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Sonar Estimation of Salmon Passage in the Yukon River Near Pilot Station, Alaska, 2023

by

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and

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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 alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

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. 25-49

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by
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ABSTRACT

The Pilot Station sonar project has provided daily passage estimates of Chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), and coho (*O. kisutch*) salmon for most years since 1986. Fish passage estimates for each species were generated in 2023 using a 2-component process: (1) estimation of total fish passage with 120 kHz split-beam sonar and an adaptive resolution imaging sonar, and (2) apportionment to species by sampling using a suite of gillnets of various mesh sizes. An estimated 1,884,891 fish passed through the sonar sampling area between June 7 and September 7. Of those fish, 287,268 passed along the right bank, and 1,597,623 passed along the left bank. Included, with 90% confidence intervals, were 45,026 ± 13,756 large Chinook salmon (>655 mm mid eye to tail fork [METF]), 13,503 ± 4,045 small Chinook salmon (≤655 mm METF), 845,988 ± 35,973 summer chum salmon, 370,015 ± 21,643 fall chum salmon, 49,697 ± 7,610 coho salmon, 5,857± 2,504 sockeye salmon, 9,735 ± 3,557 pink salmon, 222,517 ± 28,528 cisco, 224,048 ± 18,714 humpback whitefish, 30,473 ± 6,771 broad whitefish, 42,883 ± 8,146 sheefish, and 25,149 ± 4,417 other species.

Keywords: Chinook salmon *Oncorhynchus tshawytscha*, chum salmon *O. keta,* coho salmon *O. kisutch*, hydroacoustic, split-beam sonar, riverine, sonar, run strength, species apportionment, net selectivity, adaptive resolution imaging sonar, ARIS, Yukon River

INTRODUCTION

BACKGROUND

Within Alaska, Chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), and coho (*O. kisutch*) salmon are managed inseason for harvest by commercial, subsistence, and sport fisheries within the Alaska portion of the Yukon River drainage (Figure 1), as well as to meet treaty obligations made under the U.S./Canada *Yukon River Salmon Agreement*. The diversity and number of fish stocks, and the geographic range of user groups, add complexity to management decisions. Escapement estimates and run strength indices are generated by various projects within the drainage, 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 multichannel environment, gear selectivity, environmental conditions, and changes in net site characteristics.

The Pilot Station sonar project has provided daily salmon passage estimates, run timing, and biological information to fishery managers for most years since 1986. The project is located at river km 197 in a single-channel environment near the village of Pilot Station. This location is upriver enough to avoid the multiple-channel environment of the Yukon River Delta. The project provides timely abundance information to managers because travel time for salmon from the mouth of the river to the sonar site is 2 to 3 days. The Andreafsky River is the only major salmon spawning tributary downstream of the sonar site, and most migrating salmon in the Yukon River pass the sonar project on their way to the spawning grounds (Figure 1).

The primary role of the Alaska Department of Fish and Game (ADF&G) 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 and chum salmon stocks is to meet escapement requirements that will ensure sufficient fish availability for sustained future harvests in both the United States and Canada. Furthermore, managers follow guidelines specified by Alaska regulations through management plans for Yukon River Chinook, summer chum, fall chum, and coho salmon. Accurate daily salmon abundance estimates help managers regulate fishing during the season to meet harvest and escapement objectives, and are also used postseason to determine whether treaty obligations were met and judge the effects of management actions.

Since its inception, the Pilot Station sonar project has undergone many changes in equipment and methodology. Prior to 1993, ADF&G used dual-beam sonar equipment that operated at 420 kHz. In 1993, ADF&G replaced the existing sonar equipment with a new model that operated at a frequency of 120 kHz, allowing for a greater ensonification range by reducing signal loss. This modification helped increase fish detection at longer ranges (Fleischman et al. 1995). The newly configured performance of the equipment was verified using standard acoustic targets in the field.

Until 1995, ADF&G attempted to identify the direction of travel of detected targets by aiming transducers at an oblique angle relative to fish travel, either upstream or downstream. This technique was discontinued in 1995 in favor of aiming transducers perpendicular to fish travel to maximize fish detection (Maxwell et al. 1997). Due to this change and subsequent changes to counting procedures, data collected from 1995 to 2023 are not directly comparable to previous years. In 2001, the equipment was changed from dual-beam to the current split-beam sonar system, configured to operate at 120 kHz (Pfisterer et al. 2002). Reference to the use of dual-beam sonar at the Pilot Station sonar project can be found in Rich 2001. The split-beam technology can estimate the 3-dimensional position of a target in space, allowing the testing of assumptions about the direction of travel and vertical distribution of fish moving through the acoustic beam (Burwen et al. 1995).

A series of gillnets using different mesh sizes were drifted through the acoustic sampling areas to apportion the passage estimates to species. In 2004, the selectivity model used in species apportionment was refined through biometric review and analysis of historical catch data from the project's test fishery. The model that provided the best overall fit to the data was a Pearson model with a tangle parameter (Bromaghin 2004). In 2016, minimum selectivity thresholds were implemented in the model for species apportionment to prevent individual fish from skewing estimates dramatically (Pfisterer et al. 2017). The selectivity parameters used in the species apportionment model were updated using the most current catch data prior to the 2023 field season. Species proportions and passage estimates reported in this document were generated using this apportionment model and are comparable to 1995–2022 estimates, because estimates from those years have been regenerated using the most current model.

Early in the 2005 season, the Yukon River experienced high water levels and erosion, resulting in the formation of a cut bank and steepening of the bottom profile on the left bank. The altered bottom profile allowed fish near the shore to swim under the beam, compromising detection. On June 9, 2005, a multibeam dual-frequency identification sonar (DIDSON; Belcher et al. 2002; Lozori 2023) was deployed to verify nearshore fish detection. The wider beam angle, video-like images, and software algorithms that can remove the bottom structure from the image allowed the DIDSON system to detect fish passage within 20 m despite high water levels and problematic erosion. It was operated for the remainder of the season, supplanting split-beam counts in this section of the nearshore region. From 2005 to 2014, the DIDSON was integrated into the sampling routine on the left bank and operated side by side with the split-beam sonar. The DIDSON sampled the first 20 m of the left bank nearshore strata, and the split-beam sampled the remainder of the range. Beginning in 2015, the DIDSON was replaced with an adaptive resolution imaging sonar (ARIS), and the counting range was increased to 40 m (Schumann et al. 2017).

In 2008, electronic charts were tested prior to the switch from paper charts used to count fish traces. Electronic charts were found to provide many advantages, including a finer gradient of threshold levels, better consistency (no ribbons that fade), less downtime related to paper jams, and the ability to easily determine the direction of travel. In 2009, electronic echograms replaced paper charts to count fish traces (Lozori and McIntosh 2013).

For consistency with prior years when paper charts were used, all targets up and downstream were counted from 2010 to 2019 by right-clicking the computer mouse on downstream targets and left-clicking on upstream targets. In 2020, a review of data from 2010 to 2019 determined that the overall percentage of downstream targets observed was insignificant compared to the total passage estimates, and counting downstream targets was discontinued (Morrill et al. 2021).

This report presents results from the Lower Yukon River sonar project for the 2023 field season. Included are data from an extension in project operations 1 week past the normal end date. Although funding was provided for operations to begin 1 week early by the Yukon River Panel, river conditions delayed early operations. The sonar operated from June 7 until September 7, 2023.

OBJECTIVES

The primary goal of this project was to estimate daily fish passage by species during upstream migration past the sonar site.

The primary project objective was as follows:

1. Provide fishery managers with daily and cumulative passage estimates and associated confidence intervals of adult Chinook, chum, and coho salmon.

The secondary project objectives were as follows:

1. Collect biological data from all fish captured in the test fishery, including species, sex, length, and scales, as appropriate.
2. Collect Chinook and chum salmon tissue samples for separate genetic stock identification projects.
3. Collect water temperature data representative of the ensonified areas of the river.

STUDY SITE

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. The village of Pilot Station and the ADF&G sonar camp are on the right bank.

At the sonar site, the Yukon River is approximately 1,000 m wide between the left and right bank transducers (Figure 2). The left bank substrate, made of silt and fine sand, drops off gradually at a vertical angle of approximately 2° to 3°. The right bank has a stable, rocky bottom that drops off uniformly to the thalweg at a vertical angle of approximately 7° (Figure 3). The thalweg is approximately 25 m deep and approximately 200 m offshore of the right bank (Figure 4). River discharge, as observed from 2013 to 2022 at the United States Geological Survey (USGS) gauging station[1] located downstream of the project, has ranged from a maximum of 23,219 m^3/s to a minimum of 7,787 m^3/s from June 1 through September 7 (Figure 5).

[1] USGS (U.S. Geological Survey), National Water Information System: Web Interface. USGS 15565447 Yukon River at Pilot Station Alaska. USGS Surface Water data for USA: USGS Annual Statistics (cited April 1, 2024; accessed October 7, 2025)

METHODS

Daily upstream migration of targeted fish species is estimated by multiplying the daily sonar passage of all species by the daily proportions of each targeted fish species that are estimated from the drift gillnet test fishery conducted in the same area as the sonar (Figure 6). Test fishing and sonar sampling were stratified temporally and physically. Temporal stratification occurs through multiple test fishing and sonar periods per day (Table 1). The physical stratification for test fishery sampling was accomplished using different fishing zones, and for sonar sampling by dividing the right bank into 2 range strata (S1 and S2) and dividing the left bank into 3 strata (S3, S4, and S5; Figure 7).

HYDROACOUSTIC DATA ACQUISITION

Equipment

Left bank sonar equipment included the following:

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.
2. An HTI 120 kHz split-beam transducer with a 2.8° x 10° nominal beam width.
3. A 250 ft (76.2 m) HTI split-beam transducer cable connects the sounder to the transducer.
4. An ARIS Explorer 1200 unit equipped with a telephoto lens, configured to transmit and receive at 0.7 MHz and controlled via software installed on a laptop.
5. A 150 m ARIS underwater cable connecting the ARIS to the command module and laptop.

Right bank sonar equipment included the following:

1. An HTI Model 244 echosounder configured to operate at 120 kHz, controlled via DEP software installed on a laptop.
2. An HTI split-beam 120 kHz transducer with a 6° x 10° nominal beam width.
3. Three 250 ft (228.6 m combined length) HTI split-beam cables connect the sounder to the transducer.

The HTI Model 244 echosounders were ideal for the project due to their configurability and power. The echosounders were set to transmit and receive at 120 kHz, which was necessary to achieve the sampling ranges. The vertical beam dimension for each split-beam transducer was chosen to fit the water column between the bottom and surface with minimal interference, and the 10° horizontal width provided an adequate field of view. The lengths of cable were necessary for flexibility in the placement of the transducers. Transducers were mounted on metal tripods and remotely aimed using Remote Ocean Systems Model PT-25 rotators (Figure 8), which allows precision in aiming, especially at range with the split-beam sonar. Rotator movements were controlled using HTI Model 660-2 rotator controllers, which provided position feedback to the nearest 0.1°. The ARIS was ideal in the left bank nearshore stratum because it was much more robust to bottom and surface interference, and the telephoto lens was used to achieve the sampling range.

After recording echogram files, Echotastic software[2] was used to mark fish traces. Echograms and associated data were stored on a portable hard drive and transferred onto two 2-terabyte external hard drives.

Equipment Settings and Thresholds

The split-beam echosounders used a 40 log*R* time-varied gain (TVG) and 0.4 milliseconds (ms) transmit pulse duration during all sampling activities. The equipment automatically determined the receiver bandwidth based on the transmit pulse duration. On the left bank, the initial pulse repetition rate (ping rate) for S4 was set at 3 pings per second (pps), and S5 was set at 1.2 pps. On the right bank, the ping rate for S1 was set at 5 pps, and S2 was set at 3.5 pps (Table 2). On the left bank, S3 was sampled by the ARIS, which operated at an average rate of 4 frames per second.

The target sampling range of the ARIS was 0.7–50 m, depending on river conditions; however, in 2023, increased turbidity due to high water limited the end range to 45 m through the entire season. (Table 3). The digital sampling used by the split-beam sonar and ARIS does not threshold the data during collection; however, thresholds were applied to the electronic echogram files when viewed in Echotastic to reduce background noise and improve fish trace detection (Table 4). Thresholds were adjusted throughout the season depending on silt loads and other river conditions.

Aiming

Transducers were deployed on both the left and right banks in an area where the river is approximately 1,000 m wide. The transducers were positioned and aimed to maximize fish detection. Transducers were deployed in an area with the best bottom profile, and the beam was oriented approximately perpendicular to the current so that migrating fish would present the largest possible reflective surface. Because many fish travel close to the substrate, the maximum response angle of the beam was oriented slightly above the river bottom through as much of the range as possible. The right bank transducer was positioned as close to shore as possible, depending on the water level, adjusting the aim between S1 (0–40 m) and S2 (40–150 m). The left bank split-beam transducer was positioned as close to shore as possible (depending on the water level) and initially utilized 2 distinct aims to sample S4 (45–150 m) and S5 (150–300 m). The ARIS unit was normally deployed within 2 m of the split-beam transducer, and when conditions were favorable, ensonified S3 (0.7–45 m; Figure 7). The ARIS's wider beam angle was ideal for the less linear nature of the eroded left bank nearshore stratum, enabling it to detect fish targets throughout more of the water column than the narrower split-beam.

Fluctuating water levels required repositioning the transducers and subsequent re-aiming of the beams. The transducer was panned horizontally upstream and downstream approximately 15° off perpendicular, in 2° increments, to establish optimal aim. At each increment, the vertical tilt was adjusted to obtain the best possible bottom picture using an electronic echogram to confirm that the sonar beam was oriented slightly above the river bottom. The left bank transducers were re-aimed more often to compensate for the dynamic bottom conditions and continual changes associated with that bank. Once an optimal aim was obtained, the rotator settings were documented, and the auto-rotator settings were changed to the new optimal aim. Faulkner and Maxwell (2009) discuss aiming and sonar site selection protocols to count fish using side-looking sonar systems.

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2 Echotastic software. 2023. Version 3.0.14. Developed by Carl Pfisterer, ADF&G Division of Commercial Fisheries. (internal use only).

Sampling Procedures

Acoustic sampling was conducted simultaneously on both banks during three 3-hour periods each day (Table 1). Sample periods were 0530–0830, 1330–1630, and 2130–0030 hours, with strata alternating sequentially every 30 minutes.

Operators marked fish traces for the split-beam and the ARIS on electronic echograms using Echotastic (Figure 9). All personnel were trained to distinguish between valid upstream split-beam fish traces and non-target echoes. Echo traces were counted as a single fish if at least 2 pings in the cluster passed the threshold level, and the targets did not resemble inert downstream objects. Individuals within groups of fish were distinguishable when the apparent direction of movement of 1 fish trace differed from that of an adjacent trace.

Project leaders reviewed echograms daily to monitor the accuracy of the marked fish tracings and reduce individual biases. Each echogram was checked for indications of signal loss and changes to bottom reverberation markings, which could indicate either movement of the transducer or a change in the bottom profile. Data was checked daily for data entry or marking errors, then processed in the statistical software package *R*.[3]

SYSTEM ANALYSES

The performance of the split-beam hydroacoustic system was monitored following many of the procedures first established in 1995 (Maxwell et al. 1997). Monitoring of the ARIS included daily checks of sonar settings before each sampling period, routine checks of the water level near the transducers, verification of aim settings, and periodic cleaning of the transducer lens. 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. During the season, the fathometer was used regularly to monitor changing bottom conditions and to watch for the formation of sandbars capable of rerouting fish to unensonified areas.

Hydrological Measurements

Water discharge data were sourced from the real-time USGS gauging station located approximately 500 m downstream of Pilot Station and used throughout the season (Figure 5). HOBO water temperature loggers were deployed on June 7 to record water temperature on both banks and remained submerged until September 8. The data loggers were programmed to record the water temperature once every hour. Daily temperature was calculated as the mean of all recorded temperatures for the day.

SPECIES APPORTIONMENT

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 5). All nets were

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3 The R Project for statistical computing. R version 2023.06.01 (Mountain Hydrangea). (released June 01, 2023, cited March 29, 2024). Available for download from http://www.r-project.org/.

25 fathoms (45.7 m) long and approximately 8 m deep. All nets were constructed of shade 11 or equivalent, double knot multifilament nylon twine and hung "even" at a 2:1 ratio of web to corkline.

Test fishing began as soon as practical and continued through the last day of sonar operation. Test fishing was conducted twice daily between sonar periods from 0900 to 1200 hours and 1700 to 2000 hours (Table 1). On days of high subsistence fishing, only 1 test fishing period was conducted to prevent interference or overlap with the scheduled subsistence period or a sonar operation period. During each normal sampling period, 4 different mesh sizes drifted within each of 3 zones for 24 drifts per day, except when only 1 test fishing period was conducted in which all 6 mesh sizes were fished (Table 6). The order of drifts was (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 approximately 5 to 10 m offshore of the sonar transducers. The left bank offshore drift was approximately 65 m offshore of the transducers to avoid overlap with the nearshore drift. Drifts were approximately 8 minutes but were shortened as necessary to avoid snags or limit catches during high fish passage times.

Captured fish were identified to species, and length was measured to the nearest 1 mm. Salmon species lengths were measured from mid eye to tail fork (METF); nonsalmon species were measured from tip of snout to fork of tail (FL). Nonsalmon species captured and identified included cisco (*Coregonus* spp.), humpback whitefish (*C. pidschian*), broad whitefish (*C. nasus*), sheefish/inconnu (*Stenodus leucichthys*), burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), Dolly Varden (*Salvelinus malma*), and northern pike (*Esox lucius*). Sex was recorded only for salmon species and was determined by examination of internal (Chinook mortalities) and external features. Fish species, length, and sex were recorded on field data sheets. Each drift record included the date, sampling period, zone, drift start and end times, mesh size, length of net, and captain's initials. Handling mortalities among the captured fish were distributed to the local community, and fish dispersal was documented daily.

Four scale samples were collected from each Chinook salmon and mounted on scale cards, and fish and card numbers were recorded on the test fishery data sheets. Data were transferred from data sheets into a Microsoft Access database. Age, sex, and length (ASL) data are processed, analyzed, and reported annually by ADF&G staff based in Anchorage.[4]

Individual genetic tissue samples from Chinook and chum salmon were also collected in the form of an axillary process clip and placed in vials for several stock identification projects in conjunction with the test fishery portion of the project. ASL data were cross referenced with each tissue sample. The ADF&G Gene Conservation Laboratory[5] and the U.S. Fish and Wildlife Service (FWS) Conservation Genetics Laboratory (Flannery 2024) independently processed and analyzed these tissue samples.

Chinook salmon were classified as either large (>655 mm METF) or small (≤655 mm METF), and small Chinook salmon served as a proxy for jacks. The 655 mm length cutoff was derived from

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[4] Arctic–Yukon–Kuskokwim Database Management System (AYKDBMS). 2006– . Alaska Department of Fish and Game, Division of Commercial Fisheries. Juneau, AK. https://www.adfg.alaska.gov/CF_R3/external/sites/aykdbms_website/Default.aspx (accessed October 7, 2025).

[5] ADF&G (Alaska Department of Fish and Game). Yukon River Chinook Salmon Mixed Stock Analysis, Genetic Baseline. Available online: https://www.adfg.alaska.gov/index.cfm?adfg=fishinggeneconservationlab.yukonchinook_baseline (accessed October 7, 2025).

analysis of ASL data when it was determined that this was the average length separating 4- and 5-year-old Chinook salmon (Pfisterer and Maxwell 2000). Although there was 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 salmon, and those encountered after July 18 were designated as fall chum salmon.

ANALYTICAL METHODS

Daily estimates were produced from a multicomponent process that involved the following:

1. Hydroacoustic estimates of all fish targets passing the site and species composition derived from test fishery results were applied to the undifferentiated hydroacoustic estimates.
2. CPUE estimates were used as a separate index by the managers and calculated on a subset of the test fishery data.

Catch Per Unit Effort

CPUE estimates used as separate indexes by the managers, and not for species apportionment, were calculated for each day (*d*) and bank (*b*) using 2 gillnet suites (*g*) of specific size mesh sizes (*m*). Chinook salmon CPUE was calculated on the pooled catch (*c*) and effort (*f*) of the large mesh gillnets (7.5 inch and 8.5 inch); chum and coho salmon CPUE was calculated on the pooled catch and effort of the small mesh gillnets (5.25 inch, 5.75 inch, and 6.5 inch).

The duration of the test fishery drift (*j*) in minutes (*t*) was calculated as:

$$t_j = SI_j - FO_j + \frac{(FO_j - SO_j)}{2} + \frac{(FI_j - SI_j)}{2}, \tag{1}$$

where:

SO = the time the net is initially set out,

FO = the time the net is fully set out,

SI = the time the net starts back in, and

FI = 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:

$$e_{dbg} = \sum_m \frac{25 \cdot t_{dbgm}}{60}, \tag{2}$$

because 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:

$$CPUE_{dbig} = \frac{\sum_m c_{dbigm}}{e_{dbg}}. \tag{3}$$

Species Composition

Test fishery sampling was conducted on both banks to estimate the proportions of species. The right bank has only 1 zone (Z1), and the left bank was divided into 2 zones (Z2 [0–50 m] and Z3

[50–300 m]). In relation to acoustic sampling, Z1 corresponds to sonar strata S1 and S2, Z2 corresponds to S3, and Z3 corresponds to S4 and S5 (Figure 7). Test fishing was conducted twice daily between sonar periods; P1 was 0900–1200, and P2 was 1700–2000 hours. This was considered 2-stage systematic sampling in which CPUE of species (i) passing at zone (z) during period (p) of day (d) (C_{dzpi}) was considered the primary sampling unit of measurement.

