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Alaska Department of Fish and Game
Division of Commercial Fisheries
333 Raspberry Road
Anchorage, Alaska 99518

July 1999

Sonar Estimation of Fall Chum Salmon Abundance In the Sheenjek River, 1994-1998

by

Louis H. Barton

State of Alaska Tony Knowles, Governor

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AUTHOR

Louis H. Barton is the fall chum and coho salmon Yukon Area Research Biologist for the Alaska Department of Fish and Game, Division of Commercial Fisheries, 1300 College Road, Fairbanks, AK 99701.

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ABSTRACT

User non-configurable, side-looking sonar was used annually from 1994 through 1998 to estimate chum salmon *Oncorhynchus keta* escapement in the Sheenjek River during the period from approximately early August through late September. Sonar-estimated fall chum salmon escapements ranged from 33,058 in 1998 to 246,889 in 1996. The minimum biological escapement goal of 64,000 chum salmon established for the Sheenjek River was achieved each year from 1994 through 1997, but was not achieved in 1998. Run size averaged 180,000 chum salmon from 1994 through 1997.

Range of insonification was considered adequate for detection of the majority of fish passing the sonar site each year and most fish passing through the acoustic beam were nearshore oriented. However, passage estimates should be considered conservative as they do not include fish passing beyond the counting range (including along the uninsonified far bank), fish present before sonar equipment was in operation, nor fish passing upstream after counting ceased. Variations in Sheenjek River water levels and velocities, together with migration behavior of upstream migrant chum salmon can affect the ability of hydroacoustic equipment to accurately estimate salmon passage. However, changes in these parametric values were accounted for by regularly comparing sonar counter output to visual observations on an oscilloscope.

Sheenjek River chum salmon entry patterns were somewhat bimodal from 1994 through 1996 as opposed to those observed in 1997 and 1998. The 1998 Sheenjek River chum salmon run was very weak, compressed, and 11 days later than the 1986-1997 average.

A consistent diel pattern in Sheenjek River chum salmon migration was observed in most years. Migration was primarily confined to periods of darkness or suppressed light with greatest movement occurring on average between 2100 and 0300 hours (34%).

Based upon vertebra collections, age-0.3 and -0.4 fish combined composed between 93% and 97% of annual chum salmon samples from 1994 through 1996. Whereas age-0.3 fish dominated in 1994 and 1995 at 55%, they represented only 33% of the 1996 escapement samples. No age composition data are available from 1997 due to unfavorable sampling conditions from high water in that year, or for 1998 because of the extremely weak chum salmon return.

KEY WORDS: Chum salmon, *Oncorhynchus keta,* sonar, hydroacoustics, escapement, enumeration, Yukon River, Porcupine River, Sheenjek River

INTRODUCTION

Although five species of Pacific salmon *Oncorhynchus* are found in the Yukon River drainage, chum salmon *O. keta* are the most abundant and occur in genetically distinct summer and fall runs (Wilmot et al. 1992; Seeb et al. 1995). Fall chum salmon are larger, spawn later, and are less abundant than summer chum salmon. They primarily spawn in the upper portion of the drainage in streams that are spring fed, usually remaining ice-free during the winter (Buklis and Barton 1984). Major fall chum salmon spawning areas include the Tanana, Chandalar, and Porcupine River systems, as well as portions of the upper Yukon River in Canada (Figure 1).

In-river Fisheries

Fall chum salmon are in great demand commercially with harvest permitted along the entire mainstem river in Alaska as well as in the lower portion of the Tanana River. No commercial harvest is permitted in any other tributaries of the drainage including the Koyukuk and Porcupine River systems. Although commercial harvest also occurs in the Canadian portion of the Yukon River near Dawson, the majority of fish taken commercially occurs in the lower river, downstream of the village of Anvik. Fall chum salmon use as a subsistence item is greatest throughout the upper river drainage, upstream of the village of Koyukuk.

Although the Alaskan commercial fishery for Yukon River fall chum salmon developed in the early 1960's, annual harvests remained relatively low through the early to mid-1970's (JTC 1998). Estimated total in-river utilization (U.S. and Canada commercial and subsistence) of Yukon River fall chum salmon was below 300,000 fish per year prior to the mid-1970's (Table 1). However, in-river commercial fisheries became more fully developed during the late 1970's and early 1980's, with total utilization averaging 536,000 fish from 1979-1983. Harvest peaked in 1979 at 615,000 and in 1981 at 677,000 fish. Since the mid-1980's management strategies have been implemented to reduce commercial exploitation on fall chum stocks in order to improve upon low escapements observed throughout the drainage during the early 1980's. In 1987 a complete closure of the commercial fall chum fishery occurred in the Alaskan portion of the drainage, while in 1992 commercial fishing in Alaska was restricted to only a portion of the Tanana River during the fall season. In addition to a commercial fishery closure in 1993, that year marked the first in State history that a total river closure to subsistence fishing occurred in the Yukon River during the latter portion of the fall season. The fishery closure was in response to the extremely weak fall chum salmon return in that year.

Escapement Assessment

During the period 1960 through 1980 only various segments of annual runs of Yukon River fall chum salmon were occasionally estimated from mark-and-recapture (M-R) studies (Buklis and Barton 1984). Excluding these tagging studies and apart from aerial assessment of selected tributaries since the early 1970's, comprehensive escapement estimation studies were sporadic and

limited to only two streams; the Delta River (Tanana River drainage) and the Fishing Branch River (Porcupine River drainage). However, comprehensive escapement assessment studies intensified on major spawning tributaries throughout the drainage subsequent to the early 1980s. In the Canadian portion of the drainage, the Canadian Department of Fisheries and Oceans (DFO) has estimated abundance of fall chum salmon crossing the US/Canada border of the mainstem river into Yukon Territory annually since 1982 (excluding 1984) using M-R techniques (Milligan et al. 1984; JTC 1998). In addition, DFO reinstalled a weir in the Fishing Branch River in 1985 and has monitored chum salmon escapements to this stream annually, excluding 1990.

In the Alaskan portion of the drainage, the United States Fish and Wildlife Service (USFWS) estimated annual fall chum salmon escapement to the Chandalar River from 1986 through 1990 using fixed-location, single-beam hydroacoustic techniques (Daum et al. 1992). Results of that work revealed that fall chum salmon production there was similar to that of the nearby Sheenjek River. Subsequently, in 1994, the USFWS initiated a five-year study to reassess the population status of fall chum salmon with a newly developed split-beam hydroacoustic system. The initial year, 1994, was used to develop site-specific operational methods, evaluate site characteristics, and describe possible data collection biases (Daum and Osborne 1995). The project was fully operational from 1995 through 1998 with annual escapement estimates ranging from a low of 75,811 in 1998 to a high of 280,999 in 1995 (Daum and Osborne 1996; Osborne and Daum 1997; Daum and Osborne 1998; Daum and Osborne 1999).

The Alaska Department of Fish and Game (ADF&G) initiated an experimental main river sonar project near Pilot Station (rivermile 123) in 1978, for the purpose of estimating salmon passage by species. During the developmental years of 1978 through 1985, data acquisition and sampling designs were investigated using various models of scientific fisheries hydroacoustic systems. The project has operated annually since 1986, except for 1992 when it was operated for experimental purposes with upgraded sonar equipment and 1996 when it was operated for training purposes only. However, because of recent improvements in methodologies, historic data are not comparable to improved assessments available for 1995, 1997 and 1998 (JTC 1998). In addition to the Pilot Station sonar project operated by ADF&G, the USFWS has conducted a M-R project annually from 1996 through 1998 at an area known locally as "The Rapids", a narrow canyon near Rampart, 1,176 kilometers from the mouth of the Yukon River. The purpose of this project is to provide abundance estimates of adult fall chum salmon bound for the upper Yukon River (Gordon et al. 1998).

ADF&G also conducted annual M-R studies in the Tanana River from 1995 through 1998 to estimate the abundance of fall chum salmon bound for the upper river, upstream of the Kantishna River (Cappiello and Bromaghin 1997, Cappiello and Bruden 1997, Hebert and Bruden 1998, Cleary and Bruden *In press*). ADF&G also conducts replicate ground surveys of the major fall chum spawning area in the Delta River of the upper Tanana River, allowing for estimates of total spawning abundance to be made annually. Intensive ground surveys are also made annually of the major spawning area in the upper Toklat River, from which total abundance estimates are derived using spawner residence time data collected from the Delta River (Barton 1997). Hydroacoustic assessment of fall chum salmon escapement in the Toklat River was investigated in 1994, 1995, and 1996 (Barton 1997, Barton 1998).

One of the most intensely monitored Yukon River fall chum salmon spawning streams is the Sheenjek River. Although escapement observations date back to 1960 when the USFWS reported chum salmon spawning in September, the best database consists of the 25-year period 1974-1998. Prior to 1981 escapement observations in this stream were limited to aerial surveys flown in late September and early October (Barton 1984a). Subsequent to 1980, escapements were monitored annually using fixed-location, single-beam sonar systems (Barton 1982, 1983, 1984b, 1985, 1986, 1987, 1988, 1994, 1995). However, an early segment of the fall chum salmon run was not included by sonar counting operations from 1981 through 1990 due to late project startups centered around 25 August. By comparison, average startup during the period 1991 through 1998 was 8 August, more than two weeks earlier than in previous years. Termination of sonar counting was more consistent during the period 1981 through 1998, averaging 25 September. This report presents results of studies conducted from 1994 through 1998.

Study Area

The Sheenjek River is one of the most important producers of fall chum salmon in the Yukon River. Lying above the Arctic Circle, it heads in the glacial ice fields of the Romanzof Mountains, a northern extension of the Brooks Range, and flows southward approximately 400 km to its terminus on the Porcupine River (Figure 2). Although created by glaciers, the river has numerous clearwater tributaries. Water clarity in the lower river is somewhat unpredictable, but is generally clearest during periods of low water; water level normally begins to drop 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 160 km. The sonar project site is located approximately 10 km upstream from the mouth of the river. Including results reported in this report for the period 1994-1998, annual escapement estimates averaged 104,000 spawners for the period 1986-1993 and approximately 151,000 spawners for the most recent 5-year period 1994-1998. At present, there is a minimum biological escapement goal (BEG) of 64,000 fall chum salmon established for this river, based upon hydroacoustic assessment of the run during the period approximating 25 August through 25 September (Buklis 1993).

Objectives

Annual objectives for the Sheenjek River fall chum salmon studies conducted from 1994 through 1998 were to determine the timing and magnitude of adult salmon escapement and to collect age and sex information on sampled portions of the run. To accomplish these, the following specific objectives were identified for each year:

1. Document timing and magnitude of chum salmon escapement using hydroacoustic techniques,

2. Estimate age and sex composition of the spawning population from sampled portions of the escapement, and

3. Monitor selected climatological and hydrologic parameters daily at the project site for use as baseline data.

METHODS

Hydroacoustic Equipment

Various model, fixed-location, side-looking fisheries hydroacoustic systems developed by the Hydrodynamics Division of Bendix Corporation[2] were used to estimate chum salmon abundance in the Sheenjek River from 1994 through 1998. Fish passage was monitored annually by a single transceiver and transducer deployed from a right-bank point bar at the historic sonar site (Figure 3). Transceivers in use for all or part of a season included the following: a 1977- and 1981-model transceiver in 1994; a 1977-model transceiver in 1995 and 1996; a 1977-, 1978- and a newly acquired 1985-model transceiver in 1987; and, a 1977- and 1985-model transceiver in 1998. There are both functional and output differences among the various transceivers.

Regardless of the selected transceiver in use, Bendix side-looking transducers have co-axial, circular cross-section narrow (2°) and wide (4°) beam dimensions. Sampling ranges for the narrow and wide beams are each variable to 30 m but designed for optimum performance at 18.3 m and 9.1 m, respectively. Each transceiver can be operated on either the narrow or wide beam independently, or by alternating acoustic pulse transmissions between the two beams. In the latter mode, which is used on the Sheenjek River, the narrow and wide beams monitor fish passage in the outer and inner halves of the sampling range, respectively.

Each transceiver maintains a record of the spatial distribution of fish estimates based upon distance of the acoustic target from the transducer as follows; fish estimates were tallied and stored into dynamic memory by 12 or 16 equal range intervals or sectors, depending upon the model transceiver used. A tape printout showing the number of tallies (counts) by sector was printed each hour. Each transceiver was designed such that 24 counts in any one electronic sector in a 35-second period are not necessarily fish. Under such conditions, the system operator is alerted by the presence of a "debris" code appearing on the printout tape next to the suspect counts for the sector and hour in which they occurred. Examples of factors that can result in "debris counts" appearing on printout tapes include: passage of debris through the insonified water column, driving rain, snowfall, mis-aimed beam toward river bottom or water surface, high density of fish passage, and holding or spawning fish.

Operational characteristics of Bendix hydroacoustic systems and procedures can be found in Bendix Corporation (1978) and Ehrenberg (undated). However, it should be noted that, excluding 1994, all sonar transceivers in use between 1995 and 1998 had been modified to allow the system operator to lower the pulse repetition rate to a level that would not have previously

[2] Reference to trade names does not imply endorsement by the Alaska Department of Fish and Game.

been possible. This alteration was to better accommodate relatively slow chum salmon swimming speeds (A. Menin, Hydroacoustic Consulting, personal communication). This modification increased the system operator's ability to reduce the degree of positive bias associated with over-counting. In 1994 however, only one of the two Bendix transceivers in use had been modified in this manner.

Site Selection and Transducer Deployment

The actual location of hydroacoustic sampling during 1994-1998, including initial transducer deployment, was based upon the best of several river bottom profiles made at the project site each year using a recording depth sounder. When the preferred location had been identified, a more detailed river bottom profile was obtained by stretching a rope across the river and measuring water depth with a pole every 3-m.

The modular aluminum substrates designed for Bendix systems were not used due to the relatively gentle-sloping river bottom at the counting location, as well as the potential salmon avoidance problems that had been observed in earlier years (Barton 1985). The transducer was mounted on a pod made of galvanized steel water pipe (Barton 1997) and deployed from the right-bank point bar. The pod was secured in place with sandbags and designed to permit raising and lowering of the acoustic beam by using the two riser pipes that extended above the water. Fine adjustments were made with the knurled knobs that attached the transducer plate to the pod. The transducer was deployed in water ranging from approximately 0.5 to 1.0 m in depth, and aimed perpendicular to the current along the natural gravel substrate. An attempt was made to insure the transducer was deployed at locations where minimum surface water velocities did not fall below approximately 30-45 cm/s.

The system operator used an artificial acoustic target during deployment to insure transducer aim was low enough to prevent salmon from passing undetected beneath the acoustic beam. The target, an airtight, 250 ml weighted plastic bottle, was allowed to drift downstream along the river bottom and through the acoustic beam. Several drifts were made with the target in an attempt to pass it through each electronic sector of the counting range. When a transducer was properly aimed, the target appeared as a vertical deflection (spike) on an oscilloscope screen as it transected the acoustic beam at any given distance. The target may or may not have simultaneously registered a count (or multiple counts) on the sonar counter, depending upon the length of time it remained in the acoustic beam as it drifted downstream along the river bottom.

As in previous years, a fish lead was constructed shoreward from the transducer to prevent upstream salmon passage inshore of the transducer. Fish leads were constructed using 5 cm x 5 cm by 1.2-m high Tuflink-brand fencing and 2.5 m metal "T" stakes. Leads were constructed so as to include the nearfield "dead range" of the sonar transducer. Whenever a transducer was relocated because of rising or falling water level, the inshore lead was shortened or lengthened as appropriate, and the artificial target used to insure proper re-aiming. A 5-m aluminum counting tower was also deployed near the transducer to facilitate visual and electronic calibrations when water conditions permitted.

Sonar Calibrations and Count Adjustments

Daily comparisons (termed calibrations) were made between oscilloscope observations and automated counter output to determine if the number of fish registered by the sonar counter equaled the number of fish observed passing through the sonar beam. A minimum of six, 15- to 30-minute calibrations was initially targeted for each day within the following time periods: 0001-0100 hours; 0300-0400 hours; 0600-0700 hours; 1100-1200 hours; 1600-1700 hours; and 2100-2200 hours. Duration of calibrations was based upon the following criteria: 1) stop calibration at 15 minutes if less than 10 fish are observed; and, 2) extend 15-minute calibration to 30 minutes if 10 or more fish are observed in the first 15 minutes.

Calibration results were used to adjust automated passage estimates on a daily basis for positive or negative bias. Adjustment periods were defined by the time between individual calibrations. An associated adjustment factor (A), specific to each adjustment period (i) was calculated as follows:

$$A_i = \frac{OC}{SC} \tag{1}$$

where:

OC = oscilloscope count; and,
SC = sonar count.

Unadjusted hourly sonar passage estimates were multiplied by adjustment factors for each hour within the associated adjustment period. The resulting corrected hourly sonar estimates were summed, yielding the estimated daily passage ($\hat{D}$) of fall chum salmon, and is calculated as

$$\hat{D} = \sum \left(A_i SC_i \right) \tag{2}$$

Sonar counts caused by fish other than salmon were assumed to be insignificant based upon historic test fishing records collected at the site. Counts identified as "debris" on printout tapes were deleted and replaced by linearly interpolated values prior to making adjustments. Linear interpolation was also used to estimate missing sector counts as a result of occasional printer malfunctions. All interpolated values for a given electronic sector were based upon registered counts for that sector in the preceding and following hour.

Adjustments to the pulse repetition rate (PRR) or ping rate of the sonar counter were made to minimize over-counting (positive bias) or under-counting (negative bias). Over- or under-counting primarily results from changes in salmon swimming speeds which may be related to

fluctuations in water level and velocity, photoperiod, or fish densities (Barton 1985, 1986, 1987, 1995). Although a few occasions arose when the ping rate was subjectively changed based upon a qualitative evaluation of fish passage rates, the ping rate was generally changed at the end of any calibration when the oscilloscope count exceeded 59 per hour and differed by more than 15% from the sonar count. The new ping rate was calculated as: (sonar count / oscilloscope count) x current PRR setting. If passage rates during calibrations on any given day never exceeded 59 fish per hour, the ping rate was changed at 2400 hours of that particular day. However, this change was made only if the sum of sonar counts during all of the day's calibrations differed from the sum of oscilloscope counts from all calibrations by more than 15%. Otherwise, the dial setting was left unchanged.

Test Fishing and Salmon Sampling

An adult salmon beach seine (30 m long, 66 meshes deep, 6.4 cm stretch measure) was periodically fished at different locations between the sonar site and approximately 10-12 km upstream, to sample adult salmon for age and sex composition. The annual sample goal was 150 chum salmon. A small section of spine (3 vertebrae minimum) was removed in an area posterior to the anal fin of each fish for subsequent age analyses. Vertebra were later cleaned, dried, and read with the aid of a dissecting microscope. Ages were reported using European notation where the number of freshwater and saltwater annuli are separated by a decimal. Although sex was determined by external examination of most fish, positive sex determination was made by an incision in the belly of fish sampled for vertebrae, if necessary. No Sheenjek River chum salmon samples were collected from 1994 through 1998 for genetic stock identification purposes.

Climatological and Hydrologic Observations

A water level gauge was installed at the sonar site and monitored daily with readings made to the nearest centimeter. Instantaneous surface water temperature was measured daily with a pocket thermometer, while minimum and maximum air temperatures were measured with a digital thermometer. Other daily observations included recording the occurrence of precipitation, as well as the estimated wind velocity, direction, and percent cloud cover. Climatological observations were recorded at approximately 1800 hours daily.

RESULTS

River and Sonar Counting Conditions

Initial transducer deployment during 1994-1998 approximated the same place on the point bar each year. Although variations in river width and water level were observed annually, river bottom composition and gradient remained fairly similar from year to year. On average, the river bottom

sloped gently from the convex bank (right-bank point bar) at a rate of approximately 5.5 cm/m (bottom slope of ~3.5°) toward the thalweg, which lay approximately two-thirds to three-quarters of the way across the channel depending upon the date of observation (Figure 4).

Large variations in water level occurred at the project site, and periodically interrupted sonar counting (Figure 5, Appendices A.1- A.5). Between approximately early August and late September, minimum and maximum water level differed by 183 cm in 1994, 147 cm in 1995, 181 cm in 1996, 243 cm in 1997, and 109 cm in 1998. Daily fluctuations in water level affected the actual placement of the sonar transducer with respect to distance from shore, and in turn, the proportion of the river that was insonified. An expansion of sonar counts by linear interpolation or extrapolation was made to estimate fish passage for entire or partial days when sonar was not operating as a result of high water (Appendix B.1). Further, expanded passage estimates were also made for periods when raw data were missing as a result of occasional printer malfunction, or when false counting problems persisted (e.g., from high winds, intense snowfall, or mis-aimed transducer).

In 1994, river width at the project site measured approximately 58 m on 8 August and water level remained fairly stable through 27 August, with minimum and maximum levels differing by 37 cm. However, a major high water event occurred over the next three-day period, when the water level increased 142 cm, cresting at approximately 2100 hours on 30 August. High water and accompanying debris loads necessitated suspending sonar-sampling operations on 29 and 30 August. Although water level declined rapidly during the first four days of September at a rate of approximately 19 cm/d and at an average rate of 3 cm/d between 5 and 28 September, sonar sampling was again interrupted on 13 and 14 September. This interruption resulted from extremely high winds prevailing at the sonar site for nearly two days, generating false counts across the acoustic sampling range.

In 1995, river width measured 87 m on 6 September and a detailed bottom profile at the counting site was obtained. Based upon that profile and changes in water level fluctuations over the course of the project, the river was estimated to have been approximately 82 m wide on 5 August. Three high water events were observed, all between 5 and 22 August. The first occurred over the 4-day period of 5 to 9 August when water level rose 108 cm. Although water level had receded 64 cm by 13 August, another increase of 76 cm was observed over the next 5 days. On 18 August the river was nearly bankfull and almost flooded the gravel bar at the sonar site. This was the highest water level recorded in 1995 and gravel bar exposure on 18 August was judged to have been similar to that observed on 30 and 31 August in 1994. High water conditions persisted through 23 August, though a slight decline and subsequent rise was again observed. Only by 4 September had water level receded to the level observed in early August. Periodic, moderate fluctuations in water level occurred throughout the remainder of September, with an overall net decline of 27 cm observed by 24 September. Although affected, sonar sampling was not interrupted in 1995 from high water conditions. Data expansion was necessary however, to estimate passage for 14 and 15 September as a result of a mis-aimed sonar transducer that had been hit by floating debris.

The Sheenjek River measured approximately 73 m wide at the counting site on 31 July 1996. A dramatic increase in water level was observed over the next three days, rising 145 cm between 1 and

3 August. This high water event resulted in a temporary suspension of sonar sampling between 2 and 5 August. Subsequent to the peak in water elevation on 3 August, followed by a slight decline and second rise on 7 August, the overall trend was a decline in water level throughout the remainder of the season. Heavy snowfall disrupted sonar sampling for portions of 10 and 11 September.

The highest water levels ever encountered at the Sheenjek River project site occurred in 1997. A water level gauge was installed on 9 August and a river profile was made on 11 August. The river measured 76 m wide. Between 9 and 28 August, a net decline of 15 cm was observed. Daily fluctuations during this period never exceeded ± 10 cm. However, water level increased dramatically at a rate of nearly 6-7 cm/h over the next two days, cresting on 31 August after a 228-cm rise. Sonar operations were suspended on 29 August and the entire camp facility temporarily evacuated to the Porcupine River on 30 August. Water entirely covered the point bar where camp was established and was estimated to be 30 cm deep at the camp location on 31 August, the highest elevation of the point bar. By 3 September water level had receded 152 cm, allowing for sonar counting to resume. A slow but steady decline in water level occurred throughout the remainder of September, and sonar operations continued without interruption.

Three periods of high water were evident in 1998 at the project site; the first near mid-August, the second during the first week of September, and the third during the last week of September. The first and largest of these was accompanied with an unusually heavy debris load that interrupted sonar counting operations for several days. Sometime during the first week of August, a U-shaped meander of the river approximately 6-8 km upriver from the sonar site closed in upon itself. The main course of the river cut a channel through the initial portion of the meander, with levee deposits beginning to isolate the former bend (as an oxbow lake) from the river. Breaching of timber by the main channel resulted in a tremendous load of large trees and other woody vegetation that drifted past the sonar site for several days. Although sonar sampling was initiated 9 August, a temporary suspension of operations was required to protect the transducer from passing debris. River width measured 73 m at the project site on 10 August and water level increased at a rate of 35 cm/d until cresting on 13 August after a 104-cm rise. Sonar operations did not resume until 17 August, and continued without interruption for duration of the project.

The coldest water temperatures at the project site occurred in 1994 based upon instantaneous surface measurements made during the first three weeks of September, averaging 5°C (see Appendices A.1-A.5). In that year water temperature had fallen to 4°C by as early as 10 September and reached 2°C by 17 September. The warmest water temperatures occurred in 1995 and 1997, averaging 8° and 9°C, respectively, for the first three weeks of September.

Run Timing and Abundance Estimation

Run strength and timing of Sheenjek River chum salmon varied among the years 1994-1998 (Table 2, Figure 6). Sonar-estimated escapements ranged from a low of 33,058 in 1998 to a high of 246,889 in 1996. Sonar counts were adjusted daily for positive or negative bias based upon oscilloscope calibrations (Appendices C.1-C.5). Although the total number of calibrations varied annually depending upon project duration and fish passage rates, an annual average of 302

calibrations averaging 23.3 minutes in duration were made yearly from 1994 to 1998 (Table 3). This approximated an average of 117 hours of calibration time per year. The greatest seasonal correction for positive bias, approximately 107% for the season, was required in 1994. This was attributed to one of the two Bendix transceivers in use in that year (1981-model) that did not allow the PRR to be lowered below a certain threshold level.

The 1994 sonar-estimated escapement was 150,565 chum salmon for the 53-d period 7 August through 28 September. This estimate includes expansions for missing sector/hourly counts, as well as for those days or partial days when counting was temporarily suspended due to high water. A distinctly bimodal entry pattern was exhibited with prominent peaks in passage observed on 2 and 20 September. These dates also marked passage of the central half of the run. The median day of passage was recorded as 11 September. Few chum salmon were present in the river prior to initiation of sonar counting as evidenced by only 146 estimated passing the site on 7 August. Daily passage remained relatively low through 26 August, averaging only 458 fish/d, however passage increased substantially after 26 August. During the 9-day period of 27 August through 4 September, passage was estimated to have increased to an average of nearly 5,000 fish/d, with approximately 29% of the run (44,695 fish) passing. This value includes estimates for the two days sonar sampling was suspended. Peak passage during this period was estimated to have occurred 2 September (7,196 fish). Passage rates decreased slightly between 5 and 12 September, averaging approximately 3,000 fish/d. An estimated 24,426 chum salmon or 16% of the run passed during that period. From 13 to 28 September, 74,742 chum salmon were estimated passing the site, representing 49% of the total sonar-estimated escapement. During this period, large numbers of salmon were visible along the point bar, and frequent "jumpers" were also commonly seen. Average passage rate during this period approximated 4,700 fish/d with the highest daily estimate occurring on 20 September (7,583 fish). Chum salmon were still passing the project site when sampling activities terminated in 1994, as evidenced by 4,062 fish estimated passing on 28 September.

A sonar-estimated escapement of 241,855 chum salmon was made for the 48-d period 10 August through 25 September 1995. A somewhat bimodal chum salmon entry pattern was apparent in 1995, similar to that observed in 1994. The central half of the run was observed between 30 August and 17 September, with median passage occurring on 9 September. Fish passage was relatively low when sonar counting was initiated, averaging 727 fish/d through 17 August. A steady increase in fish passage rates was subsequently observed (1,172 fish/d) until reaching a peak on 1 September, when 8,782 fish were estimated passing. Passage rates averaged 6,151 fish/d over the next two-week period, during which approximately 36% of the run passed. A second peak in passage occurred on 15 September (10,161 fish). Passage rates averaged nearly 8,000 fish/d through the end of the season, representing 37% of the sonar-estimated escapement. Chum salmon were still passing the project site upon termination of counting activities at a rate of more than 6,800 fish/d.

Sonar sampling in the Sheenjek River was initiated approximately one week earlier than normal in 1996 in anticipation of an early run, based upon run timing of Yukon River chinook and summer chum salmon observed earlier in the season. A total of 15,136 fish were estimated to have passed the counting site between 30 July and 19 August with 670 fish passed on the first

day. Average passage during this period was 721 fish/d, including expansions for days sonar was not operating. A marked increase in fish passage (11,459 fish) occurred on 24 August followed by three days of continued passage in excess of 11,000 fish/d on 29-31 August. Large numbers of salmon were observed lining the point bar during this period, and "jumpers" were common. The highest daily estimate occurred on 31 August (12,522 fish). Passage rates decreased slightly over the first 15 days of September, but still averaged nearly 6,000 fish/d. A second peak in passage occurred during the third week of September; the highest counts were observed on 17 September (11,181 fish) and 19 September (10,474 fish). Visual observations made from the counting tower as well as from shore also confirmed a steady passage of large numbers of chum salmon during this period. The total sonar-estimated escapement was 246,889 chum salmon for the 57-d period 30 July through 24 September, with the central half of passage observed between 28 August and 15 September in 1996. The median date of passage occurred on 4 September.

In 1997, a uni-modal chum salmon entry pattern was observed in the Sheenjek River during the 45-d period 9 August through 23 September. The total sonar-estimated escapement was 80,423 chum salmon, including estimates for missing sector/hourly counts, as well as for days when counting was temporarily suspended as a result of high water. Daily estimates remained relatively low (< 1,000 fish/d) through 24 August, after which an increase in passage rates was observed daily until the major high water event on 29 August. The last full day of sampling prior to high water was 28 August and more than 2,300 fish were estimated passing. The presence of salmon was also evident by the frequent occurrence of "jumpers" at the sonar site. Sampling was temporarily suspended for six days from the morning of 29 August until the afternoon of 3 September, and salmon passage was estimated by linear interpolation for this period. Sonar estimates were well in excess of 3,000 fish per day when counting resumed subsequent to the high water event, and reached a peak of 4,842 on 8 September. The median day of passage was 7 September and the central half of the run was estimated passing between 31 August and 14 September. A trend of declining passage rates was observed subsequent to 8 September until termination of the project on 24 September. However, chum salmon were still passing the project site at a rate of more than 2,000 fish/d.

In 1998, the sonar-estimated escapement was only 33,058 chum salmon for the 45-d period of 17 August through 30 September, with a single mode in passage centered near mid-September. Although counting was initiated on 9 August, a temporary suspension of operations was required as a result of high water. It was believed that very few fish passed the sonar site during this period as evidenced by the low passage rates realized for several weeks once sonar counting resumed on 17 August. Average passage remained less than 60 fish/d through 27 August and only 304 fish/d between 28 August and 12 September. The central half of the run was observed within the 7-day period 15 to 21 September, with the median day of passage occurring on 18 September. Passage dropped substantially after 24 September, averaging only 606 fish/d through the end of the month.

Temporal and Spatial Distribution

A diel pattern in the migration of Sheenjek River chum salmon was observed in most years from 1994 through 1998 (Appendices D.1-D.5). In periods of darkness or suppressed light migration was heaviest, with fish moving in greater numbers close to shore. Fish migration occurred farther from shore and lessened with ensuing hours of daylight. While this diel pattern was more pronounced in some years than others (Figure 7), on the average, the period of greatest movement occurred between 2100 and 2400 hours (18%), followed by 2400 to 0300 hours (16%) (Figure 8, Table 4). Periods of least movement were 0900 to 1500 hours (8%) and 1200 to 1800 hours (9%).

For the most part, migrating chum salmon were shore-oriented, passing through the inner, nearshore sectors of the acoustic beam. However, the insonified portion of the river varied within and among years depending upon initial placement and subsequent relocation of the transducer as necessitated by fluctuations in river water level. Consequently, the amount insonified water also varied. The largest percentage of salmon passing through the outer half of the acoustic beam (the offshore electronic sectors) tended to occur at the highest water levels, when a larger proportion of the river was uninsonified.

During the early part of the 1994 season (8-20 August) when water level was relatively low, approximately 92% of the sonar detections occurred in the inner half of the acoustic range, i.e., within ~ 14 m of the transducer (Figure 9, graphs A and B). The uninsonified portion of the river during this period averaged 13 m (range 8-14 m). Over the next eight days (21-28 August) the transducer was periodically moved closer to shore to accommodate rising water levels. Each transducer move resulted in a greater portion of the river becoming uninsonified. The uninsonified distance increased from 13 m to 26 m, and counts registered in the inner half of the counting range decreased from 92% to 66%. A higher percentage of fish moved through the middle electronic sectors (graph C).

The greatest uninsonified portion in 1994 was observed during the first two weeks of September (31 August through 13 September), a period of prevailing high water subsequent to cresting of the river, and one characterized by a slow recession in water levels. The uninsonified area averaged approximately 31 m during this two-week period, ranging from a maximum of 72 m on 31 August when sonar counting resumed, to 15 m on 13 September as water levels receded, allowing the transducer to be moved farther from shore. Although, a higher portion of fish (~ 50%) passed beyond 14 m of the transducer during this period, very few fish (< 1%) were observed in the outermost sector (graph D). By 14 September water had fallen to, and remained for duration of the project at, levels similar to those observed when the project commenced. On average 80% of the river was insonified from 14 to 27 September, and fish passage was primarily confined to the inner sectors; 88% within 14 m of the transducer (graph E).

Similar patterns in fish passage were observed annually from 1995 through 1998 as illustrated in Figures 10 though 13, that show spatial distribution of sonar counts at various water stages during each year. Overall, most fish passed through the inner sectors, with a shift toward the middle and outer half of the acoustic sampling range during periods of higher water when less of

the river was insonified. For example, in 1995 approximately 61% of sonar detections were made within the inner half (~14 m) of the sampling range when high water prevailed from 11 through 22 August (Figure 10, graph A). That percentage increased to 82% after 22 August (graph B). By comparison, the uninsonified river area averaged 56 m through 22 August and 34 m after that date.

During the high water period prior to mid-August in 1996, approximately 65% of the sonar counts occurred in the inner half of the counting range, but a high portion was observed in the middle sectors (Figure 11, graph A). Although precise measurements were not made during this period, the uninsonified portion of the river is estimated to have been in excess of 21 m. By comparison, the uninsonified zone averaged 20 m after 23 August, and an increase in fish passage was observed in the inner sectors as water level receded. Between 16 and 25 August 85% of the sonar counts were observed within 14 m of the transducer, with more than 30% in sector 3 alone (graph B). From 26 August through 24 September 88% of the counts were within 14 m of the transducer, and 34% in sector 1 (graph C).

In 1997, approximately 80% of the sonar counts were observed within 14 m of the transducer prior to the high water event that occurred near the end of August (Figure 12, graph A). Between 5 and 11 September, when water levels were high and slowly receding, only 47% of the counts were within 14 m (graph B). Increased migration was observed through the middle sectors of the insonified range during this period, with nearly 23% through sector 7. Movement of fish again increased through the nearshore sectors subsequent to 11 September when lower water levels prevailed (graph C).

Water levels were fairly high throughout 1998, with an average of only 51% of the river's width insonified for the season. This was partially due to the heavy debris loads that accompanied the first high water event in mid-August. Even though counting resumed on 17 August, the sonar transducer was not positioned as far from shore as normal to lessen the likelihood of being destroyed by passing debris. As a result, between 18 and 26 August, passage was greatest through the middle sectors (Figure 13 graph A). Once the debris load lessened and the transducer was deployed further from shore, fish passage was again primarily confined (~80%) to the inner half of the sampling range (graph B).

Age and Sex Composition

Estimation of salmon escapement abundance received the highest priority at the Sheenjek River sonar project, although an attempt was made to sample annual escapements for age and sex composition. Several beach seine hauls were made annually along gravel bars in the area from the sonar site to approximately 9 km upstream (Table 5).

In 1994, a total of 180 chum salmon (89 males; 91 females) were captured in 34 seine hauls made between 24 August and 13 September. Additional species caught included 12 Arctic grayling *Thymallus arcticus signifer,* 9 longnose suckers *Catostomus catostomus,* 7 whitefish *Coregonus* spp. and 1 northern pike *Esox lucius.* Chum salmon samples were dominated by age-

0.3 fish (56%) and exhibited a male to female ratio of approximately 1:1 (Table 6). Age-0.4 fish represented nearly 41% of the sample.

In 1995, 16 seine hauls resulted in a total catch of 230 chum salmon (113 males; 117 females), 11 whitefish, and 1 longnose sucker from 24 August through 24 September. A sample of 166 chum salmon revealed age composition to be predominately age-0.3 fish (54%), followed ages 0.4 (39%) and 0.5 (6%).

Seven seine hauls made between 7 and 23 August 1996 resulted in a catch of only 15 chum salmon, 1 northern pike and 1 longnose sucker, reflecting the very low passage of salmon past the sonar site during that period. However, several hundred chum salmon were captured in each of four seine sets made on four days between 25 August and 18 September. A combined sample of 191 chum salmon from all seine sets for the year was predominated by age-0.4 fish (62%) followed by age-0.3 fish (33%).

No salmon samples were obtained in either 1997 or 1998. Prevailing high water conditions and associated high water velocities and heavy debris loads prevented successful seining in 1997. Due to the weak chum salmon run in 1998, only 3 chum salmon, 2 Arctic grayling and 2 whitefish were captured in several seine hauls made during the month of September. No attempt was made to seine during August because of extremely low fish passage at the sonar site.

DISCUSSION

Barton (1995) pointed out that the existing Sheenjek River BEG should be viewed as a minimum desired number of chum salmon passing the sonar site subsequent to 25 August. Thus, it is apparent that the BEG was met each year from 1994 through 1997, but not met in 1998, even though high water conditions periodically hindered sonar operations in all five years. At least one or more *major* high water event was realized at the project site during the month of August, and in 1998 two others were observed in early and late September. Periods of high water not only made it necessary to temporarily suspend sonar counting in four of the five years, but also greatly affected the amount of river that could be insonified with the Bendix systems. All sonar-estimated escapements are conservative because they do not include fish that passed the site before or after sonar sampling, nor do they include fish that passed beyond the range of the acoustic beam, including along the uninsonified far bank.

Drift gillnetting results during the period 1981-1983 at the historic Sheenjek River sonar sampling site demonstrated that distribution of upstream migrant chum salmon was primarily confined to the right side of the river, with only a small (but unknown) proportion passing beyond the sonar counting range (Barton 1982, 1983, 1984b). Barton (1985) further concluded from investigations in 1984 that although dispersed throughout the river well below the sonar site, upstream-migrant chum salmon orient toward the right bank before reaching the sonar sampling location due to physical and hydrologic conditions of the river. While no attempt was

made to estimate fish passage in the uninsonified river zones from 1994 through 1998, it is believed to have been comparatively small based upon a review of the spatial distribution of fish by electronic sector.

High water conditions in 1994 necessitated a temporary suspension of sonar sampling near the end of August for two days. That high water event coincided with flooding of the Koyukuk River from two vigorous weather systems that brought heavy rains to northwest Alaska during the second half of August. Occurring approximately eight days apart, the combined effect of these storms resulted in serious flooding in the Koyukuk basin (P. Meyers, Department of Commerce, NOAA, National Weather Service, personal communication). Bankfull or above bankfull levels were also reported east of the Koyukuk basin in Yukon River tributaries of the Hodzana and Chandalar Rivers. In fact, flooding of the Chandalar River, located 116 km downstream from the Sheenjek River, resulted in termination of sonar sampling activities and total evacuation of the USFWS field facilities in late August of that year.

In 1994, the Sheenjek River escapement-monitoring project played a key role in management of the Yukon River fall season fisheries. In that year, no commercial fishing and several subsistence fishery restrictions were implemented in response to an incorrect in-season assessment of Yukon River fall chum salmon run size. However, subsistence restrictions were relaxed and limited commercial fishing was permitted in portions of the Alaska drainage after it was determined that run size was in fact greater than previously estimated. This determination was largely based upon results from the Sheenjek River sonar project. There is little doubt that the reduced harvest resulted in the large escapement observed in the Sheenjek River, as well as to other fall chum spawning areas. In fact, 1994 marked the first year on record that all fall chum salmon BEG's were achieved throughout the Yukon River drainage (Bergstrom et al. 1996).

