Fishery Data Series No. 08-65

Sonar Estimation of Salmon Passage in the Yukon River Near Pilot Station, 2006

by

Holly C. Carroll

and

Bruce C. McIntosh

December 2008

Alaska Department of Fish and Game Divisions of Sport Fish 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 al (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
mid eye to fork	MEF
mid eye 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

FISHERY DATA SERIES NO. 08-65

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by
Holly C. Carroll and Bruce C. McIntosh
Alaska Department of Fish and Game, Division of Commercial Fisheries, Fairbanks

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

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Holly C. Carroll,
Alaska Department of Fish and Game, Commercial Fisheries Division,
1300 College Rd., Fairbanks, AK, USA

Bruce C. McIntosh,
Alaska Department of Fish and Game, Commercial Fisheries Division,
1300 College Rd., Fairbanks, AK, USA

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ABSTRACT

The Yukon River sonar project has provided daily passage estimates for Chinook salmon *Oncorhynchus tshawytscha*, chum salmon *O. keta*, and coho salmon *O. kisutch* for most years since 1986. Fish passage estimates for each species were generated in 2006 through a 2-component process: (1) estimation of total fish passage with 120 kHz split-beam sonar and a Dual Frequency Identification Sonar (DIDSON[1]), and (2) apportionment to species by sampling with a suite of gillnets of various mesh sizes. An estimated 5,850,452 fish passed through the sonar sampling area between June 5 and August 31; 22.5% along the right bank and 77.5% (season average) along the left bank. Included were 145,553 ± 21,148 large Chinook salmon (>655 mm METF); 23,850 ± 5,480 small Chinook salmon (≤655 mm METF); 3,767,044 ± 159,234 summer chum salmon; and 790,563 ± 62,715 fall chum salmon.

Key words: Yukon River, Chinook salmon, chum salmon, hydroacoustic, riverine, sonar, abundance estimate, species apportionment, net selectivity, split-beam, DIDSON.

INTRODUCTION

BACKGROUND

Within Alaska, 3 species of Pacific salmon (Chinook salmon *Oncorhynchus tshawytscha,* coho salmon *O. kisutch*, and chum salmon *O. keta*) are managed inseason for harvest by commercial, sport, and subsistence fisheries over 2,200 km of the Yukon River, as well as to meet treaty commitments made under the U.S. / Canada Yukon River Salmon Agreement. The diversity and number of fish stocks, combined with the geographic range of user groups, adds complexity to management decisions. Escapement estimates and run-strength indices are generated by various projects along the river, providing stock-specific abundance and timing information, however, much of this information is obtained after the fish have become unavailable to the fisheries. Timely indices of run strength are provided by gillnet test fisheries conducted in the lower Yukon River, but the functional relationship between catch per unit effort (CPUE) and actual abundance is confounded by varying migration patterns through the multi-channel environment, gear selectivity, and changes in net site characteristics.

The Yukon River sonar project has provided daily salmon passage estimates, run timing and biological information to fisheries managers for most years since 1986. The estimates from this project complement information obtained from other sources. Located in a single-channel environment at river km 197 near Pilot Station, the project is far enough upriver to avoid the wide, multiple channels of the Yukon River Delta. Because salmon migrate from the river mouth to the sonar site in 2 to 3 days, the project provides timely abundance information to managers of downstream fisheries (Figure 1). The Andreafsky River is the only major salmon spawning tributary downstream of the sonar site (Figure 2), therefore the majority of migrating salmon in the Yukon River pass the sonar project on their way to the spawning grounds.

Alaska Department of Fish and Game's (ADF&G) primary role is to manage for sustained yield under Article VIII of the Alaska Constitution, but Alaska is also obligated to manage Yukon River salmon stocks according to precautionary, abundance-based harvest-sharing principals set forth in the Yukon River Salmon Agreement. The goal of bi-national, coordinated management of Chinook salmon and chum salmon stocks is to meet escapement requirements that will ensure sufficient fish availability for sustained harvests in both the United States and Canada.

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[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

Furthermore, managers follow management plans specified in state regulations for Yukon River Chinook, summer chum, fall chum, and coho salmon. Accurate daily salmon abundance estimates not only help managers adjust harvest in season for harvest and escapement objectives, they are also used postseason to determine whether treaty obligations were met and to judge effects of management actions.

The project uses a combination of fixed-location split-beam sonar and Dual Frequency Identification Sonar (DIDSON) to estimate the daily upstream passage of fish. A series of gillnets with different mesh sizes are drifted through the acoustic sampling areas to apportion the passage estimates to species. Species apportionment methodology continues to be refined. In 2004 the selectivity curves for salmon species were updated in an attempt to more accurately estimate abundance and proportions (Bromaghin 2004).

Locations in this report are referenced by the proximate bank of the Yukon River, relative to a downstream perspective. At the sonar site the left bank is south of the right bank. Both the City of Pilot Station and the ADF&G sonar camp are located on the right bank.

The Yukon River, at the sonar site, is approximately 1000 m wide between the left and right bank transducers (Figure 3). The left bank substrate, composed of silt and fine sand, drops off gradually at a vertical angle of approximately 2° to 4°. The right bank has a stable, rocky bottom that drops off uniformly to the thalweg at a vertical angle of approximately 10°. The thalweg is approximately 25 m deep and is located approximately 200 m offshore of the right bank. Water velocity, as measured with acoustic doppler profiling, ranges up to 2 m/sec in offshore portions of the water column. Streamflow typically peaks shortly after the ice goes out at breakup in late May and early June, and then generally declines throughout the summer and fall (Figure 4). River height, as observed from 2001 to 2005 at the United States Geological Survey (USGS) gage station located downstream of the project, ranged from a maximum of 27.4 ft to a minimum of 14.3 ft during the months of June, July, and August (Figure 5).

Prior to 1993, ADF&G used dual-beam sonar equipment that operated at 420 kHz. In 1993, ADF&G changed the existing sonar equipment to operate at a frequency of 120 kHz to allow greater ensonification range and to minimize signal loss. The newly configured equipment's performance was verified using standard acoustic targets in the field in 1993. Use of lower frequency equipment increased fish detection at long range.

Up until 1995, ADF&G attempted to identify direction of travel of detected targets by aiming the acoustic beam at an upstream or downstream angle relative to fish travel. This technique was discontinued in 1995. Significant enhancements that year included implementation of an aiming strategy designed to consistently maximize fish detection. Because of this and subsequent changes in counting methodology, data collected from 1995 to 2006 are not directly comparable to previous years. In 2001 the equipment was changed from the dual-beam to the current split-beam sonar system. This technology allows better testing of assumptions about direction of travel and vertical distribution.

In 2004, the selectivity model used in species apportionment was refined through biometric review and analysis of historical catch data from the project test fishery. The model providing the best overall fit to the data was a Pearson model with a tangle parameter. Species proportions and passage estimates reported here were generated with this apportionment model, and are comparable with estimates from 1995 to the present, as historical estimates have been re-generated using the most current model and methodology (Hamazaki[2]; Bromaghin 2004).

Early in the 2005 season, the Yukon River experienced high water levels and erosion in the bottom profile that, along with a combination of changes in fish movement and distribution, affected detection of fish with the split beam sonar within 20 m of shore on the left bank. On June 19, 2005 a DIDSON imaging sonar was deployed in this area to verify nearshore fish detection. With its wider beam angle, the DIDSON system was able to detect fish passage within 20 m despite high water levels and problematic erosion nearshore, and was operated for the remainder of the season, supplanting split-beam counts in this section of nearshore region.

In 2006, the DIDSON was integrated into the sampling routine on the left bank for the whole season, operating side-by-side with the split-beam sonar. The DIDSON sampled the first 20 m of the nearshore stratum; the remainder of the 250 m range was sampled by the split-beam.

GOALS AND OBJECTIVES

The primary goal of this project is to accurately estimate daily fish passage, by species, during upstream migration past the sonar site. Project objectives were to:

1. Provide managers with timely estimates, and associated confidence intervals, of daily and seasonal passage of adult Chinook, chum and coho salmon;
2. Collect biological data from all fish captured in the test-fishery, including species, sex, length, and scales as appropriate;
3. Assist in the collection of Chinook and chum salmon tissue samples for separate genetic stock identification projects; and
4. Collect hydrological data representative of the ensonified areas of the river.

METHODS

Estimates of upstream migration of targeted fish species are produced from a combination of independently generated estimates of fish movements past the sonar site using hydroacoustic equipment, and species proportions based upon the results of drift gillnetting in the same area (Figure 6).

HYDROACOUSTIC DATA ACQUISITION

Equipment

Left bank sonar equipment included:

1. A Hydroacoustic Technology Inc (HTI) Model 244 echosounder configured to transmit and receive at 120 kHz, controlled via Digital Echo Processing (DEP) software installed on a laptop P.C.;
2. An HTI 120 kHz split-beam transducer with a 2.8°x10° nominal beam width;

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[2] Hamazaki, T. Unpublished. Comparison of net selectivity models for Yukon River Pilot Station sonar test-fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage.

3. Three 250 ft HTI split-beam transducer cables connecting the sounder to the transducer;
4. An HTI Model 405 digital chart recorder coupled with a Panasonic KXP 3624 dot matrix printer; and
5. A Hewlett-Packard (H.P.) Model 54501A digital storage oscilloscope.
6. A DIDSON-LR (Long Range) unit (12ºx29º approximate beam dimension), configured to transmit and receive at 1.2 MHz, and controlled via software installed on a laptop PC; and
7. One 500 ft. DIDSON underwater cable connecting the DIDSON to the "topside breakout box" and laptop PC.

Right bank sonar equipment included:

1. An HTI Model 244 echosounder configured to operate at 120 kHz, controlled via DEP software installed on a laptop P.C.;
2. An HTI split-beam 120 kHz transducer with a 6°x10° nominal beam width;
3. Three 250 ft (228.6 m combined length) HTI split-beam cables connecting the sounder to the transducer; and
4. An HTI Model 405 digital chart recorder coupled with Panasonic KXP 3624 dot matrix printer.

Each system configuration of sounder, transducer, and cable was calibrated by the manufacturer prior to the field season. Transducers were mounted on metal tripods and remotely aimed with HTI model 662H dual-axis rotators. Rotator movements were controlled with HTI model 660-2 rotator controllers with position feedback to the nearest 0.1^{o}. Gasoline generators (3000 W) supplied 120 VAC power. The split-beam sonar signal was processed by the digital chart recorders, printed to paper charts, and hand-marked. DIDSON data was saved onto the laptops and processed daily via electronic echograms.

Equipment Settings, Thresholds, Data Storage

The split-beam echosounders used a 40 log(R) time-varied gain (TVG) and 0.4 ms transmit pulse duration during all sampling activities (Table 1). The receiver bandwidth was automatically determined by the equipment based on the transmit pulse duration. Pulse repetition rates were set below the maximum allowed by range to avoid overloading printer buffers. On the left bank, the nearshore stratum pulse repetition rate was set to 5 pings per second (pps), the midshore stratum was set at 4 pps and the offshore stratum was set at 2.5 pps. The pulse repetition rate for the right bank nearshore was set at 5 pps and the offshore stratum was set at 4 pps.

For the split-beam system, echoes were digitized by chart recorders, and then printed on wide carriage, continuous-feed paper using dot matrix printers. Four printer thresholds, corresponding to degrees of gray-line, were set for all strata in approximately 3 dB increments. The lowest sampling threshold was set at -43 dB, approximately 13 dB lower than the theoretical on-axis target strength of a chum salmon of minimal length (450 mm) calculated using Love's equation (Love 1977). Lowering the threshold by 15 dB allows for detection across the nominal beam width (6 dB) and variability (~7 dB) induced by fish aspect and noise corruption. Transmit power was adjusted as necessary to compensate for environmentally induced signal loss. Threshold levels (in mV) were recorded and converted to target strength, $TS_{dB,}$ as follows:

$$TS_{dB} = 20 \cdot \log\left(\frac{T_{mV}}{1000\,mV}\right) - \left(SL + G_S + G_R\right) \quad (1)$$

where T_{mV} is the chart recorder threshold in mV, *SL* is the transmitted source level in dB, G_S is the through-system gain, and G_R is the receiver gain.

The DIDSON (Table 2) operated at an average rate of 8 frames/s with a starting range of 0.83 m and an end range of 20.84 m, in high-frequency mode (1.2 MHz). Files were recorded onto the laptop and were processed using electronic echograms, where operators could change intensity and threshold to increase visibility of targets on screen.

Aiming

The transducers were always positioned and aimed to maximize fish detection. With the transducer located in the area with the best bottom profile, the beam was oriented approximately perpendicular to the current so that migrating fish would present the largest possible reflective surface. Since many fish travel close to the substrate, the maximum response angle of the beam was oriented along the river bottom through as much of the range as possible.

Fluctuating water levels required repositioning of the transducers, and subsequent re-aiming of the beams. To establish an optimal aim, the transducer was panned horizontally upstream and downstream approximately 15º off perpendicular in 2º increments. At each increment, the vertical tilt was adjusted to obtain the best possible bottom picture. The left bank transducers were re-aimed more often to compensate for the dynamic bottom conditions on that side of the river. Once an optimal aim was obtained, the rotator settings were documented and chart printouts of the new aim were posted for visual reference. All operators were trained to first aim to established pan and tilt settings, then to refine that aim to match the substrate pattern on the current chart printout with those of reference chart samples.

Sampling Procedures

Transducers were deployed on both the left bank and the right bank in an area where the river is approximately 1,000 m wide. The right bank transducer was positioned approximately 3 m from shore, and the aim was adjusted between 2 strata (S1: 0–50 m and S2: 50–150 m). The left bank split-beam transducer was deployed approximately 5 m from the shoreline and utilized 3 distinct aims to sample a nearshore stratum (S3, 0–50 m), a midshore stratum (S4, 50–150 m), and an offshore stratum (S5, 150–250 m). The DIDSON unit was deployed next to the split-beam transducer (within 2 m) and ensonified 2 sectors of the nearshore stratum (0–20 m) (Figure 7). Because the DIDSON sonar's wider beam angle is ideal for the less linear nature of the eroded left bank nearshore, it is assumed that it will detect fish targets better than the split-beam which is narrower in the extreme nearshore. Therefore, when aiming the split-beam for the nearshore stratum from 0 to 50 m, when necessary for best detection, the aim is optimized for the 20 to 50 m portion of the stratum, which is not ensonified by the DIDSON. In this way, the sonar systems are used in concert to maximize detection for the entire nearshore stratum on left bank. The counts from the 2 systems cannot directly be compared for the 0 to 20 m nearshore, since the aiming strategy optimizes fish detection for DIDSON but not the split-beam within this range.

Throughout the season, strata ranges were adjusted to provide an optimal fit to the bottom profile. The left bank transducers were occasionally relocated either upstream or downstream to compensate for the dynamic bottom profile. Transducers on each bank were repositioned either inshore or offshore as needed to compensate for changing water levels.

Acoustic sampling was conducted simultaneously on both banks during three 3-h periods each day (Table 3). Sample periods were scheduled from 0530 to 0830, 1330 to 1630, and 2130 to 0030 hours, alternating sequentially between strata every 30 minutes. Each sampling stratum was subdivided into 5 equal range sectors, with sonar counts tallied by sector in 15-minute intervals during daily sampling periods. The DIDSON-generated sonar counts supplanted those of the split-beam for sectors 1 and 2 of the nearshore stratum (S3) if they were higher.

Operators counted fish traces on paper echograms for the split-beam system, and on electronic echograms for the DIDSON system. Echo traces were counted as a single fish if at least 2 pings in the cluster passed the second printer threshold level (see Equipment Settings, Thresholds, Data Storage) and the targets did not resemble inert downstream objects. Groups of fish were distinguishable when the apparent direction of movement of one fish trace differed from that of an adjacent trace.

Fish traces were tallied on field data forms and entered into an Access database. The data were checked daily for data entry or tallying errors, then processed in SAS using statistical routines developed by the regional Biometrician.

All personnel were trained to distinguish between fish tracings and non-target echoes. Chart printouts and echograms were reviewed daily by either the project leader or crew leader to monitor the accuracy of the marked fish tracings and reduce individual biases. Each chart image was checked for indications of signal loss and changes in bottom reverberation markings, which could indicate either movement of the transducer or a change in bottom structure.

SYSTEM ANALYSES

Performance of the hydroacoustic system was routinely monitored following procedures first established in 1995 (Maxwell et al. 1997). System analyses included equipment performance checks, bottom profiles using down-looking sonar, and hydrologic measurements.

Bottom Profiles

Bottom profiles were recorded along both banks using a Lowrance LCX15MT recording fathometer with GPS capabilities to locate deployment sites with suitable linear bottom profiles. All bottom profiles were recorded and stored electronically. Inseason, the fathometer was used regularly to monitor changing bottom conditions and to watch for the formation of sandbars capable of re-routing fish to unensonified areas.

Hydrological Measurements

Water level was measured using a staff gage located slightly offshore on the right bank, near the field camp. To standardize measurements with observations from previous years, water level measurements were adjusted to the USGS Water Resources Division reference located approximately 500 m downstream of Pilot Station. The information collected from the staff gage was used inseason as a relative water height indicator, and to gather information as a backup for times when the USGS water data was unavailable.

SPECIES APPORTIONMENT

Equipment and Procedures

To estimate species composition, gillnets were drifted through 3 zones (right bank, left bank nearshore, and left bank offshore) corresponding to sonar sampling strata (Figure 7). A total of 8 different mesh sizes were fished throughout the season to effectively capture all size classes of fish present and detectable by the hydroacoustic equipment (Table 4). All nets were 25 fathoms (45.7 m) long and approximately 8 m deep. All nets were constructed of Momoi MTC-50 or MT-50, shade 11, double knot multifilament nylon twine and hung "even" at a 2:1 ratio of web to corkline.

Testfishing was conducted twice daily between sonar periods, from 0900 to 1200 hours and 1700 to 2000 hours. During each sampling period, 4 different nets were drifted within each of 3 zones for a total of 24 drifts per day (Table 5). The order of drifts were 1) left bank nearshore zone, 2) right bank zone, and 3) left bank offshore zone, with a minimum of 20 minutes between drifts in the same zone. Each mesh size was fished in all 3 zones before switching to the next mesh size. The shoreward end of the left bank nearshore drift was held approximately 5 to 10 m from shore. The left bank offshore drift was approximately 65 m offshore so as not to overlap with the nearshore drift. Drifts were approximately 8 minutes in duration, but were shortened as necessary to avoid snags or to limit catches during times of high fish passage.

Captured fish were identified to species and measured to the nearest 1 mm length. Salmon species were measured from mid eye to fork of tail (MEFL); non-salmon species were measured from snout to fork of tail (FL). Fish species, length, and sex were recorded onto field data sheets. Each drift record included the date, sampling period, drift start and end times, mesh size, length of net, and captain's initials.

The probability of a fish of a given species and length being captured in a net is dependent on mesh size. To remove the effect of net selectivity, the Pearson T net selectivity model is used with coefficients generated for the following species: Chinook salmon; summer and fall chum salmon; coho salmon; pink salmon *O. gorbuscha;* cisco *Coregonus sardinella, C. laurettae;* Humpback whitefish *C. pidschian*; and Broad whitefish *C. nasus*. In addition, coefficients have also been generated for a group of other species containing: sheefish *Stenodus leucichthys;* burbot *Lota lota;* longnose sucker *Catostomus catostomus;* Dolly Varden *Salvelinus malma;* sockeye salmon *O. nerka;* and northern pike *Esox lucius*. A detailed description of the apportionment model and the derivation of net selectivity coefficients used (listed in Appendix A) can be found in Bromaghin 2004.

Scale samples were collected from Chinook salmon, mounted on scale cards, and scale and card numbers were recorded on the test-fishing data sheets. Data were transferred from data sheets into a database and processed using SAS software. Age-sex-length (ASL) data were processed, analyzed and reported by ADF&G staff based in Anchorage (Bales 2008). Handling mortalities among the captured fish were distributed to the local community, with fish dispersal documented daily.

Genetic tissue samples from both Chinook and chum salmon were also collected for several other projects, in conjunction with the Yukon Sonar project testfishing. Age, sex and length data were cross-referenced with each tissue sample. The ADF&G Gene Conservation Laboratory and the USFWS Conservation Genetics Laboratory independently processed and analyzed these samples (Bromaghin and Wenburg *In prep,* Flannery et al. *In prep*).

Chinook salmon were classified as either 'large' (> 655 MEFL) or 'small' (≤ 655 MEFL), with small Chinook salmon serving as a proxy for one-ocean 'jacks'. Although there is some temporal overlap between the summer and fall runs of chum salmon, for the purposes of estimating passage, all chum salmon encountered through July 18 were designated as summer chum and post July 18 were designated as fall chum.

ANALYTICAL METHODS

Daily estimates were produced from a multi-component process involving:

a) Hydroacoustic estimates of all fish targets passing the site, without regard to species.
b) Species composition derived from testfishing results and applied to the undifferentiated hydroacoustic estimates.
c) Traditional CPUE estimates, used as a separate index by the managers and calculated on a subset of the testfishing data.

Sparse and Missing Data

Testfishing was not conducted during commercial fishery openings and occasionally, during periods of low salmon passage, catches were too sparse to accurately estimate species proportions and associated error bounds. When sufficient gillnet samples were not available for a given day and zone, the data were pooled with data from one or more adjacent days by assigning the same report unit *u*.

Traditional CPUE estimates were calculated on a daily basis irrespective of catch size. In contrast, sonar passage, species composition, and species passage estimates were first calculated on the basis of report units (encompassing one or more full days of sampling in a zone), and then apportioned to daily estimates. For any testfish variable x the report unit u encompasses day d, testfish period p, and zone z such that:

$$x_u = \sum_{d,p,z}^{u} x_{dpz} \; . \qquad (2)$$

The report unit was then also appended to the corresponding days and zones of sonar passage estimates. In effect, any unique combination of day and zone having sufficient testfish catch was also assigned a unique report unit u, while combinations not having sufficient catch were pooled by assigning the same report unit either across zones or days.

