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Anvik River Sonar Chum Salmon Escapement Study, 2003

by

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and

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March 2007

Alaska Department of Fish and Game **Divisions of Sport and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

The Anvik River sonar project has used Bendix Corporation[1] side-looking sonar from mid June until the end of July of each year, since 1979, to estimate the passage of summer chum salmon *Oncorhynchus keta*. In 2003, an estimated 256,920 summer chum salmon passed the sonar site. This is below the minimum escapement objective for the Anvik River Biological Escapement Goal of 400,000 to 800,000 chum salmon. Based on 1979–1985 and 1987–2002 mean quartile passage dates, timing of the 2003 chum salmon run was about 2 days later average. Fifty-nine percent of the combined sonar estimates occurred in the nearshore half of the sonar counting ranges. Visual tower counts verified range distribution and species composition of the sonar counts. A consistent diurnal pattern of the chum salmon migration was observed. Chum salmon passage was highest during the darkest hours of the day, with 28.5% of sonar estimates occurring in the 6-hr period between 2200 and 0400 hours. The sex ratio of chum salmon captured in beach seines was 55.1% females. Proportion of females was higher than males in all quartiles except the first. Combined age-0.3 and age-0.4 fish comprised 97.2% of the chum salmon in 2003. Age-0.3 fish were the dominant age class with 72.7% of the samples.

A new split-beam system developed by Hydroacoustic Technology, Incorporated (HTI) was tested side-by-side with the currently used Bendix sonar. HTI sonar was used to estimate chum salmon passage in the Anvik River from June 23 through July 25, 2003. Comparison of passage estimates shows the HTI system produces similar results to the Bendix sonar; therefore, it can be used to upgrade the current system.

Key words: chum salmon, *Oncorhynchus keta,* Chinook salmon, *Oncorhynchus tshawytscha*, hydroacoustics, Anvik, sonar, oscilloscope.

INTRODUCTION

The purpose of the Anvik River sonar project is to monitor escapement of summer chum salmon *Oncorhynchus keta* to the Anvik River drainage, believed to be the largest producer of summer chum salmon in the Yukon River drainage (Bergstrom et al. 1999). Additional major spawning populations of summer chum salmon occur in other tributaries of the Yukon River: the Andreafsky located at river kilometer (rkm) 167, Rodo (rkm 719), Nulato (rkm 777), Melozitna (rkm 938), and Tozitna rivers (rkm 1,096). Spawning tributaries in the Koyukuk River (rkm 817) are the Gisasa (rkm 907) and Hogatza (rkm 1,255) rivers. The tributaries to the Tanana River (rkm 1,118) drainage include Chena (rkm 1,480), and Salcha (rkm 1,553) rivers (Figure 1). Chinook *O. tshawytscha* and pink salmon *O. gorbuscha* spawn in the Anvik River concurrently with summer chum salmon. Fall chum, a later run of chum salmon, and coho salmon *O. kisutch* have been reported to spawn in the Anvik River drainage later during the fall.

Timely and accurate reporting of information from the Anvik River sonar project allows Yukon River fishery managers to accurately assess the strength of the Anvik River summer chum salmon run to meet the established Biological Escapement Goal (BEG) of 400,000 to 800,000 salmon. This information is important in the assessment of the strength of the summer chum salmon run on the Yukon River upstream from the mouth of the Anvik River. This assessment is necessary to determine if summer chum salmon abundance will meet upstream harvest and escapement needs. Side-looking sonar, capable of detecting migrating salmon along the banks, has been in place in the Anvik River since 1980.

Electrodynamics Division of the Bendix Corporation developed the side-looking sonar and conducted a pilot study using the side-looking sonar to estimate chum salmon escapement to the Anvik River in 1979. The results indicated sonar-based estimation of chum salmon escapements to the Anvik River was superior to the counting tower method used at that time (Mauney and Buklis 1980).

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

Project results for escapement studies using sonar technology on the Anvik River from 1979 to 2002 have been reported by Mauney and Buklis (1980), Buklis (1981-1987), Sandone (1989, 1990a, 1990b, 1993-1996), Fair (1997), Chapell (2001), Moore and Lingnau (2002), Lingnau (2002), Dunbar (2003).

BACKGROUND INFORMATION

Commercial and subsistence harvests of Anvik River chum salmon occur throughout the mainstem Yukon River from the delta to the mouth of the Anvik River, and within the first 19 km of the Anvik River. This section of the Yukon River includes Lower Yukon Area Districts 1, 2, and 3, and the lower portion of Subdistrict 4-A in the Upper Yukon Area (Figure 1). Most of the effort and harvest of this stock occurs in Districts 1 and 2, and in the lower portion of Subdistrict 4-A below the confluence of the Anvik and Yukon rivers.

In the Lower Yukon Area, run timing of summer chum and Chinook salmon overlap, with runs beginning at river-ice breakup through early July. During this time, commercial fisheries in the Lower Yukon Area have traditionally targeted Chinook salmon, while Subdistrict 4-A commercial fisheries have targeted summer chum salmon. In the Lower Yukon Area, large-mesh gillnets (stretch mesh greater than 15.2 cm) were employed to harvest Chinook salmon. Although these nets were efficient for Chinook salmon, the associated harvest of summer chum salmon through 1984 was minor in relation to the size of the chum salmon run. Therefore, before the 1985 season, the Alaska Board of Fisheries (BOF), in order to allow directed harvests of summer chum salmon in the Lower Yukon, adopted regulations allowing fishing periods restricted to small-mesh (15.2 cm maximum stretch mesh) gillnets during the Chinook salmon season provided that (1) the summer chum salmon run was of sufficient size to support additional exploitation, and (2) incidental harvest of Chinook salmon during these small mesh fishing periods did not adversely affect conservation of that species.

Increased market demand prompted allocation disputes between fishers in different districts. In February 1990, the BOF established a guideline harvest range of 400,000 to 1,200,000 summer chum salmon for the entire Yukon River, allocated by district and subdistrict based on the average harvests of the previous 15 years (ADF&G 1990). Summer chum salmon escapement to the Anvik River exceeded the lower range of the Anvik River BEG (Clark and Sandone 2001) of 400,000 salmon by an average of 233,000 salmon from 1979 to 1993.

To allow commercial exploitation of surplus chum salmon returning to the Anvik River, in March of 1994 the BOF adopted the Anvik River chum salmon fishery management plan, which permits a commercial harvest of summer chum salmon in the terminal Anvik River Management Area (ARMA) (ADF&G 1994). In 1996, the BOF established a harvest limit of 100,000 pounds of chum salmon roe for the ARMA (JTC 1996). A more complete history and background information can be found in Annual Management Reports for the Yukon Area published each year by the Alaska Department of Fish and Game (ADF&G).

BENDIX REPLACEMENT

The Anvik River sonar project has used Bendix sonar equipment to estimate migrating chum salmon escapement since 1979. Although the Bendix sonar has worked well over the years, it is no longer in production and the company does not support the system. ADF&G purchased an HTI model 241 split-beam digital echo sounder sonar system for use on the Anvik River to continue providing the best possible data to manage fisheries. In 2000, the new system was tested for a short time and produced results comparable to the Bendix equipment. In 2002 the new system was tested again, producing results that were not comparable to the Bendix system. This was most likely due to placing the HTI transducer too far upstream from the Bendix transducer, allowing the fish to move too close to the transducer or migrate to the opposite shore. This report presents results of studies conducted in 2003.

OBJECTIVES

Goals for the 2003 Anvik River fall chum salmon study were to estimate the timing and magnitude of adult salmon escapement, characterize age and sex composition, and to compare passage estimates of the new HTI model 241 split-beam digital echo sounder to those of the Bendix system. To accomplish these tasks, these specific objectives were identified:

1. Estimate timing and magnitude of chum salmon escapement using Bendix, fixed-location, single-beam, side-looking hydroacoustic techniques.
2. Estimate age and sex composition of the spawning population from sampled portions of the escapement using a beach seine as the capture technique.
3. Monitor selected climatological and hydrological parameters daily at the project site for use as baseline data.
4. Locate a suitable deployment site for the new split-beam sonar.
5. Deploy and operate the HTI system side-by-side with the Bendix system.
6. Compare the HTI sonar passage estimates with the Bendix sonar and visual tower estimates.

METHODS

STUDY AREA

The Anvik River originates at an elevation of 400 m and flows in a southerly direction approximately 200 km to its mouth at rkm 512 of the Yukon River (Figure 1). This narrow runoff stream has a substrate of mainly gravel and cobble. Bedrock is exposed in some of the upper reaches. The Yellow River (Figure 2) is a major tributary of the Anvik drainage and is located approximately 100 km upstream from the mouth of the Anvik River. Downstream from the confluence of the Yellow River, the Anvik River changes from a moderate gradient system to a low gradient system meandering through a much broader flood plain. Turbid waters from the Yellow River greatly reduce water clarity of the Anvik River below their confluence. Numerous oxbows, old channel cutoffs, and sloughs are found throughout the lower Anvik River.

Anvik River salmon escapements were partially estimated from visual counts made at counting towers from 1972 to 1979 above the confluence of the Anvik and Yellow rivers (Figure 2). A site 9 km above the Yellow River on the mainstem Anvik River was used from 1972 to 1975 (Lebida *Unpublished*; Trasky 1974, 1976; Mauney 1977). From 1976 to 1979 a site on the mainstem Anvik River near the confluence of Robinhood Creek and the Anvik River was used (Figure 2; Mauney 1979, 1980; Mauney and Geiger 1977). Since 1979, the Anvik River sonar project has been located approximately 76 km upstream of the confluence of the Anvik and Yukon rivers, 5 km below Theodore Creek (Figure 2) in Sections 34 and 35, Township 31 North, Range 61 West, Seward Meridian. The land is public, managed by the Bureau of Land Management (BLM), and leased to ADF&G for public purposes until 2023. Aerial survey data indicate chum salmon spawn primarily upstream of this sonar site.

BENDIX SONAR DEPLOYMENT AND OPERATION

Sonar systems operate by transmitting sound waves outward along the riverbed, from transducers located near the shore. Echoes from targets passing through the sonar beam are reflected back to the transducer and filtered and processed in the transceiver. Echoes, which satisfy criteria for strength and frequency are considered valid and are counted as fish. Echo selection criteria are designed to estimate fish passage and minimize debris counts. Echoes are counted and combined to estimate fish abundance. For the Anvik River sonar salmon counting project, all fish targets are considered salmon. Paired visual counts confirm that nearly all fish observed are salmon.

During the 2003 season a 1985-model Bendix sonar was deployed on the right bank and a 1981-model was deployed on the left bank, and both were operated according to guidelines described by Bendix Corporation (1981) to estimate chum salmon passage (Figure 3). Transducers were deployed and operated without the prescribed artificial aluminum substrate throughout the season. This practice of operating without an artificial substrate was first employed on the Anvik River in 1986 (Buklis 1986). The right (west) and left (east) bank sites used in previous years were probed to locate uniform river bottom gradients that would provide optimum linear surfaces for ensonification. Each sonar transducer was mounted to a pipe configuration, to allow transducer movement during aiming without affecting stability. Sandbags were placed on top of the pipe base to ensure stability. Transducers were aimed perpendicular to the current and were offset to prevent interference (cross-talk) between the opposing banks (Figure 3). To prevent fish passage inshore of the transducer, portable fish leads constructed of aluminum pipe spaced 1.5 in apart were installed downstream of the transducer. Extending from shore to approximately 2 m beyond the transducer, fish leads were at an oblique angle from shore leading upstream. On the right bank, a counting tower of aluminum scaffolding material approximately 3 m in height was placed between the bank and transducer in the river upstream of the fish lead for visual observation of salmon when water conditions permitted. No tower was necessary on the left bank, as visibility from the high bank was sufficient to see fish. Transducers, leads, and counting tower were moved inshore or offshore as required by fluctuating water levels.

Transducers were aimed, and ranges adjusted, to prevent echoes resulting from the stream bottom or surface interface to register as ‘counts’ by the sonar electronics. Sensitivity, as measured in voltage from peak to peak, was adjusted to the highest level without registering false ‘counts.’ This level was usually the maximum possible for this equipment. Sonar ensonification ranges were adjusted in response to changing river conditions. The 1985-model and 1981-model counters both have a maximum range of 30 m. Because of the conical shape of the sonar beam, its width and height increase with distance from the transducer. The ensonified zone of the river encompassed approximately the bottom half of the vertical water column within the counting range throughout operations.

Counters used on the Anvik River sonar project divided each of the ensonified ranges into 16 sectors of equal length. Sector length was dependent on each transducer’s total range of ensonification and was therefore 1/16 of the total range. In subsequent analyses of data, range is divided into 16 sectors with the numbers originating at the transducer face and continuing offshore toward the thalweg.

Bendix sonar equipment was installed approximately 150 m upstream from the field campsite. The right bank transducer was situated on a gradually sloping gravel bar inside of a slight bend in the river. The left bank transducer was located on the outside of the bend where the water level increased at a more rapid rate and the current was faster than at the site inside the bend.

Historical run timing was used to plan the Anvik River sonar project start dates. In most years, some salmon pass the sonar site before and after cessation of sonar operations. However, these numbers likely comprise only a small fraction of the total run. Criteria for terminating sonar sampling were daily chum salmon passage estimates of 1% or less of the season's total passage estimate for 3 out of 4 days.

BENDIX SONAR CALIBRATION AND PASSAGE ESTIMATION

Each sonar transceiver was calibrated at least five times daily by observing passing fish targets using an oscilloscope. In this and past studies using the Bendix system, the term calibrate refers to adjusting the pulse rate (also known as ping rate) of the transducer to account for variable fish swimming speeds. Fish passing through the sonar beam produce a distinctive oscilloscope trace that resembles a tall, momentarily suspended spike. During each calibration period, the number of fish detected by an operator using an oscilloscope was compared to estimates automatically recorded by the sonar electronics.

Fish velocity control setting, which controls the sonar counter's ping rate, was adjusted immediately after a calibration if the sonar to oscilloscope estimate ratio varied from 1.0 by 15% or more. If the ratio was greater than 1.15 or less than 0.85 the existing fish velocity setting was multiplied by the calculated ratio to obtain a new fish velocity control setting. If adjustments were made to the sonar unit, the change was documented in the calibration log, and an additional calibration was made to ensure the new sonar:oscilloscope estimate ratio was within accepted limits and to initialize the counting period. Each initial calibration lasted for at least 15 minutes, until the observer estimated 100 fish had passed, or if the observer noticed immediately fish velocity settings were erroneous, whichever came first.

During setup and at least twice a day when conditions allowed, operators attempted to visually count passing fish from counting towers. This counting helped train personnel in oscilloscope monitoring and gave an estimate of the daily proportion of pink salmon since sonar counters do not distinguish between species of fish. This daily proportion of pink salmon was applied to the adjusted daily fish passage estimate to yield a daily estimate of pink salmon passage. No estimates were made for pink salmon in 2003 because none were encountered during the visual counting periods. Observers wore polarized sunglasses to reduce water surface glare. Glare, low light, wind ripples, rain, and turbid water conditions at times hampered tower observations. Aerial and carcass surveys were used to obtain a separate estimate for Chinook salmon abundance. These estimates were not subtracted from the sonar fish estimate because Chinook salmon abundance is low relative to other salmon runs in the Anvik River.

Five daily calibration times were adequate to monitor the diurnal-timing pattern of the salmon migration. Calibrations were normally conducted during 0400, 0900, 1400, 1900, and 2400 hours. Occasionally, calibration times deviated from prescribed times. Counting periods were defined by each calibration event. An adjustment factor, specific to each counting period and to each bank was calculated using the following formula:

$$A_{b,n} = \frac{OC_{b,n}}{SC_{b,n}} \tag{1}$$

Where:

A = periodic adjustment factor,

b = right or left bank,

n = counting period (0000–0400, 0400–0900, 0900–1400, 1400–1900 or 1900–2400),

OC = oscilloscope counts, and

SC = sonar counts.

For each bank, adjusted passage estimates were calculated by multiplying each calibration period's adjustment factor by unadjusted sonar estimates for each hour within the calibration period. Adjusted estimates were further corrected for missing data and corrected hourly estimates were entered into a spreadsheet program on a desktop computer. The resulting corrected sonar estimates for each hour within a day were summed, yielding the estimated fish passage for that day for that bank. Daily passage of fish for the whole river was determined by summing the daily bank-specific estimates. Daily adjustment or correction factors for each bank and for both banks combined were calculated by dividing the daily-corrected estimates by raw sonar estimates. Raw sector estimates for each day were corrected using the overall daily correction factor. Corrected hourly and sector estimates were used to describe temporal and spatial distribution of the run.

If hourly sector estimates were lacking because of debris, printer malfunction, or weather-related disruptions of sonar operations, passage estimates were calculated by averaging sector estimates for the hour before and after the missing data. When hourly data were not recorded for 3 to 12 hours within 1 day, the daily estimate was calculated by dividing the corrected partial daily value by the mean proportion of corrected estimates of the corresponding hours for the first day before and after the day in question with complete data collection. When conditions forced a suspension of sonar sampling on only one bank for 12 hours or more, that bank's daily estimates were calculated from fish passage on the opposite bank in conjunction with a bank-specific passage proportion based on all days during the season with full counts from both banks. When sampling was suspended on both banks for an entire day, the daily total fish passage estimate was made using straight-line interpolation between the previous days, and the following day's whole river corrected estimates. To recreate spatial and temporal distribution of estimates made for time periods with no recorded data for more than 2 hours, the seasonal total fish estimate for each hour and sector of each bank was divided by the adjusted season total for that bank. The resulting proportions (one for every hour and sector) were multiplied by the interpolated daily estimate, resulting in an interpolated estimate of the spatial and temporal fish passage.

HTI Sonar Deployment and Operation

An HTI hydroacoustic system was operated in conjunction with the Bendix system at the historic Anvik River sonar site in 2003. The HTI system consists of an HTI model 241 digital echo sounder (Appendix A1) and a 2°X10° 200 kHz split-beam transducer on the right bank, and a 2.8°X10° 200 kHz split-beam transducer on the left bank. Attached to the transducers were HTI model 662H dual-axis rotators with an HTI model 660 remote controller to facilitate aiming. The system is capable of distinguishing upstream fish from downstream fish and debris, determine fish velocity, discriminate between random reverberation and fish targets, and provide a less biased estimate of target strength (Hydroacoustic Technology Incorporated 2000).

The HTI digital echo sounder is a state-of-the-art system designed for fisheries research. Highly accurate time-varied gains (TVG's) and very stable transmit and receive sensitivities are possible. Short pulse widths can be used to improve resolution between targets. A Digital Echo Processor (DEP) is integrated into the system. A laptop computer paired with the sounder provides access to all the DEP settings and permits saving settings for future use. An oscilloscope can be linked to the sounder for diagnostic use, such as in-situ system calibration or transducer aiming. After all parameters are determined for data acquisition, the system operates 24 hours a day sampling each bank alternately for half hour. Files are created by the DEP and edited to produce an estimate of fish passage.

The right bank HTI transducer and automatic rotators were mounted on an aluminum pod secured with sandbags about 1m up-river and about 1-4 m inshore of the Bendix transducer. Aim adjustments were made using the remote control for the automatic rotators. The system operator used an artificial acoustic target (1.5 inch tungsten carbide sphere) during deployment to ensure transducer aim was low enough to prevent salmon from passing undetected beneath the acoustic beam. The target was held with monofilament line from a pole along the river bottom and in the acoustic beams at multiple locations to ensure that the full counting range of the transducer was covered. When properly aimed, the target appeared as a trace on the echogram or vertical deflection (spike) on an oscilloscope screen as it transected the acoustic beam at a given distance. The left bank transducer was deployed with the transducer and rotator cables running under the water to the right bank where the sounder for both transducers was located in a tent. Because of the cut bank, deep water, and Bendix priority on the left bank, suitable placement of the HTI transducer close to the Bendix transducer was seldom possible; an acceptable aim was only achieved a few times during the season. For this reason, a comparison of the two systems was not done for the left bank.

HTI Sonar Calibration and Passage Estimation

At the end of each day, data collected by the DEP in 24 thirty-minute text files for each bank was transferred to another computer for tracking and editing. To facilitate tracking, echoes from stationary objects were removed using a custom program created in *C* computer language (Appendix B1). The filtered echoes were then grouped into tracks using the *Alpha-Beta Tracker,* auto-tracking software developed by Mr. Peter Withler through a cooperative agreement with the Department of Fisheries and Oceans Canada (DFO), ADF&G and HTI. The *Alpha-Beta Tracker* implements tracking algorithms described in *Multiple-target tracking with radar applications* (Blackman 1986). The tracked data was manually edited to remove any spurious tracks such as those from any remaining bottom using *Polaris,* an echogram editor also developed by Mr. Peter Withler through the same cooperative agreement. The edited data was saved to a Microsoft Access database. Estimates from the database were exported to a Microsoft Excel spreadsheet where each 30-minute file representing a sample was multiplied by 2 to account for a full hour. Linear interpolation was used when complete 30-minute periods of data were missing. If data from a complete 30 minutes was missing, counts were interpolated by averaging counts from 2 hours before and 2 hours after the missing period. If 2 complete 30-minute sample periods were missing, counts were interpolated by averaging counts from 3 hours before and 3 hours after the missing periods. If 3 complete 30-minute sample periods were missing, counts were interpolated by averaging counts from 4 hours before and 4 hours after the missing periods. If 4 or more 30-minute sample periods were missing, counts were interpolated by averaging counts from 5 hours before and 5 hours after the missing the hour. When a portion of a 30-minute sample was missing, passage was estimated by expansion based on the known portion of the 30 minutes. Thirty minutes was divided by the known number of minutes counted (if 10 minutes or more) and then multiplied by the number of fish counted in that period.

Echoes from stationary objects were removed before tracking by dividing data into range bins (0.2 meters), calculating the moving average (averaging window of 1,000 echoes) of the voltage in each range bin and then removing the echo if the voltage was within 1.7 standard deviations of the mean and at least 100 echoes were within that range bin. The echo was not removed if the percentage of missed echoes relative to observed echoes was greater than 80. The percentage of missed relative to observed echoes was calculated by summing differences between observed ping numbers minus 1 and then dividing by the total number of echoes in the range bin.

After the data was cleaned up with the bottom removal program, the *Alpha Beta Tracker* automatically selected groups of echoes considered to be fish based on parameters selected by the operator. These echoes were grouped into fish tracks that could be enumerated to produce an estimate of fish passage. Tracking parameters include alpha and beta values for X, Y, Z (position estimates), minimum echoes per track, maximum missed pings and search radius. Alpha and beta Parameters were determined by manually tracking about 50 fish in *Polaris* and choosing values that minimized the squared differences between observed and predicted positions.

Final editing was accomplished with *Polaris*. Potential filters included mean target strength, pulse width, standard deviation of residuals, median velocity, and mean -12 dB pulse width. Values for the filters were determined by comparing histograms of the filter parameters for tracked fish and for non-fish groups of echoes. Filtered fish tracks were viewed and edited if necessary. Missed fish tracks were added manually and erroneous tracked echoes were manually removed. After all editing was complete; the data was imported to an *Access* database and an *Excel* spreadsheet where the final estimate of hourly and daily fish passage was produced. Since the HTI estimates were produced from half hour samples a variance estimate was calculated. The daily passage for bank z on day d was calculated by summing the hourly passage rates for each hour as follows:

$$\hat{y}_{dz} = \sum_{p=1}^{24} \frac{y_{dzp}}{h_{dzp}} \tag{2}$$

Where h_{dzp} is the fraction of the hour sampled on day d, bank z, period p and y_{dzp} is the count for period p on bank z of day d.