CPUE of species (i) passing zone (z) during period (p) of day (d) (C_{dzpi}) was calculated by dividing the sum of the number of species (i) of length (l) caught by meshes (m) (c_{dzpilm}) by the sum of length selectivity adjusted efforts by meshes (m) (f_{dzpilm}) and then summed across all lengths:

$$C_{dzpi}=\sum_{l}\left(\frac{\sum_m c_{dzpilm}}{\sum_m f_{dzpilm}}\right), \tag{4}$$

where length selectivity adjusted effort f_{dzpilm} is calculated as:

$$f_{dzpilm}=S_{ilm}\cdot e_{dzpm}, \tag{5}$$

and S_{ilm} is the net selectivity of the species (i) of length (l) caught by mesh (m), and e_{dzpm} is the effort (in fathom-hours) calculated by multiplying the drift time (t) (in minutes) by 25 fathoms and dividing by 60 minutes per hour (Appendix A1; Bromaghin 2004):

$$e_{dzpm}=\frac{25\cdot t_{dzpm}}{60}. \tag{6}$$

A threshold was applied to prevent individual fish with extremely low selectivity from inflating the CPUE unreasonably, such that:

$$S_{ilm}=\begin{cases}S_{ilm} & S_{ilm}\geq 0.1\\ 0.1 & \text{otherwise}\end{cases}. \tag{7}$$

The proportion of species (i) passing zone (z) during period (p) of day (d) ($\hat{p}_{dzpi}$) and the proportion for day ($\hat{p}_{dzi}$):

$$\hat{p}_{dzpi}=\frac{C_{dzpi}}{\sum_i C_{dzpi}}\text{ and }\hat{p}_{dzi}=\frac{\sum_p C_{dzpi}}{\sum_p\sum_i C_{dzpi}}. \tag{8}$$

The variance of $\hat{p}_{dzi}$ was estimated from the squared differences between the proportion for each test fishery period within the day ($\hat{p}_{dzpi}$) and the proportion for the day as a whole ($\hat{p}_{dzi}$):

$$\widehat{Var}(\hat{p}_{dzi})=\frac{\sum_p\left(\hat{p}_{dzi}-\hat{p}_{dzip}\right)^2}{n_p(n_p-1)}, \tag{9}$$

where n_p is the number of test fishery sampling periods within the day. Equation 9 requires n_p to be greater than 1, and days with less than 1 test fishery period were pooled with adjacent days such that there were at least 2 complete test fishery periods.

Sonar Passage Estimates

Fish passage was estimated separately for each sonar stratum. Let y_{dpsk} be defined as 30-minute subsampling acoustic counts (k) at stratum (s) during periods (p) of day (d). The hourly passage rate per stratum and period was calculated:

$$r_{dps}=\frac{\sum_k y_{dpsk}}{\sum_k h_{dpsk}}, \tag{10}$$

where h_{dpsk} is the fraction of the hour sampled for sample (k). Daily passage was then estimated as:

$$\hat{y}_{ds}=24\ \frac{\sum_p r_{dsp}}{n_p}, \tag{11}$$

where n_p was the number of periods in the day. The variance of $\hat{y}_{ds}$ was estimated as:

$$\hat{V}(\hat{y}_{ds})=24^2\left(\frac{s^2}{n_p}\right)\left(1\text{-}\frac{h_{ds}}{24}\right), \tag{12}$$

where s^2 is the variance of the passage rate for the day:

$$s^2=\left(\frac{\sum_p\left(r_{dsp}\text{-}\bar{r}_{ds}\right)^2}{n_p\text{-}1}\right). \tag{13}$$

Fish Passage by Species

The final step in the estimation process was combining the sonar estimates with the estimates of species proportions to compute passage by species. To estimate passage by species within each sonar stratum, the passage for each stratum was multiplied by the species proportions for the test fishery zones as follows: test fishery S1 was applied to the entire counting range of the right bank (sonar strata S1 and S2 approximately 0–150 m). Test fishery Z2 was applied to the counting range corresponding to S3 (approximately 0–50 m on the left bank). Test fishery Z3 was applied to the counting range corresponding to S4 and S5 (approximately 50–150 m and 150–300 m; Figure 7). The passage of species (i) at stratum (s) for each day was estimated by multiplying total passage ($\hat{y}_{ds}$) and proportion ($\hat{p}_{dzi}$):

$$\hat{y}_{dis}=\hat{y}_{ds}\cdot\hat{p}_{dzi}, \tag{14}$$

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 was estimated as the variance of the product of 2 independent random variables (Goodman 1960):

$$\widehat{Var}(y_{dis})=\hat{y}_{ds}^2\cdot\widehat{Var}(\hat{p}_{dzi})+\hat{p}_{dzi}^2\cdot\widehat{Var}(\hat{y}_{ds})\text{-}\widehat{Var}(\hat{y}_{ds})\cdot\widehat{Var}(\hat{p}_{dzi}). \tag{15}$$

Daily passage and variance of each species are the sum over all sonar strata:

$$\hat{y}_{di}=\sum_s\hat{y}_{dis}\ and\ \widehat{Var}(\hat{y}_{di})=\sum_s\widehat{Var}(\hat{y}_{dis}). \tag{16}$$

Likewise, total passage and variance for the season of each species are the sum of the daily passage:

$$\hat{y}_i=\sum_d\hat{y}_{di}\ and\ \widehat{Var}(\hat{y}_i)=\sum_d\widehat{Var}(\hat{y}_{di}). \tag{17}$$

Assuming normally distributed errors, 90% confidence intervals are calculated as:

$$\hat{y}_i \pm 1.645\sqrt{\widehat{Var}(\hat{y}_i)}\,. \tag{18}$$

R program code (Carl Pfisterer, Division of Commercial Fisheries, AYK Regional Sonar Coordinator, ADF&G, Fairbanks) was used to calculate CPUE, passage estimates, and estimates of variance.

RESULTS

The Pilot Station sonar project was hindered by flooding caused by ice jams, below the village of St Mary's, which delayed arrival to the sonar site until June 01 to begin camp setup. Test fishing drift areas were dragged for snags and started on June 6, and test fishing began during P1 on June 7. The project was fully operational beginning with P2 sonar on June 7, and operations continued through September 7. Passage estimates were transmitted to fishery managers daily.

ENVIRONMENTAL AND HYDROLOGICAL CONDITIONS

Ice breakup on the Yukon River at Pilot Station occurred on May 25, which was 2 weeks later than the 10-year average of May 10 (Table 7). The water discharge near Pilot Station during the 2023 season was above the 10-year mean (2013–2022) through August 13, with levels rising above the maximum average from June 1 to June 28 (Figure 5). Mean daily water temperatures on the left bank ranged from 11.14°C to 19.3°C and from 10.9°C to 18.5°C on the right bank (Figure 10). Water temperatures fell mostly below the 10-year averages on both banks, rising above the averages from July 23 to August 18 on the right bank and from July 23 to August 25 on the left bank.

TEST FISHERY

Drift gillnetting resulted in the capture of 5,818 fish: 298 Chinook salmon (242 large and 56 small), 1,975 summer chum salmon, 1,385 fall chum salmon, 290 coho salmon, and 1,870 fish of other species. Of the captured fish, 2,099 (36%) were retained as mortalities and delivered to local users within the nearby community of Pilot Station (Table 8). Of the 298 Chinook salmon captured in the test fishery, scale samples were collected from 297 fish, and 261 were ageable.[6] Tissue samples for genetic stock identification were collected from 294 Chinook salmon and 3,346 chum salmon.

HYDROACOUSTIC ESTIMATES

An estimated 1,884,891 fish passed through the sonar sampling areas between June 7 and September 7. Of that total passage, 287,268 (approximately 15%) fish passed along the right bank, and 1,597,623 (approximately 85%) fish passed along the left bank (Table 9). Total fish passage estimates (with associated errors) by zone were calculated daily (Appendix C1). Approximately 90% of the fish passage occurred within 50 m of the transducers on both the left and right banks during the summer. During the fall season, 90% of the passage occurred within 50 m on the right bank and 90 m on the left (Figures 11–12).

[6] Arctic–Yukon–Kuskokwim Database Management System. 2006– . Pilot Station test fishery project information. https://www.adfg.alaska.gov/CF_R3/external/sites/aykdbms_website/OBIReportView.aspx?origin=~/ProjectInformation.aspx (cited April 1, 2024; accessed October 7, 2024).

SPECIES ESTIMATES

Fish passage estimates by species were generated daily and reported to fishery managers each morning (Appendix D1). Chinook salmon cumulative inseason passage estimates, with 90% confidence intervals, were 45,026 ± 13,756 large Chinook salmon (>655 mm METF) and 13,503 ± 4,045 small Chinook salmon (≤655 mm METF). Chum salmon cumulative passage estimates were 845,988 ± 35,973 summer chum salmon and 370,015 ± 21,643 fall chum salmon. Coho salmon cumulative passage estimate was 49,697 ± 7,610 fish, sockeye salmon (*O. nerka*) was 5,857± 2,504 fish, and pink salmon (*O. gorbuscha*) was 9,735 ± 3,557 fish. The cisco cumulative passage estimate was 222,517 ± 28,528 fish, humpback whitefish was 224,048 ± 18,714 fish, broad whitefish was 30,473 ± 6,771 fish, sheefish was 42,883 ± 8,146 fish, and other species (burbot, longnose sucker, Dolly Varden, and northern pike) was 25,149 ± 4,417 fish (Table 9).

The initial pulse of Chinook salmon began approximately June 17 (Figure 13); however, the front end of the Chinook salmon run had a consistent flow of "tricklers" that lasted for a week before the more distinctive first pulse arrived. The Chinook salmon estimate this season was the third lowest in all the years of project operations from 1995 to 2023.

The summer chum salmon estimate this season was the seventh lowest in all the years of project operations (1995–2023). Three pulses of summer chum salmon were detected at the sonar project; the largest group consisted of approximately 329,400 fish and passed by the sonar between July 10 and July 18.

Compared to the 2013–2022 historical mean run timing, the midpoint of the Chinook salmon run occurred 7 days late (July 1) and 6 days late (July 5) for summer chum salmon (Figure 14, Appendices E and F).

There were 4 fall chum salmon pulses that passed the sonar project after July 19, and 73% of the chum salmon arriving through July 31 were genetically summer chum salmon. After that, predominantly fall chum salmon entered the river, with peak daily passage occurring on August 9 (Figure 15). Genetic mixed stock analysis (MSA) from the Pilot Station sonar project test fishery was used to generate stock composition estimates of pulses, which were distributed during season to assist management decisions. Run timing for both fall chum and coho salmon was restricted to July 19–August 31 to allow a more meaningful comparison with years that did not operate into September. The midpoint for the fall chum salmon run was August 9, which was 5 days early compared to 2013–2022 mean cumulative run timing (Figure 16, Appendices E and F).

There was low coho salmon passage until the first significant pulse on August 11 (Figure 15). As in most years, the project ended before the coho salmon run was complete; estimates were therefore considered conservative, and the timing may not reflect the total run. The midpoint for the coho salmon run was August 24, which was 1 day late compared to the 2013–2022 mean cumulative run timing (Figure 16, Appendices E and F).

MISSING DATA

Initially, there were 12 days (between June 6 and June 17) with insufficient catches in at least 1 fishing zone, which necessitated pooling days to ensure reasonable species apportionment (Table 10). There were 63 days with insufficient catches, primarily in the offshore zone on the left bank (Z3). Unlike in past years, there were no commercial fisheries this season that affected the species apportionment test fishery, which would have necessitated pooling days.

DISCUSSION

Optimal aiming of the sonar beam is essential for detecting fish on both banks. The rocky substrate found on the right bank is less dynamic than the silty bottom of the left bank and, therefore, has little or no change in profile throughout the season. Upon deployment on the left bank, high water, silt attenuation, and an eroded nearshore substrate hampered the ARIS's ability to detect fish beyond 25 m. A spreader lens was installed to increase the vertical beam from 3° to approximately 14°, accommodating the uneven bottom profile and high water levels. Additionally, the end range in stratum S3 was reduced from 50 m to 45 m, the range in S4 was changed to cover 45–150 m, and S5 covered 150–300 m for the duration of the season. The spreader lens was removed on August 5 once the water level dropped to a near-average level. The higher water levels made deployment of the sonar and gillnets challenging, but there was no reason to believe that this affected the ability to estimate the fish passage.

Historically, there have been alternating years of high pink salmon abundance. The 20-year pink salmon average passage estimate during even years was 560,707 fish, and the odd-year average was 53,334 fish (Appendix G1). Because pink salmon distributions are generally close to the sonar transducers and inaccessible to the test fishery, there are concerns of misapportionment during high pink salmon abundance, and the start range of the sonars was extended to exclude a portion of the pink salmon passage (Lozori 2020). This year's average was below the odd-year average, and sonar ranges were not adjusted to exclude a portion of the pink salmon migration. Therefore, the total estimated pink salmon passage should not be considered conservative because most of the run was sampled.

Although there were a few problems this season, estimating fish passage on the Yukon River presents major technical and logistic challenges. The sampling environment is often demanding due to the extremely dynamic nature of the water level, turbidity, bottom substrate, and range-dependent signal loss. The hydroacoustic systems employed at the Pilot Station sonar project were effective in detecting migrating salmon; however, successful estimation depended on constant attention to the frequent changes and diligent rechecking of every part of the acoustic and environmental systems. In 2023, all project goals were met, and passage estimates were given to fisheries managers daily during the season. The information generated by the Pilot Station sonar project was also disseminated weekly through multiagency international teleconferences and data sharing with stakeholders in areas ranging from the Lower Yukon River to the spawning grounds in Canada.

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REFERENCES CITED

Belcher, E. O., W. Hanot, and J. Burch. 2002. Dual-frequency identification sonar. Proceedings of the 2002 International Symposium on underwater technology, April 16–19, 2002, Tokyo, Japan.

Bromaghin, J. F. 2004. An evaluation of candidate net selectivity models for 1990–2003 Yukon River sonar gill-net catch data. U.S. Fish and Wildlife Service, Alaska Fisheries Technical Report Number 75, Anchorage.

Burwen, D. L., D. E. Bosh, and S. J. Fleischman. 1995. Evaluation of hydroacoustic assessment techniques for Chinook salmon on the Kenai River using split-beam sonar. Alaska Department of Fish and Game, Fishery Data Series No. 95-45, Anchorage.

Faulkner, A. V., and S. L. Maxwell. 2009. An aiming protocol for fish-counting sonars using river bottom profiles from a dual-frequency identification sonar (DIDSON). Alaska Department of Fish and Game, Fishery Manuscript No. 09-03, Anchorage.

Flannery, B. G. 2024. Application of mixed-stock analysis for Yukon River chum salmon. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report for Study 20-201, Anchorage, Alaska.

Fleischman, S. J, D. C. Mesiar, and P. A. Skvorc II. 1995. Lower Yukon River sonar project report 1993. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A95-33, Anchorage.

Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association 55:708–713.

Lozori, J. D. 2020. Sonar estimation of salmon passage in the Yukon River near Pilot Station, 2010. Alaska Department of Fish and Game, Fishery Data Series No. 20-13, Anchorage.

Lozori, J. D. 2023. Sonar estimation of salmon passage in the Yukon River near Pilot Station Alaska, 2002–2005. Alaska Department of Fish and Game, Fishery Data Series No. 23-37, Anchorage.

Lozori, J. D., and B. C. McIntosh. 2013. Sonar estimation of salmon passage in the Yukon River near Pilot Station, 2009. Alaska Department of Fish and Game, Fishery Data Series No. 13-28, Anchorage.

Maxwell, S. L., D. C. Huttunen, and P. A. Skvorc II. 1997. Lower Yukon River sonar project report 1995. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A97-24, Anchorage.

Morrill, R. P., K. T. Wiglesworth, and J. D. Lozori. 2021. Sonar estimation of salmon passage in the Yukon River near Pilot Station, 2019. Alaska Department of Fish and Game, Fishery Data Series No. 21-13, Anchorage.

Pfisterer, C. T. 2002. Estimation of Yukon River passage in 2001 using hydroacoustic methodologies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A02-24, Anchorage.

Pfisterer, C. T., T. Hamazaki, and B. C. McIntosh. 2017. Updated passage estimates for the Pilot Station sonar project, 1995–2015. Alaska Department of Fish and Game, Fishery Data Series No. 17-46, Anchorage.

Pfisterer, C. T., and S. L. Maxwell. 2000. Yukon River sonar project report, 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A00-11, Anchorage.

Rich, C. F. 2001. Yukon River project report 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A01-13, Anchorage.

Schumann, K. J., B. C. McIntosh, and B. P. Gray. 2017. Sonar estimation of salmon passage in the Yukon River near Pilot Station, 2015. Alaska Department of Fish and Game, Fishery Data Series No. 17-32, Anchorage.

TABLES AND FIGURES

Table 1.–Daily sampling schedule for sonar and test fishery at the Pilot Station sonar project on the Yukon River, 2023.

	Sonar (by stratum)		
Time	Right bank	Left bank	Test fishery
	Period 1		
0530	S1	S3/S4	
0600	S2	S5	
0630	S1	S3/S4	
0700	S2	S5	
0730	S1	S3/S4	
0800	S2	S5	
0830			
0900			Period 1
0930			
1000			
1030			
1100			
1130			
1200			
1230			
1300	Period 2		
1330	S1	S3/S4	
1400	S2	S5	
1430	S1	S3/S4	
1500	S2	S5	
1530	S1	S3/S4	
1600	S2	S5	
1630			
1700			Period 2
1730			
1800			
1830			
1900			
1930			
2000			
2030			
2100	Period 3		
2130	S1	S3/S4	
2200	S2	S5	
2230	S1	S3/S4	
2300	S2	S5	
2330	S1	S3/S4	
0000	S2	S5	

Table 2.–Initial split-beam sonar settings at the Pilot Station sonar project on the Yukon River, 2023.

			Bank	
Component	Setting	Stratum	Left	Right
Transducer	Beam size (h x w)		2.8° x 10°	6° x 10°
Echosounder	Transmit power (dB)	S1		27.0
		S2		27.0
		S4	33.0	
		S5	33.0	
	Receiver gain (dB)	S1		-8.0
		S2		-8.0
		S4	-12.0	
		S5	-12.0	
	Source level (dBµPa @ 1 m)	S1		216.8
		S2		216.8
		S4	222.1	
		S5	223.1	
	Through-system gain (dB)		-161.6	-162.0
	Pulse width (ms)		0.4	0.4
	Blanking range (m)		0	0
	Ping rate (pps)	S1		5.0
		S2		3.5
		S4	3.0	
		S5	1.2	
	Range (m)	S1		0–40
		S2		40–150
		S4	45–55	
		S5	55–150	

Note: ms = millisecond, dB = decibel, µPa = micropascal, pps = pings per second.

Table 3.–Technical specifications for the ARIS at the Pilot Station sonar project on the Yukon River, 2023.

Setting	Value
Field of view (h x w)	14° x 14°
Detection frequency (MHz)	0.7
Receiver gain (dB)	20.0
Samples/beam	1456.0
Start range (m)	0.7
Frame rate (f/s)	4.0
End range (m)	45.0

Table 4.–Initial range of lower and upper thresholds used in Echotastic at the Pilot Station sonar project on the Yukon River, 2023.

		Threshold (dB)	
Bank	Stratum	Upper	Lower
Right	S1	-30	-52
	S2	-23	-47
Left	S3	-27	-48
	S4	-36	-53
	S5	-29	-58

Table 5.–Specifications for drift gillnets used for test fishing, by season, at the Pilot Station sonar project on the Yukon River, 2023.

	Stretch mesh size		Mesh diameter	Meshes deep	Depth
Season	(in)	(mm)	(mm)	(md)	(m)
Summer	2.75	70	44	131	8.0
(6/7–7/18)	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	2.75	70	44	131	8.0
(7/19–9/7)	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 6.–Fishing schedule for drift gillnets used for test fishing by season at the Pilot Station sonar project on the Yukon River, 2023.

Season	Test fishery period	Mesh size (inches)			
		Odd days		Even days	
Summer	1	2.75	5.25	8.50	4.00
(6/7–7/18)		7.50	6.50	7.50	6.50
	2	7.50	6.50	7.50	6.50
		8.50	4.00	2.75	5.25
Fall	1	4.00	5.75	2.75	7.50
(7/19–9/7)		5.00	6.50	5.00	6.50
	2	5.00	6.50	5.00	6.50
		2.75	7.50	4.00	5.75

Table 7.–Yukon River ice breakup dates at Pilot Station, 2001–2023.

Year	Breakup date
2001	5/29
2002	5/18
2003	5/15
2004	5/03
2005	5/11
2006	5/25
2007	5/11
2008	5/19
2009	5/17
2010	5/19
2011	5/17
2012	5/17
2013	5/31
2014	5/03
2015	5/14
2016	4/29
2017	5/05
2018	5/13
2019	5/07
2020	5/11
2021	5/13
2022	5/09
2023	5/25

Source: National Oceanic and Atmospheric Administration (NOAA). 2023. National Weather Service, Alaska-Pacific River Forecast Center. www.weather.gov/aprfc/breakupDB (cited September 28, 2023; accessed August 25, 2025).

Table 8.–Number of fish caught and retained in the Pilot Station sonar project test fishery on the Yukon River, 2023.

Total catch	Chinook	S. Chum	F. Chum	Coho	Sockeye	Pink	Whitefish	Cisco	Burbot	Sheefish	Others[a]	Total
June	186	1,014	0	0	1	0	18	87	4	74	6	1,390
July	112	961	339	2	15	24	418	197	23	76	6	2,173
August	0	0	882	188	9	11	551	206	13	19	41	1,920
September	0	0	164	100	0	0	30	21	5	0	15	335
Total	298	1,975	1,385	290	25	35	1,017	511	45	169	68	5,818

Fish retained	Chinook	S. Chum	F. Chum	Coho	Sockeye	Pink	Whitefish	Cisco	Burbot	Sheefish	Others[a]	Total
June	85	328	0	0	0	0	5	3	1	17	0	439
July	73	286	110	0	2	0	309	4	4	14	0	802
August	0	0	325	46	2	1	391	4	1	2	0	772
September	0	0	53	12	0	0	21	0	0	0	0	86
Total	158	614	488	58	4	1	726	11	6	33	0	2,099

Proportion retained	Chinook	S. Chum	F. Chum	Coho	Sockeye	Pink	Whitefish	Cisco	Burbot	Sheefish	Others[a]	Total
June	0.457	0.323	0.000	0.000	0.000	0.000	0.278	0.034	0.250	0.230	0.000	0.316
July	0.652	0.298	0.324	0.000	0.133	0.000	0.739	0.020	0.174	0.184	0.000	0.369
August	0.000	0.000	0.368	0.245	0.222	0.091	0.710	0.019	0.077	0.105	0.000	0.402
September	0.000	0.000	0.323	0.120	0.000	0.000	0.700	0.000	0.000	0.000	0.000	0.257
Total	0.530	0.311	0.352	0.200	0.160	0.029	0.714	0.022	0.133	0.195	0.000	0.361

Note: S. chum = Summer chum; F. chum = Fall chum.

[a] Includes longnose sucker, northern pike, and Dolly Varden.

Table 9.–Cumulative fish passage estimates by zone and species with standard errors (SE) and 90% confidence intervals (CI) at the Pilot Station sonar project on the Yukon River, 2023.

