AYK Region
NS/K Esc. Report #24

1981 CHUM SALMON (*Oncorhynchus keta*) ESCAPEMENT STUDIES IN THE NOATAK RIVER, ALASKA

Frank Bird
December 1981

Alaska Department of Fish and Game
Commercial Fisheries Division
Research Section
Kotzebue, Alaska

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF APPENDICES B

ABSTRACT

Two side scan sonar units were used on the lower Noatak River in 1981 as part of a continuing sonar feasibility study. The results of the sonar counting were used extensively for the first time in making management decisions regarding the Kotzebue salmon fishery. An adjusted sonar count of 335,526 chum salmon (Oncorhynchus keta) was obtained. Based on the success in 1980 and 1981, the project will continue to be used as a management tool in the Kotzebue fishery.

A gill net test fishery was conducted in the Noatak River in conjunction with the sonar. This was the seventh consecutive year for test fishing. A total of 646 chum salmon were captured in 438 hours of fishing.

Chum salmon were examined for age,length, weight and sex in 1981.

INTRODUCTION

Chum salmon (*Oncorhynchus keta*) are the most abundant salmon species in Kotzebue Sound and are the primary fish species taken in the commercial fishery. Past studies have shown that the bulk of Kotzebue Sound chum salmon are bound for either the Noatak or Kobuk Rivers (Figure 1), with the two stocks displaying differences in run timing. Once fish have entered the primary resource utilization area, which is comprised of the Kotzebue district, Hotham Inlet (Kobuk Lake), and the Noatak and Kobuk Rivers, they are subjected to considerable utilization by both commercial and subsistence users (Schwarz 1981).

Since the inception of the commercial fishery in 1962 the mean annual commercial harvest of chum salmon has been 207,100 fish and the mean annual subsistence harvest has been 24,000 fish (Figure 2) (Bird, 1981). Management has attempted to limit the commercial harvest to levels consistent with yearly run abundance to allow subsistence harvests and adequate escapement. However, subsistence harvests have tended to decline since 1962, probably due to the decreased use of dogs in the villages along the Noatak and Kobuk Rivers, while both commercial catch and escapement have tended to increase.

In 1966, because of the lack of information concerning distribution and timing of Kotzebue district chum salmon stocks and their apparent high level of utilization, the Alaska Department of Fish and Game (ADF&G) initiated a mark and recovery study of Kotzebue Sound chum salmon.

This chum salmon tagging study was conducted during the summers of 1966

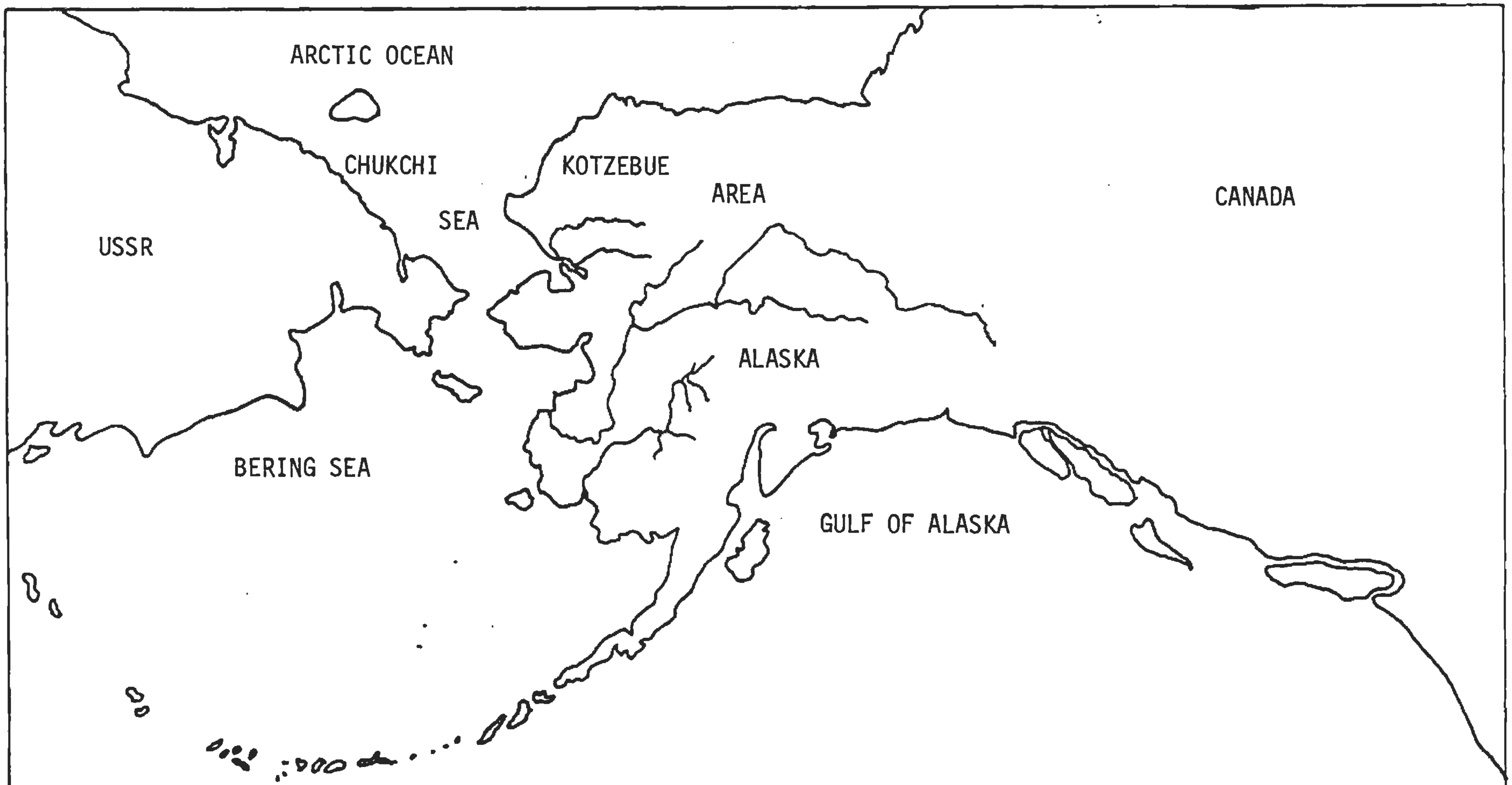

Figure 1. Kotzebue area in relation to the Bering Sea, Gulf of Alaska and adjacent land masses.

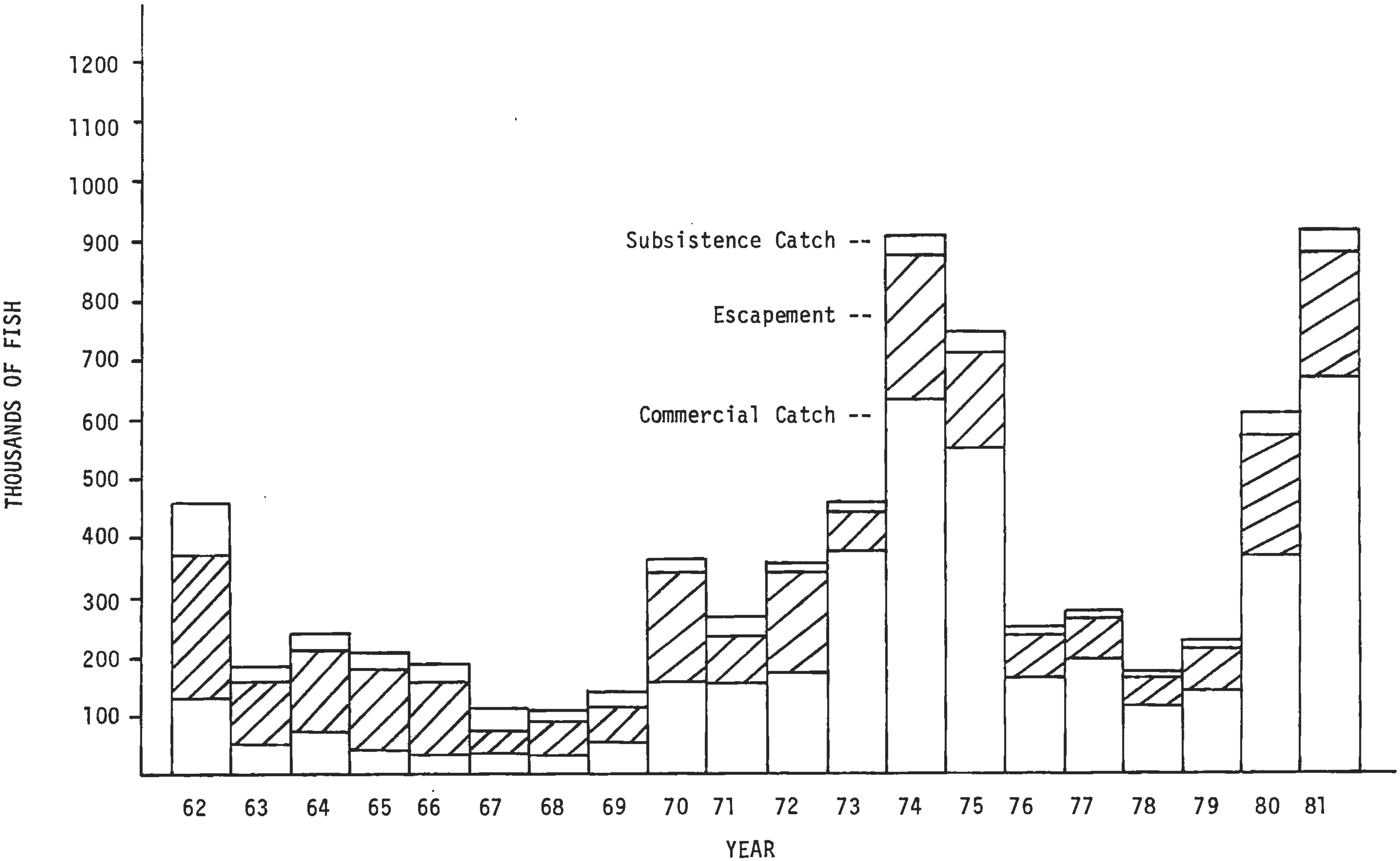

Figure 2. Composition of total adjusted chum salmon return to Noatak and Kobuk Rivers during chum forecast base period.

through 1968 for the purpose of delineating spatial and temporal distributions of Kotzebue district fish as they entered the district and dispersed to spawning streams. Results of the study indicated that fish taken within the Kotzebue district were bound for either the Noatak or Kobuk Rivers. Kobuk River stocks peaked in the fishery before Noatak River stocks and tended to follow the shores of Baldwin Peninsula when entering Hotham Inlet, (Yanagawa 1968). A similar study was initiated by ADF&G in 1981 to test initial findings of the earlier study. Results of the study have been prepared as a research progress report, on file with ADF&G in Nome, Kotzebue and Anchorage.

In 1975, as a segment of an Arctic Investigations project (State-Federal Aid PL 89-304) involving both Norton Sound and Kotzebue Sound, studies began on Noatak and Kobuk River chum salmon stocks. Objectives of the study were to determine: 1) seasonal timing of chum salmon escapements, 2) spawning distribution and abundance, 3) age, sex, and size of chum salmon constituting the escapements, and 4) to describe physical characteristics of chum salmon spawning areas. Within Kotzebue Sound, emphasis was placed on a salmon test fishery on the lower Noatak River for studying Noatak River stocks; primarily because of the importance of these stocks to commercial and subsistence users. The project continued from 1975 through 1980 with basically its original form and intent except that in 1979 all project work shifted to Noatak River stocks.

In 1981 the project was no longer funded under State-Federal Aid, and is supported instead by the State General Fund. However, program operation for 1981 remained basically unchanged from prior years. In 1979, the project on the Noatak River was expanded to include a side scan sonar feasibility study.

In its amended form the project objectives for 1979 were as follows: (1) To determine seasonal timing and relative abundance of chum salmon escapements, and (2) to assess the feasibility of utilizing hydro-acoustical techniques to monitor salmon escapements. Basically, this meant that the earlier studies would be continued with the side scan sonar augmenting the escapement segment. Unfortunately, 1979 siting for sonar was very poor and the entire project was shifted 15 km upriver in 1980. In the new location in 1980 the project was expanded to include two side sonar units, with one on each river bank to provide a total count of migrating fish. All other segments of the project remained the same in 1980, except project timing which was extended on both ends to try to have project study dates encompass more of the escapement.

In 1981 a further slight shifting of sonar sites was required due to the problems encountered in 1980 (Bird 1981). The shifts, however, were minor allowing the project to continue at its present location with some assurance of maintaining status quo. With a continuance of the program at its present location, it is likely that project emphasis will soon change from feasibility studies to management applications.

STUDY AREA

The study area consists principally of the Noatak and Kobuk River watersheds and the associated estuarine area. The Kobuk River is included in the study area because commercial catch samples which provide age, weight, length data for purposes of the study are composed of samples containing both Noatak and Kobuk River stocks in undetermined proportions. This area is located in Northwest Alaska approximately at latitude 67 30'W, encompassing about 123,500

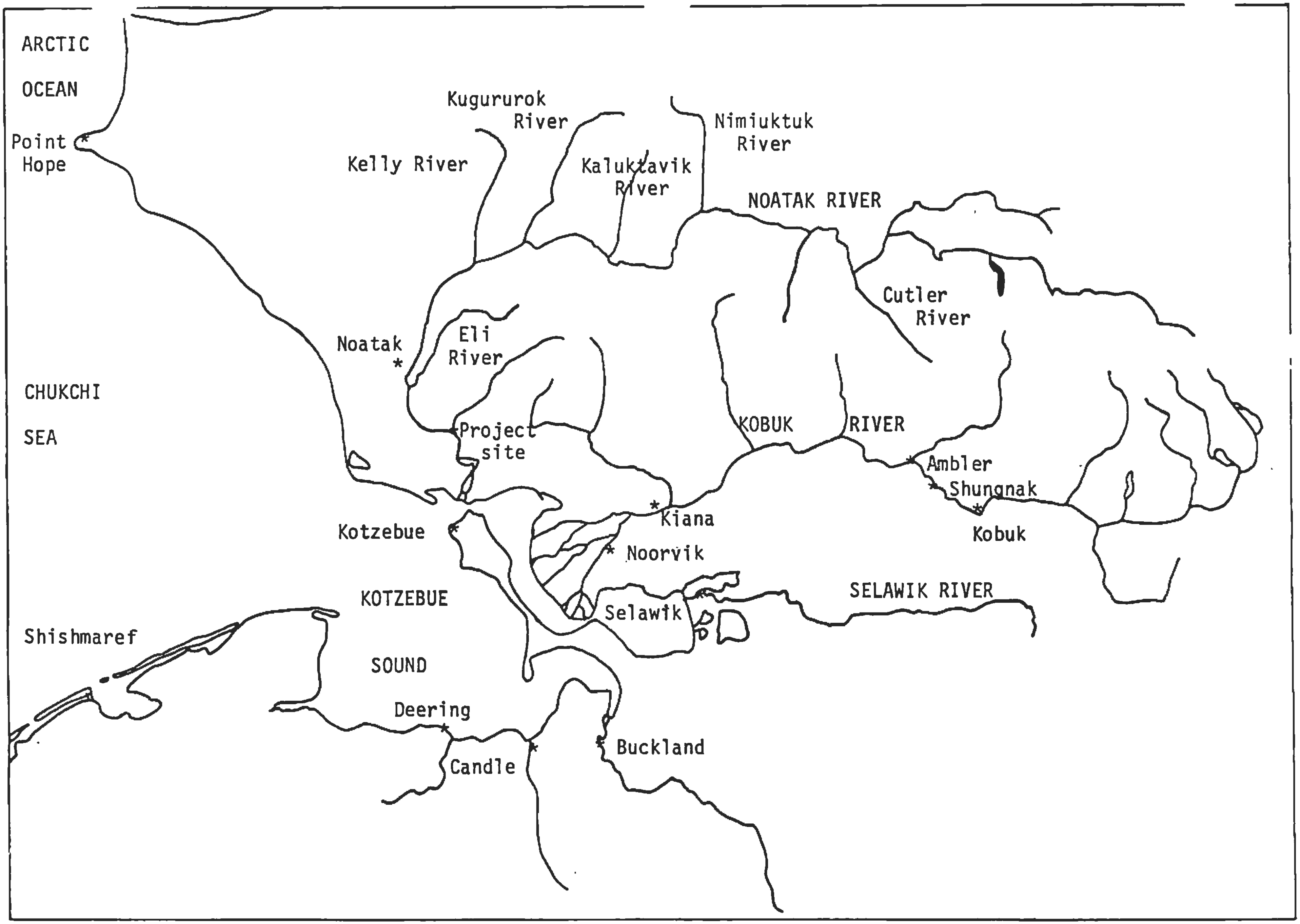

Figure 3. Kotzebue area.

square km (Figures 1 and 3). The two rivers are about 645 km long, originating in the Western Brooks Range and flowing westerly before emptying into northeast Kotzebue Sound. The entire study area lies above the Arctic Circle.