Sonar Passage Estimates

Total fish passage was estimated separately for each of 3 zones. Zone 1 consisted of the entire counting range on the right bank, corresponding to strata 1 and 2 (approximately 0–150 m). Zone 2 consisted of the counting range corresponding to stratum 3 (approximately 0–50 m on the left bank). Zone 3 consisted of the counting range corresponding to stratum 4 and stratum 5 (approximately 50–150 m and 150–250 m on the left bank, respectively).

Within zone 2, passage was simultaneously estimated in sectors 1 and 2 (representing approximately the first 20 m of stratum 3) using both the DIDSON and the HTI sonar. Although the DIDSON was the primary system used to generate estimates in those 2 sectors, the HTI system was also tallied since operating it in sectors 3, 4, and 5 also entailed operating in sectors 1 and 2. The counts generated by the HTI in those 2 sectors essentially served as a backup to the DIDSON in the event of a system failure or a loss of data. Since the ranges of the 2 systems didn't always precisely overlap, a passage rate for the DIDSON (targets per meter-hour) was first calculated, and then expanded by the sector width and count time of the corresponding HTI sample to provide consistent width and count time for all sectors 1 through 5. This was done primarily as a matter of calculation convenience.

First, for sectors 1 and 2 of stratum 3, the sector widths *w* in meters were calculated for all samples *q* on day *d*, period *p* for both the DIDSON and HTI. The DIDSON unit counts over a single continuous range while the HTI subdivides this range into equal width sectors (*k*) 1 and 2 of stratum (*s*) 3. Sector widths for both systems are based on the start and end points of the range sampled, such that:

$$w_{dpskq} = End_{dpskq} - Start_{dpskq} \,. \tag{3}$$

The mean width of sectors 1 and 2 of the HTI:

$$w_{HTI} = \frac{\sum_{s=3} \sum_{q} w_{dpksq}}{n} \tag{4}$$

and the width of the DIDSON:

$$w_{DID} = \frac{\sum_{q} w_{dpq}}{n} \tag{5}$$

samples were calculated, where *n* is the number of samples. The total hours *h* sampled with the HTI system:

$$h_{HTI} = \sum_{q} h_{dpkq} \tag{6}$$

and the DIDSON:

$$h_{DID} = \sum_{q} h_{dpq} \tag{7}$$

were summed, as were the total upstream counts y:

$$y_{HTI} = \sum_{q} y_{dpkq} \tag{8}$$

$$y_{DID} = \sum_{q} y_{dpq} \tag{9}$$

Passage rates r were then calculated for both the DIDSON and the HTI systems:

$$r_{DID} = \frac{y_{DID}}{w_{DID} \cdot h_{DID}} \tag{10}$$

$$r_{HTI} = \frac{y_{HTI}}{w_{HTI} \cdot h_{HTI}} \tag{11}$$

Due to better detection capabilities at close range, and the aiming protocol described above, it was typical that the DIDSON passage rate would exceed the HTI passage rate in both sectors 1 and 2. In this case a passage estimate was generated for the time sampled by expanding the DIDSON using the HTI sector width and hours:

$$y_{dpk} = r_{DID} \cdot w_{HTI} \cdot h_{HTI} \tag{12}$$

However, in the event of a system failure or data loss using the DIDSON, the HTI estimate for those 2 sectors would be retained and used in subsequent calculations. In this case, the estimates for this time period would be considered conservative.

Total upstream fish passage y on day d during sonar period p in zone z and stratum s was then calculated by summing net upstream targets over all sectors k and samples q:

$$y_{dpzs} = \sum_q \sum_k y_{dpzsqk} \tag{13}$$

and the duration, in hours *h*, of the time sampled as:

$$h_{dpzs} = \sum_q \sum_k h_{dpzsqk} \tag{14}$$

The hourly passage rate *r* for day *d*, sonar period *p*, and zone *z* was computed as ratio of the sum of the estimated upstream passage in strata *s* to the duration (in hours) of the sample:

$$r_{dpz} = \frac{\sum_s y_{dpzs}}{\sum_s h_{dpzs}}. \tag{15}$$

Total passage of fish in report unit *u* was estimated as the product of the average hourly passage rate and the total hours encompassed by the report unit:

$$\hat{y}_u = \left(d_2 - d_1 + 1\right)_u \cdot 24 \cdot \left(\frac{\sum_{d,p,z \in u} r_{dpz}}{n_u} \right) \tag{16}$$

where d_1 is the first day, d_2 is the last day, and n_u is the number of sonar sampling periods in report unit *u*.

Sonar sampling periods, each 3 hours in duration, were spaced at regular (systematic) intervals of 8 hours. Treating the systematically sampled sonar counts as a simple random sample would yield an over-estimate of the variance of the total, since sonar counts are highly auto correlated (Wolter 1985). To accommodate these data characteristics, a variance estimator based on the squared differences of successive observations, recommended by Brannian (1986) and modified from Wolter (1985), was employed;

$$\hat{V}ar(\hat{y}_u) = \left[(d_2 - d_1 + 1)_u \cdot 24\right]^2 \cdot \left[1 - \frac{h_u}{(d_2 - d_1 + 1)_u \cdot 24}\right] \cdot \frac{\sum_{p=3}^{n_u} (\hat{r}_{up} - \hat{r}_{u,p-1})^2}{2n_u (n_u - 1)} \quad (17)$$

Where:

$$1 - \frac{h_u}{(d_2 - d_1 + 1)_u \cdot 24} \quad (18)$$

is the finite population correction factor.

CPUE

Traditional CPUE measures were calculated for each day *d* and bank *b* using 2 gillnet suites *g* of specific size mesh *m*. Chinook salmon CPUE was calculated on the pooled catch *c* and effort *f* of the large mesh gillnets (7.5" and 8.5"); chum and coho salmon CPUE was calculated on the pooled catch and effort of the small mesh gillnets (5.25", 5.75" and 6.5").

The duration of the j^{th} test-fish drift in minutes *t* was calculated as:

$$t_j = (SIj - FOj) + \frac{(FOj - SOj)}{2} + \frac{(FIj - SIj)}{2} \quad (19)$$

where *SO* is the time the net is initially set out, *FO* is the time the net is fully set out, SI is the time the net starts back in, and FI is the time the net is fully retrieved in.

The total fishing effort (in fathom-hours) for each day, bank, and gillnet suite was calculated as:

$$f_{dbg} = \sum_g \frac{25 \cdot t_{dbg}}{60} \quad (20)$$

since all nets were 25 fathoms (45.7 m) in length. CPUE estimates (in catch per fathom-hour) for each species *i* were made daily for the right and left banks as:

$$CPUE_{dbi} = \frac{\sum_{g} c_{dbig}}{f_{dbg}}. \tag{21}$$

Species Composition

Testfishing drifts were made at stations in each of the same 3 zones (1, 2, and 3) used in the sonar passage estimates. The results of the testfishing were used to generate species proportions for each zone, which were then applied to the corresponding sonar passage estimate in that zone.

To estimate species proportions, first the total effort f (in fathom-hours) of drift j with mesh size m during report unit u was calculated as in Equations (19) and (20), where each gillnet suite g consisted of a single mesh size, rather than the pooled sizes used in CPUE reporting. Total effort for each mesh size fished was then summed over each report unit:

$$f_{um} = \sum_{j} f_{umj} \tag{22}$$

and the catch of species i of length l in each report period was summed across all mesh sizes:

$$c_{uil} = \sum_{m} c_{uilm} \tag{23}$$

for the catch of each species i of length l, the associated effort was adjusted by applying a length-based selectivity parameter S derived from the Pearson T net selectivity model:

$$f'_{uil} = \sum_{m} \left(S_{ilm} \cdot f_{um} \right) \tag{24}$$

and the CPUE of the catch of each species i of length l was calculated as:

$$CPUE'_{uil} = \frac{c_{uil}}{f'_{uil}}. \tag{25}$$

The proportion p of species i during report unit u was estimated as the ratio of the CPUE for species i to the CPUE of all species combined:

$$\hat{p}_{ui} = \frac{\sum_{l} CPUE'_{uil}}{\sum_{i,l} CPUE'_{uil}} \tag{26}$$

and the variance was estimated from the squared differences between the proportion for each testfish period x within the report unit, and the proportion for the report unit as a whole:

$$\hat{V}ar(\hat{p}_{ui}) = \frac{\sum(\hat{p}_{ui} - \hat{p}_{udxi})^2}{n_u \cdot (n_u - 1)} \tag{27}$$

where n_u = number of testfish sampling periods within the report unit.

Fish Passage by Species

The passage of species i was first estimated for each report unit u as the product of the species proportion p (Equation 10) and sonar passage y (Equation 25):

$$\hat{y}_{ui} = \hat{y}_u \cdot \hat{p}_{ui} \tag{28}$$

and the variance as:

$$\hat{V}ar(\hat{y}_{ui}) = \hat{y}_u^2 \cdot \hat{V}ar(\hat{p}_{ui}) + \hat{p}_{ui}^2 \cdot \hat{V}ar(\hat{y}_u) - \hat{V}ar(\hat{y}_u) \cdot \hat{V}ar(\hat{p}_{ui}) \ . \tag{29}$$

Daily species passage by zone was estimated by calculating the proportion of the hourly passage rate for the day and zone to the hourly passage rate for the report unit:

$$\hat{p}_{dz} = \frac{r_{udz}}{r_u} \tag{30}$$

and then applying the passage proportion p to the report unit estimate y:

$$\hat{y}_{dzi} = \hat{y}_{ui} \cdot \hat{p}_{dz} \,. \tag{31}$$

Except for the timing of sonar and gillnet sampling periods, sonar-derived estimates of total fish passage were independent of gillnet-derived estimates of species proportions. Therefore, the variance of their product (daily species passage estimates y_{dzi}) was estimated as the variance of the product of 2 independent random variables (Goodman 1960):

$$\hat{V}ar\left(\hat{y}_{dzi}\right) = \hat{V}ar\left(\hat{y}_{uzi}\right) \cdot \hat{p}_{dz} \;\;. \tag{32}$$

Total daily passage by species was estimated by summing over all zones:

$$\hat{y}_{di} = \sum_{z} \hat{y}_{dzi} \tag{33}$$

and passage estimates were summed over all zones and all days to obtain a seasonal estimate for species $y_{i,}$:

$$\hat{y}_{i} = \sum_{d} \sum_{z} \hat{y}_{dzi} \,. \tag{34}$$

Finally, passage estimates are assumed independent between zones and among days, so the variance of their sum was estimated by the sum of their variances:

$$\hat{V}ar\left(\hat{y}_{i}\right) = \sum_{d} \sum_{z} \hat{V}ar\left(\hat{y}_{dzi}\right) \tag{35}$$

and, assuming normally distributed errors, 90% confidence intervals were calculated as:

$$\hat{y}_{i} \pm 1.645 \sqrt{\hat{V}ar(\hat{y}_{i})} \tag{36}$$

SAS® program code (Hamazaki[3]) was used to calculate CPUE, passage estimates, and estimates of variance.

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[3] Hamazaki, T. Unpublished. Comparison of net selectivity models for Yukon River Pilot Station sonar test-fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage.

RESULTS

Testfishing began on June 3, with the sonar transducers deployed on the right bank on June 4. The split-beam sonar was deployed on the left bank on June 8, and the DIDSON unit was deployed on June 9. Sonar counts began on the right bank on June 5 and the project was fully operational from June 9 through August 31. Passage estimates were transmitted to fishery managers in Emmonak daily.

ENVIRONMENTAL CONDITIONS

Ice break-up on the Yukon River was late this season, delaying project start-up and sonar deployment by 4 days. Recorded gage heights exceeded mean levels in early June, fell below minimum values in late June, and exceeded maximum values in late July based on historical water levels for 2001 to 2005 (Figure 8).

TEST-FISHING

Drift gillnetting resulted in the capture of 10,977 fish during 2,062 drifts, including 557 Chinook salmon, 5,403 summer chum salmon, 2,559 fall chum salmon, 658 coho salmon, and 1,766 fish of other species. Of the captured fish, 29.5% were retained as mortalities and delivered to local users to help meet subsistence needs within the nearby community (Table 6).

Daily CPUE data is reported in Appendices B1 and B2. Correlations between daily passage estimates and testfishery CPUE for Chinook salmon, summer and fall chum salmon, and coho salmon were all significant (Figure 9). The correlation coefficient for Chinook salmon was $r = 0.974$ ($P < 0.001$), summer chum salmon was $r = 0.914$ ($P < 0.001$), fall chum salmon was $r = 0.920$ ($P < 0.001$), and coho salmon was $r = 0.658$ ($P < 0.001$).

HYDROACOUSTIC ESTIMATES

An estimated 5,850,452 fish passed through the sonar sampling areas between June 5 and August 31; 1,317,455 (22.5%) along the right bank, 3,484,223 (59.6%) along the left bank nearshore, and 1,048,774 (17.9%) along the left bank offshore (Table 7). Daily total passage estimates by zone, with their associated errors, are provided in Appendix C.

On the left bank the summer season fish passage was highest in nearshore strata (95% of total fish passage occurred within 100 m from the transducer), but in fall, fish were more evenly distributed across the strata and distribution occurred further offshore (95% of passage occurred within 160 m). On the right bank the majority of fish were distributed in the nearshore stratum with 95% of total fish passage occurring within 75 m in both summer and fall seasons (Figure 10).

Passage estimates based on 24 h sampling periods were not generated this season due to scheduling and budget constraints, therefore no results are reported for 2006.

SPECIES ESTIMATES

Summer chum and Chinook salmon were first present in the river June 7, two days after sonar estimation began. Daily passage estimates by species for the summer and fall seasons are listed in Appendix D. Chum salmon were the most abundant species during both summer and fall seasons. Cumulative passage estimates for the season totaled 5,850,452 fish (Table 7), comprised of 3,767,044 ± 159,234 (90% C.I.) summer chum salmon passing the sonar site from June 5 through July 18 and 790,563 ± 62,715 fall chum salmon passing from July 19 through August 31. Chinook salmon passage estimates were comprised of 145,553 ± 21,148 fish >655 mm MEFL and 23,850 ± 5,480 ≤655 mm MEFL. Coho salmon passage estimates were 131,919 ± 19,538 as of August 31, with the project ceasing operations before the conclusion of the entire run. The estimate of pink salmon was 115,624 ± 17,418. Other species, totaling 875,899 fish, include whitefish, cisco, sheefish, burbot, longnose sucker, Dolly Varden, sockeye salmon, and northern pike.

Of the total passage, 28% of Chinook, 27% of summer chum, and 16% of fall chum passed in the 0 to 20 m region of the left bank nearshore (sectors 1 and 2 of stratum 3), where the DIDSON is the primary sonar used for generating passage estimates. The daily estimates of fish passing through this region of left bank and the associated proportion, (also referred to as the DIDSON contribution), of the total passage are detailed in Appendices E1 and E2.

The first major pulse of both summer chum and Chinook salmon began June 16 (Figure 11). The midpoints of the runs occurred on June 27 for Chinook salmon and June 26 for summer chum. Due to the late start of the Chinook run, and relatively early start of the summer chum run, timing of Chinook in relation to summer chum differed from previous years, with 25%, 50% and 75% of the Chinook run occurring temporally close to the same points in the summer chum run (Figure 12, Appendices F1 and F2).

Fall chum salmon enumeration began July 19, with passage estimates continuing through August 31, when project operations ended. The first major pulse occurred July 19 (Figure 13) with the midpoint of the run on August 1 (Figure 14 and Appendices F1 and F2). Coho salmon were first detected July 20, with 2 large pulses on August 19 and 23 (Figure 13), comprising approximately 18% of the total coho passage estimated through August 31. While the fall chum run has largely concluded by the end of August, actual timing of the coho run is unknown since this project historically ends operations before the coho run has concluded.

MISSING DATA

Sonar data were unobtainable on the left bank for 1 period each day on June 14, 15 and 16 due to wave action, which caused the sonar charts to be unreadable for those single periods.

During the 2006 season, 6 commercial fishing openings occurred in District 2 during testfishing period 2, and 10 commercial openings occurred in District 2 during testfishing period 1. There were 7 days during the 2006 season when insufficient numbers of fish were captured, therefore variance could not be generated accurately on those days without pooling them with adjacent zones. Zones that were pooled for variance estimation and the associated reason for pooling are listed with their corresponding reporting units in Table 8.

Conductivity, turbidity, water temperature and settleable solids were not measured or recorded on a daily basis this season, and therefore no results for these are being presented in 2006.

DISCUSSION

This season the Yukon River broke up on May 25 (7 days later than the historical average) and ice flowing into the Andreafsky River delayed boat deployment and camp start-up for 5 days. Good profiles on the right bank allowed sonar to be deployed on June 4, but the left bank was not fully operational with both sonar systems running until June 9. Despite the high water, late break-up, and deployment issues on left bank, sonar was fully operational early enough to fully assess both the summer chum and Chinook runs. This was verified with the testfishery, which started on June 3.

Scouring and erosion on the left bank continues to cause challenges with finding optimal transducer deployment. In previous seasons, transducer deployment sites were forced farther downriver from the sonar tent to the limits of the sonar cabling. To alleviate this problem in 2006, the left bank sonar site was relocated approximately 200 m downstream where acceptable profiles were found and deployment options were increased within the range of the sonar cabling. However, water levels were very high during the first week of the project, which created further challenges in finding a suitable deployment site on left bank. Daily underwater profiling was conducted on left bank and the split-beam and DIDSON equipment were deployed and tested several times before finding the best location. Though there was scouring and visible erosion continuing on the left bank, the reverberation band, which has been problematic in past seasons, was not encountered this season.

The 2006 season saw record numbers of summer chum salmon passing the sonar site, and a strong run of Chinook. The sonar equipment ran smoothly, detection was good throughout the season, and data was collected consistently with very little lost throughout the entire season. Though 24-hr sonar sampling was not used as a qualitative assessment tool this season, it may be conducted in future seasons as budget and scheduling allows.

The DIDSON sonar contributed significantly to the total passage estimate when deployed on left bank in 2005, and was therefore fully integrated into the sampling schedule for the 2006 season. The proportions of total passage of fish passing in sectors 1 and 2 of the nearshore, the area counted by the DIDSON, in the 2005 season (32% of the Chinook, 21% of the summer chum and 9.3% of the fall chum) are very similar to those found in 2006 (28% of Chinook, 27% of summer chum, and 16% of fall chum). The DIDSON-generated estimates appear to contribute more significantly to overall passage in the summer season when water levels are higher, and fish are distributed closer to shore. Although the percent passage detected nearshore on left bank with the DIDSON were significant in 2005 and 2006, the change in the left bank profile is a relatively recent event. Given the more linear profiles seen in the past, it is probable the split-beam system was detecting passage more accurately in earlier years, therefore, estimates for fish passage prior to 2005 have not been adjusted or changed (Appendix G). The DIDSON was also deployed on the right bank in 2005 as an assessment of nearshore detection, and the counts were comparable to those obtained with the split-beam. This was an expected result because the rocky, stable substrate on the right bank has maintained a consistently good profile throughout the project's history.

In 2006 the summer season testfish net schedule was modified in an attempt to improve estimates of Chinook salmon passage (Table 9). In previous years the 5.25" and 6.5" mesh nets were fished at both the end of period 1 and the beginning of period 2. Since these 2 net sizes primarily target chum salmon (which are often an order of magnitude greater in abundance than Chinook), in 2006 we reordered the sequence in which nets were fished. In order to direct some fishing effort away from the more abundant chum salmon and towards the more sparse Chinook, the 7.5'' mesh drifts were duplicated rather than the 5.25" mesh drifts.

Prior to adjusting the schedule, we examined the effect of reducing effort to fishing each mesh only once per day on the cumulative passage estimates of each species. This entailed simulating the elimination of both the duplicate 5.25” and 6.5” drifts, either during period 1 or period 2, using data from the years 2003 and 2004. Although point estimates for season totals were little changed, in several cases the confidence intervals increased substantially (as was expected) due to the reduced sample sizes. While this exercise was not designed to directly simulate the schedule change, it did provide some guidance as to the effects of dropping the duplicate drifts. Although all 6 mesh sizes continued to be fished each day, the 5.25” mesh was fished only once per day while the 6.5” and 7.5” mesh were fished during both period 1 and period 2. The fall schedule remained unchanged.

In previous seasons, conductivity, turbidity, and settleable solids measurements were collected regularly. In the 2006 season, these hydrological measurements were discontinued because of equipment malfunction and reprioritization of data collection goals. Water temperatures were not consistently recorded in 2006, but in future seasons, temperature data loggers may be used as well as water temperatures measured in the fishing zones daily. An in-camp staff gage was used to track daily water changes, and the measurements have tracked well with those recorded at the official USGS water gage at Pilot Station in past years, therefore, overall water level results were reported directly from the USGS. In future seasons, it may be necessary to benchmark the camp water gage and to calibrate it with the USGS gage in case a large portion of data is not available from USGS.

In 2006 all project goals were met, with passage estimates given to fisheries managers daily during the season. Information generated at the Yukon River Sonar project was also disseminated weekly through multi-agency international teleconferences and data-sharing with stakeholders in areas from the lower Yukon River all the way to the spawning grounds in Canada.

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TABLES AND FIGURES

Table 1.–Initial split-beam sonar system settings.

			Bank	
Component	Setting	Stratum	Left	Right
Transducer	Beam size (h x w)		2.8º x 10.0º	6.0º x 10.0º
Echosounder	Transmit power (dB)		33	27
	Receiver gain (dB)		-18	-22
	Source Level (dB)		233.07	215.69
	Through-system gain (dB)		-167.65	-161
	Absorption coefficient (dB)		0.0	0.0
	Calculated threshold (dB)		-43.0	-43.0
	Pulse width (ms)		0.4	0.4
	Blanking range (m)		2.0	2.0
	Ping rate (pps)	S1		5.0
		S2		4.0
		S3	5.0	
		S4	4.0	
		S5	2.5	
	Range (m)	S1		50
		S2		150
		S3	50	
		S4	150	
		S5	250	
Chart recorder	Gray 1 (mV)		1.321	0.413
	Gray 2 (mV)		1.866	0.583
	Gray 3 (mV)		2.636	0.824
	Gray 4 (mV)		3.724	1.104

Table 2.–Technical specifications for the Dual-Frequency Identification Sonar.