All fall chum salmon BEG's were met throughout the Yukon River drainage for the second consecutive year in 1995, when another very strong run was realized (Bergstrom et al. 1997a). Although high water conditions were encountered in the Sheenjek River in 1995, sonar sampling was not interrupted and the highest escapement recorded to date was documented (242,000 chum salmon). The Sheenjek River escapement estimate was consistent with escapement trends for other upper Yukon River areas (Bergstrom et al. 1997a). Both the Chandalar River and mainstem Yukon River border escapement monitoring projects reported record run sizes. Chum salmon escapement in the Chandalar River was estimated at 281,000 fish, with run timing very similar to that observed in the Sheenjek River. Daily passage rates in both rivers remained high throughout the season, with the median passage date for the Chandalar River observed on 7 September, two days earlier than for the Sheenjek River (Daum and Osborne 1996).

Sheenjek River sonar operations were temporarily suspended in 1996, 1997 and 1998 for various time periods as a result of high water. In 1996, another record chum salmon escapement to the Sheenjek River was recorded (247,000 chum salmon). That year marked the largest even-year return of Yukon River fall chum salmon on record. Apart from one area of the Tanana River, BEG's were achieved elsewhere throughout the drainage (Bergstrom et al. 1997b). As in 1995, fall chum salmon escapement in the Sheenjek River was similar to trends observed in other upper Yukon River areas. Large numbers of returning fish were reported in other areas. Chum salmon daily

passage rates were again high in both the Chandalar and Sheenjek Rivers for most of the season, and the relative abundance and entry patterns were similar. Median passage day in the Chandalar River was 2 September, two days earlier than for the Sheenjek River (Osborne and Daum 1997).

Both 1997 and 1998 were characterized by very low salmon returns to some western Alaska river systems (Kruse 1998). In 1998, Bristol Bay suffered a second-year failure of its sockeye salmon run. The Kuskokwim Area saw weak, below-projected chum salmon runs in 1998, preceded by a total run failure of chum salmon in 1997. Both chinook and chum salmon failures were realized in the Yukon River in 1998 and Norton Sound had weak chum salmon runs. Although the overall return of Yukon River fall chum salmon in 1997 materialized near the projected level, the Tanana River component of the run was extremely weak in that year (Bergstrom et al. 1998). Again, there were similarities in the timing of Sheenjek and Chandalar River fall chum salmon runs in 1997. The median passage date for the Chandalar River (6 September) was one day earlier than reported for the Sheenjek River (Daum and Osborne 1998).

As a result of the widespread collapse of various salmon returns in 1998, the governor of Alaska declared Western Alaska a disaster area (Office of the Governor News Release dated 30 July 1998). While exact reasons for the region-wide failure are unknown, it has been speculated that it is likely an artifact of poor marine survival resulting from or accentuated by localized weather conditions in the Bering Sea (Kruse 1998). The weak salmon runs to Western Alaska have been attributed to reduced productivity (i.e., returns per spawner), and not the result of low levels of parental escapement. This is exemplified in the 1998 return of Yukon River fall chum salmon. The magnitude and quality (distribution) of Yukon River fall chum salmon escapement in 1994, the major parent year contributing to the 1998 return, was among the best on record. However, the estimated total run size of Yukon River fall chum salmon in 1998 was estimated to have materialized at less than half (only 46%) of the preseason projection (Bergstrom et al. 1999). No commercial fishing was permitted and fall season subsistence-fishing restrictions were implemented throughout the drainage. Still, no BEG was achieved in the drainage in 1998, and given dates of sonar operations, likely the poorest escapement on record was recorded for the Sheenjek River (33,000 fish).

Although sonar has been used to monitor chum salmon escapements in the Sheenjek River since 1981, only since 1986 have estimates been obtained for comparable time periods (i.e., for the period approximating 8 August through 25 September). However, Barton (1995) used run timing data collected from the Chandalar River to expand run size estimates for the years 1986-1988 and 1990 to a comparable time period (Appendix E.1). Based on the average interquartile range (central half) of run timing from 1986 through 1997, run timing in 1998 was approximately 11 days late (Appendix E.2) with the median occurring on 18 September. Again, Sheenjek River chum salmon run characteristics were very similar to those observed in the Chandalar River, where the median day of passage was 16 September, two days earlier (Daum and Osborne 1999). Further, estimated escapements in the Sheenjek (33,000) and Chandalar (75,800) Rivers in 1998 were 59% and 62% less than estimated for each respective river in 1997.

Apparent changes taking place at the Sheenjek River historic sonar sampling site may be of concern in future years. Since 1980, the point bar from which sonar is deployed is slowly

migrating downstream with erosion occurring at its upper end and deposition at the lower end. Although both width and elevation of the point bar show little difference from those in the early 1980s, the river has annually claimed more of the left cutbank, widening the river at the counting site. Changes in channel morphology appeared more pronounced in 1998 with the wetted area of the river wider than in previous years. The thalweg spanned a much wider portion of the river. As a cautionary note, continual changes in channel morphology at the current project site may render it less attractive for hydroacoustic assessment with Bendix sonar transceivers that have a maximum sampling range of only 30 m.

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Table 1. Alaskan and Canadian total utilization of Yukon River fall chum salmon, 1961–1998 (taken from JTC 1998).

Year	Canada [a]	Alaska [b,c]	Total
1961	9,076	144,233	153,309
1962	9,436	140,401	149,837
1963	27,696	99,031 [d]	126,727
1964	12,187	128,707	140,894
1965	11,789	135,600	147,389
1966	13,192	122,548	135,740
1967	16,961	107,018	123,979
1968	11,633	97,552	109,185
1969	7,776	183,373	191,149
1970	3,711	265,096	268,807
1971	16,911	246,756	263,667
1972	7,532	188,178	195,710
1973	10,135	285,760	295,895
1974	11,646	383,552	395,198
1975	20,600	361,600	382,200
1976	5,200	228,717	233,917
1977	12,479	340,757	353,236
1978	9,566	331,250	340,816
1979	22,084	593,293	615,377
1980	22,218	466,087	488,305
1981	22,281	654,976	677,257
1982	16,091	357,084	373,175
1983	29,490	495,526	525,016
1984	29,267	383,055	412,322
1985	41,265	474,216	515,481
1986	14,543	303,485	318,028
1987	44,480	361,663 [d]	406,143
1988	33,565	319,677	353,242
1989	23,020	518,157	541,177
1990	33,622	316,478	350,100
1991	35,418	403,678	439,096
1992	20,815	128,031 [f]	148,846
1993	14,090	76,925 [d]	91,015
1994	38,008	131,217	169,225
1995	45,600	415,547	461,147
1996	24,354	238,686	263,040
1997	15,580	153,612	169,192
1998 [g]	7,901	63,050 [d]	70,951 [g]
Average			
1961–87	17,009	291,834	308,843
1988–92	29,288	337,204	366,492
1993–97	27,526	203,197	230,724

[a] Catch in number of salmon. Includes commercial, Aboriginal, domestic and sport catches combined.
[b] Catch in number of salmon. Includes estimated number of salmon harvested for commercial production of salmon roe.
[c] Commercial, subsistence, and personal–use catches combined.
[d] Commercial fishery did not operate in Alaskan portion of drainage.
[f] Commercial fishery operated only in District 6 (Tanana River).
[g] Preliminary.

Table 2. Sonar–estimated escapement of fall chum salmon in the Sheenjek River, 1994–1998.

Date	1994	1995	1996	1997	1998	Date
30–Jul			670			30–Jul
31–Jul			706			31–Jul
01–Aug			541			01–Aug
02–Aug			793			02–Aug
03–Aug			685			03–Aug
04–Aug			577			04–Aug
05–Aug			469			05–Aug
06–Aug			724			06–Aug
07–Aug	146		918			07–Aug
08–Aug	75		1,554			08–Aug
09–Aug	112		930	114		09–Aug
10–Aug	38	964	963	248		10–Aug
11–Aug	214	882	479	332		11–Aug
12–Aug	243	468	315	306		12–Aug
13–Aug	328	344	315	421		13–Aug
14–Aug	215	359	903	473		14–Aug
15–Aug	261	1,045	762	420		15–Aug
16–Aug	333	863	753	534		16–Aug
17–Aug	378	891	602	341	56	17–Aug
18–Aug	524	1,172	724	307	98	18–Aug
19–Aug	497	1,656	753	430	63	19–Aug
20–Aug	257	2,105	1,662	354	35	20–Aug
21–Aug	594	2,632	1,594	291	23	21–Aug
22–Aug	642	2,677	1,178	506	27	22–Aug
23–Aug	1,673	3,525	2,472	688	58	23–Aug
24–Aug	1,035	6,301	11,459	996	43	24–Aug
25–Aug	848	4,745	9,966	1,059	95	25–Aug
26–Aug	791	4,445	7,034	1,179	93	26–Aug
27–Aug	2,934	6,358	4,545	2,329	59	27–Aug
28–Aug	3,677	4,839	5,778	2,320	114	28–Aug
29–Aug	4,082	6,842	11,457	1,884	47	29–Aug
30–Aug	4,487	7,436	12,249	2,067	143	30–Aug
31–Aug	5,472	6,517	12,522	2,250	274	31–Aug
01–Sep	6,912	8,782	7,597	2,433	248	01–Sep
02–Sep	7,196	5,856	6,326	2,616	234	02–Sep
03–Sep	5,918	7,049	6,457	2,799	117	03–Sep
04–Sep	3,666	4,185	5,113	3,404	301	04–Sep
05–Sep	2,832	4,525	5,214	3,352	118	05–Sep
06–Sep	2,952	6,084	5,763	2,761	277	06–Sep
07–Sep	3,928	6,852	7,871	2,904	254	07–Sep
08–Sep	3,587	6,318	6,333	4,842	590	08–Sep
09–Sep	2,598	5,403	3,718	2,849	412	09–Sep
10–Sep	2,341	4,957	4,364	1,995	416	10–Sep
11–Sep	3,382	6,758	7,409	1,971	594	11–Sep
12–Sep	2,796	6,597	4,735	2,323	722	12–Sep
13–Sep	3,066	6,561	6,974	3,602	1,348	13–Sep
14–Sep	3,294	6,184	5,944	2,983	1,120	14–Sep
15–Sep	3,522	10,161	5,406	3,294	1,201	15–Sep
16–Sep	4,764	9,026	7,871	2,376	2,850	16–Sep
17–Sep	4,413	9,097	11,181	2,379	2,492	17–Sep
18–Sep	3,249	8,525	7,850	2,101	2,607	18–Sep
19–Sep	6,500	8,468	10,474	2,096	2,526	19–Sep
20–Sep	7,583	8,065	6,755	1,613	2,692	20–Sep
21–Sep	5,287	9,590	6,170	1,612	2,756	21–Sep
22–Sep	6,520	5,943	3,924	2,249	2,120	22–Sep
23–Sep	5,153	6,518	4,486	2,020	1,594	23–Sep
24–Sep	4,523	6,432	1,902		811	24–Sep
25–Sep	3,607	6,853			529	25–Sep
26–Sep	3,458				430	26–Sep
27–Sep	3,600				487	27–Sep
28–Sep	4,062				736	28–Sep
29–Sep					587	29–Sep
30–Sep					661	30–Sep
Totals	150,565	241,855	246,889	80,423	33,058	

[a] Single–line boxed areas show interquartile range; wide (bold) boxed areas show median passage day.

Table 3. Sheenjek River sonar counter calibration effort, 1994–1998.

Year	Number of Calibrations	Total Calibration Time (hrs)	Average Duration (min)	Average Distribution of Daily Calibration Effort				Total Oscilloscope Count	Total Sonar Count	Overall Percent over–count (positive bias)
				0001–0600 h	0601–1200 h	1201–1800 h	1801–2400 h			
1994	351	145.9	24.9	28%	27%	15%	30%	23,241	48,080	106.9%
1995	340	147.7	26.1	28%	28%	16%	28%	35,056	35,368	0.9%
1996	352	139.0	23.7	22%	30%	15%	33%	33,476	36,340	8.6%
1997	245	89.6	21.9	30%	28%	15%	27%	7,397	8,372	13.2%
1998	221	64.6	17.5	29%	32%	19%	20%	2,882	2,905	0.8%
Average	302	117.4	23.3	28%	29%	16%	28%			

Table 4. Diel distribution of fall chum salmon at the Sheenjek River sonar project site, 1994–1998.

Time Period (hours)	Year					
	1994	1995	1996	1997	1998	Average
2400–0300	0.133	0.145	0.153	0.197	0.180	0.162
0300–0600	0.140	0.125	0.106	0.220	0.149	0.148
0600–0900	0.141	0.106	0.091	0.127	0.123	0.117
0900–1200	0.103	0.087	0.057	0.077	0.068	0.078
1200–1500	0.100	0.098	0.132	0.041	0.054	0.085
1500–1800	0.123	0.105	0.145	0.051	0.088	0.102
1800–2100	0.124	0.151	0.131	0.098	0.127	0.126
2100–2400	0.137	0.183	0.185	0.188	0.212	0.181

Table 5. Test fishing catch and effort in the Sheenjek River, 1994–1998.

Year	Date	Seine Sets	Chum Salmon Males	Chum Salmon Females	Chum Salmon Total	Arctic Grayling	Northern Pike	Whitefish species	Longnose Sucker	Remarks
1994	24–Aug	6	2	7	9	2	1		2	Seine sets between rkm 12 and 13.
	25–Aug	5	1	7	8	4			6	Seine sets between rkm 12 and 15.
	27–Aug	5	10	10	20	1				Seine sets between rkm 10 (sonar site) and rkm 13.
	03–Sep	5	18	18	36	3		6		Seine sets between rkm 10 (sonar site) and rkm 13.
	07–Sep	6	26	24	50	2		1	1	Seine sets between rkm 12 and 13.
	09–Sep	5	15	16	31					Seine sets between rkm 12 and 13.
	13–Sep	2	17	9	26					Seine sets between rkm 12 and 13.
	Total	34	89	91	180	12	1	7	9	
1995	24–Aug	2	6	9	15					Seine sets between rkm 12 and 13.
	02–Sep	1	46	43	89					Seine sets between rkm 12 and 13. ASL samples 21 male;19 female.
	08–Sep									Snagged seine near rkm 12. No catch.
	10–Sep	4	25	22	47			1	1	Rkm 12. All chums sampled for ASL.
	15–Sep	4	12	6	18			1		Seine sets between rkm 12 and 13.
	19–Sep	2	20	27	47					Seine set rkm 10. All chums sampled for ASL.
	23–Sep	2	0	4	4			8		Seine set rkm 10. Major snag of seine.
	24–Sep	1	4	6	10			1		Seine set rkm 10.
	Total	16	113	117	230	0	0	11	1	
1996	07–Aug	2	1	0	1					Seine set rkm 19.
	11–Aug	2	1	0	1		1		1	Seine set rkm 15–19.
	19–Aug	2	0	0	0					Seine set rkm 19.
	23–Aug	1	8	5	13					Seine set rkm 10.
	25–Aug	1	25	33	58					Seine set rkm 19. In addition to these ASL samples – let 100 fish go.
	30–Aug	1	26	23	49					Seine set rkm 19. In addition to these ASL samples – let 100 fish go.
	07–Sep	1	26	14	40					One seine set rkm 19. Sampled these. Released many – could hardly purse seine.
	18–Sep	1	25	14	39					One seine set rkm 19. Sampled these. Many escaped – could not hold seine.
	Total	11	112	89	201	0	1	0	1	
1997		Due to persistent high water conditions, no test fishing was possible in this yaer. Water remained high, swift and debris laden through late in season.								
	Total	–	–	–	–	–	–	–	–	
1998	03–Sep	5–6	0	0	0					Seined several bar between ~rkm 15–20. Saw no fish.
	12–Sep	5–6	0	0	0					Seined several bar between ~rkm 15–20. Saw no fish.
	15–Sep	1	2	1	3	1				Seine set ~ rkm 20.
	20–Sep		0	0	0	1		2		Made several seine hauls between ~rkm 12–20.
	Total	–	2	1	3	2	0	2	0	

Table 6. Comparative age and sex compostion of fall chum salmon sampled by beach seine in the lower Sheenjek River, 1994–1998. [a]

Year	Age 0.2	Age 0.3	Age 0.4	Age 0.5	Sample Size (Ageable)	Male:Female ratio of Age Sample	Total Fish Collected	Male:Female ratio of fish Collected
1994	0.012	0.561	0.405	0.023	173	1.00:1.01	180	1.00:1.02
1995	0.012	0.542	0.386	0.060	166	1.00:1.02	230	1.00:1.04
1996	0.016	0.330	0.618	0.037	191	1.00:0.79	>600	--
1997 [b]	--	--	--	--	0	--	0	--
1998 [c]	--	--	--	--	0	--	3	--

[a] Age determination was made using vertebrae. Age designation is European.
[b] River water levels, velocities and debris loads prevented test fishing.
[c] Due to weak chum salmon run, only three chum salmon were collected from several seine sets made throughout September.

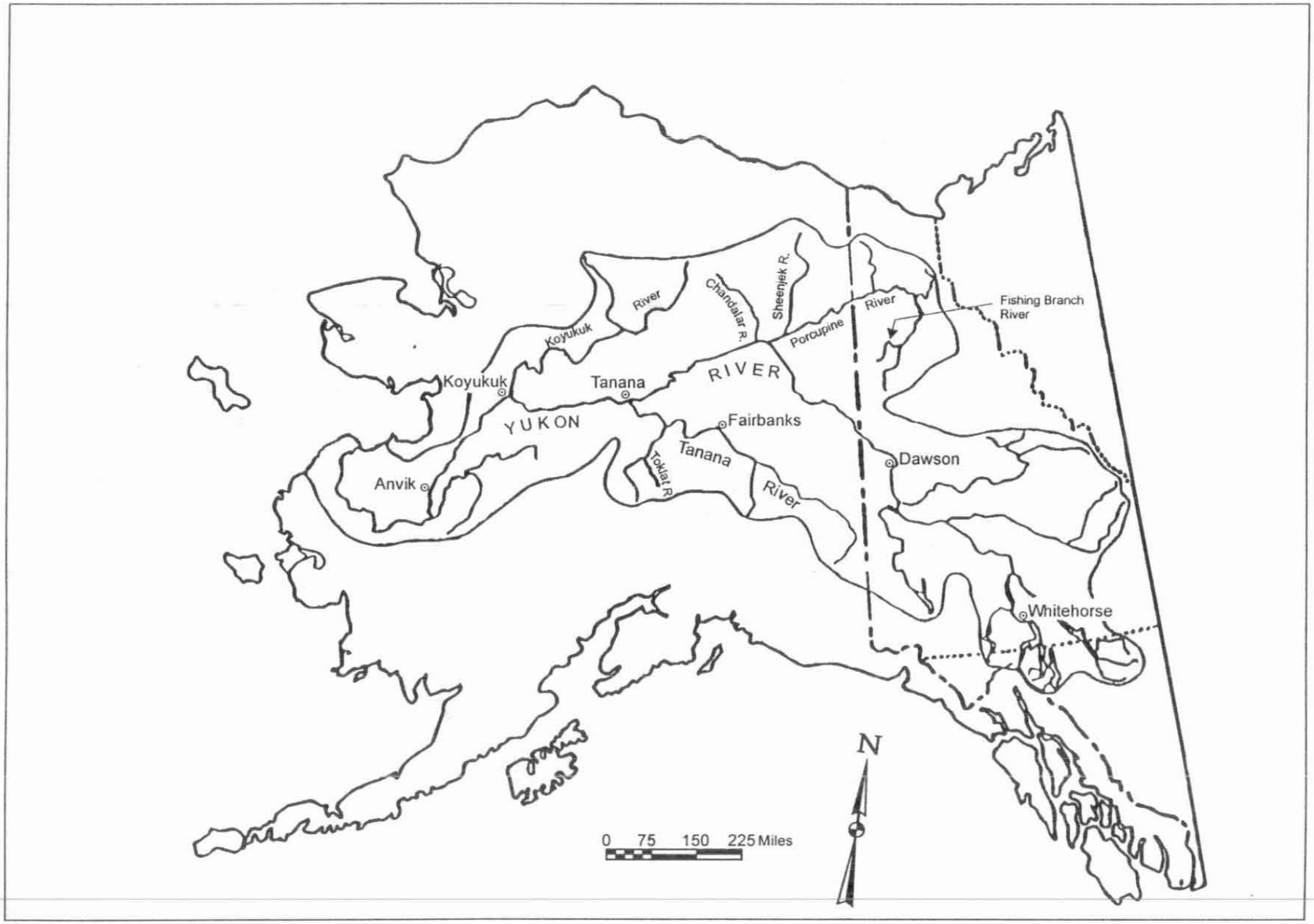

Figure 1. The Yukon River drainage showing selected locations.

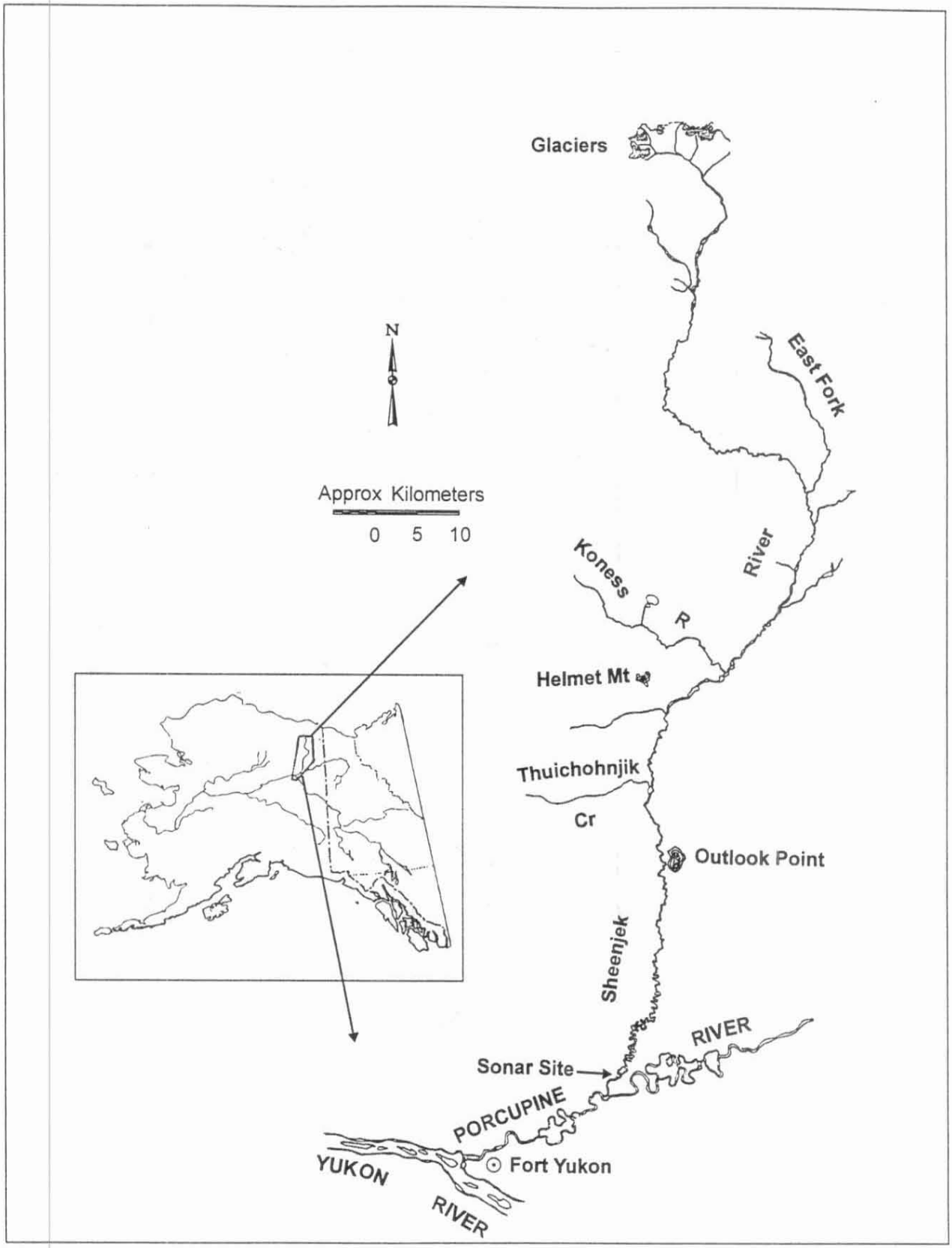

Figure 2. The Sheenjek River drainage.

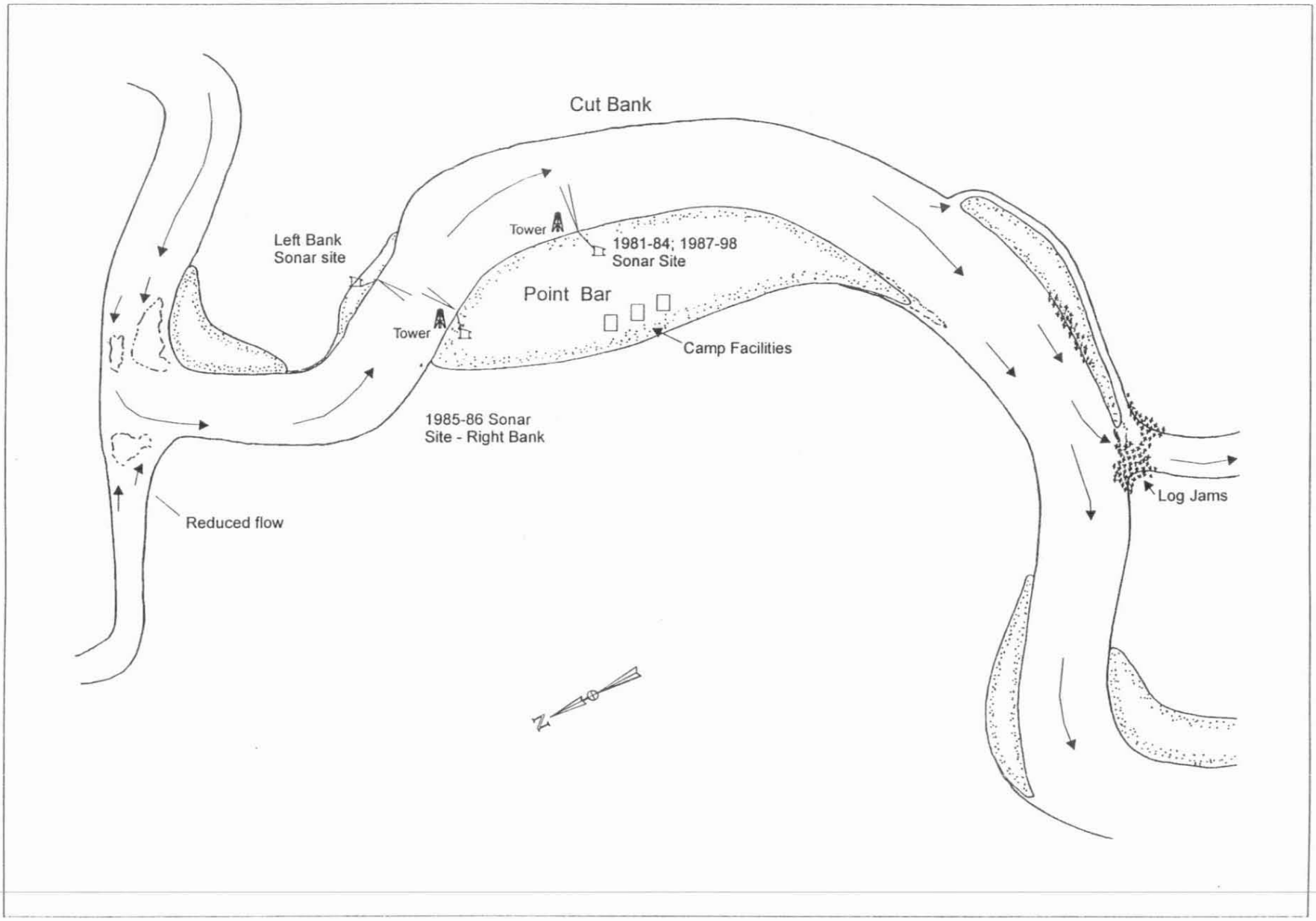

Figure 3. The Sheenjek River sonar project site.

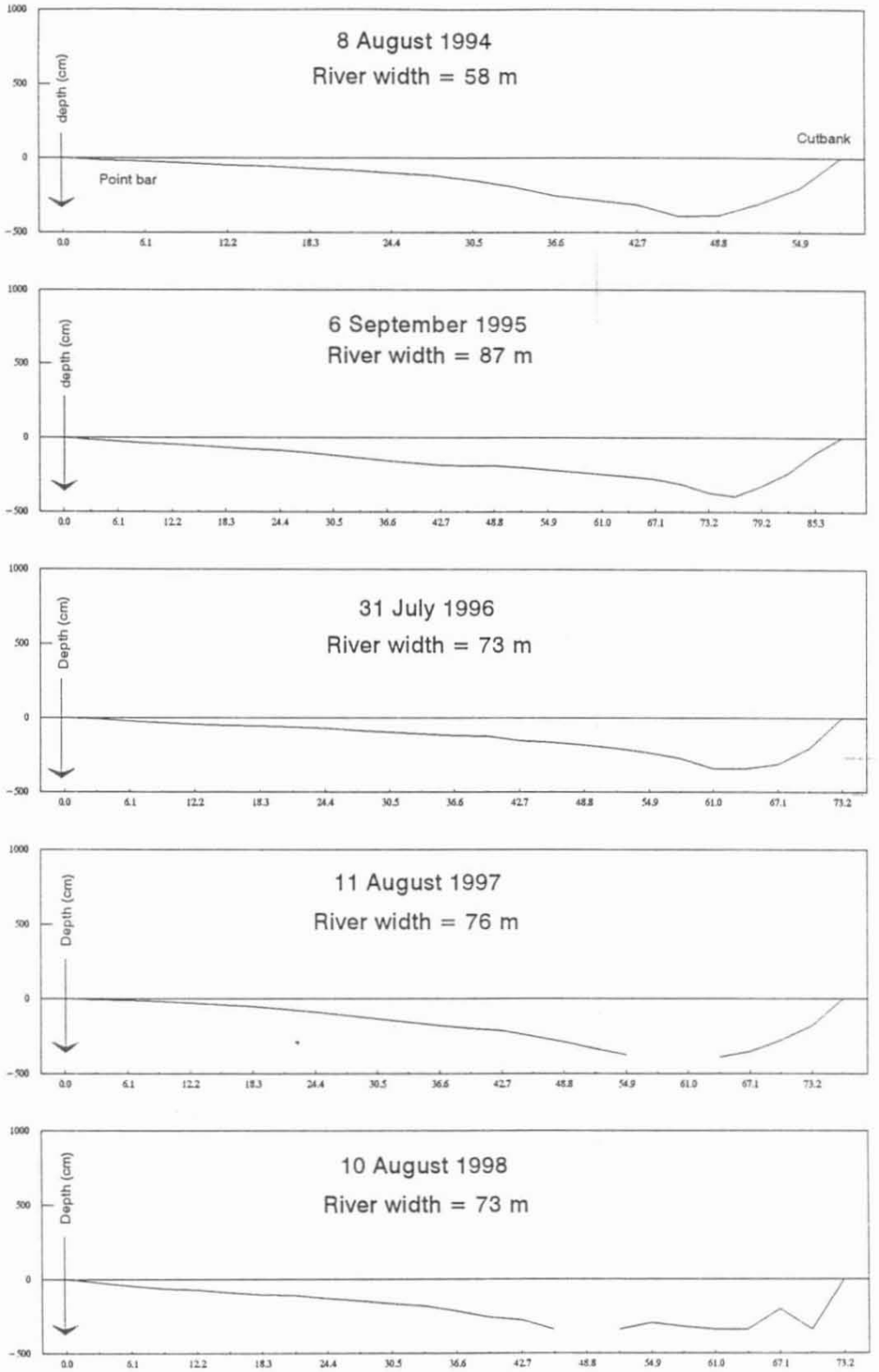

Figure 4. Depth profiles (upstream view) made on selected dates at the Sheenjek River sonar project site, 1994–1998.

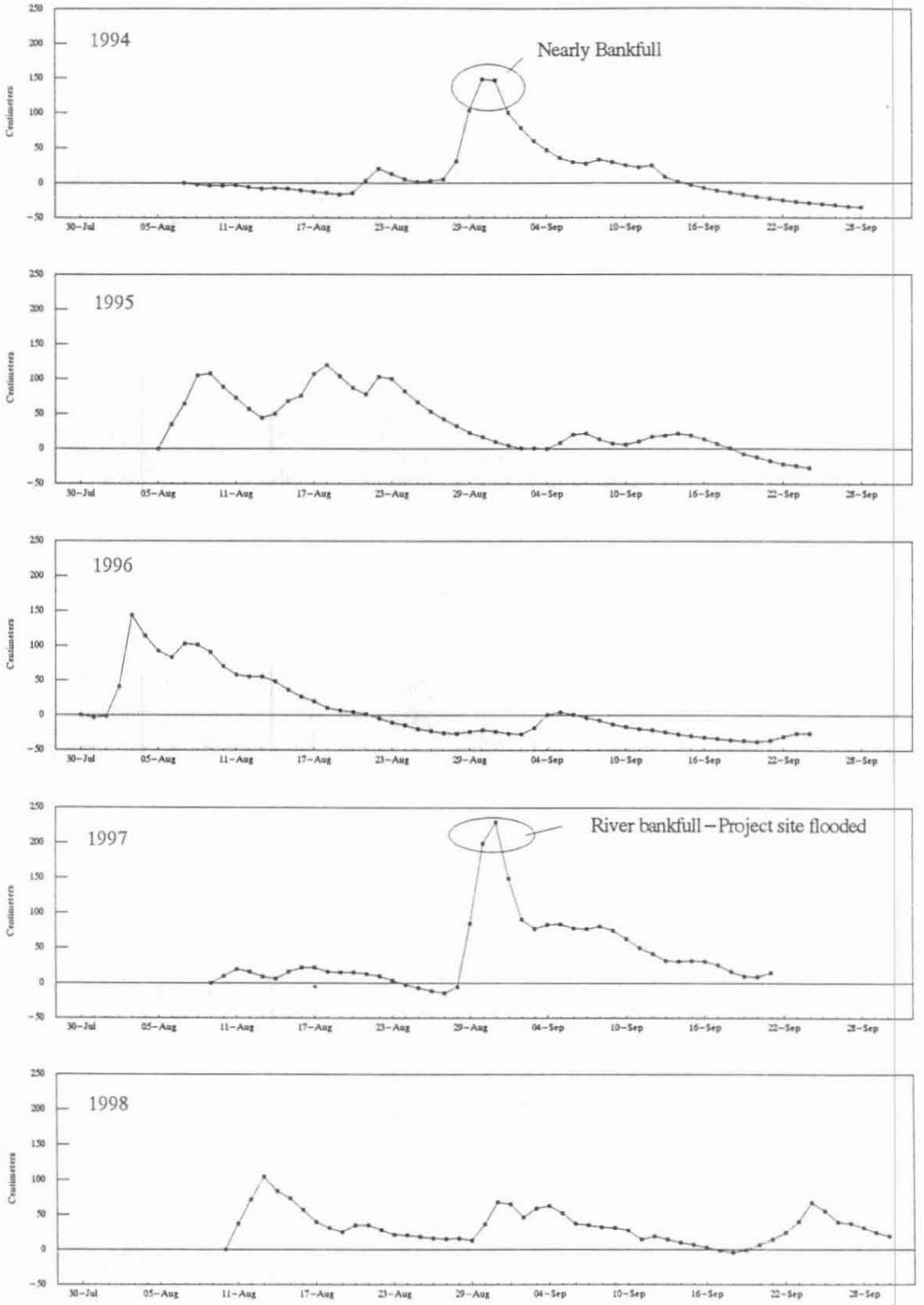

Figure 5. Relative daily water levels observed at the Sheenjek River sonar project site, 1994–1998.

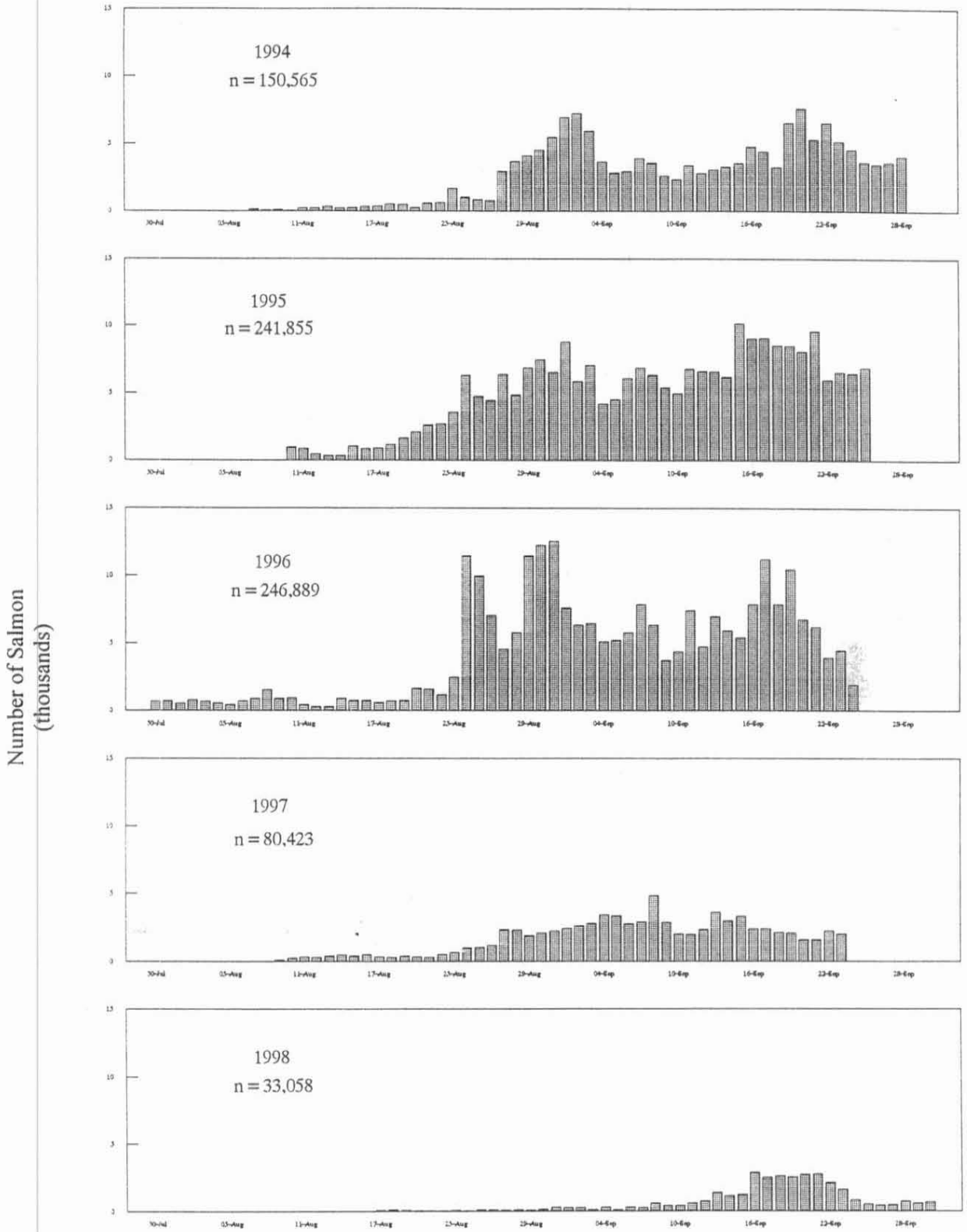

Figure 6. Sheenjek River fall chum salmon run timing based upon sonar–estimated daily passage, 1994–1998.