Because of study area latitude, climatic conditions can be severe. Since 1942, mean annual temperature has been -6.2 C. and mean annual precipitation has been 8.69 inches with 46.1 inches of snowfall (NOAA, 1979). In an average year snowfall can be expected to occur in all months, but generally not in July and August. This harshness of climatic conditions naturally exerts considerable influence on study area flora and fauna.

The Noatak River is the major chum salmon producer within the study area, with virtually all spawning occurring in spring and upwelling areas present in the lower 80 to 160 km. While spring and autumn flows are probably dependent on winter conditions and runoff from winter's accumulation of snow, winter flows probably depend upon upwelling groundwater which is somewhat dependent on summer flows; the extremes of which are determined by precipitation. The hydrology is complex but extensively involved with the freshwater biology of chum salmon.

The Kobuk River, the only other chum salmon contributor of any significance within the study area, is similar to the Noatak in hydrology with the exception of the upwelling areas. Mean monthly flows (cfs) (ec) fluctuate dramatically, ranging from approximately 800 cfs in mid winter to 65,000 cfs in June (USGS, personal communication). There is little indication of major upwelling areas in the Kobuk drainage; a factor which probably accounts for the river being a less significant chum salmon producer when compared with the Noatak River.

The location of the project site within the study area is shown in Figure 3 with project layout illustrated in Figure 4. The site was located 45.2 km upriver from the mouth of the Noatak River approximately midway between Kotzebue and the village of Noatak. All test fishing and sonar enumeration work was done here with other related stock assessment work based from this site.

HYDROACOUSTIC ESCAPEMENT ENUMERATION

Methods

During the last week in June, 1981, all electronic gear used in the sonar operation was transported by boat from Kotzebue, where it had been stored since project termination the previous year. All substrates and ancillary gear were already at the site, having been left in or near a protected storage facility over the winter. Once the sonar gear was assembled at the project site and accounted for, system assembly commenced.

Each unit of sonar gear (a unit consisting of substrate, transducer, electronics and related parts) was transported to its deployment site before assembly (see Figure 4 for deployment sites). Initially, the site opposite camp was to be located about one km below camp. After substrate assembly at the new site, however, it was decided the site was inadequate and the substrate should probably be moved upriver to a more suitable location closer

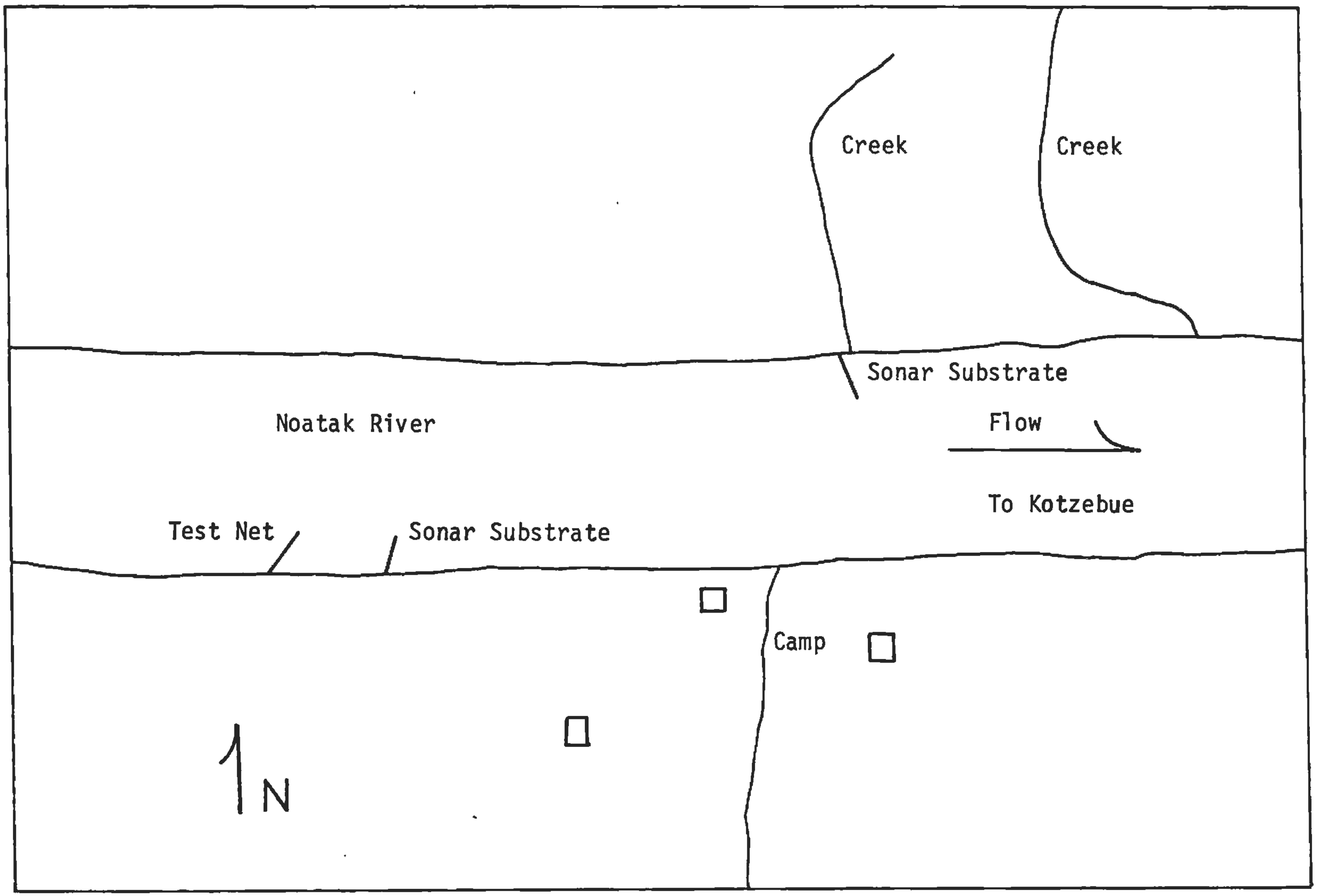

Figure 4. Noatak River sonar and test fishing site, 1981.
Scale: 1 inch equals 600 feet.

to the opposite side sonar unit. A great deal of time and energy had already been expended in unit assembly, however, so the decision was made to move the substrate the one km upstream in the assmebled condition. This was done by placing the substrate across the bow of two boats and moving the entire unit to its new location. The move was made with no problem but the procedure is recommended only for streams with a lot of room for maneuvering.

Assembly of each substrate was done according to instructions found in "Installation and Operation Manual-Side Scan Salmon Counter-1978 Model", which is found in the Project Operations Notebook kept at the project site. Basically, assembly involved bolting the three sections together, attaching the target and transducer sections, stringing two-foot deep, two-inch mesh netting along the bottom of the substrate to prevent fish from swimming under the deployed pipe, and attaching the shore cable and transducer.

Because currents are so slow in the lower Noatak River, even at high water, cables need only be attached to the outboard ends of the substrates. This was done using a quarter-inch cable secured by cable clamps to a deadman buried near the mean high water mark and located at least 50 meters upstream from the substrate deployment site. After cable attachment, deployment occurred. For deployment each substrate was pushed out into the river until just floating and parallel to shore. At this time the transducer end was secured in the desired location (where toe top of the transducer was at least six inches under water) by inserting a steel stake into the transducer end in the 2.5 inch holes provided for that purpose and driving the stake well into the river bottom.

After securing the transducer end of the substrate an outboard powered boat was used to pull the target end of the pipe out into the river, while slowly letting the cable feed through the deadman cable clamps, until it was about 10 downstream from the perpendicular. At this time the cable clamps securing the substrate to shore were tightened, thus locking the pipe into that position. Submergence of the substrate was produced by unscrewing the three-inch cap on the side of the transducer section, allowing water to enter. Attachment of the transducer to the substrate was completed last.

The transducer was attached to the transducer housing in the manner described in the operational manual. Initially, all bolts (3) were adjusted so that the transducer was flush with the face of the housing. Further adjustment was done after power was applied to the system and the oscilloscope could be used (see Sonar Operational Manual).

With substrate deployment and transducer attachment completed, the transducer was plugged into the system electronics. The electronics, or counter unit, was housed in a four-foot plywood cube located as far from the highly fluctuating water level as the double transducer coaxial cable would allow. This cube was painted and water proofed to protect the gear inside and small enough to move by hand. Inside were placed the fish counter, the 12-volt battery which powered the system and the Tektronix 323 oscilloscope which was used for visual monitoring of the system. Placed on top of the cube was an ARCO Solar Inc. 1.2 AMP solar panel which generated sufficient power to run the system day and night, and charge the battery on even the cloudiest days. Battery power cables were then attached to the counter to place the counter in operational mode. After checking that all systems were operational, all counts were zeroed and at the top of the hour set into operation for the season.

The two sonar units were located approximately opposite one another (Figure 4) with the site on the south bank (left side of river) located about 100 meters downstream from the test fishing site. The close proximity of test fishing to the sonar counter on the south side was to provide catch and count comparisons. The comparison was made using simple linear regression ($y = a + bx$), with daily test fish catch-per-unit effort (CPUE) as the (x) variable and the daily adjusted sonar count as the (y) variable, with the measure of the relationship being the correlation coefficient.

Each sonar counter was set to print counter results every hour on the hour, remaining in this mode for the duration of escapement enumeration. Printer tapes were removed each time a calibration count was made (at least three times each day for each unit) with data entered on appropriate data sheets (see Appendices B for all data forms used). It was the responsibility of each person calibrating to ensure that data entry occurred in a timely and accurate manner, subject to the scrutiny of the project leader. A count day was considered to be 0001-2400 hours.

Because of system variability created by changing environmental conditions and subtle electronic problems, frequent calibration of the output of each sonar unit was considered necessary. Using a Tektronix 323 oscilloscope an attempt was made to visually (indirectly) monitor the number of fish passing through the ensonified beam (i.e. crossing over the top of the substrate). Calibration of each unit was done for one hour, three to four times each day. This provided a comparison of presumed fish (visually observed on the oscilloscope) with fish counted by the system (printer output). Based on these comparisons, which were termed calibration counts, a daily percent agreement was derived between actual fish (oscilloscope) and electronically counted fish (printer), by grouping each day's calibration counts for each unit. This percent agreement was used to adjust each day's sonar counter output to more accurately reflect true fish counts. Percent agreement was determined using the relationship,

$$\frac{\text{visual oscilloscope count}}{\text{sonar printer count}}(100) = \text{percent agreement}$$

To determine daily percent agreement for each sonar unit the following relationship was used,

$$\frac{\text{daily sum of visual counts for (n) hours}}{\text{daily sum of sonar counts for (n) hours}}(100) = \text{daily percent agreement}$$

The percent agreement obtained for each sonar unit was then taken times the raw counter data to produce an adjusted daily count for each unit. Calibration counts were done while the counting range was in the normal, or 0-60 foot, mode.

In 1980 it was determined that a proportion of the fish moving past the sonar site were passing beyond the sonar counting range (Bird 1981). To compensate the counting range was extended to its maximum range of 100 feet and left there. However, this presented problems that were difficult to adjust for since the system has not been designed for ranges beyond 60 feet. This year, and probably every year at this site, fish were once again passing beyond the normal 60 foot counting range. Because of the problems encountered in 1980 with leaving the counter in the 100 foot count mode, compensation in 1981 for fish moving beyond the normal counting range was done only during normal calibration periods in the manner described below.

Each normal calibration count was for one hour, extending from hourly printout to printout. Three or four calibration counts made per day for each sonar unit more or less evenly spaced from 0800 hours to 2400 hours. Immediately after each of the calibration count, adjustments were made for fish passing beyond the normal counting range. As soon as the counter had ceased it's printout sequence the data switch was turned to the "OFF" position, the safety switch was turned off so it's alarm would mask count beeps, the counting range was extended to 100 feet and the scope trace adjusted so that it covered the CRT width. With the data off, calibration counts could be made without fish or target counts entered into the counter memory system (the target always counts if the counting range is extended beyond about 59 feet, with counts coming at the rate of about 4500 per hour depending on the fish velocity setting which controls the pinging rate). Determined during this portion of the calibration sequence is the proportion of the fish within the 100 foot range passing within versus beyond 60 feet. As fish pass through the ensonified beam a pulse appears on the scope trace. An example of the scope trace as it would appear with the transducer spike, listening range spike and fish present in the beam, on both sides of the target, is shown below:

Counting continued for 10 minutes in this manner. At the end of the 10 minute count period the counting range was withdrawn to its normal range (so the target is not being counted) and the data and safety switches turned to the "ON" position. At this point all the counts in the normal counting range, inside the target, which would have been counted if the counter had been operational, are added into the counter memories. This is done either by extending the counting range until the target is counting or drawing the "Dead Range" in toward the transducer until false counts begin occurring. When the number of target of false counts equal the number of fish to be entered, the counter is placed back in the normal operating mode. Although these counts may be added in sectors other than those in which they actually occurred, it was felt that having them in any sector was better than not having the data at all. In fact, the counts for 10 minutes were usually so few that insignificant error was introduced.

A summary of a typical calibration sequence for one hour might appear like this:

1) Visual oscilloscope count for one hour of 358 fish.

2) Sonar printout count for the same hour of 423 fish.

3) Percent agreement for that hour of calibration is:

(358) (100)/423 = 84.9%

4) The ten minute count immediately following calibration provides the proportion of the count being accounted for by the 0-60 foot counting range:

$$\frac{\text{(Ten minute count to left of target) (100)}}{\text{(Ten minute count to left + ten minute count to right) of target}} = \text{\% left}$$

For example (using August 18, 1981, left bank counts for one hour).

(45) (100)/(45 + 8) = 84.9% left of the target

5) Total calibrated adjustment for any hourly calibration segment can be presented in one equation by combining terms:

$$\frac{\text{(Hour scope count) (Left of target count + Right of target count)}}{\text{(Left of target count)}} =$$

(Completely adjusted hourly count)

However, since calibration counts for each unit for each day were combined, a variation of equation (5) was used. This allowed adjustment to be done in one step after all calibration for a unit on any given day had been completed.

6) Total calibrated adjustment for a given unit for a given day which produces the total calibrated daily sonar count for each unit for each day:

$$\frac{[(\text{Total daily sonar count for a unit})\ (\text{Sum of hourly scope counts})]}{(\text{Sum of hourly sonar counts})} \times$$

$$\frac{[\text{Sum of left of target counts} + \text{Sum of right of target counts})]}{(\text{Summ of left of target counts})} =$$

$$(\text{Adjusted count for a given unit for a given day})$$

This type of adjustment was made for the total daily count by each sonar counter, producing a daily, species independent, sonar count for each bank of the river.

Species composition of sonar counted fish was estimated from the test fishing portion of the project. All adjusted sonar counts were modified by applying species composition ratios, as determined from test fishing CPUE proportions, directly to the total daily adjusted sonar counts. For example, on August 18, 1981, the adjusted sonar count for both banks, as measured by equation (6) above, was 12,267 fish. The species composition proportions (by CPUE) of fish caught in the test fishery was: chum salmon 0.529, pink salmon (_O. gorbuscha_)

0.118 and arctic char (<u>Salvelinus alpinus</u>) 0.353. The adjusted sonar count on this day was apportioned to yield a final species estimate of 6,489 chum salmon, 1,448 pink salmon and 4,330 arctic char.

The magnitude of the escapement, regardless of species, was the sum of all adjusted daily sonar totals for both banks. This total escapement was examined in terms of contribution by sector and by hour for both banks combined. Also, a rather detailed analysis of calibration counter variability is presented. A comparison of the test fishery CPUE to the daily adjusted sonar counts, regardless of species, is also done using straight linear regression with the correlation coefficient as the measure of the strength of the relationship.

At project termination each sonar substrate was pulled from the water using a come-a-long. After separating the various sections of the substrate they were left above the high water mark at the storage facility at the project location. All other gear related to the sonar was transported to the office in Kotzebue for storage.

