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Sonar Estimation of Salmon Passage in the Yukon River Near Pilot Station, Alaska, 2024

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. 25-48

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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 2024 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 1,682,309 fish passed through the sonar sampling area between June 5 and September 7. Of those fish, 224,110 passed along the right bank, and 1,458,199 passed along the left bank. Included, with 90% confidence intervals, were 46,510 ± 13,181 large Chinook salmon (>655 mm mid eye to tail fork [METF]), 17,688 ± 4,988 small Chinook salmon (≤655 mm METF), 758,260 ± 39,248 summer chum salmon, 246,665 ± 14,672 fall chum salmon, 77,665 ± 7,268 coho salmon, 6,602± 4,354 sockeye salmon, 127,372 ± 20,102 pink salmon, 152,900 ± 28,232 cisco, 132,273 ± 20,056 humpback whitefish, 37,945 ± 8,947 broad whitefish, 49,719 ± 11,918 sheefish, and 28,710 ± 4,831 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 situated far enough upstream to avoid the complex 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 estimates of salmon abundance help managers regulate fishing during the season to meet harvest and escapement objectives. These estimates are also used postseason to determine whether treaty obligations were met and to 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 2024 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). 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 2024 field season. Species proportions and passage estimates reported in this document were generated using this apportionment model and are comparable to the 1995–2023 estimates because those years' estimates 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, both upstream 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 2024 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 one week early by the Yukon River Panel, river conditions delayed the start of early operations. Both sonars operated from June 5 until September 7, 2024.

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 2023 at the United States Geological Survey (USGS) gauging station[1] located downstream of the project, has ranged from a maximum of 26,108 m^3/s to a minimum of 7,787 m^3/s from June 1 through September 7 (Figure 5).

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

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[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 November 15, 2024; accessed August 25, 2025).

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 to two 2-terabyte external hard drives (one primary storage, and the other backup).

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 (Table 3).

The target sampling range of the ARIS was 0.7–50 m, depending on river conditions. However, in 2024, increased turbidity due to high water levels limited the end range to 30 m until June 23, when it was increased to 45 m. This range was later reduced to 40 m on July 12 and remained at this level for the rest of the season due to river conditions. (Table 3). From June 26 to July 2, the split-beam sonar was inoperable on the left bank. During this period the ARIS range was expanded from 0 m to 75m, which was within the range where a majority of fish passage occurred. 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 (30–150 m) and S5 (150–300 m). The ARIS unit was normally deployed within 5 m of the split-beam transducer, and when conditions were favorable, ensonified S3 (0.7–40 m) (Figure 7). The wider beam angle of the ARIS was ideal for the less linear nature of the eroded left bank nearshore stratum, enabling it to detect fish targets throughout a greater portion 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

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

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 for counting fish using side-looking sonar systems.

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, alternating sequentially between strata every 30 minutes.

Operators marked fish traces on electronic echograms using Echotastic for the split-beam and ARIS sonars (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 were checked daily for data entry and marking errors, then processed using 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 5 to record water temperature on both

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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/.

banks and remained submerged until September 7. 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 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 on June 5 after dragging the test fishery zones for snags 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 were drifted within each of 3 zones for 24 drifts per day. On days with only 1 test fishing period, 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 overlapping 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 were distributed to the local community, and fish dispersal was documented daily.

Four scales 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

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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 August 25, 2025).

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 an analysis of ASL data, which 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 indices 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:

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

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:

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

[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 August 25, 2025).

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:

$$CPUE_{dbig} = \frac{\sum_m c_{dbigm}}{e_{dbg}}. \quad (3)$$

Species Composition

Test fishery sampling was conducted on both banks to estimate species proportions. 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:

$$C_{dzpi} = \sum_l \left(\frac{\sum_m c_{dzpilm}}{\sum_m f_{dzpilm}} \right), \quad (4)$$

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

$$f_{dzpilm} = S_{ilm} \cdot e_{dzpm}, \quad (5)$$

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):

$$e_{dzpm} = \frac{25 \cdot t_{dzpm}}{60}. \quad (6)$$

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

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

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

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

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:

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

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

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

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):

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

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

$$\hat{y}_{di}=\sum_{s}\hat{y}_{dis}\ and\ \widehat{Var}\left(\hat{y}_{di}\right)=\sum_{s}\widehat{Var}(\hat{y}_{dis})\ . \tag{16}$$

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

$$\hat{y}_{i}=\sum_{d}\hat{y}_{di}\ and\ \widehat{Var}(\hat{y}_{i})=\sum_{d}\widehat{Var}\left(\hat{y}_{di}\right)\ . \tag{17}$$

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, 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 a lack of available commercial flights into the region, which delayed arrival and camp set up at the sonar site until May 30. Test fishing drift areas were dragged for snags starting on June 3, and test fishing began during P1 on June 5. The project was fully operational beginning with P2 sonar on June 5 and continued operations 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 14, which was 4 days later than the 10-year average of May 10 (Table 7). The water discharge near Pilot Station during the 2024 season was close to the 10-year mean (2014–2023) through August 7, when levels rose above the average. Water discharge values never crossed over the maximum average level during the 2024 season (Figure 5). Mean daily water temperatures on the left bank ranged from 10.6°C to 19.2°C and from 10.9°C to 18.4°C on the right bank (Figure 10). Water temperatures fell mostly below the 10-year averages on both banks, rising above the averages from June 14 to July 4 and July 23 to July 30 on the right bank, and from June 12 to July 5 and July 24 to July 29 on the left bank.

TEST FISHERY

Drift gillnetting resulted in the capture of 4,535 fish: 210 Chinook salmon (163 large and 47 small), 1,114 summer chum salmon, 1,066 fall chum salmon, 592 coho salmon, 19 sockeye salmon, and 1,534 fish of other species. Of the captured fish, 1,446 (32%) were retained as mortalities and delivered to local users within the nearby community of Pilot Station (Table 8). Of the 210 Chinook salmon captured in the test fishery, scale samples were collected from 210 fish, and 175 were ageable.[6] Tissue samples for genetic stock identification were collected from 207 Chinook salmon and 2,158 chum salmon.

HYDROACOUSTIC ESTIMATES

An estimated 1,682,309 fish passed through the sonar sampling areas between June 5 and September 7. Of that total passage, 224,110 (approximately 13%) fish passed along the right bank, and 1,458,199 (approximately 87%) 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 40 m on the right bank and 60 m on the left (Figures 11–12).

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 46,510 ± 13,181 large Chinook salmon (>655 mm METF) and 17,688 ± 4,988 small Chinook salmon (≤655 mm METF). Chum salmon cumulative passage estimates were 758,260 ± 39,248 summer chum salmon and 246,665 ± 14,672 fall chum salmon. Coho salmon cumulative passage estimate was 77,665 ± 7,268 fish, sockeye salmon (*O. nerka*) was 6,602 ± 4,354 fish, and pink salmon (*O. gorbuscha*) was 127,372 ± 20,102 fish. The cisco cumulative passage estimate was 152,900 ± 28,232 fish, humpback whitefish was 132,273 ± 20,056 fish, broad whitefish was 37,945 ± 8,947 fish, sheefish was 49,719 ± 11,918 fish, and other species (burbot, longnose sucker, Dolly Varden, and northern pike) was 28,710 ± 4,831 fish (Table 9).

The initial run of Chinook salmon began approximately June 12 (Figure 13); however, the front end of the Chinook salmon run had a consistent flow of "tricklers" that lasted for 2 weeks before the more distinctive first pulse arrived. The Chinook salmon estimate this season was the fourth lowest in all the years of project operations from 1995 to 2024.

The summer chum salmon estimate this season was the sixth lowest in all the years of project operations (1995–2024). Four pulses of summer chum salmon were detected at the sonar project; the largest group consisted of approximately 250,584 fish and passed by the sonar between July 4 and July 9.

Compared to the 2014–2023 historical mean run timing, the midpoint of the Chinook salmon run was 5 days late, and the summer chum salmon run was 3 days late; both midpoints occurred on July 2 (Figure 14, Appendices E and F).

There were 7 fall chum salmon pulses that passed the sonar project after July 19, and 43% of the chum salmon arriving through August 6 were genetically summer chum salmon. After that, predominantly fall chum salmon entered the river, with peak daily passage occurring on August 2 (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

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[6] 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 August 25, 2025).

September. The midpoint for the fall chum salmon run was August 8, which was 3 days early compared to the 2014–2023 mean cumulative run timing (Figure 16, Appendices E and F).

There was low coho salmon passage until the first significant pulse on August 17 (Figure 15). As in most years, the project concluded before the coho salmon run was complete; estimates were therefore considered conservative, and the timing may not accurately reflect the total run. The midpoint for the coho salmon run was August 22, which was 5 days later compared to the 2014–2023 mean cumulative run timing (Figure 16, Appendices E and F).

MISSING DATA

Initially, 15 days (between June 5 and June 19) had insufficient catches in at least 1 fishing zone, which made it necessary to pool days to ensure reasonable species apportionment (Table 10). There were 61 days with insufficient catches, primarily in the offshore zone on the left bank (Z3). Unlike past years, no commercial fisheries affected the species apportionment test fishery this season, which would have necessitated pooling days.

DISCUSSION

Overall, project operations went smoothly; however, the project encountered a couple of challenges during the season. Upon initial deployment, the detection range of the ARIS sonar was limited to 25 m due to high suspended sediment caused by the high water at the freshet. To compensate for the reduced range of the ARIS, the end range of the ARIS was reduced from 50 m to 30 m, and the split-beam was configured to sample from 30 m to 300 m. Normal sampling ranges were resumed once conditions improved in late June. Additionally, a spreader lens was installed to increase the vertical beam from 3° to approximately 14°, accommodating the early high water. The spreader lens was not removed because water levels continued to rise above average starting in mid-July. The higher water levels made deployment of the sonar and gillnets difficult, but there was no reason to believe that this affected the ability to estimate the fish passage.

The other challenge was the temporary loss of the split-beam from June 26 to July 2. To minimize the effect of the loss of the split-beam, the ARIS range was extended from 0 m to 75 m, which was within the range where a majority of fish passage occurred (approximately 97% of the summer passage occurred within 75 m on the left bank; Figure 11). Of the total run with both banks included, the missed passage percentage was approximately 0.08% (less than 1%), which was well within the confidence bounds of the estimates produced by the project. Considering the relatively small fraction, passage estimates for were not expanded.

Historically, there have been alternating years of high pink salmon abundance. The 20-year pink salmon average passage estimates during even years was 533,018, and the odd-year average was 53,334 (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 even-year average, and sonar ranges were adjusted to exclude a portion of the pink salmon migration. Therefore, the total estimated pink salmon passage should be considered conservative because part of the run was not sampled.

Estimating fish passage on the Yukon River presents major technical and logistical 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 2024, 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 from the Lower Yukon River to the spawning grounds in Canada.

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TABLES AND FIGURES

Table 1.–Daily sampling schedule for sonar and test fishery at the Pilot Station sonar project on the Yukon River, 2024.

	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, 2024.

Component	Setting	Stratum	Bank Left	Bank 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	27.0	
		S5	33.0	
	Receiver gain (dB)	S1		-14.0
		S2		-14.0
		S4	-12.0	
		S5	-12.0	
	Source level (dBµPa @ 1 m)	S1		216.8
		S2		216.8
		S4	222.1	
		S5	223.1	
	Blanking range (m)	S1		40–150
		S2		0–40
		S4	0–40 150–300	
		S5	0–150	
	Through-system gain (dB)		-161.6	-162
	Pulse width (ms)		0.4	0.4
	Ping rate (pps)	S1		5.0
		S2		3.5
		S4	3.0	
		S5	1.2	

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

Table 3.–Technical specifications for the ARIS (adaptive resolution imaging sonar) at the Pilot Station sonar project on the Yukon River, 2024.

Setting	Value
Field of view (h x w)	14° x 14°
Detection frequency (MHz)	0.7
Receiver gain (dB)	20.0
Samples/beam	1472.0
Start range (m)	0.7
Frame rate (f/s)	4.0
End range (m)	40.0

Table 4.–Initial range of lower and upper thresholds used in Echotastic at the Pilot Station sonar project on the Yukon River, 2024.

		Threshold (dB)	
Bank	Stratum	Upper	Lower
Right	S1	-30	-52
	S2	-23	-47
Left	S3	-14	-55
	S4	-45	-60
	S5	-35	-60

Table 5.–Specifications for drift gillnets used for test fishing, by season, at the Pilot Station sonar project on the Yukon River, 2024.

	Stretch mesh size		Mesh diameter	Meshes deep	Depth
Season	(in)	(mm)	(mm)	(md)	(m)
Summer	2.75	70	44	131	8.0
(6/5–7/18)	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, 2024.

Season	Test fishery period	Mesh size (inches)			
		Odd days		Even days	
Summer	1	2.75	5.25	8.50	4.00
(6/5–7/18)		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, 2014–2024.

Year	Breakup date
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
2024	5/14

Source: National Oceanic and Atmospheric Administration (NOAA). 2024. National Weather Service, Alaska-Pacific River Forecast Center. www.weather.gov/aprfc/breakupDB (cited September 28, 2024; accessed August 2, 2025).

Table 8.–Number of fish caught and retained in the Pilot Station sonar project test fishery on the Yukon River, 2024.

Total catch	Chinook	S. Chum	F. Chum	Coho	Sockeye	Pink	Whitefish	Cisco	Burbot	Sheefish	Others[a]	Total
June	84	473	0	0	3	19	50	43	27	103	15	817
July	126	641	175	1	14	447	227	103	15	34	16	1,799
August	0	0	802	429	1	22	176	108	11	5	14	1,568
September	0	0	89	162	1	0	49	48	1	0	1	351
Total	210	1,114	1,066	592	19	488	502	302	54	142	46	4,535

Fish retained	Chinook	S. Chum	F. Chum	Coho	Sockeye	Pink	Whitefish	Cisco	Burbot	Sheefish	Others[a]	Total
June	73	184	0	0	3	3	18	5	0	24	0	310
July	104	204	59	1	6	24	158	8	0	8	0	572
August	0	0	277	82	0	0	105	2	3	1	0	470
September	0	0	51	12	0	0	28	3	0	0	0	94
Total	177	388	387	95	9	27	309	18	3	33	0	1,446

Proportion retained	Chinook	S. Chum	F. Chum	Coho	Sockeye	Pink	Whitefish	Cisco	Burbot	Sheefish	Others[a]	Total
June	0.869	0.389	0.000	0.000	1.000	0.158	0.360	0.116	0.000	0.233	0.000	0.379
July	0.825	0.318	0.337	1.000	0.429	0.054	0.696	0.078	0.000	0.235	0.000	0.318
August	0.000	0.000	0.345	0.191	0.000	0.000	0.597	0.019	0.273	0.200	0.000	0.300
September	0.000	0.000	0.573	0.074	0.000	0.000	0.571	0.063	0.000	0.000	0.000	0.268
Total	0.843	0.348	0.363	0.160	0.474	0.055	0.616	0.060	0.056	0.232	0.000	0.319

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, 2024.

					90% CI	
Species	Right bank	Left bank	Total passage	SE	Lower	Upper
Large Chinook[a]	1,644	44,866	46,510	8,013	33,329	59,691
Small Chinook[b]	1,286	16,402	17,688	3,032	12,700	22,676
Total Chinook	2,930	61,268	64,198	8,567	50,105	78,291
Summer chum	46,523	711,737	758,260	23,859	719,012	797,508
Fall chum[c]	22,697	223,968	246,665	8,919	231,993	261,337
Coho[c]	14,552	63,113	77,665	4,418	70,397	84,933
Sockeye	768	5,834	6,602	2,647	2,248	10,956
Pink	51,353	76,019	127,372	12,220	107,270	147,474
Cisco	25,030	127,870	152,900	17,162	124,668	181,132
Humpback whitefish	18,009	114,264	132,273	12,192	112,217	152,329
Broad whitefish	12,758	25,187	37,945	5,439	28,998	46,892
Sheefish	10,756	38,963	49,719	7,245	37,801	61,637
Other[d]	18,734	9,976	28,710	2,937	23,879	33,541
Total	224,110	1,458,199	1,682,309			

[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 2024 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
6/05				IC
6/06				IC
6/07				IC
6/08				IC
6/09				IC
6/10				IC
6/11				
6/12				IC
6/13				
6/14				
6/15				IC
6/16				IC
6/17				
6/18				
6/19				
6/20				
6/21				
6/22				IC
6/23				
6/24				
6/25				
6/26				
6/27				
6/28				IC
6/29				IC
6/30				
7/01				IC
7/02				
7/03				
7/04				IC
7/05				IC
7/06				
7/07				
7/08				
7/09				
7/10				
7/11				
7/12				
7/13				
7/14				
7/15				IC
7/16				
7/17				IC
7/18				
7/19				IC

-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				IC
7/23				
7/24				
7/25				IC
7/26				
7/27				IC
7/28				
7/29				
7/30				
7/31				IC
8/01				
8/02				
8/03				IC
8/04				
8/05				IC
8/06				
8/07				
8/08				
8/09				
8/10				
8/11				IC
8/12				
8/13				IC
8/14				
8/15				IC
8/16				IC
8/17				
8/18				IC
8/19				
8/20				
8/21				IC
8/22				
8/23				
8/24				
8/25				
8/26				
8/27				
8/28				
8/29				
8/30				
8/31				IC
9/01				
9/02				IC
9/03				
9/04				
9/05				
9/06				
9/07				IC

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.