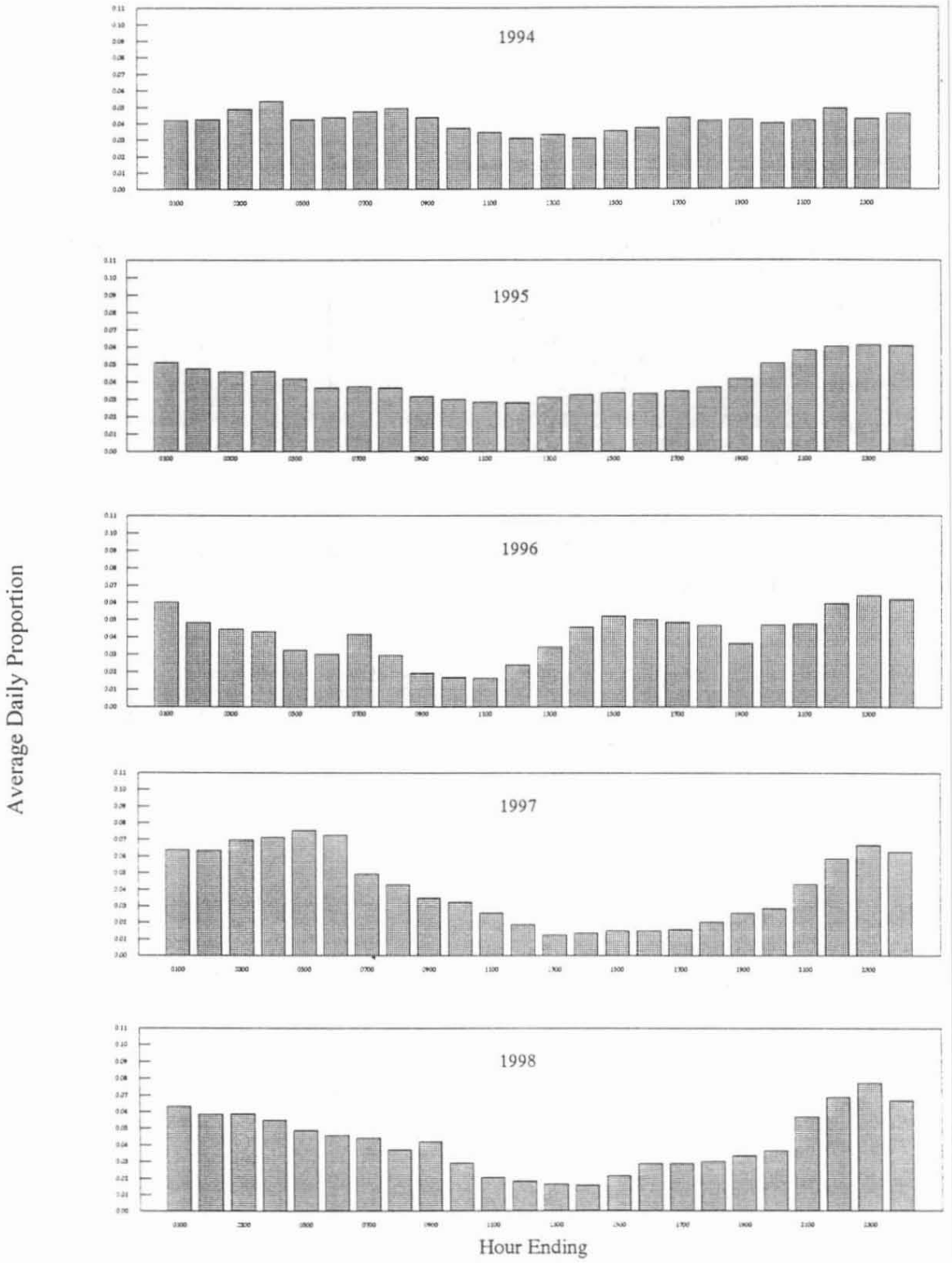

Figure 7. Annual temporal distribution of sonar counts observed in the Sheenjek River from 1994 through 1998.

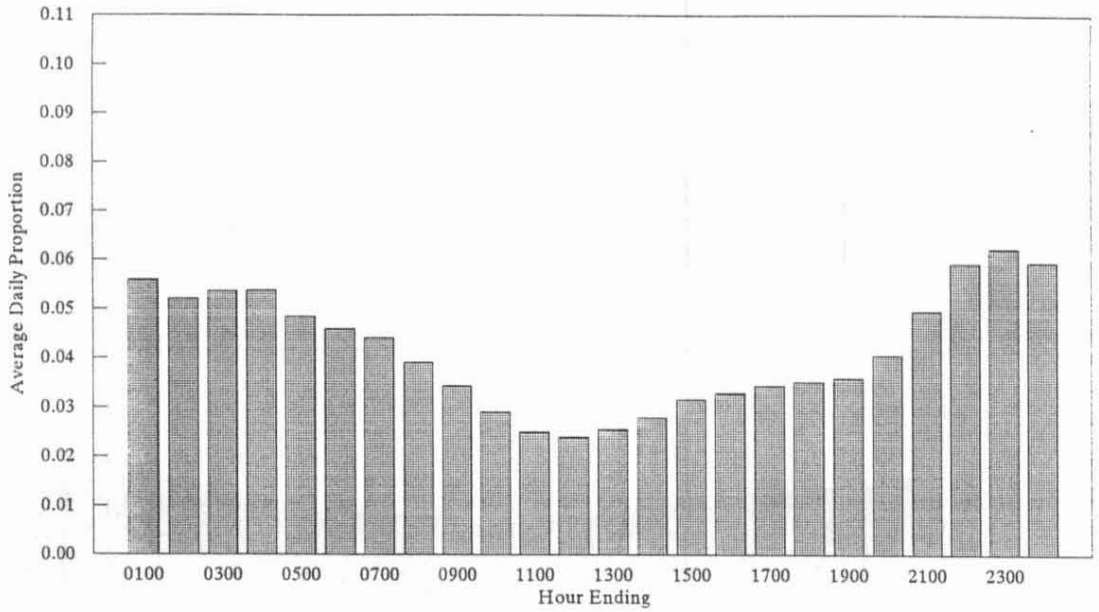

Figure 8. Average temporal migration pattern of fall chum salmon observed in the Sheenjek River, 1994–1998.

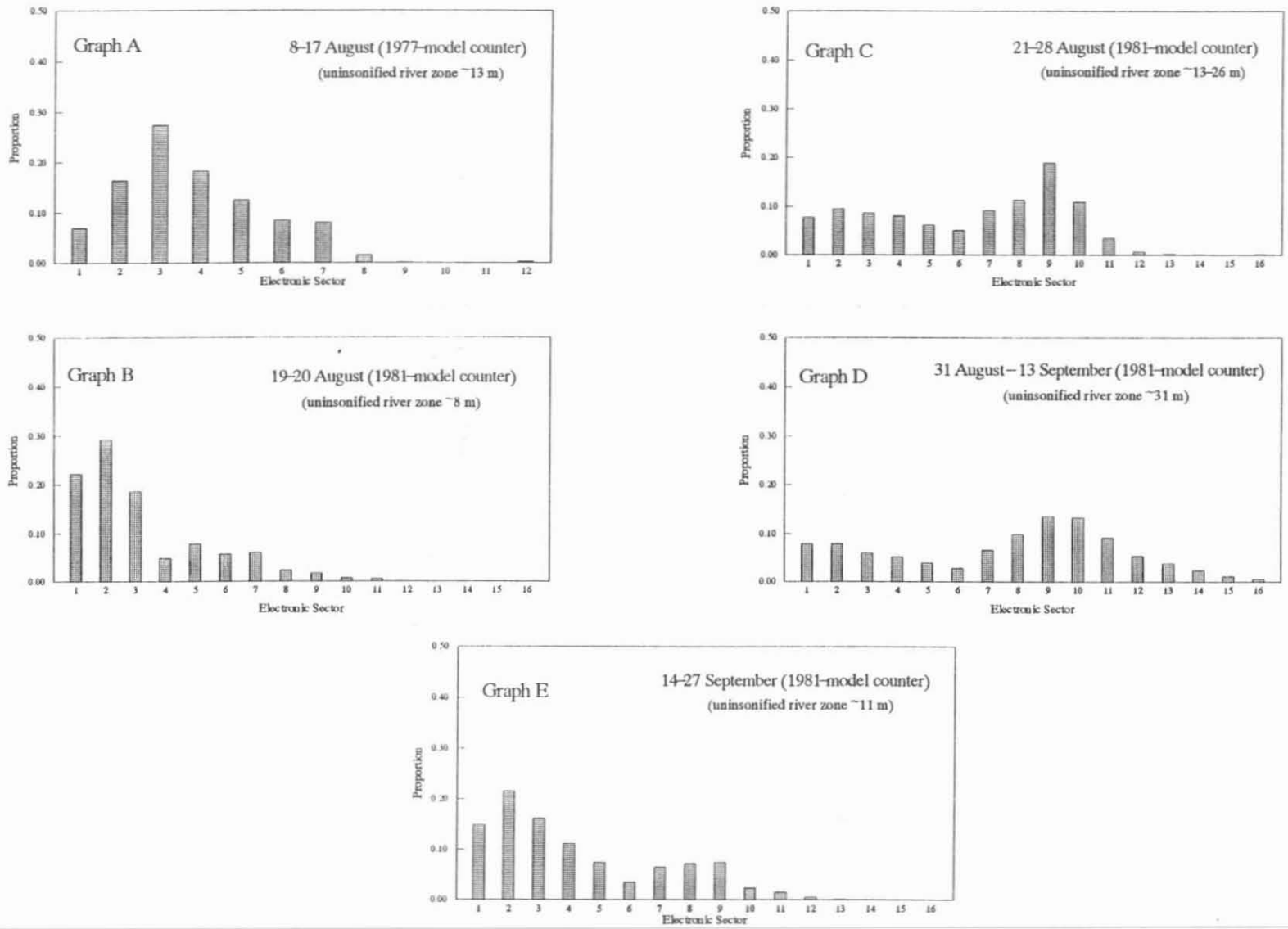

Figure 9. Estimated average percent passage of fall chum salmon in the Sheenjek River by electronic sector for different time periods in 1994, using the 1977–and 1981–model sonar counters.

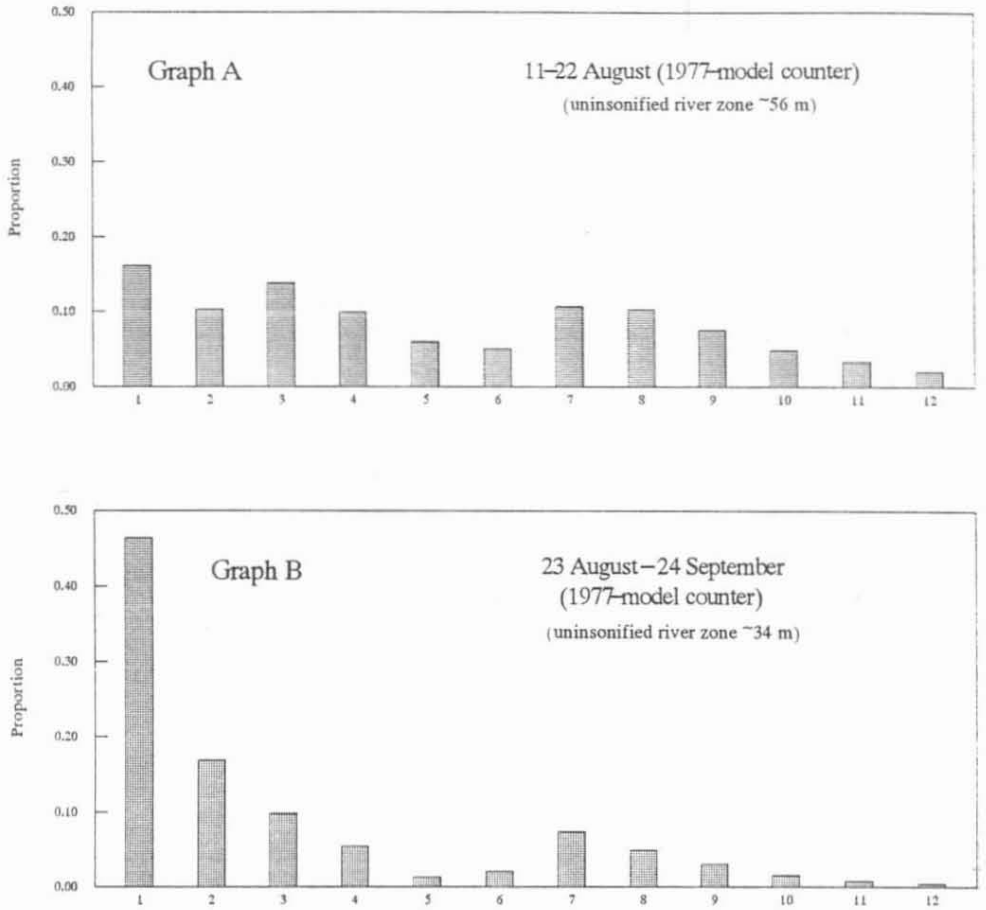

Figure 10. Estimated average percent passage of fall chum salmon in the Sheenjek River by electronic sector for 10–22 August (graph A) and 23 August through 24 September (graph B) 1995.

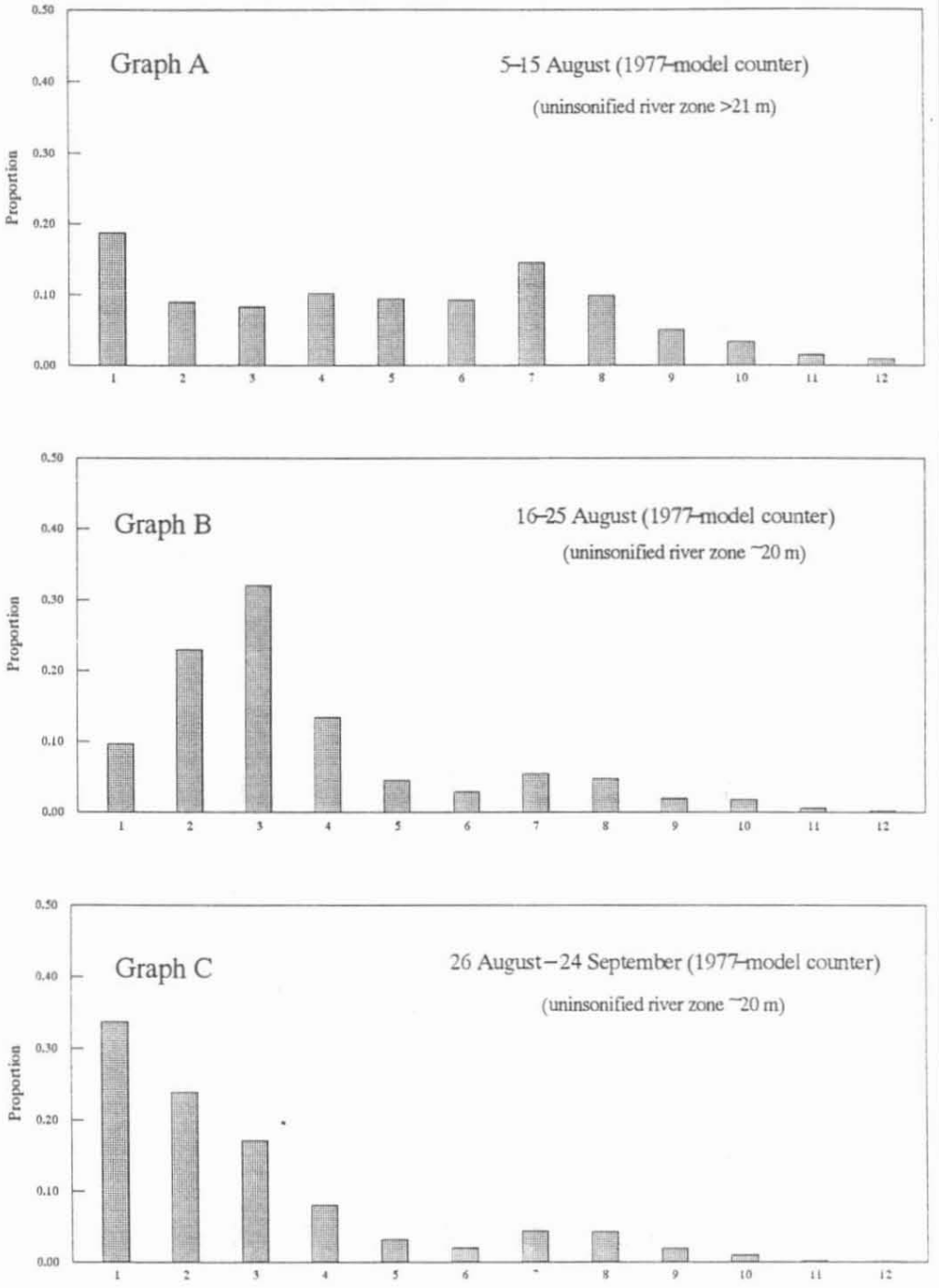

Figure 11. Estimated average percent passage of fall chum salmon in the Sheenjek River by electronic sector for 5–15 August (graph A), 16–25 August (graph B), and 26 August through 24 September (graph C) 1996.

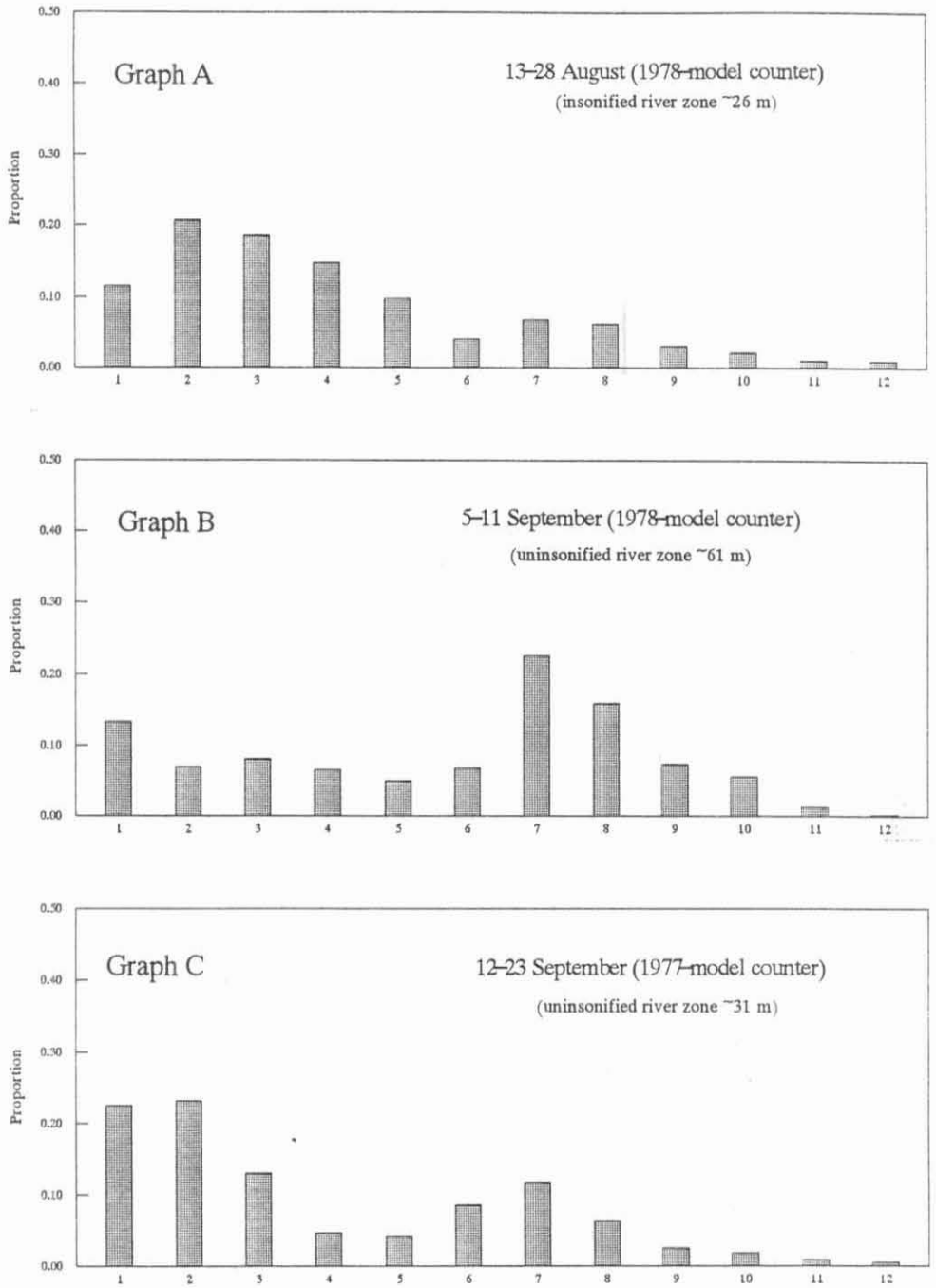

Figure 12. Estimated average percent passage of fall chum salmon in the Sheenjek River by electronic sector for 13–28 August (graph A), 5–11 September (graph B), and 12–23 September (graph C) 1997.

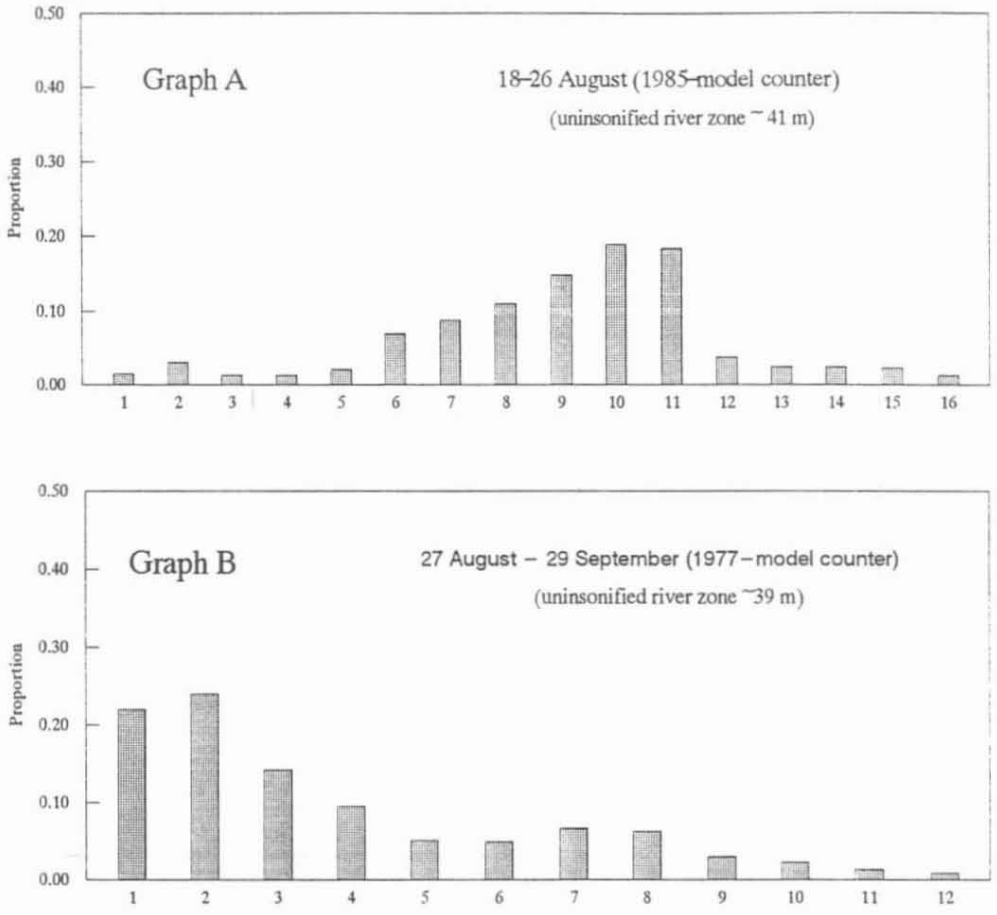

Figure 13. Estimated average percent passage of fall chum salmon in the Sheenjek River by electronic sector for 18–26 August (graph A) and 27 August through 29 September (graph B) 1998.

APPENDIX A

SHEENJEK RIVER CLIMATOLOGICAL AND HYDROLOGIC OBSERVSIONS

APPENDIX A: SHEENJEK RIVER CLIMATOLOGIC AND HYDROLOGICAL OBSERVATIONS

Appendix A.1 Climatological and hydrologic observations and miscellaneous comments made at the Sheenjek River sonar project site, 1994.

Date	Time	Precip (code)[a]	Cloud Cover (code)[b]	Wind (Direction and Velocity)	Temperature (C°) Air	Temperature (C°) Water Surface	Water Level (cm) ± 24 h Change	Water Level (cm) relative to zero datum	Water Color (code)[c]	Remarks
06–Aug		A	C						B	Arrive at project site; set up camp; 50+" velvet.
07–Aug	2100	A	C	Calm		18	0.0	zero datum	B	Installed 1977–model sonar counter (2100 h), weir, and water guage.
08–Aug	1900	A	C	S 0–5	24	17	−2.6	−2.6	B	Made bottom profile of river at counting site.
09–Aug	1830	A	C	Calm	26	17	−1.4	−4.0	B	Beautiful day.
10–Aug	1815	A	C	Calm	29	17	−0.4	−4.4	B	Too hot.
11–Aug	1806	A	S	S 0–5	23	17	0.8	−3.6	B	Grizzly bear seen across from sonar site. Light rain shower 30 min this morning.
12–Aug	1800	A	S	SW 5–10	21	16	−2.8	−6.4	B	Gusty winds all day.
13–Aug	1815	A	S	S 5–10	19	14	−2.4	−8.8	B	
14–Aug	1900	A	S	S 5–10	21	14	1.0	−7.8	B	Put up counting tower.
15–Aug	1810	A	S	S 5–20	18	14	−0.6	−8.4	B	Critter trampling in "woods" behind tents @ 2320 h.
16–Aug	1725	B	O	S 3–5	22	14	−2.6	−11.0	B	Moved transducer offshore about 6 m; light rain since 1730 h.
17–Aug	2200	B	C	S 10–15	17	14	−2.2	−13.2	B	Winds gusting to 25 mph.
18–Aug	1800	B	S	SSW 10–30	17	13	−1.6	−14.8	B	Winds gusting to 30+ mph; replaced 1977–model sonar counter with 1981–model.
19–Aug	1830	A	C	S 5–10	19	13	−1.8	−16.6	B	Winds abating today.
20–Aug	1745	B	O	Calm	13	12	1.6	−15.0	B	
21–Aug	1750	B	S	Calm	16	11	17.6	2.6	C	Water rising; moved transducer inshore about 6–7 m.
22–Aug	1800	B	B	S 5–10	12	11	17.8	20.4	D	Moved transducer in about 8 m; water crested by 180 h.
23–Aug	1940	A	B	S 5	7	9	−7.8	12.6	D	Moved transducer offshore 3 m; water very murky.
24–Aug	1800	A	O	Calm	13	9	−7.2	5.4	C	
25–Aug	1800	B	O	Calm	14	9	−4.0	1.4	C	Water continues to fall in spite of rain.
26–Aug	1800	B	S	S 3–5	22	10	1.6	3.0	C	Canada geese on east bar.
27–Aug	1800	B	B	S 5–10	13	11	2.4	5.4	C	Pretty heavy rain during night watch.
28–Aug	1800	B	B	Calm	10	11	25.2	30.6	C	Water on the rise; moved transducer inshore 9–10 m. Geese on east bank.
29–Aug	1807	B	O	N 5–10	12	10	73.0	103.6	D	Project site almost totally flooded; pulled transducer, weir, tower and sonar tent.
30–Aug	1800	B	S	Calm	12	8	44.0	147.6	D	On water watch most of day; sound back in at 1800 h; water crested near 2100 h.
31–Aug	1800	A	O	Calm	16	8	−1.4	146.2	D	Moved transducer offshore about 8 m; beautiful night with Northern Lights.
01–Sep	1958	A	O	Calm	12	8	−45.8	100.4	D	Moved transducer offshore about 20 m; water dropping rapidly.
02–Sep	1835	A	O	Calm	16	9	−22.0	78.4	D	Moved transducer offshore about 7 m; water dropping rapidly.
03–Sep	1850	B	S	Calm	16	9	−19.0	59.4	D	Moved transducer offshore about 7 m; water dropping rapidly.
04–Sep	1813	A	B	S 3–5	14	9	−13.0	46.4	D	Moved transducer offshore about 11 m.
05–Sep	1800	A	C	S 3–5	9	9	−11.0	35.4	D	Fish passage has dropped tremendously.
06–Sep	1800	A	C	SW 2–5	15	8	−6.6	28.8	C	First frost; moved transducer offshore about 7 m.
07–Sep	1900	A	O	Calm	12	8	−2.2	26.6	C	
08–Sep	1810	B	S	N 5–15	8	7	6.4	33.0	B	Northern lights beautiful.
09–Sep	1910	A	C	N 2–5	5	6	−4.0	29.0	B	Put counting tower up.
10–Sep	1810	A	C	N 5–10	9	4	−4.2	24.8	B	
11–Sep	1800	A	C	Var 2–5	6	5	−3.2	21.6	B	
12–Sep	1815	A	C	Var 2–5	10	4	3.2	24.8	B	Indian summer, beautiful.
13–Sep	1813	A	B	N 2–5	8	4	−16.6	8.2	B	Moved transducer out 6 m; strong wind picking up this evening from North @ 15–20.
14–Sep	1810	A	B	NE 25–30"	6	3	−6.8	1.4	B	Nasty, stormy day; boats blew away in night, found grounded on a downstream bar.
15–Sep	1800	A	O	N 15–20	5	3	−4.8	−3.4	B	Water continues to decline; winds gusting to 25" mph.
16–Sep	1806	E	O	NNE 20–25	3	3	−4.8	−8.2	B	Weather continues to deteriorate; wind NNE @ 30" mph / 0° C / light snow @ 0630 h.
17–Sep	1805	A	O	N 15–20	2	2	−3.6	−11.8	B	Moved transducer offshore about 5 m.
18–Sep	1871	A	B	NE 10–15	5	2	−3.0	−14.8	B	Started snowing at 2000 h and winds abating.
19–Sep	1800	E	B	Calm	4	2	−2.8	−17.6	B	4–5 cm snow accumulation; visual from boat – hundreds of chums passing.
20–Sep	1815	B	O	Var 5–10	3	2	−3.4	−21.0	A	Good tower obsrvations; good passage.
21–Sep	1810	B	O	Calm	4	3	−2.0	−23.0	A	Fish lining gravel bar and good passage rates; no holding problems; owls are active.
22–Sep	1805	A	B	Calm	7	3	−2.0	−25.0	A	Water continues to go down; river is getting quite shallow.
23–Sep	1758	A	C	Calm	7	4	−2.4	−27.4	A	Steady fish passage; northern lights were out again.
24–Sep	1800	A	O	N 10–15	6	3	−1.6	−29.0	A	Blowing snow late this evening.
25–Sep	1800	E	S	Calm	3	3	−1.4	−30.4	A	Thin dusting of snow last night.
26–Sep	1808	A	C	Calm	4	2	−1.6	−32.0	A	Ice forming along shoreline.
27–Sep	1800	A	C	Calm	4	2	−2.0	−34.0	A	First sign of real milling problems to date; river extremely low – may only be able to
28–Sep	1200	A	S	S 5–10	5	1	−1.2	−35.2	A	make one boat trip downstream. System shut down September 28 @ 1200 h.

[a] Precipitation code for the preceding 24–hr period: A = None; B = Intermittent rain; C = Continuous rain; D = Snow and rain mixed; E = Light snowfall; F = Continuous snowfall; G = Thunderstorm w/ or w/o precipitation.
[b] Instanteous cloudcover code: C = Clear and visibility unlimited (CAVU); S = Scattered (<60%); B = Broken (60–90%); O = Overcast (100%); F = Fog or thick haze or smoke.
[c] Instanteous water color code: A = Clear; B = Slightly murky or glacial; C = Moderately murky or glacial; D = Heavily murky or glacial; E = Brown, tanic acid stain.

Appendix A.2 Climatological and hydrologic observations and miscellaneous comments made at the Sheenjek River sonar project site, 1995.

Date	Time	Precip (code)[a]	Cloud Cover (code)[b]	Wind (Direction and Velocity)	Temperature (C°) Air	Temperature (C°) Water Surface	Water Level (cm) ± 24 h Change	Water Level (cm) relative to zero datum	Water Color (code)[c]	Remarks
05–Aug	1630	B	B	SW 10–20		12	0.00	zero datum	A	Set up camp at project site; installed a water gauge.
06–Aug	0900	B	B	SW 10	13	12	35.00	35.0	A	River water rising.
07–Aug	2130	A	S	N 10		12	30.00	65.0	C	Installed 1977 counter; black bear chewed up toilet paper in latrine last night.
08–Aug	1800	A	S	Calm	24		40.0	105.0	C–D	Log took out sonar and broke transducer cables.
09–Aug	1330	A	C	Calm	21	13	3.0	108.0	C–D	Water crested 12 ft from sonar tent door (0900 h); black bear across river.
10–Aug	1800	G	S	Variable	25	14	−19.0	89.0	C	Reinstalled the 1977 counter at 1050 h. Electrical storm late afternoon/evening causing false
11–Aug	1800	B	S	Calm	23	14	−16.0	73.0	B	counts at times.
12–Aug	1800	B	B	Calm	23	14	−16.0	57.0	A	
13–Aug	1800	B	B	W 5	23	14	−13.0	44.0	A	Caught a whitefish in the inshore lead.
14–Aug	2000	G	S	NW 5	17	14	6.0	50.0	A	Moved transducer out.
15–Aug	1800	B	O	Calm	16	13	18.0	68.0	B	Log hit transducer late in evening.
16–Aug	1800	A	S	W 5	18	13	8.0	76.0	B	Had to realm transducer this morning; water rising.
17–Aug	1800	A	S	N 5	19	13	31.0	107.0	C	Moved transducer in; stick storms.
18–Aug	1800	B	S	W 5	15	12	13.0	120.0	C	Water crested at tent door at 1000 h; 8 more inches and no more gravel bar.
19–Aug	1800	B	O	SW 5–10	14	12	−16.0	104.0	B	
20–Aug	1800	B	B	S 5–10	13	12	−17.0	87.0	B	Appears to be some fish holding problems.
21–Aug	1800	A	C	SW 5–10	14	12	−9.0	78.0	A	
22–Aug	1800	A	C	S 10	15	12	25.0	103.0	C	
23–Aug	1800	A	C	S 5	17	11	−3.0	100.0	B	
24–Aug	1800	B	B	N 10–15	14	11	−17.0	83.0	B	
25–Aug	1800	A	C	Calm	14	10	−16.0	67.0	A	Moved transducer out.
26–Aug	1800	A	C	N 5	14	11	−14.0	53.0	A	
27–Aug	1800	A	O	N 15	8	9	−10.0	43.0	A	Water still falling; getting colder.
28–Aug	1800	A	C	S 5	12	9	−10.0	33.0	A	Moved transducer out; great aurora display tonight (rainbow colors).
29–Aug	1800	A	O	W 20	11	9	−10.0	23.0	A	Electrical storm this afternoon; water still falling slowly.
30–Aug	1800	C	O	Calm	10	8	−6.0	17.0	A	
31–Aug	1800	B	B	Light/Variable	11	8	−7.0	10.0	A	Loon floating/diving in front of camp this evening.
01–Sep	1800	B	O	N10–15	8	8	−5.0	5.0	A	
02–Sep	1800	A	B	S 5	11	9	−4.0	1.0	A	
03–Sep	1800	B	S	S 20	10	8	0.0	1.0	A	Lots of fish passing.
04–Sep	1800	A	C	N 5	8	8	−1.0	0.0	A	
05–Sep	1800	A	S	N 20	9	8	9.0	9.0	A	115 hp quit on way back from Porcupine; lots of fish moving thru inner sectors.
06–Sep	1800	A	B	N 15	9	7	12.0	21.0	B	Made river profile; replaced 115 hp; clear and cold w/ heavy frost–stove feels good.
07–Sep	1800	B	C	N 15	8	7	1.0	22.0	B	Cold and drizzly this evening.
08–Sep	1800	B	S	Light/Variable	13	8	−8.0	14.0	A	Heard gunshots downriver this am; spent much of day untangling seine from snag.
09–Sep	1800	B	B	S 5	11	8	−6.0	8.0	A	Lots of grouse and rabbits by cache; aurora out tonight.
10–Sep	1800	A	C/F	NE 10	14	8	−2.0	6.0	A	High thick haze; occasional holding problems.
11–Sep	1800	B	B	NE 5	12	8	5.0	11.0	A	Lots of fish passing.
12–Sep	1800	B	S	Calm	14	9	7.0	18.0	A	Lots of jumpers seens; bugs are out.
13–Sep	1800	B	S	S 5	15	9	6.0	24.0	A	Dead chum in fish lead; water rising; water filled with debris–lots of leaves.
14–Sep	1800	B	C	W 15	12	9	3.0	27.0	B	Lots of fish passing; 3 chum carcasses in lead; lead filling w/ leaves fast––leaves falling from
15–Sep	1800	A	C	Calm	9	8	−3.0	24.0	B	trees like rain even with little wind, must be from freezing.
16–Sep	1800	A	C	E 5	12	7	−5.0	19.0	A	Air temperature −2°C @ 0700 h; another beautiful day.
17–Sep	1800	A	C	W 10	16	7	−7.0	12.0	A	USFWS dropped by for coffee.
18–Sep	1800	A	C	Calm	15	7	−6.0	6.0	A	
19–Sep	1800	A	C/F	Calm	15	7	−8.0	−2.0	A	Bugs out and haze in evening.
20–Sep	1800	A	S	SE 15	19	8	−5.0	−7.0	A	High 22 degrees C.
21–Sep	1800	B	B	E 5	19	8	−5.0	−12.0	A	Lots of fish passing; a very warm night.
22–Sep	1800	A	C	E 5	17	9	−5.0	−17.0	A	High 21 degrees C.
23–Sep	1800	B	B	Calm	14	8	−2.0	−19.0	A	Great! Sucked up the seine in impeller today.
24–Sep	1800	B	S	Calm	17	8	−3.0	−22.0	A	Buggy today.
25–Sep	1045				13		−1.0	−23.0	A	Shut down sonar at 1043 h.

[a] Precipitation code for the preceding 24–hr period: A = None; B = Intermittent rain; C = Continuous rain; D = Snow and rain mixed; E = Light snowfall; F = Continuous snowfall; G = Thunderstorm w/ or w/o precipitation.
[b] Instantaneous cloudcover code: C = Clear and visibility unlimited (CAVU); S = Scattered (<60%); B = Broken (60–90%); O = Overcast (100%); F = Fog or thick haze or smoke.
[c] Instantaneous water color code: A = Clear; B = Slightly murky or glacial; C = Moderately murky or glacial; D = Heavily murky or glacial; E = Brown, tanic acid stain.

Appendix A.3 Climatological and hydrologic observations and miscellaneous observations made at the Sheenjek River sonar project site, 1996.