The variance for the passage estimate for bank z on day d is estimated as:

$$\hat{V}_{y_{dz}} = 24^2 \frac{1-f_{dz}}{n_{dz}} \frac{\sum_{p=2}^{n_{dz}} \left(\frac{y_{dzp}}{h_{dzp}} - \frac{y_{dz,p-1}}{h_{dz,p-1}} \right)^2}{2(n_{dz}-1)} \tag{3}$$

Where n_{dz} is the number of samples in the day (24) and f_{dz} is the fraction of the day sampled (12/24=0.5). y_{dzp} is the hourly count for day d on bank z for sample p.

Since the passage estimates are assumed independent between zones and among days, the total variance is estimated as the sum of the variances.

$$\hat{V}ar(\hat{y}) = \sum_{d}\sum_{z}\hat{V}ar(\hat{y}_{dz}) \tag{4}$$

AGE, SEX, AND LENGTH SAMPLING

Temporal strata, used to characterize the age and sex composition of the chum salmon escapement, were defined as quartiles using dates on which 25%, 50%, 75%, and 100% of the total run had passed the sonar site. These quartile-sampling strata were determined postseason based on 2003 run timing data. They represent an attempt to sample the escapement for age, sex, and length (ASL) information in relative proportion to the total run. In 2003, these strata were: pre July 5, July 5–9, July10–15, and July 16 until end of the season.

To meet region-wide standards for the sample size needed to describe a salmon population, the initial seasonal ASL sample goal was 608 chum salmon, with a minimum of 162 chum salmon samples collected during each temporal stratum (Bromaghin 1993). Sample size goals are based on accuracy (d) and precision (α) objectives of d = 0.10 and α = 0.05, assuming 2 major age classes, and 2 minor age classes with a scale rejection rate of 15%. The beach seining goal for Chinook salmon was to sample all fish captured while pursuing the chum salmon sampling goal. A beach seine (31 m long, 66 meshes deep, 6.35-cm mesh) was drifted, beginning approximately 10 m downstream of the sonar site, to capture chum and Chinook salmon to collect ASL data (Figure 3). All resident fresh-water fish captured were tallied by species and then released. Pink salmon were counted by sex, based on external characteristics, and then released. Chum salmon were placed in a holding pen and each was noted for sex, measured to the nearest 5 mm from mideye to tail fork, and 1 scale was taken for age determination. Where possible, scales were removed from an area posterior to the base of the dorsal fin and above the lateral line on the left side of the fish (Clutter and Whitesel 1956). The adipose fin was clipped on each sampled chum salmon to prevent re-sampling. If any Chinook salmon were caught, they were sampled using the same methods, except 3 scale samples were taken from each fish. A separate project to characterize age and sex composition of Anvik River Chinook salmon involved collecting ASL samples from Chinook salmon carcasses immediately after the sonar program terminated.

CLIMATOLOGICAL AND HYDROLOGIC SAMPLING

Climatological and hydrologic data were collected at approximately 1800 hours each day at the campsite. Relative river depth was monitored using a staff gauge marked in 1 cm increments. Change in water depth was presented as negative or positive increments from the initial reading of 0.0 cm. Water temperature was measured in degrees Celsius (C) near shore at a depth of approximately 50 cm. Daily maximum and minimum air temperatures were recorded in degrees C. Subjective notes on wind speed and direction, cloud cover, and precipitation were recorded.

RESULTS

SONAR ASSESSMENT

Two Bendix sonar systems, one on each riverbank, were operated in 2003. These sites were the same sonar sites used in 2002. Right bank transducers were deployed on a slight inside bend, where a gravel bar slopes gently toward the thalweg. The right bank site was sufficient for both

HTI and Bendix transducers to operate side by side. The left bank transducers were deployed from a more steeply sloping cut-bank on the outside of the same bend. Because of the limited space on the steep bank it was not possible to get a good aim with both systems simultaneously. For this reason and the fact that the Bendix estimate was used for management purposes, priority was given to the Bendix transducer. Although both systems were operated on the left bank a comparison of count estimates was not completed for that bank.

In 2003, Bendix sonar operations on right bank began June 21. The left bank sonar system became operational on June 23. Water level started out high in 2003 causing poor visibility in the first few weeks. Although the water level did fluctuate, it remained relatively high most of the season. Water clarity on the right bank varied through the remainder of the season, which sometimes allowed excellent visual confirmation of sonar passage estimates and species apportionment and other times did not. Because of the high water, left bank visibility was poor most of the season. The Bendix sonar systems on both banks operated through July 27, while the HTI sonar was terminated on July 25.

ESCAPEMENT ESTIMATES AND RUN TIMING

The 2003 summer chum salmon passage estimate for the 37-day period from June 21 through July 27 was 256,920 (Table 1). This period includes estimates for missing sector/hourly counts and expansions for left bank passage on June 21 and 22 and July 27, and right bank passage on July 25, 26, 27. No pink salmon were observed while conducting visual counts in 2003; therefore, all counts were attributed to summer chum salmon.

Summer chum salmon passage dates were slightly later than historic run timing, based on 1979–1985 and 1987–2002 runs (Table 2). The summer chum passage quartiles were 2 to 3 days later than the historic mean. The first quartile was 2 days later, the median day was 2 days later, and the third quartile was 3 days later than the historic mean (Table 2). The central half of the run passed between July 5 and July 15 (Table 2) and its duration, 10 days, was near the historic mean of 9.9 days. Daily passage estimates between first and third quartile days ranged from 6,151 to 19,570 fish (Table 1). In the 10 days of the central half of the chum salmon run an estimated 134,375 fish passed the sonar sites. The peak passage day was July 9, when 19,570 summer chum salmon, 0.076 proportion of the estimated total escapement (Table 3), were estimated to have passed (Figure 4).

From June 21 through July 27, 2003 a total of 49:00 hours of sonar calibrations were conducted at the right bank site (Table 4). Right bank sonar:oscilloscope proportions averaged 0.98. A total of 446 chum, 10 Chinook, and no pink salmon were visually counted from a tower in 6:18 hours of visual monitoring on the right bank. On the left bank, a total of 46:05 h of sonar calibrations were conducted. The left bank sonar:oscilloscope proportions averaged 0.92. A total of 9 chum and no Chinook or pink salmon were visually counted from the left bank tower in 0:10 hours of visual monitoring (Table 4). Although visibility on the left bank was poor most of the season, water clarity was good enough to detect the presence or lack of fish.

In 2003, the pink salmon return was very weak. This was expected for pink salmon in odd years. The low numbers of returning pink salmon were not deducted from the sonar counts because visual observations indicated the pink salmon return was so weak that their numbers were negligible (Table 5). Only 1 pink salmon was observed, and that while sampling with the beach seine.

The 2003 chum salmon escapement estimate of 256,290 was 62.1% below the mean Anvik River escapement estimate of 677,745 fish, based on 1979–2002 data (Table 2; Appendix C1). The 2003 escapement estimate did not reach the lower range of the recently adopted Biological Escapement Goal (BEG) of 400,000 to 800,000 summer chum salmon. Detailed passage estimate and proportions for each hour and each sector for the season can be found in Appendix D1–D6.

Comparison of the HTI and Bendix sonar estimates was conducted during periods of low and moderately high passage during the period June 23 to July 25. During this 33 day period the HTI sonar upstream passage estimate was 205,230 (SE 1,710) chum salmon while the Bendix sonar estimated passage was 221,731 chum salmon (Table 6; Figure 5). Due to the small numbers of other species, all fish were counted as chum salmon. The cumulative passage estimate differed by approximately 8% (Figure 6). Although differences in the daily HTI and Bendix passage estimates were observed, the coefficient of determination is high (R^2=0.9218) indicating a good relationship between the two measures (Figure 7).

SPATIAL AND TEMPORAL DISTRIBUTION

Buklis (1982) first reported a distinct diurnal salmon migration pattern during the 1981 season with a higher proportion of the migration passing the sonar site during darker hours of the day (Table 7; Figure 8). Similar diurnal patterns were reported from 1985 through 2002. Temporal distribution of sonar estimates indicates a distinct diurnal pattern. Between the 8 hours of 2200 and 0600 hours, 38% of estimates were recorded. The diurnal migration pattern observed with the HTI sonar on the right bank shows a very similar pattern as the right bank Bendix sonar (Figure 9).

Before 2003, in all but 3 years sonar was used to estimate Anvik River chum salmon escapement, most of the escapement passage had been associated with the right bank. In the 3 exceptional years only 43%, 45%, and 39% (1992, 1996, and 1997), of the total adjusted estimates were observed on the right bank (Sandone 1994a; Fair 1997; Chapell 2001). The shift to left bank was attributed to low water conditions that affected chum salmon migration patterns at the sonar site. The 2003 chum salmon migrations followed the dominant right bank orientation trend with 88.7% of estimated chum salmon passing on the right bank (Table 7; Figure 10). The right bank spatial distribution observed with the HTI sonar shows a very similar pattern (Figure 11). The first 2 meters of the HTI had fewer fish due to the location of the transducer (about 1–4m) behind the Bendix transducer.

A fundamental assumption of the Anvik River Sonar project is, because of the bank-oriented migration behavior of chum salmon, the 2 sonar systems based on opposite shores detect essentially all chum salmon passing the sonar site. In 2003, this assumption was supported by lower relative passage estimates in the offshore sonar sectors (Table 8; Figure 10). During the 2003 season the sonar sectors in the nearshore half of the right bank counting range accumulated 59% of the annual right bank sonar estimates. On the left bank, the nearshore half of the sonar counting range accumulated 53% of the annual left bank sonar estimates (Table 8; Figure 10).

During the 2003 season, minor day-to-day changes of fish passage proportions between sector estimates were probably caused by changes in placement and aiming of the transducer in response to fluctuating water levels, rather than by changes caused by fish migratory patterns. Spatial distribution of fish was approximately the same with both systems. Very low numbers of fish in the first 3 meters of the HTI sonar are due to the transducer placement in relation to the Bendix transducer and the fish lead. It should also be noted that there appears to be fewer fish in the 6 to 8 meter range (sectors 7 and 8) on the right bank Bendix sonar (Figure 11). The HTI system did not show the same pattern. This was most likely a result of the electronic configuration of the "valid hit" criteria set for each sector in the Bendix system. The Bendix sonar counter accepts a target within a sector as a fish only after a certain number of hits (pulses), i.e. sector 1 may require 2 hits where sector 16 may require many more. When the crew calibrates the system, the operator counts what they see on the oscilloscope irregardless of sector. The system also counts the fish but at the same time places them in a sector. If the valid hit criterion for a sector is incorrect the system may over count fish in 1 sector and under count others. Thus, the number of fish counted by the sonar may be correct while the recorded location (sector) of the fish may be incorrect. The number of hits required to count as a fish in sectors 7 and 8 should be reduced internally in the sonar counter in order to more accurately show where the fish are in the sonar beam.

AGE AND SEX COMPOSITION

In 2003, beach seine sets were made on 11 days from June 28 to July 20 (Table 9). Of 635 chum salmon sampled, 618 (97.3%) could be aged, slightly higher than the 85% expected rate (Table 9). The number of fish sampled for the first through fourth passage strata was 154, 167, 156, and 158 chum salmon. Of those fish sampled for ASL data in each stratum, 144, 161, 162, and 151 had scales, which could be aged.

The 4 strata sampled during the 2003 season were dominated by age-0.3 chum salmon, accounting for 59.0%, 75.0%, 74.5%, and 81.5% of the passage in their respective passage strata (Appendix E1; Figure 12). The overall age composition of escapement, using temporal strata determined by the closest sample dates and weighted by escapement estimates, was 1.5% age-0.2, 72.7% age-0.3, 24.5% age-0.4, and 1.3% age-0.5 (Appendix E1). Predominant age classes of age-0.3 and age-0.4 salmon accounted for 97.2% of the 4 age classes observed in 2003. In comparison to historical mean values from 1972–2002, the age-0.3 proportion of the 2003 run was 15.5% higher and the age-0.4 proportion was 14.6% lower. These results indicate an average survival rate for age-0.3 and age-0.4 fish during their life history.

Age and sex composition of the Anvik River chum salmon escapement passing the sonar site usually changes through the duration of the run. Usually the trend is an increasing proportion of younger salmon and a higher proportion of female salmon as the run progresses (Fair 1997). This trend was also observed in the 2003 run (Appendix E1; Figure 12). Using temporal strata determined by the closest beach seine sample dates and weighted by escapement estimates, females comprised 45.1% of the first stratum, followed by an increase to 57.4% in the second stratum, then a slightly lower proportion of 54.6% in the third stratum. The percentage females in the fourth stratum of chum salmon collected increased to 62.3%. Of the entire chum salmon run estimate for 2003, 55.1% were females. Since 1979, females have dominated the escapement in 23 of the 25 years; the exceptions were 1995 and 1996 (Figure 13). Chum salmon were also sampled for length. Table 10 compares mean length by age and sex.

HYDROLOGIC AND CLIMATOLOGICAL CONDITIONS

Anvik River water level in 2003 was high and rising when the crew arrived and fluctuated widely through the season. The water level increased until June 20 when it reached 46.5 cm above the initial level recorded on June 18. The water level then decreased to 15.5 cm below the initial setting on June 23 then increased to 38.7 cm above on June 24, and again decreased to 116.1 cm below the initial level on June 30 (Table 11; Figure 14). Heavy rain resulted in a rapid

193.5 cm rise that crested at on 3 July at 77.4 cm above the initial level. Water level dropped to its lowest level on July 19 to 147.1 cm below the initial setting and then increased the remainder of the season to 54.2 cm above on July 27. The maximum daily water temperature was 17°C and minimum daily water temperature 10°C. The maximum daily air temperature was 28°C and minimum daily air temperature was -1°C (Table 11; Figure 14). The maximum/minimum air temperatures throughout the season generally bound water temperatures.

DISCUSSION

ESCAPEMENT ESTIMATION

The 2003 Anvik River summer chum salmon escapement estimate was 62% below the 1979–2002 combined average escapements of 677,745 and 44% below the 2002 average. Summer chum salmon abundance has been below average to poor since 1997 and below the BEG in 2000, 2001, 2003. Parent-year escapements in 1998 and 1999 were slightly above the lower end of the BEG. With 72.7% of these fish being 4-year-olds, the indication is the survival of 1999 offspring was significantly better than the survival rate of the 1998 brood year. Although the exact reasons for the low salmon runs are unknown, scientist speculate poor marine survival results from, or is accentuated by, localized weather conditions in the Bering Sea (Kruse 1998).

In 2003, early indications from the Yukon River run assessment project at Pilot Station indicated a run size similar to last year. Most escapement projects, including the Anvik River sonar project, provided early indications the Yukon River summer chum salmon run was weak. The 2003 Anvik River sonar project assessment of the summer chum salmon run agreed with the below average escapement estimates at all other assessment projects except the Tanana River where the assessment was not complete due to inclement weather and flooding (JTC 2004). The Yukon River summer chum commercial fishery was managed conservatively by reducing fishing periods. Commercial harvest was taken incidental to a directed Chinook fishery except for two directed chum salmon commercial fishing periods in District 6. Total estimated Alaska portion of the commercial harvest was 10,685 summer chum salmon (JTC 2004). The summer chum salmon commercial harvest was third lowest since 1968. The preliminary estimated summer chum salmon subsistence harvest for 2003 is 82,272 (Busher et al. 2004). This estimate is 20% below the recent 10-year (1993–2002) average of 103,260.

BENDIX AND HTI SONAR COMPARISON

Passage estimates, diel and spatial distribution patterns of summer chum salmon appear very similar with the Bendix and HTI sonar systems. Overall, the cumulative HTI passage estimate was approximately 8% lower than the Bendix. During periods of low salmon passage the Bendix counts were slightly higher, likely due to over counting of very slow fish. At higher salmon passage the HTI counts were relatively higher. Diel patterns were very similar with both systems. More fish were counted at night and periods of low light than were counted during daylight hours. There were hourly fluctuations in the differences between the estimates, likely the result of fish swim speed changing between Bendix calibrations. Spatial distribution was also about the same with both systems. Overall, the passage estimates produced by the two systems were nearly identical during this sample period. In the future it is recommended that the HTI sonar system be used at the same location to estimate the fall chum salmon escapement in the Anvik River.

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TABLES AND FIGURES

Table 1.–Anvik River summer chum salmon daily and cumulative counts by bank and total, 2003.

	Daily			Cumulative		
Date	Right Bank	Left Bank	Total	Right Bank	Left Bank	Total
21-Jun	220[a]	4[b]	224	220	4	224
22-Jun	435	7[b]	442	655	11	666
23-Jun	534	12[c]	546	1,189	23	1,212
24-Jun	1,609	31	1,640	2,798	54	2,852
25-Jun	4,559	54	4,613	7,357	108	7,465
26-Jun	4,217	5	4,222	11,574	113	11,687
27-Jun	2,974	87	3,061	14,548	200	14,748
28-Jun	4,890	33	4,923	19,438	233	19,671
29-Jun	4,072	16	4,088	23,510	249	23,759
30-Jun	4,615	26	4,641	28,125	275	28,400
1-Jul	7,701	66	7,767	35,826	341	36,167
2-Jul	8,161	50	8,211	43,987	391	44,378
3-Jul	8,375	153	8,528	52,362	544	52,906
4-Jul	7,738	41	7,779	60,100	585	60,685
5-Jul	6,616	373	6,989	66,716	958	67,674
6-Jul	7,693	230	7,923	74,409	1,188	75,597
7-Jul	10,863	214	11,077	85,272	1,402	86,674
8-Jul	13,709	1,022	14,731	98,981	2,424	101,405
9-Jul	16,683	2,887	19,570	115,664	5,311	120,975
10-Jul	14,244	2,146	16,390	129,908	7,457	137,365
11-Jul	10,564	695	11,259	140,472	8,152	148,624
12-Jul	12,526	1,141	13,667	152,998	9,293	162,291
13-Jul	10,956	2,153	13,109	163,954	11,446	175,400
14-Jul	11,043	2,466	13,509	174,997	13,912	188,909
15-Jul	4,772	1,379	6,151	179,769	15,291	195,060
16-Jul	3,406	788	4,194	183,175	16,079	199,254
17-Jul	3,557	1,383	4,940	186,732	17,462	204,194
18-Jul	6,170	1,516	7,686	192,902	18,978	211,880
19-Jul	6,201	2,117	8,318	199,103	21,095	220,198
20-Jul	5,340	1,884	7,224	204,443	22,979	227,422
21-Jul	3,594	1,771	5,365	208,037	24,750	232,787
22-Jul	2,631	290	2,921	210,668	25,040	235,708
23-Jul	3,381	615	3,996	214,049	25,655	239,704
24-Jul	3,645[d]	676	4,321	217,694	26,331	244,025
25-Jul	4,692[e]	1,173	5,865	222,386	27,504	249,890
26-Jul	3,612[e]	903	4,515	225,998	28,407	254,405
27-Jul	2,012[e]	503[f]	2,515	228,010	28,910	256,920
Total	228,010	28,910	256,920			

[a] Right bank sonar counting began at 12:00.

[b] Calculated using relationship of right:left bank fish passage estimates from days immediately following.

[c] Left bank sonar counting began at 00:00.

[d] Right bank sonar counts terminated at 24:00 due to spawners in beam.

[e] Calculated using relationship of right:left bank fish passage estimates from days immediately preceding.

[f] Left bank sonar counts terminated at 19:00 due to high water.

Table 2.–Annual Anvik River sonar passage estimates and associated passage timing statistics for summer chum salmon runs, 1979–2003.

Year	Sonar Passage Estimate	Day of First Salmon Counts	First Quartile Day	Median Day	Third Quartile Day	First Count & First Quartile	Days Between Quartiles: First & Median	Median & Third	First & Third
1979	277,712	23-Jun	2-Jul	8-Jul	12-Jul	9	6	4	10
1980	482,181	28-Jun	6-Jul	11-Jul	16-Jul	8	5	5	10
1981	1,479,582	20-Jun	27-Jun	2-Jul	7-Jul	7	5	5	10
1982	444,581	25-Jun	7-Jul	11-Jul	14-Jul	12	4	3	7
1983	362,912	21-Jun	30-Jun	7-Jul	12-Jul	9	7	5	12
1984	891,028	22-Jun	5-Jul	9-Jul	13-Jul	13	4	4	8
1985	1,080,243	5-Jul	10-Jul	13-Jul	16-Jul	5	3	3	6
1986	1,085,750	21-Jun	29-Jun	2-Jul	6-Jul	8	3	4	7
1987	455,876	21-Jun	5-Jul	12-Jul	16-Jul	14	7	4	11
1988	1,125,449	21-Jun	30-Jun	3-Jul	9-Jul	9	3	6	9
1989	636,906	20-Jun	1-Jul	7-Jul	13-Jul	11	6	6	12
1990	403,627	22-Jun	2-Jul	7-Jul	15-Jul	10	5	8	13
1991	847,772	21-Jun	1-Jul	10-Jul	16-Jul	10	9	6	15
1992	775,626	29-Jun	5-Jul	8-Jul	12-Jul	6	3	4	7
1993	517,409	19-Jun	5-Jul	12-Jul	18-Jul	16	7	6	13
1994	1,124,689	19-Jun	1-Jul	7-Jul	11-Jul	12	6	4	10
1995	1,339,418	19-Jun	1-Jul	6-Jul	11-Jul	12	5	5	10
1996	933,240	18-Jun	25-Jun	1-Jul	6-Jul	7	6	5	11
1997	605,752	19-Jun	28-Jun	3-Jul	10-Jul	9	5	7	12
1998	487,301	22-Jun	5-Jul	10-Jul	14-Jul	13	5	4	9
1999	437,356	27-Jun	6-Jul	10-Jul	16-Jul	9	4	6	10
2000	196,349	21-Jun	8-Jul	11-Jul	13-Jul	17	3	2	5
2001	224,058	26-Jun	6-Jul	10-Jul	15-Jul	10	4	5	9
2002	459,058	22-Jun	3-Jul	7-Jul	12-Jul	11	4	5	9
2003	256,920	21-Jun	5-Jul	10-Jul	15-Jul	14	5	5	10
Mean [a]	677,745	22-Jun	3-Jul	8-Jul	12-Jul	10.4	5.0	4.9	9.9
Median [a]	517,409	21-Jun	3-Jul	8-Jul	13-Jul	10.0	5.0	5.0	10.0
SE	361,836		3.7	3.3	3.0	3.0	1.6	1.4	2.4

[a] The mean and standard error of the timing statistics includes estimates from years 1979–1985 and 1987–2002. In 1986, sonar counting operations were terminated early, probably resulting in the incorrect calculation of the quartile statistics. Therefore, the 1986 run timing statistics were excluded from the calculation of the overall mean and timing statistic and associated SE so that the current year can be compared to the historical averages data from 2003 is not included.

Table 3.–Anvik River summer chum salmon daily and cumulative proportions by bank and total, 2003.