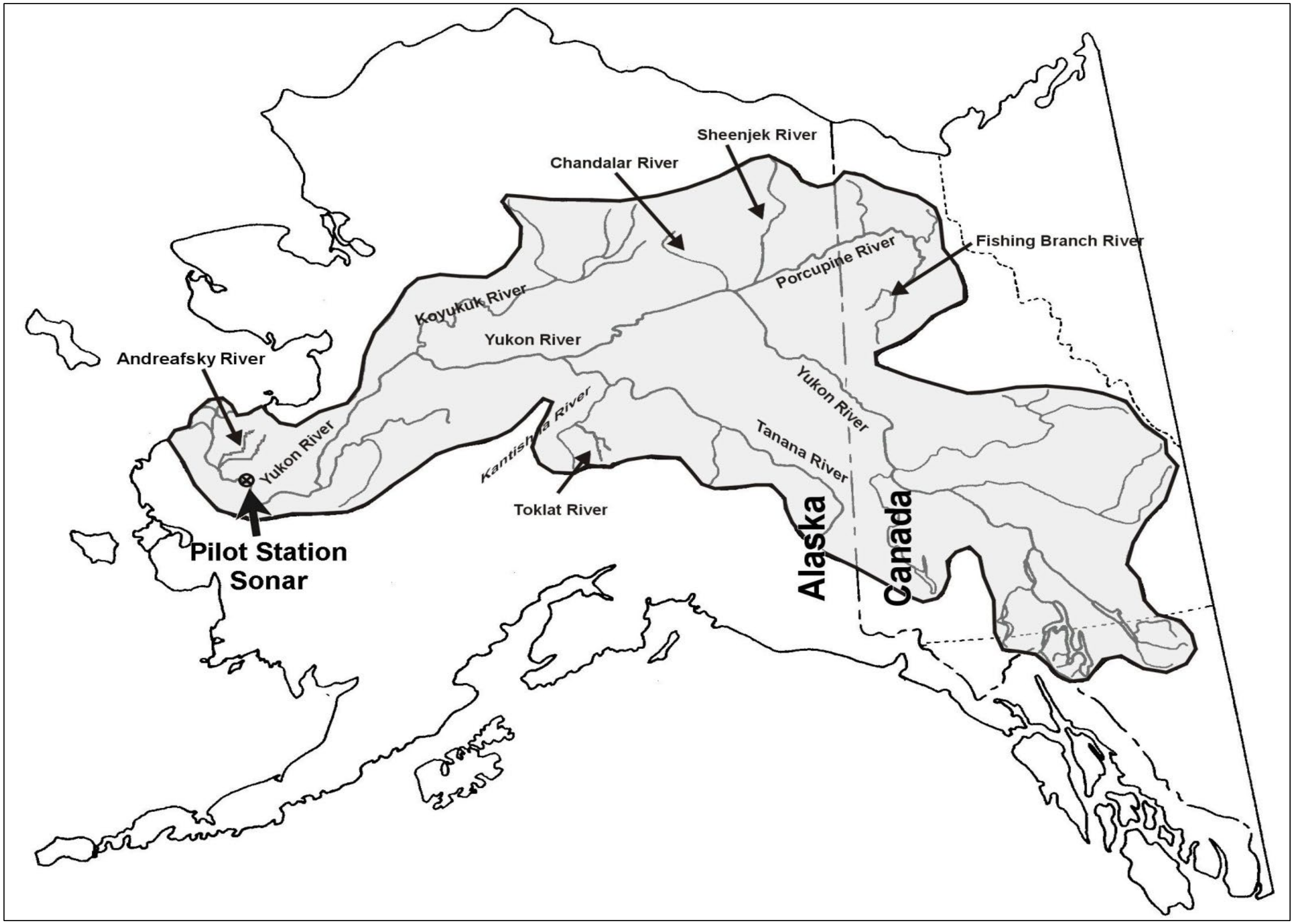


Figure 1.–Fishing districts and communities of the Yukon River drainage.

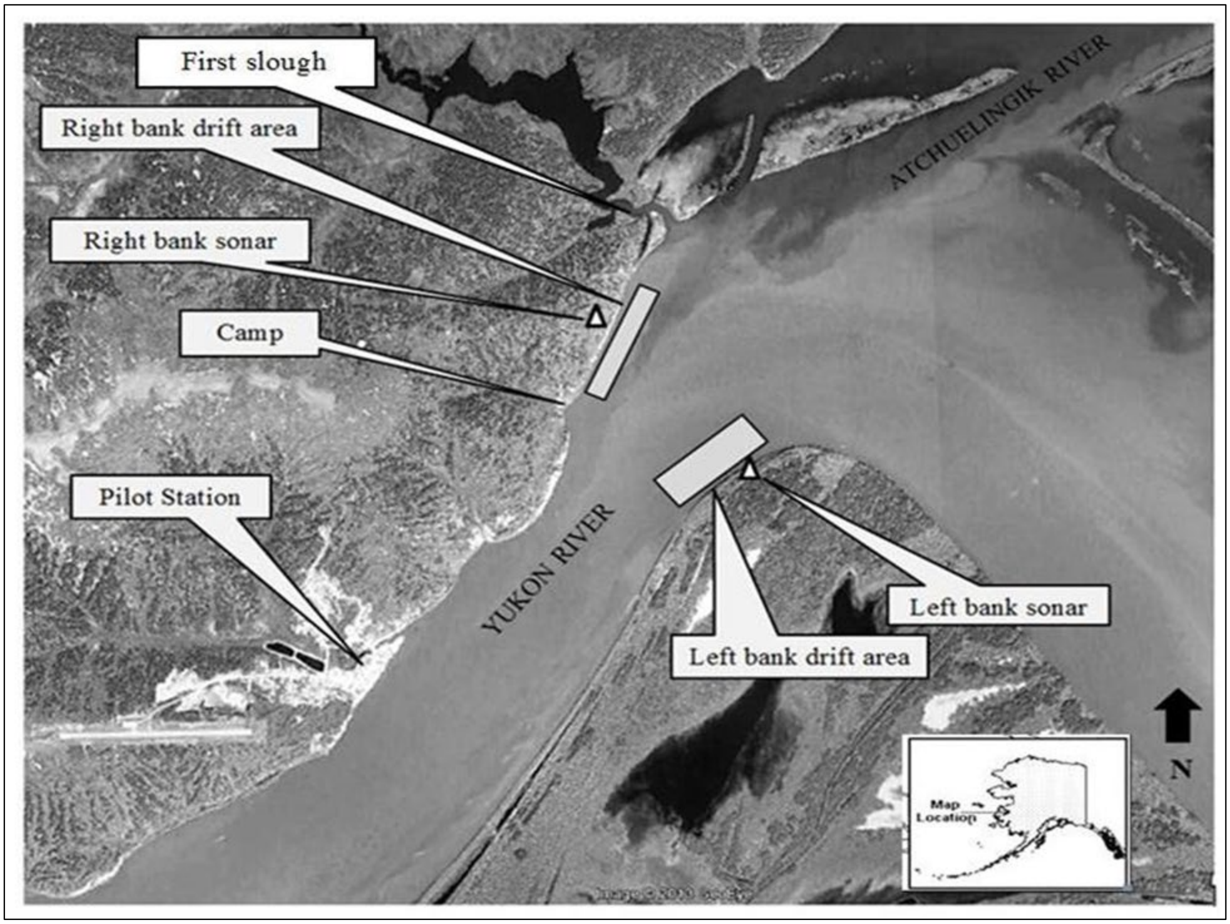


Figure 2.–Location of the Pilot Station sonar project on the Yukon River showing general transducer sites.

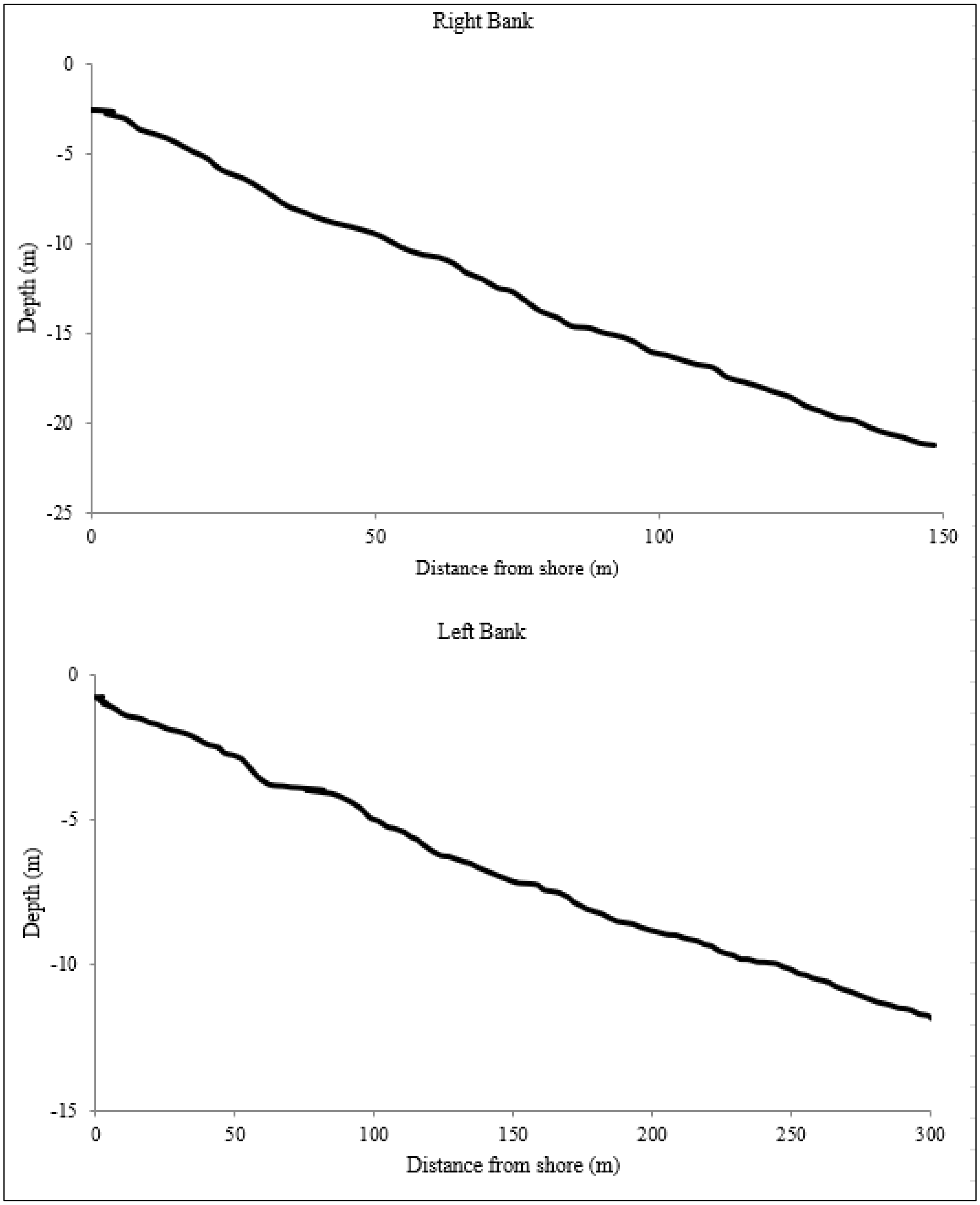


Figure 3.–Bottom profiles for the right bank (top) and left bank (bottom) at the Pilot Station sonar project on the Yukon River, 2024.

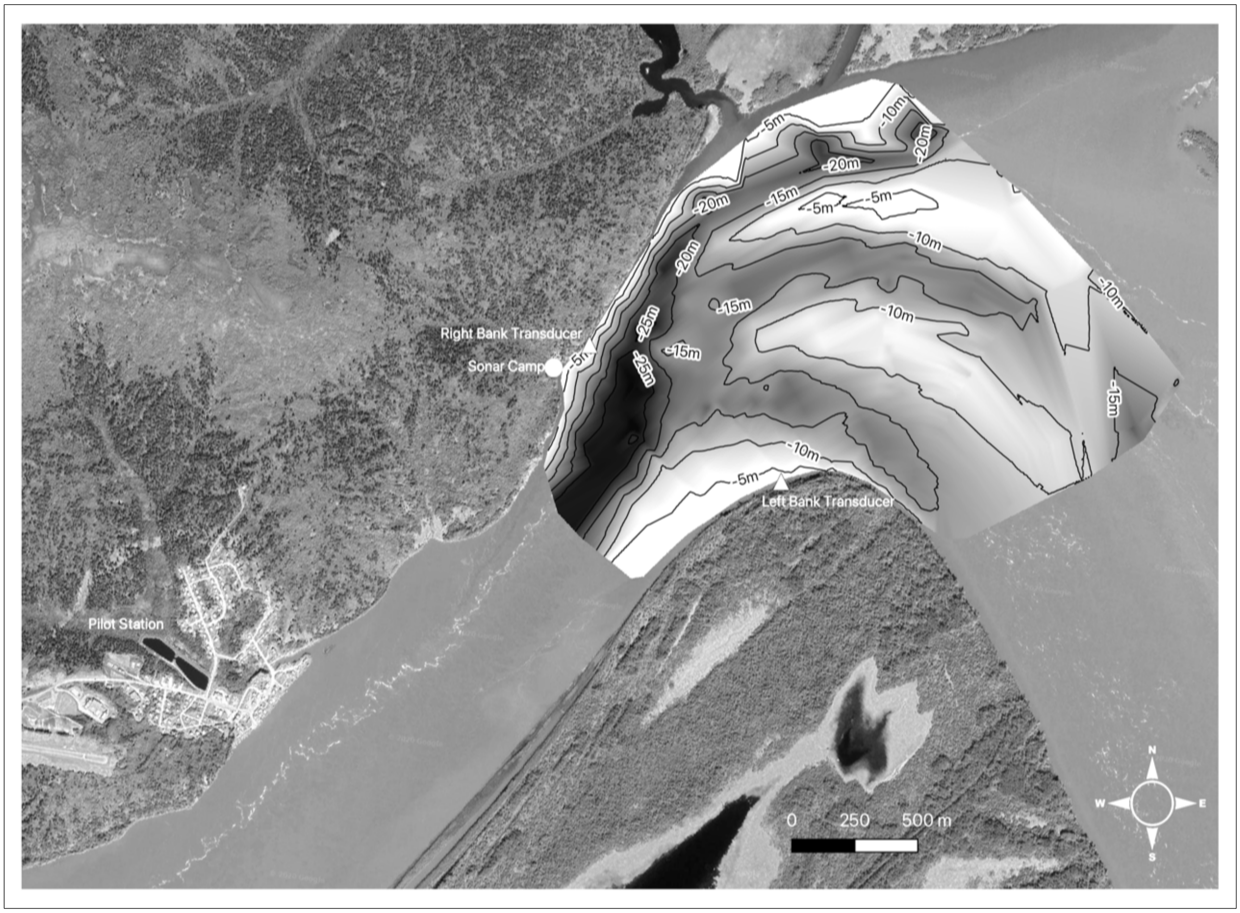


Figure 4.–Bathymetric map of the Yukon River in the vicinity of the Pilot Station sonar project.

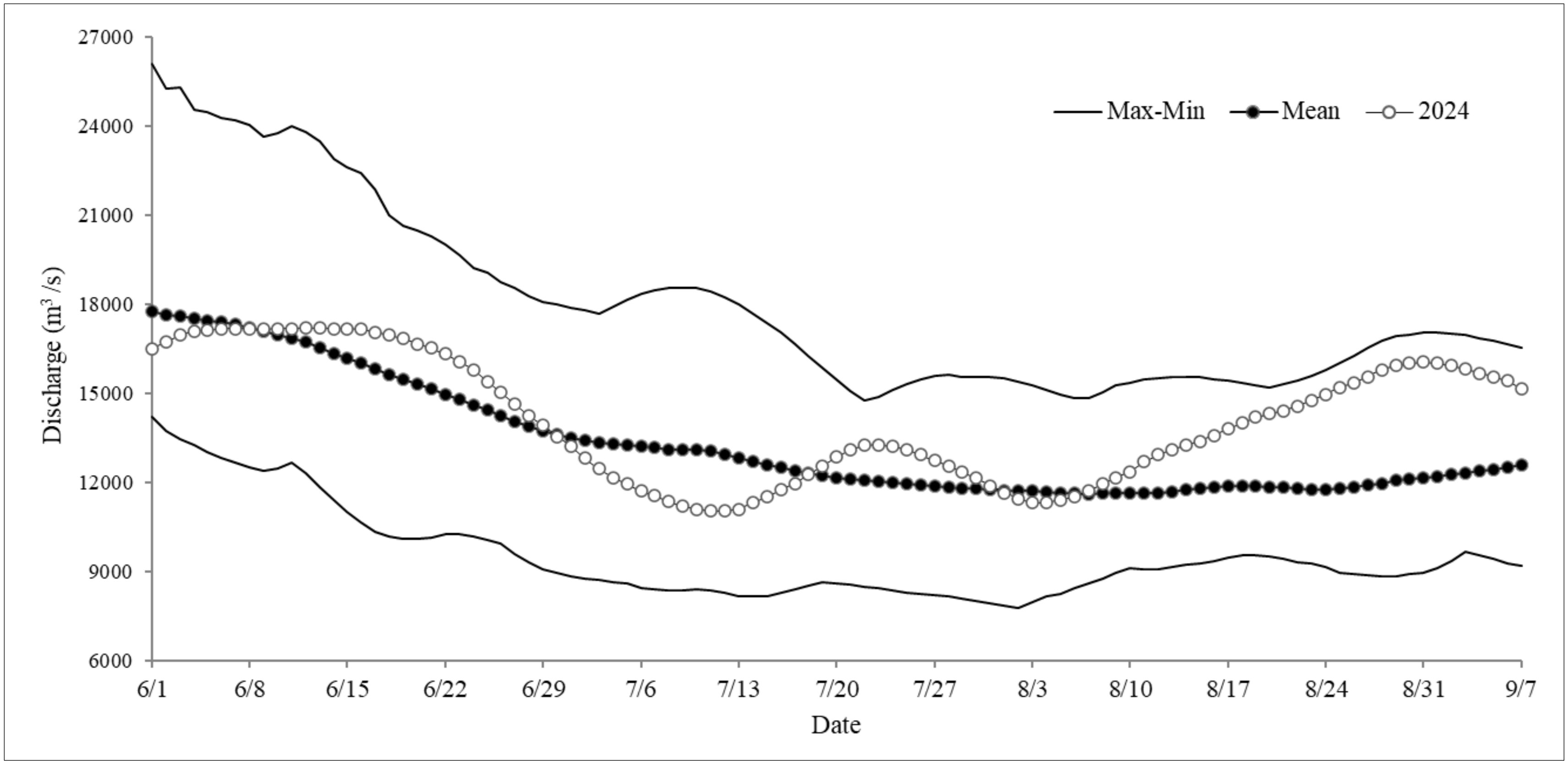


Figure 5.–Yukon River daily water discharge during the 2024 season at Pilot Station water gauge compared to 2014–2023 minimum, maximum, and mean gauge height.