Results

The two sonar units were in operation from July 2 to September 9, 1981. Total unadjusted sonar counts were 170,356 (54.4%) fish for the south bank and 142,766 (45.6%) fish for the north bank, for a total of 313,122 fish (Table 1). After adjustment for calibration, the adjusted count, regardless of species, was 182,519 (50.7%) fish for the south bank and 177,503 (49.3%) fish for the north bank, for a total adjusted sonar count of 360,022 fish (Table

1). The difference in unadjusted and adjusted counts was 6.7% for the south bank, 19.6% for the north bank and 13.3% overall. The daily percent difference between unadjusted and adjusted (percent difference column in Table 1) counts was 25.1% for all days and 11.6% for days on which counting only occurred between 0-60 feet.

The majority of all fish were counted in the inner and outer substrate sectors, on both banks (Figure 5). However, observations made during calibration counts indicated that fish were crossing more or less in all sectors with a slight majority found in the end sectors. The gap in the middle sectors is unexplained but apparently related to the hydroacoustic and electronic features of the system. Most of the side scan sonar counters tend to undercount in the middle sectors and overcount in the outer sectors.

The hourly distribution of fish indicated a monomodal distribution on the south bank and a unimodal distribution on the north bank (Figure 6). For the south bank, peak counts occurred during the 1000-1100 hours count segment with the lowest counts occurring during 0100-0200 hours. The difference between low and high hour counts for the south bank was a factor of three. For the north bank, a less definite count relationship prevailed, with maximum counts occurring during the 1900-2100 hours count segment and minimum counts occurring during the 0100-0300 hours segment. The difference in count rates between the low and high hours for the north bank was a factor of only 1.9; a considerable difference when compared to the south bank distribution pattern.

Adjusted sonar counts, after apportioning for species composition, indicate total escapement counts of 335,526 (93.2%) chum salmon, 18,281 (5.1%) pink

Table 1. Total side scan sonar counts, regardless of species, obtained from escapement counts on the Noatak River in 1981.

	Left Bank			Right Bank						
Date	Unadjusted Count	Calibration Percent	Adjusted Count	Unadjusted Count	Calibration Percent	Adjusted Count	Total Unadjusted Count	Total Adjusted Count	Percent Difference	Cumulative Adjusted Count
0702	43	1/	43	43[2/]	1/	43	86	86	0.0	86
0703	238	1/	238	238[2/]	1/	238	476	476	0.0	562
0704	344	1/	344	241	1/	241	585	585	0.0	1147
0705	440	1/	440	91	1/	91	531	531	0.0	1678
0706	491	100.0	491	73	50.0	37	564	528	6.4	2206
0707	393	92.0	362	182	100.0	182	575	544	5.4	2750
0708	330	100.0	330	309	100.0	309	639	639	0.0	3389
0709	786	94.0	739	336	58.3	196	1122	935	16.7	4324
0710	401	163.2	654	416	45.8	191	817	845	3.4	5169
0711	887	77.8	690	763	77.8	594	1650	1284	22.2	6453
0712	3024	55.2	1669	725	62.5	453	3749	2122	43.4	8575
0713	2302	57.1	1314	992	97.5	967	3616	2281	36.9	10856
0714	1942	90.8	1763	1030	71.3	734	2972	2497	16.0	13353
0715	995	132.9	1322	1329	87.0	1156	2330	2478	6.7	15831
0716	883	98.8	883	1722	68.9	1186	2605	2069	20.6	17900
0717	859	100.0	859	2226	64.8	1442	3085	2301	25.4	20201
0718	1213	110.4	1339	3027	73.4	1495	3250	2834	12.8	23035
0719	1680	108.5	1823	3627	65.8	2387	5307	4210	20.7	27245
0720	2257	104.0	2347	3752	64.3	2413	6009	4760	20.8	32005
0721	2035	101.4	2063	4377	60.3	2639	6412	4702	26.7	36707
0722	3094	97.6	3020	4656	94.5	4400	7750	7420	4.3	44127
0723	3655	97.8	3575	3219	113.2	3644	6884	7219	5.0	51346
0724	3725	95.3	3550	1644	119.9	1971	5369	5521	2.8	56867
0725	3534	97.9	3460	1975	105.3	2080[3/]	5509	5540	0.6	62407
0726	6608	136.1	8993	2068	102.3	4173[3/]	8676	13166	15.2	75573
0727	5411	98.3	5319[3/]	3513	113.7	7594[3/]	8924	12913	44.7	88486
0728	7778	63.2	6294[3/]	2437	81.0	3194[3/]	10215	9488	7.1	97974

Table 1. Total side scan sonar counts, regardless of species, obtained from escapement counts on the Noatak River in 1981 (cont.).

	Left Bank			Right Bank						
Date	Unadjusted Count	Calibration Percent	Adjusted Count	Unadjusted Count	Calibration Percent	Adjusted Count	Total Unadjusted Count	Total Adjusted Count	Percent Difference	Cumulative Adjusted Count
0729	4663	61.2	3030[3/]	1800	77.3	2058[3/]	6463	5088	21.3	103062
0730	2662	85.8	2382[3/]	1533	95.0	2464[3/]	4195	4846	15.5	107908
0731	1926	110.8	2473[3/]	1045	61.8	2190[3/]	2971	4663	57.0	112571
0801	1771	86.8	1704[3/]	1909	90.6	3459[3/]	3680	5163	40.3	117734
0802	1391	117.9	1832[3/]	2208	106.2	4492[3/]	3599	6324	75.7	124058
0803	3465	100.5	4662[3/]	2243	98.3	3522[3/]	5708	8184	43.4	132242
0804	7054	88.7	6921[3/]	2985	117.5	4141[3/]	10039	11062	10.2	143304
0805	6607	90.2	6711[3/]	3363	111.2	4819[3/]	9970	11530	15.6	154834
0806	7621	92.4	8902[3/]	5713	91.1	8248[3/]	13334	17150	28.6	171984
0807	4930	119.3	7061[3/]	3405	117.6	5688[3/]	8335	12749	53.0	184733
0808	2886	90.8	3787[3/]	2693	90.9	3438[3/]	5579	7225	29.5	191958
0809	2605	85.8	2398[3/]	2637	142.5	4329[3/]	5242	6727	28.3	198685
0810	1623	102.6	1773[3/]	2198	104.0	3533[3/]	3821	5306	38.9	203991
0811	1488	103.1	2082[3/]	1403	112.5	2105[3/]	2891	4187	44.8	208178
0812	1865	106.8	2751[3/]	861	126.7	1614[3/]	2726	4365	60.1	212543
0813	2308	85.2	3543[3/]	1683	101.7	2824[3/]	3991	6367	59.5	218910
0814	1900	89.8	2695[3/]	2223	99.4	2946[3/]	4123	5641	36.8	224551
0815	1657	70.8	1452[3/]	2294	65.5	1962[3/]	3951	3414	13.6	227965
0816	1960	91.5	1860[3/]	2473	68.7	2659[3/]	4433	4519	1.9	232484
0817	5330	89.9	6602[3/]	3780	103.2	4661[3/]	9110	11263	23.6	243747
0818	7906	85.7	7587[3/]	4800	77.8	4680[3/]	12706	12267	3.5	256014
0819	6747	80.3	6074[3/]	6480	78.6	6399[3/]	13227	12473	5.7	268487
0820	5501	84.1	4730[3/]	3801	106.6	5360[3/]	9302	10090	8.5	278577
0821	2362	120.9	2911[3/]	2315	145.3	6371[3/]	4677	9282	98.5	287859
0822	1593	114.6	2737[3/]	2658	102.8	3512[3/]	4251	6249	47.0	294108
0823	2122	113.5	4614[3/]	2559	86.4	3955[3/]	4681	8569	83.1	302677

Table 1. Total side scan sonar counts, regardless of species, obtained from escapement counts on the Noatak River in 1981 (cont.).

	Left Bank			Right Bank						
Date	Unadjusted Count	Calibration Percent	Adjusted Count	Unadjusted Count	Calibration Percent	Adjusted Count	Total Unadjusted Count	Total Adjusted Count	Percent Difference	Cumulative Adjusted Count
0824	1357	129.9	2087[3]	1338	93.1	2240[3]	2695	5047	87.3	307724
0825	1396	119.9	2657[3]	2036	122.5	4315[3]	3432	6972	103.1	314696
0826	1953	108.9	2232[3]	2871	94.6	3469[3]	4824	5701	18.2	320397
0827	981	106.8	1397[3]	2319	101.0	3152[3]	3300	4549	37.8	324946
0828	564	117.2	734[3]	1044	100.7	1546[3]	1608	2280	41.8	327226
0829	607	78.1	474[3]	1665	71.9	1596[3]	2272	2070	8.9	329296
0830	1883	83.6	1574[3]	1536	84.6	1817[3]	3419	3391	0.8	332687
0831	3322	98.9	3285	2423	90.6	2195	5745	5480	4.6	338167
0901	2364	98.9	2338	5091	90.6	4612	7455	6950	6.8	345117
0902	1965	98.9	1943	2513	90.6	2277	4478	4220	5.8	349337
0903	1256	98.9	1242	1474	90.6	1335	2730	2577	5.6	351914
0904	1075	98.9	1063	914	90.6	828	1989	1891	4.9	353805
0905	1408	98.9	1393	532	90.6	482	1940	1875	3.4	355680
0906	1365	98.9	1350	833	90.6	755	2198	2105	4.2	357785
0907	984	98.9	973	416	90.6	377	1400	1350	3.6	359135
0908	585	98.9	579	245	90.6	222	830	801	3.5	359936
0909				95	90.6	86	95	86	9.3	360022
Total	170356		182519	142766		177503	313122	360022	25.1	360022

1/ No Counts.
2/ Same as left bank; not functioning until late on 0703.
3/ Adjusted for percent passing beyond target.

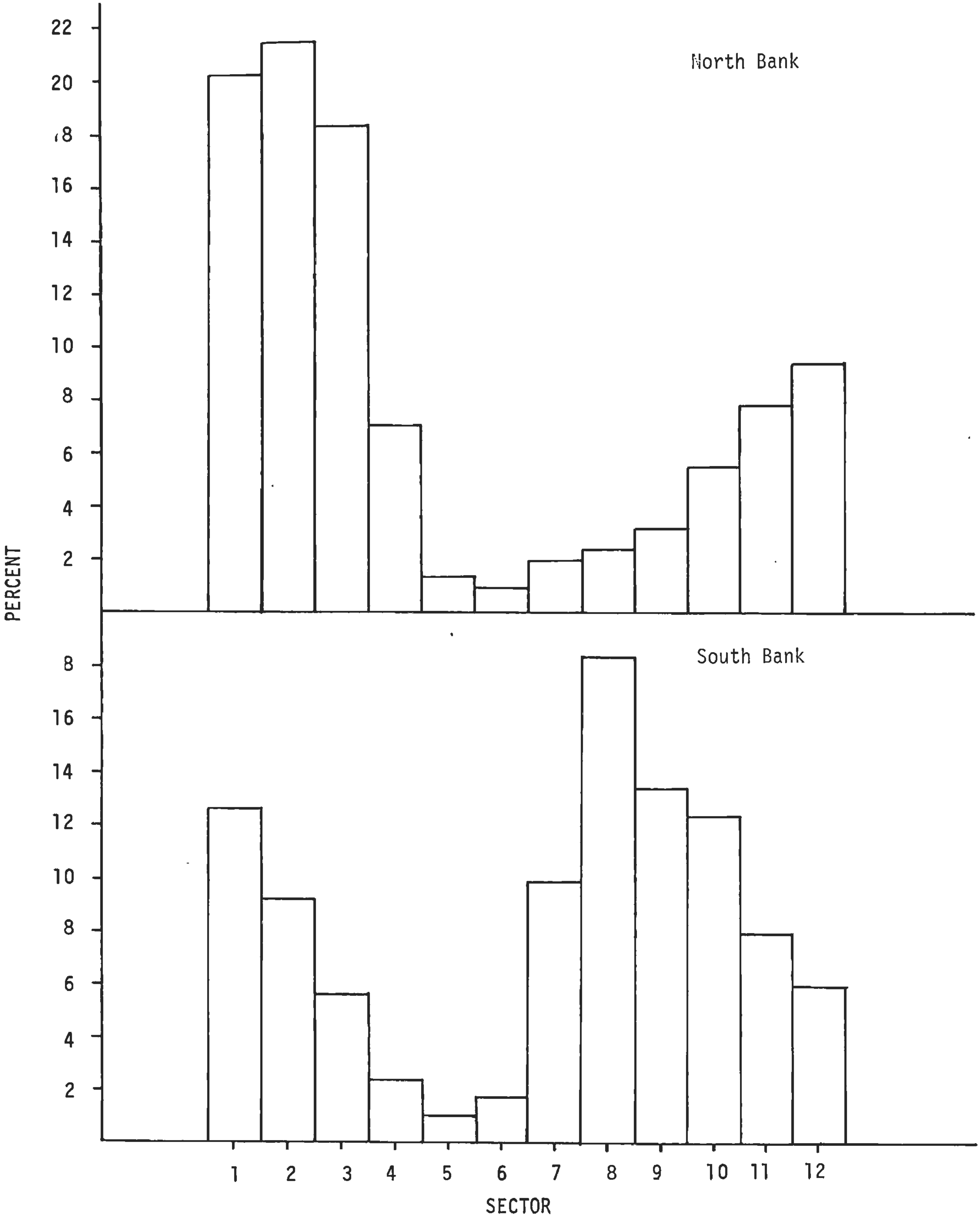

Figure 5. Percent distribution by sector for fish counted in 1981 in the Noatak River by side scan sonar for both banks.

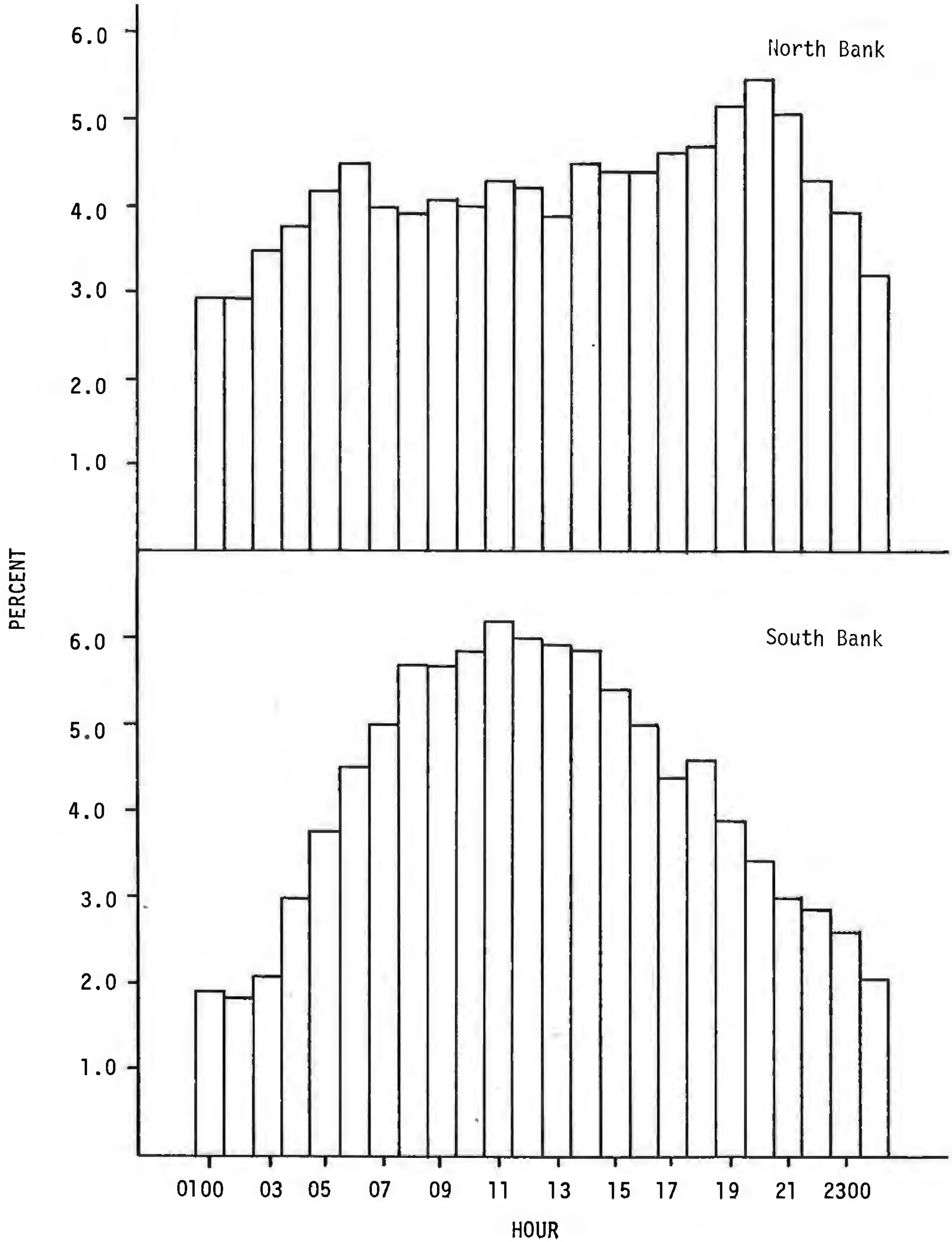

Figure 6. Hourly percent contribution for chum salmon counted by two side scan sonar units on the Noatak River in 1981.

salmon and 6,215 (1.7%) arctic char (Table 2). Peak chum salmon counts occurred on August 6, with two other distinct peaks occurring on July 26 and August 17 (Figure 7). These three peaks may represent the three major age groups (3, 4 and 5 year old fish), with the first peak applying to the 5 year fish, the second peak 4 year fish and the last peak 3 year fish (Figure 8). Chum salmon were counted throughout the count period with 50% of the run occurring between July 28 and August 20.

