AYK Region
Yukon Salmon Escapement
Report No. 33

Sheenjek River Salmon Escapement Enumeration, 1986

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December 1987

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ABSTRACT

Fall chum salmon escapement in the Sheenjek River was monitored by hydroacoustic techniques for the sixth consecutive year in 1986. The sonar-estimated escapement was 83,197 from 17 August to 24 September with the mean date of run passage occurring on 3 September. Approximately 46% of the sonar estimate was observed prior to 31 August. Daily upstream migration was primarily confined to periods of darkness with peak hourly passage occurring on the average between 0300 and 0400 hours.

Age composition as revealed from beach seine and carcass samples was 8% age 3_1 fish; 41% age 4_1 fish; and 50% age 5_1 fish. Less than 1% of the fish sampled were age 6_1. Fall chum salmon samples were also collected for subsequent analysis in support of on-going stock separation studies.

KEY WORDS: Fall chum salmon, Oncorhynchus keta, hydroacoustic, sonar, escapement, enumeration, Yukon River, Porcupine River, Sheenjek River.

INTRODUCTION

Yukon River fall chum salmon are in great demand commercially and are harvested in 6 fishing districts in the Alaskan portion of the drainage. Commercial harvest also occurs in the Canadian portion of the drainage near Dawson. Although commercial harvest is permitted in portions of the Tanana River, none is permitted in the Koyukuk or Porcupine River drainages. The majority of commercial catches are presently made in the lower river, downstream of the village of Anvik. However, value of fall chum salmon as a subsistence item is far greater throughout the upper river, upstream of the village of Koyukuk. Fall chum salmon are larger, spawn later, and are less abundant than their counterpart, summer chum salmon. They primarily spawn in the upper Yukon River drainage (upstream of the village of Tanana) in spring-fed tributaries which usually remain ice-free during the winter.

During the period 1960 through 1980, only various segments of annual returns of fall chum salmon were occasionally estimated from mark-and-recapture studies. Excluding these tagging studies and apart from aerial assessment of selected tributaries since the early 1970's, comprehensive enumeration studies were sporadic and limited to only 2 streams through 1980; the Fishing Branch River (Porcupine River drainage) and Delta River (Tanana River drainage).

Although total abundance estimates for fall chum salmon returns to the Yukon River are still lacking, comprehensive escapement enumeration studies have intensified throughout the drainage in recent years, particularly in 1985 and 1986. The Canadian Department of Fisheries and Oceans (DFO) estimated, by mark-and-recapture methods, the abundance of fall chum salmon crossing the U.S./Canada border into the Yukon Territory in 1982 and 1983 (Milligan et al. 1984) and again in 1985 and 1986. Escapement to the Fishing Branch River was monitored by DFO with reinstallation of a weir in this stream in 1985 and 1986. Fall chum salmon escapement to the Chandalar River was estimated for the first time in 1986 with the operation of hydroacoustic equipment by the U.S. Fish and Wildlife Service (USFWS) (Simmons in preparation).

The Alaska Department of Fish and Game (ADF&G) has attempted to estimate the total number of fall chum salmon in the mainstem Yukon River passing Pilot Station (rivermile 122) in both 1985 (Mesiar et al. 1986) and 1986 (Thompson and Mesiar 1987). Total abundance of fall chum salmon spawners in the Delta River was estimated by ADF&G in 1985 and 1986 based upon a spawner time-density curve developed by Barton (1986a). Finally, Sheenjek River fall chum salmon run timing and escapement abundance has been estimated annually since 1981 using hydroacoustic techniques.

STUDY AREA

The Sheenjek River heads in the glacial ice fields of the Romanzof Mountains, a northeastern extension of the Brooks Range, and flows southward approximately 250 rivermiles to its confluence with the Porcupine River. Although created by glaciers, the river's numerous clearwater tributaries quickly convert it to a clearwater stream. Water clarity is somewhat unpredictable, but is generally clearest during periods of low

water; water level normally begins dropping in late August and September. Upwelling ground water composes a significant proportion of the river flow volume, especially in winter, and it is in these spring areas that fall chum salmon spawn, particularly within the lower 100 miles of the river. An escapement objective of 40,500 fall chum salmon was established for the Sheenjek River in 1985. 1/

OBJECTIVES

Overall objectives of the 1986 Sheenjek River fall chum salmon study were to determine the timing and magnitude of adult salmon escapement and to collect age, sex, and size information on sampled portions of the run. The following specific objectives were identified:

1. estimate timing and magnitude of the fall chum salmon escapement using hydroacoustical techniques;

2. estimate age, sex, and size composition of the spawning population;

3. support stock separation studies based upon scale pattern analysis (SPA) and protein-gel electrophoretic analysis by collecting fall chum salmon scales and tissue/organ samples;

4. monitor selected climatological and hydrological parameters daily at the project site for use as baseline data.

MATERIALS AND METHODS

Two 1981-model, Bendix side-scanning sonar counters were operated at approximately rivermile 6 on the Sheenjek River in 1986 at the same counting site used in 1985 (Figures 1 and 2). One counter was operated from either bank and without deployment of artificial substrates. Fish leads were constructed to shore from each deployed transducer, preventing salmon from passing upstream inshore of the transducers. A 20-foot aluminum counting tower was assembled and deployed near the west bank transducer to facilitate visual and oscilloscope calibrations of the west bank sonar counter. Installation and operational procedures of each counter was the same as in previous years.

Daily oscilloscope-sonar counter calibrations were made for each counter and calibration procedures were the same as described by Barton (1983).

An adult salmon beach seine (100 feet long, 66 meshes deep, 2.5-inch stretch measure mesh) was periodically fished at approximately rivermile 12 to sample adult salmon for age, sex, and size composition. Captured fish were enumerated by species. Chum salmon were sexed by external examination, measured to the nearest 5 millimeters from mideye to fork of tail, and scale sampled for subsequent SPA studies. Three scales were

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1/ The current escapement objective for the Sheenjek River is 62,000 fall chum salmon.

