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KUSKOKWIM RIVER SONAR PROGRESS REPORT, 1992

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ABSTRACT

Normal operation of the Kuskokwim River sonar project was suspended in 1992 to focus on implementing and testing equipment designed to increase the accuracy and precision of sonar estimates. A left bank site was selected and 120 kHz sonar equipment was deployed on both banks of the river. Radiotelemetry equipment, tested during the season, provided a communication link between banks and enabled all operations to be controlled from the right bank site. The newly reconfigured 120 kHz equipment was able to detect fish at greater distances than was possible with the more highly attenuated 420 kHz signal used in previous years. Fish length frequency information collected from set gill nets showed length distributions of whitefish and cisco to be substantially smaller than the lower end of the distribution of commercially targeted salmon species. Dual-beam data were collected during the 1992 field season for analysis at a later time. Until the dual-beam data are analyzed, procedures will be developed using test fish catch data to apportion sonar passage estimates to species.

KEY WORDS: Salmon, *Oncorhynchus*, sonar, hydroacoustic, Kuskokwim, escapement,

INTRODUCTION

Kuskokwim River salmon stocks are harvested for both commercial and subsistence use. Exploitation occurs throughout 1,100 km of river with the most intensive commercial fishery located within 218 km of the river mouth. Management of the fishery resource requires estimates of migratory timing, run strength and escapement. Silty water and an extensive, braided river channel preclude visual observation of migrating chinook *(Oncorhynchus tshawytscha)*, sockeye *(O. keta)*, coho *(O. kisutch)*, chum *(O. keta)*, and pink *(O. gorbuscha)* salmon, making accurate estimation of these characteristics difficult. Management decisions have historically been based on abundance indices obtained from gillnet test fisheries, and on escapement indices obtained in upriver spawning tributaries. The need for more accurate and timely escapement data prompted development of the Kuskokwim River sonar project.

Development of the Kuskokwim River sonar project began in 1988 and continued through 1991. During this time two major equipment limitations were encountered. First, in 1988, an unsuccessful attempt to transfer data via cables from the left bank resulted in confinement of sonar operations to the right bank until a safe and economical method of data transfer could be developed (Hyer et. al. 1990). Second, Mesiar et. al. (1994) reported that the 420 kHz sonar signal demonstrated an uncorrectable signal loss (attenuation) at a level higher than previously reported in freshwater systems (Francios and Garrison 1982, Urick 1983, MacLennan and Simmonds 1992). Signal attenuation confounded dual-beam target strength estimation and prevented setting a threshold that would exclude whitefish and cisco from sonar counts. These equipment limitations affected the accuracy and precision of past sonar estimates.

Normal operations were suspended during the 1992 field season to focus on implementing and testing sonar equipment that is less affected by signal attenuation. Prior to the 1992 field season, echo sounders were converted to transmit at 120 kHz and two new 120 kHz transducers were purchased. A delay in the arrival of the new 120 kHz transducers forced postponement of the project starting date. When it became evident that the new transducers would not arrive for the 1992 field season, we implemented the 120 kHz system with transducers not designed specifically for the Kuskokwim River.

The need to maximize the river area sampled prompted investigation into telecommunication techniques as a mode of transmitting data across the river. A radiotelemetry system was developed by the Geophysical Institute at University of Alaska Fairbanks for the purpose of data transmission and rotator control (aiming). The first prototype was tested on the Kuskokwim River during the 1992 field season. The radiotelemetry equipment enabled us to remotely aim and process data acquired by the left bank transducer from the sonar tent on the right bank.

The goals of the 1992 field season were:

1. Deploy and test new 120 kHz sonar equipment.
2. Deploy and test new radiotelemetry hardware.

3. Establish a site on the left bank for hydroacoustic sampling and develop data processing procedures for a two bank system.
4. Collect dual-beam data for post-season target strength analysis.
5. Collect length distribution and abundance information on whitefish and cisco within 30 meters of the left bank.

METHODS

Hydroacoustic Sampling

Site Description

The sonar site is located at river km 130 (Figure 1). This site was selected in 1988 after conducting extensive surveys of the lower river for physical characteristics favorable to counting fish with sonar. It is on the main river channel, has a V-shaped bottom profile, small tidal influence, is close to Bethel and is near a subdistrict boundary in the lower river commercial fishery. At this point the river is approximately 360 m wide with a maximum depth of 12 m (Figure 2). The right bank is sandy near shore grading to mud approximately 5 m offshore while the left bank is more steeply sloped, with a muddy bottom. The bottom profile is nearly linear outward from both banks. Water flow is affected by daily tidal fluctuations and occasional flow reversals.

Expansion to a two bank sonar system required locating a favorable left bank site for hydroacoustic sampling within close proximity to the right bank site (Figure 1). Using a Lowrance X15[1] fathometer, we collected bottom profiles at 10 locations along the left bank. The profiles were run bank to bank and were approximately 15 m apart with the first starting at the mouth of Church Slough and the last starting 150 m upriver of Church Slough. A site was then selected based on consistency of the slope, evenness of the river bottom and the absence of debris.

Equipment

We operated 120 kHz sonar equipment on both banks of the Kuskokwim River (Figure 2). The right bank equipment used to collect data included a Biosonics model 102 echo sounder, a Biosonics model 111 thermal chart recorder, a Biosonics model 281 echo signal processor (ESP) card installed in a Compaq 386 deskpro personal computer, a Nicolet model 310 digital storage oscilloscope, and an Acoustic Transducer Incorporated (ATI) 4° single beam transducer (Figure 3). The left bank equipment included a Biosonics model 102 echo sounder and a Biosonics 10°x25° dual-beam circular transducer (Figure 3). Both the right and left bank echo sounders sampled at a pulse repetition rate of

[1] Use of product names in this text are for archival purposes only and do not constitute endorsement by the Alaska Department of Fish and Game.