Identification Mode	
Operating Frequency	1.2 MHz
Beam width (two-way)	0.5° H by 12 ° V
Number of beams	48
Range Settings	
Start range	0.83 m
Window length	20.01 m
Range bin size	39 mm
Pulse Length	46 µs
frame rate	8 frames/s
Field of view	29°

Table 3.–Daily sampling schedule for sonar and testfish. S1 = stratum 1, S2 = stratum 2, etc.

	Sonar		
Time	Right Bank	Left Bank	Testfishing
	Period 1		
5:30	S1	S3	
6:00	S2	S4	
6:30	S1	S5	
7:00	S2	S3	
7:30	S1	S4	
8:00	S2	S5	
8:30			
9:00			Period 1
9:30			
10:00			
10:30			
11:00			
11:30			
12:00			
12:30			
13:00	Period 2		
13:30	S1	S3	
14:00	S2	S4	
14:30	S1	S5	
15:00	S2	S3	
15:30	S1	S4	
16:00	S2	S5	
16:30			
17:00			Period 2
17:30			
18:00			
18:30			
19:00			
19:30			
20:00			
20:30			
21:00	Period 3		
21:30	S1	S3	
22:00	S2	S4	
22:30	S1	S5	
23:00	S2	S3	
23:30	S1	S4	
0:00	S2	S5	

Table 4.–Specifications for drift gillnets used for testfishing, by season, 2006.

Season	Stretch mesh size (in)	Stretch mesh size (mm)	Mesh Diameter (mm)	Meshes Deep (MD)	Depth (m)
Summer (pre 07/19)	2.75	70	44	131	8.0
	4.00	102	65	90	8.0
	5.25	133	85	69	8.0
	6.50	165	105	55	7.9
	7.50	191	121	48	8.0
	8.50	216	137	43	8.1
Fall (post 07/18)	2.75	70	44	131	8.0
	4.00	102	65	90	8.0
	5.00	127	81	72	8.0
	5.75	146	93	63	8.0
	6.50	165	105	55	7.9
	7.50	191	121	48	8.0

Table 5.–Fishing schedules for drift gillnets used during summer and fall season, 2006.

Season	Testfish Period	Calendar Day Odd Mesh size (in)		Calendar Day Even Mesh size (in)	
Summer (through 07/18)	1	2.75"	5.25"	8.5"	4.0"
		7.5"	6.5"	7.5"	6.5"
	2	7.5"	6.5"	7.5"	6.5"
		8.5"	4.0"	2.75"	5.25"
Fall (starting 07/19)	1	4.0"	5.75"	2.75"	7.5"
		5.0"	6.5"	5.0"	6.5"
	2	5.0"	6.5"	5.0"	6.5"
		2.75"	7.5"	4.0"	5.75"

Table 6.–Number of fish caught and retained in the Yukon River Sonar testfishery, 2006.

Total Catch

	Chinook	S Chum	F Chum	Sockeye	Coho	Pink	White Fish	Cisco	Burbot	Sheefish	Total all spp.
June	381	3,740		1	0	21	40	102	3	291	
July	175	1,663	1,325	19	37	345	154	196	2	38	
August	1		1,234	14	621	66	294	204	8	2	
Total	557	5,403	2,559	34	658	432	488	502	13	331	10,977

Number of Fish Retained

	Chinook	S Chum	F Chum	Sockeye	Coho	Pink	White Fish	Cisco	Burbot	Sheefish	Total all spp.
June	264	981		1	0	0	23	30	0	242	
July	102	194	318	5	17	0	142	97	0	23	
August	0		346	3	176	0	254	25	0	2	
Total	366	1,175	664	9	193	0	419	152	0	267	3,245

Percent of Total Catch Retained

	Chinook	S Chum	F Chum	Sockeye	Coho	Pink	White Fish	Cisco	Burbot	Sheefish	Total % retained
June	69.3%	26.2%	-	100.0%	-	0.0%	57.5%	29.4%	0.0%	83.2%	
July	58.3%	11.7%	24.0%	26.3%	45.9%	0.0%	92.2%	49.5%	0.0%	60.5%	
August	0.0%	-	0.2%	21.4%	28.3%	0.0%	86.4%	12.3%	0.0%	100.0%	
Total	65.7%	21.7%	25.9%	26.5%	29.3%	0.0%	85.9%	30.3%	0.0%	80.7%	29.5%

Table 7.–Cumulative passage estimates by zone and species at Yukon River Sonar, with Standard Errors (SE) and 90% Confidence Intervals (CI), 2006.

	Right	Left Bank		Total		90% CI	
Species	Bank	Nearshore	Offshore	Passage	SE	Lower	Upper
Large Chinook [a]	21,259	96,184	28,110	145,553	12,856	124,405	166,701
Small Chinook	5,136	16,178	2,536	23,850	3,331	18,370	29,330
Summer chum	882,873	2,428,261	455,910	3,767,044	96,799	3,607,810	3,926,278
Fall chum	97,658	343,133	349,772	790,563	38,125	727,848	853,278
Coho	39,976	29,375	62,568	131,919	11,877	112,381	151,457
Pink	53,605	55,508	6,511	115,624	10,588	98,206	133,042
Other	216,948	515,584	143,367	875,899	56,251	783,367	968,431
Total	1,317,455	3,484,223	1,048,774	5,850,452			

[a] Large Chinook are >655 mm MEFL, small Chinook ≤655 mm MEFL.

Table 8.–Reporting units of zones pooled for the 2006 season.

<table>
<tr><th rowspan="2">Date</th><th>Right Bank</th><th colspan="2">Left Bank</th><th rowspan="2">Reason for pooling [a]</th></tr>
<tr><th>(Zone 1)</th><th>Nearshore (Zone 2)</th><th>Offshore (Zone 3)</th></tr>
<tr><td>3-Jun</td><td colspan="3">1</td><td>I.C.</td></tr>
<tr><td>4-Jun</td><td colspan="3">2</td><td>I.C.</td></tr>
<tr><td>5-Jun</td><td colspan="3">3</td><td>I.C.</td></tr>
<tr><td>6-Jun</td><td colspan="3">4</td><td>I.C.</td></tr>
<tr><td>7-Jun</td><td rowspan="2"></td><td rowspan="2">6</td><td rowspan="2">7</td><td>I.C.</td></tr>
<tr><td>8-Jun</td><td></td></tr>
<tr><td>14-Jun</td><td rowspan="2">24</td><td rowspan="2">25</td><td rowspan="2">26</td><td></td></tr>
<tr><td>15-Jun</td><td>C.O.</td></tr>
<tr><td>23-Jun</td><td rowspan="2">48</td><td rowspan="2">49</td><td rowspan="2">50</td><td></td></tr>
<tr><td>24-Jun</td><td>C.O.</td></tr>
<tr><td>27-Jun</td><td rowspan="2">57</td><td rowspan="2">58</td><td rowspan="2">59</td><td>C.O.</td></tr>
<tr><td>28-Jun</td><td></td></tr>
<tr><td>1-Jul</td><td rowspan="2">66</td><td rowspan="2">67</td><td rowspan="2">68</td><td></td></tr>
<tr><td>2-Jul</td><td>C.O.</td></tr>
<tr><td>5-Jul</td><td rowspan="2">75</td><td></td><td></td><td></td></tr>
<tr><td>6-Jul</td><td rowspan="2">79</td><td rowspan="2">80</td><td>C.O.</td></tr>
<tr><td>7-Jul</td><td></td><td></td></tr>
<tr><td>9-Jul</td><td></td><td></td><td rowspan="2">86</td><td>I.C.</td></tr>
<tr><td>10-Jul</td><td></td><td></td><td></td></tr>
<tr><td>14-Jul</td><td></td><td></td><td rowspan="2">101</td><td>I.C.</td></tr>
<tr><td>15-Jul</td><td></td><td></td><td></td></tr>
</table>

Table 8.–Page 2 of 2.

<table>
<tr><th rowspan="2">Date</th><th>Right Bank</th><th colspan="2">Left Bank</th><th rowspan="2">Reason for pooling [a]</th></tr>
<tr><th>(Zone 1)</th><th>Nearshore (Zone 2)</th><th>Offshore (Zone 3)</th></tr>
<tr><td>1-Aug</td><td rowspan="2">152</td><td rowspan="2">153</td><td rowspan="2">154</td><td></td></tr>
<tr><td>2-Aug</td><td>C.O.</td></tr>
<tr><td>7-Aug</td><td></td><td></td><td rowspan="2">169</td><td></td></tr>
<tr><td>8-Aug</td><td rowspan="3">170</td><td rowspan="3">171</td><td>C.O.</td></tr>
<tr><td>9-Aug</td><td rowspan="2">172</td><td></td></tr>
<tr><td>10-Aug</td><td>C.O.</td></tr>
<tr><td>14-Aug</td><td rowspan="2">182</td><td rowspan="2">183</td><td rowspan="3">184</td><td>C.O.</td></tr>
<tr><td>15-Aug</td><td></td></tr>
<tr><td>16-Aug</td><td rowspan="3">185</td><td rowspan="3">186</td><td>C.O.</td></tr>
<tr><td>17-Aug</td><td rowspan="2">187</td><td></td></tr>
<tr><td>18-Aug</td><td>C.O.</td></tr>
<tr><td>20-Aug</td><td rowspan="2">191</td><td rowspan="2">192</td><td></td><td></td></tr>
<tr><td>21-Aug</td><td rowspan="2">196</td><td>C.O.</td></tr>
<tr><td>22-Aug</td><td></td><td></td><td></td></tr>
<tr><td>23-Aug</td><td rowspan="2">197</td><td rowspan="3">198</td><td rowspan="2">199</td><td>C.O.</td></tr>
<tr><td>24-Aug</td><td></td></tr>
<tr><td>25-Aug</td><td rowspan="2">200</td><td rowspan="2">202</td><td>C.O.</td></tr>
<tr><td>26-Aug</td><td></td><td></td></tr>
<tr><td>27-Aug</td><td rowspan="2">203</td><td></td><td rowspan="2">205</td><td></td></tr>
<tr><td>28-Aug</td><td rowspan="3">207</td><td>C.O.</td></tr>
<tr><td>29-Aug</td><td></td><td></td><td></td></tr>
<tr><td>30-Aug</td><td rowspan="2">209</td><td rowspan="2">211</td><td>C.O.</td></tr>
<tr><td>31-Aug</td><td></td><td></td></tr>
</table>

[a] C.O. denotes that a commercial opening prevented testfishing, therefore pooling across days enables the variance estimation of species proportions. I.C. denotes that zones were pooled when there was insufficient catch in the testfishery for variance estimation.

Table 9.–Sampling schedules for drift gillnets used in species apportionment during the summer season, prior to 2006 and in 2006. Net sizes are stretch mesh in inches.

Year	Testfish Period	Calendar Day Odd		Even	
pre-2006	1[a]	4.0"	8.5"	2.75"	7.5"
(through 07/18)		5.25"	6.5"	5.25"	6.5"
	2[b]	5.25"	6.5"	5.25"	6.5"
		2.75"	7.5"	4.0"	8.5"
2006	1[a]	2.75"	5.25"	8.5"	4.0"
(through 07/18)		7.5"	6.5"	7.5"	6.5"
	2[b]	7.5"	6.5"	7.5"	6.5"
		8.5"	4.0"	2.75"	5.25"

Note: Each net is fished sequentially in each zone (left bank nearshore → right bank → left bank offshore) before fishing next mesh size.

[a] 0900 to 1200 hours.

[b] 1700 to 2000 hours.

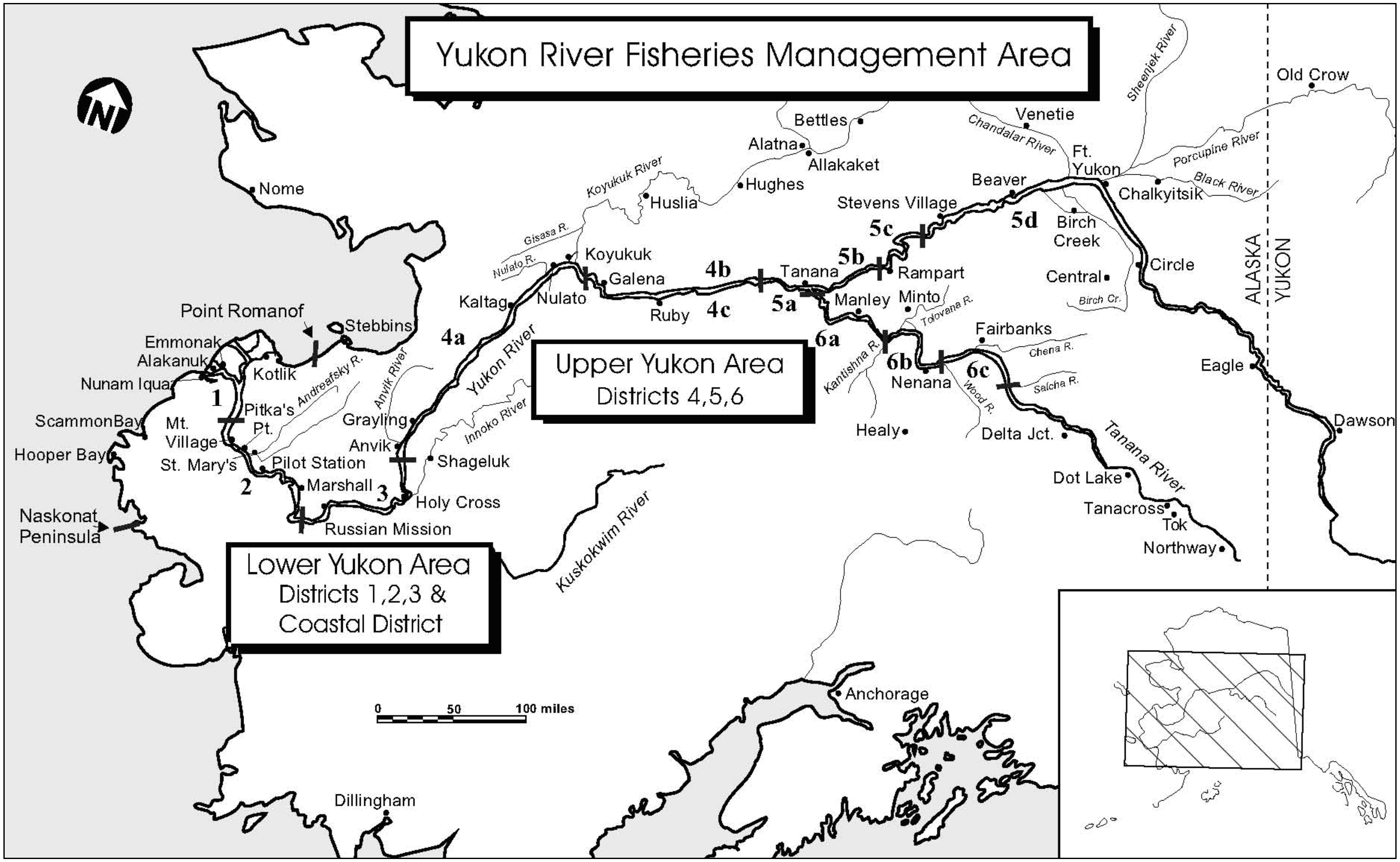


Figure 1.–Fishing districts and communities of the Yukon River watershed.

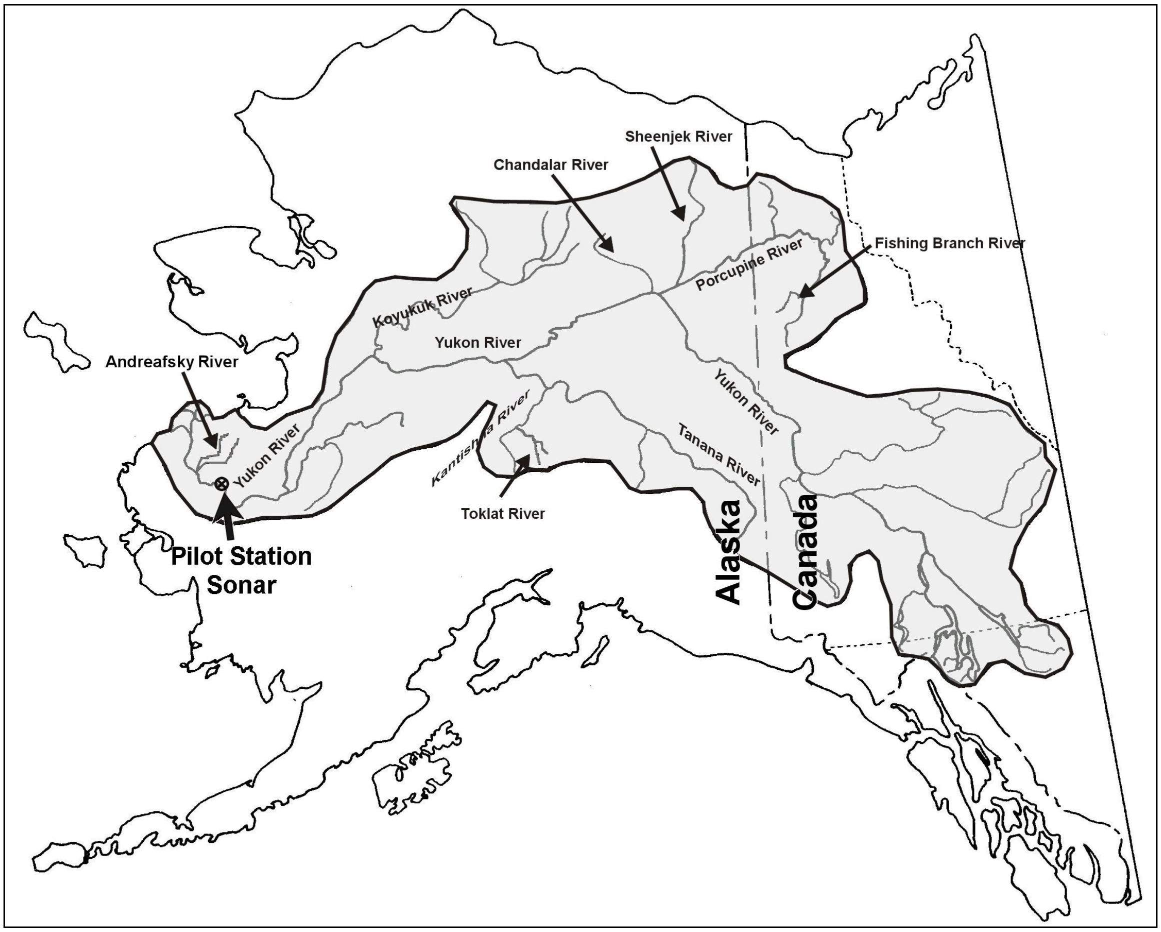


Figure 2.–Yukon River drainage showing salmon spawning tributaries.