Date	Time	Precip (code)[a]	Cloud Cover (code)[b]	Wind (Direction and Velocity)	Temperature (C°) Air	Temperature (C°) Water Surface	Water Level (cm) ± 24 h Change	Water Level (cm) relative to zero datum	Water Color (code)[c]	Remarks
29-Jul	1630			Calm					A	Forest fire at Mahler's cabin; smoke jumpers arrived.
30-Jul	1700	B	O	S 5-10			0.0	zero datum	A	Installed 1977 counter; sunk sandpoint well.
31-Jul	1920	A	S-B	S 5	18	13	-3.3	-3.3	A	Made detailed river profile.
01-Aug	2000	B	O	S 5	14	14	2.0	-1.3	A	Small black bear across river.
02-Aug	1935	B	O	S 15	12	12	42.0	40.7	B	Pulled sonar at 2000 hours due to rising water levels.
03-Aug	2125	A	B	S 5	11	12	103.0	143.7	D	
04-Aug	2130	A	B	S 5-10	14	12	-29.0	114.7	D	
05-Aug	2140	B	S	N 5-10	13	11	-22.0	92.7	C	Sound back in at 2100 hours.
06-Aug	2010	A	S	N 5-10	17	12	-9.0	83.7	D	
07-Aug	2001	A	S	SW 5	18	12	19.0	102.7	D	Black bear stuck head in sonar tent (1700 hours).
08-Aug	2000	C	O	N 10	11	11	-1.0	101.7	D	Two spawned out chums on upstream side of lead; canoers reported jumpers ~70 km
09-Aug	2100	C	O	N 10-15	11	11	-11.0	90.7	D	upriver; back bear stole pair of boots from sonar tent.
10-Aug	2259	A	C	N 5	8	10	-20.0	70.7	C	Water dropping rapidly all day; cut wood today.
11-Aug	1320									Reset water gauge and lengthened inshore lead.
	2100	A	C	N 5	15	11	-12.0	58.7	C	
12-Aug	2000	A	C	Calm	16	11	-3.0	55.7	C	Moved transducer offshore; very few fish passing.
13-Aug	2000	A	C	S 5	17	11	0.0	55.7	C	Low fish passage.
14-Aug	1600	A	B	SW 15	20	13	-7.0	48.7	C	
15-Aug	2130	B	B	SW 5	16	12	-12.0	36.7	B	
16-Aug	1430									Reset water gauge; moved transducer offshore; low fish passage.
	2130	B	B	SW 5	14	12	-10.0	26.7	B	
17-Aug	1700	A	S	Calm	21	11	-7.0	19.7	B	Bill Russell stopped – reported jumpers all the way up the Porcupine River.
18-Aug	1700	B-C	S	Calm	16	13	-9.0	10.7	B	
19-Aug	1600	B	S	N 25	9	12	-4.0	6.7	A	Cold and windy
20-Aug	1630	A	S	N 5	9	10	-2.0	4.7	A	Cold; cut wood; fish numbers picking up.
21-Aug	1615	A	S	N 25	6	9	-3.0	1.7	A	Cold and windy
22-Aug	1640	A	C	N 25	8	7	-6.0	-4.3	A	Cold and windy
23-Aug	1600	A	C	Calm	10	8	-6.0	-10.3	A	Moved transducer offshore.
24-Aug	1600	A	S	S 25	18	8	-4.0	-14.3	A	Fish passage exploded today; chum jumping everywhere; could be seen constantly
25-Aug	1700	B	O	Calm	13	10	-5.0	-19.3	A	moving from boat and shore; caught some by sport fishing.
26-Aug	1600	D/E	O	N 10	3	8	-3.0	-22.3	A	First snowfall; fish passage continues strong; collected more firewood.
27-Aug	1700	A	C	Calm	13	9	-3.0	-25.3	A	Passage rate dropped off but still good; moved sonar tent closer to river.
28-Aug	1630	A	C	Var. 5	10	9	-1.0	-26.3	A	Water visibility is very good.
29-Aug	1640	A	S	Calm	13	11	3.0	-23.3	A	Water started to rise some; very high fish passage rates.
30-Aug	1700	A	B	Calm	21	11	2.0	-21.3	A	River appeared full of fish today on way upriver to seining location.
31-Aug	1710	B	B	SW 8	12	12	-2.0	-23.3	A	Very high fish passage rates continue.
01-Sep	1400	A	S	S 5	12	12	-3.0	-26.3	A	Moved transducer out; hunter reported lots of fish downriver.
02-Sep	1800	A	B	Calm	14	10	-1.0	-27.3	A	
03-Sep	1540	A	O	S 5	17	9	9.0	-18.3	A	Fish lining gravel bar. Spotted lynx across river.
04-Sep	1620	A	S	N 5	10	9	19.0	0.7	B	Moved transducer inshore ~5 m due to rising water.
05-Sep	1415	A	C	N 5	11	7	4.0	4.7	B	
06-Sep	1600	A	C	Calm	11	7	-4.0	0.7	B	
07-Sep	1640	A	S	Calm	13	7	-4.0	-3.3		From the boat we watched a steady stream of fish pass.
08-Sep	1650	A	O	N 5-10	4	6	-4.0	-7.3		
09-Sep	1610	B	O	Calm	3	4	-5.0	-12.3	B	Spectacular display of Northern Lights tonight.
10-Sep	1640	A/F	O	N 5	3	6	-4.0	-16.3	A	Caught tagged chum in front of lead by hand; started snowing ~2200 hours.
11-Sep	1600	F/E	O	Calm	0	3	-3.0	-19.3	A	Heavy snows today (false counts) with freezing rain toward evening.
12-Sep	1615	B	O	N 5-10	3	4	-2.0	-21.3	A	
13-Sep	1650	A	B	N 15	2	4	-3.0	-24.3	A	
14-Sep	1710	A	B	NE 10	1	3	-3.0	-27.3	A	Lynx behind camp.
15-Sep	1740	E/D	O	N 5	3	4	-2.0	-29.3	A	
16-Sep	1710	D	B	Calm	6	4	-2.0	-31.3	A	Tower observations confirmed fish are not milling – moving slow but steady.
17-Sep	1610	A	O	N 5	5	4	-2.0	-33.3	A	Observations along shore confirm large surge of fish today.
18-Sep	1615	A	C	Calm	18	6	-2.0	-35.3	A	Made largest seine haul of season immediately after deployment.
19-Sep	1600	B	B	S 5-10	9	6	-1.0	-36.3	A	High steady fish passage; no holding; saw 2 tagged chums pass transducer.
20-Sep	1635	A	B	S 5	11	5	-1.0	-37.3	A	Passage dropped off some today; largest seine haul of season (short set).
21-Sep	1605	A	O	E 5	6	4	2.0	-35.3	A	Observed some spawning by the boat.
22-Sep	1630	E	O	Calm	4	4	5.0	-30.3	A	
23-Sep	1610	E	B	S 5	3	4	5.0	-25.3	A	
24-Sep	1300	E	O	S 5	1	4	0.0	-25.3	A	Snowing outside. Power down at 0800.
25-Sep		E	O						A	Winds 40-50 mph blew sleep tent/frame some 15 m down bar; destroyed them.

[a] Precipitation code for the preceding 24-hr period: A = None; B = Intermittent rain; C = Continuous rain; D = Snow and rain mixed; E = Light snowfall; F = Continuous snowfall; G = Thunderstormw/ or w/o precipitiation
[b] Instanteous cloudcover code: C = Clear and visibility unlimited (CAVU); S = Scattered (<60%); B = Broken (60-90%); O = Overcast (100%); F = Fog or thick haze or smoke.
[c] Instanteous watercolor code: A = Clear; B = Slightly murky or glacial; C = Moderately murky or glacial; D = Heavily murky or glacial; E = Brown, tanic acid stain.

Appendix A.4 Climatological and hydrologic observations and miscellaneous comments made at the Sheenjek River sonar project site, 1997.

Date	Observation Time	Precipitation (code) [a]	Cloud Cover (code) [b]	Wind: Current Azimuth and speed (mph)	Wind: Maximum (mph)	Wind: Maximum time	Temperature (C°): Water Surface	Temperature (C°): Air Minimum	Temperature (C°): Air Maximum	Water Level (cm): ± 24 h Change	Water Level (cm): relative to zero datum	Water Color (code) [c]	Remarks
09-Aug	1900	A	C	calm					16	0.0	zero datum	A-B	Deployed sonar (1985-model counter).
10-Aug	2230	A	B	180°-3			14	11	32	9.0	9.0	A-B	Installed fish lead.
11-Aug	2241	A	B	calm	13	0830	14	18	29	10.0	19.0	A-B	Made river profile.
12-Aug	1930	B	C	217°-4	19		14	14	29	-4.0	15.0	A-B	Replaced 1985-model sonar counter with 1977-model counter.
13-Aug	1930	A	B	209°-9	24		14	13	24	-7.0	8.0	A-B	
14-Aug	1930	A	B	177°-9	21		14	14	25	-3.0	5.0	A-B	
15-Aug	1800	A	C	180°-3	16	1408	14	9	27	10.0	15.0	A-B	
16-Aug	1800	B	B	193°-7	20	1357	14	9	23	6.0	21.0	A-B	
17-Aug	1630	B	O	179°-12	25	1726	12	9	17	0.0	21.0	A-B	
18-Aug	1630	B	B	0°-1	15	0358	11	2	21	-6.0	15.0	A-B	
19-Aug	1700	A	O	198°-9	21	1217	11	0	19	-1.0	14.0	A-B	
20-Aug	2130	A	B	168°-1	17	1601	11	7	23	0.0	14.0	A-B	
21-Aug	1700	A	B	178°-3			9	9	23	-2.0	12.0	A-B	
22-Aug	1645	A	S	171°-2	11	1501	11	3	28	-3.0	9.0	A-B	
23-Aug	1620	A	C	207°-2	9	1650	12	8	29	-6.0	3.0	A-B	
24-Aug	1740	A	C	calm	9	1449	12	6	29	-6.0	-3.0	A-B	Lots of fish passing.
25-Aug	1651	B	S	358°-2	12	1524	11	8	22	-5.0	-8.0	A-B	
26-Aug	1800	B,G	B	297°-4	13	1652	12	10	21	-4.0	-12.0	A-B	Nearby electrical storm late tonight.
27-Aug	1700	B	S	162°-7	21	1628	12	9	23	-3.0	-15.0	A-B	Lots of fish passing and jumpers present.
28-Aug	1600	B	B	150°-7	21	1146	11	7	22	9.0	-6.0	A-B	Water beginning to rise; attempted to beach seine.
29-Aug										90.0	84.0	D	Water rising rapidly (6-7 cm/h); sonar out @ 0735 h; rolled up
30-Aug										114.0	198.0	D	tent walls; evacuated to Porcupine River on 30 Aug - entire bar
31-Aug										30.0	228.0	D	nearly covered (0.3 m deep at campsite); estimate water crested
01-Sep										-80.0	148.0	D	sometime early morning 31 Aug; re-established camp on 1 Sep
02-Sep										-58.0	90.0	D	and 2 Sep.
03-Sep	2130	B	B				9	9	16	-14.0	76.0	C	Sonar and fish lead redeployed at 1440 h.
04-Sep	2100	B	B				9	9	19	6.0	82.0	C	Fish lead filled with debris.
05-Sep	2100	B	S				9	6	23	1.0	83.0	C	Log hit and moved transducer.
06-Sep	2345	A	C				9	9	18	-6.0	77.0	C	
07-Sep	2350	A	S				10	6	15	-1.0	76.0	C	Recovered male chum with USFWS tag (#14962) in fish lead.
08-Sep	2300	A	S				10	9	15	4.0	80.0	C	
09-Sep	2345	A	S				10	8	16	-6.0	74.0	C	
10-Sep	2140	A	C				11	9	17	-12.0	62.0	C	
11-Sep	2100	B,G	O				10	10	15	-13.0	49.0	C	Hailed today.
12-Sep	1435	B	S				10	9	15	-8.0	41.0	B-C	
13-Sep	1600	B	B				9	3	18	-10.0	31.0	B	
14-Sep	-						8			-1.0	30.0	A-B	
15-Sep	1615	A	C				8			1.0	31.0	A-B	Attempted seining - river velocity too high.
16-Sep	2115	A	S				8	3	13	-1.0	30.0	A-B	Replaced 1977-model sonar counter with 1978-model counter.
17-Sep	1540	B	S				8	3	14	-5.0	25.0	A-B	
18-Sep	1645	B	S				8	4	14	-9.0	16.0	A-B	Fish moving slow and some holding; most fish in sectors 1 and 2.
19-Sep	1821	B	B				8	3	13	-7.0	9.0	A-B	
20-Sep	1645	A	S				7	0	13	-1.0	8.0	A-B	A good frost last night.
21-Sep	1600	A	C				6	0	14	6.0	14.0	A-B	
22-Sep	1730	B	B				6	4	14	-4.0	10.0	A-B	

[a] Precipitation code for the preceding 24-hr period: A = None; B = Intermittent rain; C = Continuous rain; D = Snow and rain mixed; E = Light snowfall; F = Continuous snowfall; G = Thunderstorm w/ or w/o precipitation.
[b] Instanteous cloudcover code: C = Clear and visibility unlimited (CAVU); S = Scattered (<60%); B = Broken (60-90%); O = Overcast (100%); F = Fog or thick haze or smoke.
[c] Instanteous water color code: A = Clear; B = Slightly murky or glacial; C = Moderately murky or glacial; D = Heavily murky or glacial; E = Brown, tanic acid stain.

Appendix A.5 Climatological and hydrologic observations and miscellaneous comments made at the Sheenjek River sonar project site, 1998.

Date	Observation Time	Precipitation (code) [a]	Cloud Cover (code) [b]	Wind: Current Azimuth and speed (mph)	Wind: Maximum (mph)	Wind: Maximum time	Temperature (C°): Water Surface	Temperature (C°): Air Minimum	Temperature (C°): Air Maximum	Water Level (cm): ± 24 h Change	Water Level (cm): relative to zero datum	Water Color (code) [c]	Remarks
08-Aug													Water rising; no signs of fish.
09-Aug												B	Removed beaver cuttings from upriver; installed 1985 ctr; few fish-25 counts 1600-2400 hrs.
10-Aug	2100	A	B	210°-3	16	2130		57	65	zero datum	0.0	B	Install water gauge; made river profile at counting site; heavy debris load passing site.
11-Aug	2245	A	B	180°-2	20	1205		47	70	37.0	37.0	B-C	Very few fish; water rising rapidly; pulled sonar @ 2245 h; stick-storm.
12-Aug	1520	B	C	217°-4						35.0	72.0	C	Huge stick-storm; Mahler's cabin now on an oxbow; prepared to evacuate site.
13-Aug	1330									32.0	104.0	C	Water crested ~1300 hours
14-Aug	1800									-20.0	84.0	C	No signs of fish.
15-Aug	1800									-11.0	73.0	C	Water slowly retreating but still too high for sonar.
16-Aug	1630									-16.0	57.0	C	Water slowly retreating but still too high for sonar.
17-Aug	2200	B	O	SW 15-20						-18.0	39.0	C	Put sound back in @ 1100 hours (1985 ctr).
18-Aug	2100	B	O							-8.0	31.0	C	Moved transducer out; very slow passage rate and no other signs of fish in river.
19-Aug	1200	A	B	calm	16			40	66	-6.0	25.0	C	Passage so low, cannot calibrate; family of foxes hanging around sonar tent.
20-Aug	2130	B	O	calm	9		9.5	54	69	10.0	35.0	C	Passage so low, cannot calibrate; no other signs of fish in river.
21-Aug	1713	A	O	calm			9.5	47	62	0.0	35.0	C	
22-Aug	1600	B	O	180°-2	10		9.0	36	62	-7.0	28.0	C	Fresh bear tracks behind all tents this morning; saw a black bear swim to our bar @ 2230 hours.
23-Aug	1745	A	B	NE 3	15	1436	9.0	48	68	-7.0	21.0	B-C	Two cross foxes behind camp; rafters reported seeing one dead fish upriver (2 week float trip).
24-Aug	2000	B	C	calm	9	1449	9.0	41	66	-1.0	20.0	B	Moved transducer out; still low fish passage; scared black bear away from sleep tent door tonight.
25-Aug	1830	A	C	N 8	6	0840	9.5	49	66	-2.0	18.0	B	Bill Russell stopped by today.
26-Aug	1415	B	B	calm	12	1650	10.0	49	61	-2.0	16.0	B	Saw large grizzly across river and a small grizzly on our bar below camp about 2200 hours.
27-Aug	0800	B	O	S 3	9	0500	10.0	45	61	-1.0	15.0	B	Switched to 1977 counter due to printer problems with 1985 ctr; still very low fish passage.
28-Aug	600	B	B	calm	14	1830	10.0	45	60	1.0	16.0	B	Fish passage remains very low.
29-Aug	0800	B	O	N 4	9	1615	9.0	44	54	-3.0	13.0	B	Fish passage low; an otter and 3 kits swam upstream.
30-Aug	1633	A	C	S 10	16	1619	9.0	37	60	23.0	36.0	B	Water rising, moved transducer in ~5 meters.
31-Aug	1500	A	B	N 9	27	1755	8.5	44	60	32.0	68.0	C	Very cold with a north wind.
01-Sep	1500	A	C	ENE 4	11		8.0	39	69	-3.0	65.0	B	Water crested today; lots of debris and leaves; saw grizzly across river at 2130 hours.
02-Sep	2102	B	B	calm	11	1600	10.0	38	60	-19.0	46.0	B	Foxes hanging around camp; group from CATG dropped by; saw grizzly across river at 2115 hrs.
03-Sep	2100	A	B	calm	14	1400	10.0	43	68	13.0	59.0	C	Tried sampling - zero catch; saw no fish or jumpers upriver; passage remains low.
04-Sep	2130	A	C	calm	14	1422	10.0	42	63	4.0	63.0	C	
05-Sep	2230	A	C	calm	8	1630	9.5	46	63	-11.0	52.0	B	
06-Sep	2230	A	C	NNE 10	26	1550	9.0	37	66	-15.0	37.0	B	Grizzly set off motion sensor alarm @ 0630 h; fresh grizzly tracks behind sonar tent last night;
07-Sep	2030	B	B	calm			9.0	45	55	-2.0	35.0	B	found first dead chum in fish lead on 6 Sep. Moved transducer out ~2 m on 7 Sep.
08-Sep	1930	B	O	calm	13	1300	9.0	46	55	-3.0	32.0	B	Fish passage picked up some today.
09-Sep	2100	A	C	N 11	11	1630	8.5	43	57	-1.0	31.0	B	
10-Sep	2130	A	C	calm	20	1500	8.5	34	53	-4.0	27.0	B	
11-Sep	2055	A	C	calm	19	1045	8.0	32	51	-13.0	14.0	B	Bitter cold this AM with wind chill reading 12° F.
12-Sep	2130	A	C	calm	16	0425	8.0	34	61	5.0	19.0	B	Moved sonar tent closer to river; seined along many bars today - caught and saw zero fish.
13-Sep	2230	A	B	calm	5		6.0	34	51	-5.0	14.0	B	Moved transducer out ~8 m and extended lead; fish numbers starting to pick up.
14-Sep	2240	A	B		14		5.0	27	49	-4.0	10.0	B	
15-Sep	1125	A	C				5.0	23	50	-3.0	7.0	A	Seined along several bars today - caught zero fish.
16-Sep	2200	A	B				5.0	35	54	-4.0	3.0	A	Fish passage increased today.
17-Sep	2350	A	S				5.0	39	59	-5.0	-2.0	A	Found one dead chum in fish lead.
18-Sep	2040	B	C				6.0	38	54	-3.0	-5.0	A	
19-Sep	2350	A	C		11		6.0	37	57	4.0	-1.0	A	Heard jumpers at midnight.
20-Sep	2000	B	O		9		7.0	41	60	8.0	7.0	A	Only caught 3 fish seining today.
21-Sep	2044	A	B		24		7.0	43	55	7.0	14.0	A	Very windy; Barton encounters grizzly behind camp.
22-Sep	2130	A	O		11		6.0	29	50	10.0	24.0	A	
23-Sep	1715	A	C		11		6.0	31	54	16.0	40.0	B	Moved transducer in ~4 meters; water rising fast.
24-Sep	1921	A	C		14		5.0	36	53	27.0	67.0	B	Moved transducer in ~7 meters and reset water gauge.
25-Sep	2000	A	C		22		5.0	30	52	-12.0	55.0	B	Water has crested.
26-Sep	2000	A	C		20		4.5	35	44	-16.0	39.0	B	Some fish holding noticed; low passage; incredible Northern Light display.
27-Sep	2045	A	C		17		5.0	37	47	-2.0	37.0	A	Moved transducer out ~5 meters.
28-Sep	2000	A	C		11		5.0	30	44	-6.0	31.0	A	
29-Sep	2105	A	C		11		4.0	22	45	-7.0	24.0	A	
30-Sep	1200	A	C		6		3.0	20	31	-5.0	19.0	A	Powered down at noon.

[a] Precipitation code for the preceding 24-hr period: A = None; B = Intermittent rain; C = Continuous rain; D = Snow and rain mixed; E = Light snowfall; F = Continuous snowfall; G = Thunderstorm w/ or w/o precipitation.
G = Thunderstorm w/ or w/o precipitation.

[b] Instanteous cloudcover code: C = Clear and visibility unlimited (CAVU); S = Scattered (<60%); B = Broken (60-90%); O = Overcast (100%); F = Fog or thick haze or smoke.

[c] Instanteous water color code: A = Clear; B = Slightly murky or glacial; C = Moderately murky or glacial; D = Heavily murky or glacial; E = Brown, tanic acid stain.

APPENDIX B

SHEENJEK RIVER SONAR COUNT EXPANSIONS

APPENDIX B: SHEENJEK RIVER SONAR COUNT EXPANSIONS

Appendix B.1. Expansions made to Sheenjek River sonar counts, 1994-1998.

Partial-day count expansions included days when hourly counts were missing for a block or blocks of time as a result of one or more reasons, including but not limited to: sonar not operating, printer malfunction, mis-aimed transducer, or when false counting occurred from such factors as high winds, heavy snowfall, driving rain, etc.

Partial-day counts were expanded to daily totals by extrapolation based upon the season average temporal pattern in hourly passage. The average temporal pattern was estimated from those days when the sonar counter operated 24 hours per day. As examples: 1) On 30 July 1996 the sonar count was 246 for the period of operation 1701 hours through 2400 hours. In 1996, the percentage of sonar counts for this time-block averaged 36.3% of the daily total for the season. Thus, the total count for 30 July 1996 was estimated as 243 ÷ 0.363, or 670 fish. 2) On 29 August 1997 the sonar count was 960 for the period of operation 0001 hours through 0800 hours. In 1997, the percentage of sonar counts for this time-block averaged 51% of the daily total for the season. Thus, the total count for 29 August 1997 was estimated as 960 ÷ 0.51, or 1,884 fish.

Year	Partial-day Expansions (extrapolation)	Reason(s)
1994	7, 30 Aug; 13, 28 Sep	First and last day partial count; high water; high winds
1995	10, 15, 16, 17, 28 Aug; 14, 15, 25 Sep	First and last day partial count; high water, mis-aimed beam from debris
1996	30 Jul; 2, 5, 22, 26 Aug; 10, 11, 24 Sep	First and last day partial count; high water, heavy snowfall; printer problem
1997	9, 29 Aug; 3, 4, 14, 23 Sep	First and last day partial count; high water; printer problem
1998	17 Aug; 30 Sep	First and last day partial count

Daily passage estimates for entire days that sonar did not operate as a result of high water and/or heavy debris loads were interpolated based upon the most recent daily passage estimate prior and subsequent to the missing days. For example, estimated passage was 685 and 577 fish for 3 and 4 August, respectively, in 1996. These estimates were interpolated from estimated passage on 2 August (793 fish) and 5 August (469 fish).

Year	Total-day Expansions (linear interpolation)	Reason(s)
1994	29 Aug; 14 Sep	high water; high winds
1995	none	
1996	3, 4 Aug	high water
1997	30, 31 Aug; 1, 2 Sep	high water
1998	none	

APPENDIX C

SHEENJEK RIVER SONAR CALIBRATION DATA

APPENDIX C: SHEENJEK RIVER SONAR CALIBRATION DATA

Appendix C.1. Oscilloscope data used to calibrate the 1977–model* and 1981–model Bendix sonar salmon counter at the Sheenjek River project site, 1994.

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor [a]	PRR [b]	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
08–Aug	17 *	30	9	18	0.500	0.300	1.5	96	97.5	18
09–Aug	10 *	15	2	2	1.000	0.500	1.5	96	97.5	8
	1615 *	15	0	0	--	0.500	1.5	96	97.5	0
	2110 *	15	2	2	1.000	0.500	1.5	96	97.5	8
	2330 *	15	1	5	0.200	0.500	1.5	96	97.5	4
10–Aug	1 *	15	5	7	0.714	0.500	1.5	96	97.5	20
	630 *	15	0	0	--	0.500	1.5	96	97.5	0
	1130 *	15	0	0	--	0.500	1.5	96	97.5	0
	1605 *	15	0	0	--	0.500	1.5	96	97.5	0
	2103 *	15	1	1	1.000	0.500	1.5	96	97.5	4
	2330 *	15	2	3	0.667	0.500	1.5	96	97.5	8
11–Aug	1 *	30	47	58	0.810	0.500	1.5	96	97.5	94
	630 *	15	0	0	--	0.615	1.5	96	97.5	0
	1112 *	15	1	1	1.000	0.615	1.5	96	97.5	4
	1612 *	15	0	0	--	0.615	1.5	96	97.5	0
	2330 *	15	2	1	2.000	0.615	1.5	96	97.5	8
12–Aug	1 *	15	1	1	1.000	0.615	1.5	96	97.5	4
	605 *	15	1	1	1.000	0.615	1.5	96	97.5	4
	1101 *	15	0	0	--	0.615	1.5	96	97.5	0
	1601 *	15	0	0	--	0.615	1.5	96	97.5	0
	2101 *	15	7	8	0.875	0.615	1.5	96	97.5	28
	2332 *	15	5	4	1.250	0.615	1.5	96	97.5	20
13–Aug	1 *	15	3	4	0.750	0.615	1.5	96	97.5	12
	610 *	15	2	2	1.000	0.615	1.5	96	97.5	8
	1110 *	15	0	0	--	0.615	1.5	96	97.5	0
	1620 *	15	0	0	--	0.615	1.5	96	97.5	0
	2105 *	15	5	6	0.833	0.615	1.5	96	97.5	20
	2318 *	15	6	7	0.857	0.615	1.5	96	97.5	24
14–Aug	1 *	15	5	5	1.000	0.615	1.5	96	97.5	20
	303 *	15	0	0	--	0.615	1.5	96	97.5	0
	601 *	15	5	7	0.714	0.615	1.5	96	97.5	20
	1100 *	15	0	0	--	0.615	1.5	96	97.5	0
	1624 *	15	0	0	--	0.615	1.5	96	97.5	0
	2117 *	15	3	2	1.500	0.615	1.5	96	97.5	12
	2313 *	15	3	5	0.600	0.615	1.5	96	97.5	12
15–Aug	1 *	15	8	10	0.800	0.615	1.5	96	97.5	32
	303 *	15	3	4	0.750	0.615	1.5	96	97.5	12
	739 *	15	2	5	0.400	0.615	1.5	96	97.5	8
	1135 *	15	0	0	--	0.615	1.5	96	97.5	0
	1610 *	15	0	0	--	0.615	1.5	96	97.5	0
	2115 *	15	3	2	1.500	0.615	1.5	96	97.5	12
	2323 *	15	8	10	0.800	0.615	1.5	96	97.5	32
16–Aug	1 *	15	2	1	2.000	0.615	1.5	96	97.5	8
	303 *	15	2	3	0.667	0.615	1.5	96	97.5	8
	601 *	15	0	0	--	0.615	1.5	96	97.5	0
	1120 *	15	0	0	--	0.615	1.5	96	97.5	0
	1607 *	15	1	2	0.500	0.615	1.5	96	97.5	4
	2117 *	30	21	31	0.677	0.615	1.5	96	97.5	42
	2319 *	30	37	48	0.771	0.790	1.5	96	97.5	74
17–Aug	10 *	30	30	32	0.938	0.790	1.5	96	97.5	60
	302 *	15	4	4	1.000	0.790	1.5	96	97.5	16
	601 *	15	0	0	--	0.790	1.5	96	97.5	0
	1130 *	15	3	4	0.750	0.790	1.5	96	97.5	12
	1602 *	15	0	0	--	0.790	1.5	96	97.5	0
	2112 *	15	4	4	1.000	0.790	1.5	96	97.5	16
	2320 *	15	9	12	0.750	0.790	1.5	96	97.5	36
18–Aug	5 *	15	1	1	1.000	0.790	1.5	96	97.5	4
	302 *	15	0	0	--	0.790	1.5	96	97.5	0
	620 *	15	3	4	0.750	0.790	1.5	96	97.5	12
	1115	15	0	0	--	0.790	1.5	96	97.5	0
	1616	15	1	1	1.000	0.790	1.5	96	97.5	4
	2107	15	0	0	--	0.790	1.5	96	97.5	0
	2326	30	24	36	0.667	0.790	1.5	96	97.5	48

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Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor [a]	PRR [b]	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
19–Aug	10	15	2	2	1.000	0.900	1.5	96	97.5	8
	338	15	5	7	0.714	0.900	1.5	96	97.5	20
	615	15	0	0	--	0.900	1.5	96	97.5	0
	1125	15	0	0	--	0.900	1.5	96	97.5	0
	1635	15	0	0	--	0.900	1.5	96	97.5	0
	2110	15	0	0	--	0.900	1.5	96	97.5	0
	2316	15	9	12	0.750	0.900	1.5	96	97.5	36
20–Aug	2	15	5	7	0.714	0.900	1.5	96	97.5	20
	302	15	7	11	0.636	0.900	1.5	96	97.5	28
	601	15	2	4	0.500	0.900	1.5	96	97.5	8
	1101	15	0	0	--	0.900	1.5	96	97.5	0
	1601	15	0	0	--	0.900	1.5	96	97.5	0
	2105	15	0	0	--	0.900	1.5	96	97.5	0
	2320	30	27	32	0.844	0.900	1.5	96	97.5	54
21–Aug	1	15	7	11	0.636	0.900	1.5	96	97.5	28
	304	30	28	34	0.824	0.900	1.5	96	97.5	56
	606	15	2	2	1.000	0.900	1.5	96	97.5	8
	1116	15	0	0	--	0.900	1.5	96	97.5	0
	1605	15	0	0	--	0.900	1.5	96	97.5	0
	2101	15	1	1	1.000	0.900	1.5	96	97.5	4
	2315	15	9	15	0.600	0.900	1.5	96	97.5	36
22–Aug	1	15	9	14	0.643	0.900	1.5	96	97.5	36
	345	15	6	8	0.750	0.900	1.5	96	97.5	24
	604	15	5	7	0.714	0.900	1.5	96	97.5	20
	1235	15	4	5	0.800	0.650	1.5	45	46.5	16
	1632	15	2	4	0.500	0.650	1.5	45	46.5	8
	2105	15	1	2	0.500	0.650	1.5	98.5	100.0	4
	2335	15	8	11	0.727	0.650	1.5	98.5	100.0	32
23–Aug	20	30	28	35	0.800	0.950	1.5	98.5	100.0	56
	310	15	8	4	2.000	0.950	1.5	98.5	100.0	32
	602	30	51	82	0.622	0.950	1.5	98.5	100.0	102
	1118	30	36	99	0.364	0.950	1.5	98.5	100.0	72
	1303	30	44	92	0.478	0.999	1.5	98.5	100.0	88
	1605	15	9	12	0.750	0.999	1.5	98.5	100.0	36
	2104	15	6	9	0.667	0.999	1.5	98.5	100.0	24
	2328	30	22	26	0.846	0.999	1.5	98.5	100.0	44
24–Aug	13	30	25	28	0.893	0.999	1.5	98.5	100.0	50
	320	30	21	27	0.778	0.999	1.5	98.5	100.0	42
	605	15	7	10	0.700	0.999	1.5	98.5	100.0	28
	1103	30	29	62	0.468	0.999	1.5	98.5	100.0	58
	1604	30	21	42	0.500	0.999	1.5	98.5	100.0	42
	2107	15	9	11	0.818	0.999	1.5	98.5	100.0	36
	2317	30	19	46	0.413	0.999	1.5	98.5	100.0	38
25–Aug	1	15	8	7	1.143	0.999	1.5	98.5	100.0	32
	306	15	8	13	0.615	0.999	1.5	98.5	100.0	32
	601	30	39	128	0.305	0.999	1.5	98.5	100.0	78
	1112	15	0	0	--	0.999	1.5	98.5	100.0	0
	1612	30	17	41	0.415	0.999	1.5	98.5	100.0	34
	2119	30	34	68	0.500	0.999	1.5	98.5	100.0	68
	2319	15	9	32	0.281	0.999	1.5	98.5	100.0	36
26–Aug	1	15	7	9	0.778	0.999	1.5	98.5	100.0	28
	301	30	33	61	0.541	0.999	1.5	98.5	100.0	66
	611	30	21	63	0.333	0.999	1.5	98.5	100.0	42
	1105	15	2	5	0.400	0.999	1.5	98.5	100.0	8
	1605	15	0	0	--	0.999	1.5	98.5	100.0	0
	2104	30	20	50	0.400	0.999	1.5	98.5	100.0	40
	2315	30	39	66	0.591	0.999	1.5	98.5	100.0	78
27–Aug	10	30	38	71	0.535	0.999	1.5	98.5	100.0	76
	308	30	42	56	0.750	0.999	1.5	98.5	100.0	84
	601	30	120	239	0.502	0.999	1.5	98.5	100.0	240
	1110	30	33	89	0.371	0.999	1.5	98.5	100.0	66
	1602	30	123	177	0.695	0.999	1.5	98.5	100.0	246
	2101	30	134	304	0.441	0.999	1.5	98.5	100.0	268
	2315	30	84	117	0.718	0.999	1.5	98.5	100.0	168
28–Aug	1	30	79	108	0.731	0.999	1.5	98.5	100.0	158
	312	30	140	223	0.628	0.999	1.5	98.5	100.0	280

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Appendix C.1. (page 3 of 6).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor [a]	PRR [b]	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	605	30	80	174	0.460	0.999	1.5	98.5	100.0	160
	1101	30	46	71	0.648	0.999	1.5	98.5	100.0	92
	1433	27	35	58	0.603	0.999	1.5	98.5	100.0	78
	1605	30	24	37	0.649	0.999	1.5	98.5	100.0	48
	2138	30	95	124	0.766	0.999	1.5	98.5	100.0	190
	2310	30	174	245	0.710	0.999	1.5	98.5	100.0	348
29–Aug	10	30	148	214	0.692	0.999	1.5	98.5	100.0	296
		Sonar shut down due to high water flooding conditions.								
30–Aug	1801	30	68	65	1.046	0.900	1.5	98.5	100.0	136
	2101	30	73	61	1.197	0.900	1.5	98.5	100.0	146
	2142	10	27	33	0.818	0.800	1.5	98.5	100.0	162
	2301	30	94	108	0.870	0.800	1.5	98.5	100.0	188
31–Aug	25	30	92	102	0.902	0.800	1.5	98.5	100.0	184
	302	30	100	114	0.877	0.800	1.5	98.5	100.0	200
	608	30	110	124	0.887	0.800	1.5	98.5	100.0	220
	1104	30	113	217	0.521	0.800	1.5	98.5	100.0	226
	1138	10	40	70	0.571	0.999	1.5	98.5	100.0	240
	1617	30	105	95	1.105	0.999	1.5	98.5	100.0	210
	2103	30	121	282	0.429	0.999	1.5	98.5	100.0	242
	2307	30	122	168	0.726	0.999	1.5	98.5	100.0	244
01–Sep	5	30	136	230	0.591	0.999	1.5	98.5	100.0	272
	301	30	112	219	0.511	0.999	1.5	98.5	100.0	224
	601	30	90	337	0.267	0.999	1.5	98.5	100.0	180
	745	15	38	117	0.325	0.999	1.5	98.5	100.0	152
	1102	30	145	308	0.471	0.999	1.5	98.5	100.0	290
	1607	30	166	367	0.452	0.999	1.5	98.5	100.0	332
	2204	30	137	219	0.626	0.999	1.5	98.5	100.0	274
	2318	30	135	202	0.668	0.999	1.5	98.5	100.0	270
02–Sep	1	30	157	289	0.543	0.999	1.5	98.5	100.0	314
	312	30	174	285	0.611	0.999	1.5	98.5	100.0	348
	605	30	121	210	0.576	0.999	1.5	98.5	100.0	242
	1103	30	158	383	0.413	0.999	1.5	98.5	100.0	316
	1601	30	141	260	0.542	0.999	1.5	98.5	100.0	282
	2114	30	152	359	0.423	0.999	1.5	98.5	100.0	304
	2315	30	91	129	0.705	0.999	1.5	98.5	100.0	182
03–Sep	1	30	78	97	0.804	0.999	1.5	98.5	100.0	156
	310	30	85	103	0.825	0.999	1.5	98.5	100.0	170
	614	30	191	407	0.469	0.999	1.5	98.5	100.0	382
	1104	30	133	357	0.373	0.999	1.5	98.5	100.0	266
	1501	30	99	179	0.553	0.999	1.5	98.5	100.0	198
	2101	30	137	360	0.381	0.999	1.5	98.5	100.0	274
	2318	30	125	190	0.658	0.999	1.5	98.5	100.0	250
04–Sep	2	30	128	204	0.627	0.999	1.5	98.5	100.0	256
	335	25	75	153	0.490	0.999	1.5	98.5	100.0	180
	628	30	118	530	0.223	0.999	1.5	98.5	100.0	236
	1101	30	59	150	0.393	0.999	1.5	98.5	100.0	118
	1303	30	23	58	0.397	0.999	1.5	98.5	100.0	46
	1602	30	55	164	0.335	0.999	1.5	98.5	100.0	110
	2102	30	105	208	0.505	0.999	1.5	98.5	100.0	210
	2305	30	122	112	1.089	0.999	1.5	98.5	100.0	244
05–Sep	5	30	115	130	0.885	0.999	1.5	98.5	100.0	230
	321	30	101	208	0.486	0.999	1.5	98.5	100.0	202
	605	30	75	244	0.307	0.999	1.5	98.5	100.0	150
	1101	30	46	141	0.326	0.999	1.5	98.5	100.0	92
	1601	15	7	19	0.368	0.999	1.5	98.5	100.0	28
	2102	30	46	123	0.374	0.999	1.5	98.5	100.0	92
	2302	30	71	82	0.866	0.999	1.5	98.5	100.0	142
06–Sep	2	30	77	99	0.778	0.999	1.5	98.5	100.0	154
	320	30	108	151	0.715	0.999	1.5	98.5	100.0	216
	617	30	79	140	0.564	0.999	1.5	98.5	100.0	158
	1107	15	9	29	0.310	0.999	1.5	98.5	100.0	36
	1604	15	8	22	0.364	0.999	1.5	98.5	100.0	32
	2108	30	76	173	0.439	0.999	1.5	98.5	100.0	152
	2302	30	85	129	0.659	0.999	1.5	98.5	100.0	170
07–Sep	2	30	118	169	0.698	0.999	1.5	98.5	100.0	236