4 pings per sec. Radiotelemetry equipment on both banks consisted of a custom-manufactured control box, two uni-directional Yagi antennae, one whip antenna and one antenna tower with base anchor.

The right bank transducer was deployed directly in front of the sonar site and sampled from 0 - 145 m. We increased the sampling range to 250 m for 14 hours on August 5th to determine the maximum effective sampling range of the 120 kHz system. The left bank transducer was deployed approximately 60 m upstream from Church Slough and sampled from 0 - 80 m. Each transducer was attached to a tripod-mounted Remote Ocean System (ROS) pan and tilt unit. The tripods were positioned so that at low tide the transducers remained under one and a half feet of water.

Sampling Procedures

The sonar project was operational and collected sonar data from 13 July - 6 August. Sampling began at 0800 and continued until midnight each day. Dual-beam data collection on the left bank began two hours before the published high tide and continued for two hours after the published high tide. This sampling window was decreased when the published high tide occurred too close to 0800 or midnight and did not allow a full four hours of sampling. Only the high tides occurring between 0800 and midnight were sampled. Single-beam data was acquired on both banks at all times during the 16 hour sampling period.

Each day was divided into two eight hour shifts (0800-1600,1600-midnight). A single fisheries technician operated the equipment and recorded notes pertaining to the sampling environment and system performance during each operating shift. The technicians tallied fish traces from the 111 chart recordings by range in 15 minute intervals. This information was then entered into a standard electronic format worksheet for later analysis.

Dual-beam data processing

Echo signal processing hardware and software were used to collect dual-beam data. Echoes were initially filtered based on the following user-defined criteria: minimum narrow beam voltage (smallest accepted echo was equivalent to -41 dB), minimum and maximum half-power pulse widths (0.40 ms and 0.534 ms), and minimum range (removes data collected in the near field).

Echoes passing initial filtering by the ESP were stored in files on the microcomputer hard drive. The following data were stored for each echo: sequential ping number, echo number, wide beam voltage, narrow beam voltage, range from the transducer, wide and narrow beam pulse widths at the half power points, and beam pattern factor.

Data files were processed with a dual-beam data processing program called Gen_dbdp. This software used 26 input parameters to further filter echoes, compute target strength for valid echoes, and to group valid echoes into individually tracked fish. Echos from individual fish were grouped according to the following user-defined tracking criteria: minimum number of pings, maximum change in range between consecutive echoes, and maximum time allowed between consecutive echoes. To ensure that

the program was accurately grouping echos from fish, these three parameters were calibrated through repeated comparison with the associated chart recordings.

Two files were produced by Gen_dbdp for each input data file. The *.EKO file listed grouped echoes representing individual fish and included the following statistics for each individual echo: range, target strength, wide and narrow beam voltage, wide and narrow beam pulse width and beam pattern factor. The second file, the *.FSH file, provided mean values of these statistics for each fish tracked. These two files will be used to monitor the target strengths of species that migrated past the sonar throughout the season.

To ensure the accuracy of the dual-beam processing parameters, data were collected and processed for a 38.1 mm diameter tungsten-carbide sphere of known acoustic size (-40 dB). The sphere, or standard target, was suspended from a boat 19 meters in front of the dual-beam transducer. The transducer was aimed so the target appeared as close to the maximum response axis (MRA) as possible. The ESP collected echoes for 15 minutes and stored the data on the microcomputer hard drive. The file created by the ESP was then edited to remove all echoes not reflected from the target. A Quattro Pro worksheet calculated target strengths from individual echoes based on the Gen_dbdp input parameters. The calculated target strengths were then compared to the known acoustic size of the target to determine the accuracy of the processing parameters.

Test Fishing

Set gillnets were deployed between 13 July and 06 August to collect nearshore passage and length distribution information on whitefish and cisco. Test fish information was collected using two nets, a 6.4 cm (2.5 in) stretched mesh net 50 m long and 3.5 m deep, and a 10.3 cm (4.0 in) stretched mesh net 45 m long and 3.5 m deep. We fished the nets for 15 - 80 min during the high slack tides occurring between 0800 and midnight. The nets were set in two locations: 15 m downstream from the right bank transducer, and 100 m upstream from the mouth of Church Slough on the left bank (25 m upstream from the left bank transducer). One net was fished at each location and the nets were alternated between sites by tide. Each captured fish was identified to species and measured snout to fork-of-tail (whitefish and cisco) or mid-eye to fork-of-tail (salmon). We collected scale samples from all whitefish and cisco for future analysis.

For comparability, tidal catch per unit effort (CPUE) indices were calculated for each species caught per set. The CPUE index (I_j; number of fish caught per 100 fathom hours for set j) was calculated as:

$$I_j = 6000\ C\ (LT)^{-1}$$

where: C = catch per species
L = set net length in fathoms
T = fishing time in minutes

RESULTS

Hydroacoustic Sampling

Site Description

A mud bar extending > 15 m from shore on the left bank made transducer deployment difficult. Of the ten sites surveyed, the most favorable profile was located approximately 75 m upstream from the mouth of Church Slough. To ensure a constant bottom slope, the tripod was deployed on the edge of the mud bar 18 m from shore and the transducer was aimed into the thalweg.

Equipment

The 120 kHz sonar system was effectively deployed from both banks of the Kuskokwim River. The left bank power source, transducer aim and data collection were controlled from the right bank via the radiotelemetry system. Two minor problems were encountered with the radiotelemetry system. First, during power-up sequence, the modems occasionally had trouble establishing a communication link. This did not affect data transmission but it did hinder our ability to remotely aim the transducer. This was corrected by powering down the generator and the modem then repeating the power-up sequence. Usually during the second or third power-up sequence the modems would connect. Secondly, the digital readout on the ROS rotator control box was not a reliable indication of transducer position. The readout would change from sample to sample although the transducer had not moved. Due to this limitation, we were required to use the o-scope and chart recorder as guides during aiming. These problems were eliminated during the winter of 1992/1993.