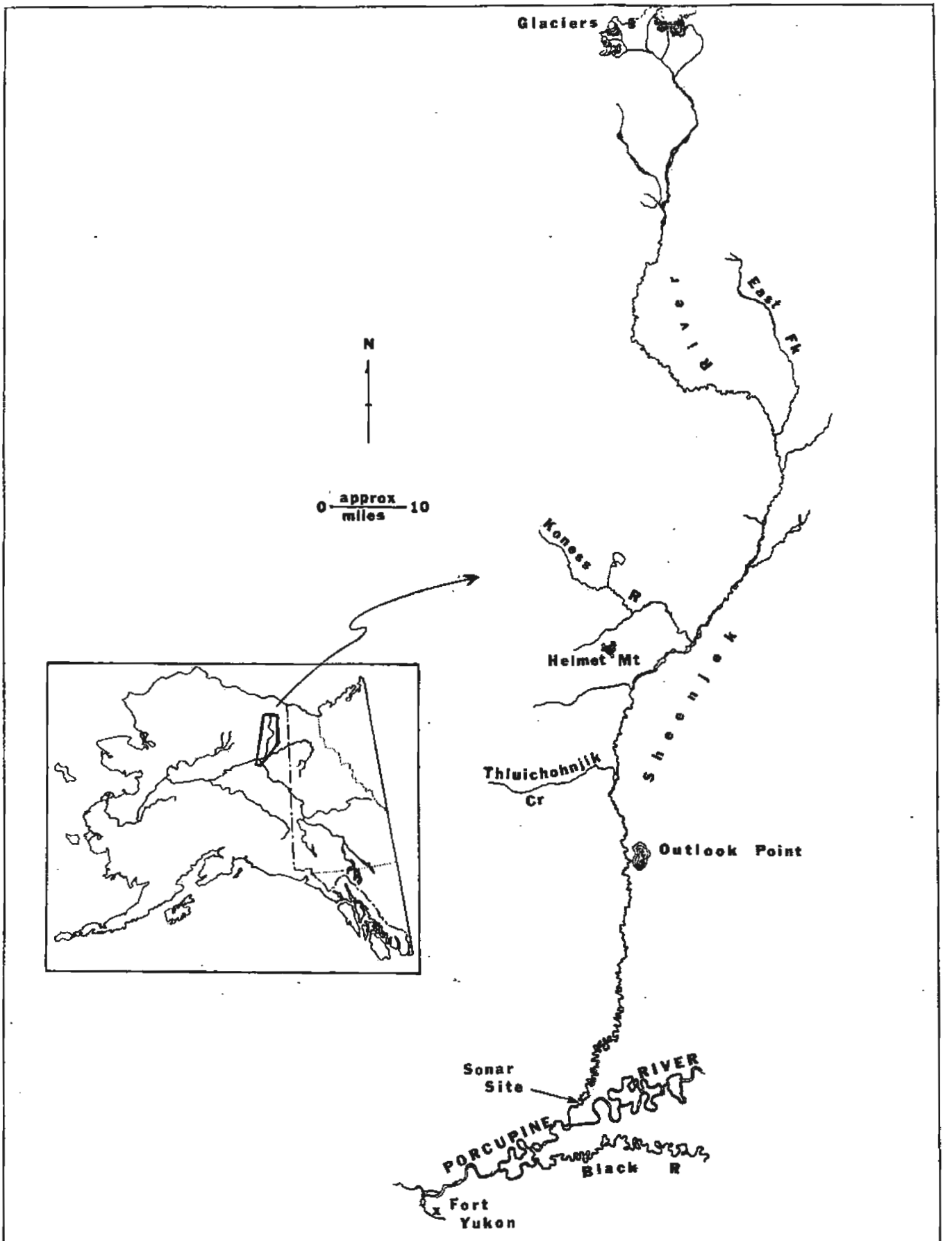

Figure 1. Sheenjek River drainage.

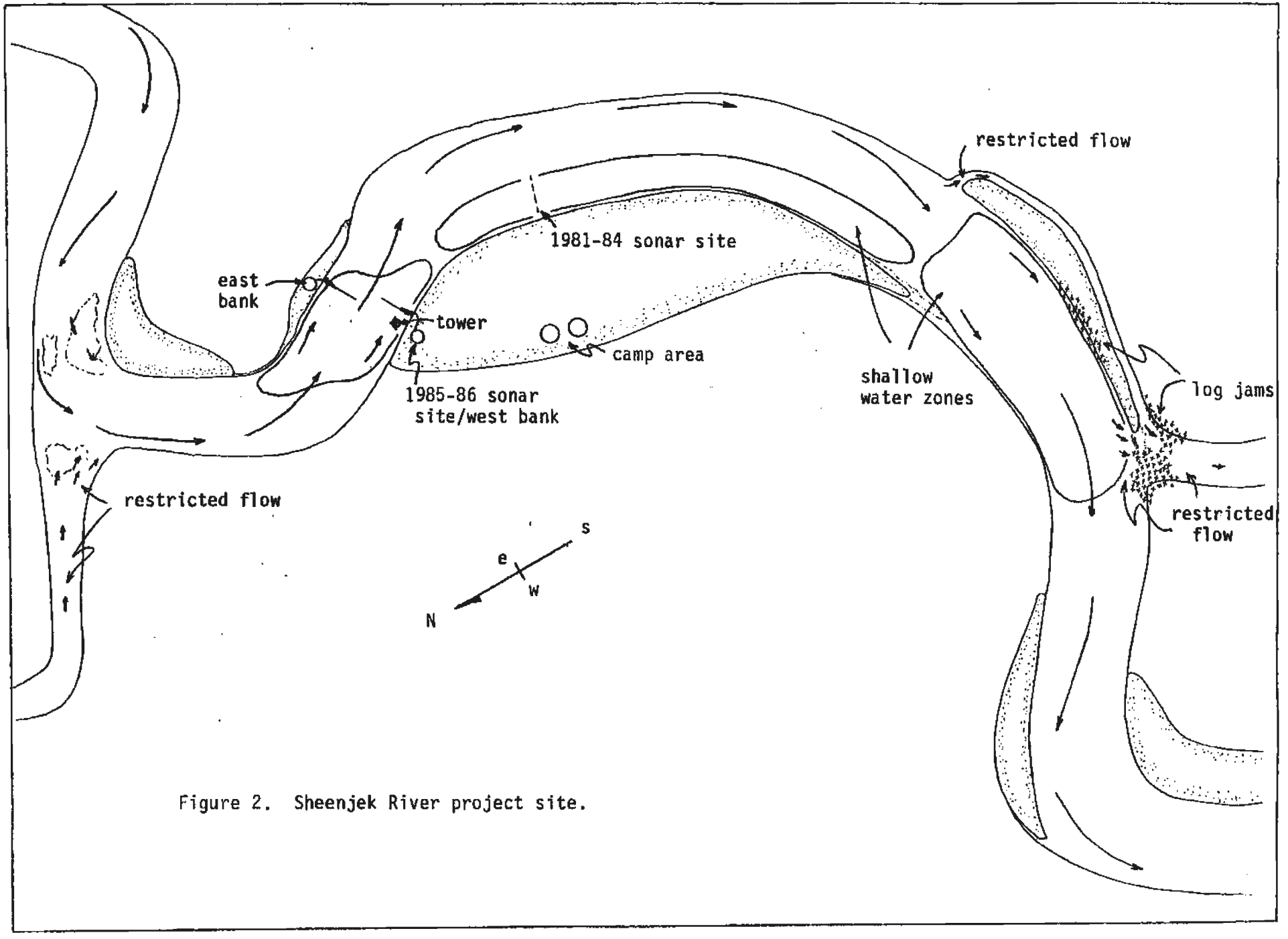

Figure 2. Sheenjek River project site.

removed from an area posterior to the base of the dorsal fin and above the lateral line on the left side of each fish. A small section of spine (3-4 vertebrae) was removed from an area posterior to the anal fin of each fish for subsequent age determinations.

One hundred fifty chum salmon were further sampled for subsequent electrophoretic analysis. Tissue samples collected from each of these fish included muscle, heart, and liver. The tissue samples from each fish were individually bagged and placed into coolers containing dry ice before being flown to Fairbanks for freezing. Containers were labeled according to location, species, and date(s) samples were collected and then forwarded to the Canadian DFO office in Nanaimo, B.C. for subsequent processing.

A depth profile was made at the counting site on 17 August by stretching a one-quarter-inch rope across the river and measuring water depth every 10 feet with a precalibrated spruce pole (Figure 3). A river water level gauge (meter stick) was installed at the sonar site on 18 August. Daily changes in water level and surface water temperature were measured at noon (Appendix Table 1). Surface water velocity was measured daily at each sonar transducer with a digital flow meter (Appendix Table 2 and Figure 4). Other daily observations included recording the occurrence of precipitation and percent cloud cover.

An aerial survey was flown of the Sheenjek River fall chum salmon spawning areas in a PA-18 (Super Cub) on 2 October to estimate abundance and distribution of adult salmon spawners.