Pink salmon counts extended from July 4 through August 19, with the peak count occurring on August 16. Fifty percent of the pink escapement occurred between July 29 and August 16. Arctic char counts extended from July 11 through August 28 with the peak occurring on August 18, when 70% of the estimated return occurred.

A comparison of calibration counts between counters and banks showed very little variation. Mean south bank counter percent agreement was 90.0% with a standard deviation of 11.4% (Table 3). Mean north bank counter percent agreements was 86.9% with a standard deviation of 13.2% (Table 4). Mean total counter percent agreement was 89.4% with a standard deviation of 11.3% (Table 5). A total of 37,550 fish were visually observed via the oscilloscope, representing 10.4% of the total measuired escapement. Mean variability between calibrators is much lower if only the best five are considered. The mean south bank counter percent agreement becomes 91.8% with a standard deviation of 3.0%, the north bank becomes 92.4% with a standard deviation of 7.3% and the total for both banks becomes 91.9% with a standard deviation of 4.7%. A comparison of total percent agreement between the two bank counts shows virtually no difference (92.0% and 92.3%). The lack of significant

Table 2. Daily and cumulative adjusted side scan sonar counts for the three major fish species taken in the Noatak River test netting in 1981.

Date	Adjusted Sonar Count	Chum Test Net CPUE Percent	Chum Sonar Count	Cumulative Chum Sonar Count	Pink Test Net CPUE Percent	Pink Sonar Count	Cumulative Pink Sonar Count	Char Test Net CPUE Percent	Char Sonar Count	Cumulative Char Sonar Count
0701	0	100.0	0	0	0	0	0	0	0	0
0702	86	100.0	86	86	0	0	0	0	0	0
0703	476	100.0	476	562	0	0	0	0	0	0
0704	585	92.2	539	1101	7.8	46	46	0	0	0
0705	531	100.0	531	1632	0	0	46	0	0	0
0706	528	100.0	528	2160	0	0	46	0	0	0
0707	544	100.0	544	2704	0	0	46	0	0	0
0708	639	100.0	639	3343	0	0	46	0	0	0
0709	935	100.0	935	4278	0	0	46	0	0	0
0710	845	100.0	845	5123	0	0	46	0	0	0
0711	1284	93.7	1203	6326	0	0	46	6.3	81	81
0712	2122	100.0	2122	8448	0	0	46	0	0	81
0713	2281	100.0	2281	10729	0	0	46	0	0	81
0714	2497	100.0	2497	13226	0	0	46	0	0	81
0715	2478	100.0	2487	15713	0	0	46	0	0	81
0716	2069	100.0	2069	17782	0	0	46	0	0	81
0717	2301	100.0	2301	20083	0	0	46	0	0	81
0718	2834	100.0	2834	22917	0	0	46	0	0	81
0719	4210	100.0	4210	27127	0	0	46	0	0	81
0720	4760	100.0	4760	31887	0	0	46	0	0	81
0721	4702	100.0	4702	36589	0	0	46	0	0	81
0722	7420	100.0	7420	44009	0	0	46	0	0	81
0723	7219	100.0	7219	51228	0	0	46	0	0	81
0724	5521	100.0	5521	56749	0	0	46	0	0	81
0725	5540	100.0	5540	62289	0	0	46	0	0	81
0726	13166	94.7	12468	74757	0	0	46	5.3	698	779
0727	12913	71.4	9220	83977	28.6	3639	3739	0	0	779

3693

321

Table 2. Daily and cumulative adjusted side scan sonar counts for the three major fish species taken in the Noatak River test netting in 1981 (cont.).

Date	Adjusted Sonar Count	Chum Test Net CPUE Percent	Chum Sonar Count	Cumulative Chum Sonar Count	Pink Test Net CPUE Percent	Pink Sonar Count	Cumulative Pink Sonar Count	Char Test Net CPUE Percent	Char Sonar Count	Cumulative Char Sonar Count
0728	9488	100.0	9488	93465	0	0	3739	0	0	779
0729	5088	66.7	3394	96859	33.3	1694	5433	0	0	779
0730	4846	100.0	4846	101705	0	0	5433	0	0	779
0731	4663	100.0	4663	106368	0	0	5433	0	0	779
0801	5163	100.0	5163	111531	0	0	5433	0	0	779
0802	6324	100.0	6324	117855	0	0	5433	0	0	779
0803	8184	100.0	8184	126039	0	0	5433	0	0	779
0804	11062	100.0	11062	137101	0	0	5433	0	0	779
0805	11530	81.8	9432	146533	18.2	2078	7511	0	0	779
0806	17150	92.3	15829	162362	7.7	1321	8832	0	0	779
0807	12749	82.6	10531	172893	17.4	2218	11050	0	0	779
0808	7225	100.0	7225	180118	0	0	11050	0	0	779
0809	6727	100.0	6727	186845	0	0	11050	0	0	779
0810	5306	100.0	5306	192151	0	0	11050	0	0	779
0811	4187	100.0	4187	196338	0	0	11050	0	0	779
0812	4365	100.0	4365	200703	0	0	11050	0	0	779
0813	6367	100.0	6367	207070	0	0	11050	0	0	779
0814	5641	100.0	5641	212711	0	0	11050	0	0	779
0815	3414	100.0	3414	216125	0	0	11050	0	0	779
0816	4519	33.3	1505	217630	66.7	3014	14064	0	0	779
0817	11263	100.0	11263	228893	0	0	14064	0	0	779
0818	12267	52.9	6489	235382	11.8	1448	15512	35.3	4330	5109
0819	12473	77.8	9704	245086	22.2	2769	18281	0	0	5109
0820	10090	100.0	10090	255176	0	0	18281	0	0	5109
0821	9282	100.0	9282	264458	0	0	18281	0	0	5109
0822	6249	100.0	6249	270707	0	0	18281	0	0	5109
0823	8569	100.0	8569	279276	0	0	18281	0	0	5109

Table 2. Daily and cumulative adjusted side scan sonar counts for the three major fish species taken in the Noatak River test netting in 1981 (cont.).

Date	Adjusted Sonar Count	Chum Test Net CPUE Percent	Chum Sonar Count	Cumulative Chum Sonar Count	Pink Test Net CPUE Percent	Pink Sonar Count	Cumulative Pink Sonar Count	Char Test Net CPUE Percent	Char Sonar Count	Cumulative Char Sonar Count
0824	5047	96.4	4865	284141	0	0	18281	3.6	182	5291
0825	6972	96.0	6693	290834	0	0	18281	4.0	279	5570
0826	5701	97.1	5536	296370	0	0	18281	2.9	165	5735
0827	4549	95.0	4322	300692	0	0	18281	5.0	227	5962
0828	2280	88.9 1/	2027	302719	0	0	18281	11.1	253	6215
0829	2070	100.0	2070	304789	-	-	18281	-	-	6215
0830	3391	100.0	3391	308180	-	-	18281	-	-	6215
0831	5480	100.0	5480	313660	-	-	18281	-	-	6215
0901	6950	100.0	6950	320610	-	-	18281	-	-	6215
0902	4220	100.0	4220	324830	-	-	18281	-	-	6215
0903	2577	100.0	2577	327407	-	-	18281	-	-	6215
0904	1891	100.0	1891	329298	-	-	18281	-	-	6215
0905	1875	100.0	1875	331173	-	-	18281	-	-	6215
0906	2105	100.0	2105	333278	-	-	18281	-	-	6215
0907	1350	100.0	1350	334628	-	-	18281	-	-	6215
0908	801	100.0	801	335429	-	-	18281	-	-	6215
0909	97	100.0	97	335526	-	-	18281	-	-	6215

1/ Last fishing day; assume 100% chum.

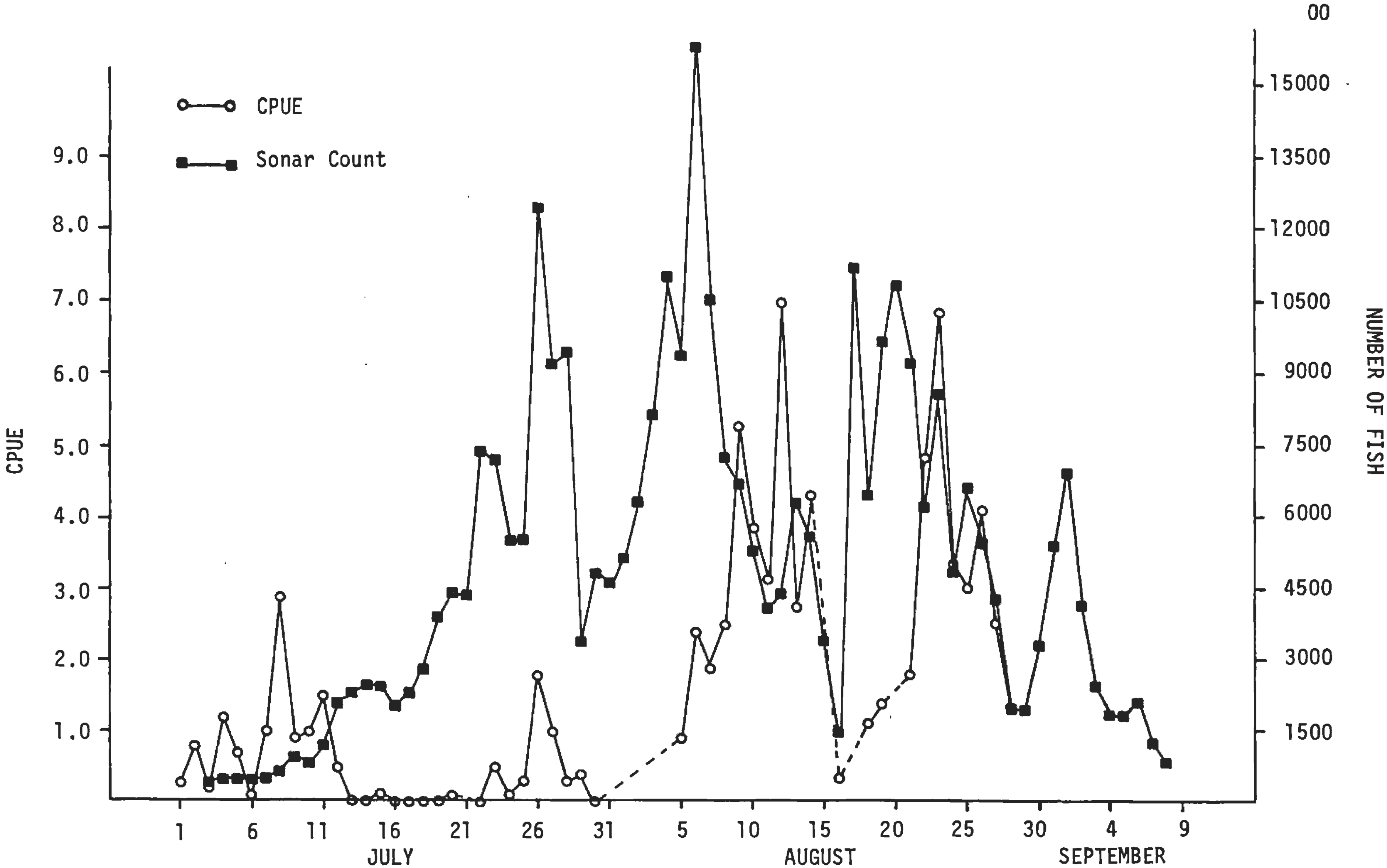

Figure 7. Comparison of 1981 test net CPUE and side scan sonar counts for chum salmon of the Noatak River. (Dotted line indicates no fishing.)

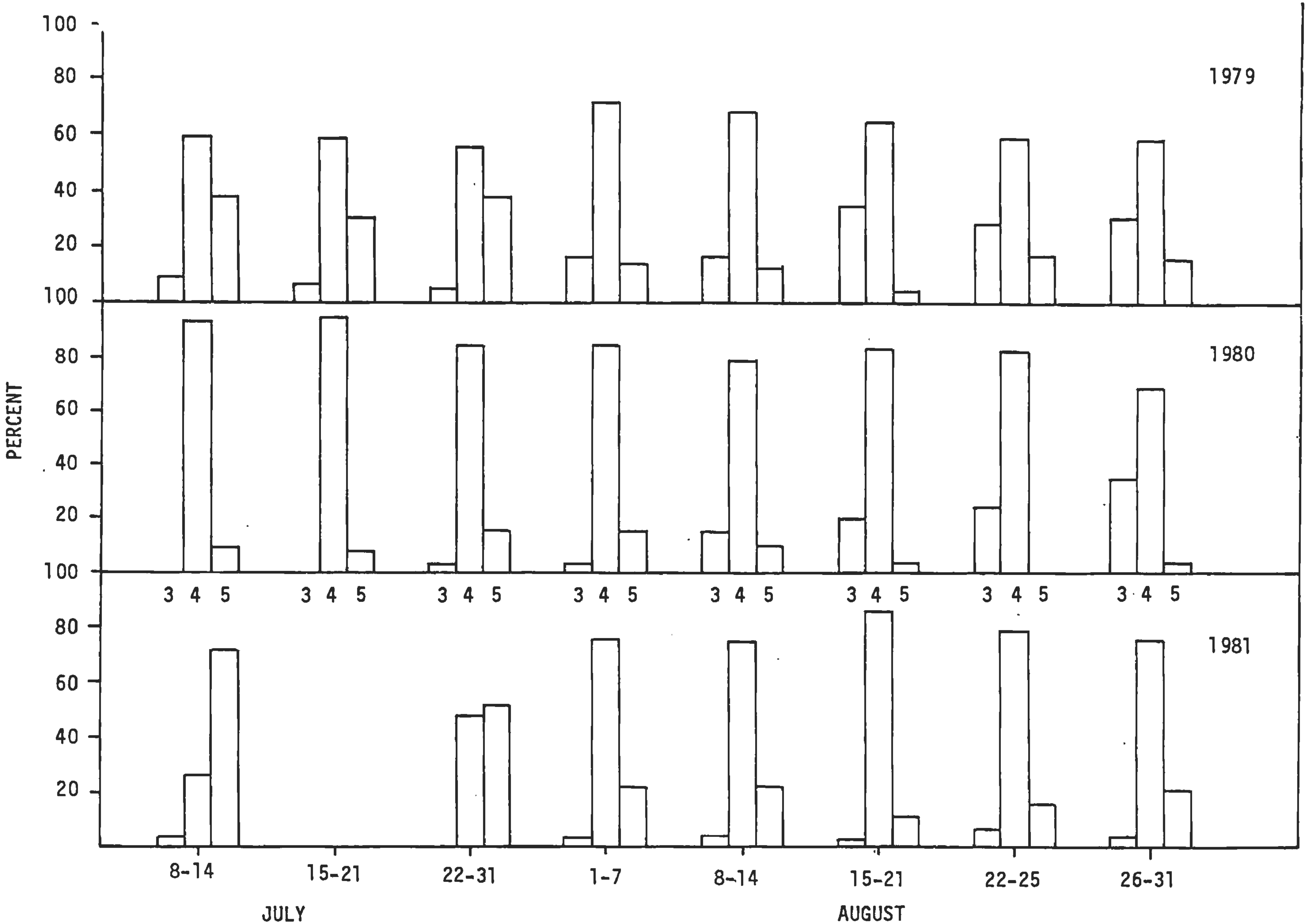

Figure 8. Age composition changes for chum salmon sampled from the Noatak River test fishery catch in 1979, 1980 and 1981.

variability in percent agreement is an improvement over 1980 (Bird 1980). This improvement is probably related to refining site locations and increased familiarity with gear and count conditions.