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Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor [a]	PRR [b]	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	330	28	161	256	0.629	0.999	1.5	98.5	100.0	345
	625	30	42	128	0.328	0.999	1.5	98.5	100.0	84
	1105	15	3	10	0.300	0.999	1.5	98.5	100.0	12
	1603	30	57	135	0.422	0.999	1.5	98.5	100.0	114
	2107	30	61	156	0.391	0.999	1.5	98.5	100.0	122
	2317	30	92	139	0.662	0.999	1.5	98.5	100.0	184
08-Sep	1	30	92	156	0.590	0.999	1.5	98.5	100.0	184
	328	30	194	402	0.483	0.999	1.5	98.5	100.0	388
	630	30	90	252	0.357	0.999	1.5	98.5	100.0	180
	1102	30	55	129	0.426	0.999	1.5	98.5	100.0	110
	1625	30	74	181	0.409	0.999	1.5	98.5	100.0	148
	2101	30	53	122	0.434	0.999	1.5	98.5	100.0	106
	2315	30	69	133	0.519	0.999	1.5	98.5	100.0	138
09-Sep	10	30	65	128	0.508	0.999	1.5	98.5	100.0	130
	335	25	101	196	0.515	0.999	1.5	98.5	100.0	242
	602	30	73	174	0.420	0.999	1.5	98.5	100.0	146
	1113	30	29	110	0.264	0.999	1.5	98.5	100.0	58
	1601	30	29	144	0.201	0.999	1.5	98.5	100.0	58
	2101	30	24	46	0.522	0.999	1.5	98.5	100.0	48
	2315	30	53	74	0.716	0.999	1.5	98.5	100.0	106
10-Sep	2	30	69	114	0.605	0.999	1.5	98.5	100.0	138
	326	30	113	272	0.415	0.999	1.5	98.5	100.0	226
	616	30	83	205	0.405	0.999	1.5	98.5	100.0	166
	1101	15	8	25	0.320	0.999	1.5	98.5	100.0	32
	1609	30	25	75	0.333	0.999	1.5	98.5	100.0	50
	2105	30	41	71	0.577	0.999	1.5	98.5	100.0	82
	2305	30	115	111	1.036	0.999	1.5	98.5	100.0	230
11-Sep	3	30	136	192	0.708	0.999	1.5	98.5	100.0	272
	305	30	131	224	0.585	0.999	1.5	98.5	100.0	262
	635	25	35	77	0.455	0.999	1.5	98.5	100.0	84
	1114	15	9	35	0.257	0.999	1.5	98.5	100.0	36
	1601	30	60	276	0.217	0.999	1.5	98.5	100.0	120
	2130	30	48	89	0.539	0.999	1.5	98.5	100.0	96
	2325	30	145	142	1.021	0.999	1.5	98.5	100.0	290
12-Sep	1	30	90	89	1.011	0.999	1.5	98.5	100.0	180
	305	30	103	209	0.493	0.999	1.5	98.5	100.0	206
	635	25	34	93	0.366	0.999	1.5	98.5	100.0	82
	1110	15	1	4	0.250	0.999	1.5	98.5	100.0	4
	1604	30	28	104	0.269	0.999	1.5	98.5	100.0	56
	2104	30	81	199	0.407	0.999	1.5	98.5	100.0	162
	2230	20	69	70	0.986	0.999	1.5	98.5	100.0	207
	2301	30	148	172	0.860	0.999	1.5	98.5	100.0	296
13-Sep	1	30	108	105	1.029	0.999	1.5	98.5	100.0	216
	325	25	67	99	0.677	0.999	1.5	98.5	100.0	161
	625	30	56	206	0.272	0.999	1.5	98.5	100.0	112
	1101	15	8	34	0.235	0.999	1.5	98.5	100.0	32
	1601	15	54	290	0.186	0.700	1.5	98.5	100.0	216
	1617	30	138	380	0.363	0.999	1.5	98.5	100.0	276
	2103	30	59	118	0.500	0.999	1.5	98.5	100.0	118
	2303	30	92	170	0.541	0.999	1.5	98.5	100.0	184
14-Sep	4	30	146	301	0.485	0.999	1.5	98.5	100.0	292
	330	30	272	631	0.431	0.999	1.5	98.5	100.0	544
	605	30	93	162	0.574	0.999	1.5	98.5	100.0	186
	1107	30	45	115	0.391	0.999	1.5	98.5	100.0	90
	1601	30	215	314	0.685	0.999	1.5	98.5	100.0	430
	2113	30	151	271	0.557	0.999	1.5	98.5	100.0	302
	2312	30	112	258	0.434	0.999	1.5	98.5	100.0	224
15-Sep	2	30	113	208	0.543	0.999	1.5	98.5	100.0	226
	330	30	64	140	0.457	0.999	1.5	98.5	100.0	128
	632	25	79	172	0.459	0.999	1.5	98.5	100.0	190
	1102	30	42	104	0.404	0.999	1.5	98.5	100.0	84
	1601	30	46	81	0.568	0.999	1.5	98.5	100.0	92
	2105	30	113	289	0.391	0.999	1.5	98.5	100.0	226
	2310	30	92	565	0.163	0.999	1.5	98.5	100.0	184
16-Sep	1	30	93	114	0.816	0.999	1.5	98.5	100.0	186
	330	30	56	156	0.359	0.999	1.5	98.5	100.0	112

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Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor [a]	PRR [b]	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	610	30	44	130	0.338	0.999	1.5	98.5	100.0	88
	1108	30	67	122	0.549	0.999	1.5	98.5	100.0	134
	1601	30	186	300	0.620	0.999	1.5	98.5	100.0	372
	2102	30	179	400	0.448	0.999	1.5	98.5	100.0	358
	2302	30	76	307	0.248	0.999	1.5	98.5	100.0	152
17-Sep	2	30	52	94	0.553	0.999	1.5	98.5	100.0	104
	305	30	69	262	0.263	0.999	1.5	98.5	100.0	138
	630	30	128	320	0.400	0.999	1.5	98.5	100.0	256
	1103	30	51	118	0.432	0.999	1.5	98.5	100.0	102
	1611	30	227	585	0.388	0.999	1.5	98.5	100.0	454
	1830	10	60	117	0.513	0.999	1.5	98.5	100.0	360
	1905	25	134	276	0.486	0.999	1.5	98.5	100.0	322
	2106	30	64	165	0.388	0.999	1.5	98.5	100.0	128
	2303	30	48	89	0.539	0.999	1.5	98.5	100.0	96
18-Sep	1	30	52	107	0.486	0.999	1.5	98.5	100.0	104
	303	30	43	238	0.181	0.999	1.5	98.5	100.0	86
	620	30	26	64	0.406	0.999	1.5	98.5	100.0	52
	1106	15	4	20	0.200	0.999	1.5	98.5	100.0	16
	1601	30	127	206	0.617	0.999	1.5	98.5	100.0	254
	2101	30	159	380	0.418	0.999	1.5	98.5	100.0	318
	2301	30	144	400	0.360	0.999	1.5	98.5	100.0	288
19-Sep	1	30	128	308	0.416	0.999	1.5	98.5	100.0	256
	301	30	154	370	0.416	0.999	1.5	98.5	100.0	308
	603	30	47	102	0.461	0.999	1.5	98.5	100.0	94
	1128	30	59	88	0.670	0.999	1.5	98.5	100.0	118
	1603	30	406	470	0.864	0.999	1.5	98.5	100.0	812
	2101	30	158	184	0.859	0.999	1.5	98.5	100.0	316
	2319	30	111	157	0.707	0.999	1.5	98.5	100.0	222
20-Sep	6	30	118	162	0.728	0.999	1.5	98.5	100.0	236
	301	30	88	141	0.624	0.999	1.5	98.5	100.0	176
	635	25	187	329	0.568	0.999	1.5	98.5	100.0	449
	1125	30	136	207	0.657	0.999	1.5	98.5	100.0	272
	1604	30	251	270	0.930	0.999	1.5	98.5	100.0	502
	2104	30	92	192	0.479	0.999	1.5	98.5	100.0	184
	2301	30	97	225	0.431	0.999	1.5	98.5	100.0	194
21-Sep	2	30	90	250	0.360	0.999	1.5	98.5	100.0	180
	302	30	100	274	0.365	0.999	1.5	98.5	100.0	200
	631	30	121	342	0.354	0.999	1.5	98.5	100.0	242
	1105	30	121	204	0.593	0.999	1.5	98.5	100.0	242
	v 1105	30	103	204	0.505					
	1607	15	65	60	1.083	0.999	1.5	98.5	100.0	260
	v 1607	15	66	60	1.100					
	1622	15	90	84	1.071	0.999	1.5	98.5	100.0	360
	2107	30	154	201	0.766	0.999	1.5	98.5	100.0	308
	2302	30	161	281	0.573	0.999	1.5	98.5	100.0	322
22-Sep	1	30	139	242	0.574	0.999	1.5	98.5	100.0	278
	327	30	153	260	0.588	0.999	1.5	98.5	100.0	306
	601	30	163	211	0.773	0.999	1.5	98.5	100.0	326
	1101	50	186	178	1.045	0.999	1.5	98.5	100.0	223
	v 1101	50	200	178	1.124	0.999	1.5	98.5	100.0	
	1208	10	44	45	0.978	0.800	1.5	98.5	100.0	264
	v 1208	10	46	45	1.022	0.800	1.5	98.5	100.0	
	1605	30	135	147	0.918	0.800	1.5	98.5	100.0	270
	2101	30	170	424	0.401	0.800	1.5	98.5	100.0	340
	2137	10	35	58	0.603	0.999	1.5	98.5	100.0	210
	2301	30	102	187	0.545	0.999	1.5	98.5	100.0	204
23-Sep	1	30	111	217	0.512	0.999	1.5	98.5	100.0	222
	301	30	87	149	0.584	0.999	1.5	98.5	100.0	174
	601	30	114	206	0.553	0.999	1.5	98.5	100.0	228
	1102	30	136	187	0.727	0.999	1.5	98.5	100.0	272
	1428	30	63	54	1.167	0.999	1.5	98.5	100.0	126
	1601	30	54	62	0.871	0.999	1.5	98.5	100.0	108
	v 1601	30	52	62	0.839	0.999	1.5	98.5	100.0	
	2125	30	106	169	0.627	0.999	1.5	98.5	100.0	212
	2305	30	115	214	0.537	0.999	1.5	98.5	100.0	230
24-Sep	35	30	86	158	0.544	0.999	1.5	98.5	100.0	172
	340	17	9	15	0.600	0.999	1.5	98.5	100.0	32

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Appendix C.1. (page 6 of 6).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor [a]	PRR [b]	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	631	30	48	129	0.372	0.999	1.5	98.5	100.0	96
	1133	30	220	343	0.641	0.999	1.5	98.5	100.0	440
	1633	30	100	140	0.714	0.999	1.5	98.5	100.0	200
	2143	30	128	251	0.510	0.999	1.5	98.5	100.0	256
	2333	30	107	235	0.455	0.999	1.5	98.5	100.0	214
25–Sep	1	30	85	126	0.675	0.999	1.5	98.5	100.0	170
	314	30	154	538	0.286	0.999	1.5	98.5	100.0	308
	632	23	116	520	0.223	0.999	1.5	98.5	100.0	303
	1105	30	131	138	0.949	0.999	1.5	98.5	100.0	262
	1601	30	52	82	0.634	0.999	1.5	98.5	100.0	104
	2115	30	143	505	0.283	0.999	1.5	98.5	100.0	286
	2302	30	103	465	0.222	0.999	1.5	98.5	100.0	206
26–Sep	1	30	139	854	0.163	0.999	1.5	98.5	100.0	278
	314	30	91	568	0.160	0.999	1.5	98.5	100.0	182
	628	30	163	453	0.360	0.999	1.5	98.5	100.0	326
	1102	32	163	231	0.706	0.999	1.5	98.5	100.0	306
	[v] 1102	32	161	231	0.839	0.999	1.5	98.5	100.0	
	1604	30	67	123	0.545	0.999	1.5	98.5	100.0	134
	2112	30	78	261	0.299	0.999	1.5	98.5	100.0	156
	2301	30	47	272	0.173	0.999	1.5	98.5	100.0	94
27–Sep	31	30	38	183	0.208	0.999	1.5	98.5	100.0	76
	330	30	119	657	0.181	0.999	1.5	98.5	100.0	238
	633	30	191	637	0.300	0.999	1.5	98.5	100.0	382
	1131	30	125	167	0.749	0.999	1.5	98.5	100.0	250
	1629	30	65	91	0.714	0.999	1.5	98.5	100.0	130
	2129	30	92	277	0.332	0.999	1.5	98.5	100.0	184
	2329	30	35	479	0.073	0.999	1.5	98.5	100.0	70
28–Sep	1	30	42	201	0.209	0.999	1.5	98.5	100.0	84
	335	25	50	397	0.126	0.999	1.5	98.5	100.0	120
	701	30	97	169	0.574	0.999	1.5	98.5	100.0	194
	1103	30	105	130	0.808	0.999	1.5	98.5	100.0	210
Total	351	8,752	23,241	48,080	0.483					

[a] The "adjustment factor" is the oscilloscope count divided by sonar count; used to adjust sonar counts.
[b] Pulse repetition rate of the sonar counter at start of calibration. When the PRR was changed, that change is reflected in the PRR shown for the start of the next calibration period.
[v] Visual calibration using tower counts.

Appendix C.2. Oscilloscope data used to calibrate the 1977–model Bendix sonar salmon counter at the Sheenjek River project site, 1995.

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
10–Aug	1204	32	27	36	0.750	0.500	2.5	90	92.5	51
	1620	30	33	55	0.600	0.500	2.5	90	92.5	66
	1651	9	15	31	0.484	0.850	2.5	90	92.5	100
	2310	15	9	6	1.500	0.850	2.5	90	92.5	36
11–Aug	10	15	5	3	1.667	0.850	2.5	90	92.5	20
	320	15	9	8	1.125	0.850	2.5	90	92.5	36
	625	15	5	5	1.000	0.850	2.5	90	92.5	20
	1102	15	6	3	2.000	0.850	2.5	90	92.5	24
	1632	30	23	19	1.211	0.850	2.5	90	92.5	46
	2103	25	12	6	2.000	0.850	2.5	90	92.5	29
	2301	15	9	9	1.000	0.550	2.5	90	92.5	36
12–Aug	1	15	9	9	1.000	0.550	2.5	96	98.5	36
	320	15	4	4	1.000	0.550	2.5	96	98.5	16
	1104	15	3	2	1.500	0.550	2.5	96	98.5	12
	1601	15	5	6	0.833	0.550	2.5	96	98.5	20
	2108	16	3	2	1.500	0.550	2.5	96	98.5	11
	2300	16	4	3	1.333	0.550	2.5	96	98.5	15
13–Aug	2	15	6	4	1.500	0.550	2.5	90	92.5	24
	302	15	2	2	1.000	0.550	2.5	90	92.5	8
	620	15	5	4	1.250	0.550	2.5	90	92.5	20
	1120	15	1	0	--	0.550	2.5	90	92.5	4
	1614	15	7	6	1.167	0.550	2.5	90	92.5	28
	2115	15	3	2	1.500	0.550	2.5	90	92.5	12
	2321	15	4	6	0.667	0.550	2.0	90	92.0	16
14–Aug	6	15	10	13	0.769	0.550	2.0	90	92.0	40
	314	15	5	3	1.667	0.550	2.0	90	92.0	20
	615	15	5	4	1.250	0.550	2.0	90	92.0	20
	1101	15	1	1	1.000	0.550	2.0	90	92.0	4
	1615	15	0	0	--	0.550	2.0	90	92.0	0
	2125	15	4	4	1.000	0.550	2.0	90	92.0	16
	2301	15	8	7	1.143	0.550	2.0	90	92.0	32
15–Aug	9	15	8	9	0.889	0.550	2.0	90	92.0	32
	416	15	5	4	1.250	0.550	2.0	90	92.0	20
	625	30	23	21	1.095	0.550	2.0	90	92.0	46
	1130	15	4	4	1.000	0.550	2.0	90	92.0	16
	1608	30	27	26	1.038	0.550	2.0	90	92.0	54
	2103	30	13	11	1.182	0.550	2.0	90	92.0	26
	2311	15	5	4	1.250	0.550	2.0	90	92.0	20
16–Aug	2	15	0	0	--	0.550	2.0	90	92.0	0
	315	15	3	2	1.500	0.550	2.0	90	92.0	12
	609	16	4	3	1.333	0.550	2.0	90	92.0	15
	753	15	3	4	0.750	0.550	2.0	90	92.0	12
	1101	20	7	8	0.875	0.550	2.0	90	92.0	21
	1605	15	9	11	0.818	0.550	2.0	90	92.0	36
	2106	15	8	9	0.889	0.550	2.0	90	92.0	32
	2301	30	25	31	0.806	0.550	2.0	90	92.0	
17–Aug	1	30	19	23	0.826	0.550	2.0	90	92.0	38
	401	15	10	15	0.667	0.550	2.0	90	92.0	40
	610	15	6	9	0.667	0.550	2.0	90	92.0	24
	645	10	6	8	0.750	0.650	2.0	90	92.0	36
	1141	19	35	37	0.946	0.670	2.5	100	102.5	111
	1605	30	33	32	1.031	0.670	2.5	100	102.5	66
	2103	15	10	8	1.250	0.670	2.5	100	102.5	40
	2301	30	35	31	1.129	0.670	2.5	100	102.5	70
18–Aug	1	30	29	29	1.000	0.670	2.5	100	102.5	58
	315	30	41	37	1.108	0.670	2.5	100	102.5	82
	607	30	28	28	1.000	0.670	2.5	100	102.5	56
	1101	30	21	20	1.050	0.670	2.5	100	102.5	42
	1618	15	9	9	1.000	0.670	2.5	100	102.5	36
	2102	30	22	21	1.048	0.670	2.5	100	102.5	44
	2302	30	21	16	1.313	0.670	2.5	100	102.5	42
19–Aug	2	15	10	8	1.250	0.670	2.5	100	102.5	40
	315	15	10	8	1.250	0.670	2.5	100	102.5	40
	609	15	10	10	1.000	0.670	2.5	100	102.5	40
	1101	30	29	22	1.318	0.670	2.5	100	102.5	58
	1603	30	33	20	1.650	0.670	2.5	100	102.5	66
	1635	10	10	10	1.000	0.540	2.5	100	102.5	60
	2106	15	9	11	0.818	0.540	2.5	100	102.5	36
	2315	15	10	11	0.909	0.540	2.5	100	102.5	40

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Appendix C.2. (page 2 of 5).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
20–Aug	3	30	25	15	1.667	0.540	2.5	100	102.5	50
	33	10	11	13	0.846	0.470	2.5	100	102.5	66
	338	22	26	25	1.040	0.470	2.5	100	102.5	71
	620	30	32	26	1.231	0.470	2.5	100	102.5	64
	650	10	10	11	0.909	0.380	2.5	100	102.5	60
	1101	30	75	90	0.833	0.380	2.5	100	102.5	150
	1132	10	22	20	1.100	0.440	2.5	100	102.5	132
	1630	20	51	77	0.662	0.440	2.5	100	102.5	153
	1650	15	16	17	0.941	0.640	2.5	100	102.5	64
	2103	30	50	45	1.111	0.640	2.5	100	102.5	100
	2301	30	34	18	1.889	0.640	2.5	100	102.5	68
	2331	10	16	17	0.941	0.450	2.5	100	102.5	96
21–Aug	21	30	30	29	1.034	0.450	2.5	89	91.5	60
	314	30	25	23	1.087	0.450	2.5	89	91.5	50
	625	30	51	64	0.797	0.450	2.5	86	88.5	102
	655	11	23	23	1.000	0.550	2.5	86	88.5	125
	1144	15	10	12	0.833	0.550	2.5	86	88.5	40
	1601	15	10	9	1.111	0.550	2.5	86	88.5	40
	2103	30	65	74	0.878	0.550	2.5	86	88.5	130
	2321	30	36	34	1.059	0.550	2.5	70	72.5	72
22–Aug	2	30	28	30	0.933	0.550	2.5	87	89.5	56
	316	30	53	48	1.104	0.550	2.5	87	89.5	106
	629	30	69	69	1.000	0.550	2.5	87	89.5	138
	1107	30	100	105	0.952	0.550	2.5	87	89.5	200
	1602	30	47	36	1.306	0.550	2.5	87	89.5	94
	1633	10	18	15	1.200	0.450	2.5	87	89.5	108
	2110	30	46	40	1.150	0.450	2.5	87	89.5	92
	2310	15	10	8	1.250	0.450	2.5	87	89.5	40
23–Aug	10	30	37	34	1.088	0.450	2.5	87	89.5	74
	320	30	33	33	1.000	0.450	2.5	87	89.5	66
	612	30	36	33	1.091	0.450	2.5	100	102.5	72
	1104	30	78	73	1.068	0.450	2.5	100	102.5	156
	1615	30	115	117	0.983	0.450	2.5	100	102.5	230
	2110	30	96	104	0.923	0.450	2.5	100	102.5	192
	2305	30	55	58	0.948	0.450	2.5	100	102.5	110
24–Aug	3	30	67	69	0.971	0.450	2.5	100	102.5	134
	325	30	49	57	0.860	0.450	2.5	100	102.5	98
	633	27	96	95	1.011	0.450	2.5	100	102.5	213
	1105	30	162	202	0.802	0.450	2.5	100	102.5	324
	1136	10	29	29	1.000	0.560	2.5	100	102.5	174
	1612	30	153	166	0.922	0.560	2.5	100	102.5	306
	2125	30	106	109	0.972	0.560	2.5	100	102.5	212
	2305	30	143	156	0.917	0.560	2.5	100	102.5	286
25–Aug	5	30	85	100	0.850	0.560	2.5	100	102.5	170
	315	40	129	157	0.822	0.560	2.5	100	102.5	194
	619	30	140	164	0.854	0.560	2.5	100	102.5	280
	650	10	53	54	0.981	0.650	2.5	100	102.5	318
	1102	30	139	177	0.785	0.650	2.5	100	102.5	278
	1700	30	52	49	1.061	0.550	2.0	90	92.0	104
	2101	30	82	81	1.012	0.550	2.0	90	92.0	164
	2301	30	100	96	1.042	0.550	2.0	90	92.0	200
26–Aug	1	30	104	98	1.061	0.550	2.0	90	92.0	208
	310	30	74	70	1.057	0.550	2.0	90	92.0	148
	621	30	95	100	0.950	0.550	2.0	90	92.0	190
	1100	30	97	104	0.933	0.550	2.0	90	92.0	194
	1700	30	58	61	--	0.550	2.0	90	92.0	116
	2101	30	137	102	1.343	0.550	2.0	90	92.0	274
	2135	10	27	28	0.964	0.500	2.0	85	87.0	162
	2301	30	126	112	1.125	0.440	2.0	85	87.0	252
27–Aug	2	30	160	146	1.096	0.440	2.0	85	87.0	320
	321	30	158	150	1.053	0.440	2.0	85	87.0	316
	625	30	94	110	0.855	0.440	2.0	85	87.0	188
	1101	30	87	95	0.916	0.440	2.0	85	87.0	174
	1609	30	98	110	0.891	0.440	2.0	85	87.0	196
	2110	30	209	217	0.963	0.440	2.0	85	87.0	418
	2323	30	152	140	1.086	0.440	2.0	85	87.0	304
28–Aug	2	30	223	210	1.062	0.440	2.0	85	87.0	446
	327	30	109	112	0.973	0.440	2.0	85	87.0	218
	629	30	123	133	0.925	0.440	2.0	85	87.0	246

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Appendix C.2. (page 3 of 5).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	1113	30	63	72	0.875	0.440	2.0	85	87.0	126
	1605	30	48	46	1.043	0.550	1.5	100	101.5	96
	2105	30	129	130	0.992	0.550	1.5	100	101.5	258
	2320	30	114	125	0.912	0.550	1.5	100	101.5	228
29–Aug	6	30	180	191	0.942	0.550	1.5	100	101.5	360
	312	30	243	262	0.927	0.550	1.5	100	101.5	486
	629	30	66	61	1.082	0.550	1.5	100	101.5	132
	1105	30	29	28	1.036	0.550	1.5	100	101.5	58
	1605	30	100	88	1.136	0.550	1.5	100	101.5	200
	2103	30	217	195	1.113	0.550	1.5	100	101.5	434
	2314	30	337	330	1.021	0.550	1.5	100	101.5	674
30–Aug	10	30	279	270	1.033	0.550	1.5	100	101.5	558
	320	30	291	280	1.039	0.550	1.5	100	101.5	582
	625	30	171	159	1.075	0.550	1.5	100	101.5	342
	1103	30	54	55	0.982	0.550	1.5	100	101.5	108
	1618	30	130	123	1.057	0.550	1.5	100	101.5	260
	2108	30	176	169	1.041	0.550	1.5	100	101.5	352
	2310	30	237	234	1.013	0.550	1.5	100	101.5	474
31–Aug	1	30	226	218	1.037	0.550	1.5	100	101.5	452
	315	30	150	163	0.920	0.550	1.5	100	101.5	300
	629	30	85	79	1.076	0.550	1.5	100	101.5	170
	1103	30	59	54	1.093	0.550	1.5	100	101.5	118
	1624	30	92	82	1.122	0.550	1.5	100	101.5	184
	2120	30	184	174	1.057	0.550	1.5	100	101.5	368
	2310	30	247	253	0.976	0.550	1.5	100	101.5	494
01–Sep	1	30	220	243	0.905	0.550	1.5	100	101.5	440
	320	30	338	364	0.929	0.550	1.5	100	101.5	676
	611	30	111	107	1.037	0.550	1.5	100	101.5	222
	1101	30	196	203	0.966	0.550	1.5	100	101.5	392
	1614	30	196	203	0.966	0.550	1.5	100	101.5	392
	2107	30	96	90	1.067	0.550	1.5	100	101.5	192
	2320	30	142	149	0.953	0.550	1.5	100	101.5	284
02–Sep	1	30	133	138	0.964	0.550	1.5	100	101.5	266
	401	30	150	155	0.968	0.550	1.5	100	101.5	300
	642	30	71	64	1.109	0.550	1.5	100	101.5	142
	1103	30	28	22	1.273	0.550	1.5	100	101.5	56
	1612	30	80	80	1.000	0.550	1.5	100	101.5	160
	2112	30	167	158	1.057	0.550	1.5	100	101.5	334
	2315	30	206	199	1.035	0.550	1.5	100	101.5	412
03–Sep	10	30	194	180	1.078	0.550	1.5	100	101.5	388
	319	30	345	370	0.932	0.550	1.5	100	101.5	690
	626	30	88	87	1.011	0.550	1.5	100	101.5	176
	1106	30	9	9	1.000	0.550	1.5	100	101.5	18
	1608	30	100	99	1.010	0.550	1.5	100	101.5	200
	2100	30	141	158	0.892	0.550	1.5	100	101.5	282
	2310	30	144	160	0.900	0.550	1.5	100	101.5	288
04–Sep	Did not calibrate – daily adjustment based on average for 3 and 5 Sep					0.550	1.5	100	101.5	
05–Sep	20	30	101	115	0.878	0.550	1.5	100	101.5	202
	306	30	129	155	0.832	0.550	1.5	100	101.5	258
	338	10	34	36	0.944	0.650	1.5	100	101.5	204
	629	30	49	43	1.140	0.650	1.5	100	101.5	98
	1103	15	9	5	1.800	0.650	1.5	100	101.5	36
	1610	40	165	205	0.805	0.650	1.5	100	101.5	248
	1920	15	69	75	0.920	0.650	1.5	100	101.5	276
	2107	30	242	198	1.222	0.650	1.5	100	101.5	484
	2145	10	83	90	0.922	0.550	1.5	100	101.5	498
	2307	30	197	224	0.879	0.550	1.5	100	101.5	394
06–Sep	10	30	130	132	0.985	0.550	1.5	100	101.5	260
	302	30	138	152	0.908	0.550	1.5	100	101.5	276
	620	30	66	70	0.943	0.550	1.5	100	101.5	132
	1610	30	128	120	1.067	0.550	1.5	100	101.5	256
	2104	30	252	271	0.930	0.550	1.5	100	101.5	504
	2326	30	294	340	0.865	0.550	1.5	100	101.5	588
07–Sep	5	30	229	244	0.939	0.600	1.5	98.5	100.0	458
	305	30	94	97	0.969	0.600	1.5	98.5	100.0	188
	629	30	143	123	1.163	0.600	1.5	98.5	100.0	286
	1200	30	121	97	1.247	0.600	1.5	98.5	100.0	242

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Appendix C.2. (page 4 of 5).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	1230	10	50	46	1.087	0.500	1.5	98.5	100.0	300
	1601	30	106	99	1.071	0.500	1.5	98.5	100.0	212
	2129	30	256	231	1.108	0.500	1.5	98.5	100.0	512
	2309	30	139	132	1.053	0.500	1.5	98.5	100.0	278
08–Sep	1	30	159	149	1.067	0.500	1.5	98.5	100.0	318
	301	30	76	84	0.905	0.500	1.5	98.5	100.0	152
	625	30	66	68	0.971	0.500	1.5	98.5	100.0	132
	1108	30	95	89	1.067	0.500	1.5	98.5	100.0	190
	1620	30	152	170	0.894	0.500	1.5	98.5	100.0	304
	2120	30	290	290	1.000	0.500	1.5	98.5	100.0	580
	2310	30	139	154	0.903	0.500	1.5	98.5	100.0	278
09–Sep	10	30	94	89	1.056	0.500	1.5	98.5	100.0	188
	305	30	69	66	1.045	0.500	1.5	98.5	100.0	138
	624	30	86	86	1.000	0.500	1.5	98.5	100.0	172
	1102	30	177	183	0.967	0.500	1.5	98.5	100.0	354
	1600	30	116	100	1.160	0.500	1.5	98.5	100.0	232
	2129	30	168	157	1.070	0.500	1.5	98.5	100.0	336
	2309	30	157	168	0.935	0.500	1.5	98.5	100.0	314
10–Sep	2	30	114	116	0.983	0.500	1.5	98.5	100.0	228
	329	30	62	60	1.033	0.500	1.5	98.5	100.0	124
	621	30	110	114	0.965	0.500	1.5	98.5	100.0	220
	1101	30	78	68	1.147	0.500	1.5	98.5	100.0	156
	1633	30	149	153	0.974	0.500	1.5	98.5	100.0	298
	2113	30	234	249	0.940	0.500	1.5	98.5	100.0	468
	2310	30	100	90	1.111	0.500	1.5	98.5	100.0	200
11–Sep	1	30	87	80	1.088	0.500	1.5	98.5	100.0	174
	302	30	80	87	0.920	0.500	1.5	98.5	100.0	160
	617	30	171	167	1.024	0.500	1.5	98.5	100.0	342
	1103	30	118	109	1.083	0.500	1.5	98.5	100.0	236
	1627	30	179	190	0.942	0.500	1.5	98.5	100.0	358
	2117	30	247	219	1.128	0.500	1.5	98.5	100.0	494
	2316	30	207	210	0.986	0.500	1.5	98.5	100.0	414
12–Sep	9	30	152	138	1.101	0.500	1.5	98.5	100.0	304
	308	30	127	126	1.008	0.500	1.5	98.5	100.0	254
	629	30	174	179	0.972	0.500	1.5	98.5	100.0	348
	1101	30	180	157	1.146	0.500	1.5	98.5	100.0	360
	1601	30	67	58	1.155	0.500	1.5	98.5	100.0	134
	2114	30	228	222	1.027	0.500	1.5	98.5	100.0	456
	2320	30	172	170	1.012	0.500	1.5	98.5	100.0	344
13–Sep	8	30	94	90	1.044	0.500	1.5	98.5	100.0	188
	312	30	144	136	1.059	0.500	1.5	98.5	100.0	288
	629	30	180	182	0.989	0.500	1.5	98.5	100.0	360
	1104	30	60	55	1.091	0.500	1.5	98.5	100.0	120
	1604	30	124	118	1.051	0.500	1.5	98.5	100.0	248
	2115	30	143	134	1.067	0.500	1.5	98.5	100.0	286
	2315	30	179	165	1.085	0.500	1.5	98.5	100.0	358
14–Sep	20	30	153	152	1.007	0.500	1.5	98.5	100.0	306
	310	30	67	69	0.971	0.500	1.5	98.5	100.0	134
	629	30	202	178	1.135	0.500	1.5	98.5	100.0	404
	1101	30	72	69	1.043	0.500	1.5	98.5	100.0	144
	1601	30	158	143	1.105	0.500	1.5	98.5	100.0	316
	2101	30	81	79	1.025	0.500	1.5	98.5	100.0	162
	2301	10	27	25	1.080	0.450	1.5	98.5	100.0	162
15–Sep	2	30	57	54	1.056	0.450	1.5	98.5	100.0	114
	315	30	38	36	1.056	0.450	1.5	98.5	100.0	76
	629	30	80	73	1.096	0.450	1.5	98.5	100.0	160
	801	5	44	68	0.647	0.450	1.5	98.5	100.0	528
	809	10	59	59	1.000	0.600	1.5	98.5	100.0	354
	1101	30	161	138	1.167	0.600	1.5	98.5	100.0	322
	1614	30	219	216	1.014	0.600	1.5	98.5	100.0	438
	2111	30	240	243	0.988	0.600	1.5	98.5	100.0	480
	2311	30	240	243	0.988	0.600	1.5	98.5	100.0	480
16–Sep	9	30	270	265	1.019	0.600	1.5	98.5	100.0	540
	329	30	131	124	1.056	0.600	1.5	98.5	100.0	262
	628	30	238	228	1.044	0.600	1.5	98.5	100.0	476
	1106	30	62	55	1.127	0.600	1.5	98.5	100.0	124
	1609	30	179	175	1.023	0.600	1.5	98.5	100.0	358
	2105	30	290	295	0.983	0.600	1.5	98.5	100.0	580
	2305	30	260	280	0.929	0.600	1.5	98.5	100.0	520

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Appendix C.2. (page 5 of 5).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
17-Sep	5	30	219	230	0.952	0.600	1.5	98.5	100.0	438
	315	30	112	120	0.933	0.600	1.5	98.5	100.0	224
	609	30	125	136	0.919	0.600	1.5	98.5	100.0	250
	1104	30	64	59	1.085	0.600	1.5	98.5	100.0	128
	1619	30	131	129	1.016	0.600	1.5	98.5	100.0	262
	2110	30	265	300	0.883	0.600	1.5	98.5	100.0	530
	2310	30	145	159	0.912	0.600	1.5	98.5	100.0	290
18-Sep	5	30	211	244	0.865	0.600	1.5	98.5	100.0	422
	310	30	160	157	1.019	0.600	1.5	98.5	100.0	320
	627	30	177	189	0.937	0.600	1.5	98.5	100.0	354
	1121	30	67	56	1.196	0.600	1.5	98.5	100.0	134
	1214	10	14	20	0.700	0.550	1.5	98.5	100.0	84
	1608	30	138	146	0.945	0.600	1.5	98.5	100.0	276
	2322	30	264	314	0.841	0.600	1.5	98.5	100.0	528
19-Sep	6	30	256	258	0.992	0.700	1.5	98.5	100.0	512
	327	30	129	142	0.908	0.700	1.5	98.5	100.0	258
	629	30	59	58	1.017	0.700	1.5	98.5	100.0	118
	710	15	33	35	0.943	0.700	1.5	98.5	100.0	132
	1106	30	78	75	1.040	0.700	1.5	98.5	100.0	156
	1635	30	173	165	1.048	0.700	1.5	98.5	100.0	346
	2106	30	312	299	1.043	0.700	1.5	98.5	100.0	624
	2317	30	292	282	1.035	0.700	1.5	98.5	100.0	584
20-Sep	12	30	229	215	1.065	0.700	1.5	98.5	100.0	458
	328	30	138	128	1.078	0.700	1.5	98.5	100.0	276
	629	30	123	118	1.042	0.700	1.5	98.5	100.0	246
	1111	30	53	53	1.000	0.700	1.5	98.5	100.0	106
	1619	30	77	70	1.100	0.700	1.5	98.5	100.0	154
	2103	30	243	202	1.203	0.700	1.5	98.5	100.0	486
	2134	10	73	68	1.074	0.600	1.5	98.5	100.0	438
	2302	30	339	330	1.027	0.600	1.5	98.5	100.0	678
21-Sep	15	30	336	335	1.003	0.600	1.5	98.5	100.0	672
	310	30	230	191	1.204	0.600	1.5	98.5	100.0	460
	343	10	76	83	0.916	0.500	1.5	98.5	100.0	456
	629	30	140	153	0.915	0.500	1.5	98.5	100.0	280
	1102	30	235	237	0.992	0.500	1.5	98.5	100.0	470
	1605	30	118	140	0.843	0.600	1.5	98.5	100.0	236
	1635	10	26	26	1.000	0.600	1.5	98.5	100.0	156
	2110	30	223	225	0.991	0.600	1.5	98.5	100.0	446
	2310	30	202	204	0.990	0.600	1.5	98.5	100.0	404
22-Sep	5	30	150	160	0.938	0.600	1.5	98.5	100.0	300
	309	30	130	144	0.903	0.600	1.5	98.5	100.0	260
	627	30	183	182	1.005	0.600	1.5	98.5	100.0	366
	1111	30	69	58	1.190	0.600	1.5	98.5	100.0	138
	1143	10	32	37	0.865	0.550	1.5	98.5	100.0	192
	1607	30	195	274	0.712	0.550	1.5	98.5	100.0	390
	2123	30	196	220	0.891	0.550	1.5	98.5	100.0	392
	2310	30	158	169	0.935	0.550	1.5	98.5	100.0	316
23-Sep	10	30	160	196	0.816	0.550	1.5	98.5	100.0	320
	49	10	48	55	0.873	0.650	1.5	98.5	100.0	288
	329	30	136	150	0.907	0.650	1.5	98.5	100.0	272
	620	30	99	99	1.000	0.650	1.5	98.5	100.0	198
	1106	30	83	89	0.933	0.650	1.5	98.5	100.0	166
	1602	30	85	69	1.232	0.650	1.5	98.5	100.0	170
	1634	10	22	20	1.100	0.550	1.5	98.5	100.0	132
	2110	30	151	139	1.086	0.550	1.5	98.5	100.0	302
	2315	30	165	182	0.907	0.550	1.5	98.5	100.0	330
24-Sep	10	30	160	178	0.899	0.550	1.5	98.5	100.0	320
	329	30	115	120	0.958	0.550	1.5	98.5	100.0	230
	618	30	123	109	1.128	0.550	1.5	98.5	100.0	246
	1125	30	52	51	1.020	0.550	1.5	98.5	100.0	104
	1601	30	116	105	1.105	0.550	1.5	98.5	100.0	232
	2107	30	106	109	0.972	0.550	1.5	98.5	100.0	212
	2305	30	165	157	1.051	0.550	1.5	98.5	100.0	330
25-Sep	6	30	188	180	1.044	0.550	1.5	98.5	100.0	376
	320	30	138	154	0.896	0.550	1.5	98.5	100.0	276
	627	30	141	133	1.060	0.550	1.5	98.5	100.0	282
Total	340	8,863	35,056	35,368	0.991					

Appendix C.3. Oscilloscope data used to calibrate the 1977–model Bendix sonar salmon counter at the Sheenjek River project site, 1996.