Sampling Procedures

Since passage estimates were not generated from the hydroacoustic data, sampling ranges on both banks were restricted to optimize the signal-to-noise ratio. The width of the (10°x25^{o}) dual-beam transducer limited the sampling range to 80 m on the left bank. By transmitting on the lowest power possible (-13 dB) and aiming into the deepest part of the river channel we ensonified a large portion of the water column without encountering unacceptable levels of noise from surface or bottom reverberation. Daily sampling on the right bank was limited to 145 m. This allowed for flexibility in aiming since the sonar beam was not required to fill the water column. Although daily right bank sampling was typically restricted to 145 m, we were able to successfully ensonify up to 250 m. Beyond this range the signal to noise ratio decreased to the point (-10 dB) where valid targets could no longer be distinguished.

Fish were detected throughout the sampling range on both banks. Between 13 July and 5 August a total of 18,699 fish were counted on the left bank (Table 1) and 62,962 fish were counted on the right bank (Table 2). On 5 August the right bank sampling range was extended to 250 m and 14 hours of

data were collected. Using the extended range, we counted 2,229 fish and detected targets throughout the sampling range with the highest passage occurring between 50 m and 200m. A noticeable drop in counts occurred beyond 200 m (Table 3).

Dual-Beam Sampling

We collected approximately 96 hours 20 min of dual-beam data during the 1992 field season. The dual-beam data have been archived for possible future analysis.

Test Fishing

Setnet test fishing efforts resulted in 30 sets with the 6.4 cm mesh net and 29 sets with 10.3 cm mesh net. The catch included 199 whitefish, 291 cisco, 2 chinook salmon, 7 chum salmon, 2 sockeye salmon and 61 pink salmon. Combined CPUE indices of whitefish and cisco indicate that a greater number of whitefish and cisco passed near shore on the right bank (CPUE = 267.53) than on the left bank (CPUE = 64.01) during the period of project operation (Figure 4).

Length frequency information collected by the sonar associated test fishery was combined with length frequency information collected by the separate Bethel drift gillnet test fishery project from 13 July through 6 August (Molyneaux, Alaska Department of Fish and Game, Anchorage, personal communication). This information (Figure 5) reconfirms our earlier observations and show the whitefish and cisco length distributions to be substantially smaller than those of commercially targeted salmon (Mesiar et. al. 1994).

DISCUSSION

The improvement of the two bank 120 kHz sonar system over the previously used 420 kHz system was encouraging. The left bank site proved to be very conducive to hydroacoustic sampling. The mud bottom has absorptive rather than reflective properties creating a relatively quiet acoustic environment, allowing for a good signal to noise ratio. The steep slope, constant bottom profile, and relatively stable conditions on the left bank allowed us to easily achieve and maintain a good aim for long periods of time.

The soft mud substrate on the left bank proved to be less of a deployment obstacle than we had originally anticipated. Initial deployment of the pod was difficult since both the pod and cables had to be carried across the mud bar at low tide. Once the pod was deployed, all repositioning was done from a boat at high tide. To ensure the pod and cables did not become permanently embedded in the mud, we lifted them weekly. After the pod had been lifted and repositioned, the transducer was reaimed.

Although the left bank site maintained a stable profile throughout the season, the soft mud substrate may be susceptible to localized erosion during break-up and high water levels in the spring. It is

therefore important to re-evaluate the left bank site prior to transducer deployment at the start of every field season. Bank to bank transects will alert us to any changes in river bottom profile and aid in determining optimum transducer configuration and position.

This was the first time that the radiotelemetry system had been tested in a field situation. It was very useful in allowing us to transfer data from the left bank. Any problems encountered with the equipment were carefully recorded in the log book. The engineer responsible for the design and development of the radiotelemetry system was periodically notified of its performance. At the end of the field season, the control boxes were returned to the Geophysical Institute at University of Alaska Fairbanks for repairs and refinement. All problems encountered during the season were rectified and an improved design was available for the 1993 field season.

The development of a two bank 120 kHz sonar system will increase the accuracy and precision with which we estimate fish passage in the Kuskokwim River. The unattenuated (within our measurement capability) 120 kHz sonar signal greatly increased the range at which we detected fish from shore as well as the cross-sectional area ensonified. This, combined with sampling from both banks, allowed us to sample more than two-thirds of the river cross-sectional area. Increasing the area sampled with the side-looking sonar beams reduces our dependence on the less intensive down-looking transect data. In the future, transect data will be relied on only to estimate mid-river fish passage.

Species apportionment based on dual-beam target strength estimation will not be possible for inseason management in the immediate future. Until the dual-beam data are fully analyzed and a functional relationship between fish length and target strength is described, we will not be able to apportion fish passage to species using sonar alone. Therefore, the nearshore test fishing effort will be increased and species apportionment procedures based on test net catches will be developed. A suite of four nets (2.75", 4.0", 4.5" and 5.5") will be fished nearshore and catch information from these nets will be used to apportion sonar counts to species. The increase in fishing effort will also provide more accurate data on both length distribution and abundance of fish passing near shore.

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Table 1. Daily left bank sonar counts by range, Kuskokwim River sonar 1992.

	Range in Meters								
Date	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Total
18-Jul	46	85	181	164	105	103	85	78	847
20-Jul	29	84	158	121	99	89	79	70	729
21-Jul	43	156	337	352	327	279	231	205	1,930
22-Jul	42	121	219	224	191	181	137	108	1,223
23-Jul	98	170	194	175	175	152	122	103	1,189
24-Jul	19	28	41	28	34	34	44	39	267
25-Jul	26	90	164	138	127	121	132	101	899
26-Jul	19	99	233	197	164	127	118	127	1,084
27-Jul	16	59	158	153	144	150	157	135	972
28-Jul	9	67	66	85	72	60	51	45	455
29-Jul	16	46	76	101	106	88	130	107	670
30-Jul	41	246	343	385	350	277	262	221	2,125
31-Jul	32	151	318	300	304	258	208	164	1,735
1-Aug	17	82	203	310	376	259	263	140	1,650
2-Aug	5	48	122	160	172	150	185	152	994
3-Aug	12	42	120	159	121	117	106	83	760
4-Aug	10	31	89	101	98	100	89	67	585
5-Aug	5	17	44	98	91	89	73	75	492
6-Aug	1	5	11	9	19	21	17	10	93
	486	1,627	3,077	3,260	3,075	2,655	2,489	2,030	18,699

Table 2. Daily right bank sonar counts by range, Kuskokwim River sonar 1992.