Source: U.S. Geological Survey National Water Information System: USGS 15565447 Yukon R. at Pilot Station AK 2022. Available from: https://nwis.waterdata.usgs.gov/nwis/inventory/?site_no=15565447 (cited November 6, 2024; accessed August 25, 2025).

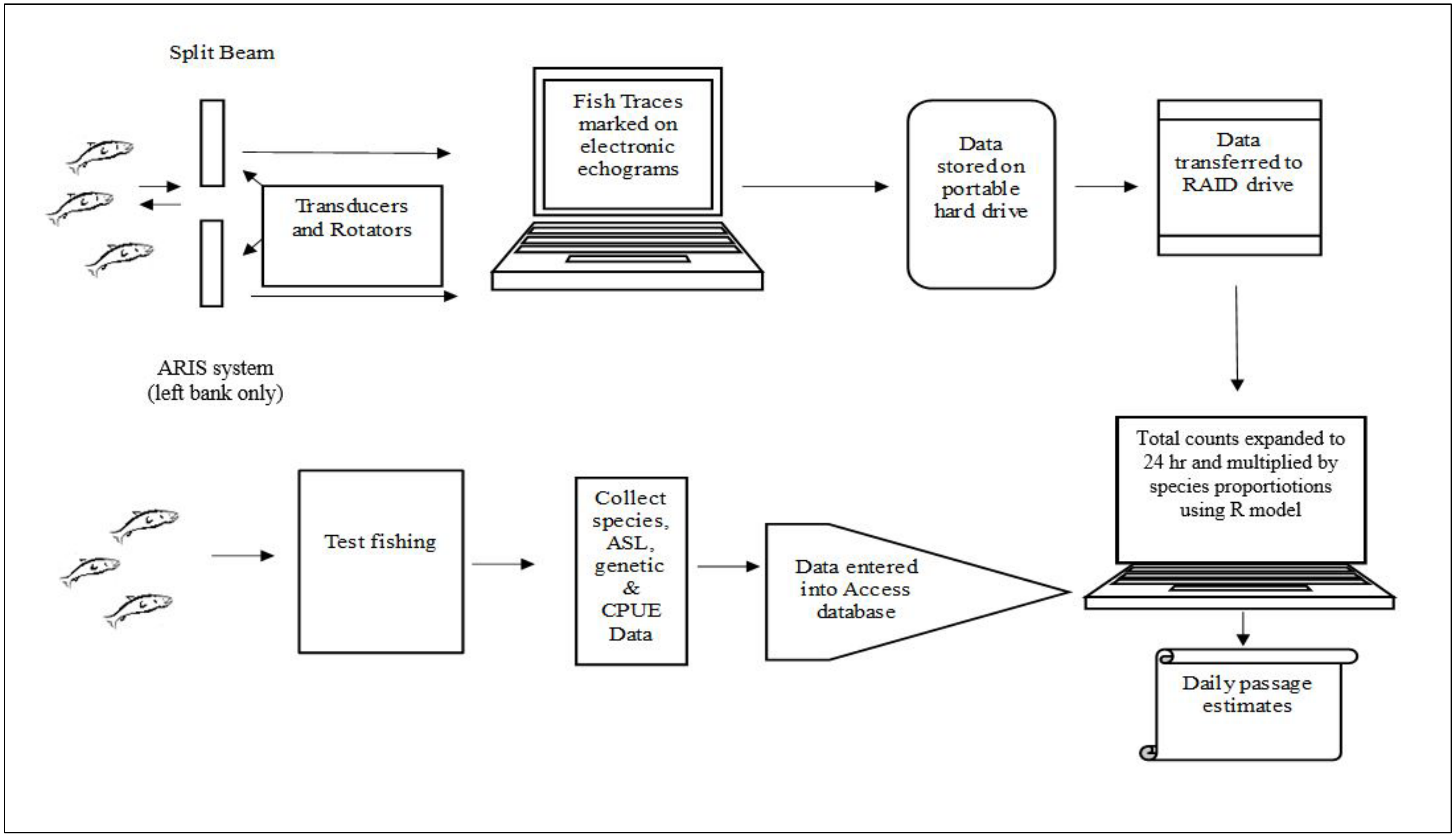


Figure 6.–Flow diagram of data collection and processing at the Pilot Station sonar project on the Yukon River, 2024.

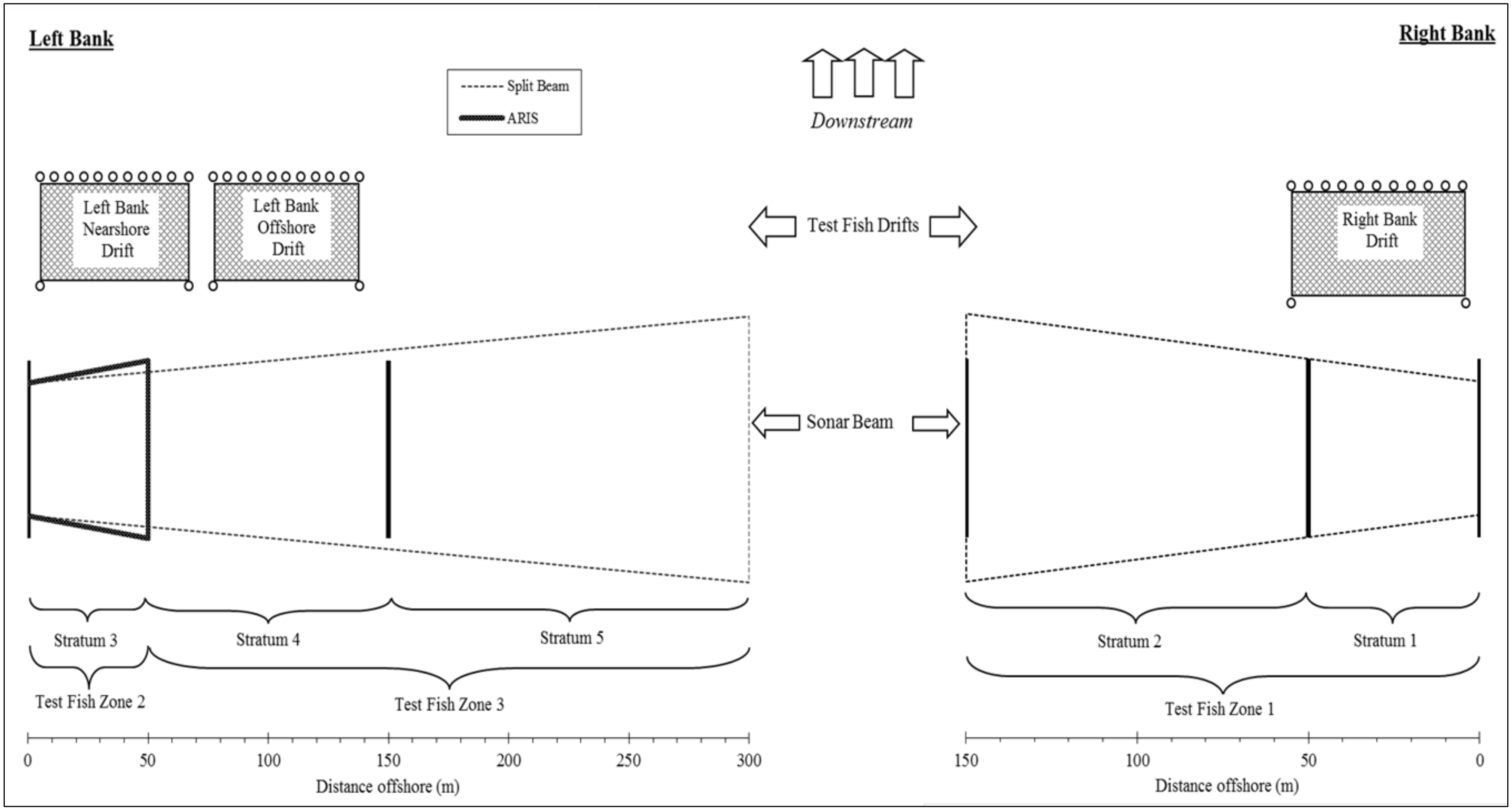


Figure 7.–Illustration of relationships between strata, zones, test fishery drifts, and approximate sonar ranges (not to scale) at the Pilot Station sonar project on the Yukon River, 2024.

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.

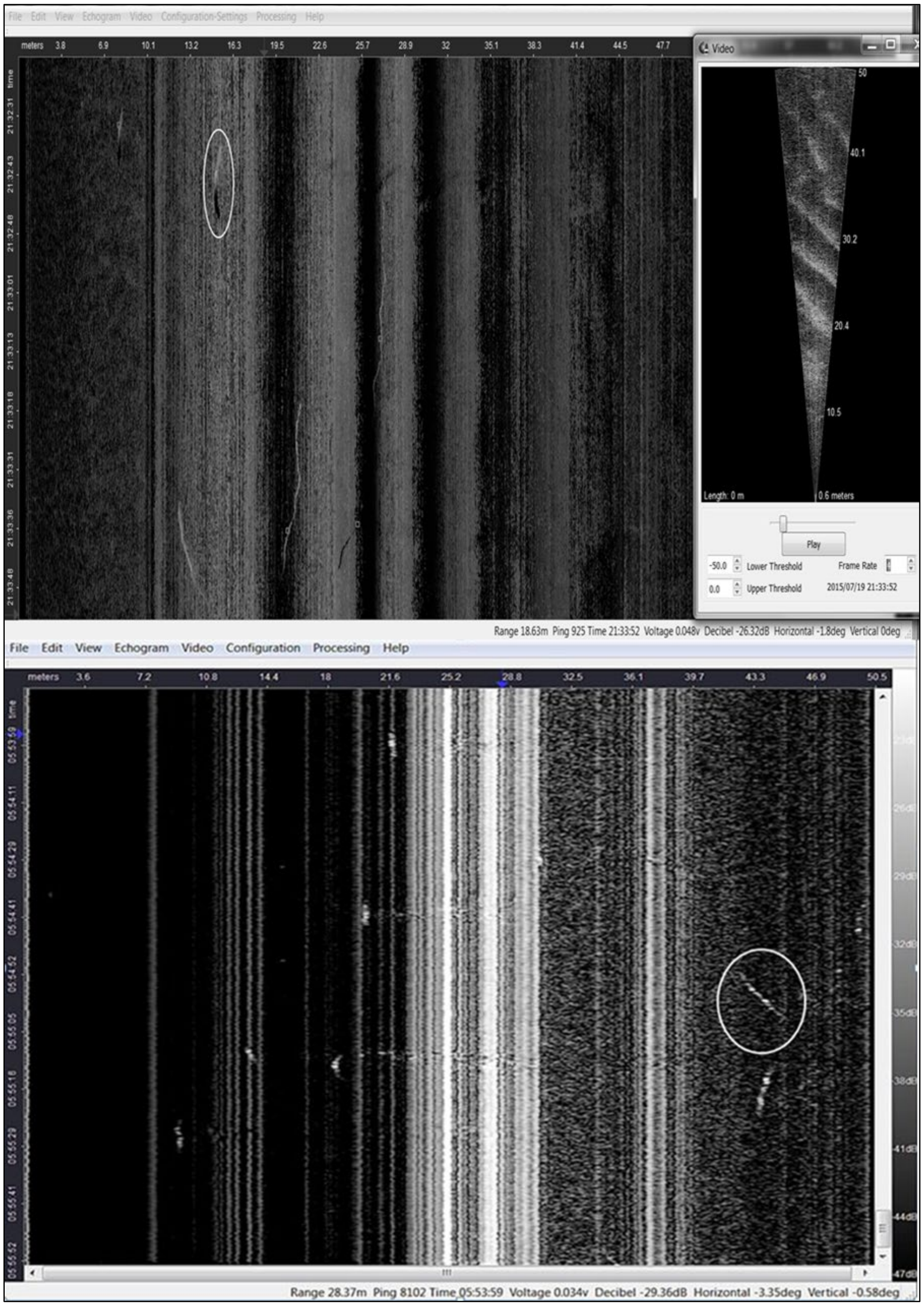


Figure 9.–Echogram of ARIS alongside video image (top) and split-beam sonar (bottom), with oval around representative fish.

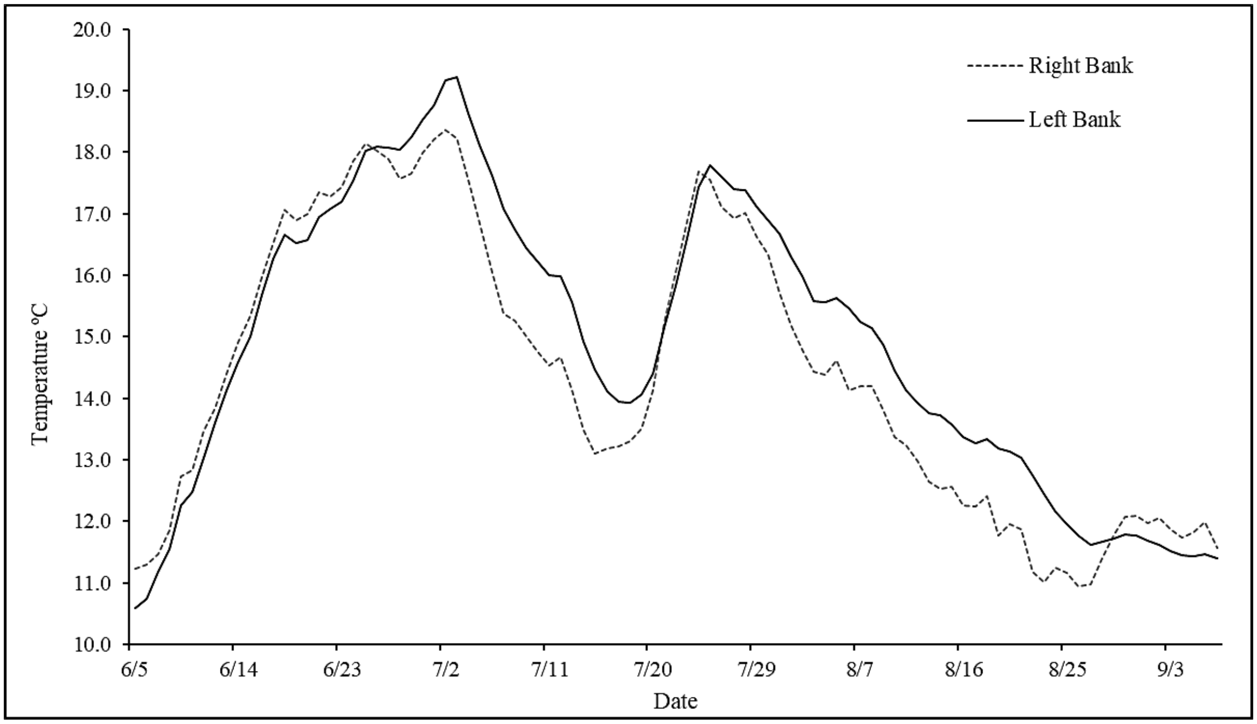


Figure 10.–Mean daily water temperatures recorded at the Pilot Station sonar project on the Yukon River with electronic data loggers by bank, 2024.