A significant number of fish passed along both banks beyond the normal counting range of 0-60 feet which were counted in the 60-100 foot range. Along the south bank 17.9% of all counted fish passed in the 60-100 foot range (Table 3). Along the north bank 29.6% of all counted fish passed in the 60-100 foot range (Table 4). For both banks combined, a total of 24.0% of all counted fish passed in the 60-100 foot range (Table 5). For the period in which counts beyond 60 feet were made, this translates roughly into 66,850 fish.

Discussion

A single side scan sonar unit was used in 1979 on one bank of the lower Noatak River to examine the feasibility of enumerating chum salmon escapement by sonar. Based on 1979 results, two units were installed in 1980 with the goal of obtaining a total count of migrating adult chum salmon. Results of this work suggested that the sonar was only partly successful on the Noatak River, because of site problems, even though the final escapement estimate was considered more valid then aerial survey counts. Minor changes in placement of the sonar units in 1981 eliminated many of the site related problems, and produced a useable estimation of 1981 Noatak River chum salmon escapement.

The major problem encountered in 1981 was still the significant numbers of fish passing beyond the normal 60 foot counting range of the sonar. In 1981

Table 3. Comparison of 1981 Noatak River side scan sonar calibrations for the left bank as derived from oscilloscope and sonar printer counts.

Counter 1/	Scope	Sonar	Percent 2/	Left of Target	Right of Target	Percent
1	6,628	6,924	95.7	580	92	86.3
2	3,438	3,904	88.1	243	42	85.3
3	5,930	6,346	93.4	405	152	72.7
4	4,572	4,954	92.3	618	113	84.5
5	330	368	89.7	50	13	79.4
6	568	849	66.9	113	26	81.3
7	52	50	104.0	-	-	-
Totals	21,518	23,395	92.0	2,009	438	82.1

Table 4. Comparison of 1981 Noatak River side scan sonar calibrations for the right bank as derived from oscilloscope and sonar printer counts.

Counter 1/	Scope	Sonar	Percent 2/	Left of Target	Right of Target	Percent
1	5,017	4,853	103.4	524	183	74.1
2	2,132	2,509	85.0	182	129	58.5
3	2,340	2,439	95.9	308	158	66.1
4	5,526	6,298	87.7	667	277	70.7
5	808	898	90.0	176	33	84.2
6	76	125	60.8	-	-	-
7	-	-	-	-	-	-
8	133	156	85.3	-	-	-
Totals	16,032	17,278	92.8	1,857	780	70.4

1/ Counters are individuals who provided calibration counts.

2/ Percent = (visual scope count/sonar printer count) x 100.

Table 5. Comparison of total 1981 Noatak River side scan sonar calibrations as derived from oscilloscope and sonar printer counts.

Counter[1/]	Scope	Sonar	Percent[2/]	Left of Target	Right of Target	Percent
1	11,645	11,777	98.9	1,104	275	80.1
2	5,570	6,413	86.9	425	171	71.3
3	8,270	8,785	94.1	713	310	69.7
4	10,098	11,252	89.7	1,285	390	76.7
5	1,138	1,266	89.9	226	46	83.1
6	644	974	66.1	113	26	81.3
7	52	50	104.0	-	-	-
8	133	156	85.3	-	-	-
Totals	37,550	40,673	92.3	3,866	1,218	76.0

1/ Counters are individuals who provided calibration counts.

2/ Percent = (visual scope count/sonar printer count) x 100.

instead of counting continuously at 100 feet, as in 1980, (Bird 1981), the counting range was extended to 100 feet for four 10 minute count periods a day to provide visual inspection of fish activity beyond normal ranges. A proportion of fish within normal count ranges and beyond normal count ranges was obtained providing a quick and reasonable adjustment for those fish moving beyond the normal count range.

Some comment is necessary on why this problem occurs and what, if any, solutions there are to the problem. First, there will probably always be some fish moving beyond normal counting ranges (because of substrate avoidance, crossover, etc.) even in the best of circumstances. In the present case, currents will always be too low to force fish to hug either the shore or bottom to the extent that they do in other systems in Alaska under sonar enumeration. In fact, for an additional 27 km upstream low flow velocity is likely to persist; tidal influence (gravitational and wind) is felt at least that far upstream.

Moving the sonar site upstream would solve the current problem but create a more fundamental problem. There is no site upriver that does not display severe braiding; of the two problems (braiding or currents), currents seem the easiest to cope with. The sonar may be presently located in the best site possible, given existing site possibilities and problems.

Because of poor current characteristics, a problem was created concerning the capability of the sonar counters to compensate electronically for fish swimming velocity. Fish swimming speed, which is partially determined by water velocity, was so slow that the transducer beam repetition rate (FISH

VELOCITY CONTROL) could not be lowered enough to avoid overcounting on most sectors. This tended to create greater differences in counter calibration results. Compensation was partly achieved in late July when system designer Al Menin installed an additional reheostat control in the fish velocity circuits allowing each machine's capabilities to be extended by a factor of about two. With this added control fish velocity could be adjusted under any water velocity regime.

This added capability allowed two choices in determining calibration procedures. Beam repetition rate could be adjusted daily to conform to water level and velocity induced changes in fish behavior, or beam repetition rate could be left on a constant rate with compensation done through calibration count adjustments. Both methods were tried and on the advice of Al Menin it was decided that adjusting fish velocity as needed was the best course.

The calibration technique used in 1981 seemed to work well. That it worked so well is the result of three factors. First, calibration sample size is easily large enough to ensure that calibration of sonar data sampled a fair representation of the escapement. The technique automatically weights calibration restiming. Once fish have entered the primary resource utilization area, which is comprised of the Kotzebue district, Hotham Inlet (Kobuk Lake), and the Noatak and Kobuk Rivers, they are subjected to considerable utilization by both commercial and subsistencveral individuals were used each day as calibrators. This reduced the possibility that individual bias influenced biases inherent in any one individual daily escapement data. Third, calibration counts were evenly spread over the working day thus preventing the biasing, or weighting, of data by any one run segment within a day. This becomes important when considering run variation displayed within a 24 hour period.

There is no good way to determine species composition of fish being counted by sonar in the Noatak River. The method presently used of proportionalizing counts by test fishery catch proportions contains bias from at least two sources. First, mesh size is uniform. This means that the catch, intended to be representative of sonar counted fish, is of a relatively uniform size. Since the sonar will count any fish larger than about 300 mm, uniformity in fish size is not necessarily desirable. There are presently no data to indicate what minimum size will count of the various species likely to cross a substrate in the Noatak River. A second problem is that; we do not know with certainty which species cross the substrate. Even if captured in the adjacent upstream test fishery, there are no guarantees that those fish had crossed the substrate.

The only possible way to eliminate these unknowns would be to either capture all fish species as they cross the substrate or to visually observe each fish crossing the substrate. Unfortunately neither of these solutions is feasible for the Noatak River system. A test fishery seems to present the best alternative.

Is the sonar count obtained a good estimator of Noatak River chum salmon escapement? From the results obtained in 1980 and 1981, and especially the latter, it appears that it is. The site problems have been minimized and a good measure of where fish are being counted is possible. The methods used to apportion counts by fish species needs work but it is probably sufficient in its present form to provide reliable estimators of counted species; these species apportionments only need to be confirmed to lend reliability to the technique.

NOATAK RIVER TEST FISHING

Methods

The Noatak River test fishery was located at the sonar site and was operated in conjunction with sonar operations (Figure 4). A two person crew fished one set gill net of 5 7/8 inch stretched mesh and 25 fathoms, for a predetermined period from 1 July through 28 August 1981 (Table 6). The net was fished from 1600-2400 hours and checked every hour during that period (checked frequently to reduce netting mortality).

Data collected and recorded included: Number and species of fish captured, by period and by day; age, length, weight and sex of chum salmon char; number of hours fished per neth; and daily relative water level in inches and water temperature in degrees Celsius. Ages were determined from scales taken from a preferred scale area (on the left side of the fish if possible), impressed onto acetate sheets, and later read using a Microfiche reader. All ages conformed to the Gilbert-Rich formula where, for example, 4_1 represents the age designation of a 4 year chum salmon (4 is the total age from egg deposition and the subscript 1 is the freshwater age from egg deposition). Since all chum salmon migrate to the sea as young-of-year fry they all have a 1 subscript. For purposes of this report the subscript will be dropped. Length measurements were made from mideye to fork-of-tail, in millimeters, by straight-line measure. All mortalities were sampled for weight in kilograms. Sex determination of fish was made on the basis of external morphology and confirmed in those cases where mortality occurred. The net catch-per-unit-effort (CPUE),or catch/hour, was compared with the sonar hourly counts to investigate the feasibility of back calculating prior year escapements from test fishing results. Also examined, using simple linear regression and correlation, were the relationships between CPUE and water depth and temperature.

Results

Initial chum salmon catches in 1981 were made with the first net set on 1 July (Table 6, Figure 7). A total of 646 chum salmon were caught in 438 hours of fishing throughout the season. CPUE data indicate that the period 6 August through 14 August was the major period of chum salmon migration in the Noatak River in 1981. Peak CPUE of 7.00 fish per hour occurred on 12 August. The CPUE for the entire season was 1.47 fish per hour. However, because of high, muddy water and debris, there were nine days in which fishing did not occur and several others in which falsely low catches occurred because of conditions prevailing during the rise or fall of these severe inclement conditions (Figure 9). When CPUE is compared to sonar counts, the catches for the two periods from 12 July to 5 August and 15-21 August probably are much lower, because of river conditions, than they should have been. As it was, daily CPUE figures ranged from 0.00 to 7.00, the highest since 1977 (Appendix Table 2). Historical test fish catches compare favorably with historical commercial catches, illustrating to some extent the delay time from commercial fishery to test fishery (Appendix Tables 3 and 4). Fluctuation of commercial catch curves from historical catch curves as a measure of after the fact early or lateness of runs shows that the run was probably about 5-7 days early in 1981 (Figure 10).

Six hundred and forty-six chum salmon were sampled in 1981 for age, sex and length (Appendix Table 5). The age composition of this sample was 3.4%, 66.9% and 29.6% for ages 3, 4 and 5, respectively. The sample was composed of 45.2% males and 54.8% females. This compares favorably with Kotzebue commercial catch data (Appendix Table 6). As in previous years, age composition of gill net caught chum salmon was noted to change over the sample period, with 4 and 5 year fish predominating in the early portion of the run and 3 and 4 year fish predominating in the later portion of the run (Figure 8). The same trend is displayed by the Kotzebue commercial fishery samples (Figure 11).

Mean lengths of chum salmon caught in the test fishery in 1981 were roughly comparable to other years (Appendix Table 5) and compared favorably with the commercial catch samples (Appendix Table 6). Males were consistently larger than females for all age groups in both test fish and commercial catch samples. There is also good agreement between years for the lengths of the different age groups, with some variation evident between years, and a slight downward trend in mean length evident over the last four years (Figure 12).

In 1981, 105 chum salmon were sampled for weight from the Noatak River test fishery. Weights by age group were: 2.2 kg for 3 year females (n = 1), 4.9 kg for 3 year males (n = 1), 3.4 kg for 4 year females (n = 45), 4.8 kg for 4 year males (n = 21), 3.9 kg for 5 year females (n = 25), and h5.4 kg for 5 year males (n = 12). Males were larger than females in all age groups. An

Table 6. Catch -per-unit-effort (CPUE) for the 1981 Noatak River chum salmon test fishing.

				Cumulative Total		
Date	Number Caught	Net Hours	CPUE	Number Caught	Net Hours	CPUE
7/1	1	3.5	.29	1	4	.25
2	8	10.0	.80	9	14	.64
3	2	10.0	.20	11	24	.46
4	12	10.0	1.20	23	34	.68
5	7	10.0	.70	30	44	.68
6	1	10.0	.10	31	54	.57
7	10	10.0	1.00	41	64	.64
8	29	10.0	2.90	70	74	.95
9	9	10.0	.90	79	84	.94
10	10	10.0	1.00	89	94	.95
11	15	10.0	1.50	104	104	1.00
12	5	10.0	.50	109	114	.96
13	0	10.0	.00	109	124	.88
14	0	2.0	.00	109	126	.87
15	1	10.0	.10	110	136	.81
16	0	10.0	.00	110	146	.75
17	0	8.0	.00	110	154	.71
18	0	10.0	.00	110	164	.67
19	0	10.0	.00	110	174	.63
20	1	10.0	.10	111	184	.60
21	-1/	-	-	111	184	.60
22	0	10.0	.00	111	194	.57
23	3	6.0	.50	114	200	.57
24	1	10.0	.10	115	210	.55
25	3	10.0	.30	118	220	.54
26	18	10.0	1.80	136	230	.59
27	10	10.0	1.00	146	240	.61
28	3	10.0	.30	149	250	.60
29	4	10.0	.40	153	260	.59
30	0	8.0	.00	153	268	.57
31	-	-	-	153	268	.57
8/1	-	-	-	153	268	.57
2	-	-	-	153	268	.57
3	-	-	-	153	268	.57
4	-	-	-	153	268	.57
5	9	10.0	.90	162	278	.58
6	24	10.0	2.40	186	288	.65
7	19	10.0	1.90	205	298	.69
8	25	10.0	2.50	230	308	.75
9	53	10.0	5.30	283	318	.89
10	31	8.0	3.88	314	326	.96
11	19	6.0	3.17	333	332	1.00

Table 6. Catch-per-unit-effort (CPUE) for the 1981 Noatak River chum salmon test fishing (cont.).

Date	Number Caught	Net Hours	CPUE	Cumulative Total Number Caught	Cumulative Total Net Hours	Cumulative Total CPUE
8/12	28	4.0	7.00	361	336	1.07
13	22	8.0	2.75	383	344	1.11
14	26	6.0	4.33	409	350	1.17
15	-	-	-	409	350	1.17
16	3	8.0	.38	412	358	1.15
17	-	-	-	412	358	1.15
18	9	8.0	1.13	421	366	1.15
19	14	10.0	1.40	435	376	1.16
20	-	-	-	435	376	1.16
21	18	10.0	1.80	453	386	1.17
22	27	6.0	4.83	480	392	1.22
23	55	8.0	6.88	535	400	1.34
24	27	8.0	3.38	562	408	1.38
25	23	8.0	3.00	585	416	1.41
26	33	8.0	4.13	618	424	1.46
27	20	8.0	2.50	638	432	1.48
28	8	6.0	1.33	646	438	1.47

1/ No fishing because of high water and debris.

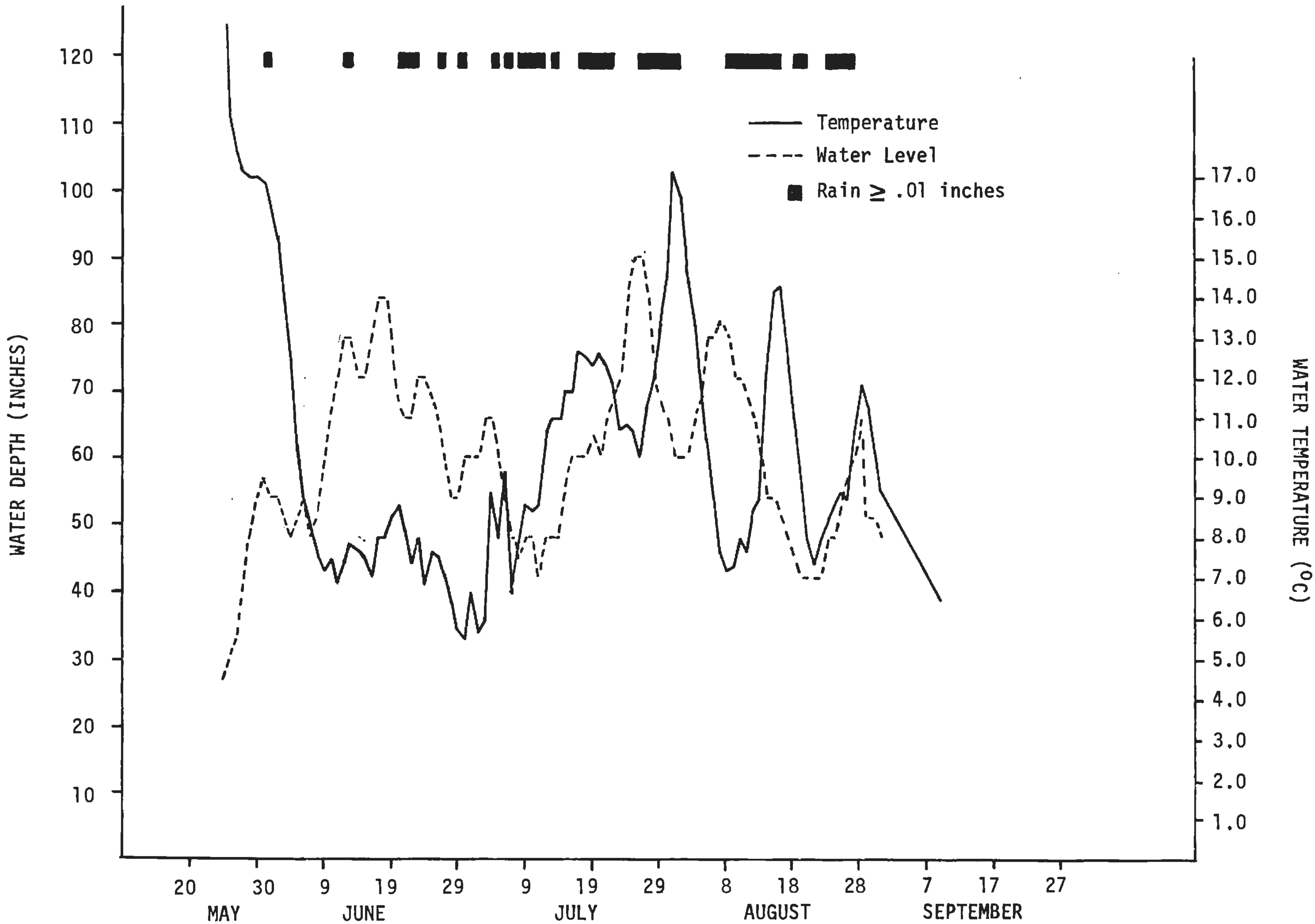

Figure 9. Noatak River temperature (C°) and water level percent change from mean water level as measured at the Noatak River test fish-sonar site in 1981.