	Daily			Cumulative		
Date	Right Bank	Left Bank	Total	Right Bank	Left Bank	Total
21-Jun	0.001	0.000	0.001	0.001	0.000	0.001
22-Jun	0.002	0.000	0.002	0.003	0.000	0.003
23-Jun	0.002	0.000	0.002	0.005	0.000	0.005
24-Jun	0.006	0.000	0.006	0.011	0.000	0.011
25-Jun	0.018	0.000	0.018	0.029	0.000	0.029
26-Jun	0.016	0.000	0.016	0.045	0.000	0.045
27-Jun	0.012	0.000	0.012	0.057	0.001	0.057
28-Jun	0.019	0.000	0.019	0.076	0.001	0.077
29-Jun	0.016	0.000	0.016	0.092	0.001	0.092
30-Jun	0.018	0.000	0.018	0.109	0.001	0.111
1-Jul	0.030	0.000	0.030	0.139	0.001	0.141
2-Jul	0.032	0.000	0.032	0.171	0.002	0.173
3-Jul	0.033	0.001	0.033	0.204	0.002	0.206
4-Jul	0.030	0.000	0.030	0.234	0.002	0.236
5-Jul	0.026	0.001	0.027	0.260	0.004	0.263
6-Jul	0.030	0.001	0.031	0.290	0.005	0.294
7-Jul	0.042	0.001	0.043	0.332	0.005	0.337
8-Jul	0.053	0.004	0.057	0.385	0.009	0.395
9-Jul	0.065	0.011	0.076	0.450	0.021	0.471
10-Jul	0.055	0.008	0.064	0.506	0.029	0.535
11-Jul	0.041	0.003	0.044	0.547	0.032	0.578
12-Jul	0.049	0.004	0.053	0.596	0.036	0.632
13-Jul	0.043	0.008	0.051	0.638	0.045	0.683
14-Jul	0.043	0.010	0.053	0.681	0.054	0.735
15-Jul	0.019	0.005	0.024	0.700	0.060	0.759
16-Jul	0.013	0.003	0.016	0.713	0.063	0.776
17-Jul	0.014	0.005	0.019	0.727	0.068	0.795
18-Jul	0.024	0.006	0.030	0.751	0.074	0.825
19-Jul	0.024	0.008	0.032	0.775	0.082	0.857
20-Jul	0.021	0.007	0.028	0.796	0.089	0.885
21-Jul	0.014	0.007	0.021	0.810	0.096	0.906
22-Jul	0.010	0.001	0.011	0.820	0.097	0.917
23-Jul	0.013	0.002	0.016	0.833	0.100	0.933
24-Jul	0.014	0.003	0.017	0.847	0.102	0.950
25-Jul	0.018	0.005	0.023	0.866	0.107	0.973
26-Jul	0.014	0.004	0.018	0.880	0.111	0.990
27-Jul	0.008	0.002	0.010	0.887	0.113	1.000
Total	0.887	0.113	1.000			

Note: Second and third quartiles in box. Mean quartile in bold outlined box.

Table 4.–Daily summary of sonar calibrations and visual salmon counts from towers, Anvik River, 2003.

	Right Bank								Left Bank							
	Sonar Calibrations				Visual Counts				Sonar Calibrations				Visual Counts			
						Net Upstream Salmon Passage								Net Upstream Salmon Passage		
Date	Elapsed Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope	Elapsed Time (hrs:min)	Chum	Chinook	Pink	Elapsed Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope	Elapsed Time (hrs:min)	Chum	Chinook	Pink
21-Jun	1:00	17	15	1.13												
22-Jun	1:00	31	31	1.00												
23-Jun	1:15	30	30	1.00					1:30	0	0					
24-Jun	1:28	89	105	0.85					1:15	0	0					
25-Jun	1:15	219	237	0.92					1:15	1	0					
26-Jun	1:15	120	142	0.85	0:00				1:13	2	3	0.67	0:00			
27-Jun	1:43	249	285	0.87	0:15				1:15	7	6	1.17	0:00			
28-Jun	1:15	253	271	0.93	0:30				1:15	2	5	0.40	0:00			
29-Jun	1:15	217	227	0.96	0:30				1:16	0	0		0:00			
30-Jun	1:30	239	254	0.94	0:30				1:15	0	0		0:00			
1-Jul	1:14	399	367	1.09	0:30				1:15	8	9	0.89	0:00			
2-Jul	2:10	699	675	1.04	1:00				1:15	2	2	1.00	0:00			
3-Jul	1:23	478	487	0.98	0:10				1:15	7	8	0.88	0:00			
4-Jul	1:31	581	564	1.03	0:00				1:15	1	2	0.50	0:00			
5-Jul	1:13	340	363	0.94	0:05				1:15	39	46	0.85	0:00			
6-Jul	2:11	639	675	0.95	0:20				1:30	13	17	0.76	0:00			
7-Jul	1:32	576	649	0.89	0:43				1:25	4	6	0.67	0:00			
8-Jul	1:24	646	681	0.95	0:19	105	0	0	1:15	39	38	1.03	0:00			
9-Jul	1:02	614	654	0.94	0:05	49	2	0	1:34	251	223	1.13	0:00			
10-Jul	1:05	490	501	0.98	0:00				1:15	140	135	1.04	0:00			
11-Jul	1:19	552	556	0.99	0:00				1:25	41	45	0.91	0:00			
12-Jul	1:17	544	623	0.87	0:09	35	0	0	1:15	46	46	1.00	0:00			
13-Jul	1:35	654	679	0.96	0:07	53	0	0	1:30	139	148	0.94	0:00			
14-Jul	1:28	563	539	1.04	0:00				1:15	89	85	1.05	0:00			
15-Jul	1:40	261	272	0.96	0:00				1:15	20	28	0.71	0:00			
16-Jul	1:30	248	217	1.14	0:00				1:00	7	8	0.88	0:00			
17-Jul	1:15	149	138	1.08	0:15	7	1	0	1:45	67	63	1.06	0:00			
18-Jul	1:30	339	375	0.90	0:10	31	0	0	1:15	64	67	0.96	0:00			
19-Jul	1:45	375	394	0.95	0:15	82	2	0	1:15	110	104	1.06	0:00			
20-Jul	1:30	310	316	0.98	0:10	56	5	0	1:15	50	47	1.06	0:10	9	0	0
21-Jul	1:30	225	222	1.01	0:00				1:41	47	49	0.96	0:00			
22-Jul	1:30	147	146	1.01	0:00				1:30	26	19	1.37	0:00			
23-Jul	1:45	239	216	1.11	0:00				1:30	31	34	0.91	0:00			

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Table 4.–Page 2 of 2.

	Right Bank								Left Bank							
	Sonar Calibrations				Visual Counts				Sonar Calibrations				Visual Counts			
						Net Upstream Salmon Passage								Net Upstream Salmon Passage		
Date	Elapsed Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope	Elapsed Time (hrs:min)	Chum	Chinook	Pink	Elapsed Time (hrs:min)	Sonar Count	Scope Count	Sonar/ Scope	Elapsed Time (hrs:min)	Chum	Chinook	Pink
24-Jul	1:45	277	254	1.09	0:00				1:15	48	47	1.02	0:00			
25-Jul					0:15	28	0	0	1:15	22	38	0.58	0:00			
26-Jul					0:00				1:01	29	32	0.91	0:00			
27-Jul					0:00				1:15	25	22	1.14	0:00			
28-Jul					0:00								0:00			
Total	49:00	11,809	12,160		6:18	446	10	0	46:05	1,377	1,382		0:10	9	0	0
Mean	1:29			0.98	0:11				1:19			0.92	0:10			

Table 5.–Anvik River raw sonar estimates, calibration adjustment factors, chum and pink salmon passage estimates by bank and day, 2003.

	Right Bank					Left Bank					Combined Banks					
	Raw[a] Daily	Adjust	Corrected Daily	Counts Attributed to Chum	Pink	Raw[a] Daily	Adjust	Corrected Daily	Counts Attributed to Chum	Pink	Raw[a] Daily	Corrected Daily	Counts Attributed to Chum Salmon		Pink Salmon	
Date	Estimate	Factor	Estimate	Salmon	Salmon	Estimate	Factor	Estimate	Salmon	Salmon	Estimate	Estimate	Daily	Cumulative	Daily	Cumulative
21-Jun [b]			220	220	0			4	4	0		224	224	224	0	0
22-Jun	341	1.28	435	435	0			7	7	0	341	442	442	666	0	0
23-Jun [c]	440	1.21	534	534	0	12	1.00	12	12	0	452	546	546	1,212	0	0
24-Jun	1,410	1.14	1,609	1,609	0	31	1.00	31	31	0	1,441	1,640	1,640	2,852	0	0
25-Jun	4,223	1.08	4,559	4,559	0	64	0.84	54	54	0	4,287	4,613	4,613	7,465	0	0
26-Jun	3,650	1.16	4,217	4,217	0	4	1.25	5	5	0	3,654	4,222	4,222	11,687	0	0
27-Jun	2,507	1.19	2,974	2,974	0	53	1.64	87	87	0	2,560	3,061	3,061	14,748	0	0
28-Jun	4,736	1.03	4,890	4,890	0	23	1.43	33	33	0	4,759	4,923	4,923	19,671	0	0
29-Jun	4,003	1.02	4,072	4,072	0	16	1.00	16	16	0	4,019	4,088	4,088	23,759	0	0
30-Jun	4,349	1.06	4,615	4,615	0	26	1.00	26	26	0	4,375	4,641	4,641	28,400	0	0
1-Jul	8,232	0.94	7,701	7,701	0	66	1.00	66	66	0	8,298	7,767	7,767	36,167	0	0
2-Jul	8,471	0.96	8,161	8,161	0	50	1.00	50	50	0	8,521	8,211	8,211	44,378	0	0
3-Jul	8,230	1.02	8,375	8,375	0	140	1.09	153	153	0	8,370	8,528	8,528	52,906	0	0
4-Jul	8,064	0.96	7,738	7,738	0	30	1.37	41	41	0	8,094	7,779	7,779	60,685	0	0
5-Jul	6,261	1.06	6,616	6,616	0	297	1.26	373	373	0	6,558	6,989	6,989	67,674	0	0
6-Jul	7,018	1.10	7,693	7,693	0	205	1.12	230	230	0	7,223	7,923	7,923	75,597	0	0
7-Jul	10,106	1.07	10,863	10,863	0	138	1.55	214	214	0	10,244	11,077	11,077	86,674	0	0
8-Jul	12,958	1.06	13,709	13,709	0	754	1.36	1,022	1,022	0	13,712	14,731	14,731	101,405	0	0
9-Jul	15,404	1.08	16,683	16,683	0	2,909	0.99	2,887	2,887	0	18,313	19,570	19,570	120,975	0	0
10-Jul	13,748	1.04	14,244	14,244	0	2,243	0.96	2,146	2,146	0	15,991	16,390	16,390	137,365	0	0
11-Jul	10,600	1.00	10,564	10,564	0	658	1.06	695	695	0	11,258	11,259	11,259	148,624	0	0
12-Jul	11,288	1.11	12,526	12,526	0	1,083	1.05	1,141	1,141	0	12,371	13,667	13,667	162,291	0	0

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Table 5.–Page 2 of 2.

	Right Bank					Left Bank					Combined Banks					
	Raw[a]		Corrected	Counts Attributed to		Raw[a]		Corrected	Counts Attributed to		Raw[a]	Corrected	Counts Attributed to			
	Daily	Adjust	Daily	Chum	Pink	Daily	Adjust	Daily	Chum	Pink	Daily	Daily	Chum Salmon		Pink Salmon	
Date	Estimate	Factor	Estimate	Salmon	Salmon	Estimate	Factor	Estimate	Salmon	Salmon	Estimate	Estimate	Daily	Cumulative	Daily	Cumulative
13-Jul	10,821	1.01	10,956	10,956	0	1,965	1.10	2,153	2,153	0	12,786	13,109	13,109	175,400	0	0
14-Jul	11,687	0.94	11,043	11,043	0	2,552	0.97	2,466	2,466	0	14,239	13,509	13,509	188,909	0	0
15-Jul	4,438	1.08	4,772	4,772	0	951	1.45	1,379	1,379	0	5,389	6,151	6,151	195,060	0	0
16-Jul	3,782	0.90	3,406	3,406	0	851	0.93	788	788	0	4,633	4,194	4,194	199,254	0	0
17-Jul	3,936	0.90	3,557	3,557	0	1,242	1.11	1,383	1,383	0	5,178	4,940	4,940	204,194	0	0
18-Jul	5,615	1.10	6,170	6,170	0	1,491	1.02	1,516	1,516	0	7,106	7,686	7,686	211,880	0	0
19-Jul	6,071	1.02	6,201	6,201	0	2,315	0.91	2,117	2,117	0	8,386	8,318	8,318	220,198	0	0
20-Jul	4,991	1.07	5,340	5,340	0	1,874	1.01	1,884	1,884	0	6,865	7,224	7,224	227,422	0	0
21-Jul	3,738	0.96	3,594	3,594	0	1,359	1.30	1,771	1,771	0	5,097	5,365	5,365	232,787	0	0
22-Jul	2,733	0.96	2,631	2,631	0	360	0.81	290	290	0	3,093	2,921	2,921	235,708	0	0
23-Jul	3,664	0.92	3,381	3,381	0	564	1.09	615	615	0	4,228	3,996	3,996	239,704	0	0
24-Jul [d]	3,886	0.94	3,645	3,645	0	745	0.91	676	676	0	4,631	4,321	4,321	244,025	0	0
25-Jul			4,692	4,692	0	725	1.62	1,173	1,173	0	725	5,865	5,865	249,890	0	0
26-Jul			3,612	3,612	0	816	1.11	903	903	0	816	4,515	4,515	254,405	0	0
27-Jul [e]			2,012	2,012	0			503	503	0		2,515	2,515	256,920	0	0
Total	211,401		228,010	228,010	0	26,612		28,910	28,910	0	238,013	256,920	256,920		0	
Percent	88.8%		88.7%	88.7%	0.0%	11.2%		11.3%	11.3%	0.0%					0.0%	
Mean		1.04					1.13									

[a] Does not include partial days.
[b] Right bank counting began at 12:00.
[c] Left bank counting began at 00:00.
[d] Right bank counting ended at 24:00.
[e] Left bank counting ended at 19:00.

Table 6.–Bendix and HTI sonar-estimated passage of summer chum salmon, right bank Anvik River, June 23–July 25, 2003.

	Bendix Number of Salmon		HTI Number of Salmon	
Date	Daily	Cumulative	Daily	Cumulative
23-Jun	534	534	764	764
24-Jun	1,609	2,143	1,672	2,436
25-Jun	4,559	6,702	2,372	4,808
26-Jun	4,217	10,919	2,289	7,097
27-Jun	2,974	13,893	3,734	10,831
28-Jun	4,890	18,783	5,808	16,639
29-Jun	4,072	22,855	4,960	21,599
30-Jun	4,615	27,470	4,761	26,360
1-Jul	7,701	35,171	5,476	31,836
2-Jul	8,161	43,332	4,619	36,455
3-Jul	8,375	51,707	6,851	43,306
4-Jul	7,738	59,445	7,455	50,761
5-Jul	6,616	66,061	7,128	57,889
6-Jul	7,693	73,754	7,813	65,702
7-Jul	10,863	84,617	11,168	76,870
8-Jul	13,709	98,326	12,613	89,483
9-Jul	16,683	115,009	14,881	104,364
10-Jul	14,244	129,253	14,374	118,738
11-Jul	10,564	139,817	10,946	129,684
12-Jul	12,526	152,343	11,746	141,430
13-Jul	10,956	163,299	12,178	153,608
14-Jul	11,043	174,342	11,784	165,392
15-Jul	4,772	179,114	3,686	169,078
16-Jul	3,406	182,520	2,852	171,930
17-Jul	3,557	186,077	3,930	175,860
18-Jul	6,170	192,247	6,049	181,909
19-Jul	6,201	198,448	5,513	187,422
20-Jul	5,340	203,788	4,395	191,817
21-Jul	3,594	207,382	3,252	195,069
22-Jul	2,631	210,013	1,760	196,829
23-Jul	3,381	213,394	2,941	199,770
24-Jul	3,645	217,039	2,988	202,758
25-Jul	4,692	221,731	2,472	205,230
Total	221,731		205,230	SE=1,710

Table 7.–Anvik River summer chum salmon estimated passage and proportions by hour and bank, 2003.

Hour Ending	Right Bank		Left Bank		Proportion of the Run		
	Count	Cum.	Count	Cum.	Right Bank	Left Bank	Total
0100	11,940	11,940	1,281	1,281	0.046	0.005	0.051
0200	11,779	23,719	1,268	2,550	0.046	0.005	0.051
0300	10,470	34,189	1,431	3,981	0.041	0.006	0.046
0400	10,763	44,952	1,193	5,173	0.042	0.005	0.047
0500	11,087	56,040	1,022	6,196	0.043	0.004	0.047
0600	11,236	67,276	898	7,094	0.044	0.003	0.047
0700	11,188	78,463	765	7,859	0.044	0.003	0.047
0800	10,977	89,441	812	8,671	0.043	0.003	0.046
0900	9,862	99,303	832	9,503	0.038	0.003	0.042
1000	9,141	108,444	879	10,382	0.036	0.003	0.039
1100	9,144	117,587	975	11,357	0.036	0.004	0.039
1200	8,823	126,410	839	12,196	0.034	0.003	0.038
1300	9,051	135,461	840	13,036	0.035	0.003	0.038
1400	8,774	144,236	971	14,007	0.034	0.004	0.038
1500	8,380	152,615	943	14,950	0.033	0.004	0.036
1600	7,089	159,705	1,101	16,051	0.028	0.004	0.032
1700	7,293	166,998	1,104	17,154	0.028	0.004	0.033
1800	7,903	174,901	1,396	18,550	0.031	0.005	0.036
1900	8,620	183,521	1,557	20,107	0.034	0.006	0.040
2000	8,293	191,815	1,615	21,722	0.032	0.006	0.039
2100	8,088	199,902	1,866	23,589	0.031	0.007	0.039
2200	8,372	208,274	2,075	25,664	0.033	0.008	0.041
2300	9,044	217,318	1,845	27,509	0.035	0.007	0.042
2400	10,692	228,010	1,402	28,911	0.042	0.005	0.047
Totals		228,010		28,911	0.887	0.113	1.000

Table 8.–Anvik River summer chum salmon estimated passage and proportions by sector and bank, 2003.

	Right Bank		Left Bank		Proportion of the Run		
Sector	**Count**	**Cum.**	**Count**	**Cum.**	**Right Bank**	**Left Bank**	**Cum.**
1	932	932	73	73	0.004	0.000	0.004
2	4,632	5,564	350	422	0.018	0.001	0.019
3	20,354	25,918	767	1,189	0.079	0.003	0.082
4	36,541	62,460	2,198	3,387	0.142	0.009	0.151
5	25,869	88,329	3,278	6,665	0.101	0.013	0.113
6	25,932	114,261	3,550	10,215	0.101	0.014	0.115
7	14,292	128,553	2,830	13,045	0.056	0.011	0.067
8	6,960	135,513	2,280	15,325	0.027	0.009	0.036
9	33,823	169,336	2,232	17,558	0.132	0.009	0.140
10	20,229	189,565	3,004	20,562	0.079	0.012	0.090
11	11,696	201,262	2,164	22,726	0.046	0.008	0.054
12	7,993	209,254	1,918	24,643	0.031	0.007	0.039
13	7,038	216,292	1,473	26,116	0.027	0.006	0.033
14	3,836	220,128	1,057	27,173	0.015	0.004	0.019
15	4,110	224,238	1,056	28,228	0.016	0.004	0.020
16	3,772	228,010	682	28,911	0.015	0.003	0.017
Total	228,010		28,911		0.887	0.113	1.000

Table 9.–Anvik River beach seine catch by species, sex, day, and stratum, and the number of chum salmon sampled for age, sex, and length information, 2003.

	Chum Salmon									Other Fish					
	Number Captured			Number Sampled			Number Aged			Salmon					
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Pink	Chinook	Grayling	Whitefish	Dolly Varden	Other
28-Jun	24	28	52	23	27	50	21	26	47	0	0	2	1	0	
29-Jun	32	10	42	32	9	41	30	9	39			2	2	1	
1-Jul	29	35	64	29	34	63	29	29	58				3		
Subtotal (Strata 1)	85	73	158	84	70	154	80	64	144	0	0	4	6	1	
6-Jul	22	23	45	21	33	54	20	31	51				1		
8-Jul	28	45	73	28	45	73	27	45	72						
9-Jul	45	39	84	21	19	40	19	19	38		1	1	1		
Subtotal (Strata 2)	95	107	202	70	97	167	66	95	161	0	0	5	8	1	
14-Jul	21	39	60	21	37	58	20	55	75		3	4	4		5
15-Jul	56	48	104	52	46	98	44	43	87	1	1	4	7		2
Subtotal (Strata 3)	77	87	164	73	83	156	64	98	162	1	5	14	20	1	
18-Jul	39	56	95	39	56	95	38	55	93			1	6	1	
19-Jul	9	16	25	8	15	23	7	14	21			2	2		
20-Jul	15	30	45	11	29	40	11	26	37			3	4		
Subtotal (Strata 4)	63	102	165	58	100	158	56	95	151	0	0	6	12	1	
Season Total	320	369	689	285	350	635	266	352	618	1	5	29	46	4	

Table 10.–Anvik River summer chum salmon escapement age and sex composition, and mean length (mm), 2003.

		Brood Year and Age Group				
		2000	1999	1998	1997	
		0.2	0.3	0.4	0.5	Total
Sample Size:	584					
Female	No. in Escapement	2,976	108,075	28,723	1,673	141,448
	Percent of Sample	1.2	42.1	11.2	0.7	55.1
	Mean Length	520.0	535.0	564.0	603.0	
	Std. Error	15.0	2.0	4.0	12.0	
Male	No. in Escapement	831	78,609	34,249	1,782	115,472
	Percent of Sample	0.3	30.6	13.3	0.7	44.9
	Mean Length	525.0	566.0	605.0	629.0	
	Std. Error	--	2.0	4.0	19.0	
Total	No. in Escapement	3,807	186,685	62,973	3,456	256,920
	Percent of Sample	1.5	72.7	24.5	1.3	100.0

Table 11.–Anvik River climatological and hydrological observations at the sonar site, 2003.

Date	Precipitation	Wind Direction	Velocity	Sky Code	Temperature (C) Air Min.	Air Max.	Water Temp.	Water Height Actual (cm)	Relative (cm)	Water Color	Comments
18-Jun	I	Calm	0	3	--	--	--	123.9	0.0	BR	Set measurement stake at 1.6'.
19-Jun	I	Calm	0	4	--	--	11	139.4	15.5	BR	
20-Jun	I	Calm	0	3	--	28	10	170.3	46.5	BR	
21-Jun	I	Calm	0	2	9	22	13	139.4	15.5	BR	
22-Jun	--	--	--	--	--	--	--	--	--	BR	Weather not recorded.
23-Jun	I	--	0-5	3	11	25	14	108.4	-15.5	BR	
24-Jun	None	Calm	0	2	10	24	12	162.6	38.7	LT	
25-Jun	I	S	10	3	9	23	12	162.6	38.7	DK	High H2O event overnight, up to 2.8'.
26-Jun	None	S	5-10	2	9	19	12	116.1	-7.7	BR	H20 dropping quickly, few bugs.
27-Jun	I	Calm	0	2	7	19	13	85.2	-38.7	LT	
28-Jun	None	S	10-15	3	7	18	13	69.7	-54.2	LT	
29-Jun	I	Calm	0	4	10	18	13	69.7	-54.2	LT	
30-Jun	I	--	0-5	4	--	15	11	7.7	-116.1	LT	
1-Jul	I	--	0-5	4	12	15	11	92.9	-31.0	LT	
2-Jul	I	--	0-2	3	11	14	10	178.1	54.2	BR	
3-Jul	None	Calm	0	3	11	18	11	201.3	77.4	BR	
4-Jul	None	Calm	0	2	12	20	12	162.6	38.7	LT	Cloudy most morning, clear midday.
5-Jul	None	Calm	0	2	12	22	12	116.1	-7.7	LT	
6-Jul	None	Calm	0	2	12	22	12	92.9	-31.0	LT	
7-Jul	None	N	10-15	1	6	23	15	69.7	-54.2	CL	
8-Jul	None	Calm	0	1	12	26	16	54.2	-69.7	CL	
9-Jul	None	S	10	1	14	26	15	46.5	-77.4	CL	Gauge moved from 0.6' to 1.8'.
10-Jul	I	Calm	0	4	10	21	14	31.0	-92.9	CL	
11-Jul	I	Calm	0	4	11	18	13	23.2	-100.6	LT	
12-Jul	None	S	0-5	1	12	24	15	23.2	-100.6	LT	
13-Jul	None	S	10-15	1	12	28	17	15.5	-108.4	CL	

-continued-

Table 11.–Page 2 of 2.