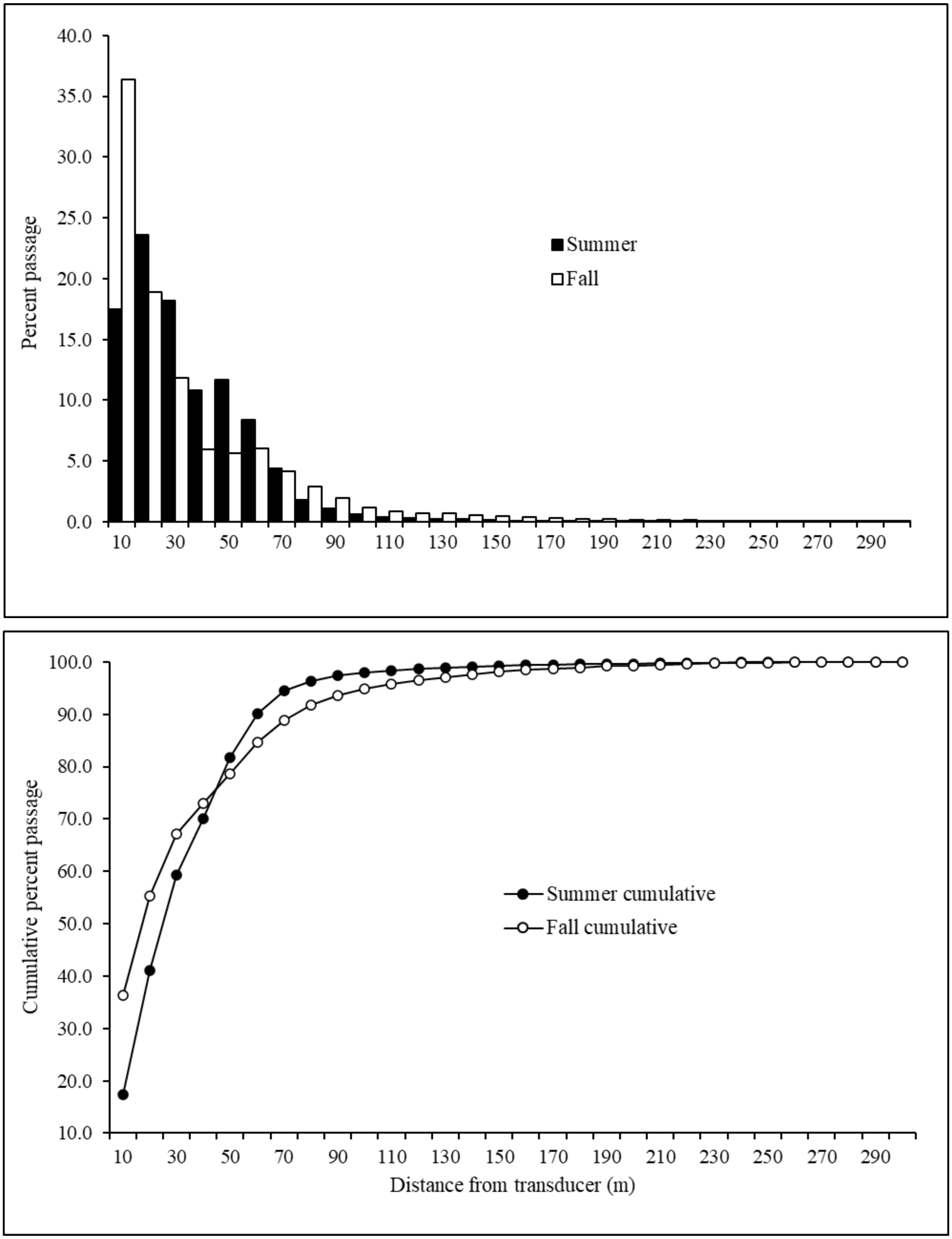


Figure 11.–Distribution of left bank passage (top) and cumulative passage as a function of range (bottom) at the Pilot Station sonar project on the Yukon River, 2024.

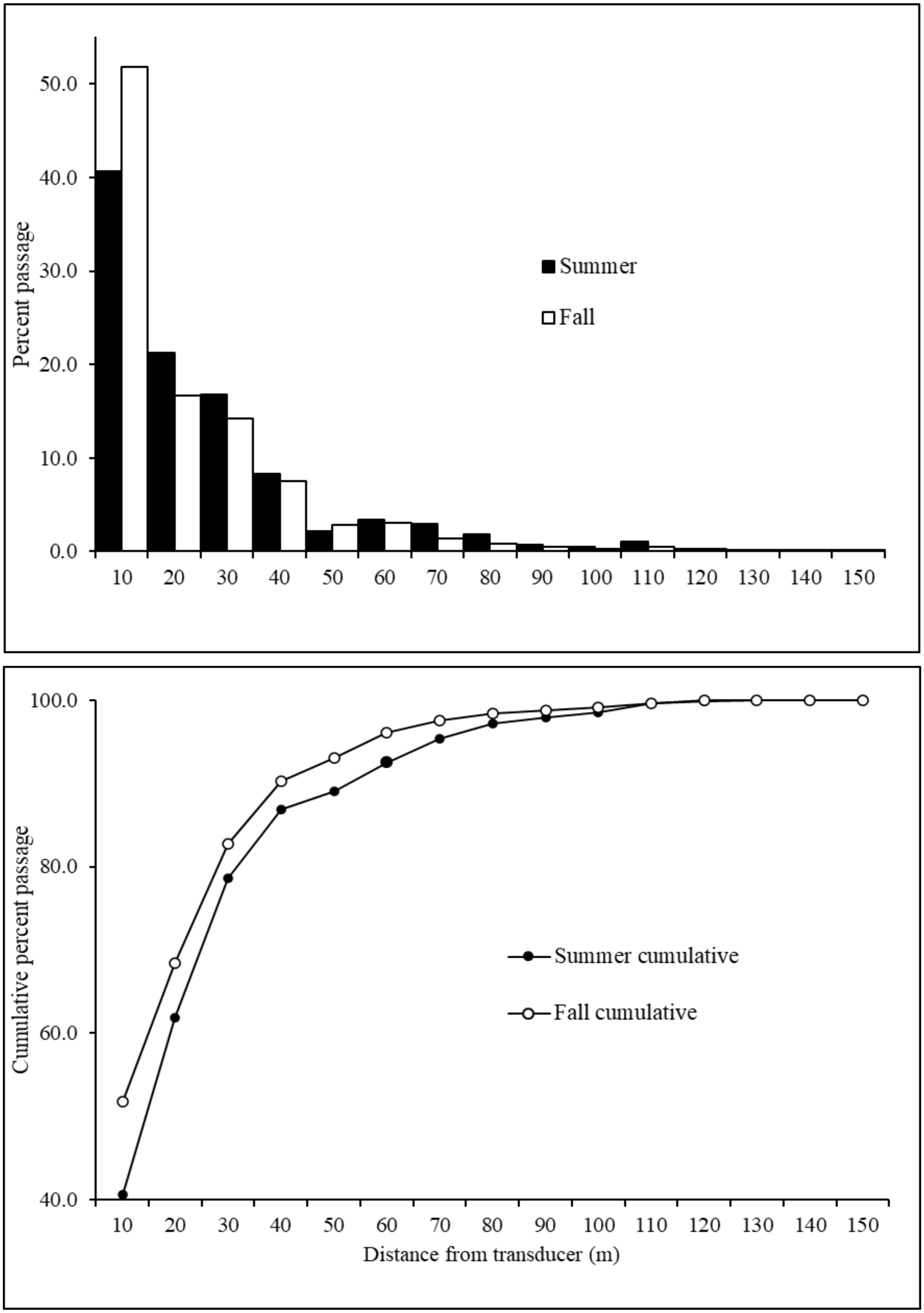


Figure 12.–Distribution of right bank passage (top) and cumulative passage as a function of range (bottom) at the Pilot Station sonar project on the Yukon River, 2024.

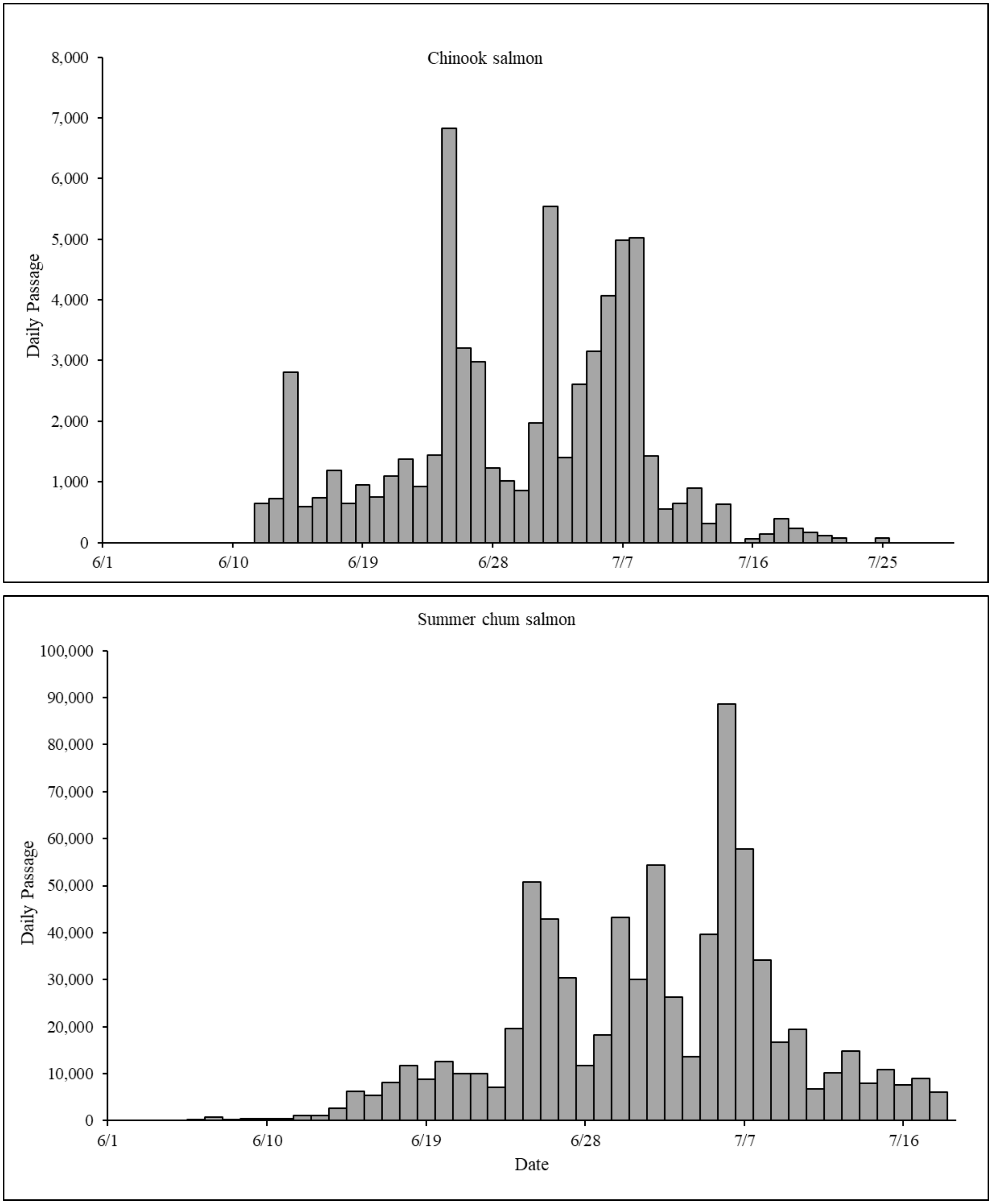
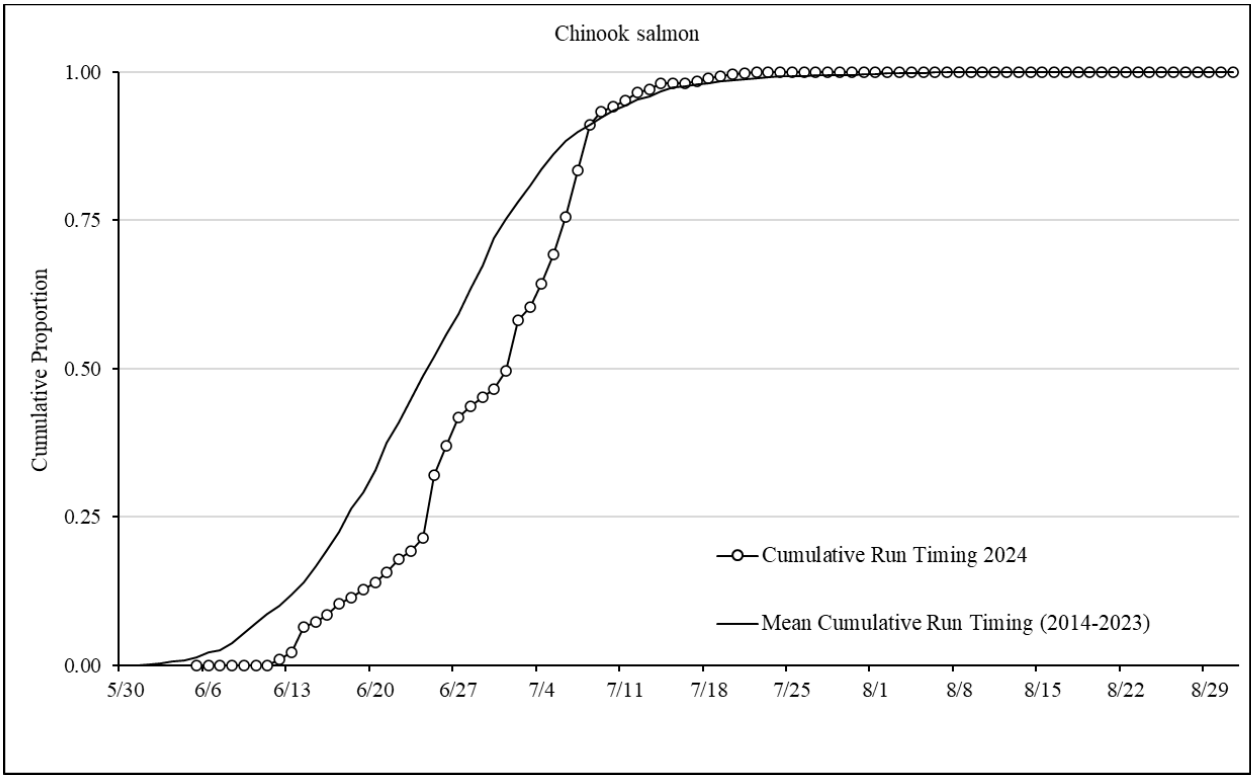


Figure 13.–Chinook (top) and summer chum salmon (bottom) daily passage estimates at the Pilot Station sonar project on the Yukon River, 2024.



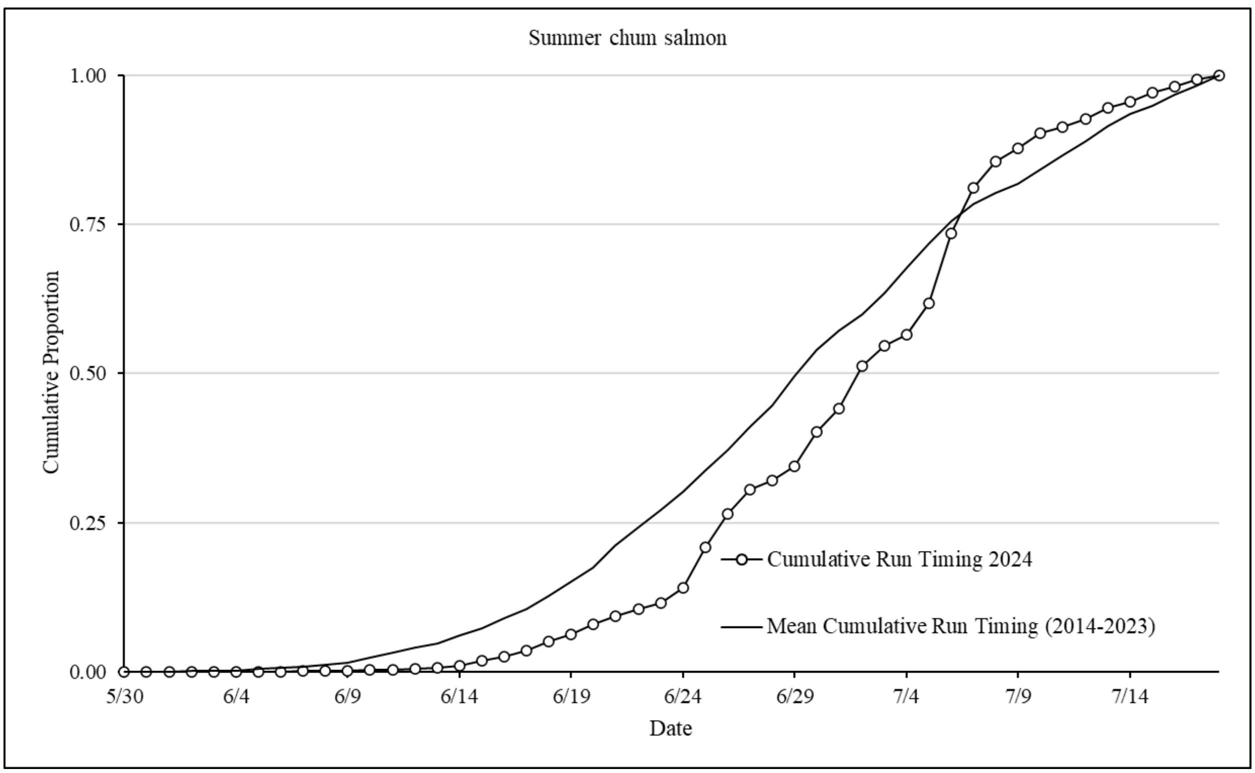


Figure 14.–2024 Chinook (top) and summer chum (bottom) salmon daily cumulative passage timing compared to the 2014–2023 mean passage timing at the Pilot Station sonar project on the Yukon River.