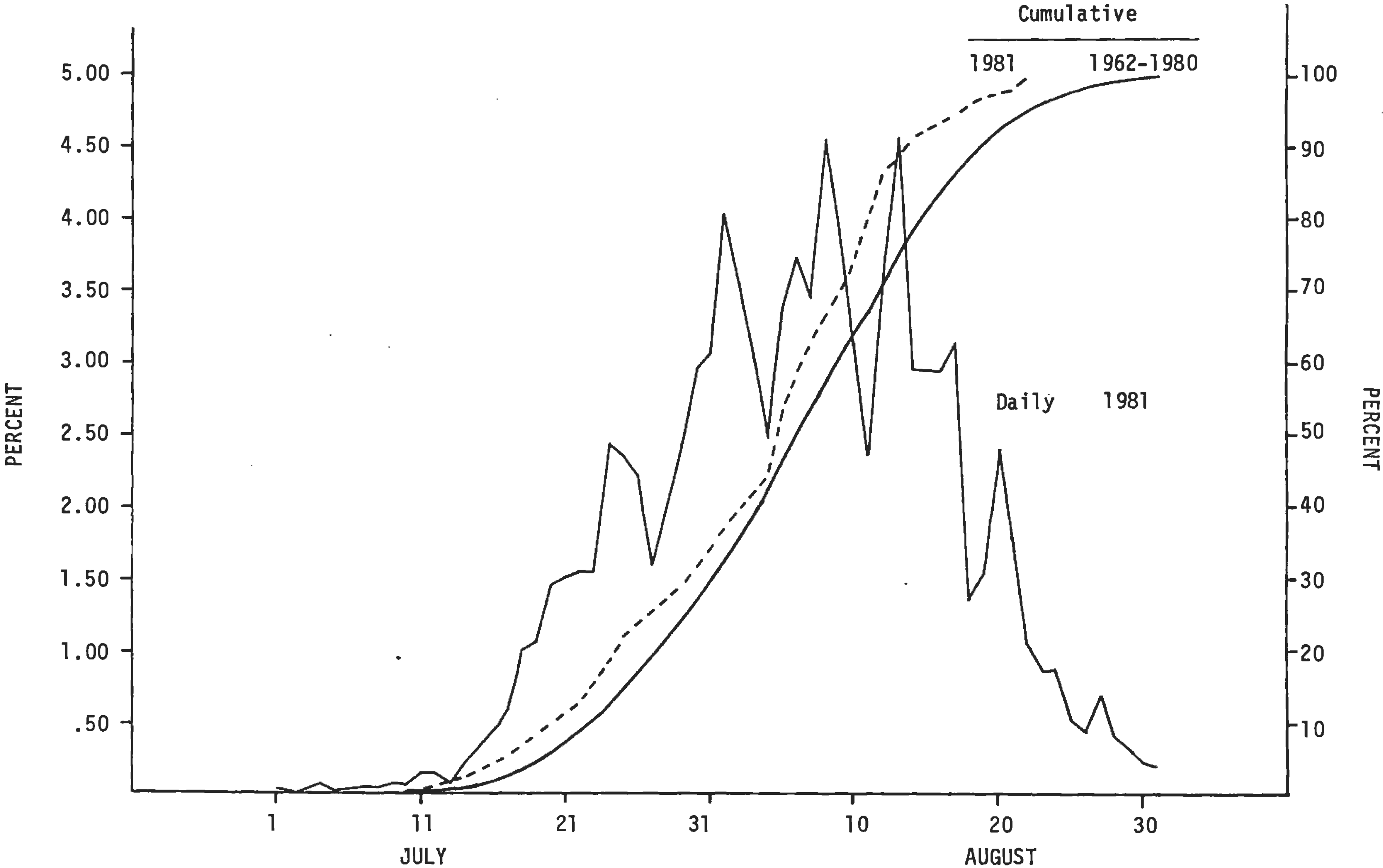

Figure 10. Percent contribution, by day and cumulative, for the total Kotzebue chum salmon commercial catch from 1962-1980.

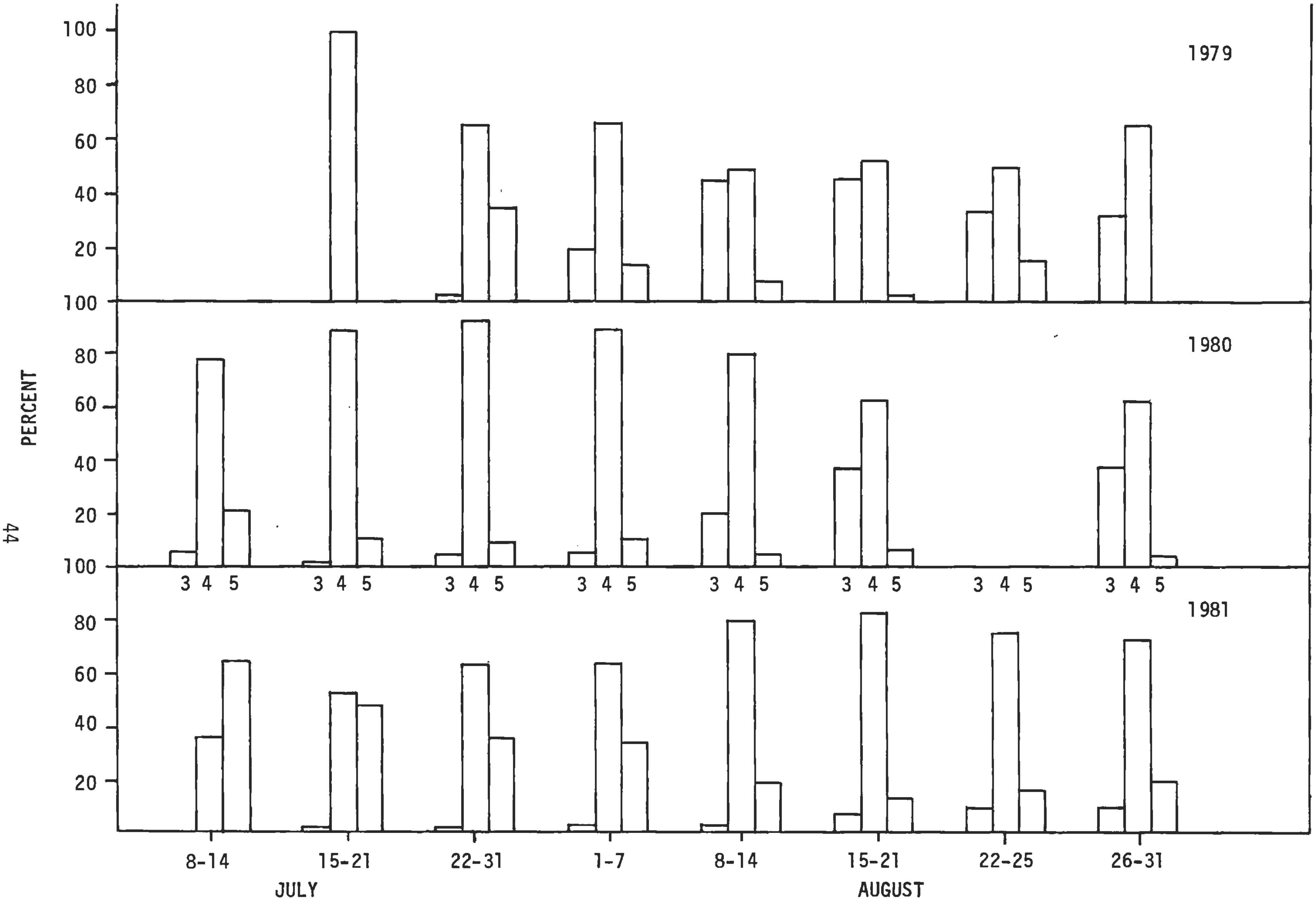

Figure 11. Age composition changes for chum salmon sampled from the Kotzebue commercial catch in 1979, 1980 and 1981.

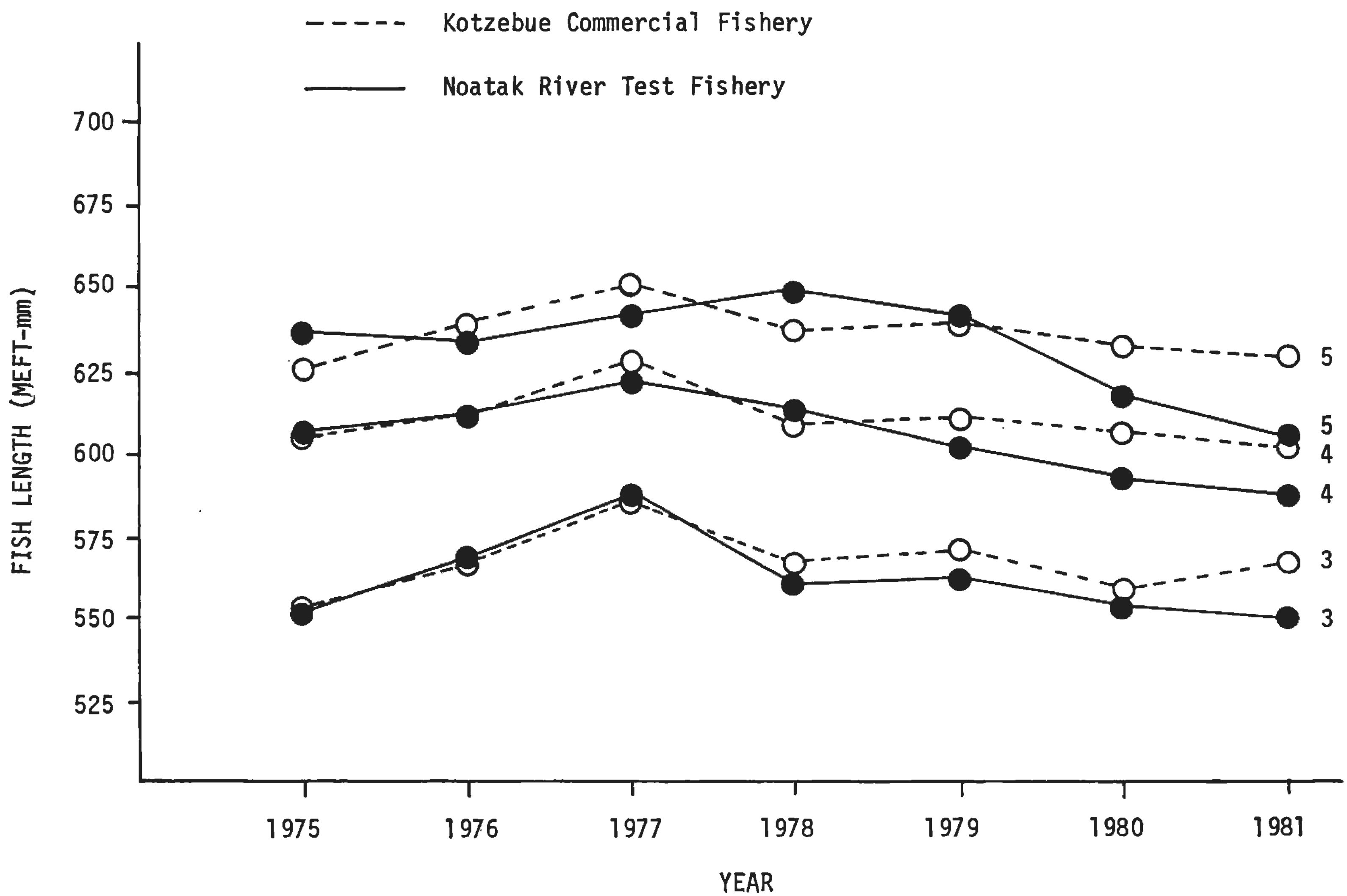

Figure 12. Comparison of age group mean lengths for both sexes between the Kotzebue commercial catch samples and the Noatak River test fishery catch samples for the years of test fishery sampling.

observation made this year is that fish taken in the Kotzebue commercial fishery seem to have a much greater condition factor than those taken in the Noatak test fishery. Much body weight seems to be lost in the travel between the two fisheries.

Other fish taken in the test fishery included 43 pink salmon (O. goruscha), 16 arctic char (Salvelinus alpinus, 6 humpback whitefish (Coregonus clupeaformis), two broad whitefish (C. nasus), one sheefish (Stenodus leucihthys) and six longnose suckers (Catostomus catostomus). All of these fish, with the exception of the arctic char, were simply noted and released. Length and sex were recorded from all arctic char.

Relative water level (inches) and water temperature (C) were recorded daily at the left bank camp site (Figure 9). There was no significant correlation between water temperature or depth and test fish CPUE or sonar counts.

Discussion

Test fishery catches were probably not representative of the Noatak River escapement in 1981. Because of the large amount of rainfall in the last half of July and the first half of August, river levels were higher than normal. This in turn produced so much debris in the river that test fishing activities had to be temporarily suspended. Unfortunately, these suspensions occurred during high sonar escapement counts. As a consequence, large portions of the escapement were not sampled in the test fishery.

Because of this sampling problem all test fishery results should be viewed with some skepticism. Affected data could include both sex and age percent composition through time and species composition as it pertains to sonar count apportionment. Hopefully, however, the missed portions of the escapement sampling conform to the adjacent escapement segments which were samples. Sample size may also compensate in part for the missing data.

This past year all chum salmon samples that related to Kotzebue stocks were aged again in the hopes of creating uniformity in all age related data. This re-aging included both Kotzebue commercial catch samples and Noatak test fishery catch samples--more than 9,000 samples. Out of 20 years of data collection (1962-1981) only 11 years of raw data existed; the remaining nine years have been misplaced or lost in the Nome area office flood of 1974. Upon re-examination of the age data available, two points were brought to light. One, in some years there existed a large disparity in ages between original results and re-aged data; the percent variation range being 1-30%. This difference explains why age and percent composition data in this report differs from past reports. These changes created changes in 11 years of age composition and length and weight data for the various age groups.

Also, upon examination of old data it was found that sex composition had been based on only those fish which could be aged. As a consequence, all available data was altered to also reflect those samples which could be sexed but not aged. This introduced measureable changes in sex composition data which are reflected in data tables in this report. Data tables in this report will thus differ substantially from those present in past reports.

As mentioned in the earlier discussion of sonar enumeration, weather and stream flows seemed to affect some portions of both sonar counts and test fishery CPUE which in turn affected the relationship between these parameters. There was no discernible relationship between daily sonar counts and test fishery CPUE (r .02). There are several possible reasons for this disparity, although their relationship to one another is unclear at this time. First, changing water level, velocity and clarity appear to affect fish behavior as it relates to both test nets and sonar substrates. As water level increases, velocity becomes greater and clarity decreases. At this time test net CPUE drops significantly. However, the distribution of fish on the sonar substrate indicates fish are somewhat closer to shore, so should be more susceptible to the net.