					Temperature (C)			Water Height			
Date	**Precipitation**	**Wind Direction**	**Velocity**	**Sky Code**	**Air Min.**	**Air Max.**	**Water Temp.**	**Actual (cm)**	**Relative (cm)**	**Water Color**	**Comments**
14-Jul	None	Calm	0	3	12	26	15	0.0	-123.9	CL	
15-Jul	I	NW	10-15	4	8	17	13	0.0	-123.9	CL	
16-Jul	None	N	10-15	2	3	13	12	15.5	-108.4	CL	
17-Jul	None	N	10-15	1	-1	17	12	7.7	-116.1	CL	Shifty winds all over.
18-Jul	None	Calm	0	2	13	22	14	-7.7	-131.6	CL	
19-Jul	None	N	5-10	1	13	25	17	-23.2	-147.1	CL	Variable winds.
20-Jul	None	N	5-10	1	10	28	17	-15.5	-139.4	CL	Gauge moved from 0.6' to 1.2'.
21-Jul	None	Calm	0	4	11	22	16	15.5	-108.4	CL	
22-Jul	I	Calm	0	4	12	21	16	23.2	-100.6	CL	
23-Jul	I	Calm	0	4	13	24	14	23.2	-100.6	CL	
24-Jul	I	Calm	0	3	14	24	13	46.5	-77.4	LT	
25-Jul	None	NW	5-10	4	13	22	13	92.9	-31.0	LT	
26-Jul	I	N	10-15	4	--	--	--	100.6	-23.2	Br	
27-Jul	I	N	10-15	4	--	--	11	178.1	54.2	Tr	

Weather Codes

SKY		PRECIPITATION		WATER COLOR	
0	No observation made.	I	Intermittent rain	Cl	Clear
1	Clear sky, cloud cover < 10% of sky.	R	Continuous rain	Lt	Light Brown
2	Cloud cover 10% - 50% of sky.	S	Snow	Br	Brown
3	Cloud cover > 50% of sky.	S&R	Mixed snow and rain	Dk	Dark Brown
4	Completely overcast.	H	Hail	Tr	Turbid: murky or glacial
5	Fog or thick haze or smoke.	T	Thunder showers		

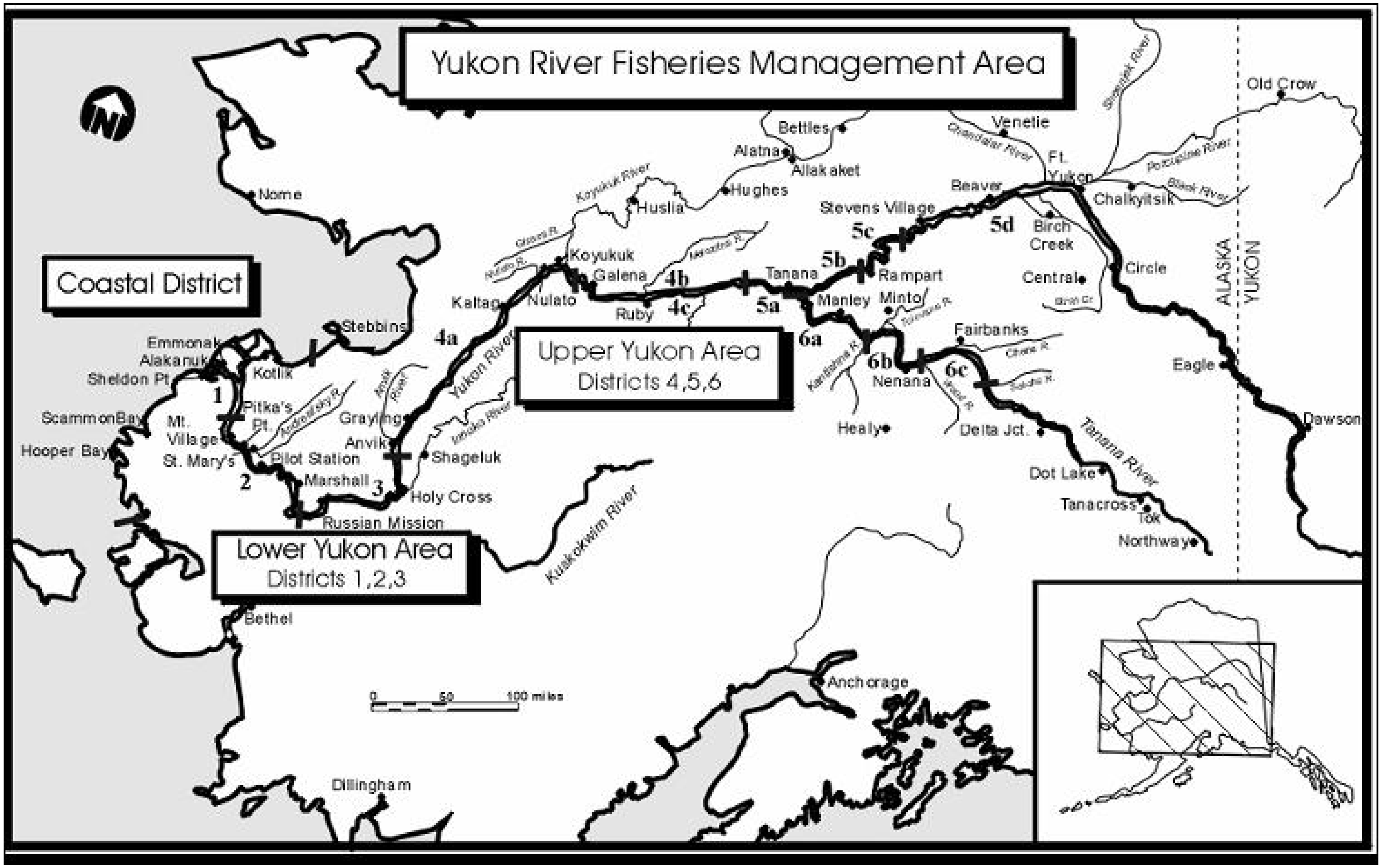


Figure 1.–Alaska portion of the Yukon River drainage showing communities and fishing districts.

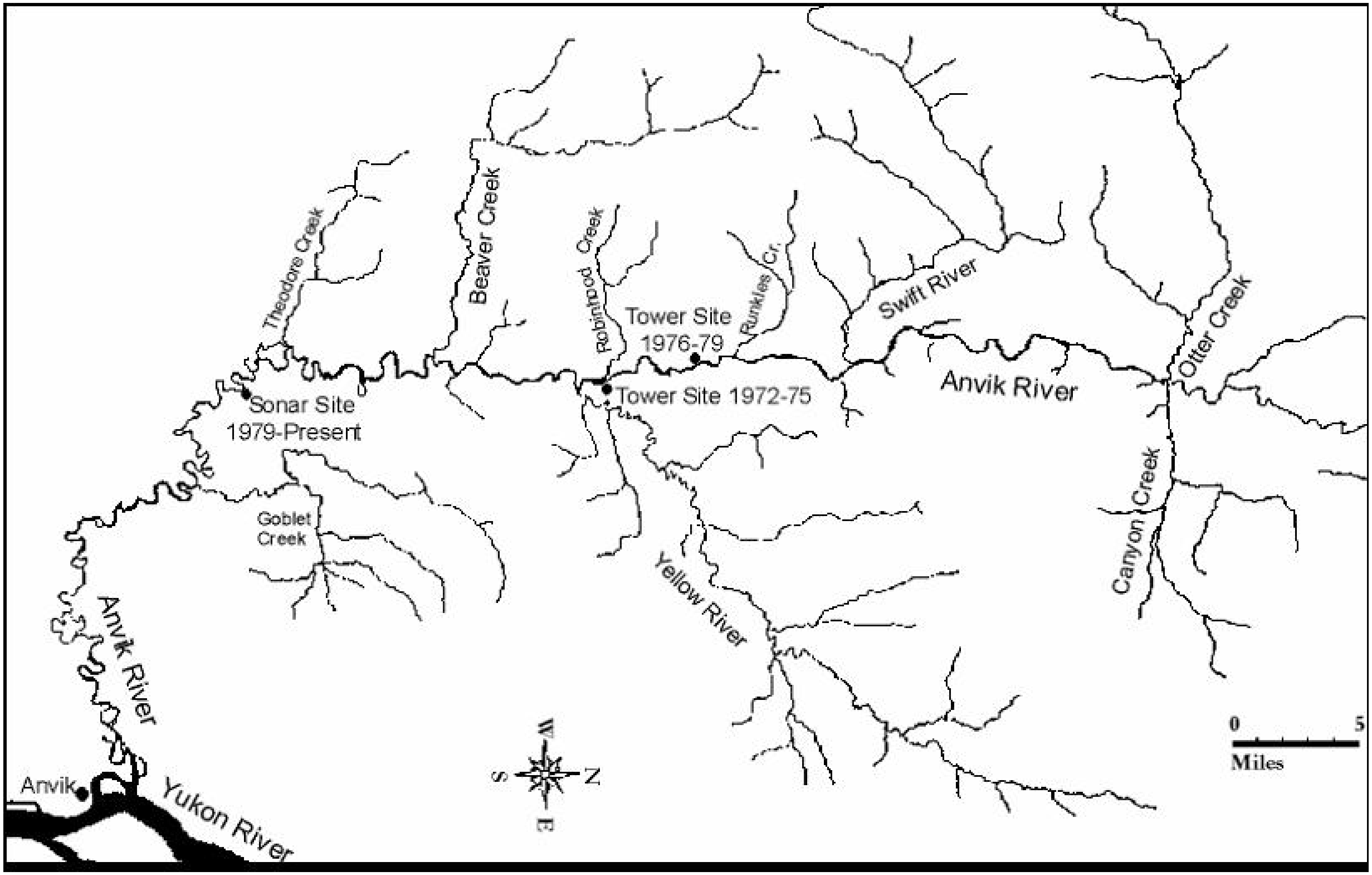


Figure 2.–Map of the Anvik River drainage with historical chum salmon escapement project locations.

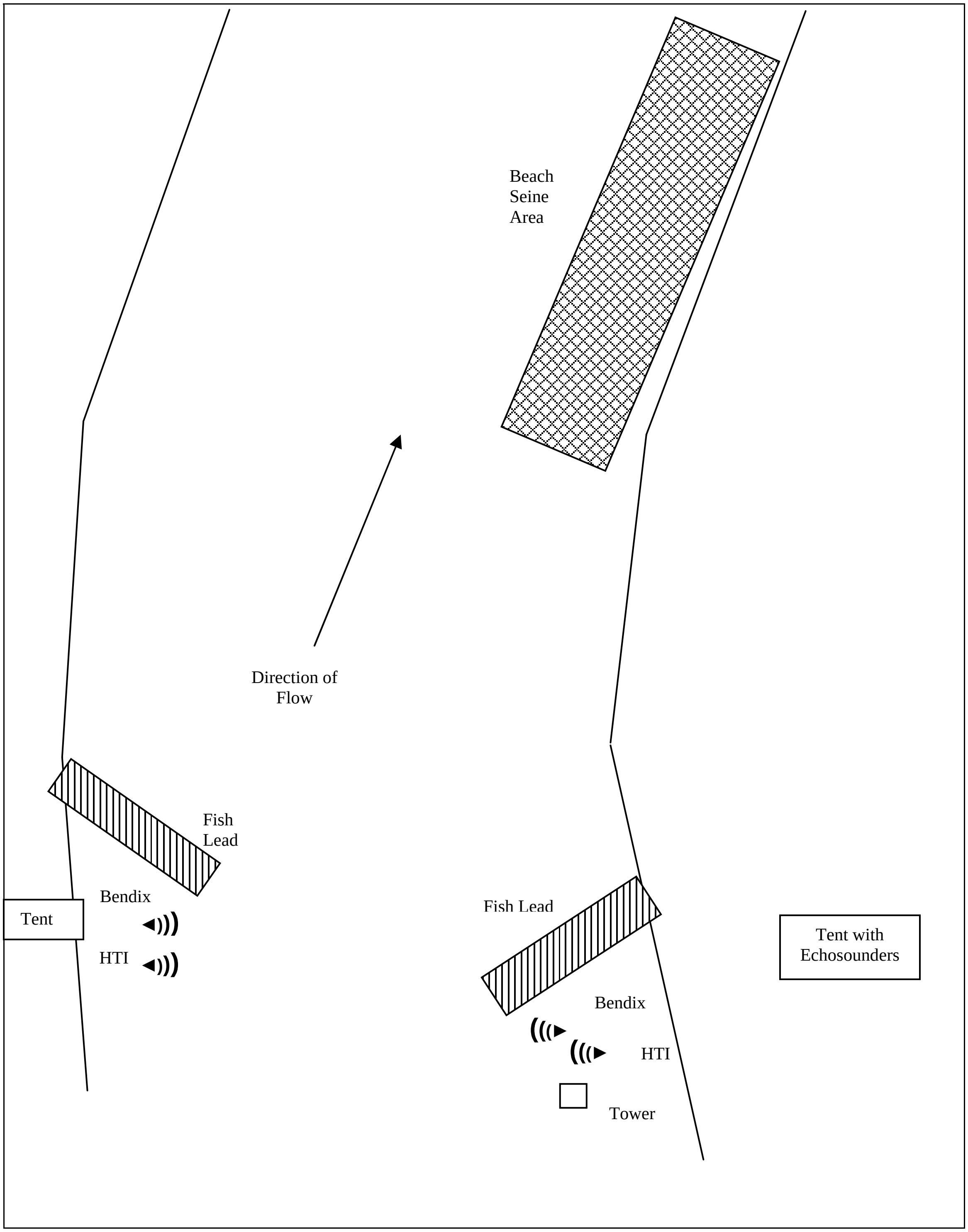


Figure 3.–Anvik River summer chum salmon sonar site and beach seine area, 2003.

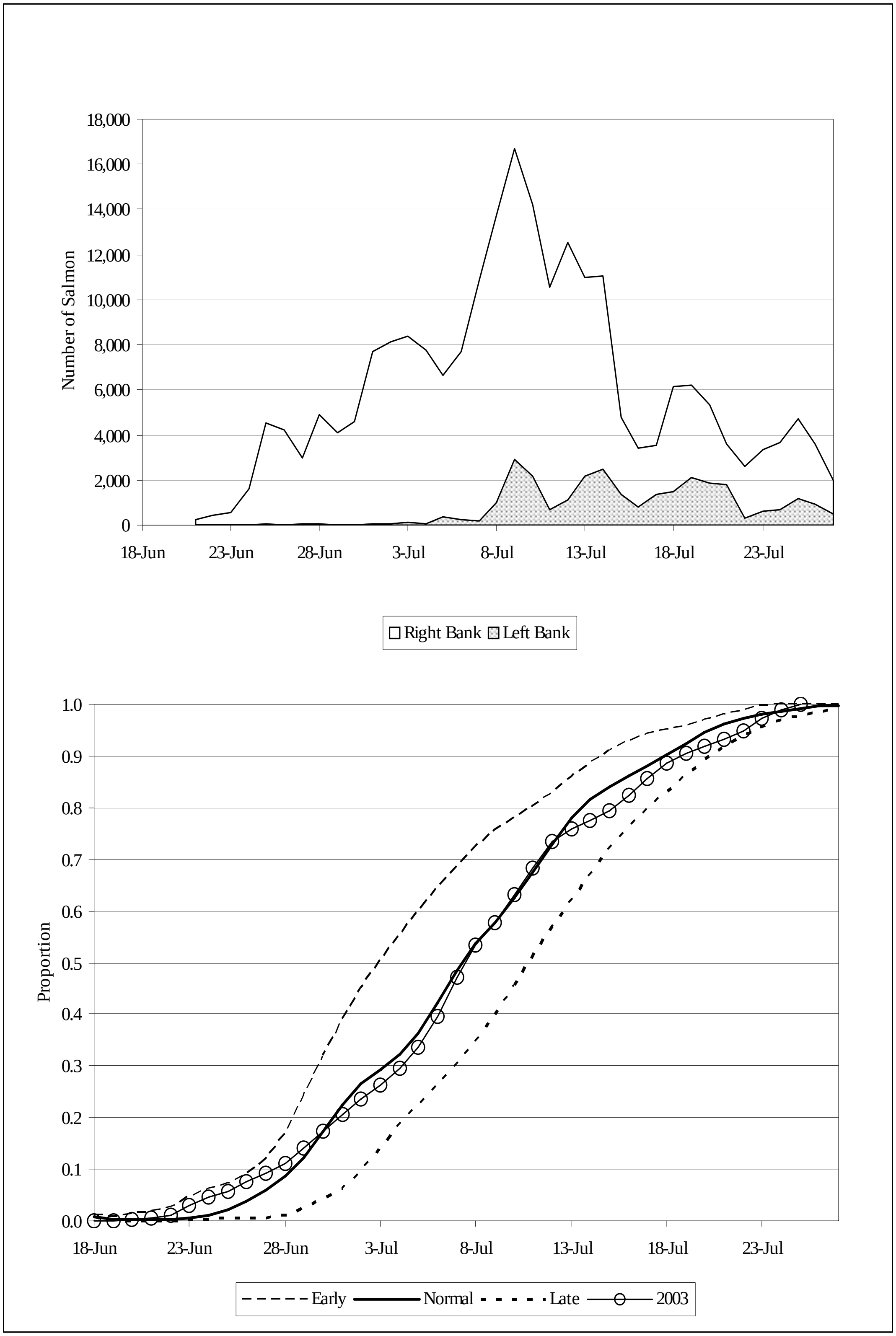


Figure 4.–Anvik River summer chum salmon Bendix sonar estimated daily escapement by bank (top) and the 2003 cumulative escapement proportions compared to Early, Normal and Late run timing based on historical run timing (bottom).

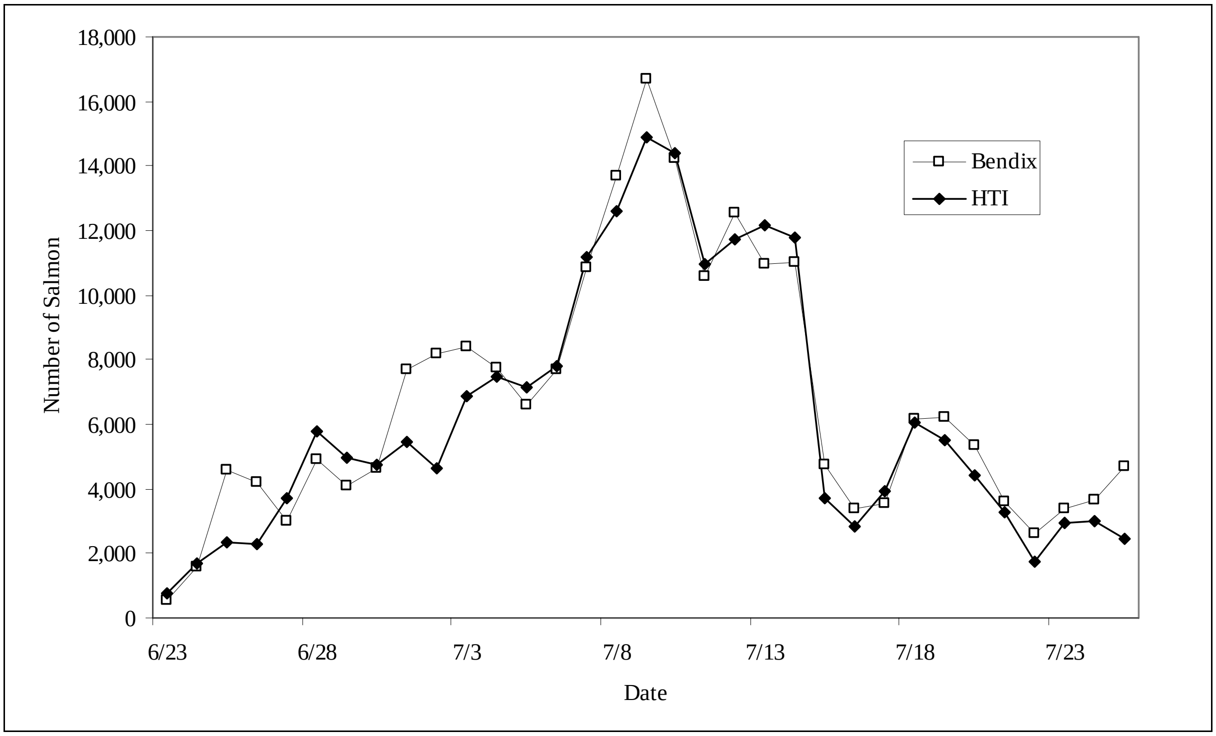


Figure 5.–Bendix and HTI sonar-estimated passage of summer chum salmon, right bank Anvik River June 23 through July 25, 2003.

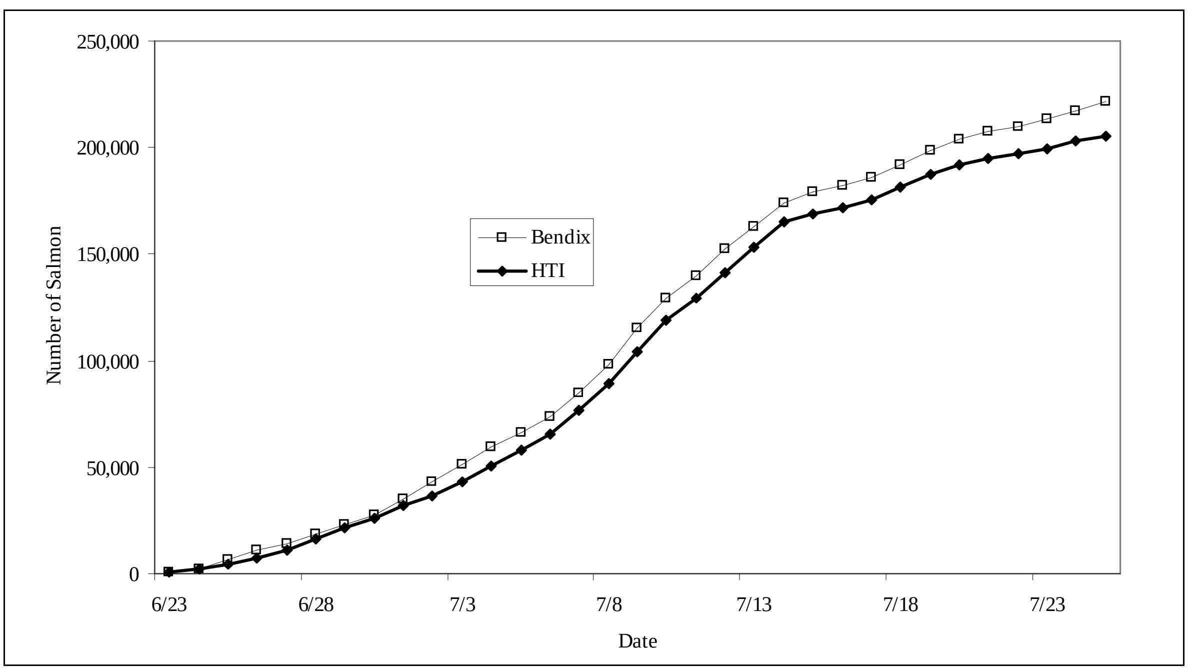


Figure 6.–Bendix and HTI cumulative escapement estimates, right bank Anvik River June 23 through July 25, 2003.