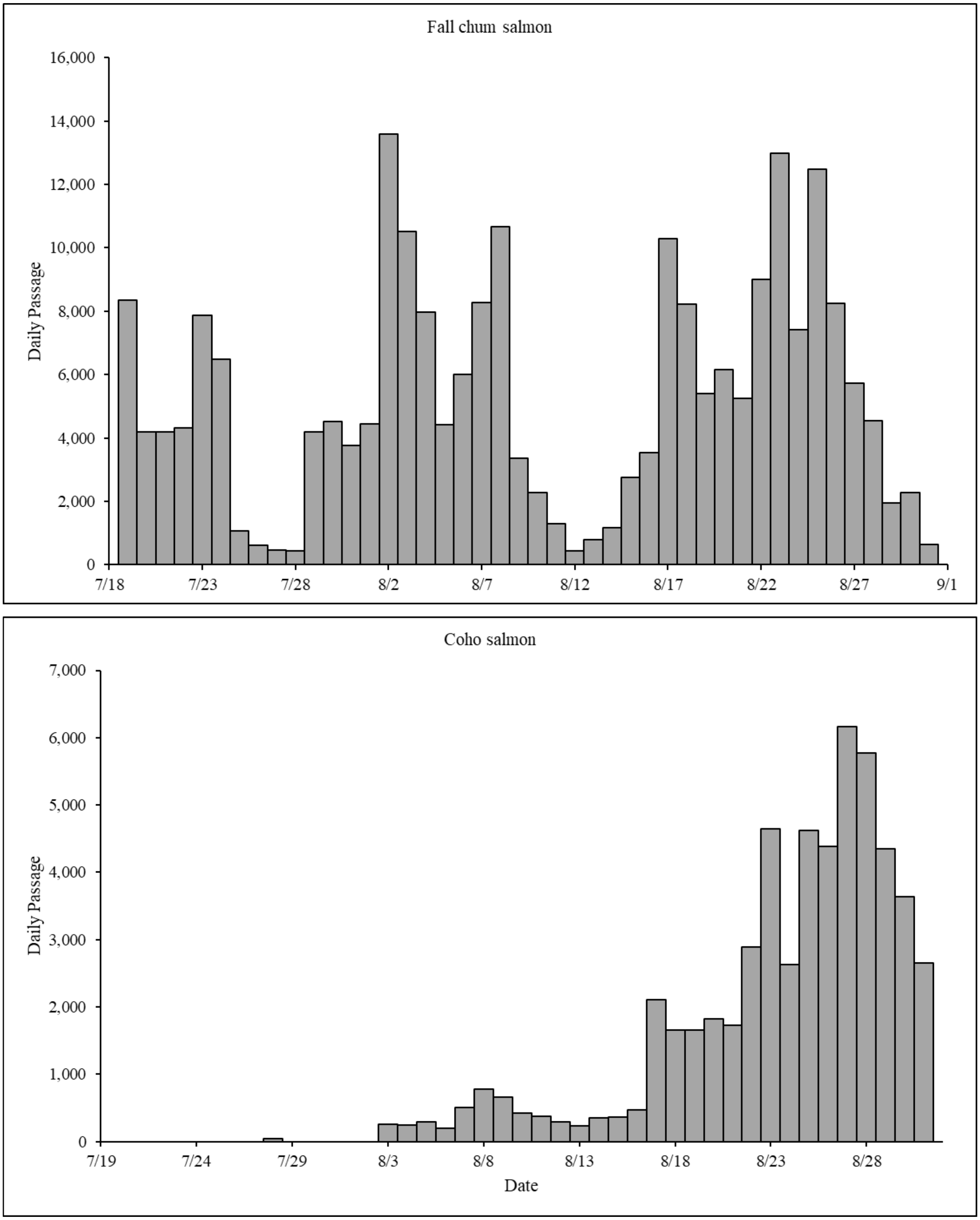


Figure 15.–Fall chum (top) and coho (bottom) salmon daily passage estimates at the Pilot Station sonar project on the Yukon River, 2024.

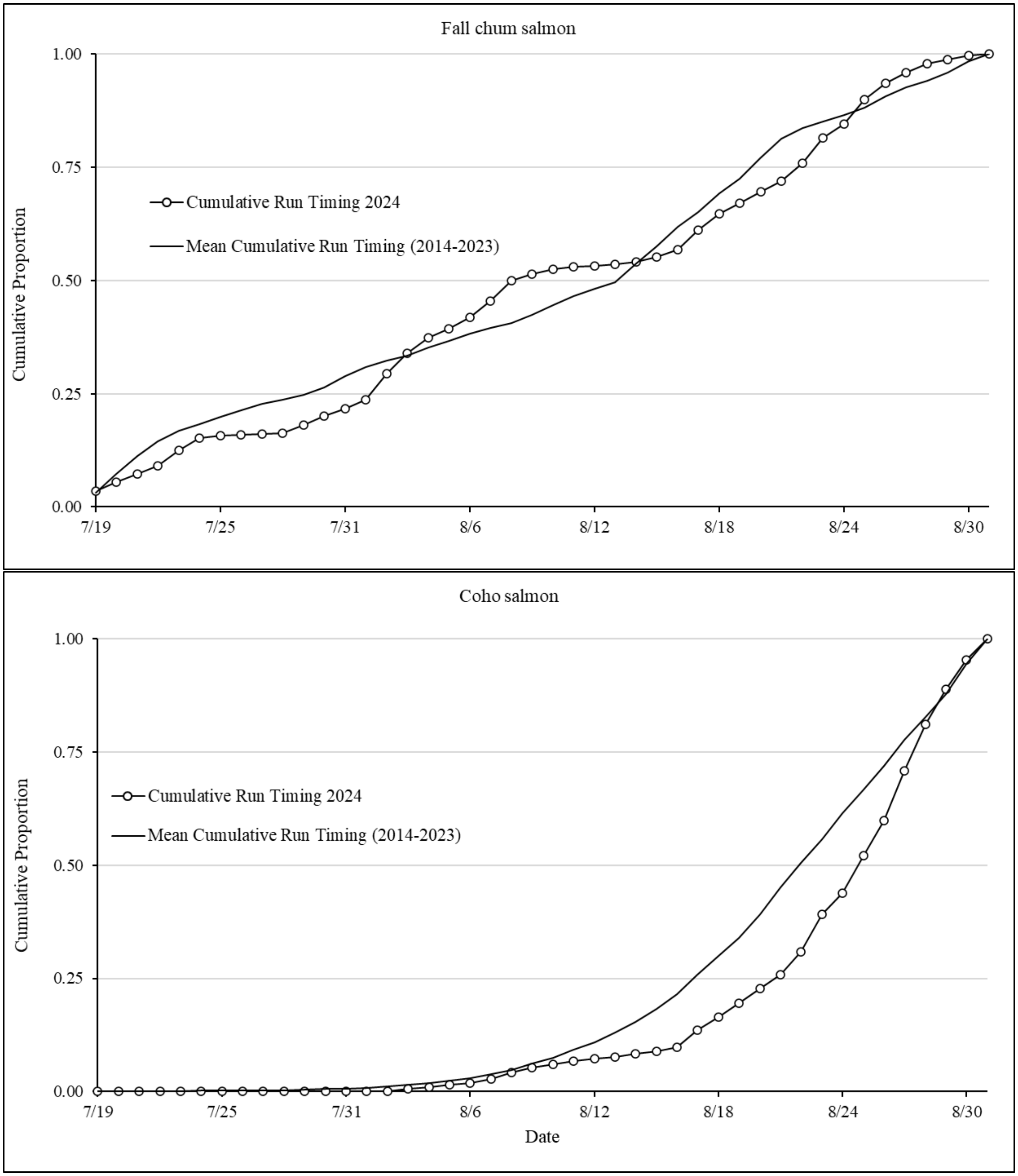


Figure 16.–2024 Fall chum (top) and coho (bottom) salmon daily cumulative passage timing compared to the 2014–2023 mean passage timing at the Pilot Station sonar project on the Yukon River.

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 the project's operation extending until September 7 in some years.

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, 2024.

Species	Tau	Sigma	Theta	Lambda	Tangle
Large Chinook[a]	1.9102	0.2203	0.6220	-0.4485	0.0053
Small Chinook[b]	1.9102	0.2203	0.6220	-0.4485	0.0053
Summer chum	1.9432	0.1320	0.4008	-0.5823	0.2109
Fall chum	1.9681	0.1467	0.7842	-0.4355	0.0417
Coho	1.8820	0.2115	1.0747	-1.0336	0.0347
Sockeye	1.9787	0.2827	0.7865	-1.2461	0.0592
Pink	1.9624	0.3502	2.5535	3.0846	0.1502
Broad whitefish	1.7770	0.1753	0.8694	-1.7234	0.0807
Humpback whitefish	1.9213	0.2592	1.1912	-2.1368	0.1258
Cisco	2.1739	0.2253	0.7775	-1.7382	0.0000
Sheefish	2.1546	0.2983	1.4583	-2.5736	0.2484
Other[c]	2.7331	0.6197	1.1272	-3.9751	0.2607

[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, 2024.

	Large mesh	Chinook		Small mesh	Summer chum		Fall chum		Coho	
Date	fathom hours	Catch	CPUE	fathom hours	Catch	CPUE	Catch	CPUE	Catch	CPUE
6/05	17.72	0	0.00	18.08	0	0.00	0	0.00	0	0.00
6/06	16.98	0	0.00	16.86	1	0.06	0	0.00	0	0.00
6/07	16.97	0	0.00	17.60	0	0.00	0	0.00	0	0.00
6/08	17.47	0	0.00	17.07	0	0.00	0	0.00	0	0.00
6/09	16.87	0	0.00	16.73	0	0.00	0	0.00	0	0.00
6/10	18.86	0	0.00	17.72	1	0.06	0	0.00	0	0.00
6/11	16.60	0	0.00	16.49	1	0.06	0	0.00	0	0.00
6/12	16.00	1	0.06	16.20	0	0.00	0	0.00	0	0.00
6/13	16.93	1	0.06	16.81	0	0.00	0	0.00	0	0.00
6/14	17.38	1	0.06	17.39	1	0.06	0	0.00	0	0.00
6/15	16.80	1	0.06	17.20	10	0.58	0	0.00	0	0.00
6/16	17.41	0	0.00	17.01	7	0.41	0	0.00	0	0.00
6/17	16.81	1	0.06	17.42	12	0.69	0	0.00	0	0.00
6/18	17.80	0	0.00	17.97	9	0.50	0	0.00	0	0.00
6/19	16.78	3	0.18	17.12	17	0.99	0	0.00	0	0.00
6/20	17.66	1	0.06	16.99	22	1.29	0	0.00	0	0.00
6/21	18.20	2	0.11	18.03	7	0.39	0	0.00	0	0.00
6/22	18.84	3	0.16	16.96	8	0.47	0	0.00	0	0.00
6/23	17.36	1	0.06	17.89	16	0.89	0	0.00	0	0.00
6/24	17.22	3	0.17	17.03	21	1.23	0	0.00	0	0.00
6/25	14.02	3	0.21	9.05	25	2.76	0	0.00	0	0.00
6/26	17.47	5	0.29	9.92	22	2.22	0	0.00	0	0.00
6/27	16.17	5	0.31	14.12	36	2.55	0	0.00	0	0.00
6/28	17.33	3	0.17	15.11	15	0.99	0	0.00	0	0.00
6/29	16.86	4	0.24	15.51	20	1.29	0	0.00	0	0.00
6/30	16.54	1	0.06	11.46	28	2.44	0	0.00	0	0.00
7/01	17.81	2	0.11	12.74	19	1.49	0	0.00	0	0.00
7/02	14.57	14	0.96	9.67	21	2.17	0	0.00	0	0.00
7/03	16.95	3	0.18	11.98	28	2.34	0	0.00	0	0.00
7/04	17.76	3	0.17	15.56	8	0.51	0	0.00	0	0.00
7/05	17.98	6	0.33	14.57	35	2.40	0	0.00	0	0.00
7/06	16.60	9	0.54	9.80	57	5.82	0	0.00	0	0.00
7/07	16.00	11	0.69	8.67	24	2.77	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	17.63	9	0.51	11.89	22	1.85	0	0.00	0	0.00
7/09	17.18	5	0.29	13.64	29	2.13	0	0.00	0	0.00
7/10	17.07	1	0.06	14.14	20	1.41	0	0.00	0	0.00
7/11	17.00	1	0.06	16.14	7	0.43	0	0.00	0	0.00
7/12	17.29	1	0.06	17.07	7	0.41	0	0.00	0	0.00
7/13	17.15	1	0.06	16.76	18	1.07	0	0.00	0	0.00
7/14	17.17	0	0.00	15.89	11	0.69	0	0.00	0	0.00
7/15	17.41	0	0.00	17.26	6	0.35	0	0.00	0	0.00
7/16	17.11	0	0.00	16.44	4	0.24	0	0.00	0	0.00
7/17	17.25	0	0.00	17.47	18	1.03	0	0.00	0	0.00
7/18	16.99	1	0.06	15.76	13	0.83	0	0.00	0	0.00
7/19	5.79	0	0.00	16.03	0	0.00	9	0.56	0	0.00
7/20	5.44	0	0.00	17.62	0	0.00	6	0.34	0	0.00
7/21	5.86	0	0.00	17.40	0	0.00	6	0.34	0	0.00
7/22	6.27	0	0.00	16.76	0	0.00	5	0.30	0	0.00
7/23	5.73	0	0.00	16.36	0	0.00	6	0.37	0	0.00
7/24	5.51	0	0.00	16.68	0	0.00	4	0.24	0	0.00
7/25	5.71	0	0.00	16.54	0	0.00	1	0.06	0	0.00
7/26	5.51	0	0.00	16.94	0	0.00	0	0.00	0	0.00
7/27	5.75	0	0.00	16.65	0	0.00	0	0.00	0	0.00
7/28	5.73	0	0.00	17.01	0	0.00	1	0.06	0	0.00
7/29	5.56	0	0.00	17.03	0	0.00	3	0.18	0	0.00
7/30	5.79	0	0.00	16.67	0	0.00	9	0.54	0	0.00
7/31	5.61	0	0.00	16.97	0	0.00	1	0.06	0	0.00
8/01	5.69	0	0.00	16.94	0	0.00	11	0.65	0	0.00
8/02	5.80	0	0.00	15.70	0	0.00	22	1.40	0	0.00
8/03	5.80	0	0.00	10.42	0	0.00	16	1.54	0	0.00
8/04	4.77	0	0.00	9.73	0	0.00	5	0.51	0	0.00
8/05	5.77	0	0.00	17.40	0	0.00	14	0.80	0	0.00
8/06	5.89	0	0.00	16.82	0	0.00	8	0.48	0	0.00
8/07	5.40	0	0.00	15.22	0	0.00	17	1.12	0	0.00

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Appendix B1.–Page 3 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
8/08	5.59	0	0.00	16.77	0	0.00	22	1.31	0	0.00
8/09	5.92	0	0.00	16.95	0	0.00	11	0.65	0	0.00
8/10	5.84	0	0.00	16.77	0	0.00	6	0.36	0	0.00
8/11	5.25	0	0.00	17.06	0	0.00	2	0.12	1	0.06
8/12	5.98	0	0.00	17.04	0	0.00	0	0	0	0.00
8/13	5.62	0	0.00	17.15	0	0.00	1	0.06	0	0.00
8/14	5.70	0	0.00	16.84	0	0.00	3	0.18	0	0.00
8/15	4.74	0	0.00	9.37	0	0.00	2	0.21	1	0.11
8/16	4.94	0	0.00	8.79	0	0.00	6	0.68	1	0.11
8/17	5.92	0	0.00	14.95	0	0.00	23	1.54	0	0.00
8/18	5.49	0	0.00	10.28	0	0.00	10	0.97	0	0.00
8/19	5.60	0	0.00	16.72	0	0.00	11	0.66	2	0.12
8/20	5.55	0	0.00	17.44	0	0.00	17	0.97	1	0.06
8/21	4.91	0	0.00	10.12	0	0.00	13	1.28	3	0.30
8/22	5.50	0	0.00	15.74	0	0.00	14	0.89	4	0.25
8/23	5.77	0	0.00	15.80	0	0.00	28	1.77	1	0.06
8/24	5.92	0	0.00	14.35	0	0.00	16	1.12	3	0.21
8/25	4.97	0	0.00	15.80	0	0.00	23	1.46	5	0.32
8/26	5.70	0	0.00	16.66	0	0.00	26	1.56	6	0.36
8/27	5.23	0	0.00	15.58	0	0.00	13	0.83	7	0.45
8/28	5.58	0	0.00	16.82	0	0.00	8	0.48	4	0.24
8/29	5.74	0	0.00	16.39	0	0.00	5	0.31	5	0.31
8/30	5.97	0	0.00	16.34	0	0.00	7	0.43	5	0.31
8/31	5.82	0	0.00	17.33	0	0.00	0	0	4	0.23
9/01	5.84	0	0.00	17.38	0	0.00	3	0.17	2	0.12
9/02	5.82	0	0.00	16.88	0	0.00	3	0.18	2	0.12
9/03	5.78	0	0.00	17.91	0	0.00	6	0.33	4	0.22
9/04	5.92	0	0.00	15.78	0	0.00	17	1.08	5	0.32
9/05	5.75	0	0.00	17.54	0	0.00	5	0.29	3	0.17
9/06	5.66	0	0.00	16.24	0	0.00	8	0.49	4	0.25
9/07	5.31	0	0.00	10.09	0	0.00	6	0.59	0	0.00
Total	1,038.68	106	6.40	1,474.96	626	47.87	459	30.52	73	4.70

Appendix B2.–Right bank catch per unit effort (CPUE), by day and salmon species, at the Pilot Station sonar project on the Yukon River, 2024.