Another factor affecting test fish CPUE is changing light levels as the seasons change. CPUE tended to drop off as hours of darkness increased, with greatest catches occurring during the lighter hours. Sonar counts seemed to be less affected bylight changes than did net catches.

There are two biological factors which could affect CPUE. These are behavioral changes associated with the changing age group composition and the perhaps related behavioral changes associated with increased pressure to spawn as the season progresses. Any behavioral changes associated with these two factors could increase the persistence of individual salmon in attaining final spawning areas. This would probably increase the chances of salmon being caught in a test fishery later in the season. If this were the case, one would expect CPUE to remain high as late run sonar counts dropped. An examination of results shows that this may have occurred in 1981.

Age composition of chum salmon caught in the test fishery in 1981 reflected general age patterns of prior years. When compared to Kotzebue commercial catch samples insignificant differences existed between age compositions of the two sample populations. Comparison of the age compositions of the two sample populations yields a strong linear correlation with r = 0.96. Considering that the commercial fishery is believed to be composed almost exclusively of Noatak River stocks this result is not surprising.

A recurring characteristic within the Noatak River chum salmon stocks that is also reflected in the Kotzebue commercial catch is the shift in age group composition over time. Early portions of the run are predominantly 4 and 5 year fish while latter portions of the run are predominantly 3 and 4 year fish. The age 4 group percent contribution remains relatively constant throughout the run. This shift is evident in prior years and is a widespread phenomenon in other chum salmon populations that have been studied (Bakkala 1970; Helle 1979). The relatively small contribution of age 3 fish in 1981 reflects the low survival of that brood year (1979), while the relatively high contribution of 4 year and 5 year fish is the result of good survival from broods in 1976 and 1977 (Bird, 1981).

LITERATURE CITED

Bakkala, R.G. 1970. Synopsis of Biological Data on the Chum Salmon, Oncorhynchus keta (Walbaum) 1972. United States Department of the Interior, Circular 315, Washington, D.C. 89 pp.

Bird, F.H. 1980. Kotzebue Sound Salmon Studies. Technical Report, December 1980. Project No. AFC-64-3. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, D.C. 35 pp.

Bird, F.H. 1981. Kotzebue Sound Salmon Studies. Technical Report, May 1981. Project No. AFC-64-4. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington D.C. 62 pp.

Helle, J.H. 1979. Influence of Marine Environment on Age and Size at Maturity, Growth, and Abundance of Chum Salmon, Oncorhynchus keta (Walbaum), from Olsen Creek, Prince William Sound, Alaska. Ph. D. Thesis, Oregon State University, Oregon. 118 pp.

NOAA. 1979. In: Local Climatological Data, Annual Summary with Comparative Data, 1979, Kotzebue, Alaska. United States Department of Commerce, National Climatic Center, Asheville, N.C. 28801. 4 pp.

Schwarz, L., Lean and F. Bird. 1981. Annual Management Report, Norton Sound-Port Clarence-Kotzebue. Alaska Dept. Fish and Game. 184 pp.

Yanagawa, C.M. 1968. Kotzebue Chum Salmon Tagging Project, 1966-68. Alaska Department of Fish and Game, Fishery Bulletin No. 7. 32 pp.

APPENDIX TABLES

Appendix Table 1. Daily and cumulative Noatak River chum salmon sonar count for 1980-81.

Date	Daily Sum of 1980-81 Chum Salmon Sonar Count	Percent of Daily Contribution To Total	Cumulative Daily sum of 1980-81 Chum Salmon Sonar Count	Cumulative Percent of Daily Contribution To Total
0701	0	0	0	0
0702	86	.01	86	.01
0703	476	.08	562	.09
0704	539	.09	1101	.18
0705	531	.09	1632	.26
0706	528	.09	2160	.35
0707	544	.09	2704	.44
0708	691	.11	3395	.55
0709	1113	.18	4508	.73
0710	1075	.17	5583	.91
0711	1457	.24	7040	1.14
0712	2209	.36	9249	1.50
0713	2563	.42	11812	1.92
0714	2570	.42	14382	2.33
0715	2665	.43	17047	2.77
0716	2069	.34	19116	3.10
0717	2576	.42	21692	3.52
0718	3051	.50	24743	4.01
0719	5466	.89	30209	4.90
0720	5051	.82	35260	5.72
0721	5006	.81	40266	6.53
0722	7420	1.20	47686	7.74
0723	8329	1.35	56015	9.09
0724	7570	1.23	63585	10.32
0725	7893	1.28	71478	11.60
0726	15632	2.54	87110	14.13
0727	13533	2.20	100643	16.33
0728	12709	2.06	113352	18.39
0729	6835	1.11	120187	19.50
0730	6298	1.02	126485	20.52
0731	7944	1.29	134429	21.81
0801	13681	2.22	148110	24.03
0802	16730	2.71	164840	26.75
0803	13750	2.23	178590	28.98
0804	16790	2.72	195380	31.70
0805	16414	2.66	211794	34.36
0806	20778	3.37	232572	37.74
0807	23906	3.88	256478	41.61
0808	12195	1.98	268673	43.59
0809	11920	1.93	280593	45.43
0810	10731	1.74	291324	47.27
0811	13971	2.27	305295	49.54

Appendix Table 1. Daily and cumulative Noatak River chum salmon sonar count for 1980-81 (cont.).

Date	Daily Sum of 1980-81 Chum Salmon Sonar Count	Percent of Daily Contribution To Total	Cumulative Daily sum of 1980-81 Chum Salmon Sonar Count	Cumulative Percent of Daily Contribution To Total
0812	13141	2.13	318436	51.67
0813	20741	3.37	339177	55.03
0814	13706	2.22	352883	57.26
0815	18685	3.03	371568	60.29
0816	10179	1.65	381747	61.94
0817	21508	3.49	403255	65.43
0818	22500	3.65	425755	69.08
0819	19206	3.12	444961	72.20
0820	18512	3.00	463473	75.20
0821	20295	3.29	483768	78.49
0822	16529	2.68	500297	81.18
0823	13201	2.14	513498	83.32
0824	8469	1.37	521967	84.69
0825	9195	1.49	531162	86.18
0826	8320	1.35	539482	87.53
0827	6857	1.11	546339	88.65
0828	4661	.76	551000	89.40
0829	4130	.67	555130	90.07
0830	4628	.75	559758	90.82
0831	7263	1.18	567021	92.02
0901	8978	1.46	575999	93.46
0902	6737	1.09	582736	94.55
0903	5061	.82	587797	95.37
0904	4308	.70	592105	96.07
0905	4564	.74	596669	96.81
0906	5389	.87	602058	97.69
0907	4930	.80	606988	98.49
0908	3467	.56	610455	99.05
0909	2324	.38	612779	99.43
0910	1551	.25	614330	99.68
0911	1437	.23	615767	99.91
0912	545	.09	616312	100.00

Appendix Table 2. Noatak River chum salmon test net Catch-Per-Unit-Effort (CPUE) for 1975-1981.

	1975		1976		1977		1978		1979		1980		1981	
Date	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
0701	-	-	-	-	-	-	-	-	-	-	-	-	1	0.3
0702	-	-	-	-	-	-	-	-	-	-	-	-	8	0.8
0703	-	-	-	-	-	-	-	-	-	-	-	-	2	0.2
0704	-	-	-	-	-	-	-	-	-	-	3	0.1	12	1.2
0705	-	-	-	-	-	-	-	-	-	-	1	Neg	7	0.7
0706	-	-	-	-	-	-	-	-	-	-	0		1	0.1
0707	-	-	-	-	-	-	-	-	-	-	-	-	10	1.0
0708	-	-	-	-	-	-	-	-	-	-	2	0.1	29	2.9
0709	-	-	-	-	-	-	-	-	-	-	3	0.2	9	0.9
0710	-	-	-	-	-	-	-	-	-	-	4	0.2	10	1.0
0711	-	-	-	-	-	-	-	-	-	-	3	0.2	15	1.5
0712	-	-	-	-	-	-	-	-	-	-	1	0.1	5	0.5
0713	-	-	-	-	-	-	-	-	-	-	8	0.4	0	0.0
0714	-	-	-	-	-	-	-	-	-	-	2	0.1	0	0.0
0715	-	-	-	-	-	-	-	-	-	-	2	0.1	1	0.1
0716	-	-	-	-	-	-	-	-	-	-	0	0.0	0	0.0
0717	-	-	-	-	-	-	-	-	2	0.3	2	0.1	0	0.0
0718	-	-	-	-	-	-	-	-	0	0.0	1	0.1	0	0.0
0719	-	-	-	-	-	-	-	-	2	0.2	3	0.2	0	0.0
0720	-	-	-	-	-	-	-	-	2	0.2	1	0.1	1	0.1
0721	-	-	-	-	-	-	-	-	1	0.1	4	0.2	-	-
0722	-	-	-	-	-	-	-	-	7	0.6	0	0.0	0	0.0
0723	-	-	-	-	-	-	3	0.4	2	0.2	5	0.3	3	0.5
0724	0	0.0	3	0.4	3	0.7	-	-	9	0.8	15	0.8	1	0.1
0725	0	0.0	11	0.9	4	0.7	-	-	4	0.3	18	0.8	3	0.3
0726	0	0.0	19	1.6	15	2.5	-	-	6	0.5	20	3.3	18	1.8
0727	0	0.0	25	2.1	1	0.2	-	-	5	0.4	17	2.8	10	1.0
0728	6	1.2	10	1.2	16	2.7	-	-	3	0.3	15	2.5	3	0.3
0729	0	0.0	22	1.8	8	1.3	-	-	2	0.2	11	1.8	4	0.4

Appendix Table 2. Noatak River chum salmon test net Catch-Per-Unit-Effort (CPUE) for 1975-1981 (Cont.).

	1975		1976		1977		1978		1979		1980		1981	
Date	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
0730	39	3.3	8	0.7	7	1.2	-	-	7	0.6	10	1.7	0	0.0
0731	79	6.6	31	2.6	15	2.5	1	0.1	2	0.2	21	3.5	-	-
0801	63	5.3	32	2.7	15	2.5	1	0.1	9	0.8	19	3.2	-	-
0802	39	4.9	7	0.9	15	2.1	2	0.1	8	0.7	25	4.2	-	-
0803	33	2.8	32	2.7	22	3.7	6	0.1	0	0.0	22	3.7	-	-
0804	93	9.3	0	0.0	13	2.2	13	0.2	10	0.8	18	3.0	-	-
0805	68	6.8	36	4.5	9	1.5	12	0.2	2	0.2	30	5.0	9	0.9
0806	25	2.1	11	1.4	12	2.0	4	0.1	0	0.0	21	3.5	24	2.4
0807	64	5.3	70	5.8	15	2.5	1	Neg	2	0.2	12	2.0	19	1.9
0808	57	4.8	55	4.6	31	5.2	4	0.1	2	0.1	15	2.5	25	2.5
0809	35	2.9	55	4.6	52	8.7	6	0.1	2	0.1	10	1.7	53	5.3
0810	93	7.8	25	2.1	30	5.0	23	0.3	2	0.1	18	3.0	31	3.9
0811	98	8.2	30	2.5	13	2.2	50	0.7	0	0.0	16	2.7	19	3.2
0812	62	7.8	31	2.6	20	3.3	18	0.2	6	0.2	11	1.8	28	7.0
0813	34	4.3	19	2.4	6	1.0	30	0.4	16	0.5	7	1.2	22	2.8
0814	55	4.6	15	1.2	5	0.8	26	0.4	17	0.6	10	1.7	26	4.3
0815	21	1.8	19	1.6	9	1.5	25	0.3	14	0.5	10	1.7	-	-
0816	41	3.4	0	0.0	13	2.2	26	0.4	12	0.4	13	2.2	3	0.4
0817	3	0.3	24	2.0	3	0.5	27	0.4	7	0.2	19	3.2	-	-
0818	65	5.4	24	2.0	11	1.8	18	0.2	11	0.3	30	5.0	9	1.1
0819	36	3.0	12	1.0	12	2.0	24	0.3	15	0.4	19	3.2	14	1.4
0820	10	1.0	3	0.2	3	0.5	13	0.2	6	0.2	9	1.5	-	-
0821	63	6.4	6	0.7	3	0.5	13	0.2	0	0.0	13	2.2	18	1.8
0822	96	8.0	35	2.9	7	1.1	14	0.2	2	0.1	19	3.2	27	4.8
0823	0	0.0	20	1.7	4	0.7	4	0.1	3	0.1	10	1.7	55	6.9
0824	78	6.5	5	0.4	3	0.5	2	Neg	1	Neg	9	1.5	27	3.4
0825	0	0.0	9	0.7	3	0.5	10	0.1	1	0.1	21	3.5	23	3.0
0826	40	3.3	10	0.8	0	0.0	6	0.1	-	-	18	3.0	33	4.1
0827	38	3.2	18	1.5	0	0.0	6	0.1	-	-	11	1.8	20	2.5

Appendix Table 2. Noatak River Chum salmon test net Catch-Per-Unit-Effort (CPUE) for 1975-1981 (Cont.).

	1975		1976		1977		1978		1979		1980		1981	
Date	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
0828	0	0.0	24	2.0	0	0.0	16	0.2	3	0.3	12	2.0	8	1.3
0829	0	0.0	26	2.2	8	1.3	2	Neg	1	0.1	18	3.0	-	-
0830	6	0.5	5	0.4	4	0.7	3	Neg	5	0.5	5	0.8	-	-
0831	-	-	16	1.3	10	1.7	7	0.1	-	-	2	0.5	-	-
Total	1440	3.4	804	1.9	420	1.8	416	0.2	211	0.3	644	1.0	646	1.5

Appendix Table 3. Daily and cumulative Noatak River chum salmon test fishing results for years 1975-81.

Date	Daily Sum of 1975-81 Chum Salmon Test Netting	Percent of Daily Contribution To Total	Cumulative Daily Sum of 1975-81 Chum Salmon Test Netting	Cumulative Percent of Daily Contribution To Total
0701	1	.02	1	.02
0702	8	.17	9	.20
0703	2	.04	11	.24
0704	15	.33	26	.57
0705	8	.17	34	.74
0706	1	.02	35	.76
0707	10	.22	45	.98
0708	31	.68	76	1.66
0709	12	.26	88	1.92
0710	14	.31	102	2.23
0711	18	.39	120	2.62
0712	6	.13	126	2.75
0713	8	.17	134	2.93
0714	2	.04	136	2.97
0715	3	.07	139	3.04
0716	0	.00	139	3.04
0717	4	.09	143	3.12
0718	1	.02	144	3.14
0719	5	.11	149	3.25
0720	4	.09	153	3.34
0721	5	.11	158	3.45
0722	7	.15	165	3.60
0723	13	.28	178	3.89
0724	31	.68	209	4.56
0725	40	.87	249	5.44
0726	78	1.70	327	7.14
0727	58	1.27	385	8.41
0728	53	1.16	438	9.57
0729	47	1.03	485	10.59
0730	71	1.55	556	12.14
0731	149	3.25	705	15.40
0801	139	3.03	844	18.43
0802	96	2.10	940	20.53
0803	115	2.51	1055	23.04
0804	147	3.21	1202	26.25
0805	166	3.62	1368	29.88
0806	97	2.12	1465	31.99
0807	183	4.00	1648	35.99
0808	189	4.13	1837	40.12
0809	213	4.65	2050	44.77

Appendix Table 3. Daily and cumulative Noatak River chum salmon test fishing results for years 1975-81 (cont.).

Date	Daily Sum of 1975-81 Chum Salmon Test Netting	Percent of Daily Contribution To Total	Cumulative Daily Sum of 1975-81 Chum Salmon Test Netting	Cumulative Percent of Daily Contribution To Total
0810	222	4.85	2272	49.62
0811	226	4.94	2498	54.55
0812	176	3.84	2674	58.40
0813	134	2.93	2808	61.32
0814	154	3.36	2962	64.69
0815	98	2.14	3060	66.83
0816	108	2.36	3168	69.19
0817	83	1.81	3251	71.00
0818	168	3.67	3419	74.67
0819	132	2.88	3551	77.55
0820	44	0.96	3595	78.51
0821	116	2.53	3711	81.04
0822	200	4.37	3911	85.41
0823	96	2.10	4007	87.51
0824	125	2.73	4132	90.24
0825	67	1.46	4199	91.72
0826	107	2.34	4306	94.06
0827	93	2.03	4399	96.09
0828	63	1.38	4462	97.47
0829	55	1.20	4517	98.67
0830	28	0.61	4545	99.28
0831	35	0.76	4580	100.00

Appendix Table 4. Percent contribution, by day and cumulative, for the total Kotzebue chum salmon commercial catch from 1962-1980.

