0	1	6
8/7/96	1	2	6.5	4.08	0	0	0	0	2	0	0	0	0	2

-Continued-

Appendix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
8/7/96	2	1	2.75	5.11	0	0	0	0	0	0	0	0	0	0
8/7/96	2	1	4	5.58	0	0	0	0	0	0	1	0	0	1
8/7/96	2	1	5	4.99	0	0	0	0	0	0	0	0	0	0
8/7/96	2	1	6.5	5.57	0	0	0	3	1	0	0	0	0	4
8/7/96	2	2	2.75	6.23	0	0	0	1	0	0	0	0	0	1
8/7/96	2	2	4	8.21	0	0	0	1	1	0	0	0	0	2
8/7/96	2	2	5	7.45	0	0	0	3	1	0	0	0	0	4
8/7/96	2	2	6.5	7.83	0	0	0	0	1	0	0	0	0	1
8/7/96	3	1	2.75	7.97	0	0	0	0	0	0	0	0	0	0
8/7/96	3	1	4	6.5	0	0	0	0	0	0	0	0	0	0
8/7/96	3	1	5	7.57	0	0	0	0	0	0	0	0	0	0
8/7/96	3	1	6.5	6.54	0	0	0	1	0	0	0	0	0	1
8/7/96	3	2	2.75	7.18	0	0	0	0	0	0	0	0	0	0
8/7/96	3	2	4	8.71	0	0	0	4	0	0	0	0	0	4
8/7/96	3	2	5	6.4	0	0	0	0	0	0	0	0	0	0
8/7/96	3	2	6.5	8.18	0	0	0	0	0	0	0	0	0	0
8/9/96	1	1	2.75	3.63	0	0	0	0	0	0	0	0	0	0
8/9/96	1	1	4	4.04	0	0	0	0	2	0	0	0	0	2
8/9/96	1	1	5	4.86	0	0	0	0	0	0	0	0	0	0
8/9/96	1	1	6.5	4.72	0	0	0	0	0	0	0	0	0	0
8/9/96	1	2	2.75	4.28	0	0	0	0	1	0	0	0	0	1
8/9/96	1	2	4	4.19	0	0	0	0	1	0	0	0	0	1
8/9/96	1	2	5	4.38	0	0	0	0	0	0	0	0	0	0
8/9/96	1	2	6.5	3.74	0	0	0	0	0	0	0	0	0	0
8/9/96	2	1	2.75	9.09	0	0	0	0	0	0	0	0	0	0
8/9/96	2	1	4	8.63	0	0	0	1	0	0	1	0	0	2
8/9/96	2	1	6.5	6.2	0	0	0	0	0	0	0	0	0	0
8/9/96	2	2	2.75	6.52	0	0	0	0	0	0	0	0	0	0
8/9/96	2	2	4	7.13	0	0	0	0	0	0	0	0	0	0
8/9/96	2	2	5	5.8	0	0	0	1	0	0	0	0	0	1
8/9/96	2	2	6.5	6.92	0	0	0	1	0	0	0	0	0	1
8/9/96	3	1	2.75	9.37	0	0	0	0	0	0	0	0	0	0
8/9/96	3	1	4	7.89	0	0	0	0	0	0	0	0	0	0
8/9/96	3	1	5	8.68	0	0	0	0	1	0	1	0	0	2
8/9/96	3	1	5	9.35	0	0	0	0	0	0	0	0	0	0
8/9/96	3	1	6.5	8.31	0	0	0	0	0	0	0	0	0	0
8/9/96	3	2	2.75	8.71	0	0	0	0	0	0	0	0	0	0
8/9/96	3	2	4	8.88	0	0	0	0	0	0	0	0	0	0
8/9/96	3	2	5	7.72	0	0	0	0	0	0	0	0	0	0
8/9/96	3	2	6.5	8.75	0	0	0	1	0	0	0	0	0	1
8/12/96	1	2	2.75	4.88	0	0	0	0	0	0	0	0	0	0
8/12/96	1	2	4	5.63	0	0	0	0	0	0	0	0	0	(
8/12/96	1	2	5	4.88	0	0	0	0	0	0	0	0	0	0

-Continued-

endix A. (Continued)

Date	Zone	Testfish Period	Mesh	Fishing Time (Minutes)	Chinook	Jack	Summer Chum	Fall Chum	Coho	Pink	Whitefish	Cisco Species	Other Species	Total Catch
8/12/96	1	2	6.5	4.44	0	0	0	1	0	0	0	0	0	1
8/12/96	2	2	2.75	8.71	0	0	0	0	0	0	0	1	0	1
8/12/96	2	2	4	6.5	0	0	0	0	0	0	0	0	0	0
8/12/96	2	2	5	6.27	0	0	0	0	1	0	0	0	0	1
8/12/96	2	2	6.5	7.4	1	0	0	0	1	0	0	0	0	2
8/12/96	3	2	2.75	9.75	0	0	0	0	0	0	0	0	0	0
8/12/96	3	2	4	10.61	0	0	0	0	0	0	0	0	0	0
8/12/96	3	2	5	9.37	0	0	0	0	0	0	1	0	0	1
8/12/96	3	2	6.5	10.32	0	0	0	0	0	0	0	0	0	0
8/14/96	1	1	2.75	5.06	0	0	0	0	0	0	0	0	0	0
8/14/96	1	1	4	4.02	0	0	0	1	0	0	0	0	0	1
8/14/96	1	1	5	4.57	0	0	0	1	0	0	0	0	1	2
8/14/96	1	1	6.5	5.28	0	0	0	23	5	0	0	0	0	28
8/14/96	1	2	2.75	3.46	0	0	0	0	0	0	0	0	0	0
8/14/96	1	2	4	4.22	0	0	0	0	1	0	0	0	0	1
8/14/96	1	2	5	3.04	0	0	0	1	1	0	0	0	0	2
'14/96	1	2	6.5	4.95	0	0	0	8	2	0	0	0	0	10
,14/96	2	1	2.75	7.33	0	0	0	0	0	0	0	0	0	0
8/14/96	2	1	4	5.29	0	0	0	0	0	0	0	0	0	0
8/14/96	2	1	5	5.43	0	0	0	0	1	0	0	0	0	1
8/14/96	2	1	6.5	5.9	0	0	0	1	0	0	0	0	0	1
8/14/96	2	2	2.75	5.54	0	0	0	0	0	0	0	1	0	1
8/14/96	2	2	4	6.28	0	0	0	0	0	0	0	0	0	0
8/14/96	2	2	5	6.21	0	0	0	0	0	0	0	0	0	0
8/14/96	2	2	6.5	5.28	0	0	0	1	0	0	0	0	0	1
8/14/96	3	1	2.75	8.72	0	0	0	0	0	0	0	0	1	1
8/14/96	3	1	4	8.55	0	0	0	0	0	0	0	0	0	0
8/14/96	3	1	5	8.18	0	0	0	3	1	0	0	0	0	4
8/14/96	3	1	6.5	9.54	0	0	0	13	2	0	0	0	0	15
8/14/96	3	2	2.75	6.83	0	0	0	0	0	0	0	0	0	0
8/14/96	3	2	4	8.29	0	0	0	0	0	0	0	0	0	0
8/14/96	3	2	5	8.38	0	0	0	4	4	0	0	0	0	8
8/14/96	3	2	6.5	8.28	0	0	0	2	0	0	0	0	0	2
				=======	=======	====	======	====	====	====	=========	=======	=======	=====
				2789.5	8	11	552	303	50	247	45	46	29	1291