RESULTS AND DISCUSSION

Timing

In 1986, the west and east bank sonar counters became functional on 17 and 19 August, respectively. This represents approximately 2 weeks earlier in start-up of fall chum salmon enumeration on the Sheenjek River compared to previous years:

Year	Starting Date	Ending Date	Total Days Monitored
1981	31 August	24 September	25
1982	31 August	22 September	23
1983	29 August	24 September	27
1984	30 August	25 September	27
1985	2 September	29 September	28
1986	17 August	24 September	39

Although sonar operations have terminated each year prior to the end of the salmon run by an unknown number of days, it is hypothesized that a

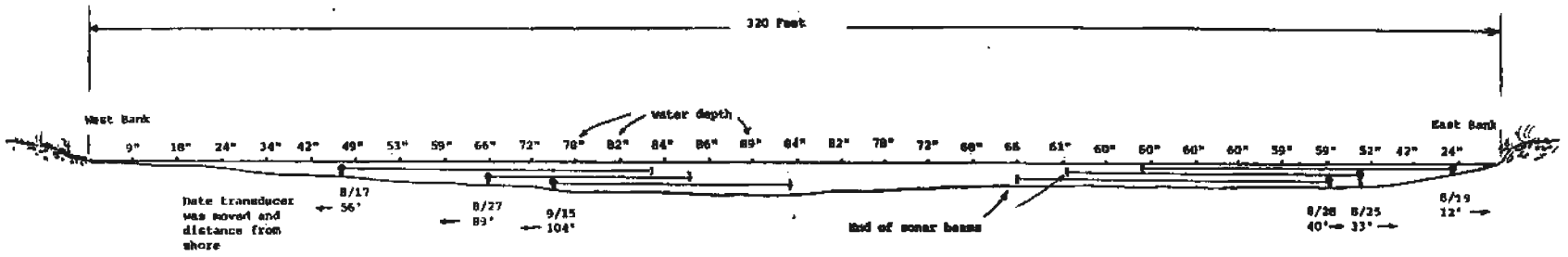

Figure 3. Sheenjek River depth profile at the sonar counting site on 17 August 1986. Also shown are subsequent dates and locations of east and west bank transducer placement.

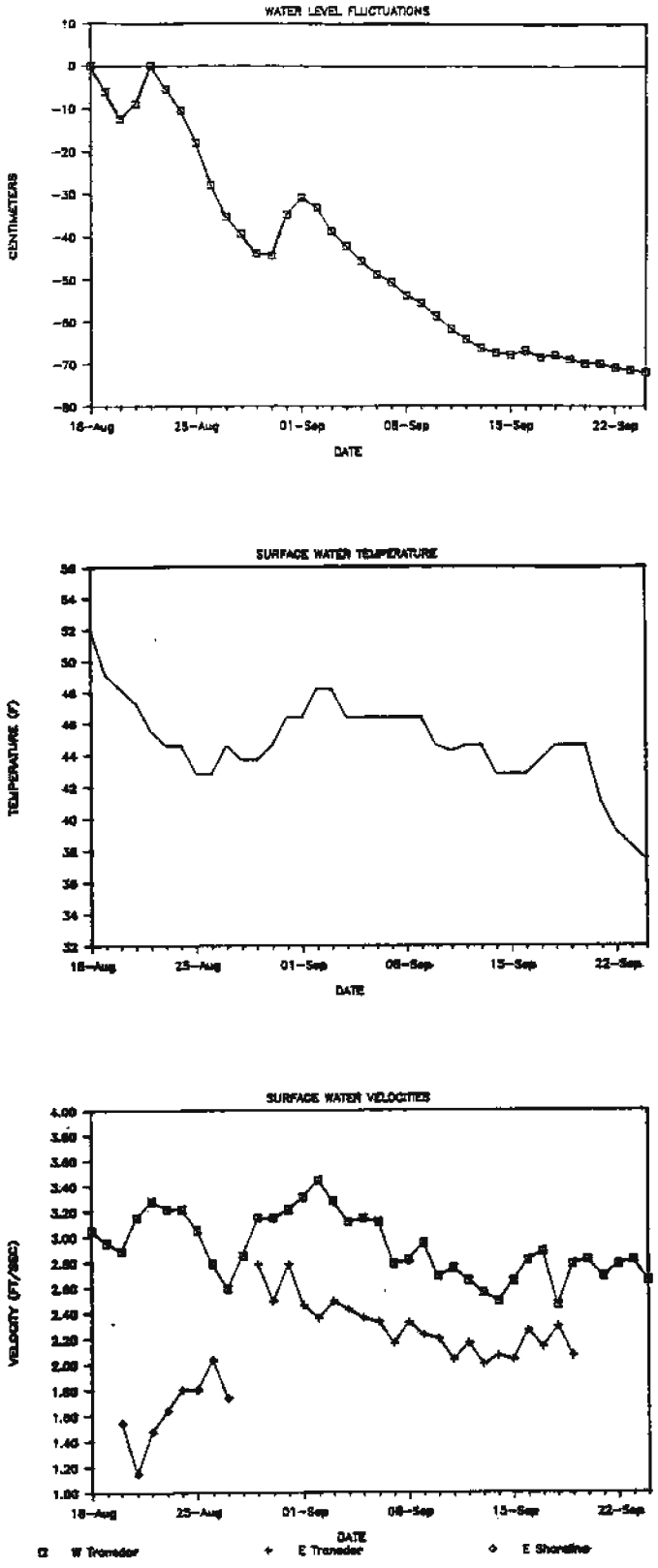

Figure 4. Water level fluctuations, surface temperatures, and surface velocities at the Sheenjek River project site from 18 August through 24 September 1986.

relatively small portion of the total run passes subsequent to the termination of annual sonar operations in most years based upon results of historic aerial surveys. Generally, salmon are present and spawning at most major spawning areas in the Sheenjek River by late September.

Based upon a time-density model developed by Mundy (1982, 1984) to describe salmon migration run timing, timing of the 1986 fall chum salmon run to the Sheenjek River was one of the earliest observed since sonar enumeration on this river began in 1981. The pattern of the migration is described by the mean date of passage (a measure of central tendency) and the standard deviation (a measure of dispersion). These statistics are calculated from the proportion of the total escapement occurring each day. Further, the median date is the date by which 50% of the sonar estimate is made. These statistical parameters are given below for the migration of fall chum salmon into the Sheenjek River during the past 6 years:

Year	Mean Date	Standard Deviation	Median Date	Duration of Project (days)
1981	8 September	5.12	7 September	25
1982	12 September	6.50	14 September	23
1983	13 September	7.26	14 September	27
1984	11 September	7.67	9 September	27
1985	18 September	7.46	20 September	28
1986	3 September	8.96	31 August	38

It is likely that the 1986 run was nearly the same (if not slightly later) as that observed in 1981. Duration of counting in 1981 was from 31 August to 24 September with a mean date of run passage indicated as 8 September. If daily counts observed in 1986 for the same period as monitored in 1981 (i.e., 31 August to 24 September) are subjected to the time-density model, the mean and median dates of run passage would have been shown as 10 September and 9 September, respectively. Thus, it is likely that timing of the 1981 and 1986 runs were very similar and earlier than fall chum salmon run timing in the Sheenjek River observed in 1982 through 1985 (Figure 5). It is thus plausible to assume a higher proportion of the run in 1981 was unsampled in the 2 weeks prior to sonar operations than in 1982 through 1985. The latest run in the Sheenjek River was observed in 1985.

The diel pattern exhibited by migrating salmon in 1981 through 1984 was again manifest in 1986. Upstream migration commenced with the onset of darkness and continued through hours of suppressed light. Overall, the period of greatest upstream movement in 1986 occurred between 2100 and 0600 hours of the following morning (Figure 6). Peak hourly passage occurred between 0300 and 0400 hours when, on the average, 9.22% of a day's count was made. In only a single year since sonar operations have been conducted on the Sheenjek River (1985) has the diel pattern in migration not been exhibited. In that year it was speculated that increased movement during periods of daylight was related to density-dependent factors, i.e., a large run size and late run timing (Barton 1986b).