					90% CI	
Species	Right bank	Left bank	Total passage	SE	Lower	Upper
Large Chinook[a]	3,746	41,280	45,026	8,362	31,270	58,782
Small Chinook[b]	1,231	12,272	13,503	2,459	9,458	17,548
Total Chinook	4,977	53,552	58,529	8,716	44,191	72,867
Summer chum	107,706	738,282	845,988	21,868	810,015	881,961
Fall chum[c]	37,212	332,803	370,015	13,157	348,372	391,658
Coho[c]	15,809	33,888	49,697	4,626	42,087	57,307
Sockeye	1,032	4,825	5,857	1,522	3,353	8,361
Pink	1,347	8,388	9,735	2,162	6,178	13,292
Cisco	43,063	179,454	222,517	17,342	193,989	251,045
Humpback whitefish	39,698	184,350	224,048	11,376	205,334	242,762
Broad whitefish	5,775	24,698	30,473	4,116	23,702	37,244
Sheefish	11,816	31,067	42,883	4,952	34,737	51,029
Other[d]	18,833	6,316	25,149	2,685	20,732	29,566
Total	287,268	1,597,623	1,884,891			

[a] Large Chinook >655 mm mid eye to tail fork (METF).

[b] Small Chinook ≤655 mm METF.

[c] Because the fall chum and coho salmon migration continued after project operations, estimates are considered incomplete.

[d] Includes burbot, longnose sucker, Dolly Varden, and northern pike.

Table 10.–Dates of zones pooled for the 2023 season at the Pilot Station sonar project on the Yukon River.

		Left bank		
Date	Right bank (Zone 1)	Nearshore (Zone 2)	Offshore (Zone 3)	Reason for pooling
6/06				IC
6/07				
6/08				
6/09				
6/10				IC
6/11				
6/12				IC
6/13				
6/14				IC
6/15				IC
6/16				
6/17				
6/18				
6/19				
6/20				
6/21				
6/22				
6/23				
6/24				IC
6/25				
6/26				IC
6/27				IC
6/28				
6/29				IC
6/30				IC
7/01				IC
7/02				IC
7/03				IC
7/04				IC
7/05				IC
7/06				
7/07				IC
7/08				IC
7/09				
7/10				IC
7/11				
7/12				IC
7/13				
7/14				
7/15				
7/16				
7/17				IC
7/18				
7/19				

-continued-

Table 10.–Page 2 of 2.

Date	Right bank (Zone 1)	Left bank: Nearshore (Zone 2)	Left bank: Offshore (Zone 3)	Reason for pooling
7/20				IC
7/21				
7/22				
7/23				
7/24				
7/25				
7/26				
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7/28				
7/29				IC
7/30				
7/31				IC
8/01				
8/02				
8/03				
8/04				IC
8/05				
8/06				
8/07				
8/08				
8/09				
8/10				
8/11				
8/12				IC
8/13				IC
8/14				IC
8/15				
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8/17				
8/18				IC
8/19				
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8/23				
8/24				
8/25				
8/26				IC
8/27				
8/28				IC
8/29				
8/30				IC
8/31				
9/01				IC
9/02				
9/03				
9/04				IC
9/05				IC
9/06				
9/07				

Note: Days with insufficient catches (IC) in at least 1 fishing zone were pooled (boxes) to ensure reasonable species apportionment. There were no commercial fisheries this season that affected the species apportionment test fishery.

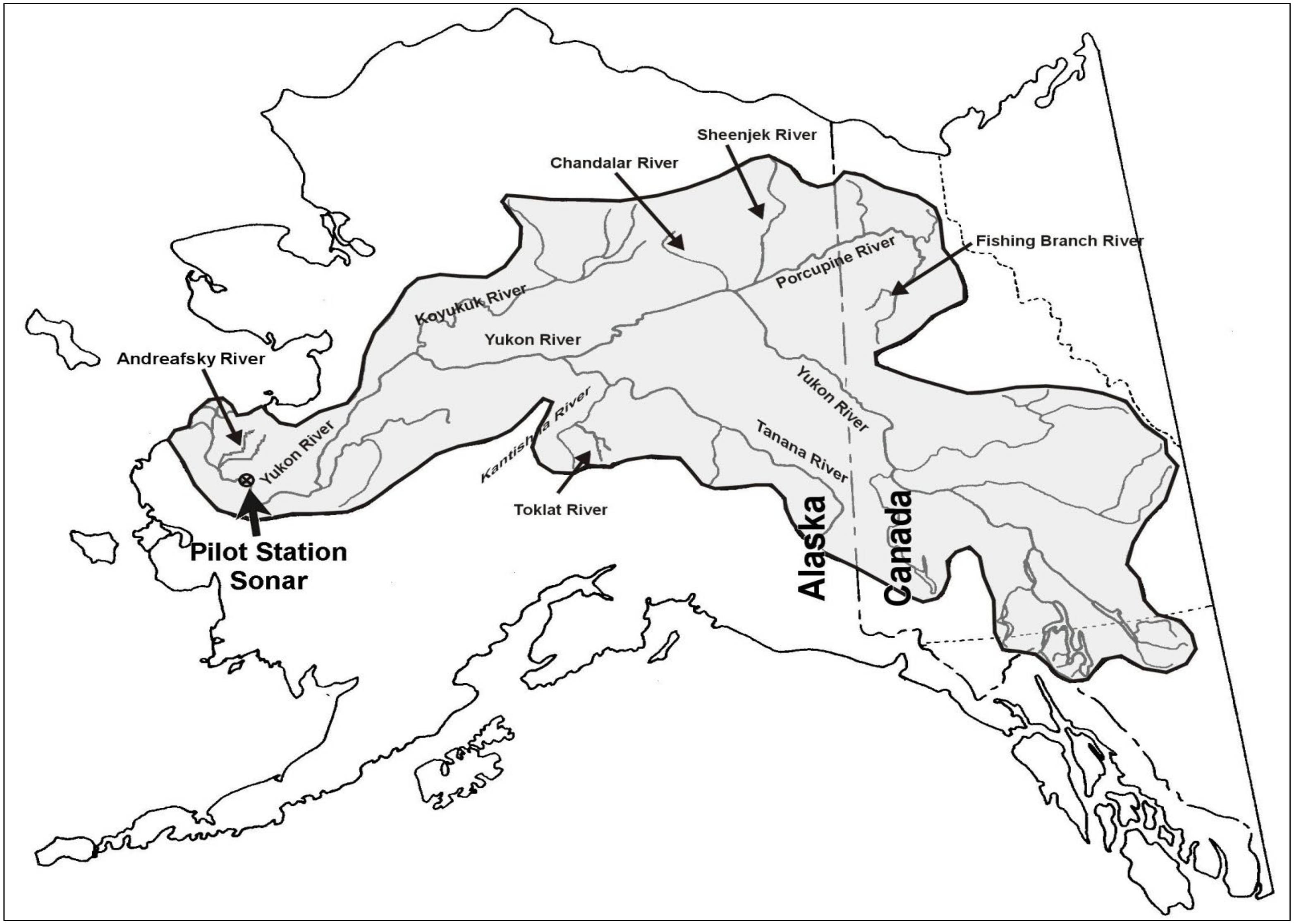

Figure 1.–Fishing districts and communities of the Yukon River drainage.

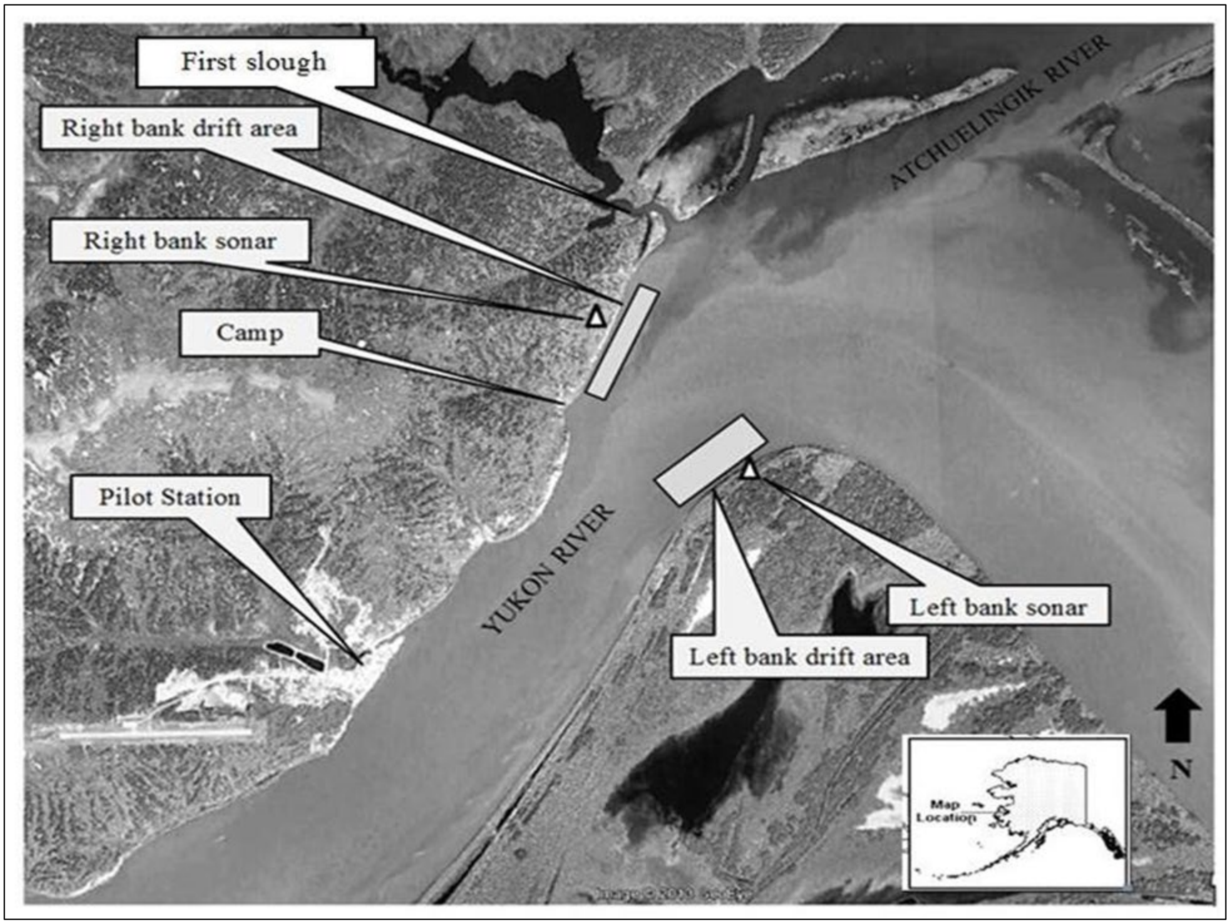

Figure 2.–Location of the Pilot Station sonar project on the Yukon River showing general transducer sites.

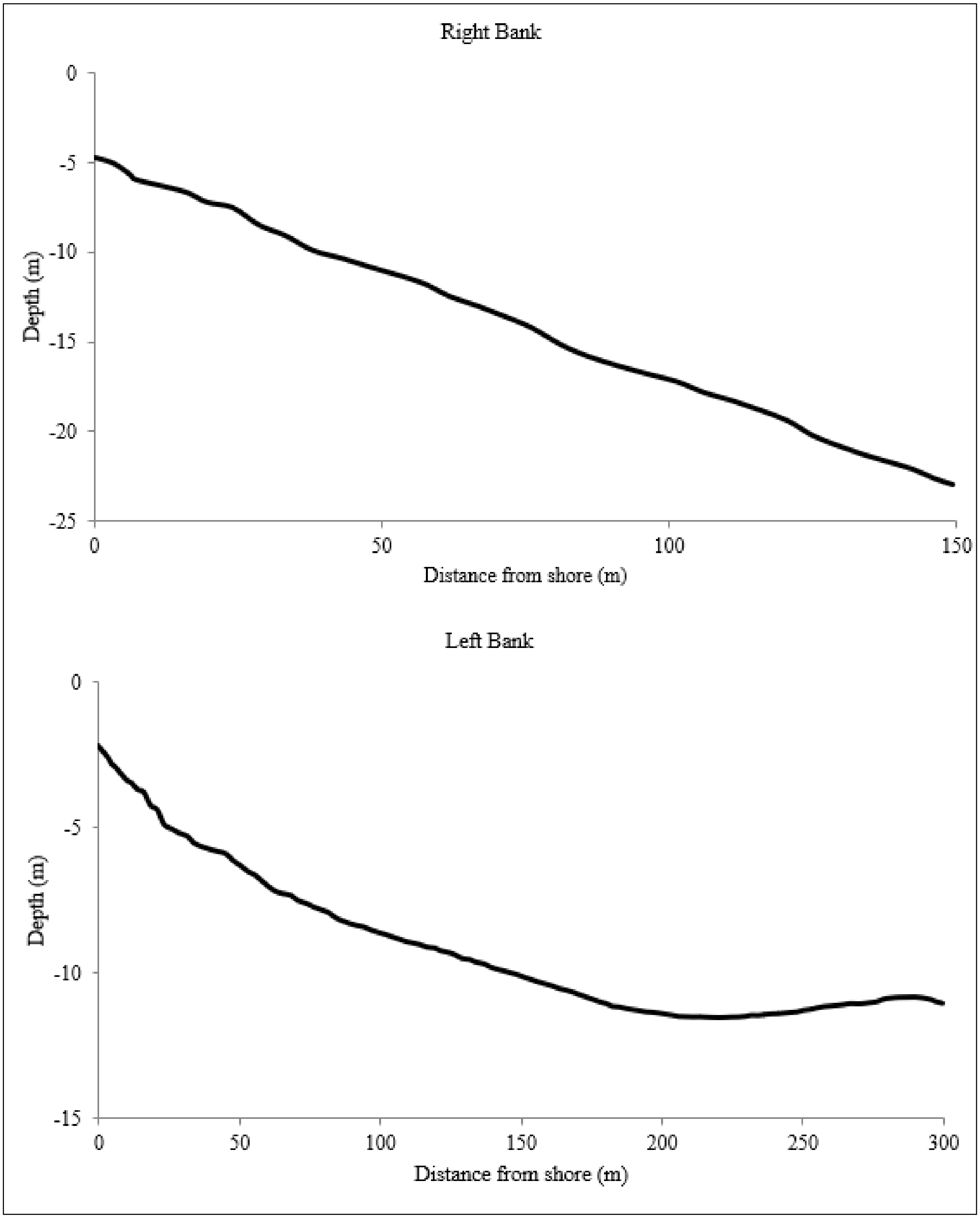

Figure 3.–Bottom profiles for the right bank (top) and left bank (bottom) at the Pilot Station sonar project on the Yukon River, 2023.

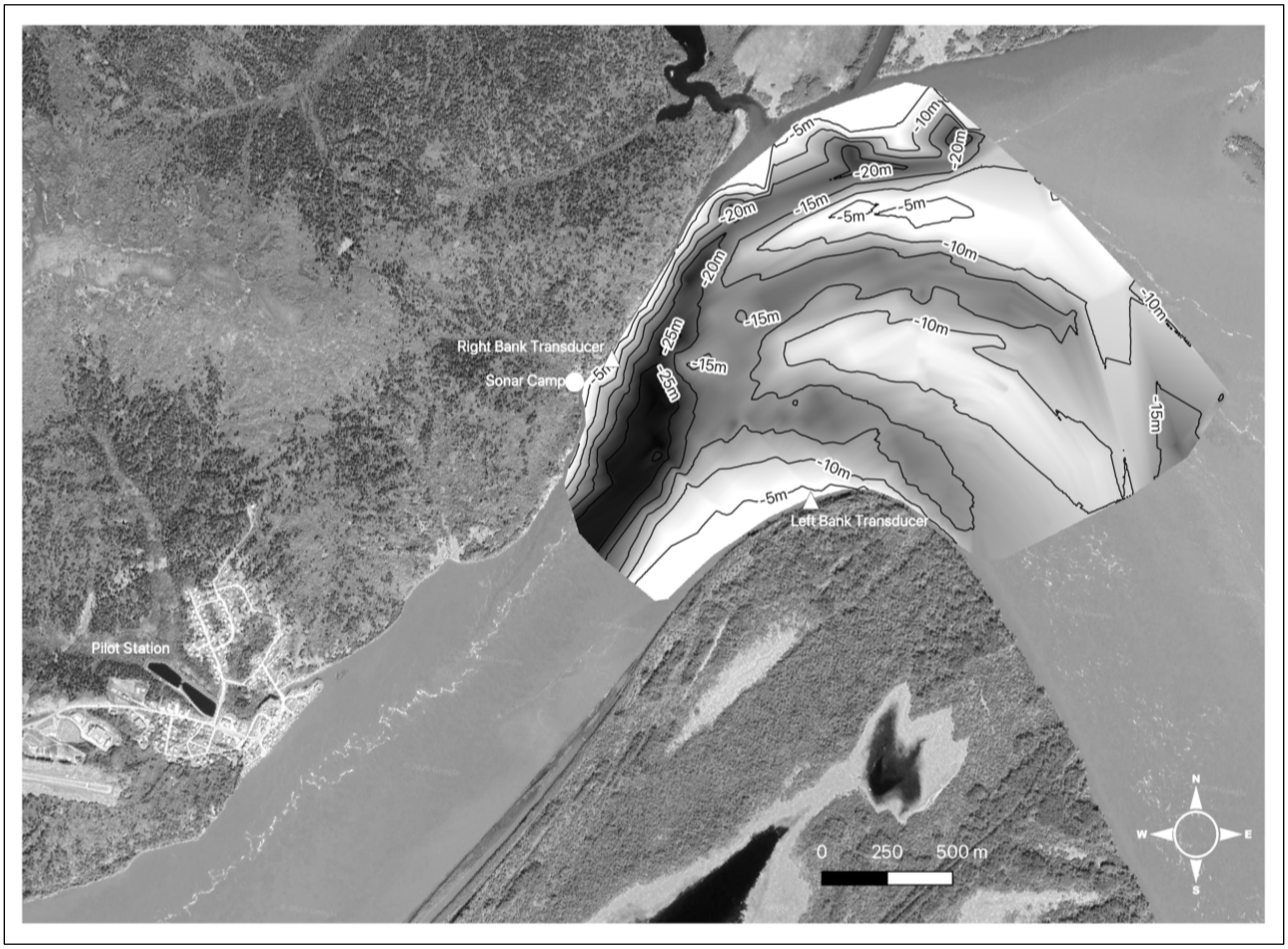

Figure 4.–Bathymetric map of the Yukon River in the vicinity of the Pilot Station sonar project.

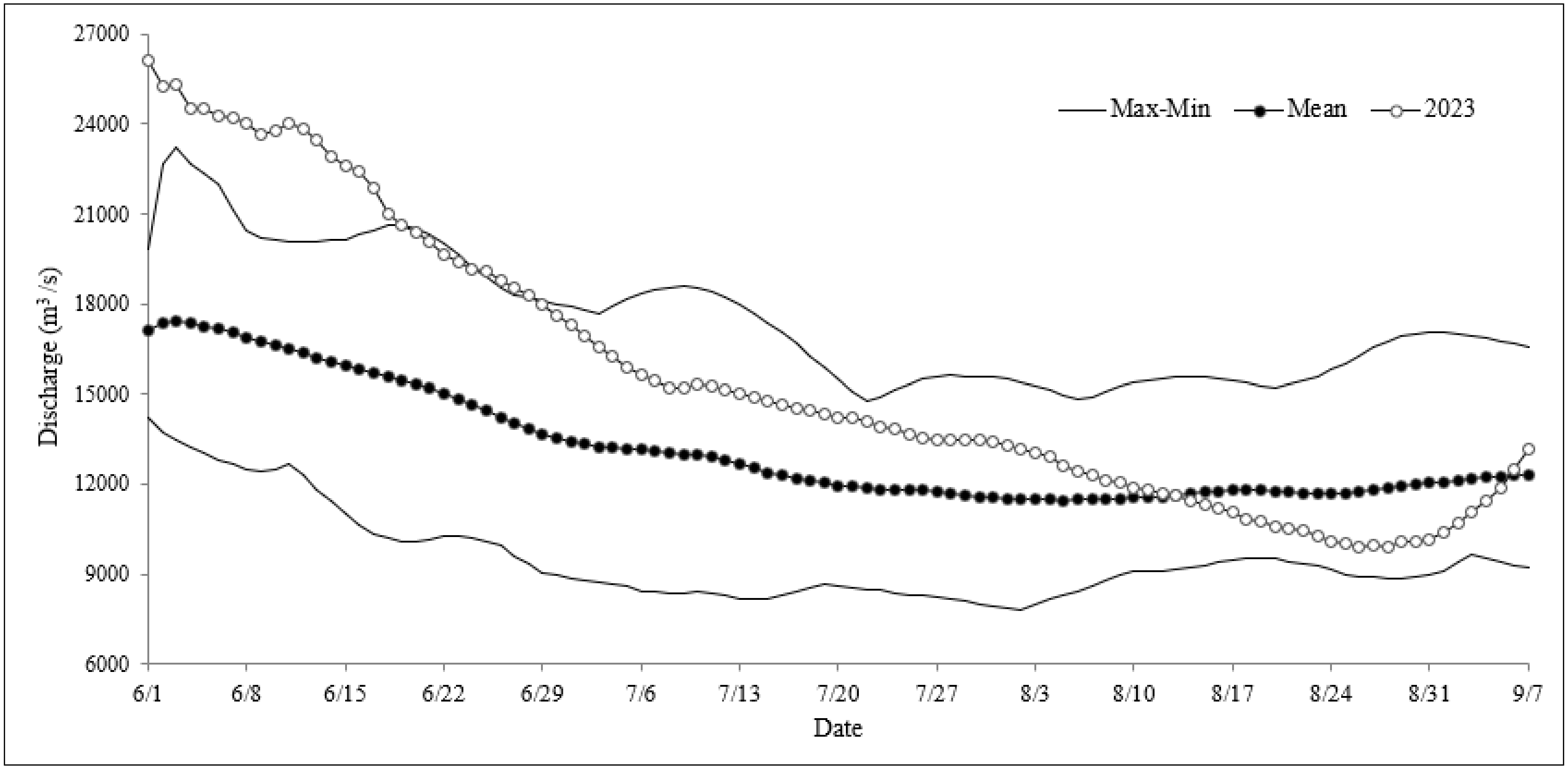

Figure 5.–Yukon River daily water discharge during the 2023 season at Pilot Station water gauge compared to 2013–2022 minimum, maximum, and mean gauge height.