Date	1962-80 Daily Total	1962-80 Cumulative Daily Total	1962-80 Daily Percent	1962-80 Cumulative Daily Percent
0701	820	820	.02	.02
0702	0	820	.00	.02
0703	284	1104	.01	.03
0704	2383	3487	.06	.09
0705	1286	4773	.03	.12
0706	68	4841	.00	.12
0707	1177	6018	.03	.15
0708	1130	7148	.03	.18
0709	2722	9870	.07	.25
0710	6667	16537	.16	.41
0711	4951	21488	.12	.53
0712	4766	26254	.11	.64
0713	5743	31997	.14	.78
0714	17042	49039	.41	1.19
0715	11273	60312	.27	1.46
0716	19130	79442	.46	1.92
0717	37112	116554	.89	2.81
0718	34640	151194	.83	3.64
0719	36602	187796	.88	4.52
0720	55737	243533	1.34	5.86
0721	83804	327337	2.02	7.88
0722	66658	393995	1.60	9.48
0723	59677	453672	1.44	10.92
0724	127398	581070	3.07	13.99
0725	92298	673368	2.22	16.21
0726	76367	749735	1.84	18.05
0727	62153	811888	1.50	19.55
0728	82958	894846	2.00	21.55
0729	109772	1004618	2.64	24.19
0730	109737	1114355	2.64	26.83
0731	130186	1244541	3.13	29.96
0801	167287	1411828	4.03	33.99
0802	122778	1534606	2.96	36.95
0803	115568	1650174	2.79	39.74
0804	124596	1774770	3.00	42.74
0805	184731	1959501	4.45	47.19
0806	171642	2131143	4.13	51.32
0807	147474	2278617	3.55	54.87
0808	178161	2456778	4.29	59.16
0809	142006	2598784	3.42	62.58
0810	149447	2748231	3.60	66.18
0811	125602	2873833	3.02	69.20

Appendix Table 4. Percent contribution, by day and cumulative, for the total Kotzebue chum salmon commercial catch from 1962-1980 (cont.)

Date	1962-80 Daily Total	1962-80 Cumulative Daily Total	1962-80 Daily Percent	1962-80 Cumulative Daily Percent
0812	165510	3039343	3.99	73.19
0813	176216	3215559	4.24	77.43
0814	118931	3334490	2.86	80.29
0815	118345	3452835	2.85	83.14
0816	105941	3558776	2.55	85.69
0817	119275	3678051	2.87	88.56
0818	58281	3736332	1.40	89.96
0819	59244	3795576	1.43	91.39
0820	86118	3881694	2.07	93.46
0821	64660	3946354	1.56	95.02
0822	48619	3994973	1.17	96.19
0823	29987	4024960	.72	96.91
0824	30784	4055744	.74	97.65
0825	18182	4073926	.44	98.09
0826	14694	4088620	.35	98.44
0827	24067	4112687	.58	99.02
0828	14122	4126809	.34	99.36
0829	11097	4137906	.27	99.63
0830	8346	4146252	.20	99.83
0831	7509	4153761	.17	100.00

Appendix Table 5. Historical age, length and sex composition data for chum salmon caught in the Noatak River test fishery.

		Combined Totals		3_1			4_1			5_1			6_1		
Year	Sex	Number	Percent	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length
1975	M	210	39.3	17	3.6	557.6	153	32.5	628.2	16	3.4	665.2	-	-	-
1975	F	325	60.7	29	6.2	547.9	241	51.2	594.4	15	3.2	607.2	-	-	-
1975	All	535	100.0	46	9.8	551.5	394	83.6	607.5	31	6.6	637.1	-	-	-
1976	M	365	44.4	44	5.9	576.8	186	24.8	624.4	100	13.3	647.3	2	0.3	647.5
1976	F	458	55.6	55	7.3	562.6	232	30.9	600.9	131	17.5	621.5	-	-	-
1976	All	823	100.0	99	13.2	568.9	418	55.7	611.4	231	30.8	632.6	2	0.3	647.5
1977	M	150	40.1	6	1.9	603.3	94	29.2	635.2	26	8.1	656.9	1	0.3	690.0
1977	F	224	59.9	6	1.9	571.7	134	41.6	612.3	52	16.2	633.5	3	0.9	628.3
1977	All	374	100.0	12	3.7	587.5	228	70.8	621.7	78	24.2	641.3	4	1.2	643.8
1978	M	44	29.7	13	9.0	567.1	24	16.7	633.1	7	4.9	673.9	-	-	-
1978	F	104	70.3	14	9.7	552.9	73	50.7	607.6	13	9.0	634.8	-	-	-
1978	All	148	100.0	27	18.8	559.7	97	67.4	613.9	20	13.9	648.5	-	-	-
1979	M	100	49.0	40	20.6	573.2	41	21.1	620.3	8	4.1	670.5	-	-	-
1979	F	104	51.0	26	13.4	547.8	64	33.0	590.4	14	7.2	624.7	1	0.5	658.0
1979	All	204	100.0	66	34.0	563.2	105	54.1	602.1	22	11.3	641.4	1	0.5	658.0
1980	M	320	48.8	45	7.0	557.3	242	37.6	607.5	25	3.9	635.2	1	0.2	693.0
1980	F	336	51.2	33	5.1	548.9	267	41.5	581.9	29	4.5	602.9	1	0.2	610.0
1980	All	656	100.0	78	12.1	553.8	509	79.2	594.1	54	8.4	617.9	2	0.3	651.5
1981	M	292	45.2	16	2.6	552.1	184	29.3	600.9	78	12.4	621.1	-	-	-
1981	F	354	54.8	5	0.8	542.4	236	37.6	578.0	108	17.2	594.8	-	-	-
1981	All	646	100.0	21	3.4	549.8	420	66.9	588.0	186	29.6	605.8	-	-	-

Appendix Table 6. Historical age, length and sex statistics for Kotzebue district commercial fishery chum salmon catches.

Year	Sex	Combined Totals 1/		3_1			4_1			5_1			6_1		
		Number	Percent	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length
1962	M	18	26.1	1	1.5	531.0	9	13.0	610.0	7	10.1	628.0	1	1.5	645.0
1962	F	51	73.9	5	7.2	547.0	34	49.3	584.0	12	17.4	620.0	-	-	-
1962	All	69	100.0	6	8.7	544.0	43	62.3	593.0	19	27.5	626.0	1	1.5	645.0
1963	M	89	35.0	37	14.6	559.0	38	14.9	612.0	13	5.1	662.0	1	0.4	620.0
1963	F	166	65.0	46	18.0	523.0	83	32.5	595.0	35	13.7	618.0	2	0.8	605.0
1963	All	255	100.0	83	32.6	539.0	121	47.4	601.0	48	18.8	629.0	3	1.2	610.0
1964	M	209	43.6	123	26.6	584.2	75	16.2	617.5	4	0.9	652.0	-	-	-
1964	F	270	56.4	136	29.4	567.3	121	26.1	598.6	4	0.9	622.0	-	-	-
1964	All	479	100.0	259	55.9	575.3	196	42.3	605.8	8	1.7	637.9	-	-	-
1965	M	210	41.5	8	1.7	571.3	174	36.6	603.0	15	3.2	606.0	-	-	-
1965	F	296	58.5	5	1.0	554.0	263	55.3	587.2	11	2.3	593.2	-	-	-
1965	All	506	100.0	13	2.7	564.6	437	91.8	593.5	26	5.5	600.6	-	-	-
1966	M	202	40.6	19	4.1	564.2	114	24.8	628.2	50	10.9	635.6	-	-	-
1966	F	296	59.4	20	4.4	568.5	183	39.8	604.4	74	16.1	614.4	-	-	-
1966	All	498	100.0	39	8.5	566.4	297	64.6	613.5	124	27.0	622.9	-	-	-
1968 2/	M	959	48.2	209	10.5	583.0	522	26.2	615.0	217	10.9	651.0	11	0.6	728.0
1968	F	1030	51.8	194	9.8	569.0	620	31.1	601.0	208	10.5	625.0	8	0.4	627.0
1968	All	1989	100.0	403	20.3	576.0	1142	57.3	607.0	425	21.4	638.0	19	1.0	686.0
1969	M	639	53.3	259	23.5	555.6	297	26.9	605.5	33	3.0	649.4	-	-	-
1969	F	561	46.7	97	8.8	552.2	388	35.1	591.2	30	2.7	609.6	-	-	-
1969	All	1200	100.0	356	32.2	554.7	685	62.1	597.4	63	5.7	630.4	-	-	-

Appendix Table 6. Historical age, length and sex statistics for Kotzebue district commercial fishery chum salmon catches (cont.).

		Combined Totals		3_1			4_1			5_1			6_1		
Year	Sex	Number	Percent	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length
1970	M	128	44.8	7	2.6	564.0	107	40.1	606.1	6	2.3	634.2	-	-	-
1970	F	158	55.2	3	1.1	552.7	140	52.4	586.8	4	1.5	611.3	-	-	-
1970	All	286	100.0	10	3.7	560.6	247	92.6	595.2	10	3.8	625.0	-	-	-
1971	M	603	54.6	79	7.1	568.0	360	32.6	605.0	164	14.8	623.0	-	-	-
1971	F	502	45.4	39	3.5	569.0	317	28.7	588.0	146	13.2	599.0	-	-	-
1971	All	1105	100.0	118	10.6	568.0	677	61.3	597.0	310	28.0	612.0	-	-	-
1972	M	500	50.9	92	9.4	600.0	290	29.6	636.0	115	11.7	640.0	3	0.3	609.0
1972	F	481	49.1	71	7.2	588.0	295	30.1	612.0	113	11.6	621.0	2	0.2	641.0
1972	All	981	100.0	163	16.6	595.0	585	59.7	624.0	228	23.3	631.0	5	0.5	622.0
1973	M	275	46.0	42	7.0	554.6	189	31.6	620.5	44	7.4	655.6	-	-	-
1973	F	323	54.0	56	9.4	560.5	218	36.4	600.7	49	8.2	615.9	-	-	-
1973	All	598	100.0	98	16.4	558.0	407	68.0	610.0	93	15.6	634.7	-	-	-
1974	M	183	46.9	70	19.5	565.5	79	22.1	631.6	17	4.8	653.2	1	0.3	717.0
1974	F	207	53.1	48	13.4	557.6	130	36.3	602.3	13	3.6	626.0	-	-	-
1974	All	390	100.0	118	33.0	562.3	209	58.4	613.4	30	8.4	641.4	1	0.3	717.0
1975	M	106	44.2	4	1.7	549.5	84	36.7	622.1	13	5.7	632.8	-	-	-
1975	F	134	55.8	7	3.1	553.9	108	47.2	595.9	13	5.7	619.0	-	-	-
1975	All	240	100.0	11	4.8	552.3	192	83.8	607.4	26	11.4	625.9	-	-	-
1976	M	292	48.7	53	9.4	571.5	124	22.0	627.7	97	17.2	654.5	-	-	-
1976	F	308	51.3	40	7.1	560.4	135	23.9	598.3	116	20.5	628.0	-	-	-
1976	All	600	100.0	93	16.5	566.7	259	45.8	612.4	213	37.7	640.0	-	-	-

Appendix Table 6. Historical age, length and sex statistics for Kotzebue district commercial fishery chum salmon catches (cont.).

		Combined Totals		3_1			4_1			5_1			6_1		
Year	Sex	Number	Percent	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length	Number	Percent	Mean length
1977	M	260	48.1	23	5.0	591.7	153	33.5	640.8	41	9.0	667.6	6	1.3	694.0
1977	F	280	51.9	15	3.3	577.9	179	39.2	617.2	38	8.3	633.2	2	0.4	635.0
1977	All	540	100.0	38	8.3	586.1	332	72.6	628.1	79	17.3	650.9	7	1.7	677.1
1978	M	302	50.3	51	8.8	569.2	137	23.5	619.6	97	16.6	644.8	2	0.3	660.5
1978	F	298	49.7	56	9.6	565.0	159	27.3	599.8	81	13.9	626.8	-	-	-
1978	All	600	100.0	107	18.4	567.0	296	50.8	608.9	178	30.5	636.6	2	0.3	660.5
1979	M	364	52.8	106	16.1	575.9	179	27.2	622.1	59	9.0	648.7	8	1.2	658.8
1979	F	326	47.2	76	11.5	563.0	163	24.8	598.8	62	9.4	631.1	5	0.8	634.0
1979	All	690	100.0	182	27.6	570.5	342	52.0	611.0	121	18.4	639.7	13	2.0	649.2
1980	M	406	56.4	55	7.8	563.3	312	43.9	616.3	33	4.6	638.9	1	0.1	625.0
1980	F	314	43.6	44	6.2	553.8	240	33.8	594.7	25	3.5	624.4	-	-	-
1980	All	720	100.0	99	13.9	559.0	552	77.8	606.9	58	8.2	632.6	1	0.1	625.0
1981	M	575	47.3	21	1.8	578.8	342	29.3	615.2	187	16.0	643.5	-	-	-
1981	F	641	52.7	18	1.5	555.3	409	35.1	592.2	189	16.2	617.3	-	-	-
1981	All	1216	100.0	39	3.3	567.9	751	64.4	602.6	376	32.2	630.3	-	-	-

1/ These numbers are for total sample and includes those fish that could not be aged.
2/ No data for this year.

APPENDICES B

Calibration Cc s

River______________________ Location____________________ Bank____________________

Date	Counter Initials	Left of Target			Right of Target			Total		
		Scope	Printer	Percent	Scope	Printer	Percent	Scope	Printer	Percent

Appendix B2

Daily Sonar Counts - by Sector

River ______________ Location __________________ Bank - ______________

	Sector Counts												
Date	1	2	3	4	5	6	7	8	9	10	11	12	Total

Daily Sonar Counts

Location:______________ Bank:______________ Date:______________

	Sector												
Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
1:00 am													
2:00 am													
3:00 am													
4:00 am													
5:00 am													
6:00 am													
7:00 am													
8:00 am													
9:00 am													
10:00 am													
11:00 am													
Noon													
1:00													
2:00													
3:00 pm													
4:00 pm													
5:00 pm													
6:00 pm													
7:00 pm													
8:00 pm													
9:00 pm													
10:00 pm													
11:00 pm													
Midnight													
Totals													
Percent													
Auto Test													

Dead Range:______________ft. Live Range:__________ft. Mode:______________

Remarks:

Appendix B

Daily Adjusted Sonar nt

River ________________ Location ___________________

Date	Left Bank			Right Bank			Total Unadjusted Count	Total Adjusted Percent	Percent Difference	Count Adjusted Count
	Unadjusted Count	Calibration Percent	Adjusted Count	Unadjusted Count	Calibration Percent	Adjusted Count				

Appendix

Sonar Count by Species

River ____________ Location ____________ Bank ____________

Date	Adjusted Sonar Count	Chum Test Net CPUE Percent	Chum Sonar Count	Cumulative Chum Sonar Count	Pink Test Net CPUE Percent	Pink Sonar Count	Cumulative Pink Sonar Count	Char Test Net CPUE Percent	Char Sonar Count	Cumulative Char Sonar Count

Appendix P

Daily Adjusted Sona unt By Species

River ____________ Location ____________ Bank ____________

Date	Chum		Pink		Char		Total	
	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative

Test Net Record

ver ____________ Location ______________ Species ______________

Date	Catch	Hours	CPUE	Cumulative Number Caught	Cumulative Net Hours	Cumulative CPUE

NET LOG

River ________________ Location ____________ Year ________ Bank _____

Date	Net In	Net Out	Hours Fished	Chum Catch		Catch Per Hour	Other Fish	Comments
				Males	Females			

AYK Form 17

DISTRICT	SECTION OR SUB-DISTRICT	RIVER (Stream)	SAMPLING LOCATION	PROJECT	DATE MONTH	DATE DAY	DATE YEAR	Fishing PERIOD	GEAR	MESH SIZE	SAMPLE NUMBER
										/	

UNIT OF MEASUREMENT		Check
	ENGLISH (1)	
	METRIC (2)	

TYPE OF LENGTH MEASUREMENT	

AGE CLASS DESIGNATION		Check
	GILBERT/RICH (1)	
	EUROPEAN (2)	

Sp No	Spec.	SEX M	SEX F	LENGTH	WEIGHT	AGE CLASS	A	B	C	D	E	F	G	H	I
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
17															
18															
19															
20															
21															
22															
23															
24															
25															
26															
27															
28															
29															
30															
31															
32															
33															
34															
35															
38															
39															
40															
Total Each Sex															

Scales Read By: ____________________