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
30–Jul	2305	25	27	50	0.540	0.400	1.5	99	100.5	65
	2345	10	7	6	1.167	0.700	1.5	99	100.5	42
31–Jul	820	15	4	5	0.800	0.700	1.5	99	100.5	16
	1123	10	1	1	1.000	0.700	1.5	99	100.5	6
	1610	15	1	0	--	0.700	1.5	99	100.5	4
	2045	15	1	0	--	0.700	1.5	99	100.5	4
	2315	30	44	56	0.786	0.700	1.5	99	100.5	88
	2345	10	14	9	1.556	0.800	1.5	99	100.5	84
01–Aug	25	30	12	12	1.000	0.750	1.5	99	100.5	24
	129	30	21	21	1.000	0.750	1.5	99	100.5	42
	615	30	27	57	0.474	0.750	1.5	99	100.5	54
	645	10	5	5	1.000	0.900	1.5	99	100.5	30
	1100	15	0	0	--	0.900	1.5	99	100.5	0
	1600	15	2	2	1.000	0.900	1.5	99	100.5	8
	2110	15	7	7	1.000	0.900	1.5	99	100.5	28
	2305	15	4	4	1.000	0.900	1.5	99	100.5	16
02–Aug	35	15	5	10	0.500	0.900	1.5	99	100.5	20
	310	15	7	8	0.875	0.900	1.5	99	100.5	28
	620	30	42	41	1.024	0.900	1.5	99	100.5	84
	1110	15	5	6	--	0.900	1.5	99	100.5	20
	1600	15	1	2	0.500	0.900	1.5	99	100.5	4
03–Aug	-- Sonar shut down due to high water conditions									
04–Aug										
05–Aug										
06–Aug	5	15	7	5	1.400	0.571	1.5	99	100.5	28
	330	15	4	3	1.333	0.571	1.5	99	100.5	16
	630	15	5	4	1.250	0.571	1.5	99	100.5	20
	1100	15	10	12	0.833	0.571	1.5	99	100.5	40
	1620	15	5	6	0.833	0.571	1.5	99	100.5	20
	2115	15	3	4	0.750	0.571	1.5	99	100.5	12
	2315	15	5	5	1.000	0.571	1.5	99	100.5	20
07–Aug	15	15	4	6	0.667	0.571	1.5	99	100.5	16
	310	15	7	9	0.778	0.571	1.5	99	100.5	28
	644	15	7	9	0.778	0.571	1.5	99	100.5	28
	1110	15	8	7	1.143	0.571	1.5	99	100.5	32
	1600	30	24	25	0.960	0.571	1.5	99	100.5	48
	2115	15	5	7	0.714	0.571	1.5	99	100.5	20
	2305	30	31	34	0.912	0.571	1.5	99	100.5	62
08–Aug	5	30	29	40	0.725	0.571	1.5	99	100.5	58
	40	10	23	30	0.767	0.650	1.5	99	100.5	138
	305	30	34	38	0.895	0.650	1.5	99	100.5	68
	629	30	29	36	0.806	0.650	1.5	99	100.5	58
	1125	15	9	10	0.900	0.650	1.5	99	100.5	36
	1600	30	30	34	0.882	0.650	1.5	99	100.5	60
	2115	15	5	7	0.714	0.650	1.5	99	100.5	20
	2305	15	7	5	1.400	0.650	1.5	99	100.5	28
09–Aug	15	30	29	36	0.806	0.650	1.5	99	100.5	58
	315	30	17	17	1.000	0.650	1.5	99	100.5	34
	632	15	7	8	0.875	0.650	1.5	99	100.5	28
	1130	15	6	7	0.857	0.650	1.5	99	100.5	24
	1644	15	9	11	0.818	0.650	1.5	99	100.5	36
	2110	30	24	45	0.533	0.650	1.5	99	100.5	48
	2305	15	8	10	0.800	0.650	1.5	99	100.5	32
10–Aug	5	15	7	8	0.875	0.650	1.5	99	100.5	28
	320	15	9	11	0.818	0.650	1.5	99	100.5	36
	610	30	28	35	0.800	0.650	1.5	99	100.5	56
	1100	15	8	7	1.143	0.650	1.5	99	100.5	32
	1600	15	1	1	1.000	0.650	1.5	99	100.5	4
	2129	30	23	22	1.045	0.650	1.5	99	100.5	46
	2310	30	17	20	0.850	0.650	1.5	99	100.5	34
11–Aug	1	15	8	9	0.889	0.650	1.5	99	100.5	32
	335	15	7	9	0.778	0.650	1.5	99	100.5	28
	610	30	25	33	0.758	0.650	1.5	99	100.5	50
	1105	15	2	3	0.667	0.650	1.5	99	100.5	8
	1605	15	1	1	1.000	0.650	1.5	99	100.5	4

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Appendix C.3. (page 2 of 6).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	2105	15	9	9	1.000	0.650	1.5	99	100.5	36
	2315	15	8	7	1.143	0.650	1.5	99	100.5	32
12–Aug	1	15	9	9	1.000	0.650	1.5	99	100.5	36
	330	15	6	6	1.000	0.650	1.5	99	100.5	24
	615	15	6	6	1.000	0.650	1.5	99	100.5	24
	1110	15	3	2	1.500	0.650	1.5	99	100.5	12
	1700	15	0	0	--	0.650	1.5	99	100.5	0
	2130	15	0	1	0.000	0.650	1.5	99	100.5	0
	2315	15	8	6	1.333	0.650	1.5	99	100.5	32
13–Aug	1	15	5	4	1.250	0.650	1.5	99	100.5	20
	330	15	9	10	0.900	0.650	1.5	99	100.5	36
	629	30	27	30	0.900	0.650	1.5	99	100.5	54
	1105	15	0	0	--	0.650	1.5	99	100.5	0
	1605	15	0	0	--	0.650	1.5	99	100.5	0
	2130	15	2	0	--	0.650	1.5	99	100.5	8
	2315	15	7	7	1.000	0.650	1.5	99	100.5	28
14–Aug	1	30	85	100	0.850	0.650	1.5	99	100.5	170
	330	40	129	157	0.822	0.650	1.5	99	100.5	194
	629	30	140	164	0.854	0.650	1.5	99	100.5	280
	1105	10	53	54	0.981	0.650	1.5	99	100.5	318
	1605	30	139	177	0.785	0.650	1.5	99	100.5	278
	2115	30	52	49	1.061	0.650	1.5	99	100.5	104
	2320	30	82	81	1.012	0.650	1.5	99	100.5	164
15–Aug	15	30	36	34	1.059	0.650	1.5	99	100.5	72
	329	30	39	44	0.886	0.650	1.5	99	100.5	78
	630	15	3	3	1.000	0.650	1.5	99	100.5	12
	1100	15	1	0	--	0.650	1.5	99	100.5	4
	1605	15	4	4	1.000	0.650	1.5	99	100.5	16
	2130	15	8	9	0.889	0.650	1.5	99	100.5	32
	2310	30	42	48	0.875	0.650	1.5	99	100.5	84
16–Aug	1	30	45	51	0.882	0.650	1.5	99	100.5	90
	329	30	48	51	0.941	0.650	1.5	99	100.5	96
	605	15	2	1	2.000	0.650	1.5	99	100.5	8
	1105	15	4	2	2.000	0.650	1.5	99	100.5	16
	1630	15	0	0	--	0.650	1.5	99	100.5	0
	2115	15	8	9	0.889	0.650	1.5	99	100.5	32
	2330	15	9	11	0.818	0.650	1.5	99	100.5	36
17–Aug	29	30	22	25	0.880	0.650	1.5	99	100.5	44
	315	30	45	58	0.776	0.650	1.5	99	100.5	90
	345	10	8	9	0.889	0.775	1.5	99	100.5	48
	615	15	2	2	1.000	0.775	1.5	99	100.5	8
	1125	15	5	10	0.500	0.775	1.5	99	100.5	20
	1630	15	0	0	--	0.775	1.5	99	100.5	0
	2115	15	4	4	1.000	0.775	1.5	99	100.5	16
	2305	30	61	59	1.034	0.775	1.5	99	100.5	122
18–Aug	15	30	38	39	0.974	0.775	1.5	99	100.5	76
	305	30	40	50	0.800	0.775	1.5	99	100.5	80
	335	10	8	7	1.143	0.825	1.5	99	100.5	48
	644	15	8	10	0.800	0.825	1.5	99	100.5	32
	1100	15	0	0	--	0.825	1.5	99	100.5	0
	1644	15	2	1	2.000	0.825	1.5	99	100.5	8
	2110	15	4	4	1.000	0.825	1.5	99	100.5	16
	2310	30	51	55	0.927	0.825	1.5	99	100.5	102
19–Aug	1	30	39	40	0.975	0.825	1.5	99	100.5	78
	310	30	47	49	0.959	0.825	1.5	99	100.5	94
	644	15	0	0	--	0.825	1.5	99	100.5	0
	1100	15	0	0	--	0.825	1.5	99	100.5	0
	1600	15	0	0	--	0.825	1.5	99	100.5	0
	2105	15	1	1	1.000	0.825	1.5	99	100.5	4
	2310	30	52	55	0.945	0.825	1.5	99	100.5	104
20–Aug	310	30	85	100	0.850	0.825	1.5	99	100.5	170
	340	10	29	30	0.967	0.900	1.5	99	100.5	174
	629	30	26	28	0.929	0.900	1.5	99	100.5	52
	1110	15	0	0	--	0.900	1.5	99	100.5	0
	1615	15	2	2	1.000	0.900	1.5	99	100.5	8
	2105	30	31	35	0.886	0.900	1.5	99	100.5	62
	2305	30	40	43	0.930	0.900	1.5	99	100.5	80

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Appendix C.3. (page 3 of 6).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	340	10	7	8	0.875	0.999	1.5	99	100.5	42
	630	15	9	9	1.000	0.999	1.5	99	100.5	36
	1115	15	0	0	--	0.999	1.5	99	100.5	0
	1620	15	6	4	1.500	0.999	1.5	99	100.5	24
	2130	15	7	5	1.400	0.999	1.5	99	100.5	28
	2329	30	33	43	0.767	0.999	1.5	99	100.5	66
21-Aug	630	15	3	4	0.750	0.999	1.5	99	100.5	12
	1130	15	3	3	1.000	0.999	1.5	99	100.5	12
	1625	15	2	1	2.000	0.999	1.5	99	100.5	8
	2100	15	9	8	1.125	0.999	1.5	99	100.5	36
	2329	30	94	114	0.825	0.999	1.5	99	100.5	188
22-Aug	330	15	9	11	0.818	0.999	1.5	99	100.5	36
	629	30	40	87	0.460	0.999	1.5	99	100.5	80
	1115	15	0	0	--	0.999	1.5	99	100.5	0
	1600	15	5	5	1.000	0.999	1.5	99	100.5	20
	2110	30	61	55	1.109	0.999	1.5	99	100.5	122
	2330	30	132	93	1.419	0.999	1.5	99	100.5	264
23-Aug	100	10	51	42	1.214	0.850	1.5	99	100.5	306
	320	30	202	169	1.195	0.800	1.5	99	100.5	404
	400	10	65	61	1.066	0.650	1.5	99	100.5	390
	630	30	50	74	0.676	0.650	1.5	99	100.5	100
	710	10	12	14	0.857	0.750	1.5	99	100.5	72
	1129	30	258	291	0.887	0.750	1.5	99	100.5	516
	1600	30	66	71	0.930	0.750	1.5	99	100.5	132
	2129	30	577	613	0.941	0.750	1.5	99	100.5	1154
	2300	30	728	804	0.905	0.750	1.5	99	100.5	1456
24-Aug	329	30	222	392	0.566	0.750	1.5	99	100.5	444
	400	10	11	10	1.100	0.950	1.5	99	100.5	66
	630	30	158	151	1.046	0.950	1.5	99	100.5	316
	1145	30	329	271	1.214	0.950	1.5	99	100.5	658
	1220	8	142	100	1.420	0.880	1.5	99	100.5	1065
	1600	30	57	50	1.140	0.700	1.5	99	100.5	114
	2129	30	257	272	0.945	0.700	1.5	99	100.5	514
	2310	30	244	304	0.803	0.700	1.5	99	100.5	488
	2340	10	59	55	1.073	0.800	1.5	99	100.5	354
25-Aug	329	30	148	218	0.679	0.800	1.5	99	100.5	296
	400	10	22	29	0.759	0.999	1.5	99	100.5	132
	629	30	136	118	1.153	0.999	1.5	99	100.5	272
	1129	30	668	551	1.212	0.999	1.5	99	100.5	1336
	1200	5	88	83	1.060	0.900	1.5	99	100.5	1056
	1605	30	114	148	0.770	0.900	1.5	99	100.5	228
	2100	30	132	135	0.978	0.950	1.5	99	100.5	264
	2329	30	216	228	0.947	0.950	1.5	99	100.5	432
26-Aug	329	30	110	148	0.743	0.950	1.5	99	100.5	220
	400	10	29	46	0.630	0.999	1.5	99	100.5	174
	629	30	61	57	1.070	0.999	1.5	99	100.5	122
	1100	15	0	0	--	0.999	1.5	99	100.5	0
	1705	30	77	85	0.906	0.999	1.5	99	100.5	154
	2100	30	180	169	1.065	0.999	1.5	99	100.5	360
	2329	30	117	124	0.944	0.999	1.5	99	100.5	234
27-Aug	344	15	9	10	0.900	0.999	1.5	99	100.5	36
	600	30	45	56	0.804	0.999	1.5	99	100.5	90
	1100	30	17	27	0.630	0.999	1.5	99	100.5	34
	1600	15	5	3	1.667	0.999	1.5	99	100.5	20
	2129	30	694	678	1.024	0.999	1.5	99	100.5	1388
	2329	30	244	272	0.897	0.999	1.5	99	100.5	488
28-Aug	300	30	336	708	0.475	0.999	1.5	99	100.5	672
	610	30	140	182	0.769	0.999	1.5	99	100.5	280
	1120	30	73	121	0.603	0.999	1.5	99	100.5	146
	1605	30	130	146	0.890	0.999	1.5	99	100.5	260
	2129	30	280	221	1.267	0.999	1.5	99	100.5	560
	2200	10	96	29	3.310	0.850	1.5	99	100.5	576
	2329	30	814	740	1.100	0.850	1.5	99	100.5	1628
29-Aug	300	30	500	517	0.967	0.850	1.5	99	100.5	1000
	629	30	67	84	0.798	0.850	1.5	99	100.5	134
	700	10	69	68	1.015	0.999	1.5	99	100.5	414
	110	30	74	76	0.974	0.999	1.5	99	100.5	148
	1700	30	100	83	1.205	0.999	1.5	99	100.5	200

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Appendix C.3. (page 4 of 6).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	1740	10	40	43	0.930	0.850	1.5	99	100.5	240
	2129	30	432	439	0.984	0.850	1.5	99	100.5	864
	2300	30	430	390	1.103	0.850	1.5	99	100.5	860
30-Aug	300	30	360	350	1.029	0.850	1.5	99	100.5	720
	600	30	192	152	1.263	0.850	1.5	99	100.5	384
	630	10	75	70	1.071	0.750	1.5	99	100.5	450
	1100	30	443	493	0.899	0.750	1.5	99	100.5	886
	1629	30	65	118	0.551	0.750	1.5	99	100.5	130
	1700	10	15	19	0.789	0.850	1.5	99	100.5	90
	2100	30	663	638	1.039	0.850	1.5	99	100.5	1326
	2305	30	116	111	1.045	0.850	1.5	99	100.5	232
31-Aug	300	30	36	39	0.923	0.850	1.5	99	100.5	72
	630	15	7	9	0.778	0.850	1.5	99	100.5	28
	1115	30	60	73	0.822	0.850	2.0	99	101.0	120
	1145	10	9	10	0.900	0.995	2.0	99	101.0	54
	1600	30	110	107	1.028	0.950	1.5	99	100.5	220
	2100	30	454	353	1.286	0.950	1.5	99	100.5	908
	2130	10	122	115	1.061	0.800	1.5	99	100.5	732
	2300	30	254	260	0.977	0.800	1.5	99	100.5	508
01-Sep	2315	30	411	409	1.005	0.800	1.5	99	100.5	822
02-Sep	300	30	32	63	0.508	0.800	1.5	99	100.5	64
	330	10	19	16	1.188	0.950	1.5	99	100.5	114
	629	30	68	72	0.944	0.950	1.5	99	100.5	136
	1115	30	89	95	0.937	0.950	1.5	99	100.5	178
	1600	30	98	91	1.077	0.950	1.5	99	100.5	196
	2120	30	198	181	1.094	0.950	1.5	99	100.5	396
	2312	30	185	149	1.242	0.950	1.5	99	100.5	370
	2345	7	46	38	1.211	0.900	1.5	99	100.5	394
03-Sep	329	30	29	36	0.806	0.850	1.5	99	100.5	58
	620	30	178	197	0.904	0.850	1.5	99	100.5	356
	1110	15	3	2	1.500	0.850	1.5	99	100.5	12
	1453	6	34	37	0.919	0.850	1.5	99	100.5	340
	1639	20	94	111	0.847	0.850	1.5	99	100.5	282
	2114	30	152	164	0.927	0.850	1.5	99	100.5	304
	2300	30	253	259	0.977	0.850	1.5	99	100.5	506
04-Sep	300	30	82	87	0.943	0.850	1.5	99	100.5	164
	629	30	170	198	0.859	0.850	1.5	99	100.5	340
	700	6	22	22	1.000	0.850	1.5	99	100.5	220
	1100	15	11	9	1.222	0.950	1.5	99	100.5	44
	1600	15	9	11	0.818	0.950	1.5	99	100.5	36
	2129	30	151	140	1.079	0.950	1.5	99	100.5	302
	2300	30	63	60	1.050	0.950	1.5	99	100.5	126
05-Sep	330	15	8	10	0.800	0.950	1.5	99	100.5	32
	629	30	109	123	0.886	0.950	1.5	99	100.5	218
	1100	15	2	2	1.000	0.950	1.5	99	100.5	8
	1605	30	147	154	0.955	0.950	1.5	99	100.5	294
	2110	30	274	257	1.066	0.950	1.5	99	100.5	548
	2329	30	408	402	1.015	0.950	1.5	99	100.5	816
06-Sep	320	30	316	336	0.940	0.950	1.5	99	100.5	632
	629	30	145	164	0.884	0.950	1.5	99	100.5	290
	1115	30	62	71	0.873	0.950	1.5	99	100.5	124
	1605	30	48	47	1.021	0.950	1.5	99	100.5	96
	2100	30	209	201	1.040	0.950	1.5	99	100.5	418
	2329	30	175	198	0.884	0.950	1.5	99	100.5	350
07-Sep	310	30	202	223	0.906	0.950	1.5	99	100.5	404
	629	30	51	56	0.911	0.950	1.5	99	100.5	102
	1110	30	78	77	1.013	0.950	1.5	99	100.5	156
	1620	30	94	124	0.758	0.950	1.5	99	100.5	188
	2110	30	234	247	0.947	0.999	1.5	99	100.5	468
	2305	30	88	96	0.917	0.999	1.5	99	100.5	176
08-Sep	315	15	5	5	1.000	0.999	1.5	99	100.5	20
	629	30	84	86	0.977	0.999	1.5	99	100.5	168
	1100	30	21	27	0.778	0.999	1.5	99	100.5	42
	1600	30	166	133	1.248	0.999	1.5	99	100.5	332
	1631	10	63	72	0.875	0.900	1.5	99	100.5	378
	2115	30	64	62	1.032	0.900	1.5	99	100.5	128
	2320	30	40	60	0.667	0.900	1.5	99	100.5	80

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Appendix C.3. (page 5 of 6).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
09-Sep	315	15	9	18	0.500	0.999	1.5	99	100.5	36
	600	30	122	161	0.758	0.999	1.5	99	100.5	244
	1100	15	5	8	0.625	0.999	1.5	99	100.5	20
	1610	30	118	104	1.135	0.999	1.5	99	100.5	236
	2110	30	99	91	1.088	0.999	1.5	99	100.5	198
	2259	30	772	782	0.987	0.999	1.5	99	100.5	1544
11-Sep	300	30	58	74	0.784	0.999	1.5	99	100.5	116
	629	30	300	383	0.783	0.999	1.5	99	100.5	600
	1105	30	48	59	0.814	0.999	1.5	99	100.5	96
	1615	30	503	516	0.975	0.999	1.5	99	100.5	1006
	2120	30	77	70	1.100	0.999	1.5	99	100.5	154
	2315	30	93	125	0.744	0.999	1.5	99	100.5	186
12-Sep	300	30	50	110	0.455	0.999	1.5	99	100.5	100
	605	30	208	264	0.788	0.999	1.5	99	100.5	416
	1110	30	31	57	0.544	0.999	1.5	99	100.5	62
	1610	30	229	237	0.966	0.999	1.5	99	100.5	458
	2129	30	46	48	0.958	0.999	1.5	99	100.5	92
	2329	30	92	150	0.613	0.999	1.5	99	100.5	184
13-Sep	300	30	30	40	0.750	0.999	1.5	99	100.5	60
	629	30	288	399	0.722	0.999	1.5	99	100.5	576
	1205	30	52	57	0.912	0.999	1.5	99	100.5	104
	1605	30	286	260	1.100	0.999	1.5	99	100.5	572
	2100	30	120	126	0.952	0.999	1.5	99	100.5	240
	2329	30	88	126	0.698	0.999	1.5	99	100.5	176
14-Sep	300	30	60	68	0.882	0.999	1.5	99	100.5	120
	645	30	154	225	0.684	0.999	1.5	99	100.5	308
	1110	30	58	59	0.983	0.999	1.5	99	100.5	116
	1629	30	210	217	0.968	0.999	1.5	99	100.5	420
	2129	30	98	200	0.490	0.999	1.5	99	100.5	196
	2329	30	52	98	0.531	0.999	1.5	99	100.5	104
15-Sep	315	30	60	140	0.429	0.999	1.5	99	100.5	120
	629	30	60	80	0.750	0.999	1.5	99	100.5	120
	1110	15	9	16	0.563	0.999	1.5	99	100.5	36
	1605	15	7	6	1.167	0.999	1.5	99	100.5	28
	2129	30	69	61	1.131	0.999	1.5	99	100.5	138
	2319	30	40	44	0.909	0.999	1.5	99	100.5	80
16-Sep	305	30	36	44	0.818	0.999	1.5	99	100.5	72
	629	30	132	192	0.688	0.999	1.5	99	100.5	264
	1120	30	83	110	0.755	0.999	1.5	99	100.5	166
	1610	30	288	283	1.018	0.999	1.5	99	100.5	576
	2100	30	339	298	1.138	0.999	1.5	99	100.5	678
	2310	30	436	410	1.063	0.999	1.5	99	100.5	872
17-Sep	329	30	172	188	0.915	0.999	1.5	99	100.5	344
	629	30	105	101	1.040	0.999	1.5	99	100.5	210
	1115	30	92	87	1.057	0.999	1.5	99	100.5	184
	1605	30	532	490	1.086	0.999	1.5	99	100.5	1064
	2110	30	68	58	1.172	0.999	1.5	99	100.5	136
	2315	30	155	218	0.711	0.711	1.5	99	100.5	310
18-Sep	329	30	186	190	0.979	0.999	1.5	99	100.5	372
	629	30	225	272	0.827	0.999	1.5	99	100.5	450
	1120	30	93	93	1.000	0.999	1.5	99	100.5	186
	1610	30	275	265	1.038	0.999	1.5	99	100.5	550
	2113	30	63	64	0.984	0.999	1.5	99	100.5	126
	2315	30	286	227	1.260	0.999	1.5	99	100.5	572
	2347	10	126	107	1.178	0.899	1.5	99	100.5	756
19-Sep	329	30	84	70	1.200	0.899	1.5	99	100.5	168
	405	10	28	27	1.037	0.800	1.5	99	100.5	168
	629	30	153	142	1.077	0.800	1.5	99	100.5	306
	1115	30	145	136	1.066	0.800	1.5	99	100.5	290
	1600	30	368	372	0.989	0.800	1.5	99	100.5	736
	2100	30	119	110	1.082	0.800	1.5	99	100.5	238
	2329	30	114	402	0.284	0.999	1.5	99	100.5	228
20-Sep	1	15	17	15	1.133	0.999	1.5	99	100.5	68
	329	30	34	36	0.944	0.999	1.5	99	100.5	68
	629	30	115	118	0.975	0.999	1.5	99	100.5	230
	1105	30	116	117	0.991	0.999	1.5	99	100.5	232
	1600	30	344	304	1.132	0.999	1.5	99	100.5	688

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Appendix C.3. (page 6 of 6).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	2115	30	101	110	0.918	0.999	1.5	99	100.5	202
	2305	20	91	118	0.771	0.999	1.5	99	100.5	273
21-Sep	410	30	35	31	1.129	0.999	1.5	99	100.5	70
	629	30	140	160	0.875	0.999	2.5	99	101.5	280
	1115	30	105	116	0.905	0.999	2.5	99	101.5	210
	1605	30	314	321	0.978	0.999	2.5	99	101.5	628
	2129	30	58	72	0.806	0.999	2.5	99	101.5	116
	2305	30	62	66	0.939	0.999	2.5	99	101.5	124
22-Sep	329	30	32	60	0.533	0.999	2.5	99	101.5	64
	629	30	110	134	0.821	0.999	2.5	99	101.5	220
	1120	30	43	64	0.672	0.999	2.5	99	101.5	86
	1600	30	63	71	0.887	0.999	2.5	99	101.5	126
	2110	30	69	120	0.575	0.999	2.5	99	101.5	138
23-Sep	1	30	62	178	0.348	0.999	2.5	99	101.5	124
	310	30	50	76	0.658	0.999	2.5	99	101.5	100
	700	30	171	236	0.725	0.999	2.5	99	101.5	342
	1100	30	76	98	0.776	0.999	2.5	99	101.5	152
	1605	30	206	259	0.795	0.999	2.5	99	101.5	412
	2129	30	98	186	0.527	0.999	2.5	99	101.5	196
24-Sep	700	30	107	160	0.669	0.999	2.5	99	101.5	214
Total	352	8,337	33,476	36,340	0.921					

Appendix C.4. Oscilloscope data used to calibrate the 1985–model *, 1978–model **, and 1977–model Bendix sonar salmon counters at the Sheenjek River project site, 1997.

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
10–Aug *	957 *	30	12	24	0.500	0.250	2.0	90	92.0	24
	1144 *	15	2	2	1.000	0.350	2.0	90	92.0	8
	1610 *	15	0	1	--	0.350	2.0	90	92.0	0
	2208 *	10	1	5	0.200	0.350	2.0	90	92.0	6
	2330 *	15	9	17	0.529	0.350	2.0	90	92.0	36
11–Aug *	35 *	10	1	1	1.000	0.600	2.0	90	92.0	6
	801 *	15	2	2	1.000	0.600	2.0	90	92.0	8
	1426 *	15	1	0	--	0.600	2.0	90	92.0	4
	2245 *	10	1	1	1.000	0.600	2.0	90	92.0	6
	2301 *	15	3	2	1.500	0.600	2.0	90	92.0	12
12–Aug	10 *	20	9	14	0.643	0.550	2.0	90	92.0	27
	37 *	15	7	11	0.636	0.600	2.0	90	92.0	28
	644 *	15	4	3	1.333	0.600	2.0	90	92.0	16
	1409	15	1	1	1.000	0.270	2.0	90	92.0	4
	1909	15	6	10	0.600	0.270	2.0	90	92.0	24
13–Aug	15	15	6	18	0.333	0.270	2.0	90	92.0	24
	30	15	2	5	0.400	0.520	2.0	90	92.0	8
	801	15	1	2	0.500	0.520	2.0	90	92.0	4
	1430	15	2	3	0.667	0.520	2.0	90	92.0	8
	1915	15	5	5	1.000	0.520	2.0	90	92.0	20
	2301	30	30	31	0.968	0.520	2.0	90	92.0	60
14–Aug	744	15	2	2	1.000	0.520	2.0	90	92.0	8
	1144	15	1	1	1.000	0.520	2.0	90	92.0	4
	1930	15	0	0	--	0.520	2.0	90	92.0	0
	2115	15	0	0	--	0.520	2.0	90	92.0	0
	2344	15	3	3	1.000	0.520	2.0	90	92.0	12
15–Aug	744	15	1	1	1.000	0.520	2.0	90	92.0	4
	1815	15	2	2	1.000	0.520	2.0	90	92.0	8
	2330	15	6	6	1.000	0.520	2.0	90	92.0	24
16–Aug	801	15	0	0	--	0.520	2.0	90	92.0	0
	1701	15	5	7	0.714	0.520	2.0	90	92.0	20
	2130	15	1	1	1.000	0.520	2.0	90	92.0	4
	2344	15	3	4	0.750	0.520	2.0	90	92.0	12
17–Aug	730	15	4	5	0.800	0.520	2.0	90	92.0	16
	1301	15	0	0	--	0.520	2.0	90	92.0	0
	1630	15	0	0	--	0.520	2.0	90	92.0	0
	2215	15	1	4	0.250	0.520	2.0	90	92.0	4
18–Aug	730	15	0	0	--	0.520	2.0	90	92.0	0
	1601	15	3	3	1.000	0.520	2.0	90	92.0	12
	2135	15	17	23	0.739	0.520	2.0	90	92.0	68
	2201	15	10	10	1.000	0.620	2.0	90	92.0	40
	2330	15	1	1	1.000	0.620	2.0	90	92.0	4
19–Aug	301	15	1	1	1.000	0.620	2.0	90	92.0	4
	630	15	1	2	0.500	0.620	2.0	90	92.0	4
	1145	15	0	0	--	0.620	2.0	90	92.0	0
	1701	15	0	0	--	0.620	2.0	90	92.0	0
	2105	15	0	0	--	0.620	2.0	90	92.0	0
20–Aug	15	15	4	4	1.000	0.620	2.0	90	92.0	16
	301	15	5	8	0.625	0.620	2.0	90	92.0	20
	645	15	7	10	0.700	0.620	2.0	90	92.0	28
	1201	15	0	0	--	0.620	2.0	90	92.0	0
	1701	15	1	1	1.000	0.620	2.0	90	92.0	4
	2101	15	4	5	0.800	0.620	2.0	90	92.0	16
	1	15	3	3	1.000	0.620	2.0	90	92.0	12
21–Aug	320	15	2	5	0.400	0.620	2.0	90	92.0	8
	701	15	0	0	--	0.620	2.0	90	92.0	0
	1115	15	1	1	1.000	0.620	2.0	90	92.0	4
	1645	15	0	0	--	0.620	2.0	90	92.0	0
	2115	15	1	1	1.000	0.620	2.0	90	92.0	4
22–Aug	1	15	4	4	1.000	0.620	2.0	90	92.0	16
	315	15	9	12	0.750	0.620	2.0	90	92.0	36
	701	15	1	1	1.000	0.620	2.0	90	92.0	4
	1201	15	1	1	1.000	0.620	2.0	90	92.0	4
	1630	15	0	0	--	0.620	2.0	90	92.0	0

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Appendix C.4. (page 2 of 4).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	2140	15	8	9	0.889	0.620	2.0	90	92.0	32
	2315	30	36	41	--	0.620	2.0	90	92.0	72
23-Aug	301	15	5	5	1.000	0.620	2.0	90	92.0	20
	630	15	1	1	1.000	0.620	2.0	90	92.0	4
	1201	15	0	0	--	0.620	2.0	90	92.0	0
	1601	15	3	9	0.333	0.620	2.0	90	92.0	12
	2130	15	6	4	1.500	0.620	2.0	90	92.0	24
	2330	15	9	11	0.818	0.620	2.0	90	92.0	36
24-Aug	401	30	54	98	0.551	0.620	2.0	90	92.0	108
	430	10	18	24	0.750	0.990	2.0	90	92.0	108
	630	15	3	4	0.750	0.990	2.0	90	92.0	12
	1135	15	0	0	--	0.990	2.0	90	92.0	0
	1700	15	0	0	--	0.990	2.0	90	92.0	0
	2101	15	3	3	1.000	0.990	2.0	90	92.0	12
	2329	30	99	100	0.990	0.990	2.0	90	92.0	198
25-Aug	301	15	10	13	0.769	0.990	2.0	90	92.0	40
	635	15	0	0	--	0.990	2.0	90	92.0	0
	1105	15	7	5	1.400	0.990	2.0	90	92.0	28
	1630	15	2	3	0.667	0.990	2.0	90	92.0	8
	2150	15	1	21	0.048	0.990	2.0	90	92.0	4
	2335	30	21	20	1.050	0.990	2.0	90	92.0	42
26-Aug	345	30	26	30	0.867	0.990	2.0	90	92.0	52
	701	15	1	1	1.000	0.990	2.0	90	92.0	4
	1115	15	2	3	0.667	0.990	2.0	90	92.0	8
	1801	15	2	2	1.000	0.990	2.0	90	92.0	8
	2150	15	10	20	0.500	0.990	2.0	90	92.0	40
27-Aug	1	30	115	136	0.846	0.990	2.0	90	92.0	230
	310	30	52	78	0.667	0.990	2.0	90	92.0	104
	715	15	10	10	1.000	0.990	2.0	90	92.0	40
	1130	15	10	12	0.833	0.990	2.0	90	92.0	40
	1601	15	4	3	1.333	0.990	2.0	90	92.0	16
	2120	30	75	74	1.014	0.990	2.0	90	92.0	150
	2330	30	139	201	0.692	0.990	2.0	90	92.0	278
28-Aug	301	30	27	34	0.794	0.990	2.0	90	92.0	54
	645	30	26	27	0.963	0.990	2.0	90	92.0	52
	1201	15	1	1	1.000	0.990	2.0	90	92.0	4
	1515	30	92	90	1.022	0.990	2.0	90	92.0	184
	2135	30	60	101	0.594	0.990	2.0	90	92.0	120
29-Aug	301	30	60	75	0.800	0.990	2.0	90	92.0	120
	629	30	110	167	0.659	0.990	2.0	90	92.0	220
30-Aug	-- Sonar shut down due to high water conditions									
31-Aug										
01-Sep										
02-Sep										
03-Sep	1500	15	5	6	0.833	0.999	1.0	90	91.0	20
	2101	15	75	77	0.974	0.999	1.0	99	100.0	300
	2345	15	80	84	0.952	0.999	1.0	99	100.0	320
04-Sep	430	30	64	70	0.914	0.999	1.0	99	100.0	128
	705	30	69	111	0.622	0.999	1.0	99	100.0	138
	1201	30	38	36	1.056	0.999	1.0	99	100.0	76
	1544	15	9	9	1.000	0.999	1.0	99	100.0	36
	2030	20	70	75	0.933	0.999	1.0	99	100.0	210
	2100	10	27	26	1.038	0.899	1.0	99	100.0	162
	2330	30	58	56	1.036	0.899	1.0	90	91.0	116
05-Sep	315	30	71	71	1.000	0.899	1.0	99	100.0	142
	640	30	74	85	0.871	0.899	1.0	99	100.0	148
	1115	15	8	7	1.143	0.899	1.0	99	100.0	32
	1715	30	34	44	0.773	0.899	1.0	99	100.0	68
	1830	10	6	5	1.200	0.999	1.0	99	100.0	36
	2130	30	99	101	0.980	0.999	2.5	98	100.5	198
	2330	30	117	109	1.073	0.999	2.5	98	100.5	234
06-Sep	310	330	66	74	0.892	0.999	2.5	98	100.5	12

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Appendix C.4. (page 3 of 4).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)	
	745	30	63	71	0.887	0.999	2.5	98	100.5	126	
	1130	30	37	36	1.028	0.999	2.5	98	100.5	74	
	1604	30	41	39	1.051	0.999	2.5	98	100.5	82	
	2101	30	94	102	0.922	0.999	2.5	98	100.5	188	
07–Sep	1	30	73	80	0.913	0.999	2.5	98	100.5	146	
	325	30	80	91	0.879	0.999	2.5	98	100.5	160	
	630	30	84	100	0.840	0.999	2.5	98	100.5	168	
	1101	30	20	13	1.538	0.999	2.5	98	100.5	40	
	1130	10	2	2	1.000	0.850	2.5	98	100.5	12	
	1635	15	10	24	0.417	0.850	2.5	98	100.5	40	
	1701	10	4	5	0.800	0.950	2.5	98	100.5	24	
	2201	30	107	129	0.829	0.950	2.5	98	100.5	214	
	2234	10	16	17	0.941	0.950	2.5	98	100.5	96	(2° beam)
08–Sep	10	15	39	45	0.867	0.950	2.5	98	100.5	156	
	25	15	43	44	0.977	0.950	2.5	98	100.5	172	(2° beam)
	310	30	105	131	0.802	0.950	2.5	98	100.5	210	
	640	20	71	107	0.664	0.950	2.5	98	100.5	213	(2° beam)
	701	15	46	78	0.590	0.950	2.5	98	100.5	184	
	1201	30	49	74	0.662	0.990	2.5	98	100.5	98	
	1629	30	36	56	0.643	0.990	2.5	98	100.5	72	
	2205	30	133	145	0.917	0.990	2.5	98	100.5	266	
09–Sep	1	30	121	135	0.896	0.990	2.5	98	100.5	242	
	301	30	90	145	0.621	0.990	2.5	98	100.5	180	
	629	30	59	99	0.596	0.990	2.5	98	100.5	118	
	1129	30	15	17	0.882	0.990	2.5	98	100.5	30	
	1601	15	2	3	0.667	0.990	2.5	98	100.5	8	
	2101	15	60	89	0.674	0.990	2.5	98	100.5	240	
10–Sep	1	15	65	92	0.707	0.990	2.5	98	100.5	260	
	245	15	130	144	0.903	0.990	2.5	98	100.5	520	
	629	30	30	31	0.968	0.990	2.5	98	100.5	60	
	1101	15	0	0	--	0.990	2.5	98	100.5	0	
	1720	15	0	0	--	0.990	2.5	98	100.5	0	
	2110	30	36	34	1.059	0.990	2.5	98	100.5	72	
11–Sep	29	30	45	46	0.978	0.990	2.5	98	100.5	90	
	329	30	66	63	1.048	0.990	2.5	98	100.5	132	
	615	30	52	52	1.000	0.990	2.5	98	100.5	104	
	1115	15	4	3	1.333	0.990	2.5	98	100.5	16	
	1701	15	3	3	1.000	0.990	2.5	98	100.5	12	
	2101	15	7	13	0.538	0.990	2.5	98	100.5	28	
	2345	30	66	67	0.985	0.990	2.5	98	100.5	132	
12–Sep	401	30	111	118	0.941	0.990	2.5	98	100.5	222	
	645	30	22	20	1.100	0.990	2.5	98	100.5	44	
	1115	15	1	1	1.000	0.990	2.5	98	100.5	4	
	1605	15	10	13	0.769	0.990	2.5	98	100.5	40	
	2100	30	80	73	1.096	0.990	2.5	98	100.5	160	
	2330	30	78	73	1.068	0.990	2.5	98	100.5	156	
13–Sep	329	30	163	172	0.948	0.990	2.5	98	100.5	326	
	645	30	82	87	0.943	0.990	2.5	98	100.5	164	
	1115	15	9	10	0.900	0.990	2.5	98	100.5	36	
	1601	15	9	11	0.818	0.990	2.5	98	100.5	36	
	2101	30	102	103	0.990	0.990	2.5	98	100.5	204	
	2329	30	70	83	0.843	0.990	2.5	98	100.5	140	
14–Sep	329	30	109	103	1.058	0.990	2.5	98	100.5	218	
	629	30	85	89	0.955	0.990	2.5	98	100.5	170	
	1115	30	26	26	1.000	0.990	2.5	98	100.5	52	
	1615	15	9	10	0.900	0.990	2.5	98	100.5	36	
	2129	30	41	43	0.953	0.990	2.5	98	100.5	82	
	2329	30	88	91	0.967	0.990	2.5	98	100.5	176	
15–Sep	310	30	71	72	0.986	0.990	2.5	98	100.5	142	
	701	30	60	60	1.000	0.990	2.5	98	100.5	120	
	1130	15	8	8	1.000	0.990	2.5	98	100.5	32	
	1615	13	9	8	1.125	0.990	2.5	98	100.5	42	
	2210	20	27	17	1.588	0.990	2.5	98	100.5	81	
	2235	10	7	7	1.000	0.800	2.5	98	100.5	42	
	2345	30	53	55	0.964	0.800	2.5	98	100.5		
16–Sep **	145	15	34	33	1.030	0.450	2.0	94	96.0	136	
	329	30	93	105	0.886	0.450	2.0	94	96.0	186	

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Appendix C.4. (page 4 of 4).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	629	30	86	98	0.878	0.450	2.0	94	96.0	172
	1129	30	34	56	0.607	0.450	2.0	94	96.0	68
	1201	10	5	5	1.000	0.650	2.0	94	96.0	30
	1701	30	15	17	0.882	0.650	2.0	94	96.0	30
	2115	30	48	43	1.116	0.650	2.0	94	96.0	96
17-Sep **	1	30	59	42	1.405	0.650	2.0	94	96.0	118
	31	10	22	20	1.100	0.500	2.0	94	96.0	132
	329	30	84	83	1.012	0.500	2.0	94	96.0	168
	629	30	59	58	1.017	0.500	2.0	94	96.0	118
	1125	30	16	32	0.500	0.500	2.0	94	96.0	32
	1155	10	3	3	1.000	0.500	2.0	94	96.0	18
	1601	15	6	6	1.000	0.500	2.0	94	96.0	24
	2105	30	52	42	1.238	0.500	2.0	94	96.0	104
	2140	10	17	15	1.133	0.650	2.0	94	96.0	102
18-Sep **	1	30	65	75	0.867	0.650	2.0	94	96.0	130
	301	30	78	75	1.040	0.650	2.0	94	96.0	156
	630	30	60	58	1.034	0.650	2.0	94	96.0	120
	1101	15	5	5	1.000	0.650	2.0	94	96.0	20
	1630	15	8	12	0.667	0.650	2.0	94	96.0	32
	2101	30	55	50	1.100	0.650	2.0	94	96.0	110
	2330	30	42	40	1.050	0.650	2.0	94	96.0	84
19-Sep **	330	15	9	7	1.286	0.650	2.0	94	96.0	36
	701	30	48	44	1.091	0.650	2.0	94	96.0	96
	1145	15	7	8	0.875	0.650	2.0	94	96.0	28
	1605	30	18	28	0.643	0.650	2.0	94	96.0	36
	1638	10	4	3	1.333	0.800	2.0	94	96.0	24
	2115	30	36	29	1.241	0.800	2.0	94	96.0	72
	2145	10	8	10	0.800	0.640	2.0	94	96.0	48
20-Sep **	1	30	53	60	0.883	0.640	2.0	94	96.0	106
	315	30	26	23	1.130	0.640	2.0	94	96.0	52
	701	30	38	46	0.826	0.640	2.0	94	96.0	76
	731	10	13	17	0.765	0.740	2.0	94	96.0	78
	1115	15	1	1	1.000	0.740	2.0	94	96.0	4
	1615	15	6	5	1.200	0.740	2.0	94	96.0	24
	2110	30	30	24	1.250	0.740	2.0	94	96.0	60
	2140	10	12	12	1.000	0.640	2.0	94	96.0	72
21-Sep **	1	15	9	8	1.125	0.640	2.0	94	96.0	36
	315	30	48	44	1.091	0.640	2.0	94	96.0	96
	701	30	42	40	1.050	0.640	2.0	94	96.0	84
	1115	30	13	18	0.722	0.640	2.0	94	96.0	26
	1146	10	3	3	1.000	0.740	2.0	94	96.0	18
	1601	15	7	7	1.000	0.740	2.0	94	96.0	28
	2101	15	9	8	1.125	0.740	2.0	94	96.0	36
22-Sep **	1	30	26	17	1.529	0.740	2.0	94	96.0	52
	15	10	11	10	1.100	0.640	2.0	94	96.0	66
	301	30	40	38	1.053	0.640	2.0	94	96.0	80
	645	30	61	78	0.782	0.640	2.0	94	96.0	122
	716	10	3	4	0.750	0.740	2.0	94	96.0	18
	1140	30	31	31	1.000	0.740	2.0	94	96.0	62
	1640	15	10	10	1.000	0.740	2.0	94	96.0	40
	2115	30	35	30	1.167	0.740	2.0	94	96.0	70
	2145	10	14	12	1.167	0.640	2.0	94	96.0	84
23-Sep **	1	30	20	18	1.111	0.640	2.0	94	96.0	40
	315	30	40	38	1.053	0.640	2.0	94	96.0	80
	710	30	88	100	0.880	0.640	2.0	94	96.0	176
	1340	20	10	18	0.556	0.640	2.0	94	96.0	30
Total	245	5,373	7,397	8,372	0.884					

Appendix C.5. Oscilloscope data used to calibrate the 1985–model* and 1977 model Bendix sonar salmon counters at the Sheenjek River project site, 1998.