Source: USGS. U.S. Geological Survey National Water Information System: USGS 15565447 Yukon R. at Pilot Station AK 2022. Available online: https://nwis.waterdata.usgs.gov/nwis/inventory/?site_no=15565447 (cited November 6, 2023; accessed August 23, 2025).

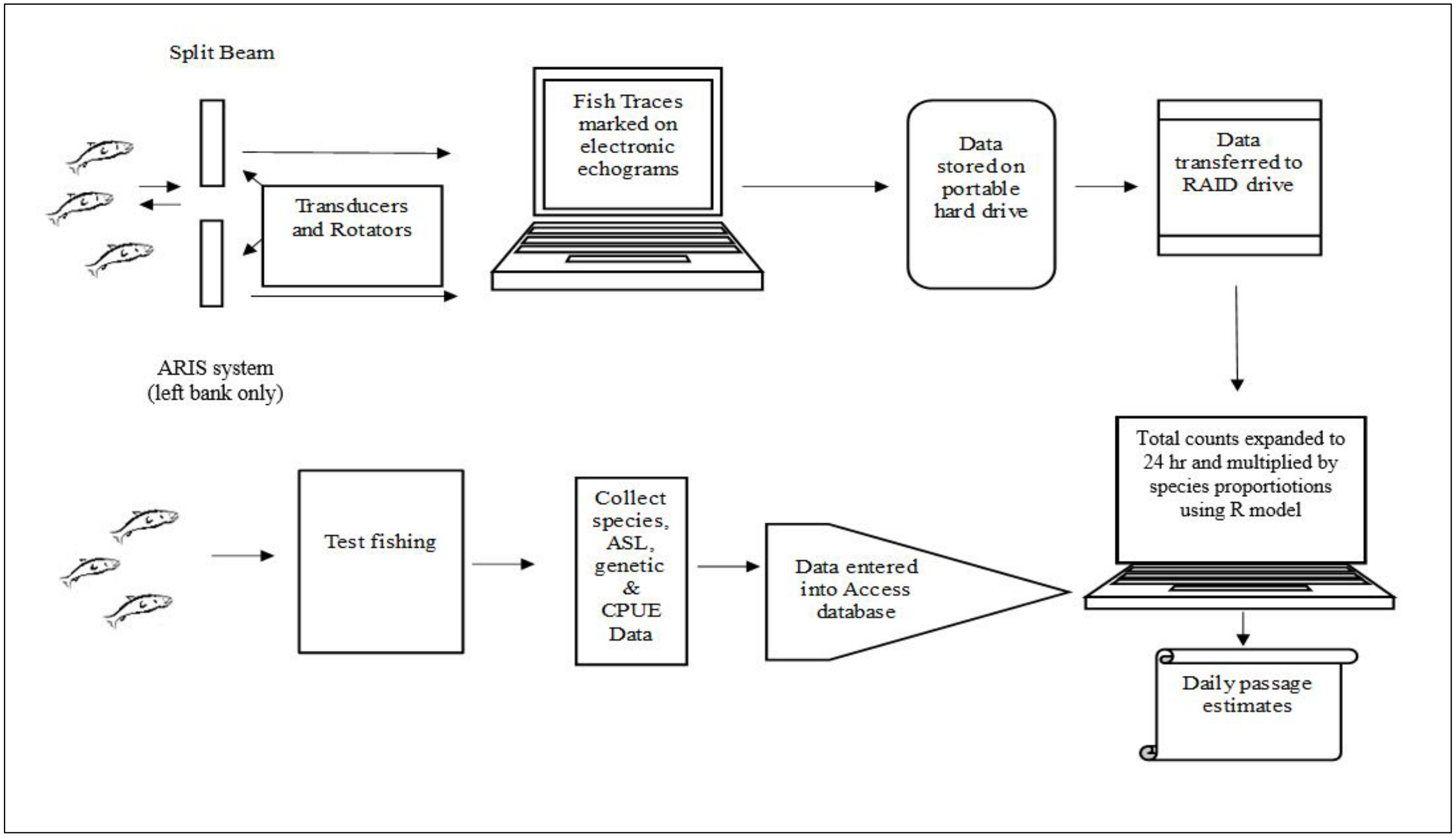

Figure 6.–Flow diagram of data collection and processing at the Pilot Station sonar project on the Yukon River, 2023.

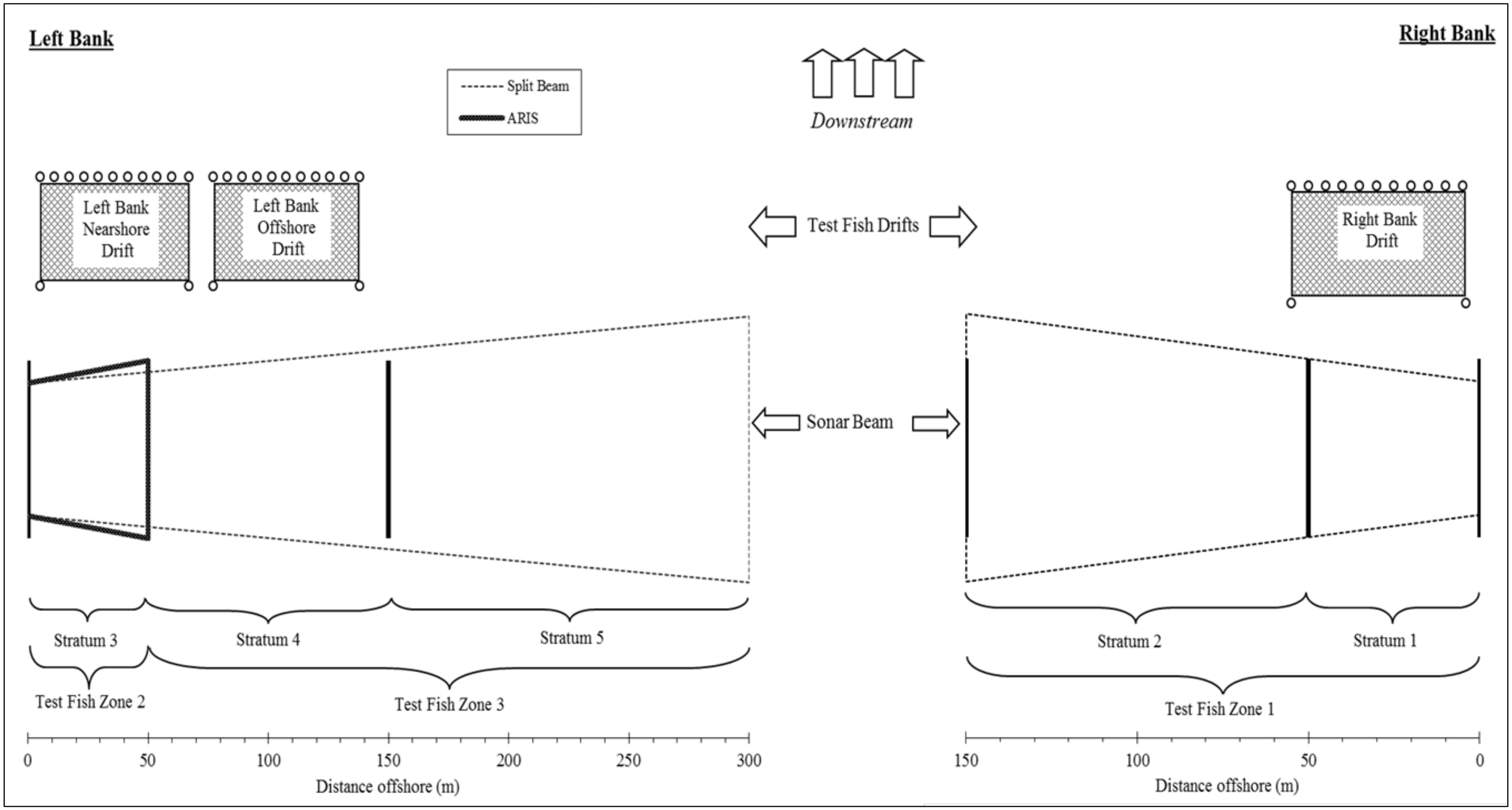

Figure 7.–Illustration of relationships between strata, zones, test fishery drifts, and approximate sonar ranges (not to scale) at the Pilot Station sonar project on the Yukon River, 2023.

Note: Strata ranges can vary during the season depending on river conditions.

Figure 8.–ARIS with a telephoto lens mounted to a pod with PT-25 rotator (top left), ARIS with spreader lens installed on the front of the telephoto lens (lower left), and HTI split-beam transducer mounted on the pod with PT-25 rotator (right), at the Pilot Station sonar project on the Yukon River.

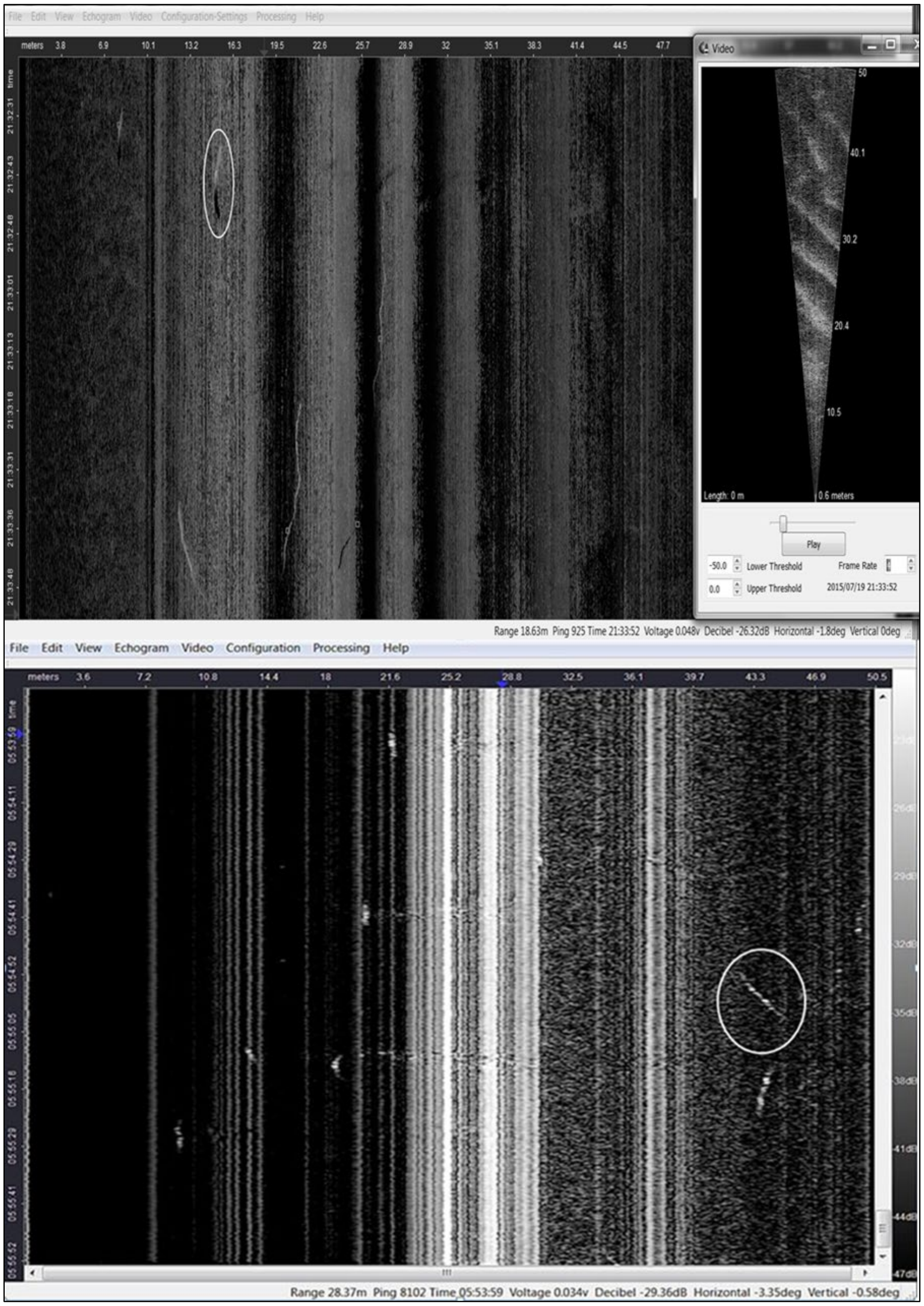

Figure 9.–Echogram of ARIS alongside video image (top) and split-beam sonar (bottom), with oval around representative fish.

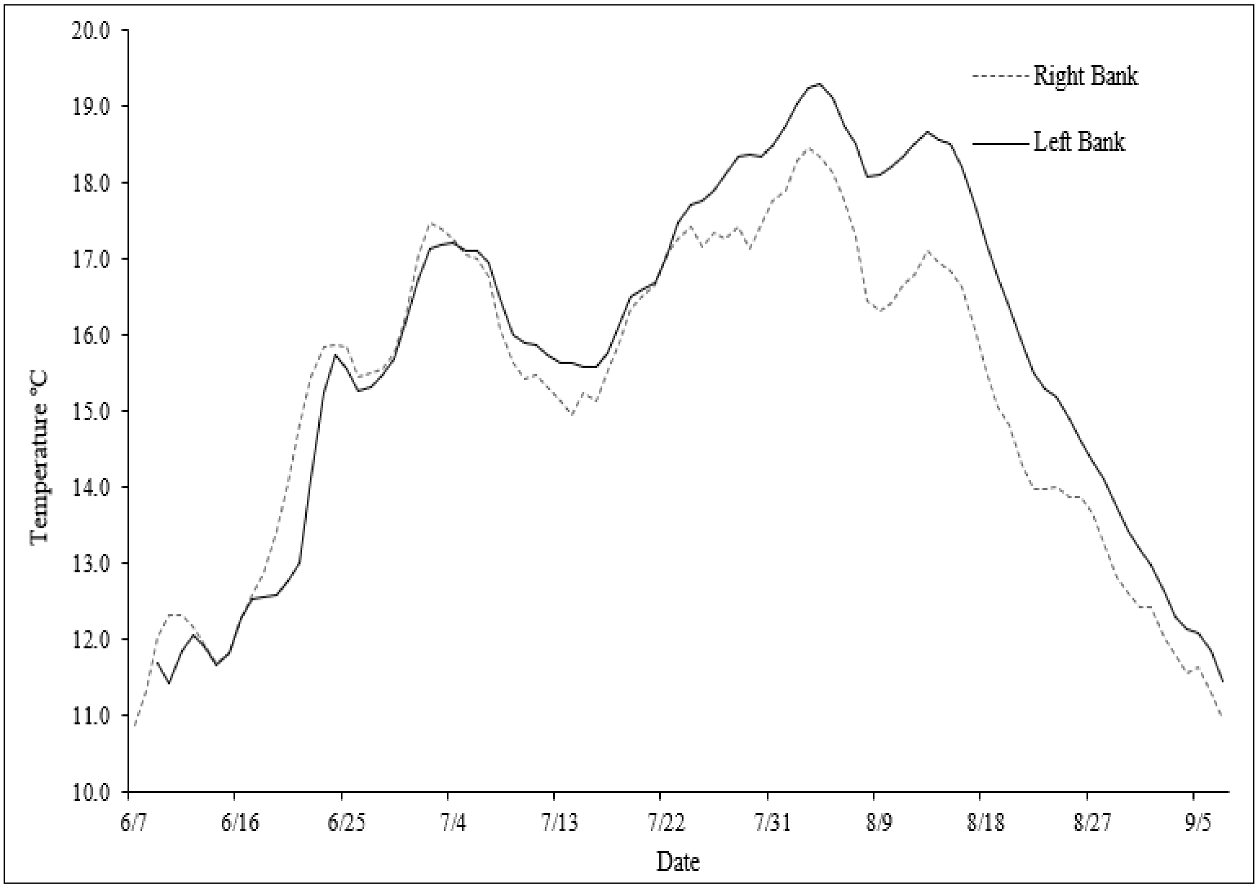

Figure 10.–Mean daily water temperatures recorded at the Pilot Station sonar project on the Yukon River with electronic data loggers by bank, 2023.

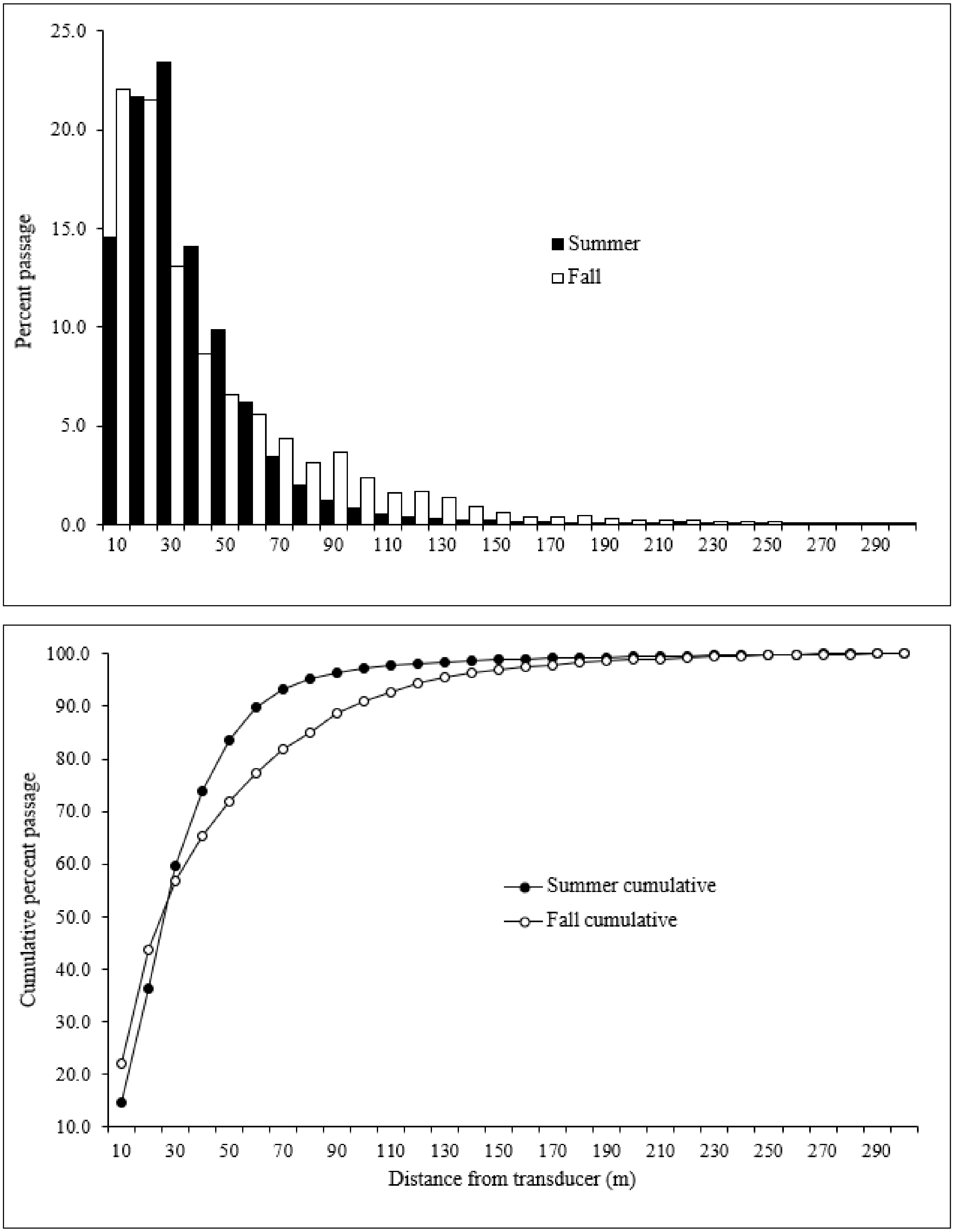

Figure 11.–Distribution of left bank passage (top) and cumulative passage as a function of range (bottom) at the Pilot Station sonar project on the Yukon River, 2023.

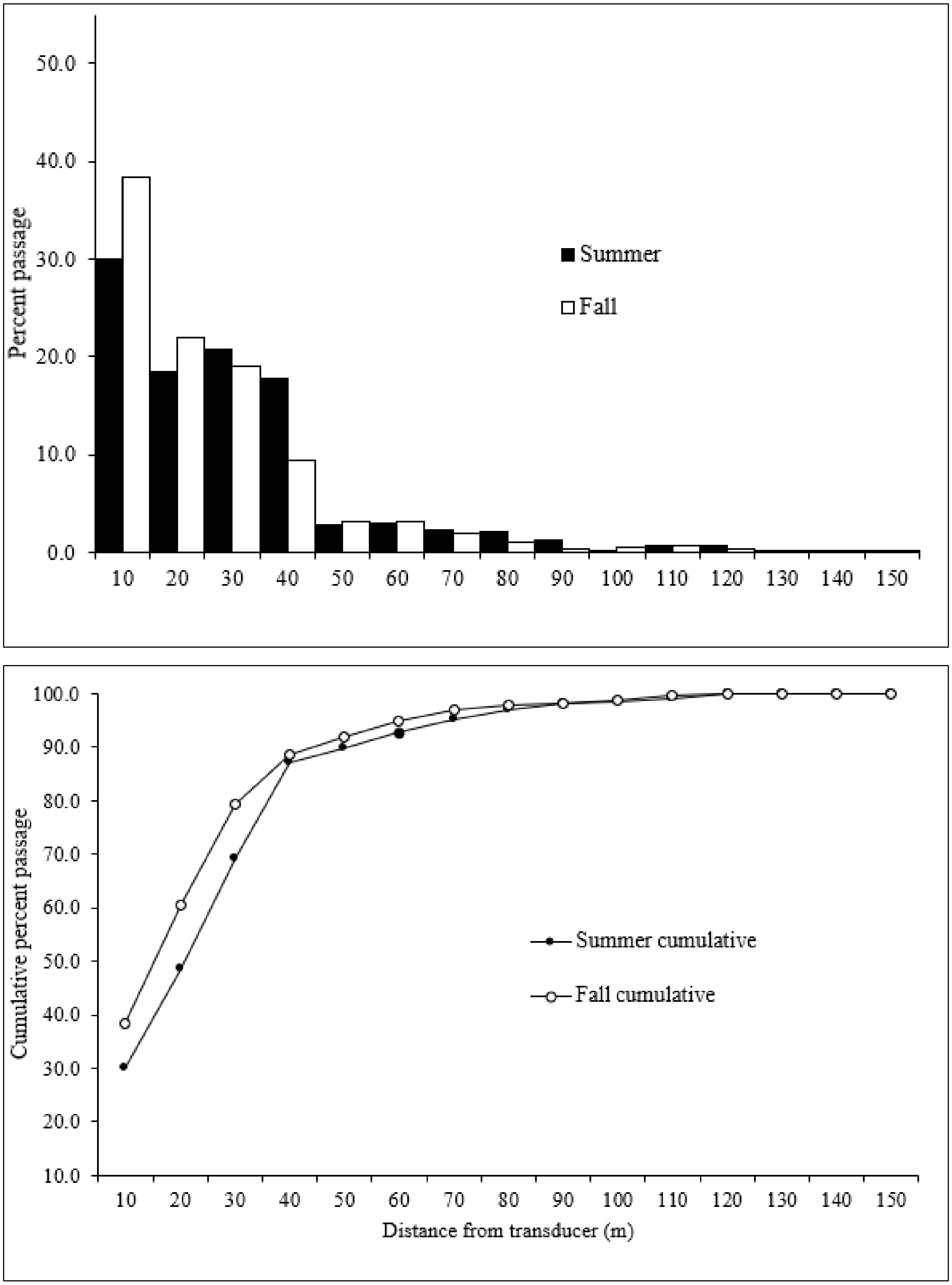

Figure 12.–Distribution of right bank passage (top) and cumulative passage as a function of range (bottom) at the Pilot Station sonar project on the Yukon River, 2023.