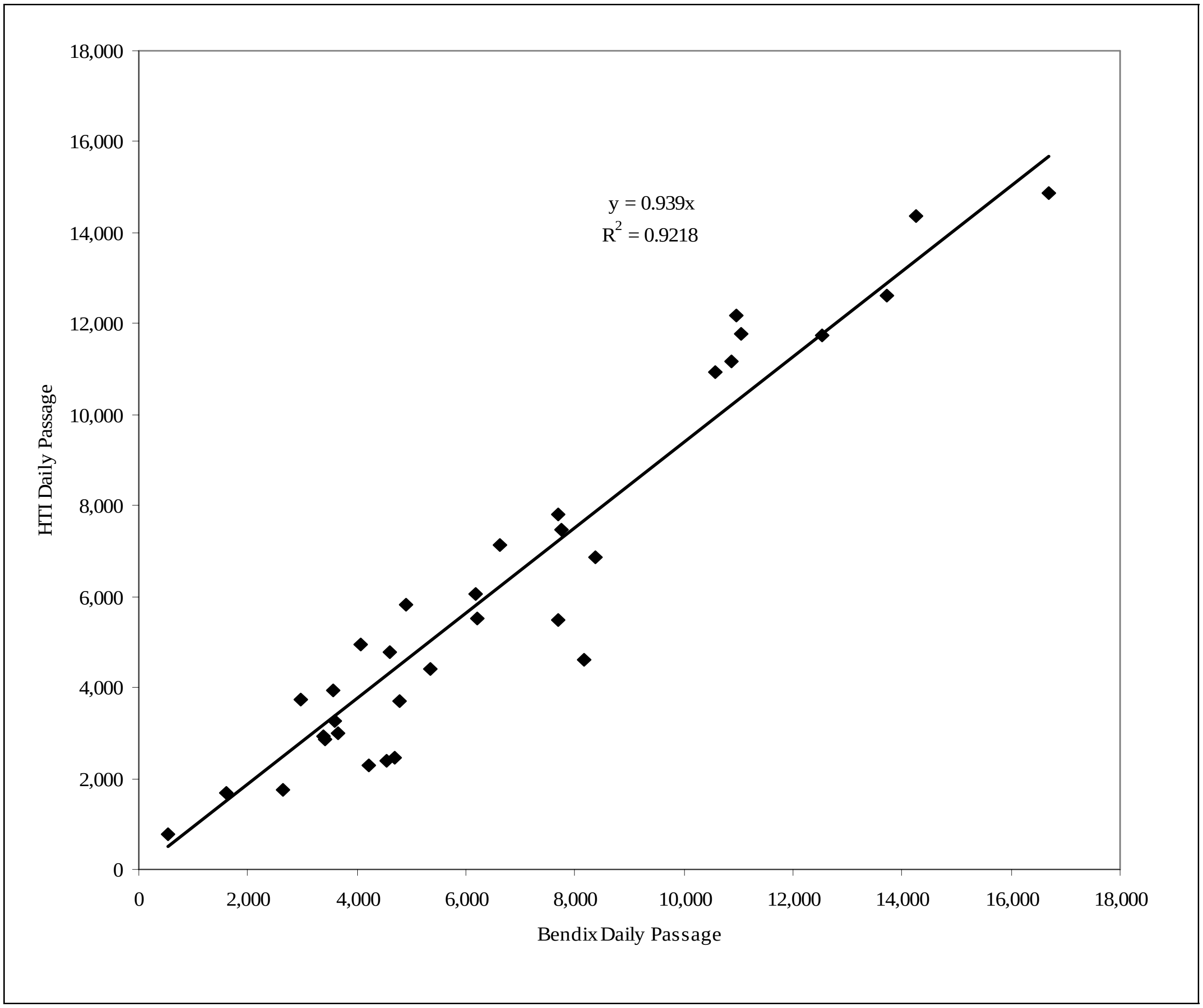


Figure 7.–Bendix and HTI comparison of daily fall chum salmon passage, right bank Anvik River, June 23 through July 25, 2003.

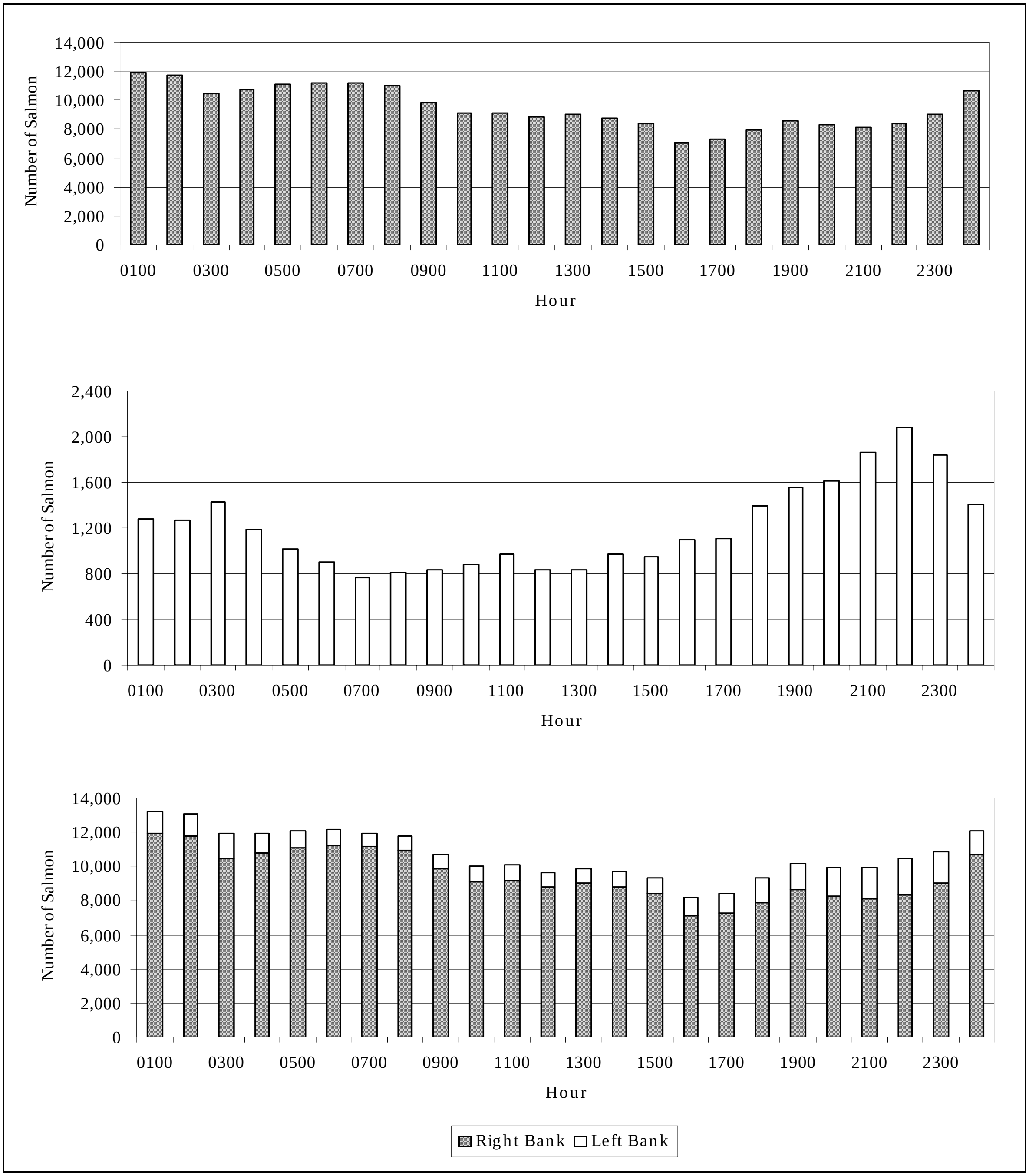


Figure 8.–Anvik River adjusted Bendix sonar estimated passage by hour for right bank (top), left bank (middle) and both banks combined (bottom), 2003.

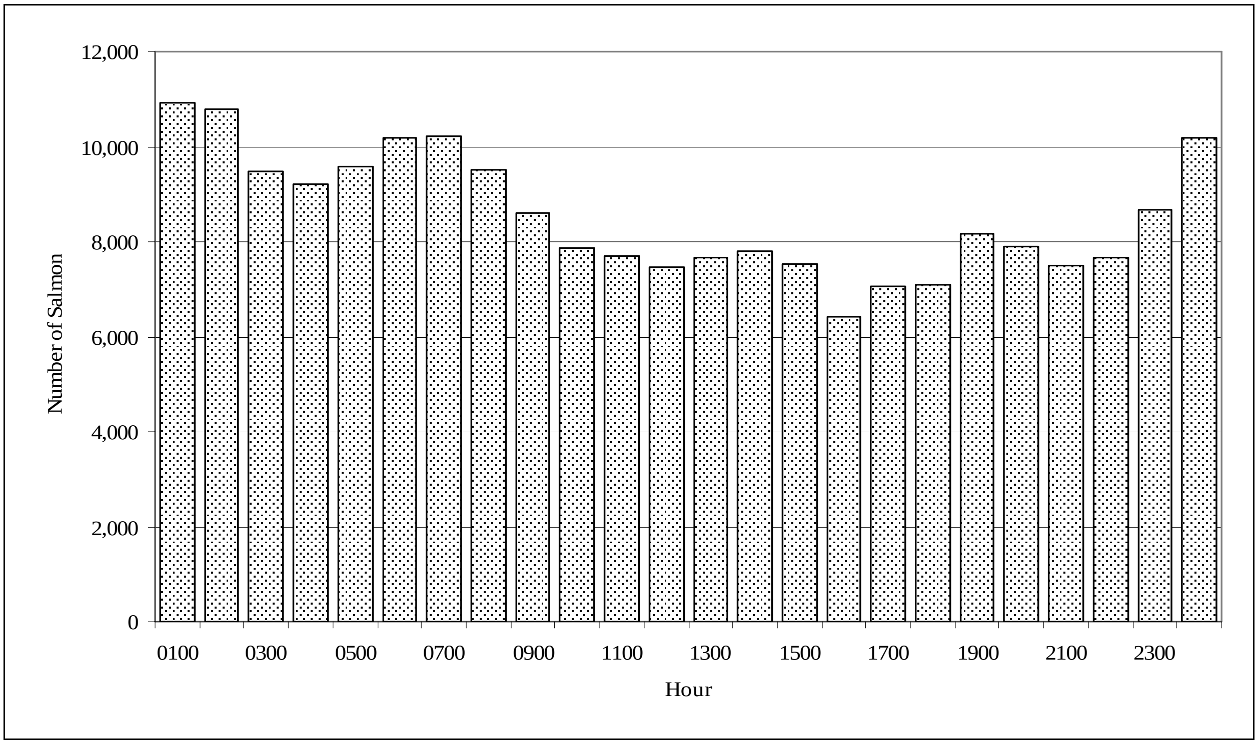


Figure 9.–Anvik River adjusted HTI sonar estimated passage by hour for the right bank, June 23 through July 25, 2003.

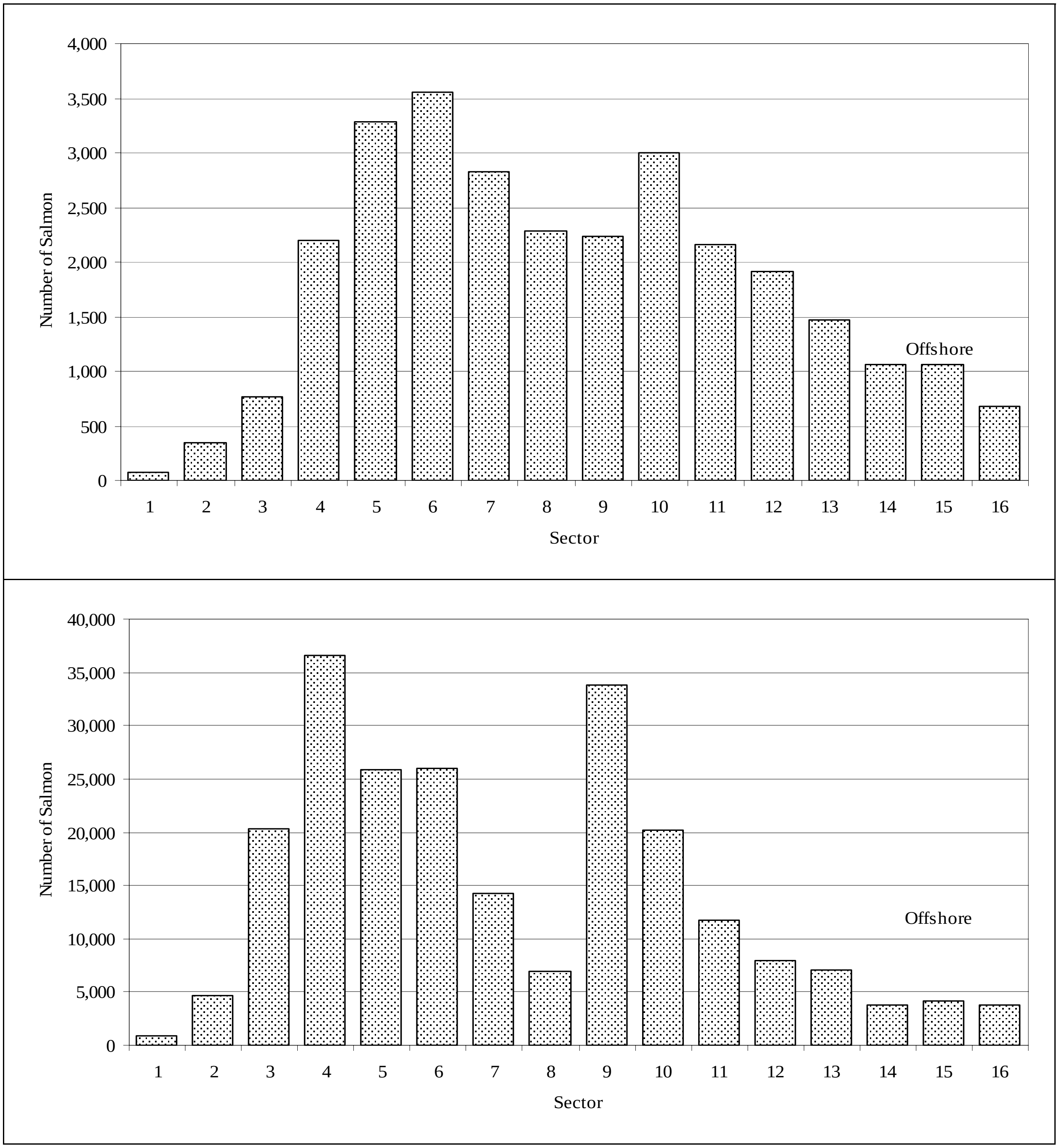
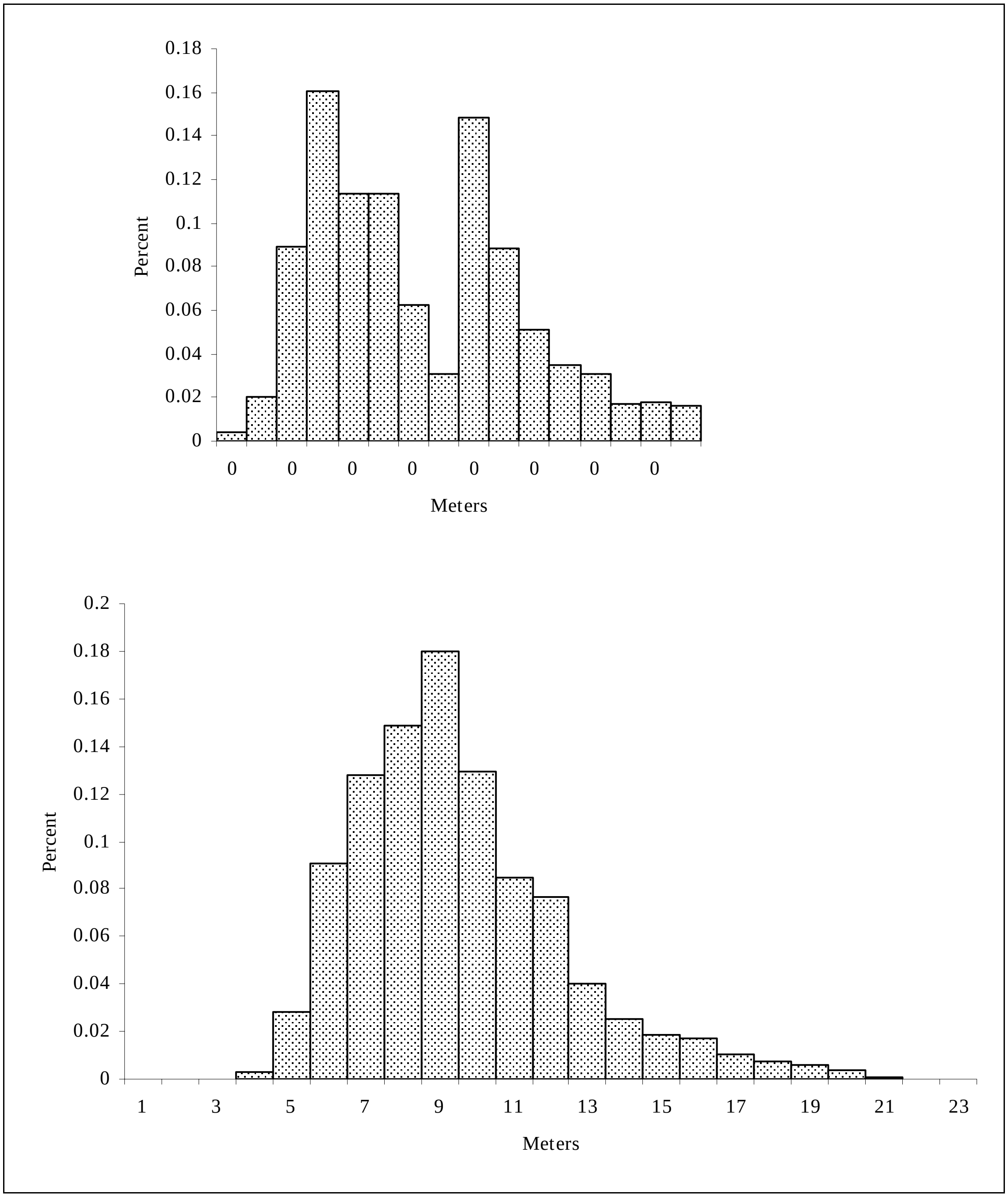
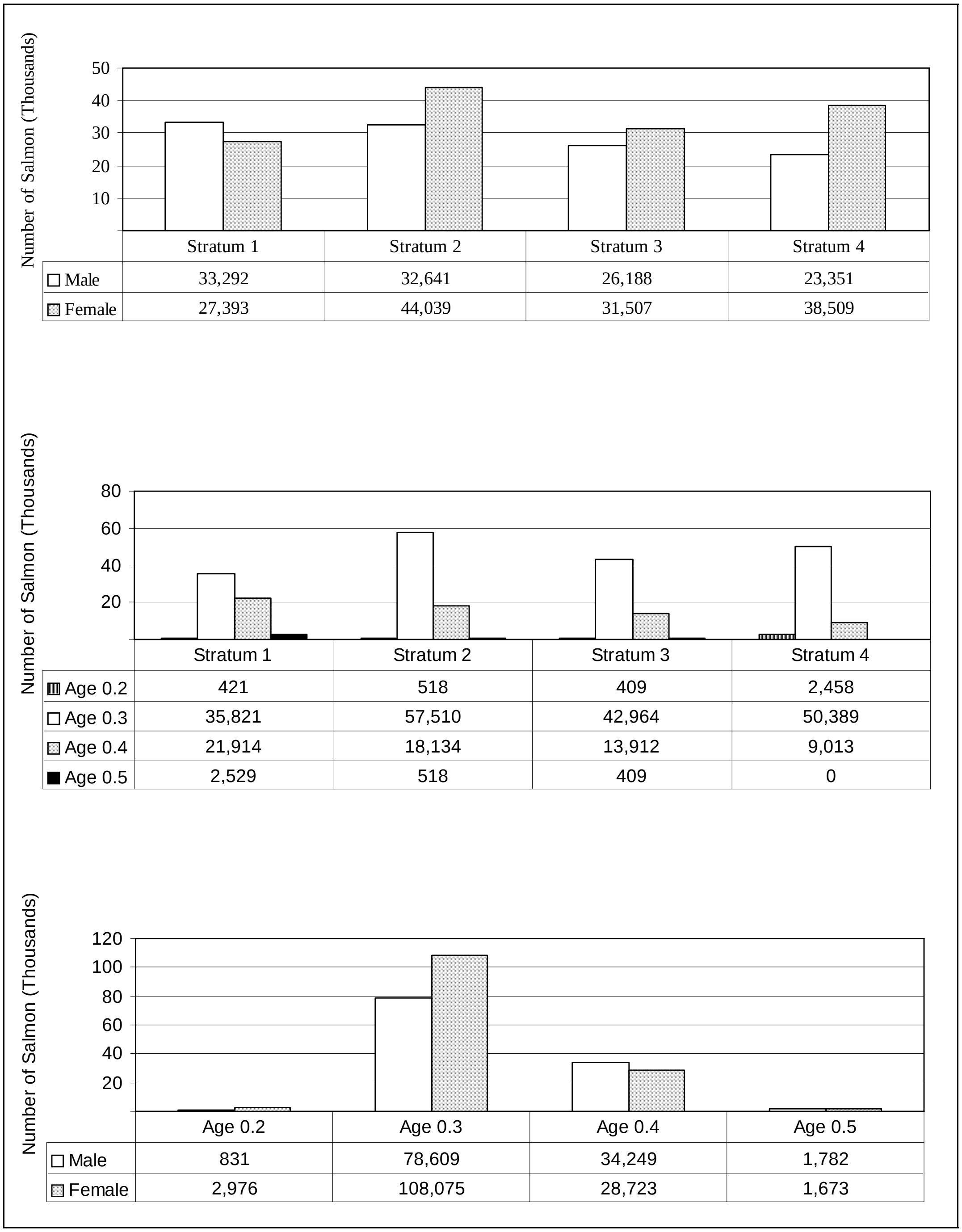


Figure 10.–Anvik River adjusted Bendix sonar-estimated passage by sector for left (top) and right bank (bottom), 2003.



Note: Charts are offset to account for transducer placement.

Figure 11.–Comparison of Bendix (top) and HTI (bottom) estimated upstream passage distribution on the right bank of the Anvik River, June 23 through July 25, 2003.



	Stratum 1	Stratum 2	Stratum 3	Stratum 4
Male	33,292	32,641	26,188	23,351
Female	27,393	44,039	31,507	38,509

	Stratum 1	Stratum 2	Stratum 3	Stratum 4
Age 0.2	421	518	409	2,458
Age 0.3	35,821	57,510	42,964	50,389
Age 0.4	21,914	18,134	13,912	9,013
Age 0.5	2,529	518	409	0

	Age 0.2	Age 0.3	Age 0.4	Age 0.5
Male	831	78,609	34,249	1,782
Female	2,976	108,075	28,723	1,673

Figure 12.–Anvik River summer chum salmon sex (top) and age (middle) composition by stratum, and sex composition by age group (bottom), 2003.