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
17–Aug *	2150	15	0	0	--	0.450	1.5	95	96.5	0
18–Aug *	801	15	0	0	--	0.550	1.5	95	96.5	0
19–Aug *	801	15	0	0	--	0.550	1.5	95	96.5	0
	1320	15	1	5	0.200	0.750	1.5	95	96.5	4
20–Aug *	701	15	0	0	--	0.750	1.5	95	96.5	0
	1601	10	0	0	--	0.750	1.5	95	96.5	0
	2344	15	0	0	--	0.750	1.5	95	96.5	0
21–Aug *	845	15	0	0	--	0.750	1.5	95	96.5	0
	1101	10	0	0	--	0.550	1.5	95	96.5	0
22–Aug *	740	15	0	0	--	0.550	1.5	95	96.5	0
	1001	15	0	0	--	0.550	1.5	95	96.5	0
23–Aug *	640	15	0	0	--	0.550	1.5	95	96.5	0
	1730	15	0	0	--	0.550	1.5	95	96.5	0
24–Aug *	801	15	0	0	--	0.550	1.5	95	96.5	0
25–Aug *	730	15	0	0	--	0.550	1.5	95	96.5	0
	1830	15	0	0	--	0.550	1.5	95	96.5	0
26–Aug *	830	15	0	0	--	0.550	1.5	95	96.5	0
	1101	15	0	0	--	0.550	1.5	95	96.5	0
	1401	15	1	3	0.333	0.550	1.5	95	96.5	4
	2201	15	1	16	0.063	0.550	1.5	95	96.5	4
27–Aug	730	15	0	0	--	0.550	1.5	95	96.5	0
28–Aug	615	15	0	0	--	0.550	1.5	95	96.5	0
	915	15	2	2	1.000	0.550	1.5	95	96.5	8
	1344	15	2	2	1.000	0.550	1.5	95	96.5	8
29–Aug	801	15	1	1	1.000	0.550	1.5	95	96.5	4
	1401	15	0	0	--	0.550	1.5	95	96.5	0
	1901	15	0	0	--	0.550	1.5	95	96.5	0
30–Aug	801	15	0	0	--	0.550	1.5	95	96.5	0
	1203	15	0	0	--	0.550	1.5	95	96.5	0
	1601	15	1	1	1.000	0.550	1.5	95	96.5	4
	2105	15	0	0	--	0.550	2.0	95	97.0	0
31–Aug	5	15	1	1	1.000	0.550	2.0	95	97.0	4
	305	15	2	2	1.000	0.550	2.0	95	97.0	8
	701	15	1	1	1.000	0.550	2.0	95	97.0	4
	1101	15	0	0	--	0.550	2.0	95	97.0	0
	2105	15	3	3	1.000	0.550	2.0	95	97.0	12
01–Sep	5	15	2	2	1.000	0.550	2.0	95	97.0	8
	305	15	1	1	1.000	0.550	2.0	95	97.0	4
	805	15	1	1	1.000	0.550	2.0	95	97.0	4
	1205	15	2	3	0.667	0.550	2.0	95	97.0	8
	1701	15	0	0	--	0.550	2.0	95	97.0	0
	2101	15	0	0	--	0.550	2.0	95	97.0	0
02–Sep	5	15	1	1	1.000	0.550	2.0	95	97.0	4
	305	15	8	9	0.889	0.550	2.0	95	97.0	32
	715	15	2	2	1.000	0.550	2.0	95	97.0	8
	1101	15	0	0	--	0.550	2.0	95	97.0	0
	1801	15	0	0	--	0.550	2.0	95	97.0	0
	2105	15	1	1	1.000	0.550	2.0	95	97.0	4
03–Sep	2	15	0	0	--	0.550	2.0	95	97.0	0
	315	15	1	1	1.000	0.550	2.0	95	97.0	4
	715	15	0	0	--	0.550	2.0	95	97.0	0
	1101	15	0	0	--	0.550	2.0	95	97.0	0
	1601	15	0	0	--	0.550	2.0	95	97.0	0
	2105	15	2	2	1.000	0.550	2.0	95	97.0	8
04–Sep	20	15	0	0	--	0.550	2.0	95	97.0	0
	305	15	0	0	--	0.550	2.0	95	97.0	0
	715	15	1	2	0.500	0.550	2.0	95	97.0	4
	1130	15	1	1	1.000	0.550	2.0	95	97.0	4

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Appendix C.5. (page 2 of 4).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	1715	15	0	0	--	0.550	2.0	95	97.0	0
	2130	30	14	64	0.219	0.550	2.0	95	97.0	28
05-Sep	30	15	0	0	--	0.550	2.0	95	97.0	0
	301	15	2	4	0.500	0.550	2.0	95	97.0	8
	630	15	0	0	--	0.550	2.0	95	97.0	0
	1130	15	0	0	--	0.550	2.0	95	97.0	0
	1630	15	0	0	--	0.550	2.0	95	97.0	0
	2105	15	1	1	1.000	0.550	2.0	95	97.0	4
06-Sep	5	15	1	1	1.000	0.550	2.0	95	97.0	4
	315	15	3	2	1.500	0.550	2.0	95	97.0	12
	630	15	0	0	--	0.550	2.0	95	97.0	0
	1130	15	1	1	1.000	0.550	2.0	95	97.0	4
	1601	15	0	0	--	0.550	2.0	95	97.0	0
	2230	15	1	0	--	0.550	2.0	95	97.0	4
07-Sep	30	15	1	1	1.000	0.550	2.0	95	97.0	4
	310	15	1	1	1.000	0.550	2.0	95	97.0	4
	701	15	3	2	1.500	0.550	2.0	95	97.0	12
	1215	15	0	0	--	0.550	2.0	95	97.0	0
	1715	15	4	5	0.800	0.550	2.0	95	97.0	16
	2105	15	2	2	1.000	0.550	2.0	95	97.0	8
08-Sep	5	15	9	8	1.125	0.550	2.0	95	97.0	36
	330	15	3	3	1.000	0.550	2.0	95	97.0	12
	830	15	5	5	1.000	0.550	2.0	95	97.0	20
	1115	15	3	4	0.750	0.550	2.0	95	97.0	12
	1415	15	0	0	--	0.550	2.0	95	97.0	0
	1801	15	2	2	1.000	0.550	2.0	95	97.0	8
	1901	15	3	3	1.000	0.550	2.0	95	97.0	12
	2140	15	6	6	1.000	0.550	2.0	95	97.0	24
09-Sep	5	15	9	11	0.818	0.550	2.0	95	97.0	36
	305	15	6	6	1.000	0.550	2.0	95	97.0	24
	715	15	5	10	0.500	0.550	2.0	95	97.0	20
	1315	15	0	0	--	0.550	2.0	95	97.0	0
	1615	15	0	0	--	0.550	2.0	95	97.0	0
	2101	15	3	3	1.000	0.550	2.0	95	97.0	12
10-Sep	1	15	8	10	0.800	0.550	2.0	95	97.0	32
	315	15	9	16	0.563	0.550	2.0	95	97.0	36
	715	15	2	4	0.500	0.750	2.0	95	97.0	8
	1115	15	0	0	--	0.750	2.0	95	97.0	0
	1630	15	0	0	--	0.750	2.0	95	97.0	0
	2101	15	1	1	1.000	0.750	2.0	95	97.0	4
11-Sep	10	15	5	5	1.000	0.750	2.0	95	97.0	20
	320	15	7	8	0.875	0.750	2.0	95	97.0	28
	712	15	9	12	0.750	0.750	2.0	95	97.0	36
	1145	15	4	4	1.000	0.750	2.0	95	97.0	16
	1601	15	1	1	1.000	0.750	2.0	95	97.0	4
	2101	15	7	8	0.875	0.750	2.0	95	97.0	28
12-Sep	5	15	36	37	0.973	0.750	2.0	95	97.0	144
	345	15	5	5	1.000	0.750	2.0	95	97.0	20
	715	15	1	1	1.000	0.750	2.0	95	97.0	4
	1201	15	1	1	1.000	0.750	2.0	95	97.0	4
	1615	15	1	1	1.000	0.750	2.0	95	97.0	4
	2130	15	5	5	1.000	0.750	2.0	95	97.0	20
13-Sep	30	15	9	10	0.900	0.750	2.0	95	97.0	36
	330	15	8	10	0.800	0.750	2.0	95	97.0	32
	615	15	9	9	1.000	0.750	2.0	95	97.0	36
	1115	15	1	1	1.000	0.750	2.0	95	97.0	4
	1630	15	3	4	0.750	0.750	2.0	95	97.0	12
	2101	15	10	12	0.833	0.750	2.0	95	97.0	40
14-Sep	30	15	7	8	0.875	0.750	2.0	95	97.0	28
	330	15	8	9	0.889	0.750	2.0	95	97.0	32
	730	15	3	5	0.600	0.750	2.0	95	97.0	12
	1101	15	0	0	--	0.750	2.0	95	97.0	0
	1630	15	5	5	1.000	0.750	2.0	95	97.0	20
	2115	30	30	32	0.938	0.750	2.0	95	97.0	60
15-Sep	15	30	41	43	0.953	0.750	2.0	95	97.0	82
	315	15	9	10	0.900	0.750	2.0	95	97.0	36

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Appendix C.5. (page 3 of 4).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	615	15	8	8	1.000	0.750	2.0	95	97.0	32
	1115	15	0	0	--	0.750	2.0	95	97.0	0
	1630	15	0	0	--	0.750	2.0	95	97.0	0
	2101	30	42	43	0.977	0.750	2.0	95	97.0	84
16-Sep	1	30	64	64	1.000	0.750	2.0	95	97.0	128
	315	30	32	34	0.941	0.750	2.0	95	97.0	64
	615	15	5	9	0.556	0.750	2.0	95	97.0	20
	1101	15	4	5	0.800	0.750	2.0	95	97.0	16
	1626	30	40	43	0.930	0.750	2.0	95	97.0	80
	2130	30	94	84	1.119	0.750	2.0	95	97.0	188
17-Sep	1	30	74	72	1.028	0.750	2.0	95	97.0	148
	301	30	79	72	1.097	0.750	2.0	95	97.0	158
	615	30	38	51	0.745	0.750	2.0	95	97.0	76
	1115	15	9	14	0.643	0.950	2.0	95	97.0	36
	1615	30	32	43	0.744	0.999	2.0	95	97.0	64
	2101	30	128	104	1.231	0.999	2.0	95	97.0	256
	2131	10	14	13	1.077	0.899	2.0	95	97.0	84
18-Sep	15	15	7	7	1.000	0.899	2.0	95	97.0	28
	301	30	59	54	1.093	0.899	2.0	95	97.0	118
	701	30	26	26	1.000	0.899	2.0	95	97.0	52
	1115	15	9	13	0.692	0.899	2.0	95	97.0	36
	1608	30	32	33	0.970	0.899	2.0	95	97.0	64
	2101	30	154	154	1.000	0.899	2.0	95	97.0	308
19-Sep	1	30	80	48	1.667	0.899	2.0	95	97.0	160
	38	10	33	30	1.100	0.700	2.0	95	97.0	198
	310	30	41	44	0.932	0.700	2.0	95	97.0	82
	630	15	7	7	1.000	0.700	2.0	95	97.0	28
	1201	15	6	8	0.750	0.700	2.0	95	97.0	24
	1601	30	34	33	1.030	0.700	2.0	95	97.0	68
	2130	30	73	67	1.090	0.700	2.0	95	97.0	146
20-Sep	1	30	82	80	1.025	0.700	2.0	95	97.0	164
	301	30	69	65	1.062	0.700	2.0	95	97.0	138
	615	30	37	36	1.028	0.700	2.0	95	97.0	74
	1110	15	24	24	1.000	0.700	2.0	95	97.0	96
	1701	30	40	41	0.976	0.700	2.0	95	97.0	80
	2101	45	124	106	1.170	0.700	2.0	95	97.0	165
21-Sep	30	30	32	30	1.067	0.700	2.0	95	97.0	64
	701	30	45	47	0.957	0.700	2.0	95	97.0	90
	1105	30	33	22	1.500	0.700	2.0	95	97.0	66
	1136	10	34	33	1.030	0.550	2.0	95	97.0	204
	1629	30	36	32	1.125	0.550	2.0	95	97.0	72
	1801	15	26	27	0.963	0.550	2.0	95	97.0	104
	2125	30	113	105	1.076	0.550	2.0	95	97.0	226
22-Sep	20	30	88	102	0.863	0.550	2.0	95	97.0	176
	310	30	62	58	1.069	0.550	2.0	95	97.0	124
	715	30	56	73	0.767	0.550	2.0	95	97.0	112
	745	10	19	19	1.000	0.750	2.0	95	97.0	114
	1101	15	8	8	1.000	0.750	2.0	95	97.0	32
	1610	30	20	28	0.714	0.750	2.0	95	97.0	40
	1640	10	9	9	1.000	0.850	2.0	95	97.0	54
	2105	15	9	8	1.125	0.850	2.0	95	97.0	36
23-Sep	15	15	7	6	1.167	0.850	2.0	95	97.0	28
	301	15	9	10	0.900	0.850	2.0	95	97.0	36
	715	30	34	32	1.063	0.850	2.0	95	97.0	68
	1130	15	8	8	1.000	0.850	2.0	95	97.0	32
	1544	15	7	8	0.875	0.850	2.0	95	97.0	28
	2101	15	10	9	1.111	0.850	2.0	95	97.0	40
24-Sep	1	30	49	46	1.065	0.850	2.0	95	97.0	98
	310	15	9	9	1.000	0.850	2.0	95	97.0	36
	601	15	12	10	1.200	0.890	2.0	95	97.0	48
	1115	25	3	3	1.000	0.850	2.0	95	97.0	7
	1605	15	0	0	--	0.850	2.0	95	97.0	0
	2015	15	4	3	1.333	0.850	2.0	95	97.0	16
25-Sep	1	15	5	7	0.714	0.850	2.0	95	97.0	20
	301	15	2	2	1.000	0.850	2.0	95	97.0	8
	701	15	2	2	1.000	0.850	2.0	95	97.0	8
	1115	15	4	2	2.000	0.850	2.0	95	97.0	16

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Appendix C.5. (page 4 of 4).

Date	Time Start	Duration	Scope Count	Sonar Count	Adjustment Factor	PRR	Dead Range	Ctng Range	Total Range	Passage Rate (fish/hour)
	1614	15	0	0	--	0.850	2.0	95	97.0	0
	2101	15	5	2	2.500	0.850	2.0	95	97.0	20
26-Sep	15	15	2	0	--	0.850	2.0	95	97.0	8
	301	15	1	1	1.000	0.850	2.0	95	97.0	4
	715	15	4	4	1.000	0.850	2.0	95	97.0	16
	1105	15	3	3	1.000	0.850	2.0	95	97.0	12
	1616	15	5	4	1.250	0.850	2.0	95	97.0	20
	2105	15	0	0	--	0.850	2.0	95	97.0	0
27-Sep	1	15	5	4	1.250	0.850	2.0	95	97.0	20
	310	15	0	0	--	0.850	2.0	95	97.0	0
	701	15	3	3	1.000	0.850	2.0	95	97.0	12
	1115	15	5	4	1.250	0.850	2.0	95	97.0	20
	1701	15	7	9	0.778	0.850	2.0	95	97.0	28
	2101	15	9	7	1.286	0.850	2.0	95	97.0	36
28-Sep	2	15	11	9	1.222	0.850	2.0	95	97.0	44
	215	15	9	4	2.250	0.850	2.0	95	97.0	36
	715	15	6	5	1.200	0.850	2.0	95	97.0	24
	1115	15	4	4	1.000	0.850	2.0	95	97.0	16
	1601	15	2	2	1.000	0.850	2.0	95	97.0	8
	2015	30	27	16	1.688	0.850	2.0	95	97.0	54
29-Sep	10	15	6	4	1.500	0.850	2.0	95	97.0	24
	310	15	8	6	1.333	0.850	2.0	95	97.0	32
	701	15	5	5	1.000	0.850	1.0	95	96.0	20
	1101	15	2	2	1.000	0.850	1.0	95	96.0	8
	1601	15	2	4	0.500	0.850	1.0	95	96.0	8
	2105	15	3	2	1.500	0.850	1.0	95	96.0	12
30-Sep	10	15	9	8	1.125	0.850	1.0	95	96.0	36
	301	15	3	1	3.000	0.850	1.0	95	96.0	12
	701	15	4	3	1.333	0.850	1.0	95	96.0	16
	1144	15	5	11	0.455	0.850	1.0	95	96.0	20
Total	221	3,875 min	2,882	2,905	0.992					

APPENDIX D

SHEENJEK RIVER TEMPORAL SONAR COUNT DATA

APPENDIX D: SHEENJEK RIVER TEMPORAL SONAR COUNT DATA.

Appendix D.1. Temporal distribution of daily sonar counts attributed to fall chum salmon in Sheenjek River, 1994.

Hour	07–Aug	08–Aug	09–Aug	10–Aug	11–Aug	12–Aug	13–Aug	14–Aug	15–Aug	16–Aug	17–Aug	18–Aug	19–Aug	20–Aug	21–Aug	22–Aug	23–Aug	24–Aug
0100	[b]	14	11	6	65	19	26	11	39	41	71	29	54	19	39	62	66	40
0200		12	20	0	11	8	55	21	24	13	30	95	162	36	54	29	99	46
0300		5	10	5	14	25	23	29	24	31	38	23	32	35	47	70	85	18
0400		8	14	3	8	9	88	8	22	20	19	65	107	13	58	50	34	68
0500		1	11	5	3	6	33	37	18	49	35	61	55	19	96	42	69	51
0600		0	8	1	0	20	14	11	6	2	42	4	4	7	1	13	93	78
0700		0	5	0	6	9	10	6	8	1	13	8	11	4	14	38	102	51
0800		0	4	0	2	6	18	3	4	2	2	3	2	0	17	27	50	50
0900		1	3	0	4	0	3	1	2	9	11	4	1	1	6	22	61	38
1000		1	1	0	11	1	1	0	1	3	8	2	1	0	2	19	85	49
1100		0	3	0	11	0	1	0	0	0	11	2	3	0	0	17	92	58
1200	(126)	3	0	0	6	0	0	0	2	0	13	1	4	0	1	14	83	38
1300	(86.3%)	1	1	0	13	0	0	0	0	2	2	2	0	2	1	8	72	18
1400		7	0	0	0	0	0	0	0	0	1	3	0	3	6	13	68	47
1500		1	0	0	4	0	0	0	0	1	0	14	5	0	0	13	63	59
1600		3	3	0	11	0	0	0	0	2	1	4	0	1	1	9	62	54
1700		1	1	1	2	0	0	0	0	17	6	3	4	3	0	17	66	35
1800		0	0	0	1	1	1	8	0	6	12	4	0	0	0	19	84	24
1900		2	0	0	1	2	0	20	8	6	2	2	2	4	58	31	79	42
2000		0	4	1	2	4	3	0	3	1	0	2	1	0	2	35	55	17
2100		0	0	1	4	14	5	2	9	13	1	2	1	1	7	34	63	35
2200	5	1	2	2	6	33	9	15	24	35	7	16	2	9	34	14	38	42
2300	12	4	6	9	8	48	16	15	23	36	22	58	23	36	88	19	58	38
2400	3	10	5	4	21	38	22	28	44	43	31	117	23	64	60	27	46	39
Daily Passage Estimate	146	75	112	38	214	243	328	215	261	333	378	524	497	257	594	642	1,673	1,035
Percent	0.1%	0.0%	0.1%	0.0%	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%	0.3%	0.3%	0.3%	0.2%	0.4%	0.4%	1.1%	0.7%

[a] Totals include only days with 24 hours counts (i.e., excludes 7, 29, 30 August and 13, 14, and 28 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Appendix D.1. (page 2 of 3).

Hour	25–Aug	26–Aug	27–Aug	28–Aug	29–Aug	30–Aug	31–Aug	01–Sep	02–Sep	03–Sep	04–Sep	05–Sep	06–Sep	07–Sep	08–Sep	09–Sep	10–Sep	11–Sep
0100	46	17	87	152	[b]	[b]	180	261	321	145	227	198	144	205	187	132	105	295
0200	56	69	49	204			177	231	312	131	209	180	170	274	211	172	100	271
0300	25	51	75	295			211	230	333	213	166	254	244	368	301	245	149	364
0400	18	63	96	320			200	271	335	163	243	252	252	434	426	299	223	327
0500	21	79	138	207			167	218	228	169	126	180	246	259	219	247	171	245
0600	51	95	190	218			161	292	277	328	257	261	292	280	176	188	129	227
0700	62	88	198	172			267	252	379	454	242	194	201	234	217	136	159	200
0800	24	25	190	183			165	182	282	389	178	125	136	120	151	88	122	108
0900	45	9	132	147			212	359	259	371	143	108	177	68	104	100	74	82
1000	26	13	74	95			196	297	347	316	142	76	90	75	100	99	75	85
1100	4	11	112	77			252	284	364	263	154	55	93	56	102	109	38	95
1200	34	5	53	46	(4,082)	(3,316)	281	277	376	295	77	116	25	67	76	89	25	38
1300	51	4	84	39		(73.9%)	238	395	309	275	86	51	20	60	86	38	27	46
1400	25	4	115	58			346	258	343	246	51	47	19	86	108	42	45	24
1500	39	8	186	78			328	337	362	189	115	37	16	111	108	54	35	4
1600	46	3	158	96			261	283	328	123	112	27	11	107	167	46	32	30
1700	26	3	143	112			189	296	285	145	80	60	29	123	141	64	43	73
1800	26	0	92	129			119	322	299	166	129	43	58	120	106	105	122	110
1900	13	9	91	137		205	135	366	320	291	135	54	74	87	105	71	127	131
2000	41	19	129	149		206	200	337	293	249	102	72	86	175	81	64	51	81
2100	38	39	123	155		195	392	297	215	274	142	94	108	141	85	27	95	61
2200	66	60	202	161		217	291	338	305	299	166	108	168	152	108	27	60	130
2300	32	57	111	147		176	253	273	195	228	184	124	125	155	110	66	123	112
2400	33	60	106	300		172	251	256	129	196	200	116	168	171	112	90	211	243
Daily Passage Estimate	848	791	2,934	3,677	4,082	4,487	5,472	6,912	7,196	5,918	3,666	2,832	2,952	3,928	3,587	2,598	2,341	3,382
Percent	0.6%	0.5%	1.9%	2.4%	2.7%	3.0%	3.6%	4.6%	4.8%	3.9%	2.4%	1.9%	2.0%	2.6%	2.4%	1.7%	1.6%	2.2%

[a] Totals include only days with 24 hours counts (i.e., excludes 7, 29, 30 August and 13, 14, and 28 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Appendix D.1. (page 3 of 3).

Hour	12-Sep	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	Total [a]	Percent
0100	145	185	[b]	208	127	120	55	241	239	123	252	168	141	85	110	159	92	5,487	0.042
0200	228	228		203	77	71	20	237	201	146	202	181	137	151	106	87	101	5,578	0.042
0300	310	175		202	115	147	26	282	171	88	269	214	204	176	72	94	110	6,408	0.049
0400	292	192		187	100	149	121	280	218	114	261	192	35	269	131	170	120	7,035	0.054
0500	181	102		93	71	107	19	184	186	138	325	355	42	99	57	231	156	5,599	0.043
0600	161	141		116	59	129	35	105	253	142	299	333	41	103	54	209	192	5,765	0.044
0700	112	206		179	107	178	43	120	414	193	300	242	108	136	153	211	228	6,237	0.047
0800	93	96		214	239	320	70	147	395	326	429	488	290	282	308	204	266	6,463	0.049
0900	60	85		114	146	222	61	121	427	357	268	497	295	216	260	163	243	5,766	0.044
1000	48	107		132	113	230	74	136	441	206	211	245	268	169	214	108	220	4,886	0.037
1100	36	80		56	148	171	39	161	360	125	168	262	304	134	194	127	197	4,552	0.035
1200	4	18	(3,294)	101	135	111	28	107	236	127	225	200	319	101	222	111	172	4,072	0.031
1300	9	66		108	164	108	23	155	324	159	276	137	442	94	228	212	[b]	4,370	0.033
1400	11	59		102	189	106	34	108	336	140	313	126	210	115	181	158		4,094	0.031
1500	13	149		78	260	199	58	331	417	98	480	86	135	143	105	105		4,675	0.036
1600	46	[b]		44	319	338	115	720	487	186	225	115	135	70	44	111		4,936	0.038
1700	88			94	379	396	262	813	449	229	319	119	226	107	123	163	(1,965)	5,735	0.044
1800	100			171	351	332	306	554	416	327	186	115	191	35	100	183	(48.4%)	5,473	0.042
1900	117	(1,176)		117	297	310	316	397	367	300	309	134	146	54	122	162		5,553	0.042
2000	136	(38.4%)		89	333	268	265	259	388	322	263	114	135	111	114	163		5,239	0.040
2100	67			167	404	129	293	333	275	371	206	223	191	39	161	134		5,471	0.042
2200	122			248	357	121	365	279	260	423	245	185	245	320	147	193		6,440	0.049
2300	139			261	111	80	346	174	171	290	299	252	135	363	101	53		5,577	0.042
2400	278			238	163	71	275	256	152	357	170	170	148	235	151	89		6,017	0.046
																		131,428 [a]	
Daily Passage Estimate	2,798	3,066	3,294	3,522	4,764	4,413	3,249	6,500	7,583	5,287	6,520	5,153	4,523	3,607	3,458	3,600	4,062	150,565 [c]	
Percent	1.9%	2.0%	2.2%	2.3%	3.2%	2.9%	2.2%	4.3%	5.0%	3.5%	4.3%	3.4%	3.0%	2.4%	2.3%	2.4%	2.7%	100.0%	

[a] Totals include only days with 24 hours counts (i.e., excludes 7, 29, 30 August and 13, 14, and 28 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

Appendix D.2. Temporal distribution of daily sonar counts attributed to fall chum salmon in the Sheenjek River, 1995.

Hour	10-Aug	11-Aug	12-Aug	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	25-Aug	26-Aug
0100	[b]	39	25	39	31	41	[b]	50	61	59	58	77	59	87	137	253	226
0200		44	77	36	33	55		33	58	89	84	72	107	97	148	185	161
0300		41	39	40	50	55		34	53	81	85	110	84	90	124	179	199
0400		41	39	28	4	64	(297)	25	64	45	83	67	97	66	168	243	198
0500	(446)	59	39	28	21	40	(34.4%)	33	36	29	76	95	106	100	232	137	139
0600	(46.3%)	68	38	7	10	67		15	73	52	73	134	93	67	226	155	191
0700		43	25	11	10	84		25	72	42	76	111	123	73	239	247	207
0800		60	20	15	6	48		23	44	71	78	129	137	134	383	295	208
0900		40	20	11	11	39	25	12	48	62	118	116	115	189	332	355	199
1000		50	12	6	14	27	48	(77) [b]	40	44	125	129	111	172	329	419	250
1100		35	14	18	2	25	36	(8.7%)	55	71	103	120	123	225	392	389	152
1200		19	12	0	0	11	43		43	60	138	55	174	157	294	227	151
1300	51	39	6	4	0	27	24	52	35	75	93	90	121	169	217	129	165
1400	47	20	7	0	0	24	29	117	29	96	83	132	140	162	312	109	109
1500	112	33	4	4	0	53	23	62	46	72	100	100	106	168	257	71	120
1600	71	53	7	1	0	50	34	52	37	62	137	131	94	163	217	34	117
1700	76	35	7	11	8	49	31	56	29	97	137	111	102	227	247	108	89
1800	20	1	5	0	6	45	32	27	49	115	89	132	149	191	301	146	170
1900	28	7	5	1	33	43	51	29	50	107	65	146	125	229	255	154	173
2000	30	12	2	10	7	28	32	30	40	80	89	117	117	182	316	176	220
2100	24	13	5	13	18	30	31	27	43	85	57	141	125	125	317	200	227
2200	33	41	11	18	23	12	42	38	48	88	67	118	99	179	294	157	226
2300	13	36	15	22	31	(128) [b]	49	29	63	51	39	116	96	174	266	167	279
2400	13	53	34	21	41	(12.2%)	36	45	56	23	52	83	74	99	298	210	269
Daily Passage Estimate	964	882	468	344	359	1,045	863	891	1,172	1,656	2,105	2,632	2,677	3,525	6,301	4,745	4,445
Percent	0.4%	0.4%	0.2%	0.1%	0.1%	0.4%	0.4%	0.4%	0.5%	0.7%	0.9%	1.1%	1.1%	1.5%	2.6%	2.0%	1.8%

[a] Totals include only days with 24 hours counts (i.e., excludes 10, 15–17, 28 August, and 14, 15, and 28 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Hour	27–Aug	28–Aug	29–Aug	30–Aug	31–Aug	01–Sep	02–Sep	03–Sep	04–Sep	05–Sep	06–Sep	07–Sep	08–Sep	09–Sep	10–Sep	11–Sep	12–Sep
0100	271	425	370	592	420	366	314	441	300	218	315	435	389	215	198	187	267
0200	299	238	356	520	346	521	314	644	295	257	328	344	241	138	110	157	194
0300	328	248	170	605	296	554	426	771	319	215	304	288	256	141	137	165	245
0400	306	229	419	496	287	739	407	820	408	237	326	205	234	160	206	183	281
0500	218	298	397	478	286	699	337	532	261	174	210	271	161	232	130	196	234
0600	298	333	210	325	256	419	272	295	212	156	148	245	121	153	233	206	285
0700	361	302	189	305	177	200	204	164	178	128	146	237	134	167	247	335	306
0800	279	199	118	248	273	164	162	149	169	117	129	208	125	163	159	299	280
0900	282	248	90	185	204	163	105	147	161	121	64	178	125	146	119	176	228
1000	314	224	105	249	172	140	106	102	89	86	49	211	163	238	139	218	227
1100	212	220	97	150	152	163	76	62	69	70	73	287	126	425	146	176	387
1200	169	113	103	145	126	421	76	85	74	66	138	299	209	392	132	223	315
1300	163	153	244	151	168	554	116	222	101	58	144	212	278	284	101	178	211
1400	151	129 [b]	157	234	266	571	200	274	120	86	124	237	271	206	86	233	160
1500	159	105	195	297	280	548	237	362	187	146	103	168	240	158	75	189	137
1600	171	82	216	255	266	462	201	227	170	125	229	195	237	240	112	281	199
1700	247	77	192	272	189	376	172	174	76	150	237	295	278	174	256	379	128
1800	242	93	203	201	116	370	169	129	65	129	231	296	296	253	183	351	221
1900	281	140	330	160	149	239	120	199	48	180	333	238	366	168	266	393	334
2000	323	136	438	197	162	142	180	118	98	226	361	342	424	204	342	383	461
2100	280	164	666	264	182	154	298	203	135	289	485	386	414	294	454	515	402
2200	426	232	541	343	333	213	422	298	166	416	519	480	506	337	492	505	478
2300	272	187	385	311	793	311	494	324	220	378	496	454	411	254	387	399	317
2400	306	264	651	453	618	293	448	307	264	497	592	341	313	261	247	431	300
Daily Passage Estimate	6,358	4,839	6,842	7,436	6,517	8,782	5,856	7,049	4,185	4,525	6,084	6,852	6,318	5,403	4,957	6,758	6,597
Percent	2.6%	2.0%	2.8%	3.1%	2.7%	3.6%	2.4%	2.9%	1.7%	1.9%	2.5%	2.8%	2.6%	2.2%	2.0%	2.8%	2.7%

[a] Totals include only days with 24 hours counts (i.e., excludes 10, 15–17, 28 August, and 14, 15, and 28 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Hour	13–Sep	14–Sep	15–Sep	16–Sep	17–Sep	18–Sep	19–Sep	20–Sep	21–Sep	22–Sep	23–Sep	24–Sep	25–Sep	Total [a]	Percent
0100	235	261	[b]	468	468	524	460	437	761	396	291	309	359	10,545	0.051
0200	221	174		410	343	364	352	417	740	290	326	272	309	9,805	0.048
0300	254	195	3,125)	335	255	320	378	391	599	248	211	217	242	9,424	0.046
0400	263	189	(31.08%)	282	234	264	274	323	464	309	229	238	254	9,494	0.046
0500	262	182		311	290	256	143	297	496	242	285	272	223	8,630	0.042
0600	219	259		333	238	274	158	311	396	251	237	274	264	7,557	0.037
0700	450	396		465	305	328	205	295	288	331	259	258	250	7,694	0.037
0800	314	361	616	476	454	300	221	289	286	328	264	293	260	7,552	0.037
0900	256	295	451	385	370	269	296	209	244	234	250	258	274	6,526	0.032
1000	130	215	281	237	332	152	152	125	343	253	208	322	348	6,144	0.030
1100	237	193	162	201	192	94	115	94	296	205	167	252	[b]	5,834	0.028
1200	149	135	265	148	125	113	132	117	393	146	186	205		5,790	0.028
1300	199	104	149	139	174	129	499	238	326	118	195	211		6,427	0.031
1400	164	150	205	151	248	206	410	242	382	136	145	206		6,756	0.033
1500	185	268	284	225	332	232	427	260	352	95	104	204	(4,070)	6,907	0.034
1600	247	296	375	232	324	217	237	168	309	143	103	265	(59.4%)	6,850	0.033
1700	244	[b]	401	380	284	280	295	179	256	264	138	171		7,186	0.035
1800	307		415	322	497	427	179	284	186	241	270	202		7,578	0.037
1900	305	(2,511)	472	471	558	404	257	394	254	231	377	385		8,636	0.042
2000	413	(40..6%)	646	562	731	645	662	399	399	261	423	346		10,434	0.051
2100	376		669	652	755	771	904	428	418	195	571	342		12,002	0.058
2200	340		530	560	619	647	628	514	415	314	440	259		12,423	0.061
2300	397		510	659	578	686	517	801	494	352	370	329		12,577	0.061
2400	394		605	622	391	623	567	853	493	360	469	342		12,539	0.061
														205,310 [a]	
Daily Passage Estimate	6,561	6,184	10,161	9,026	9,097	8,525	8,468	8,065	9,590	5,943	6,518	6,432	6,853	241,855 [c]	
Percent	2.7%	2.6%	4.2%	3.7%	3.8%	3.5%	3.5%	3.3%	4.0%	2.5%	2.7%	2.7%	2.8%	100.0%	

[a] Totals include only days with 24 hours counts (i.e., excludes 10, 15–17, 28 August, and 14, 15, and 28 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

Appendix D.3. Temporal distribution of daily sonar counts attributed to fall chum salmon in the Sheenjek River, 1996.