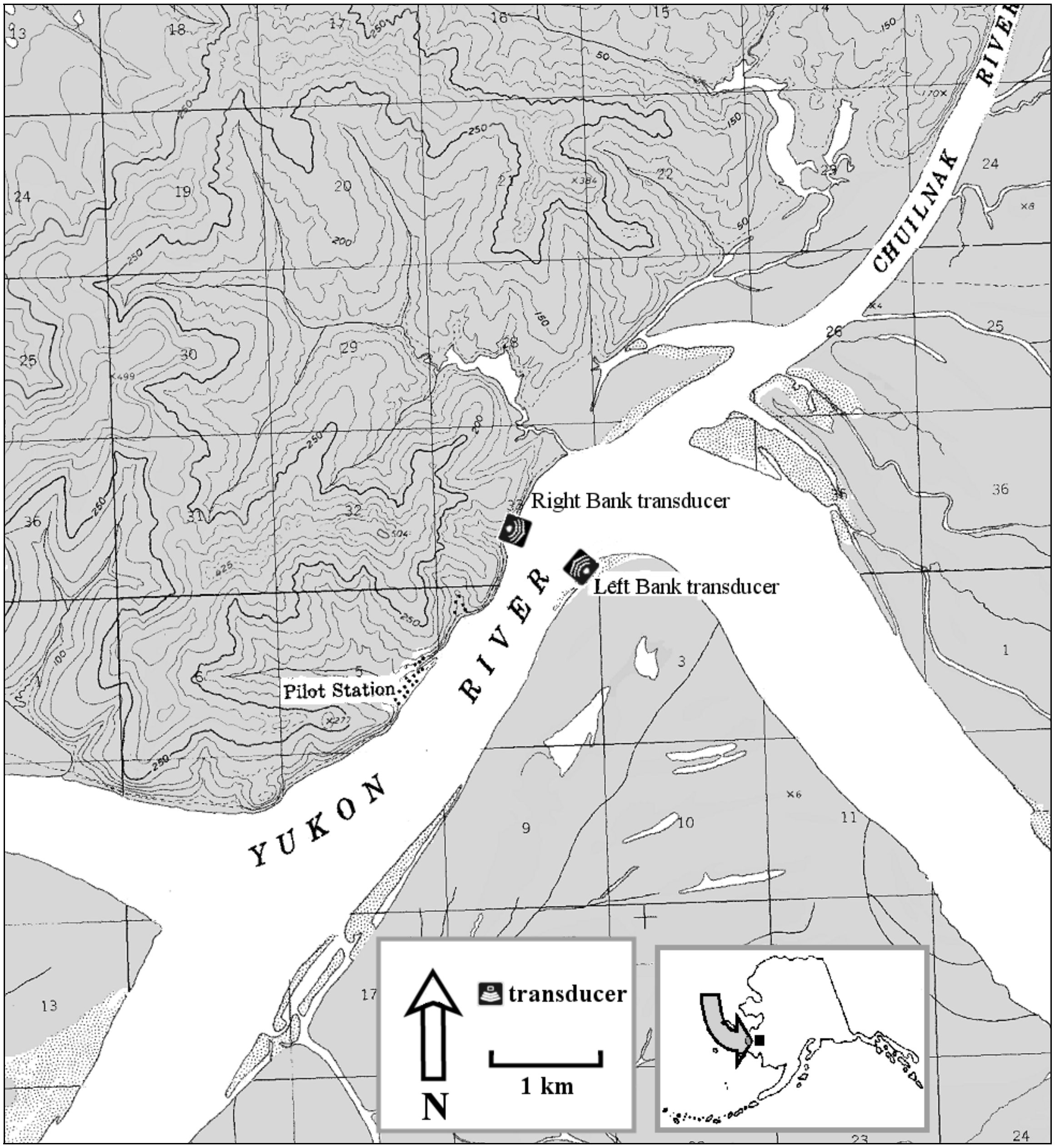
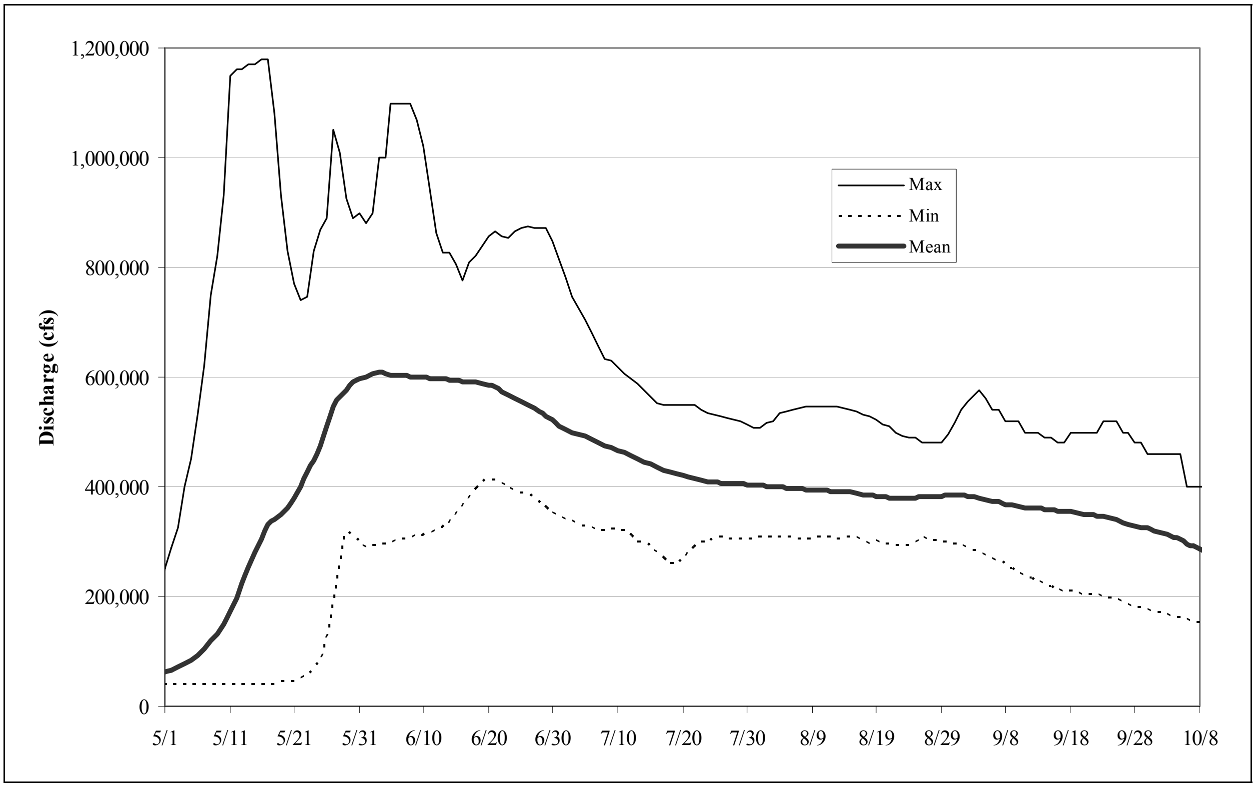
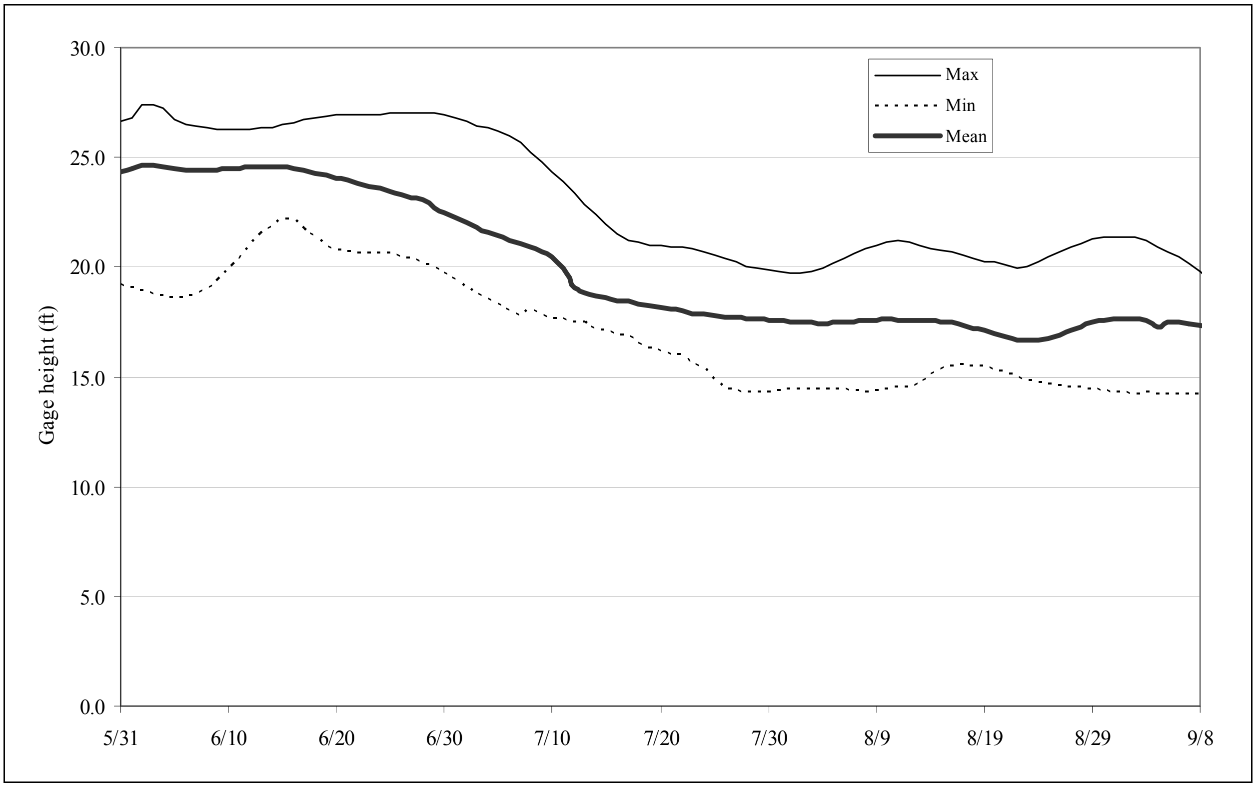


Figure 3.–Location of Yukon River Sonar project showing general transducer sites.



Source: USGS.

Figure 4.–Minimum, maximum and mean streamflow at Pilot Station, 1976 to 2005.



Source: USGS.

Figure 5.–Minimum, maximum and mean gage height at Pilot Station, 2001 to 2005.

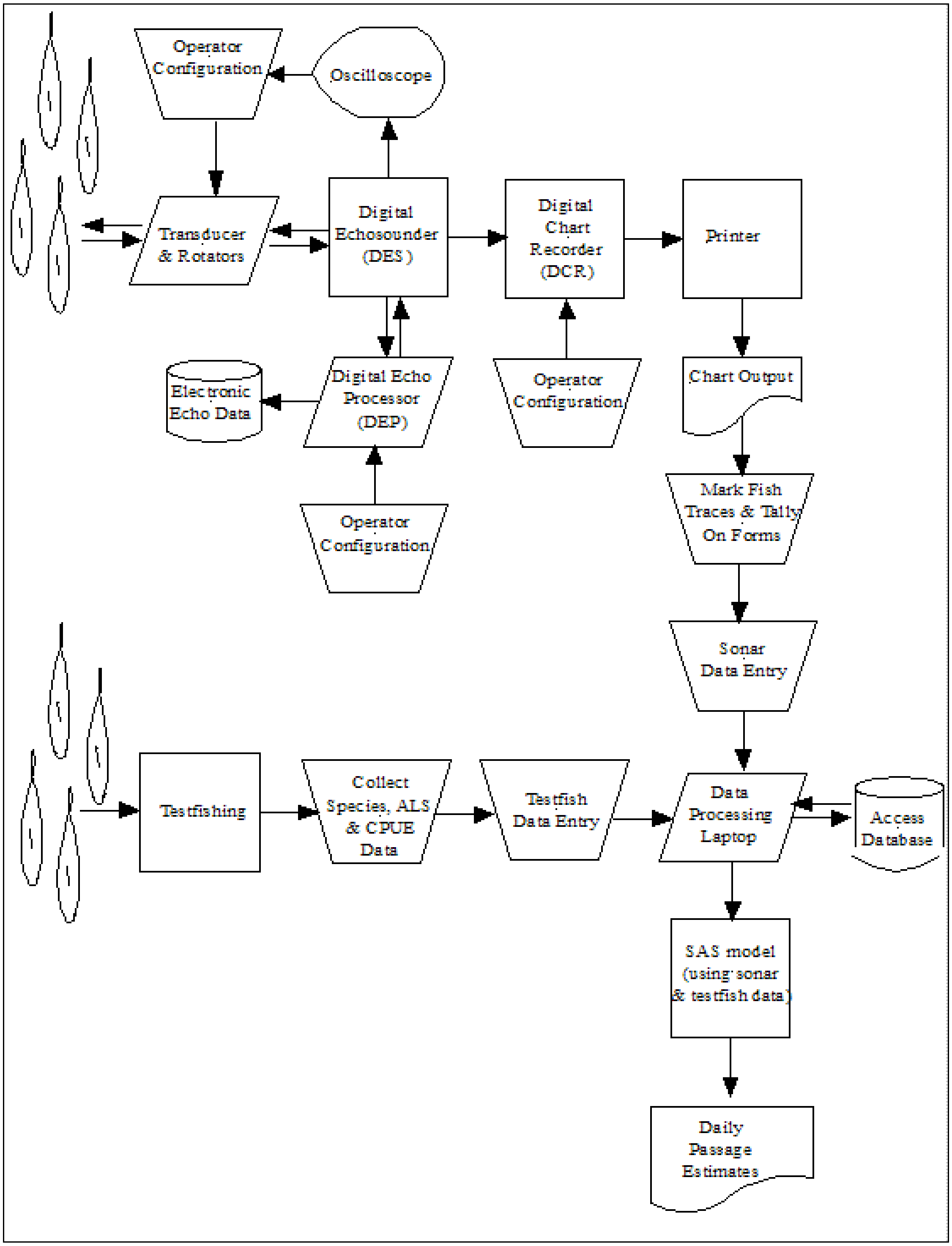


Figure 6.–Flow diagram of data collection and processing at Yukon River Sonar project.

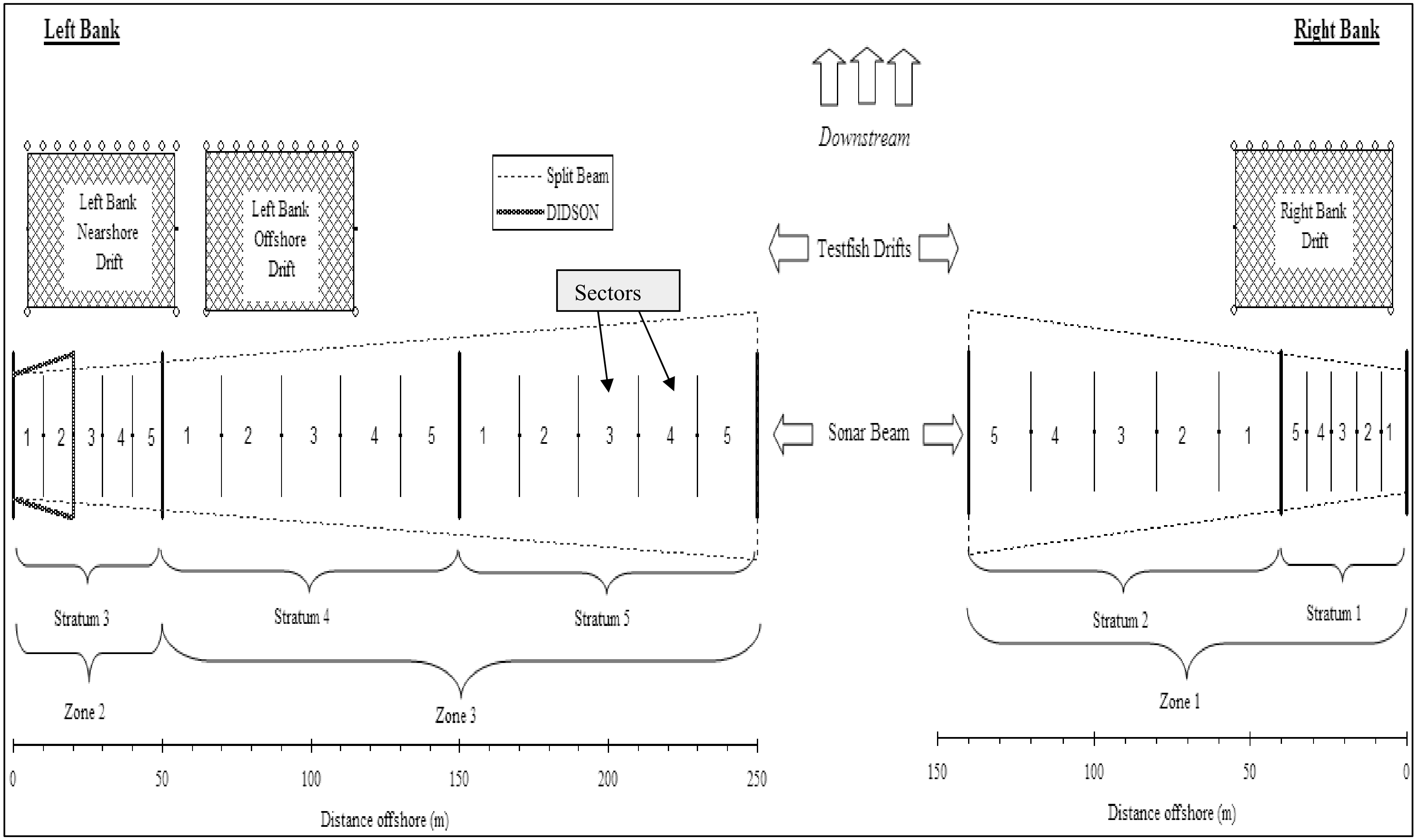
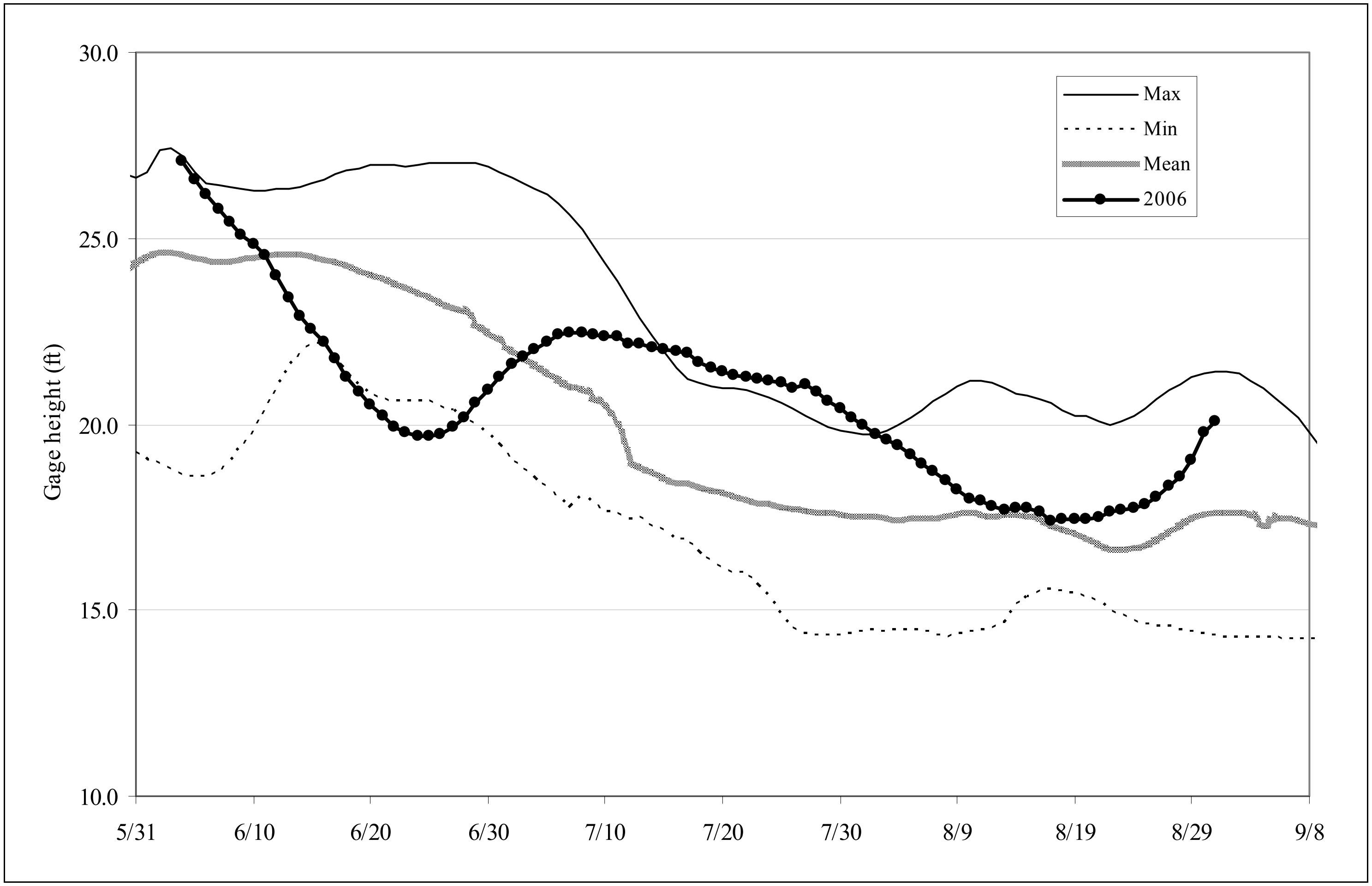


Figure 7.–Illustration of relationships between strata, sectors, zones, testfish drifts, and approximate sonar ranges (not to scale) at Yukon River Sonar project.



Source: USGS.

Figure 8.–Daily water level during 2006 season at Pilot Station water gage compared to minimum, maximum and mean gage height 2001 to 2005. (Missing values were estimated using linear interpolation).

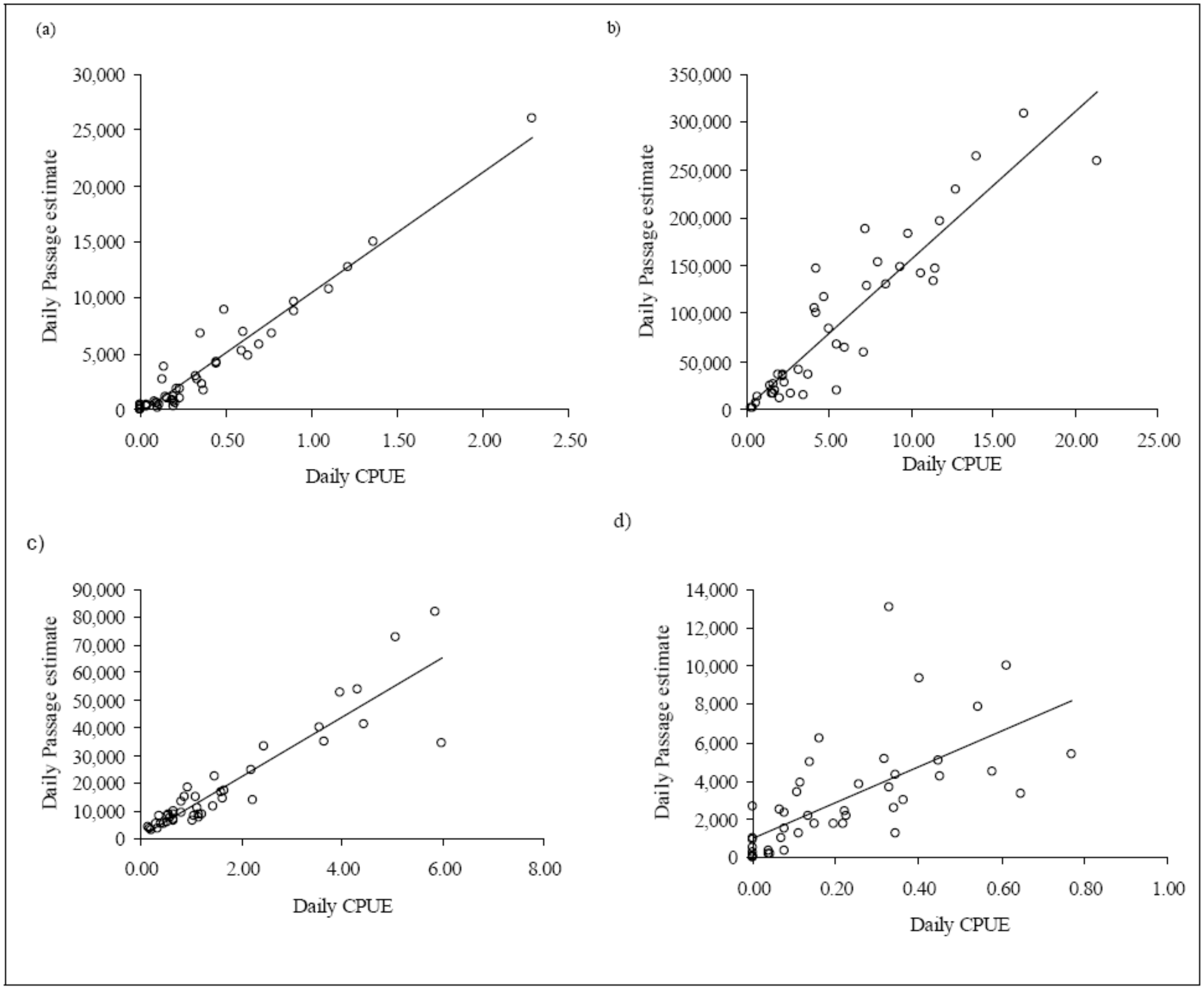


Figure 9.–Scatter plots of daily passage vs. CPUE for (a) Chinook salmon, (b) summer chum salmon, (c) fall chum, and (d) coho salmon, 2006.