	Range in Meters								
Date	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-145	Total
18-Jul	494	1,015	580	476	432	418	425	78	3,918
19-Jul	377	1,296	1,267	1,055	1,102	1,085	877	61	7,120
20-Jul	156	719	747	827	945	1,077	1,017	131	5,619
21-Jul	107	393	510	623	734	813	698	205	4,083
22-Jul	446	1,141	1,080	1,272	1,410	1,490	1,332	126	8,297
23-Jul	536	1,433	2,045	2,892	3,223	3,466	2,876	2,403	18,874
24-Jul	279	241	183	189	154	180	38	38	1,302
25-Jul	198	301	237	161	107	147	181	30	1,362
26-Jul	97	250	141	93	70	111	170	21	953
27-Jul	155	355	267	195	204	207	270	30	1,683
28-Jul	45	172	100	52	100	106	96	4	675
29-Jul	168	454	381	261	303	319	251	50	2,187
30-Jul	33	175	230	159	135	125	120	64	1,041
31-Jul	38	212	165	84	120	142	136	9	906
1-Aug	49	141	106	99	103	134	158	39	829
2-Aug	82	158	126	108	144	232	221	61	1,132
3-Aug	41	108	92	76	75	70	50	20	532
4-Aug	79	248	248	211	216	257	226	38	1,523
5-Aug	64	138	113	113	120	183	173	24	928
	3,444	8,950	8,618	8,946	9,697	10,562	9,315	3,432	62,962

Table 3. Right bank sonar counts with extended range, Kuskokwim River sonar 1992.

	Range in Meters					
Date	0-50	50-100	100-150	150-200	200-250	Total
5-Aug	100	109	188	172	50	619
6-Aug	253	339	414	423	181	1,610
	353	448	602	595	231	2,229

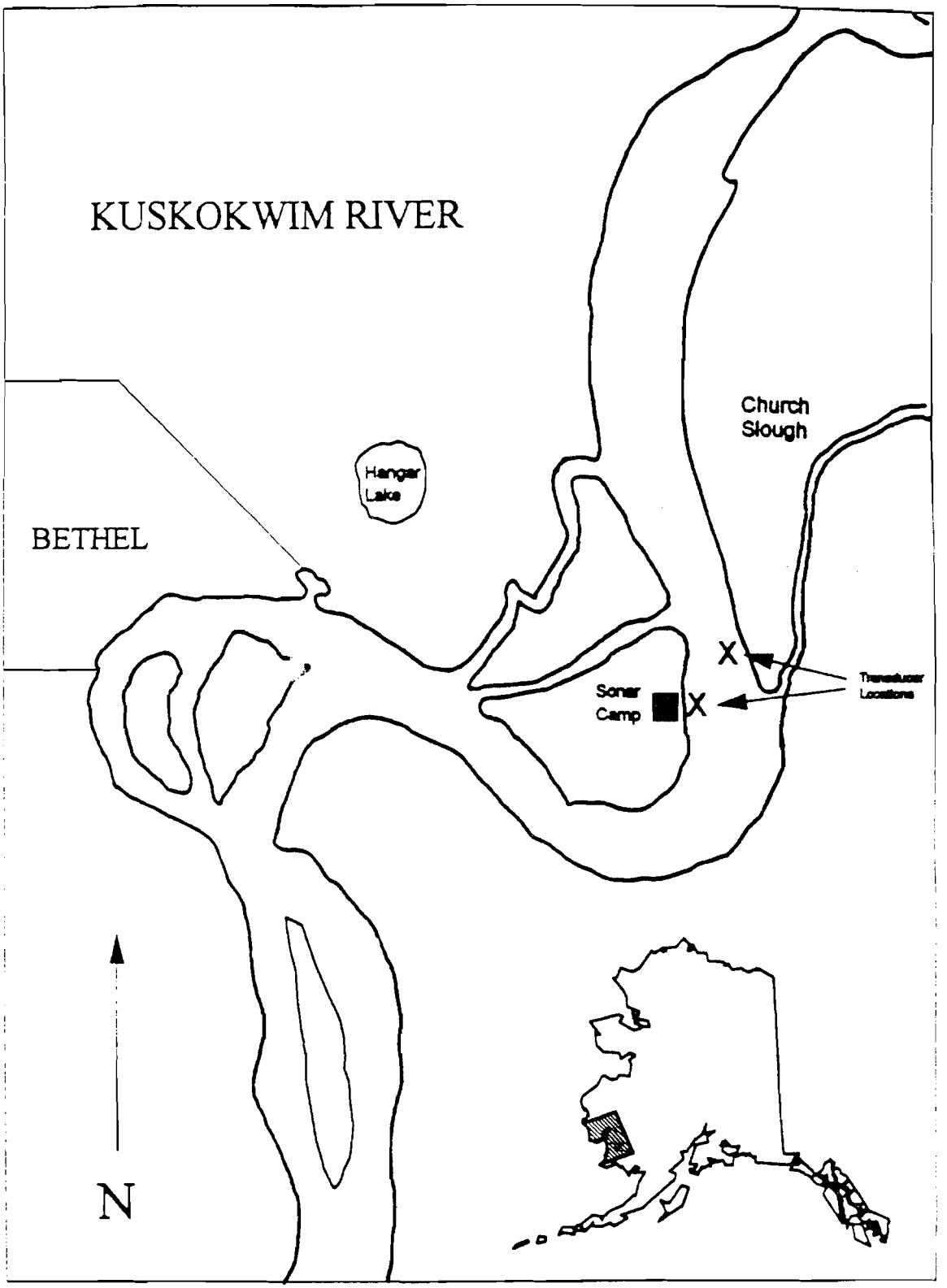

Figure 1. Map of the Kuskokwim River showing location of the 1992 sonar site.