Hour	30–Jul	31–Jul	01–Aug	02–Aug	03–Aug	04–Aug	05–Aug	06–Aug	07–Aug	08–Aug	09–Aug	10–Aug	11–Aug	12–Aug	13–Aug	14–Aug	15–Aug
0100	[b]	68	47	38	[b]	[b]	[b]	43	21	112	41	36	25	20	16	37	79
0200		74	43	45				55	15	81	44	35	27	14	13	44	75
0300		102	27	34				28	29	60	30	34	22	18	14	38	56
0400		69	24	39				33	28	51	32	44	36	37	21	52	69
0500		32	23	26				27	23	54	35	42	29	24	30	99	58
0600		50	22	88				37	29	66	30	56	27	27	36	100	80
0700		43	29	65				27	25	47	60	56	53	18	49	94	31
0800		16	6	30				39	25	60	63	43	32	5	39	48	34
0900	(427)	17	4	97			(382)	48	41	55	53	37	27	9	21	21	13
1000	(63.7%)	16	0	4			(81.5%)	37	36	12	41	56	16	25	4	8	6
1100		8	0	15				35	59	81	75	44	14	8	5	1	4
1200		1	0	22				52	56	53	44	22	6	27	0	5	0
1300		1	8	2		(581)		27	54	83	36	41	13	28	1	2	1
1400		4	7	8				27	31	68	38	44	17	5	1	8	0
1500		23	23	8				20	42	88	30	24	18	8	2	6	16
1600		13	9	8				21	50	84	29	34	11	0	0	36	11
1700		22	24	7	(684)			27	52	77	92	23	4	0	2	0	7
1800	2	9	28	10				25	42	74	22	54	7	0	0	11	20
1900	24	6	39	25				16	36	115	14	30	2	0	2	18	4
2000	72	9	7	[b]				18	37	97	21	46	7	1	4	35	15
2100	22	14	38	(222)				14	53	32	17	56	7	2	6	35	17
2200	47	26	47	(28.0%)			23	18	34	33	35	43	20	1	8	49	24
2300	23	8	29				33	25	44	41	29	35	31	15	26	71	44
2400	53	75	57				31	25	56	30	19	28	26	23	15	85	98
Daily Passage Estimate	670	706	541	793	685	577	469	724	918	1,554	930	963	479	315	315	903	762
Percent	0.3%	0.3%	0.2%	0.3%	0.3%	0.2%	0.2%	0.3%	0.4%	0.6%	0.4%	0.4%	0.2%	0.1%	0.1%	0.4%	0.3%

[a] Totals include only days with 24 hour counts (i.e., excludes 30 Jul; 2–5, 22 and 26 Aug; and 10, 11, and 24 Sep).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Hour	16–Aug	17–Aug	18–Aug	19–Aug	20–Aug	21–Aug	22–Aug	23–Aug	24–Aug	25–Aug	26–Aug	27–Aug	28–Aug	29–Aug	30–Aug	31–Aug	01–Sep
0100	94	44	117	102	144	275	213	466	349	1,145	366	386	353	815	1,098	567	475
0200	70	63	42	77	220	179	81	323	362	353	451	381	228	830	702	495	284
0300	78	52	58	61	166	101		147	412	411	269	336	215	583	1,163	697	182
0400	112	72	89	84	172	93	(177)	101	449	395	354	281	229	659	1,244	943	75
0500	74	60	52	51	163	65	(15.0%)	62	331	146	248	281	106	296	842	407	99
0600	34	42	50	48	114	98		130	216	303	420	150	277	397	334	421	486
0700	18	19	38	15	122	26	18	115	263	244	216	144	314	511	442	416	267
0800	14	16	16	23	17	10	15	20	66	412	245	114	111	332	189	275	65
0900	18	2	2	4	25	9	3	7	75	278	302	19	59	279	154	177	149
1000	40	1	2	3	0	7	6	3	70	227	355	4	27	125	41	148	181
1100	14	8	3	0	0	7	1	4	41	329		18	3	112	18	291	50
1200	10	13	8	0	2	4	8	0	176	527	(1,213)	4	182	175	266	1,078	86
1300	8	6	5	4	5	17	3	5	630	859	(17.2%)	21	53	271	518	969	263
1400	5	4	32	2	1	6	6	1	923	975		65	189	277	579	902	574
1500	18	3	8	1	7	71	24	4	958	487		105	2	292	386	392	210
1600	7	11	9	2	28	6	0	34	303	263	320	141	31	257	245	193	132
1700	15	1	3	3	15	6	5	21	540	177	213	117	43	209	211	100	275
1800	1	0	1	0	8	10	1	4	282	221	150	181	94	573	173	146	195
1900	5	6	1	0	13	7	1	88	203	201	294	116	67	588	85	224	287
2000	17	2	0	1	10	32	9	68	269	291	367	199	219	382	154	385	547
2100	10	4	10	36	71	127	78	107	149	336	163	272	311	433	366	703	742
2200	15	25	31	25	70	144	123	144	1,013	510	354	427	916	617	981	1,091	873
2300	29	58	62	40	207	90	195	336	1,860	484	409	426	1,036	1,138	1,236	952	654
2400	47	90	85	171	82	204	211	282	1,519	392	325	357	713	1,306	822	550	446
Daily Passage Estimate	753	602	724	753	1,662	1,594	1,178	2,472	11,459	9,966	7,034	4,545	5,778	11,457	12,249	12,522	7,597
Percent	0.3%	0.2%	0.3%	0.3%	0.7%	0.6%	0.5%	1.0%	4.6%	4.0%	2.8%	1.8%	2.3%	4.6%	5.0%	5.1%	3.1%

[a] Totals include only days with 24 hour counts (i.e., excludes 30 Jul; 2–5, 22 and 26 Aug; and 10, 11, and 24 Sep).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Hour	02–Sep	03–Sep	04–Sep	05–Sep	06–Sep	07–Sep	08–Sep	09–Sep	10–Sep	11–Sep	12–Sep	13–Sep	14–Sep	15–Sep	16–Sep	17–Sep	18–Sep
0100	191	713	214	420	257	916	483	99	86	(1,134) [b]	158	53	110	180	279	762	198
0200	107	452	255	270	200	703	480	125	55	(15.3%)	106	73	173	188	125	690	331
0300	73	287	133	166	192	336	383	61	36		459	71	230	111	101	825	525
0400	84	157	168	246	88	447	296	66	67	139	155	71	208	103	87	574	465
0500	76	98	70	482	46	697	168	29	30	110	135	127	133	57	110	427	220
0600	161	179	142	372	122	430	124	45	32	200	146	85	40	129	90	194	125
0700	381	298	316	414	303	402	242	212	153	481	335	377	257	174	258	172	628
0800	202	115	164	190	166	181	173	99	200	340	255	340	180	338	154	182	237
0900	93	85	138	109	182	82	206	80	138	335	140	122	103	140	111	131	102
1000	57	94	131	66	44	144	139	56	160	317	71	110	92	53	140	138	157
1100	53	119	80	49	33	32	72	80	89	312	39	183	67	67	202	179	89
1200	53	183	24	76	28	139	168	67	43	102	63	72	60	102	187	195	159
1300	125	308	53	84	42	274	485	48	246	181	43	128	70	392	153	283	150
1400	154	366	89	153	223	274	572	136	270	267	60	423	215	216	99	510	280
1500	214	514	201	169	308	294	409	171	289		227	762	684	219	364	743	553
1600	134	324	160	138	376	179	314	268	264	(1,463)	289	734	893	121	582	1,157	696
1700	397	201	144	179	326	98	218	370	290	(19.8%)	328	628	658	179	543	1,276	660
1800	905	195	317	104	217	118	104	446	220		274	679	343	412	477	973	500
1900	242	134	174	93	211	72	188	263	133	467	272	401	321	419	427	579	396
2000	324	148	417	271	664	492	233	256	330	421	249	339	306	733	589	369	287
2100	405	423	438	388	396	458	232	324	423	525	258	410	256	542	448	230	201
2200	527	451	377	322	474	381	374	179	260	241	269	252	256	209	594	153	122
2300	619	283	408	270	381	359	116	118	(550) [b]	185	117	305	137	182	854	139	199
2400	749	330	500	183	484	363	154	120	(12.6%)	189	287	229	152	140	897	300	570
Daily Passage Estimate	6,326	6,457	5,113	5,214	5,763	7,871	6,333	3,718	4,364	7,409	4,735	6,974	5,944	5,406	7,871	11,181	7,850
Percent	2.6%	2.6%	2.1%	2.1%	2.3%	3.2%	2.6%	1.5%	1.8%	3.0%	1.9%	2.8%	2.4%	2.2%	3.2%	4.5%	3.2%

[a] Totals include only days with 24 hour counts (i.e., excludes 30 Jul; 2–5, 22 and 26 Aug; and 10, 11, and 24 Sep).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Hour	19–Sep	20–Sep	21–Sep	22–Sep	23–Sep	24–Sep	Total [a]	Percent
0100	692	144	143	241	93	65	13,321	0.060
0200	680	121	115	215	170	72	10,708	0.048
0300	389	113	123	123	106	70	9,927	0.045
0400	304	141	128	192	56	68	9,530	0.043
0500	303	125	97	214	72	133	7,197	0.032
0600	184	126	104	129	103	87	6,690	0.030
0700	262	198	134	157	204	76	9,210	0.042
0800	281	253	395	219	339		6,553	0.030
0900	197	204	217	121	148		4,314	0.019
1000	366	237	139	165	197		3,732	0.017
1100	243	319	109	194	157		3,598	0.016
1200	281	237	180	97	151		5,319	0.024
1300	464	106	241	112	111		7,601	0.034
1400	811	170	338	85	179		10,138	0.046
1500	1,263	486	467	111	184	(1,331)	11,587	0.052
1600	1,117	712	525	141	296	(70.0%)	11,116	0.050
1700	707	729	525	156	373		10,761	0.049
1800	502	669	422	204	299		10,341	0.047
1900	381	415	352	200	331		8,044	0.036
2000	277	334	534	334	393		10,422	0.047
2100	235	248	351	182	161		10,554	0.048
2200	219	273	169	167	212		13,200	0.060
2300	181	201	170	98	71		14,214	0.064
2400	135	194	192	67	80		13,731	0.062
							221,808 [a]	
Daily Passage Estimate	10,474	6,755	6,170	3,924	4,486	1,902	246,889 [c]	
Percent	4.2%	2.7%	2.5%	1.6%	1.8%	0.8%	100.0%	

[a] Totals include only days with 24 hour countes (i.e., excludes 30 Jul; 2–5, 22 and 26 Aug; and 10, 11, and 24 Sep).
[b] Boxed areas indicate times when passage was estimated by interoplation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

Appendix D.4. Temporal distribution of daily sonar counts attributed to fall chum salmon in the Sheenjek River, 1997.

Hour	09–Aug	10–Aug	11–Aug	12–Aug	13–Aug	14–Aug	15–Aug	16–Aug	17–Aug	18–Aug	19–Aug	20–Aug	21–Aug	22–Aug	23–Aug	24–Aug	25–Aug
0100		18	26	17	37	73	34	28	12	5	34	37	29	33	50	92	127
0200		17	27	11	22	28	16	22	43	19	28	9	16	27	56	171	94
0300		27	25	16	39	34	59	50	10	13	34	32	29	49	58	75	96
0400		27	31	18	52	31	66	29	10	14	13	14	16	26	72	83	68
0500		27	23	17	54	35	16	37	28	32	29	39	20	51	79	114	57
0600		18	25	13	23	43	27	24	31	22	15	59	17	27	44	22	23
0700		19	17	6	13	31	17	39	16	21	18	13	8	15	27	6	11
0800		12	18	6	18	36	17	32	8	8	3	11	9	19	55	6	23
0900		9	6	9	5	0	4	4	9	10	0	11	6	6	13	8	19
1000		6	1	5	4	0	4	9	11	2	1	2	20	22	18	14	53
1100		6	9	7	2	1	5	9	7	19	5	20	4	0	5	3	16
1200	(79)	4	7	7	6	2	2	21	4	27	1	1	1	0	11	1	27
1300	(69%)	1	10	7	1	2	8	12	4	8	2	0	2	14	1	6	12
1400		1	2	9	6	5	5	4	6	4	0	2	6	0	2	5	32
1500		1	3	5	5	4	2	8	16	13	0	6	7	0	3	2	12
1600		2	1	6	7	16	1	5	10	1	0	5	3	0	2	6	14
1700		4	0	7	2	17	3	21	4	4	3	0	2	0	4	5	12
1800	1	3	13	3	3	2	3	11	10	10	2	6	3	3	1	1	20
1900	3	3	3	24	11	12	3	19	15	1	5	3	2	13	3	3	11
2000	4	9	3	11	13	9	4	27	23	4	0	3	2	4	4	2	29
2100	2	6	11	27	4	18	10	17	20	1	7	4	8	16	25	16	15
2200	5	2	29	18	20	18	31	14	10	25	11	26	12	14	22	61	15
2300	11	9	21	23	19	23	62	25	17	32	182	33	17	100	58	88	230
2400	9	17	21	34	55	33	21	67	17	12	37	18	52	67	75	206	43
Daily Passage Estimate	114	248	332	306	421	473	420	534	341	307	430	354	291	506	688	996	1,059
Percent	0.1%	0.3%	0.4%	0.4%	0.5%	0.6%	0.5%	0.7%	0.4%	0.4%	0.5%	0.4%	0.4%	0.6%	0.9%	1.2%	1.3%

[a] Totals include only days with 24 hour counts (i.e., excludes 9 Aug; 29 Aug–4 Sep; 14 Sep; and 23 Sep).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Hour	26–Aug	27–Aug	28–Aug	29–Aug	30–Aug	31–Aug	01–Sep	02–Sep	03–Sep	04–Sep	05–Sep	06–Sep	07–Sep	08–Sep	09–Sep	10–Sep	11–Sep
0100	56	266	205	67							197	194	173	193	238	180	73
0200	79	204	196	52						printer	211	189	205	219	224	197	98
0300	91	159	161	68						not working	230	172	172	213	331	202	132
0400	71	84	67	124						(1,034 from	165	199	252	234	242	294	158
0500	111	135	257	102					(1,812)	cum ctr)	198	153	244	161	245	261	213
0600	75	220	255	209					(65%)	174	213	201	207	227	281	168	227
0700	5	43	133	207						176	169	141	190	249	122	76	134
0800	15	63	46	131						168	176	148	122	196	126	109	83
0900	14	35	20							74	171	111	58	256	111	37	62
1000	16	73	4							80	96	47	34	358	52	25	70
1100	9	71	41							166	153	57	60	259	36	7	32
1200	26	39	7		(2,067)	(2,250)	(2,433)	(2,616)		71	110	51	29	167	35	2	6
1300	3	9	17							78	35	35	46	96	25	1	2
1400	4	39	26							88	69	47	46	107	26	2	13
1500	1	29	36						21	74	74	35	30	83	7	2	6
1600	2	12	119	(924)					60	102	64	35	41	35	14	9	11
1700	10	20	67	(49%)					69	56	58	55	63	65	28	15	12
1800	9	31	36						58	104	65	36	144	78	27	16	11
1900	27	60	50						41	62	48	100	115	98	19	10	119
2000	18	62	84						61	140	81	72	80	130	66	43	133
2100	55	83	113						137	184	196	97	144	287	141	54	66
2200	88	117	158						145	182	194	196	154	577	156	93	98
2300	148	210	109						203	204	192	216	159	285	151	115	121
2400	246	265	113						192	187	187	174	136	269	146	77	91
Daily Passage Estimate	1,179	2,329	2,320	1,884	2,067	2,250	2,433	2,616	2,799	3,404	3,352	2,761	2,904	4,842	2,849	1,995	1,971
Percent	1.5%	2.9%	2.9%	2.3%	2.6%	2.8%	3.0%	3.3%	3.5%	4.2%	4.2%	3.4%	3.6%	6.0%	3.5%	2.5%	2.5%

[a] Totals include only days with 24 hour counts (i.e., excludes 9 Aug; 29 Aug–4 Sep; 14 Sep; and 23 Sep).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Appendix D.4. (page 3 of 3).

Hour	12–Sep	13–Sep	14–Sep	15–Sep	16–Sep	17–Sep	18–Sep	19–Sep	20–Sep	21–Sep	22–Sep	23–Sep	Total[a]	Percent
0100	141	199	143	128	53	143	112	177	75	62	164	80	3,681	0.064
0200	112	236	213	186	47	114	140	137	87	69	119	66	3,675	0.064
0300	206	233	226	254	96	173	139	127	106	76	114	83	4,033	0.070
0400	269	360	189	259	179	223	158	97	69	80	110	93	4,140	0.072
0500	255	310	219	198	238	217	122	142	87	85	86	107	4,376	0.076
0600	211	306	273	233	231	194	146	93	70	126	97	83	4,214	0.073
0700	82	219	256	170	222	136	95	91	70	100	133	122	2,857	0.049
0800	60	165	(406)	130	161	101	120	102	98	90	107	135	2,499	0.043
0900	54	177	(14%)	155	118	77	64	118	87	84	92	91	2,020	0.035
1000	2	113	printer	135	132	88	55	104	112	97	90	126	1,875	0.032
1100	7	86	problem	89	132	49	67	68	51	42	51	112	1,485	0.026
1200	3	57	54	64	107	51	40	44	50	31	40	117	1,081	0.019
1300	1	50	28	62	34	8	45	30	18	54	61	65	722	0.012
1400	0	33	40	46	34	13	42	42	30	23	64	28	795	0.014
1500	24	56	40	90	22	12	47	80	44	19	80		864	0.015
1600	40	41	58	85	26	20	47	38	51	14	87		870	0.015
1700	33	51	49	64	26	32	31	56	49	34	63		920	0.016
1800	44	110	110	98	57	37	100	47	48	45	56		1,189	0.021
1900	116	75	53	138	39	35	103	42	27	51	91	(712)	1,494	0.026
2000	73	104	98	104	86	50	51	41	91	70	72	(35%)	1,658	0.029
2100	138	139	69	164	48	150	64	77	89	66	137		2,513	0.043
2200	164	196	133	206	90	151	118	83	65	77	87		3,396	0.059
2300	152	125	162	118	88	163	124	108	94	129	125		3,871	0.067
2400	136	161	164	118	110	142	71	152	45	88	123		3,625	0.063
													57,853[a]	
Daily Passage Estimate	2,323	3,602	2,983	3,294	2,376	2,379	2,101	2,096	1,613	1,612	2,249	2,020	80,423[c]	
Percent	2.9%	4.5%	3.7%	4.1%	3.0%	3.0%	2.6%	2.6%	2.0%	2.0%	2.8%	2.5%	100.0%	

[a] Totals include only days with 24 hour counts (i.e., excludes 9 Aug; 29 Aug–4 Sep; 14 Sep; and 23 Sep).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

Appendix D.5. Temporal distribution of daily sonar counts attributed to fall chum salmon in the Sheenjek River, 1998.

Hour	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug	01-Sep	02-Sep
0100		0	3	0	2	0	1	0	0	5	4	4	2	1	12	8	3
0200		2	0	0	2	0	0	8	9	1	0	0	5	7	6	13	15
0300		6	0	1	0	0	1	0	1	0	1	2	0	11	1	5	16
0400	(27)	1	6	11	1	0	1	3	19	5	3	3	2	12	11	28	31
0500	(50.1%)	3	1	1	0	2	3	5	9	1	7	7	4	8	7	46	15
0600		2	1	0	0	4	2	1	5	16	7	7	2	11	8	63	8
0700		0	0	0	3	3	0	9	11	10	3	4	5	8	8	11	17
0800		16	5	0	6	2	5	6	0	1	1	1	0	4	13	5	1
0900		0	0	3	0	0	4	0	0	2	0	0	5	7	7	2	10
1000		5	1	3	0	0	3	0	0	0	0	3	11	2	18	2	1
1100		0	0	0	1	2	0	0	0	0	1	2	0	1	14	2	0
1200	3	4	6	2	4	0	1	0	0	3	2	0	0	1	1	5	3
1300	0	0	8	1	0	1	0	0	0	3	2	1	2	2	7	7	12
1400	0	0	0	2	0	4	2	3	0	5	4	0	0	5	11	2	15
1500	1	0	0	1	0	0	0	0	6	8	4	2	3	11	11	0	10
1600	6	5	2	0	0	0	8	0	0	13	5	8	1	4	9	2	17
1700	0	5	6	0	1	4	0	0	0	10	1	1	0	6	11	5	8
1800	5	0	6	8	3	0	0	2	3	0	2	1	0	9	11	7	5
1900	0	7	4	0	0	0	7	0	0	0	2	21	1	7	21	16	0
2000	0	9	10	0	0	4	9	2	3	0	0	37	3	10	19	7	5
2100	1	9	0	2	0	0	5	0	5	2	2	0	0	0	43	4	2
2200	4	0	3	0	0	0	4	2	15	0	0	0	0	9	8	6	3
2300	5	24	0	0	0	0	1	1	7	3	3	10	1	5	10	2	27
2400	3	0	1	0	0	1	1	1	2	5	5	0	0	2	7	0	10
Daily Passage Estimate	56	98	63	35	23	27	58	43	95	93	59	114	47	143	274	248	234
Percent	0.2%	0.3%	0.2%	0.1%	0.1%	0.1%	0.2%	0.1%	0.3%	0.3%	0.2%	0.3%	0.1%	0.4%	0.8%	0.8%	0.7%

[a] Totals include only days with 24 hours counts (i.e., excludes 17 August and 30 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Appendix D.5. (pape 2 of 3).

Hour	03-Sep	04-Sep	05-Sep	06-Sep	07-Sep	08-Sep	09-Sep	10-Sep	11-Sep	12-Sep	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep
0100	1	1	24	3	9	81	66	34	84	59	62	93	133	157	132	145	146
0200	5	1	12	9	4	76	20	50	37	81	94	101	87	181	120	146	152
0300	2	4	6	11	6	25	32	52	28	95	99	129	133	102	104	146	152
0400	5	8	7	5	5	28	28	60	38	67	65	102	47	74	129	127	145
0500	5	5	4	12	4	26	32	26	22	21	31	115	65	62	139	143	115
0600	10	11	5	24	9	17	28	25	36	42	24	72	44	75	138	82	120
0700	5	25	8	5	33	29	36	17	26	38	56	55	43	58	112	134	100
0800	2	14	4	0	10	18	20	11	30	15	40	14	33	24	90	81	92
0900	11	14	1	8	3	23	10	4	32	8	35	33	20	75	130	143	179
1000	15	10	1	5	2	7	22	0	11	31	21	7	8	74	50	118	65
1100	10	5	1	1	7	27	6	1	1	8	6	9	7	27	59	41	60
1200	4	5	3	1	2	9	0	0	2	9	5	3	3	15	35	46	39
1300	5	0	3	2	0	6	1	0	9	1	0	3	3	16	38	110	47
1400	2	5	1	1	0	30	2	2	1	1	0	8	12	18	24	38	42
1500	0	3	0	1	1	2	3	3	10	17	7	47	3	83	12	48	47
1600	3	14	0	2	8	7	3	4	6	10	25	11	6	187	88	82	55
1700	0	0	0	64	13	20	0	4	0	11	24	8	11	122	70	83	63
1800	1	1	0	65	17	11	1	0	1	25	21	22	23	79	104	84	75
1900	1	44	2	9	0	13	3	0	12	32	64	13	44	91	73	40	123
2000	4	14	5	9	2	7	4	7	9	21	38	44	53	129	65	101	73
2100	1	31	10	5	10	4	42	15	16	15	185	51	110	277	130	200	149
2200	6	43	3	9	34	40	12	12	28	37	141	44	108	261	211	215	163
2300	19	29	9	17	34	38	12	22	62	43	116	44	73	451	299	144	182
2400	0	14	9	9	41	46	29	67	93	35	189	92	132	212	140	110	142
Daily Passage Estimate	117	301	118	277	254	590	412	416	594	722	1,348	1,120	1,201	2,850	2,492	2,607	2,526
Percent	0.4%	0.9%	0.4%	0.8%	0.8%	1.8%	1.2%	1.3%	1.8%	2.2%	4.1%	3.4%	3.6%	8.6%	7.5%	7.9%	7.6%

[a] Totals include only days with 24 hours counts (i.e., excludes 17 August and 30 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

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Appendix D.5. (page 3 of 3).

Hour	20-Sep	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	Total *	Percent
0100	194	128	159	69	74	9	42	29	28	33	55	2,040	0.063
0200	163	115	129	89	58	5	16	2	29	38	50	1,888	0.058
0300	145	113	136	88	66	23	60	1	42	57	45	1,902	0.059
0400	126	101	145	91	56	5	46	12	63	48	23	1,770	0.055
0500	128	111	128	83	87	12	5	0	25	56	23	1,581	0.049
0600	64	85	120	94	107	7	6	35	37	25	23	1,479	0.046
0700	73	133	112	62	95	3	6	11	25	37	28	1,429	0.044
0800	119	118	136	88	69	9	13	17	41	20	22	1,194	0.037
0900	183	141	80	92	2	8	6	16	28	24	12	1,349	0.042
1000	104	88	64	83	12	11	8	13	42	15	14	936	0.029
1100	95	75	54	67	10	8	5	19	22	6	21	660	0.020
1200	93	97	37	54	15	32	15	16	17	7	28	596	0.018
1300	71	37	40	22	9	7	18	9	16	9	[b]	528	0.016
1400	40	58	65	17	32	5	21	24	8	1		511	0.016
1500	40	113	44	23	19	22	10	32	34	15		695	0.021
1600	63	95	82	38	0	15	3	23	14	8		926	0.029
1700	47	109	73	84	5	17	15	4	16	11		932	0.029
1800	86	110	56	38	8	14	12	27	11	24	(317)	973	0.030
1900	94	129	30	48	8	36	23	28	12	23	(47.9%)	1,081	0.033
2000	95	121	56	40	28	14	42	18	43	18		1,178	0.036
2100	138	123	47	68	23	12	12	33	39	13		1,833	0.057
2200	191	294	102	98	6	10	0	29	56	14		2,217	0.069
2300	146	122	136	76	11	165	6	53	33	54		2,490	0.077
2400	194	140	89	82	11	80	40	36	55	31		2,153	0.067
												32,341 *	
Daily Passage Estimate	2,692	2,756	2,120	1,594	811	529	430	487	736	587	661	33,058 [c]	
Percent	8.1%	8.3%	6.4%	4.8%	2.5%	1.6%	1.3%	1.5%	2.2%	1.8%	2.0%	100.0%	

* Totals include only days with 24 hours counts (i.e., excludes 17 August and 30 September).
[b] Boxed areas indicate times when passage was estimated by interpolation or extrapolation.
[c] Total estimated passage, including days with expanded counts.

APPENDIX E

SHEENJEK RIVER HISTORIC ESCAPEMENT DATA

APPENDIX E: SHEENJEK RIVER HISTORIC ESCAPEMENT DATA

Appendix E.1. Sonar–estimated escapement of fall chum salmon in the Sheenjek River, 1986–1998.

Date	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Date
30–Jul											670			30–Jul
31–Jul											706			31–Jul
01–Aug											541			01–Aug
02–Aug											793			02–Aug
03–Aug											685			03–Aug
04–Aug											577			04–Aug
05–Aug											469			05–Aug
06–Aug											724			06–Aug
07–Aug									146		918			07–Aug
08–Aug								45	75		1,554			08–Aug
09–Aug						255	136	95	112		930	114		09–Aug
10–Aug	||	||	||	||	301	172	256	38	964	963	248		10–Aug
11–Aug	||	||	||	||	179	102	143	214	882	479	332		11–Aug
12–Aug	||	||	||	||	173	272	217	243	468	315	306		12–Aug
13–Aug	||	||	||	||	178	216	227	328	344	315	421		13–Aug
14–Aug	||	||	||	||	282	337	175	215	359	903	473		14–Aug
15–Aug	||	||	||	||	551	670	291	261	1,045	762	420		15–Aug
16–Aug	1,010 [a]	||	||	||	521	571	346	333	863	753	534		16–Aug
17–Aug	68	||	||	||	418	1,100	367	378	891	602	341	56	17–Aug
18–Aug	345	||	||	||	591	1,570	245	524	1,172	724	307	98	18–Aug
19–Aug	769	||	||	||	668	1,003	316	497	1,656	753	430	63	19–Aug
20–Aug	1,578	||	4,340 [a]	||	||	446	2,347	466	257	2,105	1,662	354	35	20–Aug
21–Aug	1,178	||	961	||	15,550 [a]	1,012	1,767	117	594	2,632	1,594	291	23	21–Aug
22–Aug	3,023	||	1,027	||	1,718	1,990	1,353	124	642	2,677	1,178	506	27	22–Aug
23–Aug	1,177	||	884	20,000 [b]	1,825	1,754	1,189	157	1,673	3,525	2,472	688	58	23–Aug
24–Aug	1,733	13,181 [a]	744	2,685	1,940	889	1,390	177	1,035	6,301	11,459	996	43	24–Aug
25–Aug	5,374	168	810	2,321	1,620	1,591	1,147	156	848	4,745	9,966	1,059	95	25–Aug
26–Aug	4,875	314	1,528	1,392	1,047	1,684	893	248	791	4,445	7,034	1,179	93	26–Aug
27–Aug	3,712	795	1,203	1,129	1,055	1,846	1,032	208	2,934	6,358	4,545	2,329	59	27–Aug
28–Aug	4,633	951	1,087	1,009	1,337	1,508	778	296	3,677	4,839	5,778	2,320	114	28–Aug
29–Aug	5,150	993	756	733	1,605	1,196	463	369	4,082	6,842	11,457	1,884	47	29–Aug
30–Aug	4,336	1,400	914	1,265	881	905	943	647	4,487	7,436	12,249	2,067	143	30–Aug
31–Aug	3,889	1,639	1,512	933	1,609	1,876	840	999	5,472	6,517	12,522	2,250	274	31–Aug
01–Sep	2,101	3,937	1,548	1,598	1,570	2,164	835	1,045	6,912	8,782	7,597	2,433	248	01–Sep
02–Sep	2,230	3,295	1,492	1,759	1,695	1,749	830	632	7,196	5,856	6,326	2,616	234	02–Sep
03–Sep	1,819	7,585	2,203	1,739	1,002	1,808	1,217	2,092	5,918	7,049	6,457	2,799	117	03–Sep
04–Sep	2,406	11,386	1,991	2,819	1,159	2,026	2,023	2,557	3,666	4,185	5,113	3,404	301	04–Sep
05–Sep	1,645	10,962	1,309	2,571	955	2,476	2,093	2,097	2,832	4,525	5,214	3,352	118	05–Sep
06–Sep	2,265	5,439	1,286	2,936	1,339	1,241	3,154	1,673	2,952	6,084	5,763	2,761	277	06–Sep
07–Sep	2,849	10,182	1,542	4,210	1,259	3,490	4,200	2,414	3,928	6,852	7,871	2,904	254	07–Sep
08–Sep	2,760	11,122	1,297	3,581	1,071	2,680	3,092	2,720	3,587	6,318	6,333	4,842	590	08–Sep
09–Sep	2,469	8,487	1,443	4,858	1,411	4,201	4,274	1,300	2,598	5,403	3,718	2,849	412	09–Sep
10–Sep	1,131	5,561	1,073	4,051	854	3,541	3,209	580	2,341	4,957	4,364	1,995	416	10–Sep
11–Sep	1,461	4,882	696	3,551	1,746	2,236	3,815	401	3,382	6,758	7,409	1,971	594	11–Sep
12–Sep	2,500	6,294	340	3,414	1,726	3,136	3,816	465	2,796	6,597	4,735	2,323	722	12–Sep
13–Sep	1,751	5,831	673	3,227	1,803	3,139	4,047	373	3,066	6,561	6,974	3,602	1,348	13–Sep
14–Sep	2,866	4,485	703	2,797	2,196	3,145	6,347	351	3,294	6,184	5,944	2,983	1,120	14–Sep
15–Sep	2,290	3,963	1,037	2,027	2,065	4,823	4,289	197	3,522	10,161	5,406	3,294	1,201	15–Sep
16–Sep	1,099	4,118	1,275	2,498	2,175	4,240	3,232	407	4,764	9,026	7,871	2,376	2,850	16–Sep
17–Sep	1,488	4,763	1,943	3,035	2,867	2,729	2,473	1,176	4,413	9,097	11,181	2,379	2,492	17–Sep
18–Sep	1,481	4,326	1,637	2,090	1,909	2,734	2,158	1,053	3,249	8,525	7,850	2,101	2,607	18–Sep
19–Sep	1,548	2,635	1,209	1,839	2,020	3,119	2,406	1,359	6,500	8,468	10,474	2,096	2,526	19–Sep
20–Sep	679	3,160	1,151	2,321	2,372	3,319	1,007	1,192	7,583	8,065	6,755	1,613	2,692	20–Sep
21–Sep	704	3,223	716	1,273	2,444	2,461	early	3,382	5,287	9,590	6,170	1,612	2,756	21–Sep
22–Sep	577	1,988	743	1,384	2,667	1,924	freezeup	2,005	6,520	5,943	3,924	2,249	2,120	22–Sep
23–Sep	587	2,878	583	2,434	1,848	2,071		1,803	5,153	6,518	4,486	2,020	1,594	23–Sep
24–Sep	653	3,324	522	2,965	1,819	1,430		1,655	4,523	6,432	1,902		811	24–Sep
25–Sep			365	2,672	1,923			1,083	3,607	6,853			529	25–Sep
26–Sep			344		1,392			1,158	3,458				430	26–Sep
27–Sep			319		1,478			568	3,600				487	27–Sep
28–Sep					798			497	4,062				736	28–Sep
29–Sep													587	29–Sep
30–Sep													661	30–Sep
Totals	84,207	153,267	45,206	99,116	77,750	86,496	78,808	42,922	150,565	241,855	246,889	80,423	33,058	

[a] Early portion of Sheenjek River fall chum salmon run estimated from run timing and entry pattern observed in the Chandalar River (Barton 1995).
[b] Early portion of Sheenjek River fall chum salmon run estimated from aerial survey (Barton 1995).

Appendix E.2. Cumulative proportion of Sheenjek River sonar counts, 1986–1998.

Date	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Date	
30–Jul											0.00			30–Jul	
31–Jul											0.01			31–Jul	
01–Aug											0.01			01–Aug	
02–Aug											0.01			02–Aug	
03–Aug											0.01			03–Aug	
04–Aug											0.02			04–Aug	
05–Aug											0.02			05–Aug	
06–Aug											0.02			06–Aug	
07–Aug									0.00		0.02			07–Aug	
08–Aug								0.00	0.00	0.00	0.03	0.00	0.00	08–Aug	
09–Aug						0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	09–Aug	
10–Aug						0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00	10–Aug	
11–Aug						0.01	0.01	0.01	0.00	0.01	0.04	0.01	0.00	11–Aug	
12–Aug						0.01	0.01	0.02	0.01	0.01	0.04	0.01	0.00	12–Aug	
13–Aug						0.01	0.01	0.02	0.01	0.01	0.04	0.02	0.00	13–Aug	
14–Aug						0.01	0.02	0.03	0.01	0.01	0.05	0.02	0.00	14–Aug	
15–Aug						0.02	0.02	0.03	0.01	0.02	0.05	0.03	0.00	15–Aug	
16–Aug	0.01 [a]					0.03	0.03	0.04	0.01	0.02	0.05	0.04	0.00	16–Aug	
17–Aug	0.01					0.03	0.05	0.05	0.02	0.02	0.06	0.04	0.00	17–Aug	
18–Aug	0.02					0.04	0.07	0.06	0.02	0.03	0.06	0.04	0.00	18–Aug	
19–Aug	0.03					0.04	0.08	0.06	0.02	0.04	0.06	0.05	0.01	19–Aug	
20–Aug	0.04		0.10 [a]			0.05	0.11	0.07	0.02	0.04	0.07	0.05	0.01	20–Aug	
21–Aug	0.06		0.12		0.20 [a]	0.06	0.13	0.08	0.03	0.06	0.07	0.06	0.01	21–Aug	1986–97
22–Aug	0.09		0.14		0.22	0.08	0.15	0.08	0.03	0.07	0.08	0.06	0.01	22–Aug	average
23–Aug	0.11		0.16	0.20 [b]	0.25	0.10	0.16	0.08	0.04	0.08	0.09	0.07	0.01	23–Aug	
24–Aug	0.13	0.09 [a]	0.18	0.23	0.27	0.12	0.18	0.09	0.05	0.11	0.14	0.08	0.01	24–Aug	0.13
25–Aug	0.19	0.09	0.19	0.25	0.29	0.13	0.19	0.09	0.06	0.13	0.18	0.10	0.02	25–Aug	0.16
26–Aug	0.25 [c]	0.09	0.23	0.27	0.30	0.15	0.21	0.10	0.06	0.15	0.20	0.11	0.02	26–Aug	0.16
27–Aug	0.29	0.09	0.25	0.28	0.32	0.17	0.22	0.10	0.08	0.17	0.22	0.14	0.02	27–Aug	0.20
28–Aug	0.35	0.10	0.28	0.29	0.34	0.19	0.23	0.11	0.11	0.19	0.25	0.17	0.02	28–Aug	0.22
29–Aug	0.41	0.11	0.30	0.30	0.36	0.21	0.23	0.12	0.13	0.22	0.29	0.19	0.02	29–Aug	0.24
30–Aug	0.46	0.12	0.32	0.31	0.37	0.22	0.25	0.13	0.16	0.25	0.34	0.22	0.03	30–Aug	0.26
31–Aug	0.51 [d]	0.13	0.35	0.32	0.39	0.24	0.26	0.16	0.20	0.28	0.39	0.25	0.04	31–Aug	0.27
01–Sep	0.53	0.15	0.38	0.33	0.41	0.26	0.27	0.18	0.24	0.31	0.42	0.28	0.04	01–Sep	0.31
02–Sep	0.56	0.17	0.42	0.35	0.43	0.28	0.28	0.19	0.29	0.34	0.45	0.31	0.05	02–Sep	0.34
03–Sep	0.58	0.22	0.46	0.37	0.44	0.30	0.29	0.24	0.33	0.37	0.48	0.34	0.06	03–Sep	0.37
04–Sep	0.61	0.30	0.51	0.40	0.46	0.32	0.32	0.30	0.36	0.38	0.50	0.39	0.06	04–Sep	0.40
05–Sep	0.63	0.37	0.54	0.42	0.47	0.35	0.35	0.35	0.37	0.40	0.52	0.43	0.07	05–Sep	0.43
06–Sep	0.66	0.40	0.57	0.45	0.49	0.37	0.39	0.39	0.39	0.43	0.54	0.46	0.08	06–Sep	0.46
07–Sep	0.69	0.47	0.60	0.50	0.50	0.41	0.44	0.45	0.42	0.46	0.57	0.50	0.08	07–Sep	0.50
08–Sep	0.72	0.54	0.63	0.53	0.52	0.44	0.48	0.51	0.44	0.48	0.60	0.56	0.10	08–Sep	0.54
09–Sep	0.75	0.60	0.66	0.58	0.54	0.49	0.53	0.54	0.46	0.50	0.61	0.59	0.11	09–Sep	0.57
10–Sep	0.77	0.64	0.68	0.62	0.55	0.53	0.57	0.55	0.48	0.53	0.63	0.62	0.13	10–Sep	0.60
11–Sep	0.78	0.67	0.70	0.66	0.57	0.55	0.62	0.56	0.50	0.55	0.66	0.64	0.14	11–Sep	0.62
12–Sep	0.81	0.71	0.71	0.69	0.59	0.59	0.67	0.57	0.52	0.58	0.68	0.67	0.17	12–Sep	0.65
13–Sep	0.83	0.75	0.72	0.72	0.61	0.63	0.72	0.58	0.54	0.61	0.71	0.72	0.21	13–Sep	0.68
14–Sep	0.87	0.78	0.74	0.75	0.64	0.66	0.80	0.59	0.56	0.63	0.73	0.75	0.24	14–Sep	0.71
15–Sep	0.90	0.80	0.76	0.77	0.67	0.72	0.86	0.60	0.58	0.68	0.75	0.80	0.28	15–Sep	0.74
16–Sep	0.91	0.83	0.79	0.80	0.70	0.77	0.90	0.61	0.62	0.71	0.79	0.83	0.36	16–Sep	0.77
17–Sep	0.93	0.86	0.83	0.83	0.73	0.80	0.93	0.63	0.64	0.75	0.83	0.85	0.44	17–Sep	0.80
18–Sep	0.94	0.89	0.87	0.85	0.76	0.83	0.96	0.66	0.67	0.79	0.86	0.88	0.52	18–Sep	0.83
19–Sep	0.96	0.90	0.90	0.87	0.78	0.87	0.99	0.69	0.71	0.82	0.91	0.91	0.59	19–Sep	0.86
20–Sep	0.97	0.93	0.92	0.89	0.82	0.91	1.00	0.72	0.76	0.85	0.93	0.93	0.68	20–Sep	0.88
21–Sep	0.98	0.95	0.94	0.90	0.85	0.93		0.80	0.79	0.89	0.96	0.95	0.76	21–Sep	0.90
22–Sep	0.99	0.96	0.95	0.92	0.88	0.96		0.84	0.84	0.92	0.97	0.97	0.82	22–Sep	0.93
23–Sep	0.99	0.98	0.97	0.94	0.90	0.98		0.88	0.87	0.95	0.99	1.00	0.87	23–Sep	0.95
24–Sep	1.00	1.00	0.98	0.97	0.93	1.00		0.92	0.90	0.97	1.00		0.90	24–Sep	0.97
25–Sep			0.99	1.00	0.95			0.95	0.93	1.00			0.91	25–Sep	
26–Sep			0.99		0.97			0.98	0.95				0.93	26–Sep	
27–Sep			1.00		0.99			0.99	0.97				0.94	27–Sep	
28–Sep					1.00			1.00	1.00				0.96	28–Sep	
29–Sep													0.98	29–Sep	
30–Sep													1.00	30–Sep	

[a] Early portion of Sheenjek River fall chum salmon run estimated from run timing and entry pattern observed in the Chandalar River (Barton 1995).

[b] Early portion of Sheenjek River fall chum salmon run estimated from aerial survey (Barton 1995).

[c] Interquartile range and median day of passage ([d]) are shown for each year.