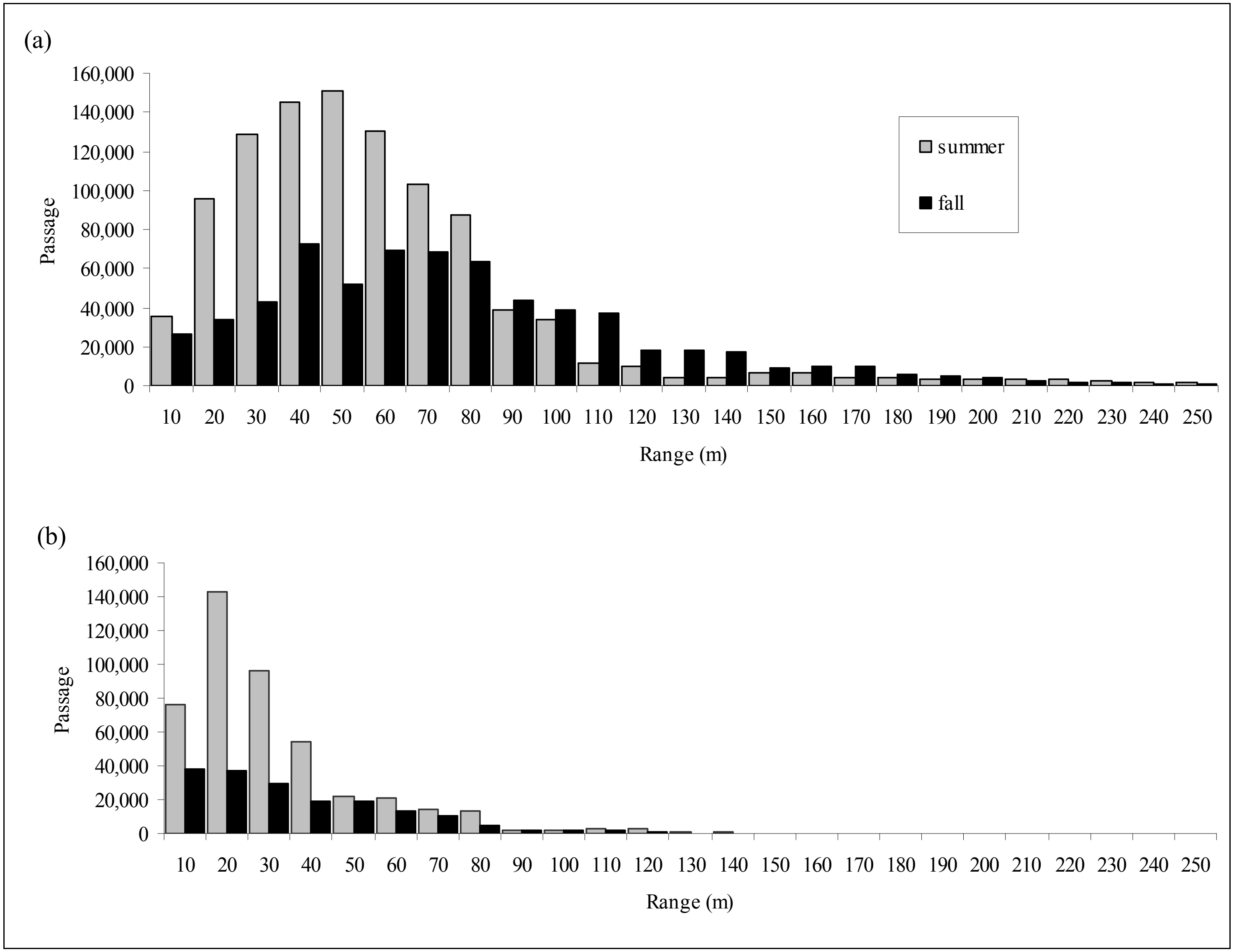


Figure 10.–Horizontal fish distribution (distance from transducer (m)) (a) left bank and (b) right bank by season.

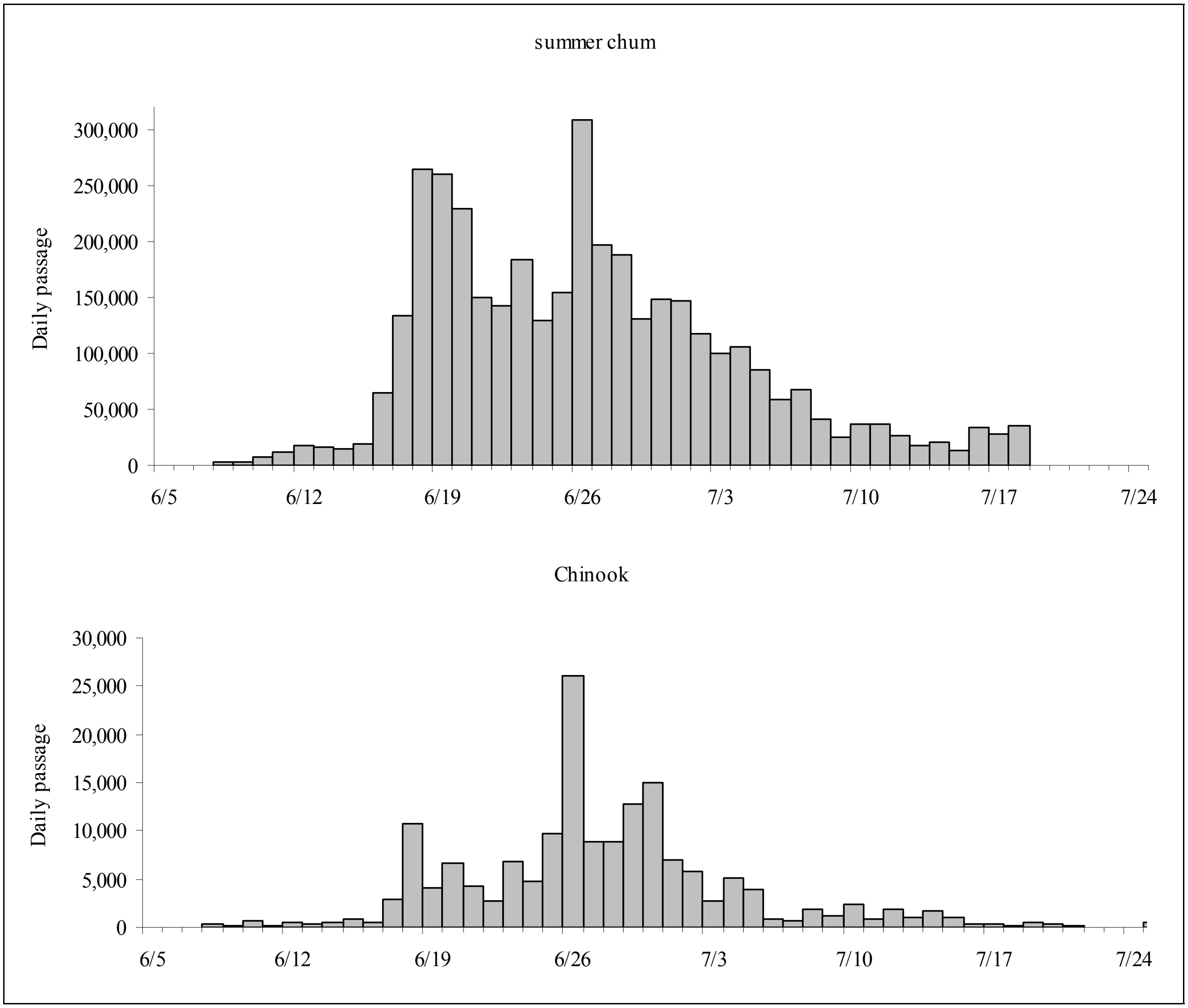


Figure 11.–Summer chum and Chinook salmon daily passage estimates, 2006.

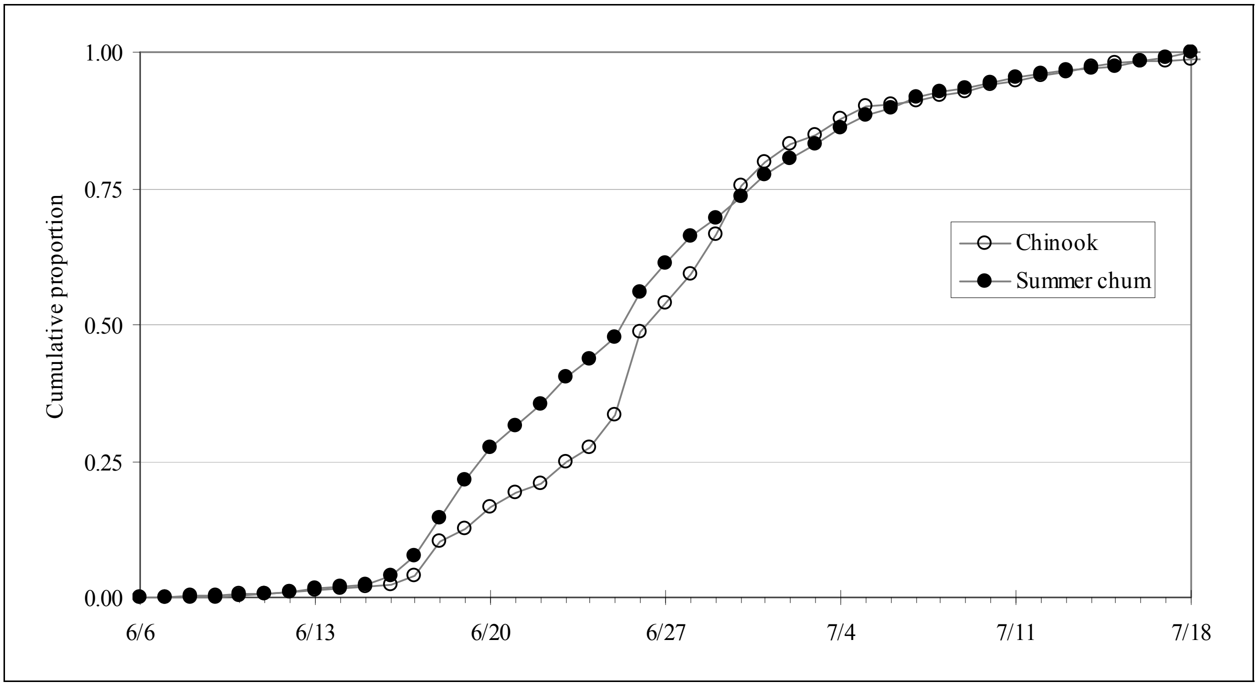


Figure 12.–Summer season daily cumulative passage timing, 2006.

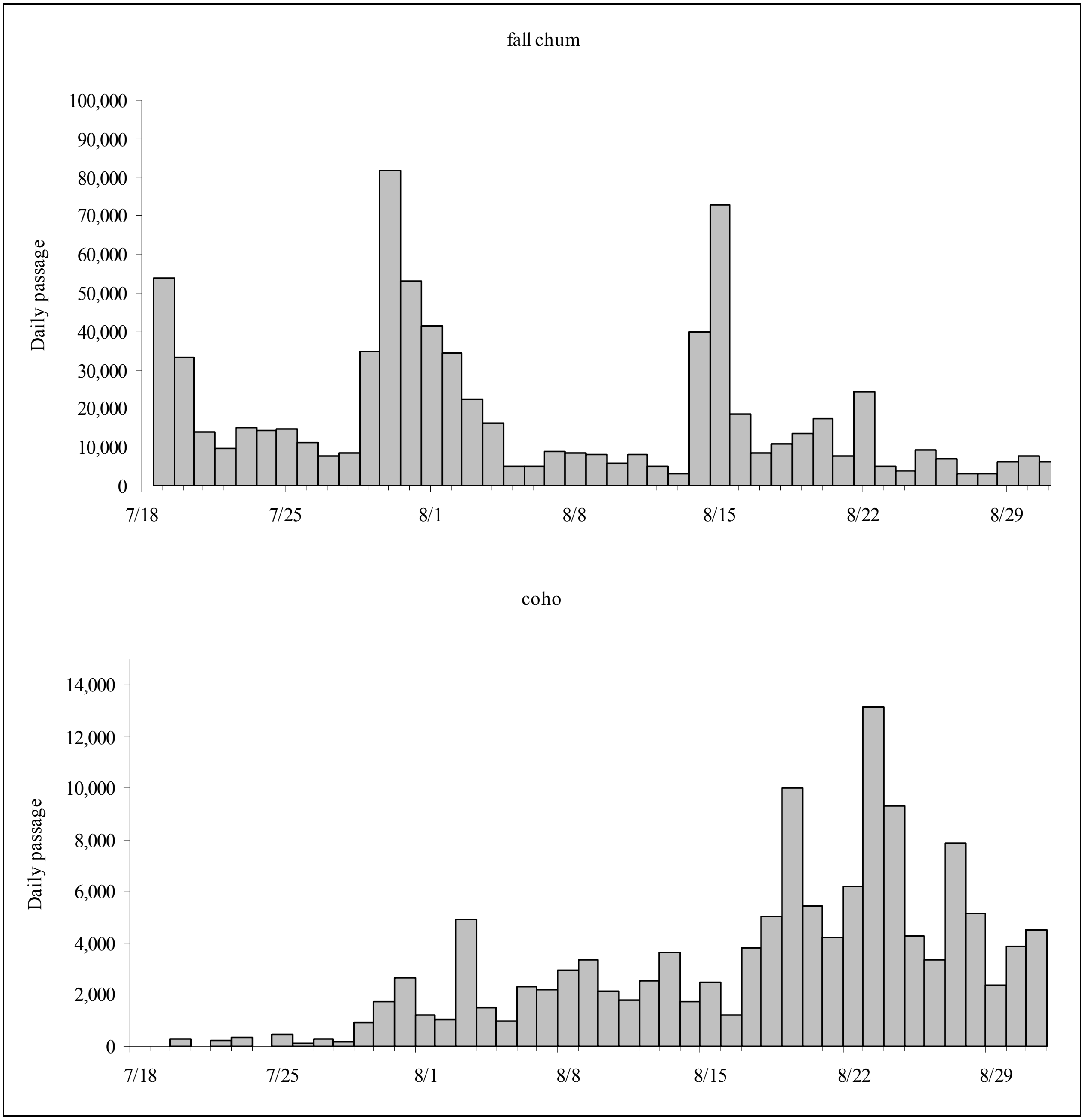


Figure 13.–Fall chum and coho salmon daily passage estimates, 2006.

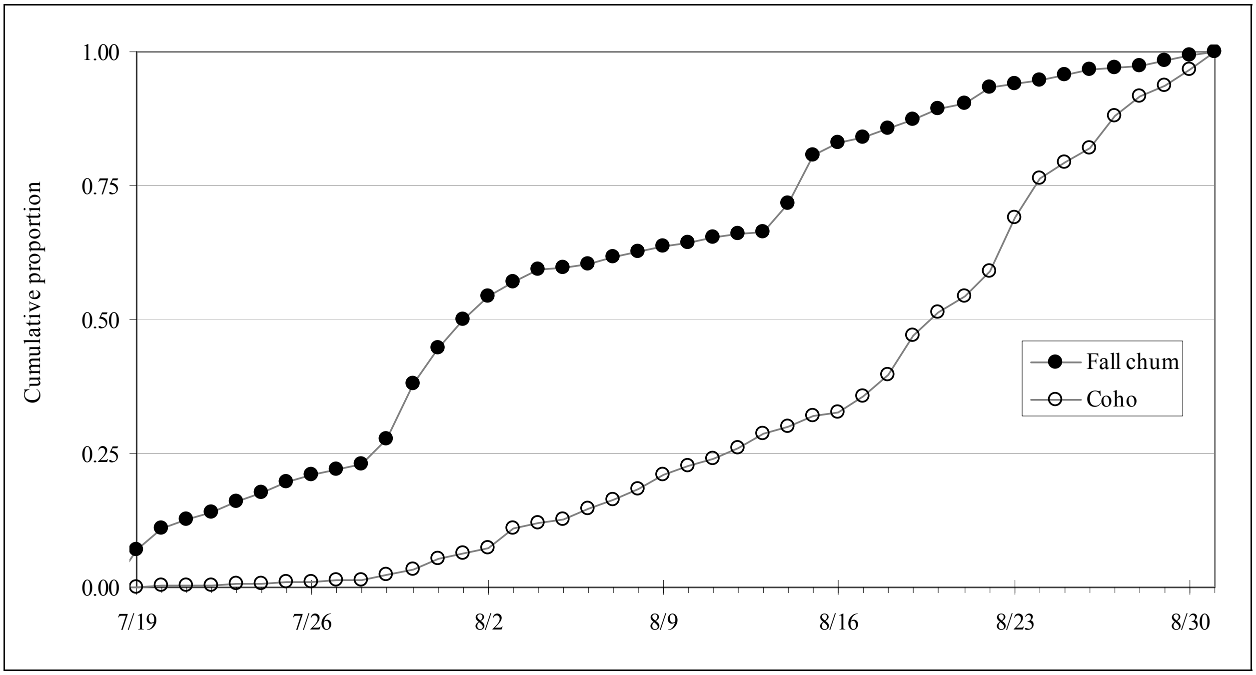


Figure 14.–Fall season daily cumulative passage timing, 2006.

APPENDIX A

Appendix A1.–Net selectivity parameters used in species apportionment at Yukon River Sonar, 2006.

Species	Tau	Sigma	Theta	Lambda	Tangle
large Chinook [a]	1.9239	0.2361	0.6261	-0.5191	0
small Chinook [b]	1.9239	0.2361	0.6261	-0.5191	0
summer chum	1.9651	0.18	0.9414	-0.3884	0.03431
fall chum	1.8746	0.2255	1.2028	-1.2115	0.02757
coho	1.9821	0.3209	1.0248	-1.5954	0.09321
pink	1.8962	0.4828	2.0846	0.2148	0.1329
broad whitefish	1.841	0.2118	0.9502	-1.9363	0.1114
humpback whitefish	1.9004	0.2249	1.1071	-1.8815	0.1022
cisco	2.064	0.1929	1.7739	-1.2745	0.1728
other	2.2249	0.3304	0.9199	-2.221	0.08338

[a] Chinook salmon > 655 mm.

[b] Chinook salmon ≤ 655mm.

APPENDIX B

Appendix B1.–Right bank CPUE by day, 2006.

Date	Lg. Mesh Fathom hrs	Chinook		Sm. Mesh Fathom hrs	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
3-Jun	8.5	0	0.00	8.63	0	0.00	0	0.00	0	0.00
4-Jun	4.94	0	0.00	9.67	0	0.00	0	0.00	0	0.00
5-Jun	5.67	0	0.00	6.58	0	0.00	0	0.00	0	0.00
6-Jun	8.01	0	0.00	7.92	0	0.00	0	0.00	0	0.00
7-Jun	8.39	0	0.00	8.49	0	0.00	0	0.00	0	0.00
8-Jun	8.61	0	0.00	8.89	0	0.00	0	0.00	0	0.00
9-Jun	8.33	0	0.00	9.59	1	0.10	0	0.00	0	0.00
10-Jun	8.48	0	0.00	9.85	5	0.51	0	0.00	0	0.00
11-Jun	8.3	1	0.12	10.56	25	2.37	0	0.00	0	0.00
12-Jun	4.92	0	0.00	9.31	10	1.07	0	0.00	0	0.00
13-Jun	7.43	0	0.00	6.02	3	0.50	0	0.00	0	0.00
14-Jun	9.46	1	0.11	6.73	19	2.82	0	0.00	0	0.00
15-Jun	3.79	0	0.00	4.11	17	4.14	0	0.00	0	0.00
16-Jun	7.99	0	0.00	7.03	54	7.68	0	0.00	0	0.00
17-Jun	7.08	1	0.14	2.58	38	14.71	0	0.00	0	0.00
18-Jun	6.26	3	0.48	2.1	40	19.01	0	0.00	0	0.00
19-Jun	6.08	5	0.82	2.55	51	20.04	0	0.00	0	0.00
20-Jun	8.48	3	0.35	2.68	76	28.39	0	0.00	0	0.00
21-Jun	7.94	3	0.38	2.63	33	12.57	0	0.00	0	0.00
22-Jun	8.2	2	0.24	3.86	44	11.40	0	0.00	0	0.00
23-Jun	7.53	3	0.40	3.66	53	14.48	0	0.00	0	0.00
24-Jun	5.16	2	0.39	1.67	23	13.77	0	0.00	0	0.00
25-Jun	5.83	5	0.86	3.72	44	11.82	0	0.00	0	0.00
26-Jun	4.08	6	1.47	2.56	31	12.11	0	0.00	0	0.00
27-Jun	4.25	2	0.47	2.08	25	12.04	0	0.00	0	0.00
28-Jun	8.45	3	0.36	4.74	24	5.07	0	0.00	0	0.00
29-Jun	5.63	0	0.00	3.42	54	15.80	0	0.00	0	0.00
30-Jun	6.61	8	1.21	2.64	17	6.43	0	0.00	0	0.00
1-Jul	6.83	4	0.59	2.54	56	22.03	0	0.00	0	0.00
2-Jul	3.28	5	1.52	2.3	12	5.23	0	0.00	0	0.00
3-Jul	7.79	1	0.13	4.08	18	4.42	0	0.00	0	0.00
4-Jul	7.92	4	0.51	4.09	26	6.36	0	0.00	0	0.00
5-Jul	8.54	0	0.00	3.26	25	7.68	0	0.00	0	0.00
6-Jul	4.69	1	0.21	2.67	14	5.24	0	0.00	0	0.00
7-Jul	7.83	0	0.00	4.35	57	13.10	0	0.00	0	0.00
8-Jul	7.85	2	0.25	5.14	17	3.31	0	0.00	0	0.00
9-Jul	7.36	1	0.14	7.1	9	1.27	0	0.00	0	0.00
10-Jul	7.09	3	0.42	5.9	21	3.56	0	0.00	0	0.00
11-Jul	7.78	0	0.00	4.92	24	4.87	0	0.00	0	0.00
12-Jul	8.74	0	0.00	7.05	8	1.13	0	0.00	0	0.00
13-Jul	9.5	0	0.00	5.82	34	5.84	0	0.00	0	0.00
14-Jul	7.13	2	0.28	6.95	14	2.01	0	0.00	0	0.00
15-Jul	8.27	2	0.24	7.45	5	0.67	0	0.00	0	0.00
16-Jul	8.41	1	0.12	6.05	14	2.31	0	0.00	0	0.00

-continued-

Appendix B1.–Page 2 of 2.