	Large mesh	Chinook		Small mesh	Summer chum		Fall chum		Coho	
Date	fathom hours	Catch	CPUE	fathom hours	Catch	CPUE	Catch	CPUE	Catch	CPUE
6/05	6.92	0	0.00	7.99	0	0.00	0	0.00	0	0.00
6/06	8.65	0	0.00	8.19	0	0.00	0	0.00	0	0.00
6/07	7.77	0	0.00	8.21	1	0.12	0	0.00	0	0.00
6/08	7.33	0	0.00	6.65	0	0.00	0	0.00	0	0.00
6/09	6.48	0	0.00	7.10	0	0.00	0	0.00	0	0.00
6/10	7.10	0	0.00	8.39	0	0.00	0	0.00	0	0.00
6/11	6.86	0	0.00	7.62	0	0.00	0	0.00	0	0.00
6/12	7.66	0	0.00	7.96	0	0.00	0	0.00	0	0.00
6/13	8.31	0	0.00	7.55	0	0.00	0	0.00	0	0.00
6/14	8.04	0	0.00	8.31	0	0.00	0	0.00	0	0.00
6/15	7.02	0	0.00	8.59	0	0.00	0	0.00	0	0.00
6/16	8.34	0	0.00	6.76	1	0.15	0	0.00	0	0.00
6/17	8.02	0	0.00	8.79	3	0.34	0	0.00	0	0.00
6/18	7.85	0	0.00	8.34	5	0.60	0	0.00	0	0.00
6/19	7.06	0	0.00	7.33	1	0.14	0	0.00	0	0.00
6/20	7.07	1	0.14	8.43	2	0.24	0	0.00	0	0.00
6/21	7.63	1	0.13	8.32	4	0.48	0	0.00	0	0.00
6/22	7.11	1	0.14	8.38	2	0.24	0	0.00	0	0.00
6/23	7.59	0	0.00	7.79	2	0.26	0	0.00	0	0.00
6/24	7.04	0	0.00	7.97	10	1.25	0	0.00	0	0.00
6/25	8.36	0	0.00	4.93	9	1.83	0	0.00	0	0.00
6/26	7.25	1	0.14	7.50	6	0.80	0	0.00	0	0.00
6/27	7.49	0	0.00	7.88	5	0.63	0	0.00	0	0.00
6/28	7.28	0	0.00	7.34	1	0.14	0	0.00	0	0.00
6/29	7.26	0	0.00	7.39	2	0.27	0	0.00	0	0.00
6/30	7.58	0	0.00	7.31	6	0.82	0	0.00	0	0.00
7/01	7.91	0	0.00	7.59	5	0.66	0	0.00	0	0.00
7/02	7.85	0	0.00	7.05	2	0.28	0	0.00	0	0.00
7/03	7.97	0	0.00	7.63	16	2.10	0	0.00	0	0.00
7/04	7.39	0	0.00	7.73	0	0.00	0	0.00	0	0.00
7/05	8.79	0	0.00	8.02	8	1.00	0	0.00	0	0.00
7/06	7.95	0	0.00	6.95	7	1.01	0	0.00	0	0.00
7/07	7.87	0	0.00	5.92	12	2.03	0	0.00	0	0.00

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Date	Large mesh fathom hours	Chinook		Small mesh fathom hours	Summer chum		Fall chum		Coho	
		Catch	CPUE		Catch	CPUE	Catch	CPUE	Catch	CPUE
7/08	8.45	2	0.24	7.74	3	0.39	0	0.00	0	0.00
7/09	7.74	0	0.00	7.18	2	0.28	0	0.00	0	0.00
7/10	8.30	1	0.12	8.33	2	0.24	0	0.00	0	0.00
7/11	8.22	0	0.00	8.30	4	0.48	0	0.00	0	0.00
7/12	7.76	1	0.13	7.25	3	0.41	0	0.00	0	0.00
7/13	8.36	0	0.00	8.18	2	0.24	0	0.00	0	0.00
7/14	8.13	0	0.00	8.10	3	0.37	0	0.00	0	0.00
7/15	8.61	0	0.00	8.05	2	0.25	0	0.00	0	0.00
7/16	7.91	0	0.00	7.83	4	0.51	0	0.00	0	0.00
7/17	7.54	0	0.00	8.12	4	0.49	0	0.00	0	0.00
7/18	7.90	0	0.00	7.67	5	0.65	0	0.00	0	0.00
7/19	2.75	0	0.00	6.29	0	0.00	6	0.95	0	0.00
7/20	2.85	0	0.00	8.06	0	0.00	1	0.12	0	0.00
7/21	1.94	0	0.00	6.92	0	0.00	3	0.43	0	0.00
7/22	2.66	0	0.00	8.07	0	0.00	1	0.12	0	0.00
7/23	2.64	0	0.00	7.09	0	0.00	1	0.14	0	0.00
7/24	2.14	0	0.00	7.24	0	0.00	3	0.41	0	0.00
7/25	2.64	0	0.00	7.66	0	0.00	1	0.13	0	0.00
7/26	2.69	0	0.00	8.26	0	0.00	0	0.00	0	0.00
7/27	2.95	0	0.00	8.16	0	0.00	1	0.12	0	0.00
7/28	2.29	0	0.00	8.01	0	0.00	2	0.25	1	0.12
7/29	2.72	0	0.00	8.40	0	0.00	2	0.24	0	0.00
7/30	2.77	0	0.00	6.88	0	0.00	0	0.00	0	0.00
7/31	2.78	0	0.00	8.06	0	0.00	0	0.00	0	0.00
8/01	2.43	0	0.00	8.16	0	0.00	1	0.12	0	0.00
8/02	2.85	0	0.00	7.51	0	0.00	1	0.13	0	0.00
8/03	2.84	0	0.00	5.05	0	0.00	0	0.00	0	0.00
8/04	2.32	0	0.00	4.95	0	0.00	0	0.00	0	0.00
8/05	2.81	0	0.00	7.49	0	0.00	0	0.00	0	0.00
8/06	2.60	0	0.00	7.73	0	0.00	3	0.39	1	0.13
8/07	2.72	0	0.00	8.01	0	0.00	6	0.75	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	2.66	0	0.00	7.91	0	0.00	4	0.51	0	0.00
8/09	2.50	0	0.00	7.90	0	0.00	0	0	0	0.00
8/10	2.61	0	0.00	8.65	0	0.00	2	0.23	1	0.12
8/11	2.44	0	0.00	7.70	0	0.00	2	0.26	0	0.00
8/12	2.92	0	0.00	7.89	0	0.00	0	0	1	0.13
8/13	2.89	0	0.00	8.09	0	0.00	0	0	0	0.00
8/14	2.97	0	0.00	8.09	0	0.00	1	0.12	0	0.00
8/15	2.23	0	0.00	4.97	0	0.00	1	0.2	0	0.00
8/16	2.40	0	0.00	4.93	0	0.00	3	0.61	1	0.20
8/17	2.34	0	0.00	8.17	0	0.00	10	1.22	0	0.00
8/18	2.26	0	0.00	5.25	0	0.00	5	0.95	3	0.57
8/19	2.67	0	0.00	7.81	0	0.00	6	0.77	4	0.51
8/20	2.74	0	0.00	7.78	0	0.00	6	0.77	1	0.13
8/21	2.43	0	0.00	4.96	0	0.00	3	0.61	0	0.00
8/22	2.78	0	0.00	7.66	0	0.00	9	1.17	0	0.00
8/23	2.44	0	0.00	7.81	0	0.00	16	2.05	3	0.38
8/24	2.75	0	0.00	5.98	0	0.00	11	1.84	3	0.50
8/25	2.75	0	0.00	7.03	0	0.00	9	1.28	3	0.43
8/26	2.30	0	0.00	7.09	0	0.00	5	0.7	8	1.13
8/27	2.70	0	0.00	7.37	0	0.00	3	0.41	3	0.41
8/28	2.34	0	0.00	7.81	0	0.00	4	0.51	1	0.13
8/29	2.25	0	0.00	7.15	0	0.00	5	0.7	4	0.56
8/30	2.85	0	0.00	6.74	0	0.00	2	0.3	2	0.30
8/31	2.42	0	0.00	8.28	0	0.00	2	0.24	5	0.60
9/01	2.36	0	0.00	7.31	0	0.00	0	0	1	0.14
9/02	2.52	0	0.00	7.83	0	0.00	0	0	5	0.64
9/03	2.64	0	0.00	7.64	0	0.00	3	0.39	1	0.13
9/04	2.19	0	0.00	7.61	0	0.00	0	0	0	0.00
9/05	2.29	0	0.00	7.48	0	0.00	1	0.13	0	0.00
9/06	2.68	0	0.00	8.00	0	0.00	1	0.13	8	1.00
9/07	2.77	0	0.00	4.95	0	0.00	4	0.81	2	0.40
Total	471.20	8	1.04	710.50	144	19.70	150	21.21	62	8.66

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, 2024.

			Total		Percent by bank	
Date	Right bank	Left bank	Passage	SE	Right	Left
6/05	2,147	3,542	5,689	525	37.7	62.3
6/06	2,029	3,486	5,515	611	36.8	63.2
6/07	2,641	5,537	8,178	1,198	32.3	67.7
6/08	2,883	3,960	6,843	772	42.1	57.9
6/09	2,035	4,481	6,516	193	31.2	68.8
6/10	2,366	3,891	6,257	384	37.8	62.2
6/11	2,300	3,611	5,911	636	38.9	61.1
6/12	3,004	5,121	8,125	581	37.0	63.0
6/13	2,545	4,908	7,453	501	34.1	65.9
6/14	2,687	8,114	10,801	514	24.9	75.1
6/15	3,097	8,217	11,314	755	27.4	72.6
6/16	2,578	9,660	12,238	568	21.1	78.9
6/17	3,737	10,550	14,287	462	26.2	73.8
6/18	2,917	11,114	14,031	1,082	20.8	79.2
6/19	2,466	10,266	12,732	1,063	19.4	80.6
6/20	2,724	14,531	17,255	1,236	15.8	84.2
6/21	3,007	13,994	17,001	1,534	17.7	82.3
6/22	2,966	12,828	15,794	1,598	18.8	81.2
6/23	2,894	11,670	14,564	1,912	19.9	80.1
6/24	5,392	17,239	22,631	2,896	23.8	76.2
6/25	6,771	52,611	59,382	5,089	11.4	88.6
6/26	3,404	51,832	55,236	4,244	6.2	93.8
6/27	3,673	36,346	40,019	6,037	9.2	90.8
6/28	2,079	21,092	23,171	3,275	9.0	91.0
6/29	1,665	27,122	28,787	8,534	5.8	94.2
6/30	1,781	47,816	49,597	3,685	3.6	96.4
7/01	1,731	37,166	38,897	1,752	4.5	95.5
7/02	2,251	68,392	70,643	2,250	3.2	96.8
7/03	4,014	38,207	42,221	7,038	9.5	90.5
7/04	3,024	18,414	21,438	1,426	14.1	85.9
7/05	3,274	43,575	46,849	5,371	7.0	93.0
7/06	3,880	93,284	97,164	4,928	4.0	96.0
7/07	2,825	67,867	70,692	6,758	4.0	96.0
7/08	3,031	43,050	46,081	3,227	6.6	93.4
7/09	2,074	26,210	28,284	1,042	7.3	92.7
7/10	1,148	26,236	27,384	638	4.2	95.8
7/11	1,257	27,358	28,615	2,069	4.4	95.6
7/12	2,522	21,524	24,046	2,933	10.5	89.5
7/13	3,467	17,549	21,016	1,775	16.5	83.5
7/14	5,729	15,227	20,956	738	27.3	72.7
7/15	2,693	13,473	16,166	813	16.7	83.3
7/16	1,413	9,128	10,541	349	13.4	86.6
7/17	3,381	10,781	14,162	1,487	23.9	76.1
7/18	3,448	11,792	15,240	964	22.6	77.4
7/19	2,923	8,640	11,563	640	25.3	74.7
7/20	2,545	6,799	9,344	717	27.2	72.8
7/21	2,522	7,163	9,685	1,052	26.0	74.0
7/22	3,167	10,912	14,079	983	22.5	77.5

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Date	Right bank	Left bank	Total Passage	Total SE	Percent by bank Right	Percent by bank Left
7/23	3,720	13480	17,200	954	21.6	78.4
7/24	3,540	12199	15,739	781	22.5	77.5
7/25	3,158	14777	17,935	1,869	17.6	82.4
7/26	3,415	15324	18,739	1,008	18.2	81.8
7/27	3,456	16508	19,964	1,452	17.3	82.7
7/28	2,863	15385	18,248	1,740	15.7	84.3
7/29	2,411	9277	11,688	1,127	20.6	79.4
7/30	3,423	12546	15,969	894	21.4	78.6
7/31	2,111	10187	12,298	327	17.2	82.8
8/01	1,714	10180	11,894	489	14.4	85.6
8/02	1,591	17404	18,995	1,585	8.4	91.6
8/03	1,118	13587	14,705	850	7.6	92.4
8/04	1,057	10415	11,472	788	9.2	90.8
8/05	1,023	7551	8,574	501	11.9	88.1
8/06	921	7901	8,822	321	10.4	89.6
8/07	1,328	9079	10,407	735	12.8	87.2
8/08	1,493	11963	13,456	480	11.1	88.9
8/09	1,576	7810	9,386	559	16.8	83.2
8/10	1,411	6394	7,805	686	18.1	81.9
8/11	1,165	4675	5,840	286	19.9	80.1
8/12	976	2768	3,744	673	26.1	73.9
8/13	643	2623	3,266	186	19.7	80.3
8/14	1,067	3803	4,870	135	21.9	78.1
8/15	1,035	3176	4,211	409	24.6	75.4
8/16	1,125	4186	5,311	453	21.2	78.8
8/17	2,026	11975	14,001	824	14.5	85.5
8/18	1,320	9763	11,083	890	11.9	88.1
8/19	1,474	6125	7,599	809	19.4	80.6
8/20	1,099	7513	8,612	324	12.8	87.2
8/21	999	6598	7,597	463	13.1	86.9
8/22	1,535	11096	12,631	1,294	12.2	87.8
8/23	2,259	15647	17,906	961	12.6	87.4
8/24	2,911	12717	15,628	1,714	18.6	81.4
8/25	2,604	16019	18,623	903	14.0	86.0
8/26	2,177	12571	14,748	785	14.8	85.2
8/27	2,233	10864	13,097	877	17.0	83.0
8/28	2,529	8662	11,191	448	22.6	77.4
8/29	2,000	6781	8,781	475	22.8	77.2
8/30	1,736	5885	7,621	599	22.8	77.2
8/31	1,671	4302	5,973	276	28.0	72.0
9/01	1,445	3965	5,410	469	26.7	73.3
9/02	1,283	3369	4,652	347	27.6	72.4
9/03	1,350	4796	6,146	314	22.0	78.0
9/04	1,441	7190	8,631	447	16.7	83.3
9/05	1,334	7363	8,697	1,232	15.3	84.7
9/06	1,675	7051	8,726	1,192	19.2	80.8
9/07	1,562	8463	10,025	1,294	15.6	84.4
Season	224,110	1,458,199	1,682,309	135,058	13.3	86.7

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, 2024.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Pink	Sockeye	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
6/05	0	0	0	0	0	0	0	0	417	1,173	1,750	2,349	0	5,689
6/06	0	0	0	275	0	0	0	0	437	602	1,377	2,486	338	5,515
6/07	0	0	0	672	0	0	0	0	644	959	1,549	3,166	1,188	8,178
6/08	0	0	0	309	0	0	0	0	684	0	913	3,201	1,736	6,843
6/09	0	0	0	399	0	0	0	0	56	731	664	3,356	1,310	6,516
6/10	0	0	0	468	0	0	0	0	70	849	1,397	2,256	1,217	6,257
6/11	0	0	0	413	0	0	0	0	26	825	1,331	2,141	1,175	5,911
6/12	62	559	621	1,114	0	0	0	0	970	1,181	1,465	1,586	1,188	8,125
6/13	120	552	672	1,189	0	0	0	0	821	1,041	1,287	1,436	1,007	7,453
6/14	1,366	1,317	2,683	2,859	0	0	0	0	868	306	450	1,909	1,726	10,801
6/15	516	224	740	6,083	0	0	0	0	0	972	985	955	1,579	11,314
6/16	194	410	604	5,415	0	0	0	0	1,430	311	1,573	1,510	1,395	12,238
6/17	443	722	1,165	8,095	0	0	0	0	2,762	522	951	792	0	14,287
6/18	393	206	599	11,795	0	0	0	0	0	724	0	913	0	14,031
6/19	675	228	903	8,854	0	0	0	0	1,445	0	0	1,275	255	12,732
6/20	753	0	753	12,554	0	0	0	0	812	433	515	1,417	771	17,255
6/21	970	126	1,096	10,043	0	0	0	0	3,315	0	296	1,898	353	17,001
6/22	1,411	0	1,411	10,036	0	0	0	348	0	1,513	1,200	847	439	15,794
6/23	975	0	975	7,101	0	0	0	560	395	1,491	2,315	780	947	14,564
6/24	1,067	271	1,338	19,683	0	0	0	0	0	320	0	590	700	22,631
6/25	6,621	210	6,831	50,863	0	0	226	0	0	248	725	335	154	59,382
6/26	1,982	1,212	3,194	42,743	0	0	5,376	0	1,400	1,129	0	1,394	0	55,236
6/27	1,829	1,147	2,976	30,436	0	0	257	425	4,312	0	0	643	970	40,019
6/28	535	696	1,231	11,746	0	0	5,332	625	1,952	0	423	1,737	125	23,171
6/29	1,019	0	1,019	18,158	0	0	1,053	0	5,352	1,366	352	1,387	100	28,787
6/30	570	289	859	43,143	0	0	1,950	0	3,460	0	0	185	0	49,597
7/01	1,770	193	1,963	30,234	0	0	365	0	5,505	0	0	131	699	38,897
7/02	4,493	1,046	5,539	54,295	0	0	1,772	0	7,569	0	0	1,386	82	70,643