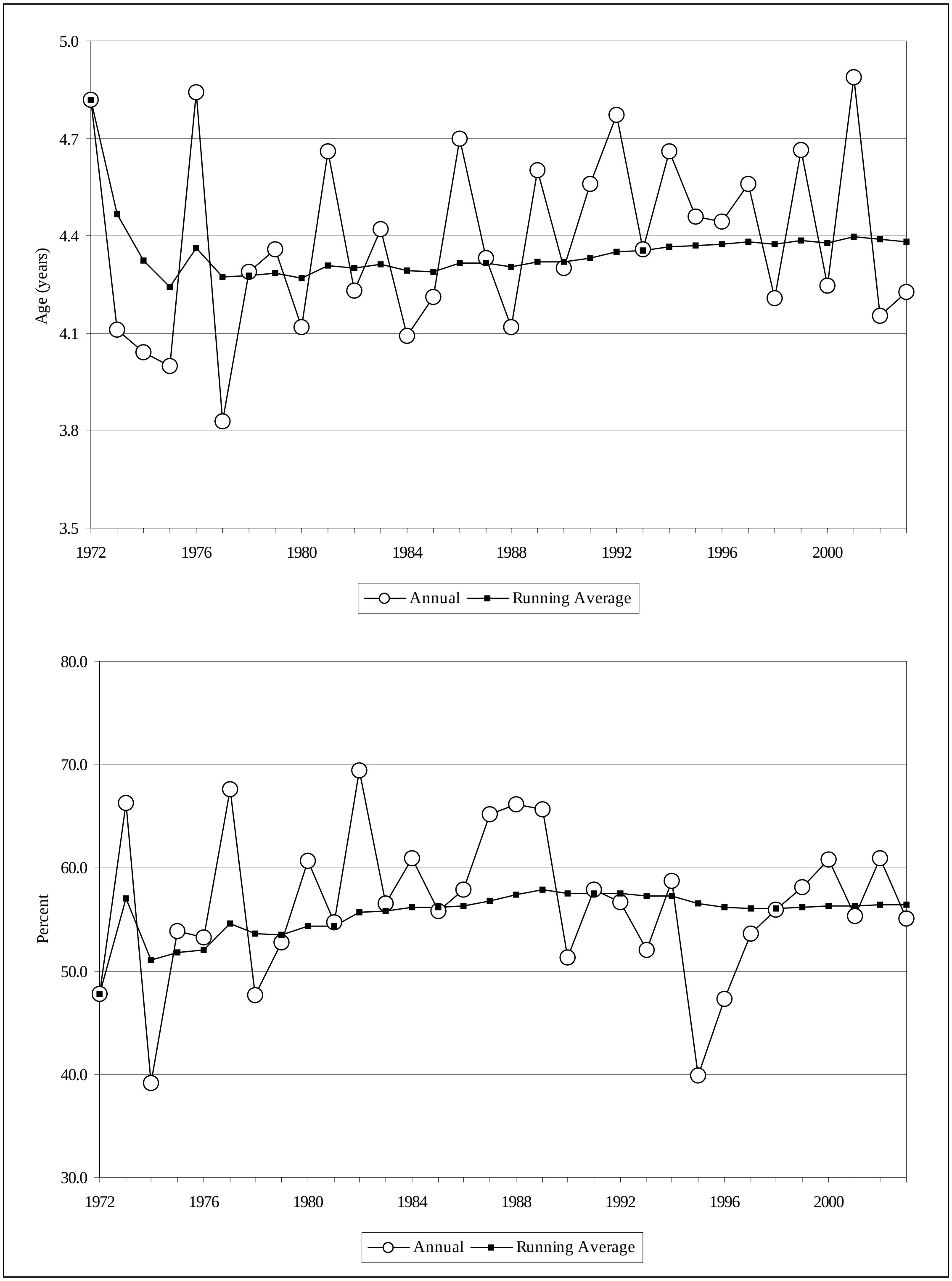


Figure 13.–Annual age at maturity (top) and percentage of females (bottom) of the Anvik River chum salmon escapement, 1972–2003.

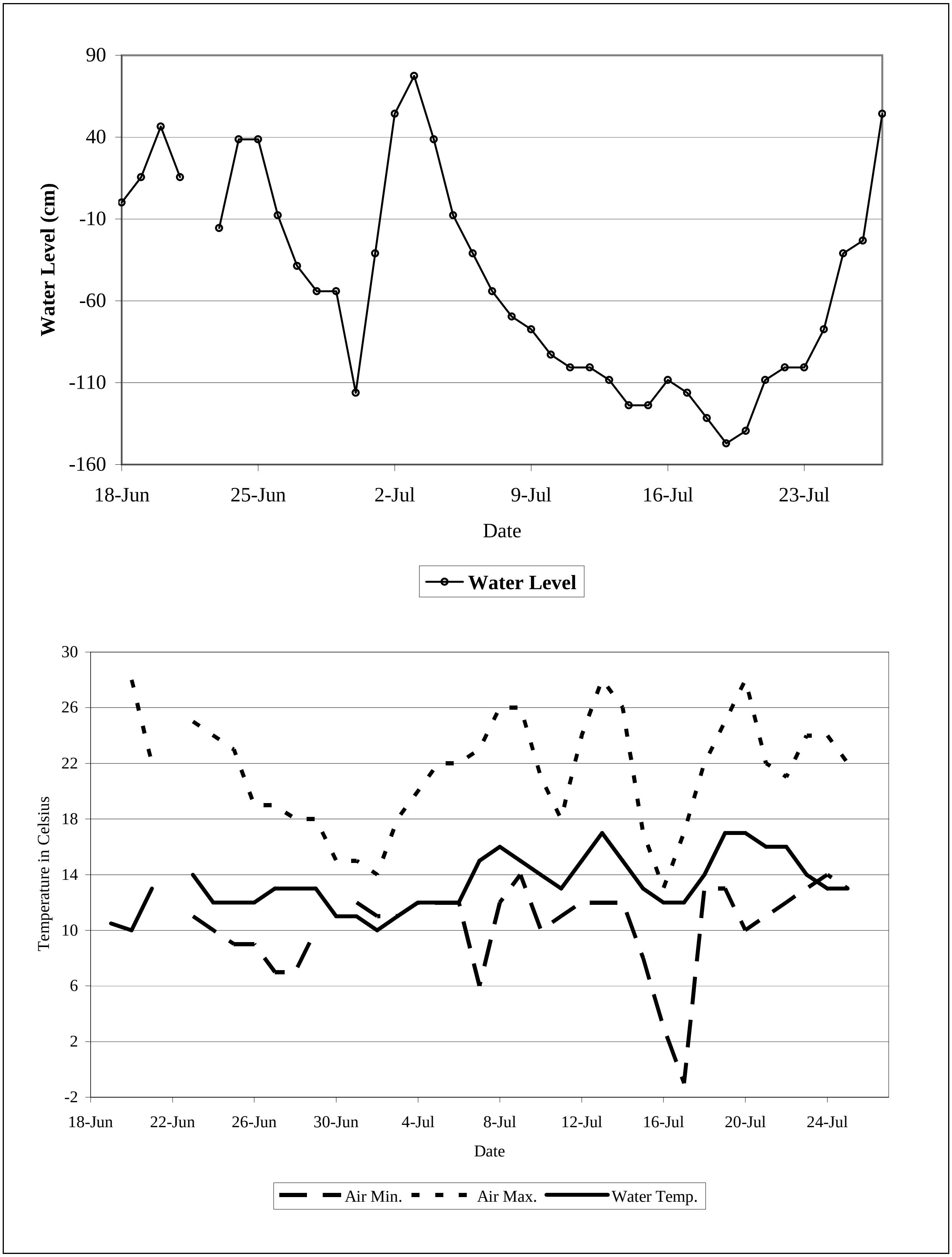


Figure 14.–Anvik River hydrological and climatological observations at the sonar site, 2003.

APPENDIX A. ECHO SOUNDER SPECIFICATIONS

Appendix A1.–Technical specifications for the Model 241 Portable Split-Beam Digital Echo Sounder (taken from model 241 operators manual).

Size:	10 inches wide x 4.3 high x 17 long, without PC or transducer (254 mm wide x 109 high x 432 long).
Weight:	20 lb. (9 kg) without PC or transducer.
Power Supply:	Nominal 12 VDC standard (120 VAC and 240 VAC optional).
Operating Temperature:	5-50°C (41-122°F).
Power Consumption:	30 watts (120 - 200 kHz), without laptop PC.
Frequency:	200 kHz standard (120 kHz and 420 kHz optional).
Transmit Power:	100 watts standard for 120-200 kHz. 50 watts standard for 420 kHz.
Dynamic Range:	140 dB
Transmitter:	Output power is adjustable in four steps over a 20 dBw range (+2, +8, +14, and 20 dBw).
Pulse Length:	Selectable from 0.1 msec to 1.0 msec in 0.1 msec steps.
Bandwidth:	Receiver bandwidth is automatically adjusted to optimize performance for the selected pulse length.
Receiver Gain:	Overall receiver gain is adjustable in five steps over a 40 dB range (-16, -8, 0, +8, +16 dB).
TVG Functions:	Simultaneous 20 and 40 log(R)+2αr TVG. Spreading loss and alpha are programmable to nearest 0.1 dB. Total TVG range is 80 dB. TVG start is selectable in 1m increments. The minimum TVG start is 1.0 m to maximum of 200 m.
Receiver Blanking:	Start and stop range blanking is selectable in 1m steps.
Undetected Output:	12 kHz, for each formed beam
Detected Output:	10 volts peak
System Synchronization:	Internal or external trigger
Ping Rate:	0.5-40.0 pings/sec
Phase Calculation:	Quadrature demodulation
Angular Resolution:	+/- <0.1° (6° beam width, 200 kHz)
Tape recording:	With Split-Beam Data Tape Interface and optional Digital Audio Tape (DAT) recorder, directly records the digitized split-beam data, permitting complete reconstruction of the raw data output.
Calibrator:	Local receiver calibration check using internal calibration source. Pulse and CW calibration functions provided in step settings.
Positioning:	GPS positioning information (NMEA 0183 format) via serial port of computer

APPENDIX B. BOTTOM REMOVAL PROGRAM CODE

Appendix B1.–C program code used to remove stationary object (bottom) echoes from HTI .raw echo files.

```
//-------------------------------------------------
//BottRemov.c
//Carl Pfisterer 11/15/2000
//
//This program removes bottom from a *.raw file by calculating a moving
//average of TS in each range bin and removing echoes that are within
//a specified distance from this average.
//
//Note: This program isn't written in a real good way.  When I get the
//chance I will try to re-write the program using a more object
//oriented design.
//-------------------------------------------------
#include <stdio.h>
#include <math.h>
#include <stdlib.h>
#include <string.h>

//Data Structures
typedef struct
{
	int fishNum;
	int pingNum;
	int include;
	char row[150];
	float TS;
	float range;
}SonarInfo;

const int avgNum=1000;

typedef struct
{
	float values[avgNum];		//TS values used in average
	int pingGaps[avgNum];		//Ping gaps
	float average;		//Average of TS values in range bin
	float gapSum;
```

-continued-

```
        float sum;          //Sum of TS values in range bin
        int number;                 //Number of values averaged over
        int lastPing;       //Ping number of last ping used in calculating the moving average
    float prevAvg;
    float sdDev;
}EchoRange;
typedef struct
{
        char headerRow[150];
}HeaderInfo;

//Prototypes
void ReadData(FILE *inFile,HeaderInfo *hRows,SonarInfo *sData,int numLines);
void PrintData(HeaderInfo *hRows,SonarInfo *sData,int numLines);
void WriteData(FILE *inFile,HeaderInfo *hRows,SonarInfo *sData,int numLines);
void WriteDebug(FILE *debugFile,SonarInfo *sData,int numLines);
void CalcStats(int numLines,SonarInfo *sData,EchoRange *rangeBins);
void ExtractData(int numLines,SonarInfo *sData);
void GetFishNum(int i,SonarInfo *sData);
void GetTS(int i,SonarInfo *sData);
void GetRange(int i,SonarInfo *sData);
void GetPingNum(int i,SonarInfo *sData);
int GetHeaderLength(FILE *inFile);
int GetNumLines(FILE *inFile);
float ExtractNumber(char dataStr[],int numSkip);
int GetMaxRng(int numLines,SonarInfo *sData);
void InitializeBins(EchoRange *rangeBins,int lastPing);

//Globals
int headerLength;
//int avgNum;
int numBins;
float binLength;
float critical;             //Critcal value used for filtering
float threshold=-40;
int minNum=70;              //Percentage of pings that must have echoes
//------------------------------------------------
//This long ugly mess is just what a main function
//should not be...long.  Well, this was just a quick
//and dirty implementation, if I ever have the time
```

-continued-

```
//or desire I will implement this better.
//-------------------------------------------------
int main(void)
{
	FILE *inFile;
	//FILE *debugFile;
	char fileName[100],saveFile[100],tempCrit[10];
	HeaderInfo *hRows;
	SonarInfo *sData;
	EchoRange *rangeBins;
	int numLines,maxRange;

	printf("Enter the file name or return to exit: \n");
	while(strlen(gets(fileName))>0)
	{
		strcpy(saveFile,fileName);
		strcat(saveFile,"f.raw");
		strcat(fileName,".raw");			//Append .raw to the file name
		if (( inFile = fopen(fileName, "r")) == NULL)
		{
			printf("Can't open file %s.\n",fileName);
			exit(1);
		}
		//printf("Enter the number of pings to average over");
		//gets(tempCrit);
		//avgNum=atoi(tempCrit);
		printf("Enter the percentage of max missed pings: ");
		gets(tempCrit);
		minNum=atoi(tempCrit);
		//printf("Enter the critical value for filtering (in positive dB):");
		printf("Enter the window width (number of std dev): ");
		gets(tempCrit);
		critical=atof(tempCrit);
		printf("Enter the size of the range bins in meters: ");
		gets(tempCrit);
		binLength=atof(tempCrit);
		headerLength=GetHeaderLength(inFile);
		hRows=new HeaderInfo[headerLength];
		numLines=GetNumLines(inFile);
		sData=new SonarInfo[numLines];
```

-continued-

```
		ReadData(inFile,hRows,sData,numLines);
		ExtractData(numLines,sData);
		maxRange=GetMaxRng(numLines,sData)+1;			//add two to give some wiggle room
		numBins=int(maxRange/binLength)+1;
		rangeBins=new EchoRange[numBins];
		InitializeBins(rangeBins,0);
		CalcStats(numLines,sData,rangeBins);
		fclose(inFile);
		if (( inFile = fopen(saveFile, "w")) == NULL)
		{
			printf("Can't open file %s.\n",fileName);
			exit(1);
		}
		//PrintData(hRows,sData,fData,numLines);
		WriteData(inFile,hRows,sData,numLines);
		printf("Done! \n");

		fclose(inFile);

		//fclose(debugFile);
		delete hRows;
		delete sData;
		printf("Enter the file name or return to exit: \n");
	}
}

//--------------------------------------------------
//This function gets the number of lines in the header
//--------------------------------------------------
int GetHeaderLength(FILE *inFile)
{
	fpos_t pos;
	char buffer[150],temp[8];
	int number=0,done=0,i;

	printf("getting header length\n");
	fgetpos(inFile,&pos);
	while(!done)
	{
		number++;
```

-continued-

```
		fgets(buffer,150,inFile);
		for(i=0;i<7;i++)
		{
			temp[i]=buffer[i];
		}
		temp[7]='\0';
		if(!strcmp(temp,"* Start"))
			done=1;
	}
	fsetpos(inFile,&pos);
	return number;
}

//-------------------------------------------------
//This function gets the number of lines that exist for fish data.
//Two is subtraced from this number because there are a couple of
//rows at the end without fish data, there are end of file information.
//-------------------------------------------------
int GetNumLines(FILE *inFile)
{
	fpos_t pos;
	char buffer[150];
	int numLines=0;

	printf("getting the number of lines\n");
	fgetpos(inFile,&pos);
	while(fgets(buffer,150,inFile)!=NULL)
	{
		numLines++;
	}
	fsetpos(inFile,&pos);
	numLines=numLines-headerLength;

	return numLines;
}

//-------------------------------------------------
//This function reads in the rows and saves the entire row into
//a character array.  This is not very efficient but it makes it
//easier to export the data in the correct format.
```

-continued-

```
//-------------------------------------------------
void ReadData(FILE *inFile,HeaderInfo *hRows,SonarInfo *sData,int numLines)
{
	int i;
	char buffer[150];

	//Read in the header rows
	printf("reading in data\n");
	for(i=0;i<headerLength;i++)
	{
		fgets(hRows[i].headerRow,150,inFile);
	}
	for(i=0;i<numLines;i++)
	{
		fgets(buffer,150,inFile);
		strcpy(sData[i].row,buffer);
	}
}

int GetMaxRng(int numLines,SonarInfo *sData)
{
	int i;
	float tempMax=0;

	for(i=0;i<numLines;i++)
	{
		if(sData[i].range>tempMax)
			tempMax=sData[i].range;
	}

	return tempMax;
}

//-------------------------------------------------
//Calculates the average voltages in each of the range bins
//-------------------------------------------------
void CalcStats(int numLines,SonarInfo *sData,EchoRange *rangeBins)
{
	int i=0,j,k,l=0,arrayNum,arrayNum2,pingGap,numPings,lastPing;
    float prevSS,sd;
```

-continued-

```
int temp;

     printf("Computing moving averages and removing bottom\n");

     while(i<numLines-2)  //subtract two for the two rows of text ending the file
     {
               if(sData[i].row[0]=='*')            //If start of a new sequence reinitialize
               {
                         lastPing=(int)ExtractNumber(sData[i].row,14);
                         InitializeBins(rangeBins,0);
                         l=0;                          //l keeps track of how many echoes in the sequence, i is for the entire file
                         i++;i++;            //go to the next line-have to do this twice for end and start of sequences
               }
               arrayNum=int(sData[i].range/binLength);     //Calculate range bin
               pingGap=(sData[i].pingNum-rangeBins[arrayNum].lastPing)-1;
               rangeBins[arrayNum].sum=rangeBins[arrayNum].sum-rangeBins[arrayNum].values[0]+sData[i].TS;

               rangeBins[arrayNum].gapSum=rangeBins[arrayNum].gapSum-rangeBins[arrayNum].pingGaps[0]+pingGap;
               if(rangeBins[arrayNum].number<avgNum)
                         rangeBins[arrayNum].number++;
               rangeBins[arrayNum].average=rangeBins[arrayNum].sum/rangeBins[arrayNum].number;
    rangeBins[arrayNum].prevAvg=rangeBins[arrayNum].average;
    if(rangeBins[arrayNum].number==1)
    {
      rangeBins[arrayNum].sdDev=0;
    }
    else if(rangeBins[arrayNum].number<avgNum)             //Moving average/sd hasn't kicked in yet, not enough data.
    {
      if(rangeBins[arrayNum].number==2)
      {
        sd=(rangeBins[arrayNum].average-sData[i].TS); //for debugging
        rangeBins[arrayNum].sdDev=pow(pow((rangeBins[arrayNum].average-sData[i].TS),2),.5);
      }
      else
      {
        prevSS=pow(rangeBins[arrayNum].sdDev,2)*(rangeBins[arrayNum].number-1);
        if(i)//(i>6000))
        {
          sd=rangeBins[arrayNum].sdDev;
          sd=rangeBins[arrayNum].number;
```

-continued-

```
                sd=rangeBins[arrayNum].average;
            }
            rangeBins[arrayNum].sdDev=pow((prevSS+pow(rangeBins[arrayNum].average-sData[i].TS,2))/(rangeBins[arrayNum].number-
1),.5);
            if(i)//(i>6000))
            {
                sd=rangeBins[arrayNum].sdDev;
                sd=rangeBins[arrayNum].number;
                sd=rangeBins[arrayNum].average;
            }
        }
    }
    else        //Start moving the std dev.
    {
        prevSS=pow(rangeBins[arrayNum].sdDev,2)*(rangeBins[arrayNum].number-1);
        sd=prevSS-pow(rangeBins[arrayNum].prevAvg-rangeBins[arrayNum].values[0],2)+
            pow(rangeBins[arrayNum].average-sData[i].TS,2);
        rangeBins[arrayNum].sdDev=pow(sd/(rangeBins[arrayNum].number-1),.5);
    }
    rangeBins[arrayNum].prevAvg=rangeBins[arrayNum].average;
            rangeBins[arrayNum].lastPing=sData[i].pingNum;
            //this next loop shifts the TS values in the bin down
            for(j=0;j<avgNum-1;j++)
            {
                rangeBins[arrayNum].values[j]=rangeBins[arrayNum].values[j+1];
                rangeBins[arrayNum].pingGaps[j]=rangeBins[arrayNum].pingGaps[j+1];
            }
            rangeBins[arrayNum].values[avgNum-1]=sData[i].TS;
            rangeBins[arrayNum].pingGaps[avgNum-1]=pingGap;
            numPings=rangeBins[arrayNum].gapSum+rangeBins[arrayNum].number;
    if(((sData[i].TS-
rangeBins[arrayNum].average)<(critical*rangeBins[arrayNum].sdDev))&&(rangeBins[arrayNum].gapSum/numPings*100<minNum)&&(l>avg
Num))
        sData[i].include=0;
            else if(l==avgNum)
            {
                for(k=i-l;k<i-1;k++)
                {
                    arrayNum2=int(sData[k].range/binLength);
                    numPings=rangeBins[arrayNum2].gapSum+rangeBins[arrayNum2].number;
        if(((sData[k].TS-rangeBins[arrayNum2].average)<(critical*rangeBins[arrayNum2].sdDev))&&(rangeBins[arrayNum2].
                                    gapSum/numPings*100<minNum))
```

-continued-

```
                                        sData[k].include=0;
                                }
                        }
                        else
                                sData[i].include=1;
                        i++;    //increment line number for file
                        l++;    //increment line number for sequence
                }
}

void InitializeBins(EchoRange *rangeBins,int lastPing)
{
        int j,k;



        for(j=0;j<numBins;j++)
        {
                rangeBins[j].average=0;
                rangeBins[j].number=0;
                rangeBins[j].sum=0;
                rangeBins[j].lastPing=lastPing;
                rangeBins[j].gapSum=0;
        rangeBins[j].prevAvg=0;
        rangeBins[j].sdDev=0;
                for(k=0;k<avgNum;k++)
                {
                        rangeBins[j].values[k]=0;
                        rangeBins[j].pingGaps[k]=0;
                }
        }
}

//-------------------------------------------------
//Writes the filtered data back to the file, overwritting the previous
//data.  Note, the flag and fishNum==0 is used to put the sequence
//seperator data back in the file.
//-------------------------------------------------
void WriteData(FILE *inFile,HeaderInfo *hRows,SonarInfo *sData,int numLines)
{
        int i;
```

-continued-

```
        printf("writing to file\n");
        for(i=0;i<headerLength;i++)
        {
                fprintf(inFile,"%s",hRows[i].headerRow);
        }

        for(i=0;i<numLines;i++)
        {
                if(sData[i].include||(sData[i].row[0]=='*'))
                {
                        fprintf(inFile,"%s",sData[i].row);
                }
        }
}

//-------------------------------------------------
//Used for debugging purposes to print a few rows of fish data and
//statistics on the screen.  Currently this function is commented
//out and is not called.
//-------------------------------------------------
void PrintData(HeaderInfo *hRows,SonarInfo *sData,int numLines)
{
        int i,j,numFish;
        int test1=5,test2=3;

        printf("print subset of data to screet\n");
        numFish=sData[numLines-1].fishNum;
        for(i=0;i<test1;i++)
        {
                printf("%s",hRows[i].headerRow);
        }
        for(i=0;i<numLines;i++)
        {
                for(j=0;j<test2;j++)
                {
                        /*if((sData[i].fishNum==j+1)&&(fData[j].rangeSD>critical)&&(sData[i].fishNum))
                        {
                                printf("%s\n",sData[i].row);
                                printf("sd of range=%f\n",fData[j].rangeSD);
```

-continued-

```
				}*/
			}
		}
}

//-------------------------------------------------
//This function extracts the fish number and range for each
//line of data (each echo) from the information stored in
//the character array.
//-------------------------------------------------
void ExtractData(int numLines,SonarInfo *sData)
{
		int i;

		printf("extracting data\n");
		for(i=0;i<numLines;i++)
		{
			GetFishNum(i,sData);
			GetTS(i,sData);
			GetRange(i,sData);
			GetPingNum(i,sData);
		}
}

//-------------------------------------------------
//Extracts the fish number from the character array.
//-------------------------------------------------
void GetFishNum(int i,SonarInfo *sData)
{
		if(sData[i].row[0]!='*')		//Note, sequence rows start with a '*'
		{
			sData[i].fishNum=(int)ExtractNumber(sData[i].row,0);
		}
		else		//If it is a sequence row, assign fish number zero
			sData[i].fishNum=0;
}

//-------------------------------------------------
//GetTS extracts the range value from the character array.
//-------------------------------------------------
```

-continued-

```
void GetTS(int i,SonarInfo *sData)
{
	if(sData[i].row[0]!='*')		//Note, sequence rows start with a '*'
	{
		//sData[i].TS=ExtractNumber(sData[i].row,10);			//Extracts TS value
		sData[i].TS=ExtractNumber(sData[i].row,2);				//Extracts voltage value
	}
	else	//If it is a sequence row, assign a TS of zero
		sData[i].TS=0;
}

void GetRange(int i,SonarInfo *sData)
{
	if(sData[i].row[0]!='*')
	{
		sData[i].range=ExtractNumber(sData[i].row,1);
	}
	else
		sData[i].range=0;
}

void GetPingNum(int i,SonarInfo *sData)
{
	if(sData[i].row[0]!='*')
	{
		sData[i].pingNum=ExtractNumber(sData[i].row,0);
	}
	else
		sData[i].pingNum=sData[i-1].pingNum;
}

//-------------------------------------------------
//Again, another debugging tool.  This just writes a debug file
//that includes the data row and the statistics for each fish.
//The debug file is overwritten each time the program is run.
//This could probably be disabled but it doesn't take much room.
//-------------------------------------------------
void WriteDebug(FILE *debugFile,SonarInfo *sData,int numLines)
{
	int i,j,numFish;
```

-continued-

```
		printf("writing to debug file\n");
		numFish=sData[numLines-1].fishNum;
		for(i=0;i<numLines+1;i++)
		{
			for(j=0;j<numFish;j++)
			{
				/*if(sData[i].fishNum==j+1)
				{
					fprintf(debugFile,"%s",sData[i].row);
					fprintf(debugFile,"range=%4.2f  sd of Range=%6.4f delta=%6.4f  max delta=%6.4f\n",
						sData[i].range,fData[j].rangeSD,fData[j].rangeMaxDelta,fData[j].rangeFL);
				}*/
			}
		}
}

//====================================
//Function extracts a number from a string that contains many groups
//of numbers or characters seperated by spaces.  Receives a string and
//the number of groups of characters or numbers to skip and returns
//the number of type float.
//====================================
float ExtractNumber(char dataStr[],int numSkip)
{
		char numStr[10];
		int done=0,flag=0;
		int cntr=1,cntr2;

		while(!done)
		{
			cntr2=0;
			if(dataStr[cntr]!=' ')
			{
				while(dataStr[cntr+cntr2]!=' ')
				{
					if(flag==numSkip)	//how many groups of numbers to skip
					{
						numStr[cntr2]=dataStr[cntr+cntr2];
						numStr[cntr2+1]='\0';
```

-continued-

```
                                        done=1;
                                }
                                cntr2++;
                        }
                        flag++;
                }
                if(cntr2)
                        cntr=cntr+cntr2;
                else
                        cntr++;
        }
        return atof(numStr);
}
```

APPENDIX C. HISTORIC ESTIMATES

Appendix C1.–Historic daily and cumulative Anvik River summer chum salmon escapements, 1979–2003.