Date	Lg. Mesh Fathom hrs	Chinook		Sm. Mesh Fathom hrs	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
17-Jul	8.01	0	0.00	6.85	25	3.65	0	0.00	0	0.00
18-Jul	7.84	0	0.00	6.59	15	2.28	0	0.00	0	0.00
19-Jul	2.15	0	0.00	5.22	0	0.00	10	1.91	0	0.00
20-Jul	3.4	1	0.29	6.42	0	0.00	22	3.42	0	0.00
21-Jul	1.84	0	0.00	6.65	0	0.00	24	3.61	0	0.00
22-Jul	2.71	0	0.00	7.55	0	0.00	3	0.40	1	0.13
23-Jul	2.1	0	0.00	7.96	0	0.00	8	1.00	0	0.00
24-Jul	2.56	0	0.00	8.15	0	0.00	17	2.09	0	0.00
25-Jul	3.03	0	0.00	7.69	0	0.00	11	1.43	0	0.00
26-Jul	3.18	0	0.00	8.27	0	0.00	23	2.78	0	0.00
27-Jul	2.77	0	0.00	7.41	0	0.00	10	1.35	0	0.00
28-Jul	2.85	0	0.00	7.02	0	0.00	4	0.57	1	0.14
29-Jul	2.61	0	0.00	6.04	0	0.00	17	2.81	0	0.00
30-Jul	2.6	0	0.00	3.81	0	0.00	25	6.57	1	0.26
31-Jul	1.98	0	0.00	3.91	0	0.00	19	4.86	0	0.00
1-Aug	2.74	0	0.00	5.56	0	0.00	18	3.24	0	0.00
2-Aug	2.4	0	0.00	2.33	0	0.00	14	6.01	0	0.00
3-Aug	2.78	0	0.00	5.77	0	0.00	13	2.25	2	0.35
4-Aug	2.74	0	0.00	8.08	0	0.00	13	1.61	2	0.25
5-Aug	3.34	0	0.00	8.94	0	0.00	5	0.56	1	0.11
6-Aug	3.09	0	0.00	8.54	0	0.00	5	0.59	0	0.00
7-Aug	2.81	0	0.00	7.86	0	0.00	17	2.16	5	0.64
8-Aug	2.11	0	0.00	3.65	0	0.00	0	0.00	4	1.10
9-Aug	2.79	0	0.00	8.22	0	0.00	11	1.34	1	0.12
10-Aug	2.37	0	0.00	5.14	0	0.00	3	0.58	1	0.19
11-Aug	3.02	0	0.00	7.77	0	0.00	4	0.51	5	0.64
12-Aug	2.7	0	0.00	9.26	0	0.00	3	0.32	6	0.65
13-Aug	3.35	0	0.00	7.74	0	0.00	0	0.00	3	0.39
14-Aug	2.19	0	0.00	5.06	0	0.00	14	2.77	1	0.20
15-Aug	3.2	0	0.00	4.89	0	0.00	26	5.32	0	0.00
16-Aug	2.67	0	0.00	4.65	0	0.00	1	0.21	5	1.07
17-Aug	2.54	0	0.00	7.49	0	0.00	4	0.53	2	0.27
18-Aug	2.99	0	0.00	5.83	0	0.00	9	1.54	8	1.37
19-Aug	3.33	0	0.00	7.81	0	0.00	9	1.15	13	1.66
20-Aug	2.16	0	0.00	8.21	0	0.00	13	1.58	12	1.46
21-Aug	2.32	0	0.00	4.1	0	0.00	2	0.49	3	0.73
22-Aug	2.43	0	0.00	6.01	0	0.00	13	2.16	2	0.33
23-Aug	2.13	0	0.00	4.25	0	0.00	3	0.71	4	0.94
24-Aug	0	0	0.00	10.19	0	0.00	4	0.39	13	1.28
25-Aug	2.29	0	0.00	4.14	0	0.00	4	0.97	2	0.48
26-Aug	3.3	0	0.00	8.23	0	0.00	9	1.09	15	1.82
27-Aug	3.1	0	0.00	6.77	0	0.00	8	1.18	12	1.77
28-Aug	3.13	0	0.00	4.98	0	0.00	1	0.20	5	1.00
29-Aug	2.84	0	0.00	7.36	0	0.00	11	1.50	5	0.68
30-Aug	2.93	0	0.00	5.49	0	0.00	2	0.36	1	0.18
31-Aug	2.65	0	0.00	6.65	0	0.00	4	0.60	4	0.60
Total	445.48	75	12.5	534.45	1081	311.79	436	74.72	140	20.81

Appendix B2.–Left bank CPUE by day, 2006.

Date	Lg. Mesh Fathom hrs	Chinook		Sm. Mesh Fathom hrs	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
3-Jun	20.30	0	0.00	21.44	0	0.00	0	0.00	0	0.00
4-Jun	14.33	0	0.00	19.72	0	0.00	0	0.00	0	0.00
5-Jun	14.31	0	0.00	21.30	0	0.00	0	0.00	0	0.00
6-Jun	21.77	0	0.00	21.29	0	0.00	0	0.00	0	0.00
7-Jun	21.68	1	0.05	20.60	2	0.10	0	0.00	0	0.00
8-Jun	21.66	1	0.05	23.23	10	0.43	0	0.00	0	0.00
9-Jun	19.87	0	0.00	21.09	10	0.47	0	0.00	0	0.00
10-Jun	22.64	3	0.13	21.89	14	0.64	0	0.00	0	0.00
11-Jun	21.51	2	0.09	21.21	40	1.89	0	0.00	0	0.00
12-Jun	23.07	1	0.04	20.32	38	1.87	0	0.00	0	0.00
13-Jun	19.71	1	0.05	19.33	35	1.81	0	0.00	0	0.00
14-Jun	19.49	5	0.26	17.92	66	3.68	0	0.00	0	0.00
15-Jun	11.38	3	0.26	8.97	55	6.13	0	0.00	0	0.00
16-Jun	16.56	1	0.06	14.75	77	5.22	0	0.00	0	0.00
17-Jun	14.33	6	0.42	7.25	74	10.21	0	0.00	0	0.00
18-Jun	11.05	16	1.45	10.07	130	12.91	0	0.00	0	0.00
19-Jun	16.36	5	0.31	6.54	143	21.86	0	0.00	0	0.00
20-Jun	15.02	15	1.00	11.57	105	9.08	0	0.00	0	0.00
21-Jun	16.94	8	0.47	9.63	82	8.52	0	0.00	0	0.00
22-Jun	19.01	7	0.37	10.46	108	10.33	0	0.00	0	0.00
23-Jun	18.08	6	0.33	10.94	91	8.31	0	0.00	0	0.00
24-Jun	12.20	9	0.74	5.85	32	5.47	0	0.00	0	0.00
25-Jun	15.22	14	0.92	8.18	51	6.23	0	0.00	0	0.00
26-Jun	10.35	27	2.61	6.70	125	18.65	0	0.00	0	0.00
27-Jun	9.11	10	1.10	4.98	58	11.65	0	0.00	0	0.00
28-Jun	18.18	10	0.55	7.59	65	8.56	0	0.00	0	0.00
29-Jun	14.99	25	1.67	12.05	77	6.39	0	0.00	0	0.00
30-Jun	16.14	23	1.42	10.41	39	3.75	0	0.00	0	0.00
1-Jul	14.64	9	0.61	8.37	69	8.25	0	0.00	0	0.00
2-Jul	9.70	4	0.41	6.44	29	4.50	0	0.00	0	0.00
3-Jul	15.28	2	0.13	12.96	54	4.17	0	0.00	0	0.00
4-Jul	17.50	11	0.63	15.72	57	3.63	0	0.00	0	0.00
5-Jul	19.37	4	0.21	12.36	53	4.29	0	0.00	0	0.00
6-Jul	11.55	2	0.17	7.32	57	7.78	0	0.00	0	0.00
7-Jul	16.95	2	0.12	12.40	35	2.82	0	0.00	0	0.00
8-Jul	18.49	4	0.22	16.00	50	3.13	0	0.00	0	0.00
9-Jul	19.54	3	0.15	15.89	24	1.51	0	0.00	0	0.00
10-Jul	20.27	7	0.35	15.53	21	1.35	0	0.00	0	0.00
11-Jul	17.58	4	0.23	15.54	54	3.47	0	0.00	0	0.00
12-Jul	19.06	6	0.31	17.91	33	1.84	0	0.00	0	0.00
13-Jul	20.44	7	0.34	19.00	33	1.74	0	0.00	0	0.00
14-Jul	17.20	7	0.41	16.72	26	1.56	0	0.00	0	0.00
15-Jul	17.19	3	0.17	17.52	13	0.74	0	0.00	0	0.00
16-Jul	17.75	0	0.00	16.51	37	2.24	0	0.00	0	0.00
17-Jul	18.83	1	0.05	17.60	32	1.82	0	0.00	0	0.00
18-Jul	17.72	1	0.06	16.04	36	2.24	0	0.00	0	0.00

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Appendix B2.–Page 2 of 2.

Date	Lg. Mesh Fathom hrs	Chinook		Sm. Mesh Fathom hrs	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
19-Jul	5.90	0	0.00	10.07	0	0.00	56	5.56	0	0.00
20-Jul	6.87	1	0.15	14.84	0	0.00	30	2.02	0	0.00
21-Jul	6.38	0	0.00	18.91	0	0.00	33	1.75	0	0.00
22-Jul	5.95	0	0.00	17.68	0	0.00	14	0.79	0	0.00
23-Jul	6.20	0	0.00	18.96	0	0.00	16	0.84	1	0.05
24-Jul	5.95	0	0.00	16.93	0	0.00	24	1.42	0	0.00
25-Jul	5.64	1	0.18	17.93	0	0.00	17	0.95	0	0.00
26-Jul	6.30	0	0.00	17.97	0	0.00	15	0.83	0	0.00
27-Jul	6.40	0	0.00	18.35	0	0.00	20	1.09	2	0.11
28-Jul	6.81	0	0.00	16.91	0	0.00	24	1.42	0	0.00
29-Jul	4.46	0	0.00	15.34	0	0.00	61	3.98	0	0.00
30-Jul	6.84	0	0.00	10.03	0	0.00	56	5.58	2	0.20
31-Jul	6.37	0	0.00	12.69	0	0.00	47	3.70	0	0.00
1-Aug	5.83	0	0.00	12.70	0	0.00	63	4.96	2	0.16
2-Aug	5.34	0	0.00	6.53	0	0.00	39	5.97	0	0.00
3-Aug	5.63	0	0.00	15.70	0	0.00	19	1.21	1	0.06
4-Aug	5.84	0	0.00	17.93	0	0.00	29	1.62	0	0.00
5-Aug	6.72	1	0.15	19.43	0	0.00	8	0.41	1	0.05
6-Aug	5.70	0	0.00	18.02	0	0.00	6	0.33	2	0.11
7-Aug	5.55	0	0.00	18.74	0	0.00	16	0.85	1	0.05
8-Aug	6.70	0	0.00	10.15	0	0.00	9	0.89	1	0.10
9-Aug	5.75	0	0.00	19.84	0	0.00	19	0.96	2	0.10
10-Aug	5.38	0	0.00	9.97	0	0.00	5	0.50	1	0.10
11-Aug	6.20	0	0.00	18.03	0	0.00	6	0.33	0	0.00
12-Aug	5.83	0	0.00	20.22	0	0.00	11	0.54	4	0.20
13-Aug	7.73	0	0.00	16.40	0	0.00	5	0.30	5	0.30
14-Aug	3.95	0	0.00	8.42	0	0.00	34	4.04	1	0.12
15-Aug	4.75	0	0.00	10.25	0	0.00	51	4.97	1	0.10
16-Aug	4.98	0	0.00	9.93	0	0.00	13	1.31	0	0.00
17-Aug	5.75	0	0.00	15.95	0	0.00	9	0.56	4	0.25
18-Aug	6.15	0	0.00	11.97	0	0.00	11	0.92	0	0.00
19-Aug	6.16	0	0.00	20.00	0	0.00	14	0.70	4	0.20
20-Aug	6.41	0	0.00	16.41	0	0.00	28	1.71	7	0.43
21-Aug	5.21	0	0.00	11.34	0	0.00	7	0.62	4	0.35
22-Aug	6.94	0	0.00	12.47	0	0.00	28	2.24	1	0.08
23-Aug	5.42	0	0.00	10.94	0	0.00	2	0.18	1	0.09
24-Aug	0.00	0	0.00	24.47	0	0.00	2	0.08	1	0.04
25-Aug	6.18	0	0.00	10.34	0	0.00	8	0.77	3	0.29
26-Aug	6.70	0	0.00	16.53	0	0.00	7	0.42	1	0.06
27-Aug	6.98	0	0.00	19.00	0	0.00	1	0.05	2	0.11
28-Aug	6.58	0	0.00	10.73	0	0.00	2	0.19	0	0.00
29-Aug	5.41	0	0.00	19.46	0	0.00	17	0.87	1	0.05
30-Aug	5.90	0	0.00	11.67	0	0.00	7	0.60	1	0.09
31-Aug	6.27	0	0.00	17.55	0	0.00	12	0.68	10	0.57
Total	1042.33	279	19.40	1322.81	2,240	221.24	901	69.71	67	4.42

APPENDIX C

Appendix C1.–Daily passage estimates by zone with Standard Errors (S.E.), 2006.

Date	Right Bank	Left Bank		Total		Percent by Bank	
		Nearshore	Offshore	Passage	S.E.	Right	Left
5-Jun	3,036	0	0	3,036	1,341	100.0	0.0
6-Jun	3,837	0	0	3,837	240	100.0	0.0
7-Jun	2,686	0	0	2,686	289	100.0	0.0
8-Jun	4,002	2,952	2,761	9,715	38,728	41.2	58.8
9-Jun	3,258	3,149	2,299	8,706	1,457	37.4	62.6
10-Jun	2,889	8,449	1,635	12,973	3,371	22.3	77.7
11-Jun	4,016	9,103	1,084	14,203	2,681	28.3	71.7
12-Jun	2,750	14,184	1,868	18,802	1,378	14.6	85.4
13-Jun	3,999	13,654	2,600	20,253	1,046	19.8	80.3
14-Jun	7,808	11,662	3,145	22,615	5,347	34.5	65.5
15-Jun	12,409	14,841	4,296	31,546	6,612	39.3	60.7
16-Jun	26,967	32,892	6,252	66,111	9,626	40.8	59.2
17-Jun	33,361	77,364	29,414	140,139	16,746	23.8	76.2
18-Jun	34,649	208,337	34,514	277,500	36,358	12.5	87.5
19-Jun	34,629	189,064	41,361	265,054	30,009	13.1	86.9
20-Jun	32,777	160,074	45,664	238,515	17,767	13.7	86.3
21-Jun	44,938	77,342	31,650	153,930	23,396	29.2	70.8
22-Jun	63,541	55,821	28,262	147,624	7,356	43.0	57.0
23-Jun	55,364	105,909	34,853	196,126	19,317	28.2	71.8
24-Jun	38,646	76,026	23,302	137,974	16,295	28.0	72.0
25-Jun	39,294	107,763	25,007	172,064	19,635	22.8	77.2
26-Jun	67,311	230,744	41,587	339,642	28,102	19.8	80.2
27-Jun	53,478	140,845	19,679	214,002	36,943	25.0	75.0
28-Jun	37,179	147,144	20,366	204,689	37,660	18.2	81.8
29-Jun	48,008	93,349	13,569	154,926	10,961	31.0	69.0
30-Jun	50,363	107,873	8,112	166,348	7,728	30.3	69.7
1-Jul	41,300	116,297	5,968	163,565	13,239	25.3	74.8
2-Jul	37,239	86,169	7,780	131,188	11,566	28.4	71.6
3-Jul	32,033	73,195	10,123	115,351	6,578	27.8	72.2
4-Jul	40,389	75,717	6,688	122,794	15,112	32.9	67.1
5-Jul	28,325	69,982	6,051	104,358	11,851	27.1	72.9
6-Jul	20,545	40,608	5,216	66,369	7,728	31.0	69.0
7-Jul	27,110	39,216	6,592	72,918	8,399	37.2	62.8
8-Jul	20,089	32,393	4,345	56,827	8,666	35.4	64.7
9-Jul	12,565	27,344	3,240	43,149	7,901	29.1	70.9
10-Jul	14,517	36,088	1,984	52,589	4,806	27.6	72.4
11-Jul	13,145	39,035	2,885	55,065	14,317	23.9	76.1
12-Jul	12,559	21,827	2,120	36,506	7,199	34.4	65.6
13-Jul	9,225	17,596	1,324	28,145	5,204	32.8	67.2
14-Jul	9,274	16,590	1,648	27,512	2,725	33.7	66.3
15-Jul	9,498	11,029	1,024	21,551	5,711	44.1	55.9
16-Jul	10,172	28,800	1,512	40,484	3,731	25.1	74.9
17-Jul	8,930	29,532	1,832	40,294	7,296	22.2	77.8
18-Jul	9,361	38,518	2,820	50,699	5,318	18.5	81.5

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Appendix C.–Page 2 of 2.

Date	Right Bank	Left Bank		Total		Percent by Bank	
		Nearshore	Offshore	Passage	S.E.	Right	Left
19-Jul	8,439	47,590	5,301	61,330	6,678	13.8	86.2
20-Jul	7,072	32,976	6,018	46,066	5,605	15.4	84.7
21-Jul	3,968	21,889	3,392	29,249	4,195	13.6	86.4
22-Jul	3,444	17,346	2,080	22,870	5,115	15.1	84.9
23-Jul	3,279	16,848	2,143	22,270	3,266	14.7	85.3
24-Jul	5,566	21,983	3,136	30,685	7,007	18.1	81.9
25-Jul	4,245	20,254	3,476	27,975	4,820	15.2	84.8
26-Jul	4,888	16,835	2,751	24,474	3,213	20.0	80.0
27-Jul	5,258	19,153	3,648	28,059	4,933	18.7	81.3
28-Jul	3,807	13,779	3,147	20,733	2,963	18.4	81.6
29-Jul	6,108	40,612	9,280	56,000	12,307	10.9	89.1
30-Jul	13,643	56,283	24,072	93,998	8,809	14.5	85.5
31-Jul	13,169	29,192	25,516	67,877	9,135	19.4	80.6
1-Aug	9,954	35,061	30,854	75,869	20,014	13.1	86.9
2-Aug	8,553	31,752	24,666	64,971	18,954	13.2	86.8
3-Aug	5,409	23,757	16,858	46,024	10,901	11.8	88.3
4-Aug	6,986	17,071	11,128	35,185	8,302	19.9	80.1
5-Aug	5,137	12,868	7,192	25,197	6,859	20.4	79.6
6-Aug	3,473	12,593	4,592	20,658	4,500	16.8	83.2
7-Aug	4,719	13,530	9,305	27,554	5,205	17.1	82.9
8-Aug	4,822	16,976	14,331	36,129	7,659	13.4	86.7
9-Aug	4,619	17,846	13,454	35,919	8,557	12.9	87.1
10-Aug	2,410	16,281	9,106	27,797	7,346	8.7	91.3
11-Aug	3,044	14,913	6,448	24,405	1,855	12.5	87.5
12-Aug	2,262	14,068	5,528	21,858	5,612	10.4	89.7
13-Aug	1,747	8,758	5,175	15,680	1,255	11.1	88.9
14-Aug	5,068	22,436	28,991	56,495	11,771	9.0	91.0
15-Aug	4,798	33,492	60,737	99,027	15,369	4.9	95.2
16-Aug	4,700	12,749	19,688	37,137	7,374	12.7	87.3
17-Aug	3,541	13,129	14,288	30,958	6,939	11.4	88.6
18-Aug	6,519	12,394	18,412	37,325	8,190	17.5	82.5
19-Aug	5,322	10,544	15,567	31,433	4,801	16.9	83.1
20-Aug	6,385	11,146	17,816	35,347	5,644	18.1	81.9
21-Aug	7,579	11,700	21,367	40,646	14,865	18.7	81.4
22-Aug	9,959	13,602	33,757	57,318	17,581	17.4	82.6
23-Aug	7,133	7,136	10,142	24,411	4,120	29.2	70.8
24-Aug	4,827	8,566	7,097	20,490	4,182	23.6	76.4
25-Aug	5,984	9,042	11,748	26,774	4,761	22.4	77.7
26-Aug	5,366	6,608	10,333	22,307	2,798	24.1	75.9
27-Aug	5,872	6,996	6,843	19,711	2,208	29.8	70.2
28-Aug	4,464	5,003	4,080	13,547	3,435	33.0	67.1
29-Aug	4,635	7,374	6,936	18,945	4,966	24.5	75.5
30-Aug	7,069	7,129	7,976	22,174	4,732	31.9	68.1
31-Aug	4,742	6,486	3,967	15,195	4,185	31.2	68.8
Total	1,317,455	3,484,223	1,048,774	5,850,452			

APPENDIX D

Appendix D1.–Daily passage estimates by species, 2006.