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	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Pink	Sockeye	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
7/03	634	766	1,400	26,294	0	0	626	351	13,082	0	0	377	91	42,221
7/04	1,256	1,657	2,913	13,358	0	0	2,907	0	1,166	105	0	799	190	21,438
7/05	2,668	0	2,668	40,071	0	0	2,080	0	1,661	113	0	51	205	46,849
7/06	2,505	1,793	4,298	88,376	0	0	1,364	0	2,889	0	0	177	60	97,164
7/07	4,516	473	4,989	57,837	0	0	2,929	1,330	3,505	0	0	102	0	70,692
7/08	3,440	1,577	5,017	34,193	0	0	3,363	216	3,234	0	0	58	0	46,081
7/09	1,425	0	1,425	16,702	0	0	3,754	110	5,650	0	0	496	147	28,284
7/10	561	0	561	19,305	0	0	4,498	449	1,773	745	0	0	53	27,384
7/11	345	303	648	6,772	0	0	7,784	0	12,305	927	0	79	100	28,615
7/12	22	872	894	10,228	0	0	8,689	738	0	49	1,700	984	764	24,046
7/13	314	0	314	14,783	0	0	3,760	0	0	1,788	0	371	0	21,016
7/14	0	627	627	7,938	0	0	7,507	695	0	3,103	0	564	522	20,956
7/15	0	0	0	10,849	0	0	2,088	0	1,090	2,015	0	124	0	16,166
7/16	0	63	63	7,530	0	0	907	0	715	1,229	0	97	0	10,541
7/17	139	0	139	9,052	0	0	4,356	36	169	102	0	95	213	14,162
7/18	397	0	397	5,997	0	0	7,935	37	172	387	0	97	218	15,240
7/19	238	0	238	0	8,339	0	1,093	86	1,661	0	0	0	146	11,563
7/20	173	0	173	0	5,114	0	2,432	39	284	1,183	0	0	119	9,344
7/21	113	0	113	0	3,230	0	3,182	292	934	1,816	0	0	118	9,685
7/22	0	73	73	0	4,325	0	5,580	0	644	3,457	0	0	0	14,079
7/23	0	0	0	0	7,877	0	1,653	0	447	6,082	0	0	1,141	17,200
7/24	0	0	0	0	6,488	0	4,035	0	2,583	2,016	617	0	0	15,739
7/25	0	76	76	0	1,066	0	3,719	0	5,346	6,697	537	269	225	17,935
7/26	0	0	0	0	624	0	3,970	0	6,519	6,741	367	518	0	18,739
7/27	0	0	0	0	473	0	6,100	0	194	10,778	1,921	82	416	19,964
7/28	0	0	0	0	432	41	3,169	0	2,723	9,273	2,610	0	0	18,248
7/29	0	0	0	0	4,182	0	343	0	356	6,376	252	0	179	11,688
7/30	0	0	0	0	4,284	0	3,794	0	0	7,520	371	0	0	15,969
7/31	0	0	0	0	4,210	0	2,544	0	0	4,468	0	1,076	0	12,298

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Date	Chinook			Chum		Coho	Pink	Sockeye	Cisco	Whitefish		Sheefish	Other[c]	Total
	Large[a]	Small[b]	Total	Summer	Fall					Humpback	Broad			
8/01	0	0	0	0	4,599	0	1,120	0	3,462	1,920	793	0	0	11,894
8/02	0	0	0	0	13,594	0	329	0	991	3,421	0	0	660	18,995
8/03	0	0	0	0	10,527	263	340	0	1,537	1,660	144	234	0	14,705
8/04	0	0	0	0	7,982	249	321	0	1,207	1,382	136	195	0	11,472
8/05	0	0	0	0	4,412	300	231	0	741	2,469	421	0	0	8,574
8/06	0	0	0	0	6,000	201	208	0	338	1,589	486	0	0	8,822
8/07	0	0	0	0	8,278	502	0	79	1,198	228	0	0	122	10,407
8/08	0	0	0	0	10,667	781	479	0	465	1,003	0	0	61	13,456
8/09	0	0	0	0	3,434	615	687	0	898	3,092	73	0	587	9,386
8/10	0	0	0	0	2,176	508	0	0	2,168	2,477	267	0	209	7,805
8/11	0	0	0	0	1,301	289	190	0	2,173	1,770	69	0	48	5,840
8/12	0	0	0	0	441	249	117	0	1,715	1,014	168	0	40	3,744
8/13	0	0	0	0	621	651	53	0	504	927	0	510	0	3,266
8/14	0	0	0	0	1,202	167	215	0	2,194	924	0	0	168	4,870
8/15	0	0	0	0	2,745	291	241	0	637	156	0	0	141	4,211
8/16	0	0	0	0	3,762	555	120	0	595	92	0	33	154	5,311
8/17	0	0	0	0	10,138	2,230	139	0	663	494	34	202	101	14,001
8/18	0	0	0	0	8,094	1,925	90	0	480	406	22	0	66	11,083
8/19	0	0	0	0	5,562	1,488	0	0	154	332	63	0	0	7,599
8/20	0	0	0	0	6,146	1,822	0	0	433	146	29	36	0	8,612
8/21	0	0	0	0	5,262	1,725	0	0	394	158	26	32	0	7,597
8/22	0	0	0	0	9,007	2,895	0	0	381	348	0	0	0	12,631
8/23	0	0	0	0	12,994	4,643	0	0	269	0	0	0	0	17,906
8/24	0	0	0	0	7,415	2,625	0	0	2,882	1,723	444	0	539	15,628
8/25	0	0	0	0	12,485	4,626	0	0	1,176	336	0	0	0	18,623
8/26	0	0	0	0	8,514	4,242	0	0	671	526	234	0	561	14,748
8/27	0	0	0	0	5,717	6,164	0	0	393	599	55	0	169	13,097
8/28	0	0	0	0	4,541	5,766	0	0	215	0	669	0	0	11,191
8/29	0	0	0	0	1,958	4,347	0	0	1,513	711	252	0	0	8,781

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Appendix D1.–Page 4 of 4.

Date	Chinook			Chum		Coho	Pink	Sockeye	Cisco	Whitefish		Sheefish	Other[c]	Total
	Large[a]	Small[b]	Total	Summer	Fall					Humpback	Broad			
8/31	0	0	0	0	634	2,500	0	0	1,001	1,367	275	0	196	5,973
9/01	0	0	0	0	401	2,195	0	0	457	1,037	1,294	0	26	5,410
9/02	0	0	0	0	1,047	2,710	0	0	714	108	73	0	0	4,652
9/03	0	0	0	0	1,675	1,683	0	186	1,199	702	234	0	467	6,146
9/04	0	0	0	0	4,214	1,761	0	0	1,040	1,616	0	0	0	8,631
9/05	0	0	0	0	1,670	4,453	0	0	1,166	1,045	363	0	0	8,697
9/06	0	0	0	0	2,052	3,903	0	0	1,284	883	586	0	18	8,726
9/07	0	0	0	0	2,400	4,583	0	0	1,287	1,036	703	0	16	10,025
Total	46,510	17,688	64,198	758,260	246,665	77,665	127,372	6,602	152,900	132,273	37,945	49,719	28,710	1,682,309

[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, 2024.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Sockeye	Pink	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
6/05	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.009	0.046	0.047	0.000	0.003
6/06	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.013	0.082	0.097	0.012	0.007
6/07	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.010	0.021	0.123	0.161	0.053	0.012
6/08	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.014	0.021	0.147	0.225	0.114	0.016
6/09	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.015	0.026	0.165	**0.293**	0.159	0.019
6/10	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.015	0.033	0.202	0.338	0.202	0.023
6/11	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.015	0.039	0.237	0.381	0.243	0.027
6/12	0.001	0.032	0.010	0.005	0.000	0.000	0.000	0.000	0.022	0.048	**0.275**	0.413	**0.284**	0.032
6/13	0.004	0.063	0.020	0.006	0.000	0.000	0.000	0.000	0.027	0.056	0.309	0.442	0.319	0.036
6/14	0.033	0.137	0.062	0.010	0.000	0.000	0.000	0.000	0.033	0.058	0.321	0.480	0.379	0.042
6/15	0.044	0.150	0.073	0.018	0.000	0.000	0.000	0.000	0.033	0.065	0.347	**0.500**	0.434	0.049
6/16	0.049	0.173	0.083	0.025	0.000	0.000	0.000	0.000	0.042	0.068	0.388	0.530	0.483	0.056
6/17	0.058	0.214	0.101	0.036	0.000	0.000	0.000	0.000	0.060	0.072	0.414	0.546	0.483	0.065
6/18	0.067	0.226	0.110	0.052	0.000	0.000	0.000	0.000	0.060	0.077	0.414	0.564	0.483	0.073
6/19	0.081	0.238	0.124	0.063	0.000	0.000	0.000	0.000	0.070	0.077	0.414	0.590	0.492	0.081
6/20	0.097	0.238	0.136	0.080	0.000	0.000	0.000	0.000	0.075	0.080	0.427	0.618	**0.518**	0.091
6/21	0.118	0.246	0.153	0.093	0.000	0.000	0.000	0.000	0.097	0.080	0.435	0.657	0.531	0.101
6/22	0.148	0.246	0.175	0.106	0.000	0.000	0.000	0.053	0.097	0.092	0.467	0.674	0.546	0.111
6/23	0.169	0.246	0.190	0.116	0.000	0.000	0.000	0.138	0.099	0.103	**0.528**	0.689	0.579	0.119
6/24	0.192	**0.261**	0.211	0.142	0.000	0.000	0.000	0.138	0.099	0.105	0.528	0.701	0.603	0.133
6/25	**0.335**	0.273	**0.318**	0.209	0.000	0.000	0.002	0.138	0.099	0.107	0.547	0.708	0.609	0.168
6/26	0.377	0.341	0.367	**0.265**	0.000	0.000	0.044	0.138	0.108	0.116	0.547	0.736	0.609	0.201
6/27	0.417	0.406	0.414	0.305	0.000	0.000	0.046	0.202	0.136	0.116	0.547	0.749	0.643	0.225
6/28	0.428	0.445	0.433	0.321	0.000	0.000	0.088	**0.297**	0.149	0.116	0.558	**0.784**	0.647	0.238
6/29	0.450	0.445	0.449	0.345	0.000	0.000	0.096	0.297	0.184	0.126	0.567	0.812	0.650	**0.255**
6/30	0.462	0.462	0.462	0.402	0.000	0.000	0.111	0.297	0.207	0.126	0.567	0.815	0.650	0.285
7/01	**0.500**	0.473	0.493	0.441	0.000	0.000	0.114	0.297	0.243	0.126	0.567	0.818	0.675	0.308
7/02	0.597	**0.532**	**0.579**	**0.513**	0.000	0.000	0.128	0.297	**0.292**	0.126	0.567	0.846	0.678	0.350
7/03	0.611	0.575	0.601	0.548	0.000	0.000	0.133	0.350	0.378	0.126	0.567	0.854	0.681	0.375
7/04	0.638	0.669	0.646	0.565	0.000	0.000	0.156	0.350	0.386	0.127	0.567	0.870	0.687	0.388
7/05	0.695	0.669	0.688	0.618	0.000	0.000	0.172	0.350	0.396	0.128	0.567	0.871	0.695	0.416
7/06	0.749	**0.770**	**0.755**	0.735	0.000	0.000	0.183	0.350	0.415	0.128	0.567	0.874	0.697	0.473
7/07	**0.846**	0.797	0.832	**0.811**	0.000	0.000	0.206	**0.551**	0.438	0.128	0.567	0.876	0.697	**0.516**
7/08	0.920	0.886	0.911	0.856	0.000	0.000	0.232	0.584	0.459	0.128	0.567	0.877	0.697	0.543
7/09	0.951	0.886	0.933	0.878	0.000	0.000	**0.262**	0.601	0.496	0.128	0.567	0.887	0.702	0.560

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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
7/10	0.963	0.886	0.942	0.904	0.000	0.000	0.297	0.669	**0.508**	0.134	0.567	0.887	0.704	0.576
7/11	0.970	0.903	0.952	0.912	0.000	0.000	0.358	0.669	0.588	0.141	0.567	0.889	0.707	0.593
7/12	0.970	0.953	0.966	0.926	0.000	0.000	0.427	**0.780**	0.588	0.141	0.612	0.909	0.734	0.607
7/13	0.977	0.953	0.970	0.945	0.000	0.000	0.456	0.780	0.588	0.154	0.612	0.916	0.734	0.620
7/14	0.977	0.988	0.980	0.956	0.000	0.000	**0.515**	0.886	0.588	0.178	0.612	0.928	**0.752**	0.632
7/15	0.977	0.988	0.980	0.970	0.000	0.000	0.531	0.886	0.596	0.193	0.612	0.930	0.752	0.642
7/16	0.977	0.992	0.981	0.980	0.000	0.000	0.538	0.886	0.600	0.202	0.612	0.932	0.752	0.648
7/17	0.980	0.992	0.983	0.992	0.000	0.000	0.573	0.891	0.601	0.203	0.612	0.934	0.759	0.657
7/18	0.989	0.992	0.990	1.000	0.000	0.000	0.635	0.897	0.602	0.206	0.612	0.936	0.767	0.666
7/19	0.994	0.992	0.993	1.000	0.034	0.000	0.644	0.910	0.613	0.206	0.612	0.936	0.772	0.672
7/20	0.998	0.992	0.996	1.000	0.055	0.000	0.663	0.916	0.615	0.215	0.612	0.936	0.776	0.678
7/21	1.000	0.992	0.998	1.000	0.068	0.000	0.688	0.960	0.621	0.229	0.612	0.936	0.780	0.684
7/22	1.000	0.996	0.999	1.000	0.085	0.000	0.731	0.960	0.625	**0.255**	0.612	0.936	0.780	0.692
7/23	1.000	0.996	0.999	1.000	0.117	0.000	0.744	0.960	0.628	0.301	0.612	0.936	0.820	0.702
7/24	1.000	0.996	0.999	1.000	0.143	0.000	**0.776**	0.960	0.645	0.316	0.628	0.936	0.820	0.712
7/25	1.000	1.000	1.000	1.000	0.148	0.000	0.805	0.960	0.680	0.367	0.642	0.941	0.828	0.722
7/26	1.000	1.000	1.000	1.000	0.150	0.000	0.836	0.960	0.723	0.418	0.652	0.952	0.828	0.734
7/27	1.000	1.000	1.000	1.000	0.152	0.000	0.884	0.960	0.724	0.499	0.703	0.953	0.842	0.745
7/28	1.000	1.000	1.000	1.000	0.154	0.001	0.909	0.960	0.742	**0.569**	**0.771**	0.953	0.842	**0.756**
7/29	1.000	1.000	1.000	1.000	0.171	0.001	0.912	0.960	0.744	0.617	0.778	0.953	0.849	0.763
7/30	1.000	1.000	1.000	1.000	0.188	0.001	0.942	0.960	0.744	0.674	0.788	0.953	0.849	0.773
7/31	1.000	1.000	1.000	1.000	0.205	0.001	0.962	0.960	0.744	0.708	0.788	0.975	0.849	0.780
8/01	1.000	1.000	1.000	1.000	0.224	0.001	0.970	0.960	**0.767**	0.723	0.809	0.975	0.849	0.787
8/02	1.000	1.000	1.000	1.000	**0.279**	0.001	0.973	0.960	0.773	0.749	0.809	0.975	0.872	0.798
8/03	1.000	1.000	1.000	1.000	0.322	0.004	0.976	0.960	0.783	**0.761**	0.812	0.980	0.872	0.807
8/04	1.000	1.000	1.000	1.000	0.354	0.007	0.978	0.960	0.791	0.772	0.816	0.984	0.872	0.814
8/05	1.000	1.000	1.000	1.000	0.372	0.011	0.980	0.960	0.796	0.790	0.827	0.984	0.872	0.819
8/06	1.000	1.000	1.000	1.000	0.396	0.014	0.982	0.960	0.798	0.802	0.840	0.984	0.872	0.824
8/07	1.000	1.000	1.000	1.000	0.430	0.020	0.982	0.972	0.806	0.804	0.840	0.984	0.876	0.830
8/08	1.000	1.000	1.000	1.000	0.473	0.030	0.985	0.972	0.809	0.811	0.840	0.984	0.878	0.838
8/09	1.000	1.000	1.000	1.000	0.487	0.038	0.991	0.972	0.815	0.835	0.842	0.984	0.898	0.844
8/10	1.000	1.000	1.000	1.000	0.496	0.045	0.991	0.972	0.829	0.854	0.849	0.984	0.906	0.849
8/11	1.000	1.000	1.000	1.000	**0.501**	0.048	0.992	0.972	0.844	0.867	0.851	0.984	0.907	0.852
8/12	1.000	1.000	1.000	1.000	0.503	0.051	0.993	0.972	0.855	0.875	0.855	0.984	0.909	0.854
8/13	1.000	1.000	1.000	1.000	0.505	0.060	0.994	0.972	0.858	0.882	0.855	0.994	0.909	0.856

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Appendix E1.–Page 3 of 3.