	1979		1980		1981		1982	
Date	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**
18-Jun								
19-Jun								
20-Jun					2,760	2,760		
21-Jun					5,795	8,555		
22-Jun					8,226	16,781		
23-Jun	813	813			54,097	70,878		
24-Jun	1,679	2,492			91,826	162,704		
25-Jun	1,549	4,041			115,356	278,060	715	715
26-Jun	1,926	5,967			82,910	360,970	2,436	3,151
27-Jun	5,639	11,606	839	839	44,491	405,461	6,026	9,177
28-Jun	8,469	20,075	3,688	4,527	36,737	442,198	3,744	12,921
29-Jun	11,232	31,307	7,604	12,131	111,356	553,554	3,669	16,590
30-Jun	18,211	49,518	17,528	29,659	69,581	623,135	4,445	21,035
1-Jul	14,692	64,210	25,744	55,403	89,992	713,127	3,795	24,830
2-Jul	11,503	75,713	22,123	77,526	80,312	793,439	3,762	28,592
3-Jul	15,027	90,740	11,898	89,424	76,740	870,179	9,671	38,263
4-Jul	13,178	103,918	9,105	98,529	88,481	958,660	23,642	61,905
5-Jul	12,433	116,351	17,000	115,529	78,032	1,036,692	22,454	84,359
6-Jul	11,667	128,018	16,809	132,338	42,931	1,079,623	22,261	106,620
7-Jul	8,718	136,736	10,877	143,215	40,410	1,120,033	14,333	120,953
8-Jul	11,578	148,314	19,080	162,295	25,856	1,145,889	27,291	148,244
9-Jul	10,454	158,768	18,442	180,737	28,654	1,174,543	40,527	188,771
10-Jul	21,370	180,138	31,980	212,717	36,015	1,210,558	25,882	214,653
11-Jul	16,770	196,908	29,926	242,643	61,612	1,272,170	19,988	234,641
12-Jul	22,118	219,026	17,757	260,400	38,459	1,310,629	36,197	270,838
13-Jul	13,709	232,735	23,542	283,942	18,149	1,328,778	33,836	304,674
14-Jul	10,114	242,849	30,746	314,688	20,979	1,349,757	33,232	337,906
15-Jul	8,612	251,461	33,689	348,377	30,072	1,379,829	18,757	356,663
16-Jul	7,449	258,910	29,092	377,469	23,569	1,403,398	13,672	370,335
17-Jul	4,375	263,285	23,053	400,522	15,523	1,418,921	14,982	385,317
18-Jul	2,751	266,036	29,042	429,564	7,766	1,426,687	12,970	398,287
19-Jul	2,810	268,846	19,761	449,325	9,809	1,436,496	11,402	409,689
20-Jul	2,705	271,551	14,676	464,001	9,922	1,446,418	7,566	417,255
21-Jul	3,436	274,987	8,117	472,118	6,041	1,452,459	7,455	424,710
22-Jul	1,276	276,263	6,202	478,320	6,397	1,458,856	5,352	430,062
23-Jul	1,449	277,712	814	479,134	10,063	1,468,919	4,685	434,747
24-Jul			1,450	480,584	5,078	1,473,997	5,530	440,277
25-Jul			1,597	482,181	2,885	1,476,882	2,167	442,444
26-Jul					1,709	1,478,591	2,137	444,581
27-Jul					991	1,479,582		
28-Jul								
29-Jul								
30-Jul								
Total	277,712		482,181		1,479,582		444,581	

-continued-

	1983		1984		1985		1986	
Date	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**
18-Jun								
19-Jun								
20-Jun								
21-Jun	217	217					234	234
22-Jun	1,351	1,568	293	293			2,970	3,204
23-Jun	1,430	2,998	307	600			4,894	8,098
24-Jun	3,293	6,291	404	1,004			12,192	20,290
25-Jun	10,836	17,127	11,528	12,532			15,769	36,059
26-Jun	12,533	29,660	16,740	29,272			18,392	54,451
27-Jun	10,132	39,792	23,824	53,096			34,844	89,295
28-Jun	16,227	56,019	16,855	69,951			88,531	177,826
29-Jun	10,894	66,913	26,456	96,407			100,102	277,928
30-Jun	23,141	90,054	25,756	122,163			117,778	395,706
1-Jul	21,532	111,586	18,148	140,311			111,472	507,178
2-Jul	11,146	122,732	21,584	161,895			89,247	596,425
3-Jul	15,906	138,638	24,471	186,366			58,444	654,869
4-Jul	13,669	152,307	28,122	214,488			58,997	713,866
5-Jul	11,653	163,960	23,509	237,997	7,998	7,998	39,913	753,779
6-Jul	9,505	173,465	40,714	278,711	47,245	55,243	55,902	809,681
7-Jul	11,792	185,257	45,103	323,814	56,091	111,334	45,280	854,961
8-Jul	17,499	202,756	53,194	377,008	58,578	169,912	40,688	895,649
9-Jul	20,358	223,114	80,563	457,571	60,265	230,177	41,088	936,737
10-Jul	22,898	246,012	58,385	515,956	61,952	292,129	37,960	974,697
11-Jul	22,800	268,812	60,851	576,807	63,641	355,770	28,766	1,003,463
12-Jul	18,866	287,678	71,000	647,807	96,664	452,434	16,250	1,019,713
13-Jul	15,618	303,296	64,041	711,848	128,110	580,544	14,092	1,033,805
14-Jul	16,348	319,644	40,196	752,044	109,585	690,129	23,838	1,057,643
15-Jul	6,972	326,616	24,561	776,605	77,433	767,562	28,107	1,085,750
16-Jul	8,628	335,244	18,008	794,613	63,007	830,569		
17-Jul	10,300	345,544	13,343	807,956	44,349	874,918		
18-Jul	7,404	352,948	13,013	820,969	37,498	912,416		
19-Jul	4,460	357,408	16,347	837,316	27,196	939,612		
20-Jul	2,465	359,873	17,643	854,959	35,903	975,515		
21-Jul	1,745	361,618	11,666	866,625	27,103	1,002,618		
22-Jul	843	362,461	5,534	872,159	22,272	1,024,890		
23-Jul	451	362,912	7,532	879,691	14,768	1,039,658		
24-Jul			4,091	883,782	11,554	1,051,212		
25-Jul			2,325	886,107	10,031	1,061,243		
26-Jul			2,841	888,948	8,133	1,069,376		
27-Jul			2,080	891,028	5,977	1,075,353		
28-Jul					4,890	1,080,243		
29-Jul								
30-Jul								
Total	362,912		891,028		1,080,243		1,085,750	

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	1987		1988		1989		1990	
Date	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**
18-Jun								
19-Jun								
20-Jun					162	162		
21-Jun	202	202	2,503	2,503	497	659		
22-Jun	339	541	1,092	3,595	2,244	2,903	158	158
23-Jun	425	966	1,841	5,436	4,919	7,822	1,515	1,673
24-Jun	467	1,433	1,853	7,289	5,258	13,080	1,603	3,276
25-Jun	605	2,038	5,264	12,553	7,268	20,348	1,838	5,114
26-Jun	1,586	3,624	9,187	21,740	7,353	27,701	7,419	12,533
27-Jun	3,043	6,667	24,682	46,422	17,792	45,493	14,742	27,275
28-Jun	3,731	10,398	57,538	103,960	21,632	67,125	5,830	33,105
29-Jun	6,401	16,799	96,842	200,802	33,533	100,658	15,800	48,905
30-Jun	14,571	31,370	84,240	285,042	36,228	136,886	19,919	68,824
1-Jul	8,637	40,007	94,566	379,608	37,460	174,346	26,093	94,917
2-Jul	13,065	53,072	104,891	484,499	33,743	208,089	25,566	120,483
3-Jul	14,974	68,046	73,286	557,785	29,033	237,122	22,724	143,207
4-Jul	21,226	89,272	57,432	615,217	24,058	261,180	12,268	155,475
5-Jul	25,487	114,759	60,081	675,298	25,797	286,977	24,385	179,860
6-Jul	36,536	151,295	68,021	743,319	22,668	309,645	16,799	196,659
7-Jul	25,139	176,434	40,829	784,148	23,907	333,552	11,987	208,646
8-Jul	16,094	192,528	42,795	826,943	28,232	361,784	11,669	220,315
9-Jul	6,074	198,602	46,130	873,073	27,763	389,547	12,419	232,734
10-Jul	11,533	210,135	25,614	898,687	20,790	410,337	11,197	243,931
11-Jul	11,624	221,759	23,131	921,818	21,804	432,141	28,262	272,193
12-Jul	13,444	235,203	30,350	952,168	28,737	460,878	14,091	286,284
13-Jul	23,464	258,667	30,468	982,636	33,821	494,699	6,170	292,454
14-Jul	29,136	287,803	26,287	1,008,923	26,856	521,555	4,872	297,326
15-Jul	35,855	323,658	27,474	1,036,397	30,602	552,157	3,535	300,861
16-Jul	28,964	352,622	15,922	1,052,319	17,803	569,960	5,673	306,534
17-Jul	15,179	367,801	5,340	1,057,659	5,003	574,963	11,394	317,928
18-Jul	13,744	381,545	12,676	1,070,335	10,460	585,423	7,304	325,232
19-Jul	13,599	395,144	11,987	1,082,322	10,035	595,458	7,535	332,767
20-Jul	16,658	411,802	5,382	1,087,704	10,872	606,330	10,970	343,737
21-Jul	13,530	425,332	7,000	1,094,704	8,299	614,629	10,280	354,017
22-Jul	9,148	434,480	5,323	1,100,027	5,300	619,929	11,819	365,836
23-Jul	8,301	442,781	5,460	1,105,487	5,490	625,419	10,739	376,575
24-Jul	6,518	449,299	6,264	1,111,751	3,366	628,785	10,662	387,237
25-Jul	3,813	453,112	8,105	1,119,856	3,827	632,612	3,403	390,640
26-Jul	2,764	455,876	4,378	1,124,234	4,294	636,906	3,663	394,303
27-Jul			1,215	1,125,449			3,181	397,484
28-Jul							2,724	400,208
29-Jul							2,216	402,424
30-Jul							1,203	403,627
Total	455,876		1,125,449		636,906		403,627	

-continued-

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	1991		1992		1993		1994	
Date	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**
18-Jun								
19-Jun					185	185	279	279
20-Jun					1,068	1,253	1,392	1,671
21-Jun	22	22	0	0	10,606	11,859	2,316	3,987
22-Jun	112	134	0	0	5,564	17,423	2,489	6,476
23-Jun	1,652	1,786	0	0	5,348	22,771	9,694	16,170
24-Jun	2,279	4,065	0	0	2,240	25,011	16,985	33,155
25-Jun	8,263	12,328	0	0	1,215	26,226	26,789	59,944
26-Jun	22,209	34,537	0	0	4,916	31,142	38,879	98,823
27-Jun	27,704	62,241	0	0	4,969	36,111	32,807	131,630
28-Jun	44,919	107,160	0	0	3,703	39,814	24,563	156,193
29-Jun	40,384	147,544	121	121	2,186	42,000	16,679	172,872
30-Jun	26,729	174,273	4,807	4,928	5,302	47,302	40,910	213,782
1-Jul	27,946	202,219	20,059	24,987	11,294	58,596	75,582	289,364
2-Jul	25,607	227,826	41,940	66,927	17,247	75,843	50,288	339,652
3-Jul	20,499	248,325	56,972	123,899	14,622	90,465	38,322	377,974
4-Jul	22,438	270,763	60,901	184,800	21,548	112,013	24,661	402,635
5-Jul	18,578	289,341	81,125	265,925	19,782	131,795	54,242	456,877
6-Jul	13,939	303,280	60,959	326,884	18,380	150,175	52,855	509,732
7-Jul	13,887	317,167	52,314	379,198	21,856	172,031	51,181	560,913
8-Jul	38,260	355,427	57,138	436,336	12,183	184,214	84,341	645,254
9-Jul	58,068	413,495	59,744	496,080	17,018	201,232	57,076	702,330
10-Jul	45,739	459,234	41,593	537,673	26,667	227,899	71,095	773,425
11-Jul	45,295	504,529	30,892	568,565	20,962	248,861	88,585	862,010
12-Jul	33,138	537,667	28,065	596,630	28,977	277,838	45,795	907,805
13-Jul	32,539	570,206	26,358	622,988	20,952	298,790	33,023	940,828
14-Jul	29,932	600,138	19,458	642,446	16,878	315,668	28,019	968,847
15-Jul	26,330	626,468	17,755	660,201	19,859	335,527	18,002	986,849
16-Jul	23,180	649,648	15,873	676,074	18,692	354,219	13,468	1,000,317
17-Jul	23,252	672,900	20,765	696,839	25,152	379,371	25,032	1,025,349
18-Jul	17,176	690,076	12,025	708,864	26,508	405,879	27,190	1,052,539
19-Jul	13,163	703,239	9,854	718,718	21,339	427,218	26,148	1,078,687
20-Jul	17,168	720,407	7,282	726,000	22,573	449,791	11,762	1,090,449
21-Jul	20,051	740,458	11,563	737,563	19,510	469,301	7,412	1,097,861
22-Jul	26,610	767,068	9,928	747,491	11,351	480,652	14,192	1,112,053
23-Jul	28,801	795,869	11,314	758,805	6,779	487,431	12,636	1,124,689
24-Jul	21,070	816,939	9,002	767,807	5,903	493,334		
25-Jul	17,231	834,170	7,819	775,626	9,187	502,521		
26-Jul	13,602	847,772			8,076	510,597		
27-Jul					6,812	517,409		
28-Jul								
29-Jul								
30-Jul								
Total	847,772		775,626		517,409		1,124,689	

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	1995		1996		1997		1998	
Date	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**
18-Jun			10,213	10,213				
19-Jun	395	395	4,615	14,828	561	561		
20-Jun	3,648	4,043	16,836	31,664	5,761	6,321		
21-Jun	5,831	9,874	43,565	75,229	8,403	14,724	1	1
22-Jun	11,639	21,513	34,257	109,486	5,072	19,796	164	165
23-Jun	6,459	27,972	50,000	159,486	22,395	42,191	1,202	1,367
24-Jun	8,723	36,695	63,193	222,679	29,758	71,949	2,103	3,471
25-Jun	15,302	51,997	28,156	250,835	23,643	95,592	3,175	6,646
26-Jun	9,389	61,386	35,303	286,138	7,181	102,773	4,161	10,807
27-Jun	36,645	98,031	46,390	332,528	19,719	122,493	4,721	15,528
28-Jun	78,678	176,709	34,348	366,876	29,291	151,784	4,210	19,738
29-Jun	87,951	264,660	33,115	399,991	36,752	188,536	4,868	24,606
30-Jun	52,897	317,557	45,936	445,927	31,248	219,783	8,063	32,669
1-Jul	53,297	370,854	58,459	504,386	32,374	252,157	14,597	47,266
2-Jul	82,228	453,082	55,211	559,597	28,963	281,120	14,835	62,101
3-Jul	59,206	512,288	39,335	598,932	28,931	310,051	24,539	86,640
4-Jul	27,695	539,983	44,112	643,044	26,746	336,797	22,857	109,496
5-Jul	50,642	590,625	61,740	704,784	26,575	363,372	25,589	135,085
6-Jul	105,422	696,047	38,482	743,266	20,109	383,481	34,503	169,588
7-Jul	105,992	802,039	49,067	792,333	24,365	407,847	35,114	204,702
8-Jul	55,108	857,147	34,221	826,554	24,356	432,202	16,755	221,457
9-Jul	38,646	895,793	23,194	849,748	15,851	448,054	14,740	236,196
10-Jul	60,116	955,909	18,093	867,841	13,710	461,764	20,959	257,156
11-Jul	64,070	1,019,979	10,579	878,420	11,550	473,315	27,179	284,335
12-Jul	41,220	1,061,199	13,038	891,458	7,663	480,977	35,455	319,790
13-Jul	39,638	1,100,837	12,871	904,329	4,803	485,780	35,331	355,121
14-Jul	33,743	1,134,580	10,077	914,406	8,467	494,246	20,702	375,822
15-Jul	39,977	1,174,557	7,411	921,817	12,436	506,683	8,195	384,017
16-Jul	30,640	1,205,197	7,173	928,990	15,943	522,626	18,556	402,574
17-Jul	24,950	1,230,147	4,250	933,240	12,682	535,308	14,564	417,138
18-Jul	25,638	1,255,785			13,040	548,348	12,179	429,318
19-Jul	16,814	1,272,599			14,631	562,979	16,685	446,003
20-Jul	26,622	1,299,221			12,826	575,806	11,525	457,528
21-Jul	19,154	1,318,375			11,684	587,490	10,702	468,230
22-Jul	11,735	1,330,110			10,177	597,667	10,020	478,250
23-Jul	5,982	1,336,092			4,701	602,368	6,082	484,332
24-Jul	3,326	1,339,418			3,384	605,752	2,969	487,301
25-Jul								
26-Jul								
27-Jul								
28-Jul								
29-Jul								
30-Jul								
Total	1,339,418		933,240		605,752		487,301	

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	1999		2000		2001		2002		2003	
Date	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**	**Daily**	**Cum.**
18-Jun										
19-Jun										
20-Jun										
21-Jun			10	10			78	78	224	224
22-Jun			9	19			2,150	2,228	442	666
23-Jun			28	47			2,177	4,405	546	1,212
24-Jun			25	72			5,812	10,217	1,640	2,852
25-Jun			49	121			6,546	16,763	4,613	7,465
26-Jun			49	170	671	671	6,341	23,104	4,222	11,687
27-Jun	85	85	218	388	445	1,115	15,963	39,067	3,061	14,748
28-Jun	274	359	97	485	951	2,066	16,415	55,482	4,923	19,671
29-Jun	1,546	1,905	104	589	2,109	4,175	11,137	66,619	4,088	23,759
30-Jun	3,176	5,081	2,167	2,756	6,208	10,383	20,220	86,839	4,641	28,400
1-Jul	10,336	15,417	5,174	7,930	3,661	14,045	22,142	108,981	7,767	36,167
2-Jul	11,038	26,455	6,427	14,357	3,671	17,716	20,879	129,860	8,211	44,378
3-Jul	15,497	41,952	6,369	20,727	12,503	30,219	11,032	140,892	8,528	52,906
4-Jul	20,660	62,612	3,904	24,631	10,098	40,317	26,869	167,761	7,779	60,685
5-Jul	31,112	93,724	4,457	29,088	9,180	49,497	26,597	194,358	6,989	67,674
6-Jul	27,755	121,479	7,322	36,410	8,769	58,266	35,944	230,302	7,923	75,597
7-Jul	33,489	154,968	9,465	45,875	7,171	65,438	26,354	256,656	11,077	86,674
8-Jul	28,502	183,470	14,495	60,370	13,328	78,766	25,029	281,685	14,731	101,405
9-Jul	22,090	205,560	17,712	78,082	11,735	90,500	25,641	307,326	19,570	120,975
10-Jul	28,185	233,745	15,124	93,206	22,636	113,137	21,199	328,525	16,390	137,365
11-Jul	21,647	255,392	23,105	116,311	12,901	126,038	22,824	351,349	11,259	148,624
12-Jul	17,370	272,761	19,212	135,523	11,241	137,279	21,703	373,052	13,667	162,291
13-Jul	15,215	287,976	11,882	147,405	11,751	149,029	16,399	389,451	13,109	175,400
14-Jul	13,615	301,591	4,334	151,739	11,810	160,839	13,027	402,478	13,509	188,909
15-Jul	13,034	314,626	10,464	162,202	11,286	172,125	14,114	416,592	6,151	195,060
16-Jul	17,692	332,318	7,362	169,565	7,773	179,898	10,207	426,799	4,194	199,254
17-Jul	14,841	347,159	4,816	174,380	7,944	187,842	6,413	433,212	4,940	204,194
18-Jul	13,842	361,001	3,750	178,130	5,193	193,035	4,832	438,044	7,686	211,880
19-Jul	15,313	376,314	4,384	182,515	6,173	199,208	4,661	442,705	8,318	220,198
20-Jul	13,196	389,511	3,244	185,758	6,816	206,024	4,289	446,994	7,224	227,422
21-Jul	12,888	402,398	1,706	187,464	4,446	210,471	6,324	453,318	5,365	232,787
22-Jul	8,474	410,873	1,318	188,782	4,072	214,543	2,936	456,254	2,921	235,708
23-Jul	8,485	419,358	1,567	190,349	2,264	216,806	2,804	459,058	3,996	239,704
24-Jul	6,452	425,810	1,255	191,604	1,992	218,798			4,321	244,025
25-Jul	4,484	430,294	907	192,510	2,197	220,995			5,865	249,890
26-Jul	2,465	432,759	1,102	193,612	1,496	222,491			4,515	254,405
27-Jul	2,747	435,506	1,569	195,181	725	223,216			2,515	256,920
28-Jul	1,850	437,356	1,168	196,349	843	224,058				
29-Jul										
30-Jul										
Total	437,356		196,349		224,058		459,058		256,920	

APPENDIX D. COUNTS AND PROPORTIONS BY BANK, HOUR AND SECTOR

Appendix D1.–Right bank Anvik River summer chum salmon counts by hour and sector, 2003.