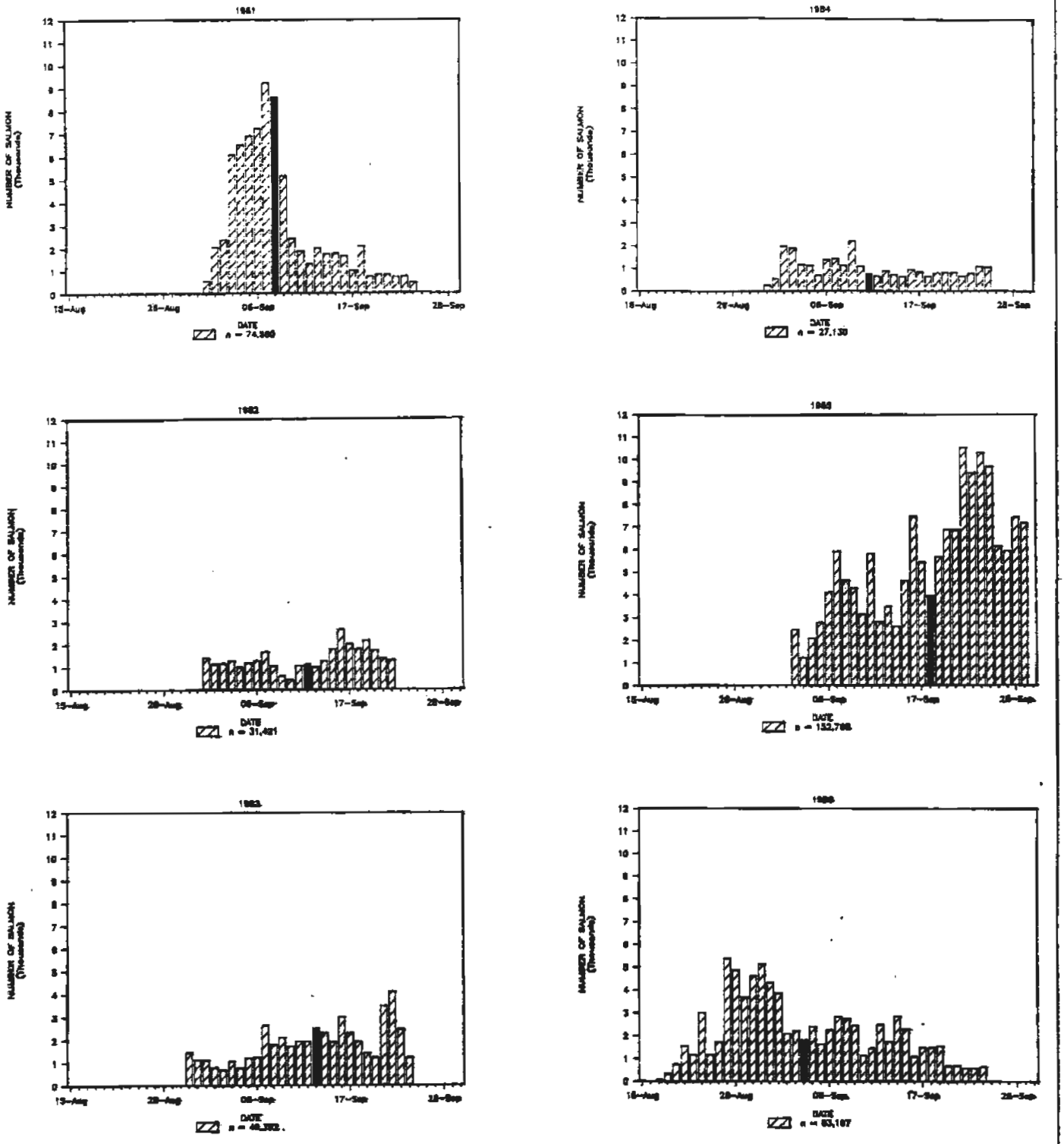

Figure 5. Fall chum salmon escapement timing in the Sheenjek River 1981-1986. Mean date of passage is represented by shaded bar.

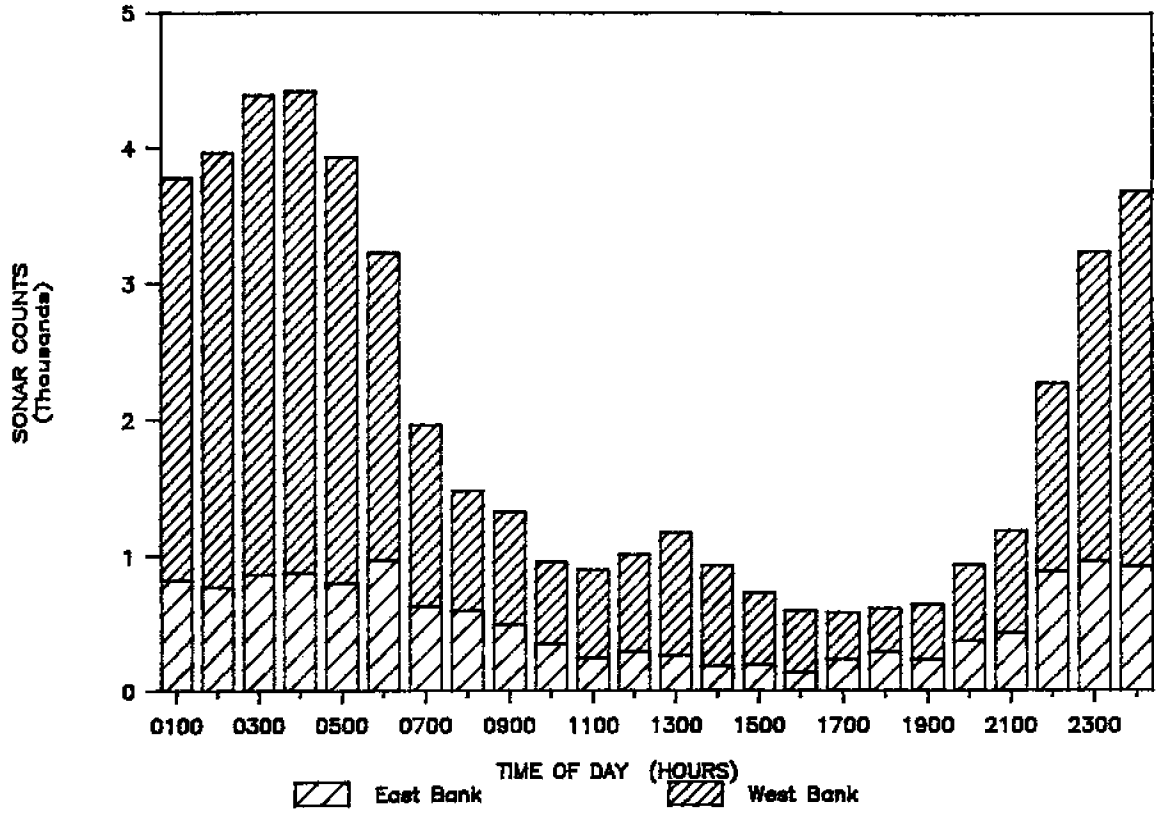

Figure 6. Average migration (percent) of Sheenjek River fall chum salmon past the sonar site by time of day from 17 August through 24 September 1986.

Abundance

The west bank sonar counter became functional by 2100 hours on 17 August and operated through 0800 hours on 24 September. The east bank sonar counter was operating by noon on 19 August and removed at approximately 1000 hours on 18 September due to electronic failure.

Sonar counts were adjusted daily based upon oscilloscope calibrations of each counter. A total of 188 calibration periods averaging 24 minutes each occurred with the west bank counter, while 148, 24-minute calibration periods occurred with the east bank counter. The lower number of periods associated with the east bank counter reflects early removal of that unit. In total, 336, 24-minute calibrations for approximately 134 hours were made for both sonar counters:

Time of Day	West Bank	East Bank	Total
0001-1200 hrs	24.6 hrs (32.9%)	20.0 hrs (33.5%)	44.6 hrs (33.2%)
1201-2400 hrs	50.0 hrs (67.1%)	39.6 hrs (66.5%)	89.6 hrs (66.8%)
Total	74.6 hrs	59.6 hrs	134.2 hrs

The east bank sonar counter was shut down on 18 September due to electronic failure, 7 days earlier than the west bank counter. Estimates for fish passing the east bank were made for those 7 days by multiplying the west bank adjusted counts by a factor of 0.4981; the average percentage that east bank counts were of west bank counts for the period 5-17 September. The resulting total adjusted east and west bank sonar count was 14,571 and 35,592, respectively, or 50,163 for both banks combined for the period 17 August through 24 September (Table 1).