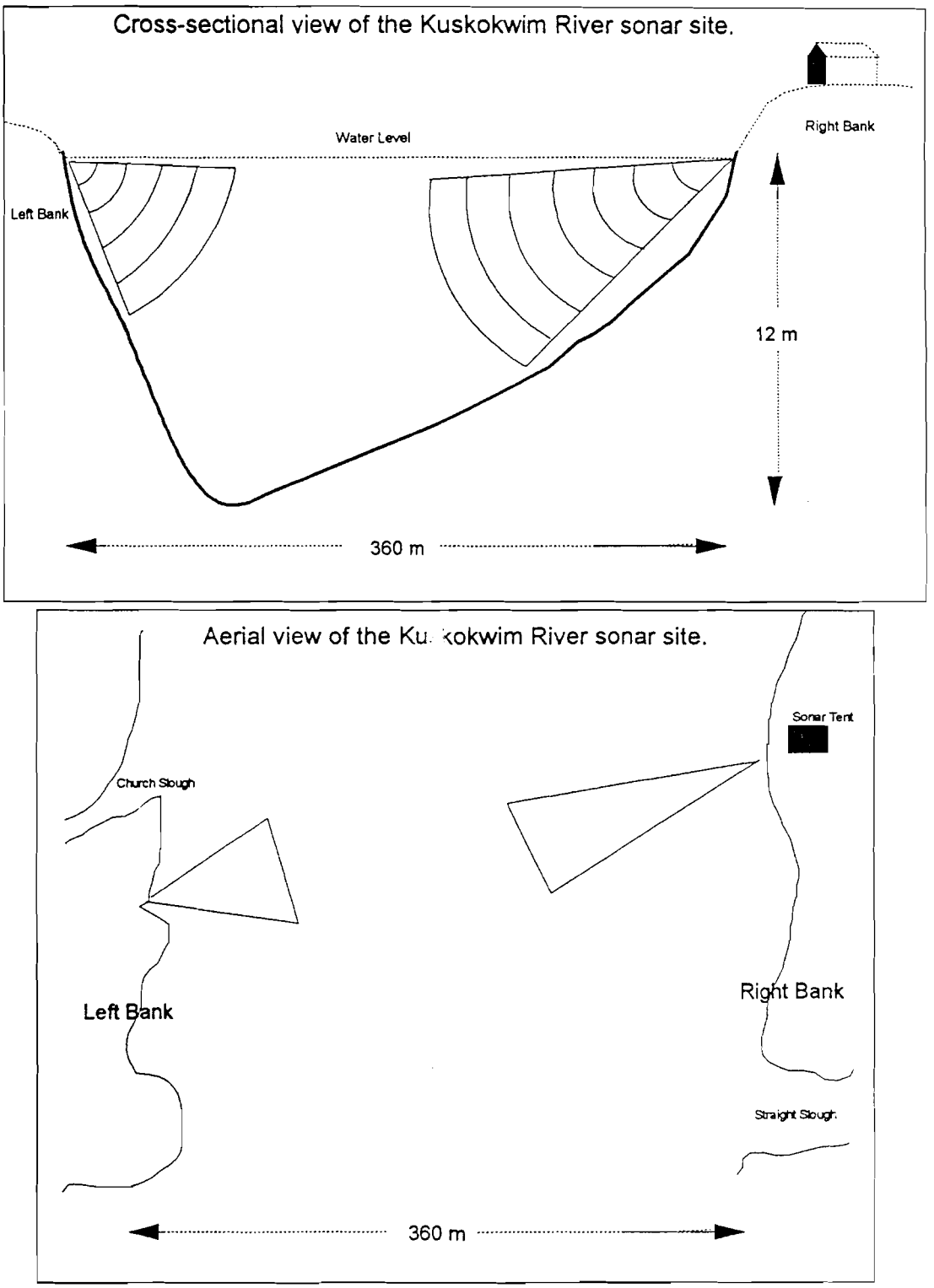

Figure 2. Cross-sectional and aerial view of the Kuskokwim River sonar site in 1992. Not drawn to scale.