Date	Large Chinook	Small Chinook	All Chinook	Chum Summer	Chum Fall	Pink	Coho	Other	Total
5-Jun	0	0	0	0	0	0	0	3,036	3,036
6-Jun	0	0	0	0	0	0	0	3,837	3,837
7-Jun	0	0	0	0	0	0	0	2,686	2,686
8-Jun	292	0	292	2,257	0	0	0	7,166	9,715
9-Jun	87	0	87	2,308	0	0	0	6,311	8,706
10-Jun	628	0	628	6,973	0	0	0	5,372	12,973
11-Jun	195	0	195	11,576	0	0	0	2,432	14,203
12-Jun	262	187	449	16,902	0	0	0	1,451	18,802
13-Jun	323	0	323	16,250	0	0	0	3,680	20,253
14-Jun	536	43	579	14,650	0	0	0	7,386	22,615
15-Jun	710	59	769	19,420	0	0	0	11,357	31,546
16-Jun	437	0	437	64,670	0	0	0	1,004	66,111
17-Jun	2,604	336	2,940	133,693	0	0	0	3,506	140,139
18-Jun	10,016	766	10,782	264,010	0	0	0	2,708	277,500
19-Jun	2,411	1,636	4,047	259,207	0	0	0	1,800	265,054
20-Jun	6,137	592	6,729	228,794	0	0	0	2,992	238,515
21-Jun	3,437	856	4,293	149,074	0	0	0	563	153,930
22-Jun	2,278	454	2,732	142,627	0	594	0	1,671	147,624
23-Jun	5,241	1,514	6,755	183,335	0	433	0	5,603	196,126
24-Jun	3,677	1,074	4,751	128,994	0	302	0	3,927	137,974
25-Jun	9,163	514	9,677	154,111	0	1,496	0	6,780	172,064
26-Jun	21,349	4,661	26,010	308,282	0	902	0	4,448	339,642
27-Jun	7,968	855	8,823	197,128	0	1,010	0	7,041	214,002
28-Jun	8,042	854	8,896	188,153	0	702	0	6,938	204,689
29-Jun	11,402	1,364	12,766	129,933	0	2,845	0	9,382	154,926
30-Jun	13,818	1,251	15,069	147,620	0	2,573	0	1,086	166,348
1-Jul	5,252	1,682	6,934	146,898	0	4,578	0	5,155	163,565
2-Jul	4,402	1,388	5,790	117,784	0	3,546	0	4,068	131,188
3-Jul	2,046	638	2,684	100,448	0	6,640	0	5,579	115,351
4-Jul	4,836	349	5,185	106,387	0	6,186	0	5,036	122,794
5-Jul	2,497	1,394	3,891	84,637	0	6,907	0	8,923	104,358
6-Jul	842	0	842	58,931	0	2,172	0	4,424	66,369
7-Jul	543	163	706	66,924	0	786	0	4,502	72,918
8-Jul	1,320	588	1,908	41,816	0	1,562	0	11,541	56,827
9-Jul	825	288	1,113	25,391	0	5,378	0	11,267	43,149
10-Jul	2,319	0	2,319	37,050	0	5,683	0	7,537	52,589
11-Jul	683	249	932	36,411	0	1,504	0	16,218	55,065
12-Jul	1,836	0	1,836	26,685	0	1,938	0	6,047	36,506
13-Jul	1,051	0	1,051	17,247	0	2,842	0	7,005	28,145
14-Jul	1,756	0	1,756	20,068	0	2,134	0	3,554	27,512
15-Jul	980	95	1,075	12,495	0	1,628	0	6,353	21,551
16-Jul	388	0	388	33,970	0	2,609	0	3,517	40,484
17-Jul	285	0	285	28,015	0	2,901	0	9,093	40,294
18-Jul	227	0	227	35,920	0	5,613	0	8,939	50,699

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Date	Large Chinook	Small Chinook	All Chinook	Chum Summer	Chum Fall	Pink	Coho	Other	Total
19-Jul	429	0	429	0	54,044	2,482	0	4,375	61,330
20-Jul	321	0	321	0	33,374	3,272	283	8,816	46,066
21-Jul	241	0	241	0	13,912	3,562	0	11,534	29,249
22-Jul	0	0	0	0	9,772	1,516	207	11,375	22,870
23-Jul	0	0	0	0	15,119	4,220	368	2,563	22,270
24-Jul	0	0	0	0	14,423	2,392	0	13,870	30,685
25-Jul	471	0	471	0	14,848	2,771	492	9,393	27,975
26-Jul	360	0	360	0	11,406	1,986	116	10,606	24,474
27-Jul	0	0	0	0	7,559	908	307	19,285	28,059
28-Jul	0	0	0	0	8,601	544	171	11,417	20,733
29-Jul	0	0	0	0	34,808	1,920	933	18,339	56,000
30-Jul	0	0	0	0	81,784	1,031	1,721	9,462	93,998
31-Jul	0	0	0	0	52,994	2,202	2,643	10,038	67,877
1-Aug	0	0	0	0	41,542	1,998	1,222	31,107	75,869
2-Aug	0	0	0	0	34,668	1,682	1,019	27,602	64,971
3-Aug	0	0	0	0	22,534	307	4,937	18,246	46,024
4-Aug	0	0	0	0	16,438	2,977	1,487	14,283	35,185
5-Aug	630	0	630	0	5,083	1,053	1,011	17,420	25,197
6-Aug	0	0	0	0	4,936	440	2,302	12,980	20,658
7-Aug	0	0	0	0	8,841	493	2,177	16,043	27,554
8-Aug	0	0	0	0	8,537	751	2,956	23,885	36,129
9-Aug	0	0	0	0	8,270	560	3,387	23,702	35,919
10-Aug	0	0	0	0	5,895	454	2,168	19,280	27,797
11-Aug	0	0	0	0	8,039	64	1,767	14,535	24,405
12-Aug	0	0	0	0	5,020	59	2,533	14,246	21,858
13-Aug	0	0	0	0	3,058	381	3,646	8,595	15,680
14-Aug	0	0	0	0	39,880	0	1,719	14,896	56,495
15-Aug	0	0	0	0	72,723	0	2,479	23,825	99,027
16-Aug	0	0	0	0	18,576	12	1,243	17,306	37,137
17-Aug	0	0	0	0	8,550	9	3,836	18,563	30,958
18-Aug	0	0	0	0	10,715	17	5,024	21,569	37,325
19-Aug	0	0	0	0	13,420	97	10,037	7,879	31,433
20-Aug	0	0	0	0	17,370	0	5,417	12,560	35,347
21-Aug	0	0	0	0	7,674	0	4,231	28,741	40,646
22-Aug	0	0	0	0	24,403	0	6,191	26,724	57,318
23-Aug	0	0	0	0	4,899	0	13,118	6,394	24,411
24-Aug	0	0	0	0	3,904	0	9,331	7,255	20,490
25-Aug	0	0	0	0	9,223	0	4,283	13,268	26,774
26-Aug	0	0	0	0	7,145	0	3,335	11,827	22,307
27-Aug	0	0	0	0	3,287	0	7,890	8,534	19,711
28-Aug	0	0	0	0	3,255	0	5,152	5,140	13,547
29-Aug	0	0	0	0	6,214	0	2,380	10,351	18,945
30-Aug	0	0	0	0	7,789	0	3,892	10,493	22,174
31-Aug	0	0	0	0	6,031	0	4,508	4,656	15,195
Total	145,553	23,850	169,403	3,767,044	790,563	115,624	131,919	875,899	5,850,452

APPENDIX E

Appendix E1.–Estimates of daily passage in sectors 1 & 2 of Strata 3 on left bank. This is the DIDSON generated component of the Left Bank Nearshore estimates listed in (Appendix C), 2006.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other
7-Jun	-	-	-	-	-	-	0	-
8-Jun	-	-	-	-	-	-	0	-
9-Jun	-	-	-	-	-	-	0	-
10-Jun	43	-	43	1,656	-	-	0	934
11-Jun	22	-	22	2,444	-	-	0	317
12-Jun	109	78	188	5,325	-	-	0	422
13-Jun	60	-	60	3,930	-	-	0	224
14-Jun	24	-	24	775	-	-	0	87
15-Jun	31	-	31	1,001	-	-	0	112
16-Jun	2	-	2	414	-	-	0	-
17-Jun	288	111	398	25,120	-	-	0	-
18-Jun	4,498	452	4,950	116,597	-	-	0	1,181
19-Jun	474	511	985	86,059	-	-	0	665
20-Jun	2,141	-	2,141	70,408	-	-	0	1,354
21-Jun	601	199	799	40,495	-	-	0	-
22-Jun	242	193	436	33,021	-	-	0	-
23-Jun	1,408	391	1,799	46,102	-	-	0	439
24-Jun	909	252	1,161	29,758	-	-	0	283
25-Jun	2,072	184	2,256	35,844	-	398	0	-
26-Jun	7,181	1,719	8,899	111,451	-	-	0	-
27-Jun	3,183	367	3,549	63,241	-	-	0	2,822
28-Jun	2,047	236	2,283	40,674	-	-	0	1,815
29-Jun	2,944	138	3,082	23,095	-	338	0	2,819
30-Jun	3,761	302	4,063	41,485	-	406	0	190
1-Jul	1,091	371	1,462	33,869	-	1,179	0	1,330
2-Jul	824	281	1,105	25,582	-	891	0	1,004
3-Jul	216	174	391	18,090	-	543	0	1,004
4-Jul	765	108	873	21,859	-	414	0	277
5-Jul	646	560	1,206	22,829	-	1,679	0	2,379
6-Jul	195	-	195	12,416	-	68	0	1,433
7-Jul	249	-	249	15,836	-	87	0	1,828
8-Jul	391	206	597	12,691	-	425	0	2,684
9-Jul	371	120	491	10,470	-	1,730	0	1,925
10-Jul	912	-	912	11,852	-	1,747	0	2,394
11-Jul	170	57	227	8,661	-	308	0	5,638
12-Jul	600	-	600	8,970	-	193	0	82
13-Jul	446	-	446	4,082	-	526	0	2,414
14-Jul	628	-	628	5,536	-	-	0	1,217
15-Jul	328	-	328	3,919	-	458	0	330
16-Jul	153	-	153	13,292	-	309	0	207
17-Jul	94	-	94	10,501	-	693	0	3,326
18-Jul	91	-	91	12,292	-	1,041	0	2,050

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Appendix E1.–Page 2 of 2.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other
19-Jul	-	-	-	-	12,681	141	0	1,040
20-Jul	-	-	-	-	8,564	661	100	2,347
21-Jul	112	-	112	-	5,069	1,755	0	4,068
22-Jul	-	-	-	-	3,909	402	93	5,470
23-Jul	-	-	-	-	7,051	1,590	141	1,075
24-Jul	-	-	-	-	4,397	508	0	6,399
25-Jul	256	-	256	-	5,897	1,054	181	3,650
26-Jul	193	-	193	-	4,794	464	0	4,674
27-Jul	-	-	-	-	1,943	281	184	9,057
28-Jul	-	-	-	-	3,202	283	93	4,353
29-Jul	-	-	-	-	8,673	315	145	5,768
30-Jul	-	-	-	-	13,823	252	220	1,707
31-Jul	-	-	-	-	6,071	580	196	1,656
1-Aug	-	-	-	-	3,069	151	86	7,124
2-Aug	-	-	-	-	2,909	143	82	6,754
3-Aug	-	-	-	-	2,963	-	398	4,147
4-Aug	-	-	-	-	3,421	648	202	1,455
5-Aug	262	-	262	-	1,118	210	141	3,618
6-Aug	-	-	-	-	1,150	-	618	4,090
7-Aug	-	-	-	-	1,314	-	392	3,336
8-Aug	-	-	-	-	881	167	200	5,904
9-Aug	-	-	-	-	937	177	213	6,279
10-Aug	-	-	-	-	927	175	211	6,216
11-Aug	-	-	-	-	1,027	-	0	5,278
12-Aug	-	-	-	-	1,308	-	559	5,049
13-Aug	-	-	-	-	317	-	354	3,951
14-Aug	-	-	-	-	3,504	-	237	3,151
15-Aug	-	-	-	-	3,444	-	232	3,096
16-Aug	-	-	-	-	482	-	166	4,286
17-Aug	-	-	-	-	608	-	209	5,407
18-Aug	-	-	-	-	420	-	145	3,741
19-Aug	-	-	-	-	639	-	1137	2,533
20-Aug	-	-	-	-	368	-	309	3,804
21-Aug	-	-	-	-	327	-	275	3,381
22-Aug	-	-	-	-	2,824	-	497	254
23-Aug	-	-	-	-	543	-	273	2,952
24-Aug	-	-	-	-	618	-	311	3,365
25-Aug	-	-	-	-	528	-	266	2,875
26-Aug	-	-	-	-	64	-	47	2,719
27-Aug	-	-	-	-	-	-	281	1,691
28-Aug	-	-	-	-	394	-	217	1,097
29-Aug	-	-	-	-	593	-	327	1,652
30-Aug	-	-	-	-	736	-	406	2,050
31-Aug	-	-	-	-	1,073	-	1138	395

Appendix E2.–Proportions, by species, of daily total passage (both banks combined) for sectors 1 and 2 of Strata 3 of the left bank nearshore region generated by the DIDSON, 2006.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	Daily Total
7-Jun	-	-	-	-	-	-	-	-	-
8-Jun	-	-	-	-	-	-	-	-	-
9-Jun	-	-	-	-	-	-	-	-	-
10-Jun	0.07	-	0.07	0.24	-	-	-	0.17	0.20
11-Jun	0.11	-	0.11	0.21	-	-	-	0.13	0.20
12-Jun	0.42	0.42	0.42	0.32	-	-	-	0.29	0.32
13-Jun	0.19	-	0.19	0.24	-	-	-	0.06	0.21
14-Jun	0.04	-	0.04	0.05	-	-	-	0.01	0.04
15-Jun	0.04	-	0.04	0.05	-	-	-	0.01	0.04
16-Jun	0.00	-	0.00	0.01	-	-	-	-	0.01
17-Jun	0.11	0.33	0.14	0.19	-	-	-	-	0.18
18-Jun	0.45	0.59	0.46	0.44	-	-	-	0.44	0.44
19-Jun	0.20	0.31	0.24	0.33	-	-	-	0.37	0.33
20-Jun	0.35	-	0.32	0.31	-	-	-	0.45	0.31
21-Jun	0.17	0.23	0.19	0.27	-	-	-	-	0.27
22-Jun	0.11	0.43	0.16	0.23	-	-	-	-	0.23
23-Jun	0.27	0.26	0.27	0.25	-	-	-	0.08	0.25
24-Jun	0.25	0.23	0.24	0.23	-	-	-	0.07	0.23
25-Jun	0.23	0.36	0.23	0.23	-	0.27	-	-	0.22
26-Jun	0.34	0.37	0.34	0.36	-	-	-	-	0.35
27-Jun	0.40	0.43	0.40	0.32	-	-	-	0.40	0.33
28-Jun	0.25	0.28	0.26	0.22	-	-	-	0.26	0.22
29-Jun	0.26	0.10	0.24	0.18	-	0.12	-	0.30	0.19
30-Jun	0.27	0.24	0.27	0.28	-	0.16	-	0.17	0.28
1-Jul	0.21	0.22	0.21	0.23	-	0.26	-	0.26	0.23
2-Jul	0.19	0.20	0.19	0.22	-	0.25	-	0.25	0.22
3-Jul	0.11	0.27	0.15	0.18	-	0.08	-	0.18	0.17
4-Jul	0.16	0.31	0.17	0.21	-	0.07	-	0.06	0.19
5-Jul	0.26	0.40	0.31	0.27	-	0.24	-	0.27	0.27
6-Jul	0.23	-	0.23	0.21	-	0.03	-	0.32	0.21
7-Jul	0.46	-	0.35	0.24	-	0.11	-	0.41	0.25
8-Jul	0.30	0.35	0.31	0.30	-	0.27	-	0.23	0.29
9-Jul	0.45	0.42	0.44	0.41	-	0.32	-	0.17	0.34
10-Jul	0.39	-	0.39	0.32	-	0.31	-	0.32	0.32
11-Jul	0.25	0.23	0.24	0.24	-	0.20	-	0.35	0.27
12-Jul	0.33	-	0.33	0.34	-	0.10	-	0.01	0.27
13-Jul	0.42	-	0.42	0.24	-	0.19	-	0.34	0.27
14-Jul	0.36	-	0.36	0.28	-	-	-	0.34	0.27
15-Jul	0.33	-	0.31	0.31	-	0.28	-	0.05	0.23
16-Jul	0.39	-	0.39	0.39	-	0.12	-	0.06	0.34
17-Jul	0.33	-	0.33	0.37	-	0.24	-	0.37	0.36
18-Jul	0.40	-	0.40	0.34	-	0.19	-	0.23	0.31

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Appendix E2.–Page 2 of 2.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	Daily Total
19-Jul	-	-	-	-	0.23	0.06	-	0.24	0.23
20-Jul	-	-	-	-	0.26	0.20	0.35	0.27	0.25
21-Jul	0.46	-	0.46	-	0.36	0.49	-	0.35	0.38
22-Jul	-	-	-	-	0.40	0.27	0.45	0.48	0.43
23-Jul	-	-	-	-	0.47	0.38	0.38	0.42	0.44
24-Jul	-	-	-	-	0.30	0.21	-	0.46	0.37
25-Jul	0.54	-	0.54	-	0.40	0.38	0.37	0.39	0.39
26-Jul	0.54	-	0.54	-	0.42	0.23	-	0.44	0.41
27-Jul	-	-	-	-	0.26	0.31	0.60	0.47	0.41
28-Jul	-	-	-	-	0.37	0.52	0.54	0.38	0.38
29-Jul	-	-	-	-	0.25	0.16	0.16	0.31	0.27
30-Jul	-	-	-	-	0.17	0.24	0.13	0.18	0.17
31-Jul	-	-	-	-	0.11	0.26	0.07	0.16	0.13
1-Aug	-	-	-	-	0.07	0.08	0.07	0.23	0.14
2-Aug	-	-	-	-	0.08	0.09	0.08	0.24	0.15
3-Aug	-	-	-	-	0.13	-	0.08	0.23	0.16
4-Aug	-	-	-	-	0.21	0.22	0.14	0.10	0.16
5-Aug	0.42	-	0.42	-	0.22	0.20	0.14	0.21	0.21
6-Aug	-	-	-	-	0.23	-	0.27	0.32	0.28
7-Aug	-	-	-	-	0.15	-	0.18	0.21	0.18
8-Aug	-	-	-	-	0.10	0.22	0.07	0.25	0.20
9-Aug	-	-	-	-	0.11	0.32	0.06	0.26	0.21
10-Aug	-	-	-	-	0.16	0.39	0.10	0.32	0.27
11-Aug	-	-	-	-	0.13	-	-	0.36	0.26
12-Aug	-	-	-	-	0.26	-	0.22	0.35	0.32
13-Aug	-	-	-	-	0.10	-	0.10	0.46	0.29
14-Aug	-	-	-	-	0.09	-	0.14	0.21	0.12
15-Aug	-	-	-	-	0.05	-	0.09	0.13	0.07
16-Aug	-	-	-	-	0.03	-	0.13	0.25	0.13
17-Aug	-	-	-	-	0.07	-	0.05	0.29	0.20
18-Aug	-	-	-	-	0.04	-	0.03	0.17	0.12
19-Aug	-	-	-	-	0.05	-	0.11	0.32	0.14
20-Aug	-	-	-	-	0.02	-	0.06	0.30	0.13
21-Aug	-	-	-	-	0.04	-	0.06	0.12	0.10
22-Aug	-	-	-	-	0.12	-	0.08	0.01	0.06
23-Aug	-	-	-	-	0.11	-	0.02	0.46	0.15
24-Aug	-	-	-	-	0.16	-	0.03	0.46	0.21
25-Aug	-	-	-	-	0.06	-	0.06	0.22	0.14
26-Aug	-	-	-	-	0.01	-	0.01	0.23	0.13
27-Aug	-	-	-	-	-	-	0.04	0.20	0.10
28-Aug	-	-	-	-	0.12	-	0.04	0.21	0.13
29-Aug	-	-	-	-	0.10	-	0.14	0.16	0.14
30-Aug	-	-	-	-	0.09	-	0.10	0.20	0.14
31-Aug	-	-	-	-	0.18	-	0.25	0.08	0.17
Season Total	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All Spp.
	0.282	0.294	0.284	0.274	0.158	0.202	0.086	0.238	0.247