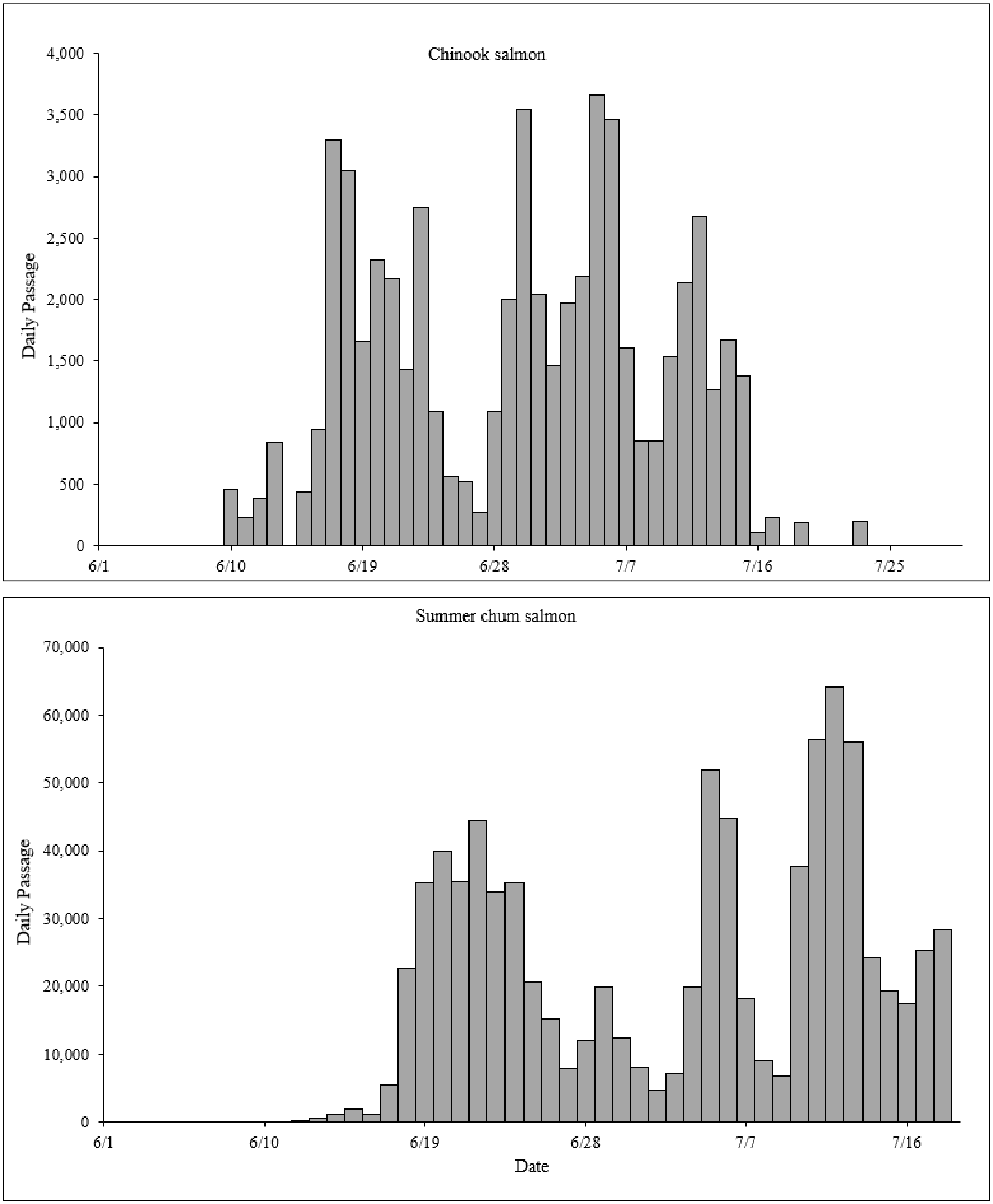

Figure 13.–Chinook (top) and summer chum salmon (bottom) daily passage estimates at the Pilot Station sonar project on the Yukon River, 2023.

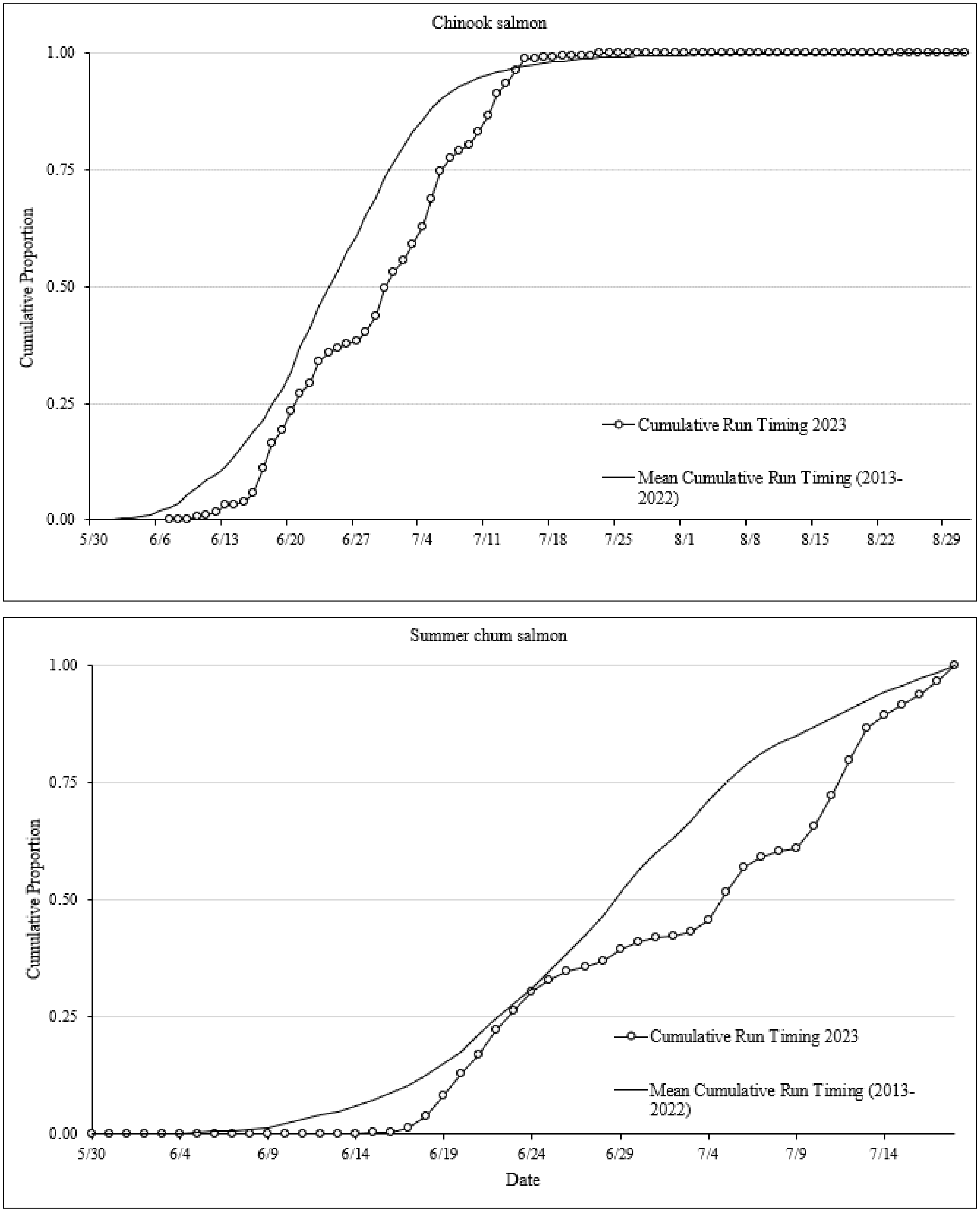

Figure 14.–2023 Chinook (top) and summer chum (bottom) salmon daily cumulative passage timing compared to the 2013–2022 mean passage timing at the Pilot Station sonar project on the Yukon River.

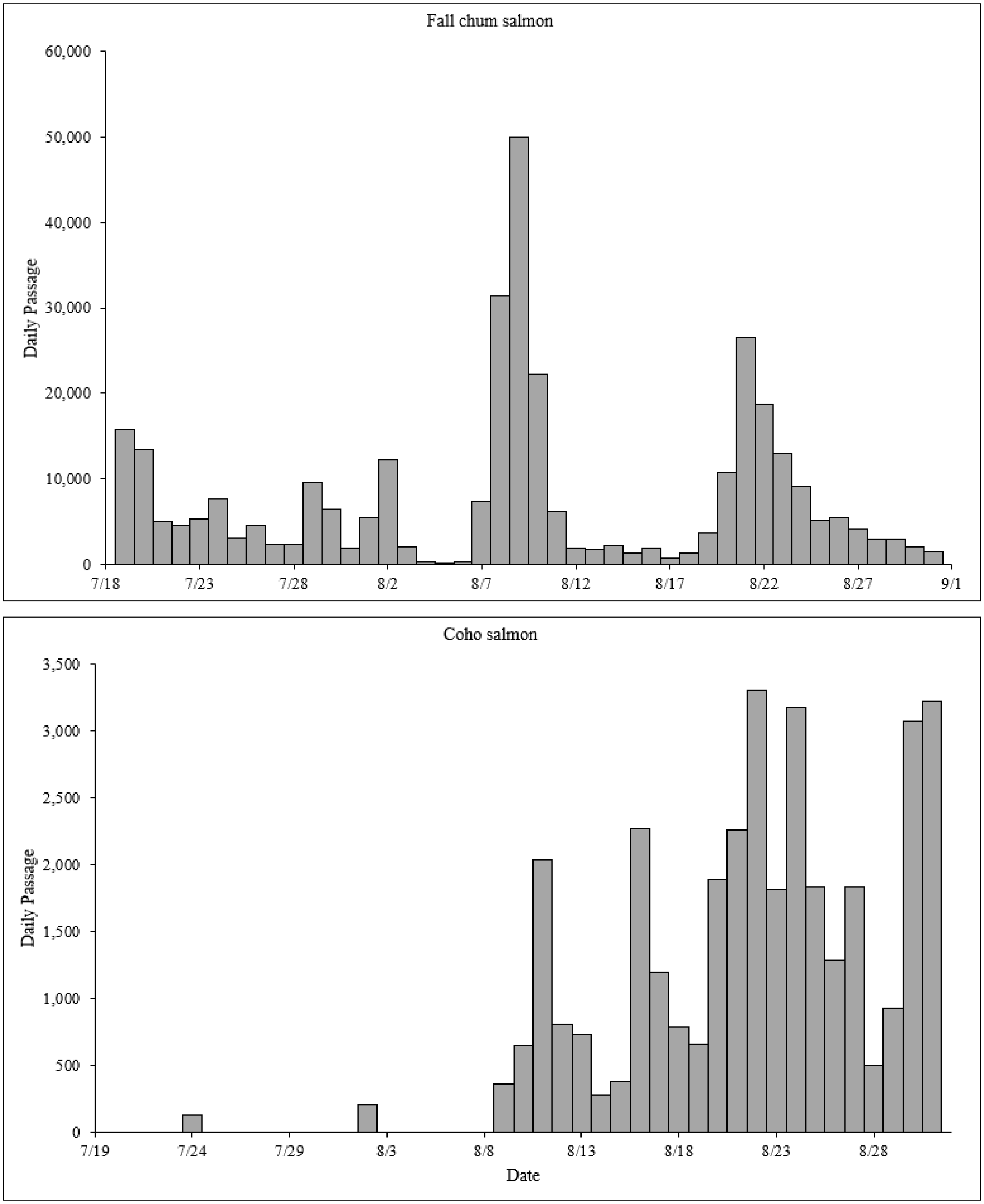

Figure 15.–Fall chum (top) and coho (bottom) salmon daily passage estimates at the Pilot Station sonar project on the Yukon River, 2023.

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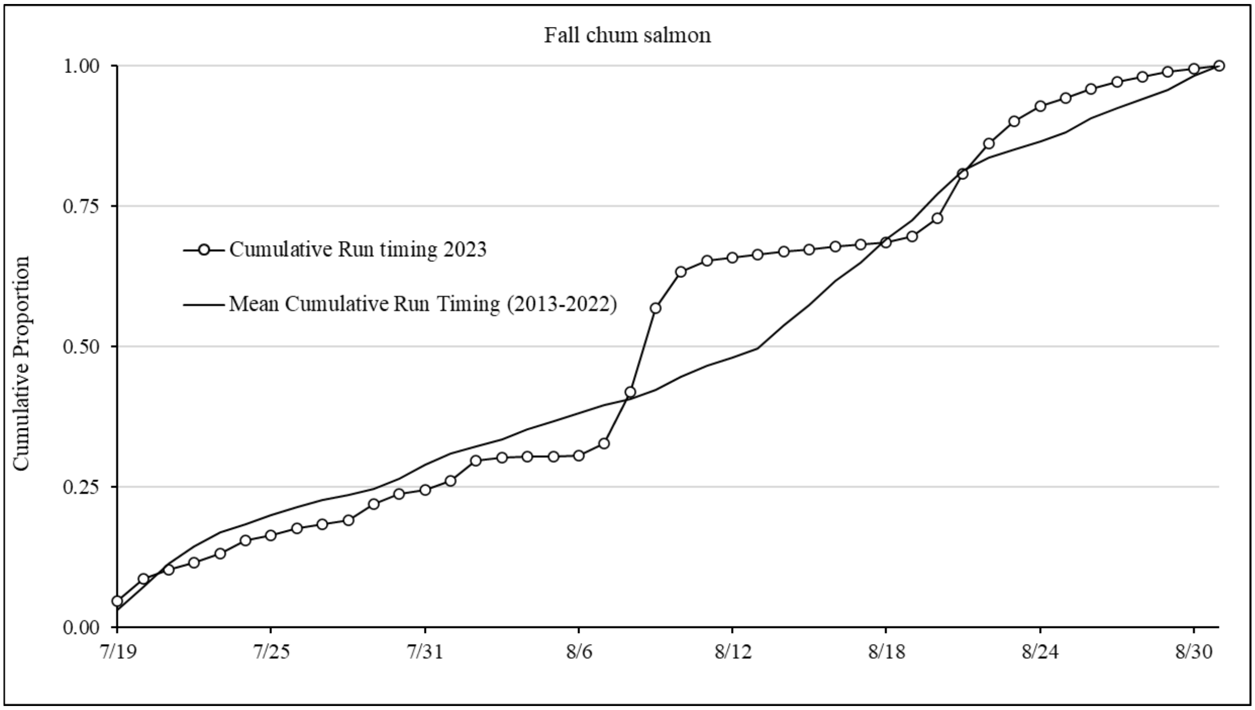

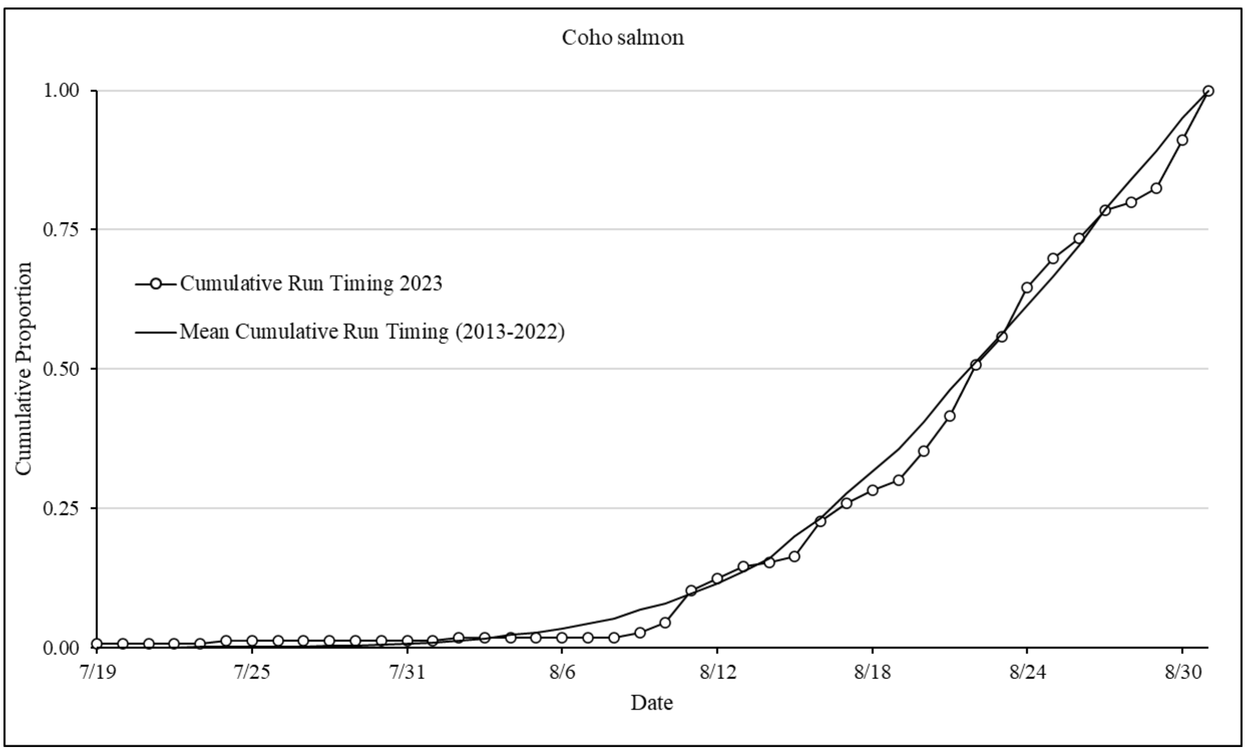

Figure 16.–2023 Fall chum (top) and coho (bottom) salmon daily cumulative passage timing compared to the 2013–2022 mean passage timing at the Pilot Station sonar project on the Yukon River.

Note: The mean cumulative run timing for both fall chum and coho salmon was based on run timing from July 19 through August 31 in order to compare timing across years, despite years when the project was in operation until September 7.

APPENDIX A: NET SELECTIVITY PARAMETERS USED IN FISH SPECIES APPORTIONMENT AT THE PILOT STATION SONAR PROJECT

Appendix A1.–Net selectivity parameters used in species apportionment, at the Pilot Station sonar project on the Yukon River, 2023.

Species	Tau	Sigma	Theta	Lambda	Tangle
Large Chinook[a]	1.9101	0.2214	0.6232	-0.4518	0.0054
Small Chinook[b]	1.9101	0.2214	0.6232	-0.4518	0.0054
Summer chum	1.9684	0.1472	0.7894	-0.4343	0.0413
Fall chum	1.8778	0.1851	0.9284	-0.8716	0.0000
Coho	1.9584	0.1454	0.4239	-0.5999	0.0100
Sockeye	1.9815	0.2915	0.8132	-1.2731	0.1350
Pink	1.9624	0.3504	2.5532	3.0808	0.1499
Broad whitefish	1.7974	0.2095	1.0464	-1.8359	0.1309
Humpback whitefish	1.9233	0.2590	1.1923	-2.1474	0.1257
Cisco	2.1539	0.3054	1.4981	-2.6183	0.2449
Sheefish	2.1702	0.2235	0.7745	-1.7469	0.0000
Other[c]	2.7252	0.5916	1.0468	-3.8418	0.0100

[a] Chinook salmon >655 mm mid eye to tail fork (METF).

[b] Chinook salmon ≤655 mm METF.

[c] Includes burbot, longnose sucker, Dolly Varden, and northern pike.

APPENDIX B: SALMON SPECIES CATCH PER UNIT EFFORT BY DAY AND BANK

Appendix B1.–Left bank catch per unit effort (CPUE), by day and salmon species, at the Pilot Station sonar project on the Yukon River, 2023.