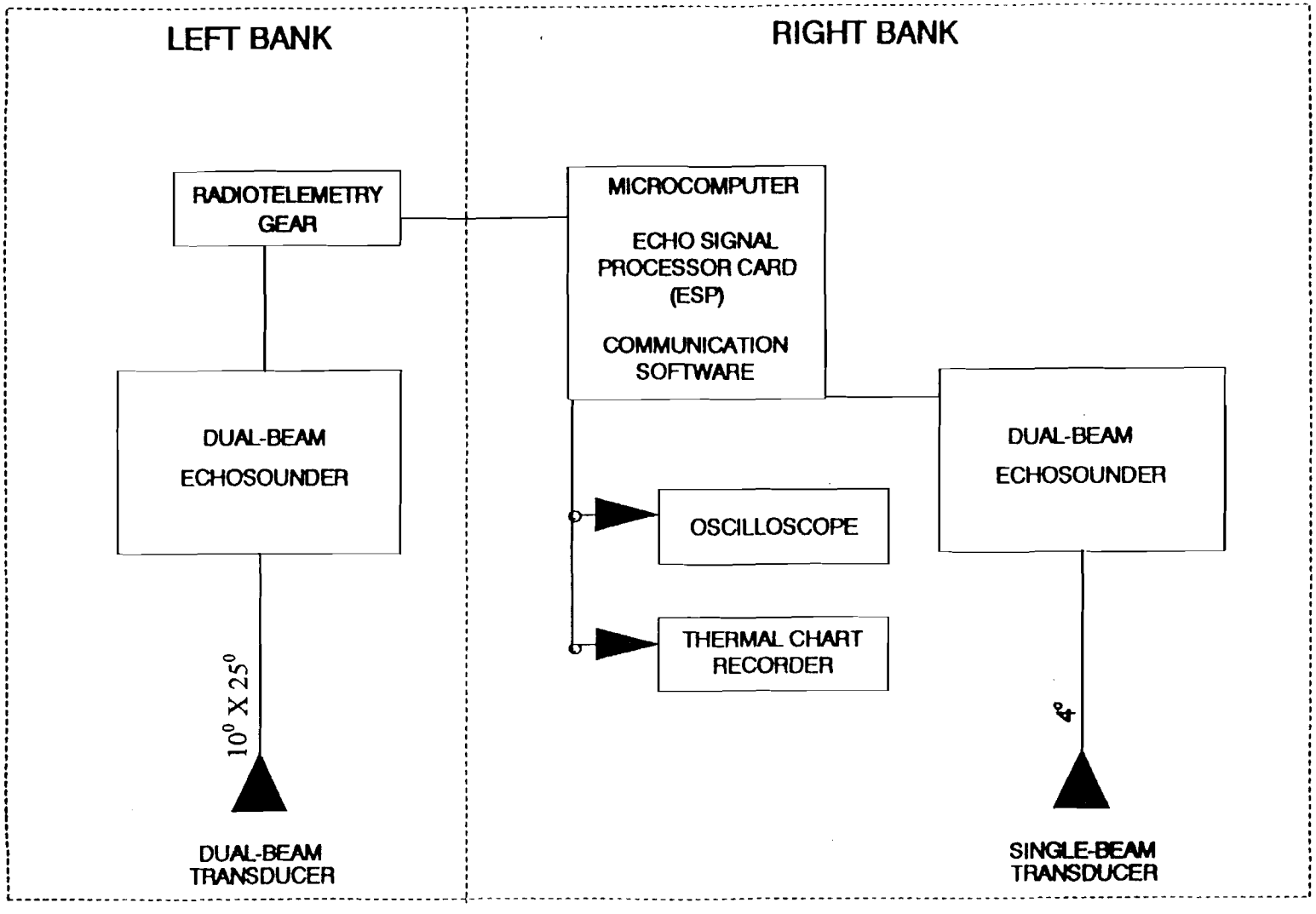

Figure 3. Kuskokwim River sonar data acquisition system, 1992.

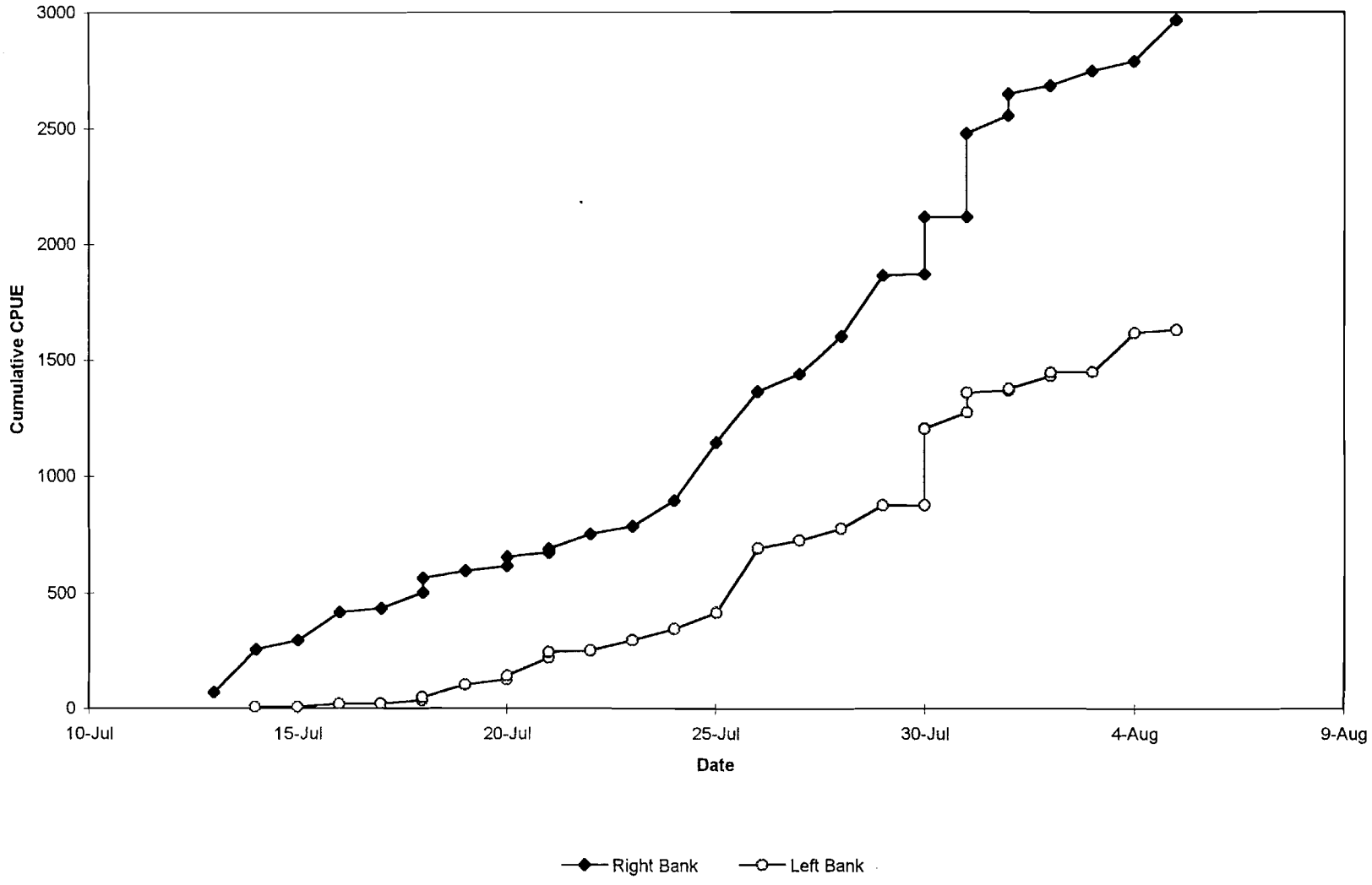

Figure 4. Cumulative set gillnet test fishing CPUE index for whitefish and cisco in Kuskokwim River sonar test fish nets by bank and day, 1992.