APPENDIX F

Appendix F1.–Daily cumulative passage estimates by species, 2006.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All species Total
5-Jun	-	-	-	-	-	-	-	3,036	3,036
6-Jun	-	-	-	-	-	-	-	6,873	6,873
7-Jun	-	-	-	-	-	-	-	9,559	9,559
8-Jun	292	-	292	2,257	-	-	-	16,725	19,274
9-Jun	379	-	379	4,565	-	-	-	23,036	27,980
10-Jun	1,007	-	1,007	11,538	-	-	-	28,408	40,953
11-Jun	1,202	-	1,202	23,114	-	-	-	30,840	55,156
12-Jun	1,464	187	1,651	40,016	-	-	-	32,291	73,958
13-Jun	1,787	187	1,974	56,266	-	-	-	35,971	94,211
14-Jun	2,323	230	2,553	70,916	-	-	-	43,357	116,826
15-Jun	3,033	289	3,322	90,336	-	-	-	54,714	148,372
16-Jun	3,470	289	3,759	155,006	-	-	-	55,718	214,483
17-Jun	6,074	625	6,699	288,699	-	-	-	59,224	354,622
18-Jun	16,090	1,391	17,481	552,709	-	-	-	61,932	632,122
19-Jun	18,501	3,027	21,528	811,916	-	-	-	63,732	897,176
20-Jun	24,638	3,619	28,257	1,040,710	-	-	-	66,724	1,135,691
21-Jun	28,075	4,475	32,550	1,189,784	-	-	-	67,287	1,289,621
22-Jun	30,353	4,929	35,282	1,332,411	-	594	-	68,958	1,437,245
23-Jun	35,594	6,443	42,037	1,515,746	-	1,027	-	74,561	1,633,371
24-Jun	39,271	7,517	46,788	1,644,740	-	1,329	-	78,488	1,771,345
25-Jun	48,434	8,031	56,465	1,798,851	-	2,825	-	85,268	1,943,409
26-Jun	69,783	12,692	82,475	2,107,133	-	3,727	-	89,716	2,283,051
27-Jun	77,751	13,547	91,298	2,304,261	-	4,737	-	96,757	2,497,053
28-Jun	85,793	14,401	100,194	2,492,414	-	5,439	-	103,695	2,701,742
29-Jun	97,195	15,765	112,960	2,622,347	-	8,284	-	113,077	2,856,668
30-Jun	111,013	17,016	128,029	2,769,967	-	10,857	-	114,163	3,023,016
1-Jul	116,265	18,698	134,963	2,916,865	-	15,435	-	119,318	3,186,581
2-Jul	120,667	20,086	140,753	3,034,649	-	18,981	-	123,386	3,317,769
3-Jul	122,713	20,724	143,437	3,135,097	-	25,621	-	128,965	3,433,120
4-Jul	127,549	21,073	148,622	3,241,484	-	31,807	-	134,001	3,555,914
5-Jul	130,046	22,467	152,513	3,326,121	-	38,714	-	142,924	3,660,272
6-Jul	130,888	22,467	153,355	3,385,052	-	40,886	-	147,348	3,726,641
7-Jul	131,431	22,630	154,061	3,451,976	-	41,672	-	151,850	3,799,559
8-Jul	132,751	23,218	155,969	3,493,792	-	43,234	-	163,391	3,856,386
9-Jul	133,576	23,506	157,082	3,519,183	-	48,612	-	174,658	3,899,535
10-Jul	135,895	23,506	159,401	3,556,233	-	54,295	-	182,195	3,952,124
11-Jul	136,578	23,755	160,333	3,592,644	-	55,799	-	198,413	4,007,189
12-Jul	138,414	23,755	162,169	3,619,329	-	57,737	-	204,460	4,043,695
13-Jul	139,465	23,755	163,220	3,636,576	-	60,579	-	211,465	4,071,840
14-Jul	141,221	23,755	164,976	3,656,644	-	62,713	-	215,019	4,099,352
15-Jul	142,201	23,850	166,051	3,669,139	-	64,341	-	221,372	4,120,903
16-Jul	142,589	23,850	166,439	3,703,109	-	66,950	-	224,889	4,161,387
17-Jul	142,874	23,850	166,724	3,731,124	-	69,851	-	233,982	4,201,681
18-Jul	143,101	23,850	166,951	3,767,044	-	75,464	-	242,921	4,252,380

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Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All species Total
19-Jul	143,530	23,850	167,380		54,044	77,946	-	247,296	4,313,710
20-Jul	143,851	23,850	167,701	-	87,418	81,218	283	256,112	4,359,776
21-Jul	144,092	23,850	167,942	-	101,330	84,780	283	267,646	4,389,025
22-Jul	144,092	23,850	167,942	-	111,102	86,296	490	279,021	4,411,895
23-Jul	144,092	23,850	167,942	-	126,221	90,516	858	281,584	4,434,165
24-Jul	144,092	23,850	167,942	-	140,644	92,908	858	295,454	4,464,850
25-Jul	144,563	23,850	168,413	-	155,492	95,679	1,350	304,847	4,492,825
26-Jul	144,923	23,850	168,773	-	166,898	97,665	1,466	315,453	4,517,299
27-Jul	144,923	23,850	168,773	-	174,457	98,573	1,773	334,738	4,545,358
28-Jul	144,923	23,850	168,773	-	183,058	99,117	1,944	346,155	4,566,091
29-Jul	144,923	23,850	168,773	-	217,866	101,037	2,877	364,494	4,622,091
30-Jul	144,923	23,850	168,773	-	299,650	102,068	4,598	373,956	4,716,089
31-Jul	144,923	23,850	168,773	-	352,644	104,270	7,241	383,994	4,783,966
1-Aug	144,923	23,850	168,773	-	394,186	106,268	8,463	415,101	4,859,835
2-Aug	144,923	23,850	168,773	-	428,854	107,950	9,482	442,703	4,924,806
3-Aug	144,923	23,850	168,773	-	451,388	108,257	14,419	460,949	4,970,830
4-Aug	144,923	23,850	168,773	-	467,826	111,234	15,906	475,232	5,006,015
5-Aug	145,553	23,850	169,403	-	472,909	112,287	16,917	492,652	5,031,212
6-Aug	145,553	23,850	169,403	-	477,845	112,727	19,219	505,632	5,051,870
7-Aug	145,553	23,850	169,403	-	486,686	113,220	21,396	521,675	5,079,424
8-Aug	145,553	23,850	169,403	-	495,223	113,971	24,352	545,560	5,115,553
9-Aug	145,553	23,850	169,403	-	503,493	114,531	27,739	569,262	5,151,472
10-Aug	145,553	23,850	169,403	-	509,388	114,985	29,907	588,542	5,179,269
11-Aug	145,553	23,850	169,403	-	517,427	115,049	31,674	603,077	5,203,674
12-Aug	145,553	23,850	169,403	-	522,447	115,108	34,207	617,323	5,225,532
13-Aug	145,553	23,850	169,403	-	525,505	115,489	37,853	625,918	5,241,212
14-Aug	145,553	23,850	169,403	-	565,385	115,489	39,572	640,814	5,297,707
15-Aug	145,553	23,850	169,403	-	638,108	115,489	42,051	664,639	5,396,734
16-Aug	145,553	23,850	169,403	-	656,684	115,501	43,294	681,945	5,433,871
17-Aug	145,553	23,850	169,403	-	665,234	115,510	47,130	700,508	5,464,829
18-Aug	145,553	23,850	169,403	-	675,949	115,527	52,154	722,077	5,502,154
19-Aug	145,553	23,850	169,403	-	689,369	115,624	62,191	729,956	5,533,587
20-Aug	145,553	23,850	169,403	-	706,739	115,624	67,608	742,516	5,568,934
21-Aug	145,553	23,850	169,403	-	714,413	115,624	71,839	771,257	5,609,580
22-Aug	145,553	23,850	169,403	-	738,816	115,624	78,030	797,981	5,666,898
23-Aug	145,553	23,850	169,403	-	743,715	115,624	91,148	804,375	5,691,309
24-Aug	145,553	23,850	169,403	-	747,619	115,624	100,479	811,630	5,711,799
25-Aug	145,553	23,850	169,403	-	756,842	115,624	104,762	824,898	5,738,573
26-Aug	145,553	23,850	169,403	-	763,987	115,624	108,097	836,725	5,760,880
27-Aug	145,553	23,850	169,403	-	767,274	115,624	115,987	845,259	5,780,591
28-Aug	145,553	23,850	169,403	-	770,529	115,624	121,139	850,399	5,794,138
29-Aug	145,553	23,850	169,403	-	776,743	115,624	123,519	860,750	5,813,083
30-Aug	145,553	23,850	169,403	-	784,532	115,624	127,411	871,243	5,835,257
31-Aug	145,553	23,850	169,403	-	790,563	115,624	131,919	875,899	5,850,452

Note: Estimates for fall chum, coho and other species are considered conservative and may not include the entire run.

Appendix F2.–Daily cumulative run proportions and timing by species, 2006. 25th, 50th, and 75th percentile are in bold.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All species Total
5-Jun	-	-	-	-	-	-	-	0.00	3,036
6-Jun	-	-	-	-	-	-	-	0.01	6,873
7-Jun	-	-	-	-	-	-	-	0.01	9,559
8-Jun	0.00	-	0.00	0.00	-	-	-	0.02	19,274
9-Jun	0.00	-	0.00	0.00	-	-	-	0.03	27,980
10-Jun	0.01	-	0.01	0.00	-	-	-	0.03	40,953
11-Jun	0.01	-	0.01	0.01	-	-	-	0.04	55,156
12-Jun	0.01	0.01	0.01	0.01	-	-	-	0.04	73,958
13-Jun	0.01	0.01	0.01	0.01	-	-	-	0.04	94,211
14-Jun	0.02	0.01	0.02	0.02	-	-	-	0.05	116,826
15-Jun	0.02	0.01	0.02	0.02	-	-	-	0.06	148,372
16-Jun	0.02	0.01	0.02	0.04	-	-	-	0.06	214,483
17-Jun	0.04	0.03	0.04	0.08	-	-	-	0.07	354,622
18-Jun	0.11	0.06	0.10	0.15	-	-	-	0.07	632,122
19-Jun	0.13	0.13	0.13	0.22	-	-	-	0.07	897,176
20-Jun	0.17	0.15	0.17	**0.28**	-	-	-	0.08	1,135,691
21-Jun	0.19	0.19	0.19	0.32	-	-	-	0.08	1,289,621
22-Jun	0.21	0.21	0.21	0.35	-	0.01	-	0.08	1,437,245
23-Jun	0.24	**0.27**	**0.25**	0.40	-	0.01	-	0.09	1,633,371
24-Jun	**0.27**	0.32	0.28	0.44	-	0.01	-	0.09	1,771,345
25-Jun	0.33	0.34	0.33	0.48	-	0.02	-	0.10	1,943,409
26-Jun	0.48	**0.53**	0.49	**0.56**	-	0.03	-	0.10	2,283,051
27-Jun	**0.53**	0.57	**0.54**	0.61	-	0.04	-	0.11	2,497,053
28-Jun	0.59	0.60	0.59	0.66	-	0.05	-	0.12	2,701,742
29-Jun	0.67	0.66	0.67	0.70	-	0.07	-	0.13	2,856,668
30-Jun	**0.76**	0.71	**0.76**	0.74	-	0.09	-	0.13	3,023,016
1-Jul	0.80	**0.78**	0.80	**0.77**	-	0.13	-	0.14	3,186,581
2-Jul	0.83	0.84	0.83	0.81	-	0.16	-	0.14	3,317,769
3-Jul	0.84	0.87	0.85	0.83	-	0.22	-	0.15	3,433,120
4-Jul	0.88	0.88	0.88	0.86	-	**0.28**	-	0.15	3,555,914
5-Jul	0.89	0.94	0.90	0.88	-	0.33	-	0.16	3,660,272
6-Jul	0.90	0.94	0.91	0.90	-	0.35	-	0.17	3,726,641
7-Jul	0.90	0.95	0.91	0.92	-	0.36	-	0.17	3,799,559
8-Jul	0.91	0.97	0.92	0.93	-	0.37	-	0.19	3,856,386
9-Jul	0.92	0.99	0.93	0.93	-	0.42	-	0.20	3,899,535
10-Jul	0.93	0.99	0.94	0.94	-	0.47	-	0.21	3,952,124
11-Jul	0.94	1.00	0.95	0.95	-	0.48	-	0.23	4,007,189
12-Jul	0.95	1.00	0.96	0.96	-	**0.50**	-	0.23	4,043,695
13-Jul	0.96	1.00	0.96	0.97	-	0.52	-	0.24	4,071,840
14-Jul	0.97	1.00	0.97	0.97	-	0.54	-	**0.25**	4,099,352
15-Jul	0.98	1.00	0.98	0.97	-	0.56	-	0.25	4,120,903
16-Jul	0.98	1.00	0.98	0.98	-	0.58	-	0.26	4,161,387
17-Jul	0.98	1.00	0.98	0.99	-	0.60	-	0.27	4,201,681
18-Jul	0.98	1.00	0.99	1.00	-	0.65	-	0.28	4,252,380

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Appendix F2.–Page 2 of 2.

Date	Large Chinook	Small Chinook	Total Chinook	Summer Chum	Fall Chum	Pink	Coho	Other	All species Total
19-Jul	0.98	1.00	0.99		0.07	0.67	-	0.28	4,313,710
20-Jul	0.99	1.00	0.99	-	0.11	0.70	0.00	0.29	4,359,776
21-Jul	0.99	1.00	0.99	-	0.13	0.73	0.00	0.31	4,389,025
22-Jul	0.99	1.00	0.99	-	0.14	**0.75**	0.00	0.32	4,411,895
23-Jul	0.99	1.00	0.99	-	0.16	0.78	0.01	0.32	4,434,165
24-Jul	0.99	1.00	0.99	-	0.18	0.80	0.01	0.34	4,464,850
25-Jul	0.99	1.00	0.99	-	0.20	0.83	0.01	0.35	4,492,825
26-Jul	1.00	1.00	1.00	-	0.21	0.84	0.01	0.36	4,517,299
27-Jul	1.00	1.00	1.00	-	0.22	0.85	0.01	0.38	4,545,358
28-Jul	1.00	1.00	1.00	-	0.23	0.86	0.01	0.40	4,566,091
29-Jul	1.00	1.00	1.00	-	**0.28**	0.87	0.02	0.42	4,622,091
30-Jul	1.00	1.00	1.00	-	0.38	0.88	0.03	0.43	4,716,089
31-Jul	1.00	1.00	1.00	-	0.45	0.90	0.05	0.44	4,783,966
1-Aug	1.00	1.00	1.00	-	**0.50**	0.92	0.06	0.47	4,859,835
2-Aug	1.00	1.00	1.00	-	0.54	0.93	0.07	**0.51**	4,924,806
3-Aug	1.00	1.00	1.00	-	0.57	0.94	0.11	0.53	4,970,830
4-Aug	1.00	1.00	1.00	-	0.59	0.96	0.12	0.54	5,006,015
5-Aug	1.00	1.00	1.00	-	0.60	0.97	0.13	0.56	5,031,212
6-Aug	1.00	1.00	1.00	-	0.60	0.97	0.15	0.58	5,051,870
7-Aug	1.00	1.00	1.00	-	0.62	0.98	0.16	0.60	5,079,424
8-Aug	1.00	1.00	1.00	-	0.63	0.99	0.18	0.62	5,115,553
9-Aug	1.00	1.00	1.00	-	0.64	0.99	0.21	0.65	5,151,472
10-Aug	1.00	1.00	1.00	-	0.64	0.99	0.23	0.67	5,179,269
11-Aug	1.00	1.00	1.00	-	0.65	1.00	0.24	0.69	5,203,674
12-Aug	1.00	1.00	1.00	-	0.66	1.00	**0.26**	0.70	5,225,532
13-Aug	1.00	1.00	1.00	-	0.66	1.00	0.29	0.71	5,241,212
14-Aug	1.00	1.00	1.00	-	0.72	1.00	0.30	0.73	5,297,707
15-Aug	1.00	1.00	1.00	-	**0.81**	1.00	0.32	**0.76**	5,396,734
16-Aug	1.00	1.00	1.00	-	0.83	1.00	0.33	0.78	5,433,871
17-Aug	1.00	1.00	1.00	-	0.84	1.00	0.36	0.80	5,464,829
18-Aug	1.00	1.00	1.00	-	0.86	1.00	0.40	0.82	5,502,154
19-Aug	1.00	1.00	1.00	-	0.87	1.00	0.47	0.83	5,533,587
20-Aug	1.00	1.00	1.00	-	0.89	1.00	**0.51**	0.85	5,568,934
21-Aug	1.00	1.00	1.00	-	0.90	1.00	0.54	0.88	5,609,580
22-Aug	1.00	1.00	1.00	-	0.93	1.00	0.59	0.91	5,666,898
23-Aug	1.00	1.00	1.00	-	0.94	1.00	0.69	0.92	5,691,309
24-Aug	1.00	1.00	1.00	-	0.95	1.00	**0.76**	0.93	5,711,799
25-Aug	1.00	1.00	1.00	-	0.96	1.00	0.79	0.94	5,738,573
26-Aug	1.00	1.00	1.00	-	0.97	1.00	0.82	0.96	5,760,880
27-Aug	1.00	1.00	1.00	-	0.97	1.00	0.88	0.97	5,780,591
28-Aug	1.00	1.00	1.00	-	0.97	1.00	0.92	0.97	5,794,138
29-Aug	1.00	1.00	1.00	-	0.98	1.00	0.94	0.98	5,813,083
30-Aug	1.00	1.00	1.00	-	0.99	1.00	0.97	0.99	5,835,257
31-Aug	1.00	1.00	1.00	-	1.00	1.00	1.00	1.00	5,850,452

Note: Estimates for fall chum, coho and other species are considered conservative and may not include the entire run.

APPENDIX G

Appendix G1.–Yukon River sonar project passage estimates, 1995, 1997–2006[a].

Species	2006 Passage Estimate	2006 lower 90% C.I.	2006 upper 90% C. I.	2005 [b]	2004	2003	2002	2001[c]	2000	1999	1998	1997 [d]	1995
				Passage Estimates									
Large Chinook [e]	145,553	124,405	166,701	142,007	110,236	245,037	92,584	85,511	39,233	127,809	71,177	118,121	130,271
Small Chinook	23,850	18,370	29,330	17,434	46,370	23,500	30,629	13,892	5,195	16,914	16,675	77,526	32,674
Chinook Total	169,403	147,557	191,249	159,441	156,606	268,537	123,213	99,403	44,428	144,723	87,852	195,647	162,945
Summer Chum	3,767,044	3,607,810	3,926,278	2,439,616	1,357,826	1,168,518	1,088,463	441,450	456,271	973,708	826,385	1,415,641	3,556,445
Fall Chum [f]	790,563	727,848	853,278	1,813,589	594,060	889,778	326,858	376,182	247,935	379,493	372,927	506,621	1,053,245
Chum Total	4,557,607	4,386,467	4,728,747	4,253,205	1,951,886	2,058,296	1,415,321	817,632	704,206	1,353,201	1,199,312	1,922,262	4,609,690
Coho [f]	131,919	112,381	151,457	184,718	188,350	269,081	122,566	137,769	175,421	62,521	136,906	104,343	101,806
Pink	115,624	98,206	133,042	37,932	243,375	4,656	64,891	665	35,501	1,801	66,751	2,379	24,604
Other Species [g]	875,899	783,367	968,431	593,248	637,257	502,878	557,779	353,431	361,222	465,515	277,566	621,857	1,011,855
Season Total	5,850,452			5,228,544	3,177,474	3,103,448	2,283,770	1,408,900	1,320,778	2,027,761	1,768,387	2,846,488	5,910,900

[a] Estimates for all years were generated with the most current apportionment model and may differ from earlier estimates.
[b] Estimates include extrapolations for the dates June 10 to June 18 to account for the time before the DIDSON was deployed.
[c] Record high water levels were experienced at Pilot Station in 2001, and therefore passage estimates are considered conservative.
[d] The Yukon River sonar project did not operate at full capacity in 1996 and therefore there are no passage estimates.
[e] Chinook salmon >655 mm.
[f] This estimate may not include the entire run.
[g] Includes sockeye salmon, cisco, whitefish, sheefish, burbot, suckers, Dolly Varden, and northern pike.

APPENDIX H

Appendix H1.–Results of simulated passage estimates after removing duplicate 5.25" and 6.5" drifts.

Species	Year	Duplicates Removed	Total Passage	SE	CV	90% CI Lower	90% CI Upper
Chinook >655 mm	2003	Period 1	245,932	37,377	0.152	184,447	307,417
		Period 2	256,545	49,297	0.192	175,452	337,638
		None	245,037	16,006	0.065	218,706	271,368
	2004	Period 1	124,118	12,358	0.100	103,789	144,447
		Period 2	117,077	40,645	0.347	50,216	183,938
		None	110,236	9,219	0.084	95,070	125,402
Small Chinook	2003	Period 1	20,350	14,331	0.704	0	43,924
		Period 2	22,197	16,695	0.752	0	49,661
		None	23,500	3,648	0.155	17,500	29,500
	2004	Period 1	41,825	5,820	0.139	32,251	51,399
		Period 2	49,189	36,505	0.742	0	109,240
		None	46,370	4,223	0.091	39,424	53,316
Summer Chum	2003	Period 1	1,167,071	54,398	0.047	1,077,587	1,256,555
		Period 2	1,156,812	67,329	0.058	1,046,056	1,267,568
		None	1,168,518	37,933	0.032	1,106,119	1,230,917
	2004	Period 1	1,320,666	35,123	0.027	1,262,888	1,378,444
		Period 2	1,342,647	53,010	0.039	1,255,446	1,429,848
		None	1,357,826	31,486	0.023	1,306,032	1,409,620
Pink	2003	Period 1	5,396	1,842	0.341	2,366	8,426
		Period 2	3,782	1,184	0.313	1,834	5,730
		None	4,656	1,273	0.273	2,562	6,750
	2004	Period 1	258,454	25,282	0.098	216,865	300,043
		Period 2	255,380	28,755	0.113	208,079	302,681
		None	243,375	22,453	0.092	206,440	280,310
Other	2003	Period 1	506,361	28,494	0.056	459,488	553,234
		Period 2	505,113	44,031	0.087	432,682	577,544
		None	502,878	24,583	0.049	462,438	543,318
	2004	Period 1	649,982	34,003	0.052	594,046	705,918
		Period 2	630,769	50,349	0.080	547,945	713,593
		None	637,257	31,618	0.050	585,245	689,269