Actual counting range for the west bank sonar counter varied throughout the season from 44 to 80 feet while that for the east bank varied from 30 to 90 feet, depending upon initial placement and subsequent relocation of transducers as necessitated by fluctuations in river water level (Appendix Tables 3 and 4). Consequently, the uninsonified zone in midstream (i.e., the distance between the ends of the 2 sonar beams) also varied throughout the season and ranged from a maximum of 193 feet on 17 August to a minimum of 50 feet on 17-18 September. This represents a much larger uninsonified zone than was experienced in 1985 (35 feet).

Unfortunately, distribution of fish passing through each sonar beam could not be accurately determined from examination of counts by electronic sector due to the inability to adjust target "valid hit" criteria by electronic sector on the 1981 model counters. It was observed that when fish were accurately being counted in nearshore sectors they were often being over or undercounted in offshore sectors (or vice versa). It was hypothesized that this was due to differences in fish swim speeds relative to water velocities at a given location. Whereas, the overall adjusted

Table 1. Adjusted east and west bank sonar counts and estimated number of salmon passing the sonar site in midstream in the Sheenjek River, 17 August - 24 September, 1986.

Date	Adjusted East Bank Sonar Count	Adjusted West Bank Sonar Count	Estimated No Chums Passing in Mid-stream	Daily		Cumulative	
				Number	Percent	Number	Percent
17-Aug	8 a	37 b	23	68	0.1%	68	0.1%
18-Aug	45 a	203	97	345	0.4%	413	0.5%
19-Aug	53 a	290	426	769	0.9%	1,182	1.4%
20-Aug	101	530	945	1,576	1.9%	2,758	3.3%
21-Aug	160	568	450	1,178	1.4%	3,936	4.7%
22-Aug	418	1,159	1,446	3,023	3.6%	6,959	8.4%
23-Aug	149	521	507	1,177	1.4%	8,136	9.8%
24-Aug	100	722	911	1,733	2.1%	9,869	11.9%
25-Aug	523	2,140	2,711	5,374	6.5%	15,243	18.3%
26-Aug	829	1,369	2,677	4,875	5.9%	20,118	24.2%
27-Aug	346	1,631	1,735	3,712	4.5%	23,830	28.6%
28-Aug	274	1,635	2,724	4,633	5.6%	28,463	34.2%
29-Aug	462	2,470	2,218	5,150	6.2%	33,613	40.4%
30-Aug	930	2,108	1,298	4,336	5.2%	37,949	45.6%
31-Aug	952	1,844	1,093	3,889	4.7%	41,838	50.3%
01-Sep	429	1,165	507	2,101	2.5%	43,939	52.8%
02-Sep	363	932	935	2,230	2.7%	46,169	55.5%
03-Sep	251	1,017	551	1,819	2.2%	47,988	57.7%
04-Sep	962	768	676	2,406	2.9%	50,394	60.6%
05-Sep	482	764	399	1,645	2.0%	52,039	62.5%
06-Sep	581	1,227	457	2,265	2.7%	54,304	65.3%
07-Sep	617	1,425	807	2,849	3.4%	57,153	68.7%
08-Sep	634	1,281	645	2,760	3.3%	59,913	72.0%
09-Sep	609	1,272	588	2,469	3.0%	62,382	75.0%
10-Sep	382	397	352	1,131	1.4%	63,513	76.3%
11-Sep	429	701	331	1,461	1.8%	64,974	78.1%
12-Sep	299	1,293	908	2,500	3.0%	67,474	81.1%
13-Sep	337	828	586	1,751	2.1%	69,225	83.2%
14-Sep	392	999	1,475	2,866	3.4%	72,091	86.7%
15-Sep	340	1,059	891	2,290	2.8%	74,381	89.4%
16-Sep	258	320	521	1,099	1.3%	75,480	90.7%
17-Sep	381	359	748	1,488	1.8%	76,968	92.5%
18-Sep	330 c	662	489	1,481	1.8%	78,449	94.3%
19-Sep	263 c	529	756	1,548	1.9%	79,997	96.2%
20-Sep	137 c	275	267	679	0.8%	80,676	97.0%
21-Sep	94 c	188	422	704	0.8%	81,380	97.8%
22-Sep	105 c	210	262	577	0.7%	81,957	98.5%
23-Sep	144 c	289	154	587	0.7%	82,544	99.2%
24-Sep	202 c	405 d	46	653	0.8%	83,197	100.0%
Total	14,571	35,592	33,034	83,197			

a Estimates based upon the average proportion east bank counts were of west bank counts on 19-21 August.
b Original sonar estimate was for 2100-2400 hours. Estimate was expanded to 37 based upon the average daily proportion of west bank counts from 2100-2400 hours on 18-20 August.
c Estimates based upon the average proportion east bank counts were of west bank counts on 5-17 September.
d Original sonar estimate was for 0001-1000 hours. Estimate was expanded to 405 based upon the average daily proportion of west bank counts from 0001-1060 hours on 21-23 September.

counts for each sonar counter are accurate, counts per electronic sector cannot be used to accurately document upstream-migrant salmon distribution. The same phenomenon was also observed in 1985 at the present site (Barton 1986b).

Since it was apparent from visual observations from the counting tower that salmon were indeed passing upstream in the uninsonified zone, the following technique was used to estimate that number:

$$X_n = \sum_{i=1}^{I} \left(\frac{C_{16ni}}{D_{16ni}} \; Z_{ni} \right)$$

where: X_n = Number of salmon to midriver in uninsonified zone for counter n

C_{16ni} = Adjusted count in sector 16 for counter n on day i

D_{16ni} = Linear distance (in feet) of sector 16 for counter n on day i

Z_{ni} = Uninsonifed zone (in feet) to midriver from counter n on day i

n = East or west bank counter

I = Total number of days sonar counter operated

The above equation was used with the west bank data to estimate midriver fish through 14 September. The equation was modified to estimate midriver fish (using west bank data) for the period 15-24 September. Movement of the west bank transducer and readjusted counting range left only 1 foot between the end of the sonar beam and midriver for that period (15-24 September). However, fish were still being counted in sector 16. Consequently, "Z" in the above equation (which was 1 foot) was subjectively given a value of 25 feet; extending the west bank midriver uninsonified estimate to 24 feet beyond midriver for this period of time. No fish were counted in sector 16 of the east bank counter after 11 September and thus the estimate of midriver counts, using east bank data subsequent to that date, was zero (Appendix Tables 3 and 4).

An estimate of 33,034 fish was made for salmon passing the sonar site in the uninsonified zone resulting in a total sonar-estimated escapement of 83,197 fall chum salmon for the period 17 August through 24 September (see Table 1). The proportion of the 1986 sonar-estimated escapement which was observed prior to 31 August (the 2-week early start-up period) was approximately 45.6% (37,949). If run timing in 1981 was in fact similar to that of 1986 (as suggested earlier), total escapement in that year may have been on the order of magnitude of 137,000 fall chum salmon. Good escapement to the Sheenjek River in 1981 is also supported by the higher-than-usual proportion of age 5 fish which returned in 1986 (see following section).

An aerial survey was flown of the Sheenjek River from the mouth upstream to the vicinity of Haystack Mountain (approximately rivermile 80) on 2 October. The survey was given an overall rating of "poor" due to high winds and turbulence, making observations difficult. A total of 12,659 fall chum salmon were enumerated (12,101 live and 558 dead). Spawning was judged to be at peak. The aerial survey attributed to only 15.2% of the total sonar-estimated escapement for the season.