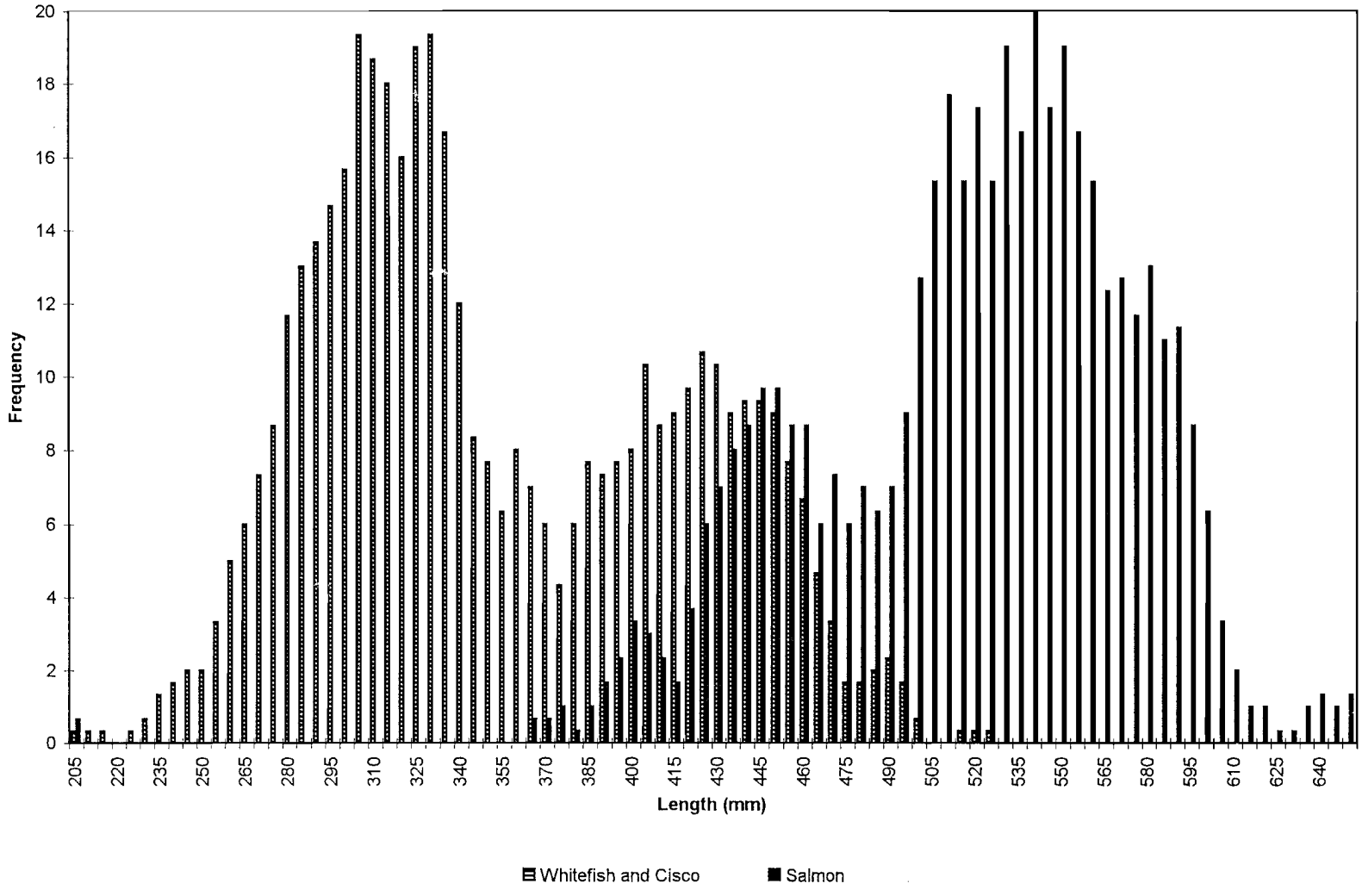

Figure 5. Length distribution of all fish caught in Kuskokwim River sonar project and Bethel test fish project set and drift gillnets between 13 July and 6 August 1992 using a 3 point smooth.

APPENDIX A

Appendix A. Testfishing results, Kuskokwim River Sonar 1992, one data row per set.