Date	Chinook			Chum		Coho	Sockeye	Pink	Cisco	Whitefish		Sheefish	Other[c]	Total
	Large[a]	Small[b]	Total	Summer	Fall					Humpback	Broad			
8/14	1.000	1.000	1.000	1.000	0.510	0.062	0.995	0.972	0.872	0.889	0.855	0.994	0.915	0.859
8/15	1.000	1.000	1.000	1.000	0.521	0.066	0.997	0.972	0.877	0.890	0.855	0.994	0.919	0.862
8/16	1.000	1.000	1.000	1.000	0.537	0.073	0.998	0.972	0.880	0.891	0.855	0.995	0.925	0.865
8/17	1.000	1.000	1.000	1.000	0.578	0.102	0.999	0.972	0.885	0.894	0.856	0.999	0.928	0.873
8/18	1.000	1.000	1.000	1.000	0.611	0.126	1.000	0.972	0.888	0.897	0.857	0.999	0.931	0.880
8/19	1.000	1.000	1.000	1.000	0.633	0.146	1.000	0.972	0.889	0.900	0.858	0.999	0.931	0.884
8/20	1.000	1.000	1.000	1.000	0.658	0.169	1.000	0.972	0.892	0.901	0.859	0.999	0.931	0.889
8/21	1.000	1.000	1.000	1.000	0.679	0.191	1.000	0.972	0.894	0.902	0.860	1.000	0.931	0.894
8/22	1.000	1.000	1.000	1.000	0.716	0.229	1.000	0.972	0.897	0.905	0.860	1.000	0.931	0.901
8/23	1.000	1.000	1.000	1.000	**0.769**	**0.288**	1.000	0.972	0.899	0.905	0.860	1.000	0.931	0.912
8/24	1.000	1.000	1.000	1.000	0.799	0.322	1.000	0.972	0.917	0.918	0.871	1.000	0.949	0.921
8/25	1.000	1.000	1.000	1.000	0.849	0.382	1.000	0.972	0.925	0.920	0.871	1.000	0.949	0.932
8/26	1.000	1.000	1.000	1.000	0.884	0.436	1.000	0.972	0.930	0.924	0.878	1.000	0.969	0.941
8/27	1.000	1.000	1.000	1.000	0.907	**0.516**	1.000	0.972	0.932	0.929	0.879	1.000	0.975	0.949
8/28	1.000	1.000	1.000	1.000	0.925	0.590	1.000	0.972	0.934	0.929	0.897	1.000	0.975	0.956
8/29	1.000	1.000	1.000	1.000	0.933	0.646	1.000	0.972	0.943	0.934	0.903	1.000	0.975	0.961
8/30	1.000	1.000	1.000	1.000	0.943	0.694	1.000	0.972	0.947	0.941	0.907	1.000	0.975	0.965
8/31	1.000	1.000	1.000	1.000	0.945	0.726	1.000	0.972	0.953	0.951	0.914	1.000	0.982	0.969
9/01	1.000	1.000	1.000	1.000	0.947	**0.754**	1.000	0.972	0.956	0.959	0.948	1.000	0.983	0.972
9/02	1.000	1.000	1.000	1.000	0.951	0.789	1.000	0.972	0.961	0.960	0.950	1.000	0.983	0.975
9/03	1.000	1.000	1.000	1.000	0.958	0.811	1.000	1.000	0.969	0.965	0.956	1.000	0.999	0.979
9/04	1.000	1.000	1.000	1.000	0.975	0.833	1.000	1.000	0.976	0.978	0.956	1.000	0.999	0.984
9/05	1.000	1.000	1.000	1.000	0.982	0.891	1.000	1.000	0.983	0.985	0.966	1.000	0.999	0.989
9/06	1.000	1.000	1.000	1.000	0.990	0.941	1.000	1.000	0.992	0.992	0.981	1.000	0.999	0.994
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, 2024.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Pink	Sockeye	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
6/05	0	0	0	0	0	0	0	0	417	1,173	1,750	2,349	0	5,689
6/06	0	0	0	275	0	0	0	0	854	1,775	3,127	4,835	338	11,204
6/07	0	0	0	947	0	0	0	0	1,498	2,734	4,676	8,001	1,526	19,382
6/08	0	0	0	1,256	0	0	0	0	2,182	2,734	5,589	11,202	3,262	26,225
6/09	0	0	0	1,655	0	0	0	0	2,238	3,465	6,253	14,558	4,572	32,741
6/10	0	0	0	2,123	0	0	0	0	2,308	4,314	7,650	16,814	5,789	38,998
6/11	0	0	0	2,536	0	0	0	0	2,334	5,139	8,981	18,955	6,964	44,909
6/12	62	559	621	3,650	0	0	0	0	3,304	6,320	10,446	20,541	8,152	53,034
6/13	182	1,111	1,293	4,839	0	0	0	0	4,125	7,361	11,733	21,977	9,159	60,487
6/14	1,548	2,428	3,976	7,698	0	0	0	0	4,993	7,667	12,183	23,886	10,885	71,288
6/15	2,064	2,652	4,716	13,781	0	0	0	0	4,993	8,639	13,168	24,841	12,464	82,602
6/16	2,258	3,062	5,320	19,196	0	0	0	0	6,423	8,950	14,741	26,351	13,859	94,840
6/17	2,701	3,784	6,485	27,291	0	0	0	0	9,185	9,472	15,692	27,143	13,859	109,127
6/18	3,094	3,990	7,084	39,086	0	0	0	0	9,185	10,196	15,692	28,056	13,859	123,158
6/19	3,769	4,218	7,987	47,940	0	0	0	0	10,630	10,196	15,692	29,331	14,114	135,890
6/20	4,522	4,218	8,740	60,494	0	0	0	0	11,442	10,629	16,207	30,748	14,885	153,145
6/21	5,492	4,344	9,836	70,537	0	0	0	0	14,757	10,629	16,503	32,646	15,238	170,146
6/22	6,903	4,344	11,247	80,573	0	0	0	348	14,757	12,142	17,703	33,493	15,677	185,940
6/23	7,878	4,344	12,222	87,674	0	0	0	908	15,152	13,633	20,018	34,273	16,624	200,504
6/24	8,945	4,615	13,560	107,357	0	0	0	908	15,152	13,953	20,018	34,863	17,324	223,135
6/25	15,566	4,825	20,391	158,220	0	0	226	908	15,152	14,201	20,743	35,198	17,478	282,517
6/26	17,548	6,037	23,585	200,963	0	0	5,602	908	16,552	15,330	20,743	36,592	17,478	337,753
6/27	19,377	7,184	26,561	231,399	0	0	5,859	1,333	20,864	15,330	20,743	37,235	18,448	377,772
6/28	19,912	7,880	27,792	243,145	0	0	11,191	1,958	22,816	15,330	21,166	38,972	18,573	400,943
6/29	20,931	7,880	28,811	261,303	0	0	12,244	1,958	28,168	16,696	21,518	40,359	18,673	429,730
6/30	21,501	8,169	29,670	304,446	0	0	14,194	1,958	31,628	16,696	21,518	40,544	18,673	479,327
7/01	23,271	8,362	31,633	334,680	0	0	14,559	1,958	37,133	16,696	21,518	40,675	19,372	518,224
7/02	27,764	9,408	37,172	388,975	0	0	16,331	1,958	44,702	16,696	21,518	42,061	19,454	588,867
7/03	28,398	10,174	38,572	415,269	0	0	16,957	2,309	57,784	16,696	21,518	42,438	19,545	631,088
7/04	29,654	11,831	41,485	428,627	0	0	19,864	2,309	58,950	16,801	21,518	43,237	19,735	652,526
7/05	32,322	11,831	44,153	468,698	0	0	21,944	2,309	60,611	16,914	21,518	43,288	19,940	699,375
7/06	34,827	13,624	48,451	557,074	0	0	23,308	2,309	63,500	16,914	21,518	43,465	20,000	796,539

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	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Pink	Sockeye	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
7/07	39,343	14,097	53,440	614,911	0	0	26,237	3,639	67,005	16,914	21,518	43,567	20,000	867,231
7/08	42,783	15,674	58,457	649,104	0	0	29,600	3,855	70,239	16,914	21,518	43,625	20,000	913,312
7/09	44,208	15,674	59,882	665,806	0	0	33,354	3,965	75,889	16,914	21,518	44,121	20,147	941,596
7/10	44,769	15,674	60,443	685,111	0	0	37,852	4,414	77,662	17,659	21,518	44,121	20,200	968,980
7/11	45,114	15,977	61,091	691,883	0	0	45,636	4,414	89,967	18,586	21,518	44,200	20,300	997,595
7/12	45,136	16,849	61,985	702,111	0	0	54,325	5,152	89,967	18,635	23,218	45,184	21,064	1,021,641
7/13	45,450	16,849	62,299	716,894	0	0	58,085	5,152	89,967	20,423	23,218	45,555	21,064	1,042,657
7/14	45,450	17,476	62,926	724,832	0	0	65,592	5,847	89,967	23,526	23,218	46,119	21,586	1,063,613
7/15	45,450	17,476	62,926	735,681	0	0	67,680	5,847	91,057	25,541	23,218	46,243	21,586	1,079,779
7/16	45,450	17,539	62,989	743,211	0	0	68,587	5,847	91,772	26,770	23,218	46,340	21,586	1,090,320
7/17	45,589	17,539	63,128	752,263	0	0	72,943	5,883	91,941	26,872	23,218	46,435	21,799	1,104,482
7/18	45,986	17,539	63,525	758,260	0	0	80,878	5,920	92,113	27,259	23,218	46,532	22,017	1,119,722
7/19	46,224	17,539	63,763	758,260	8,339	0	81,971	6,006	93,774	27,259	23,218	46,532	22,163	1,131,285
7/20	46,397	17,539	63,936	758,260	13,453	0	84,403	6,045	94,058	28,442	23,218	46,532	22,282	1,140,629
7/21	46,510	17,539	64,049	758,260	16,683	0	87,585	6,337	94,992	30,258	23,218	46,532	22,400	1,150,314
7/22	46,510	17,612	64,122	758,260	21,008	0	93,165	6,337	95,636	33,715	23,218	46,532	22,400	1,164,393
7/23	46,510	17,612	64,122	758,260	28,885	0	94,818	6,337	96,083	39,797	23,218	46,532	23,541	1,181,593
7/24	46,510	17,612	64,122	758,260	35,373	0	98,853	6,337	98,666	41,813	23,835	46,532	23,541	1,197,332
7/25	46,510	17,688	64,198	758,260	36,439	0	102,572	6,337	104,012	48,510	24,372	46,801	23,766	1,215,267
7/26	46,510	17,688	64,198	758,260	37,063	0	106,542	6,337	110,531	55,251	24,739	47,319	23,766	1,234,006
7/27	46,510	17,688	64,198	758,260	37,536	0	112,642	6,337	110,725	66,029	26,660	47,401	24,182	1,253,970
7/28	46,510	17,688	64,198	758,260	37,968	41	115,811	6,337	113,448	75,302	29,270	47,401	24,182	1,272,218
7/29	46,510	17,688	64,198	758,260	42,150	41	116,154	6,337	113,804	81,678	29,522	47,401	24,361	1,283,906
7/30	46,510	17,688	64,198	758,260	46,434	41	119,948	6,337	113,804	89,198	29,893	47,401	24,361	1,299,875
7/31	46,510	17,688	64,198	758,260	50,644	41	122,492	6,337	113,804	93,666	29,893	48,477	24,361	1,312,173
8/01	46,510	17,688	64,198	758,260	55,243	41	123,612	6,337	117,266	95,586	30,686	48,477	24,361	1,324,067
8/02	46,510	17,688	64,198	758,260	68,837	41	123,941	6,337	118,257	99,007	30,686	48,477	25,021	1,343,062
8/03	46,510	17,688	64,198	758,260	79,364	304	124,281	6,337	119,794	100,667	30,830	48,711	25,021	1,357,767
8/04	46,510	17,688	64,198	758,260	87,346	553	124,602	6,337	121,001	102,049	30,966	48,906	25,021	1,369,239
8/05	46,510	17,688	64,198	758,260	91,758	853	124,833	6,337	121,742	104,518	31,387	48,906	25,021	1,377,813
8/06	46,510	17,688	64,198	758,260	97,758	1,054	125,041	6,337	122,080	106,107	31,873	48,906	25,021	1,386,635
8/07	46,510	17,688	64,198	758,260	106,036	1,556	125,041	6,416	123,278	106,335	31,873	48,906	25,143	1,397,042

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Appendix F1.–Page 3 of 3.

	Chinook			Chum						Whitefish				
Date	Large[a]	Small[b]	Total	Summer	Fall	Coho	Pink	Sockeye	Cisco	Humpback	Broad	Sheefish	Other[c]	Total
8/08	46,510	17,688	64,198	758,260	116,703	2,337	125,520	6,416	123,743	107,338	31,873	48,906	25,204	1,410,498
8/09	46,510	17,688	64,198	758,260	120,137	2,952	126,207	6,416	124,641	110,430	31,946	48,906	25,791	1,419,884
8/10	46,510	17,688	64,198	758,260	122,313	3,460	126,207	6,416	126,809	112,907	32,213	48,906	26,000	1,427,689
8/11	46,510	17,688	64,198	758,260	123,614	3,749	126,397	6,416	128,982	114,677	32,282	48,906	26,048	1,433,529
8/12	46,510	17,688	64,198	758,260	124,055	3,998	126,514	6,416	130,697	115,691	32,450	48,906	26,088	1,437,273
8/13	46,510	17,688	64,198	758,260	124,676	4,649	126,567	6,416	131,201	116,618	32,450	49,416	26,088	1,440,539
8/14	46,510	17,688	64,198	758,260	125,878	4,816	126,782	6,416	133,395	117,542	32,450	49,416	26,256	1,445,409
8/15	46,510	17,688	64,198	758,260	128,623	5,107	127,023	6,416	134,032	117,698	32,450	49,416	26,397	1,449,620
8/16	46,510	17,688	64,198	758,260	132,385	5,662	127,143	6,416	134,627	117,790	32,450	49,449	26,551	1,454,931
8/17	46,510	17,688	64,198	758,260	142,523	7,892	127,282	6,416	135,290	118,284	32,484	49,651	26,652	1,468,932
8/18	46,510	17,688	64,198	758,260	150,617	9,817	127,372	6,416	135,770	118,690	32,506	49,651	26,718	1,480,015
8/19	46,510	17,688	64,198	758,260	156,179	11,305	127,372	6,416	135,924	119,022	32,569	49,651	26,718	1,487,614
8/20	46,510	17,688	64,198	758,260	162,325	13,127	127,372	6,416	136,357	119,168	32,598	49,687	26,718	1,496,226
8/21	46,510	17,688	64,198	758,260	167,587	14,852	127,372	6,416	136,751	119,326	32,624	49,719	26,718	1,503,823
8/22	46,510	17,688	64,198	758,260	176,594	17,747	127,372	6,416	137,132	119,674	32,624	49,719	26,718	1,516,454
8/23	46,510	17,688	64,198	758,260	189,588	22,390	127,372	6,416	137,401	119,674	32,624	49,719	26,718	1,534,360
8/24	46,510	17,688	64,198	758,260	197,003	25,015	127,372	6,416	140,283	121,397	33,068	49,719	27,257	1,549,988
8/25	46,510	17,688	64,198	758,260	209,488	29,641	127,372	6,416	141,459	121,733	33,068	49,719	27,257	1,568,611
8/26	46,510	17,688	64,198	758,260	218,002	33,883	127,372	6,416	142,130	122,259	33,302	49,719	27,818	1,583,359
8/27	46,510	17,688	64,198	758,260	223,719	40,047	127,372	6,416	142,523	122,858	33,357	49,719	27,987	1,596,456
8/28	46,510	17,688	64,198	758,260	228,260	45,813	127,372	6,416	142,738	122,858	34,026	49,719	27,987	1,607,647
8/29	46,510	17,688	64,198	758,260	230,218	50,160	127,372	6,416	144,251	123,569	34,278	49,719	27,987	1,616,428
8/30	46,510	17,688	64,198	758,260	232,572	53,877	127,372	6,416	144,752	124,479	34,417	49,719	27,987	1,624,049
8/31	46,510	17,688	64,198	758,260	233,206	56,377	127,372	6,416	145,753	125,846	34,692	49,719	28,183	1,630,022
9/01	46,510	17,688	64,198	758,260	233,607	58,572	127,372	6,416	146,210	126,883	35,986	49,719	28,209	1,635,432
9/02	46,510	17,688	64,198	758,260	234,654	61,282	127,372	6,416	146,924	126,991	36,059	49,719	28,209	1,640,084
9/03	46,510	17,688	64,198	758,260	236,329	62,965	127,372	6,602	148,123	127,693	36,293	49,719	28,676	1,646,230
9/04	46,510	17,688	64,198	758,260	240,543	64,726	127,372	6,602	149,163	129,309	36,293	49,719	28,676	1,654,861
9/05	46,510	17,688	64,198	758,260	242,213	69,179	127,372	6,602	150,329	130,354	36,656	49,719	28,676	1,663,558
9/06	46,510	17,688	64,198	758,260	244,265	73,082	127,372	6,602	151,613	131,237	37,242	49,719	28,694	1,672,284
9/07	46,510	17,688	64,198	758,260	246,665	77,665	127,372	6,602	152,900	132,273	37,945	49,719	28,710	1,682,309

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, 1995–2024

Appendix G1.–Salmon passage estimates, by species, at the Pilot Station sonar project on the Yukon River, 1995–2024.

	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
2024	46,510	17,688	64,198	758,260	246,665,	1,004,925	77,665	127,372	6,602	1,280,762

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, 1995–2024.

		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
2024[f]	152,900	132,273	37,945	49,719	28,710	401,547

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 total passage estimate.