Age, Sex, and Size Composition

A total of 18 beach seine hauls on 7 separate days from 5-22 September resulted in a catch of 376 (145 males, 231 females) chum salmon, 11 Arctic grayling, and 11 round whitefish (Appendix Table 5). Three hundred twenty-nine of these chum salmon were sampled for sex, size, scales, and vertebrae. One hundred fifty were additionally sampled for subsequent electrophoretic analysis. An additional 121 chum salmon carcasses (57 males, 64 females) were collected from gravel bars on 14 and 22 September and all sampled for sex, size, scales, and vertebrae.

Legible vertebrae from 442 chum salmon revealed age composition to be as follows:

Age 0.2	=	8.1%	(brood year 1983)
Age 0.3	=	41.2%	(brood year 1982)
Age 0.4	=	50.0%	(brood year 1981)
Age 0.5	=	0.7%	(brood year 1980)

The male-to-female ratio of the age samples was 1.0:1.2 with males larger than females for a given age group (Table 2 and Figure 7).

Table 3 contains historic age composition data for Sheenjek River chum salmon escapement samples. With the exception of 1986, all other age determinations were made from scales. Clark (1986 unpublished) found in a study using fall chum salmon spawners from the Delta and Toklat rivers (Tanana River drainage) in 1985, that vertebrae tended to represent fall chum salmon ages as older than age determinations from scales. This he attributed to the tendency of scales to erode or be absorbed as migration to the spawning grounds proceeded, while vertebrae do not. The greatest differences in age composition occurred in the proportion of age 5 (0.4) fish for both Delta and Toklat river samples. Vertebrae tended to represent a higher proportion of fish as age 5 than did scales.

Fluctuations in age composition can be explained by differences in abundance between year classes. For example, age 3 (0.2) fish predominated the 1974 samples (66%), reflecting a very large year class (1971) that returned predominantly in 1975. In subsequent years, excluding 1979 and 1980 when no samples were collected, age 4 (0.3) fish usually predominated, followed by age 5 (0.4) fish. Samples were collected with gillnets in 1981, 1982, and 1983 and consequently, age 3 fish may be underrepresented while the proportion of older aged fish overrepresented in those years. The high proportion of age 5 fish in 1986 reflects a strong 1981 year class.

Table 2. Mean length at age (by sex) of fall chum salmon sampled in the Sheenjek River in 1986. a

	Brood Year and Age Group				
	1983	1982	1981	1980	
	0.2	0.3	0.4	0.5	Total
FEMALES					
Length	555	576	589	—	581
Standard Deviation	25.19	28.32	29.77	—	31.07
Sample Size	21	98	120	2	241
Percent	4.8%	22.2%	27.2%	0.4%	54.5%
MALES					
Length	570	601	631	—	614
Standard Deviation	30.36	30.48	31.54	—	36.45
Sample Size	15	84	101	1	210
Percent	3.4%	19.0%	22.9%	0.2%	45.5%
SEXES COMBINED					
Length	561	587	609	—	596
Standard Deviation	28.37	31.79	37.05	—	37.3
Sample Size	36	182	221	3	442
Percent	8.1%	41.2%	50.0%	0.7%	100.0%

a Ages were determined from vertebrae and designated using European method.
Lengths were measured from mid-eye to fork of tail to nearest 5 millimeters.

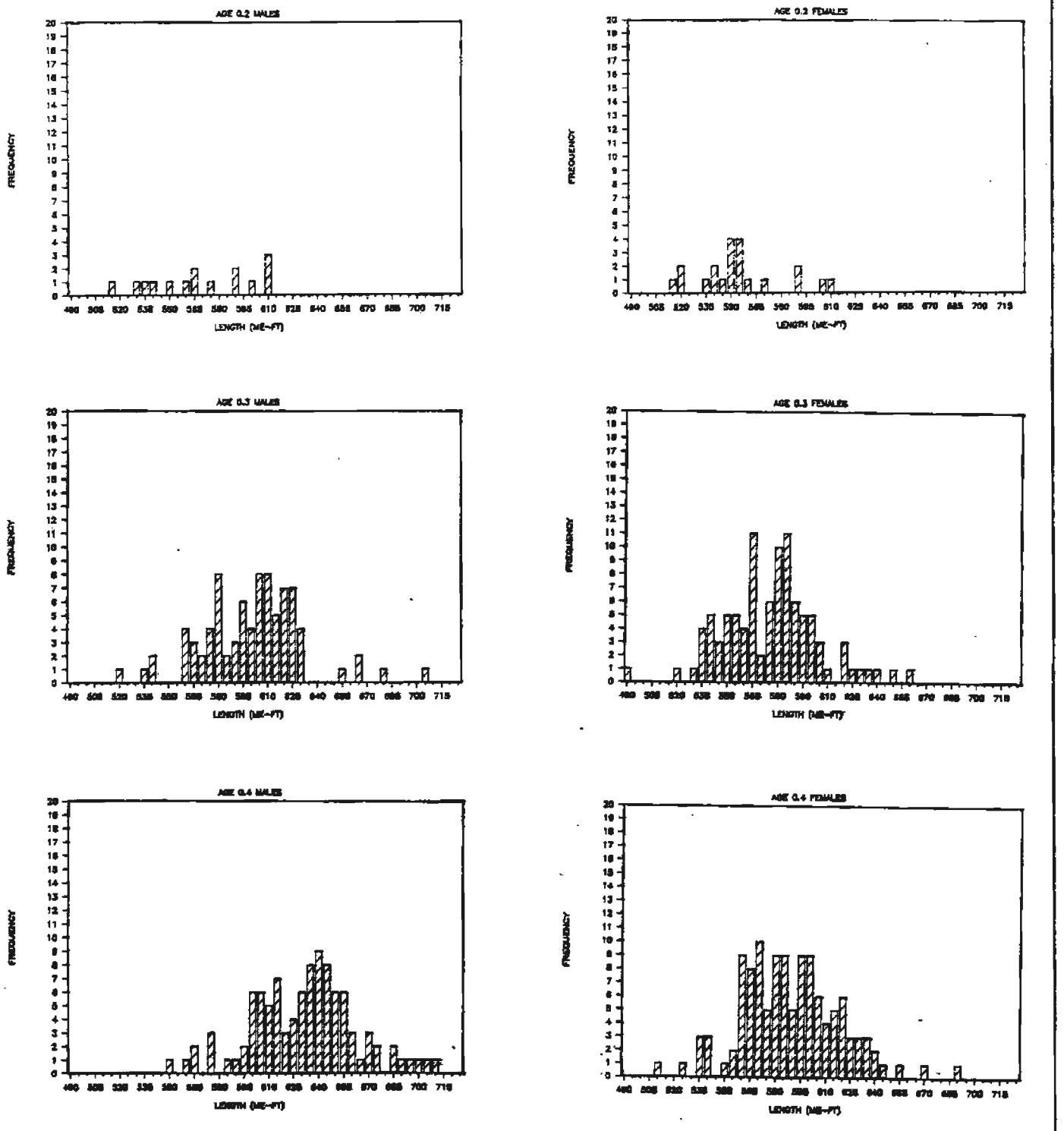

Figure 7. Length frequency distributions by sex and age groups of Sheenjek River fall chum salmon sampled in 1986.

Table 3. Comparative age compostion of Sheenjek River fall chum salmon escapements, 1974-1986. a

Year	Age 0.2	Age 0.3	Age 0.4	Age 0.5	Sample Size
1974 b	66%	30%	3%	0%	137
1975 b	3%	95%	2%	1%	197
1976 b	2%	44%	54%	0%	118
1977 b	11%	73%	16%	0%	178
1978 b	8%	82%	10%	0%	190
1979	—	—	—	—	—
1980	—	—	—	—	—
1981 c	3%	85%	12%	Trace	340
1982 c	3%	47%	50%	Trace	109
1983 c	6.5%	87%	6.5%	0%	108
1984 d	10%	81%	9%	0%	297
1985 d	1%	93%	6%	0%	513
1986 d,e	8%	41%	50%	1%	442

a All age determinations were from scales unless otherwise indicated. Age designation is European.

b Carcass samples handpicked from the spawning grounds.

c Escapement samples taken with 5-7/8 inch mesh gillnets at sonar site. Thus results are biased towards older age fish.

d Escapement samples taken with beach seine at rivermile 12.

e Age determination was by vertebrae.