Date	Mesh	Bank	Minutes Fished	Chinook		Coho		Sockeye		Pink		Chum		Whitefish		Cisco	
				Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
13-Jul	2.75	Right	35	0	0	0	0	0	0	0	0	0	0	0	0	9	69.7
14-Jul	4	Right	31	0	0	0	0	0	0	1	7.7	0	0	24	185.8	0	0
14-Jul	2.75	Left	38	0	0	0	0	1	6.3	0	0	0	0	1	6.3	0	0
15-Jul	2.75	Right	46	0	0	0	0	0	0	0	0	0	0	0	0	5	38.7
15-Jul	4	Left	42	0	0	0	0	0	0	1	5.7	0	0	0	0	0	0
16-Jul	4	Right	41	0	0	0	0	0	0	3	17.6	3	17.6	21	122.9	0	0
16-Jul	2.75	Left	48	0	0	0	0	0	0	0	0	0	0	0	0	2	15.5
17-Jul	2.75	Right	41	0	0	0	0	0	0	0	0	0	0	0	0	2	15.5
17-Jul	4	Left	28	0	0	0	0	0	0	1	8.6	0	0	0	0	0	0
18-Jul	2.75	Right	39	0	0	0	0	0	0	0	0	0	0	0	0	9	69.7
18-Jul	4	Left	46	0	0	0	0	0	0	0	0	0	0	1	5.2	1	7.7
18-Jul	2.75	Right	53	0	0	0	0	0	0	0	0	0	0	0	0	8	61.9
18-Jul	4	Left	48	0	0	0	0	0	0	4	20	0	0	3	15	0	0
19-Jul	4	Right	30	0	0	0	0	0	0	1	8	0	0	4	32	0	0
19-Jul	2.75	Left	35	0	0	0	0	0	0	0	0	0	0	0	0	7	54.2
20-Jul	4	Right	34	0	0	0	0	0	0	0	0	0	0	2	14.1	1	7.7
20-Jul	2.75	Left	31	0	0	0	0	0	0	0	0	0	0	0	0	3	23.2
20-Jul	2.75	Right	26	0	0	0	0	0	0	0	0	0	0	0	0	5	38.7
20-Jul	4	Left	33	0	0	0	0	0	0	0	0	0	0	1	7.3	1	7.7
21-Jul	4	Right	60	0	0	0	0	0	0	1	4	0	0	2	8	1	7.7
21-Jul	2.75	Left	77	0	0	0	0	0	0	0	0	0	0	0	0	10	77.4
21-Jul	4	Right	28	0	0	0	0	0	0	0	0	0	0	2	17.1	0	0
21-Jul	2.75	Left	30	0	0	0	0	0	0	0	0	0	0	0	0	3	23.2
22-Jul	2.75	Right	34	0	0	0	0	0	0	0	0	0	0	0	0	8	61.9
22-Jul	4	Left	33	0	0	0	0	0	0	1	7.3	1	7.3	1	7.3	0	0
23-Jul	4	Right	44	0	0	0	0	0	0	0	0	0	0	2	10.9	3	23.2
23-Jul	2.75	Left	41	0	0	0	0	0	0	0	0	0	0	1	5.9	5	38.7
24-Jul	2.75	Right	30	0	0	0	0	0	0	0	0	0	0	0	0	14	108.4
24-Jul	4	Left	44	0	0	0	0	0	0	2	10.9	0	0	9	49.1	0	0
25-Jul	4	Right	32	0	0	0	0	0	0	7	52.5	0	0	26	195	7	54.2
25-Jul	2.75	Left	54	0	0	0	0	0	0	3	13.3	0	0	0	0	9	69.7
26-Jul	2.75	Right	20	0	0	0	0	0	0	0	0	0	0	0	0	28	216.8
26-Jul	4	Left	25	1	9.6	4	38.4	0	0	5	48	1	9.6	29	278.4	0	0
27-Jul	4	Right	14	0	0	1	17.1	0	0	2	34.3	0	0	4	68.6	1	7.7
27-Jul	2.75	Left	22	0	0	0	0	0	0	0	0	0	0	0	0	4	31
28-Jul	2.75	Right	26	0	0	0	0	0	0	0	0	0	0	0	0	21	162.6
28-Jul	4	Left	27	0	0	1	8.9	0	0	8	71.1	2	17.8	6	53.3	0	0
29-Jul	4	Right	24	0	0	1	10	0	0	1	10	0	0	25	250	2	15.5
29-Jul	2.75	Left	30	0	0	0	0	0	0	0	0	0	0	0	0	13	100.6
30-Jul	2.75	Right	16	0	0	0	0	0	0	0	0	0	0	0	0	1	7.7
30-Jul	4	Left	24	0	0	0	0	0	0	3	125	0	0	0	0	0	0
30-Jul	2.75	Right	16	0	0	1	62.5	0	0	0	0	0	0	0	0	32	247.7
30-Jul	4	Left	25	0	0	5	200	0	0	7	280	0	0	8	320	1	7.7
31-Jul	4	Right	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul	2.75	Left	17	0	0	0	0	0	0	0	0	0	0	0	0	9	69.7
31-Jul	2.75	Left	13	0	0	0	0	0	0	0	0	0	0	0	0	11	85.2
31-Jul	4	Right	14	0	0	1	71.4	0	0	3	214.3	0	0	5	357.1	0	0
1-Aug	2.75	Right	28	0	0	0	0	0	0	0	0	0	0	0	0	10	77.4
1-Aug	4	Left	24	1	10	0	0	0	0	0	0	0	0	0	0	1	7.7
1-Aug	2.75	Right	20	0	0	0	0	0	0	0	0	0	0	0	0	12	92.9
1-Aug	4	Left	16	0	0	0	0	0	0	0	0	0	0	0	0	1	7.7
2-Aug	4	Right	20	0	0	0	0	1	12	1	12	0	0	1	12	3	23.2
2-Aug	2.75	Left	32	0	0	0	0	0	0	0	0	0	0	0	0	7	54.2
2-Aug	4	Right	20	0	0	0	0	0	0	1	50	0	0	0	0	0	0
2-Aug	2.75	Left	23	0	0	0	0	0	0	0	0	0	0	0	0	2	15.5
3-Aug	2.75	Right	16	0	0	0	0	0	0	0	0	0	0	0	0	8	61.9
3-Aug	4	Left	25	0	0	1	9.6	0	0	3	28.8	0	0	0	0	0	0
4-Aug	4	Right	14	0	0	0	0	0	0	0	0	0	0	2	34.3	1	7.7
4-Aug	2.75	Left	24	0	0	0	0	0	0	0	0	0	0	17	170	0	0
5-Aug	2.75	Right	15	0	0	0	0	0	0	0	0	0	0	0	0	23	178.1
5-Aug	4	Left	38	0	0	1	6.3	0	0	2	12.6	0	0	2	12.6	0	0
Total				2	19.6	16	424	3	2 18.3	61	1042	7	52.2	199	2238	304	2354