Date	Large mesh fathom hours	Chinook		Small mesh fathom hours	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
6/06	19.39	0	0.00	18.16	0	0.00	0	0.00	0	0.00
6/07	19.79	0	0.00	17.83	0	0.00	0	0.00	0	0.00
6/08	17.07	0	0.00	18.42	0	0.00	0	0.00	0	0.00
6/09	17.38	0	0.00	17.77	0	0.00	0	0.00	0	0.00
6/10	18.16	1	0.06	17.94	0	0.00	0	0.00	0	0.00
6/11	18.02	0	0.00	18.68	0	0.00	0	0.00	0	0.00
6/12	18.41	0	0.00	17.40	1	0.06	0	0.00	0	0.00
6/13	16.01	0	0.00	16.76	1	0.06	0	0.00	0	0.00
6/14	18.50	0	0.00	17.35	2	0.12	0	0.00	0	0.00
6/15	15.01	0	0.00	19.52	5	0.26	0	0.00	0	0.00
6/16	17.69	0	0.00	17.42	2	0.11	0	0.00	0	0.00
6/17	17.69	9	0.51	17.70	14	0.79	0	0.00	0	0.00
6/18	17.80	10	0.56	15.57	50	3.21	0	0.00	0	0.00
6/19	17.95	4	0.22	12.52	69	5.51	0	0.00	0	0.00
6/20	16.74	10	0.60	13.67	77	5.63	0	0.00	0	0.00
6/21	16.58	10	0.60	11.21	64	5.71	0	0.00	0	0.00
6/22	15.29	8	0.52	12.00	62	5.17	0	0.00	0	0.00
6/23	15.03	6	0.40	12.35	52	4.21	0	0.00	0	0.00
6/24	17.81	4	0.22	14.00	53	3.79	0	0.00	0	0.00
6/25	16.83	3	0.18	13.76	55	4.00	0	0.00	0	0.00
6/26	18.32	2	0.11	15.77	38	2.41	0	0.00	0	0.00
6/27	16.80	1	0.06	16.27	14	0.86	0	0.00	0	0.00
6/28	17.37	3	0.17	16.13	32	1.98	0	0.00	0	0.00
6/29	17.80	3	0.17	15.12	28	1.85	0	0.00	0	0.00
6/30	17.36	11	0.63	15.68	17	1.08	0	0.00	0	0.00
7/01	17.47	6	0.34	16.04	22	1.37	0	0.00	0	0.00
7/02	18.34	4	0.22	17.78	4	0.22	0	0.00	0	0.00
7/03	10.27	2	0.19	10.24	6	0.59	0	0.00	0	0.00
7/04	18.28	5	0.27	15.60	26	1.67	0	0.00	0	0.00
7/05	16.58	12	0.72	14.11	43	3.05	0	0.00	0	0.00
7/06	11.76	0	0.00	7.85	38	4.84	0	0.00	0	0.00
7/07	17.14	3	0.18	14.02	25	1.78	0	0.00	0	0.00

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Appendix B1.–Page 2 of 3.

Date	Large mesh fathom hours	Chinook Catch	Chinook CPUE	Small mesh fathom hours	Summer chum Catch	Summer chum CPUE	Fall chum Catch	Fall chum CPUE	Coho Catch	Coho CPUE
7/08	17.26	0	0.00	17.53	7	0.40	0	0.00	0	0.00
7/09	17.96	1	0.06	17.41	9	0.52	0	0.00	0	0.00
7/10	17.17	3	0.17	14.41	42	2.92	0	0.00	0	0.00
7/11	16.52	4	0.24	12.92	44	3.41	0	0.00	0	0.00
7/12	16.20	4	0.25	13.34	64	4.80	0	0.00	0	0.00
7/13	17.08	1	0.06	11.58	40	3.46	0	0.00	0	0.00
7/14	15.67	4	0.26	14.49	24	1.66	0	0.00	0	0.00
7/15	17.44	1	0.06	15.55	23	1.48	0	0.00	0	0.00
7/16	17.90	1	0.06	17.58	28	1.59	0	0.00	0	0.00
7/17	18.22	1	0.05	17.01	36	2.12	0	0.00	0	0.00
7/18	18.01	0	0.00	13.03	46	3.53	0	0.00	0	0.00
7/19	6.06	0	0.00	18.07	0	0.00	15	0.83	0	0.00
7/20	5.94	0	0.00	16.31	0	0.00	27	1.66	0	0.00
7/21	5.77	0	0.00	17.72	0	0.00	1	0.06	0	0.00
7/22	5.51	0	0.00	17.80	0	0.00	3	0.17	0	0.00
7/23	5.74	0	0.00	18.05	0	0.00	9	0.50	0	0.00
7/24	6.37	0	0.00	17.37	0	0.00	11	0.63	0	0.00
7/25	5.89	0	0.00	17.89	0	0.00	7	0.39	0	0.00
7/26	5.81	0	0.00	17.52	0	0.00	1	0.06	0	0.00
7/27	6.03	0	0.00	17.57	0	0.00	7	0.40	0	0.00
7/28	5.66	0	0.00	17.76	0	0.00	3	0.17	0	0.00
7/29	5.70	0	0.00	18.09	0	0.00	20	1.11	0	0.00
7/30	5.83	0	0.00	15.02	0	0.00	15	1.00	0	0.00
7/31	5.71	0	0.00	17.58	0	0.00	1	0.06	0	0.00
8/01	5.92	0	0.00	17.82	0	0.00	11	0.62	0	0.00
8/02	6.11	0	0.00	17.22	0	0.00	27	1.57	0	0.00
8/03	6.38	0	0.00	17.03	0	0.00	10	0.59	0	0.00
8/04	5.89	0	0.00	17.24	0	0.00	1	0.06	0	0.00
8/05	5.70	0	0.00	18.32	0	0.00	0	0.00	0	0.00
8/06	6.16	0	0.00	18.32	0	0.00	2	0.11	0	0.00
8/07	6.12	0	0.00	16.60	0	0.00	34	2.05	0	0.00

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Appendix B1.–Page 3 of 3.

Date	Large mesh fathom hours	Chinook		Small mesh fathom hours	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
8/08	5.05	0	0.00	14.41	0	0.00	60	4.16	0	0.00
8/09	4.84	0	0.00	8.09	0	0.00	58	7.17	0	0.00
8/10	5.62	0	0.00	10.28	0	0.00	41	3.99	1	0.10
8/11	5.84	0	0.00	16.85	0	0.00	8	0.47	3	0.18
8/12	6.31	0	0.00	17.56	0	0.00	2	0.11	2	0.11
8/13	5.76	0	0.00	17.79	0	0.00	7	0.39	1	0.06
8/14	5.68	0	0.00	16.32	0	0.00	9	0.55	0	0.00
8/15	6.90	0	0.00	17.58	0	0.00	2	0.11	0	0.00
8/16	6.27	0	0.00	18.47	0	0.00	5	0.27	2	0.11
8/17	6.08	0	0.00	17.44	0	0.00	1	0.06	0	0.00
8/18	5.94	0	0.00	17.37	0	0.00	0	0	0	0.00
8/19	5.71	0	0.00	17.60	0	0.00	11	0.62	0	0.00
8/20	5.88	0	0.00	18.34	0	0.00	13	0.71	0	0.00
8/21	6.24	0	0.00	14.55	0	0.00	39	2.68	1	0.07
8/22	5.93	0	0.00	14.48	0	0.00	34	2.35	4	0.28
8/23	6.15	0	0.00	17.93	0	0.00	16	0.89	1	0.06
8/24	5.51	0	0.00	18.54	0	0.00	12	0.65	2	0.11
8/25	5.80	0	0.00	17.66	0	0.00	7	0.4	2	0.11
8/26	5.98	0	0.00	17.44	0	0.00	14	0.8	1	0.06
8/27	5.95	0	0.00	17.86	0	0.00	3	0.17	1	0.06
8/28	6.01	0	0.00	17.89	0	0.00	4	0.22	1	0.06
8/29	6.11	0	0.00	18.42	0	0.00	8	0.43	0	0.00
8/30	5.69	0	0.00	17.72	0	0.00	0	0	5	0.28
8/31	6.07	0	0.00	16.66	0	0.00	3	0.18	1	0.06
9/01	5.75	0	0.00	17.45	0	0.00	9	0.52	1	0.06
9/02	6.05	0	0.00	18.70	0	0.00	23	1.23	3	0.16
9/03	6.02	0	0.00	18.15	0	0.00	6	0.33	4	0.22
9/04	5.75	0	0.00	17.84	0	0.00	13	0.73	3	0.17
9/05	5.84	0	0.00	17.89	0	0.00	2	0.11	0	0.00
9/06	6.03	0	0.00	9.80	0	0.00	0	0	2	0.20
9/07	5.95	0	0.00	18.01	0	0.00	3	0.17	1	0.06
Total	1,035.08	137	8.14	1,523.88	1,163	86.22	618	42.51	42	2.58

Appendix B2.–Right bank catch per unit effort (CPUE), by day and salmon species, at the Pilot Station sonar project on the Yukon River, 2023.

	Large mesh	Chinook		Small mesh	Summer chum		Fall chum		Coho	
Date	fathom hours	Catch	CPUE	fathom hours	Catch	CPUE	Catch	CPUE	Catch	CPUE
6/06	9.16	0	0.00	8.48	0	0.00	0	0.00	0	0.00
6/07	7.26	0	0.00	6.95	0	0.00	0	0.00	0	0.00
6/08	7.04	0	0.00	7.72	0	0.00	0	0.00	0	0.00
6/09	6.26	0	0.00	8.62	0	0.00	0	0.00	0	0.00
6/10	6.35	0	0.00	7.29	0	0.00	0	0.00	0	0.00
6/11	7.55	0	0.00	8.72	0	0.00	0	0.00	0	0.00
6/12	6.20	0	0.00	8.75	0	0.00	0	0.00	0	0.00
6/13	8.33	0	0.00	7.95	0	0.00	0	0.00	0	0.00
6/14	7.98	0	0.00	6.81	0	0.00	0	0.00	0	0.00
6/15	7.27	0	0.00	8.37	0	0.00	0	0.00	0	0.00
6/16	7.68	2	0.26	8.76	1	0.11	0	0.00	0	0.00
6/17	6.74	0	0.00	8.02	0	0.00	0	0.00	0	0.00
6/18	8.88	0	0.00	7.33	4	0.55	0	0.00	0	0.00
6/19	8.22	0	0.00	5.82	19	3.26	0	0.00	0	0.00
6/20	8.73	0	0.00	7.51	6	0.80	0	0.00	0	0.00
6/21	8.70	0	0.00	8.05	14	1.74	0	0.00	0	0.00
6/22	6.20	0	0.00	6.10	17	2.78	0	0.00	0	0.00
6/23	8.10	2	0.25	5.77	10	1.73	0	0.00	0	0.00
6/24	7.52	0	0.00	8.32	5	0.60	0	0.00	0	0.00
6/25	8.38	0	0.00	6.94	2	0.29	0	0.00	0	0.00
6/26	6.99	0	0.00	7.12	2	0.28	0	0.00	0	0.00
6/27	5.90	0	0.00	6.69	0	0.00	0	0.00	0	0.00
6/28	7.68	0	0.00	8.07	2	0.25	0	0.00	0	0.00
6/29	8.28	0	0.00	6.09	5	0.82	0	0.00	0	0.00
6/30	8.34	0	0.00	7.91	1	0.13	0	0.00	0	0.00
7/01	8.56	0	0.00	8.73	0	0.00	0	0.00	0	0.00
7/02	7.77	1	0.13	7.42	0	0.00	0	0.00	0	0.00
7/03	5.06	0	0.00	5.09	1	0.20	0	0.00	0	0.00
7/04	8.06	0	0.00	8.80	3	0.34	0	0.00	0	0.00
7/05	7.74	1	0.13	7.61	15	1.97	0	0.00	0	0.00
7/06	5.73	1	0.17	4.02	4	0.99	0	0.00	0	0.00
7/07	7.77	0	0.00	8.25	8	0.97	0	0.00	0	0.00

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Date	Large mesh fathom hours	Chinook Catch	Chinook CPUE	Small mesh fathom hours	Summer chum Catch	Summer chum CPUE	Fall chum Catch	Fall chum CPUE	Coho Catch	Coho CPUE
7/08	7.22	0	0.00	7.55	1	0.13	0	0.00	0	0.00
7/09	7.43	1	0.13	7.84	2	0.26	0	0.00	0	0.00
7/10	8.52	0	0.00	8.11	10	1.23	0	0.00	0	0.00
7/11	7.68	0	0.00	7.34	18	2.45	0	0.00	0	0.00
7/12	8.07	0	0.00	8.77	14	1.60	0	0.00	0	0.00
7/13	6.85	0	0.00	7.30	16	2.19	0	0.00	0	0.00
7/14	8.01	0	0.00	7.82	5	0.64	0	0.00	0	0.00
7/15	7.35	1	0.14	8.44	6	0.71	0	0.00	0	0.00
7/16	8.00	0	0.00	8.14	5	0.61	0	0.00	0	0.00
7/17	7.69	0	0.00	8.11	8	0.99	0	0.00	0	0.00
7/18	8.23	0	0.00	6.73	2	0.30	0	0.00	0	0.00
7/19	2.85	0	0.00	8.32	0	0.00	4	0.48	0	0.00
7/20	2.68	0	0.00	8.20	0	0.00	4	0.49	0	0.00
7/21	2.80	0	0.00	7.91	0	0.00	0	0.00	0	0.00
7/22	3.19	0	0.00	8.03	0	0.00	1	0.12	0	0.00
7/23	2.98	0	0.00	8.30	0	0.00	3	0.36	0	0.00
7/24	2.61	0	0.00	8.51	0	0.00	0	0.00	0	0.00
7/25	2.98	0	0.00	8.43	0	0.00	0	0.00	0	0.00
7/26	3.25	0	0.00	9.13	0	0.00	1	0.11	0	0.00
7/27	2.66	0	0.00	8.27	0	0.00	0	0.00	0	0.00
7/28	2.94	0	0.00	8.10	0	0.00	0	0.00	0	0.00
7/29	2.53	0	0.00	8.35	0	0.00	2	0.24	0	0.00
7/30	2.87	0	0.00	8.56	0	0.00	1	0.12	0	0.00
7/31	2.75	0	0.00	7.93	0	0.00	1	0.13	0	0.00
8/01	2.88	0	0.00	8.30	0	0.00	3	0.36	0	0.00
8/02	2.86	0	0.00	8.23	0	0.00	2	0.24	0	0.00
8/03	3.67	0	0.00	7.71	0	0.00	0	0.00	0	0.00
8/04	2.90	0	0.00	7.75	0	0.00	0	0.00	0	0.00
8/05	1.81	0	0.00	8.91	0	0.00	0	0.00	0	0.00
8/06	2.96	0	0.00	8.49	0	0.00	0	0.00	0	0.00
8/07	2.91	0	0.00	7.97	0	0.00	8	1.00	0	0.00

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Appendix B2.–Page 3 of 3.

Date	Large mesh fathom hours	Chinook		Small mesh fathom hours	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
8/08	2.90	0	0.00	8.23	0	0.00	19	2.31	0	0.00
8/09	2.99	0	0.00	6.88	0	0.00	11	1.6	0	0.00
8/10	2.98	0	0.00	8.08	0	0.00	4	0.5	1	0.12
8/11	2.84	0	0.00	8.67	0	0.00	4	0.46	0	0.00
8/12	2.97	0	0.00	8.50	0	0.00	3	0.35	0	0.00
8/13	2.89	0	0.00	8.17	0	0.00	2	0.24	0	0.00
8/14	2.88	0	0.00	8.23	0	0.00	0	0	0	0.00
8/15	3.08	0	0.00	8.36	0	0.00	2	0.24	1	0.12
8/16	2.65	0	0.00	8.92	0	0.00	1	0.11	4	0.45
8/17	2.83	0	0.00	8.32	0	0.00	0	0	1	0.12
8/18	2.91	0	0.00	8.54	0	0.00	2	0.23	1	0.12
8/19	2.69	0	0.00	8.83	0	0.00	1	0.11	0	0.00
8/20	2.92	0	0.00	8.56	0	0.00	6	0.7	1	0.12
8/21	3.11	0	0.00	8.26	0	0.00	12	1.45	2	0.24
8/22	2.92	0	0.00	8.23	0	0.00	7	0.85	1	0.12
8/23	2.68	0	0.00	8.18	0	0.00	4	0.49	1	0.12
8/24	3.09	0	0.00	8.31	0	0.00	4	0.48	2	0.24
8/25	2.93	0	0.00	8.67	0	0.00	4	0.46	2	0.23
8/26	2.85	0	0.00	8.78	0	0.00	2	0.23	1	0.11
8/27	2.91	0	0.00	8.65	0	0.00	5	0.58	2	0.23
8/28	2.94	0	0.00	8.55	0	0.00	1	0.12	1	0.12
8/29	2.86	0	0.00	7.68	0	0.00	1	0.13	3	0.39
8/30	2.72	0	0.00	8.67	0	0.00	0	0	2	0.23
8/31	2.78	0	0.00	8.48	0	0.00	1	0.12	1	0.12
9/01	2.97	0	0.00	8.56	0	0.00	7	0.82	2	0.23
9/02	2.93	0	0.00	8.24	0	0.00	16	1.94	0	0.00
9/03	2.91	0	0.00	8.97	0	0.00	8	0.89	2	0.22
9/04	2.80	0	0.00	8.74	0	0.00	1	0.11	0	0.00
9/05	2.95	0	0.00	8.24	0	0.00	2	0.24	1	0.12
9/06	3.05	0	0.00	5.06	0	0.00	2	0.4	6	1.19
9/07	2.97	0	0.00	7.90	0	0.00	1	0.13	0	0.00
Total	472.46	9	1.21	746.09	206	28.92	163	19.94	38	4.96

APPENDIX C: DAILY FISH PASSAGE ESTIMATES BY ZONE WITH STANDARD ERRORS

Appendix C1.–Daily fish passage estimates by zone with standard errors (SE) at the Pilot Station sonar project on the Yukon River, 2023.

			Total		Percent by bank	
Date	Right bank	Left bank	Passage	SE	Right	Left
6/07	451	5,038	5,489	1,327	8.2	91.8
6/08	355	5,335	5,690	1,119	6.2	93.8
6/09	351	5,517	5,868	753	6.0	94.0
6/10	240	4,589	4,829	287	5.0	95.0
6/11	139	2,293	2,432	516	5.7	94.3
6/12	428	2,108	2,536	341	16.9	83.1
6/13	411	4,566	4,977	1,033	8.3	91.7
6/14	428	6,932	7,360	1,362	5.8	94.2
6/15	486	4,593	5,079	456	9.6	90.4
6/16	830	7,049	7,879	1,087	10.5	89.5
6/17	1,399	10,649	12,048	1,065	11.6	88.4
6/18	2,562	24,672	27,234	3,257	9.4	90.6
6/19	4,068	36,426	40,494	1,244	10.0	90.0
6/20	3,430	39,478	42,908	2,348	8.0	92.0
6/21	4,053	37,566	41,619	1,343	9.7	90.3
6/22	4,955	41,454	46,409	2,700	10.7	89.3
6/23	4,866	37,853	42,719	4,674	11.4	88.6
6/24	5,213	35,563	40,776	3,859	12.8	87.2
6/25	3,424	21,286	24,710	1,931	13.9	86.1
6/26	2,619	15,362	17,981	1,184	14.6	85.4
6/27	1,602	8,261	9,863	661	16.2	83.8
6/28	2,166	12,018	14,184	2,272	15.3	84.7
6/29	3,727	21,524	25,251	4,094	14.8	85.2
6/30	3,370	16,543	19,913	1,754	16.9	83.1
7/01	2,214	11,677	13,891	754	15.9	84.1
7/02	1,497	6,617	8,114	761	18.4	81.6
7/03	2,917	9,220	12,137	1,066	24.0	76.0
7/04	3,458	22,571	26,029	2,687	13.3	86.7
7/05	12,386	49,195	61,581	8,411	20.1	79.9
7/06	9,026	43,876	52,902	6,507	17.1	82.9
7/07	6,269	21,730	27,999	2,584	22.4	77.6
7/08	3,339	10,455	13,794	1,186	24.2	75.8
7/09	3,725	8,057	11,782	1,090	31.6	68.4
7/10	9,058	34,064	43,122	7,853	21.0	79.0
7/11	8,168	53,114	61,282	6,355	13.3	86.7
7/12	10,021	62,470	72,491	3,714	13.8	86.2
7/13	8,856	54,313	63,169	8,774	14.0	86.0
7/14	6,035	25,906	31,941	2,860	18.9	81.1
7/15	5,107	23,700	28,807	1,453	17.7	82.3
7/16	5,379	18,302	23,681	1,781	22.7	77.3
7/17	4,099	26,942	31,041	1,775	13.2	86.8
7/18	3,921	28,872	32,793	1,361	12.0	88.0
7/19	4,304	23,289	27,593	1,258	15.6	84.4
7/20	3,854	19,377	23,231	1,141	16.6	83.4
7/21	2,963	15,692	18,655	525	15.9	84.1
7/22	2,857	15,042	17,899	626	16.0	84.0
7/23	3,002	14,981	17,983	1,762	16.7	83.3

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Date	Right bank	Left bank	Total		Percent by bank	
			Passage	SE	Right	Left
7/24	3,456	15,177	18,633	1,047	18.5	81.5
7/25	2,225	11,506	13,731	682	16.2	83.8
7/26	2,058	11,431	13,489	524	15.3	84.7
7/27	2,206	11,508	13,714	408	16.1	83.9
7/28	2,664	12,223	14,887	793	17.9	82.1
7/29	2,464	18,789	21,253	1,273	11.6	88.4
7/30	2,239	15,091	17,330	873	12.9	87.1
7/31	2,075	11,952	14,027	381	14.8	85.2
8/01	2,257	14,481	16,738	879	13.5	86.5
8/02	2,362	18,204	20,566	1,022	11.5	88.5
8/03	1,422	14,463	15,885	291	9.0	91.0
8/04	829	12,984	13,813	587	6.0	94.0
8/05	935	9,484	10,419	585	9.0	91.0
8/06	1,538	11,829	13,367	418	11.5	88.5
8/07	2,262	17,674	19,936	2,793	11.3	88.7
8/08	3,740	39,301	43,041	4,420	8.7	91.3
8/09	5,754	56,037	61,791	3,663	9.3	90.7
8/10	3,868	31,233	35,101	3,254	11.0	89.0
8/11	3,527	15,063	18,590	953	19.0	81.0
8/12	3,345	9,782	13,127	846	25.5	74.5
8/13	2,938	7,169	10,107	430	29.1	70.9
8/14	2,313	6,310	8,623	258	26.8	73.2
8/15	3,843	6,683	10,526	528	36.5	63.5
8/16	3,664	7,210	10,874	733	33.7	66.3
8/17	2,764	5,782	8,546	665	32.3	67.7
8/18	2,483	4,221	6,704	946	37.0	63.0
8/19	1,395	7,516	8,911	788	15.7	84.3
8/20	1,835	12,819	14,654	1,304	12.5	87.5
8/21	2,916	27,002	29,918	2,694	9.7	90.3
8/22	2,859	22,187	25,046	1,677	11.4	88.6
8/23	2,497	16,690	19,187	1,369	13.0	87.0
8/24	2,368	12,494	14,862	1,025	15.9	84.1
8/25	1,741	10,592	12,333	340	14.1	85.9
8/26	2,033	9,188	11,221	450	18.1	81.9
8/27	2,089	7,116	9,205	776	22.7	77.3
8/28	1,920	5,718	7,638	351	25.1	74.9
8/29	1,718	6,628	8,346	567	20.6	79.4
8/30	1,755	6,268	8,023	485	21.9	78.1
8/31	1,802	5,347	7,149	446	25.2	74.8
9/01	2,448	7,219	9,667	993	25.3	74.7
9/02	2,194	15,935	18,129	1,001	12.1	87.9
9/03	2,823	8,546	11,369	1,538	24.8	75.2
9/04	2,696	6,076	8,772	301	30.7	69.3
9/05	2,715	3,831	6,546	201	41.5	58.5
9/06	2,552	2,242	4,794	408	53.2	46.8
9/07	1,653	2,485	4,138	179	39.9	60.1
Season	287,268	1,597,623	1,884,891	153,090	15.2	84.8