SUMMARY

1. The 1986 Sheenjek River sonar-estimated escapement from 17 August to 24 September was 83,197 fall chum salmon, including an estimated 33,034 which passed upstream between counting units in the uninsonified zone. This represents slightly in excess of double the escapement objective established for the 1986 season in this stream (40,500).

2. Nearly 46% of the sonar-estimated escapement in 1986 was observed prior to 31 August. Mean and median dates of run passage were 3 September and 31 August, respectively.

3. Daily upstream migration of chum salmon was primarily confined to periods of darkness or suppressed light. Peak hourly passage occurred between 0300 and 0400 hours when, on the average, 9.22% of a day's count was observed.

4. A good aerial survey of the Sheenjek River to estimate fall chum salmon spawning abundance was not obtained in 1986.

5. The chum salmon sex ratio in 1986 was 39% males and 61% females based upon beach seine samples at rivermile 12 from 5-22 September. Carcass surveys in the same vicinity on 14 and 22 September resulted in a sex ratio of 47% males and 53% females. Overall age composition as determined from vertebrae was approximately 8% age 3 fish; 41% age 4 fish; and 50% age 5 fish. Less than 1% of the fish sampled were age 6.

6. Tissue/organ samples were collected from 150 chum salmon and forwarded to the Canadian DFO for subsequent electrophoretic analysis. Scales were also collected from these fish in support of stock separation studies (SPA) conducted by ADF&G.

CONCLUSIONS

1. It is essential to initiate sonar operations in the Sheenjek River not later than approximately mid-August to ensure the likelihood of determining precise fall chum salmon escapement timing to this stream, particularly in years of earlier-than-average returns.

2. The higher proportion (40%) of fish estimated passing the sonar site in the uninsonified zone in 1986 as opposed to 1985 (23%) was attributed to increased river width and, in turn, a larger uninsonified zone.

3. Data collected in 1986 on Sheenjek River fall chum salmon run timing and age composition suggest total escapement to this stream in 1981 may have been on the order of magnitude of 137,000 fish.

RECOMMENDATIONS

It is again recommended that Sheenjek River sonar operations be initiated in mid-August and continue through the end of September to more precisely document fall chum salmon escapement magnitude and run timing. Two counters should be operated from the 1986 site unless substantial alteration to the stream bottom occurs. However, it is highly recommended that at least one (possibly two) of the newer model (1985) long range, Bendix side-scan sonar units be used. The 1985-model counters can be operated at variable ranges to a maximum of 500 feet. In addition, "valid hit" criteria can be manually selected as necessary for each of the individual electronic sectors. These combined features of the 1985-model counter should result in eliminating a midriver uninsonified zone in subsequent years as well as reveal accurate spatial distribution of migrating fish.

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Appendix Table 1. Daily changes in water level and surface water temperature at the Sheenjek River project site, 1986.

		WATER LEVEL			
Day	Date	Meter Reading a	Daily Change	Zero Datum	Water Temp b
1	18-Aug	21.00	0.00	0.0	52
2	19-Aug	27.00	-6.00	-6.0	49
3	20-Aug	33.50	-6.50	-12.5	48
4	21-Aug	30.00	3.50	-9.0	47
5	22-Aug	21.00	9.00	0.0	46
6	23-Aug	26.50	-5.50	-5.5	45
7	24-Aug	31.50	-5.00	-10.5	45
8	25-Aug	39.00	-7.50	-18.0	43
9	26-Aug	49.00	-10.00	-28.0	43
10	27-Aug	56.50	-7.50	-35.5	45
11	28-Aug	60.50	-4.00	-39.5	44
12	29-Aug	65.00	-4.50	-44.0	44
13	30-Aug	65.50	-0.50	-44.5	45
14	31-Aug	56.00	9.50	-35.0	46
15	01-Sep	52.00	4.00	-31.0	46
16	02-Sep	54.50	-2.50	-33.5	48
17	03-Sep	60.00	-5.50	-39.0	48
18	04-Sep	63.50	-3.50	-42.5	46
19	05-Sep	67.00	-3.50	-46.0	46
20	06-Sep	70.00	-3.00	-49.0	46
21	07-Sep	72.00	-2.00	-51.0	46
22	08-Sep	75.00	-3.00	-54.0	46
23	09-Sep	77.00	-2.00	-56.0	46
24	10-Sep	80.00	-3.00	-59.0	45
25	11-Sep	83.00	-3.00	-62.0	44
26	12-Sep	85.50	-2.50	-64.5	45
27	13-Sep	87.50	-2.00	-66.5	45
28	14-Sep	88.50	-1.00	-67.5	43
29	15-Sep	89.00	-0.50	-68.0	43
30	16-Sep	88.00	1.00	-67.0	43
31	17-Sep	89.50	-1.50	-68.5	44
32	18-Sep	89.00	0.50	-68.0	45
33	19-Sep	90.00	-1.00	-69.0	45
34	20-Sep	91.00	-1.00	-70.0	45
35	21-Sep	91.00	0.00	-70.0	41
36	22-Sep	92.00	-1.00	-71.0	39
37	23-Sep	92.50	-0.50	-71.5	38
38	24-Sep	93.00	-0.50	-72.0	37

a Meter reading in centimeters.

b Temperature in degrees Fahrenheit.

Appendix Table 2. Surface water velocities measured daily at the east and west bank sonar transducers, Sheenjek River, 1986.

		SURFACE WATER VELOCITY			
		CM/SEC		FT/SEC	
Day	Date	West Bank	East Bank	West Bank	East Bank
1	18-Aug	93		3.05	
2	19-Aug	90		2.95	
3	20-Aug	88	47 *	2.89	1.54
4	21-Aug	96	35 *	3.15	1.15
5	22-Aug	100	45 *	3.28	1.48
6	23-Aug	98	50 *	3.22	1.64
7	24-Aug	98	55 *	3.22	1.80
8	25-Aug	93	55 *	3.05	1.80
9	26-Aug	85	62 *	2.79	2.03
10	27-Aug	79	53 *	2.59	1.74
11	28-Aug	87		2.85	
12	29-Aug	96	85	3.15	2.79
13	30-Aug	96	76	3.15	2.49
14	31-Aug	98	85	3.22	2.79
15	01-Sep	101	75	3.31	2.46
16	02-Sep	105	72	3.44	2.36
17	03-Sep	100	76	3.28	2.49
18	04-Sep	95	74	3.12	2.43
19	05-Sep	96	72	3.15	2.36
20	06-Sep	95	71	3.12	2.33
21	07-Sep	85	66	2.79	2.17
22	08-Sep	86	71	2.82	2.33
23	09-Sep	90	68	2.95	2.23
24	10-Sep	82	67	2.69	2.20
25	11-Sep	84	62	2.76	2.03
26	12-Sep	81	66	2.66	2.17
27	13-Sep	78	61	2.56	2.00
28	14-Sep	76	63	2.49	2.07
29	15-Sep	81	62	2.66	2.03
30	16-Sep	86	69	2.82	2.26
31	17-Sep	88	65	2.89	2.13
32	18-Sep	75	70	2.46	2.30
33	19-Sep	85	63	2.79	2.07
34	20-Sep	86		2.82	
35	21-Sep	82		2.69	
36	22-Sep	85		2.79	
37	23-Sep	86		2.82	
38	24-Sep	81		2.66	

* Velocities taken immediately at shoreline and not at transducer.