Hour Ending	Sector 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total	Total Adjusted
100	36	162	910	1,434	1,038	1,098	646	309	1,783	1,276	693	465	524	243	259	201	11,077	11,940
200	46	329	1,251	1,635	1,091	1,105	551	327	1,466	871	588	473	514	247	224	210	10,928	11,779
300	84	330	1,008	1,444	958	991	530	365	1,293	779	613	446	382	145	162	183	9,713	10,470
400	103	480	954	1,556	1,109	1,084	534	361	1,379	811	507	375	320	200	116	96	9,985	10,763
500	83	251	721	1,387	1,138	1,126	602	360	1,744	1,040	610	440	325	147	160	152	10,286	11,087
600	48	193	752	1,524	1,085	1,283	603	350	1,837	1,018	603	444	264	107	157	156	10,424	11,236
700	68	144	754	1,641	1,202	1,274	636	316	1,623	1,050	605	403	266	144	135	118	10,379	11,188
800	50	196	977	1,861	1,105	1,190	617	275	1,478	877	531	357	326	116	135	93	10,184	10,977
900	59	163	818	1,472	1,090	1,238	610	343	1,343	831	415	239	191	108	114	115	9,149	9,862
1000	39	139	684	1,340	925	1,120	641	294	1,371	661	363	326	297	101	69	110	8,480	9,141
1100	19	185	811	1,349	1,021	1,046	596	266	1,201	902	381	239	161	72	118	116	8,483	9,144
1200	25	119	779	1,604	1,167	1,101	631	263	1,014	500	337	171	177	83	123	91	8,185	8,823
1300	25	182	825	1,588	1,147	1,031	565	232	1,108	568	313	258	212	111	131	101	8,397	9,051
1400	24	168	814	1,644	1,157	984	570	235	920	516	325	203	211	134	109	126	8,140	8,774
1500	12	116	633	1,640	1,167	953	498	261	926	509	312	203	186	110	147	101	7,774	8,380
1600	11	80	495	1,200	871	938	468	185	833	516	236	156	172	107	141	168	6,577	7,089
1700	8	74	600	1,246	746	816	516	253	882	467	263	202	231	155	135	172	6,766	7,293
1800	13	108	710	1,157	785	820	548	207	1,156	627	362	243	180	122	140	154	7,332	7,903
1900	9	94	738	1,236	891	754	522	283	1,453	791	364	217	209	154	147	135	7,997	8,620
2000	30	130	587	1,075	729	721	497	211	1,362	819	416	291	232	172	230	192	7,694	8,293
2100	19	146	666	1,071	768	704	447	210	1,289	752	486	252	256	152	151	134	7,503	8,088
2200	15	134	748	1,008	843	749	421	157	1,311	780	432	302	262	192	231	182	7,767	8,372
2300	17	181	826	1,443	927	867	451	173	1,164	771	439	278	236	203	194	220	8,390	9,044
2400	22	193	822	1,345	1,039	1,065	559	221	1,442	1,035	657	432	395	234	285	173	9,919	10,692
Total	865	4,297	18,883	33,900	23,999	24,058	13,259	6,457	31,378	18,767	10,851	7,415	6,529	3,559	3,813	3,499	211,529	228,010
Adjusted	932	4,632	20,354	36,541	25,869	25,932	14,292	6,960	33,823	20,229	11,696	7,993	7,038	3,836	4,110	3,772	228,010	

Appendix D2.–Left bank Anvik River summer chum salmon counts by hour and sector, 2003.

Hour Ending	Sector 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total	Total Adjusted
100	1	10	41	156	147	131	119	116	85	136	88	71	34	17	28	18	1,198	1,281
200	3	33	85	192	170	113	83	83	91	105	77	49	41	21	18	22	1,186	1,268
300	12	47	127	218	179	151	110	98	71	108	85	79	27	7	12	7	1,338	1,431
400	11	41	80	173	143	135	95	77	64	110	69	51	23	17	12	14	1,115	1,193
500	1	19	36	106	144	106	80	94	77	118	64	30	29	23	8	21	956	1,022
600	4	10	15	55	112	105	90	85	76	86	47	42	63	17	23	10	840	898
700	1	3	13	43	87	90	60	69	81	91	49	70	36	9	12	1	715	765
800	3	8	14	44	85	76	78	63	71	115	55	54	40	18	23	12	759	812
900	0	1	7	38	73	98	89	66	83	87	63	54	51	30	24	14	778	832
1000	1	3	6	35	56	86	91	68	122	110	81	55	53	23	17	15	822	879
1100	0	12	32	49	98	82	74	47	73	112	77	61	64	30	48	53	912	975
1200	0	7	10	47	104	99	85	61	70	93	56	40	41	23	18	30	784	839
1300	0	9	15	22	74	79	62	48	48	109	79	73	70	42	38	17	785	840
1400	0	18	14	41	59	49	59	56	115	130	107	91	60	49	49	11	908	971
1500	0	19	20	22	42	58	70	67	86	107	111	97	67	72	26	18	882	943
1600	1	5	19	37	91	79	88	74	99	137	112	88	76	58	47	18	1,029	1,101
1700	3	2	25	52	77	121	114	85	82	137	104	88	31	50	41	20	1,032	1,104
1800	12	31	24	62	111	144	157	80	92	144	106	87	75	83	65	32	1,305	1,396
1900	4	23	21	97	184	200	121	110	88	126	106	92	73	71	81	59	1,456	1,557
2000	7	8	25	105	197	229	141	110	92	120	93	104	71	63	80	65	1,510	1,615
2100	3	6	26	98	231	289	212	126	109	133	110	98	71	65	107	61	1,745	1,866
2200	0	3	23	139	212	331	217	200	135	154	101	107	82	88	101	47	1,940	2,075
2300	1	6	25	110	218	276	190	140	104	120	91	140	121	73	64	46	1,725	1,845
2400	0	3	14	114	171	192	161	109	73	121	92	72	78	39	45	27	1,311	1,402
Total	68	327	717	2,055	3,065	3,319	2,646	2,132	2,087	2,809	2,023	1,793	1,377	988	987	638	27,031	28,911
Adjusted	73	350	767	2,198	3,278	3,550	2,830	2,280	2,232	3,004	2,164	1,918	1,473	1,057	1,056	682	28,911	

Appendix D3.–Right and left bank Anvik River summer chum salmon counts by hour and sector, 2003.

Hour Ending	**Sector**																**Total**	**Total Adjusted**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**		
100	37	172	951	1,590	1,185	1,229	765	425	1,868	1,412	781	536	558	260	287	219	12,275	13,221
200	49	362	1,336	1,827	1,261	1,218	634	410	1,557	976	665	522	555	268	242	232	12,114	13,048
300	96	377	1,135	1,662	1,137	1,142	640	463	1,364	887	698	525	409	152	174	190	11,051	11,901
400	114	521	1,034	1,729	1,252	1,219	629	438	1,443	921	576	426	343	217	128	110	11,100	11,956
500	84	270	757	1,493	1,282	1,232	682	454	1,821	1,158	674	470	354	170	168	173	11,242	12,110
600	52	203	767	1,579	1,197	1,388	693	435	1,913	1,104	650	486	327	124	180	166	11,264	12,135
700	69	147	767	1,684	1,289	1,364	696	385	1,704	1,141	654	473	302	153	147	119	11,094	11,952
800	53	204	991	1,905	1,190	1,266	695	338	1,549	992	586	411	366	134	158	105	10,943	11,789
900	59	164	825	1,510	1,163	1,336	699	409	1,426	918	478	293	242	138	138	129	9,927	10,694
1000	40	142	690	1,375	981	1,206	732	362	1,493	771	444	381	350	124	86	125	9,302	10,020
1100	19	197	843	1,398	1,119	1,128	670	313	1,274	1,014	458	300	225	102	166	169	9,395	10,119
1200	25	126	789	1,651	1,271	1,200	716	324	1,084	593	393	211	218	106	141	121	8,969	9,661
1300	25	191	840	1,610	1,221	1,110	627	280	1,156	677	392	331	282	153	169	118	9,182	9,891
1400	24	186	828	1,685	1,216	1,033	629	291	1,035	646	432	294	271	183	158	137	9,048	9,745
1500	12	135	653	1,662	1,209	1,011	568	328	1,012	616	423	300	253	182	173	119	8,656	9,323
1600	12	85	514	1,237	962	1,017	556	259	932	653	348	244	248	165	188	186	7,606	8,190
1700	11	76	625	1,298	823	937	630	338	964	604	367	290	262	205	176	192	7,798	8,397
1800	25	139	734	1,219	896	964	705	287	1,248	771	468	330	255	205	205	186	8,637	9,299
1900	13	117	759	1,333	1,075	954	643	393	1,541	917	470	309	282	225	228	194	9,453	10,177
2000	37	138	612	1,180	926	950	638	321	1,454	939	509	395	303	235	310	257	9,204	9,908
2100	22	152	692	1,169	999	993	659	336	1,398	885	596	350	327	217	258	195	9,248	9,954
2200	15	137	771	1,147	1,055	1,080	638	357	1,446	934	533	409	344	280	332	229	9,707	10,447
2300	18	187	851	1,553	1,145	1,143	641	313	1,268	891	530	418	357	276	258	266	10,115	10,889
2400	22	196	836	1,459	1,210	1,257	720	330	1,515	1,156	749	504	473	273	330	200	11,230	12,094
Total	933	4,624	19,600	35,955	27,064	27,377	15,905	8,589	33,465	21,576	12,874	9,208	7,906	4,547	4,800	4,137	238,560	256,921
Adjusted	1,005	4,982	21,121	38,739	29,147	29,482	17,122	9,240	36,055	23,234	13,860	9,910	8,510	4,893	5,166	4,454	256,921	

Appendix D4.–Right bank Anvik River summer chum salmon proportions by hour and sector, 2003.

Hour Ending	Sector 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total	Total Adjusted
100	0.000	0.001	0.004	0.007	0.005	0.005	0.003	0.001	0.008	0.006	0.003	0.002	0.002	0.001	0.001	0.001	0.052	0.056
200	0.000	0.002	0.006	0.008	0.005	0.005	0.003	0.002	0.007	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.052	0.056
300	0.000	0.002	0.005	0.007	0.005	0.005	0.003	0.002	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.046	0.049
400	0.000	0.002	0.005	0.007	0.005	0.005	0.003	0.002	0.007	0.004	0.002	0.002	0.002	0.001	0.001	0.000	0.047	0.051
500	0.000	0.001	0.003	0.007	0.005	0.005	0.003	0.002	0.008	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.049	0.052
600	0.000	0.001	0.004	0.007	0.005	0.006	0.003	0.002	0.009	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.049	0.053
700	0.000	0.001	0.004	0.008	0.006	0.006	0.003	0.001	0.008	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.049	0.053
800	0.000	0.001	0.005	0.009	0.005	0.006	0.003	0.001	0.007	0.004	0.003	0.002	0.002	0.001	0.001	0.000	0.048	0.052
900	0.000	0.001	0.004	0.007	0.005	0.006	0.003	0.002	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.043	0.047
1000	0.000	0.001	0.003	0.006	0.004	0.005	0.003	0.001	0.006	0.003	0.002	0.002	0.001	0.000	0.000	0.001	0.040	0.043
1100	0.000	0.001	0.004	0.006	0.005	0.005	0.003	0.001	0.006	0.004	0.002	0.001	0.001	0.000	0.001	0.001	0.040	0.043
1200	0.000	0.001	0.004	0.008	0.006	0.005	0.003	0.001	0.005	0.002	0.002	0.001	0.001	0.000	0.001	0.000	0.039	0.042
1300	0.000	0.001	0.004	0.008	0.005	0.005	0.003	0.001	0.005	0.003	0.001	0.001	0.001	0.001	0.001	0.000	0.040	0.043
1400	0.000	0.001	0.004	0.008	0.005	0.005	0.003	0.001	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.038	0.041
1500	0.000	0.001	0.003	0.008	0.006	0.005	0.002	0.001	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.000	0.037	0.040
1600	0.000	0.000	0.002	0.006	0.004	0.004	0.002	0.001	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.031	0.034
1700	0.000	0.000	0.003	0.006	0.004	0.004	0.002	0.001	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.032	0.034
1800	0.000	0.001	0.003	0.005	0.004	0.004	0.003	0.001	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.035	0.037
1900	0.000	0.000	0.003	0.006	0.004	0.004	0.002	0.001	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.038	0.041
2000	0.000	0.001	0.003	0.005	0.003	0.003	0.002	0.001	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.036	0.039
2100	0.000	0.001	0.003	0.005	0.004	0.003	0.002	0.001	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.035	0.038
2200	0.000	0.001	0.004	0.005	0.004	0.004	0.002	0.001	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.037	0.040
2300	0.000	0.001	0.004	0.007	0.004	0.004	0.002	0.001	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.040	0.043
2400	0.000	0.001	0.004	0.006	0.005	0.005	0.003	0.001	0.007	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.047	0.051
Total	0.004	0.020	0.089	0.160	0.113	0.114	0.063	0.031	0.148	0.089	0.051	0.035	0.031	0.017	0.018	0.017	1.000	1.078
Adjusted	0.004	0.022	0.096	0.173	0.122	0.123	0.068	0.033	0.160	0.096	0.055	0.038	0.033	0.018	0.019	0.018	1.078	

Appendix D5.–Left bank Anvik River summer chum salmon proportions by hour and sector, 2003.

Hour Ending	Sector 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total	Total Adjusted
100	0.000	0.000	0.002	0.006	0.005	0.005	0.004	0.004	0.003	0.005	0.003	0.003	0.001	0.001	0.001	0.001	0.044	0.047
200	0.000	0.001	0.003	0.007	0.006	0.004	0.003	0.003	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.044	0.047
300	0.000	0.002	0.005	0.008	0.007	0.006	0.004	0.004	0.003	0.004	0.003	0.003	0.001	0.000	0.000	0.000	0.049	0.053
400	0.000	0.002	0.003	0.006	0.005	0.005	0.004	0.003	0.002	0.004	0.003	0.002	0.001	0.001	0.000	0.001	0.041	0.044
500	0.000	0.001	0.001	0.004	0.005	0.004	0.003	0.003	0.003	0.004	0.002	0.001	0.001	0.001	0.000	0.001	0.035	0.038
600	0.000	0.000	0.001	0.002	0.004	0.004	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.001	0.001	0.000	0.031	0.033
700	0.000	0.000	0.000	0.002	0.003	0.003	0.002	0.003	0.003	0.003	0.002	0.003	0.001	0.000	0.000	0.000	0.026	0.028
800	0.000	0.000	0.001	0.002	0.003	0.003	0.003	0.002	0.003	0.004	0.002	0.002	0.001	0.001	0.001	0.000	0.028	0.030
900	0.000	0.000	0.000	0.001	0.003	0.004	0.003	0.002	0.003	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.029	0.031
1000	0.000	0.000	0.000	0.001	0.002	0.003	0.003	0.003	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.030	0.033
1100	0.000	0.000	0.001	0.002	0.004	0.003	0.003	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.002	0.002	0.034	0.036
1200	0.000	0.000	0.000	0.002	0.004	0.004	0.003	0.002	0.003	0.003	0.002	0.001	0.002	0.001	0.001	0.001	0.029	0.031
1300	0.000	0.000	0.001	0.001	0.003	0.003	0.002	0.002	0.002	0.004	0.003	0.003	0.003	0.002	0.001	0.001	0.029	0.031
1400	0.000	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.004	0.005	0.004	0.003	0.002	0.002	0.002	0.000	0.034	0.036
1500	0.000	0.001	0.001	0.001	0.002	0.002	0.003	0.002	0.003	0.004	0.004	0.004	0.002	0.003	0.001	0.001	0.033	0.035
1600	0.000	0.000	0.001	0.001	0.003	0.003	0.003	0.003	0.004	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.038	0.041
1700	0.000	0.000	0.001	0.002	0.003	0.004	0.004	0.003	0.003	0.005	0.004	0.003	0.001	0.002	0.002	0.001	0.038	0.041
1800	0.000	0.001	0.001	0.002	0.004	0.005	0.006	0.003	0.003	0.005	0.004	0.003	0.003	0.003	0.002	0.001	0.048	0.052
1900	0.000	0.001	0.001	0.004	0.007	0.007	0.004	0.004	0.003	0.005	0.004	0.003	0.003	0.003	0.003	0.002	0.054	0.058
2000	0.000	0.000	0.001	0.004	0.007	0.008	0.005	0.004	0.003	0.004	0.003	0.004	0.003	0.002	0.003	0.002	0.056	0.060
2100	0.000	0.000	0.001	0.004	0.009	0.011	0.008	0.005	0.004	0.005	0.004	0.004	0.003	0.002	0.004	0.002	0.065	0.069
2200	0.000	0.000	0.001	0.005	0.008	0.012	0.008	0.007	0.005	0.006	0.004	0.004	0.003	0.003	0.004	0.002	0.072	0.077
2300	0.000	0.000	0.001	0.004	0.008	0.010	0.007	0.005	0.004	0.004	0.003	0.005	0.004	0.003	0.002	0.002	0.064	0.068
2400	0.000	0.000	0.001	0.004	0.006	0.007	0.006	0.004	0.003	0.004	0.003	0.003	0.003	0.001	0.002	0.001	0.048	0.052
Total	0.003	0.012	0.027	0.076	0.113	0.123	0.098	0.079	0.077	0.104	0.075	0.066	0.051	0.037	0.037	0.024	1.000	1.070
Adjusted	0.003	0.013	0.028	0.081	0.121	0.131	0.105	0.084	0.083	0.111	0.080	0.071	0.054	0.039	0.039	0.025	1.070	

Appendix D6.–Right and left bank Anvik River summer chum salmon proportions by hour and sector, 2003.

Hour	Sector																	
Ending	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Total**	**Total Adjusted**
100	0.000	0.001	0.004	0.007	0.005	0.005	0.003	0.002	0.008	0.006	0.003	0.002	0.002	0.001	0.001	0.001	0.051	0.055
200	0.000	0.002	0.006	0.008	0.005	0.005	0.003	0.002	0.007	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.051	0.055
300	0.000	0.002	0.005	0.007	0.005	0.005	0.003	0.002	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.046	0.050
400	0.000	0.002	0.004	0.007	0.005	0.005	0.003	0.002	0.006	0.004	0.002	0.002	0.001	0.001	0.001	0.000	0.047	0.050
500	0.000	0.001	0.003	0.006	0.005	0.005	0.003	0.002	0.008	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.047	0.051
600	0.000	0.001	0.003	0.007	0.005	0.006	0.003	0.002	0.008	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.047	0.051
700	0.000	0.001	0.003	0.007	0.005	0.006	0.003	0.002	0.007	0.005	0.003	0.002	0.001	0.001	0.001	0.000	0.047	0.050
800	0.000	0.001	0.004	0.008	0.005	0.005	0.003	0.001	0.006	0.004	0.002	0.002	0.002	0.001	0.001	0.000	0.046	0.049
900	0.000	0.001	0.003	0.006	0.005	0.006	0.003	0.002	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.042	0.045
1000	0.000	0.001	0.003	0.006	0.004	0.005	0.003	0.002	0.006	0.003	0.002	0.002	0.001	0.001	0.000	0.001	0.039	0.042
1100	0.000	0.001	0.004	0.006	0.005	0.005	0.003	0.001	0.005	0.004	0.002	0.001	0.001	0.000	0.001	0.001	0.039	0.042
1200	0.000	0.001	0.003	0.007	0.005	0.005	0.003	0.001	0.005	0.002	0.002	0.001	0.001	0.000	0.001	0.001	0.038	0.040
1300	0.000	0.001	0.004	0.007	0.005	0.005	0.003	0.001	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.038	0.041
1400	0.000	0.001	0.003	0.007	0.005	0.004	0.003	0.001	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.038	0.041
1500	0.000	0.001	0.003	0.007	0.005	0.004	0.002	0.001	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.036	0.039
1600	0.000	0.000	0.002	0.005	0.004	0.004	0.002	0.001	0.004	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.032	0.034
1700	0.000	0.000	0.003	0.005	0.003	0.004	0.003	0.001	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.033	0.035
1800	0.000	0.001	0.003	0.005	0.004	0.004	0.003	0.001	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.036	0.039
1900	0.000	0.000	0.003	0.006	0.005	0.004	0.003	0.002	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.040	0.043
2000	0.000	0.001	0.003	0.005	0.004	0.004	0.003	0.001	0.006	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.039	0.042
2100	0.000	0.001	0.003	0.005	0.004	0.004	0.003	0.001	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.039	0.042
2200	0.000	0.001	0.003	0.005	0.004	0.005	0.003	0.001	0.006	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.041	0.044
2300	0.000	0.001	0.004	0.007	0.005	0.005	0.003	0.001	0.005	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.042	0.046
2400	0.000	0.001	0.004	0.006	0.005	0.005	0.003	0.001	0.006	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.047	0.051
Total	0.004	0.019	0.082	0.151	0.113	0.115	0.067	0.036	0.140	0.090	0.054	0.039	0.033	0.019	0.020	0.017	1.000	1.077
Adjusted	0.004	0.021	0.089	0.162	0.122	0.124	0.072	0.039	0.151	0.097	0.058	0.042	0.036	0.021	0.022	0.019	1.077	

APPENDIX E. AGE AND SEX COMPOSITION

Appendix E1.–Anvik River summer chum salmon escapement age and sex composition by stratum, and weighted season total, 2003.

		Brood Year and Age Group				
		2000	1999	1998	1997	
		0.2	0.3	0.4	0.5	Total
Stratum:	6/21–7/04		*Stratum 1*			
Sample Size:	144					
Female	No. in Escapement	0	17,700	8,428	1,264	27,393
	Percent of Sample	0.0	29.2	13.9	2.1	45.1
Male	No. in Escapement	421	18,121	13,486	1,264	33,292
	Percent of Sample	0.7	29.9	22.2	2.1	54.9
Total	No. in Escapement	421	35,821	21,914	2,529	60,685
	Percent of Sample	0.7	59.0	36.1	4.2	100.0
Stratum:	7/05–7/10		*Stratum 2*			
Sample Size:	148					
Female	No. in Escapement	518	32,641	10,880	0	44,039
	Percent of Sample	0.7	42.6	14.2	0.0	57.4
Male	No. in Escapement	0	24,869	7,254	518	32,641
	Percent of Sample	0.0	32.4	9.5	0.7	42.6
Total	No. in Escapement	518	57,510	18,134	518	76,680
	Percent of Sample	0.7	75.0	23.6	0.7	100.0
Stratum:	7/11–7/15		*Stratum 3*			
Sample Size:	141					
Female	No. in Escapement	409	24,142	6,547	409	31,507
	Percent of Sample	0.7	41.8	11.3	0.7	54.6
Male	No. in Escapement	0	18,822	7,365	0	26,188
	Percent of Sample	0.0	32.6	12.8	0.0	45.4
Total	No. in Escapement	409	42,964	13,912	409	57,695
	Percent of Sample	0.7	74.5	24.1	0.7	100.0
Stratum:	7/16–7/27		*Stratum 4*			
Sample Size:	151					
Female	No. in Escapement	2,048	33,593	2,868	0	38,509
	Percent of Sample	3.3	54.3	4.6	0.0	62.3
Male	No. in Escapement	410	16,796	6,145	0	23,351
	Percent of Sample	0.7	27.2	9.9	0.0	37.7
Total	No. in Escapement	2,458	50,389	9,013	0	61,860
	Percent of Sample	4.0	81.5	14.6	0.0	100.0
Stratum:	6/21–7/27		*Season Total*			
Sample Size:	584					
Female	No. in Escapement	2,976	108,075	28,723	1,673	141,448
	Percent of Sample	1.2	42.1	11.2	0.7	55.1
Male	No. in Escapement	831	78,609	34,249	1,782	115,472
	Percent of Sample	0.3	30.6	13.3	0.7	44.9
Total	No. in Escapement	3,807	186,685	62,973	3,456	256,920
	Percent of Sample	1.5	72.7	24.5	1.3	100.0