APPENDIX D: DAILY FISH PASSAGE ESTIMATES BY SPECIES

Appendix D1.–Daily fish passage estimates by species at the Pilot Station sonar project on the Yukon River, 2023.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
6/07	0	0	0	0	0	0	0	0	266	966	53	3,640	564	5,489
6/08	0	0	0	0	0	0	0	0	209	1,023	42	3,819	597	5,690
6/09	0	0	0	0	0	0	0	0	207	1,058	41	3,944	618	5,868
6/10	459	0	459	0	0	0	0	0	141	0	600	3,629	0	4,829
6/11	229	0	229	0	0	0	0	0	82	0	303	1,818	0	2,432
6/12	181	205	386	234	0	0	0	0	815	236	353	512	0	2,536
6/13	393	444	837	506	0	0	0	0	1,460	511	704	959	0	4,977
6/14	0	0	0	1,140	0	0	0	0	2,849	0	50	3,321	0	7,360
6/15	378	63	441	1,925	0	0	0	0	1,571	0	0	489	653	5,079
6/16	638	304	942	1,236	0	0	0	0	4,223	0	284	1,060	134	7,879
6/17	2,914	380	3,294	5,469	0	0	0	0	1,968	0	0	808	509	12,048
6/18	2,630	418	3,048	22,792	0	0	0	0	462	0	371	561	0	27,234
6/19	1,487	177	1,664	35,331	0	0	0	0	2,181	0	377	941	0	40,494
6/20	2,055	267	2,322	39,874	0	0	0	0	563	0	0	0	149	42,908
6/21	1,739	424	2,163	35,381	0	0	0	0	2,673	527	0	418	457	41,619
6/22	1,427	0	1,427	44,496	0	0	0	0	284	0	202	0	0	46,409
6/23	2,367	381	2,748	33,921	0	0	0	0	4,974	337	0	739	0	42,719
6/24	895	197	1,092	35,194	0	0	0	0	3,617	309	215	349	0	40,776
6/25	347	212	559	20,676	0	0	0	0	2,434	570	141	330	0	24,710
6/26	431	92	523	15,304	0	0	0	0	1,628	0	0	0	526	17,981
6/27	245	29	274	7,975	0	0	0	0	1,292	0	0	0	322	9,863
6/28	936	149	1,085	11,958	0	0	0	0	428	0	0	278	435	14,184
6/29	1,544	459	2,003	19,893	0	0	0	254	2,423	356	173	149	0	25,251
6/30	2,584	962	3,546	12,473	0	0	0	0	2,539	851	97	175	232	19,913
7/01	1,339	700	2,039	8,092	0	0	0	0	1,819	559	170	1,060	152	13,891
7/02	1,139	319	1,458	4,804	0	0	0	0	807	384	100	233	328	8,114
7/03	1,487	481	1,968	7,135	0	0	0	0	1,061	748	131	455	639	12,137
7/04	1,703	481	2,184	19,920	0	0	0	0	2,519	0	319	956	131	26,029

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Date	Chinook			Chum		Coho	Sockeye	Pink	Cisco	Whitefish		Sheefish	Other[c]	Total
	Large[a]	Small[b]	Total	Summer	Fall					Humpback	Broad			
7/05	2,554	1,109	3,663	52,026	0	0	0	1,128	2,237	2,045	0	380	102	61,581
7/06	2,437	1,026	3,463	44,894	0	0	0	895	1,713	1,575	0	288	74	52,902
7/07	1,280	324	1,604	18,229	0	0	0	0	7,199	0	0	967	0	27,999
7/08	672	181	853	8,945	0	0	0	0	2,131	1,468	0	323	74	13,794
7/09	852	0	852	6,731	0	0	0	172	1,844	1,483	0	617	83	11,782
7/10	652	888	1,540	37,746	0	0	0	0	2,242	791	0	803	0	43,122
7/11	1,225	917	2,142	56,516	0	0	0	0	416	1,162	0	195	851	61,282
7/12	2,164	511	2,675	64,169	0	0	0	0	4,949	698	0	0	0	72,491
7/13	1,263	0	1,263	56,158	0	0	0	0	4,183	768	0	0	797	63,169
7/14	1,314	360	1,674	24,182	0	0	0	225	4,148	0	392	542	778	31,941
7/15	724	655	1,379	19,410	0	269	0	0	5,336	902	851	292	368	28,807
7/16	110	0	110	17,474	0	0	780	286	2,163	1,768	833	0	267	23,681
7/17	232	0	232	25,380	0	0	0	427	4,310	692	0	0	0	31,041
7/18	0	0	0	28,399	0	0	0	0	1,893	2,317	0	184	0	32,793
7/19	0	192	192	0	15,837	0	1,203	177	7,129	2,394	0	661	0	27,593
7/20	0	0	0	0	13,475	0	0	362	5,327	3,229	201	0	637	23,231
7/21	0	0	0	0	4,992	0	917	0	6,635	5,211	176	235	489	18,655
7/22	0	0	0	0	4,533	0	580	358	2,523	9,207	415	79	204	17,899
7/23	0	196	196	0	5,363	0	747	99	2,155	7,739	783	901	0	17,983
7/24	0	0	0	0	7,646	133	630	0	3,565	4,660	374	1,062	563	18,633
7/25	0	0	0	0	3,159	0	370	0	4,571	4,694	133	804	0	13,731
7/26	0	0	0	0	4,593	0	298	0	3,081	4,891	194	432	0	13,489
7/27	0	0	0	0	2,312	0	274	0	2,281	7,986	529	332	0	13,714
7/28	0	0	0	0	2,355	0	0	0	870	10,217	948	497	0	14,887
7/29	0	0	0	0	9,608	0	435	0	1,158	9,565	324	163	0	21,253
7/30	0	0	0	0	6,428	0	422	0	3,129	6,471	0	194	686	17,330
7/31	0	0	0	0	1,915	0	315	111	2,412	8,553	161	248	312	14,027
8/01	0	0	0	0	5,480	0	253	394	3,472	6,613	411	115	0	16,738
8/02	0	0	0	0	12,249	200	150	0	2,179	4,790	196	81	721	20,566

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Date	Chinook			Chum					Whitefish					
	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
8/03	0	0	0	0	2,123	0	744	85	2,966	9,040	587	123	217	15,885
8/04	0	0	0	0	345	0	0	93	4,731	8,250	394	0	0	13,813
8/05	0	0	0	0	99	0	0	104	2,324	7,653	239	0	0	10,419
8/06	0	0	0	0	337	0	0	0	1,892	10,644	300	137	57	13,367
8/07	0	0	0	0	7,396	0	0	0	5,729	5,358	873	63	517	19,936
8/08	0	0	0	0	31,361	0	920	0	3,981	6,098	645	0	36	43,041
8/09	0	0	0	0	49,977	363	0	374	8,494	1,019	739	97	728	61,791
8/10	0	0	0	0	22,277	652	0	97	7,014	3,193	112	0	1,756	35,101
8/11	0	0	0	0	6,135	2,038	131	0	701	8,607	905	73	0	18,590
8/12	0	0	0	0	1,879	806	365	0	3,251	4,527	1,506	138	655	13,127
8/13	0	0	0	0	1,830	735	0	135	3,301	2,560	1,075	71	400	10,107
8/14	0	0	0	0	2,161	277	0	0	1,515	3,468	942	100	160	8,623
8/15	0	0	0	0	1,282	380	0	0	4,089	3,503	490	140	642	10,526
8/16	0	0	0	0	1,856	2,270	0	0	1,775	3,327	1,356	290	0	10,874
8/17	0	0	0	0	785	1,197	0	0	4,367	1,544	0	0	653	8,546
8/18	0	0	0	0	1,334	786	0	0	509	2,978	667	0	430	6,704
8/19	0	0	0	0	3,741	659	0	0	1,925	1,432	867	103	184	8,911
8/20	0	0	0	0	10,734	1,894	0	0	0	821	799	406	0	14,654
8/21	0	0	0	0	26,633	2,261	201	0	823	0	0	0	0	29,918
8/22	0	0	0	0	18,720	3,310	0	0	1,564	1,022	215	104	111	25,046
8/23	0	0	0	0	12,987	1,816	0	0	1,500	1,796	963	0	125	19,187
8/24	0	0	0	0	9,179	3,181	0	0	0	1,382	870	0	250	14,862
8/25	0	0	0	0	5,177	1,835	0	0	4,355	206	594	0	166	12,333
8/26	0	0	0	0	5,389	1,289	0	0	820	2,014	743	0	966	11,221
8/27	0	0	0	0	4,072	1,839	0	81	2,312	603	298	0	0	9,205
8/28	0	0	0	0	2,957	497	0	0	980	2,191	656	0	357	7,638
8/29	0	0	0	0	2,942	927	0	0	1,181	2,892	316	0	88	8,346
8/30	0	0	0	0	1,999	3,076	0	0	939	1,778	0	0	231	8,023
8/31	0	0	0	0	1,501	3,227	0	0	263	1,119	246	0	793	7,149

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	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
9/01	0	0	0	0	4,982	1,681	0	0	2,226	600	178	0	0	9,667
9/02	0	0	0	0	12,493	1,959	0	0	726	2,563	271	0	117	18,129
9/03	0	0	0	0	6,107	2,366	0	0	2,165	0	562	0	169	11,369
9/04	0	0	0	0	4,269	2,728	0	0	817	482	90	0	386	8,772
9/05	0	0	0	0	2,164	2,378	0	0	991	496	154	0	363	6,546
9/06	0	0	0	0	1,505	1,813	0	0	679	350	106	0	341	4,794
9/07	0	0	0	0	1,342	855	0	0	866	208	68	0	799	4,138
Total	45,026	13,503	58,529	845,988	370,015	49,697	5,857	9,735	222,517	224,048	30,473	42,883	25,149	1,884,891

[a] Chinook salmon >655 mm mid eye to tail fork (METF).

[b] Chinook salmon ≤655 mm METF.

[c] Includes cisco, whitefish, sheefish, burbot, longnose sucker, Dolly Varden, and northern pike.

APPENDIX E: DAILY CUMULATIVE FISH PASSAGE PROPORTIONS AND TIMING BY SPECIES

Appendix E1.–Daily cumulative fish passage proportions and timing by species at the Pilot Station sonar project on the Yukon River, 2023.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
6/07	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.002	0.085	0.022	0.003
6/08	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.009	0.003	0.174	0.046	0.006
6/09	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.014	0.004	**0.266**	0.071	0.009
6/10	0.010	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.004	0.014	0.024	0.351	0.071	0.012
6/11	0.015	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.004	0.014	0.034	0.393	0.071	0.013
6/12	0.019	0.015	0.018	0.000	0.000	0.000	0.000	0.000	0.008	0.015	0.046	0.405	0.071	0.014
6/13	0.028	0.048	0.033	0.001	0.000	0.000	0.000	0.000	0.014	0.017	0.069	0.427	0.071	0.017
6/14	0.028	0.048	0.033	0.002	0.000	0.000	0.000	0.000	0.027	0.017	0.070	**0.505**	0.071	0.021
6/15	0.036	0.053	0.040	0.004	0.000	0.000	0.000	0.000	0.034	0.017	0.070	0.516	0.097	0.023
6/16	0.051	0.075	0.056	0.006	0.000	0.000	0.000	0.000	0.053	0.017	0.080	0.541	0.102	0.028
6/17	0.115	0.103	0.113	0.012	0.000	0.000	0.000	0.000	0.062	0.017	0.080	0.560	0.122	0.034
6/18	0.174	0.134	0.165	0.039	0.000	0.000	0.000	0.000	0.064	0.017	0.092	0.573	0.122	0.049
6/19	0.207	0.147	0.193	0.081	0.000	0.000	0.000	0.000	0.074	0.017	0.104	0.595	0.122	0.070
6/20	**0.252**	0.167	0.233	0.128	0.000	0.000	0.000	0.000	0.076	0.017	0.104	0.595	0.128	0.093
6/21	0.291	0.199	**0.270**	0.170	0.000	0.000	0.000	0.000	0.088	0.019	0.104	0.604	0.146	0.115
6/22	0.323	0.199	0.294	0.223	0.000	0.000	0.000	0.000	0.090	0.019	0.111	0.604	0.146	0.139
6/23	0.375	0.227	0.341	**0.263**	0.000	0.000	0.000	0.000	0.112	0.021	0.111	0.622	0.146	0.162
6/24	0.395	0.241	0.360	0.304	0.000	0.000	0.000	0.000	0.128	0.022	0.118	0.630	0.146	0.184
6/25	0.403	**0.257**	0.369	0.329	0.000	0.000	0.000	0.000	0.139	0.025	0.123	0.637	0.146	0.197
6/26	0.412	0.264	0.378	0.347	0.000	0.000	0.000	0.000	0.147	0.025	0.123	0.637	0.167	0.206
6/27	0.418	0.266	0.383	0.356	0.000	0.000	0.000	0.000	0.152	0.025	0.123	0.637	0.180	0.212
6/28	0.439	0.277	0.401	0.370	0.000	0.000	0.000	0.000	0.154	0.025	0.123	0.644	0.197	0.219
6/29	0.473	0.311	0.436	0.394	0.000	0.000	0.000	0.043	0.165	0.026	0.128	0.647	0.197	0.233
6/30	**0.530**	0.382	0.496	0.409	0.000	0.000	0.000	0.043	0.177	0.030	0.131	0.652	0.207	0.243
7/01	0.560	0.434	**0.531**	0.418	0.000	0.000	0.000	0.043	0.185	0.033	0.137	0.676	0.213	**0.250**
7/02	0.585	0.458	0.556	0.424	0.000	0.000	0.000	0.043	0.188	0.034	0.140	0.682	0.226	0.255
7/03	0.618	0.493	0.590	0.432	0.000	0.000	0.000	0.043	0.193	0.038	0.145	0.692	**0.251**	0.261
7/04	0.656	**0.529**	0.627	0.456	0.000	0.000	0.000	0.043	0.204	0.038	0.155	0.715	0.256	0.275
7/05	0.713	0.611	0.689	**0.517**	0.000	0.000	0.000	0.236	0.215	0.047	0.155	0.723	0.260	0.308
7/06	**0.767**	0.687	0.749	0.571	0.000	0.000	0.000	**0.389**	0.222	0.054	0.155	0.730	0.263	0.336
7/07	0.795	0.711	**0.776**	0.592	0.000	0.000	0.000	0.389	**0.255**	0.054	0.155	**0.753**	0.263	0.351
7/08	0.810	0.725	0.791	0.603	0.000	0.000	0.000	0.389	0.264	0.060	0.155	0.760	0.266	0.358
7/09	0.829	0.725	0.805	0.611	0.000	0.000	0.000	0.418	0.272	0.067	0.155	0.775	0.270	0.364
7/10	0.844	**0.790**	0.831	0.655	0.000	0.000	0.000	0.418	0.282	0.071	0.155	0.793	0.270	0.387
7/11	0.871	0.858	0.868	0.722	0.000	0.000	0.000	0.418	0.284	0.076	0.155	0.798	0.303	0.420

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Appendix E1.–Page 2 of 3.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
7/12	0.919	0.896	0.914	**0.798**	0.000	0.000	0.000	0.418	0.307	0.079	0.155	0.798	0.303	0.458
7/13	0.947	0.896	0.935	0.864	0.000	0.000	0.000	0.418	0.325	0.082	0.155	0.798	0.335	0.492
7/14	0.976	0.923	0.964	0.893	0.000	0.000	0.000	0.457	0.344	0.082	0.168	0.811	0.366	**0.509**
7/15	0.992	0.971	0.988	0.916	0.000	0.005	0.000	0.457	0.368	0.086	0.196	0.817	0.381	0.524
7/16	0.995	0.971	0.989	0.936	0.000	0.005	0.080	**0.505**	0.378	0.094	0.223	0.817	0.391	0.536
7/17	1.000	0.971	0.993	0.966	0.000	0.005	0.080	0.578	0.397	0.097	0.223	0.817	0.391	0.553
7/18	1.000	0.971	0.993	1.000	0.000	0.005	0.080	0.578	0.406	0.108	0.223	0.822	0.391	0.570
7/19	1.000	0.985	0.997	1.000	0.043	0.005	0.204	0.609	0.438	0.118	0.223	0.837	0.391	0.585
7/20	1.000	0.985	0.997	1.000	0.079	0.005	0.204	0.670	0.462	0.133	0.230	0.837	0.417	0.597
7/21	1.000	0.985	0.997	1.000	0.093	0.005	**0.298**	0.670	0.491	0.156	0.236	0.843	0.436	0.607
7/22	1.000	0.985	0.997	1.000	0.105	0.005	0.357	0.731	**0.503**	0.197	0.249	0.844	0.444	0.617
7/23	1.000	1.000	1.000	1.000	0.119	0.005	0.434	0.748	0.512	0.232	**0.275**	0.865	0.444	0.626
7/24	1.000	1.000	1.000	1.000	0.140	0.008	0.499	0.748	0.528	**0.252**	0.287	0.890	0.467	0.636
7/25	1.000	1.000	1.000	1.000	0.149	0.008	**0.537**	0.748	0.549	0.273	0.292	0.909	0.467	0.643
7/26	1.000	1.000	1.000	1.000	0.161	0.008	0.568	0.748	0.563	0.295	0.298	0.919	0.467	0.650
7/27	1.000	1.000	1.000	1.000	0.167	0.008	0.596	0.748	0.573	0.331	0.315	0.927	0.467	0.658
7/28	1.000	1.000	1.000	1.000	0.174	0.008	0.596	0.748	0.577	0.376	0.346	0.938	0.467	0.666
7/29	1.000	1.000	1.000	1.000	0.200	0.008	0.640	0.748	0.582	0.419	0.357	0.942	0.467	0.677
7/30	1.000	1.000	1.000	1.000	0.217	0.008	0.684	0.748	0.596	0.448	0.357	0.947	0.494	0.686
7/31	1.000	1.000	1.000	1.000	0.222	0.008	0.716	**0.767**	0.607	0.486	0.362	0.952	**0.506**	0.694
8/01	1.000	1.000	1.000	1.000	0.237	0.008	0.742	0.835	0.623	**0.516**	0.376	0.955	0.506	0.702
8/02	1.000	1.000	1.000	1.000	**0.270**	0.012	**0.757**	0.835	0.633	0.537	0.382	0.957	0.535	0.713
8/03	1.000	1.000	1.000	1.000	0.276	0.012	0.834	0.849	0.646	0.577	0.401	0.960	0.544	0.722
8/04	1.000	1.000	1.000	1.000	0.277	0.012	0.834	0.865	0.667	0.614	0.414	0.960	0.544	0.729
8/05	1.000	1.000	1.000	1.000	0.277	0.012	0.834	0.883	0.678	0.648	0.422	0.960	0.544	0.735
8/06	1.000	1.000	1.000	1.000	0.278	0.012	0.834	0.883	0.686	0.696	0.432	0.963	0.546	0.742
8/07	1.000	1.000	1.000	1.000	0.298	0.012	0.834	0.883	0.712	0.720	0.461	0.965	0.566	**0.752**
8/08	1.000	1.000	1.000	1.000	0.383	0.012	0.928	0.883	0.730	0.747	0.482	0.965	0.568	0.775
8/09	1.000	1.000	1.000	1.000	**0.518**	0.019	0.928	0.947	**0.768**	**0.752**	**0.506**	0.967	0.597	0.808
8/10	1.000	1.000	1.000	1.000	0.578	0.033	0.928	0.963	0.799	0.766	0.510	0.967	0.667	0.827
8/11	1.000	1.000	1.000	1.000	0.595	0.074	0.942	0.963	0.803	0.804	0.540	0.968	0.667	0.836
8/12	1.000	1.000	1.000	1.000	0.600	0.090	0.979	0.963	0.817	0.824	0.589	0.972	0.693	0.843
8/13	1.000	1.000	1.000	1.000	0.605	0.105	0.979	0.986	0.832	0.836	0.624	0.973	0.708	0.849
8/14	1.000	1.000	1.000	1.000	0.610	0.110	0.979	0.986	0.839	0.851	0.655	0.976	0.715	0.853
8/15	1.000	1.000	1.000	1.000	0.614	0.118	0.979	0.986	0.857	0.867	0.671	0.979	0.740	0.859

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	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
8/16	1.000	1.000	1.000	1.000	0.619	0.163	0.979	0.986	0.865	0.882	0.716	0.986	0.740	0.865
8/17	1.000	1.000	1.000	1.000	0.621	0.188	0.979	0.986	0.885	0.889	0.716	0.986	**0.766**	0.869
8/18	1.000	1.000	1.000	1.000	0.625	0.203	0.979	0.986	0.887	0.902	0.738	0.986	0.783	0.873
8/19	1.000	1.000	1.000	1.000	0.635	0.217	0.979	0.986	0.896	0.908	**0.766**	0.988	0.791	0.877
8/20	1.000	1.000	1.000	1.000	0.664	**0.255**	0.979	0.986	0.896	0.912	0.792	0.998	0.791	0.885
8/21	1.000	1.000	1.000	1.000	0.736	0.300	1.000	0.986	0.899	0.912	0.792	0.998	0.791	0.901
8/22	1.000	1.000	1.000	1.000	**0.786**	0.367	1.000	0.986	0.906	0.917	0.799	1.000	0.795	0.914
8/23	1.000	1.000	1.000	1.000	0.821	0.403	1.000	0.986	0.913	0.925	0.831	1.000	0.800	0.925
8/24	1.000	1.000	1.000	1.000	0.846	0.467	1.000	0.986	0.913	0.931	0.859	1.000	0.810	0.932
8/25	1.000	1.000	1.000	1.000	0.860	**0.504**	1.000	0.986	0.933	0.932	0.879	1.000	0.817	0.939
8/26	1.000	1.000	1.000	1.000	0.875	0.530	1.000	0.986	0.936	0.941	0.903	1.000	0.855	0.945
8/27	1.000	1.000	1.000	1.000	0.886	0.567	1.000	1.000	0.947	0.943	0.913	1.000	0.855	0.950
8/28	1.000	1.000	1.000	1.000	0.894	0.577	1.000	1.000	0.951	0.953	0.935	1.000	0.869	0.954
8/29	1.000	1.000	1.000	1.000	0.902	0.596	1.000	1.000	0.957	0.966	0.945	1.000	0.873	0.958
8/30	1.000	1.000	1.000	1.000	0.907	0.658	1.000	1.000	0.961	0.974	0.945	1.000	0.882	0.963
8/31	1.000	1.000	1.000	1.000	0.911	0.723	1.000	1.000	0.962	0.979	0.953	1.000	0.914	0.966
9/01	1.000	1.000	1.000	1.000	0.925	**0.757**	1.000	1.000	0.972	0.982	0.959	1.000	0.914	0.971
9/02	1.000	1.000	1.000	1.000	0.958	0.796	1.000	1.000	0.975	0.993	0.968	1.000	0.918	0.981
9/03	1.000	1.000	1.000	1.000	0.975	0.844	1.000	1.000	0.985	0.993	0.986	1.000	0.925	0.987
9/04	1.000	1.000	1.000	1.000	0.986	0.898	1.000	1.000	0.989	0.995	0.989	1.000	0.940	0.992
9/05	1.000	1.000	1.000	1.000	0.992	0.946	1.000	1.000	0.993	0.998	0.994	1.000	0.955	0.995
9/06	1.000	1.000	1.000	1.000	0.996	0.983	1.000	1.000	0.996	0.999	0.998	1.000	0.968	0.998
9/07	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Note: The 25th, 50th, and 75th percentiles are bold. The mean cumulative run timing for both fall chum and coho salmon was based on run timing from July 19 through August 31 in order to compare timing across years, despite years when the project was in operation until September 7.