Appendix Table 3. Distance (feet) of insonified and uninsonified zones by the west bank sonar counter and estimated number of chum salmon passing upstream in the west side uninsonified zone in the Sheenjek River 1986.

	WEST BANK									
Date	Transducer distance from shore (1)	Dead Range (2)	Counting Range (3)	Extent of insonified zone (includes inshore lead) (1)+(2)+(3) (4)	Width of sector 16 (Ft) (5)	Sonar count sector 16 (6)	Average count per lineal ft (sector 16) (6)/(5) (7)	River Width (8)	Uninsonified zone (to mid-river) (8)/2-(4) (9)	Expanded counts (to mid-river) (9)*(7) (10)
17-Aug	56	1	70	127	4.375	3	0.7	320	33	23
18-Aug	56	1	80	137	5.000	21	4.2	320	23	97
19-Aug	56	1	60	117	3.750	31	8.3	320	43	355
20-Aug	56	1	60	117	3.750	64	17.1	320	43	734
21-Aug	56	1	60	117	3.750	30	8.0	320	43	344
22-Aug	56	1	60	117	3.750	77	20.5	320	43	883
23-Aug	56	1	60	117	3.750	35	9.3	320	43	401
24-Aug	56	1	60	117	3.750	61	16.3	320	43	699
25-Aug	56	1	60	117	3.750	150	40.0	320	43	1,720
26-Aug	56	1	60	117	3.750	162	43.2	320	43	1,858
27-Aug	85	1	70	156	4.375	226	51.7	320	30	1,550
28-Aug	89	1	45	135	2.813	189	67.2	320	25	1,680
29-Aug	89	1	45	135	2.813	184	65.4	320	25	1,636
30-Aug	89	1	45	135	2.813	123	43.7	320	25	1,093
31-Aug	89	1	45	135	2.813	123	43.7	320	25	1,093
01-Sep	89	1	45	135	2.813	57	20.3	320	25	507
02-Sep	89	1	45	135	2.813	84	29.9	320	25	747
03-Sep	89	1	45	135	2.813	62	22.0	320	25	551
04-Sep	89	1	45	135	2.813	76	27.0	320	25	676
05-Sep	89	1	44	134	2.750	41	14.9	320	26	388
06-Sep	89	1	44	134	2.750	46	16.7	320	26	435
07-Sep	89	1	44	134	2.750	83	30.2	320	26	785
08-Sep	89	1	44	134	2.750	67	24.4	320	26	633
09-Sep	89	1	44	134	2.750	61	22.2	320	26	577
10-Sep	89	1	44	134	2.750	36	13.1	320	26	340
11-Sep	89	1	44	134	2.750	35	12.7	320	26	331
12-Sep	89	1	44	134	2.750	96	34.9	320	26	908
13-Sep	89	1	44	134	2.750	62	22.5	320	26	586
14-Sep	89	1	44	134	2.750	156	56.7	320	26	1,475
15-Sep	104	1	53	158	3.313	118	35.6	320	(2) 25	891 *
16-Sep	104	1	53	158	3.313	69	20.8	320	(2) 25	521 *
17-Sep	104	1	54	159	3.375	101	29.9	320	(1) 25	748 *
18-Sep	104	1	54	159	3.375	66	19.6	320	(1) 25	489 *
19-Sep	104	1	54	159	3.375	102	30.2	320	(1) 25	756 *
20-Sep	104	1	54	159	3.375	36	10.7	320	(1) 25	267 *
21-Sep	104	1	54	159	3.375	57	16.9	320	(1) 25	422 *
22-Sep	104	1	52	157	3.250	34	10.5	320	(3) 25	262 *
23-Sep	104	1	52	157	3.250	20	6.2	320	(3) 25	154 *
24-Sep	104	1	52	157	3.250	6	1.8	320	(3) 25	46 *
						3,050				27,658

* Uninsonified zone subjectively extended 25 feet beyond the end of west bank sonar beam (i.e., farther than mid-river).

Appendix Table 4. Distance (feet) of insonified and uninsonified zones by the east bank sonar counter and estimated number of chum salmon passing upstream in the east side uninsonified zone in the Sheenjek River 1986.

	EAST BANK									
Date	Transducer distance from shore (1)	Dead Range (2)	Counting Range (3)	Extent of insonified zone (includes inshore lead) (1)+(2)+(3) (4)	Width of sector 16 (Ft) (5)	Sonar count sector 16 (6)	Average count per lineal ft (sector 16) (6)/(5) (7)	River width (8)	Uninsonified zone (to mid-river) (8)/2-(4) (9)	Expanded counts (to mid-river) (9)*(7) (10)
17-Aug								320	160	
18-Aug								320	160	
19-Aug	12	1	70	83	4.375	4	0.9	320	77	70
20-Aug	12	1	70	83	4.375	12	2.7	320	77	211
21-Aug	12	1	70	83	4.375	6	1.4	320	77	106
22-Aug	12	1	70	83	4.375	32	7.3	320	77	563
23-Aug	12	1	70	83	4.375	6	1.4	320	77	106
24-Aug	12	1	70	83	4.375	12	2.7	320	77	211
25-Aug	33	1	65	99	4.063	66	16.2	320	61	991
26-Aug	33	1	70	104	4.375	64	14.6	320	56	819
27-Aug	33	1	70	104	4.375	27	6.2	320	30	185
28-Aug	40	1	30	71	1.875	22	11.7	320	89	1,044
29-Aug	40	1	60	101	3.750	37	9.9	320	59	582
30-Aug	40	1	60	101	3.750	13	3.5	320	59	205
31-Aug	40	1	60	101	3.750	0	0.0	320	59	0
01-Sep	40	1	60	101	3.750	0	0.0	320	59	0
02-Sep	40	1	60	101	3.750	12	3.2	320	59	189
03-Sep	40	1	60	101	3.750	0	0.0	320	59	0
04-Sep *	40	1	90	131	5.625	0	0.0	320	29	0
05-Sep *	40	1	70	111	4.375	1	0.2	320	49	11
06-Sep *	40	1	70	111	4.375	2	0.5	320	49	22
07-Sep *	40	1	70	111	4.375	2	0.5	320	49	22
08-Sep *	40	1	70	111	4.375	1	0.2	320	49	11
09-Sep *	40	1	70	111	4.375	1	0.2	320	49	11
10-Sep *	40	1	70	111	4.375	1	0.2	320	49	11
11-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
12-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
13-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
14-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
15-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
16-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
17-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
18-Sep *	40	1	70	111	4.375	0	0.0	320	49	0
19-Sep								320	160	
20-Sep								320	160	
21-Sep								320	160	
22-Sep								320	160	
23-Sep								320	160	
24-Sep								320	160	
										5,372

* Days on which the sonar counter was operated on the 2 degree beam only.

Appendix Table 5. Sheenjek River beach seine catches and chum salmon sampled for age, sex, size, and electrophoresis, 1986.

DATE	NUMBER OF SETS	CHUM SALMON		ARCTIC GRAYLING	ROUND WHITEFISH	REMARKS
		MALE	FEMALE			
05-Sep	7	5	10	1		All chums sampled for AWL
06-Sep	3	11	15	2	3	All chums sampled for AWL
07-Sep	3	22	24	4	5	All chums sampled for AWL
10-Sep	1	16	4			All chums sampled for AWL
16-Sep	1	34	56	1	2	All chums sampled for AWL and electrophoresis
17-Sep	2	26	60	1	1	80 chums sampled for AWL and 60 chums for electrophoresis
22-Sep	1	31	62	2		52 chums sampled for AWL
TOTALS	18	145	231	11	11	
The following chum salmon were carcasses collected by boat survey of gravel bars.						
14-Sep		20	13			All chums sampled for AWL
22-Sep		37	51			All chums sampled for AWL
TOTALS		57	64			
GRAND TOTAL	18	202	295	11	11	Total chum salmon collected = 497 Total AWL samples = 450 Total electrophoretic samples = 150