[a] Chinook salmon >655 mm mid eye to tail fork (METF).

[b] Chinook salmon ≤655 mm METF.

[c] Includes burbot, longnose sucker, Dolly Varden, and northern pike.

APPENDIX F: DAILY CUMULATIVE FISH PASSAGE ESTIMATES BY SPECIES AT THE PILOT STATION SONAR PROJECT ON THE YUKON RIVER

Appendix F1.–Daily cumulative fish passage estimates at the Pilot Station sonar project on the Yukon River, 2023.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
6/07	0	0	0	0	0	0	0	0	266	966	53	3,640	564	5,489
6/08	0	0	0	0	0	0	0	0	475	1,989	95	7,459	1,161	11,179
6/09	0	0	0	0	0	0	0	0	682	3,047	136	11,403	1,779	17,047
6/10	459	0	459	0	0	0	0	0	823	3,047	736	15,032	1,779	21,876
6/11	688	0	688	0	0	0	0	0	905	3,047	1,039	16,850	1,779	24,308
6/12	869	205	1,074	234	0	0	0	0	1,720	3,283	1,392	17,362	1,779	26,844
6/13	1,262	649	1,911	740	0	0	0	0	3,180	3,794	2,096	18,321	1,779	31,821
6/14	1,262	649	1,911	1,880	0	0	0	0	6,029	3,794	2,146	21,642	1,779	39,181
6/15	1,640	712	2,352	3,805	0	0	0	0	7,600	3,794	2,146	22,131	2,432	44,260
6/16	2,278	1,016	3,294	5,041	0	0	0	0	11,823	3,794	2,430	23,191	2,566	52,139
6/17	5,192	1,396	6,588	10,510	0	0	0	0	13,791	3,794	2,430	23,999	3,075	64,187
6/18	7,822	1,814	9,636	33,302	0	0	0	0	14,253	3,794	2,801	24,560	3,075	91,421
6/19	9,309	1,991	11,300	68,633	0	0	0	0	16,434	3,794	3,178	25,501	3,075	131,915
6/20	11,364	2,258	13,622	108,507	0	0	0	0	16,997	3,794	3,178	25,501	3,224	174,823
6/21	13,103	2,682	15,785	143,888	0	0	0	0	19,670	4,321	3,178	25,919	3,681	216,442
6/22	14,530	2,682	17,212	188,384	0	0	0	0	19,954	4,321	3,380	25,919	3,681	262,851
6/23	16,897	3,063	19,960	222,305	0	0	0	0	24,928	4,658	3,380	26,658	3,681	305,570
6/24	17,792	3,260	21,052	257,499	0	0	0	0	28,545	4,967	3,595	27,007	3,681	346,346
6/25	18,139	3,472	21,611	278,175	0	0	0	0	30,979	5,537	3,736	27,337	3,681	371,056
6/26	18,570	3,564	22,134	293,479	0	0	0	0	32,607	5,537	3,736	27,337	4,207	389,037
6/27	18,815	3,593	22,408	301,454	0	0	0	0	33,899	5,537	3,736	27,337	4,529	398,900
6/28	19,751	3,742	23,493	313,412	0	0	0	0	34,327	5,537	3,736	27,615	4,964	413,084
6/29	21,295	4,201	25,496	333,305	0	0	0	254	36,750	5,893	3,909	27,764	4,964	438,335
6/30	23,879	5,163	29,042	345,778	0	0	0	254	39,289	6,744	4,006	27,939	5,196	458,248
7/01	25,218	5,863	31,081	353,870	0	0	0	254	41,108	7,303	4,176	28,999	5,348	472,139
7/02	26,357	6,182	32,539	358,674	0	0	0	254	41,915	7,687	4,276	29,232	5,676	480,253
7/03	27,844	6,663	34,507	365,809	0	0	0	254	42,976	8,435	4,407	29,687	6,315	492,390
7/04	29,547	7,144	36,691	385,729	0	0	0	254	45,495	8,435	4,726	30,643	6,446	518,419
7/05	32,101	8,253	40,354	437,755	0	0	0	1,382	47,732	10,480	4,726	31,023	6,548	580,000
7/06	34,538	9,279	43,817	482,649	0	0	0	2,277	49,445	12,055	4,726	31,311	6,622	632,902
7/07	35,818	9,603	45,421	500,878	0	0	0	2,277	56,644	12,055	4,726	32,278	6,622	660,901

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	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
7/08	36,490	9,784	46,274	509,823	0	0	0	2,277	58,775	13,523	4,726	32,601	6,696	674,695
7/09	37,342	9,784	47,126	516,554	0	0	0	2,449	60,619	15,006	4,726	33,218	6,779	686,477
7/10	37,994	10,672	48,666	554,300	0	0	0	2,449	62,861	15,797	4,726	34,021	6,779	729,599
7/11	39,219	11,589	50,808	610,816	0	0	0	2,449	63,277	16,959	4,726	34,216	7,630	790,881
7/12	41,383	12,100	53,483	674,985	0	0	0	2,449	68,226	17,657	4,726	34,216	7,630	863,372
7/13	42,646	12,100	54,746	731,143	0	0	0	2,449	72,409	18,425	4,726	34,216	8,427	926,541
7/14	43,960	12,460	56,420	755,325	0	0	0	2,674	76,557	18,425	5,118	34,758	9,205	958,482
7/15	44,684	13,115	57,799	774,735	0	269	0	2,674	81,893	19,327	5,969	35,050	9,573	987,289
7/16	44,794	13,115	57,909	792,209	0	269	780	2,960	84,056	21,095	6,802	35,050	9,840	1,010,970
7/17	45,026	13,115	58,141	817,589	0	269	780	3,387	88,366	21,787	6,802	35,050	9,840	1,042,011
7/18	45,026	13,115	58,141	845,988	0	269	780	3,387	90,259	24,104	6,802	35,234	9,840	1,074,804
7/19	45,026	13,307	58,333	845,988	15,837	269	1,983	3,564	97,388	26,498	6,802	35,895	9,840	1,102,397
7/20	45,026	13,307	58,333	845,988	29,312	269	1,983	3,926	102,715	29,727	7,003	35,895	10,477	1,125,628
7/21	45,026	13,307	58,333	845,988	34,304	269	2,900	3,926	109,350	34,938	7,179	36,130	10,966	1,144,283
7/22	45,026	13,307	58,333	845,988	38,837	269	3,480	4,284	111,873	44,145	7,594	36,209	11,170	1,162,182
7/23	45,026	13,503	58,529	845,988	44,200	269	4,227	4,383	114,028	51,884	8,377	37,110	11,170	1,180,165
7/24	45,026	13,503	58,529	845,988	51,846	402	4,857	4,383	117,593	56,544	8,751	38,172	11,733	1,198,798
7/25	45,026	13,503	58,529	845,988	55,005	402	5,227	4,383	122,164	61,238	8,884	38,976	11,733	1,212,529
7/26	45,026	13,503	58,529	845,988	59,598	402	5,525	4,383	125,245	66,129	9,078	39,408	11,733	1,226,018
7/27	45,026	13,503	58,529	845,988	61,910	402	5,799	4,383	127,526	74,115	9,607	39,740	11,733	1,239,732
7/28	45,026	13,503	58,529	845,988	64,265	402	5,799	4,383	128,396	84,332	10,555	40,237	11,733	1,254,619
7/29	45,026	13,503	58,529	845,988	73,873	402	6,234	4,383	129,554	93,897	10,879	40,400	11,733	1,275,872
7/30	45,026	13,503	58,529	845,988	80,301	402	6,656	4,383	132,683	100,368	10,879	40,594	12,419	1,293,202
7/31	45,026	13,503	58,529	845,988	82,216	402	6,971	4,494	135,095	108,921	11,040	40,842	12,731	1,307,229
8/01	45,026	13,503	58,529	845,988	87,696	402	7,224	4,888	138,567	115,534	11,451	40,957	12,731	1,323,967
8/02	45,026	13,503	58,529	845,988	99,945	602	7,374	4,888	140,746	120,324	11,647	41,038	13,452	1,344,533
8/03	45,026	13,503	58,529	845,988	102,068	602	8,118	4,973	143,712	129,364	12,234	41,161	13,669	1,360,418
8/04	45,026	13,503	58,529	845,988	102,413	602	8,118	5,066	148,443	137,614	12,628	41,161	13,669	1,374,231
8/05	45,026	13,503	58,529	845,988	102,512	602	8,118	5,170	150,767	145,267	12,867	41,161	13,669	1,384,650
8/06	45,026	13,503	58,529	845,988	102,849	602	8,118	5,170	152,659	155,911	13,167	41,298	13,726	1,398,017
8/07	45,026	13,503	58,529	845,988	110,245	602	8,118	5,170	158,388	161,269	14,040	41,361	14,243	1,417,953

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	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
8/08	45,026	13,503	58,529	845,988	141,606	602	9,038	5,170	162,369	167,367	14,685	41,361	14,279	1,460,994
8/09	45,026	13,503	58,529	845,988	191,583	965	9,038	5,544	170,863	168,386	15,424	41,458	15,007	1,522,785
8/10	45,026	13,503	58,529	845,988	213,860	1,617	9,038	5,641	177,877	171,579	15,536	41,458	16,763	1,557,886
8/11	45,026	13,503	58,529	845,988	219,995	3,655	9,169	5,641	178,578	180,186	16,441	41,531	16,763	1,576,476
8/12	45,026	13,503	58,529	845,988	221,874	4,461	9,534	5,641	181,829	184,713	17,947	41,669	17,418	1,589,603
8/13	45,026	13,503	58,529	845,988	223,704	5,196	9,534	5,776	185,130	187,273	19,022	41,740	17,818	1,599,710
8/14	45,026	13,503	58,529	845,988	225,865	5,473	9,534	5,776	186,645	190,741	19,964	41,840	17,978	1,608,333
8/15	45,026	13,503	58,529	845,988	227,147	5,853	9,534	5,776	190,734	194,244	20,454	41,980	18,620	1,618,859
8/16	45,026	13,503	58,529	845,988	229,003	8,123	9,534	5,776	192,509	197,571	21,810	42,270	18,620	1,629,733
8/17	45,026	13,503	58,529	845,988	229,788	9,320	9,534	5,776	196,876	199,115	21,810	42,270	19,273	1,638,279
8/18	45,026	13,503	58,529	845,988	231,122	10,106	9,534	5,776	197,385	202,093	22,477	42,270	19,703	1,644,983
8/19	45,026	13,503	58,529	845,988	234,863	10,765	9,534	5,776	199,310	203,525	23,344	42,373	19,887	1,653,894
8/20	45,026	13,503	58,529	845,988	245,597	12,659	9,534	5,776	199,310	204,346	24,143	42,779	19,887	1,668,548
8/21	45,026	13,503	58,529	845,988	272,230	14,920	9,735	5,776	200,133	204,346	24,143	42,779	19,887	1,698,466
8/22	45,026	13,503	58,529	845,988	290,950	18,230	9,735	5,776	201,697	205,368	24,358	42,883	19,998	1,723,512
8/23	45,026	13,503	58,529	845,988	303,937	20,046	9,735	5,776	203,197	207,164	25,321	42,883	20,123	1,742,699
8/24	45,026	13,503	58,529	845,988	313,116	23,227	9,735	5,776	203,197	208,546	26,191	42,883	20,373	1,757,561
8/25	45,026	13,503	58,529	845,988	318,293	25,062	9,735	5,776	207,552	208,752	26,785	42,883	20,539	1,769,894
8/26	45,026	13,503	58,529	845,988	323,682	26,351	9,735	5,776	208,372	210,766	27,528	42,883	21,505	1,781,115
8/27	45,026	13,503	58,529	845,988	327,754	28,190	9,735	5,857	210,684	211,369	27,826	42,883	21,505	1,790,320
8/28	45,026	13,503	58,529	845,988	330,711	28,687	9,735	5,857	211,664	213,560	28,482	42,883	21,862	1,797,958
8/29	45,026	13,503	58,529	845,988	333,653	29,614	9,735	5,857	212,845	216,452	28,798	42,883	21,950	1,806,304
8/30	45,026	13,503	58,529	845,988	335,652	32,690	9,735	5,857	213,784	218,230	28,798	42,883	22,181	1,814,327
8/31	45,026	13,503	58,529	845,988	337,153	35,917	9,735	5,857	214,047	219,349	29,044	42,883	22,974	1,821,476
9/01	45,026	13,503	58,529	845,988	342,135	37,598	9,735	5,857	216,273	219,949	29,222	42,883	22,974	1,831,143
9/02	45,026	13,503	58,529	845,988	354,628	39,557	9,735	5,857	216,999	222,512	29,493	42,883	23,091	1,849,272
9/03	45,026	13,503	58,529	845,988	360,735	41,923	9,735	5,857	219,164	222,512	30,055	42,883	23,260	1,860,641
9/04	45,026	13,503	58,529	845,988	365,004	44,651	9,735	5,857	219,981	222,994	30,145	42,883	23,646	1,869,413
9/05	45,026	13,503	58,529	845,988	367,168	47,029	9,735	5,857	220,972	223,490	30,299	42,883	24,009	1,875,959
9/06	45,026	13,503	58,529	845,988	368,673	48,842	9,735	5,857	221,651	223,840	30,405	42,883	24,350	1,880,753
9/07	45,026	13,503	58,529	845,988	370,015	49,697	9,735	5,857	222,517	224,048	30,473	42,883	25,149	1,884,891

Note: The mean cumulative run timing for both fall chum and coho salmon was based on run timing from July 19 through August 31 in order to compare timing across years, despite years when the project was in operation until September 7.

[a] Chinook salmon >655 mm mid eye to tail fork (METF).

[b] Chinook salmon ≤655 mm METF.

[c] Includes sockeye salmon, burbot, longnose sucker, Dolly Varden, and northern pike.

APPENDIX G: PILOT STATION SONAR FISH PASSAGE ESTIMATES BY SPECIES, 1995–2023

Appendix G1.–Salmon passage estimates, by species, at the Pilot Station sonar project on the Yukon River, 1995–2023.

	Chinook			Chum						
Year[a]	Large[b]	Small[c]	Total	Summer	Fall[d]	Total	Coho[d]	Pink	Sockeye	Total
1995	164,867	45,874	210,741	3,632,179	1,156,278	4,788,457	119,893	53,277	–	5,172,368
1997[e]	114,519	85,244	199,763	1,359,117	579,767	1,938,884	118,065	3,872	–	2,260,584
1998	88,129	19,909	108,038	824,901	375,222	1,200,123	146,365	103,416	–	1,557,942
1999	159,805	24,413	184,218	969,459	451,505	1,420,964	76,174	3,947	–	1,685,303
2000	48,321	6,239	54,560	448,665	273,206	721,871	206,365	61,389	–	1,044,185
2001[f]	104,060	17,029	121,089	442,546	408,961	851,507	160,272	2,846	–	1,135,714
2002	111,290	40,423	151,713	1,097,769	367,886	1,465,655	137,077	123,698	–	1,878,143
2003	287,729	30,359	318,088	1,183,009	923,540	2,106,549	280,552	11,370	–	2,716,559
2004	138,317	62,444	200,761	1,344,213	633,368	1,977,581	207,844	399,339	–	2,785,525
2005[g]	165,349	22,527	187,876	2,384,645	1,893,688	4,278,333	194,372	61,091	–	4,721,672
2006	192,296	36,467	228,763	3,780,760	964,238	4,744,998	163,889	183,006	–	5,320,656
2007	119,622	50,624	170,246	1,875,491	740,195	2,615,686	192,406	126,282	–	3,104,620
2008	138,220	36,826	175,046	1,849,553	636,525	2,486,078	145,378	580,127	–	3,386,629
2009[f]	128,154	49,642	177,796	1,477,186	274,227	1,751,413	240,779	34,529	–	2,204,517
2010	112,605	25,294	137,899	1,423,372	458,103	1,881,475	177,724	919,036	–	3,116,134
2011	117,213	31,584	148,797	2,051,501	873,877	2,925,378	149,533	9,754	–	3,233,462
2012	106,529	21,026	127,555	2,136,476	778,158	2,914,634	130,734	420,344	–	3,593,267
2013	120,536	16,269	136,805	2,849,683	865,295	3,714,978	110,515	6,126	–	3,968,424
2014	120,060	43,835	163,895	2,020,309	706,630	2,726,939	283,421	679,126	–	3,853,381
2015	105,063	41,796	146,859	1,591,505	669,483	2,260,988	121,193	39,690	–	2,568,730
2016	135,013	41,885	176,898	1,921,748	994,760	2,916,508	168,297	1,364,849	–	4,626,552
2017	217,821	45,193	263,014	3,093,735	1,829,931	4,923,666	166,320	166,529	–	5,519,529
2018	122,394	39,437	161,831	1,612,688	928,664	2,541,352	136,347	689,607	–	3,529,137
2019	172,242	47,382	219,624	1,402,925	842,041	2,244,966	86,401	42,353	–	2,593,344
2020	124,905	37,347	162,252	692,602	262,439	955,041	107,680	207,942	–	1,432,915
2021	104,267	20,578	124,845	153,718	146,197	299,915	22,181	37,255	–	484,196
2022	33,159	15,280	48,439	463,806	325,717	789,523	92,102	158,767	4,184	1,093,015
2023[h]	45,026	13,503	58,529	845,988	370,015	1,216,003	49,697	9,735	5,857	1,339,821

Note: En dash means no data.

[a] Estimates for all years were generated with the most current apportionment model and may differ from earlier estimates.

[b] Chinook salmon >655 mm mid eye to tail fork (METF).

[c] Chinook salmon ≤655 mm METF.

[d] This estimate may not include the entire run. However, in 2008 through 2014, 2018, and 2020 through 2022, operations were extended to September 7 instead of the usual end date of August 31.

[e] The Pilot Station sonar project did not operate at full capacity in 1996, and there are no passage estimates for this year.

[f] High water levels were experienced at Pilot Station; therefore, passage estimates are considered conservative.

[g] Estimates include extrapolations for the dates June 10 to June 18 to account for the time before the DIDSON was deployed.

[h] 2022 was the first year of sockeye salmon were apportioned at the project.

Appendix G2.–Other passage estimates, by species, at the Pilot Station sonar project on the Yukon River, 1995–2023.

		Whitefish				
Year[a]	Cisco	Humpback	Broad	Sheefish	Other[b]	Total
1995	312,907	27,788	297,888	37,322	32,842	708,747
1996[c]	–	–	–	–	–	–
1997	214,397	106,845	16,270	20,464	18,865	376,841
1998	118,820	57,477	6,489	13,513	14,378	210,677
1999	170,377	124,257	13,214	11,383	18,470	337,701
2000	167,897	66,479	7,362	9,725	11,164	262,627
2001[d]	150,350	76,722	6,848	18,894	12,935	265,749
2002	208,230	130,800	16,826	20,359	29,319	405,534
2003	123,129	169,423	31,368	20,902	34,829	379,651
2004	195,371	128,092	18,062	17,990	32,424	391,939
2005[e]	194,677	84,102	8,137	17,109	60,225	364,250
2006	258,877	188,407	18,768	37,875	27,120	531,047
2007	321,498	266,215	26,568	63,639	83,737	761,657
2008	150,308	101,799	10,104	32,399	11,615	306,225
2009[d]	257,549	231,742	24,532	33,424	42,669	589,916
2010	281,456	175,749	19,835	49,250	41,164	567,454
2011	242,950	152,164	14,671	25,139	18,613	453,537
2012	204,330	191,732	16,814	33,246	17,936	464,058
2013	383,326	250,518	16,554	49,568	32,043	732,009
2014	290,524	191,658	19,903	25,098	57,648	584,831
2015	438,860	261,688	23,122	50,261	80,058	853,989
2016	187,421	76,955	10,674	27,759	52,556	355,365
2017	414,668	231,428	37,799	32,865	79,439	796,199
2018	334,832	124,576	14,695	26,485	47,371	547,959
2019	270,434	196,905	25,694	22,673	52,870	568,576
2020	163,546	146,162	21,352	24,849	32,378	388,287
2021	195,566	264,160	23,859	34,820	38,059	556,464
2022[f]	238,030	170,551	22,019	28,902	10,479[f]	474,165
2023[f]	222,517	224,048	30,473	42,883	25,149	545,070

Note: En dash means no data.

[a] Estimates for all years were generated with the most current apportionment model and may differ from earlier estimates.

[b] Includes sockeye salmon, burbot, longnose sucker, Dolly Varden, and northern pike; however, sockeye salmon were apportioned in passage estimates and are not included in other total estimates beginning in 2022.

[c] The Pilot Station sonar project did not operate at full capacity in 1996, and there are no passage estimates for this year.

[d] High water levels were experienced at Pilot Station; therefore, passage estimates are considered conservative.

[e] Estimates include extrapolations for the dates June 10 to June 18 to account for the time before the DIDSON was deployed.

[f] Sockeye salmon were apportioned in passage estimates and are not included in the total passage estimate.